INFORMATION HANDOUT

For Contract No. 04-297624
At 04-Ala-84-22.9/25.7

Identified by
Project ID 0400020581

PERMITS

United States Army Corps of Engineers: 404 Nationwide Permits 14 and 33

No. SPN-2008-00396 S - Dated 04/11/2011

No. SPN-2008-00396 S - Dated 06/01/2012

No. SPN-2008-00396 S - Dated 05/20/2013

San Francisco Bay RegionalWater Quality Control Board: 401 Permit/Water Quality Certification

No. 717494 (BT)/02-01-C0990 - Dated 06/15/2011

Amendment No. 1 - Dated 02/02/2015

California Department of Fish and Wildlife: Operations-of-Law Notification of Lake or Streambed Alteration Agreement

No. 1600-2012-0372-3 – Dated 02/16/2011

No. 1600-2012-0433-3 – Dated 03/20/2013

California Department of Fish: Incidental Take Permit

No. 2081-2011-013-03 – Dated 11/10/2011

Amendment No. 1 No. 2081-2011-013-03 – Dated 11/18/2014

United States Fish andWildlife Service: Biological Opinion

No. 81420-2008-F-0592 – Dated 02/1/2008

Amendment No. 1 (No. 81420-2008-F-0592-R001) – Dated 04/29/2013

Amendment No. 2 (No. 081420-2010-F-0592-R002) – Dated 01/08/2015

Department of Industrial Relations Division of Occupational Safety and Health Mining and Tunneling Unit

Underground Classification – Dated 01/20/2015

WATER QUALITY

Storm Water Data Report - Dated 1/18/2011

Non-Storm Water Information Handout – Dated 10/2014

Storm Water Information Handout – Dated 10/2014

Storm Water Data Report Amendment Memo - Dated 10/2014

Bridge Design Hydraulic Study Report Amendment – Dated 11/2014

Conceptual Storm Water Pollution Prevention Plan (added per Addendum #1, dated June, 5, 2015)

MATERIALS INFORMATION

Soil and Groundwater Investigation Report – Dated 04/2008

Foundation Report Arroyo Del Valle Bridge (Widen) (Bridge No. 33-0710) – Dated 01/16/2015

Foundation Report Arroyo Del Valle Trail Bridge – Dated 01/16/2015

Foundation Report Retaining Wall Nos. 245 and 246 – Dated 01/16/2015

Geotechnical Design and Materials Report - Dated 01/21/2015

Water Availability, City of Livermore - Dated 03/27/2015

LOCAL INFRASTRUCTURE

PG&E Document #062288, Underground Conduits

PG&E Document #064309, Box-Pad for Pad-Mounted Transformers

United States Army Corps of Engineers: 404 Nationwide Permits 14 and 33

- **No. SPN-2008-00396 S - Dated 04/11/2011**
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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.

DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, U.S. ARMY CORPS OF ENGINEERS
1455 MARKET STREET, 16TH FLOOR
SAN FRANCISCO, CALIFORNIA 94103-1398

JUN 01 2012

REPLY TO
ATTENTION OF

Regulatory Division

SUBJECT: File Number SPN-2008-00396S

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

Dear Mr. Jensen:

This correspondence is in reference to your submittal of March 1, 2012, concerning Department of the Army (DA) authorization 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. Work will include construction to upgrade the roadway to consist of 12-foot travel lanes and 10-foot shoulders. The road will be separated by concrete median barriers except at intersections. The median areas at intersections will 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. 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 1)

Section 404 of the Clean Water Act (CWA) generally regulates the discharge of dredged or fill material below the plane of ordinary high water in non-tidal waters of the United States, below the high tide line in tidal waters of the United States, and within the lateral extent of wetlands adjacent to these waters. Section 10 of the Rivers and Harbors Act generally regulates

construction of structures and work, including excavation, dredging, and discharges of dredged or fill material, occurring below the plane of mean high water in tidal waters of the United States; in former diked baylands currently below mean high water; outside the limits of mean high water but affecting the navigable capacity of tidal waters; or below the plane of ordinary high water in non-tidal waters designated as navigable waters of the United States. Navigable waters of the United States generally include all waters subject to the ebb and flow of the tide; and/or all waters presently used, or have been used in the past, or may be susceptible for future use to transport interstate or foreign commerce. An authorized jurisdictional determination was completed and dated certified March 24, 2009.

Based on a review of the information in your submittal, the project qualifies for authorization under Department of the Army Nationwide Permit (NWP) 14 for Linear Transportation Projects, 77 Fed. Reg. 10184, February 21, 2012, pursuant to Section 404 of the CWA of 1972, as amended, 33 U.S.C. § 1344 *et seq*. The project must be in compliance with the terms of the NWP, the general conditions of the Nationwide Permit Program, and the San Francisco District regional conditions cited in enclosure 2. You must also be in compliance with any special conditions specified in this letter for the NWP authorization to remain valid. Non-compliance with any term or condition could result in the revocation of the NWP authorization for your project, thereby requiring you to obtain an Individual Permit from the Corps. This NWP authorization does not obviate the need to obtain other State or local approvals required by law.

This verification will remain valid for two years from the date of this letter. Activities which have commenced (i.e, are under construction) or are under contract to commence in reliance upon a NWP will remain authorized provided the activity is completed within 12 months of the date of a NWP's expiration, modification, or revocation, unless discretionary authority has been exercised on a case-by-case basis to modify, suspend, or revoke the authorization in accordance with 33 CFR 330.4(e) and 33 CFR 330.5 (c) or (d). The Chief of Engineers will periodically review NWPs and their conditions and will decide to either modify, reissue, or revoke the permits. If a NWP is not modified or reissued within five years of its effective date, it automatically expires and becomes null and void. It is incumbent upon you to remain informed of any changes to the NWPs. Changes to the NWPs would be announced by Public Notice posted on our website (http://www.spn.usace.army.mil/regulatory/index.html). 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.

You shall comply with all terms and conditions set forth by the "*Water Quality Certification for the State Route 84 Expressway Widening Project, City of Livermore, Alameda County*" issued by the San Francisco Bay Regional Water Quality Control Board on June 15, 2011 (enclosure 4). You shall consider such conditions to be an integral part of the NWP authorization for your project.

General Condition 18 stipulates that project authorization under a NWP does not allow for the incidental take of any federally-listed species in the absences of a biological opinion (BO) with incidental take provisions. As the principal federal lead agency for this project, Caltrans initiated consultation with the United States Fish and Wildlife Service (USFWS) to address project related impacts to list species, pursuant to Section 7(a) of the Endangered Species Act of 1973, as amended (16 U.S.C. Section 1531 *et seq.*). By letter of February 1, 2009, the USFWS issued a BO (81420-2008-F-0592) cited in enclosure 5, with an incidental take statement for San Joaquin kit fox, California tiger salamander, and California red-legged frog.

In order to ensure compliance with this NWP authorization, the following special conditions shall be implemented:

1. To remain exempt from the prohibitions of Section 9 of the Endangered Species Act, the non-discretionary Terms and Conditions for incidental take of federally-listed San Joaquin kit fox, California tiger salamander and California red-legged frog shall be fully implemented as stipulated in the Biological Opinion entitled, "*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*" (pages 1-90) dated February 1, 2008 (enclosure 5). Project authorization under the NWP is conditional upon compliance with the mandatory terms and conditions associated with incidental take. Failure to comply with the terms and conditions for incidental take, where a 'take' of a federally-listed species occurs, would constitute an unauthorized take and non-compliance with the NWP authorization for your project. The USFWS is, however, the authoritative federal agency for determining compliance with the incidental take statement and for initiating appropriate enforcement actions or penalties under the Endangered Species Act.

2. You shall employ sediment and erosion control best management practices as needed throughout the project area as described in enclosure 6. 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.

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 7).

    a. To ensure 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 30 days prior to the start of construction.

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 are established wetland species 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 3 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. 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.

6. Temporary fills must consist of materials, and be placed in a manner, that will not be eroded by expected high flows.

7. Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations.

8. The areas affected by temporary fills must be revegetated, as appropriate.

You may refer any questions on this matter to Paula Gill of my Regulatory staff by telephone at 415-503-6776 or by e-mail at Paula.C.Gill@usace.army.mil. All correspondence should be addressed to the Regulatory Division, South Branch, referencing the file number at the head of this letter.

The San Francisco District is committed to improving service to our customers. My Regulatory staff seeks to achieve the goals of the Regulatory Program in an efficient and cooperative manner, while preserving and protecting our nation's aquatic resources. If you would like to provide comments on our Regulatory Program, please complete the Customer Service Survey Form available on our website: http://www.spn.usace.army.mil/regulatory/.

Sincerely,

Jane M. Hicks
Chief, Regulatory Division

Enclosures

Copies furnished (w/o enclosures):

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

DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, U.S. ARMY CORPS OF ENGINEERS
1455 MARKET STREET, 16TH FLOOR
SAN FRANCISCO, CALIFORNIA 94103-1398

MAY 20 2013

REPLY TO
ATTENTION OF

Regulatory Division

SUBJECT: File Number SPN-2008-00396S

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

Dear Mr. Jensen:

This correspondence is in reference to your submittal of March 1, 2012, concerning Department of the Army (DA) authorization for the State Route (SR) 84 Expressway Widening Project. The project is located on SR 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 SR 84 to expressway standards, improve local traffic circulation, and improve bicycle and pedestrian access. The highway will 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. Also, as a part of the project, Isabel Avenue Trial will be extended to Vineyard Avenue. Work within waters of the U.S. will include widening of bridges over Arroyo del Valle and Arroyo Mocho; construction of a single-span bridge at Arroyo Mocho for utility access; and construction of a new Isabel trail two-span bridge adjacent to the widened Arroyo del Valle Bridge. Project implementation may require dewatering. Project implementation will result in temporary disruption of 0.945 acre and permanent fill of 0.281 acre of waters of the U.S. (0.159 acre of wetland and 0.122 acre of other waters). All work would be completed in accordance with the plans and drawings titled "*USACE File #2008-00396S, State Route 84 (SR 84) / Isabel Avenue Widening, March 1, 2013, Figures 1 to 40*" (enclosure 1).

Section 404 of the Clean Water Act (CWA) generally regulates the discharge of dredged or fill material below the plane of ordinary high water in non-tidal waters of the United States, below the high tide line in tidal waters of the United States, and within the lateral extent of wetlands adjacent to these waters. Section 10 of the Rivers and Harbors Act generally regulates construction of structures and work, including excavation, dredging, and discharges of dredged or fill material, occurring below the plane of mean high water in tidal waters of the United States; in former diked baylands currently below mean high water; outside the limits of mean high water but affecting the navigable capacity of tidal waters; or below the plane of ordinary high water in non-tidal waters designated as navigable waters of the United States. Navigable

waters of the United States generally include all waters subject to the ebb and flow of the tide; and/or all waters presently used, or have been used in the past, or may be susceptible for future use to transport interstate or foreign commerce. An approved jurisdictional determination was completed for the site on April 10, 2013.

Based on a review of the information in your submittal, the project qualifies for authorization under Department of the Army Nationwide Permit (NWP) 14 for *Linear Transportation Projects*, 77 Fed. Reg. 10,184, February 21, 2012, pursuant to Section 404 of the CWA of 1972, as amended (33 U.S.C. § 1344 *et seq.*). The project must be in compliance with the terms of the NWP, the general conditions of the Nationwide Permit Program, and the San Francisco District regional conditions cited in enclosure 2. You must also be in compliance with any special conditions specified in this letter for the NWP authorization to remain valid. Non-compliance with any term or condition could result in the revocation of the NWP authorization for your project, thereby requiring you to obtain an Individual Permit from the Corps. This NWP authorization does not obviate the need to obtain other State or local approvals required by law.

This verification will remain valid until March 18, 2017, unless the NWP authorization is modified, suspended, or revoked. Activities which have commenced (i.e., are under construction) or are under contract to commence in reliance upon a NWP will remain authorized provided the activity is completed within 12 months of the date of a NWP's expiration, modification, or revocation, unless discretionary authority has been exercised on a case-by-case basis to modify, suspend, or revoke the authorization in accordance with 33 C.F.R. § 330.4(e) and 33 C.F.R. §§ 330.5 (c) or (d). This verification will remain valid if, during the time period between now and March 18, 2017, the activity complies with any subsequent modification of the NWP authorization. The Chief of Engineers will periodically review NWPs and their conditions and will decide to either modify, reissue, or revoke the permits. If a NWP is not modified or reissued within five years of its effective date, it automatically expires and becomes null and void. It is incumbent upon you to remain informed of any changes to the NWPs. Changes to the NWPs would be announced by Public Notice posted on our website (http://www.spn.usace.army.mil/Missions/Regulatory.aspx). 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.

You shall comply with all terms and conditions set forth by the "*Water Quality Certification for the State Route 84 Expressway Widening Project, City of Livermore, Alameda County*" issued by the San Francisco Bay Regional Water Quality Control Board on June 15, 2011 (enclosure 4). You shall consider such conditions to be an integral part of the NWP authorization for your project.

General Condition 18 stipulates that project authorization under a NWP does not allow for the incidental take of any federally-listed species in the absences of a biological opinion (BO) with incidental take provisions. As the principal federal lead agency for this project, Caltrans initiated consultation with the United States Fish and Wildlife Service (USFWS) to address project related impacts to list species, pursuant to Section 7(a) of the Endangered Species Act of 1973, as amended (16 U.S.C. Section 1531 *et seq.*). By letter of February 1, 2009 and April 29, 2013, the USFWS issued a BO and BO amendment (81420-2008-F-0592) cited in enclosures 5 and 6, with an incidental take statement for San Joaquin kit fox, California tiger salamander, and California red-legged frog.

In order to ensure compliance with this NWP authorization, the following special conditions shall be implemented:

1. To remain exempt from the prohibitions of Section 9 of the Endangered Species Act, the non-discretionary Terms and Conditions for incidental take of federally-listed San Joaquin kit fox, California tiger salamander, and California red-legged frog shall be fully implemented as stipulated in the Biological Opinion titled, "*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*" (pages 1-90) dated February 1, 2008 and the amended Biological Opinion titled, "*Re-initiation of Consultation , on the State Route 84 Expressway Widening Project, Alameda County California (Caltrans EA 29761)"* dated April 29, 2013 (enclosures 5 & 6). Project authorization under the NWP is conditional upon compliance with the mandatory terms and conditions associated with incidental take. Failure to comply with the terms and conditions for incidental take, where a 'take' of a federally-listed species occurs, would constitute an unauthorized take and non-compliance with the NWP authorization for your project. The USFWS is, however, the authoritative federal agency for determining compliance with the incidental take statement and for initiating appropriate enforcement actions or penalties under the Endangered Species Act.

2. You shall employ sediment and erosion control best management practices as needed throughout the project area as described in enclosure 7. 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.

3. The July, 2011, "*Mitigation and Management Plan, Las Positas College Facilities Development Plan, Murray Ranch Mitigation Site*", has been approved to provide compensatory mitigation for the 0.159 acre of wetland and 0.122 acre of other waters of the U.S. through enhancement of 0.115 acre of seasonal pond and installation of riparian scrub plantings as shown on the drawings titled "*Figure 2: Murray Ranch - Proposed SR 84 Mitigation Areas*", dated July 2011 (see enclosure 8)

4. The off-site enhancement area shall be maintained in accordance with the July, 2011, "*Mitigation and Management Plan, Murray Ranch Mitigation Site*".

5. The July, 2011, "*Mitigation and Management Plan, Murray Ranch Mitigation Site*" does not include the amount of the endowment consistent with the Compensatory Mitigation for Losses of Aquatic Resources; Final Rule, 33 C.F.R. pt. 325 and 332, published on April 10, 2008. Prior to October 1, 2013, Caltrans shall provide a final Plan for Corps approval that incorporates this item.

6. Prior to March 1, 2014, Caltrans 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.

7. If enhancement of the seasonal pond and installation of riparian scrub plantings does not commence prior to September 1, 2014, then Caltrans shall submit, subject to approval by the Corps, a mitigation proposal to account for temporal loss of jurisdictional waters impacted during the delay period.

8. The Permittee retains ultimate legal responsibility for meeting the requirements of the final mitigation plan and the performance standards outlined in the final approved Murray Ranch Mitigation plan.

9. Your responsibility to complete the required compensatory mitigation as set forth in Special Condition 3 will not be considered fulfilled until you have demonstrated mitigation success and have received written verification from the U.S. Army Corps of Engineers.

10. 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.

11. Temporary fills must consist of materials, and be placed in a manner, that will not be eroded by expected high flows.

12. Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations.

13. The areas affected by temporary fills must be re-vegetated, as appropriate.

You may refer any questions on this matter to Paula Gill of my Regulatory staff by telephone at 415-503-6776 or by e-mail at Paula.C.Gill@usace.army.mil. All correspondence should be addressed to the Regulatory Division, referencing the file number at the head of this letter.

The San Francisco District is committed to improving service to our customers. My Regulatory staff seeks to achieve the goals of the Regulatory Program in an efficient and cooperative manner, while preserving and protecting our nation's aquatic resources. If you would like to provide comments on our Regulatory Program, please complete the Customer Service Survey Form available on our website: http://www.spn.usace.army.mil/regulatory/.

Sincerely,

Jane M. Hicks
Chief, Regulatory Division

Enclosures

Copies furnished (w/o enclosures):

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

INFORMATION HANDOUT
For Contract No. 04-297624 At 04-Ala-84- 22.9/25.7
Identified by Project ID 0400020581

San Francisco Bay Regional Water Quality Control Board: 401 Permit/Water Quality Certification

- **No. 717494 (BT)/02-01-C0990 - Dated 06/15/2011**
- **Amendment No. 1 - Dated 02/02/2015**

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

Sent via electronic mail: No hard copy to follow

February 2, 2015
CIWQS Place No. 717494

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

Subject: Amendment #1 to the 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:

The San Francisco Regional Water Quality Control Board issued Clean Water Act Section 401 water quality certification (certification) to the California Department of Transportation (Department) for the State Route 84 Expressway Widening Project (Project) on June 15, 2011 (see Attachment for certification).

The Department requested modification of the certification on October 16, 2014, for Project changes that include the following:

- Changes to the project design and footprint,
- The addition of dewatering activities at Arroyo Mocho and Arroyo Del Valle, and
- Changes to stormwater treatment and hydromodification best management practices (BMPs).

The certification is hereby modified as follows:

Certification Pages 2 and 3, Impacts section and tables:

Jurisdictional Wetlands and Waters Impacts: Project implementation will result in permanent impact to approximately ~~0.32~~ 0.51 acres (~~3478~~ 5827 linear feet) of State waters (See Table 1, below). Approximately ~~0.042~~ 1.168 acres (670 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~~ 0.005 acres ~~125~~ 71 linear feet
~~Fill due to~~ Construction of a pier, abutments, 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~~ 0.063 acres ~~111~~ 116 linear feet
~~Fill due to~~ Placement of abutments associated with ~~new~~ Isabel Trail bridge upstream of SR 84	Arroyo Del Valle	~~0.001~~ 0.017 acres ~~18~~ 20 linear feet
Construction of new outfall	Arroyo Del Valle	~~0.009~~ 0.02 acres ~~87~~ 35 linear feet
Shading of channel and loss of willow riparian habitat due to construction of ~~pedestrian~~ Isabel Trail bridge	Arroyo Del Valle	~~0.07~~ 0.037 acres 19 linear feet
Shading of channel due to construction of maintenance bridge	Arroyo Mocho	~~0.05~~ 0.045 acres 19 linear feet
Modification of existing roadside runoff outfall channel	Ephemeral tributary to Arroyo Del Valle (OW-3)	0.008 acres ~~25~~ 21 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~~ 0.055 acres 2,341 linear feet
Fill due to roadway widening	Ephemeral roadside drainage (OW-6)	~~0.008~~ 0.046 acres 2,149 linear feet
Construction associated with the abutments of maintenance bridge	Arroyo Mocho	0.009 acres 23 linear feet
Shading of channel and loss of willow riparian habitat due to the construction of widened overpass	Arroyo Del Valle	0.086 acres 53 linear feet
	total:	~~0.32~~ 0.51 acres ~~478~~ 4,867 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~~ new access bridge, replacement of existing riprap, work platforms, and water diversion.	Arroyo Mocho	~~0.084~~ 0.579 acres ~~140~~ 294 linear feet
Replacement of existing riprap associated with new trail bridge upstream of SR 84. Construction access for the following activities: widening of SR 84 overpass on upstream side, construction of new Isabel Trail Bridge, and creek diversion.	Arroyo Del Valle	0.580 acres 284 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~~ 0.003 acre ~~4.5~~ 9 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~~
Cleaning of culvert	Intermittent drainage (OW-4)	0.006 acres 83 linear feet
	total:	~~0.42~~ 1.168 acres ~~1,070~~ 670 linear feet

Certification page 3, Roadway Pollutant Impacts section:

Roadway Pollutant Impacts: Project implementation would result in approximately ~~33.9~~ 36.8 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*.

Certification pages 4 and 5, Wetlands and Waters Mitigation section and table:

Jurisdictional Wetlands and Waters Mitigation: To mitigate for the permanent impacts to approximately ~~0.32~~ 0.51 acres (~~478~~ 4,867 linear feet) of State waters, the Department shall restore ~~0.52~~ 0.86 acres of seasonal wetland within approximately ~~800~~ 1,003 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. The Department shall also construct 4,490 linear feet of vegetated, ephemeral roadside drainages along the widened SR 84.

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~~ 0.005 acres ~~125~~ 71 linear feet	~~0.036~~ 0.010 acres Offsite Wetland Restoration at Murray Ranch
~~Fill due to~~ Construction of pier, abutments, 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~~ 0.063 acres ~~111~~ 116 linear feet	~~0.004~~ 0.126 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~~ Isabel Trail Bridge upstream of SR 84	Arroyo Del Valle	~~0.001~~ 0.017 acres ~~18~~ 20 linear feet	~~0.002~~ 0.034 acres Offsite Wetland Restoration at Murray Ranch
Construction of new outfall	Arroyo Del Valle	~~0.009~~ 0.02 acres ~~87~~ 35 linear feet	~~0.018~~ 0.04 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~~ 0.037 acres 19 linear feet	~~0.07~~ 0.037 acres Offsite Wetland Restoration at Murray Ranch
Shading of channel due to	Arroyo Mocho	~~0.05~~ 0.045 acres	~~0.05~~ 0.045 acres Offsite

Activity	Jurisdictional Feature Impacted (Feature ID)	Area and/or Linear Footage of **Permanent** Impact	Mitigation for Permanent Impacts
construction of maintenance bridge		19 linear feet	Wetland Restoration at Murray Ranch
Modification of existing roadside runoff outfall channel	Ephemeral tributary to Arroyo Del Valle (OW-3)	0.008 acres ~~25~~ 21 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~~ 0.055 acres 2,341 linear feet	~~0.06~~ 0.110 acres Offsite Wetland Restoration at Murray Ranch. Construction of 2341 linear feet of ephemeral roadside drainage along SR 84 adjacent to OW-5.
Fill due to roadway widening	Ephemeral roadside drainage (OW-6)	~~0.008~~ 0.046 acres 2,149 linear feet	~~0.016~~ 0.092 acres Offsite Wetland Restoration at Murray Ranch. Construction of 2149 linear feet of ephemeral roadside drainage along SR 84 adjacent to OW-6.
Construction associated with the abutments of maintenance bridge	Arroyo Mocho	0.009 acres 23 linear feet	0.016 acres Offsite Wetland Restoration at Murray Ranch
Shading of channel and loss of willow riparian habitat due to the construction of widened overpass	Arroyo Del Valle	0.086 acres 53 linear feet	0.086 acre Offsite Wetland Restoration at Murray Ranch. Preservation of willow roots where possible an planting of willow roots.
	totals:	~~0.32~~ 0.514 acres ~~478~~ 4867 linear feet	~~0.51~~ 0.86 acres ~~800~~ 5290 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.

Page 5 and 6, Roadway Pollutant Mitigation section and table:

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~~ 36.82 acres of impervious area using ~~five~~ seven 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	Roadway ~~SR 84 eastbound/ westbound~~	From SR 84 Post Mile	To SR 84 Post Mile	BMP Length (feet)	Treated Impervious Area (acres)
Strip 1	~~eastbound~~ SR 84 southbound	~~22.94~~ 22.90	22.98	~~244~~ 352	~~0.27~~ 0.52
Strip 2	~~eastbound~~ SR 84 northbound	~~23.02~~ 23.06	~~23.18~~ 23.12	~~879~~ 305	~~2.09~~ 0.88
~~Swale 6s*~~ Strip 3	~~eastbound~~ SR 84 northbound	~~23.58~~ 23.14	~~23.59~~ 23.20	~~150~~ 276	~~0.86~~ 0.62
~~Strip 3*~~ Strip 4	~~eastbound~~ SR 84 northbound	~~23.57~~ 23.21	~~23.61~~ 23.24	~~227~~ 120	~~0.15~~ 0.28
~~Strip 4~~ ~~+~~ Strip 5*	~~eastbound~~ SR 84 northbound	~~23.62~~ 23.40	~~23.69~~ 23.43	~~590~~ 226	~~0.59~~ 0.12
Swale 4ad [+]	~~Eastbound~~ Vallecitos Road westbound	~~23.64~~ 23.47	~~23.70~~ 23.53	~~400~~ 357	~~2.95~~ 2.97
~~Swale 20m~~ Swale 6y*	~~eastbound~~ SR 84 northbound	~~24.17~~ 23.41	~~24.25~~ 23.42	~~375~~ 83	~~2.53~~ 0.64
~~Swale 25b~~ Strip 6[+]	~~westbound~~ Vallecitos Road westbound	~~24.43~~ 23.45	~~24.51~~ 23.45	~~350~~ 561	~~3.10~~ 0.59
~~Strip 5~~ Swale 20m	~~eastbound~~ SR 84 southbound	~~24.18~~ 24.01	~~24.69~~ 24.08	~~2709~~ 380	~~3.52~~ 2.54
Strip 7	SR 84 southbound	24.01	24.52	2674	3.51
Swale 22i	~~eastbound~~ SR 84 southbound	~~24.38~~ 24.21	~~24.42~~ 24.25	~~200~~ 210	1.12
Swale 26e	~~eastbound~~ SR 84 southbound	~~24.48~~ 24.31	~~24.51~~ 24.33	~~150~~ 162	~~0.52~~ 0.53
Swale 29g	~~eastbound~~ SR 84 southbound	~~24.59~~ 24.42	~~24.62~~ 24.44	~~150~~ 162	0.61
Swale 25b	SR 84 northbound	24.27	24.33	370	3.10
Bioretention Vault 1	~~westbound~~ SR 84 southbound	24.84	24.87	--	10.36
Bioretention Vault 2	~~eastbound~~ SR 84 northbound	26.19	26.21	--	8.43
				total:	~~37.10~~ 36.82

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

Certification page 6, Hydromodification Mitigation table (footnotes remain in the original certification but are not included here):

Mitigation Measures	Swale or Strip No(s).	Receiving Water	Mitigated Impervious Area (ac)
~~One biofiltration strip,~~ Two biofiltration swales	Swales 4ad, ~~6s, Strip 2~~ 6y	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	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

Certification page 8, Certification Conditions 5 and 6:

5. The Department shall install ~~five~~ seven biofiltration strips, seven biofiltration swales, and two bioretention vaults to treat stormwater contaminants from no less than ~~37~~ 36.82 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. The Department shall submit as-built plans of the biofiltration swales, strips, and vaults described in this certification no later than 30 days following the completion of Project construction.;

6. The Department shall restore no less than ~~0.52~~ 0.86 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~~ March 15, 2015. The HMMP should 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~~ 0.86 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 mitigation Project, 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).

Certification page 9, Certification conditions 7 and 8:

7. Off-site mitigation implementation shall be completed no later than November 1, ~~2012~~ 2016;

8. ~~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.~~ Water Board staff has previously accepted plans for the temporary diversion of Arroyo Mocho. Plans for the temporary diversion of Arroyo Del Valle shall be submitted to water board staff no later than 30 days prior to implementation of the diversion. Any diversion plan shall include a plan to have the diversion system removed by October 1 and installed no sooner than June 1;

Additional Certification Condition 20:

20. The Department shall construct not less than 4,490 linear feet of vegetated, ephemeral roadside drainages along the widened SR 84. Those drainages shall have a jurisdictional width of 1 foot or more. The Department shall submit as-built plans, no later than 30 days after Project construction completion, of the ephemeral roadside drainages constructed along SR 84 as mitigation for impacts to ephemeral roadside drainages OW-5 and OW-6, photographs of the completed drainages, and a letter report confirming that the constructed drainages meet the length and width requirements of this condition .

Certification page 10 and 11, Closing:

Conditions 2, 5, 6, 7, 9, 12, 13, and 20 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.

If you have any questions, please contact Derek Beauduy at (510) 622-2348, or via e-mail to derek.beauduy@waterboards.ca.gov.

Sincerely,

for Bruce H. Wolfe
Executive Officer

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

Attachment A – SR 84 Expressway Certification Amendment #1

Biofiltration Swale and Strip Design and Soil Plans and Specifications

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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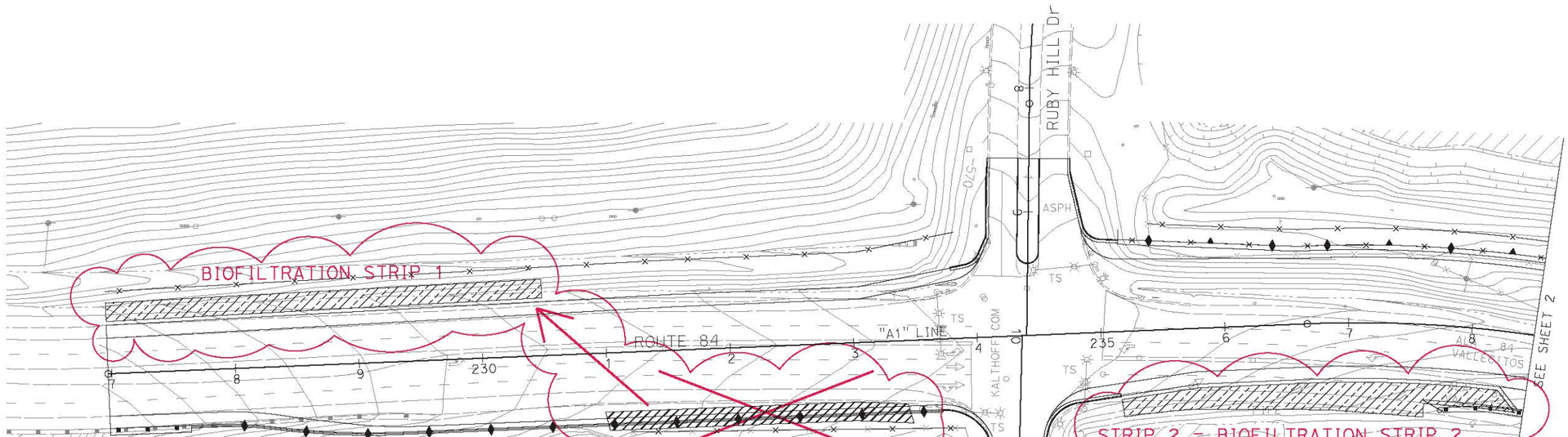
RED DENOTES RELOCATION OR RENAMED BMP

PURPLE DENOTES NO SIGNIFICANT CHANGE TO BMP

PLEASANTON



LIVERMORE

ROADWAY POLLUTANT MITIGATION PLAN

SCALE 1"=50'

PLAN-1

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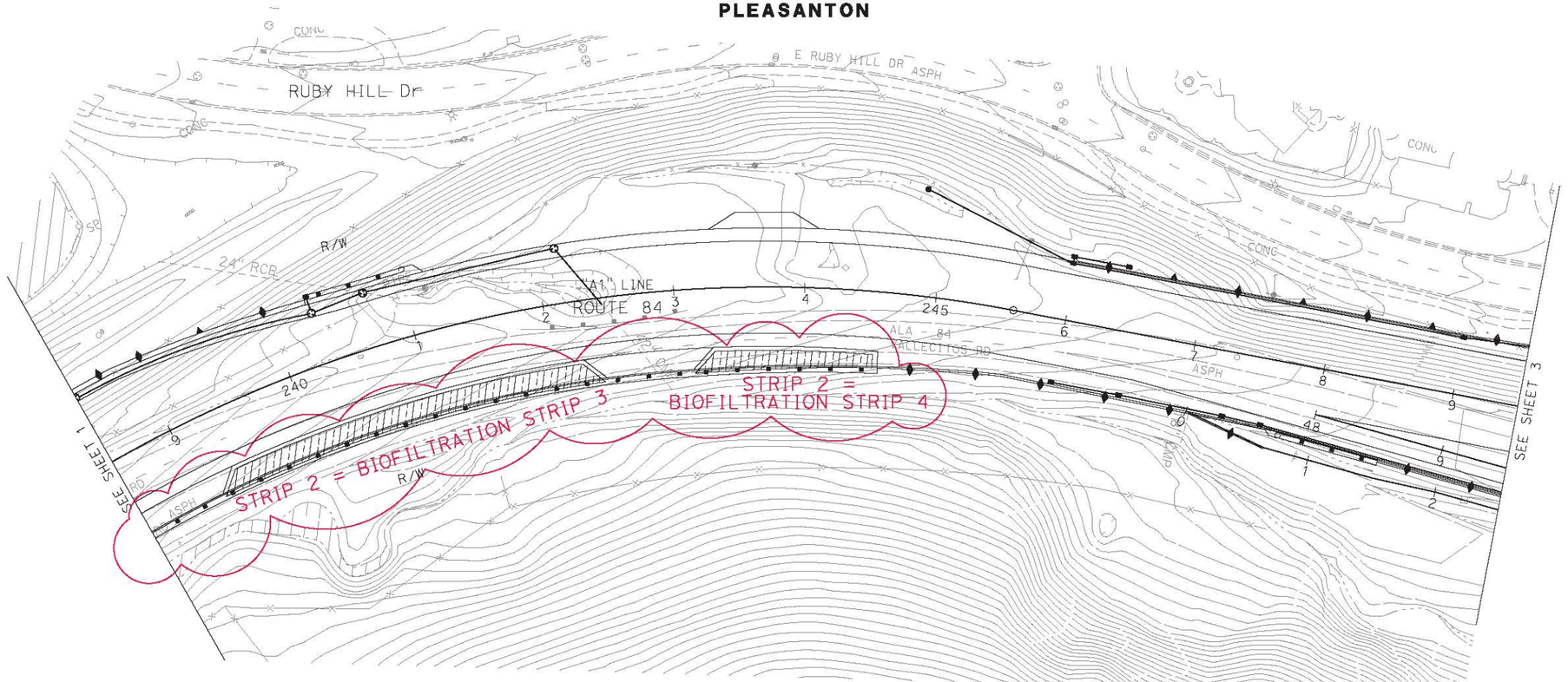

LIVERMORE

ROADWAY POLLUTANT MITIGATION PLAN

SCALE 1"=50'

PLAN-2

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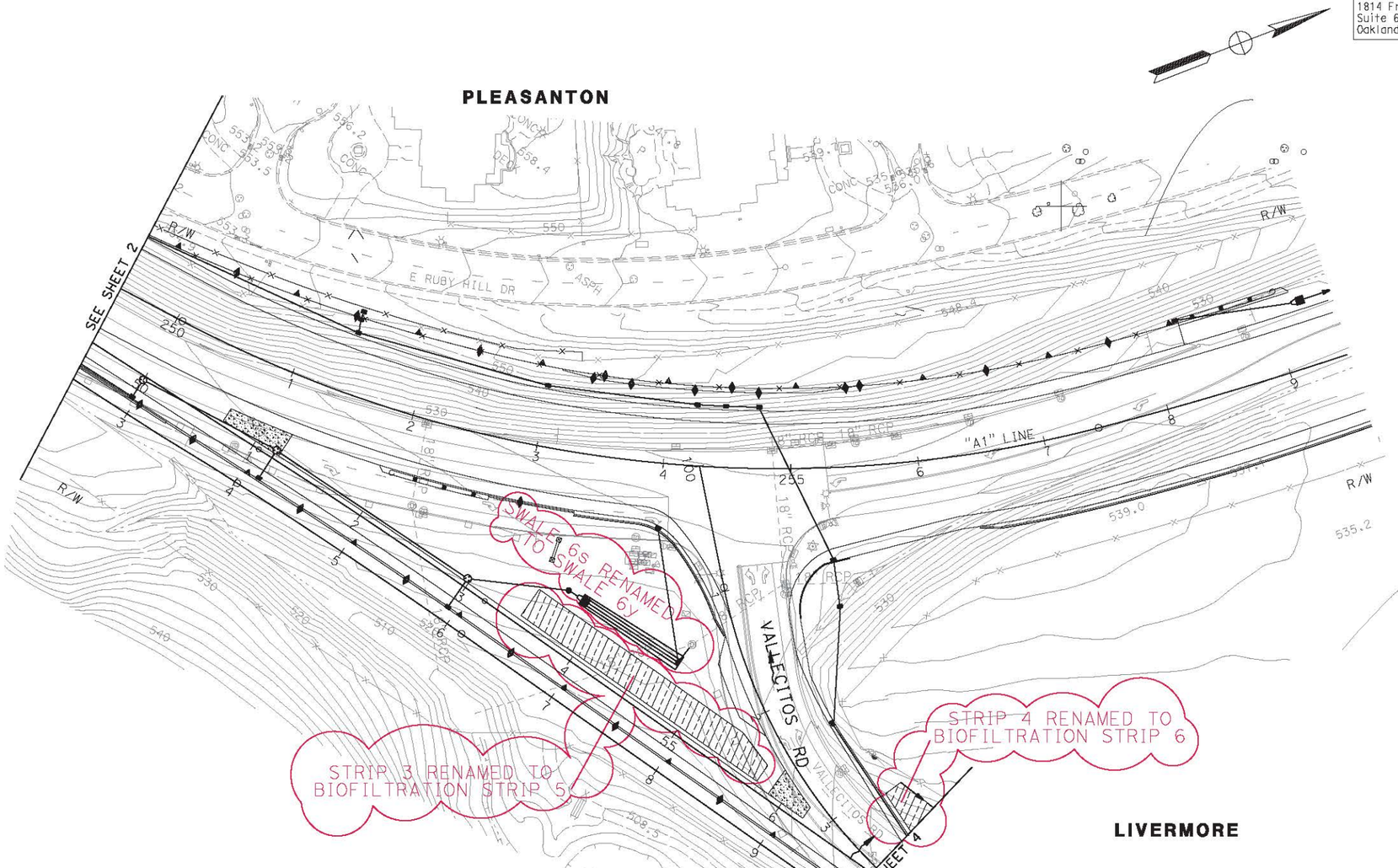

ROADWAY POLLUTANT MITIGATION PLAN

SCALE 1"=50'

PLAN-3

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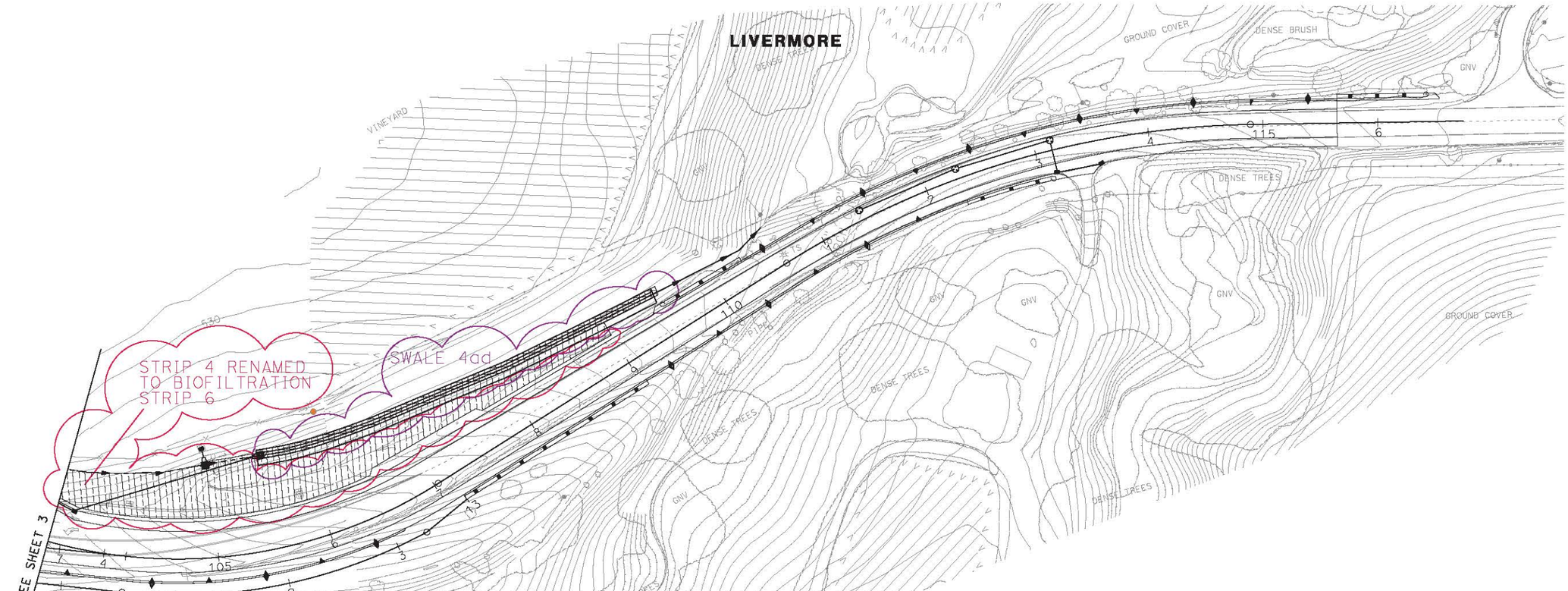

ROADWAY POLLUTANT MITIGATION PLAN

SCALE 1"=50'

PLAN-4

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04	Ala	84	22.9/25.7	7	

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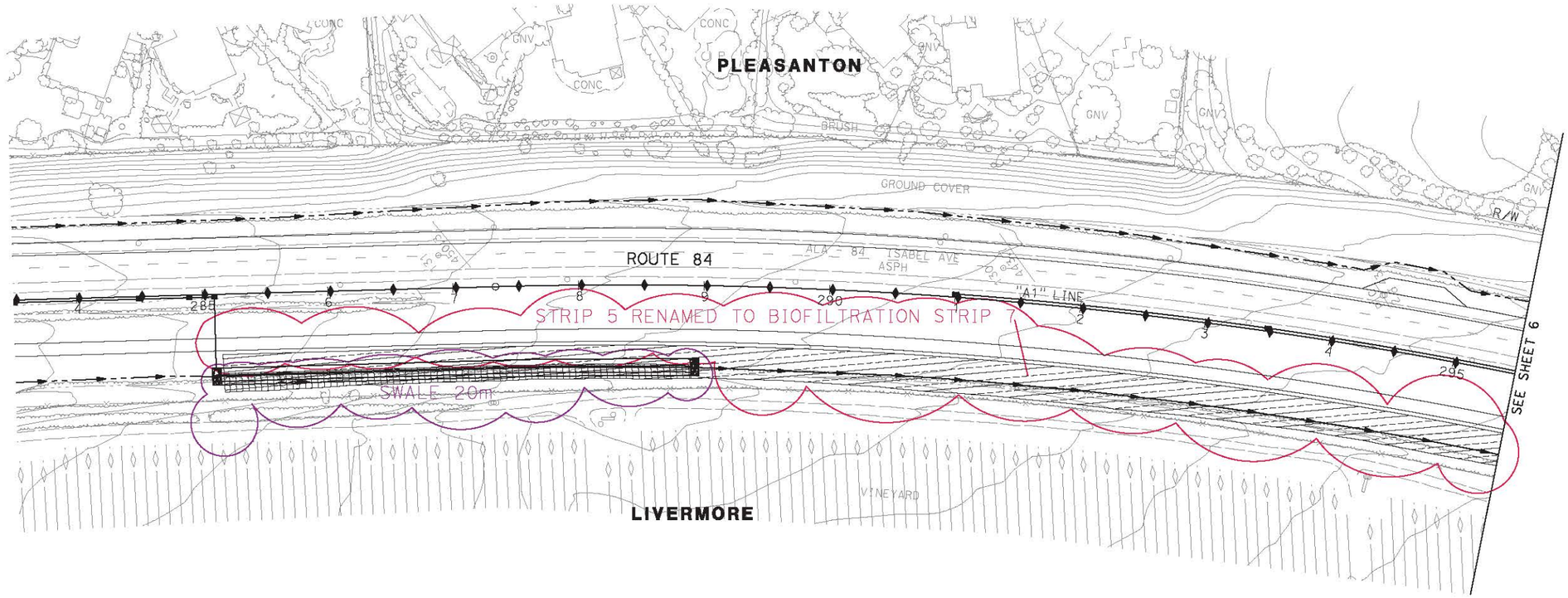

ROADWAY POLLUTANT MITIGATION PLAN

SCALE 1"=50'

PLAN-5

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04	Ala	84	22.9/25.7	8	

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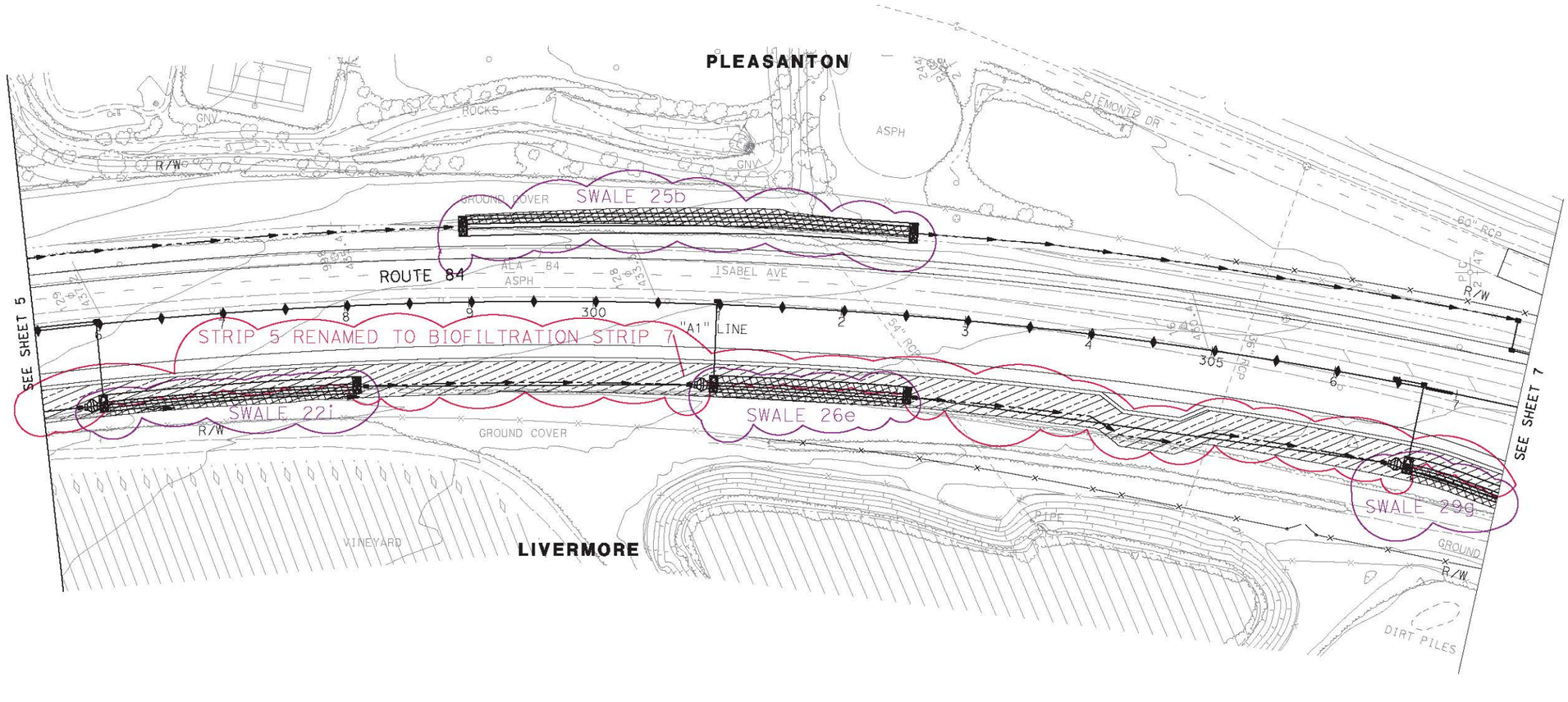

ROADWAY POLLUTANT MITIGATION PLAN

SCALE 1"=50'

PLAN-6

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04	Ala	84	22.9/25.7	9	

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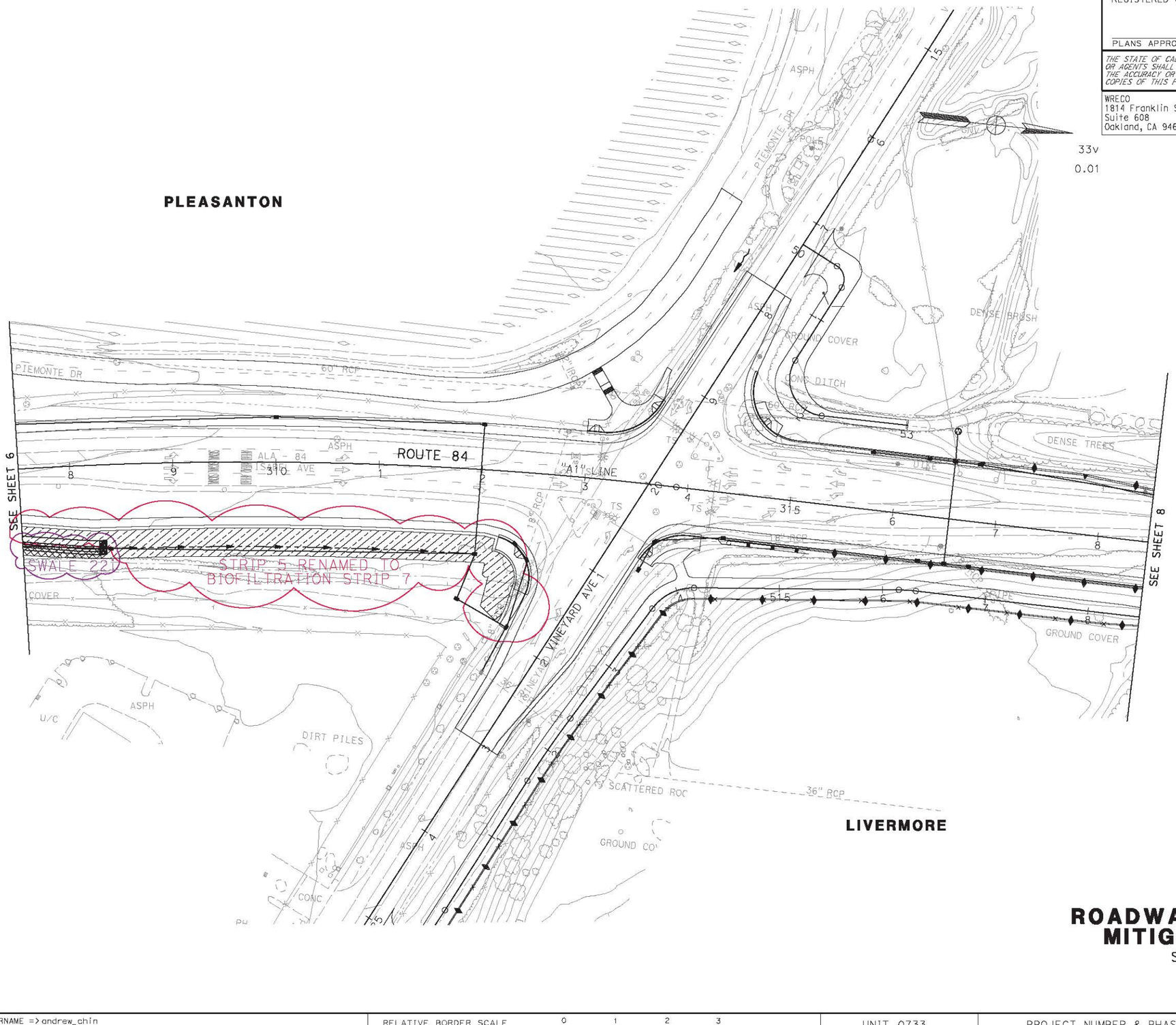

ROADWAY POLLUTANT MITIGATION PLAN

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PLAN-7

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	10	

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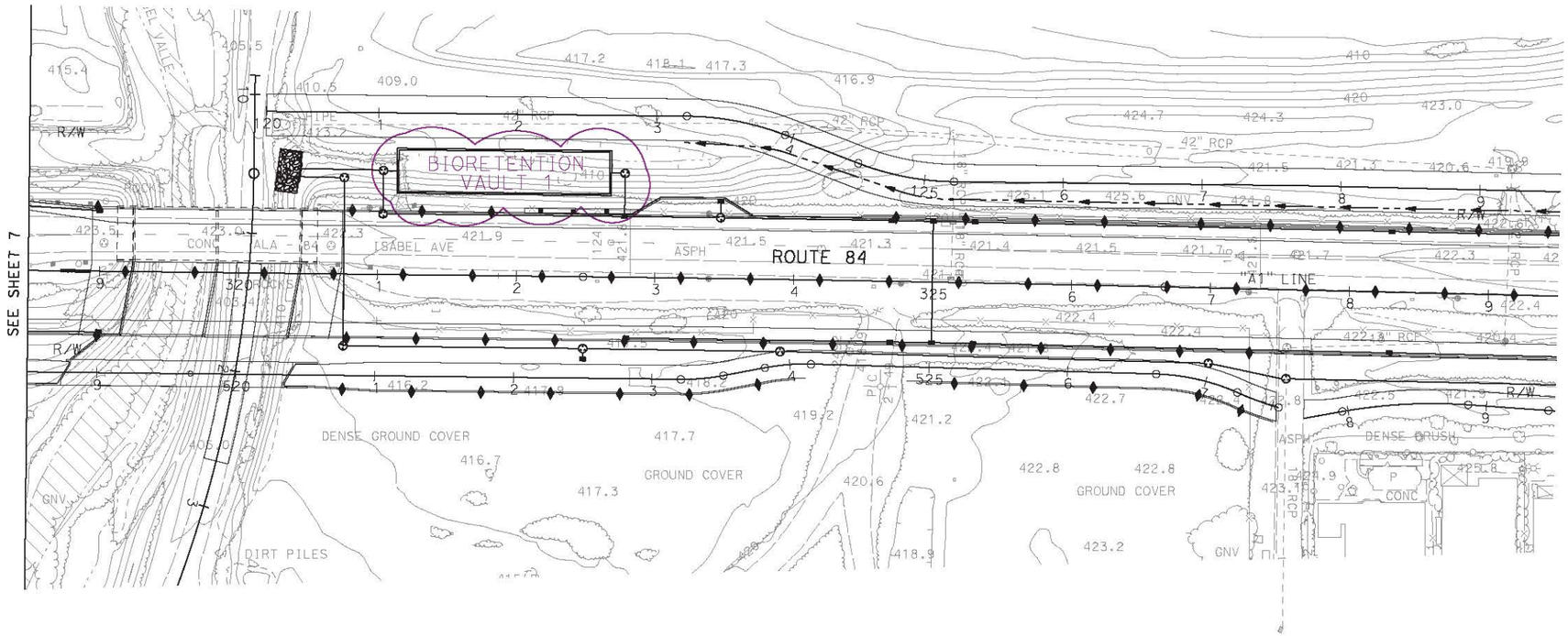

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ROADWAY POLLUTANT MITIGATION PLAN

SCALE 1"=50'

PLAN-8

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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 DATE

PLANS APPROVAL DATE

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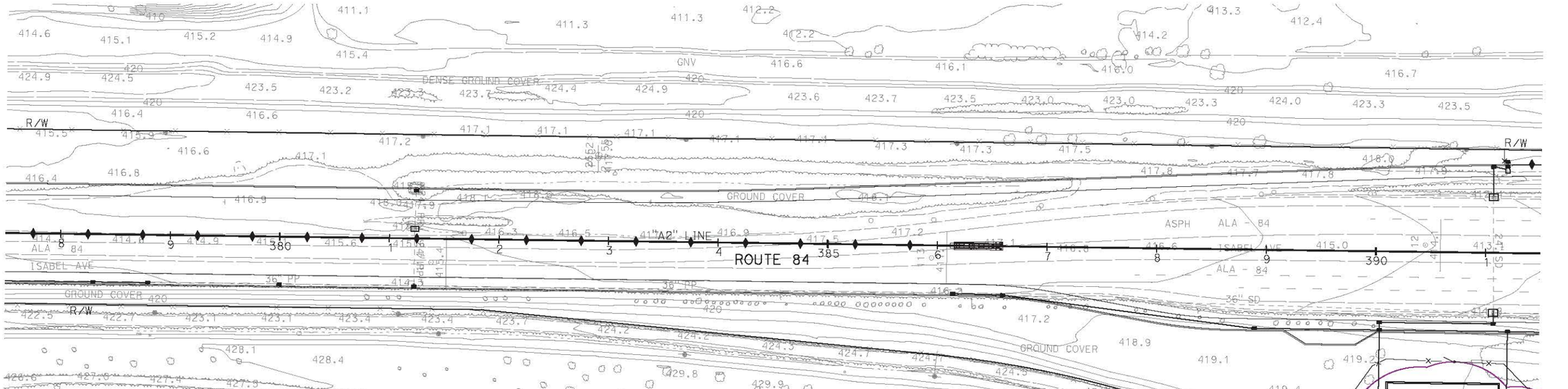

ROADWAY POLLUTANT MITIGATION PLAN

SCALE 1"=50'

PLAN-9

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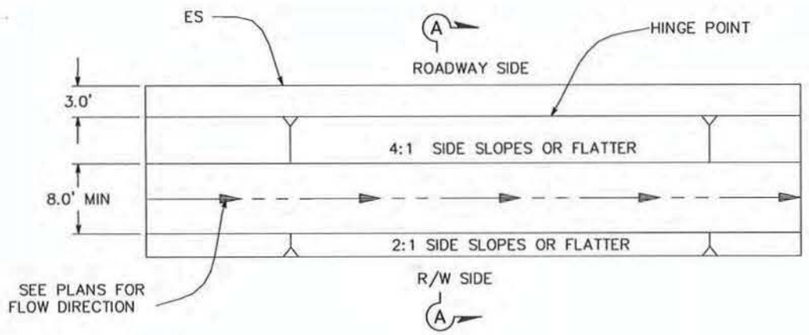
PROJECT NUMBER & PHASE 04000205801



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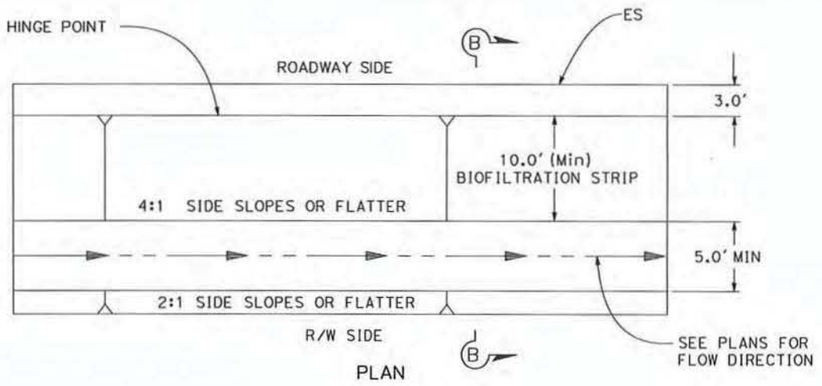

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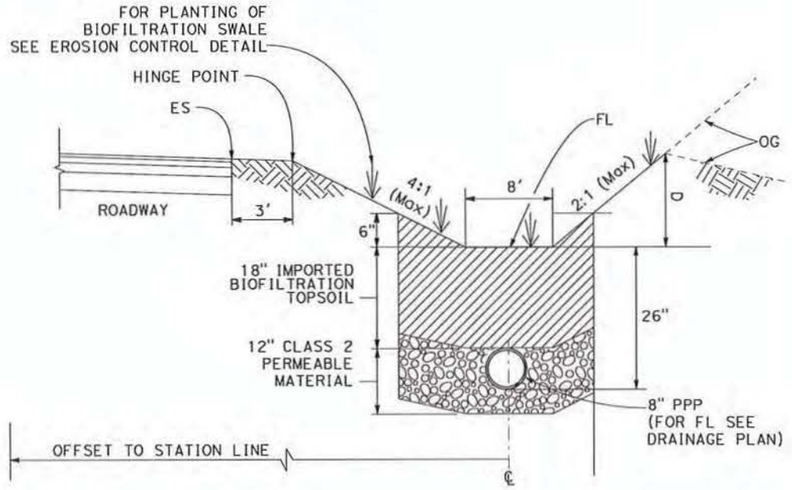
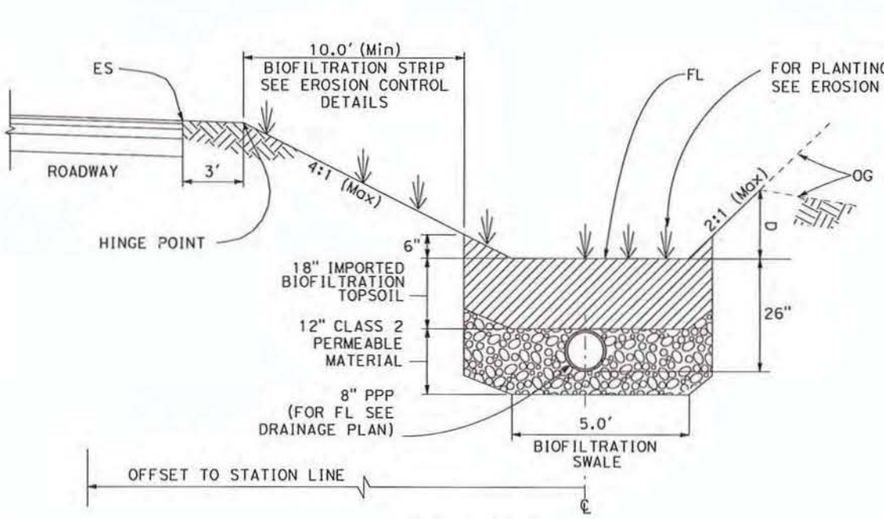


SECTION A–A

BIOFILTRATION SWALE (TYPE A)

(25)(b)



SECTION B–B

BIOFILTRATION SWALE (TYPE B)

(4)(ad)(6)(y)(20)(m)(22)(i)(26)(e)(29)(g)

DRAINAGE UNIT	APPROXIMATE ℄ LOCATION	BEGIN FLOWLINE (Ft)	END FLOWLINE (Ft)	WIDTH (W)(Ft)	DEPTH (D)(Ft)	LENGTH (Ft)
(4)(ad)	81.02' Lt "V" 105+51 TO 37.95' Lt "V" 109+50	515.06	508.30	5.0	1.4	375
(6)(y)	112.76' Rt "A1" 253+52 TO 154.89' Rt "A1" 254+24	529.00	528.05	5.0	1.0	91
(20)(m)	65.57' Rt "A1" 285+07 TO 65.07' Rt "A1" 288+97	448.97	441.85	5.0	1.4	380
(22)(i)	64.09' Rt "A1" 295+96 TO 64.09' Rt "A1" 298+11	431.33	429.37	5.0	1.4	215
(25)(b)	60.92' Lt "A1" 298+93 TO 66.61' Lt "A1" 302+57	432.33	428.16	8.0	1.4	370
(26)(e)	64.10' Rt "A1" 300+96 TO 64.06' Rt "A1" 302+62	427.17	426.11	5.0	1.4	162
(29)(g)	64.10' Rt "A1" 306+69 TO 80.06' Rt "A1" 308+33	423.70	422.69	5.0	1.4	162

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 10/31/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/14 — 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 COMMISSION
1111 BROADWAY, SUITE 800
OAKLAND, CA 94607

NOTES:

1. EXCAVATION TO BIOFILTRATION SWALE FL AND FG IS INCLUDED IN ROADWAY EXCAVATION.
2. EXCAVATION FOR IMPORTED BIOFILTRATION SOIL AND PERMEABLE MATERIAL IS INCLUDED IN DITCH EXCAVATION.

DRAINAGE DETAILS

NO SCALE

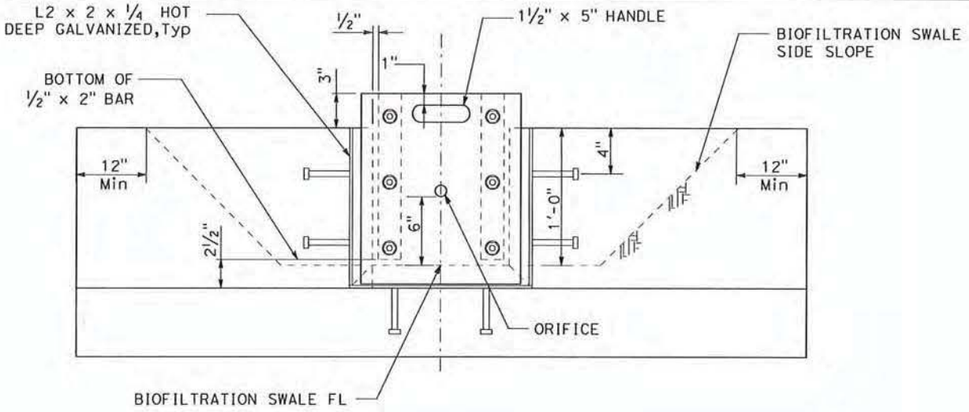
DD-6

REVISED BY	DATE REVISED
JENNIFER ABRAMS	05/30/14
PY	09/12/14
PY	10/31/14
ANALETTE OCHOA	AC

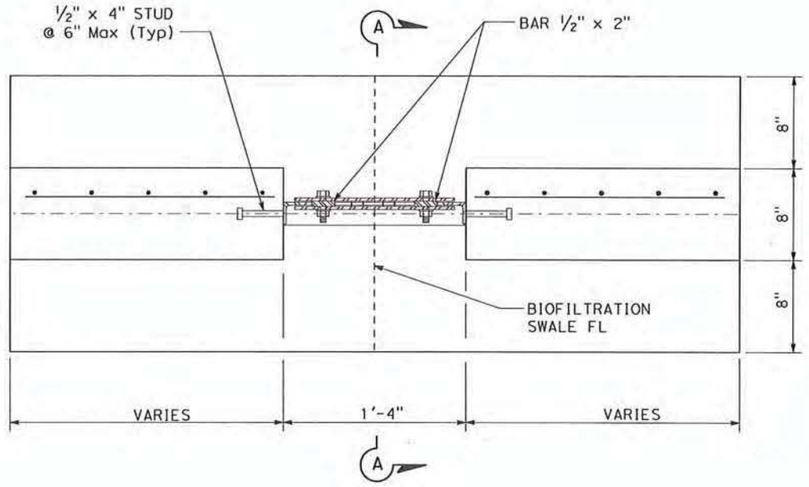
CALCULATED-DESIGNED BY
CHECKED BY
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Gb Gatbans

LAST REVISION 10-31-14 | DATE PLOTTED => 10/30/2014 | TIME PLOTTED => 4:03:04 PM

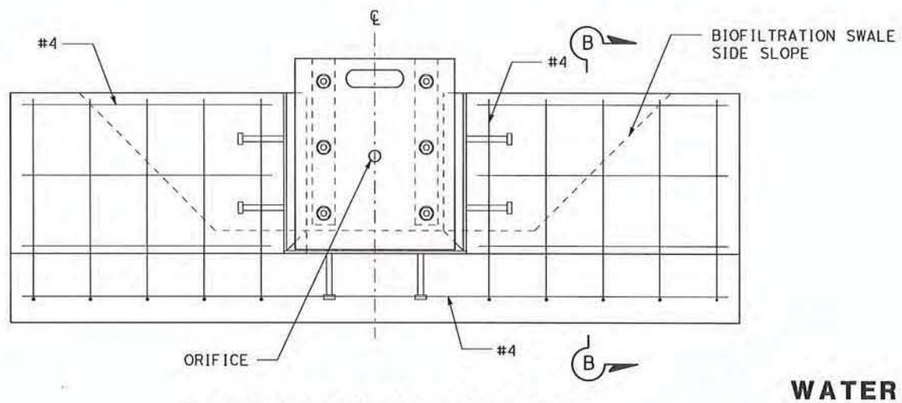
BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\det\429760ic006.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811



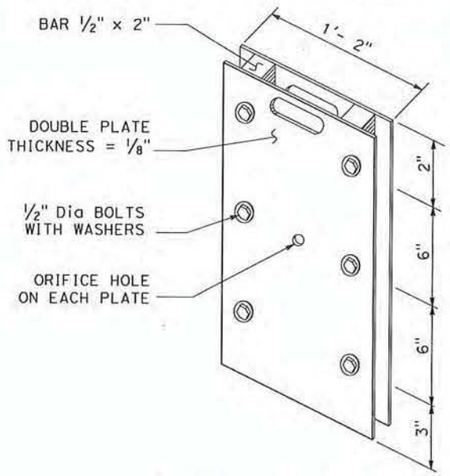
ELEVATION



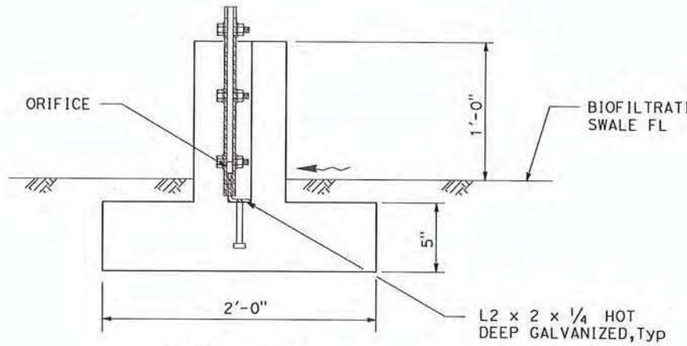
PLAN



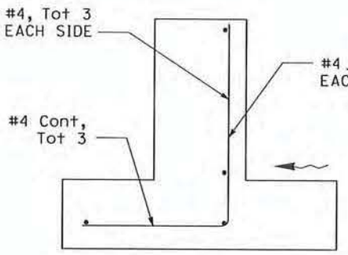
REINFORCEMENT DETAILS



SLIDING WEIR PLATES DETAIL



SECTION A-A



SECTION B-B

DRAINAGE SYSTEM No.	ORIFICE DIAMETER (In)	APPROXIMATE ℄ LOCATION
4 ae	6	39.35' Lt "V" 109+50
21 a	3	65.59' Rt "A1" 288+90
27 a	3	67.58' Lt "A1" 302+50

Swale 4ad
Swale 20m
Swale 25b

WATER QUALITY WEIR

4 ae 21 a 27 a

NOTES:

1. REINFORCED CONCRETE STRUCTURE:
   f'c =4,000 PSI
   fy = 60 ksi
2. STEEL STRUCTURE:
   GRADE 50
3. ALL STEEL MEMBERS EXPOSED TO WEATHER SHALL BE HOT DEEP GALVANIZED.
4. SEE DD-6 FOR BIOFILTRATION SWALE DETAILS.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 11/19/14
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/16
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.

WRECO
1814 FRANKLIN STREET
SUITE 608
OAKLAND, CA 94612

ALAMEDA COUNTY
TRANSPORTATION COMMISSION
1111 BROADWAY, SUITE 800
OAKLAND, CA 94607

DRAINAGE DETAILS

NO SCALE

DD-8

REVISED BY	DATE REVISED
AC	11/19/14
PY	09/12/14
PY	05/30/14

CALCULATED-DESIGNED BY: JENNIFER ABRAMS
CHECKED BY: ANALETTE OCHOA
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 11-19-14 DATE PLOTTED => 1/29/2015 TIME PLOTTED => 8:48:47 AM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin DGN FILE => ...\Dwg\det\04000205811ic008.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

Attachment B – SR 84 Expressway Certification Amendment #1

Original 401 Certification issued June 15, 2011

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
717494

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,

Shin-Roei Lee acting for 2011.06.15 16:04:49 -07'00'

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

Attachment A
Biofiltration Swale and Strip Design and Soil Plans and Specifications

10-1.__ IMPORTED BIOFILTRATION SOIL

GENERAL

Summary

This work includes furnishing, and applying imported biofiltration soil.

Submittals

Compost: Before mixing compost with sand and topsoil, submit:

1. A Certificate of Compliance from the compost supplier in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.
2. A copy of the compost producer's compost technical data sheet. The compost technical data sheet must include:

    2.1. Laboratory analytical test results
    2.2. List of product ingredients

3. A copy of the compost producers Seal of Testing Assurance certification.

Imported biofiltration soil: Imported biofiltration soil must be accompanied by a Certificate of Compliance, from the soil supplier, in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications.

Quality Control and Assurance

Saturated hydraulic conductivity for imported biofiltration soil must be at least 5 inches per hour.

MATERIAL

Imported biofiltration soil consists of a uniform mixture of sand, compost, and topsoil. The ratio of the components of imported biofiltration soil by volume must consist of two-parts sand; one-part compost; 0.5-part topsoil.

Sand

Sand must be free of wood, waste, coating such as clay, stone dust, carbonate, or any other deleterious material. All aggregate passing No. 200 sieve size must be non-plastic. Sand must be graded within the following limits:

Sieve Sizes	Percentage Passing
3/8"	100
No. 4	90 - 100
No. 8	70 - 100
No. 16	40 - 95
No. 30	15 - 70
No. 40	5-55
No. 100	0 - 15
No. 200	0 - 5

Grain size analysis results of the sand component must be performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.

Compost

The compost producer must be fully permitted as specified under the California Integrated Waste Management Board, Local Enforcement Agencies and any other State and Local Agencies that regulate solid waste facilities. If exempt from State permitting requirements, the composting facility must certify that it follows guidelines and procedures for production of compost meeting the environmental health standards of Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7.

The compost producer must be a participant in the United States Composting Council's Seal of Testing Assurance program.

Compost may be derived from any single or mixture of any of the following feedstock materials:

1. Green material consisting of chipped, shredded, or ground vegetation; or clean processed recycled wood products
2. Biosolids
3. Manure
4. Mixed food waste

Compost feedstock materials such that weed seeds, pathogens and deleterious materials are reduced as specified under Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7, Section 17868.3.

Compost must not be derived from mixed municipal solid waste and must be reasonably free of visible contaminates. Compost must not contain paint, petroleum products, pesticides or any other chemical residues harmful to animal life or plant growth. Compost must not possess objectionable odors.

Metal concentrations in compost must not exceed the maximum metal concentrations listed in Title 14, California Code of Regulations, Division 7, Chapter 3.1, Section 17868.2.

Compost must comply with the following:

Physical and Chemical Requirements

Property	Test Method	Requirement
pH	TMECC 04.11-A Elastometric pH 1:5 Slurry Method pH Units	6.5–8.0
Soluble Salts	TMECC 04.10-A Electrical Conductivity 1:5 Slurry Method dS/m (mmhos/cm)	0–6.0
Moisture Content	TMECC 03.09-A Total Solids & Moisture at 70+/- 5 deg C % Wet Weight Basis	30–60
Organic Matter Content	TMECC 05.07-A Loss-On-Ignition Organic Matter Method (LOI) % Dry Weight Basis	35–75
Maturity	TMECC 05.05-A Germination and Vigor Seed Emergence Seedling Vigor % Relative to Positive Control	 80 or Above 80 or Above
Stability	TMECC 05.08-B Carbon Dioxide Evolution Rate mg CO_2-C/g OM per day	8 or below
Particle Size	TMECC 02.02-B Sample Sieving for Aggregate Size Classification % Dry Weight Basis	Inches % Passing 3 100% 1/2 0 – 95% 1/4 0-75% Max. Length 4 inches
Pathogen	TMECC 07.01-B Fecal Coliform Bacteria < 1000 MPN/gram dry wt.	Pass
Pathogen	TMECC 07.01-B Salmonella < 3 MPN/4 grams dry wt.	Pass
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Plastic, Glass and Metal % > 4mm fraction	Combined Total: < 1.0
Physical Contaminants	TMECC 02.02-C Man Made Inert Removal and Classification: Sharps (Sewing needles, straight pins and hypodermic needles) % > 4mm fraction	None Detected

NOTE: TMECC refers to "Test Methods for the Examination of Composting and Compost," published by the United States Department of Agriculture and the United States Compost Council (USCC).

Topsoil

Topsoil must be free of wood, waste or other deleterious material. The topsoil texture must be loamy. Overall dry weight percentages must be 60 to 90 percent sand, with less than 20 percent passing the No.200 sieve, less than 5 percent clay, and no gravel.

CONSTRUCTION

Comply with Section 20-3.02, "Preparation," of the Standard Specifications.

Place imported biofiltration soil in lifts 8 to 12 inches. Lifts are not to be compacted.

MEASUREMENT AND PAYMENT

Quantity of imported biofiltration soil is measured by the cubic yard.

The contract unit price paid per cubic yard for imported biofiltration soil includes full compensation for furnishing all labor, materials, tools, equipment, incidentals, and for doing all the work involved in imported biofiltration soil, including testing, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Dist	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.3/8.3		

David Williams 7/16/10
REGISTERED CIVIL ENGINEER DATE

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.

REGISTERED PROFESSIONAL ENGINEER — David A. Williams — No. C58697 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

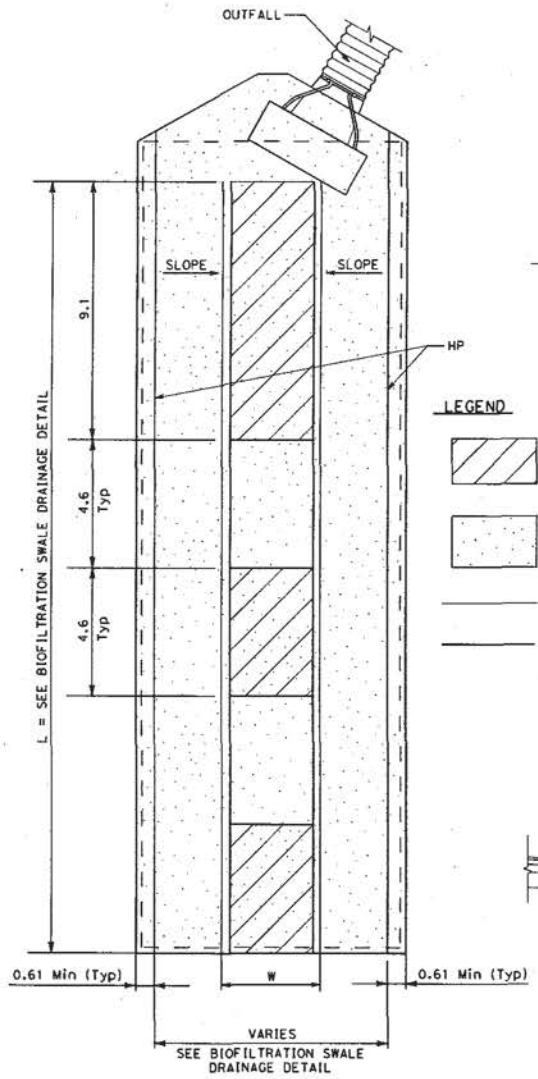
URS CORPORATION
1380 LEAD HILL BLVD,
SUITE 100
ROSEVILLE, CA 95661

CITY OF PETALUMA
11 ENGLISH STREET
PETALUMA, CA 94952

Caltrans Metric

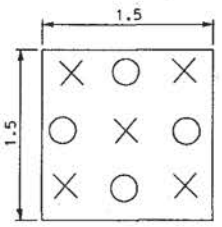
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN
CALCULATED-DESIGNED BY: D.A.W.
CHECKED BY: SL
REVISED BY
DATE REVISED



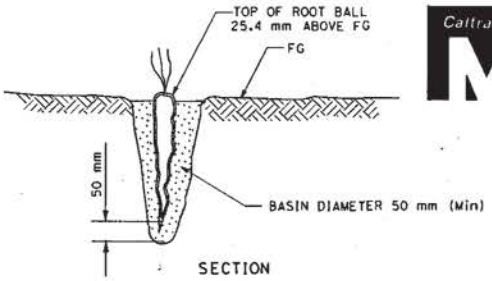
PLAN

BIOFILTRATION SWALE DETAIL



PLAN

TYPICAL LINER PLANTS SPACING



SECTION

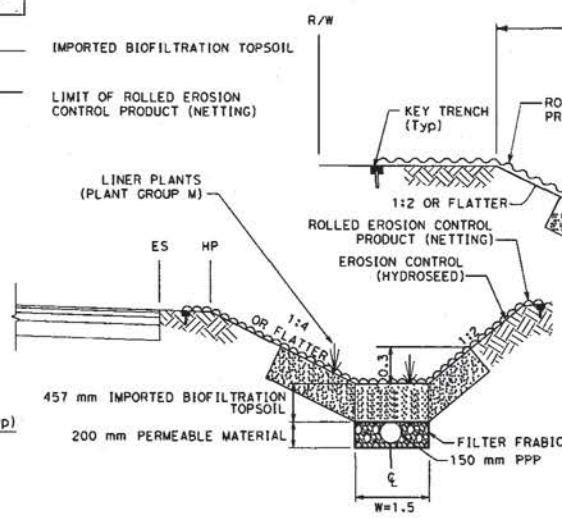
PLANT BASIN (LINER)

PLANT LIST AND PLANTING SPECIFICATIONS

PLANT GROUP	PLANT No.	SYMBOL	BOTANICAL MAME	COMMON NAME	SIZE	HOLE SIZE (mm)	
						Dia	DEPTH
M	1	X	HORDEUM BRACHYANTHERUM	MEADOW BARLEY	LINER	50	100
	2	O	FESTUCA RUBRA 'MOLATE'	MOLATE FESCUE	LINER	50	100

LEGEND

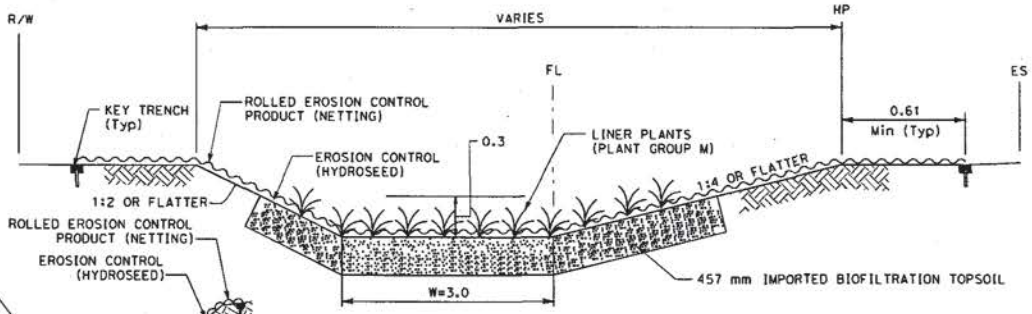
- LINER PLANS (PLANT GROUP M)
- EROSION CONTROL (HYDROSEED)
- IMPORTED BIOFILTRATION TOPSOIL
- LIMIT OF ROLLED EROSION CONTROL PRODUCT (NETTING)



SECTION

DITCH D - BIOFILTRATION SWALE DETAIL

"R3" 79+81.107 TO 80+11.170



SECTION

DITCH A - BIOFILTRATION SWALE DETAIL

"P" 75+25.000 TO 75+55.000

EROSION CONTROL DETAILS

NO SCALE

ALL DIMENSIONS ARE IN METERS
UNLESS OTHERWISE SHOWN

ECD-3

LAST REVISION DATE PLOTTED => 8/16/2010
07-16-10 TIME PLOTTED => 1013842 AM

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => huey_nham
DGN FILE => 426400gf003.dgn

CU 04276

EA 264041

California Department of Fish and Wildlife: Operations-of-Law Notification of Lake or Streambed Alteration Agreement

- **No. 1600-2012-0372-3 – Dated 02/16/2011**
- **No. 1600-2012-0433-3 – Dated 03/20/2013**

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

Escarom 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

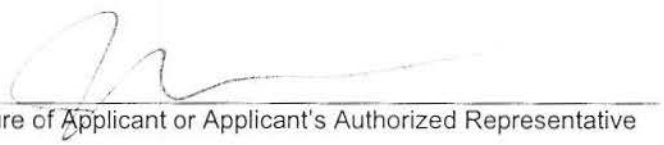
Is any of the information included as part of the notification available in digital format (i.e., CD, DVD, etc.)?

☑ 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

10/18/10

Date

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.

State of California – The Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Bay Delta Region
7329 Silverado Trail
Napa, CA 94558
(707) 944-5500
www.wildlife.ca.gov

EDMUND G. BROWN JR., *Governor*
CHARLTON H. BONHAM, *Director*

March 20, 2013

Jeffrey G. Jensen
California Department of Transportation
Post Office Box 23660
Oakland, CA 94623-0660

Subject: Notification of Lake or Streambed Alteration No. 1600-2012-0433-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 March 18, 2013 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 March 18, 2013. 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 Melissa Escaron, Environmental Scientist at (707)339-0334 or Melissa.Escaron@wildlife.ca.gov.

Sincerely,

Craig J. Weightman
Senior Environmental Scientist
Bay Delta Region

cc: Denis Coghlan
Lieutenant Christensen
Warden Pritting
Melissa Escaron

FOR DEPARTMENT USE ONLY				
Date Received	Amount Received	Amount Due	Date Complete	Notification No.
12/17/12	$ 4,482.75	$		1600-2012-0433-3

QLH00299212
JRS

STATE OF CALIFORNIA
DEPARTMENT OF FISH AND GAME

Escarcon
Rocco
Christenson

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
DEC 17 2012
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	Denis Coghlan		
Street Address	111 Grand Avenue		
City, State, Zip	Oakland, CA 94612 P.O. Box 23660, Oakland, CA 94623-0660		
Telephone	(510) 286-5434	Fax	(510) 286-6301
Email			

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*)	
2012	2015	06/15	10/14	484.00

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	$82,000,000.00	$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: Caltrans Notification Number: 1600-2010-0372-R3 Date: 02/16/11

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 Interstate 580 (I-580)/Isabel Avenue Interchange Project (EA 171300) to the north.

State Route 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 Table 1 in Box 8L of the attached supplemental information packet.

☑ *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 Hill Drive (Figure 3).

Please see additional information in Box 10A of the attached supplemental information packet.

☑ *Continued on additional page(s)*

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

The following types of equipment are anticipated to be used for bridge construction: cranes, loaders, graders, compactors, tracked and rubber tired backhoes, sweepers, dump trucks, welding equipment, pipe drivers, concrete mixers/pumping equipment, jack hammers and backhoe mounted jack hammer.

☐ *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 text and Tables 2 and 3 in Box 11A of the attached supplemental information packet.

☑ *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 Table 4 in Box 11B of the attached supplemental information.	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)
Please see Table 5 in Box 11B of the attached supplemental information packet.		

☐ *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

Please see Box 11C in the attached supplemental information packet.

☑ *Continued on additional page(s)*

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

Please see Box 11D in the attached supplemental information packet.

☑ *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.

General avoidance and minimization measures will be implemented as part of construction activities to prevent sediment from entering watercourses during and after construction. The general avoidance and minimization measures that will be implemented during project construction are listed in Box 12A of the 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 general avoidance and minimization measures that will be implemented during project construction are listed in Box 12B of the attached supplemental information packet.

☑ *Continued on additional page(s)*

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

Impacts to wildlife and plant resources will be mitigated for using a variety of measures, which are discussed in Box 12C of the 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. Please see Box 13 of the attached supplemental information packet. ☐ Applied ☐ Issued

B. _____ ☐ Applied ☐ Issued

C. _____ ☐ 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*): _____
☑ 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	Valerie Shearer	F. Telephone Number	(510) 286-5594

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 I-580/Isabel Avenue 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.

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*):
☑ 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	Valerie Shearer	F. Telephone Number	(510) 286-5594

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 I-580/Isabel Avenue 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

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☐ 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 12/12/12

Jeffrey G. Jensen

Print Name

Box 8L-Assessor's Parcel Number

Table 1 Assessor's Parcel Information

Item	Sheet	APN#	Owner	Land Use Designation	Current Property Use	Impact Description
1	L-1	950-0023-013-03	Ruby Hill Development	Unknown	Vacant	Partial take; Utility Easement; no effect to residents or businesses
2	L-2	950-0023-006-02	Ruby Hill Development	Unknown	Vacant	Partial take; Utility Easement; no effect to residents or businesses
3	L-2	950-0023-005-00	Ruby Hill Development	Unknown	Vacant	Partial take; Utility Easement; no effect to residents or businesses
4	L-2, L-3	950-0023-010-00	Ruby Hill Development	Unknown	Vacant	Partial take; Permanent Easement; no effect to residents or businesses
5	L-2	950-0023-004-02	Ruby Hill Development	Street	Ruby Hill Drive R/W	Partial take; no effect to residents or businesses
6	L-6	950-0010-012-00	Ruby Hill Development	Unknown	Vacant	Access Control Rights
7	L-6, L-7	950-0010-013-00	Ruby Hill Development	Unknown	Vacant	Access Control Rights
8	L-7	950-0010-011-00	Ruby Hill Development	Unknown	Vacant	Utility Easement
9	L-2, L-5 – L-7	---	City of Livermore	County Road	Isabel Avenue	Access Control Rights
10	L-4 - L-6	---	City of Pleasanton	County Road	Isabel Avenue	Access Control Rights
11	L-2	099-1343-034-02	Vishvendra & Rathna Rao	Agriculture	Vacant	Partial take; no effect to residents or businesses
12	L-2	099-1343-035-00	Susan Saul	Agriculture	Vacant	Partial take; Utility Easement; no effect to residents or businesses
13	L-3	099-1343-030-00	Livermore Crest, LLC	Agriculture	Vacant	Utility Easement
14	L-3	099-1343-029-00	David Chandler	Agriculture	Vacant	Utility Easement
15	L-8	950-0010-008-02	Stealth Street Partners	Agriculture	Vacant, part of Agricultural Conservation Easement	Partial take; Utility easement; no effect to residents or businesses
16	L-8	099-1356-008-00	Piazza Rubino	Commercial	Vacant	Utility Easement; no effect to residents or businesses
17	L-8	950-0006-004-02	PG&E	Public Utility	Utility	Full Take
18	L-8	950-0006-001-05	Lonestar California	Quarry	Vacant	Partial take; Utility Easements; Not within mining limits. Obtain access control rights.

Table 1 Assessor's Parcel Information

Item	Sheet	APN#	Owner	Land Use Designation	Current Property Use	Impact Description
19	L-8, L-9	099-0290-011-07	Lonestar California	Quarry	Vacant	Partial take; Utility Easements; New mining limits. Obtain access control.
20	L-9 – , L-11	904-0008-002-04	Pleasanton Gravel Co.	Gravel Quarry	Vacant	Partial take; Utility Easements; Partially New mining limits. Obtain access control rights.
21	L-9	---	City of Livermore	County Road	Isabel Avenue	Partial Take.
22	L-10	099-0283-003-01	City of Livermore	County Road/ Public trail	Isabel Avenue Multi-Use Trail	Partial Take.
23	L-10	099-0283-003-02	Orchid Ranch	Light Industrial	Former orchid nursery. Develop for condominiums	Partial Take; Impacts 4 buildings (to be removed as part of condo development.
24	L-13	099-0260-011-02	State of California	Unknown	Vacant	Partial Take.
25	L-13	099-0260-007-04	City of Livermore	County Road	Isabel Ave/Stanley Boulevard	Partial Take.
26	L-13	---	City of Livermore	County Road	Stanley Boulevard	Section 83 from City; Obtain access control rights
27	L-13	099-0185-004-00	UPRR	Public Utility	Rail Road	Access Control Rights
28	L-13	099-0185-003-00	UPRR	Public Utility	Rail Road	Access Control Rights
29	L-13, L-14	099-0176-007-04	City of Livermore	County Road	Isabel Avenue	Partial take; Permanent Easement
30	L-14	099-0185-006-02	City of Livermore	County Road	Isabel Avenue	Partial Take.
31	L-14	904-0010-002-05	Alameda County Flood Control & Water District	Flood Control	Arroyo Mocho R/W	Partial Take; Ingress/Egress Easement. Obtain access control
32	L-14	099-0176-005-04	Alameda County Flood Control & Water District	Flood Control	Arroyo Mocho R/W	Partial Take; Permanent Easement.
33	L-14	904-0008-002-02	Pleasanton Gravel Co.	Gravel Quarry	Vacant	Egress/Ingress Easements; Not within mining limits.
34	L-14 – L-16	904-0012-008-00	City of Livermore	Unknown	Vacant	Partial Take.
35	L-14, L-15	904-0012-008-00	Livermore Airway Association	Light Industrial	Oaks Business Park. Under development	Ingress/Egress Easement.
36	L-16, L-17	904-0005-002-18	Wal-Mart Stores	Light Industrial	Planned commercial development	Partial Take; Utility Easement.
37	L-17	099-0185-006-02	City of Livermore	Unknown	Vacant	Partial take; Obtain access control rights.

Box 10A – Project Description

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 (Figure 1). State Route (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, Stanley Connector, 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 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.

Proposed project elements that will impact riparian corridors which fall under the jurisdiction of the California Department of Fish and Game (CDFG) include:

1. Widen SR 84 bridges at Arroyo del Valle and Arroyo Mocho to accommodate the roadway widening.
2. Construct a new single-span bridge crossing at Arroyo Mocho for access to PG&E, Zone 7, and City of Livermore.
3. Construct a new Isabel Trail two-span bridge adjacent to the widened Arroyo del Valle bridge. A 24-inch gas main and 15-inch sanitary sewer will also be relocated from the existing Arroyo del Valle bridge to the new Isabel Trail bridge.

Proposed project elements that will impact hydrological features such as: wetlands, intermittent drainages, road side ditched and ephemeral drainages that CDFG may take jurisdiction of include:

1. Widen and upgrade SR 84 to expressway standards (55 mph design speed) 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 (PM 22.5) and Stanley Boulevard, and from two to six lanes between Stanley Boulevard and Jack London Boulevard (PM 27.3). The widening would generally follow the existing roadway alignment and would conform to the SR 84 Pigeon Pass Safety Project to the south and the I-580/Isabel Avenue Interchange Project to the north.
2. Extend the Isabel Trail, located on the eastern side of SR 84 between Jack London Boulevard and Alden Lane, southward to Vineyard Avenue.
3. Widen and upgrade the signalized intersections at Ruby Hill Drive, Vallecitos Road, Vineyard Avenue, Concannon Boulevard, Stanley Boulevard, Stanley Connector, Discovery Drive, and Jack London Boulevard to accommodate year 2030 traffic demands. The Vallecitos Road intersection would be reconfigured to

exclude the southbound SR 84 to eastbound Vallecitos Road turning movement. An exit connector would be constructed to accommodate the high volume of traffic moving from northbound SR 84 into central Livermore.

The project would create approximately 29.82 acres of new pavement. The total action area of the project, including permanent and temporary work areas, is approximately 103.74 acres. Partial right-of-way acquisition of 30 parcels (totaling about 12 acres) would be required to accommodate the road widening and intersection improvements. No land fee acquisition will be required from an existing conservation easement area on the eastern side of SR 84 between Ruby Hill Drive and Vallecitos Road. A total of 1.682 acre of impacts to waters of the state (including wetlands) is currently proposed by the project. This includes 1.168 acre of temporary impacts and 0.514 acre of permanent impacts.

Construction activities that will impact bodies of water, riparian areas, wetlands, intermittent drainages, road side ditched and ephemeral drainages that fall (or have the potential to fall) under the jurisdiction of the CDFG are outlined below in three sections: Arroyo del Valle Bridge Construction, Arroyo Mocho Bridge Construction and Mainline Expressway Widening.

Arroyo del Valle Bridge Construction

The existing 40-foot-wide and 121-foot-long, two-span bridge at Arroyo del Valle would be widened by 54 feet to the east to accommodate the SR 84 widening (Figure 4A and 4B, sheet 2). Located within the OHWM, the low-flow channel of Arroyo del Valle passes on the southern side of the bridge pier and would require approximately 1,800 cubic yards of replacement rock slope protection to prevent scour. The OHWM is the high-water flow elevation level as determined by the U.S. Army Corps of Engineers (USACE 2009). The low-flow channel is contained within a berm that extends down the southern side of the overall channel and active floodplain of Arroyo del Valle in the project area. During high-flow events during the wet season, creek flows extend beyond the bermed channel through gaps that occur along the length of the berm, and from other upstream hydrologic inputs. Therefore, on the southern side of the creek channel, the OHWM extends beyond the low-flow channel.

An unpaved maintenance road passes under the northern side of the bridge pier. Excavation and pile foundations would be required for widening the two abutments and bridge pier by 54 feet. Bridge foundation work will occur outside of the low-flow channel. However, work would occur within the OHWM of Arroyo del Valle. The top of bank or outer edge of contiguous riparian vegetation, whichever is greater, is typically used to define CDFG jurisdiction for Lake and Streambed Alteration Agreements. 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 (Attachment 5).

A new two-span bridge would be constructed across Arroyo del Valle to accommodate the Isabel Trail extension. The low-flow channel would pass on the southern side of the

bridge pier, and the new pier would require approximately 800 cubic yards of rock slope protection to prevent scour during high-flow events. An existing unpaved maintenance road that passes on the northern side of the bridge pier would be graded to provide clearance under the bridge. The single bridge pier for the new bridge will be constructed outside of the low-flow channel but within the OHWM (Attachment 5). The abutments for the new bridge will be constructed outside of the OHWM. Excavation and driven pile foundations will be required for the 15-foot-wide abutments and bridge pier. Bridge foundation work will occur outside of the low-flow channel but within the OHWM and may impact adjacent riparian areas of the creek floodplain. 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 12 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, after a stream diversion-dewatering plan has been implemented (Attachment 5). The stream diversion plan will include installing a cofferdam of gravel-filled bag berms or bladder dams within the existing creek bed approximately 145 feet upstream and 65 feet downstream of the eastern side of the existing bridge deck. The gravel-filled bag berms or bladder dam will allow creek waters to pass through the construction work area by gravity flow through the use of two 36-inch pipes. The berms or dams will be constructed across the extent of the channel up to approximately the ordinary high water level of the streambed. 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. On completion of the Arroyo del Valle bridge and the Isabel Trail bridge, the upstream and downstream berms or bladder dams and pipes will be removed and the creek flow will be restored to preconstruction conditions. Construction activities in the Arroyo del Valle will be limited to between June 15th and October 15th.

Construction activity in Arroyo del Valle will begin with construction of temporary localized sheet-pile cofferdams for both bridge piers to capture any subsurface water that may be exposed during pier excavations. 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 waterway. Dewatering operations will include approved construction Best Management Practices (BMPs) to remove sediments from water to be pumped from excavations. Following the completion of work in Arroyo del Valle, the stream diversion will be removed.

A pile-driving rig and crane will be required for bridge pile installation. The footprint of the pile-driving equipment will be approximately 20 feet by 30 feet. The localized cofferdams will be erected providing for 1 foot of clearance around the actual final width of the columns, and concrete will be poured. Temporary impact areas have been provided to allow for access for column construction. Concrete for the foundations will be poured

from outside the arroyo banks using standard concrete pumping hoses to reach the pier foundation forms within the cofferdams.

Removal of the existing bridge overhang (east of bridge only) and exposure of rebar to allow for an effective concrete pour 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, as defined by the OHWM, to construct the bridge piers will be from the existing quarry access road on the east side of SR 84 that follows the northern side of the floodplain and extends into the OHWM of the stream near the bridge. A backhoe will be used for the bridge pier foundation excavations. Stockpiles of soils and materials (e.g., 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.

In addition to the two bridge construction operations, a drainage outfall (OW-3) at the Arroyo del Valle bridge will be altered. North of the SR 84 bridge crossing over Arroyo del Valle, there is an existing 42-inch culvert combining flows from the City of Livermore and highway runoff from the existing SR 84 drainage system (Figure 4A and 4B, sheet 2). This 42-inch culvert currently discharges into Arroyo del Valle on the west side (downstream end) of the bridge. The SR 84 Expressway Widening Project proposes to separate the city flows from Caltrans' highway runoff via two parallel pipes. The project proposes to construct a new drainage system, within the city's right of way, to discharge into Arroyo del Valle on the west end of the SR 84 bridge (downstream side). This new outfall would be 42-inch. An alternative pipe culvert is proposed with a new headwall, flap gate, and rock slope protection. There would be temporary impacts in the creek as well as permanent fill. 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 Isabel Trail Bridge. The sanitary sewer pipeline would be protected from damage by being placed inside a larger steel pipe (sleeve) for the water crossing.

Construction in the vicinity of Arroyo del Valle will result in permanent and temporary impacts to OW-3 and WL-2, as shown on Figures 4A and 4B, sheet 2. A quantitative analysis of the impacts associated with the construction in the vicinity of Arroyo del Valle is outlined in the impact tables in Attachment 1, Box 11a of the supplemental information package.

Arroyo Mocho Bridge Construction

The existing 61-foot-wide and 123-foot-long, three-span bridge at Arroyo Mocho would be widened by 71 feet to the west to accommodate the roadway widening (Figure 4A, sheet 1). The intermittent or seasonal flow channel passes between the two bridge piers and would not require additional rock slope protection. Excluding the bridge piers, 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. Because this portion of Arroyo Mocho is heavily human-altered with portions of the channel being concrete lined and the banks armored with cement and boulder rip-rap, no impacts to riparian vegetation are expected. The existing abutments and piers would be extended to accommodate the widened structure (Attachment 5).

In addition to the main-line bridge widening a new single-span bridge would be constructed across Arroyo Mocho (Arroyo Mocho Access Bridge) to provide private access to PG&E, City of Livermore, and Zone 7 facilities. The abutments will require approximately 350 cubic yards of rock slope protection. Abutments for the new bridge will be constructed outside of the OHWM of Arroyo Mocho, but will extend below the top of bank (Appendix 5). Excavation and driven pile foundations will be required for the 15-foot-wide abutments and bridge pier. Bridge foundation work and construction of falsework will occur outside of the vegetated low-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, between June 15 and October 15, when no surface flow occurs within this seasonal creek, but there is a possibility of controlled dry season flow releases by Zone 7 water agency into this channel, as this channel serves as a recharge area for the aquifer. Bridge construction for each bridge will take approximately 5 months. Staging areas for abutments and pier construction will be provided outside Arroyo Mocho and will follow regulatory permit requirements. Temporary supports for falsework will be installed in Arroyo Mocho. Work platforms needed for machinery to work around the falsework would be placed mostly on rock slope areas of the banks, and part of the bed. A plastic liner and a thin soil layer would separate the rock slope and the platform. Once temporary falsework supports are installed, construction work for extending the foundations of the two bridge piers within the OHWM of Arroyo Mocho will be completed during one dry season.

The need for a surface water diversion is not anticipated during the dry season construction window, unless Zone 7 conducts water releases during the dry season. However, a stream diversion system is proposed for the Arroyo Mocho Access Bridge construction to address the possibility of Zone 7 releasing water in the dry season. Construction activity in Arroyo Mocho will begin with construction of the temporary stream diversion-dewatering plan (Attachment 5). The stream diversion plan will include installing a cofferdam of gravel-filled bag berms or bladder dams within the existing creek bed approximately 28 feet upstream and 267 feet downstream of the eastern side of the existing bridge deck. The gravel-filled bag berms or bladder dam will allow creek

waters to pass through the construction work area by gravity flow through the use of two 30-inch pipes. The berms or dams will be constructed across the extent of the channel up to the ordinary high water level of the streambed. Supports for falsework will be installed in Arroyo Mocho, after a stream diversion-dewatering plan has been implemented. On completion of the Arroyo Mocho Access bridge, the upstream and downstream berms or bladder dams and pipes will be removed and the creek flow will be restored to preconstruction conditions.

Once the stream diversion-dewatering plan has been implemented, bridge foundation construction will proceed, and would involve installation of shoring followed by excavation to the required footing depth. If seepage of water into the excavations occurs, a submersible 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. Following the completion of work in the Arroyo Mocho, the stream diversion will be removed.

A pile-driving rig and crane will be required for bridge pile installation. The footprint of the pile-driving equipment will be approximately 20 feet by 30 feet. Concrete for the foundations will be poured from outside the arroyo banks using standard concrete pumping hoses to reach the pier foundation forms within the cofferdams.

Removal of the existing bridge overhang (western side of the bridge only) and exposure of rebar to allow for an effective concrete pour 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 armored 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. Stockpiles of soils and materials (e.g., steel piles, steel sheets, steel reinforcement bars, and plywood and wood stakes) will be located outside the top-of-bank of Arroyo Mocho within portions of the Caltrans right-of-way, and will follow regulatory permit requirements. Localized 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.

Construction in the vicinity of Arroyo Mocho will result in permanent and temporary impacts to OW-1 shown on Figures 4A and B, sheet 1. A quantitative analysis of the impacts associated with the construction in the vicinity of Arroyo Mocho is outlined in the impact tables in Box 11A of the supplemental information package.

Mainline Expressway Widening

This section of roadway between Ruby Hill Drive and Vineyard Avenue includes residential development on the western side of SR 84 (the Ruby Hill Development), and environmental and agricultural (vineyard) conservancy areas on the eastern side of SR 84 (Attachment 4). The Tri-Valley Conservancy and the City of Livermore are the co-holders of easements over these conservancy areas, which are held in perpetuity. SR 84 would be realigned to avoid encroachment into the adjacent intermittent drainage located southwest of the Arroyo del Valle and the environmental conservancy area located to the south and east. Mainline widening will result in permanent impacts to OW- 5, OW-6 and OW-7 (Figure 4B, sheets 1-6) and WL-5 (Figure 4B, sheet 6) and temporary impacts to OW-4 (Figure 4A, sheet 6). A quantitative analysis of the impacts associated with the mainline widening is outlined in the impact tables in Attachment1, Box 11a of the supplemental information package.

The project limits will extend eastward into the agricultural and environmental conservancy area to accommodate the relocation of a high-voltage (60-kilovolt) PG&E transmission line from the west side of SR 84 to the east side. The relocation of the transmission line, which is proposed to be a combination of overhead and underground transmission methods, would take place between Vallecitos Road and Kalthoff Common.

Portions of the SR 84 alignment would be moved closer to Ruby Hill, and a special retaining wall to the west would be required to retain the cut slope adjacent to East Ruby Hill Drive. The retaining wall height would vary approximately from 5 feet to 30 feet, and portions would require soil nail wall construction or similar techniques. A concrete retaining barrier that would vary in height from 0 feet to 3 feet is required on the east side of SR 84 to provide a buffer to an environmentally sensitive area (ESA). A temporary high-visibility fence will be placed to delineate the ESA limits during project construction.

The profile grade of super elevated (banked) sections of SR 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.

The Vallecitos Road intersection would be reconstructed at its current location. The approach to the intersection along Vallecitos Road would be increased in elevation to conform to the new standard super elevation of SR 84. Approximately 1,500 linear feet of Vallecitos Road would be reconstructed. Retaining walls would be constructed on both sides of Vallecitos Road to minimize and avoid impacts to ESAs and the box-culverted crossing the road. The exit connector from northbound SR 84 would conform to the new elevation of Vallecitos Road. A concrete retaining barrier would be constructed at the beginning of the connector, which would connect to the retaining barrier on east side of SR 84. The barrier would connect to an approximately 980-foot-long retaining wall along the roadway to prevent impacts to the ESA east of the connector.

From Vallecitos Road to Vineyard Avenue, SR 84 would generally be widened to the east and incorporate the existing roadway pavement. A retaining wall would be required along a portion of the western side of the road. The retaining wall height would vary from 5 to 30 feet, portions of which would require soil nail wall 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. Drainage bioswales would be constructed on both sides of SR 84.

All storm water from the project action area will be treated (e.g., to reduce sediments) prior to discharging into natural watercourses using Caltrans BMPs for water quality. BMPs proposed for the project include biofiltration swales and retention/detention facilities. Biofiltration swales remove pollutants, reduce runoff, and improve water quality of storm water by filtration through vegetation, uptake by plant biomass, sedimentation, absorption to soil particles, and infiltration through the soil.

A total of three biofiltration swales are proposed within the project limits. They will be located near the southeast corner of the proposed SR 84/Vallecitos Road intersection, the north side of Vallecitos Road, and east of SR 84 to the south of the Vineyard Avenue intersection. Each biofiltration swale has been designed to Caltrans standards and complies with Caltrans BMPs. The swales would be trapezoidal in shape and composed of the following construction materials: imported soil media, permeable material, underdrain, compost, rolled erosion control product (netting), hydroseed, and hydromulch. Two Austin Vault Sand Filter structures are proposed to be constructed: one northwest of the Arroyo del Valle bridge widening area, and one southeast of the SR 84/Stanley Connector intersection.

Box 11A – Impact Analysis

Impacts to Waters of the state, including wetlands within waters will occur at Arroyo Mocho (Intermittent Stream OW-1 on Figures 4A and 4B, sheet 1, of attached Project Impacts to Waters and Wetlands set of figures), Arroyo del Valle (Perennial Stream/Wetland – WL-2 on Figures 4A and 4B, sheet 2), a broadleaf cattail roadside ditch (Intermittent Drainage/Wetland - WL-5 on Figure 4B, sheets 2-4), that is tributary to Arroyo del Valle, near Ruby Hills Drive and removal, OW-7 culverted ephemeral drainage that drains into the Arroyo del Valle, and replacement of a portion of the culverted (OW-4) intermittent drainage that drains WL-5 under SR 84 to WL-6 (Figure 4B, sheets 2-4). Two one- foot wide ephemeral roadside drainage ditches (OW-5 and OW-6 on Figure 4A, sheets 2-4) 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 to replace the function of OW-5 and OW-6.

Impacts at Arroyo del Valle

Temporary and permanent impacts associated with the work at Arroyo del Valle will include water diversion upstream and downstream of the existing bridge, permanent fill and construction work within a portion of an outfall channel associated with a culverted roadside ditch (Ephemeral Drainage OW-3 on Figures 4A and 4B, sheet 2) 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. Construction at Arroyo del Valle will not reduce channel width or impede flow rates under SR-84.

North of the SR 84 bridge crossing over Arroyo del Valle, there is an existing 42-inch culvert combining flows from the city of Livermore and highway runoff from the existing SR 84 drainage system. This 42-inch culvert currently discharges into Arroyo del Valle on the west side (downstream end) of the bridge. The SR 84 Expressway Widening Project proposes to separate the city flows from Caltrans' highway runoff via two parallel pipes. The project proposes 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-inch. An APC is 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-inch 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 replacement rock slope protection.

Impacts at Arroyo Mocho

Temporary and permanent impacts associated with the work at Arroyo Mocho will include a water diversion upstream and downstream of the existing bridge, the construction of extension support walls (bents) for the large culvert conveying the drainage under SR 84 (Isabel Avenue), installation of temporary work platforms, installation of temporary falsework and construction of walls and footings into the edge of the streambed just west and downstream of this crossing for an off-ramp. Construction at Arroyo Mocho will not reduce channel width or impede flow rates under SR-84.

Mainline Widening Impacts

The road widening at the intersection of Vineyard Avenue and SR 84 (Isabel Avenue) will result in the permanent fill of a culverted ephemeral drainage (OW-7 (Revised)).

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-foot-wide shallow and ephemeral roadside ditches that border either side of SR 84 (Isabel Avenue) 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.

Total Construction Related Impacts

A total of 1.682 acre of impacts to waters of the state (including wetlands) is currently proposed by the project. This includes 1.168 acre of temporary impacts and 0.514 acre of permanent impacts. For temporary and permanent impact acreages and amount of fill for each feature see Tables 2 and 3.

Table 2: Potential Permanent Impacts

Location	Reason for Impact	Acres	Linear Feet
OTHER WATERS OF THE U.S. AND STATE			
OW-1 Arroyo Mocho[1]	Fill due to construction of two support wall extensions on downstream side of SR 84 to accommodate overpass widening.	0.005	70.68
	Shading of channel due to construction of maintenance bridge	0.045	18.50
	Construction associated with the abutments of maintenance bridge	0.009	22.60
OW-3 Ephemeral tributary to Arroyo Del Valle	Modification of existing roadside runoff outfall channel	0.008	20.81
OW-5 Ephemeral roadside drainage	Fill due to roadway widening	0.055	2340.88
OW-6 Ephemeral roadside drainage	Fill due to roadway widening	0.046	2149.01
OW-7 Culverted ephemeral drainage[2]	Remove Culvert	0.008	244.28
OTHER WATERS OF THE U.S. SUBTOTAL		***0.176***	***4866.76***
WETLANDS			
WL-2 Arroyo del Valle[1]	Construction of pier, abutments, and footings on upstream side of SR 84 to accommodate widening of overpass.	0.063	116.30
	Placement of abutments associated with pedestrian bridge upstream of SR 84	0.017	20.20
	Construction of new outfall	0.020	35.22
	Shading of channel and loss of willow riparian habitat due to construction of pedestrian bridge	0.037	18.50
	Shading of channel and loss of willow riparian habitat due to the construction of widened overpass	0.086	53.42
WL-5 Seasonal wetland	Fill due to roadway widening	0.115	716.99
WETLANDS SUBTOTAL		***0.338***	***960.63***
TOTAL IMPACTS		***0.514***	***5827.39***

Source: URS 2010

1. Due to changes in the project design, dewatering activities at the Arroyo del Valle and Mocho will occur in areas that are outside the USACE jurisdictional delineation maps. An amendment to the USACE jurisdictional delineation maps is being requested. The impacts for the Arroyo del Valle and Mocho are based on the revised delineated area.

2. The culverted waters shown on the USACE jurisdictional maps for OW-7 and OW-8 are not the same as the as built design plans for State Route 84. An amendment to the USACE jurisdictional delineation maps is being requested. The impacts for OW-7are based on the revised delineated area.

Table 3: Potential Temporary Impacts

Location	Reason for Impact	Acres	Linear Feet
OTHER WATERS OF THE U.S. AND STATE			
OW-1 Arroyo Mocho[1]	Construction access for support wall extensions, replacement of existing riprap, access for new access bridge, work platforms and water diversions	0.579	294.12
OW-3 Ephemeral tributary to Arroyo Del Valle	Construction access for modification of existing roadside runoff outfall channel	0.003	9.28
OW-4 Intermittent drainage	Cleaning of Culvert	0.006	83.00
OTHER WATERS OF THE U.S. SUBTOTAL		***0.588***	***386.40***
WETLANDS			
WL-2 Arroyo Del Valle	Construction access for widening of SR 84 overpass on upstream side.	0.58	284.02
	Construction access for construction of new trail bridge, replacement of existing riprap associated with new trail bridge upstream of SR 84		
	Construction access for creek diversion		
	Replacement of existing riprap underneath and downstream of SR 84 to accommodate widening of overpass	This is included in the quantity noted above	
	Replacement of existing riprap associated with new trail bridge upstream of SR 84		
WETLANDS SUBTOTAL		***0.58***	***284.02***
TOTAL WATERS OF THE U.S AND STATE		***1.168***	***670.42***

Source: URS 2010

1. Due to changes in the project design, dewatering activities at the Arroyo del Valle and Mocho will occur in areas that are outside the jurisdictional delineation maps. An amendment to the jurisdictional delineation maps is being requested. The impacts for the Arroyo del Valle and Mocho are based on the revised delineated area.

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.)
California Annual Grassland (Ephemeral roadside ditches OW-5)	0	0	2340.88	0.055
California Annual Grassland (Ephemeral roadside ditches OW-6)	0	0	2149.01	0.046
California Annual Grassland (Intermittent Drainage/Wetland WL-5)	0	0	716.99	0.115
Mixed Willow Forest (Arroyo del Valle – Perennial Drainage/Wetland WL-2)	284.02	0.58	243.64	0.223
TOTAL	***284.02***	***0.58***	***5450.52***	***0.439***

BOX 11B – Vegetation and Tree Survey Data

Table 5: List of Trees to be removed from the Arroyo del Valle

	1 'inch DBH	2 inch DBH	3 inch DBH	4 inch DBH	5 inch DBH	6 inch DBH	7 inch DBH	8 inch DBH	9 inch DBH	10 inch DBH
West of the bridge, south bank of the Arroyo del Valle on the southbound side of SR 84										
Salix spp.	11	4	6	3						
West of the bridge, north bank of the Arroyo del Valle on the southbound side of SR 84										
Salix spp.	17	12	6	4	5					
East of the bridge, north bank of the Arroyo del Valle on the northbound side of SR 84										
Salix spp.	146	59	25	13	4	1	1	1	1	0
Acer spp.								1		
East of the bridge, south bank of the Arroyo del Valle on the northbound side of SR 84										
Salix spp.	260	139	75	14	3	4	1	1	2	1
TOTAL	***434***	***214***	***112***	***34***	***12***	***5***	***2***	***3***	***3***	***1***

BOX 11C – Special Status Species

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 and state Endangered Species Act.

Species	**Listing Status**
California tiger salamander (*Ambystoma californiense*)	FT/ST
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 – Special Status Species Information Source

- 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 – Sediment Protection Measures

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 – Species Protection Measures

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:

- 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 no more than three days 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 - Environmental Mitigation and Compensation Measures

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 (CTS) and California red-legged frog (CRLF), 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. Due to the modifications in the project description, an amendment to the Biological Opinion is being requested for additional impacts to CTS, CRLF and San Joaquin kit fox. The proposed compensatory mitigation will include purchase of 50.94 acres of mitigation credits at a USFWS and CDFG approved mitigation bank.

Other mitigation will include the planting of 71 native oak trees to replace 31 oak trees that are greater than 6” diameter at breast height (dbh)dbh and the reseeding of temporarily disturbed areas with a native grassland seed mix.

Ephemeral roadside ditches, such as OW-5 and OW-6, will be replaced on either side of the new widened roadway at locations that are currently upland, providing replacement of in-kind ephemeral other waters of the U.S. that capture roadside run-off.

Installation of the water diversion at the Arroyo del Valle will result in the removal of 119 *Salix* spp. and 1 *Acer* spp. trees with a dbh equal to or greater than 4 inches. Success criteria would include successful establishment of a minimum of 75% percent cover of

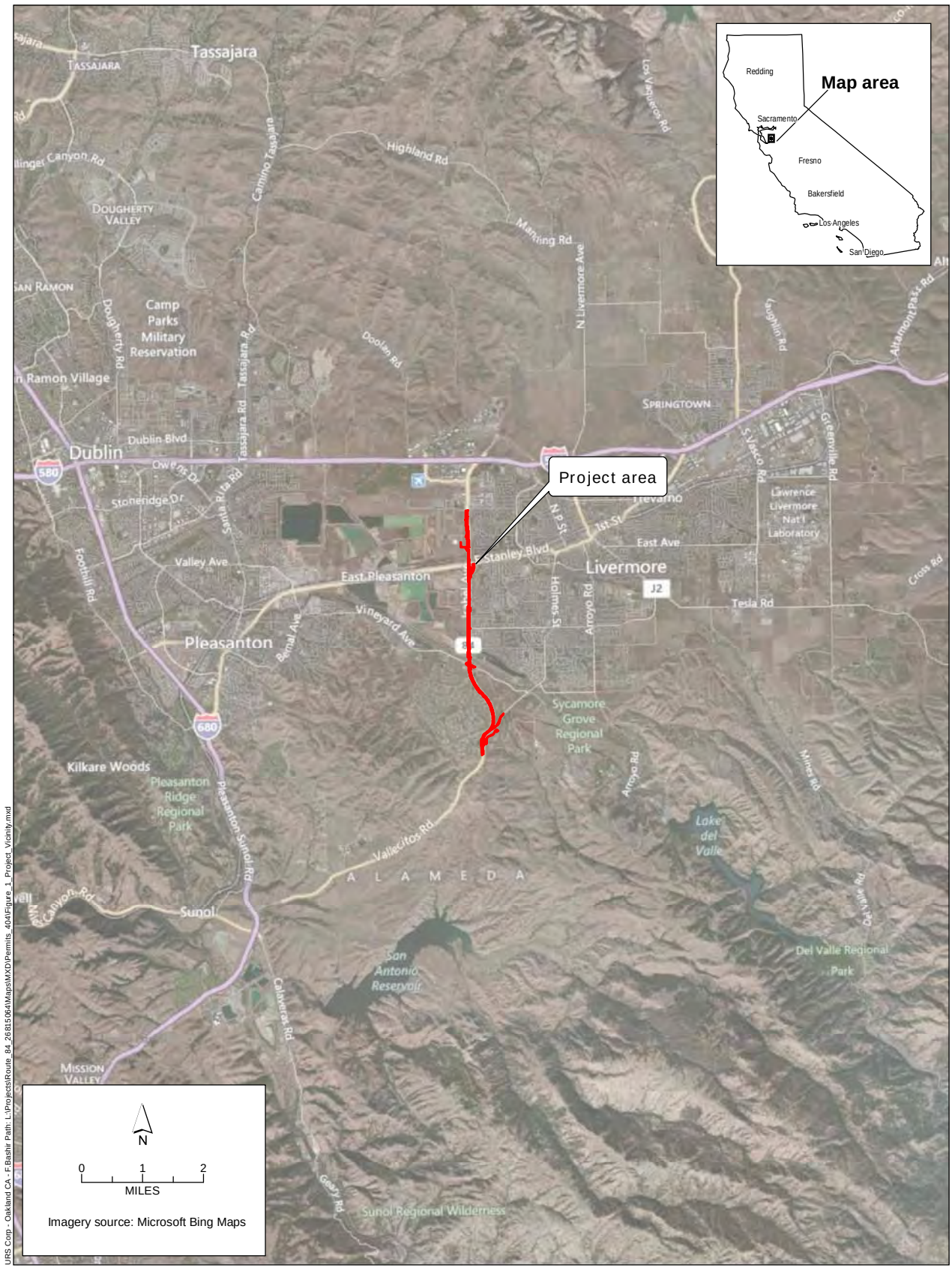
the planted willow trees or cuttings or other wetland plants in the restored area. Agency consultation is still pending. Table 5 lists the number of trees that will be removed as a result of the water diversion at the Arroyo del Valle.

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

Box 13 – Project Related Permits

The following permits have been issued for the project:

- U.S. Fish and Wildlife Service (USFWS) Biological Opinion; EA 04-2976000; February 1, 2008. An amendment to the Biological Opinion for the water diversion is being requested for additional impacts to CRLF, CTS and San Joaquin kit fox, as a result of modifications to the project design is being requested.
- USACE Nationwide Permit # 14 and # 33 (SPN-2008-00396S) issued April 11, 2011 and June 1, 2012. A new Nationwide Permit is being requested for the water diversions at the Arroyo Mocho and the Arroyo del Valle.
- USACE Jurisdictional Determination (SPN-2008-00396S), February 24, 2009. An amendment to the Jurisdictional Delineation Maps is being requested to include a portion of the dewatered area at the Arroyo Mocho and Arroyo del Valle that is not included in the current maps. In addition, the location of OW-7 and OW-8 Culverted Ephemeral Waters is incorrect and needs to be corrected on the maps.
- CDFG Op Law Lake and Streambed Alteration Agreement (1600-2010-0372-R3) issued February 16, 2011.
- CDFG Incidental Take Permit (2081-2011-013-03), issued November 9, 2011. An amendment to the Incidental Take Permit for additional impacts to CTS as a result of modifications to the project design is being requested.
- 401 Water Board; 02-01-C0990; June 15, 2011. An amendment to the water Quality Certification for the water diversion is being requested for the water diversions at the Arroyo Mocho and the Arroyo del Valle.



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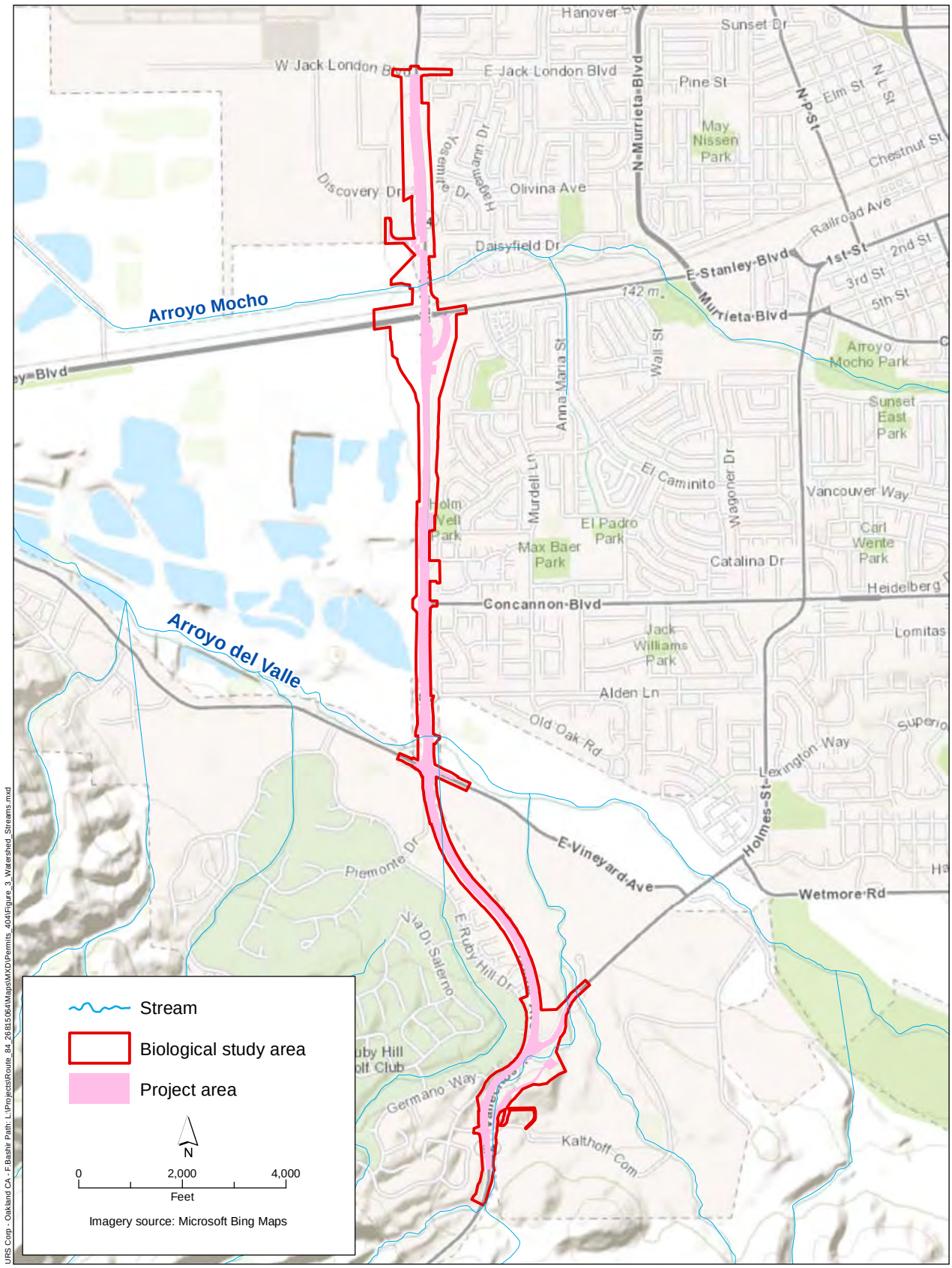
Caltrans
State Route 84 Expressway Project

Figure 1
Project vicinity map

Caltrans
State Route 84 Expressway Project

Figure 2
Proposed project and biological study area map



Caltrans
State Route 84 Expressway Project

Figure 3
Watershed and stream order map

PROJECT IMPACTS
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PERMANENT SHADING=0.123
TEMPORARY=0.58
OTHER WATERS IMPACTS:
PERMANENT = 0.131
PERMANENT SHADING=0.045
TEMPORARY=0.588

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1 INCH = 150 FEET AT 11x17-INCH PAGE SIZE

Imagery source: Microsoft Bing Maps

LABELING NOTES:
T = TEMPORARY
P = PERMANENT
A = AREA

Project area

Biological study area

Temporary impacts

Wetlands

Other Waters (OW)

Wetlands (WL)

STATE ROUTE 84 EXPRESSWAY PROJECT

ALAMEDA COUNTY, CA
EA 04-297600

FIGURE 4 A
Sheet 1 of 6

TEMPORARY IMPACTS TO WETLANDS AND OTHER WATERS OF THE U.S AND THE STATE IN THE STUDY AREA

NOVEMBER 2012

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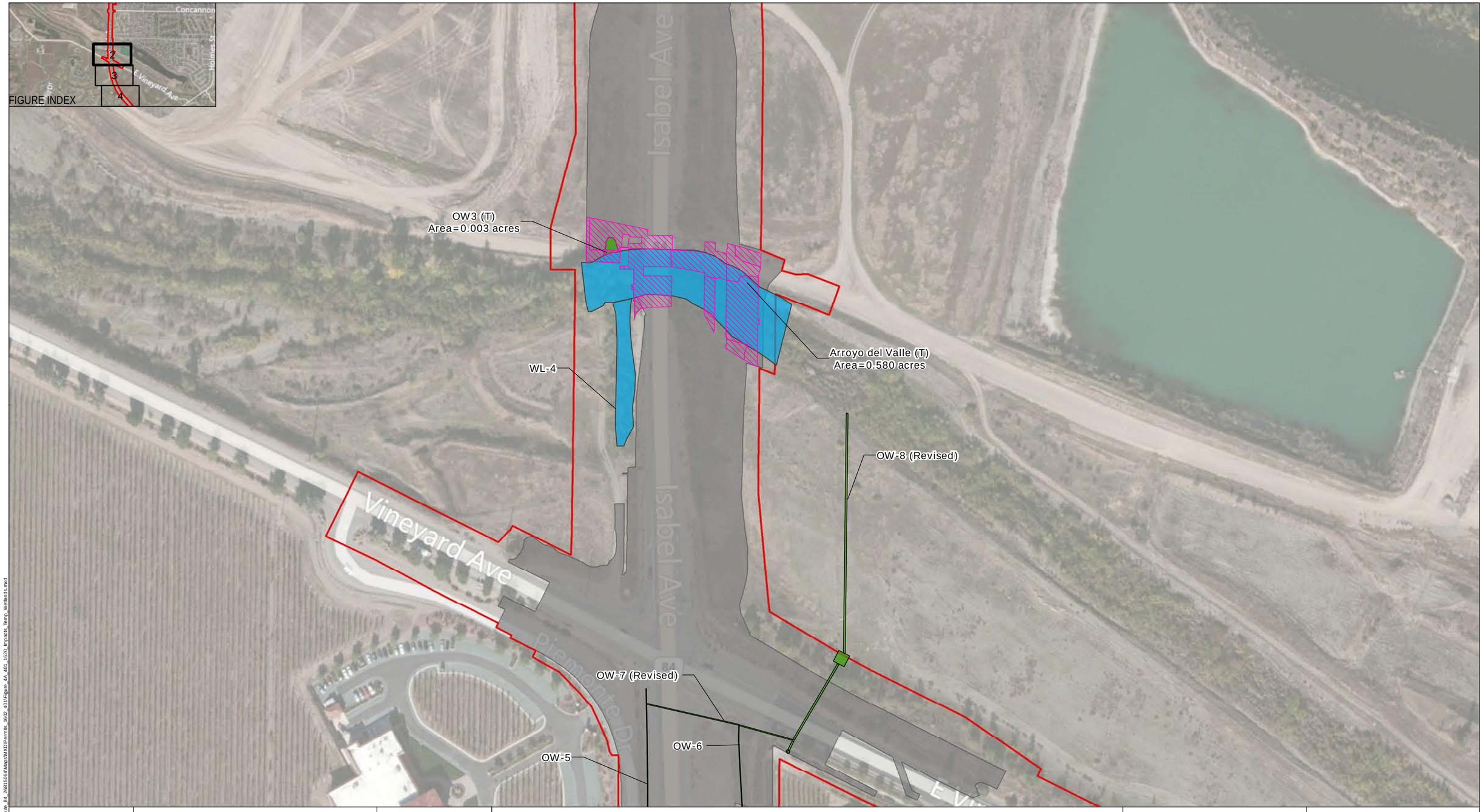

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Wetlands (WL)

STATE ROUTE 84 EXPRESSWAY PROJECT

ALAMEDA COUNTY, CA
EA 04-297600

FIGURE 4 A
Sheet 2 of 6

TEMPORARY IMPACTS TO WETLANDS AND OTHER WATERS OF THE U.S AND THE STATE IN THE STUDY AREA

NOVEMBER 2012

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STATE ROUTE 84 EXPRESSWAY PROJECT

ALAMEDA COUNTY, CA
EA 04-297600

FIGURE 4 A
Sheet 3 of 6

TEMPORARY IMPACTS TO
WETLANDS AND OTHER WATERS
OF THE U.S AND
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NOVEMBER 2012

URS Corp - Oakland CA - P:\Bathini\Projects\Route_84_26815064\Maps\MXD\Permits_1602_401\Figure_4A_401_1602_Impacts_Temp_Wetlands.mxd

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STATE ROUTE 84 EXPRESSWAY PROJECT

ALAMEDA COUNTY, CA
EA 04-297600

FIGURE 4 A
Sheet 4 of 6

TEMPORARY IMPACTS TO WETLANDS AND OTHER WATERS OF THE U.S AND THE STATE IN THE STUDY AREA

NOVEMBER 2012

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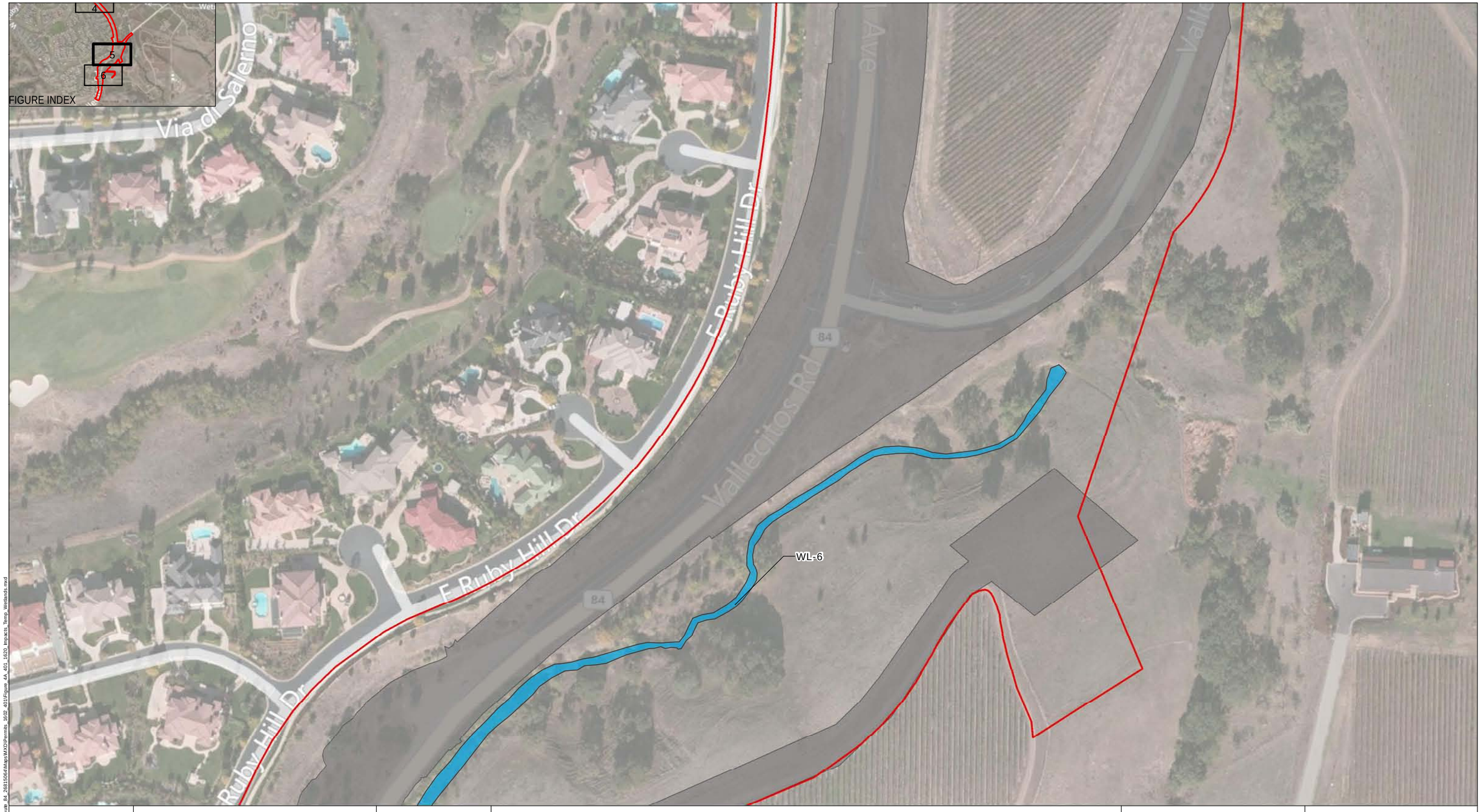

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STATE ROUTE 84 EXPRESSWAY PROJECT

ALAMEDA COUNTY, CA
EA 04-297600

FIGURE 4 A
Sheet 5 of 6

TEMPORARY IMPACTS TO WETLANDS AND OTHER WATERS OF THE U.S AND THE STATE IN THE STUDY AREA

NOVEMBER 2012

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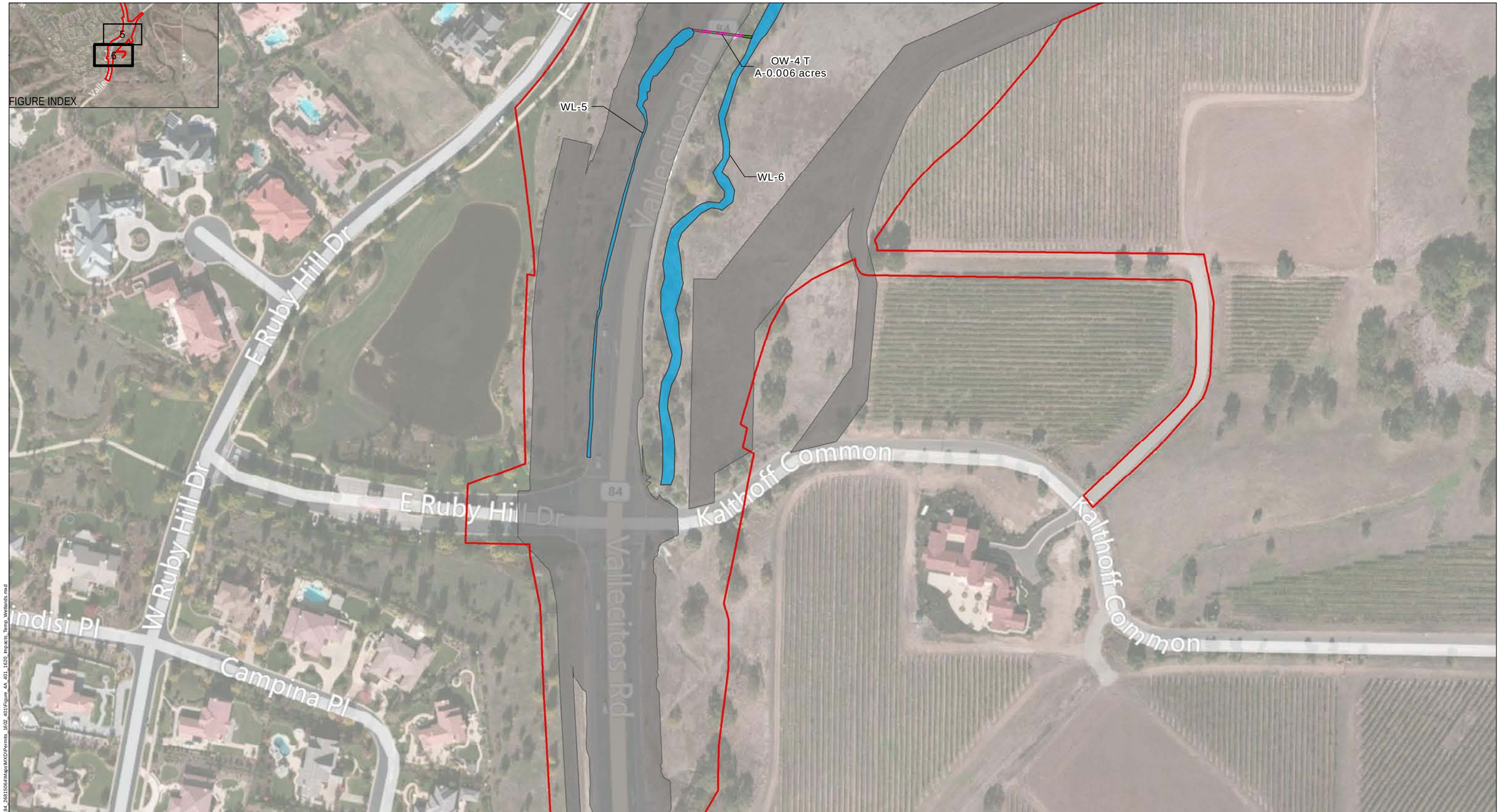

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STATE ROUTE 84 EXPRESSWAY PROJECT

ALAMEDA COUNTY, CA
EA 04-297600

FIGURE 4 A
Sheet 6 of 6

TEMPORARY IMPACTS TO WETLANDS AND OTHER WATERS OF THE U.S AND THE STATE IN THE STUDY AREA

NOVEMBER 2012

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STATE ROUTE 84 EXPRESSWAY PROJECT

ALAMEDA COUNTY, CA
EA 04-297600

Figure 4B
Sheet 1 of 6

PERMANENT IMPACTS TO WETLANDS AND OTHER WATERS OF THE U.S AND THE STATE IN THE STUDY AREA

NOVEMBER 2012

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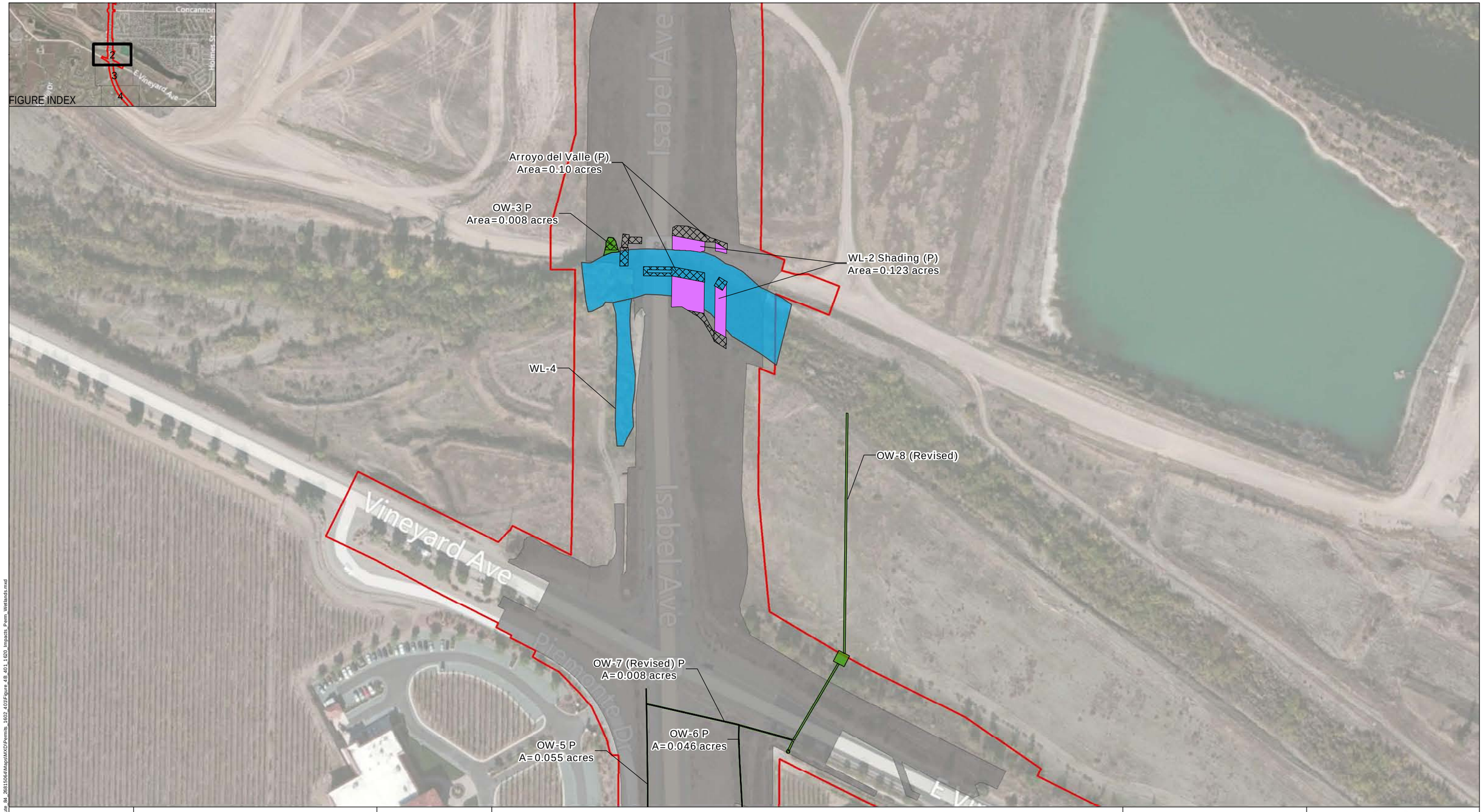

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ALAMEDA COUNTY, CA
EA 04-297600

Figure 4B
Sheet 2 of 6

PERMANENT IMPACTS TO
WETLANDS AND OTHER WATERS
OF THE U.S AND
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NOVEMBER 2012

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STATE ROUTE 84 EXPRESSWAY PROJECT

ALAMEDA COUNTY, CA
EA 04-297600

Figure 4B
Sheet 3 of 6

PERMANENT IMPACTS TO WETLANDS AND OTHER WATERS OF THE U.S AND THE STATE IN THE STUDY AREA

NOVEMBER 2012

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ALAMEDA COUNTY, CA
EA 04-297600

Figure 4B
Sheet 4 of 6

PERMANENT IMPACTS TO WETLANDS AND OTHER WATERS OF THE U.S AND THE STATE IN THE STUDY AREA

NOVEMBER 2012

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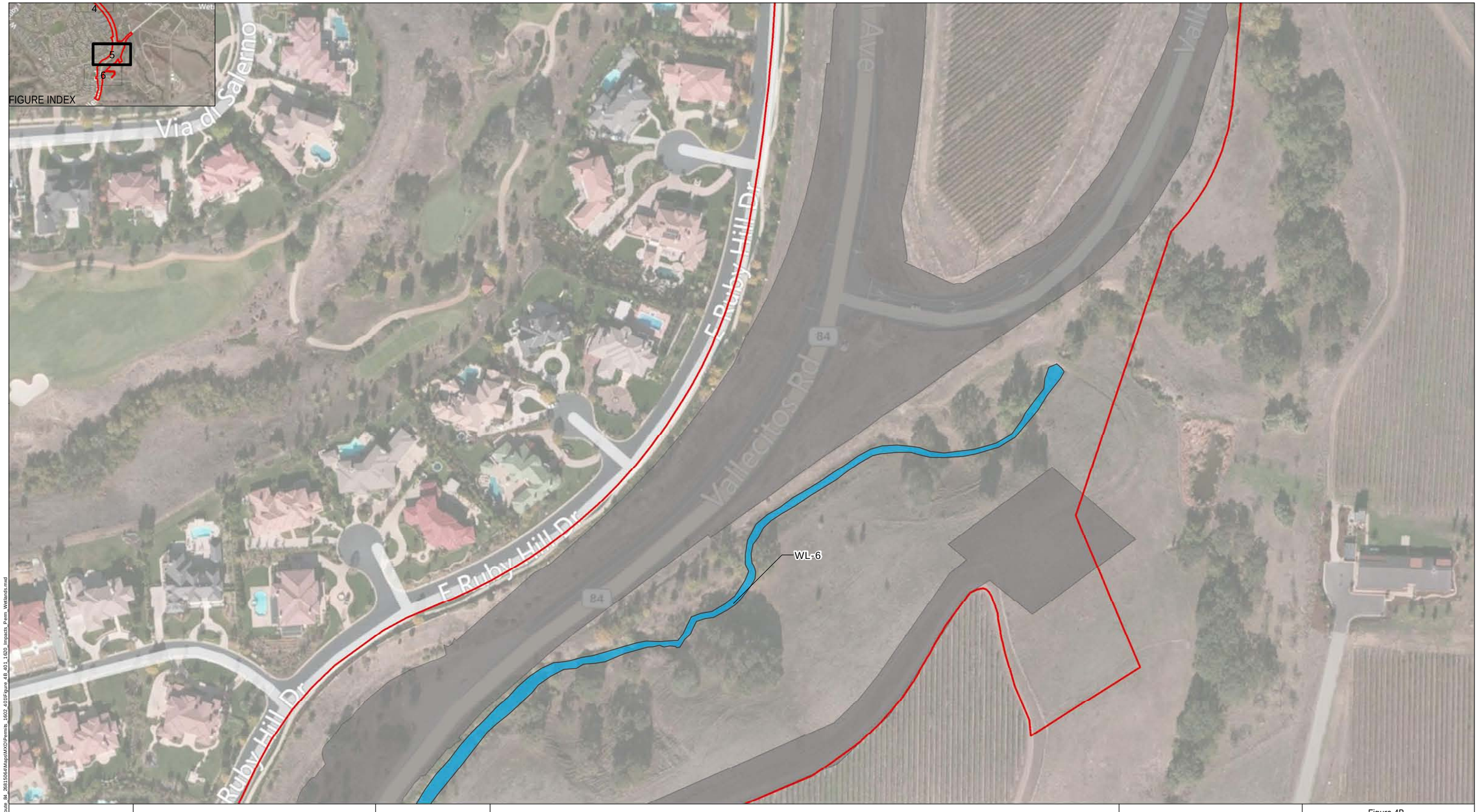

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STATE ROUTE 84 EXPRESSWAY PROJECT

ALAMEDA COUNTY, CA
EA 04-297600

Figure 4B
Sheet 5 of 6

PERMANENT IMPACTS TO WETLANDS AND OTHER WATERS OF THE U.S AND THE STATE IN THE STUDY AREA

NOVEMBER 2012

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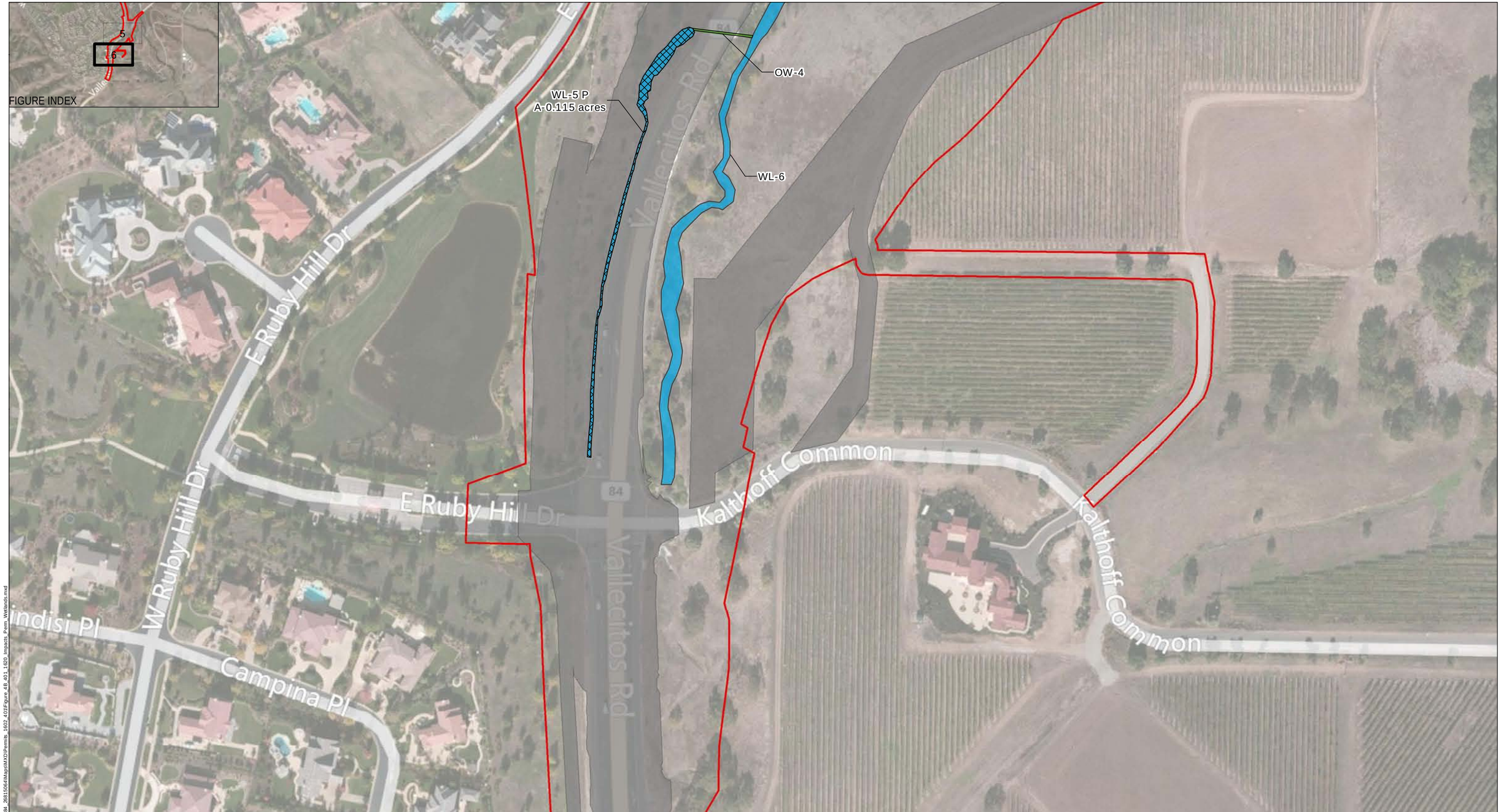

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STATE ROUTE 84 EXPRESSWAY PROJECT

ALAMEDA COUNTY, CA
EA 04-297600

Figure 4B
Sheet 6 of 6

PERMANENT IMPACTS TO WETLANDS AND OTHER WATERS OF THE U.S AND THE STATE IN THE STUDY AREA

NOVEMBER 2012

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DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84	22.9/25.7		

10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Guoping Xu — No. C 63977 — Exp. 09/30/12 — CIVIL — STATE OF CALIFORNIA

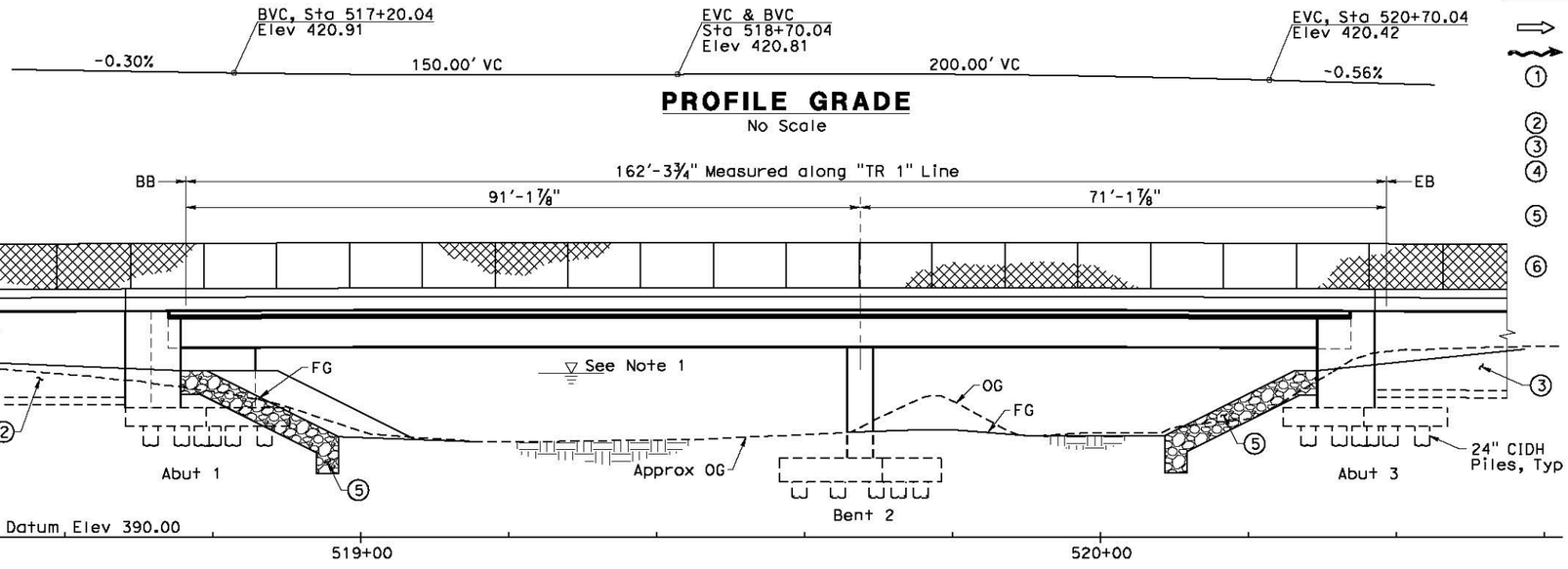
The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

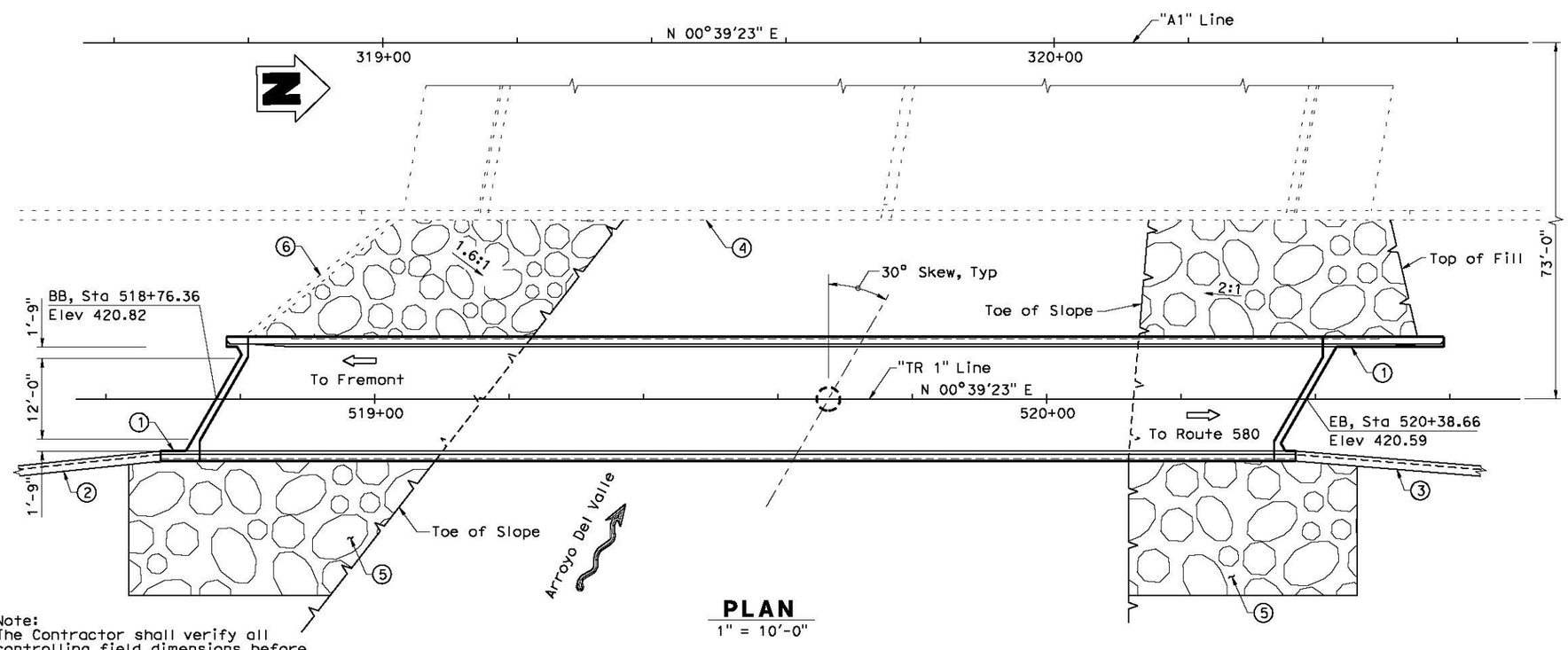
ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 BROADWAY, SUITE 300
OAKLAND, CA 94612

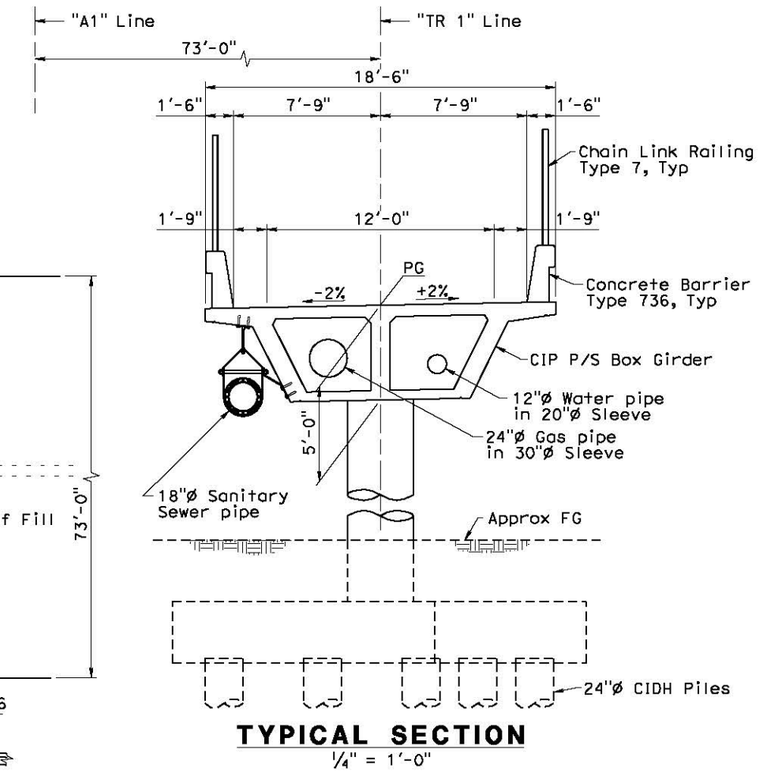
MGE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831

LEGEND

- ⇨ Indicates Direction of Travel
- ⇝ Indicates Direction of Flow
- ① Paint "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
- ⑤ Rock Slope Protection (1/4-Ton, Method B)
- ⑥ Type 1 Retaining Wall, see "Arroyo Del Valle Bridge (Widen)" plans







NOTES:

1. For General Notes, Pile Data Table and Hydrologic Summary, see "FOUNDATION PLAN" sheet.
2. For Index to Plans, see "DECK CONTOURS" sheet.

DESIGN OVERSIGHT	DESIGN	BY G. Xu	CHECKED D. Wang	LOAD AND RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 and Permit Design Vehicle		
SIGN OFF DATE	DETAILS	BY P. Zhao	CHECKED D. Wang	LAYOUT	BY G. Xu	CHECKED D. Wang	
	QUANTITIES	BY R. Huang	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 0733
EA 297621

BRIDGE NO. N/A
POST MILES N/A

ARROYO DEL VALLE TRAIL BRIDGE
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): 02/28/08 | 04/07/08 | 09/29/08 | 11/28/08 | 12/28/08 | 05/14/09 | 01/28/10 | 08/16/10 | 10/21/10

SHEET 1 OF 19

FILE => P:\397 Route 84 Widenings\100% PS&E 2nd Submittal\Arroyo Del Valle Trail Bridge\00-Trail-a-gp01.dgn

USERNAME => Peter DATE PLOTTED => 10/19/2010 TIME PLOTTED => 9:11:37 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84	22.9/25.7		

10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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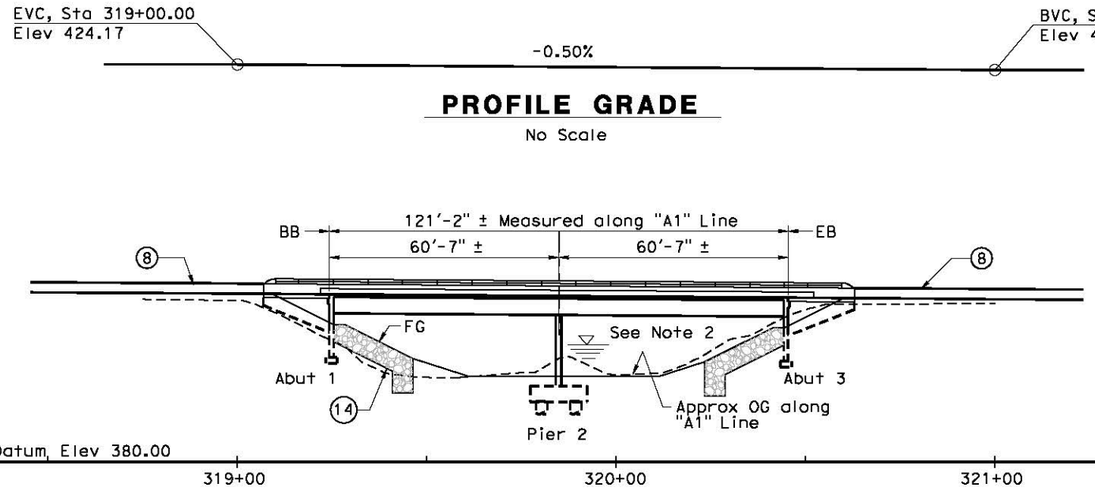
REGISTERED PROFESSIONAL ENGINEER — Guoping Xu — No. C 63977 — Exp. 09/30/12 — CIVIL — STATE OF CALIFORNIA

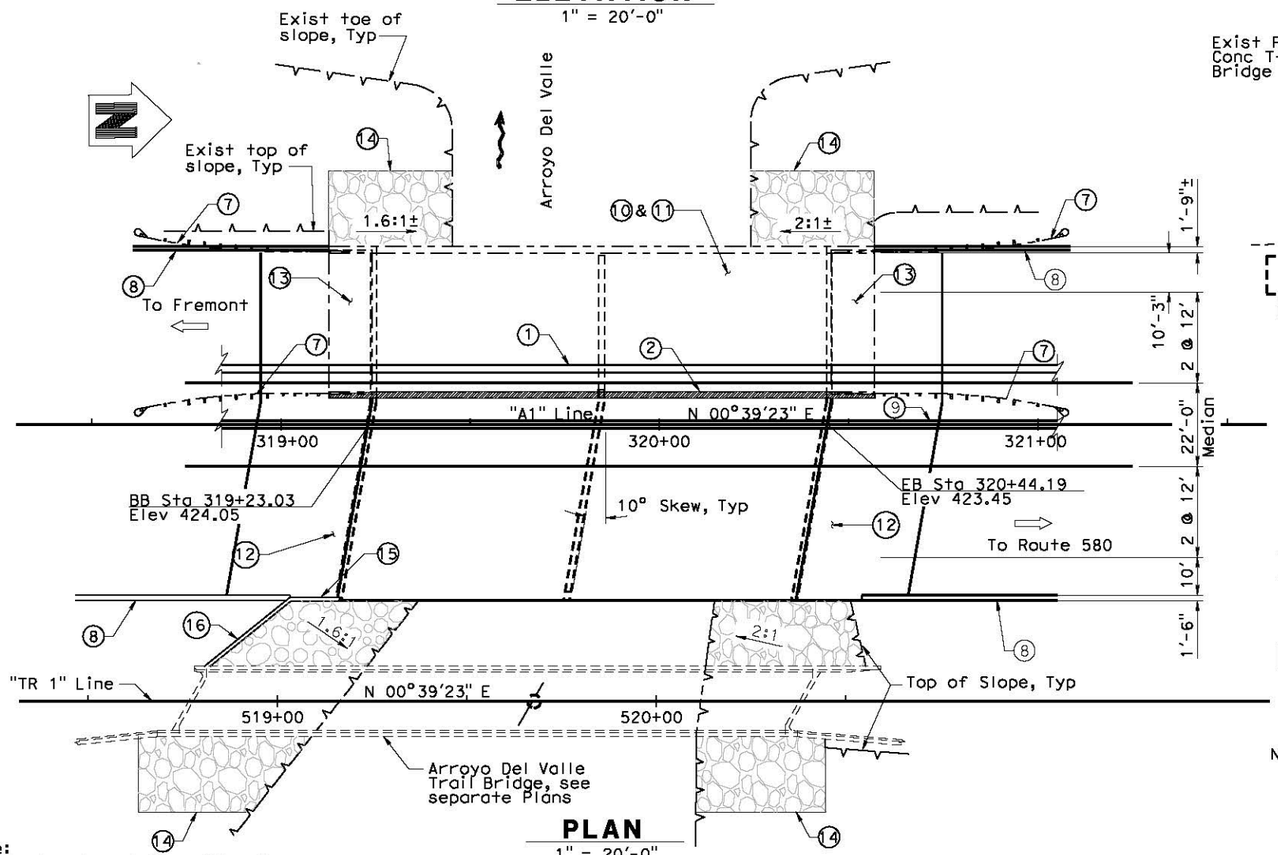
ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 BROADWAY, SUITE 300
OAKLAND, CA 94612

MGE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831



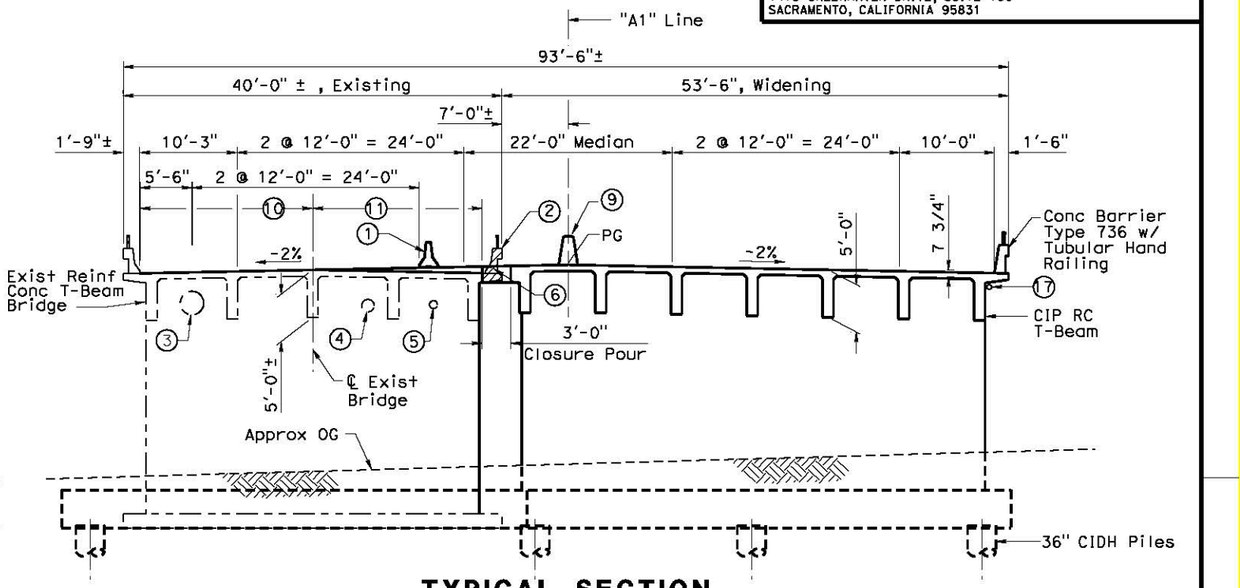
PROFILE GRADE
No Scale

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

Notes:

1. For General Notes and Index to Plans, see "INDEX TO PLANS".
2. 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" ∅ Steel Casing to remain
4. Existing 16"∅ D.I.P. Sewer Line to be relocated by others
5. Existing 12"∅ Water Line to remain
6. Existing 2 - 3"∅ Conduits to be relocated by others
7. Existing Metal Beam Guard Rail to be removed , see "Road Plan"
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 (30D)
13. Remove Exist Approach Slab and replace with Structure Approach, Type R (30D)
14. Rock Slope Protection (1-Ton, Method B)
15. Paint "Bridge No. 33-0710" & "Arroyo Del Valle Bridge"
16. Retaining Wall, Type 1
17. Irrigation cross-over per Std Plan sheet H9

DESIGN OVERSIGHT	DESIGN	BY G. Xu	CHECKED D. Wang	LOAD AND RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 WITH "LOW-BOY" AND PERMIT DESIGN VEHICLE	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Guoping Xu PROJECT ENGINEER
SIGN OFF DATE	DETAILS	BY P. Zhao	CHECKED D. Wang	LAYOUT BY G. Xu	CHECKED D. Wang		
	QUANTITIES	BY W. Sennett	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 0733
EA 297621

BRIDGE NO. 33-0710
POST MILES 24.8

ARROYO DEL VALLE BRIDGE (WIDEN)
GENERAL PLAN

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY): 09/09/08 | 04/07/08 | 05/30/08 | 10/14/08 | 12/16/08 | 05/21/09 | 01/27/10 | 08/16/10 | 10/21/10

SHEET 1 OF 21

FILE => P:\397 Route 84 Widenings\100% PS&E 2nd Submittal\Arroyo Del Valle Widen\33-0710-a-gp01.dgn

USERNAME => Peter DATE PLOTTED => 10/19/2010 TIME PLOTTED => 9:50:38 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL
04	Ala	84	22.5/27.3		

10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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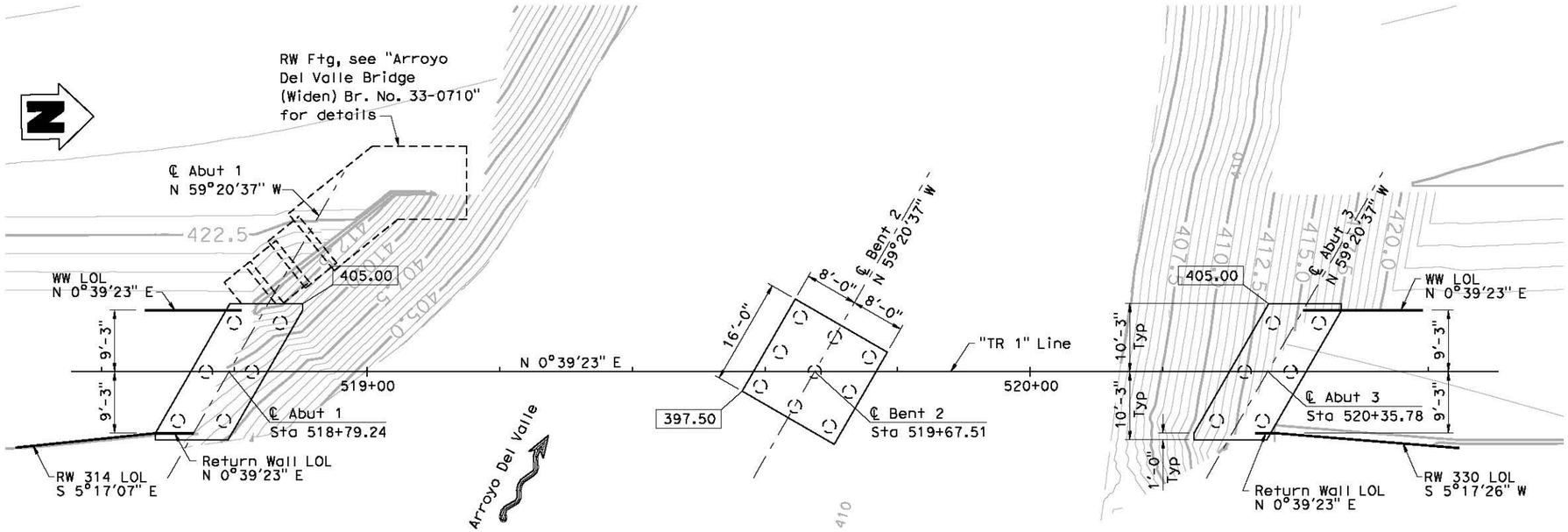
REGISTERED PROFESSIONAL ENGINEER
Guoping Xu
No. C 63977
Exp. 09/30/12
CIVIL
STATE OF CALIFORNIA

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 BROADWAY, SUITE 300
OAKLAND, CA 94612

MGE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831



FOUNDATION PLAN
1" = 10'-0"

LEGEND

- Indicates Direction of Flow
- 405.00 Indicates Bottom of Footing Elevation
- Indicates 24" CIDH Piles

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	320	0	354.0 (a) 371.0 (c)	354.0
Bent 2	24" CIDH	350	120	338.0 (a) 356.0 (b) 358.0 (c)	338.0
Abut 3	24" CIDH	290	0	357.0 (a) 371.0 (c)	357.0

Design tip elevation is controlled by the following demands:
(a) Compression, (b) Tension, (c) Lateral

HYDROLOGIC SUMMARY

Drainage Area 160 square miles

	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.

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

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 VINEYARD, 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

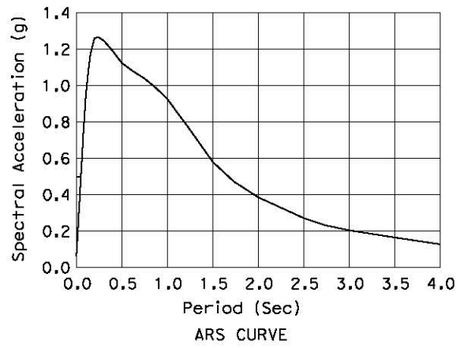
DESIGN: AASHTO LRFD Bridge Design Specifications, 4th Edition and the Caltrans Amendments, Preface dated December 2008; except that Abutments and Concrete Barrier Type 736 are designed using Bridge Design Specifications ('96 AASHTO w/ Revisions by Caltrans)

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



CONCRETE: f_y = 60 ksi
f'_c = 3.6 ksi
n = 8
See "Prestressing Notes" on "Girder Layout" sheet.

Stephen Huang
GEOTECHNICAL PROFESSIONAL APPROVAL DATE 08/18/2010

DESIGN OVERSIGHT	SCALE: 1"=10'-0"	VERT.DATUM NAVD88	HORZ.DATUM NAD83	DESIGN	BY G. Xu	CHECKED D. Wong	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Guoping Xu PROJECT ENGINEER	BRIDGE NO. N/A
	PHOTOGRAMMETRY AS OF: 11/10/2005	ALIGNMENT TIES		DETAILS	BY P. Zhao	CHECKED D. Wong			POST MILE N/A
SIGN OFF DATE	SURVEYED BY Dan Scott	DRAFTED BY Abhijeet Bhai		QUANTITIES	BY R. Huang	CHECKED W. Sennett			
	FIELD CHECKED BY Dan Scott	CHECKED BY							

ARROYO DEL VALLE TRAIL BRIDGE
FOUNDATION PLAN

FOUNDATION PLAN SHEET (ENGLISH) (REV. 2-25-05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 0733
EA 297621

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY): 02/04/08 | 04/07/08 | 08/15/08 | 10/14/08 | 12/23/08 | 01/26/10 | 08/26/10 | 10/21/10

SHEET 3 OF 19

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DATE PLOTTED => 10/19/2010 TIME PLOTTED => 9:14:44 AM USERNAME => Peter

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84	22.9/25.7		

10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Guoping Xu — No. C 63977 — Exp. 09/30/12 — CIVIL — STATE OF CALIFORNIA

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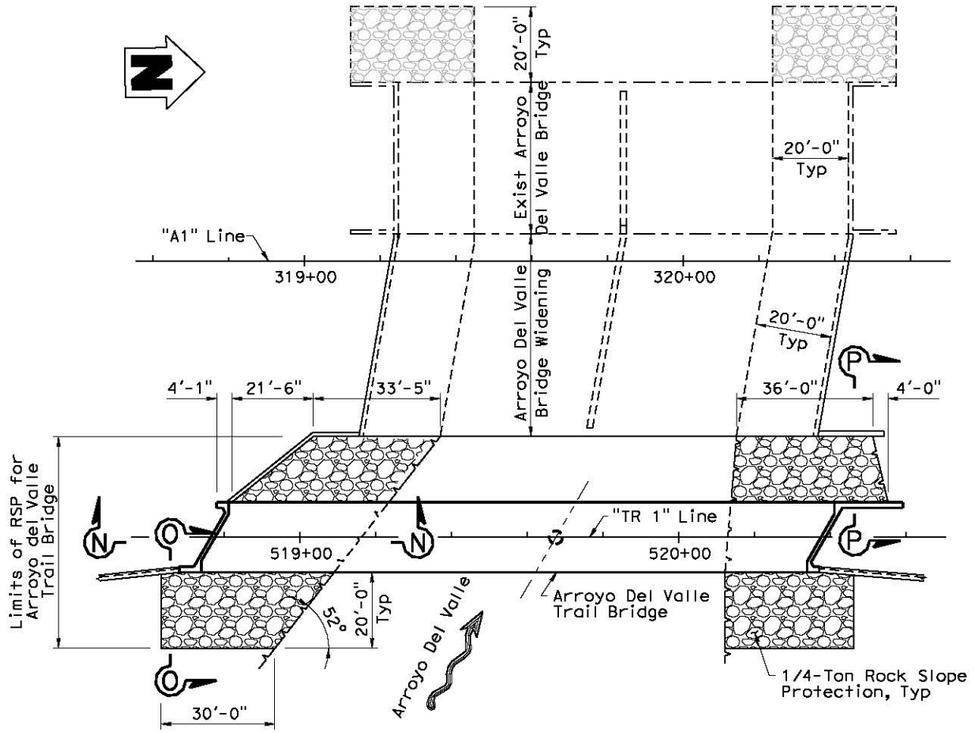
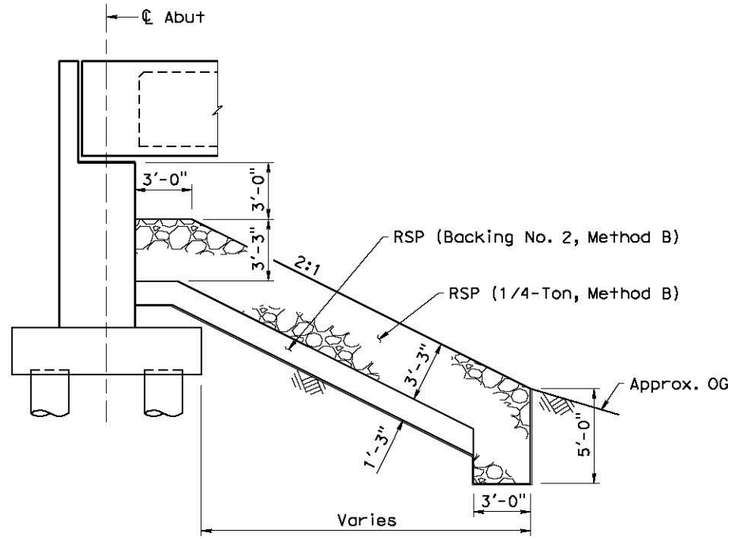
OAKLAND, CA 94612

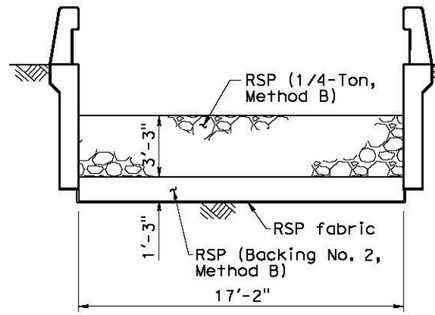
MGE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831



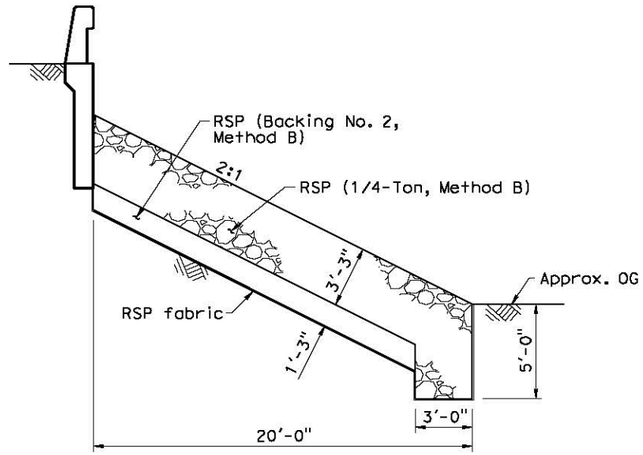
LIMITS OF RSP PLAN
1" = 20'-0"



SECTION N-N
1/4" = 1'-0"



SECTION P-P
1/4" = 1'-0"



SECTION O-O
1/4" = 1'-0"

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

DESIGN OVERSIGHT		DESIGN	BY G. Xu	CHECKED D. Wang	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
SIGN OFF DATE		DETAILS	BY P. Zhao	CHECKED D. Wang	Guoping Xu, PROJECT ENGINEER
DESIGN DETAIL SHEET (ENGLISH) (REV. 2/25/05)		QUANTITIES	BY R. Huang	CHECKED W. Sennett	CU 0733 EA 297621

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

BRIDGE NO.	ARROYO DEL VALLE TRAIL BRIDGE
POST MILES N/A	ROCK SLOPE PROTECTION

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 12/23/08 | 05/14/09 | 01/22/10 | 08/14/10 | 10/21/10

SHEET 15 OF 19

FILE => p:\397 route 84 widenings\100% ps&e 2nd submittal\arroyo del valle trail bridge\00-Trail-u-rk01.dgn

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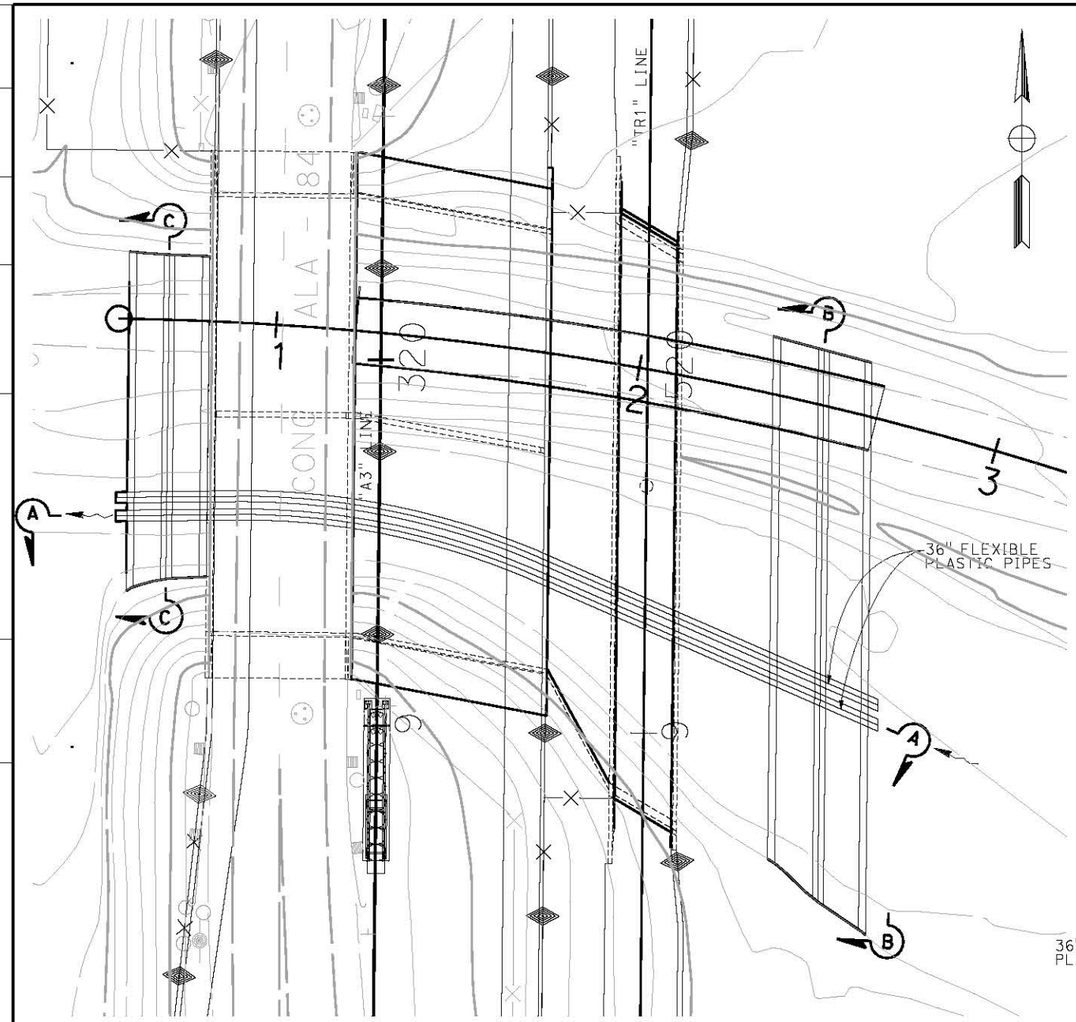


ARROYO DEL VALLE CREEK TEMPORARY CREEK DIVERSION

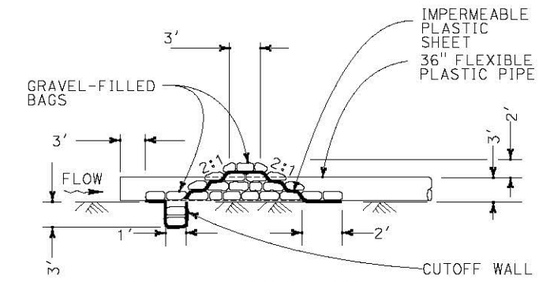
SCALE 1" = 20'

NOTES:

1. EXACT LENGTH AND LOCATION OF THE PLASTIC PIPE TO BE DETERMINED IN THE FIELD BY THE ENGINEER.
2. GRAVEL-FILLED BAG ANCHORS TO BE PLACED AT INTERMEDIATE LOCATIONS AS DETERMINED BY ENGINEER.
3. USE FLEXIBLE PIPE OR RIGID PIPE WITH WATER TIGHT JOINTS.

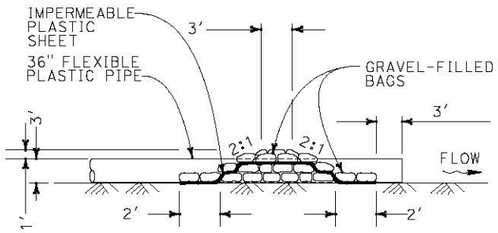
HYDROLOGIC SUMMARY

OBSERVED WATER DEPTH NON RAINY SEASON (ft)	MAXIMUM SLOPE (Percent)	AVERAGE FLOW (ft /s)	PIPE Diam. (inches)
1.5-2.0	2.00	25-30	36



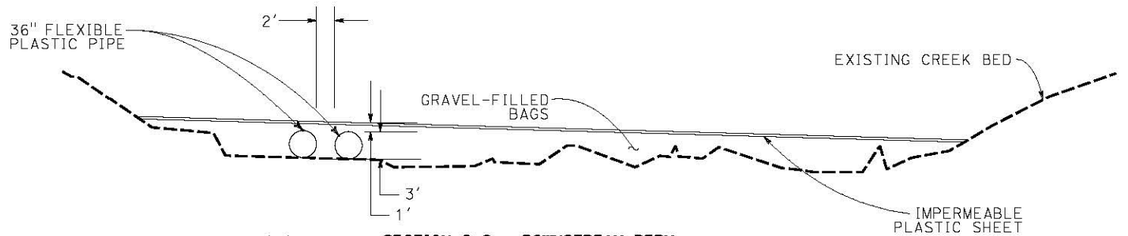
DETAIL A - UPSTREAM BERM

NTS



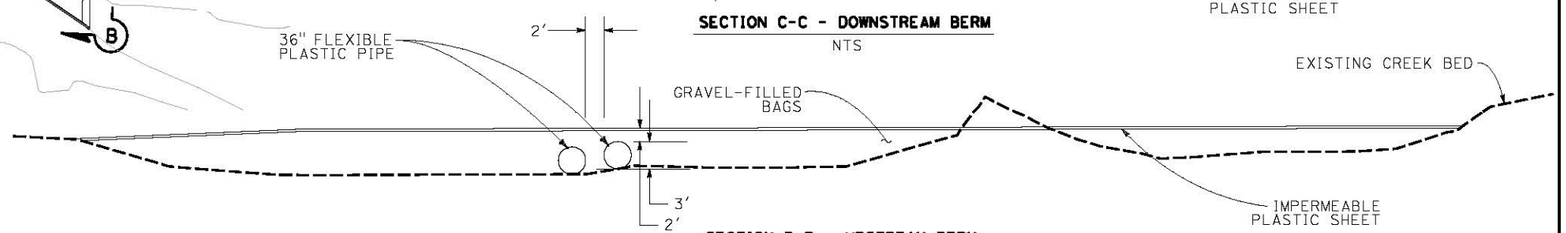
DETAIL B - DOWNSTREAM BERM

NTS



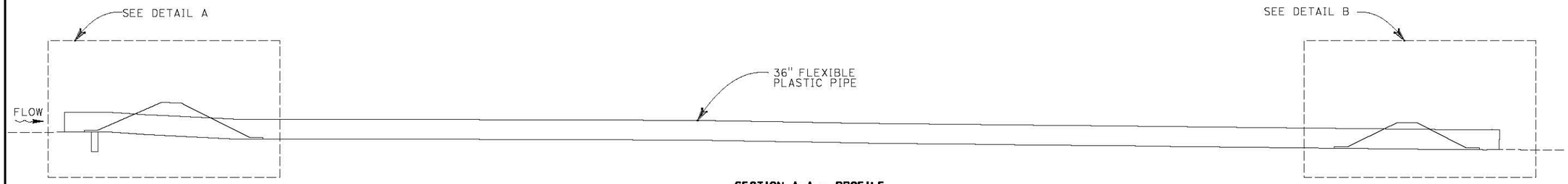
SECTION C-C - DOWNSTREAM BERM

NTS



SECTION B-B - UPSTREAM BERM

NTS



SECTION A-A - PROFILE

NTS

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		425

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. 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

3

DRAINAGE DETAILS TEMPORARY DRAINAGE

NO SCALE

REVISED BY | DATE REVISED

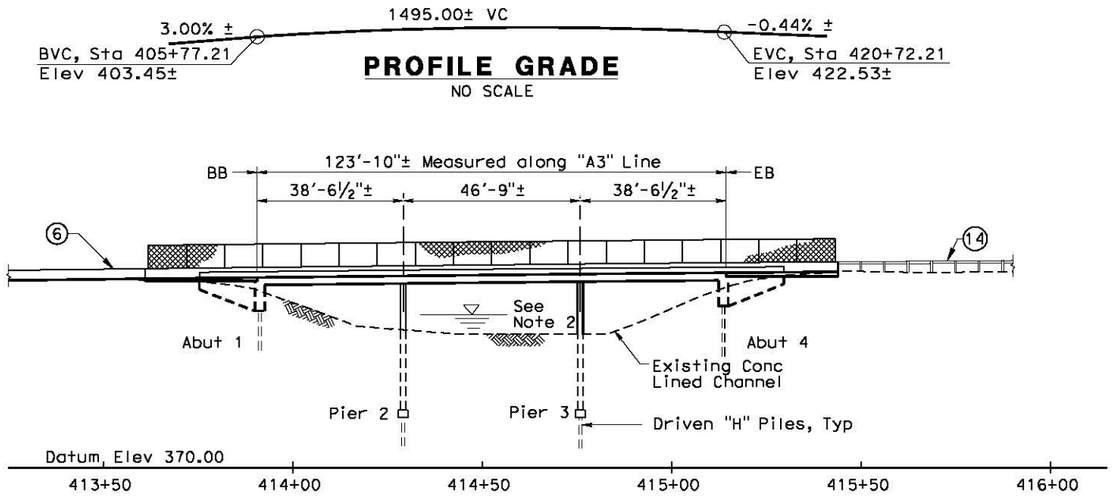
CALCULATED-DESIGNED BY | CHECKED BY

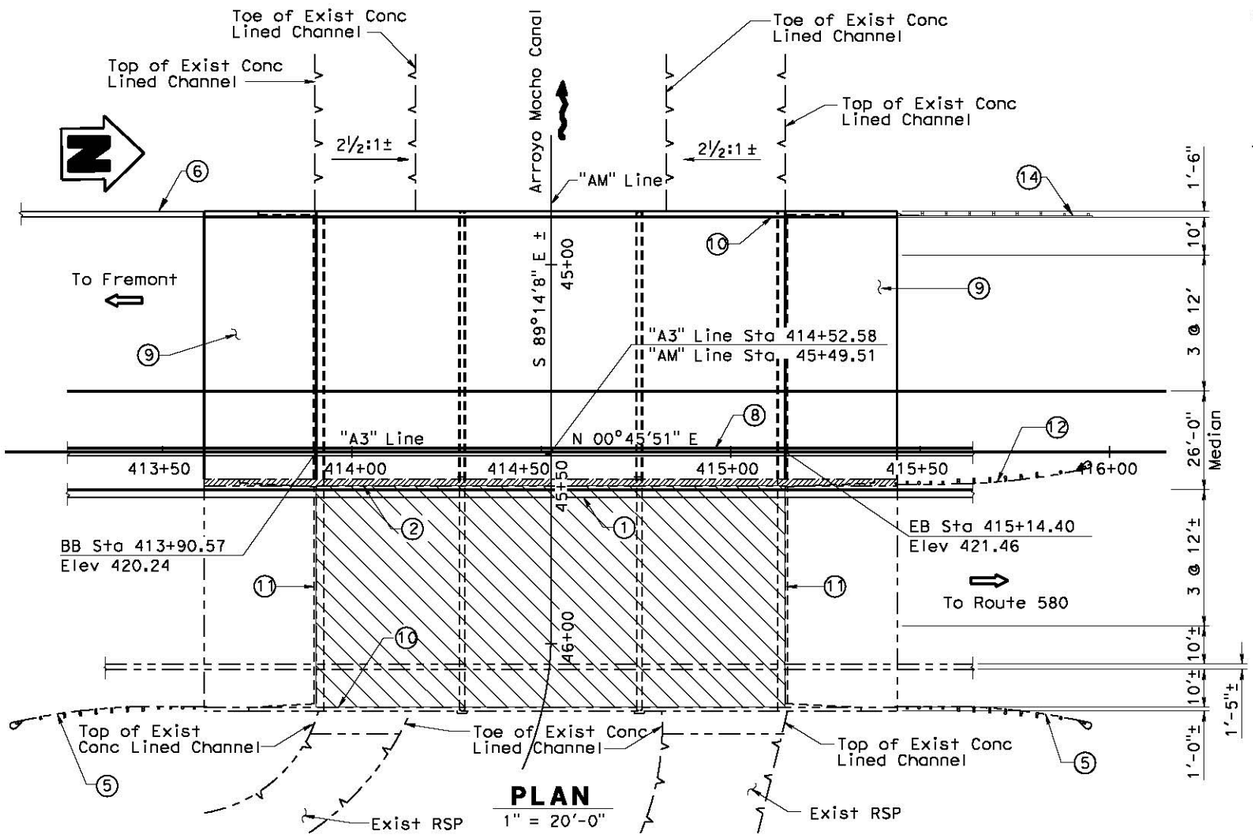
CONSULTANT FUNCTIONAL SUPERVISOR

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

LAST REVISION 10-08-12 | DATE PLOTTED => 10/8/2012 | TIME PLOTTED => 3:11:17 PM





QUANTITIES

Public Safety Plan	LS	1
Remove Unsound Concrete	CF	22
Bridge Removal (Portion)	LS	1
Clean Bridge Deck	SF	7,585
Structure Excavation (Type D)	CY	477
Structure Excavation (Bridge)	CY	146
Structure Backfill (Bridge)	CY	69
Furnish Steel Piling (HP 10x57)	LF	2,568
Drive Steel Pile (HP 10x57)	EA	58
Structural Concrete (Bridge Footing)	CY	26
Structural Concrete (Bridge)	CY	1,055
Structural Concrete Approach Slab (Type N)	CY	157
Drill and Bond Dowel	LF	255
Drill and Bond Dowel (Chemical Adhesive)	EA	124
Joint Seal (MR=1/2")	LF	264
Rapid Setting Concrete (Patch)	CF	22
Bar Reinforcing Steel (Bridge)	LB	177,090
Treat Bridge Deck	SF	7,585
Furnish Bridge Deck Treatment Material	GAL	84
Chain Link Railing (Type 7)	LF	184
Concrete Barrier (Type 60A)	LF	184
Concrete Barrier (Type 736)	LF	184
Refinish Bridge Deck	SF	279

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84	25.5/27.1	356	425

12/10/10
REGISTERED CIVIL ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER — Guoping Xu — No. C 63977 — Exp. 09/30/12 — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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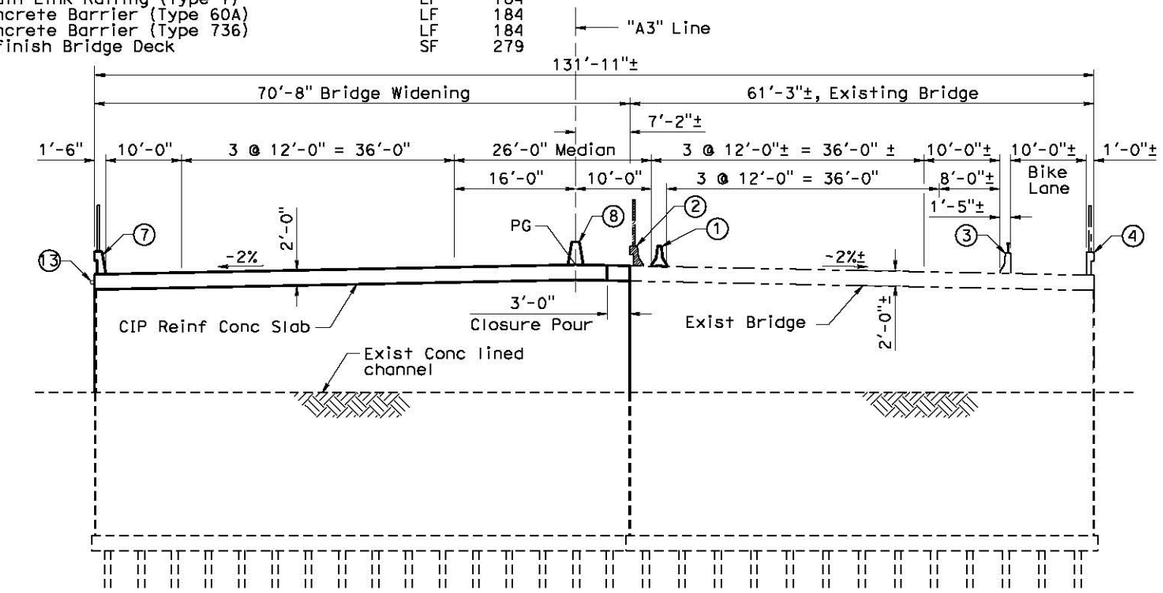

TYPICAL SECTION

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"
13. Supply line per Std Plan sheet H9
14. MBGR, See "Road Plans"

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 material.

DESIGN OVERSIGHT	DESIGN	BY G. Xu	CHECKED R. Sennett	LOAD & RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 W/ "LOW-BOY" AND PERMIT DESIGN VEHICLE		
SIGN OFF DATE	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	

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Guoping Xu
PROJECT ENGINEER

BRIDGE NO. 33-0713
POST MILES 26.6

ARROYO MOCHO BRIDGE (WIDEN)
GENERAL PLAN

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 06-01-09)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 0733
EA 297611

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY): 02/28/08 04/07/08 09/15/08 05/01/09 01/29/10 08/16/10 10/21/10 12/10/10

SHEET 1 OF 16

FILE => G:\From URS with Sheet Numbers\AM Bridge Widen\33-0713-a-gp.dgn

USERNAME => Peter DATE PLOTTED => 1/17/2011 TIME PLOTTED => 10:29:25 AM

FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

No.	STATION	OFFSET	EP ELEVATION
1	"AC2" 212+53.68	6.00' Rt	419.86
2	"AC2" 212+53.68	5.98' Lt	419.86
3	"AC2" 212+65.78	6.00' Lt	420.14
4	"AC2" 213+03.72	46.22' Lt	418.61
5	"AC2" 213+02.18	72.61' Lt	414.35
6	"AC2" 213+25.13	91.78' Lt	414.88
7	"AC2" 213+37.25	63.83' Lt	417.36
8	"AC2" 213+44.43	45.60' Lt	419.30
9	"AC2" 213+64.72	13.31' Lt	422.04
10	"AC2" 213+85.63	7.50' Lt	422.45
11	"AC2" 215+05.15	7.50' Lt	422.37
12	"AC2" 215+14.62	7.50' Lt	422.24
13	"AC2" 215+23.31	27.77' Lt	420.06
14	"AC2" 215+09.45	42.33' Lt	418.82
15	"AC2" 215+01.19	54.15' Lt	418.19
16	"AC2" 214+85.68	85.52' Lt	416.20
17	"AC2" 214+83.12	89.32' Lt	416.12
18	"AC2" 214+98.06	99.37' Lt	416.00
19	"AC2" 215+21.22	64.90' Lt	418.17
20	"AC2" 216+73.02	10.00' Lt	419.19

No.	STATION	OFFSET	EP ELEVATION
21	"AC2" 216+38.28	10.00' Rt	419.76
22	"AC2" 215+85.98	7.98' Rt	420.85
23	"AC2" 215+63.03	26.59' Rt	418.69
24	"AC2" 215+54.27	45.83' Rt	417.05
25	"AC2" 215+41.46	35.89' Rt	417.15
26	"AC2" 215+25.38	9.25' Rt	421.31
27	"AC2" 215+05.15	7.50' Rt	422.37
28	"AC2" 213+85.63	7.50' Rt	422.45
29	"AC2" 213+55.69	9.64' Rt	421.96
30	"AC2" 213+42.40	9.19' Rt	421.71
31	"AC2" 213+10.46	6.00' Rt	421.08

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
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

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1	34	425

ARBhoi 1/18/11
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER Abhijeet R. Bhoi No. 68606 Exp. 09-30-11 CIVIL STATE OF CALIFORNIA

PLANS APPROVAL DATE

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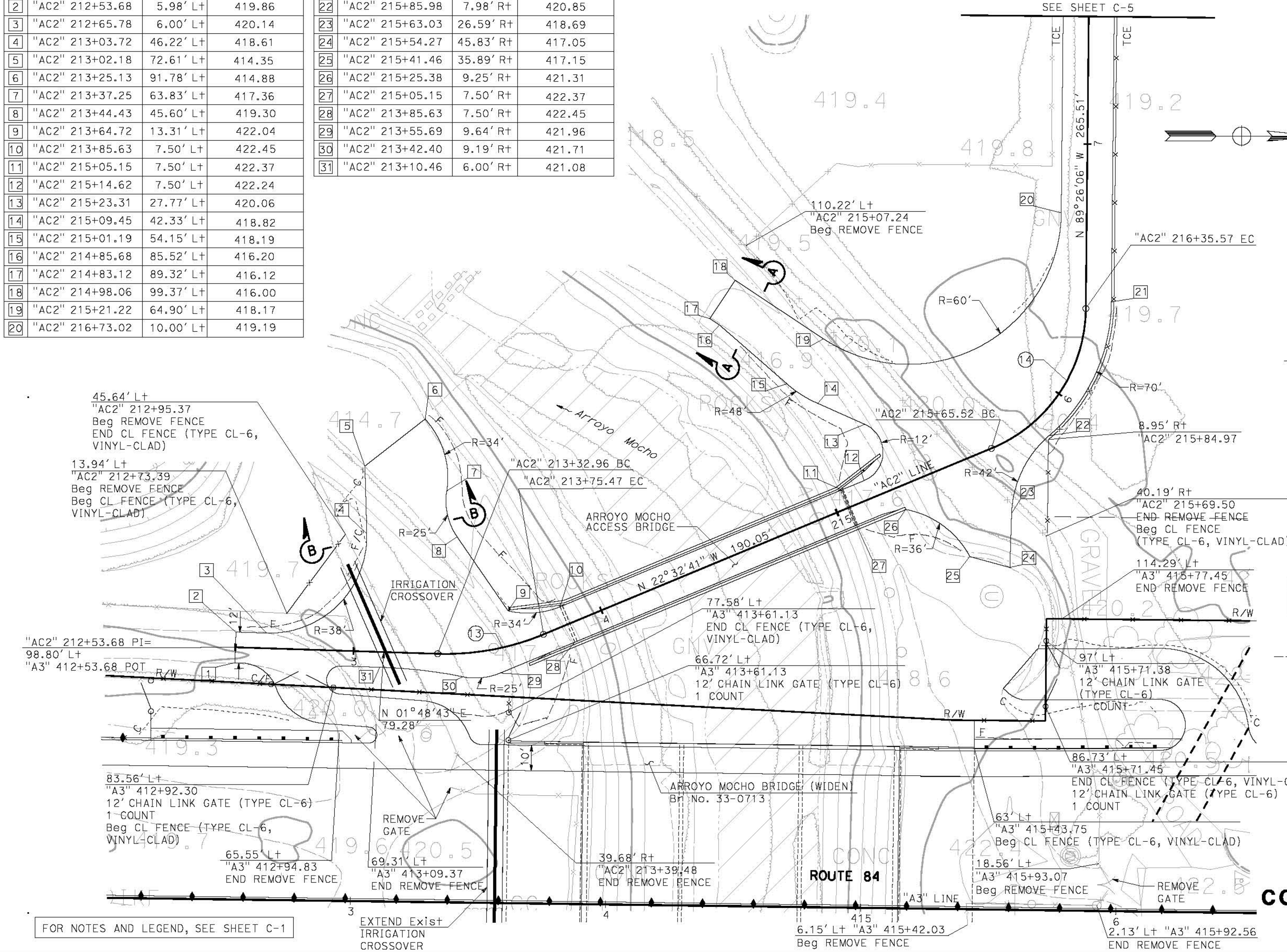
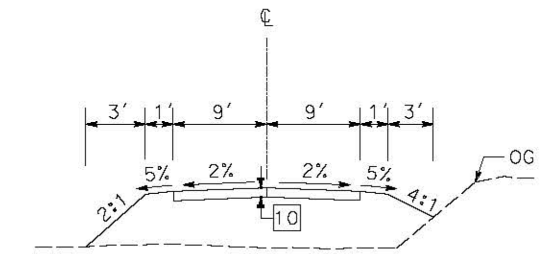
URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 94612

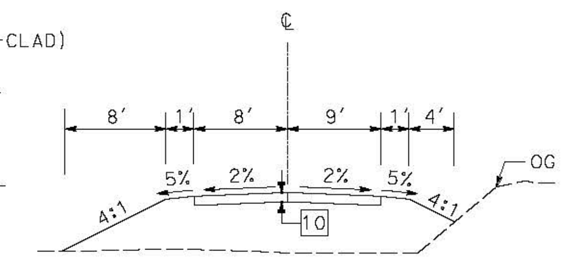
ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

SEE SHEET C-5





SECTION A-A
NTS



SECTION B-B
NTS

FOR NOTES AND LEGEND, SEE SHEET C-1

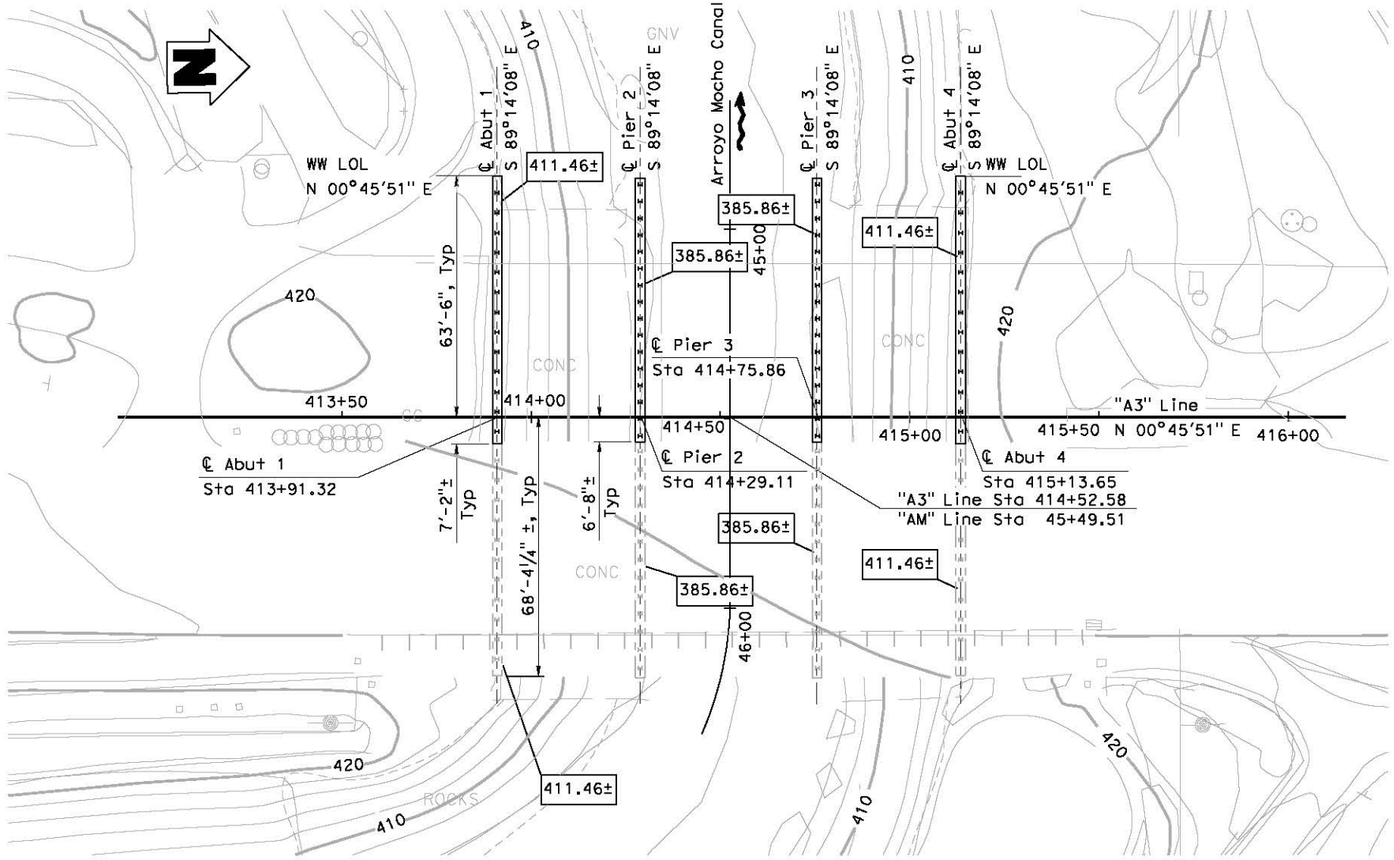
CONSTRUCTION DETAILS
SCALE: 1" = 20'

C-4

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: 01/16/11

DATE PLOTTED => 1/17/2011
TIME PLOTTED => 10:05:48 AM
LAST REVISION 01-18-11



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 SHEETS
04	Ala	84	25.5/27.1	358	425

12/10/10
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER
Guoping Xu
No. C 63977
Exp. 09/30/12
CIVIL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

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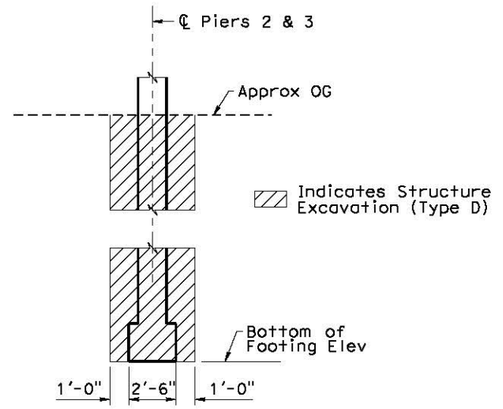
ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 BROADWAY, SUITE 300
OAKLAND, CA 94612

MCE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
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.

Stephen Huang 08/18/2010
GEOTECHNICAL PROFESSIONAL APPROVAL DATE

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

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 5/8" 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

DESIGN OVERSIGHT	SCALE: 1"=20'-0"	VERT.DATUM NAVD88	HORZ.DATUM NAD83	DESIGN	BY G. Xu	CHECKED R. Sennett	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Guoping Xu PROJECT ENGINEER	BRIDGE NO. 33-0713
	PHOTOGRAMMETRY AS OF: 11/10/2005	ALIGNMENT TIES		DETAILS	BY P. Zhao	CHECKED R. Sennett			POST MILE 26.6
SIGN OFF DATE	SURVEYED BY Dan Scott	DRAFTED BY Abhijeet Bhoi		QUANTITIES	BY W. Sennett	CHECKED R. Huang		CU 0733 EA 297611	DISREGARD PRINTS BEARING EARLIER REVISION DATES →
	FIELD CHECKED BY Dan Scott	CHECKED BY							

ARROYO MOCHO BRIDGE (WIDEN)
FOUNDATION PLAN

REVISION DATES (PRELIMINARY STAGE ONLY): 09/28/08 | 04/07/08 | 09/15/08 | 12/19/08 | 05/07/09 | 01/27/10 | 08/16/10 | 10/27/10 | 12/10/10

SHEET 3 OF 16

FOUNDATION PLAN SHEET (ENGLISH) (REV. 06-01-09)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

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USERNAME => Peterr DATE PLOTTED => 1/17/2011 TIME PLOTTED => 10:15:04 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84	25.5/27.1	360	425

REGISTERED CIVIL ENGINEER — 12/10/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Guoping Xu — No. C 63977 — Exp. 09/30/12 — CIVIL — STATE OF CALIFORNIA

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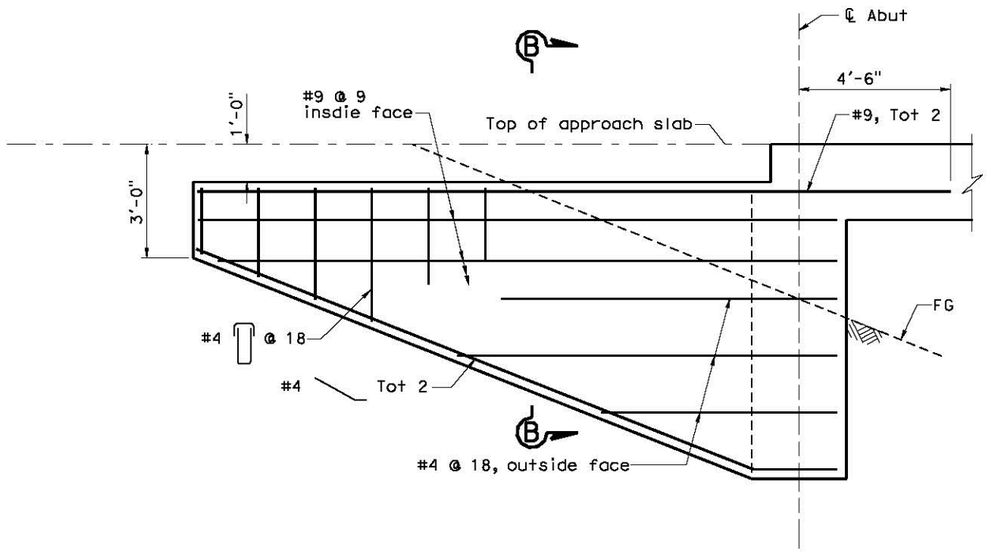
ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 BROADWAY, SUITE 300
OAKLAND, CA 94612

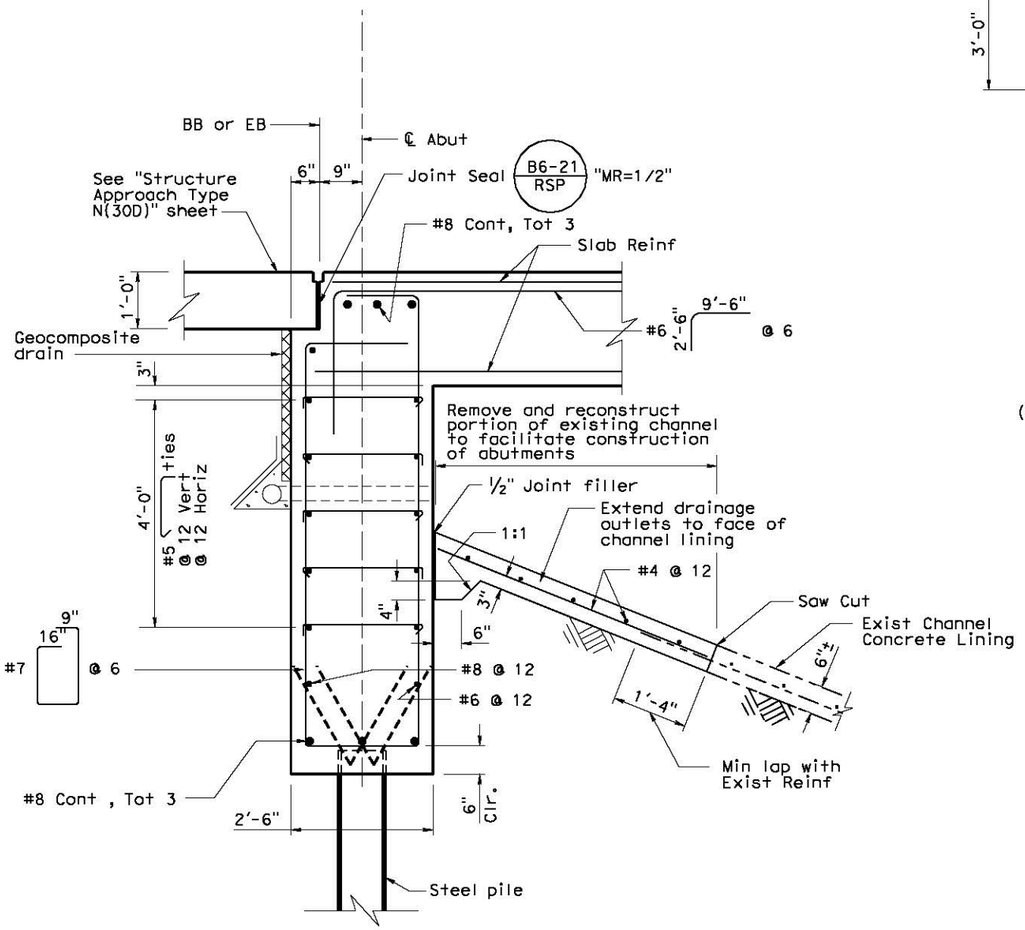
MCE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831



(Concrete Barrier and Chain Link Railing not shown for clarity)

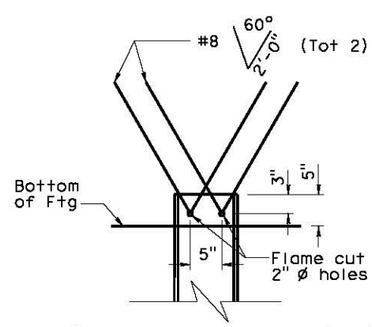
WINGWALL ELEVATION

Scale: ½" = 1'-0"



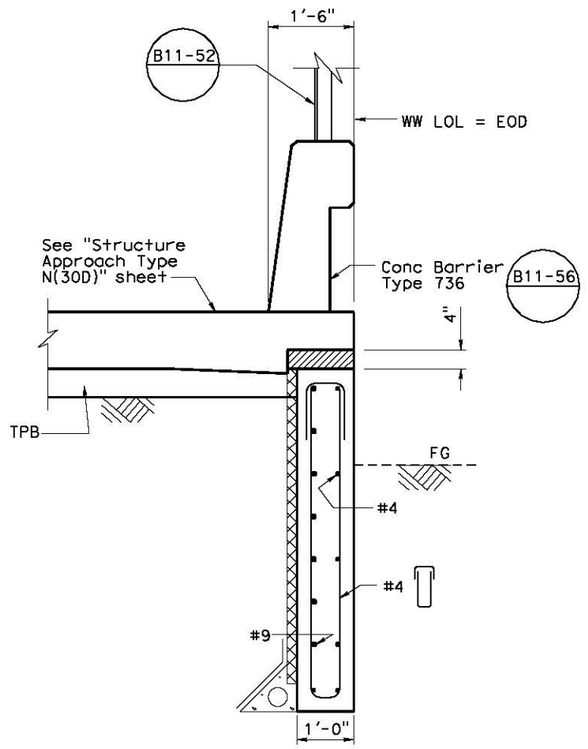
SECTION A-A

Scale: ¾" = 1'-0"



STEEL PILE ANCHOR

Scale: 1" = 1'-0"



SECTION B-B

Scale: ¾" = 1'-0"

NOTE:

For location of Section A-A, see "ABUTMENT LAYOUT" sheet.

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

DESIGN OVERSIGHT		DESIGN	BY G. Xu	CHECKED R. Sennett	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
SIGN OFF DATE		DETAILS	BY P. Zhao	CHECKED R. Sennett	
		QUANTITIES	BY W. Sennett	CHECKED R. Huang	

Guoping Xu
PROJECT ENGINEER

CU 0733
EA 297611

BRIDGE NO. 33-0713
POST MILE 26.6

ARROYO MOCHO BRIDGE (WIDEN)
ABUTMENT DETAILS NO.1

DESIGN DETAIL SHEET (ENGLISH) (REV. 06-01-09)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY): 05/07/09 | 01/22/10 | 08/16/10 | 10/21/10 | 12/10/10

SHEET 5 OF 16

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1	425		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. Exp. CIVIL — STATE OF CALIFORNIA

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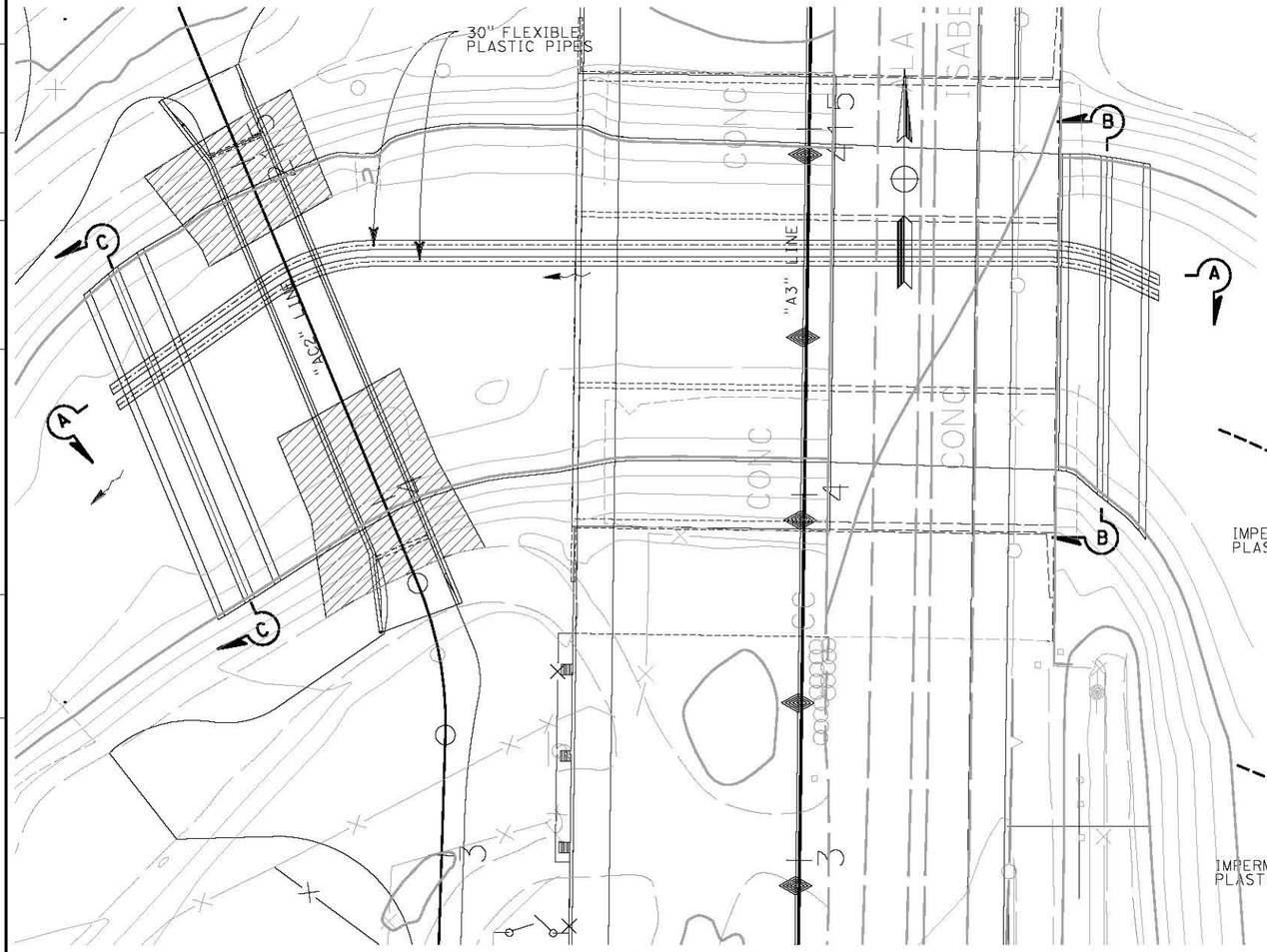
NOTES:

1. EXACT LENGTH AND LOCATION OF THE PLASTIC PIPE TO BE DETERMINED IN THE FIELD BY THE ENGINEER.
2. GRAVEL-FILLED BAG ANCHORS TO BE PLACED AT INTERMEDIATE LOCATIONS AS DETERMINED BY ENGINEER.
3. USE FLEXIBLE PIPE OR RIGID PIPE WITH WATER TIGHT JOINTS.

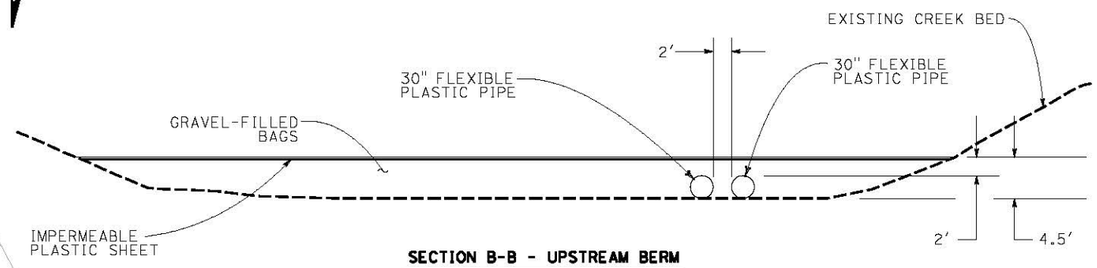
URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612



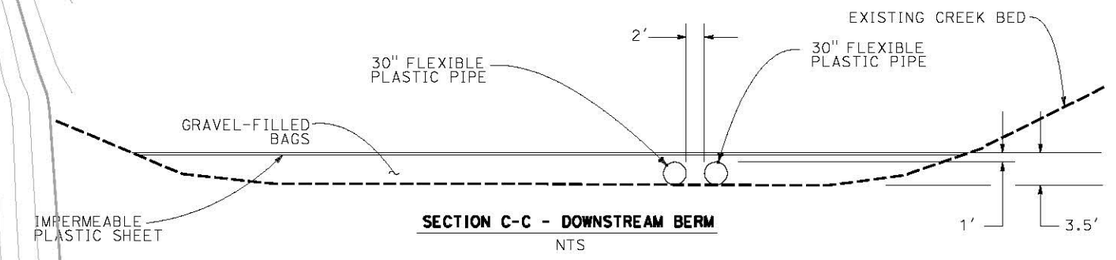
ARROYO MOCHO CREEK TEMPORARY CREEK DIVERSION

SCALE 1" = 20'



SECTION B-B - UPSTREAM BERM

NTS

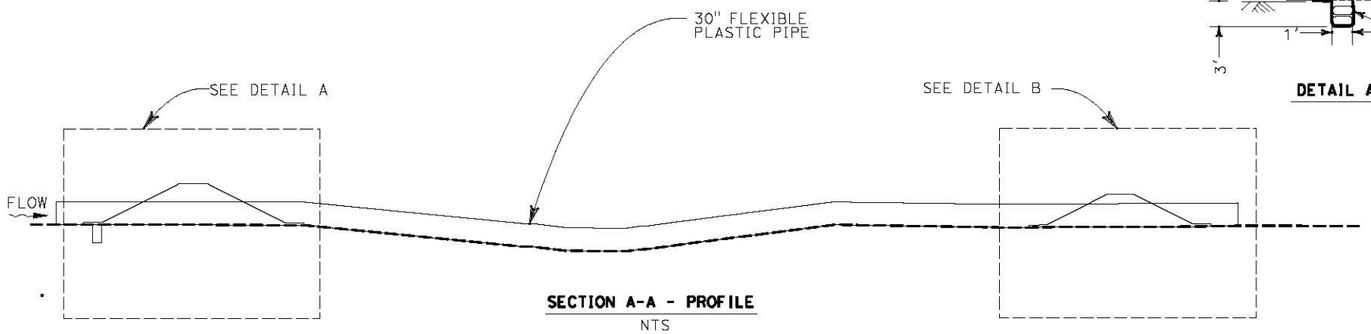


SECTION C-C - DOWNSTREAM BERM

NTS

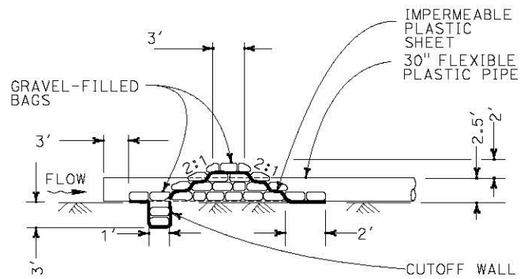
HYDROLOGIC SUMMARY

OBSERVED WATER DEPTH NON RAINY SEASON (ft)	MAXIMUM SLOPE (Percent)	AVERAGE FLOW (ft³/s)	PIPE Diam. (inches)
1	0.59	20	30



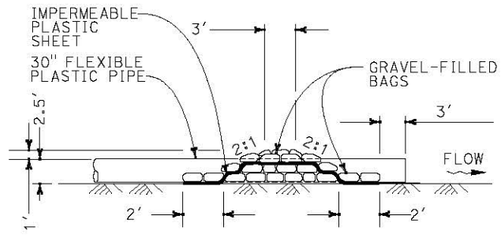
SECTION A-A - PROFILE

NTS



DETAIL A - UPSTREAM BERM

NTS



DETAIL B - DOWNSTREAM BERM

NTS

DRAINAGE DETAILS TEMPORARY DRAINAGE

NO SCALE

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans®

CONSULTANT FUNCTIONAL SUPERVISOR

CALCULATED-DESIGNED BY

CHECKED BY

REVISED BY | DATE REVISED

LAST REVISION 10-08-12 | DATE PLOTTED => 11/19/2012 | TIME PLOTTED => 12:11:37 PM

BORDER LAST REVISED 7/2/2010

USERNAME => amber_grant
DGN FILE => ...\Arroyo Mocho_full diversion.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

California Department of Fish: Incidental Take Permit

- **No. 2081-2011-013-03 – Dated 11/10/2011**
- **Amendment No. 1 No. 2081-2011-013-03 – Dated 11/18/2014**

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

---

[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:

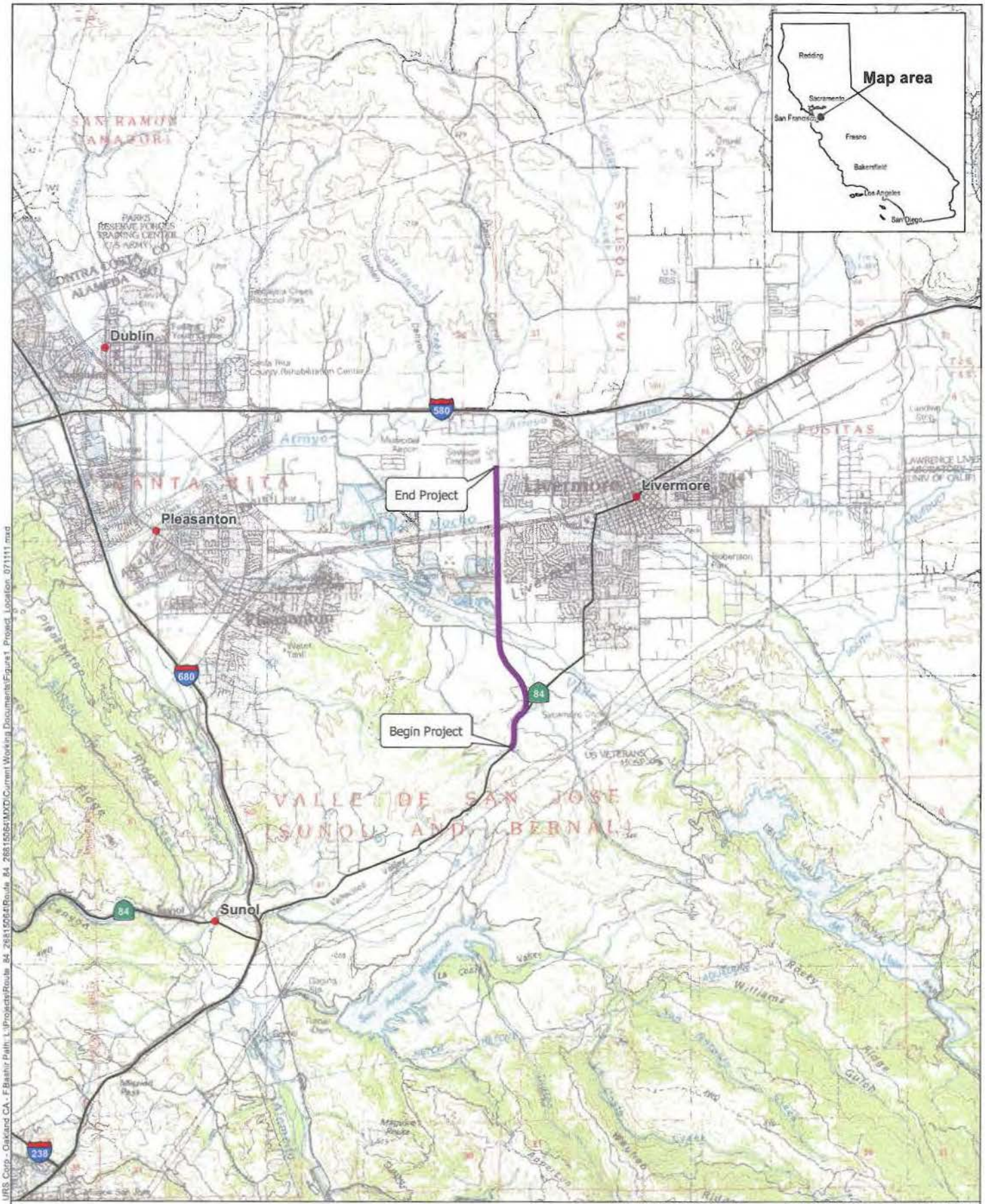
John H. Mattox
Staff Counsel IV

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



Base map source:USGS 100K Topo (Stockton, CA)

URS Corp - Oakland CA - F:\Basthir Path: L:\Projects\Route 84_26815064\Route 84_26815064\MXD\Current Working Documents\Figure1 Project_Location_071111.mxd

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

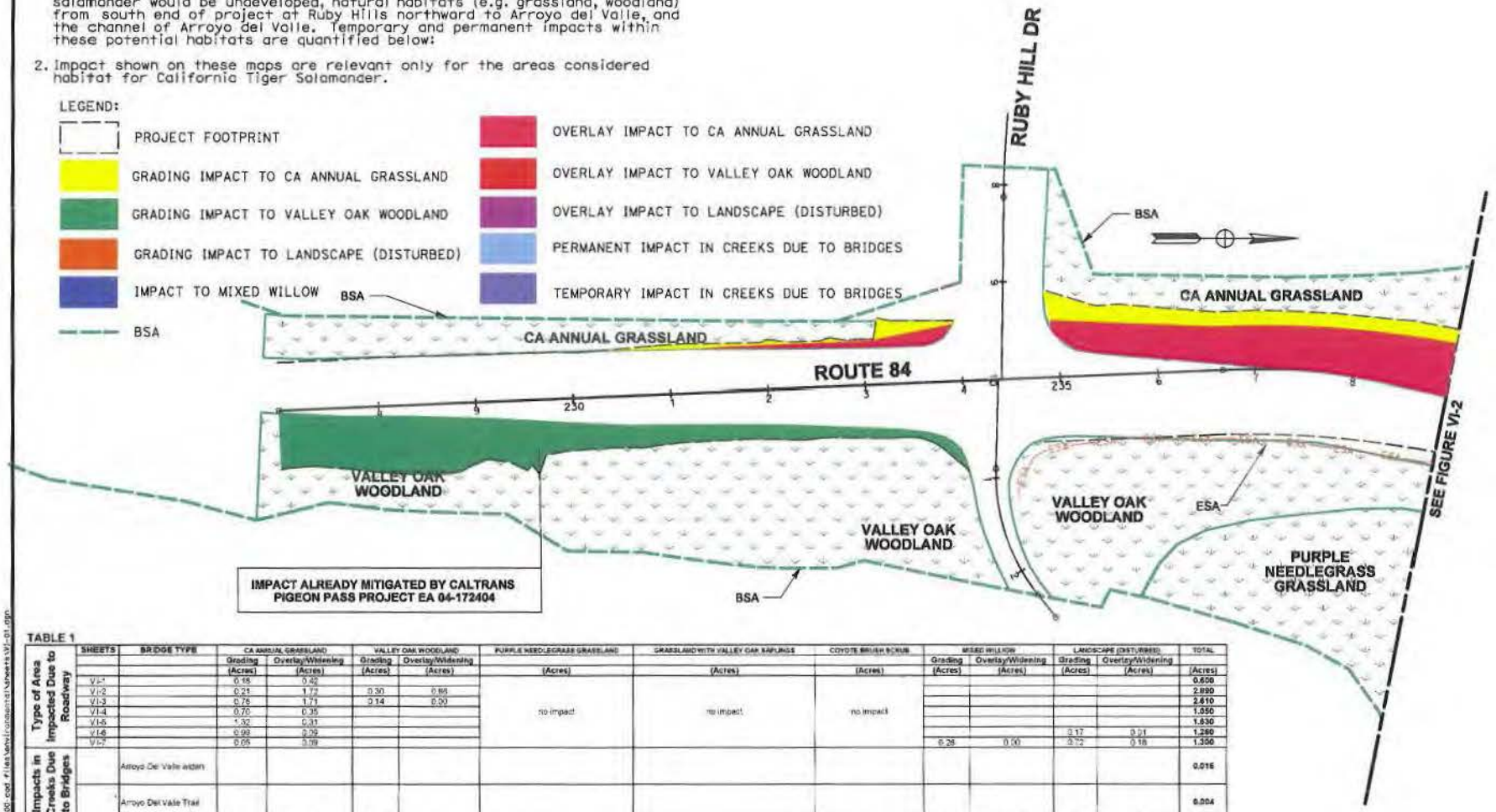


TABLE 1

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		0.75	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	0.29								0.17	0.21	1.280
	VI-7		0.05	0.09						0.28	0.00	0.72	0.18	1.350
Impacts in Creeks Due to Bridges		Arroyo Del Valle widen												0.016
		Arroyo Del Valle Trail												0.004
Total			4.20	4.70	0.44	0.66				0.28	0.00	0.89	0.19	11.36

ABBREVIATIONS
BSA Biological Study Area
ESA Environmental Sensitive Area

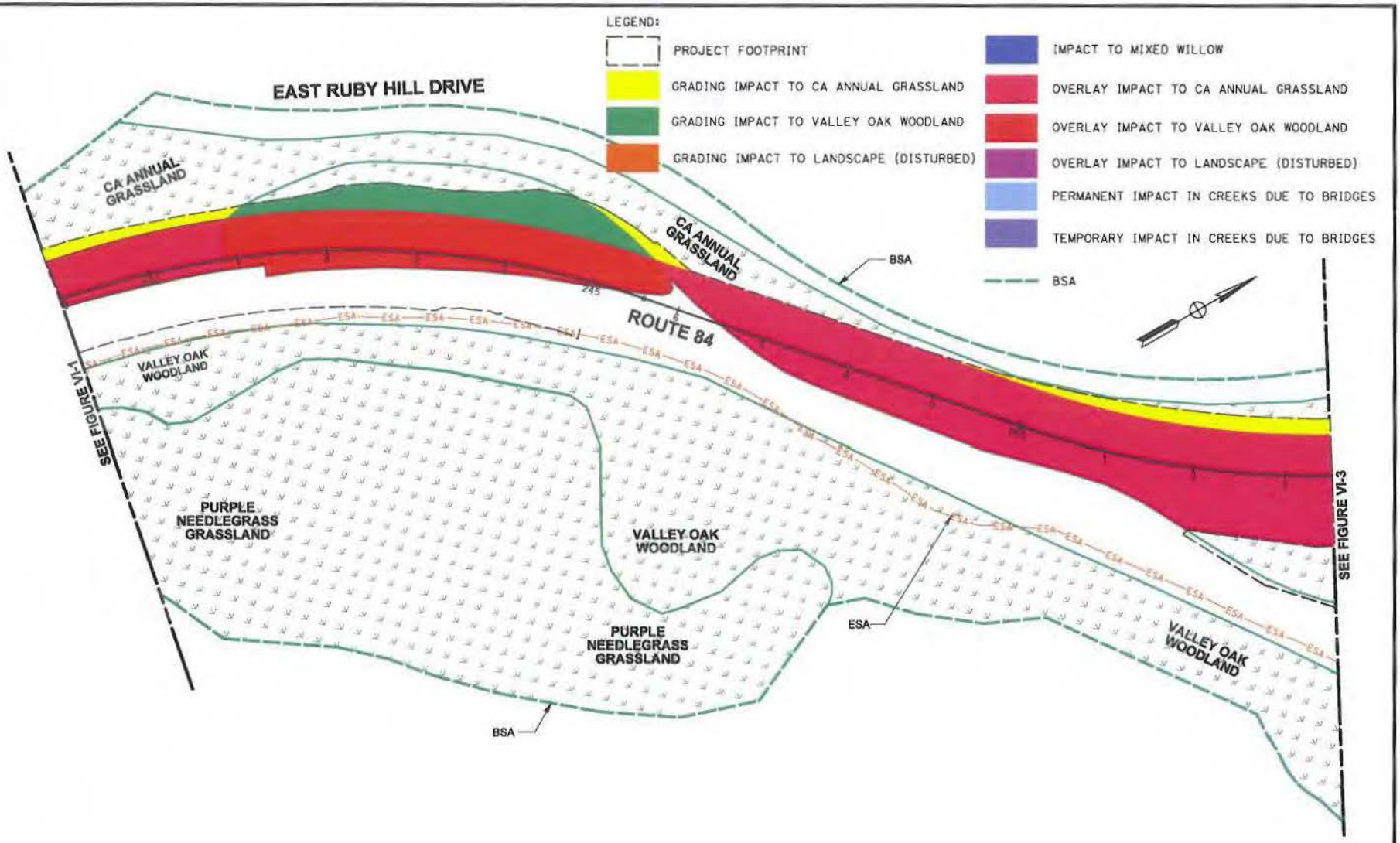
URS

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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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

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

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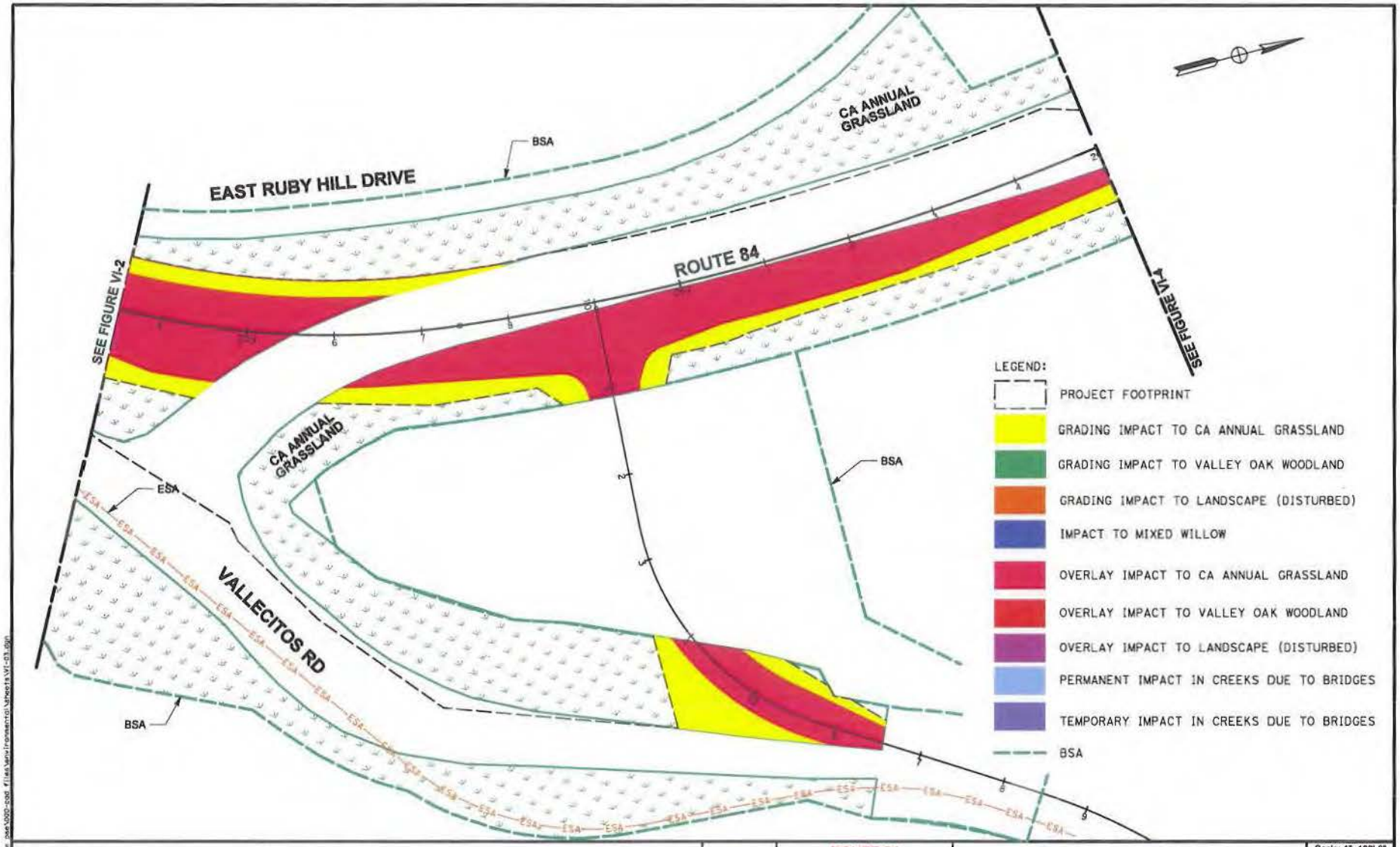

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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

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

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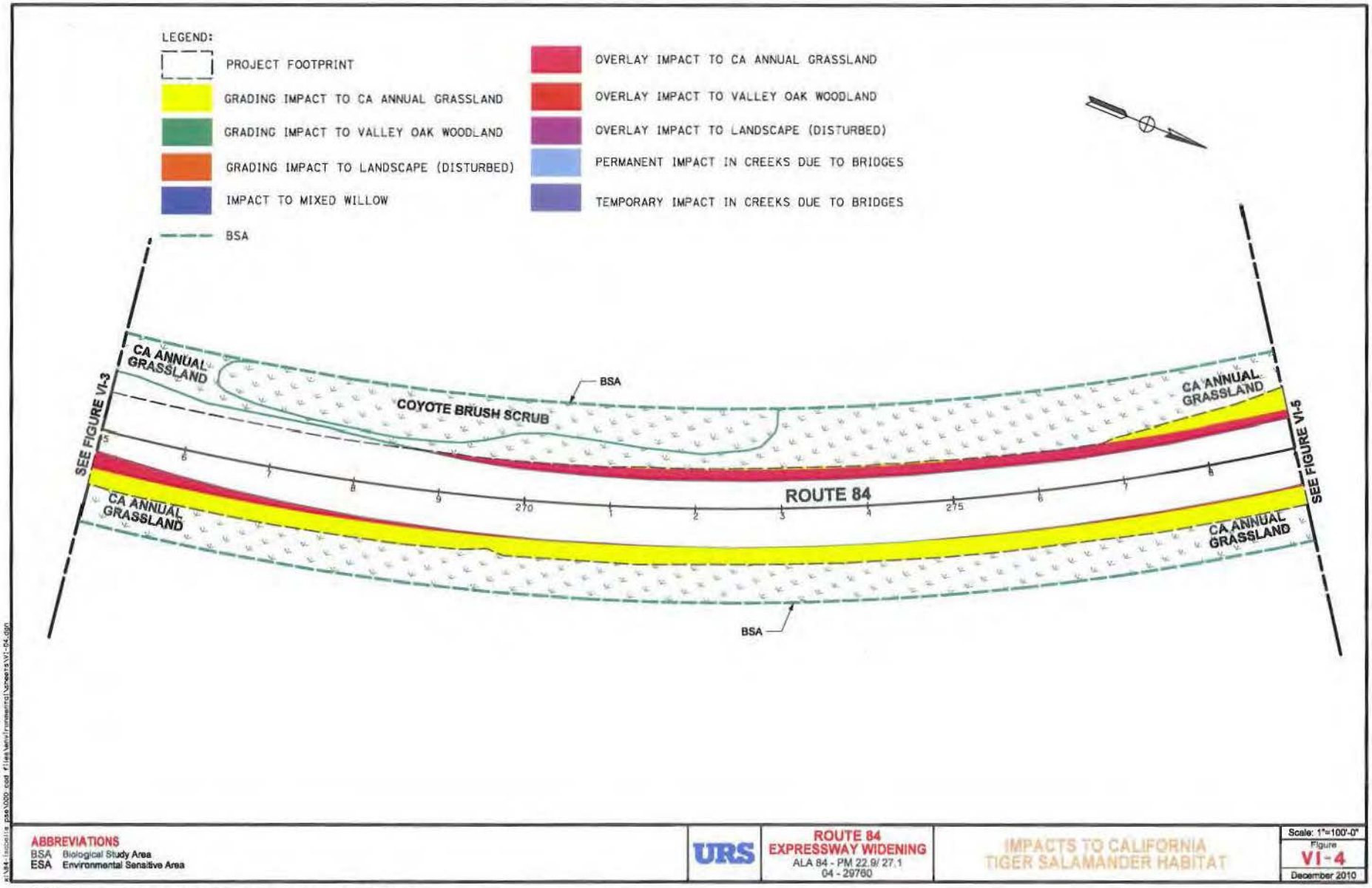

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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

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

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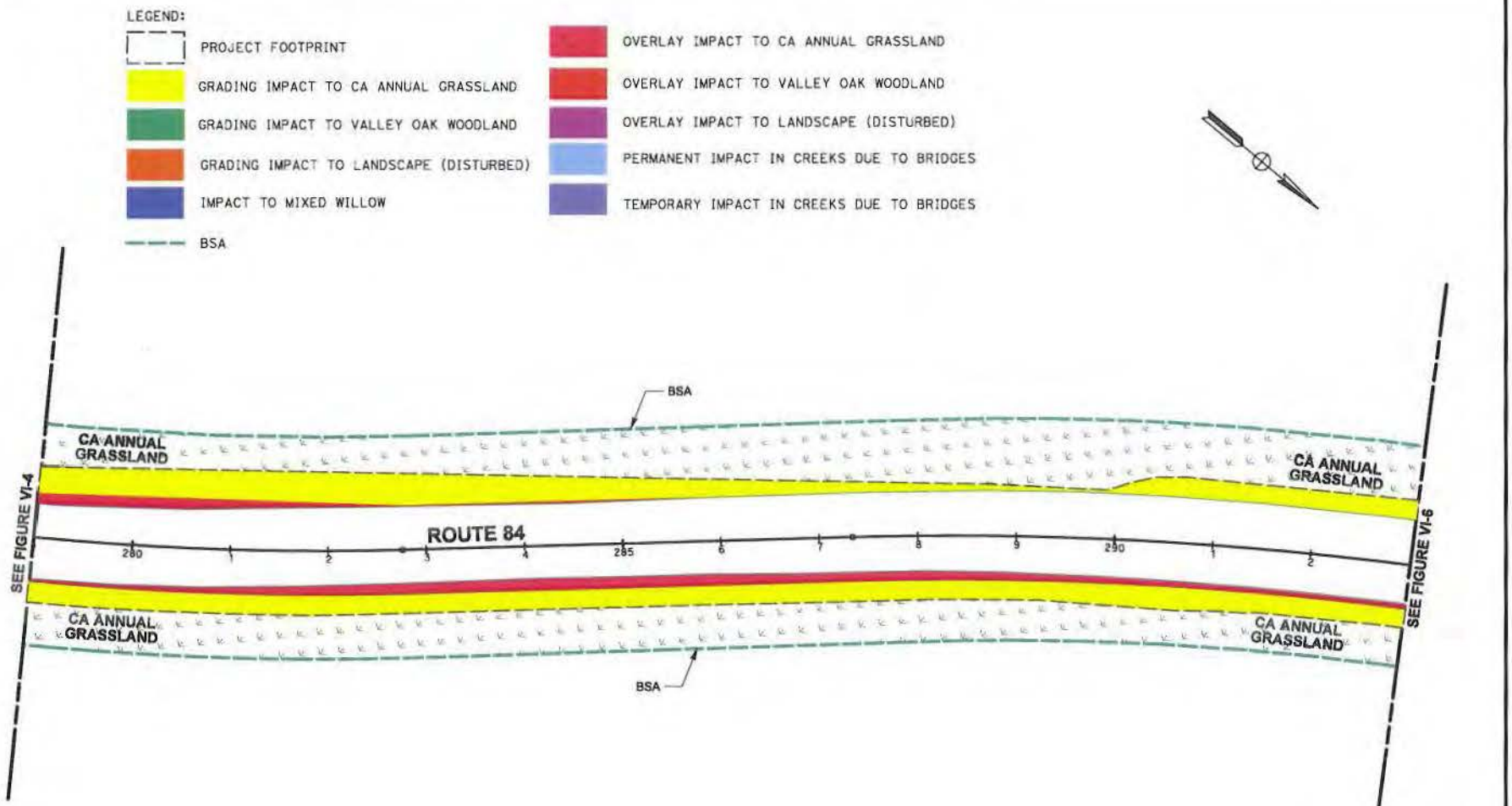

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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

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

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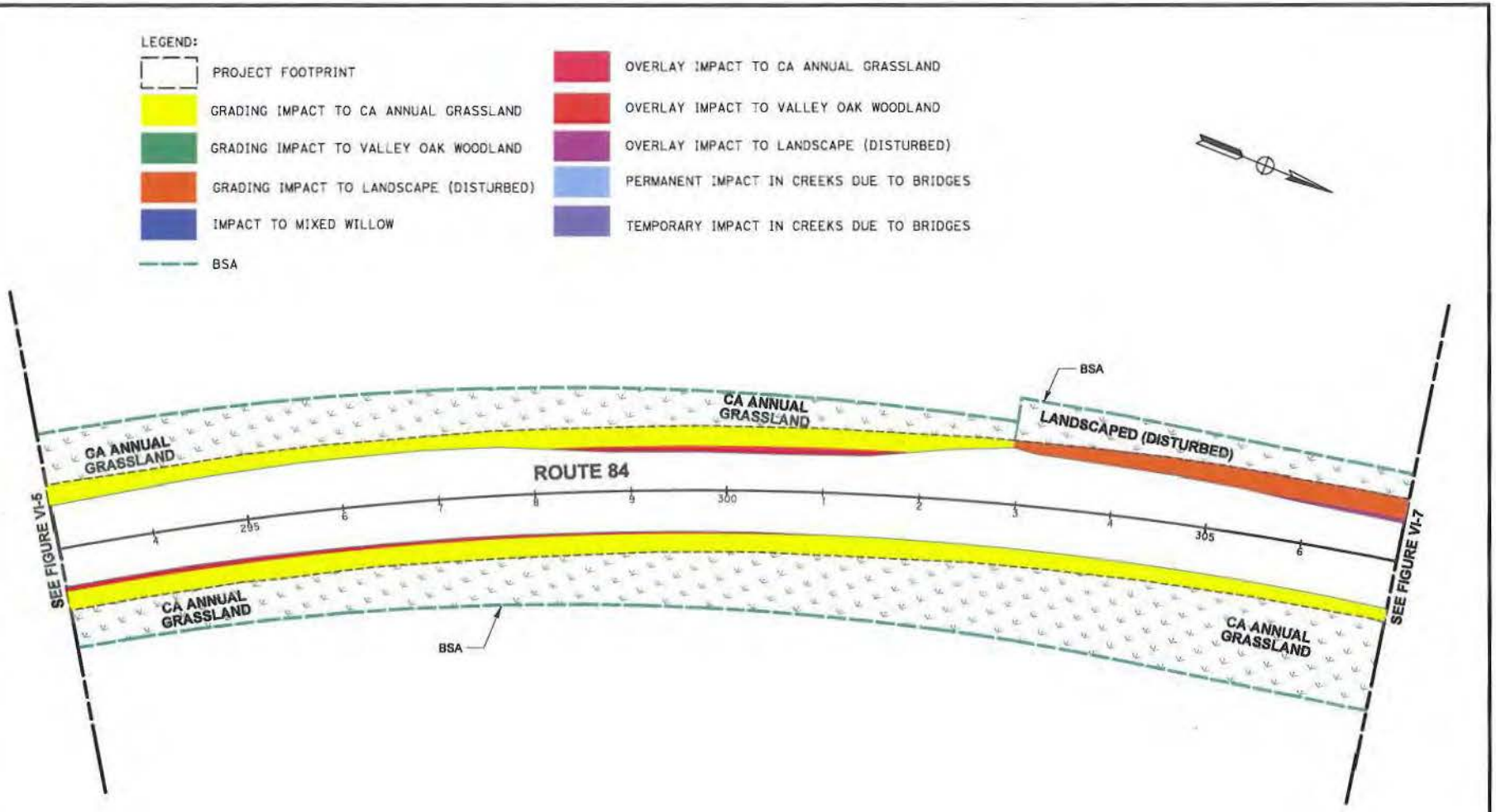

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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

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

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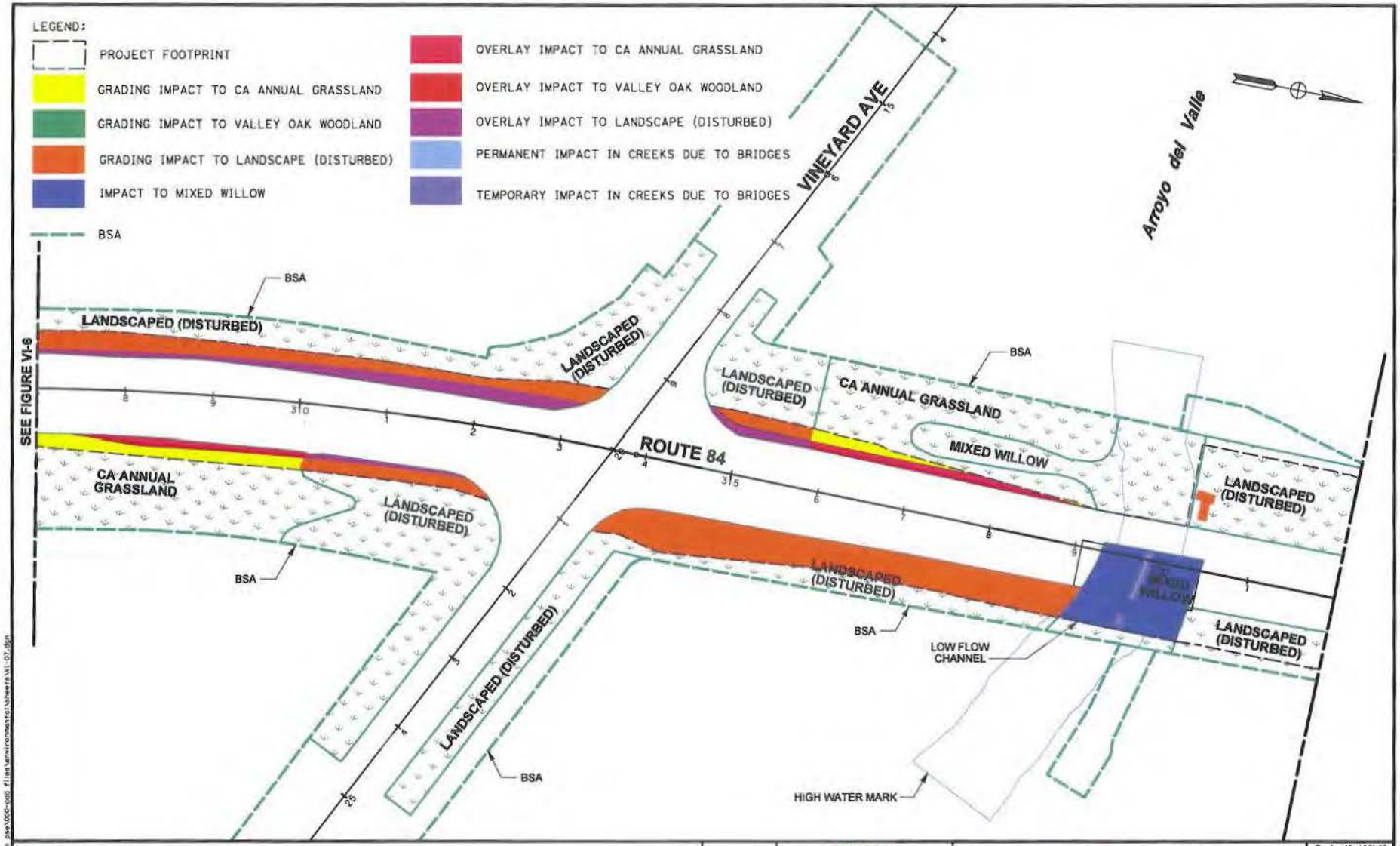

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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

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

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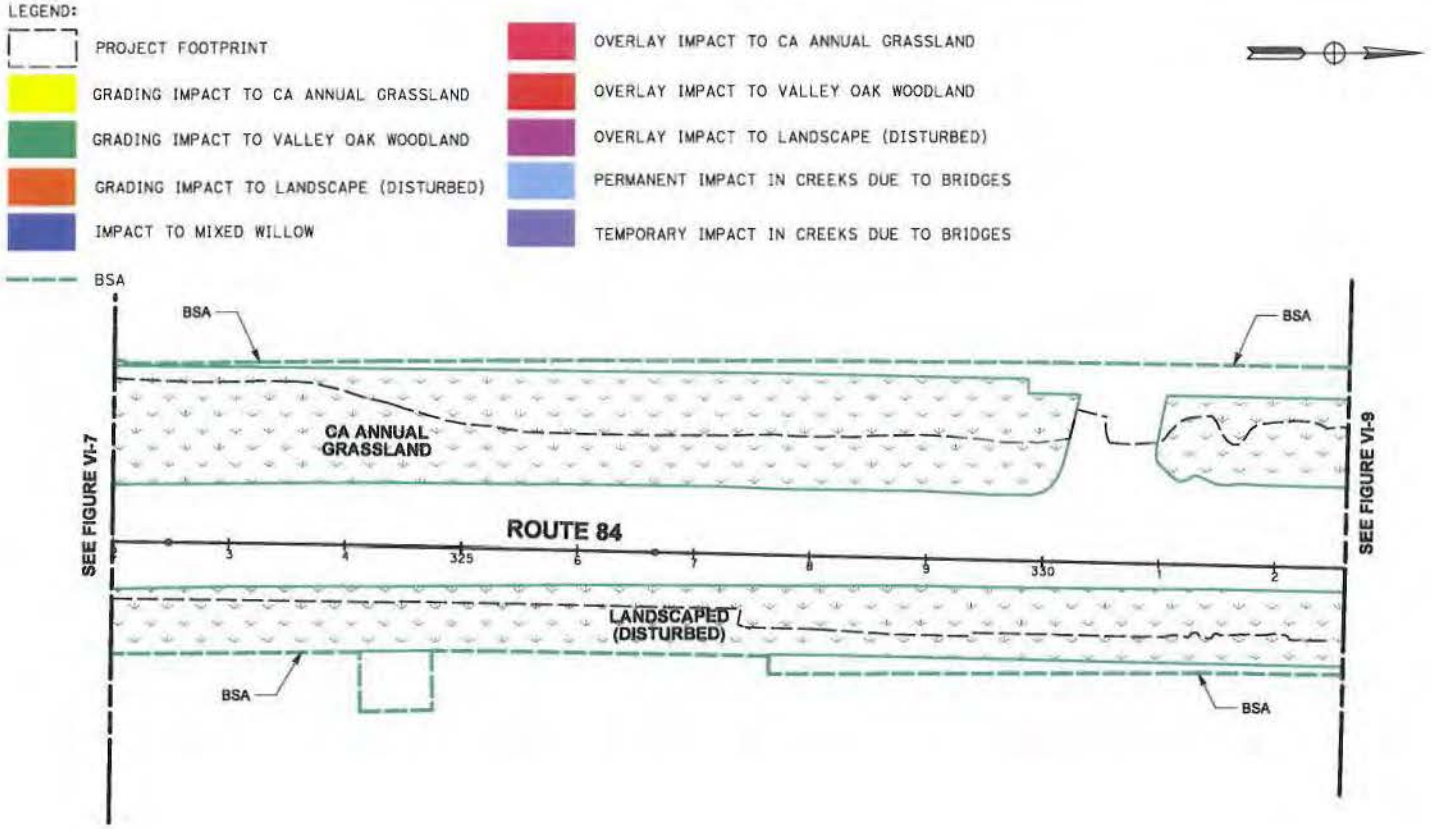

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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

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

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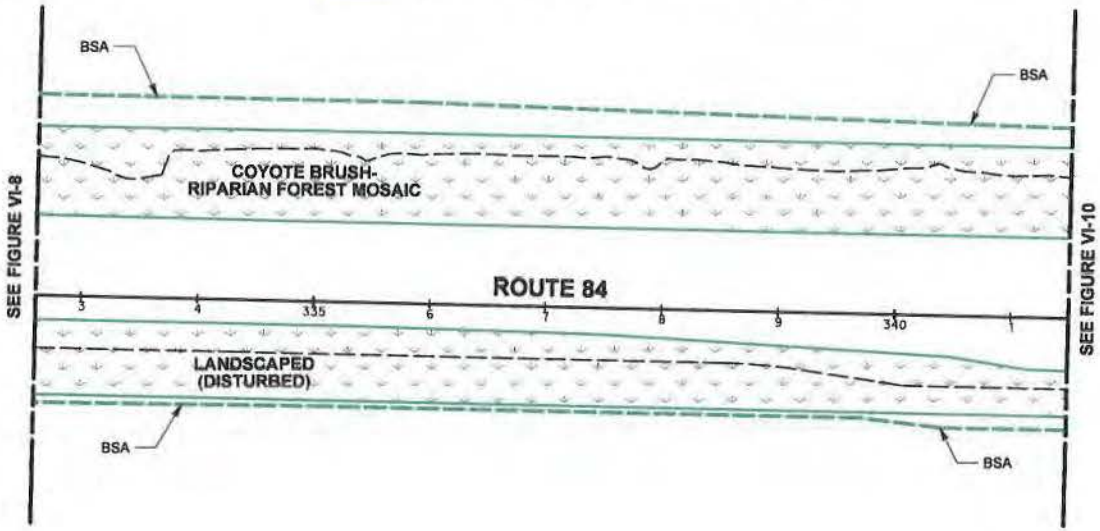

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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

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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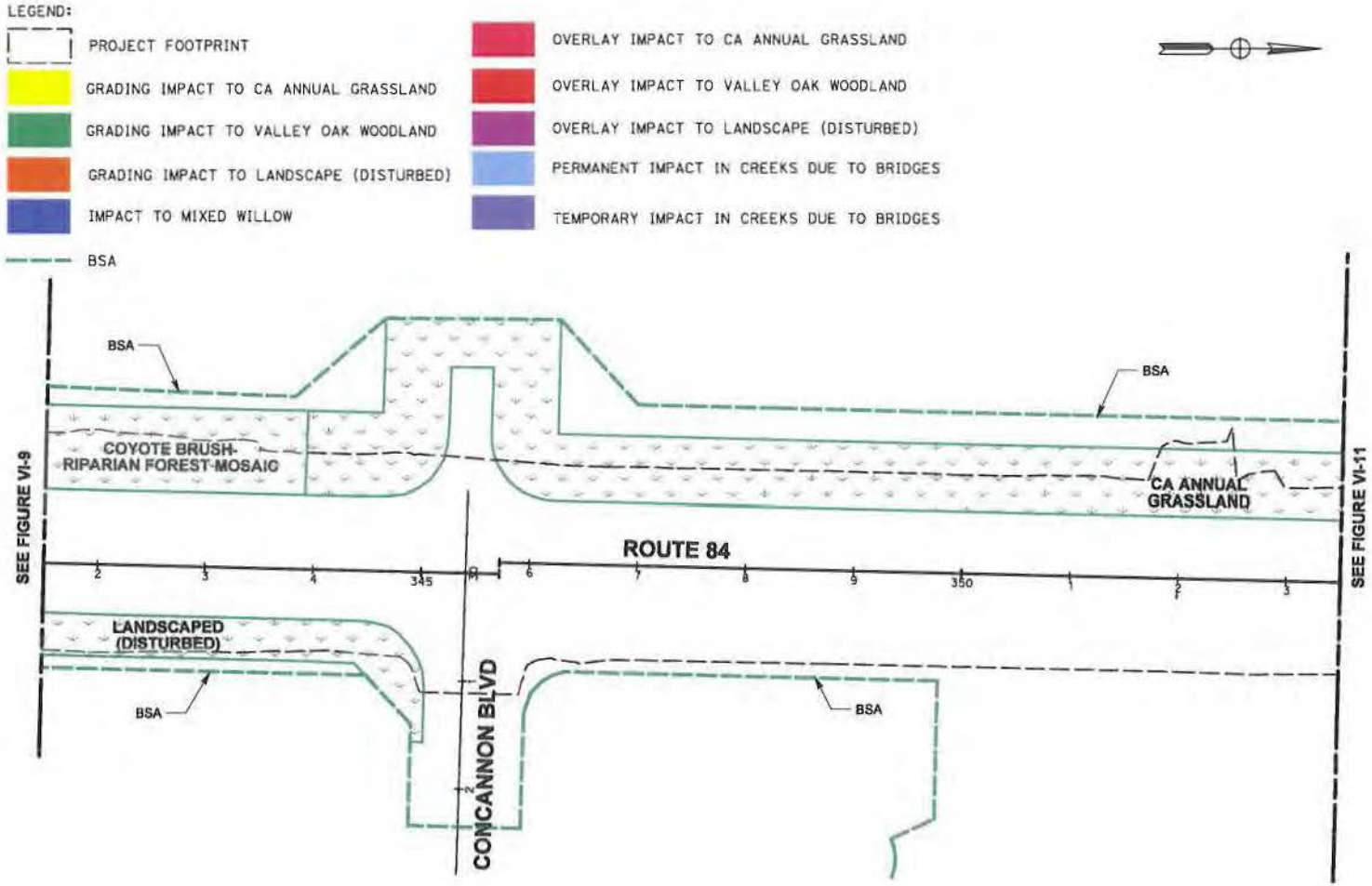

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IMPACTS TO CALIFORNIA
TIGER SALAMANDER HABITAT

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

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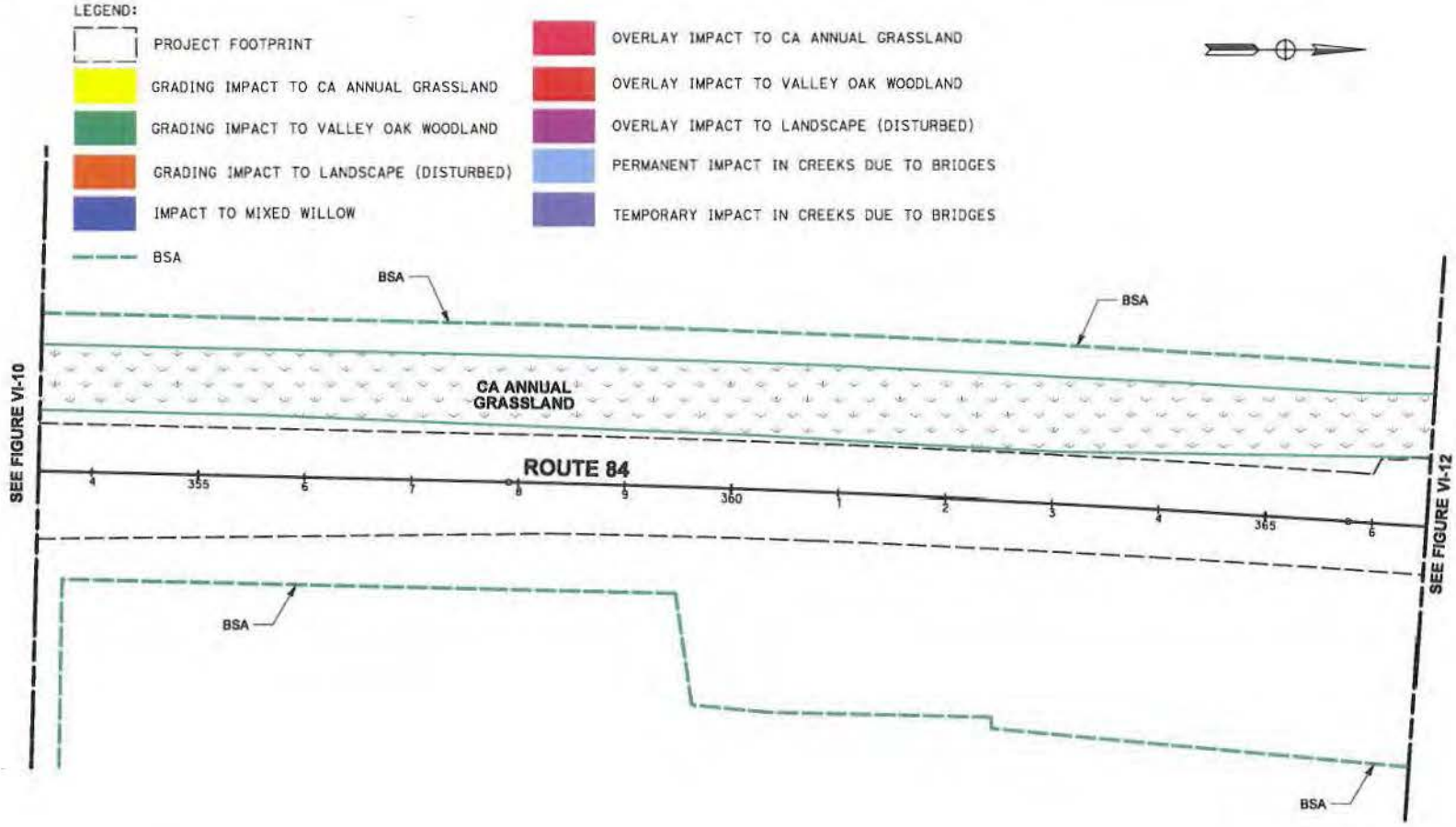

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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

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

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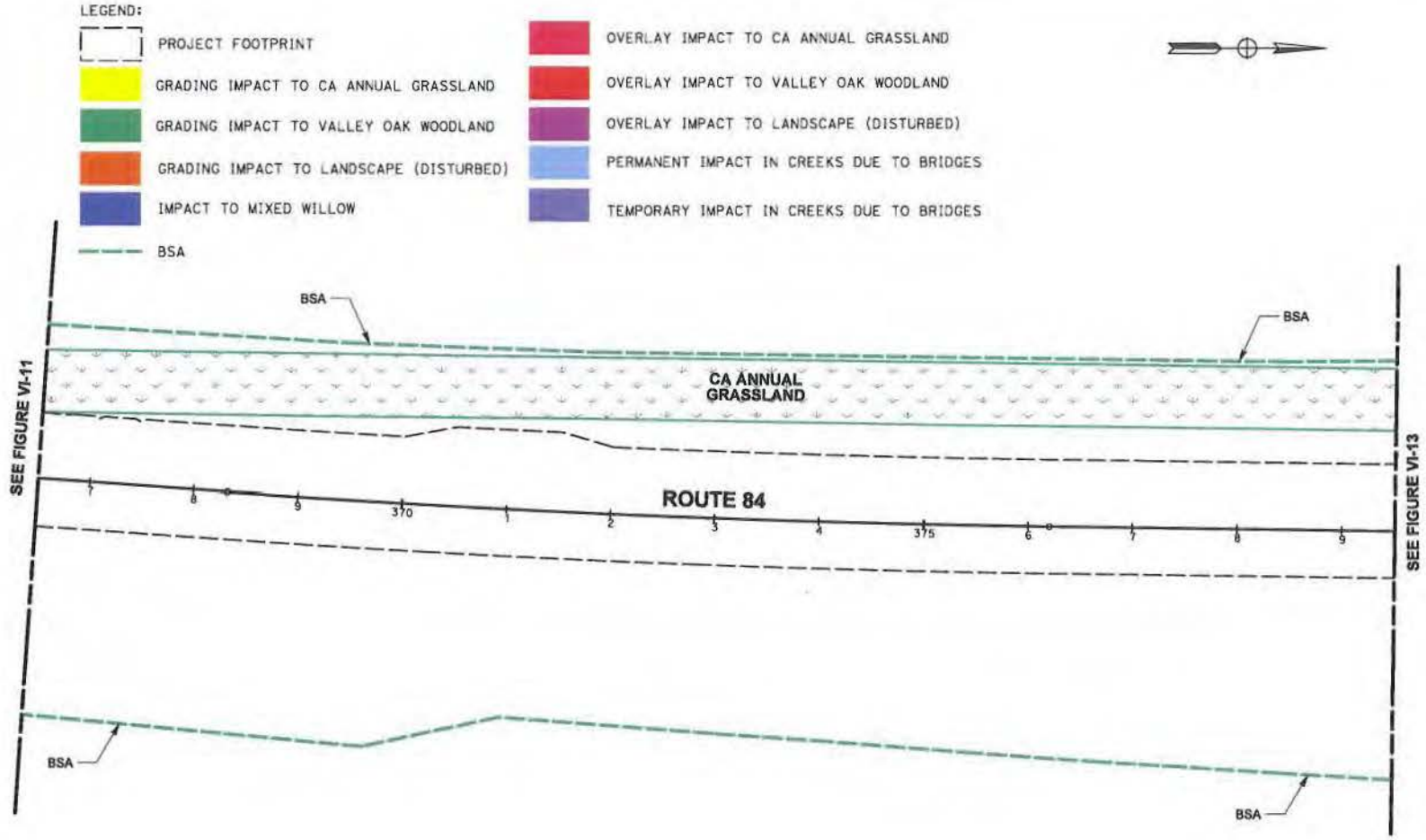

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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

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

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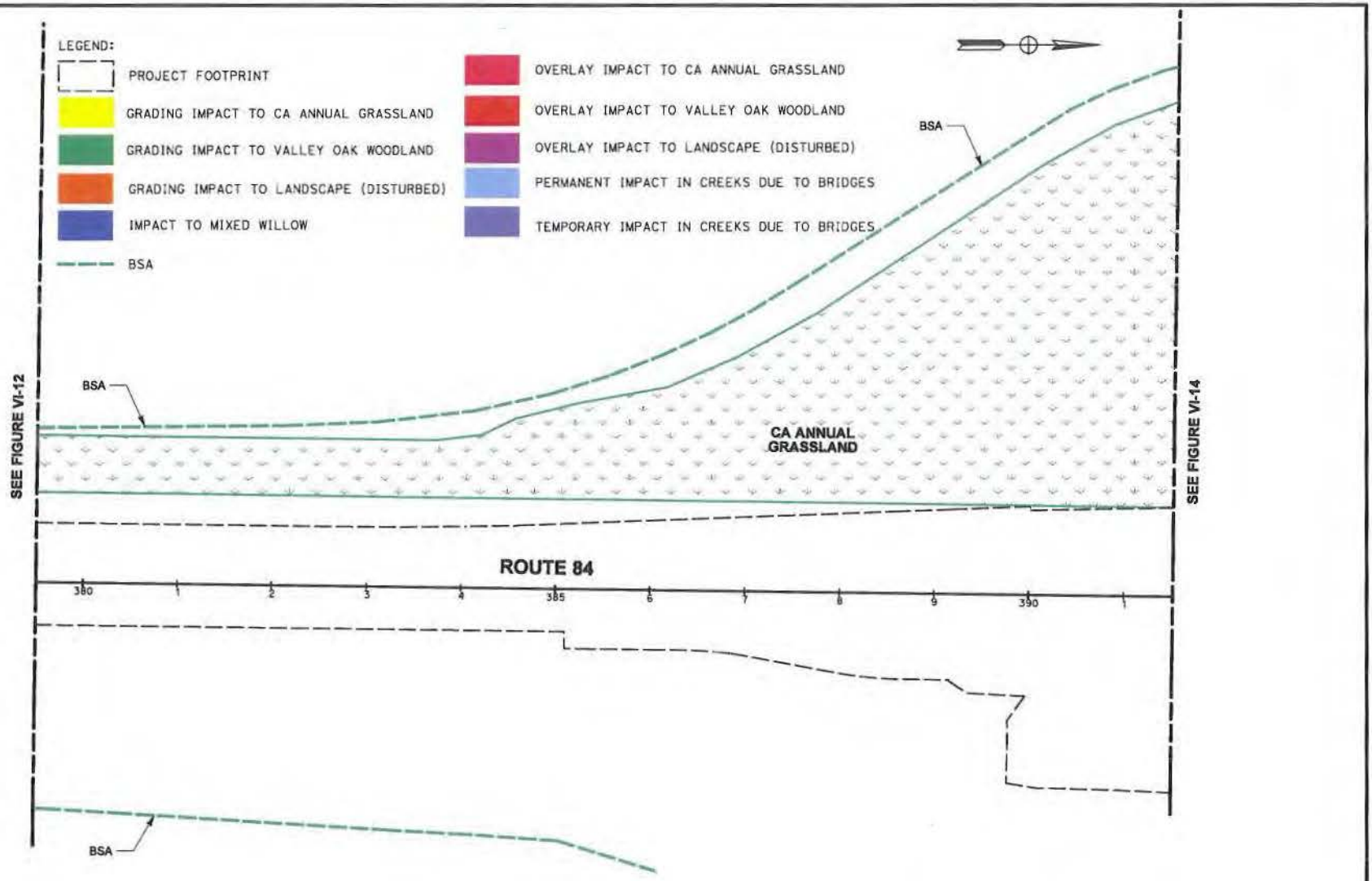

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Scale: 1"=100'-0"
Figure
VI-13
December 2010

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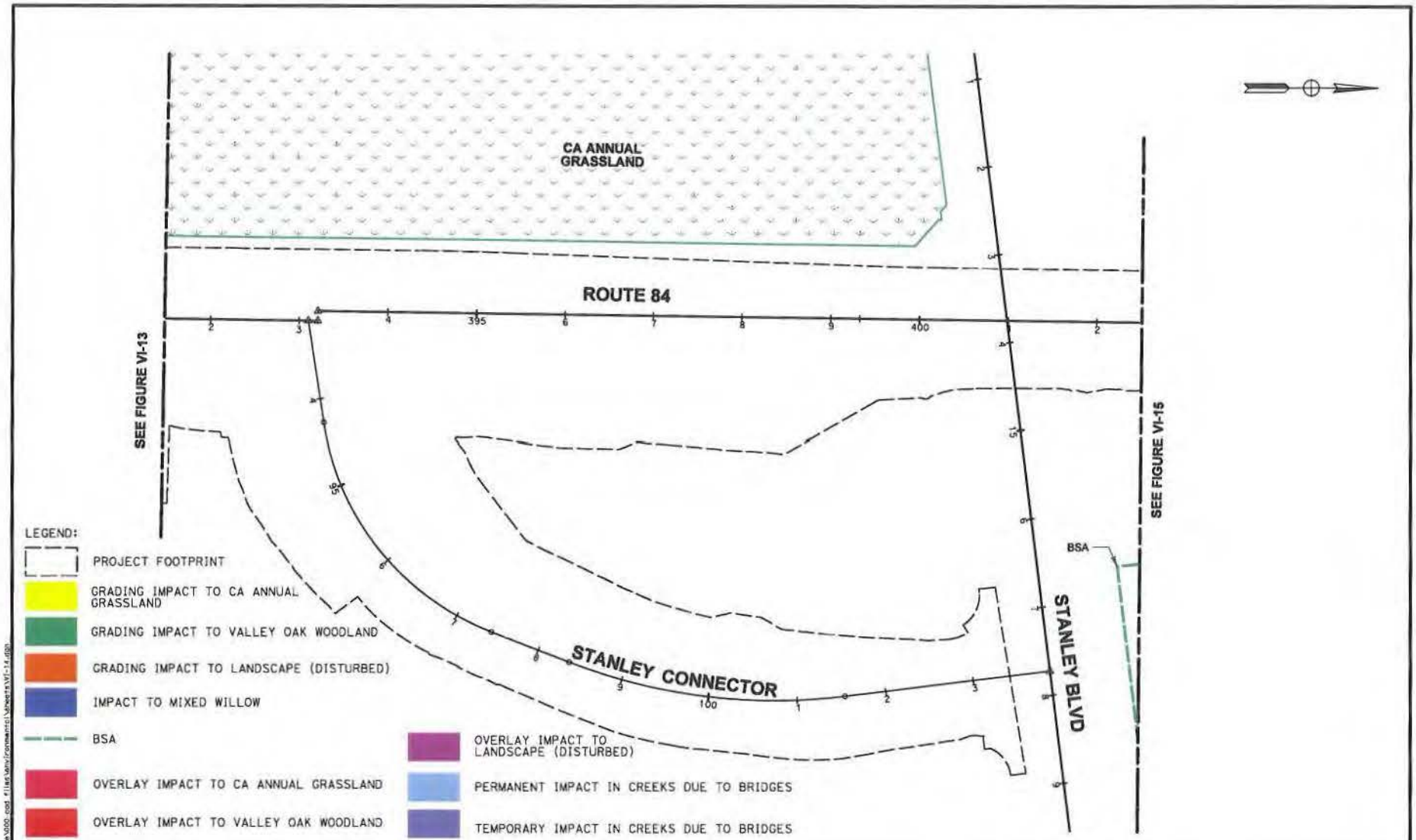

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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

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

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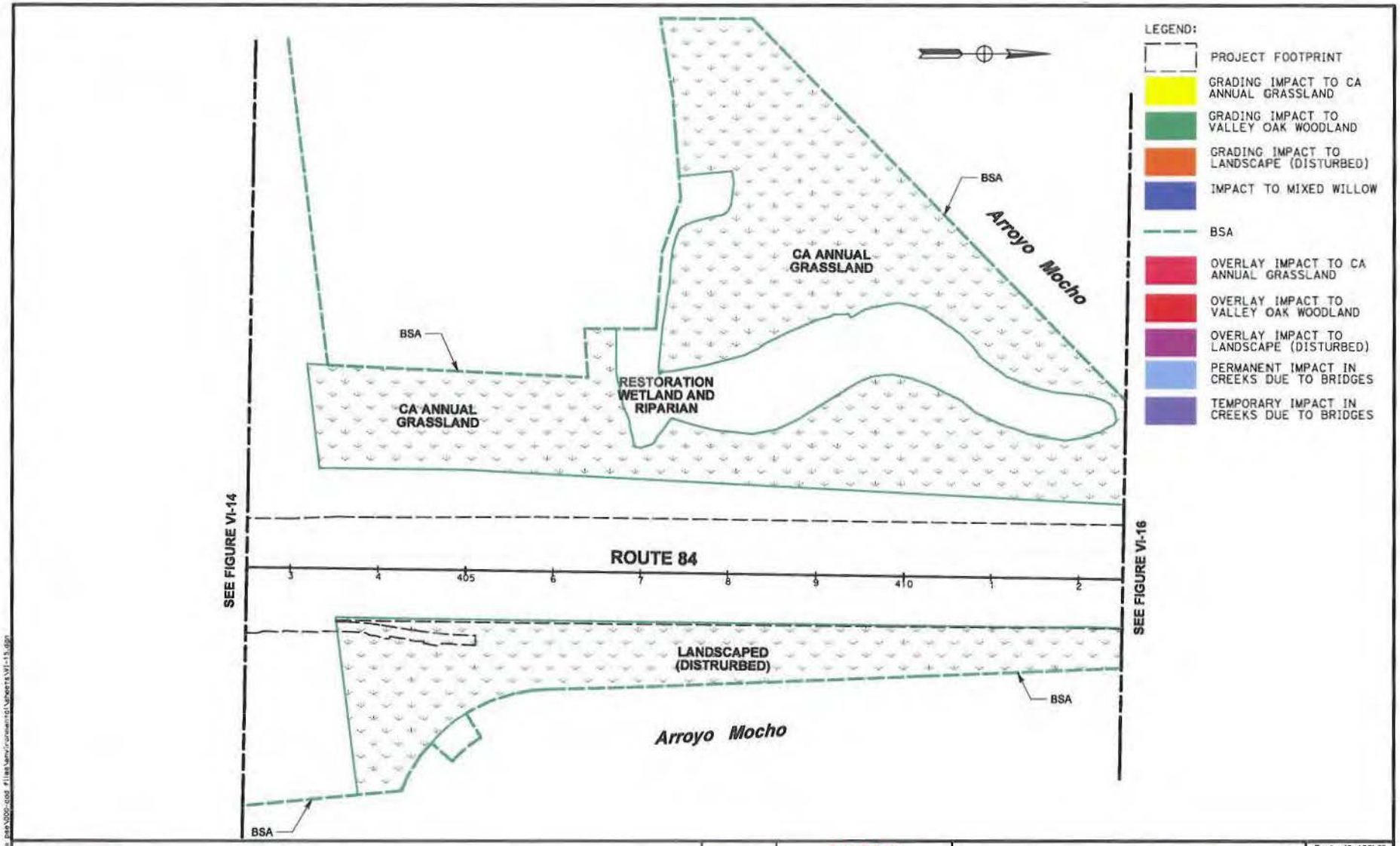

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Scale: 1"=100'-0"
Figure
VI-15
December 2010

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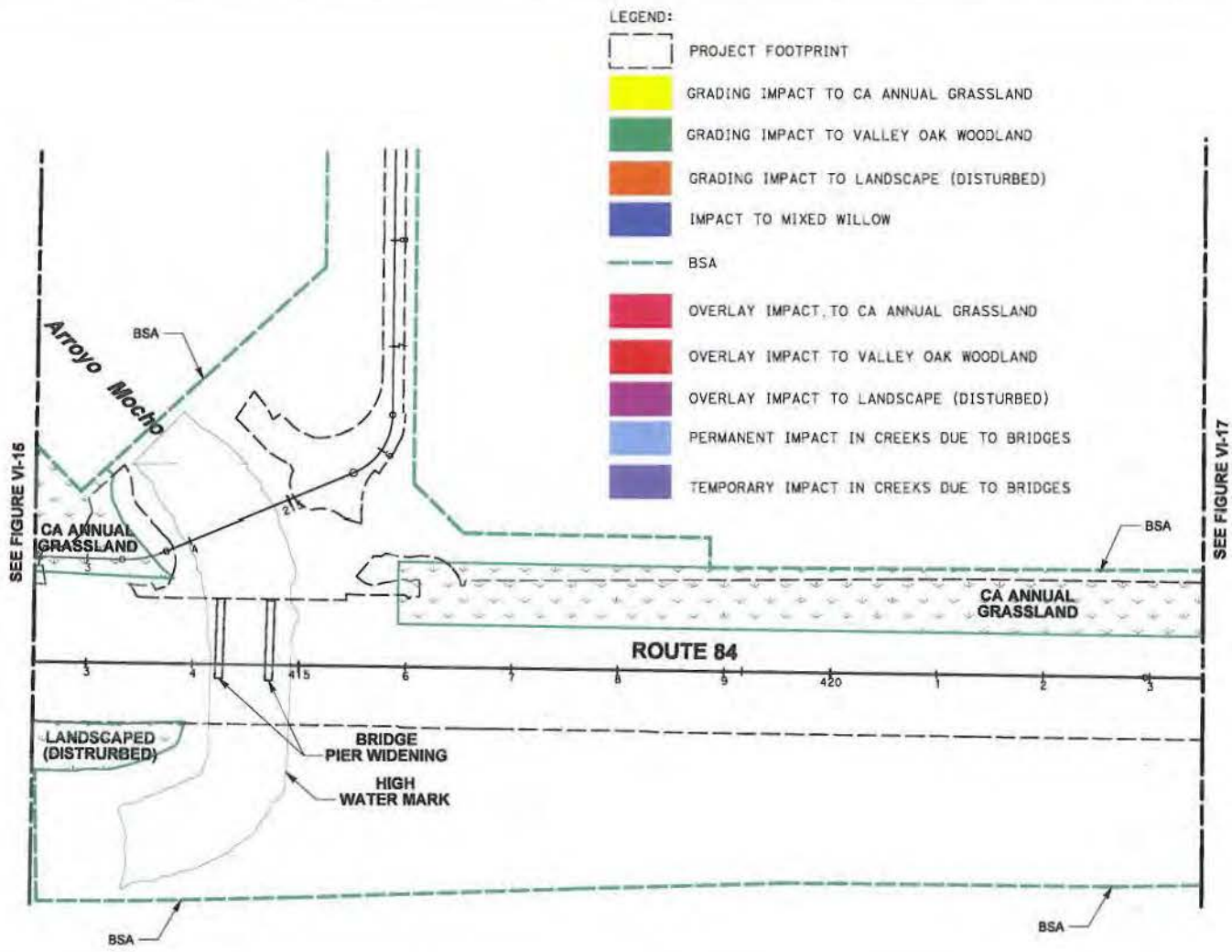

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Figure
VI-16
December 2010

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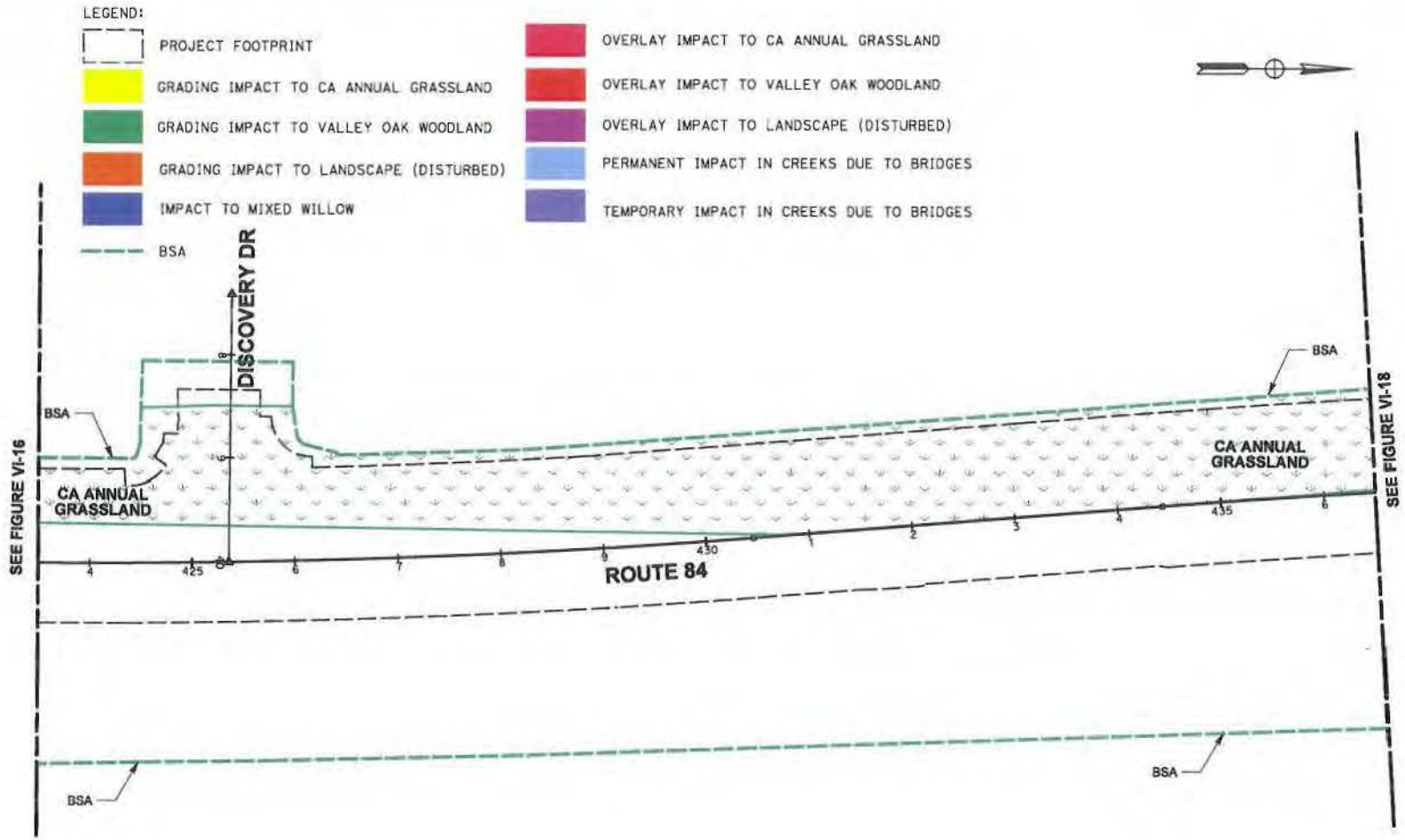

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Figure
VI-17
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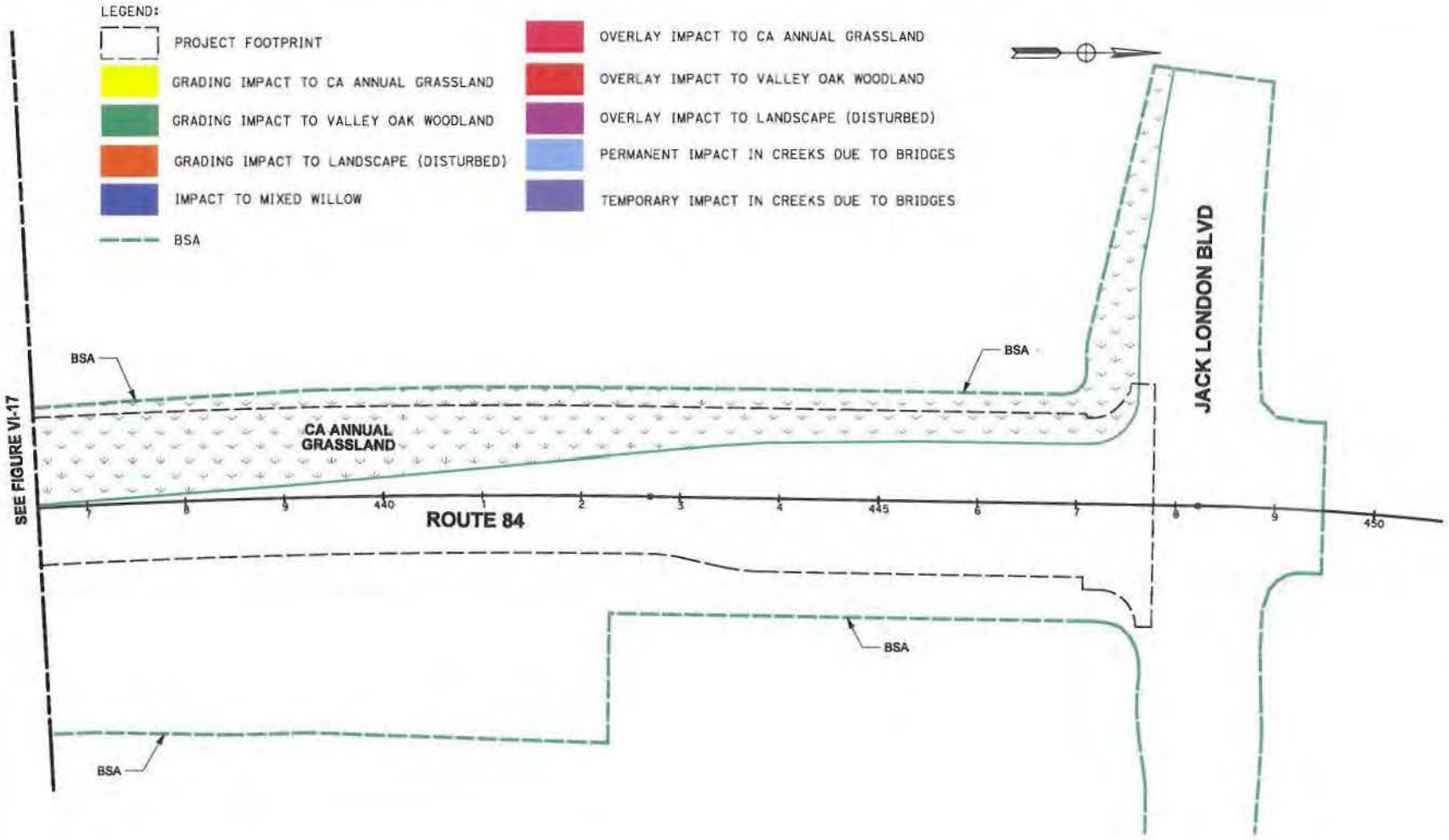

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IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

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

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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: _____
_____
_____

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
BAY DELTA REGION
7329 SILVERADO TRAIL
NAPA, CA 94599

AMENDMENT NO. 1
(A Major Amendment)
California Endangered Species Act
Incidental Take Permit No. 2081-2011-013-03
California Department of Transportation
State Route 84 Expressway Widening Project in Alameda County

INTRODUCTION

On November 9, 2011, the California Department of Fish and Wildlife (CDFW) issued Incidental Take Permit No. 2081-2011-013-03 (ITP) to the California Department of Transportation (Permittee), authorizing take of the California tiger salamander (*Ambystoma californiense*) (Covered Species) associated with and incidental to the State Route 84 Expressway Widening Project in Alameda County, California (Project). The Project as described in the ITP as originally issued by CDFW includes in general, the widening of 4.8 miles of State Route 84 to expressway standards. In issuing the ITP, CDFW found, among other things, that Permittee's compliance with the Conditions of Approval of the ITP would fully mitigate Project impacts of the taking on the Covered Species and that issuance of the ITP would not jeopardize the continued existence of the Covered Species.

This Amendment is being requested to update the Project Description to include the construction of a Pacific Gas and Electric Company (PG&E) utility alignment, three biofiltration swales, and the construction of associated temporary access. The authorization of this additional work will increase temporary and permanent Covered Species impacts as well as the HM Lands mitigation requirement.

This Amendment revises Figure 2 to reflect these changes to the Covered Activities area and the associated impacts, included as Attachment 1 to this Amendment.

This Major Amendment No. 1 (Amendment) makes the following changes to the existing ITP:

First, this Amendment changes the Principal Officer.

Second, this Amendment changes the Contact Person.

Third, this Amendment extends the term of the ITP to accommodate construction schedule delays.

Fourth, this Amendment makes various changes to the Project Description to include utility relocations, and construction of a utility access road and three biofiltration swales.

Fifth, this Amendment increases the temporary and permanent Impacts of Taking on Covered Species, including Table 1.

Sixth, this Amendment includes a reference to a second file number for the LSA Compliance.

Seventh, this Amendment updates the ESA Compliance reference to capture a recent Biological Opinion Amendment.

Eighth, this Amendment removes the exclusion fencing brand name to avoid sole sourcing problems.

Ninth, this Amendment removes Rain Restriction language, in keeping with more recent CDFW authorizations.

Tenth, this Amendment increases the HM Lands requirement, includes on-site restoration language and amends the HM Lands completion date.

Eleventh, this Amendment increases the Land Acquisition costs.

Twelfth, this Amendment increases the Start Up costs.

Thirteenth, this Amendment increases the Long-term Management costs.

Fourteenth, this Amendment stipulates the cost of On-site restoration for temporary and long-term effects.

Fifteenth, this Amendment includes a provision for an On-site Vegetation Restoration Plan.

Sixteenth, this Amendment increases the HM Lands Security Amount associated with the increase in impacts and mitigation.

Seventeenth, this Amendment updates Figure 2 with Figure 2A to reflect changes to the Covered Activities area and the associated impacts.

AMENDMENT

The ITP is amended as follows (amended language in ***bold italics***; deleted language in ~~strikethrough~~). Note that changes to mitigation quantities and the associated security amount also apply to the MMRP:

1. The Principal Officer shall be changed on Page 1 as follows:

Principal Officer: ~~Jeffrey G. Jensen~~ ***Hardeep Takhar***, District Office Chief

2. The Contact Person shall be changed on Page 1 as follows:

Contact Person: ~~Nicole Rucker~~ ***Denis Coghlan***

3. The Expiration Date shall be changed on Page 1 as follows:

Unless renewed by DFG, this ITP's authorization to take the Covered Species shall expire on December 31, 201~~5~~**7**.

4. The Project Description shall be changed on pages 1 through 3 as follows:

The Project includes widening and upgrading of ***4.7*** ~~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. ***A connector access would be constructed at the SR 84/Vallecitos Road intersection to accommodate the high volume of traffic moving from northbound SR 84 to the City of Livermore.*** 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 ***southward*** 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 project would also construct a new access bridge for local utility and maintenance facilities, provide a new bridge for the Isabel Trail crossing, and widen the existing bridges across Arroyo Del Valle and Arroyo Mocho.***

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 a ***new Isabel Trail bridge*** ~~two new bridge crossings,~~ adjacent to the ~~widened bridges, at Arroyo Del Valle and at Arroyo Mocho.~~ ***widened Arroyo Del Valle bridge. Due to changes in the environmental setting, a water diversion will be needed at the Arroyo Del Valle.***

- Relocate existing private driveway accesses to signalized intersections on SR 84, including constructing a new bridge crossing at Arroyo Mocho for access to ***PG&E,*** ~~Pacific Gas and Electric~~, Zone 7, and City of Livermore facilities with access from Discovery Drive.

- Extend the ***Isabel Trail*** ~~multi-use trail~~, located on the eastern side of SR 84 between Jack London Boulevard and ***Alden Lane*** ~~Concannon Boulevard, from~~ ***southward to*** Vineyard Avenue ~~to the proposed new bridge crossing at Arroyo Del Valle. The~~ ***A*** 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~~ ***Isabel Trail*** bridge.

- Widen and upgrade the signalized intersections at Ruby Hill Drive, Vallecitos Road, Vineyard Avenue, Concannon Boulevard, Stanley Boulevard, ***Stanley Connector*** Discovery Drive, and Jack London Boulevard to accommodate year 2030 traffic demands. To address safety concerns for an expressway facility, the Vallecitos Road intersection will be ~~relocated approximately 450 feet to the north.~~ ***reconfigured to exclude the southbound SR 84 to eastbound Vallecitos Road turning movement. An exit connector would be constructed to accommodate the high volume of traffic moving from northbound SR 84 to the City of Livermore.***

- ***Install a total of three biofiltration swales in the following locations: near the southeast corner of the proposed SR 84/Vallecitos Road intersection, the north side of Vallecitos Road, and east of SR 84 to the south of the Vineyard Avenue intersection.***

- ***Relocate an existing overhead alignment containing PG&E three-phase 60 kilovolt (kV) transmission lines, PG&E three-phase 21 kV distribution lines, AT&T telephone cables.***

- ***Underground a 24-inch gas line (PG&E), a 12-inch water line (California Water Service Company), a 15-inch to 39-inch sanitary sewer line (City of Livermore), and a few valve boxes (Zone 7 Water Agency).***

The Project would create approximately ***31*** ~~45~~ acres of new pavement. The total Project area, including permanent and temporary work areas, is approximately ***105 acres*** ~~88 acres~~. Partial right-of-way acquisition from ***37*** ~~30~~ parcels (approximately ***14.21*** ~~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.

5. Page 4, Paragraph 1, line 7 shall be amended to read:

The Project will also cause the ***temporary loss of 9.35 acres and the*** permanent loss of ***12.41*** ~~11.36~~ acres of habitat for the Covered Species ***for a total of 21.76 acres of impact to Covered Species habitat***.

Page 4, Paragraph 2 shall be amended to read:

Expected impacts to the Covered Species by habitat type and ~~Covered Activity~~ ***impact*** category are summarized below in Table 1. Of the ~~88~~ ***105*** acres within the project area, approximately ***9.35 acres of Covered Species' habitat will be temporarily impacted and 12.41*** ~~11.36~~ acres of Covered Species' habitat will be permanently impacted by the Project as shown in Figure 2***A*** by habitat area within the "Project Footprint."

Page 4, Table 1 shall be replaced with the following table:

Table 1: Impacts to California Tiger Salamander by Habitat Type

	CA Annual Grassland	*Valley Oak Woodland*	*Coyote Brush Scrub*	*Mixed Willow*	*Riverine Gravel*	*Landscape Disturbed*	*Total*
Temporary Impact	*7.27*	*0.75*	*0.10*	*0.00*	*0.00*	*1.23*	*9.35*
Permanent Impact	*8.93*	*1.52*	*0.00*	*0.35*	*0.08*	*1.53*	*12.41*
Total	*16.2*	*2.27*	*0.10*	*0.35*	*0.08*	*2.76*	*21.76*

~~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~~

6. Page 5, Condition of Approval 3 shall be amended to read:

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 ***and 1600-2012-0433-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.

7. Page 5, Condition of Approval 4 shall be amended to read:

ESA Compliance. Permittee shall implement and adhere to the terms and conditions that apply to the Covered Species in the Biological Opinion (BO) ***and subsequent amendment*** 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 ***and 81420-2008-F-0592-R001).*** 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.

8. Page 7, Condition of Approval 6.10 shall be amended to read:

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***A*** 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.

The corresponding MMRP Measure 6, Page 1, shall be amended to read the same as above.

9. Page 8, Condition of Approval 6.13 shall be amended to read:

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~~ ***wildlife exclusion*** fencing, per manufacturer installation recommendations, immediately outside the high visibility fencing.

The corresponding MMRP Measure 9, Page 2, shall be amended to read the same as above.

10. Page 11, Condition of Approval 8.4 shall be deleted:

~~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.~~

The corresponding MMRP Measure 33, Page 7, shall be deleted.

11. Page 12, Condition of Approval 9, Paragraph 2, Line 1 shall be amended to read:

To meet this requirement, the Permittee shall provide for the permanent protection and management of ***47.52*** ~~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 the 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 ***Amendment*** if Security is provided pursuant to Condition 10 below. ***The Permittee shall also restore temporary impacts to 9.35 acres of on-site Covered Species habitat.***

The corresponding MMRP Measure 13, Page 2 shall be amended to read the same as above.

12. Page 12, Condition of Approval 9.1.1 shall be amended to read:

Land Acquisition. Land acquisition costs for the HM lands identified in Condition 9.2, below, estimated at $15,000/acre for ~~34.08~~ ***47.52*** acres: ***$712,800*** ~~$511,200~~. Land acquisition costs are estimated using local fair market current value for lands with habitat values meeting mitigation requirements;

13. Page 13, Condition of Approval 9.1.2 shall be amended to read:

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 ***$29,784*** ~~$27,264~~.

14. Page 13, Condition of Approval 9.1.4 shall be amended to read:

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 ***47.52*** ~~34.08~~ acres: ***$1,086,171*** ~~$778,971~~. The long-term management endowment fund is estimated initially for the purpose of providing Security to ensure implementation of HM land management.

15. Page 13, Condition of Approval 9.1.6 shall be added to read:

Restoration On-site. Restoration of on-site temporary and long term effects to Covered Species habitat as described in Condition 9.5, calculated at $336,600.

16. Page 16, Condition of Approval 9.5 shall be added to read:

Habitat Restoration. Permittee shall restore all slopes and unpaved surfaces affected by the Project to pre-Project or better conditions. Prior to the installation of any temporary impacts, the Permittee shall prepare a Vegetation Restoration Plan to facilitate restoration and revegetation of the 9.35 acres of temporary construction disturbance on-site, and shall ensure that the Plan is successfully implemented by the contractor. The Vegetation Restoration Plan shall be reviewed and approved by the DFG prior to initiation of any temporary impacts. The Vegetation Restoration Plan shall include detailed specifications for restoring all temporarily disturbed areas, such as seed mixes and application methods.

The MMRP shall be amended to include the above language as Measure 41, to be implemented Post-Construction.

17. Page 16, Condition of Approval 10.1 shall be amended to read:

Security Amount. The Security shall be in the amount of ***$2,176,835*** ~~$1,331,435~~. This amount is based on the cost estimates identified in Condition 9.1 above;

The corresponding MMRP Measure 17, Page 5, shall be amended to read the same as above.

18. Page 20 in the Attachments section shall be amended to read:

FIGURE 2***A Updated*** Map Showing Project Footprint/Covered Activities Area

All terms and conditions of the ITP and MMRP that are not expressly amended herein remain in effect and must be implemented and adhered to by the Permittee.

FINDINGS

Issuance of this Amendment will increase the amount of take of the Covered Species compared to the Project as originally approved; however, it is not expected that this

Amendment will increase Project impacts on these species (i.e., "impacts of taking" as used in Fish and Game Code Section 2081, subd. (b)(2)).

Discussion: This Amendment makes 17 specific changes to the ITP as originally issued. The changes reflect an increase in temporary and permanent impacts to accommodate utilities relocations and a utility access bridge and three biofiltration swales among other things. This Amendment captures the resultant impacts. The impact change represents an incremental increase and the impacts will be mitigated through an increased HM Lands requirement.

CDFW has determined that the proposed design and impact changes will not increase the amount of take or the severity of other impacts of the taking on the Covered Species. CDFW believes that given the increased HM Lands requirement, the Project changes and associated habitat impacts as described in this Amendment, will not increase the net impacts to the Covered Species.

Issuance of this Amendment does not affect CDFW's previous determination that issuance of the ITP meets and is otherwise consistent with the permitting criteria set forth in Fish and Game Code section 2081, subdivisions (b) and (c).

Discussion: CDFW determined in November 2011, that the Project, as approved, met the standards for issuance of an ITP under CESA. This determination included findings that, among other things, the impacts of the taking would be minimized and fully mitigated and that the Project would not jeopardize the continued existence of the Covered Species. Those findings are unchanged with respect to this Amendment because the Permittee's continued adherence to and implementation of the avoidance and minimization measures set forth in the ITP's Conditions of Approval and MMRP will minimize and fully mitigate impacts of the taking on the Covered Species.

None of the factors that would trigger the need for subsequent or supplemental environmental analysis of the Project under Public Resources Code section 21166 or California Code of Regulations, title 14, sections 15162 and 15163, exist as a result of this Amendment.

Discussion: CDFW issued the ITP in November, 2011 as a responsible agency under the California Environmental Quality Act (CEQA) (Pub. Resources Code, § 21000 et seq.) after, among other things, considering the Mitigated Negative Declaration adopted by the California Department of Transportation as the lead agency for the Project. CDFW finds that approval of the Amendment will not result in and does not have the potential to create any new significant or substantially more severe environmental effects than previously analyzed and disclosed by California Department of Transportation during its lead agency review of the Project, particularly with respect to the impacts authorized by CDFW pursuant to the ITP as amended. As a result, CDFW finds that no additional subsequent or supplemental environmental review is required by CEQA as part of CDFW's approval of this Amendment.

CDFW finds that this Amendment is a Major Amendment, as defined in California Code of Regulations, title 14, section 783.6, subdivision (c)(5).

Discussion: In Summary, this Amendment adds to the Project Description the relocation of overhead and underground utilities, construction of a utility access road, and three biofiltration swales. Although this Amendment will not significantly modify the scope or nature of the permitted Project or activity, or the minimization, mitigation, or monitoring measures in the ITP, the changes do represent an increase in impacts, thereby necessitating a Major Amendment.

The authorization provided by this Amendment is not valid until Permittee signs and dates the acknowledgement below, and returns one of the duplicate originals of this Amendment by registered first class mail to CDFW at:

California Department of Fish and Wildlife
Habitat Conservation Planning Branch
Attention: CESA Permitting Program
1416 Ninth Street, Suite 1260
Sacramento, California 95814

Attachments:

Attachment 1 Figure 2A: Updated Map Showing Project Footprint/Covered Activities Area

APPROVED BY THE CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

on 11/13/14.

Scott Wilson
Regional Manager
Bay Delta Region

ACKNOWLEDGMENT

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

By: _____ Date: 11-18-14

Printed Name: HARDEEP TAKHAR Title: ACTING OFFICE CHIEF

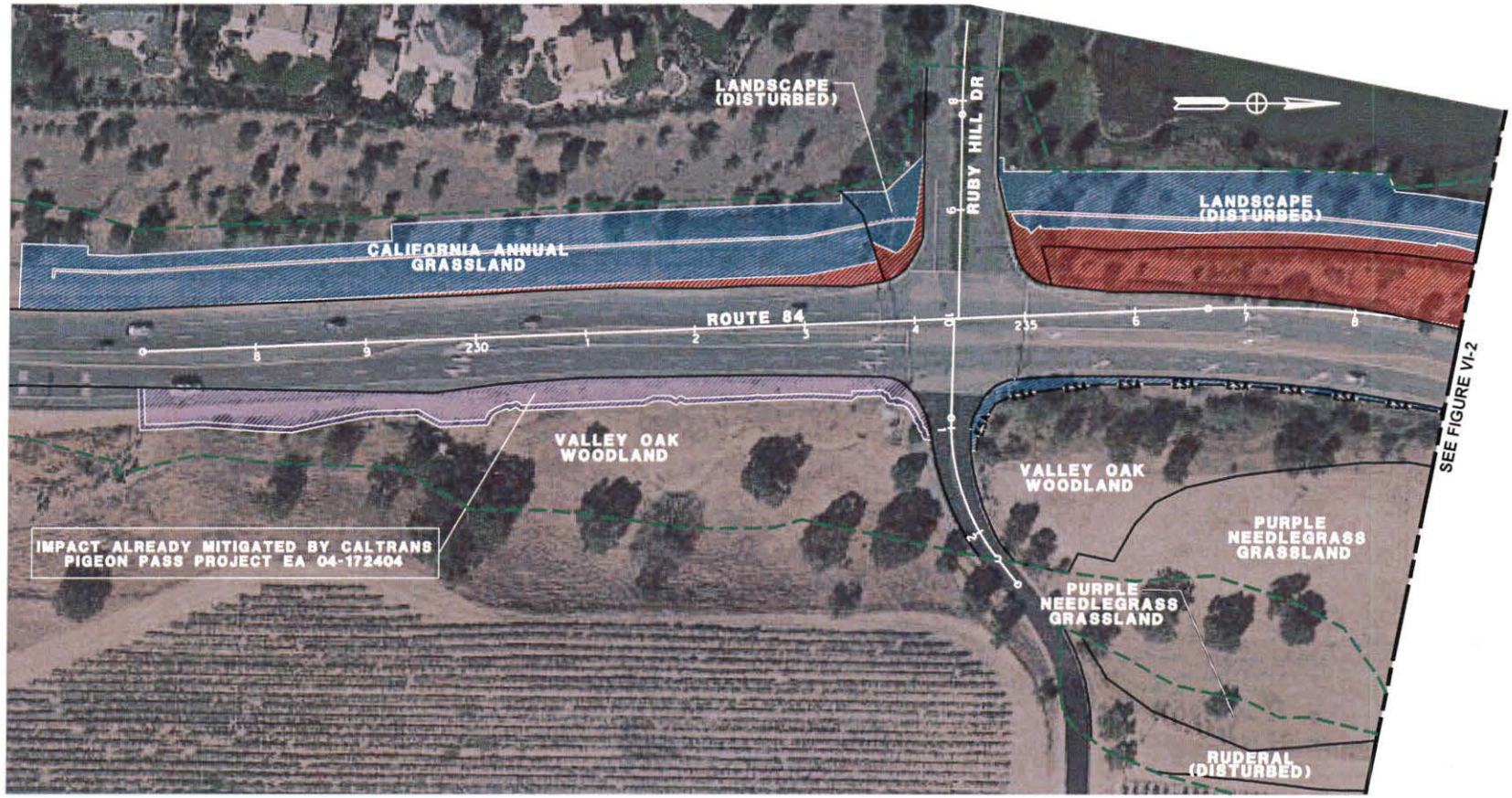
NOTES:

1. Permanent and temporary impacts to potential California tiger salamander were developed per guidance provided by John Cleckler of the USFWS during a field meeting on November 20, 2007 and follow-up phone conversation on December 18, 2007. The new impact areas were delineated from new design files provided in February 2014 using Microstation Drafting Software. Areas considered potential habitat for California tiger salamander would be undeveloped, natural habitats (e.g. grassland, woodland) from south end of project near Ruby Hills northward to Arroyo del Valle, and the channel of Arroyo del Valle.
2. Impact shown on these maps are relevant only for the areas considered habitat for California Tiger Salamander.

Figure 2A - Updated Map Showing Project Footprint / Covered Activities Area

LEGEND:

- TEMPORARY IMPACTS
- PERMANENT IMPACTS
- BSA



ABBREVIATIONS

BSA Biological Study Area
ESA Environmental Sensitive Area

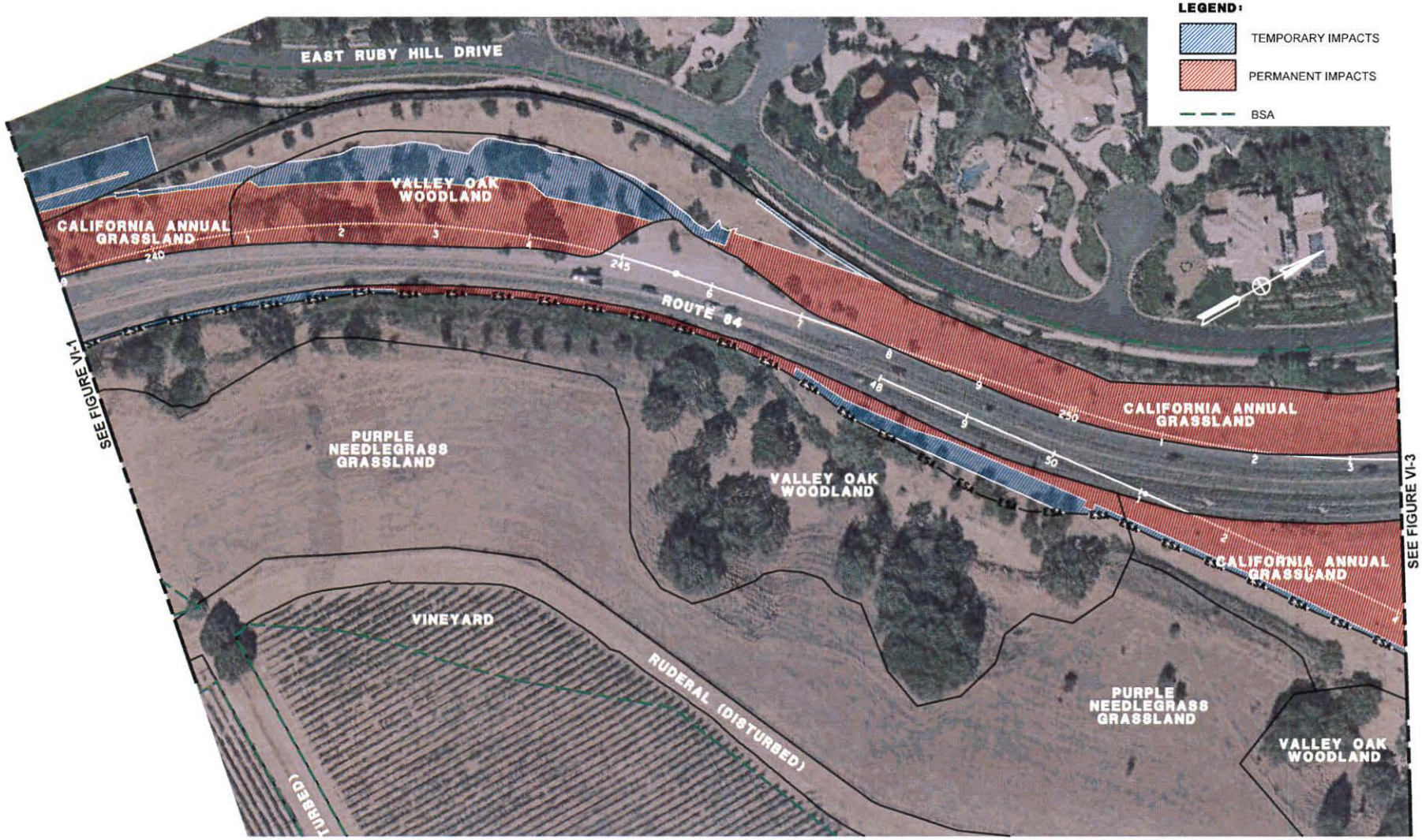
URS

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

NEW IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

Scale: 1"=100'-0"
Figure
VI-1
FEB 2014

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



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EXPRESSWAY WIDENING
ALA 84 - PM 22.9/ 27.1
04 - 297600

NEW IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

Scale: 1"=100'-0"
Figure
VI-2
FEB 2014

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

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ESA Environmental Sensitive Area

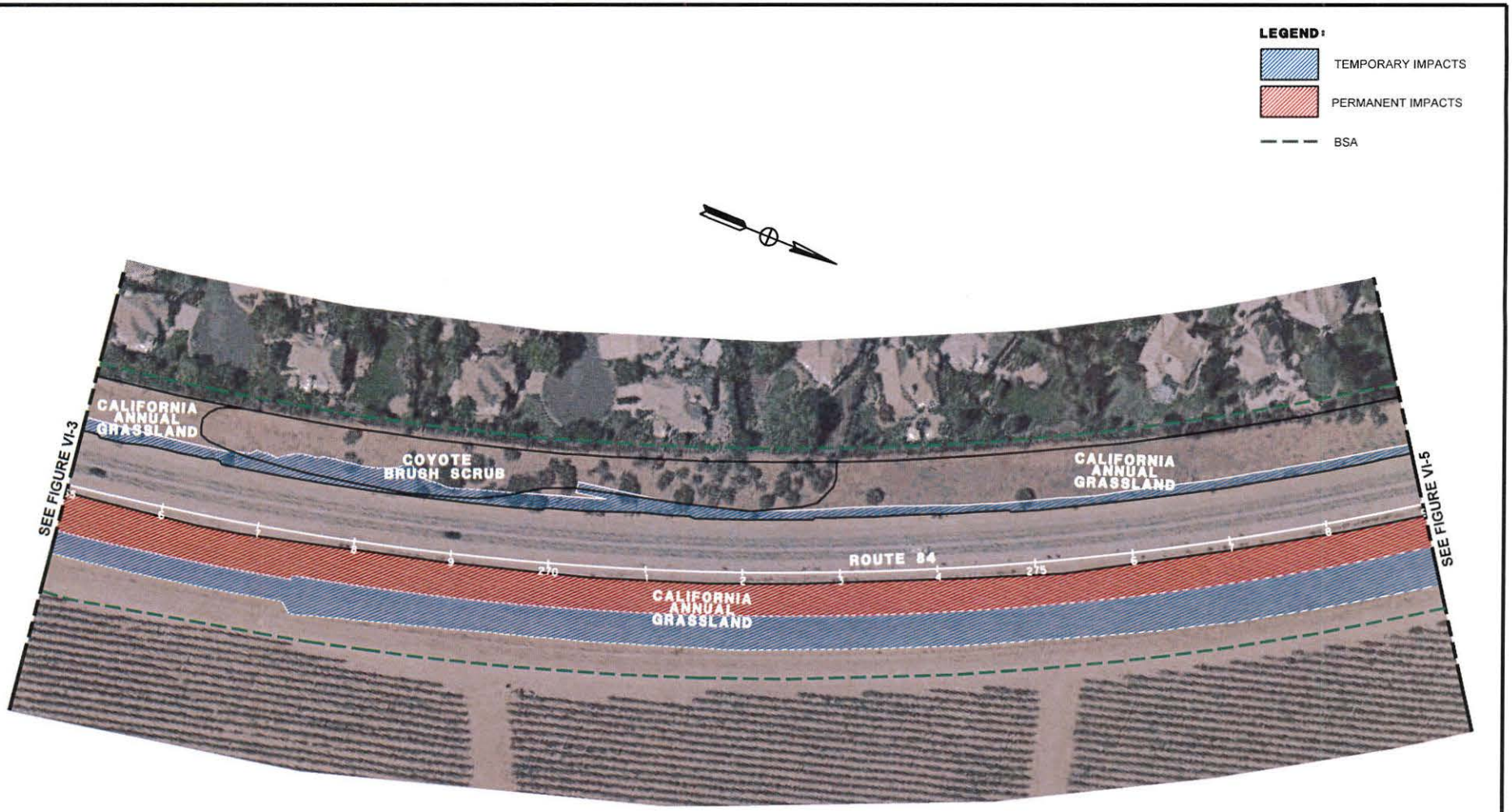
URS

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

NEW IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

Scale: 1"=100'-0"
Figure
VI-3
FEB 2014

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



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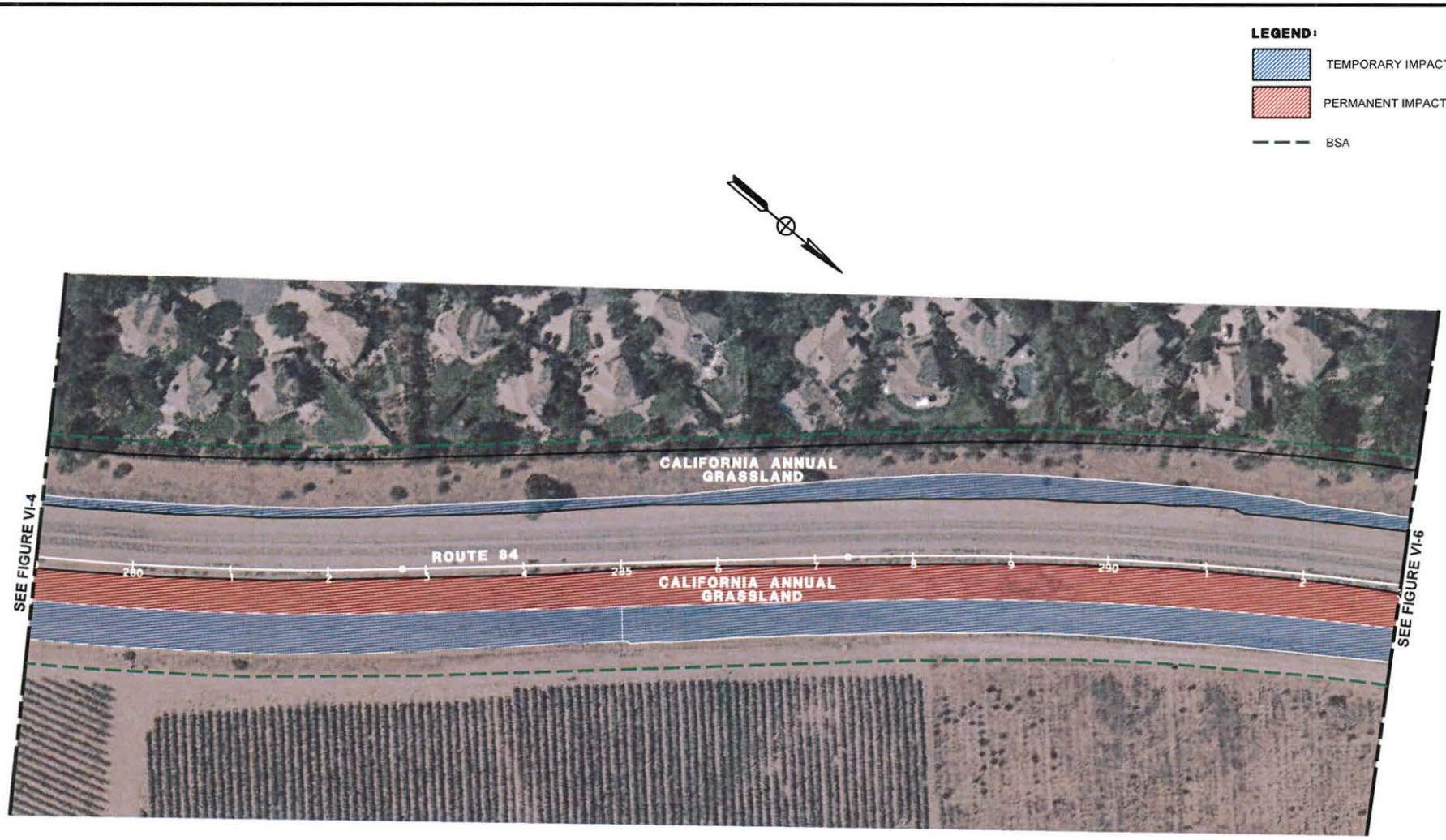
04 - 29760

NEW IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

Scale: 1"=100'-0"
Figure
VI - 4
FEB 2014

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



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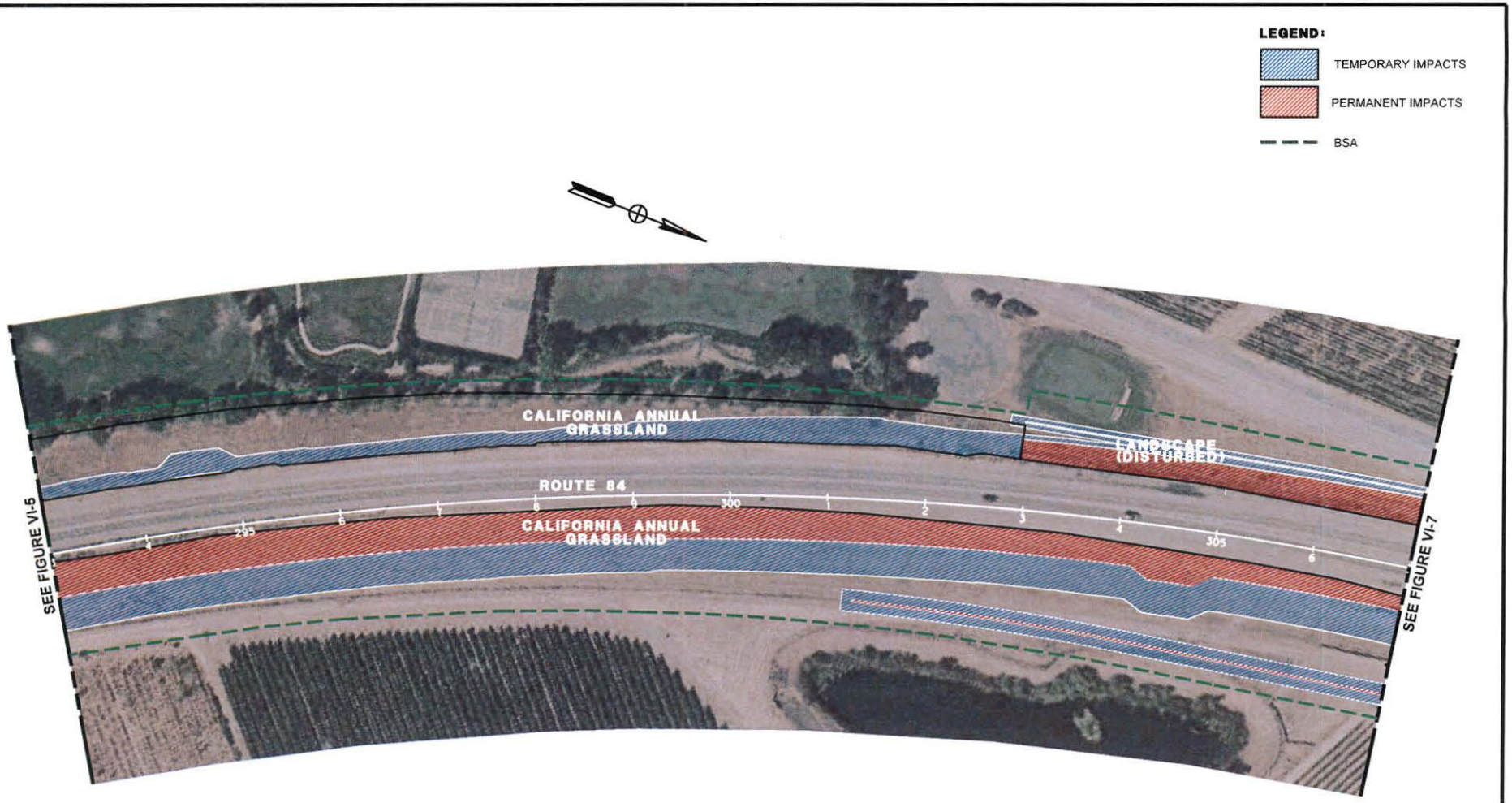
ALA 84 - PM 22.9/ 27.1
04 - 29760

NEW IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

Scale: 1"=100'-0"
Figure
VI-5
FEB 2014

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



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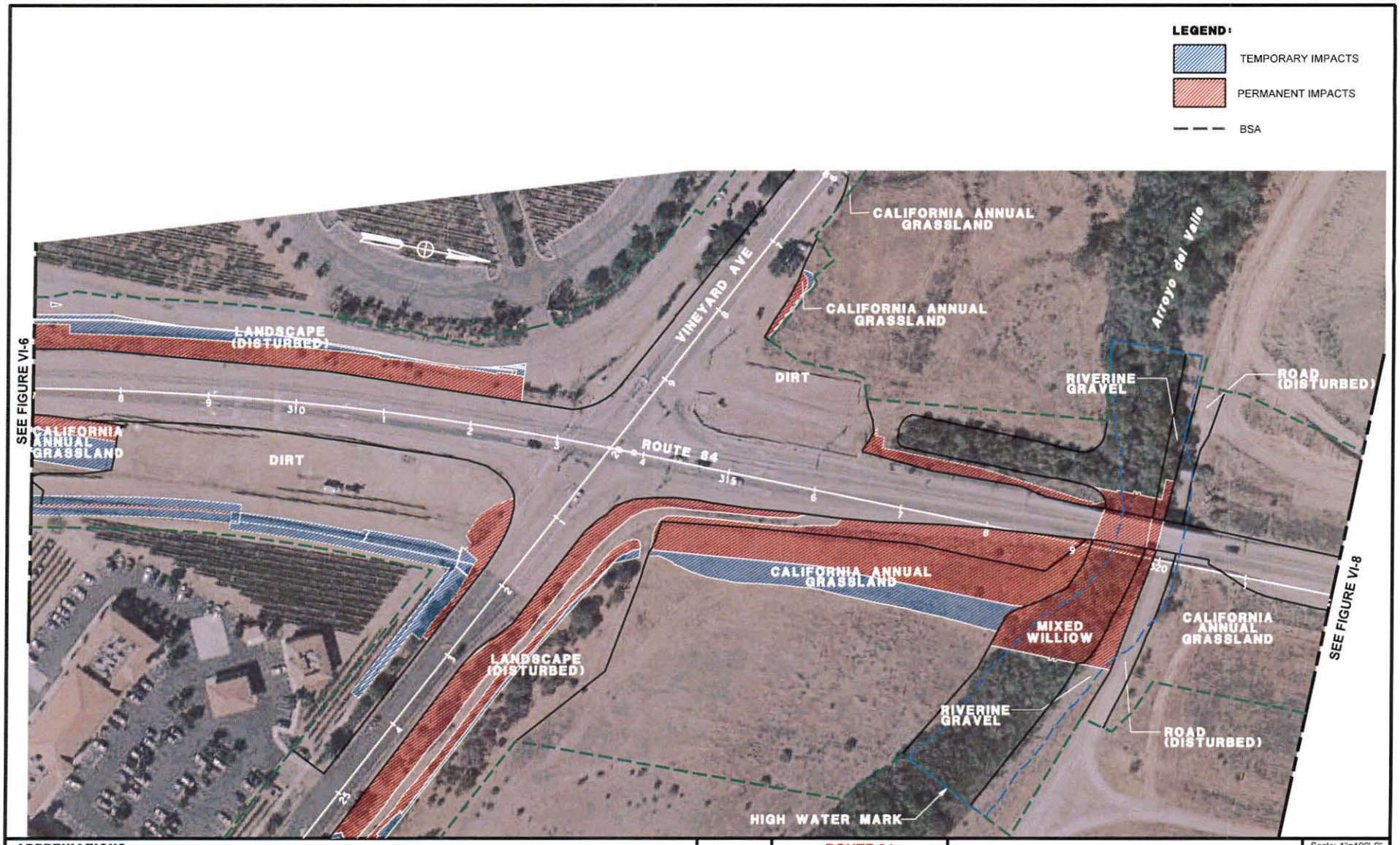
ROUTE 84
EXPRESSWAY WIDENING
ALA 84 - PM 22.9/ 27.1
04 - 29760

NEW IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

Scale: 1"=100'-0"
Figure
VI-6
FEB 2014

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



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

NEW IMPACTS TO CALIFORNIA TIGER SALAMANDER HABITAT

Scale: 1"=100'-0"
Figure
VI-7
FEB 2014

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

United States Fish and Wildlife Service: Biological Opinion

- **No. 81420-2008-F-0592 – Dated 02/1/2008**
- **Amendment No. 1 (No. 81420-2008-F-0592-R001) – Dated 04/29/2013**
- **Amendment No. 2 (No. 081420-2010-F-0592-R002) – Dated 01/08/2015**

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
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Marcia Grefsrud, California Department of Fish and Game, Yountville, California
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United States Department of the Interior

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In Reply Refer To:
81420-2008-F-0592-R001

APR 29 2013

Ms. Melanie Brent, Office Chief
Caltrans District 4 Environmental Analysis
California Department of Transportation
P.O. Box 23660
Oakland, California 94623-0660

Subject: Reinitiation of Consultation on the State Route 84 Expressway Widening Project, Alameda County, California (Caltrans EA 29761)

Dear Ms. Brent:

This letter is a reinitiation of formal consultation for the February 1, 2008, biological opinion for the State Route 84 (SR-84) Expressway Widening Project (Service File No. 81420-2008-F-0592) located in Alameda County, California. Reinitiation of consultation was requested by the California Department of Transportation (Caltrans) on December 5, 2012, to address modifications to the project design that effects threatened California red-legged frog (*Rana draytonii*), threatened California tiger salamander (*Ambystoma californiense*), and endangered San Joaquin kit fox (*Vulpes macrotis mutica*). Reinitiation of consultation is exercised under the authority of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) (Act).

The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users legislation (23 U.S.C. 327) allows the Secretary of the U.S. Department of Transportation acting through the Federal Highway Administration (FHWA) to establish a Surface Transportation Project Delivery Pilot Program, whereby a State may assume the FHWA responsibilities under the National Environmental Policy Act for environmental review, agency consultation and other action pertaining to the review or approval of a specific project. Caltrans assumed these responsibilities for the FHWA on July 1, 2007 through a Memorandum of Understanding (MOU) within the State of California (http://www.dot.ca.gov/ser/downloads/MOUs/nepa_delegation/sec6005mou.pdf).

The following changes are made to the February 1, 2008, biological opinion:

1. Add the following to the **Consultation History** on page 2:

December 10, 2012	The Service received a request from Caltrans dated December 5, 2012, to reinitiate formal consultation to address changes to the project design and its effects on the California red-legged frog, California tiger salamander and San Joaquin kit fox.

December 6, 2012 - March 28, 2013	Electronic and phone correspondence between Caltrans, California Department of Fish and Wildlife (CDFW), and the Service.

2. Make the following changes to paragraph 1 under the **Description of the Proposed Action** on page 3:

Caltrans and the Federal Highway Administration (FHWA), in cooperation with **Alameda County Transportation Commission (ACTC)** ~~ACTIA~~ and the City of Livermore, is proposing to widen and upgrade ~~4.8~~ **4.70** 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~~ **103.78** acres of which ~~36~~ **37.93** acres are occupied by existing hardscape/pavement (Caltrans 2007b).

3. Make the following changes to the *General Scope of Work* under the **Description of the Proposed Action** on page 4:

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. **A connector access would be constructed at the State Route 84/Vallecitos Road intersection to accommodate the high volume of traffic moving from northbound State Route 84 to the City of Livermore.** 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 **southward** to Vineyard Avenue~~, using the proposed new bridge at Arroyo del Valle~~. **The project would also construct a new access bridge for local utility and maintenance facilities, provide a new bridge for the Isabel Trail crossing, and widen the existing bridges across Arroyo Del Valle and Arroyo Mocho.**

4. Make the following changes to the *Construction Schedule* under the **Description of the Proposed Action** on page 4:

Construction for the State Route 84 Expressway project is anticipated to begin in the spring of ~~2010~~ **2012** and be completed by the end of ~~2012~~ **2016. Construction of the project has been divided into a northern segment, which will be constructed in 2012 and 2013, and a southern segment, which will be constructed from 2014 to 2016.** Full funding for the project will be from federal, state, and local sources. Funding sources will include **ACTC** ~~ACTIA~~ Measure B, State Transportation Improvement Program (STIP) and Tri-Valley Transportation Council funds.

5. Make the following changes to the *Construction Activities* under the **Description of the Proposed Action** on page 4:

   1. Widen and upgrade State Route 84 to expressway standards (55 mph **design speed**) 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 1-580/Isabel Avenue Interchange Project to the north.

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

   3. Construct **a new Isabel Trail bridge,** ~~two new bridge crossings,~~ adjacent to the widened ~~bridges, at~~ Arroyo del Valle **Bridge** ~~and at Arroyo Mocho~~.

   4. Relocate existing private driveway access**es** 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 **Isabel Trail** ~~multi-use trail~~, located on the east side of State Route 84 between Jack London Boulevard and **Alden Lane** ~~Concannon Boulevard~~, **southward** to Vineyard Avenue ~~on to the proposed new bridge crossing at Arroyo Del Valle. The~~ **A** 24-inch gas main and 15-inch sanitary sewer will also be relocated from the existing Arroyo del Valle bridge to the new **Isabel Trail** ~~Arroyo del Valle trail~~ bridge.

   6. Widen and upgrade signalized intersections at Ruby Hill Drive, Vallecitos Road, Vineyard Avenue, Concannon Boulevard, Stanley Boulevard, **Stanley Connector,** 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~~ **reconfigured to exclude the southbound State Route 84 to eastbound Vallecitos Road turning movement. An exit connector would be constructed to accommodate the high volume of traffic moving from northbound State Route 84 to the City of Livermore.**

      During construction, the project **would be split into a North and South segment and** would create about ~~45~~ **29.82** acres of new pavement. The total action area of the project, including permanent and temporary work areas, is estimated at ~~88~~ **103.78** acres. Partial right-of-way acquisition from 30 parcels (totaling about 12 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 **fee** acquisition is required from the existing environmental conservancy area between Ruby Hill Drive and Vallecitos Road.

6. Make the following changes to the *(1) Ruby Hill Drive to Vineyard Avenue* subheading under the **Description of the Proposed Action** on page 5:

   (1) Ruby Hill Drive to ~~Vineyard Avenue~~ **Vallecitos Road.**

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.

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

The project limits will extend eastward into the agricultural and environmental conservancy area to accommodate the relocation of a high-voltage (60-kilovolt) PG&E transmission line from the west side of State Route 84 to the east side. The relocation of the transmission line, which is proposed to be a combination of overhead and underground transmission methods, would take place between Vallecitos Road and Kalthoff Common.

Portions of the **State Route 84** alignment ~~are~~ **would be** moved closer to ~~the~~ Ruby Hill ~~Development~~ and a special retaining wall to the west **would be** required to retain the cut slope adjacent to East Ruby Hill Drive. The retaining wall height would vary from 5 feet to 30 feet, **and** portions ~~of which~~ would require soil nail wall construction, or similar techniques. A **concrete** ~~short~~ retaining barrier wall is also required on the east side of State Route 84 to provide a buffer to the environmental sensitive area. The ~~retaining wall~~ **concrete retaining barrier** height would vary from 0 feet to ~~9~~ **3** 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 super elevated (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.~~

The Vallecitos Road intersection would be reconstructed at its current location. The approach to the intersection along Vallecitos Road would be increased in elevation to conform to the new standard super-elevation of State Route 84. Approximately 1,500 linear feet of Vallecitos Road would be reconstructed. Retaining walls would be constructed on both sides of Vallecitos Road to minimize and avoid impacts to the environmentally sensitive areas and the box culverted crossing of the creek with the road. The exit connector from northbound State Route 84 would conform to the new elevation of Vallecitos Road. A concrete retaining barrier would be constructed at the beginning of the connector, which would connect to the retaining barrier on east side of State Route 84. The barrier would connect to an approximately 980 foot-long retaining wall along the roadway to prevent impacts to environmentally sensitive area east of the connector.

7. Make the following changes to the *(2) Vallecitos Road to Vineyard Avenue* subheading under the **Description of the Proposed Action** on page 6:

(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. **Drainage bioswales would be constructed on both sides of State Route 84.** ~~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.~~

8. Make the following changes to the *(3) Vineyard Avenue to Stanley Boulevard* subheading under the **Description of the Proposed Action** on page 6:

This section of roadway includes residential development and **the Isabel Trail** ~~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 **Isabel Tail** ~~multi-use trail~~ and a partial **right-of-way** 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. **Operations of the** ~~M~~**m**ining **facilities** ~~operations~~ will occur to within 50 feet of the ~~existing~~ right of way limits. ~~Significant mining~~ **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.

9. Make the following changes to the *BSA Focus Area 2* subheading under the **Description of the Proposed Action** on page 7:

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 low flow channel passes on the south side of the bridge pier and will require replacement 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 will 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 **existing** unpaved maintenance road **that** ~~will~~ passes on the **northern** side of the bridge pier **would be graded to provide clearance under the bridge.** ~~Abutments and~~ **The single** bridge pier for the new bridge will be constructed outside of **the low-flow channel** ~~riparian areas~~. **The abutments for the new bridge would be constructed outside of the ordinary high water mark.** 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 **within the ordinary high water mark** ~~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 **twelve** ~~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, **after a stream diversion-dewatering plan has been implemented** ~~outside the live stream area~~.

The stream diversion plan will include installing a cofferdam of gravel-filled bag berms or bladder dams within the existing creek bed 145 feet upstream of the eastern side of the existing bridge deck and 25 feet downstream of the western side of the existing bridge deck. The gravel-filled bag berms or bladder dam will allow creek waters to pass through the construction work area by gravity flow through the use of two 36-inch pipes. The berms or dams will be constructed across the extent of the channel up to approximately the ordinary high water level of the streambed. 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. **On completion of the Arroyo Del Valle Bridge Widen and the Arroyo Del Valle Trail Bridge, the upstream and downstream berms or bladder**

dams and pipes will be removed and the creek will be restored to preconstruction conditions. Construction activities **in the** ~~will be limited to outside~~ Arroyo Del Valle **will be limited to** ~~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. **Following the completion of work in Arroyo Del Valle, the stream diversion will be removed.**

A pile driving rig and crane will be required for bridge pile installation. The footprint of the pile driving equipment will be approximately ~~20~~ 10 feet by ~~30~~ 20 feet. **The localized cofferdams will be erected providing for 1 foot of clearance around the actual final width of the columns, and concrete will be poured. Temporary impact areas have been provided to allow for access for column construction.** Concrete for the foundations will be poured from outside the arroyo banks **using standard concrete pumping hoses to reach the pier foundation forms within the cofferdams.**

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 **on the east side of State Route 84 that follows the northern side of the floodplain and extends into the ordinary high water of the stream near the bridge**. 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.~~

10. Make the following changes to the *BSA Focus Area 3* subheading under the **Description of the Proposed Action** on page 9:

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 **intermittent or seasonal** flow channel passes between the two bridge piers and would not require additional rock slope protection ~~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 **(Arroyo Mocho Access Bridge)** 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 **the ordinary high water mark** ~~riparian areas~~ of the Arroyo Mocho**, and will extend below the top of bank.** Excavation and driven pile foundations will be required for the 15 **foot** wide abutments and bridge pier. **Although** bridge foundation work **and construction of falsework** will occur **within the** ~~flow channel~~ **vegetated low-flow channel. The associated impact will be temporary and will occur within one construction season**. 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 designated dry season ~~and will take approximately thirteen months overall.~~ **Construction for each bridge will take approximately five months.** ~~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. Once temporary falsework supports are installed, construction work within Arroyo Mocho will be very limited. Foundations for bridge piers will be constructed during the dry season. Construction activities will be limited to outside Arroyo Mocho during the dry season, between June 15th and October 15th.

The need for a surface water diversion is not anticipated during the dry season construction window, unless Zone 7 conducts water releases during the dry season. However, a stream diversion system is proposed for the Arroyo Mocho Access Bridge construction to address the possibility of Zone 7 releasing water in the dry season. Construction activity in Arroyo Mocho will begin with construction of temporary cofferdams for widened bridge piers. Construction activity in Arroyo Del Valle will ~~generally~~ begin with construction of temporary cofferdams for **widening** ~~both~~ bridge piers. **Supports for falsework will be installed in Arroyo Mocho, after a stream diversion-dewatering plan has been implemented. The stream diversion plan will include installing a cofferdam of gravel-filled bag berms or bladder dams will be constructed within the existing creek bed and begins 120 feet upstream and ends 267 feet downstream of the eastern side of the existing bridge deck. The gravel-filled bag berms or bladder dam will allow creek waters to pass through the construction work area by gravity flow through the use of two 36-inch pipes. The berms or dams will be constructed across the extent of the channel up to the ordinary high water level of the streambed. On completion of the Arroyo Mocho Access Bridge, the upstream and downstream berms or bladder dams and pipes will be removed and the creek will be restored to preconstruction conditions. Once the stream diversion-dewatering plan has been implemented,** ~~Bridge~~ bridge foundation construction **would** ~~will~~ involve installation of shoring followed by excavation to the required footing depth. If seepage of water into the excavations occurs, a submersible 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.

Following the completion of work in the Arroyo Mocho, the stream diversion will be removed.

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 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 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 Del Valle. Cofferdams will be removed once installation is completed. Backfill and grading operations by backhoe and bulldozer will restore the Arroyo Mocho grades to preexisting conditions. Native topsoil will be stockpiled prior to excavation activities and reused for the final grading.

11. Make the following changes to the *Drainage and Utilities* subheading under the **Description of the Proposed Action** on page 10:

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. **to** reduced sediments) prior to discharging into natural watercourses using Caltrans BMPs for water quality. BMPs proposed for the project include biofiltration swales and retention/detention facilities. **Biofiltration swales remove pollutants, reduce runoff, and improve water quality of storm water by filtration through vegetation, uptake by plant biomass, sedimentation, absorption to soil particles, and infiltration through the soil.**

A total of three biofiltration swales are proposed within the project limits. They will be located near the southeast corner of the proposed State Route 84/Vallecitos Road intersection, the north side of Vallecitos Road, and east of State Route 84 to the south of the Vineyard Avenue intersection. Each biofiltration swale has been designed to Caltrans standards and complies with Caltrans Best Management Practices. The swales would be trapezoidal in shape and composed of the following construction materials: imported soil media, permeable material, underdrain, compost, rolled erosion control product (netting), hydroseed, and hydromulch. Two Austin Vault Sand Filter structures are proposed to be constructed: one northwest of the Arroyo Del Valle bridge widening area, and one southeast of the State Route 84/Stanley Connector intersection.

Existing gas, sanitary sewer, storm drain, electrical, cable and telephone utilities lie within the proposed **project** right of way ~~for the State Route 84 Expressway Project and~~ **will** need to be relocated to comply with Caltrans expressway standards. **Utilities to be relocated include an existing overhead alignment containing PG&E three-phase high-voltage (60 kV) transmission lines, PG&E three-phase 21 kV distribution lines, and AT&T telephone cables (hereafter referred to as the PG&E alignment). The existing PG&E alignment currently fronts the Ruby Hill development between Ruby Hill Drive and Vallecitos Road. During final design, PG&E staff determined that custom steel poles on concrete pile foundations would be required to support the westerly shift of the transmission line because there is not adequate space along the route for wooden poles supported by guy wires. PG&E requires 25 feet between the existing 24-inch gas transmission line along East Ruby Hill Drive and the steel poles, and space is not available to provide the required clearance. The narrow corridor between State right-of-way and East Ruby Hill Drive, combined with the proximity of other utilities, would also complicate maintenance access to the relocated transmission line. Additionally, the soil nail wall that will be installed at the slope between East Ruby Hill Drive and State Route 84 complicates the constructability of a transmission line along this route. Because of these constraints, PG&E requested that a segment of the high-voltage transmission line be relocated from the west side of SR 84 to the east side.**

The design team, in coordination with PG&E staff, Caltrans, ACTC and the City of Livermore, has developed a revised PG&E alignment. The portion of the alignment fronting the Ruby Hill development would be relocated to the east side of State Route 84, where it would pass through an undeveloped area and rejoin the existing alignment at Vallecitos Road.

The proposed relocated PG&E alignment would extend from a new wooden pole along Vallecitos Road just northeast of its intersection with State Route 84 to an existing pole along State Route 84 just north of Kalthoff Common. The new pole along Vallecitos Road would be 2 feet in diameter, 55 to 75 feet high, and would be set directly in the ground (not in concrete). Installation of this and other poles for the overhead portions of the PG&E alignment would not require grading. Two rigs would be needed for pole installation—one to drill the hole and one to set the pole.

From the new pole along Vallecitos Road, the PG&E alignment would pass for approximately 464 feet to a new distribution riser pole and a new transmission riser pole at the northern end of the proposed alignment, 150 feet from a vineyard fenceline. The transmission riser pole would be steel, approximately 4 feet in

diameter and 60 feet high, and set on a concrete foundation approximately 5 feet in diameter. The distribution riser would be a 2-foot-diameter, 40- to 60-foot tall wooden pole set directly in the ground. Installation of these northern riser poles would require grading for the access of construction equipment and construction of a patrol road with base rock material for PG&E's maintenance access.

The conduits would be strung from the new pole along Vallecitos Road to the riser poles by using a hand-carried guide gable, to avoid disturbing the creek and riparian woodland in this area. The riser poles would convey the conduits into two parallel underground trenches, one approximately 18 inches wide and approximately 37 inches deep and the other approximately 24 inches wide and 50 inches deep. The trenches would contain schedule 40 3-inch, 4-inch and 6-inch PVC pipes with the conduits inside. The trenches would be at least 25 feet apart and extend southward for approximately 1,550 feet along the hilltop vineyard, fenceline, and grassland, largely in a ruderal, previously disturbed agricultural area. At the southern end of the realignment corridor, the conduits would be conveyed from the underground trenches to a new distribution riser pole and a new transmission riser pole near Kalthoff Common, where the conduits would connect with the existing pole. A patrol road filled with base rock material will be placed for the PG&E's maintenance access to the southern riser poles.

Construction and maintenance equipment and vehicles would use an existing dirt road that extends between Kalthoff Common and Vallecitos Road along the vineyard fence line. The access road would be strengthened using base rock material for a width of 16 feet to accommodate PG&E's maintenance equipment. An additional access and staging area located within a grassland area, east of the State Route 84/Kalthoff Common intersection, would also be used for construction and maintenance equipment. Since the current PG&E transmission lines has a permanent 20-foot aerial easement on either side (40 feet total) to accommodate line movement from winds, PG&E will have a matching permanent 40 foot total easement for both aerial and underground lines and additional access easements from a new gate at the access road to the new permanent easement for their maintenance purpose. Construction activities for the transmission line relocation would be completed in approximately 6 to 9 months (270 calendar days)

The study area for this project includes provision of utility corridors outside of state right of way to accommodate **utility** relocation ~~of private utilities~~. **Beside the PG&E 60-kV transmission relocation between Kalthoff Common and Vallecitos Road,** ~~Final~~ **final** design ~~may require~~ **requires** the relocation of several utilities to accommodate the State Route 84 Expressway Project. These **relocations** ~~may~~ include **two high-voltage (115-kV) poles (PG&E), 21-kV overhead electrical line (PG&E),** 24-inch gas line (**PG&E** ~~Pacific Gas & Electric~~**), 12-inch water line (California Water Service Company)** ~~and~~ 15-inch to 39-inch sanitary sewer line (City of Livermore)~~.~~**, and a few valve boxes (Zone 7 Water Agency). The existing PG&E 115-kV transmission overhead line runs along Vineyard Ave and transversely crosses State Route 84. Due to the widening of state right of way, two PG&E poles for the 115-kV transmission overhead line need to be moved to outside of state right of way without altering the overhead alignment.** 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~~ **Isabel** Trail Bridge. The sanitary sewer pipeline would be protected from damage by being placed inside a larger steel pipe (sleeve) for the water crossing.

12. Make the following changes to the *Wildlife Crossings* subheading under the **Description of the Proposed Action** on page 11:

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~~ **ACTC** proposes to maintain these crossings.

13. Make the following changes to paragraph 1 of the *Effects to Habitat Type* subheading under the **Description of the Proposed Action** on page 13:

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. **Although** ~~Given that~~ the action for the State Route 84 Expressway Widening Project will ~~each~~ require more than one year of construction**, disturbance within some areas will be restored to baseline within one year. As part of the first order of work, areas along State Route 84 will be graded and biofiltration swales will be installed. Upon completion, these areas will be fenced off using ESA fencing and no construction activities or access will be allowed in these areas. The PG&E realignment is expected to take less than a year to complete. Temporary access and staging areas will be restored to baseline conditions upon completion of the realignment work** ~~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 **and temporarily** affected by the proposed project. Caltrans/**ACTC** ~~ACTIA~~ has the option of reinitiating consultation for the purposes of revisiting the amount of habitat compensation if it can be documented that portions of the action area subjected 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 initial disturbance.

14. Make the following changes to the *Habitat Compensation* subheading under the **Description of the Proposed Action** on page 14:

The **temporary** effects to **11.60 acres and permanent effects to 12.97** ~~11.39~~ acres of California red-legged frog habitat shall be compensated at **a 1.1:1 and** 3:1 ratio, **respectively** (**51.67** ~~4.17~~ acres **total**) of occupied California red-legged frog habitat. The **temporary** effects to **11.14 acres and permanent effects to 12.96** ~~11.36~~ acres of California tiger salamander habitat shall be compensated at a **1.1:1 and** 3:1 ratio, **respectively** (**51.13** ~~4.08~~ acres **total**) 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 **for permanent impacts may be mitigated at a ratio** less than 3:1 ~~may be appropriate~~ if the acquired habitat is considered to have special value to the species.

15. Make the following changes to the **Action Area** on page 22:

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~~ **103.78** acre project footprint and roads (except for County roads, and State and Federal highways) and other areas accessed by project vehicles.

16. Make the following changes to the last paragraph of the *California Tiger Salamander* subheading under the **Status of the Species and Environmental Baseline** on page 44:

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~~ **24.10** acres of road construction action area south of Arroyo de Valle.

17. Make the following changes to the second paragraph of the *California Red-Legged Frog* subheading under the **Status of the Species and Environmental Baseline** on page 50:

Based on the preceding information, the Service has determined it is reasonable to conclude the California red-legged frog inhabits the ~~11.89~~ **24.57** 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.

18. Make the following changes to the first paragraph of the *San Joaquin Kit Fox* subheading under the **Effects of the Proposed Action** on page 54:

Construction of the interchange project will result in the loss and degradation of approximately ~~11.39~~ **23.76** 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.

19. Make the following changes to the last paragraph of the *California Tiger Salamander and California Red-legged Frog* subheading under the **Effects of the Proposed Action** on page 58:

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~~ **24.10** acres of California tiger habitat salamander, south of Arroyo del Valle and ~~11.39~~ **24.57** 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.

20. Make the following changes to the **Conclusion** on page 63:

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/**ACTC** ~~ACTIA~~ will purchase **51.67** ~~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.

21. Make the following changes to the **Amount or Extent of Take** on page 65:

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 **23.76** ~~11.86~~ acre action area south of Arroyo del Valle 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 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 **24.10** ~~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 **24.57** ~~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.

22. Change **Term and Condition 2.c.** on page 68 from:

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.

To:

Preconstruction surveys shall be conducted by a Service-approved biologist immediately prior to the initiation of any ground disturbing activities and vegetation clearing that may result in take of San Joaquin kit fox, California tiger salamander, or California red-legged frog as determined by the Service. All suitable aquatic and upland habitat including refugia habitat such as dense vegetation, small woody debris, refuse, burrows, etc., shall be thoroughly inspected. The Service-approved biologist(s) shall conduct clearance surveys at the beginning of each day and regularly throughout the workday when construction activities are occurring that may result in take of San Joaquin kit fox, California tiger salamanders, or California red-legged frogs as determined by the Service. If a San Joaquin kit fox, California tiger salamanders, or California red-legged frogs are observed, the Service-approved biologist shall implement the species observation and handling protocol outlined below. All fossorial mammal burrows will be inspected for frogs or salamanders. If it is determined that a burrow may be occupied by a California red-legged frog and/or California tiger salamander, the burrow will be excavated by hand, if possible, and the individual(s) relocated in accordance with the observation and handling protocol promulgated by the Service.

23. Change **Term and Condition 2.d.** on page 68 from:

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.

To:

If a California red-legged frog(s) and/or California tiger salamander(s) is encountered in the action area, work activities within 50 feet of the California red-legged frog(s) and/or California tiger salamander(s) shall cease immediately and the Resident Engineer and Service-approved biologist shall be notified. Based on the professional judgment of the Service-approved biologist, if project activities can be conducted without harming or injuring the California red-legged frog(s) and/or California tiger salamander(s), it may be left at the location of discovery and monitored by the Service-approved biologist. All project personnel will be notified of the finding and at no time shall work occur within 50 feet of the California red-legged frog(s) and/or California tiger salamander(s) without a Service-approved biologist present. If it is determined by the Service-approved biologist that relocating the California red-legged frog(s) and/or California tiger salamander(s) is necessary, the following steps shall be followed:

1) Prior to handling and relocation the Service-approved biologist will take precautions to prevent introduction of amphibian diseases in accordance with the *Revised Guidance on Site Assessments and Field Surveys for the California Red-legged Frog* (Service 2005) and *Interim Guidance on Site Assessment and Field Surveys for Determining Presence or a Negative Finding of the California Tiger Salamander* (Service 2003). Disinfecting equipment and clothing is especially important when biologists are coming to the action area to handle amphibians after working in other aquatic habitats.

2) California red-legged frogs and California tiger salamanders shall be captured by hand, dipnet or other Service-approved methodology, transported by hand, dipnet or temporary holding container, and released as soon as practicable the same day of capture. Handling of California red-legged frogs and California tiger salamanders will be minimized to the maximum extent practicable. Holding/transporting containers and dipnets shall be thoroughly cleaned, disinfected and rinsed with freshwater prior to use within the action area.

3) California red-legged frogs and California tiger salamanders shall be relocated to nearby suitable habitat outside of the work area and released in a safe area on the same side of roadway where they were discovered. The individual(s) shall be released within the Caltrans right-of-way only if suitable habitat exists and would not pose a risk to the animal's survival or well-being. Otherwise, California red-legged frogs and California tiger salamanders shall be released at a location subject to the approval of the property owner. If suitable habitat cannot be identified, the Service shall be contacted to determine an acceptable alternative. If salamanders are captured from burrows, they shall be relocated to the nearest active burrow network outside of the work zone. The release burrow shall be

actively occupied by ground squirrels, since inactive burrows can collapse if not maintained. No more than two individuals shall be released into the same burrow. If California red-legged frogs or California tiger salamanders are relocated, the Service shall be notified within 24 hours of relocation.

24. Change the **Reporting Requirements** on page 69 from:

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.

To:

Proof of environmental training shall be provided to the Endangered Species Program, Sacramento Fish and Wildlife Office, 2800 Cottage Way, Room W-2605, Sacramento, California 95825-1846. Observations of San Joaquin kit fox, California tiger salamanders, California red-legged frogs, or any listed or rare species should be reported to the California Natural Diversity Database (CNDDB) within thirty (30) calendar days of the observation.

Injured San Joaquin kit fox, California tiger salamanders, and California red-legged frogs must be cared for by a licensed veterinarian or other qualified person, such as the Service-approved biologist. Dead animals shall be placed in a plastic storage bag with a piece of paper indicating the date, time, location and name of the person who found it. The bag shall be placed in a freezer located in a secure location until instructions are

received from the Service regarding the disposition of the specimen or until the Service takes custody of the specimen. The Service must be notified within 24 hours of the discovery of death or injury resulting from project-related activities or is observed at the project site. Notification shall include the date, time, and location of the incident or 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 Coast-Bay/Forest Foothills Division Chief, Endangered Species Program, Sacramento Fish and Wildlife Office at (916) 414-6600, and Resident Agent-in-Charge of the Service's Law Enforcement Division at (916) 569-8444.

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: (1) dates that construction occurred; (2) pertinent information concerning the success of the project in meeting compensation and other conservation measures; (3) an explanation of failure to meet such measures, if any; (4) known project effects on the California red-legged frog, if any; (5) incidental take of this species, if any; (6) documentation of employee/contractor environmental education; and (7) other pertinent information.

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 twenty-four (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 stated above, 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.

This concludes the reinitiation of formal consultation on the SR-84 Expressway Widening Project in Alameda County, California. The remainder of the February 1, 2008, biological opinion is unchanged. If you have questions concerning this reinitiation, please contact Jerry Roe or Ryan Olah, Coast Bay/Forest Foothills Division Chief, at (916) 414-6600.

Sincerely,

E. Tattersall

for Jan C. Knight
Acting Field Supervisor

cc:
Melisa Escaron, California Department of Fish and Game, Yountville, California

LITERATURE CITED

U. S. Fish and Wildlife Service (Service). 2003. *Interim Guidance on Site Assessment and Field Surveys for Determining Presence or a Negative Finding of the California Tiger Salamander*. Sacramento Field Office, Sacramento, California.

_____ 2005. *Revised Guidance on Site Assessments and Field Surveys for the California Red-legged Frog.*

United States Department of the Interior

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

In Reply Refer to:
081420-
2010-F-0592-R002

Ms. Melanie Brent, Office Chief
Caltrans District 4 Environmental Analysis
California Department of Transportation
P.O. Box 23660
Oakland, California 94623-0660

JAN 0 8 2015

Subject: Reinitiation of Consultation on the State Route 84 Expressway Widening Project, Alameda County, California (Caltrans EA 29761)

Dear Ms. Brent:

This is in response to your letter dated May 9, 2014, requesting reinitiation of formal consultation with the U.S. Fish and Wildlife Service (Service) on the State Route 84 (SR-84) Expressway Widening Project located in Alameda County, California. The original biological opinion dated February 1, 2008, (Service File No. 81420-2008-F-0592) was amended on April 29, 2013, (Service File No. 81420-2008-F-0592-R001). Your request was received on May 13, 2014. Reinitiation of consultation was requested to address changes in the project description that resulted in changes to the effects to the threatened California red-legged frog (*Rana draytonii*), threatened California tiger salamander (*Ambystoma californiense*) Central Distinct Population Segment (Central California tiger salamander), and endangered San Joaquin kit fox (*Vulpes macrotis mutica*). This response is provided under the authority of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act).

The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) legislation (23 U.S.C. 327) allows the Secretary of the U.S. Department of Transportation acting through the Federal Highway Administration (FHWA) to establish a Surface Transportation Project Delivery Pilot Program, whereby a State may assume the FHWA responsibilities under the National Environmental Policy Act (NEPA) for environmental review, agency consultation and other action pertaining to the review or approval of a specific project. Caltrans assumed these responsibilities for the FHWA on July 1, 2007 through a Memorandum of Understanding (MOU) within the State of California (http://www.dot.ca.gov/ser/downloads/MOUs/nepa_delegation/sec6005mou.pdf).

The following changes are made to the February 1, 2008, biological opinion:

1. Add the following to the **Consultation History** on page 2:

May 13, 2014	The Service received a request from Caltrans dated May 9, 2014, to reinitiate formal consultation to address changes to the project

description that resulted in additional effects to the California red-legged frog, Central California tiger salamander and San Joaquin kit fox.

2. Change number 2 on page 3 of the April 29, 2013, amendment to the biological opinion from:

Caltrans and the Federal Highway Administration (FHWA), in cooperation with Alameda County Transportation Commission (ACTC) and the City of Livermore, is proposing to widen and upgrade 4.70 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 103.78 acres of which 37.93 acres are occupied by existing hardscape/pavement (Caltrans 2007b).

To:

Caltrans and the Federal Highway Administration (FHWA), in cooperation with Alameda County Transportation Commission (ACTC) and the City of Livermore, is proposing to widen and upgrade 4.70 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 **102 acres** ~~103.78 acres~~ of which **38 acres** ~~37.93 acres~~ are occupied by existing hardscape/pavement (Caltrans 2007b).

Table 1. Revised Permanent and Temporary Effects to California Red-Legged Frog (CRF), Central California Tiger Salamander (CTS) and San Joaquin kit fox (SJKF) Habitat.

Habitat	Temporary Effect (acres)	Permanent Effect (acres)	Total (acres)
CA Annual Grassland	7.27	8.93	16.19
Valley Oak Woodland	0.75	1.52	2.27
Coyote Brush Scrub	0.10	0.00	0.10
Mixed Willow	0.00	0.35	0.35
Riverine Gravel[1]	0.00	0.08	0.08
Low Flow Channel (Arroyo Mocho)[1]	0.00	<0.01	0.005
Landscape Disturbed	1.23	1.53	2.76
Total:	**9.35**	**12.41 (CTS/SJKF) 12.42 (CRF)**	**21.76 (CTS/SJKF) 21.77 (CRF)**

[1] This habitat is located at the Arroyo Mocho Creek and is considered habitat for the California red-legged frog, but not the Central California tiger salamander or San Joaquin kit fox.

Table 2. Compensation for the Effects to California Red-Legged Frog, Central California Tiger Salamander and San Joaquin kit fox Habitat.

	Total	Mitigation Ratio	Proposed Compensatory Mitigation
California Red-Legged Frog			
Temporary Impacts	9.35	1:1.1	10.29
Permanent Impacts	12.42	3:1	37.26
		Total Proposed Compensation:	***47.55***
Central California Tiger Salamander and San Joaquin kit fox			
Temporary Impacts	9.35	1:1.1	10.29
Permanent Impacts	12.41	3:1	37.23
		Total Proposed Compensation:	***47.52***

3. Change number 5, paragraph 7, on page 3 of the April 29, 2013, amendment to the biological opinion from:

   During construction, the project would be split into a North and South segment and would create about 29.82 acres of new pavement. The total action area of the project, including permanent and temporary work areas, is estimated at 103.78 acres. Partial right-of-way acquisition from 30 parcels (totaling about 12 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 fee acquisition is required from the existing environmental conservancy area between Ruby Hill Drive and Vallecitos Road.

   To:

   During construction, the project would be split into a North and South segment and would create about **31 acres** ~~29.82 acres~~ of new pavement. The total action area of the project, including permanent and temporary work areas, is estimated at **102 acres** ~~103.78 acres~~.

Partial right-of-way acquisition from **37 parcels** ~~30 parcels~~ (totaling about **14.21 acres** ~~12 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 fee acquisition is required from the existing environmental conservancy area between Ruby Hill Drive and Vallecitos Road.

4. Change number 6, paragraph 3, on page 4 of the April 29, 2013, amendment to the biological opinion from:

The project limits will extend eastward into the agricultural and environmental conservancy area to accommodate the relocation of a high-voltage (60-kilovolt) PG&E transmission line from the west side of State Route 84 to the east side. The relocation of the transmission line, which is proposed to be a combination of overhead and underground transmission methods, would take place between Vallecitos Road and Kalthoff Common.

To:

The project limits will extend eastward into the agricultural and environmental conservancy area to accommodate the relocation of a high-voltage (60-kilovolt) PG&E transmission line from the west side of State Route 84 to the east side. The **overhead** relocation of the transmission line~~, which is proposed to be a combination of overhead and underground transmission methods,~~ would take place between Vallecitos Road and Kalthoff Common.

5. Change number 11 on page 10-11 of the April 29, 2013, amendment to the biological opinion from:

Existing gas, sanitary sewer, storm drain, electrical, cable and telephone utilities lie within the proposed project right of way will need to be relocated to comply with Caltrans expressway standards. Utilities to be relocated include an existing overhead alignment containing PG&E three-phase high-voltage (60 kV) transmission lines, PG&E three-phase 21 kV distribution lines, and AT&T telephone cables (hereafter referred to as the PG&E alignment). The existing PG&E alignment currently fronts the Ruby Hill development between Ruby Hill Drive and Vallecitos Road. During final design, PG&E staff determined that custom steel poles on concrete pile foundations would be required to support the westerly shift of the transmission line because there is not adequate space along the route for wooden poles supported by guy wires. PG&E requires 25 feet between the existing 24-inch gas transmission line along East Ruby Hill Drive and the steel poles, and space is not available to provide the required clearance. The narrow corridor between State right-of-way and East Ruby Hill Drive, combined with the proximity of other utilities, would also complicate maintenance access to the relocated transmission line. Additionally, the soil nail wall that will be installed at the slope between East Ruby Hill Drive and State Route 84 complicates the constructability of a transmission line along this route. Because of these constraints, PG&E requested that a segment of the high-voltage transmission line be relocated from the west side of SR 84 to the east side.

The design team, in coordination with PG&E staff, Caltrans, ACTC and the City of Livermore, has developed a revised PG&E alignment. The portion of the alignment fronting the Ruby Hill development would be relocated to the east side of State Route 84, where it would pass through an undeveloped area and rejoin the existing alignment at Vallecitos Road.

The proposed relocated PG&E alignment would extend from a new wooden pole along Vallecitos Road just northeast of its intersection with State Route 84 to an existing pole along State Route 84 just north of Kalthoff Common. The new pole along Vallecitos Road would be 2 feet in diameter, 55 to 75 feet high, and would be set directly in the ground (not in concrete). Installation of this and other poles for the overhead portions of the PG&E alignment would not require grading. Two rigs would be needed for pole installation—one to drill the hole and one to set the pole.

From the new pole along Vallecitos Road, the PG&E alignment would pass for approximately 464 feet to a new distribution riser pole and a new transmission riser pole at the northern end of the proposed alignment, 150 feet from a vineyard fenceline. The transmission riser pole would be steel, approximately 4 feet in diameter and 60 feet high, and set on a concrete foundation approximately 5 feet in diameter. The distribution riser would be a 2-foot-diameter, 40- to 60-foot-tall wooden pole set directly in the ground. Installation of these northern riser poles would require grading for the access of construction equipment and construction of a patrol road with base rock material for PG&E's maintenance access.

The conduits would be strung from the new pole along Vallecitos Road to the riser poles by using a hand-carried guide gable, to avoid disturbing the creek and riparian woodland in this area. The riser poles would convey the conduits into two parallel underground trenches, one approximately 18 inches wide and approximately 37 inches deep and the other approximately 24 inches wide and 50 inches deep. The trenches would contain schedule 40 3-inch, 4-inch and 6-inch PVC pipes with the conduits inside. The trenches would be at least 25 feet apart and extend southward for approximately 1,550 feet along the hilltop vineyard, fenceline, and grassland, largely in a ruderal, previously disturbed agricultural area. At the southern end of the realignment corridor, the conduits would be conveyed from the underground trenches to a new distribution riser pole and a new transmission riser pole near Kalthoff Common, where the conduits would connect with the existing pole. A patrol road filled with base rock material will be placed for the PG&E's maintenance access to the southern riser poles.

Construction and maintenance equipment and vehicles would use an existing dirt road that extends between Kalthoff Common and Vallecitos Road along the vineyard fence line. The access road would be strengthened using base rock material for a width of 16 feet to accommodate PG&E's maintenance equipment. An additional access and staging area located within a grassland area, east of the State Route 84/Kalthoff Common intersection, would also be used for construction and maintenance equipment. Since the current PG&E transmission lines has a permanent 20-foot aerial easement on either side (40 feet total) to accommodate line movement from winds, PG&E will have a matching permanent 40 foot total easement for both aerial and underground lines and additional access easements from an new gate at the access road to the new permanent easement for their maintenance purpose. Construction activities for the transmission line relocation would be completed in approximately 6 to 9 months (270 calendar days)

The study area for this project includes provision of utility corridors outside of state right of way to accommodate utility relocation. Beside the PG&E 60-kV transmission relocation between Kalthoff Common and Vallecitos Road, final design requires the relocation of several utilities to accommodate the State Route 84 Expressway Project. These relocations include two high-voltage (115-kV) poles (PG&E), 21-kV overhead electrical line (PG&E),

24-inch gas line (PG&E), 12-inch water line (California Water Service Company) 15-inch to 39-inch sanitary sewer line (City of Livermore), and a few valve boxes (Zone 7 Water Agency). The existing PG&E 115-kV transmission overhead line runs along Vineyard Ave and transversely crosses State Route 84. Due to the widening of state right of way, two PG&E poles for the 115-kV transmission overhead line need to be moved to outside of state right of way without altering the overhead alignment. Other utilities located in the State Route 84 Expressway Project area would be protected in-place.

To:

Existing gas, sanitary sewer, storm drain, electrical, cable and telephone utilities lie within the proposed project right of way will need to be relocated to comply with Caltrans expressway standards. Utilities to be relocated include an existing overhead alignment containing PG&E three-phase high-voltage (60 kV) transmission lines, PG&E three-phase 21 kV distribution lines, and AT&T telephone cables (hereafter referred to as the PG&E alignment). The existing PG&E alignment currently fronts the Ruby Hill development between Ruby Hill Drive and Vallecitos Road. **The revised PG&E corridor would be conveyed overhead from an existing pole on the northwest corner of SR-84 and Ruby Hill Drive to a new pole approximately 300 feet to the north on the same side of SR-84, where it would cross to the east side of SR-84. From there, new poles would convey the PG&E corridor within State right-of-way along the eastern side of SR-84 to an existing pole on the east side of Vallecitos Road.**

A single pole would be installed on the west side of SR-84, just north of Ruby Hill Drive. Access to this pole would be from the Ruby Hill community. The remaining poles would be located along the east side of SR-84 between the environmentally sensitive areas (ESA) and existing paved area. A 12-foot paved shoulder would be provided between the most southerly poles. At the northern end of the shoulder, a barrier with a sliding gate will provide entry to a one-way (northbound-only) 10-foot-wide gravel access road for maintenance and utility access. The road will be separated from northbound SR-84 by concrete barriers and retaining walls. Grading would be required for access road construction. Another gate would be provided to access the most northerly installed pole and the existing pole where the relocated PG&E corridor would rejoin the existing aerial alignment and for access to northbound Vallecitos Road.

The pole type and installation methods may differ among locations. In some locations, the poles would be wooden and installed using a drill rig from the roadway shoulder. The wooden poles would be 2 feet in diameter, 40 to 60 feet high, and set 10 feet below ground surface directly in the ground (not in concrete). At other locations, PG&E may use Tubular Steel Poles (TSPs) and/or light-duty steel poles in lieu of wooden poles to eliminate the need for guy wires. The TSPs would be 3 to 4 feet in diameter and 80 feet high, and would require a drilled pier foundation measuring 20 to 30 feet deep and 5 feet in diameter. The light-duty steel poles would be 2 to 3 feet in diameter and 85 feet high, and would be set directly in the ground in a manner similar to the wooden poles.

~~During final design, PG&E staff determined that custom steel poles on concrete pile foundations would be required to support the westerly shift of the transmission line because~~

there is not adequate space along the route for wooden poles supported by guy wires. PG&E requires 25 feet between the existing 24-inch gas transmission line along East Ruby Hill Drive and the steel poles, and space is not available to provide the required clearance. The narrow corridor between State right-of-way and East Ruby Hill Drive, combined with the proximity of other utilities, would also complicate maintenance access to the relocated transmission line. Additionally, the soil nail wall that will be installed at the slope between East Ruby Hill Drive and State Route 84 complicates the constructability of a transmission line along this route. Because of these constraints, PG&E requested that a segment of the high-voltage transmission line be relocated from the west side of SR 84 to the east side.

The design team, in coordination with PG&E staff, Caltrans, ACTC and the City of Livermore, has developed a revised PG&E alignment. The portion of the alignment fronting the Ruby Hill development would be relocated to the east side of State Route 84, where it would pass through an undeveloped area and rejoin the existing alignment at Vallecitos Road.

The proposed relocated PG&E alignment would extend from a new wooden pole along Vallecitos Road just northeast of its intersection with State Route 84 to an existing pole along State Route 84 just north of Kalthoff Common. The new pole along Vallecitos Road would be 2 feet in diameter, 55 to 75 feet high, and would be set directly in the ground (not in concrete). Installation of this and other poles for the overhead portions of the PG&E alignment would not require grading. Two rigs would be needed for pole installation—one to drill the hole and one to set the pole.

From the new pole along Vallecitos Road, the PG&E alignment would pass for approximately 464 feet to a new distribution riser pole and a new transmission riser pole at the northern end of the proposed alignment, 150 feet from a vineyard fenceline. The transmission riser pole would be steel, approximately 4 feet in diameter and 60 feet high, and set on a concrete foundation approximately 5 feet in diameter. The distribution riser would be a 2-foot-diameter, 40- to 60-foot-tall wooden pole set directly in the ground. Installation of these northern riser poles would require grading for the access of construction equipment and construction of a patrol road with base rock material for PG&E's maintenance access.

The conduits would be strung from the new pole along Vallecitos Road to the riser poles by using a hand-carried guide gable, to avoid disturbing the creek and riparian woodland in this area. The riser poles would convey the conduits into two parallel underground trenches, one approximately 18 inches wide and approximately 37 inches deep and the other approximately 24 inches wide and 50 inches deep. The trenches would contain schedule 40 3-inch, 4-inch and 6-inch PVC pipes with the conduits inside. The trenches would be at least 25 feet apart and extend southward for approximately 1,550 feet along the hilltop vineyard, fenceline, and grassland, largely in a ruderal, previously disturbed agricultural area. At the southern end of the realignment corridor, the conduits would be conveyed from the underground trenches to a new distribution riser pole and a new transmission riser pole near Kalthoff Common, where the conduits would connect with the existing pole. A patrol road filled with base rock material will be placed for the PG&E's maintenance access to the southern riser poles.

Construction and maintenance equipment and vehicles would use an existing dirt road that extends between Kalthoff Common and Vallecitos Road along the vineyard fence line. The

~~access road would be strengthened using base rock material for a width of 16 feet to accommodate PG&E's maintenance equipment. An additional access and staging area located within a grassland area, east of the State Route 84/Kalthoff Common intersection, would also be used for construction and maintenance equipment. Since the current PG&E transmission lines has a permanent 20-foot aerial easement on either side (40 feet total) to accommodate line movement from winds, PG&E will have a matching permanent 40 foot total easement for both aerial and underground lines and additional access easements from an new gate at the access road to the new permanent easement for their maintenance purpose. Construction activities for the transmission line relocation would be completed in approximately 6 to 9 months (270 calendar days)~~

The study area for this project includes provision of utility corridors outside of state right of way to accommodate utility relocation. ~~Beside the PG&E 60-kV transmission relocation between Kalthoff Common and Vallecitos Road, f~~**Final** design requires the relocation of several utilities to accommodate the State Route 84 Expressway Project. These relocations include two high-voltage (115-kV) poles (PG&E), 21-kV overhead electrical line (PG&E), 24-inch gas line (PG&E), 12-inch water line (California Water Service Company) 15-inch to 39-inch sanitary sewer line (City of Livermore), and a few valve boxes (Zone 7 Water Agency). The existing PG&E 115-kV transmission overhead line runs along Vineyard Ave and transversely crosses SR-84. Due to the widening of state right-of-way, two PG&E poles for the 115-kV transmission overhead **line located near the SR 84/Vineyard Avenue intersection** need to be moved ~~to outside of state right of way without altering the overhead alignment~~ **along the same alignment from inside of the Caltrans right-of-way to outside of the right-of-way, into areas where PG&E has an easement**. Other utilities located in the action area would be protected in-place.

6. Change number 14 on page 12-13 of the April 29, 2013, amendment to the biological opinion from:

The temporary effects to 11.60 acres and permanent effects to 12.97 acres of California red-legged frog habitat shall be compensated at a 1.1:1 and 3:1 ratio, respectively (51.67acres total) of occupied California red-legged frog habitat. The temporary effects to 11.14 acres and permanent effects to12.96 acres of California tiger salamander habitat shall be compensated at a 1.1:1 and 3:1 ratio, respectively (51.13 acres total) 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 for permanent impacts may be mitigated at a ratio less than 3:1 if the acquired habitat is considered to have special value to the species.

To:

The temporary effects to **9.35 acres** ~~11.60 acres~~ and permanent effects to **12.42 acres** ~~12.97 acres~~ of California red-legged frog habitat shall be compensated at a 1.1:1 and 3:1 ratio, respectively (**47.55 acres** ~~51.67 acres~~ total) of occupied California red-legged frog habitat. The temporary effects to **9.35 acres** ~~11.14 acres~~ and permanent effects to **12.41 acres** ~~12.96 acres~~ of **Central** California tiger salamander habitat shall be compensated at a 1.1:1 and 3:1 ratio, respectively (**47.52 acres** ~~51.13 acres~~ total) of occupied **Central** California tiger

salamander habitat. This does not include the 0.5-acre 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 for permanent impacts may be mitigated at a ratio less than 3:1 if the acquired habitat is considered to have special value to the species.

7. Change number 15 on page 13 of the April 29, 2013, amendment to the biological opinion from:

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 103.78 acre project footprint and roads (except for County roads, and State and Federal highways) and other areas accessed by project vehicles

To:

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 **102 acres** ~~103.78 acres~~ project footprint and roads (except for County roads, and State and Federal highways) and other areas accessed by project vehicles

8. Change number 16 on page 13 of the April 29, 2013, amendment to the biological opinion from:

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 24.10 acres of road construction action area south of Arroyo de Valle.

To:

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 **Central** 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 **Central California tiger salamander** ~~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 **21.76 acres** ~~24.10 acres~~ of road construction action area south of Arroyo del Valle.

9. Change number 17 on page 13 of the April 29, 2013, amendment to the biological opinion from:

Based on the preceding information, the Service has determined it is reasonable to conclude the California red-legged frog inhabits the 24.57 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.

To:

Based on the preceding information, the Service has determined it is reasonable to conclude the California red-legged frog inhabits the **21.77 acres** ~~24.57acres~~ which includes **the** 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.

10. Change number 18 on page 13 of the April 29, 2013, amendment to the biological opinion from:

Construction of the interchange project will result in the loss and degradation of approximately 23.76 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.

To:

Construction of the interchange project will result in the loss and degradation of approximately **21.76 acres** ~~23.76 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-acre of **San Joaquin kit** 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.

11. Change number 19 on page 14 of the April 29, 2013, amendment to the biological opinion from:

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 24.10 acres of California tiger habitat salamander, south of Arroyo del Valle and 24.57 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.

To:

The proposed project could have direct effects to the **Central** 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 **Central** 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 **21.76 acres** ~~24.10 acres~~ of **Central** California tiger habitat salamander, south of Arroyo del Valle and **21.77 acres** ~~24.57 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-acre 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.

12. Change number 20 on page 14 of the April 29, 2013, amendment to the biological opinion from:

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/ACTC will purchase 51.67 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.

To:

After reviewing the current status of the San Joaquin kit fox, **Central** California tiger salamander, and California red-legged frog; the environmental baseline for the action area; the effects of the proposed ~~State Route 84~~ **SR-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 **Central** 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/ACTC will purchase **47.55 acres** ~~51.67 acres~~ of habitat that will benefit the California red-legged frog, **Central** 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 **Central** California tiger salamander and California red-legged frog have been designated; however, none is ~~located~~ **designated within** the action area. Therefore ~~none~~ **no designated critical habitat for the Central California tiger salamander and California red-legged frog** will be affected by the proposed project.

13. Change number 21 on page 14-16 of the April 29, 2013, amendment to the biological opinion from:

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 23.76 acre action area south of Arroyo del Valle 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 24.10 acre action at the Arroyo del Valle and 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 24.57 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.

To:

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 **21.76 acres** ~~23.76 acres~~ action area south of Arroyo del Valle 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~~ **Wildlife** 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~~ **Wildlife** determines that this Federal document is not consistent with the California Endangered Species Act.

The Service anticipates that incidental take of the **Central** 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 **Central** 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 **Central** 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 **Central** California tiger salamander inhabiting or utilizing the **21.76 acres** ~~24.10 acres~~ action at the Arroyo del Valle and south of Arroyo del Valle. The incidental take is expected to be in the form of harm, harassment, injury, and mortality to adult **Central** 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 **21.77 acres** ~~24.57 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.

This concludes the reinitiation of formal consultation on the SR-84 Expressway Widening Project in Alameda County, California. The remainder of the February 1, 2008, biological opinion, as amended, is unchanged. If you have questions concerning this reinitiation, please contact Jerry Roe or Ryan Olah, Coast Bay/Forest Foothills Division Chief, at (916) 414-6600.

Sincerely,

E. Tattersall

for Cay C. Goude
Assistant Field Supervisor

cc:
Melissa Escaron, California Department of Fish and Wildlife, Napa, California

Department of Industrial Relations Division of Occupational Safety and Health Mining and Tunneling Unit

- **Underground Classification – Dated 01/20/2015**

DEPARTMENT OF INDUSTRIAL RELATIONS
DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT
2424 Arden Way, Suite 125
Sacramento, California 95825
doshM&Tsac@dir.ca.gov

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

January 20, 2015

State of Calif. Dept. of Transportation
c/o URS Corporation
100 W. San Fernando St, Ste 200
San Jose, CA 95113

Attention: Sang Kim, Project Engineer

Subject: Project: Route 84 Expressway Widening Project, Alameda County
Classification: Potentially Gassy With Special Conditions
Amended Classifications: C047-001-11T, C048-001-11T, C049-001-11T
New Classifications: 11176-001CT, 11177-001-CT

The information provided to this office relative to the above project has been reviewed. On the basis of this analysis, Underground Classifications of "Potentially Gassy With Special Conditions" have been assigned to the tunnels identified on your submittal. Additionally, the listed Underground Classifications above have been amended. Please retain the original Classifications for your records and deliver a true and correct copy of each Classification to the tunnel contractor 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 Pre-Job Conference with the Division prior to commencing any activity associated with boring of the tunnels. A Pre-Job Request Form is enclosed.

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,

Douglas Patterson
Senior Engineer

enc: Classifications
Pre-Job Request Form

cc: sang.kim@aecom.com
rbrockman@dir.ca.gov

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C047-001-11T
AMENDMENT 1

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

of PO BOX 23660; OAKLAND, CA 94623

at ROUTE 84 EXPRESSWAY WIDENING PROJECT

has been classified as *** POTENTIALLY GASSY WITH SPECIAL CONDITIONS ***

as required by the California Labor Code § 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 30-inch-diameter 98-foot-long tunnel bore beneath Route 84 located at the Route 84 & Vallecitos Road intersection in Livermore, Alameda County

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

Douglas Patterson, Senior Engineer

January 20, 2015

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C048-001-11T
AMENDMENT 1

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

of PO BOX 23660; OAKLAND, CA 94623

at ROUTE 84 EXPRESSWAY WIDENING PROJECT

has been classified as *** POTENTIALLY GASSY WITH SPECIAL CONDITIONS ***

as required by the California Labor Code § 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 75-foot-long tunnel bore beneath Route 84 located approximately 160 feet south of the Route 84 & Vineyard Ave intersection in Livermore, Alameda County

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

Douglas Patterson, Senior Engineer

January 20, 2015

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C049-001-11T
AMENDMENT 1

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

of PO BOX 23660; OAKLAND, CA 94623

at ROUTE 84 EXPRESSWAY WIDENING PROJECT

has been classified as *** POTENTIALLY GASSY WITH SPECIAL CONDITIONS ***

as required by the California Labor Code § 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 30-inch-diameter 48-foot-long tunnel bore beneath Route 84 located approximately 1,100 feet north of the Route 84 & Vineyard Ave intersection in Livermore, Alameda County

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

Douglas Patterson, Senior Engineer

January 20, 2015

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

11176-001CT **STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION**

of **PO BOX 23660; OAKLAND, CA 94623**

at **ROUTE 84 EXPRESSWAY WIDENING PROJECT**

has been classified as ***** POTENTIALLY GASSY WITH SPECIAL CONDITIONS *****

as required by the California Labor Code § 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 58-foot-long tunnel bore beneath Route 84 located approximately 700 feet north of the Route 84 & Vineyard Ave intersection in Livermore, Alameda County

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

Douglas Patterson, Senior Engineer

January 20, 2015

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

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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 30-inch-diameter 176-foot-long tunnel bore beneath Route 84 located at the Route 84 & Concannon Boulevard intersection in Livermore, Alameda County

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

Douglas Patterson, Senior Engineer

January 20, 2015

State of California
Department of Industrial Relations
Division of Occupational Safety & Health

REQUEST FOR PRE-JOB (TUNNEL)

ATTACH COPY OF CLASSIFICATION AND DIESEL PERMIT

Company Name:_____

Phone_____FAX:_____

DATE FAXED: _____

PLEASE NOTE: THE BORING CONTRACTOR SHOULD SCHEDULE THE PREJOB AS FAR IN ADVANCE AS POSSIBLE – AT LEAST 3-4 DAYS IN ADVANCE. THE DIVISION REQUIRES THE JOB TO BE SET UP WHEN THE FIELD ENGINEER ARRIVES FOR THE PREJOB. THIS MEANS THAT THE BORE PIT HAS BEEN DUG AND PROPERLY GUARDED, THE CRANE IS IN PLACE AND READY TO LIFT, THE BORING MACHINE IS IN THE PIT AND READY TO GO, AND THE CREW IS READY TO BEGIN BORING THE TUNNEL. IF THERE IS A DELAY IN SETTING UP THE JOB, THE BORING CONTRACTOR SHOULD CONTACT THE DIVISION IMMEDIATELY.

PRE-JOB REQUEST DATE & TIME: _____

ON-SITE SUPERVISOR & CELL NO.: _____

CLASSIFICATION #: _____ **DIESEL PERMIT #:** _____

BORE DIAMETER AND LENGTH: _____ _____
(Diameter) (Length)

IS BORE ENTRY ANTICIPATED? YES NO
(Circle One)

You MUST contact the Division if entry is planned, REGARDLESS of the bore diameter.

MANNER OF EXCAVATION: _____

_____

JOB-SITE LOCATION AND DIRECTIONS: _____

_____

_____

GENERAL CONTRACTOR: _____

SUBMITTED BY: _____

REVIEWED BY: _____ **DATE:** _____

☐ *Mining & Tunneling Unit, District 1*
2424 Arden Way, Suite 125
Sacramento, California 95825-2400
(916) 574-2540; ***FAX: (916) 574-2542***

☐ *Mining & Tunneling Unit, District 2*
6150 Van Nuys Blvd., Suite 310
Van Nuys, California 91401-3333
(818) 901-5420; ***FAX: (818) 901-5579***

☐ *Mining & Tunneling Unit, District 3*
464 West Fourth Street, Suite 354
San Bernardino, California 92401-1442
(909) 383-6782; ***FAX: (909) 388-7132***

INFORMATION HANDOUT
For Contract No. 04-297624 At 04-Ala-84- 22.9/25.7
Identified by Project ID 0400020581

Storm Water Data Report - Dated 1/18/2011

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**

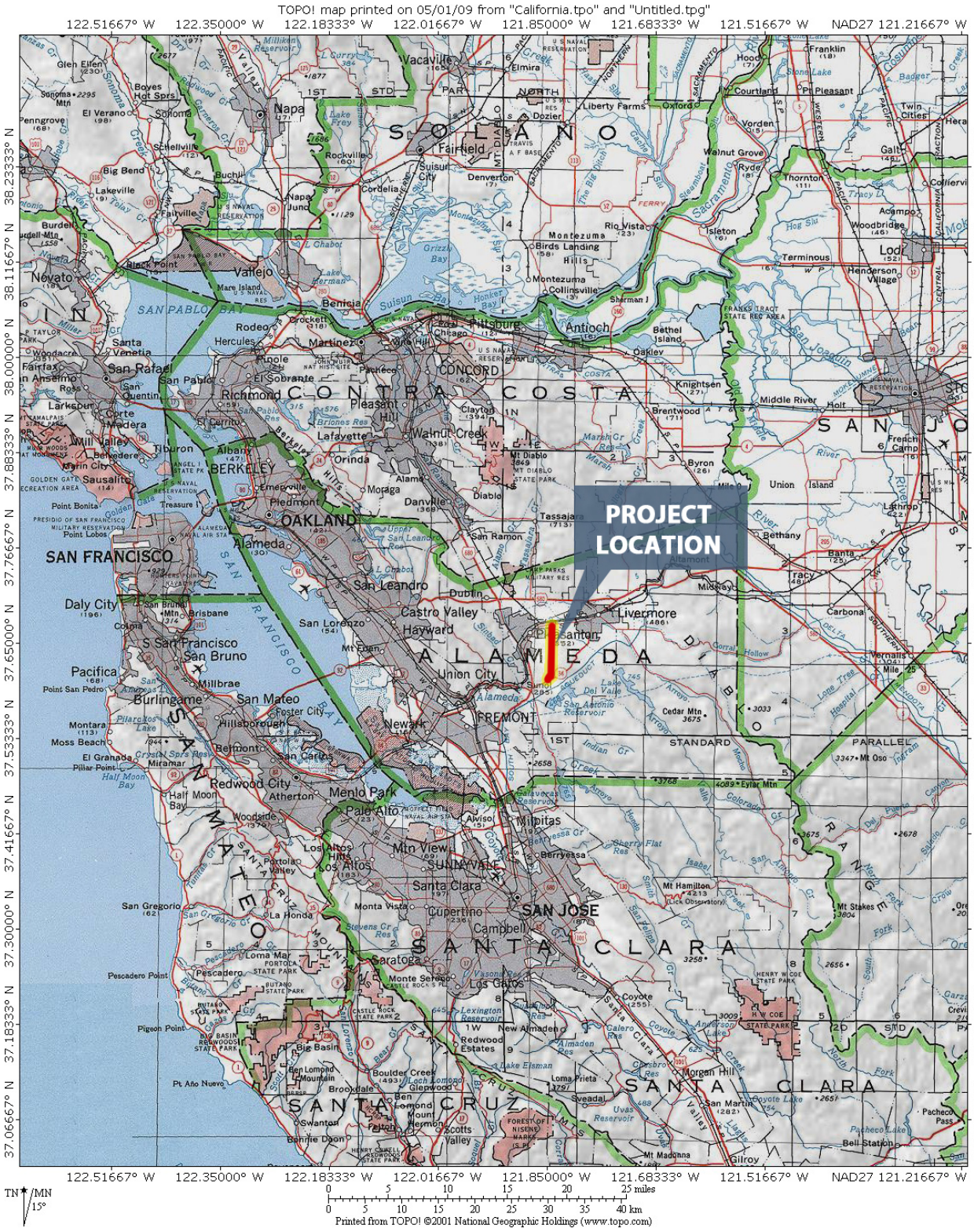


Figure 1. Location Map

Source: USGS

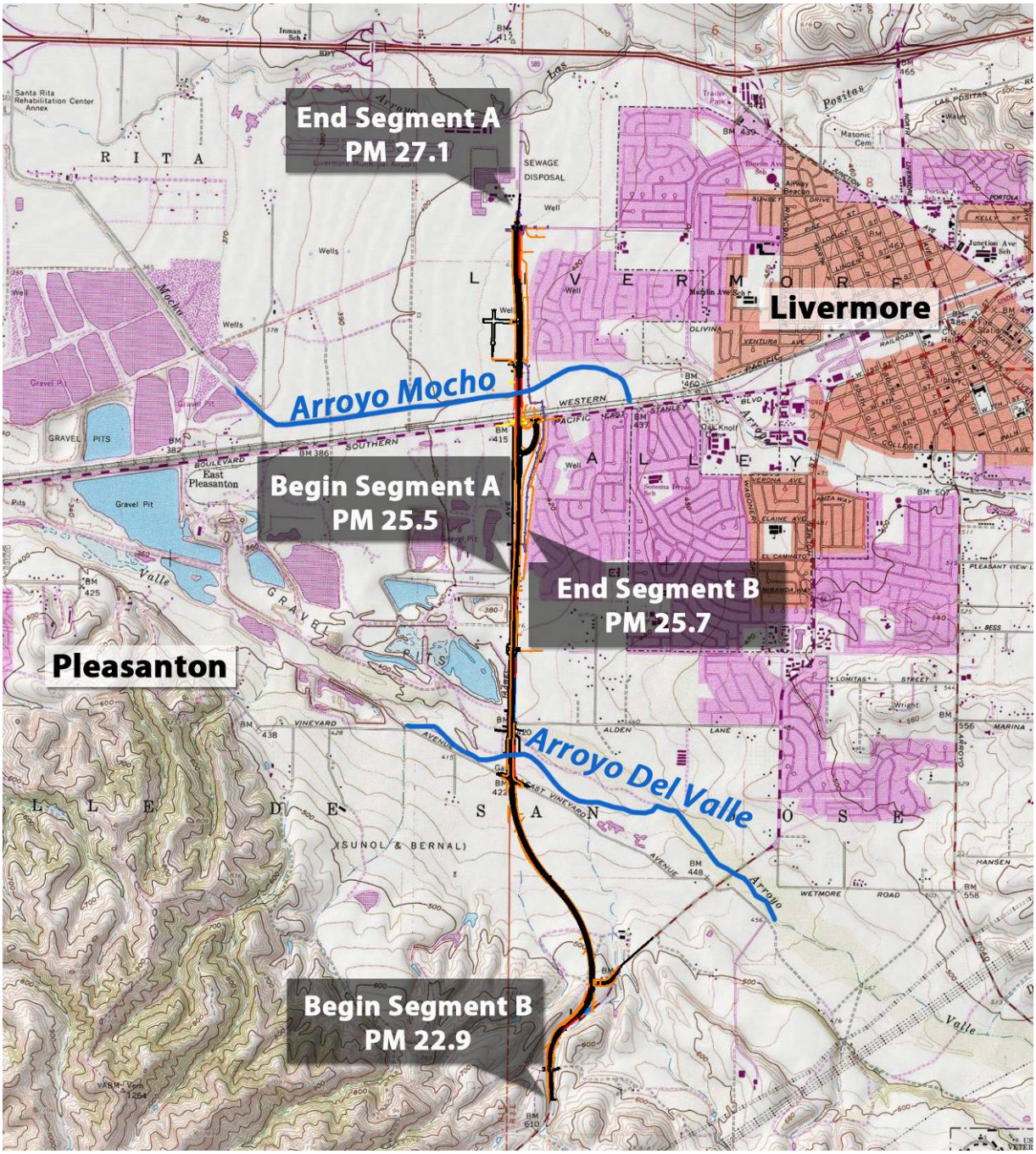


Figure 2. Vicinity Map

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

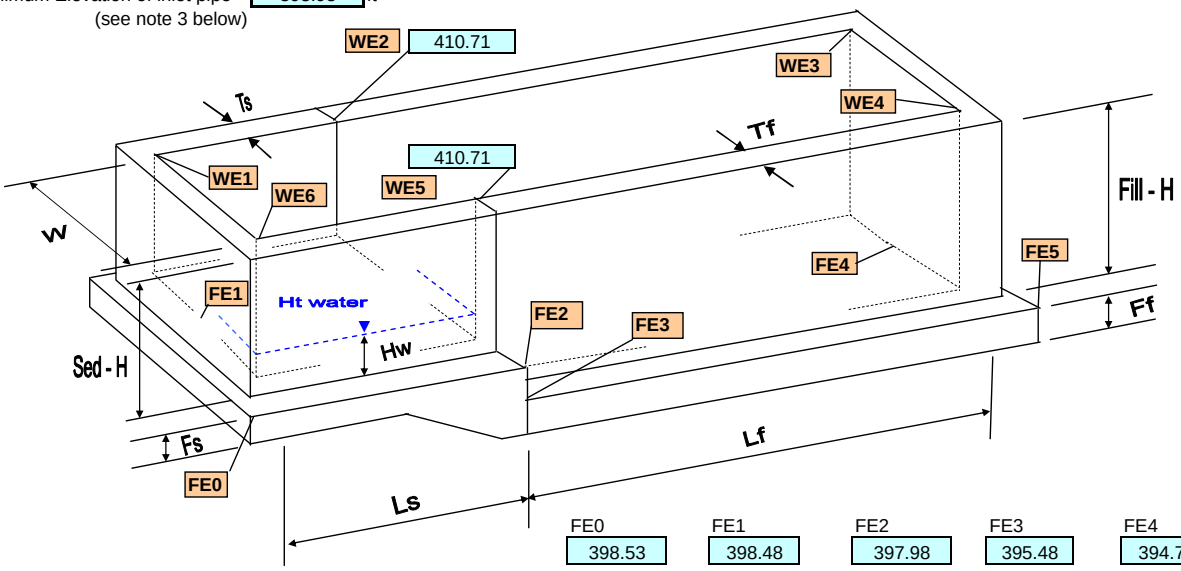
Vault Type	WQV (ft^3)	W (ft)	Ls (ft)	Lf (ft)	Hw (ft)
S-15000-6	22,500	45	25	76	6

	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
1
2
3.
4.
5.
6.

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

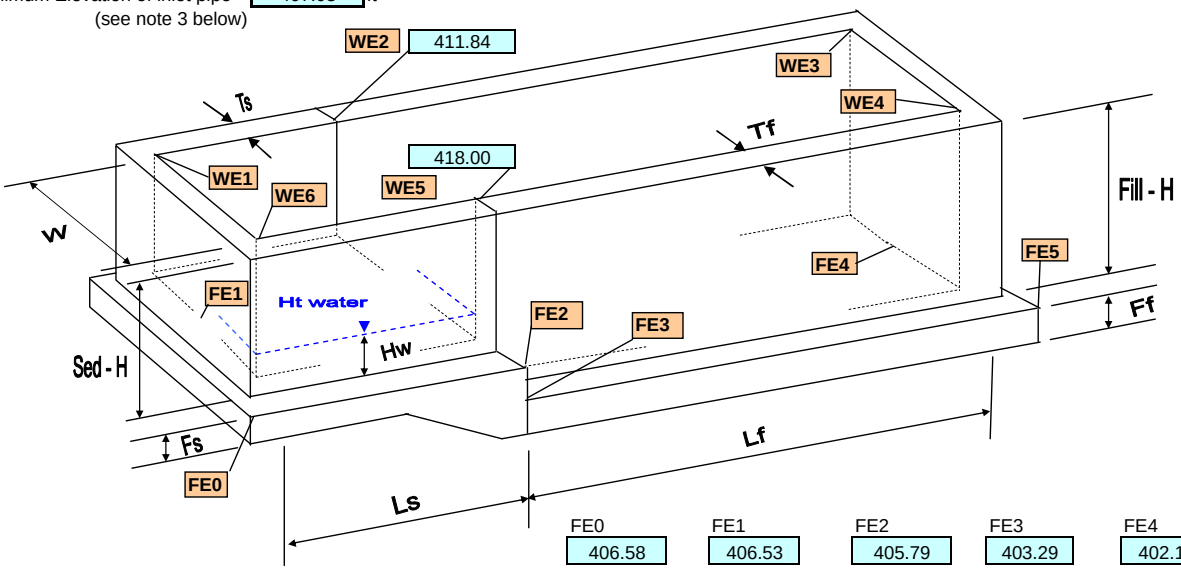
Vault Type	WQV (ft^3)	W (ft)	Ls (ft)	Lf (ft)	Hw (ft)
L-15000-6	22,500	30	37	115	6

	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
1
2
3.
4.
5.
6.

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

PM : 22.9/27.1 EA: 04-297601

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
PM : 22.9/27.1 EA: 04-297601
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
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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
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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

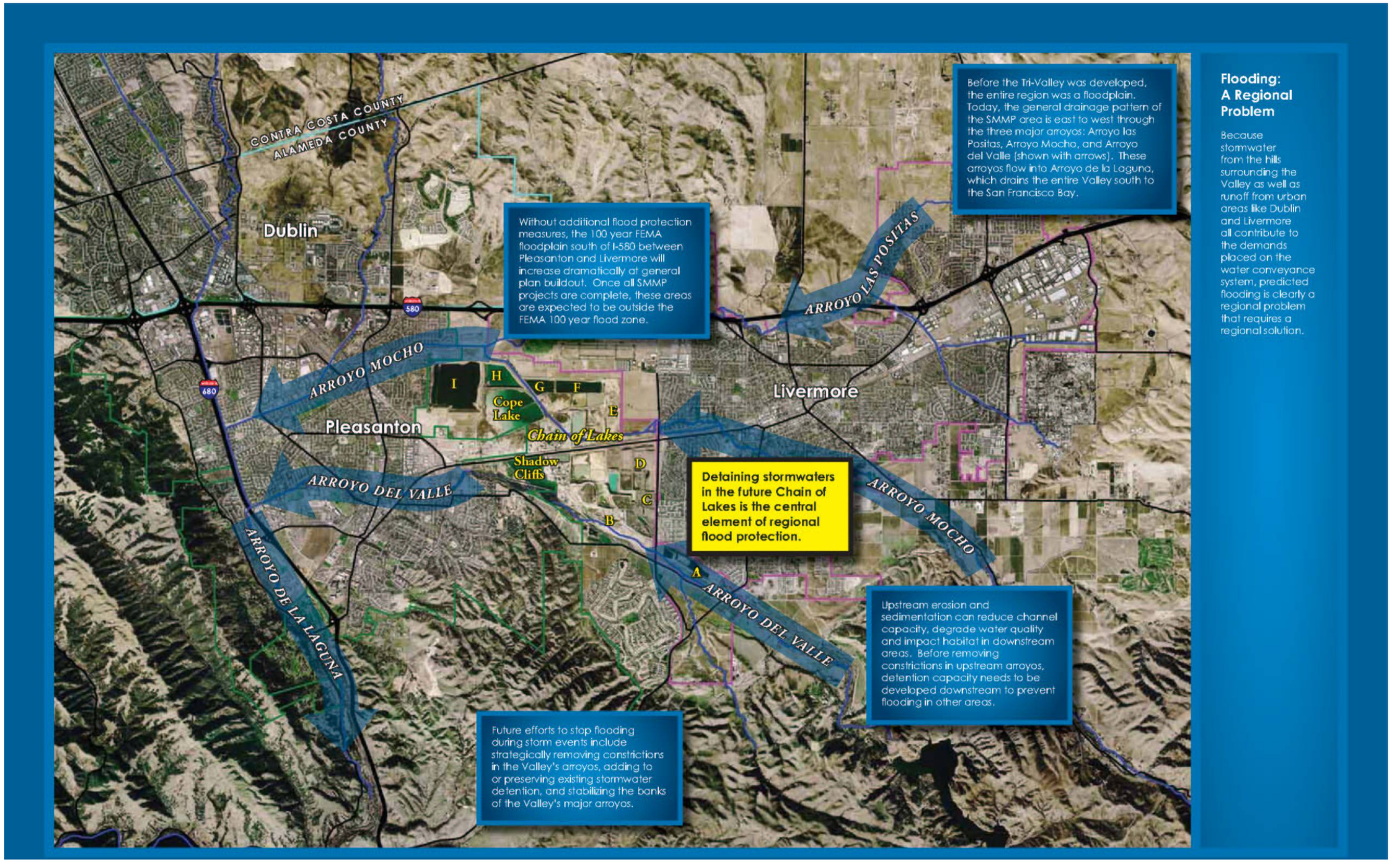
(c) Designate as a separate contract bid line item if the requirements in Construction Site management (SSP 07-346) are anticipated to be inadequate or if requested by Construction. ☒ Complete

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

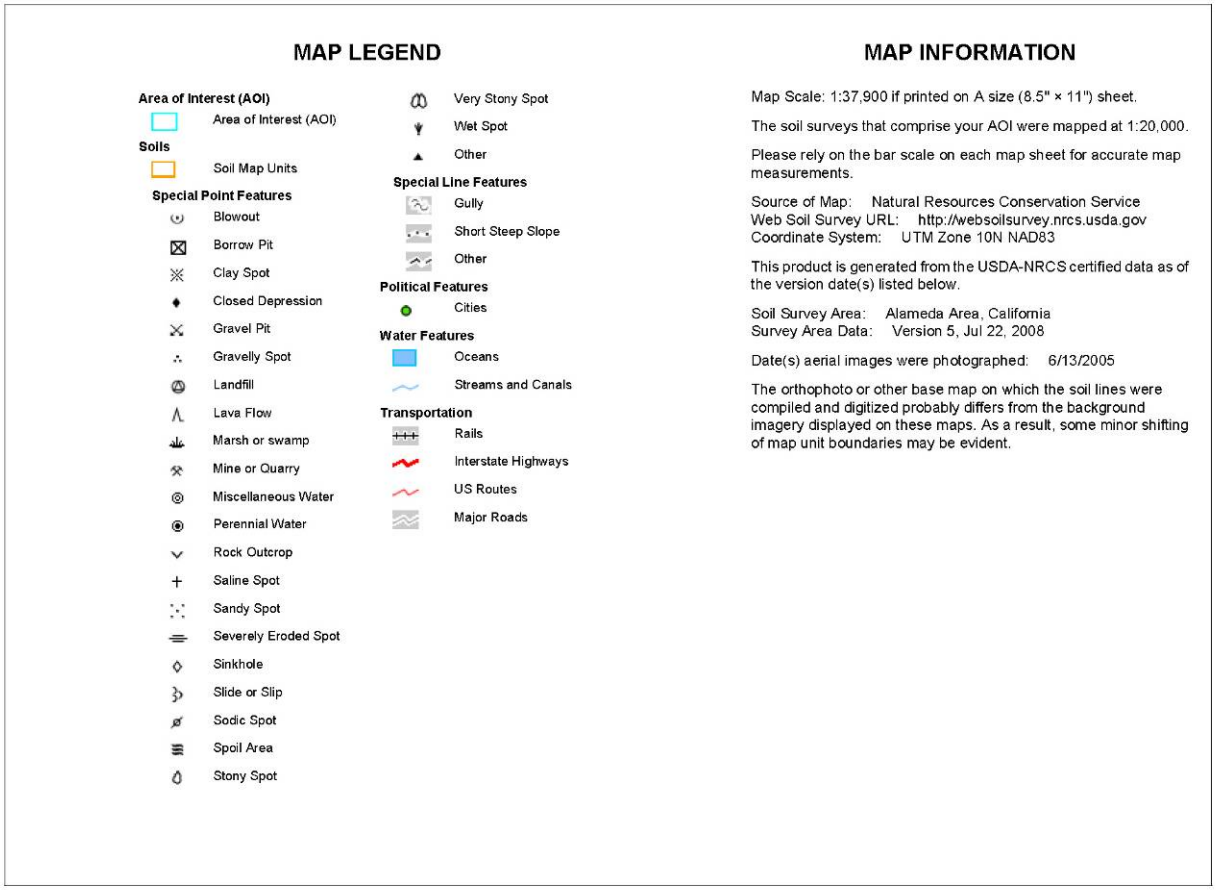
Chain of Lakes Map


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)



USDA Natural Resources Conservation Service | Web Soil Survey, National Cooperative Soil Survey | 3/2/2010 Page 2 of 3

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		

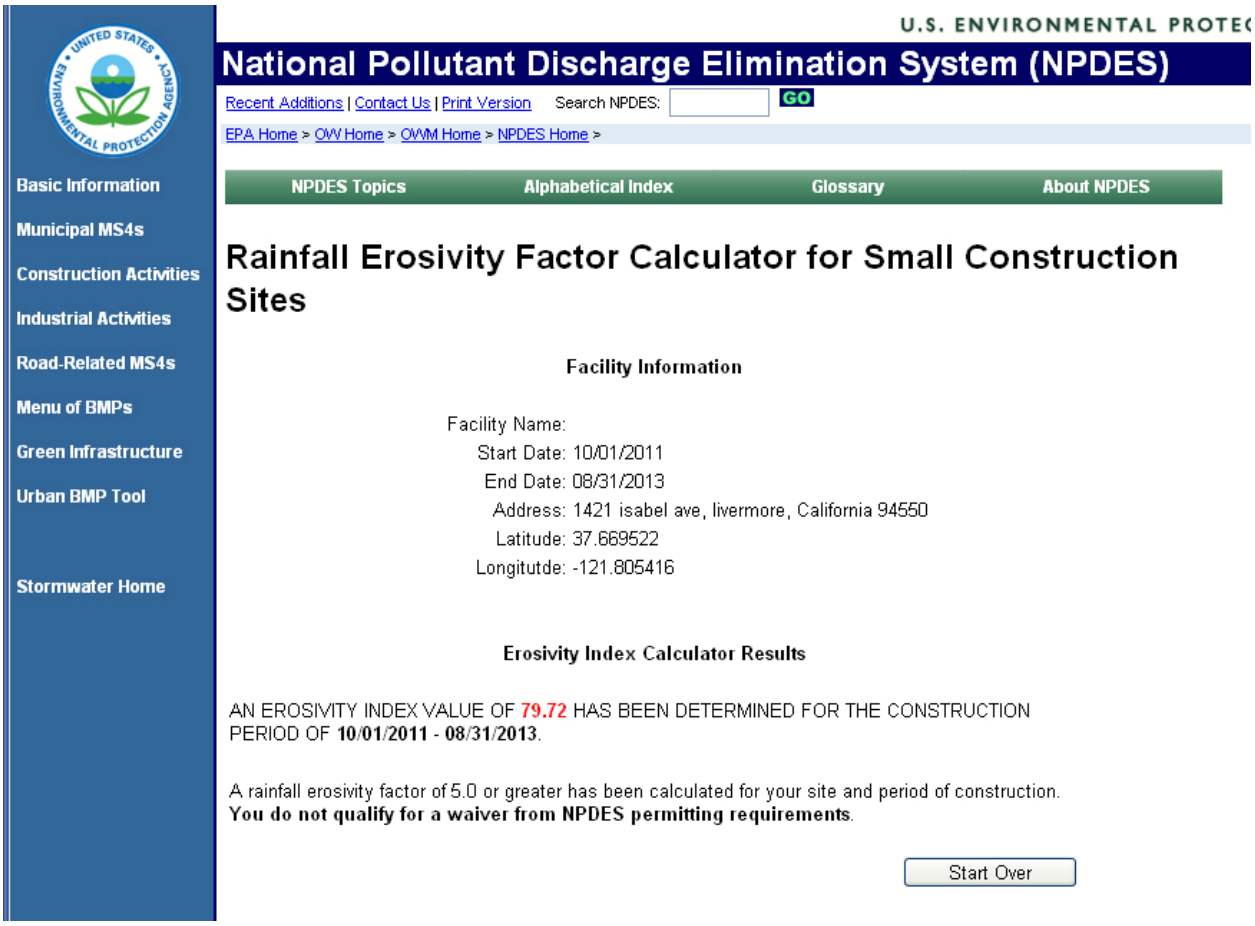
Combined Risk Level Matrix

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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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

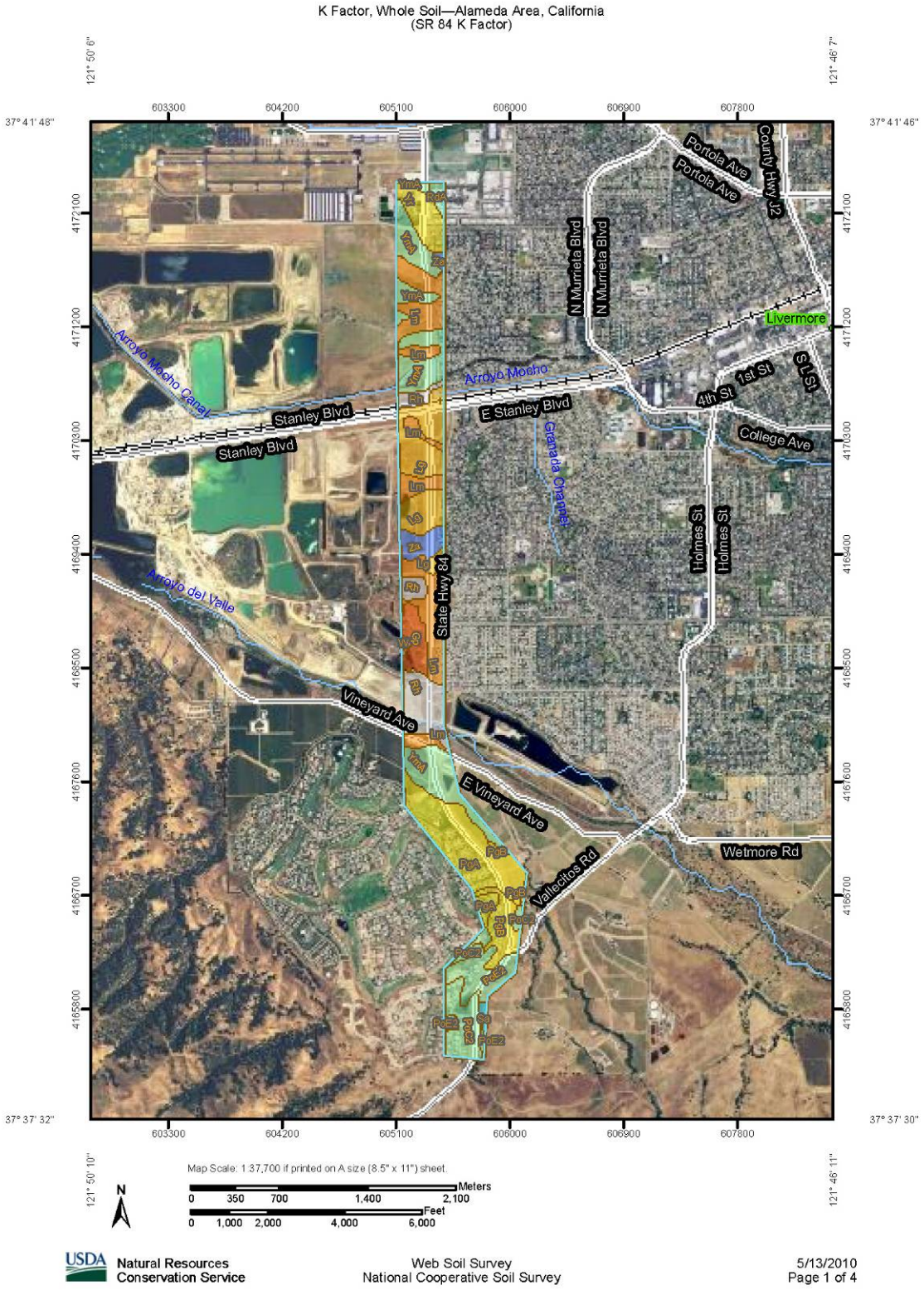
Facility Name:
Start Date: 10/01/2011
End Date: 08/31/2013
Address: 1421 isabel ave, livermore, California 94550
Latitude: 37.669522
Longitutde: -121.805416

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
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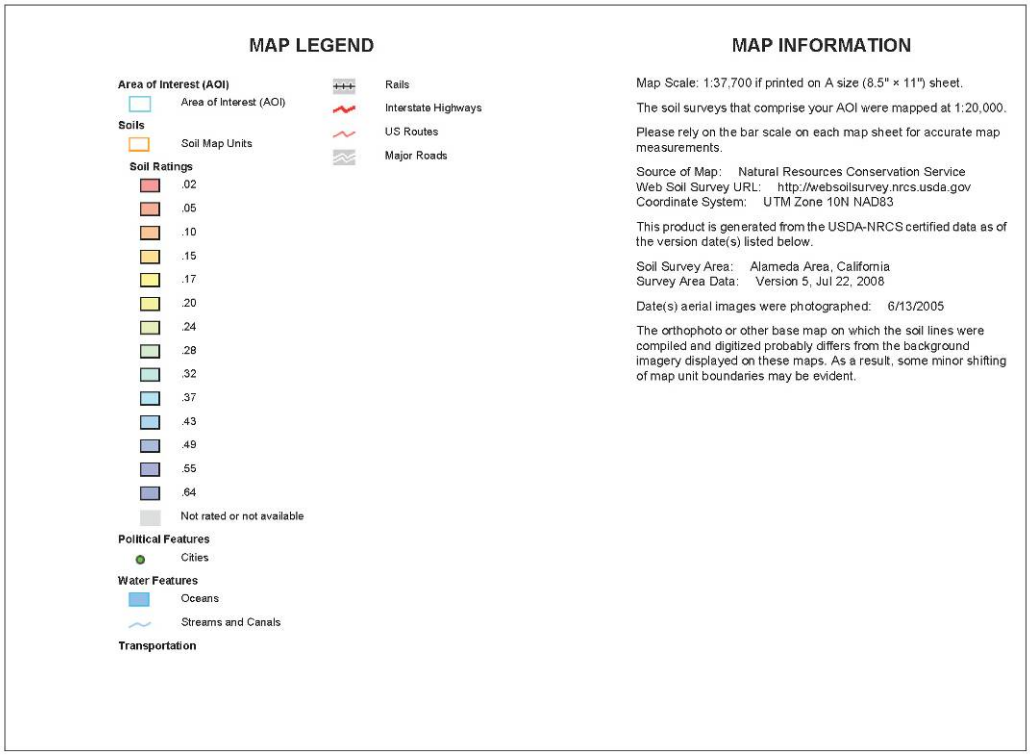
K Factor, Whole Soil–Alameda Area, California
(SR 84 K Factor)



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

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.

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 58606 — Exp. 09-30-11 — CIVIL — STATE OF CALIFORNIA

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:

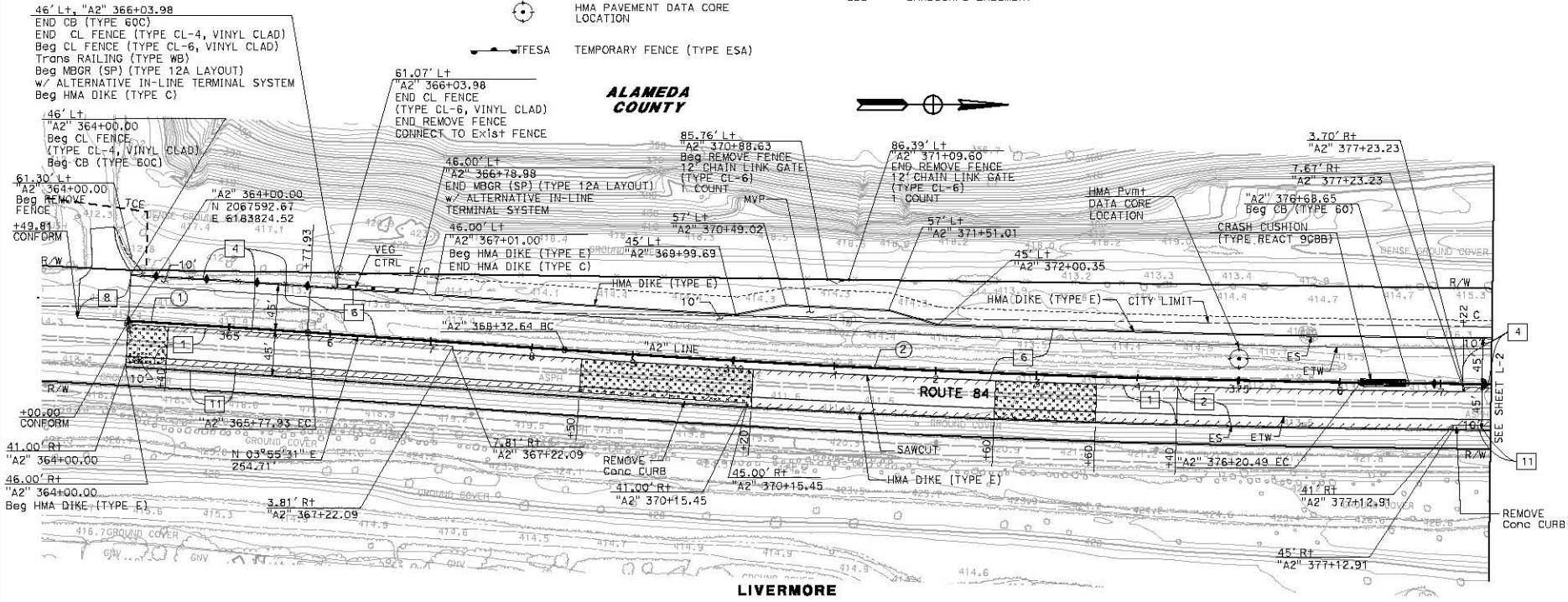
1. COORDINATES, DISTANCES AND BEARINGS SHOWN ARE BASED ON CALIFORNIA COORDINATE SYSTEM ZONE 3. THE HORIZONTAL DATUM IS NAD 83 (1991.35). THE VERTICAL DATUM IS NAVD 1988.
2. FOR LIMITS OF MBGR AND Conc REMOVAL ITEMS, SEE SUMMARY OF QUANTITY SHEETS.
3. FOR LIMITS OF CONTRACT ITEMS AND OTHER INFORMATION 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'	2068575.677	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
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 REVISED: DATE PLOTTED => 11/14/2011 TIME PLOTTED => 12:19:39 PM
10-21-10

BORDER LAST REVISED 7/2/2010
USERNAME => amber_grant
DGN FILE => 04000205801aa001.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 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 58606 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.

URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 94612

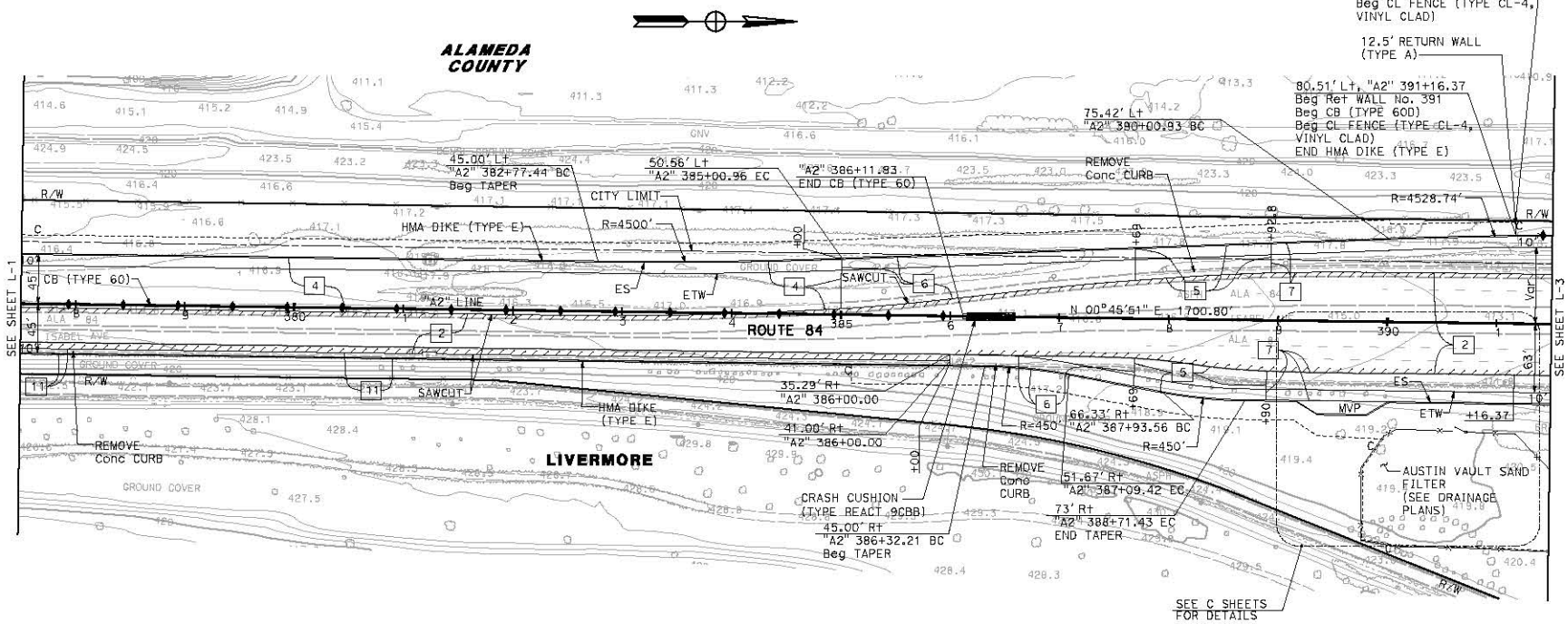
ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

REVISED BY	DATE REVISED
AB	10/18/10

CALCULATED-DESIGNED BY	CHECKED BY
ABHIJEET BHOI	ELIE ABI-JAOUDE

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION



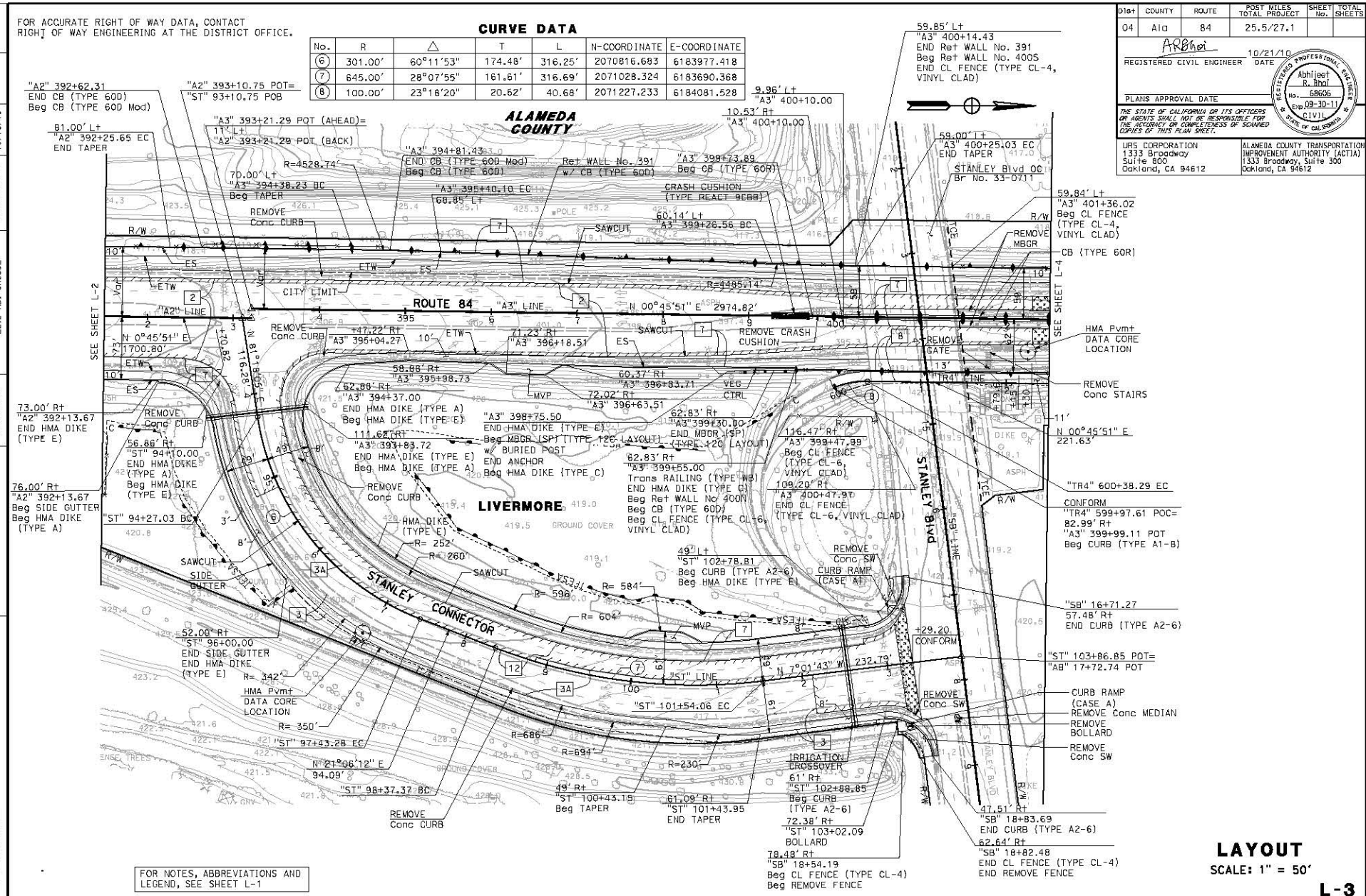
FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

LAYOUT
SCALE: 1" = 50'

L-2

LAST REVISION DATE PLOTTED => 11/14/2011
TIME PLOTTED => 12:19:57 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => amber_grant | DGN FILE => 04000205801aa002.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. 58606 Exp. 09-30-11 CIVIL STATE OF CALIFORNIA

PLANS APPROVAL DATE

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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 REVISED: DATE PLOTTED => 11/14/2011 TIME PLOTTED => 12:20:10 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => amber_grant DGN FILE => 04000020580aa003.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. 58606 Exp. 09-30-11 CIVIL STATE OF CALIFORNIA

PLANS APPROVAL DATE

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1333 Broadway, Suite 300
Oakland, CA 94612

57.06′ Lt
"A3" 402+99.26
Beg CB (TYPE 60D Mod)
END CB (TYPE 60D)

59.83′ Lt
"A3" 402+99.26
Beg Ret WALL No. 403
Beg CB (TYPE 60D Mod)
Beg CL FENCE (TYPE CL-4, VINYL CLAD)
END CB (TYPE 60D)

20:1 TAPER

9.92′ Lt
"A3" 403+40

59.83′ Lt
"A3" 403+55.25
END CB (TYPE 60D Mod)
Beg CB (TYPE 60D)

"A3" 403+68.00
END CB (TYPE 60R)
Beg CB (TYPE 60)

ISABEL Ave UP
Br No. 33-0712

Union Pacific Railroad

REMOVE CRASH CUSHION

59.00′ Lt
"A3" 403+97.74
Beg TAPER

56.95′ Lt
"A3" 402+57.80
Beg CB (TYPE 60D)

59.83′ Lt
"A3" 402+57.63
END Ret WALL No. 400S
END CB (TYPE 60D)
END CL FENCE (TYPE CL-4, VINYL CLAD)

10′

10.22′ Rt
"A3" 403+40.00

62.00′ Lt
"A3" 405+77.73
END TAPER

6.82′ Lt
"A3" 408+75.00

1.93′ Lt
"A3" 408+75.00

HMA Pvmt
DATA CORE LOCATION

62.83′ Lt
"A3" 411+80.00
END Ret WALL No. 403
END CB (TYPE 60D)
Beg CB (TYPE 60C)

86.36′ Lt
"A3" 412+20.96
Beg REMOVE FENCE
Beg CL FENCE (TYPE CL-6, VINYL-CLAD)

73.30′ Lt
"A3" 412+20.96
END CL FENCE (TYPE CL-6, VINYL CLAD)
12′ CHAIN LINK GATE (TYPE CL-6)
1 COUNT

62.83′ Lt
"A3" 412+20.96
END CB (TYPE 60C)
Trans RAILING (TYPE WB)
Beg MBGR (SP) (TYPE 12A LAYOUT)
w/ ALTERNATIVE IN-LINE TERMINAL SYSTEM
Beg HMA DIKE (TYPE C)
END CL FENCE (TYPE CL-4, VINYL-CLAD)
Beg FENCE (TYPE CL-6, VINYL-CLAD)

ALAMEDA COUNTY

REMOVE Conc CURB

SAWCUT

CITY LIMIT

"A3" LINE

ROUTE 84

ETW

ES

N 00°45′51″ E 2974.82′

57.40′
"A3" 409+86.36

REMOVE MBGR

REMOVE Conc CURB

52.68′ Rt
"A3" 410+51.64
END REMOVE MBGR
Beg REMOVE CB

"TR4" LINE

59′ Rt
"A3" 406+31.26
Beg TAPER

"TR4" 605+13.80 EC
CONFORM

"TR4" 604+40.75 BC

Ret WALL No. 400N w/ CB (TYPE 60D) CL FENCE (TYPE CL-4, VINYL CLAD)

34.36′ Rt
"A3" 408+79.66

41.13′ Rt
"A3" 408+79.53

LIVERMORE

Arroyo Mocho

ARROYO MOCHO

GROUND COVER

"TR4" 602+59.92 BC

"TR4" 602+68.55 PRC

N 08°57′19″ E
36.43′

"TR4" 604+04.31 EC

"TR4" 602+74.72 EC

"TR4" 602+75.11
END CURB (TYPE A1-8)

N 00°45′51″ E 88.28′

"TR4" 603+62.99 BC

61.65′ Rt
"A3" 403+93.26
END CL FENCE(TYPE CL-6, VINYL-CLAD)
Beg CL FENCE(TYPE CL-4, VINYL-CLAD)

57.53′ Rt
"A3"411+80.00
END Ret WALL No. 400N
END CB (TYPE 60D)
Beg CB (TYPE 60C)

SEE SHEET L-3

SEE SHEET L-5

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET L-1

LAYOUT

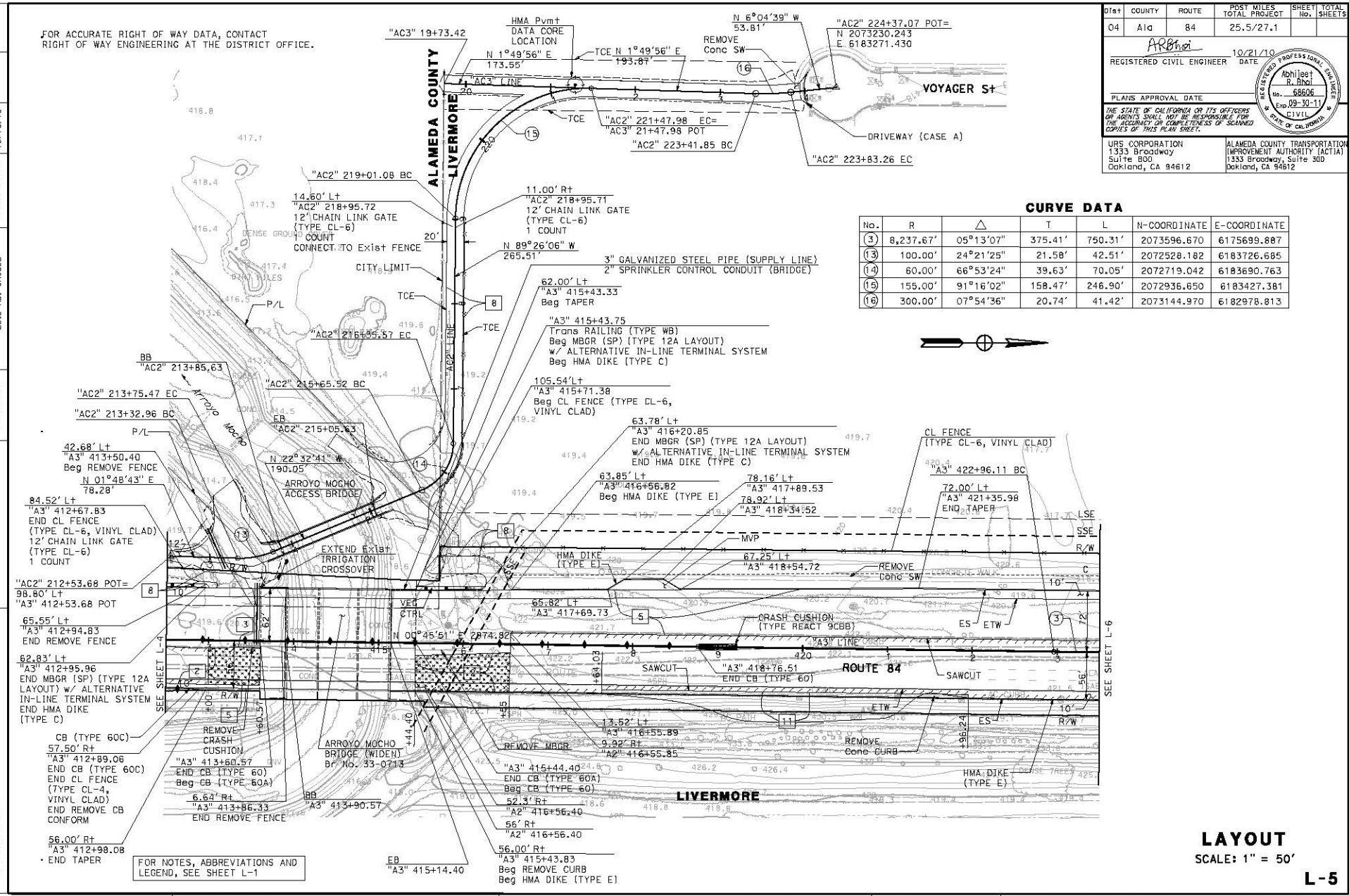
SCALE: 1" = 50′

L-4

LAST REVISED
DATE PLOTTED => 11/14/2011
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 => 04000205801aa004.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 10/21/10
REGISTERED CIVIL ENGINEER DATE

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.

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-11 — CIVIL — STATE OF CALIFORNIA

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	10/18/10

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 => 10-21-10 | TIME PLOTTED => 12:20:43 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => amber_grant | DGN FILE => 040002058oea005.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 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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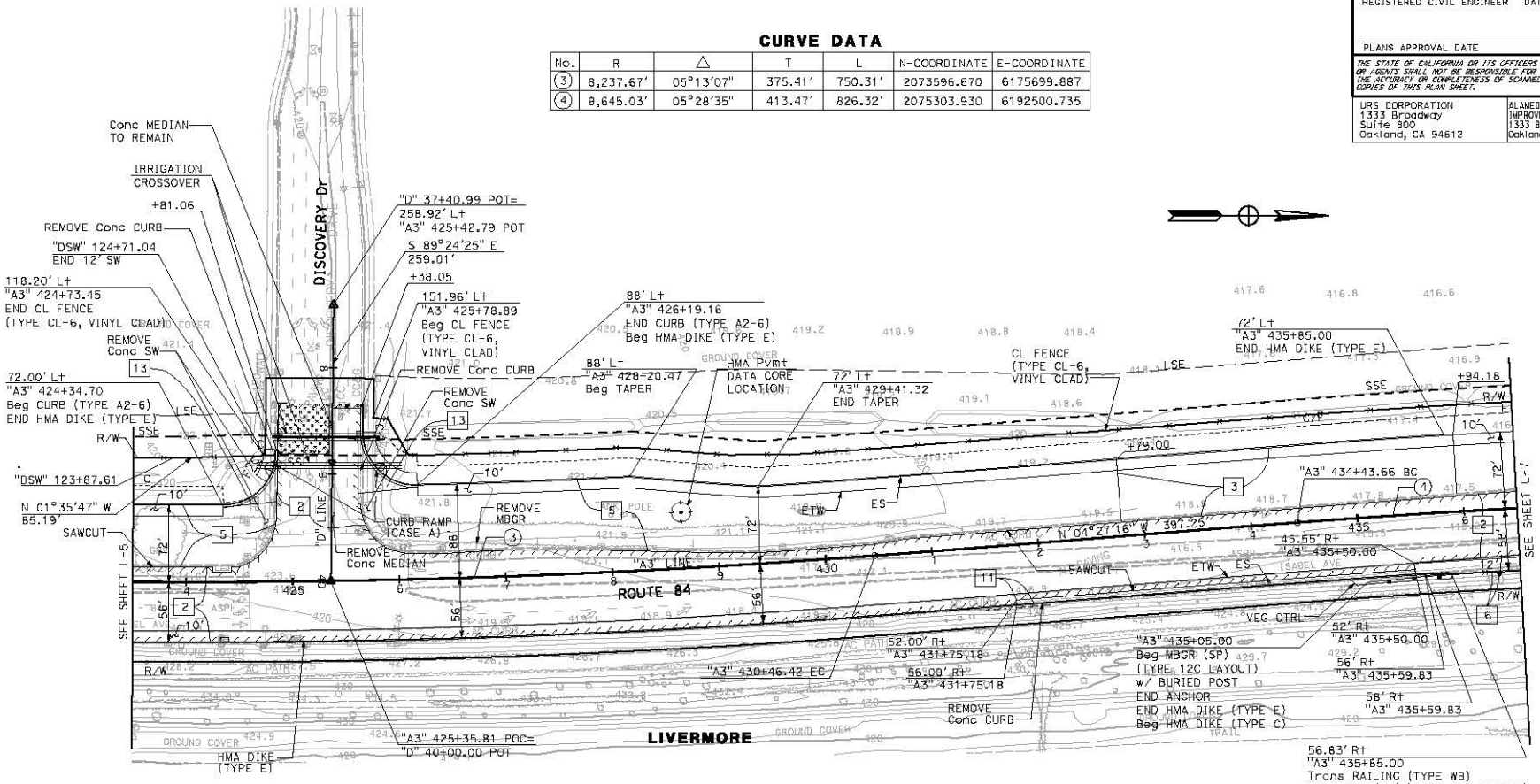
Abhijeet R. Bhoi No. 58606 Exp. 09-30-11 CIVIL STATE OF CALIFORNIA — REGISTERED PROFESSIONAL ENGINEER

URS CORPORATION
1333 Broadway
Suite 800
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
(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	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
	RAMSEY J. HISSEN	ABHIJEET BHOI	ELIE ABI-JAOUDE	AB	10/18/10

BORDER LAST REVISED 7/2/2010

USERNAME => amber_grant
DGN FILE => 04000205801aa006.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

LAST REVISION DATE PLOTTED => 11/14/2011
TIME PLOTTED => 12:20:59 PM
10-21-10

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

CURVE DATA

No.	R	Δ	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

Abhijeet R. Bhoi No. 58606 Exp. 09-30-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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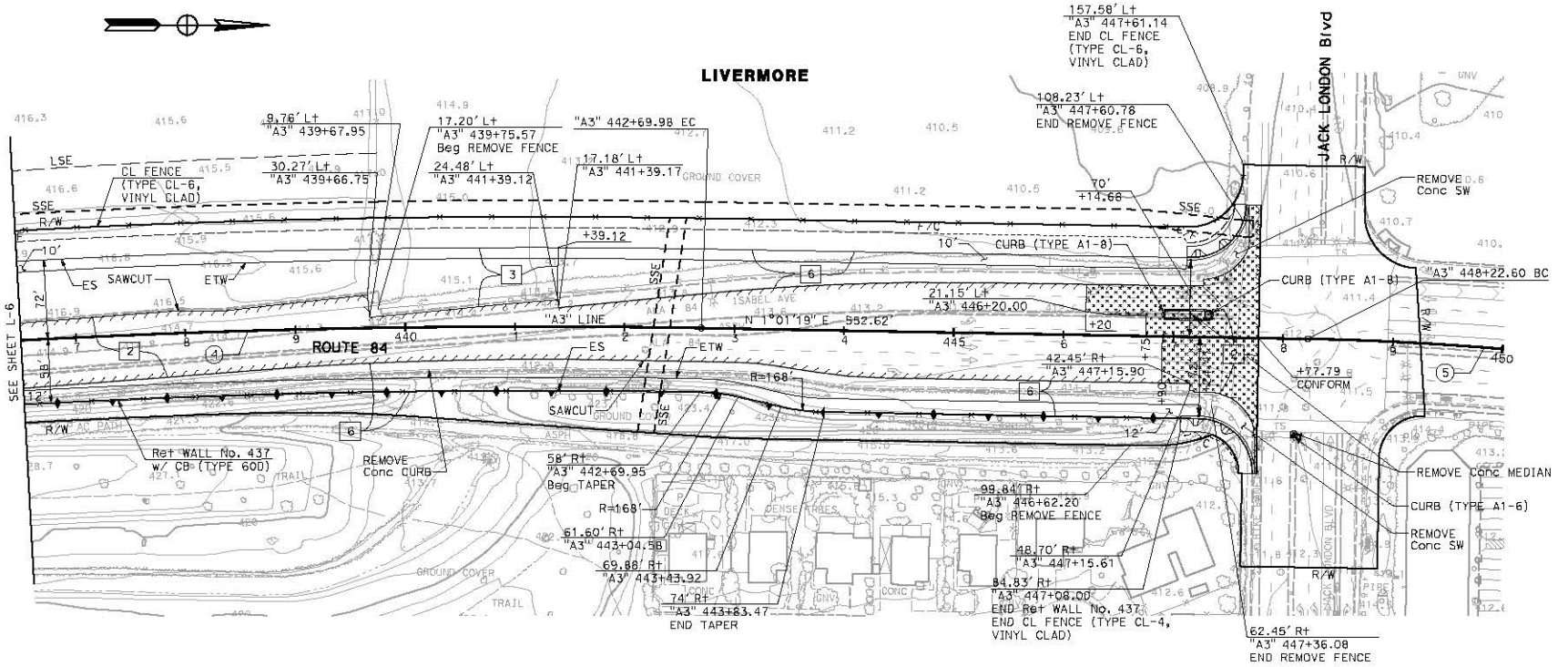
Oakland, CA 94612



FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET L-1.

LAYOUT
SCALE: 1" = 50′

L-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 REVISED | DATE PLOTTED => 11/14/2011 | 10-21-10 | TIME PLOTTED => 12:21:11 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => amber_grant | DGN FILE => 04000205801aa007.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

Layout Sheets – Segment B

By URS Corporation

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

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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:

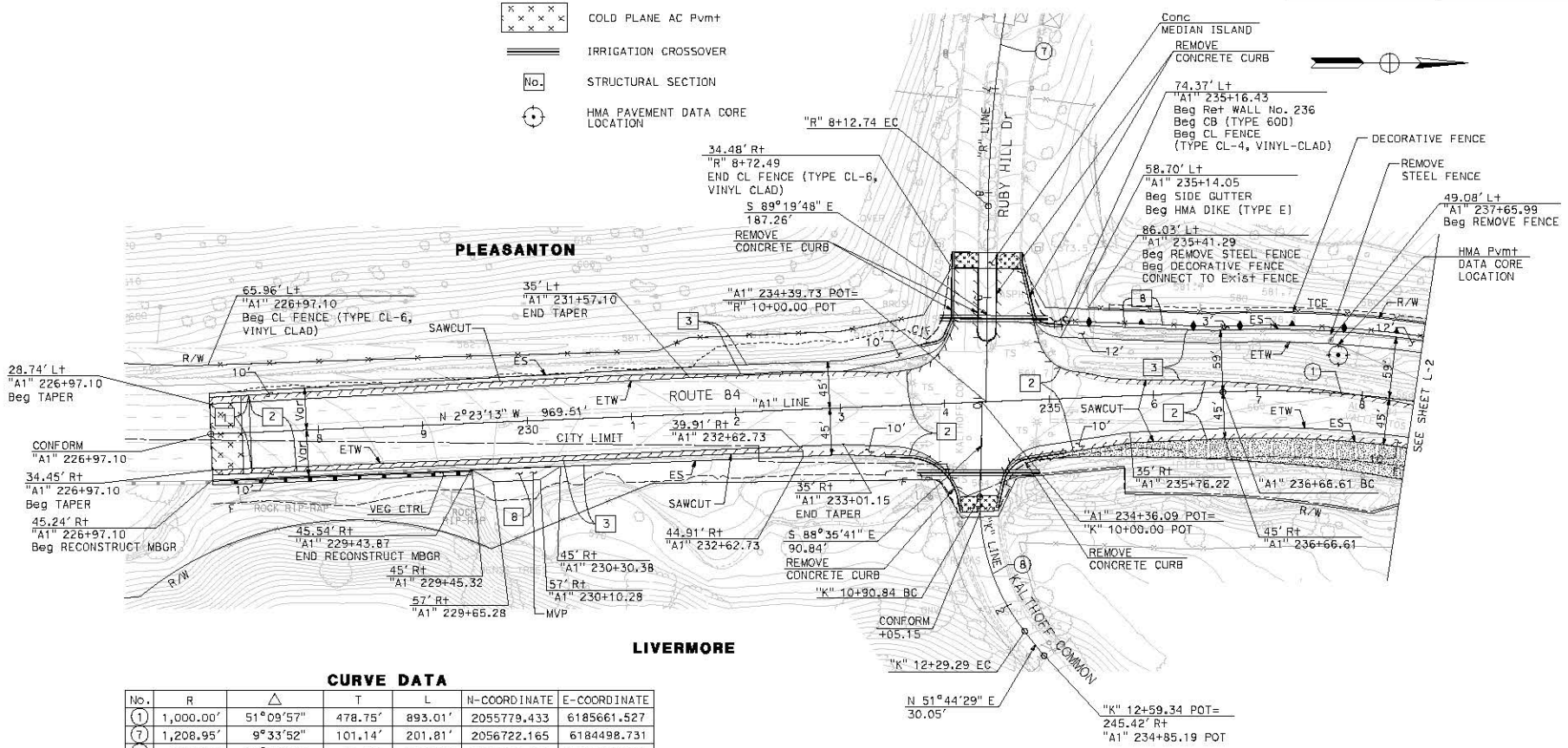
1. COORDINATES, DISTANCES AND BEARINGS SHOWN ARE BASED ON CALIFORNIA COORDINATE SYSTEM ZONE 3. THE HORIZONTAL DATUM IS NAD 83 (1991.35). THE VERTICAL DATUM IS NAVD 1988.
2. FOR LIMITS OF METAL BEAM GUARD RAIL, CHAIN LINK FENCE, CONCRETE BARRIERS AND REMOVAL ITEMS, SEE SUMMARY OF QUANTITY SHEETS.
3. FOR 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



CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
(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

Rev.	By	Date
	AB	10/18/10
REVISED BY	ABHIJEET BHOI	ELIE ABI-JAOUDE
DATE REVISED	CALCULATED-DESIGNED BY	CHECKED BY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

LAST REVISION 10-21-10 | DATE PLOTTED => 10/21/2010 | TIME PLOTTED => 9:28:54 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

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

CURVE DATA

No.	R	Δ	T	L	N-COORDINATE	E-COORDINATE
(1)	1,000.00′	51°09′57"	478.75′	893.01′	2055779.433	6185661.527

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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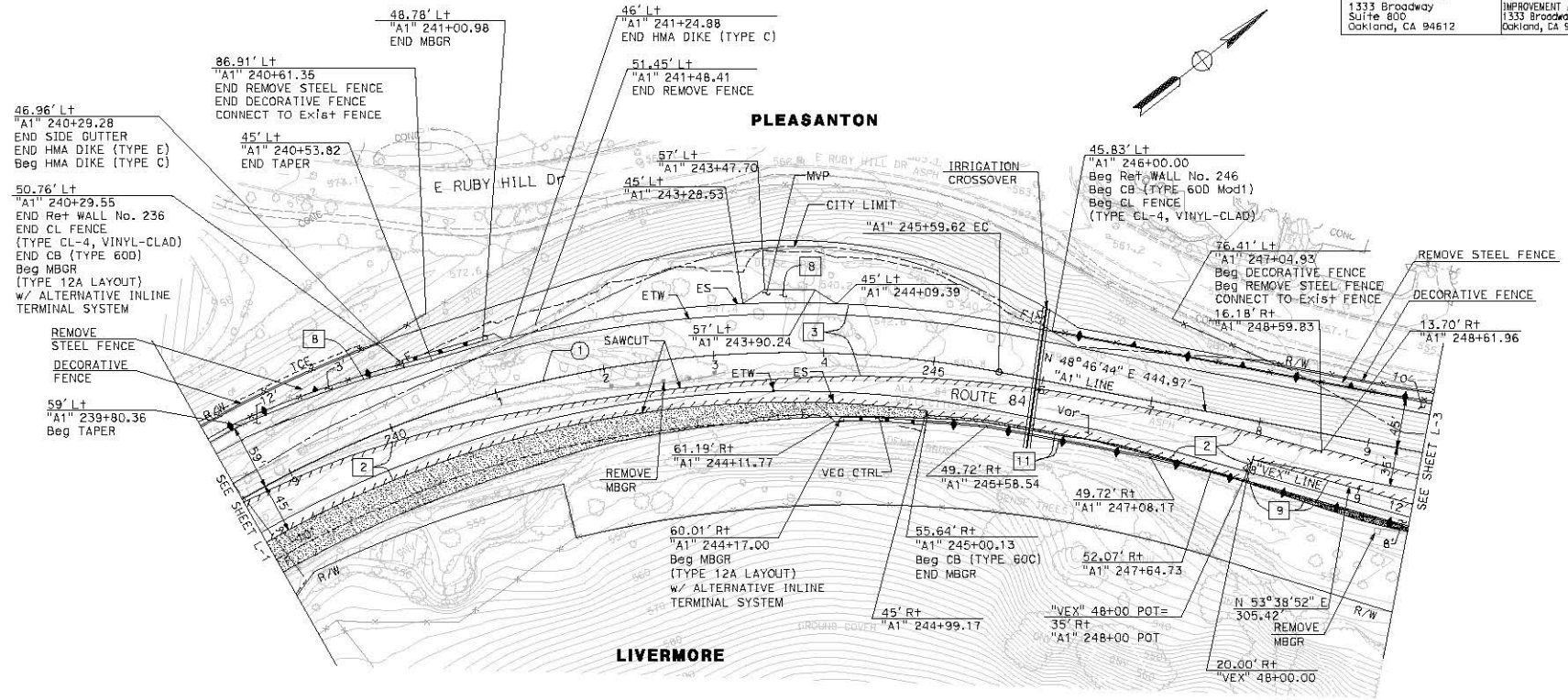
Oakland, CA 94612



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 10-21-10 | DATE PLOTTED => 10/21/2010 | TIME PLOTTED => 9:28:03 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 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 58606 — Exp. 09-30-11 — CIVIL — STATE OF CALIFORNIA

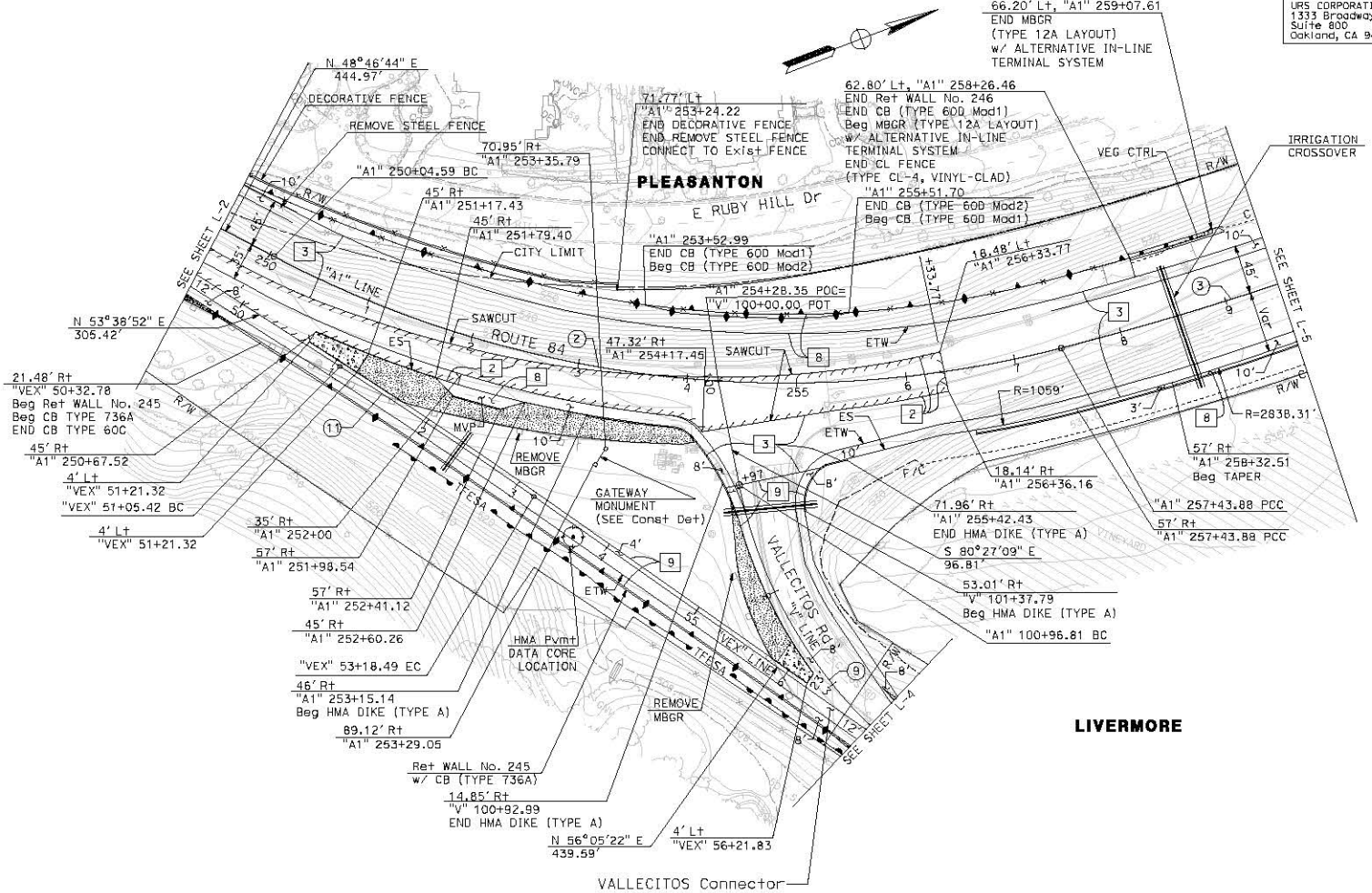
URS CORPORATION
1333 Broadway
Suite 600
Oakland, CA 94612

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.

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
(2)	1,002.00′	42°16′25″	387.36′	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: 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 => 9:26:10 AM

BORDER LAST REVISED 7/2/2010 | USERNAME => minyoung_kim | DGN FILE => ...\EA-Layout\428762ea003.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

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 STATE OF CALIFORNIA REGISTERED PROFESSIONAL ENGINEER

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

LIVERMORE

26.37' L+
"V" 116+41.22
END MBGR (TYPE 12A LAYOUT)
w/ ALTERNATIVE IN-LINE
TERMINAL SYSTEM

21.48' L+
"V" 115+64.62
END Ret WALL No. 110
END CB (TYPE 736A)
Beg MBGR (TYPE 12A LAYOUT)
w/ ALTERNATIVE IN-LINE
TERMINAL SYSTEM

VEG CTRL

HMA Pvmt
DATA CORE
LOCATION

N 49°02'57" E 401.53'

22.92' L+
"V" 110+30.05
Beg Ret WALL No. 110
Beg CB (TYPE 736A)
END MBGR

12' R+
"V" 110+87.34
END TAPER

REMOVE
MBGR

VEG CTRL

31.10' L+
"V" 109+53.42
Beg MBGR
(TYPE 12AA LAYOUT)
w/ ALTERNATIVE IN-LINE
TERMINAL SYSTEM

VALLECITOS RD

31.67' L+
"V" 107+54.34
Beg MBGR(TYPE 16A LAYOUT)
w/ ALTERNATIVE IN-LINE
TERMINAL SYSTEM

"V" 107+03.83 EC

VEG CTRL

24' R+
"V" 103+90.34
Beg TAPER

33.88' L+
"V" 106+70.13
END MBGR

"V" LINE

N 17°42'47" E 358.73'

"V" 114+89.15 EC

SEE SHEET C-14
FOR DRIVEWAY DETAILS

CONFORM +64.62

"V" 116+74.45 POT

VEG CTRL

23.27' R+
"V" 113+08.82
END MBGR
(TYPE 12AA LAYOUT)
w/ ALTERNATIVE IN-LINE
TERMINAL SYSTEM

"V" 110+62.56 BC

21.48' R+
"V" 112+30.19
END Ret WALL No. 109
END CB (TYPE 736A)
Beg MBGR
(TYPE 12AA LAYOUT)
w/ ALTERNATIVE IN-LINE
TERMINAL SYSTEM

21.48' R+
"V" 109+05.00
Beg Ret WALL No. 109
Beg CB (TYPE 736A)
END MBGR (TYPE 12D LAYOUT)

24' R+
"V" 103+68.09

"VEX" LINE

SEE SHEET L-3

VEG CTRL

21.48' R+
"V" 106+59.99
END Ret WALL No. 245
END CB (TYPE 736A)
Beg MBGR (TYPE 12D LAYOUT)

"V" 104+19.17 POC=
"VEX" 57+58.08 POT

FOR NOTES, ABBREVIATIONS AND
LEGEND, SEE SHEET L-1

LAYOUT

SCALE: 1" = 50'

L-4

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 => 9:26:15 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

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

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.

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-11 — CIVIL — STATE OF CALIFORNIA

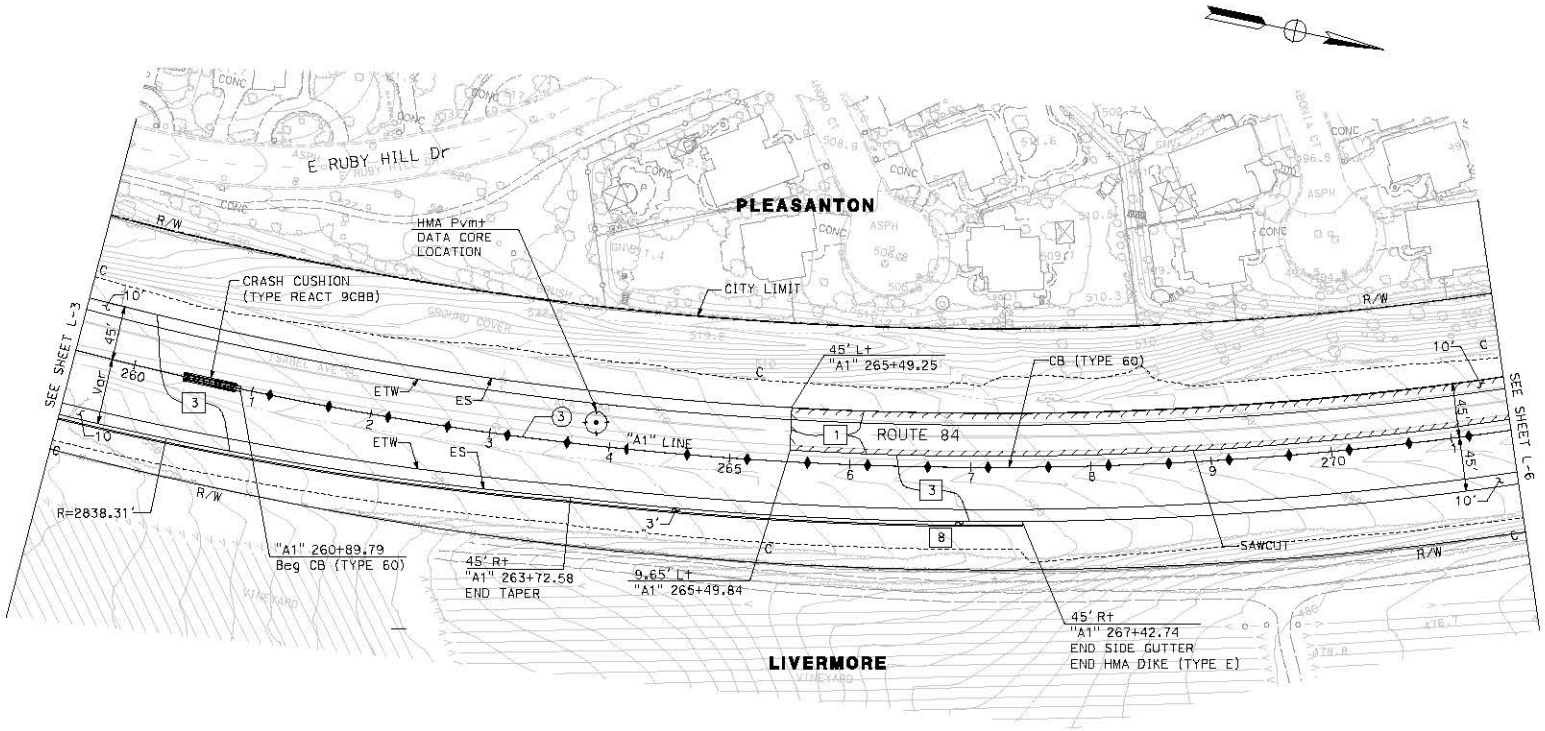
URS CORPORATION
1333 Broadway
Suite 600
Oakland, CA 94612

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.

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



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	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 => 9:28:27 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

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. 58606 — Exp. 09-30-11 — CIVIL — STATE OF CALIFORNIA

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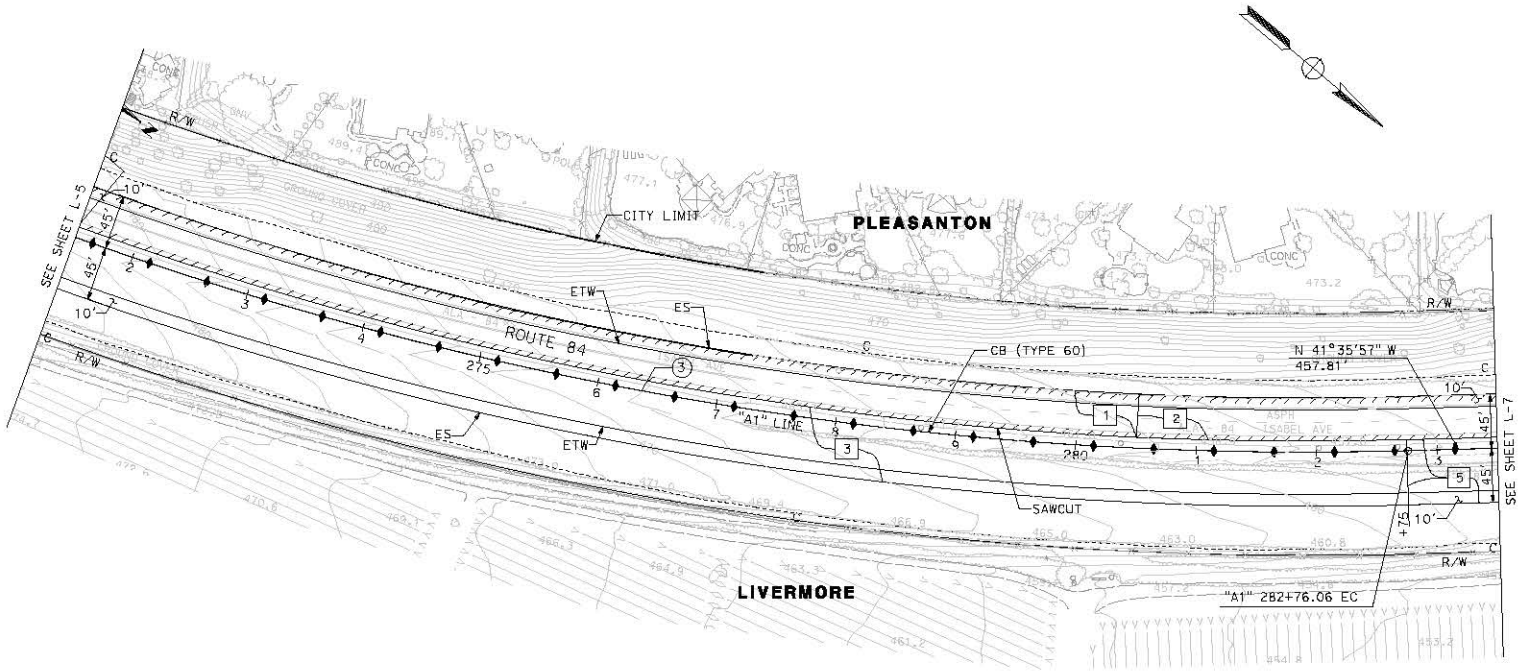
1333 Broadway, Suite 300
Oakland, CA 94612

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
(3)	3,016.00'	48°06'16"	1,346.10'	2,532.18'	2057806.674	6182675.934



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

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

LAST REVISION | DATE PLOTTED => 10/21/2010 | TIME PLOTTED => 9:28:16 AM
10-21-10

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

CURVE DATA

No.	R	Δ	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 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 58606 — Exp. 09-30-11 — CIVIL — STATE OF CALIFORNIA

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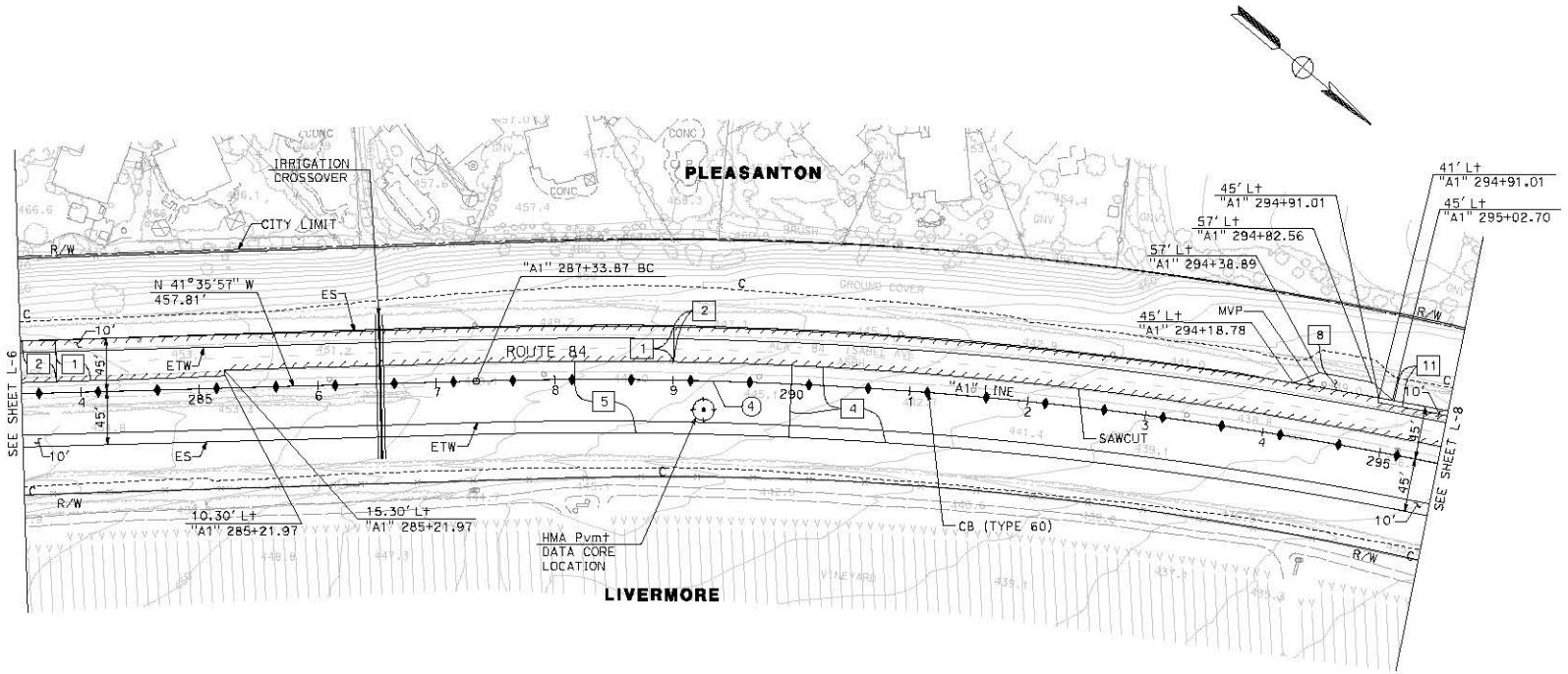
1333 Broadway
Suite 800
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612



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 | 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

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoj 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoj No. 58606 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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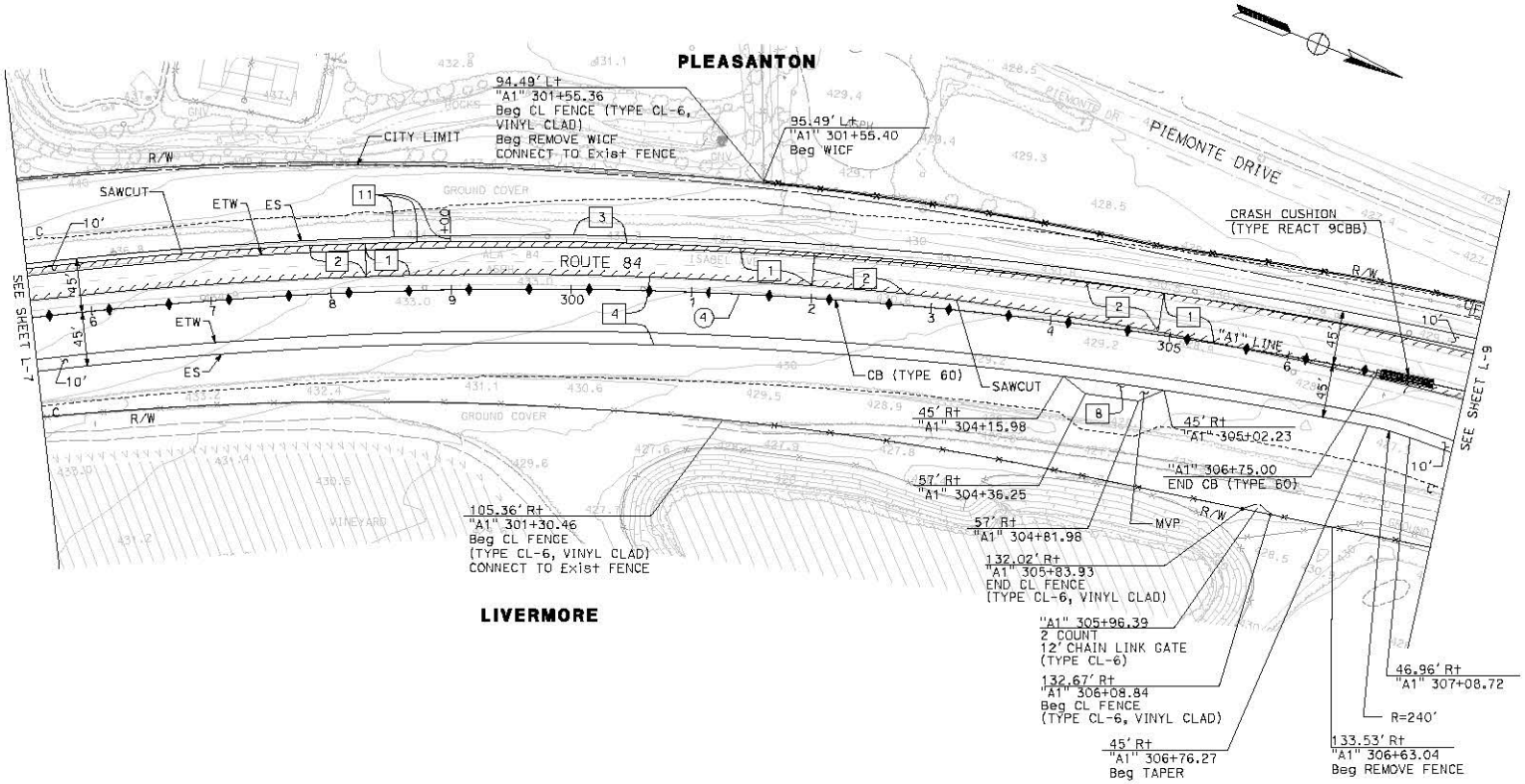
Suite 800
Oakland, CA 94612

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.

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

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | CONSULTANT FUNCTIONAL SUPERVISOR | CALCULATED-DESIGNED BY | CHECKED BY | REVISED BY | DATE REVISED

RAMSEY J. HISSEN | ABHIJEET BHOJ | ELIE ABI-JAOUDE | AB | 10/18/10

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

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

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.

Abhijeet R. Bhoi No. 68606 Exp. 09-30-11 CIVIL STATE OF CALIFORNIA

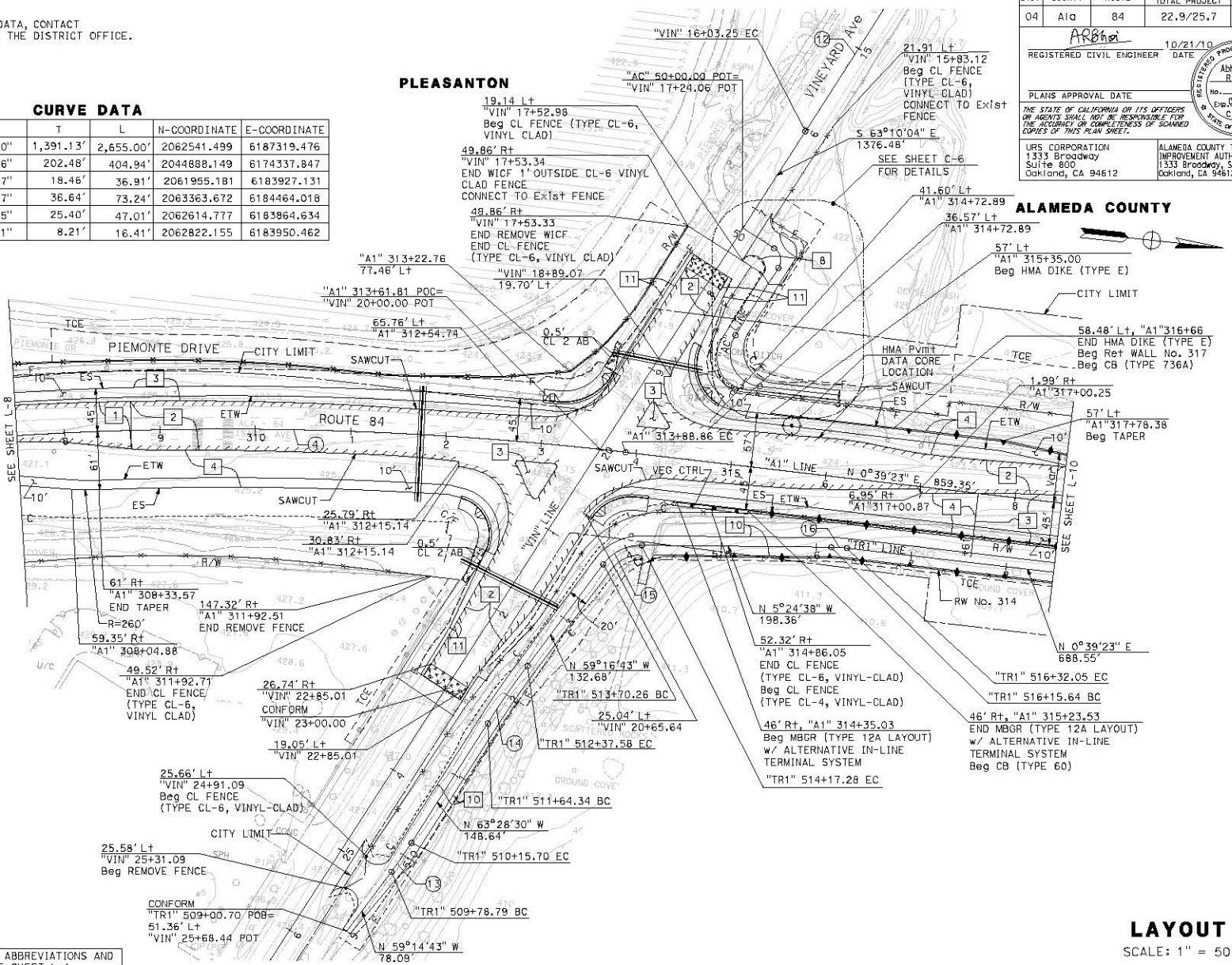
URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 94612

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.

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

LAYOUT

SCALE: 1" = 50'

L-9

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 => 9:27:29 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		

ABhijeet 10/21/10
REGISTERED CIVIL ENGINEER DATE

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.

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoj — No. 58606 — Exp. 09-30-11 — CIVIL — STATE OF CALIFORNIA

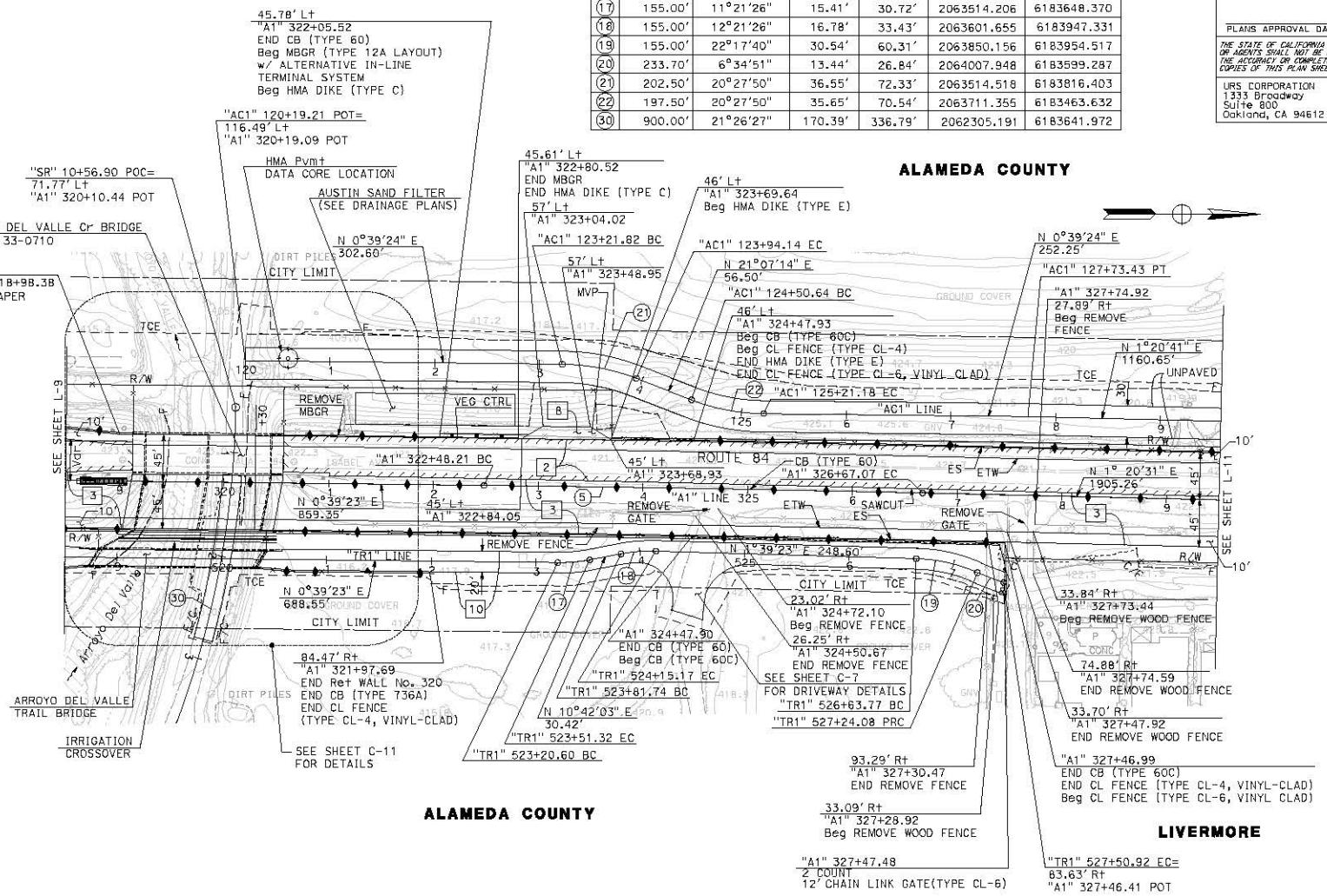
URS CORPORATION
1333 Broadway
Suite 600
Oakland, CA 94612

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.

CURVE DATA

No.	R	Δ	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
	RAMSEY J. HISSEN	ABHIJEET BHOJ	ELIE ABI-JAOUDE	AB	10/18/10

LAST REVISION 10-21-10 | DATE PLOTTED => 10/21/2010 | TIME PLOTTED => 9:21:57 AM

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

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

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.

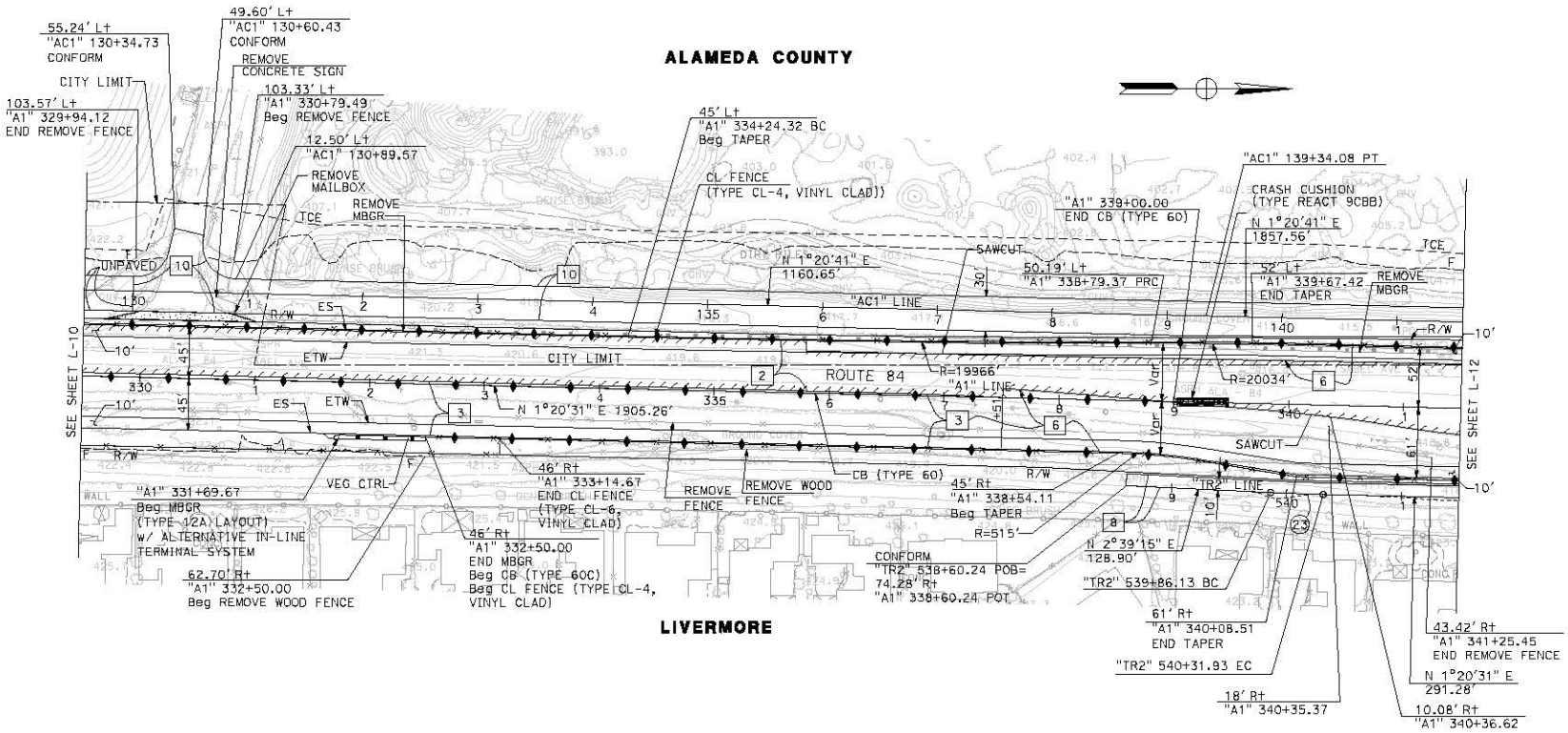
Abhijeet R. Bhoi No. 58606 Exp. 09-30-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

URS CORPORATION
1333 Broadway
Suite 800
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
(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

BORDER LAST REVISED 7/2/2010 | USERNAME => minyoung_klm | DGN FILE => ...\EA-Layout\429762ea011.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 => 9:27:45 AM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ABhijeet 10/21/10
REGISTERED CIVIL ENGINEER — DATE

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.

Abhijeet R. Bhoj No. 68606 Exp. 09-30-11 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

URS CORPORATION
1333 Broadway
Suite 600
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.

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

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

94.02′ Lt "A1" 343+84.22 Beg REMOVE FENCE

129.11′ Lt "A1" 343+92.51 END REMOVE FENCE

87.06′ Lt "A1" 344+07.55 Beg REMOVE FENCE

153.77′ Lt "A1" 344+17.48 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

"CON" 29+25.01 POE= "AC1" 145+49.21 POT

"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)

68.02′ Lt "A2" 346+18.10 END REMOVE FENCE

82.96′ Lt "A1" 343+47.13 Beg REMOVE FENCE

13.50′ Lt "AC1" 143+39.18 END CL FENCE (TYPE CL-6, VINYL CLAD)

"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

UNPAVED

SAWCUT

"AC1" LINE

N 1°20′41" E 1857.56′

N 1°20′31"E 1905.26′ "A1" LINE

ROUTE 84

CITY LIMIT

N 1°20′31" E 1218.82′

"A2" LINE

"A1" 344+40.32 56.81′ Rt END REMOVE WOOD FENCE

REMOVE CONCRETE SIDEWALK

CURB RAMP (CASE C)

747′ Lt "A1" 348+14.55 Beg TAPER

SEE SHEET L-11

SEE SHEET L-13

HMA Pvmt DATA CORE LOCATION

SAWCUT

N 1°20′31" E 674.77′

63′ Rt "A1" 350+33.02

ETW

ES

R/W

"TR2" LINE

"TR3" LINE

"TR2" 543+23.21 BC

"A1" 343+38.11 63.00′ Rt END CB (TYPE 60C)

N 1°20′31" E 291.28′

LOT "B"

REMOVE CONCRETE SIDEWALK

REMOVE BOLLARD

81.07′ Rt "A2" 346+14.76 BOLLARD

REMOVE CONCRETE CURB

"TR3" 546+08.02 POB= 86.07′ Rt "A2" 346+08.02 POT

90.07′ Rt "A2" 349+79.95 Beg REMOVE FENCE

63.40′ Rt "A2" 349+84.26 END REMOVE FENCE

REMOVE GATE

63.40′ Rt "A2" 350+03.98 Beg REMOVE FENCE

73′ Rt "A1" 350+33.19 Beg TAPER

REMOVE GATE

70.55′ Rt "A2" 353+07.97 END REMOVE FENCE

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

63.59′ Rt "A1" 344+53.87 END CL FENCE (TYPE CL-4, VINYL CLAD)

"TR2" 544+83.96 POT= 75.44′ Rt "A1" 344+84.68

74.93′ Rt "A1" 344+85.53 Beg CURB (TYPE A1-6)

S 89°14′35" E 787.67′ "CON" LINE 2 CONCANNON Blvd

REMOVE CONCRETE ISLAND

2.78′ Lt "CON" 31+11.15 END CURB (TYPE A1-6) CONFORM

1.83′ Rt "CON" 31+11.15 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: ABHIJEET BHOJ | CHECKED BY: ELIE ABI-JAOUDE | REVISED BY: AB | DATE REVISED: 10/18/10

BORDER LAST REVISED 7/2/2010 | USERNAME => minyoung_kim | DGN FILE => ...\EA-Layout\420762ea012.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

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.

Abhijeet R. Bhoi No. 68606 Exp. 09-30-11 CIVIL STATE OF CALIFORNIA

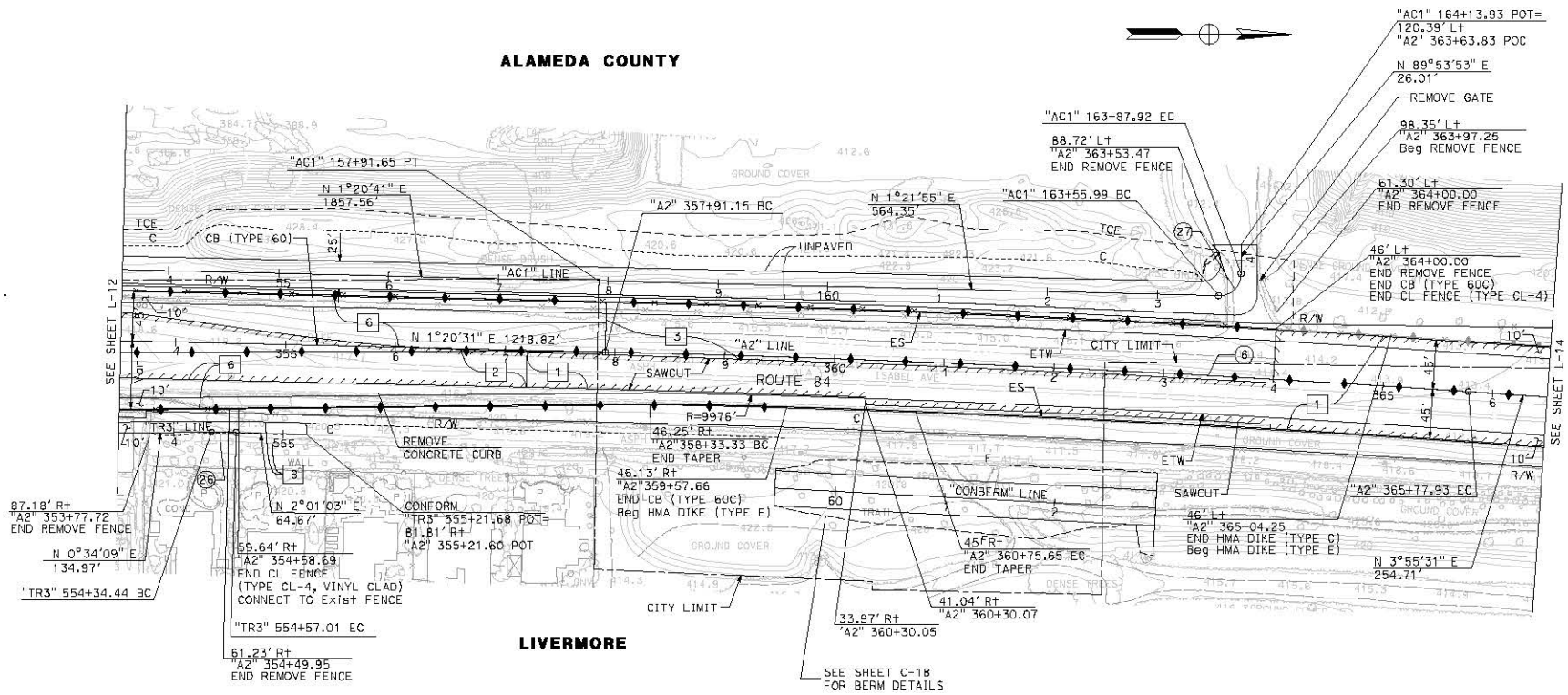
URS CORPORATION
1333 Broadway
Suite 600
Oakland, CA 94612

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.

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
10-21-10 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

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 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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REGISTERED PROFESSIONAL ENGINEER
Abhijeet R. Bhoi
No. 58606
Exp. 09-30-11
CIVIL
STATE OF CALIFORNIA

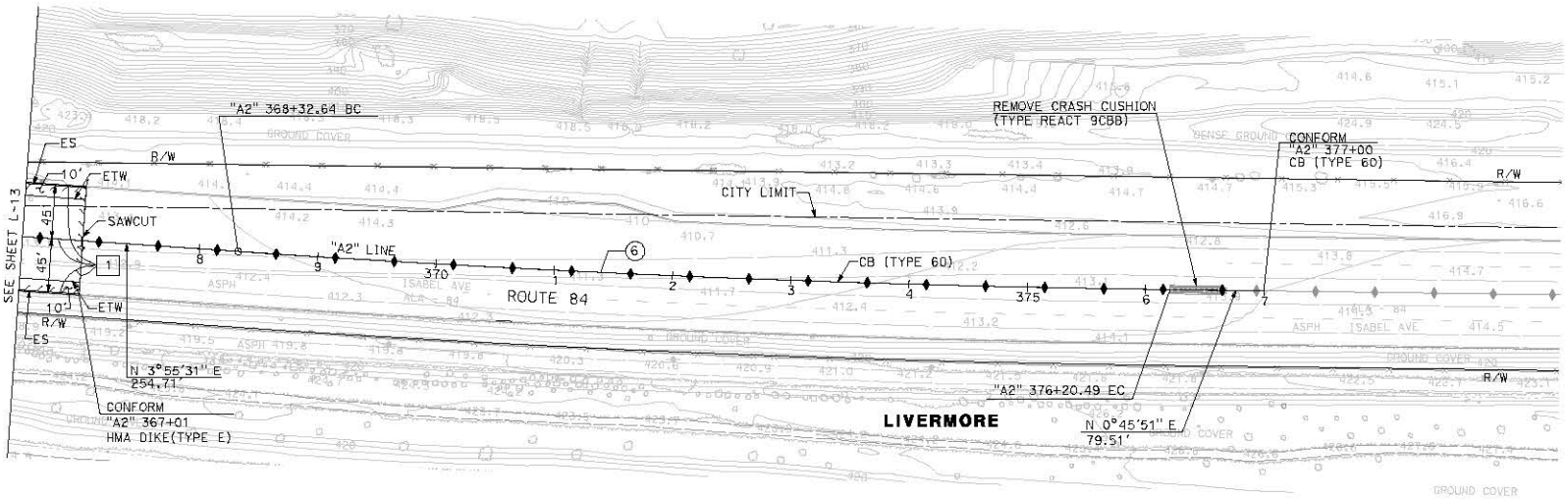
URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

CURVE DATA

No.	R	Δ	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
Caltrans

LAST REVISION 10-21-10 | DATE PLOTTED => 10/21/2010 | TIME PLOTTED => 9:28:23 AM

BORDER LAST REVISED 7/2/2010 | USERNAME => minyoung_klm | 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

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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1333 Broadway
Suite 800
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

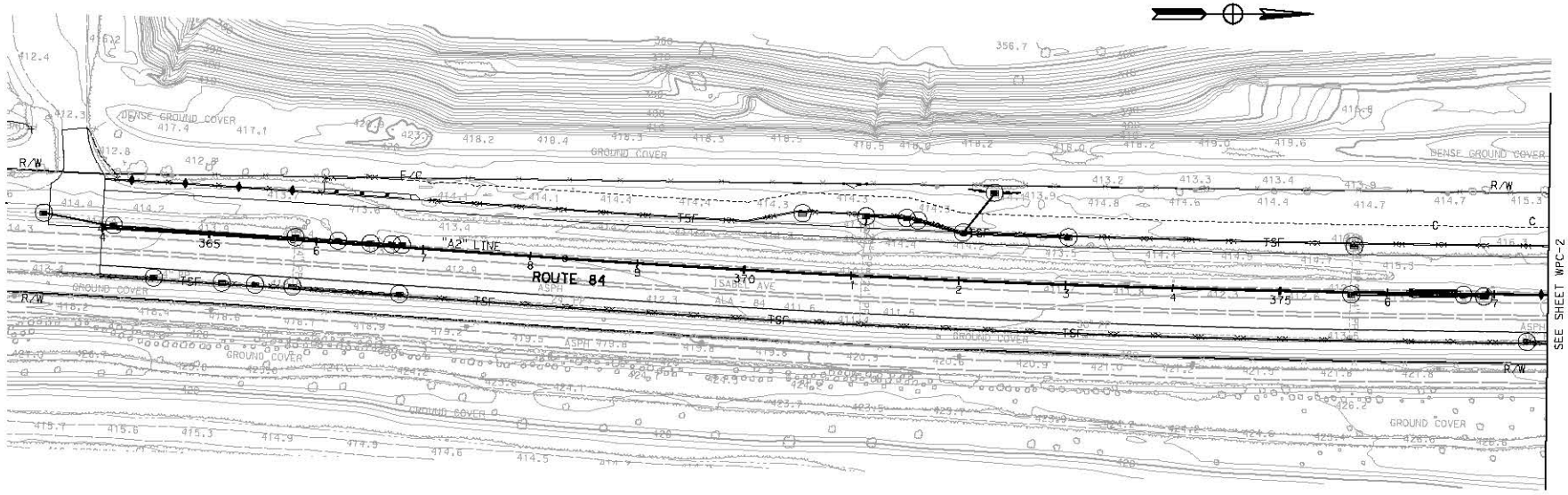
FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

NOTES:

1. 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
- TSF — TEMPORARY SILT FENCE
- TFR — TEMPORARY FIBER ROLL



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

BORDER LAST REVISED 7/2/2010
USERNAME => amber_grant
DGN FILE => 04000205801gD001.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205801

LAST REVISED 10-21-10 | DATE PLOTTED => 1/14/2011 | TIME PLOTTED => 11:58:28 AM

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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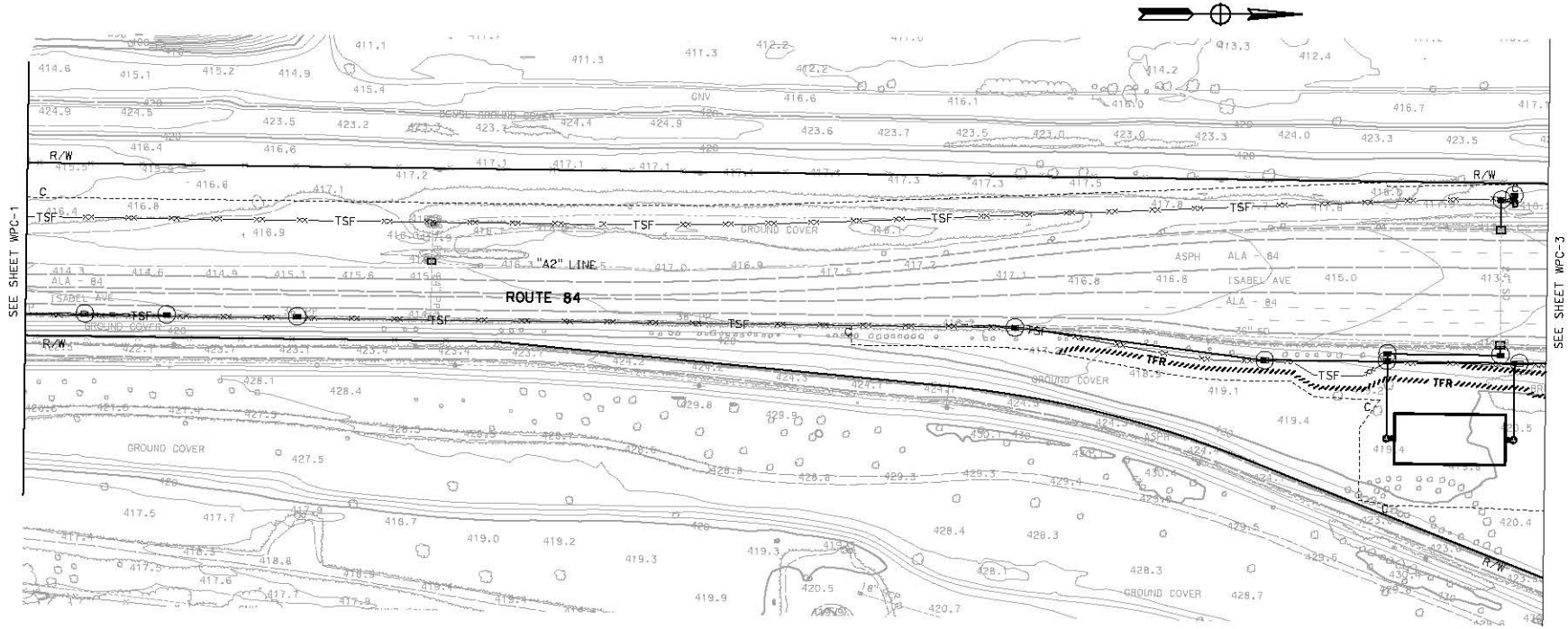

FOR NOTES AND LEGEND,
SEE SHEET WPC-1

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-2

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	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
DATE PLOTTED => 1/14/2011
TIME PLOTTED => 11:48:43 AM

BORDER LAST REVISED 7/2/2010

USERNAME => amber_grant
DGN FILE => 04000205801gD002.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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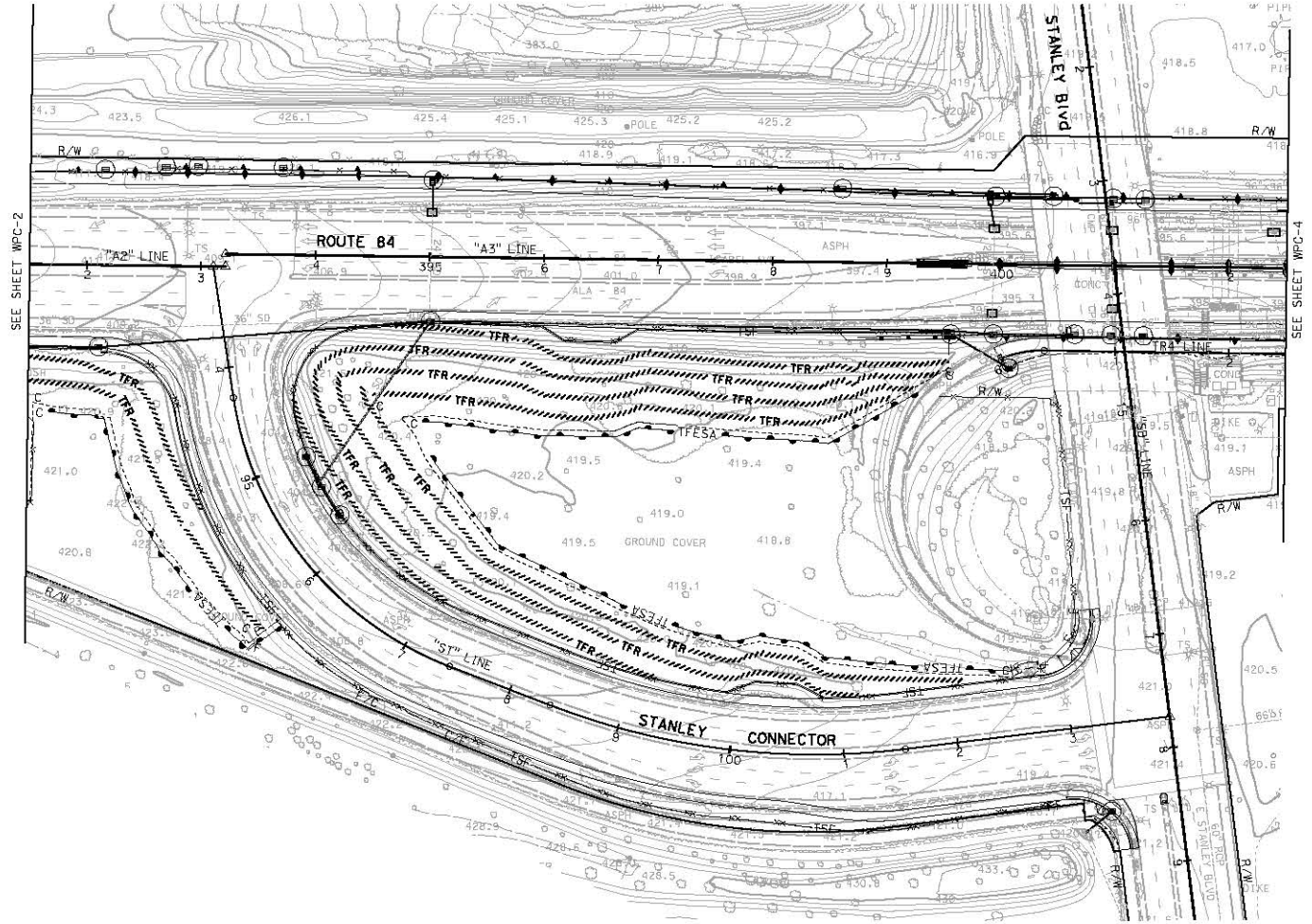
Oakland, CA 94612



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: RAMSEY J. HISSEN

CALCULATED-DESIGNED BY: MARIA SEDGHI

CHECKED BY: ABHIJEET BHOI

REVISED BY: MS

DATE REVISED: 10/19/10

LAST REVISED: DATE PLOTTED => 11/14/2011 TIME PLOTTED => 11:48:54 AM

BORDER LAST REVISED 7/2/2010

USERNAME => amber_grant
DGN FILE => 04000205801gD003.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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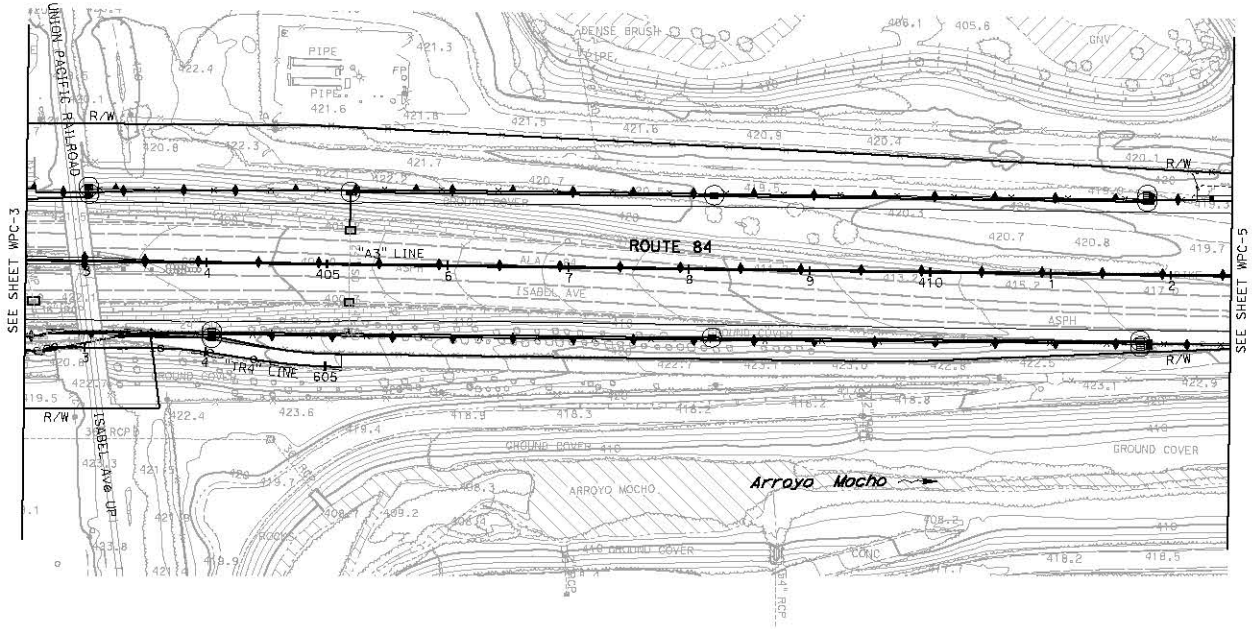

FOR NOTES, ABBREVIATIONS AND LEGEND SEE SHEET WPC-1.

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

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

CALCULATED-DESIGNED BY: MARIA SEDGHI

CHECKED BY: ABHIJEET BHOI

REVISED BY: MS

DATE REVISED: 10/19/10

LAST REVISED
DATE PLOTTED => 1/14/2011
TIME PLOTTED => 11:49:07 AM

BORDER LAST REVISED 7/2/2010

USERNAME => amber_grant
DGN FILE => 04000205801gD004.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

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REGISTERED PROFESSIONAL ENGINEER — Maria Sedghi — No. 74619 — Exp. 12-31-11 — CIVIL — STATE OF CALIFORNIA

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Oakland, CA 94612

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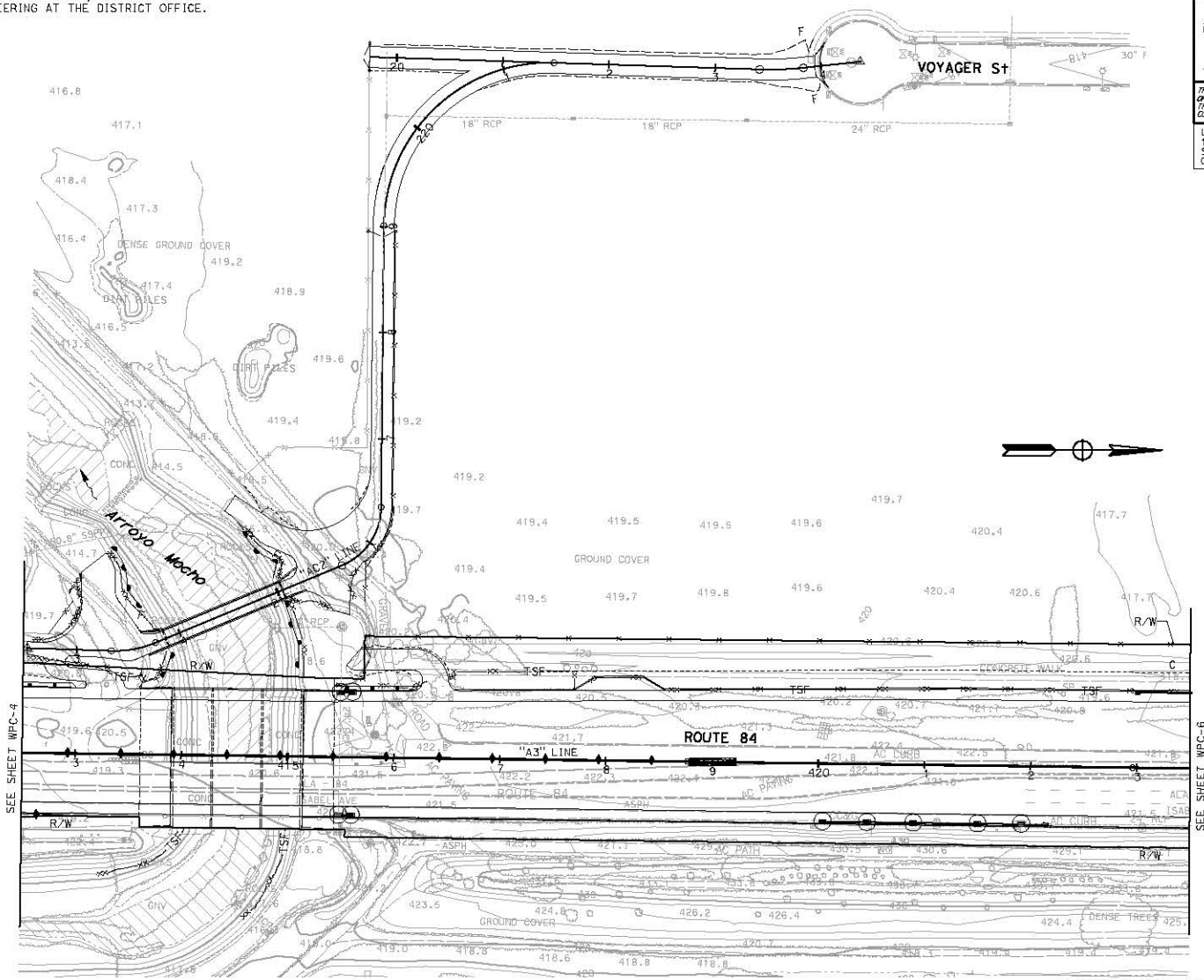
1333 Broadway, Suite 300
Oakland, CA 94612



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-5

CHECKED BY	ABHIJEET BHOI	10/19/10	
CALCULATED-DESIGNED BY	MARIA SEDGHI	REVISED BY	MS
CONSULTANT FUNCTIONAL SUPERVISOR	RAMSEY J. HISSEN	DATE REVISED	

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

DATE PLOTTED => 1/14/2011
TIME PLOTTED => 11:49:17 AM
LAST REVISION 10-21-10

BORDER LAST REVISED 7/2/2010 | USERNAME => amber_grant | DGN FILE => 04000205801gd005.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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1333 Broadway
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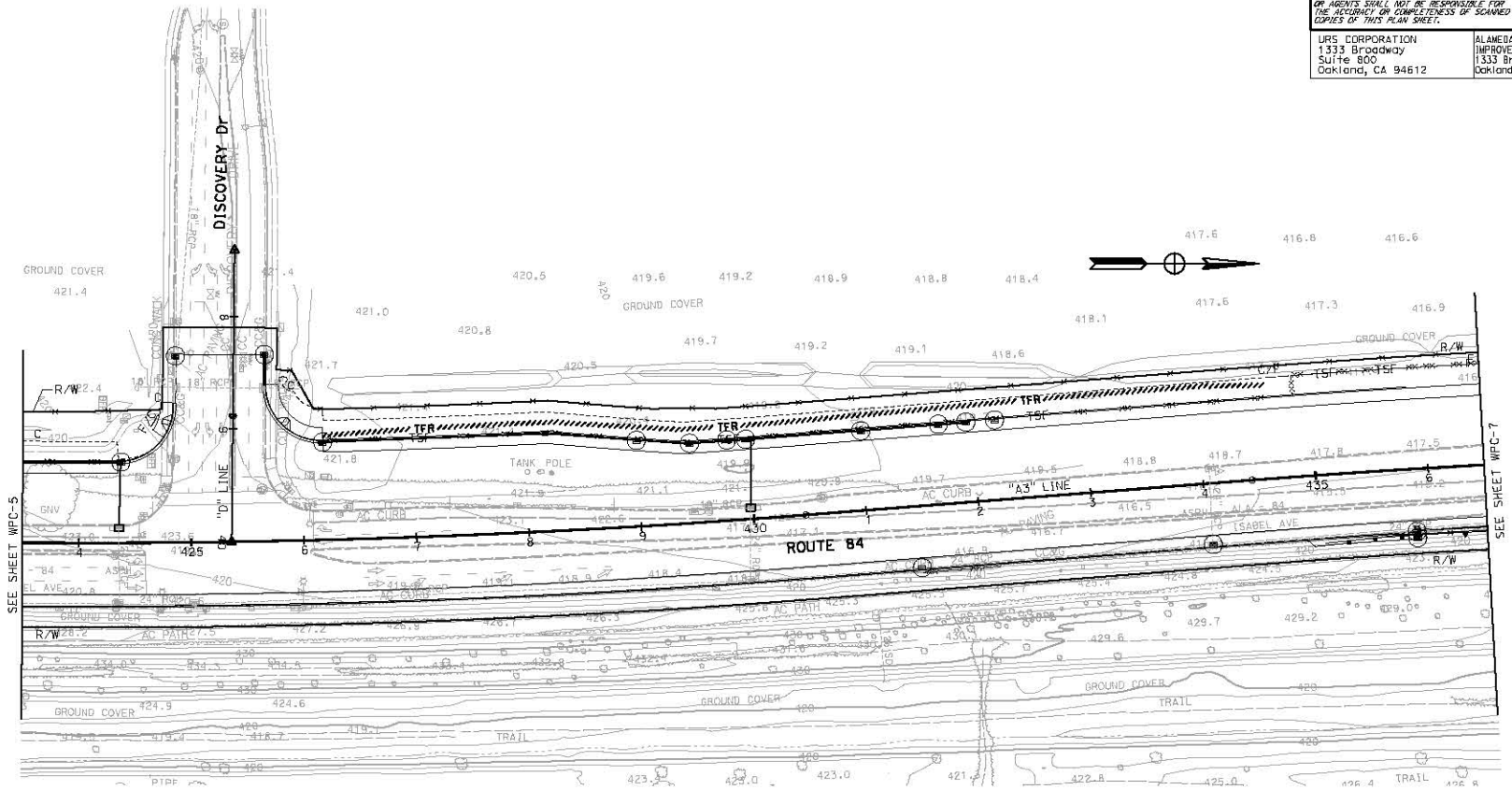
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
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-6

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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 | DATE PLOTTED => 11/14/2011 | TIME PLOTTED => 11:49:29 AM
10-21-10

BORDER LAST REVISED 7/2/2010 | USERNAME => amber_grant | DGN FILE => 04000205801gd006.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

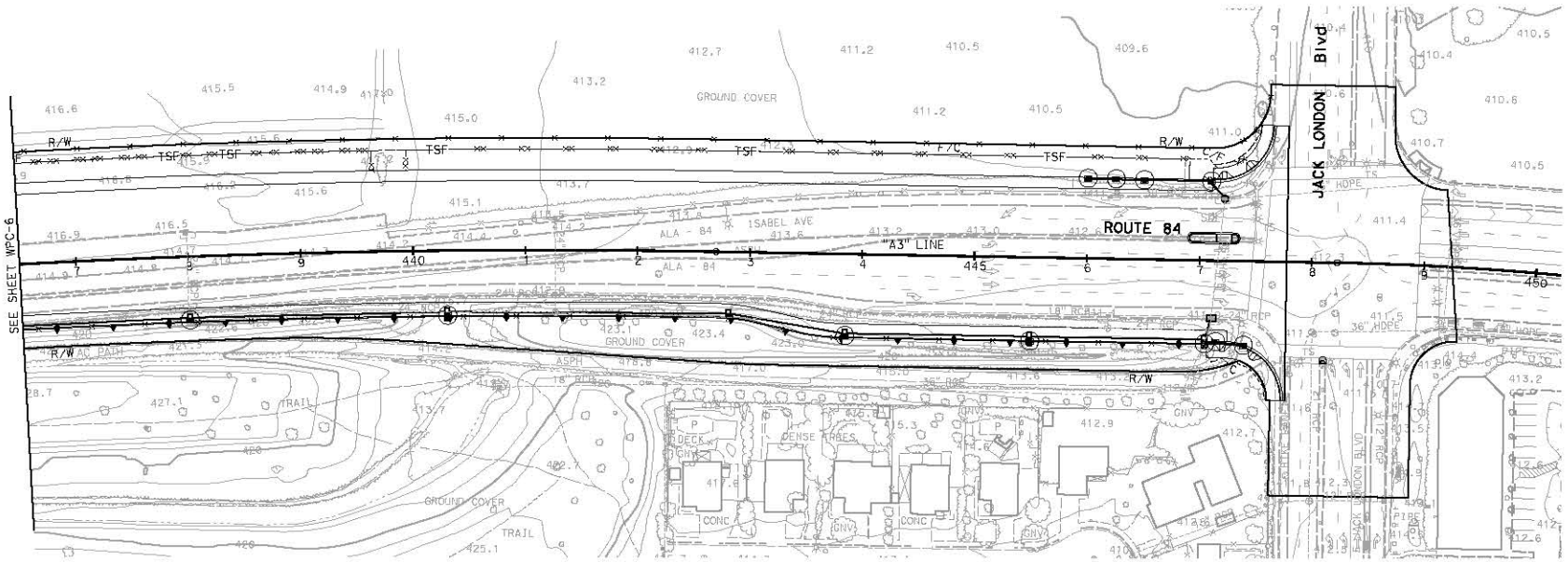
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Maria Sedghi — No. 74619 — Exp. 12-31-11 — CIVIL — STATE OF CALIFORNIA

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 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	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
RAMSEY J. HISSEN	MARIA SEDGHI	ABHIJEET BHOI	MS	10/19/10

LAST REVISION | DATE PLOTTED => 11/14/2011 | 10-21-10 | TIME PLOTTED => 11:49:38 AM

BORDER LAST REVISED 7/2/2010 | USERNAME => amber_grant | DGN FILE => 04000205801gD007.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

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
- TSF — TEMPORARY SILT FENCE
- TFR — TEMPORARY FIBER ROLL
- TEMPORARY COVER

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

Maria Sedghi No. 74619 Exp. 12-31-11 CIVIL STATE OF CALIFORNIA

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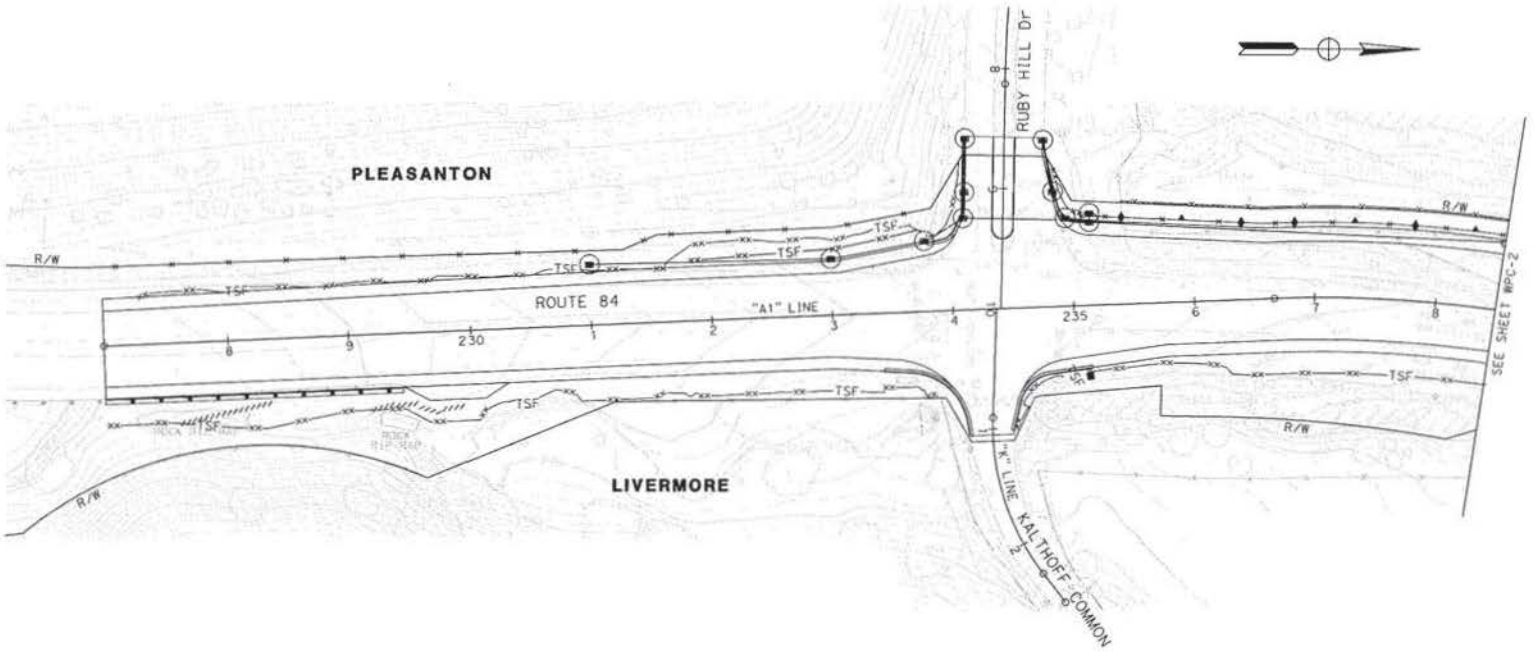

TEMPORARY WATER POLLUTION CONTROL PLAN

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

DATE REVISION: 10-21-10 | DATE PLOTTED => 10/20/2010 | TIME PLOTTED => 1106:12 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => maria_sedghi | DGN FILE => ...\429760pb001.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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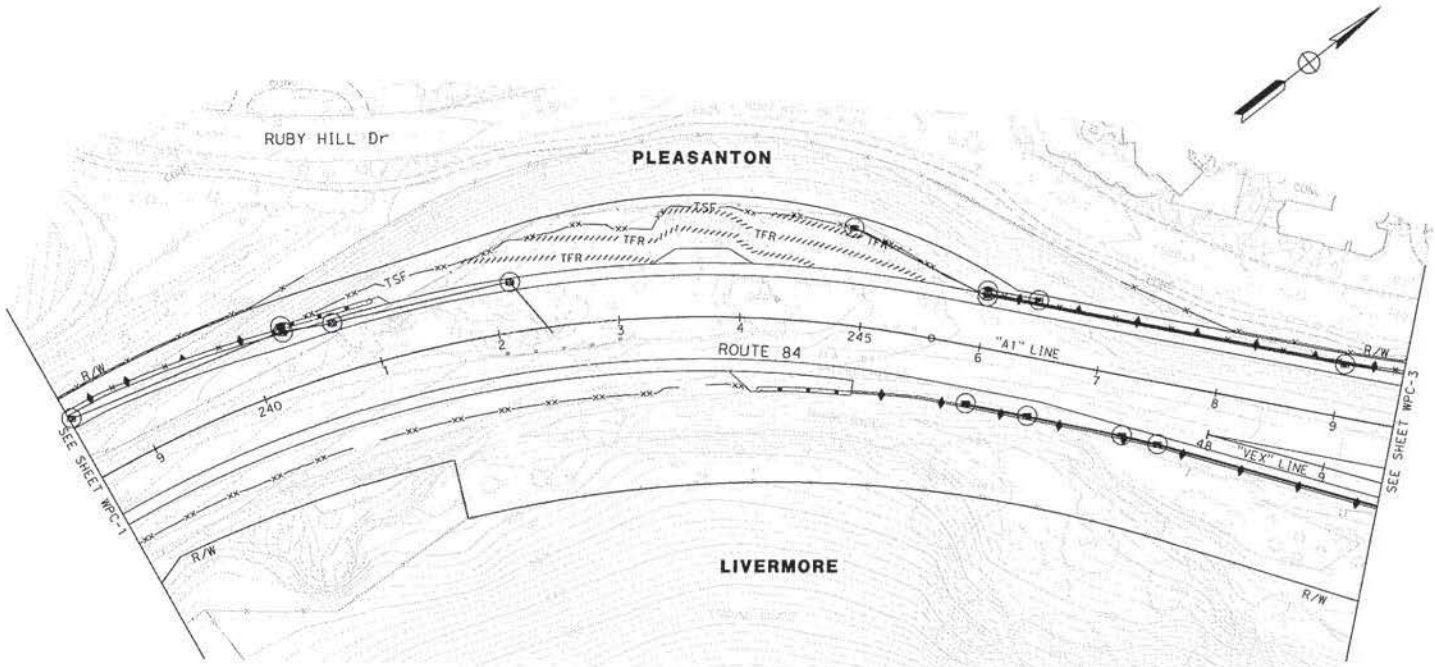

FOR NOTES AND LEGEND,
SEE SHEET WPC-1

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-2

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

	REVISED BY	MS
	DATE REVISED	10/19/10
MARIA SEDGHI	CALCULATED-DESIGNED BY	
ABHIJEET BHOI	CHECKED BY	
RAMSEY J. HISSEN	CONSULTANT FUNCTIONAL SUPERVISOR	

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

DATE PLOTTED => 10/20/2010
TIME PLOTTED => 11:06:15 PM
LAST REVISION 10-21-10

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

Mario Sedghi No. 74619 Exp. 12-31-11 CIVIL STATE OF CALIFORNIA

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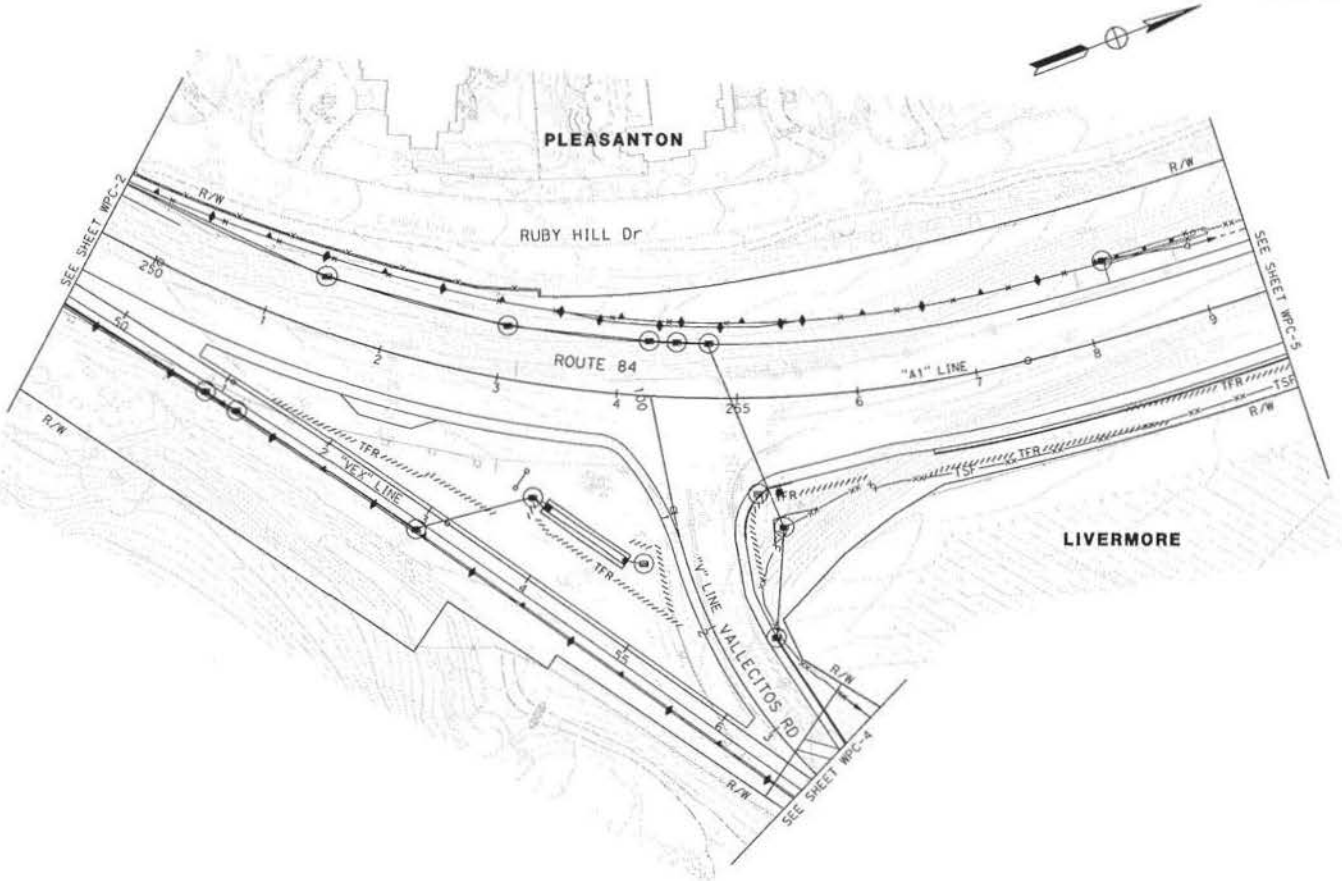

FOR NOTES AND LEGEND, SEE SHEET WPC-1

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-3

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	MARIA SEDGHI	REVISED BY	MS
Caltrans	RAMSEY J. HISSEN	CHECKED BY	ABHIJEET BHOI	DATE REVISED	10/19/10

DATE PLOTTED => 10/20/2010
TIME PLOTTED => 11:06:16 AM

BORDER LAST REVISED 7/2/2010 | USERNAME => maria_sedghi | DGN FILE => ...\429760gb003.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

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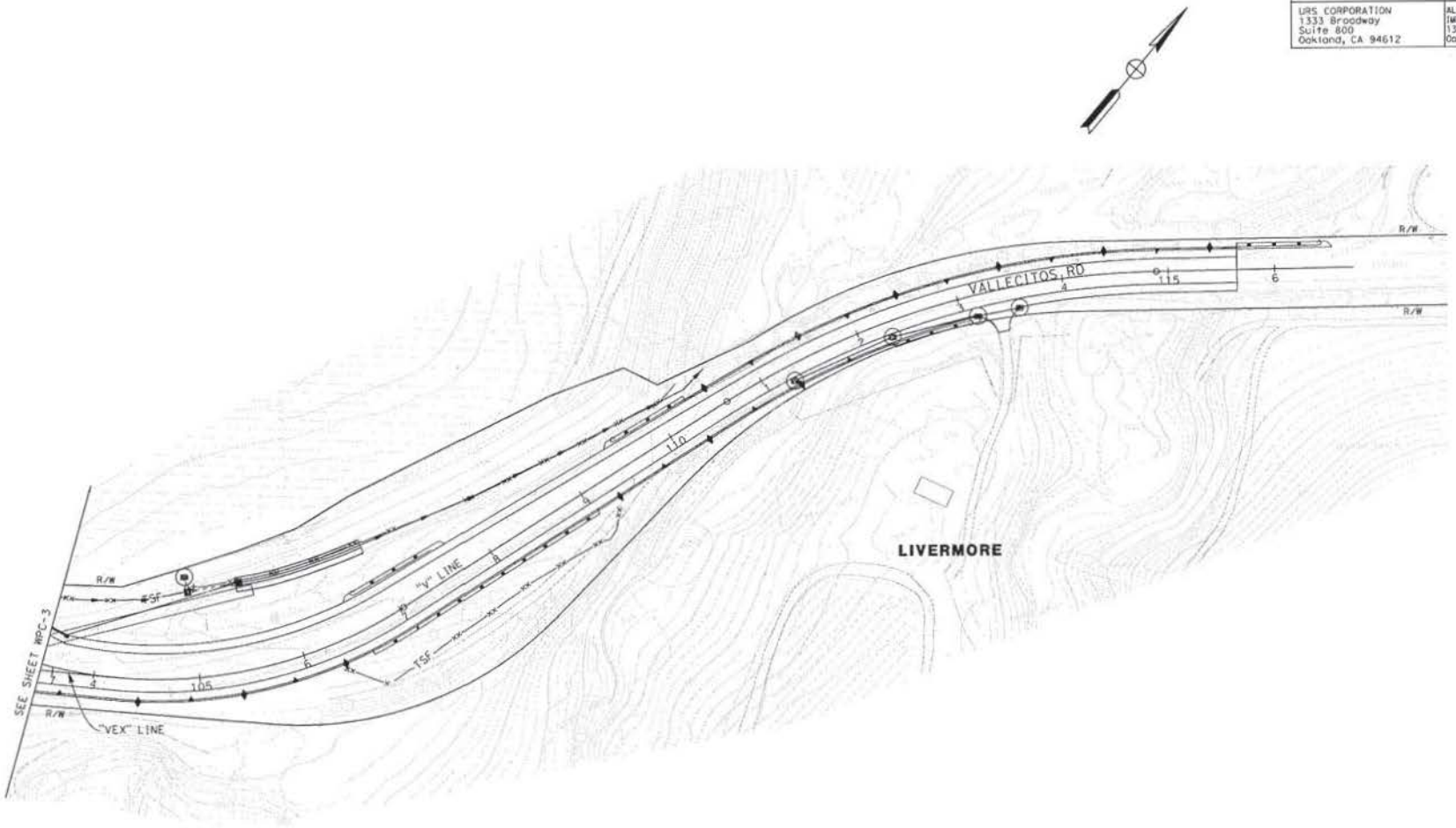

FOR NOTES AND LEGEND, SEE SHEET WPC-1

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-4

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 => 10/20/2010
10-21-10 TIME PLOTTED => 11:06:12 PM

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

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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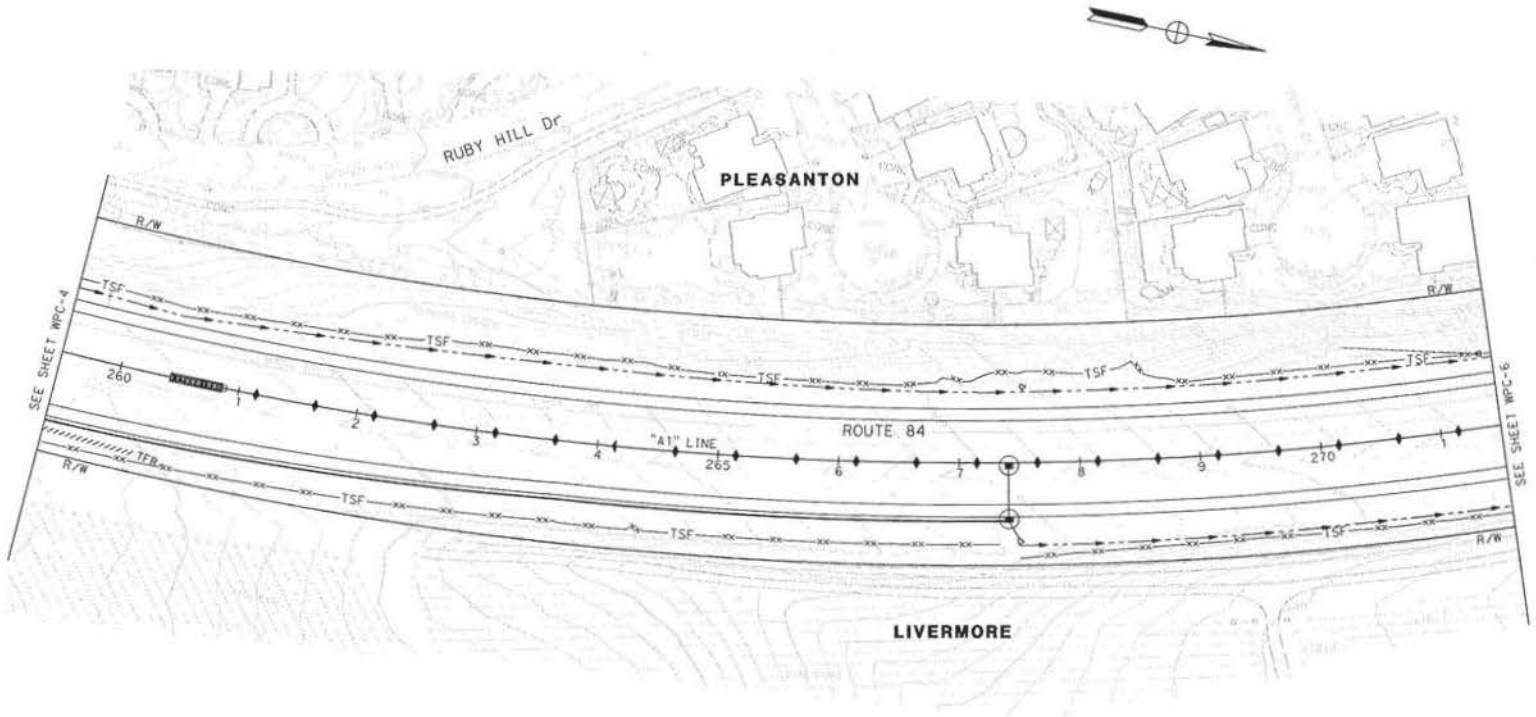

FOR NOTES AND LEGEND,
SEE SHEET WPC-1

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-5

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 BHOJ
REVISED BY: MS
DATE REVISED: 10/19/10

DATE PLOTTED => 10/20/2010
TIME PLOTTED => 11:06:18 AM

BORDER LAST REVISED 7/2/2010
USERNAME => maria_sedghi
DGN FILE => ...\429760g0005.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

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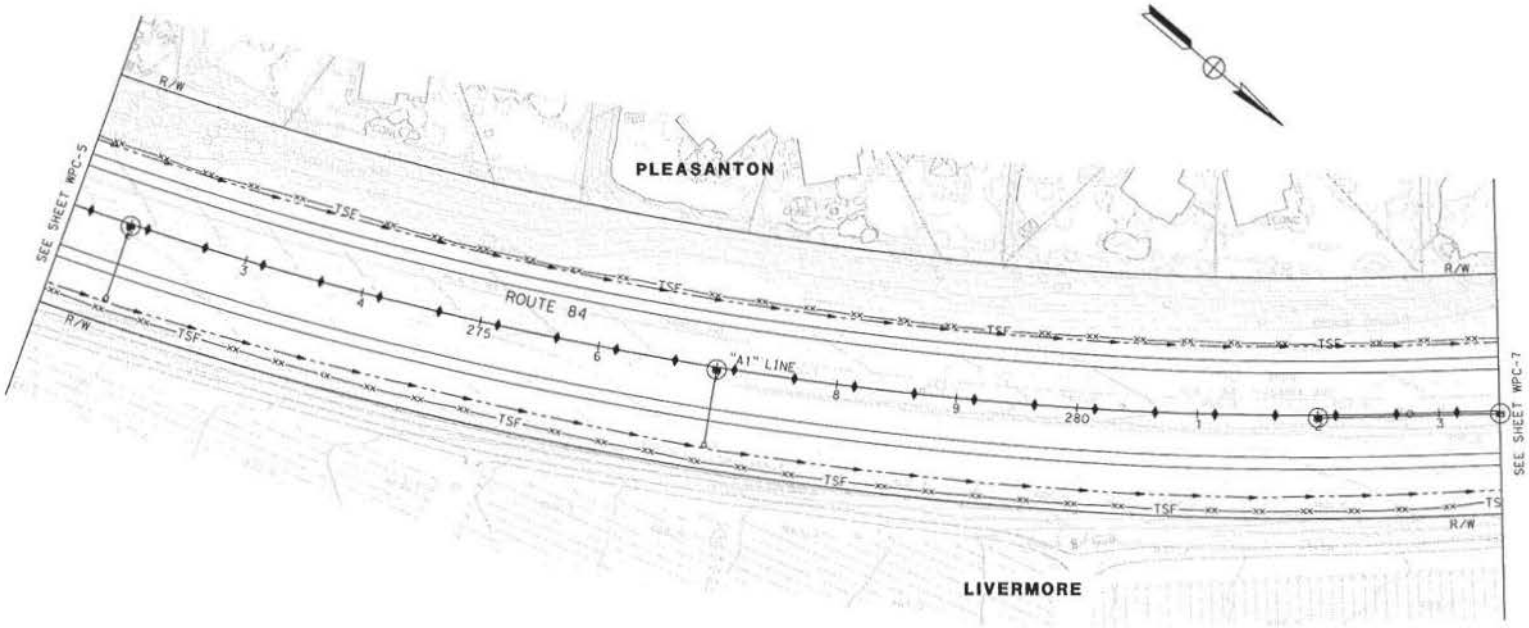

FOR NOTES AND LEGEND,
SEE SHEET WPC-1

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
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 => 11:06:19 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => maria_sedghi DGN FILE => ...\4297604gb006.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 CAL.

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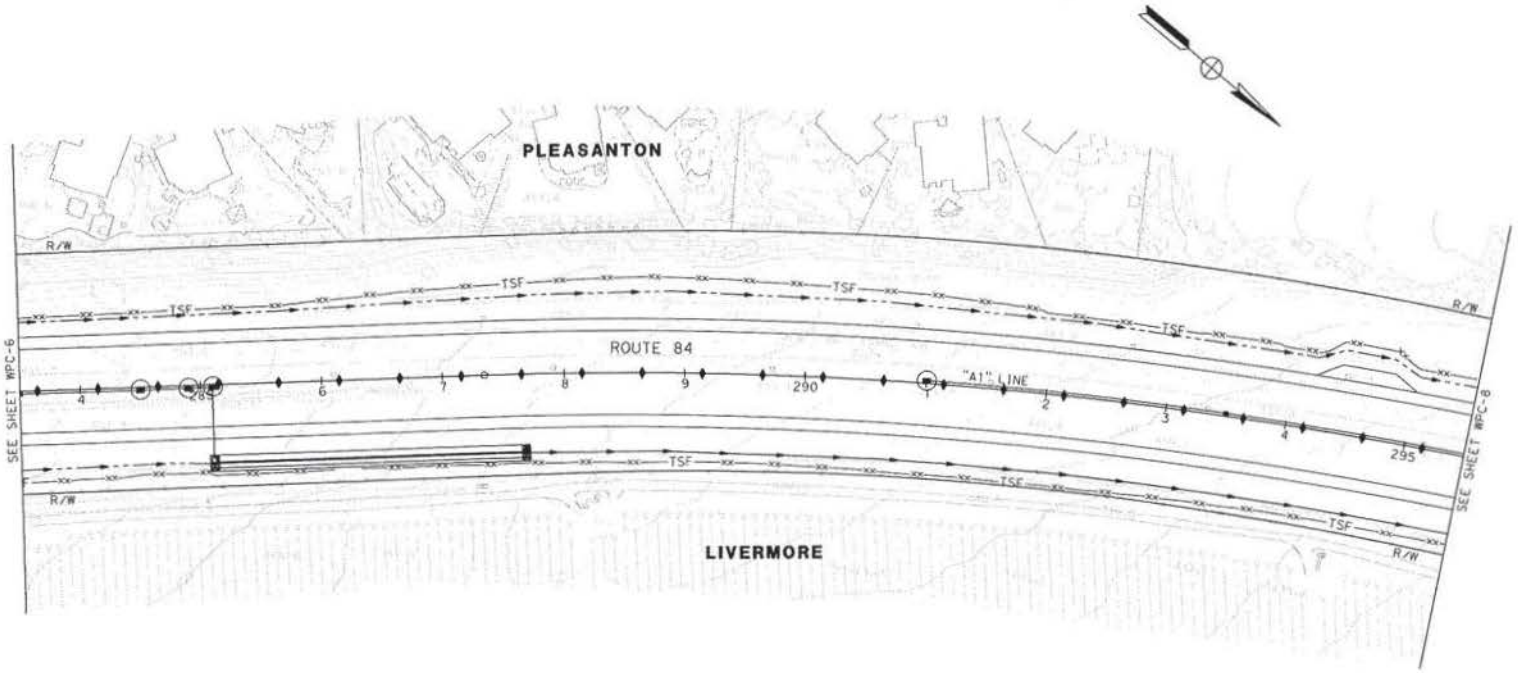

FOR NOTES AND LEGEND,
SEE SHEET WPC-1

THIS PLAN ACCURATE FOR TEMPORARY WATER POLLUTION CONTROL WORK ONLY

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-7

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	
Caltrans	RAMSEY J. HISSEN	CHECKED BY	DATE REVISED	10/19/10
		MARIA SEDGHI	MS	
		ABHIJEET BHOI		

LAST REVISED: DATE PLOTTED => 10/20/2010
TIME PLOTTED => 11:06:21 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => maria_sedghi | DGN FILE => ...\4209760g0007.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
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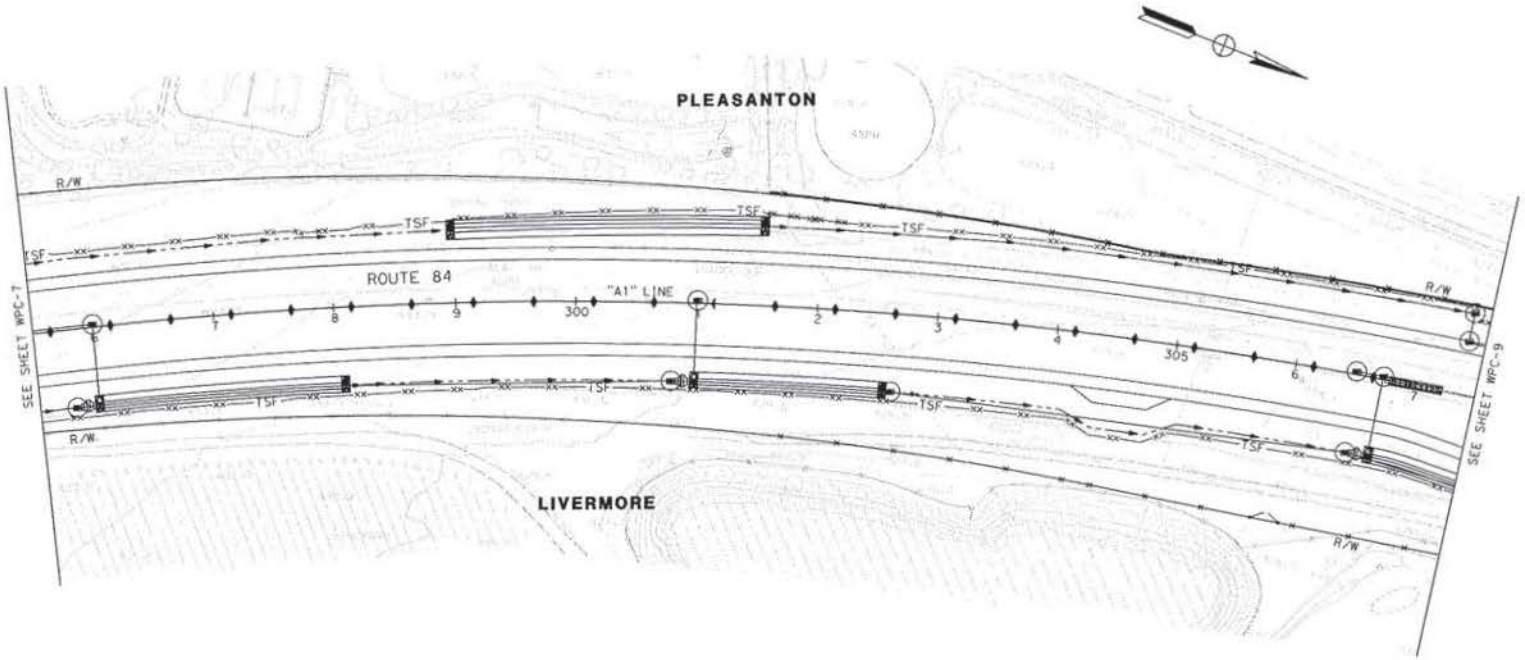

FOR NOTES AND LEGEND,
SEE SHEET WPC-1

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

BORDER LAST REVISED 7/2/2010

USERNAME =>maria_sedghi
DGN FILE =>...\429760pb008.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205811

LAST REVISED DATE PLOTTED =>10/20/2010
TIME PLOTTED =>11:06:22 PM
10-21-10

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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

Maria Sedghi No. 74619 Exp. 12-31-11 CIVIL STATE OF CALIFORNIA

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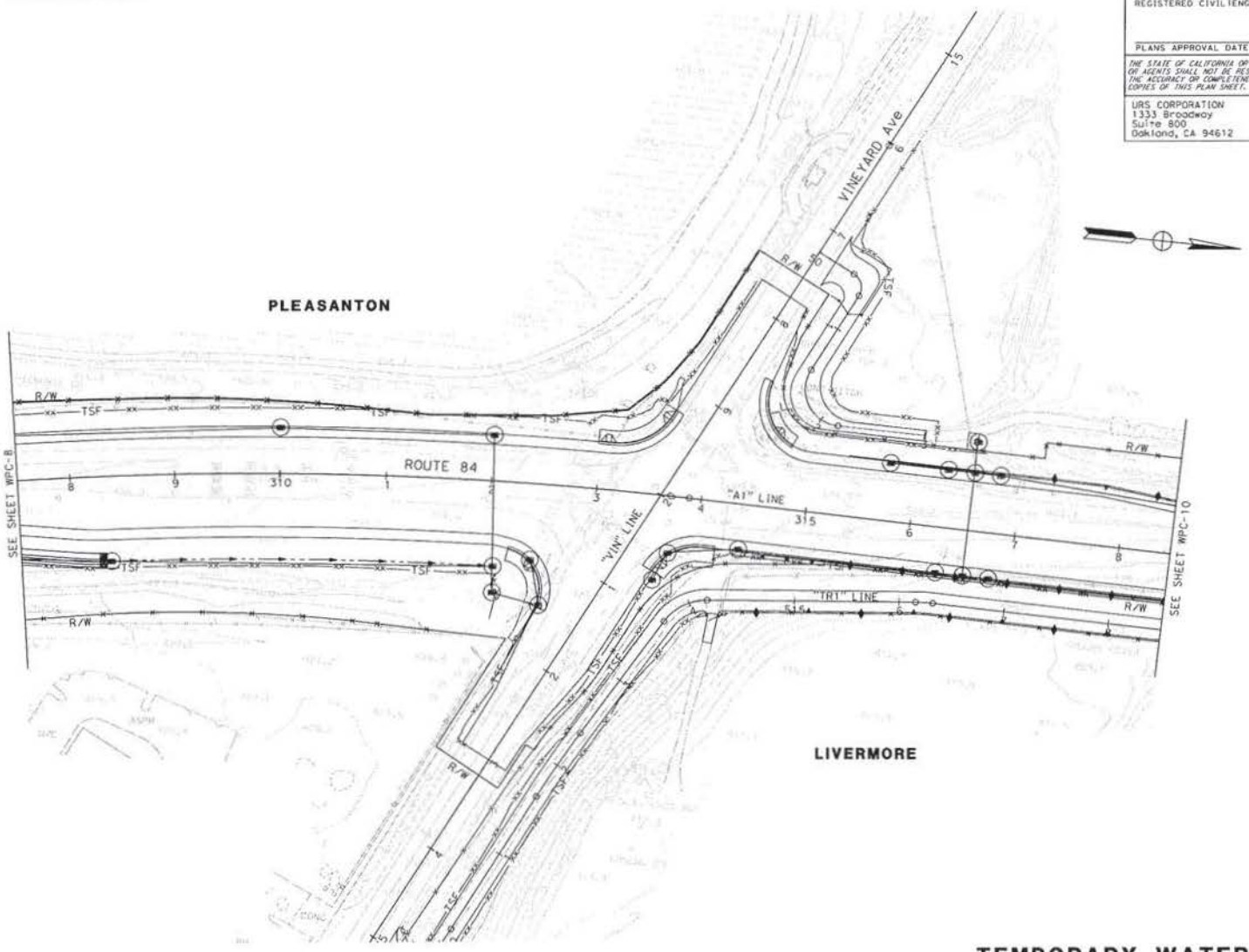
REVISED BY	MS
DATE REVISED	10/19/10
CALCULATED-DESIGNED BY	MARIA SEDGHI
	ABHIJEET BHOI
CHECKED BY	
CONSULTANT FUNCTIONAL SUPERVISOR	RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans



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

DATE PLOTTED => 10/20/2010
TIME PLOTTED => 1106:23 PM

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

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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

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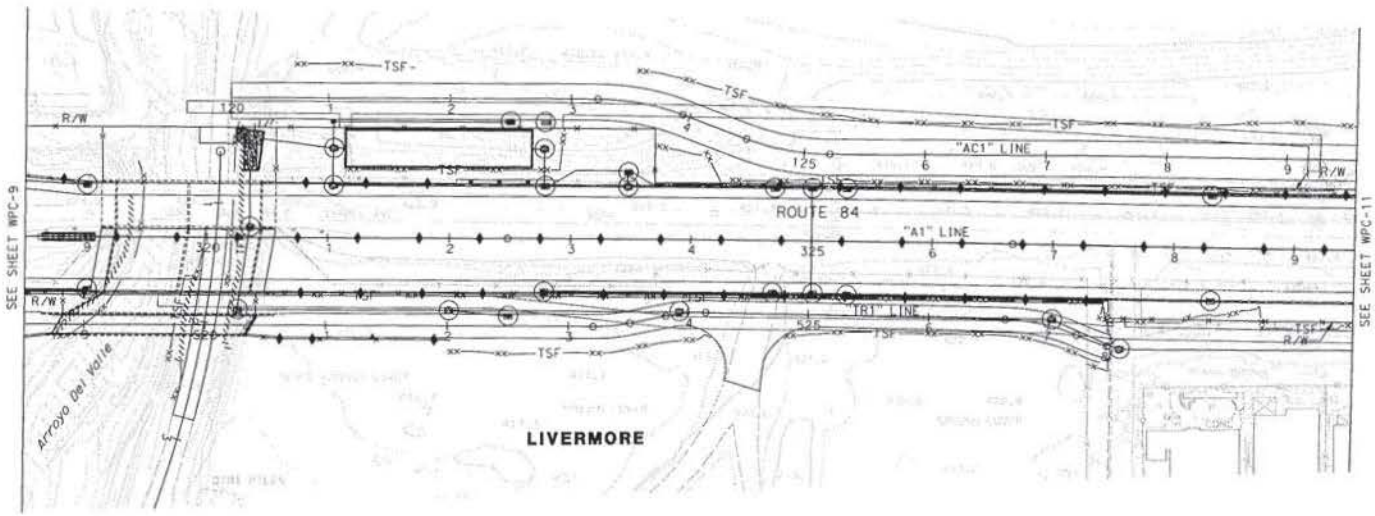
Oakland, CA 94612



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	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_seoghi
DGN FILE => ...\429760gb010.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205811

DATE PLOTTED => 10/20/2010
TIME PLOTTED => 11:06:24 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		

M Sedghi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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Maria Sedghi
No. 74619
Exp. 12-31-11
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

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Oakland, CA 94612

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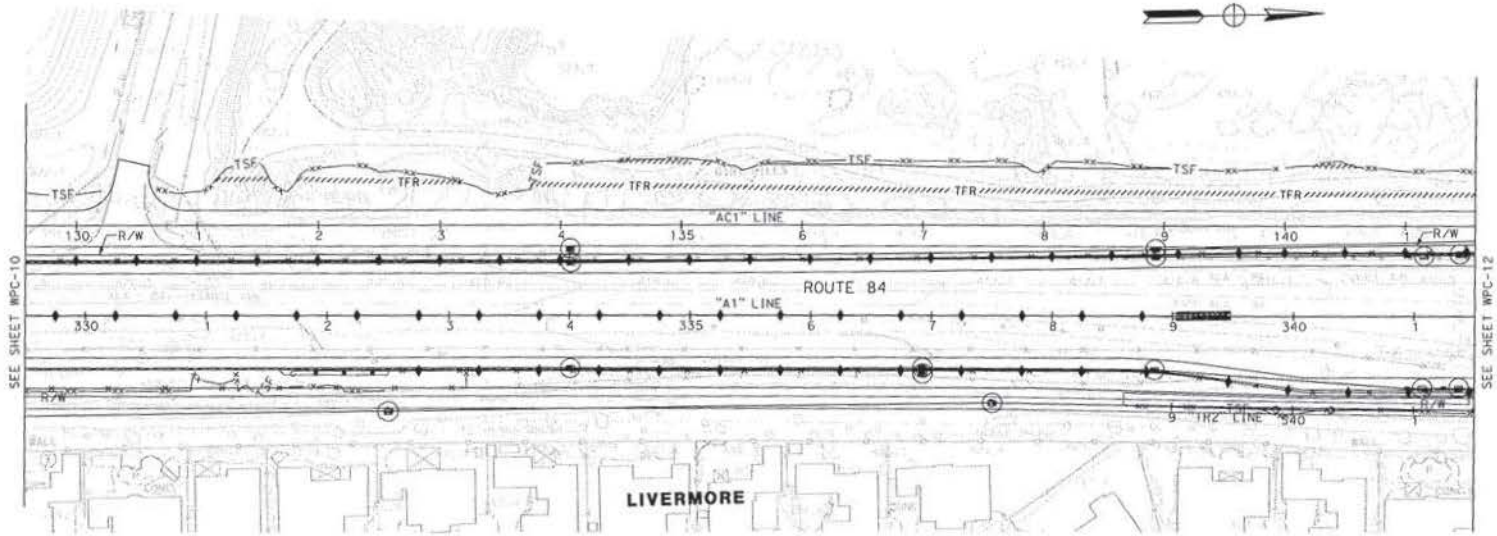
Oakland, CA 94612



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: 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 => mario_sedghi
DGN FILE => ...\4291\8dgb01.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205811

LAST REVISION 10-21-10 DATE PLOTTED => 10/20/2010 TIME PLOTTED => 11:06:25 PM

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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

Mario Sedghi No. 74619 Exp. 12-31-11 CIVIL STATE OF CALIFORNIA

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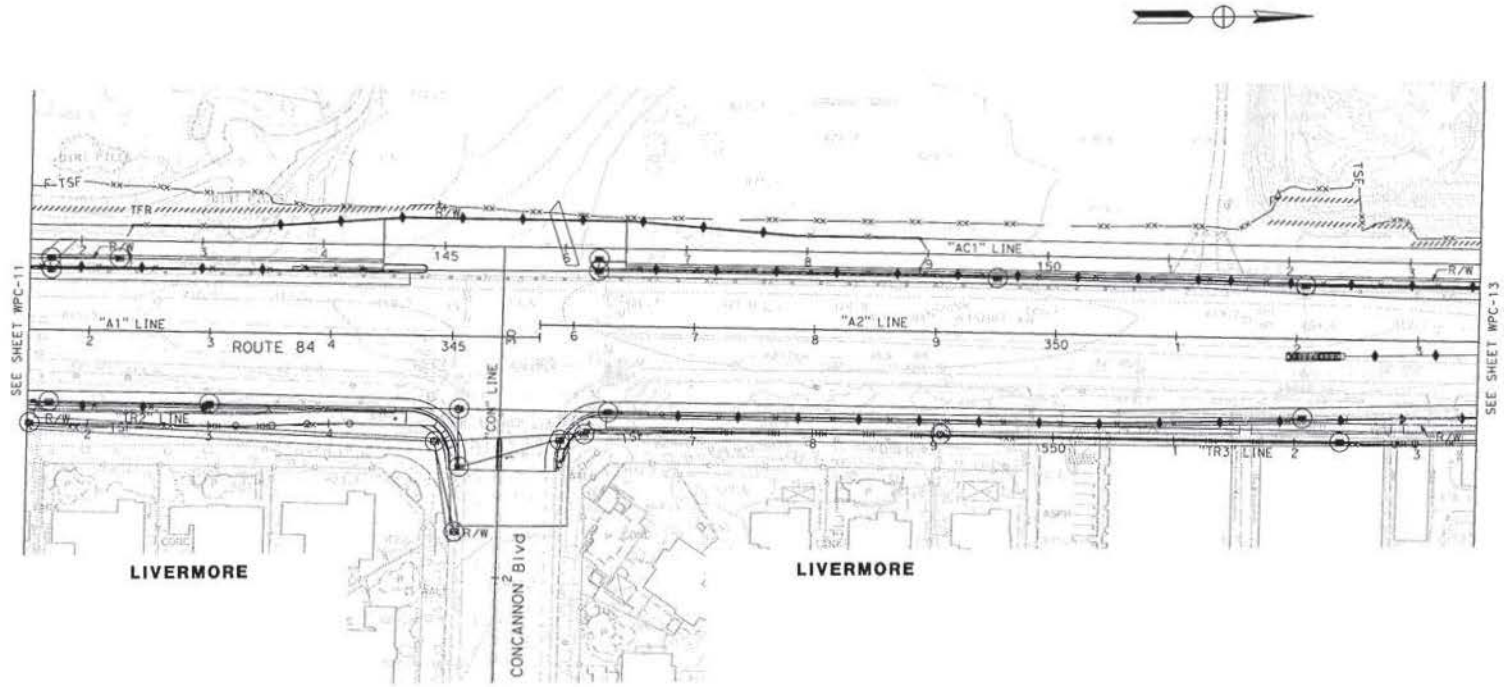

FOR NOTES AND LEGEND,
SEE SHEET WPC-1

TEMPORARY WATER POLLUTION CONTROL PLAN

SCALE: 1" = 50'

WPC-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

BORDER LAST REVISED 7/2/2010

USERNAME => mario_sedghi
DGN FILE => ...\429760gb012.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205811

LAST REVISED DATE PLOTTED => 10/20/2010
TIME PLOTTED => 11:06:27 PM
10-21-10

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

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REGISTERED PROFESSIONAL ENGINEER — Maria Sedghi — No. 74619 — Exp. 12-31-11 — CIVIL — STATE OF CALIFORNIA

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Oakland, CA 94612

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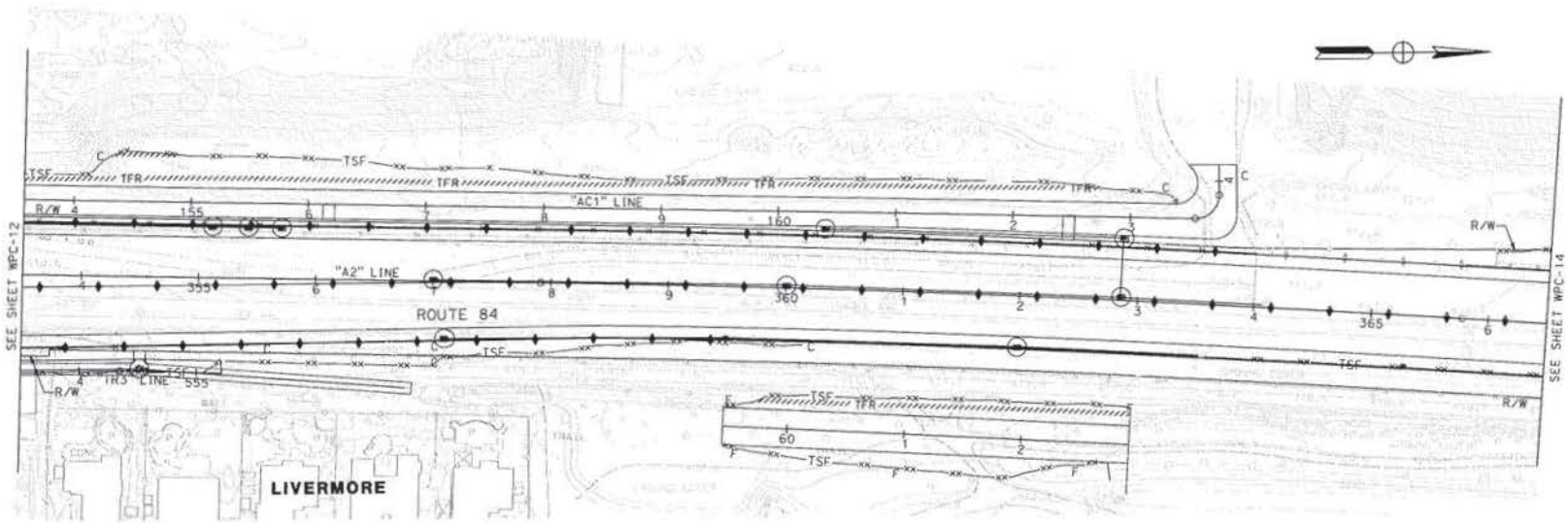

FOR NOTES AND LEGEND,
SEE SHEET WPC-1

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	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_seoghi
DGN FILE => ...\429760gb013.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205811

DATE PLOTTED => 10/20/2010
TIME PLOTTED => 11:06:28 PM

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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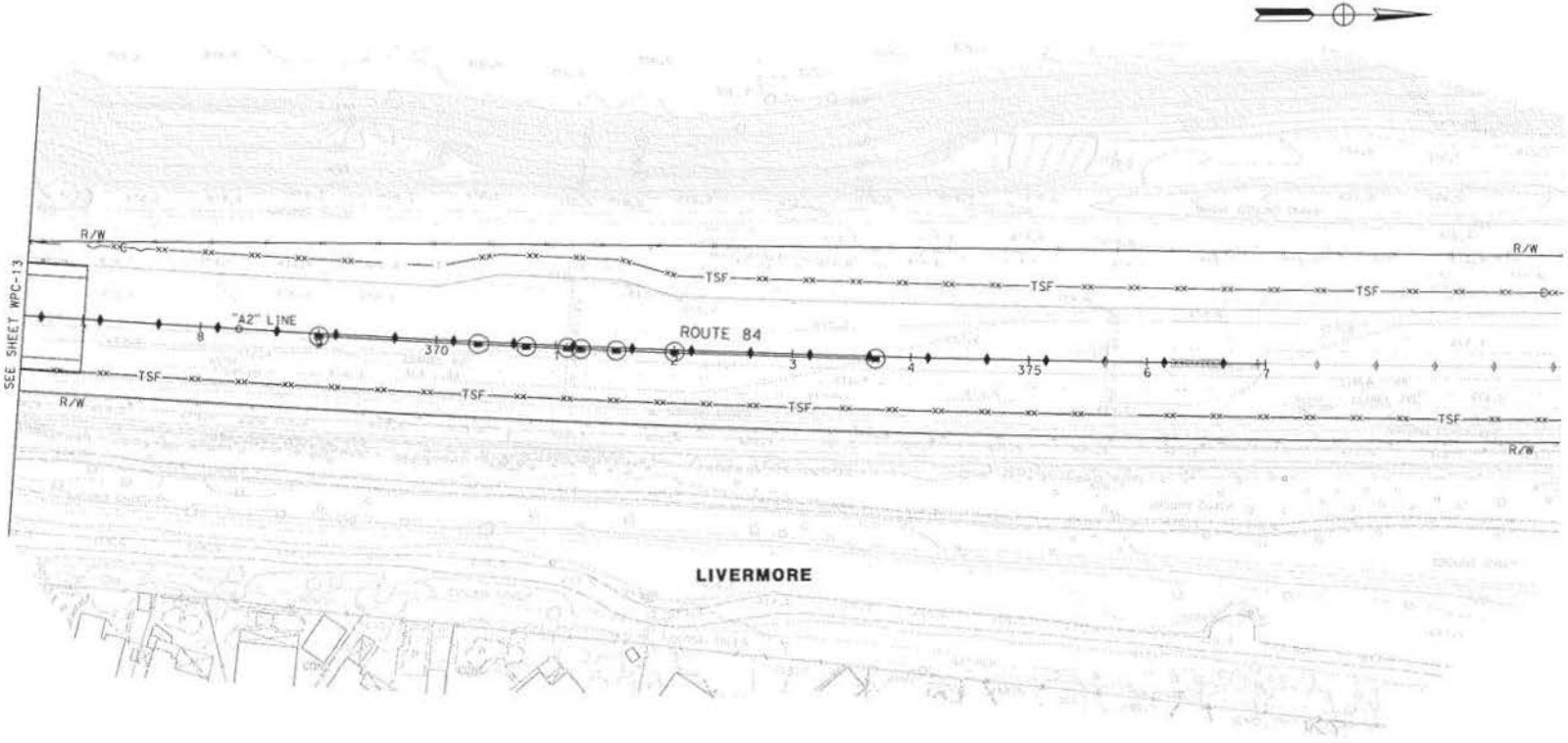
URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612



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

LAST REVISION: DATE PLOTTED => 10/20/2010, TIME PLOTTED => 11:06:29 PM

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

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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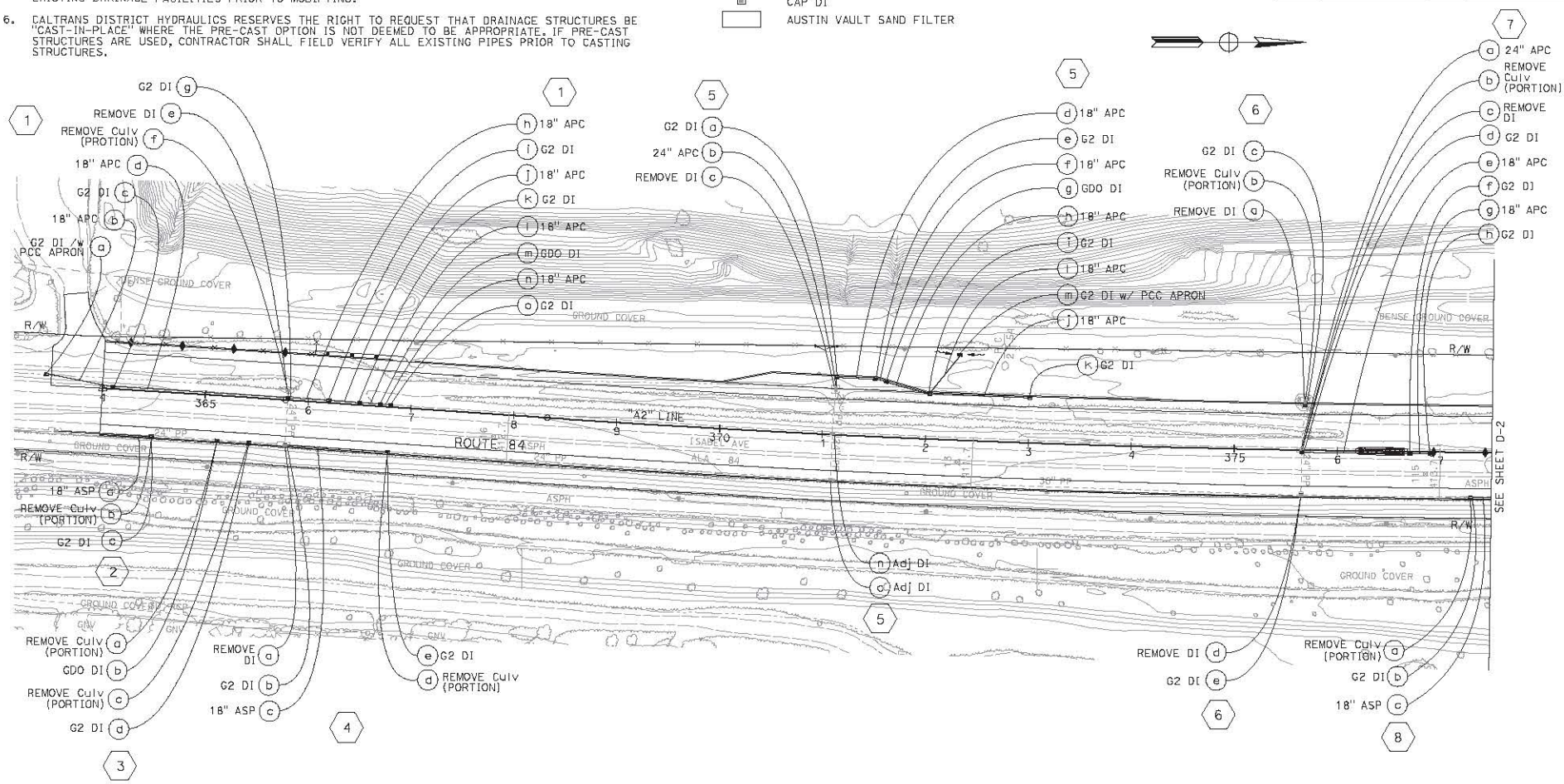

DRAINAGE PLAN

SCALE: 1" = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

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 10-19-10
DATE PLOTTED => 1/14/2011
TIME PLOTTED => 15:43:43 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

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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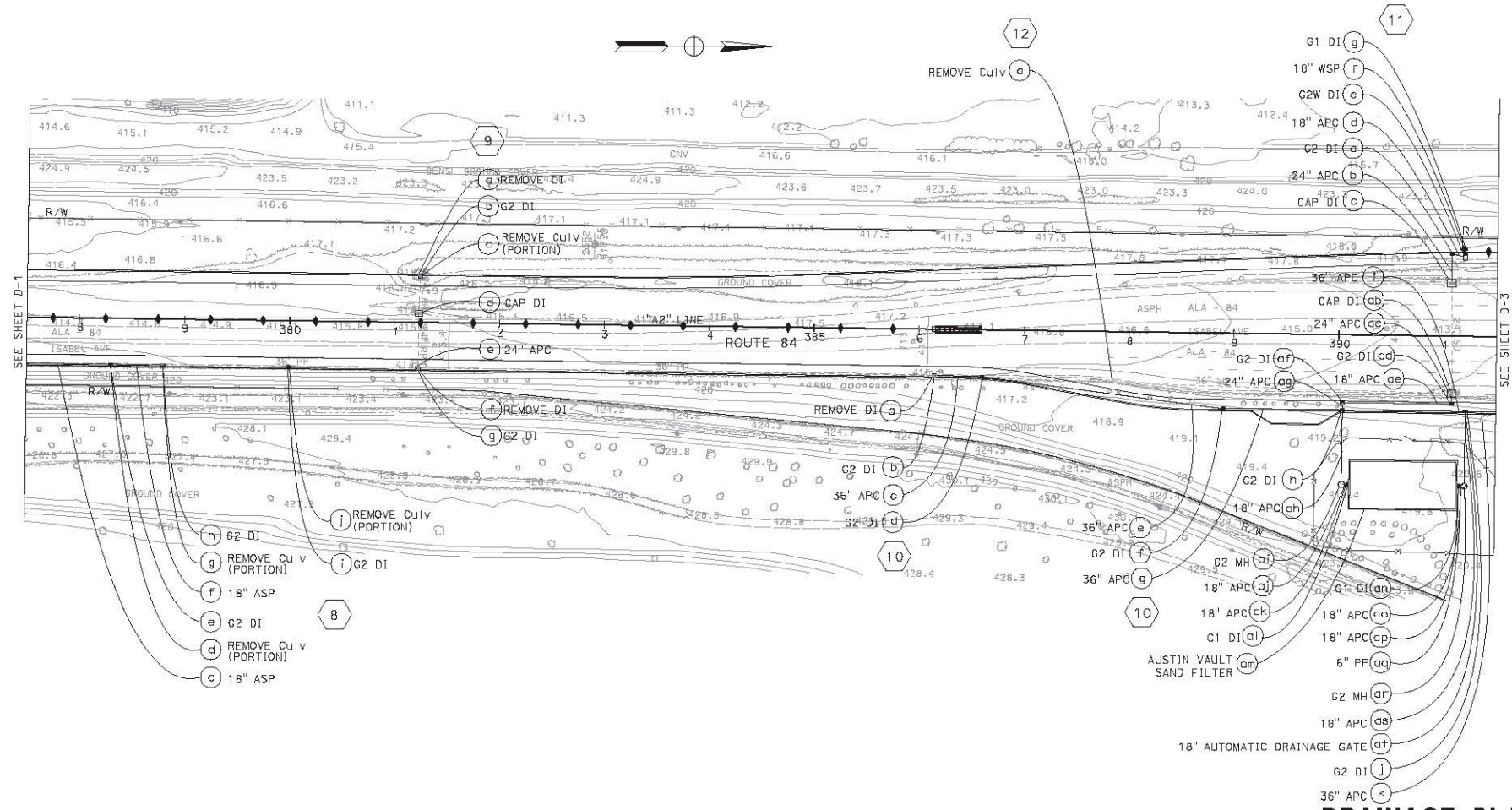


DRAINAGE PLAN

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

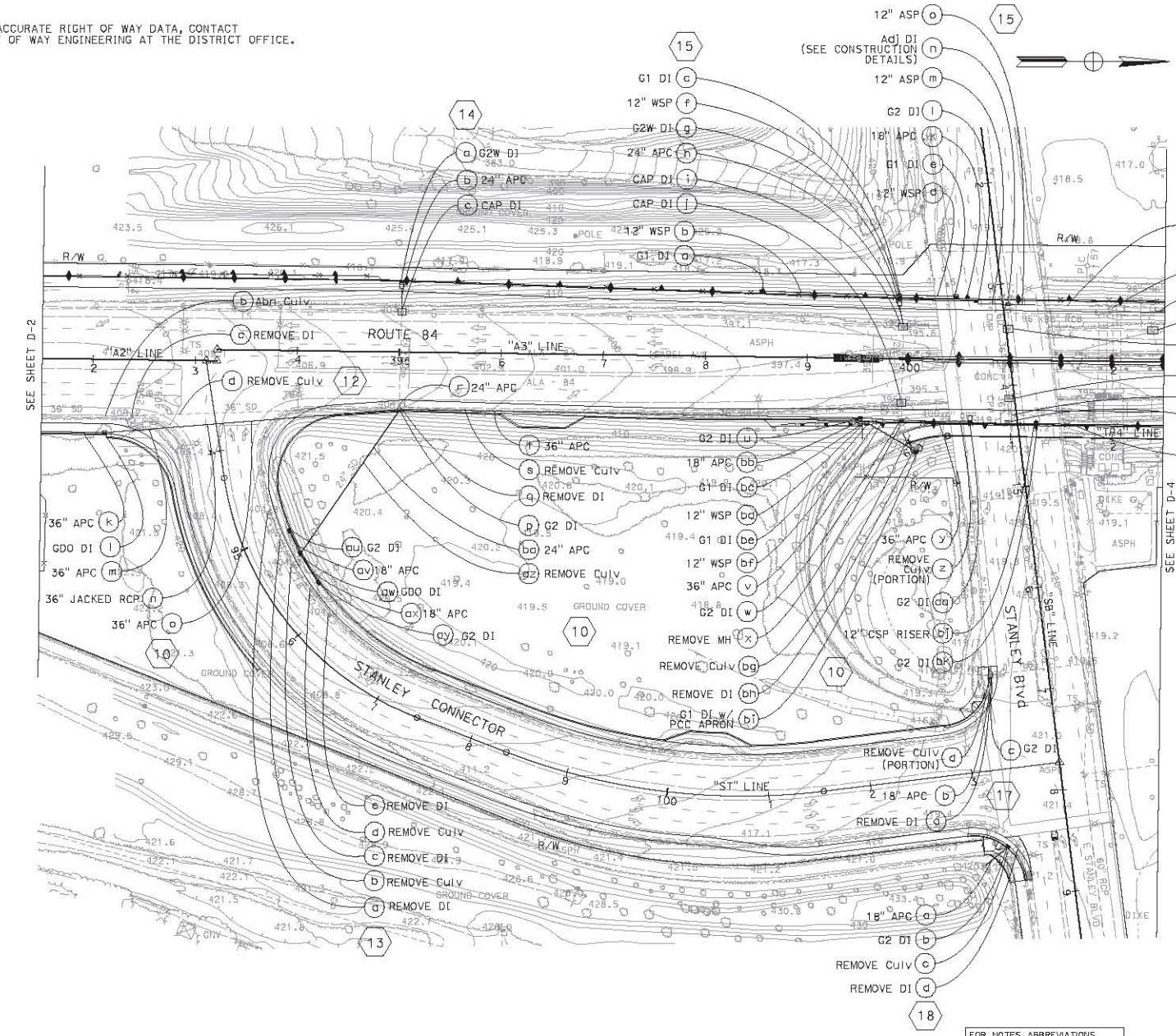
FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

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 TIME PLOTTED => 8:43:46 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz DGN FILE => ...\04000205801ca002.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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Oakland, CA 94612

DRAINAGE PLAN

SCALE: 1" = 50'

D-3

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	REVISED BY	DATE REVISED
Caltrans	HAN-BIN LIANG	IRENE LIU	JP	1/11/11
		CHECKED BY	ANALETTE OCHOA	

LAST REVISION 10-19-10
DATE PLOTTED => 1/14/2011
TIME PLOTTED => 8:43:50 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz | DGN FILE => ...\04000205801ca003.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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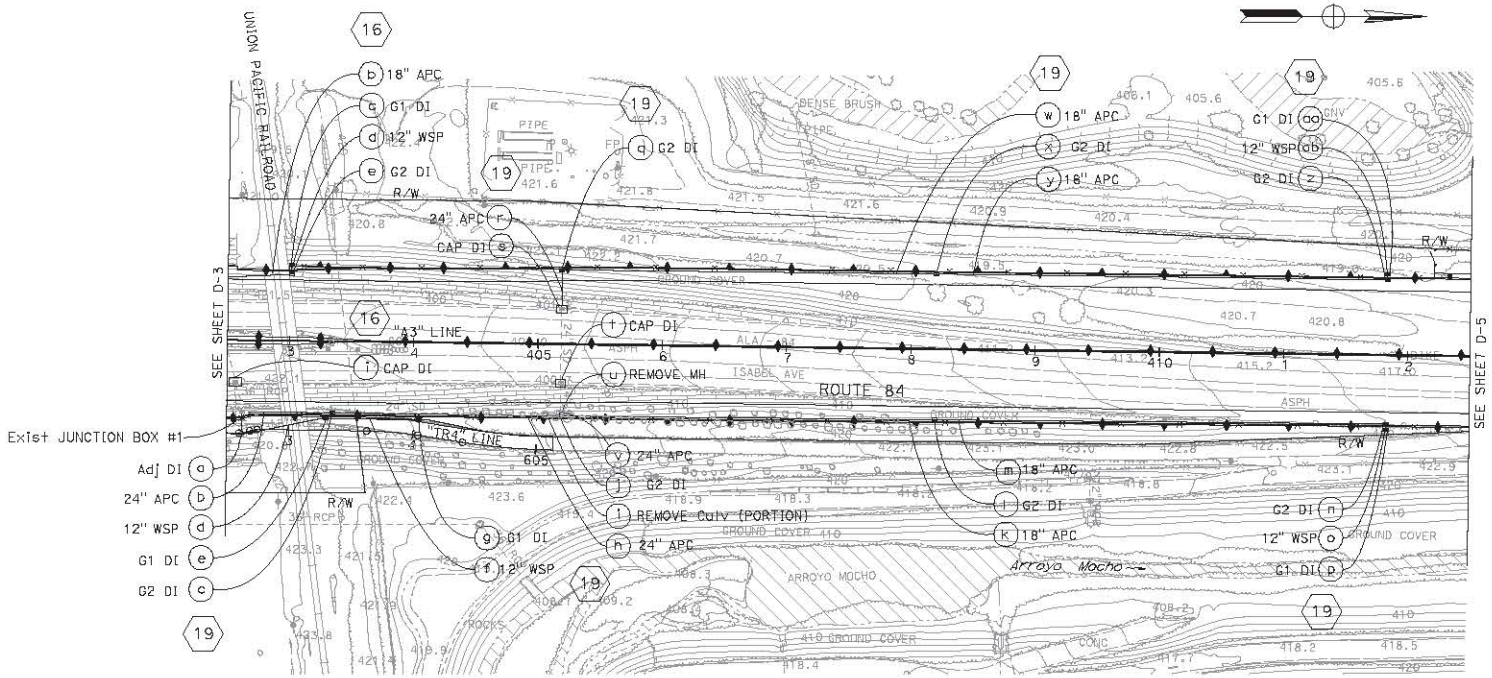


DRAINAGE PLAN

SCALE: 1" = 50'

D-4

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

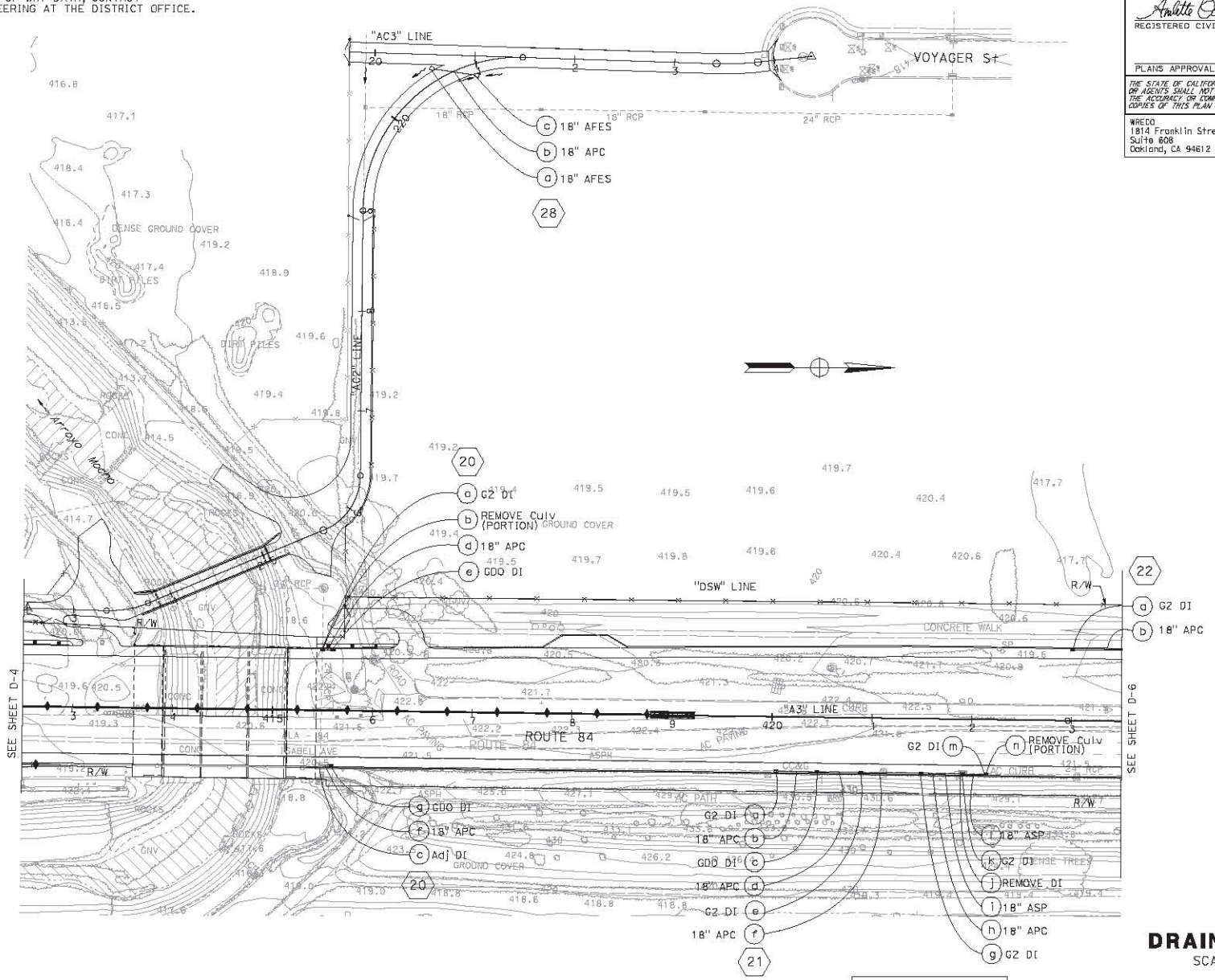
FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	JP
Caltrans	HAN-BIN LIANG	CHECKED BY	DATE REVISED	1/11/11
		IRENE LIU		
		ANALETTE OCHOA		

LAST REVISION 10-19-10
DATE PLOTTED => 1/14/2011
TIME PLOTTED => 11:43:58 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz | DGN FILE => ...\04000205801a004.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		

Annette Ochoa — 1/17/11
REGISTERED CIVIL ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER — ANNETTE OCHOA — No. C 55219 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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DRAINAGE PLAN

SCALE: 1" = 50'

D-5

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

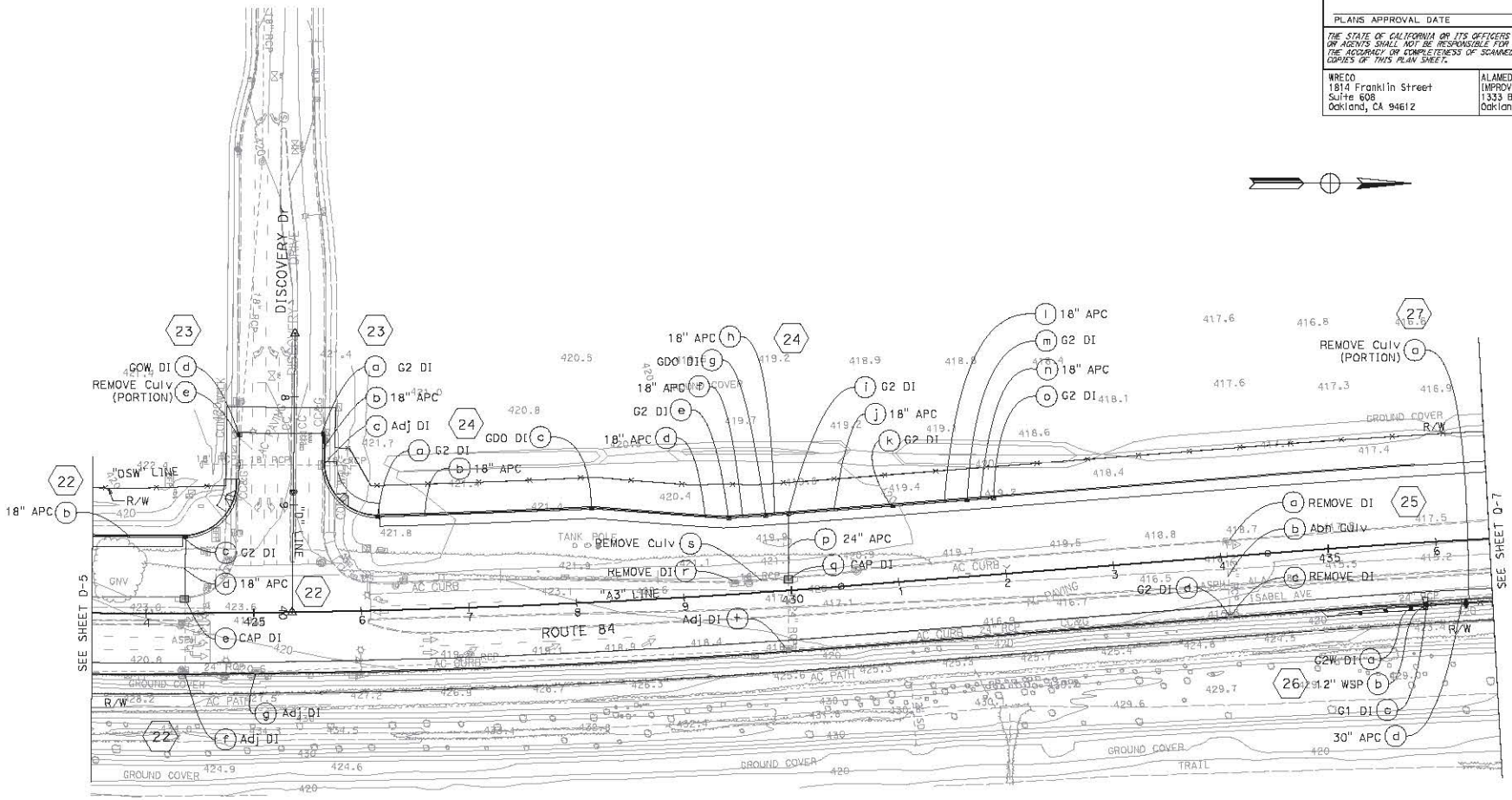
FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

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 => 1/14/2011, TIME PLOTTED => 8:44:05 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz | DGN FILE => ...\04000205801ia005.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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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

DRAINAGE PLAN

SCALE: 1'' = 50'

D-6

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

LAST REVISION
DATE PLOTTED => 1/14/2011
TIME PLOTTED => 8:44:09 PM

BORDER LAST REVISED 7/2/2010

USERNAME => jessica_pollitz
DGN FILE => ...\04000205801ca008.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 55219
Exp. 12/31/12
CIVIL
STATE OF CALIFORNIA

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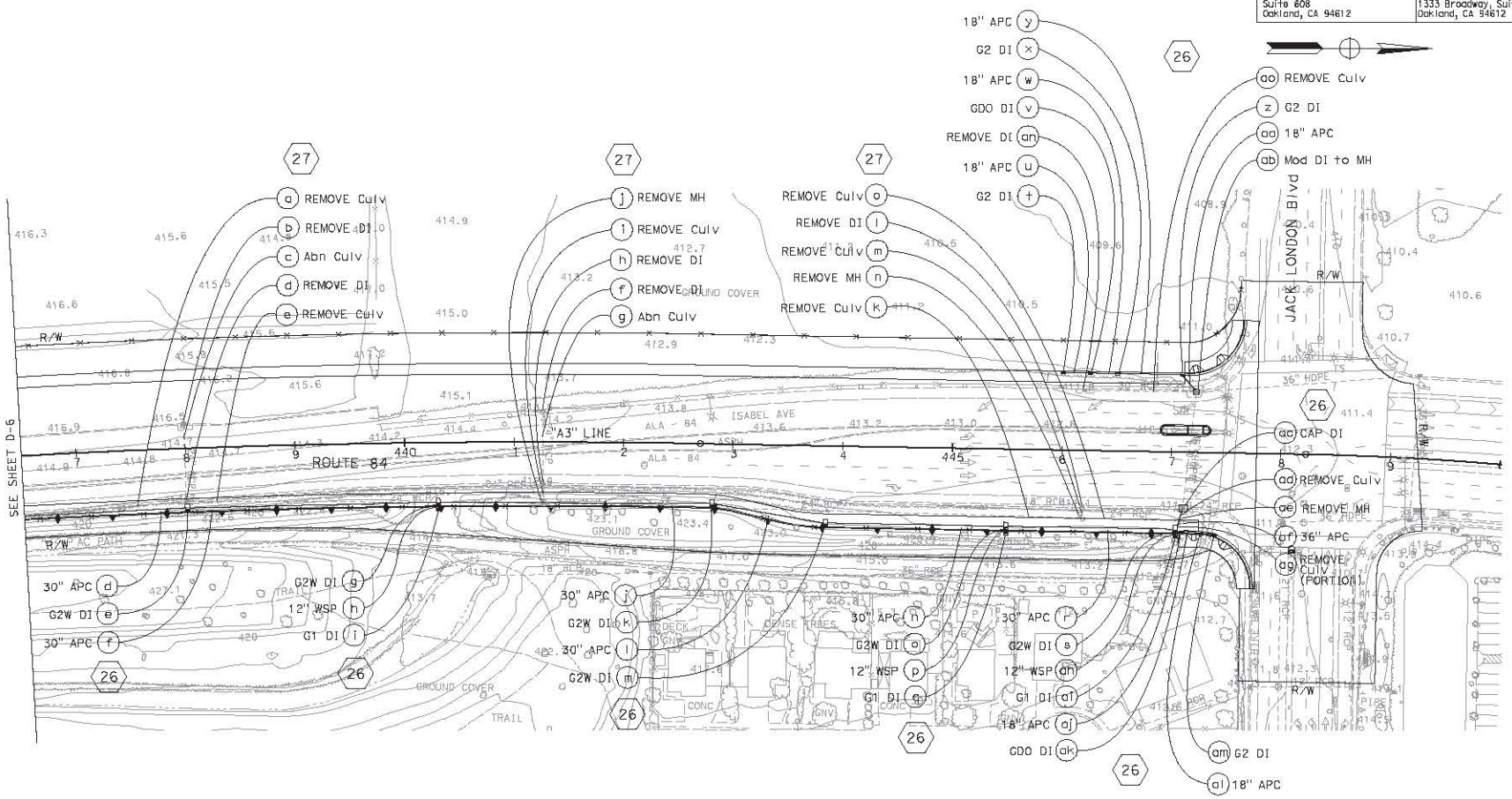

DRAINAGE PLAN

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: HAN-BIN LIANG | CALCULATED-DESIGNED BY: IRENE LIU | CHECKED BY: ANALETTE OCHOA | REVISED BY: JP | DATE REVISED: 1/11/11

LAST REVISION: DATE PLOTTED => 1/14/2011 | TIME PLOTTED => 8:44:14 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz | DGN FILE => ...\04000205801ca007.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.

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

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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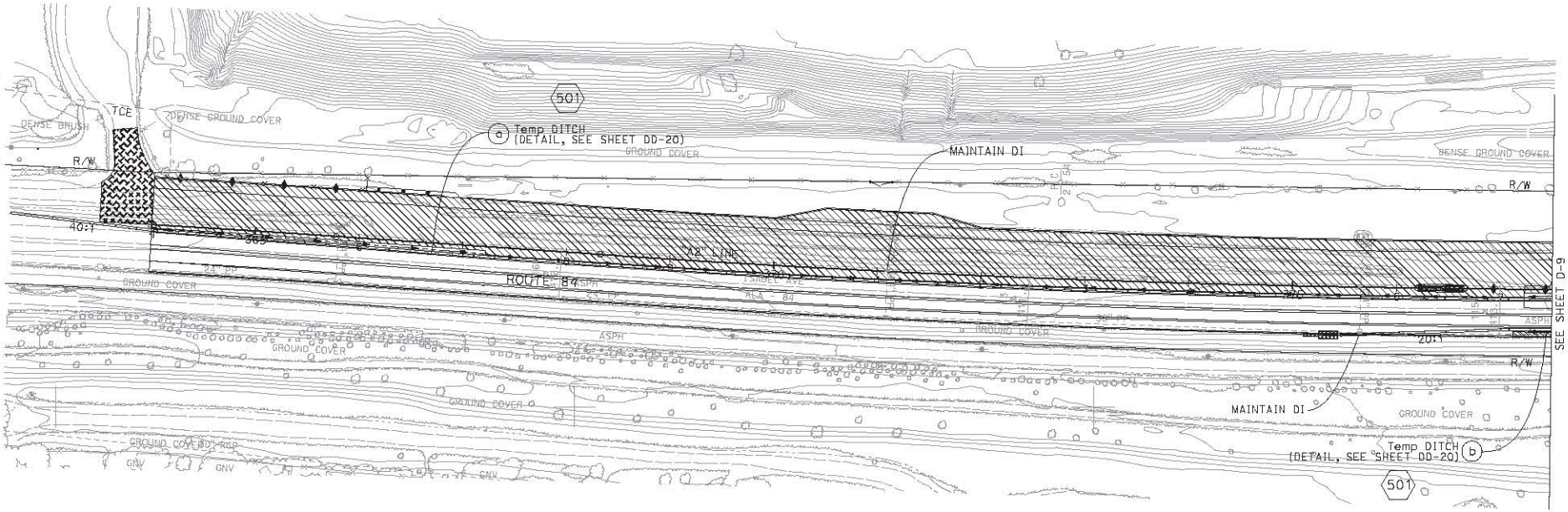

DRAINAGE PLAN TEMPORARY DRAINAGE (STAGE 1)

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

D-8

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 => 1/14/2011
TIME PLOTTED => 11:44:20 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz | DGN FILE => ...\04000205801ia008.dgn | 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
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
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PLANS APPROVAL DATE

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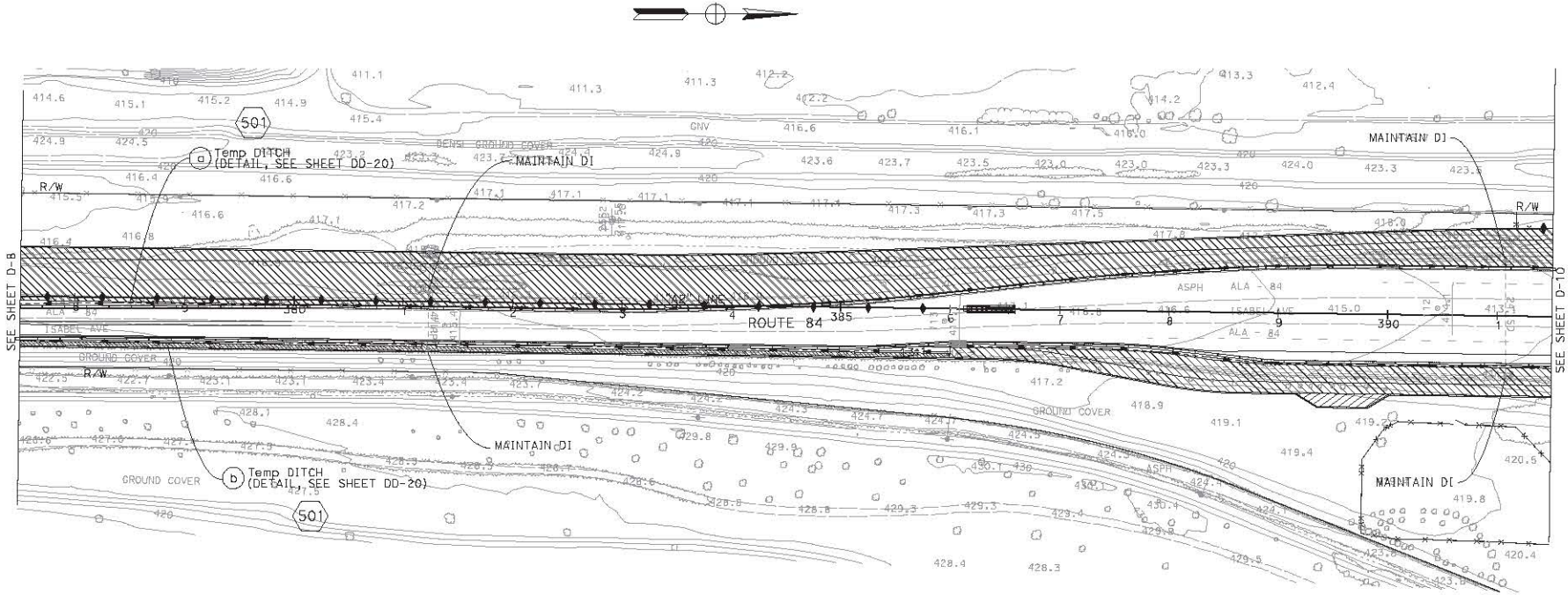

DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-8

D-9

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 => 1/14/2011
TIME PLOTTED => 8:44:25 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
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

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp 12/31/12
CIVIL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

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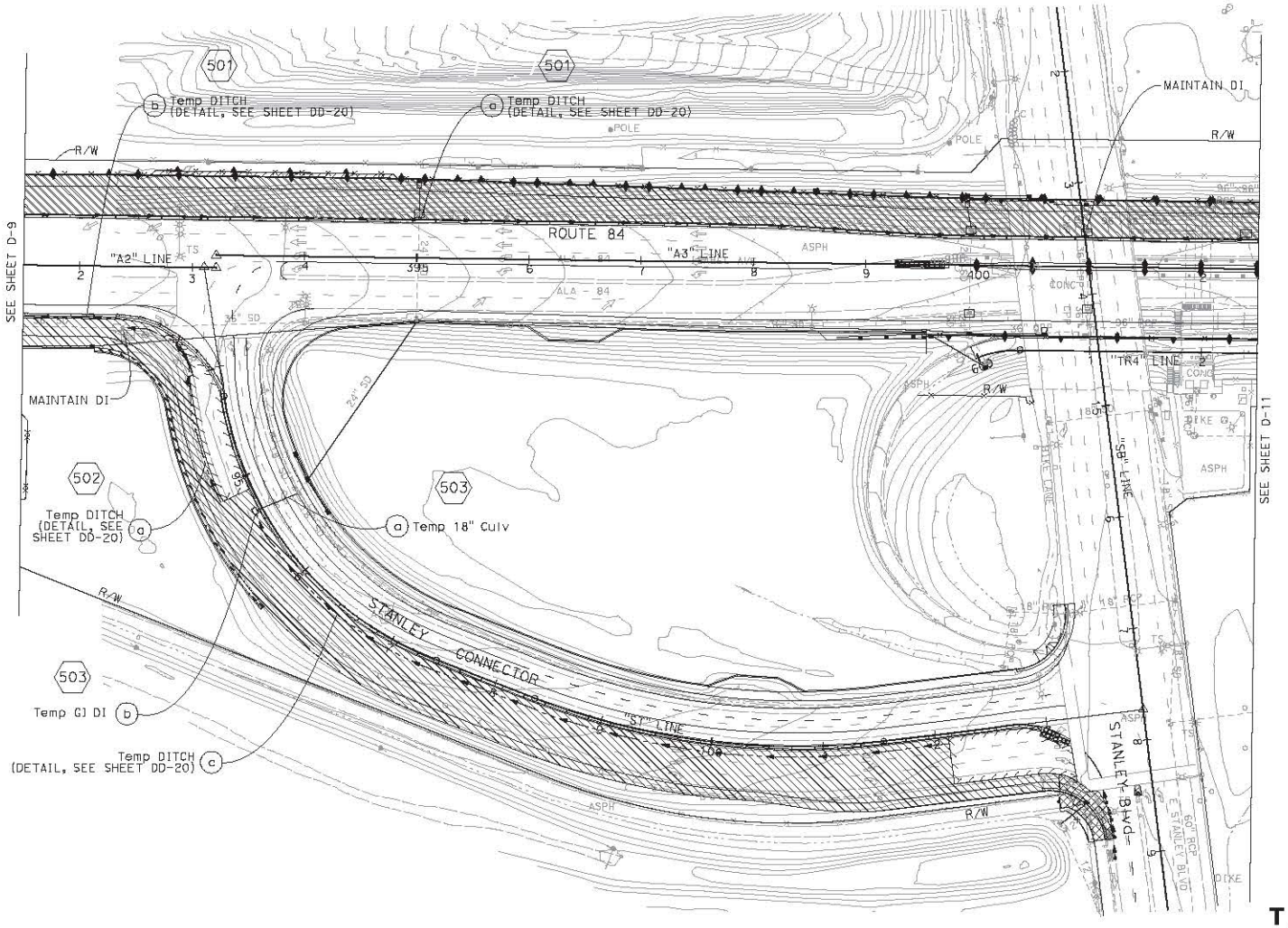

DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-8

D-10

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | 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 10-19-10 | DATE PLOTTED => 1/14/2011 | TIME PLOTTED => 11:44:30 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => jessica_pollitz | DGN FILE => ...\04000205801d010.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

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp 12/31/12
CIVIL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

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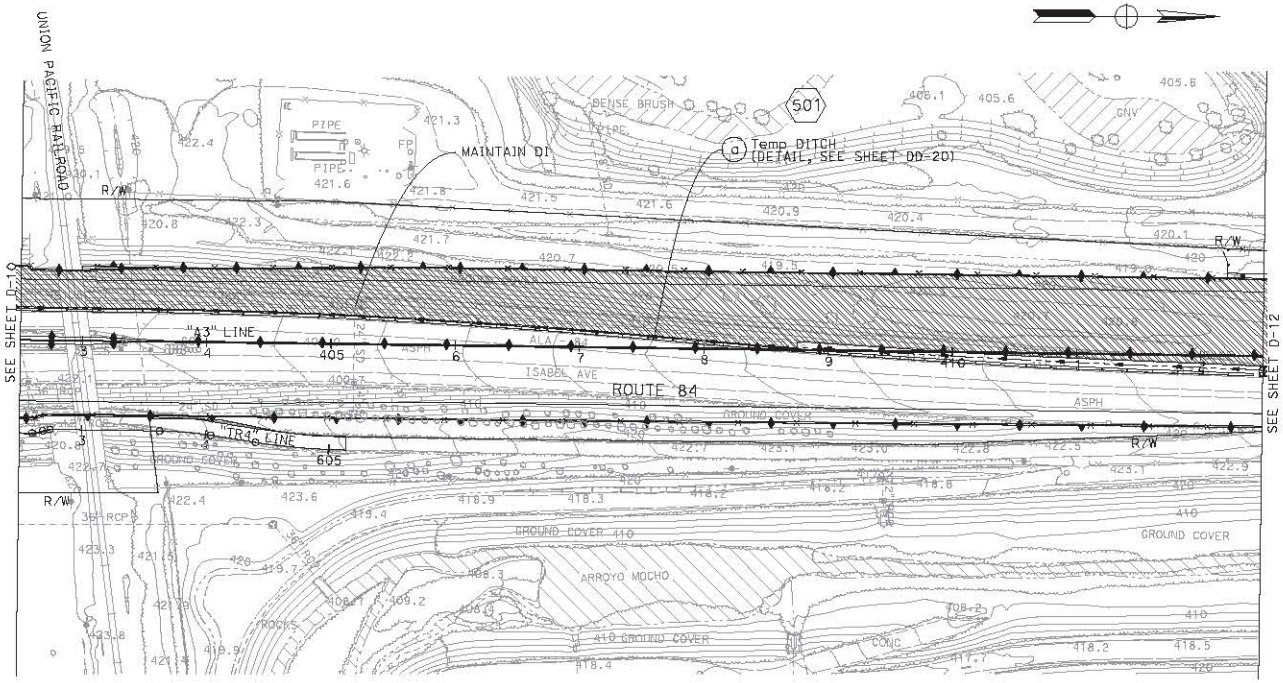

DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1'' = 50'

D-11

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	REVISED BY	
Caltrans	HAN-BIN LIANG	CHECKED BY	DATE REVISED	
		IRENE LIU	JP	
		ANALETTE OCHOA	1/11/11	

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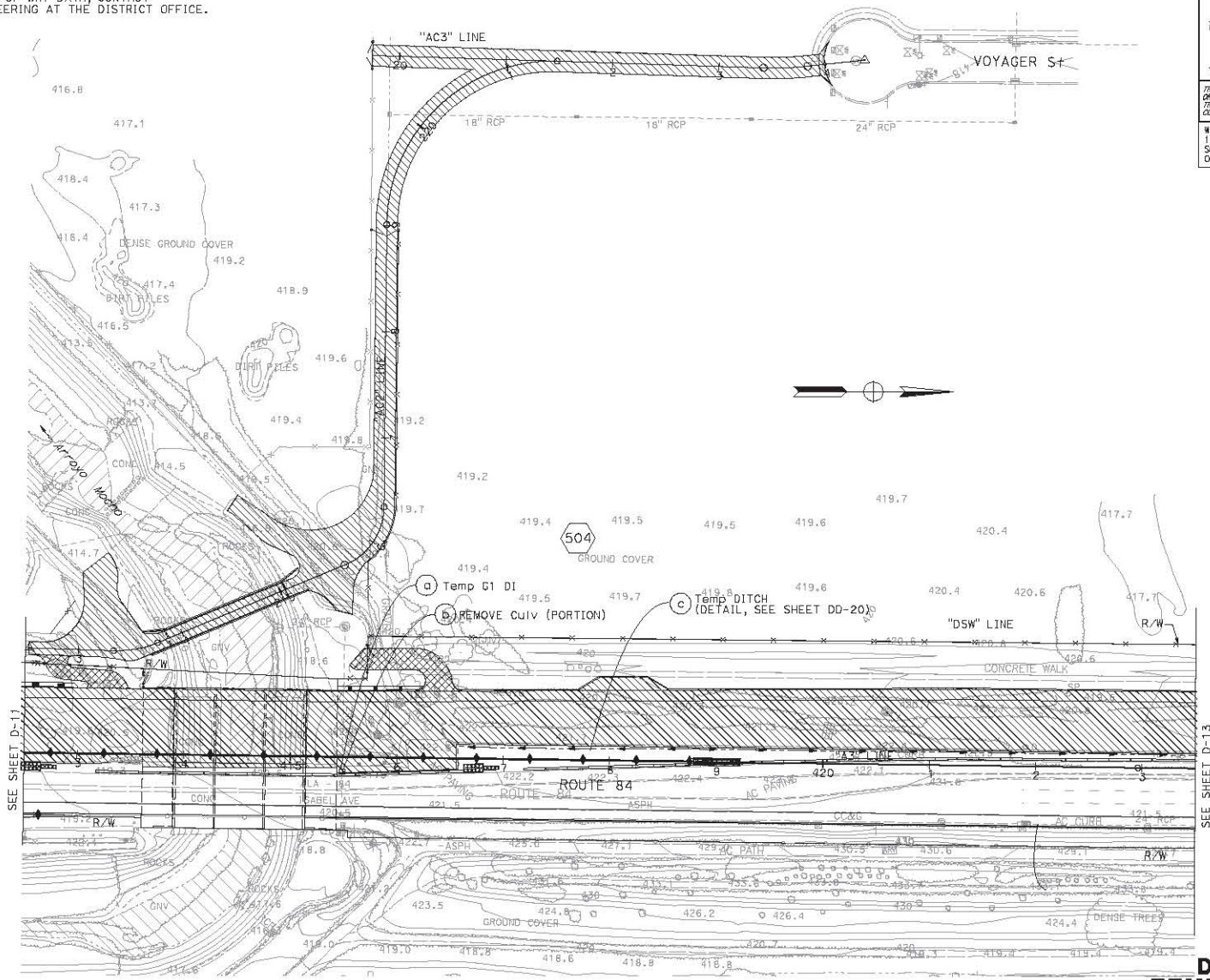

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Analette Ochoa 1/17/11
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55219 — Exp. 12/31/12 — CIVIL — STATE OF CALIFORNIA

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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

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

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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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CHECKED BY	ANALETTE OCHOA	DATE REVISED	1/11/11

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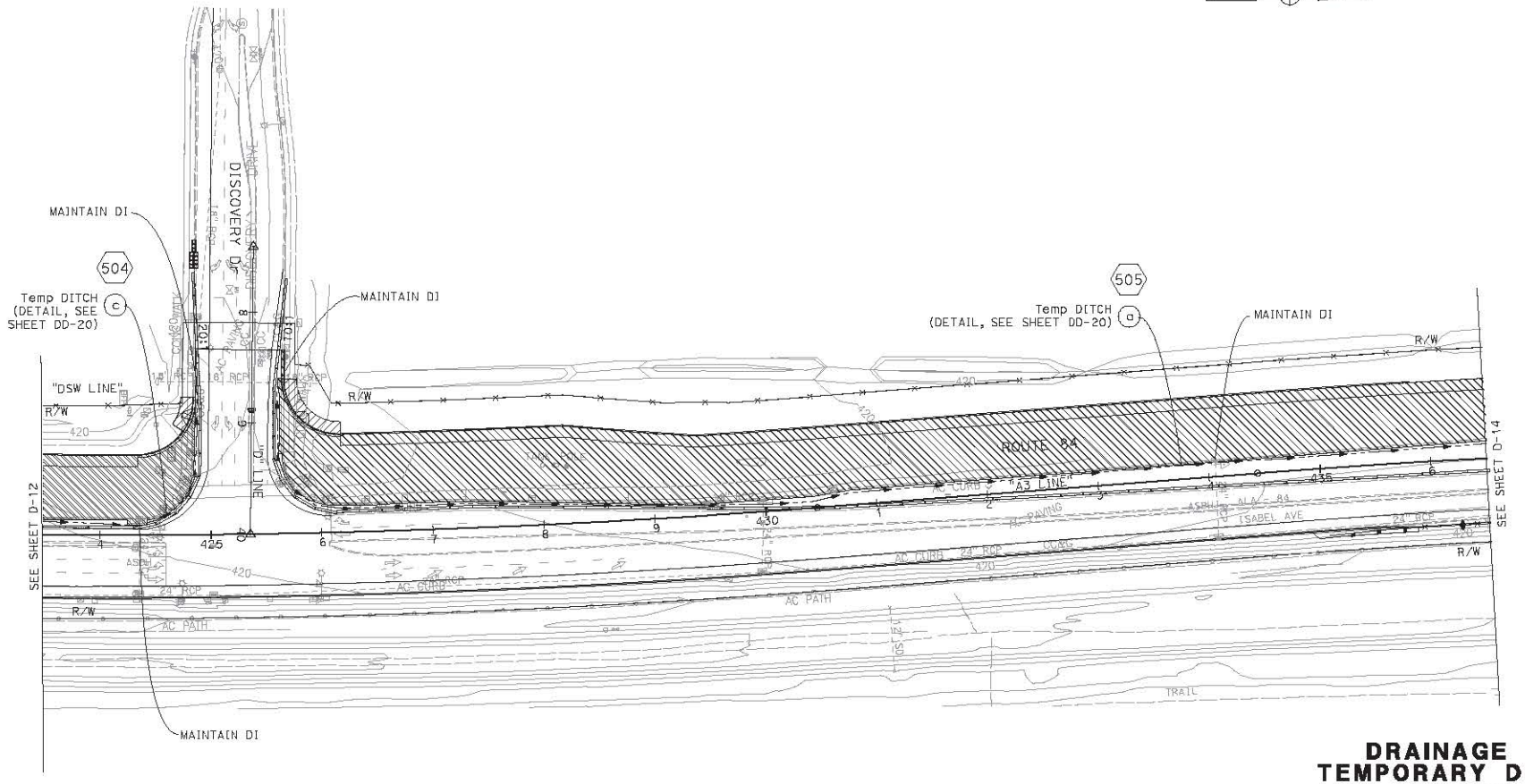
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG



DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1'' = 50'

D-13

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

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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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REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp 12/31/12
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Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR
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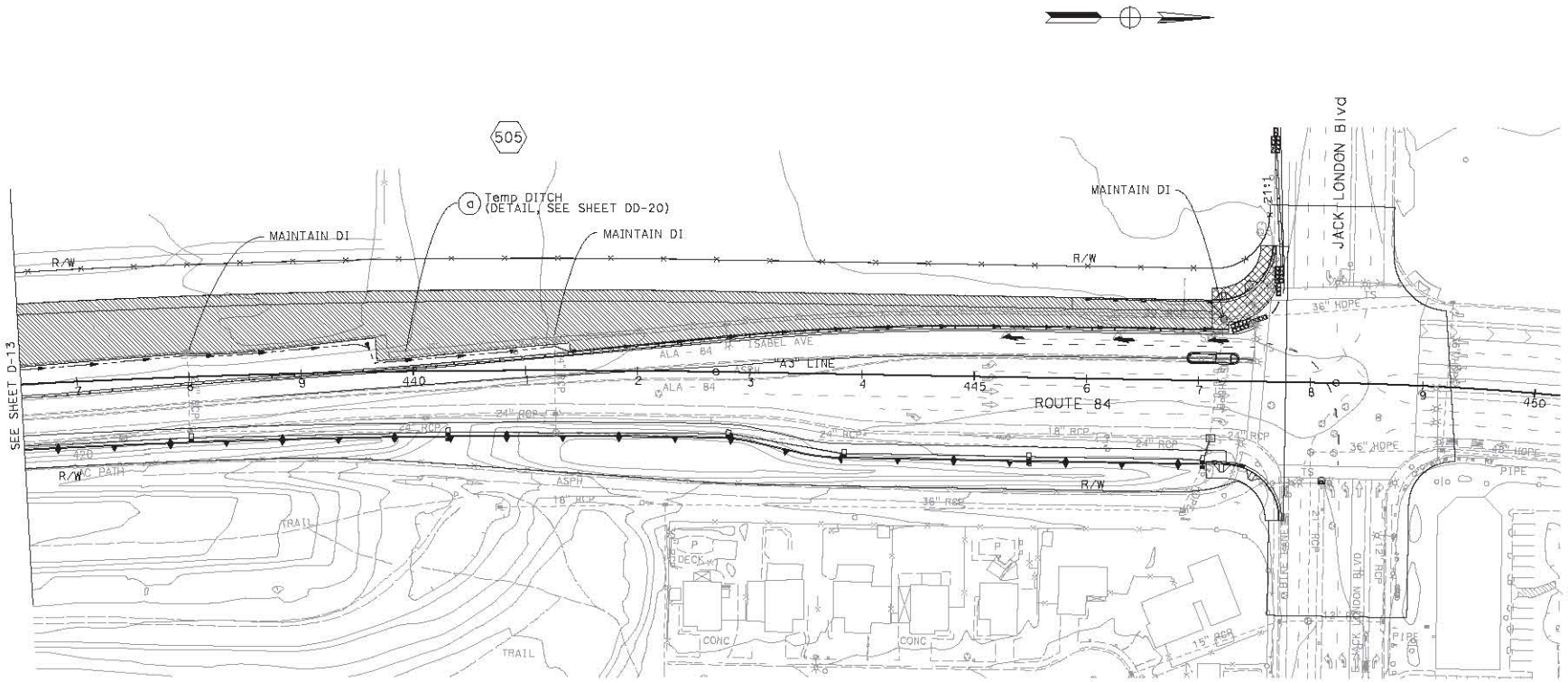

DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1" = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-8

D-14

LAST REVISION
10-19-10

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DGN FILE => ...\04000205801a014.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0733

PROJECT NUMBER & PHASE 04000205801

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		

Anlette 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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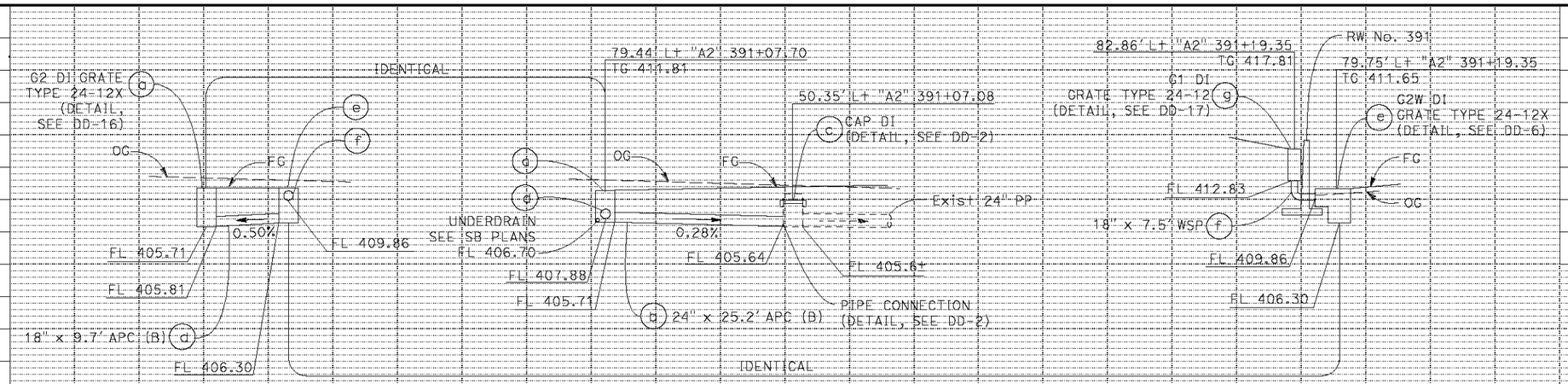
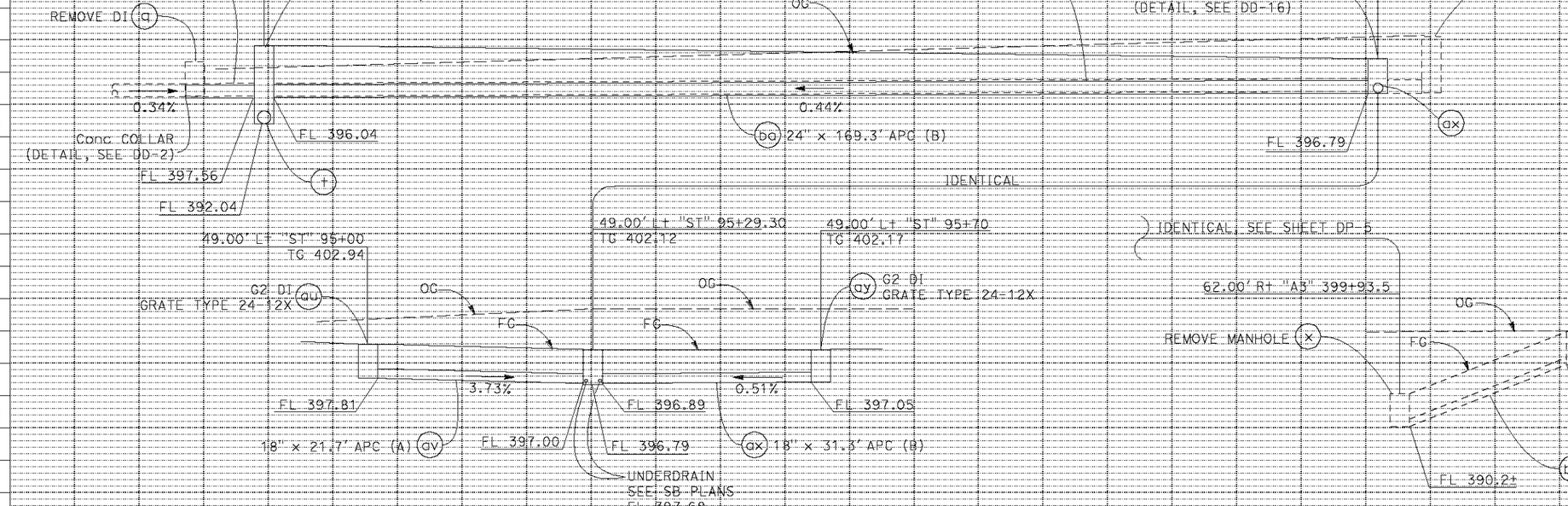
DRAINAGE SYSTEM No. 11



DRAINAGE SYSTEM No. 10



DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-4

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
REVISED BY: IL — DATE REVISED: 1/11/11

LAST REVISION DATE PLOTTED => 1/14/2011
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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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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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CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

REMOVE DI (a)
45.00' Rt "A2" 386+14.60
TC 416.67
(b) G2 DI GRATE TYPE 24-12X
45.86' Rt "A2" 386+60
TC 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 401.75
FL 401.45
FL 401.35
A
A
IDENTICAL, SEE SHEET DP-6
73.00' Rt "A2" 388+90
TC 414.71
73.00' Rt "A2" 390+04
TC 413.44
(f) G2 DI GRATE TYPE 24-12X
(h) G2 DI GRATE TYPE 24-12X
OG
FG
0.50%
FL 400.20
FL 400.10
(g) 36" x 111.1' APC (A)
FL 399.54
FL 404.05
FL 399.44
(ah)
B
B
73.00' Rt "A2" 392+11.70
TC 410.08
"ST" LINE
GDO DI (i)
GRATE TYPE 24-12X
(DETAIL, SEE DD-16)
UNDERDRAIN
SEE SB PLANS
FL 404.48
66.45' Rt "A2" 392+72.26
OG
FG
0.50%
0.50%
FL 393.68
FL 393.58
36" x 87.8' APC (A) (k)
36" x 59.3' APC (A) (m)
C
C
UNDERDRAIN
SEE SB PLANS
FL 390.65
OG
FG
0.79%
0.48%
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)
IDENTICAL, SEE SHEET DP-6
59.88' Rt "A3" 399+53.02
TC 395.38
(u) G2 DI GRATE TYPE 24-12X
(DETAIL, SEE DD-16)
UNDERDRAIN
SEE SB PLANS
FL 390.21
JACKED 36" x 76.6' RCP (n)
IDENTICAL, SEE SHEET DP-4
62.00' Rt "A3" 399+93.50
TC 394.95
(w) G2 DI GRATE TYPE 24-12X
(DETAIL, SEE DD-16)
(x) REMOVE MH
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)
0.53%
FL 387.78
FL 387.63
70.72' Rt "A3" 393+48.62
OG
FG
0.50%
FL 403.48
FL 394.12
36" x 113.1' APC (A) (j)
62.00' Rt "A3" 400+95
TC 394.60
(o) 36" x 151.1' APC (A)
Exist 36" RCP
62.00' Rt "A3" 400+60
TC 394.64
G2 DI GRATE TYPE 24-12X
(DETAIL, SEE DD-3, DD-16) (aa)
0.34%±
FL 387.53
Exist 36" CPP
Exist JUNCTION BOX
Exist 96" RCP STORAGE BAY
IDENTICAL, SEE SHEET DP-6
73.00' Rt "A2" 391+21
TC 411.71
(j) G2 DI GRATE TYPE 24-12X
B
B
0.50%
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)
C
C
UNDERDRAIN
SEE SB PLANS
FL 399.42
(r)
0.50%
0.79%
FL 392.56
FL 392.14
62.00' Rt "A3" 401+25
TC 394.63
FL 392.04
G2 DI GRATE TYPE 24-12X (DETAIL, SEE DD-3) (bk)
Mod DI (SEE Misc DETAIL OF RW No. 400N)
FG
FL 391.63
12" x 2.1' CSP RISER (DETAIL, SEE DD-16) (bj)

DRAINAGE SYSTEM No. 10

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-5

LAST REVISION DATE PLOTTED => 11/14/2011
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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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CHECKED BY: ANALETTE OCHOA
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
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
FL 404.05
FL 399.44
24" x 4.0' APC (B) (ag)
FL 404.26
(i)
142.50' Rt "A2" 390+04
TC 413.00
G2 MH (ai) FRAME & COVER TYPE U45 (DETAIL, SEE DD-4)
FL 399.10
(ah) 18" x 68.0' APC (B)
IDENTICAL
142.50' Rt "A2" 390+09.53
TC 409.84
(ak) 18" x 3.1' APC (B)
(al) G2 DI GRATE TYPE 24-12 (DETAIL, SEE DD-17)
0.46%
FL 406.11
FL 406.13
FL 399.10
FL 399.00
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)
FL 406.13
FL 400.89
FL 394.89
END CHAMBER FL 394.72
0.46%
FL 400.56
(as)
FL 394.56
FL 394.86
18" x 6.5' APC (B) (ap)
6" x 6.5' PP (aq)
AUSTIN VAULT SAND FILTER TYPE S-15000-6 (DETAIL, SEE DD-7 TO DD-15, DD-18) (am)
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)
(at) 18" AUTOMATIC DRAINAGE GATE (DETAIL, SEE DD-19)
(k)
0.50%
FL 394.12
FL 394.22
(gs) 18" x 68.0' APC (B)
FL 394.56
IDENTICAL
RW No. 400N RETURN WALL TYPE 1
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
FL 406.11
FL 392.35
(v)
FL 388.38
(bc) G1 DI GRATE TYPE 24-12 (DETAIL, SEE DD-17)
(bd)
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
IDENTICAL
64.13' Rt "A3" 399+58.99
TG 402.35
(be) G1 DI GRATE TYPE 24-12X (DETAIL, SEE DD-17)
FL 399.35
1.93%
FL 400.33
(bf) 12" x 50.8' WSP (DETAIL, SEE DD-3)
(bd) 12" x 9.9' WSP
91.50' Rt "A3" 400+07.92
TG 404.33
G1 DI w/ PCC APRON GRATE TYPE 24-12 (DETAIL, SEE DD-3) (bi)
64.75' Rt "A2" 390+04
TC 413.85
G2 DI (af)
OG
FG
0.50%
FL 404.38
FL 404.28
(ae) 18" x 100.9' APC (B)
IDENTICAL
64.60' Rt "A2" 391+07.78
TC 412.35
54.81' Rt "A2" 391+07.63
TC 412.60
G2 DI (ad) GRATE TYPE 24-12X
CAP DI (db) (DETAIL, SEE DD-2)
(ac)
FL 404.88
FL 404.98
Exist 24" PP
FL 405.04
0.50%
0.58%
64.60' Rt "A2" 391+07.78
TC 412.35
(ad)
OG
FG
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 DATE PLOTTED => 1/14/2011
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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 — STATE OF CALIFORNIA

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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

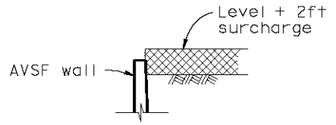
Wall & Footing (LFD): 1.5 D + 1.5 E + 1.5 W + 1.5 SC
Where D = Dead Load
E = Earth Load
W = Water Load
SC = Surcharge

Capacity reduction factor is included.

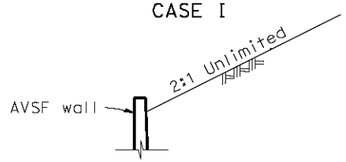
Earth Load:
125 lb/ft^3 vertical,

Water Load:
62.4 lb/ft^3 horizontal/vertical,

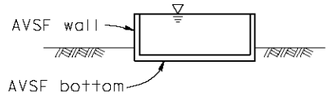
Earth pressure for 2:1 unlimited slope determined from Rankine's formula with $\phi = 33°42'$ (Case II).



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
fy = 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

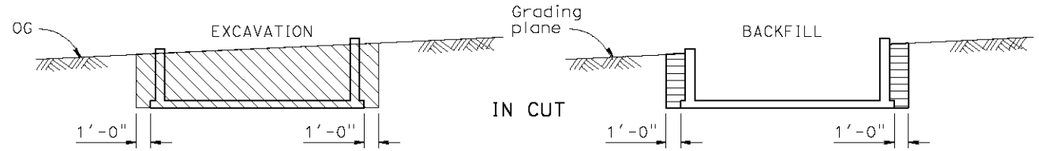
CONSTRUCTION NOTES

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

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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
04	Ala	84	25.5/27.1		

Anlette Ochoa — 1/17/11
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PLANS APPROVAL DATE

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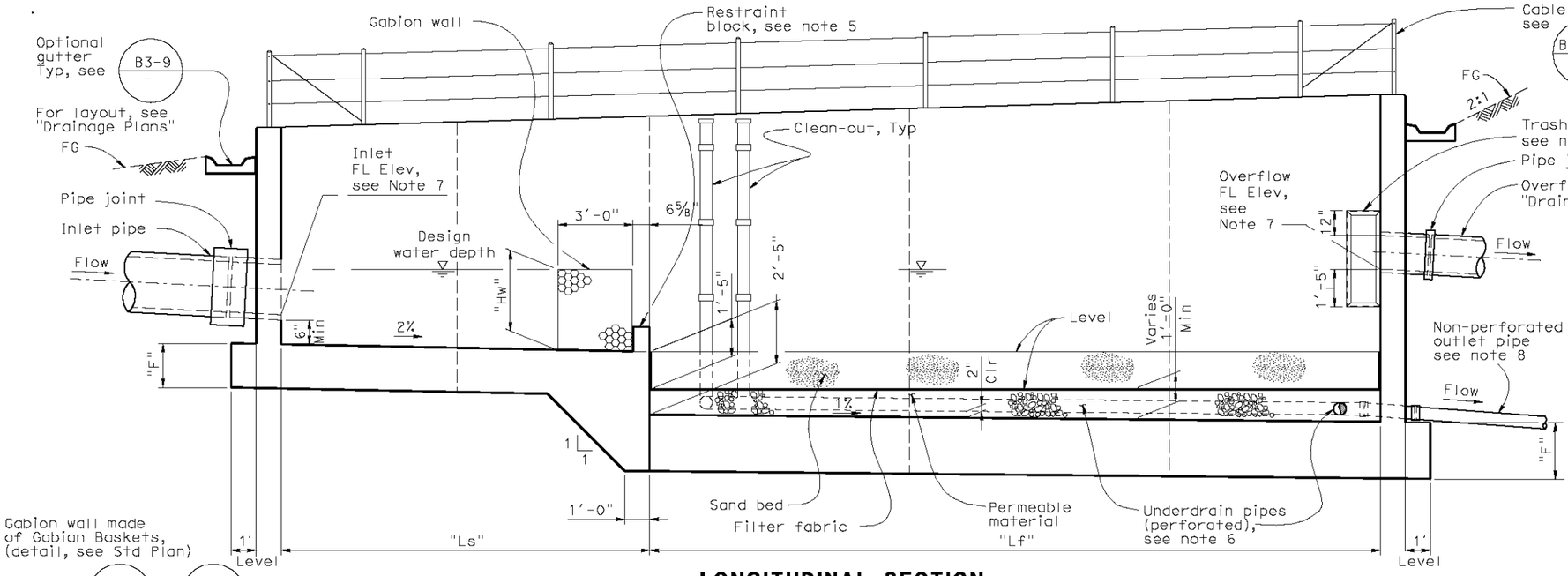
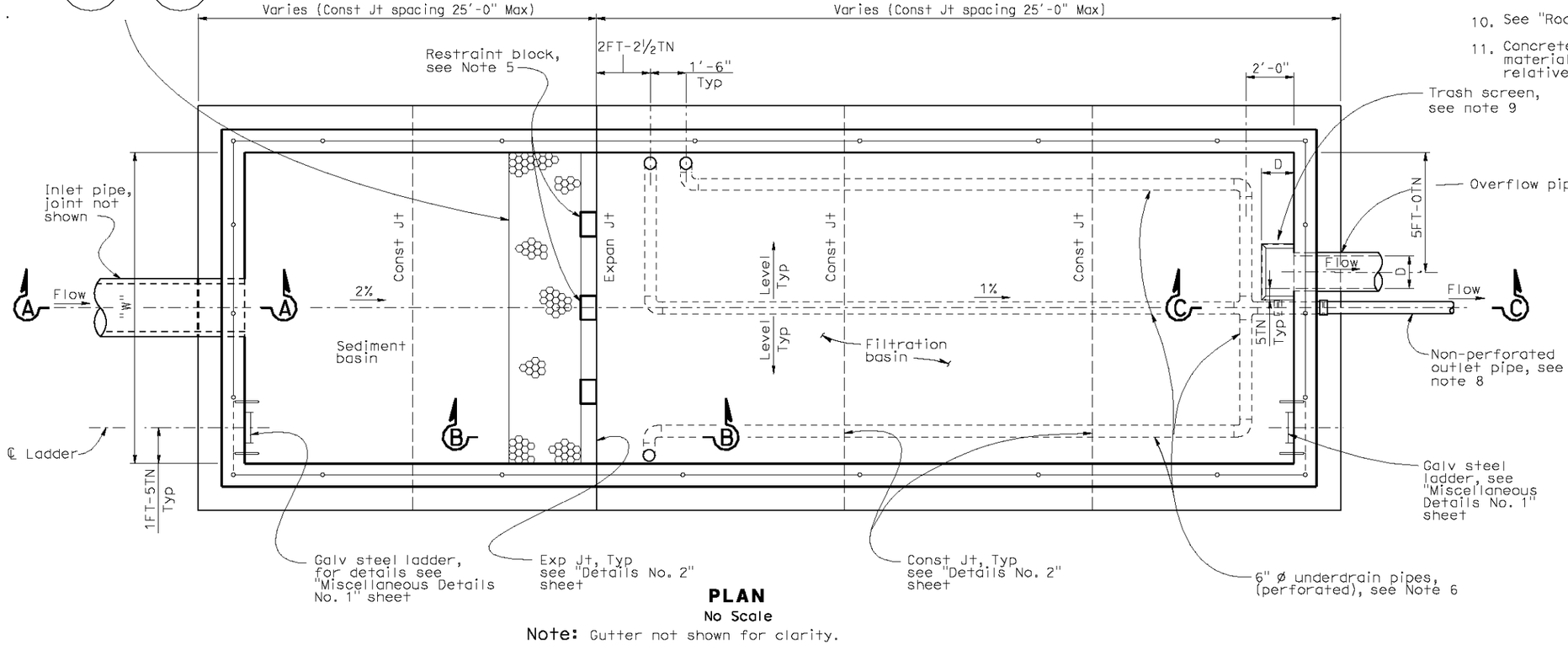


LONGITUDINAL SECTION

No Scale

D100A & D100B



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

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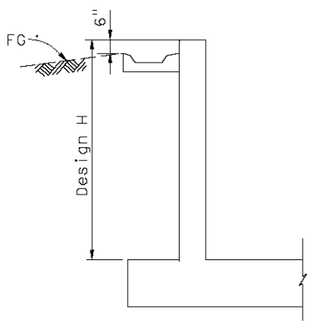
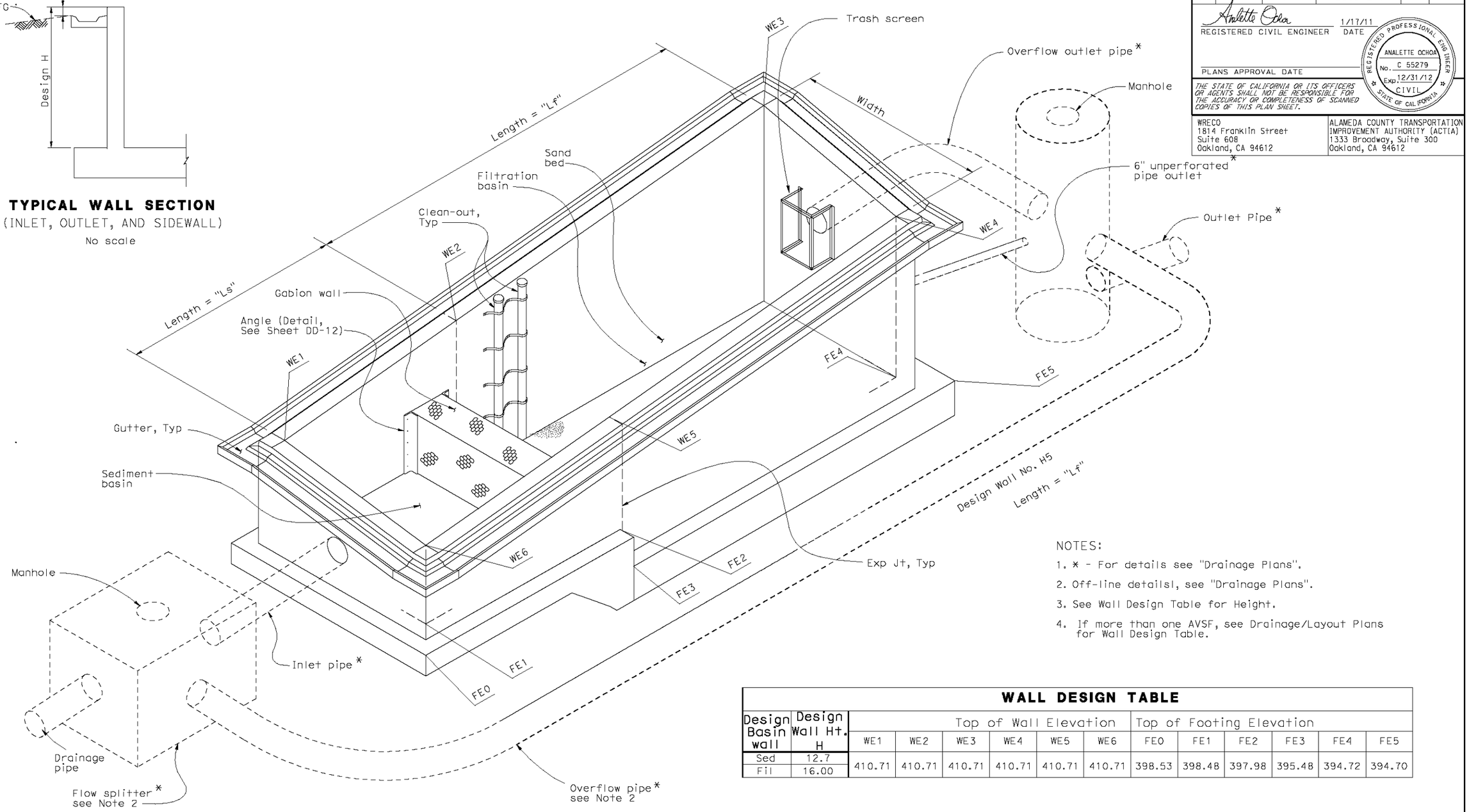


TYPICAL WALL SECTION
(INLET, OUTLET, AND SIDEWALL)
No scale



NOTES:

1. * - For details see "Drainage Plans".
2. Off-line details, 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												

ISOMETRIC VIEW - AUSTIN VAULT SAND FILTER DRAINAGE SYSTEM
No Scale
NOTE: Steel ladders and cable railings not shown for clarity.

AUSTIN VAULT SAND FILTER
LAYOUT No. 2

DRAINAGE DETAILS
NO SCALE

DD-9

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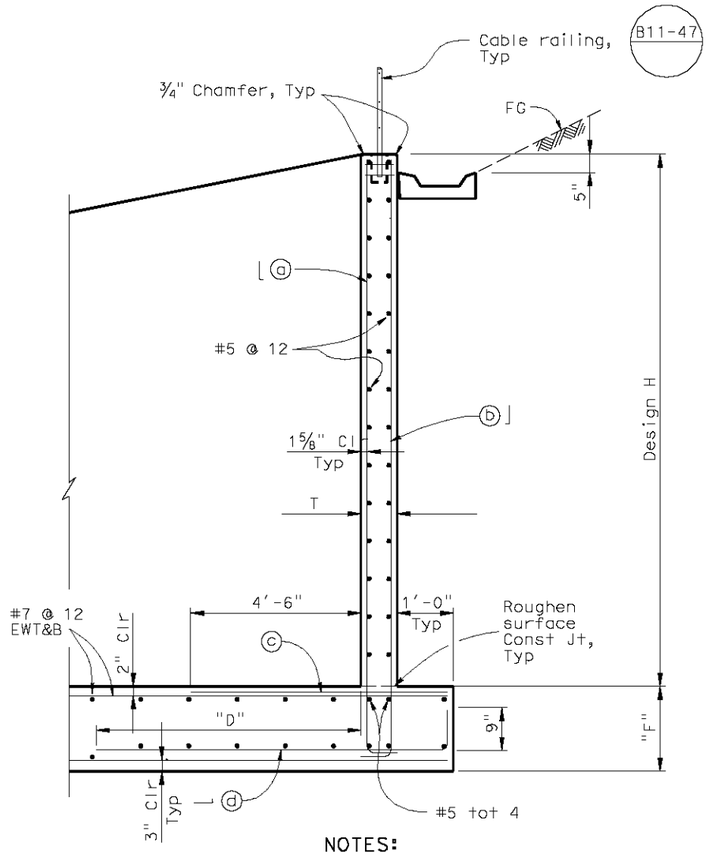
UNIT 0733
PROJECT NUMBER & PHASE 04000205801



NOTES:

"D" = 8'-0" when "W" ≤ 30'-0"

"D" = 12'-0" when "W" > 30'-0"

TYPICAL SECTION

No Scale

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"
⌋ (a) bars # @ "	6 @ 12	6 @ 12	6 @ 8	7 @ 8	8 @ 8	9 @ 6
⌊ (b) bars # @ "	6 @ 12	6 @ 12	6 @ 8	7 @ 8	8 @ 8	8 @ 6
(c) bars # @ "	6 @ 12	6 @ 12	6 @ 8	6 @ 8	7 @ 8	7 @ 6
— (d) bars # @ "	6 @ 12	6 @ 12	6 @ 8	6 @ 8	7 @ 8	7 @ 6

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.

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Analette Ochoa
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ANALETTE OCHOA — CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR - HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
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AUSTIN VAULT SAND FILTER
WALL DETAILS

DRAINAGE DETAILS
NO SCALE

DD-10

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Analette Ochoa 1/17/11
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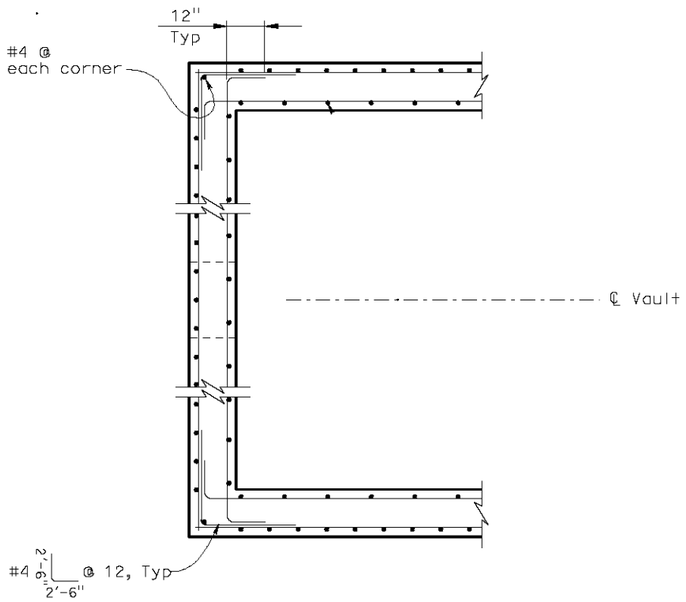
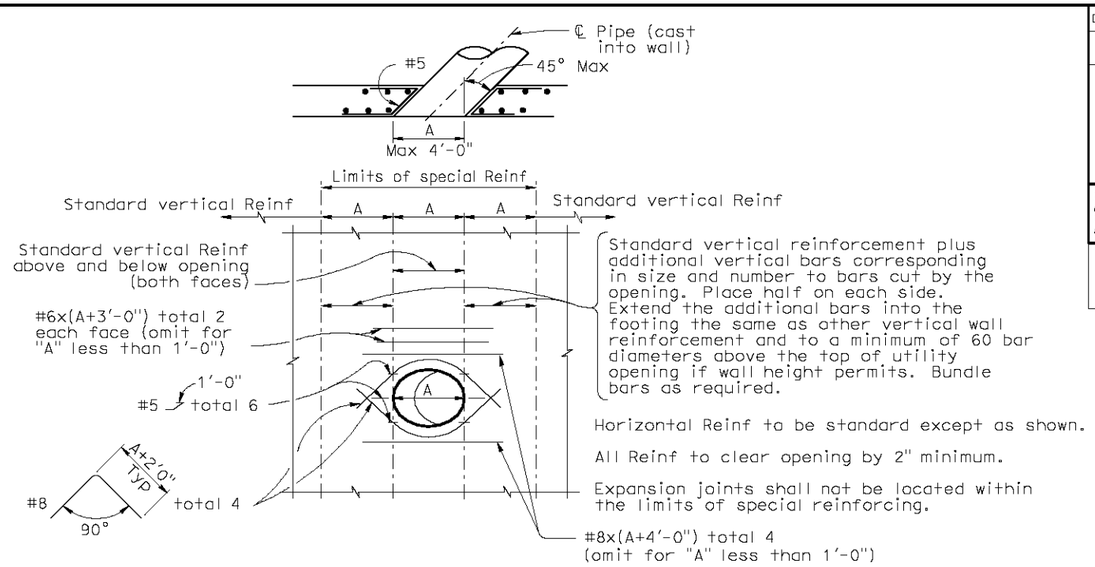


TYPICAL CORNER DETAIL

No Scale

NOTE: Inlet wall shown, outlet wall similar.



WALL OPENING DETAIL

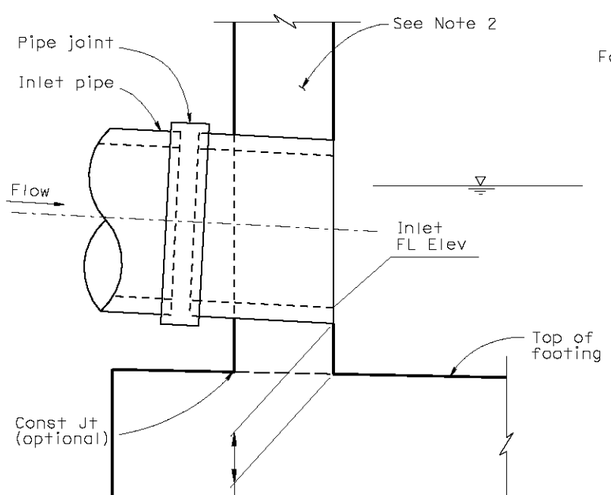
No Scale

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.

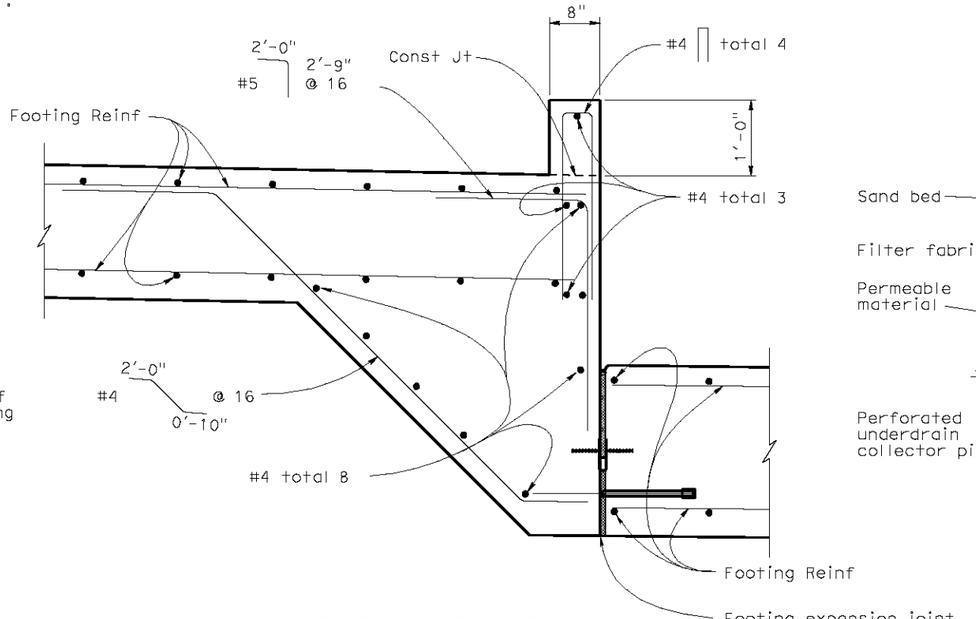
NOTES:

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

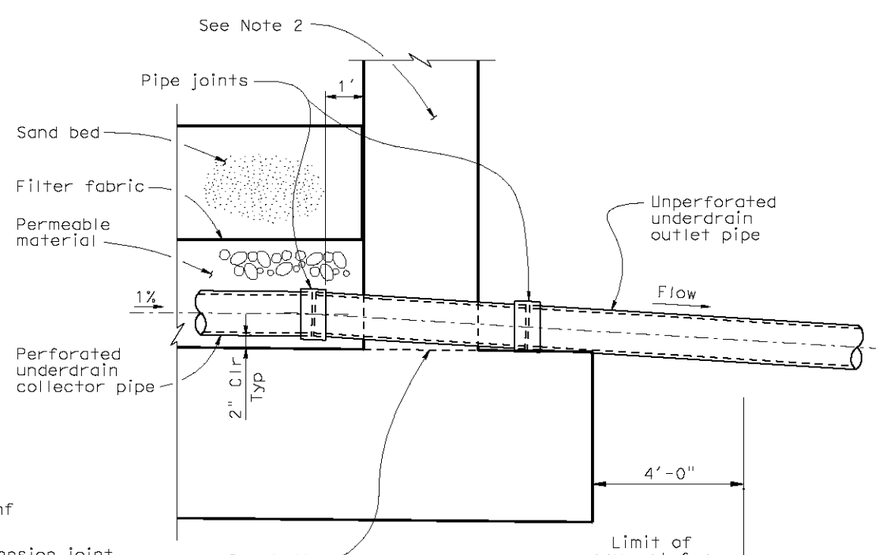
No Scale



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

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CHECKED BY: ANALETTE OCHOA
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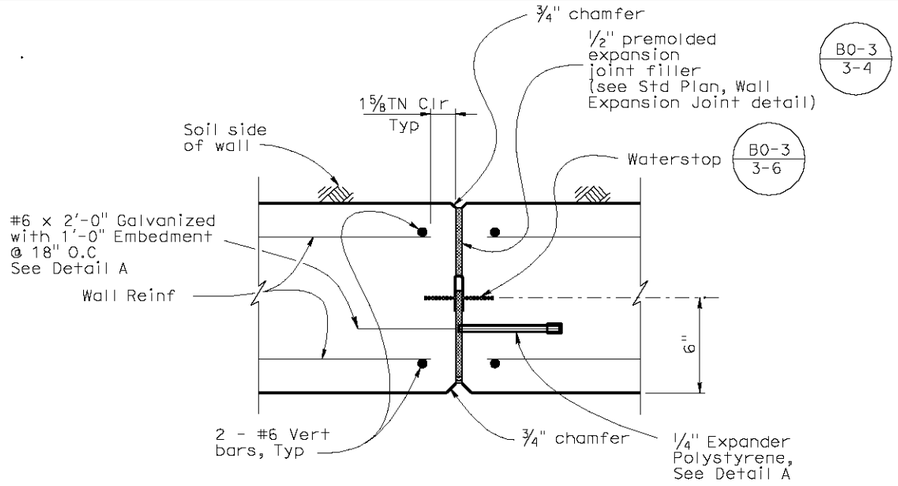
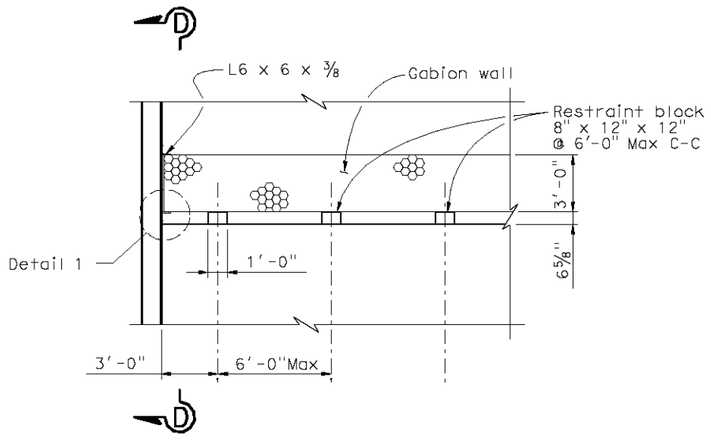


WALL EXPANSION JOINT DETAIL - PLAN SECTION

No Scale

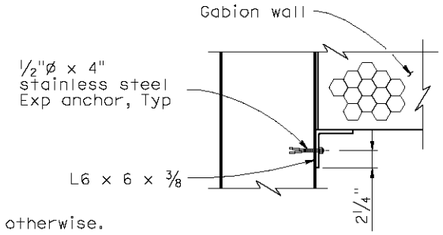


RESTRAINT BLOCK DETAIL

No Scale

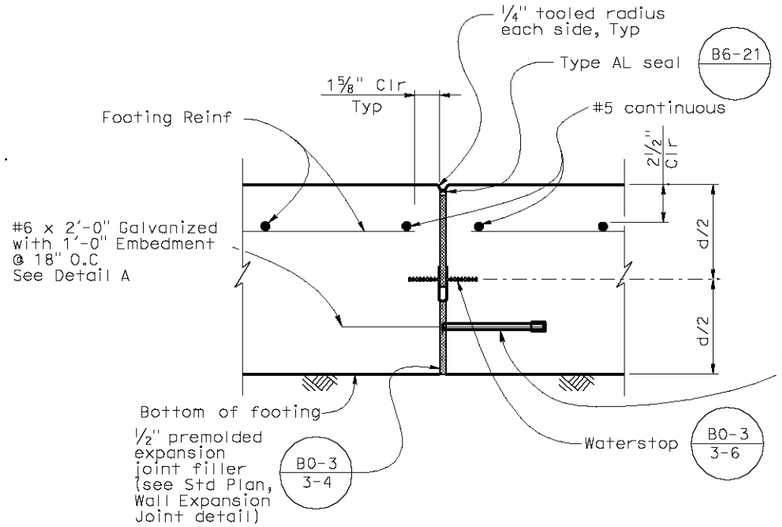
Notes:

1. Stagger splices unless noted otherwise.



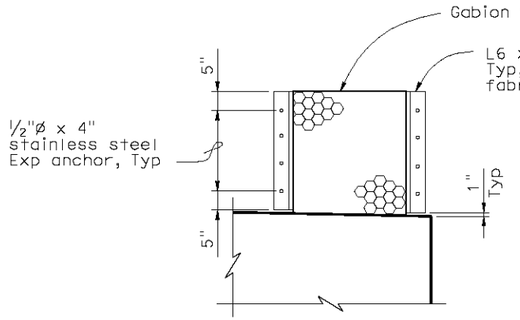
DETAIL 1

No Scale



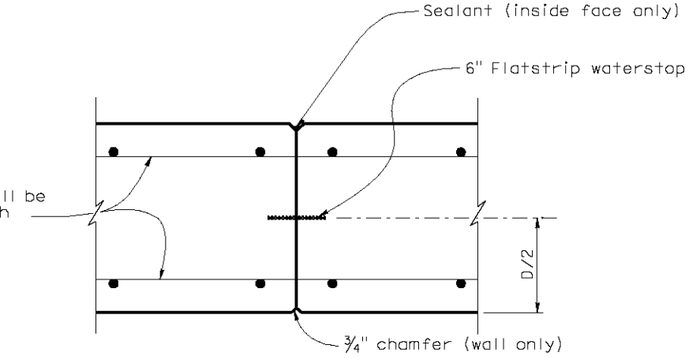
FOOTING EXPANSION JOINT DETAIL

No Scale



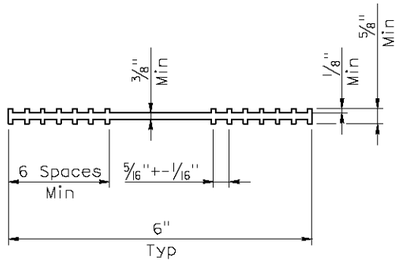
SECTION D - D

No Scale



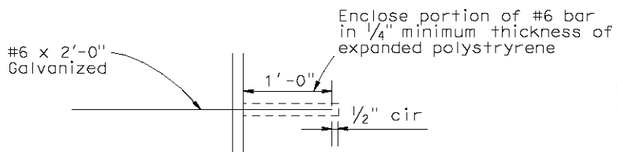
WALL CONSTRUCTION JOINT DETAIL

No Scale



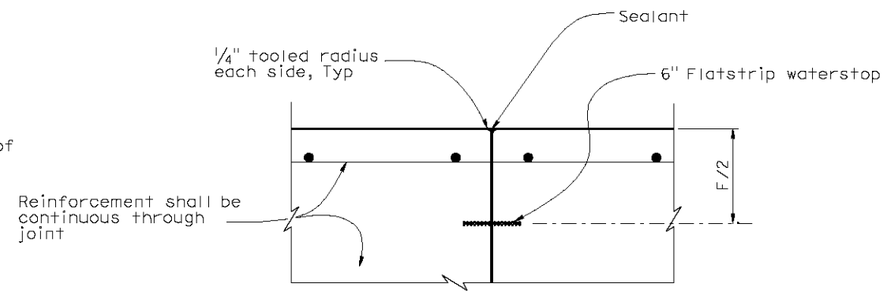
6" FLATSTRIP WATER STOP DETAIL

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

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HAN-BIN LIANG — CONSULTANT FUNCTIONAL SUPERVISOR
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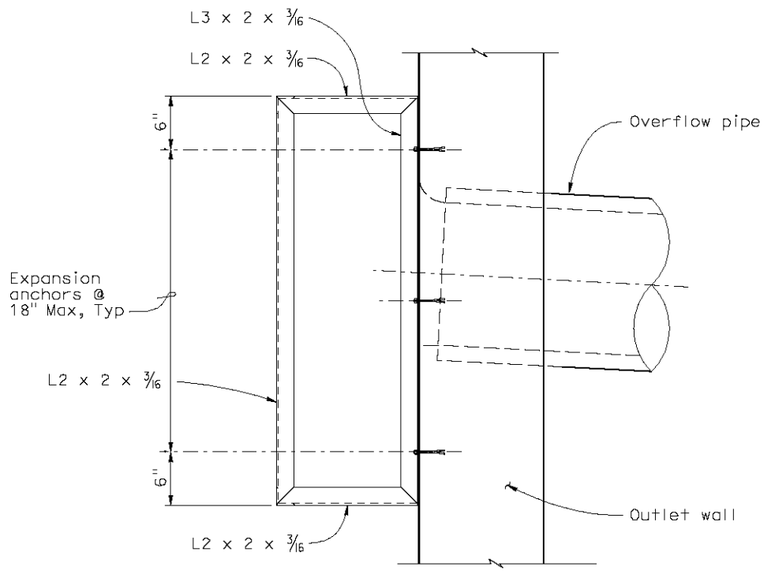
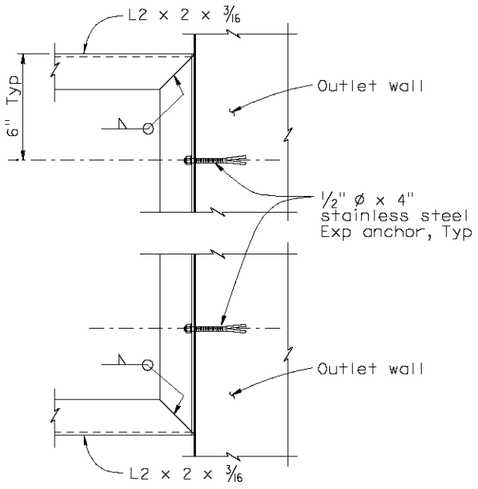
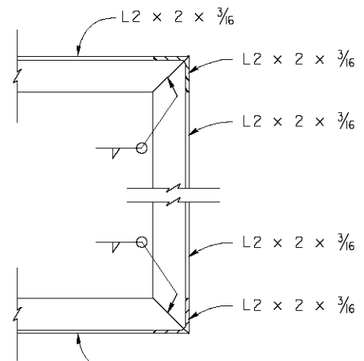


TRASH SCREEN - SIDE ELEVATION
No scale



SECTION F - F
No Scale



SECTION E - E
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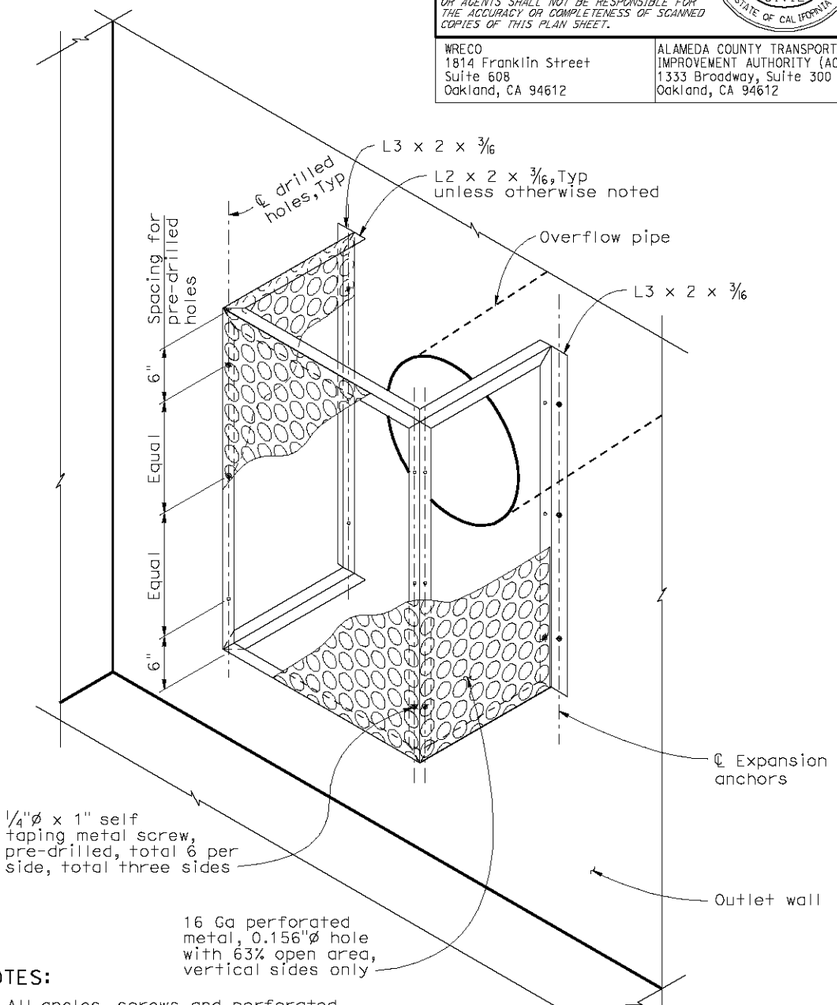
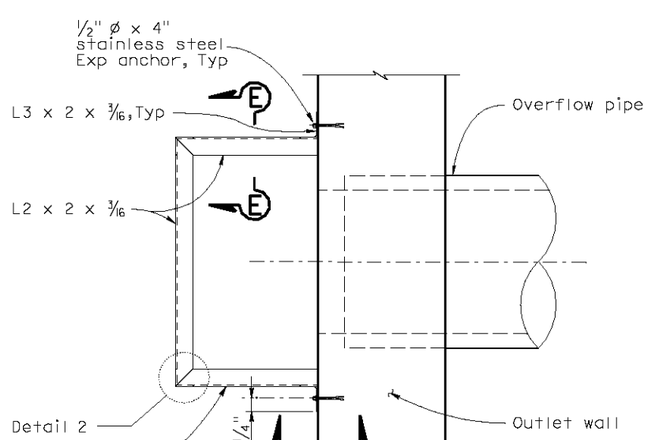
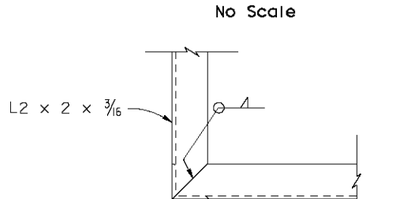


NOTES:
1. All angles, screws and perforated metal shall be galvanized.
2. Paint all weld joints with zinc rich paint or galvanize after welding.

ISOMETRIC VIEW - TRASH SCREEN
No scale
NOTE: Metal hole ø exaggerated for emphasis.



TRASH SCREEN - PLAN
No Scale



DETAIL 2
No Scale

AUSTIN VAULT SAND FILTER DETAILS No. 3

DRAINAGE DETAILS
NO SCALE

DD-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: IL
DATE REVISED: 1/11/11

LAST REVISION DATE PLOTTED => 1/15/2011
TIME PLOTTED => 2:03:35 PM
10-19-10

BORDER LAST REVISED 7/2/2010
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DGN FILE => ...\0400020580ic013.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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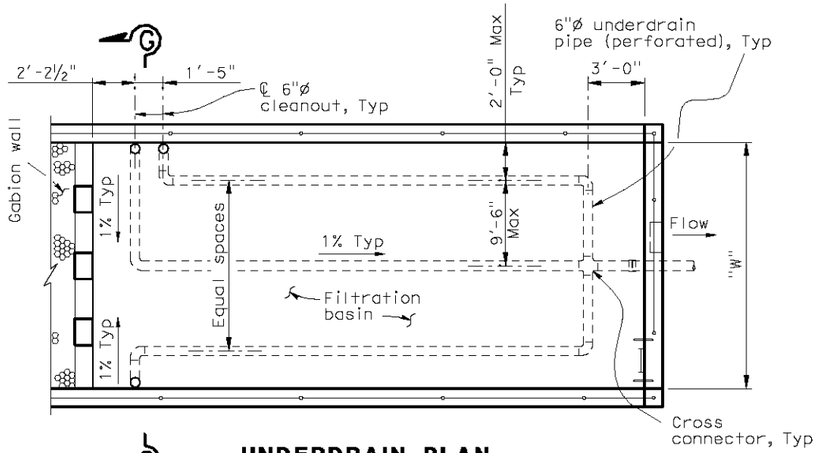
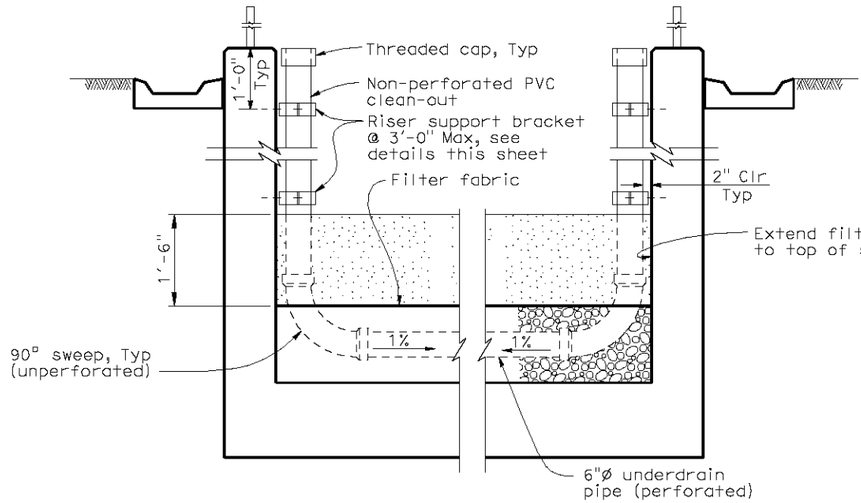


UNDERDRAIN PLAN (FILTRATION BASIN)

"W" = 15' - 21'
No Scale
AVSF Type = (S or L 3500)

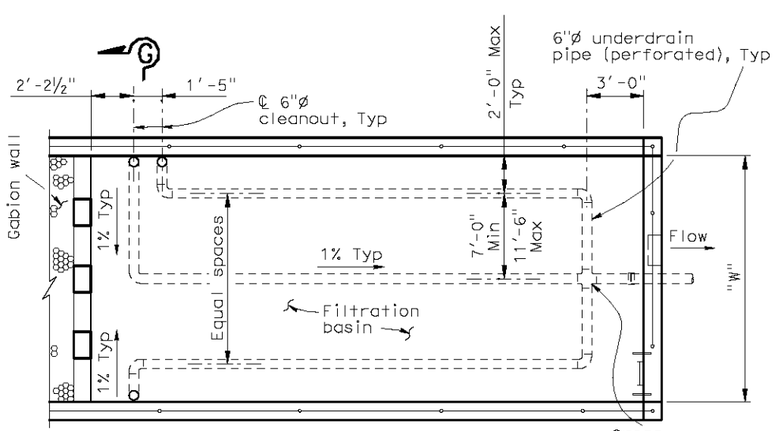


SECTION G - G

No Scale

NOTE:

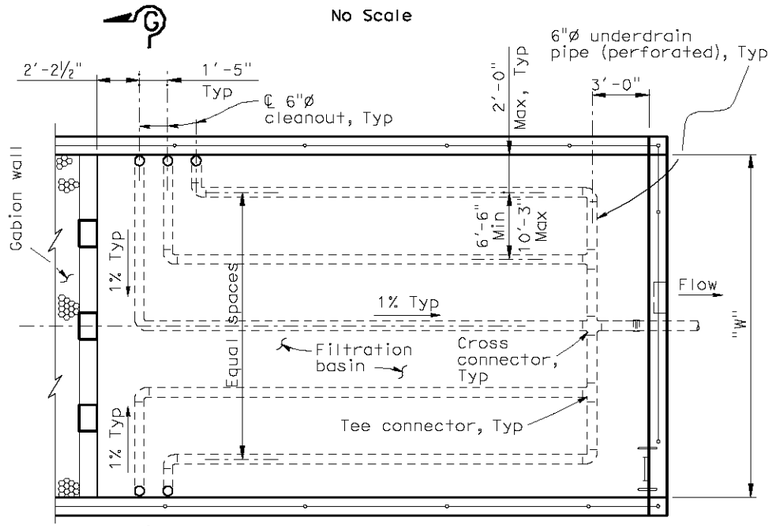
1. See "Layout No. 1" sheet for Typical cover and depth of sand bed.



UNDERDRAIN PLAN (FILTRATION BASIN)

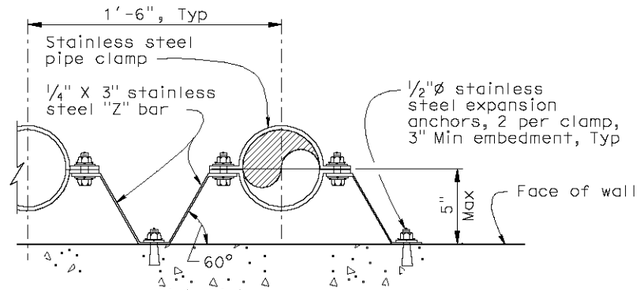
"W" = 18' - 24' - 27'
No Scale
AVSF Type = (S or L 5000) L 10000)

No Scale



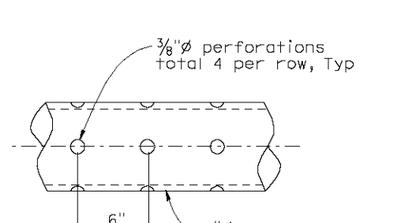
UNDERDRAIN PLAN (FILTRATION BASIN)

"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 | DATE PLOTTED => 1/15/2011
10-19-10 | TIME PLOTTED => 2103:39 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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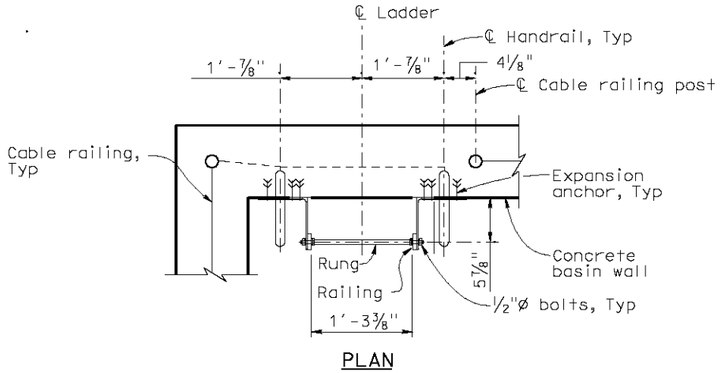
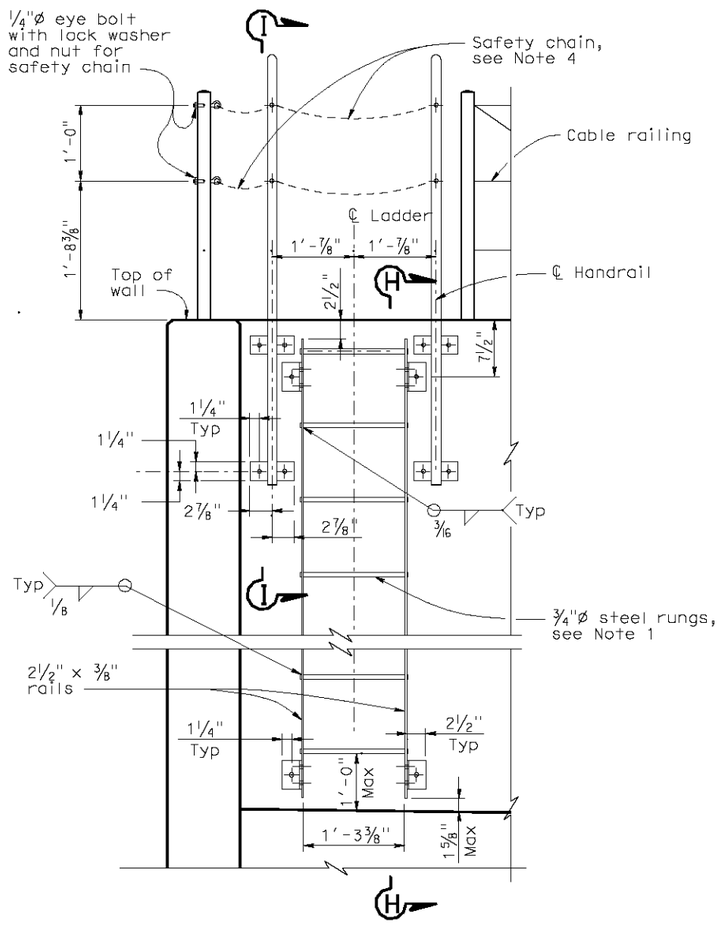
Suite 608
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612



PLAN

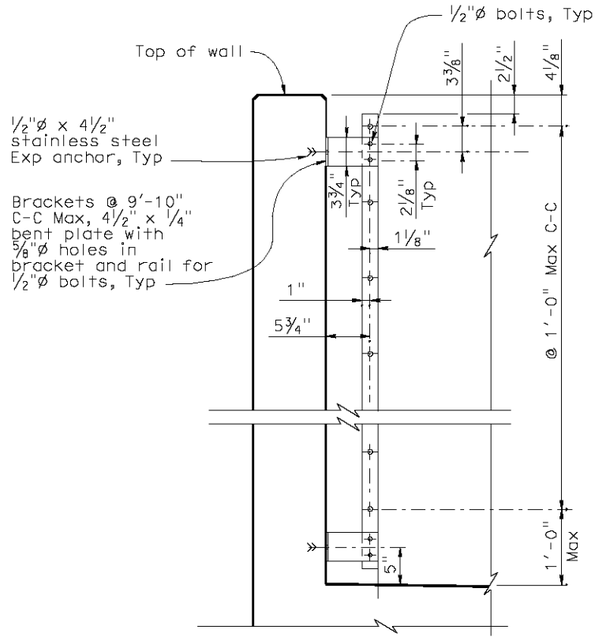


ELEVATION

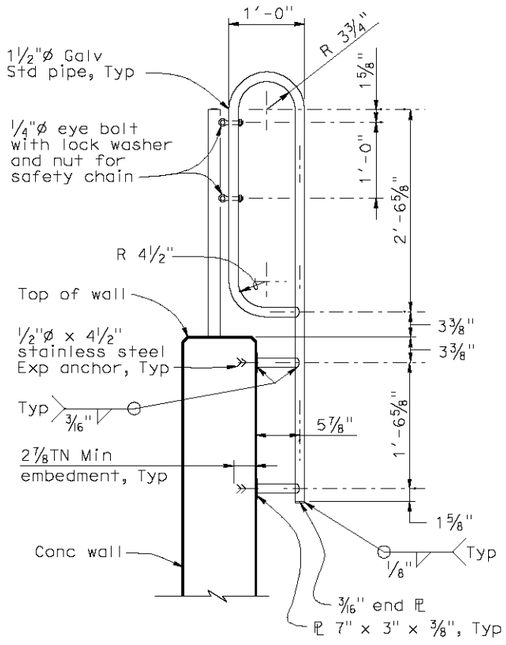
LADDER
No Scale
NOTE: Cable railing not shown for clarity.

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.



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

CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
IRENE LIU	ANALETTE OCHOA	IL	1/11/11

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION | DATE PLOTTED => 1/15/2011 | TIME PLOTTED => 21:03:46 PM
10-19-10

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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		

Anlette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 85279 — Exp. 12/31/10 — 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.

NOTES:

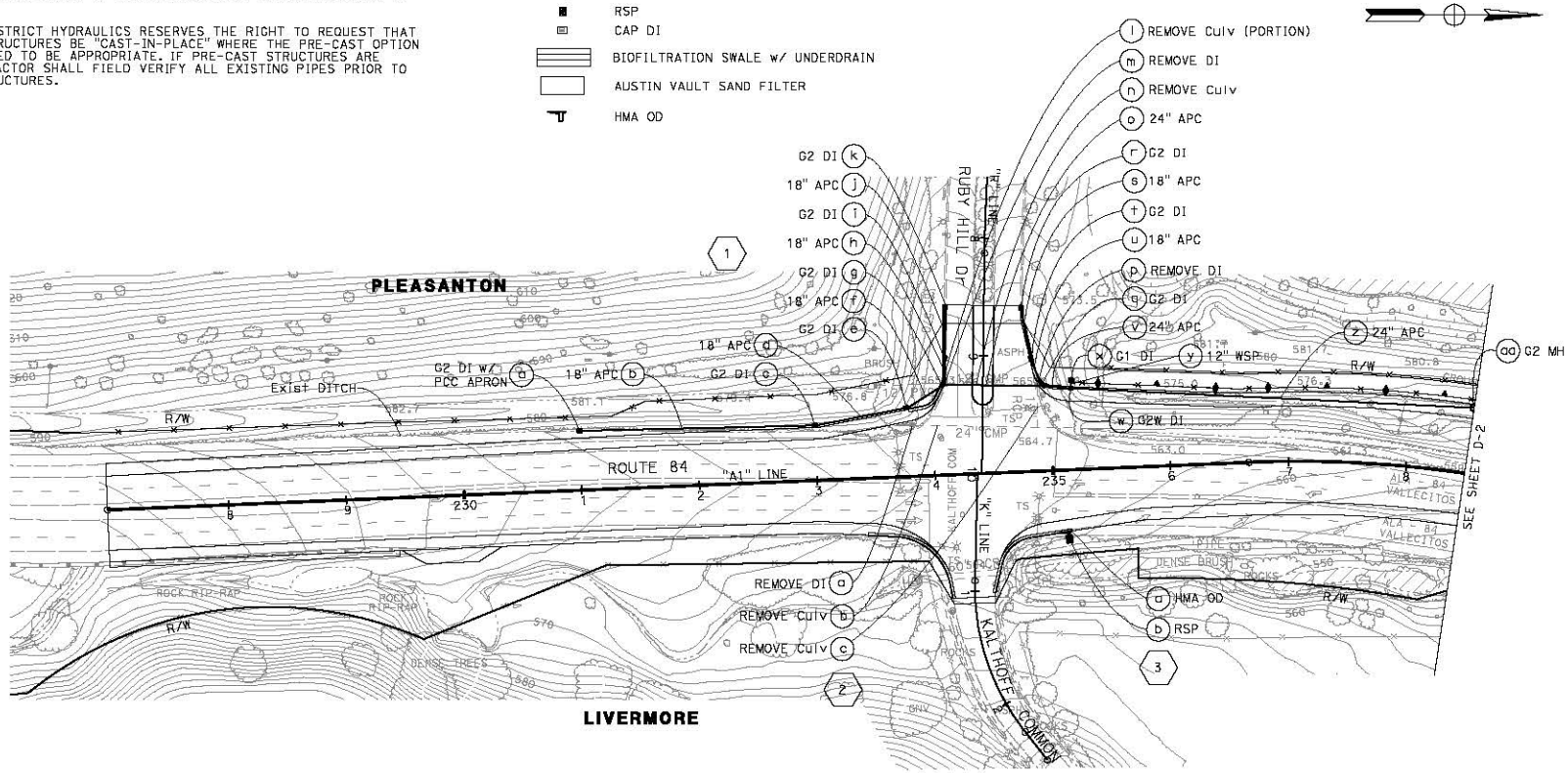
1. FOR UTILITIES, SEE EXISTING UTILITIES PLAN SHEETS.
2. STATION & OFFSET TIES TO DRAINAGE STRUCTURES ARE MEASURED PER DETAILS ON SHEET DD-1.
3. FOR FINISHED GRADE, SEE PROFILES, CONSTRUCTION DETAILS AND PAVEMENT ELEVATION SHEETS.
4. CONTRACTOR IS RESPONSIBLE TO PROVIDE POSITIVE DRAINAGE FROM ALL ROADWAY 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	REVISED BY	DATE REVISED
IRENE LIU	ANALETTE OCHOA	EC	10/19/10

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

BORDER LAST REVISED 7/2/2010

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DGN FILE => ...\dwg\Seg B\pl\429760io001.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 => 1:44:00 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 55279
Exp. 12/31/10
CIVIL
STATE OF CALIFORNIA

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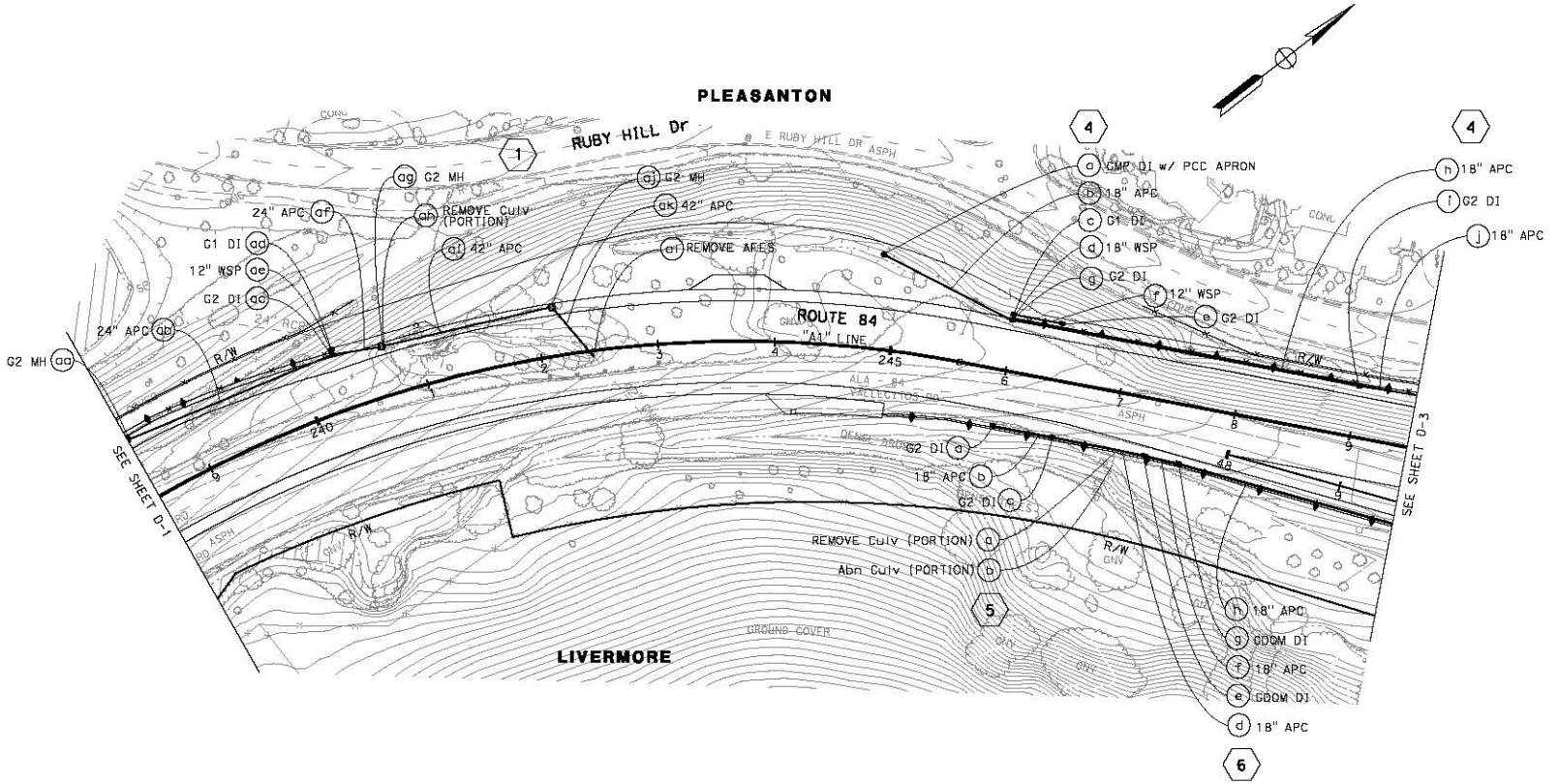
REVISED BY	DATE REVISED
EC	10/19/10

CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION



DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-2

LAST REVISION DATE PLOTTED => 10/20/2010
TIME PLOTTED => 1:44:03 PM

BORDER LAST REVISED 7/2/2010

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DGN FILE => ...\dwg\Seg B\pl\429760io002.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
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REVISED BY	DATE REVISED
EC	10/19/10

CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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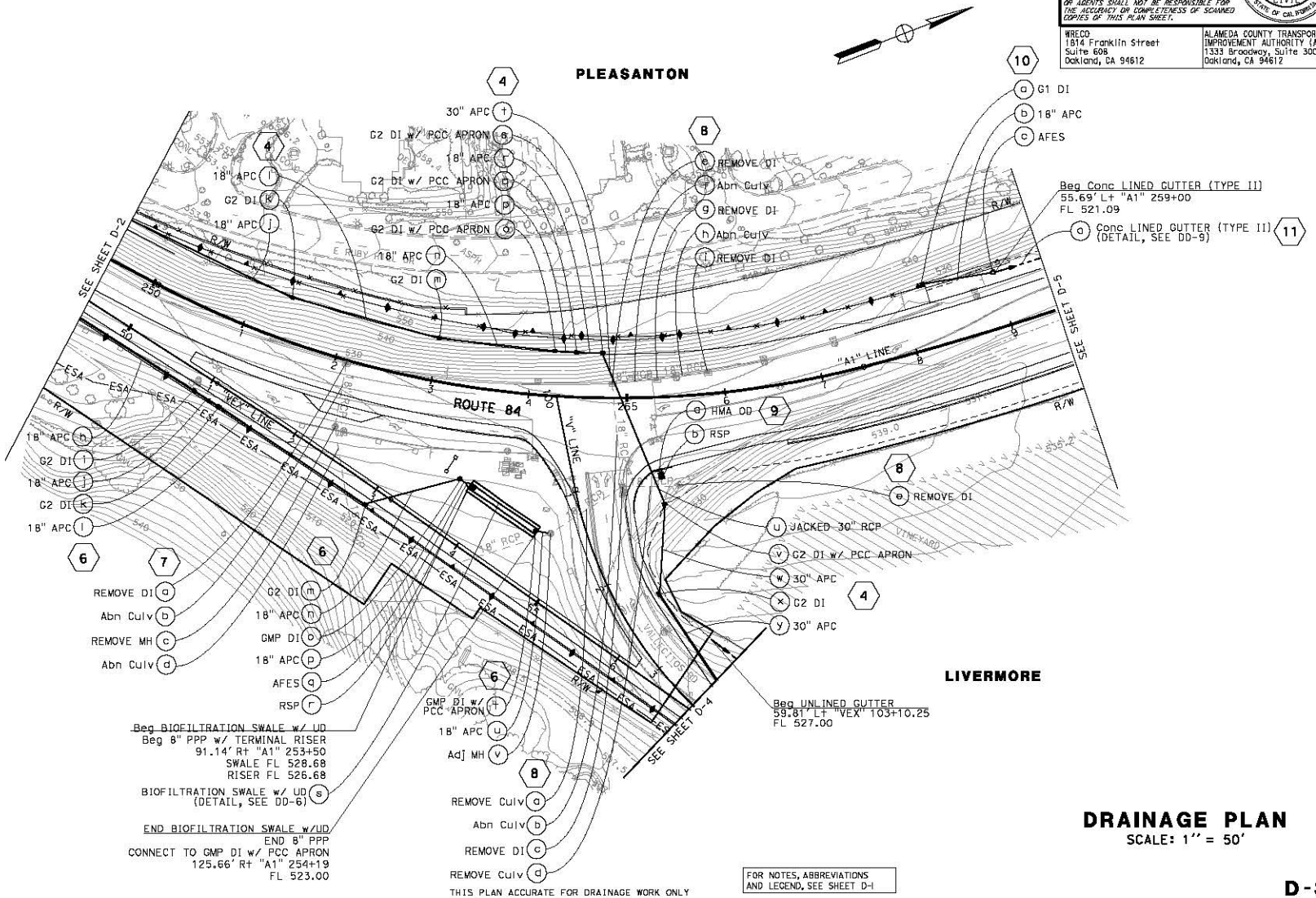

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

DRAINAGE PLAN

SCALE: 1" = 50'

D-3

LAST REVISED: DATE PLOTTED => 10/20/2010 TIME PLOTTED => 11:44:07 AM

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		

Anlette 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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Oakland, CA 94612

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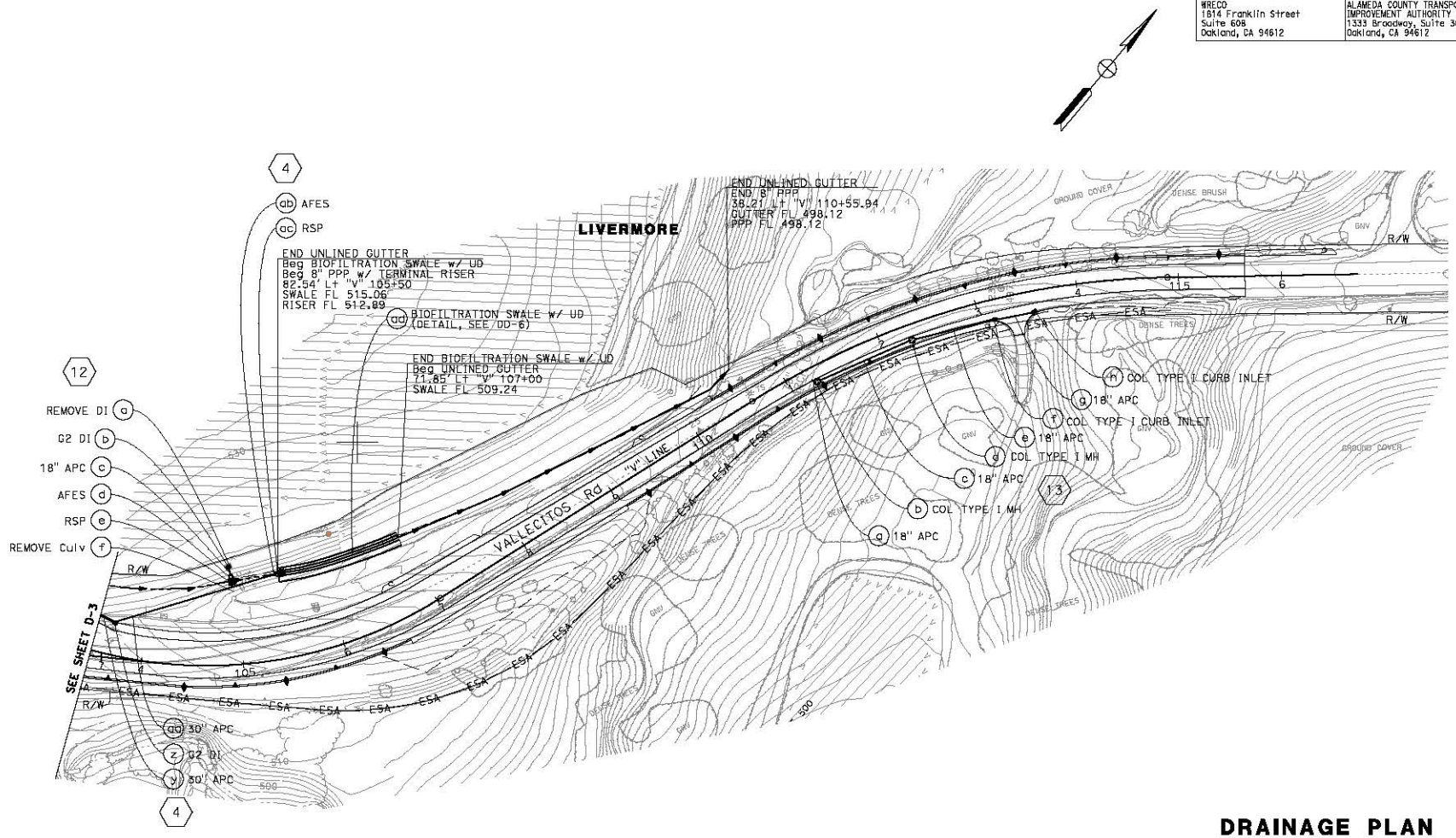
Oakland, CA 94612



DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-4

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 — DATE PLOTTED => 10/20/2010 — TIME PLOTTED => 11:44:11 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		

Anlette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 85279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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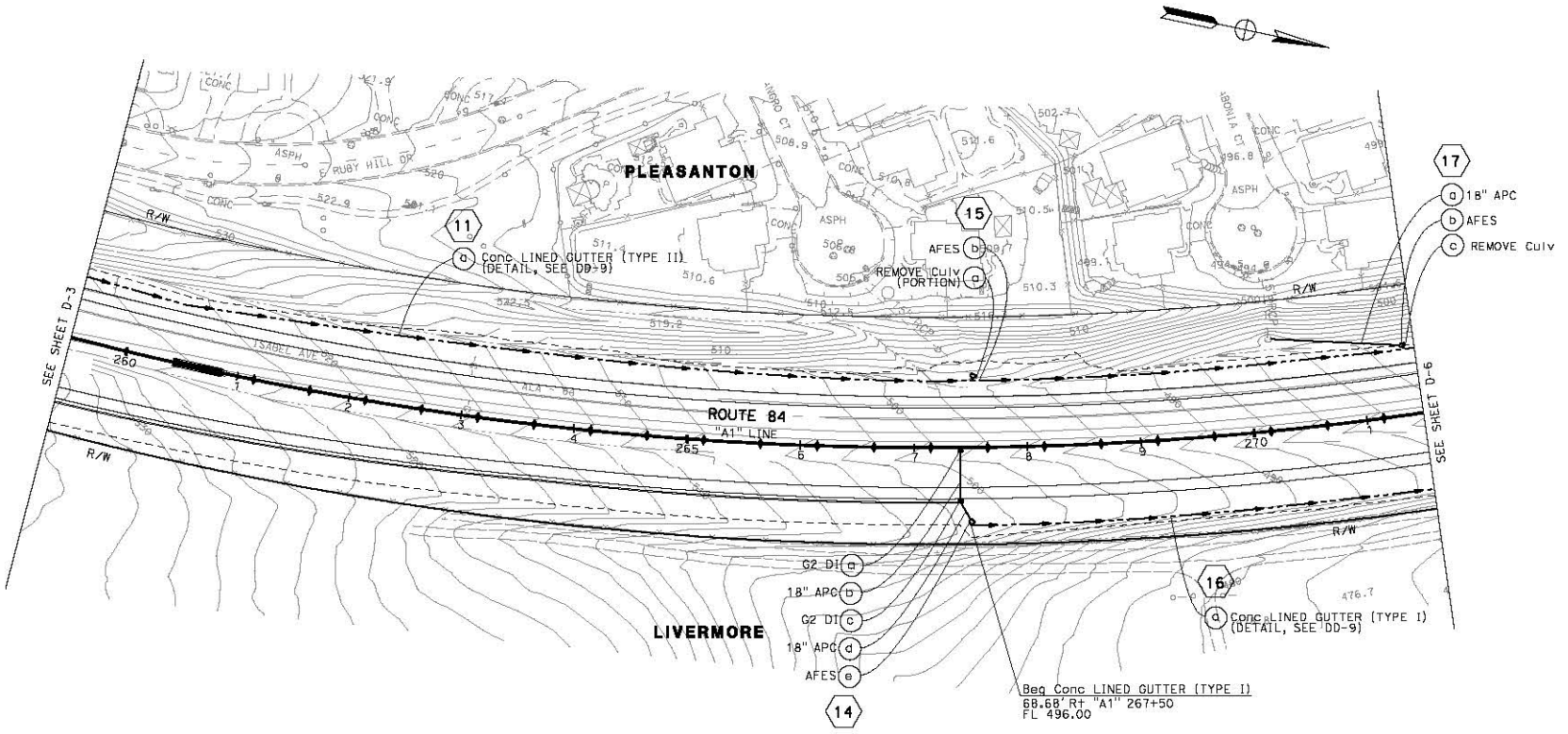

DRAINAGE PLAN
SCALE: 1" = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

D-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

BORDER LAST REVISED 7/2/2010
USERNAME => irena_liu
DGN FILE => ...\dwg\Seg B\pl\429760io005.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 => 1:44:13 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		

Anlette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

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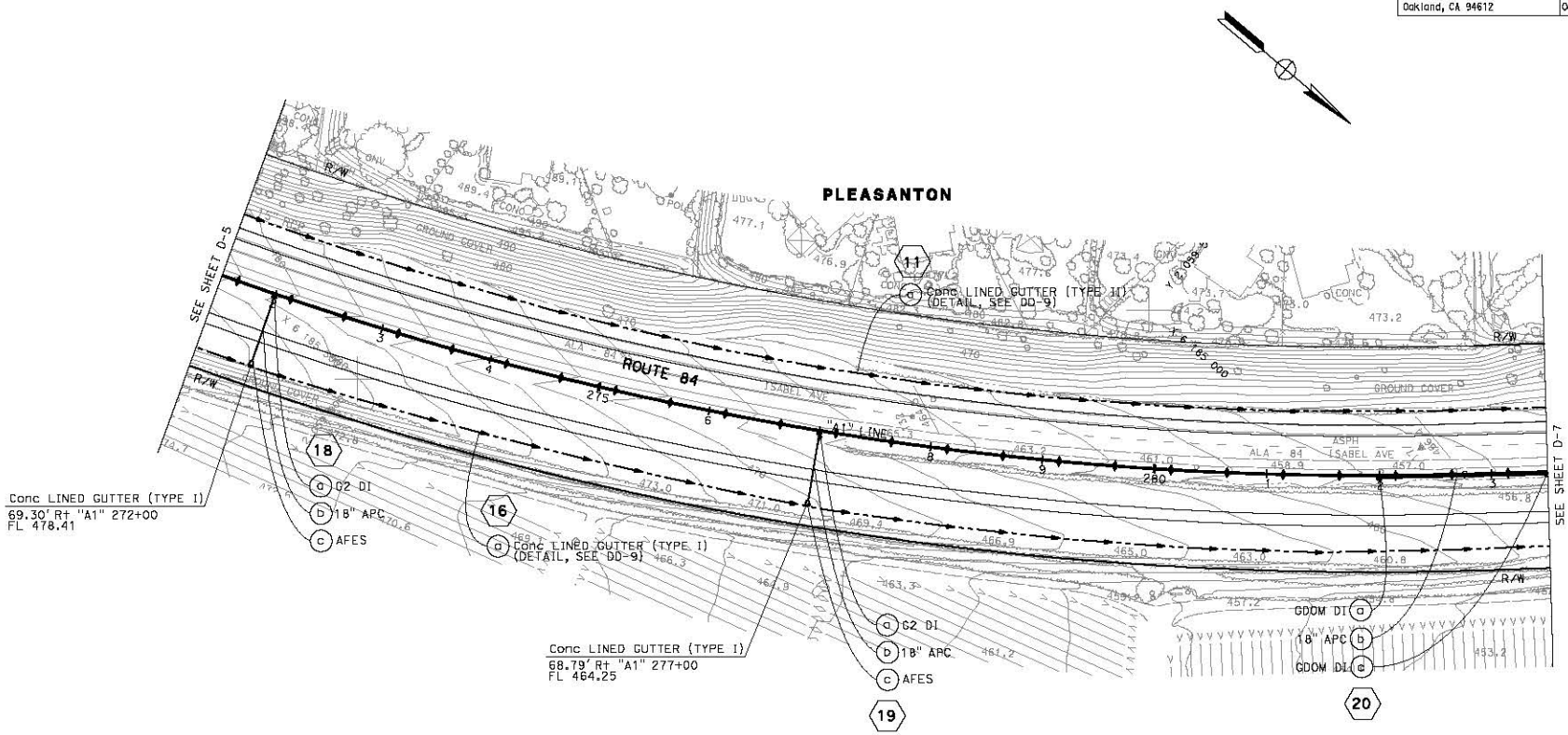

DRAINAGE PLAN
SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-6

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 DATE PLOTTED => 10/20/2010
TIME PLOTTED => 1:44:17 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => Irena_Liu | DGN FILE => ...\dwg\Seg B\pl\429760io006.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

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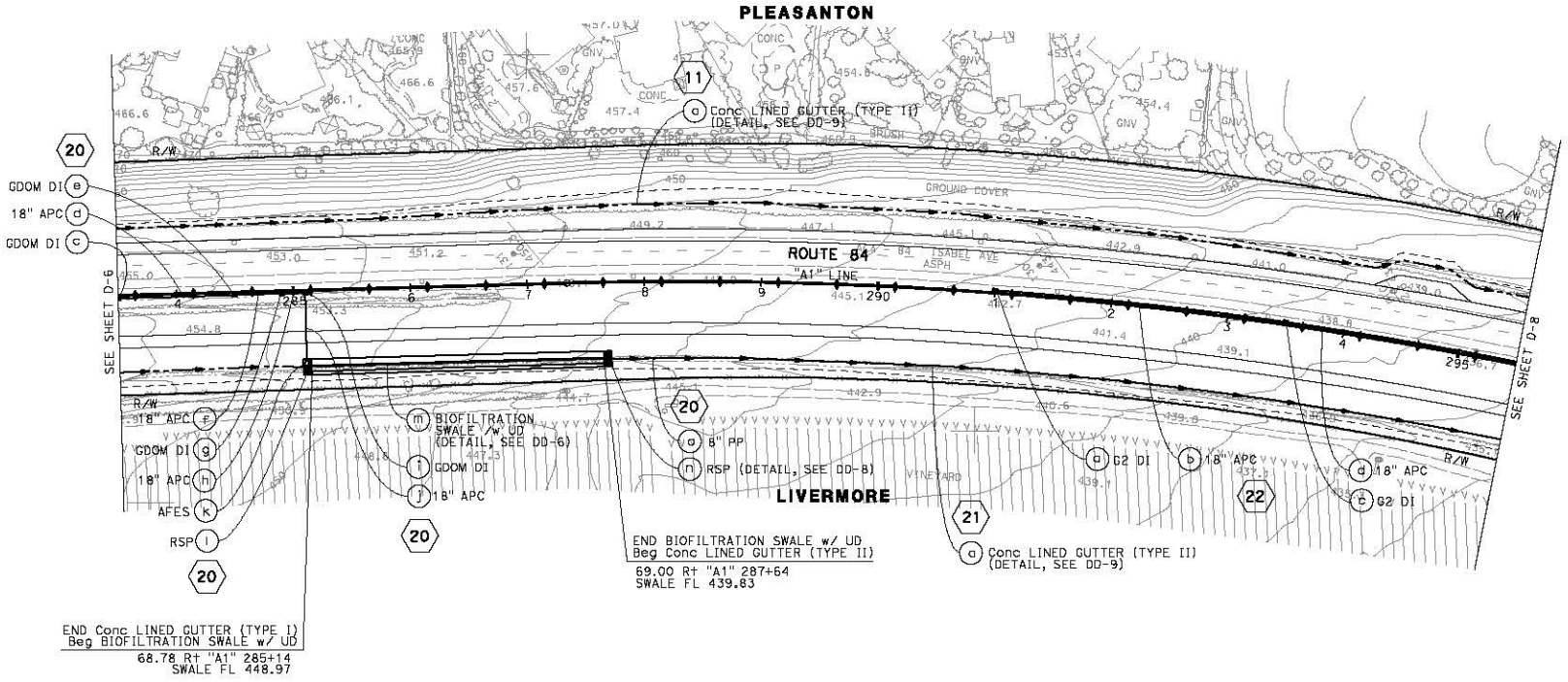
REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

WRECO 1814 Franklin Street Suite 608 Oakland, CA 94612	ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA) 1333 Broadway, Suite 300 Oakland, CA 94612



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	CHECKED BY	DATE REVISED	10/19/10
		IRENE LIU		
		ANALETTE OCHOA		

BORDER LAST REVISED 7/2/2010 | USERNAME => Irena_liu | DGN FILE => ...\dwg\Seg B\pl\429760io007.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		

Anlette 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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Oakland, CA 94612

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

B" 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

RSP (DETAIL, SEE DD-8)

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

30" APC

G2 DI

Conc LINED GUTTER (TYPE II) (DETAIL, SEE DD-9)

END Conc LINED GUTTER (TYPE II)
65.49' Rt "A1" 300+78.40
FL 427.00

BIOFILTRATION SWALE w/ UD (DETAIL, SEE DD-6)

G2 DI

18" APC

AFES

RSP

G2 DI w/ PCC APRON

30" APC

RSP BERM (DETAIL, SEE DD-8)

END BIOFILTRATION SWALE w/ UD
Beg Conc LINED GUTTER (TYPE II)
68.86' Rt "A1" 302+54
SWALE FL 426.11

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)

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 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	CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
	HAN-BIN LIANG	IRENE LIU	ANALETTE OCHOA	EC	10/19/10

LAST REVISED DATE PLOTTED => 10/20/2010
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BORDER LAST REVISED 7/2/2010 | USERNAME => Irene_liu | DGN FILE => ...\dwg\Seg B\pl\429760ia008.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

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REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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Oakland, CA 94612

PLEASANTON

ROUTE 84 "A1" LINE

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

"V1A" LINE

VINEYARD Ave

LIVERMORE

- a REMOVE DI
- b REMOVE DI
- c REMOVE Culv
- d REMOVE Culv
- e REMOVE DI
- f REMOVE Culv
- 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

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
	HAN-BIN LIANG	CHECKED BY	DATE REVISED	10/19/10
		IRENE LIU		
		ANALETTE OCHOA		

LAST REVISED: DATE PLOTTED => 10/20/2010 TIME PLOTTED => 1:44:26 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		

Annette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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REGISTERED PROFESSIONAL ENGINEER — ANNETTE OCHOA — No. C 85279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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1333 Broadway, Suite 300
Oakland, CA 94612

36 G1 DI e, 18" APC f, G2 MH g, 42" APC h, G2 MH i, 42" APC d
36 l 6" PP, m 18" APC, n AUSTIN VAULT SAND FILTER, a 42" APC
38 c REMOVE Culv, d REMOVE MH, e REMOVE Culv
38 REMOVE HW b, REMOVE RSP a
36 HW c, AUTOMATIC DRAINAGE GATE b, RSP a
Conc SLAB, SEE LAYOUT PLAN
33 G2 DI aa, 18" APC z
SEE SHEET D-9
18" APC l, G2 DI m
RSP a, AUTOMATIC DRAINAGE GATE b, HW c, 42" APC d, COL TYPE II MH e, 42" APC f
35
Arroyo del Valle
DIRT PILES
37 a REMOVE OVERSIDE DRAIN, b REMOVE OVERSIDE DRAIN
"TR1" LINE
h 42" APC, g COL TYPE II MH
35 COL TYPE II MH l, 18" APC j, COL FIELD INLET k, 42" APC l, COL TYPE II MH m
GROUND COVER
36 G2 DI s, 18" APC r, G2 MH q, 18" APC p, G1 DI k, 18" APC j
36 u G2 DI, v 18" APC, w G2 MH, x 42" APC
39 JACKED 30" RCP a, c G2 DI 30" APC b
"AC1" LINE
ROUTE 84
"A1" LINE
18" APC d, G2 DI e, 18" APC f, CDOM DI g, 24" APC h, G2 DI i
39
LIVERMORE
38 f REMOVE MH, g REMOVE Culv
36 y G2 DI, z 42" APC, aa G2 DI, ab 36" APC, ac G2 DI
GROUND COVER
30" APC af, G2 DI ae, 30" APC ad
38 h REMOVE DI, i Abn Culv, j Abn DI
GROUND COVER
38
42" APC n, COL TYPE II MH o, 42" APC p, COL TYPE II MH q, 42" APC r
35
ALDEN LN
38 k REMOVE Culv, l REMOVE MH, m REMOVE Culv
SEE SHEET D-11
39 j 24" APC, K G2 DI, l 24" APC
DENSE BRUSH
e REMOVE Culv, d REMOVE MH, c REMOVE Culv, b REMOVE MH, a REMOVE Culv (PORTION)
40

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

DRAINAGE PLAN
SCALE: 1" = 50'

D-10

LAST REVISION DATE PLOTTED => 10/20/2010
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10-19-10

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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 => Irena_liu
DGN FILE => ...\dwg\Seg B\pl\429760io010.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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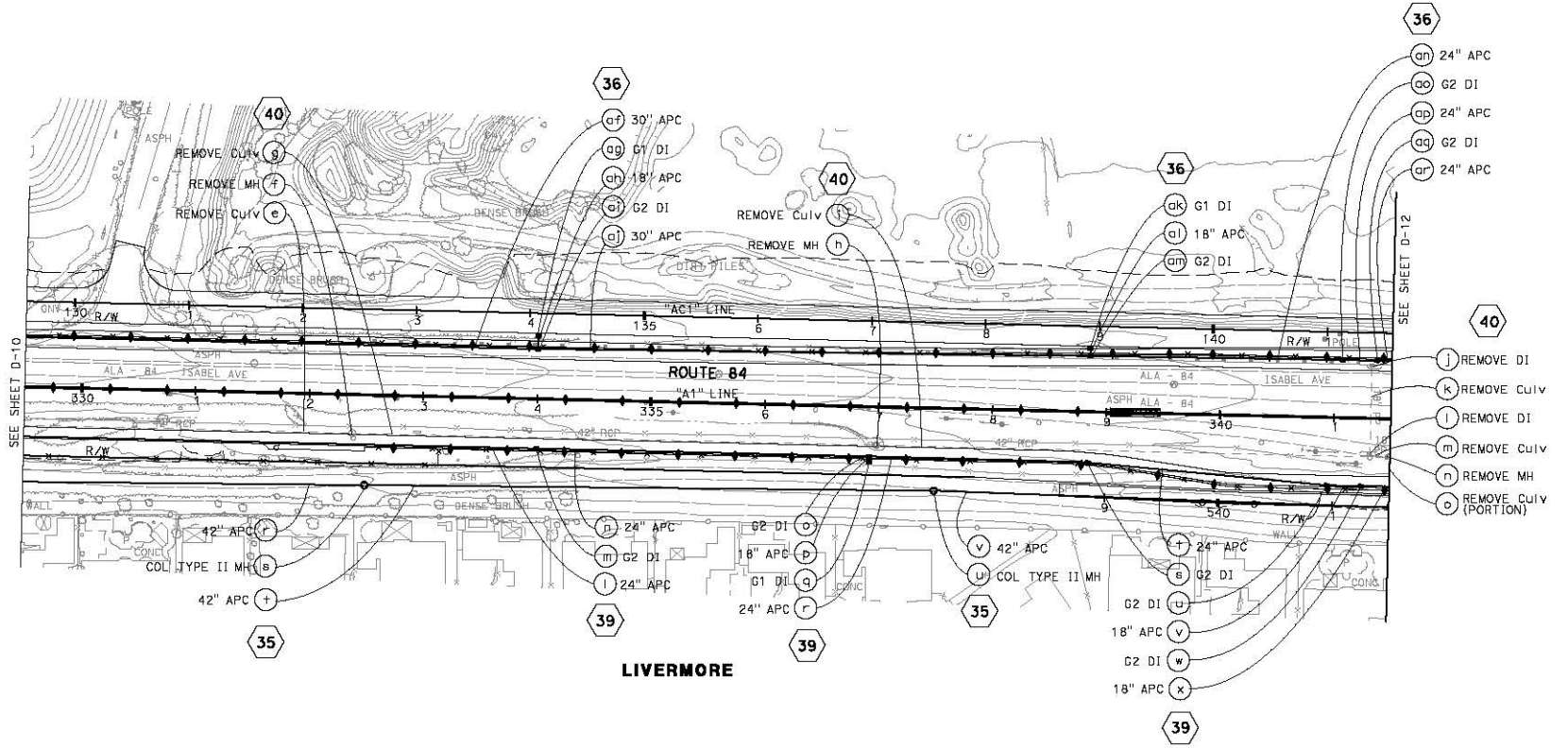

DRAINAGE PLAN
SCALE: 1'' = 50'

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	CHECKED BY	REVISED BY	DATE REVISED
	HAN-BIN LIANG	IRENE LIU	ANALETTE OCHOA	EC	10/19/10

LAST REVISION DATE PLOTTED => 10/20/2010
TIME PLOTTED => 1:44:31 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		

Annette Ochoa 10/19/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANNETTE OCHOA — No. C 85279 — Exp. 12/31/10 — CIVIL — STATE OF CALIFORNIA

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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

SEE SHEET D-11

SEE SHEET D-13

ROUTE 84

"A1" LINE

"A2" LINE

"AC1" LINE

"CON" LINE

CONCANNON Blvd

ALA - 84

ISABEL AVE

TOURMALINE CT

ARIA CT

LIVERMORE

R/W

42" RCP

18" RCP

ASPH

CONC

TREES

DIRT PILE

GROUND COVER

(36) ay G2 DI
az G2 DI
ba G1 DI
bb 18" APC
bc G2 DI
bd 18" APC

(36) ar 24" APC
as G1 DI
at 18" APC
au G2 DI
av 18" APC
aw G1 DI
ax 24" APC

(40) REMOVE Culv w
REMOVE Culv(PORTION) v
REMOVE DI u
REMOVE Culv t
REMOVE MH s

(40) x REMOVE Culv
y REMOVE DI
z REMOVE Culv
aa REMOVE DI
ab REMOVE MH
ac REMOVE Culv
ad REMOVE DI
ae REMOVE Culv

(40) af REMOVE MH
ag REMOVE Culv
ah REMOVE DI
ai REMOVE Culv (PORTION)

(36) be G2 DI

(40) aj REMOVE Culv

(36) bf 18" APC
bg CDD DI
bh 18" APC

(40) an REMOVE DI
ao REMOVE Culv
ap REMOVE MH
aq REMOVE Culv
ar REMOVE DI
as REMOVE Culv
at REMOVE Culv
au REMOVE DI
ax REMOVE MH
aw REMOVE Culv
av REMOVE Culv

(40) REMOVE Culv r
REMOVE DI q
REMOVE Culv p

COL TYPE II MH w
42" APC x

(35)

(39) 18" APC ab
G2 MH ac
18" APC ad
G2 DI ae

aa G2 DI
z 18" APC
y G2 DI

(35) COL TYPE II MH y
18" APC z
COL TYPE I MH aa
42" APC ab

(39) ag G2 DI
af 18" APC

(35) ac COL FIELD INLET

ai G2 DI
ah 18" APC

42" APC ad
COL TYPE II MH ae

(35)

(40) REMOVE DI ak
REMOVE Culv al
REMOVE Culv am

(39) 18" APC aj
G2 DI ak

(35) ah 36" APC
ag COL TYPE I CURB INLET
af 36" APC

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

DRAINAGE PLAN

SCALE: 1" = 50'

D-12

LAST REVISED DATE PLOTTED => 10/20/2010
TIME PLOTTED => 1:44:34 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		

Anlette 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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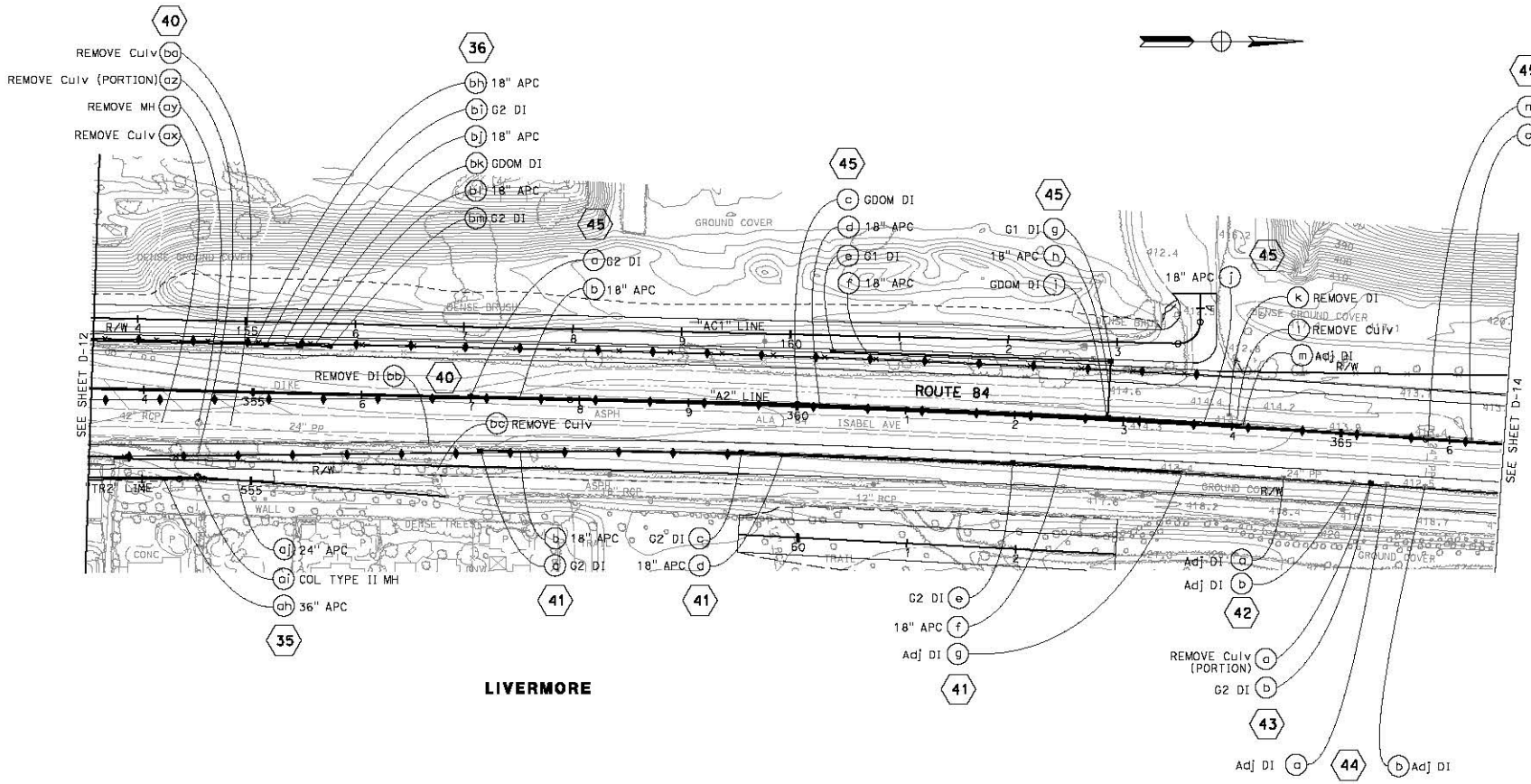

LIVERMORE

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	CALCULATED-DESIGNED BY	REVISED BY	EC	10/19/10
	HAN-BIN LIANG	CHECKED BY	DATE REVISED		
		IRENE LIU			
		ANALETTE OCHOA			

LAST REVISION DATE PLOTTED => 10/20/2010
TIME PLOTTED => 1:44:38 PM

BORDER LAST REVISED 7/2/2010	USERNAME => Irena_liu DGN FILE => ...\dwg\Seg B\pl\429760io013.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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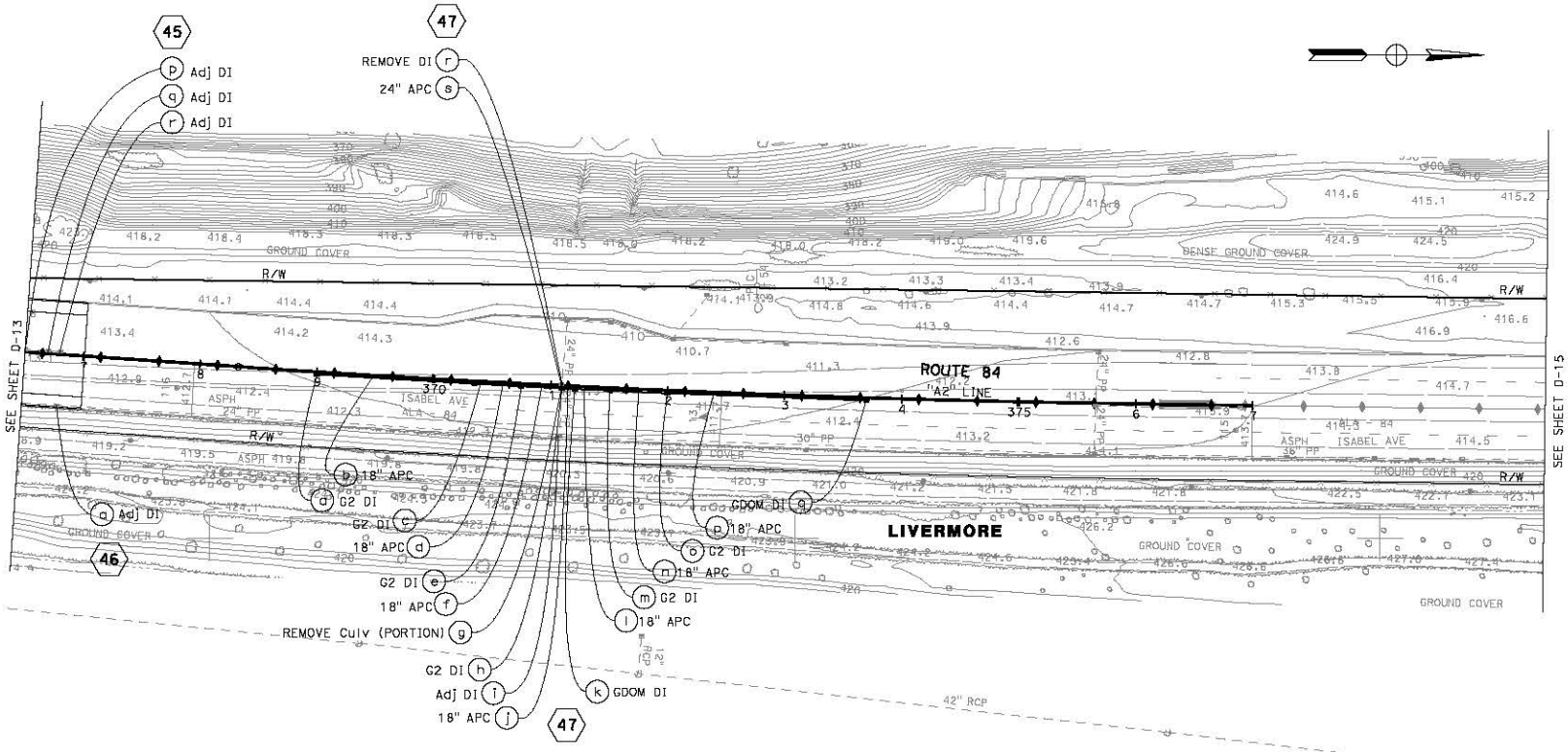

DRAINAGE PLAN
SCALE: 1'' = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

D-14

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		

BORDER LAST REVISED 7/2/2010

USERNAME => Irena_Liu
DGN FILE => ...\dwg\Seg B\pl\429760io014.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 => 1:44:41 PM

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

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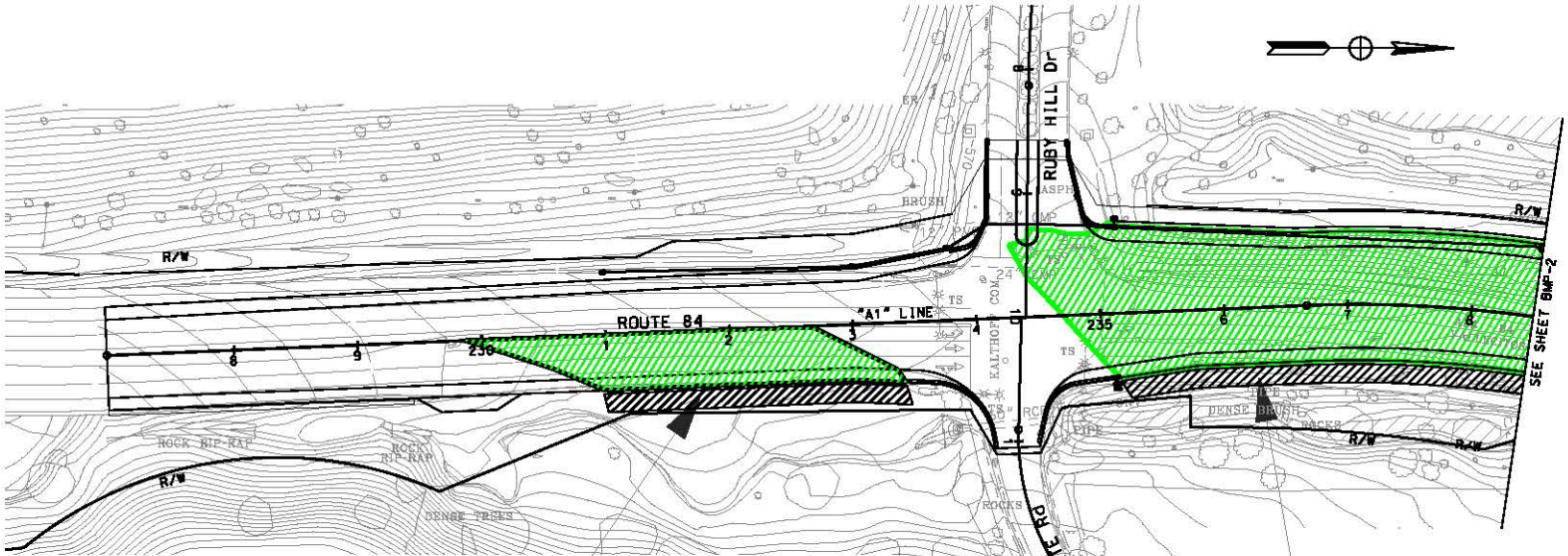
WRECO 1814 Franklin St., Suite 600 Oakland, CA 94612

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

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG | CALCULATED-DESIGNED BY: ANALETTE OCHOA | CHECKED BY | REVISED BY | DATE REVISED

LAST REVISION 00-00-00 | DATE PLOTTED = 10/14/2010 | TIME PLOTTED = 08:40 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 = sFILES | 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

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1333 Broadway, Suite 300
Oakland, CA 94612

WRECO
1814 Franklin St., Suite 600
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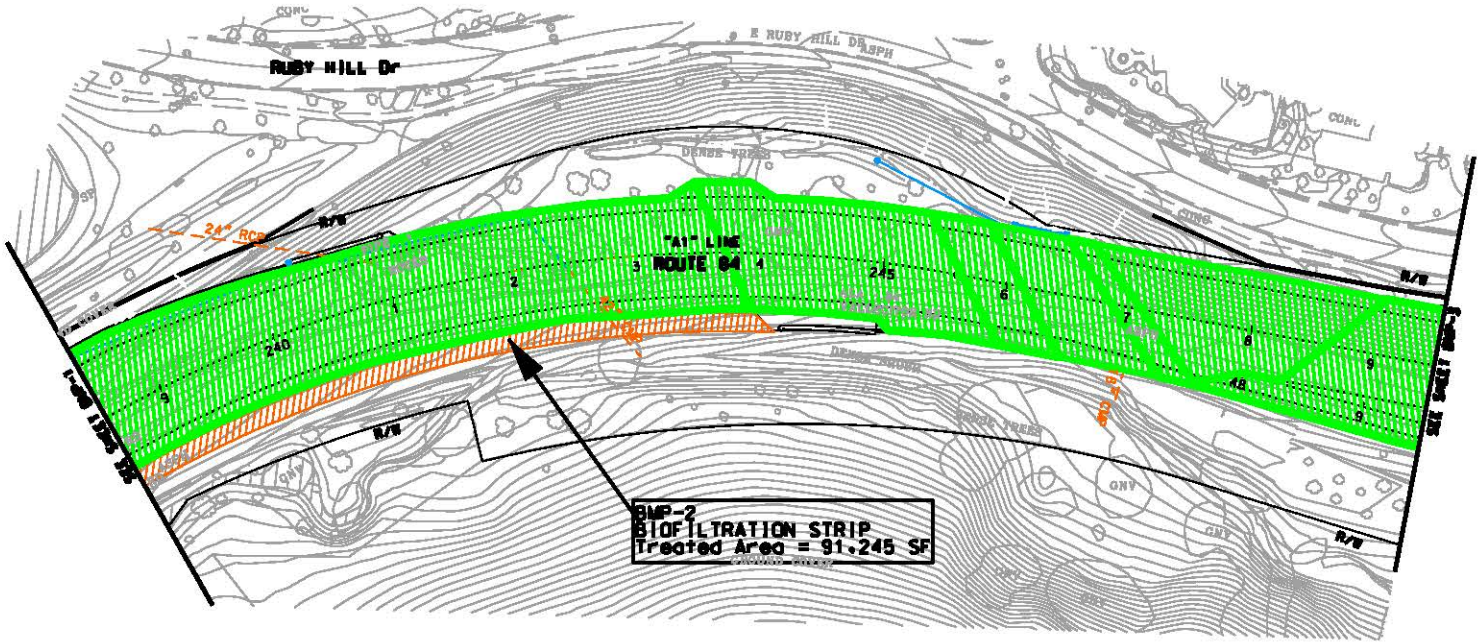

PROPOSED TREATMENT BMPS

SCALE 1"=50'

BMP- 2

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

DESIGNED BY	CALCULATED-DESIGNED BY	ANALETTE OCHOA	REVISED BY	
DRAWN BY	CHECKED BY		DATE REVISED	
CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG			

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 00-00-00 | DATE PLOTTED 10DATE | TIME PLOTTED 10TIME

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

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Oakland, CA 94612

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1814 Franklin St., Suite 608
Oakland, CA 94612

REVISED BY	DATE REVISED	ANALETTE OCHOA	CALCULATED-DESIGNED BY	CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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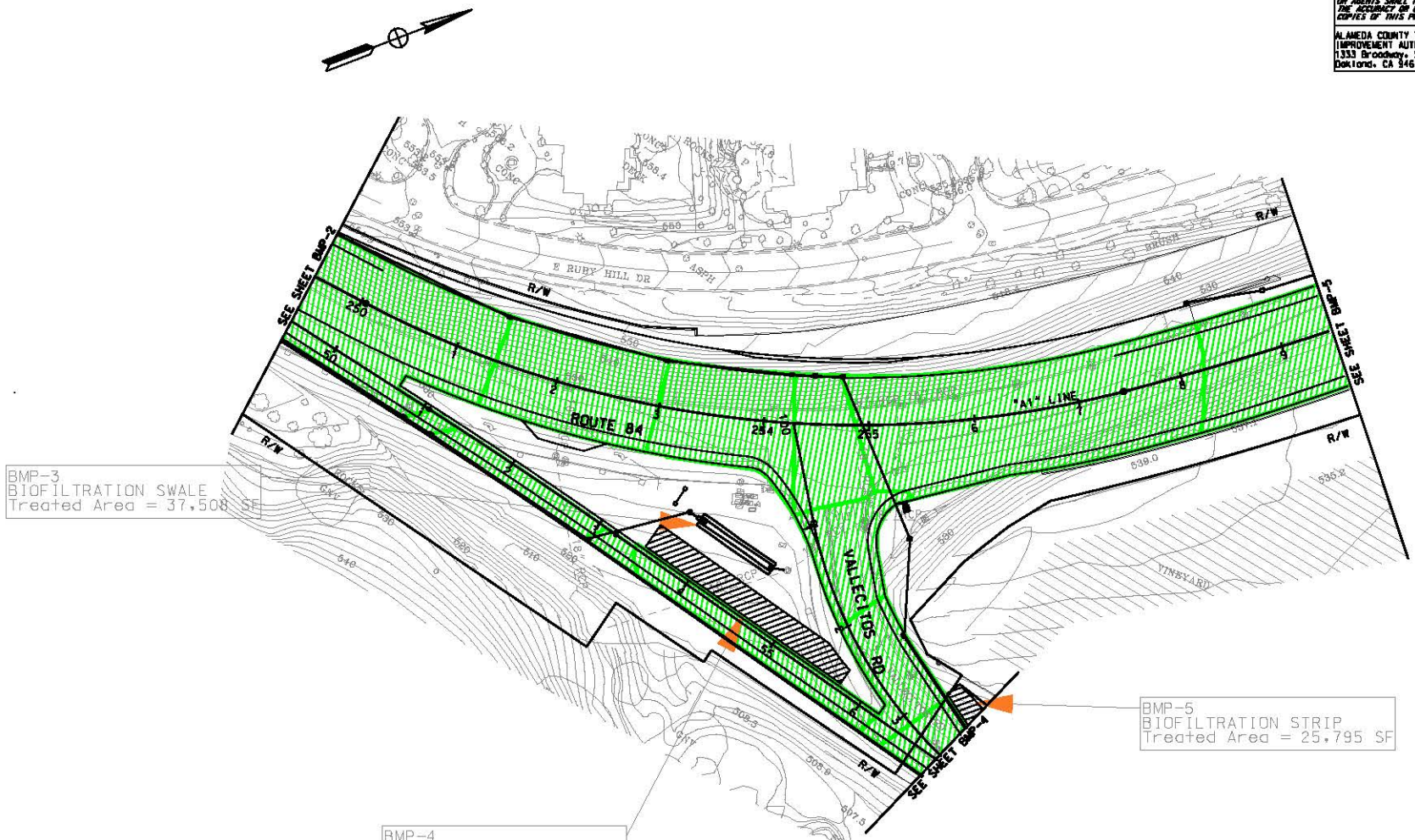

PROPOSED TREATMENT BMPS

SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

BMP- 3

LAST REVISION — DATE PLOTTED = 10/14/2010 — TIME PLOTTED = 08:56 PM — 00-00-00

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME = catherine_byun
DGN FILE = sFILE8

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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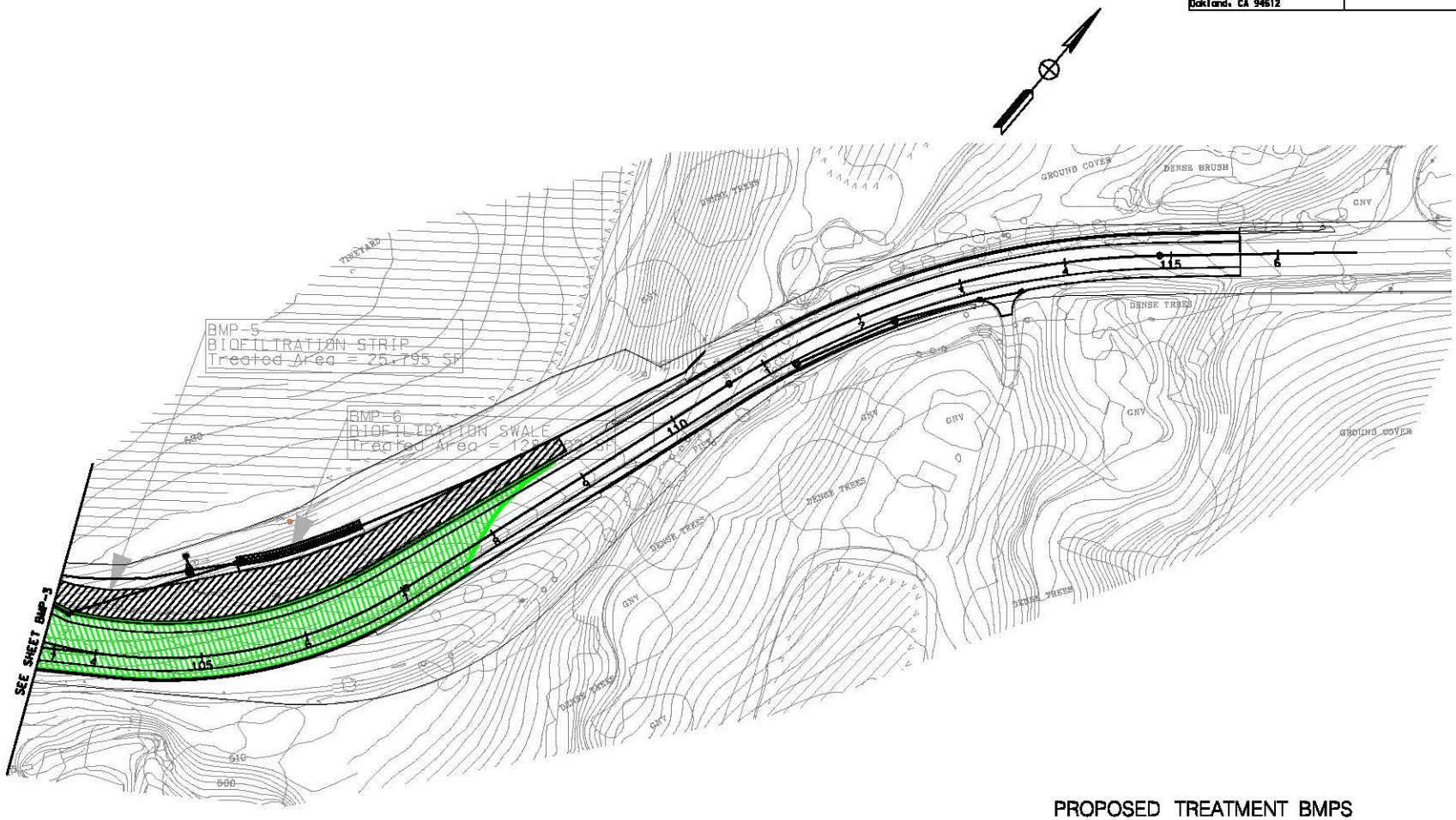
REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

WRECO
1814 Franklin St., Suite 600
Oakland, CA 94612

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA.
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.



PROPOSED TREATMENT BMPS

SCALE 1"=50'

BMP- 4

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

REVISED BY	ANALETTE OCHOA
DATE REVISED	
CALCULATED-DESIGNED BY	
CHECKED BY	
CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	Caltrans

LAST REVISION 00-00-00
DATE PLOTTED = 10/14/2010
TIME PLOTTED = 04:07:01 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 = sFILE1

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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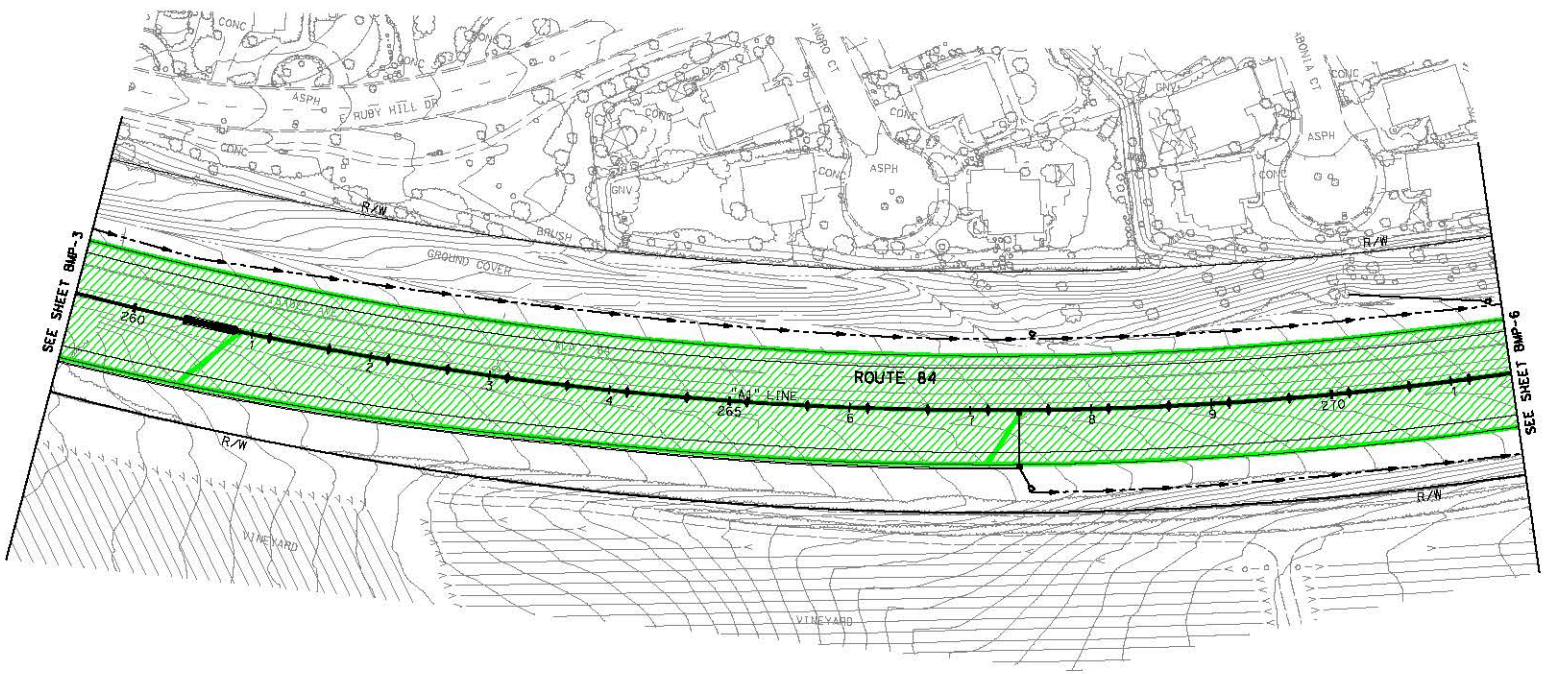
Oakland, CA 94612

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.

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

SCALE 1"=50'

BMP-5

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	ANALETTE OCHOA	REVISED BY
Caltrans	HAN-BIN LIANG	CHECKED BY		DATE REVISED

LAST REVISION DATE PLOTTED => 10/14/2010
00-00-00 TIME PLOTTED => 17:28:10 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	6	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
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WRECO
1814 Franklin St., Suite 608
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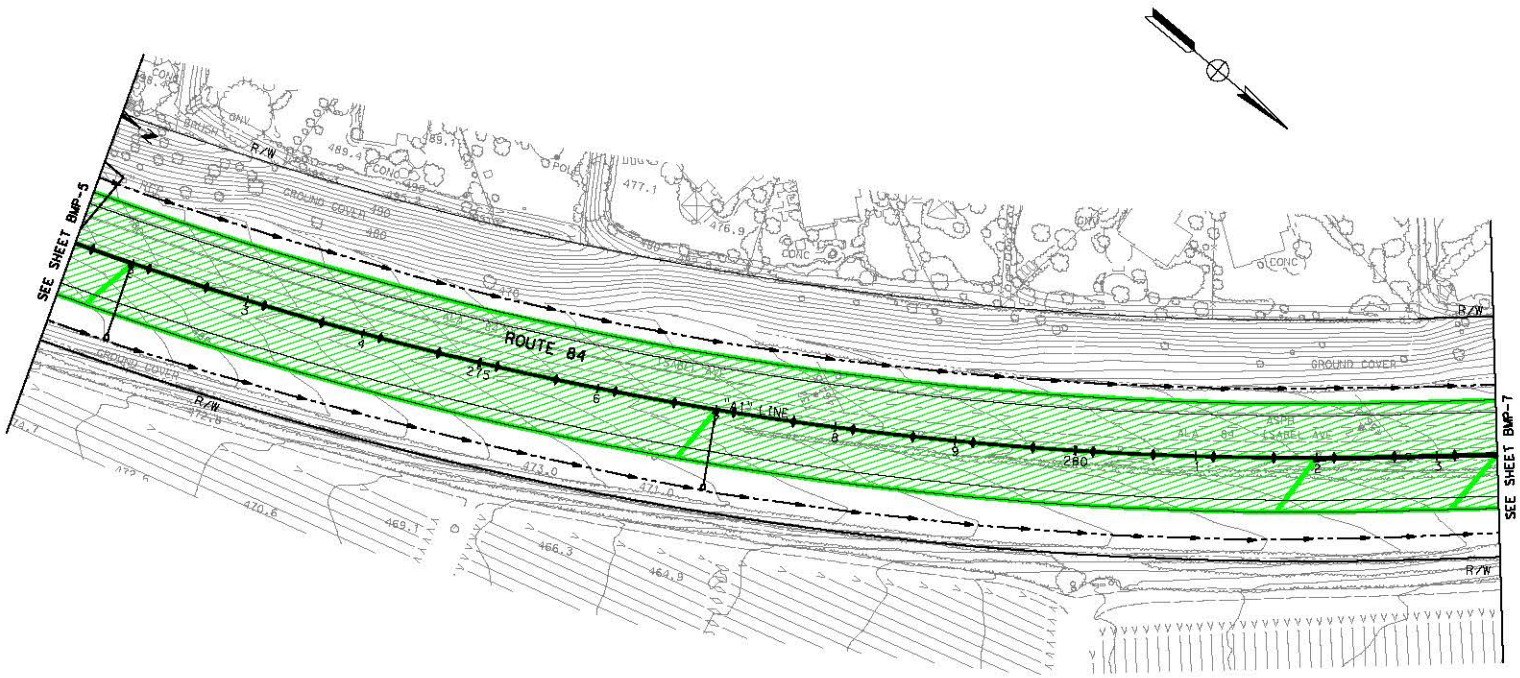

PROPOSED TREATMENT BMPS

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-6

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 DATE PLOTTED => 10/14/2010
00-00-00 TIME PLOTTED => 14:28:15 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	7	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. EXP. CIVIL STATE OF CALIFORNIA

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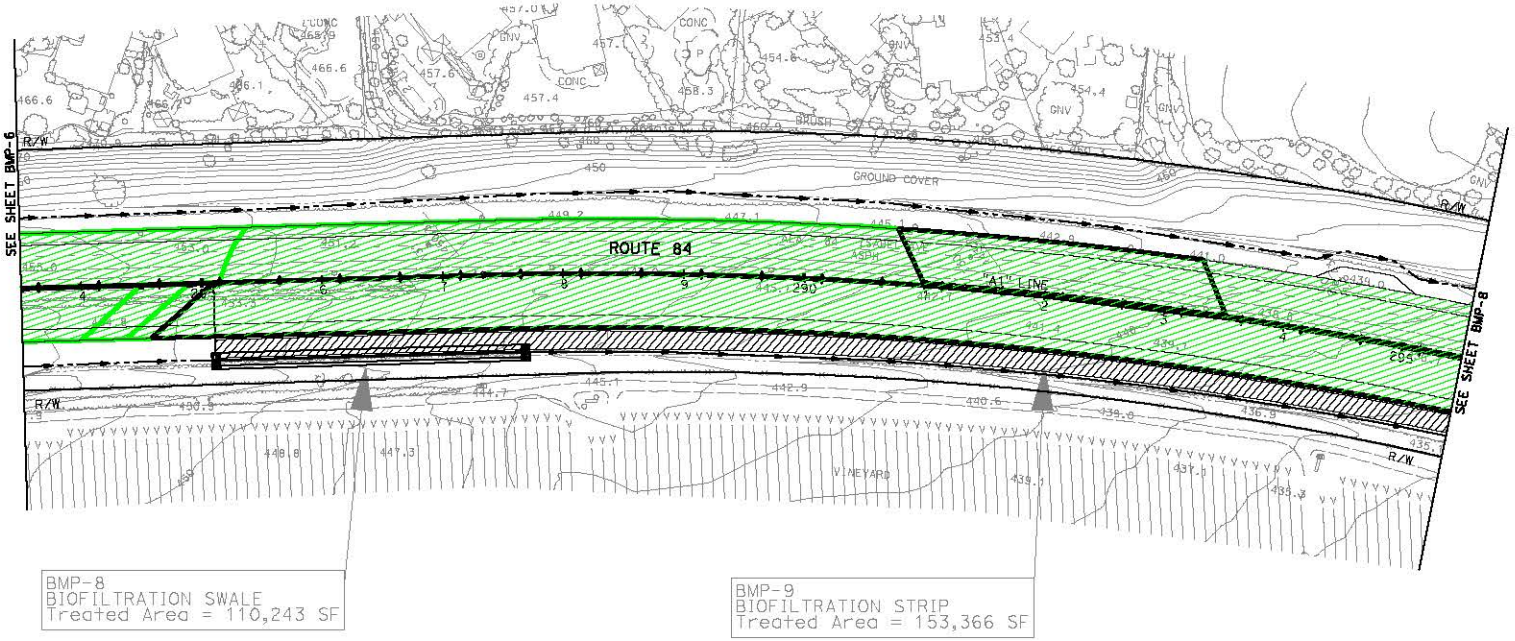
NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.



PROPOSED TREATMENT BMPS

SCALE 1"=50'

BMP-7

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY
HAN-BIN LIANG	ANALETTE OCHOA	
	CHECKED BY	DATE REVISED

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION DATE PLOTTED => 10/14/2010
OC-OO-OO TIME PLOTTED => 12:28:21 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

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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

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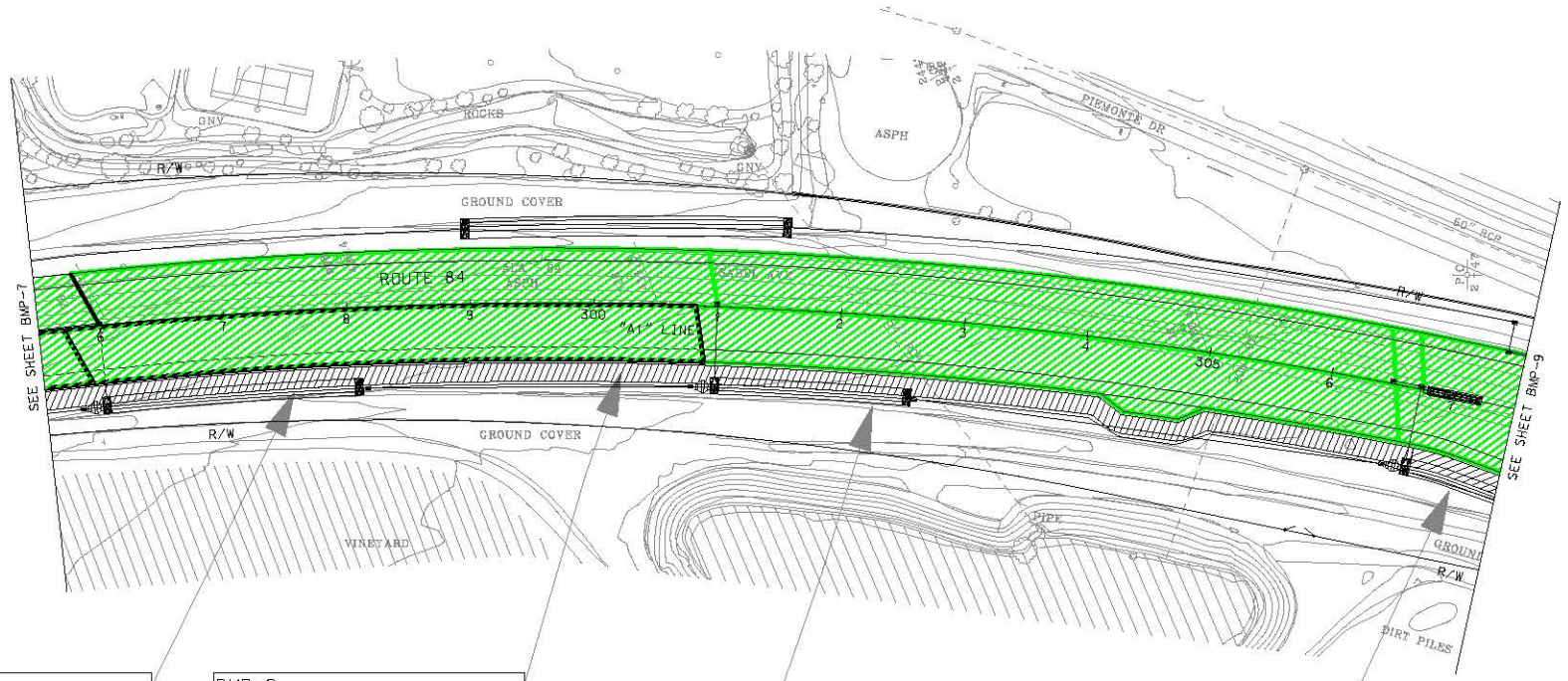
1814 Franklin St., Suite 608
Oakland, CA 94612

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA.
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.



PROPOSED TREATMENT BMPS

SCALE 1"=50'

BMP- 8

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

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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 = 8:08:27 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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Oakland, CA 94612

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1814 Franklin St., Suite 608
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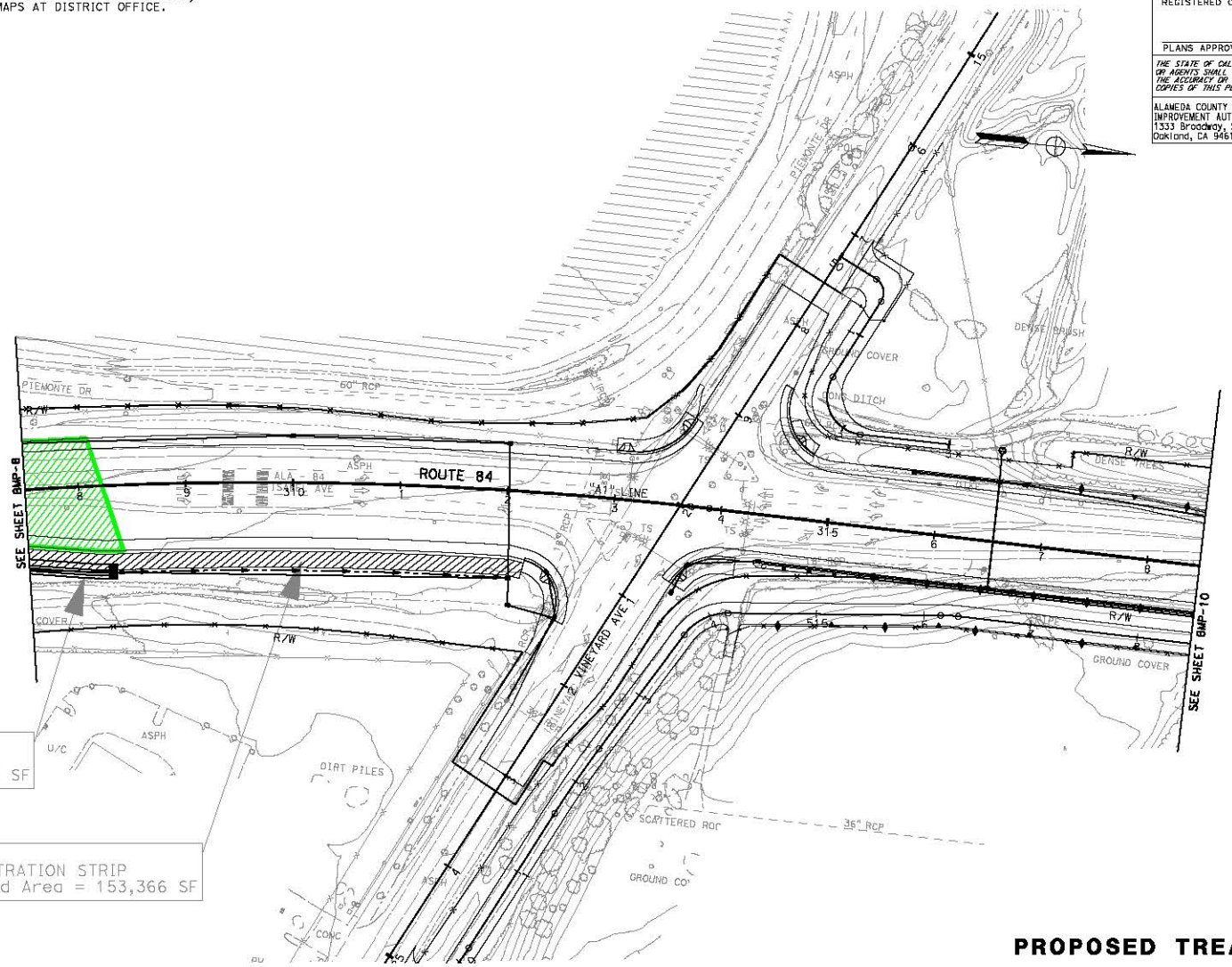

BMP-12
BIOFILTRATION STRIP
Treated Area = 26,355 SF

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

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	ANALETTE OCHOA	REVISED BY
HAN-BIN LIANG	CHECKED BY		DATE REVISED

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

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LAST REVISION DATE PLOTTED => 10/14/2010
00-00-00 TIME PLOTTED => 4:28:28 PM

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => frane_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

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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WRECO
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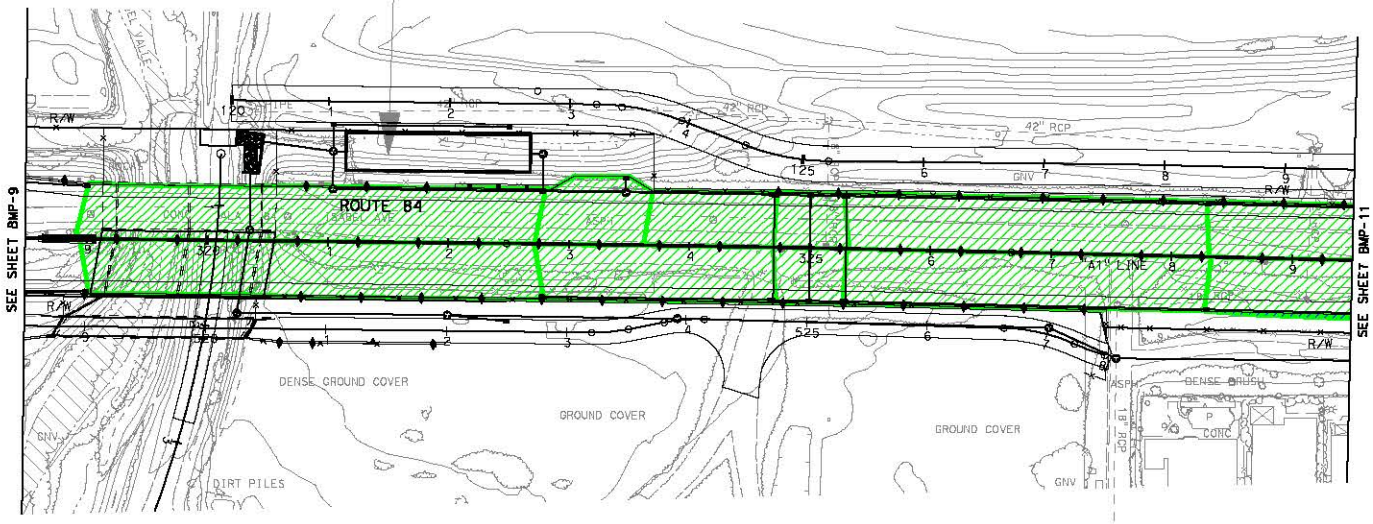
Oakland, CA 94612

BMP-13
AUSTIN VAULT SAND FILTER
Treated Area = 451,148 SF



PROPOSED TREATMENT BMPS

SCALE 1"=50'

BMP-10

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

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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

LAST REVISION 00-00-00 DATE PLOTTED => 10/14/2010 TIME PLOTTED => 4:28:32 PM

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

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REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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Oakland, CA 94612

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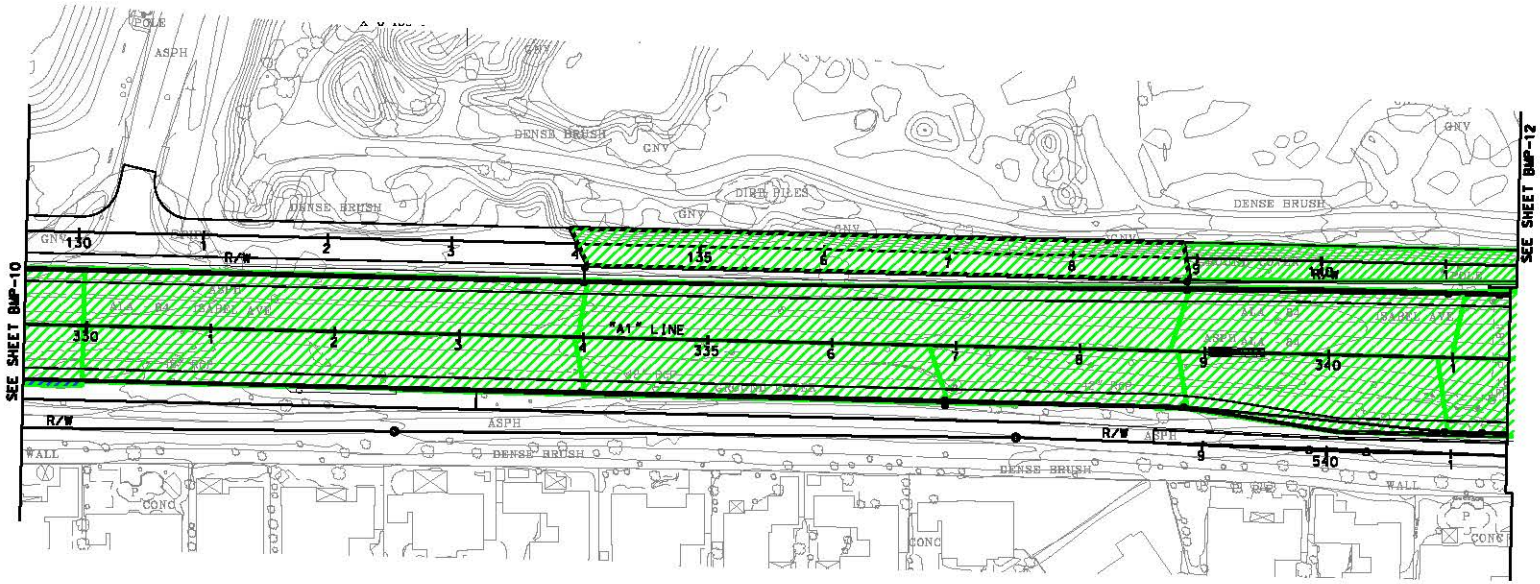
1814 Franklin St., Suite 600
Oakland, CA 94612

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'

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

BMP- 11

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG | CALCULATED-DESIGNED BY: ANALETTE OCHOA | CHECKED BY | REVISED BY | DATE REVISED

G:\Projects\Y2007\P0728 SR 84 Widening\Dra\bmps\BMP-11 (NO WORD).dgn

LAST REVISION | DATE PLOTTED = 10/14/2010 | TIME PLOTTED = 09:08:58 PM

BORDER LAST REVISED 3/1/2007 | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | USERNAME = catherine_byun | DGN FILE = sFILES | 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	12	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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Oakland, CA 94612

WRECO
1814 Franklin St., Suite 600
Oakland, CA 94612

REVISED BY	DATE REVISED

CALCULATED-DESIGNED BY	ANALETTE OCHOA
CHECKED BY	

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

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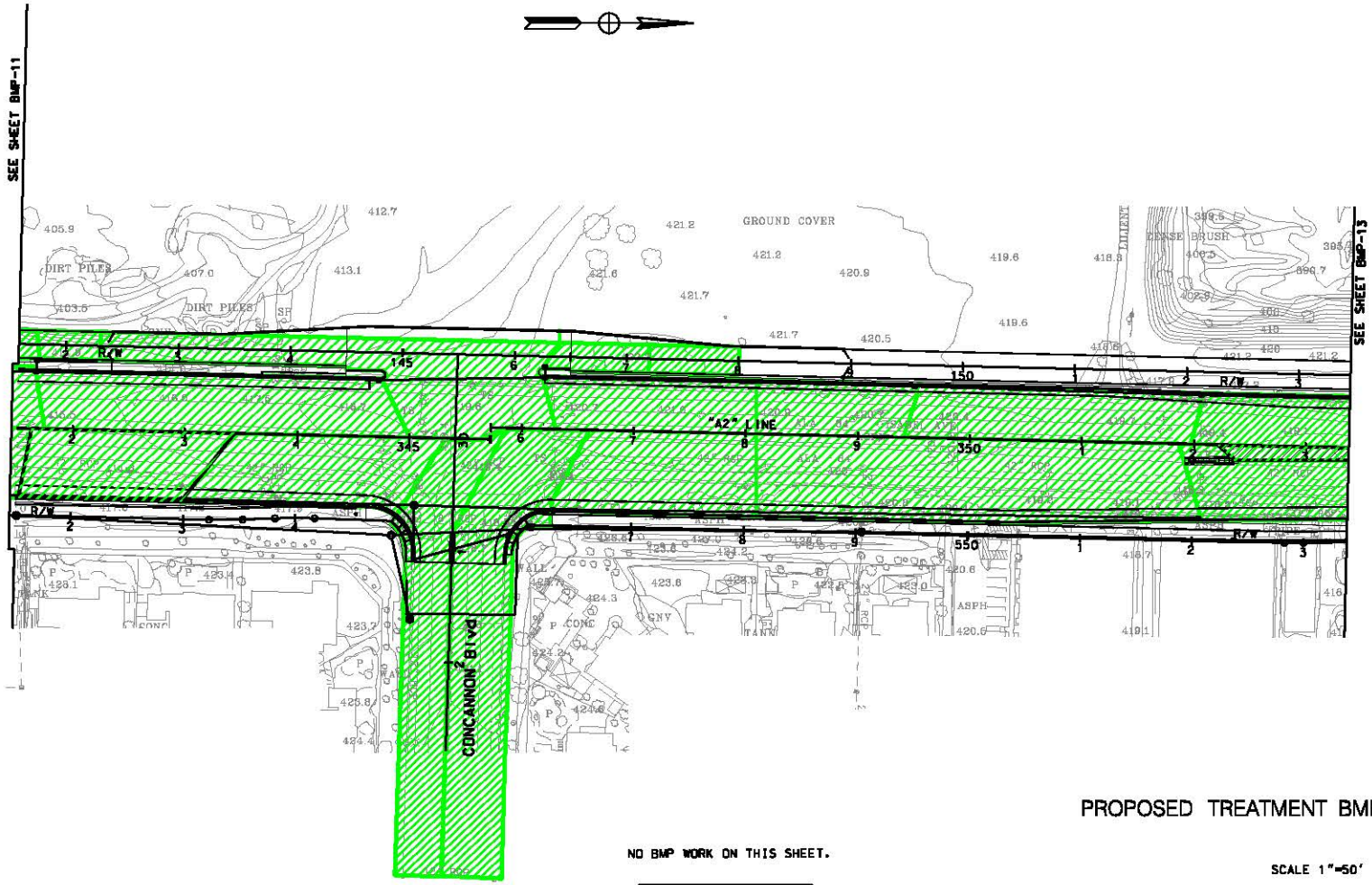

PROPOSED TREATMENT BMPS

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- 12

LAST REVISION — DATE PLOTTED = 10/14/2010 — TIME PLOTTED = 04:19:51 PM

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME = catherine_byun
DGN FILE = sFILES

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	13	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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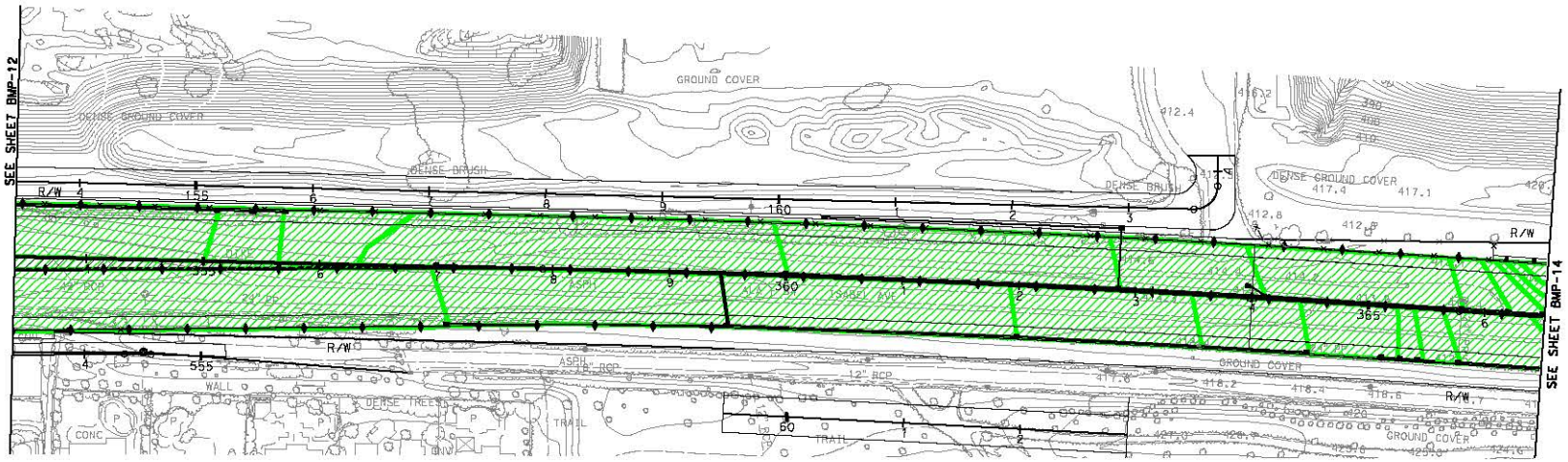
Oakland, CA 94612

WRECO
1814 Franklin St., Suite 608
Oakland, CA 94612



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-13

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 DATE PLOTTED => 10/14/2010
OC-OO-OO TIME PLOTTED => 4:28:50 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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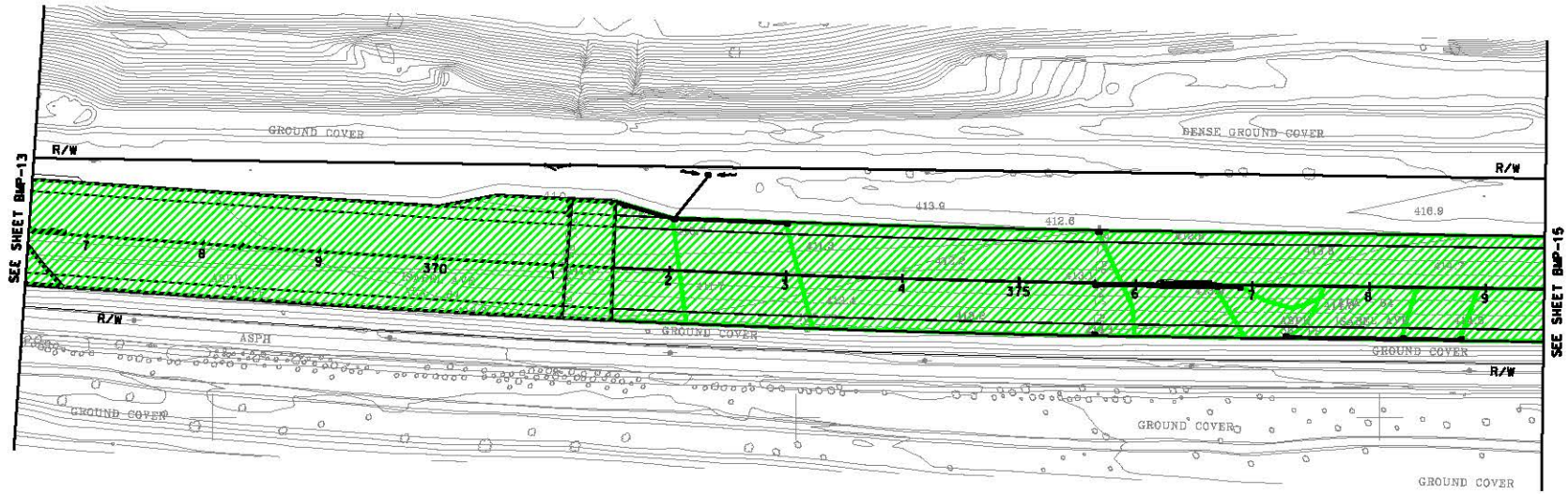

NO BMP WORK ON THIS SHEET.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

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ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

PROPOSED TREATMENT BMPS

SCALE 1"=50'

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 01:08:08 PM

BORDER LAST REVISED 3/1/2007 | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | USERNAME catherine_byun | DGN FILE sFILE1 | 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

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NOTE:
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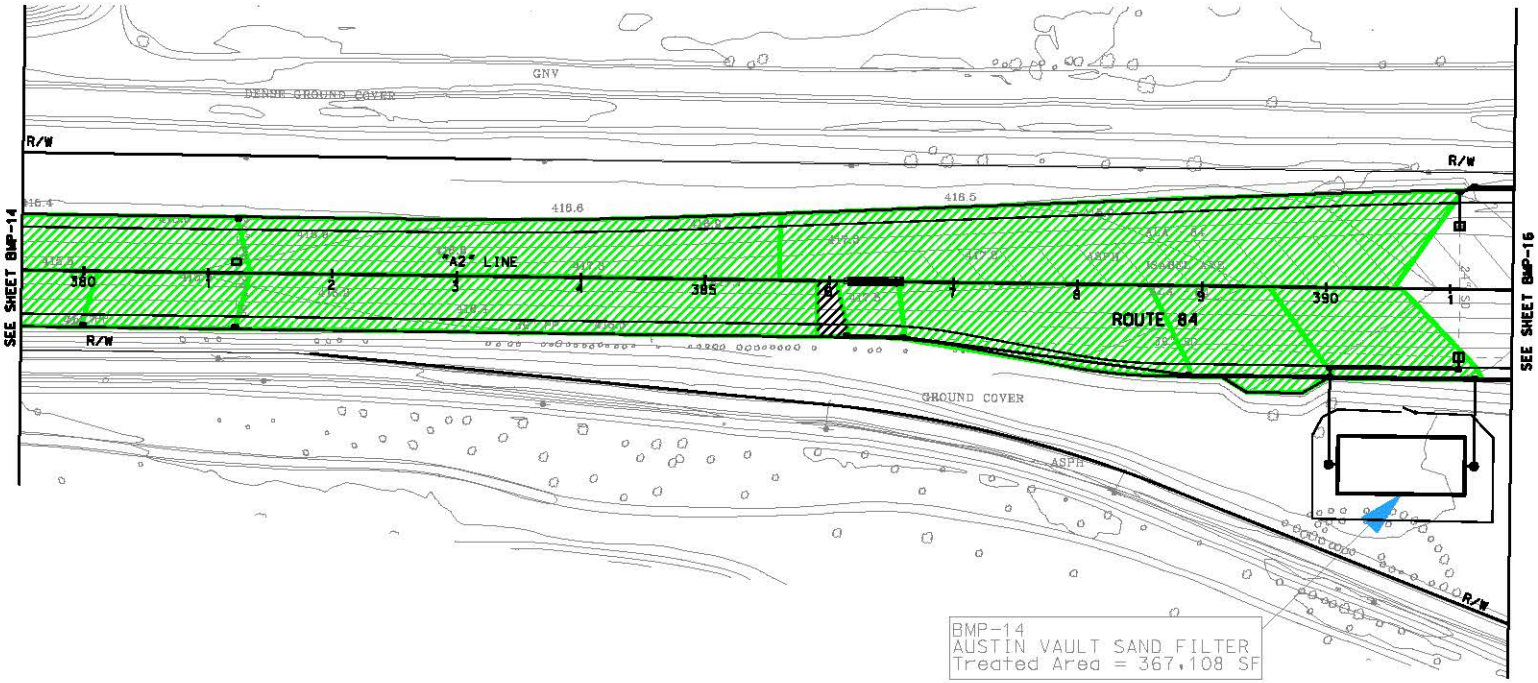

PROPOSED TREATMENT BMPS

SCALE 1"=50'

BMP- 15

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY
Caltrans	HAN-BIN LIANG	ANALETTE OCHOA	DATE REVISED
		CHECKED BY	

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FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

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LAST REVISION 00-00-00 DATE PLOTTED = 10/14/2010 TIME PLOTTED = 08:08 PM

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME = catherine_byun
DGN FILE = sFILES

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

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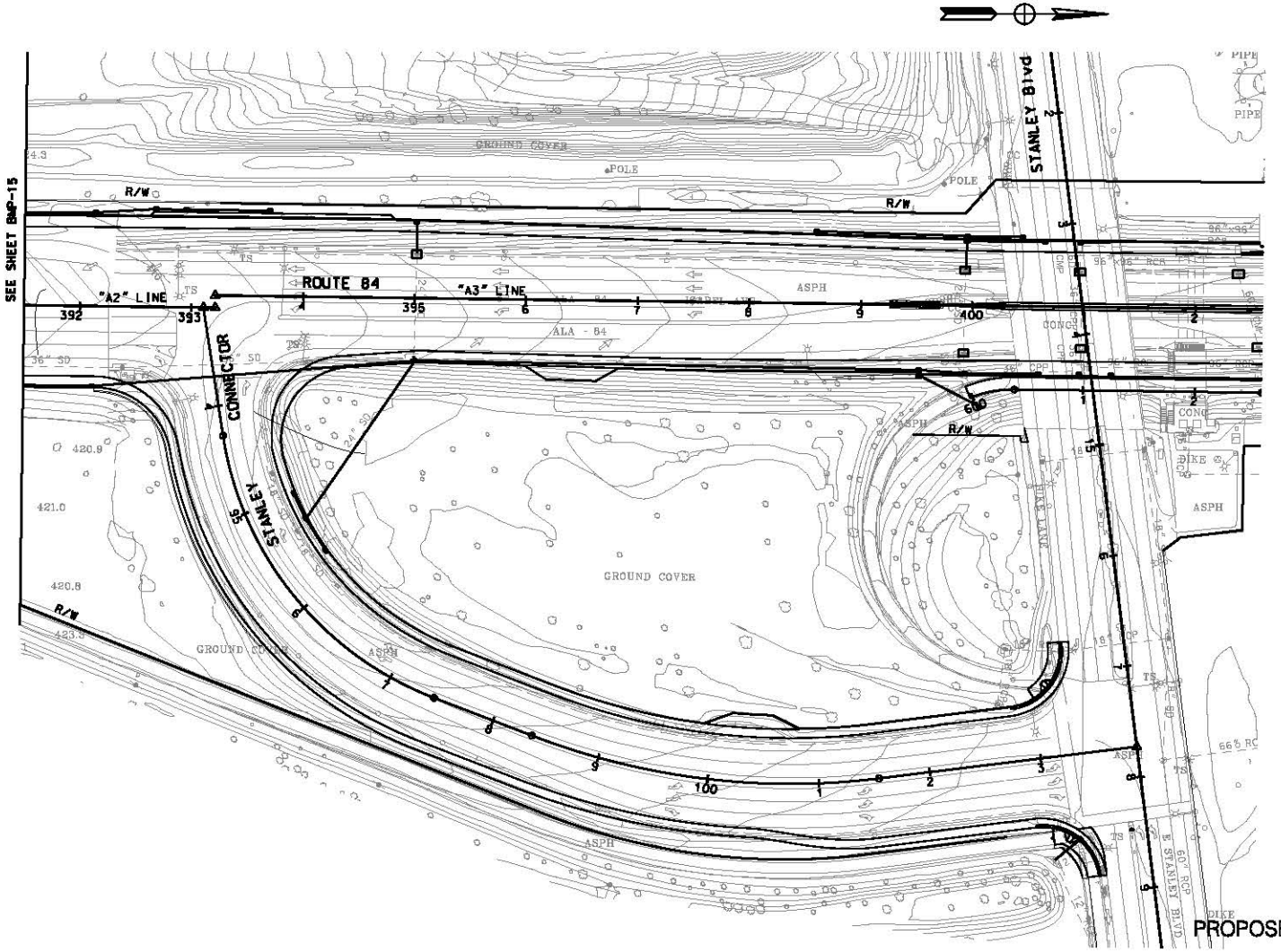

PROPOSED TREATMENT BMPS

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

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY
Caltrans	HAN-BIN LIANG	CHECKED BY	DATE REVISED

ANALETTE OCHOA

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LAST REVISION 00-00-00
DATE PLOTTED = 10/14/2010
TIME PLOTTED = 01:08:08 PM

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME = catherine_byun
DGN FILE = sFILES

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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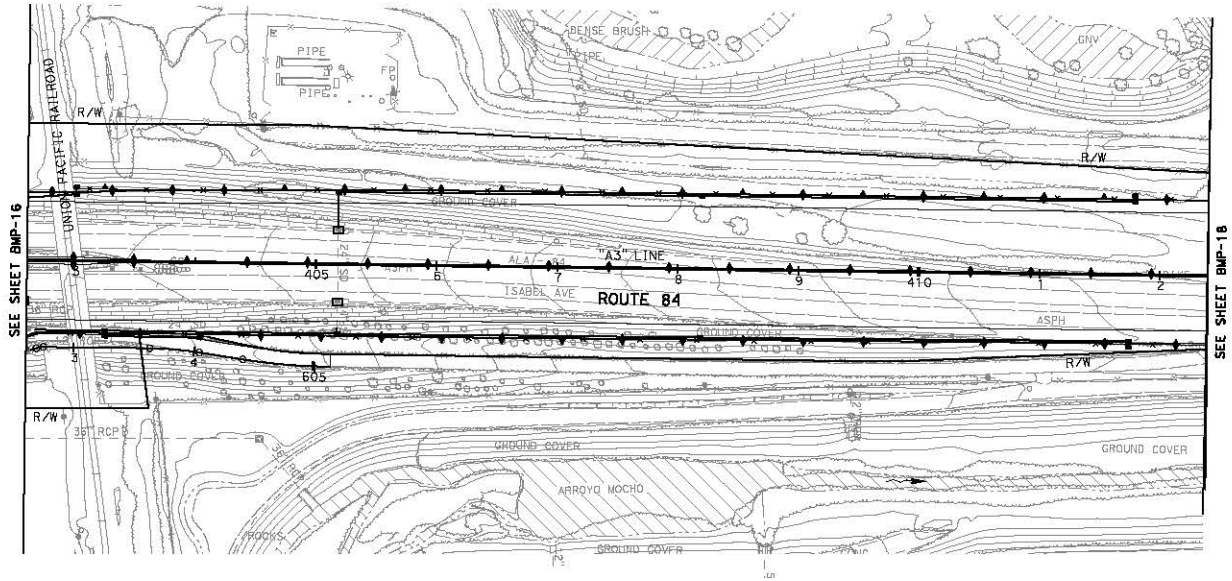

PROPOSED TREATMENT BMPS

NO BMP WORK ON THIS SHEET.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

SCALE 1"=50'

BMP-17

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	ANALETTE OCHOA	REVISED BY	
Caltrans	HAN-BIN LIANG	CHECKED BY		DATE REVISED	

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BORDER LAST REVISED 3/1/2007 | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | USERNAME => frane_liu DGN FILE => &FILE& | CU 00000 | EA 297601

NOTE:
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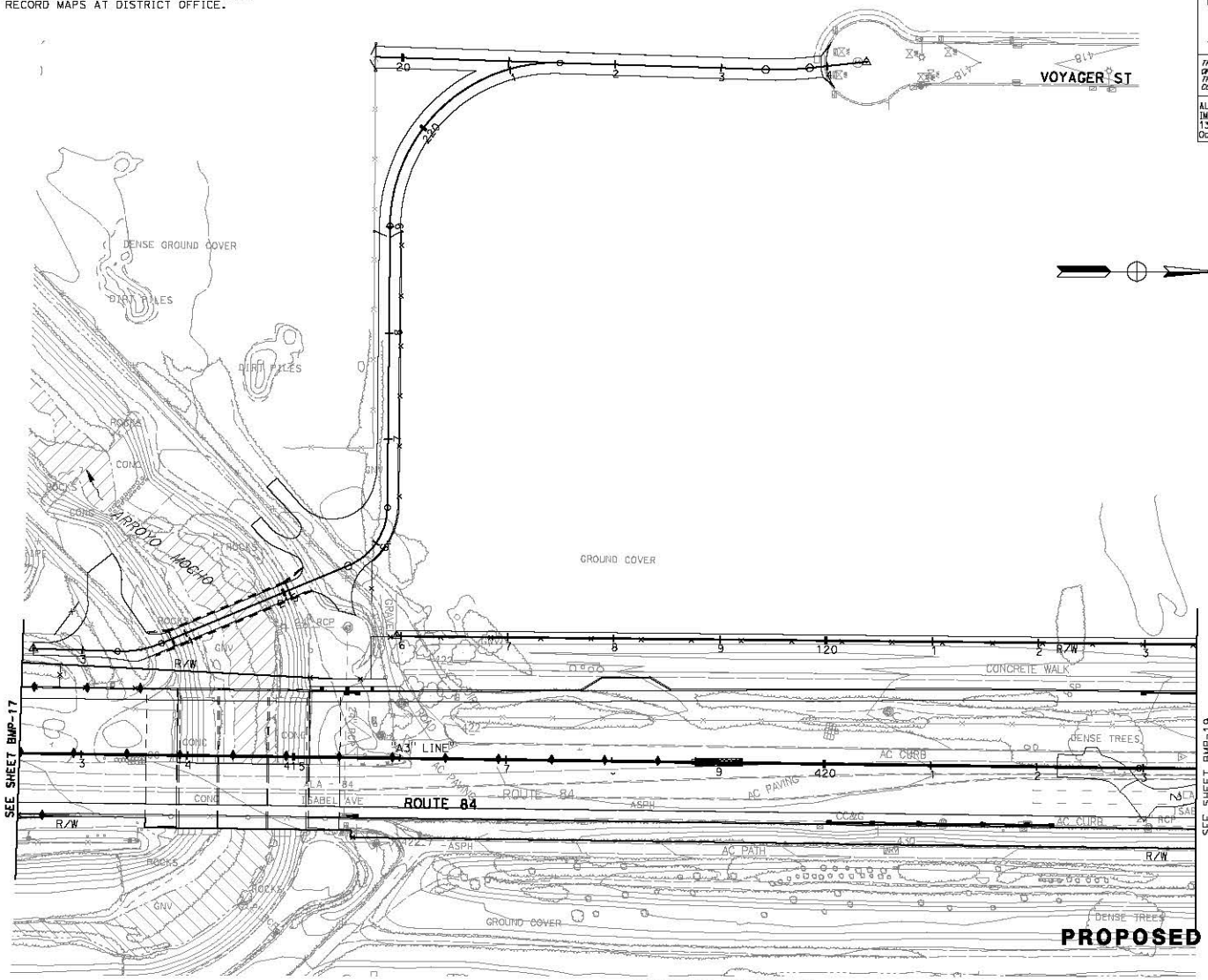
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.



PROPOSED TREATMENT BMPS

NO BMP WORK ON THIS SHEET.

SCALE 1"=50'

BMP-18

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	18	

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ANALETTE OCHOA	

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CHECKED BY

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

USERNAME => frane_liu
DGN FILE => $FILE$

CU 00000

EA 297601

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA,
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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	19	

REGISTERED CIVIL ENGINEER DATE

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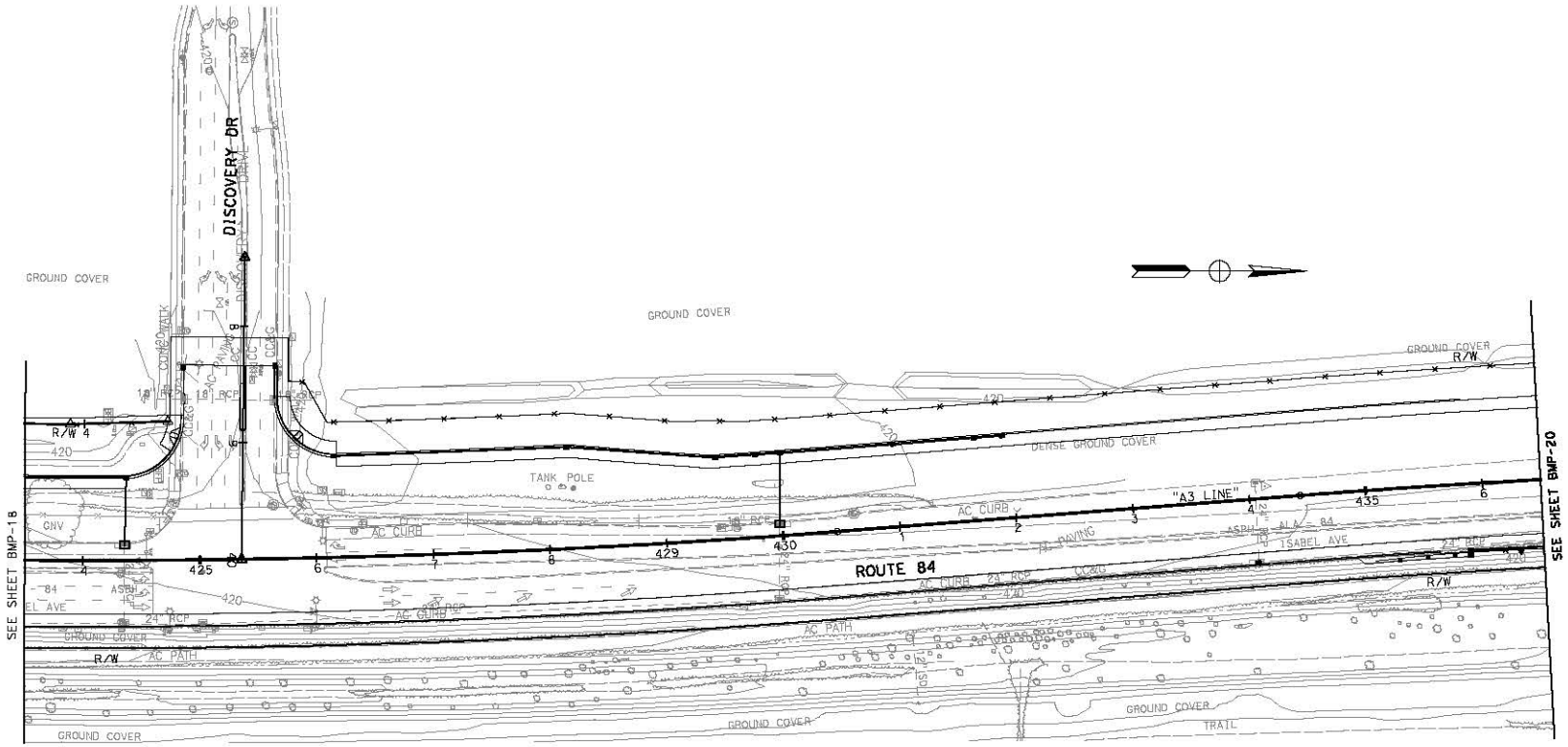

PROPOSED TREATMENT BMPS

NO BMP WORK ON THIS SHEET.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

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SCALE 1"=50'

BMP-19

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Caltrans		CHECKED BY		DATE REVISED

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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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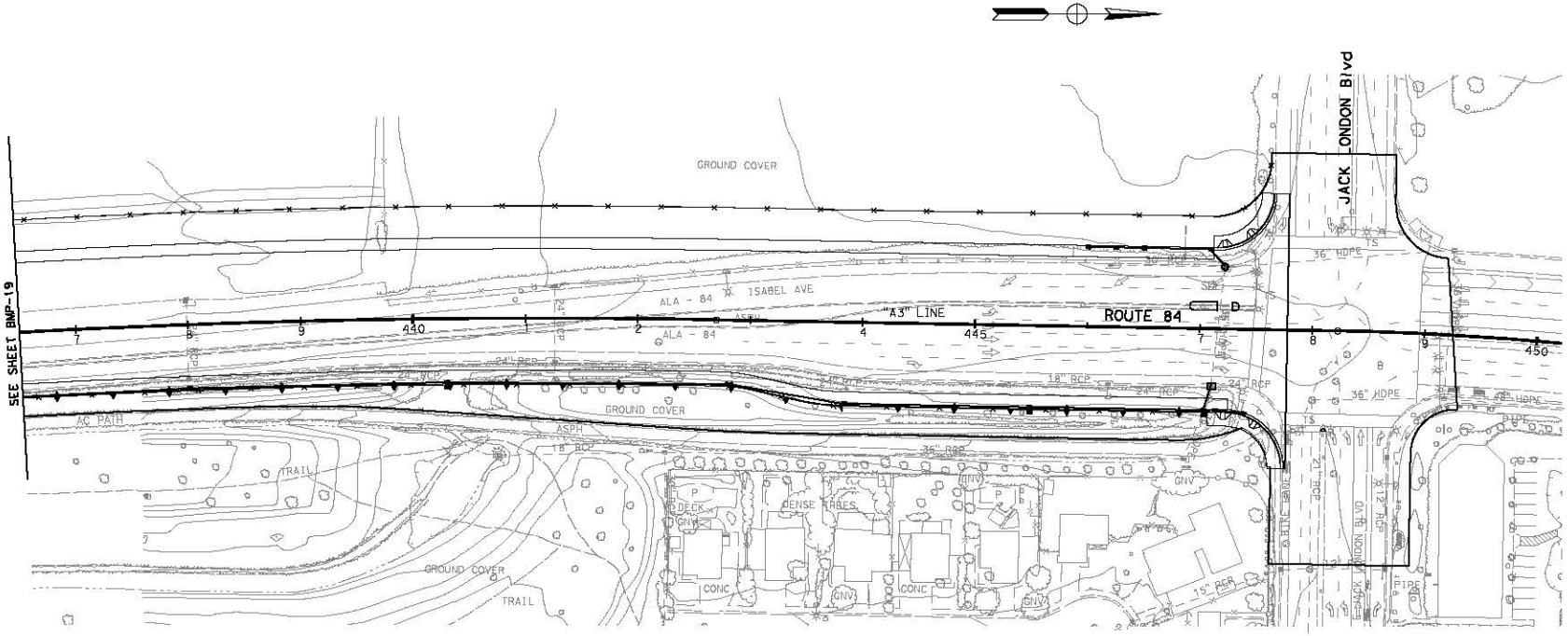

PROPOSED TREATMENT BMPS

NO BMP WORK ON THIS SHEET.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

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BMP-20

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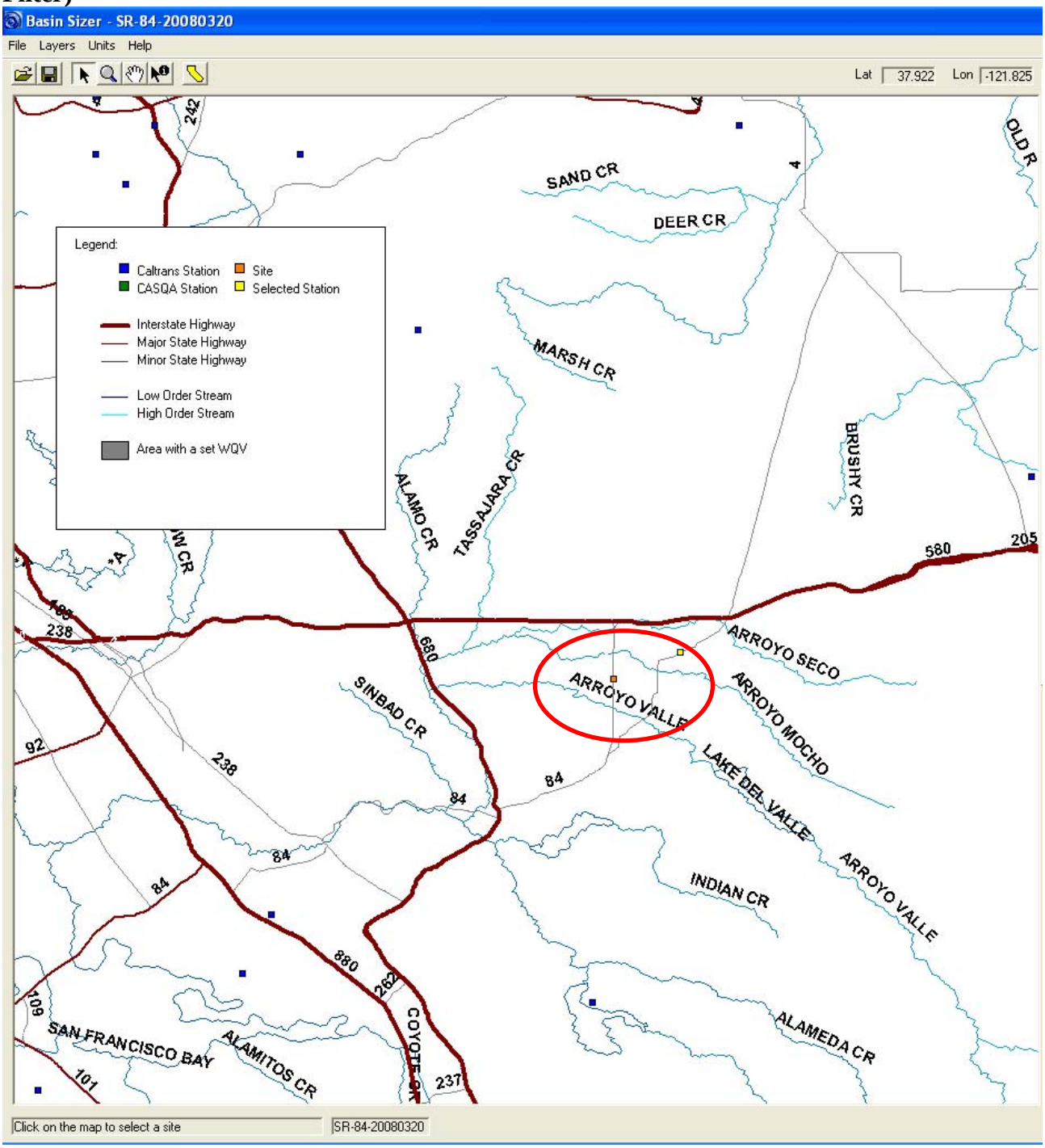
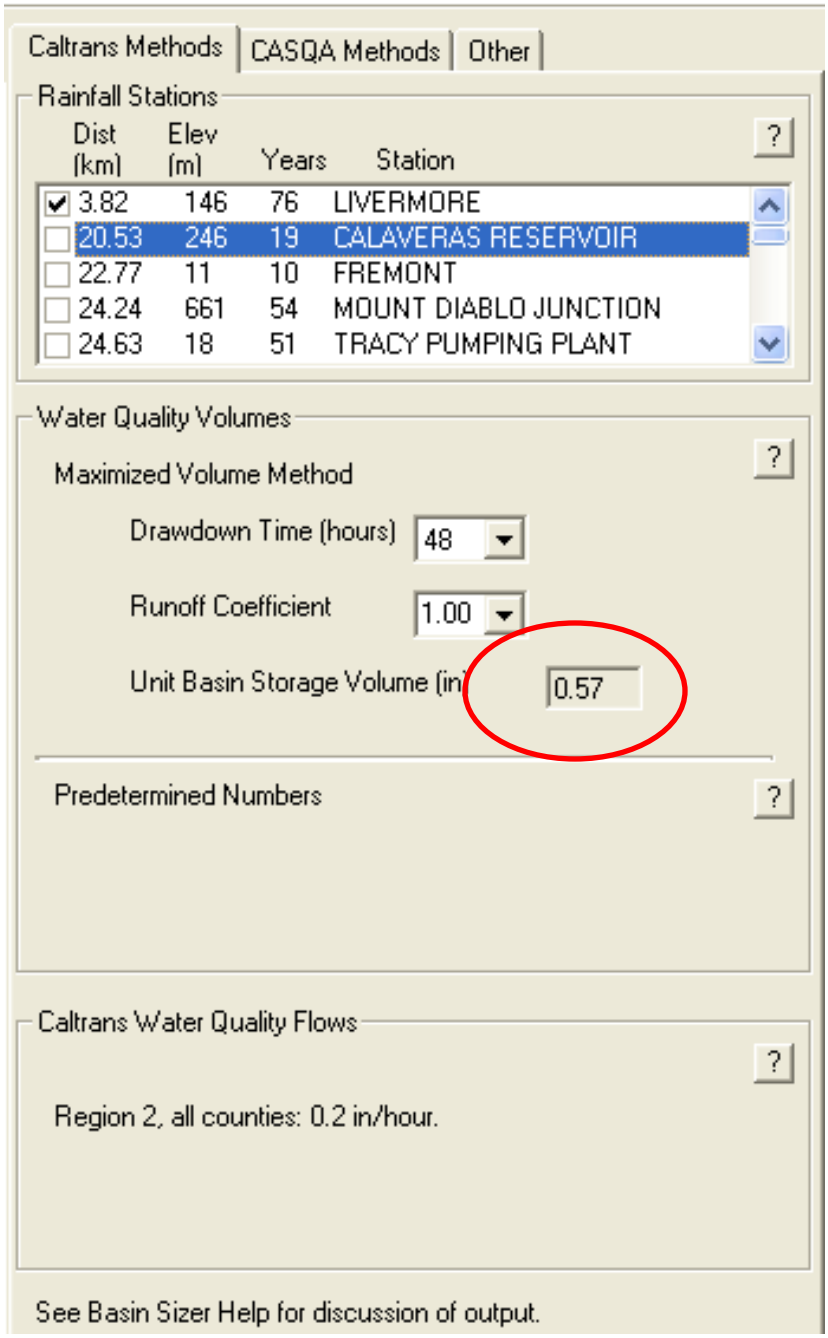
EA 297601

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

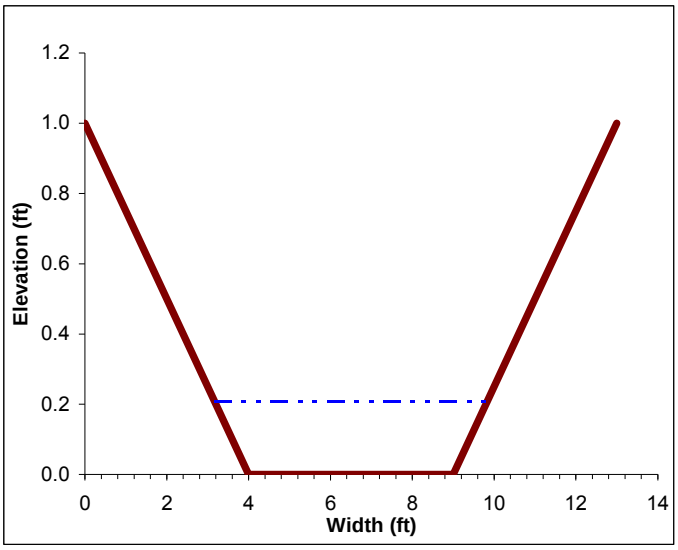
* AVSF Type = Length configuration (S or L) - water quality volume (CF) - design water depth (Hw elevation)

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

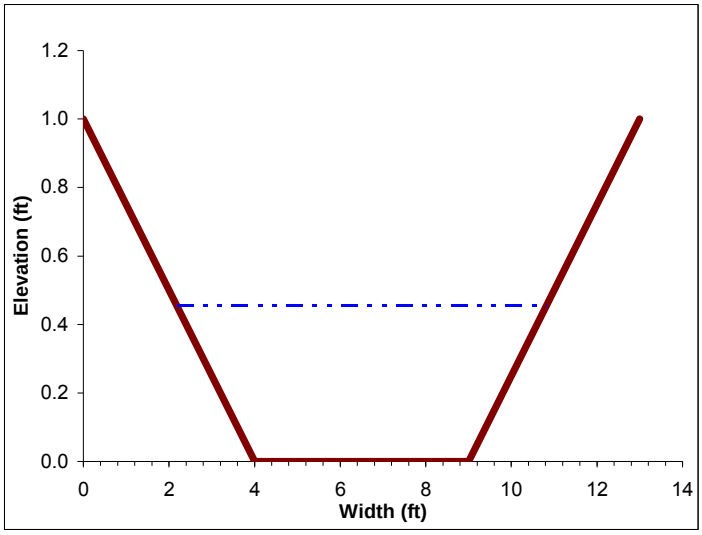
Normal Depth Calculations for Channels using Manning's Equation
Biofiltration Swale at Station 53+76 to 54+59 Lt "Vex" Line 4u

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

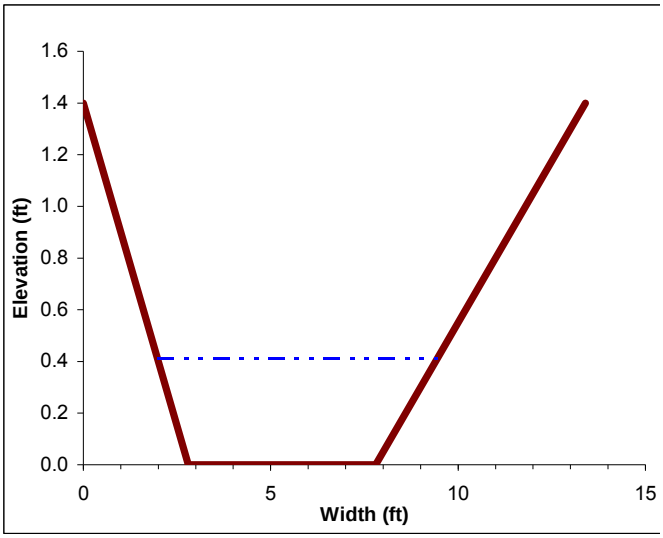
Tributary area for unpaved areas
35,149 sf
0.81 acre
0.6 C for unpaved areas

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

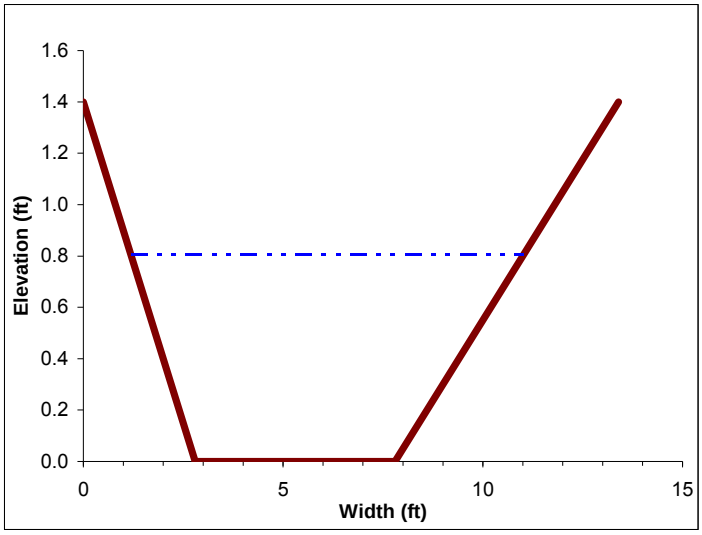
Normal Depth Calculations for Channels using Manning's Equation
Biofiltration Swale at Station 105+50 to 107+00 Lt "V" Line 6u

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

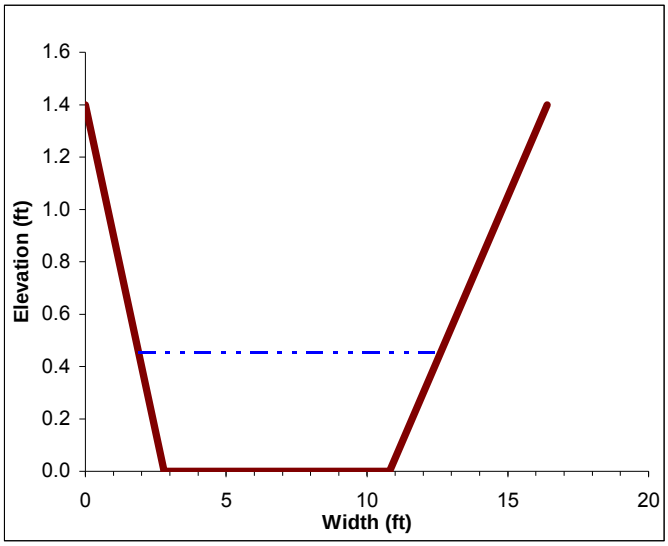
Biofiltration Swale at Station 299+00 to 301+50 Lt "A1" Line 17b

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

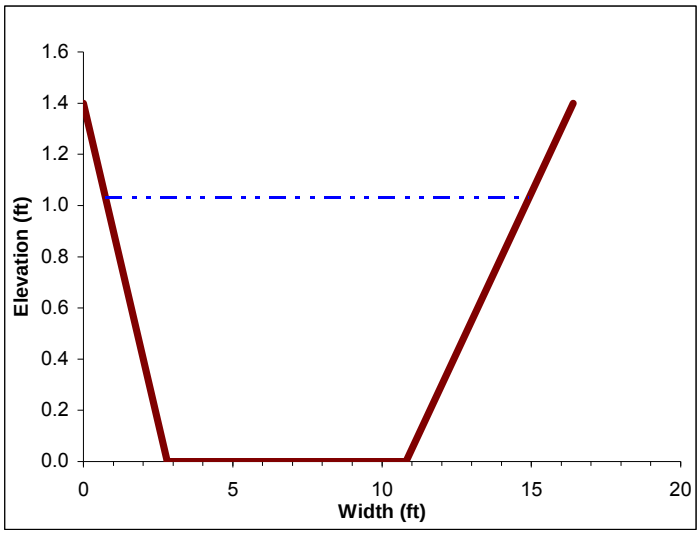
Normal Depth Calculations for Channels using Manning's Equation
Biofiltration Swale at Station 299+00 to 301+50 Lt "A1" Line 17b

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

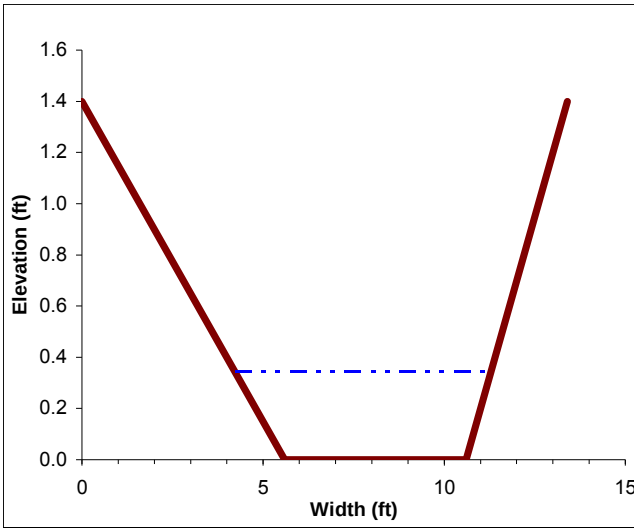
Tributary area for unpaved cul-de-sac areas
279,955 sf
6.43 acre
0.4 C for unpaved areas

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

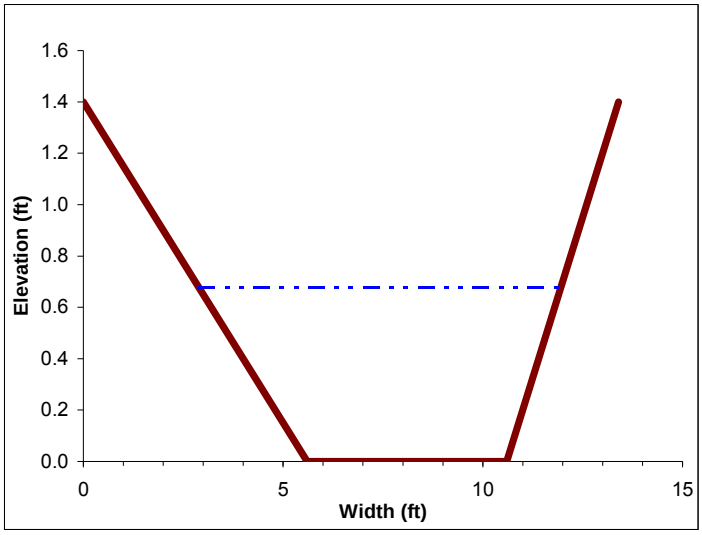
Biofiltration Swale at Station 285+14 to 287+64 Rt "A1" Line 16m

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

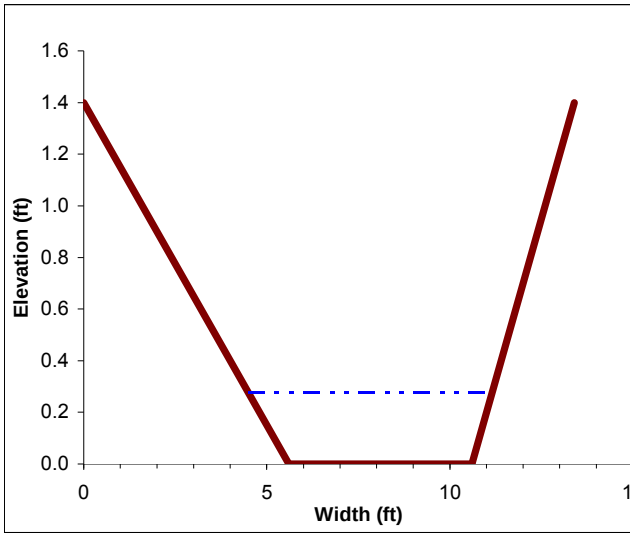
Tributary area for unpaved areas

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

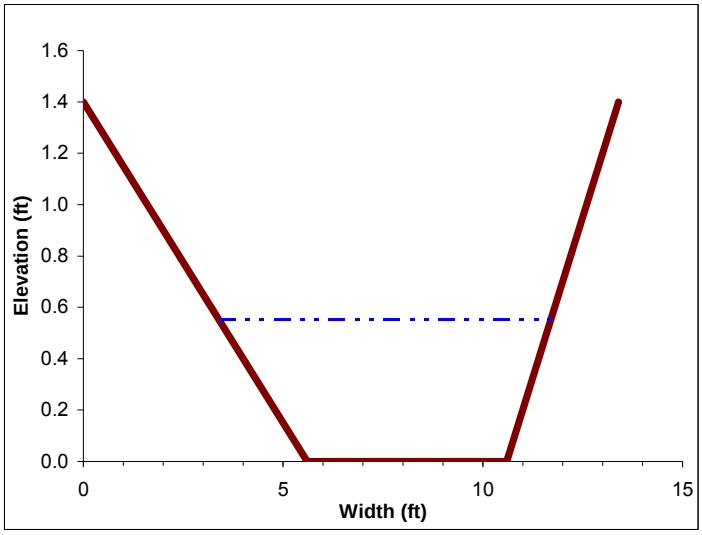
Normal Depth Calculations for Channels using Manning's Equation
Biofiltration Swale at Station 296+04 to 298+04 Rt "A1" Line 18i

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

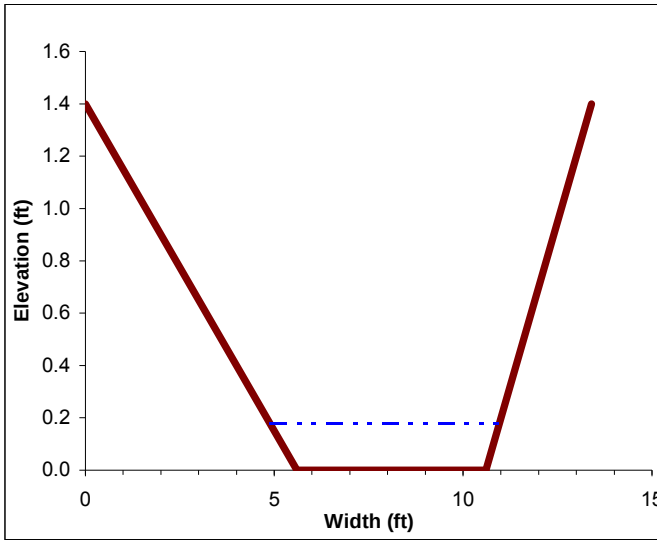
Tributary area for unpaved areas
35,377 sf
0.81 acre
0.6 C for unpaved areas

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

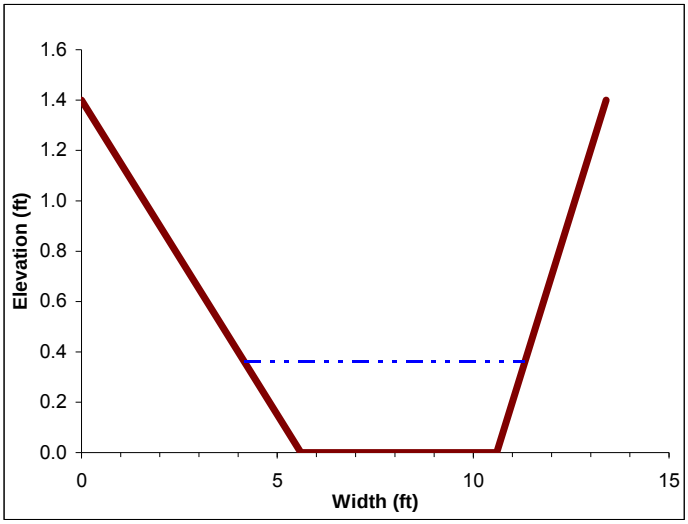
Biofiltration Swale at Station 301+04 to 302+54 Rt "A1" Line 19e

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

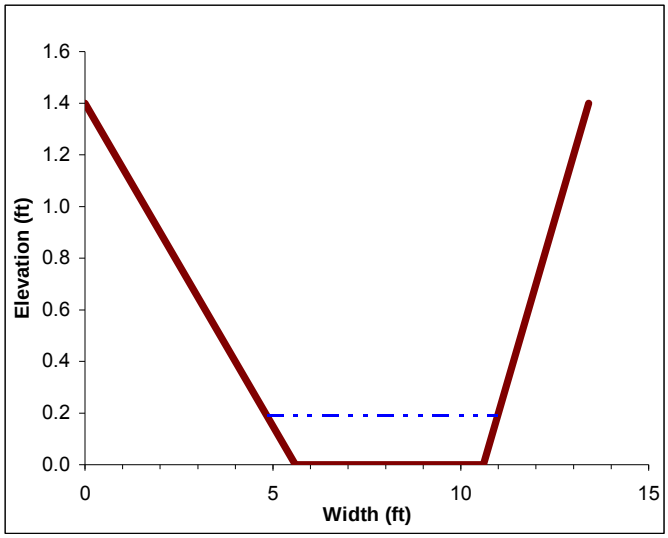
Biofiltration Swale at Station 306+75 to 308+25 Rt "A1" Line 20g

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.

Non-Storm Water Information Handout – 10/2014

State Route 84 Expressway Widening Project
Alameda County, California
EA 04-297621
October 2014

Non-Storm Water Information Handout

Prepared for:

Caltrans

ALAMEDA County Transportation Commission

Prepared by:

WRECO

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Appendix A Water Quality Objectives from Water Quality Control Plan (Basin Plan) for San Francisco Bay Region
Appendix B Livermore Municipal Code, Chapter 13.32
Appendix C Pleasanton Municipal Code, Chapter 15
Appendix D VOC and Fuel General Permit

Disclaimer

A "Disclaimer" is required specifying that the information provided in this Non-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 National Pollutant Discharge Elimination System (NPDES) *Discharge or Reuse of Extracted and Treated Groundwater Resulting from the Cleanup of Groundwater Polluted by Volatile Organic Compounds (VOC), Fuel Leaks and Other Related Wastes* (Order No, R2-2012-0012, NPDES No. CAG912002), or Municipal Batch Discharge Permits from the cities of Livermore and Pleasanton. Bidders and contractors are cautioned to make independent investigations and examinations as they deem necessary to satisfy the conditions encountered in performance of work.

Acronyms

ACTC	Alameda County Transportation Commission
ATS	Active treatment system
Basin Plan	Water Quality Control Plan for the San Francisco Bay Basin
bgs	Below ground surface
Caltrans	California Department of Transportation
CPPP	Coagulant Pollution Prevention Plan
CFR	Code of Federal Regulations
CRZ	Clear recovery zone
CTR	California Toxics Rule
I-	Interstate
DDP	Dewatering and Discharge Plan
DSRSD	Dublin San Ramon Services District
MGD	million gallons per day
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NTR	National Toxics Rule
POTW	Publicly Owned Treatment Works
O&M	Operation & Maintenance
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SR	State Route
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
VOC	Volatile Organic Compounds
WDR	Waste Discharge Requirement
WPCP	Water Pollution Control Plan
WQO	Water Quality Objectives

1 INTRODUCTION AND BACKGROUND

1.1 Introduction

During construction of the State Route (SR) 84 Expressway Widening Project (Project), it's likely that groundwater would be encountered during the excavation of Bent 2 at both the Arroyo del Valle trail bridge and Arroyo del Valle bridge (widen). These groundwater inflows, as well as accumulated stormwater in excavations and water from piling work, would require dewatering.

Due to the presence of potentially contaminated groundwater along the Project alignment, non-stormwater will need to be collected, monitored, and potentially treated to meet regulatory criteria prior to discharge. Non-stormwater may be discharged into the City of Livermore or City of Pleasanton's sanitary sewer system. If discharging to a sanitary sewer system is not feasible, non-stormwater may be discharged through the Project stormwater drainage system. Alternatively, treated non-stormwater may be reused.

This report presents the estimated groundwater seepage rates, local publicly owned treatment works (POTW) facility information, and the applicable NPDES permits that apply to the non-stormwater collection, treatment, and discharge activities. Table 1 provides the locations of this information within this document.

Table 1. Location of Non-Storm Water Information Handout Package Items

Non-Storm Water Information Handout Item	Location in Document
Estimated groundwater seepage rates	Section 3.3.1
Livermore POTW facility information	Section 2.2, Section 4.2.1, Section 5.1.4, Appendix B
Pleasanton POTW facility information	Section 2.3, Section 4.2.2, Section 5.1.5, Appendix C
Caltrans NPDES Permit	Section 2.1
VOC and Fuel General Permit	Section 2.4, Section 4.2.3, Section 5.1.6, Appendix D

See Figure 1 and Figure 2 for the Project location map and vicinity map.

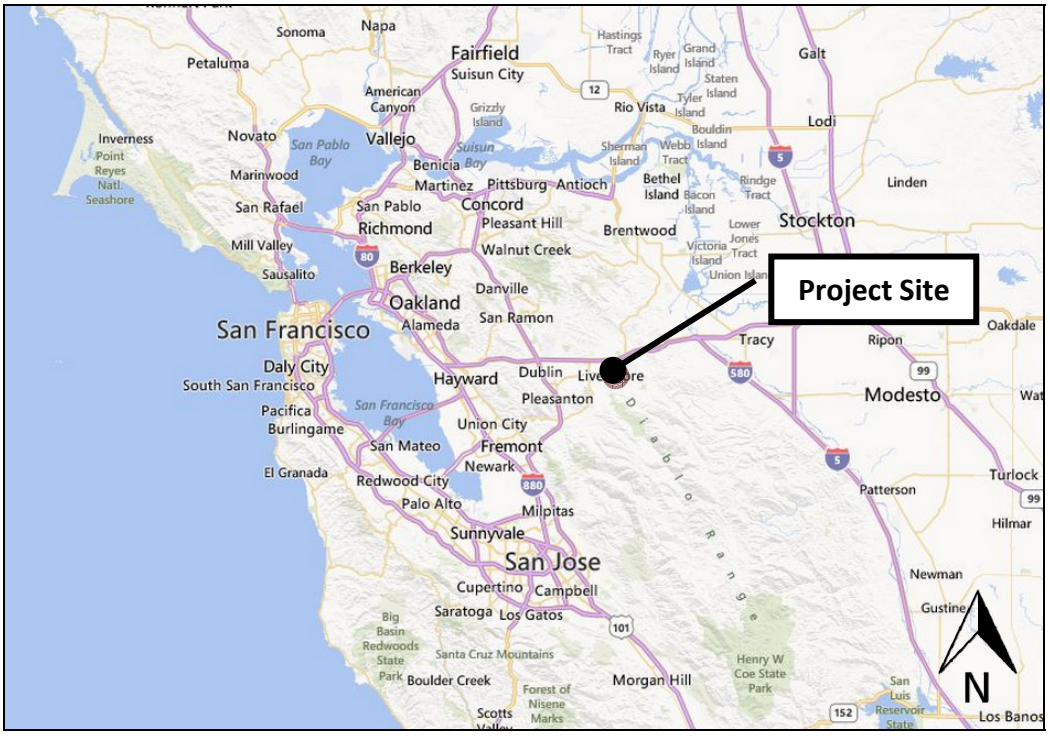

Figure 1. Project Location Map

Source: Bing Maps

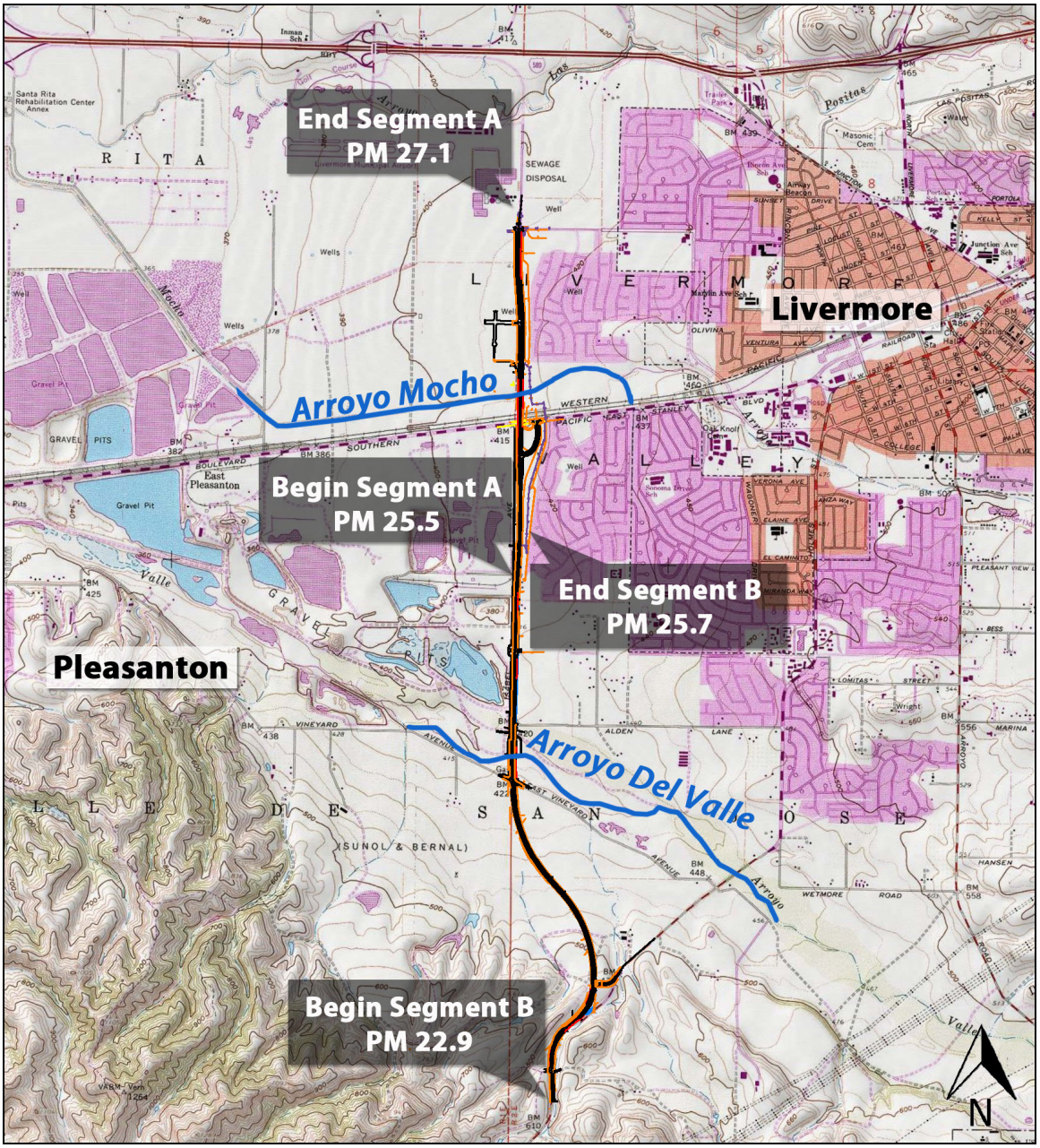

Figure 2. Project Vicinity Map

Source: United States Geological Survey (USGS)

1.2 Project Description

The State Route (SR) 84 Expressway Widening Project (Project), located in Livermore and Pleasanton in Alameda County, proposes to widen and upgrade 2.8 miles of SR 84 from 0.1 mile south of Ruby Hill Drive to 0.6 mile north of Concannon Boulevard to expressway standards (55 miles per hour [mph]). 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, and Concannon Boulevard will be widened and upgraded to accommodate future traffic movements. A connector access will be constructed at the SR 84/Vallecitos Road

intersection to accommodate the high volume of traffic moving from northbound SR 84 to the City of Livermore. 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 southward to Vineyard Avenue. The Project will also construct a new access bridge at Arroyo Del Valle for local utility and maintenance facilities, the Isabel Trail crossing, and widen the existing bridge across Arroyo Del Valle. The Project will construct retaining walls where right-of-way is restricted.

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 4:1 or flatter to provide a clear recovery zone (CRZ) for errant vehicles. Outside the CRZ, side slopes will be 2:1 or flatter. The roadway median area at intersections will be widened up to 36 feet to accommodate left-turn lanes.

2 REGULATORY SETTING

During construction, non-stormwater discharges will have to be controlled, monitored, and treated prior to discharge. There are three potential discharge conditions, each of which potentially require treatment of non-stormwaters: through the City of Livermore's sanitary sewer with a 13.32 Wastewater Discharge Permit, through the City of Pleasanton's sanitary sewer system with a 15.36 Wastewater Discharge Permit, or through the Project drainage system with the VOC and Fuel General Permit (Order No. R2-2012-0012, NPDES No. CAG912002).

In order to adhere to the requirements of the 13.32 Wastewater Discharge Permit, 15.36 Wastewater Discharge Permit, and VOC and Fuel General NPDES Permit during construction, non-stormwater discharges must be monitored and meet effluent limits. The following sections summarize the discharge criteria for those permits.

2.1 Caltrans NPDES Permit

The State Water Resources Control Board (SWRCB) issued the Caltrans Statewide NPDES Permit Order No. 99-06-DWQ adopted July 15, 1999 (Order No. 99-06-DWQ), to regulate all Caltrans projects and facilities in the State. The permit was reissued (Order No. 2012-0011-DWQ), and the new permit became effective on July 1, 2013. Because Project non-stormwaters are expected to be contaminated, discharges of non-stormwaters from the Project site must be regulated under the City of Livermore's 13.32 Wastewater Discharge Permit, City of Pleasanton's 15.36 Wastewater Discharge Permit, or the VOC and Fuel General NPDES Permit (Order No, R2-2012-0012, NPDES No. CAG912002).

2.2 13.32 Wastewater Discharge Permit

The City of Livermore has a POTW located at 101 West Jack London Boulevard. It has a design capacity of 8.5 million gallons per day (MGD), and it currently processes over 6 MGD of wastewater from the Livermore area. The plant utilizes primary, secondary, and tertiary treatment methods, as well as disinfection by ultraviolet light.

Chapter 13 of the City of Livermore's Municipal Code contains applicable laws and regulations pertaining to public services, and Chapter 13.32 discusses wastewater collection and treatment. These laws:

> "regulate direct and indirect discharge into the wastewater collection and treatment system by establishing standards of discharge through regulations as necessary to control the quality and quantity of wastewater entering the system, to comply with all applicable state and federal laws required by the Clean Water Act of 1977 and the General Pretreatment Regulations (40 Code of Federal Regulations [CFR], Part 403)" (Livermore, California Municipal Code §13.32.010).

2.2.1 Permit Acquisition

All dischargers must complete, file, and pay for the 13.32 Wastewater Discharge Permit at least 60 days prior to discharging non-stormwaters to the City of Livermore's sanitary sewer system. The permit application will include the following, at a minimum:

1. Name, address and location (if different from the address).
2. Standard Industrial Classification (SIC) code according to the SIC Manual, Bureau of the Budget, 1972, as amended.
3. Wastewater constituents and characteristics including, but not limited to, those mentioned in Livermore Municipal Code 13.32.060 as determined by a reliable analytical laboratory (sampling and analysis shall be performed in accordance with procedures established by the EPA pursuant to Section 304(g) of the Clean Water Act and contained in 40 CFR, Part 136, as amended).
4. Time and duration of contribution.
5. Average daily and 30-minute peak wastewater flow rates, including daily, monthly and seasonal variations if any.
6. Site plans, floor plans, mechanical and plumbing plans and details to show all sewers, sewer connections and appurtenances by the size, location and elevation.
7. Description of activities, facilities and plant processes on the premises including all materials which are or could be discharged.
8. Where known, the nature and concentration of any pollutants in the discharge which are limited by any city, state or federal pretreatment standards, and a statement regarding whether or not the pretreatment standards are being met on a consistent basis and if not, whether additional operation and maintenance (O&M) and/or additional pretreatment is required for the user to meet applicable pretreatment standards. This statement shall be signed by an authorized representative of the industrial user and certified by a qualified professional.
9. If additional pretreatment and/or O&M will be required to meet the pretreatment standards, the shortest schedule by which the user will provide such additional pretreatment. The completion date in this schedule shall not be later than the compliance date established for the applicable pretreatment standard. The following conditions shall apply to this schedule:
    a. The schedule shall contain increments of progress in the form of dates for the commencement and completion of major events leading to the construction and operation of additional pretreatment required for the user to meet the applicable pretreatment standards (e.g., hiring an engineer, completing preliminary plans, completing final plans, executing contract for major components, commencing construction, completing construction, etc.).
    b. No increment referred to in subsection (A)(9) (a) shall exceed nine months.
    c. Not later than 14 days following each date in the schedule and the final date for compliance, the user shall submit a progress report to the superintendent including, as a minimum, whether or not it complied with the increment of progress to be met on such date and, if not, the date on which it expects to comply with this increment of progress, the reason for delay, and the steps being taken by the user to return the construction to the schedule established. In no event shall

more than nine months elapse between such progress reports to the superintendent.

10. Each product produced by type, amount, process or processes and rate of production.
11. Type and amount of raw materials processed (average and maximum per day).
12. Number and type of employees, and hours of operation of plant and proposed or actual hours of operation and pretreatment system.
13. Any other information as may be deemed by the City to be necessary to evaluate the permit application. Users which are subject to National Pretreatment Standards under 40 CFR Chapter I, Subchapter N, Parts 405 – 471, are required to submit a Baseline Monitoring Report as specified in 40 CFR(b).

Permits are issued for specific time periods, not to exceed five years. Users must apply for permit reissuance at least 180 days prior to the expiration of the existing permit.

2.2.2 Discharge Criteria

The following sections contain the City of Livermore's discharge criteria for contributions to the sanitary sewer system and POTW.

2.2.2.1 General Discharge Prohibitions

Chapter 13.32.060 of the City of Livermore's Municipal Code contains General Discharge Prohibitions for the POTW, and they are provided below.

1. Any liquids, solids or gases with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees centigrade using the test methods specified in 40 CFR. At no time shall two successive readings on an explosion hazard meter, at the point of discharge into the system (or at any point in the system) be more than five percent nor any single reading over 10 percent of the lower explosive limit of the meter. Prohibited materials include, but are not limited to, gasoline, kerosene, naphtha, benzene, toluene, xylene, ethers, alcohols, ketones, aldehydes, peroxides, chlorates, perchlorates, bromates, carbides, hydrides and sulfides and any other substances which the City of Livermore, the state or EPA has notified the user is a fire hazard or a hazard to the system.
2. Solid or viscous substances which may cause obstruction to the flow in a sewer or other interference with the operation of the wastewater treatment facilities such as, but not limited to: grease, garbage with particles greater than one-half inch in any dimension, animal guts or tissues, paunch manure, bones, hair, hides or fleshings, entrails, whole blood, feathers, ashes, cinders, sand, spent lime, stone or marble dust, metal, glass, straw, shavings, grass clippings, rags, spent grains, spent hops, wastepaper, wood, plastics, gas, tar, asphalt residues, residues from refining, or processing of fuel or lubricating oil, mud, or glass grinding or polishing wastes.
3. Any wastewater having a pH less than 6.0 or greater than 9.0, unless a City of Livermore permit is obtained (see LMC 13.32.120). Discharge of wastewater with a pH lower than 5.0 is prohibited at all times. Wastewater having any other corrosive property capable of causing damage or hazard to structures, equipment and/or personnel is also prohibited.
4. Any wastewater containing toxic pollutants in sufficient quantity, either singly or by interaction with other pollutants, to injure or interfere with any wastewater treatment process, constitute a hazard to humans or animals, create a toxic effect in the receiving

waters of the POTW, or to exceed the limitation set forth in the categorical pretreatment standard. A toxic pollutant shall include, but not be limited to, any pollutant identified pursuant to Section 307(a) of the Act.

5. Any noxious or malodorous liquids, gases or solids which either singly or by interaction with other wastes are sufficient to create a public nuisance or hazard to life or are sufficient to prevent entry into the sewers for maintenance and repair.
6. Any substance which may cause the POTW's effluent or any other product of the POTW such as residues, sludges, scums or gases, to be unsuitable for reclamation and reuse or to interfere with the reclamation process. In no case shall a substance discharged to the POTW cause the POTW to be in noncompliance with sludge use or disposal criteria, guidelines or regulations developed under Section 405 of the Act, any criteria, guidelines or regulations affecting sludge use or disposal developed pursuant to the Solid Waste Disposal Act, the Clean Air Act, the Toxic Substances Control Act, or state criteria applicable to the sludge management method being used.
7. Any waters or wastes which contain more than 100 mg/1 of freon extractable fat, oil or grease.
8. Any substance which will cause the POTW to violate its NPDES permit or the receiving water quality standards.
9. Any wastewater with objectionable color not removed in the treatment process, such as, but not limited to, dye wastes and vegetable tanning solutions.
10. Any wastewater having a temperature which will inhibit biological activity in the POTW treatment plant resulting in interference, but in no case wastewater with a temperature at the introduction into the POTW which exceeds 40 degrees centigrade (104 degrees Fahrenheit).
11. Any pollutants, including oxygen-demanding pollutants (BOD, etc.) released at a flow rate and/or pollutant concentration which a user knows or has reason to know will cause interference to the POTW.
12. Any wastewater containing any radioactive wastes or isotopes of such half-life or concentration as may exceed the limits established by the state or federal regulatory agency applicable to the POTW user.
13. Any wastewater which causes a hazard to human life or creates a public nuisance.

2.2.2.2 Specific Pollutant Limitations

Chapter 13.32.110 of the City of Livermore's Municipal Code contains Specific Pollutant Limitations for contributions to the sanitary sewer system. No contributions to the City of Livermore's sanitary sewer system may contain a daily maximum concentration that exceeds the values provided in Table 1.

Table 2. Specific Pollutant Limitations

Pollutant	Concentration (mg/L)
Arsenic	0.06
Cadmium	0.14
Copper	1.0
Chromium (total)	0.62
Lead	0.20
Mercury	0.01
Nickel	0.61
Silver	0.20
Zinc	3.00
Cyanide	0.04
Total Toxic Organics	1.00

2.3 15.36 Wastewater Discharge Permit

The City of Pleasanton contracts with the Dublin San Ramon Services District (DSRSD) to treat its wastewater. The DSRSD's operates a POTW located on Johnson Drive south of Stoneridge Drive and just west of the Val Vista Park in Pleasanton. The City of Pleasanton's treated wastewater is subsequently discharged into the San Francisco Bay for disposal through facilities owned by the Livermore Amador Valley Water Management Agency. The City of Pleasanton owns and operates all of the sewer pipelines and pumping stations within the city limits needed to deliver wastewater to DSRSD's POTW.

2.3.1 Discharge of Groundwater

Chapter 15.28.040 of the City of Pleasanton's Municipal Code prohibits the discharge of unpolluted effluent to the sanitary sewer system that could otherwise be discharged into storm drains and surface waters. If the City of Pleasanton determines that no other reasonable alternative exists, the director may permit discharge into the sanitary sewer system.

2.3.2 Permit Acquisition

All discharges must complete, file, and pay for the 15.36 Wastewater Discharge Permit prior to discharging non-stormwater to the City of Pleasanton's sanitary sewer system. The permit application will include the following, at a minimum:

1. The applicant's name, address, and industrial classification number according to the Standard Industrial Classification Manual, United States Bureau of the Budget, as amended;
2. The volume of wastewater proposed to be discharged daily;
3. The wastewater constituents and characteristics;
4. The time and duration of discharge;
5. The average and 15-minute peak period wastewater flow rates, including daily, monthly and seasonal variations, if any;

6. The site plans, floor plans, mechanical plans, plumbing plans, and erection details showing all sewers and appurtenances by size, location, and elevation;
7. A description of the activities, facilities, equipment, and plant processes proposed for the premises, including all materials, processes, and types of materials which are or could be discharged;
8. Each product produced, by type, amount and rate of production;
9. The number and type of employees and hours worked;
10. A hazardous materials survey.

Permits are issued for specific time periods, not to exceed three years.

2.3.3 Discharge Criteria

The following sections contain the City of Pleasanton's discharge criteria for contributions to the sanitary sewer system and POTW.

2.3.3.1 Limitations on Constituents and Characteristics

Chapter 15.28.060 of the City of Pleasanton's Municipal Code contains Limitations of Sewage Constituents and Characteristics for contributions to the sanitary sewer system. No contributions to the sanitary sewer system shall cause any of the following:

1. Any liquid or vapor having a temperature higher than 150 degrees Fahrenheit;
2. Any water or wastes which contain more than 200 milligrams per liter of fat, oil or grease that is soluble by the freon extraction process;
3. Any gasoline, benzene, naphtha, fuel oil or other liquid, solid or gas which, by reason of its nature or quantity, if sufficient, or may be sufficient, to cause, either alone or by interaction with other substances, fire, explosion or injury in any other way to any person, property or the sewerage system;
4. Any garbage, except garbage properly ground with a mechanical garbage grinder and meeting the requirements of Section 15.28.100 of this chapter;
5. Any ashes, cinders, sand, mud, straw, shavings, metal, glass, rags, feathers, tar, coal tar, asphalt, cement, plastics, woods, paunch manure or any other solid or viscous substance capable of causing obstruction to the flow in sewers or other interference with the proper and economical operation of the sewerage system;
6. Any waters or wastes with a pH lower than 6 or higher than 11, or having any corrosive property capable of causing damage or hazard to structures, equipment and/or personnel;
7. Any waters or wastes exceeding the following constituent concentrations, unless a contract is entered with the city providing payment for additional treatment or plant expansion costs (see Table 3):

Table 3. Limitations on Sewage Constituent Concentrations

Constituent	Limit (mg/L)
Biological Oxygen Demand (BOD)	400
Chemical Oxygen Demand (COD)	1,500
Suspended Solids (SS)	400
Total Dissolved Solids (TDS)	1,000

8. Any waters or uses having a fluoride concentration greater than five milligrams per liter;
9. Wastes discharged into the sewerage system from the regeneration of any water softeners of any kind or description, whether private or commercial;
10. Any sulfide forming pollutant or waste which, when discharged to the sewerage system, generates sulfide concentrations in excess of one milligram per liter;
11. Any wastewater with objectionable color not removed in the treatment process, such as, but not limited to, dye wastes and vegetable tanning solutions;
12. Any noxious or malodorous liquids, gases or solids which either singly or by interaction with other wastes are sufficient to create a public nuisance or hazard to life or are sufficient to prevent entry into the sewerage system for maintenance and repair;
13. Any waters or wastes in excess of the maximum volumes, flows and/or rates of flow prescribed in the applicable permits issued pursuant to this chapter;
14. In addition to the restrictions set forth in this section, any pollutants, including oxygen demanding pollutants such as BOD and COD, discharged at a flow rate and/or pollutant concentration which a user knows, or has reason to know, is likely to cause interference with the treatment works.

2.3.3.2 Limitations on Toxic Pollutants

Chapter 15.28.070 of the City of Pleasanton's Municipal Code contains Limitations on Toxic Pollutants for contributions to the sanitary sewer system. No contributions to the City of Pleasanton's sanitary sewer system may contain a concentration in excess of the following limits:

Table 4. Limitations on Toxic Pollutants

Pollutant	Concentration (mg/L)
Arsenic	0.50
Cadmium	1.00
Chromium (total)	1.00
Copper	1.00
Lead	2.00
Mercury	0.01
Nickel	1.50
Selenium	1.30
Silver	1.50
Zinc	4.00
Cyanide	0.50
Phenols	20.00
Polychlorinated Biphenyls (PCBs)	0.01
Total Identifiable Chlorinated Hydrocarbons	0.02
Total Toxic Organics (TTO)	5.00
Polynuclear Aromatic Hydrocarbons (PAH)	6.50
Oil and Grease (animal/vegetable)	200
Oil and Grease (hydrocarbon)	150
pH	6<pH<11

2.4 VOC and Fuel General NPDES Permit

The SFBRWQCB adopted Resolution No. 88-160 on October 19, 1988, and it urges potential dischargers to discharge to a POTW system through a sanitary sewer if reuse of extracted and treated groundwater is not economically and/or technically feasible. Reuse can take many forms, such as irrigation of landscaping, dust control, soil compaction, and industrial water supply. If discharging to a POTW is infeasible and the beneficial uses of the receiving water would not be adversely affected, a permit from the SFBRWQCB would be obtained to regulate discharges to surface water.

The most applicable General Waste Discharge Requirement (WDR)/NPDES Permit for this construction activity is titled *Discharge or Reuse of Extracted and Treated Groundwater Resulting from the Cleanup of Groundwater Polluted by Volatile Organic Compounds (VOC), Fuel Leaks and Other Related Wastes* (VOC and Fuel General Permit; Order No, R2-2012-0012, NPDES No. CAG912002). The VOC and Fuel General Permit was adopted by the SFBRWQCB on February 8, 2012, and expires on March 15, 2017.

However, the excavations are anticipated to receive greater than 10,000 gallons of groundwater inflow per day and groundwater testing data for VOCs, fuels, and fuel additives are currently unavailable, so the WDR titled *Discharge or Reuse of Extracted Brackish Groundwater, Reverse Osmosis Concentrate Resulting from Treated Brackish Groundwater, and Extracted Groundwater from Structural Dewatering Requiring Treatment* (Groundwater General Permit; Order No. R2-2012-0060, NPDES No. CAG912004) may also be applicable to the Project.

To obtain coverage under the VOC and Fuel General Permit, the contractor will need to submit a Notice of Intent (NOI) to the SFBRWQCB for approval, prior to the start of non-stormwater collection, treatment, and discharge activities.

2.4.1 Effluent Limitations

The effluent must not contain concentrations of toxic pollutants above the concentrations as outlined in the VOC and Fuel General Permit. Table 5 provides the effluent limitations under the VOC and Fuel General Permit.

Table 5. Effluent Limitations for Toxic Pollutants

No.	Compound	CAS Number	Column A: Discharge to Drinking Water Areas[1]		Column B: Discharge to Other Surface Water Areas	
			Average Monthly Effluent Limitation (µg/L)	Maximum Daily Effluent Limitation (µg/L)	Average Monthly Effluent Limitation (µg/L)	Maximum Daily Effluent Limitation (µg/L)
1	Benzene	71432	---	1	---	5
2	Carbon Tetrachloride	56235	0.25[2]	0.50	4.4	5
3	Chloroform	67663	---	5	---	5
4	1,1-Dichloroethane	75343	---	5	---	5
5	1,2-Dichloroethane	107062	0.38[2]	0.5	---	5
6	1,1-Dichloroethylene	75354	0.057[2]	0.11[2]	3.2	5
7	Ethylbenzene	100414	---	5	---	5
8	Methylene Chloride	75092	4.7	5	---	5
9	Tetrachloroethylene (PCE)	127184	0.8	1.6	---	5
10	Toluene	108883	---	5	---	5
11	Cis 1,2-Dichloroethylene	156592	---	5	---	5
12	Trans 1,2-Dichloroethylene	156605	---	5	---	5
13	1,1,1-Trichloroethane	71556	---	5	---	5
14	1,1,2-Trichloroethane	79005	0.6	1.2	---	5
15	Trichloroethylene (TCE)	79016	2.7	5	---	5
16	Vinyl Chloride	75014	---	0.5	---	1
17	Total Xylenes	1330207	---	5	---	5
18	Methyl Tertiary Butyl Ether (MTBE)	1634044	---	5	---	5
19	Total Petroleum Hydrocarbons[TPHs (as gasoline or as diesel)]	---	---	50	---	50
20	Ethylene Dibromide (1,2-Dibromoethane)	106934	---	0.05[2]	---	5
21	Trichloro-trifluoroethane	76131	---	5	---	5
22	Total Chlorine Residual	---	---	0.0[3]	---	0.0[3]

Table Notes:
[1] Drinking water areas are defined as surface waters with the existing or potential beneficial uses of "Municipal and Domestic Supply" and "Groundwater Recharge" (the latter includes recharge areas to maintain salt balance or to halt salt water intrusion into fresh water aquifers).
[2] If reported detection level is greater than effluent limit, then a non-detect result using a 0.5 µg/L detection level will not be deemed to be out of compliance.
[3] There shall be no detectable levels of residual chlorine in the effluent (a non-detect result using a detection level equal or less than 0.08 milligram per liter (mg/L) will not be deemed to be out of compliance). This limit only applies to Dischargers that chlorinate their extracted groundwater.

Source: SFBRWQCB 2012

In addition to Table 5, the following effluent limitations apply:

- The pH must not exceed 8.5 or be depressed below 6.5;

- Toxicity: the results of the rainbow trout test fish, in 96-hr static renewal bioassays of the discharge, must be no less than a three sample moving median of 90% survival and a single test value of no less than 70% survival.

Discharges must not cause the following conditions to exist in the receiving water:

- Floating, suspended, or deposited macroscopic particulate matter or foam;
- Aquatic growth and bottom deposits that are a nuisance or adversely affecting the beneficial uses;
- Alteration of temperature, turbidity, taste, odor, and apparent color beyond natural background levels;
- Visible, floating, suspended, or deposited oil or other products of petroleum origin;
- Toxic or other deleterious substances in concentrations or quantities that would cause deleterious effects on biota, or that would render any of these biota unfit for human consumption.

The discharge must not cause the following limits to be exceeded in the waters of the State, in any place within 1 foot of the water surface:

- Dissolved oxygen: the median dissolved oxygen for any three consecutive months must be less than 80% of the dissolved oxygen content at saturation;
- Dissolved sulfide: natural background levels;
- pH: the pH must not be depressed below 6.5 or raised above 8.5, nor caused to vary from normal ambient pH by more than 0.5 pH units;
- Un-ionized ammonia: 0.025 mg/L as an annual median and 0.4 mg/L as a maximum for Lower San Francisco Bay;
- Nutrients: waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses.

In addition, discharges must not cause or contribute to a violation of any water quality standards for receiving waters. Monitoring would be performed during construction per Attachment E of the VOC and Fuel General Permit.

2.4.2 Receiving Waters and Water Quality Objectives

The SFBRWQCB established a *Water Quality Control Plan* (Basin Plan) with goals and policies that apply to the region's water resources regarding beneficial uses and water quality objectives (WQOs). Non-stormwater discharges to surface waters should adhere to these objectives, in addition to those under the VOC and Fuel General Permit (Order No, R2-2012-0012, NPDES No. CAG912002).

2.4.2.1 Receiving Water Bodies and Beneficial Uses

The Project 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, runoff from the Project discharges to Arroyo del Valle and Arroyo Mocho. Arroyo Del Valle and Arroyo Mocho eventually discharge into Arroyo de la Laguna approximately 9 mi from the Project limits.

The Basin Plan lists the existing beneficial uses of Arroyo del Valle as:

- Municipal and Domestic Supply (MUN)
- Groundwater Recharge (GWR)
- Cold Freshwater Habitat (COLD)
- Preservation of Rare and Endangered Species (RARE)
- Spawning, Reproduction, and/or Early Development (SPWN)
- Warm Freshwater Habitat (WARM)
- Wildlife Habitat (WILD)
- Water Contact Recreation (REC-1)
- Noncontact Water Recreation (REC-2)

The potential beneficial uses for Arroyo del Valle are:

- Fish Migration (MIGR)

The Basin Plan lists the existing beneficial uses of Arroyo Mocho as:

- Groundwater Recharge (GWR)
- Cold Freshwater Habitat (COLD)
- Migration of Aquatic Organisms (MIGR)
- Spawning, Reproduction, and/or Early Development (SPWN)
- Warm Freshwater Habitat (WARM)
- Wildlife Habitat (WILD)
- Water Contact Recreation (REC-1)
- Noncontact Water Recreation (REC-2)

The Basin Plan lists the existing beneficial uses of Arroyo de la Laguna as:

- Groundwater Recharge (GWR)
- Cold Freshwater Habitat (COLD)
- Migration of Aquatic Organisms (MIGR)
- Spawning, Reproduction, and/or Early Development (SPWN)
- Warm Freshwater Habitat (WARM)
- Wildlife Habitat (WILD)
- Water Contact Recreation (REC-1)
- Non-contact Water Recreation (REC-2)

The 2010 Clean Water Act Section 303(d) List of Water Quality Limited Segments (303[d] List) lists Arroyo Mocho, Arroyo Del Valle, and Arroyo de la Laguna as impaired water bodies due to diazinon. In addition, the 303(d) List shows Arroyo Mocho as impaired by temperature due to channelization, habitat modification, and the removal of riparian vegetation.

2.4.2.2 Water Quality Objectives

The Basin Plan lists numerical and narrative objectives for surface waters. These WQOs for surface waters are located in Chapter 3 of the Basin Plan, referenced in Appendix A of this report, and listed below:

- Bacteria
- Bioaccumulation
- Biostimulatory Substances
- Color
- Dissolved Oxygen
- Floating Material
- Oil and Grease
- Population and Community
- Ecology
- pH
- Radioactivity
- Salinity
- Sediment
- Settleable Material
- Suspended Material
- Sulfide
- Tastes and Odors
- Toxicity
- Turbidity
- Un-Ionized Ammonia
- Objectives for Specific Chemical Constituents

Table 6 lists the numerical Water Quality Objectives for toxic pollutants for freshwater.

Table 6. Freshwater[a] Water Quality Objectives for Toxic Pollutants for Surface Waters

Compound	4-day Average	1-hr Average
Arsenic[b, c, d]	150	340
Cadmium[b, d]	e	e
Chromium III[f]		
Chromium VI[b, c, d, g]	11	16
Copper[b, c, d]	9.0[h]	13[h]
Cyanide[i]		
Lead[b, c, d]	2.5[j]	65[j]
Mercury[k]	0.025	2.4
Nickel[b, c, d]	52[l]	470[l]
Selenium[m]		
Silver[b, c, d]		3.4[n]
Tributyltin[o]		
Zinc[b, c, d]	120[p]	120[p]

Source: SFBRWQCB 2013

Notes:
Values are in ug/L
a. Freshwaters are those in which the salinity is equal to or less than 1 part per thousand 95% of the time, as set forth in Chapter 4 of the Basin Plan. Unless a site-specific objective has been adopted, these objectives shall apply to all freshwaters except for the South Bay south of Dumbarton Bridge, where the California Toxics Rule (CTR) applies. For waters in which the salinity is between 1 and 10 parts per thousand, the applicable objectives are the more stringent of the marine (Table 3-3) and freshwater objectives.
b. Source: 40 CFR Part 131.38 (California Toxics Rule or CTR), May 18, 2000.

c. These objectives for metals are expressed in terms of the dissolved fraction of the metal in the water column.
d. These objectives are expressed as a function of the water-effect ratio (WER), which is a measure of the toxicity of a pollutant in site water divided by the same measure of the toxicity of the same pollutant in laboratory dilution water. The 1-hr. and 4-day objectives = table value X WER. The table values assume a WER equal to one.
e. The objectives for cadmium and other noted metals are expressed by formulas where H = ln (hardness) as $CaCO_3$ in mg/l: The four-day average objective for cadmium is $e^{(0.7852\ H\ -\ 3.490)}$. This is 1.1 µg/l at a hardness of 100 mg/l as $CaCO_3$. The one-hour average objective for cadmium is $e^{(1.128\ H\ -\ 3.828)}$. This is 3.9 µg/l at a hardness of 100 mg/l as $CaCO_3$.
f. Chromium III criteria were promulgated in the National Toxics Rule (NTR). The NTR criteria specifically apply to San Francisco Bay upstream to and including Suisun Bay and Sacramento-San Joaquin Delta. Note: at the time of writing, the values are 180 ug/l (4-day average) and 550 ug/l (1-hr. average). The objectives for chromium III are based on hardness. The values in this footnote assume a hardness of 100 mg/l $CaCO_3$. At other hardnesses, the objectives must be calculated using the following formulas where H = ln (hardness): The 4-day average objective for chromium III is $e^{(0.8190H+1.561)}$. The 1-hour average for chromium III is $e^{(0.8190\ H+3.688)}$.
g. This objective may be met as total chromium.
h. The objectives for copper are based on hardness. The table values assume a hardness of 100 mg/l $CaCO_3$. At other hardnesses, the objectives must be calculated using the following formulas where H = ln (hardness): The 4-day average objective for copper is $e^{(0.8545H-1.702)}$. The 1-hour average for copper is $e^{(0.9422H-1.700)}$.
i. Cyanide criteria were promulgated in the National Toxics Rule (NTR). The NTR criteria specifically apply to San Francisco Bay upstream to and including Suisun Bay and Sacramento-San Joaquin Delta. Note: at the time of writing, the values are 5.2 ug/l (4-day average) and 22 ug/l (1-hr. average).
j. The objectives for lead are based on hardness. The table values assume a hardness of 100 mg/l $CaCO_3$. At other hardnesses, the objectives must be calculated using the following formulas where H = ln (hardness): The 4-day average objective is $e^{(1.273H\ -4.705)}$. The 1-hour average for lead is $e^{(1.273H-1.460)}$.
k. Source: U.S. EPA Quality Criteria for Water 1986 (EPA 440/5-86-001), which established a mercury criterion of 0.012 ug/l. The Basin Plan set the objective at 0.025 based on considerations of the level of detection attainable at that time. The 4-day average value for mercury does not apply to Walker Creek and Soulajule Reservoir and their tributaries nor to waters of the Guadalupe River watershed; instead, the water quality objectives specified in Table 3-4A apply. The 1-hour average value continues to apply to waters specified in Table 3-4A.
l. The objectives for nickel are based on hardness. The table values assume a hardness of 100 mg/l $CaCO_3$. At other hardnesses, the objectives must be calculated using the following formulas where H = ln (hardness): The 4-day average objective is $e^{(0.8460H\ +\ 0.0584)}$. The 1-hour average objective is $e^{(0.8460H\ +\ 2.255)}$.
m. Selenium criteria were promulgated for all San Francisco Bay/Delta waters in the National Toxics Rule (NTR). The NTR criteria specifically apply to San Francisco Bay upstream to and including Suisun Bay and Sacramento-San Joaquin Delta. Note: at the time of writing, the values are 5.0 ug/l (4-day average) and 20 ug/l (1-hr. average).
n. The objective for silver is based on hardness. The table value assumes a hardness of 100 mg/l $CaCO_3$. At other hardnesses, the objective must be calculated using the following formula where H = ln (hardness): The 1-hour average objective for silver is $e^{(1.72H\ –\ 6.52)}$. U.S. EPA has not developed a 4-day criterion.
o. Tributyltin is a compound used as an antifouling ingredient in marine paints and toxic to aquatic life in low concentrations. U.S. EPA has published draft criteria for protection of aquatic life (Federal Register: December 27, 2002, Vol. 67, No. 249, Page 79090-79091). These criteria are cited for advisory purposes. The draft criteria may be revised.
p. The objectives for zinc are based on hardness. The table values assume a hardness of 100 mg/l $CaCO_3$. At other hardnesses, the objectives must be calculated using the following formulas where H = ln (hardness): The 4-day average objective for zinc is $e^{(0.8473\ H+0.884)}$. The 1-hour average for zinc is $e^{(0.8473\ H+\ 0.884)}$.

3 GEOLOGY, SOILS, AND GROUNDWATER

3.1 Geology

The Project is located in the Livermore Valley within the central portion of the Coast Ranges geomorphic province, where northwest-southeast trending valleys and ridges characterize the regional morphology of the Coast Ranges province. 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; Graymer et al. 1996). More recent mapping subdivides the alluvium into latest Holocene alluvial fan deposits, Holocene alluvial fan deposits, and historic stream channel deposits within the active channels of Arroyo Mocho and Arroyo del Valle (Witter et al. 2006).

The underlying bedrock in this portion of Alameda County is the nonmarine sedimentary Livermore Gravels Formation. This formation is up to approximately 400 ft thick and lies as much as 400 ft below the alluvium in central Livermore Valley. It consists of poorly to moderately consolidated cobble conglomerate, conglomeratic sandstone, and coarse-grained sandstone with some siltstone and claystone. (URS 2011)

3.2 Soil

On March 20 and 21, 2008, BASELINE Environmental Consulting collected 64 soil samples from 16 boring locations. At each location, soil was collected adjacent to the edge of pavement and approximately 10 ft from the edge of pavement from both the ground surface and 1.5 ft below ground surface (bgs); therefore, each boring location produced 4 discrete soil samples.

Lead was reported in all 64 samples, ranging from 2.8 to 52 mg/kg. Fifteen soil samples reported Waste Extraction Test (soluble) lead above the laboratory reporting limit of 0.15 mg/L; soluble lead concentrations ranged from 0.19 to 1.5 mg/L. In addition, arsenic, copper, and mercury were detected above laboratory reporting limits, with concentrations ranging from 2.7 to 4.2 mg/kg, 13 to 36 mg/kg, and 0.023 to 0.064 mg/kg, respectively.

Organochlorine pesticides were not detected in any soil samples. (BASELINE Environmental Consulting 2008)

3.3 Groundwater

None of the shallow roadway borings (RB) completed for pavement design encountered groundwater; these borings were generally 10 to 15 ft in depth. However, the deeper, multipurpose borings (NB) completed for the retaining wall, sign, and bridge structures encountered groundwater. These borings ranged from about 3 to 101.5 ft in depth and groundwater was encountered in some of the borings at depths ranging from 14.5 to 28 ft bgs. The aforementioned borings were completed for the Geotechnical Design Report and Materials Report between November 2007 and March 2008, and December 2008 and January 2009. (URS 2011)

It is likely that groundwater would be encountered during the excavation of Bent 2 at both the Arroyo del Valle trail bridge and Arroyo del Valle (widen), and dewatering would be required. Because the subsurface soils encountered in the borings near the bottom of the footing and pile cap elevations consist primarily of clays and clayey sands, dewatering these excavations may be accomplished by sumping (URS 2010a).

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. (URS 2011)

See Table 7 for groundwater measurements collected during the geotechnical investigation.

Table 7. Groundwater Measurements

Boring Number	Water Depth (ft)	Boring Depth (ft)	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 ft
NB04	Dry	25.0	Hollow stem auger	--
NB05	Not measured	56.5	Rotary wash	Dry to 7 ft
NB05A	Dry	35.0	--	Hillside boring
NB06	Not measured	80.0	Rotary wash	Dry to 7 ft
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 ft to drilling fluid upon completion of drilling
NB12	Not measured	71.5	Rotary wash	8 ft to drilling fluid level on 2nd day of drilling
NB13	Not measured	80.0	Rotary wash	14 ft to drilling fluid level on 2nd day of drilling
NB14	Not measured	60.0	Rotary wash	Dry to 11.5 ft
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 ft to drilling fluid level after 6th day
NB24	Not measured	101.5	Rotary wash	26.5 ft to drilling fluid level on 2nd day of drilling
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	--

Source: URS 2011

3.3.1 Groundwater Seepage Rates

URS identified locations where construction dewatering might be required based on groundwater levels encountered in nearby borings. Dewatering is anticipated at Bent 2 of both the Arroyo del Valle trail bridge and Arroyo del Valle (widen). Excavations to the bottom of pile caps or spread footings during bridge construction are not likely to require dewatering. Engineering calculations using site soil conditions and empirical relationships between grain sizes and permeability estimate the required dewatering pumping rate, which ranges from 30 to 200 gallons per minute. Neither laboratory testing nor field pumping tests were performed, so this estimate is an order of magnitude approximation. (URS 2010b)

3.3.2 Groundwater Quality

On March 24 and 25, 2008, Precision Sampling, Incorporated, collected groundwater samples under the supervision of BASELINE Environmental Consulting at the locations specified in Figure 3 for analysis at Curtis and Tompkins Environmental Testing Laboratory. Groundwater levels were measured at 45 ft bgs, 40 ft bgs, 35 ft bgs, and 55 ft bgs at GW-1, GW-2, GW-3, and GW-5, respectively. The boring at GW-4 did not encounter groundwater to a maximum depth of 72 ft bgs. See Table 8 for groundwater quality testing data.

Figure 3. Groundwater Sampling Locations

Source: BASELINE Environmental Consulting 2008

Table 8. Groundwater Quality Testing Results

Sample ID	GW-1	GW-2	GW-3	GW-5	Basin Plan WQOs[1]	Livermore §13.32.110	Pleasanton §15.28.070
Date	3/25/2008	3/24/2008	3/25/2008	3/24/2008			
Antimony	<0.010	<0.010	<0.010	<0.010	--	--	--
Arsenic	0.035	0.027	0.01	**0.49**	0.34	0.06	0.50
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**	0.0039[2]	0.14	1.00
Chromium (total)	0.19	0.26	0.081	**5.7**	--	0.62	1.00
Chromium III	--	--	--	--	0.55[3]	--	--
Chromium VI	--	--	--	--	0.016	--	--
Cobalt	0.28	0.066	0.14	1.6	--	--	--
Copper	**0.22**	**0.12**	**0.077**	**2.7**	0.013	--	1.00
Cyanide	<0.01	<0.01	<0.01	<0.01	0.022[4]	--	0.50
Lead	0.025	0.034	0.031	**0.67**	0.065	0.20	2.00
Mercury	**0.012**	<0.0002	0.0019	**0.0095**	0.0024	0.01	0.01
Molybdenum	<0.005	0.0082	0.0057	0.13	--	--	--
Nickel	**0.54**	**0.61**	0.43	**20**	0.47	0.61	1.50
Selenium	<0.010	<0.010	<0.010	**0.081**	0.02[5]	--	1.30
Silver	<0.005	<0.005	**0.005**	**0.0065**	0.0034	0.20	1.50
Thallium	<0.010	<0.010	<0.010	<0.010	--	--	--
Tributyltin	--	--	--	--	--[6]	--	--
Vanadium	0.14	0.12	0.056	2.2	--	--	--
Zinc	**0.35**	**0.22**	**0.16**	**3.8**	0.12	3.00	4.00
pH (SU)	7.5	7.4	7.5	7.4	6.5<pH<8.5	6<pH<9	6<pH<11

Notes:
Units are mg/L

1. Regional Water Quality Control Board's 1-hour average Water Quality Objectives as listed in the Water Quality Control Plan (Basin Plan), dated 2013, Chapter 3 and Table 3-4
Red, bolded values exceeded a regulatory limit, either the Basin Plan, §13.32.110 of the City of Livermore's municipal code, or §15.28.070 of the City of Pleasanton's municipal code

2. The objectives for cadmium and other noted metals are expressed by formulas where H = ln (hardness) as $CaCO_3$ in mg/l: The four-day average objective for cadmium is e(0.7852 H - 3.490). This is 1.1 µg/l at a hardness of 100 mg/l as CaCO3. The one-hour average objective for cadmium is e(1.128 H - 3.828). This is 3.9 µg/l at a hardness of 100 mg/l as CaCO3.

3. Chromium III criteria were promulgated in the National Toxics Rule (NTR). The NTR criteria specifically apply to San Francisco Bay upstream to and including Suisun Bay and Sacramento-San Joaquin Delta. Note: at the time of writing, the values are 180 ug/l (4-day average) and 550 ug/l (1-hr. average). The objectives for chromium III are based on hardness. The values in this footnote assume a hardness of 100 mg/l CaCO3. At other hardnesses, the objectives must be calculated using the following formulas where H = ln (hardness): The 4-day average objective for chromium III is e(0.8190H+1.561). The 1-hour average for chromium III is e(0.8190 H+3.688).

4. Cyanide criteria were promulgated in the NTR. The NTR criteria specifically apply to San Francisco Bay upstream to and including Suisun Bay and Sacramento-San Joaquin Delta. Note: at the time of writing, the values are 5.2 ug/l (4-day average) and 22 ug/l (1-hr. average).

5.Selenium criteria were promulgated for all San Francisco Bay/Delta waters in the NTR. The NTR criteria specifically apply to San Francisco Bay upstream to and including Suisun Bay and Sacramento-San Joaquin Delta. Note: at the time of writing, the values are 5.0 ug/l (4-day average) and 20 ug/l (1-hr. average).

6.Tributyltin is a compound used as an antifouling ingredient in marine paints and toxic to aquatic life in low concentrations. U.S. EPA has published draft criteria for protection of aquatic life (Federal Register: December 27, 2002, Vol. 67, No. 249, Page 79090-79091). These criteria are cited for advisory purposes. The draft criteria may be revised.

According to Table 8, groundwater from all sampled locations (GW-1, GW-2, GW-3, and GW-5) exceeded the Freshwater Water Quality Objectives for Toxic Pollutants for Surface Waters (SFBRWQCB 2013); therefore, dewatered groundwater may not be discharged to surface waters, either directly or through a stormwater drainage system, without prior treatment.

4 WATER TREATMENT SYSTEM

4.1 Treatment System

Based on the groundwater samples collected for the Project and the applicable effluent limitations, a water treatment system is proposed for non-stormwater and groundwater collected during construction. The treatment system must be designed according to site conditions and the anticipated flow rates, and it must include a means of collection and conveyance, temporary holding tanks, and a discharge method. The treatment system should be consistent with the Project's dewatering specification, section 13-13.02.

At a minimum, the treatment system must be capable of removing sediment, turbidity-producing suspended solids, petroleum hydrocarbons, VOCs, and metals; see Table 8 for groundwater quality testing results. Primary and secondary treatment may be required, or the design of the system may require combined use of various components to achieve effective treatment. The system must have components to:

- Remove sediment, turbidity-producing suspended solids, TPHs, VOCs, and metals. Components may include desilting basins, weir tanks, settling tanks, sediment traps, gravity bag filters, sand media filters, pressurized bag filters, cartridge filters, in-line chemical coagulants and flocculants, activated clay filters, activated carbon filters, or any combination necessary to provide primary and secondary treatment.

In addition, the treatment system must adjust pH or dissolved oxygen by:

- Addition of sulfuric, phosphoric, citric, or nitric acid under the supplier's specifications and by the SFBRWQCB (hydrochloric acid may be used if the water is dechlorinated before discharge);
- Filtration through a limestone bed or addition of sodium hydroxide. Diffusion of carbon dioxide may be used to produce carbonic acid to adjust pH; or
- Aeration to treat low dissolved oxygen.

The non-stormwater collection and conveyance system would include a series of drain inlet structures, piping, trenches, and pumps. Pumps and piping must comply with Caltrans Standard Specification 74-2 "Drainage Pumping Equipment" (2010), and a flow meter must be used to measure all discharges from treatment activities.

All non-stormwater not directed to other excavations must be stored in temporary holding tanks, such as transportable, closed-top holding tanks or tanker trucks, to allow for the deposition of suspended sediments. Each holding tank must have an inlet and outlet capable of receiving and discharging flows at a rate sufficient to dewater the excavations. A sufficient number of holding tanks should be provided based on anticipated flow rates, pumping rates, capacity inefficiencies due to sediment retention, sedimentation rates, sediment removal frequency, and anticipated water loss or reuse rates to handle all dewatering activities and prevent delay of work. In

addition, 1 ft of freeboard must be maintained within each holding tank at all times, and the tanks must be cleaned when 25% of their volume is filled with sediment.

Non-stormwater may be recirculated through the treatment system if the applicable water quality criteria are not met after one cycle.

4.2 Discharge Conditions

The last component of the treatment system would be the discharge method and location. Relevant permits have additional discharge requirements, as summarized below.

4.2.1 Discharges under 13.32 Wastewater Discharge Permit

The City Engineer and City Water Resources Manager must approve all preliminary studies, plans, and specifications for pretreatment facilities required to comply with the City of Livermore's Municipal Code. Therefore, coordination with the City of Livermore is required to finalize the details of the water treatment system and discharge condition.

4.2.2 Discharges under 15.36 Wastewater Discharge Permit

The City of Pleasanton must review and approve of all plans and specifications pertaining to the water treatment system prior to construction thereof, and all plans and specification must be prepared by a registered professional engineer. Therefore, coordination with the City of Pleasanton is required to finalize the details of the water treatment system and discharge condition.

4.2.3 Discharges under VOC and Fuel General NPDES Permit

If reuse of Project non-stormwaters is not feasible, then the VOC and Fuel General Permit would be invoked for reuse or discharge of treated non-stormwaters to the Project stormwater drainage system. Discharges may not cause scouring or erosion where the system releases flows into the receiving water, and discharges may not contribute to scouring of banks, excessive sedimentation, or flooding downstream. In addition, discharges may not impact the natural channel bedding and aquatic life.

5 SUBMITTALS, MONITORING, AND REPORTING

Discharges under the 13.32 Wastewater Discharge Permit, 15.36 Wastewater Discharge Permit, and VOC and Fuel General Permit require submittals, monitoring, and reporting. The following sections outline these requirements; however, the specific terms and conditions of regulatory compliance will be contained within the permits issued to the Project.

5.1.1 Dewatering and Discharge Plan

According to specification 13-13.01B(2), the Project requires a Dewatering and Discharge Plan (DDP). DDPs outline all applicable information pertaining to the non-stormwater treatment system, including operation, maintenance, spill prevention, inspection, etc. The DDP must be approved by Caltrans and the SFBRWQCB. Construction may begin 30 days after the DPP has been approved by the Project Engineer. The DDP must include the following:

1. Title sheet
2. Table of contents
3. Certification and approval sheet described in Caltrans' Storm Water Pollution Prevention Plan (SWPPP) and Water Pollution Control Plan (WPCP) Preparation Manual
4. Amendment log and format described in Caltrans' SWPPP and WPCP Preparation Manual
5. Description and schedule of the dewatering and discharge operations
6. Discharge alternatives, including:
    a. Dust control
    b. Percolation
    c. Storm sewers
    d. Surface waters
7. Treatment system description and components
8. Anticipated flow rates
9. Operation and maintenance manual for equipment
10. Monitoring, sampling, and reporting plan, including quality assurance and quality control
11. Health and safety plan
12. Spill prevention plan
13. Field-recorded data, visual inspection, calibration procedures, and examples of logs
14. Measuring equipment descriptions
15. Shop drawings showing:
    a. Section and plan views of stormwater effluent treatment systems
    b. Location of sampling points for water quality measurements
    c. Flow path and placement of pipes, hoses, pumps, holding tanks, and other equipment used to convey water
    d. General position of treatment components relative to excavations or other areas requiring dewatering
    e. Point of stormwater discharge
16. Daily inspection report form that must include:
    a. Discharge volumes
    b. Water quality monitoring records

c. Discharge point information that includes:
    i. Date and time
    ii. Weather conditions, including wind direction and velocity
    iii. Presence or absence of water fowl or aquatic wildlife
    iv. Color and clarity of the effluent discharge
    v. Erosion or ponding downstream of the discharge site
    vi. Photographs labeled with the time, date, and location

17. Municipal batch discharge permit from a POTW facility, if used
18. Coagulant Pollution Prevention Plan (CPPP) with the DDP if chemical coagulants, in-line flocculants, or both, are used in the treatment system. Chemical coagulants and flocculants proposed for use in the CPPP must comply with Attachment F Provisions D and E in General Permit for *Stormwater Discharges Associated with Construction and Land Disturbance Activities* (Order No. 2009-0009-DWQ, NPDES No. CAS000002). The CPPP must include:
    a. Description of best management practices to prevent accidental spillage, overfeeding into the treatment system, or other mishandling of coagulant agents
    b. Monitoring plan for all coagulants, flocculants, or both that complies with Attachment F in Order 2009-0009
    c. Description of the agents, including chemical and trade names
    d. Determination of acute and chronic toxicity for aquatic organisms conforming to U.S. Environmental Protection Agency methods for the agents
    e. Monitoring plan to detect a residual agent at concentrations at or below established acute toxicity levels for freshwater and marine conditions for that agent.

5.1.2 Notice of Discharge Report

According to specification 13-13.01B(3), whenever observations and monitoring equipment confirm that effluent limitations or water quality standards are exceeded, a Notice of Discharge report must be submitted within 48 hours. Included in the report should be documentation regarding the reasons for the exceedance and any corrective actions taken to prevent recurrence.

5.1.3 Daily Inspection Report

According to specification 13-13.01B(4), Daily Inspection Reports shall be submitted within 24 hours if the non-stormwater treatment system is discharging. Records documenting the addition or removal of non-stormwater treatment system components must be included.

5.1.4 Requirements under 13.32 Wastewater Discharge Permit

This section only pertains to the discharge condition regulated under the City of Livermore's 13.32 Wastewater Discharge Permit, and it contains relevant information from Chapter 13.32.280 and 13.32.290 of Livermore Municipal Code. Within 90 days following initial discharge to the sanitary sewer for treatment at the POTW, a report describing the nature and concentration of all pollutants in the discharge and the average and maximum daily flow rates for all discharges subject to pretreatment standards. In addition, periodic compliance reports must be submitted in the months of June and December. These reports must describe the nature and concentration of pollutants as well as a record of daily flow rates that indicates the flows that

exceeded the average daily flow described in the permit application. Refer to the City of Livermore's Municipal Code for more information, provided as Appendix B of this report.

5.1.5 Requirements under 15.36 Wastewater Discharge Permit

If the City of Pleasanton determines that additional information is necessary to maintain compliance with the Municipal Code, the discharger may be required to file a periodic discharge report. These reports would be in addition to self-monitoring reports and information furnished for the 15.36 Wastewater Discharge Permit, and they would contain the following, at a minimum:

1. Information relating to the nature of manufacturing, fabricating, or other processes conducted by the user;
2. Statements of the amount of fresh or non-wastewater volumes, wastewater volumes, rates of flow, mass emission rates, production quantities, hours of operation, and number and classification of employees; or
3. Other information relating to the generation of waste, including wastewater constituents and characteristics of the pertinent wastewater discharge as required by the director.

Refer to the City of Pleasanton's Municipal Code for more information, provided as Appendix C of this report.

5.1.6 Requirements under VOC and Fuel General NPDES Permit

This section only pertains to the discharge conditions regulated under the VOC and Fuel General Permit. A monitoring system will be required to continuously monitor the flow rate and the quality of effluent discharged from the temporary treatment system. Flow metering systems will need to be installed throughout the process. All monitoring and reporting activities must comply with the requirements specified in Attachment E of the VOC and Fuel General Permit; see Appendix D.

The Project may be required to comply with additional monitoring requirements, as the groundwater seepage rates are anticipated to exceed 10 gallons per minute. Any additional requirements will be specified in the Authorization to Discharge letter. These requirements could include:

- Monitoring in response to a complaint received about a facility authorized to discharge under this permit;
- Stormwater monitoring;
- Dioxins and furans monitoring;
- Regional Monitoring Program monitoring;
- Additional discharge observations; and
- Additional effluent and ambient priority pollutant scans.

6 REFERENCES

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Appendix A Water Quality Objectives from Water Quality Control Plan (Basin Plan) for San Francisco Bay Region

CHAPTER 3: WATER QUALITY OBJECTIVES

The overall goals of water quality regulation are to protect and maintain thriving aquatic ecosystems and the resources those systems provide to society and to accomplish these in an economically and socially sound manner. California's regulatory framework uses water quality objectives both to define appropriate levels of environmental quality and to control activities that can adversely affect aquatic systems.

3.1 WATER QUALITY OBJECTIVES

There are two types of objectives: narrative and numerical. Narrative objectives present general descriptions of water quality that must be attained through pollutant control measures and watershed management. They also serve as the basis for the development of detailed numerical objectives.

Historically, numerical objectives were developed primarily to limit the adverse effect of pollutants in the water column. Two decades of regulatory experience and extensive research in environmental science have demonstrated that beneficial uses are not fully protected unless pollutant levels in all parts of the aquatic system are also monitored and controlled. The Regional Board is actively working towards an integrated set of objectives, including numerical sediment objectives, that will ensure the protection of all current and potential beneficial uses.

Numerical objectives typically describe pollutant concentrations, physical/chemical conditions of the water itself, and the toxicity of the water to aquatic organisms. These objectives are designed to represent the maximum amount of pollutants that can remain in the water column without causing any adverse effect on organisms using the aquatic system as habitat, on people consuming those organisms or water, and on other current or potential beneficial uses (as described in Chapter 2).

The technical bases of the region's water quality objectives include extensive biological, chemical, and physical partitioning information reported in the scientific literature, national water quality criteria, studies conducted by other agencies, and information gained from local environmental and discharge monitoring (as described in Chapter 6). The Regional Board recognizes that limited information exists in some cases, making it difficult to establish definitive numerical objectives, but the Regional Board believes its conservative approach to setting objectives has been proper. In addition to the technical review, the overall feasibility of reaching objectives in terms of technological, institutional, economic, and administrative factors is considered at many different stages of objective derivation and implementation of the water quality control plan.

Together, the narrative and numerical objectives define the level of water quality that shall be maintained within the region. In instances where water quality is better than that prescribed by the objectives, the state Antidegradation Policy applies (State Board Resolution 68-16: Statement of Policy With Respect to Maintaining High Quality of Waters in California). This policy is aimed at protecting relatively uncontaminated aquatic systems where they exist and preventing further degradation. The state's Antidegradation Policy is consistent with the federal Antidegradation Policy, as interpreted by the State Water Resources Control Board in State Board Order No. 86-17.

When uncontrollable water quality factors result in the degradation of water quality beyond the levels or limits established herein as water quality objectives, the Regional Board will conduct a case-by-case analysis of the benefits and costs of preventing further degradation. In cases where this analysis indicates that beneficial uses will be adversely impacted by allowing further degradation, then the Regional Board will not allow controllable water quality factors to cause any further degradation of water quality. Controllable water quality factors are those actions, conditions, or circumstances resulting from human activities that may influence the quality of the waters of the state and that may be reasonably controlled.

The Regional Board establishes and enforces waste discharge requirements for point and nonpoint source of pollutants at levels necessary to meet numerical and narrative water quality objectives. In setting waste discharge requirements, the Regional Board will consider, among other things, the potential impact on beneficial uses within the area of influence of the discharge, the existing quality of receiving waters, and the appropriate water quality objectives.

In general, the objectives are intended to govern the concentration of pollutant constituents in the main water mass. The same objectives cannot be applied at or immediately adjacent to submerged effluent discharge structures. Zones of initial dilution within which higher concentrations can be tolerated will be allowed for such discharges.

For a submerged buoyant discharge, characteristic of most municipal and industrial wastes that are released from submerged outfalls, the momentum of the discharge and its initial buoyancy act together to produce turbulent mixing. Initial dilution in this case is completed when the diluting wastewater ceases to rise in the water column and first begins to spread horizontally.

For shallow water submerged discharges, surface discharges, and nonbuoyant discharges, characteristic of cooling water wastes and some individual discharges, turbulent mixing results primarily from the momentum of discharge. Initial dilution, in these cases, is considered to be completed when the momentum-induced velocity of the discharge ceases to produce significant mixing of the waste, or the diluting plume reaches a fixed distance from the discharge to be specified by the Regional Board, whichever results in the lower estimate for initial dilution.

Compliance with water quality objectives may be prohibitively expensive or technically impossible in some cases. The Regional Board will consider modification of specific water quality objectives as long as the discharger can demonstrate that the alternate objective will protect existing beneficial uses, is scientifically defensible, and is consistent with the state Antidegradation Policy. This exception clause properly indicates that the Regional Board will conservatively compare benefits and costs in these cases because of the difficulty in quantifying beneficial uses.

These water quality objectives are considered necessary to protect the present and potential beneficial uses described in Chapter 2 of this Plan and to protect existing high quality waters of the state. These objectives will be achieved primarily through establishing and enforcing waste discharge requirements and by implementing this water quality control plan.

3.2 OBJECTIVES FOR OCEAN WATERS

The provisions of the State Board's "Water Quality Control Plan for Ocean Waters of California" (Ocean Plan) and "Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California" (Thermal Plan) and any revision to them will apply to ocean waters. These plans describe objectives and effluent limitations for ocean waters.

3.3 OBJECTIVES FOR SURFACE WATERS

The following objectives apply to all surface waters within the region, except the Pacific Ocean.

3.3.1 BACTERIA

Table 3-1 provides a summary of the bacterial water quality objectives and identifies the sources of those objectives. Table 3-2 summarizes U.S. EPA's water quality criteria for water contact recreation based on the frequency of use a particular area receives. These criteria will be used to differentiate between pollution sources or to supplement objectives for water contact recreation.

3.3.2 BIOACCUMULATION

Many pollutants can accumulate on particles, in sediment, or bioaccumulate in fish and other aquatic organisms. Controllable water quality factors shall not cause a detrimental increase in concentrations of toxic substances found in bottom sediments or aquatic life. Effects on aquatic organisms, wildlife, and human health will be considered.

3.3.3 BIOSTIMULATORY SUBSTANCES

Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses. Changes in chlorophyll a and associated phytoplankton communities follow complex dynamics that are sometimes associated with a discharge of biostimulatory substances. Irregular and extreme levels of chlorophyll a or phytoplankton blooms may indicate exceedance of this objective and require investigation.

3.3.4 COLOR

Waters shall be free of coloration that causes nuisance or adversely affects beneficial uses.

3.3.5 DISSOLVED OXYGEN

For all tidal waters, the following objectives shall apply:

In the Bay:

Downstream of Carquinez Bridge	5.0 mg/l minimum
Upstream of Carquinez Bridge	7.0 mg/l minimum

For nontidal waters, the following objectives shall apply:

Waters designated as:

Cold water habitat	7.0 mg/l minimum
Warm water habitat	5.0 mg/l minimum

The median dissolved oxygen concentration for any three consecutive months shall not be less than 80 percent of the dissolved oxygen content at saturation.

Dissolved oxygen is a general index of the state of the health of receiving waters. Although minimum concentrations of 5 mg/l and 7 mg/l are frequently used as objectives to protect fish life, higher concentrations are generally desirable to protect sensitive aquatic forms. In areas unaffected by waste discharges, a level of about 85 percent of oxygen saturation exists. A three-month median objective of 80 percent of oxygen saturation allows for some degradation from this level, but still requires a consistently high oxygen content in the receiving water.

3.3.6 FLOATING MATERIAL

Waters shall not contain floating material, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses.

3.3.7 OIL AND GREASE

Waters shall not contain oils, greases, waxes, or other materials in concentrations that result in a visible film or coating on the surface of the water or on objects in the water, that cause nuisance, or that otherwise adversely affect beneficial uses.

3.3.8 POPULATION AND COMMUNITY ECOLOGY

All waters shall be maintained free of toxic substances in concentrations that are lethal to or that produce significant alterations in population or community ecology or receiving water biota. In addition, the health and life history characteristics of aquatic organisms in waters affected by controllable water quality factors shall not differ significantly from those for the same waters in areas unaffected by controllable water quality factors.

3.3.9 pH

The pH shall not be depressed below 6.5 nor raised above 8.5. This encompasses the pH range usually found in waters within the basin. Controllable water quality factors shall not cause changes greater than 0.5 units in normal ambient pH levels.

3.3.10 RADIOACTIVITY

Radionuclides shall not be present in concentrations that result in the accumulation of radionuclides in the food web to an extent that presents a hazard to human, plant, animal, or aquatic life. Waters designated for use as domestic or municipal supply shall not contain concentrations of radionuclides in excess of the limits specified in Table 4 of Section 64443 (Radioactivity) of Title 22 of the California Code of Regulations (CCR), which is incorporated by reference into this Plan. This incorporation is prospective, including future changes to the incorporated provisions as the changes take effect (see Table 3-5).

3.3.11 SALINITY

Controllable water quality factors shall not increase the total dissolved solids or salinity of waters of the state so as to adversely affect beneficial uses, particularly fish migration and estuarine habitat.

3.3.12 SEDIMENT

The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.

Controllable water quality factors shall not cause a detrimental increase in the concentrations of toxic pollutants in sediments or aquatic life.

3.3.13 SETTLEABLE MATERIAL

Waters shall not contain substances in concentrations that result in the deposition of material that cause nuisance or adversely affect beneficial uses.

3.3.14 SUSPENDED MATERIAL

Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.

3.3.15 SULFIDE

All water shall be free from dissolved sulfide concentrations above natural background levels. Sulfide occurs in Bay muds as a result of bacterial action on organic matter in an anaerobic environment.

Concentrations of only a few hundredths of a milligram per liter can cause a noticeable odor or be toxic to aquatic life. Violation of the sulfide objective will reflect violation of dissolved oxygen objectives as sulfides cannot exist to a significant degree in an oxygenated environment.

3.3.16 TASTES AND ODORS

Waters shall not contain taste- or odor-producing substances in concentrations that impart undesirable tastes or odors to fish flesh or other edible products of aquatic origin, that cause nuisance, or that adversely affect beneficial uses.

3.3.17 TEMPERATURE

Temperature objectives for enclosed bays and estuaries are as specified in the "Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays of California," including any revisions to the plan.

In addition, the following temperature objectives apply to surface waters:

- The natural receiving water temperature of inland surface waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Board that such alteration in temperature does not adversely affect beneficial uses.
- The temperature of any cold or warm freshwater habitat shall not be increased by more than 5°F (2.8°C) above natural receiving water temperature

3.3.18 TOXICITY

All waters shall be maintained free of toxic substances in concentrations that are lethal to or that produce other detrimental responses in aquatic organisms. Detrimental responses include, but are not limited to, decreased growth rate and decreased reproductive success of resident or indicator species. There shall be no acute toxicity in ambient waters. Acute toxicity is defined as a median of less than 90 percent survival, or less than 70 percent survival, 10 percent of the time, of test organisms in a 96-hour static or continuous flow test.

There shall be no chronic toxicity in ambient waters. Chronic toxicity is a detrimental biological effect on growth rate, reproduction, fertilization success, larval development, population abundance, community composition, or any other relevant measure of the health of an organism, population, or community.

Attainment of this objective will be determined by analyses of indicator organisms, species diversity, population density, growth anomalies, or toxicity tests (including those described in Chapter 4), or other methods selected by the Water Board. The Water Board will also consider other relevant information and numeric criteria and guidelines for toxic substances developed by other agencies as appropriate.

The health and life history characteristics of aquatic organisms in waters affected by controllable water quality factors shall not differ significantly from those for the same waters in areas unaffected by controllable water quality factors.

3.3.19 TURBIDITY

Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases from normal background light penetration or turbidity relatable to waste discharge shall not be greater than 10 percent in areas where natural turbidity is greater than 50 NTU.

3.3.20 UN-IONIZED AMMONIA

The discharge of wastes shall not cause receiving waters to contain concentrations of un-ionized ammonia in excess of the following limits (in mg/l as N):

Annual Median	0.025
Maximum, Central Bay (as depicted in Figure 2-5) and upstream	0.16
Maximum, Lower Bay (as depicted in Figures 2-6 and 2-7):	0.4

The intent of this objective is to protect against the chronic toxic effects of ammonia in the receiving waters. An ammonia objective is needed for the following reasons:

- Ammonia (specifically un-ionized ammonia) is a demonstrated toxicant. Ammonia is generally accepted as one of the principle toxicants in municipal waste discharges. Some industries also discharge significant quantities of ammonia.
- Exceptions to the effluent toxicity limitations in Chapter 4 of the Plan allow for the discharge of ammonia in toxic amounts. In most instances, ammonia will be diluted or degraded to a nontoxic state fairly rapidly. However, this does not occur in all cases, the South Bay being a notable example. The ammonia limit is recommended in order to preclude any build up of ammonia in the receiving water.
- A more stringent maximum objective is desirable for the northern reach of the Bay for the protection of the migratory corridor running through Central Bay, San Pablo Bay, and upstream reaches.

3.3.21 OBJECTIVES FOR SPECIFIC CHEMICAL CONSTITUENTS

Surface waters shall not contain concentrations of chemical constituents in amounts that adversely affect any designated beneficial use. Water quality objectives for selected toxic pollutants for surface waters are given in Tables 3-3, 3-3A, 3-3B, 3-3C, 3-4 and 3-4A.

The Water Board intends to work towards the derivation of site-specific objectives for the Bay-Delta estuarine system. Site-specific objectives to be considered by the Water Board shall be developed in accordance with the provisions of the federal Clean Water Act, the State Water Code, State Board water quality control plans, and this Plan. These site-specific objectives will take into consideration factors such as all available scientific information and monitoring data and the latest U.S. EPA guidance, and local environmental conditions and impacts caused by bioaccumulation. The objectives in Tables 3-3 and 3-4 apply throughout the region except as otherwise indicated in the tables or when site-specific objectives for the pollutant parameter have been adopted. Site-specific objectives have been adopted for copper in segments of San Francisco Bay (see Figure 7.2-1-01), for nickel in South San Francisco Bay (Table 3-3A), and for cyanide in all

San Francisco Bay segments (Table 3-3C). Objectives for mercury that apply to San Francisco Bay are listed in Table 3-3B. Objectives for mercury that apply to Walker Creek, Soulajule Reservoir, and their tributaries, and to waters of the Guadalupe River watershed are listed in Table 3-4A.

South San Francisco Bay south of the Dumbarton Bridge is a unique, water-quality-limited, hydrodynamic and biological environment that merits continued special attention by the Water Board. Controlling urban and upland runoff sources is critical to the success of maintaining water quality in this portion of the Bay. Site-specific water quality objectives have been adopted for dissolved copper and nickel in this Bay segment. Site-specific objectives may be appropriate for other pollutants of concern, but this determination will be made on a case-by-case basis, and after it has been demonstrated that all other reasonable treatment, source control and pollution prevention measures have been exhausted. The Water Board will determine whether revised water quality objectives and/or effluent limitations are appropriate based on sound technical information and scientific studies, stakeholder input, and the need for flexibility to address priority problems in the watershed.

3.3.22 CONSTITUENTS OF CONCERN FOR MUNICIPAL AND AGRICULTURAL WATER SUPPLIES

At a minimum, surface waters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of constituents in excess of the maximum (MCLs) or secondary maximum contaminant levels (SMCLs) specified in the following provisions of Title 22, which are incorporated by reference into this plan: Table 64431-A (Inorganic Chemicals) of Section 64431, and Table 64433.2-A (Fluoride) of Section 64433.2, Table 64444-A (Organic Chemicals) of Section 64444, and Table 64449-A (SMCLs-Consumer Acceptance Limits) and 64449-B (SMCLs-Ranges) of Section 64449. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. Table 3-5 contains water quality objectives for municipal supply, including the MCLs contained in various sections of Title 22 as of the adoption of this plan.

At a minimum, surface waters designated for use as agricultural supply (AGR) shall not contain concentrations of constituents in excess of the levels specified in Table 3-6.

3.4 OBJECTIVES FOR GROUNDWATER

Groundwater objectives consist primarily of narrative objectives combined with a limited number of numerical objectives. Additionally, the Water Board will establish basin- and/or site-specific numerical groundwater objectives as necessary. For example, the Water Board has groundwater basin-specific objectives for the Alameda Creek watershed above Niles to include the Livermore-Amador Valley as shown in Table 3-7.

The maintenance of existing high quality of groundwater (i.e., "background") is the primary groundwater objective.

In addition, at a minimum, groundwater shall not contain concentrations of bacteria, chemical constituents, radioactivity, or substances producing taste and odor in excess of the objectives described below unless naturally occurring background concentrations are greater. Under existing law, the Water Board regulates waste discharges to land that could affect water quality,

including both groundwater and surface water quality. Waste discharges that reach groundwater are regulated to protect both groundwater and any surface water in continuity with groundwater. Waste discharges that affect groundwater that is in continuity with surface water cannot cause violations of any applicable surface water standards.

3.4.1 BACTERIA

In groundwater with a beneficial use of municipal and domestic supply, the median of the most probable number of coliform organisms over any seven-day period shall be less than 1.1 most probable number per 100 milliliters (MPN/100 mL) (based on multiple tube fermentation technique; equivalent test results based on other analytical techniques as specified in the National Primary Drinking Water Regulation, 40 CFR, Part 141.21 (f), revised June 10, 1992, are acceptable).

3.4.2 ORGANIC AND INORGANIC CHEMICAL CONSTITUENTS

All groundwater shall be maintained free of organic and inorganic chemical constituents in concentrations that adversely affect beneficial uses. To evaluate compliance with water quality objectives, the Water Board will consider all relevant and scientifically valid evidence, including relevant and scientifically valid numerical criteria and guidelines developed and/or published by other agencies and organizations (e.g., U.S. Environmental Protection Agency (U.S. EPA), the State Water Board, California Department of Health Services (DHS), U.S. Food and Drug Administration, National Academy of Sciences, California Environmental Protection Agency's (Cal/EPA) Office of Environmental Health Hazard Assessment (OEHHA), U.S. Agency for Toxic Substances and Disease Registry, Cal/EPA Department of Toxic Substances Control (DTSC), and other appropriate organizations.)

At a minimum, groundwater designated for use as domestic or municipal supply (MUN) shall not contain concentrations of constituents in excess of the maximum (MCLs) or secondary maximum contaminant levels (SMCLs) specified in the following provisions of Title 22, which are incorporated by reference into this plan: Tables 64431-A (Inorganic Chemicals) of Section 64431, Table 64433.2-A (Fluoride) of Section 64433.2, and Table 64444-A (Organic Chemicals) of Section 64444. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. (See Table 3-5.)

Groundwater with a beneficial use of agricultural supply shall not contain concentrations of chemical constituents in amounts that adversely affect such beneficial use. In determining compliance with this objective, the Water Board will consider as evidence relevant and scientifically valid water quality goals from sources such as the Food and Agricultural Organizations of the United Nations; University of California Cooperative Extension, Committee of Experts; and McKee and Wolf's "Water Quality Criteria," as well as other relevant and scientifically valid evidence. At a minimum, groundwater designated for use as agricultural supply (AGR) shall not contain concentrations of constituents in excess of the levels specified in Table 3-6.

Groundwater with a beneficial use of freshwater replenishment shall not contain concentrations of chemicals in amounts that will adversely affect the beneficial use of the receiving surface water.

Groundwater with a beneficial use of industrial service supply or industrial process supply shall not contain pollutant levels that impair current or potential industrial uses.

3.4.3 RADIOACTIVITY

At a minimum, groundwater designated for use as domestic or municipal supply (MUN) shall not contain concentrations of radionuclides in excess of the MCLs specified in Table 4 (Radioactivity) of Section 64443 of Title 22, which is incorporated by reference into this plan. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. (See Table 3-5.)

3.4.4 TASTE AND ODOR

Groundwater designated for use as domestic or municipal supply (MUN) shall not contain taste- or odor-producing substances in concentrations that cause a nuisance or adversely affect beneficial uses. At a minimum, groundwater designated for use as domestic or municipal supply shall not contain concentrations in excess of the SMCLs specified in Tables 64449-A (Secondary MCLs-Consumer Acceptance Limits) and 64449-B (Secondary MCLs-Ranges) of Section 64449 of Title 22, which is incorporated by reference into this plan. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect. (See Table 3-5.)

3.5 OBJECTIVES FOR THE DELTA

The objectives contained in the State Water Board's 1995 "Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary" and any revisions thereto shall apply to the waters of the Sacramento-San Joaquin Delta and adjacent waters as specified in that plan.

3.6 OBJECTIVES FOR ALAMEDA CREEK WATERSHED

The water quality objectives contained in Table 3-7 apply to the surface and groundwaters of the Alameda Creek watershed above Niles.

Wastewater discharges that cause the surface water limits in Table 3-7 to be exceeded may be allowed if they are part of an overall wastewater resource operational program developed by those agencies affected and approved by the Water Board.

TABLES

Table 3-1: Water Quality Objectives for Bacteria

Table 3-2: U.S. EPA Bacteriological Criteria for Water Contact Recreation

Table 3-3: Marine Water Quality Objectives for Toxic Pollutants for Surface Waters

Table 3-3A: Water Quality Objectives for Copper and Nickel in San Francisco Bay Segments

Table 3-3B: Marine Water Quality Objectives for Mercury in San Francisco Bay

Table 3-3C: Marine Water Quality Objectives for Cyanide in San Francisco Bay

Table 3-4: Freshwater Water Quality Objectives for Toxic Pollutants for Surface Waters

Table 3-4A: Freshwater Water Quality Objectives for Mercury in Walker Creek, Soulajule Reservoir, and All Tributary Waters

Table 3-5: Water Quality Objectives for Municipal Supply

Table 3-6: Water Quality Objectives for Agricultural Supply

Table 3-7: Water Quality Objectives for the Alameda Creek Watershed above Niles

Table 3-1: Water Quality Objectives for Bacteria[a]

Beneficial Use	Fecal Coliform (MPN/100ml)	Total Coliform (MPN/100ml)	Enterococcus (MPN/100ml)[g]
Water Contact Recreation	geometric mean < 200 90th percentile < 400	median < 240 no sample > 10,000	geometric mean < 35 no sample > 104
Shellfish Harvesting[b]	median < 14 90th percentile < 43	median < 70 90th percentile < 230[c]	
Non-contact Water Recreation[d]	mean < 2000 90th percentile < 4000		
Municipal Supply: - Surface Water[e] - Groundwater	geometric mean < 20	geometric mean < 100 < 1.1[f]	

Notes:

a. Based on a minimum of five consecutive samples equally spaced over a 30-day period.

b. Source: National Shellfish Sanitation Program.

c. Based on a five-tube decimal dilution test or 300 MPN/100 ml when a three-tube decimal dilution test is used.

d. Source: Report of the Committee on Water Quality Criteria, National Technical Advisory Committee, 1968.

e. Source: California Department of Public Health recommendation.

f. Based on multiple tube fermentation technique; equivalent test results based on other analytical techniques, as specified in the National Primary Drinking Water Regulation, 40 CFR, Part 141.21(f), revised June 10, 1992, are acceptable.

g. Applicable to marine and estuarine waters only. Numeric values are based on Section 7958 of Title 17 of the California Code of Regulations, 69FR 67217 et seq., and 40 CFR Part 131.41 (effective date December 16, 2004).

Table 3-2: U.S. EPA Bacteriological Criteria for Water Contact Recreation[1,2]
(in colonies per 100 ML)

	Fresh Water		Salt Water
	Enterococci	**E. Coli**	**Enterococci**
Steady State (all areas)	33	126	35
Maximum at:			
- designated beach	61	235	104
- moderately used area	89	298	124
- lightly used area	108	406	276
- infrequently used area	151	576	500

NOTES:

1. The criteria were published in the Federal Register, Vol. 51, No. 45 / Friday, March 7, 1986 / 8012-8016. The Criteria are based on:
(a) Cabelli, V.J. 1983. Health Effects Criteria for Marine Recreational Waters. U.S. EPA, EPA 600/1-80-031, Cincinnati, Ohio, and
(b) Dufour, A.P. 1984. Health Effects Criteria for Fresh Recreational Waters. U.S. EPA, EPA 600/1-84-004, Cincinnati Ohio.

2. The U.S. EPA criteria apply to water contact recreation only. The criteria provide for a level of production based on the frequency of usage of a given water contact recreation area. The criteria may be employed in special studies within this region to differentiate between pollution sources or to supplement the current coliform objectives for water contact recreation.

Table 3-3: Marine[a] Water Quality Objectives for Toxic Pollutants for Surface Waters (all values in ug/l)

Compound	4-day Average	1-hr Average	24-hr Average
Arsenic[b, c, d]	36	69	
Cadmium[b, c, d]	9.3	42	
Chromium VI[b, c, d, e]	50	1100	
Copper[c, d, f]			
Cyanide[g]			
Lead[b, c, d]	8.1	210	
Mercury[h]	0.025	2.1	
Nickel[b, c, d]	8.2	74	
Selenium[i]			
Silver[b, c, d]		1.9	
Tributyltin[j]			
Zinc[b, c, d]	81	90	
PAHs[k]			15

NOTES:

a. Marine waters are those in which the salinity is equal to or greater than 10 parts per thousand 95% of the time, as set forth in Chapter 4 of the Basin Plan. Unless a site-specific objective has been adopted, these objectives shall apply to all marine waters except for the South Bay south of Dumbarton Bridge (where the California Toxics Rule (CTR) applies) or as specified in note h (below). For waters in which the salinity is between 1 and 10 parts per thousand, the applicable objectives are the more stringent of the freshwater (Table 3-4) or marine objectives.

b. Source: 40 CFR Part 131.38 (California Toxics Rule or CTR), May 18, 2000.

c. These objectives for metals are expressed in terms of the dissolved fraction of the metal in the water column.

d. According to the CTR, these objectives are expressed as a function of the water-effect ratio (WER), which is a measure of the toxicity of a pollutant in site water divided by the same measure of the toxicity of the same pollutant in laboratory dilution water. The 1-hr. and 4-day objectives = table value X WER. The table values assume a WER equal to one.

e. This objective may be met as total chromium.

f. Water quality objectives for copper were promulgated by the CTR and may be updated by U.S. EPA without amending the Basin Plan. Note: at the time of writing, the values are 3.1 ug/l (4-day average) and 4.8 ug/l (1-hr. average). The most recent version of the CTR should be consulted before applying these values.

g. Cyanide criteria were promulgated in the National Toxics Rule (NTR) (Note: at the time of writing, the values are 1.0 µg/l (4-day average) and 1.0 µg/l (1-hr. average)) and apply, except that site-specific

marine water quality objectives for cyanide have been adopted for San Francisco Bay as set forth in Table 3-3C.

h. Source: U.S. EPA Ambient Water Quality Criteria for Mercury (1984). The 4-day average value for mercury does not apply to San Francisco Bay; instead, the water quality objectives specified in Table 3-3B apply. The 1-hour average value continues to apply to San Francisco Bay.

i. Selenium criteria were promulgated for all San Francisco Bay/Delta waters in the National Toxics Rule (NTR). The NTR criteria specifically apply to San Francisco Bay upstream to and including Suisun Bay and Sacramento-San Joaquin Delta. Note: at the time of writing, the values are 5.0 ug/l (4-day average) and 20 ug/l (1-hr. average).

j. Tributyltin is a compound used as an antifouling ingredient in marine paints and toxic to aquatic life in low concentrations. U.S. EPA has published draft criteria for protection of aquatic life (Federal Register: December 27, 2002, Vol. 67, No. 249, Page 79090-79091). These criteria are cited for advisory purposes. The draft criteria may be revised.

k. The 24-hour average aquatic life protection objective for total PAHs is retained from the 1995 Basin Plan. Source: U.S. EPA 1980.

Table 3-3A: Water Quality Objectives for Copper and Nickel in San Francisco Bay Segments (ug/L)

Compound	4-day Average (CCC)[1]	1-hr Average (CMC)[2]	Extent of Applicability
Copper	6.9	10.8	The portion of Lower San Francisco Bay south of the line representing the Hayward Shoals shown on Figure 7.1. and South San Francisco Bay
Copper	6.0	9.4	The portion of the delta located in the San Francisco Bay Region, Suisun Bay, Carquinez Strait, San Pablo Bay, Central San Francisco Bay, and the portion of Lower San Francisco Bay north of the line representing the Hayward Shoals on Figure 7.1.
Nickel	11.9	62.4*	South San Francisco Bay

[1]Criteria Continuous Concentration

[2]Criteria Maximum Concentration

*Handbook of Water Quality Standards, 2nd ed. 1994 in Section 3.7.6 states that the CMC = Final AcuteValue/2; 62.4 is the Final Acute Value (resident species database)/2; so the site-specific CMC is lower than the California Toxics Rule value because we are using the resident species database instead of the National Species Database.

Table 3-3B: Marine[a] Water Quality Objectives for Mercury in San Francisco Bay[b]		
Protection of Human Health	0.2 mg mercury per kg fish tissue	Average wet weight concentration measured in the edible portion of trophic level 3 and trophic level 4 fish[c]
Protection of Aquatic Organisms and Wildlife	0.03 mg mercury per kg fish	Average wet weight concentration measured in whole fish 3–5 cm in length

Notes:

a. Marine waters are those in which the salinity is equal to or greater than 10 parts per thousand 95% of the time, as set forth in Chapter 4 of the Basin Plan. For waters in which the salinity is between 1 and 10 parts per thousand, the applicable objectives are the more stringent of the freshwater or marine objectives.

b. Objectives apply to all segments of San Francisco Bay, including Sacramento/San Joaquin River Delta (within San Francisco Bay region), Suisun Bay, Carquinez Strait, San Pablo Bay, Richardson Bay, Central San Francisco Bay, Lower San Francisco Bay, and South San Francisco Bay (including the Lower South Bay).

c. Compliance shall be determined by analysis of fish tissue as described in Chapter 6, Surveillance and Monitoring.

Table 3-3C: Marine [a] Water Quality Objectives for Cyanide in San Francisco Bay [b] (values in ug/l)		
Cyanide	Chronic Objective (4-day Average)	2.9
Cyanide	Acute Objective (1-hour Average)	9.4

Notes:

a. Marine waters are those in which the salinity is equal to or greater than 10 parts per thousand 95% of the time, as set forth in Chapter 4 of the Basin Plan. For waters in which the salinity is between 1 and 10 parts per thousand, the applicable objectives are the more stringent of the freshwater or marine objectives.

b. Objectives apply to all segments of San Francisco Bay, including Sacramento/San Joaquin River Delta (within San Francisco Bay region), Suisun Bay, Carquinez Strait, San Pablo Bay, Central San Francisco Bay, Lower San Francisco Bay, and South San Francisco Bay.

Table 3–4: Freshwater[a] Water Quality Objectives for Toxic Pollutants for Surface Waters (all values in ug/l)

Compound	4-day Average	1-hr Average
Arsenic[b, c, d]	150	340
Cadmium[b, d]	e	e
Chromium III[f]		
Chromium VI[b, c, d, g]	11	16
Copper[b, c, d]	9.0[h]	13[h]
Cyanide[i]		
Lead[b, c, d]	2.5[j]	65[j]
Mercury[k]	0.025	2.4
Nickel[b, c, d]	52[l]	470[l]
Selenium[m]		
Silver[b, c, d]		3.4[n]
Tributyltin[o]		
Zinc[b, c, d]	120[p]	120[p]

Notes:

a. Freshwaters are those in which the salinity is equal to or less than 1 part per thousand 95% of the time, as set forth in Chapter 4 of the Basin Plan. Unless a site-specific objective has been adopted, these objectives shall apply to all freshwaters except for the South Bay south of Dumbarton Bridge, where the California Toxics Rule (CTR) applies. For waters in which the salinity is between 1 and 10 parts per thousand, the applicable objectives are the more stringent of the marine (Table 3-3) and freshwater objectives.

b. Source: 40 CFR Part 131.38 (California Toxics Rule or CTR), May 18, 2000.

c. These objectives for metals are expressed in terms of the dissolved fraction of the metal in the water column.

d. These objectives are expressed as a function of the water-effect ratio (WER), which is a measure of the toxicity of a pollutant in site water divided by the same measure of the toxicity of the same pollutant in laboratory dilution water. The 1-hr. and 4-day objectives = table value X WER. The table values assume a WER equal to one.

e. The objectives for cadmium and other noted metals are expressed by formulas where H = ln (hardness) as $CaCO_3$ in mg/l: The four-day average objective for cadmium is $e^{(0.7852\ H\ -\ 3.490)}$. This is 1.1 µg/l at a hardness of 100 mg/l as $CaCO_3$. The one-hour average objective for cadmium is $e^{(1.128\ H\ -\ 3.828)}$. This is 3.9 µg/l at a hardness of 100 mg/l as $CaCO_3$.

f. Chromium III criteria were promulgated in the National Toxics Rule (NTR). The NTR criteria specifically apply to San Francisco Bay upstream to and including Suisun Bay and Sacramento-San Joaquin Delta. Note: at the time of writing, the values are 180 ug/l (4-day average) and 550 ug/l (1-hr. average). The objectives for chromium III are based on hardness. The values in this footnote assume a hardness of 100 mg/l $CaCO_3$. At other hardnesses, the objectives must be calculated using the following formulas where H = ln (hardness): The 4-day average objective for chromium III is $e^{(0.8190H+1.561)}$. The 1-hour average for chromium III is $e^{(0.8190\ H+3.688)}$.

g. This objective may be met as total chromium.

h. The objectives for copper are based on hardness. The table values assume a hardness of 100 mg/l $CaCO_3$. At other hardnesses, the objectives must be calculated using the following formulas where H = ln (hardness): The 4-day average objective for copper is $e^{(0.8545H-1.702)}$. The 1-hour average for copper is $e^{(0.9422H-1.700)}$.

i. Cyanide criteria were promulgated in the National Toxics Rule (NTR). The NTR criteria specifically apply to San Francisco Bay upstream to and including Suisun Bay and Sacramento-San Joaquin Delta. Note: at the time of writing, the values are 5.2 ug/l (4-day average) and 22 ug/l (1-hr. average).

j. The objectives for lead are based on hardness. The table values assume a hardness of 100 mg/l $CaCO_3$. At other hardnesses, the objectives must be calculated using the following formulas where H = ln (hardness): The 4-day average objective is $e^{(1.273H -4.705)}$. The 1-hour average for lead is $e^{(1.273H-1.460)}$.

k. Source: U.S. EPA Quality Criteria for Water 1986 (EPA 440/5-86-001), which established a mercury criterion of 0.012 ug/l. The Basin Plan set the objective at 0.025 based on considerations of the level of detection attainable at that time. The 4-day average value for mercury does not apply to Walker Creek and Soulajule Reservoir and their tributaries nor to waters of the Guadalupe River watershed; instead, the water quality objectives specified in Table 3-4A apply. The 1-hour average value continues to apply to waters specified in Table 3-4A.

l. The objectives for nickel are based on hardness. The table values assume a hardness of 100 mg/l $CaCO_3$. At other hardnesses, the objectives must be calculated using the following formulas where H = ln (hardness): The 4-day average objective is $e^{(0.8460H + 0.0584)}$. The 1-hour average objective is $e^{(0.8460H + 2.255)}$.

m. Selenium criteria were promulgated for all San Francisco Bay/Delta waters in the National Toxics Rule (NTR). The NTR criteria specifically apply to San Francisco Bay upstream to and including Suisun Bay and Sacramento-San Joaquin Delta. Note: at the time of writing, the values are 5.0 ug/l (4-day average) and 20 ug/l (1-hr. average).

n. The objective for silver is based on hardness. The table value assumes a hardness of 100 mg/l $CaCO_3$. At other hardnesses, the objective must be calculated using the following formula where H = ln (hardness): The 1-hour average objective for silver is $e^{(1.72H - 6.52)}$. U.S. EPA has not developed a 4-day criterion.

o. Tributyltin is a compound used as an antifouling ingredient in marine paints and toxic to aquatic life in low concentrations. U.S. EPA has published draft criteria for protection of aquatic life (Federal Register: December 27, 2002, Vol. 67, No. 249, Page 79090-79091). These criteria are cited for advisory purposes. The draft criteria may be revised.

p. The objectives for zinc are based on hardness. The table values assume a hardness of 100 mg/l $CaCO_3$. At other hardnesses, the objectives must be calculated using the following formulas where H = ln (hardness): The 4-day average objective for zinc is $e^{(0.8473 H+0.884)}$. The 1-hour average for zinc is $e^{(0.8473 H+ 0.884)}$.

Table 3-4A: Freshwater Water Quality Objectives for Mercury in Walker Creek, Soulajule Reservoir, and Their Tributaries; and in Waters of the Guadalupe River Watershed, Except Los Gatos Creek and its Tributaries Upstream of Vasona Dam, Lake Elsman, Lexington Reservoir, and Vasona Lake

Protection of Aquatic Organisms and Wildlife[a]	0.05 mg methylmercury per kg fish	Average wet weight concentration measured in whole trophic level 3 fish 5–15 cm in length
	0.1 mg methylmercury per kg fish	Average wet weight concentration measured in whole trophic level 3 fish 15 – 35 cm in length

a. The freshwater water quality objectives for the protection of aquatic organisms and wildlife also protect humans who consume fish from the Walker Creek and Guadalupe River watersheds.

Table 3-5: Water Quality Objectives for Municipal Supply

Parameter	Objective (in MG/L)
Physical:	
Color (units)[a]	15.0
Odor (number)[a]	3.0
Turbidity (NTU)[a]	5.0
pH[b]	6.5 - 8.0
TDS[c]	500.0
EC (mmhos/cm)[c]	900
Corrosivity	non-corrosive
Inorganic Parameters:	
Aluminum[d]	1.0[d] / 0.2[a]
Antimony[d]	0.006
Arsenic[d]	0.05
Asbestos[d]	7 MFL[e]
Barium[d]	1.0
Beryllium[d]	0.004
Chloride[c]	250.0
Cadmium[d]	0.005
Chromium[d]	0.05
Copper[a]	1.0
Cyanide[d]	0.15
Fluoride[f]	0.6 - 1.7[g]
Iron[a]	0.3
Lead[b]	0.05
Manganese[a]	0.05
Mercury[d]	0.002
Nickel[d]	0.1
Nitrate (as NO_3)[d]	45.0
Nitrate + Nitrite (as N)[d]	10.0
Nitrite (as N)[d]	1.0
Selenium[d]	0.05
Silver[b]	0.1
Sulfate[c]	250.0
Thallium[d]	0.002
Zinc[a]	5.0
Organic Parameters:	
MBAS (Foaming agents)[a]	0.5
Oil and grease[b]	none
Phenols[b]	0.001
Trihalomethanes[b]	0.1
Chlorinated Hydrocarbons:	
Endrin[h]	0.002
Lindane[h]	0.0002
Methoxychlor[h]	0.03
Toxaphene[h]	0.003
2,3,7,8-TCDD (Dioxin)[h]	3×10^{-8}
2,4-D[h]	0.07
2,4,4-TP Silvex[h]	0.05

Parameter	Objective (in MG/L)
Synthetic Organic Chemicals:	
Alachor[h]	0.002
Atrazine[h]	0.001
Bentazon[h]	0.018
Benzo(a)pyrene[h]	0.0002
Dalapon[h]	0.2
Dinoseb[h]	0.007
Diquat[h]	0.02
Endothall[h]	0.1
Ethylene dibromide[h]	0.00005
Glyphosate[h]	0.7
Heptachlor[h]	0.00001
Heptachlor epoxide[h]	0.00001
Hexachlorecyclopentadiene[h]	0.001
Molinate[h]	0.02
Oxarnyl[h]	0.05
Pentachlorophenol[h]	0.001
Picloram[h]	0.5
Polychlorinated Biphenyls[h]	0.0005
Simazine[h]	0.004
Thiobencarb[h]	0.07 / 0.001
Volatile Organic Chemicals:	
Benzene[h]	0.001
Carbon Tetrachloride[h]	0.005
1,2-Dibromo-3-chloropropane[h]	0.0002
1,2-Dichlorobenzene[h]	0.6
1,4-Dichlorobenzene[h]	0.005
1,1-Dichloroethane[h]	0.005
1,2-Dichloroethane[h]	0.0005
cis-1,2-Dichloroethlyene[h]	0.006
trans-1,2-Dichloroethylene[h]	0.01
1,1-Dichloroethylene[h]	0.006
Dichloromethane[h]	0.005
1,2-Dichloropropane[h]	0.005
1,3-Dichloropropene[h]	0.0005
Ethylbenzene[h]	0.7
Methyl-tert-butyl ether[h]	0.13 / 0.005
Monochlorobenzene[h]	0.07
Styrene[h]	0.1
1,1,2,2-Tetrachloroethane[h]	0.001
Tetrachloroethylene[h]	0.005
1,2,4-Trichlorobenzene[h]	0.005
1,1,1-Trichloroethane	0.200
1,1,2-Trichloroethane[h]	0.005
Trichloroethylene[h]	0.005
Trichlorofluoromethane	0.15

Parameter	Objective (in MG/L)
Volatile Organic Chemicals (cont'd):	
1,1,2-Trichloro-1,2,2-trifluoromethane[h]	1.2
Toluene[h]	0.15
Vinyl Chloride[h]	0.0005
Xylenes (single or sum of isomers)[h]	1.750
Radioactivity:	
Combined Radium-226 and Radium-228[i]	5
Gross Alpha Particle Activity[i]	15i
Tritium[i]	20,000
Strontium-90[i]	8
Gross Beta Particle Activity[i]	50
Uranium[i]	20

NOTES:

a. Secondary Maximum Contaminant Levels as specified in Table 64449-A of Section 64449, Title 22 of the California Code of Regulations, as June 3, 2005.

b. Table III-2, 1986 Basin Plan

c. Secondary Maximum Contaminant Levels as specified in Table 64449-B of Section 64449, Title 22 of the California Code of Regulations, as of June 3, 2005. (Levels indicated are "recommended" levels. Table 64449-B contains a complete list of upper and short-term ranges.)

d. Maximum Contaminant Levels as specified in Table 64431-A (Inorganic Chemicals) of Section 64431, Title 22 of the California Code of Regulations, as of June 3, 2005.

e. MFL = million fibers per liter; MCL for fibers exceeding 10 um in length.

f. Flouride objectives depend on temperature.

g. A complete list of optimum and limiting concentrations is specified in Table 64433.2-A of Section 64433.2, Title 22 of the California Code of Regulations, as of June 3, 2005.

h. Maximum Contaminant Levels as specified in Table 64444-A (Organic Chemicals) of Section 64444, Title 22 of the California Code of Regulations, as of June 3, 2005.

i. Maximum Contaminant Levels as specified in Table 4 (Radioactivity) of Section 64443, Title 22 of the California Code of Regulations, as of June 3, 2005.

j. Included Radium-226 but excludes Radon and Uranium.

MG/L Milligrams per liter
pCi/L pico Curries per liter

Table 3-6: Water Quality Objectives for Agricultural Supply[a] (in mg/l)

Parameter	Threshold	Limit	Limit for Livestock Watering
Physical:			
pH	5.5-8.3	4.5-9.0	
TDS			10,000.0
EC (mmhos / cm)		0.2-3.0	
Inorganic Parameters:			
Aluminum	5.0	20.0	5.0
Arsenic	0.1	2.0	0.2
Beryllium	0.1	0.5	
Boron	0.5	2.0	5.0
Chloride	142.0	355.0	
Cadmium	0.01	0.5	0.05
Chromium	0.1	1.0	1.0
Cobalt	0.05	5.0	1.0
Copper	0.2	5.0	0.5
Flouride	1.0	15.0	2.0
Iron	5.0	20.0	
Lead	5.0	10.0	0.1
Lithium		2.5[b]	
Manganese	0.2	10.0	
Molybdenum	0.01	0.05	0.5
Nickel	0.2	2.0	
$NO_3 + NO_2$ (as N)	5.0	30[c]	100.0
Selenium		0.02	0.05
Sodium adsorption ratio (adjusted)[d]	3.0	9.0	
Vanadium	0.1	1.0	0.1
Zinc	2.0	10.0	25

NOTES:

a. For an extensive discussion of water quality for agricultural purposes, see "A Compilation of Water Quality Goals," Central Valley Regional Water Quality Control Board, May 1993.

b. For citrus irrigation, maximum 0.075 mg/l.

c. For sensitive crops. Values are actually for NO_3-N + NH_4-N.

d. Adjusted SAR = $\{ Na /[(Ca + Mg)+2]^{0.5} \}\{1 + [8.4 – pHc]\}$, where pHc is a calculated value based on total cations, Ca + Mg, and CO_3 + HCO_3, in me/l. Exact calculations of pHc can be found in "Guidelines for Interpretation of Water Quality for Agriculture" prepared by the Univ. of California Cooperative Extension.

Table 3-7: Water Quality Objectives for the Alameda Creek Watershed Above Niles

SURFACE WATER QUALITY OBJECTIVES (ALAMEDA CREEK AND TRIBUTARIES)

TDS:	250 mg/l (90 day-arithmetic mean)
	360 mg/l (90 day-90th percentile)
	500 mg/l (daily maximum)
Chlorides:	60 mg/l (90 day-arithmetic mean)
	100 mg/l (90 day-90th percentile)
	250 mg/l (daily maximum)

GROUNDWATER QUALITY OBJECTIVES

(Concentration not to be exceeded more than 10 percent of the time during one year.)

Central Basin

TDS:	Ambient or 500 mg/l, whichever is lower
Nitrate (NO_3):	45 mg/l

Fringe Subbasins

TDS:	Ambient or 1000 mg/l, whichever is lower
Nitrate (NO_3):	45 mg/l

Upland and Highland Areas

California domestic water quality standards set forth in California Code of Regulations, Title 22 and current county standards.

Ambient water quality conditions at a proposed project area will be determined by Zone 7 of the Alameda County Flood Control and Water Conservation District at the time the project is proposed, with the cost borne by the project proponents. Ambient conditions apply to the water-bearing zone with the highest quality water.

Waters designated for use as domestic or municipal water supply shall not contain concentrations of chemicals in excess of natural concentrations or the limits specified in California Code of Regulations, Title 22, Chapter 15, particularly Tables 64431-A and 64431-B of Section 64431, Table 64444-A of Section 64444, and Table 4 of Section 64443.

Appendix B Livermore Municipal Code, Chapter 13.32

Chapter 13.32
WASTEWATER COLLECTION AND TREATMENT SYSTEM*

Sections:

13.32.010 Purpose of chapter.
13.32.020 Definitions.
13.32.030 Sewage to be discharged to public sewers.
13.32.040 Private disposal of sewage.
13.32.050 Discharge of stormwaters, etc., to sanitary sewers prohibited without permit.
13.32.060 General discharge prohibitions.
13.32.070 Trucked/hauled wastes.
13.32.080 Discharge from home regenerated water softeners.
13.32.090 Federal Categorical Pretreatment Standards.
13.32.100 Modification of Federal Categorical Pretreatment Standards.
13.32.110 Specific pollutant limitations.
13.32.120 Pollutant thresholds.
13.32.130 State requirements.
13.32.140 City's right of revision.
13.32.150 Excessive discharge.
13.32.160 Notification of changed discharge.
13.32.170 Accidental discharges.
13.32.180 Notification of discharge of hazardous waste.
13.32.190 Fees and charges.
13.32.200 Wastewater discharges.
13.32.210 Wastewater contribution permits.
13.32.220 Permit application.
13.32.230 Permit modifications.
13.32.240 Permit conditions.
13.32.250 Permits duration.
13.32.260 Permit transfer.
13.32.270 Signatory requirements.
13.32.280 Reporting requirements for permittee.
13.32.290 Periodic compliance reports.
13.32.300 Monitoring facilities.
13.32.310 Industrial user self-monitoring.
13.32.320 Inspection and sampling.
13.32.330 Pretreatment facilities.
13.32.340 Confidential information.
13.32.350 Harmful contributions – Suspension of service/permit.
13.32.360 Revocation of permit.
13.32.370 Notification of revocation hearing.
13.32.380 Purpose and conduct of hearing.
13.32.390 Falsifying information.
13.32.400 Violations constituting misdemeanors.
13.32.410 Violations constituting a public nuisance.

13.32.420 Violations subject to administrative civil penalties.
13.32.430 Enforcement response plan.

*Prior legislation: Ords. 1134 and 1333, and 1960 code §§ 18.57 – 18.76.

13.32.010 Purpose of chapter.

A. The purpose of this chapter is to regulate direct and indirect discharge into the wastewater collection and treatment system by establishing standards of discharge through regulations as necessary to control the quality and quantity of wastewater entering the system, to comply with all applicable state and federal laws required by the Clean Water Act of 1977 and the General Pretreatment Regulations (40 CFR, Part 403)

B. The objectives of this chapter are:

1. To prevent the introduction of pollutants into the wastewater system which will interfere with the operation of the system or contaminate the resulting sludge;

2. To prevent the introduction of pollutants into the wastewater system which will pass through the system, inadequately treated, into receiving waters or the atmosphere or otherwise be incompatible with the system;

3. To improve the opportunity to recycle and reclaim wastewaters, sludges, gases, and other byproducts from the system; and

4. To provide for equitable distribution of the cost of the wastewater system.

C. This chapter provides for the regulation of direct and indirect contributors to the wastewater system through the issuance of permits to certain nondomestic users and through enforcement of general requirements for the other users, authorizes monitoring and enforcement activities, requires user reporting, assumes that existing user's capacity will not be preempted, and provides for the setting of fees for equitable distribution of costs resulting from the program established in this chapter.

D. This chapter shall apply to the city of Livermore and to persons outside the city who are, by contract or agreement with the city, users of the city publicly owned treatment works (POTW). Except as otherwise provided, the superintendent of the POTW shall administer, implement and enforce the provisions of this chapter. (Ord. 1437 § 1, 1995)

13.32.020 Definitions.

A. For purposes of this chapter, the following words, phrases, and abbreviations shall have the meanings respectively ascribed to them in this section unless the context specifically indicates otherwise:

"Act" or "the Act" means the Federal Water Pollution Control Act, also known as the Clean Water Act, as amended, 33 U.S.C. 1251, et seq.

"Applicant" means any person, or group of persons, who applies for sewer service or a wastewater discharge permit.

An "authorized representative of an industrial user" may be:

a. A principal executive officer of at least the level of vice president, if the industrial user is a corporation;

b. A general partner or proprietor if the industrial user is a partnership or proprietorship, respectively;

c. A duly authorized representative of the individual designated above if such representative is responsible for the overall operation of the facilities from which the indirect discharge originates.

"Biochemical oxygen demand (BOD)" means the quantity of oxygen utilized in the biochemical oxidation of organic matter under standard laboratory procedure, five days at 20 degrees centigrade expressed in terms of weight and concentration (milligrams per liter (mg/1)).

"Building sewer" means a sewer conveying wastewater from the premises of a user to the service lateral.

"Categorical standards" means the National Categorical Pretreatment Standards or pretreatment standard.

"City" means the city of Livermore or the city council of Livermore.

"City engineer" means the city engineer of the city of Livermore, or his authorized representative, acting within the scope of his assigned duties.

"Commercial garbage grinder" means a mechanical unit for pulverizing large quantities of wastes by a commercial user.

"Cooling water" means the water discharged from any use such as air conditioning, cooling or refrigeration, or to which the only pollutant added is heat.

"Council" means the council of the city of Livermore.

"Customer" means any person, firm, association, corporation or governmental agency served or entitled to be served by the city, for or without compensation.

"Developer" means any person, or group of persons, who requests the council to extend its sewage collection facilities.

"Direct discharge" means the discharge of treated or untreated wastewater directly to the waters of the state of California.

"Environmental Protection Agency" or "EPA" means the U.S. Environmental Protection Agency, or where appropriate the term may also be used as a designation for the administrator or other duly authorized official of said agency.

"Grab sample" means a sample which is taken from a waste stream on a one-time basis with no regard to the flow in the waste stream and without consideration of time.

"Grease," "oil" and "fats" means any material, or like material, that is freon extractable.

"Holding tank waste" means any waste from holding tanks such as vessels, chemical toilets, campers,

trailers, septic tanks and vacuum-pump tank trucks.

"Indirect discharge" means the discharge or the introduction of pollutants into a POTW from any nondomestic source regulated under Section 307(b), (c), or (d) of the Clean Water Act.

"Industrial user" means a source of indirect discharge.

"Industrial wastes" means the wastes from industrial processes, including Zeolite type softening regeneration plants.

"Interference" means the inhibition or disruption of the POTW treatment processes or operations which contributes to the violation of any requirement of the city's NPDES permit. The term includes prevention of sewage sludge use or disposal by the POTW in accordance with Section 405 of the Act, (33 U.S.C. 1345) or any criteria, guidelines or regulations developed pursuant to the Solid Waste Disposal Act (SWDA), the Clean Air Act, the Toxic Substances Control Act, or more stringent state criteria (including those contained in any state sludge management plan prepared pursuant to Title IV of SWDA) applicable to the method of disposal or use employed by the POTW.

"National Pollution Discharge Elimination System permit" or "NPDES permit" means a permit issued pursuant to Section 402 of the Act (33 U.S.C. 1342).

"National Pretreatment Standard" or "pretreatment standard" means any regulation containing pollutant discharge limits promulgated by the EPA in accordance with Section 307(b) and (c) of the Act (33 U.S.C. 1347) which applies to industrial users. This term includes prohibitive discharge limits established pursuant to 40 CFR CFR.

"National Prohibitive Discharge Standard" or "prohibitive discharge standard" means any regulation developed under the authority of Section 307(b) of the Act and 40 CFR, Section 403.5.

"New source" means any building, structure, facility or installation from which there is or may be a discharge of pollutants subject to national pretreatment standards or any provision of this chapter, the construction of which commences after the publication of proposed pretreatment standard under Section 307(c) of the Act which will be applicable to such sources if such standards are thereafter promulgated in accordance with that section and subject to the terms outlined in 40 CFR CFR(k)(1).

"Pass through" means a discharge which exits the POTW into waters of the United States in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation).

"Person" means any individual, partnership, copartnership, firm, company, corporation, association, joint stock company, trust, estate, governmental entity or any other legal entity, or their legal representative, agents or assigns. The masculine gender shall include the feminine and the singular shall include the plural where indicated by the context.

"pH" means the logarithm (base 10) of the reciprocal of the concentration of hydrogen ion expressed in grams per liter of solution.

"Pollutant" means any dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or

discharged equipment, rock, sand, cellar dirt and industrial, municipal and agricultural waste discharged into water.

"Pollution" means the manmade or man-induced alteration of the chemical, physical, biological, and the radiological integrity of water.

"POTW treatment plant" means that portion of the POTW designed to provide treatment to wastewater.

"Pretreatment" or "treatment" means the reduction of the amounts of pollutants, the concentration of pollutants, the elimination of pollutants, or the alteration of the nature of pollutant properties in wastewater to a less harmful state prior to or in lieu of discharging or otherwise introducing such pollutants into a POTW. The reduction or alteration can be obtained by physical, chemical or biological processes, or process changes or other means, except as prohibited by 40 CFR Section 403.6(d).

"Pretreatment requirements" means any substantive or procedural requirement related to pretreatment, other than a National Pretreatment Standard imposed on an industrial user.

"Publicly owned treatment works (POTW)" means a treatment works as defined by Section 212 of the Act (33 U.S.C. 1292) which is owned in this instance by the city. This definition includes any sewers that convey wastewater to the POTW treatment plant, but does not include pipes, sewers or other conveyances not connected to a facility providing treatment. For the purposes of this chapter, "POTW" shall also include any sewers that convey wastewaters to the POTW from persons outside the city who are, by contract or agreement with the city, users of the city's POTW.

"Sanitary sewage" means the portion of sewage exclusive of industrial wastes and stormwaters.

"Sanitary sewer" means a sewer to which storm, surface and ground waters are not intentionally admitted.

"Service lateral" means the pipe between the city's sewer line and the customer's service connection at the edge of the street or easement.

"Sewage" means water carrying wastes from residences, business buildings, institutions and industrial establishments, together with such other waters as may be present, or any combination of such wastes and water. Also see "wastewater."

"Sewage works" means all sewers and facilities operated for carrying, collecting, pumping, treating and disposing of sewage; also POTW.

"Sewer" means a pipe or conduit for carrying sewage.

"Shall" is mandatory; "may" is permissive.

"Side sewer" means a connection with a service lateral from a house or other structure; also building sewer.

"Significant industrial user" means any industrial user of the city's wastewater disposal system who (a) has a discharge flow of 25,000 gallons or more per average workday; or (b) contributes process wastewater which makes up five percent or more of the dry weather average hydraulic or organic capacity of the POTW; or (c) has in his wastes toxic pollutants as defined pursuant to Section 307 of

the Act of (State) Statutes and rules; or (d) is found by the city, regional water quality control board, State Water Resources Control Board or the U.S. Environmental Protection Agency (EPA) to have reasonable potential to adversely affect, either singly or in combination with other contributing industries, the wastewater treatment system, the quality of sludge, the system's effluent quality, or air emissions generated by the system.

"Significant noncompliance" means (a) chronic violations (exceeding the daily maximum limit or the average limit 66 percent of the time during a six-month period) of the same pollutant parameter; (b) technical review criteria (TRC) violations (33 percent or more of measurements for each pollutant parameter taken during a six-month period equal or exceeding the product of the applicable limit and the TRC value (1.4 for conventional pollutants or 1.2 for toxic pollutants); (c) a violation of pass through or interference; (d) a discharge of imminent endangerment to human health, welfare or the environment, or which required the POTW to use its emergency authorities under 40 CFR CFR(f)(1)(vi)(B); (e) violations of compliance schedule milestones by 90 days; (f) violations of report submittal deadlines by 30 days; (g) failure to report noncompliance; and (h) any other violation deemed significant by the control authority.

"Standard Industrial Classification (SIC)" means a classification pursuant to the Standard Industrial Classification Manual issued by the Executive Office of the President, Office of Management and Budget, 1972.

"State" means the state of California.

"Storm sewer or storm drain" means a sewer which carries storm and surface water but excludes sewage and polluted industrial wastes.

"Stormwater" means any flow occurring during or following any form of natural precipitation and resulting therefrom.

"Suspended solids" means the total suspended matter that floats on the surface of, or is suspended in, water, wastewater or other liquids, and which is removable by laboratory filtering.

"Total toxic organics" means the sum total of all detectable organic compounds which are on the United States Environmental Protection Agency's current priority pollutant list and which are present in concentrations of 0.01 mg/1 or greater. In calculating total toxic organics, the concentration of specific compounds measured at detection limits in excess of 0.02 mg/1 shall be assumed to be one-half the detection limit.

"Toxic pollutant" means any pollutant or combination of pollutants listed as toxic in regulations promulgated by the Administrator of the Environmental Protection Agency under the provision of CWA 307(a) or other Acts.

"User" means any person who contributes, causes or permits the contribution of wastewater into the city's POTW.

"Wastewater" means the liquid and water-carried industrial or domestic wastes from dwellings, commercial buildings, industrial facilities, and institutions, together which may be present, whether treated or untreated, which is contributed into or permitted to enter the POTW. Also see "sewage."

"Wastewater contribution permit" means as set forth in LMC 13.32.210.

"Water resources manager" means the person designated by the city to manage and supervise the operation of the publicly owned treatment works and who is charged with certain duties and responsibilities by this chapter, or his duly authorized representative.

"Water softener" means a unit using the ion exchange process requiring sodium chloride to regenerate the exchange bed.

"Waters of the state" means all streams, lakes, ponds, marshes, watercourses, waterways, wells, springs, reservoirs, aquifers, irrigation systems, drainage systems and all other bodies or accumulations of water, surface or underground, natural or artificial, public or private, which are contained within, flow through, or border upon the state or any portion thereof.

B. Abbreviations. The following abbreviations shall have the designated meanings:

BOD Biochemical oxygen demand

CFR Code of Federal Regulations

COD Chemical oxygen demand

EPA Environmental Protection Agency

1 Liter

mg Milligrams

mg/1 Milligrams per liter

NPDES National Pollutant Discharge Elimination System

POTW Publicly owned treatment works

SIC Standard Industrial Classification

SS Suspended solids

SWDA Solid Waste Disposal Act, 42 U.S.C. 6901, et seq.

TTO Total toxic organics

USC United States Code

(Ord. 1437 § 1, 1995)

13.32.030 Sewage to be discharged to public sewers.

All sewage shall be discharged to public sewers except as provided in this chapter. (Ord. 1437 § 1, 1995)

13.32.040 Private disposal of sewage.

It is unlawful to construct any privy, privy vault, septic tank, cesspool, or other facility intended or used

for the disposal of sewage except when special permit is granted by the council. (Ord. 1437 § 1, 1995)

13.32.050 Discharge of stormwaters, etc., to sanitary sewers prohibited without permit.

No person shall discharge or cause to be discharged any stormwater, surface water, groundwater, roof runoff or any nonpolluted waters to any sanitary sewer unless authorized or director by the water resources manager. Authorization may be granted, by permit, to discharge groundwater, surface water, stormwater or nonpolluted water subject to limits on volume, discharge time period, concentrations of pollutants, and other considerations. (Ord. 1437 § 1, 1995)

13.32.060 General discharge prohibitions.

A. No person shall contribute or cause to be contributed, directly or indirectly, any pollutant or wastewater which will interfere with the operation or performance of the POTW. These general prohibitions apply to all such users of the POTW whether or not the user is subject to National Categorical Pretreatment Standards or any other national, state or local pretreatment standards or requirements. A user may not contribute the following substances to the POTW:

1. Any liquids, solids or gases with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees centigrade using the test methods specified in 40 CFR CFR. At no time shall two successive readings on an explosion hazard meter, at the point of discharge into the system (or at any point in the system) be more than five percent nor any single reading over 10 percent of the lower explosive limit (LEL) of the meter. Prohibited materials include, but are not limited to, gasoline, kerosene, naphtha, benzene, toluene, xylene, ethers, alcohols, ketones, aldehydes, peroxides, chlorates, perchlorates, bromates, carbides, hydrides and sulfides and any other substances which the city, the state or EPA has notified the user is a fire hazard or a hazard to the system;

2. Solid or viscous substances which may cause obstruction to the flow in a sewer or other interference with the operation of the wastewater treatment facilities such as, but not limited to: grease, garbage with particles greater than one-half inch in any dimension, animal guts or tissues, paunch manure, bones, hair, hides or fleshings, entrails, whole blood, feathers, ashes, cinders, sand, spent lime, stone or marble dust, metal, glass, straw, shavings, grass clippings, rags, spent grains, spent hops, wastepaper, wood, plastics, gas, tar, asphalt residues, residues from refining, or processing of fuel or lubricating oil, mud, or glass grinding or polishing wastes.

Specifically excluded from the sewers are waste products resulting from the handling, storage and sale of fruits and vegetables from other than retail produce establishments, or other foods not intended primarily for immediate consumption;

3. Any wastewater having a pH less than 6.0 or greater than 9.0, unless a city permit is obtained (see LMC 13.32.120). Discharge of wastewater with a pH lower than 5.0 is prohibited at all times. Wastewater having any other corrosive property capable of causing damage or hazard to structures, equipment and/or personnel is also prohibited;

4. Any wastewater containing toxic pollutants in sufficient quantity, either singly or by interaction with other pollutants, to injure or interfere with any wastewater treatment process, constitute a hazard to humans or animals, create a toxic effect in the receiving waters of the POTW, or to

exceed the limitation set forth in the categorical pretreatment standard. A toxic pollutant shall include, but not be limited to, any pollutant identified pursuant to Section 307(a) of the Act;

5. Any noxious or malodorous liquids, gases or solids which either singly or by interaction with other wastes are sufficient to create a public nuisance or hazard to life or are sufficient to prevent entry into the sewers for maintenance and repair;

6. Any substance which may cause the POTW's effluent or any other product of the POTW such as residues, sludges, scums or gases, to be unsuitable for reclamation and reuse or to interfere with the reclamation process. In no case shall a substance discharged to the POTW cause the POTW to be in noncompliance with sludge use or disposal criteria, guidelines or regulations developed under Section 405 of the Act, any criteria, guidelines or regulations affecting sludge use or disposal developed pursuant to the Solid Waste Disposal Act, the Clean Air Act, the Toxic Substances Control Act, or state criteria applicable to the sludge management method being used;

7. Any waters or wastes which contain more than 100 mg/1 of freon extractable fat, oil or grease;

8. Any substance which will cause the POTW to violate its NPDES permit or the receiving water quality standards;

9. Any wastewater with objectionable color not removed in the treatment process, such as, but not limited to, dye wastes and vegetable tanning solutions;

10. Any wastewater having a temperature which will inhibit biological activity in the POTW treatment plant resulting in interference, but in no case wastewater with a temperature at the introduction into the POTW which exceeds 40 degrees centigrade (104 degrees Fahrenheit);

11. Any pollutants, including oxygen-demanding pollutants (BOD, etc.) released at a flow rate and/or pollutant concentration which a user knows or has reason to know will cause interference to the POTW;

12. Any wastewater containing any radioactive wastes or isotopes of such half-life or concentration as may exceed the limits established by the state or federal regulatory agency applicable to the POTW user;

13. Any wastewater which causes a hazard to human life or creates a public nuisance.

B. When the superintendent determines that a user(s) is contributing to the POTW, any of the above-enumerated substances in such amounts as to interfere with the operation of the POTW, the superintendent shall: (1) advise the user(s) of the impact of the contribution on the POTW; and (2) develop effluent limitation(s) for such user to correct the interference with the POTW. (Ord. 1437 § 1, 1995)

13.32.070 Trucked/hauled wastes.

The discharge of trucked or otherwise hauled wastes to the sanitary sewer system is prohibited, except as authorized by, and at points designated by, the water resources manager in accordance with the provisions of this chapter. (Ord. 1437 § 1, 1995)

13.32.080 Discharge from home regenerated water softeners.

A. This chapter shall not prohibit the use of water softener units which:

1. Were installed and in operation on or before January 31, 1966;

2. Were registered by the owner with the city as required by Ordinance 586; and

3. Are regenerated by the owner at the place of use of the unit.

B. This requirement shall not apply to softener units which are commercially recharged and are not regenerated at the customer's address. The discharge of salt waste from any unit allowed continuance by the provisions of this chapter shall be prohibited if the existing unit is replaced or repairs are made thereto in excess of 50 percent of the original cost of such unit. (Ord. 1437 § 1, 1995)

13.32.090 Federal Categorical Pretreatment Standards.

The Federal Categorical Pretreatment Standards, found in 40 CFR Chapter I, Subchapter N, Parts 405 – 471, are incorporated into this chapter. Upon the promulgation of the Federal Categorical Pretreatment Standards for a particular industrial subcategory, the Federal Standard, if more stringent than limitations imposed under this chapter for sources in that subcategory, shall immediately supersede the limitations imposed under this chapter. The superintendent shall notify all affected users of the applicable reporting requirements under 40 CFR, Section 403.12. (Ord. 1437 § 1, 1995)

13.32.100 Modification of Federal Categorical Pretreatment Standards.

Where the city's wastewater treatment system achieves consistent removal of pollutants limited by federal pretreatment standards, the city may apply to the state/EPA for modification of specific limits in the federal pretreatment standards. "Consistent removal" means reduction in the amount of pollutant or alteration of the nature of the pollutant, by the wastewater treatment system, to the less toxic or harmless state, in the effluent which is achieved by the system in 95 percent of the samples taken when measured according to the procedures set forth in Section 403.7(c)(2) of (Title 40 Code of Federal Regulations, Part 403) "General Pretreatment Regulations for Existing and New Sources of Pollution" promulgated pursuant to the Act. The city may then modify pollutant discharge limits in the federal pretreatment standards if the requirements contained in 40 CFR, Part 403, Section 403.7, are fulfilled and prior approval from state/EPA is obtained. (Ord. 1437 § 1, 1995)

13.32.110 Specific pollutant limitations.

No person shall discharge wastewater containing a daily maximum concentration in excess of:

0.06 mg/1 arsenic

0.14 mg/1 cadmium

1.0 mg/1 copper

0.62 mg/1 chromium (total)

0.20 mg/1 lead

0.01 mg/1 mercury

0.61 mg/1 nickel

0.20 mg/1 silver

3.00 mg/1 zinc

0.04 mg/1 cyanide

1.00 mg/1 total toxic organics

(Ord. 1437 § 1, 1995)

13.32.120 Pollutant thresholds.

To maintain and improve opportunities to recycle and reclaim municipal wastewater, the city has established the following pollutant thresholds above which a discharge permit must be obtained. No user may discharge wastewater containing pollutants in excess of the following threshold limits without first obtaining a wastewater discharge permit:

A. Any waters or wastes containing total dissolved solids increment greater than 300 and 25 mg/1, nor chloride increment greater than 75 mg/1, increase during a single cycle use of the water supply;

B. Any water or wastes having a BOD greater than 300 (the average BOD for residential users);

C. Any waters or wastes containing more than 300 mg/1 of suspended solids (the average suspended solids for residential users);

D. Any waters or wastes with a pH less than 6.0 or greater than 9.0. The water resources manager may, at his discretion, establish a pH range of 5.0 to 10.0 for specific users provided certain conditions are met, however at no time shall the pH drop below 5.0. (Ord. 1437 § 1, 1995)

13.32.130 State requirements.

State requirements and limitations on discharges shall apply in any case where they are more stringent than federal requirements and limitations or those in this chapter. (Ord. 1437 § 1, 1995)

13.32.140 City's right of revision.

The city reserves the right to establish by ordinance more stringent limitations or requirements on discharges to the wastewater disposal system if deemed necessary to comply with the objectives presented in LMC 13.32.010. (Ord. 1437 § 1, 1995)

13.32.150 Excessive discharge.

No user shall ever increase the use of process water or, in any way, attempt to dilute a discharge as a partial or complete substitute for adequate treatment to achieve compliance with the limitations contained in the Federal Categorical Pretreatment Standards, or in any other pollutant-specific limitation developed by the city or state. (Ord. 1437 § 1, 1995)

13.32.160 Notification of changed discharge.

All users, whether permitted or unpermitted, must receive prior approval from the water resources manager for any new introduction of wastewater or pollutants or for substantial changes in the volume or

character of pollutants in their discharge. (Ord. 1437 § 1, 1995)

13.32.170 Accidental discharges.

A. Each user will ensure that the POTW is protected from accidental discharge of prohibited materials or other substances regulated by this chapter. Such protection shall be provided and maintained by the user at the owner or user's own cost and expense. Detailed plans showing facilities and/or operating procedures to provide this protection shall be submitted to the city for review and shall be approved by the city before construction of the facility. All existing users shall complete such a plan by June 30, 1983. No user who commences contribution to the POTW after the effective date of this chapter shall be permitted to introduce pollutants into the system until accidental discharge procedures have been approved by the city. Review and approval of such plans and operating procedures shall not relieve the industrial user from the responsibility to modify the user's facility as necessary to meet the requirements of this chapter. In the case of an accidental discharge, it is the responsibility of the user to immediately telephone and notify the POTW of the incident. The notification shall include location of discharge, type of waste, concentration and volume and corrective actions.

B. Written Notice. Within five days following an accidental discharge, the user shall submit to the superintendent a detailed written report describing the cause of the discharge and the measures to be taken by the user to prevent similar future occurrences. Such notification shall not relieve the user of any expense, loss, damage, or other liability which may be incurred as a result of damage to the POTW, fish kills, or any other damage to person or property nor shall such notification relieve the user of any fines, civil penalties, or other liability which may be imposed by this chapter or other applicable law.

C. Notice to Employees. A notice shall be permanently posted on the user's bulletin board or other prominent place advising employees whom to call in the event of a dangerous discharge. Employers shall insure that all employees who may cause or suffer such a dangerous discharge to occur are advised of the emergency notification procedure. (Ord. 1437 § 1, 1995)

13.32.180 Notification of discharge of hazardous waste.

Pursuant to 40 CFR CFR(p)(1) and (3), industrial users discharging any substance which, if disposed of by other means, would be a hazardous or acutely hazardous waste under 40 CFR CFR, must submit written notification to the POTW, the state and the EPA unless exempted under the provisions of 40 CFR CFR(p)(2). (Ord. 1437 § 1, 1995)

13.32.190 Fees and charges.

In order to recover from the users of the city's wastewater disposal system, the cost of implementing the program established by this chapter, the city council shall adopt by resolution fees and charges which may include:

A. Fees for reimbursement of costs of setting up and operating the city's pretreatment program;

B. Fees for monitoring, inspections and surveillance procedures;

C. Fees for reviewing accidental discharge procedures and construction;

D. Fees for permit applications;

E. Fees for filing appeals;

F. Fees for consistent removal by the city of pollutants otherwise subject to federal pretreatment standards;

G. Other fees as the city may deem necessary to carry out the requirements contained in this chapter. (Ord. 1437 § 1, 1995)

13.32.200 Wastewater discharges.

It is unlawful to discharge without a city permit to any natural outlet within the city, or in any area under the jurisdiction of the city, and/or to the POTW any wastewater, except as authorized by the water resources manager in accordance with the provisions of this chapter. (Ord. 1437 § 1, 1995)

13.32.210 Wastewater contribution permits.

Wastewater discharge permits will be required in the following manner:

A. Mandatory Permits. All significant users proposing to connect to or contribute to the POTW shall obtain a wastewater discharge permit before connecting to or contributing to the POTW. All existing significant users connected to or contributing to the POTW shall obtain a wastewater contribution permit within 180 days after the effective date of this chapter.

B. Optional Permits. The water resources manager may issue a wastewater discharge permit to any user, upon application, in the following categories:

1. Any industrial user with no significant flow, but who uses toxic pollutants, stores hazardous materials or uses materials which singly or in combination with other wastewater streams may cause the Livermore Water Reclamation Plant to violate its NPDES permit; or

2. Any industrial user not classified in any other category who is required to operate and maintain a grease/oil interceptor, silver recovery unit, or other such pretreatment device prior to discharging wastewater into the sewer system; or

3. Any user who is required by LMC 13.28.080 or 13.36.070 to have sewer service charges and sewer connection fees calculated based on an estimation of flow, BOD and suspended solids. (Ord. 1437 § 1, 1995)

13.32.220 Permit application.

A. Users required to obtain a wastewater contribution permit shall complete and file with the city, an application in the form prescribed by the city, and accompanied by the prescribed fee. Existing significant users shall apply for a wastewater contribution permit within 60 days after the effective date of this chapter, and proposed new users shall apply at least 60 days prior to connecting to or contributing to the POTW. In support of the application, the user shall submit, in units and terms appropriate for evaluation, the following information:

1. Name, address and location (if different from the address);

2. SIC number according to the Standard Industrial Classification Manual, Bureau of the Budget, 1972, as amended;

3. Wastewater constituents and characteristics including, but not limited to, those mentioned in LMC 13.32.060 as determined by a reliable analytical laboratory (sampling and analysis shall be performed in accordance with procedures established by the EPA pursuant to Section 304(g) of the Act and contained in 40 CFR, Part 136, as amended);

4. Time and duration of contribution;

5. Average daily and 30-minute peak wastewater flow rates, including daily, monthly and seasonal variations if any;

6. Site plans, floor plans, mechanical and plumbing plans and details to show all sewers, sewer connections and appurtenances by the size, location and elevation;

7. Description of activities, facilities and plant processes on the premises including all materials which are or could be discharged;

8. Where known, the nature and concentration of any pollutants in the discharge which are limited by any city, state or federal pretreatment standards, and a statement regarding whether or not the pretreatment standards are being met on a consistent basis and if not, whether additional operation and maintenance (O&M) and/or additional pretreatment is required for the user to meet applicable pretreatment standards. This statement shall be signed by an authorized representative of the industrial user and certified by a qualified professional;

9. If additional pretreatment and/or O&M will be required to meet the pretreatment standards, the shortest schedule by which the user will provide such additional pretreatment. The completion date in this schedule shall not be later than the compliance date established for the applicable pretreatment standard. The following conditions shall apply to this schedule:

a. The schedule shall contain increments of progress in the form of dates for the commencement and completion of major events leading to the construction and operation of additional pretreatment required for the user to meet the applicable pretreatment standards (e.g., hiring an engineer, completing preliminary plans, completing final plans, executing contract for major components, commencing construction, completing construction, etc.).

b. No increment referred to in subsection (A)(9) (a) of this section shall exceed nine months.

c. Not later than 14 days following each date in the schedule and the final date for compliance, the user shall submit a progress report to the superintendent including, as a minimum, whether or not it complied with the increment of progress to be met on such date and, if not, the date on which it expects to comply with this increment of progress, the reason for delay, and the steps being taken by the user to return the construction to the schedule established. In no event shall more than nine months elapse between such progress reports to the superintendent;

10. Each product produced by type, amount, process or processes and rate of production;

11. Type and amount of raw materials processed (average and maximum per day);

12. Number and type of employees, and hours of operation of plant and proposed or actual hours of operation and pretreatment system;

13. Any other information as may be deemed by the city to be necessary to evaluate the permit application. Users which are subject to National Pretreatment Standards under 40 CFR Chapter I, Subchapter N, Parts 405 – 471, are required to submit a Baseline Monitoring Report as specified in 40 CFR CFR(b).

B. The city will evaluate the data furnished by the user and may require additional information. After evaluation and acceptance of the data furnished, the city may issue a wastewater contribution permit subject to terms and conditions provided in this chapter. (Ord. 1437 § 1, 1995)

13.32.230 Permit modifications.

Within nine months of the promulgation of a National Categorical Pretreatment Standard, found in 40 CFR Chapter I, Subchapter N, Parts 405 – 471, the wastewater contribution permit of users subject to such standards shall be revised to require compliance with such standard within the time frame prescribed by such standard. Where a user, subject to a National Categorical Pretreatment Standard, has not previously submitted an application for a wastewater contribution permit as required by LMC 13.32.220, the user shall apply for a wastewater contribution permit within 180 days after the promulgation of the applicable National Categorical Pretreatment Standard. In addition, the user with an existing wastewater contribution permit shall submit to the superintendent within 180 days after the promulgation of an applicable Federal Categorical Pretreatment Standard the information required by LMC 13.32.220(A)(8) and (9). (Ord. 1437 § 1, 1995)

13.32.240 Permit conditions.

Wastewater discharge permits shall be expressly subject to all provisions of this chapter and all other applicable regulations, user charges and fees established by the city. Permits may contain the following:

A. The unit charge or schedule of user charges and fees for the wastewater to be discharged to a community sewer;

B. Limits on the average and maximum wastewater constituents and characteristics;

C. Limits on average and maximum rate and time of discharge or requirements for flow regulation and equalization;

D. Requirements for installation and maintenance of inspection and sampling facilities;

E. Specifications for monitoring programs which may include sampling locations, frequency of sampling, number, types and standards for tests and reporting schedule;

F. Compliance schedules;

G. Requirements for submission of technical reports or discharge reports (see LMC 13.32.280);

H. Requirements for maintaining and retaining plant records relating to wastewater discharge as specified by the city, and affording city access thereto. Pursuant to 40 CFR CFR(o), users must retain records of monitoring activities and results for a minimum of three years, or longer in cases of unresolved litigation, or when requested by the Regional Water Quality Control Board or the city;

I. Requirements for notifying of the city of and receiving approval for any new introduction of wastewater

or pollutants or for any changes in current volume or character of pollutants discharged;

J. Requirements for notification of "slug" discharges as per LMC 13.32.350;

K. Other conditions as deemed appropriate by the city to ensure compliance with this chapter. (Ord. 1437 § 1, 1995)

13.32.250 Permits duration.

Permits shall be issued for a specified time period, not to exceed five years. A permit may be issued for a period less than a year or may be stated to expire on a specific date. The user shall apply for permit reissuance a minimum of 180 days prior to the expiration of the user's existing permit. The terms and conditions of the permit may be subject to modification by the city during the term of the permit as limitations or requirements as identified in LMC 13.32.230 are modified or other just cause exists. The user shall be informed of any proposed changes in his permit at least 30 days prior to the effective date of change. Any change or new conditions in the permit shall include a reasonable time schedule for compliance. (Ord. 1437 § 1, 1995)

13.32.260 Permit transfer.

Wastewater discharge permits are issued to a specific user for a specific operation. A wastewater discharge permit shall not be reassigned or transferred or sold to a new owner, new user, different premises, or a new or changed operation without the approval of the city. Any succeeding owner or user shall also comply with the terms and conditions of the existing permit. (Ord. 1437 § 1, 1995)

13.32.270 Signatory requirements.

All applications, reports or monitoring information submitted to the city must contain the following certification statements and be signed as required in subsection A, B, C or D of this section:

> I certify under penalty of law that this document and all attachments were prepared under my direction or 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, and accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

The statement must be signed in the following manner:

A. By a responsible corporate officer, if the industrial user submitting the report is a corporation. For the purpose of this subsection, a "responsible corporate officer" means: a president, secretary, treasurer or vice president of the corporation in charge of a principle business function, or any other person who performs similar policy, or decision-making functions for the corporation;

B. By a general partner or proprietor if the industrial user submitting the report is a partnership or sole proprietorship respectively;

C. By a duly authorized representative of the individual designated in subsection A or B of this section if:

1. The authorization is made in writing by the individual described in subsection A or B of this section,

2. The authorization specifies either an individual or a position having responsibility for the overall operation of the facility from which the discharge originates, such as the position of plant manager, superintendent, or a position of equivalent responsibility for environmental matters for the company, and

3. The written authorization is submitted to the city.

D. If an authorization under subsection C of this section is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, or overall responsibility for the environmental matters for the company, a new authorization satisfying the requirements of subsection C of this section must be submitted to the city prior to or together with any reports to be signed by the authorized representative. (Ord. 1437 § 1, 1995)

13.32.280 Reporting requirements for permittee.

Within 90 days following the date for final compliance with applicable pretreatment standards or, in the case of a new source, following commencement of the introduction of wastewater into the POTW, any user subject to pretreatment standards and requirements shall submit to the superintendent a report indicating the nature and concentration of all pollutants in the discharge from the regulated process which are limited by pretreatment standards and requirements and the average and maximum daily flow for these process units in the user facility which are limited by such pretreatment standards or requirements. The report shall state whether the applicable pretreatment standards or requirements are being met on a consistent basis and, if not, what additional O&M and/or pretreatment is necessary to bring the user into compliance with the applicable pretreatment standards or requirements. This statement shall be signed by an authorized representative of the industrial user, and certified by a qualified professional. (Ord. 1437 § 1, 1995)

13.32.290 Periodic compliance reports.

A. Any user subject to a pretreatment standard, after the compliance date of such pretreatment standard, or, in the case of a new source, after commencement of the discharge into the POTW, shall submit to the superintendent during the months of June and December, unless required more frequently in the pretreatment standard or by the superintendent, a report indicating the nature and concentration of pollutants in the effluent which are limited by such pretreatment standards. In addition, this report shall include a record of all daily flows which during the reporting period exceeded the average daily flow reported in LMC 13.32.220 (A)(5).

At the discretion of the superintendent and in consideration of such factors as local high or low flow rates, holidays, budget cycles, etc., the superintendent may agree to alter the months during which the above reports are to be submitted.

B. The superintendent may impose mass limitation on users which require using dilution to meet applicable pretreatment standards or requirements, or in other cases where the imposition of mass limitations is appropriate. In such cases, the report required by subsection A of this section shall indicate the mass of pollutants regulated by pretreatment standards in the effluent of the user. These reports shall contain the results of sampling and analysis of the discharge, including the flow and the

nature and concentration, or production and mass where required by the superintendent, of pollutants contained therein which are limited by the applicable pretreatment standards. The frequency of monitoring shall be prescribed in the applicable pretreatment standard.

All analysis shall be performed in accordance with procedures established by the administrator pursuant to Section 304(g) of the Act and contained in 40 CFR, Part 136 and amendments thereto or with any other test procedures approved by the administrator. Sampling shall be performed in accordance with the techniques approved by the administrator. Where 40 CFR, Part 136 does not include a sampling or analytical technique for the pollutant in question, sampling and analysis shall be performed in accordance with the procedures set forth in the EPA publication, Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants, April, 1977, and amendments thereto, or with any other sampling and analytical procedures approved by the administrator. (Ord. 1437 § 1, 1995)

13.32.300 Monitoring facilities.

The city shall require to be provided and operated at the user's own expense, monitoring facilities to allow inspection, sampling and flow measurement of the building sewer and/or internal drainage systems. The monitoring facility should normally be situated on the user's premises, but the city may, when such a location would be impractical or cause undue hardship on the user, allow the facility to be constructed in the public street or sidewalk area and located so that it will not be obstructed by landscaping or parked vehicles.

There shall be ample room in or near such sampling manhole or facility to allow accurate sampling and preparation of samples for analysis. The facility, sampling and measuring equipment shall be maintained at all times in a safe and proper operating condition at the expense of the user.

Where constructed on public or private property, the sampling and monitoring facilities shall be provided in accordance with the city's requirements and all applicable local construction standards and specifications. Construction shall be completed within 90 days following written notification by the city. (Ord, 1437 § 1, 1995)

13.32.310 Industrial user self-monitoring.

The city may require industrial users to collect and analyze samples of their discharge to verify compliance with all applicable federal and local limits. Under 40 CFR CFR(g), the user must notify the POTW within 24 hours of discovery of any violation of Federal Categorical Pretreatment Standards, state or local discharge limitations. The user must repeat sampling and pollutant analysis of those pollutants which exceeded limitation requirements and shall submit, in writing, the results of this second analysis within 30 days of becoming aware of the violation. (Ord. 1437 § 1, 1995)

13.32.320 Inspection and sampling.

The city shall inspect the facilities of any user to ascertain whether the purpose of this chapter is being met and all requirements are being complied with. Persons or occupants of premises where wastewater is created or discharged shall allow the city or their representative ready access at all reasonable times to all parts of the premises for the purposes of inspection, sampling or the performance of any of their duties. The city, state and EPA shall have the right to examine and/or copy records, and to set up on the user's property such devices as are necessary to conduct sampling inspection, compliance

monitoring and/or metering operations.

Where a user has security measures in force which would require proper identification and clearance before entry into their premises, the user shall make necessary arrangements with their security guards so that upon presentation of suitable identification, personnel from the city, approval authority and EPA will be permitted to enter, without delay, for the purposes of performing their specific responsibilities. (Ord. 1437 § 1, 1995)

13.32.330 Pretreatment facilities.

A. Users shall provide necessary wastewater treatment as required to comply with this chapter and shall achieve compliance with all Federal Categorical Pretreatment Standards within the time limitations as specified by the federal pretreatment regulations. Any facilities required to pretreat wastewater to a level acceptable to the city shall be provided, operated and maintained at the user's expense. Detailed plans showing the pretreatment facilities and operating procedures shall be submitted to the city for review, and shall be acceptable to the city before construction of the facility. The review of such plans and operating procedures will in no way relieve the user from the responsibility of modifying the facility as necessary to produce an effluent acceptable to the city under the provisions of this chapter. Any subsequent changes in the pretreatment facilities wastewater volume, pollutant characteristics or method of operation shall be reported to and be approved by the city prior to the user's initiation of the changes.

B. All preliminary studies, plans and specifications must be prepared by a registered professional engineer retained by the discharger and the plans shall be reviewed and approved by the city engineer and water resources manager.

C. The city shall annually publish in the Tri-Valley Herald newspaper or such other newspaper as the council may designate, a list of the users which were in violation of any pretreatment requirements or standards at least once during the preceding 12 months. The notification shall also summarize any enforcement actions taken against the user(s) during the same 12 months.

D. All records relating to compliance and pretreatment standards shall be made available to officials of the EPA or state upon request.

E. The businesses categories below are required to install the following minimum pretreatment facilities to help ensure compliance with federal, state and local discharge limitations:

1. Food Preparation Facilities. All facilities where food is prepared or served shall be equipped with an oil and grease interceptor with a minimum capacity of 750 gallons. The interceptor shall be connected to the sanitary sewer, and all kitchen-generated wastewater, with the exception of dishwasher and garbage disposal drainage, shall discharge through the interceptor.

2. Car Washes, Wash Racks and Vehicle Service Facilities. All car washes, wash racks, and other facilities where vehicles or parts are washed or steam cleaned must be equipped with a sand and oil interceptor with a minimum size of 750 gallons. All wastewater produced from the washing or steam cleaning operations must discharge through the interceptor.

3. Photo or X-Ray Processing Facilities. Facilities processing photographs, negatives or x-rays which discharge photo chemicals to the sewer system shall be equipped with a silver recovery

system capable of reducing the effluent silver concentration to 0.20 mg/1 or less. (Ord. 1437 § 1, 1995)

13.32.340 Confidential information.

Information and data on a user obtained from reports, questionnaires, permit applications, permits and monitoring programs and from inspections shall be available to the public or other governmental agency without restriction unless the user specifically requests and is able to demonstrate to the satisfaction of the city that the release of such information would divulge information, processes or methods of production entitled to protection as trade secrets of the user.

When requested by the person furnishing a report, the portions of a report which might disclose trade secrets or secret processes shall not be made available for inspection by the public but shall be made available upon written request to governmental agencies for uses related to this chapter, the National Pollutant Discharge Elimination System (NPDES) permit, State Disposal System permit and/or the pretreatment programs; provided, however, that such portions of a report shall be available for use by the state or any state agency in judicial review or enforcement proceedings involving the person furnishing the report. Wastewater constituents and characteristics will not be recognized as confidential information.

All information accepted by the city as confidential shall be available to the public to the extent provided under 40 CFR Section 2.302 et seq. Any claim of confidentiality must be asserted at the time of submitting the information, in a manner prescribed by the water resources manager. (Ord. 1437 § 1, 1995)

13.32.350 Harmful contributions – Suspension of service/permit.

The city may suspend the wastewater treatment service and/or a wastewater contribution permit when such suspension is necessary, in the opinion of the city, in order to stop an actual or threatened discharge which presents or may present an imminent or substantial endangerment to the health or welfare of persons or to the environment, causes or threatens to cause interference to the POTW, or causes the city to violate any condition of its NPDES permit.

Any person notified of a suspension of the wastewater treatment service and/or the wastewater contribution permit shall immediately stop or eliminate the contribution. In the event of a failure of the person to comply voluntarily with the suspension order, the city shall take such steps as deemed necessary including immediate severance of the sewer connection, to prevent or minimize damage to the POTW system or endangerment to any individuals. The city shall reinstate the wastewater contribution permit and/or wastewater treatment service upon proof of the elimination of the noncomplying discharge. A detailed written statement submitted by the user describing the causes of the harmful contribution and the measures taken to prevent any future occurrence shall be submitted to the city within 15 days of the date of occurrence. (Ord. 1437 § 1, 1995)

13.32.360 Revocation of permit.

Any user who violates the following conditions of this chapter, or applicable state and federal regulations, is subject to having his permit revoked in accordance with the procedures of this chapter:

A. Failure of a user to factually report the wastewater constituents and characteristics of his discharge;

B. Failure of the user to notify the city of significant change in operations, or wastewater constituents and characteristics or failure to receive city approval prior to making significant changes in operations or wastewater constituents and characteristics;

C. Refusal of reasonable access to the user's premises for the purpose of inspection or monitoring; or

D. Violation of conditions of the permit. (Ord. 1437 § 1, 1995)

13.32.370 Notification of revocation hearing.

Prior to the revocation of any permit, a hearing shall be held by the director of public works. Written notice of the hearings shall be served personally or by registered or certified mail (return receipt requested) on the user at least 10 days before the hearing. The notice shall state the nature of the violation, as well as the time and place of the hearing. (Ord. 1437 § 1, 1995)

13.32.380 Purpose and conduct of hearing.

The purpose of the hearing is to provide the user with an opportunity to show cause why the permit should not be revoked. The director of public works shall hear all facts and testimony he deems pertinent and shall not be limited to the technical rules of evidence. The decision of the director of public works shall be final. Notice of the decision shall be mailed to the user within 10 days of the conclusion of the hearing. (Ord. 1437 § 1, 1995)

13.32.390 Falsifying information.

No person shall knowingly make any false statements, representation or certification in any application, record, report, plan or other document filed or required to be maintained pursuant to this chapter, or wastewater contribution permit, nor falsify, tamper with, or knowingly render inaccurate any monitoring device or method required under this chapter. (Ord. 1437 § 1, 1995)

13.32.400 Violations constituting misdemeanors.

The violation of any provision of this chapter, or failure to comply with any of the mandatory requirements of this chapter shall constitute a misdemeanor. A person shall be deemed guilty of a separate offense for each and every day during any portion of which a violation of this chapter is committed, continued or permitted by the person. (Ord. 1437 § 1, 1995)

13.32.410 Violations constituting a public nuisance.

In addition to the remedies contained in LMC 13.32.400, the city attorney may take any or all of the following actions in response to a violation of any provision of this chapter:

A. A violation of any provision of this chapter is declared a public nuisance, and may be abated and enjoined by way of civil action brought by the city attorney. The cost of such abatement shall be a lien against the property on which the public nuisance emanates, and a personal obligation against the person maintaining or causing the public nuisance.

B. The city attorney may petition the superior court to impose, assess and recover a sum not to exceed $25,000 a day for each violation pursuant to Government Code Section 54740. No liability shall be recoverable under this subsection for any violation for which liability is recovered under LMC 13.32.420. (Ord. 1437 § 1, 1995)

13.32.420 Violations subject to administrative civil penalties.

In addition to the remedies contained in LMC 13.32.400 and 13.32.410A, the city may issue an administrative complaint to any person who violates any provision of this chapter. All administrative complaints issued pursuant to this section shall be in accordance with Government Code Section 54740.5. No penalties shall be recoverable under this section for any violation for which liability is recovered under LMC 13.32.410(B). (Ord. 1437 § 1, 1995)

13.32.430 Enforcement response plan.

To achieve maximum compliance with this chapter, the city has developed an enforcement response plan which details the enforcement actions which will be used in response to specific violations of this chapter. Actions listed in the plan range from informal warnings and written notices of violation to civil or criminal action. The enforcement response plan lists escalating levels of enforcement response for repetitive or serious violations. The city reserves the right to omit steps in the process for willful violations or for those violations which threaten public health and safety or the environment, at the discretion of the water resources manager. The enforcement mechanisms provided in the enforcement response plan may be cumulative in respect to such other enforcement mechanisms or civil and criminal penalties as may be available under the laws of the state of California and may be available under the laws of the state of California and the United States of America. Nothing in this chapter is intended to prevent state and/or federal regulatory agencies from undertaking enforcement actions as may otherwise be available due to a violation of this chapter which also constitutes a violation of federal or state statutes and regulations. (Ord. 1437 § 1, 1995)

The Livermore Municipal Code is current through Ordinance 1994, passed February 24, 2014.
Disclaimer: The City Clerk's Office has the official version of the Livermore Municipal Code. Users should contact the City Clerk's Office for ordinances passed subsequent to the ordinance cited above.

Appendix C Pleasanton Municipal Code, Chapter 15

Chapter 15.04 GENERAL PROVISIONS

15.04.010 Purpose.

The purpose of this title is to establish standards and conditions, and to provide revenues, relating to the use and management of the sewerage system. It is further the purpose of this title to establish uniform requirements for discharges into the wastewater collection and treatment system used jointly with other public entities who are parties to the joint exercise of powers agreement establishing and providing for the Livermore-Amador Valley water management agency, a public entity, and any successor thereto. This chapter shall also serve as a vehicle enabling the city to comply with and meet applicable laws, regulations, standards and conditions established by federal and state law, or by agencies thereof in implementation of such law. The city council finds and declares that the health, safety and welfare of the people of the city require the enactment of the provisions of this chapter. (Ord. 1082 § 2, 1983; prior code § 2-15.10.01)

15.04.020 Conflict with uniform codes.

In the event of any conflicts or inconsistencies between the provisions of this title and the standards and regulations promulgated hereunder, and any provisions of the city adopted uniform plumbing code or other building or construction codes, the provisions of such uniform codes shall control. (Ord. 1082 § 2, 1983; prior code § 2-15.10.04)

Chapter 15.08 DEFINITIONS

15.08.010 Generally.

For the purpose of this title, the words, terms and phrases used in this title shall have the meanings defined in this chapter, unless the context clearly indicates a different meaning. (Ord. 1082 § 2, 1983; prior code § 2-15.01.00)

15.08.015 Apartment.

"Apartment" means multiple-dwelling units not individually owned and on a single lot. (Ord. 1895 § 1, 2003)

15.08.020 Applicant.

"Applicant" means any person, or group of persons, applying for sewer service. (Ord. 1082 § 2, 1983; prior code § 2-15.01.01)

15.08.030 Billable parameters.

"Billable parameters" means those parameters, including, without limitation, flow, BOD, capacity, SS, volume and 1/1, for which the treatment works is designed to treat and for which average user charge unit costs are calculated pursuant to Chapter 15.20 of this title. (Ord. 1082 § 2, 1983; prior code § 2-15.01.02)

15.08.040 Biochemical oxygen demand (BOD).

"Biochemical oxygen demand (BOD)" means the measure of oxygen utilized in the biochemical oxidation of the organic matter in a sample of sewage for five days at 20 degrees centigrade, as determined by the method of testing for BOD pursuant to the standard methods. (Ord. 1082 § 2, 1983; prior code § 2-15.01.03)

15.08.050 Capacity.

"Capacity" means all or a portion of the total volume of sewage and industrial waste, expressed in terms of gallons per day, average dry weather flow ("GPDADWF"), that the city is entitled to collect and discharge into the treatment plant, and which may be allocated to users. (Ord. 1082 § 2, 1983; prior code § 2-15.01.04)

15.08.060 Charge.

"Charge" means the rental or other charge established by this title for services and facilities furnished by the city to any premises in connection with the operation of sewer facilities. (Ord. 1082 § 2, 1983; prior code § 2-15.01.05)

15.08.070 Chemical oxygen demand (COD).

"Chemical oxygen demand (COD)" means the measure of oxygen utilized in the oxidation of the organic

matter in a sample of sewage by a strong oxidant, as determined by the method of testing for COD pursuant to the standard methods. (Ord. 1082 § 2, 1983; prior code § 2-15.01.06)

15.08.080 City.

"City" means the city of Pleasanton, county of Alameda, state of California. (Ord. 1082 § 2, 1983; prior code § 2-15.01.07)

15.08.090 City council.

"City council" means the city council of the city. (Ord. 1082 § 2, 1983; prior code § 2-15.01.08)

15.08.100 City sewer.

"City sewer" means any sewer serving as a part of the sewerage system which is owned by the city. (Ord. 1082 § 2, 1983; prior code § 2-15.01.09)

15.08.110 Commercial building.

"Commercial building" means any building devoted principally to a nonresidential use allowed by the zoning ordinance codified in Title 18 of this code. (Ord. 1082 § 2, 1983; prior code § 2-15.01.10)

15.08.120 Commercial garbage grinder.

"Commercial garbage grinder" means a mechanical unit for pulverizing large quantities of wastes by a commercial user. (Ord. 1082 § 2, 1983; prior code § 2-15.01.11)

15.08.130 Commercial user.

"Commercial user" means any nonresidential user that the director determines discharges to the sewerage system primarily sanitary sewage. (Ord. 1082 § 2, 1983; prior code § 2-15.01.12)

15.08.140 Condominium.

"Condominium" means three or more attached dwelling units, consisting of an undivided interest in common in a portion of real property coupled with a separate interest in a space called a dwelling unit. (Ord. 1895 § 1, 2003; Ord. 1203 § 2, 1985; prior code § 2-15.01.12.5)

15.08.150 County.

"County" means the county of Alameda. (Ord. 1082 § 2, 1983; prior code § 2-15.01.13)

15.08.160 Developer.

"Developer" means any person who applies to the city for permission to build, improve, expand or convert any premises or tract of land to a use which will require the use of, or expanded use of, the sewerage system. (Ord. 1082 § 2, 1983; prior code § 2-15.01.14)

15.08.170 Director.

"Director" means the operations services director for the city or the authorized representative thereof. (Ord. 2000 § 1, 2009; Ord. 1082 § 2, 1983; prior code § 2-15.01.15)

15.08.180 District.

"District" means the Dublin-San Ramon services district. (Ord. 1082 § 2, 1983; prior code § 2-15.01.16)

15.08.183 Duet.

"Duet" means two attached dwelling units located on two separate lots. (Ord. 1895 § 1, 2003)

15.08.185 Duplex.

"Duplex" means two attached dwelling units located on a single lot. (Ord. 1895 § 1, 2003)

15.08.190 Dwelling unit.

"Dwelling unit" means a distinct attached or a detached space, which provides complete independent living facilities for one household. A dwelling unit shall include permanent provisions for living, sleeping, eating, cooking, and sanitation within the unit. (Ord. 1895 § 1, 2003; Ord. 1082 § 2, 1983; prior code § 2-15.01.17)

15.08.200 Existing users.

"Existing users" means all users discharging into the sewerage system on the effective date hereof. (Ord. 1082 § 2, 1983; prior code 2-15.01.18)

15.08.210 Flow.

"Flow" means the movement of a quantity of sewage or other liquid past a given point or through a given section of sewer. (Ord. 1082 § 2, 1983; prior code § 2-15.01.19)

15.08.220 Gallons per day (GPD).

"Gallons per day (GPD)" means the volume, measured in gallons per day, of any flow. (Ord. 1082 § 2, 1983; prior code § 2-15.01.20)

15.08.230 Garbage.

"Garbage" means solid wastes from the preparation, cooking and dispensing of food and from the handling, storage and sale of produce. (Ord. 1082 § 2, 1983; prior code § 2-15.01.21)

15.08.240 Grease, oil and fats.

"Grease, oil and fats" means any material or like material that is soluble by the freon extraction process. (Ord. 1082 § 2, 1983; prior code § 2-15.01.22)

15.08.250 Industrial building.

"Industrial building" means any building devoted principally to uses permitted by the zoning ordinance other than residential and retail uses. (Ord. 1082 § 2, 1983; prior code § 2-15.01.23)

15.08.260 Industrial user.

"Industrial user" means an establishment engaged in producing, manufacturing or processing operations, and all other users engaged in any activity resulting in the production of industrial wastes which enter the sewerage system. (Ord. 1082 § 2, 1983; prior code § 2-15.01.24)

15.08.270 Industrial wastes or industrial sewage.

"Industrial wastes" or "industrial sewage" means a combination of liquid or water carried sewage or waste resulting from a manufacturing process employed in industrial establishments, including, without limitation, any washing water, cleaning water or drain water from such process. The same shall also include waste from Zeolite type softening regeneration plants and water from commercial laundries. (Ord. 1082 § 2, 1983; prior code § 2-15.01.25)

15.08.280 Infiltration and inflow.

"Infiltration and inflow" means the infiltration and inflow of water into the sewerage system. (Ord. 1082 § 2, 1983; prior code § 2-15.01.26)

15.08.285 Livermore.

"Livermore" shall mean the city of Livermore, California. (Ord. 1979 § 1, 2008)

15.08.290 Local costs.

"Local costs" means costs which are borne in their entirety by the city and include all expenses incurred up to the point of delivery of effluent to the district system and all expenses associated with disposing of city effluent via the Livermore-Amador Valley water management agency's wastewater export system. (Ord. 1082 § 2, 1983; prior code § 2-15.01.27)

15.08.300 Major contributing industry.

"Major contributing industry" means an industrial user who meets one or more of the following criteria, as determined by the director:

A. The user is one of the 34 natural resources defense council ("NRDC") industries for which the United States environmental protection agency intends to set categorical standards, and the user is not in an exempt subcategory;

B. The user's average flow exceeds 25,000 GPD or the average BOD or SS loading exceeds 50 pounds per day;

C. The user's average flow exceeds 2,500 GPD, and priority pollutants or prohibited discharge pollutants are known to be present;

D. The user's average flow is less than 2,500 GPD, and priority pollutants or prohibited discharge pollutants are known to be present in significant concentrations;

E. The user is known to have caused, is suspected to have caused, or has the potential to cause, operational problems at the treatment plant. (Ord. 1082 § 2, 1983; prior code § 2-15.01.28)

15.08.310 Million gallons/million gallons per day (MG/MGD).

"Million gallons/million gallons per day (MG/MGD)" means 1,000,000 gallons and 1,000,000 gallons per day, respectively. (Ord. 1082 § 2, 1983; prior code § 2-15.01.29)

15.08.320 Mobilehome.

"Mobilehome" means any dwelling unit so constructed as to allow relocation from place to place. (Ord. 1895 § 1, 2003; Ord. 1082 § 2, 1983; prior code § 2-15.01.30)

15.08.330 Multi-family unit.

"Multi-family unit" means any dwelling unit located on a single lot containing three or more dwelling units, including, without limitation, triplexes, quadplexes, apartments, and mobilehomes in mobilehome parks. (Ord. 1895 § 1, 2003; Ord. 1203 § 1, 1985; Ord. 1082 § 2, 1983; prior code § 2-15.01.31)

15.08.340 New users.

"New users" means all persons who commence discharging into the sewerage system after the effective date hereof. (Ord. 1082 § 2, 1983; prior code § 2-15.01.32)

15.08.350 NPDES.

"NPDES" means the national pollution discharge elimination system. (Ord. 1082 § 2, 1983; prior code § 2-15.01.33)

15.08.360 Occupant.

"Occupant" means and includes individual, firm, corporation or other organization owning, renting, leasing or otherwise occupying any premises. (Ord. 1082 § 2, 1983; prior code § 2-15.01.34)

15.08.370 Person.

"Person" means and includes any firm, association, corporation, partnership or governmental agency. (Ord. 1082 § 2, 1983; prior code § 2-15.01.35)

15.08.380 pH.

"pH" means the logarithm of the reciprocal of the weight of hydrogen ions in grams per liter of solution. (Ord. 1082 § 2, 1983; prior code § 2-15.01.36)

15.08.390 Pollute.

"Pollute" means to alter the quality of water by intentional or unintentional means that render it less usable or unusable for any beneficial use of prohibit it from being safely discharged to surface waters or to storm drains. (Ord. 1082 § 2, 1983; prior code § 2-15-01.37)

15.08.400 Premises.

"Premises" means any lot, parcel of land, building or establishment. (Ord. 1082 § 2, 1983; prior code § 2-15.01.38)

15.08.410 Pretreatment.

"Pretreatment" means the use of any works or device for treatment, alteration, control or flow limitation of sewage or industrial waste, prior to discharge into the sewerage system. (Ord. 1082 § 2, 1983; prior code § 2-15.01.39)

15.08.420 Regional costs.

"Regional costs" means costs which are shared by the city and district in accordance with the cost of providing service for each agency, including all wastewater treatment costs incurred by the district. (Ord. 1082 § 2, 1983; prior code § 2-15.01.40)

15.08.430 Residential discharge equivalent (RDE).

"Residential discharge equivalent (RDE)" means a sewage discharge equal in volume and strength to the discharge from a typical single-family dwelling, as such discharge shall be determined from time to time by the director. Sewage discharge, for purposes of calculating RDE, shall be comprised of flow, BOD and SS, and any other constituent which may be added from time to time by the director. (Ord. 1146 § 1(a), 1984; Ord. 1082 § 2, 1983; prior code § 2-15.01.41)

15.08.440 Residential user.

"Residential user" means any user introducing into the sewerage system sanitary sewage from a single-family dwelling, or from a single unit of a multiple-family dwelling. (Ord. 1082 § 2, 1983; prior code § 2-15.01.42)

15.08.450 Sanitary sewage.

"Sanitary sewage" means wastewater containing only human excrement and sanitary and household wastes derived from dwellings or other places of abode, institutions, restaurants and restrooms, locker rooms, showers, and washrooms of commercial and industrial premises. (Ord. 1082 § 2, 1983; prior code § 2-15.01.43)

15.08.460 School.

"School" means any public or private institution of learning which discharges into the city's sewerage system primarily sanitary sewage. (Ord. 1082 § 2, 1983; prior code § 2-15.01.44)

15.08.470 Auxiliary (secondary) unit.

"Auxiliary (secondary) unit" means any dwelling unit added to a lot of a single-family dwelling unit as defined in Government Code Section 65852.2, as may be amended or as provided in city of Pleasanton local ordinances. Also referred to as "in-law unit," "au pair unit," "granny unit," "auxiliary dwelling unit," "guest unit," or "second unit." (Ord. 1895 § 1, 2003; Ord. 1203 § 3, 1983; prior code § 2-15.01.44.5)

15.08.480 Service lateral.

"Service lateral" means the pipe between the trunk line and the user's side sewer connection at the edge of the street or easement. (Ord. 1082 § 2, 1983; prior code § 2-15.01.45)

15.08.490 Sewage.

"Sewage" means water carrying wastes from residences, business buildings, institutions and industrial establishments, together with such other waters as may be present, or any combination of such wastes and waters, but excluding unpolluted water. (Ord. 1082 § 2, 1983; prior code § 2-15.01.46)

15.08.500 Sewer.

"Sewer" means a pipe or conduit for carrying sewage. (Ord. 1082 § 2, 1983; prior code § 2-15.01.47)

15.08.510 Sewerage system.

"Sewerage system" means all sewers and facilities operated for carrying, collecting, pumping, treating and disposing of sewage. (Ord. 1082 § 2, 1983; prior code § 2-15.01.48)

15.08.520 Shall, may.

The term "shall" is mandatory; the term "may" is permissive. (Ord. 1082 § 2, 1983; prior code § 2-15.01.49)

15.08.530 Side sewer.

"Side sewer" means a pipe connecting to a service lateral from a house or other structure. (Ord. 1082 § 2, 1983; prior code § 2-15.01.50)

15.08.540 Single-family dwelling unit.

"Single-family dwelling unit" means a detached dwelling unit on a single lot with no common wall. (Ord. 1895 § 1, 2003; Ord. 1203 § 1, 1985; Ord. 1082 § 2, 1983; prior code § 2-15.01.51)

15.08.550 Standard methods of testing.

"Standard methods of testing" means the measurements, tests and analyses of the characteristics of water and wastes as determined in accordance with the most recent edition of the "Standard Methods For The Examination of Water And Waste Water", published jointly by the American Public Health Association, the American Water Works Association and the Water Pollution Control Federation. If such testing standards are not provided in the standard methods, the procedures contained in Title 40, Code of Federal Regulations, Part 136, as amended, shall apply. In the event specific value limits have been established, such values shall be determined from 24-hour composite samples that are representative of the waste. However, if intermittent discharges are made that are not representative of the 24-hour discharge, sampling requirements shall be determined on a case by case basis. (Ord. 1082 § 2, 1983; prior code § 2-15.01.52)

15.08.560 State.

"State" means the state of California. (Ord. 1082 § 2, 1983; prior code § 2-15.01.53)

15.08.570 Storm drains.

"Storm drains" means those pipes, canals and conduits provided to carry storm and surface waters and unpolluted wastewater. (Ord. 1082 § 2, 1983; prior code § 2-15.01.54)

15.08.580 Stormwater.

"Stormwater" means water derived from a rainfall or resulting therefrom. (Ord. 1082 § 2, 1983; prior code § 2-15.01.55)

15.08.590 Suspended solids (SS).

"Suspended solids" means the measure of solids that float or are in suspension in a sample of sewage which are removable by filtration, as determined by the method of testing for SS pursuant to the standard methods. (Ord. 1082 § 2, 1983; prior code § 2-15.01.56)

15.08.600 Total dissolved solids (TDS).

"Total dissolved solids (TDS)" means the measure of all solids that are colloidal or in solution in a sample of sewage that are not removable by filtration, but which remain after evaporation, as determined by the method of testing for TDS pursuant to the standard methods. (Ord. 1082 § 2, 1983; prior code § 2-15.01.57)

15.08.605 Townhome or townhouse.

"Townhome or townhouse" means three or more attached dwelling units, consisting of an individual ownership interest in real property and a dwelling unit. (Ord. 1895 § 1, 2003)

15.08.610 Treatment plant or treatment works.

"Treatment plant" or "treatment works" means the district wastewater treatment facilities defined by the district as "treatment works". (Ord. 1082 § 2, 1983; prior code § 2-15.01.58)

15.08.620 Trunk line or trunk sewer.

"Trunk line" or "trunk sewer" means a main sewer line to which two or more service laterals are connected and which serves the primary purpose of transporting sewage from service laterals to the treatment plant. (Ord. 1082 § 2, 1983; prior code § 2-15.01.59)

15.08.630 Uncommitted capacity.

"Uncommitted capacity" means the total capacity to which the city is entitled, less the sum of the following:

A. That capacity being used, or which may be permitted to be used, by existing users;

B. That capacity committed under connection permits outstanding but not connected to the sewerage system; and

C. That capacity committed to future use by agreements, reservations, or other specific purposes, as determined by the city, remaining to be reserved in such agreements, reservations of other specific purposes. (Ord. 1082 § 2, 1983; prior code § 2-15.01.60)

15.08.640 User.

"User" means a person who uses the sewerage system by discharging sewage or industrial wastes therein. (Ord. 1082 § 2, 1983; prior code § 2-15.01.61)

15.08.650 Volume.

"Volume" means the wastewater flow occurring over a specified period of time. (Ord. 1082 § 2, 1983; prior code § 2-15.01.62)

15.08.660 Wastewater.

"Wastewater" has the same meaning as the term "sewage". (Ord. 1082 § 2, 1983; prior code § 2-15.01.63)

15.08.670 Wastewater discharge permit.

"Wastewater discharge permit" means the permit required of all major contributing industries and available to other users as provided in Chapter 15.36 of this title. (Ord. 1082 § 2, 1983; prior code § 2-15.01.64)

15.08.680 Water softener.

"Water softener" means a unit using the ion exchange process requiring sodium ion chloride to regenerate the exchange bed. (Ord. 1082 § 2, 1983; prior code § 2-15.01.65)

15.08.690 Zoning ordinance.

"Zoning ordinance" means Title 18 of this code. (Ord. 1082 § 2, 1983; prior code § 2-15.01.66)

Chapter 15.12 ENFORCEMENT

15.12.010 Responsibility.

The primary responsibility for enforcement of the provisions of this title shall be vested with the director. The director may designate as his or her agent any employee of the city or district. Field inspectors or other employees of the city or district so designated shall be authorized to act as agents of the city for and on behalf of the director and shall possess the power to inspect and issue notices of violations of this title. Notwithstanding the foregoing, responsibility for enforcement of all aspects of pretreatment shall be vested with the district. (Ord. 1175 § 1(c), 1985; Ord. 1082 § 2 (part), 1983; prior code § 2-15.60.01)

15.12.020 Issuance of cease and desist orders.

In the event the director finds that a discharge of wastewater has taken place or is likely to take place in violation of this chapter or the provisions of an applicable wastewater discharge permit, the director may issue an order to cease and desist such discharge or practice or operation likely to cause future discharges. The cease and desist order may provide for either immediate or delayed compliance.

A. Immediate Remedial or Preventative Action. The director may direct that any person failing to comply with any of the prohibitions, limits, requirements or provisions of this title comply forthwith and take appropriate remedial or preventative action.

B. Submission of Time Schedule for Compliance. The director may require the user to submit for approval, with such modifications as the director deems necessary, a detailed time schedule of specific actions which the user shall take in order to prevent or correct a violation of this chapter, and the user shall comply in accordance with the time schedule so set forth. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.60.02)

15.12.030 Emergency corrections.

Pursuant to any provision of law relating to the emergency performance of public work and the expenditure of public funds therefor, or pursuant to any other provision of law authorizing public work on private property, the director is authorized to correct, eliminate or abate any condition upon any premises which has caused, causes, or threatens to cause a violation of any provision of this title, any applicable permit, or any other requirement of law. In the event emergency repairs, construction or other public work are performed on any premises pursuant to this section, the user responsible for the occurrence or condition giving rise to such work, the occupant of the premises and the owner of the premises shall be liable, jointly and severally, to the city for such expenses. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.60.03)

15.12.040 Damage to facilities—User's liability.

When a user's discharge of wastes causes an obstruction, damage or any other impairment to the sewerage system, the city may assess a charge against the user for the work required to clean or repair the facility and add such charge to the user's ordinary charges and fees. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.60.04)

15.12.050 Revocation of permit.

The city may revoke the wastewater discharge permit of any user violating any one of the following conditions, any provisions of this title or applicable state or federal regulations:

A. Failure of the user to factually report the wastewater constituents and characteristics of the user's discharge;

B. Failure of the user to report significant changes in operations or wastewater constituents and characteristics;

C. Refusal of reasonable access to the user's premises for the purpose of inspection or monitoring;

D. Violation of any conditions of an applicable permit;

E. Failure to pay any fees and charges imposed by this title;

F. Falsification of any information or tampering with any monitoring facility. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.60.05)

15.12.060 Termination of service.

The city may terminate or cause to be terminated water services and/or sewerage services to any premises upon a showing that (1) any provision of this title, any applicable permit, or any other regulation has been violated or threatens to be violated; or (2) user fees have not been paid.

A. Use of Capacity in Excess of Allocation. For purposes of termination of service, a user's use of capacity in excess of the user's allocation of capacity shall exist if the volume of the user's wastewater exceeds the aggregate volume of permitted discharge for a period of time equal to two billing periods for water service to the premises or four months if there is no water service to such premises.

B. Disconnection of Service. In the event of a violation culminating in the termination of sewerage service pursuant to this section, the director is authorized, and it shall be the director's duty, to disconnect the water services to the premises so designated for termination. In the event there is no city water service provided to the premises, or if such disconnection would not preclude discharges to the sewerage system, the director is authorized to disconnect all sewer connections to the city sewers.

C. Procedure for Termination of Service. Prior to termination of service, the user shall be provided with 17 days' notice of the city's intention to terminate service to the user, except in the case of emergencies, in which cases no prior notice shall be necessary so long as the user is promptly given a hearing after such service is terminated, as otherwise provided in this chapter. The user may request a hearing prior to termination. Such hearing shall be scheduled in front of the director and a representative of the city manager's office on a date not more than 30 days nor less than 15 days after the mailing of said notice to the user in order to present the user with an opportunity to explain the user's failure to comply with the terms of this title. Absent a showing of good cause by the user, the city may terminate service.

D. Reconnection—Fee. When water service has been disconnected, as provided by this chapter, the director shall require the person requesting reestablishment of the service to pay a fee of $25.00 before granting permission to reconnect to the water system. In the event sewerage service has been disconnected, the person requesting reestablishment shall pay all expenses incurred by the city related to such disconnection and for reestablishing such connection. Before water or sewerage services are reestablished, the person making said application shall take all steps required by the director to assure correction of any violation. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.60.06)

15.12.070 Falsification of information.

It is unlawful for any user to knowingly make or submit any false statement, representation, record, report, plan or other document or knowingly tamper with or render inaccurate any monitoring device or equipment installed or operated pursuant to this title or of any permit issued under this title. Any such falsification or tampering shall be grounds for revocation of any permit issued in addition to any punishment or remedy provided

by this chapter or other applicable law. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.60.07)

15.12.080 Recovery of delinquent fees and charges.

An action may be brought in the name of the city in any court of competent jurisdiction against the person who occupied the property when the service was rendered or the deposit became due, or against any person guaranteeing payment of bills at the time the service becomes delinquent for the collection of any delinquent charges and all penalties thereon provided for in this chapter. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.60.08)

15.12.090 Public nuisance.

Any discharge of waste or other condition or act in violation of any of the provisions of this title or any permit issued pursuant to this title or other directive of the director authorized by the provisions of this chapter is declared to be a public nuisance. Such nuisance may be abated, removed or enjoined and damages assessed therefor, in any manner provided by law. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.60.09)

15.12.100 Violation—Civil penalties.

Any person who intentionally or negligently violates, or causes the violation of, any provision of this title or of any permit issued pursuant to this title, or who intentionally or negligently discharges waste or wastewater which causes pollution, or who violates any cease and desist order issued pursuant to this chapter, or other effluent limitation, national standard of performance or national pretreatment or toxicity standard, shall be civilly liable to the city in a sum not to exceed $6,000.00 for each day in which such violation occurs. The city is authorized to enforce the provisions hereof in any court of competent jurisdiction. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.60.10)

15.12.110 Violation—Misdemeanor.

Any person violating any provision of this title, knowingly making any false statement, representation, record or report required under this title or knowingly tampering with and/or rendering inaccurate any meter reading or violating the terms of any permit issued pursuant to this title shall be guilty of a misdemeanor and conviction thereof shall be punishable by imprisonment in the county jail for a term not to exceed six months, or by a fine not to exceed $500.00, or by both such imprisonment and fine. Each day such violation continues shall constitute a separate offense. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.60.11)

15.12.120 Remedies cumulative.

The remedies provided for in this chapter shall be cumulative and not exclusive and shall be in addition to any and all other remedies available to the city. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.60.12)

15.12.130 Appeals.

A. Any user, permit holder, applicant or other person aggrieved by any decision, action, finding, determination, order or directive of the director made or authorized pursuant to the provisions of this chapter, or relating to any permit issued, or interpreting or implementing the same, may file a written request with the director for reconsideration thereof within 10 days of such a decision, action, finding, determination or order, setting forth in detail the facts supporting such user's or person's request for reconsideration. The director shall render a final decision within 10 days of receipt of such request for reconsideration. There shall be no right to appeal such final decision to the director a second time.

B. Any user, permit holder, applicant or other person aggrieved by the final determination of the director may appeal such determination to the city council within 10 days after notification of the final determination of the director, and shall set forth in detail the facts and reasons supporting the appeal. The appeal shall be heard by the city council within 30 days from the date of filing a notice of appeal. The appellant, the director and the city council shall be heard at the hearing on such appeal. Upon conclusion of the hearing, the city council may affirm, reverse or modify the final determination of the director as the city council deems just and equitable and in furtherance of the provisions, purposes and intent of this title. During the pendency of such appeal, the final determination of the director shall remain in full force and effect. The city council's determination on the appeal shall be final. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.60.13)

Chapter 15.16 CONNECTIONS TO SEWERAGE SYSTEM

15.16.010 Sewer connection mandatory.

All premises generating sewage shall be connected to the sewerage system except as provided pursuant to Section 15.16.020. The maintenance and use of any means of sewage disposal except as provided in this chapter shall be unlawful and is deemed to constitute a public nuisance. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.10.02)

15.16.020 Private disposal of sewage.

A. It is unlawful to construct any privy, privy vault, septic tank, cesspool, holding tank or other facility intended or used for the disposal of sewage in any manner other than through the sewerage system unless approval has been granted by the city council in accordance with the provisions of this section.

1. Applications for private disposal of sewage shall be made to the director who shall forward the request, together with the director's recommendation, to the city council for approval, conditional approval or disapproval.

2. No private system for sewage disposal shall be approved unless the system meets the minimum requirements of the county health department and any applicable provisions of city council policies which may have been adopted, from time to time, regulating such private system of sewage disposal.

B. All buildings inhabited by human beings which are not more than 250 feet from the sewerage system or an extension thereof, and for which there is a grade sufficient to allow gravity flow, shall be connected to the sewerage system.

C. All privies, privy vaults, septic tanks, cesspools, holding tanks, or other facilities used for the private disposal of sewage preexisting at the time of adoption of this title shall be permitted to continue, subject to the abatement provisions in subsection B of this section, and subject to their continued operation in a safe and healthy manner. Any preexisting private disposal facility which fails, and/or becomes a nuisance in fact, shall be immediately repaired, replaced or abandoned, and the city shall have the authority and all enforcement powers provided in Chapter 15.12 of this title to require repair or replacement of the same or connection to the sewerage system. Any replacement private system for sewage disposal shall require city council approval pursuant to subsection A of this section as if the same constituted a new system.

* **Editor's Note:** For rules regulating septic tanks, see Res. 73-139, on file in the office of the city clerk.

(Ord. 1082 § 2 (part), 1983; prior code § 2-15.10.03)

Chapter 15.20 RATES, FEES AND CHARGES

15.20.010 Classification of users.

Users of the sewerage system shall be classified as follows:

A. Residential—single-family;

B. Residential—multiple-family;

C. Commercial—bakeries;

D. Commercial—commercial laundry;

E. Commercial—restaurant;

F. Commercial—other;

G. Industrial;

H. Schools. (Ord. 1082 § 2, 1983; prior code § 2-15.50.01)

15.20.020 Permit fees.

A. Permit fees shall be charged in order to recover the costs of application processing, investigation, classification and inspection for all new sewer construction and connections, capacity allocations, wastewater discharge permits, special permits, and other services expressly or reasonably required to be performed by the city pursuant to this chapter.

B. Fees shall be those charged as may be established in the city's resolution of fees and charges, codified in the Appendix to Title 3 of this code.

C. In the event a fee has not been set pursuant to subsection B of this section for a permit or service required by this chapter, the fee collected shall be an amount reasonably calculated, as determined by the director, to reimburse the city for its actual costs in processing the permit application or providing the services requested. (Ord. 1082 § 2, 1983; prior code § 2-15.50.02)

15.20.030 User fees and charges—Generally.

The city council, from time to time, shall establish user fees and charges for the use of the sewerage system, and shall adopt user fees and charges for the district and Livermore as provided by agreement. Such fees and charges shall provide for the recovery of all local costs and regional costs incurred by the city, district and Livermore in providing sewerage service, including, but not limited to, the capital, operational, maintenance, administration, monitoring and replacement costs of the sewerage system. Fees and charges to each user shall be based on the determination of the city, the district or Livermore of the user's proportional share of such costs considering the degree of effort required to treat the sewage of each classification of user and any special costs of billing, inspecting, monitoring and administration. (Ord. 1979 § 2, 2008; Ord. 1082 § 2, 1983; prior code § 2-15-50.03)

15.20.040 User charge—Designated.

Users of the sewerage system must pay bimonthly user charges as set forth in the master fee schedule. The charges provided in such schedule shall accrue from the date the user makes the service connection.

A. Residential User Charges. The residential user charge shall be a flat rate per dwelling unit depending upon the classification of the user pursuant to Section 15.20.010 of this chapter.

B. Commercial User Charges. Commercial users shall be charged rates per 100 cubic feet of metered water delivered to the user, during the billing period depending upon the classification of the user pursuant to Section 15.20.010 of this chapter.

C. Industrial User Charges. Industrial user charges shall be the sum of: (1) the "demand" charges, established for each industrial user based on the maximum-month average-day discharge of billable parameters during the previous year; (2) "loading" charges, resulting from the quantity of billable parameters discharged by a user during a billing period; and (3) monitoring costs established for each user. For new industrial users such charges shall be as determined by the director. If the billable parameters representing a user's sewage strength are relatively constant, as determined by the director, the director may establish a unit rate per quantity of wastewater discharged based upon the strength of the sewage. Such rate shall remain constant unless and until the director determines that there has been a significant change in the user's sewage strength.

D. School User Charges. The school user charge shall be a flat rate per student based on the most current record of average daily attendance (ADA) provided by the school district.

E. Pretreatment Program User Charges. The pretreatment program user charge shall be designed to recover program costs and shall consist of: (1) a demand (service) charge, based on classes of users, designed to recover program administrative costs; and (2) a loading (sampling) charge based on the number and type of sampling analyses conducted during the billing period. Local pretreatment program user charges are set forth in Section 15.20.180 of this chapter. Regional pretreatment program user charges are set forth in the master fee schedule. (Ord. 1979 § 3, 2008; Ord. 1203 § 8, 1985; Ord. 1082 § 2, 1983; prior code § 2-15.50.03(a))

15.20.050 User charge—Determination of wastewater volume.

For purposes of determining user charges based on sewage flow, the wastewater volume discharged by any user shall be determined upon the basis of the volume of fresh water, including all sources of nonwastewater, used by, or furnished to, the user. If a user receives water solely for irrigation purposes through a totally separate meter and water system, such irrigation water shall not be included in determining the user charge.

A. Exception—Wastewater Metering. Upon application of a user, and upon a finding by the director that a significant portion of fresh water or nonwastewater, received by the user from any metered source, does not flow into the sewerage system because of the activity of the user, or by reason of removal of wastewater by other means, the director may authorize determination of the volume of wastewater discharge to be made by an appropriate metering device. Upon such determination by the director, a metering device of a type approved by the director and at a location approved by the director shall be installed, at the user's expense. Such metering device shall measure either the amount of wastewater discharged into the sewerage system, or the amount of fresh water or nonwastewater diverted from the sewerage system. Upon installation, such meters shall be maintained and tested periodically for accuracy in accordance with requirements established by the director, all of which maintenance and testing shall be at the expense of the user.

B. Exception—Estimated Volume. In lieu of the use of a metering device as specified in this section, and upon a determination by the director that it would be unnecessary or impracticable to install, maintain, or operate such a metering device, wastewater volume discharged by a user into the sewerage system may be based upon an estimate thereof determined by the director. The determination of such estimated wastewater volume shall be based upon such factors as the number of fixtures through which wastewater flows into the sewerage system from the user's premises, the seating capacity of buildings or improvements upon the premises, the population equivalent associated with the premises, the annual production of goods and services related to the premises, or other factors reasonably relating to water use, wastewater volume calculations, or diversions of wastewater flow from sewerage facilities, as determined by the director.

C. Users Without Water Service. Users not receiving metered water service shall be charged on the

basis of RDEs determined by an estimate of the user's discharge. The director shall make the estimate in accordance with procedures established for estimating discharges of new users pursuant to Section 15.24.050 of this title. The director may require unmetered users to install appropriate metering devices, at the user's expense if the director suspects that the estimate of the unmetered user's discharge will not adequately reflect the user's actual volume of discharge.

D. Permit Required. Permission for calculation of wastewater volumes to be determined in accordance with the provisions of subsections A, B and C of this section shall only be granted by a permit issued by the director or as a provision of such other permit as may be required or provided under this chapter. In the event such permission is granted pursuant to a separate permit, applications therefor shall be in writing in such form as the director shall require, and shall set forth the following:

1. The name and address of the applicant;

2. The location, or other description of the premises served by the sewerage system for which such calculation is proposed to be made;

3. Reasons supporting the need for a metering device or calculation of estimated volumes, as appropriate; and

4. Such data, statistics, or other information deemed necessary or appropriate by the director to enable the director to make the finding or determination specified as appropriate.

Permits authorized pursuant to the provisions of this section shall be subject to reasonable terms and conditions determined necessary or appropriate by the director in order to carry out the provisions of, and ensure compliance with, this chapter, or other requirements of law. (Ord. 1175, 1985; Ord. 1082 § 2, 1983; prior code § 2-15.50.03(b))

15.20.060 User charge—Minimum.

The minimum bimonthly service charge per user for use of the sewerage system shall be the appropriate bimonthly rate for those users charged a flat rate and shall be a rate equivalent to the single-family residential flat rate for users billed on a sewage flow basis. (Ord. 1082 § 2, 1983; prior code § 2-15.50.03(c))

15.20.070 User charge—Partial period use.

Charges for use of the sewerage system by users paying a flat rate for portions of a billing period shall be prorated at a daily rate equal to one-sixtieth of the bimonthly rate. Charges shall accrue from the date the service connection is made. Charges for those paying based on sewage flow shall be based on actual flow for the partial period plus a prorated portion of any flat rate charges, including demand charges and monitoring costs. (Ord. 1082 § 2, 1983; prior code § 2-15.50.03(d))

15.20.080 Collection and payment of user charges.

User charges shall be included in the municipal water service bill for each user's premises, and shall, unless otherwise provided herein, be due, payable and collected in the same manner and at the same time as the water bill. User charges shall be delinquent 21 days after billing therefor. Delinquent payments shall incur a basic penalty of 10 percent for the first month delinquent. A penalty of one-half of one percent per month shall be charged for each succeeding month for nonpayment of the charges and basic penalty. Enforcement of payment shall, unless otherwise provided herein, be made in the same manner as provided in Chapter 15.12 of this title. If there is no water service, billing and payment shall be made in the same manner, time and place as for water service. In lieu of charges collected with water service bills, the city may provide for collection of fixed rate user charges as part of the annual general county tax bill. (Ord. 1082 § 2, 1983; prior code § 2-15.50.03(e))

15.20.090 Security deposits.

A. For a new residential applicant, whether the applicant is the property owner or a tenant of a residential unit that is not master metered, The finance director may require from the applicant a security deposit in an amount not to exceed twice the average periodic (i.e., bimonthly) bill.

B. For a new residential applicant for a building that is master metered, The finance director may require from the property owner a security deposit in an amount not to exceed an estimated 12 months' average bills.

C. For a new nonresidential applicant, whether the applicant is the property owner or the tenant, The finance director may require from the applicant a security deposit in an amount not to exceed an estimated 12 months' average bills.

D. Where the new residential applicant is a tenant in a residence that is not master metered, The finance director shall not require, as a condition of the new applicant's establishing an account and receiving service, that the account be established in the property owner's name unless the property owner consents through a written agreement.

E. Where the new residential applicant is a tenant in a residence where the account for the previous tenant has outstanding charges and/or penalties, The finance director shall not require the new applicant to pay those charges/penalties as a condition of establishing an account and receiving service unless the new applicant was an adult living in the residence when the charges/penalties accrued.

F. If a portion or all of a bill is not paid, the security deposit shall be applied to satisfy the bill. Any charges/penalties not satisfied from the security deposit may be collected by the city as provided in Section 15.20.080 of this chapter. (Ord. 1703 § 2, 1997; Ord. 1082 § 2, 1983; prior code § 2-15.50.03(f))

15.20.100 Sewer and drainage operation and maintenance fund.

All revenues received from the user charges prescribed in Sections 15.20.030 through 15.20.090 of this chapter shall be deposited in a fund entitled "Sewer and Drainage Operation and Maintenance Fund," and used for any purpose described in Sections 15.20.030 through 15.20.090 of this chapter. (Ord. 1082 § 2, 1983; prior code § 2-15.50.03(g))

15.20.110 Commencement of peak month loading charges.

Peak month loading charges for every user shall commence on the date the user purchases a connection permit, or on the date the district's treatment and disposal facilities are ready for use, whichever is later. Peak month loading charges shall be based on the total capacity purchased. The peak month loading charges shall be based on unit costs for each user demand charge, except for collection, as determined by the director. (Ord. 1203 § 5, 1985; prior code § 2-15.50.03(h))

15.20.120 Connection fees and charges—Generally.

Connection fees and charges shall be assessed new users or existing users desiring expanded capacity in the sewerage system. Connection fees and charges shall provide for the recovery of the user's proportional share of:

A. The city's and district's capital costs of the sewerage system;

B. The cost of treatment plant expansion, improvements and rehabilitation;

C. The cost of repairing, replacing and expanding the sewerage system;

D. The cost of purchasing capacity from another sewerage system; and

E. Any other sewerage system related purpose. (Ord. 1082 § 2, 1983; prior code § 2-15.50.04)

15.20.130 Connection fee—Levied.

Connection fees shall be assessed new users or existing users desiring expanded capacity according to the schedule set forth in Section 15.20.180 of this chapter. Connection fees shall be levied and are due and payable to the city at the time a permit is issued authorizing connection to the sewerage system.

A. District Connection Fee. A district connection fee shall be levied and collected by the city from each applicant unless the applicant has paid the appropriate district connection fee directly to the district pursuant to agreements entered into prior to the adoption of this chapter. Applicants who have paid the district connection fee directly to the district shall furnish the city satisfactory evidence of a valid district connection permit at the time of application for sewerage connection. District connection fees collected by the city shall be transferred to the district monthly and shall be deposited by the district in its sewer expansion fund.

B. City Connection Fee. The city connection fee shall be levied and collected by the city from each applicant. City connection fees shall be deposited in the sewer improvement fund.

C. City Connection Surcharge. In the event the city has entered into any reimbursement agreement or other agreement requiring the collection and/or redistribution of connection fees from all or any particular portion of the city, the city shall collect said connection fees in the amount and manner as prescribed in those agreements.

D. Exception—Reconstruction of Damaged Structures. No sewer connection fee or charge shall be made for the construction, rehabilitation, or repair to any existing structure damaged or destroyed by a natural catastrophe or act of God, including, but not limited to, fires, earthquakes, and floods.

E. Exception—Credits. A credit against connection fees and charges shall be permitted for all lands subject to any agreement that specifically provides for credits or reimbursements against such fees and charges. (Ord. 1082 § 2, 1983; prior code § 2-15.50.04(a))

15.20.140 Connection fee—Additional capacity.

Any change in use or addition to premises resulting in a need for greater capacity in the sewerage system shall require the payment of additional fees as prescribed herein. (Ord. 1082 § 2, 1983; prior code § 2-15.50.04(b))

15.20.150 Connection fee—Payment when.

Prior to the issuance of any building permit or other permit authorizing connection to or additional use of capacity in the sewerage system by the city, the applicant therefor shall pay to the city the necessary connection fees provided for in this chapter, together with such other fees as may be now in effect or hereafter adopted. (Ord. 1082 § 2, 1983; prior code § 2-15.50.04(c))

15.20.160 City sewer improvement fund.

All revenues deposited in the sewer improvement fund shall be used for any of the purposes described in this section. Interest earned on such funds shall remain in the sewer improvement fund and shall be used for the same purposes as the principal. (Ord. 1082 § 2, 1983; prior code § 2-15.50.04(d))

15.20.170 Connection fee—Waiver.

Upon application and good cause shown, the city council may, in its sole discretion, waive any of the fees and charges prescribed in this chapter over which it has authority. (Ord. 1082 § 2, 1983; prior code § 2-15.50.05)

15.20.180 Schedule of rates, fees and charges.

Sewer rates, fees and charges shall be in accordance with the amounts specified in the master fee schedule. (Ord. 2002 § 1, 2010; Ord. 1981 § 1, 2008; Ord. 1979 § 4, 2008; Ord. 1952 § 1 (Exh. A), 2007; Ord. 1910 § 1, 2004; Ord. 1837 § 1, 2001; Ord. 1807 § 1, 2000; Ord. 1787 § 1, 1999; Ord. 1784 § 1, 1999; Ord. 1712 § 1, 1997; Ord. 1671 § 1, 1995; Ord. 1651 § 1, 1995; Ord. 1618 § 1, 1994; Ord. 1587 § 1, 1993; Ord. 1535 § 1, 1992; Ord. 1500 § 1, 1991; Ord. 1499 § 1, 1991; Ord. 1426 § 1, 1989; Ord. 1397 § 1, 1989; Ord. 1326 § 1, 1987; Ord. 1256 § 1, 1986; Ord. 1203 §§ 6, 7, 1985; Ord. 1082 § 2, 1983; prior code § 2-15.50.06)

Chapter 15.24 SEWER SERVICE REGULATIONS

15.24.010 Connection permit—Required.

Application for permission to discharge sewage into the sewerage system shall be made to the city on an application form as prescribed by the director and containing such information as may be required to determine the capacity required and the need for any wastewater discharge permit or other special permit. No discharge to the sewerage system shall be allowed until a connection permit has been issued authorizing a permitted amount of sewage flow in accordance with the capacity allocated in the connection permit. (Ord. 1082 § 2, 1983; prior code § 2-15.30.01)

15.24.020 Adequate sewerage system capacity required.

A connection permit shall be issued only if collection lines exist sufficient and adequate to transport the new user's sewage flow to the treatment plant, and if: (a) the user has secured capacity for that flow through prior purchase of a connection permit or through some reservation agreement; or (b) uncommitted capacity exists at the treatment plant and sewage export facilities for that flow. (Ord. 1082 § 2, 1983; prior code § 2-15.30.01(a))

15.24.030 Payment of fees.

No connection permit shall be issued unless connection and other fees and charges have been paid as provided in Chapter 15.20 of this title. (Ord. 1082 § 2, 1983; prior code § 2-15.20.01(b))

15.24.040 Maximum permissible discharge.

No connection permit shall be issued if, based on the estimated capacity required for the project as shown in the application, the capacity required would exceed both: (a) a rate of 3,000 gallons per day per net acre; and (b) a total flow of 7,000 gallons per day unless the application has been approved by the city council. If, after reviewing an application to exceed the maximum permissible discharge, the city council determines that granting the connection permit would adversely affect the ability of the city to serve other new users due to the scarcity of capacity and the percentage of such capacity necessary for the project, the city council may require measures be taken to reduce the volume of sewage flow or may deny the application. (Ord. 1101 § 1 (part), 1983; Ord. 1082 § 2 (part), 1983; prior code § 2-15.30.01(c))

15.24.050 Sewage capacity allocation.

The city's uncommitted capacity shall be available to new or expanded users in accordance with the provisions of this section.

A. First Come, First Served. Uncommitted capacity shall be available on a first-come, first-served basis. Other than capacity allocated, and reserved, through agreement between a user and the city, capacity shall be allocated only upon the issuance of a connection permit in conjunction with a valid building, plumbing, or other permit requiring a sewage connection.

B. Capacity Required. The sewage capacity required by any project shall be based on the estimated flow, as determined by the city, in terms of the residential discharge equivalency ("RDE").

1. Single-family Residential. Each single-family residential dwelling shall be assured to require one

RDE of sewage capacity.

2. Other Residential. Each non-single-family residential dwelling, including, without limitation, condominium and multi-family dwellings, shall require the number of RDEs, or fraction thereof, which approximates the strength and flow of the particular dwelling's, or class of dwelling's, sewage discharge, as determined by the director.

3. Nonresidential Uses. The sewage capacity required shall be the number of RDEs, or fraction thereof, which approximates the strength and flow of the user's discharge.

a. For purposes of estimating capacity requirements, the city shall base its estimates of sewage strength and flow on the number of plumbing fixture units contained in the project. If the director determines that the fixture unit method would be inappropriate in estimating sewage capacity requirements, the director may base his or her estimate on any other relevant factors, including, but not limited to, the applicant's estimate of capacity required, the seating capacity of buildings or improvements upon the premises, the population associated with the premises, the annual production of goods and services related to the premises, the estimated strength of discharges and number of employees and shifts, or any other factors reasonably related to wastewater volume or strength for the average working day during the peak month of sewage generation.

b. The applicant may request the director to make an adjustment to the sewage capacity estimated at the time the permit is issued, and receive a partial refund from the connection fee paid, if the applicant is able to show that the actual discharge after one year of operation is at least 10 percent less than the flow estimated for connection purposes. (Ord. 1203 § 4, 1985; Ord. 1175 § 1(a), 1985; Ord. 1146 § 1(b), 1984; Ord. 1082 § 2 (part), 1983; prior code § 2-15.30.02)

15.24.060 Allocation of capacity to existing users.

For purposes of this chapter, the capacity allocated to any existing commercial user or industrial user shall be the larger of (1) the capacity purchased upon obtaining a city connection permit, or (2) the average day maximum month discharge, including both flow and strength characteristics, during the calendar year 1982, or some prior year when it can be shown to the satisfaction of the director that some prior year's flow is more representative of a user's flow than that occurring in 1982. Sewage connections issued on a fixture unit basis prior to the year 1979 shall be considered to have capacity equivalent to 280 gallons per day for every 21 fixture units; those issued on or after January 1, 1979, shall be considered to have capacity equivalent to 220 gallons per day for every 21 fixture units. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.30.03)

15.24.070 Connection permit—Lapse.

A connection permit shall lapse and be of no further effect upon the lapse of the building, plumbing, or other permit requiring the issuance of the connection permit. The connection fees paid to the city shall be refundable upon the applicant's request in event the connection permit has lapsed. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.30.04)

15.24.080 Use restrictions—Inspection.

The use of the side sewer connection shall be limited to the facilities covered by the connection permit. Before connecting any additional facilities to the side sewer, the property owner shall make application to the city for such service and pay such additional fees as may be applicable. In the event the applicant desires to make greater than one connection to the side sewer with respect to a single property, the applicant shall apply for the same and the permit may allocate such connection rights to specific portions of the property. Periodic inspection of the premises may be made by the director to determine if any unauthorized connections have been made. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.30.05)

Chapter 15.28 SEWER USE REGULATIONS

15.28.010 General prohibitions.

No person shall discharge, deposit, or throw, or cause, allow or permit to be discharged, into any public sewer or plumbing fixture or to any drain, manhole, culvert, catchbasin, sanitary catchbasin, or private sewer which connects to the sewerage system, any substance of any kind whatsoever tending to obstruct or injure the sewerage system, or cause a nuisance, or which shall in any manner interfere with the proper repair or maintenance of the sewerage system, or which shall in any way render it difficult for any workmen to operate or repair the sewerage system, or render it impossible to meet the effluent or solid residues disposal requirements which may be set by the regional water quality control board, including, but not limited to, any discharge of waste into the sewerage system which causes, threatens to cause, or is capable of causing, either alone or by interaction with other substances, any of the following:

A. Fire or explosion,

B. Obstruction of the flow in, or injury to, the sewerage system, or any portion thereof;

C. Danger to the life or safety of any person;

D. Condition inhibiting or preventing the effective maintenance or operation of the sewerage system;

E. Strong or offensive odor, air pollution, or any noxious, toxic or malodorous gas or substance, or gas-producing substances;

F. Interference with the wastewater treatment process, or excessive collection or treatment costs;

G. Use of a share of the capacity of the sewerage system in excess of that permitted;

H. Interference with any wastewater reclamation process which does or may operate in conjunction with the sewerage system, or any overloading or breakdown of such reclamation process, or excessive reclamation costs, or which results in any product of the treatment process which renders such reclamation process impracticable or infeasible under normal operating conditions;

I. Detrimental environmental impact, or a nuisance wherever located or a condition unacceptable to any public agency having regulatory jurisdiction over operation of the sewerage system;

J. Discoloration, or any other adverse condition in the quality of the effluent from the sewerage system such that discharge wastewater quality requirements established by any applicable law, rule, regulation, chapter, or permit condition cannot reasonably be met by the treatment works; or

K. Conditions at or near the sewerage system, or any portion thereof, which cause, or may cause, the city or the district to be in violation of the requirements of any applicable law, rule, regulation, chapter or permit. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.40.01)

15.28.020 Discharge to sewers.

All sewage shall be discharged to the sewerage system except as provided in this chapter. Discharge shall be through a city-approved sewer connection to a service lateral unless a special permit has been issued by the director to allow direct discharge into a manhole or other part of the sewerage system. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.40.02)

15.28.030 Accidental discharge.

A. Protection from Accidental Discharge. As required by the director, users shall provide protection from accidental discharges of prohibited materials or other wastes regulated by this chapter. Facilities to prevent accidental discharge of prohibited materials shall be provided and maintained at the user's expense. Detailed plans showing facilities and operating procedures to provide this protection shall be submitted to the city for review and shall be approved by the city prior to construction of the facility. The review and approval of such plans and operating procedures shall in no way relieve the user of the responsibility for modifying the facility as required by the city to provide the protection necessary to meet the requirements of this chapter.

B. Notification Required. All users shall notify the director and the treatment plant by telephone immediately upon accidentally discharging, or discovering the discharge of, wastes in violation of this chapter so that the city and/or the district may take countermeasures to minimize damage to the sewerage system, treatment plant, treatment process and the receiving waters. The telephone notification shall be followed within 15 days of the date of occurrence by a detailed written statement, delivered to the director, describing the cause of the accidental discharge and the measures being taken to prevent similar future occurrences. Such notification shall not relieve the user of liability for any loss, cost or expense incurred by the city and/or district as a result of such discharge, including, without limitation, loss or damage to the sewerage system, treatment plant or treatment process and any fines imposed by any agency of the city and/or district on account thereof.

C. Notice to Employees. The director may require that notice be permanently posted on a bulletin board in the offices of each commercial and/or industrial user, and shall require similar posting by each major contributing industry, advising such user's employees of the numbers to call in case of an accidental discharge in violation of this chapter. (Ord. 1082 § 2, 1983; prior code § 2-15.40.03)

15.28.040 Discharge of storm drainage, ground water, and unpolluted waters prohibited—Exception.

No person shall discharge, cause to be discharged, or permit to be discharged into the sewerage system any stormwater, ground water, rainwater, street drainage, subsurface drainage, swimming pool drainage, roof runoff, yard drainage, water from irrigation, water from cooling condensers, unpolluted industrial process water, water from processing or other sources which produces an unpolluted effluent satisfactory for direct discharge into the storm drains or surface waterways. However, if the director determines that no reasonable alternative method of disposal other than discharge into the sewerage system of such waters is available, the director may permit discharge into the sewerage system of such waste if a contract is entered into between such person and the city providing for payment by such person of additional processing and facilities expansion costs, if any. (Ord. 1082 § 2, 1983; prior code § 2-15.40.04)

15.28.050 Controlled discharge.

As deemed necessary by the director, a user shall provide facilities for storage of peak flows to prevent flows beyond the capacity of the sewerage system or the user's allocation of capacity. (Ord. 1082 § 2, 1983; prior code § 2-15.40.05)

15.28.060 Limitations on sewage constituents and characteristics.

No person shall discharge or cause to be discharged into the sewerage system any of the following:

A. Any liquid or vapor having a temperature higher than 150 degrees Fahrenheit;

B. Any water or wastes which contain more than 200 milligrams per liter of fat, oil or grease that is soluble by the freon extraction process;

C. Any gasoline, benzene, naphtha, fuel oil or other liquid, solid or gas which, by reason of its nature or quantity, if sufficient, or may be sufficient, to cause, either alone or by interaction with other substances, fire, explosion or injury in any other way to any person, property or the sewerage system;

D. Any garbage, except garbage properly ground with a mechanical garbage grinder and meeting the requirements of Section 15.28.100 of this chapter;

E. Any ashes, cinders, sand, mud, straw, shavings, metal, glass, rags, feathers, tar, coal tar, asphalt, cement, plastics, woods, paunch manure or any other solid or viscous substance capable of causing obstruction to the flow in sewers or other interference with the proper and economical operation of the sewerage system;

F. Any waters or wastes with a pH lower than 6 or higher than 11, or having any corrosive property capable of causing damage or hazard to structures, equipment and/or personnel;

G. Any waters or wastes exceeding the following constituent concentrations, unless a contract is entered with the city providing payment for additional treatment or plant expansion costs:

Constituent	Limit, mg/l
BOD	400
COD	1,500
SS	400
TDS	1,000

H. Any waters or uses having a fluoride concentration greater than five milligrams per liter;

I. Wastes discharged into the sewerage system from the regeneration of any water softeners of any kind or description, whether private or commercial;

J. Any sulfide forming pollutant or waste which, when discharged to the sewerage system, generates sulfide concentrations in excess of one milligram per liter;

K. Any wastewater with objectionable color not removed in the treatment process, such as, but not limited to, dye wastes and vegetable tanning solutions;

L. Any noxious or malodorous liquids, gases or solids which either singly or by interaction with other wastes are sufficient to create a public nuisance or hazard to life or are sufficient to prevent entry into the sewerage system for maintenance and repair;

M. Any waters or wastes in excess of the maximum volumes, flows and/or rates of flow prescribed in the applicable permits issued pursuant to this chapter;

N. In addition to the restrictions set forth in this section, any pollutants, including oxygen demanding pollutants such as BOD and COD, discharged at a flow rate and/or pollutant concentration which a user knows, or has reason to know, is likely to cause interference with the treatment works. (Ord. 1319 § 1, 1987; Ord. 1303 § 1, 1987; Ord. 1082 § 2, 1983; prior code § 2-15.40.06)

15.28.070 Limitations on toxic pollutants.

A. No user shall discharge any of the following toxic substances in excess of its respective concentration limit:

	Discharge Limit
Pollutant	**mg/l**
Arsenic	0.50
Cadmium	1.00
Total chromium	1.00

Copper	1.00
Lead	2.00
Mercury	0.01
Nickel	1.50
Selenium	1.30
Silver	1.50
Zinc	4.00
Cyanide	0.50
Phenols	20.00
Polychlorinated biphenyl	0.01
Total identifiable chlorinated hydrocarbon	0.02
TTO	5.00
PAH	6.50
Oil and grease (animal/vegetable)	200
Oil and grease (hydrocarbon)	150
pH	6<pH<11

B. In addition, no person shall discharge or cause to be discharged any wastewater containing toxic substances that are likely to endanger public health or safety, interfere with the treatment process, cause the effluent water from the treatment plant to exceed NPDES prescribed limits, or render treatment plant sludge unfit for agricultural applications. (Ord. 1896 § 1, 2003; Ord. 1082 § 2, 1983; prior code § 2-15.40.07)

15.28.080 Radioactive wastes.

A. General Prohibition—Exceptions. No person shall discharge, or cause to be discharged, any radioactive wastes into the sewerage system, except where:

1. The waste is discharged in strict conformance with current radiation control regulations and federal regulations and recommendations for safe disposal of such wastes;

2. The discharging of such radioactive wastes will not cause injury to personnel or damage to the sewerage system, irrespective of the provisions of subsection (A)(1) of this section; and

3. A wastewater discharge permit has been issued pursuant to this chapter.

B. Reports—Accidental Spills. Any person permitted to discharge a radioactive waste into the sewerage system in accordance with this section shall submit to the director such reports as the director may deem necessary. In the event of any accidental spill of any radioactive material into the sewerage system, the person responsible shall:

1. Immediately notify the city and the district; and

2. Render such technical or other assistance to the city and the district as may be within such person's power in order to prevent the sewerage system from becoming contaminated with radioactivity. (Ord. 1082 § 2, 1983; prior code § 2-15.40.08)

15.28.090 Septic tank and similar discharges.

No septic tank, holding tank, cesspool or chemical toilet waste shall be discharged into the sewerage system at any points other than those designated by the director. The director may grant a special permit for such discharges; provided, that only waste material meeting the requirements of this chapter shall be discharged. A fee for such discharge shall be made as determined by the director. (Ord. 1082 § 2, 1983; prior code § 2-15.40.09)

15.28.100 Discharge of garbage.

Garbage shall be admitted to the sewerage system only if first passed through a mechanically operated grinder. Garbage which increases operation costs or decreases the treatment plant's effectiveness, such as: (a) commercial garbage, (b) disposal of wastes from establishments such as, but not limited to, restaurants, markets, hospitals, or nursing homes, or (c) food processing wastes, shall be permitted only when a special permit has been issued by the director providing for payment of additional costs incurred as a result of said discharges. (Ord. 1082 § 2, 1983; prior code § 2-15.40.10)

15.28.110 Specific user limitations.

In addition to the limitations upon the characteristics or quantity of wastewater discharged, caused to be discharged or permitted to be discharged into the sewerage system pursuant to this chapter, the director may, in connection with the issuance of permits pursuant to the provisions of this chapter, establish additional specific limitations on wastewater discharges upon a finding by the director that:

A. The limitations set forth in this chapter may not be sufficient to protect the operation of the city's sewerage system, district treatment facilities, or any portion thereof, or the waste or wastewater proposed to be discharged otherwise constitutes a hazard to, or unreasonable burden upon, such operation; or

B. The limitations expressly set forth in this chapter may not be sufficient to enable the operation of the sewerage system or district treatment facilities to comply with water quality standards or effluent limitations specified in the NPDES permit or any other applicable permit. (Ord. 1082 § 2, 1983; prior code § 2-15.40.11)

15.28.120 Dilution prohibited.

No user shall increase the use of process water or in any way attempt to dilute a discharge as a partial or complete substitute for adequate pretreatment in order to achieve compliance with the limitations contained in the federal standards, or in any other pollutant specific limitation developed by the city, state or federal government. (Ord. 1082 § 2, 1983; prior code § 2-15.40.12)

15.28.130 Special agreement allowed.

Nothing contained in this chapter shall be construed as preventing any special agreement between the city and any person whereby any water or waste of unusual strength or character or composition may be accepted by the city for treatment. Such agreements may be allowed, and, in the event that any such special agreement or arrangement shall involve additional or extraordinary expense to the city or district, such individual shall be required to reimburse the city therefor, and to post with the city such bond or other guarantee as shall be acceptable to the city to protect the city against any damage which may be caused thereby. (Ord. 1082 § 2, 1983; prior code § 2-15.40.13)

15.28.140 Further limitations.

Upon the promulgation of the federal categorical pretreatment standards ("federal standards") or any new standards by the district for a particular industrial subcategory, the federal standards or the new district standards, if more stringent than limitations imposed under this chapter for sources in any applicable subcategory, shall

immediately supersede the limitations imposed under this chapter. (Ord. 1082 § 2, 1983; prior code § 2-15.40.14)

15.28.150 Testing standards.

All measurements, tests and analyses of the characteristics of water and wastes shall be determined according to the standard methods. (Ord. 1082 § 2, 1983; prior code § 2-15.40.15)

15.28.160 Requirement for pretreatment.

The director may require any user to install, prior to discharging into the sewerage system and at such user's expense, pretreatment or screening of such user's sewage, or such other measures as may be necessary to reduce objectionable characteristics or constituents so that the discharged sewage conforms with the requirements set forth in this chapter. All plans and specifications relating to such pretreatment or screening shall be reviewed by the director prior to construction thereof. Approval of plans by the director shall not constitute a guarantee of pretreatment performance. All such plans and specifications shall be drawn by a registered professional engineer. (Ord. 1082 § 2, 1983; prior code § 2-15.40.16)

15.28.170 Monitoring facilities.

A. The director may require any user to install and operate, at the user's expense, monitoring facilities to allow inspection, sampling and flow measurement in the side sewer or internal drainage systems. In the event monitoring facilities are not available on any premises, the city may monitor the sewage flow at the nearest manholes in the public trunk sewer upstream and downstream of the service lateral serving the user's premises and impute any difference therein to the user's sewage.

B. Monitoring facilities shall be situated on the user's premises, but the director may allow, when such location would be impractical or cause undue hardship on the user, the facility to be constructed within the public street or sidewalk area in the service lateral, provided that the same is located in such a manner that it will not be obstructed by landscaping or parked vehicles.

C. There shall be ample room in or near such monitoring facility to allow accurate sampling and composting of samples for analysis. If the monitoring facility is inside the user's fence, accommodations shall be made to allow access to the same by city personnel, such as a gate secured with a city lock.

D. Monitoring facilities shall be provided in accordance with city design standards and specifications whether constructed on public or private property.

E. Monitoring facilities shall be maintained at all times in a safe and proper operating condition at the full expense of the user.

F. Monitoring facilities not installed upon initial construction of a project shall be constructed and completed within 90 days following written notification by the director that such facilities are required. The director may grant a time extension upon a finding of good cause. (Ord. 1082 § 2, 1983; prior code § 2-15.40.17)

15.28.180 Inspection and sampling.

The director is authorized to inspect the premises of any user at all reasonable times in order to ascertain whether the provisions of this chapter or the provisions of any permit issued pursuant to this chapter are being complied with. Owners or occupants of premises where wastewater is created, held or discharged shall allow ready access at all reasonable times to all parts of the premises for the purposes of inspection, sampling, monitoring, records examinations, or performing any or all of the duties reasonably necessary or appropriate in carrying out or enforcing the provisions of this chapter or any permit issued pursuant to this chapter. The director shall further have the right to install and use on the user's premises such devices as are reasonably necessary or

appropriate to conduct sampling, metering, or monitoring operations or any other of the aforesaid duties. In the event a user has established security measures requiring identification and clearance prior to entry onto such user's premises, the user shall furnish and provide identification or clearance to the director so as to permit ready access by the director to the premises for the purposes described in this section. (Ord. 1082 § 2, 1983; prior code § 2-15.40.18)

15.28.190 Discharge reports.

A. Upon determination by the director that such information is necessary or appropriate for the director to reasonably carry out the provisions of this chapter, the director may require that any person discharging, causing to be discharged, permitting to be discharged, or proposing to discharge wastewater into the sewerage system file a periodic discharge report, the cost of which shall be borne by such person.

B. Discharge reports shall include the following:

1. Information relating to the nature of manufacturing, fabricating, or other processes conducted by the user;

2. Statements of the amount of fresh or nonwastewater volumes, wastewater volumes, rates of flow, mass emission rates, production quantities, hours of operation and number and classification of employees; or

3. Other information relating to the generation of waste, including wastewater constituents and characteristics of the pertinent wastewater discharge as required by the director.

C. The director may require that discharge reports include the chemical constituents and quantity of liquid, gaseous, or solid materials stored on the premises relating to such discharge, even though such materials are not normally discharged into the sewerage system.

D. Discharge reports shall be in addition to self-monitoring reports, information furnished in connection with wastewater discharge permits, or other permits authorized under this chapter. The reports authorized and required under this section shall be filed with the director periodically and/or at such other times as the director may reasonably require. (Ord. 1082 § 2, 1983; prior code § 2-15.40.19)

Chapter 15.32 SEWER CONSTRUCTION AND MAINTENANCE

15.32.010 Master plan and standards.

All new sewerage systems shall conform to the master plan of the sewerage system as established by the director. The director shall cause to be prepared, and is authorized to prepare, a master plan for the sewerage system and all necessary design and construction standards for construction of sewers within the city.

A. Conformity to Plans. All sewers, whether trunklines, service laterals or side sewers, shall conform to the city master plan and the city's design and construction standards, whether installed by the city, developer, or any other person. City approval of plans for such construction shall be required notwithstanding the ultimate ownership of the sewer lines.

B. Ownership of Sewers. Trunk sewers and service laterals shall be owned by the city unless the city council approves the construction and retention of private trunk sewers and service laterals. Except for city council approved private sewers, the city shall not provide sewerage service by means of any trunk sewer or service lateral to which it does not have full and complete title at the time of rendering such service. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.20.01)

15.32.020 Construction permit required.

Application for permission to construct, install, alter or repair a side sewer, service lateral or trunk sewer shall be made to the city. The applicant's proposed sewerage system shall conform to the city's sewerage system master plan for the general area and all city design and construction standards as established by the director. No construction shall commence until city approval of the application and issuance of a permit for the construction has been obtained. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.20.02(a))

15.32.030 Contractor required—Bonds—Exception.

Except as provided in this section, it is unlawful for any person who is not a contractor or master plumber licensed under the state Contractor's License Law (Section 7000 et seq., of the Business and Professions Code of the state of California) to install or construct any sewer.

A. Contractor's Bonds and Insurance. In any instance where a contractor or master plumber is required to do work pursuant to this section, prior to commencement of any work by such contractor or master plumber, the same shall file a certificate of insurance with the city showing public liability and property damage insurance and workers' compensation insurance in amounts specified, from time to time, by the city attorney to insure the protection of the city, its citizens,, officers and employees.

B. Exception to Contractor Requirement. A registered contractor or master plumber is not necessary for work done solely on private property, but such work shall be subject to inspection by city representatives to insure an acceptable quality of workmanship and compliance with this chapter and all design and construction standards promulgated under this chapter. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.20.02(b))

15.32.040 Sewer construction bond.

An applicant for a permit for the construction, installation, alteration or repair of a city sewer shall furnish to the city a good and sufficient surety bond in an amount as required by the city on a form furnished by the city or

other forms satisfactory to the city attorney. Such bond shall guarantee the repair of physical damage to facilities suffered by the city and private parties and cover additional expense in case of poor or improper workmanship and materials. Such guarantee shall be for a period of one year after the work is completed and accepted by the city. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.20.02(c))

15.32.050 Road excavation permit—Bond.

No excavation shall be made in any state highway, county road, city street, easement, or other public right-of-way within the city limits, unless and until an encroachment permit has been issued therefor. Application for encroachment permits shall be made with the city and shall be accompanied by a cash deposit or bond as prescribed in this chapter. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.20.02(d))

15.32.060 Barriers and lights.

The installer shall maintain such barriers, lights and signs as are necessary to give warning to the public at all times during construction of any dangerous condition to be encountered in consequence thereof. The installer shall protect the public, particularly in the use of walkways, against any hazardous condition arising in connection with the construction of any sewer. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.20.02(e))

15.32.070 Inspection.

All sewer construction work in the city shall be inspected by the director or his or her designated agents.

A. Trenches. All trenches shall be left open and the pipes therein shall be left uncovered until after inspection thereof by the director shall have been made and the pipe laying shall have been approved by the director. After inspection by the director, such trenches shall be backfilled without delay and any street opened shall be restored to its original or better condition.

B. Advance Notice. In all instances where an inspection is required, not less than 24 hours' advance notice shall be given to the office of the director stating the time when the work will be sufficiently advanced for inspection.

C. Substandard Construction. In case any sewer work has been inspected and any portion thereof has been found substandard by the director, prior to approval of the work by the city, a written notice to that effect shall be given informing the owner of the premises, the agent of such owner, the developer, or other person requesting the inspection to make the repairs necessary to place the sewer in satisfactory condition. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.20.02(f))

15.32.080 Responsibility for defects.

All persons performing or permitted to perform work under this chapter shall be held strictly responsible for any and all acts of their agents or employees in connection with the work. Upon being notified in writing by the city of any defect in any sewer work or of any violation of the provisions of this chapter or design and construction standards promulgated hereunder, the person or persons responsible for the work shall take immediate steps to correct such defect or violation. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.20.02(g))

15.32.090 Connection of side sewers to city sewer.

Connection to the sewer lines owned and operated by the city shall be made only in the manner approved by the director. No connection shall be approved which is not deemed safe by the director or which fails to conform with any provision of this chapter or any design or construction standard promulgated thereunder. Connection of a side sewer, or any portion thereof, to a city sewer shall be made by the owner or the owner's

designated representative, at the owner's expense, after the appropriate applications have been filed and approved. After such connection is made, the same shall be left exposed until it has been inspected and approved by the director. Thereafter, the installer may commence use of the sewer connection.

A. Separation of Sewer Connections. All premises, except those for which private sewerage systems are permitted as provided in this chapter, shall have independent connections with the city sewer; provided, that multiple premises located on a single parcel of land which cannot be subdivided and which premises are all under one ownership may, upon approval of the director, be connected to the same service lateral.

B. Sewer Plans for Groups of Buildings. No group of buildings shall be connected in a city sewer without first having the plan of the private sewerage system serving such buildings approved by the director.

C. Service Point. Sewage shall be delivered to the service point selected by the city at the elevation selected by the city. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.20.03)

15.32.100 Maintenance responsibility.

The city shall maintain all trunk sewers. Maintenance of side sewers and service laterals shall be the responsibility of the property owner served by such sewers. Any private sewer system, including private trunk sewers, shall be maintained by the owner of the private system. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.20.04)

Chapter 15.36 WASTEWATER DISCHARGE PERMITS

15.36.020 Optional.

A wastewater discharge permit may be issued by the director to any user, upon application therefor, who: (1) requests that charges and fees established pursuant to this chapter be based upon an estimated volume of wastewater discharged, or to be discharged, into the sewerage system, or (2) establishes to the satisfaction of the director that wastewater proposed to be discharged from the user's premises into the sewerage system has, or will have, due to pretreatment, process changes, or other reasons related to such wastewater characteristics, wastewater strength characteristics less than the normal range for the user classification to which such user is assigned. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.40.20(b))

15.36.030 Application.

A. Users seeking a wastewater discharge permit shall complete and file with the director an application in the form prescribed by the director and accompanied by the applicable fees. The applicant may be required by the director to submit, in units and terms appropriate for evaluation, the following information:

1. The applicant's name, address and industrial classification number according to the Standard Industrial Classification Manual, United States Bureau of the Budget, as amended;

2. The volume of wastewater proposed to be discharged daily;

3. The wastewater constituents and characteristics;

4. The time and duration of discharge;

5. The average and 15-minute peak period wastewater flow rates, including daily, monthly and seasonal variations, if any;

6. The site plans, floor plans, mechanical plans, plumbing plans and erection details showing all sewers and appurtenances by size, location and elevation;

7. A description of the activities, facilities, equipment and plant processes proposed for the premises, including all materials, processes and types of materials which are or could be discharged;

8. Each product produced, by type, amount and rate of production;

9. The number and type of employees and hours worked;

10. A hazardous materials survey.

B. The director shall evaluate the data furnished by the applicant and may require additional information to evaluate the permit application. After evaluation and approval of all data required, the director may issue a wastewater discharge permit subject to terms and conditions provided in this chapter. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.40.20(c))

15.36.040 Permit conditions.

Wastewater discharge permits shall be expressly subject to all provisions of this chapter and all other regulations, user charges and fees established by the city. The conditions imposed in all wastewater discharge permits shall be uniformly enforced by the director in accordance with this chapter and applicable state and federal regulations. Permits may impose, without limitation, conditions and requirements as follows:

A. That the applicant separate the industrial wastes from the sanitary sewage prior to discharge into the public sewer;

B. Limitations on the average and maximum wastewater constituents and characteristics;

C. Limitations on the rate of flow and the time of discharge from the premises;

D. Installation by the applicant of inspection and sampling facilities sufficient to monitor the quantity and quality of sewage discharged;

E. Such pretreatment requirements, including a compliance schedule, as the director may deem necessary;

F. Specifications for monitoring programs, which may include sampling locations, frequency and method of sampling, number, types and standards for tests, and reporting schedules. Monitoring shall be provided by the user at the user's expense, using a state-certified laboratory. The user's laboratory, where available, may be used if approved by the director;

G. Submission of technical reports or discharge reports;

H. Maintenance of plant records relating to wastewater discharge as specified by the director and affording the director access thereto;

I. Mean and maximum mass emission rates, or other appropriate limits, when incompatible pollutants are proposed or present in the user's wastewater discharge;

J. Other conditions as deemed appropriate by the director to insure compliance with this chapter;

K. The installation and maintenance by the user, at the user's expense, of grease, oil and sand interceptors or traps that are necessary for the proper handling of liquid wastes, the containment of grease and excessive amounts of inflammable wastes and other harmful ingredients. All interceptors or traps shall be of a type and shall have a capacity approved by the city and shall be located so as to be readily and easily accessible for cleaning and inspection. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.40.20(d))

15.36.050 Duration—Modifications.

A. Wastewater discharge permits shall be issued for a specified time period, not to exceed three years. A permit may be issued for a period less than one year and may expire on a specific date.

B. The terms and conditions of the permit may be subject to modification and change by the city during the life of the permit as limitations or requirements identified in this chapter are modified and changed.

C. The user shall be informed of any proposed changes in the user's permit, other than termination of the date originally scheduled, at least 30 days prior to the effective date of such change. Any changes or new conditions in the permit shall include a reasonable time for compliance. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.40.20(e))

15.36.060 Nontransferable.

Each wastewater discharge permit shall be issued to a specific user for a specific operation. A wastewater discharge permit shall not be reassigned or transferred or sold to a new owner, new user, different premises, or a new or changed operation. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.40.20(f)

15.36.070 Special permits.

Applications for any special permit required by this chapter, accompanied by the applicable fees, shall be filed with the director on a form containing such information as required by the director. The director may approve, disapprove, or conditionally approve such applications. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.40.21)

15.36.080 Confidential information.

All information and data on users obtained from inspections, reports, questionnaires, permit applications, permits and monitoring programs shall be available to the public and other governmental agencies without restriction unless the user specifically requests and is able to demonstrate to the satisfaction of the director that the release of such information would divulge information, processes or methods which are confidential or which would be detrimental to the user's competitive position. Wastewater constituents and characteristics shall not be recognized as confidential information. When requested by the person furnishing a report, the portions of a report which might disclose trade secrets or secret processes shall not be made available for inspection by the public but shall be made available to governmental agencies for use in making studies as necessary; provided, however, that such confidential information shall be available for use by the state or any agency of the state in judicial review or enforcement proceedings involving the person furnishing the report. Information accepted by the city as confidential shall not be transmitted to any governmental agency or to the general public by the city unless prior and adequate notification is given to the user. (Ord. 1082 § 2 (part), 1983; prior code § 2-15.40.22)

Chapter 15.40 COLLECTION AND DISPOSAL OF SEWAGE EFFLUENT

15.40.010 Collection contract.

The city council may contract with any person and grant to such person the exclusive right and privilege to collect, transport, remove and/or dispose of effluent and waste material produced, kept and/or accumulated in private or public sewage disposal systems, permitted by Chapter 15.32 of this code, within the territorial boundaries of the city. The city may grant such contract upon such terms and conditions as the council may, from time to time, determine to be for the best interests of the city. It is unlawful for any persons, other than such contractor authorized by the city, to collect, transport, remove, and/or dispose of any effluent and waste material produced, kept and/or accumulated within such territorial boundaries. (Prior code § 4-2.1601)

Chapter 15.44 PROTECTION OF SANITARY SEWER SYSTEM FROM FATS, OIL AND GREASE

15.44.010 Scope and purpose.

To aid in the prevention of sanitary sewer blockages and obstructions from contributions and accumulation of fats, oils and greases into the sanitary sewer system from any industrial or commercial establishments, particularly food preparation and serving facilities. The city of Pleasanton is committed to reduce sanitary sewer overflows that are harmful to the environment and costly to the rate payers in terms of increased maintenance and cleanup. Fats, oils and grease are a major contributor to this problem both locally and throughout California. (Ord. 1984 § 1, 2008)

15.44.020 Definitions.

A. "California Plumbing Code" means the most recent edition of the California Plumbing Code, as amended by the city of Pleasanton's Municipal Code.

B. "Fats, oils and greases" mean organic polar compounds derived from animal and/ or plant sources that contain multiple carbon chain triglyceride molecules. These substances are detectable and measurable using analytical test procedures established in the United States Code of Federal Regulations 40 CFR 136, as may be amended from time to time. All are sometimes referred to herein as "grease" or "greases."

C. "Fixture" means a plumbing fixture is a device which is part of a system to deliver and drain away water, but which is also configured to enable a particular use. The most common plumbing fixtures are: water closets (known as toilets), urinals, bathtubs, showers, bidets, sinks (kitchen and utility), drinking fountains, and hose bibs (connections for water hoses). Water closets, urinals, and bidets shall not be connected to sewer lines intended for grease interceptor or grease trap service.

D. "Food service establishments" mean those establishments engaged in preparing, serving, or otherwise making available food for consumption by the public. These establishments include but are not limited to restaurants, commercial kitchens, caterers, grocery stores and markets, hotels, schools, hospitals, prisons, correctional facilities and senior care living facilities. These establishments use one or more of the following preparation activities: cooking by frying, baking, grilling, rotisserie cooking, broiling, boiling, blanching, roasting, toasting, poaching, infrared heating, searing, barbecuing and any other food preparation activity that produces fat, oil or grease food product in or on a receptacle that requires washing.

E. "Grease interceptor" means an interceptor of at least 750 gallons capacity to serve one or more fixtures. A structure or device designed for the purpose of removing and preventing fats, oils and grease from entering the sanitary sewer collection system. These devices are often below-ground units in outside areas and are built as two or three chamber baffled tanks.

F. "Grease trap" means a device designed to retain grease from one to a maximum of four fixtures. A device designed for the purpose of removing and preventing fats, oils and grease from entering the sanitary sewer collection system. Such traps are typically under-the-sink units that are near food preparation areas with a minimum grease containment capacity of 40 pounds and flow rate of 20 gallons per minute (gpm).

G. "Minimum design capability" means the design features of a grease interceptor and its ability or volume required to effectively intercept and retain greases from grease-laden wastewaters discharged to the public sanitary sewer. At a minimum, the design capability shall be consistent with the California Plumbing Code.

H. "Operations services director" means the city's operations services director or designee.

I. "User" means any person, including those located outside the jurisdictional limits of the city who

contributes, causes or permits the contribution or discharge of wastewater into sewers within the city's boundaries, including persons who contribute such wastewater from mobile sources, such as those who discharge hauled wastewater. (Ord. 1984 § 1, 2008)

15.44.030 Food service establishment permit requirement.

All food service establishments are required to obtain a permit in order to discharge wastewater into the city's sanitary sewer collection system. It is unlawful for any person or food service establishment to discharge or cause to be discharged any fat, oil or grease into the sewer system without first obtaining a permit from the operations services director. Permits shall be issued only for a specific use and to a specific operator. Any sale, lease, transfer or assignment of the premises or operation for which the permit was issued shall require a new permit to be issued. Any new or changed conditions of operation shall require a new permit to be issued. As a condition of obtaining a permit, all food service establishments shall have a grease interceptor and/or grease trap installed as specified by the operations services director and subject to the requirements set forth herein. (Ord. 1984 § 1, 2008)

15.44.040 Grease interceptor requirements.

Grease Interceptor Requirements. All food service establishments are required to install, operate, and maintain an approved type and adequately sized grease interceptor necessary to maintain compliance with the objectives of this chapter. All grease interceptors must meet the requirements of the California Plumbing Code.

A. New Food Service Establishments. All new establishments are subject to grease interceptor requirements. All such facilities must obtain prior approval from the operations services director for grease interceptor sizing prior to submitting plans for a building permit.

B. Existing Food Service Establishments. All existing food service establishments determined by the operations services director to have a potential to adversely impact the city's sewer system will be notified of their obligation to install a grease interceptor within the specified period set forth in the notification letter. In addition, existing establishments with planned modification with a building permit evaluation of $50,000.00 or more will be required to include plans to comply with the grease interceptor requirements. These facilities must obtain approval from the operations services director for grease interceptor sizing prior to submitting plans for a building permit.

C. Shared Grease Interceptors. One or more food service establishments may comply with the requirements of this chapter by use of a shared grease interceptor. Such shared interceptor may be located on an adjacent or adjoining parcel, provided, however, that the food service establishment seeking to establish compliance by means of this section shall demonstrate to the satisfaction of the operations services director that: (1) it has enforceable rights to utilize the shared interceptor pursuant to an easement; declaration; covenants, conditions, and restrictions; or similar instrument; and (2) the shared interceptor is sized as necessary to accommodate the discharges of all food service establishments enjoying rights to use such interceptor; and (3) there is a mechanism providing for continued maintenance of such shared interceptor.

D. Variance from Grease Interceptor Requirements. Grease interceptors required under this chapter shall be installed unless the operations services director determines that the installation of a grease interceptor would not be feasible and authorizes the installation of an indoor grease trap or other alternative pretreatment technology. Alternative pretreatment technology includes, but is not limited to, devices that are used to trap, separate and hold grease from wastewater and prevent it from being discharged into the sanitary sewer collection system. All alternative pretreatment technology must be appropriately sized and approved by the operations services director.

The food service establishment bears the burden of demonstrating that the installation of a grease interceptor is not feasible. The operations services director may authorize the installation of an indoor grease trap where the installation of a grease interceptor is not feasible due to space constraints or other considerations. If a

food service establishment believes the installation of a grease interceptor is infeasible, because of documented space constraints, the request for alternate pretreatment technology shall contain the following information:

1. Location of sewer main and any easements in relation to available exterior space outside the building;

2. Existing building and site plumbing line plan that uses common plumbing for all services at that site;

3. Proposed drawings and plans for alternative pretreatment technology. (Ord. 2038 § 1, 2012; Ord. 1984 § 1, 2008)

15.44.050 Grease interceptor standards.

A. Grease interceptor sizing and installation shall conform to the current edition of the California Plumbing Code.

B. Grease interceptors shall be constructed in accordance with a design approved by the operations services director and shall have a minimum of two compartments with fittings designed for grease retention.

C. Grease interceptors shall be installed at a location where it shall be easily accessible for inspection, cleaning, and removal of intercepted grease. Accept as allowed in Provision C3 of the Alameda County Clean Water Program National Pollutant Discharge Elimination System (NPDES) permit, the grease interceptor may not be installed in any part of the building where food is handled. Location of the grease interceptor must meet the approval of the operations services director.

D. All such grease interceptors shall be serviced and emptied of accumulated waste content as required in order to maintain minimum design capability. These devices should be inspected at least monthly but in no case shall the User fail to inspect and maintain every 60 days. Food service establishments are required to maintain a grease interceptor and shall:

1. Provide for a minimum hydraulic retention time in accordance with the California Plumbing Code;

2. Remove any accumulated grease cap and sludge pocket as required. Grease interceptors shall be kept free of inorganic solid materials such as grit, rocks, gravel, sand, eating utensils, cigarettes, shells, towels, rags, etc., which could settle into this pocket and thereby reduce the effective volume of the device.

E. The user shall maintain a written record of all inspection, maintenance, pumping and hauling activities. The user shall submit copies of these documents to the operations services director on or before June 30th and December 31st of each year. The user shall also keep copies of these records for the preceding two years and shall make these records available for on-site inspection by the operations services director during all operating hours.

F. Sanitary wastes from water closets, urinals, and bidets are not allowed to be connected to sewer lines intended for grease interceptor service. (Ord. 1984 § 1, 2008)

15.44.060 Grease trap standards.

A. Upon approval by the operations services director, a grease trap complying with the provisions of this section must be installed in the waste line leading from sinks, drains, and other fixtures or equipment in food service establishments where grease may be introduced into the drainage or sewage system in quantities that can affect line stoppage or hinder sewage treatment or private sewage disposal.

B. Grease trap sizing and installation shall conform to the California Plumbing Code.

C. Grease traps shall be kept in efficient operating conditions by periodic removal of the accumulated grease. Grease traps should be inspected and maintained in accordance with the manufacturer's recommendations but in no case shall the User fail to inspect and maintain less than bi-weekly. No such collected grease shall be introduced into any drainage piping, water closet, or public or private sewer; it shall be placed in a leak-proof

container and then disposed of in the appropriate trash bin.

D. Wastewater in excess of 140 degrees Fahrenheit or 60 degrees Celsius shall not be discharged into a grease trap.

E. No food waste disposal unit or dishwasher shall be connected to or discharge into any grease trap.

F. The user shall maintain a written record of all inspection, maintenance, pumping and hauling activities. The user shall submit copies of these documents to the operations services director on or before June 30th and December 31st of each year. The user shall also keep copies of these records for the preceding two years and shall make these records available for on-site inspection by the operations services director during all operating hours. (Ord. 1984 § 1, 2008)

15.44.070 Enforcement.

A. Authority to Inspect.

1. Request for Entry. Whenever necessary to make an inspection to enforce any of the provisions of this chapter, or whenever the operations services director has reasonable cause to believe that there exists in any building or upon any premises any condition which constitutes a violation of this chapter, the operations services director may enter such building or premises at all reasonable times to inspect or perform any duty authorized by this chapter; provided, that: (a) if such building or premises be occupied, he or she shall first present proper credentials and request entry; and (b) if such building or premises be unoccupied, he or she shall first make a reasonable effort to locate the owner or other persons having charge or control of the building or premises and request entry.

2. Selection Processes. Routine or area inspections shall be based upon such reasonable selection processes as may be deemed necessary to carry out the objectives of this chapter, including, but not limited to, random sampling and/or sampling in areas with evidence of fat, oil or grease discharges or similar factors.

3. Inspection Fees. Food service establishments shall not be charged a fee for routine or area inspections. Unless waived by the operations services director, the food service establishment shall be charged an inspection fee for all other inspections, including follow-up inspections or inspections performed where the city suspects that a violation may exist.

4. Authority to Inspect and Sample. The city shall have the right to establish on any property such devices as are necessary to conduct sampling operations and may take any samples deemed necessary to determine if a violation exists.

B. Concealment. Causing, permitting, aiding, abetting or concealing a violation of any provision of this chapter shall constitute a violation of this provision.

C. Civil Actions. In addition to any other remedies provided in this section, any violation of this section may be enforced by civil action brought by the city. In any such action, the city may seek and the court shall grant, as appropriate, any or all of the following remedies:

1. A temporary and/or permanent injunction;

2. Assessment of the violator for the costs of any investigation, inspection or monitoring survey which led to the establishment of the violation, and for the reasonable costs of preparing and bringing legal action;

3. Costs incurred in removing, correcting or terminating the adverse effects resulting from the violation; and

4. Compensatory damages for loss or destruction to water quality, wildlife, fish and aquatic life. Assessments under this subsection shall be paid to the city to be used exclusively for costs associated with monitoring, implementing, or enforcing the provisions of this chapter.

D. Violations Deemed a Public Nuisance—Abatement—Lien Against Property.

1. Nuisance Declared—Abatement. In addition to the penalties hereinbefore provided, any condition

caused or permitted to exist in violation of any of the provisions of this chapter is a threat to the public health, safety and welfare, and is declared and deemed a nuisance, and may be summarily abated and/or restored by the operations services director, and/or civil action to abate, enjoin or otherwise compel the cessation of such nuisance may be taken by the city attorney.

2. Written Notice. Prior to bringing any action to abate the nuisance, the city shall provide written notice to the food service establishment. The notice shall state that if the nuisance is not voluntarily abated within the stated period, the city will abate the nuisance and the expense of abatement shall become a charge and shall be a lien against the property. In the event that the food service establishment does not own the underlying property where the violation exists, the city shall also provide written notice to the owner of the property as shown in the last equalized assessment roll. In the event the nuisance relates to a shared grease interceptor, the city shall provide written notice: (a) to any entity responsible for the maintenance of such shared interceptor; and (b) to the owner of the property on which the food service establishment that has caused the nuisance is located or, in the event it cannot be determined which food service establishment caused the nuisance, to the owners of all properties upon which a food service establishment that uses such shared interceptor is located.

3. Cost Borne by Owner—Lien. The cost of such abatement and restoration shall be borne by the owner of the property and the cost thereof shall be a lien recorded upon and against the property and such lien shall continue in existence until the same shall be paid. If the lien is not satisfied by the owner of the property within 30 days after the completion by the operations services director of the removal of the nuisance, the city may record a lien against the property to recover the costs of abatement as well as any costs, including attorneys' fees, incurred by the city to secure the lien. The cost of such abatement and restoration in the case of a shared grease interceptor shall be borne jointly and severally by the entity responsible for the maintenance of such shared interceptor and: (a) the owner of the property on which the food service establishment that has caused the nuisance is located; or (b) in the event it cannot be determined which food service establishment caused the nuisance, the owners of all properties upon which a food establishment that uses such shared interceptor is located. The cost thereof shall be a lien recorded upon and against the property on which the food service establishment that has caused the nuisance is located or, in the event it cannot be determined which food service establishment caused the nuisance, the owners of all properties on which a food establishment that uses the shared interceptor is located.

4. Assessment Lien Confirmed by City Council—Notice and Hearing. The operations services director shall keep an account of the costs incurred by the city and shall provide a reporting to the city council for hearing and confirmation. the operations services director shall mail notice to the owner of the property of the time and place for the hearing. The notice shall be in a form substantially as follows:

NOTICE OF HEARING: ASSESSMENT LIEN TO BE RECORDED AGAINST PROPERTY TO COVER COSTS OF ABATEMENT FOR DISCHARGE TO SANITARY SEWER SYSTEM

This is a notice to advise you that the City Council for the City of Pleasanton will be holding a hearing on _____, 201_ at ____p.m. in the Council Chambers located at 200 Old Bernal, Pleasanton California. The City Council will consider ordering the City Clerk to record a lien against your property to cover the costs of abating a discharge that occurred on your property to the City's sanitary sewer system. Said costs will include attorneys' fees and other costs necessary to secure the lien against your property. At the time and place stated above, the City Council shall consider a report by the Operations Services Director. The City Council shall also consider any protests or objections raised by you or any interested person. The Council may make any corrections or modifications in any proposed assessment which it may deem to be excessive or incorrect and then shall confirm the amount of costs by resolution and the amount thereof shall become a lien against the property.

In the event that the costs are not paid within 30 days of confirmation by the City Council, the City Clerk shall be directed to record an assessment lien against the property and ask the tax collector to collect the assessment amount as part of the next regular bill for taxes levied against the property. The assessment shall be subject to the same penalties as are provided for other delinquent taxes or assessments of the City.

E. Administrative Enforcement Powers. In addition to the other enforcement powers and remedies established by this chapter, the operations services director has the authority to utilize the following administrative remedies:

1. Cease and Desist Orders. When the operations services director finds that a violation exists or is likely to take place in violation of this chapter, he or she may issue an order to cease and desist such discharge or practice or operation likely to cause such discharge and direct that those persons not complying shall: (a) comply with the requirement; (b) comply with a time schedule for compliance; and/or (c) take appropriate remedial or preventive action to prevent the violation from recurring.

2. Notice to Clean. Whenever the operations services director finds that a violation has occurred, he or she may give notice to clean or correct in any manner that he or she may reasonably provide. The recipient of such notice shall undertake the activities as described in the notice.

F. Violations Constituting Misdemeanors. Unless otherwise specified by ordinance, the violation of any provision of this chapter, or failure to comply with any of the mandatory requirements of this chapter shall constitute a misdemeanor; except that notwithstanding any other provisions of this chapter, any such violation constituting a misdemeanor under this chapter may, in the discretion of the operations services director, be charged and prosecuted as an infraction or may be issued an administrative citation.

G. Penalty for Violation.

1. Upon conviction of a misdemeanor, a person shall be subject to payment of a fine or imprisonment, or both, not to exceed the limits set forth in California Government Code Section 36901.

2. Upon conviction of an infraction, a person shall be subject to payment of a fine, not to exceed the limits set forth in California Government Code Section 36900. Subsequent violations may be charged as a misdemeanor.

3. Continuing Violation. Unless otherwise provided, a person shall be deemed guilty of a separate offense for each and every day during any portion of which a violation of this chapter is committed, continued or permitted by the person and shall be punishable accordingly as herein provided.

H. Authority to Arrest or Issue Citations. The Operations services director shall have and are hereby vested with the authority to arrest or cite any person who violates any section of this code in the manner provided by the California Penal Code for the arrest or release on citation of misdemeanor infractions as prescribed by Chapters 5, 5c and 5d of Title 3, Part 2 of the Penal Code (or as the same may be hereinafter amended).

The operations services director may issue a citation and notice to appear in the manner prescribed by Chapter 5c of Title 3, Part 2 of the Penal Code, including Section 853.6 (or as the same may hereafter be amended). It is the intent of the city council that the immunities prescribed in Section 836.5 of the Penal Code be applicable to public officers or employees or employees acting in the course and scope of employment pursuant to this chapter.

I. Disconnect Water Service. In the event of a violation of any terms of this chapter (including Section 15.44.030 which requires food service establishments to obtain a permit), the operations services director may disconnect water service to the premises for which such violation relates after first notifying in writing the person causing, allowing, or committing such violation. The notice shall specify the violation and the time after which (upon the failure of such person to prevent or rectify the violation) the director will exercise his or her authority to disconnect the food service establishment from the water system. The notice shall be deposited in the United States Post Office in the city of Pleasanton and addressed to the person to whom notice is given and shall be sent at least 10 days prior to service being disconnected. If the operations services director disconnects water service according to this section, the food service establishment shall be required to pay a reconnect fee (as provided in the master fee schedule) before water service is reestablished.

J. Remedies Not Exclusive. Remedies under this chapter are in addition to and do not supersede or limit any and all other remedies, civil or criminal. The remedies provided for herein shall be cumulative and not

Appendix D VOC and Fuel General Permit

Matthew Rodriquez
Secretary for Environmen Protection

California Regional Water Quality Control Board
San Francisco Bay Region

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Edmund G. Brown Jr.
Governor

ORDER NO. R2-2012-0012
NPDES NO. CAG912002

GENERAL WASTE DISCHARGE REQUIREMENTS FOR:
Discharge or Reuse of Extracted and Treated Groundwater Resulting from the Cleanup of Groundwater Polluted by Volatile Organic Compounds (VOC), Fuel Leaks and Other Related Wastes (VOC and Fuel General Permit)

Table 1. Administrative Information

This Order was adopted by the Regional Water Quality Control Board on:	**February 8, 2012**
This Order shall become effective on:	**March 15, 2012**
This Order shall expire on:	**March 15, 2017**
CIWQS Regulatory Measure Number:	**383087**
The U.S. Environmental Protection Agency (USEPA) and the Regional Water Quality Control Board have classified the discharges under this General National Pollutant Discharge Elimination System (NPDES) Permit as minor discharges based on the discharges' impacts to receiving water bodies.	
To obtain coverage under this General Permit, dischargers must submit a Notice of Intent (NOI) Form as described in Attachment B and a filing fee equivalent to the first year's annual fee. If the NOI is complete, Authorization to Discharge will be issued by the Regional Water Quality Control Board Executive Officer.	
Authorized dischargers who need to continue discharging after the expiration date of this Order shall file a completed NOI form no later than 180 days in advance of this Order's expiration date. Such dischargers for whom coverage is extended will become subject to the new Order upon authorization by the Executive Officer.	

I, Bruce H. Wolfe, Executive Officer, do hereby certify that this Order with all attachments is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, San Francisco Bay Region, on the date indicated above.

_____

Bruce H. Wolfe, Executive Officer

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I. SCOPE OF GENERAL PERMIT

Facilities that may be covered under this Order are groundwater treatment facilities located at active or closed sites, such as service stations or construction sites. These groundwater treatment facilities are in operation to extract and treat groundwater polluted by volatile organic compounds (VOC), fuel, and fuel additives. This Order covers discharges from these facilities to all surface waters such as creeks, streams, rivers including flood control channels, lakes, or San Francisco Bay. Such discharges may occur directly to surface waters or through constructed storm drain systems.

II. FINDINGS

The California Regional Water Quality Control Board, San Francisco Bay Region (hereinafter, the Regional Water Board), finds:

A. Background. There are 20 permittees authorized (as of November 2011) to discharge pursuant to Order No. R2-2006-0075, NPDES Permit No. CAG912002 (General Waste Discharge Requirements for Discharge or Reuse of Extracted and Treated Groundwater Resulting from the Cleanup of Groundwater Polluted by Fuel Leaks and Other Related Waste at Service Stations and Similar Sites). Of this group, 18 submitted Notices of Intent (NOI) applications and applied for an NPDES permit to continue their discharge of treated wastewater from their groundwater extraction and treatment facilities (hereinafter Facility or Facilities).

In addition, there are 56 permittees currently authorized to discharge pursuant to Order No. R2-2009-0059, NPDES Permit No. CAG912003 (General Waste Discharge for Discharge or Reuse of Extracted and Treated Groundwater Resulting from the Cleanup of Groundwater Polluted by VOC). Order No. R2-2009-0059 will not be reissued upon expiration on September 30, 2014, and permittees with a continued need to discharge shall seek coverage under this General Permit.

For the purposes of this Order, references to the "Discharger" or "permittee" in applicable federal and State laws, regulations, plans, or policy are held to be equivalent to references to the Discharger(s) herein. A discharger who is authorized under this Order is hereinafter a Discharger.

B. Facility Description. Dischargers typically use aeration and/or granular activated carbon (GAC) systems to treat their groundwater prior to discharge. Facilities that use other types of treatment systems that are effective at removal of VOC or fuel pollutants may be covered by this Order subject to the approval of the Executive Officer. Treated wastewaters are typically discharged through storm drain systems, rivers, and/or creeks to San Francisco Bay. To obtain coverage under this Order, a discharger must include a complete description of the treatment system installed at its facility in the Notice of Intent (NOI) application form (Attachment B).

C. Regional Water Board Preference for Reuse or Discharge to POTW: The Regional Water Board adopted Resolution No. 88-160 on October 19, 1988. The Resolution urges dischargers of extracted groundwater from site cleanup projects to reuse their treated groundwater. When reuse is not technically and/or economically feasible, to discharge to a publicly owned treatment works (POTW). Only if neither reuse nor discharge to a POTW is technically or economically feasible, and if beneficial uses of the receiving water are not adversely affected, the Regional Water

Board may authorize the discharge of treated extracted groundwater in accordance with the requirements of this Order.

D. Legal Authorities. This Order is issued pursuant to Clean Water Act (CWA) section 402 and implementing regulations adopted by the U.S. Environmental Protection Agency (USEPA) and chapter 5.5, division 7 of the California Water Code (CWC) (commencing with section 13370). It shall serve as an NPDES permit for point source discharges from each Facility, regulated under this Order, to surface waters. This Order also serves as General Waste Discharge Requirements (GWDRs) pursuant to CWC article 4, chapter 4, division 7 (commencing with section 13260).

States may request authority to issue general NPDES permits pursuant to title 40 of the Code of Federal Regulations (40 CFR) section 122.28. On June 8, 1989, the State Water Resources Control Board (State Water Board) submitted an application to USEPA requesting revisions to its NPDES Program in accordance with 40 CFR 122.28, 123.62, and 403.10. The application included a request to add general permit authority to its approved NPDES Program. On September 22, 1989, USEPA Region 9 approved the State Water Board's request and granted authorization for the State to issue general NPDES permits.

E. Background and Rationale for Requirements. The Regional Water Board developed the requirements in this Order based on information submitted as part of NOIs, through monitoring and reporting programs, and other available environmental information. The Fact Sheet (Attachment F), which contains background information and rationale for Order requirements, is hereby incorporated into this Order and constitutes part of the Findings for this Order. Attachments A through F are also incorporated into this Order.

F. California Environmental Quality Act (CEQA). Under CWC section 13389, this action to adopt an NPDES permit is exempt from Chapter 3 of CEQA.

G. Technology-based Effluent Limitations. CWA section 301(b) and NPDES regulations at 40 CFR 122.44 require that permits include conditions meeting applicable technology-based requirements, at a minimum, and any more stringent effluent limitations necessary to meet applicable water quality standards. Discharges authorized by this Order must meet technology-based effluent limitations based on Best Professional Judgment (BPJ) in accordance with 40 CFR 125.3. A detailed discussion of the technology-based effluent limitations development and BPJ is included in the Fact Sheet (Attachment F).

H. Water Quality-Based Effluent Limitations. CWA section 301(b) and NPDES regulations at 40 CFR 122.44(d) require that permits include limitations more stringent than applicable federal technology-based requirements where necessary to achieve applicable water quality standards. NPDES regulations at 40 CFR122.44(d)(1)(i) mandate that permits include effluent limitations for all pollutants that are or may be discharged at levels that have the reasonable potential to cause or contribute to an exceedance of a water quality standard, including numeric and narrative objectives within a standard. Where reasonable potential has been established for a pollutant, but there is no numeric criterion or objective for the pollutant, WQBELs must be established using: (1) USEPA criteria guidance under CWA section 304(a), supplemented where necessary by other relevant information; (2) on an indicator parameter for the pollutant of concern; or (3)

using a calculated numeric water quality criterion, such as a proposed state criterion or policy interpreting the state's narrative criterion, supplemented with other relevant information, as provided in 40 CFR 122.44(d)(1)(vi).

I. Water Quality Control Plans. The *Water Quality Control Plan for the San Francisco Bay Basin* (Basin Plan) is the Regional Water Board's master water quality control planning document. It designates beneficial uses and water quality objectives (WQOs) for waters of the State, including surface waters and groundwater. It also includes programs of implementation to achieve WQOs. The Basin Plan was duly adopted by the Regional Water Board and approved by the State Water Board, Office of Administrative Law, and USEPA.

The Basin Plan states that the beneficial uses of any specifically identified water body generally apply to its tributary streams. The Basin Plan may not specifically identify beneficial uses for every receiving water regulated under this permit, but may identify present and potential uses for the downstream water body, to which the receiving water, via an intermediate water body, is tributary. These potential and existing beneficial uses are municipal and domestic supply, fish migration and fish spawning, industrial service supply, navigation, industrial process supply, marine habitat, agricultural supply, estuarine habitat, groundwater recharge, shellfish harvesting, water contact and non-contact recreation, ocean, commercial, and sport fishing, wildlife habitat, areas of special biological significance, cold freshwater and warm freshwater habitat, and preservation of rare and endangered species for surface waters and municipal and domestic supply, industrial service supply, industrial process supply, agricultural supply, and freshwater replenishment for groundwaters. In addition, the Basin Plan implements State Water Board Resolution No. 88-63, which established State policy that all waters, with certain exceptions, should be considered suitable or potentially suitable for municipal or domestic supply. Requirements of this Order implement the Basin Plan.

On September 18, 1975, the State Water Board adopted the *Water Quality Control Plan for Control of Temperature in the Coastal Interstate Waters and Enclosed Bays and Estuaries of California* (hereinafter the Thermal Plan). The Thermal Plan contains objectives governing cooling water discharges, providing different and specific numeric and narrative water quality objectives for new and existing discharges.

The State Water Board's *Water Quality Control Plan for Enclosed Bays and Estuaries—Part 1, Sediment Quality* became effective on August 25, 2009. This plan supersedes other narrative sediment quality objectives and establishes new sediment quality objectives and related implementation provisions for specifically defined sediments in most bays and estuaries.

J. National Toxics Rule (NTR) and California Toxics Rule (CTR). USEPA adopted the NTR on December 22, 1992, and later amended it on May 4, 1995, and November 9, 1999. About 40 criteria in the NTR apply in California. On May 18, 2000, USEPA adopted the CTR. The CTR promulgated new toxics criteria for California and, in addition, incorporated the previously adopted NTR criteria that were applicable in the State. The CTR was amended on February 13, 2001. These rules contain water quality criteria (WQC) for priority pollutants.

K. State Implementation Policy. On March 2, 2000, the State Water Board adopted the *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of*

California (State Implementation Policy or SIP). The SIP became effective on April 28, 2000, with respect to the priority pollutant criteria promulgated for California by USEPA through the NTR and to the priority pollutant objectives established by the Regional Water Board in the Basin Plan. The SIP became effective on May 18, 2000, with respect to the priority pollutant criteria promulgated by USEPA through the CTR. The State Water Board adopted amendments to the SIP on February 24, 2005, that became effective on July 13, 2005. The SIP establishes implementation provisions for priority pollutant criteria and objectives and provisions for chronic toxicity control. Requirements of this Order implement the SIP.

L. Recycled Water Policy. The State Water Board adopted Resolution No. 2009-0011 (*Policy for Water Quality Control for Recycled Water*) on February 3, 2009. The policy is intended to promote sustainable local water supplies by increasing the acceptance and promoting the use of recycled water. It sets a goal of increasing recycled water use statewide by at least one million acre feet per year by 2030. The policy also requires Regional Water Boards to exercise their authority to the fullest extent possible to encourage recycled water use and to develop watershed-based salt and nutrient management plans to ensure that groundwater resources are not degraded by recycled water use.

M. Alaska Rule. On March 30, 2000, USEPA revised its regulation that specifies when new and revised state and tribal water quality standards (WQS) become effective for CWA purposes. [40 CFR 131.21; 65 Fed. Reg. 24641 (April 27, 2000)] Under the revised regulation (also known as the Alaska rule), new and revised standards submitted to USEPA after May 30, 2000, must be approved by USEPA before being used for CWA purposes. The final rule also provides that standards already in effect and submitted to USEPA by May 30, 2000, may be used for CWA purposes, whether or not approved by USEPA.

N. Stringency of Requirements for Individual Pollutants. This Order contains both technology-based and water quality-based effluent limitations (WQBELs) for individual pollutants. Derivation of these limitations is discussed in the Fact Sheet (Attachment F.) This Order's technology-based pollutant restrictions on benzene, carbon tetrachloride, chloroform, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethylene, ethylbenzene, methylene chloride, tetrachloroethylene, toluene, cis-1,2-dichloroethylene, trans-1,2-dichloroethylene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethylene, vinyl chloride, total xylenes, methyl tertiary butyl ether, total petroleum hydrocarbons, and trichlorotrifluoroethane implement the minimum applicable federal technology-based requirements and meet requirements of the Basin Plan.

WQBELs have been derived to implement WQOs that protect beneficial uses. Both the beneficial uses and the WQOs have been approved pursuant to federal law and are the applicable federal water quality standards. To the extent that toxic pollutant WQBELs were derived from the CTR, the CTR is the applicable standard pursuant to 40 CFR 131.38. The procedure for calculating individual WQBELs for priority pollutants is based on the SIP. Most beneficial uses and WQOs contained in the Basin Plan were approved under State law and submitted to and approved by USEPA. Any WQOs and beneficial uses submitted to USEPA prior to May 30, 2000, but not approved by USEPA before that date, are nonetheless "applicable water quality standards for the purposes of the CWA" pursuant to 40 CFR 131.21(c)(1).

O. Antidegradation Policy. NPDES regulations at 40 CFR 131.12 require that state water quality standards include an antidegradation policy consistent with the federal policy. The State Water Board established California's antidegradation policy in State Water Board Resolution No. 68-16, which incorporates the federal antidegradation policy where the federal policy applies under federal law and requires that existing quality of waters be maintained unless degradation is justified based on specific findings. The Basin Plan implements, and incorporates by reference, both the State and federal antidegradation policies.

P. Anti-Backsliding Requirements. CWA sections 402(o)(2) and 303(d)(4) and 40 CFR 122.44(l) prohibit backsliding in NPDES permits. These anti-backsliding provisions require that effluent limitations in a reissued permit be as stringent as those in the previous permit, with some exceptions where limitations may be relaxed. This Order retains effluent limitations no less stringent than those established by previous orders.

Q. Endangered Species Act. This Order does not authorize any act that results in the taking of a threatened or endangered species or any act that is now prohibited, or becomes prohibited in the future, under either the California Endangered Species Act (Fish and Game Code sections 2050 to 2097) or the federal Endangered Species Act (16 U.S.C.A. sections 1531 to 1544). This Order requires compliance with effluent limits, receiving water limits, and other requirements to protect the beneficial uses of waters of the State. Dischargers are responsible for meeting all requirements of applicable State and federal law pertaining to threatened and endangered species.

R. Monitoring and Reporting. NPDES regulations at 40 CFR 122.48 require that all NPDES permits specify requirements for recording and reporting monitoring results. CWC sections 13267 and 13383 authorize the Regional Water Board to require technical and monitoring reports. The Monitoring and Reporting Program establishes monitoring and reporting requirements to implement federal and State requirements. This Monitoring and Reporting Program is provided in Attachment E.

S. Standard and Special Provisions. Standard Provisions, which apply to all NPDES permits in accordance with 40 CFR section 122.41, and additional conditions applicable to specified categories of permits in accordance with 40 CFR 122.42 and as modified for this General Permit, are provided in Attachment D. Dischargers must comply with all standard provisions and with those additional conditions that are applicable under 40 CFR 122.42. The Regional Water Board has also included in this Order special provisions applicable to the Dischargers. The attached Fact Sheet (Attachment F) provides rationale for the special provisions contained in this Order.

T. Provisions and Requirements Implementing State Law. The provisions/requirements in subsections IV.B (Reclamation Specifications) and V.B (Groundwater Limitations) of this Order are included to implement State law only. These provisions/requirements are not required or authorized under the federal CWA; consequently, violations of these provisions/requirements are not subject to the enforcement remedies that are available for NPDES violations.

U. Notification of Interested Parties. The Regional Water Board notified the Dischargers and interested agencies and persons of its intent to prescribe GWDRs for the discharge and has

provided them with an opportunity to submit their written comments and recommendations. The Fact Sheet (Attachment F) provides details of the notification.

V. Consideration of Public Comment. The Regional Water Board, in a public meeting, heard and considered all comments pertaining to the discharge. The Fact Sheet (Attachment F) provides details of the public hearing.

IT IS HEREBY ORDERED, that this Order supersedes Order No. R2-2006-0075 and, effective September 30, 2014, Order No. R2-2009-0059, except for enforcement purposes, and in order to meet the provisions contained in CWC Division 7 (commencing with section 13000) and regulations adopted thereunder, and the provisions of the federal CWA and regulations and guidelines adopted thereunder, the Discharger shall comply with the following requirements in this Order.

III. DISCHARGE PROHIBITIONS

A. The discharge of extracted and treated groundwater polluted by fuel, fuel components, VOC, and related wastes to surface waters from service stations, construction sites, and similar sites, is prohibited unless an NOI application for proposed discharge has been submitted, and the Executive Officer has provided the Discharger with an Authorization to Discharge.

B. Discharges other than the following are prohibited: extracted groundwater treated only with treatment chemicals approved by the Executive Officer and added in a manner consistent with the proper operation and maintenance of the treatment facility.

C. The discharge of extracted and treated groundwater from a specific site in excess of the flow rate specified by the Executive Officer in the Authorization to Discharge is prohibited.

D. Discharges to a storm drain shall not cause scouring or erosion at the point where the storm drain discharges into the receiving water and shall not cause or contribute to scouring of banks, excessive sedimentation, or flooding of the storm drain system or receiving water downstream of the point of discharge.

E. Neither the treatment nor the discharge of pollutants shall create a pollution, contamination, or nuisance, as defined by CWC section 13050.

F. Bypass or overflow of untreated or partially treated groundwater polluted by fuel, fuel components, VOC, or other related wastes to waters of the State either at the treatment system or from any of the collection or transport systems or pump stations tributary to the treatment system is prohibited, except as provided for in the conditions stated in section I.G.2 and I.G.4 of Attachment D.

IV. EFFLUENT LIMITATIONS AND DISCHARGE SPECIFICATIONS

A. Effluent Limitations (For Dischargers to Surface Water Only)

1. **Toxic Pollutants:** The discharge of treated groundwater shall maintain compliance with the following effluent limitations at Monitoring Location EFF-001 as specified in the Authorization to Discharge:

Table 2. Effluent Limitations for Toxic Pollutants

No.	Compound	CAS Number	Column A: Discharge to Drinking Water Areas[1]		Column B: Discharge to Other Surface Water Areas	
			Average Monthly Effluent Limitation (µg/L)	Maximum Daily Effluent Limitation (µg/L)	Average Monthly Effluent Limitation (µg/L)	Maximum Daily Effluent Limitation (µg/L)
1	Benzene	71432	---	1	---	5
2	Carbon Tetrachloride	56235	0.25[2]	0.50	4.4	5
3	Chloroform	67663	---	5	---	5
4	1,1-Dichloroethane	75343	---	5	---	5
5	1,2-Dichloroethane	107062	0.38[2]	0.5	---	5
6	1,1-Dichloroethylene	75354	0.057[2]	0.11[2]	3.2	5
7	Ethylbenzene	100414	---	5	---	5
8	Methylene Chloride	75092	4.7	5	---	5
9	Tetrachloroethylene (PCE)	127184	0.8	1.6	---	5
10	Toluene	108883	---	5	---	5
11	Cis 1,2-Dichloroethylene	156592	---	5	---	5
12	Trans 1,2-Dichloroethylene	156605	---	5	---	5
13	1,1,1-Trichloroethane	71556	---	5	---	5
14	1,1,2-Trichloroethane	79005	0.6	1.2	---	5
15	Trichloroethylene (TCE)	79016	2.7	5	---	5
16	Vinyl Chloride	75014	---	0.5	---	1
17	Total Xylenes	1330207	---	5	---	5
18	Methyl Tertiary Butyl Ether (MTBE)	1634044	---	5	---	5
19	Total Petroleum Hydrocarbons[TPHs (as gasoline or as diesel)]	---	---	50	---	50

No.	Compound	CAS Number	Column A: Discharge to Drinking Water Areas[1]		Column B: Discharge to Other Surface Water Areas	
			Average Monthly Effluent Limitation (µg/L)	Maximum Daily Effluent Limitation (µg/L)	Average Monthly Effluent Limitation (µg/L)	Maximum Daily Effluent Limitation (µg/L)
20	Ethylene Dibromide (1,2-Dibromoethane)	106934	---	0.05[2]	---	5
21	Trichloro-trifluoroethane	76131	---	5	---	5
22	Total Chlorine Residual	---	---	0.0[3]	---	0.0[3]

Table Notes:
[1] Drinking water areas are defined as surface waters with the existing or potential beneficial uses of "Municipal and Domestic Supply" and "Groundwater Recharge" (the latter includes recharge areas to maintain salt balance or to halt salt water intrusion into fresh water aquifers).
[2] If reported detection level is greater than effluent limit, then a non-detect result using a 0.5 µg/L detection level will not be deemed to be out of compliance.
[3] There shall be no detectable levels of residual chlorine in the effluent (a non-detect result using a detection level equal or less than 0.08 milligram per liter (mg/L) will not be deemed to be out of compliance). This limit only applies to Dischargers that chlorinate their extracted groundwater.

2. **pH:** The pH of the discharge shall not exceed 8.5 nor be less than 6.5.

3. **Acute Toxicity:**

   a. Representative samples of the discharge, with compliance measured at Monitoring Location EFF-001 as described in the Authorization to Discharge, shall meet the following limits for acute toxicity. Bioassays shall be conducted in compliance with Section V.A of the Monitoring and Reporting Program (Attachment E).

   The survival of test fish in 96-hour static renewal bioassays with the discharge shall be not less than a three sample moving median of 90% survival and a single test value of not less than 70% survival.

   b. These acute toxicity limitations are further defined as follows:

   (1) 3-sample median. A bioassay test showing survival of less than 90 percent represents a violation of this limitation, if one or more of the past two or less bioassay tests show less than 90 percent survival.

   (2) Single sample. A bioassay test showing survival of less than 70 percent represents a violation of this limitation.

   c. Bioassays shall be performed using the most up-to-date USEPA protocol. Bioassays shall be conducted using rainbow trout as the test species in compliance with *Methods for Measuring the Acute Toxicity of Effluents and Receiving Water to Freshwater and Marine Organisms*, currently 5th Edition (EPA-821-R-02-012), with exceptions granted

to the Discharger by the Executive Officer and the Environmental Laboratory Accreditation Program (ELAP) upon the Discharger's request with justification.

B. Groundwater Reuse Specifications (For Dischargers that Reuse All or a Portion of Treated Groundwater)

1. **Reuse Policy:** As noted in the findings, the Regional Water Board adopted Resolution No. 88-160 on October 19, 1988. The Resolution urges dischargers of extracted groundwater from site cleanup projects to reuse their effluent and that when reuse is not technically and/or economically feasible, to discharge to a POTW.

2. **Reuse Allowed:** This Order permits reuse of extracted treated groundwater in conjunction with the discharge to surface water. Reuse of extracted treated groundwater can take many forms, such as irrigation of landscaping or agriculture, dust control or soil compaction on construction sites, and industrial water supply.

3. **Water Reuse Specifications (Water Reuse Only)**

   a. Water for beneficial reuse shall meet the requirements in Section IV.A - Effluent Limitations.

   b. Water reuse activities shall be described in the Discharger's NOI, including the method of any additional treatment and the location and type of water reuse.

   c. The reuse of treated groundwater shall not impair the quality of waters of the State, nor shall it create a nuisance as defined by CWC section 13050(m).

   d. Adequate measures shall be taken to minimize public contact with the reused groundwater and to prevent the breeding of flies, mosquitoes, and other vectors of public health significance during or after the process of reuse.

   e. Appropriate public warnings must be posted to advise the public that the water is not suitable for drinking. Signs must be posted in the area, and all reused water valves and outlets appropriately labeled.

   f. There shall be no cross-connection between the potable water supply and piping containing treated groundwater intended for reuse.

   g. Water reuse consisting of recharge or reinjection is not authorized under this Order. Any reinjection must be performed in accordance with a cleanup order approved by the Regional Water Board, or another lead oversight agency.

V. RECEIVING WATER LIMITATIONS

A. Surface Water Limitations

Discharges shall not cause the following in surface receiving waters:

1. The discharge of waste shall not cause the following conditions to exist in waters of the State at any place:

a. Floating, suspended, or deposited macroscopic particulate matter or foam;

b. Bottom deposits or aquatic growths to the extent that such deposits or growths cause nuisance or adversely affect beneficial uses;

c. Alteration of temperature, turbidity, or apparent color beyond present natural background levels;

d. Visible, floating, suspended, or deposited oil or other products of petroleum origin; and

e. Toxic or other deleterious substances to be present in concentrations or quantities that will cause deleterious effects on aquatic biota, wildlife, or waterfowl, or which render any of these unfit for human consumption either at levels created in the receiving waters or as a result of biological concentration.

2. The discharge of waste shall not cause the following limits to be exceeded in waters of the State in any place within one foot of the water surface:

a. Dissolved oxygen:	<u>For all tidal waters</u>: In the Bay downstream of Carquinez Bridge - 5.0 mg/L minimum Upstream of Carquinez Bridge - 7.0 mg/L minimum <u>For nontidal waters</u>: Waters designated as cold water habitat - 7.0 mg/L minimum Waters designated as warm water habitat - 5.0 mg/L minimum <u>For all inland surface waters</u>: The median dissolved oxygen concentration for any three consecutive months shall not be less than 80% of the dissolved oxygen content at saturation. When natural factors cause concentrations less than that specified above, the discharge shall not cause further reduction in ambient dissolved oxygen concentrations.
b. Dissolved Sulfide	Natural background levels

c. pH:	The pH shall not be depressed below 6.5 nor raised above 8.5, nor caused to vary from normal ambient pH by more than 0.5 pH units.
d. Un-ionized Ammonia	0.025 mg/L as an annual median; 0.16 mg/L as a maximum for Central Bay and upstream; 0.4 mg/L as a maximum for Lower Bay.
e. Nutrients	Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses.

3. Discharges shall not cause or contribute to a violation of any applicable water quality standard for receiving waters adopted by the Regional Water Board or the State Water Board as required by the CWA and regulations adopted there under. If more stringent applicable water quality standards are promulgated or approved pursuant to CWA section 303, or amendments thereto, the Regional Water Board will revise and modify this Order in accordance with such more stringent standards.

B. Groundwater Limitations – No discharges to groundwater authorized by this Order

VI. PROVISIONS

A. Standard Provisions

Dischargers shall comply with federal Standard Provisions included in Attachment D of this Order.

B. Monitoring and Reporting Program Requirements

1. Dischargers shall comply with the Monitoring and Reporting Program (Attachment E), and future revisions thereto, including applicable sampling and reporting requirements in the standard provisions listed in VI.A, above.

2. Dischargers authorized under this Order, especially those Dischargers with flow rates exceeding 10 gallons per minute, may be required to comply with additional monitoring requirements. The Executive Officer will specify such additional monitoring requirements in the Authorization to Discharge letter. Examples of additional monitoring that may be required are listed below:

a. Monitoring in response to a complaint received about a facility authorized to discharge under this permit,
b. Storm water monitoring,
c. Dioxins and furans monitoring,
d. Regional Monitoring Program (RMP) monitoring,
e. Additional discharge observations, and
f. Additional effluent and ambient priority pollutant scans.

C. Special Provisions

1. Reopener Provisions

The Regional Water Board may modify or reopen this Order prior to its expiration date in any of the following circumstances as allowed by law:

a. If present or future investigations demonstrate that the discharges governed by this Order have or will have a reasonable potential to cause or contribute to, or will cease to have, adverse impacts on water quality or beneficial uses of the receiving waters.

b. If new or revised WQOs or total maximum daily loads (TMDLs) come into effect for the San Francisco Bay Estuary and contiguous water bodies (whether statewide, regional, or site-specific). In such cases, effluent limitations in this Order will be modified as necessary to reflect updated WQOs and waste load allocations in TMDLs. Adoption of effluent limitations contained in this Order is not intended to restrict in any way future modifications based on legally adopted WQOs or TMDLs, or as otherwise permitted under federal regulations governing NPDES permit modifications.

c. If State Water Board precedential decisions, new policies, new laws, or new regulations on chronic toxicity or total chlorine residual become available.

d. If an administrative or judicial decision on a separate NPDES permit or WDRs addresses requirements similar to this discharge.

e. The Discharger may request permit modification based on any of the circumstances described above. In any such request, the Discharger shall include an antidegradation and anti-backsliding analysis.

f. The California Department of Public Health established a notification level for 1, 4-dioxane in November 2010 and has determined that it is reasonably anticipated to be a human carcinogen. Although this Order does not provide an effluent limit for 1,4-dioxane, the Regional Water Board may reopen this Order prior to its expiration to revise permit provisions pertaining to 1,4-dioxane.

g. Or as otherwise authorized by law.

2. NOI or Modified NOI Application. The NOI or Modified NOI application for each point of proposed discharge to a storm drain system shall contain the information required in the NOI Application as explained in Attachment B of this Order and as may be amended by the Executive Officer.

3. NOI Review. Upon receipt of a complete NOI application package for proposed discharge, the Executive Officer will review the application to determine whether the proposed Discharger is eligible to discharge waste under this Order. The application package shall document that:

a. The proposed discharge results from the cleanup of groundwater polluted by fuel leaks,

VOC leaks, and other related wastes;

b. The proposed Discharger has met the provisions of Regional Water Board Resolution No. 88-160 (*Regional Water Board Position on the Disposal of Extracted Groundwater from Groundwater Cleanup Projects*); and

c. The proposed treatment system and associated operation, maintenance, and monitoring plans are capable of ensuring that the discharge will meet the provisions, prohibitions, effluent limitations, and receiving water limitations of this Order.

4. **Discharge Authorization.** If the Regional Water Board Executive Officer determines that the proposed Discharger is eligible to discharge waste under this Order, the Executive Officer will issue an Authorization to Discharge. This Authorization to Discharge may be terminated by the Executive Officer at any time.

5. **Non-Compliance Is A Violation.** Upon receipt of the Regional Water Board Executive Officer's Authorization to Discharge, the Discharger shall comply with all applicable conditions and limitations of this Order and its Attachments. Any noncompliance (violations of requirements in this Order or Monitoring Program) constitutes a violation of the CWA and the CWC and is grounds for enforcement action and/or termination or modification of authorization to discharge.

6. **Triggers.** The following triggers are not effluent limitations and must not be construed as such. Instead, the triggers are levels above which additional investigation is required to determine further action. If any constituent in the discharge exceeds the corresponding trigger as listed in Table 3, below, the Discharger shall take monthly influent and effluent samples for three consecutive months for each exceeded constituent and conduct activities as required in Provisions VI.C.7 or VI.C.8. If additional monitoring has already been completed, the Discharger shall summarize the results including a description of plans underway to address the previous exceedance, such as details of source elimination, changes in operation of existing treatment units, or the re-design of any treatment unit.

Table 3. Trigger Pollutants

Pollutant	Chemical Abstract Service (CAS) Number	Trigger (µg/L)[1],[2]
Antimony	7440360	6
Arsenic	7440382	10
Beryllium	7440417	4
Cadmium	7440439	1.1
Chromium (VI)	18540299	11[3]
Copper[4]	7440508	5.9
Copper[5]	7440508	3.4
Copper[6]	7440508	4.7
Lead	7439921	3.2
Mercury	7439976	0.025
Nickel[4]	7440020	30
Nickel[5]	7440020	13
Nickel[6]	7440020	19
Selenium	7782492	5
Silver	7440224	2.2
Thallium	7440280	1.7
Zinc	7440666	86
Cyanide	57125	2.9

Pollutant	Chemical Abstract Service (CAS) Number	Trigger (µg/L)[1],[2]
Acrylonitrile	107131	0.059
Bromoform	75252	4.3
Chlorodibromomethane	124481	0.401
Dichlorobromomethane	75274	0.56
1,2-Dichloropropane	78875	0.52
1,3-Dichloropropylene	542756	0.5
1,1,2,2-Tetrachloroethane	79345	0.17
Pentachlorophenol	87865	0.28
2,4,6-Trichlorophenol	88062	2.1
Benzidine	92875	0.00012
Benzo(a)anthracene	56553	0.0044
Benzo(a)pyrene	50328	0.0044
Benzo(b)fluoranthene	205992	0.0044
Benzo(k)fluoranthene	207089	0.0044
Bis(2-chloroethyl)ether	111444	0.031
Bis(2-ethylhexyl)phthalate	117817	1.8
Chrysene	218019	0.044
Dibenzo(a,h)anthracene	53703	0.0044
3,3'-Dichlorobenzidine	91941	0.04
2,4-Dinitrotoluene	121142	0.11
1,2-Diphenylhydrazine	122667	0.040
Hexachlorobenzene	118741	0.00075
Hexachlorobutadiene	87683	0.44
Hexachloroethane	67721	1.9
Indeno(1,2,3-c,d)pyrene	193395	0.0044
N-nitrosodimethylamine	62759	0.00069
N-nitrosodi-n-propylamine	621647	0.005
Aldrin	309002	0.00013
alpha-BHC	319846	0.0039
beta-BHC	319857	0.014
gamma-BHC	58899	0.019
Chlordane	57749	0.00057
4,4-DDT	50393	0.00059
4,4-DDE	72559	0.00059
4,4-DDD	72548	0.00083
Dieldrin	60571	0.00014
alpha-Endosulfan	959988	0.0087
beta-Endosulfan	33213659	0.0087
Endrin	72208	0.0023
Endrin aldehyde	7421934	0.76
Heptachlor	76448	0.00021
Heptachlor epoxide	1024573	0.00010
PCBs, sum	1336363	0.00017
Toxaphene	8001352	0.0002
1,4-dioxane	123911	3
Turbidity (NTU)	---	5
Odor-Threshold (Units)	---	3
Oxygenates Other than MTBE	---	5
TPHs (other than gasoline and diesel)	---	50[7]
Sulfate	---	250,000
Foaming agents	---	500
Color (Units)	-	15

Table Notes:

[1] Units are in µg/L unless noted otherwise right after the name of pollutant

[2] If a discharger is reporting non-detect monitoring data with a reporting level higher than the trigger, the reason for the higher detection level shall be consistent with Appendix 4 of the SIP (Minimum Levels) and must be explained within the monitoring report. Please refer to the Regional Water Board web site for the latest version of SIP.

[3] If total chromium concentration exceeds 11 µg/L, then analysis for chromium (VI) shall also be conducted.

[4] Applicable to Suisun Bay and San Pablo Bay segments of San Francisco Bay.

[5] Applicable to Central Bay and Lower Bay segments of San Francisco Bay

[6] Applicable to South San Francisco Bay, south of Hayward Shoals.

[7] If a discharger is reporting monitoring data with a detection level higher than 50 µg/L, the reason for the higher

Pollutant	Chemical Abstract Service (CAS) Number	Trigger (µg/L)[1],[2]
detection level shall be explained within the monitoring report. In case of Bunker C Fuel, any non-detect result with reporting levels not exceeding 100 µg/L will not be deemed to be out of compliance with the 50 ug/L trigger level.		

7. **Trigger Case 1:** If the results of all three additional discharge samples **do not** exceed the triggers, the Discharger shall report the results in the next Monitoring Report and shall return to the schedule of sampling and analysis in the attached Monitoring and Reporting Program (Attachment E).

8. **Trigger Case 2:** If the results of **at least one of the three** additional discharge samples show exceedance of the same trigger, the Discharger shall investigate the source (e.g., comparing influent and discharge sample results) and investigate source control and/or treatment options for each triggered pollutant. The Discharger shall document its progress on these efforts in the Annual Self-Monitoring Report required by section IX.B of the Monitoring and Reporting Program (Attachment E). Until the Executive Officer determines that the "triggered pollutants" investigation is complete, the Discharger must implement the following monitoring schedule for the triggered pollutants:

   a. In case of a triggered inorganic pollutant, the Discharger shall accelerate monitoring of the discharge to quarterly and provide information, updated annually, confirming that pollutant source is background and explain the reasons why treatment of that pollutant is not feasible. Specifically, the annual monitoring reports shall include site-specific background groundwater concentrations, types of treatment available, and costs of treatment systems for each triggered inorganic pollutant, and

   b. In case of a triggered organic pollutant, the Discharger shall accelerate monitoring of the discharge to every two weeks and provide information, updated annually, confirming the reason(s) why that pollutant could not be treated to the level not exceeding the trigger for that pollutant.

9. The Executive Officer may require the Discharger to perform additional investigations or take additional actions if the Discharger: (1) exceeds a trigger value for the same pollutant and confirms (Trigger Case 2 above) the exceedance greater than two times in one calendar year; and (2) is not pursuing resolution of trigger exceedances in a timely fashion in the judgment of the Executive Officer. These two trigger exceedances do not include the data collected to verify the trigger (i.e., effluent data collected to confirm the trigger exceedance). These conditions are also grounds for termination of the Authorization to Discharge.

10. **Individual NPDES Permit May Be Required.** The USEPA Administrator may request the Regional Water Board Executive Officer to require any Discharger authorized to discharge waste by the General Permit to apply for and obtain an individual NPDES permit. The Executive Officer may require any Discharger authorized to discharge waste by the General Permit to apply for and obtain an individual NPDES permit. Cases where an individual NPDES permit may be required include the following:

a. The Discharger is not in compliance with the conditions of this Order or as authorized by the Executive Officer;

b. A change has occurred in the availability of demonstrated technology or practices for the control or abatement of pollutants applicable to the point source;

c. Effluent limitation guidelines are promulgated for point sources covered by the General NPDES Permit; or

d. A water quality control plan containing requirements applicable to such point sources is approved.

11. Treatment Reliability. Dischargers shall, at all times, retain a professional engineer certified in the State of California to oversee the design and operation and maintenance of the treatment system to properly operate and maintain all facilities that are used by the Dischargers to achieve compliance with this Order. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. All of these procedures shall be described in an Operation and Maintenance (O&M) Manual. The Discharger shall keep in a state of readiness all systems necessary to achieve compliance with the conditions of this Order. All systems, both those in service and reserve, shall be inspected and maintained on a regular basis. Records shall be kept of the tests (e.g., analytical or treatment system tests) and made available to the Regional Water Board for at least five years. Additional requirements for compliance with this provision are explained in Attachments B and C of the Order.

12. No Preemption. This Order permits the discharge of treated groundwater to waters of the State subject to the prohibitions, effluent limitations, and provisions of this Order. It does not preempt or supersede the authority of municipalities, flood control agencies, or other local agencies to prohibit, restrict, or control discharges of waste to storm drain systems or other watercourses subject to their jurisdiction. For example, this Order provides no water or groundwater rights and does not preempt the authority of any local or State agency as relates to water rights.

VII. COMPLIANCE DETERMINATION

Compliance with the effluent limitations contained in Section IV of this Order will be determined as specified below:

A. General

Compliance with effluent limitations for priority pollutants shall be determined using sample reporting protocols defined in the Monitoring and Reporting Program and Attachment A of this Order. For purposes of reporting and administrative enforcement by the Regional and State Water Boards, the Discharger shall be deemed out of compliance with effluent limitations if the concentration of the priority pollutant in the monitoring sample is greater than the effluent limitation and greater than or equal to the reporting level (RL).

B. Multiple Sample Data

When determining compliance with an Average Monthly Effluent Limitation (AMEL) **or** Maximum Daily Effluent Limitation (MDEL) for priority pollutants and more than one sample result is available, the Discharger shall compute the arithmetic mean unless the data set contains one or more reported determinations of "Detected, but Not Quantified" (DNQ) or "Not Detected" (ND). In those cases, the Discharger shall compute the median in place of the arithmetic mean in accordance with the following procedure:

1. The data set shall be ranked from low to high, ranking the reported ND determinations lowest, DNQ determinations next, followed by quantified values (if any). The order of the individual ND or DNQ determinations is unimportant.

2. The median value of the data set shall be determined. If the data set has an odd number of data points, then the median is the middle value. If the data set has an even number of data points, then the median is the average of the two values around the middle unless one or both of the points are ND or DNQ, in which case the median value shall be the lower of the two data points where DNQ is lower than a value and ND is lower than DNQ.

ATTACHMENT A – ACRONYMS AND DEFINITIONS

Acronyms

CIWQS	California Integrated Water Quality System
AMEL	Average Monthly Effluent Limitation
Basin Plan	Water Quality Control Plan for the San Francisco Bay Basin
BPJ	Best Professional Judgment
CFR	Code of Federal Regulations
CTR	California Toxics Rule
CV	Coefficient of Variation
CWA	Federal Clean Water Act
DNQ	Detected, but Not Quantified
DO	Dissolved oxygen
ECA	Effluent Concentration Allowance
EFF	Effluent
MDEL	Maximum Daily Effluent Limitation
MDL	Method Detection Limit
ML	Minimum Level
MTBE	Methyl Tertiary Butyl Ether
ND	Not Detected
NTR	National Toxics Rule
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
PCE	Tetrachloroethylene
POTW	Publicly Owned Treatment Work
RL	Reporting Level
RPA	Reasonable Potential Analysis
SIP	State Implementation Policy
SSTs	Site-Specific Translators
TCE	Trichloroethylene
TPHG	Total Petroleum Hydrocarbons as Gasoline
TPHD	Total Petroleum Hydrocarbons as Diesel
µg/L	Microgram per Liter
USEPA	U.S. Environmental Protection Agency
VOC	Volatile Organic Compounds

Definitions

Arithmetic Mean (µ), also called the average, is the sum of measured values divided by the number of samples. For ambient water concentrations, the arithmetic mean is calculated as follows:

Arithmetic mean = $\mu = \Sigma x / n$ where: Σx is the sum of the measured ambient water concentrations, and n is the number of samples.

Average Monthly Effluent Limitation (AMEL) is the highest allowable average of daily discharges over a calendar month, calculated as the sum of all daily discharges measured during a calendar month divided by the number of daily discharges measured during that month.

Bioaccumulative pollutants are those substances taken up by an organism from its surrounding medium through gill membranes, epithelial tissue, or from food and subsequently concentrated and retained in the body of the organism.

Carcinogenic pollutants are substances that are known to cause cancer in living organisms.

Coefficient of Variation (CV) is a measure of the data variability and is calculated as the estimated standard deviation divided by the arithmetic mean of the observed values.

Detected, but Not Quantified (DNQ) are those sample results less than the RL, but greater than or equal to the laboratory's MDL.

Dilution Credit is the amount of dilution granted to a discharge in the calculation of a water quality-based effluent limitation, based on the allowance of a specified mixing zone. It is calculated from the dilution ratio or determined through conducting a mixing zone study or modeling of the discharge and receiving water.

Duly Authorized Representative is one whose:

a. Authorization is made in writing by a principal executive officer or ranking elected official;

b. Authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as general partner in a partnership, sole proprietor in a sole proprietorship, the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company (A duly authorized representative may thus be either a named individual or any individual occupying a named position).

Effluent Concentration Allowance (ECA) is a value derived from the water quality criterion/objective, dilution credit, and ambient background concentration that is used, in conjunction with the coefficient of variation for the effluent monitoring data, to calculate a long-term average (LTA) discharge concentration. The ECA has the same meaning as waste load allocation (WLA) as used in USEPA guidance (Technical Support Document For Water Quality-based Toxics Control, March 1991, second printing, EPA/505/2-90-001).

Estimated Chemical Concentration is the estimated chemical concentration that results from the confirmed detection of the substance by the analytical method below the ML value.

Field Blank is defined as an individual sample demonstrated to be free from the contaminants of interest and other potentially interfering substances, and treated as a sample in all respects, including exposure to grab-sampling site conditions, storage, preservation, and all analytical procedures. The purpose of the field blank is to determine if the field or sample transporting procedures and

environments have contaminated the sample.

Flow Sample is defined as the accurate measurement of the average daily flow volume using a properly calibrated and maintained flow-measuring device.

Grab Sample is defined as an individual sample collected in a short period of time not exceeding 15 minutes. Grab samples shall be collected during normal peak loading conditions for the parameter of interest, which may or may not be during hydraulic peaks. It is used primarily in determining compliance with maximum daily limits and average monthly limits. Grab samples represent only the condition that exists at the time the wastewater is collected.

Instantaneous Maximum Effluent Limitation is the highest allowable value for any single grab sample or aliquot (i.e., each grab sample or aliquot is independently compared to the instantaneous maximum limitation).

Instantaneous Minimum Effluent Limitation is the lowest allowable value for any single grab sample or aliquot (i.e., each grab sample or aliquot is independently compared to the instantaneous minimum limitation).

Maximum Daily Effluent Limitation (MDEL) means the highest allowable daily discharge of a pollutant, over a calendar day (or 24-hour period). For pollutants with limitations expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the daily discharge is calculated as the arithmetic mean measurement of the pollutant over the day.

Median is the middle measurement in a set of data. The median of a set of data is found by first arranging the measurements in order of magnitude (either increasing or decreasing order). If the number of measurements (n) is odd, then the median = $X_{(n+1)/2}$. If n is even, then the median = $(X_{n/2} + X_{(n/2)+1})/2$ (i.e., the midpoint between the n/2 and n/2+1).

Method Detection Limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero, as defined in title 40 of the Code of Federal Regulations, Part 136, Attachment B, revised as of July 3, 1999.

Minimum Level (ML) is the concentration at which the entire analytical system must give a recognizable signal and acceptable calibration point. The ML is the concentration in a sample that is equivalent to the concentration of the lowest calibration standard analyzed by a specific analytical procedure, assuming that all the method specified sample weights, volumes, and processing steps have been followed.

Not Detected (ND) are those sample results less than the laboratory's MDL.

Ocean Waters are the territorial marine waters of the State as defined by California law to the extent these waters are outside of enclosed bays, estuaries, and coastal lagoons. Discharges to ocean waters are regulated in accordance with the State Water Board's California Ocean Plan.

Quality Assurance Officer is a qualified individual who was not otherwise involved in sample collection, transport, or analysis (please refer to the following web site for a more detailed description: http://www.waterboards.ca.gov/swamp/docs/swampqapp_template032404.doc) to investigate the cause of data error.

Persistent Pollutants are substances for which degradation or decomposition in the environment is nonexistent or very slow.

Reporting Level (RL) is the ML (and its associated analytical method) chosen by the Discharger for reporting and compliance determination from the MLs included in this Order. The MLs included in this Order correspond to approved analytical methods for reporting a sample result that are selected by the Regional Water Board either from Appendix 4 of the SIP in accordance with section 2.4.2 of the SIP or established in accordance with section 2.4.3 of the SIP. The ML is based on the proper application of method-based analytical procedures for sample preparation and the absence of any matrix interferences. Other factors may be applied to the ML depending on the specific sample preparation steps employed. For example, the treatment typically applied in cases where there are matrix-effects is to dilute the sample or sample aliquot by a factor of ten. In such cases, this additional factor must be applied to the ML in the computation of the RL.

Source of Drinking Water is any water designated as municipal or domestic supply (MUN) in a Regional Water Board Basin Plan.

Standard Deviation (σ) is a measure of variability that is calculated as follows:

$$\sigma = (\sum[(x - \mu)^2]/(n - 1))^{0.5}$$

where:

x is the observed value;

μ is the arithmetic mean of the observed values; and

n is the number of samples.

Toxicity Reduction Evaluation (TRE) is a study conducted in a step-wise process designed to identify the causative agents of effluent or ambient toxicity, isolate the sources of toxicity, evaluate the effectiveness of toxicity control options, and then confirm the reduction in toxicity. The first steps of the TRE consist of the collection of data relevant to the toxicity, including additional toxicity testing, and an evaluation of facility operations and maintenance practices, and best management practices. A Toxicity Identification Evaluation (TIE) may be required as part of the TRE, if appropriate. (A TIE is a set of procedures to identify the specific chemical(s) responsible for toxicity. These procedures are performed in three phases (characterization, identification, and confirmation) using aquatic organism toxicity tests.)

ATTACHMENT B – NOTICE OF INTENT (NOI) APPLICATION FORM AND INSTRUCTIONS

Complete and submit this NOI to apply for Authorization or Reauthorization to Discharge and/or reuse extracted and treated groundwater resulting from the cleanup of groundwater polluted by volatile organic compounds (VOC), fuel leaks, and other related waste under the requirements of NPDES Permit No. CAG912002 (VOC and Fuel General Permit)

I certify under penalty of law that this document and all attachments are prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the design engineer whose signature and engineering license number is documented in this notice, 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 a fine and imprisonment.

_____ _____

Name (print) Signature and Date

_____ _____

Title/Organization Address of Responsible Official

This Application is for the Groundwater Treatment Facility located at (provide street address):

_____

This NOI form and all required attachment shall be uploaded to Geo-Tracker, http://www.waterboards.ca.gov/ust/electronic_submittal/index.shtml (contact Lourdes Gonzales at (510) 622-2365 or lgonzales@waterboards.ca.gov if you have any questions). If electronic submittal is not possible, applicants may submit the NOI package to the following address: California Regional Water Quality Control Board, San Francisco Bay Region, 1515 Clay Street, Suite 1400, Oakland, California 94612. Please include a check for $11,195 (as of December 2011), or the most current fee amount, payable to the State Water Resources Control Board.

Table B-1. Mark only one as applicable

1	**This is a new discharge.**	
2	**This discharge is currently authorized under Order No. R2-2009-0059 (VOC General Permit)**, which requires authorized dischargers, who need to continue discharging after September 30, 2014, to file a completed NOI form no later than April 3, 2014.	
3	**This discharge is currently authorized under this Order (VOC and Fuel General Permit)**, which requires authorized dischargers who **need to continue** discharging after January 11, 2017, to file a completed NOI form no later than July 15, 2016.	
4	**This discharge is currently authorized under this Order (VOC and Fuel General Permit)** and this Form is submitted for **modification** of the current Authorization to Discharge.	

Table B-2. Mark or provide information as applicable

1	I have contacted the local sanitary sewer agency serving the above address and determined that discharging to the local sanitary sewer system is not a feasible option.	
2	I have contacted the local agencies having jurisdiction over the use of the storm drain system or watercourse and inform them about this proposed discharge.	
3	Approximately, what percentage of the total effluent is reused or will be reused?	%

Table B-3. Facility and Professional Engineer(s) information

1	Facility Name Discharger Name Discharger's Contact Person Name, Mail Address, Phone number, and Email Address	
2	Authorized Person to Sign & Submit Reports	
3	Billing Information Contact Person Name, Mail Address, Phone number, and Email Address	
4	Design Professional Engineer's Name, California License Number, Mail Address, Phone Number, and Email Address	
5	Operation and Maintenance Professional Engineer's Name, California License Number, Mail Address, Phone Number, and Email Address	
6	Groundwater treatment system design capacity as certified by Professional Engineer in gallons per minute (gpm).	_____ gpm
7	Attach design capacity certification report including flow schematics showing every components of the treatment system to this application. The Professional Engineer shall affix his/her stamp including signature and engineering license number to the certification report.	
8	Type of Site or Project. For example: active service station, closed service station, solvent spills/leaks active or closed groundwater cleanup sites, short term dewatering project, long term dewatering Project, or other (please explain if "other")	

9	Watershed. To determine the watershed, refer to the State of California Watershed Browser located online at www.conservation.ca.gov/dlrp/watershedportal/Watershed Browser/Pages/WatershedBrowser.aspx or the Guide to San Francisco Bay Area Creeks located online at http://museumca.org/creeks/index.html.	
10	Discharge path to Receiving Water. Please list the complete path of the discharge and attach an aerial map [e.g., the discharge would travel about a quarter of a mile inside a storm drain system before reaching a river (provide the name of the river), and then would travel two miles in the river before reaching the bay].	
11	Project Brief Description and Tentative Completion Date	

Table B-4. Treatment System Description

	Unit	**Number**	**Size or capacity (e.g. pounds of GAC) and Further Description (If Applicable)**
1	Total number of extraction well(s) on site		
2	Extraction Wells with Dedicated Treatment Unit(s)		
3	Wellhead Treatment Unit(s)		
4	Settling Tank(s) in series		
5	Settling Tank(s) in parallel		
6	Oil/Water Separator(s)		
7	Filter(s) for particulates in groundwater		
8	Air Strippers with Air Filters		
9	Air Strippers without Air Filters		
10	Other Treatment Unit(s) (e.g. units installed for removing 1,4-dioxane)		
11	Granular Activated Carbon (GAC) Vessel(s) in Series		
12	GAC Vessel(s) in Parallel		
13	Chemical Additives		
14	Effluent Reuse Tank(s)		

Table B-5. Discharge location information

Discharge Point Location	Discharge Point Latitude	Discharge Point Longitude	Receiving Water
Storm Drain Location where discharge enters:	____° ____' ____"	____° ____' ____"	Not applicable (complete the row below)
Location where discharge enters receiving water either directly or via storm drain system:	____° ____' ____"	____° ____' ____"	

Table B-6. List of pollutants (For new and existing discharges. For existing discharges, complete one table for influent and one for effluent)

Monitoring data since effective date of the initial discharge authorization letter, or estimated from groundwater monitoring data for new discharges	Pollutant 1	Pollutant 2	Pollutant 3	Add Columns and/or tables as needed (all detected pollutants with effluent limitations and all triggered pollutants exceeding the triggers shall be listed in this table)
Number of Samples				
Maximum Concentration				
Average Concentration (average of detected pollutants only)				
Number of times the effluent limitation was exceeded				
Median Concentration				
Minimum Concentration				
Number of Non-Detects				
Lowest Reporting Limit				
Highest Reporting Limit				
Number of Samples with Lowest Reporting Limit				
Most recent sample Date, Method Number				

Note: The Regional Water Board may modify this form at any time to reflect any new fees and other needed improvements as applicable.

ATTACHMENT C – NOTICE OF TERMINATION

Complete and Submit to Request Termination of Coverage Under Requirements of General Waste Discharge Requirements for Discharge or Reuse of Extracted and Treated Groundwater resulting from the Cleanup of Groundwater Polluted by Volatile Organic Compounds (VOC), Fuel Leaks, and Other Related Wastes NPDES Permit No. CAG912002 (VOC and Fuel General Permit)

For the Groundwater Treatment Facility located at:

_____ _____

Facility Street Address, City, Zip Code CIWQS Place Identification Number

A PDF electronic copy of this form shall be uploaded on GeoTracker and a confirmation email shall be sent to the responsible staff member at this office, currently Lourdes Gonzales, at lgonzales@waterboards.ca.gov.

Table C-1. Mark only one as applicable

1	Temporary groundwater dewatering project, e.g., during a construction project, has been completed.	
2	Groundwater cleanup work has been completed.	
3	Method of groundwater cleanup has been changed with no need to discharge treated groundwater.	
4	Extract and treat method of groundwater cleanup will be stopped for a while and only monitoring of groundwater will occur at this site. Please attach documentation that the agency overseeing cleanup has no objection to cessation of groundwater extraction and treatment.	
5	Other reason. Please specify below (e.g., discharge to POTW has been granted):	

Table C-2. Agency Approval (applicable if Table C-1 row 2, 3, or 4 marked)

	Name, address, email, and phone number of the agency and agency staff overseeing the cleanup work	Have you provided a copy of this termination notice to this staff? (Yes/No. If No, please explain the reason)
1		

I, the Discharger, certify under penalty of law that this notice is prepared under my direction or supervision and last/final date of this discharge was _____. I am aware that discharging without a discharge authorization is in violation of California Water Code.

_____

Name (print) Signature and Date

_____

Title/Organization (Discharger's Organization) Address, email, and phone number

Note: The Regional Water Board may modify this form at any time to reflect new requirements and other needed improvements.

ATTACHMENT D –STANDARD PROVISIONS

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ATTACHMENT D –STANDARD PROVISIONS

I. STANDARD PROVISIONS – PERMIT COMPLIANCE

A. Duty to Comply

1. The Discharger must comply with all of the conditions of this Order. Any noncompliance constitutes a violation of the Clean Water Act (CWA) and the California Water Code and is grounds for enforcement action, for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application. (40 CFR § 122.41(a).)

2. The Discharger shall comply with effluent standards or prohibitions established under Section 307(a) of the CWA for toxic pollutants within the time provided in the regulations that establish these standards or prohibitions, even if this Order has not yet been modified to incorporate the requirement. (40 CFR § 122.41(a)(1).)

B. Need to Halt or Reduce Activity Not a Defense

It shall not be a defense for a Discharger in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this Order. (40 CFR § 122.41(c).)

C. Duty to Mitigate

The Discharger shall take all reasonable steps to minimize or prevent any discharge in violation of this Order that has a reasonable likelihood of adversely affecting human health or the environment. (40 CFR § 122.41(d).)

D. Proper Operation and Maintenance

The Discharger shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the Discharger to achieve compliance with the conditions of this Order. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems that are installed by a Discharger only when necessary to achieve compliance with the conditions of this Order. (40 CFR § 122.41(e).)

E. Property Rights

1. This Order does not convey any property rights of any sort or any exclusive privileges. (40 CFR § 122.41(g).)

2. The issuance of this Order does not authorize any injury to persons or property or invasion of other private rights, or any infringement of state or local law or regulations (40 CFR § 122.5(c)).

F. Inspection and Entry

The Discharger shall allow the Regional Water Board, State Water Board, United States Environmental Protection Agency (USEPA), and/or their authorized representatives (including an authorized contractor acting as their representative), upon the presentation of credentials and other documents, as may be required by law, to (40 CFR § 122.41(i); Wat. Code, § 13383):

1. Enter upon the Discharger's premises where a regulated facility or activity is located or conducted, or where records are kept under the conditions of this Order (40 CFR § 122.41(i)(1));

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this Order (40 CFR § 122.41(i)(2));

3. Inspect and photograph, at reasonable times, any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Order (40 CFR § 122.41(i)(3)); and

4. Sample or monitor, at reasonable times, for the purposes of assuring Order compliance or as otherwise authorized by the CWA or the Water Code, any substances or parameters at any location. (40 CFR § 122.41(i)(4).)

G. Bypass

1. Definitions

   a. "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility. (40 CFR § 122.41(m)(1)(i).)

   b. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities, which causes them to become inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production. (40 CFR § 122.41(m)(1)(ii).)

2. Bypass of extracted groundwater. During a dewatering project, the Discharger may allow any bypass of uncontaminated extracted groundwater to occur which originates from uncontaminated extraction well(s). The Discharger shall monitor the water quality of these extractions wells to confirm that the extracted water remains uncontaminated. The Discharger may also allow any bypass to occur which does not cause exceedances of effluent limitation, but only if it is for essential maintenance to assure efficient operation. In this case, weekly monitoring results of pollutants of concern shall be reported in the quarterly monitoring reports.

3. Prohibition of bypass. Bypass is prohibited, and the Regional Water Board may take enforcement action against a Discharger for bypass, unless (40 CFR § 122.41(m)(4)(i)):

a. Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage (40 CFR § 122.41(m)(4)(i)(A));

b. There were no feasible alternatives to the bypass, such as turning off the extraction wells pump(s), discharge to a POTW, retention of untreated wastes, maintenance during normal periods of equipment downtime, or the use of auxiliary treatment facilities. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass that occurred during normal periods of equipment downtime or preventive maintenance (40 CFR § 122.41(m)(4)(i)(B)); and

c. The Discharger submitted notice to the Regional Water Board as required under Standard Provisions – Permit Compliance I.G.5 below. (40 CFR § 122.41(m)(4)(i)(C).)

4. The Regional Water Board may not take enforcement action against a Discharger for bypass, if the Regional Water Board determines that the three conditions listed in Standard Provisions – Permit Compliance I.G.3 above have been met. (40 CFR § 122.41(m)(4)(ii).)

5. Notice

a. Anticipated bypass of uncontaminated extracted groundwater. If the Discharger knows in advance of the need for a bypass of uncontaminated extracted groundwater, it shall submit the necessary information in the initial or modified Notice of Intent, if possible at least 45 days before the date of the bypass. The necessary information includes but not limited to the name and number of extraction wells, flow rates for each well, the distance to other contaminated wells, and monitoring data such as turbidity, color, conductivity, pH, temperature, metals, TPH, VOC, SVOC, PAHs, Oxygenates.

b. Unanticipated bypass. The Discharger shall submit notice of an unanticipated bypass as required in Standard Provisions - Reporting V.E below (24-hour notice). (40 CFR § 122.41(m)(3)(ii).)

H. Upset

Upset means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the Discharger. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation. (40 CFR § 122.41(n)(1).)

1. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology based permit effluent limitations if the requirements of Standard Provisions – Permit Compliance I.H.2 below are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review. (40 CFR § 122.41(n)(2)).

2. Conditions necessary for a demonstration of upset. A Discharger who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs or other relevant evidence that (40 CFR § 122.41(n)(3)):

   a. An upset occurred and that the Discharger can identify the cause(s) of the upset (40 CFR § 122.41(n)(3)(i));

   b. The permitted facility was, at the time, being properly operated (40 CFR § 122.41(n)(3)(ii));

   c. The Discharger submitted notice of the upset as required in Standard Provisions – Reporting V.E.2.b below (24-hour notice) (40 CFR § 122.41(n)(3)(iii)); and

   d. The Discharger complied with any remedial measures required under Standard Provisions – Permit Compliance I.C above. (40 CFR § 122.41(n)(3)(iv).)

3. Burden of proof. In any enforcement proceeding, the Discharger seeking to establish the occurrence of an upset has the burden of proof. (40 CFR § 122.41(n)(4).)

II. STANDARD PROVISIONS – PERMIT ACTION

A. General

This Order may be modified, revoked and reissued, or terminated for cause. The filing of a request by the Discharger for modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any Order condition. (40 CFR § 122.41(f).)

B. Duty to Reapply

If the Discharger wishes to continue an activity regulated by this Order after the expiration date of this Order, the Discharger must submit a completed Notice of Intent form (see Attachment B), 180 days in advance of the Order expiration date, **to** obtain a new permit. (40 CFR § 122.41(b).)

C. Transfers

Any authorization to discharge issued under this Order is not transferable to any person except after filing a modified Notice of Intent with the Regional Water Board. If the new Discharger has a different professional engineer, the modified Notice of Intent shall be revised accordingly.\

III. STANDARD PROVISIONS – MONITORING

A. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity. (40 CFR § 122.41(j)(1).)

B. Monitoring results must be conducted according to test procedures under 40 CFR Part 136 or other test procedures specified in this Order. (40 CFR § 122.41(j)(4); § 122.44(i)(1)(iv).)

IV. STANDARD PROVISIONS – RECORDS

A. The Discharger shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this Order, and records of all data used to complete the application for this Order, for a period of at least three (3) years from the date of the sample, measurement, report or application. This period may be extended by request of the Regional Water Board Executive Officer at any time (40 CFR § 122.41(j)(2).)

B. Records of monitoring information shall include:

1. The date, exact place, and time of sampling or measurements (40 CFR § 122.41(j)(3)(i));
2. The individual(s) who performed the sampling or measurements (40 CFR § 122.41(j)(3)(ii));
3. The date(s) analyses were performed (40 CFR § 122.41(j)(3)(iii));
4. The individual(s) who performed the analyses (40 CFR § 122.41(j)(3)(iv));
5. The analytical techniques or methods used (40 CFR § 122.41(j)(3)(v)); and
6. The results of such analyses. (40 CFR § 122.41(j)(3)(vi).)

C. Claims of confidentiality for the following information will be denied (40 CFR § 122.7(b)):

1. The name and address of any permit applicant or Discharger (40 CFR § 122.7(b)(1)); and
2. Permit applications and attachments, permits and effluent data. (40 CFR § 122.7(b)(2).)

V. STANDARD PROVISIONS – REPORTING

A. Duty to Provide Information

The Discharger shall furnish to the Regional Water Board, State Water Board, or USEPA within a reasonable time, any information which the Regional Water Board, State Water Board, or USEPA may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this Order or to determine compliance with this Order. Upon request, the Discharger shall also furnish to the Regional Water Board, State Water Board, or USEPA copies of records required to be kept by this Order. (40 CFR § 122.41(h); California Water Code (CWC), § 13267.)

B. Signatory and Certification Requirements

1. All applications, reports, or information submitted to the Regional Water Board, State Water Board, and/or USEPA shall be signed and certified in accordance with Standard Provisions – Reporting V.B.2, V.B.3, V.B.4, and V.B.5 below. (40 CFR § 122.41(k).)
2. All permit applications shall be signed by a responsible person as explained below:
    a. **For a corporation.** All permit applications shall be signed by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means: (i) A president, secretary, treasurer, or vice-president of the corporation in charge of a

principal business function, or any other person who performs similar policy- or decision-making functions for the corporation, or (ii) the manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures. (40 CFR § 122.22(a)(1).)

b. **For a partnership or sole proprietorship.** All permit applications shall be signed by a general partner or the proprietor, respectively. (40 CFR § 122.22(a)(2).)

c. **For a municipality, State, federal, or other public agency.** All permit applications shall be signed by either a principal executive officer or ranking elected official. For purposes of this provision, a principal executive officer of a federal agency includes: (i) the chief executive officer of the agency, or (ii) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of USEPA). (40 CFR § 122.22(a)(3).).

3. All reports required by this Order and other information requested by the Regional Water Board, State Water Board, or USEPA shall be signed by a person described in Standard Provisions – Reporting V.B.2 above, or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   a. The authorization is made in writing by a person described in Standard Provisions – Reporting V.B.2 above (40 CFR § 122.22(b)(1));

   b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.) (40 CFR § 122.22(b)(2)); and

   c. The written authorization is submitted to the Regional Water Board. (40 CFR § 122.22(b)(3).)

4. If an authorization under Standard Provisions – Reporting V.B.3 above is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Standard Provisions – Reporting V.B.3 above must be submitted to the Regional Water Board and State Water Board prior to or together with any reports, information, or applications, to be signed by an authorized representative. (40 CFR § 122.22(c).)

5. Any person signing a document under Standard Provisions – Reporting V.B.2 or V.B.3 above shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or 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 and imprisonment for knowing violations." (40 CFR § 122.22(d).)

C. Monitoring Reports

1. Monitoring results shall be reported at the intervals specified in the Monitoring and Reporting Program (Attachment E) in this Order. (40 CFR § 122.22(l)(4).)

2. Monitoring results must be reported on a Discharge Monitoring Report (DMR) form (40 CFR § 122.41(l)(4)(i).) or paper or electronic forms provided or specified by the Regional Water Board or State Water Board.

3. If the Discharger monitors any pollutant more frequently than required by this Order using test procedures approved under Part 136 or as specified in this Order, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR or other reporting form specified by the Regional Water Board. (40 CFR § 122.41(l)(4)(ii).)

4. Calculations for all limitations, which require averaging of measurements, shall utilize an arithmetic mean unless otherwise specified in this Order. (40 CFR § 122.41(l)(4)(iii).)

D. Compliance Schedules

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this Order, shall be submitted no later than 14 days following each schedule date. (40 CFR § 122.41(l)(5).)

E. Twenty-Four Hour Reporting

1. The Discharger shall report any noncompliance that may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the Discharger becomes aware of the circumstances. A written submission shall also be uploaded on GeoTracker (**http://www.waterboards.ca.gov/ust/electronic_submittal/index.shtml)** within five (5) days of the time the Discharger becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to

reduce, eliminate, and prevent reoccurrence of the noncompliance. (40 CFR § 122.41(l)(6)(i).)

2. The following shall be included as information that must be reported within 24 hours under this paragraph (40 CFR § 122.41(l)(6)(ii)):

   a. Any unanticipated bypass that exceeds any effluent limitation in this Order. (40 CFR § 122.41(l)(6)(ii)(A).)

   b. Any upset that exceeds any effluent limitation in this Order. (40 CFR § 122.41(l)(6)(ii)(B).)

3. The Regional Water Board may waive the above-required written report under this provision on a case-by-case basis if an oral report has been received within 24 hours. (40 CFR § 122.41(l)(6)(iii).)

F. Planned Changes

The discharger shall file with the Executive Officer an amended Notice of Intent at least 60 days before making any material change in the character, location, or volume of the discharge. In case of proposing any change of treatment system or operation and maintenance procedures, a professional engineer certified in State of California shall certify the adequacy of the design and/or the procedures. A modified Notice of Intent is required under this provision only when (40 CFR § 122.41(l)(1)) the alteration or addition could significantly change the nature or increase the quantity of pollutants discharged (pollutants regulated or not regulated by this Order). Three examples of significant changes are a change in discharge location, a change of the engineer responsible for the design and/or operation and maintenance of the treatment system, and an increase in discharge flow rates.

G. Anticipated Noncompliance

The Discharger shall give advance notice to the Regional Water Board or State Water Board of any planned changes in the permitted facility or activity that may result in noncompliance with the requirements in this Order. (40 CFR § 122.41(l)(2).)

H. Other Noncompliance

The Discharger shall report all instances of noncompliance not reported under Standard Provisions – Reporting V.C, V.D, and V.E above at the time monitoring reports are submitted. The reports shall contain the information listed in Standard Provision – Reporting V.E above. (40 CFR § 122.41(l)(7).)

I. Other Information

When the Discharger becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Regional Water Board, State Water Board, or USEPA, the Discharger shall promptly submit such facts or information. (40 CFR § 122.41(l)(8).)

VI. STANDARD PROVISIONS – ENFORCEMENT

The Regional Water Board is authorized to enforce the terms of this permit under several provisions of the Water Code, including, but not limited to, sections 13385, 13386, and 13387.

VII. ADDITIONAL PROVISIONS – NOTIFICATION LEVELS

A. Non-Municipal Facilities

Existing manufacturing, commercial, mining, and silvicultural Dischargers shall notify the Regional Water Board as soon as they know or have reason to believe (40 C.F.R. § 122.42(a)):

1. That any activity has occurred or will occur that would result in the discharge, on a routine or frequent basis, of any toxic pollutant that is not limited in this Order, if that discharge will exceed the highest of the following "notification levels" (40 C.F.R. § 122.42(a)(1)):

    a. 100 micrograms per liter (µg/L) (40 C.F.R. § 122.42(a)(1)(i));

    b. 200 µg/L for acrolein and acrylonitrile; 500 µg/L for 2,4-dinitrophenol and 2-methyl-4,6-dinitrophenol; and 1 milligram per liter (mg/L) for antimony (40 C.F.R. § 122.42(a)(1)(ii));

    c. Five (5) times the maximum concentration value reported for that pollutant in the Report of Waste Discharge (40 C.F.R. § 122.42(a)(1)(iii)); or

    d. The level established by the Regional Water Board in accordance with section 122.44(f). (40 C.F.R. § 122.42(a)(1)(iv).)

2. That any activity has occurred or will occur that would result in the discharge, on a non-routine or infrequent basis, of any toxic pollutant that is not limited in this Order, if that discharge will exceed the highest of the following “notification levels" (40 C.F.R. § 122.42(a)(2)):

    a. 500 micrograms per liter (µg/L) (40 C.F.R. § 122.42(a)(2)(i));

    b. 1 milligram per liter (mg/L) for antimony (40 C.F.R. § 122.42(a)(2)(ii));

    c. Ten (10) times the maximum concentration value reported for that pollutant in the Report of Waste Discharge (40 C.F.R. § 122.42(a)(2)(iii)); or

    d. The level established by the Regional Water Board in accordance with section 122.44(f). (40 C.F.R. § 122.42(a)(2)(iv).)

ATTACHMENT E – MONITORING AND REPORTING PROGRAM

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ATTACHMENT E – MONITORING AND REPORTING PROGRAM

National Pollutant Discharge Elimination System (NPDES) regulations at 40 CFR 122.48 require that all NPDES permits specify monitoring and reporting requirements. California Water Code (CWC) Sections 13267 and 13383 also authorize the Regional Water Quality Control Board (Regional Water Board) to require technical and monitoring reports. This Monitoring and Reporting Program establishes monitoring and reporting requirements that implement the federal and State regulations.

I. GENERAL MONITORING PROVISIONS

A. The Discharger shall comply with this Monitoring and Reporting Program. The Executive Officer may amend this Monitoring and Reporting Program pursuant to 40 CFR 122.62, 122.63, and 124.5.

B. The Discharger shall conduct all monitoring in accordance with Attachment D, section III, and all tests must be performed by laboratories certified for the analyses in accordance with the California Water Code Section 13176. Equivalent test methods must be more sensitive than those specified in 40 CFR 136 and must be specified in the permit or in the related discharge authorization letter.

C. Monthly discharge flow volume, total quarterly flow, and annual flow shall be recorded.

D. The number and frequency of bypasses and accidental spills shall be recorded.

E. A copy of this Order, a complete copy of the Notice of Intent (NOI) filed, documentation of the Authorization to Initiate Discharge received from the Regional Water Board, a full copy of the Operation and Maintenance (O&M) Manual, and any other documents relevant to the operation and maintenance of the treatment facility shall be stored at or near the treatment facility, and made available to Regional Water Board staff, USEPA staff, or their contractors upon request. The Discharger shall inspect its facility as frequently as required by the O&M Manual.

II. MONITORING LOCATIONS

The Discharger shall establish the following monitoring locations to demonstrate compliance with the effluent limitations, discharge specifications, and other requirements in this Order:

Table E-1. Monitoring Station Locations

Discharge Point Name (if applicable)	Monitoring Location Name	Monitoring Location Description (include Latitude and Longitude when available)
---	INF-001	At a point in the extraction system immediately prior to inflow to the treatment unit.
001	EFF-001	At a point in the discharge line immediately following treatment and before it joins or is diluted by any other waste stream, body of water, or substance.
---	RSW-001U	At a point 50 feet upstream from the point of discharge into the receiving water, or if access is limited, at the first point upstream which is accessible.
---	RSW-001D	At a point 50 feet downstream from the point of discharge into the receiving water, or if access is limited, at the first point downstream which is accessible.

Discharge Point Name (if applicable)	Monitoring Location Name	Monitoring Location Description (include Latitude and Longitude when available)
---	REU-001	At a point immediately prior to reuse location. Not applicable if effluent is not reused or reclaimed.

III. INFLUENT MONITORING REQUIREMENTS

The Discharger shall monitor influent to the facility at Monitoring Location INF-001 in accordance with the schedule shown on Column 1 of Table E.2.

IV. EFFLUENT MONITORING REQUIREMENTS

Dischargers shall monitor discharges of treated wastewater from the facility at Monitoring Location EFF-001, in accordance with the schedule shown on Column 2 of Table E.2. Effluent sampling shall occur concurrently (within 30 minutes) with influent sampling.

A. Monitoring during bypass. When any type of bypass occurs, grab samples shall be collected on a daily basis for all constituents at all affected discharge points that have effluent limits for the duration of the bypass.

B. Required Actions After Any Effluent Violation. If the analytical results show violation of any effluent limitation, the Discharger shall take a confirmation effluent sample, together with receiving water samples (see Column 3 of Table E-2) within 24 hours of becoming aware of the violation of effluent limit. The Discharger must have the confirmation sample analyzed by expedited methods and obtain results within 24 hours of sample collection. If the analytical results are also in violation of the effluent limit, the Discharger shall terminate the discharge until it has corrected the cause of violation. In this case, both the initial and confirmed results are violations. However, if the confirmation effluent sampling shows compliance, the Regional Water Board will consider only the initial exceedance as a violation.

V. WHOLE EFFLUENT ACUTE TOXICITY TESTING REQUIREMENTS

The Discharger shall monitor acute toxicity at EFF-001 as follows:

A. Compliance with the acute toxicity effluent limitations of this Order shall be evaluated by measuring survival if test organisms to 96-hour static renewal bioassays at Monitoring Location EFF-001.

B. Test organisms shall be rainbow trout unless the Executive Officer specifies otherwise in writing.

C. All bioassays shall be performed according to the most up-to-date protocols in 40 CFR 136m currently in *Methods for Measuring the Acute Toxicity of Effluents and Receiving Water to Freshwater and Marine Organisms*, 5th Edition.

D. If specific identifiable substances in the discharge can be demonstrated by the Discharger as being rapidly rendered harmless upon discharge to the receiving water, compliance with the acute toxicity limitation may be determined after the test samples are adjusted to remove the influence of those substances. Written approval from the Executive Officer must be obtained to authorize such an adjustment.

E. The sample may be taken from effluent prior to chlorination. Monitoring of the bioassay water shall include, on a daily basis, the following parameters: pH, dissolved oxygen, ammonia, (if toxicity is observed), temperature, hardness, and alkalinity. These results shall be reported. If a violation of acute toxicity requirements occurs, the bioassay test shall be repeated with new fish as soon as practical and shall be repeated until a test fish survival rate of 90 percent or greater is observed. If the control fish survival rate is less than 90 percent, the bioassay test shall be restarted with new fish and shall continue as soon as practical until an acceptable test is completed (i.e., control fish survival rate is 90 percent or greater).

VI. RECLAMATION MONITORING REQUIREMENTS

The Discharger shall monitor reuse effluent at Monitoring Location REU-001 as shown on Column 2 of Table E.2.

VII. RECEIVING WATER MONITORING REQUIREMENTS – SURFACE WATER AND GROUNDWATER

The Discharger shall monitor receiving water at Monitoring Locations RSW-001U and RSW-001D as shown on Column 3 of Table E.2.

A. Receiving water sampling shall occur concurrently with effluent sampling.

B. Receiving water samples shall be collected at each station on each sampling day during the period within 1 hour following low slack water, if relevant. Where sampling at lower slack water period is not practical, sampling shall be performed during higher slack water period. Samples shall be collected within the discharge plume and 50 feet down current of the discharge point so as to be representative, unless otherwise stipulated.

C. Samples should be collected within one foot below the surface of the receiving water body. Explanation shall be provided in the monitoring report if this specification could not be met.

Table E-2. Schedule for Sampling, Measurements, and Analysis

Required Analytical Test Method Number, Technique, Standard Methods (SM), USEPA Method Number (EPA), 40 CFR Part (or equivalent)/Sampling Station	Column 1 Minimum Sampling Frequency for Influent INF-001	Column 2 Minimum Sampling Frequency for Effluent EFF-001 or Effluent for Reuse REU-001	Column 3 Minimum Sampling Frequency for Receiving Surface Water RSW-001U and RSW-001D
Unit is "µg/L" and Type of Sample is "Grab" unless noted otherwise	**Grab**	**Grab**	**Grab**
Discharge Flow (gpm & gpd)	-	Continuous	-
Reclamation Flow Rate (gpm & gpd or gallons reclaimed during the calendar quarter if reclamation is not continuous)	-	Continuous	-
Fish Toxicity, 96-hr (% survival), EPA-821-R-02-012 Test, Method 2019.0	-	Q/Y	-
All Applicable Standard Observations (No Unit)	D/M	D/M	V
Volatile Organic Compounds, EPA 8260b for discharges from sites contaminated with fuel leaks and other related wastes	Y	Y	V
Volatile Organic Compounds, EPA 8260b for dischargers from sites contaminated with VOC	2/Y	D/M	V
1,4-Dioxane (See Note 3), EPA 8270c	-	2/Y	-

Required Analytical Test Method Number, Technique, Standard Methods (SM), USEPA Method Number (EPA), 40 CFR Part (or equivalent)/Sampling Station	Column 1 Minimum Sampling Frequency for Influent INF-001	Column 2 Minimum Sampling Frequency for Effluent EFF-001 or Effluent for Reuse REU-001	Column 3 Minimum Sampling Frequency for Receiving Surface Water RSW-001U and RSW-001D
Unit is "µg/L" and Type of Sample is "Grab" unless noted otherwise	**Grab**	**Grab**	**Grab**
Semi Volatile Organic Compounds except PAHs (See Note 1), EPA 8270c	D/Q	D/M	-
Turbidity	-	D/Q/Y	-
pH	D/M/Q/Y	D/M/Q/Y	V
Dissolved Oxygen (mg/L)	-	-	V
Total Dissolved Solids (mg/L) (construction and dewatering projects)	-	D/M	-
Temperature (ºC)	-	D/M/Q/Y	-
Electrical Conductivity	-	D/M/Q/Y	-
Hardness (mg/L as $CaCO_3$)	-	-	T
Salinity (parts per thousand)	-	-	T
Ethylene Dibromide (EDB) (See Note 1), 504	D/Q	D/M	V
Benzene, Toluene, Ethylbenzene, and/or Total Xylenes (See Note 1), EPA 8020	D/Q	D/M	V
Methyl Tertiary Butyl Ether (MTBE) (See Note 1), EPA 8020	D/Q	D/M	V
Total Petroleum Hydrocarbons as Gasoline (See Note 1), EPA 8015 Modified	D/Q	D/M	V
Total Petroleum Hydrocarbons as Diesel (See Note 1), EPA 8015 Modified	D/Q	D/M	V
Total Petroleum Hydrocarbons other than Gasoline and Diesel (required if Petroleum Hydrocarbons other than Gasoline and Diesel present in the soil and groundwater) (See Note 1), EPA 8015 Modified	D/Q	D/M	V
Polynuclear Aromatic Hydrocarbons (PAHs) (See Note 1), 8310	D/Q	D/M	V
Tertiary Amyl Methyl Ether (TAME), DiIsopropyl Ether (DIPE), Ethyl Tertiary Butyl Ether (ETBE), Tertiary Butyl Alcohol (TBA), Ethanol, and/or Methanol (See Note 1)	D/Y	D/Y	-
Total Chlorine Residual (See Note 1), (Field Kit, EPA 330 or SM 4500-Cl)	D/Q	D/M	V
Antimony (EPA 204.2), Arsenic (EPA 206.3), Beryllium (GFAA or ICPMS), Cadmium (GFAA or ICPMS), Hexavalent and Total Chromium (SM 3500), Copper (EPA 200.9), Cyanide (SM 4500-CN C or I), Lead (EPA 200.9), Mercury (EPA 1631), Nickel (EPA 249.2), Selenium (SM 3114B OR C), Silver (EPA 272.2), Thallium (EPA 279.2), and Zinc (EPA 200.8) (See Note 2) for dischargers from sites contaminated with VOC		3Y	
Antimony (EPA 204.2), Arsenic (EPA 206.3), Beryllium (GFAA or ICPMS), Cadmium (GFAA or ICPMS), Hexavalent and Total Chromium (SM 3500), Copper (EPA 200.9), Cyanide (SM 4500-CN C or I), Lead (EPA 200.9), Mercury (EPA 1631), Nickel (EPA 249.2), Selenium (SM 3114B OR C), Silver (EPA 272.2), Thallium (EPA 279.2), and Zinc (EPA 200.8) (See Note 2) for discharges from sites contaminated with fuel leaks and other related wastes	-	D/Y	-
Other pollutants such as non VOC-related odor, sulfate and foaming agents (See Note 1), SM	D/Q/Q/Y	D/M/Q/Y	V

Notes:
Note 1: if known to be present in the influent.
Note 2: Inorganic compounds samples shall be analyzed for total (unfiltered) constituents with the reporting levels not exceeding the following: 0.002 ug/L for Mercury; 0.25 ug/L for Cadmium and Silver; 1 ug/L for Nickel, Thallium, and Zinc; 2.0 ug/L for Arsenic and Selenium; 1 ug/L for Cyanide; and 0.5 ug/L for Antimony, Beryllium, Total Chromium, Copper, and Lead (SIP Appendix 4 Minimum Levels

http://www.waterboards.ca.gov/iswp/docs/final.pdf). If the Discharger cannot attain the reporting levels for Zinc, Arsenic, or Total Chromium, the reason(s) along with any supporting documentation shall be documented in the monitoring reports. Water Board staff shall make a compliance determination based on data provided. If the Discharger exceeds the trigger for mercury of 0.025, the Discharger may consider re-sampling and re-analyzing another sample using ultra-clean techniques as described in USEPA methods 1669 and 1631 to eliminate the possibility of artifactual contamination of the sample. For pollutants not listed in Appendix 4 of the SIP, the Discharger shall provide the reason for the higher detection level along with any supporting documentation in the monitoring reports. Water Board staff shall make a compliance determination based on data provided.
Note 3: Use techniques such as selective ion mode or isotope dilution to achieve reporting levels not exceeding 1 ug/l.

Definitions: ug/L = microgram per liter or parts per billion (ppb); g/day = grams per day; gpm = gallons per minute; mg/L = milligram per liter or parts per million (ppm); gpd = gallons per day; MFL = million fibers per liter
GC = Gas Chromatography; GCMS = Gas Chromatography/Mass Spectrometry; FAA = Flame Atomic Absorption; GFAA = Graphite Furnace Atomic Absorption; Hydride = Gaseous Hydride Atomic Absorption; ICP = Inductively Coupled Plasma; and ICPMS = Inductively Coupled Plasma/Mass Spectrometry.

Legends:
D/M Once during the first and fifth day of startup; monthly thereafter. For VOC, if a discharger has no VOC detected in the influent or the effluent other than Total Petroleum Hydrocarbons, Benzene, Toluene, Ethylbenzene, Xylenes, Tertiary Amyl Methyl Ether (TAME), DiIsopropyl Ether (DIPE), Ethyl Tertiary Butyl Ether (ETBE), Tertiary Butyl Alcohol (TBA), Ethanol, or Methanol then frequency of VOC monitoring may be reduced to once a year.
D/Q Once during the first and fifth day of startup; quarterly thereafter.
Y Once during the first week of startup; annually thereafter.
3Y Once during the first week of startup; every three years thereafter.
2/Y Once during the first week of startup; twice per year thereafter.
D/Y Once during the first and fifth day of startup; annually thereafter.
Q/Y Quarterly for first year of operation, annually thereafter.
D/Q/Y Once during the first and fifth day of startup; quarterly for first year of operation, annually thereafter.
D/M/Q/Y Once during the first and fifth day of startup; monthly for first year of operation, quarterly for the second year, and annually thereafter. In case of pH analysis, this monitoring requirement is only for facilities with a treatment process that would cause no pH variances in the effluent. If any chemical used in the treatment process may cause pH variances in the effluent, the frequency of pH monitoring in the effluent shall be increased to twice per week for the first month of operation and weekly thereafter if pH monitoring data for the first month of operation demonstrate compliance with pH effluent limits.
V Receiving Waters sampling must be performed together (on the same calendar day) with the required effluent confirmation sampling that is required when a violation of an effluent limit is known, and the sample analyzed for that specific violated parameter and the Dissolved Oxygen level. In no case, should a Discharger continue discharging in known violation of effluent limits just to comply with this receiving water sampling requirement.
T Sampling shall be performed when Cadmium, Chromium (total), Copper, Lead, Nickel, Silver, or Zinc triggers are exceeded.

VIII. OTHER MONITORING REQUIREMENTS

A. Startup Phase Monitoring. During the original startup for the treatment system, sampling of the effluent must occur on the first day and fifth day of operation (weekend days may be excluded).

1. On the first day of the original startup, the system shall be allowed to run until at least three to five well volumes are removed and until three consecutive readings for pH, conductivity, and temperature are within five percent of each other; then, the influent and effluent shall be sampled and submitted for analyses. Prior to receipt of the results of the initial samples, all effluent shall be discharged into a holding tank (that is contained, not discharged to the receiving water) or discharged to the sanitary sewer until the results of the analyses show the discharge to be within the effluent limits established in this Order and/or as authorized by the Executive Officer. The treatment system may be shut down after the first day's sampling to await the analyses results and thereby reduce the amount of storage needed. If the treatment system is shut down more than 120 hours during the original startup (awaiting analyses results, etc.), the original startup procedures and sampling must be repeated. For the stored effluent, if the results of the analyses show the discharge to be in violation, the effluent shall: (1) be retreated until the retreated effluent is in compliance, or (2) be disposed of in accordance with the applicable provisions of California Code of Regulations.

2. If the first day's sampling shows compliance, the treatment system shall be operated for a total of five days with the discharge to the storm sewer or other conveyance system leading to the receiving water, and be sampled again during the fifth day. While the fifth day's

samples are being analyzed, the effluent may be discharged to the receiving water as long as the analyses are received within 120 hours of sampling, and then, continue to be discharged to the receiving water if the analyses show compliance. Otherwise, the original startup procedures and sampling must be repeated. In case of a temporary shutdown, if the facility reported effluent limit violation(s) during the previous three years, then any re-startup shall follow the original startup procedures.

B. Chemical Additives Monitoring: If applicable, monitoring related to chemical usage shall be conducted by the Discharger as required in its treatment system design specification and Operation and Maintenance Manual.

C. Standard Observations for Receiving Water

1. Floating and suspended materials (e.g., oil, grease, algae, and other macroscopic particulate matter): presence or absence, source, and size of affected area.

2. Discoloration and turbidity: description of color, source, and size of affected area.

3. Odor: presence or absence, characterization, source, distance of travel, and wind direction.

4. Beneficial water use: presence of water-associated waterfowl or wildlife, fisherperson, and other recreational activities in the vicinity of each sampling station.

5. Hydrographic condition, if relevant:

    a. Time and height of corrected high and low tides (corrected to nearest National Oceanic and Atmospheric Administration location for the sampling date and time of sample and collection).

    b. Depth of water columns and sampling depths.

6. Weather condition:

    a. Air temperature.

    b. Wind direction and estimated velocity.

    c. Total precipitation during the five days prior to observation.

D. Standard Observations for Onsite Usage of Reclaimed Water

1. Floating and suspended materials of waste origin (to include oil, grease, algae, and other macroscopic particulate matter): presence or absence, source, and size of affected area.

2. Discoloration and turbidity: description of color, source, and size of affected area.

3. Odor: presence or absence, characterization, source, distance of travel, and wind direction.

4. Weather condition:

a. Air temperature.

b. Wind direction and estimated velocity.

c. Total precipitation during the previous five days and on the day of observation.

5. Deposits, discolorations, and/or plugging in the conveyance system that could adversely affect the system reliability and performance.

6. Operation of the valves, outlets, sprinkler heads, and/or pressure shutoff valves in conveyance system.

E. Standard Observations for Groundwater Treatment System

1. Odor: presence or absence, characterization, source, distance of travel, and wind direction.

2. Weather condition: wind direction and estimated velocity.

3. Deposits, discolorations, and/or plugging in the treatment system (stripping tower, carbon filters, etc.) that could adversely affect the system reliability and performance.

4. Operation of the float and/or pressure shutoff valves installed to prevent system overflow or bypass.

IX. REPORTING REQUIREMENTS

A. General Monitoring and Reporting Requirements

The Discharger shall comply with all Standard Provisions (Attachment D) and in this document related to monitoring, reporting, non-compliance reporting, and record keeping.

B. Self Monitoring Reports (SMRs)

1. **SMR Format.** At any time during the term of this Order, the State or Regional Water Board may notify the Discharger to electronically submit SMRs using the State Water Board's California Integrated Water Quality System (CIWQS) Program Web site (http://www.waterboards.ca.gov/ciwqs/index.html). The CIWQS website will provide additional directions for SMR submittal. In the interim, Dischargers shall submit SMRs using the submittal method specified in the Authorization to Discharge letter.

2. **SMR Due Dates and Contents.** The Discharger shall submit SMRs by the due dates, and with the contents, specified below:

   a. The Discharger shall submit quarterly SMRs no later than 45 days after the end of each calendar quarter, including the results of all required monitoring.

   b. The Discharger shall submit annual reports by February 15 of each year, covering the previous calendar year. The annual report shall contain all data required for the fourth quarter in addition to summary data required for annual reporting. This report may be submitted in lieu of the report for the fourth quarter of a calendar year.

c. The Discharger shall report in the SMR the results for all monitoring specified in this Monitoring and Reporting Program under sections III through VIII. If there has been no discharge during the entire reporting period, quarterly and annual reports must still be submitted to report that has been the case.

d. The Discharger shall attach a cover letter to the monitoring reports. The information contained in the cover letter shall clearly identify number of permit violations; discuss corrective actions taken or planned; and the proposed time schedule for corrective actions. Identified violations must include a description of the requirement that was violated and a description of the violation. In the cover letter, the Discharger shall also document the volume of the effluent reused during that reporting period.

e. The Discharger shall arrange all reported data in a tabular format. The data shall be summarized to clearly illustrate whether the facility is operating in compliance with the effluent limitations. The Discharger shall not include laboratory reports unless requested.

f. Monitoring reports must be submitted to the Regional Water Board signed, certified, and using the submittal method specified by the Authorization to Discharge letter.

g. The monitoring reports shall also include a description of operation and maintenance (O&M) of the groundwater extraction and treatment system consistent with the O&M manual, which shall be available to all personnel who are responsible for operation and maintenance activities.

h. The monitoring reports shall include the results of analyses and observations as follows:

(1) Calculations for all limitations that require averaging of measurements shall utilize an arithmetic mean unless otherwise specified in this permit.

(2) A table identifying by method number the analytical procedures used for analyses. Any special methods shall be identified and should have prior approval of the Regional Water Board's Executive Officer.

(3) Laboratory results shall be summarized in tabular form but actual laboratory reports do not need to be included in the report. A summary of quality assurance/quality control activities data such as field, travel, and laboratory blanks shall be reported for each analyzed constituent or group of constituents.

(4) A summary of the monitoring data to include information such as source of the sample (influent, effluent, or receiving water); the constituents; the methods of analysis used; the laboratory reporting limits in µg/L; the sample results (µg/L); the date sampled; and the date sample was analyzed.

(5) Flow (in gpm) and mass removal data (in kilograms).

(6) Summary of treatment system status during the reporting period (e.g., in operation/on standby) and reason(s) for non-routine treatment system shut down.

(7) The annual reports shall contain tabular summary of the monitoring data obtained during the previous year. In addition, the annual reports shall contain a comprehensive discussion of the compliance record and the corrective actions taken or planned which may be needed to bring the Discharger into full compliance with the waste discharge requirements including any trigger study required by Special Provision VI.C.6 and the progress in satisfaction of Special Provisions VI.C.7 and VI.C.8 of this Order. The annual report shall document that the annual fee has been paid.

(8) If, during any calendar quarter, a Discharger becomes aware that any monitoring data obtained for compliance with this Order may be invalid, the Discharger shall submit a claim of invalid monitoring data, as uploaded on GeoTracker, with a confirmation email to the Regional Water Board staff in charge of this permit, within 45 days after end of that calendar quarter. The Discharger shall include with this claim, the name, phone number, and email of its assigned staff to investigate the cause(s) of errors and the corrective actions taken, or date when actions will be completed to eliminate or reduce future data errors. The Discharger shall also provide, in this claim, a date that the O&M manual will be updated to include errors prevention measures. These preventive measures shall include but not be limited to accelerated monitoring (e.g., twice a month monitoring for at least one month) to provide valid monitoring data indicating the effectiveness of the proposed preventive measures.

i. Additional Specifications for Submitting SMRs to CIWQS — If the Discharger submits SMRs to CIWQS, it shall submit analytical results and other information using one of the following methods:

Table E-3. SMR Reporting for CIWQS

Parameter	Method of Reporting	
	EDF/CDF data upload or manual entry	**Attached File**
All parameters identified in influent, effluent, and receiving water monitoring tables (except Dissolved Oxygen and Temperature)	Required for All Results	
Dissolved Oxygen Temperature	Required for Monthly Maximum and Minimum Results Only (1)	Discharger may use this method for all results or keep records
Cyanide Arsenic Cadmium Chromium Copper Lead Mercury Nickel Selenium Silver Zinc Dioxins and Furans (by U.S. EPA Method 1613)	Required for All Results (2)	

Antimony Beryllium Thallium Pollutants by U.S. EPA Methods 601, 602, 608, 610, 614, 624, and 625	Not Required (unless identified in influent, effluent, or receiving water monitoring tables), But Encouraged [1]	Discharger may use this method and submit results with application for permit reissuance, unless data submitted by CDF/EDF upload
Analytical Method	Not Required (Discharger may select "data unavailable") [1]	
Collection Time Analysis Time	Not Required (Discharger may select "0:00") [1]	

Notes for Table E-3:

[1] The Discharger shall continue to monitor at the minimum frequency specified in the monitoring tables, keep records of the measurements, and make the records available upon request.

[2] These parameters require EDF/CDF data upload or manual entry regardless of whether monitoring is required by this Monitoring and Reporting Program or other provisions of this Order (except for biosolids, sludge, or ash provisions).

3. Monitoring periods and reporting for all required monitoring shall be completed according to the following schedule:

Table E-4. Monitoring Periods and Reporting Schedule

Sampling Frequency	Monitoring Period Begins On…	Monitoring Period
Continuous	Effective startup date	All
Daily	Effective startup date	(Midnight through 11:59 PM) or any 24-hour period that reasonably represents a calendar day for purposes of sampling.
Weekly	Effective startup date	Effective startup day through one week after Effective startup date
Monthly	First day of calendar month following the last day of the startup date	1st day of calendar month through last day of calendar month
Quarterly	Closest of January 1, April 1, July 1, or October 1 following (or on) the last day of the startup date	January 1 through March 31 April 1 through June 30 July 1 through September 30 October 1 through December 31
Semiannually	Closest of January 1 or July 1 following (or on) the last day of the startup date	January 1 through June 30 July 1 through December 31
Annually	January 1 following (or on) the last day of the start -up date	January 1 through December 31

4. The Discharger shall report with each sample result the applicable Reporting Level (RL) and the current Method Detection Limit (MDL), as determined by the procedure in 40 CFR Part 136. The Discharger shall report the results of analytical determinations for the presence of chemical constituents in a sample using the following reporting protocols:

   a. Sample results greater than or equal to the RL shall be reported as measured by the laboratory (i.e., the measured chemical concentration in the sample).

   b. Sample results less than the RL, but greater than or equal to the laboratory's MDL, shall

be reported as "Detected, but Not Quantified," or DNQ. The estimated chemical concentration of the sample shall also be reported. For the purposes of data collection, the laboratory shall write the estimated chemical concentration next to DNQ as well as the words "Estimated Concentration" (may be shortened to "Est. Conc."). The laboratory may, if such information is available, include numerical estimates of the data quality for the reported result. Numerical estimates of data quality may be percent accuracy (± a percentage of the reported value), numerical ranges (low to high), or any other means considered appropriate by the laboratory.

c. Sample results less than the laboratory's MDL shall be reported as "Not Detected," or ND.

d. Dischargers are to instruct laboratories to establish calibration standards so that the Minimum Level (ML) value (or its equivalent if there is differential treatment of samples relative to calibration standards) is the lowest calibration standard. At no time is the Discharger to use analytical data derived from *extrapolation* beyond the lowest point of the calibration curve.

C. Discharge Monitoring Reports (DMRs) - Not Applicable

D. Other Reports

1. Startup Report: A report on the startup phase shall be included in the first quarterly monitoring report. This report shall include a certification that a professional engineer certified in the State of California oversees the treatment system operation and maintenance activities including the startup work.

2. Spill Reports: If any hazardous substance is discharged in or on any waters of the state, or discharged and deposited where it is, or probably will be discharged in or on any waters of the state, the Discharger shall report such a discharge to this Regional Water Board, at (510) 622-2369, and to the California Emergency Management Agency, at (800) 852-7550, within 24 hours of becoming aware of the spill. A written report shall be uploaded on GeoTracker, with an confirmation email to staff, within five working days and shall contain information relative to:

a. Nature of waste or pollutant,

b. Quantity involved,

c. Duration of incident,

d. Cause of spilling,

e. Spill Prevention, Control, and Countermeasure Plan (SPCC) in effect, if any,

f. Estimated size of affected area,

g. Nature of effects (i.e., fish kill, discoloration of receiving water, etc.),

h. Corrective measures that have been taken or planned, and a schedule of these activities, and

i. Persons/agencies notified.

3. Reports of Treatment Unit Bypass and Permit Violation: In the event the Discharger violates or threatens to violate the conditions of the waste discharge requirements and prohibitions or intends to permit a treatment unit bypass, the Discharger shall notify the Regional Water Board within 24 hours of when the Discharger or Discharger's agent has knowledge of the incident and confirm this notification in writing and uploaded on GeoTracker with a confirmation email to Regional Water Board staff, within 5 working days of the initial notification. The written report shall include time, date, duration and estimated volume of waste bypassed, method used in estimating volume and person notified of the incident. The report shall include pertinent information explaining reasons for the noncompliance and shall indicate what steps were taken to prevent the problem from recurring.

A treatment unit bypass may occur due to:

a. Maintenance work, power failures, or breakdown of waste treatment equipment,

b. Accidents caused by human error or negligence,

c. The self-monitoring program results exceeding effluent limitations,

d. Any activity that would result in a frequent or routine discharge of any toxic pollutant not limited by this Order, or

e. Other causes, such as acts of nature.

4. Additional Reporting: If a violation of the effluent limitations should occur, the Discharger shall direct the effluent to a holding tank and contained, or the extraction and treatment system shall be shut down. The confirmation sampling shall be conducted when the discharge is directed to a holding tank and contained or right before the extraction and treatment system is shut down. The content of the holding tank shall be retreated until the retreated effluent is in compliance, be discharged to a publicly owned treatment works (POTW), or be disposed in accord with the provisions of applicable California Code of Regulations. The Discharger shall obtain permission from the POTW for any temporary or permanent discharges to the sanitary sewer. All confirmation sampling results shall be reported.

ATTACHMENT F – FACT SHEET

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ATTACHMENT F – FACT SHEET

As described in Section II of this Order, this Fact Sheet includes the legal requirements and technical rationale that serve as the basis for the requirements of this Order. This Order has been prepared under a standardized format to accommodate a broad range of discharge requirements for dischargers in California. Except where identified as "not applicable", all sections or subsections are applicable to the discharges regulated under this Order.

This Order is intended to cover discharges of extracted and treated groundwater resulting from the cleanup of groundwater polluted by volatile organic compounds (VOC), fuel leaks, and other related wastes. This Order combines two previously issued Regional Water Board orders:

a. R2-2006-0075, NPDES General Permit for the discharge of extracted and treated groundwater resulting from the cleanup of groundwater polluted by fuel leaks and other related wastes at service stations and similar sites (**Fuel General Permit**), and

b. R2-2009-0059, NPDES General Permit for the discharge of extracted and treated groundwater resulting from the cleanup of groundwater polluted by volatile organic compounds (**VOC General Permit**). The VOC General Permit remains in effect and the dischargers authorized under this permit will need to seek coverage under this Order no later than April 3, 2014.

I. PERMIT INFORMATION

From 1980 to date, approximately 11,000 sites with underground fuel or VOC storage tanks in the San Francisco Bay Region are known to be leaking or to have leaked. Historically, a number of these sites were cleaned-up by extracting and treating contaminated groundwater and discharging treated groundwater to surface water. Because the number of such applications exceeded the capacity of available Regional Water Board staff to develop and bring individual waste discharge requirements to the Regional Water Board for adoption, in the early 1990s, the Regional Water Board issued National Pollutant Discharge Elimination System (NPDES) General Permits to cover such discharges.

In 1991, the Regional Water Board issued the Fuel General Permit. This permit was reissued in 1996, 2001, and 2006. The 2006 permit (Regional Water Board Order No. R2-2006-0075) expired on January 12, 2012. There are 20 current Dischargers covered under this permit. In 2011, 18 Dischargers submitted Notice of Intent (NOI) applications to either continue discharging or initiate the discharge of treated groundwater to surface water under the Fuel General Permit after it expires.

In 1994, the Regional Water Board issued the VOC General Permit. This permit was reissued in 1999, 2004, and 2009. The current VOC General Permit (Regional Water Board Order No. R2-2009-0059) was adopted on August 12, 2009, became effective October 1, 2009, and expires September 30, 2014. There are 56 current Dischargers covered under this permit.

The Fuel General Permit needs to be reissued because 18 Dischargers have submitted NOI applications to either continue discharging or initiate the discharge of treated groundwater to surface water. In addition, within the next five years, it is anticipated that a number of fuel-contaminated sites will be conducting cleanup by extracting contaminated groundwater, treating, and discharging

treated groundwater. Some Publicly Owned Treatment Works (POTWs) do not accept new discharges from groundwater clean-up, and, therefore, a number of sites conducting groundwater cleanup will require waste discharge requirements from the Regional Water Board for discharge to surface water. The number of cleanups anticipated exceeds the capacity of available Regional Water Board staff to develop and bring individual waste discharge requirements to the Regional Water Board for adoption. These circumstances create the need for an expedited system to process the anticipated requests. The reissuance of the Fuel General Permit will expedite the processing of requirements, enable the Regional Water Board to better utilize limited staff resources, and permit cleanups to begin promptly.

What is New in this Permit Reissuance - Because the nature and treatment of pollutants present in fuel-contaminated groundwater and VOC-contaminated groundwater is similar, the Regional Water Board expects to cover both types of discharges under this General Permit. It is also anticipated that the total number of VOC and fuel-contaminated sites that will be conducting cleanup by extracting contaminated groundwater, and treating and discharging treated groundwater to surface water will decline. This decline is the result of several factors:

(i) Fewer open cases as the Regional Water Board closes cases but finds not as many new cases to take their place,
(ii) Significant shift in groundwater cleanup technology away from "pump and treat" and towards in-situ methods, due to the latter's greater effectiveness, and
(iii) Wider use of the Regional Water Board low-threat closure tool for both fuel and VOC cleanup sites.

For the above reasons, two separate general NPDES permits will not be needed when the VOC General Permit expires in 2014. Those requiring continued permit coverage and new dischargers are expected to submit NOI applications for coverage under this Order.

The following VOC and fuel clean-up discharges are normally not eligible for coverage: discharges from cleanups involving significant contamination by metals, pesticides, or other conservative pollutants and discharges from sites with other NPDES discharges (e.g., process waste). Dischargers that combine extracted groundwater with stormwater before treatment are normally not eligible for coverage under this Order because the amount of rainwater varies and may exceed the treatment system capacity.

The following table (Table F-1) is a standard template primarily useful for individual permits. For this General Permit, it provides cross-references to the specific sections of the Notice of Intent (NOI) Form, in Attachment B, that each Discharger enrolled under this Order must initially complete and submit as part of the NOI.

Table F-1. Facility Information

California Integrated Water Quality System (CIWQS) Regulatory measure and Place ID	A CIWQS Place ID and Regulatory measure identification number will be assigned to a facility when the Executive Officer issues the Authorization to Initiate Discharge
Discharger	NOI Form in Attachment B
Name of Facility	
Facility Address	
Facility Contact, Title, Phone, and email address	
Consultant Name, Phone, and email address	
Authorized Person to Sign and Submit Reports	
Mailing Address and Contact Person Name, Phone, and email address	
Billing Address and Contact Person Name, Phone, and email address	
Type of Project	
Major or Minor Facility	Minor
Pretreatment Program	Not Applicable
Reclamation Requirements	Producer (See NOI in Attachment B)
Facility Permitted Flow	NOI Form in Attachment B
Facility Design Flow	
Watershed	
Receiving Water Type	

A. Site Owners or Operators who apply for an authorization to discharge under this Order and who are granted such authorization are hereinafter called Discharger(s). The groundwater treatment facility is considered the facility regulated under this Order (hereinafter Facility). For the purposes of this Order, references to the "Discharger(s)" or "permittee(s)" in applicable federal and State laws, regulations, plans, or policy are held to be equivalent to references to the Discharger(s) herein.

B. The Facilities regulated under the previously issued Fuel and VOC General NPDES permits discharge wastewater to multiple receiving waters of the State and/or the United States, mainly in Santa Clara County. The Fuel General Permit was adopted on November 13, 2006, became effective on January 12, 2007, and expired on January 12, 2012. The terms and conditions of Order No. R2-2006-0075 were automatically continued in effect until new Waste Discharge Requirements and NPDES permit are adopted pursuant to this Order. During the term of Order No. R2-2006-0075, 78 facilities were authorized to discharge treated groundwater to the receiving water documented in the NOI submitted for each discharge. Out of 78 facilities, 60 completed groundwater cleanup or changed to different cleanup methods that obviate the need to discharge any treated groundwater.

C. As of November 2011, 18 Dischargers had filed a report of waste discharge by submitting an NOI to continue their discharge authorization under this NPDES General Permit. In the process of reviewing and approving NOIs, supplemental information may be requested from a subset of these facilities. It may also be necessary to visit facilities for which an NOI has been submitted, to observe operations and collect additional data to determine the eligibility of authorizing those discharges

under this Order. This Order requires Dischargers to submit monitoring data according to the requirements contained in the Monitoring and Reporting Program (Attachment E). If monitoring data indicate significant contamination by metals, pesticides, or other conservative pollutants, Dischargers authorized under this Order may be required to apply for an individual NPDES permit.

II. FACILITY DESCRIPTION

The facilities that may be covered under this Order are groundwater treatment facilities located at active or closed sites with solvent and/or fuel leaks. These groundwater treatment facilities are in operation to extract and treat groundwater polluted mainly by VOC and/or fuel components. This Order covers discharges from these facilities to all surface waters such as creeks, streams, rivers including flood control channels, lakes, or San Francisco Bay. Such discharges may occur directly to surface waters or through constructed storm drain systems.

A. Description of Wastewater Treatment

Dischargers authorized under this Order typically use aeration and/or granular activated carbon (GAC) systems to treat their groundwater prior to discharge. Facilities that use other types of treatment systems that are effective at removal of VOC pollutants may be covered by this Order subject to the approval of the Executive Officer. The most common VOC pollutants contained in the influent of these treatment systems are tetrachloroethylene and trichloroethylene. The most common pollutants contained in groundwater influent that has been contaminated by fuel leaks are benzene, ethylbenzene, toluene, total xylenes, methyl tertiary butyl ether (MTBE), and other petroleum hydrocarbons collectively called total petroleum hydrocarbons (TPHs). Other volatile or semi-volatile organic compounds may also be present in the influent of a subset of facilities regulated under this permit. Less commonly, inorganic pollutants, such as metals, are present in the influent and effluent and may be naturally occurring.

Except for some inorganic compounds and some other organic compounds such as 1,4 dioxane, the concentrations of organic pollutants in the effluents of the discharges are usually below detectable levels. The Fuel and VOC Dischargers reported design flow rates ranging from 5 gpm to 840 gpm, and discharge flow rates ranging from 2.5 gpm to 605 gpm.

The reported detection limit for benzene, ethylbenzene, toluene, total xylenes, and most VOC is 0.5 microgram per liter (ug/L); for MTBE, the reported detection limit ranges from 0.5 to 5.0 ug/L; for TPH, the reported detection limit is mostly 50.0 ug/L; and the reported detection limits for semi volatile organic compounds are mostly 5.0 or 10.0 ug/L.

B. Discharge Points and Receiving Waters

The NOI Form (Attachment B) requires every Discharger to provide the discharge location and a map highlighting the discharge path to surface waters.

C. Summary of Existing Requirements

The effluent limitation contained in the previously issued Fuel (Order No. R2-2006-0075) and VOC (Order No. R2-2009-0059) General Permits is summarized in Table F-2. Except the residual chlorine effluent limit in the VOC General NPDES permit, the effluent limitations contained in the previously issued Fuel and VOC General Permits were the same.

Table F-2. Historic Effluent Limitations

No.	Compound	CAS Number	Column A: Discharge to Drinking Water Areas[2]		Column B: Discharge to Other Surface Water Areas	
			Average Monthly Effluent Limitation (µg/L)	Maximum Daily Effluent Limitation (µg/L)	Average Monthly Effluent Limitation (µg/L)	Maximum Daily Effluent Limitation (µg/L)
1	Benzene	71432		1		5
2	Carbon Tetrachloride	56235	0.25 [1]	0.50	4.4	5
3	Chloroform	67663		5		5
4	1,1-Dichloroethane	75343		5		5
5	1,2-Dichloroethane	107062	0.38 [1]	0.5		5
6	1,1-Dichloroethylene	75354	0.057 [1]	0.11[1]	3.2	5
7	Ethylbenzene	100414		5		5
8	Methylene Chloride (Dichloromethane)	75092	4.7	5		5
9	Tetrachloroethylene	127184	0.8	1.6		5
10	Toluene	108883		5		5
11	Cis 1,2-Dichloroethylene	156592		5		5
12	Trans 1,2-Dichloroethylene	156605		5		5
13	1,1,1-Trichloroethane	71556		5		5
14	1,1,2-Trichloroethane	79005	0.6	1.2		5
15	Trichloroethylene	79016	2.7	5		5
16	Vinyl Chloride	75014		0.5		1
17	Total Xylenes	1330207		5		5
18	Methyl Tertiary Butyl Ether (MTBE)	1634044		5		5
19	Total Petroleum Hydrocarbons (as Gasoline or as Diesel)			50		50
20	Ethylene Dibromide (1,2-Dibromoethane)	106934		0.05[1]		5
21	Trichloro-trifluoroethane	76131		5		5
22	Total Chlorine Residual	---	---	0.0[3]	---	0.0[3]

Notes for Table F-2:

[1] If reported detection level is greater than effluent limit, then a non-detect result using a 0.5 µg/L detection level will not be deemed to be out of compliance.

[2] Drinking water areas are defined as surface waters with the existing or potential beneficial uses of "municipal and domestic supply" and "groundwater recharge" (the latter includes recharge areas to maintain salt balance or to halt salt water intrusion into fresh water aquifers).
[3] There shall be no detectable levels of residual chlorine in the effluent (a non-detect result using a detection level equal or less than 0.08 milligram per liter (mg/L) will not be deemed to be out of compliance). This limit only applies to Dischargers that chlorinate their extracted groundwater.

D. Compliance Summary

Forty-four effluent limit and 17 late reporting violations (for a total of 61 violations) are reported in CIWQS during the term of the Fuel General Permit. On average, the Dischargers reported effluent limit compliance rates of about 99% for TPHd, TPHg, and on-time report submittal, and almost 100% for the remaining pollutants with effluent limits in Table F-2. Regional Water Board enforcement staff completed enforcement actions for 53 of these violations, and continues to review the remaining 8 violations. The VOC General Permit compliance summary is on page F-4 of Order No. R2-2009-0059.

E. Planned Changes

As required in Attachment D, a Discharger authorized under this Order shall submit a modified NOI before making any material change in the character, location, or volume of the discharge.

III. APPLICABLE PLANS, POLICIES, AND REGULATIONS

The requirements contained in the Order are based on the requirements and authorities described in this section.

A. Legal Authorities

This Order is issued pursuant to section 402 of the federal Clean Water Act (CWA) and implementing regulations adopted by the U.S. Environmental Protection Agency (USEPA) and chapter 5.5, division 7 of the California Water Code [(CWC), commencing with section 13370]. It shall serve as a NPDES permit for point source discharges from these facilities to surface waters. This Order also serves as General Waste Discharge Requirements (GWDRs) pursuant to CWC article 4, chapter 4, division 7 (commencing with section 13260). States may request authority to issue general NPDES permits pursuant to Code of Federal Regulations, Title 40, Chapter 1, Subchapter D, part 122.28 (40 CFR 122.28). 40 CFR 122.28 provides for the issuance of general permits to regulate discharges of waste which result from similar operations, are the same types of waste, require the same effluent limitations, require similar monitoring, and are more appropriately regulated under a general permit rather than individual permits. This general permit meets the requirements of 40 CFR 122.28 because the discharges and proposed discharges:

- result from similar operations (all involve extraction, treatment, and discharge of groundwater);
- are the same types of waste (all are groundwater containing VOC, fuel components, and other related wastes due to leaks and spills);
- require similar effluent limitations for the protection of the beneficial uses of surface waters in the San Francisco Bay Region (this general permit does not cover direct discharges to the Pacific Ocean);

- require similar monitoring; and
- are more appropriately regulated under a general permit rather than individual permits.

B. California Environmental Quality Act (CEQA)

Under CWC section 13389, this action to issue an NPDES permit is exempt from the provisions of CEQA.

C. State and Federal Regulations, Policies, and Plans

1. **Water Quality Control Plans.** *The Water Quality Control Plan for the San Francisco Bay Basin* (the Basin Plan) is the Regional Water Board's master water quality control planning document. It designates beneficial uses and water quality objectives (WQOs) for waters of the State, including surface and groundwater. It also includes implementation programs to achieve WQOs. The Basin Plan was duly adopted by the Regional Water Board and approved by the State Water Resources Control Board (State Water Board), the Office of Administrative Law, and USEPA. Requirements of this Order implement the Basin Plan.

   The Basin Plan designates beneficial uses, establishes water quality objectives, and contains implementation programs and policies to achieve those objectives for all waters addressed through the plan. The Basin Plan states that the beneficial uses of any specifically identified water body generally apply to its tributary streams. The Basin Plan may not specifically identify beneficial uses for every receiving water regulated under this permit, but identifies present and potential uses for the downstream water body, to which the receiving water, via an intermediate water body, is tributary. These potential and existing beneficial uses are: municipal and domestic supply, fish migration and fish spawning, industrial service supply, navigation, industrial process supply, marine habitat, agricultural supply, estuarine habitat, groundwater recharge, shellfish harvesting, water contact and non-contact recreation, ocean, commercial, and sport fishing, wildlife habitat, areas of special biological significance, cold freshwater and warm freshwater habitat, and preservation of rare and endangered species for surface waters and municipal and domestic supply, industrial service supply, industrial process supply, agricultural supply, and freshwater replenishment for groundwaters. In addition, the Basin Plan implements State Water Board Resolution No. 88-63, which established state policy that all waters, with certain exceptions, should be considered suitable or potentially suitable for municipal or domestic supply. Requirements of this Order implement the Basin Plan.

   On September 18, 1975, the State Water Board adopted the *Water Quality Control Plan for Control of Temperature in the Coastal Interstate Waters and Enclosed Bays and Estuaries of California* (hereinafter the Thermal Plan). The Thermal Plan contains objectives governing cooling water discharges, providing different and specific numeric and narrative water quality objectives for new and existing discharges.

   The State Water Board's *Water Quality Control Plan for Enclosed Bays and Estuaries—Part 1, Sediment Quality* became effective on August 25, 2009. This plan supersedes other narrative sediment quality objectives and establishes new sediment quality objectives and

related implementation provisions for specifically defined sediments in most bays and estuaries.

2. **National Toxics Rule (NTR) and California Toxics Rule (CTR).** USEPA adopted the NTR on December 22, 1992, and amended it on May 4, 1995, and November 9, 1999. About 40 criteria in the NTR and apply in California. On May 18, 2000, USEPA adopted the CTR. The CTR promulgated new toxics criteria for California and, in addition, incorporated the previously adopted NTR criteria that applied in the State. The CTR was amended on February 13, 2001. These rules contain water quality criteria (WQC) for priority toxic pollutants.

3. **State Implementation Policy.** On March 2, 2000, the State Water Board adopted the *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California* (State Implementation Policy or SIP). The SIP became effective on April 28, 2000, with respect to the priority pollutant criteria promulgated through the NTR and to the WQOs established in the Basin Plan. The SIP became effective on May 18, 2000, with respect to the priority pollutant criteria promulgated through the CTR. The State Water Board adopted amendments to the SIP on February 24, 2005, which became effective on July 13, 2005. The SIP establishes implementation provisions for priority pollutant criteria and objectives and provisions for chronic toxicity control. Requirements of this Order implement the SIP.

4. **Alaska Rule.** On March 30, 2000, USEPA revised its regulation that specifies when new and revised state and tribal water quality standards (WQS) become effective for CWA purposes [65 Fed. Reg. 24641 (April 27, 2000), codified at 40 CFR 131.21]. Under the revised regulation (also known as the Alaska Rule), new and revised standards submitted to USEPA after May 30, 2000, must be approved by USEPA before being used for CWA purposes. The final rule also provides that standards already in effect and submitted to USEPA by May 30, 2000, may be used for CWA purposes, whether or not approved by USEPA.

5. **Antidegradation Policy.** 40 CFR 131.12 requires that state WQS include an antidegradation policy consistent with the federal policy. The State Water Board established California's antidegradation policy in State Water Board Resolution 68-16, which incorporates the federal antidegradation policy where the federal policy applies under federal law and requires that existing quality of waters be maintained unless degradation is justified based on specific findings. The Regional Water Board's Basin Plan implements, and incorporates by reference, both the State and federal antidegradation policies.

6. **Anti-Backsliding Requirements.** CWA Sections 402(o)(2) and 303(d)(4) and 40 CFR 122.44(l) prohibit backsliding in NPDES permits. These anti-backsliding provisions require that effluent limitations in a reissued permit must be as stringent as those in the previous permit, with some exceptions in which limitations may be relaxed. This Order retains effluent limitations no less stringent than those established by previous orders.

D. Impaired Water Bodies on CWA 303(d) List

In November 2006, USEPA approved a revised list of impaired water bodies prepared pursuant to CWA section 303(d), which requires identification of specific waterbodies where it is expected that water quality standards will not be met after implementation of technology-based effluent limitations on point sources. In November 2010, USEPA partially approved an updated 303(d) list. Where it has not already done so, the Regional Water Board plans to adopt Total Maximum Daily Loads (TMDLs) for pollutants on the 303(d) list. TMDLs establish wasteload allocations for point sources and load allocations for non-point source sand are established to achieve the water quality standards for the impaired waterbodies. The SIP requires final effluent limitations for all 303(d)-listed pollutants to be based on total maximum daily loads and associated waste load allocations.

IV. RATIONALE FOR EFFLUENT LIMITATIONS AND DISCHARGE SPECIFICATIONS

The CWA requires point source dischargers to control the amount of conventional, non-conventional, and toxic pollutants that are discharged into the waters of the United States. The control of pollutants discharged is established through effluent limitations and other requirements in NPDES permits. There are two principal bases for effluent limitations in 40CFR: Section 122.44(a) requires that permits include applicable technology-based limitations and standards; and Section 122.44(d) requires that permits include water quality-based effluent limitations to attain and maintain applicable numeric and narrative water quality criteria to protect the beneficial uses of the receiving water.

Several specific factors affecting the development of limitations and requirements in this Order are discussed as follows:

A. Discharge Prohibitions

1. **Prohibition III.A (Unauthorized discharges of extracted and treated groundwater are prohibited):** This discharge prohibition is retained from the previously issued Fuel and VOC General Permits and is based on CWC section 13260, which requires filing of a report of waste discharge (ROWD) before discharges can occur. Discharges which have not been described in a Discharger's NOI are prohibited.

2. **Prohibition III.B (Discharges of effluent other than extracted groundwater treated only with approved chemicals are prohibited):** This prohibition is retained from the previously issued Fuel and VOC General Permits and is based on the fact that the requirements in the Order were developed for discharges of treated groundwater from VOC or fuel-contaminated groundwater sites so only discharges associated with this type of activity can be permitted under this Order.

3. **Prohibition III.C (Discharges in excess of the authorized flow rate are prohibited):** This prohibition is retained from the previously issued Fuel and VOC General Permits. The basis for the prohibition is the same rationale documented for Prohibition III.A. Dischargers have submitted NOIs that included a description of treatment facility design and the maximum

design flow rate, certified by a professional engineer. Flows in excess of the design flow rate may result in lowering the reliability of achieving compliance with water quality requirements.

4. **Prohibition III.D (No scouring or erosion due to discharge of extracted and treated groundwater at the point where a storm drain discharges to a receiving water):** This prohibition is retained from the previously issued Fuel and VOC General Permits, with slight revisions for consistency with similar provisions of the Municipal Regional Stormwater NPDES Permit (Order No. R2-2009-0074), and is based on the sediment and erosion control goals of section 4.19 of the Basin Plan.

5. **Prohibition III.E (No pollution, contamination, or nuisance):** This prohibition is based on CWC section 13050, and has been retained from the previously issued Fuel and VOC General Permits.

6. **Prohibition III.F (No bypass or overflow of untreated or partially treated polluted groundwater**): This prohibition is retained from the previously issued Fuel and VOC General Permits and is based on 40 CFR 122.41(m).

B. Shallow Water Discharges and Basin Plan Discharge Prohibition 1

The Basin Plan (Chapter 4, Table 4-1, Discharge Prohibition 1) prohibits discharges not receiving a minimum 10:1 initial dilution or to dead end sloughs. In accordance with the Basin Plan, this Order continues to grant Dischargers an exception to the discharge prohibition for discharges to shallow waters. The exception is based on section 4.2 of the Basin Plan, which states that an exception to Prohibition 1 will be considered where:

- A discharge is approved as part of a reclamation project; or
- It can be demonstrated that net environmental benefits will be derived as a result of the discharge; or
- A discharge is approved as part of a groundwater cleanup project and, in accordance with Resolution No. 88-160 'Regional Board Position on the Disposal of Extracted Groundwater from Groundwater Clean-Up Projects', it has been demonstrated that neither reclamation nor discharge to a publicly owned treatment works is technically and economically feasible, and the discharger has provided certification of the adequacy and reliability of treatment facilities and a plan that describes procedures for proper operation and maintenance of all treatment facilities.

The Basin Plan further states:

> Significant factors to be considered by the Regional Water Board in reviewing requests for exceptions will be the reliability of the discharger's system in preventing inadequately treated wastewater from being discharged to the receiving water and the environmental consequences of such discharges.

To comply with the exception, this Order requires Dischargers to document in the NOI application that neither reclamation nor discharge to a POTW is technically and economically

feasible. In addition, to prevent inadequately treated wastewater from being discharged to receiving waters, Dischargers are required to document in the NOI that the discharge of inadequately treated waste will be reliably prevented.

C. Technology-Based Effluent Limitations

If any extracted and treated groundwater receives less than proper treatment, the pollutants listed in Table F-2 may be discharged at levels that have a reasonable potential to cause or contribute to an exceedance of any applicable criterion established by the USEPA pursuant to CWA section 303.

1. Scope and Authority

The CWA requires technology-based effluent limitations (TBELs) based on several levels of controls:

- Best practicable treatment control technology (BPT) represents the average of the best performance by plants within an industrial category or subcategory. BPT standards apply to toxic, conventional, and non-conventional pollutants.

- Best available technology economically achievable (BAT) represents the best existing performance of treatment technologies that are economically achievable within an industrial point source category. BAT standards apply to toxic and non-conventional pollutants.

- Best conventional pollutant control technology (BCT) represents the control from existing point sources of conventional pollutants including BOD, TSS, fecal coliform, pH, and oil and grease. The BCT standard is established after considering the "cost reasonableness" of the relationship between the cost of attaining a reduction in effluent discharge and the benefits that would result, and also the cost effectiveness of additional industrial treatment beyond BPT.

- New source performance standards (NSPS) represent the best available demonstrated control technology standards. The intent of NSPS guidelines is to set limitations that represent state-of-the-art treatment technology for new sources.

The CWA requires USEPA to develop effluent limitations, guidelines, and standards (ELGs) representing application of BPT, BAT, BCT, and NSPS. Section 402(a)(1) of the CWA and 40 CFR 125.3 authorize the use of Best Professional Judgment (BPJ) to derive TBELs on a case-by-case basis where ELGs are not available for certain industrial categories and/or pollutants of concern. Where BPJ is used, the permit writer must consider specific factors outlined in 40 CFR 125.3.

2. Applicable Technology-Based Effluent Limitations

Regional Water Board staff used BPJ in developing TBELs in this Order. BPJ is defined as the highest quality technical opinion developed by a permit writer after consideration of all reasonably available and pertinent data or information that forms the basis for the terms and conditions of a NPDES permit. The authority for BPJ is contained in CWA section 402(a)(1).

In the treatment systems regulated by this Order, organic compounds, including VOC and petroleum compounds, are removed from contaminated groundwater using such technologies as air stripping and activated carbon. Treated groundwater is then discharged to surface waters. When properly designed and operated, these treatment systems can lower the concentration of such pollutants to levels below analytical detection limits.

USEPA Region 9 issued a document titled *NPDES Permit Limitations for Discharge of Contaminated Groundwater: Guidance Document* (USEPA, 1986) in which USEPA concluded that the cost of reducing concentrations of most organic compounds commonly detected in contaminated groundwater to a non-detect concentration of 5 µg/L, and to a non-detect concentration for vinyl chloride of 1 µg/L, is considered economically achievable.

Based on an understanding that available treatment technologies can economically remove organic pollutants from contaminated groundwater, the Regional Water Board has established TBELs using BPJ at 5.0 µg/L for benzene, carbon tetrachloride, chloroform, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethylene, ethylbenzene, methylene chloride, tetrachloroethylene, Toluene, Cis 1,2-Dichloroethylene, Trans 1,2-Dichloroethylene, 1,1,1-Trichloroethane, 1,1,2-Trichloroethane, Trichloroethylene, and total xylenes, and at 1.0 µg/L for vinyl chloride.

Petroleum-based compounds and fuel additives are commonly found at sites with fuel or fuel VOC commingled plumes. This Order therefore retains TBELs for TPHs, ethylene dibromide, and MTBE from the previous Fuel General Permit. Limitations for TPH are 50 µg/L and for ethylene dibromide and MTBE are 5 µg/L, which reflect a level of treated wastewater quality that is economically achievable by the treatment technologies contemplated by this Order.

Because a number of facilities covered under the Fuel General Permit are former semiconductor manufacturing operations, which used trichlorotrifluoroethane (Freon 113) in a manufacturing process and have detected concentrations of this compound in contaminated groundwater, this Order retains the effluent limitation from the previous Fuel General Permit for Freon. The effluent limitation of 5 µg/L reflects a level of treated wastewater quality that is economically achievable by the treatment technologies contemplated by this Order.

Table F-3, below, summarizes the TBELs established by this Order.

Table F-3. Summary of Technology-Based Effluent Limitations

No.	Compound	Limitations Established by BPJ	
		USEPA	RWB
1	Benzene	5	---
2	Carbon Tetrachloride	5	---
3	Chloroform	5	---
4	1,1-Dichloroethane	5	---
5	1,2-Dichloroethane	5	---
6	1,1-Dichloroethylene	5	---
7	Ethylbenzene	5	---

No.	Compound	Limitations Established by BPJ	
		USEPA	RWB
8	Methylene Chloride	5	---
9	Tetrachloroethylene	5	---
10	Toluene	5	---
11	Cis-1,2-Dichloroethylene	5	---
12	Trans-1,2-Dichloroethylene	5	---
13	1,1,1-Trichloroethane	5	---
14	1,1,2-Trichloroethane	5	---
15	Trichloroethylene	5	---
16	Vinyl Chloride	1	---
17	Total Xylenes	5	---
18	Methyl Tertiary Butyl Ether (MTBE)	5	5
19	Total Petroleum Hydrocarbons (TPH)	---	50
20	Ethylene Dibromide (1,2-Dibromoethane)	---	5
21	Trichlorotrifluoroethane	---	5

D. Water Quality-Based Effluent Limitations (WQBELs)

WQBELs have been derived to implement WQOs that protect beneficial uses. Both the beneficial uses and the WQOs have been approved pursuant to federal law. The procedures for calculating individual WQBELs are based on the SIP and the Basin Plan. Most Basin Plan beneficial uses and WQOs were approved under State law and submitted to and approved by USEPA prior to May 30, 2000. Any WQOs and beneficial uses submitted to USEPA prior to May 30, 2000, but not approved by USEPA before that date, are nonetheless "applicable water quality standards for purposes of the [Clean Water] Act" pursuant to 40 CFR 131.21(c)(1). Collectively, this Order's restrictions on individual pollutants are no more stringent than those required by CWA water quality standards.

1. Scope and Authority

a. 40 CFR 122.44(d)(1)(i) mandates that permits include effluent limitations for all pollutants that are or may be discharged at levels that have reasonable potential to cause or contribute to an excursion of a water quality standard, including numeric and narrative objectives within a standard. As specified in 40 CFR 122.44(d)(1)(i), permits are required to include WQBELs for all pollutants "which the Director determines are or may be discharged at a level which will cause, have the reasonable potential to cause, or contribute to an excursion above any state water quality standard."

The process for determining "reasonable potential" and calculating WQBELs when necessary is intended to protect the designated beneficial uses of the receiving water as

specified in the Basin Plan, and achieve applicable WQOs contained in other state plans and policies, and applicable WQC contained in the CTR and NTR.

b. NPDES regulations and the SIP provide the basis to establish Maximum Daily Effluent Limitations (MDELs).

(1) NPDES regulations at 40 CFR 122.45(d) state, "For continuous discharges all permit effluent limitations, standards, and prohibitions, including those necessary to achieve water quality standards, shall *unless impracticable* be stated as maximum daily and average monthly discharge limitations for all discharges other than publicly owned treatment works."

(2) SIP section 1.4 requires WQBELs to be expressed as MDELs and average monthly effluent limitations (AMELs).

c. MDELs are used in this Order to protect against acute water quality effects. MDELs are necessary for preventing fish kills or mortality to aquatic organisms.

2. Applicable Beneficial Uses and Water Quality Criteria and Objectives

The WQOs applicable to the receiving waters for these discharges are from the Basin Plan; the CTR, established by USEPA at 40 CFR 131.38; and the NTR, established by USEPA at 40 CFR 131.36. Some pollutants have WQOs established by more than one of these three sources.

a. Basin Plan. The Basin Plan specifies numeric WQOs for 10 priority toxic pollutants, as well as narrative WQOs for toxicity and bioaccumulation in order to protect beneficial uses. The pollutants for which the Basin Plan specifies numeric objectives are arsenic, cadmium, chromium (VI), copper in fresh and marine water, lead, mercury, nickel, silver, zinc, and cyanide. The narrative toxicity objective states, "All waters shall be maintained free of toxic substances in concentrations that are lethal to or that produce other detrimental responses in aquatic organisms." The bioaccumulation objective states, "Controllable water quality factors shall not cause a detrimental increase in concentrations of toxic substances found in bottom sediments or aquatic life. Effects on aquatic organisms, wildlife, and human health will be considered." Effluent limitations and provisions contained in this Order are designed to implement these objectives, based on available information.

The Basin Plan also contains a narrative objective for surface waters designated for use as a domestic or municipal supply (MUN) which states that these surface waters shall not contain concentrations of constituents in excess of the maximum contaminant levels (MCLs) or secondary MCLs specified in Title 22 of the California Code of Regulations. Effluent limitations and provisions contained in this Order are designed to implement these objectives, based on available information.

b. CTR. The CTR specifies numeric aquatic life criteria for 23 priority toxic pollutants and numeric human health criteria for 57 priority toxic pollutants. These criteria apply to all

inland surface waters and enclosed bays and estuaries of the San Francisco Bay Region, although Tables 3-3 and 3-4 of the Basin Plan include numeric objectives for certain of these priority toxic pollutants, which supersede criteria of the CTR (except in the South Bay south of the Dumbarton Bridge).

Human health criteria are further identified as "water and organisms" and "organisms only." The CTR criteria applicable to "water and organisms" are applied in the Reasonable Potential Analysis (RPA) for discharges to receiving waters with a MUN designation, and criteria applicable to "organisms only" were used in the RPA for discharges to receiving waters that are not MUN-designated.

c. NTR. The NTR establishes numeric aquatic life criteria for selenium and numeric "organisms only" human health criteria for 33 toxic pollutants for waters of San Francisco Bay upstream to, and including Suisun Bay and the San Joaquin-Sacramento River Delta.

d. Sediment Quality Objectives. The *Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1, Sediment Quality* contains a narrative WQO, "Pollutants in sediments shall not be present in quantities that, alone or in combination, are toxic to benthic communities in bays and estuaries of California." This WQO is to be implemented by integrating three lines of evidence: sediment toxicity, benthic community condition, and sediment chemistry. The policy requires that is the Regional Water Board determines that a discharge has reasonable potential to cause or contribute to an exceedance of this WQO, it is to impose the WQO as a receiving water limit.

e. Basin Plan Receiving Water Salinity Policy. The Basin Plan (like the CTR and the NTR) states that the salinity characteristics (i.e., freshwater vs. saltwater) of the receiving water are to be considered in determining the applicable WQOs. Freshwater criteria apply to discharges to waters with salinities equal to or less than one part per thousand (ppt) at least 95 percent of the time. Saltwater criteria apply to discharges to waters with salinities equal to or greater than 10 ppt at least 95 percent of the time in a normal water year. For discharges to water with salinities between these two categories, or tidally influenced freshwaters that support estuarine beneficial uses, the WQOs are the lower of the salt or freshwater WQOs (the latter calculated based on ambient hardness) for each substance.

Receiving waters considered by for this permit are the San Francisco Bay and other estuarine and tidally influences waters, and inland freshwaters. The Basin Plan implements State Water Board Resolution No. 88-63, which establishes State policy that all waters, with certain exceptions, should be considered suitable or potentially suitable for municipal or domestic supply (MUN). Because of marine influence on all reaches of San Francisco Bay and other tidally influenced waters, total dissolved solids levels exceed 3,000 mg/L and thereby meet an exception to State Water Board Resolution No. 88-63. The RPA therefore separately considered criteria that were applicable to receiving waters with a MUN designation and to receiving waters that are not MUN-designated.

Aquatic life criteria were based on the most stringent of the fresh and salt water criteria, to be fully protective of all receiving waters.

f. Receiving Water Hardness. Ambient hardness values are used to calculate freshwater WQOs that are hardness dependent. In determining the WQOs for this Order, Regional Water Board staff used a hardness value of 100 mg/L as $CaCO_3$, which is a conservative value and generally protective of aquatic life in all circumstances contemplated by the General Permit.

g. Site-Specific Translators (SSTs). NPDES regulations at 40 CFR 122.45(c) require that effluent limitations for metals be expressed as total recoverable metal. Since applicable WQOs for metals are typically expressed as dissolved metal, translators must be used to convert metals concentrations from dissolved to total recoverable and vice versa. The CTR includes default translators; however, site-specific conditions, such as water temperature, pH, suspended solids, and organic carbon greatly affect the form of metal (dissolved, non-filterable, or otherwise) present in the water and therefore available to cause toxicity. In general, the dissolved form of the metal is more available and more toxic to aquatic life than non-filterable forms. Site-specific translators can be developed to account for site-specific conditions, thereby preventing exceedingly stringent or under protective WQOs.

Receiving waters for discharges from the facilities covered under the General Permit are varied, and, therefore, site specific conditions are varied. In determining the need for and calculating WQBELs for all metals except for copper and nickel, the Regional Water Board has used default translators established by the USEPA in the CTR at 40 CFR 131.38 (b) (2), Table 2 to be protective in all circumstances. Most discharges are anticipated to eventually enter San Francisco Bay, and, therefore, the site specific translators were applied in determining criteria for copper and nickel. For copper, the Regional Water Board applied the SSTs adopted by Regional Water Board Resolution No. R2-2007-0042 for North and Central San Francisco Bay, and the SST contained in the Basin Plan Table 7.2.1-1 for South San Francisco Bay. For nickel, the Regional Water Board applied the translators for North and Central San Francisco Bay based on the recommendation of the Clean Estuary Partnership's *North of Dumbarton Bridge Copper and Nickel Development and Selection of Final Translators* (2005), and applied the translators contained in Table 7.2.1-1 of the Basin Plan for South San Francisco Bay. These translators for copper and nickel are summarized below.

Table F-4. SSTs for Copper and Nickel for San Francisco Bay

	Copper		Nickel	
San Francisco Bay Segment	**AMEL Translator**	**MDEL Translator**	**AMEL Translator**	**MDEL Translator**
North	0.38	0.66	0.27	0.57
Central	0.73	0.87	0.65	0.85
South	0.53	0.53	0.44	0.44

3. Determining the Need for WQBELs

Assessing whether a pollutant has Reasonable Potential is the fundamental step in determining whether or not a WQBEL is required.

a. Reasonable Potential Methodology

For priority pollutants and most other toxic pollutants, the RPA identifies the observed maximum effluent concentration (MEC) for each pollutant based on effluent concentration data. There are three triggers in determining Reasonable Potential according to SIP Section 1.3.

(1) The first trigger (Trigger 1) is activated if the MEC is greater than or equal to the lowest applicable WQO (MEC ≥ WQO), which has been adjusted, if appropriate, for pH, hardness, and translator data. If the MEC is greater than or equal to the adjusted WQO, then that pollutant has Reasonable Potential, and a WQBEL is required.

(2) The second trigger (Trigger 2) is activated if the observed maximum ambient background concentration (B) is greater than the adjusted WQO (B > WQO), and the pollutant is detected in any of the effluent samples (MEC > ND).

(3) The third trigger (Trigger 3) is activated if a review of other information determines that a WQBEL is required to protect beneficial uses, even though both MEC and B are less than the WQO/WQC.

b. Effluent Data

Each Discharger currently covered under the Fuel General Permit was required to conduct effluent monitoring pursuant to the Self-Monitoring Program for Order No. R2-2006-0075. The Regional Water Board analyzed the Dischargers' priority pollutant data and the nature of the discharges to determine if discharges have Reasonable Potential. Effluent data used to conduct this RPA consisted of data submitted as part of each Fuel General Permit facility's NOI which was combined with data submitted by facilities as part of the NOI application for coverage under the VOC General Permit. The Regional Water Board analyzed effluent quality data collected from 2004 to 2011 for a total of 55 facilities (43 from the VOC General Permit and 12 from the Fuel General Permit) in the San Francisco Bay Region. Effluent monitoring data from three NOIs received after the July 15, 2011, due date were not included in this RPA.

From this analysis, it was concluded that the data for metals would be excluded for use in RPA pursuant to SIP 1.2. The reason is that the metals were detected only occasionally and at low levels likely from natural background in the groundwater.

c. Ambient Background Data

The SIP states that, for calculating WQBELs, ambient background concentrations are either the observed maximum ambient water column concentrations or, for objectives

intended to protect human health from carcinogenic effects, the arithmetic mean of observed ambient water concentrations. Ambient background concentrations are the observed maximum detected water column concentrations for aquatic life protection.

Because the receiving waters for discharges from the facilities covered under this Order are varied, receiving water background concentrations were not considered for this RPA.

d. Reasonable Potential Determination for Priority Pollutants

The MECs and the most stringent applicable WQC used in the RPA are presented in the following table, along with the RPA results (yes or no) for each pollutant. Reasonable Potential was not determined for all pollutants because there are not applicable WQC for all pollutants, or monitoring data are not available for others. Based on a review of the effluent data, the pollutants that demonstrate reasonable potential by Trigger 1 are benzene, bromoform, chlorodibromomethane, 1,2-dichloroethane, 1,1-dichloroethylene, methylene chloride, trichloroethylene, vinyl chloride, and bis(2-ethylhexyl)phthalate.

The Regional Water Board has also determined that Reasonable Potential exists to exceed water quality objectives, by Trigger 3, for the organic pollutants that have been identified as pollutants that are commonly present in VOC and fuel-contaminated groundwater (i.e., those pollutants for which TBELs have been established.) As these TBELs limitations are achievable dependent on the proper design and operation of treatment systems, there is Reasonable Potential for excursions above applicable water quality criteria for these pollutants if the system is not designed or operated correctly.

Total residual chlorine is also identified as a pollutant with Reasonable Potential to exceed the Basin Plan narrative toxicity objective, as determined by Trigger 3. The Regional Water Board has identified that chlorine may be used in conjunction with air stripping and/or activated carbon treatment systems to control biological growth, and therefore Reasonable Potential exists for total residual chlorine for those facilities that use it.

Table F-5. Summary of RPA Results

CTR #	Priority Pollutants	MEC or Minimum DL [1][2] (µg/L)	Governing Applicable Criteria (µg/L)				RPA Results [3]
			Aquatic Life	Human Health			
			(Most stringent of salt and fresh water)	CTR Water + Organisms	Basin Plan Title 22 MCLs	CTR Organisms Only	
1	Antimony	**21**	---	14	6	4300	Ud
2	Arsenic	**140**	36	---	10	---	Ud
3	Beryllium	0.00053	---	---	4	---	Ud
4	Cadmium	0.36	1.1	---	5	---	Ud
5a	Chromium (III)	NA	207	---	50	---	Ud
5b	Chromium (VI)	**14**	11	---	---	---	Ud
6	Copper	**24**	4.7[4]	---	1000	---	Ud

CTR #	Priority Pollutants	MEC or Minimum DL [1][2] (µg/L)	Governing Applicable Criteria (µg/L)				RPA Results [3]
			Aquatic Life	Human Health			
			(Most stringent of salt and fresh water)	CTR Water + Organisms	Basin Plan Title 22 MCLs	CTR Organisms Only	
	Copper	**24**	3.4[5]	---	1000	---	Ud
	Copper	**24**	5.9[6]	---	1000	---	Ud
7	Lead	0.048	3.2	---	---	---	Ud
8	Mercury (303d listed)	0.00082	0.025	0.050	2	0.051	Ud
9	Nickel	**49**	19[7]	610	100	4600	Ud
	Nickel	**49**	13[8]	610	100	4600	Ud
	Nickel	**49**	30[9]	610	100	4600	Ud
10	Selenium (303d listed)	**25**	5.0	---	---	---	Ud
11	Silver	<0.25	2.2	---	---	---	Ud
12	Thallium	**7.3**	---	1.7	2.0	6.3	Ud
13	Zinc	**150**	86	---	5000	---	Ud
14	Cyanide	**30**	2.9[10]	700	150	220,000	Ud
19	**Benzene**	**1.2**	---	1.2	1	71	**Yes**
20	**Bromoform**	**5.2**		4.3	---	360	**Yes**
23	**Chlorodibromomethane**	**2.8**	---	0.401	---	34	**Yes**
26	**Chloroform**	**7.1**	---	No Criteria			**Yes**
28	**1,1-Dichloroethane**	**4.1**	---	---	5	---	**Yes**
29	**1,2-Dichloroethane**	**0.6**	---	0.38	0.5	99	**Yes**
30	**1,1-Dichloroethylene**	**5.7**	---	0.057	6	3.2	**Yes**
33	**Ethylbenzene**	**<0.5**	---	3100	300	29,000	**Yes**
36	**Methylene Chloride**	**23**	---	4.7	5	1600	**Yes**
38	**Tetrachloroethylene**	**25**	---	0.8	5	8.85	**Yes**
39	**Toluene**	**3.07**	---	6800	150	200,000	**Yes**
---	**1,2-Cis-Dichloroethylene**	**20**	---	---	6	---	**Yes**
40	**1,2-Trans-Dichloroethylene**	**4.2**	---	700	10	140,000	**Yes**
41	**1,1,1-Trichloroethane**	**15**	---	---	200	---	**Yes**
42	**1,1,2-Trichloroethane**	**0.5**	---	0.60	5	42	**Yes**
43	**Trichloroethylene**	**460**	---	2.7	5	81	**Yes**
44	**Vinyl Chloride**	**2.1**	---	2	0.5	525	**Yes**
68	**Bis-2(ethylhexyl)phthalate**	100		1.8	4	5.9	**Yes**
70	Butylbenzyl Phthalate	22	---	3000	---	5200	No
---	**Total Xylenes**	**3**	---	---	1750	---	**Yes**
---	**Methyl Tertiary Butyl Ether (MTBE)**	**2.7**	---	---	13	---	**Yes**
---	Total Petroleum Hydrocarbons (TPH)	1600	No Criteria				Ud
---	**Ethylene Dibromide**	**<0.05**	---	---	0.05	---	**Yes**
---	**Trichlorotrifluoroethane**	**5.4**	---	---	1200	---	**Yes**
---	**Total Residual Chlorine[11]**	**NA**	---	---	---	---	**Yes**

Notes for Table F-5:

[1] The Maximum Effluent Concentration (MEC) and maximum background concentration are the actual detected concentrations unless preceded by a "<" sign, in which case the value shown is the minimum detection level (DL).

[2] The MEC or maximum background concentration is "Not Available" (NA) when there are no monitoring data for the constituent.

[3] RPA Results = Yes, if MEC > WQO/WQC, B > WQO/WQC and MEC is detected, or Trigger 3;
= No, if MEC and B are < WQO/WQC or all effluent data are undetected;
= Undetermined (Ud), if no criteria have been promulgated or there are insufficient data. For metals and cyanide, Ud was determined because as noted previously the reported discharge data were excluded for use in RPA pursuant to SIP 1.2. Though the detected levels are high as shown in the MECs above, these were in just a few samples. Metals and cyanide were detected only occasionally and generally at low levels likely from

natural background in the groundwater extracted for cleanup. Because this Order would exclude coverage for sites where there is persistent metals contamination, and the relative small load of background metals to the Bay from all the discharges, a finding of undetermined is appropriate.

[4] Criterion based on the Basin Plan marine SSO for copper, and the site-specific translators (0.53 acute and chronic) for the Lower and South Bay.

[5] Criterion based on the Basin Plan marine SSO for copper, and the site-specific translators (0.87 acute, 0.73 chronic) for the Central Bay.

[6] Criterion based on the Basin Plan marine SSO for copper, and the site-specific translators (0.66 acute, 0.38 chronic) for Suisun and San Pablo Bay.

[7] Criterion based on the Basin Plan marine SSO for nickel and the site-specific translators (0.44 acute and chronic) for the Lower and South Bay.

[8] Criterion based on the Basin Plan marine WQO for nickel, and the site-specific translators (0.85 acute, 0.65 chronic) for the Central Bay.

[9] Criterion based on the Basin Plan marine WQO for nickel, and the site-specific translators (0.57 acute, 0.27 chronic) for Suisun and San Pablo Bay.

[10] Criterion based on the Basin Plan marine SSO for cyanide.

[11] Total Residual Chlorine: The water quality objective applicable to total residual chlorine is the Basin Plan narrative objective for toxicity which states "[a]ll waters shall be maintained free of toxic substances in concentrations that are lethal to or that produce other detrimental responses in aquatic organisms."

e. Constituents with limited data

In some cases, Reasonable Potential cannot be determined because effluent data are limited, or ambient background concentrations are unavailable. When additional data become available, further RPA will be conducted to determine whether numeric effluent limitations are necessary.

f. Pollutants with No Reasonable Potential

WQBELs are not included in this Order for constituents that do not demonstrate Reasonable Potential; however, monitoring for those pollutants is still required. If concentrations of these constituents are found to have increased significantly, the Discharger will be required to investigate the sources of the increases. Remedial measures are required if the increases pose a threat to receiving water quality.

g. RPA Determination for Sediment Quality Objectives

To date there is no evidence directly linking compromised sediment conditions to the discharges subject to this Order; therefore the Regional Water Board cannot draw a conclusion about Reasonable Potential for the discharges to cause or contribute to exceedances of the sediment quality objectives. However, due to the relatively small discharge volumes and the type and level of treatment, it is unlikely that the discharges would contribute to exceedance of sediment objectives.

4. WQBEL Calculations

a. Pollutants with Reasonable Potential. WQBELs were developed for the toxic and priority pollutants that were determined to have Reasonable Potential to cause or contribute to exceedances of the WQOs or WQC. The WQBELs were calculated based on WQOs and the appropriate procedures specified in Section 1.4 of the SIP. The WQOs used for each pollutant with Reasonable Potential are discussed below.

b. Shallow/Deep Water Discharge. The Basin Plan defines a deep water discharge as a discharge through an outfall equipped with a diffuser that achieves a minimum initial dilution of 10:1. Because the General Permit authorizes discharges to many types of receiving waters, Dischargers covered under the General Permit are classified by the

Regional Water Board as shallow water discharges, so that the General Permit is protective under all circumstances.

c. Dilution Credit. The General Permit assumes minimal dilution is available for discharges that it authorizes, and therefore no dilution credit is granted in calculating WQBELs. No dilution credit is granted because almost all discharges of treated groundwater regulated under this Order are to storm drain systems that discharge to rivers, creeks, and streams. Many of these creeks and streams are dry during the summer months. Therefore, for a few months of the year, these discharges may represent all or nearly all of the flow in some portions of the receiving creeks or streams. These discharges therefore also have the potential to recharge groundwaterss protected as drinking waters.

d. Development of WQBELs for Specific Pollutants. To develop WQBELs for pollutants that demonstrate reasonable potential based on CTR human health criteria (benzene, bromoform, chlorodibromomethane, 1,2-dichloroethane, and bis(2-ethylhexyl)phthalate) , the average monthly effluent limitation (AMEL) is established as the most stringent WQC because the WQC are based on applicable human health criteria. To calculate the maximum daily effluent limitation (MDEL), the AMEL is multiplied by a MDEL/AMEL multiplier of 2.01, which assumes a coefficient of variation (CV) of effluent data of 0.60, because not enough data were available to calculate a CV.

For pollutants with criteria based on Title 22 MCLs (benzene, vinyl chloride), where the MUN designation is applicable to the receiving water, MDELs are set equal to the MCL, because the MCLs are levels that shall not be exceeded in the receiving water, and no credit for dilution is granted.

WQBELs for total residual chlorine are based in Table 4-2 of the Basin Plan.

For the CTR metals and cyanide, WQBELs are not being established at this time. Instead, trigger values will be set for these inorganic pollutants as a backstop to ensuring that sites with metals or cyanide contamination are appropriately identified and addressed. Exceedance of these trigger values in the discharge would trigger actions specified Provision VI.C.6, which if warranted may also lead to termination of discharge authorization under this Order.

Table F-6. Summary of WQBELs

No.	Compound	Discharge to Receiving Waters used as Drinking Water Source[1]		Discharge to Other Receiving Waters	
		AMEL (µg/L)	MDEL (µg/L)	AMEL (µg/L)	MDEL (µg/L)
1	Benzene	---	1	71	142
2	Carbon Tetrachloride	0.25	0.5	4.4	8.8
3	Chloroform	---	---	---	---
4	1,1-Dichloroethane	---	5	---	---

No.	Compound	Discharge to Receiving Waters used as Drinking Water Source[1]		Discharge to Other Receiving Waters	
		AMEL (µg/L)	MDEL (µg/L)	AMEL (µg/L)	MDEL (µg/L)
5	1,2-Dichloroethane	0.38	0.5	99	199
6	1,1-Dichloroethylene	0.057	0.11	3.2	6.4
7	Ethylbenzene	---	300	29,000	58,000
8	Methylene Chloride	4.7	9.4	1600	3200
9	Tetrachloroethylene	0.8	1.6	8.85	17.8
10	Toluene	---	150	200,000	400,000
11	Cis-1,2-Dichloroethylene	---	6	---	---
12	Trans-1,2-Dichloroethylene	---	10	140,000	280,000
13	1,1,1-Trichloroethane	---	200	---	---
14	1,1,2-Trichloroethane	0.60	1.2	42	84
15	Trichloroethylene	2.7	5.4	81	160
16	Vinyl Chloride	---	0.5	525	1060
17	Total Xylenes	---	1750	---	---
18	Methyl Tertiary Butyl Ether (MTBE)	---	13	---	---
19	Total Petroleum Hydrocarbons (TPH)	---	---	---	---
20	Ethylene Dibromide (1,2-Dibromoethane)	---	0.05	---	---
21	Trichlorotrifluoroethane	---	1200	---	---
22	Total Residual Chlorine[2]	---	0.0	---	0.0

Notes for Table F-6:

[1] Receiving waters which are sources of drinking water are surface waters with the existing or potential beneficial use of Municipal and Domestic Supply, and/or Groundwater Recharge.

[2] The total residual chlorine requirement is defined as below the limit of detection in standard test methods defined in the latest USEPA approved edition of *Standard Methods for the Examination of Waste and Wastewater*.

5. Whole Effluent Toxicity (WET)

The Basin Plan requires dischargers to either conduct flow-through effluent toxicity tests or perform static renewal bioassays (Chapter 4, Acute Toxicity) to measure the toxicity of wastewaters and to assess negative impacts upon water quality and beneficial uses caused by the aggregate toxic effect of the discharge of pollutants. This Order retains the effluent limitation for whole effluent acute toxicity. Compliance evaluation with these limitations is based on 96-hour static-renewal bioassays. All bioassays shall be performed according to the USEPA-approved method in 40 CFR Part 136, currently *"Methods for Measuring the Acute Toxicity of Effluents and Receiving Water, 5th Edition."*

6. Final Effluent Limitations

The following table presents a summary of final effluent limitations for toxic pollutants established by this Order. The most stringent of the TBELs and WQBELs are established by the Order as final effluent limitations. For pollutants where the WQBEL is more stringent than the

TBEL, average monthly and maximum daily effluent limitations have been established, which is consistent with the SIP. When the TBEL is limiting, only an MDEL is established. For pollutants where the analytical detection limit is higher than the effluent limitation, the Regional Water Board shall deem a discharge out of compliance if the sample result is greater than the detection limit.

In summary, the effluent limitations contained in the previously issued Fuel and VOC General Permits (Regional Water Board Order Nos. R2-2006-0075 and R2-2009-0059) were the same except the residual chlorine effluent limit in the VOC General NPDES permit, which has been continued into this Order as summarized in Table F-7.

Table F-7. Summary of Final Effluent Limitations

No.	Compound	Discharge to Receiving Waters used as Drinking Water Source[1]		Discharge to Other Receiving Waters	
		AMEL (µg/L)	MDEL (µg/L)	AMEL (µg/L)	MDEL (µg/L)
1	Benzene	---	1	---	5
2	Carbon Tetrachloride	0.25	0.5	4.4	5
3	Chloroform	---	5	---	5
4	1,1-Dichloroethane	---	5	---	5
5	1,2-Dichloroethane	0.38	0.5	---	5
6	1,1-Dichloroethylene	0.057	0.11	3.2	5
7	Ethylbenzene	---	5	---	5
8	Methylene Chloride	4.7	5	---	5
9	Tetrachloroethylene	0.8	1.6	---	5
10	Toluene	---	5	---	5
11	Cis-1,2-Dichloroethylene	---	5	---	5
12	Trans-1,2-Dichloroethylene	---	5	---	5
13	1,1,1-Trichloroethane	---	5	---	5
14	1,1,2-Trichloroethane	0.60	1.2	---	5
15	Trichloroethylene	2.7	5	---	5
16	Vinyl Chloride	---	0.5	---	1
17	Total Xylenes	---	5	---	5
18	Methyl Tertiary Butyl Ether (MTBE)	---	5	---	5
19	Total Petroleum Hydrocarbons (TPH)	---	50	---	50
20	Ethylene Dibromide (1,2-Dibromoethane)	---	0.05	---	5
21	Trichlorotrifluoroethane	---	5	---	5
22	Total Residual Chlorine[2]	---	0.0	---	0.0

Notes:
[1] Receiving waters which are sources of drinking water are surface waters with the existing or potential beneficial use of Municipal and Domestic Supply, and/or Groundwater Recharge.
[2] Limitation defined as below the limit of detection using standard test methods defined in the latest USEPA approved edition of *Standard Methods for the Examination of Waste and Wastewater*

7. Anti-backsliding and Antidegradation

Effluent limitations in this Order comply with anti-backsliding and antidegradation requirements because all effluent limitations are as least as stringent as the limitations contained in the previously issued Fuel and VOC General Permits.

E. Reclamation Specifications

Reclamation or Reuse Specifications are retained from the previously issued Fuel and VOC General Permits. Reclamation specifications are required because reuse of treated groundwater is a preferred method of disposal. The basis for these requirements is Resolution No. 88-160.

V. RATIONALE FOR RECEIVING WATER LIMITATIONS

A. Surface Water Limitations

Receiving water limitations V.A.1 and V.A.2 are based on narrative and numeric WQOs in Basin Plan Chapter 3.

Receiving water limitation V.A.3 is a more general requirement intended to protect receiving water quality based on water quality standards not expressly addressed in this Order and Fact Sheet. It is retained from the previously issued Fuel and VOC permits and requires compliance with all federal and State water quality standards established pursuant to the CWA.

B. Groundwater Limitations

Groundwater limitations are in section 3.4 of the Basin Plan.

VI. RATIONALE FOR MONITORING AND REPORTING REQUIREMENTS

NPDES regulations at 40 CFR 122.48 require that all NPDES permits specify monitoring and reporting requirements. California Water Code (CWC) sections 13267 and 13383 also authorize the Regional Water Board to require technical and monitoring reports. This Monitoring and Reporting Program establishes monitoring and reporting requirements that implement federal and State regulations.

The principal purposes of a monitoring program are to:

- Document compliance with waste discharge requirements and prohibitions established by the Regional Water Board,
- Facilitate self-policing by the Discharger in the prevention and abatement of pollution arising from waste discharge,
- Develop or assist in the development of limitations, discharge prohibitions, national standards of performance, pretreatment and toxicity standards, and other standards, and

- Prepare water and wastewater quality inventories.

The Monitoring and Reporting Program is a standard requirement in almost all NPDES permits issued by the Regional Water Board, including this Order. It contains definitions of terms and sets out requirements for reporting of routine monitoring data in accordance with NPDES regulations, the CWC, and State and Regional Water Board policies. The Monitoring and Reporting Program also defines the sampling stations and frequency, the pollutants to be monitored, and additional reporting requirements. Pollutants to be monitored include all parameters for which effluent limitations are specified. Monitoring for additional constituents, for which no effluent limitations are established, is also required to provide data for future completion of RPAs.

The following provides the rationale for the monitoring and reporting requirements contained in the Monitoring and Reporting Program for this facility.

A. Influent Monitoring

The purpose of influent monitoring is to provide documentation that pollutant loadings are below the level that the treatment system was designed for and to provide a warning if one or more new pollutants are being extracted that the as-built treatment system was not designed to remove. All influent monitoring requirements are retained from the previous Fuel General Permit and the VOC General Permit. If there is a discrepancy in monitoring frequency between the two General Permits, the more frequent requirement was retained.

B. Effluent Monitoring

The purpose of effluent monitoring is to provide documentation that the treatment system adequately removed all pollutants of concern in compliance with the limitations contained in the Order. Effluent monitoring data can also indicate if one or more pollutants are detected at levels less than effluent limits, but greater than trigger levels, which may indicate poor maintenance or other unexpected problems. All effluent monitoring requirements are retained from the previous Fuel General Permit and the VOC General Permit. If there is a discrepancy in monitoring frequency between the two General Permits, the more frequent requirement was retained.

C. Whole Effluent Toxicity Testing Requirements

The selected test species and frequency of testing are the same as previously issued Fuel and VOC General Permits and appropriately cost effective for the Dischargers covered under this Order.

D. Receiving Water Monitoring

The purpose of receiving water monitoring is to provide documentation about the condition of the receiving water should any effluent limit violations occur that may harm the life in the receiving water. The receiving water monitoring frequency is the same as previously issued Fuel and VOC General Permits.

E. Other Monitoring Requirements

The purpose of additional monitoring requirements is to investigate complaints, identify the discharges that should be regulated by individual NPDES permits, coordinate stormwater monitoring with municipalities, and quantify potential impacts of extracted and treated groundwater discharge on the receiving water and the ambient conditions of the receiving waters.

F. Reporting Requirements

Reporting requirements are included in the Monitoring and Reporting Program. The reporting requirements establish requirements for report submittal format.

VII. RATIONALE FOR PROVISIONS

A. Standard Provisions (Provision VI.A)

Standard Provisions, which in accordance with 40 CFR 122.41and 122.42 apply to all NPDES discharges and must be included in every NPDES permit, are provided in Attachments D of this Order. 40 CFR 122.41(a)(1) and (b) through (n) establish conditions that apply to all state-issued NPDES permits. These conditions must be incorporated into the permits either expressly or by reference. 40 CFR 123.25(a)(12) allows the state to omit or modify conditions to impose more stringent requirements. In accordance with 40 CFR 123.25, this Order omits federal conditions that address enforcement authority specified in 40 CFR 122.41(j)(5) and (k)(2) because the CWC enforcement authority is more stringent. In lieu of these conditions, this Order incorporates by reference CWC section 13387(e).

B. Monitoring and Reporting Program Requirements (Provision VI.B)

The Discharger is required to monitor the permitted discharge in order to evaluate compliance with permit conditions. Monitoring requirements are contained in the Monitoring and Reporting Program (Attachment E), and Standard Provisions (Attachment D). This provision requires compliance with these documents and is authorized by 40 CFR 122.41(h) and (j), and CWC sections 13267 and 13383.

C. Special Provisions (Provision VI.C)

1. **Reopener Provisions.** These reopener provisions are based on 40 CFR 122.63 and allow modification of this Order and its effluent limitations as necessary in response to updated WQOs, regulations, or other new relevant information that may be established in the future and other circumstances allowed by law.

2. **Notice of Intent (NOI) Application.** Provision VI.C.2, Notice of Intent (NOI) Application, is based on 40 CFR 122.28(b).

3. **NOI Review.** Provision VI.C.3, NOI Review, is based on 40 CFR 122.28(b).

4. **Discharge Authorization.** Provision VI.C.4, Discharge Authorization, is based on 40 CFR 122.28(b).

5. **Non-Compliance is a Violation.** Provision VI.C.5, Non-Compliance is a Violation, is based on 40 CFR 122.41(a).

6. **Triggers.** Dischargers authorized under this Order are expected to use BAT and treat their fuel or VOC pollutants to non-detectable levels. Some compounds other than pollutants with

effluent limitations may be detected in the effluent of some of the treatment systems, however. These pollutants include both organic and inorganic compounds. The purpose of these provisions is to require Dischargers to do additional activities should any pollutants exceed the triggers in Table F-8. These triggers are not effluent limitations, and must not be construed as such. Instead, they are levels at which additional investigation is warranted to determine whether a numeric limit for a particular constituent is necessary. Unless explained in a note, the concentration-based triggers in Table F-8 are set at the minimum applicable criterion, as determined from State MCLs, federal MCLs, CTR criteria, or Basin Plan WQOs. The reason for this approach is explained in section IV of this Fact Sheet, and further explained below.

a. Triggers for Inorganic Compounds. Antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc (hereinafter called inorganic compounds) are present in fuel- or VOC-cleanup discharges, primarily due to background concentrations in the shallow groundwater being remediated. The discharge volume and concentrations of inorganic compounds concentrations in the effluent are relatively low. The Regional Water Board has concluded that Bay-wide inorganic compounds loading from fuel- or VOC-cleanup discharges represent a very small portion of total inorganic compounds loadings from sources within the Region (including municipal and industrial point source discharges and stormwater discharges), and, therefore, shall cause no impairment of beneficial uses or potential exceedances of inorganic compounds objectives in receiving waters.

Facilities where inorganic compounds have adversely impacted groundwater are not eligible for coverage under this Order. Each Discharger shall submit, as part of the NOI application for proposed discharge, analytical results including inorganic compounds concentrations in the influent and effluent, if available, or maximum concentrations in any individual extraction wells, if not operating yet. Based on these data, the Discharger may receive a discharge authorization letter. In some cases after starting up an extraction and treatment system, the effluent concentration of some inorganic compounds may exceed the triggers listed in Table F-8. In this case, the Discharger shall take three additional samples and have them analyzed for the inorganic compound of concern and comply with the Provisions VI.C.7, VI.C.8, or VI.C.9.

Triggers for copper and nickel have been updated in the General Permit from the previous Fuel General Permit to reflect the recently adopted SSOs and SSTs for copper throughout San Francisco Bay, and the SSOs and SSTs for nickel in the South Bay.

b. Triggers for Organic Compounds. Dischargers authorized under this Order are expected to use BAT and treat their VOC pollutants to non-detectable levels. Sites where pesticides or other conservative pollutants have adversely impacted groundwater are not eligible for coverage under this Order. Each Discharger shall submit, as part of the NOI application for proposed discharge, analytical results including volatile and semi-volatile organic compounds concentrations in the influent and effluent if available or maximum concentrations in any individual extraction wells, if not operating yet. In addition, each Discharger shall submit a report, to the satisfaction of Executive Officer, certifying the

adequacy of the proposed treatment system in removal of all organic pollutants of concern. Based on these data and information, the Discharger may receive a discharge authorization letter. However, some organic compounds, other than pollutants with effluent limitations, may be detected in the effluent of some of the treatment systems. This could be due to the movement of the contaminated groundwater from a neighboring site into the capture zone of the treatment facility authorized under this permit. Table F-8 contains concentration-based triggers for conducting additional activities for a list of pollutants reported by Dischargers or listed in the CTR. This provision would allow Dischargers to continue groundwater cleanup while investigating the ability to treat any detected volatile or semi-volatile organic compounds, in excess of Table F-8 triggers.

Table F-8. Basis for Table 3 Trigger Compounds

Pollutant	CAS Number	Minimum State/Federal MCL (µg/L)	Minimum Basin Plan Criteria[1] (µg/L)	Minimum CTR Criteria[1] (µg/L)	Trigger[1][7] (µg/L)
Antimony	7440360	6	---	14	6
Arsenic	7440382	10	36	36	10
Beryllium	7440417	4	---	---	4
Cadmium	7440439	5	1.1	2.5	1.1
Chromium (VI)	18540299	---	11	11	11[2]
Copper[3]	7440508	1000	5.9	---	5.9
Copper[4]	7440508	1000	3.4	---	3.4
Copper[5]	7440508	1000	4.7	---	4.7
Lead	7439921	15	3.2	3.2	3.2
Mercury	7439976	2	0.025	0.050	0.025
Nickel[3]	7440020	100	30	30	30
Nickel[4]	7440020	100	13	13	13
Nickel[5]	7440020	100	19	19	19
Selenium	7782492	50	---	5	5
Silver	7440224	100	2.2	2.2	2.2
Thallium	7440280	2	---	1.7	1.7
Zinc	7440666	5000	86	86	86
Cyanide	57125	150	2.9	5.2	2.9
2,3,7,8-TCDD	1746016	0.00003	---	1.3E-08	1.3E-08
Acrylonitrile	107131	---	---	0.059	0.059
Bromoform	75252	80	---	4.3	4.3
Chlorodibromomethane	124481	80	---	0.401	0.401
Dichlorobromomethane	75274	80	---	0.56	0.56
1,2-Dichloropropane	78875	5	---	0.52	0.52
1,3-Dichloropropylene	542756	0.5	---	10	0.5
1,1,2,2-Tetrachloroethane	79345	1	---	0.17	0.17
Pentachlorophenol	87865	1	---	0.28	0.28
2,4,6-Trichlorophenol	88062	---	---	2.1	2.1
Benzidine	92875	---	---	0.00012	0.00012
Benzo(a)anthracene	56553	---	---	0.0044	0.0044
Benzo(a)pyrene	50328	0.2	---	0.0044	0.0044
Benzo(b)fluoranthene	205992	---	---	0.0044	0.0044
Benzo(k)fluoranthene	207089	---	---	0.0044	0.0044
Bis(2-chloroethyl)ether	111444	---	---	0.031	0.031
Bis(2-ethylhexyl)phthalate	117817	---	---	1.8	1.8
Chrysene	218019	---	---	0.0044	0.044

Pollutant	CAS Number	Minimum State/Federal MCL (µg/L)	Minimum Basin Plan Criteria[1] (µg/L)	Minimum CTR Criteria[1] (µg/L)	Trigger[1][7] (µg/L)
Dibenzo(a,h)anthracene	53703	---	---	0.0044	0.0044
3,3'-Dichlorobenzidine	91941	---	---	0.04	0.04
2,4-Dinitrotoluene	121142	---	---	0.11	0.11
1,2-Diphenylhydrazine	122667	---	---	0.040	0.040
Hexachlorobenzene	118741	1	---	0.00075	0.00075
Hexachlorobutadiene	87683	---	---	0.44	0.44
Hexachloroethane	67721	---	---	1.9	1.9
Indeno(1,2,3-c,d)pyrene	193395	---	---	0.0044	0.0044
N-nitrosodimethylamine	62759	---	---	0.00069	0.00069
N-nitrosodi-n-propylamine	621647	---	---	0.005	0.005
Aldrin	309002	---	---	0.00013	0.00013
alpha-BHC	319846	---	---	0.0039	0.0039
beta-BHC	319857	---	---	0.014	0.014
gamma-BHC	58899	0.2	---	0.019	0.019
Chlordane	57749	0.1	---	0.00057	0.00057
4,4-DDT	50393	---	---	0.00059	0.00059
4,4-DDE	72559	---	---	0.00059	0.00059
4,4-DDD	72548	---	---	0.00083	0.00083
Dieldrin	60571	---	---	0.00014	0.00014
alpha-Endosulfan	959988	---	---	0.0087	0.0087
beta-Endosulfan	33213659	---	---	0.0087	0.0087
Endrin	72208	2	---	0.0023	0.0023
Endrin aldehyde	7421934	---	---	0.76	0.76
Heptachlor	76448	0.01	---	0.00021	0.00021
Heptachlor epoxide	1024573	0.01	---	0.00010	0.00010
PCBs, sum	1336363	0.5	---	0.00017	0.00017
Toxaphene	8001352	3	---	0.0002	0.0002
1,4-dioxane	123911	3	---	---	3
Turbidity (NTU)	---	5	---	---	5
Odor-Threshold (Units)	---	3	---	---	3
TPHs (other than gasoline and diesel)	---	---	---	---	50[6]
Sulfate	---	250,000	---	---	250,000
Foaming agents	---	500	---	---	500
Color (units)	---	15	---	---	15

Notes for Table F-8:
[1] Unit is µg/L unless noted otherwise right after the name of pollutant
[2] If total chromium concentration exceeds 11 µg/L, then analysis for chromium(VI) shall also be conducted
[3] Applicable to Suisun Bay and San Pablo Bay segments of San Francisco Bay.
[4] Applicable to Central Bay and Lower Bay segments of San Francisco Bay.
[5] Applicable to South San Francisco Bay, south of Hayward Shoals.
[6] Trigger value based on Regional Water Board staff BPJ. If a discharger is reporting monitoring data with a detection level higher than 50 µg/L, the reason for the higher detection level shall be fully explained within the monitoring report.
[7] If a discharger is reporting non-detect monitoring data with a reporting level higher than the trigger, the reason for the higher detection level shall be consistent with the SIP Appendix 4 required minimum levels (please refer to our web site for the latest version of SIP) and must be explained within the monitoring report.

8. **Individual NPDES Permit May Be Required.** Provision VI.C.11 is retained from the previously issued Fuel and VOC General Permits and is based on 40 CFR 122.28(b)(3).

9. **Treatment Reliability Requirement.** Provision VI.C.12, Treatment Reliability, is mostly based on 40 CFR 122.41. The basis for the requirement for a certified engineer to oversee the treatment and operation of the treatment system is to ensure that qualified professionals perform this work. Service stations operators are generally not qualified for this technical level of oversight.

VIII. PUBLIC PARTICIPATION

The Regional Water Board is considering the reissuance of general waste discharge requirements (GWDRs) that will serve as a General NPDES Permit. As a step in the GWDRs adoption process, the Regional Water Board has developed tentative GWDRs. The Regional Water Board encourages public participation in the GWDR adoption process.

A. Notification of Interested Parties

The Regional Water Board has notified the Dischargers and interested agencies and persons of its intent to prescribe GWDRs for the discharge and has provided them with an opportunity to submit their written comments and recommendations. Notification was provided through the Recorder on December 12, 2011.

B. Written Comments

Staff determinations are tentative. Interested persons are invited to submit written comments concerning this Order. Comments should be submitted either in person or by mail to the Executive Officer at the Regional Water Board at the address above on the cover page of this Order.

To be fully responded to by staff and considered by the Regional Water Board, written comments should be received at the Regional Water Board offices by 5:00 p.m. on January 12, 2012**.**

C. Public Hearing

The Regional Water Board will hold a public hearing on the tentative WDRs during its regular Board meeting on the following date and time and at the following location:

Date:	February 8, 2012
Time:	9:00 a.m.
Location:	Elihu Harris State Building (1st Floor auditorium) 1515 Clay Street (Walking distance from City Center 12th Street BART station) Oakland, CA 94612

Interested persons are invited to attend. At the public hearing, the Regional Water Board will hear testimony, if any, pertinent to the discharge, GWDRs, and permit. Oral testimony will be heard; however, for accuracy of the record, important testimony should be in writing.

Please be aware that dates and venues may change. Our web address is http://www.waterboards.ca.gov/sanfranciscobay where you can access the current agenda for changes in dates and locations.

D. Waste Discharge Requirements Petitions

Any aggrieved person may petition the State Water Resources Control Board to review the decision of the Regional Water Board regarding the final GWDRs. The petition must be submitted within 30 days of the Regional Water Board's action to the following address:

State Water Resources Control Board
Office of Chief Counsel
P.O. Box 100, 1001 I Street
Sacramento, CA 95812-0100

E. Information and Copying

Report of Waste Discharges, related documents, tentative effluent limitations and special provisions, comments received, and other information are on file and may be inspected at the address above during regular office hours, which are generally weekdays from 8:00 a.m. to 5:00 p.m., excluding 12:00 p.m. to 1:00 p.m. lunch hours and holidays. Copying of documents may be arranged through the Regional Water Board by calling (510) 622-2300.

F. Register of Interested Persons

Any person interested in being placed on the mailing list for information regarding the GWDRs and NPDES permit should contact the Regional Water Board, reference this facility, and provide a name, address, and phone number.

G. Additional Information

Requests for additional information or questions regarding this order should be directed to **Farhad Azimzadeh at (510) 622-2310 or by e-mail at fazimzadeh@waterboards.ca.gov.**

Storm Water Information Handout – Dated 10/2014

State Route 84 Expressway Widening Project
Alameda County, California
EA 04-297621
October 2014

Storm Water Information Handout

Prepared for:

Caltrans

ALAMEDA County Transportation Commission

Prepared by:

WRECO

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Appendix A Notice of Intent (NOI)
Appendix B Conceptual Sampling Plan

Disclaimer

A "Disclaimer" is required specifying that the information provided in this 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 National Pollutant Discharge Elimination System (NPDES) Construction General Permit (CGP), Number CAS000002, Order No. 2012-0006-DWQ. 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

The California Department of Transportation in cooperation with the Alameda County Transportation Commission proposes to widen and upgrade State Route (SR) 84 from 0.1 mile south of Ruby Hill Drive to 0.6 mile north of Concannon Blvd to expressway standards (Project).

1.1 Intent of this Document

The objectives of this Storm Water Information Handout (SWIH) are:

- To summarize general water quality information of the Project;
- To summarize the requirements of the Construction General Permit (CGP), Order No. 2012-0006-DWQ, which became effective on July 17, 2012;
- To aid in developing the Storm Water Pollution Prevention Plan (SWPPP) of the Project; and
- To highlight information necessary to file Permit Registration Documents (PRDs) as part of the Notice of Intent (NOI) prior to the start of construction to the State Water Resources Control Board (SWRCB) via the Stormwater Multi Application Reporting and Tracking System (SMARTS).

1.2 Summary of Requirements

The "National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities" (NPDES Number CAS000002, Order No. 2012-0006-DWQ), or CGP, regulates discharges from construction activities within the Project area.

The CGP is based on a risk level (RL) permitting approach. The RL is calculated by 1) project sediment risk and 2) receiving water risk. See the risk assessment calculations in Section 3.1 of this document for details.

A risk assessment was done for the **State Route 84 Expressway Widening Project**, and the Project was determined to be **RL 2**.

RL 2 projects will be subject to best management practice (BMP) implementation, visual monitoring requirements, stormwater monitoring and sampling requirements, plus Numeric Action Levels (NALs) for pH and turbidity.

All projects will have to upload stormwater data into SMARTS, such as the NOI, SWPPP, annual reports, and monitoring data, as applicable.

2 GENERAL PROJECT INFORMATION

2.1 Location

The Project is located along SR 84/Vallecitos Road/Isabel Avenue, from Post Mile (PM) 22.9 to 25.7, in Alameda County, between the cities of Livermore and Pleasanton (Figure 1).

2.2 Major Engineering Features

The State Route (SR) 84 Expressway Widening Project (Project) located in Livermore and Pleasanton in Alameda County, proposes to widen and upgrade 2.8 miles of SR 84 from 0.1 mile south of Ruby Hill Drive to 0.6 mile north of Concannon Boulevard to expressway standards (55 miles per hour [mph]). 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, and Concannon Boulevard will be widened and upgraded to accommodate future traffic movements. A connector access will be constructed at the SR 84/Vallecitos Road intersection to accommodate the high volume of traffic moving from northbound SR 84 to the City of Livermore. 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 southward to Vineyard Avenue. The Project will also construct a new access bridge at Arroyo Del Valle for local utility and maintenance facilities, the Isabel Trail crossing, and widen the existing bridge across Arroyo Del Valle. The Project will construct retaining walls where right-of-way is restricted.

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 4:1 or flatter to provide a clear recovery zone (CRZ) for errant vehicles. Outside the CRZ, side slopes will be 2:1 or flatter. The roadway median area at intersections will be widened up to 36 feet to accommodate left-turn lanes.

2.3 Construction Dates

The RL is dependent on the construction schedule; the RL determination presented in this SWIH is based on the following estimated construction dates:

Construction Start Date: **07/20/2015**

Construction End Date: **06/23/2017**

The Office of Water Quality Water Pollution Control Branch or Office of Construction Environmental Engineering Support should be contacted if the actual construction dates significantly differ from the dates shown above for guidance on whether a new RL determination is necessary based on the actual construction schedule.

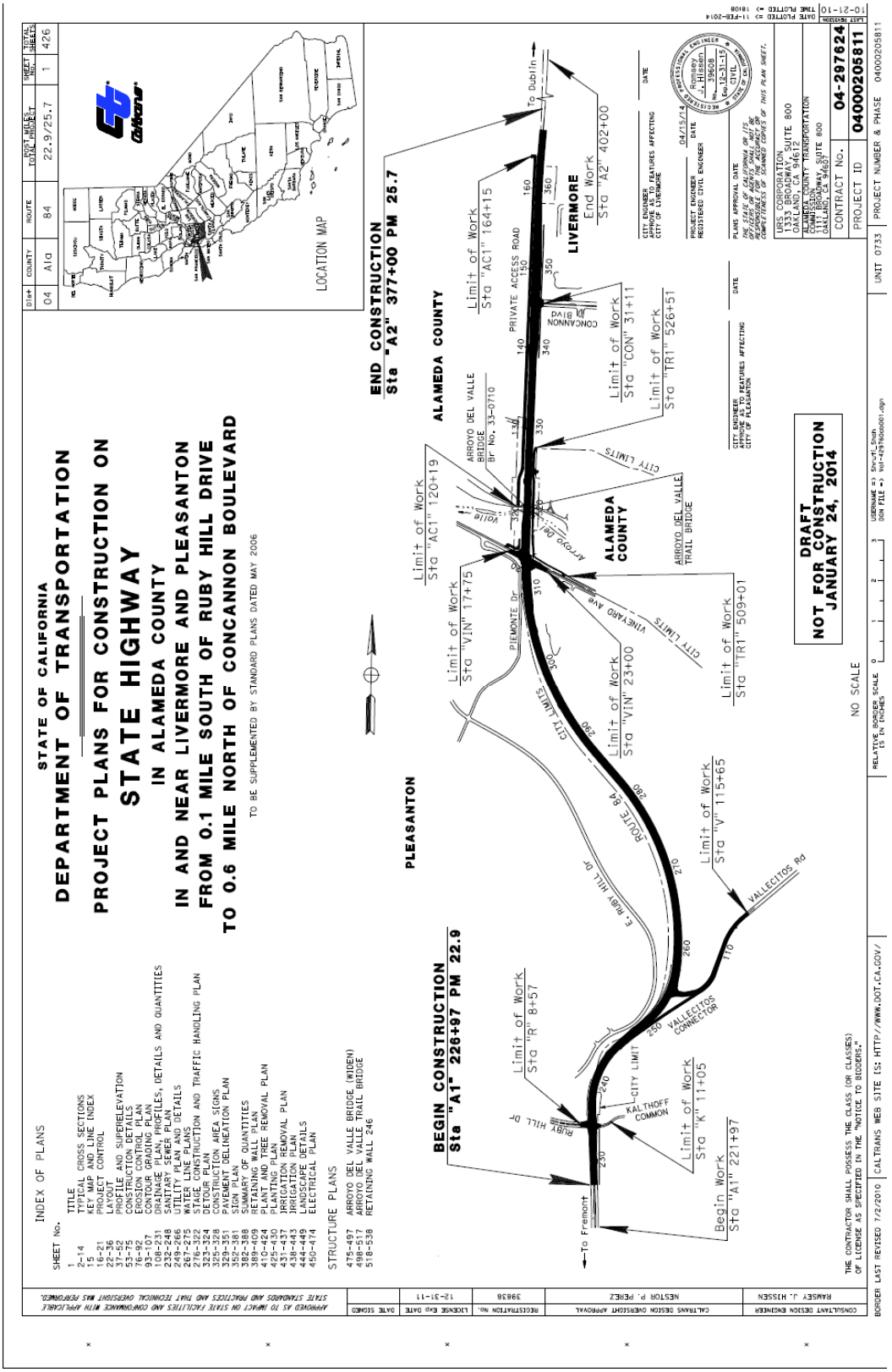


Figure 1. Project Location Map

2.4 Receiving Water Bodies

Runoff from the Project discharges to Arroyo Del Valle and Arroyo Mocho. Arroyo Del Valle crosses SR 84 at Bridge Number 33 0710; the bridge is located just north of the SR 84/Vineyard Avenue intersection, at PM R25.45. The Project will widen this existing bridge and construct a new trail bridge at Arroyo Del Valle located 19 feet upstream of the widened bridge. Arroyo Mocho crosses SR 84 at PM R27.10, outside the northern limit of the Project.

A total maximum daily load (TMDL) for diazinon for both Arroyo Del Valle and Arroyo Mocho has been approved by the United State Environmental Protection Agency (EPA). Additionally, Arroyo Mocho is listed as impaired for water temperature on the SWRCB's 2010 303(d) List of Water Quality Limited Segments.

The San Francisco Bay Regional Water Quality Control Board (RWQCB) Basin Plan lists the following existing (E) and potential (P) beneficial uses for:

Arroyo Del Valle:

- (E) Municipal and Domestic Supply (MUN)
- (E) Groundwater Recharge (GWR)
- (E) Cold Freshwater Habitat (COLD)
- (P) Fish Migration (MIGR)
- (E) Preservation of Rare and Endangered Species (RARE)
- (E) Fish Spawning (SPWN)
- (E) Warm Freshwater Habitat (WARM)
- (E) Wildlife Habitat (WILD)
- (E) Water Contact Recreation (REC-1)
- (E) Non-contact Water Recreation (REC-2)

Arroyo Mocho:

- (E) GWR
- (E) COLD
- (E) MIGR
- (E) SPWN
- (E) WARM
- (E) WILD
- (E) REC-1
- (E) REC-2

2.5 Existing (Pre-Construction) Control Practices

There are no existing treatment BMPs within Project limits; however, runoff from the northern portion of Project will discharge to an Austin Vault Sand Filter constructed under EA 04-297614.

There are existing hard surface BMPs, including rock slope protection and flared end sections within the Project. An estimated 22 cubic yards of existing rock slope protection and one flared end section are expected to be removed in order to construct new drainage systems.

2.6 Climate and Rainfall

The following precipitation totals were obtained from the US Department of Commerce National Oceanic & Atmospheric Administration *Climatography of the United States No. 20* (2004), see Figure 2.

Rainy days per year (assumed equal to precipitation of 0.10 inches or greater): **35.4** days

Qualifying rain events per year (precipitation of 0.5 inches or greater): **9.0** days

2.7 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 ranges from a minimum of 3 feet to as much as 25 feet 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. 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.

The erosion factor (K) indicates the erodibility of the fine-earth fraction of the soil. The factor is given as a percentage or fraction ranging from 0.02 to 0.69; the higher the value, the more susceptible the soil is to sheet and rill erosion by water. The K factors for the soils within the Project were obtained from the Natural Resources Conservation Service "Web Soil Survey" (see Figure 3 and Figure 4). The weighted average K value for this Project was calculated to be 0.30.

2.8 Hazardous Waste

A soil and groundwater investigation was conducted within the Project area in April 2008. The conclusion mentions that the soils in the Project area would be considered non-hazardous. The investigation did not find any presence of aerially deposited lead (ADL) above the Total Threshold Limit Concentration or Soluble Threshold Limit Concentration. Additionally, most of the Project area has been reconstructed after 1993, and no ADL was found in the Project area by these earlier projects. Therefore, there are no special handling instructions for ADL, and the ADL variance would not be invoked for this Project.

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 **NWS Call Sign:** **Elevation: 480 Feet** **Lat: 37° 42N** **Lon: 121° 47W**

Climate Division: CA 4 **COOP ID: 044997**

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 2. Precipitation Totals

Source: US Department of Commerce

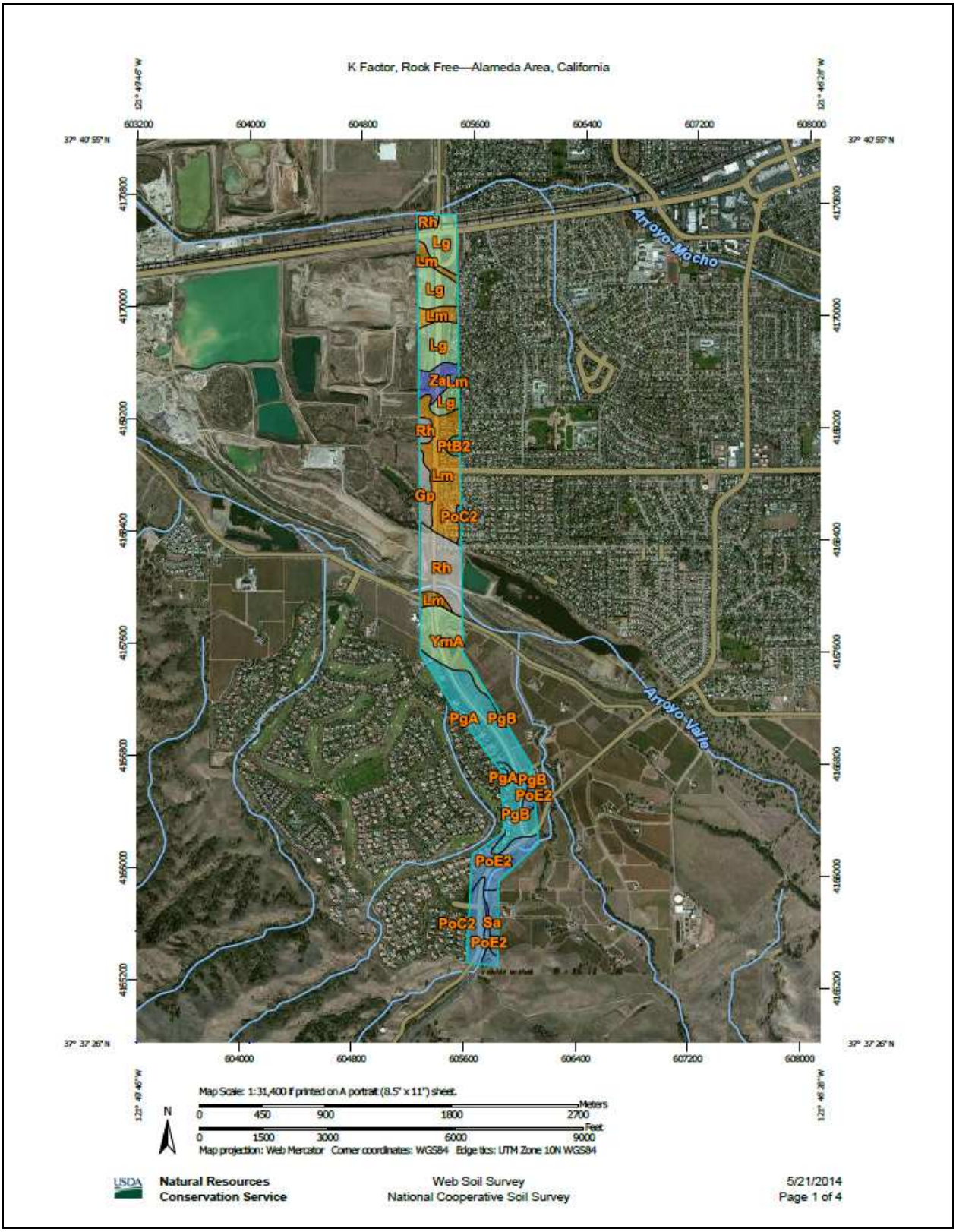


Figure 3. Soil Map

Source: Natural Resources Conservation Service

K Factor, Rock Free— Summary by Map Unit — Alameda Area, California (CA609)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
Gp	Gravel pit		9.4	2.6%
Lg	Livermore gravelly loam	.28	67.2	18.2%
Lm	Livermore very gravelly coarse sandy loam	.10	64.6	17.5%
PgA	Pleasanton gravelly loam, 0 to 3 percent slopes	.37	53.4	14.5%
PgB	Pleasanton gravelly loam, 3 to 12 percent slopes	.37	25.2	6.8%
PoC2	Positas gravelly loam, 2 to 20 percent slopes, eroded	.43	21.2	5.7%
PoE2	Positas gravelly loam, 20 to 40 percent slopes, eroded	.43	29.5	8.0%
PtB2	Positas gravelly loam, thick surface, 2 to 10 percent slopes, eroded	.37	3.0	0.8%
Rh	Riverwash		42.0	11.4%
Sa	San Ysidro loam	.43	8.0	2.2%
YmA	Yolo loam, 0 to 3 percent slopes	.28	32.3	8.7%
Za	Zamora silt loam, 0 to 4 percent slopes	.49	13.1	3.6%
Totals for Area of Interest			**368.9**	**100.0%**

Figure 4. K Factor Summary Source: Natural Resources Conservation Service

3 CONSTRUCTION GENERAL PERMIT

To minimize the potential effects of construction runoff on the quality of the receiving water bodies, any construction activity disturbing 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.

3.1 Risk Assessment

The 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 (receiving water risk) to determine the risk level of the Project.

3.1.1 Sediment Risk

The sediment risk is based on the following equation from the CGP "Fact Sheet" (Section J.1.a pg. 28):

Equation 1. Sediment Risk Equation
A = (R)(K)(LS)(C)(P)

Where:

A = Rate of sheet and rill erosion (tons per acre)
R = Runoff erosivity factor
K = Soil erodibility factor
LS = Length-slope
C = Cover
P = Management operations and support practices

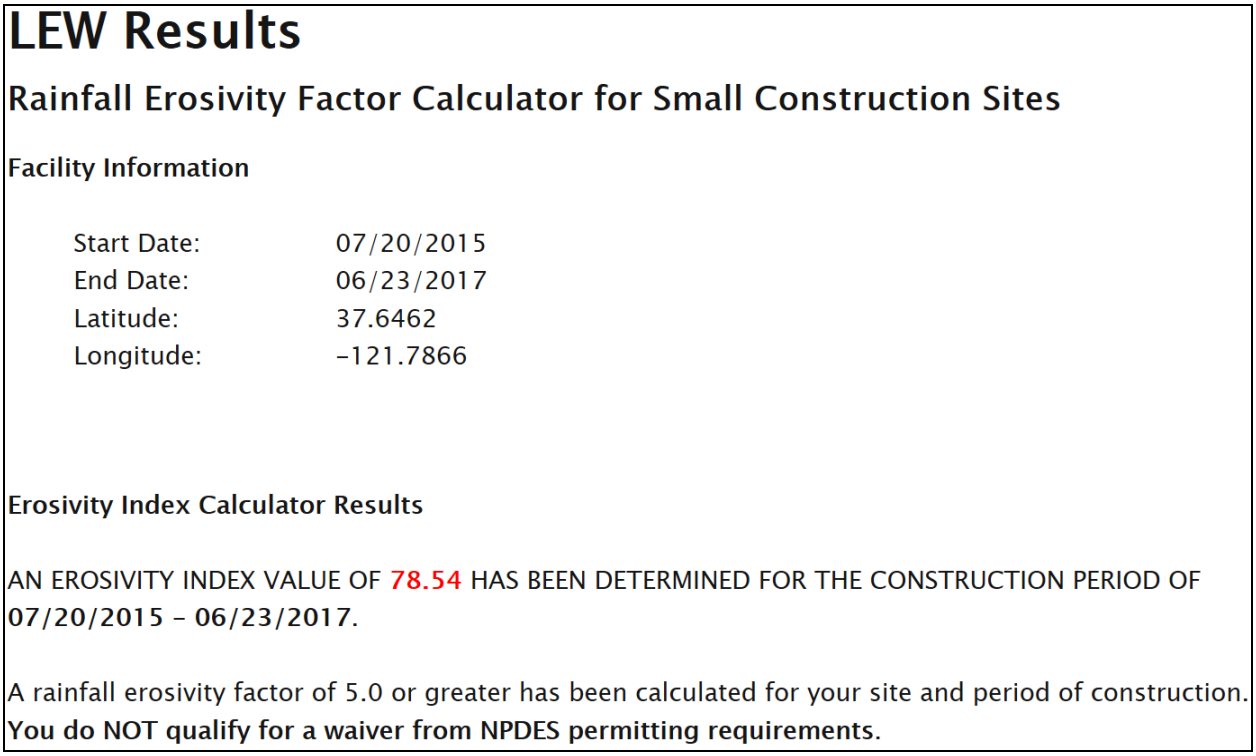
The rainfall runoff erosivity factor (R) of **78.54** was determined from the United States EPA's "Rainfall Erosivity Factor Calculator for Small Construction Sites" (Figure 5).

As stated in Section 2.5, the soil erodibility factor (K) for the Project is **0.30**.

The length-slope factor (LS) of **0.53** was determined by using the Topography Tool developed by Caltrans (Table 1).

The cover factor (C) and management operations and support practices (P) are given values of 1.0 by the CGP to simulate bare ground conditions.

Based on these factors, the rate of sheet and rill erosion (A) is **12** tons per acre. Because this value is less than 15, the Project is classified as having a **LOW** sediment risk (Table 2).



LEW Results

Rainfall Erosivity Factor Calculator for Small Construction Sites

Facility Information

Start Date:	07/20/2015
End Date:	06/23/2017
Latitude:	37.6462
Longitude:	-121.7866

Erosivity Index Calculator Results

AN EROSIVITY INDEX VALUE OF 78.54 HAS BEEN DETERMINED FOR THE CONSTRUCTION PERIOD OF 07/20/2015 - 06/23/2017.

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.

Figure 5. Rainfall Erosivity Factor Source: U.S. EPA

Table 1. Project LS Factor

Number of X-Sections = 37

Alignment		Number of	Slope Segment 1				Slope Segment 2				Slope Segment 3				Slope Segment 4				Slope Segment 5				Slope Segment 6				Weighted Average for All segments	
Station	Line	Segments	Length	Rise	Steepness	LS	Length	Rise	Steepness	LS	Length	Rise	Steepness	LS	Length	Rise	Steepness	LS	Length	Rise	Steepness	LS	Length	Rise	Steepness	LS	Total Slope Length	Weighted LS
			(ft)	(ft)	(%)		(ft)	(ft)	(%)		(ft)	(ft)	(%)		(ft)	(ft)	(%)		(ft)	(ft)	(%)		(ft)	(ft)	(%)		(ft)	
227+00	A1	5	4.24	0.67	15.85	0.43	2.45	0.14	5.79	0.25	1.58	0.91	57.49	0.62	4.86	2.00	41.16	0.74	9.60	2.00	20.84	0.71		0.00	N/A	0.00	22.730	0.61
237+00	A1	4	24.85	1.62	6.53	0.38	30.04	13.50	44.94	3.07	13.87	0.62	4.45	0.21	14.24	1.08	7.61	0.31		0.00	N/A	0.00		0.00	N/A	0.00	82.999	1.31
247+00	A1	3	46.79	14.88	31.81	3.22	10.06	0.27	2.64	0.16	40.85	2.95	7.22	0.56		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	97.700	1.79
257+00	A1	6	25.56	10.00	39.12	2.40	14.25	1.43	10.04	0.40	56.50	1.30	2.31	0.25	9.70	0.33	3.43	0.18	34.14	13.20	38.65	2.98	14.05	0.50	3.58	0.19	154.193	1.22
267+00	A1	3	8.80	2.04	23.13	0.74	12.83	0.25	1.94	0.13	22.85	1.01	4.41	0.27		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	44.472	0.32
277+00	A1	3	3.98	0.01	0.35	0.06	33.17	1.44	4.34	0.32	4.54	1.51	33.22	0.63		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	41.686	0.33
287+00	A1	6	4.46	0.19	4.35	0.21	4.59	1.38	29.99	0.61	4.22	1.18	28.06	0.56	16.65	0.09	0.56	0.07	21.51	0.24	1.13	0.10	4.34	0.17	3.92	0.20	55.767	0.19
297+00	A1	4	3.83	0.03	0.78	0.08	6.09	0.46	7.55	0.31	11.00	0.13	1.18	0.10	30.02	0.69	2.30	0.19		0.00	N/A	0.00		0.00	N/A	0.00	50.940	0.17
307+00	A1	5	7.56	0.14	1.85	0.12	12.23	1.12	9.16	0.36	4.24	0.28	6.60	0.28	8.46	1.51	17.85	0.59	31.05	0.65	2.09	0.18		0.00	N/A	0.00	63.540	0.27
317+00	A1	4	10.19	3.80	37.29	1.16	18.80	3.89	20.69	1.03	8.20	3.87	47.20	1.17	18.39	0.60	3.26	0.19		0.00	N/A	0.00		0.00	N/A	0.00	55.580	0.80
327+00	A1	4	28.59	0.00	0.02	0.05	14.12	3.19	22.59	0.92	15.41	3.86	25.05	1.06	41.33	0.14	0.34	0.06		0.00	N/A	0.00		0.00	N/A	0.00	99.450	0.34
337+00	A1	6	30.54	0.32	1.05	0.11	13.03	2.10	16.12	0.64	17.31	10.33	59.68	2.45	16.44	0.25	1.52	0.11	4.43	0.40	9.03	0.34	6.15	1.64	26.67	0.68	87.900	0.70
345+00	A1	2	49.26	3.75	7.61	0.66	33.33	0.60	1.80	0.16		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	82.590	0.46
364+00	A2_A	2	7.65	0.00	N/A	0.00	11.21	0.33	2.94	0.17		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	18.860	0.10
374+00	A2_A	4	13.40	0.00	N/A	0.00	2.89	0.49	16.96	0.39	1.75	0.00	N/A	0.00	2.77	0.66	23.83	0.44		0.00	N/A	0.00		0.00	N/A	0.00	20.810	0.11
384+00	A2_A	1	17.61	0.61	3.46	0.20		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	17.610	0.20
392+00	A2_A	2	36.30	7.26	20.00	1.63	18.31	-0.22	-1.20	0.05		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	54.610	1.10
393+00	A2_A	2	5.75	0.12	2.09	0.13	4.15	0.89	21.45	0.48		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	9.900	0.28
346+00	A2_B	2	8.51	0.01	0.12	0.05	4.16	0.25	6.01	0.26		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	12.670	0.12
356+00	A2_B	3	6.52	0.10	1.53	0.11	6.79	1.39	20.47	0.60	8.96	0.69	7.70	0.31		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	22.270	0.34
366+00	A2_B	2	4.40	0.40	9.09	0.34	14.20	0.08	0.56	0.07		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	18.600	0.14
395+00	A3_A	4	6.58	3.97	60.33	1.15	23.55	9.87	41.91	2.38	24.41	2.74	11.22	0.64	33.05	0.69	2.09	0.18		0.00	N/A	0.00		0.00	N/A	0.00	87.590	0.97
405+00	A3_A	2	13.82	0.47	3.40	0.18	10.39	0.46	4.43	0.21		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	24.210	0.20
413+50	A3_A	5	29.10	0.03	0.10	0.05	12.73	2.70	21.21	0.82	40.48	0.25	0.62	0.09	3.06	0.12	3.92	0.20	8.14	0.25	3.07	0.17		0.00	N/A	0.00	93.510	0.19
423+00	A3_A	2	5.29	0.32	6.05	0.26	13.25	0.11	0.83	0.08		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	18.540	0.13
433+00	A3_A	1	21.89	0.13	0.59	0.08		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	21.890	0.08
443+00	A3_A	1	20.80	0.48	2.31	0.16		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	20.800	0.16
122+00	AC1_A	1	15.69	0.07	0.45	0.07		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	15.690	0.07
133+00	AC1_A	4	3.99	0.13	3.26	0.18	24.49	3.06	12.49	0.73	5.43	1.57	28.91	0.66	11.55	5.31	45.97	1.48		0.00	N/A	0.00		0.00	N/A	0.00	45.460	0.86
143+00	AC1_A	3	29.75	0.48	1.61	0.14	10.36	3.15	30.41	1.00	6.39	3.53	55.24	1.07		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	46.500	0.46
153+00	AC1_A	5	9.24	0.16	1.73	0.12	16.71	5.35	32.02	1.42	17.56	11.49	65.43	2.49	26.56	12.99	48.91	2.99	14.39	0.27	1.88	0.13		0.00	N/A	0.00	84.460	1.77
162+00	AC1_A	3	10.87	0.17	1.56	0.11	7.15	1.68	23.50	0.67	16.12	7.58	47.02	1.92		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	34.140	1.08
95+00	ST_A	6	50.51	0.41	0.81	0.11	16.48	1.35	8.19	0.35	7.95	2.62	32.96	0.90	14.57	7.14	49.00	1.84	10.62	5.05	47.55	1.42	4.51	1.00	22.17	0.51	104.640	0.60
103+00	V_B	2	18.64	4.06	21.78	1.07	8.28	2.24	27.05	0.80		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	26.920	0.99
113+00	V_B	2	4.10	1.64	40.00	0.65	9.75	0.64	6.56	0.28		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	13.850	0.39
53+30	VEX_B	2	72.36	2.72	3.76	0.43	66.76	4.73	7.09	0.75		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	139.120	0.59
18+70	VIN_B	3	34.70	0.09	0.26	0.05	3.08	0.17	5.52	0.25	1.85	0.12	6.49	0.27		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	39.630	0.08
																							Area Weighted LS =				**0.53**
																							(Composite Weighted LS / Number of X-Sections)			

Table 2. Sediment Risk Factor Worksheet

Sediment Risk Factor Worksheet	Entry
A) R Factor	
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.	
http://cfpub.epa.gov/npdes/stormwater/LEW/lewCalculator.cfm	
R Factor Value	78.54
B) K Factor (weighted average, by area, for all site soils)	
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.	
Site-specific K factor guidance	
K Factor Value	0.30
C) LS Factor (weighted average, by area, for all slopes)	
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.	
LS Table	
LS Factor Value	0.53
Watershed Erosion Estimate (=RxKxLS) in tons/acre	12
Site Sediment Risk Factor Low Sediment Risk: < 15 tons/acre Medium Sediment Risk: >=15 and <75 tons/acre High Sediment Risk: >= 75 tons/acre	**Low**

3.1.2 Receiving Water Body Risk

The receiving water risk for discharges to Arroyo Del Valle is **LOW** because it is not on the 303(d) List as impaired for sediment, does not have an approved TMDL for sediment, and does not have the combined existing beneficial uses of SPWN, COLD, and MIGR (Table 3).

Table 3. Receiving Water Risk Factor Worksheet for Arroyo Del Valle

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 visit the link below) or has a **USEPA approved TMDL implementation plan for sediment**?:	**No**	**Low**
http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml		
OR		
A.2. Does the disturbed area discharge to a waterbody with designated beneficial uses of SPAWN & COLD & MIGRATORY? (For help please review the appropriate Regional Board Basin Plan)		
http://www.waterboards.ca.gov/waterboards_map.shtml		

The receiving water risk for discharges to Arroyo Mocho is **HIGH** because it has the combined existing beneficial uses of SPWN, COLD, and MIGR (Table 4).

Table 4. Receiving Water Risk Factor Worksheet for Arroyo Mocho

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 visit the link below) or has a **USEPA approved TMDL implementation plan for sediment**?:	**Yes**	**High**
http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml		
OR		
A.2. Does the disturbed area discharge to a waterbody with designated beneficial uses of SPAWN & COLD & MIGRATORY? (For help please review the appropriate Regional Board Basin Plan)		
http://www.waterboards.ca.gov/waterboards_map.shtml		

3.1.3 Project Risk Level

Based on the low sediment risk and low receiving water risk, areas discharging to Arroyo Del Valle can be classified as needing to comply with RL 1 requirements (Table 5). Based on low sediment risk and high receiving water risk, areas discharging to Arroyo Mocho can be classified as needing to comply with RL 2 requirements (Table 6). To maintain consistency throughout the

Project, and to ensure best efforts are taken to protect water quality, this Project is classified **RL 2**.

Table 5. Combined Risk Level Matrix for Arroyo Del Valle

Combined Risk Level Matrix				
		Sediment Risk		
		Low	Medium	High
Receiving Water Risk	Low	Level 1	Level 2	
	High	Level 2		Level 3
	Project Sediment Risk:		Low	
	Project RW Risk:		Low	
	Project Combined Risk:		Level 1	

Table 6. Combined Risk Level Matrix for Arroyo Mocho

Combined Risk Level Matrix				
		Sediment Risk		
		Low	Medium	High
Receiving Water Risk	Low	Level 1	Level 2	
	High	Level 2		Level 3
	Project Sediment Risk:		Low	
	Project RW Risk:		High	
	Project Combined Risk:		Level 2	

4 PERMIT REGISTRATION DOCUMENTS

To obtain permit coverage under the CGP, all dischargers must electronically file PRDs, 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. Locations of sensitive habitats, watercourses, or other features that are not to be disturbed
    m. Locations of all post-construction BMPs
    n. 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**

4.1 General Information Included

The following is a list of information included in this SWIH that can be used for the PRDs:

- Vicinity Map (Figure 1)
- Risk Assessment (Section 3.1)

4.2 Storm Water Pollution Prevention Plan

The contractor for the Project is required to prepare a SWPPP because the Project involves disturbing more than 1 acre 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

4.3 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.

4.4 Site Maps

Registration requirements can be met by the inclusion of the following plans, which can be found in the appendices.

- Conceptual Sampling Plan (Appendix B)
  - For reference purposes only; not for construction
  - Subject to changes by the Contractor and approved by the Resident Engineer

5 TEMPORARY CREEK DIVERSION SYSTEM

A temporary creek diversion system is proposed for this Project for the widening of the existing SR 84 bridge and construction of the new access road bridge over Arroyo Del Valle. Work within Arroyo Del Valle is limited to one construction season within the period from June 15 to October 1. Flows within Arroyo Del Valle during the allowable work period are mainly a result of releases from the Zone 7 Water Agency. The maximum expected flows identified by the agency are 50 cubic feet per second.

A conceptual temporary creek diversion system is shown on drainage detail 30 (DD-30) of the contract plans. The Contractor is responsible for developing the temporary creek diversion system to be used on-site based on physical site conditions, proposed work and order of work. The temporary creek diversion system must be submitted to the Resident Engineer for Caltrans and Regional Water Quality Control Board comments and approval.

Appendix A Notice of Intent (NOI)

Attachment 2

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. ☒ New Construction 2. ☐ Change of Information for WDID#

II. PROPERTY OWNER

Name	Contact Person		
California Department of Transportation	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.[X]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 B	Caltrans Resident Engineer		
Physical Address/Location	Latitude	Longitude	County
State Route 84 from Ruby Hill Drive to Concannon Blvd	37.6461	-121.78	Alameda County
City (or nearest City)	Zip	Site Phone Number	Emergency Phone Number
Pleasanton & Livermore	94550		

A. Total size of construction site area: 60 Acres

B. Total area to be disturbed: 43.51 Acres (% of total 73)

C. Percent of site imperviousness (including rooftops):
Before Construction: 35 %
After Construction: 64 %

D. Tract Number(s): _____, _____

E. Mile Post Marker: 22.9/25.7

F. Is the construction site part of a larger common plan of development or sale?
☒ YES ☐ NO

G. Name of plan or development: State Route 84 Expressway Widening Project

H. Construction commencement date: 07 / 20 / 15

I. % of site to be mass graded: _____

J. Projected construction dates:
Complete grading: ____/____/____
Complete project: 06 / 23 / 17

K. Type of Construction (Check all that apply):
1. ☐ Residential 2. ☐ Commercial 3. ☐ Industrial 4. ☐ Reconstruction 5. ☒ 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: 401 Certification dated 06/15/11; 404 Permit dated 04/11/2011

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): Arroyo Del Valle and Arroyo Mocho

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

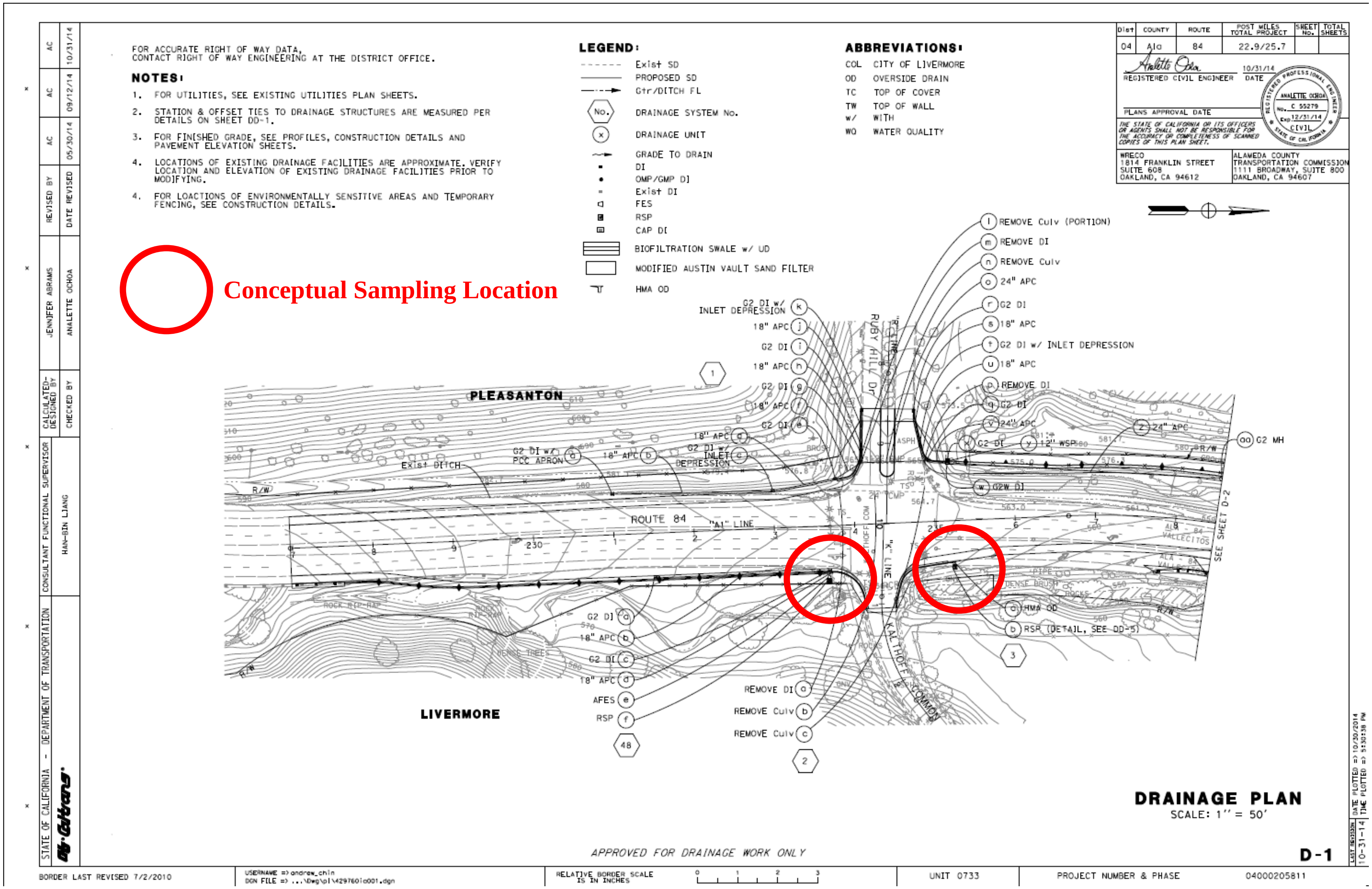
"I certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage 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."

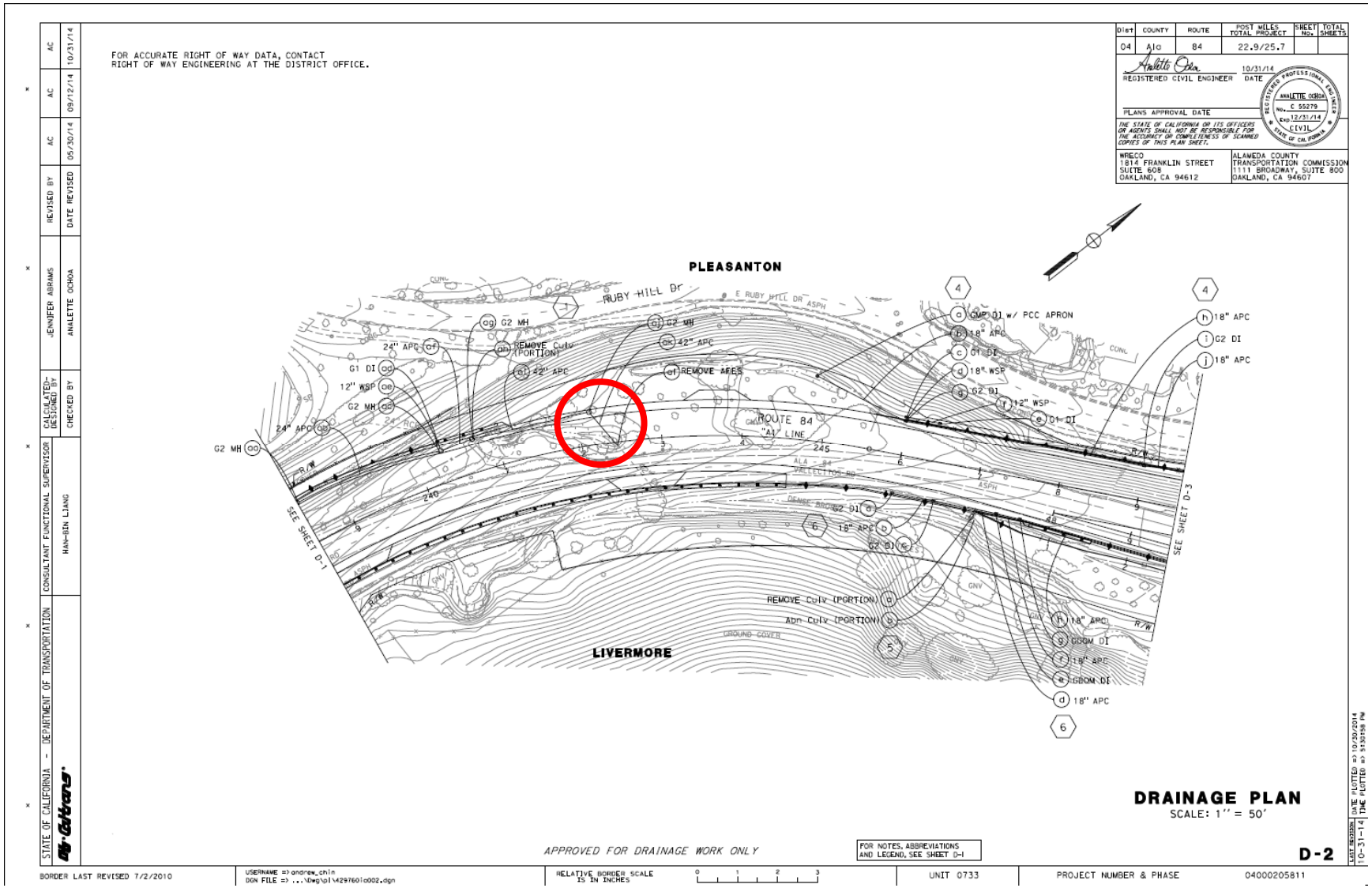
Printed Name: _____

Signature: _____ **Date:** _____

Title: _____

Appendix B Conceptual Sampling Plan


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. LOCATIONS OF EXISTING DRAINAGE FACILITIES ARE APPROXIMATE. VERIFY LOCATION AND ELEVATION OF EXISTING DRAINAGE FACILITIES PRIOR TO MODIFYING.
4. FOR LOACTIONS OF ENVIRONMENTALLY SENSITIVE AREAS AND TEMPORARY FENCING, SEE CONSTRUCTION DETAILS.
LEGEND:
Exist SD
PROPOSED SD
Gtr/DITCH FL
DRAINAGE SYSTEM No.
DRAINAGE UNIT
GRADE TO DRAIN
DI
OMP/GMP DI
Exist DI
FES
RSP
CAP DI
BIOFILTRATION SWALE w/ UD
MODIFIED AUSTIN VAULT SAND FILTER
HMA OD
ABBREVIATIONS:
COL CITY OF LIVERMORE
OD OVERSIDE DRAIN
TC TOP OF COVER
TW TOP OF WALL
w/ WITH
WQ WATER QUALITY
Conceptual Sampling Location
PLEASANTON
LIVERMORE
ROUTE 84
"A1" LINE
RUBY HILL DR
"K" LINE
ISABEL AVE
REMOVE Culv (PORTION)
REMOVE DI
REMOVE Culv
24" APC
G2 DI
18" APC
G2 DI w/ INLET DEPRESSION
G2 MH
HMA OD
RSP (DETAIL, SEE DD-5)
AFES
SEE SHEET D-2
REGISTERED CIVIL ENGINEER
DATE
PLANS APPROVAL DATE
ANALETTE OCHOA
C 55279
12/31/14
CIVIL
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 COMMISSION
1111 BROADWAY, SUITE 800
OAKLAND, CA 94607
Dist 04 COUNTY Ala ROUTE 84 POST MILES TOTAL PROJECT 22.9/25.7
DRAINAGE PLAN
SCALE: 1" = 50'
APPROVED FOR DRAINAGE WORK ONLY
D-1
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
BORDER LAST REVISED 7/2/2010
RELATIVE BORDER SCALE IS IN INCHES
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
REGISTERED CIVIL ENGINEER
10/31/14
DATE
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.
WRECO
1814 FRANKLIN STREET
SUITE 608
OAKLAND, CA 94612
ALAMEDA COUNTY
TRANSPORTATION COMMISSION
1111 BROADWAY, SUITE 800
OAKLAND, CA 94607
PLEASANTON
RUBY HILL Dr
E RUBY HILL DR
ROUTE 84
"A1" LINE
LIVERMORE
SEE SHEET D-1
SEE SHEET D-3
REMOVE Culv (PORTION)
Add Culv (PORTION)
DRAINAGE PLAN
SCALE: 1'' = 50'
APPROVED 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-GIN LIANG
CALCULATED-DESIGNED BY
CHECKED BY
JENNIFER ABRAMS
ANALETTE OCHOA
REVISED BY
DATE REVISED
AC 10/31/14
AC 09/12/14
AC 05/30/14
BORDER LAST REVISED 7/2/2010
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DGN FILE => ...\Dwg\pl\429760lo002.dgn
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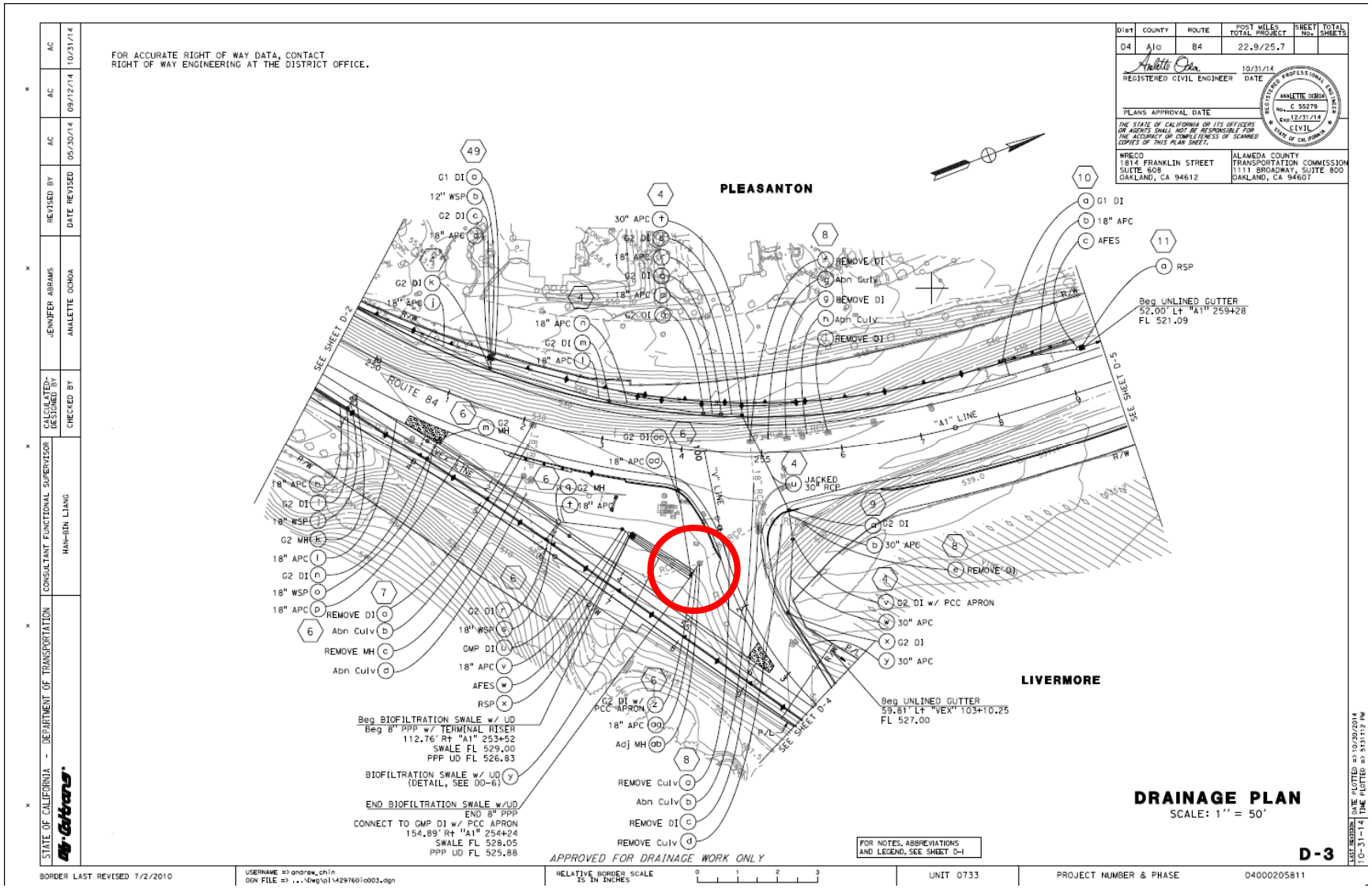
UNIT 0733
PROJECT NUMBER & PHASE
04000205811
DATE PLOTTED => 10/30/2014
TIME PLOTTED => 15:57:58 PM
LAST REVISION 10-31-14


FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.
PLEASANTON
LIVERMORE
ROUTE 84
"A1" LINE
"V" LINE
SEE SHEET D-2
SEE SHEET D-4
SEE SHEET D-5
Beg UNLINED GUTTER
52.00' Lt "A1" 259+28
FL 521.09
Beg UNLINED GUTTER
59.81' Lt "VEX" 103+10.25
FL 527.00
Beg BIOFILTRATION SWALE w/ UD
Beg 8" PPP w/ TERMINAL RISER
112.76' Rt "A1" 253+52
SWALE FL 529.00
PPP UD FL 526.83
BIOFILTRATION SWALE w/ UD
(DETAIL, SEE DD-6)
END BIOFILTRATION SWALE w/UD
END 8" PPP
CONNECT TO GMP DI w/ PCC APRON
154.89' Rt "A1" 254+24
SWALE FL 528.05
PPP UD FL 525.88
JACKED 30" RCP
APPROVED FOR DRAINAGE WORK ONLY
FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1
DRAINAGE PLAN
SCALE: 1'' = 50'
D-3
Dist 04 | COUNTY Ala | ROUTE 84 | POST MILES TOTAL PROJECT 22.9/25.7
REGISTERED CIVIL ENGINEER 10/31/14 DATE
PLANS APPROVAL DATE
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1814 FRANKLIN STREET
SUITE 608
OAKLAND, CA 94612
ALAMEDA COUNTY
TRANSPORTATION COMMISSION
1111 BROADWAY, SUITE 800
OAKLAND, CA 94607
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-GIN LIANG
CALCULATED-DESIGNED BY: JENNIFER ABRAMS
CHECKED BY: ANALETTE OCHOA
REVISED BY: AC | 05/30/14 | DATE REVISED
AC | 09/12/14
AC | 10/31/14
BORDER LAST REVISED 7/2/2010
USERNAME => andrew_chin
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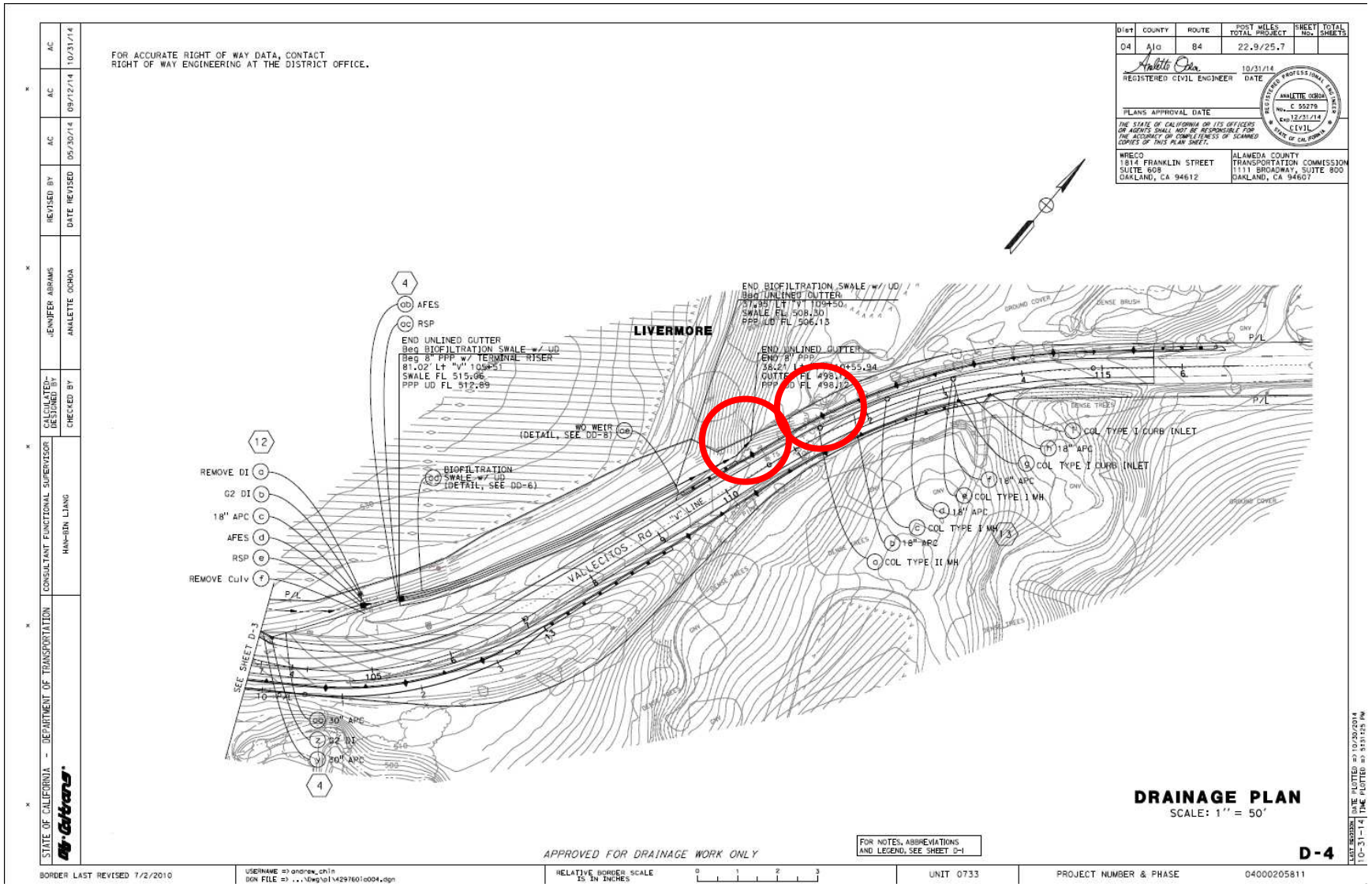
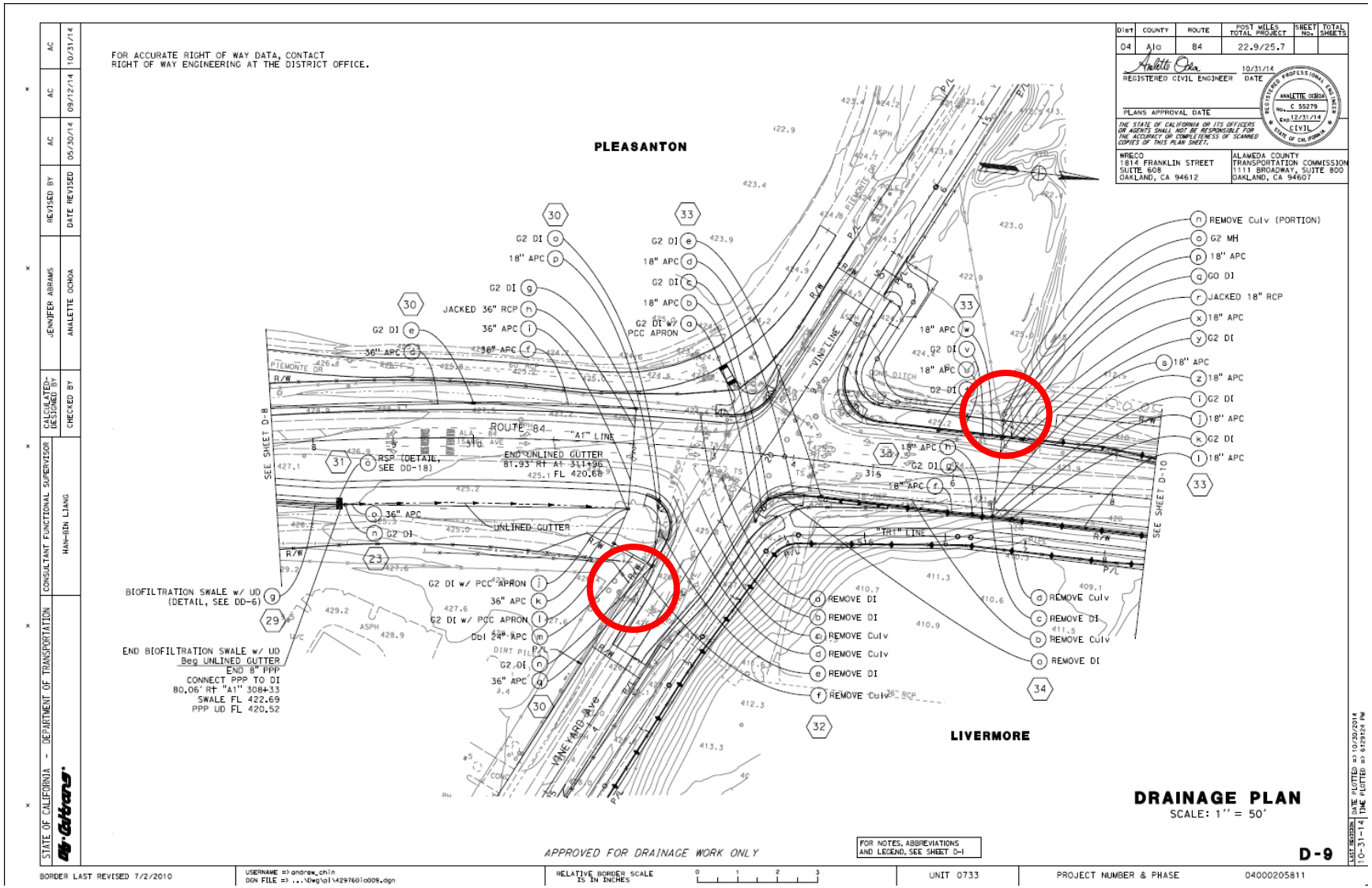
RELATIVE BORDER SCALE IS IN INCHES
UNIT 0733
PROJECT NUMBER & PHASE 04000205811
LAST REVISION
DATE PLOTTED => 10/30/2014
TIME PLOTTED => 15:51:12 PM


FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.
LIVERMORE
VALLECITOS Rd
"V" LINE
DRAINAGE PLAN
SCALE: 1'' = 50'
APPROVED FOR DRAINAGE WORK ONLY
D-4


FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.
PLEASANTON
LIVERMORE
ROUTE 84
"A1" LINE
"TR1" LINE
END UNLINED GUTTER
81.93' Rt A1 311+96
FL 420.68
UNLINED GUTTER
BIOFILTRATION SWALE w/ UD
(DETAIL, SEE DD-6)
END BIOFILTRATION SWALE w/ UD
Beg UNLINED GUTTER
END 8" PPP
CONNECT PPP TO DI
80.06' Rt "A1" 308+33
SWALE FL 422.69
PPP UD FL 420.52
RSP (DETAIL, SEE DD-18)
SEE SHEET D-8
SEE SHEET D-10
REMOVE DI
REMOVE Culv
REMOVE Culv (PORTION)
G2 MH
G2 DI
18" APC
JACKED 36" RCP
36" APC
Dbl 24" APC
G2 DI w/ PCC APRON
GO DI
DRAINAGE PLAN
SCALE: 1'' = 50'
APPROVED FOR DRAINAGE WORK ONLY
FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1
D-9
REGISTERED CIVIL ENGINEER
PLANS APPROVAL DATE
ANALETTE OCHOA
C 55279
Exp 12/31/14
CIVIL
STATE OF CALIFORNIA
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OAKLAND, CA 94612
ALAMEDA COUNTY
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OAKLAND, CA 94607
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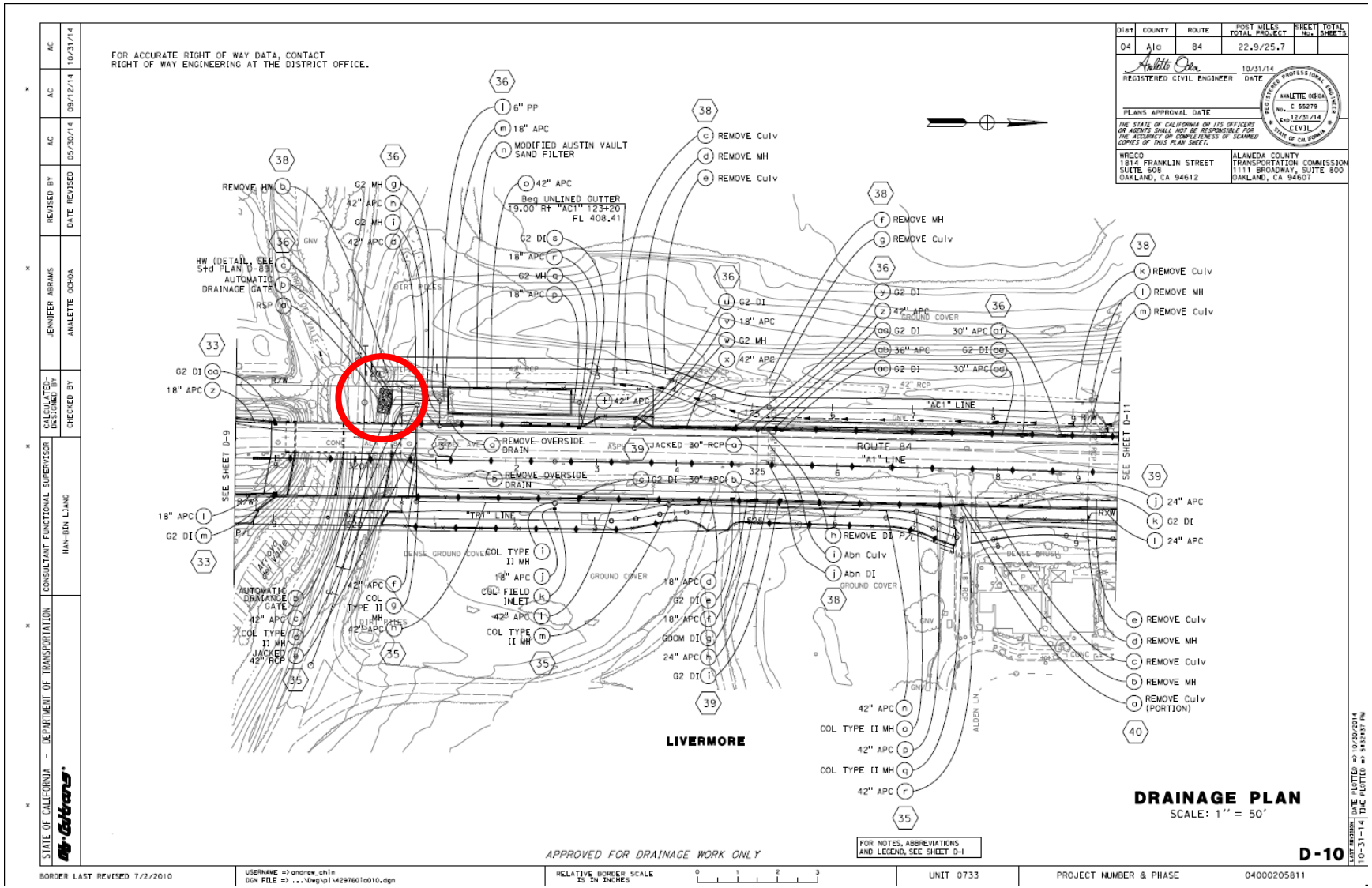
CHECKED BY
JENNIFER ABRAMS
ANALETTE OCHOA
REVISED BY
DATE REVISED
AC
05/30/14
09/12/14
10/31/14
BORDER LAST REVISED 7/2/2010
UNIT 0733
PROJECT NUMBER & PHASE
04000205811


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
REGISTERED CIVIL ENGINEER 10/31/14 DATE
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OAKLAND, CA 94607
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CONSULTANT FUNCTIONAL SUPERVISOR
HAN-GIN LIANG
CALCULATED-DESIGNED BY
JENNIFER ABRAMS
CHECKED BY
ANNALETTE OCHOA
REVISED BY
DATE REVISED
AC 10/31/14
AC 09/12/14
AC 05/30/14
SEE SHEET D-9
SEE SHEET D-11
ROUTE 84
"A1" LINE
"AC1" LINE
"TR1" LINE
LIVERMORE
DRAINAGE PLAN
SCALE: 1'' = 50'
APPROVED FOR DRAINAGE WORK ONLY
FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1
D-10
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PROJECT NUMBER & PHASE 04000205811
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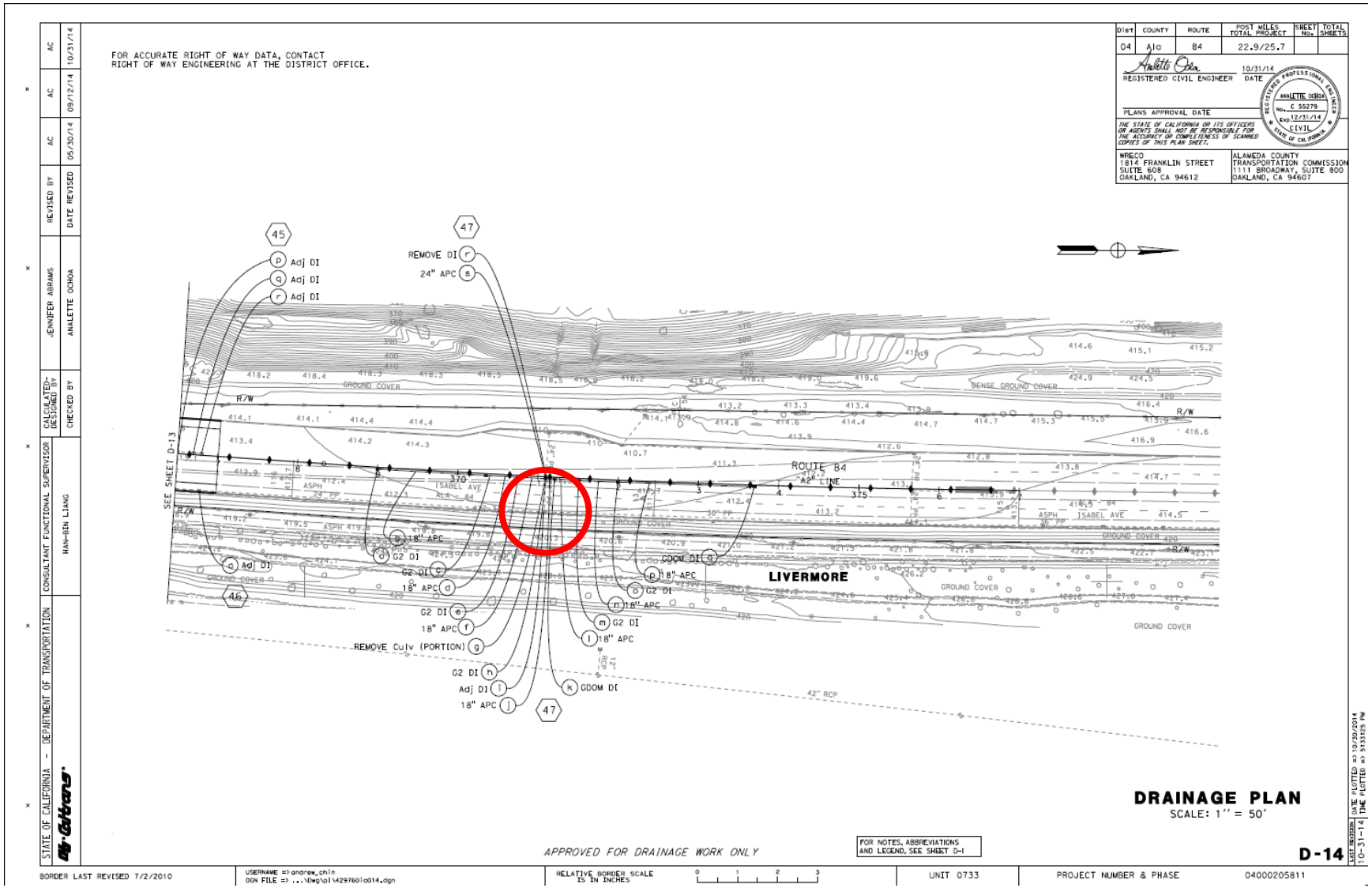
FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.
Dist | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No. | TOTAL SHEETS
04 | Ala | 84 | 22.9/25.7
REGISTERED CIVIL ENGINEER
10/31/14
DATE
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OAKLAND, CA 94607
REVISED BY
DATE REVISED
JENNIFER ABRAMS
ANALETTE OCHOA
05/30/14
09/12/14
10/31/14
CALCULATED-DESIGNED BY
CHECKED BY
CONSULTANT FUNCTIONAL SUPERVISOR
HAN-GIN LIANG
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
SEE SHEET D-13
ROUTE 84
"A2" LINE
LIVERMORE
ISABEL AVE
ASPH
GROUND COVER
DENSE GROUND COVER
R/W
REMOVE Culv (PORTION)
42" RCP
Adj DI
G2 DI
GDOM DI
18" APC
24" APC
REMOVE DI
DRAINAGE PLAN
SCALE: 1'' = 50'
APPROVED FOR DRAINAGE WORK ONLY
FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1
D-14
BORDER LAST REVISED 7/2/2010
USERNAME => andrew_chin
DGN FILE => ...\Dwg\pl\429760lo014.dgn
RELATIVE BORDER SCALE IS IN INCHES
UNIT 0733
PROJECT NUMBER & PHASE
04000205811
DATE PLOTTED => 10/30/2014
TIME PLOTTED => 15:33:25 PM

Storm Water Data Report Amendment Memo - Dated 10/2014

Storm Water Data Report Amendment*

**Note: This cover and signature page is for the Storm Water Data Report Amendment dated 10/31/2014*

Dist-County-Route: 04-Ala-84
Post Mile Limits: 22.9/25.7
Project Type: Expressway Widening
Project ID (or EA): 04-297621 (04000205811)
Program Identification: _____
Phase: ☐ PID ☐ PA/ED ☒ PS&E

Regional Water Quality Control Board(s): San Francisco Bay (2)

Is the Project required to consider 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 30 days prior to the projects RTL date. List RTL Date: _____

Total Disturbed Soil Area: 43.51 acres Risk Level: 2
Estimated: Construction Start Date: 07/20/2015 Construction Completion Date: 06/23/2017
Notification of Construction (NOC) Date to be submitted: 06/2015

Erosivity Waiver	Yes ☐	Date: _____	No ☒
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 date upon which recommendations, conclusions, and decisions are based. Professional Engineer or Landscape Architect stamp required at PS&E.

Analette Ochoa — 10/31/14
Analette Ochoa, P.E., Registered Project Engineer — Date

I have reviewed the stormwater quality design issues and find this report to be complete, current and accurate:

REGISTERED PROFESSIONAL ENGINEER
ANALETTE A. OCHOA
No. 55279
Exp. 12/31/14
CIVIL
STATE OF CALIFORNIA
[Stamp Required for PS&E only]

Issa Bouri — 1/21/2015
Issa Bouri, Project Manager — Date

Robert W. Braga — 1/21/15
Robert Braga, Designated Maintenance Representative — Date

FOR Alex Mcdonald — 1/20/2015
David Yam, Designated Landscape Architect Representative — Date

Jonathan R Wallen (for Norman) — 12/19/2014
Norman Gonsalves, District/Regional Design SW Coordinator or Designee — Date

WRECO

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Walnut Creek, CA 94596
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Fax: 925.941.0018
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Memorandum

Date: October 31, 2014

To: Norman Gonsalves, P.E. – Storm Water Coordinator, Caltrans District 4

From: Analette Ochoa, P.E. – WRECO

Subject: EA 04-297621 State Route 84 Expressway Widening Project – Storm Water Data Report Amendment

---

This memorandum is an amendment to the State Route 84 Expressway Widening Project (EA 04-297601) *Storm Water Data Report* (SWDR). The SWDR was signed by the Registered Project Engineer on 01/18/2011 and received final signatures from the required Caltrans functional units on 02/02/2011. The State Route 84 Expressway Widening Project was split into two segments, from post mile (PM) 25.5/27.1 (EA 04-297611) and from PM 22.9/25.7 (EA 04-297621). EA 04-297611 is currently in construction and EA 04-297621 was put on hold in 2011 and is now currently completing the PS&E phase. This amendment to the SWDR summarizes the design changes to EA 04-297621 since approval of the SWDR.

Section 1. Project Description

The Project Description for EA 04-297621 is as follows:

The State Route (SR) 84 Expressway Widening Project (Project) located in Livermore and Pleasanton in Alameda County, proposes to widen and upgrade 2.8 miles of SR 84 from 0.1 mile south of Ruby Hill Drive to 0.6 mile north of Concannon Boulevard to expressway standards (55 miles per hour [mph]). 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, and Concannon Boulevard will be widened and upgraded to accommodate future traffic movements. A connector access will be constructed at the SR 84/Vallecitos Road intersection to accommodate the high volume of traffic moving from northbound SR 84 to the City of Livermore. 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 southward to Vineyard Avenue. The Project will also construct a new access bridge at Arroyo Del Valle for local utility and maintenance facilities, the Isabel Trail crossing, and widen the existing bridge across Arroyo Del Valle. The Project will construct retaining walls where right-of-way is restricted.

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 4:1 or flatter to provide a clear recovery zone (CRZ) for errant vehicles. Outside the CRZ, side slopes will be 2:1 or flatter. The roadway median area at intersections will be widened up to 36 feet to accommodate left-turn lanes.

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Disturbed Soil and Impervious Areas

The disturbed soil area (DSA) and impervious area values for this Project were re-assessed based on changes to the design since approval of the original parent SWDR. This Project is estimated to result in a total DSA of 43.51 acres. 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. This Project adds 16.97 acres of impervious area and reworks 5.69 acres of impervious area.

Considering both this Project and EA 04-297611, the total added impervious area is 27.28 acres and total reworked impervious area is 9.56 acres. Therefore, the total impervious area required to be treated between both this Project and EA 04-297611 is 36.84 acres.

Section 2. Site Data and Strom Water Quality Design Issues

The following are revisions to the approved SWDR:

303(d) List of Water Quality Limited Segments

The 2010 Clean Water Act Section 303(d) List of Water Quality Limited Segments (303[d] List) lists Arroyo Del Valle as impaired for diazinon, and Arroyo Mocho as impaired for diazinon and water temperature.

Current and Potential Beneficial Uses of Affected Waters

The San Francisco Bay Regional Water Quality Control Board (RWQCB) Basin Plan (2011) lists the following existing (E) and potential (P) beneficial uses for:

Arroyo Del Valle:

- (E) Municipal and Domestic Supply (MUN)
- (E) Groundwater Recharge (GWR)
- (E) Cold Freshwater Habitat (COLD)
- (P) Fish Migration (MIGR)
- (E) Preservation of Rare and Endangered Species (RARE)
- (E) Fish Spawning (SPWN)
- (E) Warm Freshwater Habitat (WARM)
- (E) Wildlife Habitat (WILD)
- (E) Water Contact Recreation (REC-1)
- (E) Non-contact Water Recreation (REC-2)

Arroyo Mocho:

- (E) GWR
- (E) COLD
- (E) MIGR
- (E) SPWN
- (E) WARM
- (E) WILD
- (E) REC-1
- (E) REC-2

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Existing Treatment Best Management Practices and R/W

There are no existing treatment BMPs within Project limits; however, runoff from the northern portion of Project will discharge to an Austin Vault Sand Filter (AVSF) constructed under EA 04-297611.

Section 3. Regional Water Quality Control Board Agreements

The following are revisions to the approved SWDR:

Permit Requirements

A 401 Certification from the San Francisco Bay RWQCB was issued for the greater State Route 84 Expressway Project, which applies to this Project and EA 04-297611, CIWQS Place No. 717494 (BT), 401 Database Site No. 02-01-C0990. The certification was issued on June 15, 2011. The treatment BMP strategy for this Project, including use of AVSFs, was approved under this 401 Certification. The design team submitted to Caltrans an amendment to the 401 Certification in mid-October 2014. The amendment reflects changes to the temporary and permanent impacts as result of alterations in the design of this Project. The amendment is attached to this memorandum.

A 404 Permit from the U.S. Army Corps of Engineers (USACE) and a 1602 Permit from the California Department of Fish and Wildlife was issued for the greater State Route 84 Expressway Project. The 404 permit was issued on April 11, 2011 and 1602 Permit on February 16, 2011.

Section 4. Proposed Design Pollution Prevention BMPs to be used on the Project

The general design pollution prevention BMP strategy for the Project is consistent with the approved SWDR. Revisions to the erosion control measures were primarily due to meeting current Caltrans 2010 standards and current plan development methods.

Section 5. Proposed Permanent Treatment BMPs to be used on the Project

This Project and EA 04-297611 are required to treat a combined 36.84 acres of impervious area. 8.43 acres of impervious area treatment is provided by an Austin Vault Sand Filter constructed under EA 04-297611. The remaining 28.41 acres of impervious area is treated by this Project (Table 1).

There were no revisions to the treatment BMP types feasible for this Project; the Project still uses biofiltration strips and swales, and AVSFs to provide stormwater treatment. There are changes to BMP locations and the amount of impervious area treated by the BMPs (Table 1).

These changes include:

- BMP-1: the biofiltration strip was relocated because the SR-84 proposed alignment was slightly revised to allow for an improved turn lane onto Kalthoff Common.
- BMP-2: the impervious watershed was reduced because additional maintenance vehicle pullouts were placed outside the shoulder, and adequate space is not available to shift the biofiltration strip around these pullouts.

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- BMP-6, BMP-7, and BMP-8 were lengthened so the biofiltration swale area equal s 4% of the impervious area treated by the swale.

For the remainder of the BMPs, the location on plan view did not change; however, there were slight modifications to station location and offset callouts. The watersheds for these BMPs were also revised based on the updated roadway contour grading.

While there were changes to BMP locations and watersheds, the Project still achieves the goal of treating impervious area equal to the combined added and reworked impervious area (Table 1). Watershed maps identifying the impervious area treated by each BMP, including the AVSF constructed under EA 04-297611, is attached to the memorandum

Austin Vault Sand Filters

The AVSF proposed for this segment is designed as an off-line system. Only first-flush flows, or flows resulting in a depth of six inches or less, will flow to the AVSF. Flows greater than six inches will continue through drainage system (DS) 36 and outfall to Arroyo Del Valle. DS 36 is designed assuming no bypass or loss of flow through the system as a result of the AVSF. Hydraulic grade line calculations for DS 36 are attached to this memorandum.

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Table 1. Proposed Treatment BMPs for the Project

		From Approved SWDR (2011)				Current Final PS&E (August 2014)			
BMP ID No.	**Treatment Type**	**Begin Station**	**End Station**	**Rt or Lt**	**Treated Area (ac)**	**Begin Station**	**End Station**	**Rt or Lt**	**Treated Area (ac)**
BMP-1	Biofiltration Strip	"A1" Line 231+00	"A1" Line 233+44	Rt	0.27	Biofiltration Strip Removed and Replaced with:			
						"A1" Line 226+97	"A1" Line 230+49	Lt	0.52
BMP-2	Biofiltration Strip	"A1" Line 235+25	"A1" Line 244+04	Rt	2.09	Biofiltration Strip Segmented from:			
						"A1" Line 235+15	"A1" Line 238+43	Rt	0.88
						"A1" Line 239+16	"A1" Line 242+40	Rt	0.62
						"A1" Line 243+13	"A1" Line 244+56	Rt	0.28
BMP-3	Biofiltration Swale	"VEx" Line 53+76	"VEx" Line 54+59	Lt	0.86	"A1" Line 253+52	"A1" Line 254+24	Rt	0.64
BMP-4	Biofiltration Strip	"VEx" Line 53+47	"VEx" Line 55+74	Lt	0.15	"A1" Line 253+11	"A1" Line 254+84	Rt	0.12
BMP-5	Biofiltration Strip	"V" Line 103+10	"V" Line 109+00	Lt	0.59	"V" Line 103+11	"V" Line 109+00	Lt	0.59
BMP-6	Biofiltration Swale	"V" Line 105+50	"V" Line 107+00	Lt	2.95	"V" Line 105+51	"V" Line 109+50	Lt	2.97
BMP-7	Biofiltration Swale	"A1" Line 299+00	"A1" Line 301+50	Lt	3.10	"A1" Line 298+93	"A1" Line 302+57	Lt	3.10
BMP-8	Biofiltration Swale	"A1" Line 285+14	"A1" Line 287+64	Rt	2.53	"A1" Line 285+07	"A1" Line 288+97	Rt	2.54
BMP-9	Biofiltration Strip	"A1" Line 285+10	"A1" Line 312+19	Rt	3.52	"A1" Line 285+16	"VIN" Line 21+92	Rt	3.51
BMP-10	Biofiltration Swale	"A1" Line 296+04	"A1" Line 298+04	Rt	1.12	"A1" Line 295+96	"A1" Line 298+11	Rt	1.12
BMP-11	Biofiltration Swale	"A1" Line 301+04	"A1" Line 302+54	Rt	0.52	"A1" Line 300+96	"A1" Line 302+62	Rt	0.53
BMP-12	Biofiltration Swale	"A1" Line 306+75	"A1" Line 308+25	Rt	0.61	"A1" Line 306+69	"A1" Line 308+33	Rt	0.61
BMP-13	Austin Vault Sand Filter	"A1" Line 321+15	"A1" Line 322+67	Lt	10.36	"A1" Line 321+15	"A1" Line 322+67	Lt	10.59
BMP-14	Austin Vault Sand Filter (EA 04-297614)	"A2" Line 390+14	"A2" Line 391+15	Rt	8.43	"A2" Line 390+12	"A2" Line 391+15	Rt	8.43
			Total Proposed Treatment:		37.10		Total Proposed Treatment:		37.05
				Goal:	37.05			Goal:	36.84
			Percent Treatment:		100%		Percent Treatment:		101%

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Section 6. Proposed Temporary Construction Site BMPs to be used on the Project

The only revision to this section is to the risk level (RL) determination and temporary creek diversion system for the widening of the existing SR 84 bridge and construction of the new access road bridge over Arroyo Del Valle. The general temporary construction site BMP strategy for the Project is consistent with the approved SWDR.

Temporary Creek Diversion System

A temporary creek diversion system is required for this Project at Arryo Del Valle. The temporary creek diversion system is necessary for the widening of the existing SR 84 bridge and construction of the new access road bridge over the arroyo. Work within Arroyo Del Valle is scheduled to be completed during Stage 1 and is limited to one construction season within the period from June 15 to October 1. Flows within Arroyo Del Valle during the allowable work period are mainly a result of releases from the Zone 7 Water Agency. The maximum expected flows identified by the agency are 50 cubic feet per second, which is reflected in the meeting notes attached to this memorandum.

A conceptual temporary creek diversion system is shown on drainage detail 30 (DD-30) of the contract plans. The Contractor is responsible for developing the temporary creek diversion system to be used on-site based on physical site conditions, proposed work, and order of work. The temporary creek diversion system developed by the Contractor will be submitted to the Resident Engineer for Caltrans and Regional Water Quality Control Board comments and approval.

Construction General Permit

The overall RL for the Project, RL 2, did not change from what is shown in the approved SWDR; however, the method of RL determination has since changed, and is as follows:

Sediment Risk

The rainfall runoff erosivity factor (R) of **78.54** was determined from the United States EPA's "Rainfall Erosivity Factor Calculator for Small Construction Sites" (Figure 1).

The K factors for the soils within the Project were obtained from the Natural Resources Conservation Service "Web Soil Survey" (Figure 2 and Figure 3). The weighted-average K value for this Project was calculated to be **0.30**.

The length-slope factor (LS) of **0.53** was determined by using the Topography Tool developed by Caltrans (Table 2).

Based on these factors, the rate of sheet and rill erosion (A) is **12** tons per acre. Because this value is less than 15, the Project is classified as having a **LOW** sediment risk (Table 3).

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LEW Results

Rainfall Erosivity Factor Calculator for Small Construction Sites

Facility Information

Start Date:	07/20/2015
End Date:	06/23/2017
Latitude:	37.6462
Longitude:	-121.7866

Erosivity Index Calculator Results

AN EROSIVITY INDEX VALUE OF 78.54 HAS BEEN DETERMINED FOR THE CONSTRUCTION PERIOD OF 07/20/2015 - 06/23/2017.

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.

Figure 1. Rainfall Erosivity Factor Source: U.S. EPA

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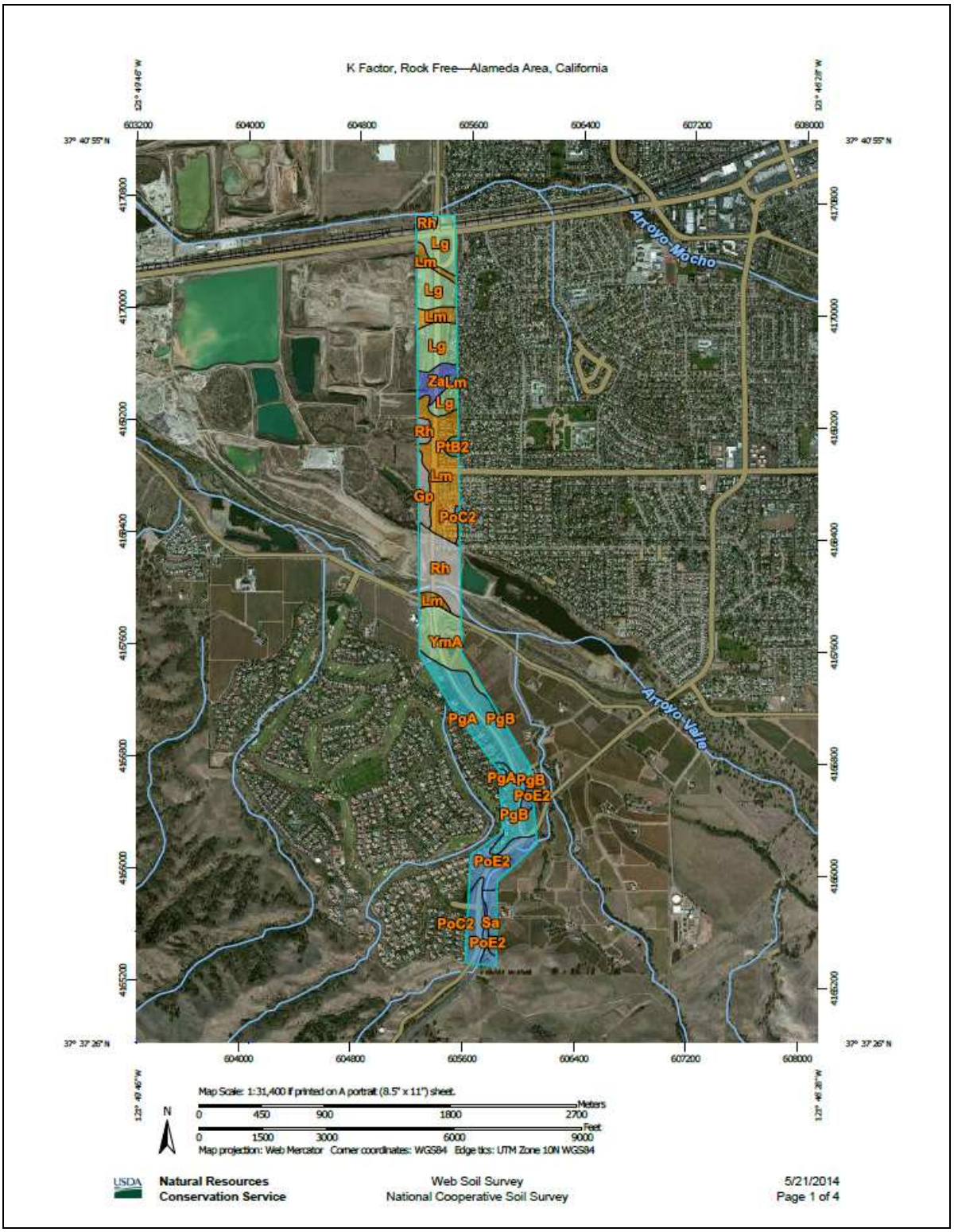

Figure 2. Soil Map

Source: Natural Resources Conservation Service

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K Factor, Rock Free— Summary by Map Unit — Alameda Area, California (CA609)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
Gp	Gravel pit		9.4	2.6%
Lg	Livermore gravelly loam	.28	67.2	18.2%
Lm	Livermore very gravelly coarse sandy loam	.10	64.6	17.5%
PgA	Pleasanton gravelly loam, 0 to 3 percent slopes	.37	53.4	14.5%
PgB	Pleasanton gravelly loam, 3 to 12 percent slopes	.37	25.2	6.8%
PoC2	Positas gravelly loam, 2 to 20 percent slopes, eroded	.43	21.2	5.7%
PoE2	Positas gravelly loam, 20 to 40 percent slopes, eroded	.43	29.5	8.0%
PtB2	Positas gravelly loam, thick surface, 2 to 10 percent slopes, eroded	.37	3.0	0.8%
Rh	Riverwash		42.0	11.4%
Sa	San Ysidro loam	.43	8.0	2.2%
YmA	Yolo loam, 0 to 3 percent slopes	.28	32.3	8.7%
Za	Zamora silt loam, 0 to 4 percent slopes	.49	13.1	3.6%
Totals for Area of Interest			**368.9**	**100.0%**

Figure 3. K Factor Summary Source: Natural Resources Conservation Service

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Table 2. Project LS Factor

Number of X-Sections = 37

Alignment		Number of	Slope Segment 1				Slope Segment 2				Slope Segment 3				Slope Segment 4				Slope Segment 5				Slope Segment 6				Weighted Average for All segments	
Station	Line	Segments	Length	Rise	Steepness	LS	Length	Rise	Steepness	LS	Length	Rise	Steepness	LS	Length	Rise	Steepness	LS	Length	Rise	Steepness	LS	Length	Rise	Steepness	LS	Total Slope Length	Weighted LS
			(ft)	(ft)	(%)		(ft)	(ft)	(%)		(ft)	(ft)	(%)		(ft)	(ft)	(%)		(ft)	(ft)	(%)		(ft)	(ft)	(%)		(ft)	
227+00	A1	5	4.24	0.67	15.85	0.43	2.45	0.14	5.79	0.25	1.58	0.91	57.49	0.62	4.86	2.00	41.16	0.74	9.60	2.00	20.84	0.71		0.00	N/A	0.00	22.730	0.61
237+00	A1	4	24.85	1.62	6.53	0.38	30.04	13.50	44.94	3.07	13.87	0.62	4.45	0.21	14.24	1.08	7.61	0.31		0.00	N/A	0.00		0.00	N/A	0.00	82.999	1.31
247+00	A1	3	46.79	14.88	31.81	3.22	10.06	0.27	2.64	0.16	40.85	2.95	7.22	0.56		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	97.700	1.79
257+00	A1	6	25.56	10.00	39.12	2.40	14.25	1.43	10.04	0.40	56.50	1.30	2.31	0.25	9.70	0.33	3.43	0.18	34.14	13.20	38.65	2.98	14.05	0.50	3.58	0.19	154.193	1.22
267+00	A1	3	8.80	2.04	23.13	0.74	12.83	0.25	1.94	0.13	22.85	1.01	4.41	0.27		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	44.472	0.32
277+00	A1	3	3.98	0.01	0.35	0.06	33.17	1.44	4.34	0.32	4.54	1.51	33.22	0.63		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	41.686	0.33
287+00	A1	6	4.46	0.19	4.35	0.21	4.59	1.38	29.99	0.61	4.22	1.18	28.06	0.56	16.65	0.09	0.56	0.07	21.51	0.24	1.13	0.10	4.34	0.17	3.92	0.20	55.767	0.19
297+00	A1	4	3.83	0.03	0.78	0.08	6.09	0.46	7.55	0.31	11.00	0.13	1.18	0.10	30.02	0.69	2.30	0.19		0.00	N/A	0.00		0.00	N/A	0.00	50.940	0.17
307+00	A1	5	7.56	0.14	1.85	0.12	12.23	1.12	9.16	0.36	4.24	0.28	6.60	0.28	8.46	1.51	17.85	0.59	31.05	0.65	2.09	0.18		0.00	N/A	0.00	63.540	0.27
317+00	A1	4	10.19	3.80	37.29	1.16	18.80	3.89	20.69	1.03	8.20	3.87	47.20	1.17	18.39	0.60	3.26	0.19		0.00	N/A	0.00		0.00	N/A	0.00	55.580	0.80
327+00	A1	4	28.59	0.00	0.02	0.05	14.12	3.19	22.59	0.92	15.41	3.86	25.05	1.06	41.33	0.14	0.34	0.06		0.00	N/A	0.00		0.00	N/A	0.00	99.450	0.34
337+00	A1	6	30.54	0.32	1.05	0.11	13.03	2.10	16.12	0.64	17.31	10.33	59.68	2.45	16.44	0.25	1.52	0.11	4.43	0.40	9.03	0.34	6.15	1.64	26.67	0.68	87.900	0.70
345+00	A1	2	49.26	3.75	7.61	0.66	33.33	0.60	1.80	0.16		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	82.590	0.46
364+00	A2_A	2	7.65	0.00	N/A	0.00	11.21	0.33	2.94	0.17		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	18.860	0.10
374+00	A2_A	4	13.40	0.00	N/A	0.00	2.89	0.49	16.96	0.39	1.75	0.00	N/A	0.00	2.77	0.66	23.83	0.44		0.00	N/A	0.00		0.00	N/A	0.00	20.810	0.11
384+00	A2_A	1	17.61	0.61	3.46	0.20		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	17.610	0.20
392+00	A2_A	2	36.30	7.26	20.00	1.63	18.31	-0.22	-1.20	0.05		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	54.610	1.10
393+00	A2_A	2	5.75	0.12	2.09	0.13	4.15	0.89	21.45	0.48		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	9.900	0.28
346+00	A2_B	2	8.51	0.01	0.12	0.05	4.16	0.25	6.01	0.26		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	12.670	0.12
356+00	A2_B	3	6.52	0.10	1.53	0.11	6.79	1.39	20.47	0.60	8.96	0.69	7.70	0.31		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	22.270	0.34
366+00	A2_B	2	4.40	0.40	9.09	0.34	14.20	0.08	0.56	0.07		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	18.600	0.14
395+00	A3_A	4	6.58	3.97	60.33	1.15	23.55	9.87	41.91	2.38	24.41	2.74	11.22	0.64	33.05	0.69	2.09	0.18		0.00	N/A	0.00		0.00	N/A	0.00	87.590	0.97
405+00	A3_A	2	13.82	0.47	3.40	0.18	10.39	0.46	4.43	0.21		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	24.210	0.20
413+50	A3_A	5	29.10	0.03	0.10	0.05	12.73	2.70	21.21	0.82	40.48	0.25	0.62	0.09	3.06	0.12	3.92	0.20	8.14	0.25	3.07	0.17		0.00	N/A	0.00	93.510	0.19
423+00	A3_A	2	5.29	0.32	6.05	0.26	13.25	0.11	0.83	0.08		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	18.540	0.13
433+00	A3_A	1	21.89	0.13	0.59	0.08		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	21.890	0.08
443+00	A3_A	1	20.80	0.48	2.31	0.16		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	20.800	0.16
122+00	AC1_A	1	15.69	0.07	0.45	0.07		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	15.690	0.07
133+00	AC1_A	4	3.99	0.13	3.26	0.18	24.49	3.06	12.49	0.73	5.43	1.57	28.91	0.66	11.55	5.31	45.97	1.48		0.00	N/A	0.00		0.00	N/A	0.00	45.460	0.86
143+00	AC1_A	3	29.75	0.48	1.61	0.14	10.36	3.15	30.41	1.00	6.39	3.53	55.24	1.07		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	46.500	0.46
153+00	AC1_A	5	9.24	0.16	1.73	0.12	16.71	5.35	32.02	1.42	17.56	11.49	65.43	2.49	26.56	12.99	48.91	2.99	14.39	0.27	1.88	0.13		0.00	N/A	0.00	84.460	1.77
162+00	AC1_A	3	10.87	0.17	1.56	0.11	7.15	1.68	23.50	0.67	16.12	7.58	47.02	1.92		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	34.140	1.08
95+00	ST_A	6	50.51	0.41	0.81	0.11	16.48	1.35	8.19	0.35	7.95	2.62	32.96	0.90	14.57	7.14	49.00	1.84	10.62	5.05	47.55	1.42	4.51	1.00	22.17	0.51	104.640	0.60
103+00	V_B	2	18.64	4.06	21.78	1.07	8.28	2.24	27.05	0.80		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	26.920	0.99
113+00	V_B	2	4.10	1.64	40.00	0.65	9.75	0.64	6.56	0.28		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	13.850	0.39
53+30	VEX_B	2	72.36	2.72	3.76	0.43	66.76	4.73	7.09	0.75		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	139.120	0.59
18+70	VIN_B	3	34.70	0.09	0.26	0.05	3.08	0.17	5.52	0.25	1.85	0.12	6.49	0.27		0.00	N/A	0.00		0.00	N/A	0.00		0.00	N/A	0.00	39.630	0.08
																								Area Weighted LS =			0.53
																								(Composite Weighted LS / Number of X-Sections)			

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Table 3. Sediment Risk Factor Worksheet

Sediment Risk Factor Worksheet	Entry
A) R Factor	
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.	
http://cfpub.epa.gov/npdes/stormwater/LEW/lewCalculator.cfm	
R Factor Value	78.54
B) K Factor (weighted average, by area, for all site soils)	
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.	
Site-specific K factor guidance	
K Factor Value	0.30
C) LS Factor (weighted average, by area, for all slopes)	
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.	
LS Table	
LS Factor Value	0.53
Watershed Erosion Estimate (=RxKxLS) in tons/acre	12
Site Sediment Risk Factor Low Sediment Risk: < 15 tons/acre Medium Sediment Risk: >=15 and <75 tons/acre High Sediment Risk: >= 75 tons/acre	**Low**

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Receiving Water Risk

The receiving water risk for discharges to Arroyo Del Valle is **LOW** because it is not on the 303(d) List as impaired for sediment, does not have an approved TMDL for sediment, and does not have the combined existing beneficial uses of SPWN, COLD, and MIGR (Table 4).

Table 4. Receiving Water Risk Factor Worksheet for Arroyo Del Valle

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 visit the link below) or has a **USEPA approved TMDL implementation plan for sediment**?:	**No**	**Low**
http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml		
OR		
A.2. Does the disturbed area discharge to a waterbody with designated beneficial uses of SPAWN & COLD & MIGRATORY? (For help please review the appropriate Regional Board Basin Plan)		
http://www.waterboards.ca.gov/waterboards_map.shtml		

The receiving water risk for discharges to Arroyo Mocho is **HIGH** because it has the combined existing beneficial uses of SPWN, COLD, and MIGR (Table 5).

Table 5. Receiving Water Risk Factor Worksheet for Arroyo Mocho

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 visit the link below) or has a **USEPA approved TMDL implementation plan for sediment**?:	**Yes**	**High**
http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml		
OR		
A.2. Does the disturbed area discharge to a waterbody with designated beneficial uses of SPAWN & COLD & MIGRATORY? (For help please review the appropriate Regional Board Basin Plan)		
http://www.waterboards.ca.gov/waterboards_map.shtml		

Project Risk Level

Based on the low sediment risk and low receiving water risk, areas discharging to Arroyo Del Valle can be classified as needing to comply with RL 1 requirements (Table 6). Based on low sediment risk and high receiving water risk, areas discharging to Arroyo Mocho can be classified as needing to comply with RL 2 requirements (Table 7). To maintain consistency throughout the Project and to ensure best efforts are taken to protect water quality, this Project is classified **RL 2**.

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Table 6. Combined Risk Level Matrix for Arroyo Del Valle

Combined Risk Level Matrix				
		Sediment Risk		
		Low	Medium	High
Receiving Water Risk	Low	Level 1	Level 2	
	High	Level 2		Level 3
	Project Sediment Risk:		Low	
	Project RW Risk:		Low	
	Project Combined Risk:		Level 1	

Table 7. Combined Risk Level Matrix for Arroyo Mocho

Combined Risk Level Matrix				
		Sediment Risk		
		Low	Medium	High
Receiving Water Risk	Low	Level 1	Level 2	
	High	Level 2		Level 3
	Project Sediment Risk:		Low	
	Project RW Risk:		High	
	Project Combined Risk:		Level 2	

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Section 7. Maintenance BMPs

There are no revisions to this section.

Attachments

1. Copy of approved *Storm Water Data Report* signature page
2. Storm Water BMP Cost Summary
3. 401 Certification Amendment
4. Water Quality Permits (401 Certification, 1602 Permit, and 404 Permit)
5. Treatment BMP Watershed Maps
6. Treatment BMP Calculations
7. Drainage System 36 Hydraflow Results
8. Meeting notes identifying flows for temporary creek diversion system
9. Austin Vault Sand Filter plans from EA 04-297611
10. Pump Station watershed maps from EA 04-297611

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Attachment 1

Storm Water Data Report

Caltrans

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:

Issa Bouri — 2/1/11
Issa Bouri, *Project Manager* — Date

Robert D. Braga — 2/1/11
Bob Braga, *Designated Maintenance Representative* — Date

FOR — 2/2/11
David Yam, *Designated Landscape Architect Representative* — Date

Norman Gonsalves — 02/01/2011
Norman Gonsalves *District/Regional SW Coordinator or Designee* — Date

REGISTERED PROFESSIONAL ENGINEER
ANALETTE A. OCHOA
No. 55279
Exp. 12/31/12 STAMP
CIVIL
STATE OF CALIFORNIA
[Required for PS&E only]

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Attachment 2 - Storm Water BMP Cost Summary

PRELIMINARY SCHEDULE OF PRICES AND QUANTITIES FOR BMP ITEMS
Route 84 Isabel Widening Project - South Segment
Final PS&E Submittal
30-Oct-14

Item No.	Item Code		Item Description	Unit	Estimated Quantity	Unit Price	Item Total
1	130100		Job Site Management	LS	1	300,000.00	300,000.00
2	130810A		Dewatering and Non Storm Water Discharge System	LS	1	80,000.00	80,000.00
3	130300		Prepare Storm Water Pollution Prevention Plan	LS	1	15,000.00	15,000.00
4	130730		Street Sweeping	LS	1	20,000.00	20,000.00
5	066595		Water Pollution Control Maintenance Sharing	LS	1	76,000.00	76,000.00
6	066596		Additional Water Pollution Control	LS	1	62,500.00	62,500.00
7	066597		Storm Water Sampling and Analysis	LS	1	16,500.00	16,500.00

Temporary Water Pollution Control Items

1	130310		Rain Event Action Plan	EA	90	$ 500.00	$ 45,000
2	130320		Storm Water Sampling and Analysis Day	EA	55	$ 1,100.00	$ 60,500
3	130330		Storm Water Annual Report	EA	3	$ 2,000.00	$ 6,000
4	130505		Move-in/Move-Out (Temporary Erosion Control)	EA	22	$ 860.00	$ 18,920
5	130530		Temporary Hydraulic Mulch (Bonded Fiber Matrix)	SQYD	60,200	$ 1.00	$ 60,200
6	130570		Temporary Cover	SQYD	810	$ 3.00	$ 2,430
7	130610		Temporary Check Dam	LF	250	$ 6.50	$ 1,625
8	130620		Temporary Drainage Inlet Protection	EA	160	$ 150.00	$ 24,000
9	130640		Temporary Fiber Roll	LF	11,400	$ 3.00	$ 34,200
10	130670		Temporary Reinforced Silt Fence (Type 1)	LF	23,700	$ 8.00	$ 189,600
11	130710		Temporary Construction Entrance	EA	20	$ 2,450.00	$ 49,000
12	130900		Temporary Concrete Washout	LS	1	$ 50,000.00	$ 50,000

Erosion Control Items

1	210010		Move-in/Move-Out (Erosion Control)	EA	13	$ 800.00	$ 10,400
2	210270		Rolled Erosion Control Product (Netting)	SQFT	149,000	$ 0.25	$ 37,250
3	210300		Hydromulch	SQFT	632,000	$ 0.10	$ 63,200
4	210350		Fiber Rolls	LF	12,400	$ 3.00	$ 37,200
5	210420		Straw	SQFT	483,000	$ 0.05	$ 24,150
6	210430		Hydroseed	SQFT	632,000	$ 0.10	$ 63,200
7	210600		Compost	SQFT	632,000	$ 0.25	$ 158,000
8	210630		Incorporate Materials	SQFT	101,000	$ 1.00	$ 101,000

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Attachment 3 – 401 Certification Amendment

DEPARTMENT OF TRANSPORTATION
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Flex your power!
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October 16, 2014

Mr. Bruce H. Wolfe
Executive Officer
California Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA 94612

Attn: Derek Beauduy, Environmental Specialist

Subject: Amendment to the Water Quality Certification for the State Route 84 Expressway Widening Project, City of Livermore, Alameda County (02-01-C0990)

Dear Mr. Beauduy:

The San Francisco Bay Regional Water Quality Control Board (RWQCB) issued a Water Quality Certification to the California Department of Transportation (Caltrans) for the proposed State Route (SR) 84 Expressway Widening Project (project) on June 15, 2011 (02-01-C0990). On January 24, 2013, Caltrans requested an amendment to the Water Quality Certification due to modifications of the proposed action after the completion of consultation. These modifications were a result of changes in the project footprint and proposed dewatering activities in Arroyo Mocho and Arroyo del Valle that will be needed to complete project construction. On May 9, 2013, the RWQCB gave Caltrans permission via email to continue work at the Arroyo Mocho while they reviewed and amended the existing Water Quality Certification. In January 2014, Caltrans and Alameda County Transportation Commission (Alameda CTC) met with the RWQCB to discuss the mitigation for impacts to Waters of the State.

Enclosed is the new amendment request that includes additional changes in the proposed project design and mitigation that were made after the submittal of the January 2013 amendment request. To prevent a delay in the current construction schedule, Caltrans requests that the amendment to the Water Quality Certification be issued by December 31, 2014.

The following project permits and authorizations are also being updated to reflect the changes in project design:

- Amended jurisdictional delineation from the U.S. Army Corps of Engineers (USACE), dated April 10, 2013 (2008-00396S).
- New Nationwide Permit from the USACE, dated May 20, 2013 (SPN-2008-00396S).
- New Lake and Streambed Alteration Agreement Operation-of-Law letter from the California Department of Fish and Game, dated March 20, 2013 (1600-2012-0433-R3).

Changes in the Proposed Project Design

Changes in the proposed project design are summarized in the revisions listed below and shown in the revised impact figures (Figures 1A and 1B).

Water Diversion at Arroyo Mocho

A stream diversion system is proposed for the Arroyo Mocho access bridge construction to address the possibility of Zone 7 Water Agency releasing water into the arroyo during construction. Construction activity in Arroyo Mocho will begin with construction of the temporary stream diversion-dewatering plan. The stream diversion plan will include installing a cofferdam of gravel-filled bag berms or bladder dams within the existing creek bed approximately 28 feet upstream and 267 feet downstream of the eastern side of the existing bridge deck. The gravel-filled bag berms or bladder dam will allow water in the creek to pass through the construction work area by gravity flow through two 30-inch pipes. The berms or dams will be constructed across the extent of the channel up to the ordinary high water level of the streambed. Supports for falsework will be installed in Arroyo Mocho after the stream diversion-dewatering plan has been implemented. Work platforms needed for machinery to work around the falsework would be placed mostly on rock slope areas of the banks, and part of the bed. A plastic liner and a thin soil layer would separate the rock slope and the platform. On completion of the Arroyo Mocho access bridge, the upstream and downstream berms or bladder dams and pipes will be removed, and the creek flow will be restored to preconstruction conditions.

Once the stream diversion-dewatering plan has been implemented, bridge foundation construction will proceed. Construction will involve installation of shoring followed by excavation to the required footing depth. If seepage of water into the excavations occurs, a submersible 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 the water that is pumped from the excavated footings.

Water Diversion at Arroyo del Valle

A stream diversion system is proposed at Arroyo del Valle for widening the existing bridge and installing a new two-span bridge to accommodate the Isabel Trail extension. Construction for both bridges in the Arroyo del Valle creek area (including deck falsework) will be limited to the designated dry season. 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 of Arroyo del Valle. Temporary supports for falsework will be installed in Arroyo del Valle after a stream diversion-dewatering plan has been implemented. Temporary work pads will be constructed in the dewatered areas. Prior to construction, the design of the temporary work pad will be submitted to the RWQCB for review. The stream diversion plan will include installing a cofferdam of gravel-filled bag berms or bladder dams within the existing creek bed approximately 145 feet upstream and 65 feet downstream of the eastern side of the existing bridge deck. The gravel-filled bag berms or bladder dam will allow creek waters to pass through the construction work area by gravity flow through the use of two 36-inch pipes. The berms or dams will be constructed across the extent of the channel up to approximately the ordinary high water level of the streambed. Once temporary falsework supports are installed, construction work within Arroyo del Valle will be very limited. Bridge foundation construction will involve installation of shoring followed by excavation to the required footing depth and will be constructed during one dry season. 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.

On completion of the Arroyo del Valle Bridge and the Isabel Trail Bridge, the upstream and downstream berms or bladder dams and pipes will be removed and the creek flow will be restored to preconstruction

conditions. Construction activities in Arroyo del Valle will be limited to between June 15 and October 15.

Biofiltration Features

As mitigation for increased pollutant loads associated with impervious areas, Caltrans will provide treatment of stormwater runoff from the 36.84 acres of impervious area using seven biofiltration strips, seven bioretention swales, and two bioretention vaults.

The biofiltration strips and bioretention swales would be within the project limits, between the southwest corner of the proposed SR 84/Ruby Hill Drive intersection and the southeast corner of the SR 84/Vineyard Avenue intersection. Each biofiltration swale has been designed to Caltrans standards and complies with Caltrans BMPs. The swales would be trapezoidal in shape and composed of the following construction materials: imported soil media, permeable material, underdrain, compost, rolled erosion control product (netting), hydroseed, and hydromulch. Biofiltration strips would be made of layers of compost, hydroseed, straw and hydromulch.

Two Austin Vault Sand Filter structures are proposed to be constructed also within the project limits: one northwest of the Arroyo del Valle bridge widening area, and one southeast of the SR 84/Stanley Connector intersection.

Changes in Impacts to Waters of the State

Temporary and Permanent Impacts

The project would have a total of 1.682 acres of impacts to Waters of the State (including wetlands). This includes 1.168 acres of temporary impacts and 0.514 acre of permanent impacts. Tables 1 and 2 present the original and revised temporary and permanent impacts to Waters of the State. Changes in the project impacts are shown in Tables 1 and 2 as track changes.

At the Arroyo Mocho (OW-1 on Sheet 1 of Figures 1A and 1B), temporary and permanent impacts would occur as a result of the stream diversion upstream and downstream of the existing bridge, the construction of extension support walls (bents) for the large culvert conveying the drainage under SR 84, installation of temporary work platforms, installation of temporary falsework, and construction of walls and footings into the edge of the streambed just west and downstream of the water crossing.

Temporary and permanent impacts associated with the work at Arroyo del Valle (WL-2 on Sheet 2 of Figures 1A and 1B) will include a stream diversion upstream and downstream of the existing bridge, and permanent fill and construction work within a portion of an outfall channel associated with a culverted roadside ditch (Ephemeral Drainage OW-3 on Sheet 2 of Figures 1A and 1B) that drains 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 the Isabel Trail Bridge on the upstream (eastern) side of SR 84 and the upstream extension of the bent under the SR 84 bridge.

North of the SR 84 bridge crossing over Arroyo del Valle, there is an existing 42-inch culvert combining flows from the City of Livermore and highway runoff from the existing SR 84 drainage system. This 42-inch culvert currently discharges into Arroyo del Valle on the west side (downstream end) of the bridge. The project proposes to separate the city flows from Caltrans' highway runoff via two parallel pipes. The project proposes 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 inches. An alternative culvert (APC) is proposed with a new headwall, flap gate, and rock slope protection. This would have temporary impacts in the creek as well as permanent fill.

Caltrans highway runoff would discharge at the same location as the existing 42-inch 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.

Two 1-foot-wide ephemeral roadside drainage ditches (OW-5 and OW-6; sheets 2-4 of Figures 1A and 1B) that drain to the south side of Arroyo del Valle and 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 current upland areas to replace the function of OW-5 and OW-6.

The roadway widening at the southernmost 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. A portion of the culverted intermittent drainage (OW-4) that drains WL-5 under SR 84 to WL-6 (sheets 5 and 6 of Figures 1A and 1B) will be removed and replaced.

The roadway widening at the SR 84/Vineyard Avenue intersection will result in the permanent fill of a culverted ephemeral drainage (OW-7 on Sheet 2 of Figures 1A and 1B).

Table 1: Changes in Temporary Impacts to Waters of the State

	Map Page Number and Sheet	Activity	Jurisdictional Feature Impacted (Feature ID)	Impacts per the Issued Water Quality Certification		Revised	
				acres	linear feet	acres	linear feet
1	Figure 1A, sheet 1	Construction access for support wall extensions ~~on downstream side of overpass~~, **new access bridge, replacement of existing riprap, work platforms and water diversion.**	Arroyo Mocho[1] (OW-1)	0.084	140	**0.579**	**294.12**
2	Figure 1A, sheet 2	Construction access for widening of SR 84 overpass on upstream side	Arroyo del Valle[1] (WL-2)	0.035	150		
3	Figure 1A, sheet 2	Construction access for construction of new Isabel Trail Bridge, replacement of existing riprap associated with new trail bridge upstream of SR 84	Arroyo del Valle[1] (WL-2)	0.030	130		
4	Figure 1A, sheet 2	Construction access ~~and possible~~ creek diversion ~~for construction of new outfall~~	Arroyo del Valle[1] (WL-2)	0.009	101	**0.58**	**284.02**
5	Figure 1A, sheet 2	Construction access for modification of existing roadside runoff outfall channel	Ephemeral tributary to Arroyo del Valle (OW-3)	0.001	4.5	**0.003**	
6	Figure 1A, sheets 2-4	Construction of roadside ditch	Roadside drainage (OW-5)	0.005	225	**0**	
7		~~Construction access for new access bridge~~	~~Arroyo Mocho[1] (OW-1)~~	0.05	125	**Impacts included in the revised impacts shown for item number 1.**	
8	Figure 1A, sheet 2	Replacement of existing riprap underneath and downstream of SR 84 to accommodate widening of overpass	Arroyo del Valle[1] (WL-2)	0.090	103	**Replacement riprap is included in the quantity noted above in number one.**	
9	Figure 1A, sheet 2	Replacement of existing riprap associated with ~~near trail bridge~~ **Isabel Trail Bridge** upstream of SR 84	Arroyo del Valle[1] (WL-2)	0.060	47		
10		~~Replacement of existing riprap associated with new trail bridge downstream of SR 84~~	~~Arroyo Mocho[1] (OW-1)~~	0.051	46	**Impacts included in the revised impacts shown for item number 1.**	
11	**Figure 1A, sheet 6**	**Cleaning of Culvert**	**Intermittent drainage (OW-4)**	**0**	**0**	**0.006**	**83.00**
		Total		**0.415**	**1071.50**	**1.168**	**670.42**

Source: URS 2012

1. Due to changes in the project design, dewatering activities at Arroyo del Valle and Arroyo Mocho will occur in areas that are outside the jurisdictional delineation maps. On April 10, 2013, the USACE issued an amendment to the jurisdictional delineation maps showing the correct location of these features. The impacts for Arroyo del Valle and Arroyo Mocho are based on the revised delineated area.

Table 2: Changes in Permanent Impacts to Waters of the State

	Map Page Number and Sheet	Activity	Jurisdictional Feature Impacted (Feature ID)	Impacts per the Issued Water Quality Certification		Revised	
				acres	linear feet	acres	linear feet
1	Figure 1B, sheet 1	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[1] (OW-1)	0.018[2]	125	**0.005**	**70.68**
2	Figure 1B, sheet 2	~~Fill due to~~ Construction of pier, **abutments,** 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[1] (WL-2)	0.002	111	**0.063**	**116.30**
3	Figure 1B, sheet 2	~~Fill due to~~ Placement of abutments associated with ~~bridge~~ **Isabel Trail Bridge** upstream of SR 84	Arroyo del Valle[1] (WL-2)	0.001	18	**0.017**	**20.20**
4	Figure 1B, sheet 2	Construction of new outfall	Arroyo del Valle[1] (WL-2)	0.009	87	**0.020**	**35.22**
5	Figure 1B, sheet 2	Shading of channel and loss of willow riparian habitat due to construction of the Isabel Trail Bridge	Arroyo del Valle[1] (WL-2)	0.070	19	**0.037**	**18.50**
6	Figure 1B, sheet 1	Shading of channel due to construction of the access bridge	Arroyo Mocho[1] (OW-1)	0.050	19	**0.045**	**18.50**
7	Figure 1B, sheet 2	Modification of existing roadside runoff outfall channel	Ephemeral tributary to Arroyo del Valle (OW-3)	0.008	25	**0.008**	**20.81**
8	Figure 1B, sheet 6	Fill due to roadway widening	Seasonal wetland (WL-5)	0.115	0	**0.115**	**716.99**
9	Figure 1B, sheet 6	Culvert extension to accommodate roadway widening	Intermittent drainage (OW-4)	0.005	74	**0**	**0**
10	Figure 1B, sheets 2-4	Fill due to roadway widening	Ephemeral roadside drainage (OW-5)	0.030	0	**0.055**	**2340.88**
11	Figure 1B, sheets 2-4	Fill due to roadway widening	Ephemeral roadside drainage (OW-6)	0.008	0	**0.046**	**2149.01**
12	**Figure 1B, sheet 1**	**Construction associated with the abutements of maintenance bridge**	**Arroyo Mocho (OW-1)**	**0**	**0**	**0.009**	**22.60**
13	**Figure 1B, sheet 2**	**Remove Culvert**	**Culverted ephemeral drainage (OW-7)[3]**	**0**	**0**	**0.008**	**244.28**
14	**Figure 1B, sheet 2**	**Shading of channel and loss of willow riparian habitat due to the construction of widened overpass**	**Arroyo del Valle[1] (WL-2)**	**0**	**0**	**0.086**	**53.42**
		Total		**0.316**	**478**	**0.514**	**5827.39**

Source: URS 2012

1. Due to changes in the project design, dewatering activities at Arroyo del Valle and Arroyo Mocho will occur in areas that are outside the jurisdictional delineation maps. On April 10, 2013, the USACE issued an amendment to the jurisdictional delineation maps. . The impacts for Arroyo del Valle and Mocho are based on the revised delineated area.
2. The Water Quality Certification indicated 0.18 acre of Arroyo Mocho would be permanently impacted due to construction of two support wall extensions on downstream side of SR 84 to accommodate overpass widening and shading of the creek channel. Based on the impact maps included in the original 401 permit, this impact is associated with the widening of the Arroyo Mocho bridge pier walls (which were built) and the abutment of the Arroyo Mocho trail bridge (which was not built). The potential shading impact associated with the widening of the pier walls and trail bridge is not included in the 0.018 acre of permanent impact.
3. The culverted waters shown on the jurisdictional maps for OW-7 and OW-8 are not the same as the as-built design plans for SR 84. On April 10, 2013, the USACE issued an amendment to the jurisdictional delineation maps showing the correct location of these features. .

Table 3: Mitigation for Proposed Permanent Impacts

Activity	Jurisdictional Feature Impacted (Feature ID)	Mitigation per the Issued Water Quality Certification		Revised Mitigation	
		Area and/or Linear Footage of Permanent Impacts	Mitigation for Permanent Impacts	Area and/or Linear Footage of Permanent Impacts	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 (OW-1)	0.018 acre 125 linear feet	0.036 acre offsite wetland restoration	0.005 acre 70.68 linear feet	0.010 acre offsite wetland restoration
~~Fill due to~~ Construction of pier, **abutments,** 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 (WL-2)	0.002 acre 111 linear feet	0.126 acre offsite wetland restoration	0.063 acre 116.30 linear feet	0.126 acre offsite wetland restoration
~~Fill due to~~ Placement of abutments associated with Isabel Trail Bridge upstream of SR 84	Arroyo del Valle (WL-2)	0.001 acre 18 linear feet	0.034 acre offsite wetland restoration	0.017 acre 20.20 linear feet	0.034 acre offsite wetland restoration
Construction of new outfall	Arroyo del Valle (WL-2)	0.009 acre 87 linear feet	0.04 acre offsite wetland restoration	0.02 acre 35.22 linear feet	0.04 acre offsite wetland restoration
Shading of channel and loss of willow riparian habitat due to construction of pedestrian bridge	Arroyo del Valle (WL-2)	0.07 acre 19 linear feet	0.037 acre offsite wetland restoration	0.037 acre 18.50 linear feet	0.037 acre offsite wetland restoration
Shading of channel due to construction of maintenance bridge	Arroyo Mocho (OW-1)	0.05 acre 19 linear feet	0.045 acre offsite wetland restoration	0.045 acre 18.5 linear feet	0.045 acre offsite wetland restoration
Modification of existing roadside runoff outfall channel	Ephemeral tributary to Arroyo del Valle (OW-3)	0.008 acre 25 linear feet	0.016 acre offsite wetland restoration	0.008 acre 20.81 linear feet	0.016 acre offsite wetland restoration
Fill due to roadway widening	Seasonal wetland (WL-5)	0.115 acre	0.230 acre offsite wetland restoration	0.115 acre	0.230 acre offsite wetland restoration
Culvert extension to accommodate roadway widening	Intermittent drainage (OW-4)	0.005 acre 74 linear feet	0	0 acre 0 linear feet	0
Fill due to roadway widening	Ephemeral roadside drainage (OW-5)	0.030 acre	0.11 acre offsite wetland restoration	0.055 acre	0.110 acre offsite wetland restoration
Fill due to roadway widening	Ephemeral roadside drainage (OW-6)	0.008 acre	0.092 acre offsite wetland restoration	0.046 acre	0.092 acre offsite wetland restoration
Construction associated with the abutments of maintenance bridge	**Arroyo Mocho (OW-1)**			0.009 acre 22.60 linear feet	0.018 acre offsite wetland restoration
Remove culvert	**Culverted ephemeral drainage (OW-7)**			0.008 acre 244.28 linear feet	0.016 acre offsite wetland restoration
Shading of channel and loss of willow riparian habitat due to the construction of widened overpass	**Arroyo del Valle (WL-2)**			0.086 acre 53.42 linear feet	0.086 acre offsite wetland restoration preservation of willow roots where possible and planting of willow roots
	Total	0.51 acre 800 linear feet	0.32 acre 478 linear feet	0.86 acre 5827.39 linear feet	0.86 acre

Roadway Pollutant Mitigation

As mitigation for increased pollutant loads associated with impervious areas, the Department shall provide treatment of stormwater runoff for the 36.84 acres of impervious area using seven biofiltration strips, seven bioretention swales, and two bioretention vaults.

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

Table 4: Roadway Pollutant Mitigation[1]

BMP	Side of Roadway	From SR 84 Post Mile	To SR 84 Post Mile	BMP Length	Treated Impervious Area
Biofiltration Strip 1	SR 84 Southbound	22.90	22.98	352	0.52
Biofiltration Strip 2	SR 84Northbound	23.06	23.12	305	0.88
Biofiltration Strip 3	SR 84Northbound	23.14	23.20	276	0.62
Biofiltration Strip 4	SR 84Northbound	23.21	23.24	120	0.28
Biofiltration Strip 5*	SR 84Northbound	23.40	23.43	226	0.12
Biofiltration Swale (Drainage System 6y)*	SR 84Northbound	23.41	23.42	83	0.64
Biofiltration Strip 6+	Vallecitos Road Westbound	23.45	23.52	561	0.59
Biofiltration Swale (Drainage System 4ad)+	Vallecitos Road Westbound	23.47	23.53	375	2.97
Biofiltration Swale (Drainage System 20m)	SR 84Southbound	24.01	24.08	380	2.54
Biofiltration Strip 7	SR 84Southbound	24.01	24.52	2674	3.51
Biofiltration Swale (Drainage System 22i)	SR 84Southbound	24.21	24.25	210	1.12
Biofiltration Swale (Drainage System 26e)	SR 84Southbound	24.31	24.33	162	0.53
Biofiltration Swale (Drainage System 29g)	SR 84Southbound	24.42	24.44	162	0.61
Biofiltration Swale (Drainage System 25b)	SR 84Northbound	24.27	24.33	370	3.10
Bioretention Vault 1 (Austin Vault Sand Filter)	SR 84Southbound	24.84	24.87		10.59
Bioretention Vault 2 (Austin Vault Sand Filter)	SR 84Northbound	26.19	26.21		8.43
Total					37.05

1. The table was updated to reflect changes in the location of the biofiltration swales, strips and bioretention vaults.
* Between SR 84 mainline and eastbound 84 to Vallecitos Road connector
+ Between SR 84 and Vallecitos Road mainlines

Hydromodification Mitigation

Table 5: Hydromodification Mitigation[1]

Mitigation Measures	Swale or Strip No(s).	Receiving Water	Mitigated Impervious Area (Acre)
Two biofiltration swales	Swales 4ad, 6y	Tributary to the Arroyo del Valle	1.5
Five biofiltration swales	Swales 20m, 25b, 22i, 26e, 29g	Arroyo del Valle	8.2
Pump station	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
1. The table was updated to reflect changes in the location of the biofiltration swales, strips and retention vaults.			

Construction Schedule

The project will be implemented in two sections. The north section of the project, which extends from north of Concannon Boulevard in the south to Jack London Boulevard in the north (PM 25.5 to 27.1), is in construction. The south section, which extends from south of Ruby Hill Drive to north of Concannon Boulevard (PM 22.9 to 25.7), is scheduled to start construction in 2015 and end in 2018. Construction activities at the Arroyo del Valle are expected to occur in 2016.

Should you have any questions regarding this submittal, please contact me at (510) 286-5585.

Sincerely,

CYRUS VAFAI, P.E.
Branch Chief, Water Quality Permits
Caltrans District 4

Attachments
Figure 1A Temporary Impacts to Waters and Wetlands
Figure 1B Permanent Impacts to Waters and Wetlands

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Attachment 4 – Water Quality Permits

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

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

Escarom 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

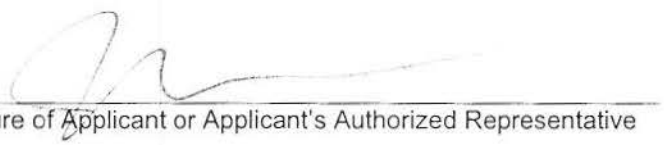
Is any of the information included as part of the notification available in digital format (i.e., CD, DVD, etc.)?

☑ 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

10/18/10

Date

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.

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.

1243 Alpine Road, Suite 108
Walnut Creek, CA 94596
Phone: 925.941.0017
Fax: 925.941.0018
www.wreco.com

Attachment 5a – Treatment BMP Watershed Maps for EA 04-297621 (subject Project of this memo)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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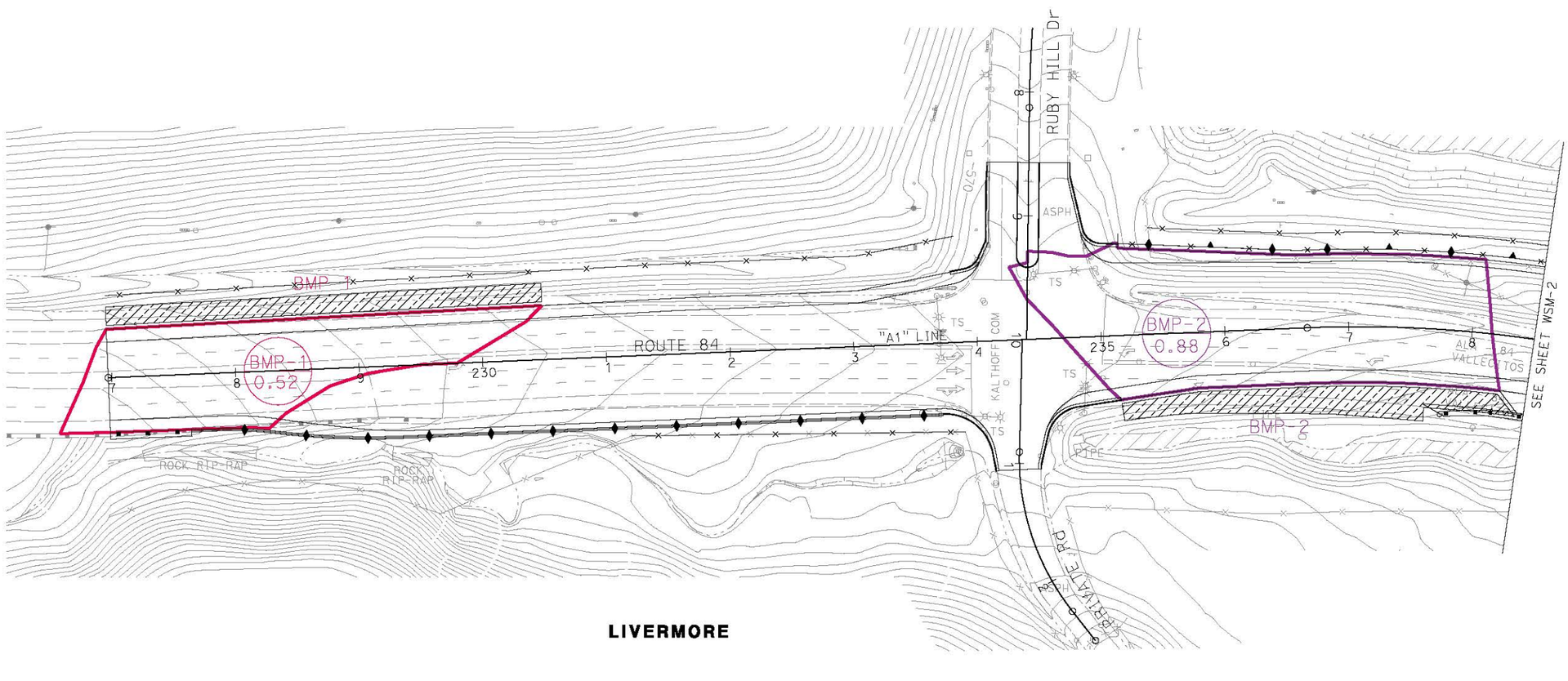
LEGEND:

BMP No. / AREA (ac)

FLOW DIRECTION

TREATED IMPERVIOUS AREA

PLEASANTON



LIVERMORE

WATERSHED MAP

SCALE 1"=50'

WSM-1

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04	Ala	84	22.9/25.7	2	

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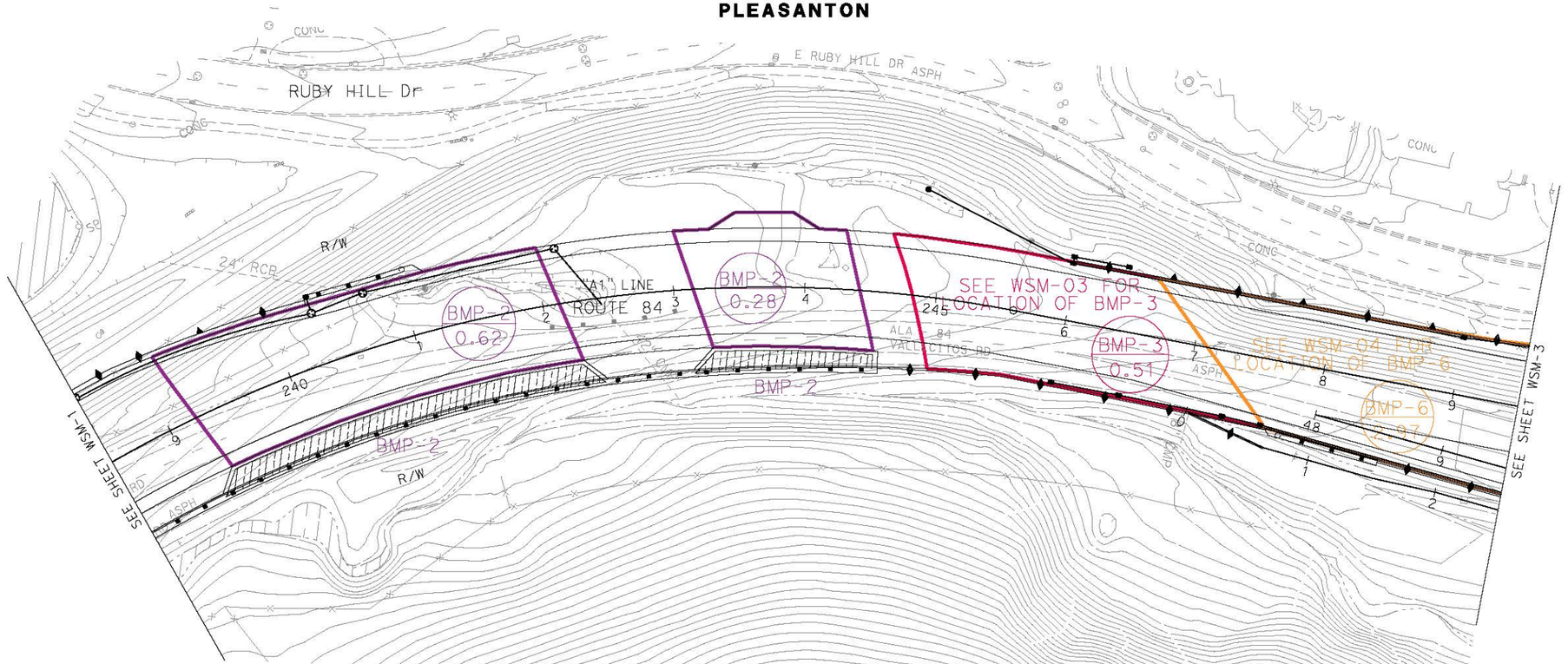

LIVERMORE

WATERSHED MAP

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WSM-2

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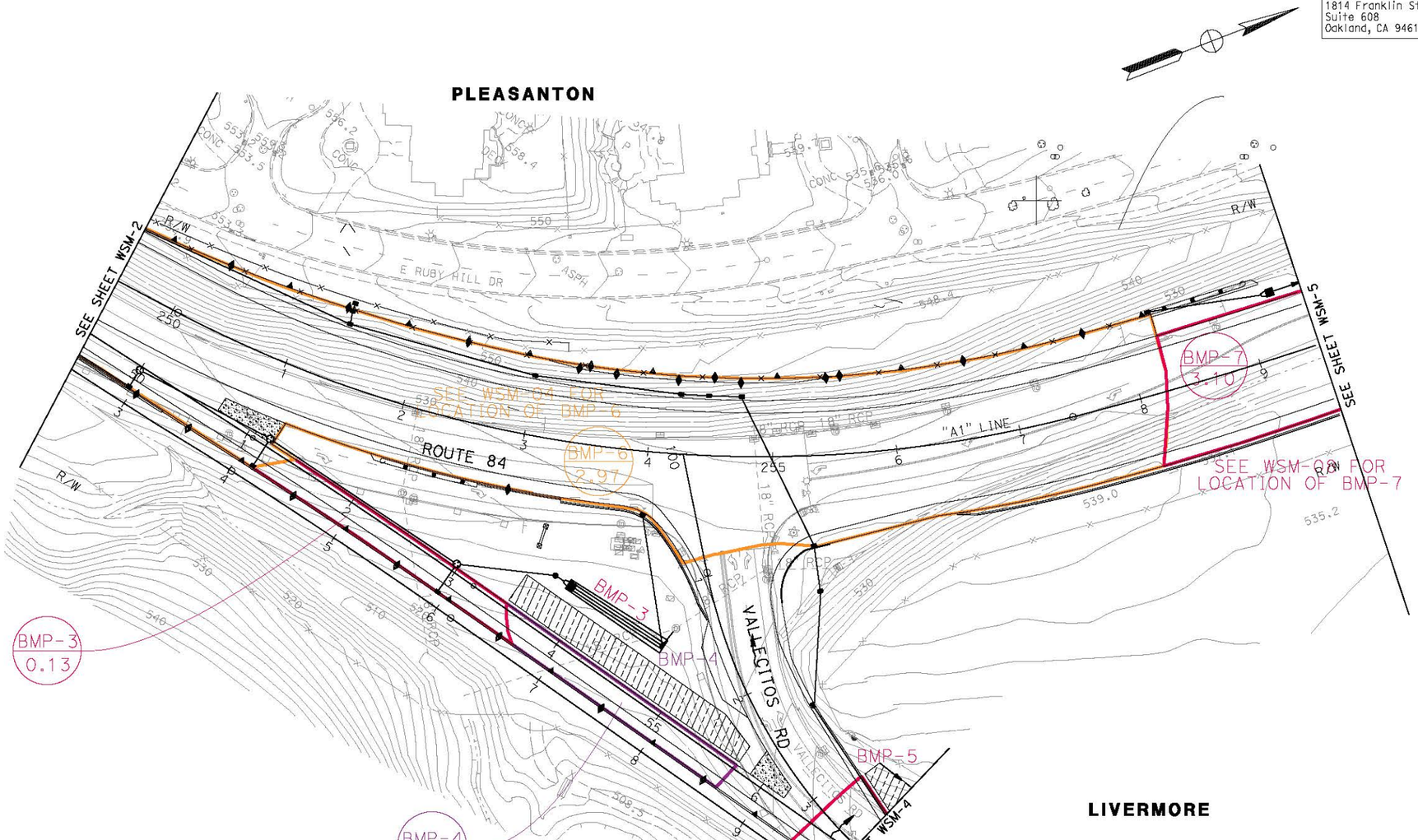

WATERSHED MAP

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WSM-3

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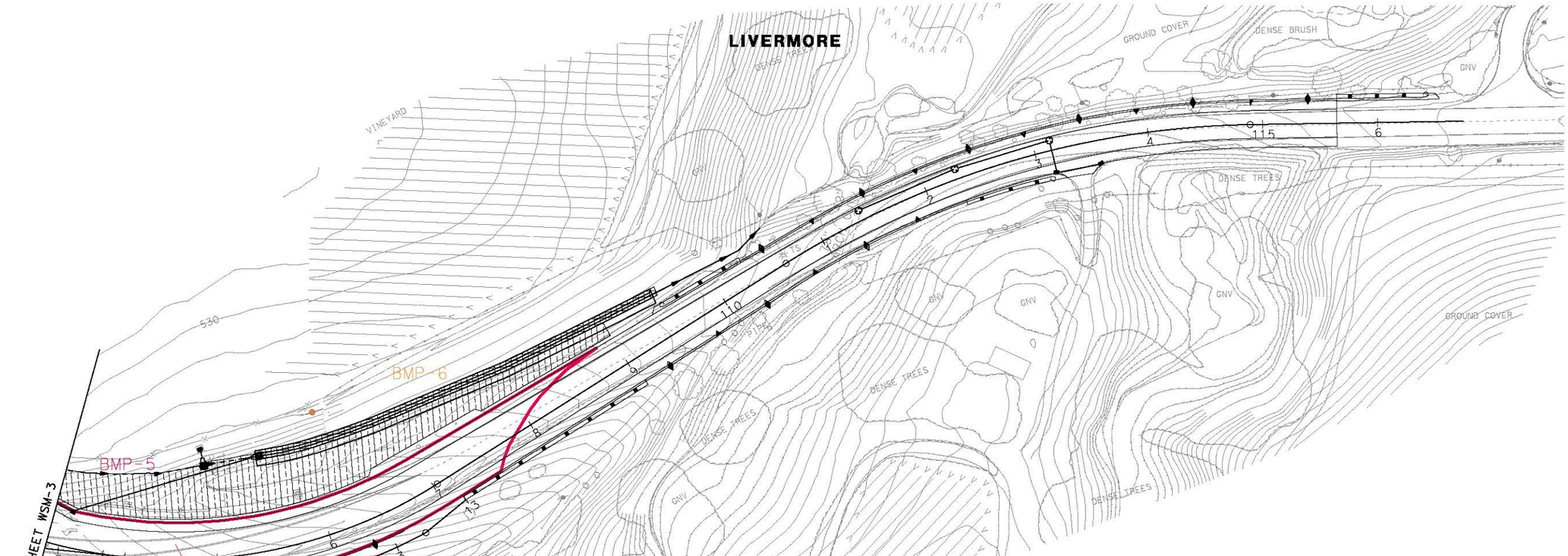

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04	Ala	84	22.9/25.7		

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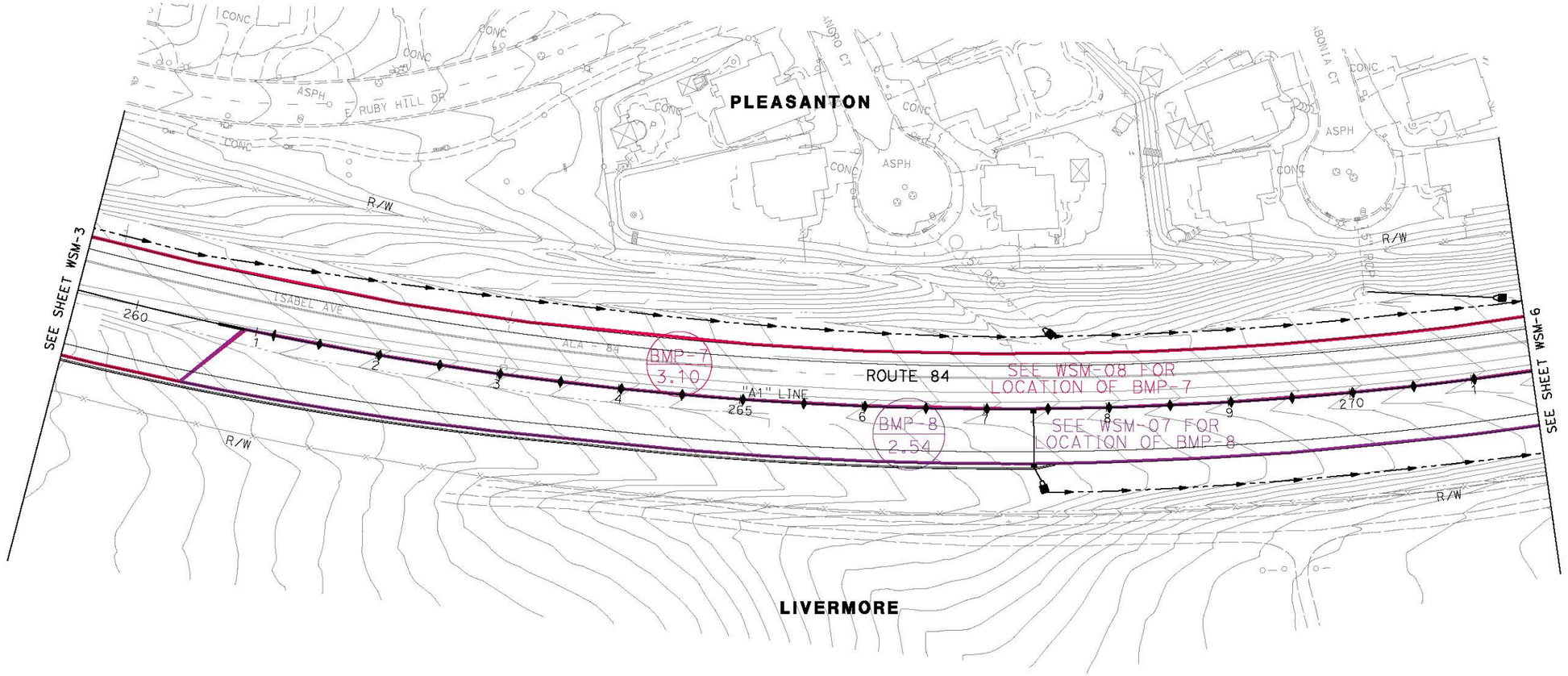

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WSM-5

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04	Ala	84	22.9/25.7	6	

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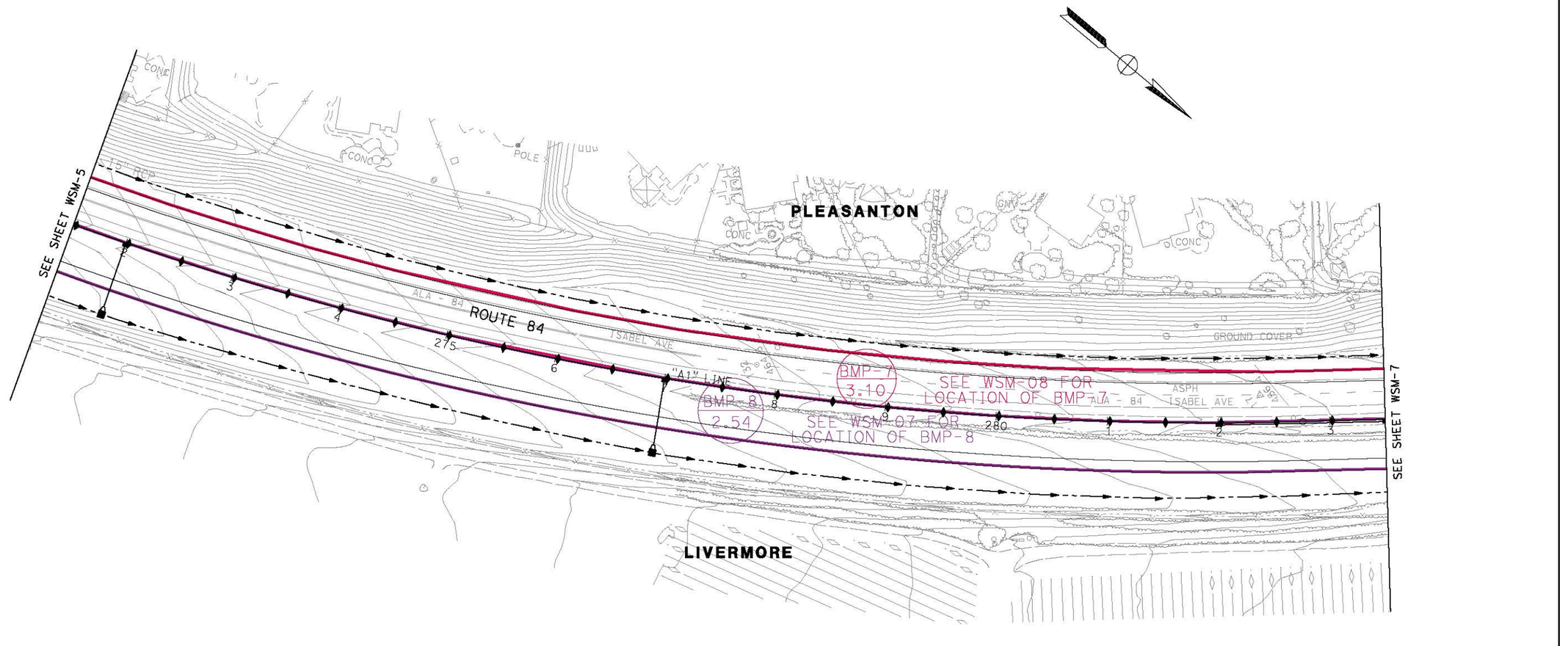

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WSM-6

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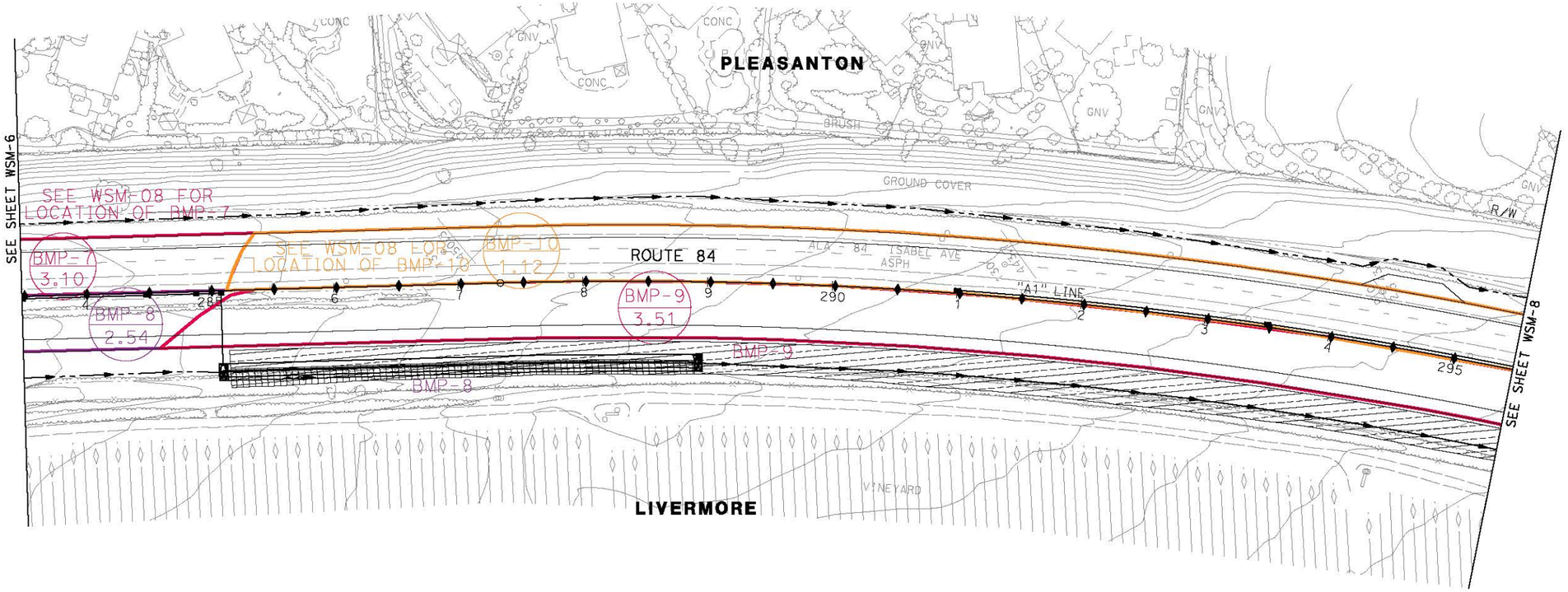

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WSM-7

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04	Ala	84	22.9/25.7	8	

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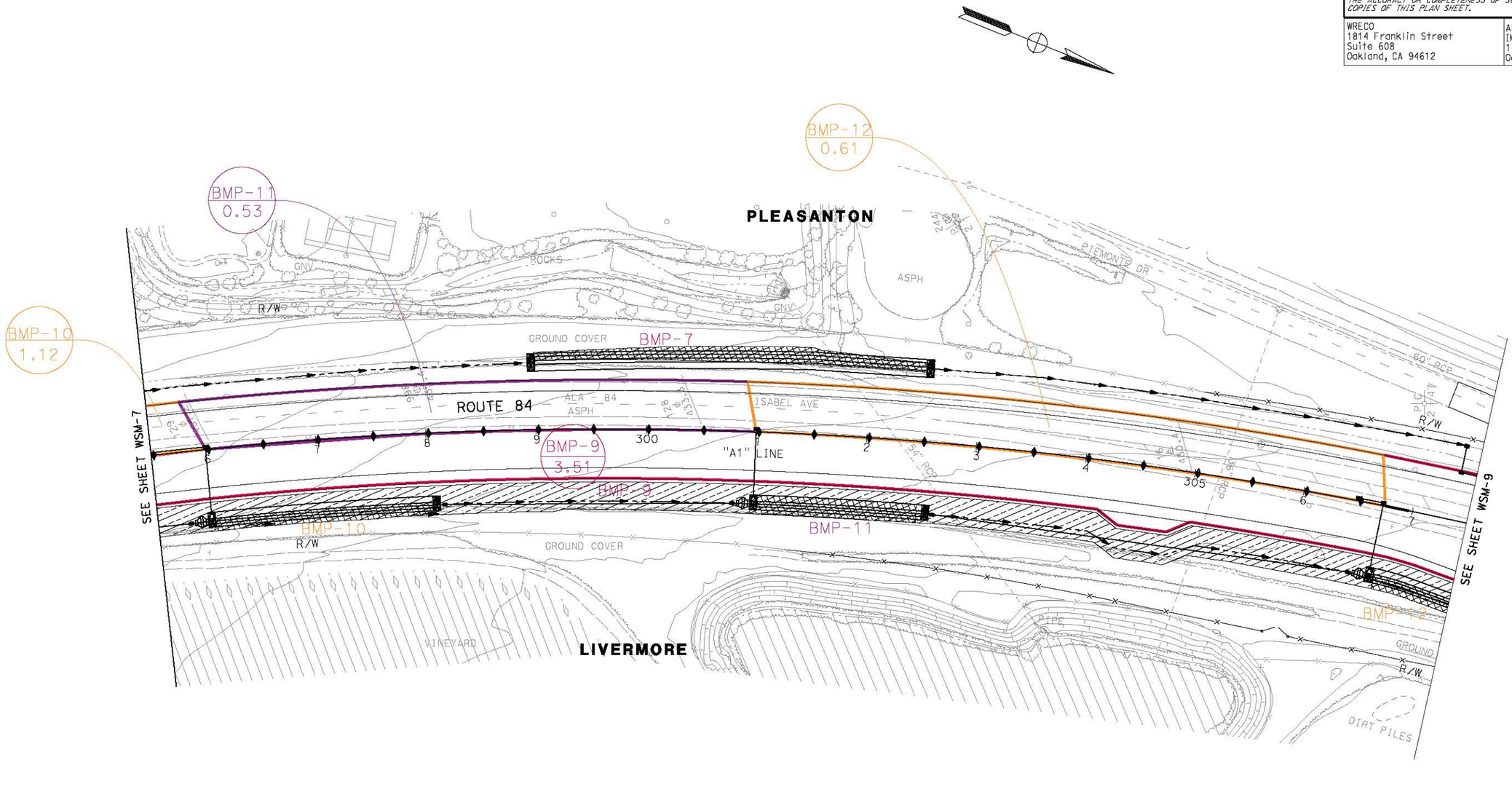

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WSM-8

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04	Ala	84	22.9/25.7	9	

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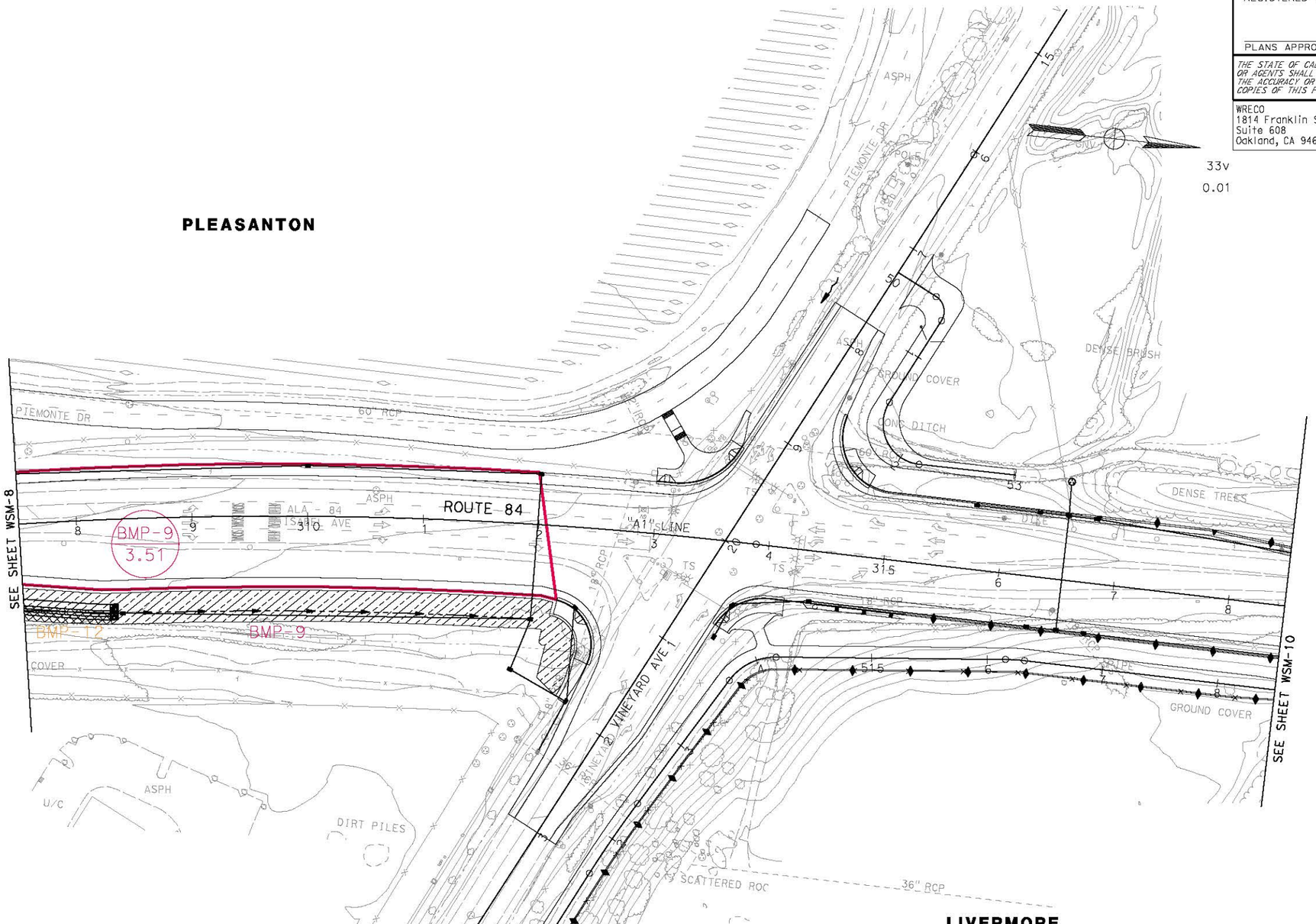

LIVERMORE

WATERSHED MAP

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WSM-9

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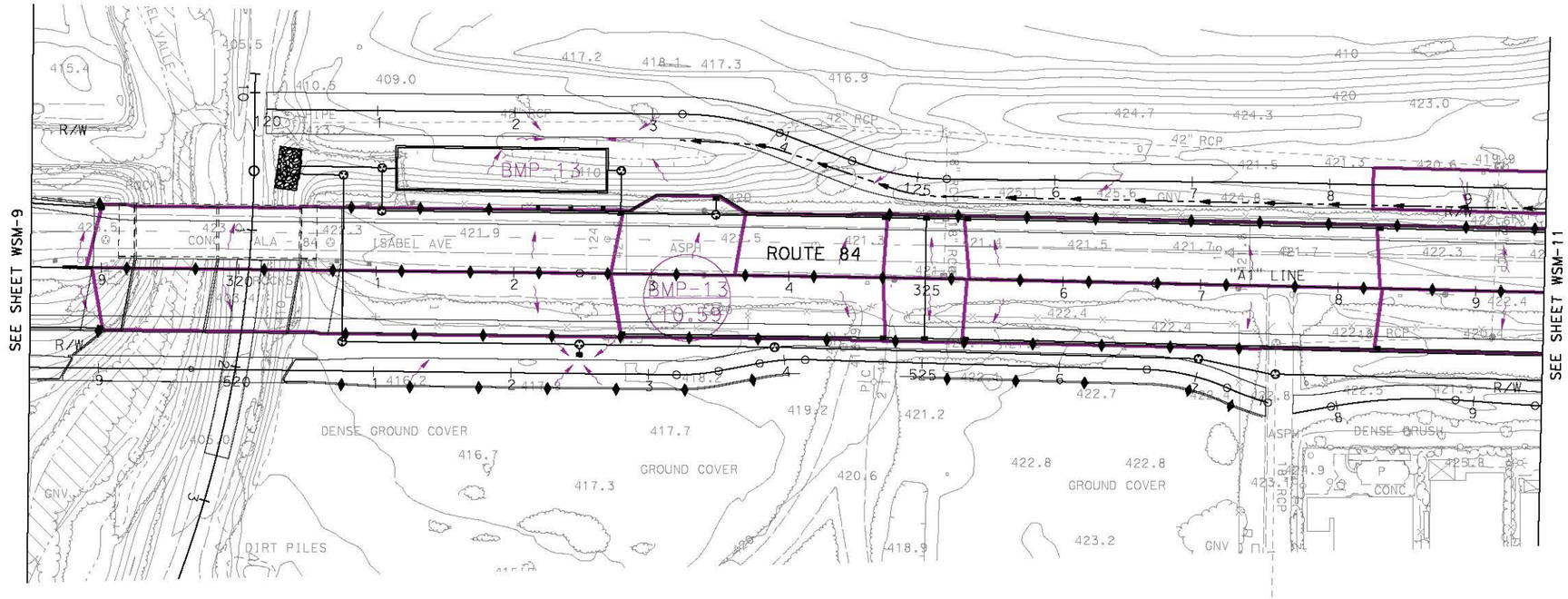

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WSM-10

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UNIT 0733

PROJECT NUMBER & PHASE 04000205811

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	11	

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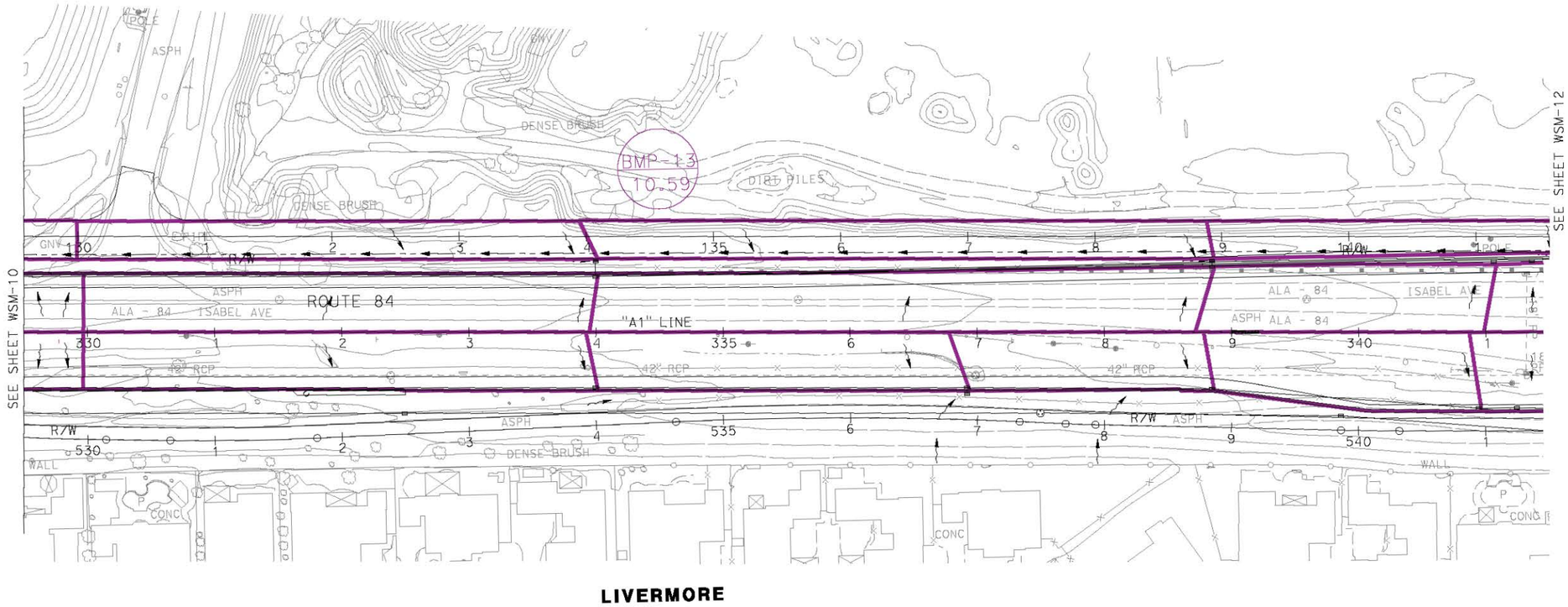

LIVERMORE

WATERSHED MAP

SCALE 1"=50'

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WSM-11

UNIT 0733	PROJECT NUMBER & PHASE	04000205811

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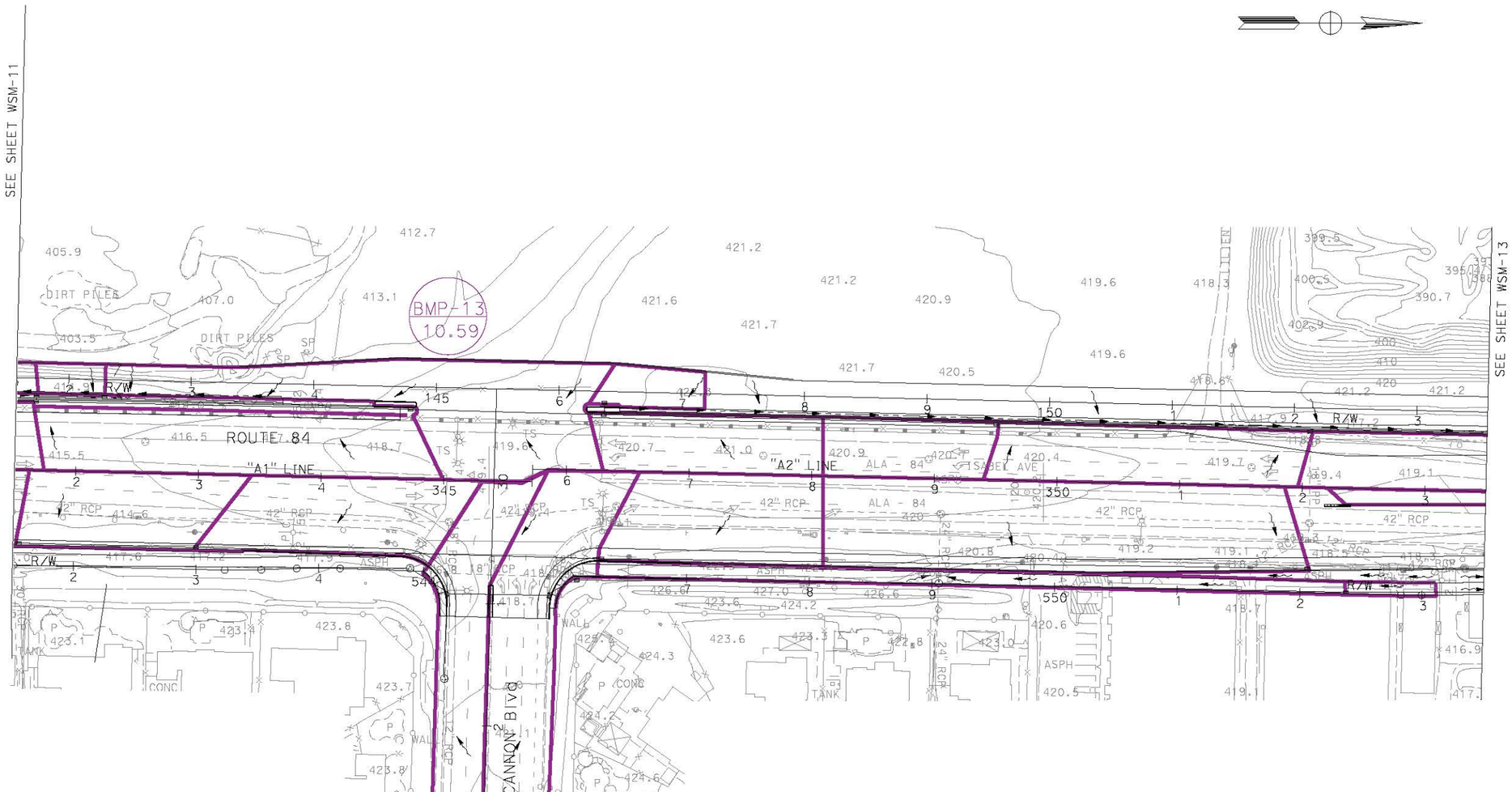

LIVERMORE

WATERSHED MAP

SCALE 1"=50'

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

WSM-12

CALCULATED-DESIGNED BY

CHECKED BY

REVISED BY

DATE REVISED

CONSULTANT FUNCTIONAL SUPERVISOR

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Caltrans

LAST REVISION DATE PLOTTED => 10/31/2014
10-31-14 TIME PLOTTED => 6:07:03 PM

BORDER LAST REVISED 7/2/2010

USERNAME => andrew_chin
DGN FILE => ...\WSM\WSM-12.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	13	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. Exp. CIVIL — STATE OF CALIFORNIA

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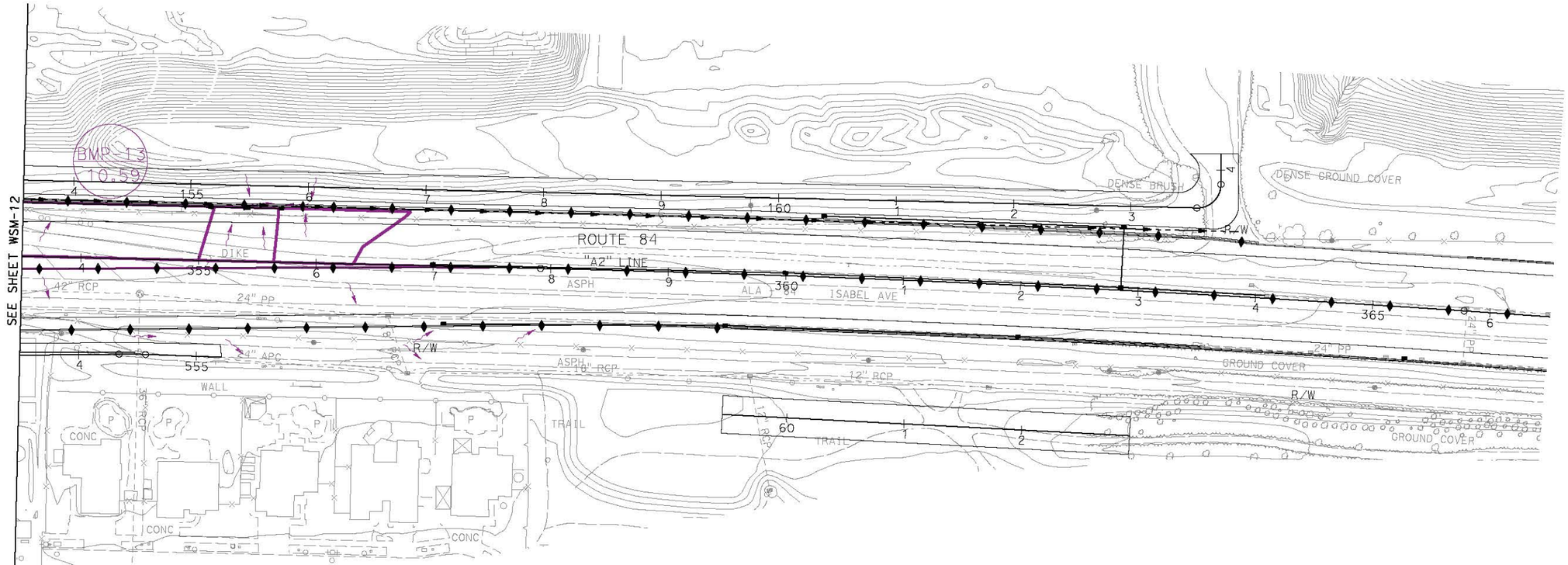

WATERSHED MAP

SCALE 1"=50'

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

WSM-13

REVISED BY | DATE REVISED

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TIME PLOTTED => 6:07:19 PM
10-31-14

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Attachment 5b – Treatment BMP Watershed Maps for EA 04-297611 (constructed adjacent project)

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	12	

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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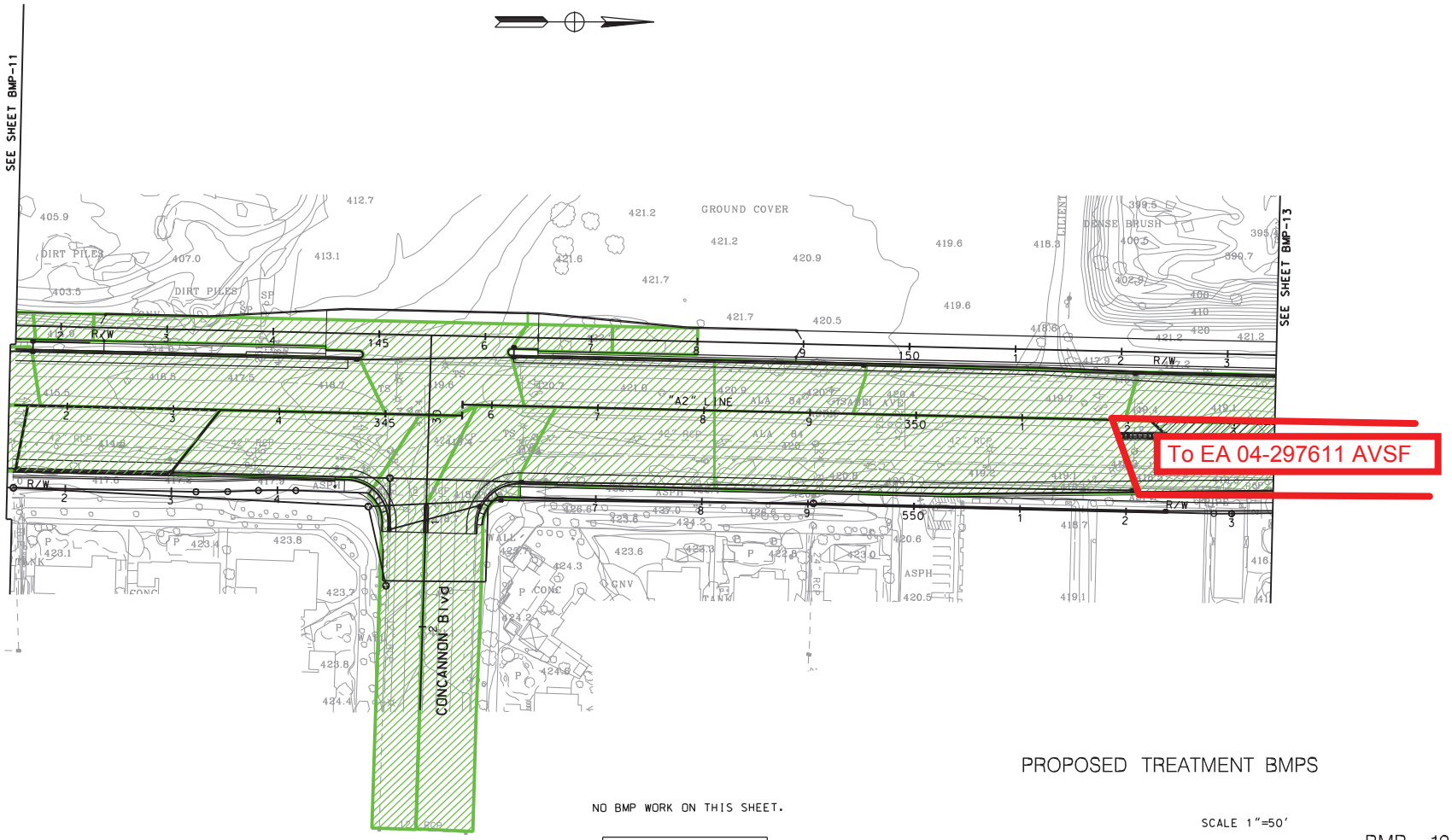

PROPOSED TREATMENT BMPS

NO BMP WORK ON THIS SHEET.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

SCALE 1"=50'

BMP- 12

REVISED BY	DATE REVISED
ANALETTE OCHOA	

CALCULATED-DESIGNED BY	CHECKED BY
CONSULTANT FUNCTIONAL SUPERVISOR	
HAN-BIN LIANG	

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LAST REVISION 00-00-00
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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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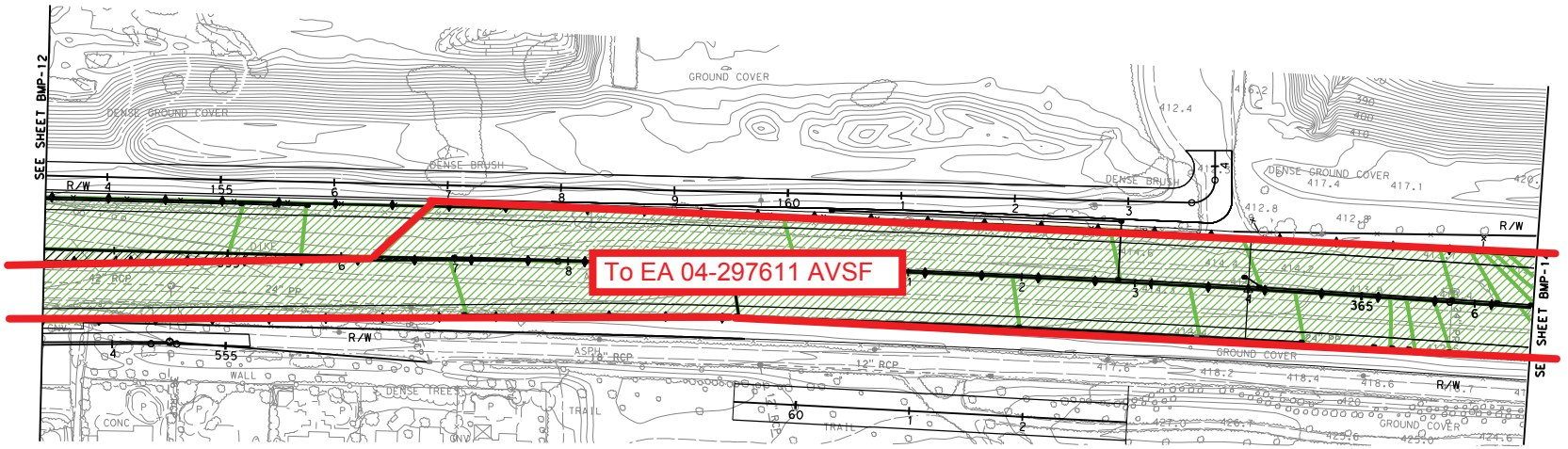
NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.



PROPOSED TREATMENT BMPS

NO BMP WORK ON THIS SHEET.

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

BMP-13

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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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	14	

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA,
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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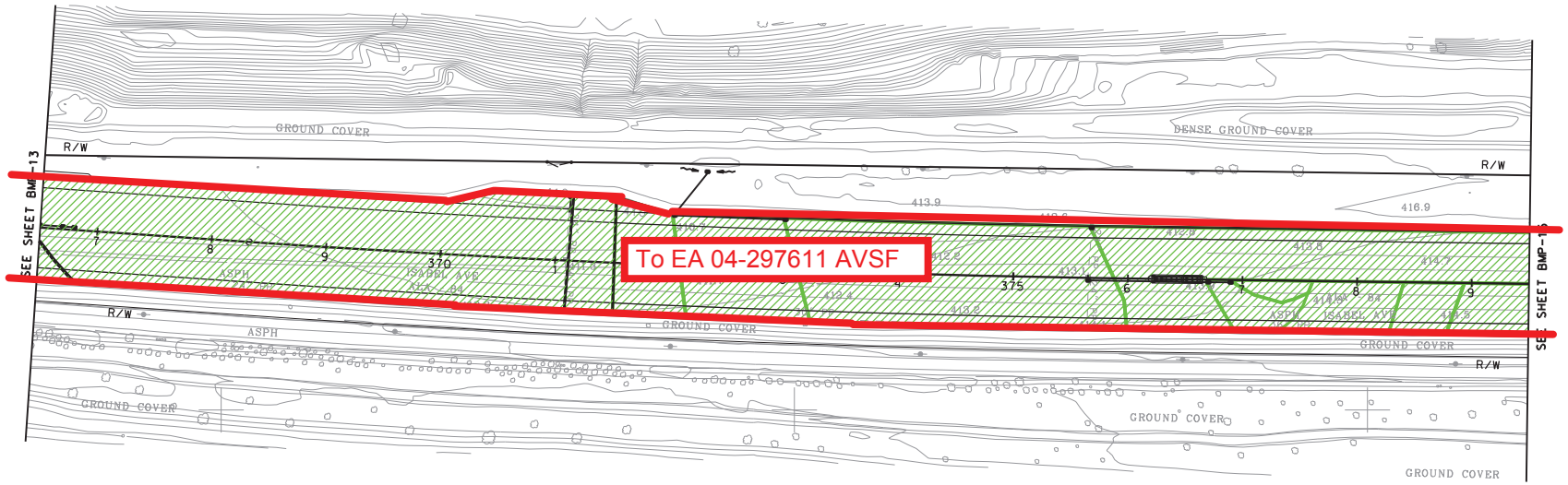

PROPOSED TREATMENT BMPS

NO BMP WORK ON THIS SHEET.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

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SCALE 1"=50'

BMP- 14

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LAST REVISION 00-00-00
DATE PLOTTED = 10/14/2010
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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

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

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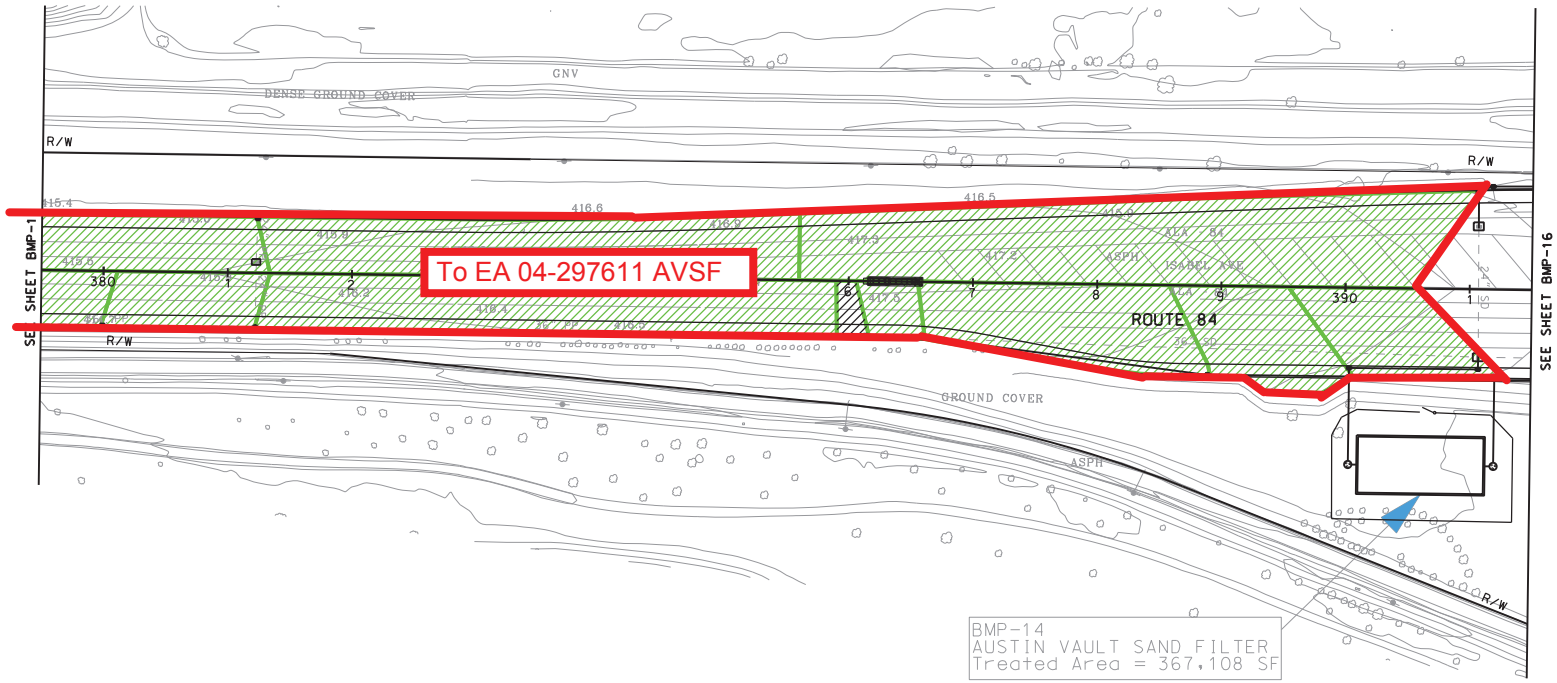
NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA,
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.



PROPOSED TREATMENT BMPS

SCALE 1"=50'

BMP– 15

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FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET BMP-1

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Caltrans		CHECKED BY		

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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

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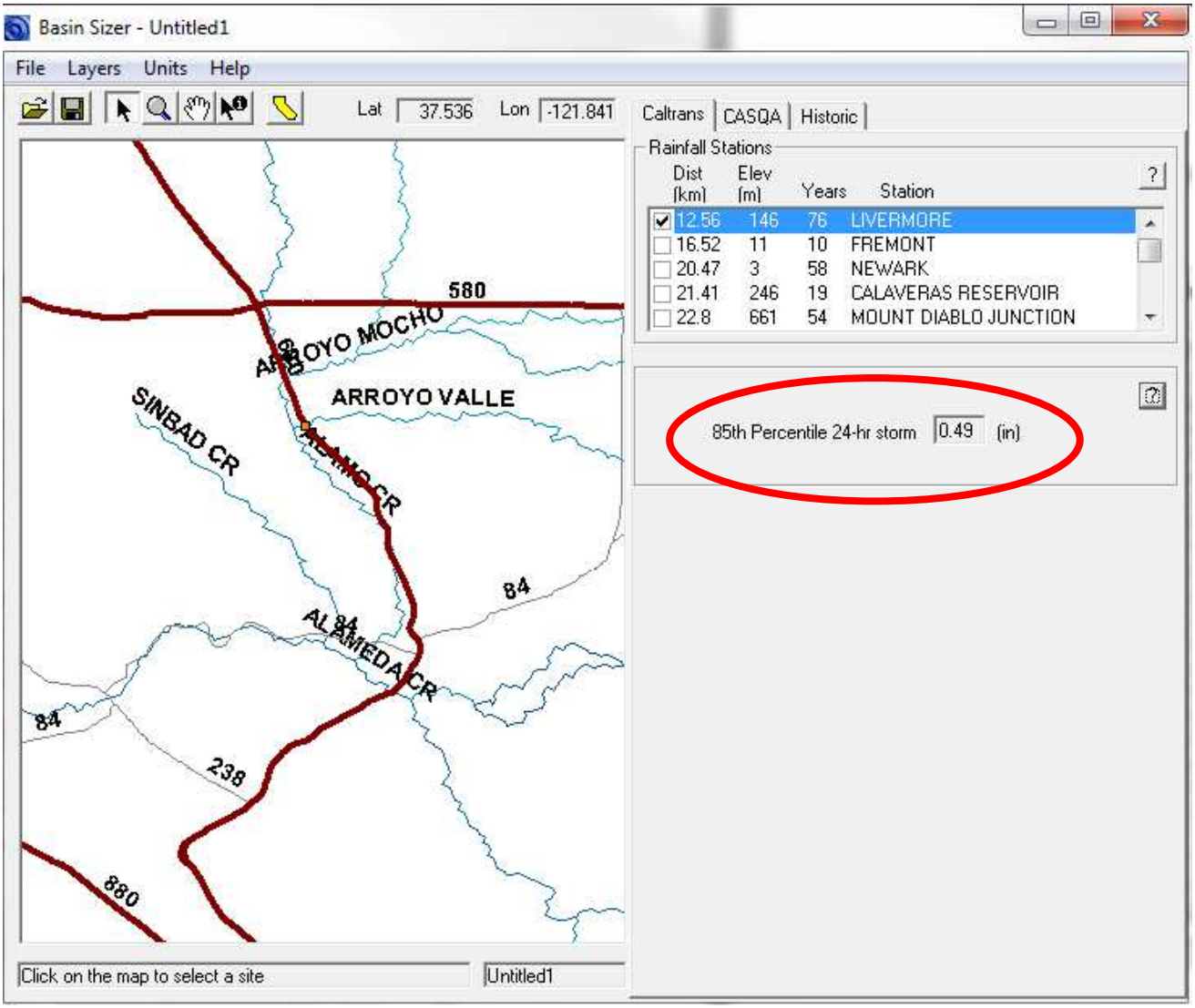
Attachment 6 - Austin Vault Sand Filter Calculations

85th Percentile 24-hour storm = 0.49 inches



Water Quality Volume (WQV)

WQV = (Watershed to BMP) x (Runoff Coefficient) x (85th Percentile 24-hour storm)

WQV = (10.59 acres) x (1) x (0.49 inches) = 5.19 acre-inch

WQV = 18,836 cubic feet

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DESIGN WATER QUALITY VOLUMES (WQV)

AVSF TYPE*	WQV (CUFT)	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

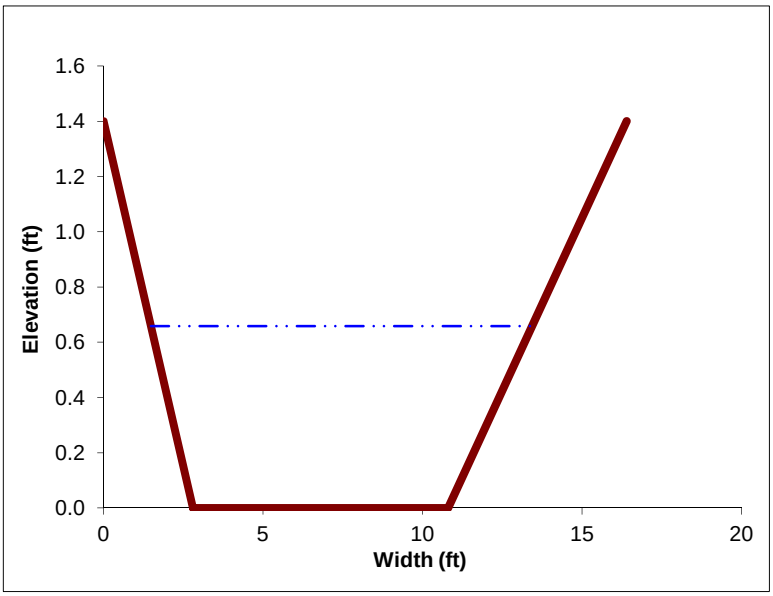
* AVSF TYPE = LENGHT CONFIGURATION (S OR L) - WATER QUALITY VOLUME (CUFT) - DESIGN WATER DEPTH (Hw ELEVATION)

Normal Depth Calculations for Channels using Manning's Equation

Bioswale from "A1" Line 298+93 to 302+57, Lt

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	0.011	ft/ft
Design Flow	13.74	cfs



Normal Depth for Channel

Depth	0.7	ft
Area	6.57	ft^2
Perimeter	12.19	ft
Rh	0.54	ft
V	2.09	ft/s
Q	13.74	cfs
Goal Seek	0.00	

Length 370 ft

Watershed Area

Unpaved	0.37	ac
Paved	0.00	ac
Upstream	16.42	ac
Total	16.79	ac

C Value

Unpaved	0.66
Paved	1.00
Upstream	0.72
Weighted	0.72

Time of Concentration

Tt Upstream	36.9	min
Tt Self	3.0	min
Tc	39.8	min

Precipitation 1.13 in/hr

Freeboard

Energy head (He)=	0.73	ft
Min freeboard (0.2He)=	0.15	ft
Ditch freeboard =	0.74	ft
Sufficient freeboard?	yes	

FL US	432.33	ft
FL DS	428.16	ft
Weir Height =	1.0	ft
Weir Length =	12.8	ft

Flow through rectangular weir (x2)

q = 3.33 (b - 0.2 h) h^3/2

q = flow rate (cfs) = 1/2 design flow

h = head on the weir (ft)

b = width of the weir = 1/2 weir length above

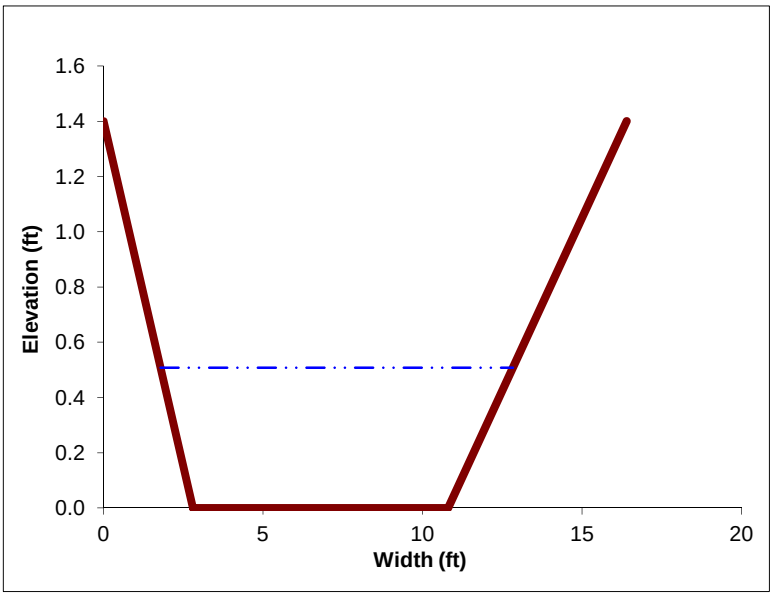
q =	6.9	cfs
b =	6.4	ft
h =	0.565	ft
calc q =	8.9	
Flow depth at weir =	1.6	ft

Normal Depth Calculations for Channels using Manning's Equation

Bioswale from "A1" Line 298+93 to 302+57, Lt

Input Values

Height	1.4	ft
Width	8	ft
LT Side Slope	2	:1 (h:v)
Rt Side Slope	4	:1 (h:v)
Mannings	0.2	
Slope	0.011	ft/ft
Design Flow	2.18	cfs



Normal Depth for Channel

Depth	0.5	ft
Area	4.84	ft^2
Perimeter	11.23	ft
Rh	0.43	ft
V	0.45	ft/s
Q	2.18	cfs
Goal Seek	0.00	

Length 370 ft

Watershed Area

Unpaved	0.37	ac
Paved	0.00	ac
Upstream	16.42	ac
Total	16.79	ac

C Value

Unpaved	0.60
Paved	0.90
Upstream	0.65
Weighted	0.65

Precipitation 0.20 in/hr

FL US	432.33	ft
FL DS	428.16	ft

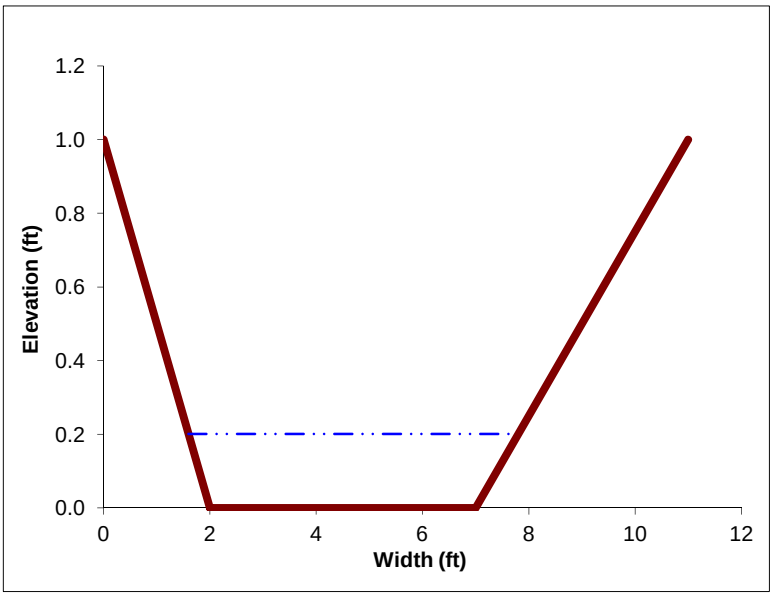
Hydraulic residence time =	13.7	min
Velocity less than 1 ft/s?	yes	
Depth less than 6"?	yes	
Treatment soil height over FL =	0.5	ft
Treatment soil top width =	11	ft
Treatment soil area =	4,070	sq. ft
Untreated imperv. WS area =	3.12	ac
	135,907	sq. ft
Swale % of total imperv. =	3.0	%

Normal Depth Calculations for Channels using Manning's Equation

Bioswale from "A1" Line 253+52 to 254+24, Rt

Input Values

Height	1	ft
Width	5	ft
LT Side Slope	2	:1 (h:v)
Rt Side Slope	4	:1 (h:v)
Mannings	0.05	
Slope	0.010	ft/ft
Design Flow	1.09	cfs



Normal Depth for Channel

Depth	0.2	ft
Area	1.13	ft^2
Perimeter	6.28	ft
Rh	0.18	ft
V	0.97	ft/s
Q	1.09	cfs
Goal Seek	0.00	

Length 91 ft

Watershed Area

Unpaved	0.73	ac
Paved	0.18	ac
Upstream	0.00	ac
Total	0.91	ac

C Value

Unpaved	0.66
Paved	1.00
Upstream	0.81
Weighted	0.73

Time of Concentration

Tt Upstream	17.5	
Tt Self	1.6	min
Tc	19.1	min
		min

Precipitation 1.65 in/hr

Freeboard

Energy head (He)=		
Min freeboard (0.2He)=	0.22	
Ditch freeboard =	0.04	ft
Sufficient freeboard?	0.80	ft
	yes	ft

FL US	529.00	ft
FL DS	528.05	ft
Weir Height =	1.0	ft
Weir Length =	9.8	ft

Flow through rectangular weir (x2)

q = 3.33 (b - 0.2 h) h^3/2

q = flow rate (cfs) = 1/2 design flow

h = head on the weir (ft)

b = width of the weir = 1/2 weir length above

q =	0.5	cfs
b =	4.9	ft
h =	0.525	ft
calc q =	6.1	
Flow depth at weir =	1.5	ft

Normal Depth Calculations for Channels using Manning's Equation **WQF Calc**

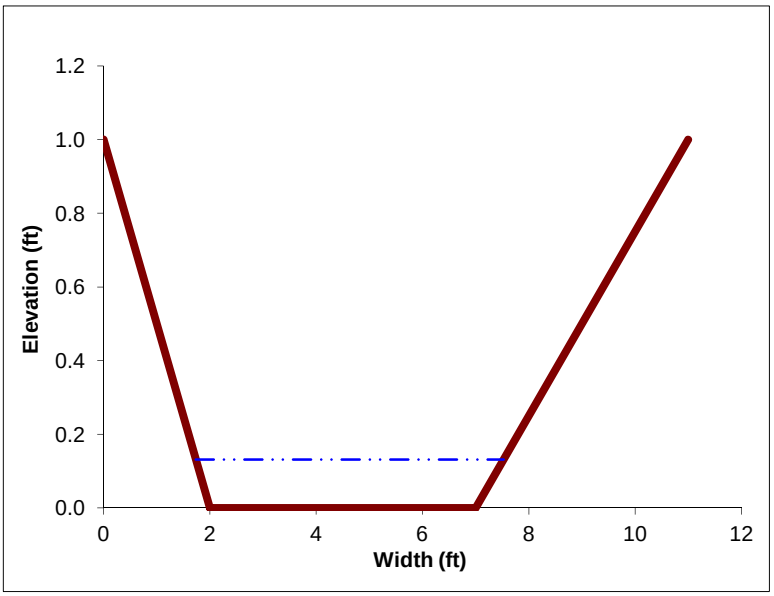
Bioswale from "A1" Line 253+52 to 254+24, Rt

Input Values

Height	1	ft
Width	5	ft
LT Side Slope	2	:1 (h:v)
Rt Side Slope	4	:1 (h:v)
Mannings	0.2	
Slope	0.010	ft/ft
Design Flow	0.13	cfs

Normal Depth for Channel

Depth	0.1	ft
Area	0.71	ft^2
Perimeter	5.84	ft
Rh	0.12	ft
V	0.19	ft/s
Q	0.13	cfs
Goal Seek	0.00	



Length 91 ft

FL US	529.00	ft
FL DS	528.05	ft

Watershed Area

Unpaved	0.73	ac
Paved	0.18	ac
Upstream	0.00	ac
Total	0.91	ac

C Value

Unpaved	0.66
Paved	1
Upstream	0.813239
Weighted	0.73

Precipitation 0.20 in/hr

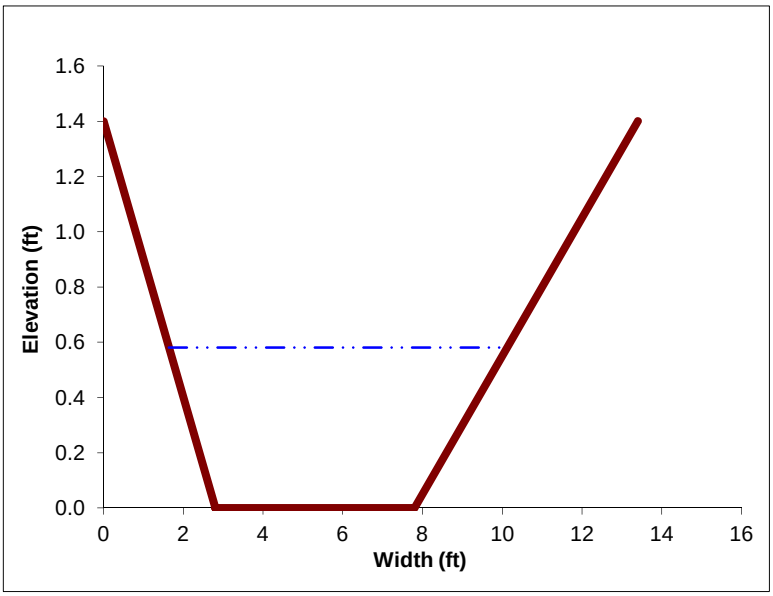
Hydraulic residence time =	8.1	min
Velocity less than 1 ft/s?	yes	
Depth less than 6"?	yes	
Treatment soil top width =	11	ft
Treatment soil area =	1,001	sq. ft
Untreated imperv. WS area =	2.94	ac
	128,066	sq. ft
Swale % of total imperv. =	0.8	%

Normal Depth Calculations for Channels using Manning's Equation

Bioswale from "A1" Line 285+07 to 288+97, Rt

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	0.019	ft/ft
Design Flow	9.35	cfs



Normal Depth for Channel

Depth	0.6	ft
Area	3.91	ft^2
Perimeter	8.69	ft
Rh	0.45	ft
V	2.39	ft/s
Q	9.35	cfs
Goal Seek	0.00	

Length 380 ft

Watershed Area

Unpaved	0.29	ac
Paved	0.41	ac
Upstream	2.84	ac
DS 20	0.82	ac
Total	4.36	ac

C Value

Unpaved	0.66
Paved	1.00
Upstream	0.81
DS 20	1.00
Weighted	0.86

Time of Concentration

Tt Upstream	5.7	min
Tt Self	2.7	min
Tc	8.4	min

Precipitation 2.51 in/hr

Freeboard

Energy head (He)=	0.67	ft
Min freeboard (0.2He)=	0.13	ft
Ditch freeboard =	0.82	ft
Sufficient freeboard?	yes	

FL US	448.97	ft
FL DS	441.85	ft

Weir Height =	1.0	ft
Weir Length =	9.8	ft

Flow through rectangular weir (x2)

q = 3.33 (b - 0.2 h) h^3/2

q = flow rate (cfs) = 1/2 design flow

h = head on the weir (ft)

b = width of the weir = 1/2 weir length above

q =	4.7	cfs
b =	4.9	ft
h =	0.525	ft

calc q = 6.1

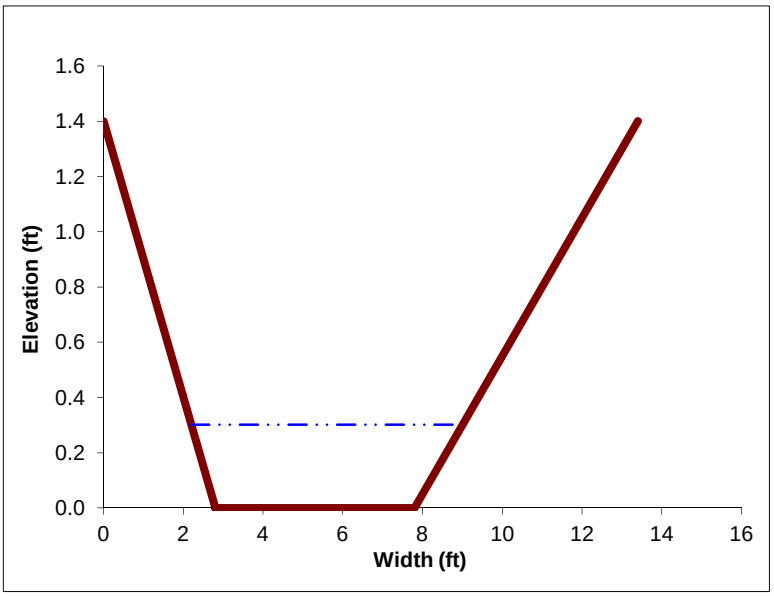
Flow depth at weir = 1.5 ft

Normal Depth Calculations for Channels using Manning's Equation **WQF Calc**

Bioswale from "A1" Line 285+07 to 288+97, Rt

Input Values

Height	1.4	ft
Width	5	ft
LT Side Slope	2	:1 (h:v)
Rt Side Slope	4	:1 (h:v)
Mannings	0.2	
Slope	0.019	ft/ft
Design Flow	0.73	cfs



Normal Depth for Channel

Depth	0.3	ft
Area	1.78	ft^2
Perimeter	6.92	ft
Rh	0.26	ft
V	0.41	ft/s
Q	0.73	cfs
Goal Seek	0.00	

Length 380 ft

FL US	448.97	ft
FL DS	441.85	ft

Watershed Area

Unpaved	0.29	ac
Paved	0.41	ac
Upstream	2.84	ac
DS 20	0.82	ac
Total	4.36	ac

Hydraulic residence time =	15.4	min
Velocity less than 1 ft/s?	yes	
Depth less than 6"?	yes	
Treatment soil top width =	13.4	ft
Treatment soil area =	5,092	sq. ft
Untreated imperv. WS area =	2.94	ac
	128,066	sq. ft
Swale % of total imperv. =	4.0	%

C Value

Unpaved	0.6	
Paved	0.90	
Upstream	0.81	
DS 20	1.00	<-- uses the Q25 C values (conservatively large)
Weighted	0.84	

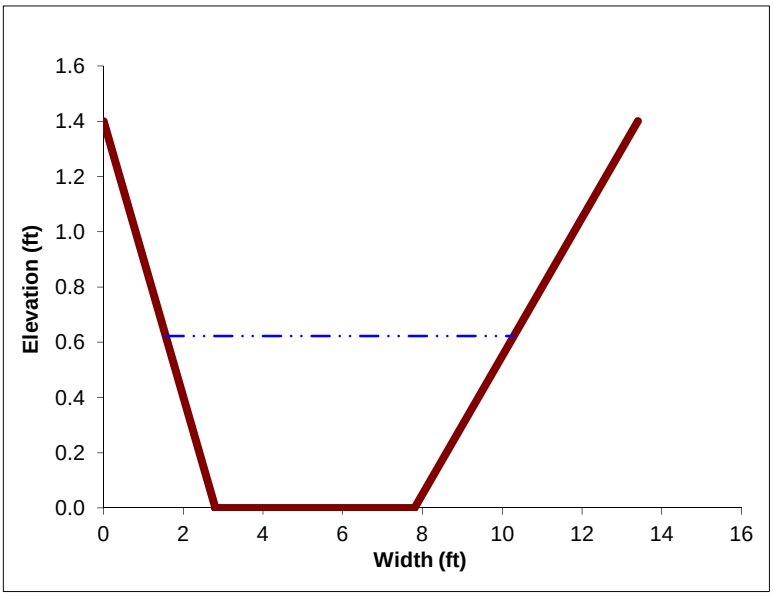
Precipitation 0.20 in/hr

Normal Depth Calculations for Channels using Manning's Equation

Bioswale from "A1" Line 295+96 to 298+11, Rt

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	0.009	ft/ft
Design Flow	7.48	cfs



Normal Depth for Channel

Depth	0.6	ft
Area	4.27	ft^2
Perimeter	8.96	ft
Rh	0.48	ft
V	1.75	ft/s
Q	7.48	cfs
Goal Seek	0.00	

Length 210 ft

FL US	431.33	ft
FL DS	429.37	ft

Watershed Area

Unpaved	0.18	ac
Paved	1.35	ac
Upstream	0.00	ac
DS 22	0.82	ac
Total	2.35	ac

C Value

Unpaved	0.66
Paved	1.00
Upstream	0.00
DS 20	1.00
Weighted	0.97

Time of Concentration

Tt Upstream	0.0	min
Tt Self	2.0	min
Tc	2.0	min

Precipitation 3.27 in/hr

Freeboard

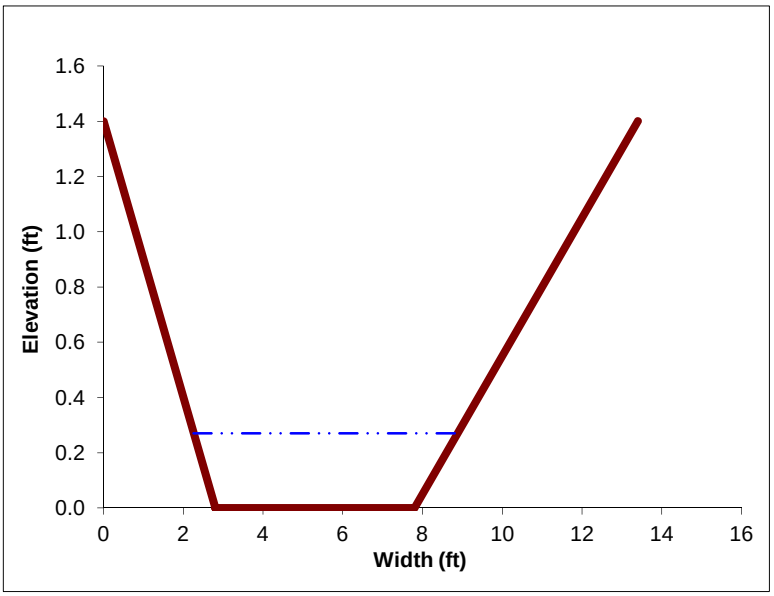
Energy head (He)=	0.67	ft
Min freeboard (0.2He)=	0.13	ft
Ditch freeboard =	0.78	ft
Sufficient freeboard?	yes	

Normal Depth Calculations for Channels using Manning's Equation **WQF Calc**

Bioswale from "A1" Line 295+96 to 298+11, Rt

Input Values

Height	1.4	ft
Width	5	ft
LT Side Slope	2	:1 (h:v)
Rt Side Slope	4	:1 (h:v)
Mannings	0.2	
Slope	0.009	ft/ft
Design Flow	0.43	cfs



Normal Depth for Channel

Depth	0.3	ft
Area	1.57	ft^2
Perimeter	6.72	ft
Rh	0.23	ft
V	0.27	ft/s
Q	0.43	cfs
Goal Seek	0.00	

Length 210 ft

FL US	431.33	ft
FL DS	429.37	ft

Watershed Area

Unpaved	0.18	ac
Paved	1.35	ac
Upstream	0.00	ac
DS 22	0.82	ac
Total	2.35	ac

Hydraulic residence time =	12.8	min
Velocity less than 1 ft/s?	yes	
Depth less than 6"?	yes	
Treatment soil top width =	13.4	ft
Treatment soil area =	2,814	sq. ft
Untreated imperv. WS area =	1.35	ac
	58,806	sq. ft
Swale % of total imperv. =	4.8	%

C Value

Unpaved	0.60	
Paved	0.90	
Upstream	0.00	
DS 20	1.00	<-- uses the Q25 C values (conservatively large)
Weighted	0.91	

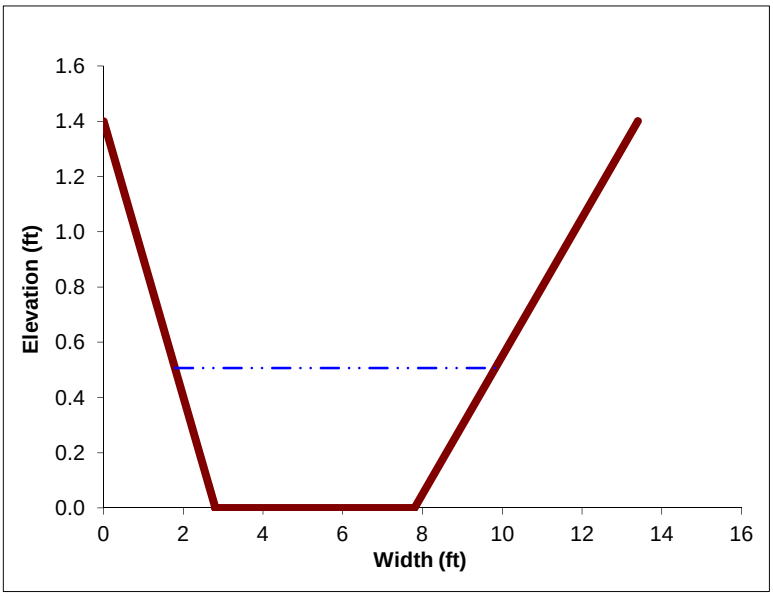
Precipitation 0.20 in/hr

Normal Depth Calculations for Channels using Manning's Equation

Bioswale from "A1" Line 300+96 to 302+62, Rt

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	0.007	ft/ft
Design Flow	4.32	cfs



Normal Depth for Channel

Depth	0.5	ft
Area	3.30	ft^2
Perimeter	8.22	ft
Rh	0.40	ft
V	1.31	ft/s
Q	4.32	cfs
Goal Seek	0.00	

Length 162 ft

FL US	427.17	ft
FL DS	426.11	ft

Watershed Area

Unpaved	0.17	ac
Paved	0.69	ac
Upstream	0.00	ac
DS 26	0.52	ac
Total	1.38	ac

C Value

Unpaved	0.66
Paved	1.00
Upstream	0.00
DS 20	1.00
Weighted	0.96

Time of Concentration

Tt Upstream	0.0	min
Tt Self	2.1	min
Tc	2.1	min

Precipitation 3.27 in/hr

Freeboard

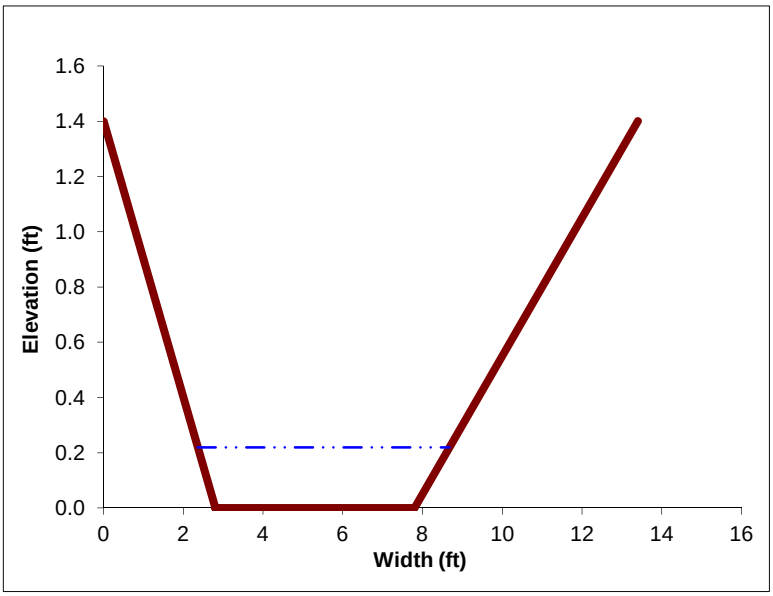
Energy head (He)=	0.53	ft
Min freeboard (0.2He)=	0.11	ft
Ditch freeboard =	0.89	ft
Sufficient freeboard?	yes	

Normal Depth Calculations for Channels using Manning's Equation **WQF Calc**

Bioswale from "A1" Line 300+96 to 302+62, Rt

Input Values

Height	1.4	ft
Width	5	ft
LT Side Slope	2	:1 (h:v)
Rt Side Slope	4	:1 (h:v)
Mannings	0.2	
Slope	0.007	ft/ft
Design Flow	0.25	cfs



Normal Depth for Channel

Depth	0.2	ft
Area	1.24	ft^2
Perimeter	6.39	ft
Rh	0.19	ft
V	0.20	ft/s
Q	0.25	cfs
Goal Seek	0.00	

Length 162 ft

FL US	427.17	ft
FL DS	426.11	ft

Watershed Area

Unpaved	0.17	ac
Paved	0.69	ac
Upstream	0.00	ac
DS 26	0.52	ac
Total	1.38	ac

Hydraulic residence time =	13.4	min
Velocity less than 1 ft/s?	yes	
Depth less than 6"?	yes	
Treatment soil top width =	13.4	ft
Treatment soil area =	2,171	sq. ft
Untreated imperv. WS area =	0.69	ac
	30,056	sq. ft
Swale % of total imperv. =	7.2	%

C Value

Unpaved	0.6	
Paved	0.90	
Upstream	0.00	
DS 20	1.00	<-- uses the Q25 C values (conservatively large)
Weighted	0.90	

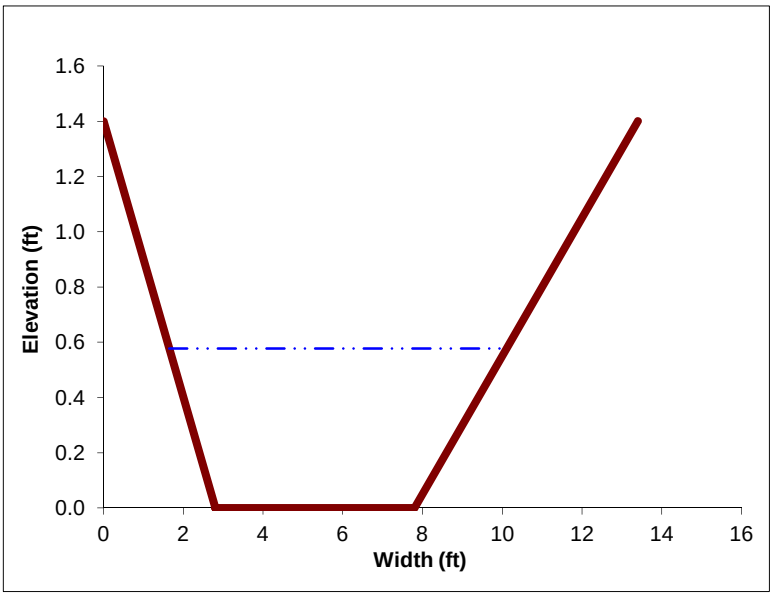
Precipitation 0.20 in/hr

Normal Depth Calculations for Channels using Manning's Equation

Bioswale from "A1" Line 306+69 to 308+33, Rt

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	0.006	ft/ft
Design Flow	5.34	cfs



Normal Depth for Channel

Depth	0.6	ft
Area	3.89	ft^2
Perimeter	8.67	ft
Rh	0.45	ft
V	1.37	ft/s
Q	5.34	cfs
Goal Seek	0.00	

Length 162 ft

FL US	423.70	ft
FL DS	422.69	ft

Watershed Area

Unpaved	0.11	ac
Paved	0.96	ac
Upstream	0.00	ac
DS 29	0.60	ac
Total	1.67	ac

C Value

Unpaved	0.66
Paved	1.00
Upstream	0.00
DS 20	1.00
Weighted	0.98

Time of Concentration

Tt Upstream	0.0	min
Tt Self	2.0	min
Tc	2.0	min

Precipitation 3.27 in/hr

Freeboard

Energy head (He)=	0.61	ft
Min freeboard (0.2He)=	0.12	ft
Ditch freeboard =	0.82	ft
Sufficient freeboard?	yes	

Normal Depth Calculations for Channels using Manning's Equation **WQF Calc**

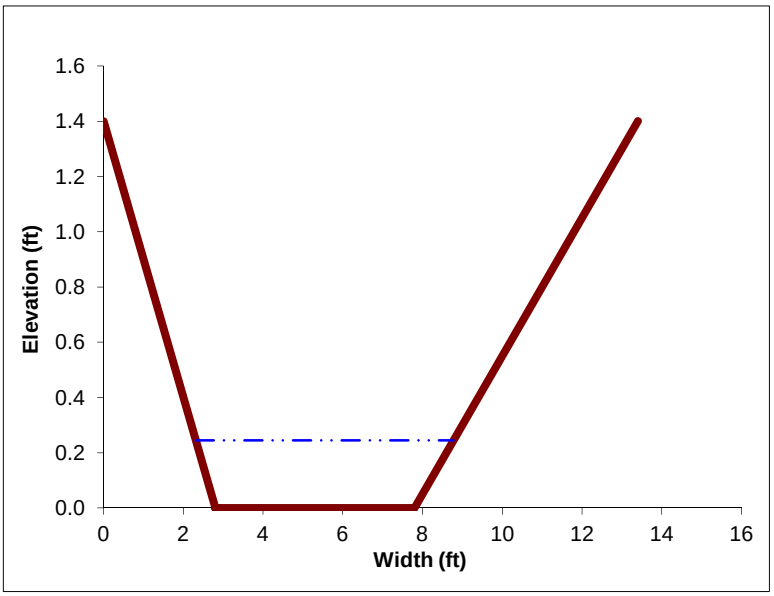
Bioswale from "A1" Line 306+69 to 308+33, Rt

Input Values

Height	1.4	ft
Width	5	ft
LT Side Slope	2	:1 (h:v)
Rt Side Slope	4	:1 (h:v)
Mannings	0.2	
Slope	0.006	ft/ft
Design Flow	0.29	cfs

Normal Depth for Channel

Depth	0.2	ft
Area	1.40	ft^2
Perimeter	6.55	ft
Rh	0.21	ft
V	0.21	ft/s
Q	0.29	cfs
Goal Seek	0.00	



Length 162 ft

FL US	423.70	ft
FL DS	422.69	ft

Watershed Area

Unpaved	0.11	ac
Paved	0.96	ac
Upstream	0.00	ac
DS 29	0.60	ac
Total	1.67	ac

C Value

Unpaved	0.60
Paved	0.90
Upstream	0.00
DS 20	0.90
Weighted	0.88

Precipitation 0.20 in/hr

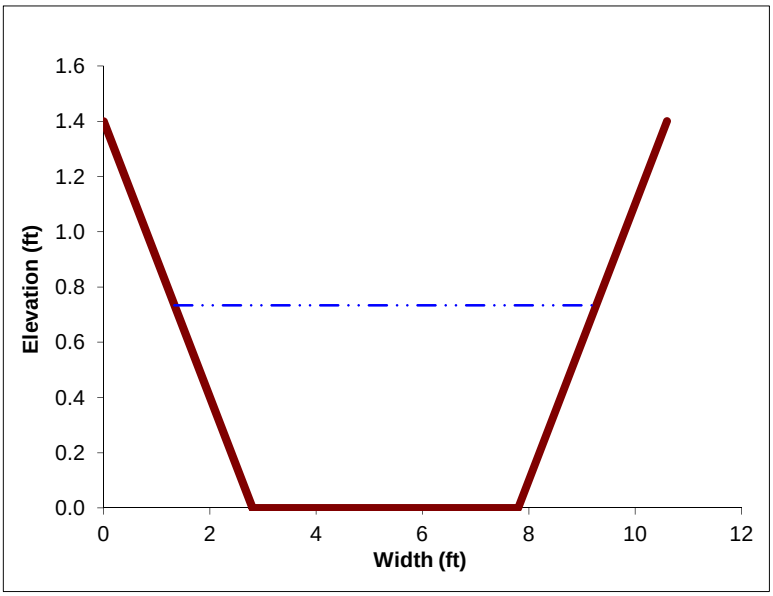
Hydraulic residence time =	12.9	min
Velocity less than 1 ft/s?	yes	
Depth less than 6"?	yes	
Treatment soil top width =	13.4	ft
Treatment soil area =	2,171	sq. ft
Untreated imperv. WS area =	0.96	ac
	41,818	sq. ft
Swale % of total imperv. =	5.2	%

Normal Depth Calculations for Channels using Manning's Equation

Bioswale 4ad, from "V" Line 105+51 to 109+50, Lt

Input Values

Height	1.4	ft
Width	5	ft
LT Side Slope	2	:1 (h:v)
Rt Side Slope	2	:1 (h:v)
Mannings	0.05	
Slope	0.018	ft/ft
Design Flow	13.08	cfs



Normal Depth for Channel

Depth	0.734	ft
Area	4.75	ft^2
Perimeter	8.28	ft
Rh	0.57	ft
V	2.75	ft/s
Q	13.08	cfs
Goal Seek	0.00	

Length 375 ft

Watershed Area

Unpaved	1.37	ac
Paved	3.87	ac
Upstream	2.61	ac
Total	7.85	ac

C Value

Unpaved	0.66
Paved	1.00
Upstream	0.71
Weighted	0.84

Time of Concentration

Tt Upstream	11.1	min
Tt Self	2.3	min
Tc	13.4	min

Precipitation 1.97 in/hr

Freeboard

Energy head (He)=	0.85	ft
Min freeboard (0.2He)=	0.17	ft
Ditch freeboard =	0.67	ft
Sufficient freeboard?	yes	

Weir Height = 1.0 ft

Weir Length = 7.8 ft

Flow through rectangular weir (x2)

q = 3.33 (b - 0.2 h) h^3/2

q = flow rate (cfs) = 1/2 design flow

h = head on the weir (ft)

b = width of the weir = 1/2 weir length above

q =	6.5	cfs
b =	3.9	ft
h =	0.65	ft

calc q = 6.6

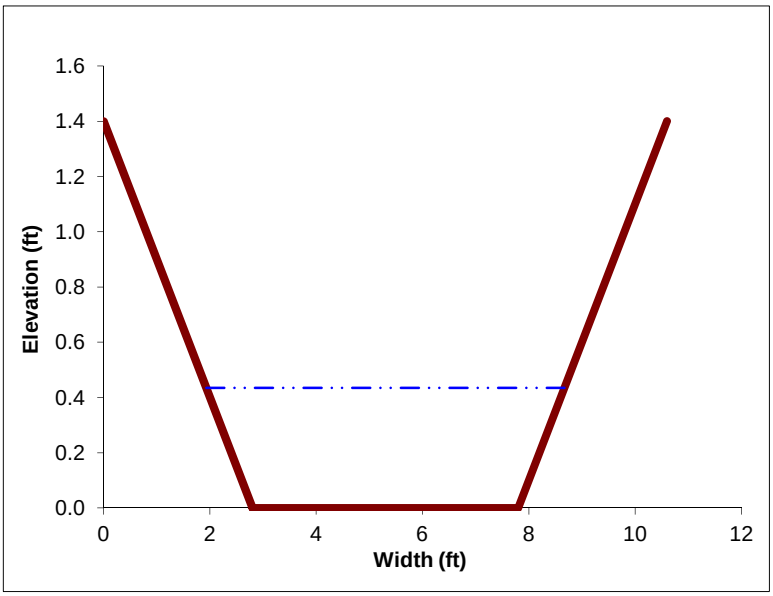
Flow depth at weir = 1.7 ft

Normal Depth Calculations for Channels using Manning's Equation

Bioswale 4ad, from "V" Line 105+51 to 109+50, Lt

Input Values

Height	1.4	ft
Width	5	ft
LT Side Slope	2	:1 (h:v)
Rt Side Slope	2	:1 (h:v)
Mannings	0.2	
Slope	0.018	ft/ft
Design Flow	1.31	cfs



Normal Depth for Channel

Depth	0.435	ft
Area	2.55	ft^2
Perimeter	6.95	ft
Rh	0.37	ft
V	0.51	ft/s
Q	1.31	cfs
Goal Seek	0.00	

Length 375 ft

Watershed Area

Unpaved	1.37	ac
Paved	3.87	ac
Upstream	2.61	ac
Total	7.85	ac

C Value

Unpaved	0.60
Paved	1.00
Upstream	0.71
Weighted	0.83

Precipitation 0.20 in/hr

Hydraulic residence time =	12.2	min
Velocity less than 1 ft/s?	yes	
Depth less than 6"?	yes	
Treatment soil height over FL =	0.5	ft
Treatment soil top width =	7	ft
Treatment soil area =	2,625	sq. ft
Untreated imperv. WS area =	1.85	ac
	80,586	sq. ft
Swale % of total imperv. =	3.3	%

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Walnut Creek, CA 94596
Phone: 925.941.0017
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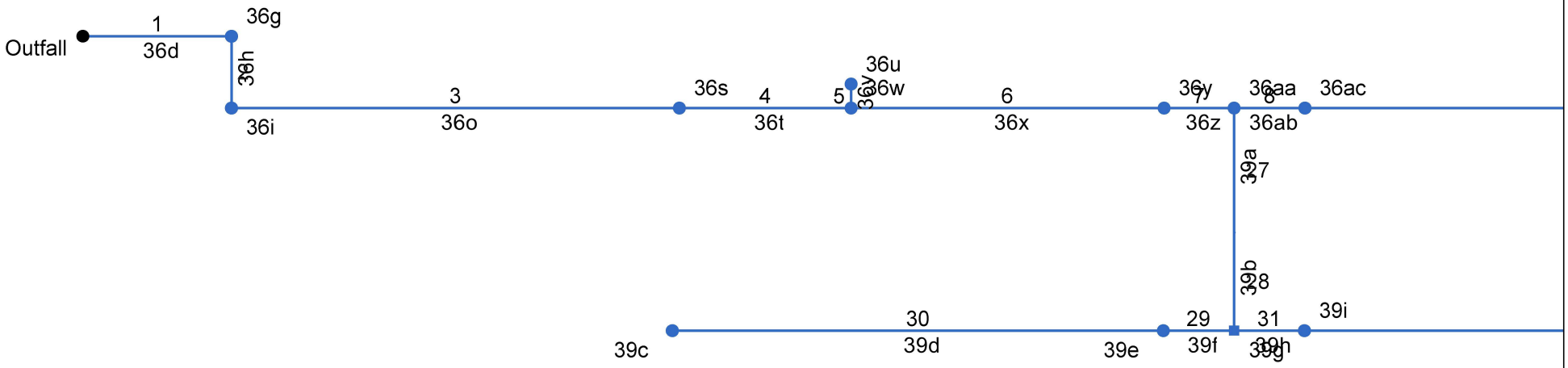
www.wreco.com

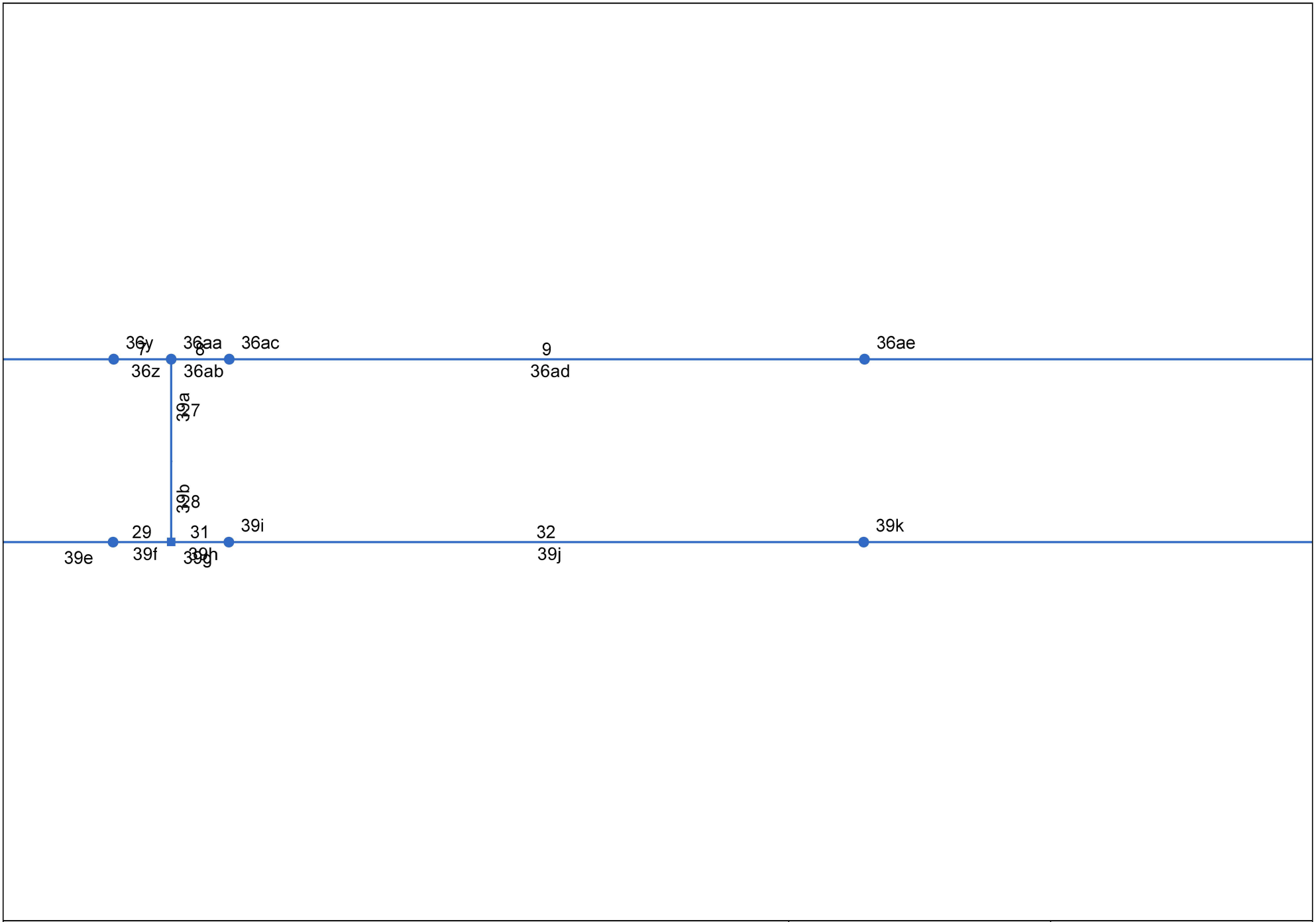
Attachment 7 – DS 36 Hydraflow Results

DS 36 & 39 (Final)



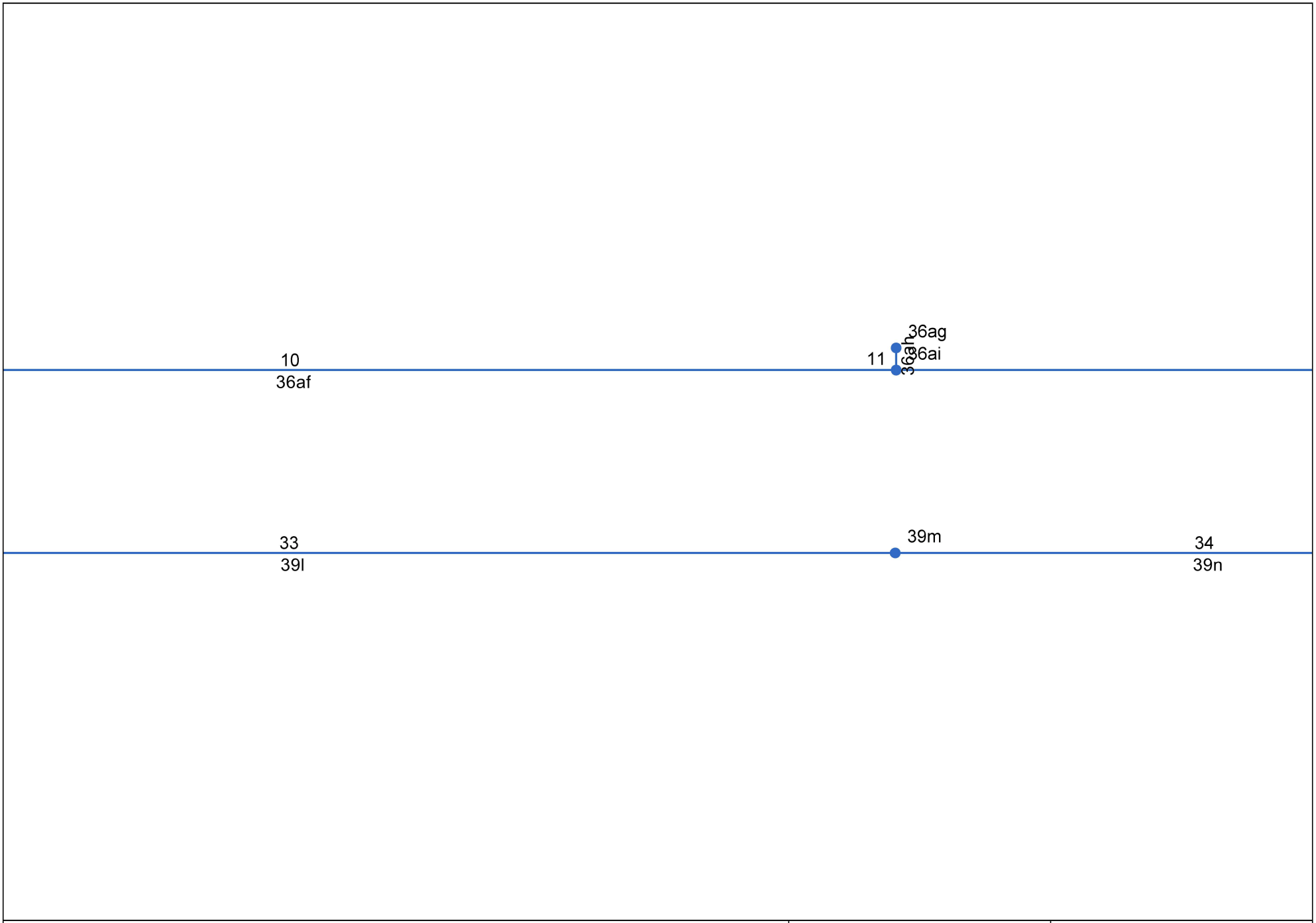
Project File: DS_36_39.stm	Number of lines: 42	Date: 10/31/2014

DS 36 & 39 (Final)



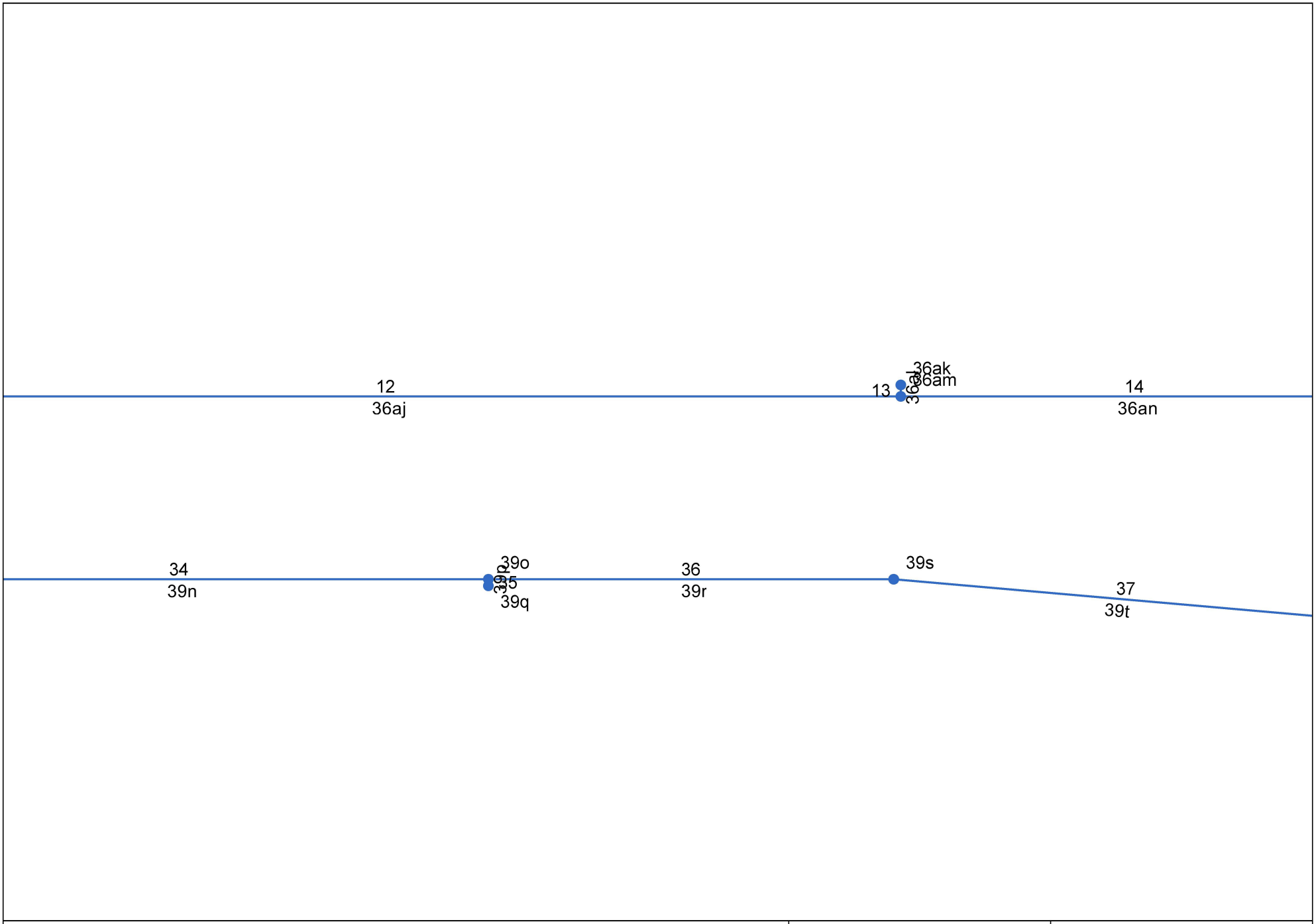
Project File: DS_36_39.stm	Number of lines: 42	Date: 10/31/2014

DS 36 & 39 (Final)



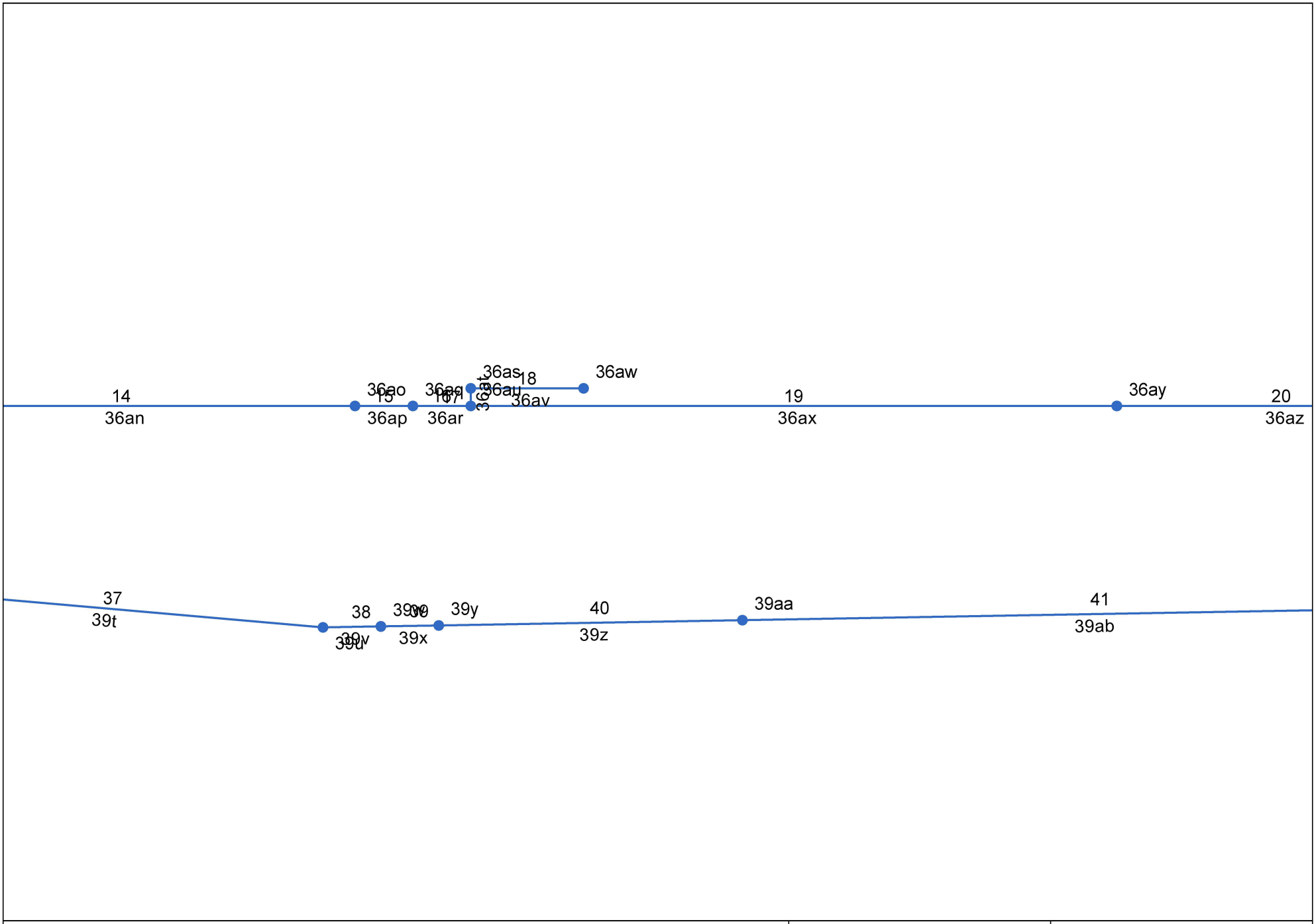
Project File: DS_36_39.stm	Number of lines: 42	Date: 10/31/2014

DS 36 & 39 (Final)



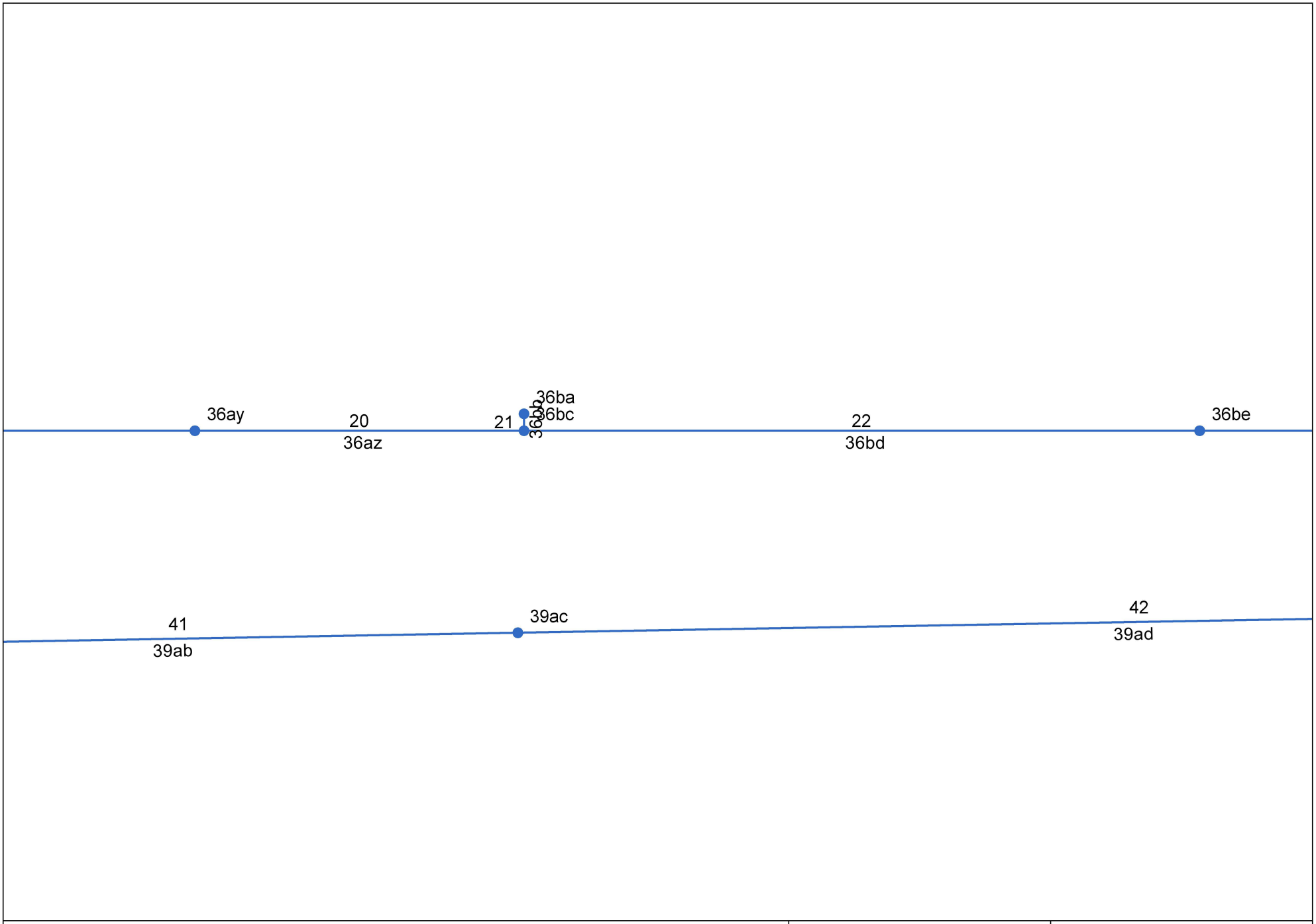
Project File: DS_36_39.stm	Number of lines: 42	Date: 10/31/2014

DS 36 & 39 (Final)



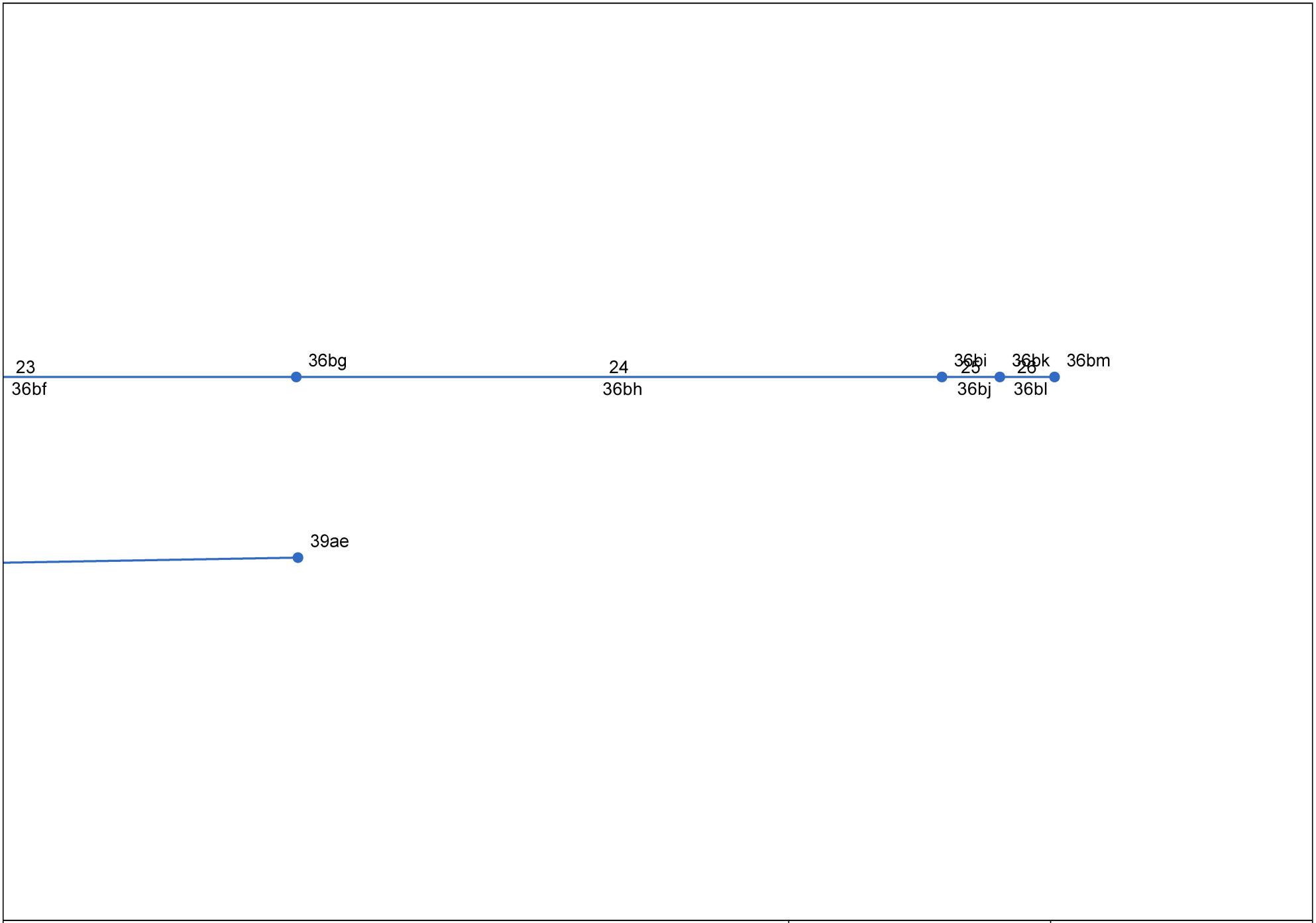
Project File: DS_36_39.stm	Number of lines: 42	Date: 10/31/2014

DS 36 & 39 (Final)



Project File: DS_36_39.stm	Number of lines: 42	Date: 10/31/2014

DS 36 & 39 (Final)



Project File: DS_36_39.stm	Number of lines: 42	Date: 10/31/2014

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	57.1	0.0	MH	0.00	0.00	0.00	0.0	404.18	0.09	404.23	42	Cir	0.013	1.00	410.00	36d
2	1	27.7	90.0	MH	0.00	0.00	0.00	0.0	404.33	9.13	406.86	42	Cir	0.013	1.00	421.54	36h
3	2	172.1	-90.0	Genr	0.00	0.39	1.00	5.0	406.96	1.60	409.72	42	Cir	0.013	0.50	421.29	36o
4	3	66.0	0.0	MH	0.00	0.00	0.00	0.0	409.12	0.11	409.19	42	Cir	0.013	1.00	421.16	36t
5	4	9.2	-90.0	Genr	0.00	0.11	1.00	5.0	416.25	2.07	416.44	18	Cir	0.024	1.00	420.49	36v
6	4	120.3	0.0	Genr	0.00	0.11	0.00	5.0	409.19	0.10	409.31	42	Cir	0.013	0.50	421.01	36x
7	6	26.9	0.0	Genr	0.00	0.06	1.00	5.0	409.31	0.11	409.34	42	Cir	0.013	1.50	420.73	36z
8	7	27.2	0.0	Genr	0.00	0.31	1.00	5.0	409.34	0.11	409.37	36	Cir	0.013	0.50	420.74	36ab
9	8	297.3	0.0	Genr	0.00	0.17	1.00	5.0	409.37	0.10	409.67	30	Cir	0.013	0.50	421.56	36ad
10	9	567.1	0.0	Genr	0.00	0.41	1.00	5.0	409.67	0.10	410.24	30	Cir	0.013	1.50	419.72	36af
11	10	10.4	-90.0	Genr	0.00	0.65	0.89	5.0	413.19	2.02	413.40	18	Cir	0.024	1.00	417.39	36ah
12	10	482.1	0.0	Genr	0.00	0.53	1.00	5.0	410.24	0.10	410.72	30	Cir	0.013	1.50	416.36	36aj
13	12	5.4	-90.0	Genr	0.00	0.54	0.87	5.0	410.72	2.04	410.83	18	Cir	0.024	1.00	414.50	36al
14	12	218.7	0.0	Genr	0.00	0.28	1.00	5.0	410.72	0.10	410.94	24	Cir	0.013	0.50	414.23	36an
15	14	27.1	0.0	Genr	0.00	0.09	1.00	5.0	410.94	0.11	410.97	24	Cir	0.013	0.50	414.22	36ap
16	15	27.1	0.0	Genr	0.00	0.42	1.00	5.0	411.07	0.11	411.10	24	Cir	0.013	1.50	414.20	36ar
17	16	8.3	-90.0	Genr	0.00	0.26	0.89	5.0	411.10	0.12	411.11	18	Cir	0.013	1.50	413.46	36at
18	17	52.8	90.0	Genr	0.00	0.58	0.95	5.0	411.11	0.13	411.18	18	Cir	0.013	1.00	413.39	36av
19	16	302.3	0.0	Genr	0.00	0.01	1.00	5.0	411.20	0.10	411.51	24	Cir	0.013	0.50	418.61	36ax
20	19	154.0	0.0	Genr	0.00	0.21	0.98	5.0	411.61	0.15	411.84	24	Cir	0.013	1.50	419.65	36az
21	20	8.0	-90.0	Genr	0.00	0.06	1.00	5.0	417.37	1.00	417.45	18	Cir	0.024	1.00	419.95	36bb
22	20	316.2	0.0	Genr	0.00	0.15	1.00	5.0	411.94	0.26	412.76	18	Cir	0.013	0.50	420.06	36bd
23	22	253.1	0.0	Genr	0.00	0.28	1.00	5.0	412.86	0.26	413.51	18	Cir	0.013	0.50	418.77	36bf

DS 36 & 39 (Final) | Number of lines: 42 | Date: 10/31/2014

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
24	23	302.2	0.0	Genr	0.00	0.33	1.00	5.0	413.61	0.26	414.40	18	Cir	0.013	0.50	417.59	36bh
25	24	27.1	0.0	Genr	0.00	0.06	1.00	5.0	414.50	0.26	414.57	18	Cir	0.013	0.50	417.50	36bj
26	25	25.6	0.0	Genr	0.00	0.09	1.00	5.0	414.67	0.27	414.74	18	Cir	0.013	1.00	417.55	36bl
27	7	48.0	90.0	None	0.00	0.00	0.00	0.0	409.44	0.12	409.50	30	Cir	0.013	0.15	420.72	39a
28	27	37.8	0.0	Genr	0.00	0.06	1.00	5.0	409.50	0.13	409.55	30	Cir	0.013	2.25	420.73	39b
29	28	27.2	90.0	Genr	0.00	0.20	1.00	5.0	410.50	1.21	410.83	18	Cir	0.024	0.50	420.74	39f
30	29	188.7	0.0	Genr	0.00	0.39	1.00	5.0	410.93	0.86	412.55	18	Cir	0.013	1.00	421.24	39d
31	28	27.0	-90.0	Genr	0.00	0.32	1.00	5.0	409.55	0.19	409.60	24	Cir	0.013	0.50	420.74	39h
32	31	297.1	0.0	Genr	0.00	0.65	0.81	5.0	409.60	0.16	410.07	24	Cir	0.013	0.50	421.57	39j
33	32	567.1	0.0	Genr	0.00	0.42	1.00	5.0	410.07	0.09	410.58	24	Cir	0.013	0.50	419.62	39l
34	33	289.5	0.0	Genr	0.00	0.30	1.00	5.0	410.58	0.18	411.10	24	Cir	0.013	1.50	417.72	39n
35	34	3.1	90.0	Genr	0.00	0.70	0.75	5.0	414.01	2.26	414.08	18	Cir	0.024	1.00	418.80	39p
36	34	189.7	0.0	Genr	0.00	0.20	1.00	5.0	411.10	0.18	411.44	24	Cir	0.013	0.50	416.45	39r
37	36	207.8	5.0	Genr	0.00	0.27	1.00	5.0	411.44	0.18	411.81	24	Cir	0.013	0.50	414.81	39t
38	37	27.1	-6.0	Genr	0.00	0.09	1.00	5.0	412.02	0.26	412.09	18	Cir	0.013	0.50	414.74	39v
39	38	27.1	0.0	Genr	0.00	0.23	1.00	5.0	412.19	0.26	412.26	18	Cir	0.013	0.50	414.76	39x
40	39	142.1	0.0	Genr	0.00	0.28	1.00	5.0	412.36	0.26	412.73	18	Cir	0.013	0.50	415.99	39z
41	40	326.4	0.0	Genr	0.00	0.28	1.00	5.0	412.83	0.29	413.77	18	Cir	0.013	0.50	419.20	39ab
42	41	573.1	0.0	Genr	0.00	0.65	1.00	5.0	413.87	0.26	415.36	18	Cir	0.013	1.00	418.33	39ad

DS 36 & 39 (Final) | Number of lines: 42 | Date: 10/31/2014

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	57.1	0.00	11.14	0.00	0.00	10.53	0.0	42.1	1.1	11.58	29.78	1.20	42	0.09	404.18	404.23	408.70	408.71	411.43	410.00	36d
2	1	27.7	0.00	11.14	0.00	0.00	10.53	0.0	41.8	1.1	11.62	304.1	1.75	42	9.13	404.33	406.86	408.73	408.68	410.00	421.54	36h
3	2	172.1	0.39	11.14	1.00	0.39	10.53	5.0	41.3	1.1	11.70	127.4	5.36	42	1.60	406.96	409.72	408.82	410.44	421.54	421.29	36o
4	3	66.0	0.00	10.75	0.00	0.00	10.14	0.0	40.5	1.1	11.38	32.77	1.37	42	0.11	409.12	409.19	411.97	411.98	421.29	421.16	36t
5	4	9.2	0.11	0.11	1.00	0.11	0.11	5.0	5.0	3.2	0.36	8.17	2.31	18	2.07	416.25	416.44	416.46	416.65	421.16	420.49	36v
6	4	120.3	0.11	10.64	0.00	0.00	10.03	5.0	39.0	1.1	11.46	31.77	1.40	42	0.10	409.19	409.31	412.01	412.03	421.16	421.01	36x
7	6	26.9	0.06	10.53	1.00	0.06	10.03	5.0	38.7	1.1	11.51	33.60	1.44	42	0.11	409.31	409.34	412.04	412.04	421.01	420.73	36z
8	7	27.2	0.31	5.43	1.00	0.31	5.23	5.0	38.2	1.2	6.04	22.15	0.89	36	0.11	409.34	409.37	412.10	412.10	420.73	420.74	36ab
9	8	297.3	0.17	5.12	1.00	0.17	4.92	5.0	34.1	1.2	6.02	13.03	1.23	30	0.10	409.37	409.67	412.11	412.17	420.74	421.56	36ad
10	9	567.1	0.41	4.95	1.00	0.41	4.75	5.0	27.1	1.4	6.53	13.00	1.42	30	0.10	409.67	410.24	412.18	412.32	421.56	419.72	36af
11	10	10.4	0.65	0.65	0.89	0.58	0.58	5.0	5.0	3.2	1.87	8.08	3.64	18	2.02	413.19	413.40	413.68	413.89	419.72	417.39	36ah
12	10	482.1	0.53	3.89	1.00	0.53	3.76	5.0	21.2	1.6	5.86	12.94	1.45	30	0.10	410.24	410.72	412.37	412.47	419.72	416.36	36aj
13	12	5.4	0.54	0.54	0.87	0.47	0.47	5.0	5.0	3.2	1.52	8.12	0.86	18	2.04	410.72	410.83	412.56	412.56	416.36	414.50	36al
14	12	218.7	0.28	2.82	1.00	0.28	2.76	5.0	18.8	1.7	4.58	7.17	1.58	24	0.10	410.72	410.94	412.53	412.61	416.36	414.23	36an
15	14	27.1	0.09	2.54	1.00	0.09	2.48	5.0	18.4	1.7	4.15	7.53	1.47	24	0.11	410.94	410.97	412.63	412.64	414.23	414.22	36ap
16	15	27.1	0.42	2.45	1.00	0.42	2.39	5.0	18.1	1.7	4.03	7.53	1.52	24	0.11	411.07	411.10	412.66	412.66	414.22	414.20	36ar
17	16	8.3	0.26	0.84	0.89	0.23	0.78	5.0	5.9	3.0	2.34	3.64	1.32	18	0.12	411.10	411.11	412.73	412.73	414.20	413.46	36at
18	17	52.8	0.58	0.58	0.95	0.55	0.55	5.0	5.0	3.2	1.78	3.82	1.01	18	0.13	411.11	411.18	412.78	412.80	413.46	413.39	36av
19	16	302.3	0.01	1.19	1.00	0.01	1.19	5.0	13.0	2.0	2.37	7.24	1.03	24	0.10	411.20	411.51	412.73	412.77	414.20	418.61	36ax
20	19	154.0	0.21	1.18	0.98	0.21	1.18	5.0	11.3	2.1	2.52	8.74	1.48	24	0.15	411.61	411.84	412.78	412.83	418.61	419.65	36az
21	20	8.0	0.06	0.06	1.00	0.06	0.06	5.0	5.0	3.2	0.19	5.69	1.49	18	1.00	417.37	417.45	417.56	417.64	419.65	419.95	36bb
22	20	316.2	0.15	0.91	1.00	0.15	0.91	5.0	9.2	2.4	2.17	5.35	2.40	18	0.26	411.94	412.76	412.91	413.40	419.65	420.06	36bd

DS 36 & 39 (Final) | Number of lines: 42 | Run Date: 10/31/2014

NOTES:Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

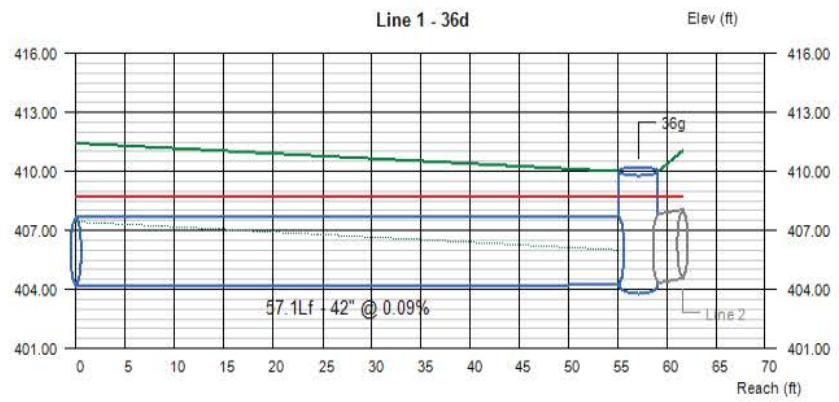
Storm Sewer Tabulation

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	253.1	0.28	0.76	1.00	0.28	0.76	5.0	7.7	2.6	1.98	5.32	2.80	18	0.26	412.86	413.51	413.49	414.14	420.06	418.77	36bf
24	23	302.2	0.33	0.48	1.00	0.33	0.48	5.0	5.7	3.0	1.45	5.37	2.58	18	0.26	413.61	414.40	414.14	414.93	418.77	417.59	36bh
25	24	27.1	0.06	0.15	1.00	0.06	0.15	5.0	5.4	3.1	0.47	5.34	1.22	18	0.26	414.50	414.57	414.94	414.95	417.59	417.50	36bj
26	25	25.6	0.09	0.09	1.00	0.09	0.09	5.0	5.0	3.2	0.29	5.49	1.21	18	0.27	414.67	414.74	414.99	415.01	417.50	417.55	36bl
27	7	48.0	0.00	5.04	0.00	0.00	4.74	0.0	28.7	1.3	6.34	14.50	1.29	30	0.12	409.44	409.50	412.10	412.11	420.73	420.72	39a
28	27	37.8	0.06	5.04	1.00	0.06	4.74	5.0	28.2	1.3	6.39	14.91	1.30	30	0.13	409.50	409.55	412.11	412.12	420.72	420.73	39b
29	28	27.2	0.20	0.59	1.00	0.20	0.59	5.0	6.4	2.9	1.69	6.27	0.97	18	1.21	410.50	410.83	412.19	412.22	420.73	420.74	39f
30	29	188.7	0.39	0.39	1.00	0.39	0.39	5.0	5.0	3.2	1.26	9.73	2.25	18	0.86	410.93	412.55	412.23	412.92	420.74	421.24	39d
31	28	27.0	0.32	4.39	1.00	0.32	4.09	5.0	28.0	1.4	5.54	9.73	1.76	24	0.19	409.55	409.60	412.18	412.20	420.73	420.74	39h
32	31	297.1	0.65	4.07	0.81	0.53	3.77	5.0	25.0	1.4	5.40	9.00	1.72	24	0.16	409.60	410.07	412.23	412.40	420.74	421.57	39j
33	32	567.1	0.42	3.42	1.00	0.42	3.25	5.0	19.2	1.6	5.32	6.78	1.69	24	0.09	410.07	410.58	412.42	412.73	421.57	419.62	39l
34	33	289.5	0.30	3.00	1.00	0.30	2.83	5.0	16.1	1.8	5.06	9.59	1.66	24	0.18	410.58	411.10	412.76	412.89	419.62	417.72	39n
35	34	3.1	0.70	0.70	0.75	0.53	0.53	5.0	5.0	3.2	1.70	8.55	3.76	18	2.26	414.01	414.08	414.46	414.53	417.72	418.80	39p
36	34	189.7	0.20	2.00	1.00	0.20	2.00	5.0	13.8	1.9	3.89	9.58	1.37	24	0.18	411.10	411.44	412.96	413.01	417.72	416.45	39r
37	36	207.8	0.27	1.80	1.00	0.27	1.80	5.0	11.6	2.1	3.82	9.54	1.61	24	0.18	411.44	411.81	413.02	413.09	416.45	414.81	39t
38	37	27.1	0.09	1.53	1.00	0.09	1.53	5.0	11.4	2.1	3.27	5.34	2.41	18	0.26	412.02	412.09	413.12	413.15	414.81	414.74	39v
39	38	27.1	0.23	1.44	1.00	0.23	1.44	5.0	11.2	2.2	3.10	5.34	2.53	18	0.26	412.19	412.26	413.19	413.23	414.74	414.76	39x
40	39	142.1	0.28	1.21	1.00	0.28	1.21	5.0	10.3	2.2	2.72	5.36	2.52	18	0.26	412.36	412.73	413.34	413.53	414.76	415.99	39z
41	40	326.4	0.28	0.93	1.00	0.28	0.93	5.0	8.4	2.5	2.32	5.64	2.77	18	0.29	412.83	413.77	413.69	414.40	415.99	419.20	39ab
42	41	573.1	0.65	0.65	1.00	0.65	0.65	5.0	5.0	3.2	2.10	5.35	2.84	18	0.26	413.87	415.36	414.53	416.01	419.20	418.33	39ad

DS 36 & 39 (Final) | Number of lines: 42 | Run Date: 10/31/2014

NOTES:Intensity = 7.44 / (Inlet time + 0.10) ^ 0.51 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

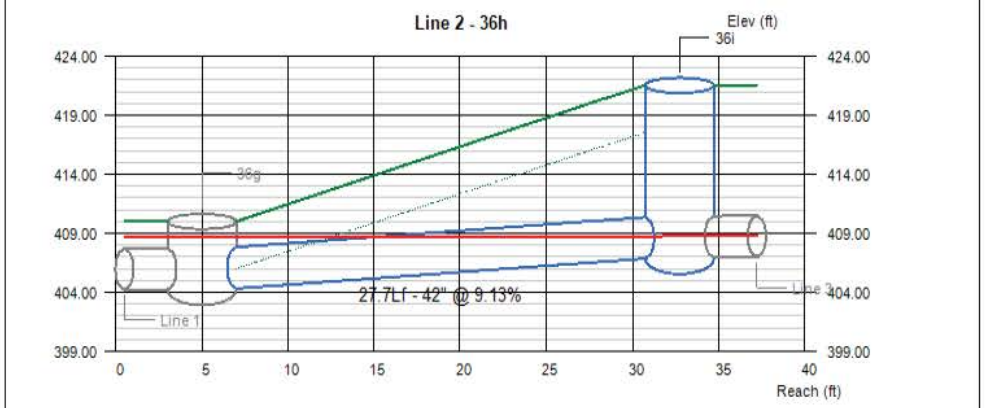
Line Profile (Line 1) - 36d



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	11.68	404.18	404.23	3.50	3.50	4.50	408.70	408.71	408.73	1.20	1.20	3.75	2.27

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

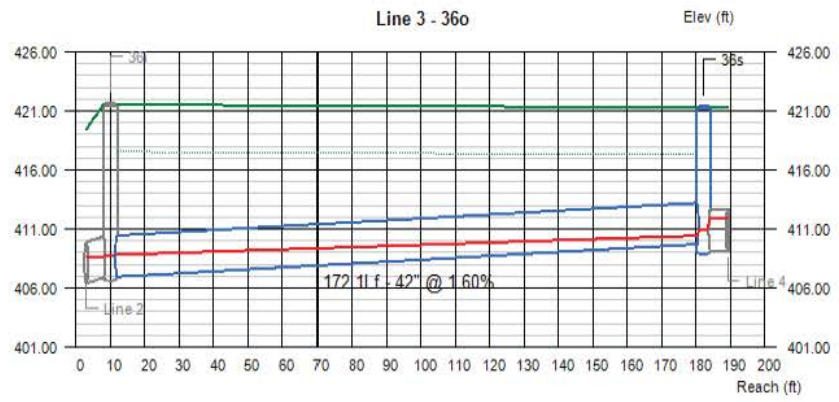
Line Profile (Line 2) - 36h



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	11.62	404.33	406.86	3.50	1.82	1.90	408.73	408.68	408.76	1.21	2.30	2.17	11.18

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

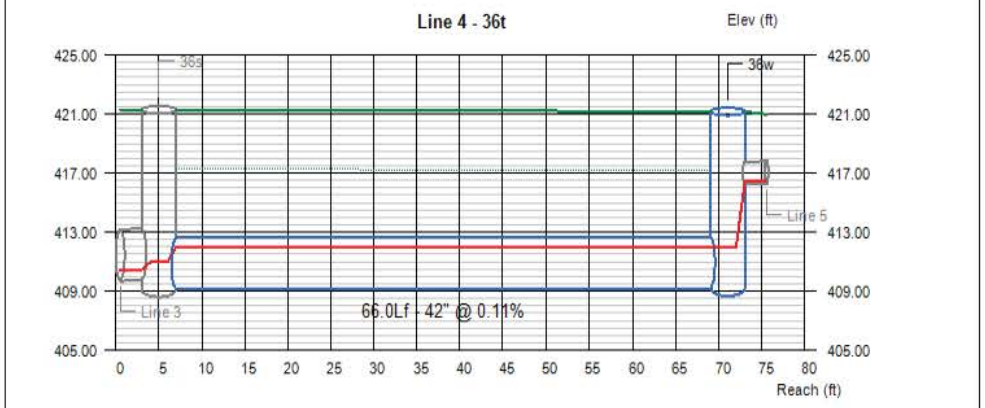
Line Profile (Line 3) - 36o



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)
3	11.70	406.96	408.72	1.86	0.72	1.25	408.82	410.44	410.97	2.48	8.25	11.08	8.07

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

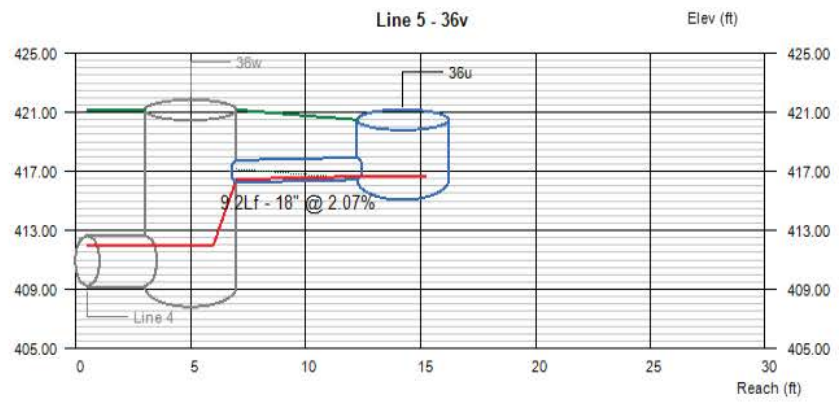
Line Profile (Line 4) - 36t



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)
4	11.36	409.12	409.19	2.85	2.79	2.82	411.97	411.98	412.01	1.36	1.38	8.67	8.47

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

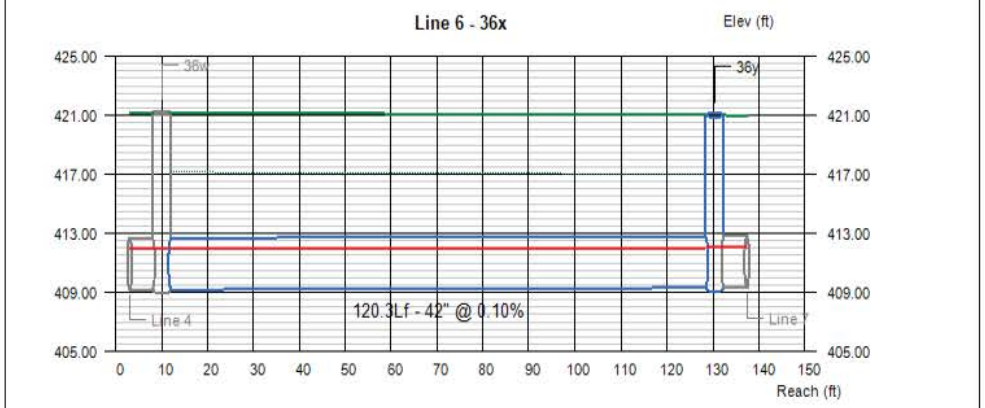
Line Profile (Line 5) - 36v



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	0.35	416.26	416.44	0.21	0.21	0.21	416.48	416.65	416.65	2.31	2.31	3.41	2.55

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

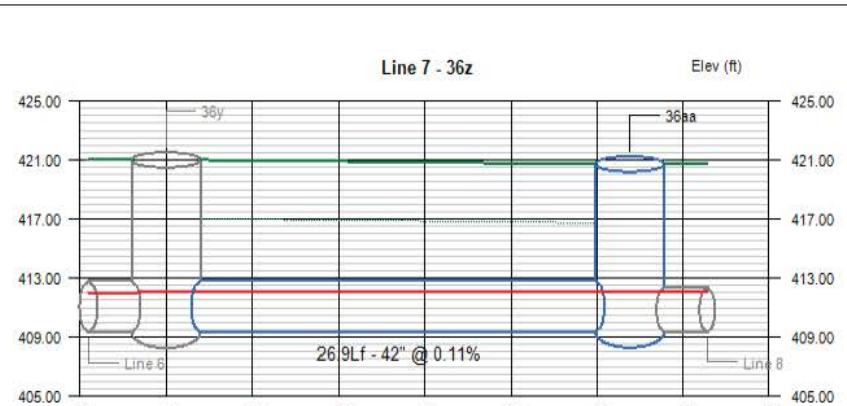
Line Profile (Line 6) - 36x



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	11.46	409.19	409.31	2.82	2.72	2.73	412.01	412.03	412.04	1.38	1.43	8.47	8.20

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

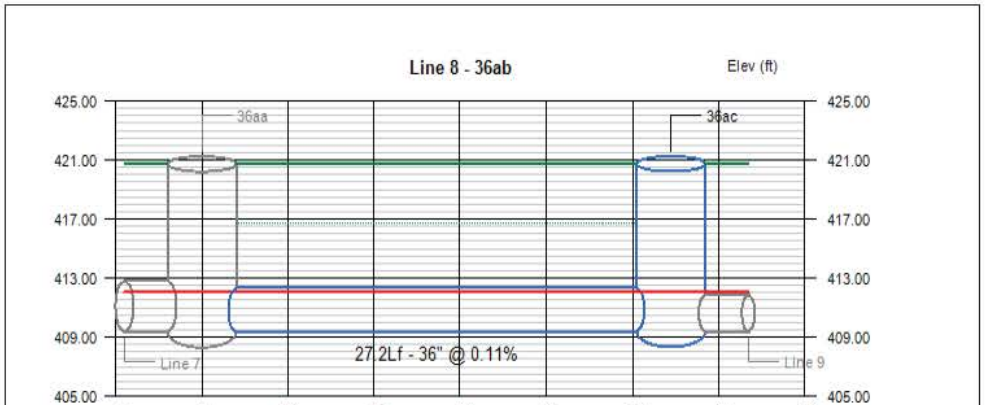
Line Profile (Line 7) - 36z



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	11.51	409.31	409.34	2.73	2.70	2.75	412.04	412.04	412.09	1.43	1.44	8.20	7.89

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

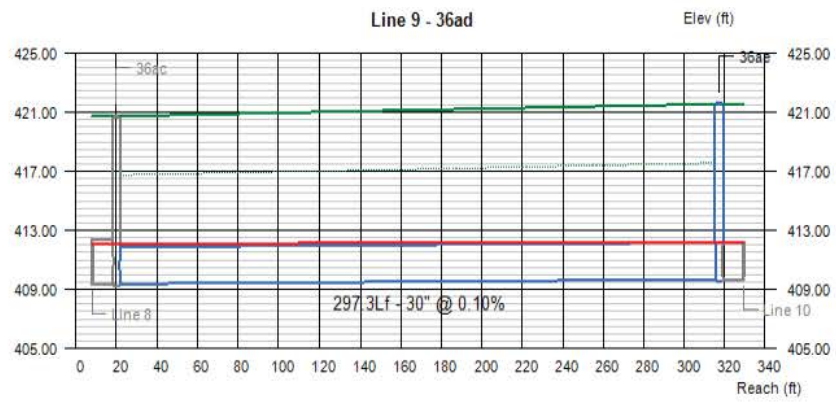
Line Profile (Line 8) - 36ab



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	6.04	409.34	409.37	2.76	2.73	2.74	412.10	412.10	412.11	0.88	0.89	8.39	8.07

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

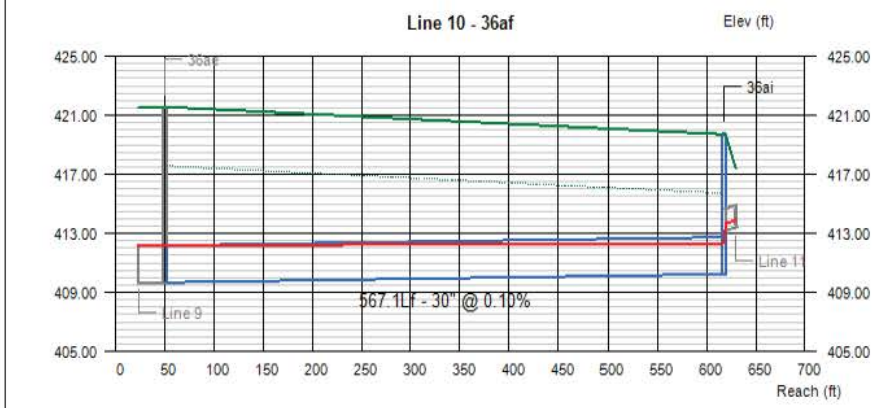
Line Profile (Line 9) - 36ad



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	6.02	409.37	409.67	2.50	2.50	2.51	412.11	412.17	412.18	1.23	1.23	8.87	9.39

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

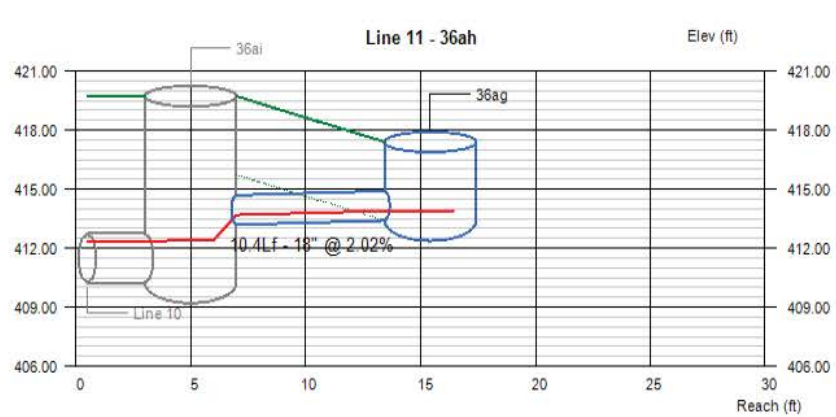
Line Profile (Line 10) - 36af



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)
10	5.53	409.67	410.24	2.50	2.08	2.13	412.18	412.32	412.37	1.33	1.50	9.39	8.98

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

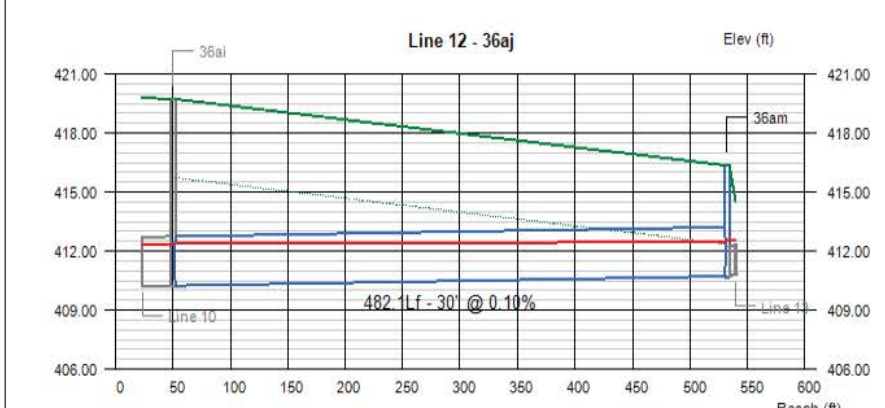
Line Profile (Line 11) - 36ah



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)
11	1.87	413.19	413.40	0.49	0.49	0.49	413.68	413.89	413.89	3.66	3.72	5.03	2.49

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

Line Profile (Line 12) - 36aj



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)
12	6.86	410.24	410.72	2.13	1.75	1.81	412.37	412.47	412.53	1.31	1.59	8.98	8.14

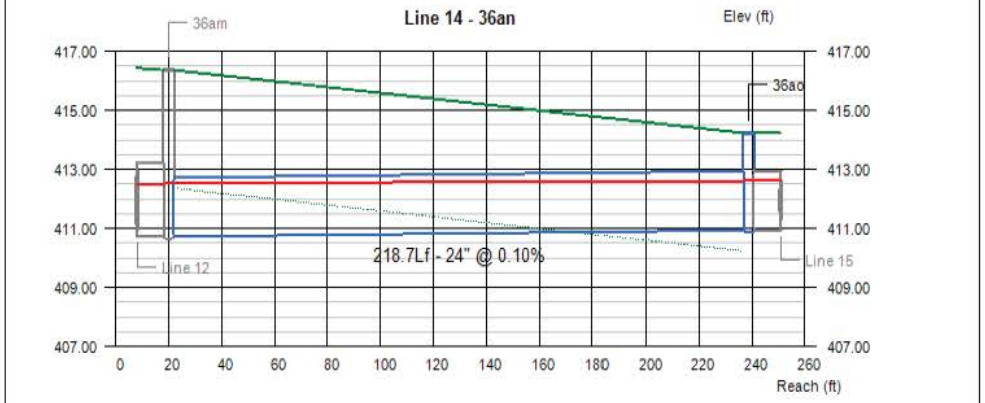
DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

Line Profile (Line 13) - 36al

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	1.52	410.72	410.83	1.50	1.50	1.75	412.58	412.56	412.58	0.86	0.85	4.14	2.17

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

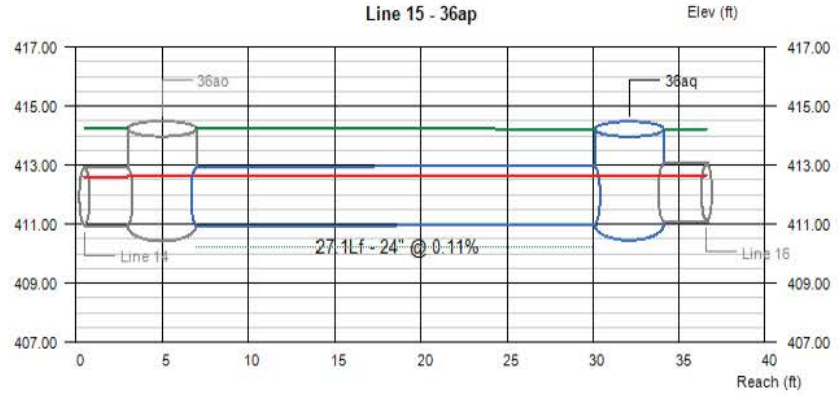
Line Profile (Line 14) - 36an



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	4.58	410.72	410.94	1.87	1.67	1.89	412.63	412.61	412.63	1.53	1.63	3.64	1.29

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

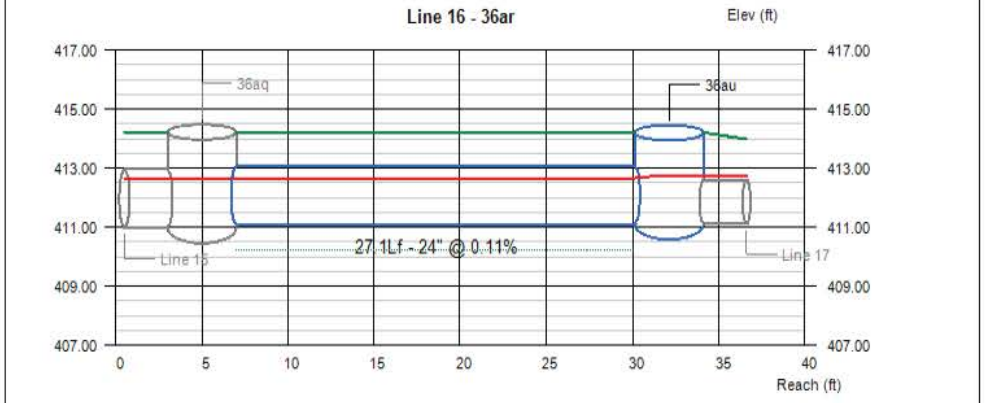
Line Profile (Line 15) - 36ap



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	4.16	410.94	410.97	1.69	1.67	1.69	412.63	412.64	412.66	1.46	1.48	1.29	1.25

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

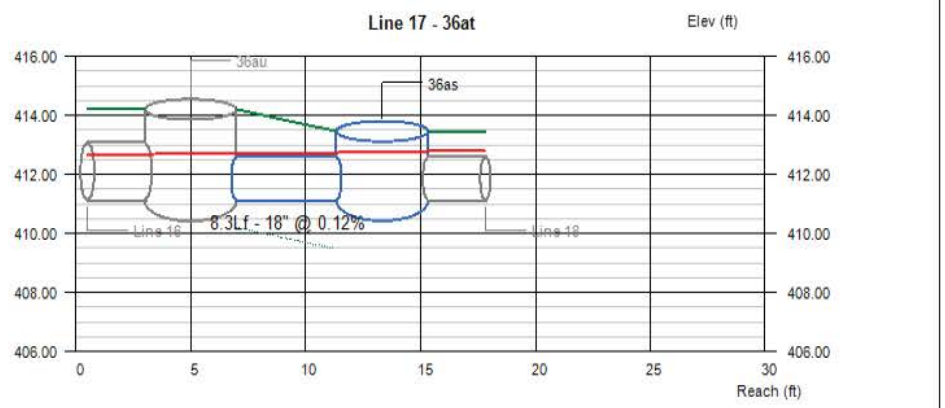
Line Profile (Line 16) - 36ar



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	4.03	411.07	411.10	1.69	1.59	1.82	412.66	412.66	412.72	1.51	1.53	1.15	1.10

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

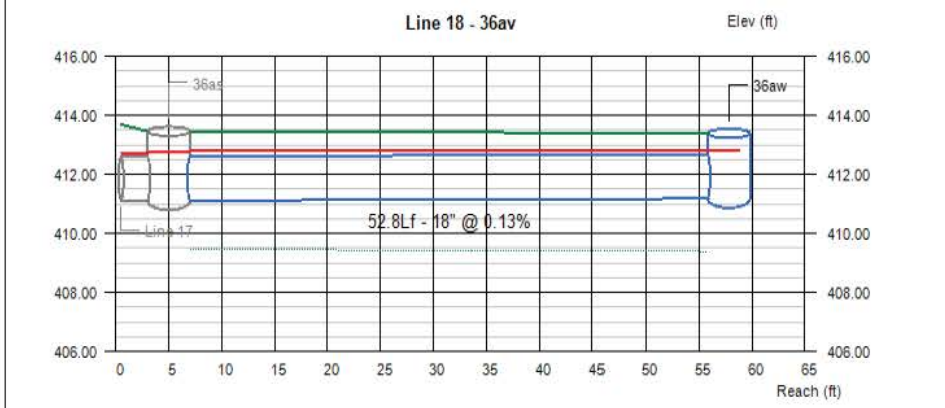
Line Profile (Line 17) - 36at



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)
17	2.34	411.10	411.11	1.50	1.50	1.66	412.73	412.73	412.77	1.32	1.32	1.60	0.85

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

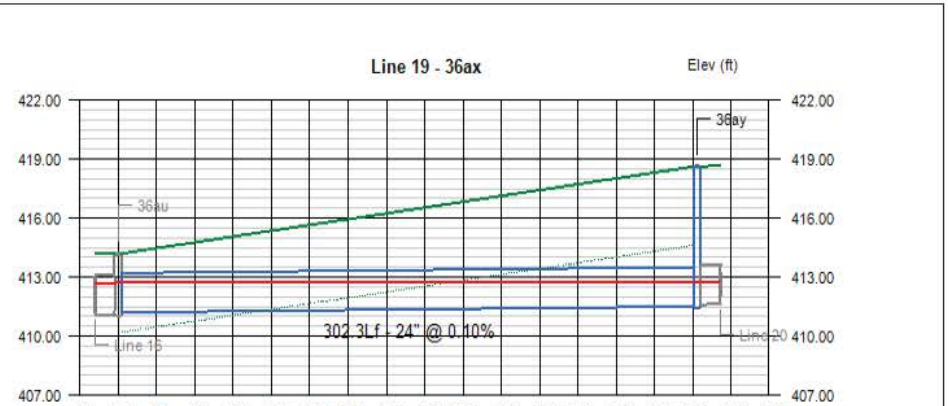
Line Profile (Line 18) - 36av



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
		Dn	Up	Dn	Up	Hw	Dn	Up	Jnc.	Dn	Up	Dn	Up
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/s)	(ft/s)	(ft)	(ft)
18	1.78	411.11	411.18	1.50	1.50	1.63	412.78	412.80	412.81	1.01	1.01	0.85	0.71

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

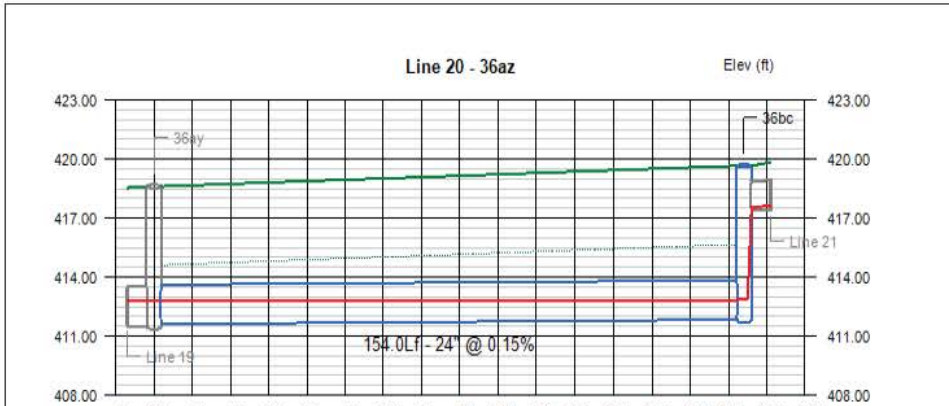
Line Profile (Line 19) - 36ax



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)
19	2.37	411.20	411.61	1.53	1.26	1.27	412.73	412.77	412.78	0.92	1.14	1.00	5.10

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

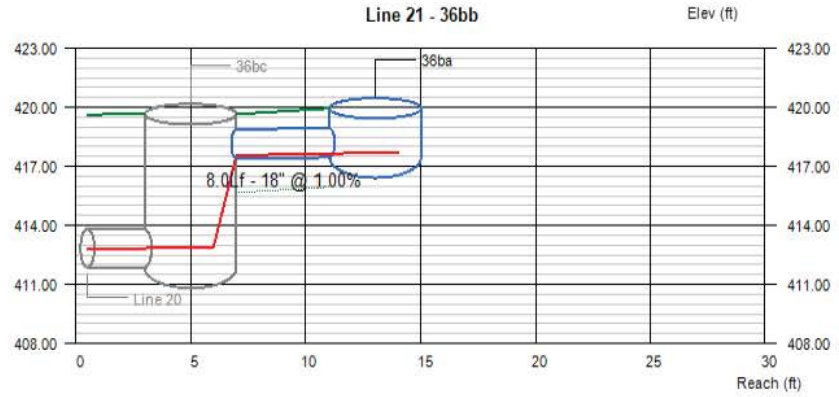
Line Profile (Line 20) - 36az



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)
20	2.52	411.61	411.84	1.17	0.99	1.05	412.78	412.83	412.89	1.32	1.63	5.00	5.61

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

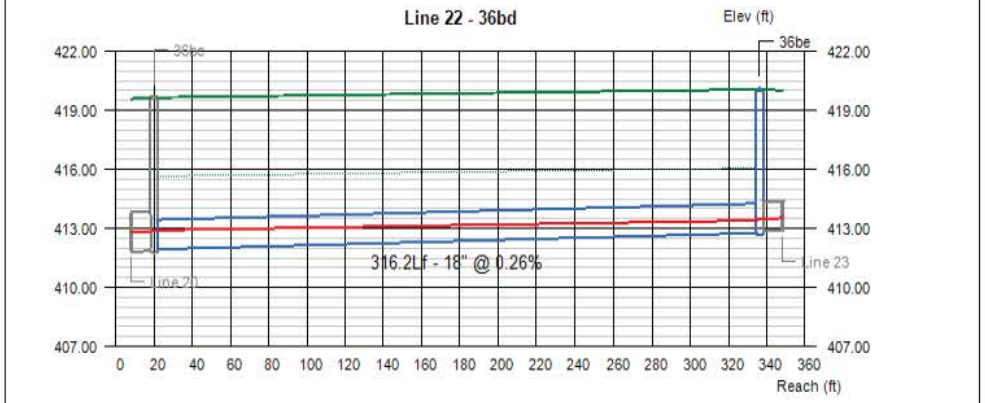
Line Profile (Line 21) - 36bb



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	0.19	417.37	417.45	0.19	0.19	0.22	417.56	417.64	417.67	1.50	1.48	0.78	1.30

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

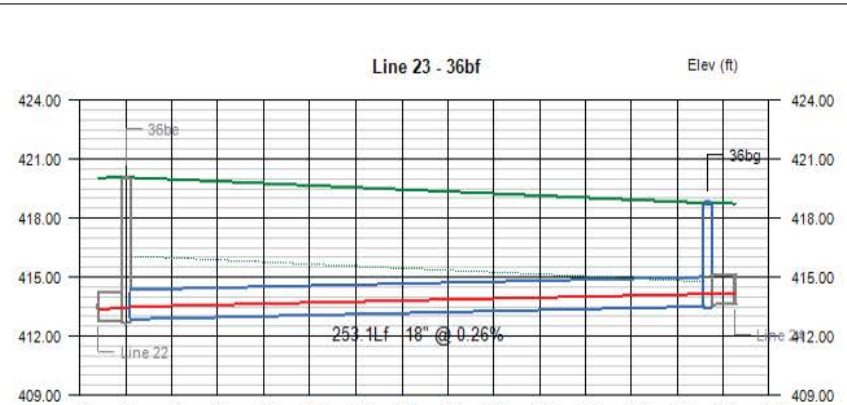
Line Profile (Line 22) - 36bd



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	2.17	417.84	417.76	0.97	0.64	0.68	417.91	418.40	418.44	1.80	3.00	6.21	5.80

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

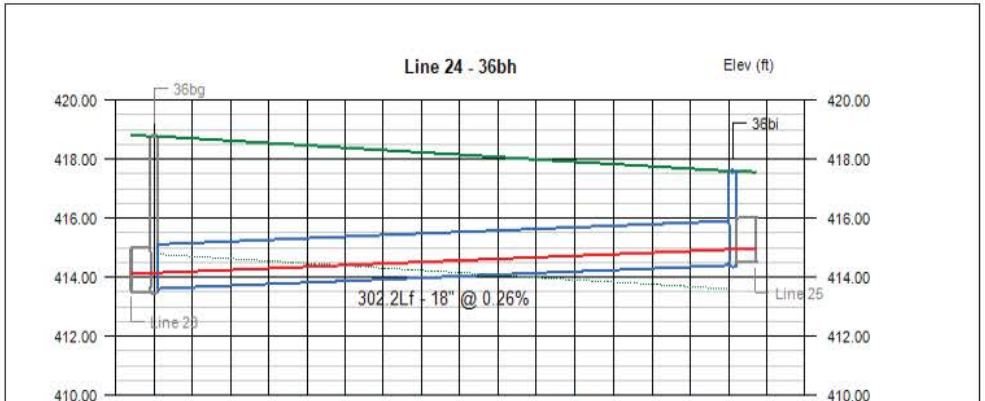
Line Profile (Line 23) - 36bf



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	1.98	412.86	413.61	0.63	0.63	0.63	413.49	414.14	414.14	2.79	2.80	5.70	3.76

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

Line Profile (Line 24) - 36bh



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	1.45	413.61	414.40	0.53	0.53	0.54	414.14	414.93	414.94	2.58	2.57	3.66	1.68

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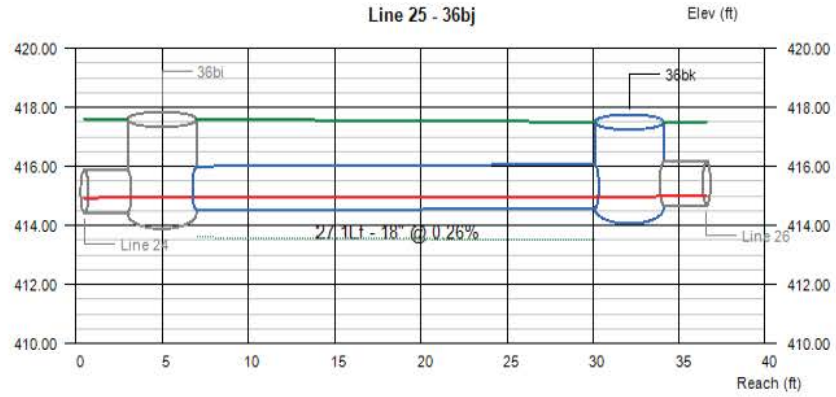
Line Profile (Line 25) - 36bj



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)
25	0.47	414.50	414.67	0.43	0.36	0.39	414.94	414.95	414.96	1.10	1.34	1.69	1.43

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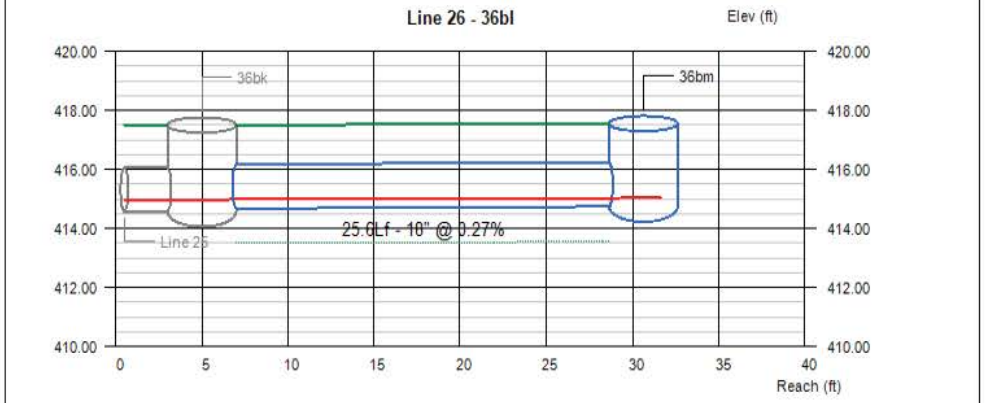
Line Profile (Line 26) - 36bl



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)
26	0.29	414.67	414.74	0.32	0.27	0.30	414.99	415.01	415.04	1.08	1.36	1.32	1.31

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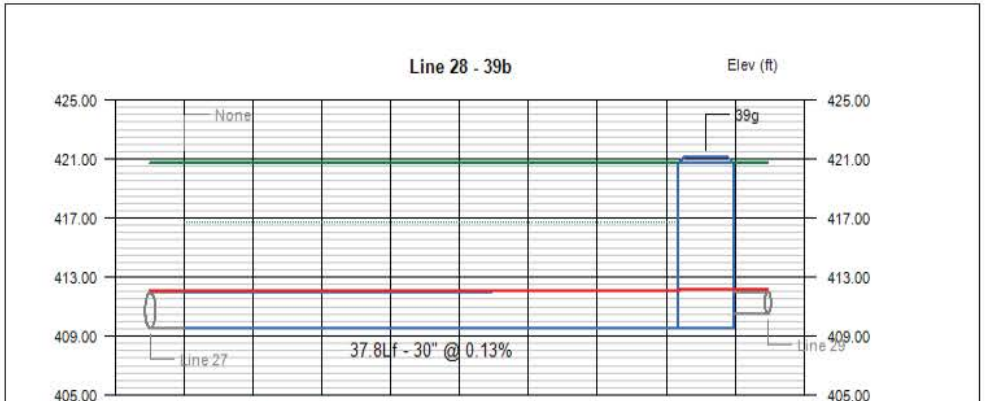
Line Profile (Line 27) - 39a

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)
27	6.34	409.44	409.60	2.50	2.50	2.61	412.10	412.11	412.11	1.29	1.28	8.79	8.72

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

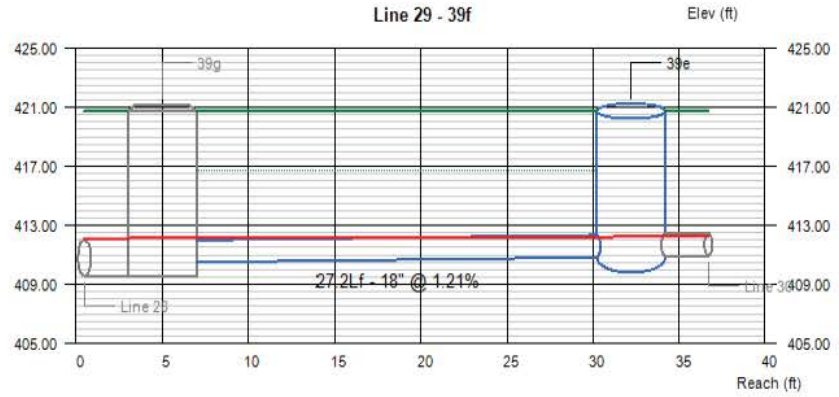
Line Profile (Line 28) - 39b



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)
28	6.39	409.60	409.55	2.50	2.50	2.63	412.11	412.12	412.18	1.30	1.30	8.72	8.68

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

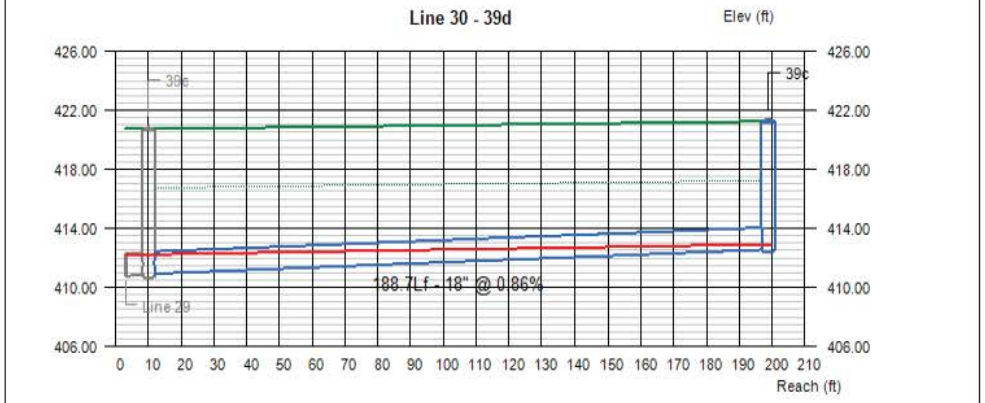
Line Profile (Line 29) - 39f



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	1.69	410.50	410.83	1.50	1.39	1.39	412.18	412.22	412.22	0.96	0.98	8.73	8.41

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

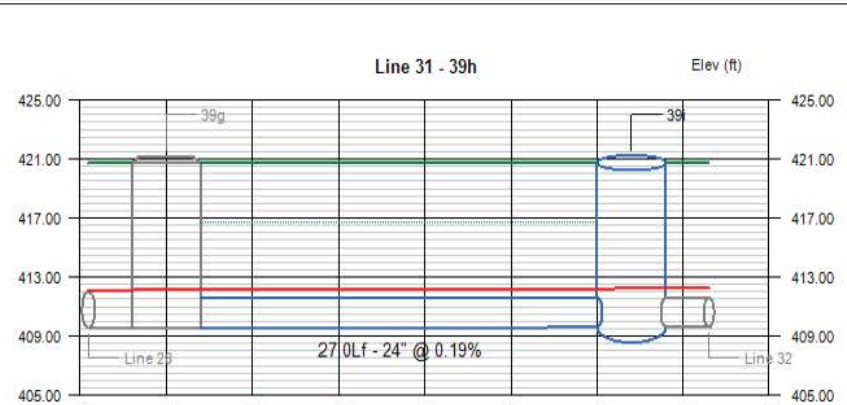
Line Profile (Line 30) - 39d



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	1.26	410.83	412.55	1.30	0.37	0.37	412.23	412.92	412.92	0.71	3.79	8.31	7.18

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

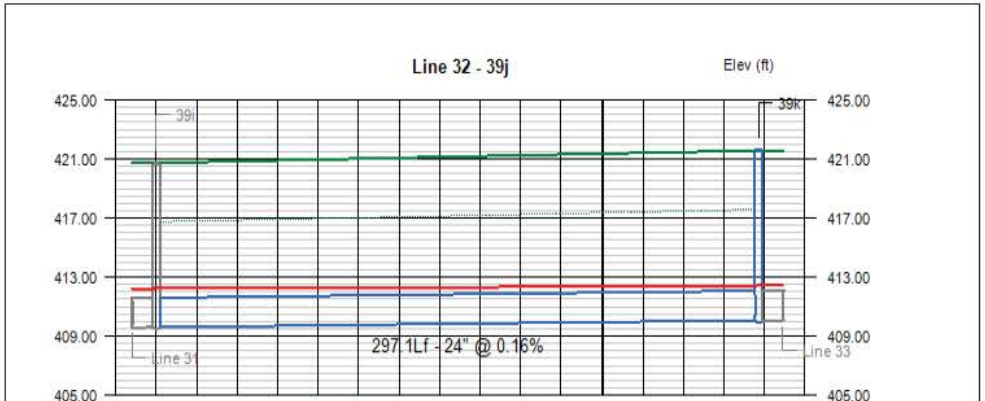
Line Profile (Line 31) - 39h



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	5.54	409.56	409.60	2.00	2.00	2.62	412.18	412.20	412.22	1.76	1.78	9.18	9.14

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

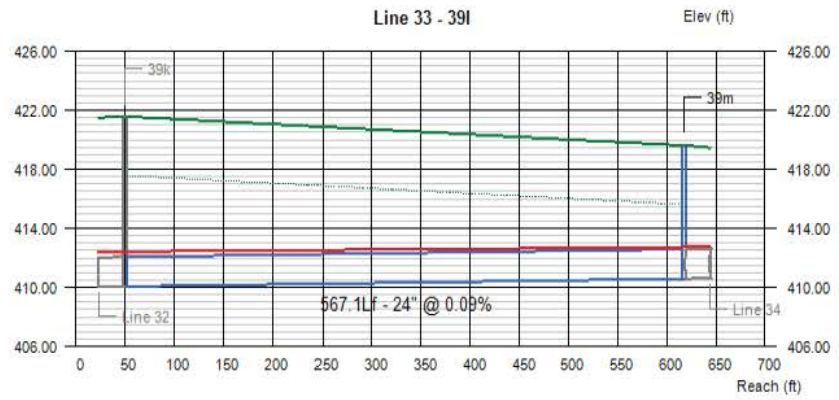
Line Profile (Line 32) - 39j



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	5.40	409.60	410.37	2.00	2.00	2.35	412.23	412.40	412.42	1.72	1.72	9.14	8.50

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

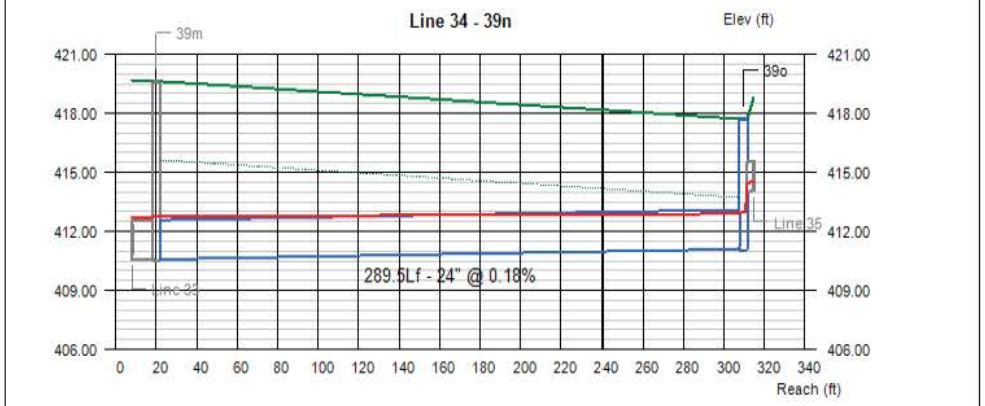
Line Profile (Line 33) - 39l



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	5.32	410.07	410.63	2.00	2.00	2.18	412.42	412.73	412.76	1.59	1.68	9.60	7.04

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

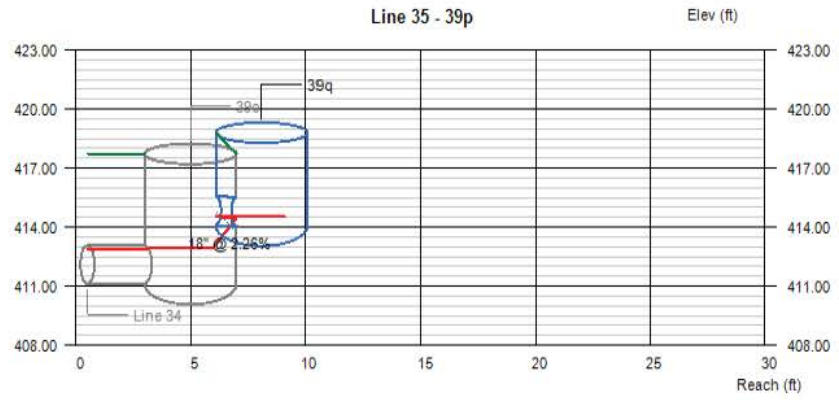
Line Profile (Line 34) - 39n



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)
34	5.06	410.58	411.10	2.00	1.79	1.86	412.76	412.89	412.96	1.61	1.70	7.04	4.62

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

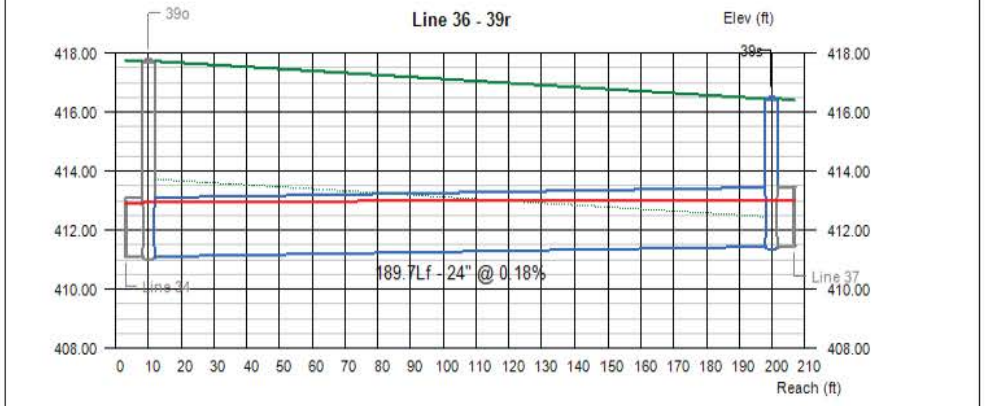
Line Profile (Line 35) - 39p



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)
35	1.70	414.01	414.03	0.45	0.45	0.46	414.46	414.53	414.53	3.76	3.77	2.21	3.32

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

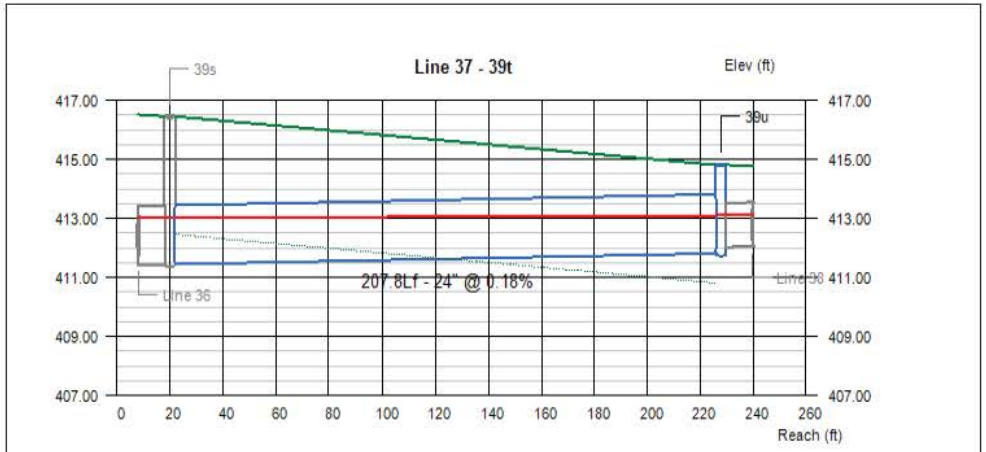
Line Profile (Line 36) - 39r



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)
36	3.89	411.10	411.44	1.86	1.57	1.58	412.96	413.01	413.02	1.28	1.47	4.62	3.01

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

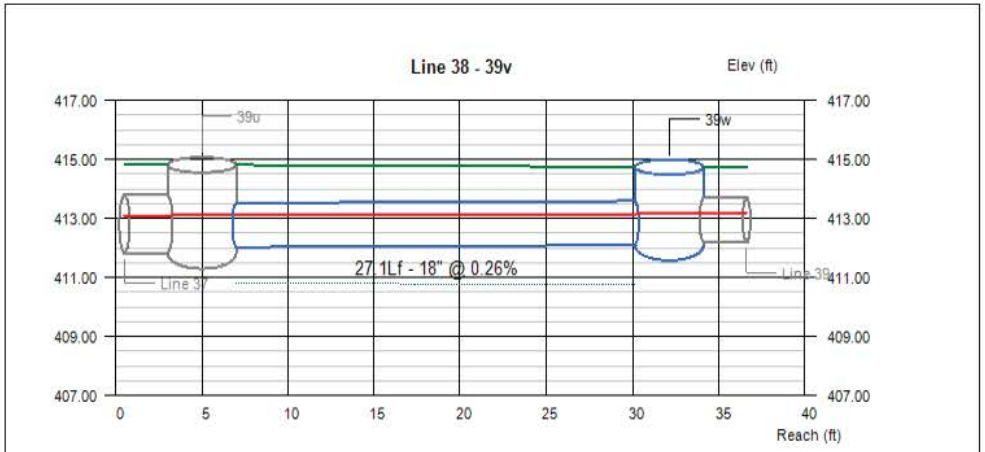
Line Profile (Line 37) - 39t



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)
37	3.82	411.44	411.81	1.58	1.26	1.31	413.02	413.09	413.12	1.43	1.78	3.01	1.90

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

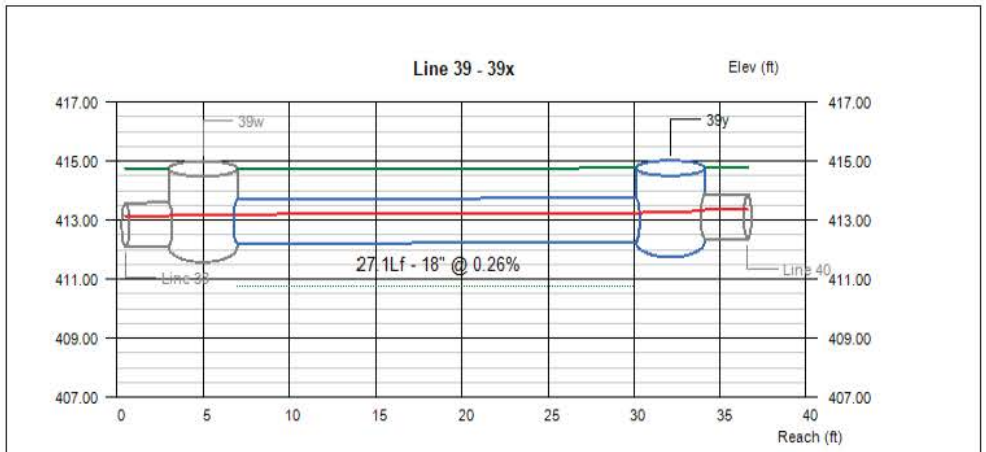
Line Profile (Line 38) - 39v



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)
38	3.27	412.02	412.09	1.10	1.06	1.10	413.12	413.15	413.19	2.38	2.46	1.29	1.75

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

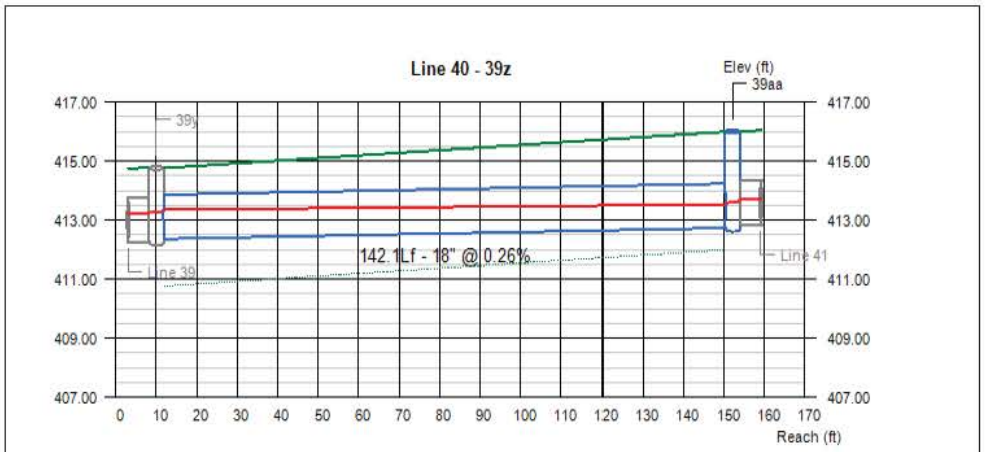
Line Profile (Line 39) - 39x



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)
39	3.10	412.19	412.26	1.00	0.97	1.02	413.19	413.23	413.28	2.47	2.58	1.05	1.30

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

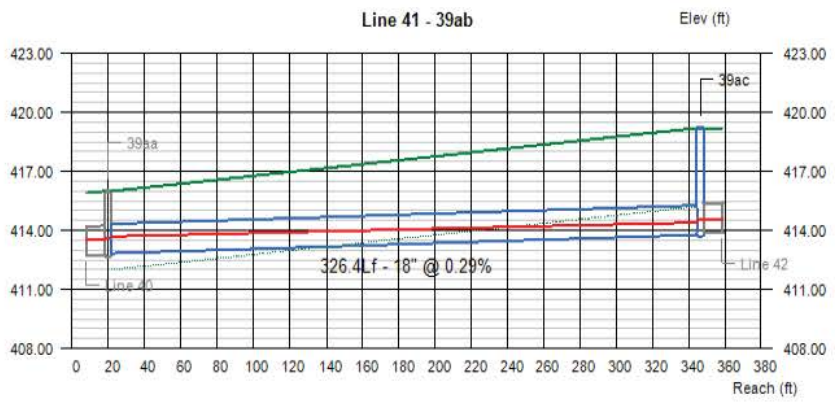
Line Profile (Line 40) - 39z



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)
40	2.72	412.36	412.73	0.98	0.80	0.86	413.34	413.53	413.59	2.22	2.83	0.90	1.76

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

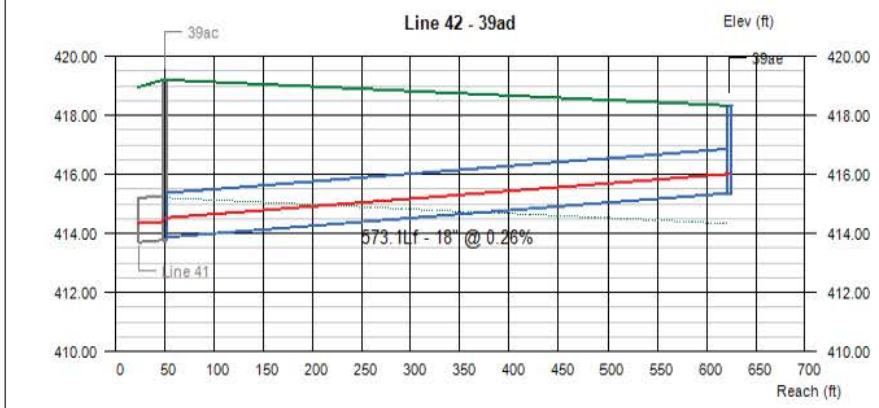
Line Profile (Line 41) - 39ab



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)
41	2.32	412.83	413.77	0.86	0.63	0.76	413.69	414.40	414.53	2.21	3.33	1.66	3.93

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

Line Profile (Line 42) - 39ad



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
		Dn	Up	Dn	Up	Hw	Dn	Up	Jnc.	Dn	Up	Dn	Up
	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/s)	(ft/s)	(ft)	(ft)
42	2.10	413.87	415.36	0.86	0.65	0.86	414.53	416.01	416.02	2.80	2.87	3.83	1.47

DS 36 & 39 (Final) | No. Lines: 42 | Run Date: 10/31/2014

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www.wreco.com

Attachment 8 – Meeting notes identifying flows for temporary creek diversion system

Subject:	SR 84 Isabel Expressway Zone 7 Meeting			
Date:	2:30 September 5, 2014		Job:	28649640
Location:	Zone 7 Offices, 100 North Canyons Parkway, Livermore, CA		File:	391.02

ATTENDEES

Susan Chang, ACTC	Ramsey Hissen, URS	Sang Kim, URS	Dennis Gambs, Zone 7	Janrail Chahal, Zone 7
Carol Mahoney, Zone 7				

Minutes prepared by Ramsey Hissen and Sang Kim, URS

DISCUSSION ITEMS

ITEM	DESCRIPTION	ACTION BY/ Date
1.	Project Information and Updates: • The project will widen the existing Arroyo Del Valle Roadway Bridge and construct a new trail bridge. Utilities will be placed under the city multi-use trail and in the trail bridge that include a PGE 24 inch gas transmission line, a PGE 21kV electrical distribution line, a City of Livermore sewer line and a Cal Water water line. • The project will be ready to list for advertisement in March of 2015, with construction starting in late 2015. • Work in the Arroyo is anticipated in 2016 between June 15 and October 1.	URS to provide Zone 7 the project plan set after the Final PS&E submittal.
2.	Construction • The project was no longer looking at a variance request and reducing the require 50 foot setback. The project will acquire some RW and mineral rights from Cemex and Pleasanton Gravel Company. • A PGE 24 gas transmission line will be located with a 15 foot easement at the State RW in the 50 foot setback. Planting would probably not be allowed over the pipe. Perhaps some climbing ivy may be allowed. • Jarnail indicated that Zone 7 would not be able to stop release of water on Arroyo Del Valle. The amount of water reaching the construction site was low. Jernail recommended that a 50 cfs demand for the diversion system be deigned.	URS to check the temporary creek diversion system for a max 50cfs flow.
3.	Right of Way • PGC has indicated that it was their preference to have the small triangular section needed for the access bridge at Arroyo Mocho taken in fee rather than easement. Dennis thought that it would make sense to have Zone 7 take this parcel in fee. • The access road from the new intersection of SR 84 with Concannon would be an Alameda County road to allow Cemex access to their property. Zone 7 wanted an agreement with the parties involved that the access road would be provided to Zone 7 in fee once the Chain of Lakes are completed. • The City of Livermore is reviewing improvement plans that would alter the Voyager entrance. Fencing and gating the entrance was discussed. There may be a need to modify the gates and fencing that had been constructed. • For the emergency gate installed as part of the SR 84 North project, Zone 7 needs provide any documentation of the past request between agencies and justifications for the need. Upon receipt, URS would request a supplemental Encroachment Policy Variance Request (EPVR) memo to	URS to speak with Caltrans RW and find out how to transfer the County Road. Zone 7 to provide documentation and justification for the emergency gate. URS to issue a

DRAFT

ITEM	DESCRIPTION	ACTION BY/ Date
	Caltrans to reinstate the installation.	supplemental EPVR memo.
	Future Cemex 84 Inch Pipe • As part of Cemex responsibilities was to place an 84 inch pipe between Lakes A and C. The pipe will be placed about 30 feet below grade and will cross State RW. It is envisioned that the pipe will require a 102 inch casing. Zone 7 was interested to see that Caltrans would agree to allow this pipe to be placed.	

The following was provided by Dennis Gambs. Answers to each item are provided.

Issues in Connection With SR 84 Widening and Lakes C and D/PGC Property

BACKGROUND

The Chain of Lakes was established by adoption of the Specific Plan for the Livermore-Amador Valley Quarry Reclamation ("Specific Plan") by the Alameda County Board of Supervisors in November 1981. Per the Specific Plan and through agreements between Zone 7 and the quarry operators, the gravel pits will be converted into interconnected lakes for Zone 7 use for groundwater recharge and flood protection. Zone 7 entered into agreement with Pleasanton Gravel Company (PGC) on April 20, 1988 to memorialize the required reclamation plan improvements and grant obligations of PGC. This agreement was also acknowledged in the Memorandum of Agreement recorded in the Official Records of County of Alameda as Series No. 89-161287.

As the future property owner of Lake C and D, Zone 7 will be responsible for their operation and maintenance. Under the agreement PGC is required to grant Lakes C and D to Zone 7, including a 25 feet wide strip surrounding the lakes. Lakes C and D are located on the western boundary of SR Route 84 project between Vineyard Avenue and Stanley Blvd.

IMPACTS IDENTIFIED IN THE COMMENTS TO THE NEGATIVE DECLARATION

Listed below are project impacts to Zone 7 based on the plans reviewed with the Negative Declaration for the SR 84 Widening in November of 2007. As suggested in the Caltrans response to Zone 7's comments, a number of these issues have been resolved in finalizing the plans. It has been a number of years since we last reviewed the plans or any updates. I have no comprehensive documentation for addressing some of Zone 7's concerns and hope to do so in reviewing the final plans and meeting with ACTC and URS. Accordingly, many of our concerns are repeated below.

1) **Setback impacts**

The Alameda County Mining Ordinance requires that there be a minimum of 50 feet setback from the top of bank to a public road right of way. This minimum 50-foot setback is also a requirement of the agreements between Zone 7 and the gravel quarry operators. **This project does not currently provide the required 50-foot setback in all areas, including the areas between stations 323+00 to 335+00**.

Note that within this 50-foot setback requirement, OSHA requires a barrier at top of bank, such as an earthen berm up to 12 feet wide, to prevent vehicles from traveling over the bank. In addition, the Alameda County Surface Mining Permit requires landscaped areas along the quarry, which may need to be up to 20 feet wide. A maintenance road will also be required within this setback area which will be used to access the lake areas in order to maintain bank slopes that would be up to 240 feet in depth. Therefore, impinging upon this 50-foot setback would pose a significant impact to Zone 7's ability to access and maintain these lakes.

Answer: Project will provide a 50 setback. The project is no longer applying for a variance.

Currently, there are existing utilities that are within the 50-foot setback in certain areas around the lake. These include a 24" PG&E gas line, 42" storm drain, overhead electrical lines, cable television and phone lines. The Project proposes to relocate utilities, including 24" PG&E gas line and a 15" sanitary sewer line, within the 50-foot setback area. The proposed Negative Declaration does not contain plans with enough detail to determine if the Setback Area can accommodate all the utilities and uses, within the Setback Area without conflicting with existing and future planned uses. Without more detailed design plans, which show existing utilities with the proposed uses as well as an understanding of all the utility owners' easement requirements (particularly PG&E) Zone 7 cannot evaluate the impacts on the planned uses for the Chain of Lakes**. Zone 7 recommends that no new utilities be relocated within this 50-foot setback area that may conflict with existing utilities, earthen berm or other barrier at top of bank, required landscaping, and planned maintenance and operation of the Chain of Lakes. In addition, Zone 7 recommends that Project provide a minimum 50-foot setback from Route 84 right of way to the top of bank of any lake**.

Answer: The only utility that will be present in the setback is a 24 Inch PGE gas transmission line with a 15 foot easement. This is currently in the setback and will remain the in future adjusted setback.

a) **Geotechnical Impacts**

Section 2.12.2.3 Geologic Hazards briefly discusses landslides and states that much of the project area has relatively flat topography; therefore, there is negligible hazard from slope movement. In addition, **an appropriate geotechnical investigation should be conducted during design to ensure that the same conditions do not exist at the Project site**.

The topography is not flat in the quarry area adjacent to the Project where pits are up to 240 feet in depth. The Negative Declaration should require that **the project include a geotechnical study assessing slope failure of the quarry/Chain of Lakes banks and mitigate any identified risk associated with relocated utilities or other project improvements.**

I believe ACTC provided Zone 7 a Geotechnical Investigation report but need to confirm.

Answer: Zone 7 has been provided the geotech studies.

b) **Other Impacts**

DRAFT

i) Leakage from the relocated Sanitary Sewer could lead to slope stability. **The Negative Declaration should require that the relocated sewer lines be installed utilizing methods that prevent leakage of flows from the pipe**.

I believe the Sewer alignment was relocated to the east side of SR 84 but need to confirm.

Answer: The sewer line in being placed under the trail path on the east side of SR 84.

ii) Proposed bio-swales can saturate the bank area and lead to slope failure. **A geotechnical study assessing risk to the access road and utilities from slope failure has not been done. The Negative Declaration should require that the project include a geotechnical study assessing slope failure of the quarry/Chain of Lakes banks and mitigate any identified risk associated with project improvements**.

Answer: the project will not place bioswales adjacent the 50 foot setback

iii) **The project should assess the increased maintenance responsibilities and liabilities to Zone 7 from utilities relocated within the Setback Area**. **The Negative Declaration should require that the project assess and address any conflicts between the property rights/easements needed by the utilities with the existing utilities or planned Chain of Lakes**.

Answer: Project will provide a 50 setback. The project is no longer applying for a variance.

2) The Project will be impacting A number of points of access to the quarry mining area along the west side of Route 84, adjacent to the future Lakes C and D are being consolidated at the intersection of Concannon Blvd**. In addition, an emergency access point located between Lakes C and D at Station 371+00 (see Sheet 6-12) is being proposed as part of the Project.** See Emergency Access below

Noted

3) Zone 7 owns and maintains the portion of the Arroyo Mocho adjacent to Route 84. Zone 7's access to this channel is directly off of Route 84. The Project needs to provide alternative access before closing Zone 7's access to the Arroyo Mocho. This would include all of the improvements being proposed as part of the Project as well as the Right of Way Zone 7 requires. Also, prior to any work within Zone 7 Right of Way, an Encroachment Permit issued by Zone 7 is required.

Noted

ADDITIONAL POTENTIAL IMPACTS

<u>Emergency Access Agreement</u>

Caltrans has constructed an Emergency Access at Station 371to mitigate in part the loss of access caused by the Project. Permission for using this emergency access needs documentation. **We will need an agreement with Caltrans for use of the emergency access or some documented process for obtaining such permission**?

I understand that Caltrans wants documentation explaining the reason for the emergency access. I would be happy to provide this.

Answer: URS will proceed with obtaining a Caltrans Encroachment Policy Variance Request, EPVR

Road Access between CEMEX Property and Concannon Blvd

The PGC property along top of bank between CEMEX and Concannon Blvd. is being constructed as a roadway to be owned and maintained by the County of Alameda. Under the Zone 7/ PGC agreement, this area is to be granted in fee to Zone 7.

An agreement for use of the property and transferring its ownership in fee Zone 7 with the rest of Lake C needs to be drafted and accepted by the parties (Alameda County, PGC, Vulcan, Caltrans and Zone 7.

Answer: URS will evaluate options to address this future transfer.

These minutes are based on the perception of the recorder. Please submit any corrections to ramsey.hissen@urs.com or Sang.kim @urs.com

DRAFT

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Attachment 9 – Austin Vault Sand Filter plans from EA 04-297611

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	68	495

Analette Ochoa 1/18/11
REGISTERED CIVIL ENGINEER DATE

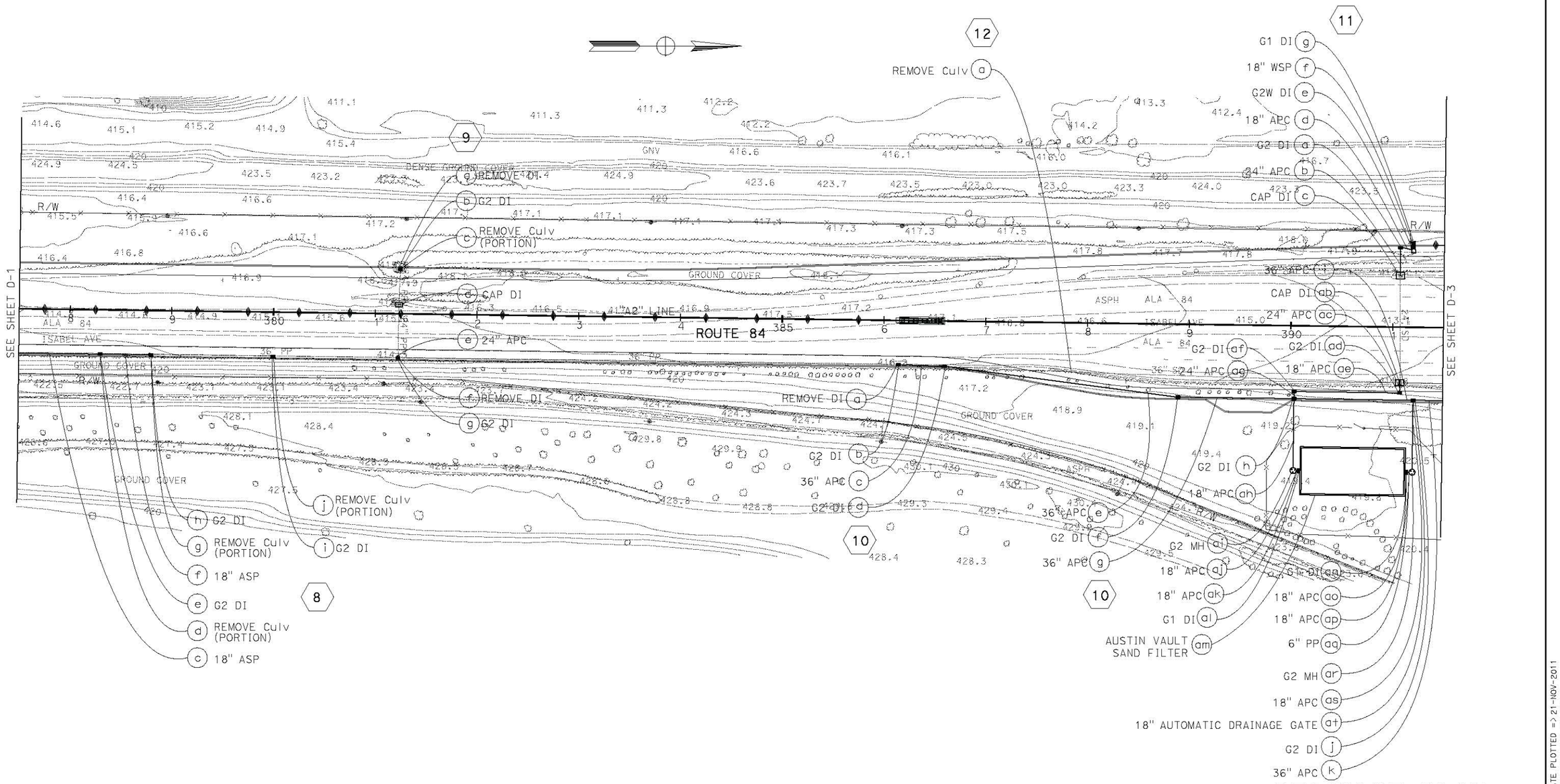
6-27-10
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/12 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF 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



DRAINAGE PLAN

SCALE: 1'' = 50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-2

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

LAST REVISION DATE PLOTTED => 21-NOV-2011
TIME PLOTTED => 14:51

BORDER LAST REVISED 7/2/2010 | USERNAME => s124496 | DGN FILE => 04000205801a002.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	100	495

Annette Ochoa 1/18/11
REGISTERED CIVIL ENGINEER DATE

6-27-11
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/12 — CIVIL — STATE OF CALIFORNIA

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Suite 608
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 Broadway, Suite 300
Oakland, CA 94612

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

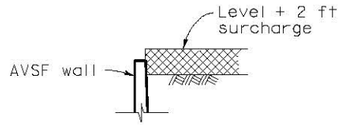
Wall & Footing (LFD): 1.5 D + 1.5 E + 1.5 W + 1.5 SC
Where D = Dead Load
E = Earth Load
W = Water Load
SC = Surcharge

Capacity reduction factor is included.

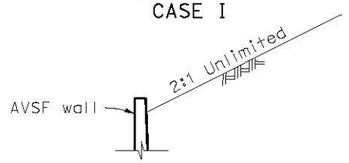
Earth Load:
125 lb/ft^3 vertical,

Water Load:
62.4 lb/ft^3 horizontal/vertical,

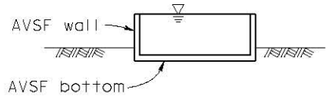
Earth pressure for 2:1 unlimited slope determined from Rankine's formula with ø = 33°42' (Case II).



CASE I



CASE II



CASE III

DETAIL OF DESIGN LOADING CASES

CASE I Level + 2 ft 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

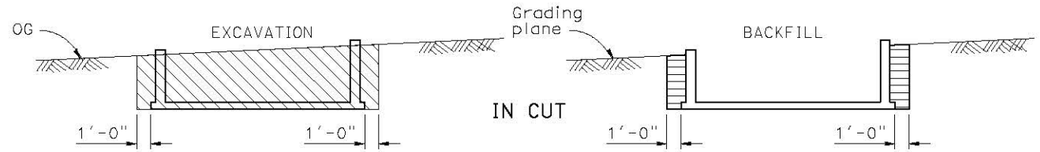
CONSTRUCTION NOTES

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
RSP 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
Caltrans

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1	101	495

Anlette Ochoa
REGISTERED CIVIL ENGINEER — 1/18/11 DATE

6-27-11
PLANS APPROVAL DATE

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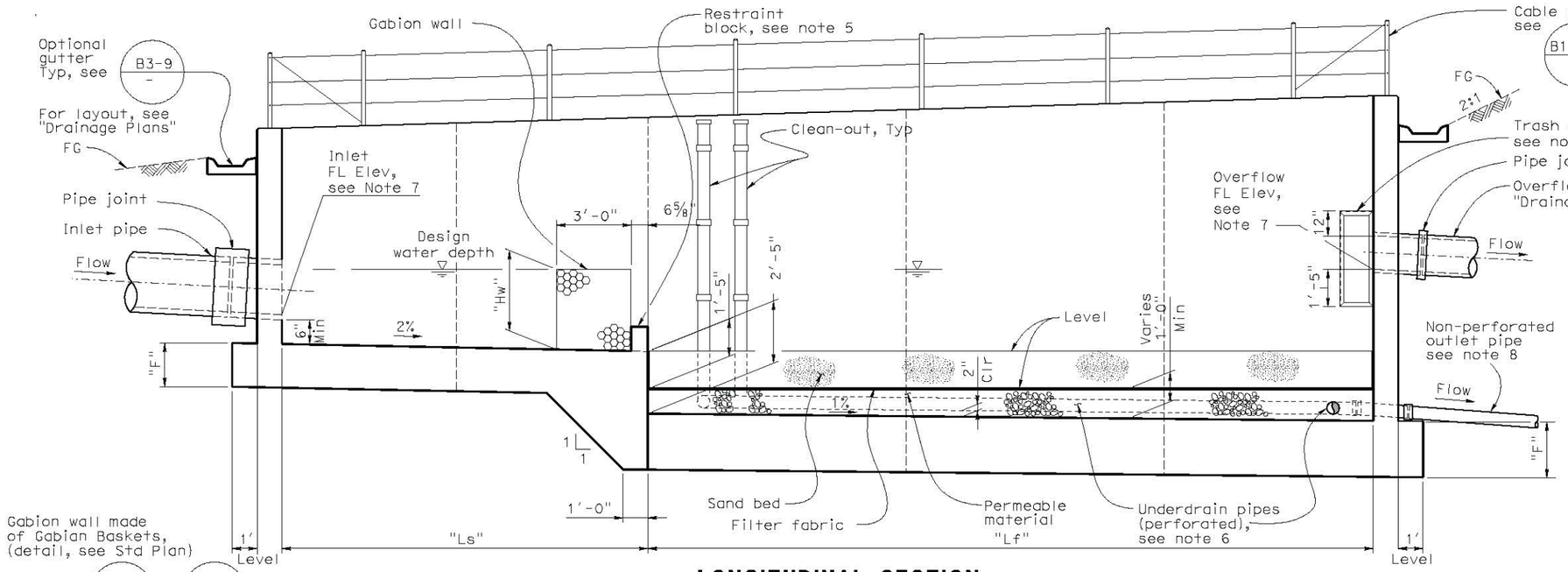
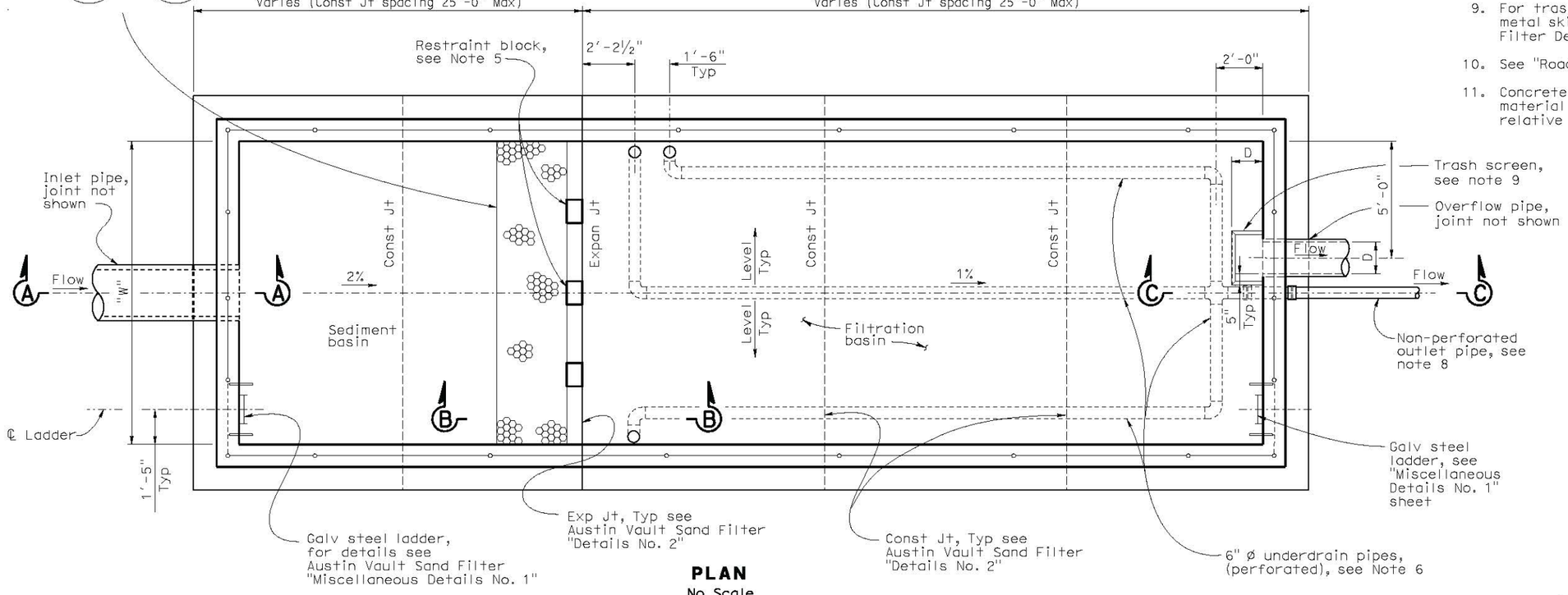


LONGITUDINAL SECTION
No Scale



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 "Austin Vault Sand Filter Wall Details".
3. For Typical Section, see "Austin Vault Sand Filter Wall Details".
4. For Section A - A, B - B and C - C, see "Austin Vault Sand Filter Details No. 1".
5. For restraint block details, see "Details No. 1" and "Austin Vault Sand Filter Details No. 2".
6. For details of underdrain (sand filter), see "Austin Vault Sand Filter Details No. 4".
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 "Austin Vault Sand Filter Details No 3".
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

CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
REVISED BY: IL — DATE REVISED: 1/11/11
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION DATE PLOTTED => 21-NOV-2011
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BORDER LAST REVISED 7/2/2010 | USERNAME => s123631 | DGN FILE => 04000205801c008.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	102	495

Analette Ochoa
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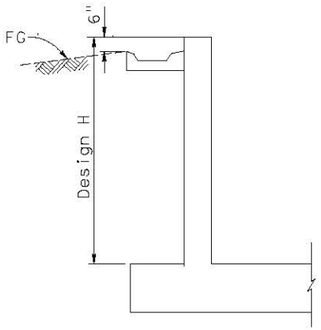
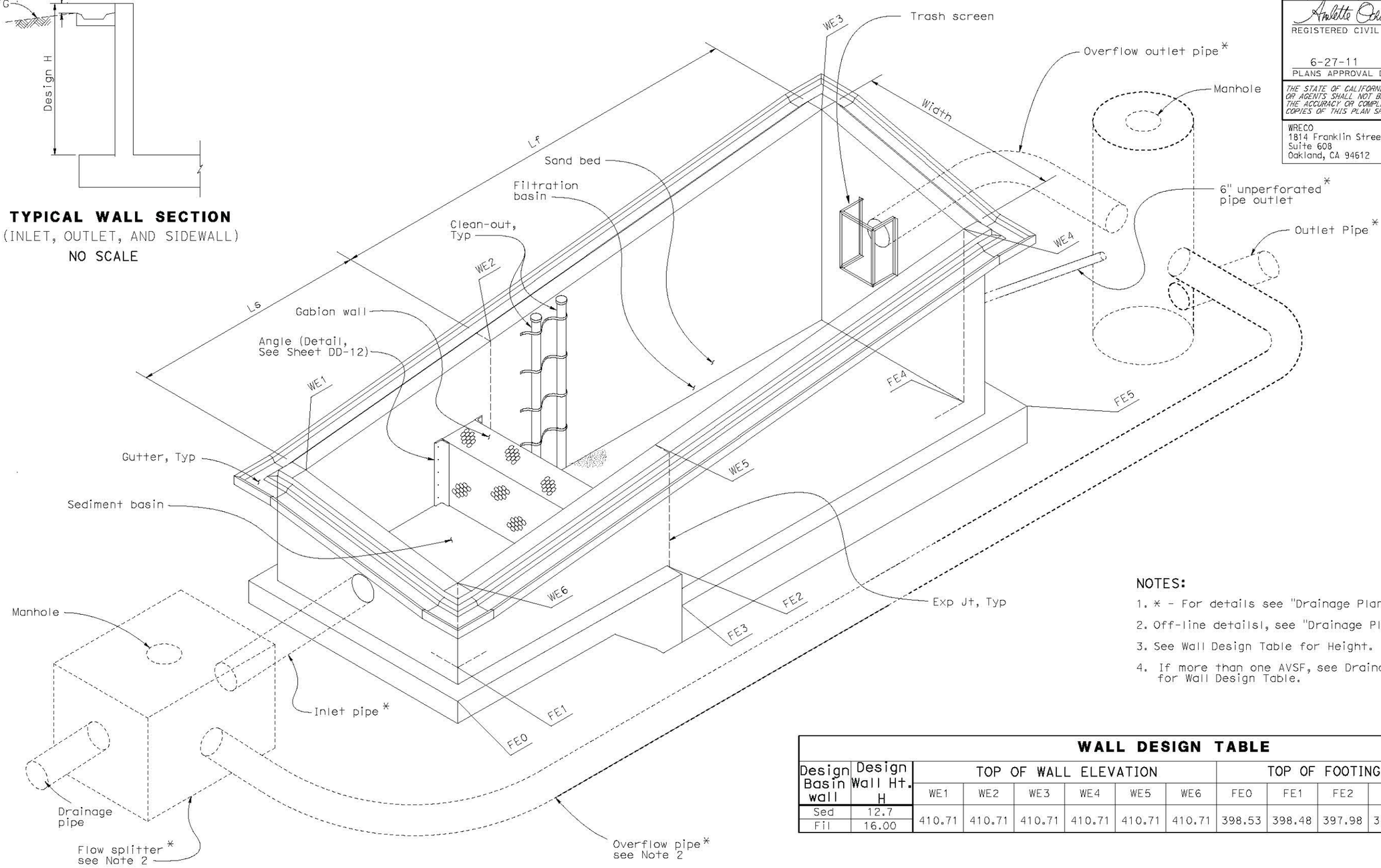


TYPICAL WALL SECTION
(INLET, OUTLET, AND SIDEWALL)
NO SCALE



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 details, 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

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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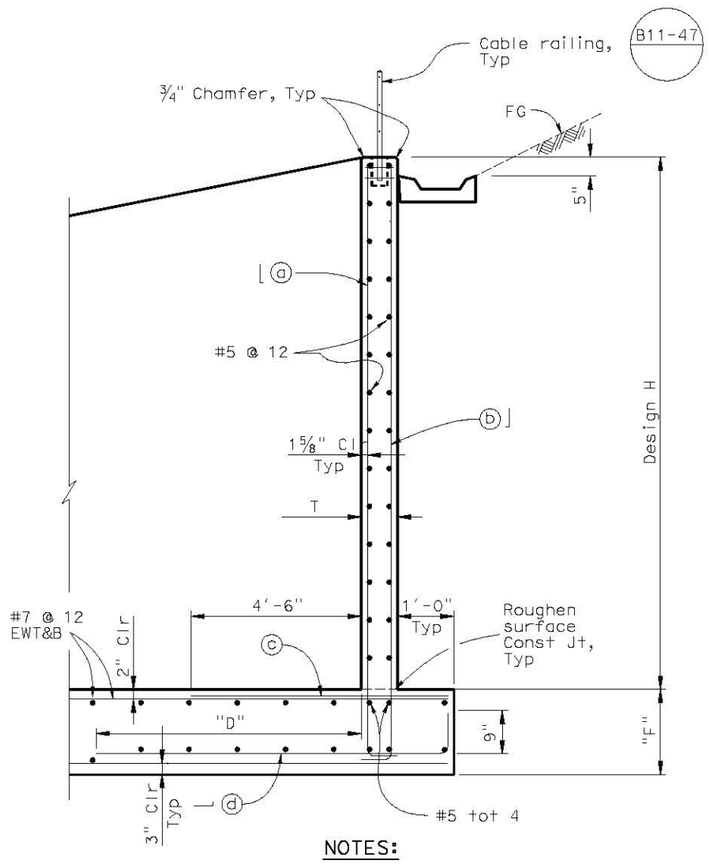

NOTES:

"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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UNIT 0733
PROJECT NUMBER & PHASE 04000205801

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Annette Ochoa 1/18/11
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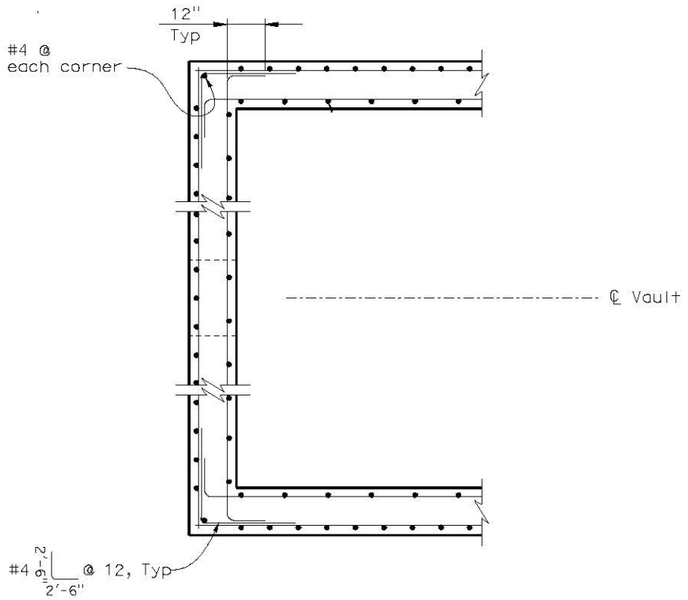
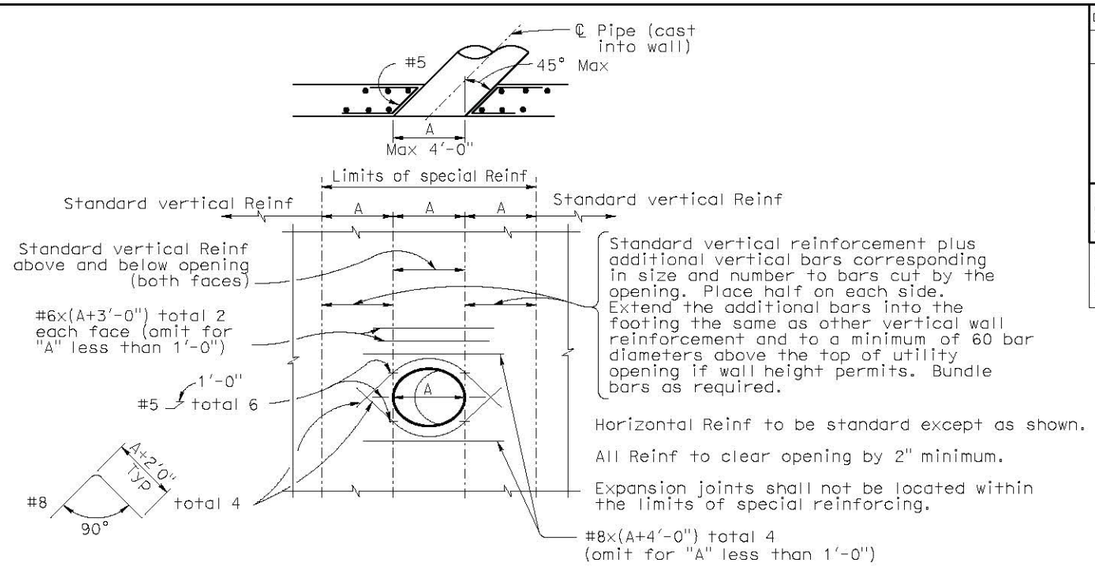


TYPICAL CORNER DETAIL
NO SCALE

NOTE: Inlet wall shown, outlet wall similar.



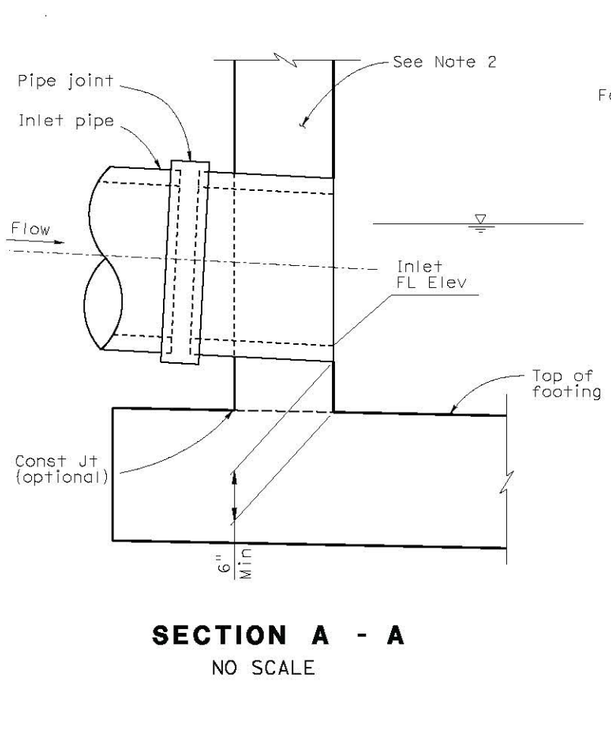
WALL OPENING DETAIL
NO SCALE

To be used at inlet, outlet and overflow pipe locations

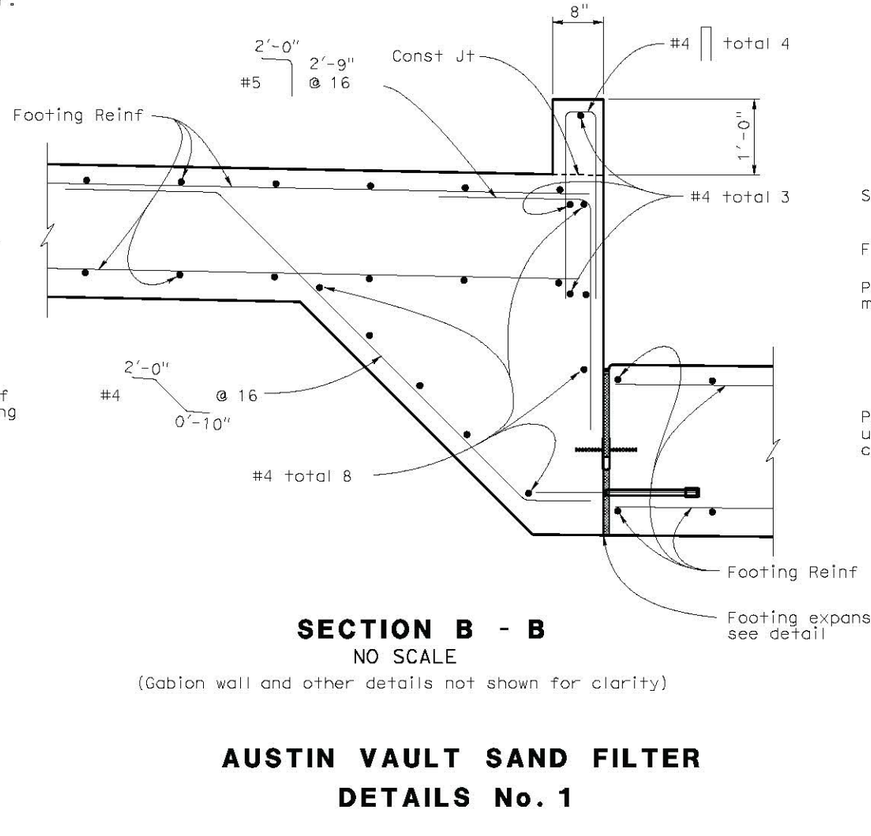
NOTE: The rebar lengths shown are maximum and shall be adjusted due to the limitations of space.

NOTES:

1. For section locations, see "Layout No. 1 " sheet.
2. For wall and footing reinforcement details, see Typical Section on "Wall Details" sheet.

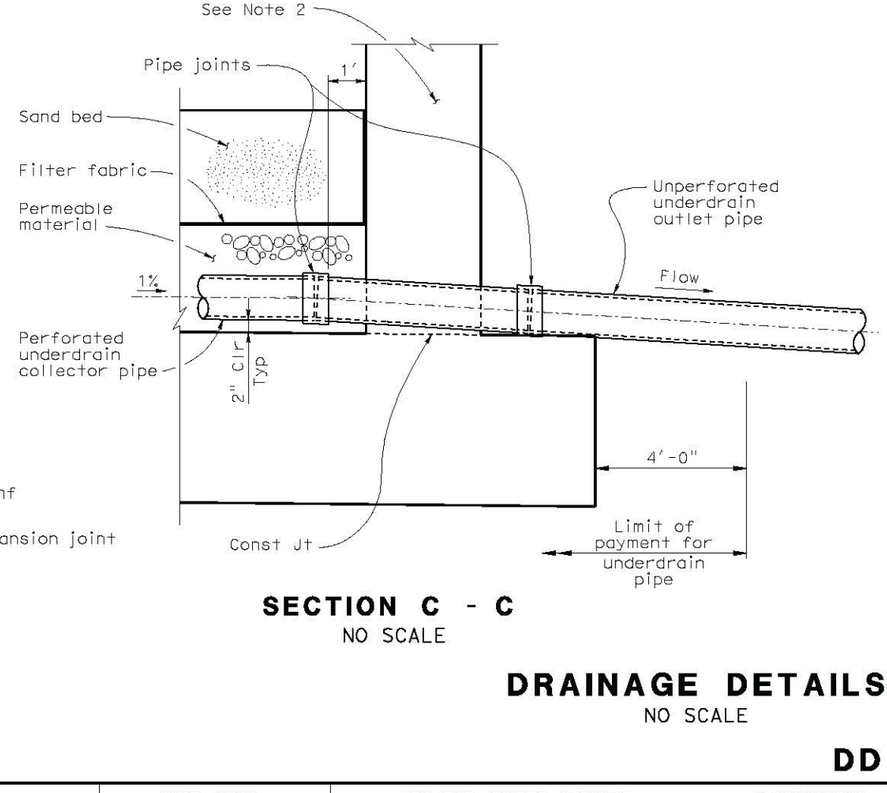


SECTION A - A
NO SCALE



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

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Anlette Ochoa 1/18/11
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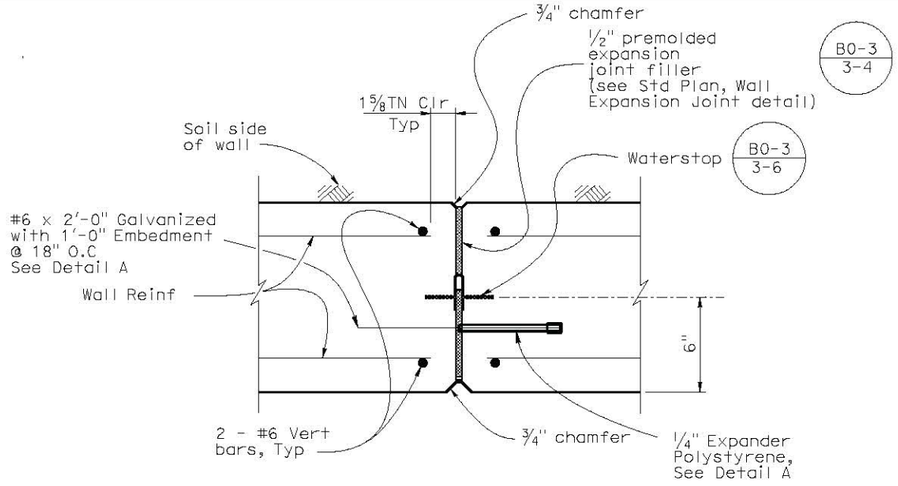
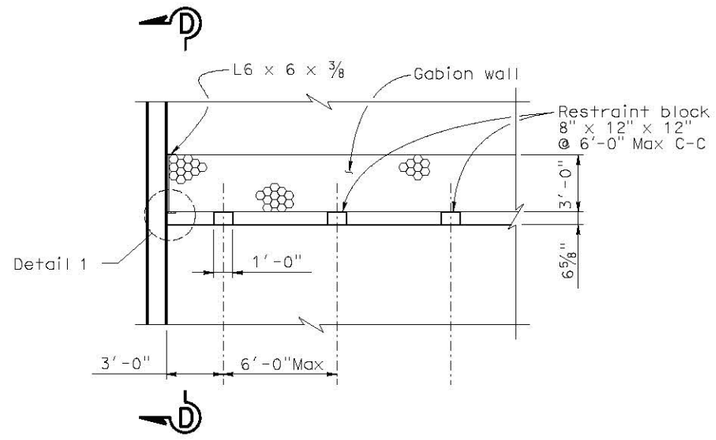
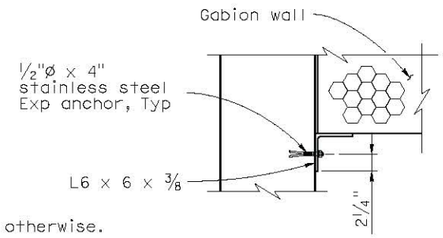


WALL EXPANSION JOINT DETAIL - PLAN SECTION
No Scale

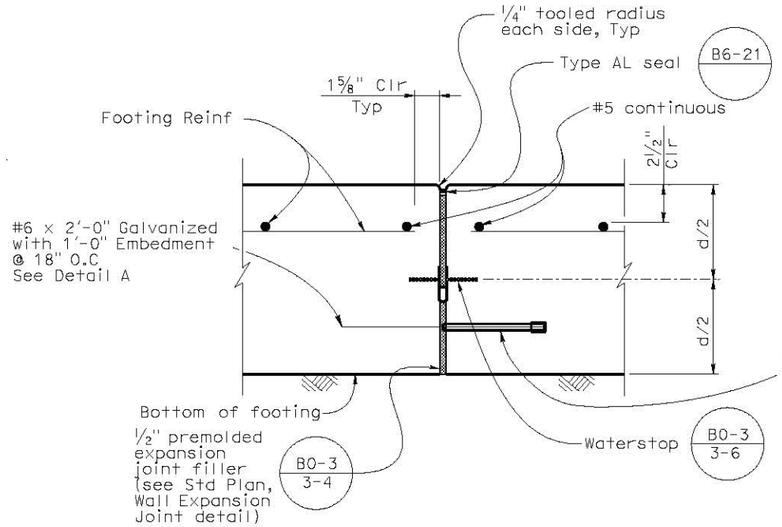


RESTRAINT BLOCK DETAIL
No Scale

Notes:
1. Stagger splices unless noted otherwise.



DETAIL 1
No Scale



FOOTING EXPANSION JOINT DETAIL
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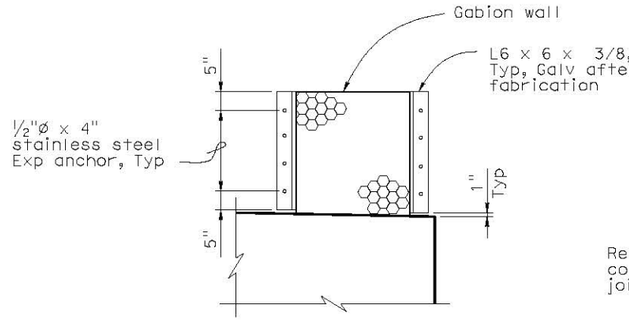

SECTION D - D
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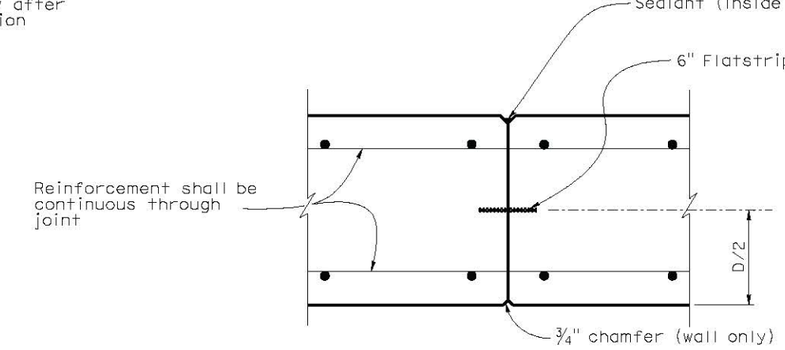
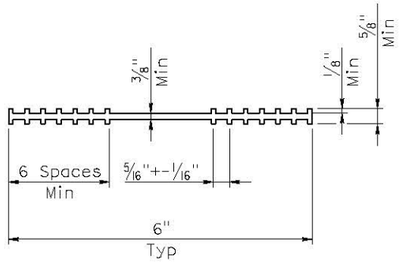
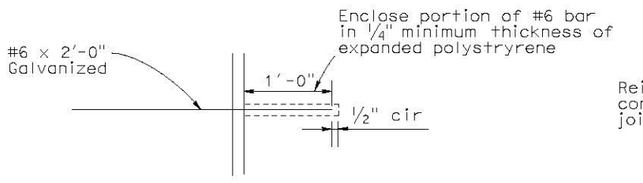


WALL CONSTRUCTION JOINT DETAIL
No Scale



6" FLATSTRIP WATER STOP DETAIL
No Scale



DETAIL A
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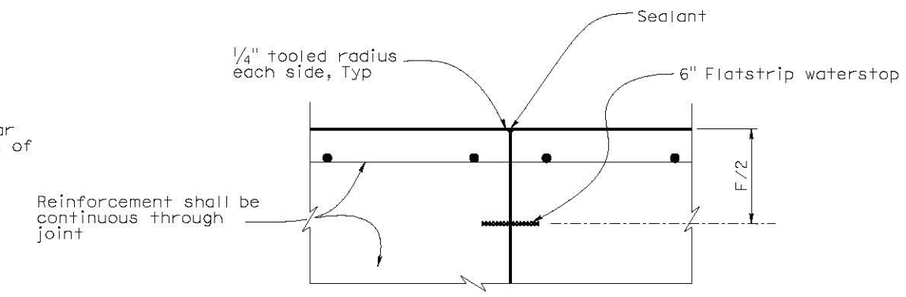

FOOTING CONSTRUCTION JOINT DETAIL
No Scale

AUSTIN VAULT SAND FILTER DETAILS No. 2

DRAINAGE DETAILS
NO SCALE

DD-12

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Caltrans

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REVISED BY: IL
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PROJECT NUMBER & PHASE 04000205801

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Analette Ochoa 1/18/11
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6-27-11
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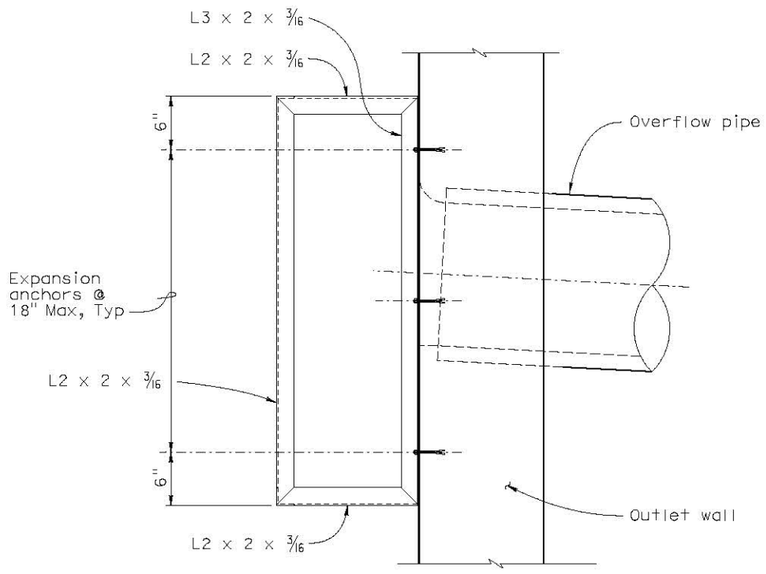
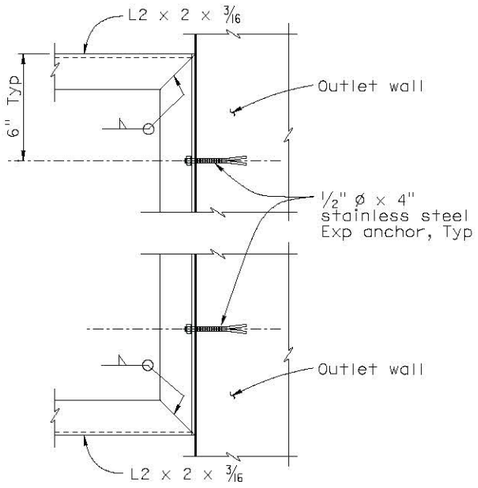
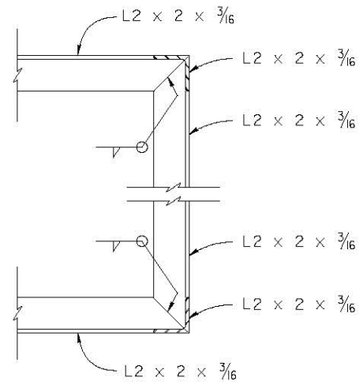


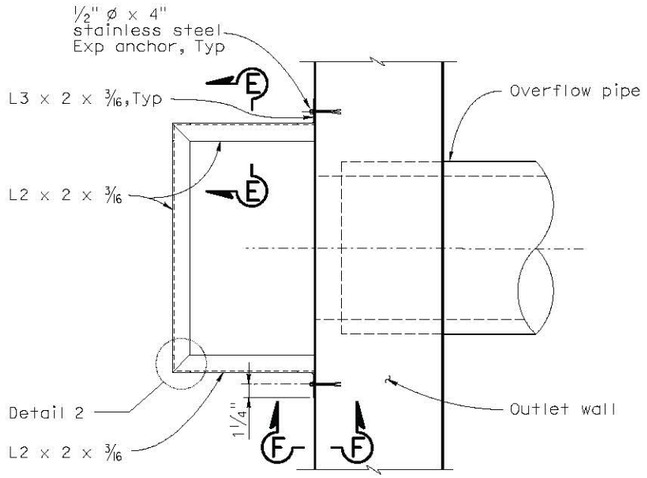
TRASH SCREEN - SIDE ELEVATION



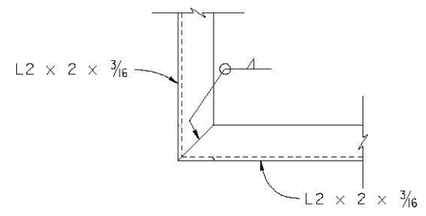
SECTION F - F



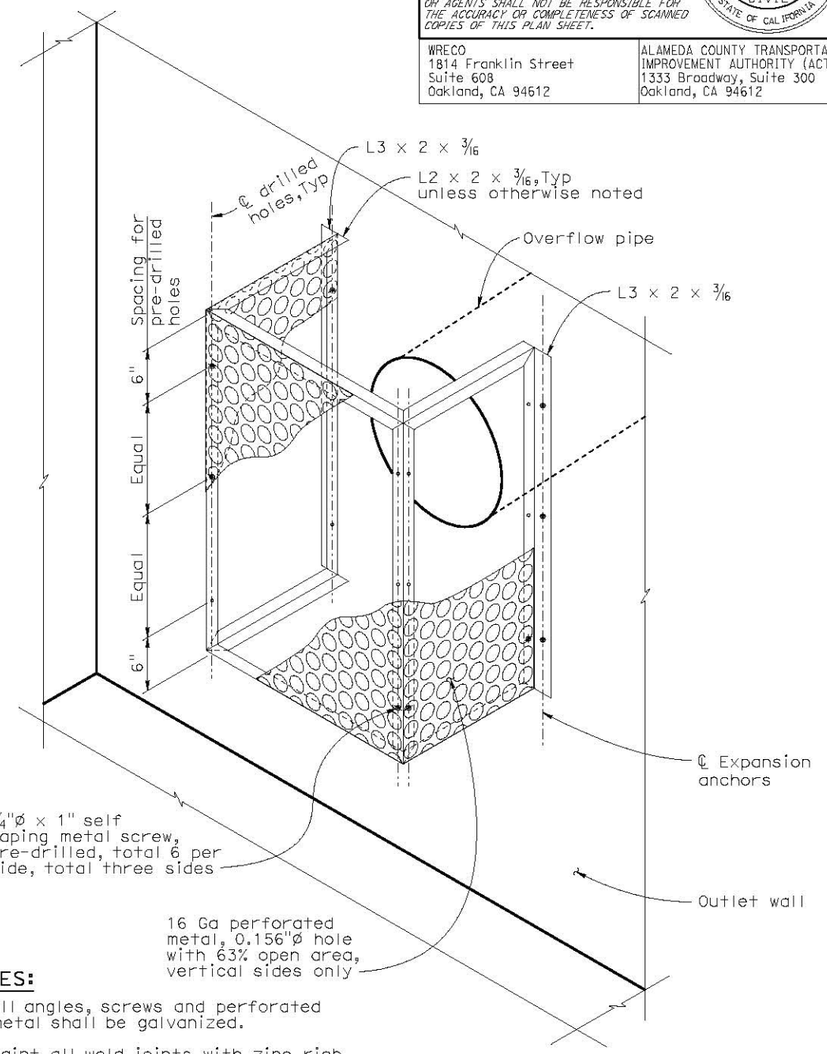
SECTION E - E



TRASH SCREEN - PLAN



DETAIL 2



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

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		

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

LAST REVISION 1-11-11
DATE PLOTTED => 21-NOV-2011
TIME PLOTTED => 14:52

BORDER LAST REVISED 7/2/2010 | USERNAME => s123631 | DGN FILE => 04000205801c013.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	107	495

Analette Ochoa 1/18/11
REGISTERED CIVIL ENGINEER DATE

6-27-11
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/12 — CIVIL — STATE OF CALIFORNIA

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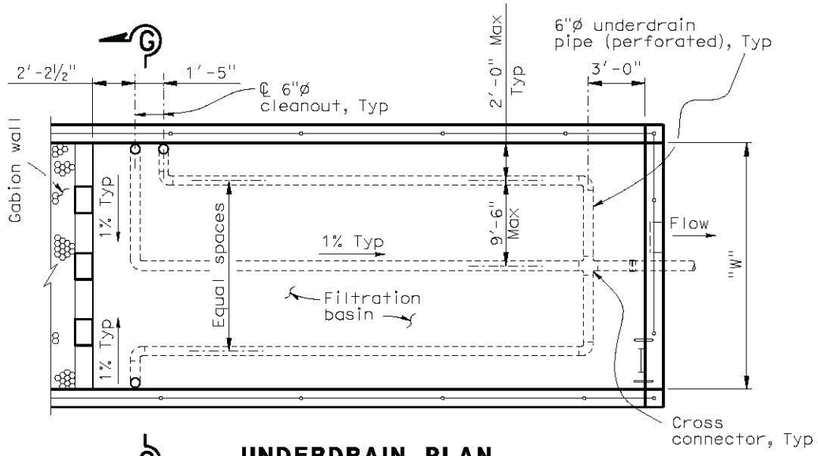
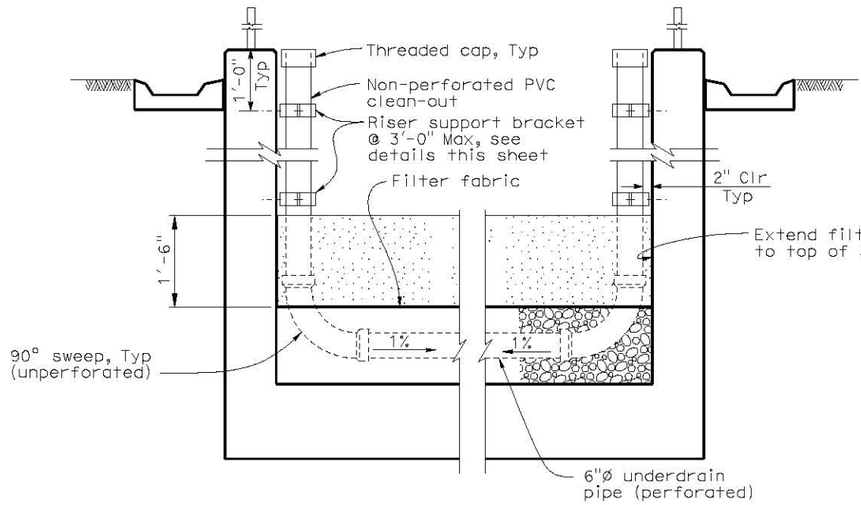
1333 Broadway, Suite 300
Oakland, CA 94612



UNDERDRAIN PLAN (FILTRATION BASIN)

"W" = 15' - 21'

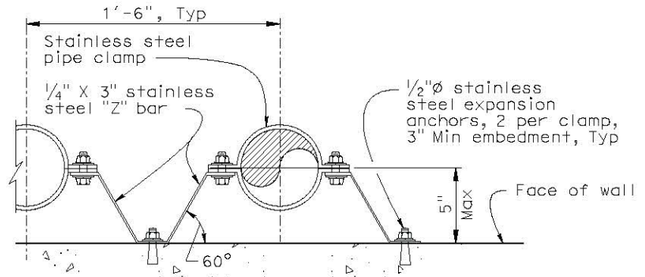
AVSF Type = (S or L 3500)



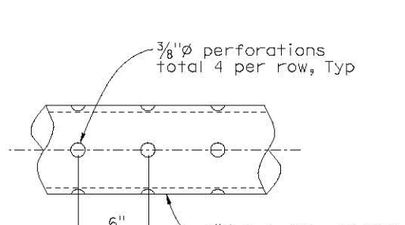
SECTION G - G

NOTE:

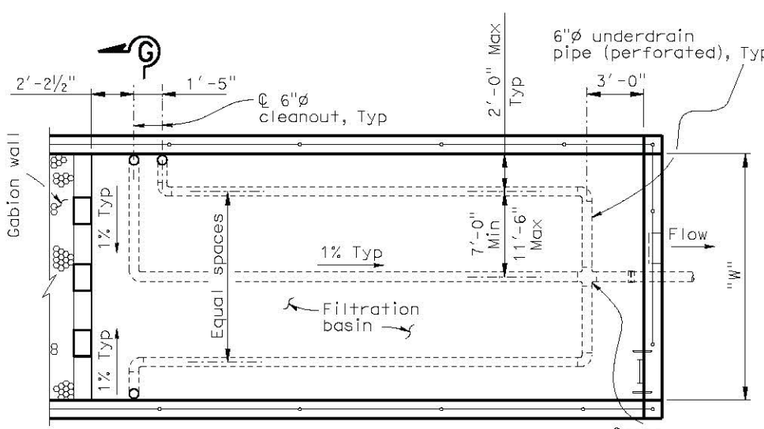
1. See "Layout No. 1" sheet for Typical cover and depth of sand bed.



RISER SUPPORT BRACKET DETAIL



PERFORATED UNDERDRAIN PIPE

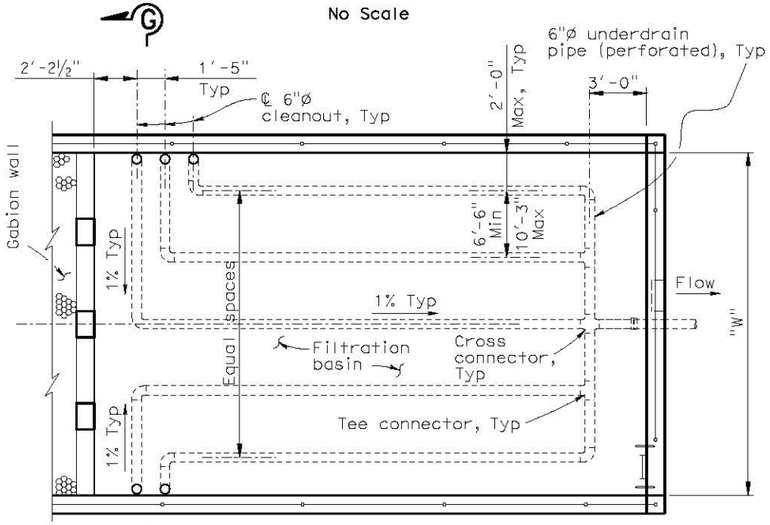


UNDERDRAIN PLAN (FILTRATION BASIN)

"W" = 18' - 24' - 27'

AVSF Type = (S or L 5000) L 10000)

No Scale



UNDERDRAIN PLAN (FILTRATION BASIN)

"W" = 30' - 36' - 45'

AVSF Type = (S 10000, S or L 15000)

AUSTIN VAULT SAND FILTER DETAILS No. 4

DRAINAGE DETAILS

NO SCALE

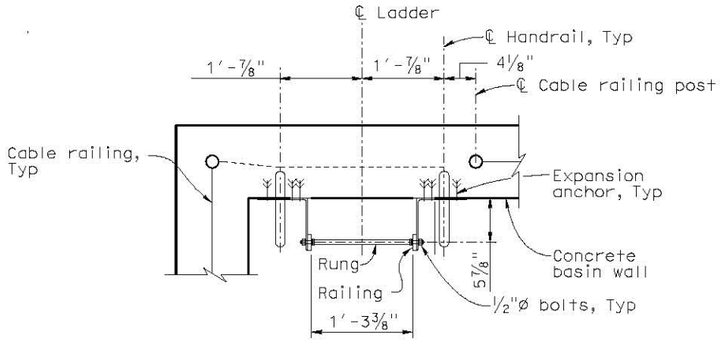
DD-14

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

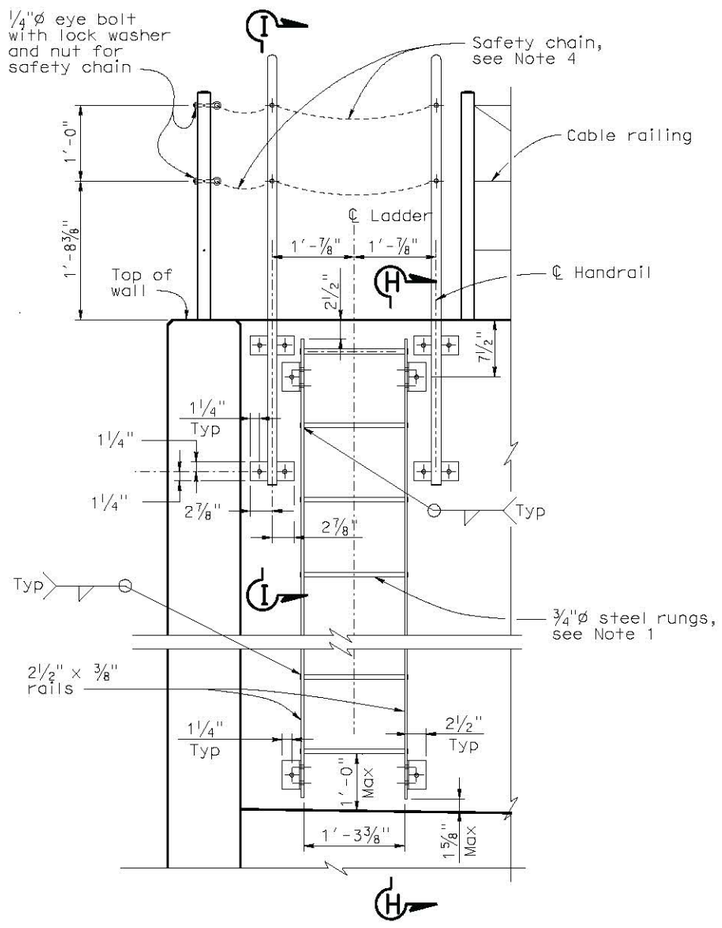
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY: IRENE LIU
CHECKED BY: ANALETTE OCHOA
REVISED BY: IL
DATE REVISED: 1/11/11

LAST REVISION: 1-11-11
DATE PLOTTED => 21-NOV-2011
TIME PLOTTED => 14:52

BORDER LAST REVISED 7/2/2010
USERNAME => s123631
DGN FILE => 04000205801c014.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205801



PLAN



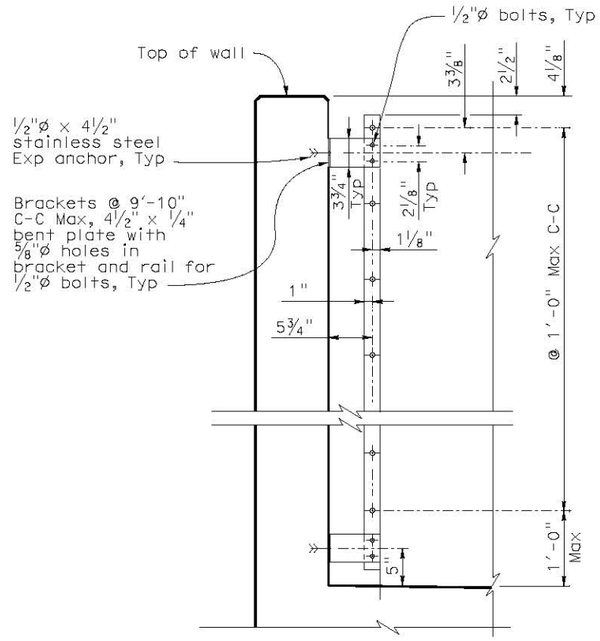
ELEVATION

LADDER

NOTE: Cable railing not shown for clarity.

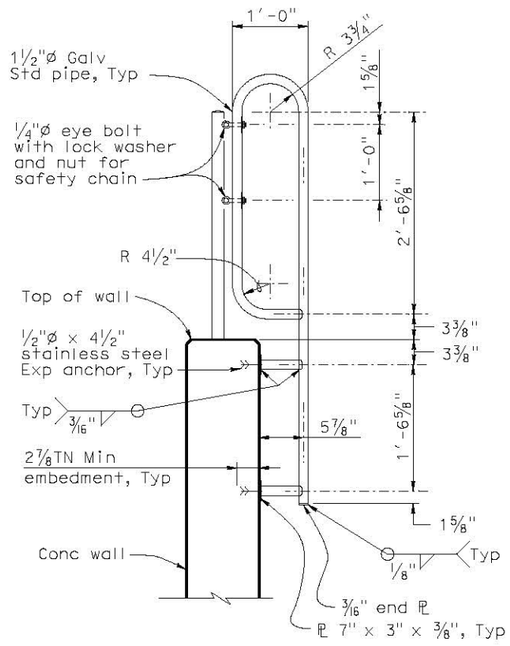
NOTES:

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.



SECTION H - H

NOTE: Handrail and cable railing not shown for clarity.



SECTION I - I

AUSTIN VAULT SAND FILTER
MISCELLANEOUS DETAILS No. 1

DRAINAGE DETAILS
NO SCALE

DD-15

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	25.5/27.1	108	495

Analette Ochoa
REGISTERED CIVIL ENGINEER — 1/18/11 DATE

6-27-11
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/12 — CIVIL — STATE OF CALIFORNIA

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1333 Broadway, Suite 300
Oakland, CA 94612

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
Caltrans

LAST REVISION 1-11-11
DATE PLOTTED => 21-NOV-2011
TIME PLOTTED => 14:52

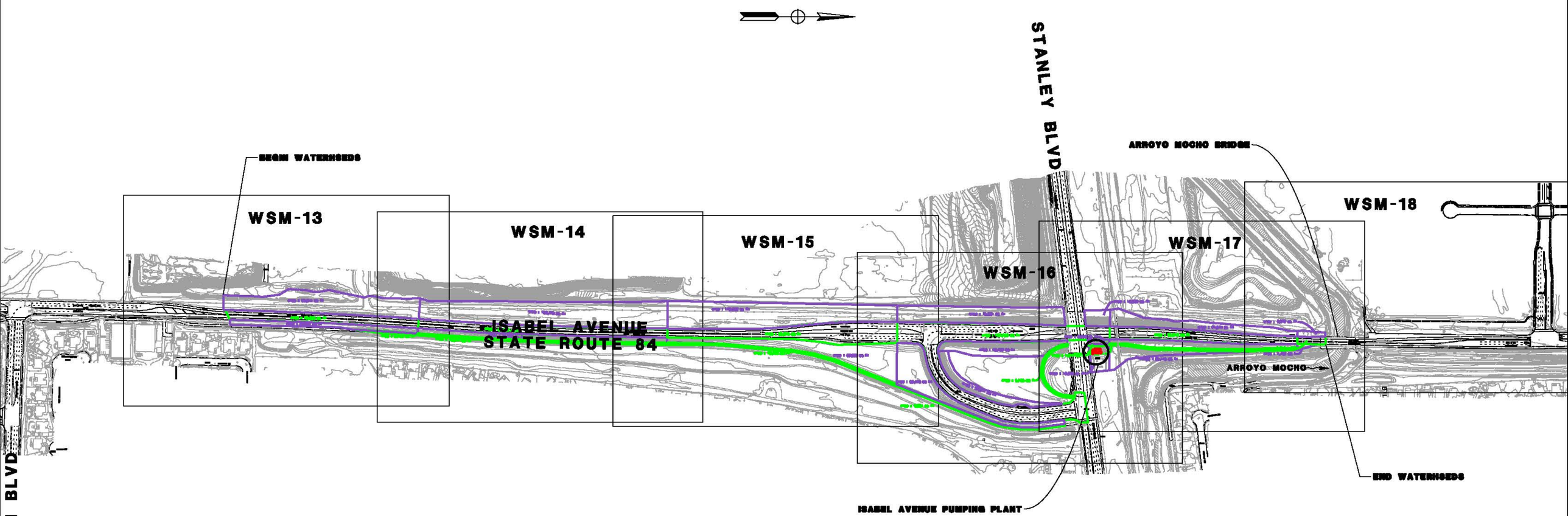
BORDER LAST REVISED 7/2/2010 | USERNAME => s123631 | DGN FILE => 04000205801ic015.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205801

1243 Alpine Road, Suite 108
Walnut Creek, CA 94596
Phone: 925.941.0017
Fax: 925.941.0018
www.wreco.com

Attachment 10 – Pump Station watershed maps from EA 04-297611

LEGEND:

- OFF-SITE WATERSHED BOUNDARY
- ON-SITE WATERSHED BOUNDARY
- Exist STORM DRAIN
- Exist DITCH FLOW LINE
- Exist INLET



STATE ROUTE 84 PUMPING PLANT WATERSHED MAP (EXISITING)

NOT TO SCALE

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	13	20

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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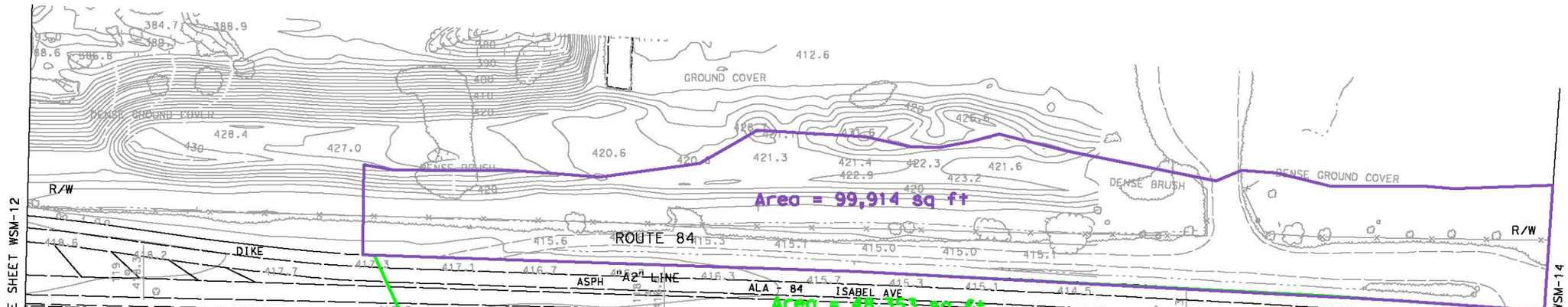
LEGEND:

- OFF-SITE WATERSHED BOUNDARY
- ON-SITE WATERSHED BOUNDARY
- Exist STORM DRAIN
- Exist DITCH FLOW LINE
- Exist INLET



ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

WATERSHED MAP (EXISTING)

SCALE 1"=50'

WSM-13

CALCULATED-DESIGNED BY: WANA CHIU
CHECKED BY: ANALETTE OCHOA
CONSULTANT FUNCTIONAL SUPERVISOR: ANALETTE OCHOA
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
REVISED BY | DATE REVISED
LAST REVISION 00-00-00
DATE PLOTTED => $DATE
TIME PLOTTED => $TIME
$REQUEST

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

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	14	20

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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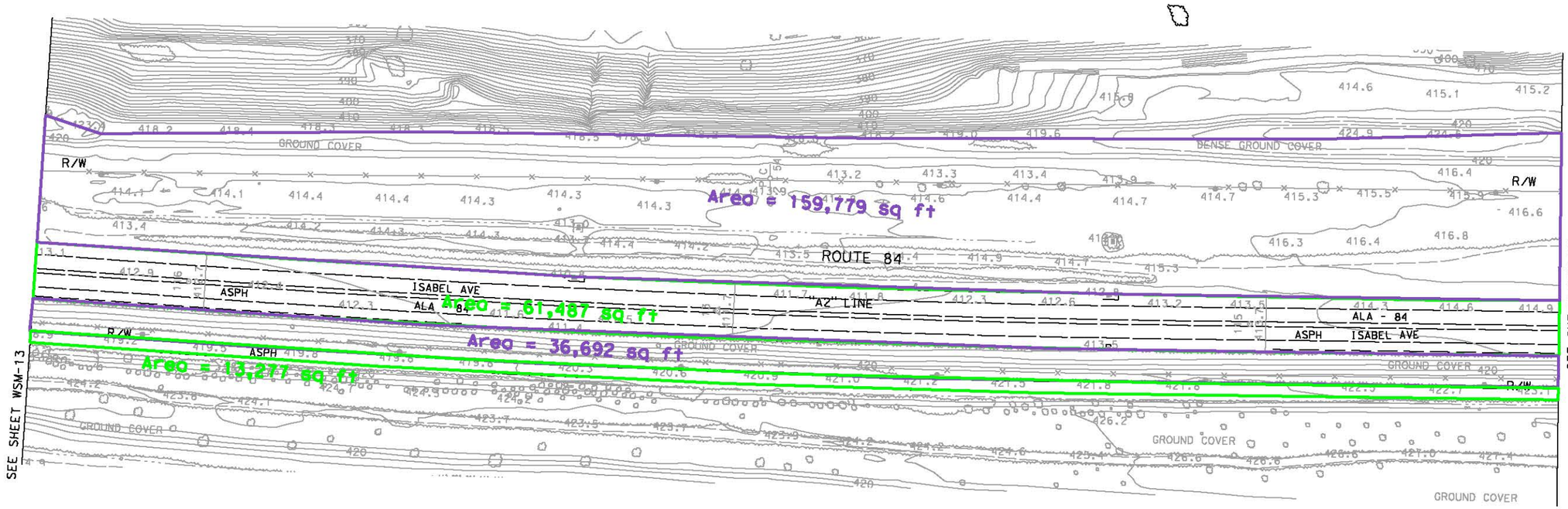
Oakland, CA 94612

LEGEND:

- OFF-SITE WATERSHED BOUNDARY
- ON-SITE WATERSHED BOUNDARY
- Exist STORM DRAIN
- Exist DITCH FLOW LINE
- Exist INLET



ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

WATERSHED MAP (EXISTING)

SCALE 1"=50'

WSM-14

REVISED BY | DATE REVISED

CALCULATED-DESIGNED BY: WANA CHIU

CHECKED BY: ANALETTE OCHOA

CONSULTANT FUNCTIONAL SUPERVISOR: ANALETTE OCHOA

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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LAST REVISION 00-00-00 | DATE PLOTTED => $DATE | TIME PLOTTED => $TIME

$REQUEST

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

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	15	20

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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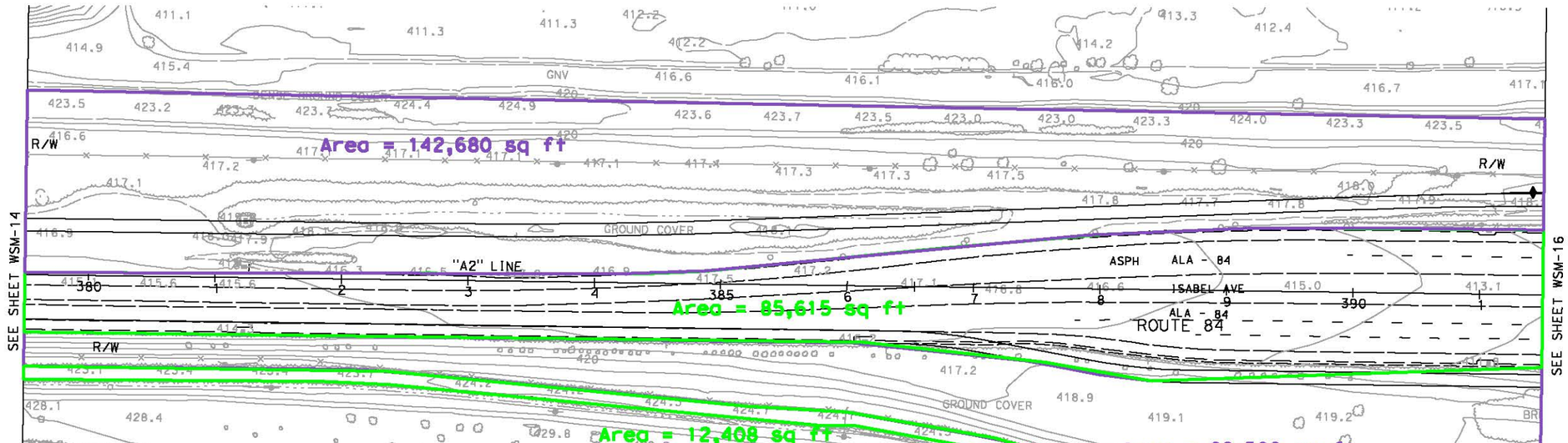
LEGEND:

- OFF-SITE WATERSHED BOUNDARY
- ON-SITE WATERSHED BOUNDARY
- Exist STORM DRAIN
- Exist DITCH FLOW LINE
- Exist INLET



ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

WATERSHED MAP (EXISTING)

SCALE 1"=50'

WSM-15

CALCULATED-DESIGNED BY: WANA CHIU
CHECKED BY: ANALETTE OCHOA
REVISED BY
DATE REVISED
CONSULTANT FUNCTIONAL SUPERVISOR: ANALETTE OCHOA
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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

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	16	20

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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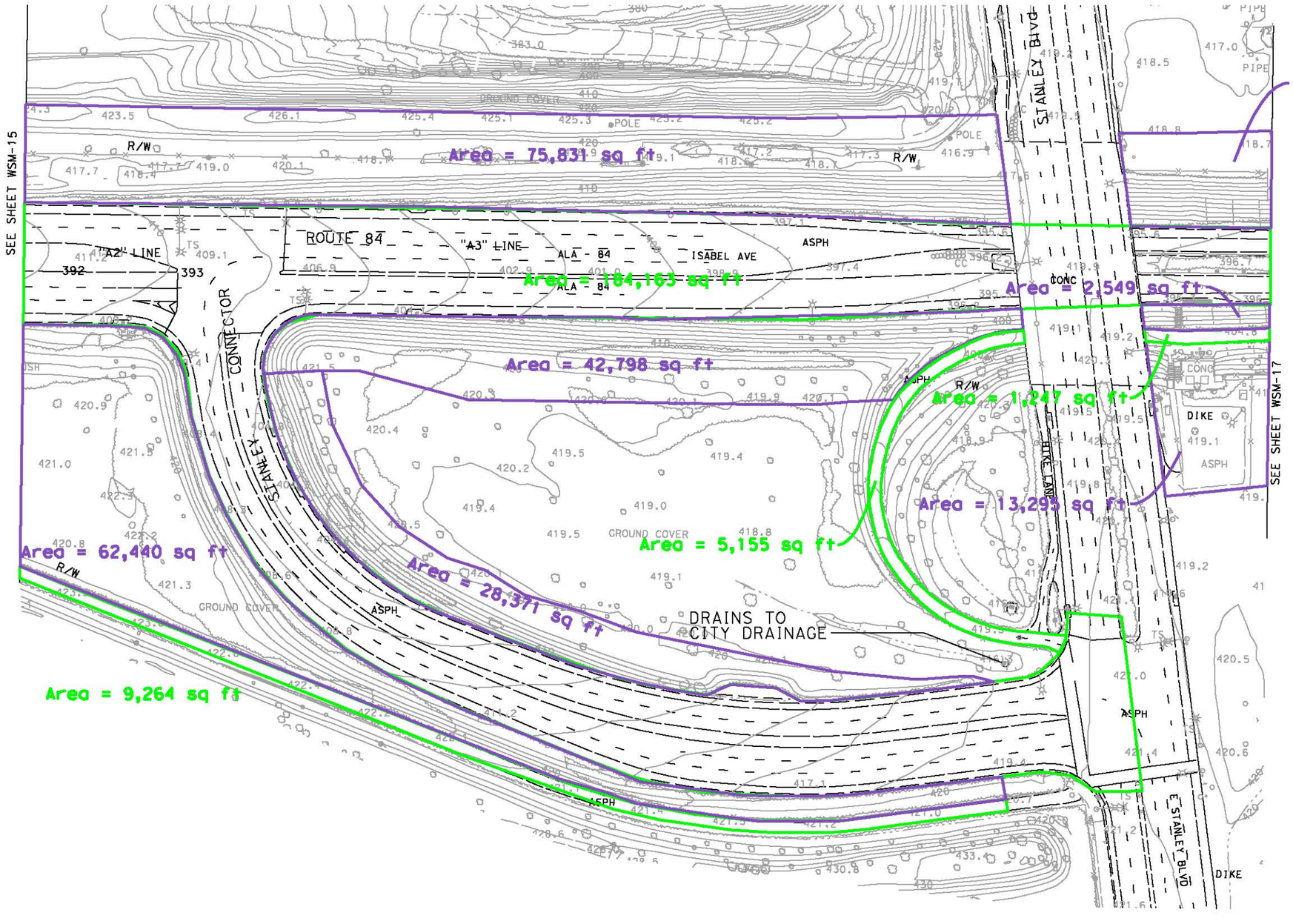
Oakland, CA 94612

LEGEND:

- OFF-SITE WATERSHED BOUNDARY
- ON-SITE WATERSHED BOUNDARY
- Exist STORM DRAIN
- Exist DITCH FLOW LINE
- Exist INLET



ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

WATERSHED MAP (EXISTING)

SCALE 1"=50'

WSM-16

REVISED BY	DATE REVISED
WANA CHIU	ANALETTE OCHOA
CALCULATED-DESIGNED BY	
CHECKED BY	
CONSULTANT FUNCTIONAL SUPERVISOR	ANALETTE OCHOA
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	
Caltrans	
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

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	17	20

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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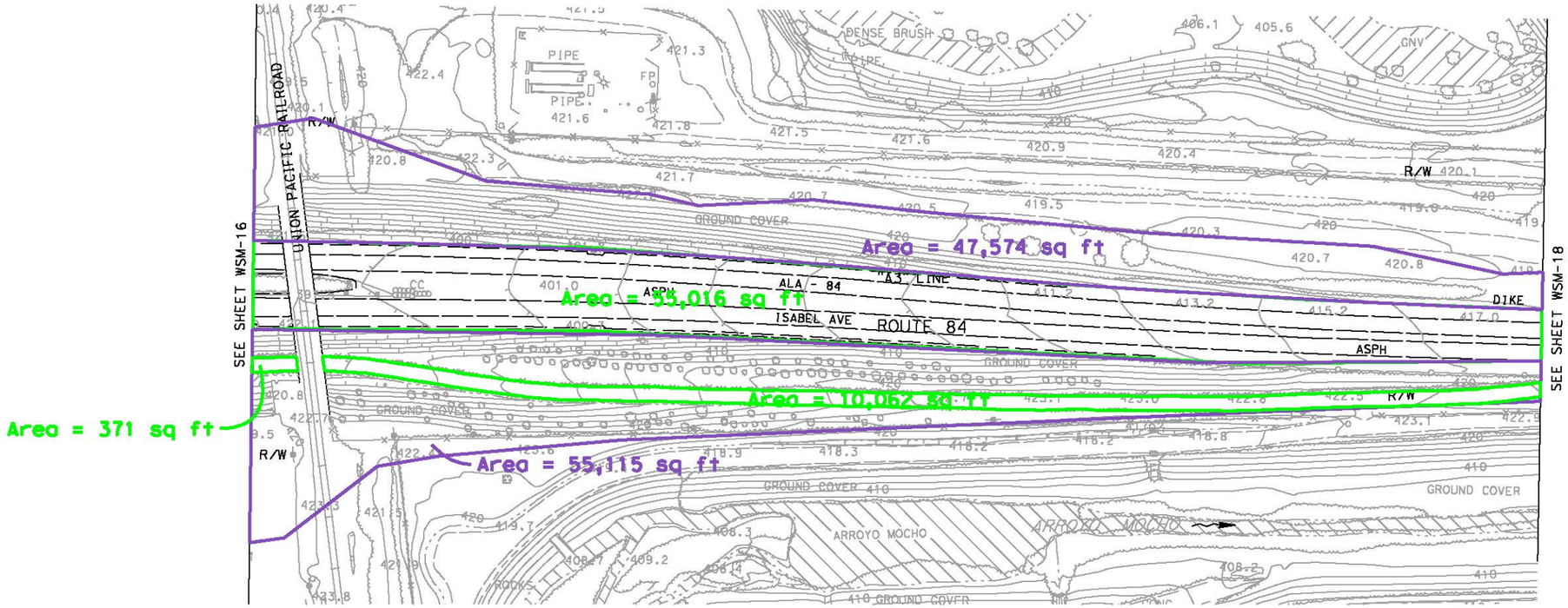
Oakland, CA 94612

LEGEND:

- OFF-SITE WATERSHED BOUNDARY
- ON-SITE WATERSHED BOUNDARY
- Exist STORM DRAIN
- Exist DITCH FLOW LINE
- Exist INLET



ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

WATERSHED MAP (EXISTING)

SCALE 1"=50'

WSM-17

CALCULATED-DESIGNED BY: WANA CHIU
CHECKED BY: ANALETTE OCHOA
CONSULTANT FUNCTIONAL SUPERVISOR: ANALETTE OCHOA
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
REVISED BY | DATE REVISED
LAST REVISION 00-00-00 | DATE PLOTTED => $DATE | TIME PLOTTED => $TIME
$REQUEST

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

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/27.1	18	20

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. Exp. CIVIL — STATE OF CALIFORNIA

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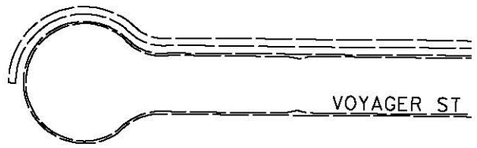
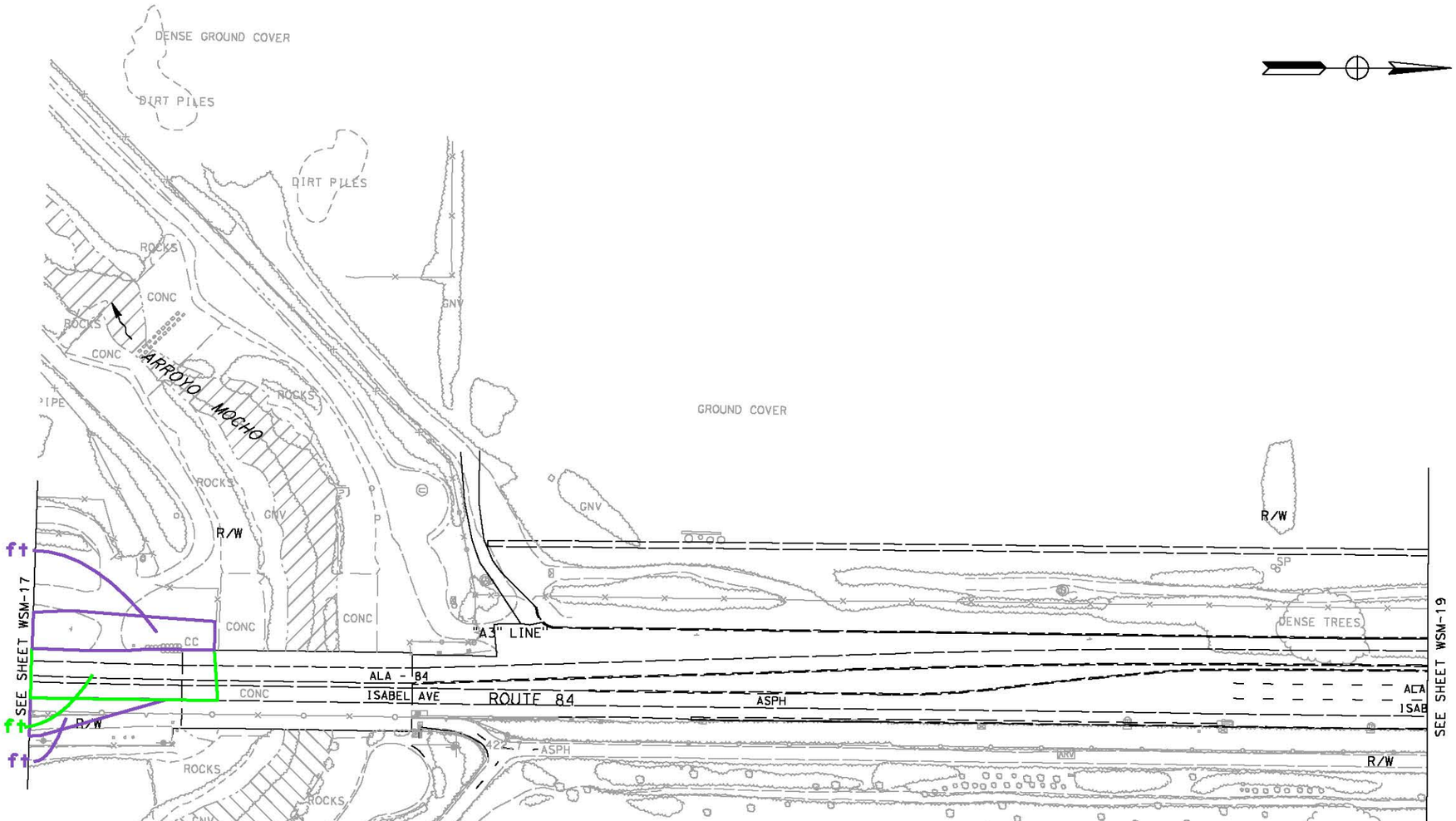
LEGEND:

- OFF-SITE WATERSHED BOUNDARY
- ON-SITE WATERSHED BOUNDARY
- Exist STORM DRAIN
- Exist DITCH FLOW LINE
- Exist INLET





Area = 3,972 sq ft

Area = 5,749 sq ft

Area = 1,752 sq ft

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

WATERSHED MAP (EXISTING)

SCALE 1"=50'

WSM-18

WANA CHIU — CALCULATED-DESIGNED BY
ANALETTE OCHOA — CHECKED BY
REVISED BY — DATE REVISED
CONSULTANT FUNCTIONAL SUPERVISOR: ANALETTE OCHOA
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
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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

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
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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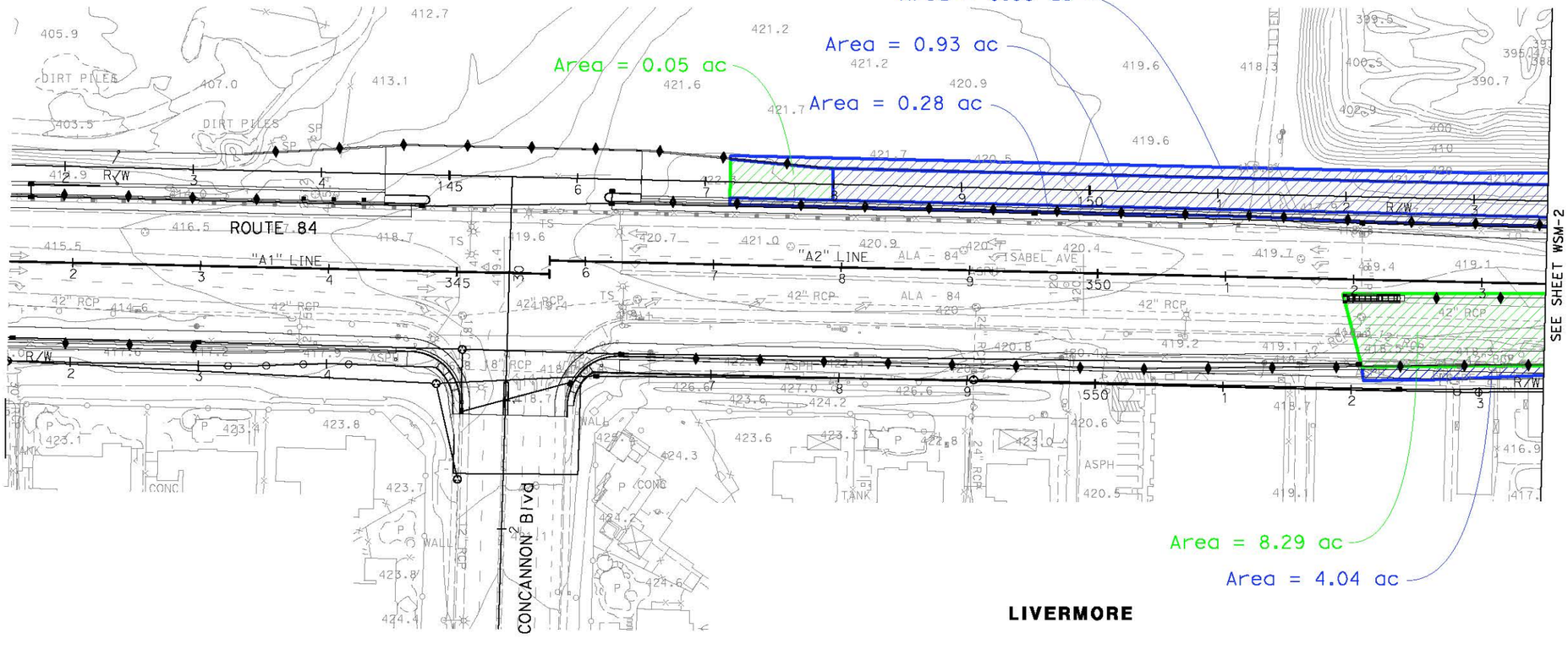
LEGEND:

PERVIOUS WATERSHED BOUNDARY

IMPERVIOUS WATERSHED BOUNDARY (TREATED)

IMPERVIOUS WATERSHED BOUNDARY (NON-TREATED)



WATERSHED MAP

SCALE 1"=50'

WSM-1

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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 => 7/17/2013
TIME PLOTTED => 12:08:18 PM

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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	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

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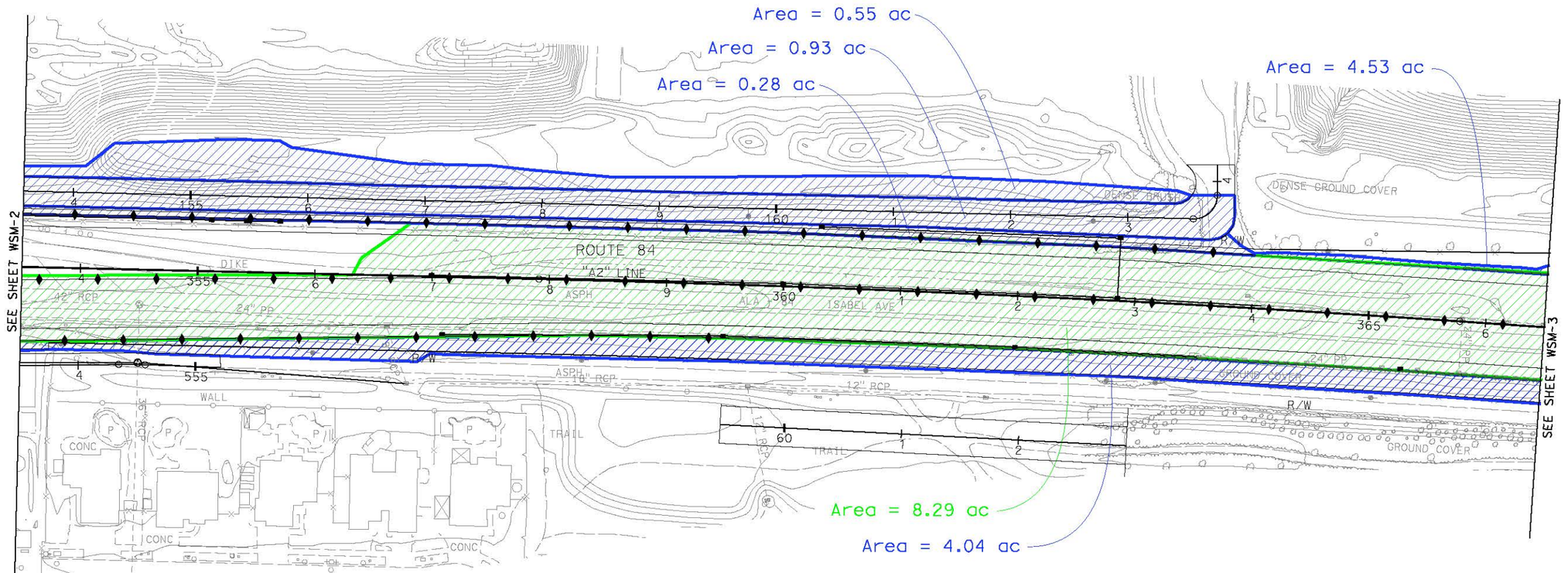

WATERSHED MAP
SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

WSM-2

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.

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
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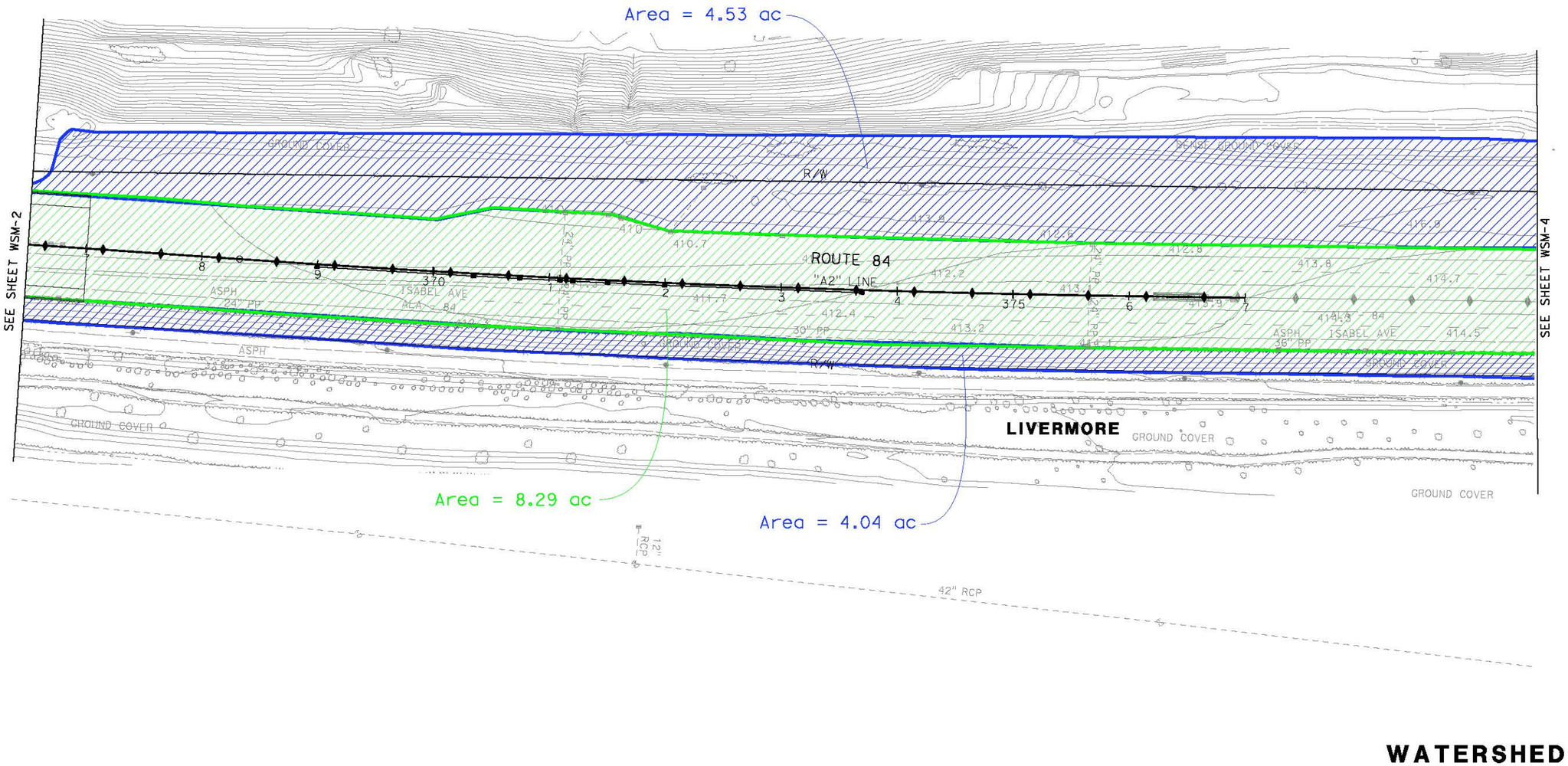

WATERSHED MAP
SCALE 1"=50'

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WSM-3

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DATE REVISED	10/19/10		
CALCULATED-DESIGNED BY	IRENE LIU		
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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 — 10/19/10 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
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Exp 12/31/12
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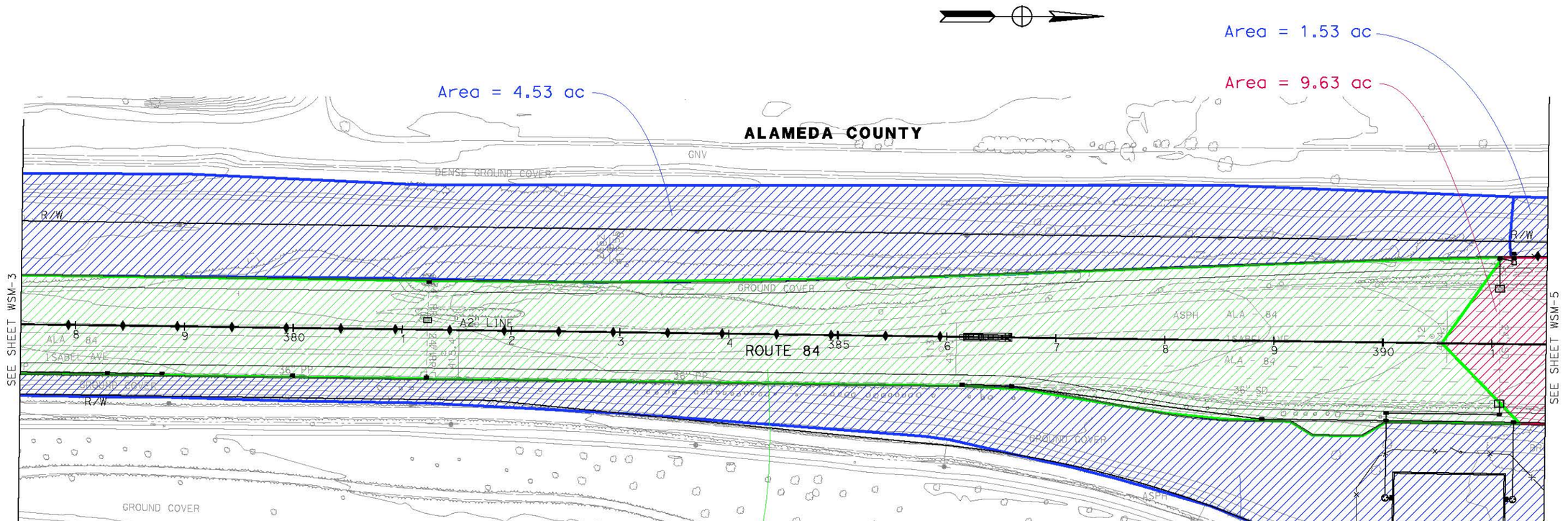

WATERSHED MAP

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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CHECKED BY	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

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

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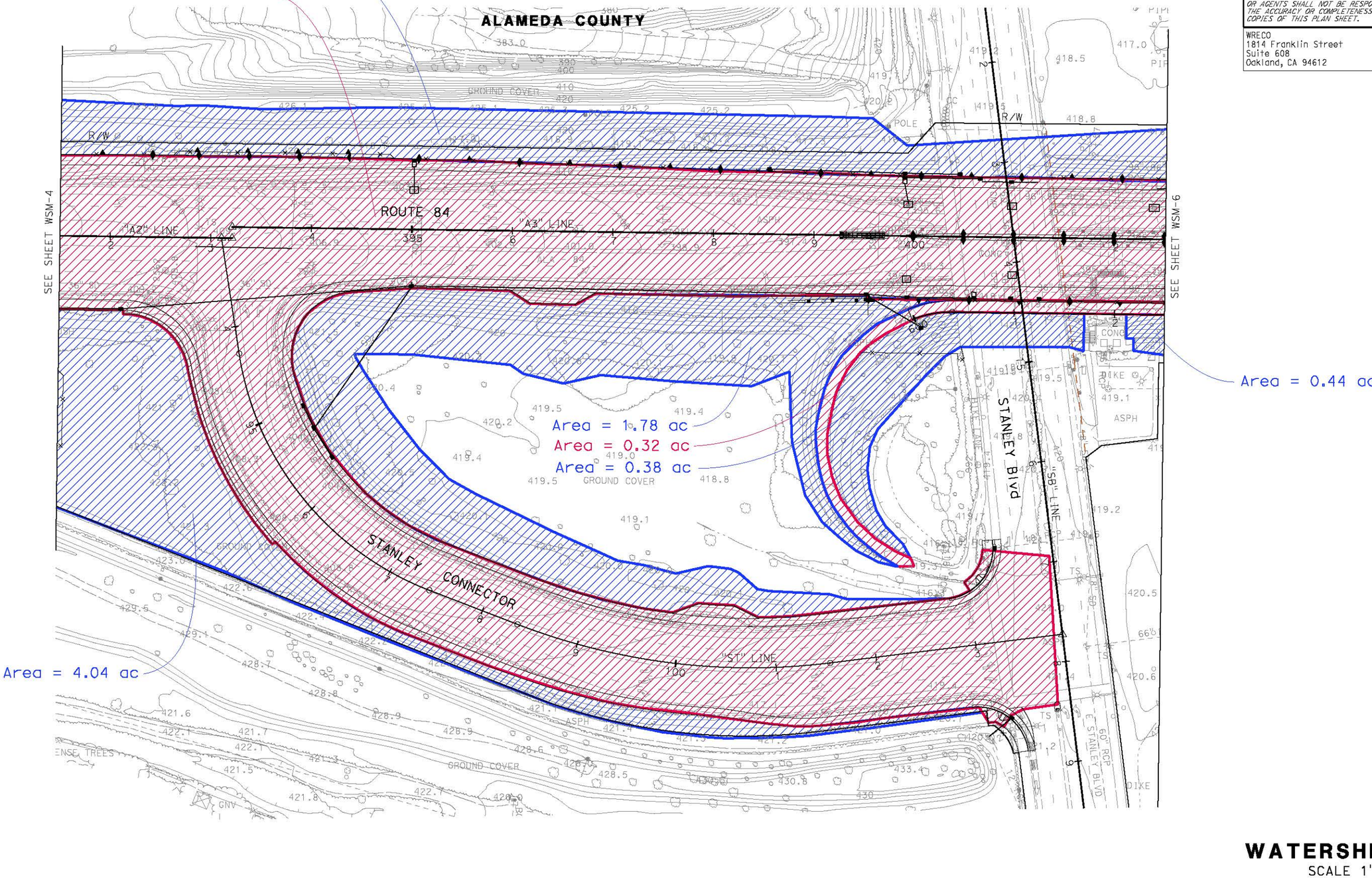

WATERSHED MAP
SCALE 1"=50'

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

WSM-5

IRENE LIU	ANALETTE OCHOA	10/19/10
CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY / DATE REVISED
CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG	IL

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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		

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
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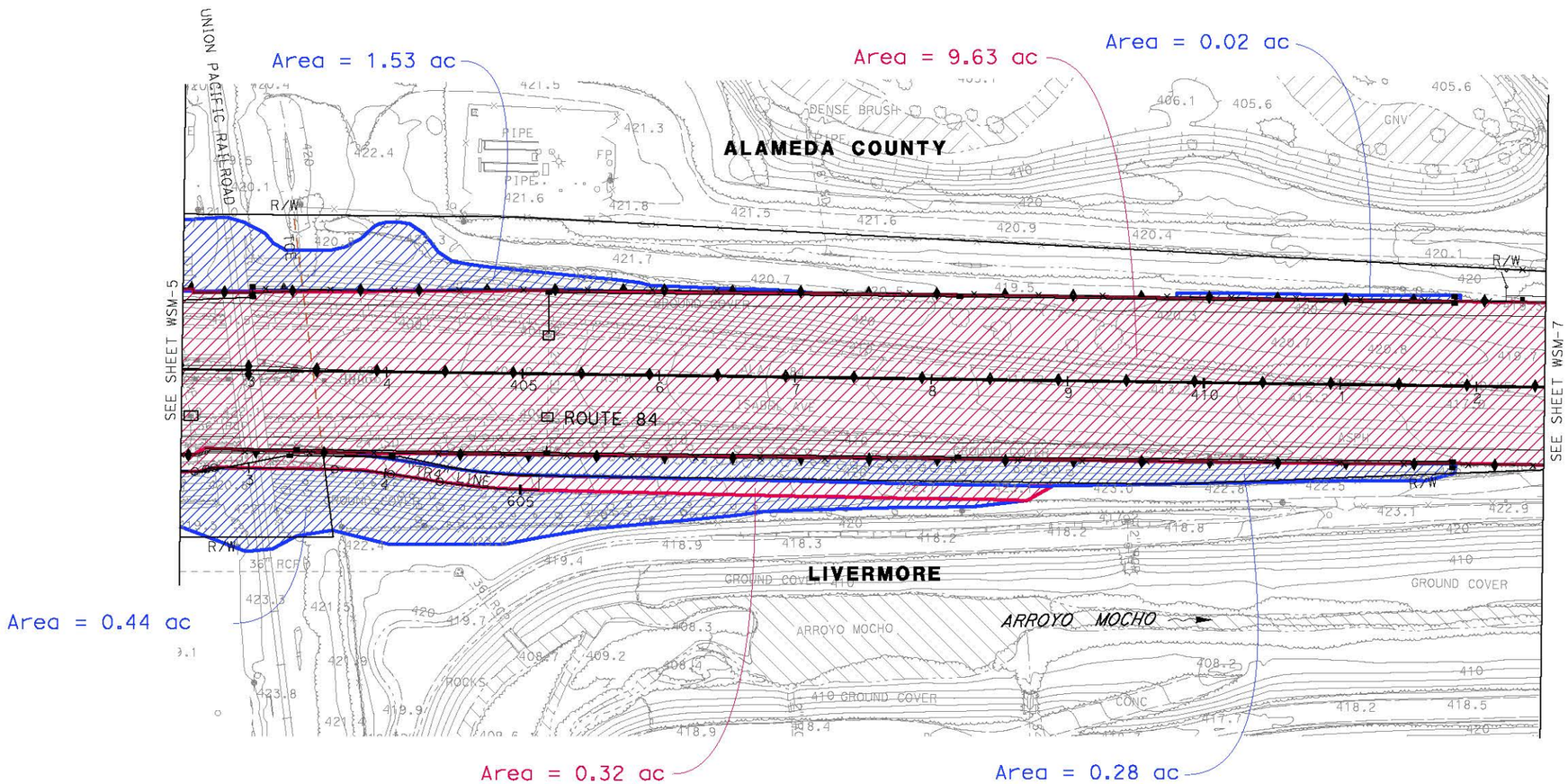

WATERSHED MAP
SCALE 1"=50'

WSM-6

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FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

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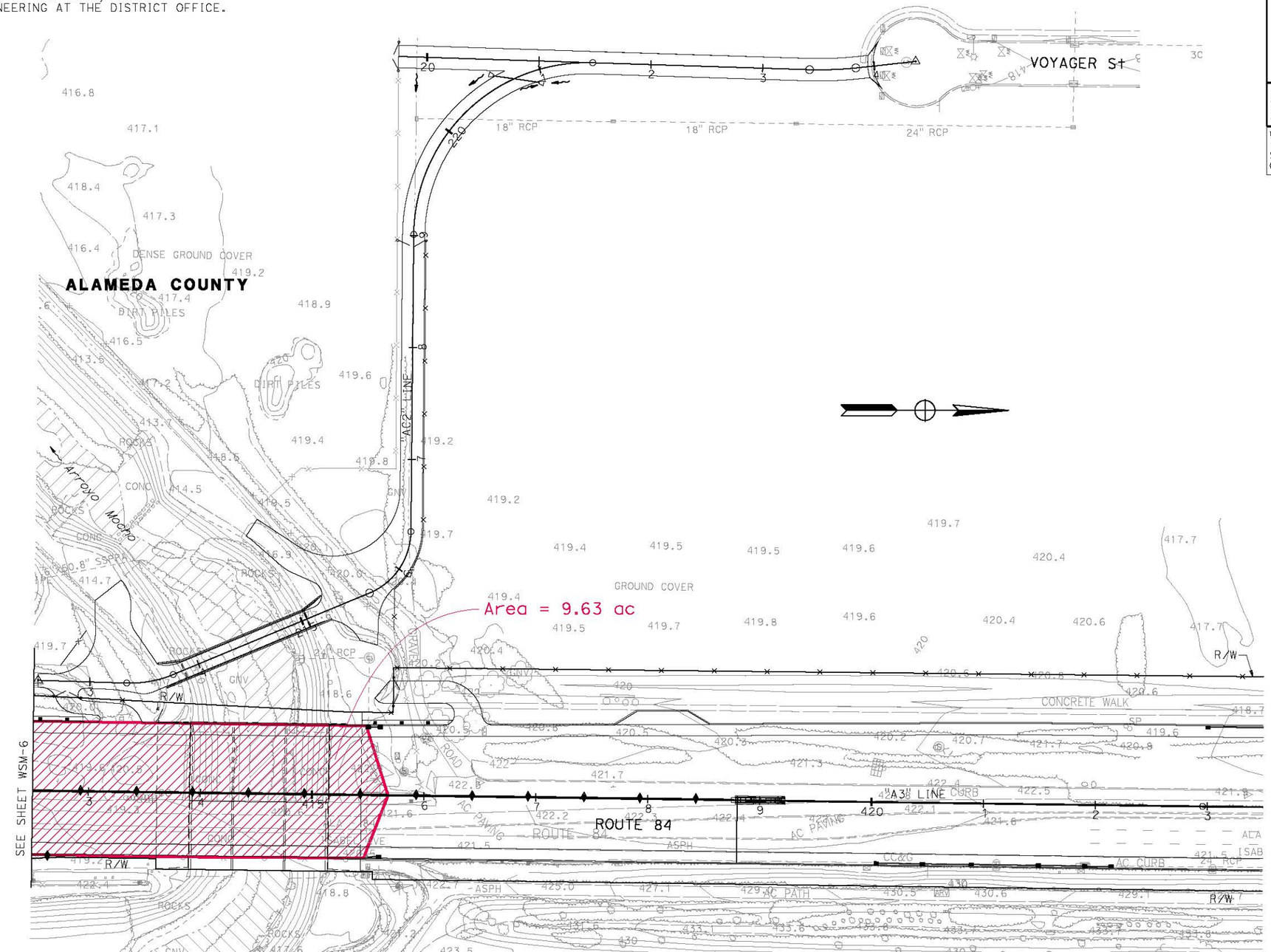
FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.



WATERSHED MAP
SCALE 1"=50'

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

WSM-7

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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REVISED BY	DATE REVISED
IL	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 DATE PLOTTED => 7/17/2013
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BORDER LAST REVISED 7/2/2010
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DGN FILE => ...\Dwg\Seg B\MEMO\WSM-7.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205801

Bridge Design Hydraulic Study Report Amendment – Dated 11/2014

WRECO

1243 Alpine Road, Suite 108
Walnut Creek, CA 94596
Phone: 925.941.0017
Fax: 925.941.0018
www.wreco.com

Memorandum

Date: **November 14, 2014**

To: **Tony Nedwick – Hydraulic Engineer, Structure Hydraulics & Hydrology**

Cc: **David Soon – Structure Liaison Engineer, Division of Engineering Services**

From: **Analette Ochoa, P.E. & Jeff Tudd – WRECO**

Subject: **EA 04-297624 State Route 84 Expressway Widening Project – Bridge Design Hydraulic Study Report Amendment**

I. Introduction

This memorandum is an amendment to the State Route 84 Expressway Widening Project (EA 04-297601) *Bridge Design Hydraulic Study Report*. The Bridge Design Hydraulic Study Report was signed by the Registered Civil Engineer for the bridge design on 05/20/2009 (see Attachment C). The current project EA is 04-297624 and the Project ID is 0400020581. On July 3, 2014, Structure Hydraulics & Hydrology comments were provided to the Office of Special Funded Projects, Program Project and Resource Management, Division of Engineering Services. Since then, WRECO has coordinated with URS Corporation and MGE Engineering to address these comments.

The following sections provide amendments to the original report.

II. Executive Summary

The fourth sentence of the first paragraph is as follows: "The piles of the piers for the widened SR 84 Expressway Bridge at Arroyo del Valle and the Trail Bridge at Arroyo Mocho should have tip elevations deeper than the estimated total scour, taking into account the estimated total scour during pile design."

III. Section 1. General Description

The Project Description for EA 04-297624 is amended as follows:

The State Route (SR) 84 Expressway Widening Project (Project), located in Livermore and Pleasanton in Alameda County, proposes to widen and upgrade 2.8 miles of SR 84 from 0.1 mile south of Ruby Hill Drive to 0.6 mile north of Concannon Boulevard to expressway standards (55 miles per hour [mph]). 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, and Concannon Boulevard will be widened and upgraded to accommodate future traffic movements. A connector access will be constructed at the SR 84/Vallecitos Road intersection to accommodate the high volume of traffic moving from northbound SR 84 to the City of Livermore. 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 southward to Vineyard Avenue; a Trail Bridge crossing will be included at Arroyo del Valle. The Project will also construct a new access bridge at Arroyo del

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Valle for local utility and maintenance facilities and widen the existing bridge across Arroyo del Valle. The Project will construct retaining walls where right-of-way is restricted.

The roadway cross section will consist of 12-ft-wide travel lanes and 10-ft-wide shoulders separated by a concrete median barrier. Roadway slopes will vary in steepness depending on safety requirements. Where practical, side slopes will be 4:1 or flatter to provide a clear recovery zone (CRZ) for errant vehicles. Outside the CRZ, side slopes will be 2:1 or flatter. The roadway median area at intersections will be widened up to 36 ft to accommodate left-turn lanes.

IV. Section 2. Description of Watershed

There are no revisions to this section.

V. Section 3. Description of Stream and Site

Section 3.3 Proposed Action of the proposed bridge at Arroyo del Valle is amended to match the alternative founded on 36-in. CIDH piles. The body of the text shall be revised to indicate foundation specifics used in the study and scour analysis. The foundation of the pier is on bridge footing consisting of structural concrete, and below the bridge footing are 36-in. CIDH concrete piles. The bottom of footing elevation is 398.67 ft and the pier wall thickness is 1.5 ft. Although the foundations differ between the latest May 2014 General Plan and the previous version of the General Plan, the bridge length, bridge width, and pier width are the same.

A new bridge General Plan for the SR 84 Expressway at Arroyo del Valle was prepared for the Project dated November 2014 (see Figure 1).

A new bridge General Plan for the Trail Bridge at Arroyo del Valle was prepared for the Project dated November 2014 (see Figure 2).

VI. Section 4. Hydrology

There are no revisions to this section.

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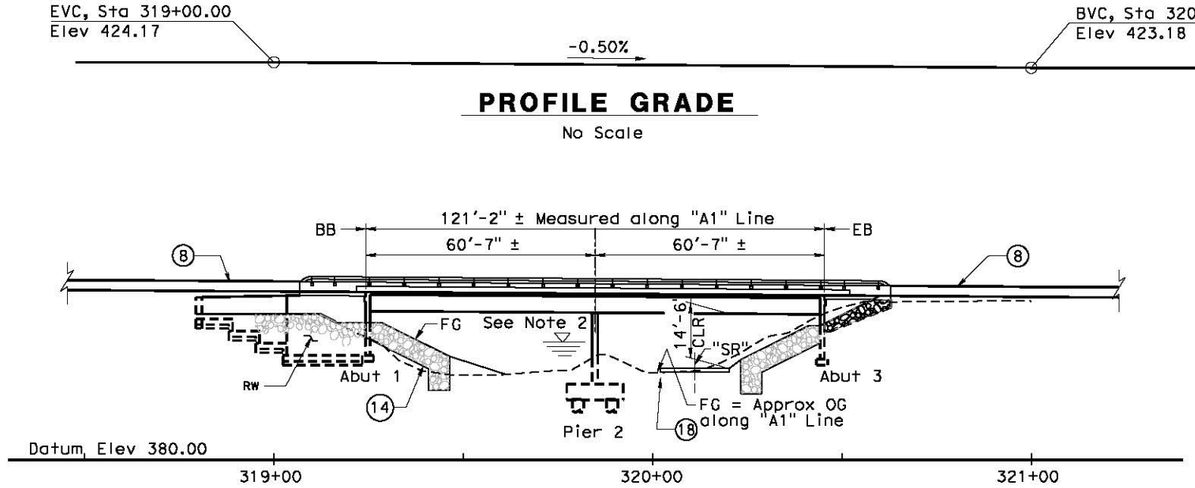
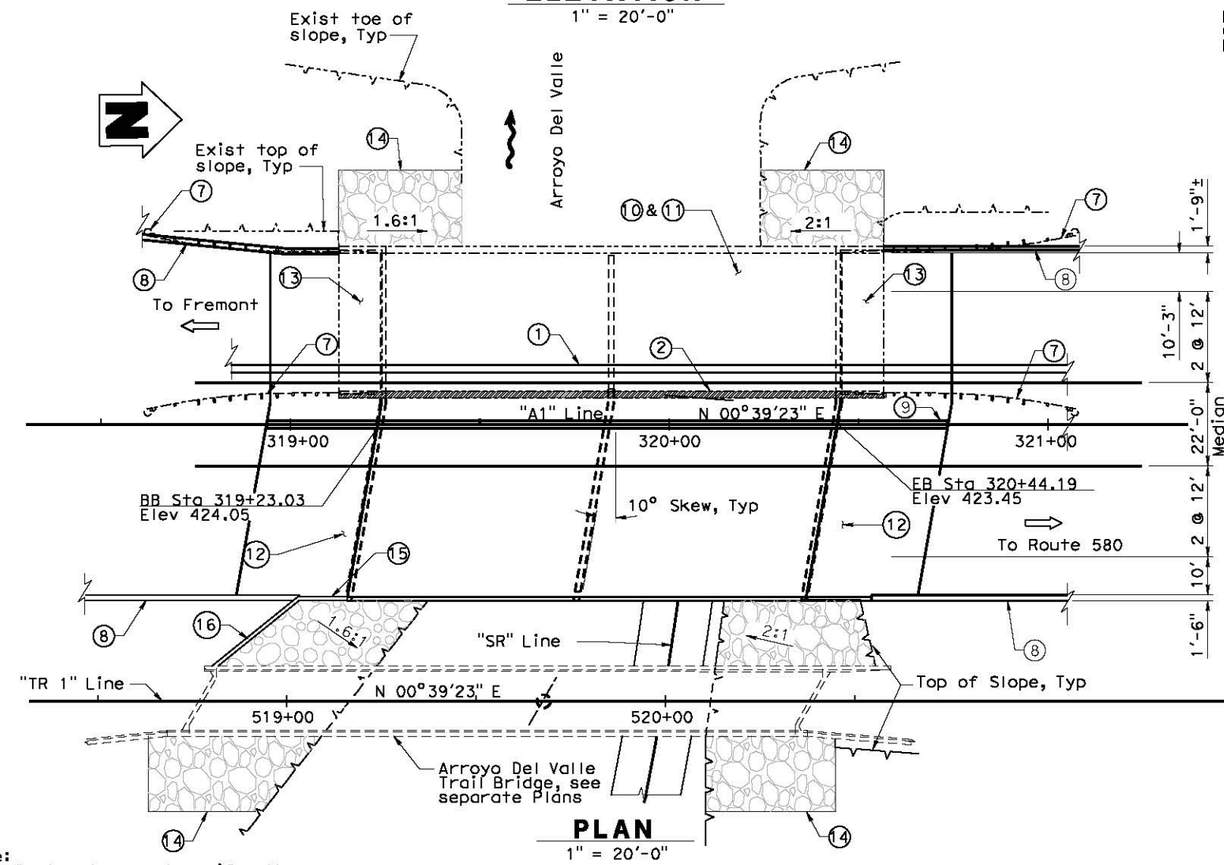
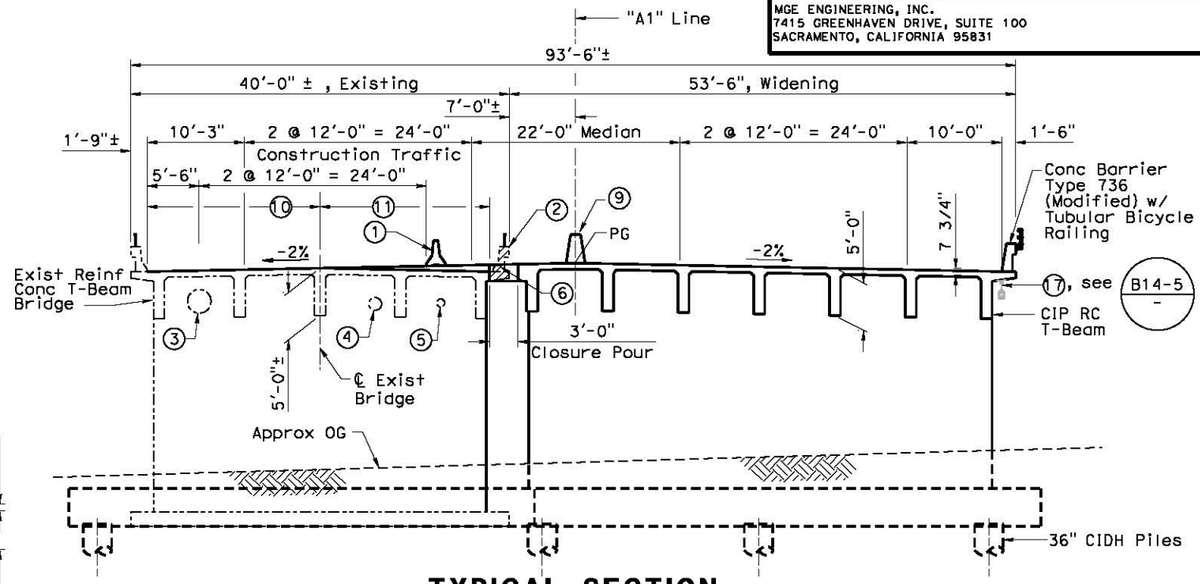
Figure 1. SR 84 Expressway at Arroyo del Valle Bridge General Plan





Note:
The Contractor must verify all controlling field dimensions before ordering or fabricating any material.



LEGEND

- Indicates Exist Structure
- Indicates New Construction
- Indicates Direction of Travel
- Indicates Direction of Flow
- Indicates Bridge Removal (Portion)

NOTES:

1. For General Notes, Quantities and Index to Plans, see "GENERAL NOTES" Sheet.
2. For Pile Data Table, Spread Footing Data Table and Hydrologic Summary, see "FOUNDATION PLAN" sheet.

NOTES:

1. Temporary Railing (Type K), see "Roadway Plans"
2. Remove Existing Barrier, Railing & Overhang
3. Existing 30" Ø Steel Casing to remain
4. Existing 16"Ø DIP Sewer Line to be relocated by others
5. Existing 12"Ø Water Line to remain
6. Existing 2 - 3"Ø Conduits to be relocated by others
7. Existing Metal Beam Guard Rail to be removed, see "Roadway Plan"
8. Concrete Barrier, see "Roadway 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 (Varies, 10" max in Thickness) and place 3/4" Polyester Concrete Overlay
12. Structure Approach, Type N (30D)
13. Remove Exist Approach Slab and replace with Structure Approach, Type R (30D)
14. Rock Slope Protection , See "ROCK SLOPE PROTECTION" Sheet.
15. Paint "Bridge No. 33-0710" & "Arroyo Del Valle Bridge"
16. Retaining Wall, Type 1
17. 2" Supply Line (Bridge)
18. "SR" road, see "Roadway Plans"

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

Xiangyang Fu 01/16/15
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER — XIANGYANG FU — No. C 72514 — Exp. 06/30/16 — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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OAKLAND, CA 94607

MGE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831

	BY	CHECKED	LOAD & RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 W/"LOW-BOY"; PERMIT DESIGN VEHICLE	
DESIGN	X. Fu	D. Wang			
DETAILS	K. Wang	D. Wang	LAYOUT	X. Fu	D. Wang
QUANTITIES	W. Sennett	R. Huang	SPECIFICATIONS	R. E. Sennett	PLANS AND SPECS COMPARED X. Fu

DESIGN OVERSIGHT
SIGN OFF DATE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Xiangyang Fu
PROJECT ENGINEER

BRIDGE NO. 33-0710
POST MILES 24.8

ARROYO DEL VALLE BRIDGE (WIDEN)
GENERAL PLAN

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0733
PROJECT NUMBER & PHASE: 04000205811 CONTRACT NO.: 04-297624

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES				SHEET	OF
03/08/08	10/21/10	05/28/14	01/16/15	1	20

FILE => P:\397 Route 84 Wideninga\Segment B PS&E\Arroyo Del Valle Widen\CADD\33-0710-a-gp01.dgn

DATE PLOTTED => 1/13/2015 TIME PLOTTED => 5:02:12 PM USERNAME => Kai

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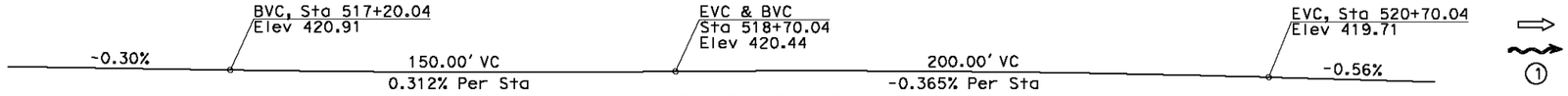
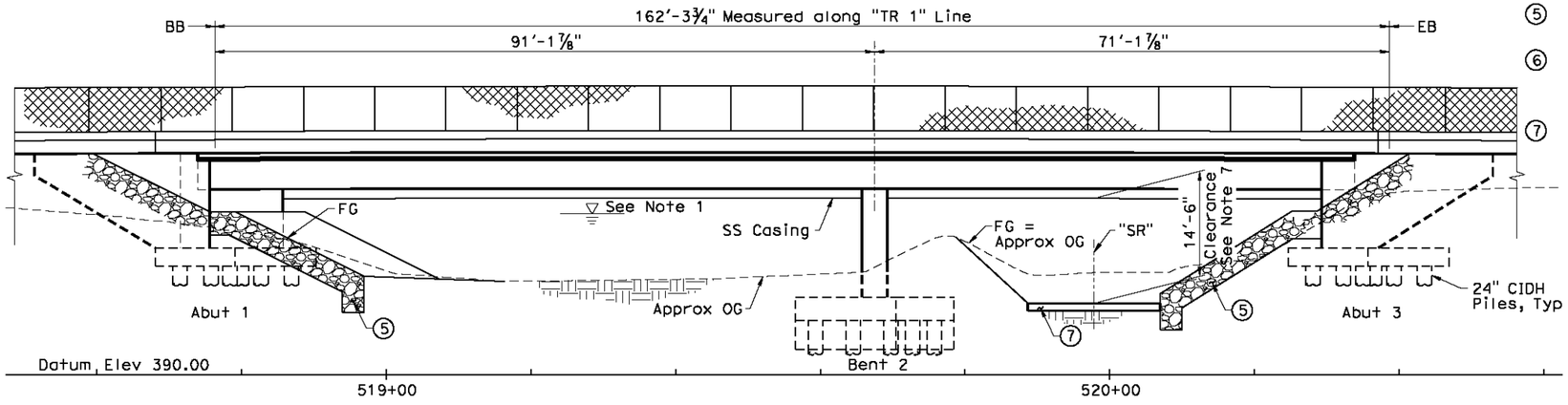
Figure 2. Trail Bridge at Arroyo del Valle Bridge General Plan



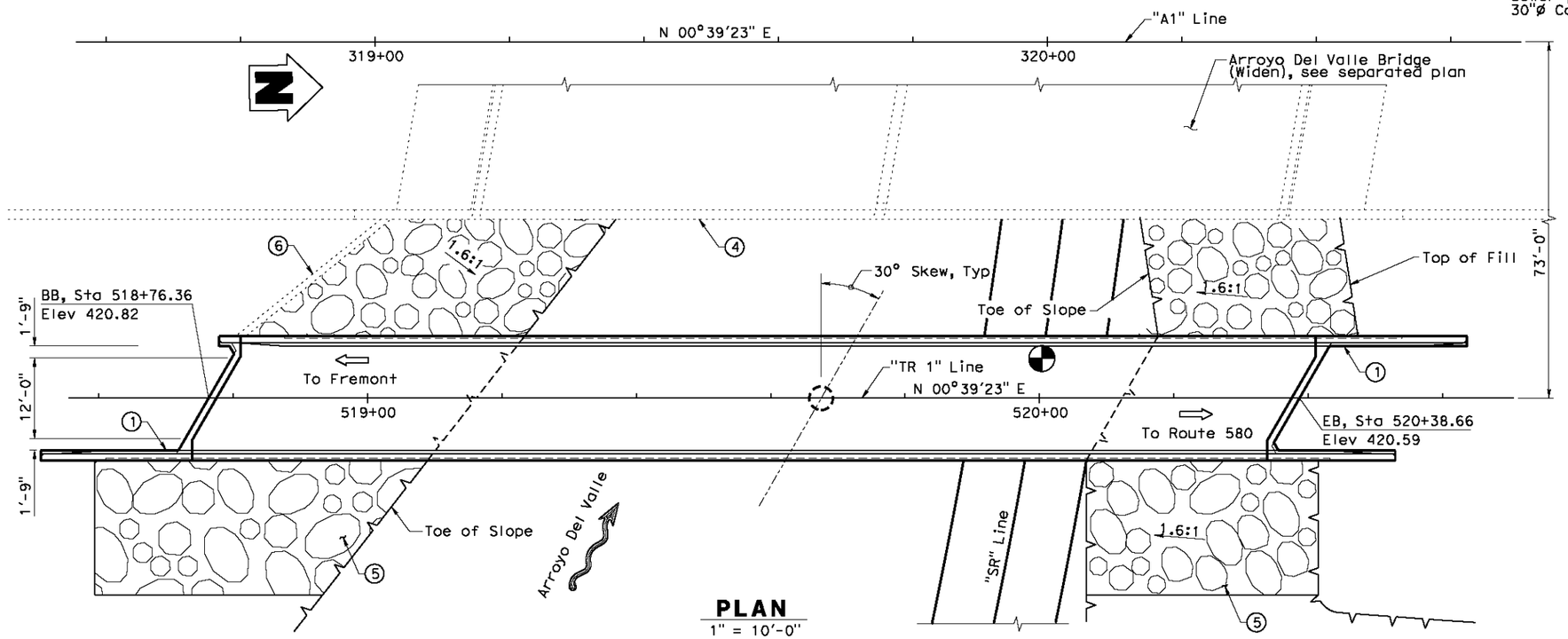
PROFILE GRADE

No Scale



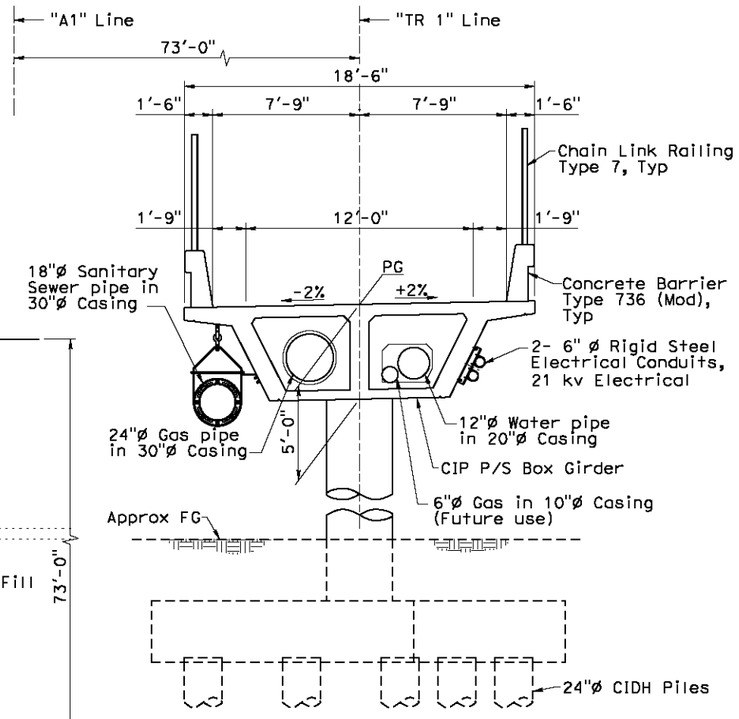
ELEVATION

1" = 10'-0"



PLAN

1" = 10'-0"



TYPICAL SECTION

¼" = 1'-0"

LEGEND

- ⇨ Indicates Direction of Travel
- ⇝ Indicates Direction of Flow
- ① Paint "Arroyo Del Valle Trail Bridge"
- ④ Arroyo Del Valle Bridge (Widen) Bridge No. 33-0710
- ⑤ Rock Slope Protection, See "ROCK SLOPE PROTECTION" SHEET
- ⑥ Type 1 Retaining Wall, see "Arroyo Del Valle Bridge (Widen)" plans
- ⑦ "SR" Road, see "Roadway Plans"

NOTES:

1. For General Notes, Quantities, Pile Data Table and Hydrologic Summary, see "FOUNDATION PLAN" sheet.
2. For Index to Plans, see "DECK CONTOURS" sheet.
3. For alignment and details of Sanitary Sewer, see "Sanitary Sewer Plan", SSD-4.
4. For alignment and details of Water pipe, see "Utility Plan", U-23.
5. For alignment and detail of Gas pipes and Electrical Conduits, see "Joint Utility Trench" sheets.
6. For utility Hanger Details not Shown, See "BRIDGE UTILITY DETAILS" Sheet.
7. 14'-6" vertical clearance is measured from the bottom of SS casing to the finished grade of "SR" roadway.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

Xiangyang Fu 01/16/15
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — XIANGYANG FU — No. C 72514 — Exp. 06/30/16 — CIVIL — STATE OF CALIFORNIA

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ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 BROADWAY, SUITE 800
OAKLAND, CA 94607

MGE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831

DESIGN OVERSIGHT	DESIGN	BY X. Fu	CHECKED D. Wang	LOAD & RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 AND PERMIT DESIGN VEHICLE		
SIGN OFF DATE	DETAILS	BY K. Wang	CHECKED D. Wang	LAYOUT	BY X. Fu	CHECKED D. Wang	
	QUANTITIES	BY R. Huang	CHECKED W. Sennett	SPECIFICATIONS	BY R. E. Sennett	PLANS AND SPECS COMPARED X. Fu	

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Xiangyang Fu
PROJECT ENGINEER

BRIDGE NO. N/A
POST MILES N/A

ARROYO DEL VALLE TRAIL BRIDGE
GENERAL PLAN

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0733
PROJECT NUMBER & PHASE: 04000205811 CONTRACT NO.: 04-297624

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES				SHEET	OF
02/05/08	10/21/10	05/27/14	01/16/15	1	19

FILE => P:\397 Route 84 Widenings\Segment B PS&E\Arroyo Del Valle Trail Bridge\CADD\33-advtb-a-gp01.dgn

USERNAME => Koi
DATE PLOTTED => 1/14/2015
TIME PLOTTED => 4:18:49 PM

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VII. Section 5. Hydraulic Analysis

Because updated topo was provided by URS Corporation on November 3 for existing original grade and on November 11 for proposed finished grade, new existing and proposed HEC-RAS models were performed. Table 9 of the original report has been updated by this memorandum's Table 1 and Table 11 of the original report has been updated by this memorandum's Table 2:

Table 1. Arroyo del Valle Water Surface Elevations (ft)

River Station	D/S Length	100-year			50-year		
		Ex	Prop	Change	Ex	Prop	Change
2112	330	413.76	413.19	-0.57	412.41	411.93	-0.48
1782	20	412.92	412.07	-0.85	411.64	410.83	-0.81
1762	0.5	412.75	412.04	-0.71	411.48	410.79	-0.69
U/S Trail Bridge	18.5	N/A	411.93	N/A	N/A	410.71	N/A
D/S Trail Bridge	11	N/A	410.75	N/A	N/A	409.76	N/A
1732	0.5	411.90	410.84	-1.06	410.77	409.83	-0.94
U/S Prop SR 84 Bridge	53.5	N/A	410.52	N/A	N/A	409.59	N/A
U/S Ex SR 84 Bridge	40	409.79	N/A	N/A	409.12	N/A	N/A
D/S Ex / Prop SR 84 Bridge	56	410.20	410.20	0	409.25	409.25	0
1582	55	408.81	408.81	0	407.96	407.96	0
1527	39	407.99	407.99	0	407.46	407.46	0
1488	488	407.89	407.89	0	407.31	407.31	0
1000	0	404.27	404.27	0	404.27	404.27	0

Table 2. Arroyo del Valle Flow Velocities (ft/s)

River Station	D/S Length	100-year			50-year		
		Ex	Prop	Change	Ex	Prop	Change
2112	330	4.97	5.72	+0.75	5.48	6.24	+0.76
1782	20	5.89	6.60	+0.71	5.45	6.18	+0.73
1762	0.5	5.78	6.50	+0.72	5.35	6.06	+0.71
U/S Trail Bridge	18.5	N/A	6.97	N/A	N/A	6.42	N/A
D/S Trail Bridge	11	N/A	10.72	N/A	N/A	9.70	N/A
1732	0.5	9.23	10.09	+0.86	8.45	9.14	+0.69
U/S Prop SR 84 Bridge	53.5	N/A	10.96	N/A	N/A	9.85	N/A
U/S Ex SR 84 Bridge	40	13.23	N/A	N/A	11.63	N/A	N/A
D/S Ex / Prop SR 84 Bridge	56	10.24	10.24	0	9.31	9.31	0
1582	55	12.74	12.74	0	11.78	11.78	0
1527	39	12.25	12.25	0	10.67	10.67	0
1488	488	10.46	10.46	0	9.22	9.22	0
1000	0	5.91	5.91	0	5.43	5.43	0

Generally, there are minimal changes between the existing and proposed conditions. There is no change downstream of the SR 84 Bridge. Upstream of the SR 84 Bridge, flow velocities increase and

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water surface elevations decrease due to the new Trail Bridge and widened SR 84 Bridge. For detailed HEC-RAS results, see Attachment A. Figure 8 of the original report has been updated with this memorandum's Figure 3.

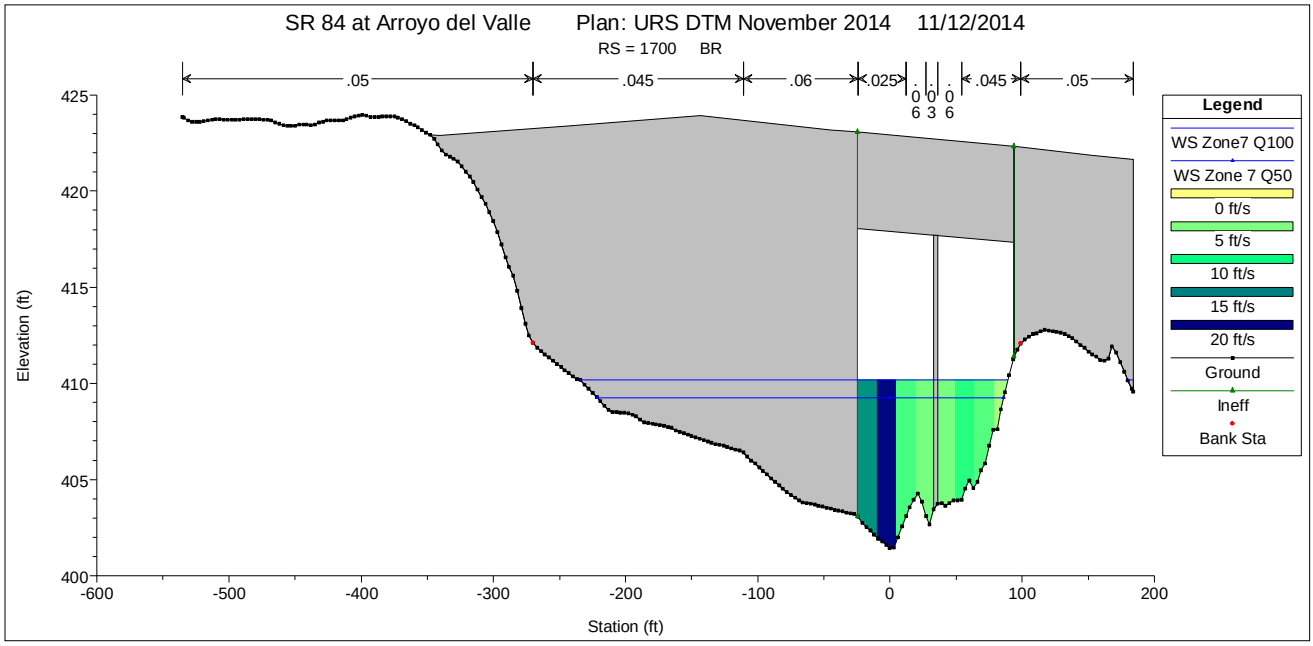

Figure 3. SR 84 Expressway Arroyo del Valle Bridge Cross-Section

Figure 9 of the original report has been updated with this memorandum's Figure 4.

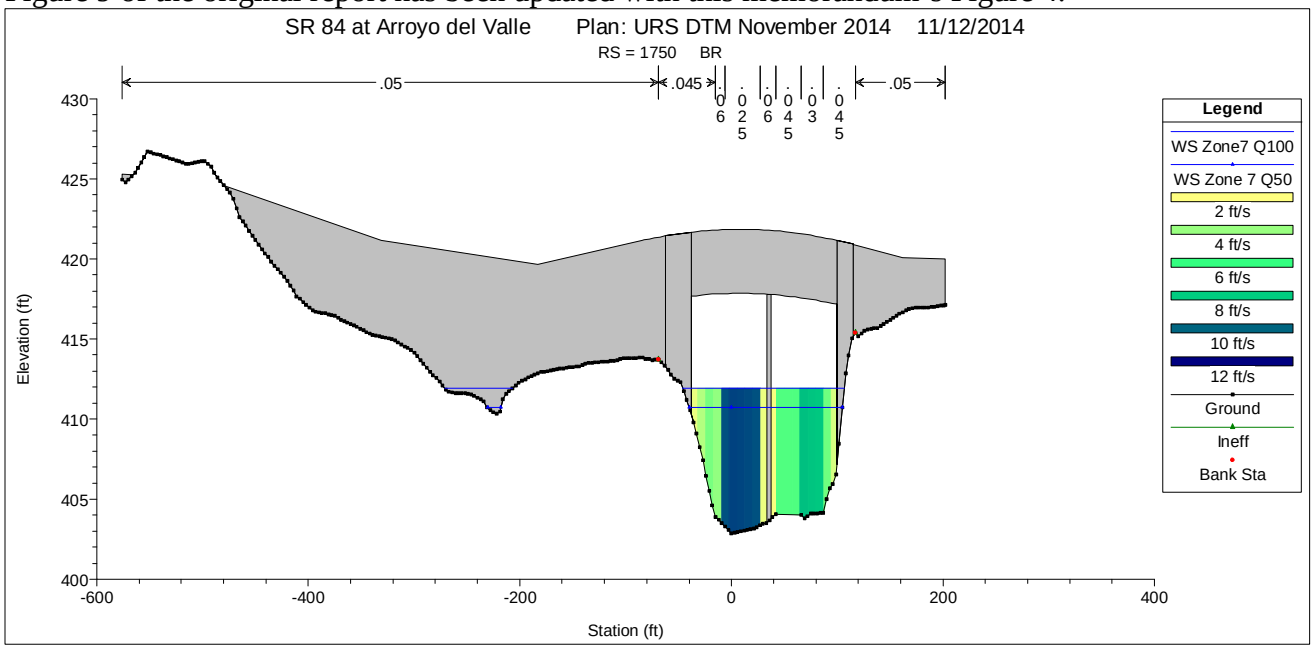

Figure 4. Arroyo del Valle Trail Bridge Cross-Section

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VIII. Section 6. Scour Analysis

To address long term-bed change, two cross sections were compared from the Caltrans Bridge Inspection Reports on 07/20/1999 (Table 3) and 10/18/2011 (Table 4). These cross sections were obtained from the bridge upstream face. Although the thalweg (lowest point of the channel) has increased 1.5 ft, the overall channel bed is stable. See comparison in Figure 5.

Table 3. SR 84 Bridge at Arroyo del Valle BIR 7/20/1999 (measured from top of concrete [2.66 ft])

Location	Horizontal (ft)	Vertical (ft)	Comments
A1	0.00	-14.11	
RSP toe	21.10	-21.69	
EOW	32.84	-24.38	
TW	39.01	-24.51	
EOW	48.85	-22.60	
P2/ top of berm	59.09	-16.63	
Edge of compacted channel	67.36	-22.93	
midpoint of access road	82.09	-22.87	
Edge of compacted channel	95.11	-22.38	
RSP toe	100.46	-20.51	
A3	117.95	-8.92	

Table 4. SR 84 Bridge at Arroyo del Valle BIR 10/18/2011 (measured from top of rail H=2.82 ft)

Location	Horizontal (ft)	Vertical (ft)	Comments
Abutment 1	0.00	-10.05	Face of A1 (top of RSP)
	14.11	-19.89	Toe RSP (EOW)
	31.17	-25.14	Thalweg
	39.80	-23.83	EOW
Pier 2	63.98	-21.86	center P2
	71.52	-22.19	Edge of haul road
	90.75	-22.71	Edge of haul road
	97.77	-20.87	Toe RSP
Abutment 3	118.83	-12.01	Face of A3

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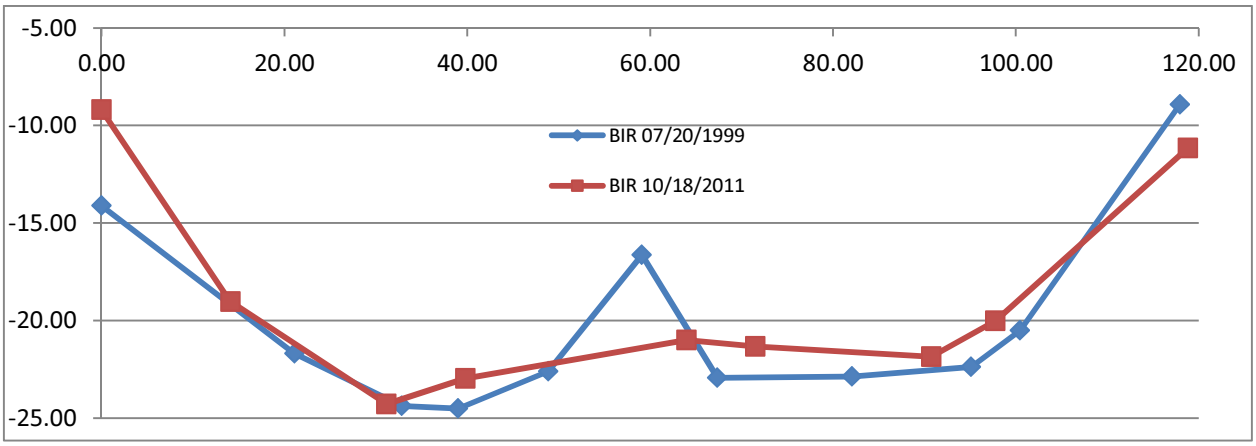

Figure 5. Comparison of BIR Cross-Sections from 07/20/1999 and 10/18/2011 (upstream face)

No berm was surveyed on 10/18/2011. However, Photo 1 shows the berm to the left of the haul road. The berm is necessary for maintaining the haul road and for Arroyo del Valle's flows to be contained on the other side of the berm.

Photo 1. Haul Road and Berm at Arroyo del Valle (taken on 8/25/2014)

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Complex pier scour calculations were performed per the Federal Highway Administration the *HEC-18 Manual* "Evaluating Scour at Bridges," Fifth Edition (April 2012), and the scour analysis was re-evaluated for the SR 84 Expressway Bridge widening at Arroyo del Valle and the new Arroyo del Valle Trail Bridge.

Using the live-bed contraction scour equation at the channel, the calculated contraction scour depths at the channel are:

- 0.8 ft (SR 84 Expressway Bridge at Arroyo del Valle)
- 0.1 ft (Trail Bridge at Arroyo del Valle)

The complex pier scour equations were utilized to determine pier scour at the following locations:

- 1.3 ft (SR 84 Bridge at Arroyo del Valle with 5 ft pile cap overhang extension upstream)
- 3.7 ft (Trail Bridge at Arroyo del Valle)

Using the Froelich Equation to determine live-bed abutment scour, the calculated abutment scour depths are:

- 9.6 ft (Left Abutment) at Arroyo del Valle SR 84 Expressway Bridge
- 0.8 ft (Left Abutment) Trail Bridge at Arroyo del Valle
- 1.0 ft (Right Abutment) Trail Bridge at Arroyo del Valle

The itemized total scour depth for the abutments and piers of the proposed bridge is shown in the following tables and supercede Tables 3 and 4 of the Executive Summary and Tables 13 and 14 of the original report.

Summary of Scour at Proposed SR 84 Expressway Bridge at Arroyo del Valle

Location	Long-term Bed Change	Contraction Scour	Local Scour	Total Scour Depth	Total Scour Elevation
Abutment 1	Negligible	0.2 ft	9.6 ft	9.8 ft	396.2 ft
Pier 2	Negligible	0.2 ft	1.3 ft	1.5 ft	400.9 ft

Summary of Scour at Proposed Arroyo del Valle Trail Bridge

Location	Long-term Bed Change	Contraction Scour	Local Scour	Total Scour Depth	Total Scour Elevation
Abutment 1	Negligible	0.8 ft	0.8 ft	1.2 ft	410.8 ft
Pier 2	Negligible	0.8 ft	3.7 ft	4.5 ft	398.4 ft
Abutment 3	Negligible	0.8 ft	1.0 ft	1.3 ft	410.7 ft

For detailed scour calculations, see hand calculations in Attachment B.

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Active gravel mining will be ongoing until 2030 with permits allowing up to 50 feet from the existing State right-of-way. However, we cannot determine the future elevations of the channel flow line at this time, because the CEMEX plans show that Arroyo del Valle will be realigned and relocated to create Lake A and Lake B, but there is no detailed information at the bridge crossing. There is no guarantee that a grade control structure will be built in the future. If the grade control structure is constructed in the future as part of the Zone 7 Reclamation Plan, the permittee would be required to provide justification that further degradation would not occur and the integrity of the bridge would be maintained.

As mentioned in the BDHS' Appendix G, 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 scope of the highway widening project. This matter should be referred to Zone 7 for further action.

To reiterate the BDHS' Appendix G, because the future spillway could block fish passage, its construction may be prohibited by environmental resource agencies. This issue should be further investigated by Zone 7.

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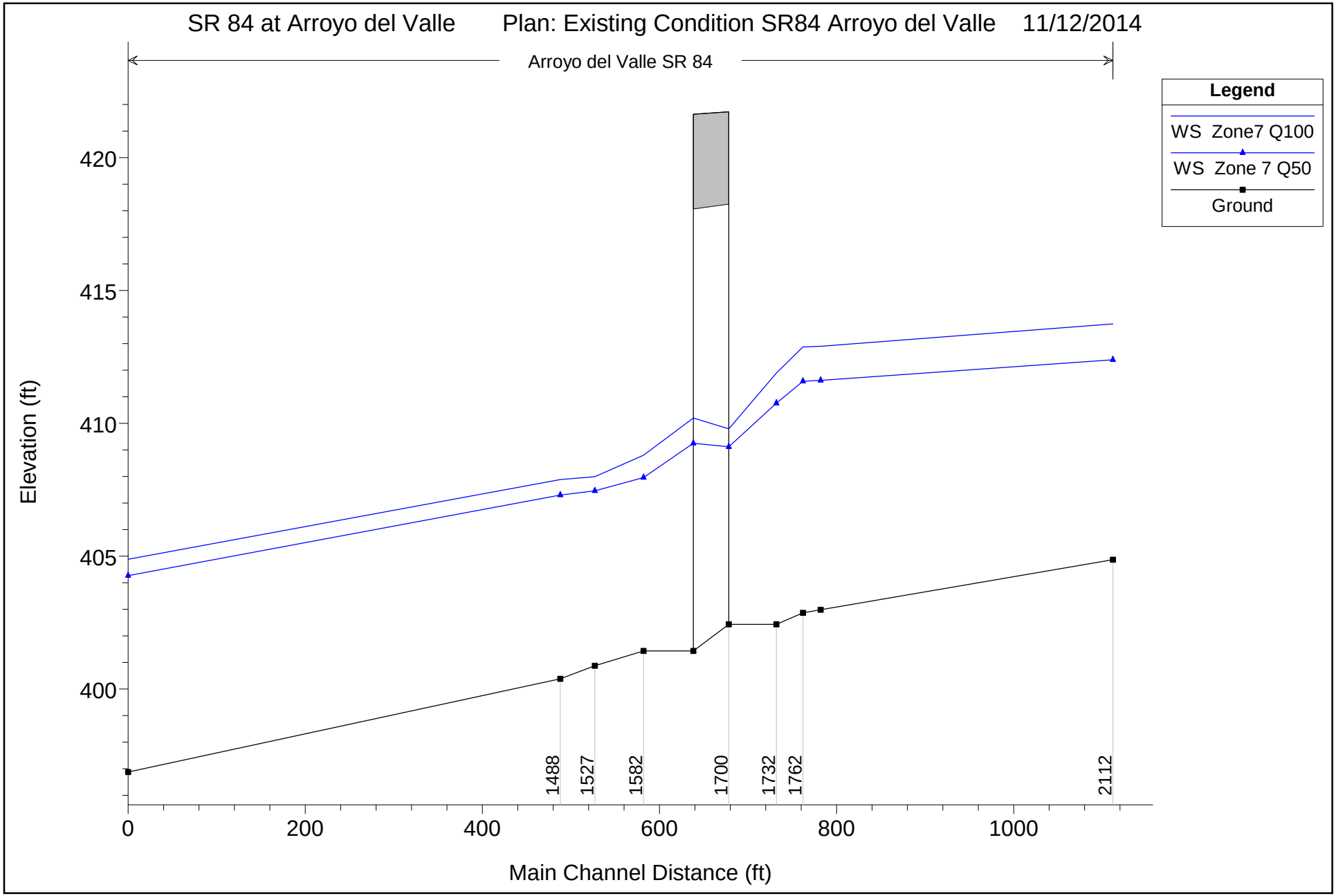
Attachment A:

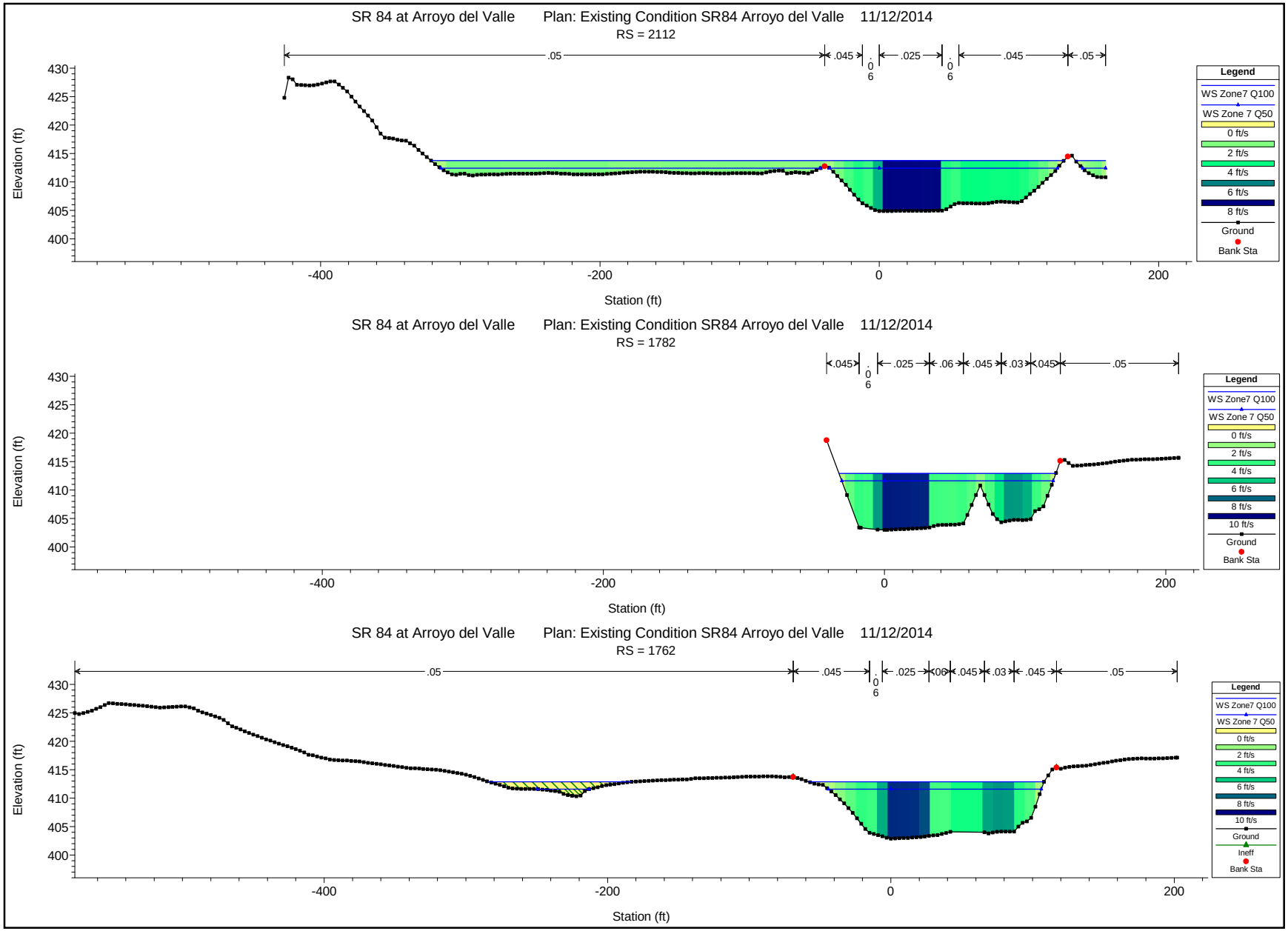
HEC-RAS Results

HEC-RAS Plan: E+S River: Arroyo del Valle Reach: SR 84

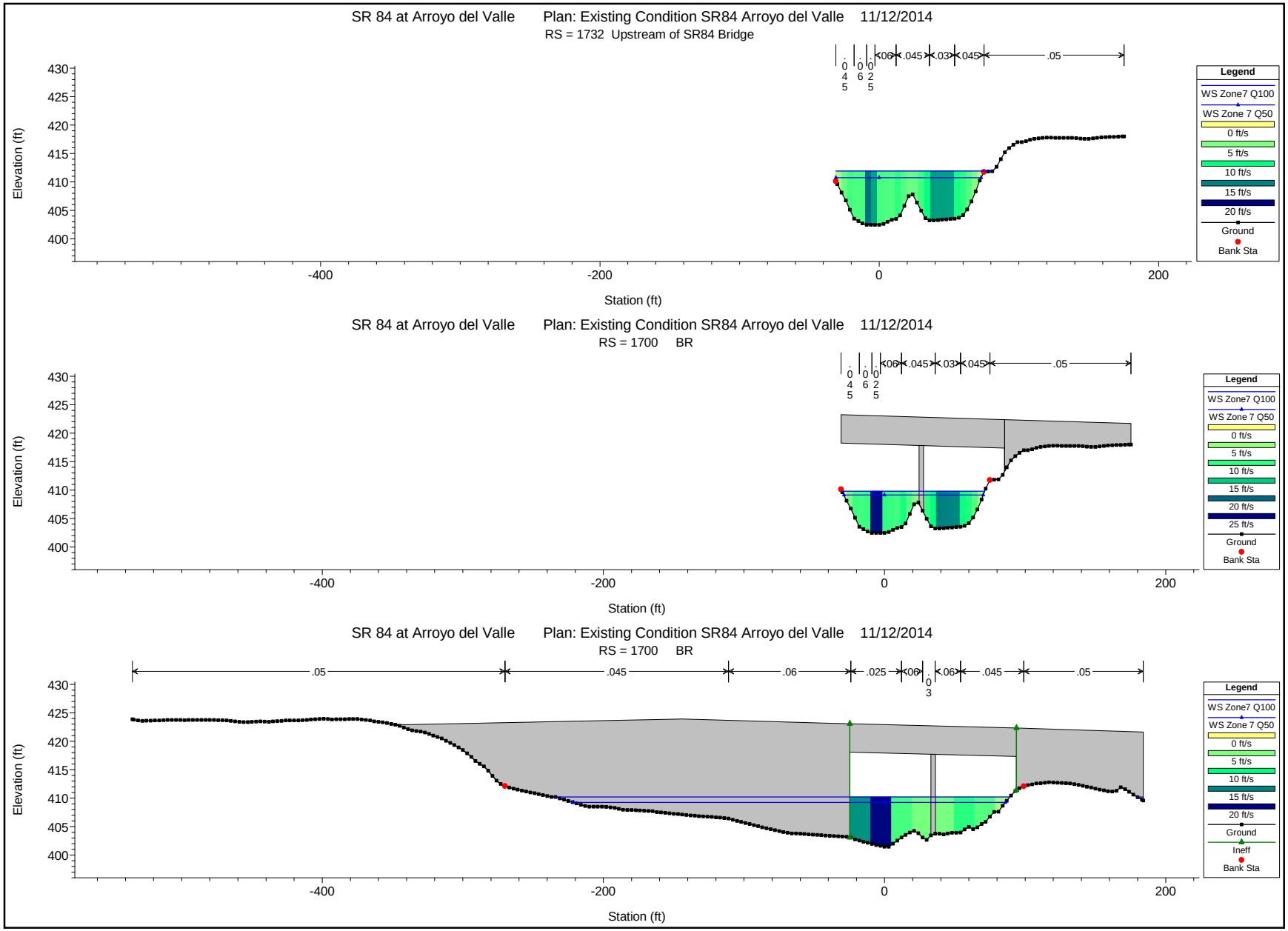
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
SR 84	2112	Zone7 Q100	7000.00	404.87	413.76		414.08	0.001618	4.95	1805.62	474.65	0.34		330.00
SR 84	2112	Zone 7 Q50	5400.00	404.87	412.41		412.85	0.002459	5.47	1179.78	451.67	0.40		330.00
SR 84	1782	Zone7 Q100	7000.00	402.99	412.92		413.46	0.002032	5.88	1189.90	154.31	0.37		20.00
SR 84	1782	Zone 7 Q50	5400.00	402.99	411.64		412.09	0.002116	5.43	993.81	150.53	0.37		20.00
SR 84	1762	Zone7 Q100	7000.00	402.87	412.75		413.40	0.002496	6.49	1078.54	234.81	0.43		30.00
SR 84	1762	Zone 7 Q50	5400.00	402.87	411.48		412.04	0.002357	6.00	900.10	163.07	0.41		30.00
SR 84	1732	Zone7 Q100	7000.00	402.44	411.90	409.77	413.22	0.006292	9.23	758.57	112.07	0.61	7.33	53.80
SR 84	1732	Zone 7 Q50	5400.00	402.44	410.77	408.84	411.87	0.006363	8.45	639.13	104.04	0.60	6.40	53.80
SR 84	1700		Bridge											
SR 84	1582	Zone7 Q100	7000.00	401.44	408.81	408.81	411.33	0.008384	12.74	549.36	300.05	1.00	7.37	55.00
SR 84	1582	Zone 7 Q50	5400.00	401.44	407.96	407.96	410.12	0.008403	11.78	458.26	267.45	1.00	6.52	55.00
SR 84	1527	Zone7 Q100	7000.00	400.88	407.99	407.99	410.32	0.015899	12.25	571.41	123.91	1.01	7.11	39.00
SR 84	1527	Zone 7 Q50	5400.00	400.88	407.46	407.22	409.23	0.013774	10.67	506.14	121.84	0.92	6.34	39.00
SR 84	1488	Zone7 Q100	7000.00	400.39	407.89	407.41	409.58	0.011615	10.46	669.23	145.70	0.86	7.02	488.00
SR 84	1488	Zone 7 Q50	5400.00	400.39	407.31		408.63	0.010413	9.22	585.81	142.68	0.80		488.00
SR 84	1000	Zone7 Q100	7000.00	396.88	404.89	403.40	405.43	0.005606	5.91	1184.80	316.13	0.54	6.52	
SR 84	1000	Zone 7 Q50	5400.00	396.88	404.27	402.76	404.73	0.005601	5.43	995.19	300.38	0.53	5.88	



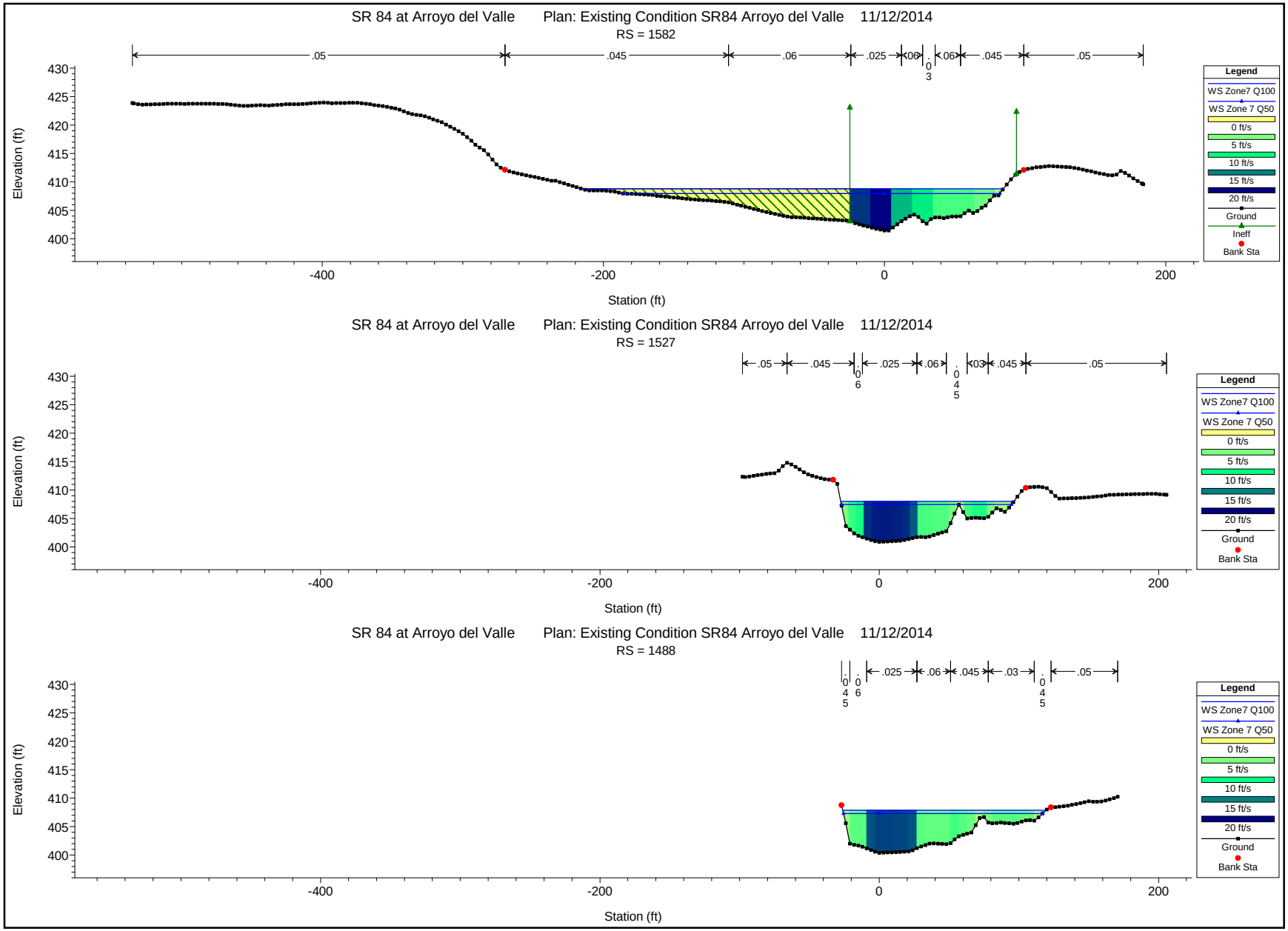
1 in Horiz. = 150 ft 1 in Vert. = 5 ft



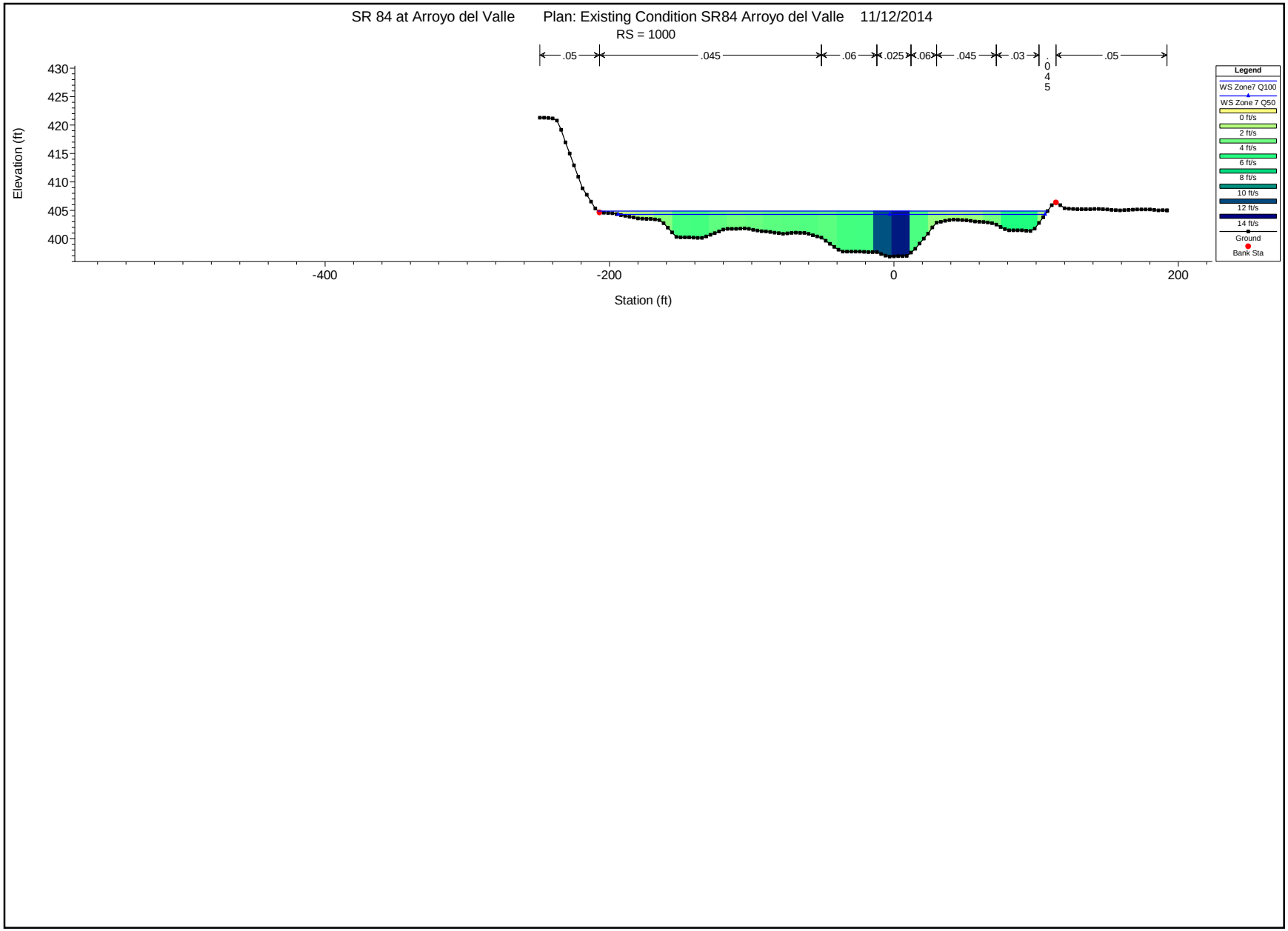
1 in Horiz. = 100 ft 1 in Vert. = 25 ft



1 in Horiz. = 100 ft 1 in Vert. = 25 ft



1 in Horiz. = 100 ft 1 in Vert. = 25 ft



1 in Horiz. = 100 ft 1 in Vert. = 25 ft

Plan: exist Arroyo del Valle SR 84 RS: 1700 Profile: Zone7 Q100

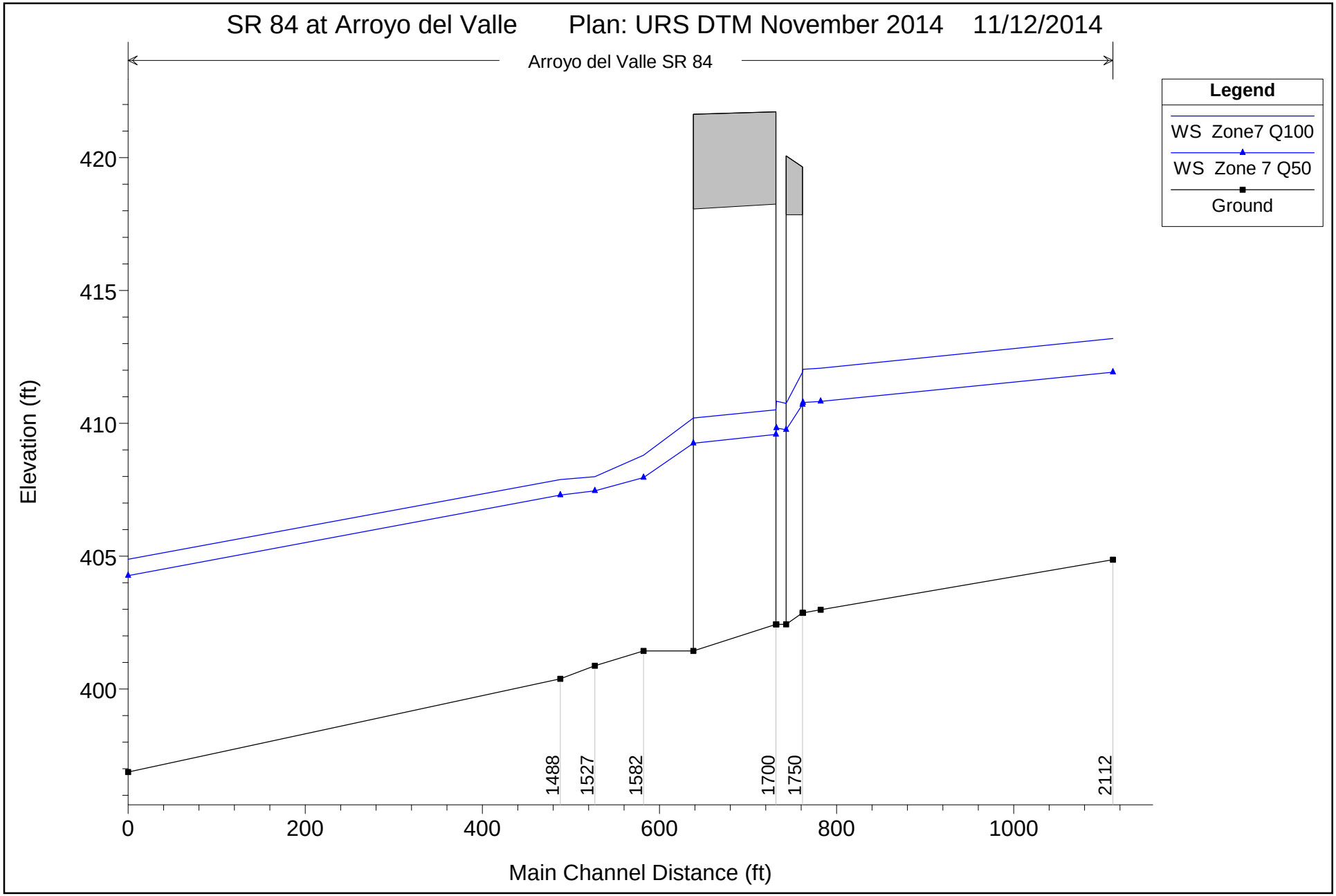
E.G. US. (ft)	413.22	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	411.90	E.G. Elev (ft)	412.51	411.83
Q Total (cfs)	7000.00	W.S. Elev (ft)	409.79	410.20
Q Bridge (cfs)	7000.00	Crit W.S. (ft)	409.79	408.92
Q Weir (cfs)		Max Chl Dpth (ft)	7.35	8.76
Weir Sta Lft (ft)		Vel Total (ft/s)	13.23	10.24
Weir Sta Rgt (ft)		Flow Area (sq ft)	529.17	683.56
Weir Submerg		Froude # Chl	1.01	0.73
Weir Max Depth (ft)		Specif Force (cu ft)	4476.72	4564.40
Min El Weir Flow (ft)	422.34	Hydr Depth (ft)	5.38	6.18
Min El Prs (ft)	418.26	W.P. Total (ft)	109.01	132.30
Delta EG (ft)	1.89	Conv. Total (cfs)	47308.0	87144.8
Delta WS (ft)	3.09	Top Width (ft)	98.42	110.60
BR Open Area (sq ft)	1410.12	Frctn Loss (ft)		0.41
BR Open Vel (ft/s)	13.23	C & E Loss (ft)		0.09
Coef of Q		Shear Total (lb/sq ft)	6.64	2.08
Br Sel Method	Energy only	Power Total (lb/ft s)	-31.00	-535.00

Plan: exist Arroyo del Valle SR 84 RS: 1700 Profile: Zone 7 Q50

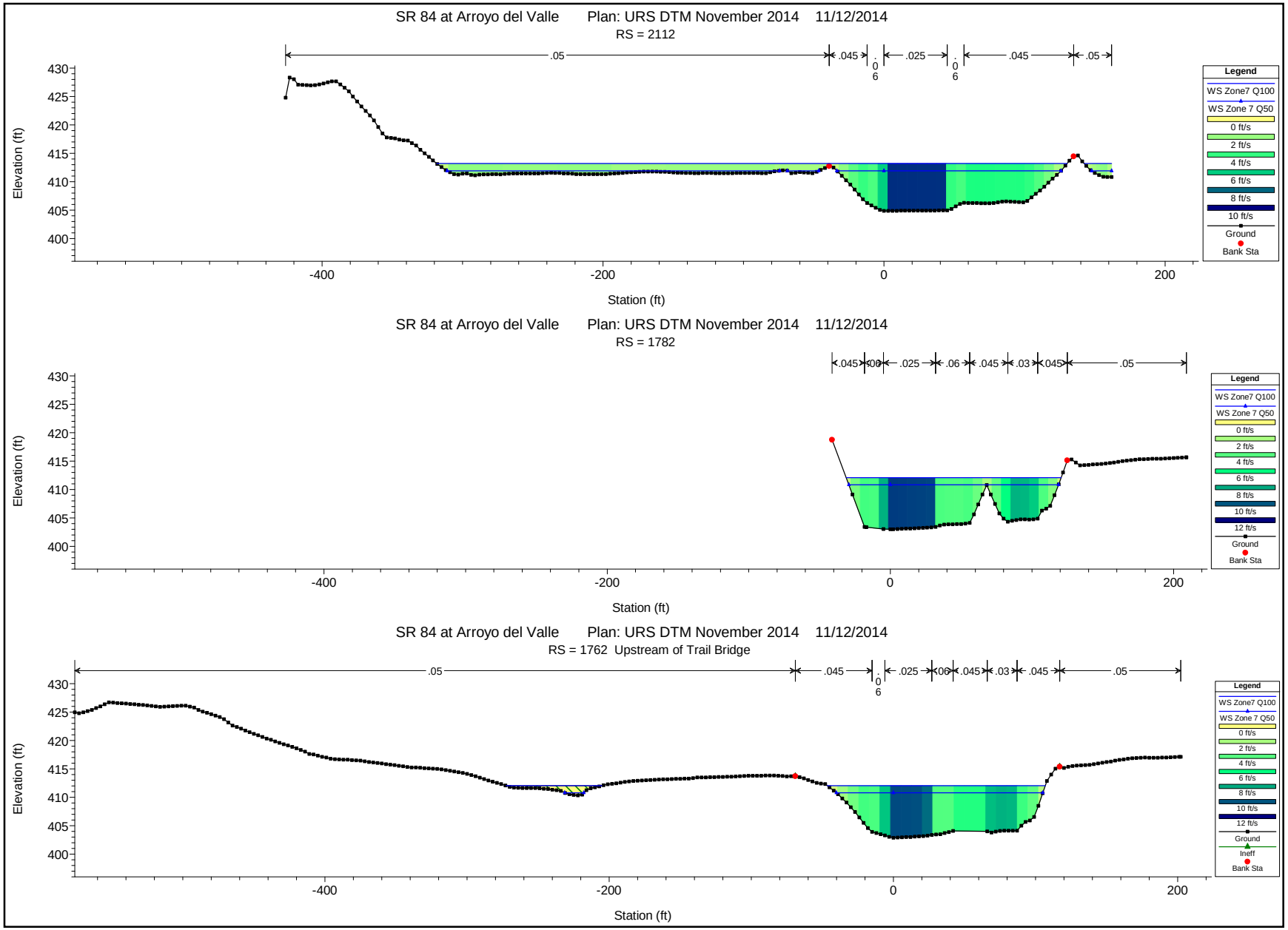
E.G. US. (ft)	411.87	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	410.77	E.G. Elev (ft)	411.22	410.60
Q Total (cfs)	5400.00	W.S. Elev (ft)	409.12	409.25
Q Bridge (cfs)	5400.00	Crit W.S. (ft)	408.88	408.06
Q Weir (cfs)		Max Chl Dpth (ft)	6.68	7.81
Weir Sta Lft (ft)		Vel Total (ft/s)	11.63	9.31
Weir Sta Rgt (ft)		Flow Area (sq ft)	464.21	580.04
Weir Submerg		Froude # Chl	0.93	0.71
Weir Max Depth (ft)		Specif Force (cu ft)	3220.04	3299.82
Min El Weir Flow (ft)	422.34	Hydr Depth (ft)	4.83	5.40
Min El Prs (ft)	418.26	W.P. Total (ft)	104.92	126.15
Delta EG (ft)	1.76	Conv. Total (cfs)	38995.2	68871.1
Delta WS (ft)	2.80	Top Width (ft)	96.03	107.44
BR Open Area (sq ft)	1410.12	Frctn Loss (ft)	0.40	0.40
BR Open Vel (ft/s)	11.63	C & E Loss (ft)	0.23	0.08
Coef of Q		Shear Total (lb/sq ft)	5.30	1.76
Br Sel Method	Energy only	Power Total (lb/ft s)	-31.00	-535.00

HEC-RAS Plan: Proposed River: Arroyo del Valle Reach: SR 84

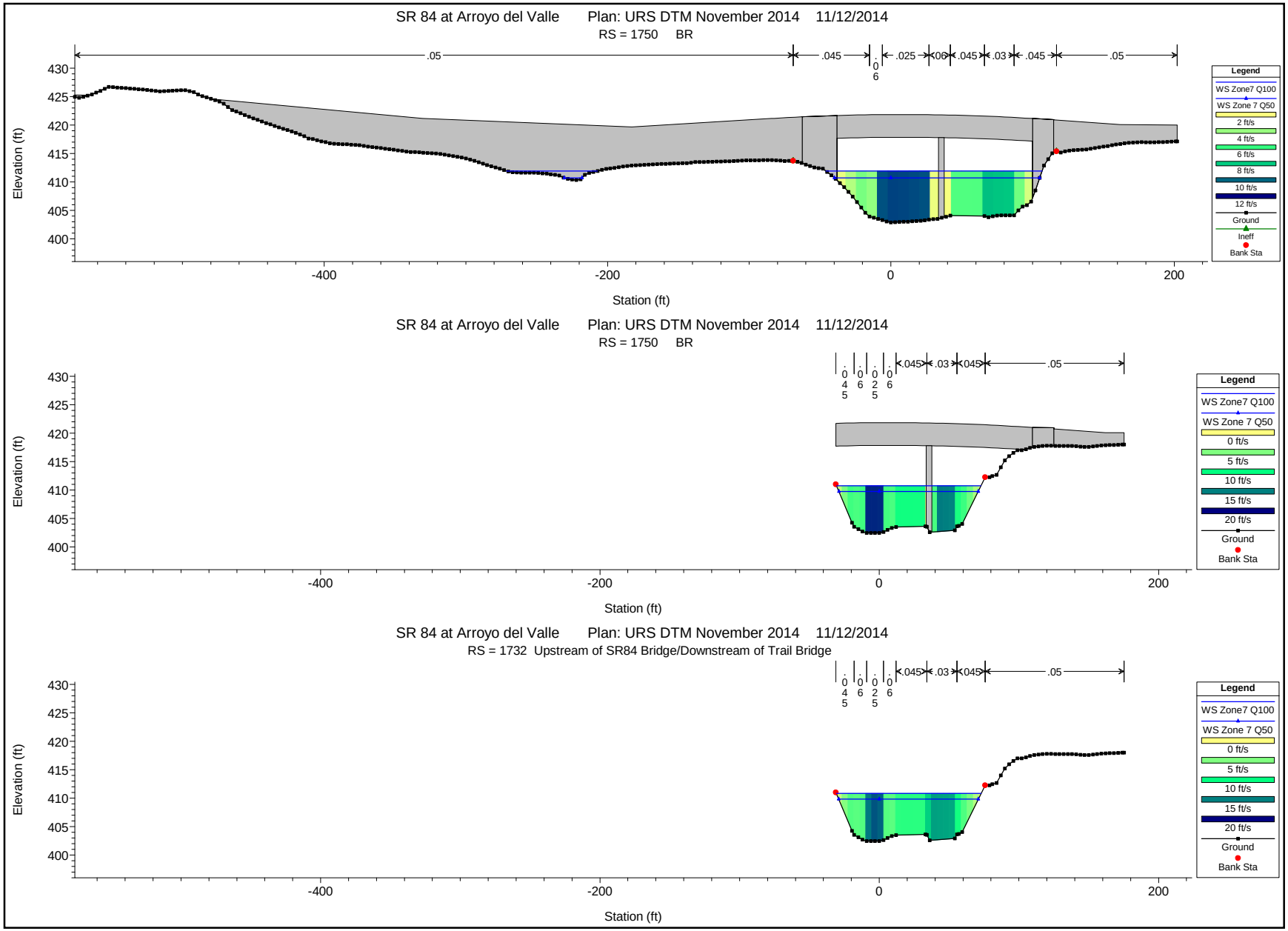
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
SR 84	2112	Zone7 Q100	7000.00	404.87	413.20		413.64	0.002372	5.71	1542.46	468.06	0.40		330.00
SR 84	2112	Zone 7 Q50	5400.00	404.87	411.93		412.52	0.003477	6.23	965.76	433.18	0.48		330.00
SR 84	1782	Zone7 Q100	7000.00	402.99	412.08		412.76	0.002900	6.60	1061.06	151.84	0.44		20.00
SR 84	1782	Zone 7 Q50	5400.00	402.99	410.83		411.43	0.003161	6.18	874.14	148.17	0.45		20.00
SR 84	1762	Zone7 Q100	7000.00	402.87	411.83	408.92	412.68	0.003415	7.39	947.73	193.43	0.50	6.05	0.50
SR 84	1762	Zone 7 Q50	5400.00	402.87	410.61	408.13	411.35	0.003520	6.89	784.18	140.20	0.50	5.26	0.50
SR 84	1750		Bridge											
SR 84	1732	Zone7 Q100	7000.00	402.44	410.85	409.21	412.42	0.007079	10.07	694.91	103.76	0.69	6.77	0.50
SR 84	1732	Zone 7 Q50	5400.00	402.44	409.84	408.25	411.13	0.006794	9.13	591.72	99.99	0.66	5.81	0.50
SR 84	1700		Bridge											
SR 84	1582	Zone7 Q100	7000.00	401.44	408.81	408.81	411.33	0.008384	12.74	549.36	300.05	1.00	7.37	55.00
SR 84	1582	Zone 7 Q50	5400.00	401.44	407.96	407.96	410.12	0.008404	11.78	458.26	267.45	1.00	6.52	55.00
SR 84	1527	Zone7 Q100	7000.00	400.88	407.99	407.99	410.32	0.015899	12.25	571.41	123.91	1.01	7.11	39.00
SR 84	1527	Zone 7 Q50	5400.00	400.88	407.46	407.22	409.23	0.013774	10.67	506.14	121.84	0.92	6.34	39.00
SR 84	1488	Zone7 Q100	7000.00	400.39	407.89	407.41	409.58	0.011615	10.46	669.23	145.70	0.86	7.02	488.00
SR 84	1488	Zone 7 Q50	5400.00	400.39	407.31		408.63	0.010413	9.22	585.81	142.68	0.80		488.00
SR 84	1000	Zone7 Q100	7000.00	396.88	404.89	403.40	405.43	0.005606	5.91	1184.80	316.13	0.54	6.52	
SR 84	1000	Zone 7 Q50	5400.00	396.88	404.27	402.76	404.73	0.005601	5.43	995.19	300.38	0.53	5.88	



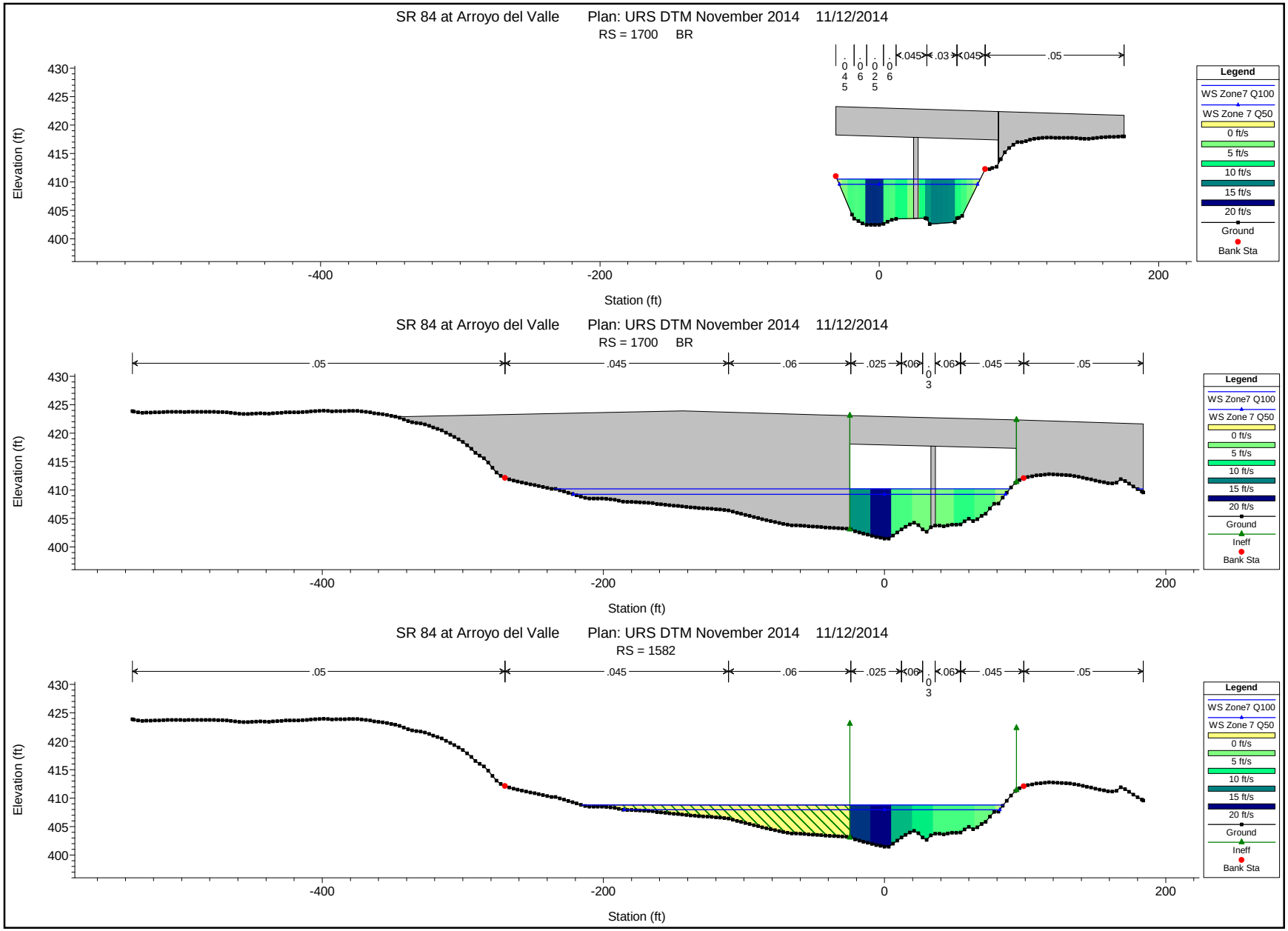
1 in Horiz. = 150 ft 1 in Vert. = 5 ft



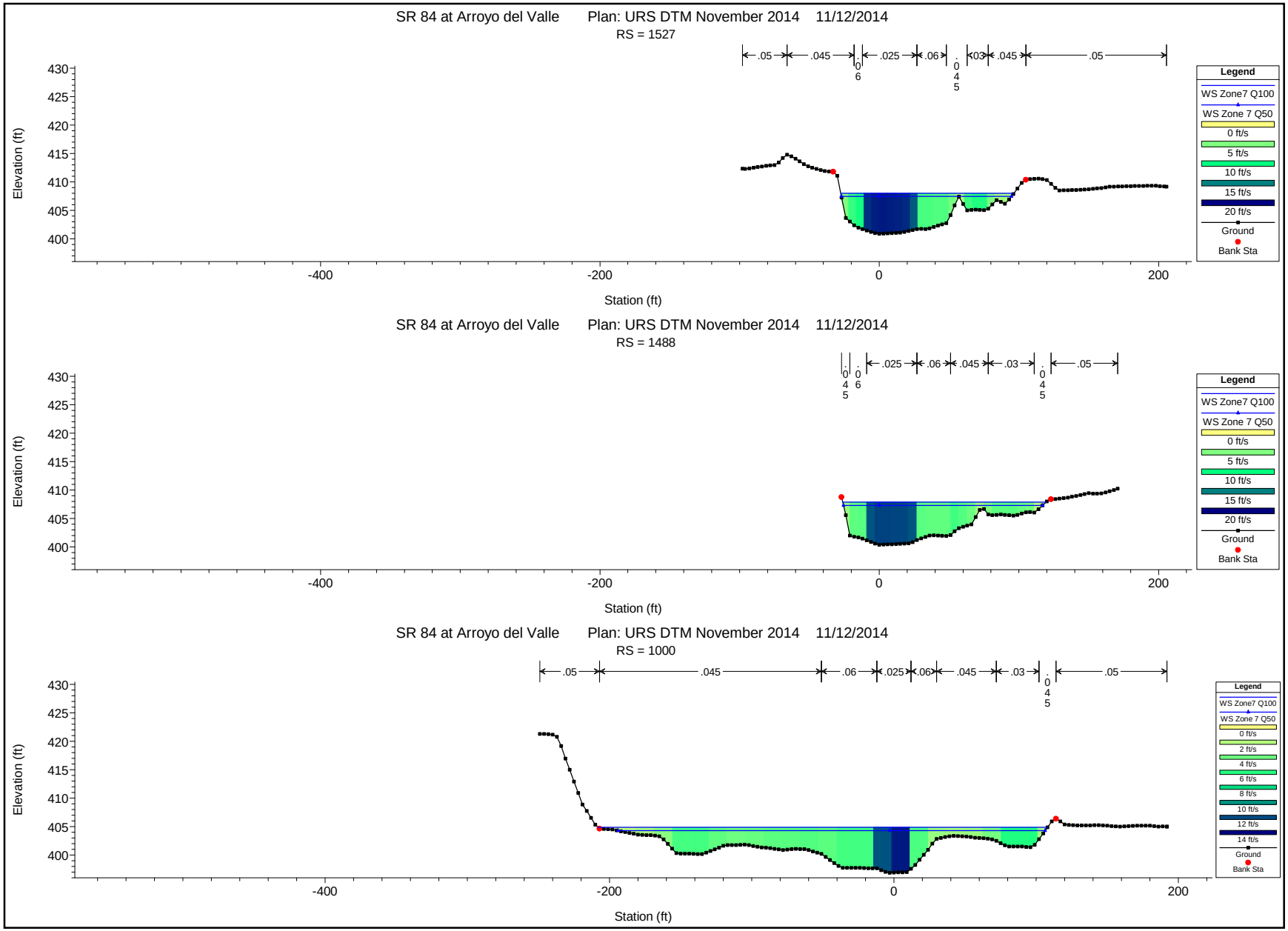
1 in Horiz. = 100 ft 1 in Vert. = 25 ft



1 in Horiz. = 100 ft 1 in Vert. = 25 ft



1 in Horiz. = 100 ft 1 in Vert. = 25 ft



1 in Horiz. = 100 ft 1 in Vert. = 25 ft

Plan: URS DTM Nove Arroyo del Valle SR 84 RS: 1750 Profile: Zone7 Q100

E.G. US. (ft)	412.69	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	412.04	E.G. Elev (ft)	412.68	412.54
Q Total (cfs)	7000.00	W.S. Elev (ft)	411.93	410.75
Q Bridge (cfs)	7000.00	Crit W.S. (ft)	408.71	409.42
Q Weir (cfs)		Max Chl Dpth (ft)	9.06	8.31
Weir Sta Lft (ft)		Vel Total (ft/s)	6.97	10.72
Weir Sta Rgt (ft)		Flow Area (sq ft)	1004.41	652.90
Weir Submerg		Froude # Chl	0.45	0.74
Weir Max Depth (ft)		Specif Force (cu ft)	5463.55	4705.04
Min El Weir Flow (ft)	420.08	Hydr Depth (ft)	7.50	6.57
Min El Prs (ft)	417.85	W.P. Total (ft)	156.66	118.43
Delta EG (ft)	0.27	Conv. Total (cfs)	187484.5	112313.4
Delta WS (ft)	1.20	Top Width (ft)	133.94	99.30
BR Open Area (sq ft)	1441.45	Frctn Loss (ft)	0.04	0.06
BR Open Vel (ft/s)	10.72	C & E Loss (ft)	0.10	0.06
Coef of Q		Shear Total (lb/sq ft)	0.56	1.34
Br Sel Method	Energy only	Power Total (lb/ft s)	-576.00	-31.00

Plan: URS DTM Nove Arroyo del Valle SR 84 RS: 1750 Profile: Zone 7 Q50

E.G. US. (ft)	411.36	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	410.79	E.G. Elev (ft)	411.35	411.23
Q Total (cfs)	5400.00	W.S. Elev (ft)	410.71	409.76
Q Bridge (cfs)	5400.00	Crit W.S. (ft)	407.96	408.46
Q Weir (cfs)		Max Chl Dpth (ft)	7.84	7.32
Weir Sta Lft (ft)		Vel Total (ft/s)	6.42	9.70
Weir Sta Rgt (ft)		Flow Area (sq ft)	841.65	556.69
Weir Submerg		Froude # Chl	0.45	0.71
Weir Max Depth (ft)		Specif Force (cu ft)	3902.92	3404.33
Min El Weir Flow (ft)	420.08	Hydr Depth (ft)	6.28	5.82
Min El Prs (ft)	417.85	W.P. Total (ft)	153.12	112.28
Delta EG (ft)	0.23	Conv. Total (cfs)	141884.8	89352.8
Delta WS (ft)	0.96	Top Width (ft)	133.94	95.63
BR Open Area (sq ft)	1441.45	Frctn Loss (ft)	0.04	0.05
BR Open Vel (ft/s)	9.70	C & E Loss (ft)	0.08	0.05
Coef of Q		Shear Total (lb/sq ft)	0.50	1.13
Br Sel Method	Energy only	Power Total (lb/ft s)	-576.00	-31.00

Plan: URS DTM Nove Arroyo del Valle SR 84 RS: 1700 Profile: Zone7 Q100

E.G. US. (ft)	412.42	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	410.84	E.G. Elev (ft)	412.38	411.83
Q Total (cfs)	7000.00	W.S. Elev (ft)	410.52	410.20
Q Bridge (cfs)	7000.00	Crit W.S. (ft)	409.32	408.92
Q Weir (cfs)		Max Chl Dpth (ft)	8.08	8.76
Weir Sta Lft (ft)		Vel Total (ft/s)	10.96	10.24
Weir Sta Rgt (ft)		Flow Area (sq ft)	638.50	683.56
Weir Submerg		Froude # Chl	0.76	0.73
Weir Max Depth (ft)		Specif Force (cu ft)	4647.69	4564.40
Min El Weir Flow (ft)	422.34	Hydr Depth (ft)	6.43	6.18
Min El Prs (ft)	418.26	W.P. Total (ft)	117.09	132.30
Delta EG (ft)	1.09	Conv. Total (cfs)	107506.6	87144.8
Delta WS (ft)	2.03	Top Width (ft)	99.32	110.60
BR Open Area (sq ft)	1443.62	Frctn Loss (ft)	0.48	0.41
BR Open Vel (ft/s)	10.96	C & E Loss (ft)	0.07	0.09
Coef of Q		Shear Total (lb/sq ft)	1.44	2.08
Br Sel Method	Energy only	Power Total (lb/ft s)	-31.00	-535.00

Plan: URS DTM Nove Arroyo del Valle SR 84 RS: 1700 Profile: Zone 7 Q50

E.G. US. (ft)	411.12	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	409.83	E.G. Elev (ft)	411.10	410.60
Q Total (cfs)	5400.00	W.S. Elev (ft)	409.59	409.25
Q Bridge (cfs)	5400.00	Crit W.S. (ft)	408.37	408.06
Q Weir (cfs)		Max Chl Dpth (ft)	7.15	7.81
Weir Sta Lft (ft)		Vel Total (ft/s)	9.85	9.31
Weir Sta Rgt (ft)		Flow Area (sq ft)	548.09	580.05
Weir Submerg		Froude # Chl	0.73	0.71
Weir Max Depth (ft)		Specif Force (cu ft)	3367.30	3299.83
Min El Weir Flow (ft)	422.34	Hydr Depth (ft)	5.72	5.40
Min El Prs (ft)	418.26	W.P. Total (ft)	111.32	126.15
Delta EG (ft)	1.00	Conv. Total (cfs)	86260.8	68871.6
Delta WS (ft)	1.86	Top Width (ft)	95.88	107.44
BR Open Area (sq ft)	1443.62	Frctn Loss (ft)	0.45	0.40
BR Open Vel (ft/s)	9.85	C & E Loss (ft)	0.05	0.08
Coef of Q		Shear Total (lb/sq ft)	1.20	1.76
Br Sel Method	Energy only	Power Total (lb/ft s)	-31.00	-535.00

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Attachment B:

Detailed Scour Calculations

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SR84 Widening
Alameda County, California
Contraction Scour

100-year Flow
Calculation guideline from HEC-18 5th Edition
Input from HEC-RAS for URS DTM Nov2014, Proposed Condition

Units = (SI or English)	English	
Ku = constant = 6.19 (SI) or 11.17 (English)	11.17	
g = acceleration due to gravity =	32.2	ft/s^2

Channel

Vchannel = Mean velocity of flow in main channel just upstream of bridge =	10.1	ft/s
D50channel = grain size in channel for which 50% of bed material is finer =	0.0082	ft
Yochannel = existing depth in the contracted channel section before scour =	6.4	ft
Ychannel = depth of flow just upstream of bridge in channel =	6.7	ft
VcD50channel = Ku*(Ychannel^(1/6))*(D50channel^(1/3))	3.1	ft/s
Contraction scour equation for channel =	**Live Bed Equation**	

Live Bed Equation

Q1 channel = Flow in the upstream channel transporting sediment =	7000	ft^3/s
Q2 channel = Flow in the contracted channel = transporting sediment =	7000	ft^3/s
W1 channel = top width of the upstream channel that is transporting bed material =	99	ft
W2 channel = top width of the contracted channel section less pier widths =	101	ft
ω channel = fall velocity of bed material based on D50 =	0.59	ft/s
S channel = slope of energy grade line in main channel =	0.007	ft/ft
V* channel = shear velocity in the upstream channel section = (Ychannel*g*S channel)^.5 =	1.2	ft/s
V* channel/ω channel =	2.1	
k1 channel = (if V*/ω <0.5, 0.59, if(0.5<=V*/ω<=2,0.64,0.69)) =	0.69	
Y2channel = average depth in contracted section after scour = Ychannel*((Q2 channel/Q1 channel)^(6/7))*((W1 channel/W2 channel)^k1 channel) =	6.6	ft
Ys channel = Y2 channel - Yo channel =	**0.2**	**ft**

Clear Water Equation

Ku = constant = 0.0077 (English) or 0.025 (SI) =	0.0077	
Q = Discharge through bridge associated with the width W =	7000	ft^3/s
Dm = Diameter of the smallest non transportable particle in the bed material in contracted section = 1.25*d50 =	0.010253	ft
W = Bottom width of contracted section less pier widths =		ft
Y2channel = average depth in contracted section after scour = ((Ku*(Q^2))/((Dm^(2/3))*(W^2)))^(3/7) =	n/a	ft
Ys channel = Y2 channel - Yo channel =	**n/a**	**ft**

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SR84 Widening

Alameda County, California

Local Scour at Piers - Cohesionless

100-year Flow
Calculation guideline from HEC-18 5th Edition
Input from HEC-RAS for URS DTM Nov2014, Proposed Condition

Units = (SI or English) =	English	
Complex Pier Scour? (Yes or No)	Yes	

Pier Scour component

Water Surface Elevation	410.5	ft
f = distance between front edge of cap/footing and pier =	5.00	ft
T = thickness of pile cap or footing (enter n/a for no pile cap) =	4	ft
Top of Pile Cap Elevation (enter n/a for no pile cap)	402.67	ft
Bottom of Pile Cap Elevation (enter n/a for no pile cap)	398.67	ft
Ground Elevation at Pier	403.6	ft
Contraction Scour Depth	0.2	ft
ho = height of pile cap above bed at beginning of computation (negative indicates partially or entirely submerged pile cap) =	-4.8	ft
a = pier width =	1.5	ft
S = spacing between columns of piles, center to center =	n/a	ft
h1 = ho+T=height of the pier stem above the bed before scour (negative indicates top of pile cap is below bed elevation) =	-0.8	ft
y1 = Approach flow depth at the beginning of computations =	6.9	ft
V1 = Approach velocity used at the beginning of computations	8.8	ft/s
Khpier = coefficient to account for the height of the pier stem above the bed and the shielding effect by the pile cap overhang distance "f" in front of the pier stem	0.27	
Θ = angle of attack of flow =	0	degrees
Pier shape	Square nose	
K1 = correction factor for pier nose shape =	1.1	
L = length of pier =		ft
L/a (if L/a is larger than 12, then use 12 as a maximum)	0	
K2 = correction factor for angle of attack = (cosΘ+(L/a)*sinΘ)^0.65	1.0	
K3 = correction factor for bed condition =	1.1	
D50 = grain size for which 50% of bed material is finer =	0.0082	ft
D95 = grain size for which 95% of bed material is finer =	0.0131	ft
Ku = constant = 6.19 (SI) or 11.17 (English)	11.17	
VcD50 = Ku*(y1^(1/6))*(D50^(1/3))	3.1	ft/s
VcD95 = Ku*(y1^(1/6))*(D95^(1/3))	3.6	ft/s
g = acceleration due to gravity =	32.2	ft/s^2
Yspier = scour component for the pier stem in the flow = y1*(Khpier*(2*K1*K2*K3*((a/y1)^0.65)*((V1/((g*y1)^0.5))^0.43)) =	**1.3**	**ft**

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Pile cap/footing component scour

Case Type = (Case 1 or Case 2 from ho)	Case 2	
apc = width of pile cap =	15	ft
y2 = y1 + Yspier/2 = adjusted flow depth for pile cap computations =	7.56	ft
V2 = V1*(y1/y2) = adjusted velocity for pile cap computations =	7.97	ft/s
h2 = ho +Yspier/2 = height of pile group after the pier stem scour component has been computed =	-4.11	ft
Kw = wide pier correction factor (The correction factor should be applied when the ratio of depth of flow (y) to pier width (a) is less than 0.8 (y/a < 0.8); the ratio of pier width (a) to the median diameter of the bed material (D50) is greater than 50 (	0.77	

Case 1: Pile cap/footing in the flow above the bed (entire depth of cap exposed to flow)

K1 = correction factor for pier nose (pile cap nose) shape =	1.1	
a'pc = equivalent full depth solid pier width of pile cap = apc*exp(-2.705 + 0.51*LN(T/y2) - 2.783*((h2/y2)^3) + 1.751/(exp(h2/y2))) = (if y2 > 3.5*apc, then y2 = 3.5*apc) =	n/a	ft
Yspc = scour component for the pier cap/footing in the flow = y2*((2*K1*K2*K3*K4*Kw*((a'pc/y2)^0.65)*((V2/((g*y2)^0.5))^0.43)) =	**n/a**	**ft**

Case 2: Bottom of Pile Cap (footing) located on or below the bed

Ks = grain roughness of the bed (D84 of the bed material) =	0.0098	ft
yf = h1 + Yspier/2 = distance from the bed (after degradation, contraction scour and pier stem scour) to the top of the footing (negative indicates entirely submerged pile cap)	-0.11	ft
Vf = average velocity in the flow zone below the top of the footing = V2*((LN((10.93*(yf/Ks))+1)))/(LN((10.93*(y2/Ks))+1))) =	n/a	ft/s
Yspc = scour component for the pier cap/footing in the flow = yf*(2*K1*K2*K3*K4*Kw*((apc/yf)^0.65)*((Vf/((g*yf)^0.5))^0.43) =	**0.00**	**ft**

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Pile group scour component

h3 = ho + Yspier/2 + Yspc/2 = height of the pile group after the pier stem and pile cap scour components have been computed =	-4.11	ft
y3 = y1 + Yspier/2 + Ypc/2 = adjusted flow depth for pile group computations =	7.56	ft
V3 = V1*(y1/y3) = adjusted velocity for pile group computations =	7.97	ft/s
S = Spacing of piles (center to center)	9.00	ft
a = width of single pile	3.00	ft
aproj = sum of non-overlapping projected widths of piles =	6.00	ft
Ksp = coefficient for pile spacing = 1-(4/3)*((1-(1/(aproj/a)))*(1-((S/a)^-0.6)) =	0.68	
m = number of rows of piles in direction of flow =	4.00	
Km = coefficient for number of aligned rows = 0.9+0.1*m-0.0714*(m-1)*(2.4-1.1*(S/a)+0.1*((S/a)^2)) =	1.30	ft
a'pg = effective width of an equivalent full depth pier = aproj*Ksp*Km =	5.29	ft
Khpg = pile group height factor = (3.08*(h3/y3)-5.23*((h3/y3)^2)+5.25*((h3/y3)^3)-2.1*((h3/y3)^4))^(1/0.65) = (note that y3max = 3.5*a'pg) =	0.0000	
Yspg = scour component for the piles exposed to the flow = y3*Khpg*(2*K1*K3*K4*Kw*((a'pg/y3)^0.65)*((V3/((g*y3)^0.5))^0.43) =	**0.00**	**ft**

Total Scour

Ys = Yspier + Yspc + Yspg = total scour from superposition of components =	**1.3**	**ft**

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SR84 Widening

Alameda County, California

Local Scour at Abutments - Froehlich or HIRE

100-year Flow
Calculation guideline from HEC-18 5th Edition
Input from HEC-RAS for URS DTM Nov2014, Proposed Condition

Units = (SI or English)	English	
g = acceleration due to gravity =	32.2	ft/s^2

Left Overbank = Abutment 1 (South Bank)

y1 = depth of flow at abutment on the overbank or in the main channel =	4.5	ft
L = length of embankment projected normal to flow =	8.0	ft
Ratio of projected embankment length to flow depth = L/y1 =	1.771E+00	
Abutment scour equation to be used =	Froehlich	

Froehlich's Live Bed Abutment Scour Equation

L' = length of active flow obstructed by the embankment =	7.2	ft
Ae = flow area of the approach cross section obstructed by the embankment =	16.2	ft^2
ya = average depth of flow on the flood plain = Ae/L'	2.25	ft
Qe = flow obstructed by the abutment and approach embankment =	107	ft^3/s
Ve = flow velocity = Qe/Ae =	6.6	ft/s
Fr = Froude Number of approach flow upstream of the abutment =	0.78	
Θ = abutment skew =	100	degrees
K1 = coefficient for abutment shape =	1	
K2 = coefficient for angle of embankment shape = (Θ/90)^0.13 =	1.01	
Ys = abutment scour = ya*(2.27*k1*k2*((L'/ya)^0.43)*(Fr^0.61)+1) =	**9.6**	**ft**

HIRE Live Bed Abutment Scour Equation

V = velocity of flow at upstream face of abutment =		ft/s
Fr = Froude Number = V/((g*y1)^.5) =	n/a	
Θ = abutment skew =		degrees
K1 = coefficient for abutment shape =		
K2 = coefficient for angle of embankment shape = (Θ/90)^0.13 =	n/a	
Ys = abutment scour = y1*(4*(Fr^0.33)*(K1/0.55)*K2) =	**n/a**	**ft**

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SR84 Widening
Alameda County, California
Contraction Scour

100-year Flow
Calculation guideline from HEC-18 5th Edition
Input from HEC-RAS for Proposed Alternative x

Units = (SI or English)	English	
Ku = constant = 6.19 (SI) or 11.17 (English)	11.17	
g = acceleration due to gravity =	32.2	ft/s^2

Channel

Vchannel = Mean velocity of flow in main channel just upstream of bridge =	6.6	ft/s
D50channel = grain size in channel for which 50% of bed material is finer =	0.0007	ft
Yochannel = existing depth in the contracted channel section before scour =	6.8	ft
Ychannel = depth of flow just upstream of bridge in channel =	7.0	ft
VcD50channel = Ku*(Ychannel^(1/6))*(D50channel^(1/3))	1.3	ft/s
Contraction scour equation for channel =	**Live Bed Equation**	

Live Bed Equation

Q1 channel = Flow in the upstream channel transporting sediment =	7000	ft^3/s
Q2 channel = Flow in the contracted channel = transporting sediment =	7000	ft^3/s
W1 channel = top width of the upstream channel that is transporting bed material =	152	ft
W2 channel = top width of the contracted channel section less pier widths =	134	ft
ω channel = fall velocity of bed material based on D50 =	0.08	ft/s
S channel = slope of energy grade line in main channel =	0.003	ft/ft
V* channel = shear velocity in the upstream channel section = (Ychannel*g*S channel)^.5 =	0.8	ft/s
V* channel/ω channel =	9.8	
k1 channel = (if V*/ω <0.5, 0.59, if(0.5<=V*/ω<=2,0.64,0.69)) =	0.69	
Y2channel = average depth in contracted section after scour = Ychannel*((Q2 channel/Q1 channel)^(6/7))*((W1 channel/W2 channel)^k1 channel) =	7.6	ft
Ys channel = Y2 channel - Yo channel =	**0.8**	**ft**

Clear Water Equation

Ku = constant = 0.0077 (English) or 0.025 (SI) =	0.0077	
Q = Discharge through bridge associated with the width W =	7000	ft^3/s
Dm = Diameter of the smallest non transportable particle in the bed material in contracted section = 1.25*d50 =	0.000820	ft
W = Bottom width of contracted section less pier widths =		ft
Y2channel = average depth in contracted section after scour = ((Ku*(Q^2))/((Dm^(2/3))*(W^2)))^(3/7) =	n/a	ft
Ys channel = Y2 channel - Yo channel =	**n/a**	**ft**

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SR84 Widening
Alameda County, California
Local Scour at Piers - Cohesionless

100-year Flow
Calculation guideline from HEC-18 5th Edition
Input from HEC-RAS for Proposed Alternative x

Units = (SI or English) =	English	
Complex Pier Scour? (Yes or No)	Yes	

Pier Scour component

Water Surface Elevation	411.7	ft
f = distance between front edge of cap/footing and pier =	6.25	ft
T = thickness of pile cap or footing (enter n/a for no pile cap) =	3.25	ft
Top of Pile Cap Elevation (enter n/a for no pile cap)	400.75	ft
Bottom of Pile Cap Elevation (enter n/a for no pile cap)	397.5	ft
Ground Elevation at Pier	404.1	ft
Contraction Scour Depth	0.8	ft
ho = height of pile cap above bed at beginning of computation (negative indicates partially or entirely submerged pile cap) =	-5.74	ft
a = pier width =	3.5	ft
S = spacing between columns of piles, center to center =	n/a	ft
h1 = ho+T=height of the pier stem above the bed before scour (negative indicates top of pile cap is below bed elevation) =	-2.49	ft
y1 = Approach flow depth at the beginning of computations =	7.7	ft
V1 = Approach velocity used at the beginning of computations	5.2	ft/s
Khpier = coefficient to account for the height of the pier stem above the bed and the shielding effect by the pile cap overhang distance "f" in front of the pier stem	0.54	
Θ = angle of attack of flow =	0	degrees
Pier shape	Square nose	
K1 = correction factor for pier nose shape =	1.1	
L = length of pier =		ft
L/a (if L/a is larger than 12, then use 12 as a maximum)	0	
K2 = correction factor for angle of attack = (cosΘ+(L/a)*sinΘ)^0.65	1.0	
K3 = correction factor for bed condition =	1.1	
D50 = grain size for which 50% of bed material is finer =	0.0007	ft
D95 = grain size for which 95% of bed material is finer =	0.0066	ft
Ku = constant = 6.19 (SI) or 11.17 (English)	11.17	
VcD50 = Ku*(y1^(1/6))*(D50^(1/3))	1.4	ft/s
VcD95 = Ku*(y1^(1/6))*(D95^(1/3))	2.9	ft/s
g = acceleration due to gravity =	32.2	ft/s^2
Yspier = scour component for the pier stem in the flow = y1*(Khpier*(2*K1*K2*K3*((a/y1)^0.65)*((V1/((g*y1)^0.5))^0.43)) =	**3.7**	**ft**

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Pile cap/footing component scour

Case Type = (Case 1 or Case 2 from ho)	Case 2	
apc = width of pile cap =	16	ft
y2 = y1 + Yspier/2 = adjusted flow depth for pile cap computations =	9.51	ft
V2 = V1*(y1/y2) = adjusted velocity for pile cap computations =	4.18	ft/s
h2 = ho +Yspier/2 = height of pile group after the pier stem scour component has been computed =	-3.89	ft
Kw = wide pier correction factor (The correction factor should be applied when the ratio of depth of flow (y) to pier width (a) is less than 0.8 (y/a < 0.8); the ratio of pier width (a) to the median diameter of the bed material (D50) is greater than 50 (	0.65	

Case 1: Pile cap/footing in the flow above the bed (entire depth of cap exposed to flow)

K1 = correction factor for pier nose (pile cap nose) shape =	1.1	
a'pc = equivalent full depth solid pier width of pile cap = apc*exp(-2.705 + 0.51*LN(T/y2) - 2.783*((h2/y2)^3) + 1.751/(exp(h2/y2))) = (if y2 > 3.5*apc, then y2 = 3.5*apc) =	n/a	ft
Yspc = scour component for the pier cap/footing in the flow = y2*((2*K1*K2*K3*K4*Kw*((a'pc/y2)^0.65)*((V2/((g*y2)^0.5))^0.43)) =	**n/a**	**ft**

Case 2: Bottom of Pile Cap (footing) located on or below the bed

Ks = grain roughness of the bed (D84 of the bed material) =	0.0033	ft
yf = h1 + Yspier/2 = distance from the bed (after degradation, contraction scour and pier stem scour) to the top of the footing (negative indicates entirely submerged pile cap)	-0.64	ft
Vf = average velocity in the flow zone below the top of the footing = V2*((LN((10.93*(yf/Ks))+1)))/(LN((10.93*(y2/Ks))+1))) =	n/a	ft/s
Yspc = scour component for the pier cap/footing in the flow = yf*(2*K1*K2*K3*K4*Kw*((apc/yf)^0.65)*((Vf/((g*yf)^0.5))^0.43) =	**0.00**	**ft**

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Pile group scour component

h3 = ho + Yspier/2 + Yspc/2 = height of the pile group after the pier stem and pile cap scour components have been computed =	-3.89	ft
y3 = y1 + Yspier/2 + Ypc/2 = adjusted flow depth for pile group computations =	9.51	ft
V3 = V1*(y1/y3) = adjusted velocity for pile group computations =	4.18	ft/s
S = Spacing of piles (center to center)	6.00	ft
a = width of single pile	2.00	ft
aproj = sum of non-overlapping projected widths of piles =	6.00	ft
Ksp = coefficient for pile spacing = 1-(4/3)*((1-(1/(aproj/a)))*(1-((S/a)^-0.6)) =	0.57	
m = number of rows of piles in direction of flow =	3.00	
Km = coefficient for number of aligned rows = 0.9+0.1*m-0.0714*(m-1)*(2.4-1.1*(S/a)+0.1*((S/a)^2)) =	1.20	ft
a'pg = effective width of an equivalent full depth pier = aproj*Ksp*Km =	4.11	ft
Khpg = pile group height factor = (3.08*(h3/y3)-5.23*((h3/y3)^2)+5.25*((h3/y3)^3)-2.1*((h3/y3)^4))^(1/0.65) = (note that y3max = 3.5*a'pg) =	0.0000	
Yspg = scour component for the piles exposed to the flow = y3*Khpg*(2*K1*K3*K4*Kw*((a'pg/y3)^0.65)*((V3/((g*y3)^0.5))^0.43) =	**0.00**	**ft**

Total Scour

Ys = Yspier + Yspc + Yspg = total scour from superposition of components =	3.7	**ft**

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SR84 Widening

Alameda County, California

Local Scour at Abutments - Froehlich or HIRE

100-year Flow
Calculation guideline from HEC-18 5th Edition
Input from HEC-RAS for Proposed Alternative x

Units = (SI or English)	English	
g = acceleration due to gravity =	32.2	ft/s^2

Left Overbank = Abutment x (Cardinal Direction)

y1 = depth of flow at abutment on the overbank or in the main channel =	0.5	ft
L = length of embankment projected normal to flow =	0.8	ft
Ratio of projected embankment length to flow depth = L/y1 =	1.600E+00	
Abutment scour equation to be used =	Froehlich	

Froehlich's Live Bed Abutment Scour Equation

L' = length of active flow obstructed by the embankment =	0.8	ft
Ae = flow area of the approach cross section obstructed by the embankment =	0.20	ft^2
ya = average depth of flow on the flood plain = Ae/L'	0.25	ft
Qe = flow obstructed by the abutment and approach embankment =	0	ft^3/s
Ve = flow velocity = Qe/Ae =	1.1	ft/s
Fr = Froude Number of approach flow upstream of the abutment =	0.38	
Θ = abutment skew =	100	degrees
K1 = coefficient for abutment shape =	1	
K2 = coefficient for angle of embankment shape = (Θ/90)^0.13 =	1.01	
Ys = abutment scour = ya*(2.27*k1*k2*((L'/ya)^0.43)*(Fr^0.61)+1) =	**0.8**	**ft**

HIRE Live Bed Abutment Scour Equation

V = velocity of flow at upstream face of abutment =		ft/s
Fr = Froude Number = V/((g*y1)^.5) =	n/a	
Θ = abutment skew =		degrees
K1 = coefficient for abutment shape =		
K2 = coefficient for angle of embankment shape = (Θ/90)^0.13 =	n/a	
Ys = abutment scour = y1*(4*(Fr^0.33)*(K1/0.55)*K2) =	**n/a**	**ft**

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SR84 Widening

Alameda County, California

Local Scour at Abutments - Froehlich or HIRE

100-year Flow
Calculation guideline from HEC-18 5th Edition
Input from HEC-RAS for Proposed Alternative x

Units = (SI or English)	English	
g = acceleration due to gravity =	32.2	ft/s^2

Right Overbank = Abutment x (Cardinal Direction)

y1 = depth of flow at abutment on the overbank or in the main channel =	0.5	ft
L = length of embankment projected normal to flow =	1.0	ft
Ratio of projected embankment length to flow depth =	2.000E+00	
Abutment scour equation to be used =	Froehlich	

Froehlich's Live Bed Abutment Scour Equation

L' = length of active flow obstructed by the embankment =	1.0	ft
Ae = flow area of the approach cross section obstructed by the embankment =	0.3	ft^2
ya = average depth of flow on the flood plain = ae/L	0.25	ft
Qe = flow obstructed by the abutment and approach embankment =	0	ft^3/s
Ve = flow velocity = Qe/Ae =	1.9	ft/s
Fr = Froude Number of approach flow upstream of the abutment =	0.66	
Θ = abutment skew =	80	degrees
K1 = coefficient for abutment shape =	1	
K2 = coefficient for angle of embankment shape = (Θ/90)^0.13 =	0.98	
Ys = abutment scour = ya*(2.27*k1*k2*((L'/ya)^0.43)*(Fr^0.61)+1) =	**1.0**	**ft**

HIRE Live Bed Abutment Scour Equation

V = velocity of flow at upstream face of abutment =		ft/s
Fr = Froude Number = V/((g*y1)^.5) =	n/a	
Θ = abutment skew =		degrees
K1 = coefficient for abutment shape =		
K2 = coefficient for angle of embankment shape = (Θ/90)^0.13 =	n/a	
Ys = abutment scour = y1*(4*(Fr^0.33)*(K1/0.55)*K2) =	**n/a**	**ft**

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Attachment C:

Response to Comments

Review Discipline:	91% Structure Hydraulic Review Comments – EA 297621	**By:**	Caltrans
Comments Due By:		**Date:**	November 14, 2014
Date Reviewed By:		**Next JRT Meeting Date:**	TBD

TECHNICAL COMMENT REVIEW AND RESPONSE

Comments from Highway Operations

CODE: A - Will Comply; B – URS to Evaluate; C - Will Not Incorporate; D – Agency (ACTC) to Evaluate; E - No Action Required

AGCY	INIT	Item No.	Drawing or Page No.	Review Comments	Designer Responses	Rev. By	Initial Disp.	JRT Disp.	Final Disp.
Arroyo del Valle Bridge Route 84 Widening									
Caltrans HQ – Structure Hydraulics	Tony Nedwick (TN)	1.	BDHS Amendment Memo – Attachment A	Attachment A, Detailed Scour Calculations. According to the HEC-RAS output contained in the 2009 report, the "Minimum Channel Elevation" upstream of the Route 84 bridge is 401.81 feet. There are no engineered features that would restrain lateral migration. Based on the Section V of the October 2014 Amendment (Description of Stream and Site) and the Foundation Plan (Revision Date 9/12/14), the bottom of the footing elevation is 398.67 ft. With no current data, it is assumed that the 2009 channel data is still applicable. The calculated Total Scour of 5.57 ft calculated would place the Total Scour at approximately elevation 396.24 ft, below the bottom of the proposed footing. Since the footing cannot be placed at a lower elevation (due to structural design issues as noted in the comments contained in the May 2009 report, Review Comment Matrix), the pier scour equations are invalid for this scenario. Complex pier scour analysis should be used for calculations, per Section 7.5, Scour for Complex Pier Foundations, of the FHWA HEC-18. Please provide revised Total Scour elevations to ensure the proper design and specified tip elevations of the CIDH piles.	Scour calculation was revised based on the latest design and used complex pier scour calculation. The scour hole elevation when referencing channel thalweg elevation was above the bottom of the footing elevation.	WRE CO	A		
Caltrans HQ – Structure Hydraulics	TN	2.	BDHS Amendment Memo – Attachment A	Attachment A, Detailed Scour Calculations. Some of the values used in the scour calculations do not match those found in the Standard Output Tables (Appendix C of the 2009 report). Please provide the updated Standard Output Tables corresponding to the values used in the Detailed Scour Calculation worksheets in Attachment A. For future submittals, please include the applicable HEC-RAS files on portable computer media.	Provided updated standard output table and HEC-RAS files, by email coordination on 11/05/2014. A CD is included with the revised memo.	WRE CO	A		
Arroyo del Valle Trail Bridge									
Caltrans HQ – Structure Hydraulics	TN	3.	BDHS Amendment Memo – Attachment A	Attachment A, Detailed Scour Calculations. According to the HEC-RAS output contained in the 2009 report, the "Minimum Channel Elevation" upstream of the Route 84 bridge is 402.77 feet. Based on the Foundation Plan (Revision Date 9/12/14), the bottom of the footing elevation is 397.50 ft. With no current data, it is assumed that the 2009 channel data is still applicable. The calculated Total Scour of 10.36 ft calculated would place the Total Scour at approximately elevation 392.41 ft, below the bottom of the proposed footing. Therefore, the pier scour equations are invalid for this scenario. Complex pier scour analysis should be used for calculations, per Section 7.5, Scour for Complex Pier Foundations, of the FHWA HEC-18. Please provide revised Total Scour elevations to ensure the proper design and specified tip elevations of the CIDH piles.	Scour calculation was revised based on the latest design and used complex pier scour calculation. The scour hole elevation when referencing channel thalweg elevation was above the bottom of the footing elevation.	WRE CO	A		
Caltrans HQ – Structure Hydraulics	TN	4.	BDHS Amendment Memo – Attachment A	Attachment A, Detailed Scour Calculations. Some of the values used in the scour calculations do not match those found in the Standard Output Tables (Appendix C of the 2009 report). Please provide the updated Standard Output Tables corresponding to the values used in the Detailed Scour Calculation worksheets in Attachment A. For future submittals, please include the applicable HEC-RAS files on portable computer media.	Provided updated standard output table and HEC-RAS files, by email coordination on 11/05/2014. A CD is included with the revised memo.	WRE CO	A		

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Attachment D:

Original Bridge Design Hydraulic Study Report (May 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

State Route 84 Expressway Widening Project
Cities of Livermore and Pleasanton, Alameda County, California

Bridge Design Hydraulic Study Report

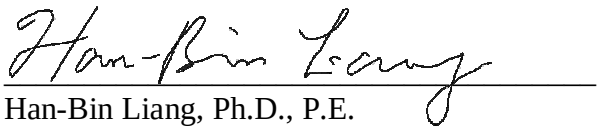
Submitted to:

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

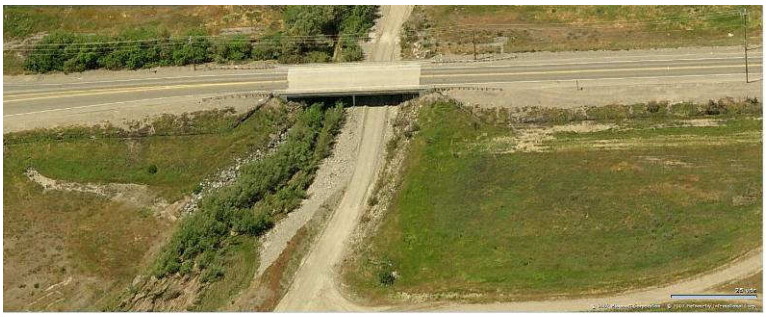

Photo 1. Aerial of SR 84 Expressway at Arroyo del Valle (maps.live.com)

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.

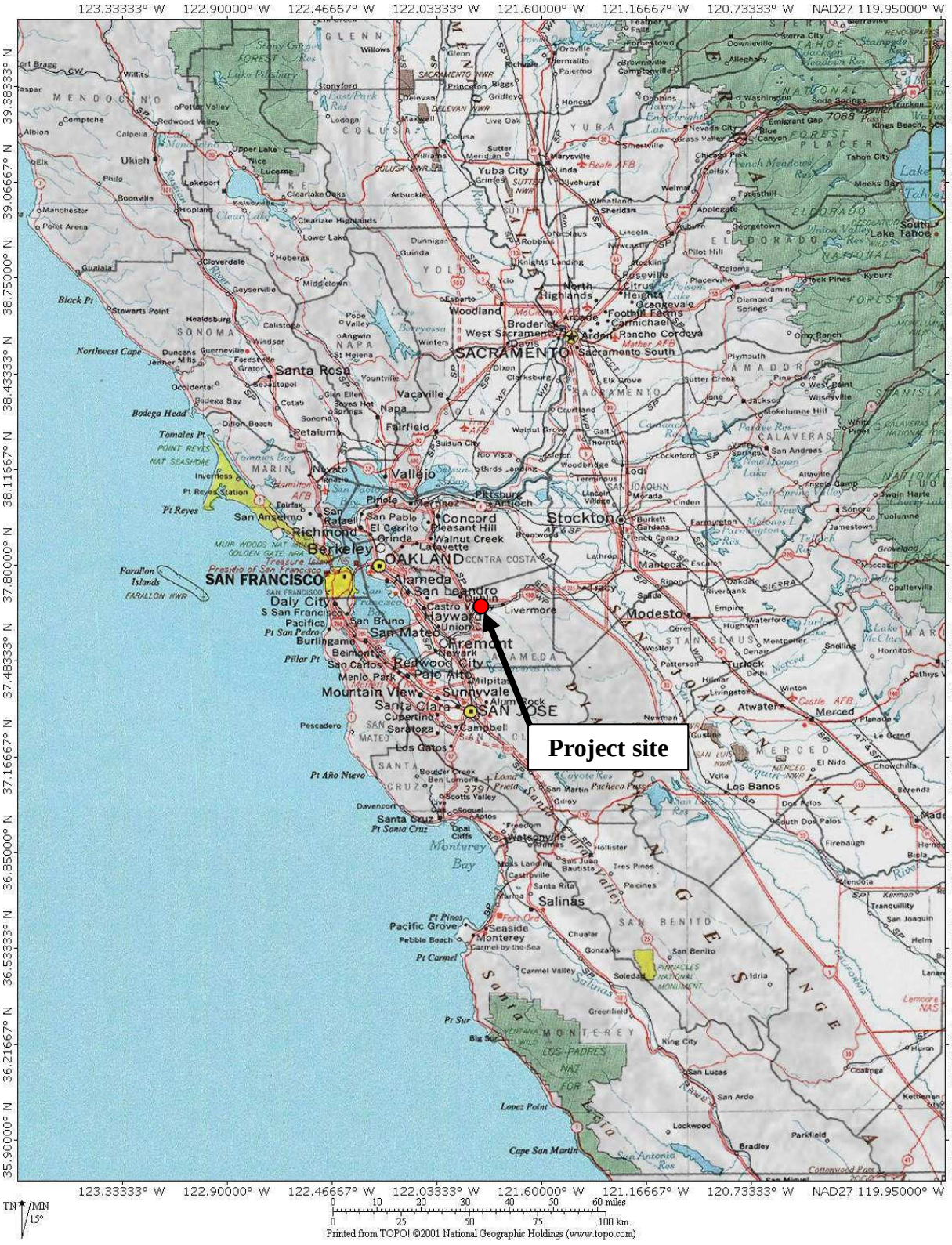

Figure 1. Project Location Map

Source: United States Geological Survey (USGS)

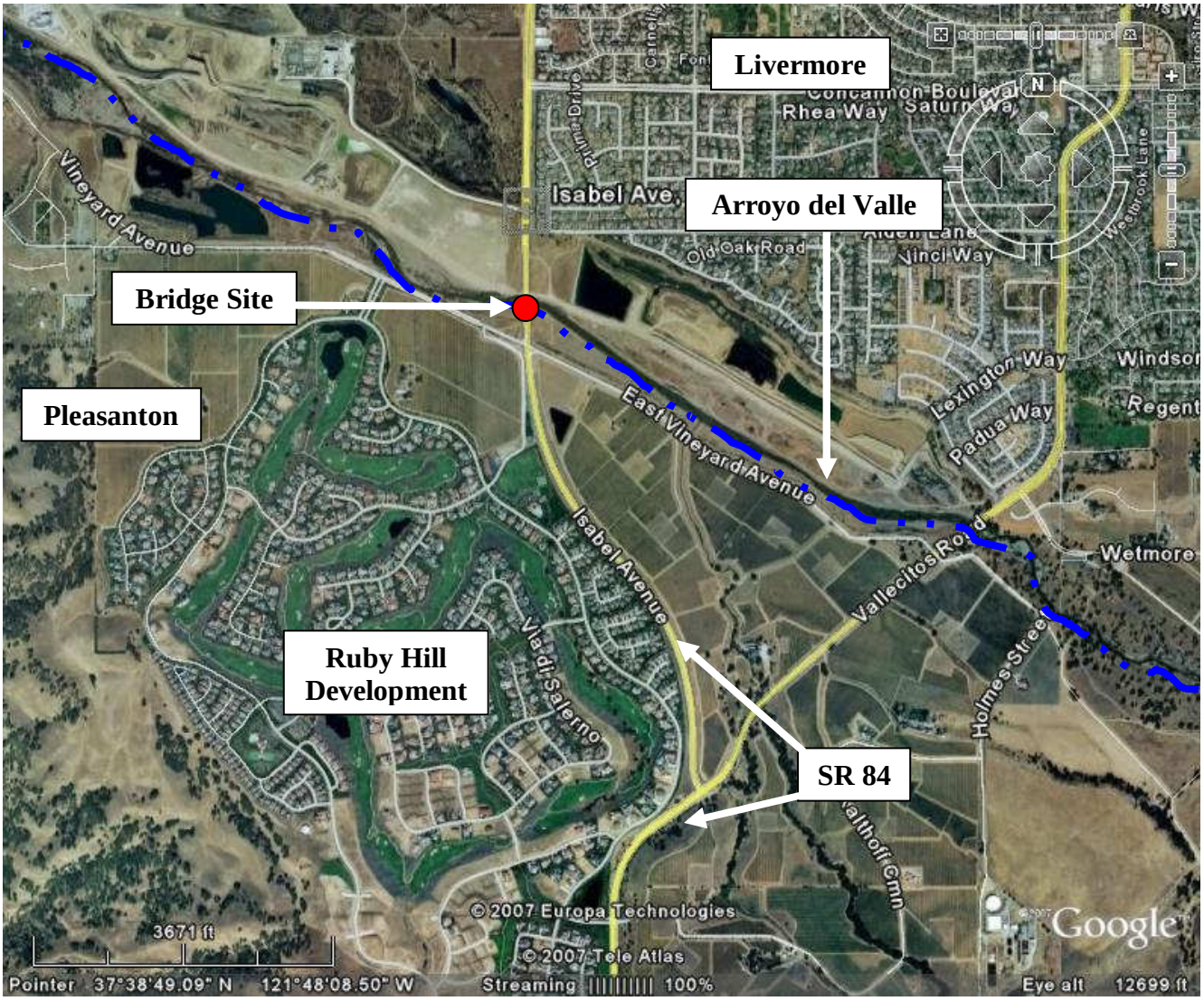

Figure 2. Arroyo del Valle Vicinity Map

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.

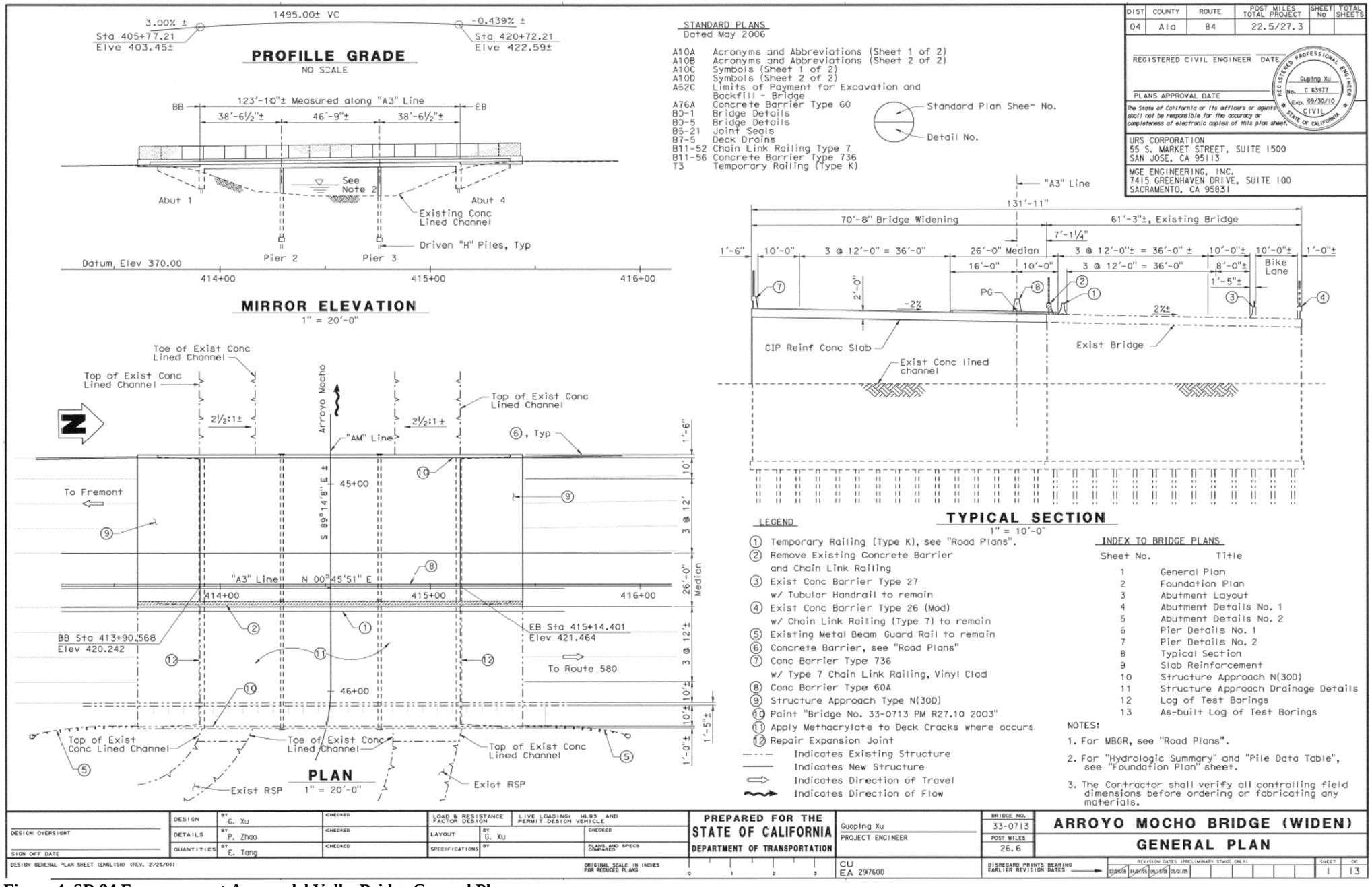

Figure 4. SR 84 Expressway at Arroyo del Valle Bridge General Plan

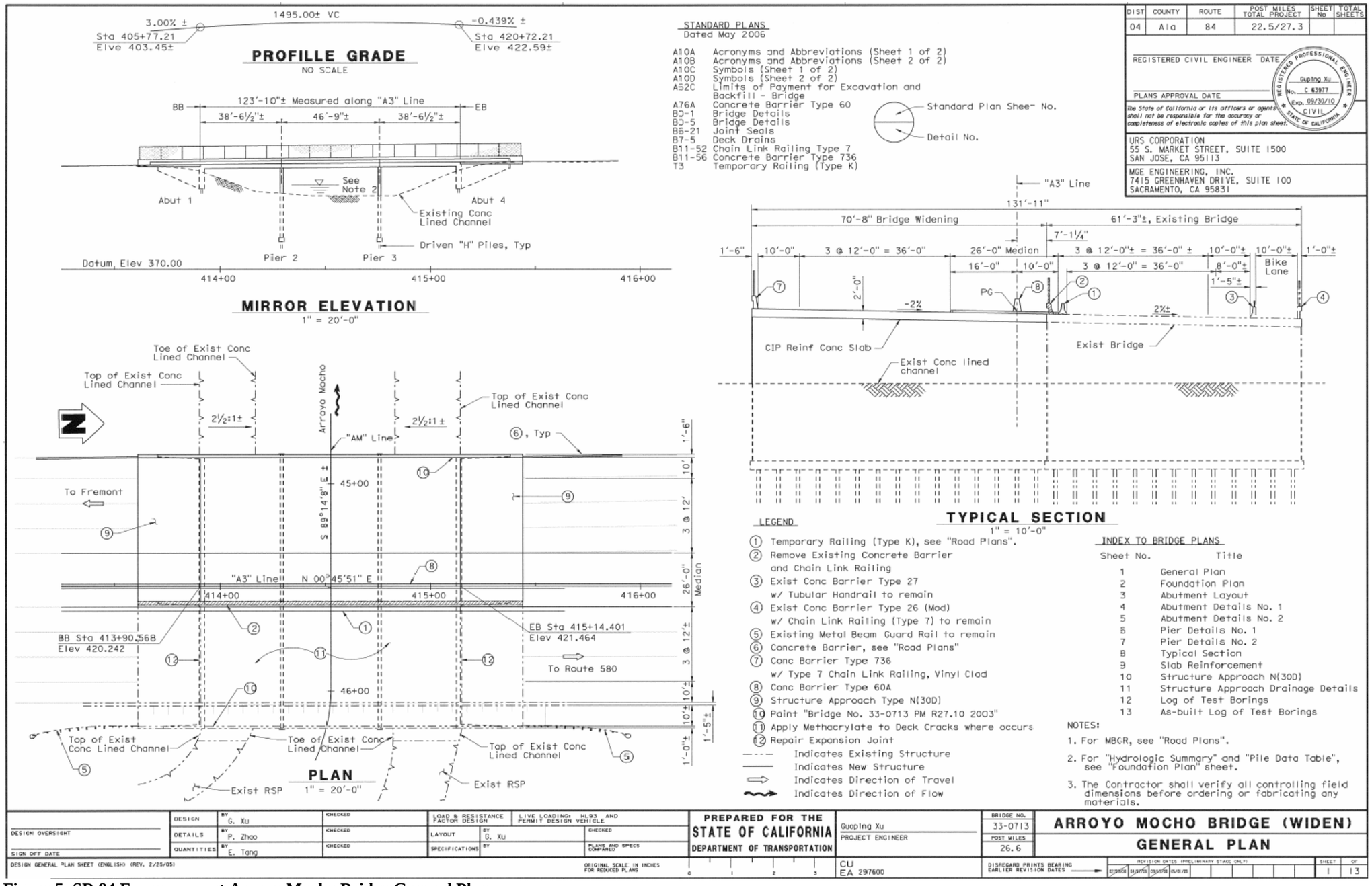

Figure 5. SR 84 Expressway at Arroyo Mocho Bridge General Plan

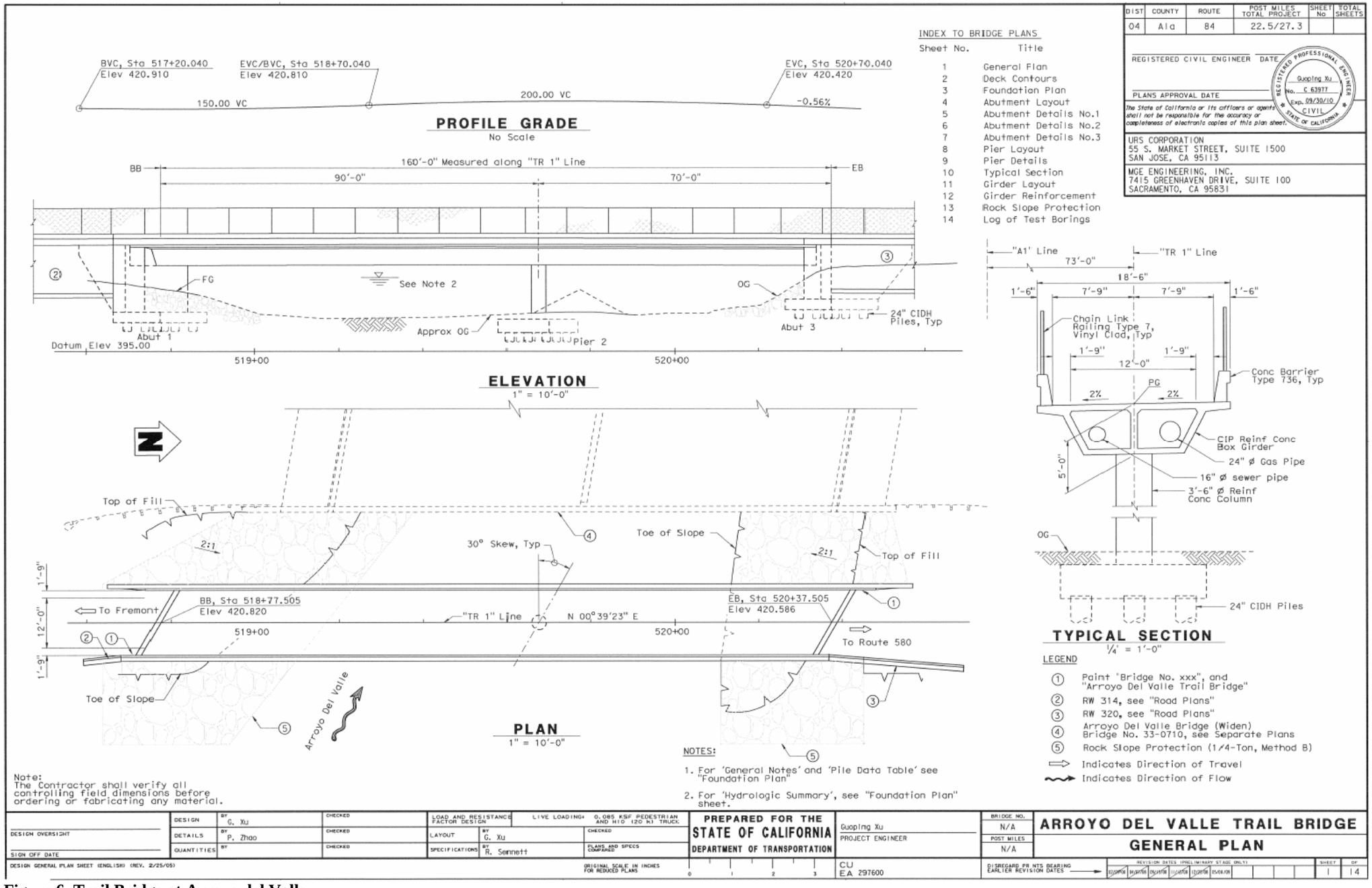

Figure 6. Trail Bridge at Arroyo del Valle

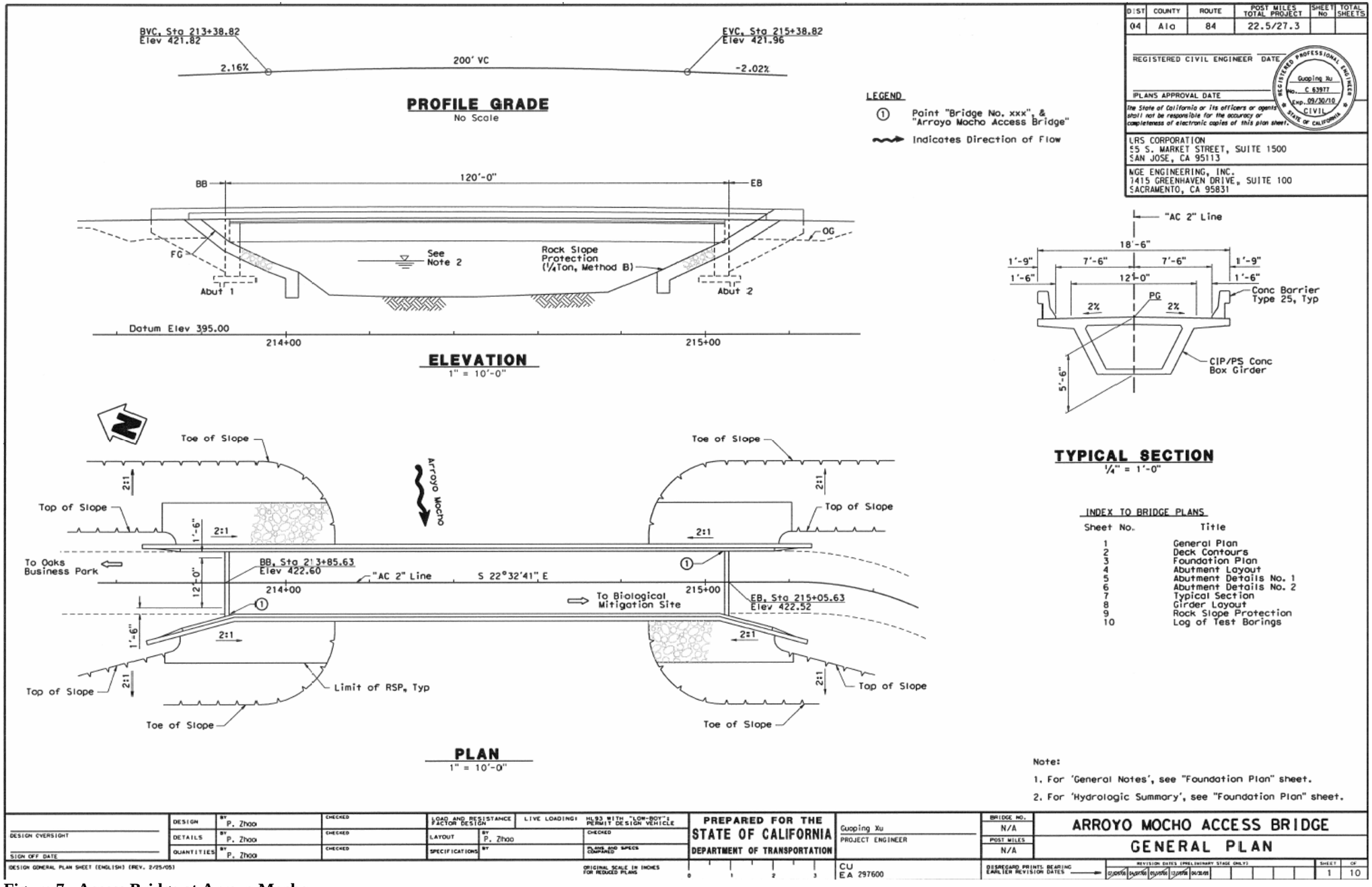

Figure 7. Access Bridge at Arroyo Mocho

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.

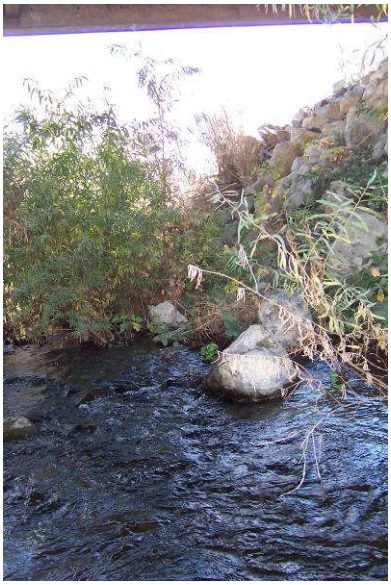

Photo 9.
Arroyo del Valle channel

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.

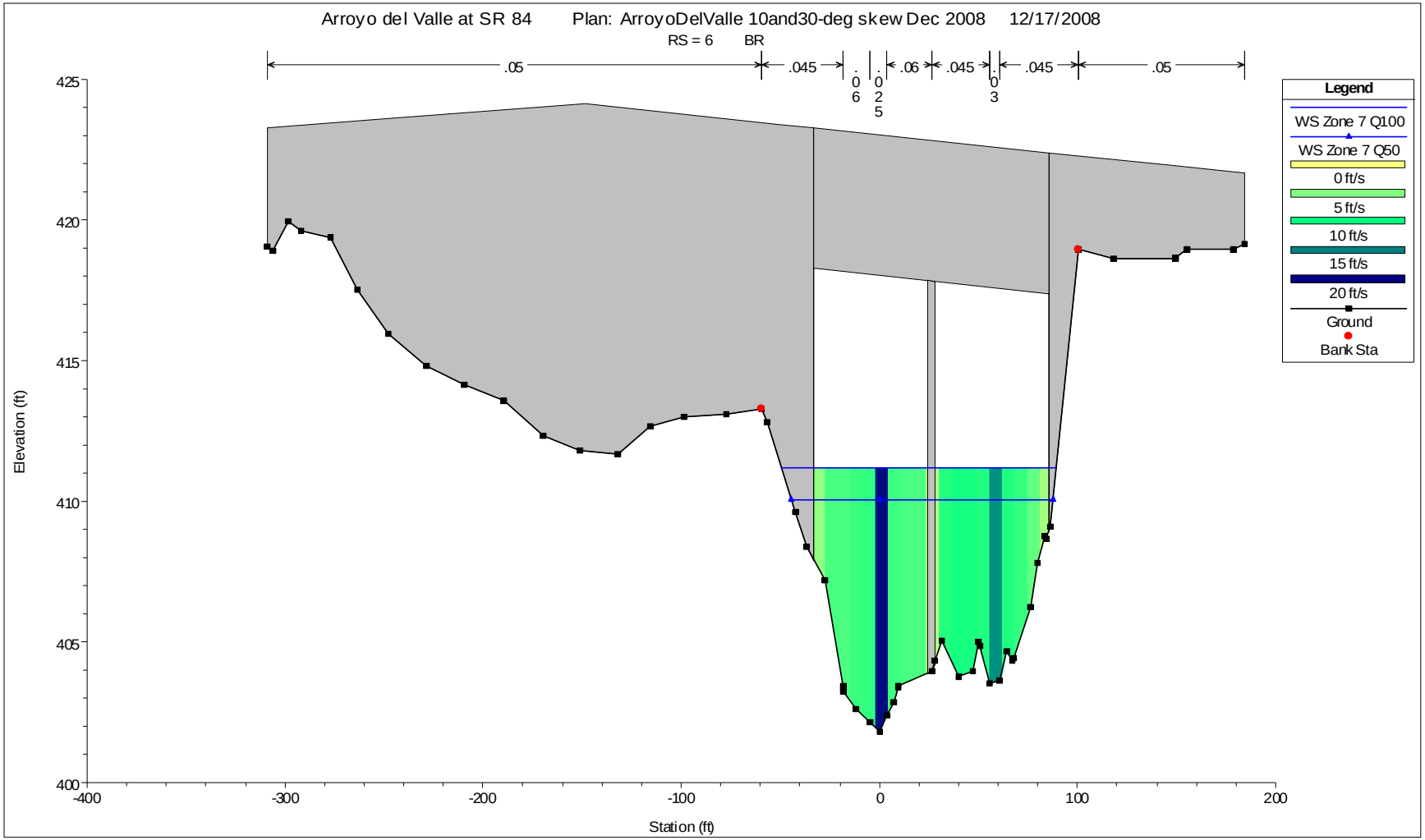

Figure 8. SR 84 Expressway Arroyo del Valle Bridge Upstream Face Cross-Section

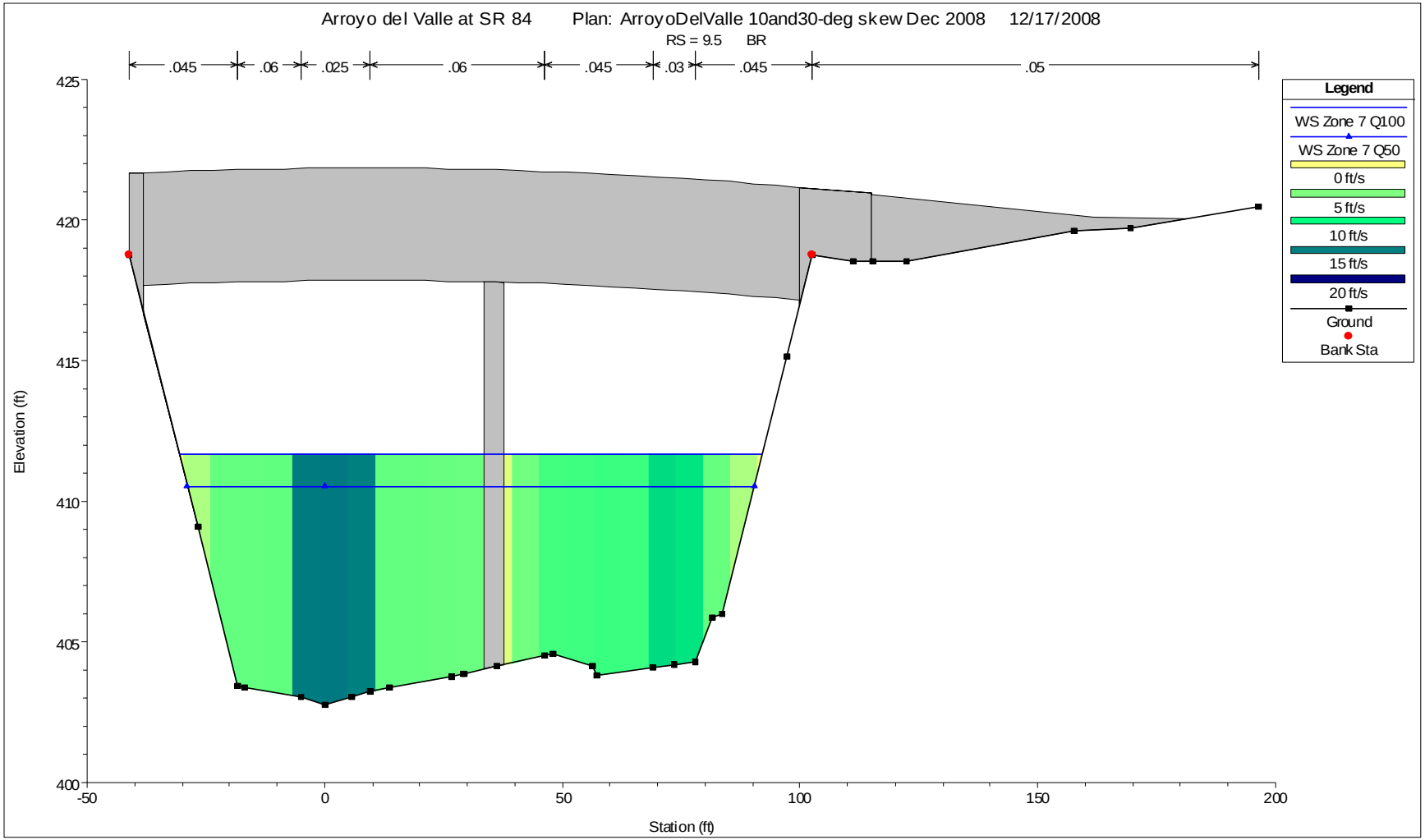

Figure 9. Arroyo del Valle Trail Bridge Upstream Face Cross-Section

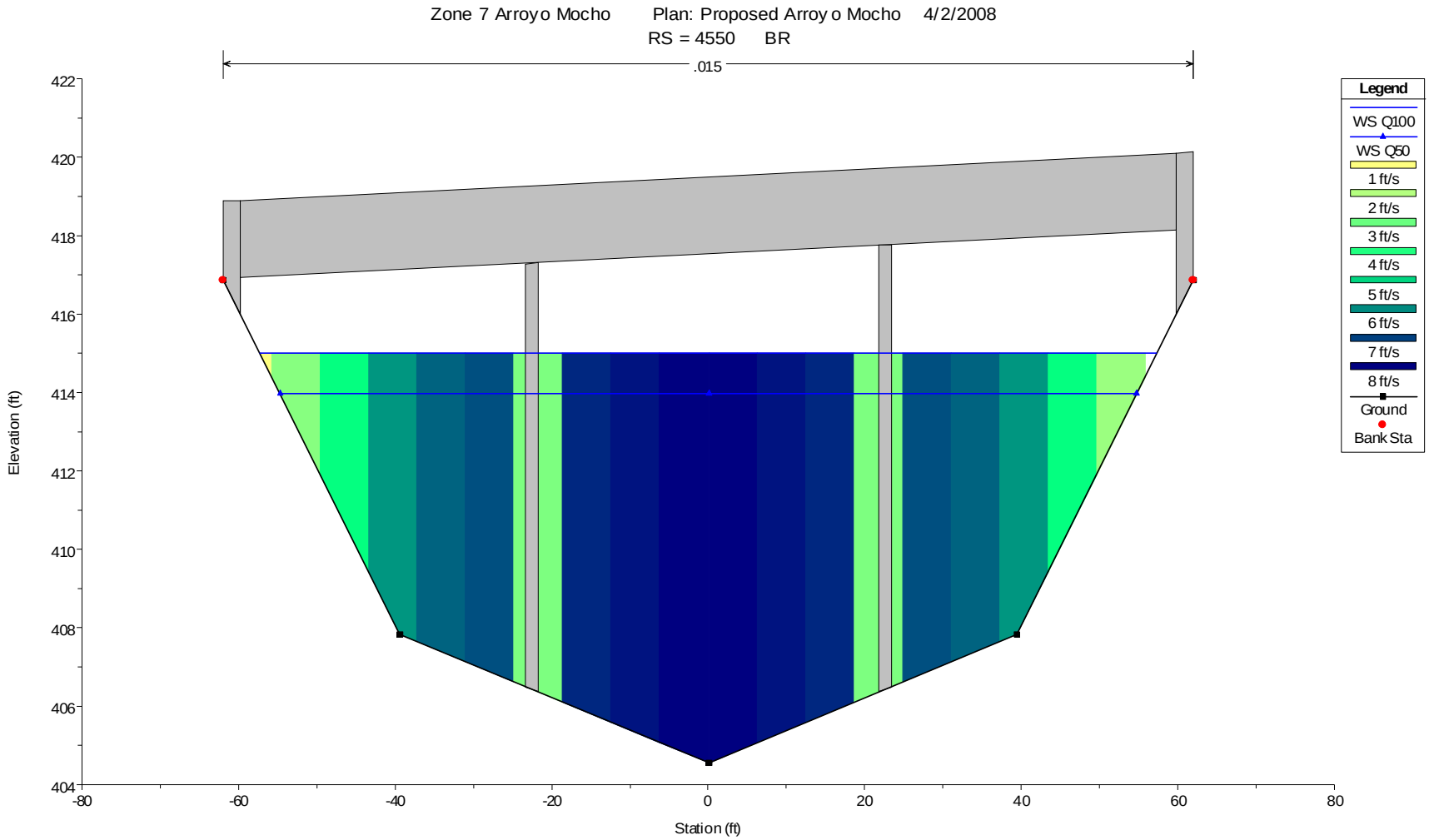

Figure 10. SR 84 Expressway Arroyo Mocho Bridge Upstream Face Cross-Section

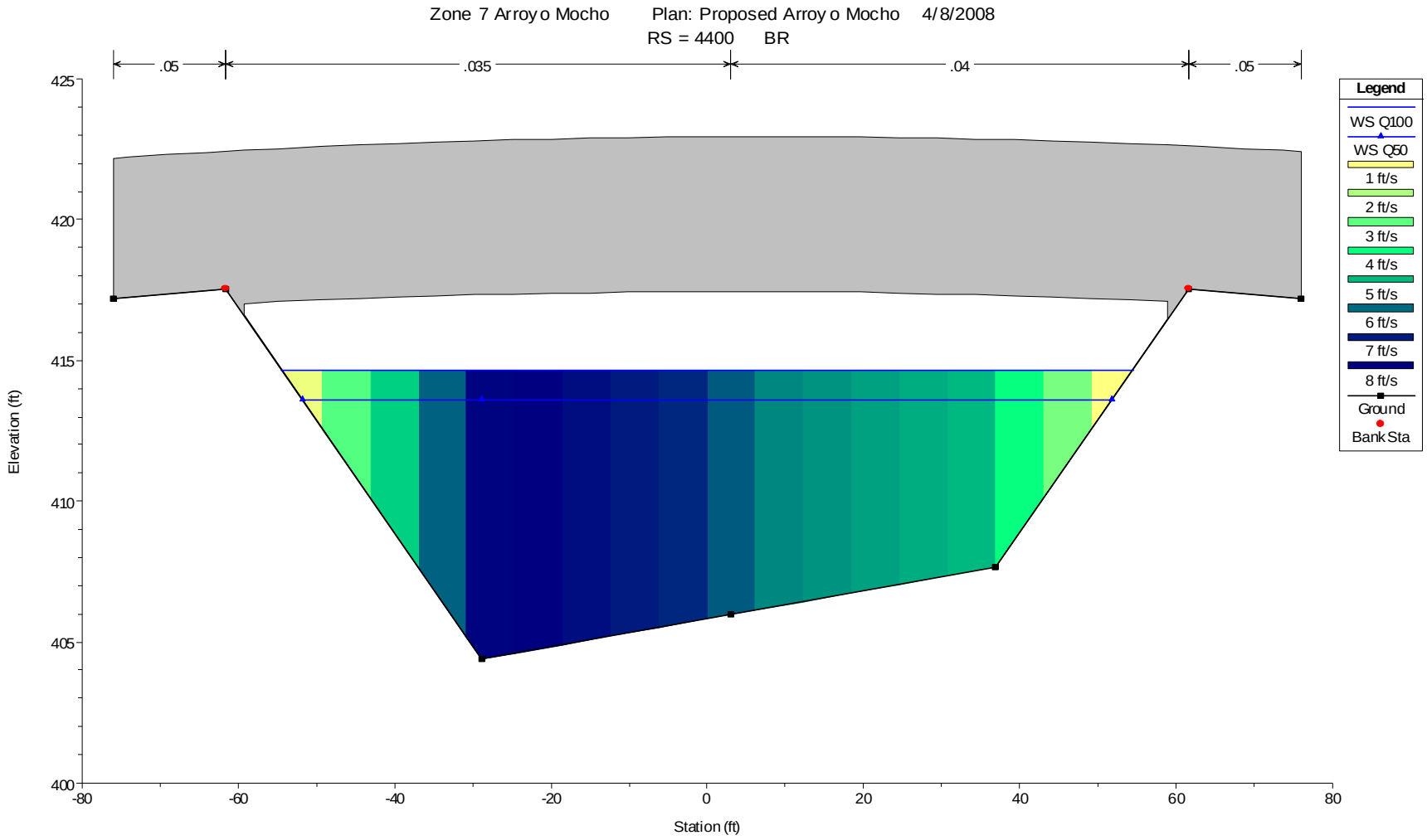

Figure 11. Arroyo Mocho Access Bridge Upstream Face Cross-Section

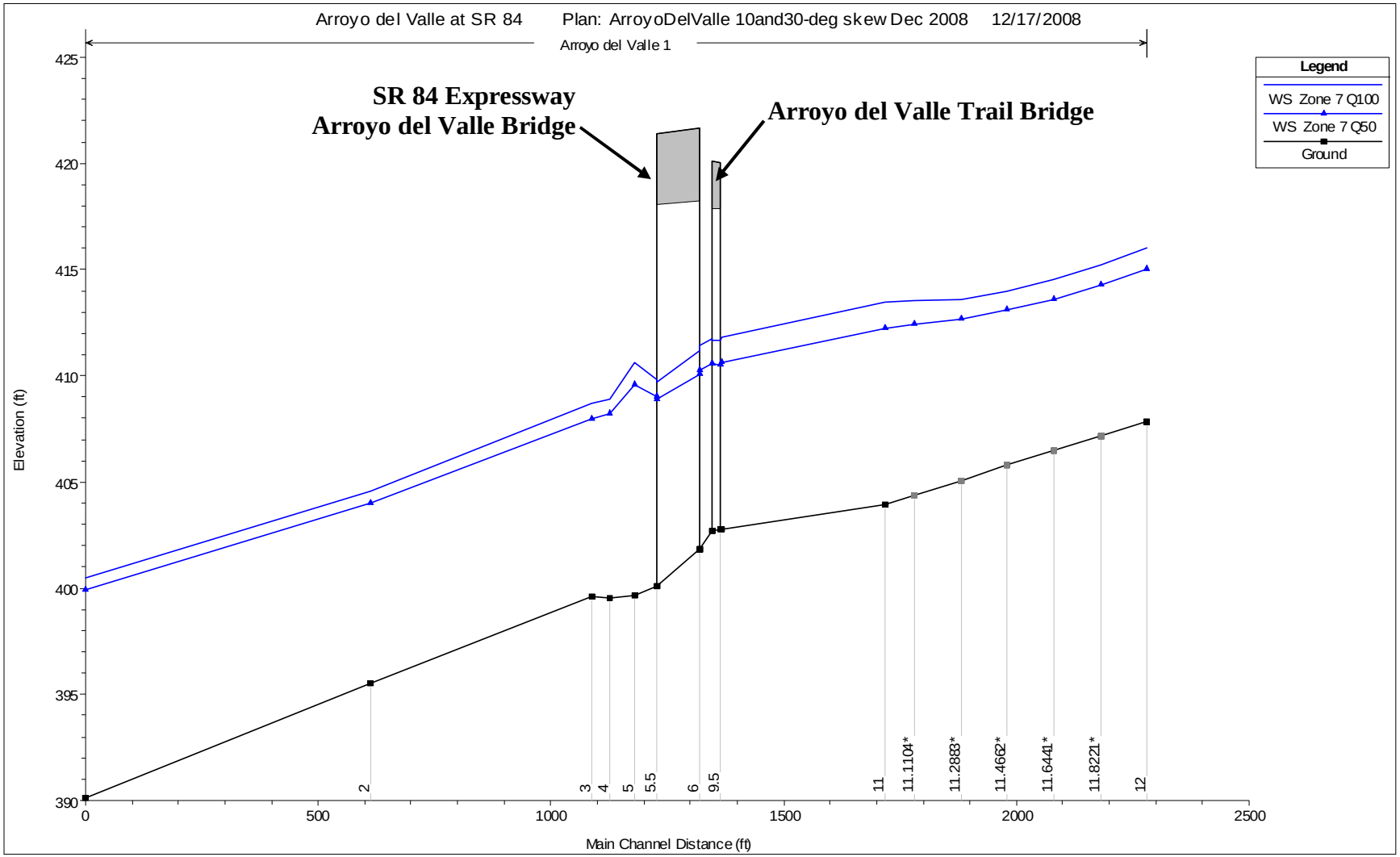

Figure 12. Arroyo del Valle Profile

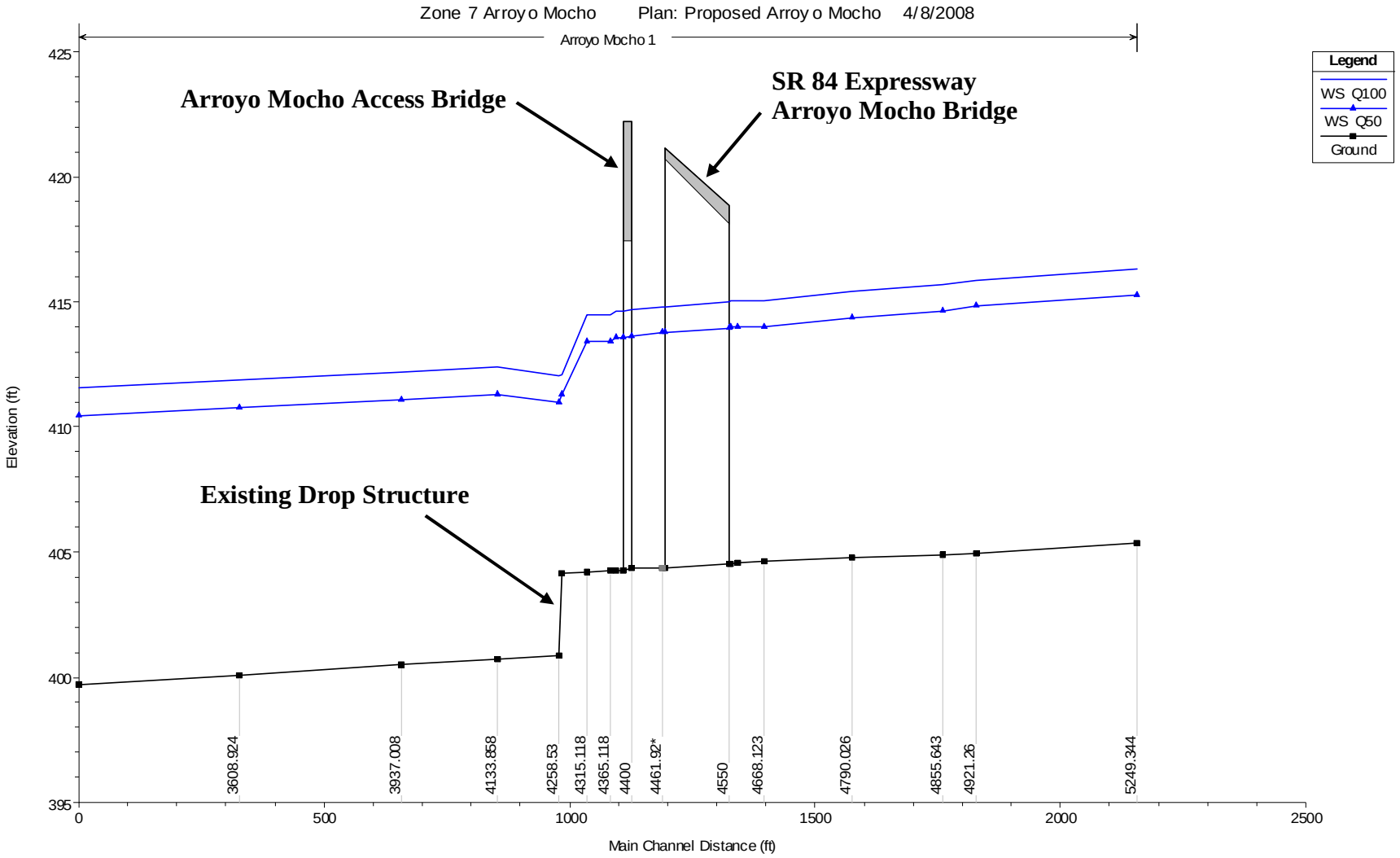

Figure 13. Arroyo Mocho Profile

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

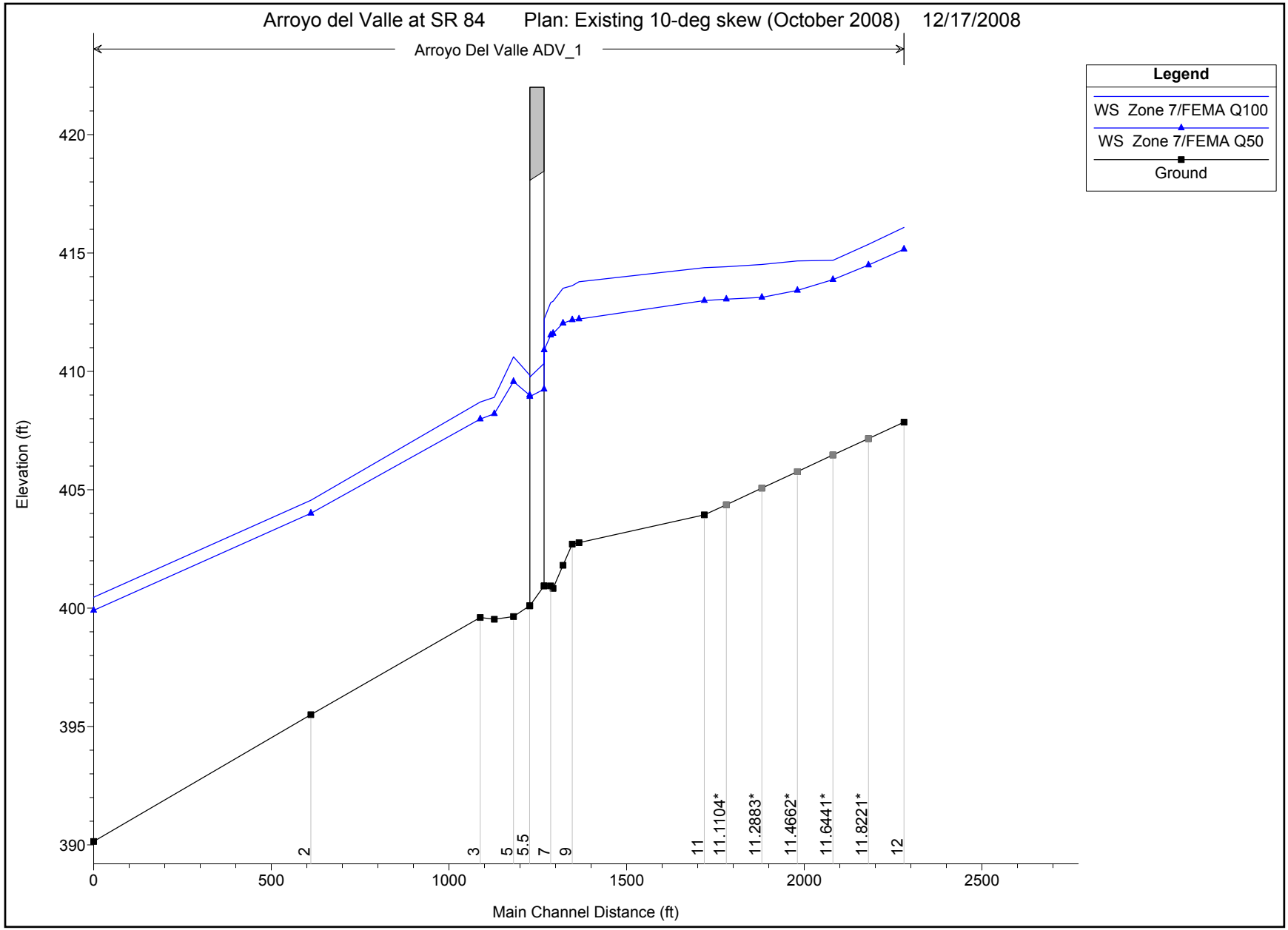
HEC-RAS Results: Existing Condition

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	

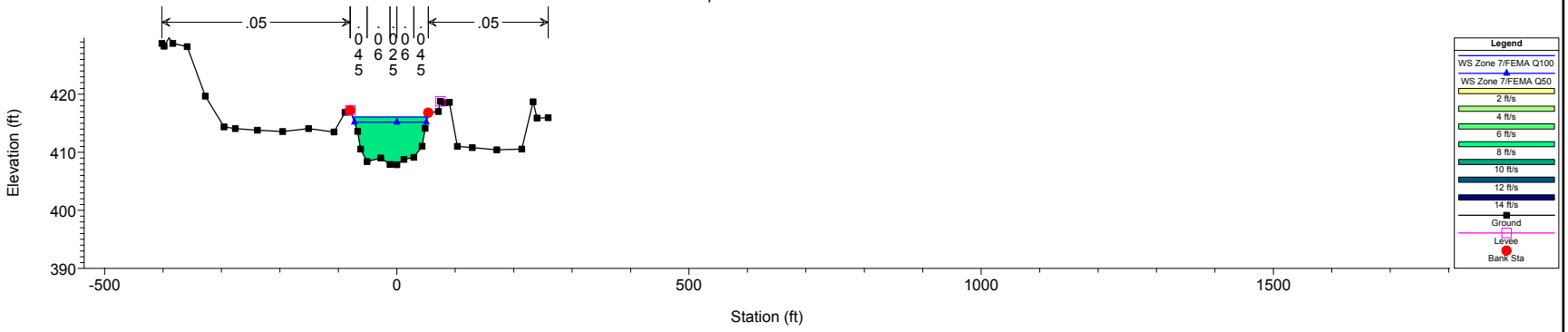


1 in Horiz. = 400 ft 1 in Vert. = 6 ft

No Data for Plot

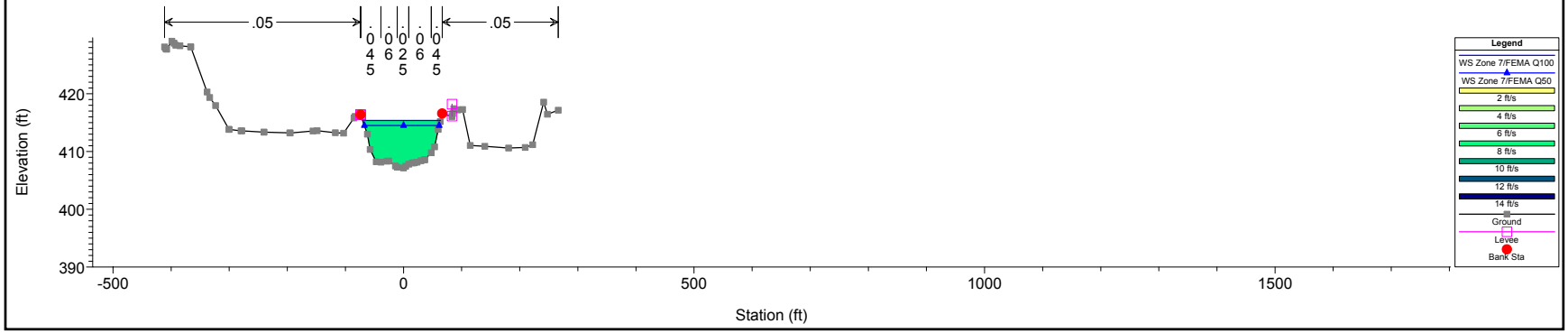
Arroyo del Valle at SR 84 Plan: Existing 10-deg skew (October 2008) 12/17/2008

RS = 12 Upstream end of the cross sections

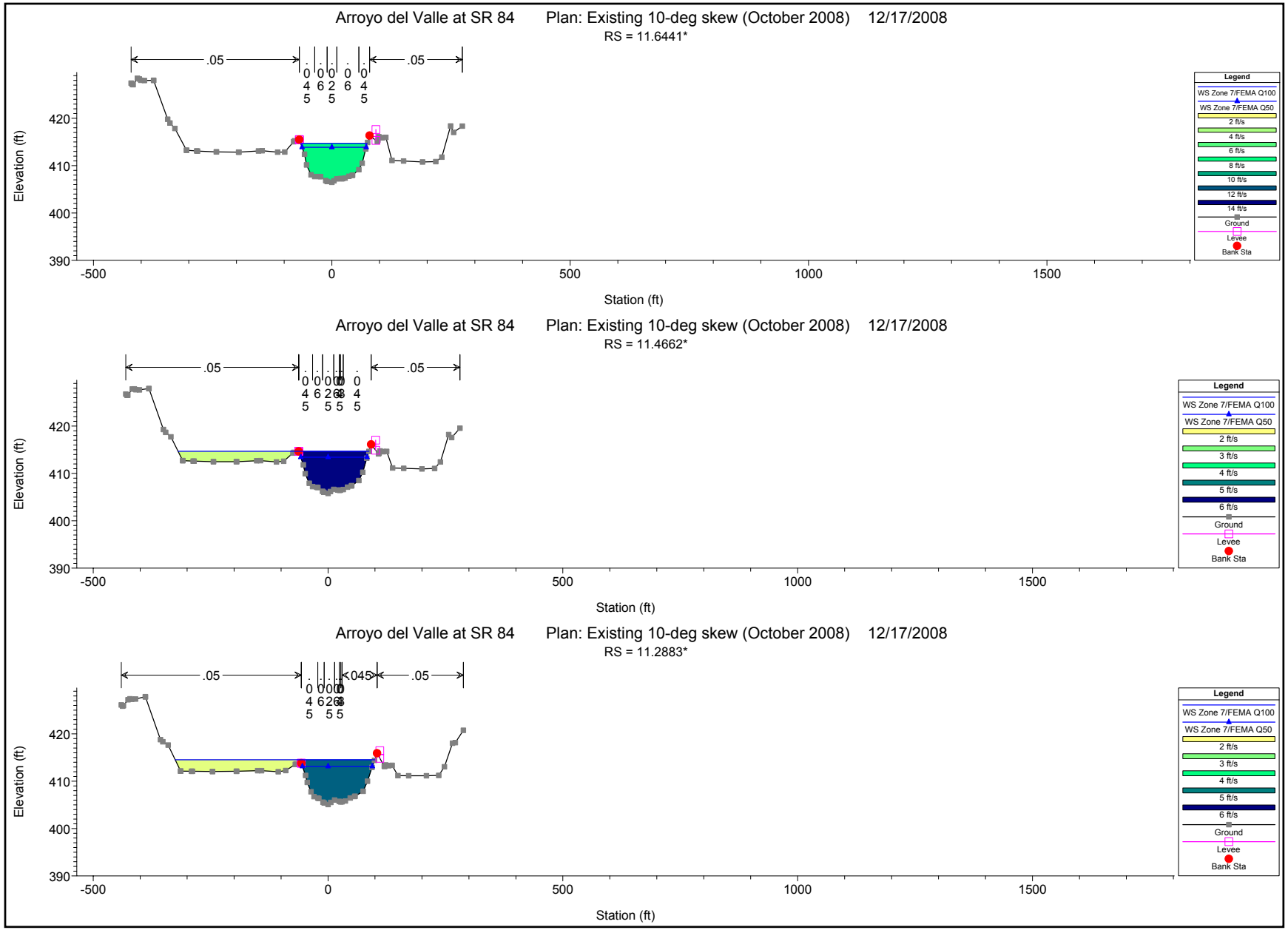


Arroyo del Valle at SR 84 Plan: Existing 10-deg skew (October 2008) 12/17/2008

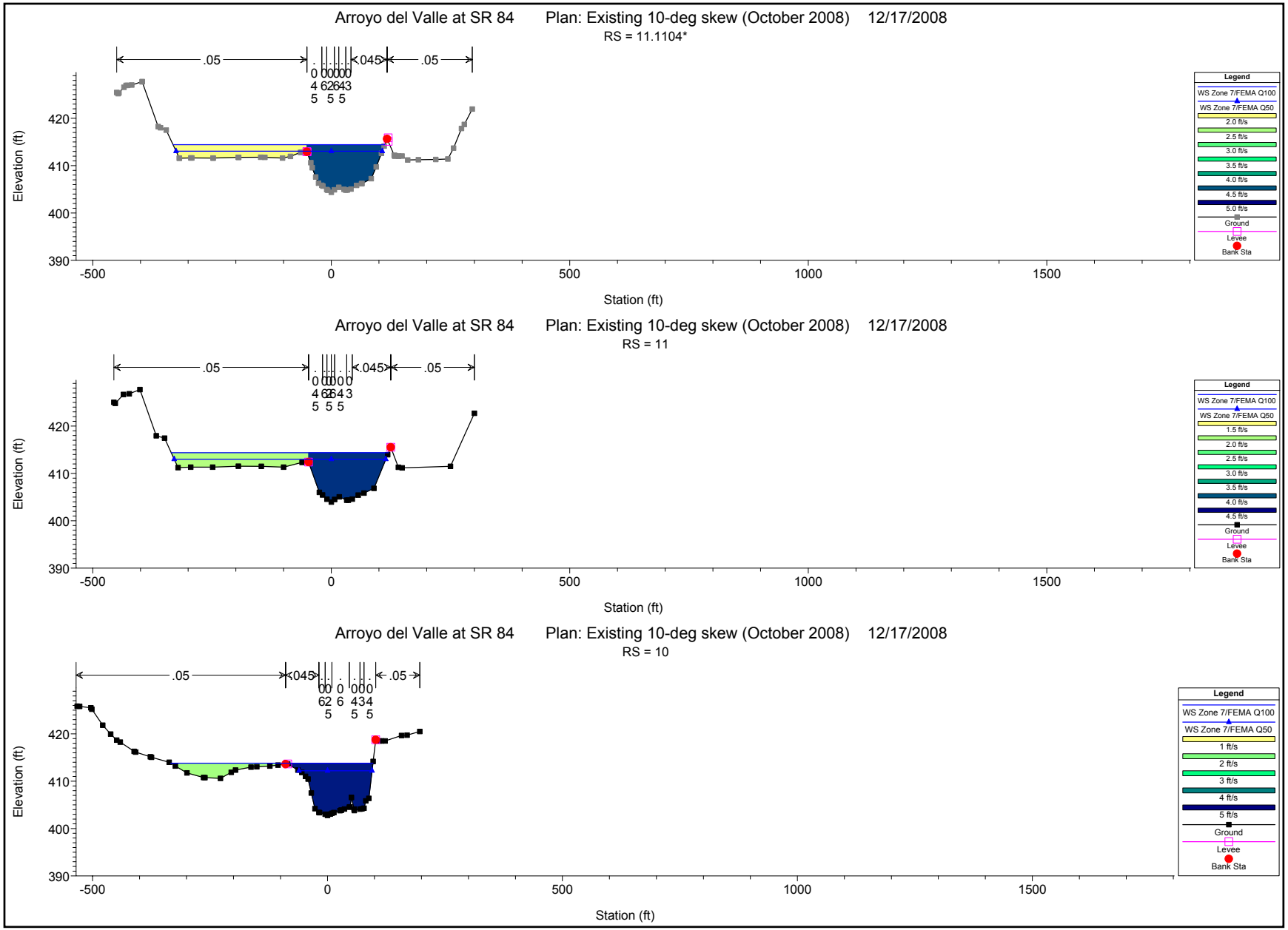
RS = 11.8221*



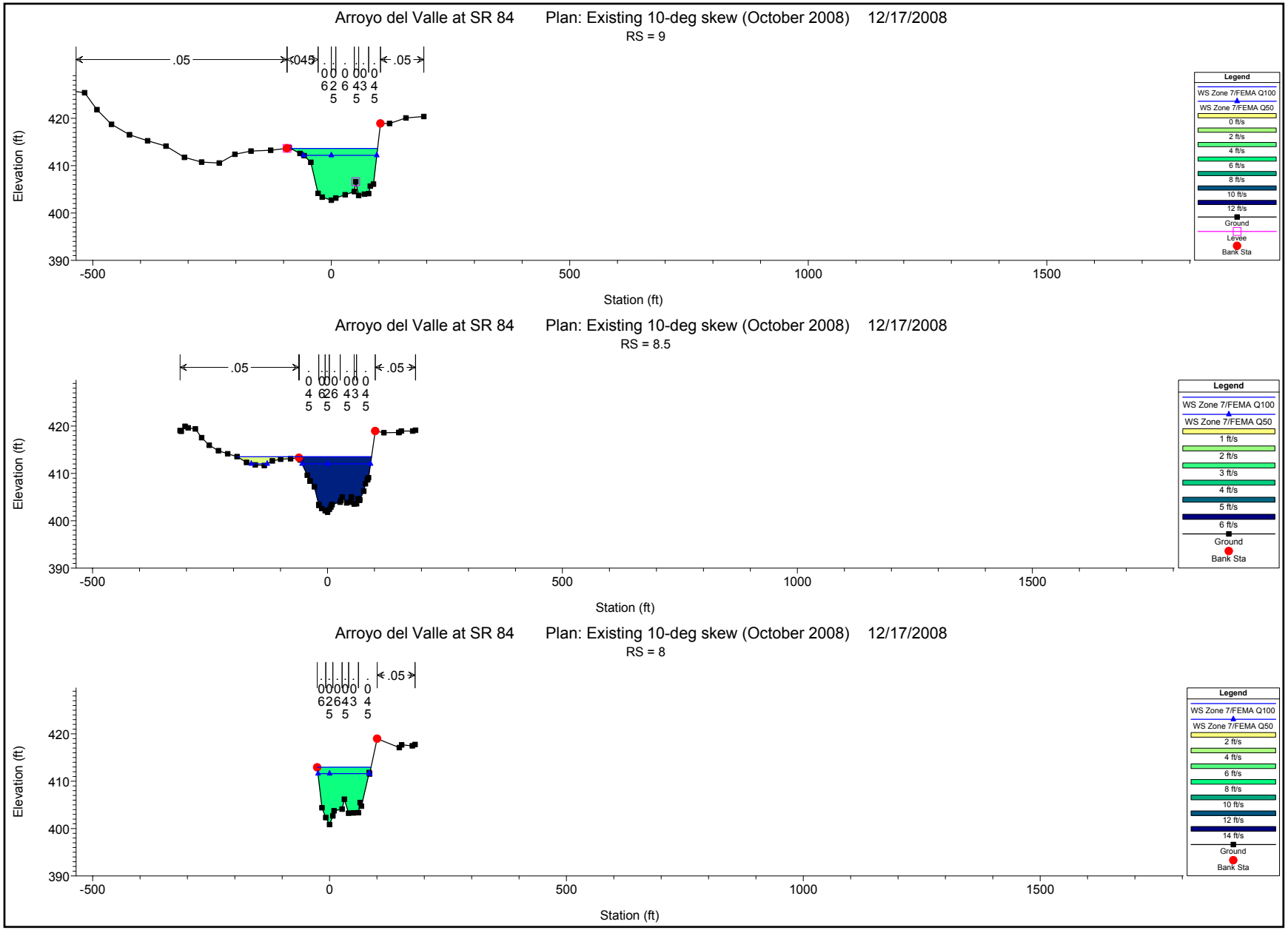
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



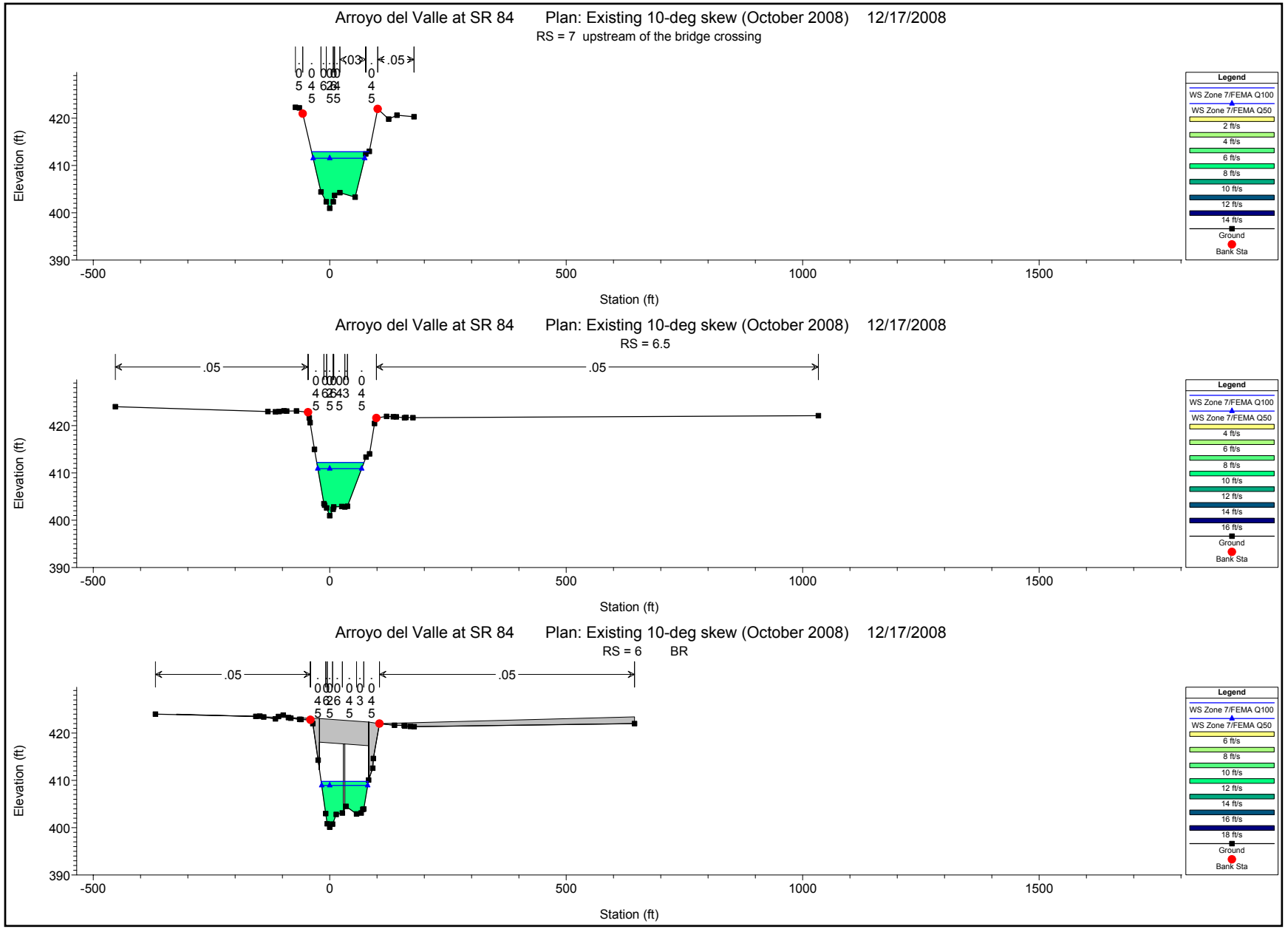
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



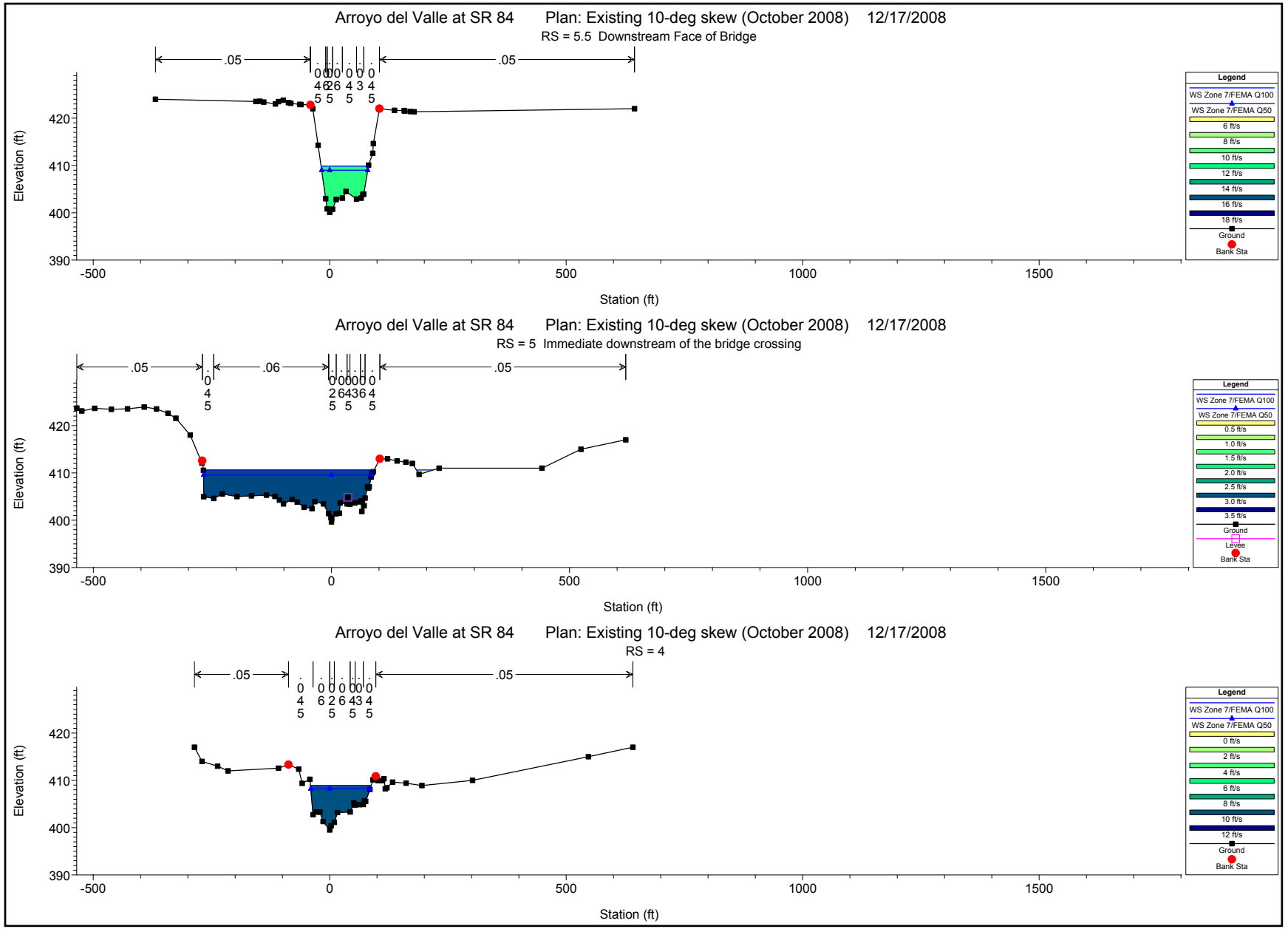
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



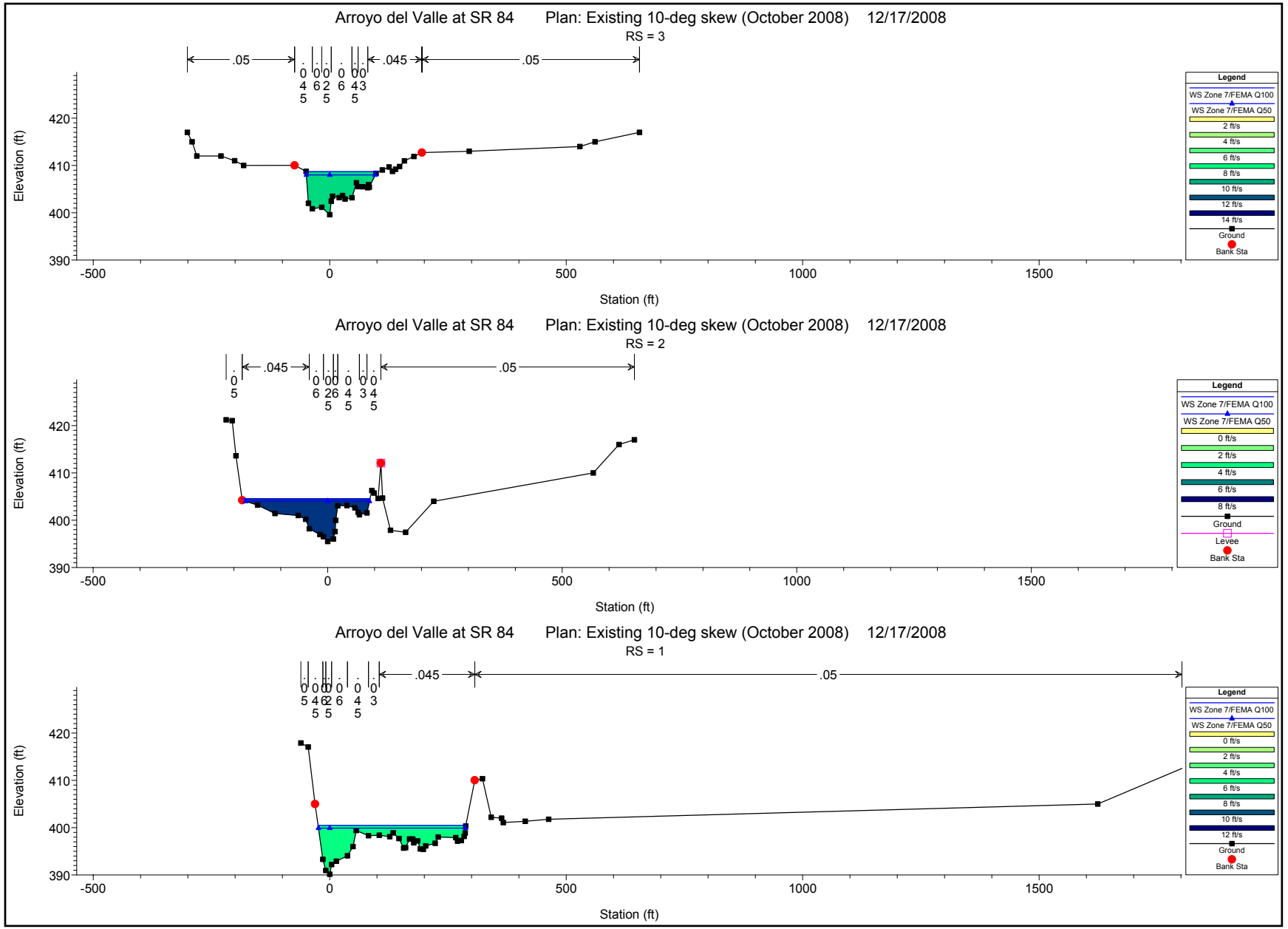
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



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

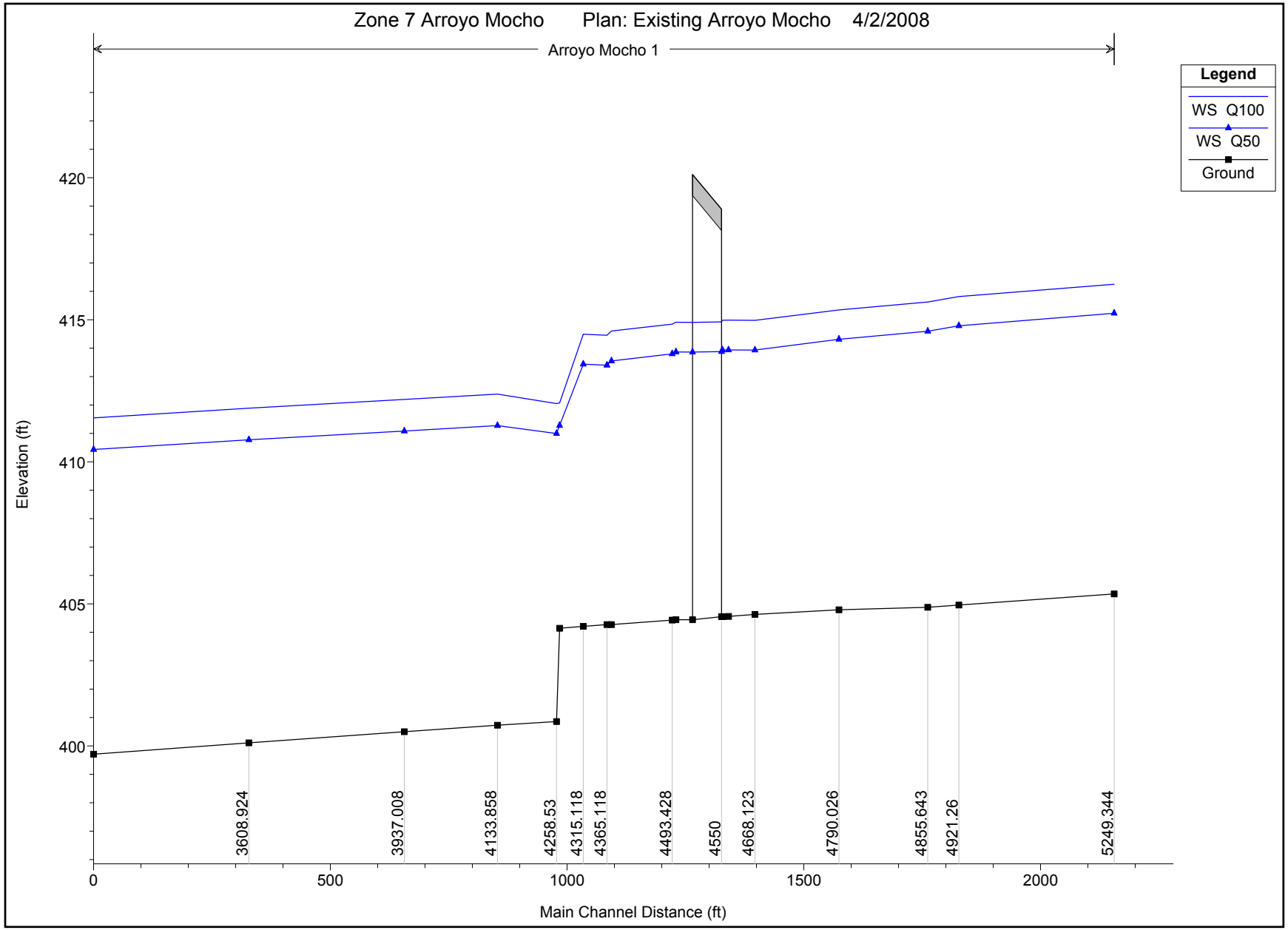
HEC-RAS Results: Existing Condition

HEC-RAS Plan: Existing River: Arroyo Mocho Reach: 1

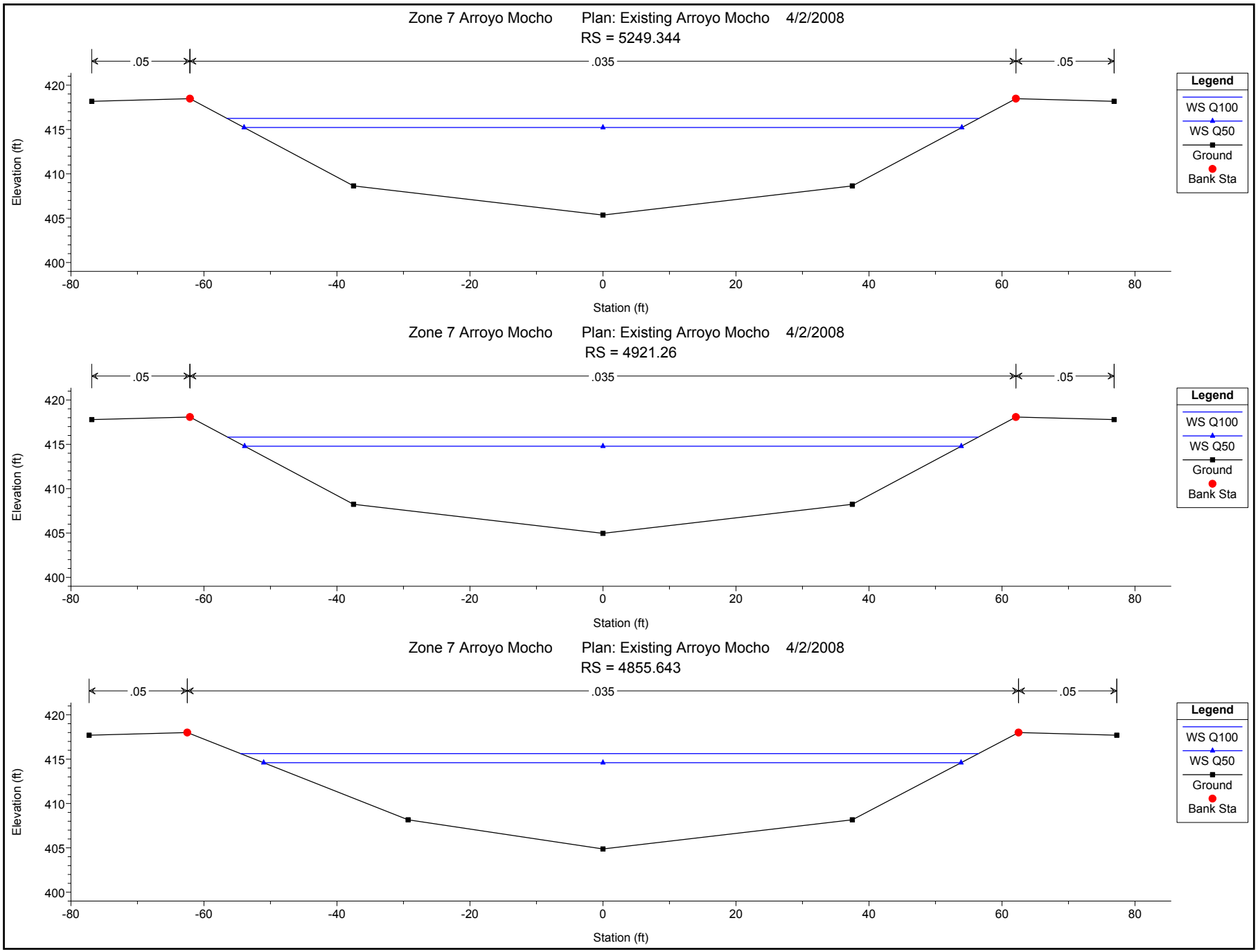
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
1	5249.344	Q100	4800.00	405.35	416.25		416.76	0.001302	5.72	839.06	113.06	0.37		328.08
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)

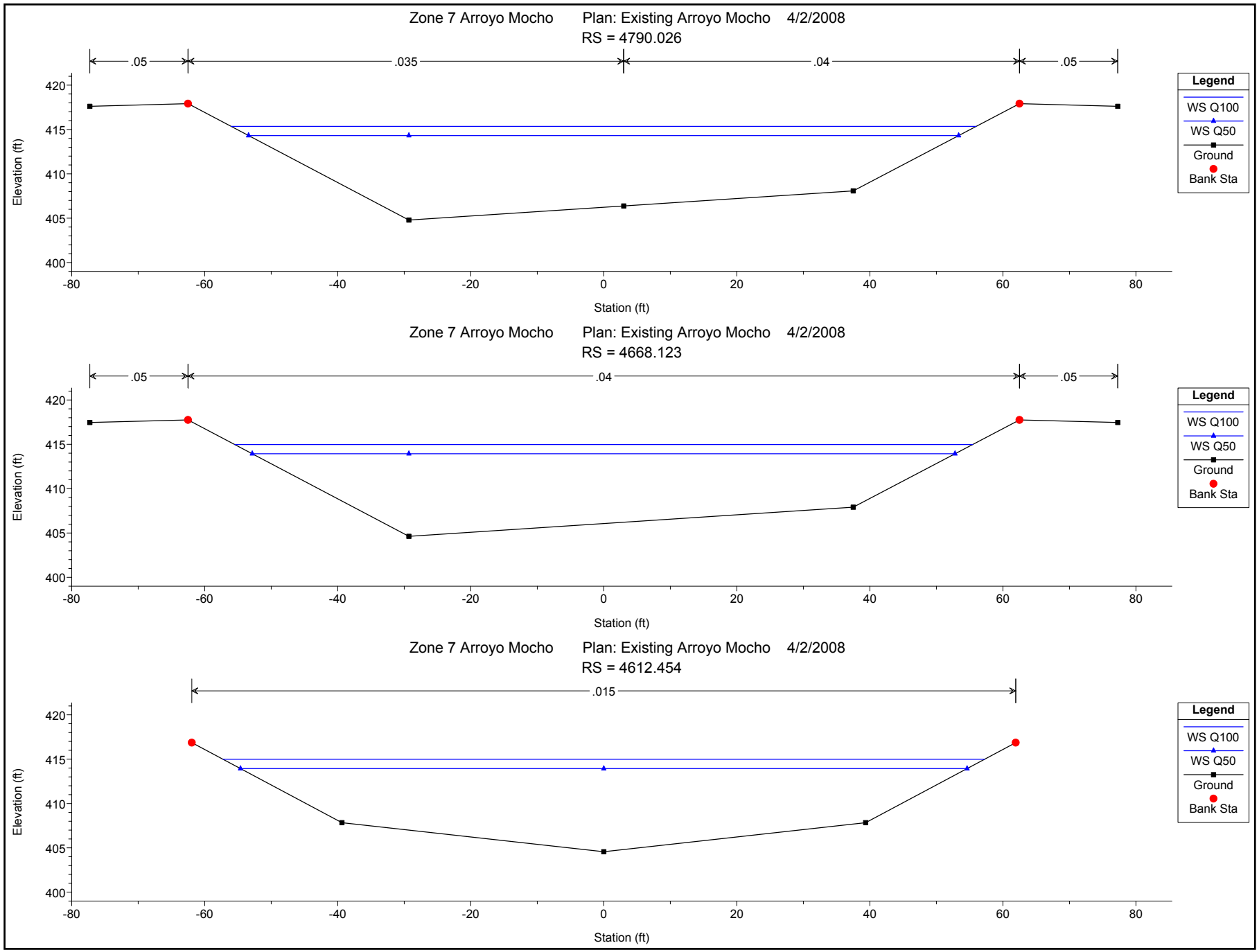
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
1	4133.858	Q50	3900.00	400.73	411.27		411.64	0.000987	4.88	799.77	111.33	0.32		196.85
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	



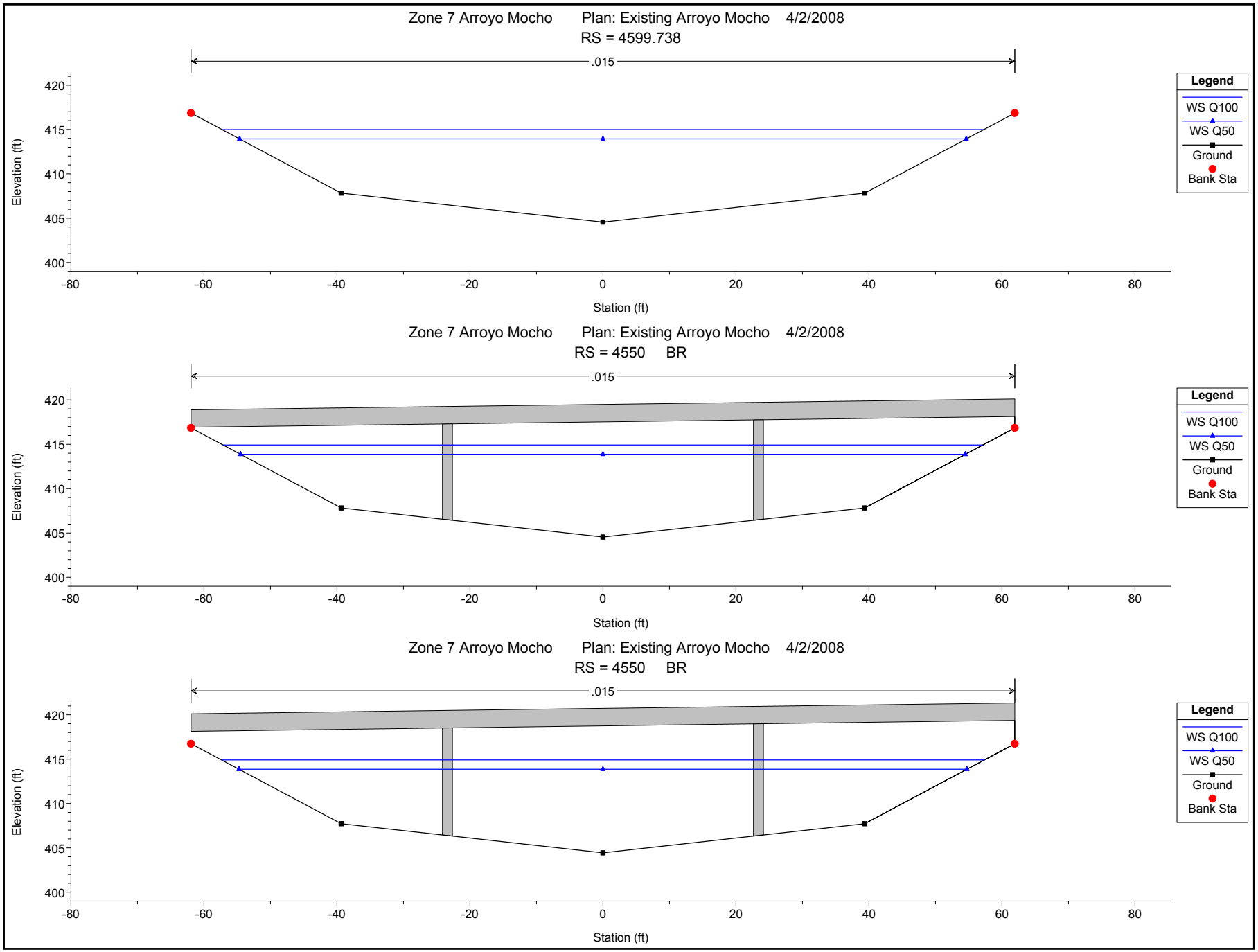
1 in Horiz. = 300 ft 1 in Vert. = 5 ft



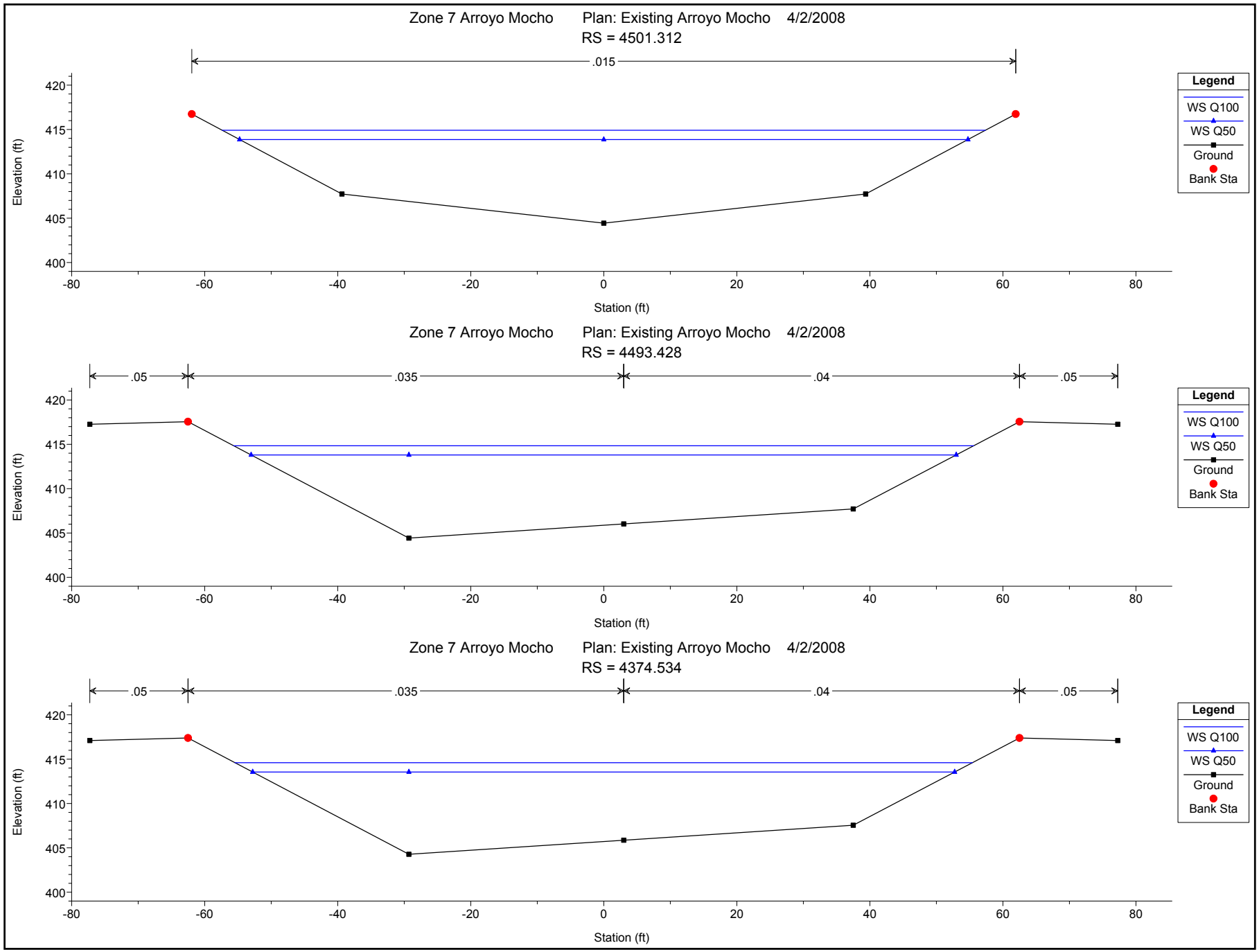
1 in Horiz. = 20 ft 1 in Vert. = 15 ft



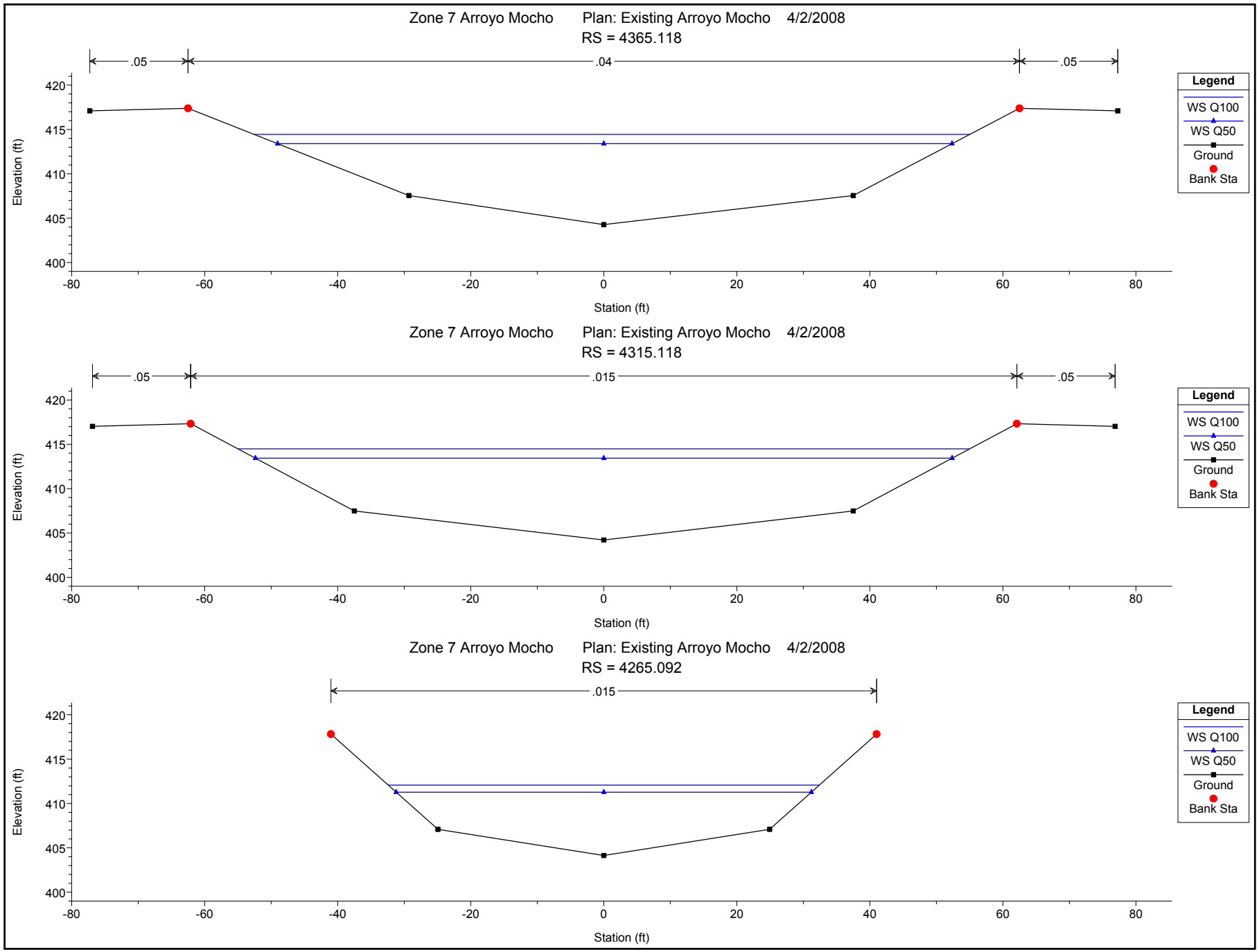
1 in Horiz. = 20 ft 1 in Vert. = 15 ft



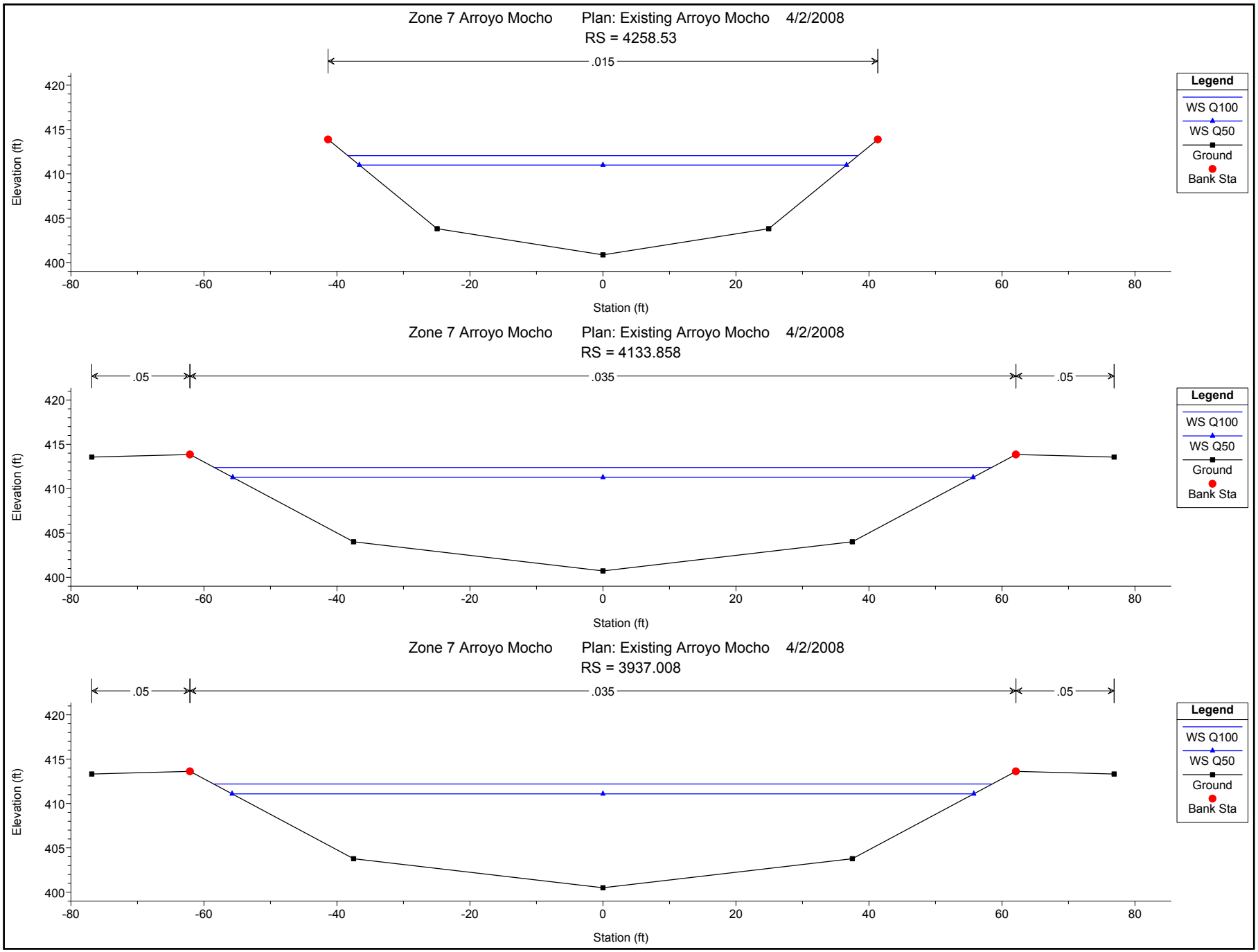
1 in Horiz. = 20 ft 1 in Vert. = 15 ft



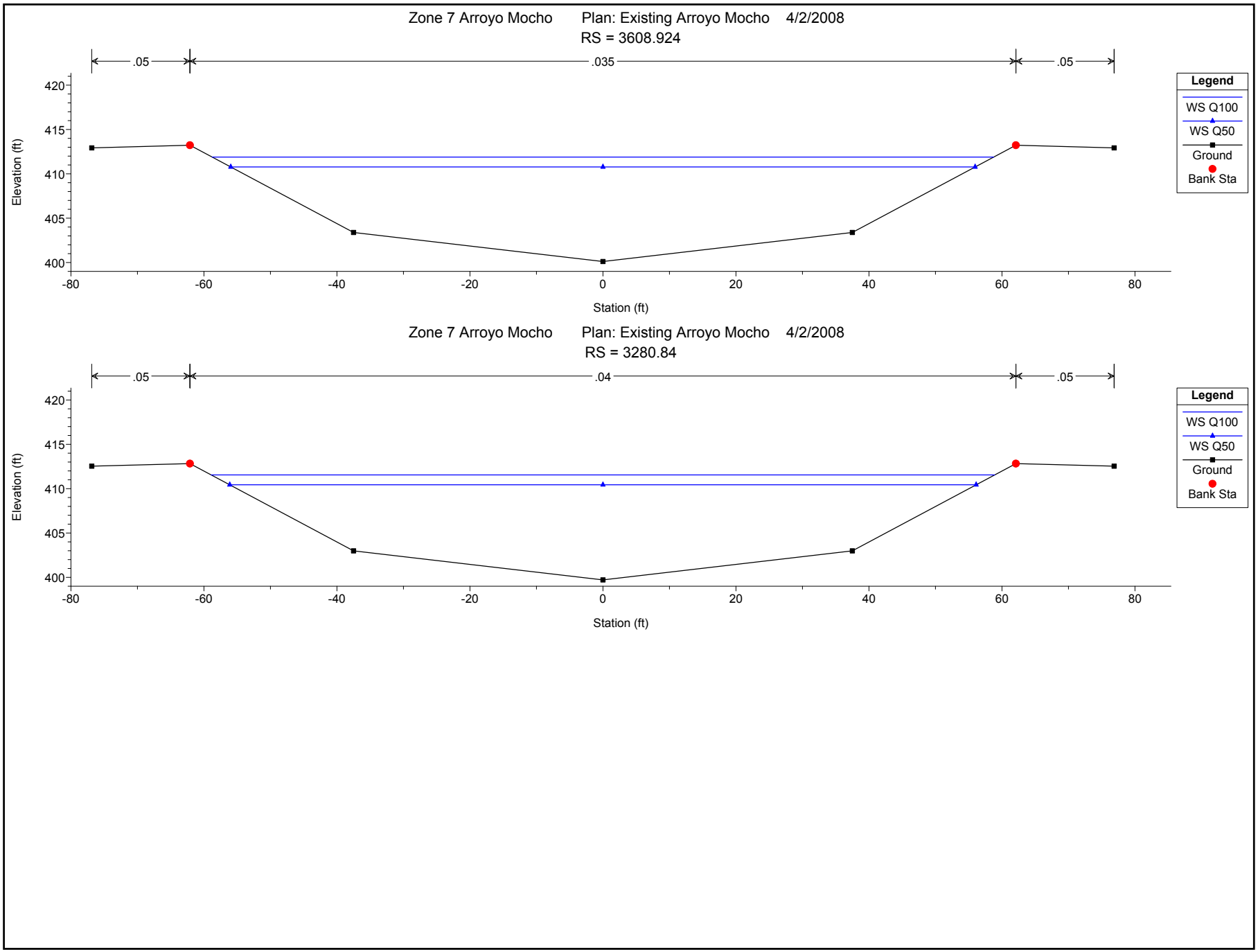
1 in Horiz. = 20 ft 1 in Vert. = 15 ft



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

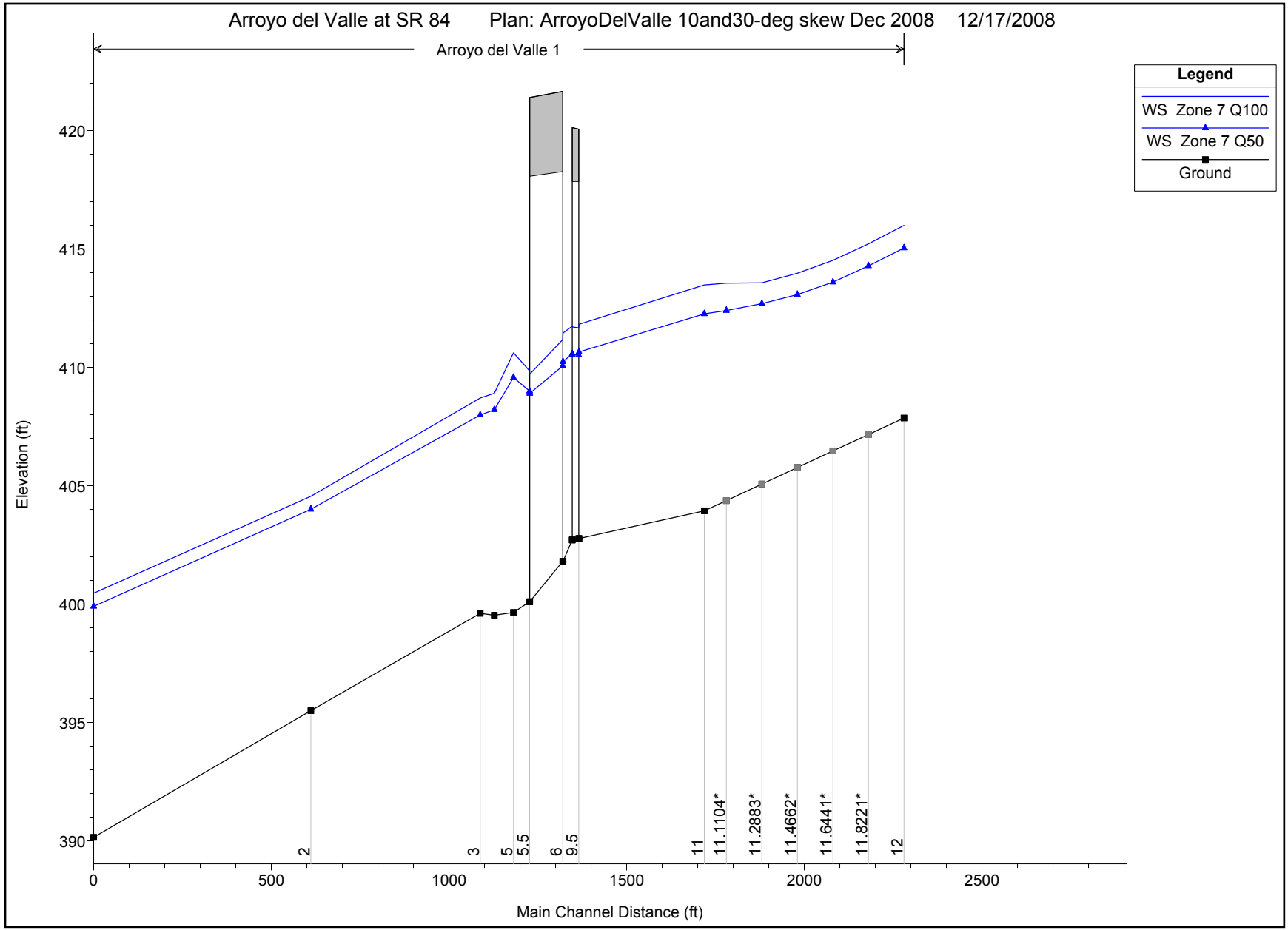
HEC-RAS Results: Proposed Condition

HEC-RAS Plan: proposed1208 River: Arroyo del Valle Reach: 1

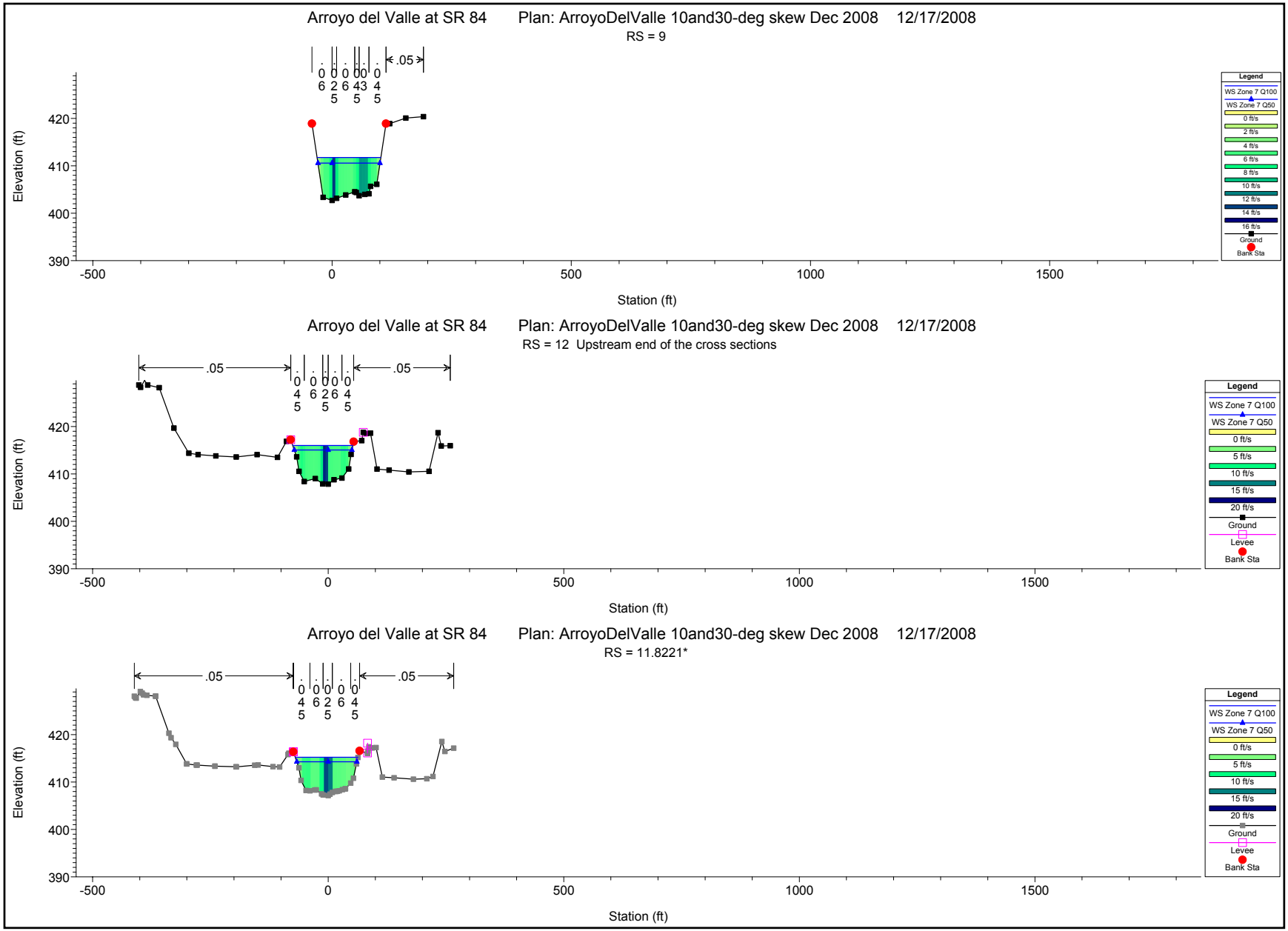
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
1	12	Zone 7 Q100	7000.00	407.86	416.00	414.01	417.17	0.008116	8.71	804.13	127.57	0.61	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)

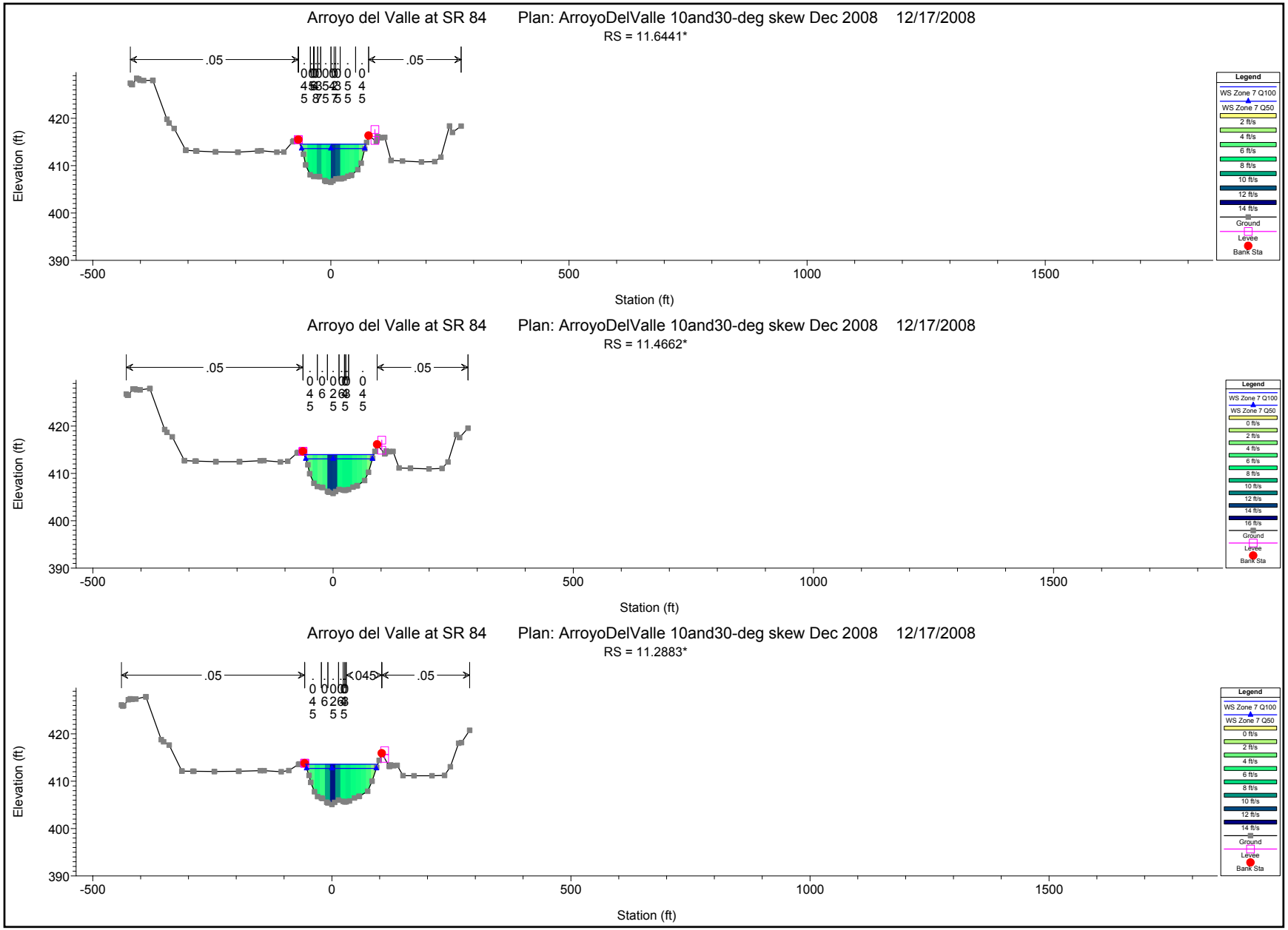
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
1	1	Zone 7 Q100	7000.00	390.15	400.46	399.06	401.00	0.005604	5.89	1187.73	312.18	0.53	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	



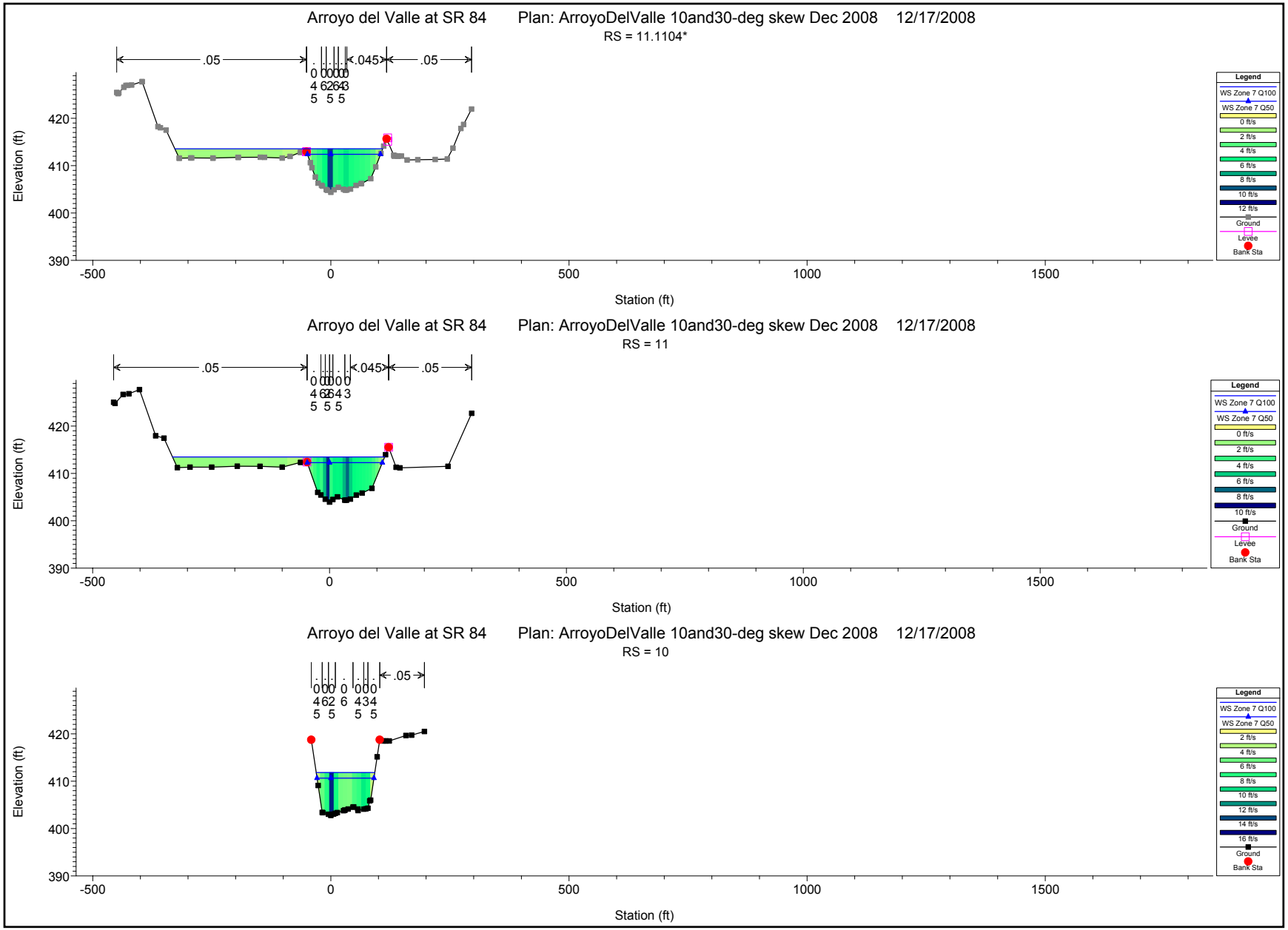
1 in Horiz. = 400 ft 1 in Vert. = 6 ft



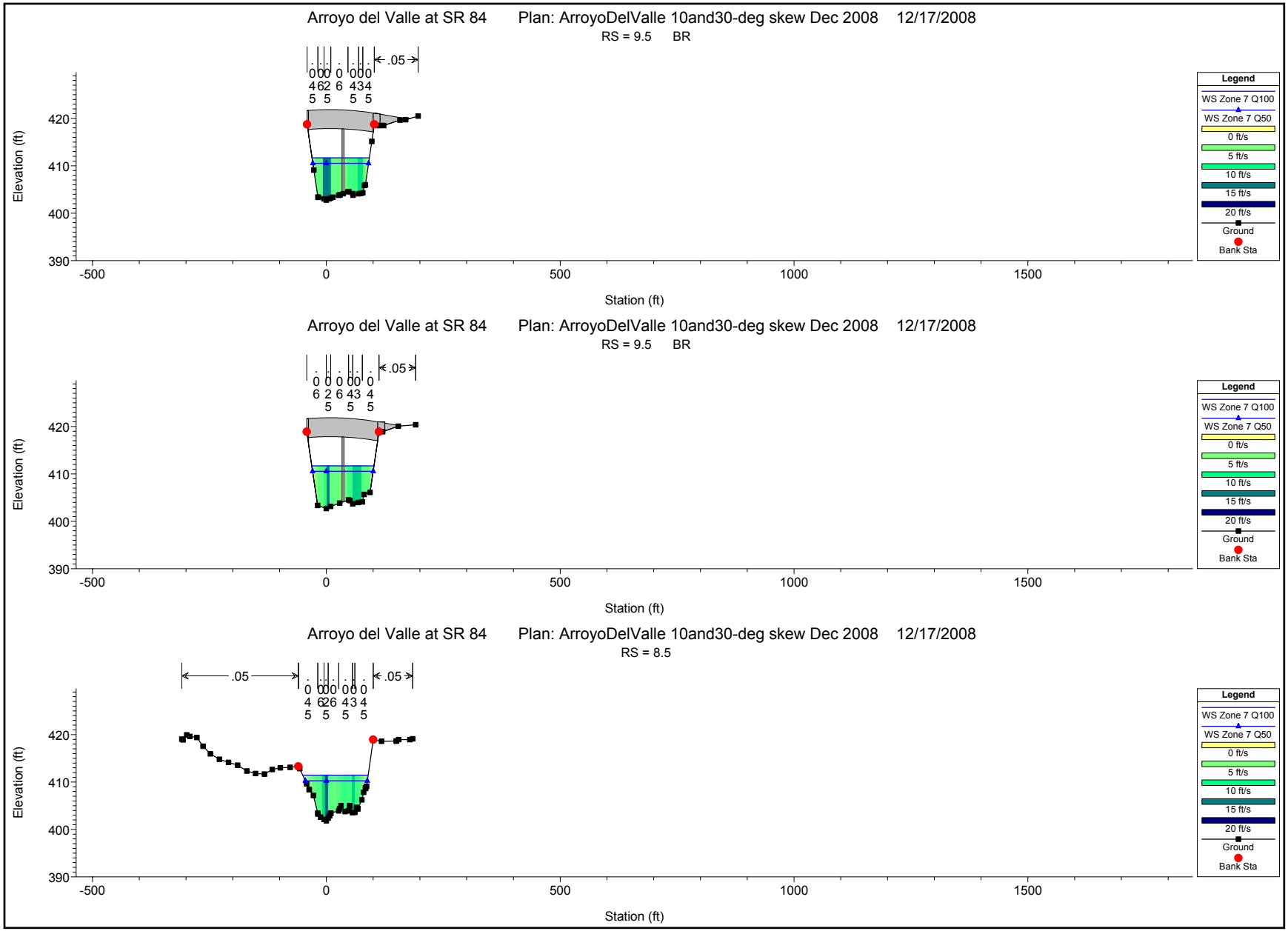
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



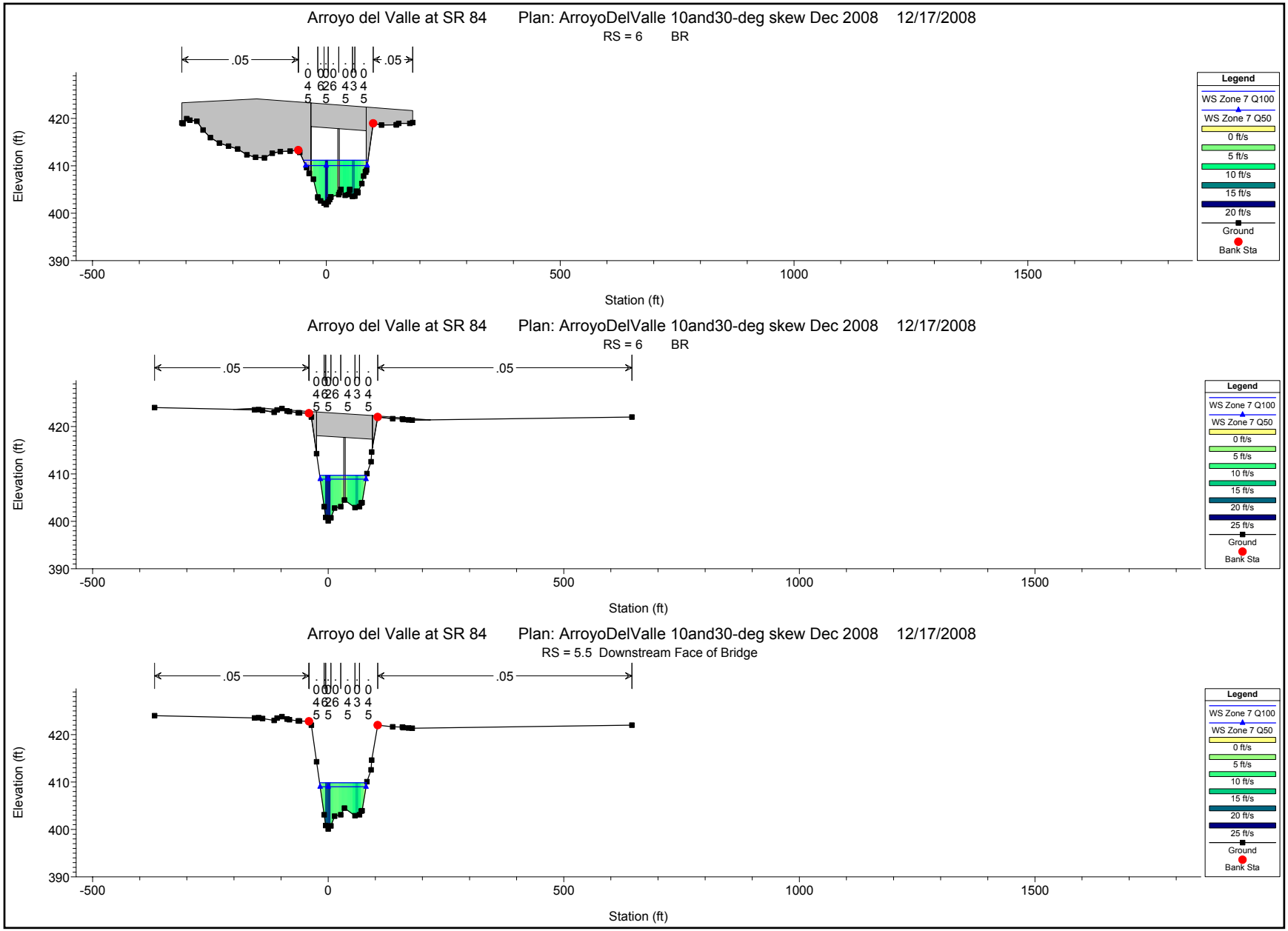
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



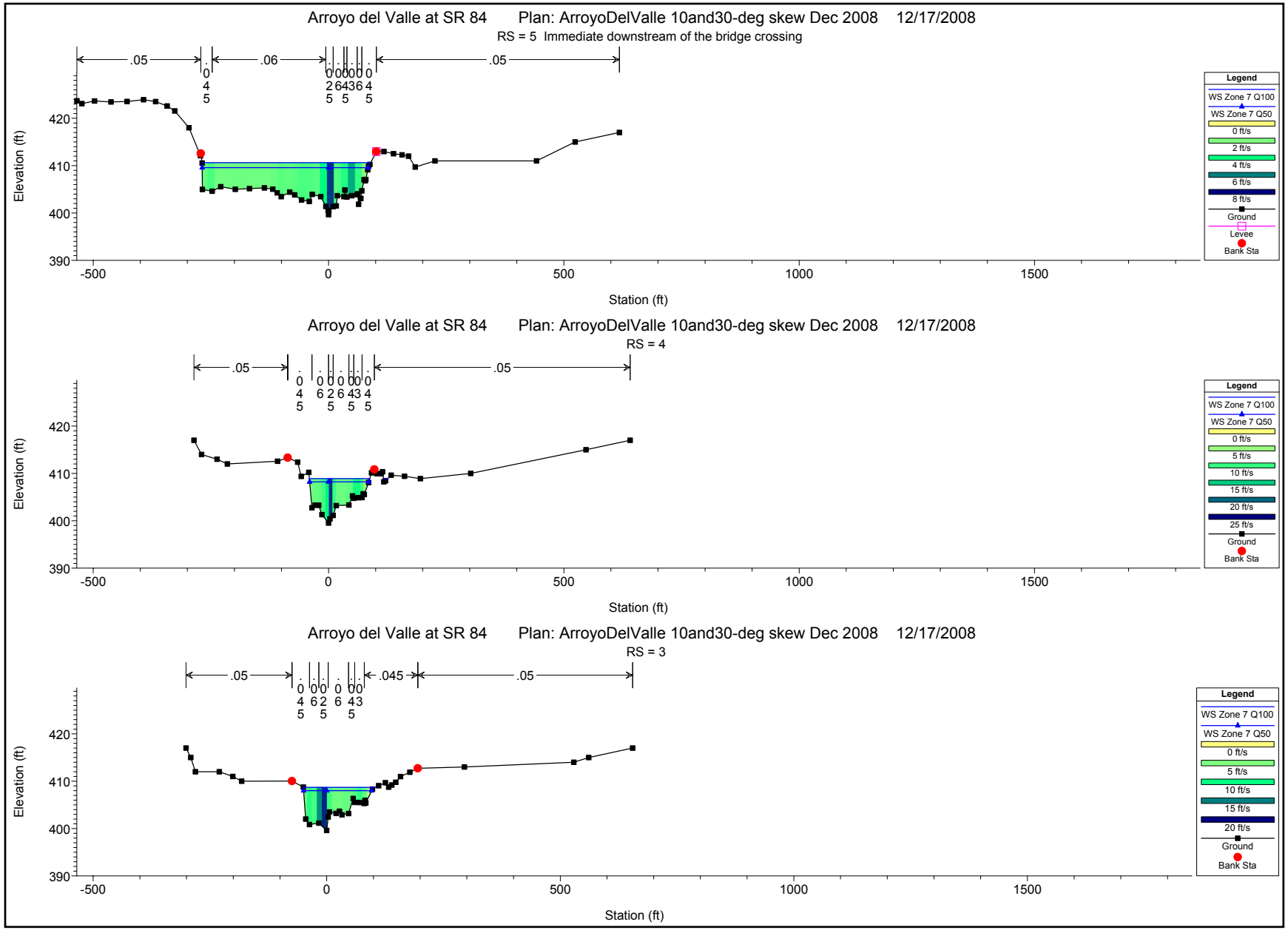
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



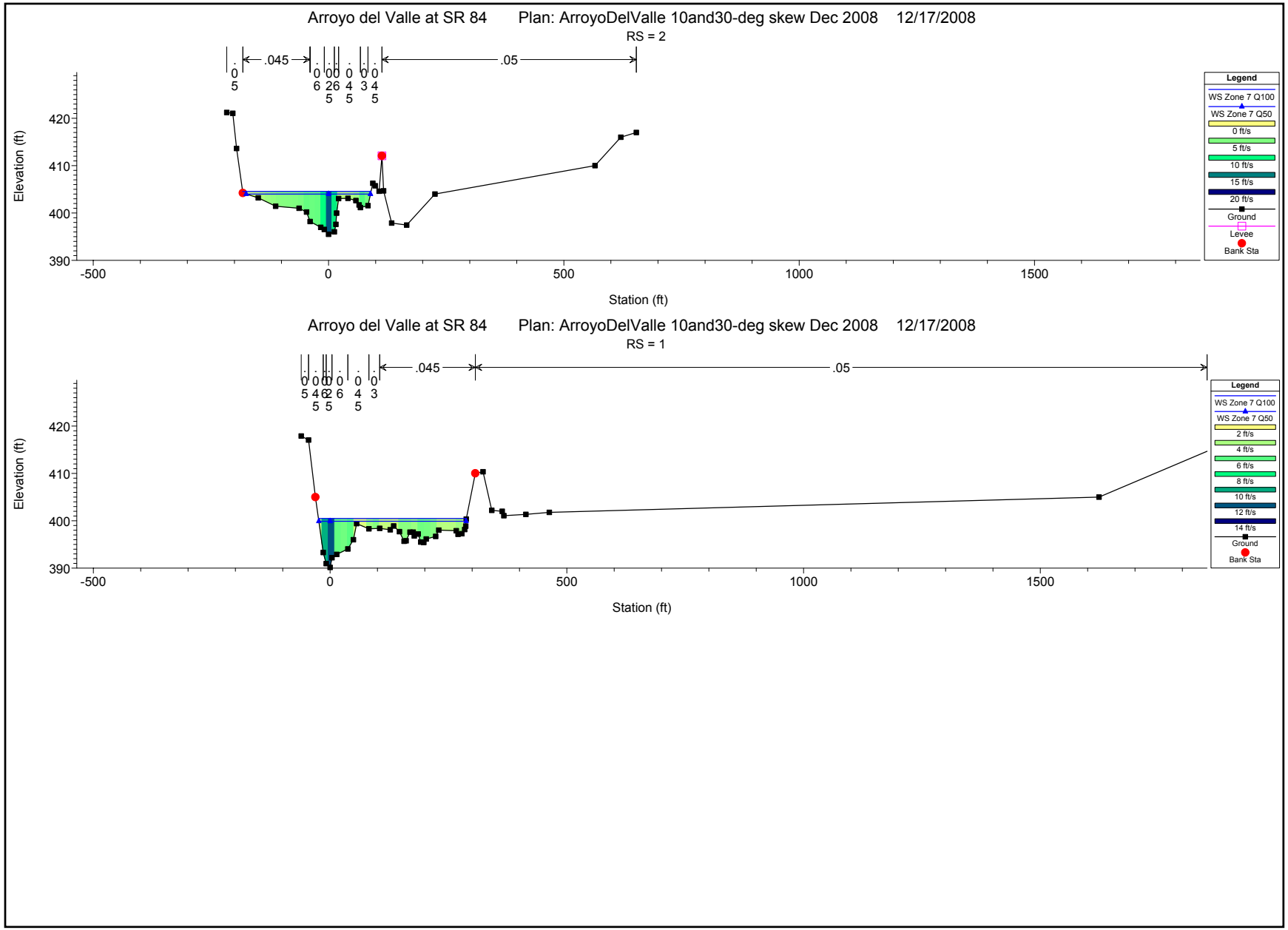
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



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

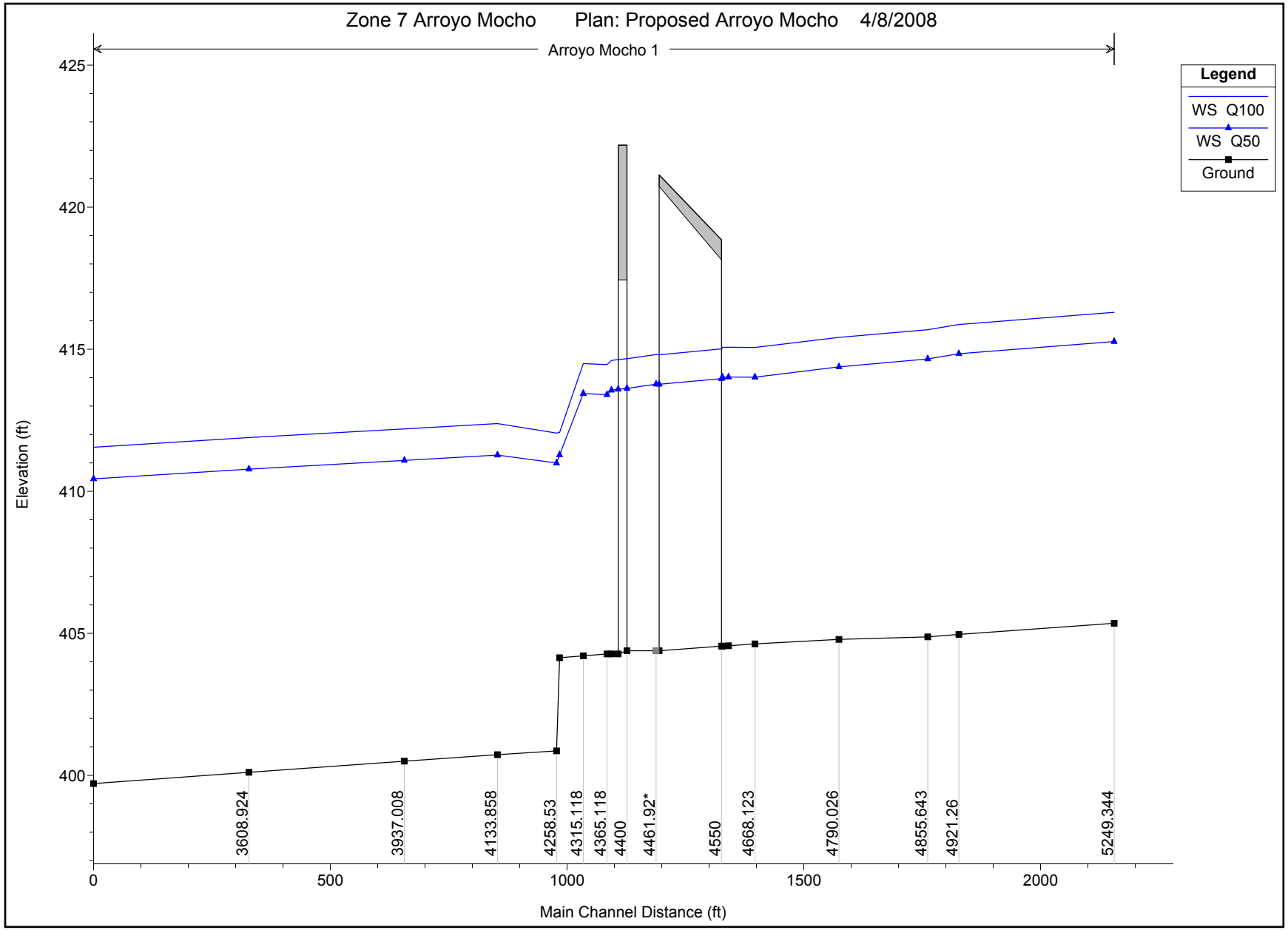
HEC-RAS Results: Proposed Condition

HEC-RAS Plan: Proposed River: Arroyo Mocho Reach: 1

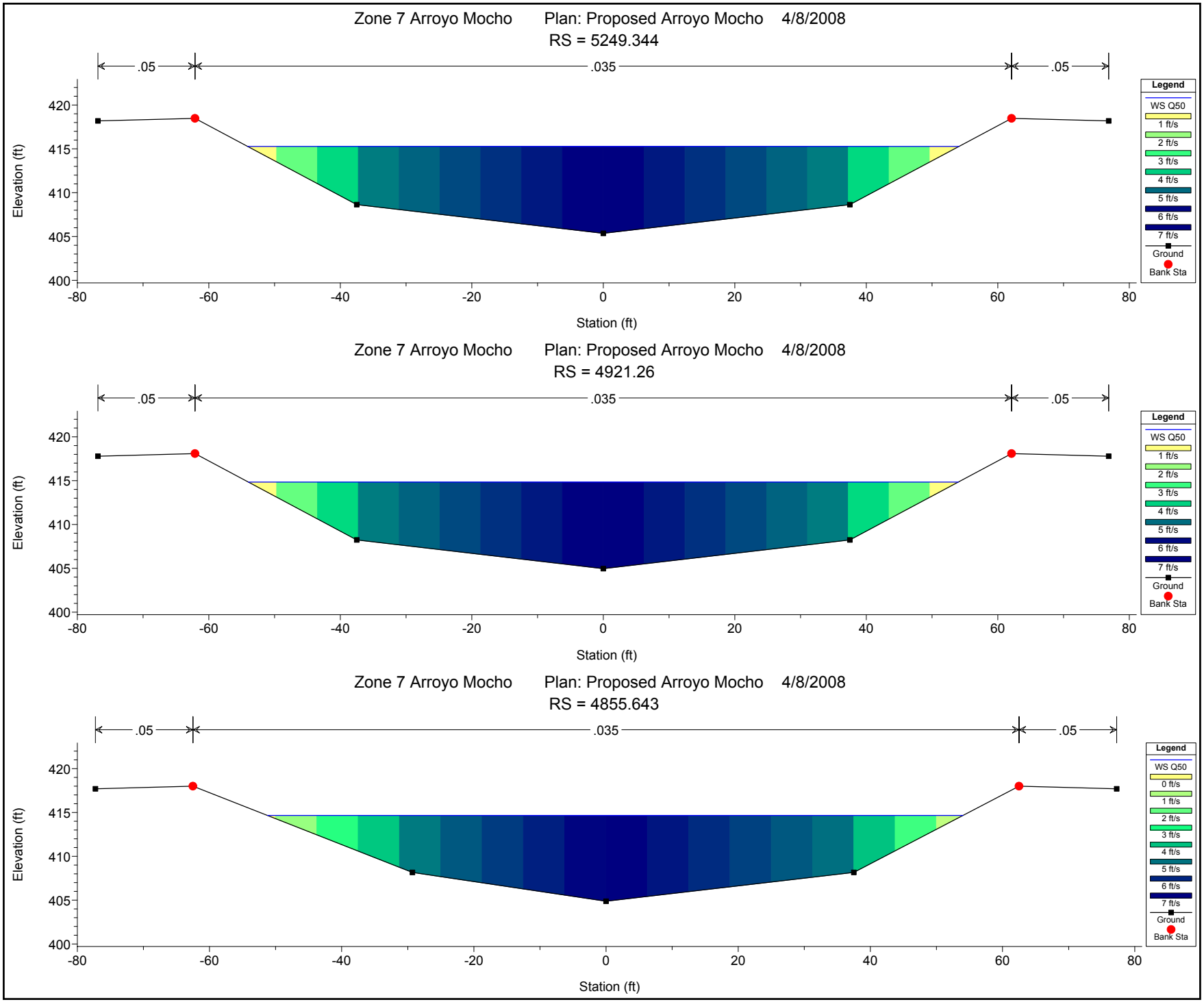
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
1	5249.344	Q100	4800.00	405.35	416.30		416.80	0.001278	5.68	844.46	113.31	0.37		328.08
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)

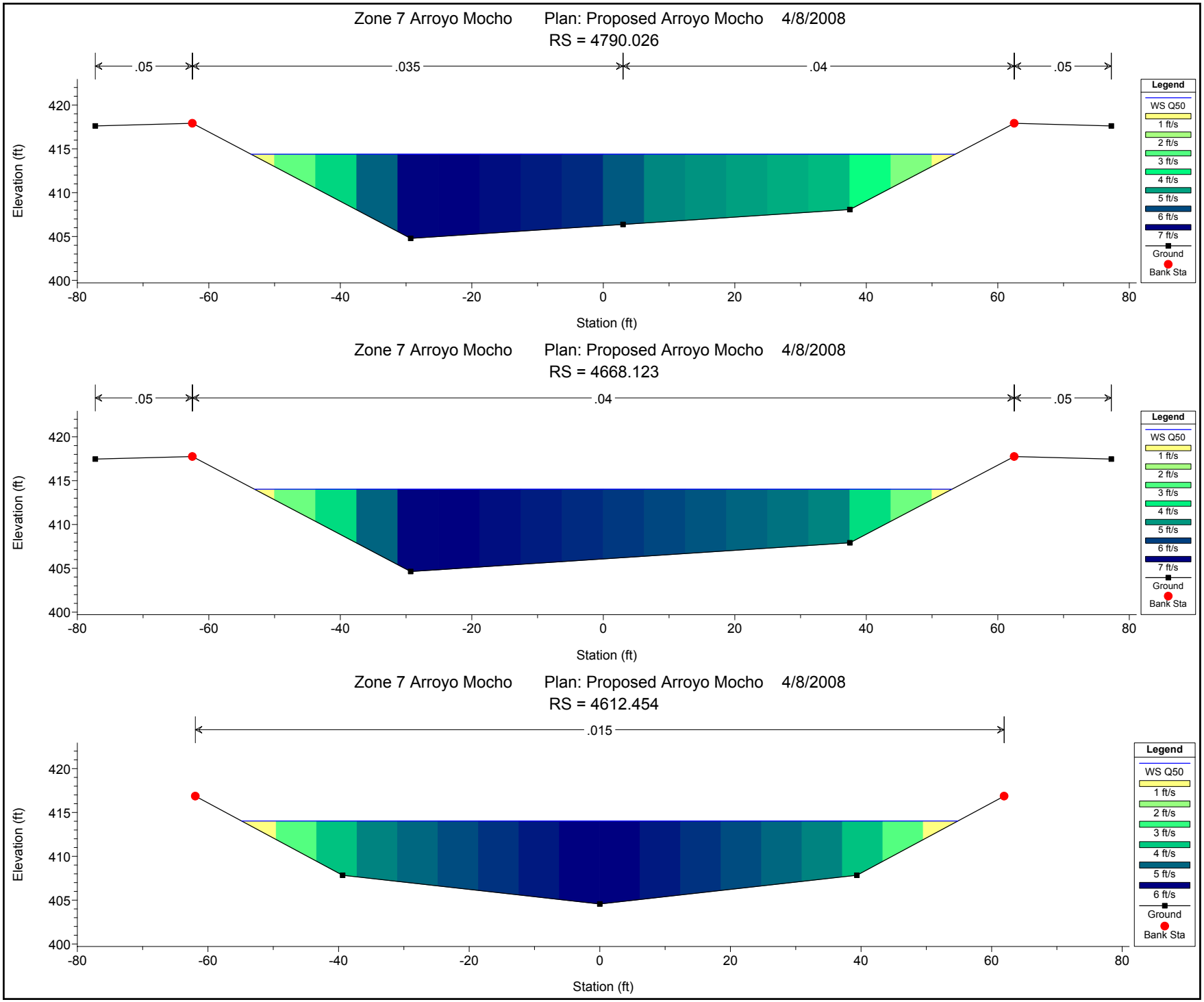
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
1	3937.008	Q100	4800.00	400.50	412.20		412.61	0.000966	5.15	931.30	117.08	0.32		328.08
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	



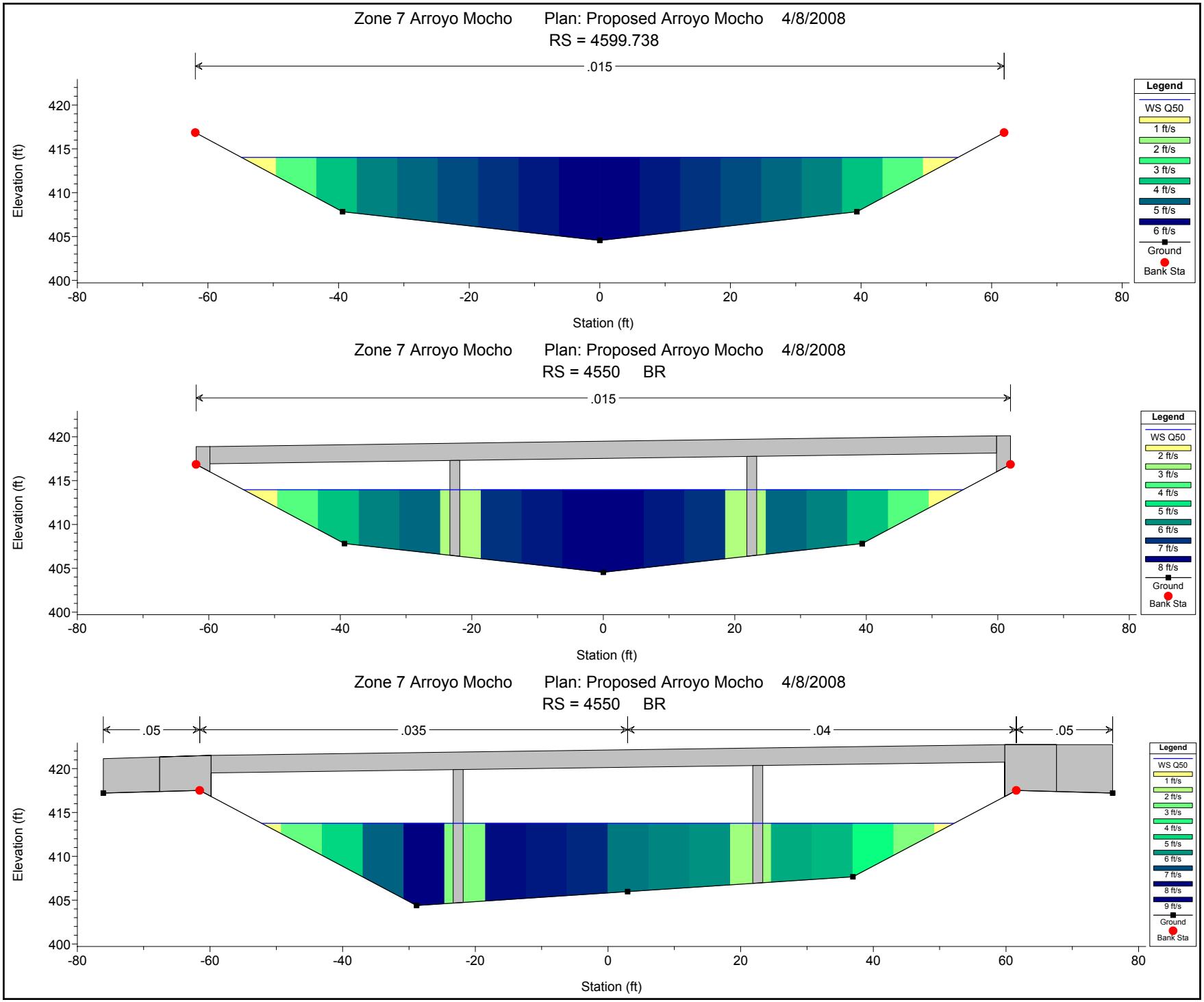
1 in Horiz. = 300 ft 1 in Vert. = 5 ft



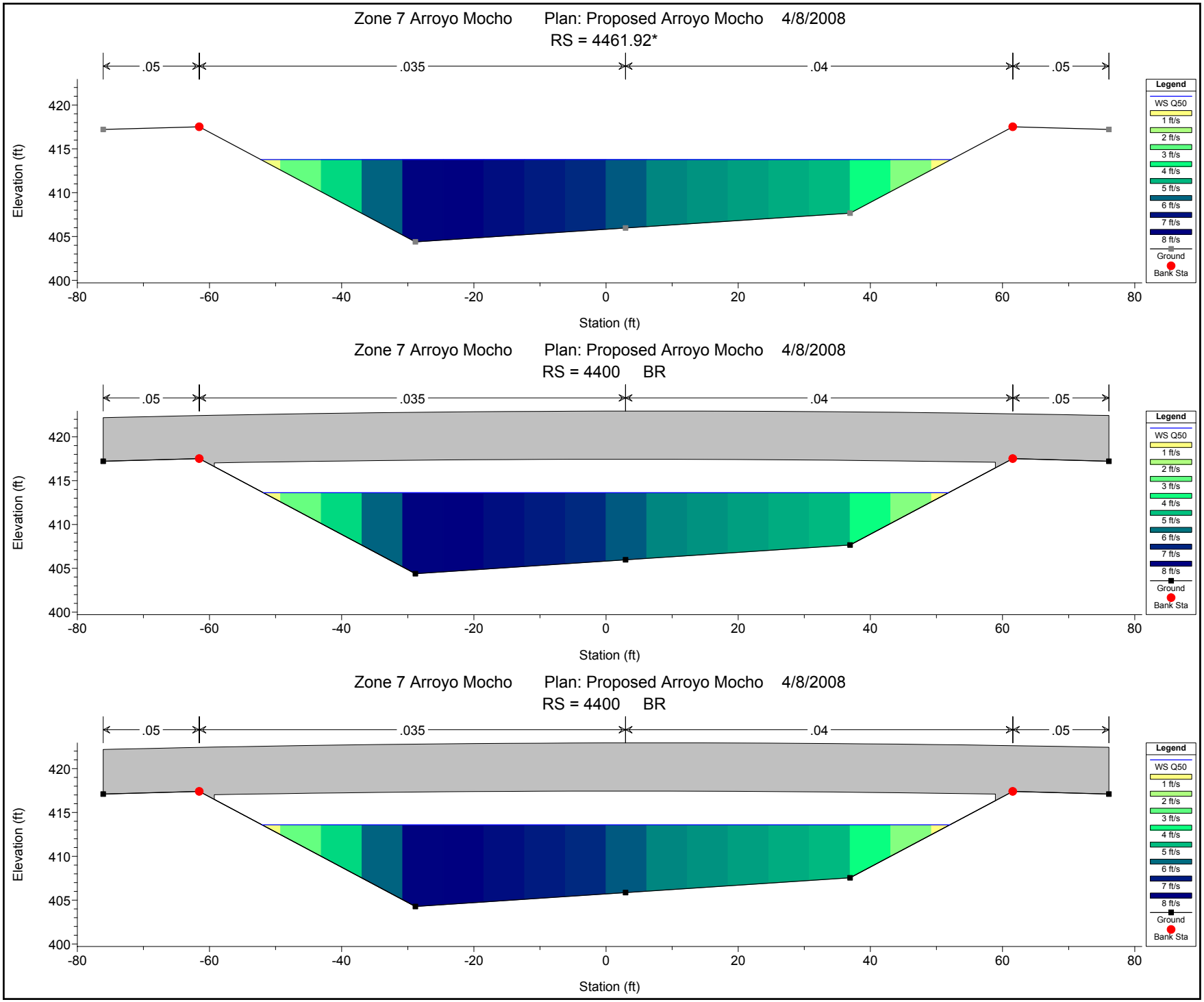
1 in Horiz. = 20 ft 1 in Vert. = 15 ft



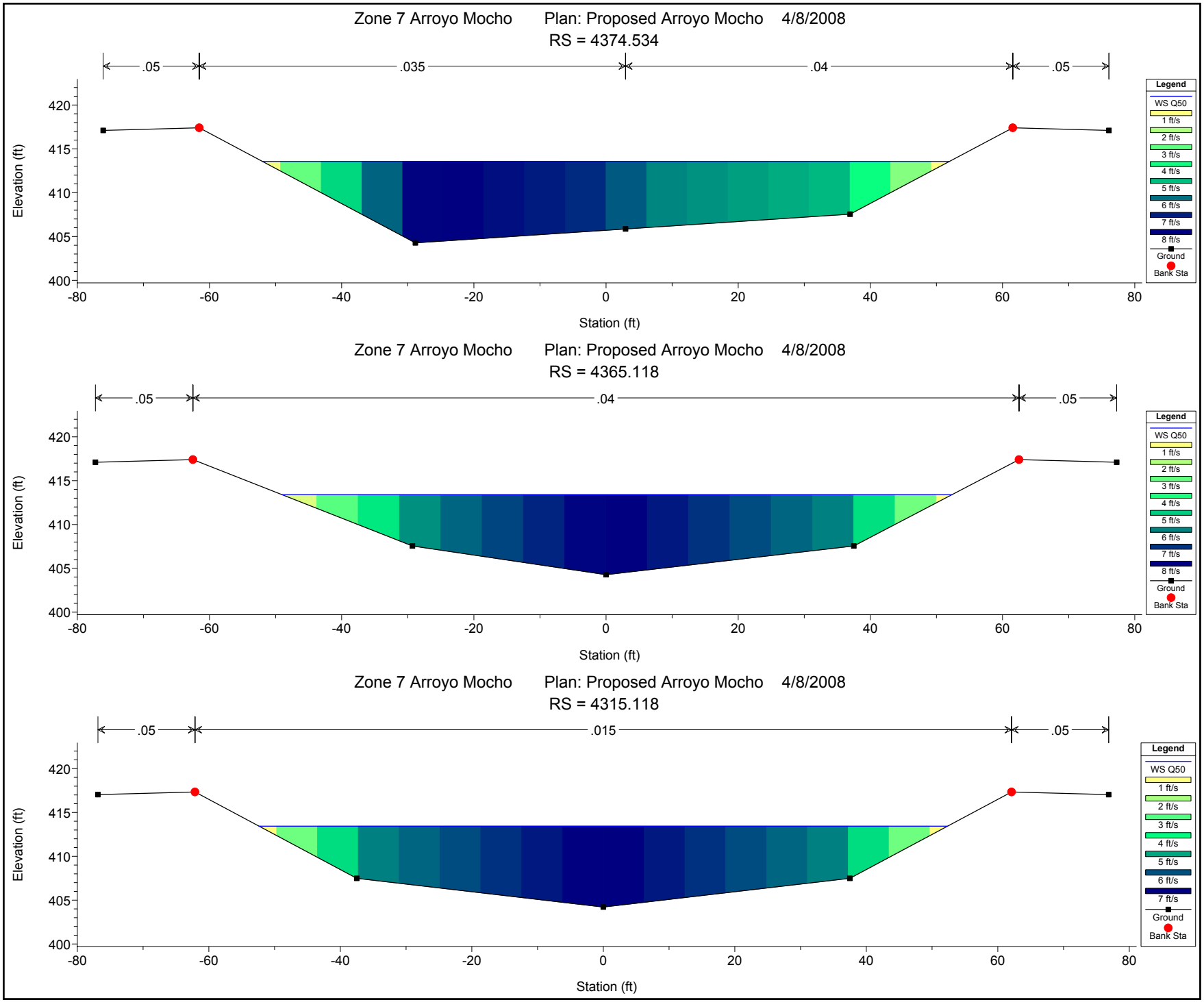
1 in Horiz. = 20 ft 1 in Vert. = 15 ft



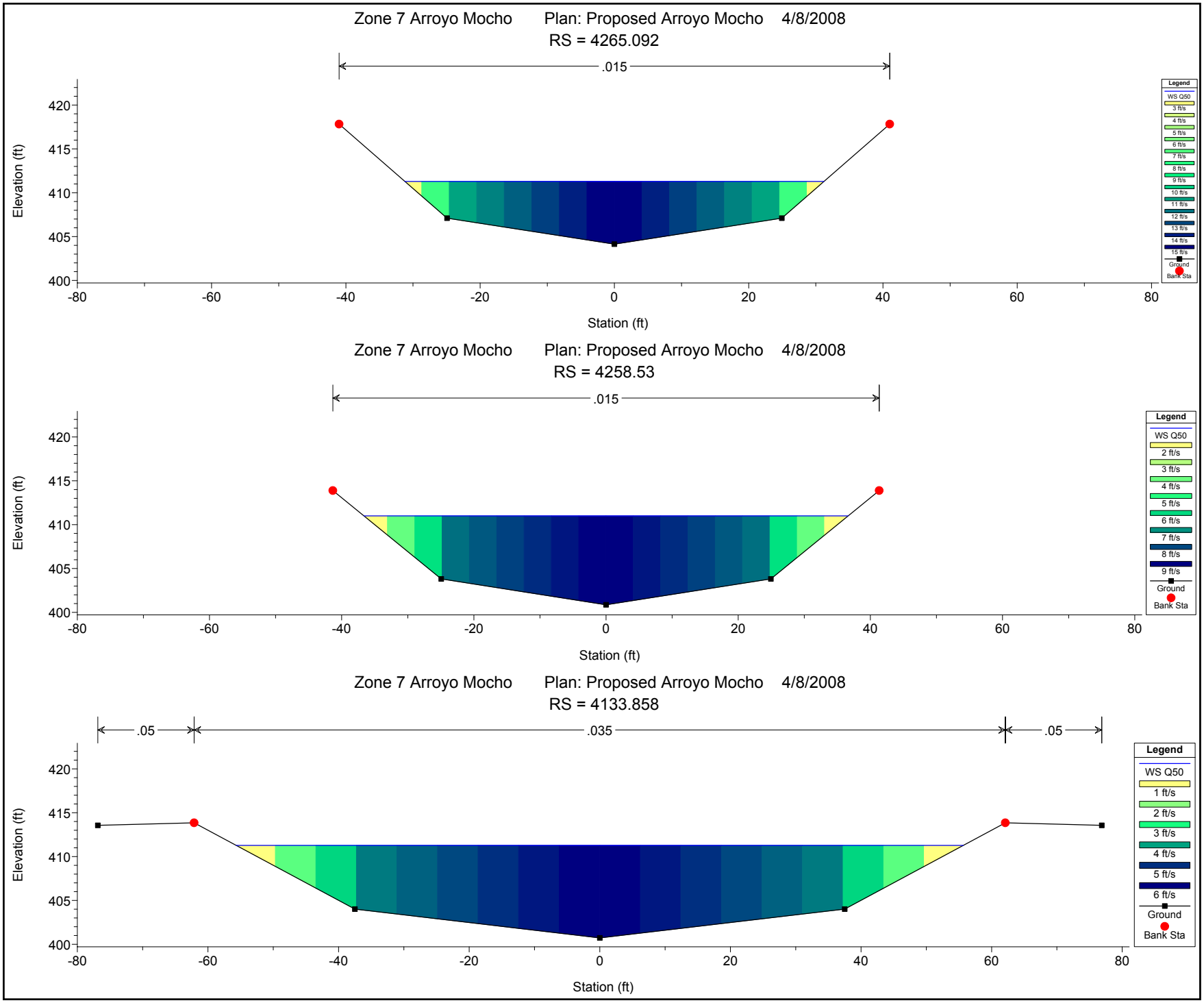
1 in Horiz. = 20 ft 1 in Vert. = 15 ft



1 in Horiz. = 20 ft 1 in Vert. = 15 ft

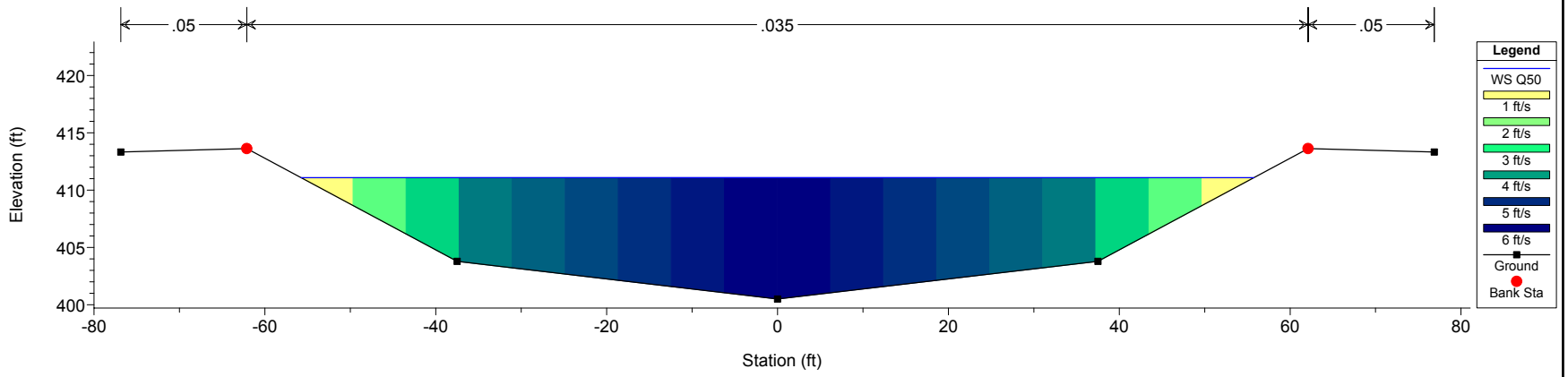


1 in Horiz. = 20 ft 1 in Vert. = 15 ft

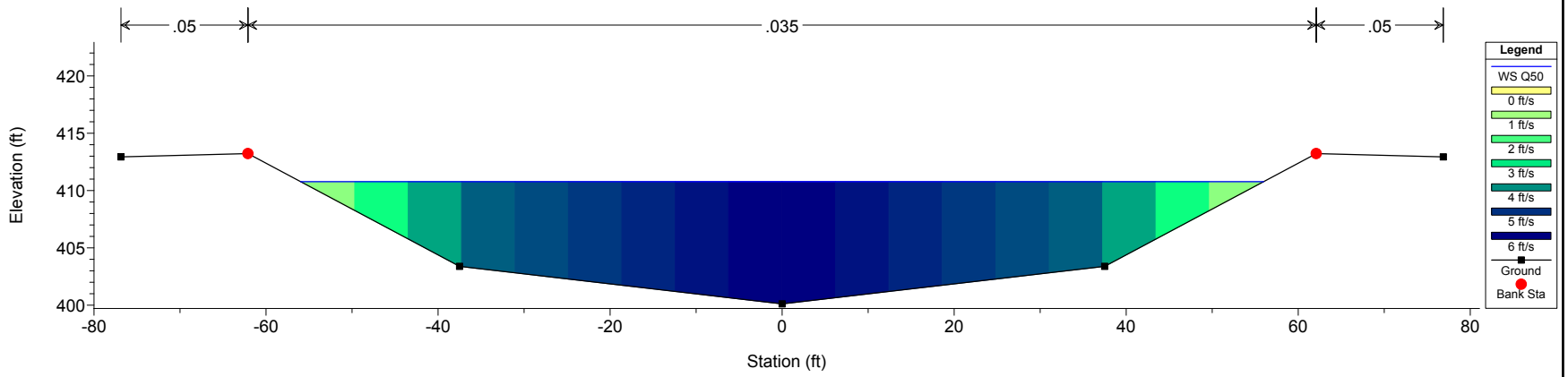


1 in Horiz. = 20 ft 1 in Vert. = 15 ft

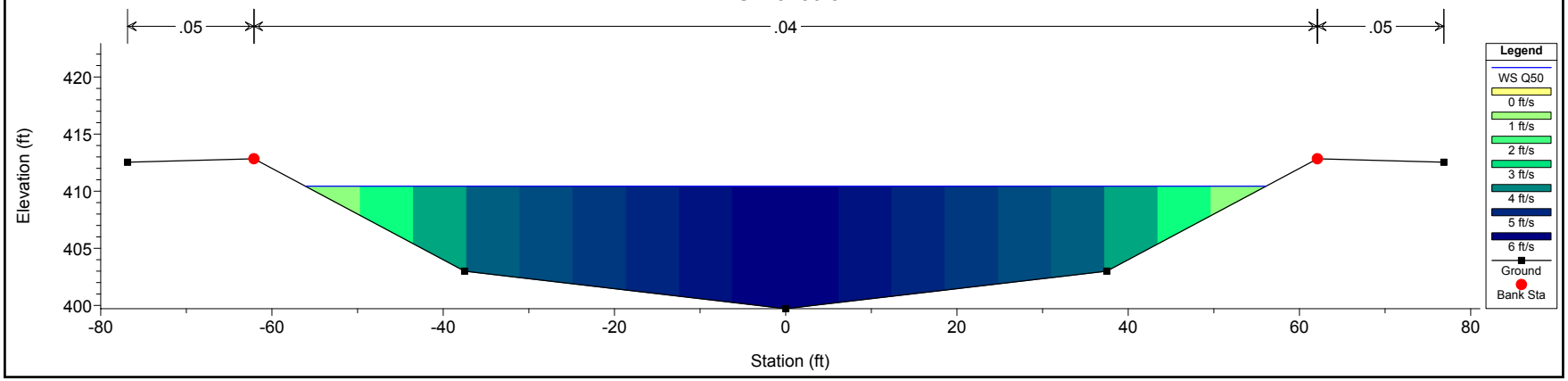
Zone 7 Arroyo Mocho Plan: Proposed Arroyo Mocho 4/8/2008
RS = 3937.008



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

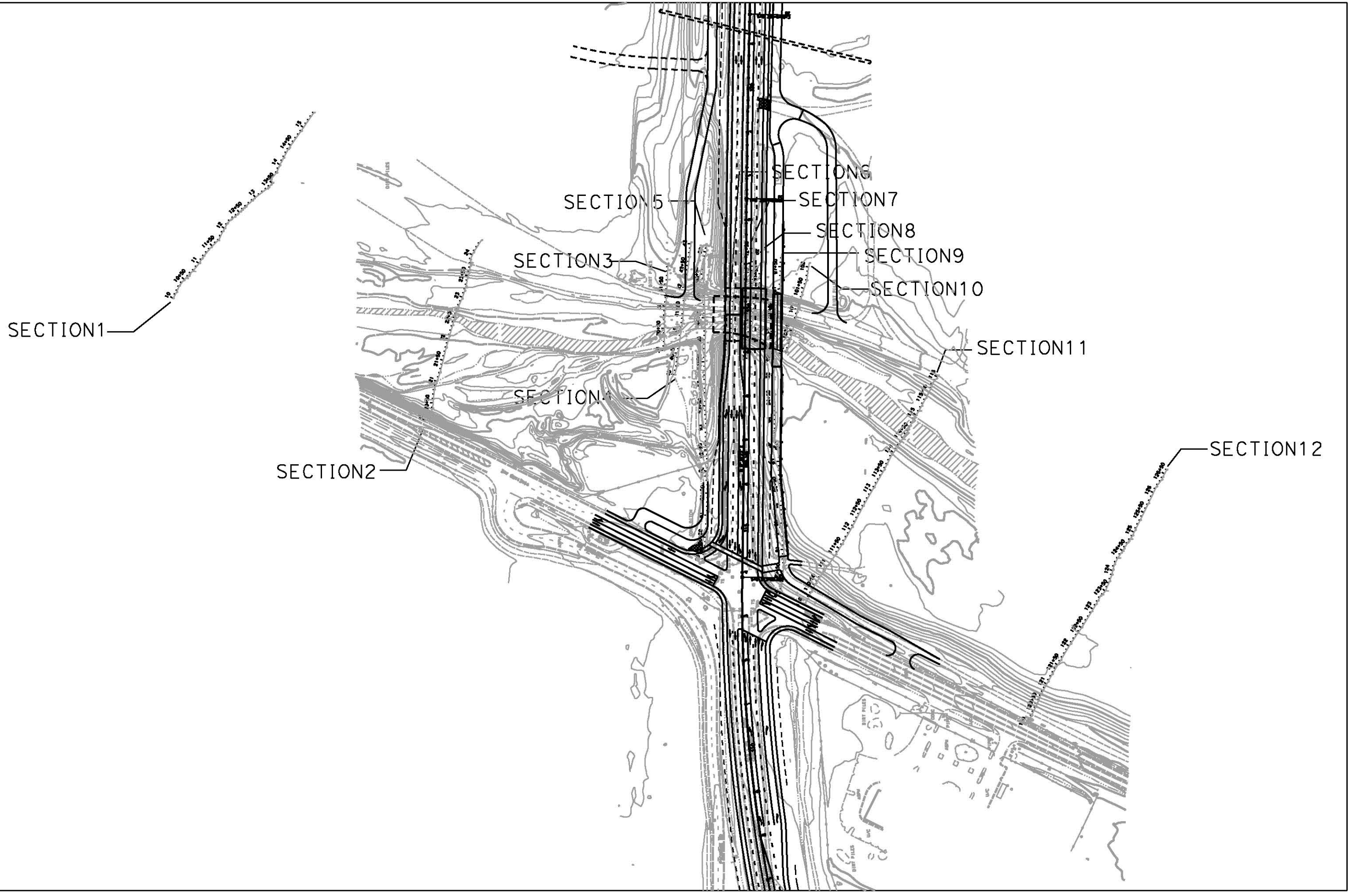
Plan: Proposed Arroyo Mocho 1 RS: 4400 Profile: Q100

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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SECTION12

Appendix F Scour Calculations and Rip Rap Sizing

12/17/08 P0728: SR84 Widening

Trail Bridge Scour Calcs

Contraction Scour

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{k_1} \left(\frac{W_1}{W_2}\right)^{k_1} \qquad \frac{y_2}{6.96} = \left(\frac{7000}{5907}\right)^{1.157} \left(\frac{163.92}{119.57}\right)^{1.243 \cdot 0.69} = 10.01'$$

$y_s = y_2 - y_0$

$W_1 = 163.92$, $W_2 = 119.57$, $y_1 = 6.96$ $\qquad y_s = y_2 - y_0 = 10.01 - 7.11 = \boxed{2.90'}$

Pier Scour

$$\frac{y_s}{a} = 2 k_1 k_2 k_3 k_4 \left(\frac{y_1}{a}\right)^{0.35} F_r^{0.43}$$

$a = 3$, $k_1 = 1.1$, $k_2 = 2.44$, $k_3 = 1.1$, $k_4 = 1.0$, $F_r = 0.889$, $y_1 = 8.92$

$y_s = (2)(1)(2.44)(1.1)(1)\left(\frac{8.92}{3}\right)^{0.35}(0.889)^{0.43}(3)$

$= (5.37)(1.464)(0.951)(3)$

$= \boxed{22.43'}$

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 P072B: SR 24 Widening

SR 24 Bridge Scour Calcs

Contraction Scour

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{6/7}\left(\frac{W_1}{W_2}\right)^{K_1}$$

$$\frac{y_2}{13.65} = \left(\frac{7000}{7000}\right)^{6/7}\left(\frac{133.24}{115.47}\right)^{0.69} = 15.07'$$

($K_1 = 1$, $1.104^{0.69} = 1.07$)

$y_s = y_2 - y_0$

$W_1 = 133.24$, $W_2 = 115.47$, $y_1 = 13.65$

$y_s = y_2 - y_0 = 15.07' - 13.92' = \boxed{1.15'}$

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 $K_1 = 1$, $K_2 = 0.98$, $L' = 20$, $y_a = 3.44$

$$y_s = \left[(2.27)(1)(0.98)\left(\frac{20}{3.44}\right)^{.43}(0.40)^{.61} + 1\right] 3.44$$

$$= [(2.22)(2.13)(.57) + 1]\, 3.44$$

$$= \boxed{12.74'}$$

Right Abutment $K_1 = 1$, $K_2 = 1.01$, $L' = 5$, $y_a = 2.11$

$$y_s = \left[(2.27)(1)(1.01)\left(\frac{5}{2.11}\right)^{.43}(0.43)^{.61} + 1\right] 2.11$$

$$= [(2.29)(1.45)(0.6) + 1]\, 2.11$$

$$= \boxed{6.31'}$$

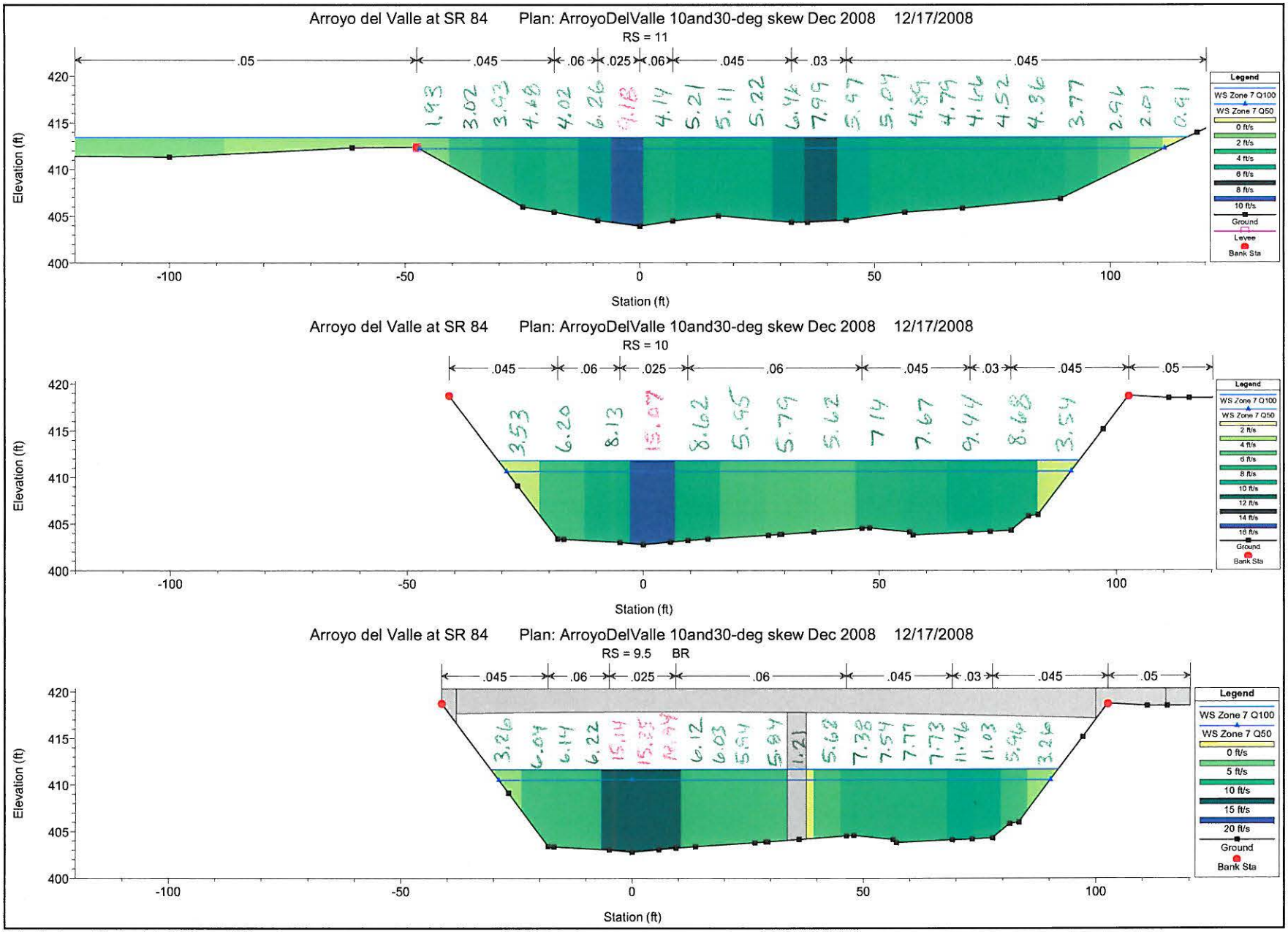
12/18/08 P0728 : SR 84 widening

Riprap Sizing

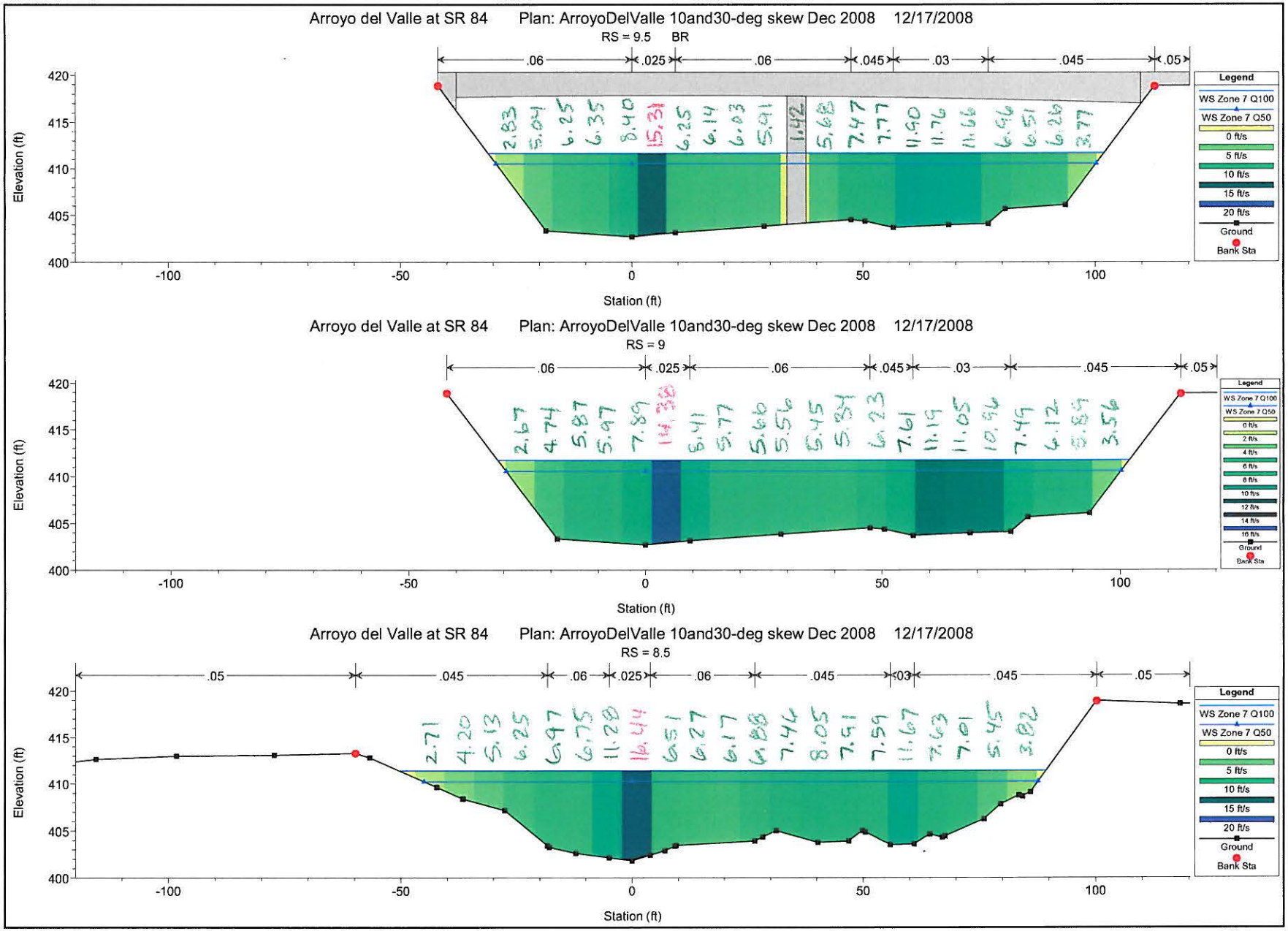
Isbash formula $D_{50} = \frac{0.692\,(KV)^2}{(2g(S_s - 1))}$

		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'	$\frac{1}{4}$-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

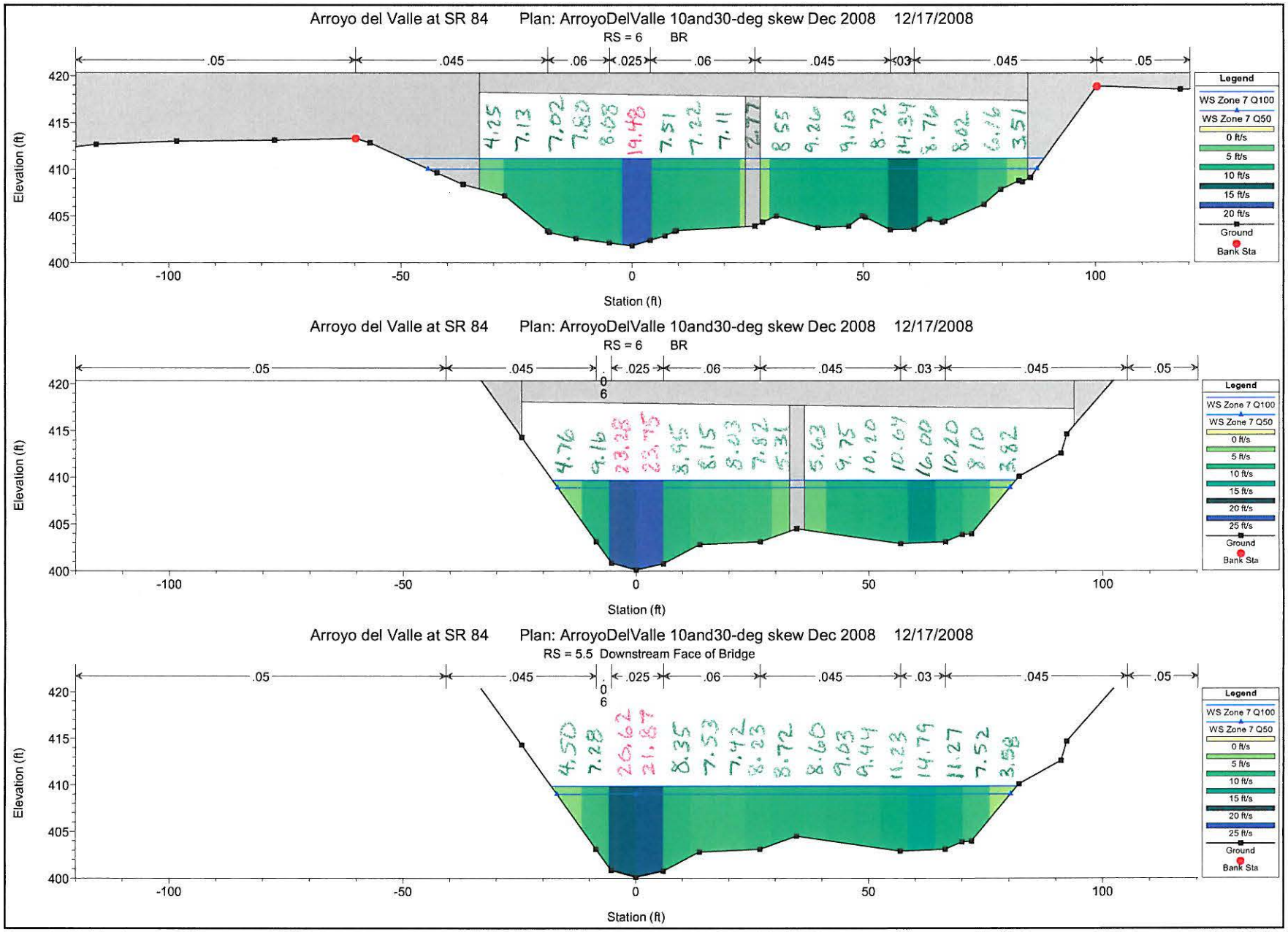
$$D_{50} = \frac{0.692\,((1)(V))^2}{106.26}$$



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.

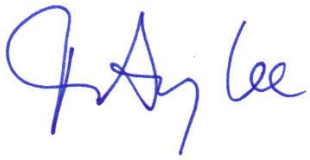
Other Issues

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**

REVIEW COMMENTS MATRIX

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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

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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
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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.

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CHANNEL X-SECTION

Side : Upstream

X-Section Date: 03/02/2006

Measured From : Deck surface

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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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
33C-0710/33C-0713

State Route 84 Expressway Widening Project
Cities of Livermore and Pleasanton, Alameda County, California

Bridge Design Hydraulic Study Report

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

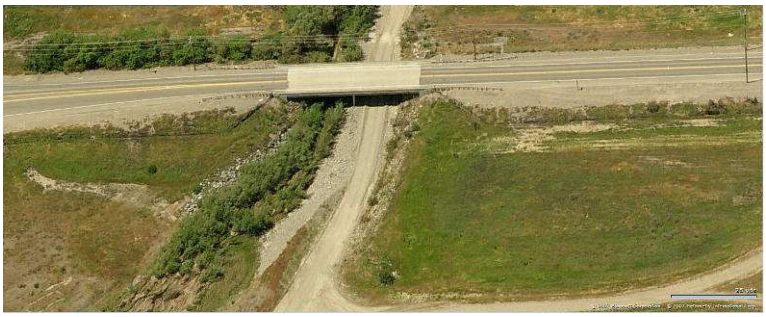

Photo 1. Aerial of SR 84 Expressway at Arroyo del Valle (maps.live.com)

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.

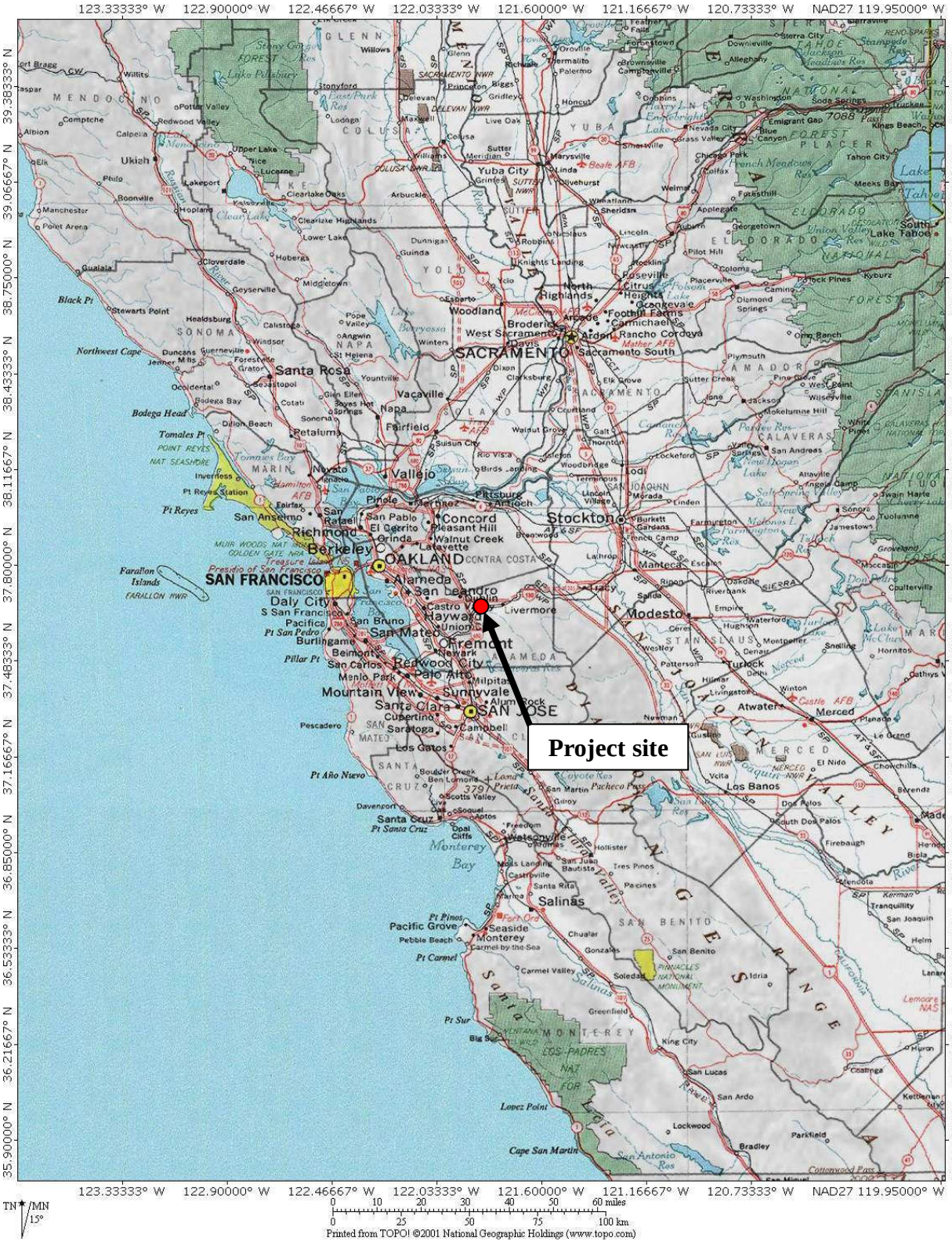

Figure 1. Project Location Map

Source: United States Geological Survey (USGS)

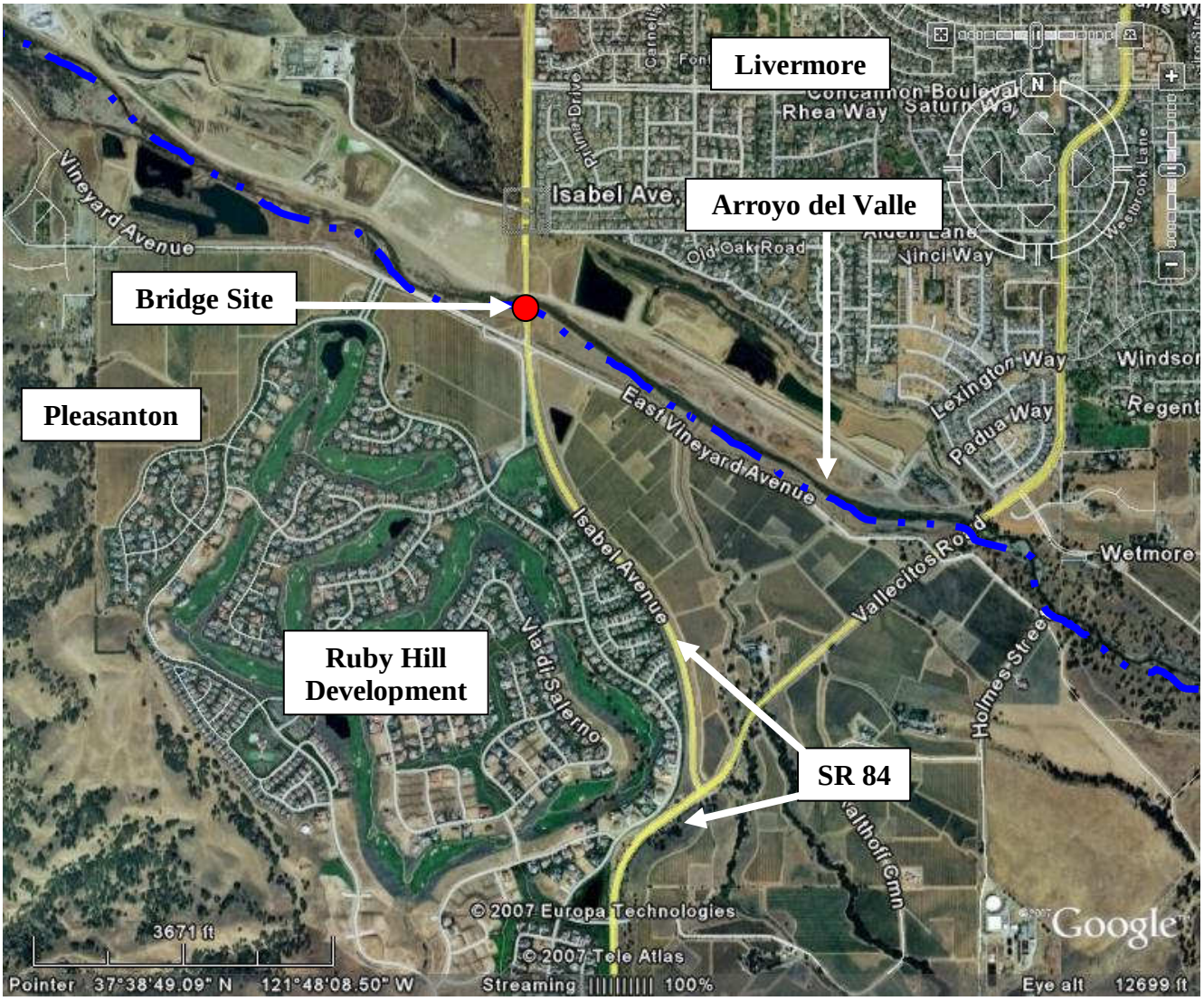

Figure 2. Arroyo del Valle Vicinity Map

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.

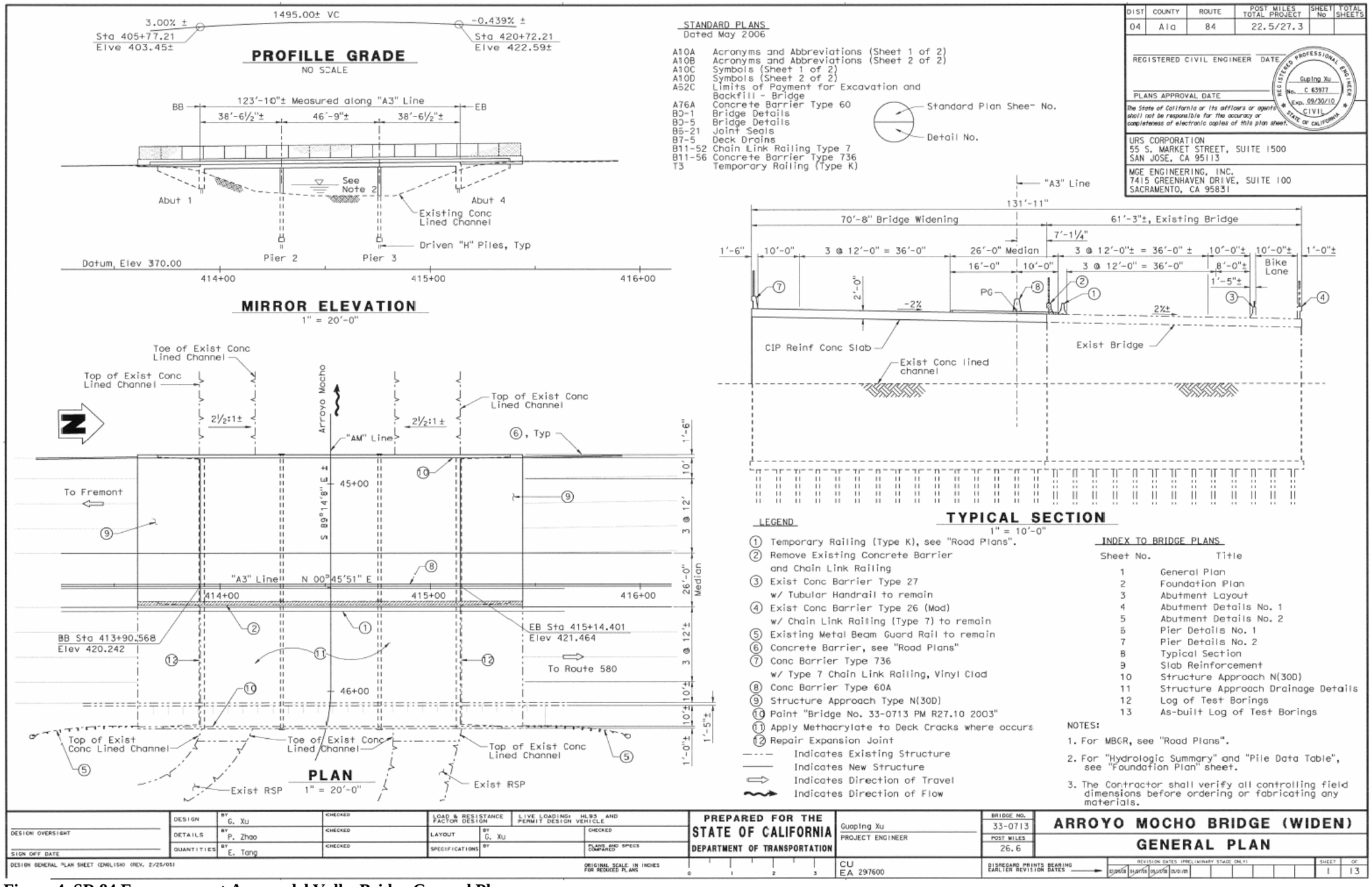

Figure 4. SR 84 Expressway at Arroyo del Valle Bridge General Plan

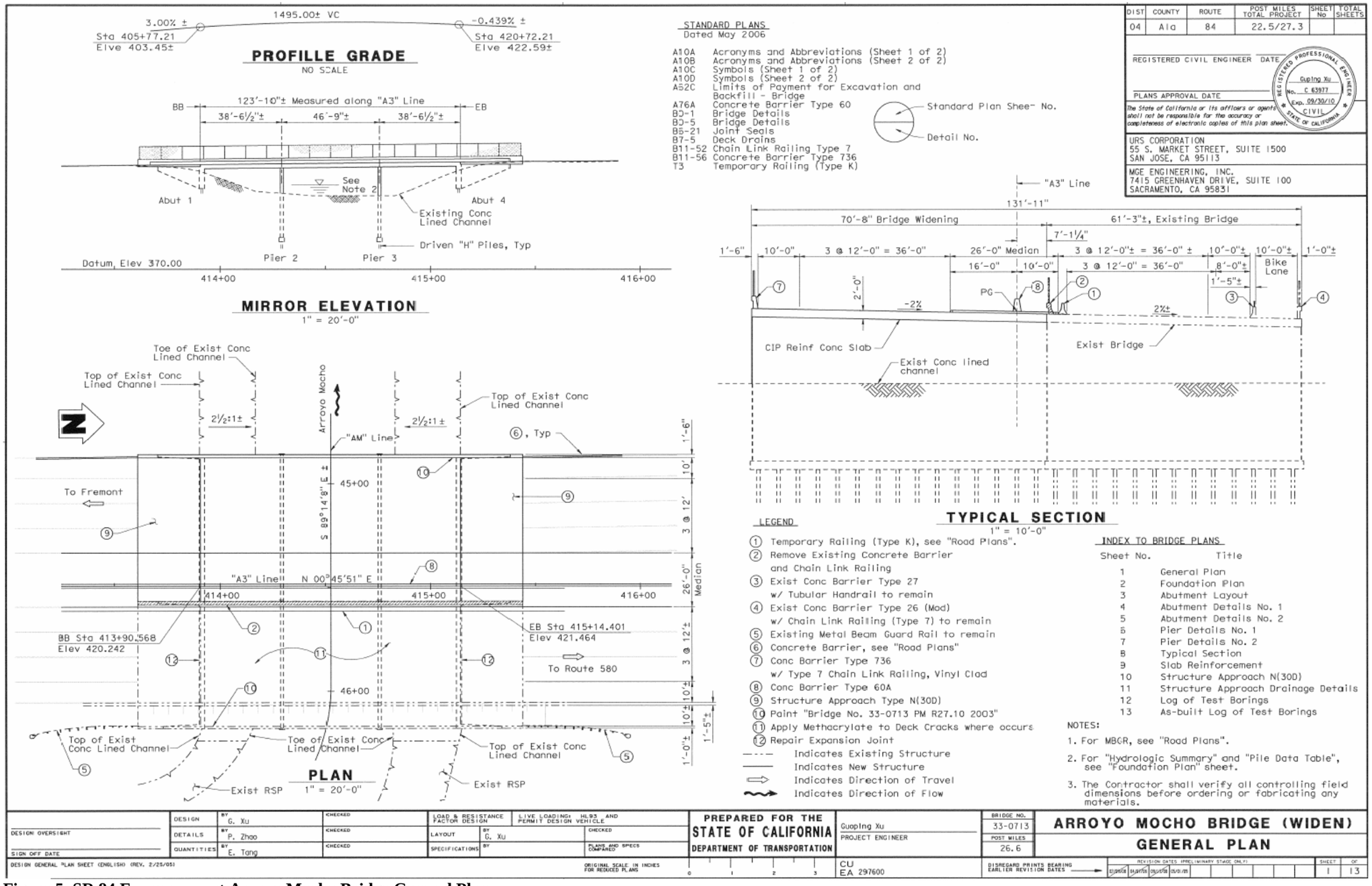

Figure 5. SR 84 Expressway at Arroyo Mocho Bridge General Plan

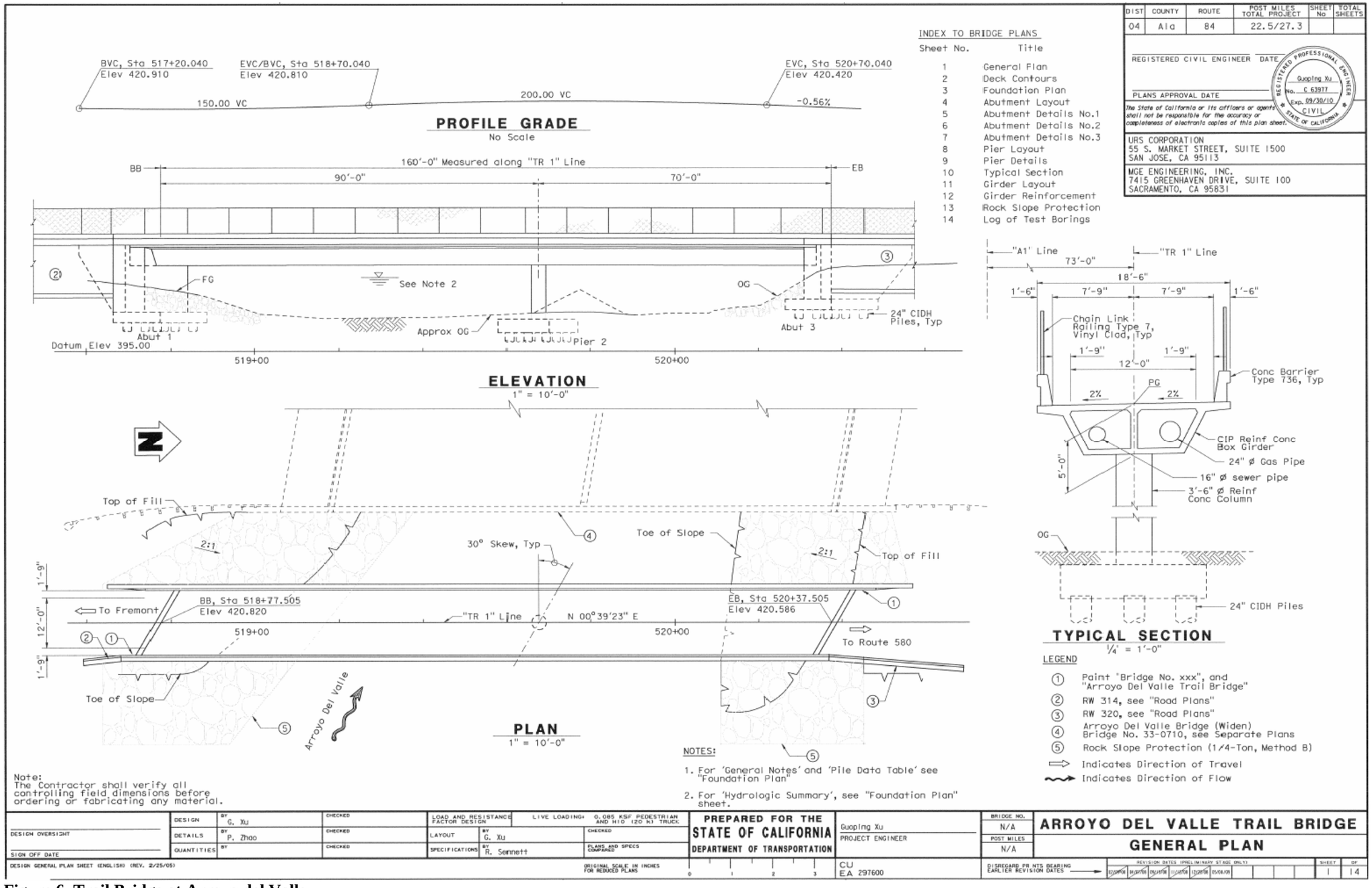

Figure 6. Trail Bridge at Arroyo del Valle

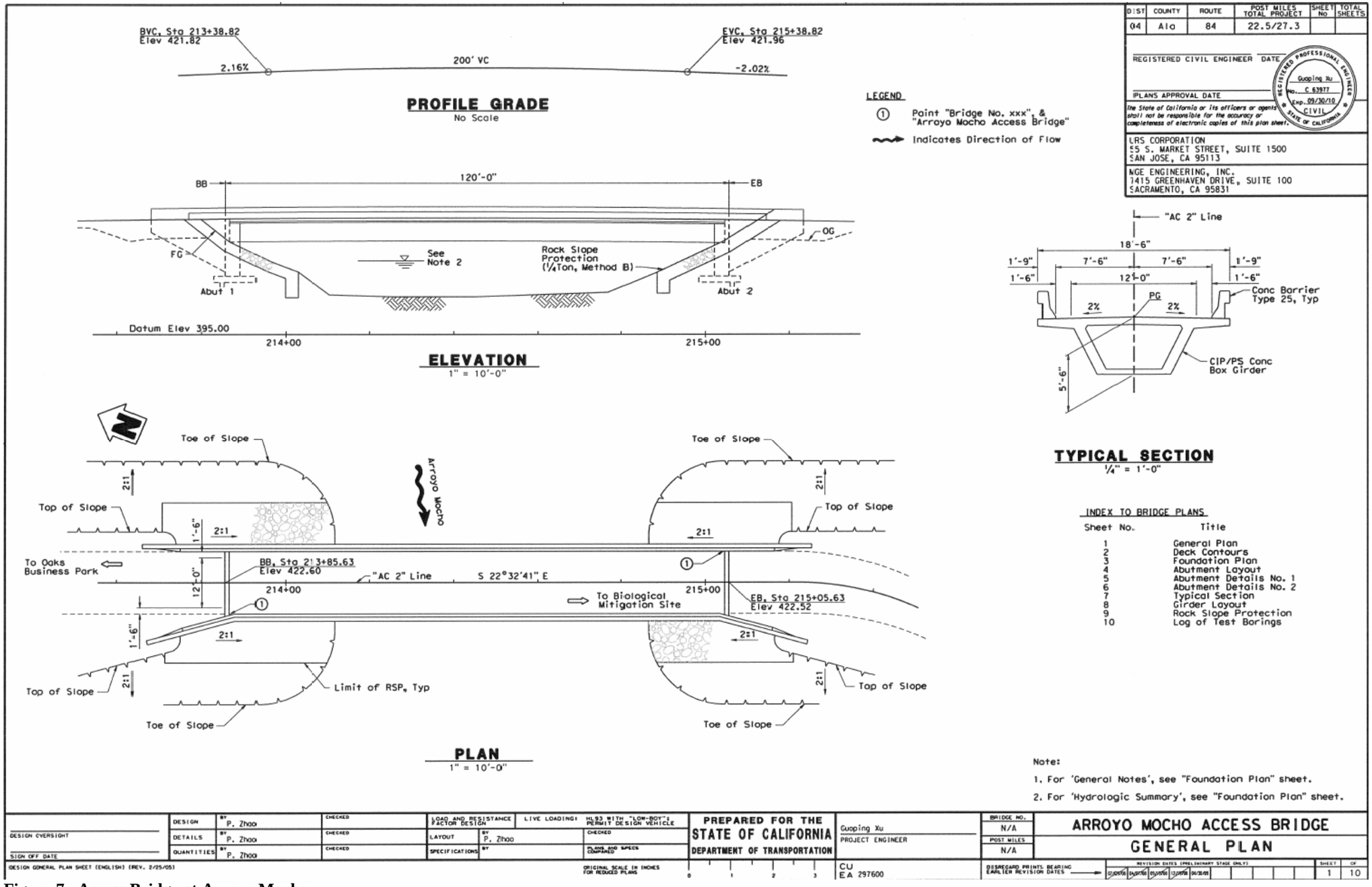

Figure 7. Access Bridge at Arroyo Mocho

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.

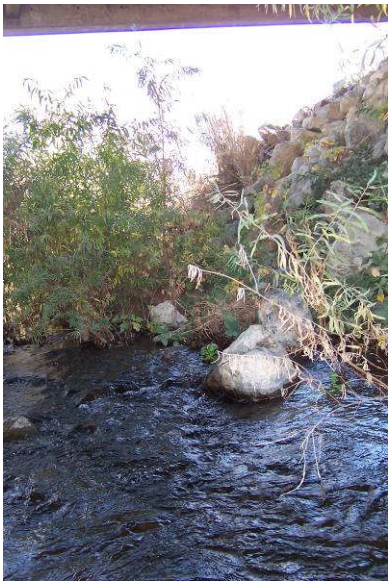

Photo 9.
Arroyo del Valle channel

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.

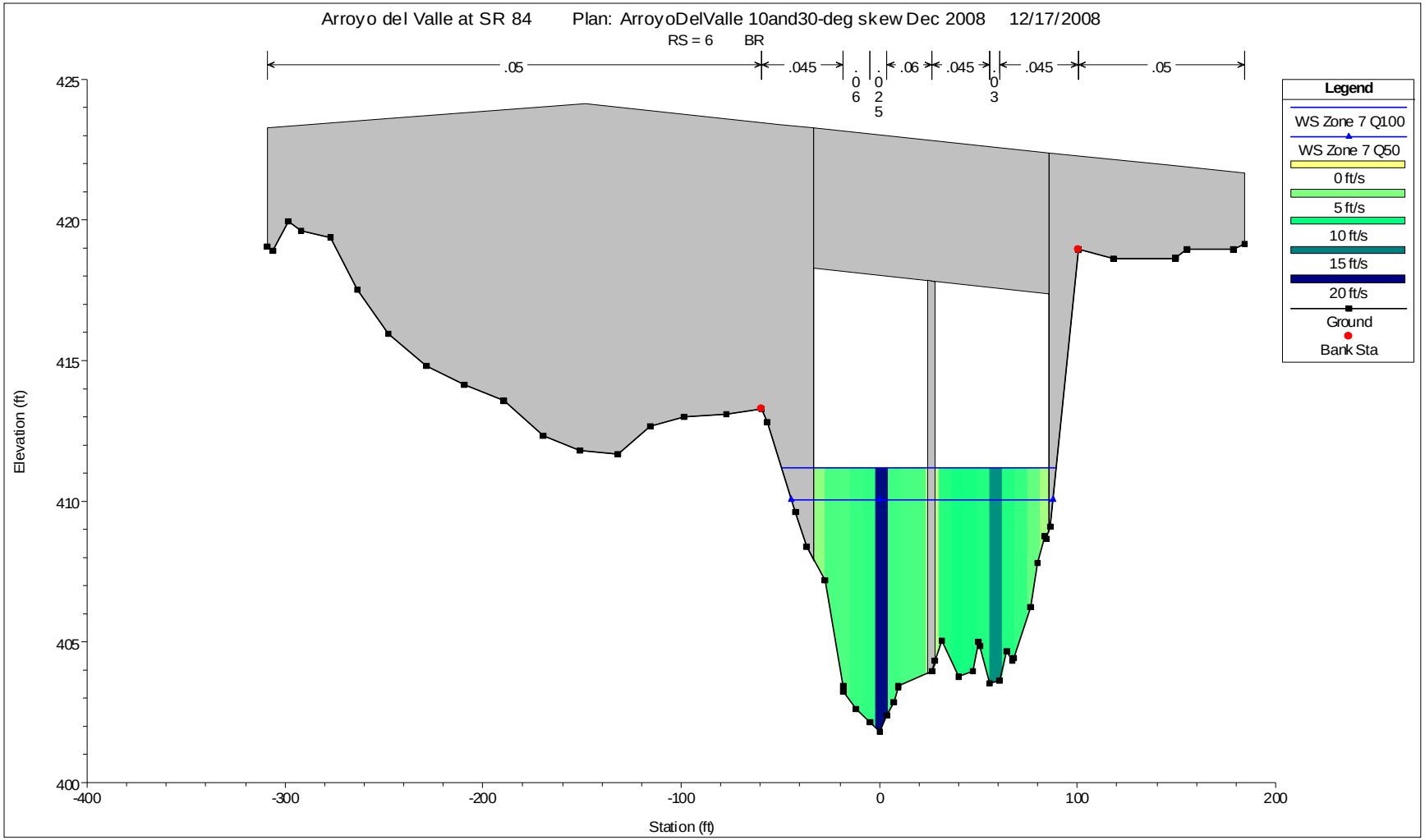

Figure 8. SR 84 Expressway Arroyo del Valle Bridge Upstream Face Cross-Section

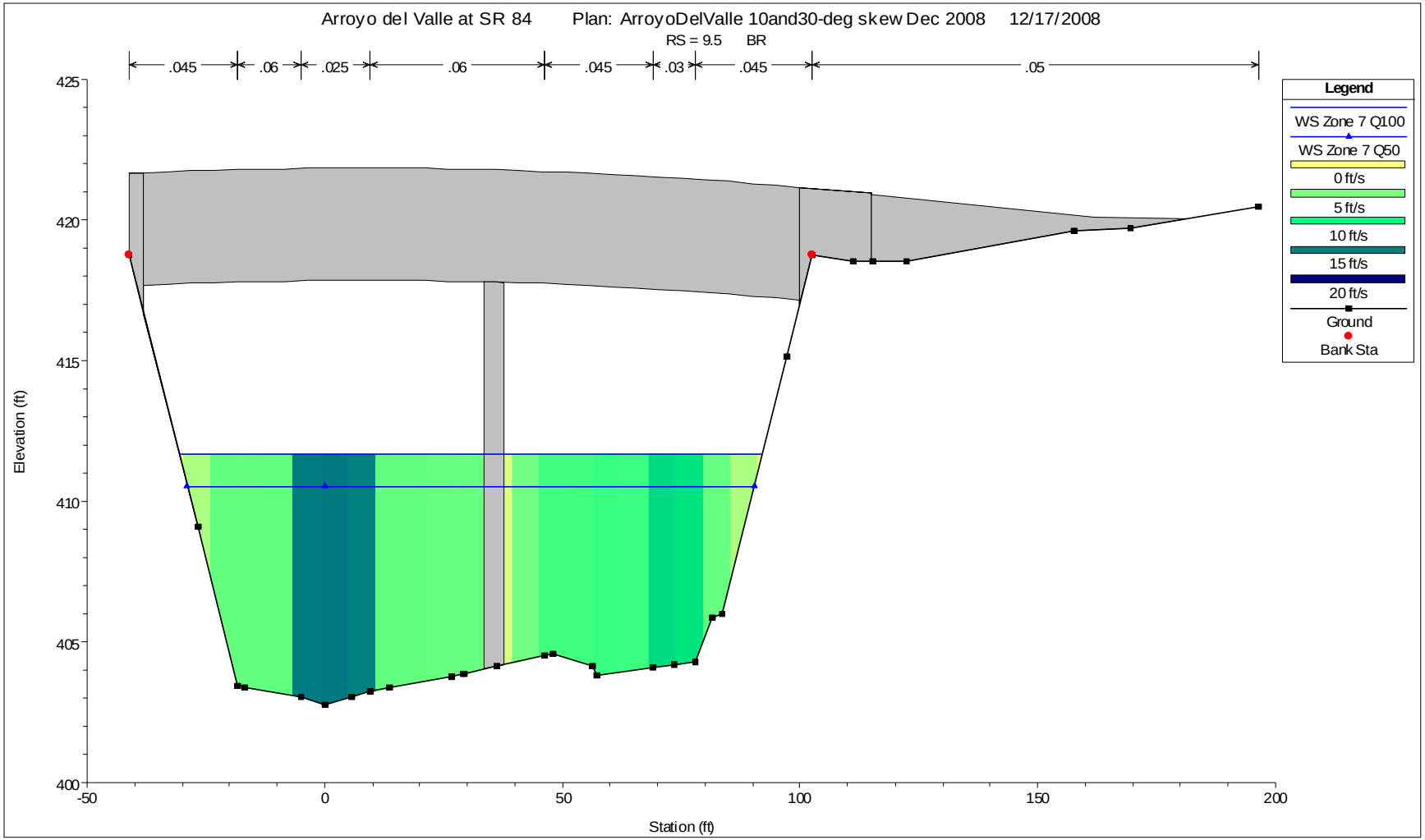

Figure 9. Arroyo del Valle Trail Bridge Upstream Face Cross-Section

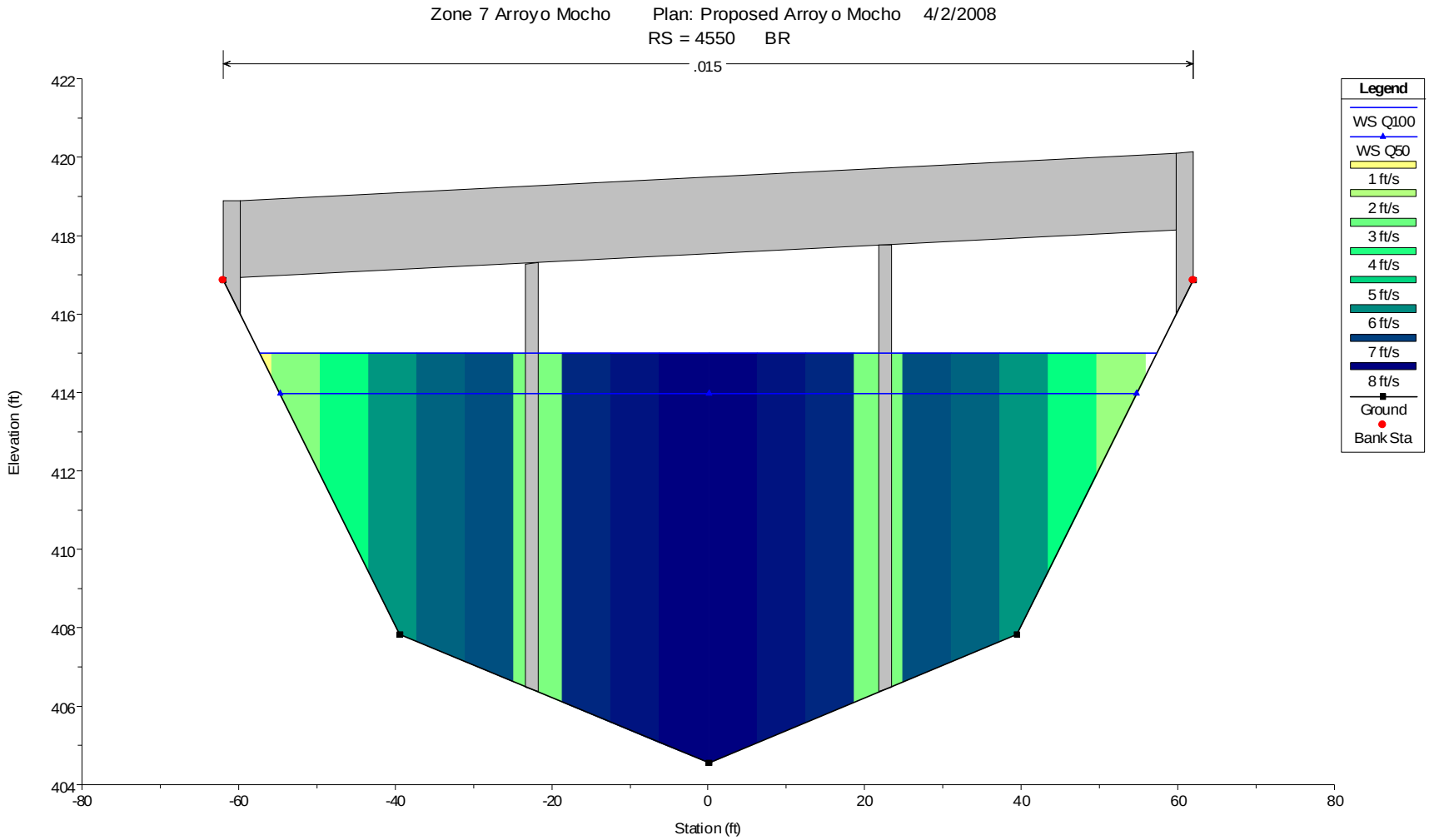

Figure 10. SR 84 Expressway Arroyo Mocho Bridge Upstream Face Cross-Section

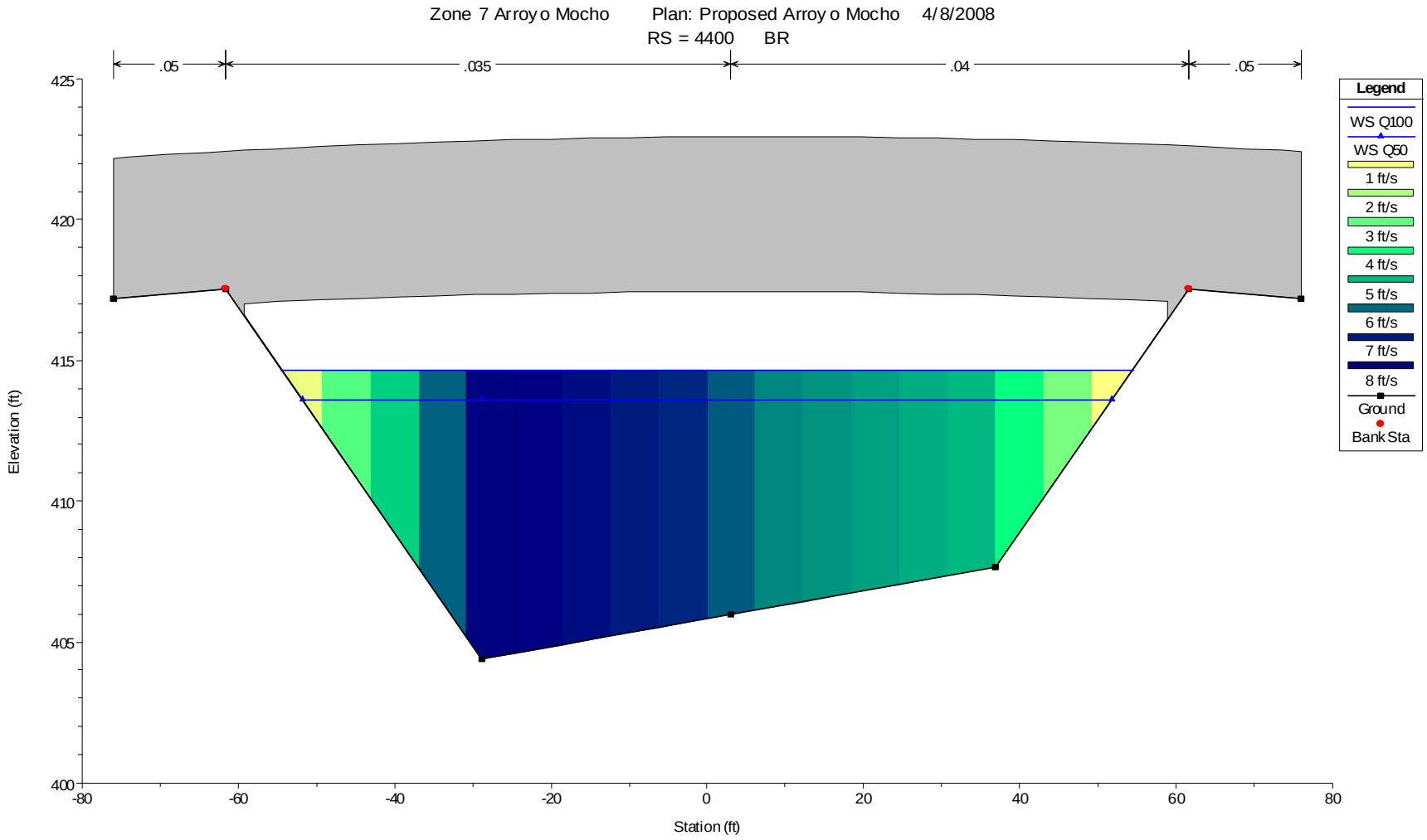

Figure 11. Arroyo Mocho Access Bridge Upstream Face Cross-Section

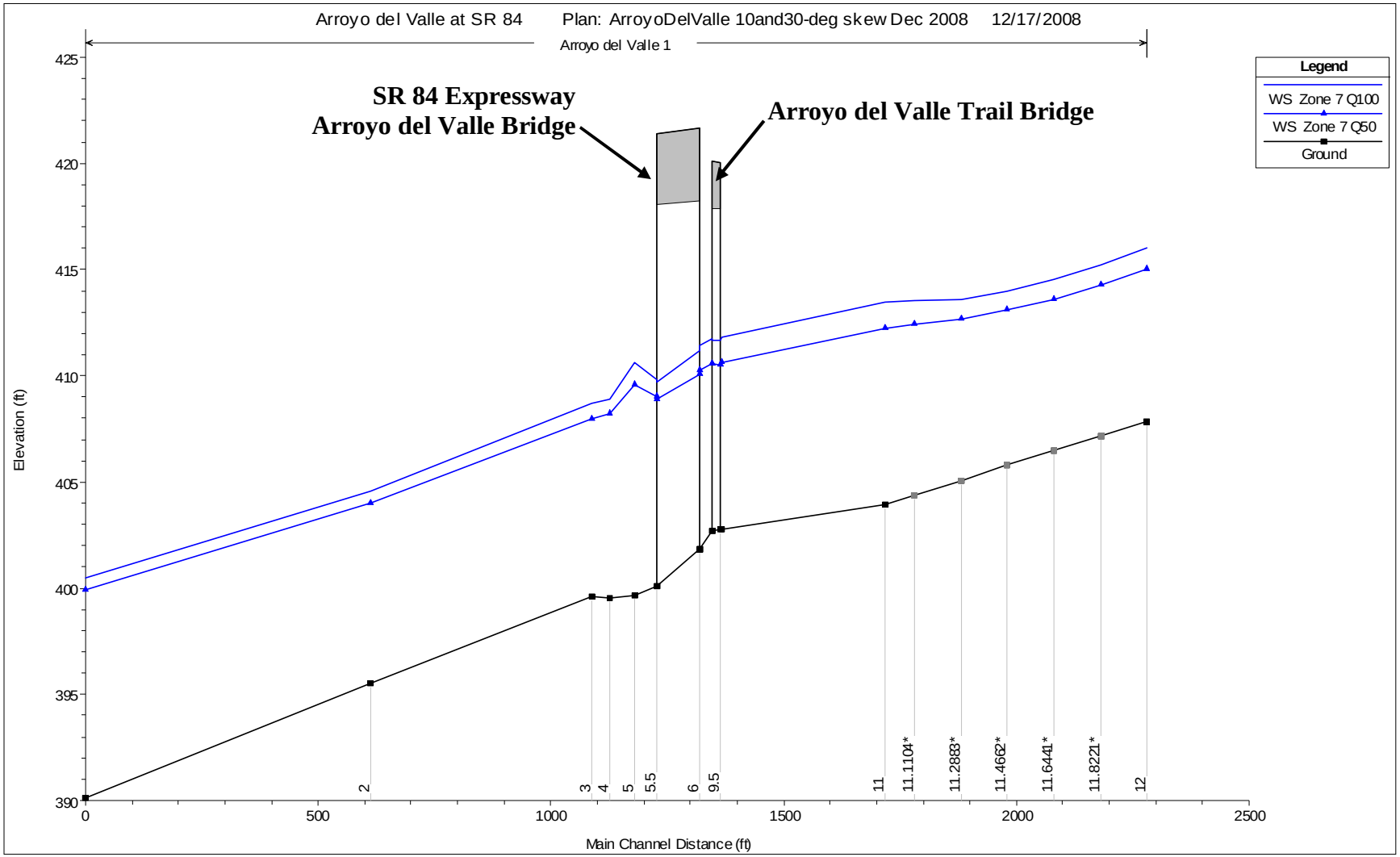

Figure 12. Arroyo del Valle Profile

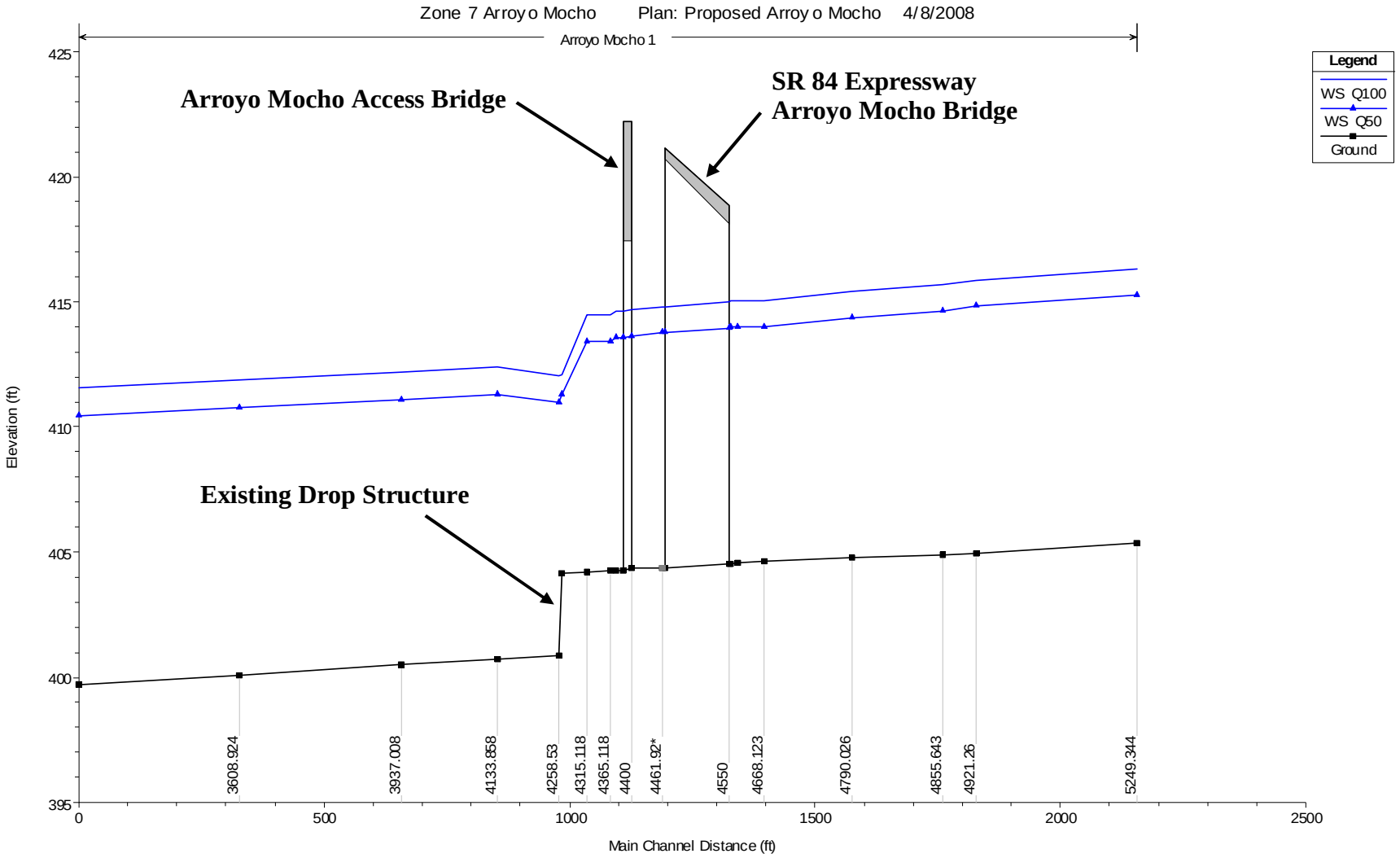

Figure 13. Arroyo Mocho Profile

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

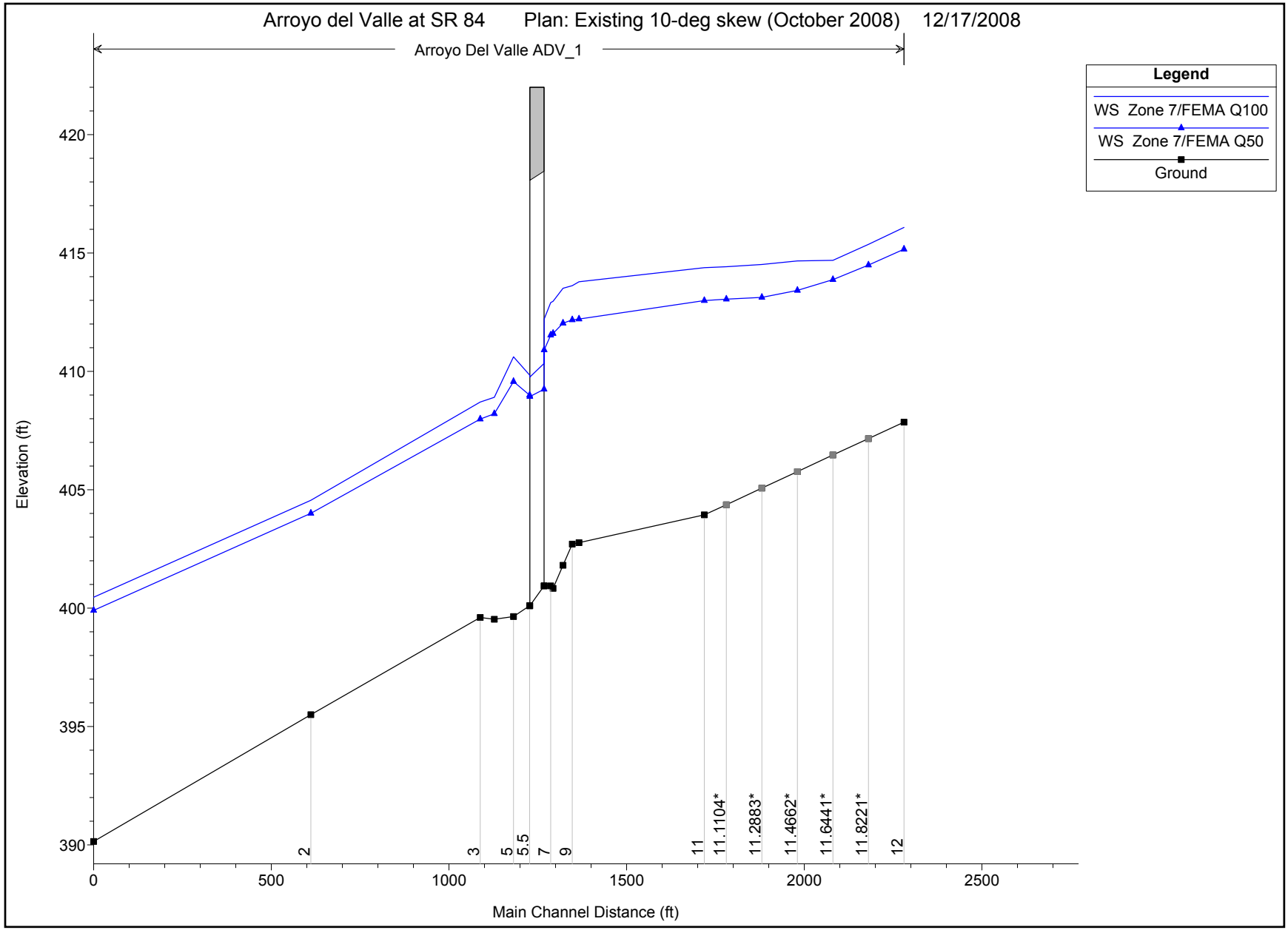
HEC-RAS Results: Existing Condition

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	

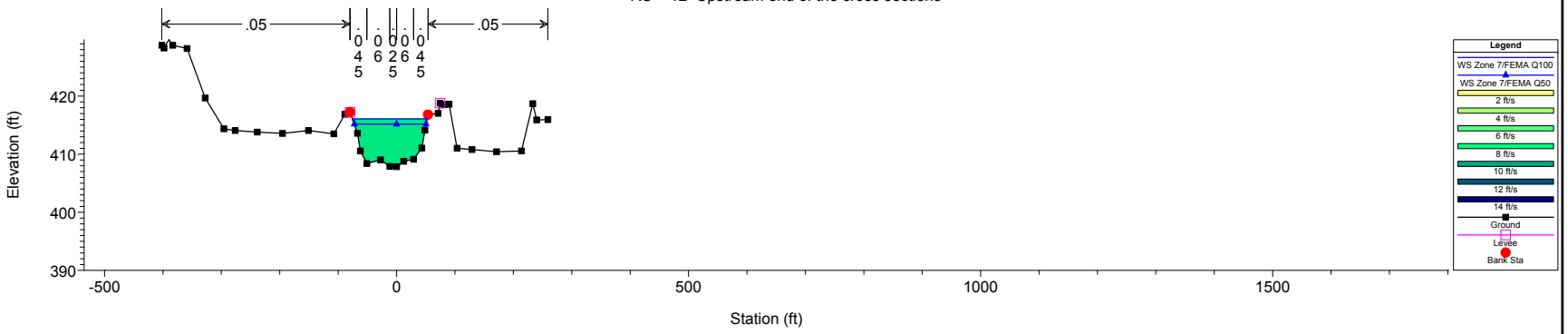


1 in Horiz. = 400 ft 1 in Vert. = 6 ft

No Data for Plot

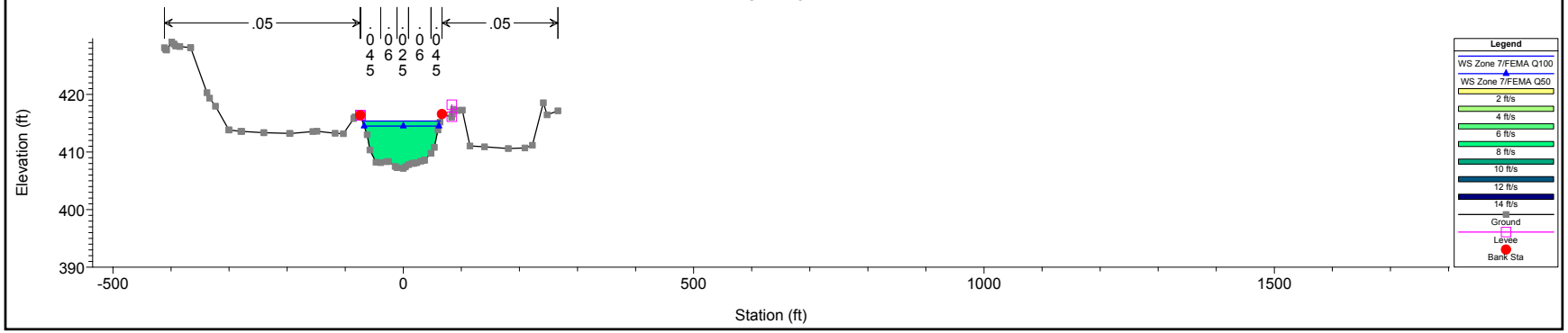
Arroyo del Valle at SR 84 Plan: Existing 10-deg skew (October 2008) 12/17/2008

RS = 12 Upstream end of the cross sections

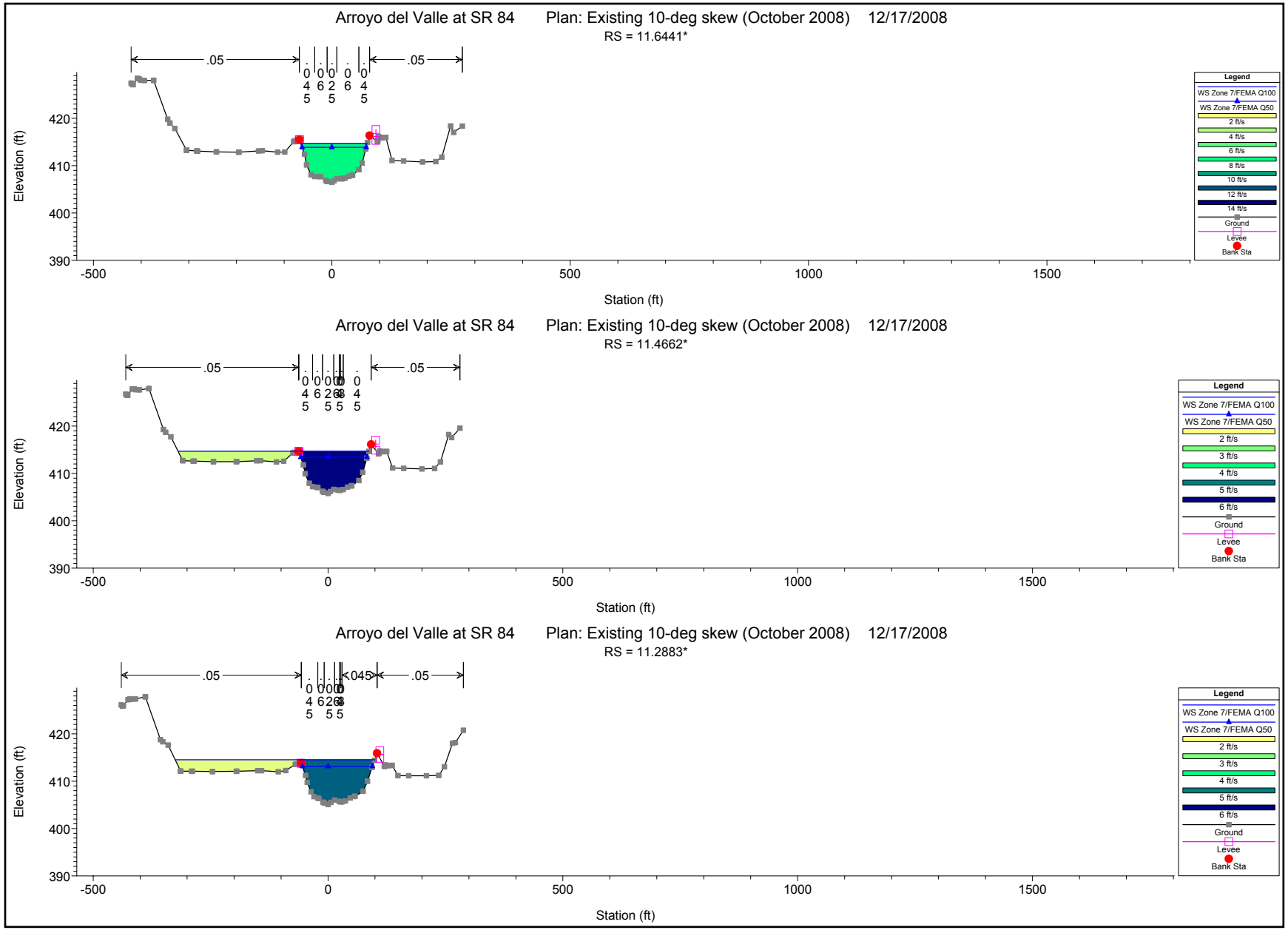


Arroyo del Valle at SR 84 Plan: Existing 10-deg skew (October 2008) 12/17/2008

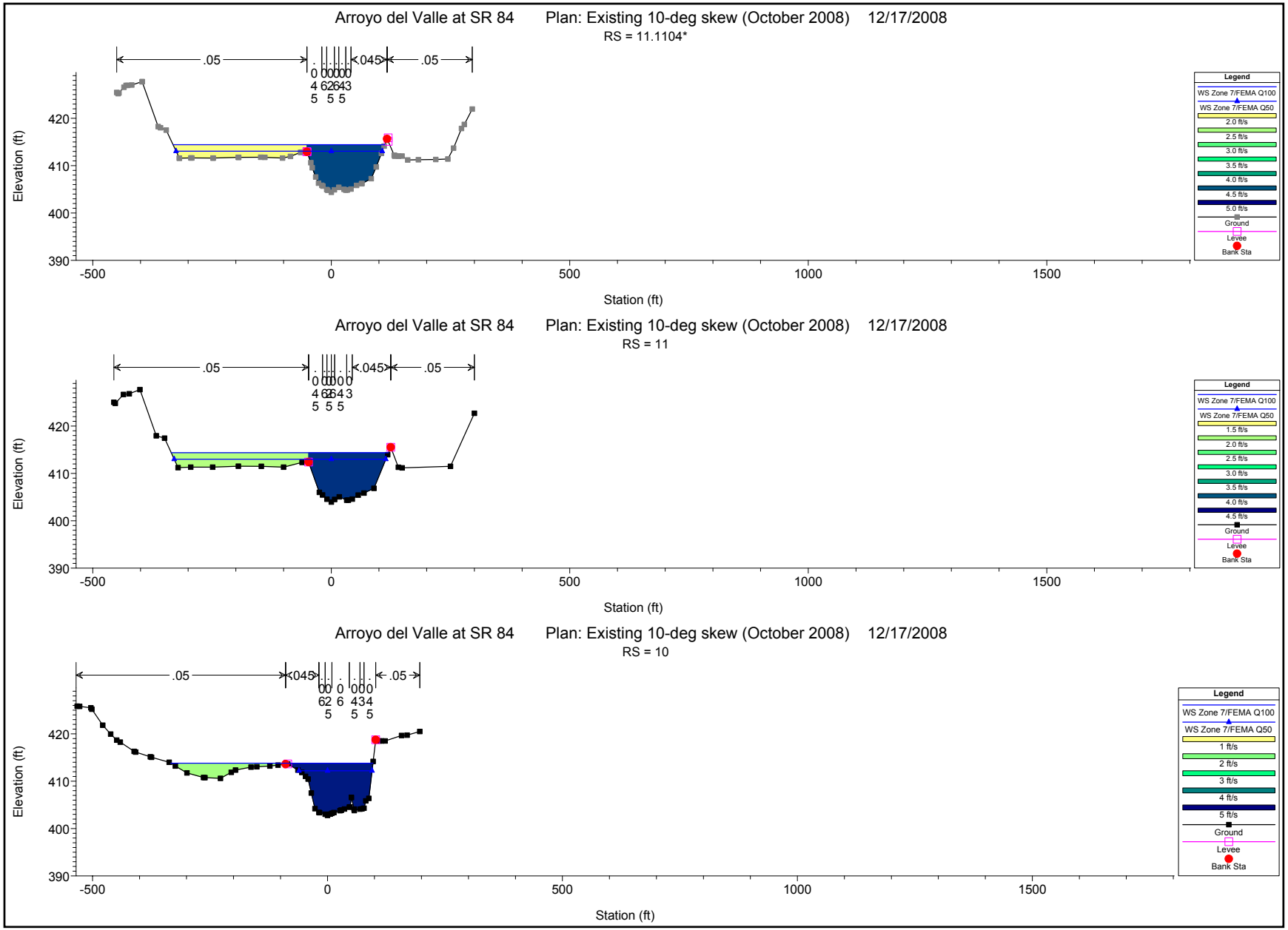
RS = 11.8221*



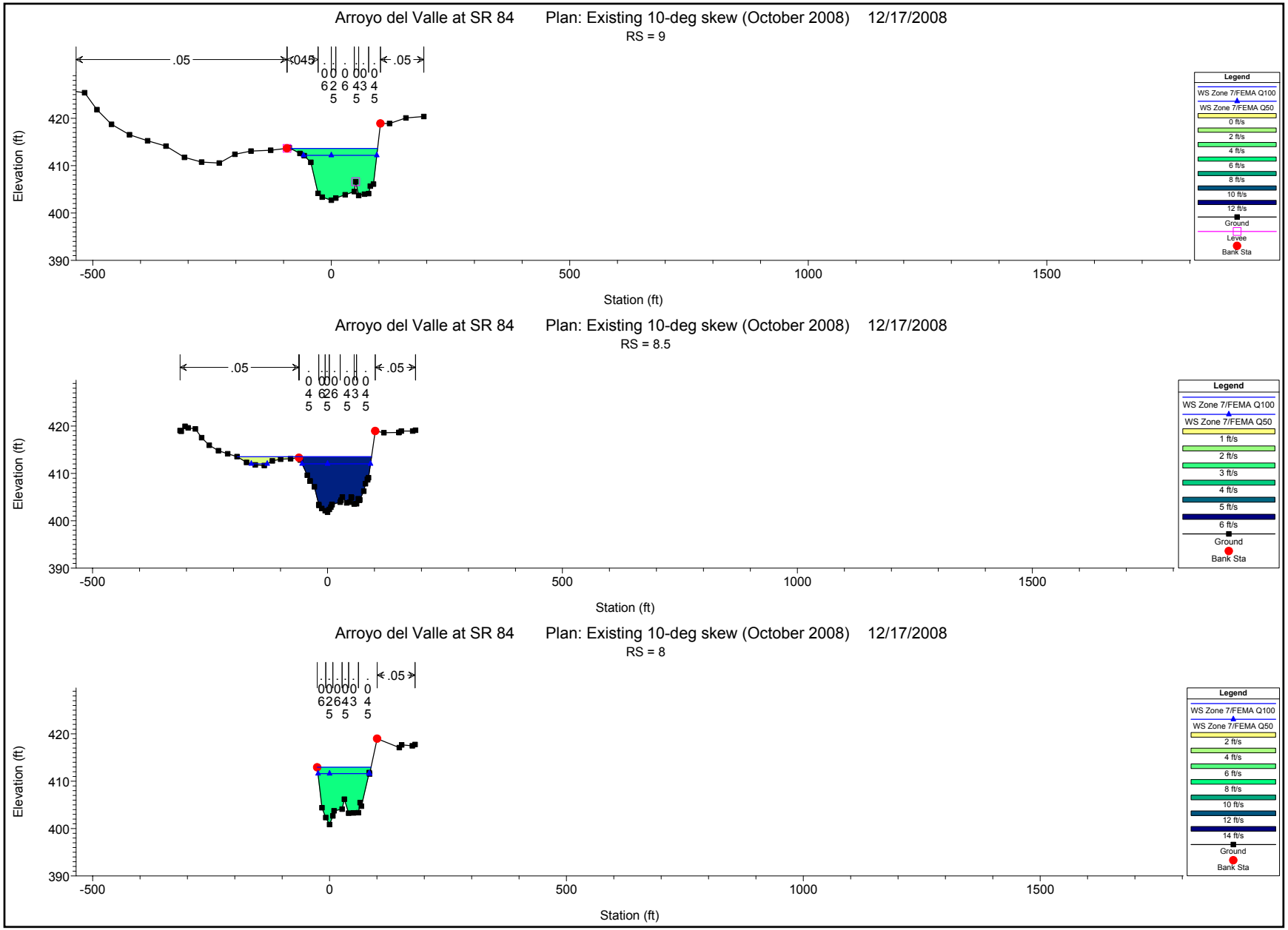
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



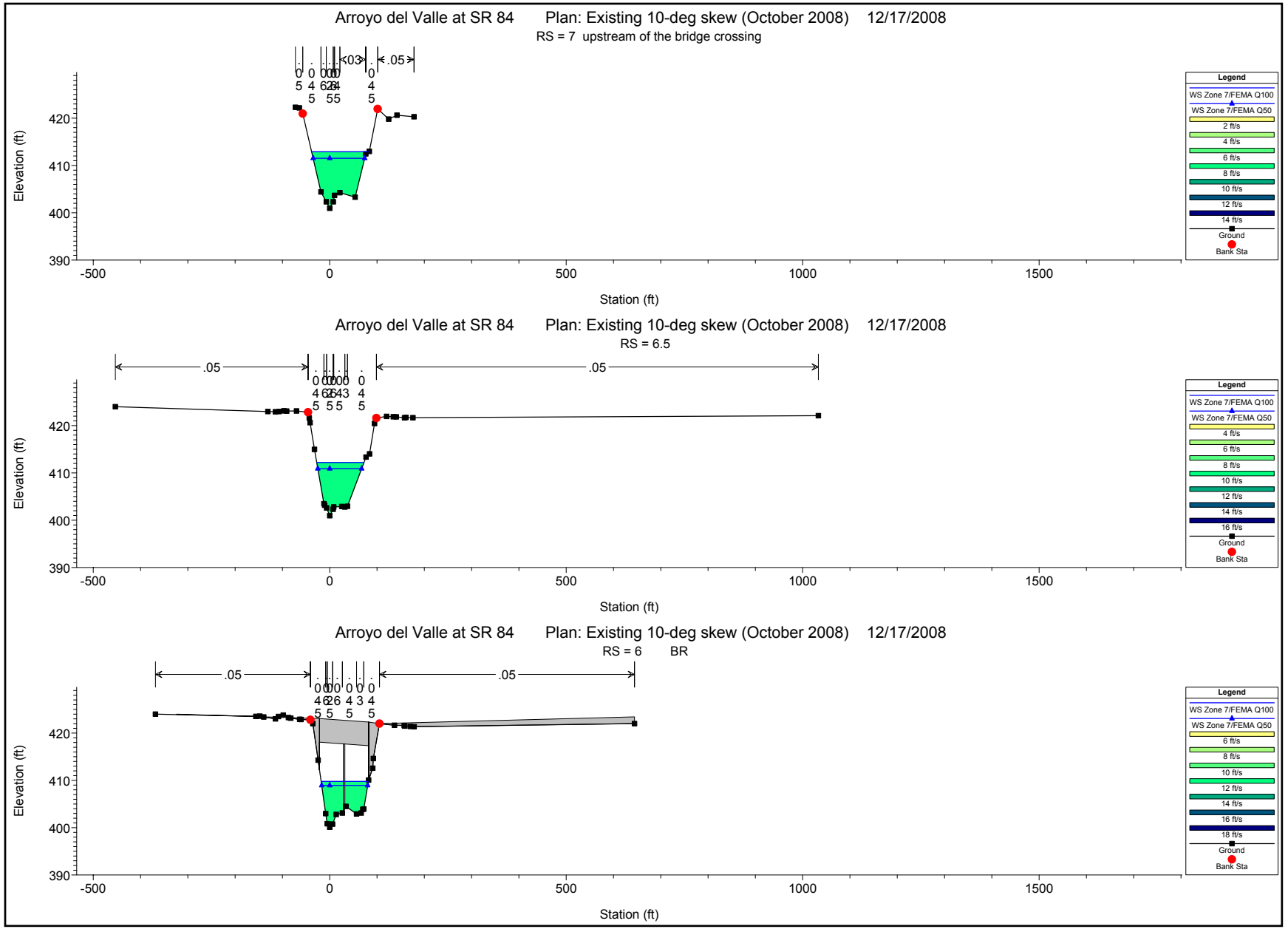
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



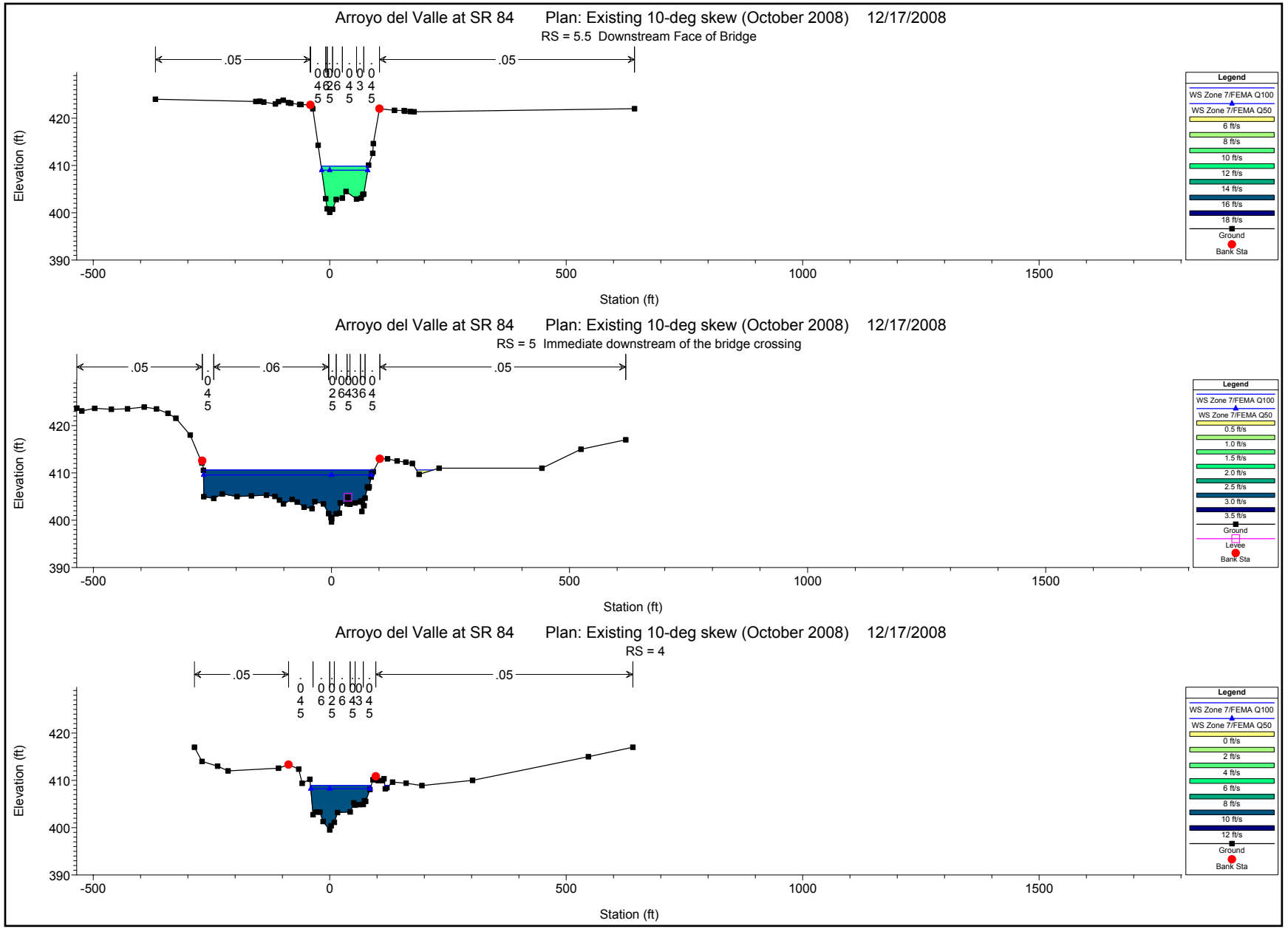
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



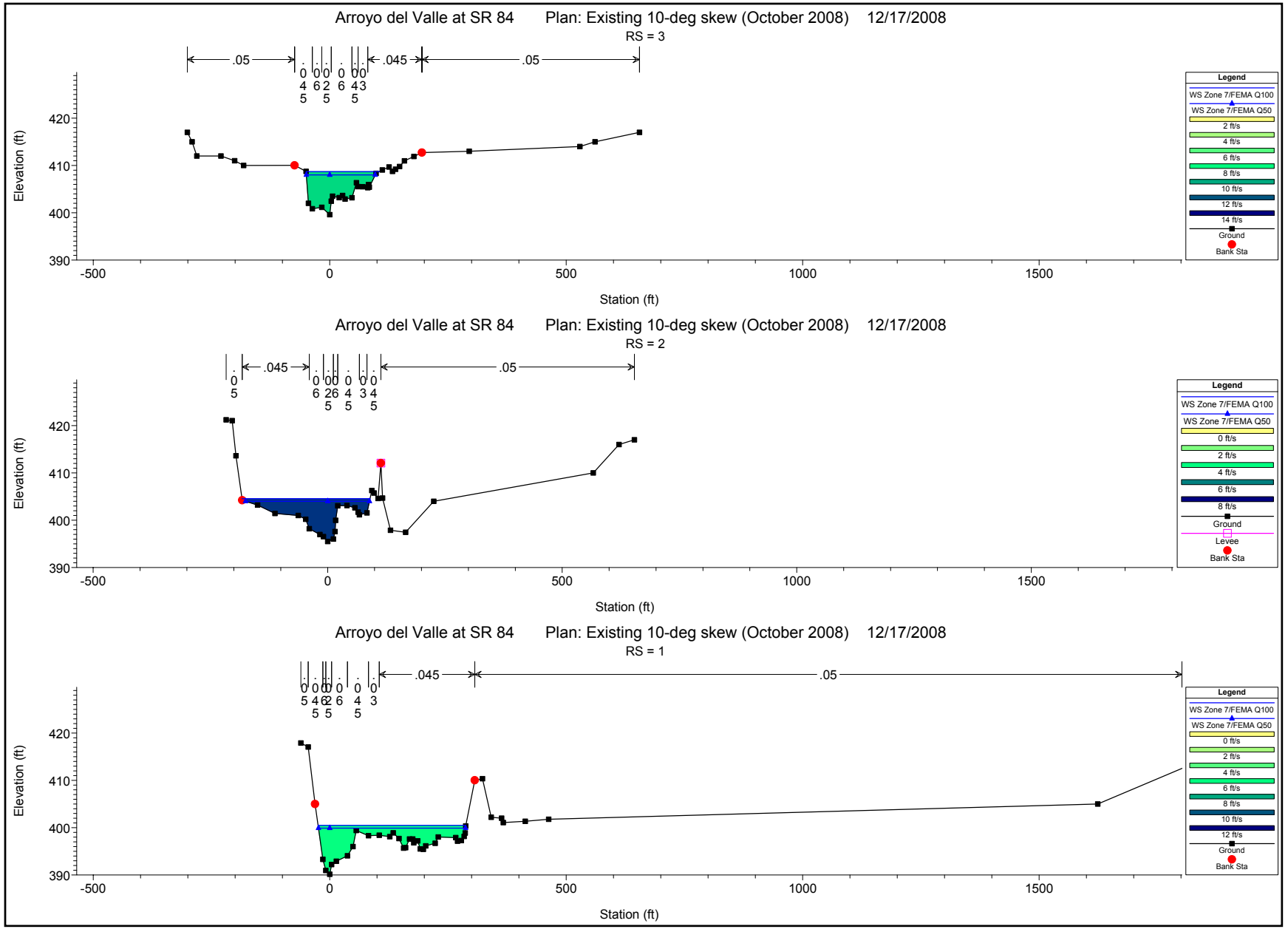
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



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

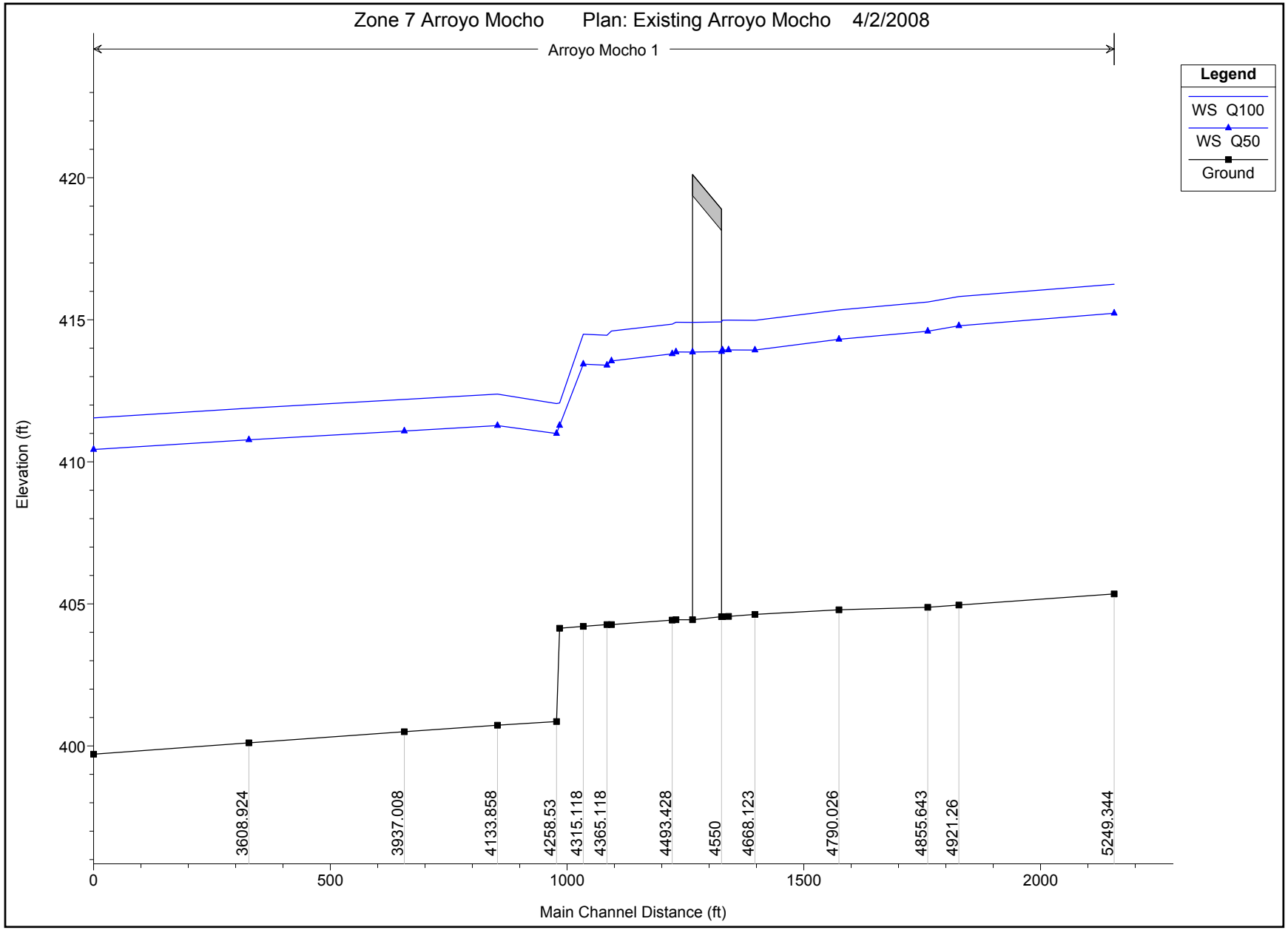
HEC-RAS Results: Existing Condition

HEC-RAS Plan: Existing River: Arroyo Mocho Reach: 1

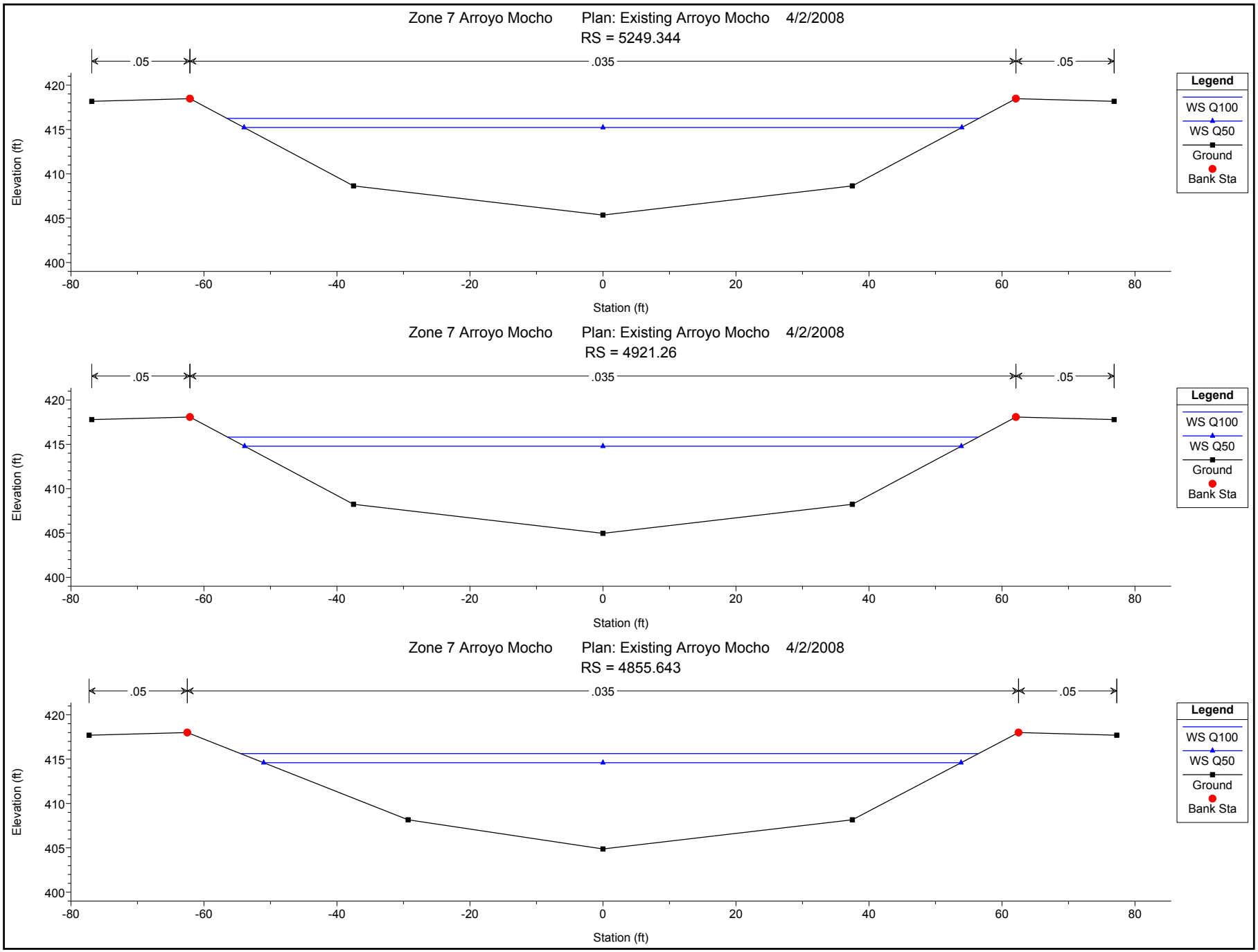
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
1	5249.344	Q100	4800.00	405.35	416.25		416.76	0.001302	5.72	839.06	113.06	0.37		328.08
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)

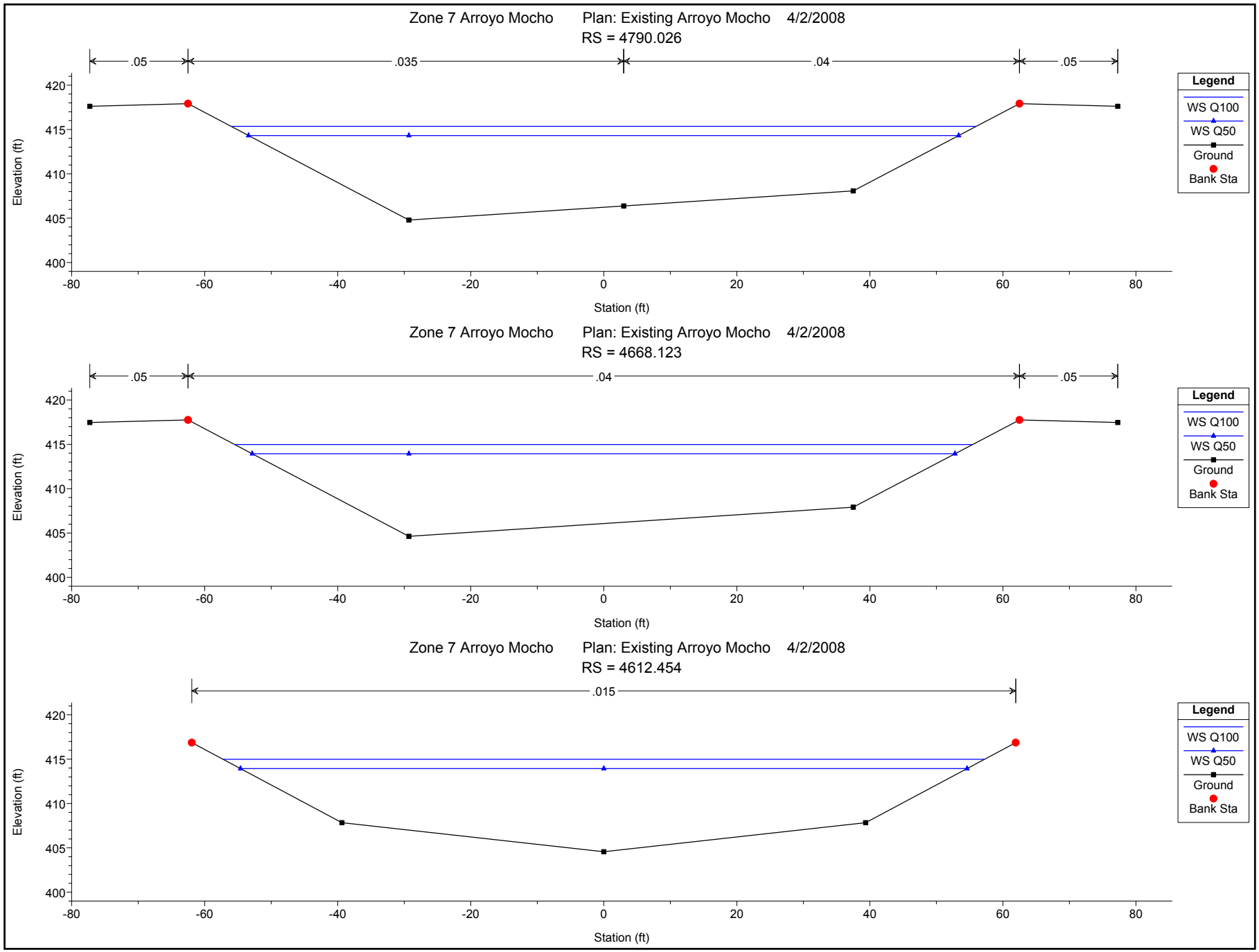
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
1	4133.858	Q50	3900.00	400.73	411.27		411.64	0.000987	4.88	799.77	111.33	0.32		196.85
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	



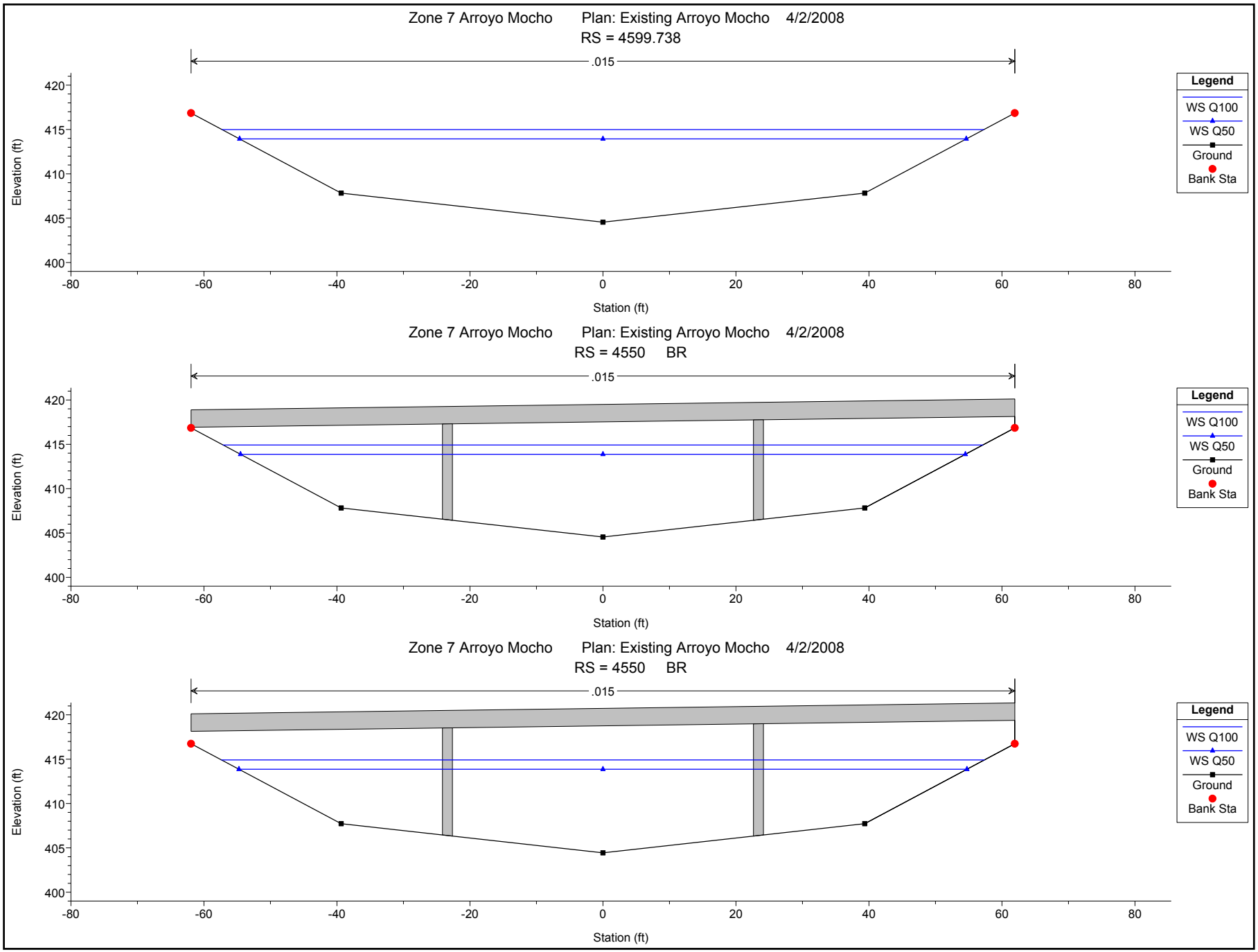
1 in Horiz. = 300 ft 1 in Vert. = 5 ft



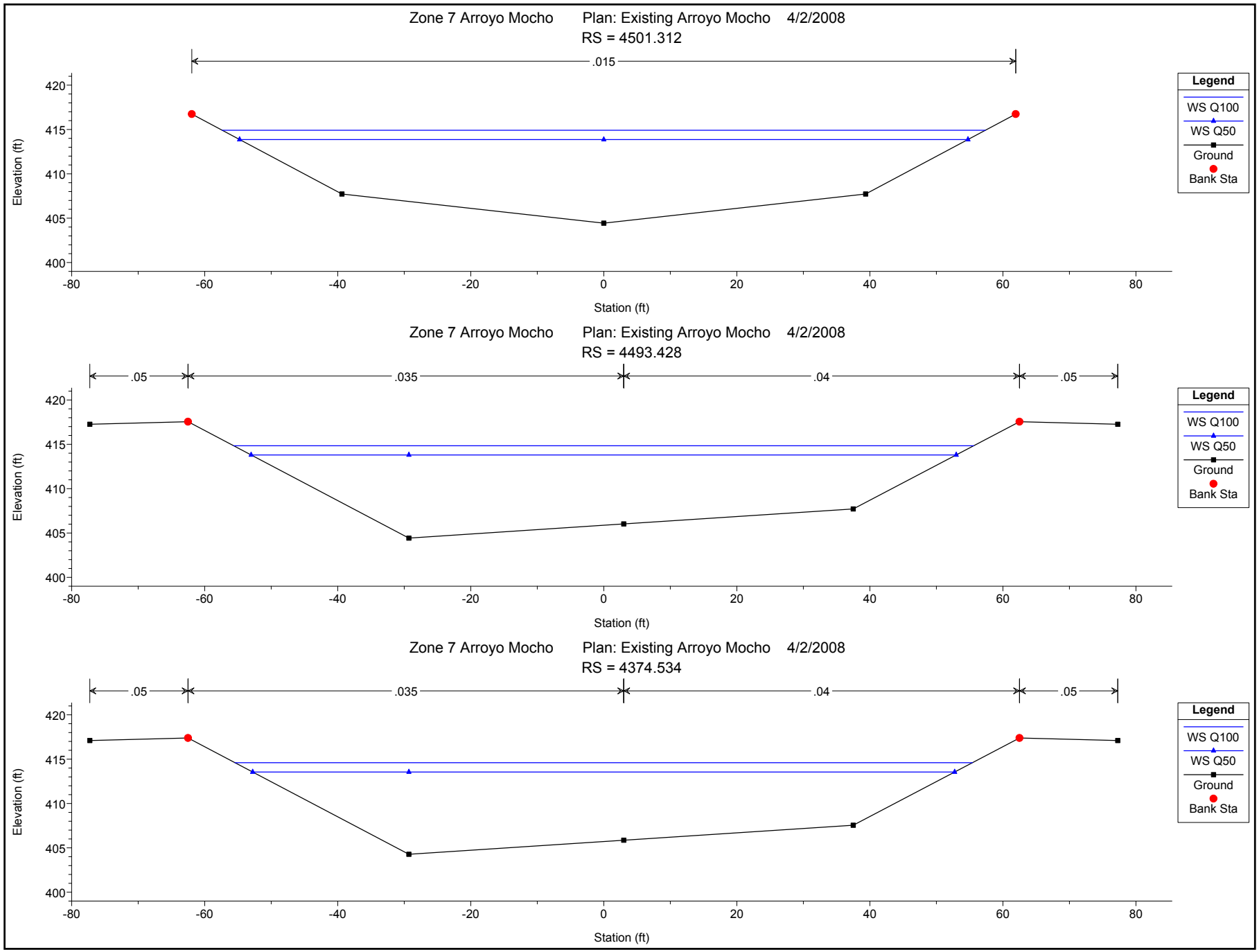
1 in Horiz. = 20 ft 1 in Vert. = 15 ft



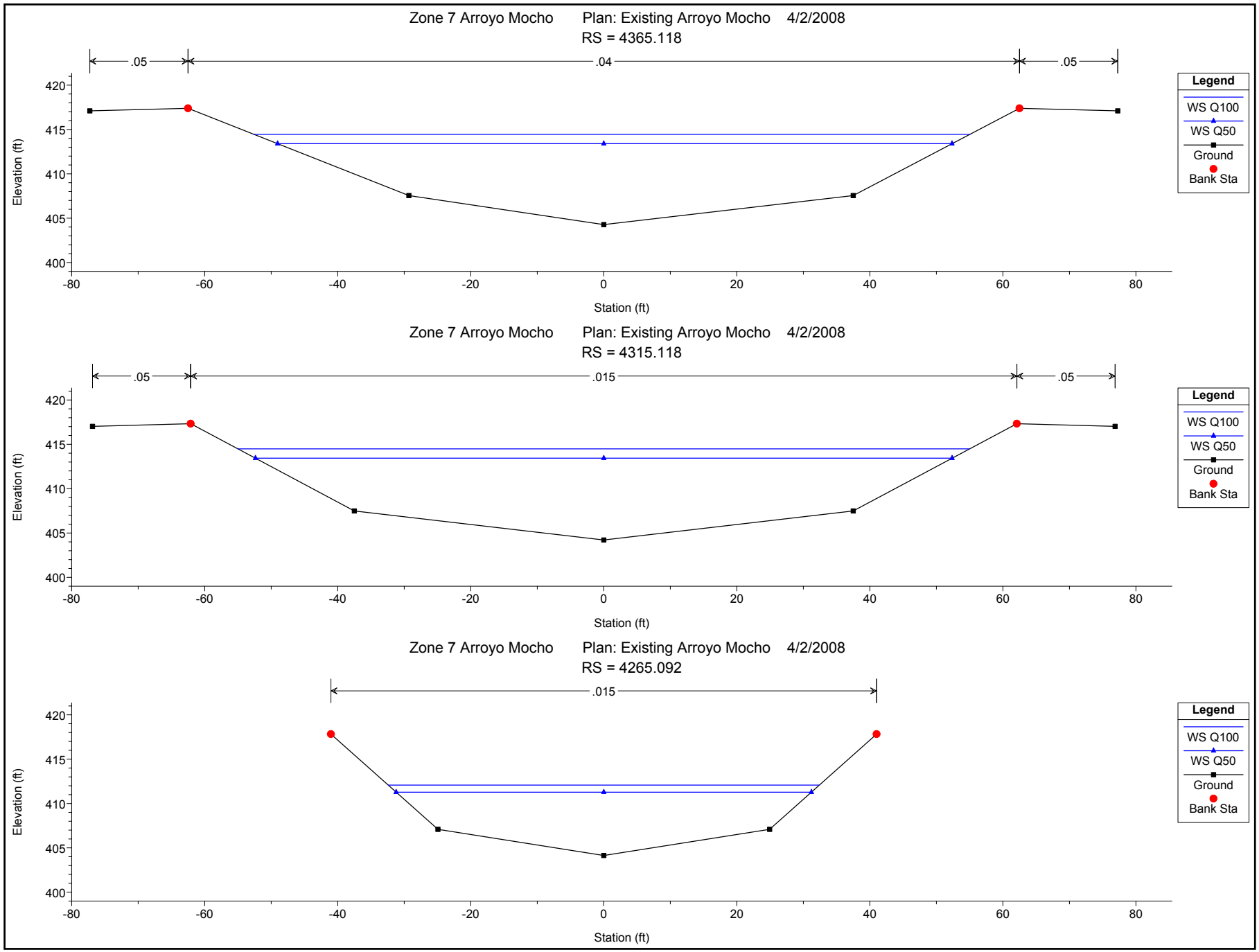
1 in Horiz. = 20 ft 1 in Vert. = 15 ft



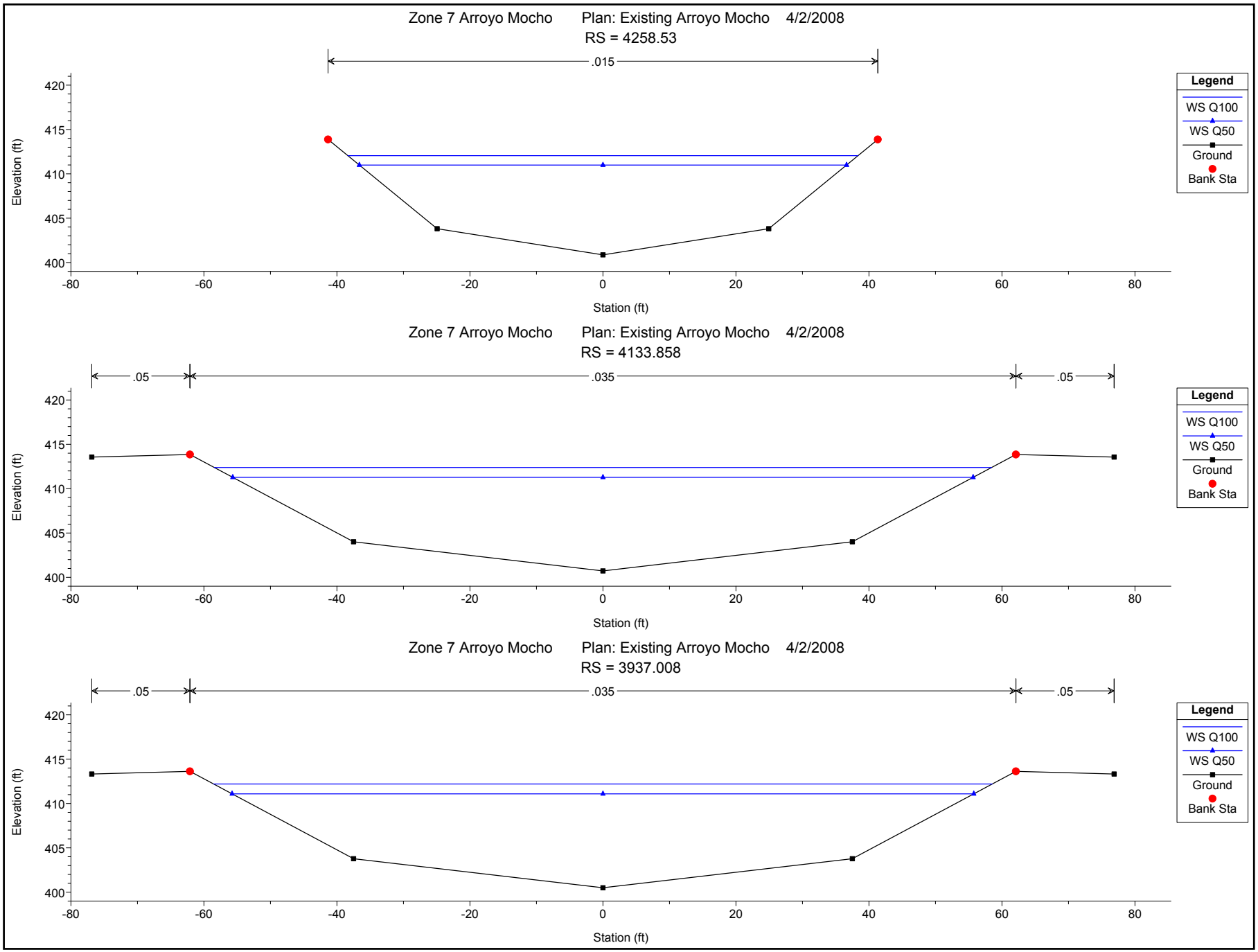
1 in Horiz. = 20 ft 1 in Vert. = 15 ft



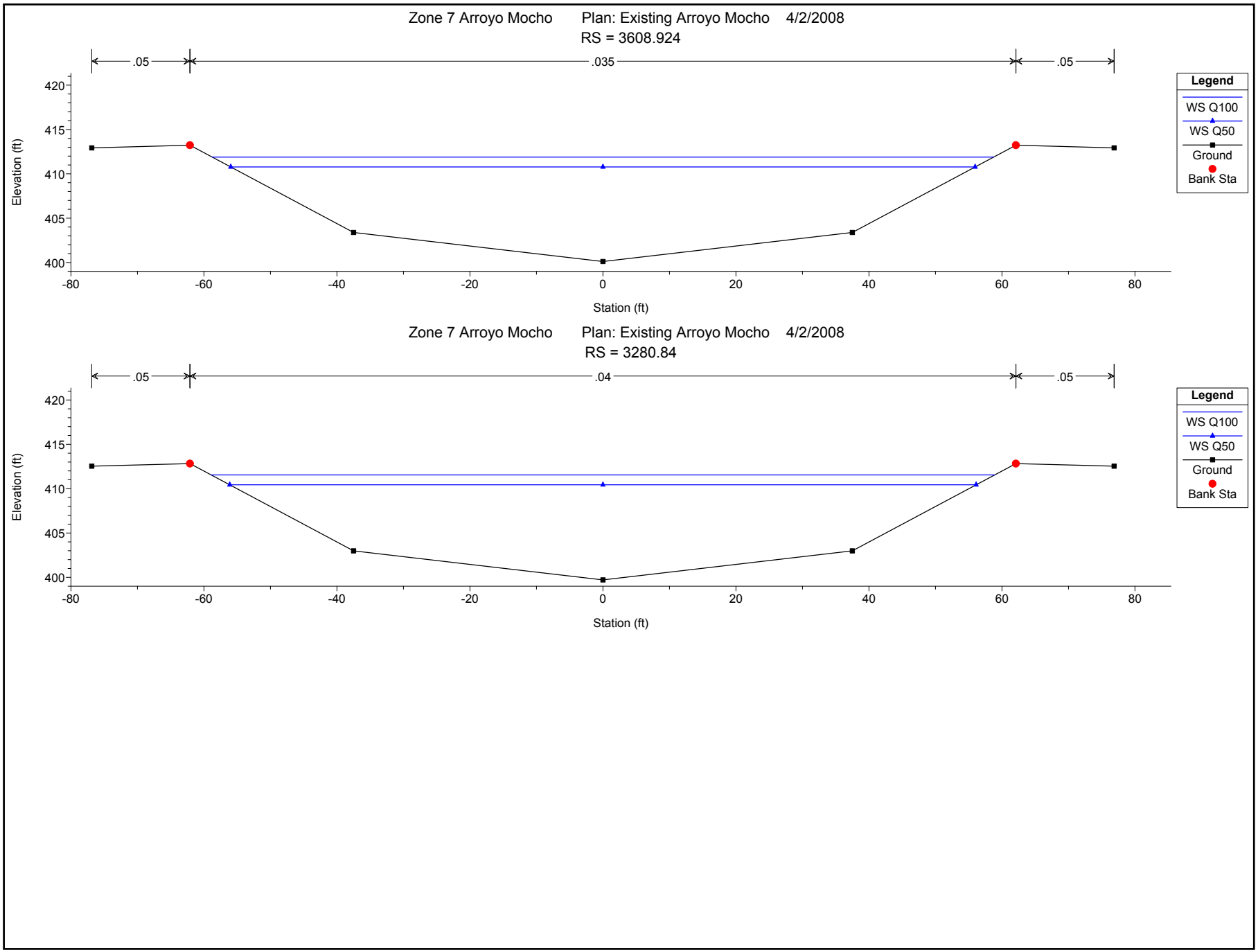
1 in Horiz. = 20 ft 1 in Vert. = 15 ft



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

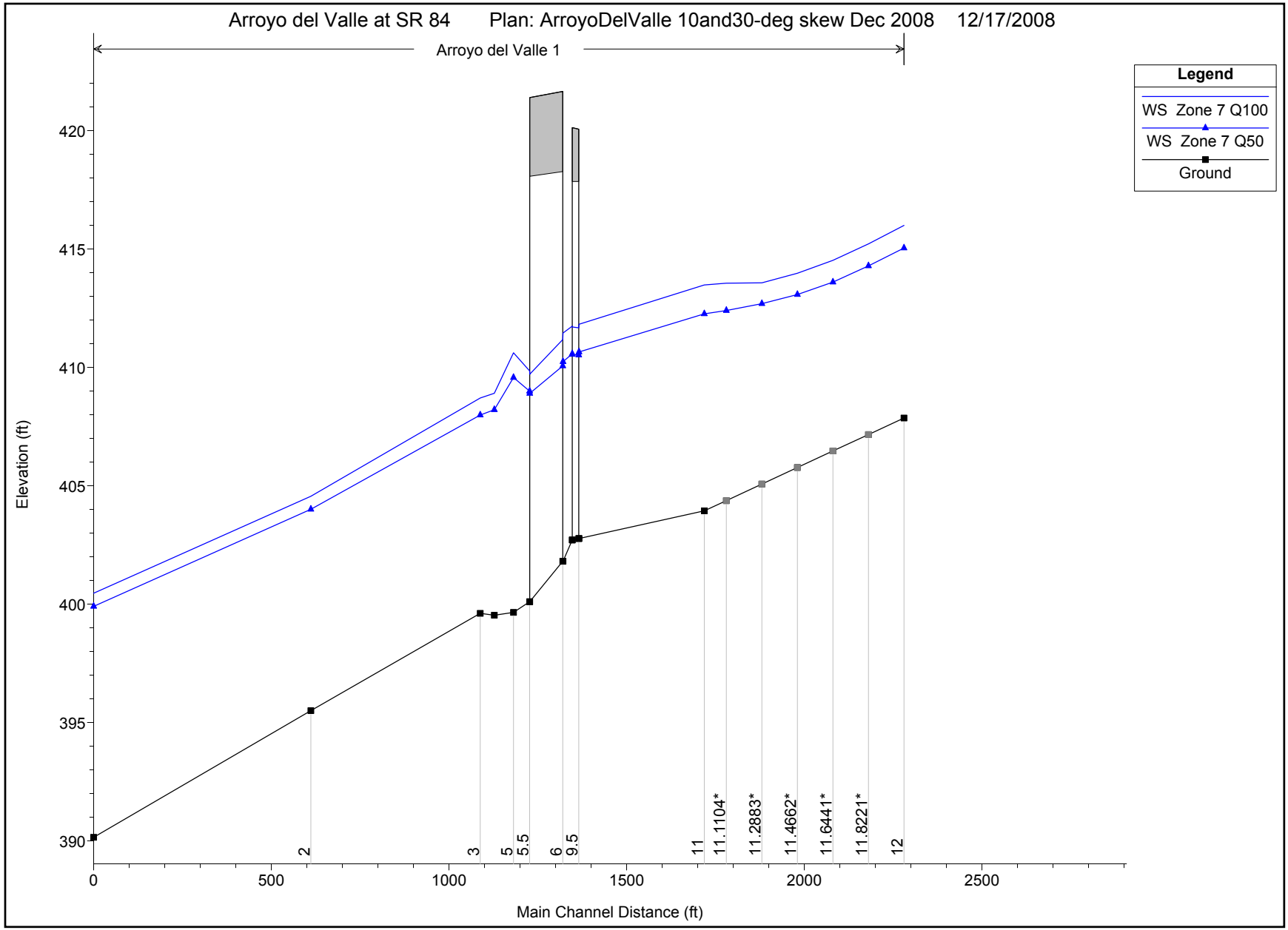
HEC-RAS Results: Proposed Condition

HEC-RAS Plan: proposed1208 River: Arroyo del Valle Reach: 1

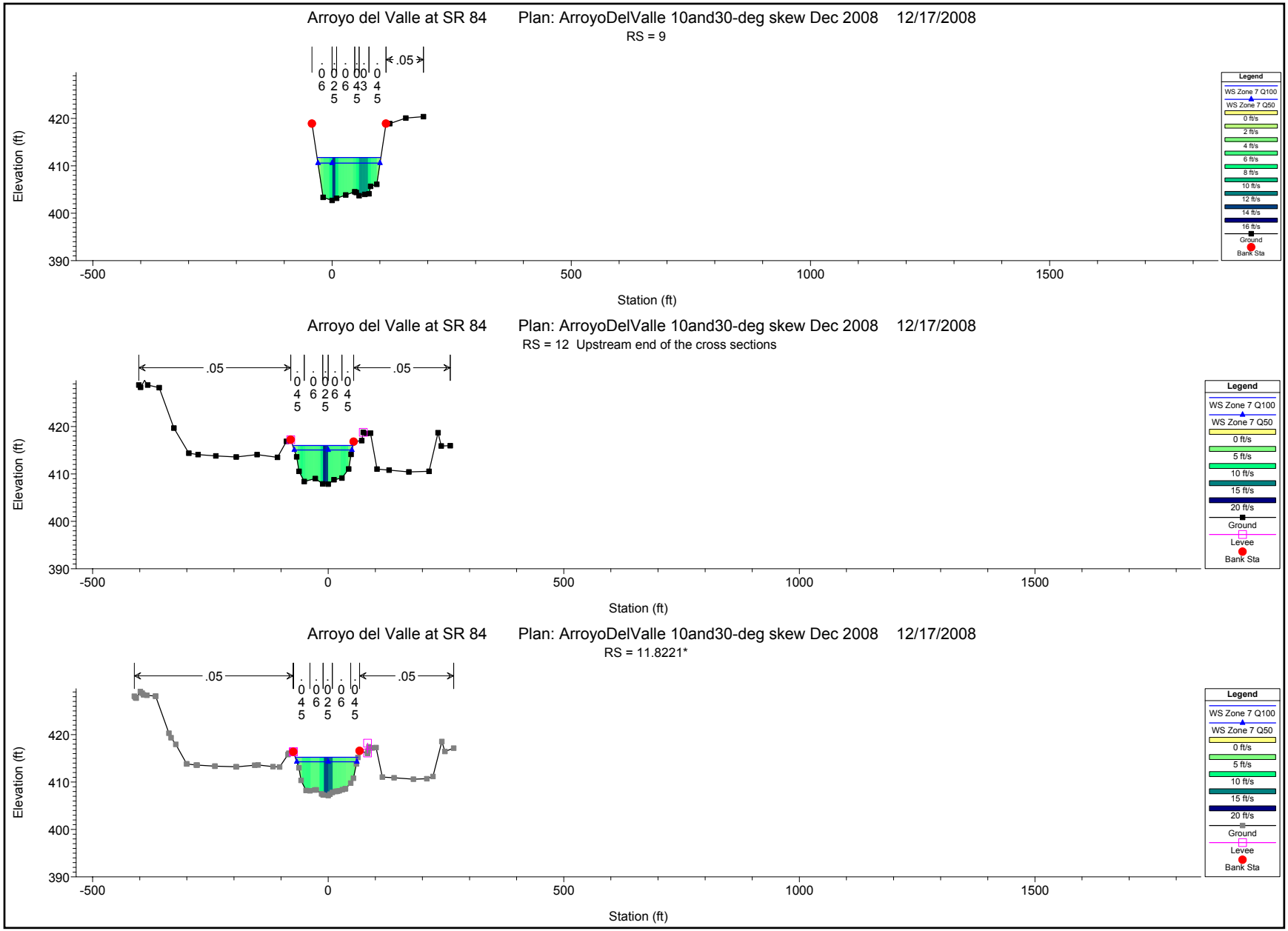
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
1	12	Zone 7 Q100	7000.00	407.86	416.00	414.01	417.17	0.008116	8.71	804.13	127.57	0.61	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)

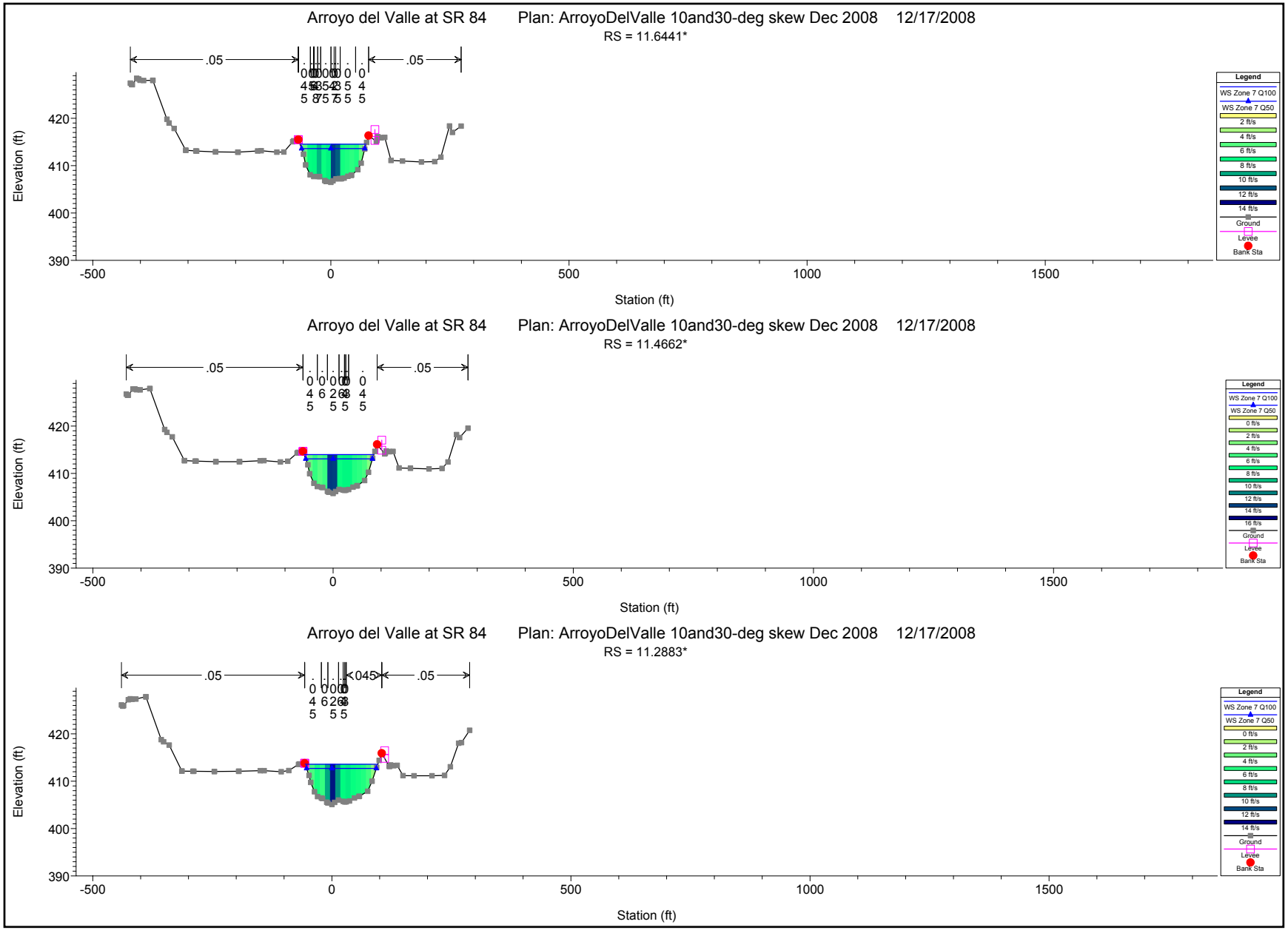
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
1	1	Zone 7 Q100	7000.00	390.15	400.46	399.06	401.00	0.005604	5.89	1187.73	312.18	0.53	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	



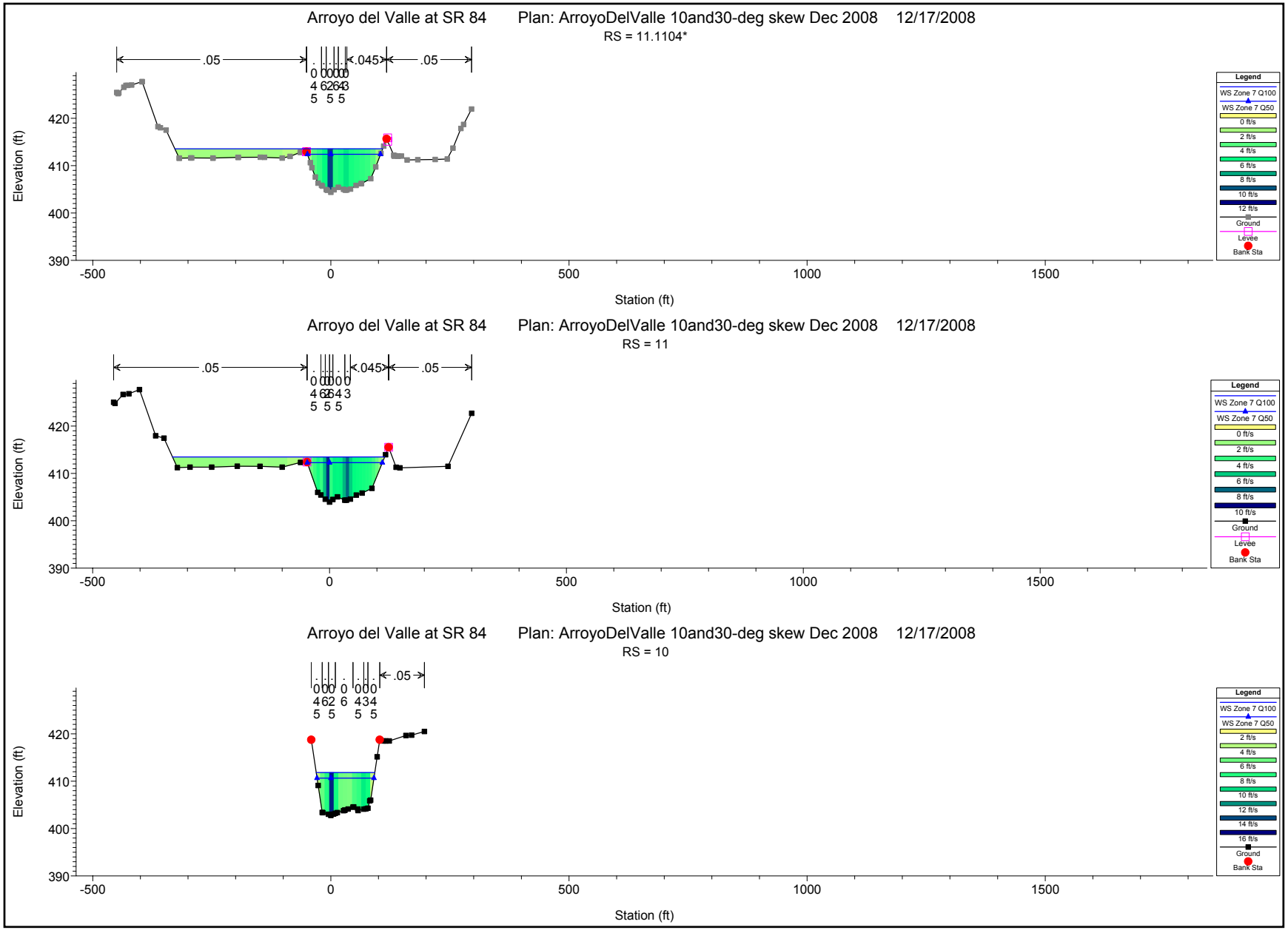
1 in Horiz. = 400 ft 1 in Vert. = 6 ft



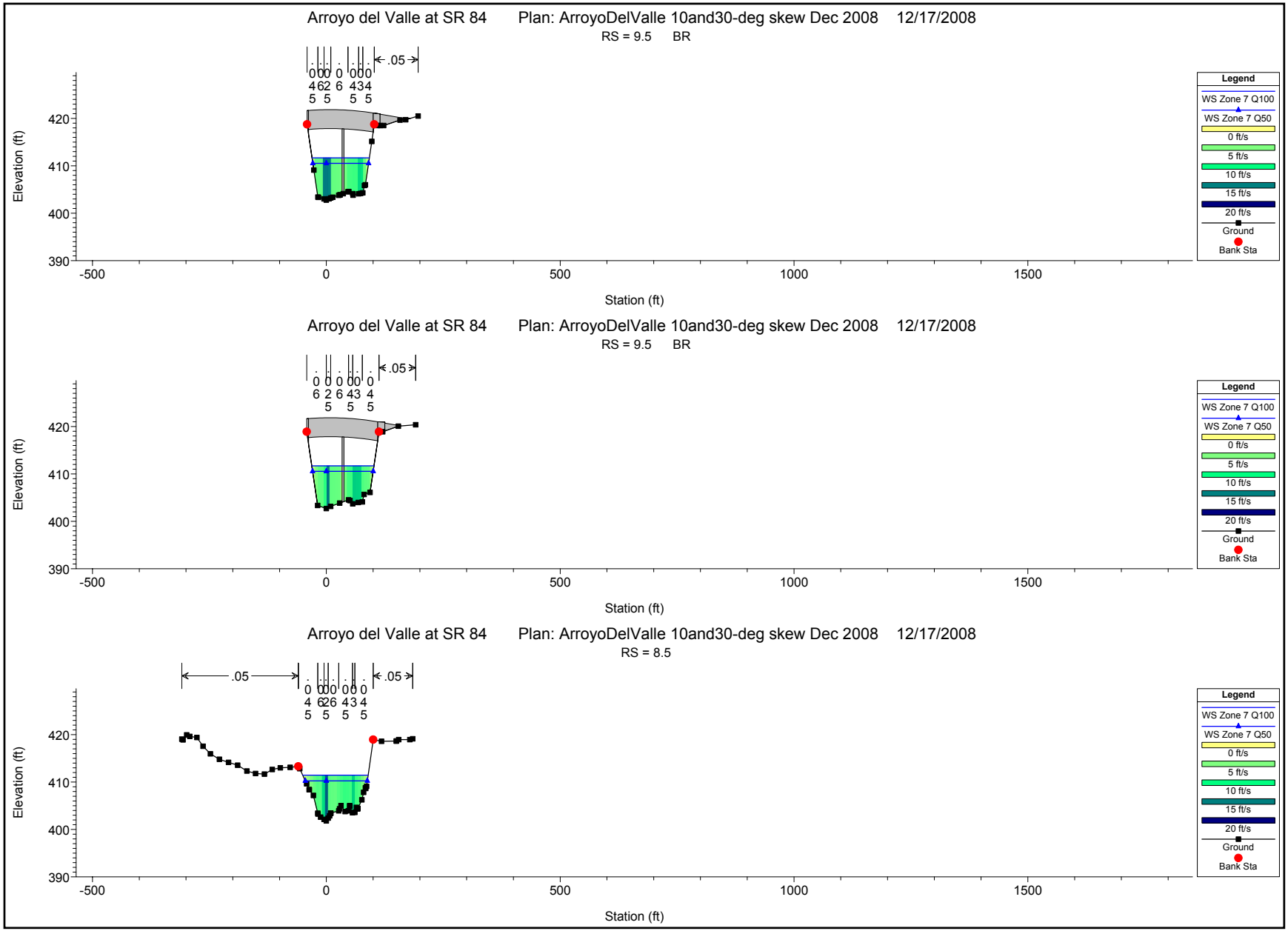
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



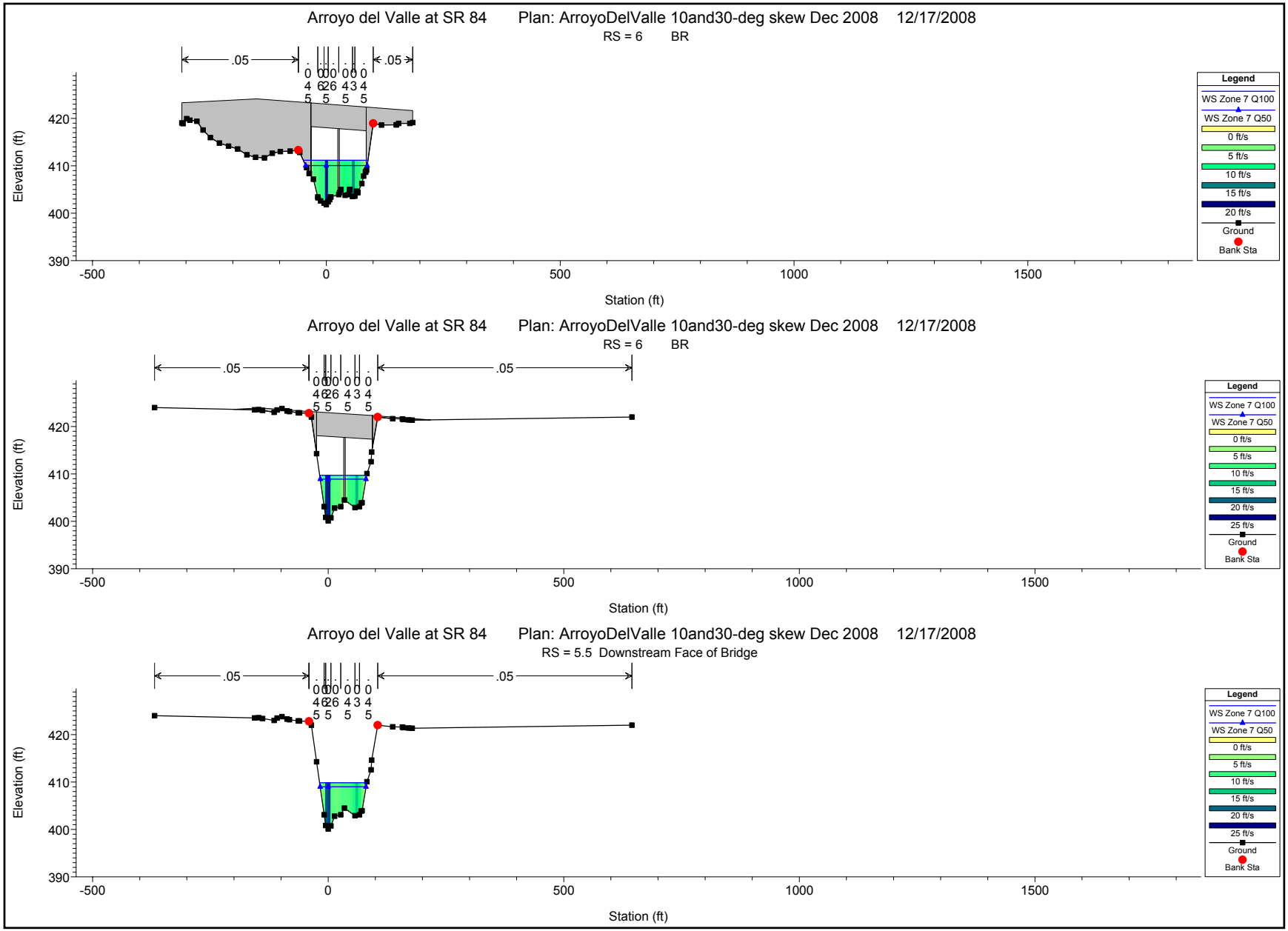
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



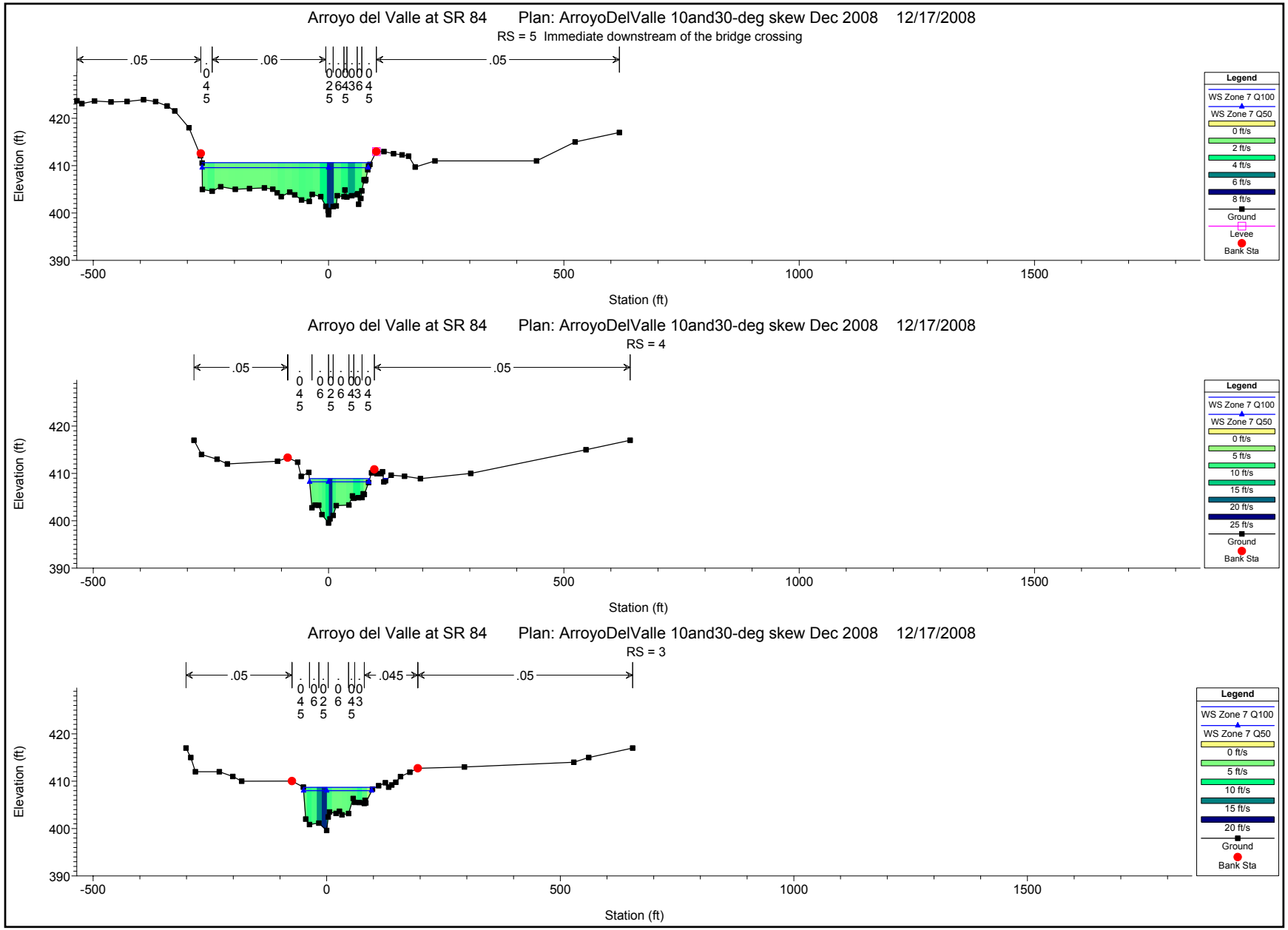
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



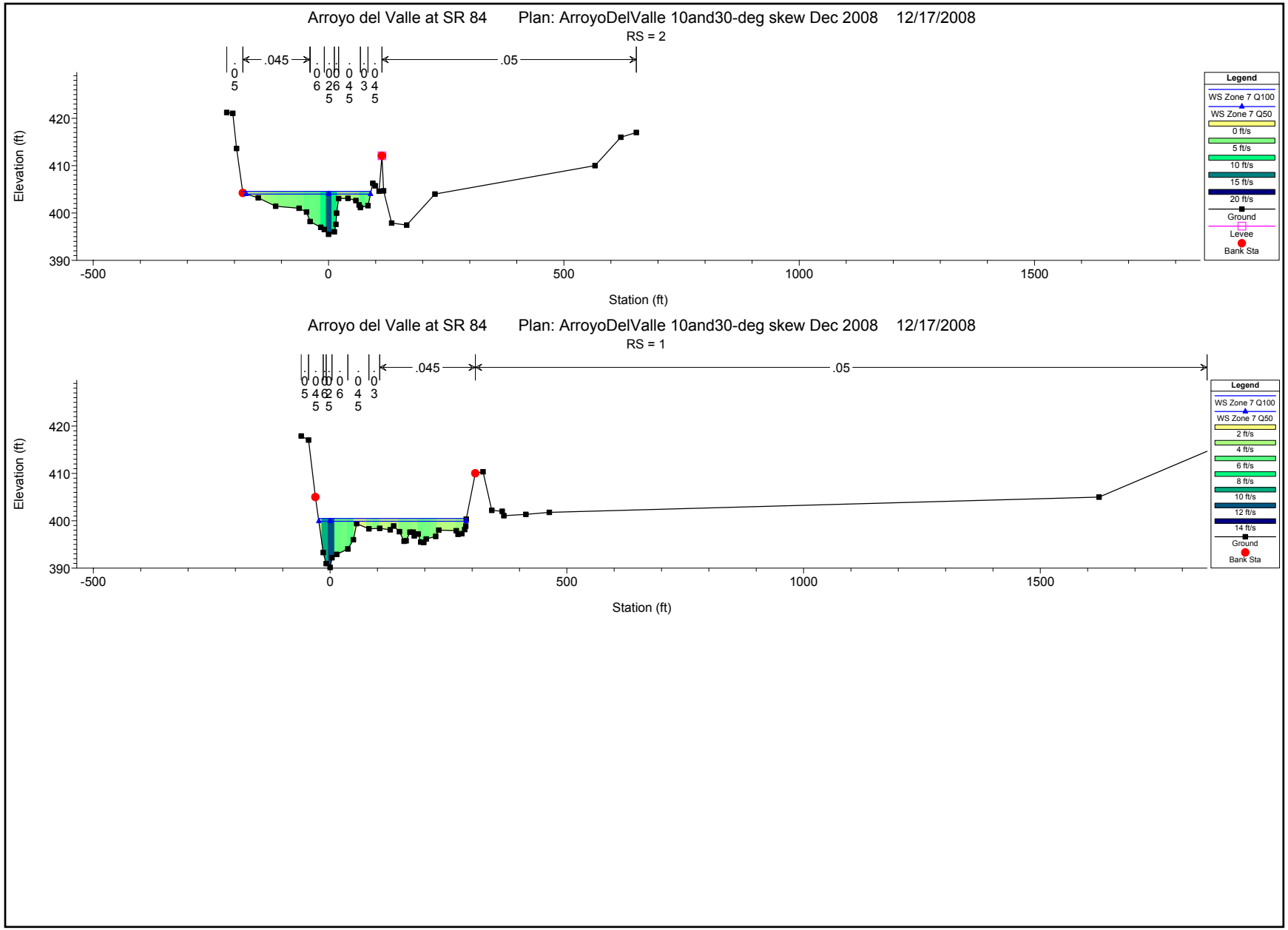
1 in Horiz. = 300 ft 1 in Vert. = 30 ft



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

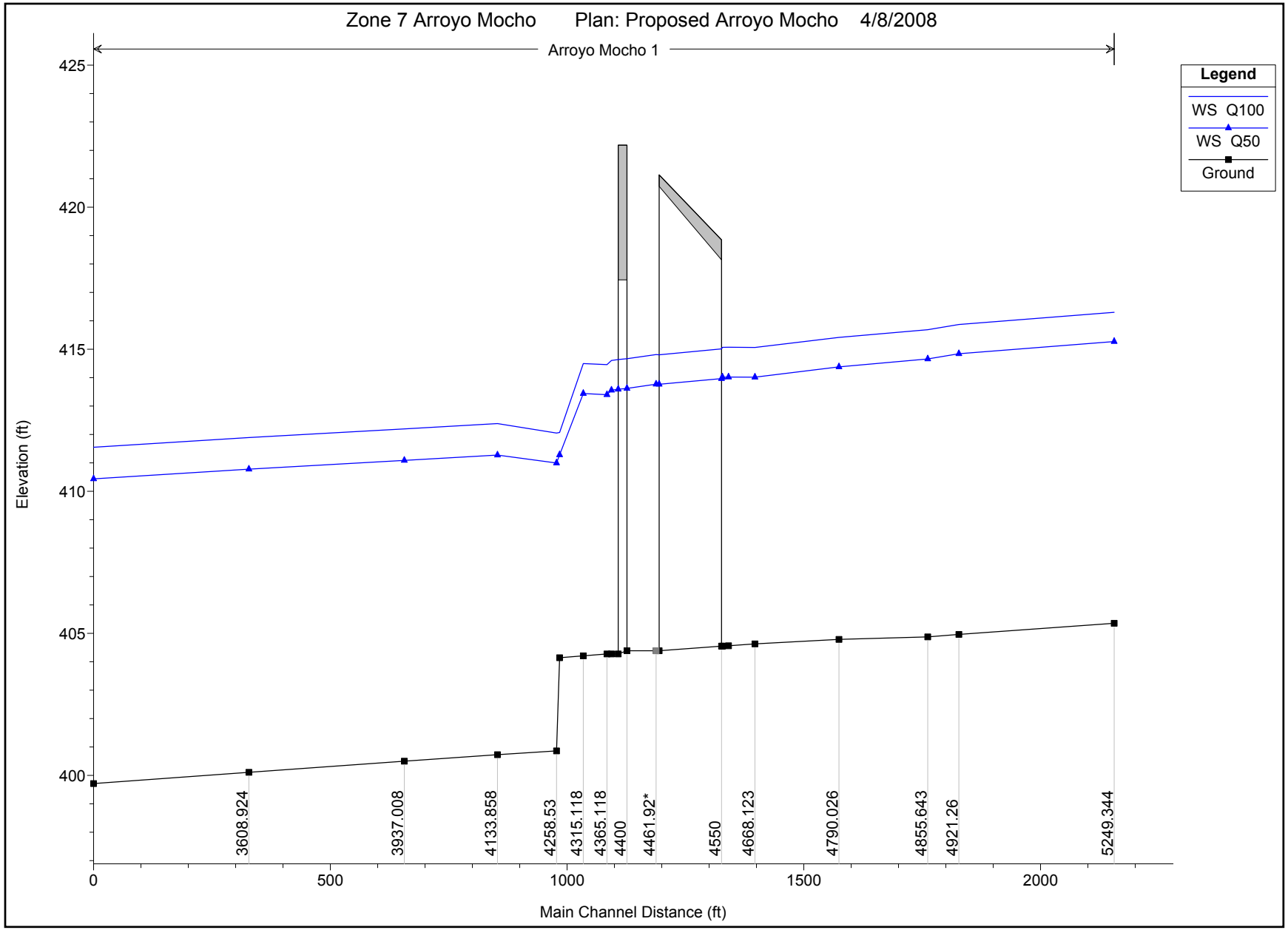
HEC-RAS Results: Proposed Condition

HEC-RAS Plan: Proposed River: Arroyo Mocho Reach: 1

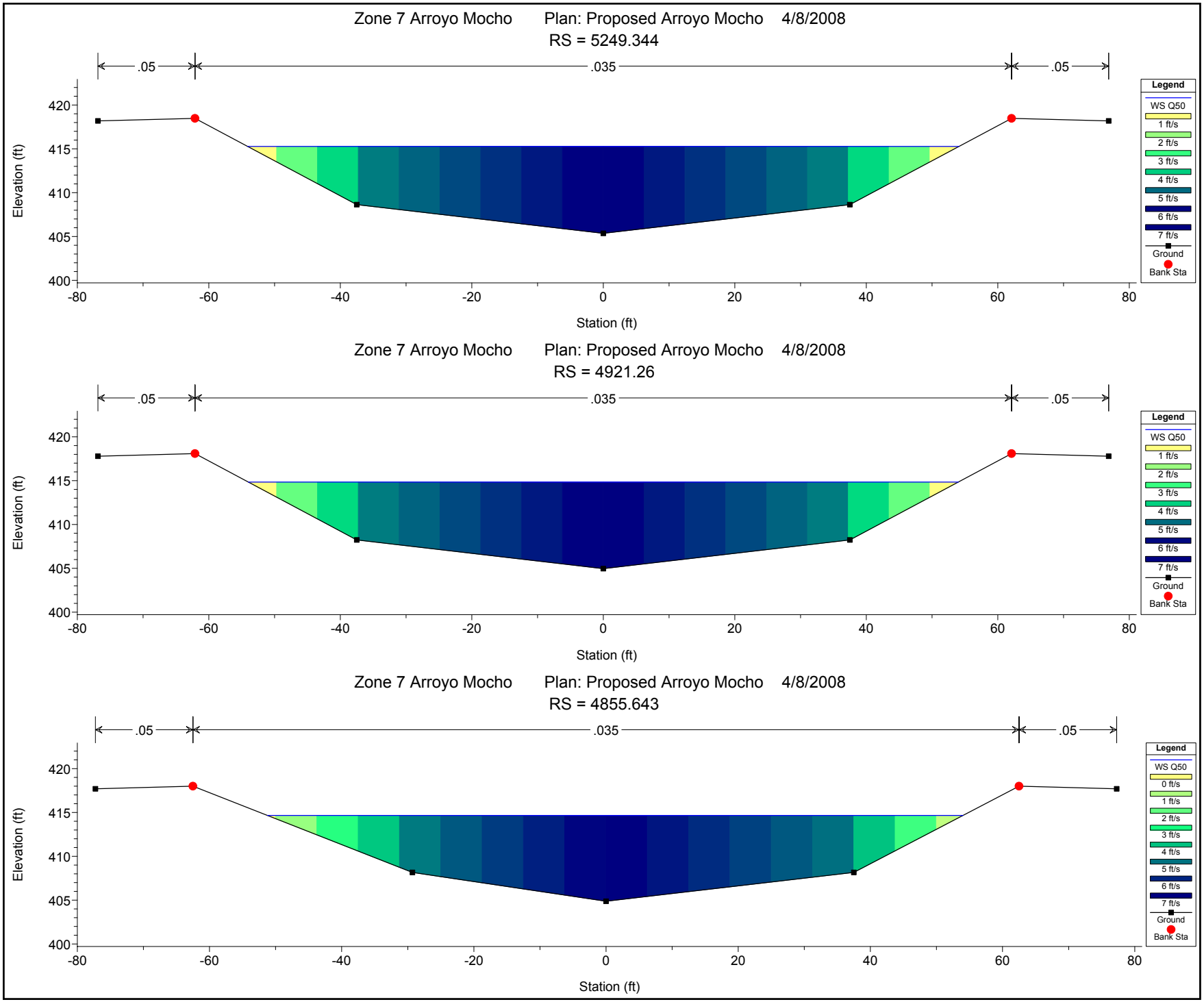
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
1	5249.344	Q100	4800.00	405.35	416.30		416.80	0.001278	5.68	844.46	113.31	0.37		328.08
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	



1 in Horiz. = 300 ft 1 in Vert. = 5 ft



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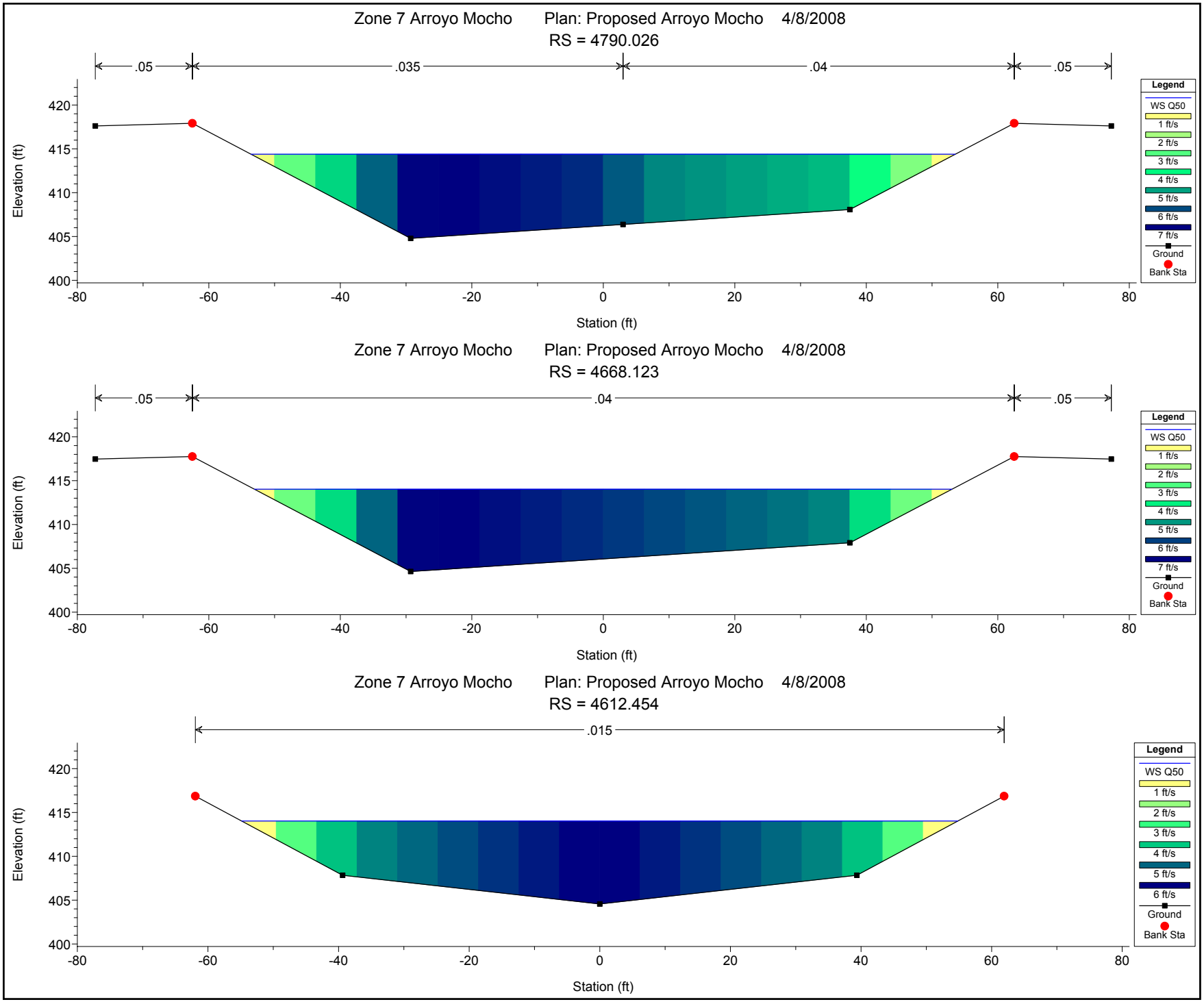

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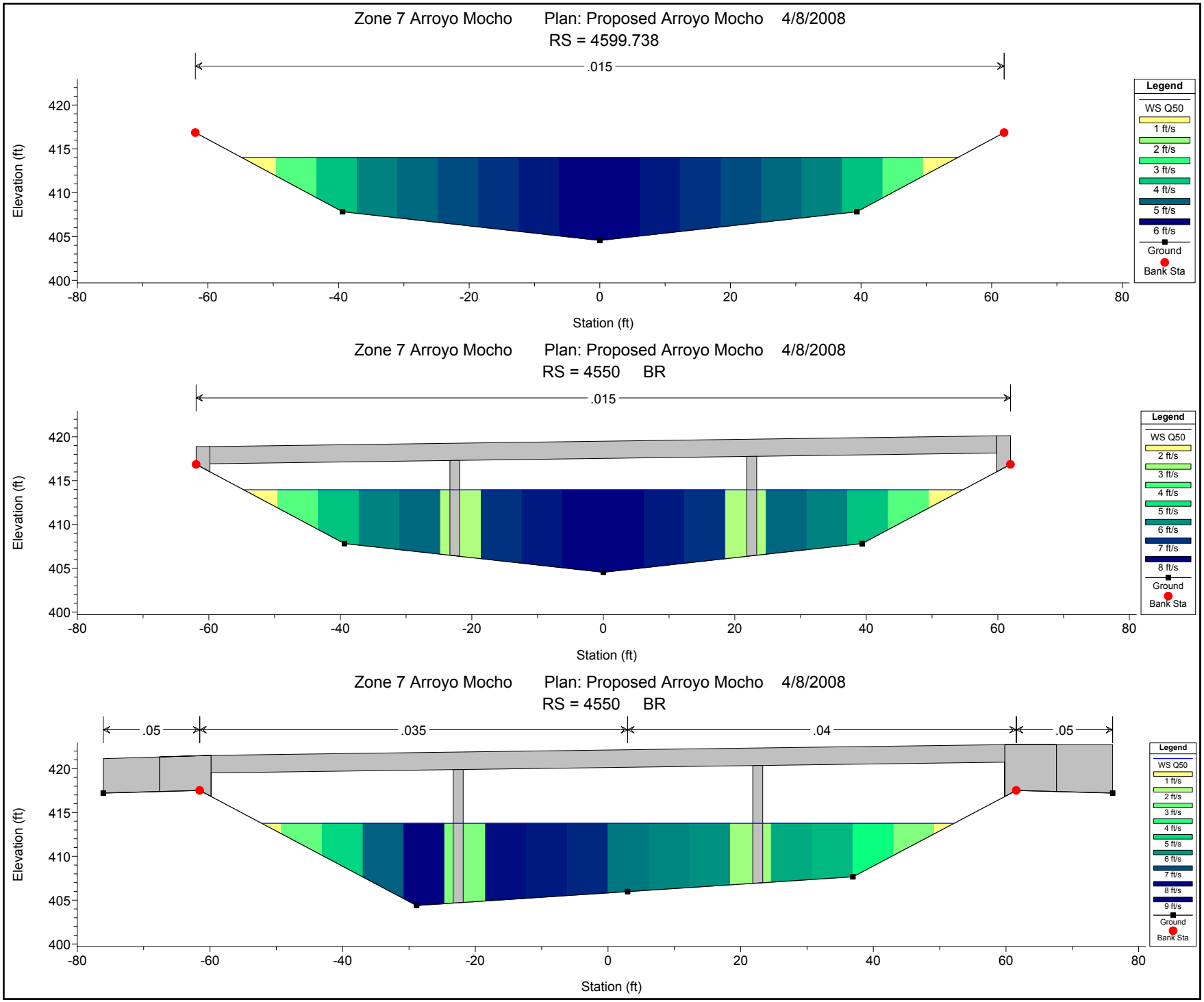

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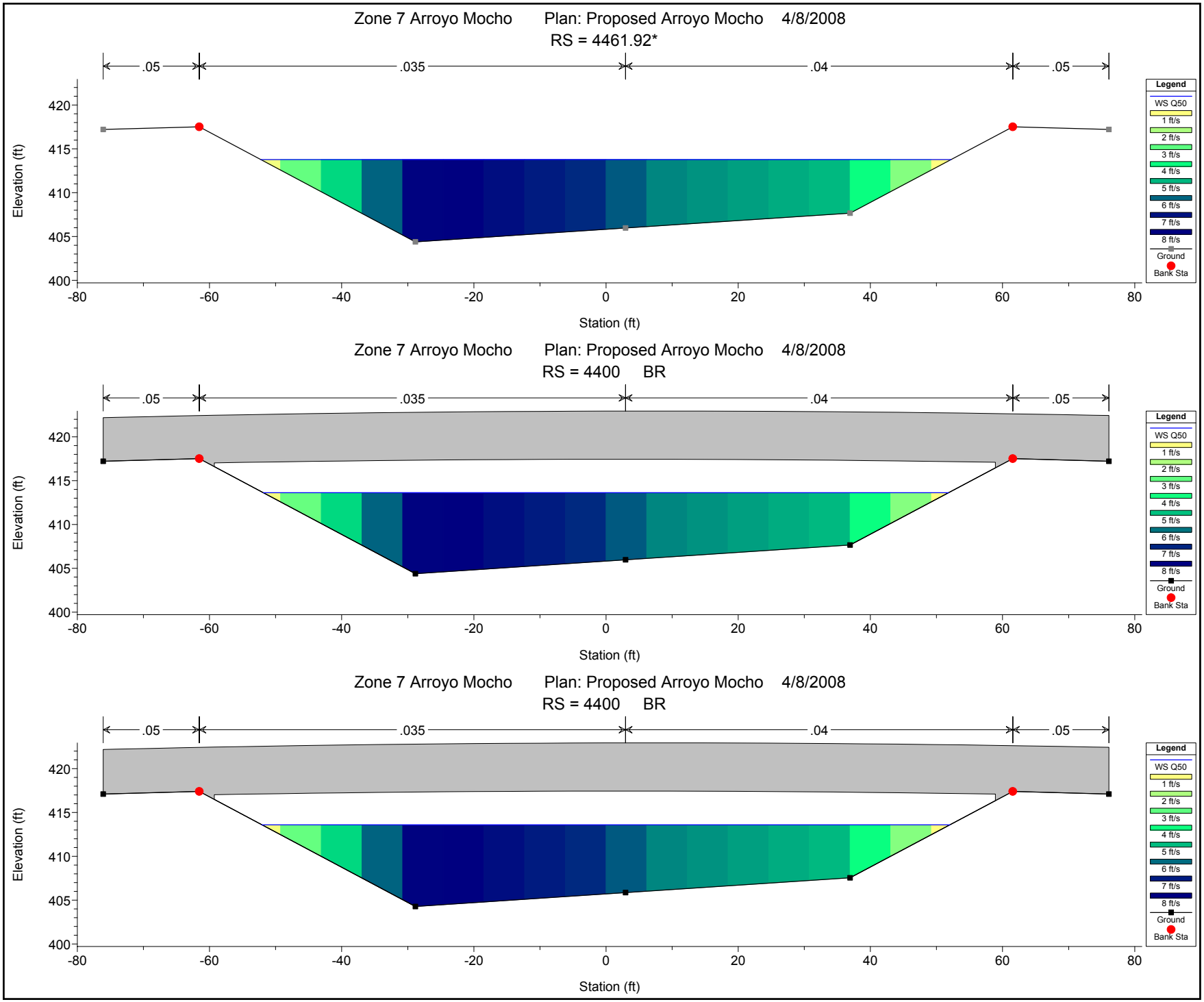

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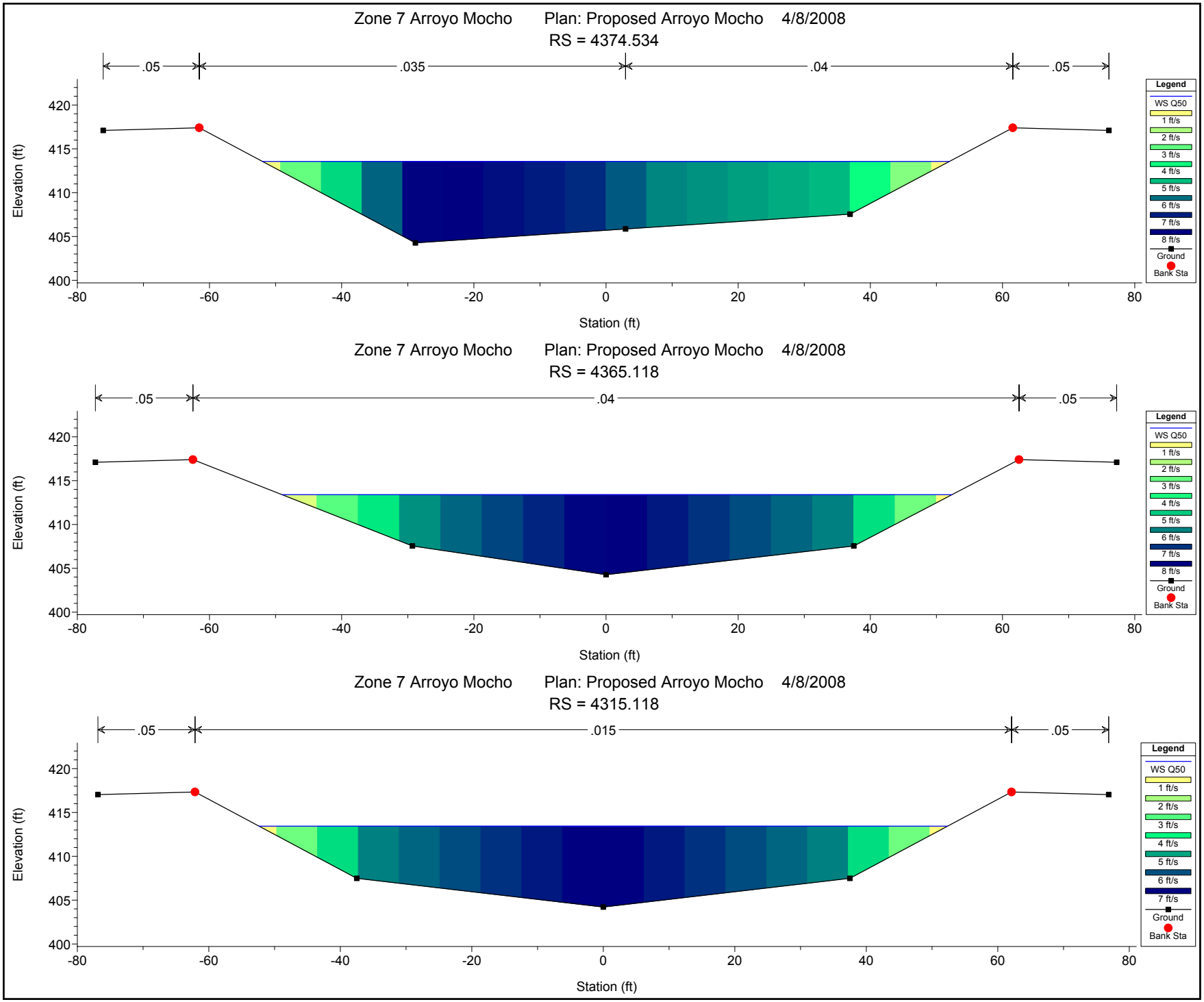
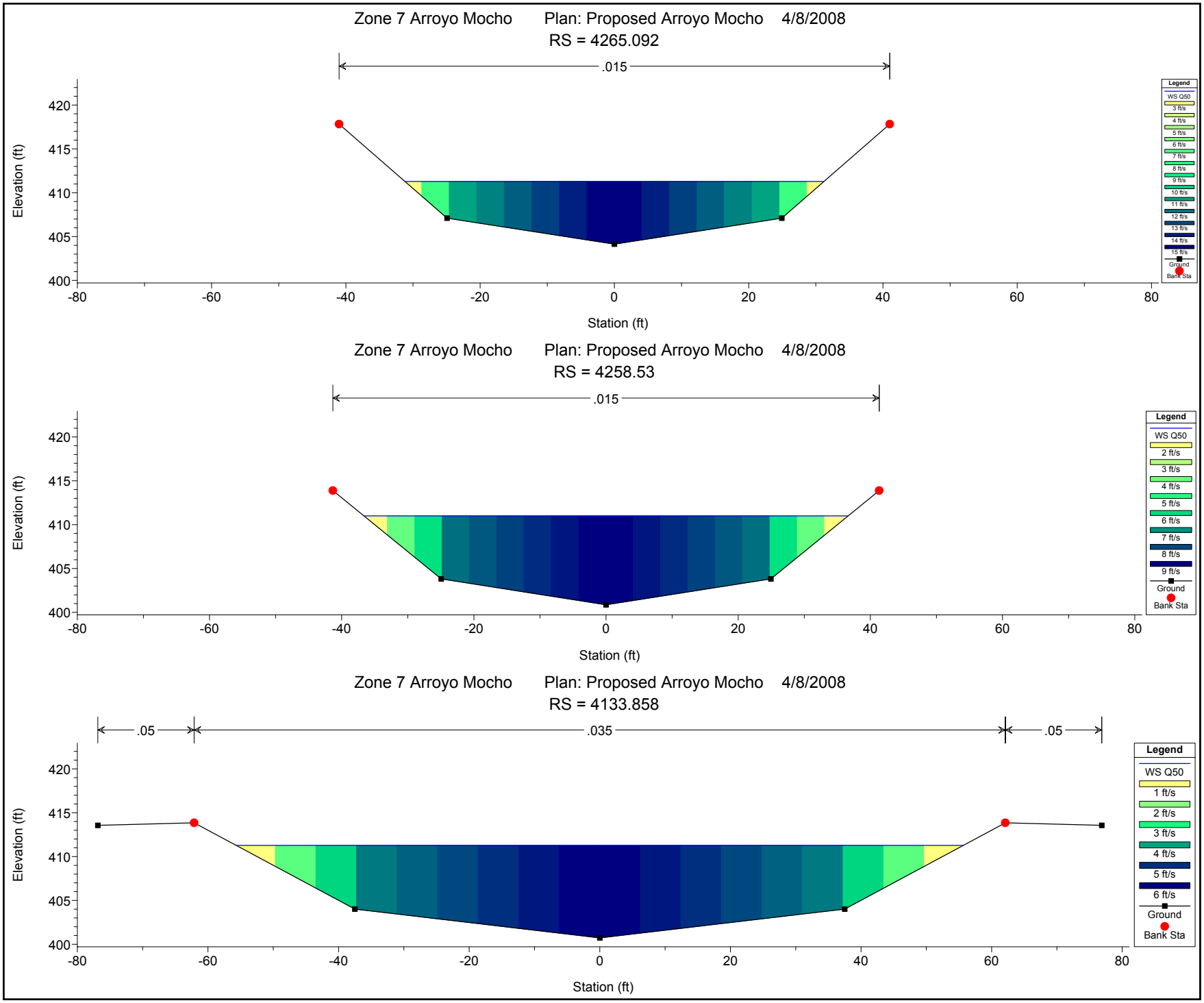
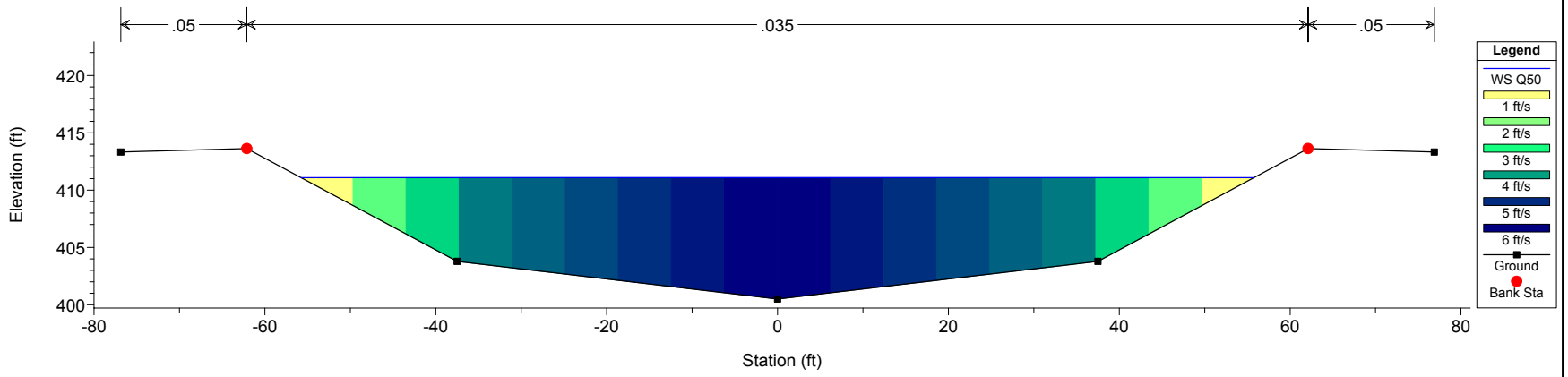


1 in Horiz. = 20 ft 1 in Vert. = 15 ft



1 in Horiz. = 20 ft 1 in Vert. = 15 ft

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
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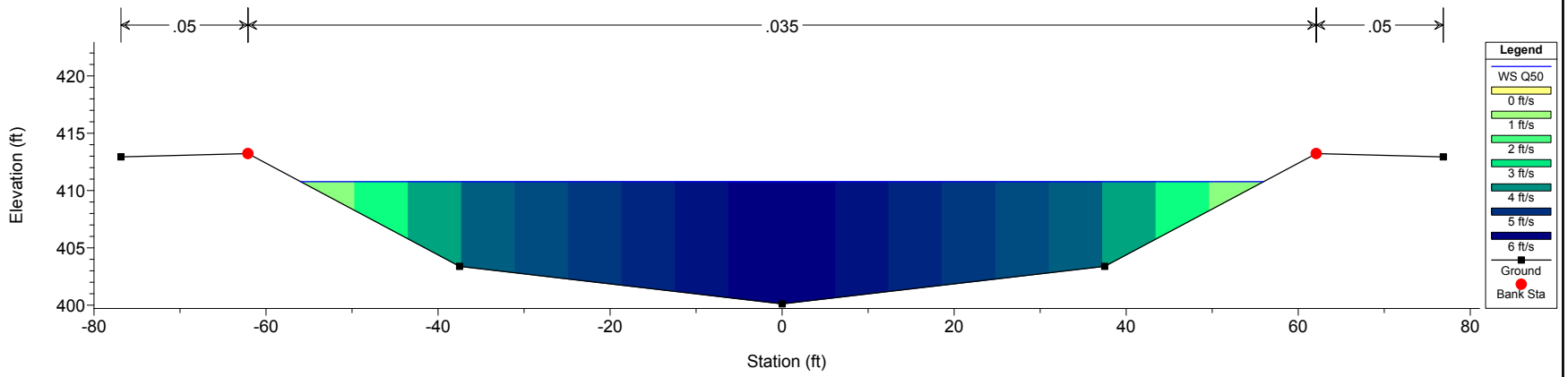
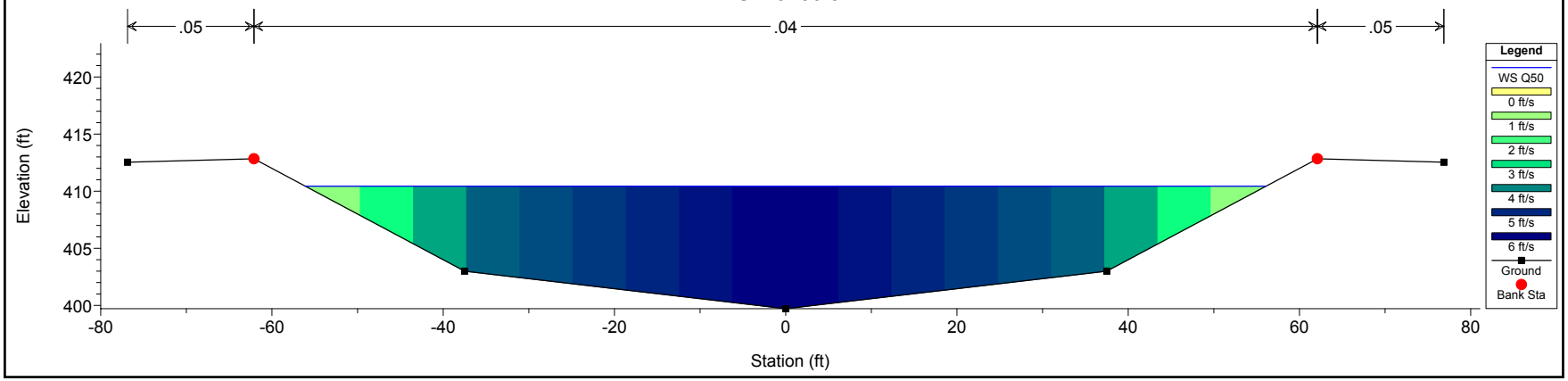


Zone 7 Arroyo Mocho Plan: Proposed Arroyo Mocho 4/8/2008
RS = 3280.84



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

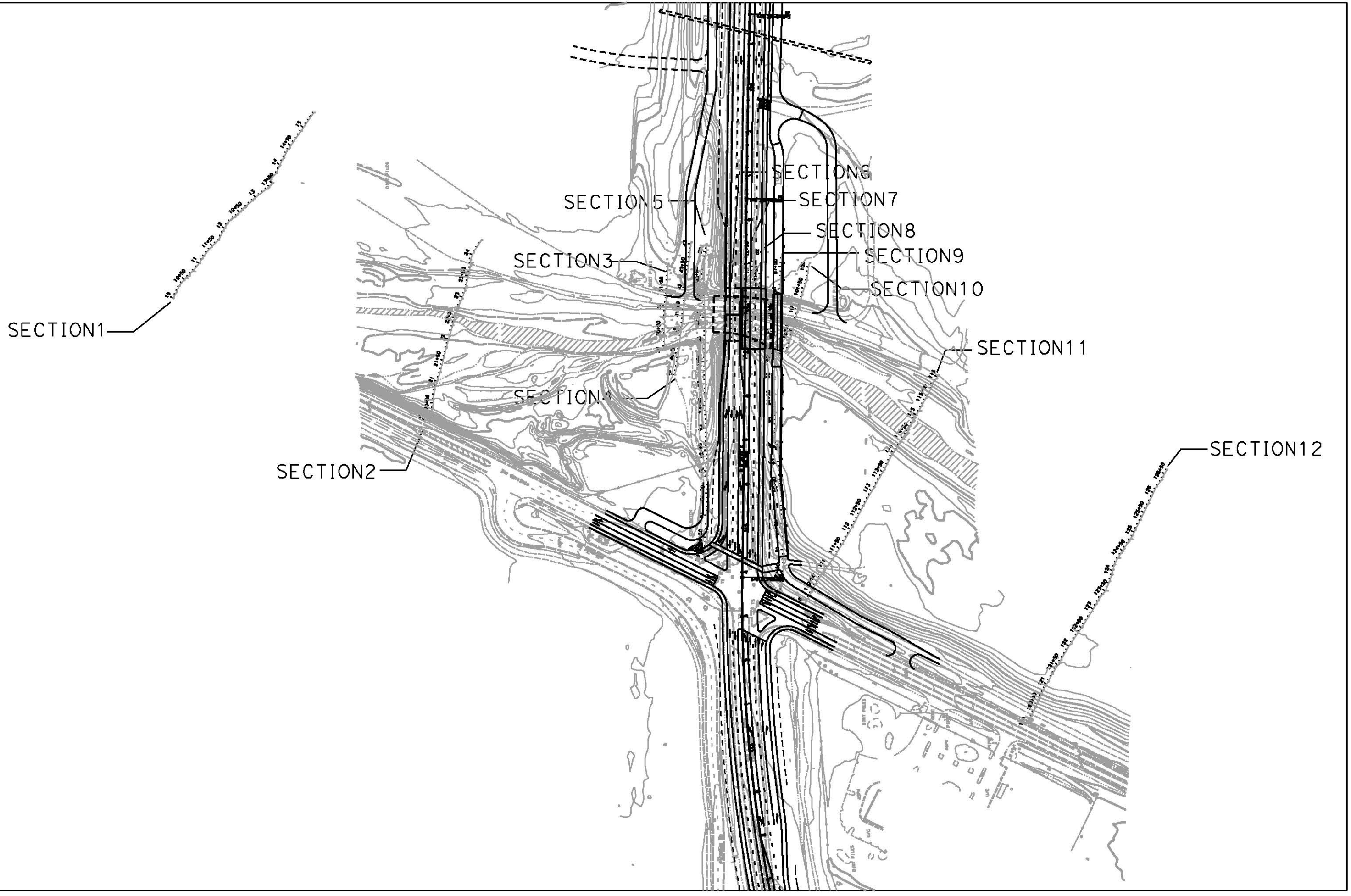
Plan: Proposed Arroyo Mocho 1 RS: 4400 Profile: Q100

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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SECTION12

Appendix F Scour Calculations and Rip Rap Sizing

12/17/08 P0728: SR84 Widening

Trail Bridge Scour Calcs

Contraction Scour

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{k_1} \left(\frac{W_1}{W_2}\right)^{k_1} \qquad \frac{y_2}{6.96} = \left(\frac{7000}{5907}\right)^{1.157} \left(\frac{163.92}{119.57}\right)^{1.243 \cdot 0.69} = 10.01'$$

$y_s = y_2 - y_0$

$W_1 = 163.92$, $W_2 = 119.57$, $y_1 = 6.96$ $\qquad y_s = y_2 - y_0 = 10.01 - 7.11 = \boxed{2.90'}$

Pier Scour

$$\frac{y_s}{a} = 2 k_1 k_2 k_3 k_4 \left(\frac{y_1}{a}\right)^{0.35} F_r^{0.43}$$

$a = 3$, $k_1 = 1.1$, $k_2 = 2.44$, $k_3 = 1.1$, $k_4 = 1.0$, $F_r = 0.889$, $y_1 = 8.92$

$y_s = (2)(1)(2.44)(1.1)(1)\left(\frac{8.92}{3}\right)^{0.35}(0.889)^{0.43}(3)$

$= (5.37)(1.464)(0.951)(3)$

$= \boxed{22.43'}$

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 P072B: SR 24 Widening

SR 24 Bridge Scour Calcs

Contraction Scour

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{6/7}\left(\frac{W_1}{W_2}\right)^{K_1}$$

$$\frac{y_2}{13.65} = \left(\frac{7000}{7000}\right)^{6/7}\left(\frac{133.24}{115.47}\right)^{0.69} = 15.07'$$

($K_1 = 1$, $1.104^{0.69} = 1.07$)

$y_s = y_2 - y_0$

$W_1 = 133.24$, $W_2 = 115.47$, $y_1 = 13.65$

$y_s = y_2 - y_0 = 15.07' - 13.92' = \boxed{1.15'}$

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 $K_1 = 1$, $K_2 = 0.98$, $L' = 20$, $y_a = 3.44$

$$y_s = \left[(2.27)(1)(0.98)\left(\frac{20}{3.44}\right)^{.43}(0.40)^{.61} + 1\right] 3.44$$

$$= [(2.22)(2.13)(.57) + 1]\, 3.44$$

$$= \boxed{12.74'}$$

Right Abutment $K_1 = 1$, $K_2 = 1.01$, $L' = 5$, $y_a = 2.11$

$$y_s = \left[(2.27)(1)(1.01)\left(\frac{5}{2.11}\right)^{.43}(0.43)^{.61} + 1\right] 2.11$$

$$= [(2.29)(1.45)(0.6) + 1]\, 2.11$$

$$= \boxed{6.31'}$$

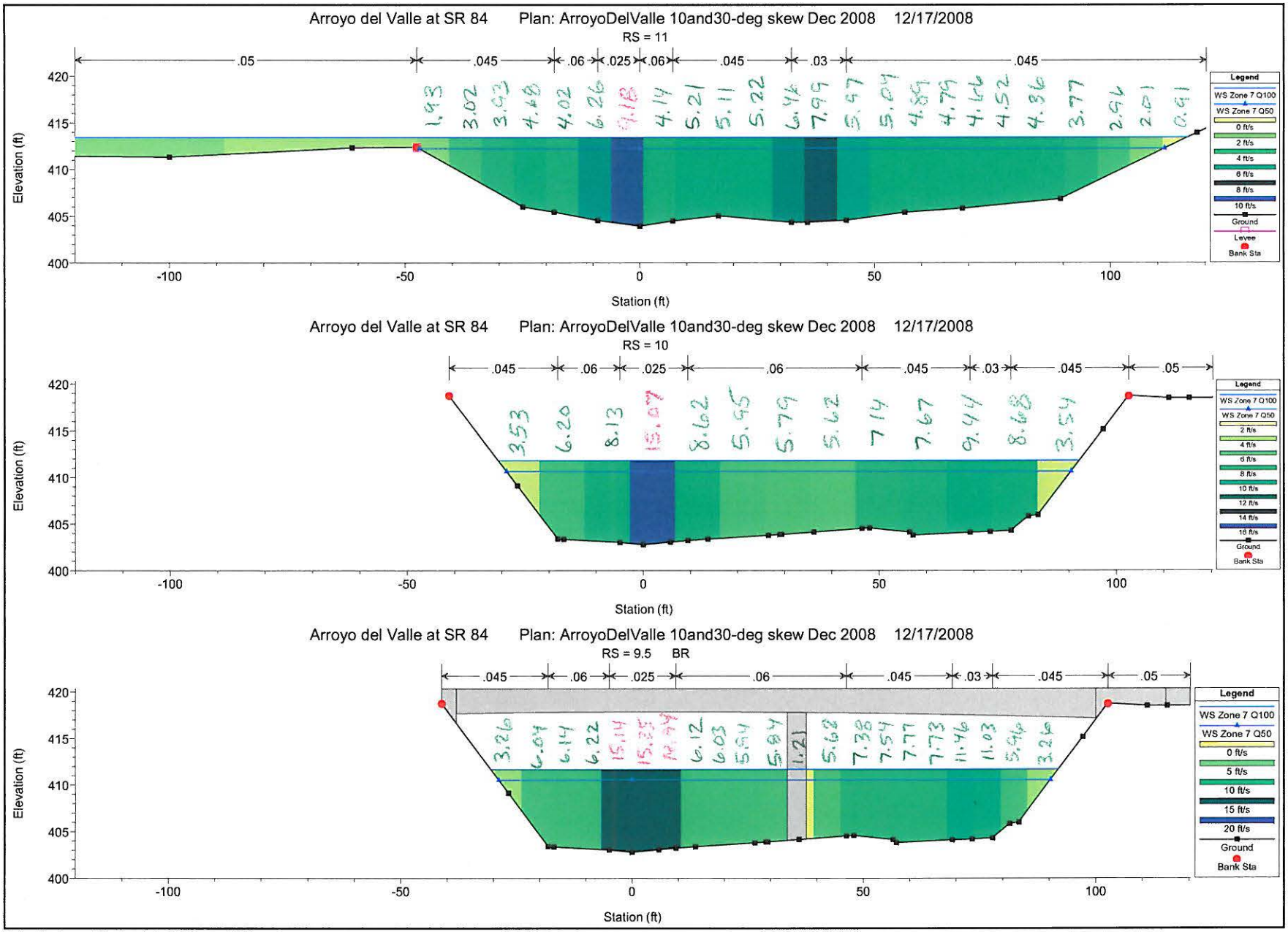
12/18/08 P0728 : SR 84 widening

Riprap Sizing

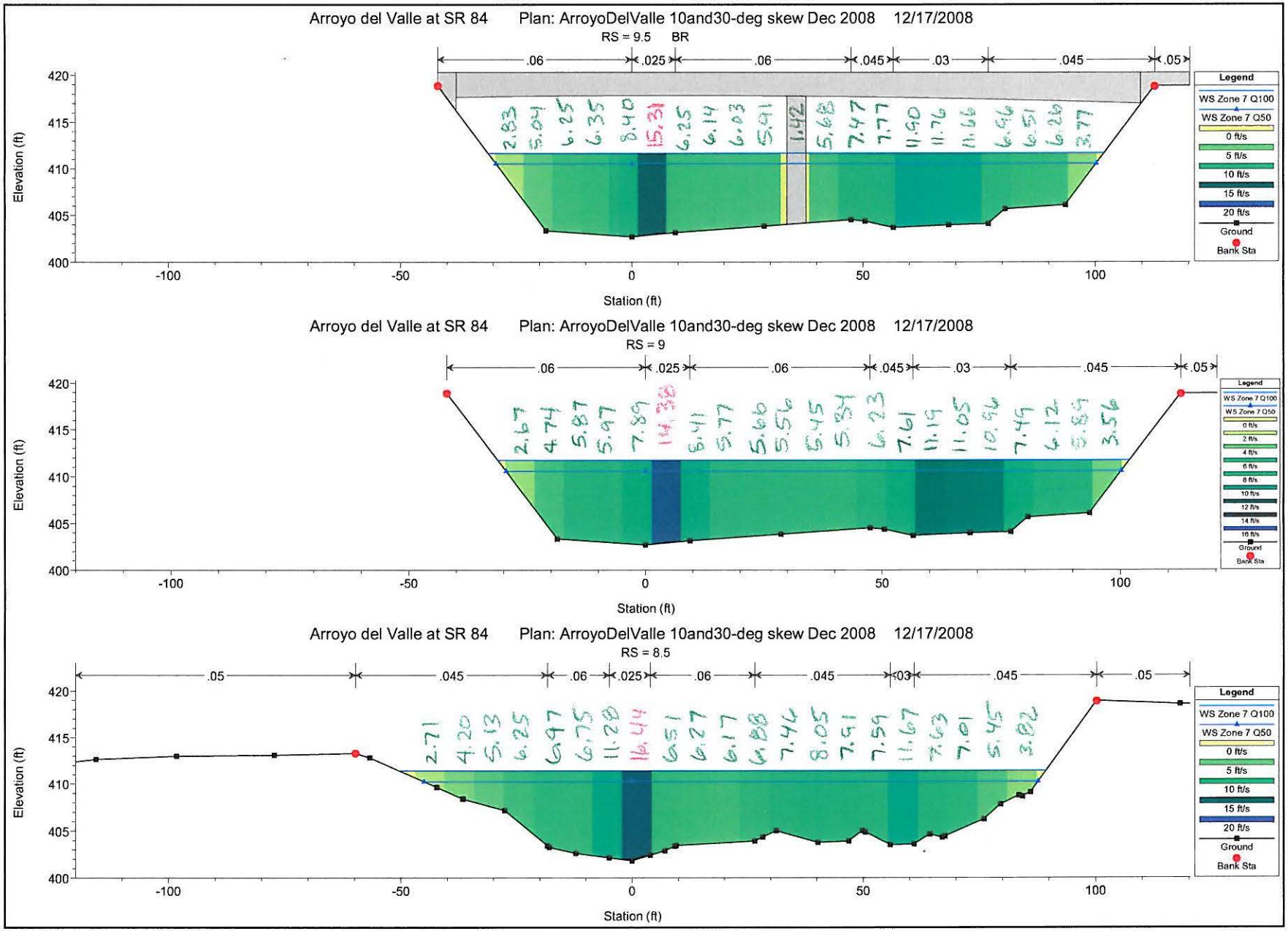
Isbash formula $D_{50} = \frac{0.692\,(KV)^2}{(2g(S_s - 1))}$

		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'	$\frac{1}{4}$-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

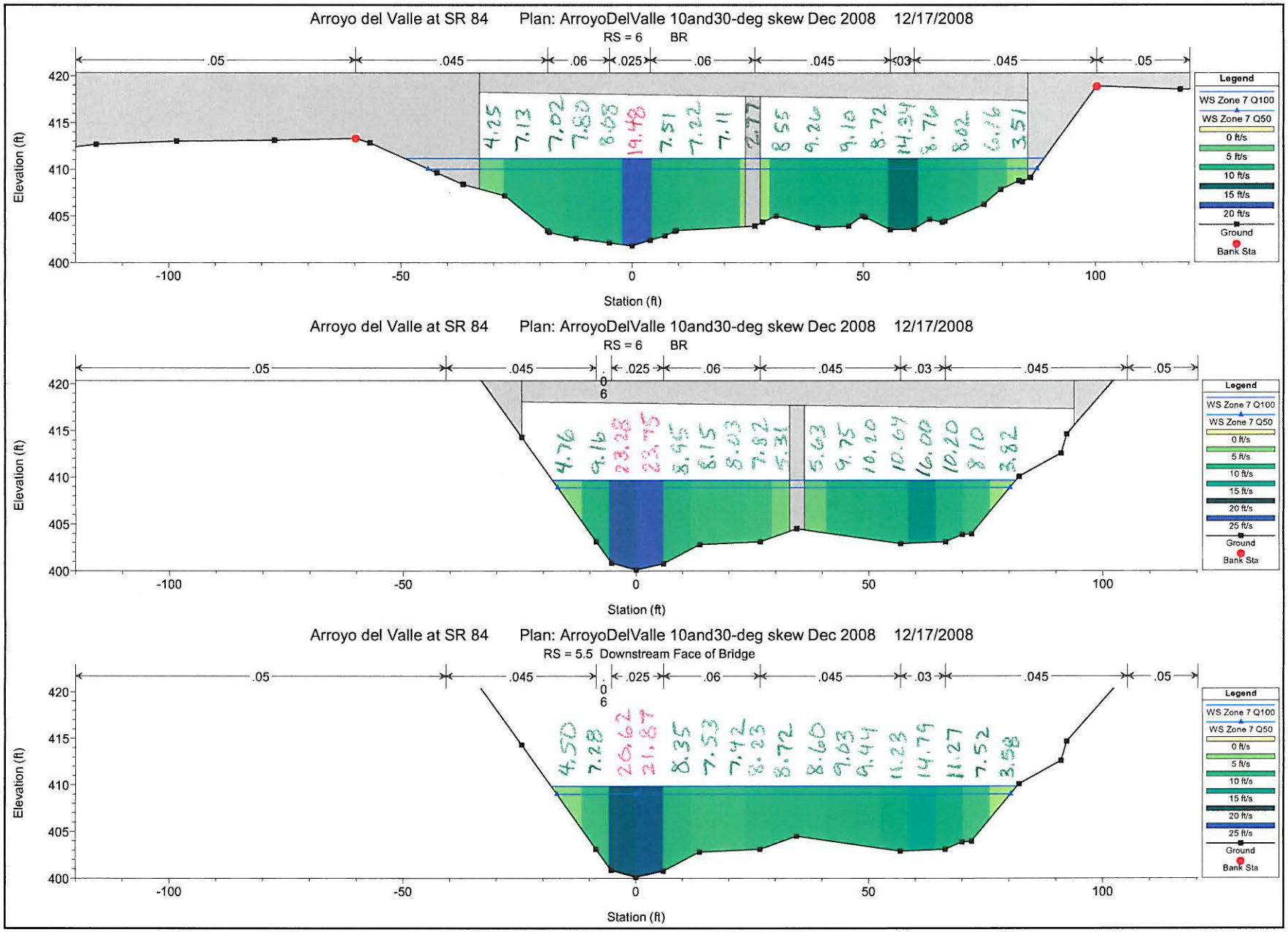
$$D_{50} = \frac{0.692\,((1)(V))^2}{106.26}$$



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.

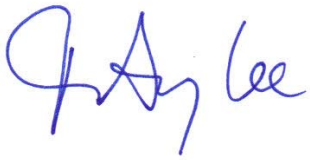
Other Issues

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**

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:
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

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:
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**

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:
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

X-Section Date: 03/02/2006

Measured From : Deck surface

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

ClibPDF - www.fastio.com

Conceptual Storm Water Pollution Prevention Plan

WASTE DISCHARGE IDENTIFICATION (WDID) NUMBER:

STORMWATER POLLUTION PREVENTION PLAN

for

Route 84 Expressway Widening Project-South Segment

CONTRACT NO.: 04-297624

CALTRANS Project Identifier NUMBER: 0400020581

RISK LEVEL: 2

Prepared for:

California Department of Transportation
111 Grand Avenue
Oakland, CA 94623
Rommel Pardo
(510) 715-7920

Submitted by:

,

Project Site Address

In Alameda County, In And Near Livermore And Pleasanton, From 0.1 Mile South Of Ruby Hill Drive To 0.6 Mile North Of Concannon Boulevard

Contractor's Water Pollution Control (WPC) Manager/Qualified S WPPP Developer(QSD)

Contractor's Qualified SWPPP Developer (QSD) (if SWPPP not developed by WPC Manager)

Contractor's Qualified S WPPP Practitioner (QSP) (if different from WPC Manager)

SWPPP Developed by:

AECOM
100 W. San Fernando Street, Suite 200
San Jose, CA 95113
Sherina Lam - Senior Engineer

SWPPP Date

May 1, 2015

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Appendix P .....CEM-2063 Numeric Effluent Limitation Violation Report – ATS Discharges Form

SWPPP Files

File Category 20.01 .....Stormwater Pollution Prevention Plan (SWPPP)
File Category 20.02 .....Stormwater Pollution Prevention Plan Amendments
File Category 20.03 .....Water Pollution Control Schedule Updates
File Category 20.05 .....Notice of Construction or Notice of Intent
File Category 20.06 .....Legally Responsible Person Authorization of Approved Signatory

File Category 20.10 .....Correspondence
File Category 20.21 .....Subcontractor Contact Information and Notification Letters
File Category 20.22 .....Material Suppliers Contact Information and Notification Letters
File Category 20.23 .....Contractor Personnel Training Documentation
File Category 20.31 .....Contractor Stormwater Site Inspection Reports
File Category 20.32 .....Caltrans Stormwater Site Inspection Reports
File Category 20.33 .....Site Visual Monitoring Inspection Reports
File Category 20.34 .....Best Management Practices Monthly Status Reports
File Category 20.35 .....Corrective Actions Summary
File Category 20.40 .....Weather Monitoring Logs
File Category 20.45 .....Rain Event Action Plans
File Category 20.46 .....Rain/Storm Event Sampling and Analysis Plan
File Category 20.50 .....Non-Stormwater Discharge Sampling and Test Results
File Category 20.51 .....Non-Visible Pollutant Sampling and Test Results
File Category 20.52 .....Turbidity, pH and SSC Sampling and Test Results
File Category 20.53 .....Required Regional Water Board Monitoring Sampling and Test Results
File Category 20.54 .....ATS Monitoring Sampling and Test Results
File Category 20.55 .....Field Testing Equipment Maintenance and Calibration Records
File Category 20.61 .....Notice of Discharge Reports
File Category 20.62 .....Numeric Action Level Exceedance Reports
File Category 20.63 .....Numeric Effluent Limitation Violation Reports
File Category 20.70 .....Annual Certification of Compliance
File Category 20.80 .....Stormwater Annual Reports
File Category 20.90 .....Notice of Termination

SECTION 100
SWPPP Certifications and Approval

100.1 Legally Responsible Person Certification and Caltrans Approval

The California Department of Transportation (Caltrans) District Director, as the Legally Responsible Person (LRP), has authorized the Caltrans RE to be the authorized Approved Signatory of Caltrans for reviewing, signing, and certifying the Stormwater Pollution Prevention Plan (SWPPP) in conformance with Section IV.I of the Construction General Permit (CGP) (CAS000002, Order No. 2009-0009-DWQ as ammended by Order 2010-0014-DWQ and 2012-006-DWQ). The LRP authorization for the RE to be the Approved Signatory is provided as Attachment A. The SWPPP was developed by the Contractor and submitted for review and acceptance to the RE, pursuant to the Special Provisions, the SWPPP / Water Pollution Control Program (WPCP) Preparation Manual, and the Standard Specifications Section 7-1.01G – Water Pollution. The Contractor is responsible and liable at all times for compliance with applicable requirements of the CGP (CAS000002, Order No. 2009-009- DWQ as ammended by Order 2010-0014-DWQ and 2012-006-DWQ) for which compliance is ultimately determined by the Regional Water Quality Control Board (RWQCB), the State Water Resources Control Board (SWRCB), and/or the U.S. Environmental Protection Agency (USEPA). Copies of the SWRCB-issued Waste Discharge Identification Number and Notice of Intent form are provided as Attachment B.

For Caltrans Use Only

RE's Acceptance of the
Stormwater Pollution Prevention Plan

Project Name:	Route 84 Expressway Widening Project-South Segment
Caltrans Contract Number:	04-297624
Caltrans Project Identification Number:	0400020581

"I certify under penalty of law that this document and all attachments were reviewed under my direction or 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, to the best of my knowledge and belief, the information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations."

This SWPPP is accepted based on a review performed by myself or personnel acting under my direction that determined that the SWPPP meets the requirements set forth in the contract special provisions, Caltrans Standard Specifications, and the Caltrans SWPPP/WPCP Preparation Manual.

RE's Signature	Date of SWPPP Acceptance

Rommel Pardo	(510) 715-7920
RE's Name	RE's Telephone Number

100.2 Contractor and QSD SWPPP Certification

Contractor's Certification of SWPPP

Project Name: Route 84 Expressway Widening Project-South Segment

Caltrans Contract Number: 04-297624

Caltrans Project Identification Number: 0400020581

"I certify under a penalty of law that this document and all attachments were prepared under my direction or 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, to the best of my knowledge and belief, is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations."

Contractor's Signature	Date
Contractor's Name	Telephone Number
Contractor's Title	

QSD's Certification of SWPPP

Project Name: Route 84 Expressway Widening Project-South Segment

Caltrans Contract Number: 04-297624

Caltrans Project Identification Number: 0400020581

"I certify under penalty of law that I relied upon available project and site information, current watershed and basin plan maps and available soil data to develop this SWPPP so that Best Management Practices (BMPs) were designed and placed in accordance with industry standards and best professional judgment to reduce pollutants from leaving the job site. All other sources relied upon to gain information for this project's SWPPP were appropriate and dependable, based on my best professional judgment. To the best of my knowledge and belief, the information submitted in this SWPPP is in compliance with all requirements of the Construction General Permit (CAS000002, Order No. 2009-009-DWQ as ammended by Order 2010-0014-DWQ and 2012-006-DWQ). I certify that the 'required text' portions of this document are unaltered from the original required text and content."

QSD's Signature	Date
AECOM	
QSD's Name	QSD's Telephone Number
Senior Engineer	
QSD's Title	

100.3 Amendments

100.3.1 SWPPP Amendments Certification and Approval

This SWPPP is meant to be a "living document," therefore, updated and additional information is expected to be added to the SWPPP as the project progresses, including information regarding changes in the field that do not require an amendment, such as the following:

- adding BMPs as required by a *Rain Event Action Plan*
- increasing or decreasing the quantity of BMPs in the field that are already part of the erosion control plan in the SWPPP,
- moving BMPs shown on the WPCDs to protect water quality during different phases of construction,
- updating WPCDs to reflect actual site conditions, and
- maintenance and repairs to BMPs.

This SWPPP shall be amended when:

- a change in construction or operations affects the discharge of pollutants to surface waters, groundwater(s), or a municipal separate storm sewer system (MS4);
- a contract change order includes additional water pollution control practices, not already specified in the approved SWPPP;
- deemed necessary by the RE;
- SWPPP objectives to reduce or eliminate pollutants in stormwater discharges have not been achieved; or
- a CGP violation has occurred; when the RWQCB determines that a CGP violation has occurred, the SWPPP shall be amended and corrective actions implemented within 14 calendar days after notification by the RWQCB.

The following information shall be included in each amendment:

- who requested the amendment;
- the location of proposed change;
- the reason for the change;
- the original BMP proposed, if any;
- the new BMP proposed; and
- any existing implemented BMP(s).

Approved and certified amendments shall be inserted into the appropriate section or attachment of the SWPPP. All SWPPP amendments prepared by the WPC Manager and approved by the Contractor shall be accepted and certified by the LRP or Approved Signatory. A blank copy of the CEM-2008 SWPPP/WPCP Amendment Certification and Approval form is in Appendix A. For approved amendments, the signed SWPPP Amendment Certification and Approval form shall be attached to the SWPPP amendment.

A copy of each approved and certified amendment shall be inserted into Attachment AA. All SWPPP amendments shall be listed in the SWPPP Amendment Log, available in Appendix B. The Amendment Log shall be kept in SWPPP File Category 20.02 and a copy shall be inserted into Attachment AA.

The SWPPP will be completely revised if either the number of amendments or the amount of information contained in the amendments makes implementation of the SWPPP confusing, as determined by the RE, or the Contractor requests to revise the SWPPP based on planned changes in activities that would require a major SWPPP amendment.

100.3.2 Amendment Log

All approved and certified SWPPP amendments shall be shown on the SWPPP Amendment Log. A blank Amendment Log is available in Appendix B. The SWPPP Amendment Log shall include the following information:

- amendment number;
- amendment date;
- brief description of the amendment;
- name of individual requesting amendment; and
- approval date.

All SWPPP amendment(s) prepared and approved as discussed in Section 100.3.1 shall be documented in the Amendment Log and kept in SWPPP File Category 20.02: Stormwater Pollution Prevention Plan Amendments. A copy of the Amendment Log shall also be inserted into Attachment AA.

100.4 Annual Compliance and Approval

By July 15 of each year, the Contractor shall submit the Contractor's Annual Certification of Compliance to the RE stating that the project is in compliance with the terms and conditions of the Permits and the SWPPP. By August 1 of each year, the Caltrans LRP, or RE as authorized Approved Signatory, will complete an Annual Certification of Compliance stating that the project is in compliance with the terms and conditions of the Permits and the SWPPP. A blank copy of the CEM-2070 SWPPP/WPCP Annual Certification of Compliance form is included in Appendix C. Completed Annual Certification of Compliance forms will be filed in SWPPP File Category 20.70: Annual Certification of Compliance.

SECTION 200
OBJECTIVES

This SWPPP has five (5) main objectives, which are listed below.

1. All pollutants and their sources, including sources of sediment associated with construction, construction site erosion, and all other activities associated with construction activity, are controlled.

2. Where not otherwise required to be under a California Regional Water Quality Control Board (RWQCB) permit, all non-stormwater discharges are identified and either eliminated, controlled, or treated.

3. Site BMPs are effective and result in the reduction or elimination of pollutants in stormwater discharges and authorized non- stormwater discharges from the construction activity to the best available technology (BAT) / best conventional technology (BCT) standard.

4. Calculations and design details for site run-on, as well as BMP controls, are complete and correct.

5. Stabilization BMPs designed to eliminate or reduce pollutants after construction is complete have been installed

This SWPPP was developed to conform to the required elements of the CGP (CAS000002, Order No. 2009-0009-DWQ as ammended by Order 2010-0014-DWQ and 2012-006-DWQ) issued by the SWRCB.

This SWPPP is designed to be a useful document for those who must implement the SWPPP on a daily basis in the field. Most of the information necessary for the daily implementation of the SWPPP is contained in Attachment BB: Water Pollution Control Drawings, Attachment CC: Water Pollution Control Best Management Practices List, and Attachment DD: Water Pollution Control Schedule.

This SWPPP is also a "living document" because updated and additional information is added to the SWPPP file categories as the project progresses, including:

- SWPPP Amendments;
- Subcontractor and Material Supplier Information;
- Contractor Personnel Training Documentation;
- Site Inspection Reports;
- Monthly Status Reports;
- Rain Event Action Plans;
- Sampling and Analysis Results; and
- Notice of Discharge Reports.

The SWPPP shall be readily available on site for the duration of the project.

SECTION 300
PROJECT AND CONTRACTOR INFORMATION

300.1 Project Description

The Project Description for EA 04-297624 is as follows:

The State Route (SR) 84 Expressway Widening Project (Project) located in Livermore and Pleasanton in Alameda County, proposes to widen and upgrade 2.8 miles of SR 84 from 0.1 mile south of Ruby Hill Drive to 0.6 mile north of Concannon Boulevard to expressway standards (55 miles per hour [mph]). 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, and Concannon Boulevard will be widened and upgraded to accommodate future traffic movements. A connector access will be constructed at the SR 84/Vallecitos Road intersection to accommodate the high volume of traffic moving from northbound SR 84 to the City of Livermore. 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 southward to Vineyard Avenue. The Project will also construct a new access bridge at Arroyo Del Valle for local utility and maintenance facilities, the Isabel Trail crossing, and widen the existing bridge across Arroyo Del Valle. The Project will construct retaining walls where right-of-way is constrained.

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 4:1 or flatter to provide a clear recovery zone (CRZ) for errant vehicles. Outside the CRZ, side slopes will be 2:1 or flatter. The roadway median area at intersections will be widened up to 36 feet to accommodate left-turn lanes.

A first order of work shall be clearing obstructions for the proposed outside pavement widening on SR 84 WB/EB directions (Westbound, "A1" 226+98 to "A1" 259+18 Lt)/Eastbound, "A1" 257+00 to "A1" 259+50 Rt) and constructing Vallecitos Connector ("A1" 245+00 to "V" 113+18 Rt). The activities will consist of removal of existing trees, disposal of existing vegetation, and grading work.

Another first order of work shall be to begin construction of Retaining Walls No. 236, 246, and MSE Wall No. 245 along Vallecitos Connector.

This Conceptual SWPPP only covers work during the first 60 days of construction while the SWPPP is being amended or developed by the Contractor for submittal to Caltrans. On the 61st day of construction, this Conceptual SWPPP will no longer be effective unless otherwise directed by the Resident Engineer. Work to be conducted during this 60-day period includes construction of the aforementioned outside pavement widening (WB/EB directions), Retaining Walls No. 236, 246, and MSE Wall No. 245 along Vallecitos Connector, and removal and disposal of existing vegetation for these construction activities.

This Conceptual SWPPP is necessary to avoid delays in construction due to regulatory seasonal exclusion dates for construction activities related to tree removal as stated in the regulatory permits referenced in Section 400 "Permits and Agreements" and included in Attachment F.

300.2 Project Risk Level

The risk level assessment of the project site was calculated to be Risk Level 2 . This risk level will determine the minimum level of BMPs that will be acceptable based on the project site and the project construction activities. The risk level is the basis for the minimum level of site-specific monitoring and reporting that will be required. The risk level is based on project duration, proximity to impaired receiving waters, and soil conditions. The Risk Level Determination is discussed in Section 500.1.3 and the calculations are included in Attachment C.

300.3 Construction Sites Estimates

The following are estimates of the construction site.

- Construction site area 6.8 acres
- Percentage impervious area before construction 11.6%
- Runoff coefficient before construction 0.30
- Percentage impervious area after construction 63.2%
- Runoff coefficient after construction 0.60

Run-on from off-site areas anticipated: ◉ Yes ○ No

Anticipated stormwater run-on flow rate to the construction site:

Anticipated drainage patterns following the completion of grading activities are shown on the WPCDs from Attachment BB.

For the work covered under this Conceptual SWPPP.

Significant run-on to the Project site is not anticipated for work covered under this Conceptual SWPPP. If a rain event occurs during coverage under this Conceptual SWPPP, run-on should be managed in accordance with Section 500.3.1 of this this Conceptual SWPPP. The Contractor's QSD should evaluate and address anticipated run-on for work covered under the Contractor's SWPPP.

Locations of potential run-on with the estimated flow rates shall be noted on the WPCDs. The BMPs designed to handle the run-on flows are included in Section 500.3.1.

300.4 Vicinity and Site Map

The construction project vicinity map showing the project location, surface water boundaries, geographic features, construction site perimeter, and general topography, is located in Attachment D. The project contract plan Title Sheet provides additional detail regarding the project location and is also included in Attachment D.

300.5 Unique Site Features

Project has Fill Material: ◉ Yes ○ No

Project has Native Material: ◉ Yes ○ No

Hydrologic Soil Group: ☐ A (high infiltration rate) ☐ B (moderate infiltration rate) ☐ C (slow infiltration rate) ☑ D (very slow infiltration rate)

Soil Erodibility: ☐ Slight ☑ Moderate ☐ Severe

Unique Features Onsite: ☐ Water Bodies ☑ Wetlands ☑ Endangered or Protected Species

☑ Environmentally Sensitive Areas ☐ Other ☐ None

Please note that vehicles and equipment cannot be parked in wetted areas, including ponded, flowing, or wetlands areas. Equipment parked adjacent to stream and wetted areas must be positioned over drip pans.

Please note that the Contractor shall complete a survey, with an Caltrans-Approved Biologist, of the project area looking for San Joaquin kit fox, California tiger salamander, and california red-legged frog. Consultation with the CT biologist must be completed prior to work in these areas.

Please note that the construction CSWPPP measures presented in this report only pertains to the construction work to be carried on during the first 60 days. The CSWPPP is good up to 60 days and/or completion of work of Retaining Walls No. 236, 246, & 245 and clearing obstructions for the proposed outside widening of SR 84 WB/EB directions, whichever comes first.

The Contractor is to implement BMPs to meet the requirements of the CSWPPP for the first 60 days. The BMPs used are the base line for site inspections and visual monitoring. Duties of the Contractor's WPC Manager include but are not limited to: monitoring discharges performing general site cleanup activities, performing fueling and maintenance activities; providing spill control; ensuring that no materials other than stormwater are discharged to receiving waters or storm drain systems; etc.

The CSWPPP must conform with the elements of Permits and with required elements of the general Permit issued by the State of California and State Water Resources Control Board (SWRCB).

All trees not marked for preservation and all snags, logs, brush, stumps, shrubs, rubbish, and similar materials shall be cleared from within the limits of the designated areas. All materials cleared and grubbed from the designated areas to be properly disposed of. The contractor is responsible for complying with all regulations and Permit requirements.

300.6 Contact Information for Responsible Parties

The following parties are responsible for this SWPPP:

WPC Manager

Name:

Title: **Water Pollution Control Manager**

Company: **TBD**

Address: **TBD**

TBD,

Phone Number: **TBD**

Emergency Phone Number (24/7):

Email address: **TBD**

Resident Engineer

Name:	**Rommel Pardo**
Title:	**Resident Engineer**
Company:	**California Department of Transportation**
Address:	**111 Grand Avenue**
	Oakland, CA 94623
Phone Number:	**(510) 715-7920**
Emergency Phone Number (24/7)	**TBD**
Email address:	**TBD**

Contractor

Name:	
Title:	**Contractor**
Company:	
Address:	
	,
Phone Number:	
Emergency Phone Number (24/7)	**TBD**
Email address:	**TBD**

Erosion and Sediment Control Provider

Name:	**TBD**
Title:	**TBD**
Company:	**TBD**
Address:	**TBD**
	,
Phone Number:	**TBD**
Emergency Phone Number (24/7)	**TBD**
Email address:	**TBD**

Stormwater Sampling and Testing Agent

Name:	**TBD**
Title:	**TBD**
Company:	**TBD**
Address:	**TBD**
	,
Phone Number:	**TBD**
Emergency Phone Number (24/7)	**TBD**
Email address:	**TBD**

300.7 List of Subcontractor and Materials Suppliers

The following subcontractors will be working on this project:

1 **TBD**

SWPPP Responsibility:

2 **TBD**

SWPPP Responsibility:

Contact information for each subcontractor will be provided in the SWPPP Notification log in SWPPP File Category 20.21: Subcontractor Contact Information and Notification Letters. Contact information shall include subcontractor name, type of work performed, contact name, phone number and emergency telephone number (24/7).

The following materials suppliers will be delivering materials to the project site and must comply with pertinent SWPPP requirements:

1 **TBD**

2 **TBD**

Contact information for each material supplier will be provided in the SWPPP Notification log in SWPPP File Category 20.22: Material Supplier Contact Information and Notification Letters. Contact information shall include company name, type of material supplied, contact name and phone number.

All subcontractors and material suppliers shall be notified that the project is covered by the

- SWRCB Order No. 2009-0009-DWQ as amended by Order 2010-0014-DWQ and 2012-006-DWQ, NPDES General Permit No. CAS000002, National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities, September 02, 2009 (Construction General Permit).

Each subcontractor and material supplier shall also be notified that the project has a SWPPP and the pertinent water pollution control BMPs with which the subcontractor or material supplier must comply. If subcontractors or material suppliers are added during the project, appropriate notification that the project has a SWPPP and the pertinent water pollution control BMPs shall be given to the subcontractor or materials supplier prior to working or supplying materials on the project site.

A SWPPP Notification Letter shall be sent to all subcontractors and material suppliers. A sample notification letter and notification letter log is provided in Appendix D. A copy of SWPPP Notification Letters sent to subcontractors and material suppliers are in SWPPP File Category 20.21: Subcontractor Contact Information and Notification Letters or 20.22 Material Supplier Contact Information and Notification Letters. Notification letter logs and contact information are filed in SWPPP File Category 20.21: Subcontractor Contact Information and Notification Letters and File Category 20.22: Material Supplier Contact Information and Notification Letters.

300.8 Training

The Contractor's WPC Manager is a QSD. The WPC Manager for this project, meets the qualifications and certification requirements of Section VII, Training Qualifications and Certification Requirements, of the CGP based on:

- TBD

The WPC Manager has received the following training:

- TBD
- TBD

The WPC Manager has the following SWPPP development and implementation experience:

- TBD
- TBD

Ongoing, formal training sessions for individuals responsible for SWPPP development and implementation shall be selected from one of the following organizations.

- City of Los Angeles Storm Water Program
- County of Los Angeles Storm Water Program
- State of California RWQCB
- ECA-, ABAG- and/or AGC-sponsored training
- USEPA-sponsored training
- Recognized municipal stakeholder organizations throughout California
- Professional organizations and societies in the building and construction field
- TBD

Contractor or subcontractor employees responsible for water pollution control BMP installation, maintenance and repair have received the following training.

- TBD

Contractor and subcontractor employees shall be trained prior to working on the site in the following subjects:

- water pollution control rules and regulations
- implementation and maintenance for:
  - temporary soil stabilization,
  - temporary sediment control,
  - tracking control,
  - wind erosion control,
  - material pollution prevention control,
  - waste management, and
  - non-stormwater management
- identification and handling of hazardous substances
- potential dangers to humans and the environment from spills and leaks or exposure to toxic or hazardous substances

Informal employee training shall include tailgate site meetings to be conducted weekly; tailgate meetings should address the following topics:

- water pollution control BMP deficiencies and corrective actions;
- BMPs that are required for work activities during the week;
- spill prevention and control;
- material delivery, storage, use, and disposal;
- waste management; and
- non-stormwater management procedures.

A summary of formal and informal training of various personnel is shown in Attachment E. A copy of all training certificate(s) (e.g., Caltrans 24-Hour Training Class and CGP Training) for the WPC Manager and the Qualified SWPPP Developer are included in Attachment E.

Training records for project personnel shall be updated by completing the CEM-2023 Stormwater Training Record form, available in Appendix E, and the CEM-2024 Stormwater Training Log - Optional form, available in Appendix F. Records of training, with training certificates attached, when applicable, and the training log will be kept in SWPPP File Category 20.23: Contractor Personnel Training Documentation. Personnel training records, with required documentation attached and an updated training log, shall be submitted to the RE within five (5) days of completion of training.

Training information, consisting of the following items, shall be provided in the Stormwater Annual Report:

- documentation of all training for individuals responsible for all activities associated with compliance with CGP

- documentation of all training for individuals responsible for BMP installation, inspection, maintenance, and repair, and
- documentation of all training for individuals responsible for overseeing, revising, and amending the SWPPP.

SECTION 400
REFERENCES, OTHER PLANS, PERMITS AND AGREEMENTS

The documents listed below are made a part of this SWPPP by reference.

- Standard Plans and Specifications, dated 2010.
- Contract Plans and Special Provisions for Contract No. 04-297624, dated May 2015, prepared by Abhijeet Bhoi and Maria Sedghi.
- SWRCB-Order No. 2009-0009-DWQ, Order No. 2009-0009-DWQ as amended by Order 2010-0014-DWQ and 2012-006-DWQ NPDES General Permit No. CAS000002, National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated With Construction and Land Disturbance Activities (Construction General Permit), September 2009
- *Caltrans Statewide Storm Water Management Plan* (SWMP), dated May 2003
- *Caltrans SWPPP/WPCP Preparation Manual,* dated June 2011
- *Caltrans Construction Site Monitoring Program Guidance Manual,*

Attachment F includes copies of the Caltrans Statewide Permit, the CGP, and other local, state, and federal plans and permits. A list of the other local, state, and federal plans and permits included in Attachment F is provided below.

- Clean Water Act Section 401 Water Quality Certification for the Route 84 Expressway Widening Project (South Segment) issued by the San Francisco Bay RWQCB, dated 06/15/11, 02/02/15
- Clean Water Act Section 404 Nationwide Permit issued by the U.S. Army Corps of Engineers, dated 04/11/11, 06/01/12, 05/20/13
- Department of Fish and Game Streambed Alteration Agreement, dated 11/10/11, 11/18/14

SECTION 500
DETERMINATION OF CONSTRUCTION SITE BEST MANAGEMENT PRACTICES

500.1 Pollutant Sources

500.1.1 Inventory of Materials and Activities that May Pollute Stormwater

The following table contains a list of construction activities that have the potential to contribute pollutants, including sediment, to stormwater discharges. All potential pollutants, except sediment, and their locations shall be listed in this section, and, where possible, the locations shall be shown on the WPCDs from Attachment BB. Details for controlling these pollutants using soil stabilization and sediment control BMPs are discussed in Sections 500.3.1 through 500.3.5. Potential non-storm water and waste management-related discharges are further described in Sections 500.4.1 and 500.4.2, respectively.

TABLE 500.1.1
ANTICIPATED CONSTRUCTION SITE ACTIVITIES WITH THE POTENTIAL TO DISCHARGE POLLUTANTS

☑ Demolition	☑ Pavement Removal (asphalt concrete, concrete) ☐ Structure Demolition/Removal over or Adjacent to Water ☐ Building Demolition (Structure, HVAC, insulation) ☑ Hardscape Demolition (Parking areas, curbs, gutters, sidewalks)
☑ Earthwork	☑ Clearing and Grubbing ☑ Grading Activities ☑ Soil Import and Export ☑ Stockpiling ☑ Excavation ☐ Disturbance of Contaminated Soil ☑ Dewatering ☐ Temporary Stream Crossing ☑ Drainage Construction ☑ Dredging ☐ Pile Driving ☑ Utilities ☐ Line Flushing (hydrostatic test water, pipe flushing) ☑ Landscaping, Planting and Plant Maintenance, Amending of Soil and Mulching ☐ Material and Equipment Use over Water
☐ Masonry, Concrete, Asphalt Work	☑ Saw Cutting (cement and brick dust, saw cut slurries) ☑ Paving and Grinding

TABLE 500.1.1 ANTICIPATED CONSTRUCTION SITE ACTIVITIES WITH THE POTENTIAL TO DISCHARGE POLLUTANTS	
	☑ Concrete Placement (colored chalks) ☑ Concrete Curing (curing and glazing compounds) ☑ Concrete Finishing (surface cleaners) ☑ Concrete Waste Management
☐ Building Construction	☐ Paint Preparation, Painting, Stenciling, and Etching ☐ Material Use ☐ Material Delivery and Storage ☐ Adhesives (glues, resins, epoxy synthetics, caulks, sealers, putty, sealing agents and coal tars) ☐ Cleaning, Polishing (metal, ceramic, tile), and Sandblasting Operations ☐ Plumbing [solder (lead, tin), flux (zinc chloride), pipe fitting] ☐ Framing (sawdust, particle board dust and treated woods) ☐ Interior Construction (tile cutting, flashing, saw-cutting drywall, galvanized metal in nails and fences, and electric wiring)
☐ Equipment Use	☐ Vehicle and Equipment Cleaning ☑ Vehicle and Equipment Fueling ☑ Vehicle and Equipment Maintenance
☐ Waste Management	☑ Hazardous Waste Management ☑ Solid Waste Management (litter, trash, and debris) ☑ Liquid Waste Management (wash water) ☑ Sanitary Septic Waste Management (portable toilets, disturbance of existing sewer lines)

The WPC Manager shall update the list of potential pollutants in accordance with onsite conditions, documenting all materials or equipment that have been received or produced onsite that are not designed to be outdoors and are potential sources of stormwater contamination.

Materials Management Plan

A list of construction materials that will be on site and have the potential to contribute pollutants, other than sediment, to stormwater runoff, which has been prepared to prevent or minimize the off-site discharge of those pollutants, are provided below.

The following stockpiles will be covered and bermed prior to likely precipitation events.

- Soil amendments

The following materials will be kept off the ground or bermed and covered prior to likely precipitation events.

- RHMA-G
- HMA (TYPE A)
- Cl 2 AB
- Cl 3 AS

- Pressure treated wood
- Portland cement

The following materials will be properly stored according to Material Safety Data Sheet requirements.

- Chemical containers (including paint, curing compounds, solvents, fuel and grease)

The following dumpsters shall be covered prior to likely precipitation events.

The following areas will be inspected for leaks or spills prior to likely precipitation events.

- Portable Toilets
- Chemical containers
- Staging and storage areas
- Temporary concrete washout facilities

Potential pollutants shall not be stored within 50 feet of stormwater conveyance features or concentrated flow paths. In addition, non-stormwater discharges shall not be made within 50 feet of potential pollutants.

500.1.2 Potential Pollutants from Site Features or Known Contaminates

Former site usage or known site contamination may contribute pollutants to stormwater discharges from the site. Based on information available for the project site, the following site usage and historical contamination has been determined:

Former Industrial Operations: ○ Yes ◉ No

Description of Former Industrial Operations

Historic Contamination: ○ Yes ◉ No

The following contaminants are known to exist at the project site locations identified:

500.1.3 Risk Level Determination

Arroyo Del Valle - The project has a Low Site Sediment Risk Factor and a Low Receiving Water Risk Factor; the combined risk is Level 1.

Arroyo Mocho - The project has a Low Site Sediment Risk Factor and a High Receiving Water Risk Factor; the combined risk is Level 2.

The overall project risk is Level 2.

500.2 Pre-Construction Existing Stormwater Control Measures

The following are existing (pre-construction) control measures encountered within the project site.

- Slopes within the construction site are protected with native vegetation.
- Vegetated ditches within the construction site.
- Deployed perimeter fencing and barriers.

500.3 BMP Selection for Erosion and Sediment Control

The Contractor shall control construction site erosion through the implementation of effective erosion and sediment control measures in accordance with the CGP. The Contractor and the WPC Manager shall develop a schedule that includes the sequencing of construction activities and the implementation of effective erosion control BMPs while taking local climate (rainfall, wind, etc.) into consideration, thereby reducing the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking. The SWPPP schedule shall: describe when work activities will be performed that could cause the discharge of pollutants in stormwater; describe the water pollution control practices associated with each construction phase; and identify the soil stabilization and sediment control practices for all disturbed soil areas. Effective soil cover shall be provided for:

- Soil stockpiles
- Inactive areas
- Disturbed soil areas
- Finished slopes

Additional erosion and sediment control BMPs may be required in other locations on the project site as work progresses in order to prevent sediment from leaving the construction site. These measures shall be determined by the Contractor and the WPC Manager in the field. As long as the water pollution control measures consist of additions to the BMPs already selected in the approved SWPPP, then these additional measures do not require a SWPPP amendment and the WPC Manager shall simply show the additional measures on the WPCDs. If erosion control or sediment control BMPs must be changed because of field conditions or because they are determined to be ineffective, the SWPPP must be amended. Once deemed necessary, corrective actions/design changes to the SWPPP shall be reviewed and signed by the WPC Manager, implemented, as required by Standard Specification 13-1.03A, within 24 hours of identification unless a longer period is authorized (but cannot be authorized longer than required by the CGP: implemented within 72 hours of identification and completed as soon as possible thereafter). Immediate corrective action is required for numeric action level (NAL) exceedances. Routine BMP maintenance or the implementation of an additional quantity of a BMP included in the SWPPP as recommended by the WPC Manager does not require an amendment to the SWPPP.

An effective combination of erosion (soil stabilization) and sediment control BMPs shall be implemented and maintained during the project. The following principles shall be followed to the maximum extent practicable to control erosion and sedimentation in disturbed areas at the site.

- Fit grading to the surrounding terrain.
- Time grading operations to minimize soil exposure.
- Retain existing vegetation whenever feasible.
- Vegetate and mulch or otherwise stabilize disturbed areas.
- Minimize the length and steepness of slopes.

- Keep runoff velocities low.
- Prepare drainage ways and outlets to handle concentrated runoff until permanent drainage structures are constructed.
- Trap sediment onsite.
- Inspect and maintain control measures frequently.

A more concise listing of the BMP control measures to be implemented and maintained at the project site are denoted in the BMP selection tables in the following sub-sections.

500.3.1 Temporary Run-on Control BMPs

The NPDES CGP states Risk Level 2 dischargers shall effectively manage all run-on, all runoff within the site and all runoff that discharges off the site. Run-on from off-site shall be directed away from all disturbed areas or shall collectively be in compliance with the effluent limitations in the CGP. Temporary diversion BMPs shall be implemented when deemed necessary by the WPC Manager to protect the site from run-on.

Run-on from off-site areas shall be prevented from flowing through areas that have been disturbed by construction unless appropriate conveyance systems are in place. Run-on from off-site areas is not anticipated.

Stormwater from off-site should be diverted around the project site or directed to an interior drain so that it does not impact disturbed soil or material storage areas. Within the project limits, to enhance the effectiveness of other BMPs:

•Divert water away from areas of soil disturbance,
•Divert water from the top of disturbed slopes, which aids greatly in reducing erosion of slopes,
•Divert water around stockpiles, material storage areas or other sensitive areas, and
•Place BMPs so that diverted water is safely directed to an inlet, temporary conveyance, or infiltrated into a vegetated area.
•Risk Level 2 dischargers must effectively manage all run-on that discharges onto the project site. Run-on will be directed away from all disturbed areas and stockpiles. Run-on that enters the project site should meet the numeric action levels once it discharges from the project site.

TABLE 500.3.1
TEMPORARY RUN-ON CONTROL BMPs

CONSTRUCTION BMP ID NO.(1)	BMP NAME	CONTRACT MIN REQUIRE-MENT(2)	CONTRACT BID ITEM	BMP USED		IF A CONTRACT MINIMUM REQUIREMENT BUT NOT USED, STATE REASON
				Yes	No	
SS-1	Scheduling	☑	☑	◉	○	
SS-2	Preservation of Property/ Preservation of Existing Vegetation	☑	☑	◉	○	
SS-9	Earth Dikes / Drainage Swales & Lined Swales	☐	☐	○	◉	
SS-10	Outlet Protection / Velocity Dissipation Devices	☐	☐	○	◉	

SS-11	Slope Drains	☐	☐	○	◉	
SS-12	Streambank Stabilization	☐	☐	○	◉	
SC-4	Temporary Check Dam	☐	☑	○	◉	Will be implemented at the direction of the R.E.
SC-5	Fiber Rolls	☑	☑	◉	○	
SC-6	Temporary Gravel Bag Berm	☐	☐	◉	○	Will be implemented at the direction of the R.E.
SC-8	Temporary Sandbag Barrier	☐	☐	◉	○	Will be implemented at the direction of the R.E.
ALTERNATIVE BMPs USED (3) ◉ Yes ○ No						
CONSTRUCTION BMP ID NO. (1)	**BMP NAME**					**IF USED, STATE REASON**
SS-2	Temporary Fence (Type ESA)					To preserve existing vegetation and natural resources throughout the project site.

Notes:
(1)The BMP designations (SS-1, SC-5, etc.) are solely for maintaining continuity with existing Caltrans documents and are not provided to imply that the Construction Site BMP Reference Manual is a required contract document.
(2)Minimum requirements are based on the required Contract Provisions, Standard Special Provisions, Plans and Specifications. Not all minimum requirements may be applicable to every project. Applicability to a specific project shall be determined by the QSD or WPC Manager.
(3)Use of alternative BMPs will require written approval by the RE.

Implementation of Temporary Run-on Controls BMPs

- SS-1 Scheduling - The contractor/WPC Manager will schedule as much soil disturbing activities as possible during the dry season, leaving as much soil undisturbed as possible.
- SS-2 Preservation of Existing Vegetation - The slopes will be protected in place. Only BMPs needed to divert run-on away from the site will disturb the slopes. No vehicle or foot traffic will be allowed on the slopes.
- SC-5 Fiber Rolls - Fiber Rolls may be used in conjunction with drainage swales as necessary to divert run-on away from disturbed construction areas. It may also be used to inhibit and break-up and slow down concentrated flows.
- SC-6 Temporary Gravel Bag - Tempoary gravel bag can be used to create berms to breakup and slow down concentrated flow, and impede sediment transport.
- SC-8 Temporary Sandbag Barrier - Temporary sandbag barrier can be used to intercept and slow the flow of sediment-laden sheet flow runoff. Sandbag barriers allow sediment to settle from runoff before water leaves the construciton site.

500.3.2 Soil Stabilization (Erosion Control)

Soil stabilization, also referred to as erosion control, consists of source control measures that are designed to prevent soil particles from detaching and becoming transported in stormwater runoff. Soil stabilization BMPs protect the soil surface by covering and/or binding soil particles. This project will incorporate SWPPP/WPCP Preparation Manual minimum temporary soil stabilization requirements, temporary soil stabilization measures required by the contract documents, and other measures selected by the Contractor.

Sufficient soil stabilization materials will be maintained on site to allow implementation in conformance with Caltrans requirements and as described in this SWPPP. This includes implementation requirements for active and non-active areas that require deployment before the onset of rain.

The following soil stabilization BMP selection table indicates the BMPs that shall be implemented to control erosion on the construction site. Temporary soil stabilization BMPs are listed by location in the WPCBMPL in Attachment CC and are shown on the WPCDs from Attachment BB. Any details for temporary soil stabilization BMPs are shown in Attachment BB.

TABLE 500.3.2
TEMPORARY EROSION CONTROL BMPs

CONSTRUCTION BMP ID NO.(1)	BMP NAME	CONTRACT MIN REQUIRE-MENT(2)	CONTRACT BID ITEM	BMP USED		IF A CONTRACT MINIMUM REQUIREMENT BUT NOT USED, STATE REASON
				Yes	No	
SS-1	Scheduling	☑	☑	◉	○	
SS-2	Preservation of Property/ Preservation of Existing Vegetation	☑	☑	◉	○	
SS-3	Temporary Hydraulic Mulch (Bonded Stabilized Fiber Matrix)	☐	☑	◉	○	
SS-3	Temporary Hydraulic Mulch (Polymer Stabilized Fiber Matrix)	☐	☐	○	◉	
SS-4	Temporary Erosion Control (With Temporary Seeding)	☐	☐	○	◉	
SS-5	Temporary Soil Stabilizer	☐	☐	○	◉	
SS-6	Temporary Erosion Control (Straw Mulch with Stabilizing Emulsion)	☐	☐	○	◉	
SS-7	Temporary Erosion Control Blanket (On Slope)	☐	☐	○	◉	
SS-7	Temporary Erosion Control Blanket (In swale or ditch)	☐	☐	○	◉	

SS-7	Temporary Cover (Geotextiles and Mats)	☐	☑	◉	○	
SS-8	Temporary Mulch (Wood)	☐	☐	○	◉	
SS-9	Earth Dikes / Drainage Swales & Lined Swales	☐	☐	○	◉	
SS-10	Outlet Protection/ Velocity Dissipation Devices	☐	☐	○	◉	
SS-11	Slope Drains	☐	☐	○	◉	
SS-12	Streambank Stabilization	☐	☐	○	◉	
SS-13	Polyacrylamide	☐	☐	○	◉	
ALTERNATIVE BMPs USED (3) ◉ Yes ○ No						
SS-2	Temporary Fence (Type ESA)					To preserve existing vegetation and natural resources throughout the project site.

Notes:
(1)The BMP designations (SS-1, SC-3, etc.) are solely for maintaining continuity with existing Caltrans documents and are not provided to imply that the Construction Site BMP Reference Manual is a required contract document.
(2)Minimum requirements are based on the required Contract Provisions, Standard Special Provisions, Plans and Specifications. Not all minimum requirements may be applicable to every project. Applicability to a specific project shall be determined by the QSD or WPC Manager.
(3)Use of alternative BMPs will require written approval by the RE.

The BMPs selected for the project are listed below along with an explanation of how they will be incorporated into the project.

- SS-1 Scheduling - The Contractor/WPC Manager will schedule as much soil disturbing activities as possible during the dry season, leaving as much soil undisturbed as possible.
- SS-2 Preservation of Existing Vegetation - The slopes will be protected in place. Only BMPs needed to divert run-on away from the site will disturb the slopes. No vehicle or foot traffic will be allowed on the slopes.
- SS-3 Temporary Hydraulic Mulch - It can be used to temporarily protect exposed soil from erosion by raindrop impact or wind.
- SS-7 Temporary Cover - It would be placed on disturbed slope areas that might be susceptible to erosion, from either runoff or wind. The use of plastic cover will be only used for short term durationl however for long term duration use SS-3

500.3.3 Sediment Control

Sediment controls are structural measures that are intended to complement and enhance the selected soil stabilization (erosion control) measures and reduce sediment discharges from construction areas. Sediment controls are designed to intercept and settle out soil particles that have been detached and transported by the force of water. This project will incorporate SWPPP/WPCP Preparation Manual minimum temporary sediment control requirements, temporary sediment control measures required by the contract documents, and other measures selected by the Contractor.

Sediment control BMPs will be installed at all appropriate locations along the site perimeter and at all operational internal inlets to storm drain systems at all times.

Throughout the duration of the project, temporary sediment control materials, equivalent to 10 percent of the materials installed on site, will be maintained on site for implementation in event of predicted rain, or the need for rapid response to failures or emergencies, in conformance with other Caltrans requirements, and as described in the SWPPP. This includes implementation requirements for active areas and non-active areas before the onset of rain.

The following sediment control BMP selection table indicates the BMPs that shall be implemented to control sediment on the construction site. Temporary sediment control BMPs are listed by location in the WPCBMPL in Attachment CC and are shown on the WPCDs from Attachment BB. Any details for temporary sediment control BMPs are shown in Attachment BB.

TABLE 500.3.3
TEMPORARY SEDIMENT CONTROL BMPs

CONSTRUCTION BMP ID NO.(1)	BMP NAME	CONTRACT MIN REQUIRE-MENT(2)	CONTRACT BID ITEM	BMP USED		IF A CONTRACT MINIMUM REQUIREMENT BUT NOT USED, STATE REASON
				Yes	No	
SC-1	Temporary Silt Fence	☐	☑	◉	○	Temporary Reinfored Silt Fence (Type I)
SC-2	Temporary Sediment Basin	☐	☐	○	◉	
SC-3	Temporary Sediment Trap	☐	☐	○	◉	
SC-4	Temporary Check Dam	☐	☑	○	◉	Will be implemented at the direction of the RE.
SC-5	Fiber Rolls	☑	☑	◉	○	
SC-6	Temporary Gravel Bag Berm	☐	☐	○	◉	
SC-7	Street Sweeping	☑	☑	◉	○	
SC-8	Temporary Sandbag Barrier	☐	☐	○	◉	
SC-9	Temporary Straw Bale Barrier	☐	☐	○	◉	

SC-10	Temporary Drain Inlet Protection	☑	☑	◉	○	
SC-11	Temporary Chemical Treatment	☐	☐	○	◉	
ALTERNATIVE BMPs USED (3) ○ Yes ◉ No						

Notes:
(1)The BMP designations (SS-1, SC-3, etc.) are solely for maintaining continuity with existing Caltrans documents and are not provided to imply that the Construction Site BMP Reference Manual is a required contract document.
(2)Minimum requirements are based on the required contract provisions, standard special provisions, plans and specifications. Not all minimum requirements may be applicable to every project. Applicability to a specific project shall be determined by the QSD or WPC Manager.
(3)Use of alternative BMPs will require written approval by the RE

The following list of BMPs and associated narratives explain how the selected BMPs will be incorporated into the project.

- SC-1 Temporary Reinforced Silt Fence (Type I) - Silt fences will be deployed along the toe of exterior cut and fill slopes to settle out soil particles from stormwater runoff and around environmentally sensitive areas
- SC-5 Temporary Fiber Rolls - Fiber rolls will be placed on and along slopes, and at toe of slope as shown in the contract plans.
- SC-7 Street Sweeping - Road sweeping and vacuuming will occur during soil hauling and as necessary to keep streets clear of tracked material and debris.
- SC-10 Temporary Drain Inlet Protection - temporary measure used during construction to stop trash and sediment from entering into the existing drain inlets.

500.3.4 Tracking Control

Tracking control BMPs are be implemented to reduce sediment tracking from the construction site onto private or public roads. This project will incorporate SWPPP/WPCP Preparation Manual minimum temporary tracking control requirements, temporary tracking control measures required by the contract documents, and other measures selected by the Contractor.

The following tracking control BMP selection table indicates the BMPs that shall be implemented to reduce sediment tracking from the construction site onto private or public roads. Temporary tracking control BMPs are listed by location in the WPCBMPL in Attachment CC and shown on the WPCDs from Attachment BB. Any details for temporary tracking control BMPs are shown in Attachment BB.

TABLE 500.3.4
TEMPORARY TRACKING CONTROL BMPs

CONSTRUCTION BMP ID NO.(1)	BMP NAME	CONTRACT MIN REQUIRE-MENT(2)	CONTRACT BID ITEM	BMP USED		IF A CONTRACT MINIMUM REQUIREMENT BUT NOT USED, STATE REASON
				Yes	No	
SC-7	Street Sweeping	☑	☑	◉	○	

TC-1	Temporary Construction Entrance	☑	☑	◉	○	
TC-2	Stabilized Construction Roadway	☐	☐	○	◉	
TC-3	Temporary Entrance / Outlet Tire Wash	☐	☐	○	◉	
ALTERNATIVE BMPs USED (3) ○ Yes ◉ No						

Notes:
(1)The BMP designations (SS-1, SC-3, etc.) are solely for maintaining continuity with existing Caltrans documents and are not provided to imply that the Construction Site BMP Reference Manual is a required contract document.
(2) Minimum requirements are based on the required Contract Provisions, Standard Special Provisions, Plans and Specifications. Not all minimum requirements may be applicable to every project. Applicability to a specific project shall be determined by the QSD or WPC Manager.
(3)Use of alternative BMPs will require written approval by the RE.

The following list of BMPs and associated narratives explain how the selected BMPs will be incorporated into the project.

- SC-7 Street Sweeping Washing of sediment tracked onto streets into storm drains will not occur. Street Sweeping shall start at the beginning of clearing and grubbing and shall continue until completion of the project, or as directed by the engineer.
- TC-1 Temporary Construction Entrance - A stabilized construction entrance/exit will be constructed and maintained at construction site entrances and exits, equipment yard, HMA batch plants and crushing plants & water filling area for water trucks.

500.3.5 Wind Erosion Control

Wind erosion control BMPs will be implemented to prevent sediment from leaving the construction site. This project will incorporate SWPPP/WPCP Preparation Manual minimum temporary wind erosion control requirements, temporary wind erosion control measures required by the contract documents, and other measures selected by the Contractor.

The following temporary wind erosion control BMP selection table indicates the BMPs that shall be implemented to reduce wind erosion at the construction site. Temporary wind erosion control BMPs are listed by location in the WPCBMPL in Attachment CC and shown on the WPCDs from Attachment BB. Any details for temporary wind erosion control BMPs are shown in Attachment BB.

TABLE 500.3.5
TEMPORARY WIND EROSION CONTROL BMPs

CONSTRUCTION BMP ID NO.(1)	BMP NAME	CONTRACT MIN REQUIRE-MENT(2)	CONTRACT BID ITEM	BMP USED		IF A CONTRACT MINIMUM REQUIREMENT BUT NOT USED, STATE REASON
				Yes	No	
WE-1	Wind Erosion Control	☑	☐	◉	○	

TC-1	Temporary Construction Entrance	☑	☑	◉	○	
TC-2	Stabilized Construction Roadway	☐	☐	○	◉	
----	All Soil Stabilization Measures included in Section 500.3.2	☐	☐	○	◉	
ALTERNATIVE BMPs USED (3) ○ Yes ◉ No						

Notes:
(1)The BMP designations (SS-1, SC-3, etc.) are solely for maintaining continuity with existing Caltrans documents and are not provided to imply that the Construction Site BMP Reference Manual is a required contract document.
(2) Minimum requirements are based on the required contract provisions, standard special provisions, plans and specifications. Not all minimum requirements may be applicable to every project. Applicability to a specific project shall be determined by the QSD or WPC Manager.
(3)Use of alternative BMPs will require written approval by the RE.

The following list of BMPs and narrative explain how the selected BMPs shall be incorporated into the project.

- TC-1 Temporary Construction Entrance - A stabilized construction entrance/exit will be constructed and maintained at construction site entrances and exits, equipment yard, HMA batch plants and crushing plants, water filling area for water trucks.

500.4 BMP Selection for Construction Site Management

Construction site management shall consist of controlling potential sources of water pollution before they come in contact with stormwater systems or watercourses. The Contractor shall control material pollution and manage waste and non-stormwater discharges at the construction site by implementing effective handling, storage, use, and disposal practices.

500.4.1 Non-Stormwater Site Management

Non-stormwater discharges into storm drainage systems or waterways, which are not authorized under the Caltrans Permit or authorized under a separate NPDES permit, shall be prohibited. The selection of non-stormwater BMPs is based on whether construction activities with a potential for non-stormwater discharges will be conducted, as discussed in the Materials Management Plan and in Section 500.4. This project will incorporate SWPPP/WPCP Preparation Manual minimum non-stormwater pollution control requirements, non-stormwater pollution temporary wind erosion control measures required by the contract documents, and other measures selected by the Contractor.

The following non-stormwater control BMP selection table indicates the BMPs that shall be implemented to prevent non-stormwater discharges from construction activities conducted at the project site. Non-stormwater pollution control BMPs are listed by location in the WPCBMPL in Attachment CC and shown on the WPCDs from Attachment BB. Any details for non-stormwater pollution control BMPs are shown in Attachment BB.

TABLE 500.4.1

TEMPORARY NON-STORMWATER POLLUTION CONTROL BMPs						
CONSTRUCTION BMP ID NO.(1)	**BMP NAME**	**CONTRACT MIN REQUIRE-MENT(2)**	**CONTRACT BID ITEM**	**BMP USED**		**IF A CONTRACT MINIMUM REQUIREMENT BUT NOT USED, STATE REASON**
				Yes	No	
NS-1	Water Control and Conservation	☑	☐	◉	○	
NS-2	Dewatering(3)	☐	☑	○	◉	To be evaluated and addressed by the Contractor's SWPPP.
NS-3	Paving, Sealing, Sawcutting, and Grinding Operations	☐	☐	◉	○	Outside Pavement Widening for SR84 WB/EB directions.
NS-4	Temporary Stream Crossing (3)	☐	☐	○	◉	
NS-5	Clear Water Diversion (3)	☐	☐	○	◉	
NS-6	Illegal Connection and Illegal Discharge Detection Reporting	☑	☐	◉	○	
NS-7	Potable Water / Irrigation	☐	☐	◉	○	
NS-8	Vehicle and Equipment Cleaning	☑	☑	◉	○	Paid for under "Construction Site Management."
NS-9	Vehicle and Equipment Fueling	☑	☑	◉	○	Paid for under "Construction Site Management."
NS-10	Vehicle and Equipment Maintenance	☑	☑	◉	○	Paid for under "Construction Site Management."
NS-11	Pipe Driving Operations	☐	☑	◉	○	Paid for under "Construction Site Management."
NS-12	Concrete Curing	☐	☑	◉	○	Paid for under "Construction Site Management."
NS-13	Material and Equipment Used Over Water	☐	☑	◉	○	Paid for under "Construction Site Management."
NS-14	Concrete Finishing	☐	☑	◉	○	Paid for under "Construction Site Management."
NS-15	Structure Demolition / Removal Over or Adjacent to Water	☐	☐	○	◉	Not to be performed under this Conceptual SWPPP.

ALTERNATIVE BMPs USED (4)	
○ Yes ◉ No	

Notes:
(1) The BMP designations (SS-1, SC-3, etc.) are solely for maintaining continuity with existing Caltrans documents and are not provided to imply that the Construction Site BMP Reference Manual is a required contract document.
(2) Minimum requirements are based on the required contract provisions, standard special provisions, plans and specifications. Not all minimum requirements may be applicable to every project. Applicability to a specific project shall be determined by the QSD or WPC Manager.
(3) The BMPs listed above are incidental and do not include operations listed as separated line items in the contract.
(4) Use of alternative BMPs will require written approval by the RE.

The following list of BMPs and associated narratives explain how the selected BMPs will be incorporated into the project.

- NS-1 Water Control and Conservation - Manage water used for work activities to prevent erosion or discharge of pollutants into storm drain systems or watercourses.
- NS-3 Paving, Sealing, Sawcutting, Grinding - BMPs shall be implemented and efforts taken to prevent the following materials from entering storm drain facilities and receiving water bodies; cementitious material, asphaltic material, aggregate, etc.
- NS-8, NS-9, NS-10 Vehicle and Equipment Operations - Vehicle and equipment Cleaning on the construction site is absolutely discouraged, except that which is necessary to control vehicle tracking or hazardous waste.
- NS-11 - Pile Driving Operations - Driven sheet piles are used for shoring. Proper control and use of equipment, materials, and waster products from pile driving operations will reduce the discharge of potential pollutants to storm drains.
- NS-12 Concrete Curing - Concrete curing includes the use of both chemical and water methods. Proper procedures minimize pollution of runoff during concrete curing
- NS-13 Material and Equipment Used Over Water - Drip pans and absorbent pads wil be placed under vehicles or equipment used over water.
- NS-14 Concrete Finishing - Methods include sand blasting, shot blasting, grinding, or high pressure water blasting. Proper procedures minimize the impact that concrete-finishing methods may have on runoff.

Vehicle and Equipment Fueling and Vehicle and Equipment Maintenance shall be performed off- site. If it must be done on site, BMPs must be utilized to prevent discharges of fuel and vehicle fluids.Vehicle and Equipment Fueling shall be conducted at least 300 feet from riparian, water bodies and drainage inlet facilities. If fueling must be done within 300 feet of riparian, water bodies and drainage inlet facilities, but at no time it can be less than 50 feet. In case Fueling and Equipment maintenance would be conducted within 50 feet the Contractor must perform those activities outside the Construction site in proper Facilities.

All materials used for cleaning tools and any wastes generated by this activity, shall be adequately contained to prevent contact with soil and the surface water and properly disposed.

Saw-cutting: During and immediately after the rain there shoud be no Saw-Cutting operation. Generated Slurry has to be Vaccumed and properly disposed off.

Retaining Walls and Concrete Wash-out Facilities: Construction of Retaining Walls and generated Concrete Waste during the operation shall be adequately contained and properly disposed off.

The area selected by contractor as Staging area needs to be approved by RE. Since the area might be an Environmentally Sensitive Area therefore the RE needs to clear the area as being suitable to be used as Staging Area and approve it.

500.4.2 Waste Management and Materials Pollution Control

An inventory of construction activities, materials, and wastes is provided in Section 500.1.1. The following BMP consideration checklist lists the BMPs that have been selected to control construction site wastes and materials. Locations and details of applicable materials handling and waste management BMPs are shown on the WPCDs from Attachment BB. In the narrative description, a list of waste disposal facilities and the type of waste to be disposed at each facility is also provided. The following list of BMPs and associated narratives explain how the selected BMPs will be incorporated into the project.

TABLE 500.4.2
TEMPORARY WASTE MANAGEMENT AND MATERIALS POLLUTION CONTROL BMPs

CONSTRUCTION BMP ID NO.(1)	BMP NAME	CONTRACT MIN REQUIRE-MENT(2)	CONTRACT BID ITEM	BMP USED		IF A CONTRACT MINIMUM REQUIREMENT BUT NOT USED, STATE REASON
				Yes	No	
WM-1	Material Delivery and Storage	☑	☑	◉	○	Paid for under "Construction Site Management."
WM-2	Material Use	☑	☑	◉	○	Paid for under "Construction Site Management."
WM-3	Stockpile Management	☑	☑	◉	○	Paid for under "Construction Site Management."
WM-4	Spill Prevention and Control	☑	☑	◉	○	Paid for under "Construction Site Management."
WM-5	Solid Waste Management	☑	☑	◉	○	Paid for under "Construction Site Management."
WM-6	Hazardous Waste Management (3)	☑	☐	◉	○	
WM-7	Contaminated Soil Management (3)	☐	☐	○	◉	
WM-8	Concrete Waste Management	☑	☑	◉	○	Paid for under "Construction Site Management."
WM-8	Temporary Concrete Washout (Portable)	☑	☑	◉	○	Paid for under "Construction Site Management."
WM-8	Temporary Concrete Washout Facility	☑	☑	◉	○	Paid for under "Construction Site Management."
WM-9	Sanitary/Septic Waste Management	☑	☑	◉	○	Paid for under "Construction Site Management."
WM-10	Liquid Waste Management	☐	☐	○	◉	

ALTERNATIVE BMPs USED (4) ◉ Yes ○ No			
CONSTRUCTION BMP ID NO. (1)	**BMP NAME**		**IF USED, STATE REASON**
SS-7	Temporary Cover		It would be placed on disturbed slope areas that might be susceptible to erosion, from either runoff or wind.

Notes:
(1) The BMP designations (SS-1, SC-3, etc.) are solely for maintaining continuity with existing Caltrans documents and are not provided to imply that the Construction Site BMP Reference Manual is a required contract document.
(2) Minimum requirements are based on the required contract provisions, standard special provisions, plans and specifications. Not all minimum requirements may be applicable to every project. Applicability to a specific project shall be determined by the QSD or WPC Manager.
(3) The BMPs listed above are incidental and do not include operations listed as separated line items in the contract.
(4) Use of alternative BMPs will require written approval by the RE.

WM-1 and WM-2 Material Delivery and Storage and Material Use
•Minimize or eliminate discharge of material into the air, storm drain systems, and receiving waters while taking delivery of, using, or storing the following materials:

1. Hazardous chemicals, including acids, lime, glues, adhesives, paints, solvents, and curing compounds
2. Soil stabilizers and binders
3. Fertilizers
4. Detergents
5. Plaster
6. Petroleum materials, including fuel, oil, and grease
7. Asphalt and concrete components
8. Pesticides and herbicides
9. Street sweeping and waste debris

•The following activities must be performed at least 150 feet from concentrated flows of stormwater, drainage courses, and inlets if within the floodplain and at least 150 feet if outside the floodplain, unless otherwise approved by the Engineer:

1. Stockpiling materials
2. Storing pile-driving equipment and liquid waste containers
3. Washing vehicles and equipment in outside areas
4. Fueling and maintaining vehicles and equipment

•If materials are stored:

1. Store liquids, petroleum materials, and substances listed in 40 CFR 110, 117, and 302 and place them in secondary containment facilities as specified by US DOT for storage of hazardous materials.
2. Secondary containment facilities must be impervious to the materials stored there for a minimum contact time of 72 hours.
3. Cover secondary containment facilities during non-working days and whenever precipitation is forecasted. Secondary containment facilities must be adequately ventilated.
4. Keep secondary containment facilities free of accumulated rainwater or spills. After precipitation, or in the event of spills or leaks, collect accumulated liquid and place it into drums within 24 hours. Handle the liquid as hazardous waste under "Waste Management" of these special provisions unless testing confirms that the liquid is nonhazardous.
5. Do not store incompatible materials, such as chlorine and ammonia, in the same secondary containment facility.
6. Store materials in their original containers with the original material labels maintained in legible condition.

Immediately replace damaged or illegible labels.
7. Secondary containment facilities must have the capacity to contain precipitation from a 24-hour-long, 25-year storm, plus 10 percent of the aggregate volume of all containers or the entire volume of the largest container within the facility, whichever is greater.
8. Store bagged or boxed material on pallets. Protect bagged or boxed material from wind and rain during nonworking days and whenever precipitation is forecasted.
9. Provide sufficient separation between stored containers to allow for spill cleanup or emergency response access. Storage areas must be kept clean, well-organized, and equipped with cleanup supplies appropriate for the materials being stored.
10. Repair or replace perimeter controls, containment structures, covers, and liners as necessary. Inspect storage areas before and after precipitation and at least weekly during other times.

WM-3 Stockpile Management
•BMP WM-3, Stockpile Management shall be implemented to reduce or eliminate pollution of stormwater from stockpiles of soil and paving materials such as portland cement concrete (PCC) rubble, asphalt concrete (AC), asphalt concrete rubble, aggregate base, aggregate subbase, pre¬mixed aggregate and asphalt binder (so called "cold mix" asphalt). Stockpiles shall be surrounded with sediment controls (BMP SC-5, Fiber rolls or SC-8, sandbag barrier). Plastic covers, or SS-5, Soil Binders, shall be used.

WM-4 Spill Prevention and Control
•BMP WM-4, Spill Prevention and Control shall be implemented to contain and clean-up spills and prevent material discharges to the storm drain system. Spill prevention is also discussed above in Material Delivery, Storage and Use BMP, and below in the following waste management section.

WM-5, WM-6 Waste Management
•BMP WM-5, Solid Waste Management and BMP WM-6, Hazardous Waste Management BMPs shall be implemented to minimize stormwater contact with waste materials and prevent waste discharges. Solid wastes shall be loaded directly onto trucks for offsite disposal. When on-site storage is necessary, solid wastes shall be stored in watertight dumpsters in the general storage area of the contractor's yard. Solid waste, including rubble stockpiles, shall be removed and disposed offsite at least weekly. ABC Waste Disposal (License CA9999999) shall provide solid waste disposal services. Liquid hazardous wastes shall be stored in the covered containment area discussed above for materials storage. Solid hazardous waste shall be stored in the shipping container or in the covered containment area. Hazardous wastes shall be appropriate and clearly marked containers and segregated from other non-waste materials. Wastes shall be stored in sealed containers constructed of a suitable material and shall be labeled as required by Title 22 CCR, Division 4.5 and 49 CFR Parts 172, 173, 178, and 179. All hazardous waste shall be stored, transported, and disposed as required in Title 22 CCR, Division 4.5 and 49 CFR 261-263.

WM-7 Contaminated Soil Management
•When contaminated soils are encountered, the Resident Engineer shall be notified, the contaminated soils shall be contained, covered if stockpiled, and disposed of per the Contaminated Soil Management BMP, and the Special Provisions. Employees shall be instructed to recognize evidence of contaminated soil, such as buried debris, discolored soil, and unusual odors.

WM-8 Concrete Residuals and Washout Wastes
•The overall project includes placement of approximately 130 yd3 of concrete in four separate pours, the largest pour being approximately 50 yd3. The estimated maximum washout volume is 3.5 ft3.
•Discharges will consist of rinse water and residual concrete (PCC, aggregates, admixture, and water). Estimated pour dates are shown on the project schedule in Section 500.7. Concrete pours shall not be conducted during or immediately prior to rainfall events.
•Concrete Waste Management shall be implemented in accordance with contract documents, and maintained at the contractor's yard.
•Concrete washout facilities shall be designed in accordance with Standard Detail T59. All excess concrete and concrete washout slurries shall be discharged to the washout facility for drying. BMP maintenance, waste disposal, and BMP removal shall be conducted as described in Concrete Waste Management Special Provision.

•No concrete work will be performed as part of this CSWPPP. Concrete work will be covered in an amendment to this CSWPPP or a new SWPPP, both to be developed by the Contractor's QSD

WM-9 Sanitary and Septic Wastes
•The contractor shall implement Sanitary and Septic Waste Management BMP. Portable toilets shall be located and maintained at the contractors' yard for the duration of the project. Weekly maintenance shall be provided each Wednesday by ABC Sanitation (license CA0Q45W) and wastes shall be disposed offsite.

500.5 Water Pollution Control Drawings

The WPCDs are the component of the project SWPPP that show the BMPs, by project phase/stage, that are necessary for the project to be in compliance with the CGP. The construction activity phases used in this SWPPP are the preliminary phase, grading phase, highway construction phase, and the highway planting / erosion control establishment phase. These phases are defined below.

Preliminary Phase (Pre-Construction Phase – Part of the Grading Phase)

Includes rough grading/or disking, clearing and grubbing operations, or any soil disturbance prior to mass grading.

Grading Phase

Includes reconfiguring the topography for the highway, including excavation for roadway (e.g., necessary blasting of hard rock), highway embankment construction (fills); mass grading, and stockpiling of select material for capping operations.

Highway Construction Phase

Encompasses both highway and structure construction. Highway construction includes final roadway excavation, placement of base materials and highway paving, finish grading, curbs, gutters and sidewalks, public utilities, public water facilities including fire hydrants, public sanitary sewer systems, storm drain systems and/or other drainage improvements, highway lighting, traffic signals and/or other highway electrical work, guardrail, concrete barriers, sign installation, pavement markers, traffic striping and pavement markings. Structure construction includes structure footings, bridges, retaining walls, major culverts, overhead sign structures and buildings.

Highway Planting / Erosion Control Establishment Phase

Includes clearing and grubbing operations, soil preparation (grading, incorporation of soil amendments, and placement of topsoil), irrigation (trenching, installation and trench backfilling), minor grading (top dressing and fine grading of lawn and ground cover areas), planting (seeding and planting of vegetation), mulching (application of wood chips or other mulches) and plant establishment (weeding, plant replacement, and, if needed, fertilizer application, irrigation maintenance, and reapplication of mulch). Erosion control includes placement of permanent erosion control materials and maintenance of temporary sediment controls during the erosion control establishment period.

The WPCDs provide field staff with the information on where to install BMPs so that they are effective. The WPCDs, WPCBML and Water Pollution Control Schedule provide the necessary tools for a Contractor to plan and implement BMPs to meet the requirements of the project SWPPP.

The WPCD cover sheet(s) shall include a listing of the BMPs that will be used along with the associated BMP symbols used on the WPCDs.

WPCDs are provided for all areas that are directly related to the construction activity, including but not limited to staging areas, storage yards, material borrow areas and storage areas, access roads, etc., whether or not they reside within the Caltrans rights-of-way

The WPCDs shall show the construction project site in detail, including:

- the construction site perimeter;
- geographic features within or immediately adjacent to the site; include surface waters such as lakes, streams, springs, wetlands, estuaries, ponds, and the ocean;
- site topography before and after construction; include roads, paved areas, buildings, slopes, drainage facilities, and areas of known or suspected contamination; and
- permanent (post-construction) BMPs.

The WPCDs shall show the following site information:

- discharge points from the project to off-site storm drain systems or receiving waters;
- tributary areas and drainage patterns across the project area (show using flow arrows) into each on-site stormwater inlet or receiving water;
- tributary areas and drainage patterns to each on-site stormwater inlet, receiving water or discharge point;
- off-site tributary drainage areas that generate run-on to the project;
- temporary on-site drainage(s) to carry concentrated flows;
- drainage patterns and slopes anticipated after major grading activities are completed;
- outlines of all areas of existing vegetation, soil cover, or native vegetation that will remain undisturbed during the project;
- outlines of all areas of planned soil disturbance (disturbed soil areas, DSAs);
- known location(s) of contaminated or hazardous soils; and
- any potential non-stormwater discharges and activities, such as dewatering operations, concrete saw-cutting or coring, pressure washing, waterline flushing, diversions, cofferdams, and vehicle and equipment cleaning; if operations can't be located on the WPCDs, a narrative description should be provided.

The WPCDs show proposed locations of all construction site BMPs. Additional detail drawings are provided if necessary to convey site-specific BMP configurations. The WPCDs shall show construction site BMPs including the following:

- temporary soil stabilization and temporary sediment control BMPs that will be used during construction; any temporary on-site drainage(s) to carry concentrated flows, BMPs implemented to divert off-site drainage around or through the construction site, and BMPs that protect stormwater inlets;
- construction entrances used for site ingress and egress points and any proposed temporary construction roads;
- BMPs to mitigate or eliminate non-stormwater discharges;
- BMPs for waste management and materials pollution control, including, but not limited to storage of soil or waste; construction material loading, unloading, storage and access areas; and areas designated for waste handling and disposal; and
- BMPs for vehicle and equipment storage, fueling, maintenance, and cleaning.

The WPCDs can be found in Attachment BB of the SWPPP.

WPCDs shall show the construction site perimeter, geogragic features within/adjacent to the site, permanent (post-

construction) BMPs, discharge pioints from the project to off-site storm drain systems, tributary areas, draiange patterns, off-site tributary drainage areas, temporary fencing, temporary construction entrances/exits, BMPs to mitigate or eliminate non-stormwaer discharges, clearing and grubbing areas, etc.

500.6 Water Pollution Control BMP List

The Water Pollution Control Best Management Practices List (WPCBMPL) provides, by location and project phase/stage, the BMPs necessary for the project to be in compliance with the CGP. The WPCBMPL provides field staff both with a list of necessary BMPs and with an estimated quantity for each BMP by location and phase/stage of the project. The construction activity phases are typically the Preliminary Phase, Grading Phase, Highway Construction Phase, and the Highway Planting / Erosion Control Establishment Phase. The construction activity phases are defined in Section 500.5.

The WPCBMPL, water pollution control drawings and water pollution control schedule provide the tools necessary for the Contractor to plan and implement BMPs to meet the requirements of the project SWPPP. The BMPs listed on the WPCBMPL are the base line for site inspections and visual monitoring.

The WPCBMPL cover sheet includes a list of all BMPs to be used on the project based on Section 500 Determination of Construction Site Best Management Practices.

The names and number of locations listed on the WPCBMPL were established so that field staff and inspectors can easily identify where BMPs need to be located. The WPCBMPL includes all locations that are directly related to the construction activity, including but not limited to staging areas, storage yards, material borrow areas and storage areas, access roads, etc., whether or not they reside within Caltrans rights-of-way.

Necessary additional information to convey site-specific BMP configurations or BMP modifications are noted on the WPCBMPL.

All construction site BMPs are listed on the WPCBMPL including the following:

- temporary soil stabilization and temporary sediment control BMPs that will be used during construction; include temporary on-site drainage(s) to carry concentrated flows
- BMPs implemented to divert off-site drainage around or through the construction site, and BMPs that protect stormwater inlets
- BMPs to mitigate or eliminate non-stormwater dischargesBMPs for waste management and materials pollution control, including, but not limited to storage of soil or waste; construction material loading, unloading, storage and access areas; and areas designated for waste handling and disposal
- BMPs for vehicle and equipment storage, fueling, maintenance, and cleaning
- permanent BMPs that are a component of the project SWPPP

The WPCBMPL can be found in Attachment CC of the SWPPP.

Temporary soil stabilization and temporary sediment control BMPs that will used during construction; include temporary on-site drainage(s) to carry concentrated flows.

BMPs implemented to divert off-site drainage around or through the construction site, and BMPs that protect stormwater inlets.

BMPs to mitigate or eliminate non-stormwater discharges BMPs for waster management and materials pollution control, including, nut not limited to storage of soil or waste; construction material loading, unloading, storage and access areas;

and areas designated for waste handling and disposal.

BMPs for vehicle and equipment storage, fueling, maintenance, and cleaning.

Permanent BMPs that are a component of the project SWPPP.

500.7 Water Pollution Control Schedule

The Water Pollution Control Schedule (WPCS) is the component of the project SWPPP that shows the timeline for when BMPs will be installed so that the project is in compliance with the CGP. The WPCS provides field staff with the information necessary to plan for adequate materials and crews to install BMPs at the right time so that they are effective. The WPCS, WPCBMPL, and WPCDs provide the necessary tools for the Contractor to plan and implement BMPs to meet the requirements of the project SWPPP.

The WPCS shall contain an adequate level of detail to show major activities sequenced with the implementation of construction site BMPs, including:

- project start and finish dates, including each stage of the project
- SWPPP review and approval
- annual certifications
- mobilization dates
- mass clearing and grubbing/roadside clearing dates
- major grading/excavation dates
- dates named in other permits such as TRPA, Fish and Game and Army Corps of Engineers Permits
- dates for submittal of SWPPP amendments as required in the contract specifications

The WPCS shall show by location the dates for the deployment of:

- temporary soil stabilization BMPs
- temporary sediment control BMPs
- wind erosion control BMPs
- tracking control BMPs
- non-stormwater BMPs
- waste management and materials pollution control BMPs

The WPCS shall include:

- paving, saw-cutting, and any other pavement-related operations;
- major planned stockpiling operations;
- dates for other significant long-term operations or activities that may cause non-stormwater discharges, such as dewatering, grinding, etc; and
- final stabilization activities for each disturbed soil area of the project.

The WPCS shall be updated quarterly and the quarterly updates shall be filed in SWPPP File Category 20.03: Water Pollution Control Schedule Updates.

The Water Pollution Control Schedule can be found in Attachment DD of the SWPPP.

SECTION 600
PROJECT SITE IMPLEMENTATION PROGRAM

600.1 Water Pollution Control Manager Responsibilities

The WPC Manager shall have primary responsibility and authority to implement the SWPPP and ensure the project is in compliance with the CGP. The WPC Manager is responsible for implementing the SWPPP and amending the SWPPP when any of the conditions specified in Section 100.3 are met. The Contractor has assigned authority to the WPC Manager to mobilize crews and subcontractors, as necessary, for SWPPP and CGP compliance. The WPC Manager will be available at all times throughout duration of the project.

Duties of the Contractor's WPC Manager include but are not limited to the following

- ensuring full compliance with the SWPPP and the CGP
- implementing all elements of the SWPPP, including but not limited to implementing:
    - prompt and effective erosion and sediment control measures
    - all non-stormwater management, and materials and waste management activities such as: monitoring discharges (dewatering, diversion devices); performing general site cleanup; cleaning vehicles and equipment, performing fueling and maintenance activities; providing spill control; ensuring that no materials other than stormwater are discharged in quantities that will have an adverse effect on receiving waters or storm drain systems, etc.
- overseeing and ensuring that the following site inspections and visual site monitoring are conducted:
    - daily required BMP inspections
    - weekly routine stormwater site BMP inspections
    - quarterly non-stormwater site inspections
    - pre-storm inspections prior to forecasted storm events
    - daily inspections during extended forecasted storm events
    - post-storm inspections for qualifying rain events
- mobilizing crews to repair, replace, and/or implement additional BMPs due to deficiencies, failures or other shortcomings identified during inspections, to be completed within 24 hours of identification in compliance with Standard Specification 13-1.03A (the contractor's WPC Manager shall be assigned authority by the Contractor to mobilize crews), unless a longer period is authorized.
- coordinating with the RE to assure that if design changes to BMPs are required due to deficiencies, failures or other shortcomings identified during inspections, the changes are completed as soon as possible and the SWPPP is revised accordingly
- monitoring NWS Forecast Office forecasts for both forecasted storm events and qualifying rain events; these events are defined as follows:
    - forecasted storm event is defined as a 50% or greater likelihood that 0.10 inch or more of precipitation will fall within a 24-hour period

  - a qualifying rain event is defined as a rain event that may produce or has produced ½ inch or greater of precipitation at the time of discharge, with a 72-hour dry period between events

- monitoring weather at the project site
- preparing and implementing qualifying rain event sampling and analysis plans
- preparing and implementing Rain Event Action Plans for forecasted storm events
- mobilizing crews immediately, in the event of NAL exceedances, to repair existing BMPs and/or implement additional BMPs (the Contractor's WPC Manager shall be assigned authority by the Contractor to mobilize crews),
- coordinating with the RE in the event of NAL exceedances to assure that any SWPPP revisions (corrective actions) are made immediately, either to prevent pollutants and authorized non-stormwater discharges from contaminating stormwater, or to substantially reduce the pollutants to levels consistently below the NALs, so that the project complies with the SWPPP, the CGP and approved plans at all times,
- submitting NAL exceedances reports to the RE
- submitting test results for stormwater samples to the RE
- preparing amendments to the SWPPP when required
- preparing contractor's SWPPP Annual Compliance Certification
- preparing the Stormwater Annual Reports
- ensuring elimination of all unauthorized discharges
- preparing and submitting Notice of Discharge reports to the RE
- preparing and submitting reports of illicit connections or illegal discharges to the RE

600.2 Site Inspections

Stormwater site inspections and visual monitoring are necessary to ensure that the project is in compliance with the requirements of the CGP. Project site visual monitoring requirements are covered in Section 700 Construction Site Monitoring Program. Project site inspections of stormwater BMPs are conducted to identify and record:

- that BMPs are properly installed
- what BMPs need maintenance to operate effectively
- what BMPs have failed
- what BMPs could fail to operate as intended.

Routine stormwater site inspections shall be conducted by the contractor's WPC Manager or other 24-hour trained staff at the following minimum frequencies:

- daily inspections of:
  - storage areas for hazardous materials and waste
  - hazardous waste disposal and transporting activities

- hazardous material delivery and storage activities
- vehicle and equipment cleaning facilities if vehicle and equipment cleaning occurs daily
- vehicle and equipment maintenance and fueling areas if vehicle and equipment maintenance and fueling occurs daily
- vehicles and equipment at the job site to verify that operators are inspecting vehicles and equipment each day of use.
- demolition sites within 50 feet of storm drain systems and receiving waters
- pile driving areas for leaks and spills if pile driving occurs daily
- temporary concrete washouts if concrete work occurs daily
- paved roads at job site access points for street sweeping if earthwork and other sediment or debris generating activities occur daily
- dewatering work if dewatering work occurs daily
- temporary active treatment system if temporary active treatment system activities occur daily
- work over water if work over water occurs daily

- daily inspections for projects within the Lake Tahoe Hydrologic Unit
- daily inspections of access roadways
- weekly inspection of site BMPs

Stormwater site inspections shall be documented on CEM-2030 Stormwater Site Inspection Report, in Appendix G. Completed stormwater inspection reports shall be submitted to the RE within 24 hours after completion of the inspection. Copies of completed inspection reports will be kept in SWPPP File Category 20.31: Contractor Stormwater Site Inspection Reports,

Deficiencies identified during site inspections and correction of deficiencies will be tracked on the CEM-2035 Stormwater Corrective Actions Summary, in Appendix I. Corrective Action Summary forms shall be submitted to the RE when corrections are completed but must be submitted within five (5) days after completion of the site inspection. Completed Stormwater Site Inspection Report Corrective Actions Summary forms shall be filed in SWPPP File Category 20.35: Corrective Actions Summary. A copy of the completed Corrective Actions Summary form will also be attached to the corresponding Stormwater Site Inspection Report that generated the need for the CEM-2035 Stormwater Corrective Actions Summary

600.3 Weather Forecast Monitoring

The WPC Manager shall have primary responsibility to monitor the National Weather Service Forecast Office for forecasted precipitation based on project site location. Precipitation forecast information shall be obtained from the National Weather Service Forecast Office accessible at: http://www.srh.noaa.gov/.

The project site location to be used for obtaining forecast from National Weather Forecast Office website is:

In Alameda County, In And Near Livermore And Pleasanton, From 0.1 Mile South Of Ruby Hill Drive To 0.6 Mile North Of Concannon Boulevard

The WPC Manager shall monitor the weather forecast on a daily basis for predicted precipitation within the following 96 hours. The WPC Manager shall monitor the forecast for the next 24, 48, 72 and 96 hours to determine if the forecast for precipitation is 50 percent or greater for any 6-hour period. If the forecast for precipitation is 50 percent or greater, the WPC Manager shall calculate the amount of precipitation forecasted for each 24-hour period and the total precipitation for the forecasted storm event and record the information. Weather forecast monitoring shall be recorded be filed in File Category 20.40: Weather Monitoring Logs.

When the forecast for precipitation is 50 percent or greater and the forecasted amount of precipitation is 0.10 inch or more for any 24-hour period within the next 72 hours, the WPC Manager shall perform a pre-storm site inspection and ensure that the site is prepared for the likely forecasted storm event.

For Risk Level 2 and 3 the WPC Manager will prepare a Rain Event Action Plan for forecasted storm events.

Forecasted storm event site preparation shall include, but is not limited to, the installation of soil stabilization and sediment BMPs on active disturbed soil areas and stockpiles.

600.4 Weather Monitoring

The WPC Manager shall have primary responsibility to monitor weather at the project site. The WPC Manager, on a daily basis, shall monitor the weather and record the weather conditions.

When there is precipitation, the WPC Manager shall ensure that storm precipitation data is obtained from the project site rain gauge. Precipitation monitoring will include recording the time, amount of precipitation measured in the project site rain gauge, amount of precipitation within a 24-hour period, and total cumulative amount of precipitation for the forecasted storm event.

If no pre-storm visual site monitoring was performed, and the amount of precipitation for any 24-hour period is 0.10 inch or greater, the WPC Manager will implement during storm visual site monitoring, as discussed in Section 700.1.

When a forecasted storm event was not forecasted to be a qualifying rain event, but the measured cumulative amount of precipitation for the storm event and the expected severity of the continuing storm event results in ½ inch or more of precipitation, the WPC Manager will prepare to sample.

Weather monitoring will be conducted daily. Weather monitoring documentation shall be kept in File Category 20.40: Weather Monitoring Logs.

600.5 Best Management Practices Status Report

The WPC Manager shall prepare a monthly status report of the water pollution control BMPs (site BMPs) installed on the project site. The monthly BMP status report will be based on the progress of the work and the WPCBMPL for the project, with any additional BMPs the WPC Manager has determined are necessary based on the stage of construction and construction activities.

Because the SWPPP, including the WPCBMPL and WPCDs, are based on the entire project site and all construction activities, the monthly BMP status report should be a "snapshot" of which BMPs are deployed on the project site, so a project inspector or reviewer can easily determine what could be expected to be seen on the project site that month. The monthly status report will be used by stormwater inspectors and contractor personnel to ensure SWPPP compliance.

The weekly status report will be used to ensure that weekly training meetings cover BMPs that are required for work activities during the week. The weekly status report will be provided to regulatory agency staff who visit the project site to indicate which BMPs should be in place and which are scheduled to be implemented during the coming week.

The monthly status of stormwater BMPs will be documented on CEM-2034 Stormwater Best Management Practices and Materials Inventory Report form, in Appendix H. Completed monthly status reports shall be submitted to the RE 48 hours prior to the beginning of the work week. Copies of the completed reports will be kept in SWPPP File Category 20.34: Monthly Best Management Practices and Materials Inventory Reports.

600.6 Rain Event Action Plans (REAP)

REAPs will be prepared by the WPC Manager when there is a forecasted storm event. A forecasted storm event is any weather pattern that is forecasted to have a 50 percent or greater probability of producing precipitation of 0.10 inch or more within any 24-hour period at the project site location. The WPC Manager will prepare the REAP for the forecasted storm event based on the current construction activity phase of the project. For REAPs, the construction activity phases are the Highway Construction Phase, Highway Planting / Erosion Control Establishment Phase or Inactive Project Phase. The construction activity phases are defined in Section 500.5.

When the NWS forecast for 72 hours and greater predicts a forecasted storm event, the WPC Manager will prepare a REAP using the REAP form appropriate to the current project stage. REAP forms are available in Appendix L. Prepared REAPs shall be submitted to the RE at least 48 hours prior to a forecasted stormevent. If the NWS forecast changes and a storm event is forecasted to occur within 24-72 hours then a REAP must be prepared. If the NWS forecast changes and a storm event is forecasted to occur within the next 24 hours a REAP will not be prepared and the WPC Manager will take immediate actions to ready the project site for the forecasted storm event.

The WPC Manager shall implement a REAP within the 48 hours prior to the forecasted storm event. A copy of the REAP shall be available on the job site at least 48 hours prior to the forecasted storm event. Copies of REAPs will be maintained in SWPPP File Category 20.45: Rain Event Action Plans in reverse chronologic order.

SECTION 700
CONSTRUCTION SITE MONITORING PROGRAM

700.1 Site Visual Monitoring Inspection

This Construction Site Monitoring Program includes conducting site visual monitoring inspections of the project site to address the following objectives:

- determine whether non-visible pollutants are present at the construction site and are causing or contributing to exceedances of water quality objectives
- determine whether BMPs included in the SWPPP are effective in preventing or reducing pollutants in stormwater discharges and authorized non-stormwater discharges
- determine whether BMPs included in the REAP are effective in preventing or reducing pollutants in stormwater discharges and authorized non-stormwater discharges
- demonstrate that the site is in compliance with the discharge prohibitions and applicable NALs and Receiving Water Monitor Triggers of the CGP
- determine whether immediate corrective actions, additional BMP implementation, or SWPPP amendments are necessary to reduce pollutants in stormwater and authorized non-stormwater discharges
- demonstrate that the site is in compliance with the discharge prohibitions
- document the presence or evidence of any non-stormwater discharge (authorized or unauthorized), pollutant characteristics (floating and suspended material, sheen, discoloration, turbidity, odor, etc.), and source, if applicable, and the response taken to eliminate unauthorized non-stormwater discharges and to reduce or prevent pollutants from contacting non-stormwater discharges

700.1.1 Visual Monitoring Locations

Locations of Visual Monitoring Prior To A Storm Event

Visual monitoring (a pre-storm inspection) of the project site is required when the forecast for precipitation is greater than 50 percent within the next 24, 48, 72, 96 hours, and the amount of precipitation forecasted for any 24-hour period is 0.10 inch or greater. Within 48 hours of a forecasted storm event, a stormwater visual monitoring site inspection shall be performed and shall include observations of:

- stormwater drainage areas to identify any spills, leaks, or uncontrolled pollutant sources
- BMPs to identify whether they have been properly implemented
- any stormwater storage and containment areas to detect leaks and ensure maintenance of adequate freeboard

7 drainage area(s) on the project site and the Contractor's yard, staging areas, and storage areas have been identified as required forecasted storm event visual observation location(s), according to Section I.3.e of Attachments C, D, and E of the CGP. Drainage area(s) are shown on the WPCDs in Attachment BB and are listed by drainage area location number and location description in Table 700.1.1.1: Drainage Areas.

TABLE 700.1.1.1
DRAINAGE AREAS

Drainage Area No.	Location
DA1	57.49' Lt "A1" 230+57.03
DA2	69.36' Lt "A1" 237+10.88
DA3	72.19' Lt "A1" 242+94.93
DA4	47.75' Lt "A1" 251+76.82
DA5	2.31' Rt "VEX" 54+60.07
DA6	61.60' Rt "A1" 259+35.51
DA7	39.02' Rt "V" 107+69.90

0 stormwater storage or containment area(s) are located on the project site. These stormwater storage and containment area(s) have been identified as required forecasted storm event visual observation location(s). Stormwater storage or containment area(s) are shown on the WPCDs from Attachment BB and are listed by storage or containment area location number and location description in Table 700.1.1.2: Stormwater Storage and Containment Areas.

TABLE 700.1.1.2
STORMWATER STORAGE AND CONTAINMENT AREAS

Location No.	Location
	No storage or containment work will be required within outside pavement widening areas and retaining wall limits.

Locations of Visual Monitoring during Extended Forecasted Storm Events and within 48 Hours After a Qualifying Rain Event

During any extended forecasted storm events and within 48 hours after a qualifying rain event (a rain event that has produced ½ inch or more of precipitation), a stormwater visual monitoring site inspection is required to observe:

- stormwater discharges at all discharge locations
- BMPs to identify and record those that need maintenance to operate effectively, those that have failed, and those that could fail to operate as intended
- the discharge of stored or contained stormwater

6 discharge location(s) are located on the project site. These stormwater discharge location(s) have been identified as required visual observation location(s). Stormwater discharge location(s) are shown on the WPCDs in Attachment BB and are listed in Table 700.1.1.3: Stormwater Discharge Locations.

TABLE 700.1.1.3
STORMWATER DISCHARGE LOCATIONS

Unique Sampling Location Identifier	Location
TS1	91.77' Rt "A1" 233+65.65
TS2	95.71' Rt "A1" 235+10.73
TS3	41.29' Lt "A1" 242+16.51
TS4	25.95' Rt "V" 101+46.95
TS5	35.10' Lt "V" 110+25.67
TS6	29.10' Lt "V" 111+38.05

BMP locations shown on the WPCDs in Attachment BB and are listed on the WPCBMPL in Attachment CC.

0 stormwater storage or containment area(s) are located on the project site. Stormwater storage or containment area(s) are shown on the WPCDs in Attachment BB and are listed on Table 700.1.1.2: Stormwater Storage and Containment Areas.

Locations of Visual Monitoring for Non-Stormwater Discharges

A visual monitoring site inspection for non-stormwater discharges requires that each drainage area be observed for the presence of or indications of prior unauthorized and authorized non-stormwater discharges.

7 drainage area(s) are located on the project site and in the contractor's yard, staging areas, and storage areas that have been identified as observation location(s) for non-stormwater discharges. Drainage area(s) are shown on the WPCDs in Attachment BB and are listed in Table 700.1.1.1: Drainage Areas.

700.1.2 Visual Monitoring Schedule

On a daily basis, contractor personnel will visual monitor the all immediate access roadways.

On a daily basis contractor personnel will visually monitor BMPs during applicable activities:

- storage areas for hazardous materials and waste
- hazardous waste disposal and transporting activities
- hazardous material delivery and storage activities
- vehicle and equipment cleaning facilities if vehicle and equipment cleaning occurs daily
- vehicle and equipment maintenance and fueling areas if vehicle and equipment maintenance and fueling occurs daily
- vehicles and equipment at the job site to verify that operators are inspecting vehicles and equipment each day of use.
- demolition sites within 50 feet of storm drain systems and receiving waters
- pile driving areas for leaks and spills if pile driving occurs daily
- temporary concrete washouts if concrete work occurs daily

- paved roads at job site access points for street sweeping if earthwork and other sediment or debris generating activities occur daily
- dewatering work if dewatering work occurs daily
- temporary active treatment system if temporary active treatment system activities occur daily
- work over water if work over water occurs daily

Stormwater site visual monitoring inspections shall be conducted at a minimum:

- within 48 hours prior to a forecasted storm event (any weather pattern that is forecasted to have a 50 percent or greater probability of producing 0.1 inches or more of precipitation in the project area within a 24 period)
- at 24-hour intervals during any extended forecasted storm event
- within 48 hours after a qualifying rain event (a rain event that has produced ½ inch or more of precipitation)

Non-stormwater discharge site visual monitoring inspections shall be conducted, at a minimum, during each of the following periods: January-March, April-June, July-September, and October-December.

If visual monitoring of the site for stormwater is unsafe because of dangerous weather conditions, such as flooding and electrical storms, then the site inspector shall document the conditions that prevented the inspection. The documentation of the site visual monitoring inspection shall be filed in SWPPP File Category 20.33: Site Visual Monitoring Inspection Reports.

700.1.3 Visual Monitoring Procedures

Site visual monitoring inspections shall be overseen by the contractor's WPC Manager. Stie visual monitoring will be conducted by the WPC Manager , appointed QSP or stormwater inspector.

The name(s) and contact number(s) of the site visual monitoring inspection personnel are listed below and their training qualifications are provided in Attachment E:

- Assigned Inspector: TBD Contact phone: TBD
- Alternate Inspector: TBD Contact phone: TBD

Daily Access Road Monitoring

All immediate access roads must be inspected on a daily basis. Any sediment or other construction-related materials deposited on the roads must be removed daily (or more frequently when necessary) and prior to any rain event.

Daily BMP Monitoring During Applicable Activities

Standard Specification 13-1.03C requires that the contractor personnel on the site shall inspect the following activities on a daily basis:

- storage areas for hazardous materials and waste
- hazardous waste disposal and transporting activities
- hazardous material delivery and storage activities
- vehicle and equipment cleaning facilities if vehicle and equipment cleaning occurs daily

- vehicle and equipment maintenance and fueling areas if vehicle and equipment maintenance and fueling occurs daily
- vehicles and equipment at the job site to verify that operators are inspecting vehicles and equipment each day of use.
- demolition sites within 50 feet of storm drain systems and receiving waters
- pile driving areas for leaks and spills if pile driving occurs daily
- temporary concrete washouts if concrete work occurs daily
- paved roads at job site access points for street sweeping if earthwork and other sediment or debris generating activities occur daily
- dewatering work if dewatering work occurs daily
- temporary active treatment system if temporary active treatment system activities occur daily
- work over water if work over water occurs daily

Discharge Monitoring

During inspections, the contractor personnel shall be observant of any discharges or evidence of a prior discharge that could cause adverse conditions in the storm sewer system or the receiving water. If a discharge or evidence of a prior discharge is discovered by the contractor, the WPC Manager or contractor shall immediately notify the RE, and shall file a written report on the CEM-2061 Notice of Discharge form with the RE within 24 hours of the discharge or discovery of evidence of a prior discharge. Corrective measures shall be implemented immediately following the discovery of the discharge. Form CEM-2061 for reporting discharges is available in Appendix K.

Caltrans will notify the owner/operator of the MS4 and the RWQCB as soon as practicable, but no later than 24 hours after onset of or threat of discharge which can cause adverse conditions to the storm sewer system or the receiving water. This applies to any such discharge that is not covered by California Emergency Management Agency procedures for discharges from a highway to a storm sewer system subject to a MS4 permit.

Discharges requiring reporting include:

- stormwater from a DSA discharged to a waterway without treatment by an effective combination of temporary erosion and sediment control BMPs
- non-stormwater, except conditionally exempted discharges, discharged to a waterway or a storm drain system, without treatment by an approved control measure (BMP)
- stormwater discharged to a waterway or a storm drain system where the control measures (BMPs) have been overwhelmed or not properly maintained or installed
- discharge of hazardous substances above the reportable quantities, as provided in 40 CFR 110.3, 117.3 or 302.4
- stormwater runoff containing hazardous substances from spills discharged to a waterway or storm drain system

The initial notification to the RWQCB of a discharge or threat of discharge will be made immediately for any discharge that can cause adverse conditions to the storm sewer system or the receiving water, with a follow-up in writing within 24 hours. Adverse conditions include, but are not limited to, serious violations or serious threatened violations of Waste Discharge Requirements (WDRs), significant spills of petroleum products or toxic chemicals, or serious damage to control facilities that could affect compliance. Caltrans shall perform follow-up monitoring of major spills and/or perform confirmation sampling to ensure that threats to waters of the U.S. have been eliminated as determined by the local RWQCB.

Weekly BMP Monitoring

Weekly monitoring is required to identify and record BMPs that need maintenance to operate effectively, that have failed, or that could fail to operate as intended. The weekly BMP monitoring shall include observations of:

- all stormwater storage and containment areas identified in Table 700.1.1.2 to detect leaks and ensure maintenance of adequate freeboard
- all BMPs for proper installation and adequate maintenance.

Observations of the site and any recommended corrective actions will be documented in the CEM-2030 Stormwater Site Inspection Report. Any photographs used to document observations will be referenced in the stormwater site inspection report. Corrective actions documented in site inspection reports shall be immediately reviewed by the WCP Manager and, if deemed necessary, implemented within 24 hours.

Visual Monitoring Prior To A Forecasted Storm Event

Visual monitoring of the project site is required when the forecast for precipitation is greater than 50 percent within the next 24, 48, 72, or 96 hours and the amount of precipitation forecasted for any 24-hour period during the storm event is 0.10 inch or greater within a 24-hour period. Site visual monitoring shall be conducted within 48 hours prior to a forecasted storm event. The pre-storm site visual monitoring shall include observations of:

- all drainage areas identified in Table 700.1.1.1 to identify any spills, leaks, or uncontrolled pollutant sources;
- all stormwater storage and containment areas identified in Table 700.1.1.2 to detect leaks and ensure maintenance of adequate freeboard
- all BMPs for proper installation and adequate maintenance.

Observations of the site and any recommended corrective actions will be documented in the CEM-2030 Stormwater Site Inspection Report. Any photographs used to document observations will be referenced in the stormwater site inspection report. Corrective actions documented in site inspection reports shall be immediately reviewed by the WCP Manager and, if deemed necessary, implemented within 24 hours and prior to the forecasted storm event.

Any corrective actions identified by a pre-storm visual monitoring site inspection shall be included in the REAP for the forecasted storm event.

Visual Monitoring during Extended Forecasted Storm Events

Stormwater visual monitoring site inspections shall be conducted at least once each 24-hour period during any extended forecasted storm events. During any extended forecasted storm event, the site visual monitoring inspector shall visually observe:

- stormwater discharges at all discharge locations (Table 700.1.1.3)
- all stored or contained stormwater that is derived from and discharged subsequent to the qualifying rain event producing precipitation of ½ inch or more at the time of discharge; stored or contained stormwater that will likely discharge after working hours, due to anticipated precipitation, shall be observed prior to the discharge during working hours

Stormwater discharges and stored or contained stormwater will be observed for the presence or absence of floating and suspended materials, sheens on the surface, discolorations, turbidity, odors, and source(s) of any observed pollutants.

During any forecasted storm event, stormwater visual monitoring site inspections will include the observation of all site BMPs for:

- proper installation
- achievement of maintenance requirements
- possible failure
- BMPs that could fail to operate as intended
- effectiveness, so that design changes can be implemented as soon as feasible if needed

Observations of the site and any recommended corrective actions will be documented in the CEM-2030 Stormwater Site Inspection Report. Any photographs used to document observations will be referenced on the stormwater site inspection report. Corrective actions documented in site inspection reports shall be immediately reviewed by the WCP Manager and, if deemed necessary, implemented , as required by Standard Specification 13-1.03A, within 24 hours of identification unless a longer period is authorized (but cannot be authorized longer than required by the CGP: implemented within 72 hours of identification and completed as soon as possible thereafter). If BMPs require design changes, the changes shall be implemented and the SWPPP shall be amended to include the changes.

Visual Monitoring Within 48 Hours after a Qualifying Rain Event

Site visual monitoring post-qualifying rain events shall be conducted within 48 hours after the qualifying rain event. The post-storm site visual monitoring inspection shall include observations of:

- discharges of stormwater that have not been processed by a BMP or evidence of stormwater that has not been processed by a BMP at all discharge locations
- evidence of a breach at stored or contained stormwater that is derived from and discharged subsequent to the qualifying rain event producing precipitation of ½ inch or more at the time of discharge; stored or contained stormwater that will likely discharge after working hours, due to anticipated precipitation, shall be observed prior to the discharge during working hours

Stormwater discharges and stored or contained stormwater will be observed for the presence or absence of floating and suspended materials, sheens on the surface, discolorations, turbidity, odors, and source(s) of any observed pollutants.

Post-qualifying rain event stormwater visual monitoring site inspections will include observation of all site BMPs to determine if BMPs have failed to operate as intended because of:

- improper installation
- lack of maintenance
- lack of effectiveness

Observations of the site and any recommended corrective actions will be documented in the CEM-2030 Stormwater Site Inspection Report. Any photographs used to document observations will be referenced on the stormwater site inspection report. Corrective actions documented in site inspection reports shall be immediately reviewed by the WCP Manager and, if deemed necessary, necessary implemented, as required by Standard Specification 13-1.03A, within 24 hours of identification unless a longer period is authorized (but cannot be authorized longer than required by the CGP: implemented within 72 hours of identification and completed as soon as possible thereafter). If BMPs require design changes, the changes shall be implemented and the SWPPP shall be amended to include the changes.

Visual Monitoring of Non-Stormwater Discharges

For non-stormwater site visual monitoring, each drainage area will be monitored quarterly for the presence or prior indications of unauthorized and authorized non-stormwater discharges, and their sources. The presence or absence of non-stormwater discharges based on site observations will be documented in the CEM-2030 Stormwater Site Inspection Report. Documentation of observed non-stormwater discharges will include presence or absence of floating and suspended materials, sheens on the surface, discolorations, turbidity, odors, and source(s) of any observed pollutants.

Site observations of the site and any recommended corrective actions will be documented. Corrective actions documented in site inspection reports shall be immediately reviewed by the WCP Manager and, if deemed necessary implemented, as required by Standard Specification 13-1.03A, within 24 hours of identification unless a longer period is authorized (but cannot be authorized longer than required by the CGP: implemented within 72 hours of identification and completed as soon as possible thereafter). If BMPs require design changes, the changes shall be implemented and the SWPPP shall be amended to include the changes. Corrective actions shall be documented in the CEM-2035 Stormwater Corrective Actions Summary. Any photographs used to document observations will be referenced in the CEM-2030 Stormwater Site Inspection Report.

700.1.4 Visual Monitoring Follow-up and Tracking Procedures

For deficiencies identified during visual monitoring (site inspections), the required repairs or maintenance of BMPs shall begin and be completed as soon as possible, while taking into consideration worker safety. For deficiencies identified during visual site inspections that require design changes, including additional BMPs, the implementation, as required by Standard Specification 13-1.03A, will begin within 24 hours of identification unless a longer period is authorized (but cannot be authorized longer than required by the CGP: implemented within 72 hours of identification and completed as soon as possible thereafter). When design changes to BMPs are required, the SWPPP shall be amended, including the WCBMPL and WPCDs. If NALs are exceeded, corrective actions shall be approved by the WPC Manager and implemented immediately.

Deficiencies identified on site inspection reports, as well as corrections of deficiencies, will be tracked on the CEM-2035 Stormwater Corrective Actions Summary, in Appendix I. Corrective action summaries shall be submitted to the RE when corrections are completed, but must be submitted within five (5) days of a site inspection.

700.1.5 Data Management and Reporting

The results of site visual monitoring (pre-storm, during storm, post-storm, and quarterly inspections) shall be recorded on the CEM-2030 Stormwater Site Inspection Report, in Appendix G. A copy of each report shall be kept in SWPPP File Category 20.33.

All reports shall be provided to the RE within 24 hours of the site inspection.

Deficiencies identified during visual monitoring (site inspections) and correction of deficiencies will be tracked on the CEM-2035 Stormwater Corrective Actions Summary, in Appendix I. Corrective Action Summary forms shall be submitted to the RE when corrections are completed, but must be submitted within five (5) days of the site inspection. Completed Stormwater Corrective Actions Summary forms shall be filed in SWPPP File Category 20.35: Corrective Actions Summary. A copy of the completed Corrective Actions Summary form will also be attached to the corresponding inspection report and shall be kept in the SWPPP Category 20.33.

If a discharge or evidence of a prior discharge that could cause adverse condition in the storm sewer or the receving water is discovered by the Contractor, the WPC Manager or Contractor shall immediately notify the RE, and no more than 6 hours after discovery, and will file a written report to the RE within 24 hours of the discovery of evidence of a prior discharge. The written report to the RE will contain:

- the date, time, location, and type of unauthorized discharge;

- The nature of the operation that caused the discharge;
- An initial assessment of any impacts caused by the discharge;
- the BMPs deployed before the discharge;
- the date of deployment and type of BMPs deployed after the discharge, including additional measures installed or planned to reduce or prevent re-occurrence
- steps taken or planned to reduce, eliminate and/or prevent recurrence of the discharge

Reporting of discharges shall be documented on the CEM-2061 Notice of Discharge form, in Appendix K. Completed Notice of Discharge reports shall be submitted to the RE within 24 hours of discovery of evidence of a discharge. Copies of the Notice of Discharge reports will be kept in SWPPP File Category 20.61: Notice of Discharge Reports.

700.2 Sampling and Analysis Plans

700.2.1 General SAP

A sampling and analysis plan (SAP) describes how samples will be collected, under what conditions, where and when the samples will be collected, what the sample will be tested for, what test methods and detection limits will be used, and what methods/procedures will be performed to ensure the integrity of the sample during collection, storage, shipping and testing (i.e., quality assurance/quality control protocols). Therefore, a SAP shall include the components listed below.

1. Scope of Monitoring Activities
2. Monitoring Preparation
3. Monitoring Strategy
4. Sample Collection and Handling
5. Sampling Analysis
6. Quality Control and Assurance
7. Data Management and Reporting
8. Data Evaluation
9. Change of Conditions

This SWPPP contains a non-visible pollutants SAP. The SWPPP may also contain four additional specific SAPS based on the project risk level, project dewatering requirements, RWQCB sampling and analysis requirements, and a SAP for monitoring an active treatment system.

700.2.1.1 Scope of Monitoring Activities

For specific details with regard to monitoring activities, refer to the specific SAP identified below.

- Non-visible Pollutants (Section 700.2.2.1)
- Non-Stormwater Discharges (Section 700.2.3.1)

- Stormwater pH and Turbidity (Section 700.2.4.1)
- Monitoring required by the Regional Board (Section 700.2.5.1)
- Monitoring for Active Treatment Systems (ATS) (Section 700.2.6.1)

700.2.1.2 Monitoring Preparation

To ensure an effective construction site monitoring and reporting program, the following monitoring preparation activities are required:

- identifying qualified sampling personnel
- ensuring the availability of an adequate quantity of monitoring supplies
- ensuring the availability of field instruments; field instruments must be properly maintained and calibrated prior to sampling events
- identifying a qualified testing laboratory that is capable of performing stormwater and non-stormwater analysis for those constituents that must be tested in a laboratory

700.2.1.2.1 Qualified Sampling Personnel

Sampling personnel shall be trained to collect, maintain, and ship samples in accordance with the Surface Water Ambient Monitoring Program (SWAMP) 2008 Quality Assurance Program Plan (QAPrP).

Samples on the project site will be collected by the contractor sampling personnel.

- Stormwater sampling and field analysis will be performed by the following primary and alternative stormwater samplers: TBD
- TBD

The primary stormwater sampler has received the following stormwater sampling training:

- TBD
- TBD

The primary stormwater sampler has the following stormwater sampling experience:

- TBD
- TBD

The alternate stormwater sampler has received the following stormwater sampling training:

- TBD
- TBD

The alternate stormwater sampler has the following stormwater sampling experience:

- TBD

- TBD

Training records of designated contractor sampling personnel are provided in Attachment D, Contractor Personnel Stormwater Training.

Safety practices for sample collection will be in accordance with the TBD.

700.2.1.2.2 Monitoring Supplies

An adequate stock of monitoring supplies and equipment for sampling will be available on the project site prior to a sampling event. Monitoring supplies and equipment will be stored in a cool temperature environment that will prevent the supplies/equipment from coming into contact with rain or direct sunlight. Supplies maintained at the project site will include, but are not limited to, surgical gloves, sample collection equipment, coolers, appropriate number and volume of sample bottles, identification labels, re-sealable storage bags, paper towels, personal rain gear, and ice.

The contractor will obtain and maintain the field testing instruments, identified in Section 700.2.1.2.3, for analyzing samples in the field by contractor sampling and testing personnel.

700.2.1.2.3 Field Instruments

The field instrument(s) shown in Table 700.2.1.2.3: Field Instruments will be used to analyze the constituents shown:

TABLE 700.2.1.2.3
FIELD INSTRUMENTS

Field Instrument	Constituent
TBD	pH
TBD	Turbidity

The instrument(s) shall be maintained in accordance with manufacturer's instructions.

The instrument(s) shall be calibrated before each sampling and analysis event.

A Standard Operating Procedure (SOP) for calibration and maintenance of field instruments shall be implemented based on the meter manufacturer's instructions. A copy of the manufacturer's instructions shall be attached to the SOP so that they are readily available.

Maintenance and calibration records shall be maintained in SWPPP File Category 20.55: Field Testing Equipment Maintenance and Calibration Records.

700.2.1.2.4 Testing Laboratory

Samples collected on the project site that require laboratory testing will be tested by a laboratory certified by the State Department of Health Services. Samples collected on the project site will be analyzed by:

Laboratory Name: **TBD**

Address: **TBD**

,

Contact Name: **TBD**

Title:	**TBD**
Phone Number:	**TBD**
Emergency Phone Number (24/7):	**TBD**
Email Address:	**TBD**

700.2.1.3 Monitoring Strategy

The monitoring strategy includes identifying analytical constituents, potential sampling locations, identification of actual sampling locations, and sampling schedule,

700.2.1.3.1 Analytical Constituents

Stormwater and non-stormwater discharges shall be monitored for the analytical constituents specified in the specific SAP(s) in this SWPPP.

700.2.1.3.2 Potential Sampling Locations

Potential sampling locations must be representative of the stormwater and non-stormwater discharges from the construction site. Existing conditions and associated construction activities within each drainage area form the basis for determining representative stormwater sampling locations.

Project drainage areas and potential sampling locations have been determined by:

- reviewing project plans
- visiting project site
- reviewing topography maps

The WPCDs show the demarcation of all drainage areas that are either:

- within the project site
- cover part of the project site

The QSD must identify potential sampling locations where concentrated run-off:

- leaves the Caltrans right-of-way
- drains into an MS4
- discharges into a receiving water

Potential run-on sampling locations were determined where concentrated run-on:

- enters the right-of-way
- combines with the stormwater on site and then discharges into an MS4, including the location(s) of discharge into the MS4

The following locations were determined when runoff discharges directly into receiving water bodies:

- the discharge location(s) into the receiving water
- a potential sampling location upstream of all discharge locations
- a potential sampling location downstream from all discharge location(s) into the receiving water.

Necessary potential sampling locations were determined when:

- there are potential sources of non-visible pollutants, as discussed in Section 500.1, and discharge locations are downgradient
- run-on locations are present that may contribute non-visible pollutants
- there are potential non-stormwater discharges and corresponding discharge locations are downgradient
- there are proposed dewatering construction activities

If an ATS is used on site, then sample locations must be included in Section 700.2.6.

Potential stormwater and non-stormwater sampling locations must be shown on the WPCDs in Attachment BB and listed in Attachment EE: Stormwater Sample Locations. The QSD has identified each of the potential sampling locations with a unique sample location identification code, as shown below. The identification code must start with a number and must be different for each location. If the construction site lies in a west-to-east orientation, starting with one (01) from the east, the potential sampling locations shall be numbered toward the west. If the construction site lies in a south-to-north orientation, the potential sampling locations shall be numbered toward the north.

To further distinguish among the locations, each potential sampling location has been identified with one of the following abbreviations based on the sampling location type:

- discharge locations leaving Caltrans right-of-way: DL
- discharge locations from areas with known non-visible pollutants: NVP
- discharge locations upgradient of areas with known non-visible pollutants: UNVP
- discharge locations to an MS4: MS
- run-on locations: RO
- discharge locations into a receiving water: RW
- downstream of all discharge locations: RWD
- upstream of all discharge locations: RWU
- dewatering discharge locations: DDL
- contained stormwater discharge locations: CSDL
- discharge locations for ATS: ATS

The unique sample location identification code shall follow this format, **SSSTTTTXX** , where:

SSS	=	sampling location identifier number (e.g., 010)
TTTT	=	sampling location type (e.g. DL)
XX	=	identifier number for the type of sampling location

For example, the sampling location identification for the 15th sampling location based on starting from the south end of the project for a stormwater discharge location that has been identified to be the ninth discharge location would be **015DL09.**

Potential sampling locations shown on the WPCDs shall be identified with unique sampling location identifiers. Each potential sample location must be listed on Stormwater Sample Locations in Attachment EE. The unique identification of each potential sampling location based on its number and abbreviation of type shall be used on all sampling documentation.

The WPC Manager may have to revise and/or add additional sampling locations during the course of construction as conditions dictate.

700.2.1.3.3 Identification of Actual Sampling Locations

For each forecasted storm event, actual sampling locations will be determined by the WPC Manager based on the strategy described in each specific SAP.

700.2.1.3.4 Sampling Schedule

For the sampling schedule, see the specific SAPs in this CSMP. If a scheduled sampling activity is unsafe because of dangerous weather conditions, such as flooding and electrical storms, then the stormwater sampler shall document why an exception to performing the sampling was necessary.

700.2.1.4 Sample Collection and Handling

Sample collection procedures shall be used to ensure that representative samples are collected and that the potential for contamination of samples is minimized. Sample handing procedures are followed to ensure that samples are identified accurately and that the required analysis is clearly documented. Chain-of-custody requirements for samples are necessary to trace the possession of the sample from collection through analysis.

700.2.1.4.1 Sample Collection Procedures

Samples shall be collected, maintained and shipped in accordance with the SWAMP's 2008 QAPrP.

Grab samples shall be collected and preserved in accordance with the methods identified in each specific SAP. Only personnel trained in proper water quality sampling shall collect samples.

Samples from areas of sheet flow can be collected using the collection procedures shown in the video at http://www.youtube.com/watch?v=AmEJUNp44aU. For pH and turbidity sampling, sheet flow sampling can be conducted as described below to concentrate the flow in order to collect a sample or follow other procedures approved by the RE.

- Place several rows of sandbags in a half circle directly in the path of the sheet flow to pond water, and wait for enough water to spill over. Then place a cleaned or decontaminated flexible hose along the top, and cover with another sandbag so that ponded water will only pour through the flexible hose and into sample bottles. Do not reuse the same sandbags during future sampling events as they may cross-contaminate future samples.

- Place a cleaned or decontaminated dustpan with open handle in the path of the sheet flow so that water will pour through the handle and into sample bottles.

For receiving water sampling, upstream samples shall be collected to represent the water body upgradient of the construction site. Downstream samples shall be collected to represent the water body mixed with direct discharge from the construction site. Samples shall not be collected directly from ponded, sluggish, or stagnant water.

Receiving water upstream and downstream samples shall be collected using one of the following methods:

- placing a sample bottle directly into the stream flow in or near the main current upstream of sampling personnel and allowing the sample bottle to fill completely;

  OR

- placing a decontaminated or sterile bailer or other sterile collection devise in or near the main current to collect the sample and then transferring the collected water to appropriate sample bottles allowing the sample bottle to fill completely.

To maintain sample integrity and prevent cross-contamination, sampling collection personnel shall follow the procedures listed below.

- Wear a clean pair of surgical gloves donned prior to the collection and handling of each sample at each location.
- Decontaminate sampling equipment prior to sample collection using a TSP-soapy water wash, distilled water rinse, and final rinse with distilled water. Dispose of decontamination water/soaps appropriately (i.e., do not discharge to the storm drain system or receiving water).
- Do not allow the inside of the sample bottle to come into contact with any material other than the run-off sample.
- Discard sample bottles or sample lids that have been dropped onto the ground prior to sample collection.
- Do not leave the cooler lid open for an extended period of time once samples are placed inside.
- Do not sample near a running vehicle where exhaust fumes may impact the sample.
- Do not touch the exposed end of a sampling tube, if applicable.
- Avoid allowing rainwater to drip from rain gear or other surfaces into sample bottles.
- Do not eat, smoke, or drink during sample collection/field measurement.
- Do not sneeze or cough in the direction of an open sample bottle.
- Minimize the exposure of the samples to direct sunlight, as sunlight may cause biochemical transformation of the sample.

700.2.1.4.2 Sample Handling Procedures

Immediately following collection, sample bottles to be forwarded for laboratory analytical testing shall be capped, labeled, documented on the Chain-of-Custody Record, sealed in a re-sealable storage bag, placed in an ice-chilled cooler, at 0 ±4 degrees Celsius, and delivered within 24 hours to the laboratory shown in sub-section 700.2.1.2.4.

Immediately following collection, samples used for field analysis shall be tested in accordance with the field instrument manufacturer's instructions and results recorded on the CEM-2052 Stormwater Sample Field Test Report form.

700.2.1.4.3 Sample Documentation Procedures

All original data documented on sample bottle identification labels, the Chain-of-Custody, and the CEM-2051 Stormwater Sampling and Testing Activity Log - Optional Form, shall be recorded using waterproof ink. These shall be considered accountable documents. If an error is made on an accountable document, the individual shall make corrections by lining through the error and entering the correct information. The erroneous information shall not be obliterated. All corrections shall be initialed and dated.

The following form, used for sample documentation, is provided in the SWPPP appendices:

- CEM-2051 Stormwater Sampling and Testing Activity Log - Optional Form, in Appendix M

Duplicate samples shall be identified in a manner consistent with the numbering system for other samples to prevent the laboratory from identifying duplicate samples. Duplicate samples can be identified in the CEM-2051 Stormwater Sampling and Testing Activity Log - Optional Form.

Sample Bottle Identification Labels: Sampling personnel shall attach an identification label to each sample bottle, which shall include, at a minimum, the following information:

- project name
- contract number and/or project identifier number
- unique sample identification code, which shall follow this format, **SSSSSYYMMDDHHmmTT** , where

SSSSS	=	sampling location identifier number (e.g., 01MS1)
YY	=	last two digits of the year (e.g. 11)
MM	=	month (01-12)
DD	=	day (01-31)
HH	=	hour sample collected (00-23)
mm	=	minute sample collected (00-59)
TT	=	Type or QA/QC Identifier (if applicable)
G	=	grab
FS	=	field duplicate

For example, the sample number for a grab sample collected at Station 01MS1, collected at 4:15PM on December 8, 2011 would be **01MS11112081615G.**

- constituent to be analyzed
- initials of person who collected the sample

Stormwater Sampling and Testing Activity Log: A log of sampling events and test results shall include:

- sampling date
- separate times for collected samples and QA/QC samples, recorded to the nearest minute
- unique sample identification number and location
- constituent analyzed
- names of sampling personnel
- weather conditions (including precipitation amount)
- test results
- other pertinent data

Sample Information, Identification and Chain-of-Custody Record Forms: All samples to be analyzed by a laboratory will be accompanied by a Chain-of-Custody. The samplers will sign the Chain-of-Custody when samples are turned over to the testing laboratory. Chain-of-custody procedures will be strictly adhered to for QA/QC purposes.

700.2.1.5 Sample Analysis

For the analytical methods to be used to determine the presence of pollutant(s), see the specific SAPs in this CSMP.

700.2.1.6 Quality Assurance/Quality Control

For verification of laboratory or field analysis, duplicate samples shall be collected at a rate of 10 percent or 1 minimum duplicate per sampling event. The duplicate sample shall be collected, handled, and analyzed using the same protocols as primary samples. A duplicate sample shall be collected immediately after the primary sample has been collected. Duplicate samples shall not influence any evaluations or conclusions; however, they shall be used as a check on laboratory or field analysis quality assurance.

700.2.1.7 Data Management and Reporting

All test results shall be documented on either the CEM-2052 Stormwater Sample Field Test Report form and/or may be entered on the CEM-2051 Stormwater Sampling and Testing Activity Log - Optional Form. These shall be considered accountable documents. If an error is made on an accountable document, the individual shall make corrections by lining through the error and entering the correct information. The erroneous information shall not be obliterated. All corrections shall be initialed and dated.

For field tests, the submitted information shall include a signed copy of the Chain-of-Custody and CEM-2052 Stormwater Sample Field Test Report form. Appendix N contains the CEM-2052 Stormwater Sample Field Test Report form , which must accompany the Chain-of-Custody Record. The test results can be recorded on the CEM-2051 Stormwater Sampling and Testing Activity Log - Optional Form, in Appendix M.

For laboratory testing, all laboratory analysis results shall be reviewed for consistency among laboratory methods, sample identifications, dates, and times for both primary samples and QA/QC samples. The test results may be recorded on the CEM-2051 Stormwater Sampling and Testing Activity Log - Optional Form.

All sampling and testing documentation, including the Chain-of-Custody, CEM-2051 Stormwater Sampling and Testing Activity Logs - Optional Form, CEM-2052 Stormwater Sample Field Test Reports, and Laboratory Test Reports shall be kept in the appropriate SWPPP file category. Sampling and testing documentation shall be filed in the appropriate following SWPPP file category based on the specific SAP that required the sampling and analysis:

- non-visible pollutant sampling and testing – SWPPP File Category 20.51;
- non-stormwater discharge sampling and testing – SWPPP File Category 20.50
- turbidity, pH, and SSC sampling and testing – SWPPP File Category 20.52
- required RWQCB sampling and testing – SWPPP File Category 20.53
- ATS sampling and testing – SWPPP File Category 20.54

If corrective actions are taken as a result of the data evaluation, a copy of the completed CEM-2035 Stormwater Corrective Actions Summary shall be filed in File Category 20.35: Corrective Actions Summary.

A copy of completed sampling records and reports and an updated CEM-2051 Stormwater Sampling and Testing Log - Optional shall be submitted to the RE. All water quality analytical results, including QA/QC data, shall be submitted to the RE within 48 hours of sampling for field analyzed samples, and within 30 days for laboratory analyses.

In addition to a paper copy of the water quality test results, the test results shall be submitted electronically in Microsoft Excel (.xls) format, and shall include, at a minimum, the following information from the lab: Sample ID Number, Contract Number, Constituent, Reported Value, Laboratory Name, Method Reference, Method Number, Method Detection Limit, and Reported Detection Limit. Electronic copies of stormwater data shall be forwarded by email to Rommel Pardo at TBD for inclusion into a statewide database.

700.2.1.8 Data Evaluation

For data evaluation of stormwater sample test results, see specific SAPs.

700.2.1.9 Change of Conditions

Whenever stormwater visual monitoring site inspections indicate a change in site conditions that might affect the appropriateness of sampling locations, sampling and testing protocols shall be revised accordingly. All such revisions shall be implemented as soon as feasible, and the SWPPP updated or amended.

700.2.2 Sampling and Analysis Plan for Non-Visible Pollutants

This SAP has been prepared for monitoring non-visible pollutants in stormwater and non-stormwater discharges from the project site and off-site activities directly related to the project, in accordance with the requirements of the CGP and applicable requirements of the Caltrans Construction Site Monitoring Program Guidance Manual, . This SAP for monitoring non-visible pollutants includes all of the components listed in Section 700.2.1.

700.2.2.1 Scope of Monitoring Activities

The scope of monitoring for discharges of non-visible pollutants from the construction site is based on the construction materials and construction activities to be performed on the project site, potential for the presence of non-visible pollutants, based on the historical use of the site, and potential non-visible pollutants in run-off from areas where soil amendments have been used on the project site.

The construction materials, wastes or activities listed below, and identified in Section 500.1.1, are potential sources of non-visible pollutants to stormwater discharges from the project. Storage, use, and operational locations are shown on the WPCDs in Attachment BB.

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The existing site features listed below, and identified in Section 500.1.2, are potential sources of non-visible pollutants to stormwater discharges from the project.

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The soil amendments listed below have the potential to change the chemical properties, engineering properties, or erosion resistance of the soil and will be used on the project site.

-
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700.2.2.2 Monitoring Preparation

Refer to the general requirements in General SAP Section 700.2.1.2 for monitoring preparation.

700.2.2.2.1 Qualified Sampling Personnel

Refer to the general requirements in General SAP Section 700.2.1.2.1 for Qualified Sampling Personnel.

700.2.2.2.2 Monitoring Supplies

Refer to the general information in General SAP Section 700.2.1.2.2 regarding monitoring supplies.

700.2.2.2.3 Field Instruments

Refer to the general information in General SAP Section 700.2.1.2.3 regarding field instruments.

700.2.2.2.4 Testing Laboratory

Refer to the contact information found in General SAP Section 700.2.1.2.4 for the Testing Laboratory.

700.2.2.3 Monitoring Strategy

The monitoring strategy for non-visible pollutants in stormwater discharges is to identify all potential non-visible pollutants that may be on the project site, non-visible pollutant sources, and water quality indicators that will indicate the presence of the non-visible pollutant in stormwater discharges. Locations will be identified where sources of non-visible pollutants will be used, stored or exist because of historical use of the project site so that these areas are monitored prior to and during forecasted storm events.

Non-visible pollutant monitoring is only required where a discharge can cause or contribute to an exceedance of a water quality standard based on one of the following triggers:

- construction materials are waste are exposed
- the site contains historical non-visible pollutants
- construction activity has occurred or material has been placed within the past 24 hours that may cause an exceedance of a water quality standard
- there is run-on to the site that may contains non-visible pollutants
- there is a breach, malfunction, leak or spill from a BMP

When one of the triggers that indicates a non-visible pollutant source may have come in contact with stormwater is discovered during a site inspection conducted prior to, during or after a forecasted storm event, the WPC Manager will require that sampling and analysis of the stormwater discharge be conducted for the applicable non-visible pollutant water quality indicator(s).

For the forecasted storm event in which a trigger for a non-visible pollutant sampling and analysis has occurred, the WPC Manager will also require the collection of an uncontaminated sample of runoff as a background sample for comparison with the samples being analyzed for non-visible pollutants. The WPC Manager will perform an evaluation of the analysis results from the non-visible pollutant stormwater discharge sampling location and the analysis results from the uncontaminated run-off sampling location to determine if there is an increased level of the tested non-visible pollutant analyte in the stormwater discharge.

700.2.2.3.1 Analytical Constituents

Identification of Potential Non-Visible Pollutants

The following table lists the specific sources and types of potential non-visible pollutants on the project site and the applicable water quality indicator constituent(s) for that pollutant.

TABLE 700.2.2.3.1
POTENTIAL NON-VISIBLE POLLUTANTS AND WATER QUALITY INDICATOR CONSTITUENTS

Pollutant Source	Pollutant	Water Quality Indicator Constituent
Dust Palliative Products	Salts	Chloride, TDS, Cations (Sodium, Magnesium, Calcium)
Vehicle	Antifreeze, Batteries, Fuels, Lubricants	Lead, pH, Sulfuric Acid
Portland Cement Concrete & Maasonry Products	Masonry Products, Sealant, Fly Ash, Municipal Solid Waste, Curing Compounds	pH, Alalinity, Methyl Methacrylate, Metals, VOC, SVOC
Contaminated Soil	Aerially Deposited Lead, Petroleum, etc.	Lead, Contaminant specific
Soil Amendment/Stabilization Products	Polymer/Copolymer	Organic Nitrogen, BOD, COD, DOC, Nitrate, Sulfate, Nickel

Landscaping Products	Fertilizers, Inorganic and Organic, Herbicides, Natural Earth	Aluminum, TDS, Sulfate, Nitrate, Phosphate, pH, Organic Nitrogen and COD
Treated Wood Products	Ammoniacal-Copper-Zinc-Arsenate (ACZA), Copper-Chromium-Arsenic (CCA), Ammoniacal-Copper Naphthenate, Creosote	Arsenic, Total Chromium, Copper and Zinc
Adhesives	Adhesives	COD, Phenois, SVOC
Cleaning Products	Acids, Bleaches, Detergents, TSP, Solvents	pH, Residual Chlorine, Phosphate, VOC, SVOC

700.2.2.3.2 Potential Sampling Locations

Using the criteria in Section 700.2.1.3.2, the potential sampling locations on the project site for monitoring non-visible pollutants were identified. Sampling locations are based on: proximity to planned non-visible pollutant storage; occurrence or use; accessibility for sampling and personnel safety; and other factors in accordance with the applicable requirements in the Caltrans Construction Site Monitoring Program Guidance Manual, latest edition. Sampling locations shall be shown on the WPCDs in Attachment BB and listed on Stormwater Sampling Locations in Attachment EE:

2 sampling location(s) on the project site and the contractor's support facilities have been identified as potential locations for the collection of samples of runoff from planned material and waste storage areas and areas where non-visible pollutant producing construction activities are planned. Potential non-visible pollutant sampling locations are listed in the Table 700.2.2.3.2.1: Potential Non-Visible Pollutant Sampling Locations.

TABLE 700.2.2.3.2.1
POTENTIAL NON-VISIBLE POLLUTANT SAMPLING LOCATIONS

Sampling Location Identifier	Location Description
SW1	55.50' Lt "A1" 226+55.03
SW2	55.16' Lt "V" 106+24.27

Potential non-visible pollutant sampling locations shall be shown on the WPCDs in Attachment BB and listed on Stormwater Sampling Locations in Attachment EE:

2 sampling location(s) has been identified for the collection of an uncontaminated sample of runoff as a background sample for comparison with the samples being analyzed for non-visible pollutants. This location(s) was selected such that the sample will not have come in contact with (1) operational or storage areas associated with the materials, wastes, and activities identified in Section 500.1.1; (2) potential non-visible pollutants due to historical use of the site, as identified in Section 500.1.2; (3) areas in which soil amendments that have the potential to change the chemical properties, engineering properties, or erosion resistance of the soil have been applied; or (4) disturbed soils areas. Potential non-visible pollutant uncontaminated sampling locations are listed in Table 700.2.2.3.2.2: Potential Uncontaminated Non-visible Pollutant Sampling Locations.

TABLE 700.2.2.3.2.2
POTENTIAL UNCONTAMINATED NON-VISIBLE POLLUTANT SAMPLING LOCATIONS

Sampling Location Identifier	Location Description
TS1	91.77' Rt "A1" 233+65.65

TS6	29.10' Lt "V" 111+38.05

Potential non-visible pollutant uncontaminated sampling locations shall be shown on the WPCDs from Attachment BB and listed on Stormwater Sampling Locations in Attachment EE.

700.2.2.3.3 Actual Sampling Locations

Sampling for non-visible pollutants at any potential non-visible pollutant sampling location will be based on any of the conditions listed below having been identified during the visual monitoring site inspections.

- Locations where materials or wastes containing potential non-visible pollutants are not stored under watertight conditions. Watertight conditions are defined as (1) storage in a watertight container, (2) storage under a watertight roof or within a building, or (3) protected by temporary cover and containment that prevents stormwater contact and runoff from the storage area.

- Locations where materials or wastes containing potential non-visible pollutants are stored under watertight conditions, but (1) a breach, malfunction, leakage, or spill is observed, (2) the leak or spill is not cleaned up prior to the forecasted storm event, and (3) the potential exists for discharge of non-visible pollutants to surface waters or a storm drain system.

- Locations where a construction activity (including but not limited to those identified in Section 500.1.1) with the potential to contribute non-visible pollutants (1) was occurring during or within 24 hours prior to the forecasted storm event, (2) involved the use of applicable BMPs that were observed to be breached, malfunctioning, or improperly implemented, and (3) resulted in the potential for discharge of non-visible pollutants to surface waters or a storm drain system.

- Locations where soil amendments that have the potential to change the chemical properties, engineering properties, or erosion resistance of the soil have been applied, and the potential exists for discharge of non-visible pollutants to surface waters or a storm drain system.

- Locations where stormwater runoff from an area contaminated by historical usage of the site has been observed to combine with stormwater runoff from the site, and the potential exists for discharge of non-visible pollutants to surface waters or a storm drain system.

If the presence of a material storage, waste storage, or operations area where spills have been observed or the potential for the discharge of non-visible pollutants to surface waters or a storm drain system was noted during a site inspection conducted prior to or during a forecasted storm event and such an area has not been identified on the list of potential non-visible pollutant sampling locations, the WPC Manager must identify the corresponding discharge location and the corresponding upgradient sampling location as actual non-visible sampling locations. The additional sampling location for non-visible pollutant monitoring shall be shown on the WPCDs from Attachment BB and added to Attachment EE: Stormwater Sampling Locations.

For forecasted storm events, the selection of the actual sampling locations for non-visible pollutants by the WPC Manager will be documented on the CEM-2048 Storm Event Sampling and Analysis Plan form, in Appendix N. The completed SAP for each storm event will be filed in File Category 20.46: Storm/Rain Event Action, Sampling and Analysis Plans. Within 24 hours prior to a storm event, a copy of the storm event SAP shall be submitted to the RE.

For qualifying rain events, the selection of the actual sampling locations for non-visible pollutants by the WPC Manager will be documented on the CEM-2049 Qualifying Rain Event Sampling and Analysis Plan, in Appendix O. The completed SAP for each qualifying rain event will be filed in File Category 20.46: Storm/Rain Event Sampling and Analysis Plans. Within 24 hours prior to a storm event, a copy of the SAP shall be attached to the REAP and submitted to the RE.

700.2.2.3.4 Sampling Schedule

In addition to the general scheduling requirements in General SAP Section 700.2.1.3.4, samples for non-visible pollutant monitoring, including both the non-visible pollutants samples and uncontaminated background samples, shall be collected during the first two hours of discharge from storm events that result in a sufficient discharge for sample collection. Samples shall be collected during daylight hours, 7 days a week.

700.2.2.4 Sample Collection and Handling

Refer to the general requirements for sample collection and handling in General SAP Section 700.2.1.4.

700.2.2.4.1 Sample Collection Procedures

Refer to the general procedures for sample collection in General SAP Section 700.2.1.4.1.

700.2.2.4.2 Sample Handling Procedures

Refer to the general procedures for sample handling in General SAP Section 700.2.1.4.2.

700.2.2.4.3 Sample Documentation Procedures

In addition to the general sample documentation procedures provided in General SAP Section 700.2.1.4.3, when applicable, the contractor's stormwater inspector will document in the CEM-2030 Stormwater Site Inspection Report, that samples for non-visible pollutants were taken during a storm event, based on the criteria for non-visible pollutant sampling described in Section 700.2.2.3.3.

700.2.2.5 Sample Analysis

For samples collected for field analysis, collection, analysis and equipment calibration shall be in accordance with the field instrument manufacturer's specifications.

Refer to General SAP Section 700.2.1.2.3 for general information regarding field instrument identification and requirements.

700.2.2.6 Quality Assurance/Quality Control

Refer to the general requirements regarding Quality Assurance/Quality Control (QA/QC) in General SAP Section 700.2.1.6.

700.2.2.7 Data Management and Reporting

Refer to general requirements for data management and reporting in Section General SAP 700.2.1.7.

700.2.2.8 Data Evaluation

Water quality sample analytical results for non-visible pollutants shall be compared to the uncontaminated background sample results. Should the discharge (downgradient) sample show an increased level of the tested non-visible pollutant analyte relative to the background sample, the BMPs, site conditions, and surrounding influences shall be assessed to determine the probable cause for the increase.

As determined by the site and data evaluation, appropriate BMPs shall be repaired or modified to mitigate discharges of non-visual pollutant concentrations. Once deemed necessary, corrective actions shall be implemented , as required by Standard Specification 13-1.03A, within 24 hours of identification unless a longer period is authorized (but cannot be authorized longer than required by the CGP: implemented within 72 hours of identification and completed as soon as possible thereafter), and documented on the CEM-2035 Stormwater Corrective Actions Summary. Revisions/design changes to BMPs required as a result of data evaluation and site assessment shall be implemented based on an amendment to the SWPPP.

700.2.2.9 Change of Conditions

Refer to the general requirements for change of conditions in General SAP Section 700.2.1.9.

700.2.3 Sampling and Analysis Plan for Non-Stormwater Discharges

This SAP has been prepared for monitoring non-stormwater discharges from the project site and off-site activities directly related to the project, in accordance with the requirements of the CGP and applicable requirements of the Caltrans Construction Site Monitoring Program Guidance Manual, . This SAP for monitoring non-stormwater discharges includes all of the components listed in Section 700.2.1.

700.2.3.1 Scope of Monitoring Activities

Non-stormwater discharges can be authorized by a separate NPDES permit or conditional exemption. For non-stormwater discharges that are unauthorized where runoff is discharged off site, sampling and testing of the discharge must be conducted in compliance with the CGP.

Examples of unauthorized non-stormwater discharges common to construction activities include:

- vehicle and equipment wash water, including concrete washout water
- slurries from concrete cutting and coring operations, or grinding operations
- slurries from concrete or mortar mixing operations
- residue from high-pressure washing of structures or surfaces
- wash water from cleaning painting equipment
- runoff from dust control applications of water or dust palliatives
- sanitary and septic wastes

- chemical leaks and/or spills of any kind, including but not limited to, petroleum, paints, cure compounds, etc

When an unauthorized non-stormwater discharge is discovered, the WPC Manager will require sampling and analysis of the effluent to detect whether non-visible pollutants are present in the discharge. Sampling and analysis of non-stormwater discharges shall be performed in accordance with Section 700.2.2, the SAP for non-visible pollutants.

Non-stormwater from dewatering operations or impounded stormwater may be discharged off site during this project. Stored stormwater is defined as rain collected in trenches, foundation excavations, and excavations for pavement structural sections. Non-stormwater dewatering discharges or discharges of impounded stormwater shall be monitored for turbidity, pH and potential non-visible pollutants.

Sampling and analysis for pH and turbidity of stored or impounded stormwater discharges subsequent to a qualifying rain event (a rain event that has produced ½ inch or more of precipitation at the time of discharge) shall be performed in accordance with Section 700.2.4, the SAP for stormwater pH and turbidity.

This project is covered by dewatering permit number issued by RWQCB. The scope of monitoring based on the permit requirements is described below.

The strategy for monitoring dewatering discharges requires monitoring of the following parameters:

Monitoring will be required at the following locations:

Monitoring must be performed:

A copy of the dewatering permit is in Attachment F.

700.2.3.2 Monitoring Preparation

Refer to the general requirements for monitoring preparation in General SAP Section 700.2.1.2.

700.2.3.2.1 Qualified Sampling Personnel

Refer to the general requirements for Qualified Sampling Personnel in General SAP Section 700.2.1.2.1.

700.2.3.2.2 Monitoring Supplies

Refer to the general information regarding monitoring supplies in General SAP Section 700.2.1.2.2.

700.2.3.2.3 Field Instruments

Refer to the general information regarding field instruments in General SAP Section 700.2.1.2.3.

700.2.3.2.4 Testing Laboratory

Refer to the contact information for the testing laboratory found in General SAP Section 700.2.1.2.4.

700.2.3.3 Monitoring Strategy

Non-stormwater discharges from the construction site will be monitored for exceedances of water quality standards.

700.2.3.3.1 Analytical Constituents

For non-stormwater dewatering discharges and discharges of stored stormwater, samples shall be analyzed for the following constituents:

- turbidity
- pH

Non-stormwater dewatering discharge samples shall be analyzed for the following permit-required constituents:

- turbidity
- pH

700.2.3.3.2 Potential Sampling Locations

Using the criteria in Section 700.2.1.3.2, potential sampling locations on the project site for monitoring dewatering discharges, discharges of impounded stormwater, and other non-stormwater discharges were identified. Sampling locations were based on: proximity to planned non-stormwater dewatering; non-stormwater occurrence or use; accessibility for sampling and personnel safety; and other factors in accordance with the applicable requirements in the *Caltrans Construction Site Monitoring Program Guidance Manual,*
Sampling locations shall be shown on the WPCDs in Attachment BB and listed on Stormwater Sampling Locations in Attachment EE.

sampling location(s) on the project site have been identified as potential locations for the collection of non-stormwater dewatering samples and the sampling location(s) are listed in Table 700.2.3.3.2.1: Potential Non-stormwater Dewatering Sampling Locations.

TABLE 700.2.3.3.2.1
POTENTIAL NON-STORMWATER DEWATERING SAMPLING LOCATIONS

Sampling Location Identifier	Location Description

sampling location(s) on the project site been identified as potential locations for the collection of discharge samples of impounded stormwater and the sampling location(s) are listed in Table 700.2.3.3.2.2: Potential Impounded Stormwater Discharge Sampling Locations.

TABLE 700.2.3.3.2.2
POTENTIAL IMPOUNDED STORMWATER DISCHARGE SAMPLING LOCATIONS

Sampling Location Identifier	Location Description
	No dewatering sampling locations are proposed for this Conceptual SWPPP. Dewatering operations are not covered under this Conceptual SWPPP.
	Impounded Stormwater sampling locations to be determined in the field by the Contractor.

700.2.3.3.3 Actual Sampling Locations

Actual sampling locations will be determined by the WPC Manager prior to dewatering activities based on the potential dewatering discharge sample locations initially selected.

Dewatering discharge sampling locations will be determined by the WPC Manager based on the criteria specified in the dewatering permit number issued by RWQCB.

When stormwater is impounded in excavations on the project site and the impounded stormwater has the pontential to create runoff from the project site, the WPC Manager will determine the actual sampling location for collecting impounded stormwater discharge samples.

If new locations for dewatering discharges or impounded stormwater discharges that have not been identified on the list of potential stormwater and non-stormwater sampling locations are identified during the course of construction, the WPC Manager must create sampling location identifiers for the dewatering discharge sampling location. The additional sampling location for dewatering discharge monitoring shall be shown on the WPCDs in Attachment BB and added to Attachment EE: Stormwater Sampling Locations.

700.2.3.3.4 Sampling Schedule

Whenever there are dewatering discharges or impounded stormwater discharges, sampling will be performed daily during discharging. Sampling will be performed upon commencement of the dewatering discharge or impounded stormwater discharge, and then at least a minimum of three (3) samples per day will be collected for analysis, depending on visual monitoring.

Dewatering discharge sampling schedule will be determined by the WPC Manager based on the criteria specified in the dewatering permit number issued by RWQCB.

700.2.3.4 Sample Collection and Handling

Refer to the general requirements for sample collection and handling in General SAP Section 700.2.1.4.

700.2.3.4.1 Sample Collection Procedures

Refer to the general procedures for sample collection in General SAP Section 700.2.1.4.1.

700.2.3.4.2 Sample Handling Procedures

Refer to the general procedures for sample handling in General SAP Section 700.2.1.4.2.

700.2.3.4.3 Sample Documentation Procedures

In addition to the general procedures for sample documentation in General SAP Section 700.2.1.4.3, when applicable, the contractor's stormwater inspector will document on the CEM-2030 Stormwater Site Inspection Report that samples for non-stormwater discharge pollutants were taken based on a visual monitoring site inspection.

700.2.3.5 Sample Analysis

Samples from non-stormwater discharges shall be analyzed for pH and turbidity.

The WPC Manager may determine that samples of non-stormwater discharges, need to be analyzed for non-visible pollutants. If the WPC Manager determines that non-visible pollutants may have contaminated the discharge, the samples shall be analyzed for the suspected pollutants. Sampling and analysis for non-visible pollutants in non-stormwater discharges shall be performed following the guidance in Section 700.2.2, the SAP for non-visible pollutants.

Samples shall be analyzed for based on the requirements specified in the dewatering permit number issued by RWQCB.

Samples shall be analyzed for the constituents indicated in the following table, titled "Sample Collection, Preservation and Analysis for Monitoring Water Extracted by Dewatering or Impounded Stormwater Discharges."

TABLE 700.2.3.5
SAMPLE COLLECTION, PRESERVATION AND ANALYSIS FOR MONITORING WATER EXTRACTED BY DEWATERING OR IMPOUNDED STORMWATER DISCHARGES

Parameter	Test Method	Sample Preservation	Minimum Sample Volume(1)	Sample Bottle	Maximum Holding Time	Detection Limit (min)
Turbidity	Field test with calibrated portable instrument	Store at 4˚ C (39.2˚ F)	100 mL	Polypropylene or Glass	48 hours	1 NTU
pH	Field test with calibrated portable instrument	Store at 4˚ C (39.2˚ F)	100 mL	Polypropylene	15 Minutes	0.2

Notes: 1. Minimum sample volume recommended. Specific volume requirements will vary by instrument; check instrument manufacturer instructions.

°C - degrees Celsius
°F - degrees Fahrenheit
L - liter
Ml - milliliters
NTU - Nephelometric Turbidity Unit

For samples collected for field analysis, collection, analysis and equipment calibration shall be in accordance with the field instrument manufacturer's specifications.

Refer to general information for field instrument identification and requirements in General SAP Section 700.2.1.2.3.

700.2.3.6 Quality Assurance/Quality Control

Refer to the general requirements regarding Quality Assurance/Quality Control (QA/QC) in Section General SAP 700.2.1.6. For samples analyzed for turbidity and pH the following replaces the requirements for QA/QC in Section 700.2.1.6:

The contractor shall coordinate with the Caltrans RE on sampling locations and timing for quality assurance verification of field sampling and analysis. The contractor shall notify the RE at least 24 hours prior to dewatering discharge or impounded stormwater discharge sampling events.

700.2.3.7 Data Management and Reporting

Refer to the general requirements for data management and reporting in General SAP Section 700.2.1.7.

700.2.3.8 Data Evaluation

An evaluation of the water quality sample analytical results, including sampling locations and the QA/QC data, shall be submitted to the RE for every day that the water from dewatering is discharged. Should the dewatering discharge concentrations exceed applicable water quality standards, discharging will be stopped immediately and the WPC Manager or other personnel shall evaluate the dewatering BMPs to determine the probable cause for the exceedance. For dewatering discharges, Caltrans requires that the turbidity of any sample must not exceed 200 NTU. The pH value of any sample must be within the range of 6.7 to 8.3 pH units.

Samples of non-stormwater collected during discharge shall be evaluated by determining if suspected contaminants are present. Unauthorized discharges will be stopped as soon as possible and the RE will be notified immediately and a written report of discharge shall be completed and submitted to the RE. Authorized discharges shall be sampled for pH and turbidity and all suspected pollutants. For pH and turbidity, sample results shall be compared to the NAL.

As determined by the data evaluation and project site assessment, appropriate BMPs shall be repaired or modified to mitigate the exceedances. Corrective actions taken shall be documents on the CEM-2035 Stormwater Corrective Actions Summary. Any revisions/design changes to BMPs shall be implemented based on an amendment to the SWPPP.

700.2.3.9 Changes of Conditions

Refer to the general requirements for changes of conditions in General SAP Section 700.2.1.9.

700.2.4 Sampling and Analysis Plan for Stormwater pH and Turbidity

This SAP has been prepared for monitoring pH and turbidity in stormwater discharges from the project site and off-site activities directly related to the project in accordance with the requirements of the CGP and applicable requirements of the Caltrans Construction Site Monitoring Program Guidance Manual, . This SAP for monitoring pH and turbidity includes all of the components listed in Section 700.2.1.

700.2.4.1 Scope of Monitoring Activities

The scope of monitoring for this SAP includes monitoring for pH and turbidity in stormwater discharges from the project site and, run-on to the project site.

700.2.4.2 Monitoring Preparation

Refer to the general requirements for monitoring preparation in General SAP Section 700.2.1.2.

700.2.4.2.1 Qualified Sampling Personnel

Refer to the general requirements for Qualified Sampling Personnel in General SAP Section 700.2.1.2.1.

700.2.4.2.2 Monitoring Supplies

Refer to the general information regarding monitoring supplies in General SAP Section 700.2.1.2.2.

700.2.4.2.3 Field Instruments

Refer to the general information regarding field instruments in General SAP Section 700.2.1.2.3.

700.2.4.2.4 Testing Laboratory

Refer to the contact information for the testing laboratory found in General SAP Section 700.2.1.2.4.

700.2.4.3 Monitoring Strategy

Monitor representative stormwater discharges from the project site for pH and turbidity during qualifying rain events (a rain event that has produced precipitation in the form of rain and produced run-off at the time of discharge).

700.2.4.3.1 Analytical Constituents

Stormwater discharge samples are to be analyzed for pH and turbidity.

700.2.4.3.2 Potential Sampling Locations

Using the criteria in Section 700.2.1.3.2, the potential sampling locations on the project site for monitoring pH and turbidity were identified. Potential sampling locations for monitoring stormwater discharges for pH and turbidity are based on drainage areas; run-on and runoff locations; accessibility for sampling and personnel safety; and other factors in accordance with the applicable requirements in the Caltrans Construction Site Monitoring Program Guidance Manual, . Stormwater discharge locations shall be shown on the WPCDs in Attachment BB and listed on Stormwater Sample Locations in Attachment EE:

The stormwater discharge locations on the project site are listed in Table 700.2.4.3.2.1 "Stormwater Discharge Locations."

TABLE 700.2.4.3.2.1
STORMWATER DISCHARGE LOCATIONS

Sampling Location Identifier	Location
TS1	91.77' Rt "A1" 233+65.65
TS6	29.10' Lt "V" 111+38.05

The project does not receive run-on with the potential to combine with stormwater discharges.

700.2.4.3.3 Actual Sampling Locations

The WPC Manager shall select sampling locations from the list of potential sampling locations for stormwater discharge sampling shown on the WPCDs from Attachment BB and listed on Stormwater Sampling Locations in Attachment EE. If the construction activity has not started within the drainage area at a sampling location, and there is no disturbed soil within a drainage area, sampling from the stormwater discharge location from that drainage area is not required.

Within 72 to 48 hours prior to each qualifying rain event, the WPC Manager must identify the drainage areas that must be sampled. To identify these drainage areas, the WPC Manager must refer to the WPCDs and consider the conditions described below and activities within each drainage area that could have an effect on the stormwater discharge pH or turbidity.

1. Turbidity: The area of the disturbed soil at the time of precipitation could have an impact on the stormwater run-off turbidity. The area of the disturbed soil at the time of predicted precipitation must be expressed as a percentage of the total drainage area. It is reasonable to assume that a larger percentage of disturbed soil area could result in a more turbid run-off.
2. pH: The type of construction activities that could have an impact on stormwater run-off pH (for example, concrete work and saw cutting, lime stabilization work, use of crushed concrete, etc).

For representative sampling of construction site discharges, 20 percent of the drainage areas with disturbed soil areas and 20 percent of the drainage areas where activities that could potentially have an impact on the discharge pH must be sampled. At least five (5) drainage area discharge locations for each qualifying rain event must be sampled. If there are five (5) or fewer drainage area sampling locations in a project, then all drainage area sampling locations must be sampled. The drainage areas with the largest percentage of disturbed soil area must be included in the selected drainage areas to be sampled. The drainage areas where the most extensive activities (activities that potentially can alter discharge pH) are in progress must be included in the selected drainage areas to be sampled.

This representative monitoring strategy for stormwater discharges requires collection of additional samples based upon the preceding sampling event stormwater discharge pH or turbidity analysis results when the:

- turbidity analysis results – even in one sampling location – in the previous sampling event have exceeded 200 NTU, the number of drainage areas with disturbed soil areas requiring sampling will be raised to 50 percent.
- turbidity analysis results – even in one sampling location – in the previous sampling event have exceeded 250 NTU, the number of drainage areas with disturbed soil areas requiring sampling will be raised to 100 percent.
- pH analysis results – even in one sampling location – in the previous sampling event have not fallen within 6.5 to 8.5 pH unit range, the number of drainage areas requiring sampling where construction activities could have an impact on the discharge pH readings will be raised to 50 percent.
- pH analysis results – even in one sampling location – in the previous sampling event have not fallen within 6.0 to 9.0 pH unit range, the number of drainage areas requiring sampling where construction activities could have an impact on the discharge pH readings will be raised to 100 percent.

The selection of additional sampling locations, based on turbidity results, will involve drainage areas with the highest percentage of disturbed soil area. The selection of additional sampling locations, based on pH results, will be involve drainage areas with construction activities that are most likely to affect stormwater discharge pH.

700.2.4.3.4 Sampling Schedule

Discharge samples shall be collected for turbidity and pH for qualifying rain events that result in a discharge from the project site. When applicable, upstream, downstream, and run-on samples shall be collected for analysis of turbidity and pH. Sampling and testing for turbidity and pH will be performed daily during all qualifying rain events. Samples shall be collected during working hours.

At least 48 hours prior to each qualifying rain event, the WPC Manager must prepare a list of sampling locations that must be sampled for the qualifying rain event.

The locations shall include all of the following sampling location types:

- discharge locations from the drainage areas with the largest percentage of disturbed soil areas,
- discharge locations from the drainage areas where construction activities that could have an impact on stormwater run-off pH are in progress, and
- if applicable, at least one sampling location from drainage areas where the disturbed soil areas have been stabilized.

The sampling locations must be sampled in the following order: starting with the sampling location on the northwest corner of the WPCDs as the first entry and move clockwise on the WPCDs.

The Caltrans stormwater site inspector and contractor inspector must coordinate and select the sampling locations and the time to meet and collect simultaneous samples for the purposes of QA/QC.

Every reasonable attempt has to be made to collect at least three grab samples per day from each sampling location during the qualifying rain event.

Sampling must start immediately after the flow begins or as soon as possible thereafter. The individual responsible for collecting samples must begin sampling with the first sampling location identified and move on to the next sampling location until all locations are sampled. It is preferable that the three rounds of sampling are performed over the first three hours of the flow; however, depending on the time of the day or other dictating conditions in the field, the three rounds of sampling could be performed over a shorter period of time to ensure that three samples per location are collected.

If stormwater sampling is unsafe because of dangerous weather conditions, such as flooding and electrical storms, then the stormwater sampler shall document the conditions resulting in the sampling not being performed as planned.

700.2.4.4 Sample Collection and Handling

Refer to the general requirements for sample collection and handling in General SAP Section 700.2.1.4.

700.2.4.4.1 Sample Collection Procedures

In addition to the general procedures for sample collection in General SAP Section 700.2.1.4.1, the procedures described below apply to sample collection for monitoring of pH and turbidity.

- Grab samples shall be collected and preserved in accordance with the methods identified in Table 700.2.4.5.1: Sample Collection, Preservation and Analysis for Monitoring Turbidity and pH, provided in Section 700.2.4.5.
- Only personnel trained in proper water quality sampling shall collect samples.

700.2.4.4.2 Sample Handling Procedures

Refer to the general procedures for sample handling in General SAP Section 700.2.1.4.2.

700.2.4.4.3 Sample Documentation Procedures

Refer to the general procedures for sample documentation in General SAP Section 700.2.1.4.3.

700.2.4.5 Sample Analysis

Samples shall be analyzed for the constituents indicated in Table 700.2.4.5.1: "Sample Collection, Preservation and Analysis for Monitoring Turbidity and pH."

TABLE 700.2.4.5.1
SAMPLE COLLECTION, PRESERVATION AND ANALYSIS FOR MONITORING TURBIDITY AND PH

Parameter	Test Method	Sample Bottle	Minimum	Sample	Maximum	Detection

Parameter	Test Method	Sample Bottle	Minimum Sample Volume(1)	Sample Preservation	Maximum Holding Time	Detection Limit (min)
Turbidity	Field test with calibrated portable instrument	Polypropylene or Glass	100 mL	Store at 4˚ C (39.2˚ F)	48 hours	1 NTU
pH	Field test with calibrated portable instrument	Polypropylene	100 mL	Store at 4˚ C (39.2˚ F)	15 minutes	0.2

Acronyms/Notes:

C = Celsius
F = Fahrenheit
Min = minimum
mL = milliliter
NTU = Nephelometric Turbidity Units

(1) Minimum sample volume recommended. Specific volume requirements will vary by instrument; check instrument manufacturer instructions.

700.2.4.6 Quality Assurance/Quality Control

Refer to the general requirements regarding Quality Assurance/Quality Control (QA/QC) in General SAP Section 700.2.1.6. The following replaces the requirements for QA/QC in Section 700.2.1.6 for turbidity and pH quality assurance testing. However, Section 700.2.1.6 requirements apply for SSC quality assurance testing: The contractor shall coordinate with Caltrans RE on sampling locations and timing for quality assurance verification of field sampling and analysis activities. The contractor shall notify the RE at least 24 hours prior to sampling events.

700.2.4.7 Data Management and Reporting

Refer to general requirements for data management and reporting in General SAP Section 700.2.1.7.

In addition to the general requirements for data management and reporting in Section 700.2.1.7, the additional reporting described below is required.

Numeric Action Limit Exceedance Reportin - This project is subject to NALs for pH and turbidity as shown in Table 700.2.4.7.1 "NALs for Monitoring pH and Turbidity."

TABLE 700.2.4.7.1
NALs FOR MONITORING pH AND TURBIDITY

Parameter	Test Method	Detection Limit (min)	Unit	Numeric Action Level
pH	Field test with calibrated portable instrument	0.2	pH units	Lower NAL = 6.5 Upper NAL = 8.5
Turbidity	Field test with calibrated portable instrument	1	NTU	250 NTU

Acronyms:

Min = Minimum

NAL = numeric action level

NTU = Nephelometric Turbidity Units

If the NAL for pH or turbidity or both are exceeded, then form CEM-2062 NAL Exceedance Report will be completed and submitted to the RE within 48 hours after the sampling and analysis event. The NAL Exceedance Report will

- test results, analytical methods, reporting units, and detection limits
- date, sampling location, time of sampling, and visual observations
- predicted quantity of precipitation of the forecasted storm event, and estimated quantity of precipitation at the time of sampling
- description of BMPs
- corrective actions taken to manage the NAL exceedance

Once deemed necessary, corrective actions shall be immediately implemented and documented. Appendix I contains the CEM-2035 Stormwater Corrective Actions Summary form and Appendix O contains the CEM-2062 NAL Exceedance Report form. NAL exceedance reports will be filed in SWPPP File Category 20.62: Numeric Action Level Exceedance Reports.

700.2.4.8 Data Evaluation

An evaluation of the water quality sample analytical results, including sampling locations and the QA/QC data, shall be submitted to the RE for every day of stormwater sampling. If the stormwater discharge concentrations exceed applicable water quality standards, the WPC Manager or other personnel shall evaluate the project site BMPs to determine the probable cause for the exceedance.

As determined by the data evaluation and project site assessment, appropriate BMPs shall be repaired or modified to mitigate the exceedances. Corrective actions taken shall be documented on the CEM-2035 Stormwater Corrective Actions Summary. Any revisions/design changes to BMPs shall be implemented based on an amendment to the SWPPP.

700.2.4.9 Change of Condition

Refer to the general requirements for changes of conditions in General SAP Section 700.2.1.9.

700.2.5 Sampling and Analysis Plan for Monitoring Required by Regional Board

This project does not require a Sampling and Analysis Plan for Monitoring required by a RWQCB.

700.2.6 Sampling and Analysis Plan for Monitoring of Active Treatment System

This project does not require a SAP for an ATS because deployment of such a system is not planned.

SECTION 800
POST-CONSTRUCTION CONTROL PRACTICES

800.1 Post-Construction Control Practices

The following are the post-construction BMPs for the project site

- Biofiltration Swales/Strips
- Unlined and lined ditches and swales
- Permanent erosion control, seeding and planting
- Outlet protection/velocity dissipation devices
- Rock Slope Protection

800.2 Post-Construction Operation/Maintenance

The post-construction BMPs that are listed above will be funded and maintained in the following manner.

short-term funding: Caltrans District 4 Maintenance

long-term funding: Caltrans District 4 Maintenance

The responsible party for the long-term maintenance of post-construction BMPs is Caltrans District 4 Maintenance

SECTION 900
SWPPP REPORTING REQUIREMENTS

900.1 Recordkeeping

To manage the various documents required by the SWPPP and to provide easy access to the documents, the following SWPPP file categories will be used to file SWPPP compliance documents:

File Category 20.01 .....Stormwater Pollution Prevention Plan (SWPPP)
File Category 20.02 .....Stormwater Pollution Prevention Plan Amendments
File Category 20.03 .....Water Pollution Control Schedule Updates
File Category 20.05 .....Notice of Construction or Notice of Intent
File Category 20.06 .....Legally Responsible Person Authorization of Approved Signatory
File Category 20.10 .....Correspondence
File Category 20.21 .....Subcontractor Contact Information and Notification Letters
File Category 20.22 .....Material Suppliers Contact Information and Notification Letters
File Category 20.23 .....Contractor Personnel Training Documentation
File Category 20.31 .....Contractor Stormwater Site Inspection Reports
File Category 20.32 .....Caltrans Stormwater Site Inspection Reports
File Category 20.33 .....Site Visual Monitoring Inspection Reports
File Category 20.34 .....Best Management Practices Weekly Status Reports
File Category 20.35 .....Corrective Actions Summary
File Category 20.40 .....Weather Monitoring Logs
File Category 20.45 .....Rain Event Action Plans
File Category 20.46 .....Storm/Rain Event Sampling and Analysis Plan
File Category 20.50 .....Non-Stormwater Discharge Sampling and Test Results
File Category 20.51 .....Non-Visible Pollutant Sampling and Test Results
File Category 20.52 .....Turbidity, pH and SSC Sampling and Test Results
File Category 20.53 .....Required Regional Water Board Monitoring Sampling and Test Results
File Category 20.54 .....ATS Monitoring Sampling and Test Results
File Category 20.55 .....Field Testing Equipment Maintenance and Calibration Records
File Category 20.61 .....Notice of Discharge Reports
File Category 20.62 .....Numeric Action Level Exceedance Reports
File Category 20.63 .....Numeric Effluent Limitation Violation Reports
File Category 20.70 .....Annual Certification of Compliance
File Category 20.80 .....Stormwater Annual Reports
File Category 20.90 .....Notice of Termination

Records shall be retained for a minimum of three years for the following items:

- approved SWPPP document and amendments
- Stormwater Site Inspection Reports
- Site Inspection Report Corrections Summary
- Rain Event Action Plans (REAPs)
- Notice of Discharge Reports
- Numeric Action Limit (NAL) Exceedance Reports
- Numeric Effluent Limitaion (NEL) Violation Reports
- sampling records and analysis reports
- Annual Compliance Certifications
- copies of all applicable permits

900.2 Stormwater Annual Report

A Stormwater Annual Report will be prepared for this project to document the stormwater monitoring information and training information.

The stormwater monitoring information listed below shall be included in the Stormwater Annual Report.

- A summary and evaluation of all sampling and analysis results, including copies of laboratory reports.
- The analytical method(s), method reporting unit(s), and method detection limit(s) of each analytical parameter.
- A summary of all corrective actions taken during the compliance year.
- Identification of any compliance activities or corrective actions that were not implemented.
- •Â summary of all violations of the CGP.
- The names of individual(s) who performed site inspections, sampling, site visual monitoring inspections and/or measurements.
- The date, place, and time of site inspections, sampling, site visual monitoring inspections, and/or measurements, including precipitation (rain gauge).
- Any site visual monitoring inspection and sample collection exception records.

The stormwater training information listed below shall be included in the Stormwater Annual Report.

- Documentation of all training for individuals responsible for all activities associated with compliance with the CGP.
- Documentation of all training for individuals responsible for BMP installation, inspection, maintenance, and repair.
- Documentation of all training for individuals responsible for overseeing, revising and amending the SWPPP.

900.3 Discharge Reporting

If an unauthorized discharge is discovered or evidence of a previously unseen discharge is discovered, the Contractor shall notify the RE within 6 hours of the discovery, and will file a written report with the RE within 24 hours after the discovery. The written report to the RE will contain the following items:

- date, time, location, and type of unauthorized discharge
- nature of operation that caused the discharge
- initial assessment of any impacts caused by the discharge
- BMPs deployed before the discharge event and date(s) of deployment
- BMPs deployed after the discharge event, including re-installation, maintenance or repair of initial BMPs
- steps taken or planned to reduce, eliminate and/or prevent recurrence of the discharge

Reporting of discharges shall be documented on the CEM-2061 Notice of Discharge form in Appendix M. A log of all reportable discharges shall be documented on CEM-2065 Discharge Reporting Log form in Appendix Z. Completed CEM-2061 Notice of Discharge forms shall be submitted to the RE within 24 hours after the discharge event or discovery of evidence of a prior discharge. Copies of completed forms will be kept in File Category 20.61: Notice of Discharge Reports.

900.4 Regulatory Agency Notice or Order Reporting

If a written notice or order is issued to the project by any regulatory agency, the Contractor will notify the RE within 6 hours of receiving the notice or order and will file a written report to the RE within 48 hours of receiving the notice or order. Corrective measures will be implemented immediately following receipt of the notice or order.

The report to the RE will contain the following items

- the date, time, location, and cause or nature of the notice or order
- the BMPs deployed prior to receiving the notice or order
- the date of deployment and type of BMPs deployed after receiving the notice or order, including additional BMPs installed or planned to reduce or prevent recurrence
- an implementation and maintenance schedule for any affected BMPs

900.5 Illicit Connection/Illegal Discharge Reporting

If the Contractor discovers an illicit connection to a storm drain system or any pipe discharging onto the project site, not shown on the project plans, the Contractor shall notify the RE within 6 hours of the discovery and shall file a written report to the RE within 48 hours of the discovery.

If the Contractor discovers any illegal discharge, including illegal disposing of material on the project site, the Contractor shall immediately notify the RE and shall file a written report to the RE within 3 days of discovery.

The report to the RE will contain the following items:

- the date, time, and location of the discovery
- the details for the illicit connection or illegal discharge, including any photographs taken
- any actions taken to contain the illegal discharge

- any sampling and testing performed on material that was illegally disposed of or discharged

Soil and Groundwater Investigation Report – Dated 04/2008

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).

---

[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.

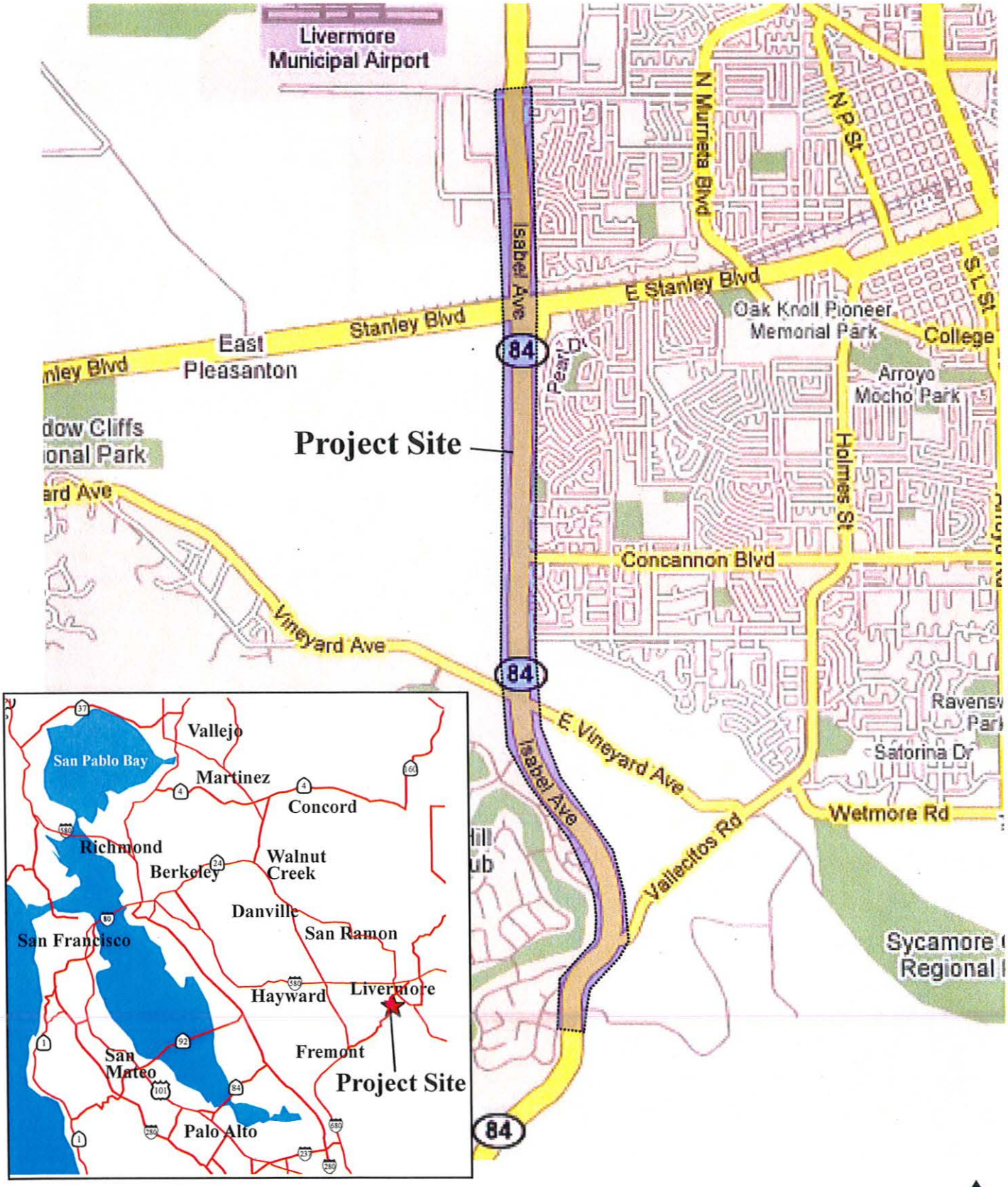
The passage of time, manifestation of latent conditions, or occurrence of future events may require further exploration at the project site, analysis of the data, and re-evaluation of the findings, observations, conclusions, and recommendations expressed in the report.

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

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Y5302.01.00960.Fig1.cdr 04/30/09

SOIL SAMPLING LOCATIONS

Figure 2A

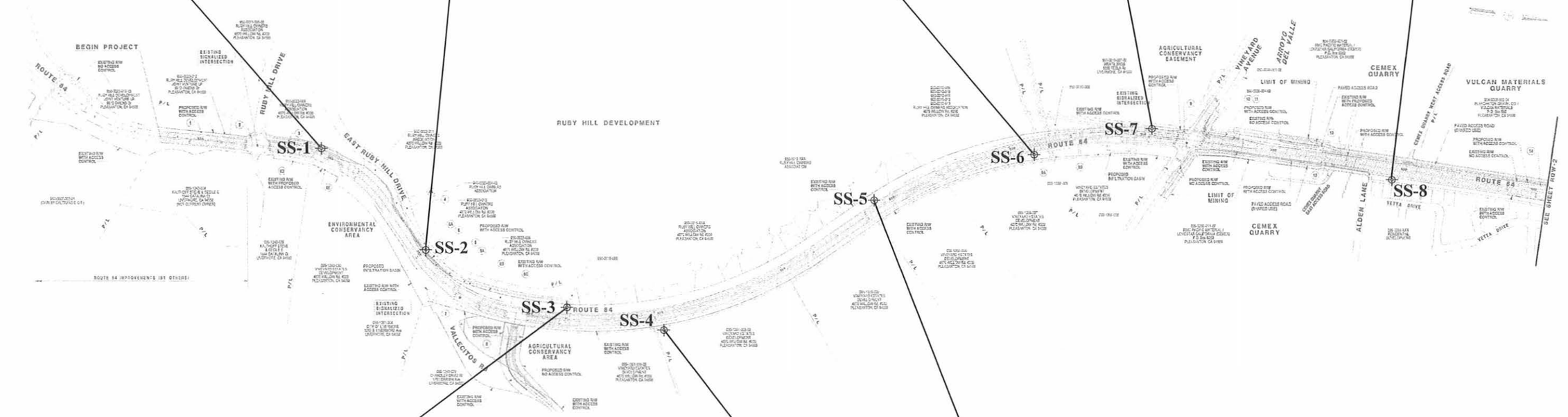
SS-1		3/20/2008	
Type	Depth (ft bgs)	Total Pb (mg/kg)	Soluble Pb (mg/L)
A	0.0	4.8	<0.15
	1.5	8.3	<0.15
B	0.0	6.4	<0.15
	1.5	9.3	0.27

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

Approximate
0 800 Feet

SR 84 Expressway Widening Project
Livermore, California

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Y5302.01.00960.Fig2A.cdr 04/30/09

SOIL SAMPLING LOCATIONS

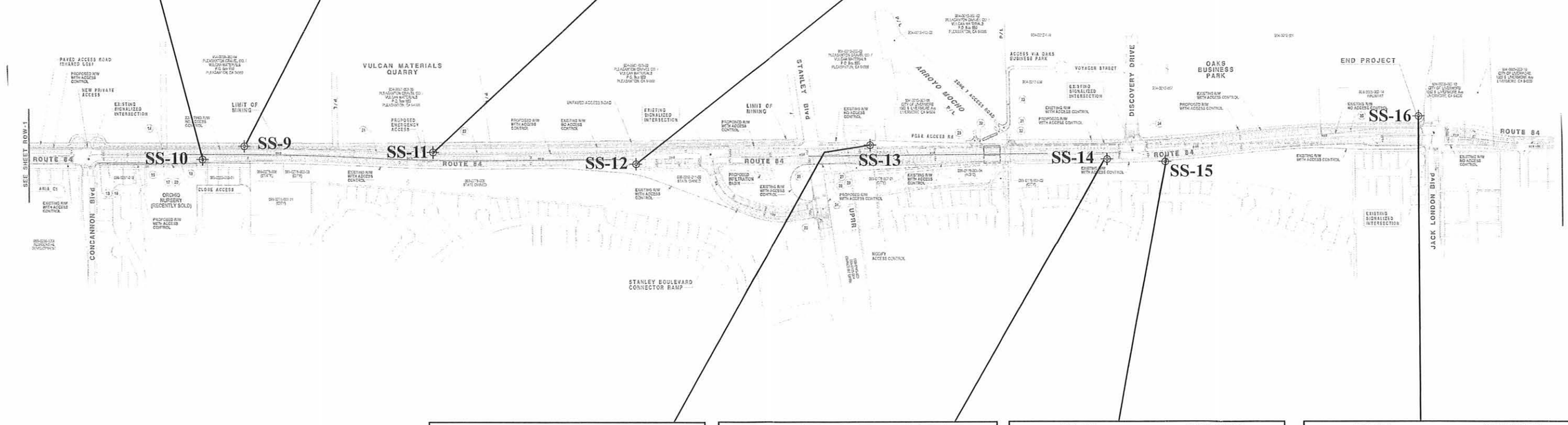
Figure 2B

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

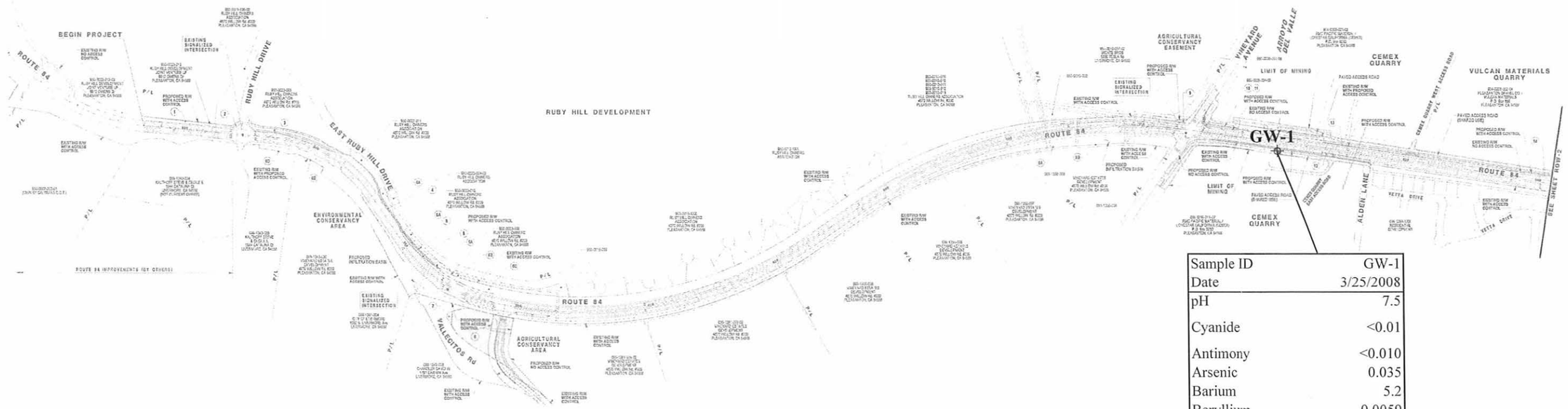
SR 84 Expressway Widening Project
Livermore, California

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

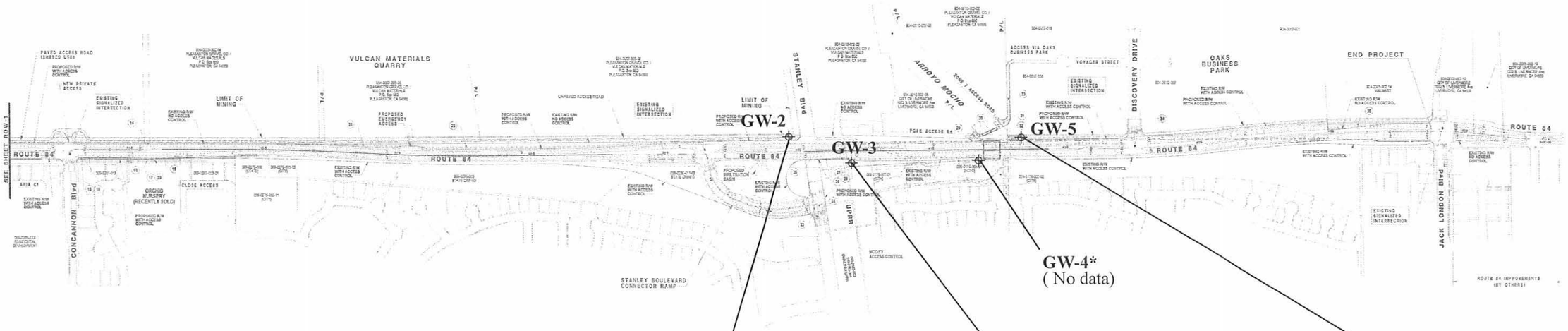
SR 84 Expressway Widening Project
Livermore, California

BASELINE

Y5302.01.00960.Fig3A.cdr 04/30/09

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

SR 84 Expressway Widening Project
Livermore, California

BASELINE

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**

Foundation Report Arroyo Del Valle Bridge (Widen) (Bridge No. 33-0710) – Dated 01/16/2015

04-ALA-84, PM 22.9/25.7
EA 297624
PID 0400020581

JANUARY 16, 2015

FOUNDATION REPORT

ARROYO DEL VALLE BRIDGE (WIDEN) (BRIDGE NO. 33-0710) LIVERMORE, CALIFORNIA

Prepared for
Alameda County Transportation Commission (ACTA)
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URS

100 West San Fernando Street, Suite 200
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January 16, 2015
Project 28649640

File No.04-ALA-84-PM 24.8
EA 297624
Project ID 0400020581

Mr. Gary Sidhu
Project Coordinator
Alameda County Transportation Commission
1111 Broadway, Suite 800
Oakland, CA 94607

Subject: **Foundation Report**
Arroyo Del Valle Bridge (Widen), Bridge No. 33-0710
Route 84 Expressway Widening
Livermore, California

Dear Mr. Sidhu:

URS has updated the accompanying Foundation Report for the Arroyo Del Valle Bridge (widen) in Livermore, California. The report was updated to incorporate comments from Caltrans dated January 6, 2105, and was prepared in accordance with Caltrans Guidelines for Foundation Report Preparation for Bridge Foundations, dated December 2009 and generally with 2010 Caltrans Standard Specifications.

This Foundation Report presents our engineering opinions and recommendations regarding the geotechnical factors influencing the design and construction of the proposed bridge (widen). The opinions and recommendations are based upon the results of our field investigation, laboratory testing, engineering judgment and local experience. Mr. Allen Moore, G.E., and Mr. Madhu Thummaluru, G.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.

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

REGISTERED PROFESSIONAL ENGINEER
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Appendix C Bridge Design Hydraulic Study Report – Executive Summary
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1.1 GENERAL

The project proposes to widen and upgrade State Route (SR) 84 to expressway standards (55 mph) from south of Ruby Hill Drive in Pleasanton to Jack London Boulevard in Livermore 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. In addition, the project also proposes to improve pedestrian and bicycle access along this section of SR 84 by connecting multi-use trails.

The south segment of SR 84 will be widened from two to four lanes between Ruby Hill Drive and Concannon Boulevard. The widening will 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 will be limited to intersections to improve traffic flow and safety. Signalized intersections at Ruby Hill Drive, Vallecitos Road, Vineyard Avenue, and Concannon Boulevard will be widened and upgraded to accommodate future traffic movements.

Improvements to the south segment of SR 84 will include widening of one existing bridge structure, constructing one new bridge structure, and constructing 6 retaining walls. The bridge structures include:

- Arroyo Del Valle Bridge (existing Isabel Avenue SR84 Bridge at Arroyo Del Valle creek crossing, Bridge No. 33-0710)
- Arroyo Del Valle Trail Bridge (new structure)

The subject of this Foundation Report (FR) is widening of Arroyo Del Valle Bridge (Bridge No. 33-0710) located at PM 24.8 in Livermore, California. Figure 1-1 shows the location of this structure.

1.2 SCOPE OF INVESTIGATION

The geotechnical services performed for the Arroyo Del Valle Bridge (widen) were as follows:

- Review plans for the existing Isabel Avenue (SR84) Bridge at Arroyo Del Valle creek crossing
- Geotechnical field investigation including six exploratory borings, R-07-011, R-07-012, R-07-013 and R-07-014, R-08-037, and R-08-038
- Laboratory testing to estimate pertinent engineering properties
- Design recommendations and opinions for the following topics:
  - Spread footing design recommendations
  - Cast-in-drilled-hole (CIDH) 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

Reviews related to environmental and hazardous waste issues were performed by Baseline Environmental and the results are presented in a separate report.

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. The south segment will require widening of an existing bridge at Arroyo Del Valle. The existing two-span bridge at Arroyo Del Valle is to be widened approximately 53 feet to the east, and a new, separate trail bridge across Arroyo Del Valle is to be constructed just east of the widened bridge. The Arroyo Del Valle Bridge (widen), the subject of this FR, is to be a cast-in-place reinforced concrete T-beam bridge, supported on two abutments and one center pier; spread footings are the planned foundation type at the abutments, while 36-inch diameter CIDH piles are planned at the center pier. The existing bridge is approximately 40 feet wide with overall length of 121 feet, and was designed and constructed in 1983. The bridge (widen) is to have a deck at about Elevation 424 feet and soffit at about Elevation 419 feet. The 53 foot widening will include a 22-foot-wide median, two 12-foot-wide (each) travel lanes and a 10-foot-wide shoulder. The proposed widening will be skewed at 10° to better align with flow of the existing creek. Flow in the channel will pass along both sides of the center pier. Total load at each abutment is expected to be approximately 823 kips; each abutment is to be supported on a 3-foot-wide and 53½-foot-long spread footing. The bottom of footing at Abutments 1 and 3 are planned at Elevation 408.67 feet and 408.17 feet, respectively. Bottom of pile cap at Pier 2 is planned to be at Elevation 398.67 feet. Excavation depths at abutments and pier will be in the range of 5 to 15 feet. Based on the project hydraulic report (Wreco, 2009), the 100-year water surface is estimated at Elevation 411.18 feet.

The existing bridge has been declared "scour critical" by Caltrans such that retrofitting of the existing center pier, which is supported on a spread footing, will be required. We understand that this retrofit will include construction of four 36-inch-diameter CIDH piles along the perimeter of the existing spread footing. Based on the general plan provided as part of the Type Selection Report (MGE Engineering, 2009), we understand that rock slope protection having side slope inclinations of 1½:1 to 2:1 (horizontal:vertical) is currently planned along the channel slopes to mitigate scour at the abutments. An existing unpaved maintenance road will cross under the northern portion of the bridge.

A Caltrans Standard Type 1 retaining wall is planned east of Abutment No. 1 as shown on the Foundation Plan (Appendix A). The wall will be approximately 40 feet long with a maximum design height of 20 feet. Bottom of footing for the retaining wall is planned at Elevation 403 to 406 feet.

The plan and elevation sections for the proposed bridge (widen) are shown on the General Plan, (Appendix A).

3.1 GEOLOGIC SETTING

3.1.1 Regional Geology

The SR 84 alignment lies within the Livermore Valley, in 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; Graymer et al., 1996). More recent mapping by Witter and others (2006) subdivides the alluvium into latest Holocene alluvial fan deposits, Holocene alluvial fan deposits, and historic stream channel deposits. The geologic map (Figure 3-1) 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 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 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 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 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 in the borings between the gravelly alluvium soils and the older Livermore Gravels Formation.

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 Calaveras and Pleasanton faults. 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. These faults are included as Alquist-Priolo (A-P) zoned faults. 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.

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). Other nearby mapped faults include the southwest extension of the Las Positas fault, located about 1.7 miles (2.8 km) southeast of the southern end of the project alignment. The project alignment does not cross either the Los Positas fault or the Livermore fault.

The following are brief descriptions of the nearby active faults.

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 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. The Calaveras fault has a Maximum Magnitude, Mmax, equal to 6.9.

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 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).

The Las Positas fault is a strike-slip fault with Mmax equal to 6.4.

Pleasanton Fault

The Pleasanton fault is located about 2.1 miles southwest of the southern end of the project alignment. The Pleasanton fault is a strike-slip fault that is located at the base of the hills on the north side of the Vallecitos Valley (CGS, 2000). It is a predominantly vertical fault with Mmax equal to 6.6.

3.1.3 Local Geology

Based on a review of the borings completed along the project alignment, the soil profile typically consists of a few feet of fill overlying alluvium. The fill, where encountered, ranged from about 2 to 3 feet thick to as much as 12 feet thick in Boring R-07-013, drilled near the north abutment of the existing Isabel Avenue (SR84) Bridge at Arroyo Del Valle Creek. The fill consists of locally derived silt, sand and clay with gravel and occasionally contains asphalt and concrete fragments. Alluvium was encountered in all of the borings underlying the road base and fill materials. 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. In general the alluvium encountered south of Arroyo Del Valle, where the road alignment gradually climbs a gentle alluvial fan, was more dense/stiff compared with the alluvium north of the drainage. The uncorrected N-values from borings located south of the drainage were nearly all above 40 blows per foot and most were well above 50 blows per foot, even in the silts and clays. North of Arroyo Del Valle, the alluvium is less dense/stiff with N-values typically in the 10 to 30 blows per foot range for the upper 20 to 30 feet of the soil profile and increasing with depth.

3.2 SITE AND SUBSURFACE CONDITIONS

3.2.1 Site Topography

The south segment of SR 84 alignment between Concannon 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 Concannon Boulevard at "A1" Line Station 448+00 to the drainage crossing of Arroyo Del Valle at "A1" Line Station 320+00. The incised Arroyo Del Valle drainage crossing is 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 "A1" Line 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 "A1" Line Station 314+00 north of Vineyard Avenue to "A1" Line Station 415+00 at the Arroyo Mocho bridge crossing, north of the south segment. The majority of the gravel quarries are located along the west side of SR 84.

3.2.2 Field Exploration

Plans for the existing Arroyo Del Valle Bridge, provided by the County Public Works, did not include subsurface data.

We performed a subsurface investigation for widening of the existing bridge and for the proposed trail bridge on December 19 and 20, 2007, and January 3 and 18, 2008; our investigation included four rotary wash borings, R-07-011, R-07-012, R-07-013 and R-07-014. Pursuant to Caltrans requirements for scour critical structures, two additional borings (R-08-037 and R-08-038) were drilled on December 11 and 15, 2008 in the Arroyo Del Valle creek bed in vicinity of proposed center pier. Our investigation included a total of six rotary wash borings, which extended to terminal depths of 60 to 90 feet. A 4-inch-diameter solid flight auger was used initially to depths of about 4 to 12 feet below ground surface (bgs) so the depth to groundwater could be measured. Thereafter, the drilling method was switched to 4⅞-inch-diameter rotary wash. The locations of the borings are shown on Figure 3-3.

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. Descriptions of the soils encountered in the borings are presented on Figures 3-4a and 3-4b. The logging method used in preparing the LOTBs is consistent with Caltrans Soil and Rock Logging, Classification and Presentation Manual, 2007 edition. 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 unit weight, plastic and liquid limits, grain size distribution, and unconfined compressive strength 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 depths on the LOTBs. 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 generally consist of loose to medium dense sandy silt and silty sand encountered in Boring R-07-012 to a depth of about 4 feet below ground surface (bgs) and in Boring R-07-013 to a depth of about 11½ feet bgs. More details regarding the fills are presented on the LOTBs. Fill was not encountered in Borings R-07-011 or R-07-014, or in the channel borings, R-08-037 and R-08-038.

3.2.4.2 Native

Beginning at the ground surface in Borings R-07-011 and R-07-014 and underlying the fill in Borings R-07-012 and R-07-013, are predominantly granular soils consisting of very dense silty sand, clayey sand, clayey gravel, and silty gravel. The silty sand and clayey sand deposits contain numerous gravel pieces, whereas the gravel deposits contain occasional cobbles. A layer of cobbles and boulders was encountered at a depth of about 11½ to 15 feet bgs in Boring R-07-013. The alluvial deposits contain several fine-grained interbeds consisting of medium stiff to stiff sandy lean clay between depths of 17 to 19½ feet bgs in Boring R-07-012, sandy fat clay between depths of 20 to 24½ feet bgs in Boring R-07-013, lean clay between depths of 14 to 18 feet bgs in Boring R-07-014, and lean clay between depths of 55 to 58 feet bgs in Boring R-07-014.

Borings R-08-037 and R-08-038, drilled near the center of Arroyo Del Valle, encountered predominantly granular soils consisting of dense to very dense clayey sand with gravel, clayey gravel with sand to a depth of 90 feet, the terminal depth of both borings. Stiff lean clay was encountered between depths of about 5 to 7 feet in Boring R-08-037; medium dense sandy silt was encountered between depths of about 43 and 48 feet in Boring R-08-037.

3.2.5 Groundwater

Free groundwater was not encountered in Borings R-07-011, R-07-012, R-07-013 and R-07-014 at time of drilling to depths of 7 feet bgs in Boring R-07-011, 4 feet bgs in Boring R-07-012, and 12 feet bgs in Borings R-07-013 and R-07-014, after which the drilling method was switched to rotary wash, thereby precluding groundwater measurement. Free groundwater was encountered at the time of drilling in Boring R-08-038 at a depth of about 3 feet (Elevation 401 feet). Free groundwater was not initially encountered in Boring R-08-037 to a depth of about 5 feet where the drilling method was switched to rotary wash; however, drilling fluid was observed in this boring at a depth of about 3.5 feet (Elevation 400.5 feet), two days after drilling was temporarily stopped.

Free groundwater was encountered at a depth of about 23 feet (Elevation 398½ feet) in a nearby hollow-stem auger Boring A-07-010, drilled approximately 300 feet from the site for proposed retaining wall structures near Arroyo Del Valle.

None of the shallow borings completed along the project alignment for pavement design 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. Seasonal fluctuations in the groundwater level should be anticipated throughout the year with fluctuations in precipitation, evaporation, and surface runoff.

In our opinion, a design groundwater level at Elevation 401 feet would be appropriate for the Arroyo Del Valle 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, Las Positas, 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 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 landslides.

3.3.3 Scour

Based on the project bridge design hydraulic report (Wreco, May 2009), the rock slope protection currently overlying the side slopes beneath the existing Isabel Avenue Bridge over Arroyo Del Valle is substandard and will need to be replaced. The channel bottom is unlined. Based on the project hydraulic analysis, we understand that total scour of 1.5 feet is expected at the center pier, extending to about Elevation 400.9 feet, approximately 2 feet above the bottom of the pile cap. The executive summary section of the hydraulic report by Wreco with recent addendum (November 2014) is presented in Appendix C.

3.3.4 Flooding

Outside the active channel of Arroyo Del Valle, the bridge 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 Compression

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).

Seismic compression 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 granular soils encountered in the upper 4 feet bgs in Borings R-07-012 and R-07-013, the cohesionless granular materials are dense to very dense at the Arroyo Del Valle crossing. For design, we estimated the potential post-earthquake settlement at Borings R-07-011, R-07-012, R-07-013, R-07-014, and R-08-037 using the computer program LIQUEFY PRO. In our analyses, we used a peak ground acceleration (PGA) of 0.61g and design earthquake moment magnitude (Mw) of 6.8. The results of these studies indicate seismic compression of less than about ¼ inch. We believe that settlement of the native soils due to seismic compression during strong ground shaking at bents to be negligible. Copies of these calculations are included in Appendix D.

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 Arroyo Del Valle are mapped as having "very high" liquefaction susceptibility.

Borings R-07-013 and R-07-014 completed outside of the Arroyo Del Valle creek bed in 2007 and 2008 encountered several discontinuous layers of medium dense clayey sand and clayey gravel within the upper 20 feet of the soil profile, extending to about Elevation 400 feet. These granular soils could be subject to liquefaction if saturated; however, free groundwater was encountered at depths of about 3 to 4 feet in borings drilled in the creek bed in 2008, corresponding to about Elevation 401 to 400 feet. On this basis, the potential for liquefaction of these medium granular soils is considered low and, in our opinion, the potential for liquefaction induced lateral spreading that could impact bridge abutments is considered to be low.

The granular soils encountered below a depth of 20 feet are mostly dense to very dense, and therefore the potential for liquefaction of these materials to occur is also considered to be low. However, a potentially liquefiable sandy silt layer was encountered in R-08-037 at a depth of 44 feet bgs. We analyzed post-liquefaction settlement of the medium dense sandy silt layer for a PGA of 0.61g and Mw equal to 6.8 by correcting the measured driving resistance (blow counts) in the field for hammer type, sample size, overburden pressure, rod length, and fines content. The values of PGA and Mw were determined utilizing the tool on USGS Probabilistic Seismic Hazard Analysis (PSHA) Interaction Deaggregation web site based on a probability of exceedance of 5 percent in 50 years.

The magnitude of settlement is estimated to be less than ½ inch. Copies of these calculations are included in Appendix D.

3.4 GEOLOGICAL PROFILES AND ENGINEERING PARAMETERS

A generalized soil profile is presented as Figure 3-4 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. Plastic and liquid limit tests and particle size 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 one 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 one 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 E. 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 to determine the corrosivity of the soil to the proposed Arroyo Del Valle Bridge (Widen). 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:

- The chloride concentration is 500 ppm (mg/kg) or greater,
- The sulfate concentration is 2,000 mg/kg or greater, or
- 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, and 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 and water 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 Soil Resistivity (ohm-cm)	pH	Chloride Content (mg/kg)	Sulfate Content (mg/kg)
R-07-011, 5-3	7,255	7.4	<2	<5
R-07-012, 2-X	10,028	8.6	<2	<5
R-07-013, 6-3	7,992	8.3	<2	<5
R-07-014, 2-3	10,586	8.5	<2	<5
Water	1,686**	8.3	19.9*	63.7*

*The chloride and sulfate results for the water sample are in milligrams/liter (mg/L)
Boring R-07-011 corresponds to Boring NB11, Boring R-07-012 corresponds to Boring NB12, etc. in the corrosion report.
** Water resistivity in ohm-cm

As shown above, the pH of the soil samples analyzed ranged from 7.4 to 8.6. The water soluble chloride ion concentrations were below the minimum detection level of 2 milligrams per kilogram (mg/kg). The water soluble sulfate ion concentrations of the soil samples were below the minimum detection level of 5 mg/kg. The minimum (saturated) resistivity of the four samples selected from the borings ranged from 7,255 ohm-cm to 10,586 ohm-cm.

As shown above, the pH of the water sample analyzed was 8.3 with water soluable chloride and sulfate ion concentrations of 19.9 mg/L and 63.7 mg/L, respectively. The minimum resistivity of the water sample was 1,686 ohm-cm.

4.3 CONCLUSIONS

Soil samples were obtained for corrosion analysis from Borings R-07-011 through R-07-014. As shown in the preceding Table 4-1, the soil and water 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 and water at the site are considered non-corrosive. In addition, the proposed structure is not located with 1,000 feet of salt or brackish water. Therefore, the site can be classified as *non-corrosive*.

4.4 RECOMMENDATIONS

4.4.1 Buried Reinforced Concrete Structures and CIDH Piles

Buried concrete structures and CIDH piles should be constructed of durable concrete as described in Section 8.22 of the Caltrans Bridge Design Specifications and 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. Sand and water 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 Pipe Piles

At this time, steel piling is not planned at the site. However, based on the results of the corrosion analyses, the site is considered non-corrosive to steel pipe piles.

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 1.7, April 2013
- Foundation Report Preparation for Bridge Foundations, dated December 2009
- Caltrans ARS Online (v2.3.06)

5.2 GROUND MOTION

The active faults close to the SR 84 alignment between Ruby Hill Drive and Jack London Boulevard are the Calaveras, Pleasanton and Las Positas faults. These faults are designated with Maximum magnitudes (M_{Max}) ranging from 6.4 to 6.9. The SR 84 alignment is roughly parallel to the Calaveras fault, and the distance from the site to the Calaveras fault is approximately 5.2 miles.

Table 5-1 Seismic Source Parameters

Fault	Type	M_{Max}	Distance (miles)[1]	Near Field Effects?
Calaveras	strike-slip	6.9	5.2	Y
Pleasanton	strike-slip	6.6	3.3	Y
Las Positas	strike-slip	6.4	2.2	Y

1. Note the horizontal distance provided for each fault is the horizontal distance to the fault trace or surface projection of the top of rupture plane.

Average shear wave velocity, V_{s30}, in the upper 30 meters of the soil profile is estimated to be 360 meters per second. The V_{s30} values are based on National Earthquake Hazards Reduction Program (NEHRP) recommendations and correlations based on in-situ SPT data. This V_{s30} value corresponds to Soil Profile Type D. Shear wave velocity calculations are presented in Appendix F.

5.3 FAULT TYPE, NEAR-FIELD, AND SPECTRAL ACCELERATION INCREASES

The 2007 fault database that accompanies the 2007 Caltrans Deterministic PGA Map indicates the nearby active faults have strike-slip displacement. Therefore, in accordance with Caltrans design procedures referenced above, no increase in design spectral accelerations is required for fault type. However, the project site is located less than 9.3 miles from the nearest active fault, the design spectral accelerations should be modified to account for near-field 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

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 DESIGN ACCELERATION RESPONSE SPECTRA

Based on Caltrans ARS Online, the design seismic response spectrum for the site is presented graphically on Figure 5-1, along with tabulated spectral acceleration values corresponding with varying periods.

Based on plans prepared by the County of Alameda Public Works Agency, Road Division, dated June 1983, the existing Isabel Avenue Bridge (SR 84) at the Arroyo Del Valle creek crossing is a two-span bridge supported at abutments on the north and south ends (Abutment 1 and Abutment 3) and a middle bent (Pier 2). The abutments and pier are supported on spread footings. Table 6-1 below presents a summary of the design capacities and bottom of footing elevations taken from the plans:

Table 6-1 As-Built Spread Footing Data Table (Isabel Avenue Bridge)

Location	Footing Dimensions	Allowable Bearing Pressure (psf)			Bottom of Footing Elevation (feet)[4]
		DL[1]	DL+LL[2]	ALL[3]	
Abutment 1	3 feet wide by 40 feet long	4,000	6,000	8,000	408.7
Pier 2	5 feet wide by 32 feet long	6,000	8,500	11,000	398.7
Abutment 3	3 feet wide by 40 feet long	4,000	6,000	8,000	408.2

Notes:
1. DL = Dead load only;
2. DL+LL = Dead plus live loads;
3. ALL = All loads including wind and seismic
4. BOF elevation converted from project plans (datum NGVD29) to current project datum based on NGVD88

Pertinent available as-built plans for the bridge are provided in Appendix G. Notes on the General Plan (1983) indicate that footings at Abutments 1 and 3 were to be overexcavated to depths of about 5 and 4½ feet, respectively, to remove loose subgrade material. The resulting excavations were to be backfilled with compacted select material. Overexcavation was not required on the plans for the footing at the center pier.

7.1 DISCUSSION

The proposed bridge is underlain predominantly by very dense sands and gravels embedded with occasional lenses of silty and clayey deposits. Fills ranging from about 4 to 12 feet were encountered in several of the borings.

The principal geotechnical issues at the site are:

- Selection of the type and depth of foundation that will be compatible with the underlying soils;
- Projected scour at bridge pier and abutments; and
- Settlement of underlying soils due to new structural dead and live loads.

We understand the project Structural Engineer has elected to use spread footings to support the bridge (widen) at the abutments and 36-inch-diameter CIDH piles at the center pier. To provide more uniform subsurface conditions for foundation support, we recommend that abutment footings be overexcavated to a depth of 5 feet below bottom of footing, and that resulting excavations be backfilled with compacted structural backfill (engineered fill). The excavations should extend laterally beyond the edge of the footing a distance equal to or greater than the distance from the design footing elevation to the bottom of the excavation. The additional excavation limits are recommended to provide appropriate lateral confinement to the foundation soils. Depending on the proximity of new foundations to existing foundations for the nearby Isabel Avenue Bridge at Arroyo Del Valle, and the extent of overexcavation required, it is possible that underpinning of existing foundations could be necessary during construction.

Since the existing bridge has been termed "scour critical" by Caltrans, retrofit of the existing center pier including construction of four 36-inch-diameter CIDH piles, is currently proposed. Removal of the existing rock slope protection (RSP) that lines the channel banks and replacement with larger size RSP are also planned.

Based on available subsurface data, CIDH piles are appropriate at the center pier of proposed bridge widening. Furthermore, we believe that installation of CIDH piles in gravel and cobbles will be less problematic than for driven concrete piles or large diameter steel pipe piles.

The following sections present geotechnical design parameters for spread footings and CIDH piles.

7.2 DESIGN CAPACITY

7.2.1 Bearing Capacity of Spread Footings at Abutments

Current Caltrans practice is to design abutments in accordance with Working Stress Design (WSD) methodology consistent with Caltrans Memo to Designers 3-1. Table 7-1 presents a summary of the spread footing design load data provided by the Structural Engineer for the Load Factor Resistance Design (LRFD) Service-I Limit State.

Table 7-1 Foundation Design Data for Abutments at Arroyo Del Valle Bridge (Widen)

Support Location	(LRFD Service-I Limit State)						
	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 1	823	3.0	53.5	0	463	3.0	53.5
Abut 3	823	3.0	53.5	0	463	3.0	53.5

Assuming overexcavation to a depth of 5 feet below bottom of footing and replacement with compacted structural backfill, footings should be designed for the soil bearing capacity or nominal bearing resistance shown in Table 7-2.

Table 7-2 Spread Footing Data Table at Arroyo Del Valle Bridge (Widen)

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	401.5 to 408.7	5.0	9.00	6.00
Abut 3	3.0	53.5	408.2	5.0	7.50	6.00

Using the soil bearing pressures described above, we estimate a total settlement of less than 1 inch at abutments and differential settlement of less than ½ inch between the center pier and abutments.

7.2.2 Axial Capacity of CIDH Piles

We understand the Structural Engineer has elected to use 36-inch-diameter CIDH piles for the center pier at the retrofit for the existing Arroyo Del Valle and for the proposed widening. Current Caltrans' practice is to design bents/piers in accordance with LRFD. Table 7-3 presents a summary of the foundation design data for center pier provided by the Structural Engineer.

Table 7-3 Foundation Design Data for Arroyo Del Valle 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
Pier 2	LRFD	36-inch CIDH	405.00	398.67	15	100	1	8

The design loading conditions and nominal resistance are developed in accordance with the LRFD approach. Table 7-4 presents the design loads at Pier 2.

Table 7-4 Foundation Design Loads for Arroyo Del Valle 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
Pier 2	3,995	N/A	3,135	5,380	856	0	0	3,770	882	0	0

The specified tip elevations presented in the Table 7-5 are based on frictional resistance in the subgrade soils that underlie the site. The corresponding design loading conditions and nominal resistance are developed in accordance with LRFD approach.

Table 7-5 Pile Data Table for Arroyo Del Valle Bridge (Widen)

Location	Pile Type	Nominal Resistance (kips)		Design Tip Elevation (ft)	Specified Tip Elevation (ft)
		Compression	Tension		
Pier 2	36-inch CIDH	1,230	0	323.0 (a) 375.0 (b)	323.0

Design tip elevation is based on the following demands:
(a) Compression (b) Lateral

The vertical supporting capacity of all soils located in the potential scour zone was neglected in determining the design tip elevations. The results of our axial pile capacity analysis, which form the basis for the design tip elevation provided above, are presented in Appendix H. The piles with a specified tip elevation at 322.0 feet meet Caltrans' construction guidelines with a length to diameter ratio of about 28.

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.

7.2.3 Resistance to Lateral Loads

Resistance to transient lateral loads at the abutments from wind or earthquakes can be developed by friction between the bottom of the 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 bottoms 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 pounds per cubic foot against the footings. The recommended values presented above are ultimate values, and should be used with an appropriate factor of safety.

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 potential scour zone have been removed. We used LPILE 5.0 (Reese et al., October 2000) to estimate the lateral load resistance of 36-inch-diameter CIDH piles.

Output files for laterally loaded piles at the center pier are presented in Appendix I and include deflection versus depth, bending moment versus depth, shear versus depth, and total stress versus depth. Charts showing lateral load versus deflection and lateral load versus maximum bending moment for free and fixed head condition at top of pile are included in Appendix I.

California Amendment to AASHTO LRFD Bridge Design Specifications recommends that a P-multiplier (Pm) be applied to the lateral capacity of individual piles to account for pile group efficiency. Table 7-6 presents the Caltrans recommended Pm for the corresponding rows of piles within a group based on Caltrans Amendments of AASHTO LRFD, Section 10.7.2.4. Row 1 refers to the leading row of piles in the direction of loading.

Table 7-6 **Pile P-Multiplier, Pm for Multiple Row Shading**

Pile Center-to-Center Spacing (in the direction of loading)	Group Efficiency Factor (P-Multiplier, Pm)		
	Row 1	Row 2	Row 3 and higher
2 x Pile Width/Diameter (B)	0.60	0.35	0.25
3 B	0.75	0.55	0.4
5 B	1.0	0.85	0.7
7 B	1.0	1.0	0.9

7.3 CIDH PILE INSTALLATION

All piles should be installed in accordance with Section 49 of the Caltrans Standard Specifications, Piling, and the project special provisions. Specific additions and modifications to these requirements are discussed below.

Based on Borings R-07-011, R-07-012, R-07-013, R-07-014, R-08-037, and R-08-038, we anticipate that proposed CIDH piles will be drilled through predominantly granular soils consisting of very dense clayey sand and clayey gravel. The clayey sand deposits contain numerous gravel pieces. Since groundwater is relatively shallow, some sloughing and caving can be expected in drilled pier excavations. Therefore, we recommend the Contractor have casing 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 5 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 Caltrans' specifications could be used to facilitate CIDH pile construction. Contractor should anticipate some difficulty during auguring and casing installation due to the gravels encountered at the site.

Concrete should be placed by the tremie method. Concrete placement operations should be controlled to confirm 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 RETAINING WALL

An approximately 40-foot-long, maximum 20-foot-high retaining wall is planned between the proposed trail bridge and east end of Abutment 1 of the bridge widen. A concrete barrier is planned along an approximately 12-foot-long section of the retaining wall. Drawings and details for this Caltrans' Type 1 retaining wall are presented in Appendix A.

Based on the project quantity estimates, we understand there could be excess material generated by the proposed cuts and fills. Therefore, we assume that any on-site soils which meet Caltrans' material requirements for fill will be used as embankment fill and wall backfill. Based on exploratory boring data at the proposed cut slopes, we expect that fills consisting of on-site materials will be primarily clayey sands, silty sands, clayey gravels and silty gravels, having an average as compacted moist unit weight of 135 pounds per cubic foot (pcf) and internal friction angle, ϕ', of at least 38 degrees. The resulting equivalent fluid pressure of the wall backfill based on these parameters would be equal to or less than 36 pounds per square foot per lineal foot of wall. Therefore, the Standard Plan Type 1 wall soil design parameters are applicable.

Based on Caltrans ARS Online and utilizing the tool on USGS Probabilistic Seismic Hazard Analysis (PSHA) Interaction Deaggregation for events with a probability of exceedance of 5 percent in 50 years, we estimate a peak ground acceleration (PGA) of 0.61g. For earthquake loading, the walls should be designed for a horizontal seismic coefficient (k_h) equals to one-third of PGA; i.e. k_h = 0.2g. This is consistent with the design basis for Standard Plan retaining walls.

Table 7-7 below presents a summary of the gross uniform bearing stress for a Caltrans' Standard Plan Type 1 wall for the maximum proposed wall height. The factored gross nominal bearing resistance is also presented for each retaining wall based on bottom of footing elevation and subsurface conditions encountered in explorations.

Table 7-7 Bearing Capacity Analyses for Caltrans Standard Type 1 Retaining Wall

Wall No. (Wall Type)	Wall Design Height (ft)	Footing Width	Bottom of Footing Elevation (ft)	Strength Limit State		Extreme Event State	
				Factored Gross Nominal Bearing Resistance φb = 0.55 (ksf)	Gross Uniform Bearing Stress[1] (ksf)	Factored Gross Nominal Bearing Resistance φb = 1.0 (ksf)	Gross Uniform Bearing Stress[1] (ksf)
Type 1	20	13'-3"	401.5 to 406.0	6.4	3.8	11.7	6.4

1. Gross uniform bearing stress values are from 2010 Caltrans Standard Plans.

Geotechnical engineering calculations for estimated settlement and bearing capacity for the standard retaining wall are presented in Appendix K.

7.5 APPROACH EMBANKMENT SETTLEMENT

We evaluated the settlement of the approach embankment due to placement of about 4 feet of new fill needed to raise the grade at this location. Based on our analysis, we estimate that settlement of less than ¼ inch could occur along the approach centerline. We expect the settlement will be immediate and should occur during fill placement; long-term consolidation settlement should be negligible.

7.6 SLOPE STABILITY

Based on topographic data, it appears the existing slopes along Arroyo Del Valle at the proposed bridge (widen) are inclined at about 2:1 (horizontal:vertical). The General Plan (Appendix A) for the structure indicates that rock slope protection is to be placed at an inclination of 2:1 along the slope. The elevation drawing on the General Plan indicates the rock slope protection is to be keyed into the toe of the existing slope.

The embankment soils consist primarily of medium dense to very dense silty and clayey sands and gravels with thin interbeds of lean to fat clay, which in our opinion, are sufficiently strong to support the proposed 2:1 slopes.

We analyzed the global slope stability of the abutments supported on spread footing foundations for static and seismic conditions. The results presented as Figures J-1 through J-4 in Appendix J show the minimum computed factors of safety at both abutments exceed the minimum required value of 1.5 for static conditions and 1.1 for pseudo-static conditions noted in Section 5.2.2.3 of Bridge Design Specifications (August 2004). Slope stability analyses were performed with the assumption the rock slope protection along the abutment slopes will protect the slopes from scour.

Because liquefaction potential at the abutments is considered to be low, we believe that potential for lateral spreading is also low. Based on the bridge hydraulic report, slopes as steep as 1:1 could form at the center pier due to scour during the design flood event. For that reason, we recommend that Caltrans inspect the condition of channel bed and slopes following any flood event (flood refers to return period greater than 10 years), and perform maintenance work as necessary.

7.7 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.

7.8 FOUNDATION EXCAVATION

Footings and pile caps should be excavated as required to bring those areas to their finish subgrade elevations. To provide more uniform subsurface conditions for foundation support, we recommend that abutment footings be overexcavated to a depth of 5 feet below bottom of footing, and that resulting excavations be backfilled with compacted structural backfill (engineered fill). The excavations should extend laterally beyond the edge of the footing a distance equal to or greater than the distance from the design footing elevation to the bottom of the excavation. The additional excavation limits are recommended to provide appropriate lateral confinement to the foundation soils. Depending on the proximity of new foundations to existing foundations for the nearby Isabel Avenue Bridge at Arroyo Del Valle, and the extent of overexcavation required, it is possible that underpinning of existing foundations could be necessary during construction.

All loose soil should be removed prior to footing construction. Because shallow groundwater could be encountered during excavation of the center pier pile cap and the abutment footings,

depending on the extent of overexcavation required, we recommend the type of excavation be classified as a "Structure Excavation Type D" 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 15 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 the recent borings, the soils at the abutments and center pier 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 pile cap at the center pier is planned at Elevation 398.7 feet. Bottom of footing at Abutments 1 and 3 and at the retaining wall are planned at elevations ranging from 401.5 to 408.7 feet. Free groundwater was encountered in Boring R-08-038 performed in the channel during this investigation at a depth of about 3 feet (Elevation 401 feet). Drilling fluid was measured at Elevation 400.5 feet in Boring R-08-037, two days after drilling was stopped temporarily. In addition, free groundwater was encountered at about Elevation 398 feet in Boring A-07-010, located about 300 feet south of Arroyo Del Valle. Based on this groundwater data, in our opinion, it is possible that groundwater could be encountered during excavation of the pier cap, as well as at the abutments, depending upon the extent of overexcavation required. Since the subsurface soils encountered in the borings near the bottom of footing and pile cap elevations consist primarily of clays, clayey gravels and clayey sands, it is likely that dewatering of these excavations can be accomplished by sumping. A temporary cofferdam should be specified to divert creek flow around the excavations. The bottom of the footing and pile cap excavations should include a seal course with a minimum thickness of 2 feet. The actual thickness of the seal course should be based on water head at the bottom of excavation during construction.

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 bridge foundations, underpinning of the existing footings could be required.

We received comments prepared by Caltrans (June 2, 2008) for the Arroyo Del Valle Bridge (Widen) FR (April 11, 2008), 65% FR submittal (March 31, 2009), 95% FR submittal (April 27, 2010), and for the 100% PS&E submittal (July 7, 2014). We also received comments from Caltrans following the 100% PS&E submittal (October 10, 2014) and subsequent submittal (November 14, 2014). Our responses to these comments are incorporated into this report and presented in Appendix L.

The recommendations presented in this Foundation Report are based on information obtained from new 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 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, foundation excavation, CIDH 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 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

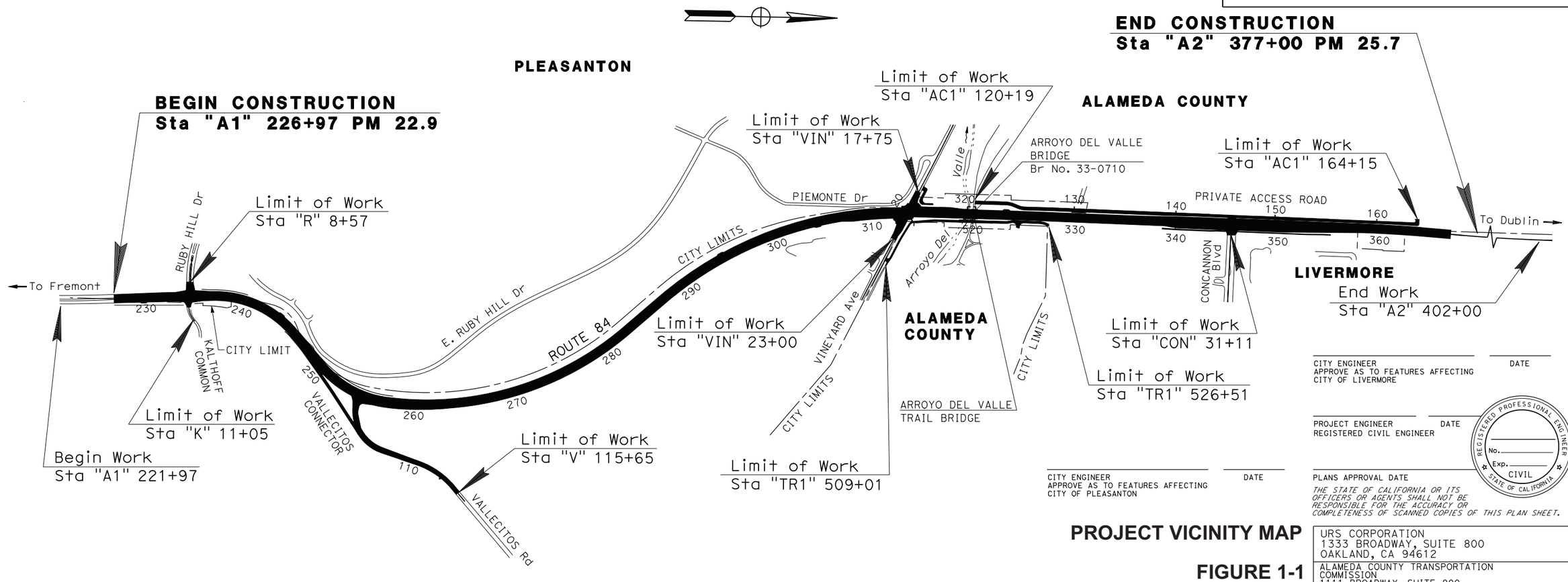
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

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 0.6 MILE NORTH OF CONCANNON BOULEVARD

TO BE SUPPLEMENTED BY STANDARD PLANS DATED 2010

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

LOCATION MAP



CITY ENGINEER
APPROVE AS TO FEATURES AFFECTING
CITY OF LIVERMORE — DATE

PROJECT ENGINEER — DATE
REGISTERED CIVIL ENGINEER

CITY ENGINEER
APPROVE AS TO FEATURES AFFECTING
CITY OF PLEASANTON — DATE

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.

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

PROJECT VICINITY MAP

FIGURE 1-1

THE CONTRACTOR SHALL POSSESS THE CLASS (OR CLASSES) OF LICENSE AS SPECIFIED IN THE "NOTICE TO BIDDERS."

NO SCALE

APPROVED AS TO IMPACT ON STATE FACILITIES AND CONFORMANCE WITH APPLICABLE STATE STANDARDS AND PRACTICES AND THAT TECHNICAL OVERSIGHT WAS PERFORMED.

CONSULTANT DESIGN ENGINEER: RAMSEY J. HISSEN — REGISTRATION No. 39838 — LICENSE Exp DATE 12-31-15 — DATE SIGNED

CALTRANS DESIGN OVERSIGHT APPROVAL: NESTOR P. PEREZ — DATE SIGNED

URS CORPORATION
1333 BROADWAY, SUITE 800
OAKLAND, CA 94612

ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 BROADWAY, SUITE 800
OAKLAND, CA 94607

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PROJECT ID	04000205811

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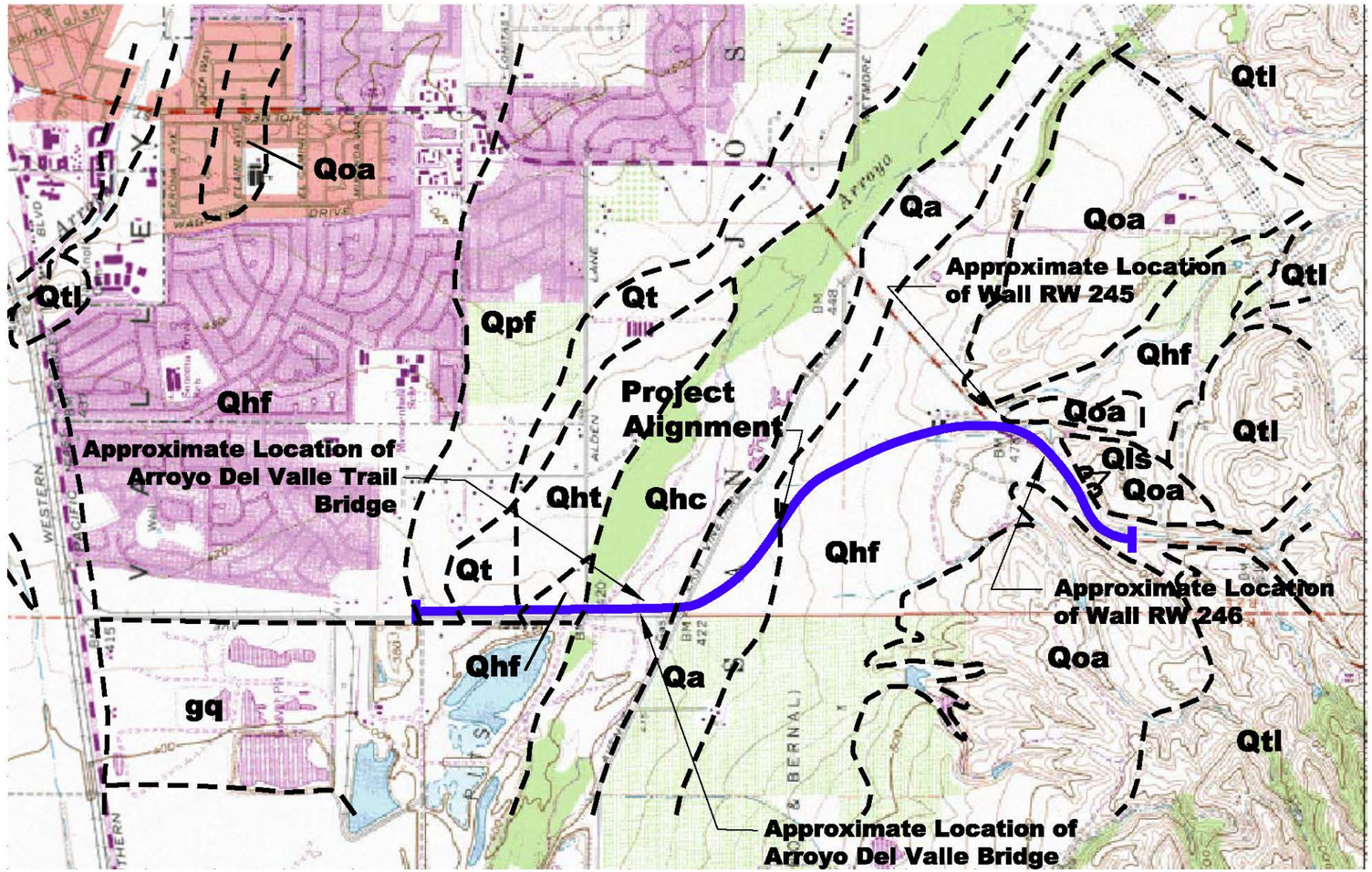


LEGEND:

- Approximate geologic contact

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

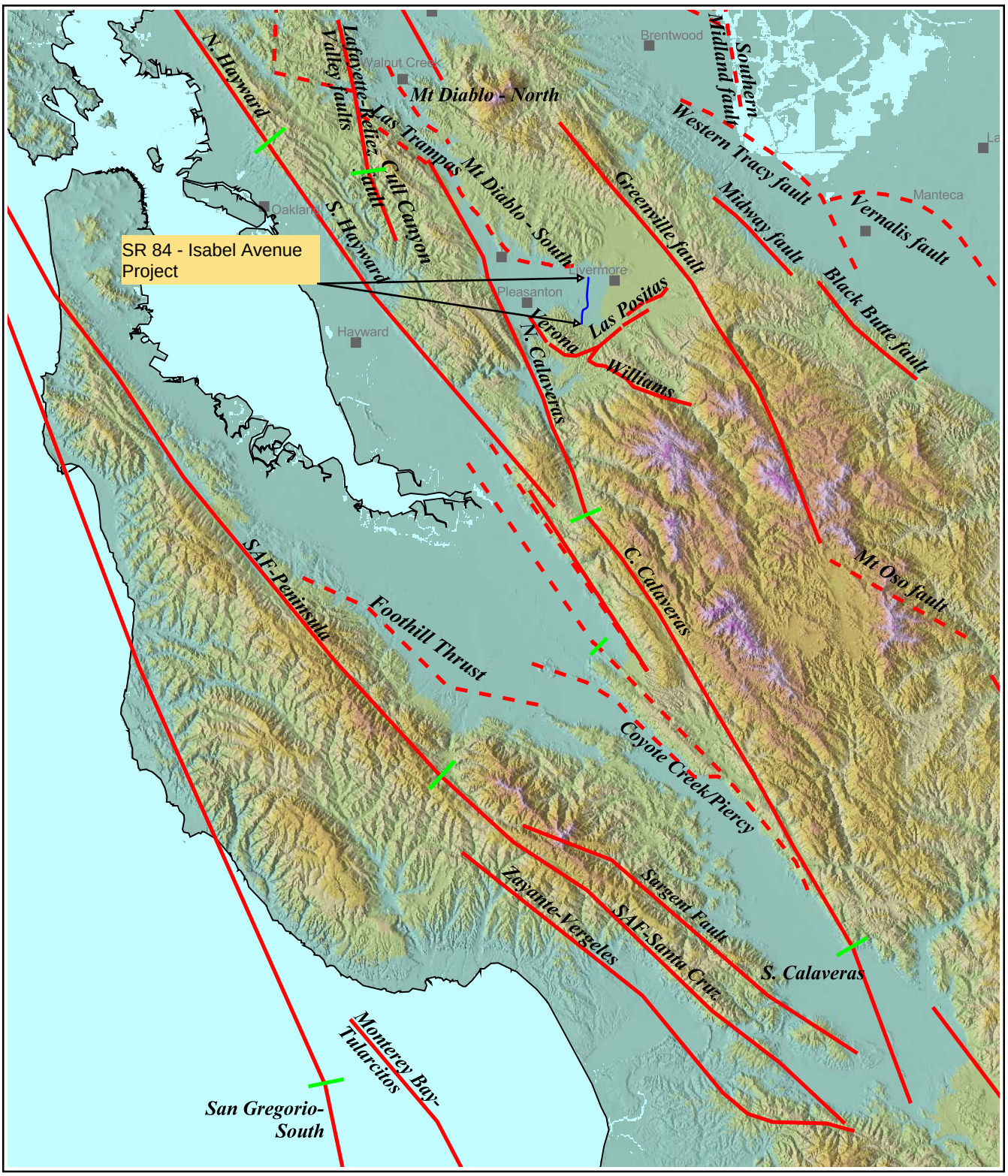
Geologic map modified from Dibblee, T.W., 1980 and Witter, R.C., et al, 2006

URS

SR 84 Isabel Ave
Livermore, California
Alameda County

SITE AND GEOLOGIC MAP

SCALE
Figure
3-1
November 2014



Fault Sources: URS Seismic Hazard Model

URS	28649640 SR 84 - Isabel Ave Livermore, CA	REGIONAL FAULT MAP	Figure **3-2**

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Stephen Huang No. C 42289 Exp. 3-31-16 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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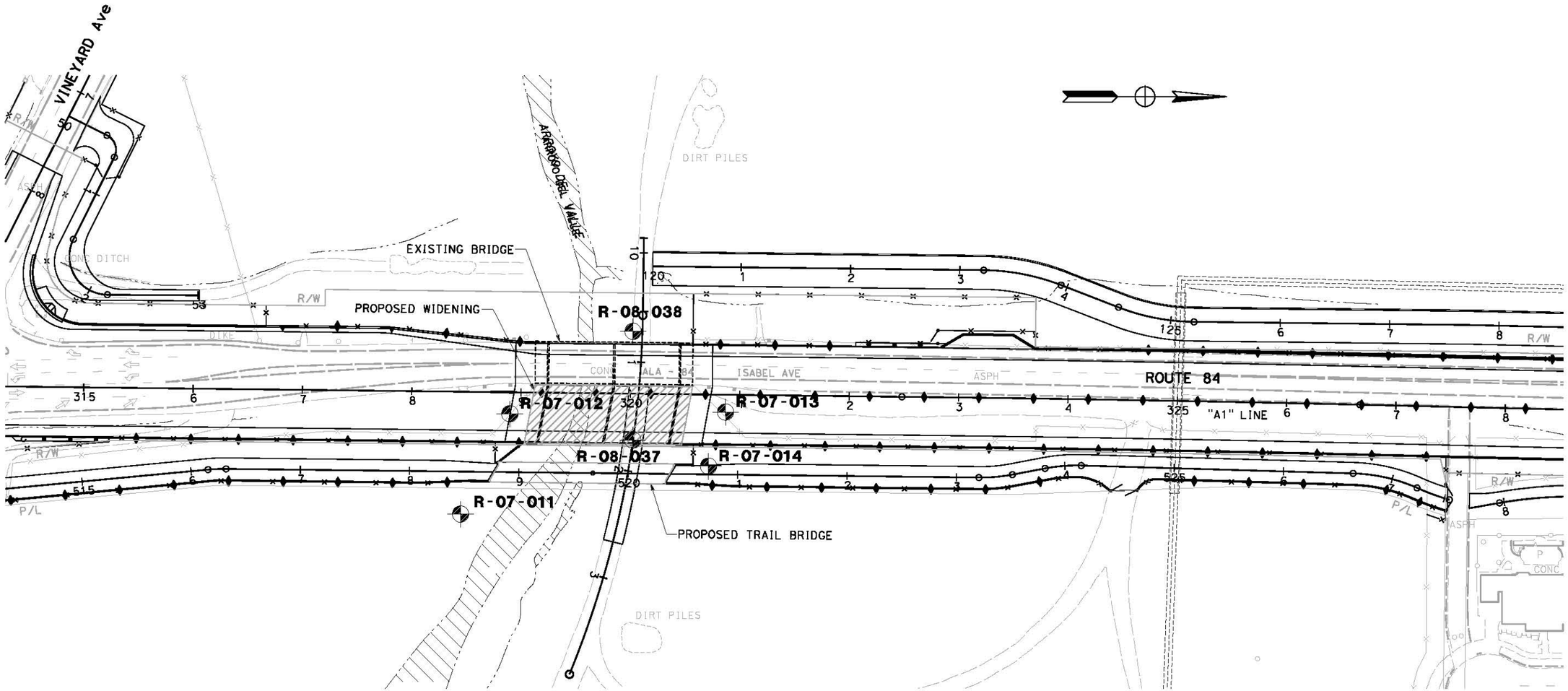
URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION COMMISION
1111 Broadway, Suite 800
Oakland, CA 94607

NOTE:

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.



LEGEND:

EXPLORATORY BORING FROM CURRENT STUDY
R-08-038

ARROYO DEL VALLE BRIDGE (WIDEN)
SITE AND BORING LOCATION PLAN

SCALE 1"=100'

FIGURE 3-3

CALCULATED-DESIGNED BY | CHECKED BY | REVISED BY | DATE REVISED
XXXX | XXXX

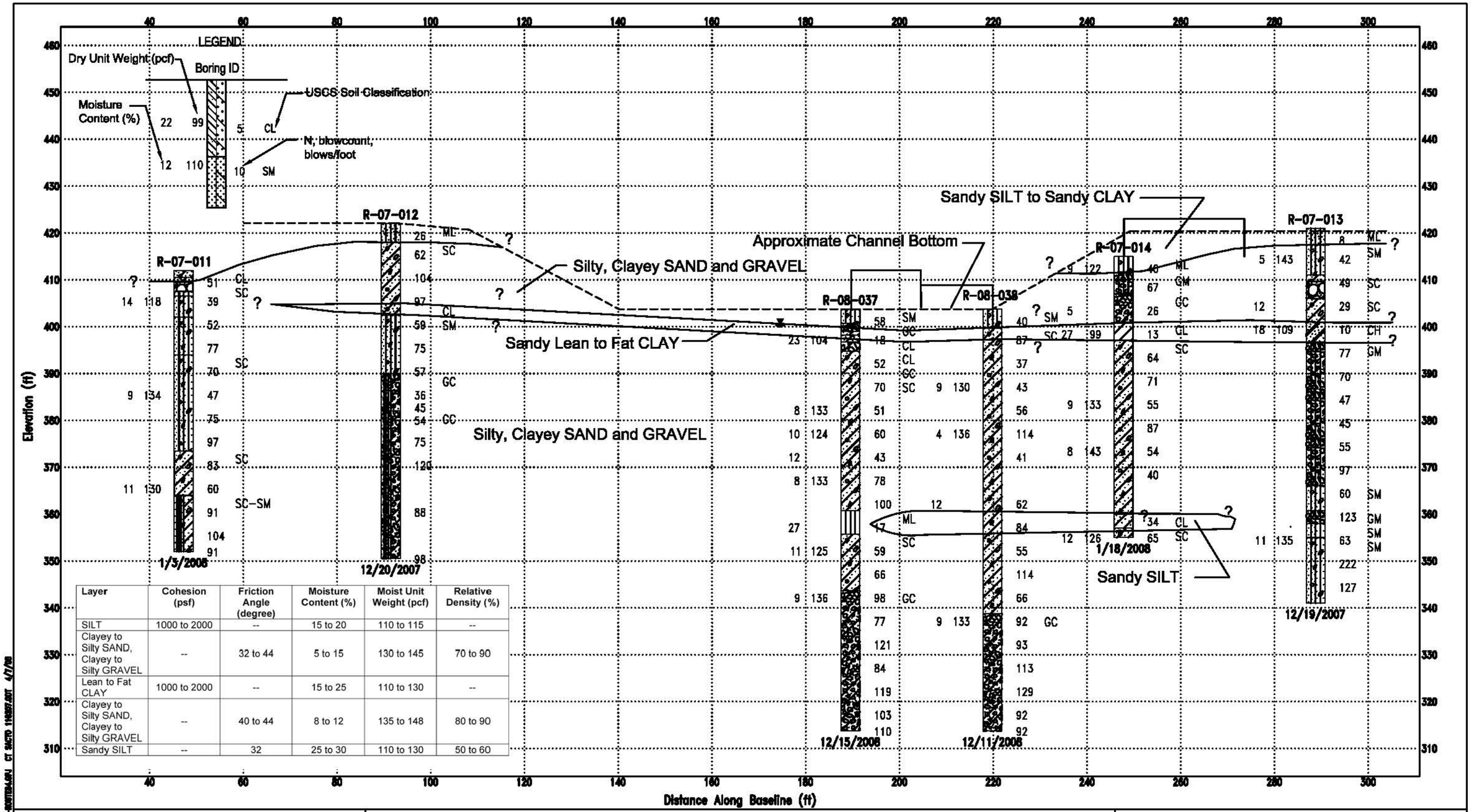
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

DATE PLOTTED => $DATE
TIME PLOTTED => $TIME
LAST REVISION 5-30-14

BORDER LAST REVISED 7/2/2010 | USERNAME => $USER | DGN FILE => $REQUEST | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811



Layer	Cohesion (psf)	Friction Angle (degree)	Moisture Content (%)	Moist Unit Weight (pcf)	Relative Density (%)
SILT	1000 to 2000	--	15 to 20	110 to 115	--
Clayey to Silty SAND, Clayey to Silty GRAVEL	--	32 to 44	5 to 15	130 to 145	70 to 90
Lean to Fat CLAY	1000 to 2000	--	15 to 25	110 to 130	--
Clayey to Silty SAND, Clayey to Silty GRAVEL	--	40 to 44	8 to 12	135 to 148	80 to 90
Sandy SILT	--	32	25 to 30	110 to 130	50 to 60

URS Corporation – San Jose

Project Number: 28649640

LITHOLOGY GRAPHICS

USCS Sandy Lean Clay with gravel; USCS Clayey Sand with gravel; Boulders and cobbles; USCS Silty Sand with gravel; USCS Silty, Clayey Sand with gravel

USCS Sandy Silt; USCS Silty, Clayey Gravel with sand; Asphalt; USCS Sandy Fat Clay; USCS Silty Gravel with sand

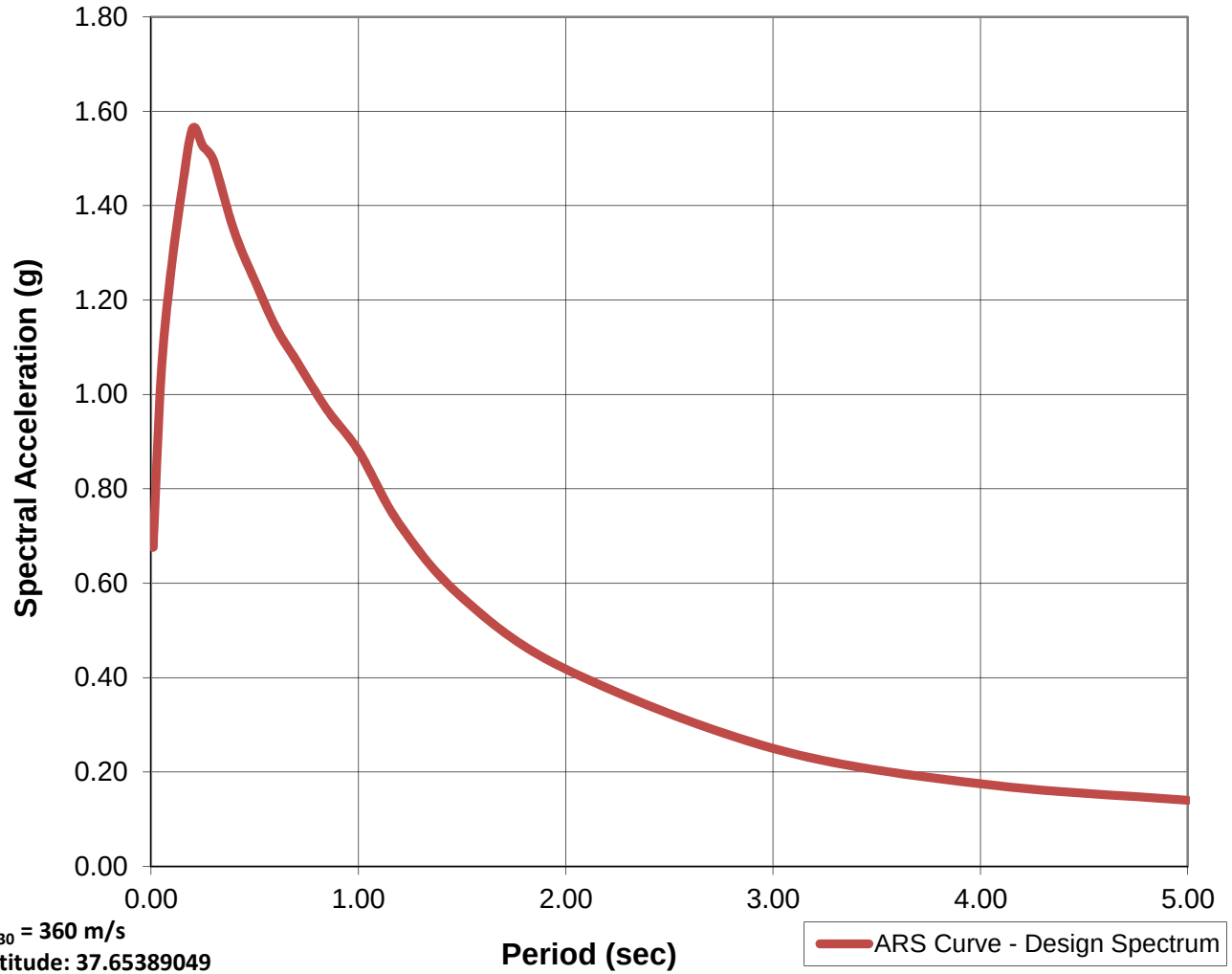
USCS Silty Sand; USCS Silt with gravel; USCS Silty Gravel (poorly graded); USCS Clayey Gravel with sand; USCS Lean Clay

GENERALIZED SOIL PROFILE
ARROYO DEL VALLE CREEK CROSSING
Route 84 Expressway Widening
Alameda County, California

Figure 3-4

SIMPLE FORCE 2 – 8 SIZE 28649640-ROUTE84.PLN CT SACTO 11/20/2007 4/7/08

Probabilistic ARS Curve (5% Damping) 975 Year Return Period - Design Spectrum



V_{s30} = 360 m/s
Latitude: 37.65389049
Longitude: -121.80558756

Envelope

Period (sec)	SA (g)
0.01	0.68
0.05	1.05
0.10	1.28
0.15	1.44
0.20	1.56
0.25	1.53
0.30	1.50
0.40	1.35
0.50	1.24
0.60	1.14
0.70	1.07
0.85	0.97
1.00	0.88
1.20	0.72
1.50	0.57
2.00	0.42
3.00	0.25
4.00	0.18
5.00	0.14

ARS Curve for Bridge No. 33-0710/ARROYO DEL VALLE

Project No. 28649640	Date: April 2014	Project: SR 84 ISABEL - SEGMENT B	Figure 5-1

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

Xiangyang Fu 12/22/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — XIANGYANG FU — No. C 72514 — Exp. 06/30/16 — CIVIL — STATE OF CALIFORNIA

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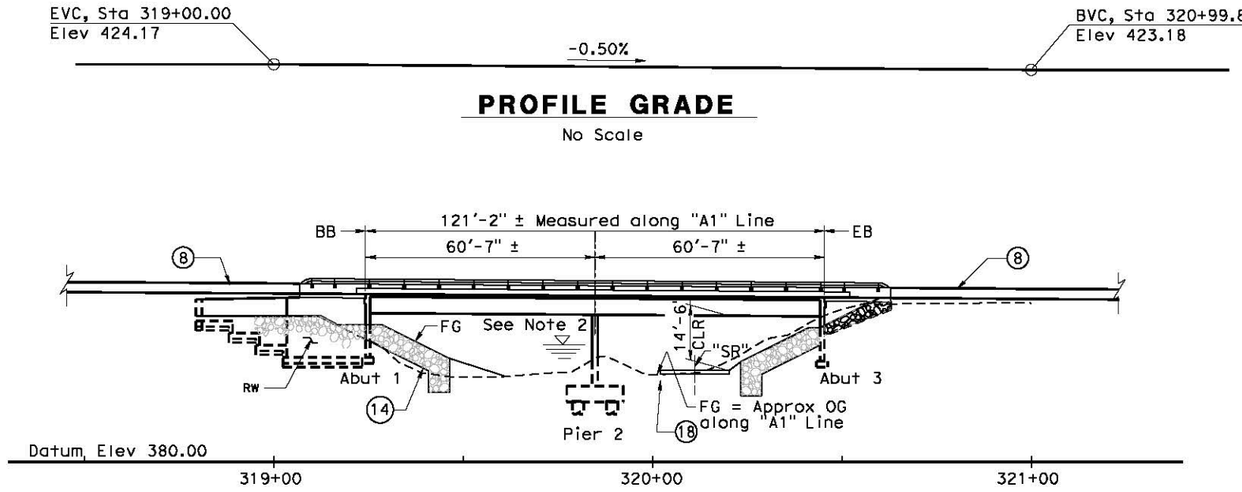
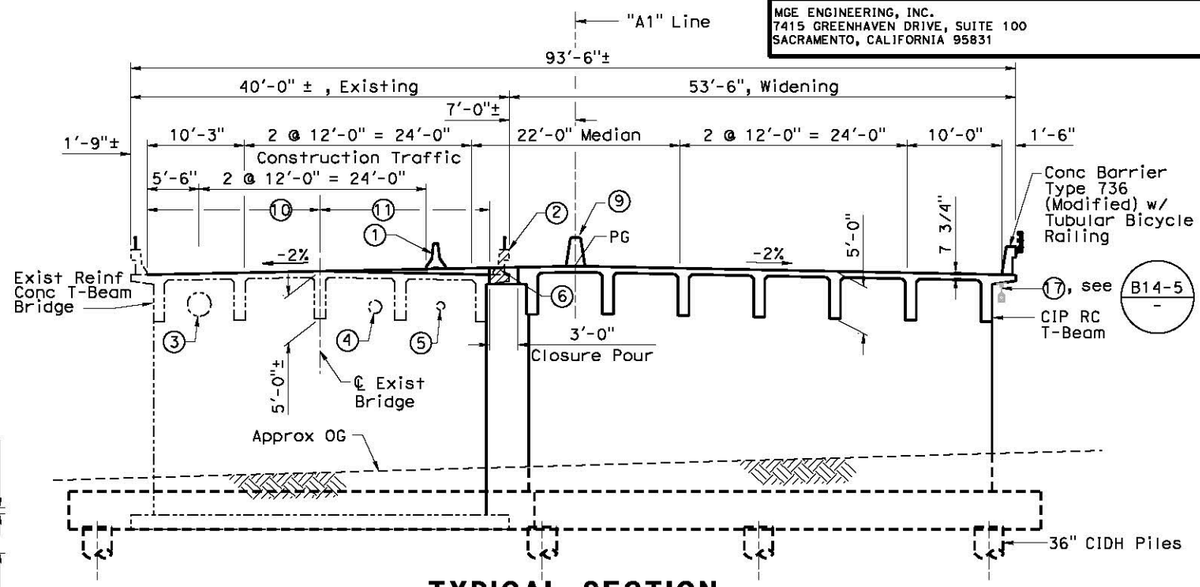
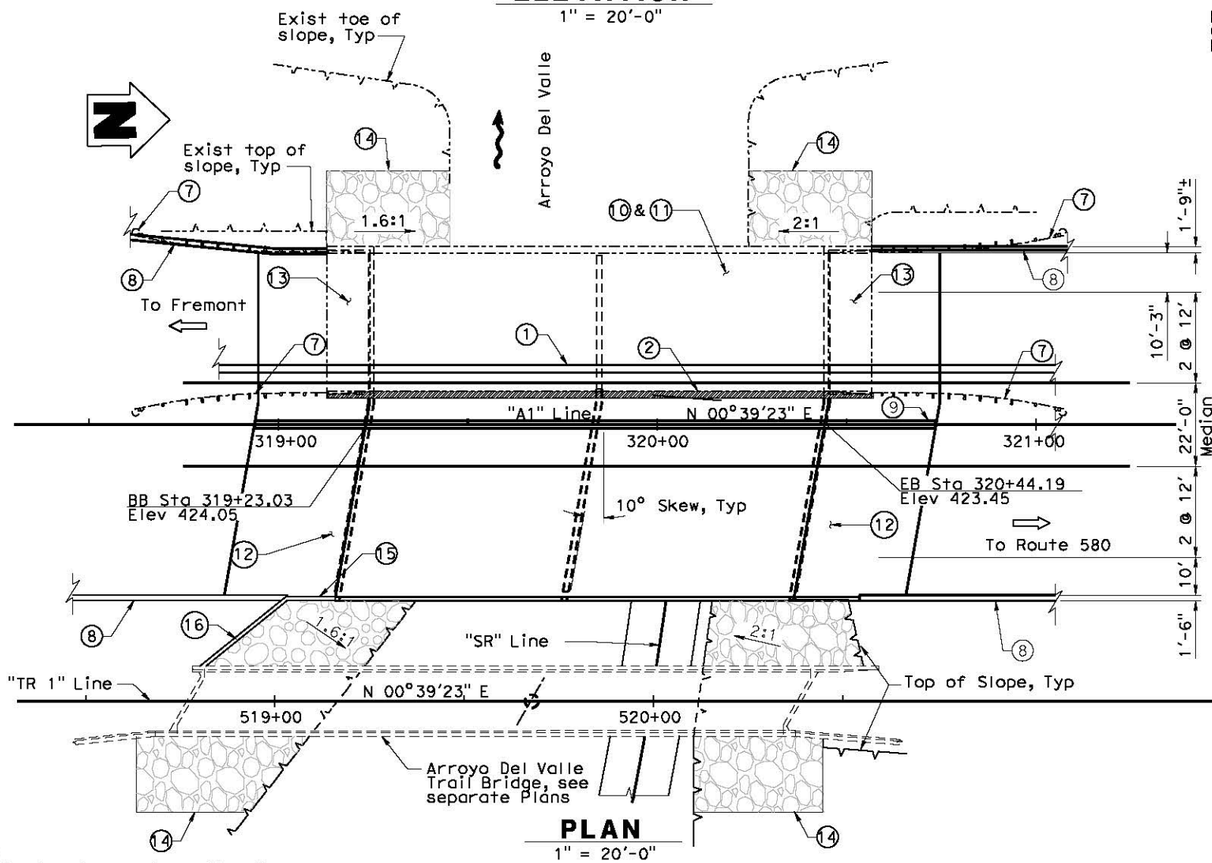
1111 BROADWAY, SUITE 800
OAKLAND, CA 94607

MGE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831





TYPICAL SECTION
1/8" = 1'-0"



ELEVATION
1" = 20'-0"

PLAN
1" = 20'-0"

Note:
The Contractor must verify all controlling field dimensions before ordering or fabricating any material.

LEGEND

- Indicates Exist Structure
- Indicates New Construction
- Indicates Direction of Travel
- Indicates Direction of Flow
- Indicates Bridge Removal (Portion)

NOTES:

1. For General Notes, Quantities and Index to Plans, see "GENERAL NOTES" Sheet.
2. For Pile Data Table, Spread Footing Data Table and Hydrologic Summary, see "FOUNDATION PLAN" sheet.

NOTES:

1. Temporary Railing (Type K), see "Roadway Plans"
2. Remove Existing Barrier, Railing & Overhang
3. Existing 30" ∅ Steel Casing to remain
4. Existing 16"∅ DIP Sewer Line to be relocated by others
5. Existing 12"∅ Water Line to remain
6. Existing 2 - 3"∅ Conduits to be relocated by others
7. Existing Metal Beam Guard Rail to be removed, see "Roadway Plan"
8. Concrete Barrier, see "Roadway 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 (Varies, 10" max in Thickness) and place 3/4" Polyester Concrete Overlay
12. Structure Approach, Type N (30D)
13. Remove Exist Approach Slab and replace with Structure Approach, Type R (30D)
14. Rock Slope Protection , See "ROCK SLOPE PROTECTION" Sheet.
15. Paint "Bridge No. 33-0710" & "Arroyo Del Valle Bridge"
16. Retaining Wall, Type 1
17. 2" Supply Line (Bridge)
18. "SR" road, see "Roadway Plans"

DESIGN OVERSIGHT	DESIGN	BY X. Fu	CHECKED D. Wang	LOAD & RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 W/"LOW-BOY"; PERMIT DESIGN VEHICLE		
SIGN OFF DATE	DETAILS	BY K. Wang	CHECKED D. Wang	LAYOUT	BY X. Fu	CHECKED D. Wang	
	QUANTITIES	BY W. Sennett	CHECKED R. Huang	SPECIFICATIONS	BY R. E. Sennett	PLANS AND SPECS COMPARED X. Fu	

PREPARED FOR THE STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

Xiangyang Fu
PROJECT ENGINEER

BRIDGE NO. 33-0710
POST MILES 24.8

ARROYO DEL VALLE BRIDGE (WIDEN)
GENERAL PLAN

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0733
PROJECT NUMBER & PHASE: 04000205811 CONTRACT NO.: 04-297624

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES				SHEET	OF
05/08/08	10/21/10	05/29/14	12/22/14	1	20

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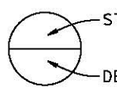
USERNAME => kdi

INDEX TO PLANS

Sheet No.	Title
1	GENERAL PLAN
2	GENERAL NOTES
3	DECK CONTOUR
4	FOUNDATION PLAN
5	ABUTMENT 1 LAYOUT
6	ABUTMENT 3 LAYOUT
7	ABUTMENT DETAILS NO. 1
8	ABUTMENT DETAILS NO. 2
9	RETAINING WALL, PLAN AND ELEVATION
10	PIER LAYOUT
11	PIER DETAILS
12	TYPICAL SECTION
13	GIRDER LAYOUT
14	CIDH CONCRETE PILE DETAILS
15	STRUCTURE APPROACH, TYPE N (30D)
16	STRUCTURE APPROACH, TYPE R (30D)
17	STRUCTURE APPROACH DRAINAGE DETAILS
18	TUBULAR BICYCLE RAILING DETAILS
19	ROCK SLOPE PROTECTION
20	LOG OF TEST BORINGS

STANDARD PLANS DATED 2010

A10A	ABBREVIATIONS (SHEET 1 OF 2)
A10B	ABBREVIATIONS (SHEET 2 OF 2)
A10C	LINES AND SYMBOLS (SHEET 1 OF 3)
A10D	LINES AND SYMBOLS (SHEET 2 OF 3)
A10E	LINES AND SYMBOLS (SHEET 3 OF 3)
A62B	LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL - BRIDGE SURCHARGE AND WALL
A62C	LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL - BRIDGE
A76A	CONCRETE BARRIER TYPE 60
B0-1	BRIDGE DETAILS
B0-3	BRIDGE DETAILS
B0-5	BRIDGE DETAILS
RSP B3-1A	RETAINING WALL TYPE 1 (CASE 1)
RSP B3-5	RETAINING WALL DETAILS NO. 1
B6-1	T-BEAM DETAILS
B6-21	JOINT SEALS (MAXIMUM MOVEMENT RATING = 2")
RSP B11-47	CABLE RAILING
RSP B11-56	CONCRETE BARRIER TYPE 736
B14-5	WATER SUPPLY LINE (DETAILS) (PIPE SIZE LESS THAN 4")
T3(A)	TEMPORARY RAILING (TYPE K)
T3(B)	TEMPORARY RAILING (TYPE K)



Note:
The Contractor must verify all controlling field dimensions before ordering or fabricating any material.

GENERAL NOTES
LOAD AND RESISTANCE FACTOR DESIGN

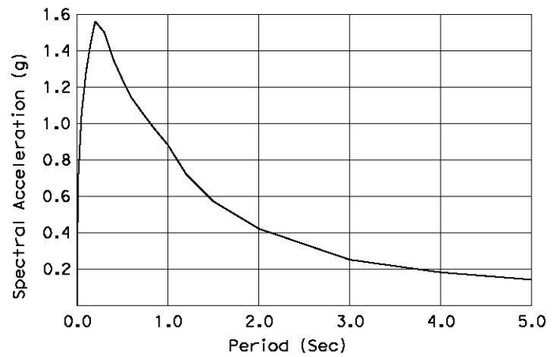
DESIGN: AASHTO LRFD Bridge Design Specifications, 4th Edition and the Caltrans Amendments, Preface dated November 2011; except that Abutments and Concrete Barrier Type 736 are designed using Bridge Design Specifications ('96 AASHTO w/ Revisions by Caltrans)

SEISMIC DESIGN: Caltrans Seismic Design Criteria (SDC) Version 1.7 dated April 2013

DEAD LOAD: Includes 35 psf for future wearing surface

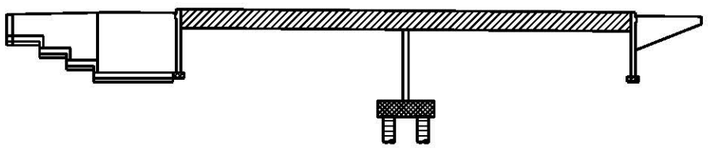
LIVE LOADING: HL93 and Permit Design Vehicle

SEISMIC LOADING: Modified Caltrans SDC ARS Curve
Peak Ground Acceleration = 0.61g
V_{S30} = 360 m/s



ARS CURVE

CONCRETE: fy = 60 ksi
f'c = 3.6 ksi
n = 8
See "Prestressing Notes" on "Girder Layout" sheet.



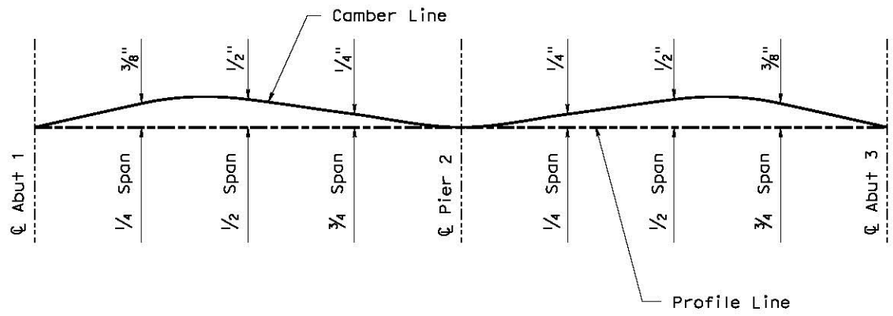
Structural Concrete, Bridge (4.0 ksi @ 28 days)

Structural Concrete, Bridge Footing

Structural Concrete, Bridge

36" CIDH Concrete Pile (4.0 ksi @ 28 Days)

CONCRETE STRENGTH AND TYPE LIMITS
No Scale



Note: Camber shown does not include allowance for falsework settlement. Camber values are shown in inches.

CAMBER DIAGRAM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

Xiangyang Fu 12/22/14
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER — XIANGYANG FU — No. C 72514 — Exp. 06/30/16 — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831

DESIGN OVERSIGHT
SIGN OFF DATE

	BY	CHECKED
DESIGN	X. Fu	D. Wang
DETAILS	K. Wang	D. Wang
QUANTITIES	W. Sennett	R. Huang

PREPARED FOR THE STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

Xiangyang Fu
PROJECT ENGINEER

BRIDGE NO. 33-0710
POST MILES 24.8

ARROYO DEL VALLE BRIDGE (WIDEN)
GENERAL NOTES

DESIGN DETAIL SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0733
PROJECT NUMBER & PHASE: 04000205811 CONTRACT NO.: 04-297624

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES				SHEET	OF
10/27/10	05/29/14	11/17/14	12/22/14	2	20

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DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

Xiangyang Fu 12/22/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — XIANGYANG FU — No. C 72514 — Exp. 06/30/16 — CIVIL — STATE OF CALIFORNIA

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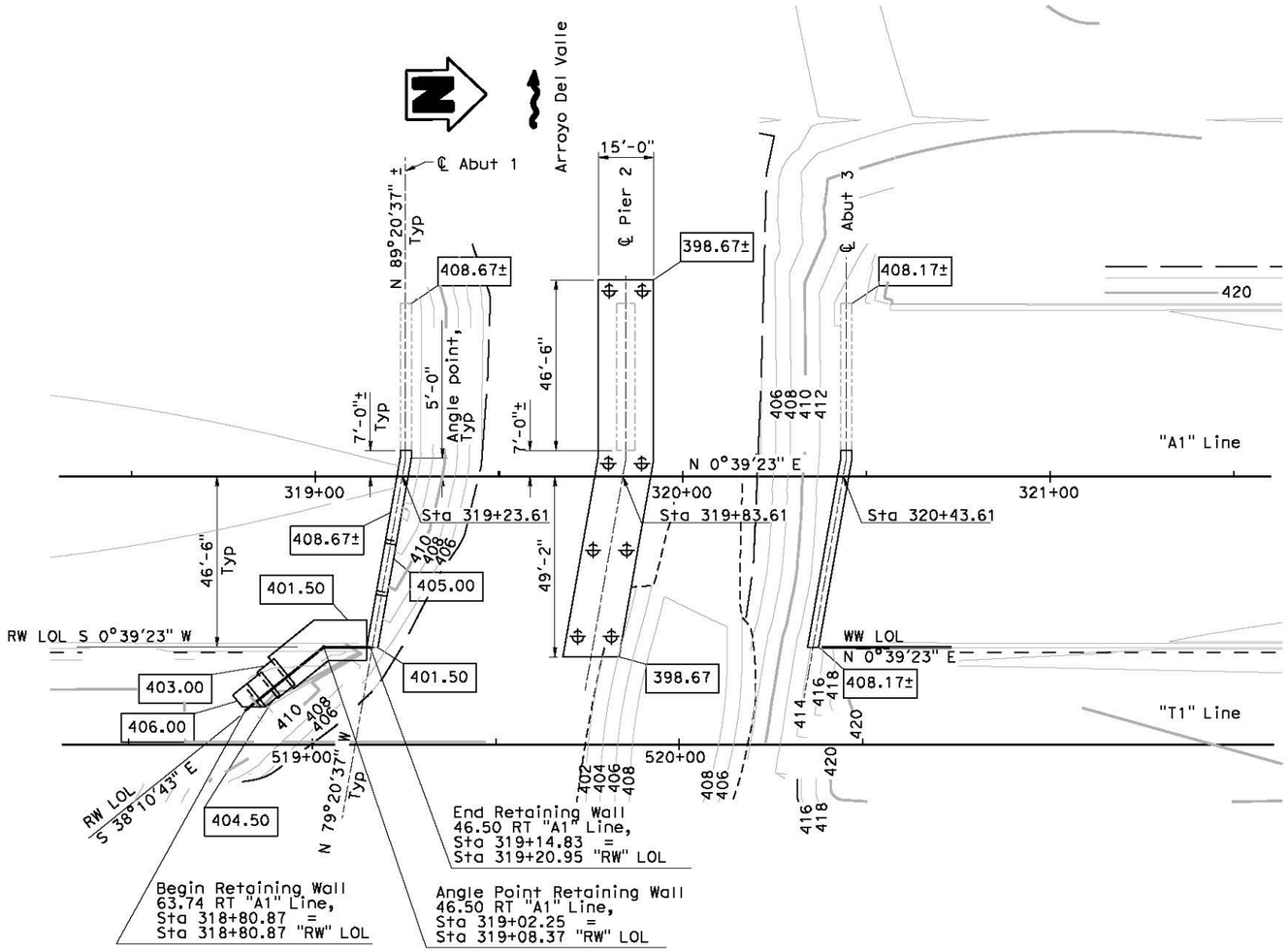
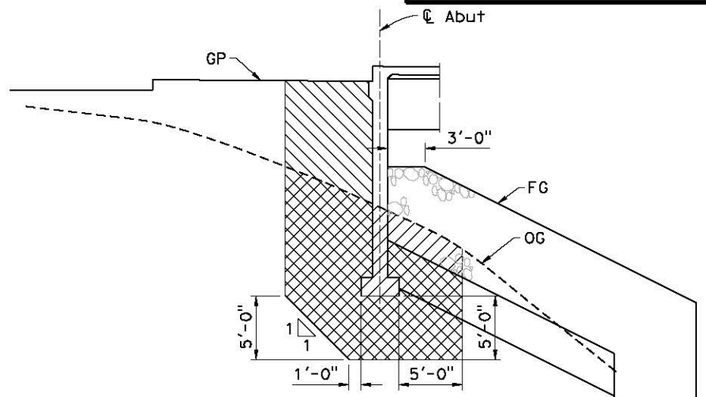
SACRAMENTO, CALIFORNIA 95831



FOUNDATION PLAN
1" = 20'-0"

LEGEND

- Indicates Existing Structure
- Indicates New Construction
- Indicates Direction of Flow
- XXX.xx Indicates Bottom of Footing Elevation
- Indicates 36" CIDH Piles
- Indicates structure excavation (Bridge)
- Indicates structure backfill (Bridge)



LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL (BRIDGE)
No Scale

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 1	9.00	6.00	N/A	N/A	N/A
Abut 3	7.50	6.00	N/A	N/A	N/A

HYDROLOGIC SUMMARY

Drainage Area: 160 square miles

	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.

Note:
The Contractor must verify all controlling field dimensions before ordering or fabricating any material.

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

PILE DATA TABLE

Location	Pile Type	Nominal Resistance (kips)		Design Tip Elevations (ft)	Specified Tip Elevations (ft)
		Compression	Tension		
Pier 2	36" CIDH	1,230	0	323.0 (1) 375.0 (2)	323.0

The design tip elevation is controlled by the following demands:
(1) Compression; (2) Lateral.

Stephen Hung 12/17/14
GEOTECHNICAL PROFESSIONAL APPROVAL DATE

DESIGN OVERSIGHT	SCALE: 1"=20'	VERT.DATUM NAVD88	HORZ.DATUM NAD83	DESIGN	BY X. Fu	CHECKED D. Wang	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Xiangyang Fu PROJECT ENGINEER	BRIDGE NO. 33-0710
	PHOTOGRAMMETRY AS OF: 11/10/2005	ALIGNMENT TIES		DETAILS	BY K. Wang	CHECKED D. Wang			POST MILES 24.8
SIGN OFF DATE	SURVEYED BY Dan Scott	DRAFTED BY Abhijeet Bhoi		QUANTITIES	BY W. Sennett	CHECKED R. Huang			
	FIELD CHECKED BY Dan Scott	CHECKED BY							

ARROYO DEL VALLE BRIDGE (WIDEN)
FOUNDATION PLAN

FOUNDATION PLAN SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0733
PROJECT NUMBER & PHASE: 04000205811 CONTRACT NO.: 04-297624

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES				SHEET	OF
10/21/10	05/25/14	11/17/14	12/22/14	4	20

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DATE PLOTTED => 12/17/2014
TIME PLOTTED => 12:45:07 PM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

11-14-14
GEOTECHNICAL PROFESSIONAL DATE

REGISTERED PROFESSIONAL ENGINEER
Stephen Huang
No. C 42289
Exp. 3-31-16
GEOTECHNICAL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

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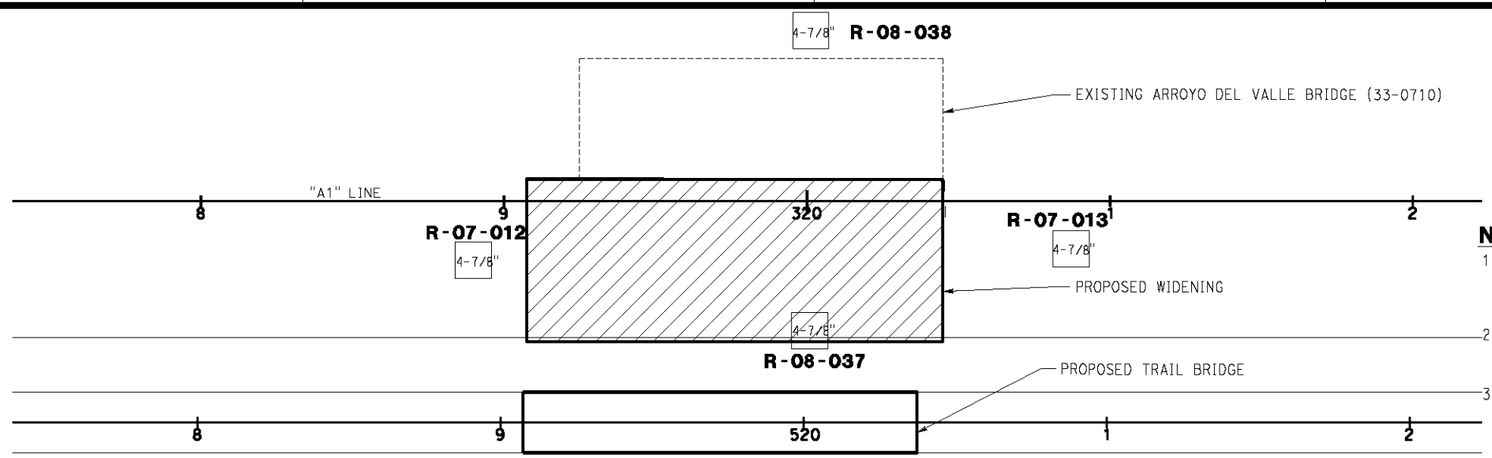
URS CORPORATION
1333 BROADWAY, SUITE 800
OAKLAND, CA 94612

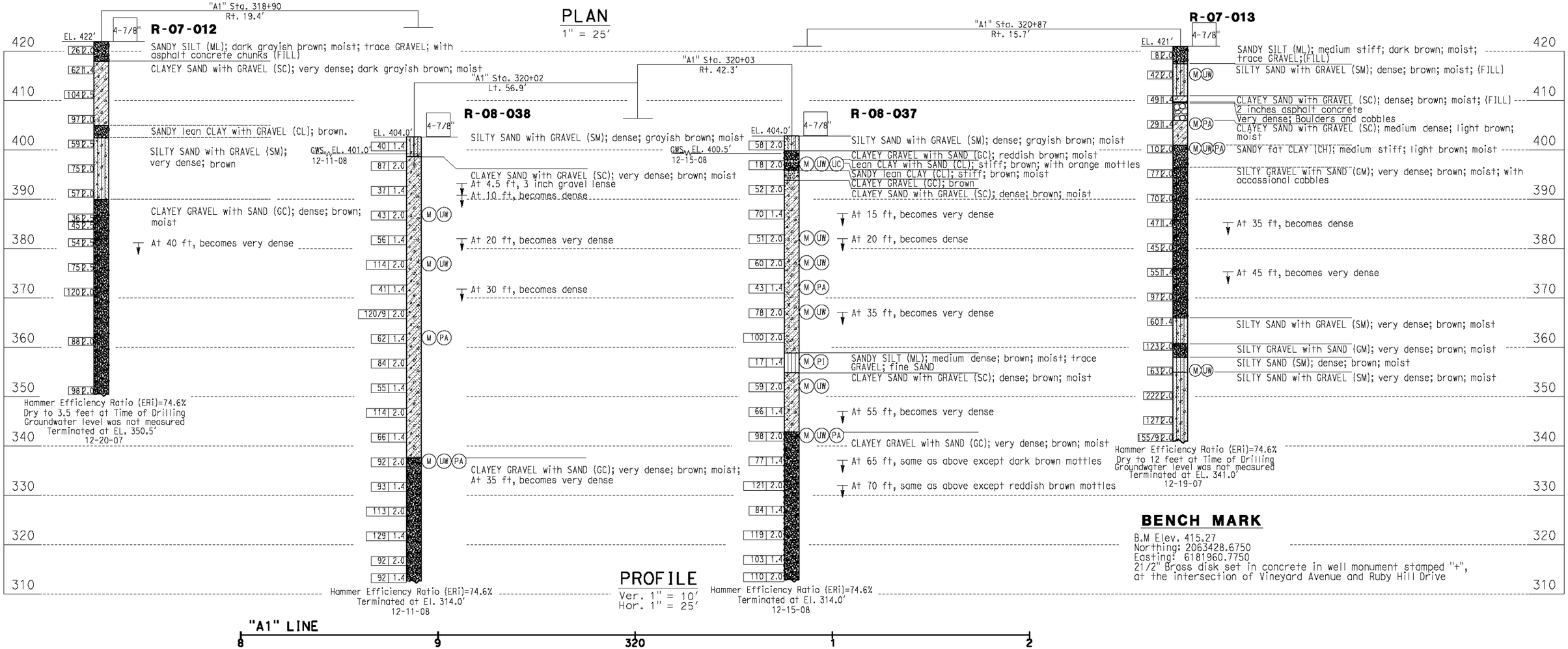
ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 BROADWAY, SUITE 800
OAKLAND, CA 94607



NOTES

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. 400.5 feet in NB37, 2 days after temporyily stopped drilling.
3. Design groundwater level at El. 401 feet.

PLAN
1" = 25'



PROFILE
Ver. 1" = 10'
Hor. 1" = 25'

BENCH MARK

B.M Elev. 415.27
Northing: 2063428.6750
Easting: 6181960.7750
21/2" Brass disk set in concrete in well monument stamped "+", at the intersection of Vineyard Avenue and Ruby Hill Drive

DESIGN OVERSIGHT	DRAWN BY	A. Cheung	C. Rambo		PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Stephen Huang	BRIDGE NO. 33-0710	ARROYO DEL VALLE BRIDGE (WIDEN)
SIGN OFF DATE	CHECKED BY	A. M. Moore	FIELD INVESTIGATION BY: DATE: Dec 2007-Dec 2008			PROJECT ENGINEER	POST MILES 24.8	LOG OF TEST BORINGS

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0733
PROJECT NUMBER & PHASE: 04000205811 CONTRACT NO.: 04-297624

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES | SHEET | OF

FILE => LOTB-Widen.dgn

USERNAME => bimt_huang
DATE PLOTTED => 12/10/2014 TIME PLOTTED => 11:38:27 AM

FIELD EXPLORATION PROGRAM

The geotechnical field investigation consisted of six geotechnical borings extending to depths of 60 to 90 feet below the existing ground surface. The explorations were performed between December 18, 2007 and January 3, 2008, and between December 11 and 15, 2008, by Pitcher Drilling of East Palo Alto, 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 (R-07-011, R-07-012, R-07-013, R-07-014, R-08-037, and R-08-038)

Six rotary wash borings were performed at the proposed bridge location during the current study. At the time of the exploration, borings were designated NB11 through NB14, NB37 and NB38. Boring designations were revised to R-07-011, R-07-012, R-07-013, R-07-014, R-08-037 and R-08-038 in accordance with Caltrans 2007 guidelines.

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. All explorations were advanced to depths of 60 to 90 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 12 inches 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 sample were covered with plastic caps, and carefully transported to 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. These tests were performed at the URS' laboratory.

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 plastic limit, liquid limit, gradation analyses, moisture content and dry density determinations. Plastic and liquid limit tests were performed in accordance with ASTM D 4318. Particle size analyses were performed in accordance with ASTM D 422. The moisture content tests were performed in accordance with ASTM D 2216. Dry unit weight 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 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.

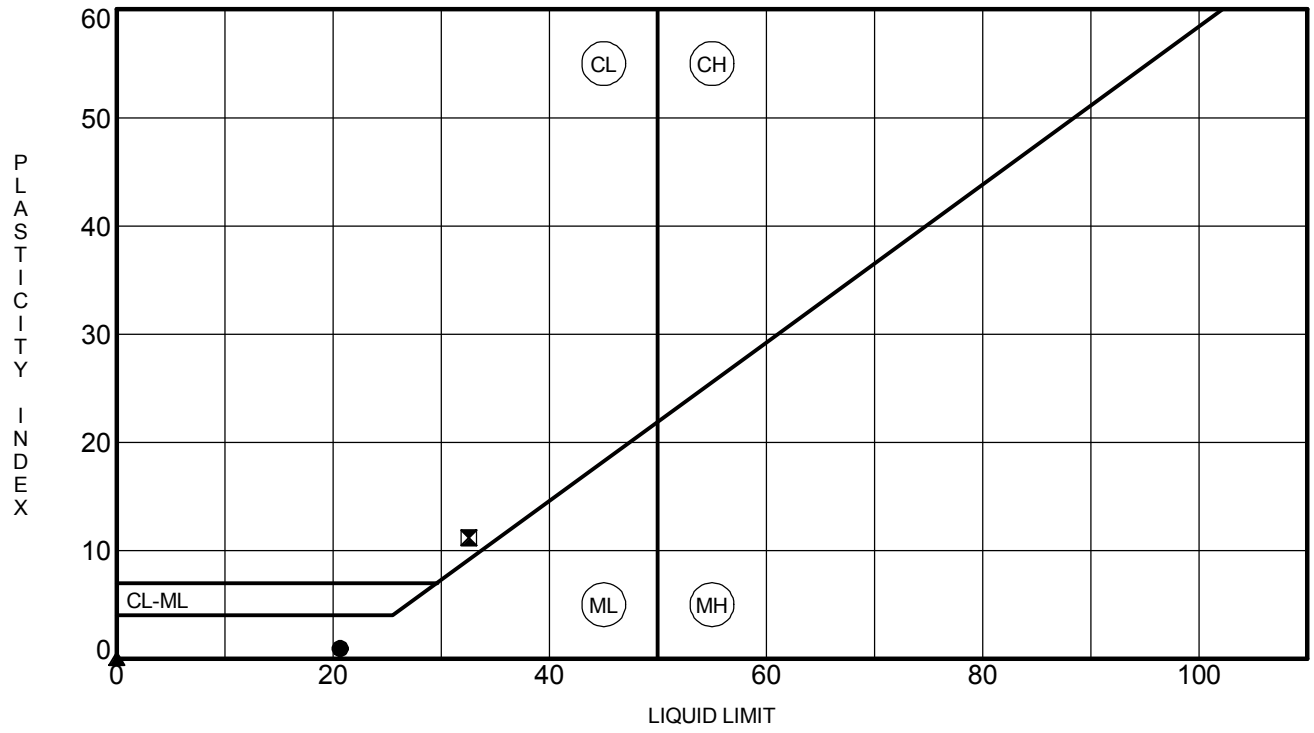
Boring Designation Correlation

The correlation between original and revised boring designations is presented in the following table and is provided for reference with laboratory test data presented in Table B-1 and on Figures B-1 and B-2.

Boring Number (Old)	Boring Number (New)*		Boring Number (Old)	Boring Number (New)*
NB11	R-07-011		NB14	R-07-014
NB12	R-07-012		NB37	R-08-037
NB13	R-07-013		NB38	R-08-038

TABLE B-1
SUMMARY OF LABORATORY TEST RESULTS

Boring or Sample No.	Date Sampled	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)
NB11	2-Jan-08	5		100	98	89	84	62	46	29	19	15	13	12						14	118
NB11		25																		8.7	134
NB11		45																		10.7	130
NB13	18-Dec-07	5																		4.6	143
NB13		15	100	94	94	83	77	57	42	31	23	18	15	13						12	
NB13		20	100	94	100	92	91	88	80	71	65	62	60	53						17.8	109
NB13		65																		11.2	135
NB14	18-Jan-08	1														21	20	1		8.8	122
NB14		10			96	83	75	56	44	34	26	21	16	14						4.8	
NB14		15														33	21	12		27	99
NB14		30																		9.5	133
NB14		40																		7.9	143
NB14		58.5																		12.5	126
NB37	12-Dec-08	5																	1900	23	104
NB37		20																		8.3	133
NB37		25																		10	124
NB37		30	100	92	84	80	75	60	46	34	25	19	15	12						11.8	
NB37		35																		8.4	133
NB37		45														NP	NP	NP		26.6	
NB37		50																		11	125
NB37		60	87	83	79	71	66	52	41	33	26	20	17	15						9.2	136
NB38	11-Dec-08	15																		9.3	130
NB38		25																		4.3	136
NB38		40	100	100	95	87	76	58	42	31	24	19	15	13						12.3	
NB38		65	100	93	81	75	68	57	47	38	31	25	21	18						9.4	133



Sample Identification/Depth (ft)			LL	PL	PI	Fines	Classification
●	**NB14**	**1.0**	**21**	**20**	**1**		**Silty SAND (SM) with gravel (SM)**
⊠	**NB14**	**15.0**	**33**	**21**	**12**		**Lean CLAY (CL) with sand (CL)**
▲	**NB37**	**45.0**	**NP**	**NP**	**NP**		**Sandy SILT (ML) (ML)**

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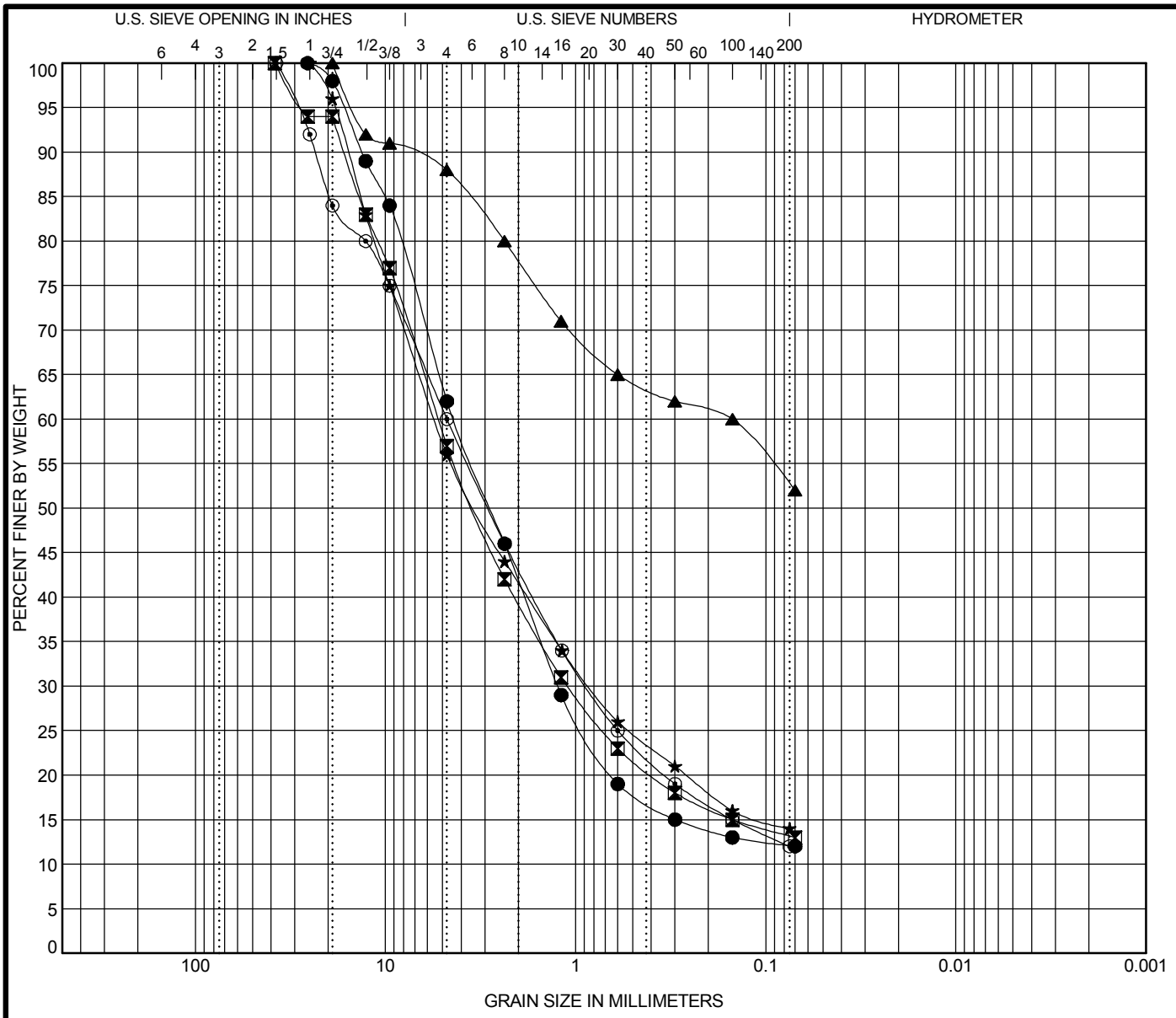
PLASTICITY CHART

Project Name: SR 84 Expy Widen (URS 28649640)
Location: Alameda 84 22.9/27.1
Number: 297601

Figure B-1

URS PLASTICITY CHART 28649640-ROUTE84.GPJ SNJ_CT.GLB 5/30/14



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample Identification/Depth (ft)		Classification	LL	PL	PI	Cc	Cu
●	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					
⊙	NB37	30.0	Clayey SAND (SC) with gravel				3.40	100.54

	Sample Identification/Depth (ft)		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	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	
⊙	NB37	30.0	37.5	4.75	0.874		40.0	48.0	12.0	

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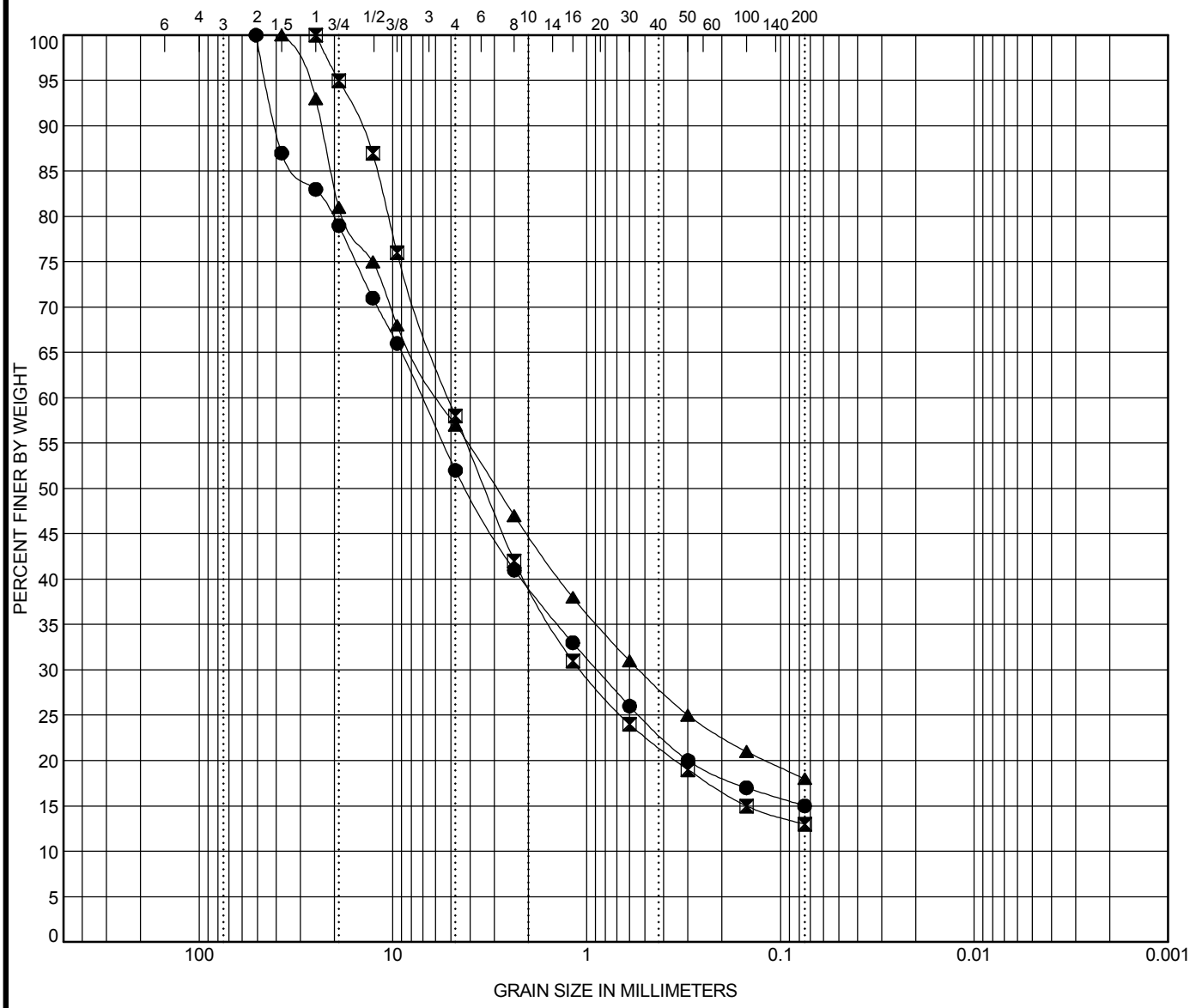
GRAIN SIZE DISTRIBUTION

Project Name: SR 84 Expy Widen (URS 28649640)
Location: Alameda 84 22.9/27.1
Number: 297601

Figure B-2

URS GRAIN SIZE 28649640-ROUTE84.GPJ SNJ_CT.GLB 5/30/14



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample Identification/Depth (ft)		Classification	LL	PL	PI	Cc	Cu
●	**NB37**	**60.0**	**Clayey GRAVEL (GC) with sand**					
⊠	**NB38**	**40.0**	**Clayey SAND (SC) with gravel**					
▲	**NB38**	**65.0**	**Clayey GRAVEL (GC) with sand**					

	Sample Identification/Depth (ft)		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**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**	

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GRAIN SIZE DISTRIBUTION

Project Name: SR 84 Expy Widen (URS 28649640)
Location: Alameda 84 22.9/27.1
Number: 297601

Figure B-3

URS GRAIN SIZE 28649640-ROUTE84.GPJ SNJ_CT.GLB 5/30/14

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Memorandum

Date: **November 13, 2014**

To: **Tony Nedwick – Hydraulic Engineer, Structure Hydraulics & Hydrology**

Cc: **David Soon – Structure Liaison Engineer, Division of Engineering Services**

From: **Analette Ochoa, P.E. & Jeff Tudd – WRECO**

Subject: **EA 04-297624 State Route 84 Expressway Widening Project – Bridge Design Hydraulic Study Report Amendment**

I. Introduction

This memorandum is an amendment to the State Route 84 Expressway Widening Project (EA 04-297601) *Bridge Design Hydraulic Study Report*. The Bridge Design Hydraulic Study Report was signed by the Registered Civil Engineer for the bridge design on 05/20/2009 (see Attachment C). The current project EA is 04-297624 and the Project ID is 0400020581. On July 3, 2014, Structure Hydraulics & Hydrology comments were provided to the Office of Special Funded Projects, Program Project and Resource Management, Division of Engineering Services. Since then, WRECO has coordinated with URS Corporation and MGE Engineering to address these comments.

The following sections provide amendments to the original report.

II. Executive Summary

The fourth sentence of the first paragraph is as follows: "The piles of the piers for the widened SR 84 Expressway Bridge at Arroyo del Valle and the Trail Bridge at Arroyo Mocho should have tip elevations deeper than the estimated total scour, taking into account the estimated total scour during pile design."

III. Section 1. General Description

The Project Description for EA 04-297624 is amended as follows:

The State Route (SR) 84 Expressway Widening Project (Project), located in Livermore and Pleasanton in Alameda County, proposes to widen and upgrade 2.8 miles of SR 84 from 0.1 mile south of Ruby Hill Drive to 0.6 mile north of Concannon Boulevard to expressway standards (55 miles per hour [mph]). 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, and Concannon Boulevard will be widened and upgraded to accommodate future traffic movements. A connector access will be constructed at the SR 84/Vallecitos Road intersection to accommodate the high volume of traffic moving from northbound SR 84 to the City of Livermore. 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 southward to Vineyard Avenue; a Trail Bridge crossing will be included at Arroyo del Valle. The Project will also construct a new access bridge at Arroyo del

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Valle for local utility and maintenance facilities and widen the existing bridge across Arroyo del Valle. The Project will construct retaining walls where right-of-way is restricted.

The roadway cross section will consist of 12-ft-wide travel lanes and 10-ft-wide shoulders separated by a concrete median barrier. Roadway slopes will vary in steepness depending on safety requirements. Where practical, side slopes will be 4:1 or flatter to provide a clear recovery zone (CRZ) for errant vehicles. Outside the CRZ, side slopes will be 2:1 or flatter. The roadway median area at intersections will be widened up to 36 ft to accommodate left-turn lanes.

IV. Section 2. Description of Watershed

There are no revisions to this section.

V. Section 3. Description of Stream and Site

Section 3.3 Proposed Action of the proposed bridge at Arroyo del Valle is amended to match the alternative founded on 36-in. CIDH piles. The body of the text shall be revised to indicate foundation specifics used in the study and scour analysis. The foundation of the pier is on bridge footing consisting of structural concrete, and below the bridge footing are 36-in. CIDH concrete piles. The bottom of footing elevation is 398.67 ft and the pier wall thickness is 1.5 ft. Although the foundations differ between the latest May 2014 General Plan and the previous version of the General Plan, the bridge length, bridge width, and pier width are the same.

A new bridge General Plan for the SR 84 Expressway at Arroyo del Valle was prepared for the Project dated November 2014 (see Figure 1).

A new bridge General Plan for the Trail Bridge at Arroyo del Valle was prepared for the Project dated November 2014 (see Figure 2).

VI. Section 4. Hydrology

There are no revisions to this section.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

Xiangyang Fu 11/17/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — XIANGYANG FU — No. C 72514 — Exp. 06/30/16 — CIVIL — STATE OF CALIFORNIA

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OAKLAND, CA 94607

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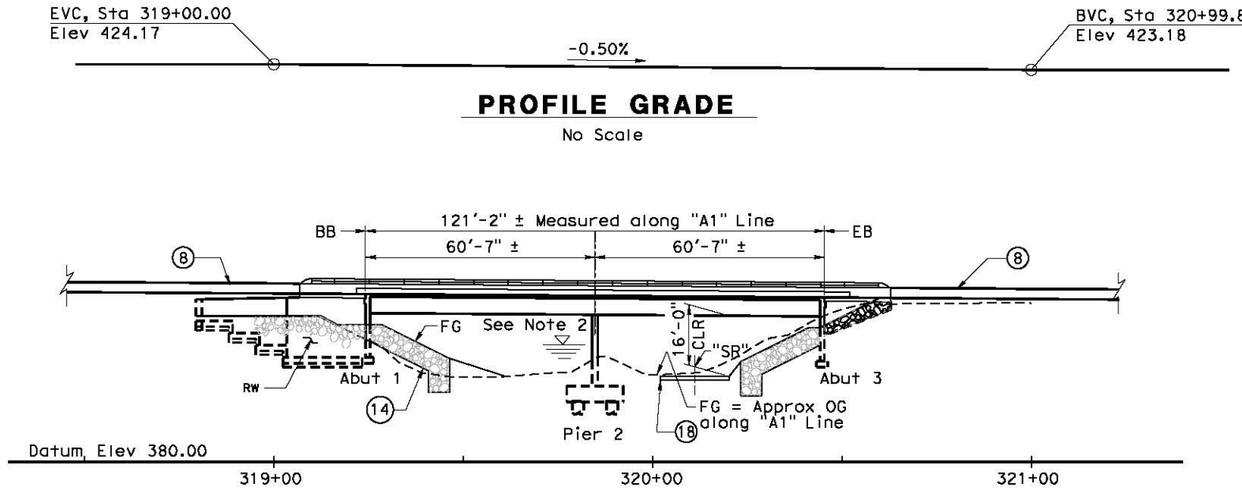
SACRAMENTO, CALIFORNIA 95831

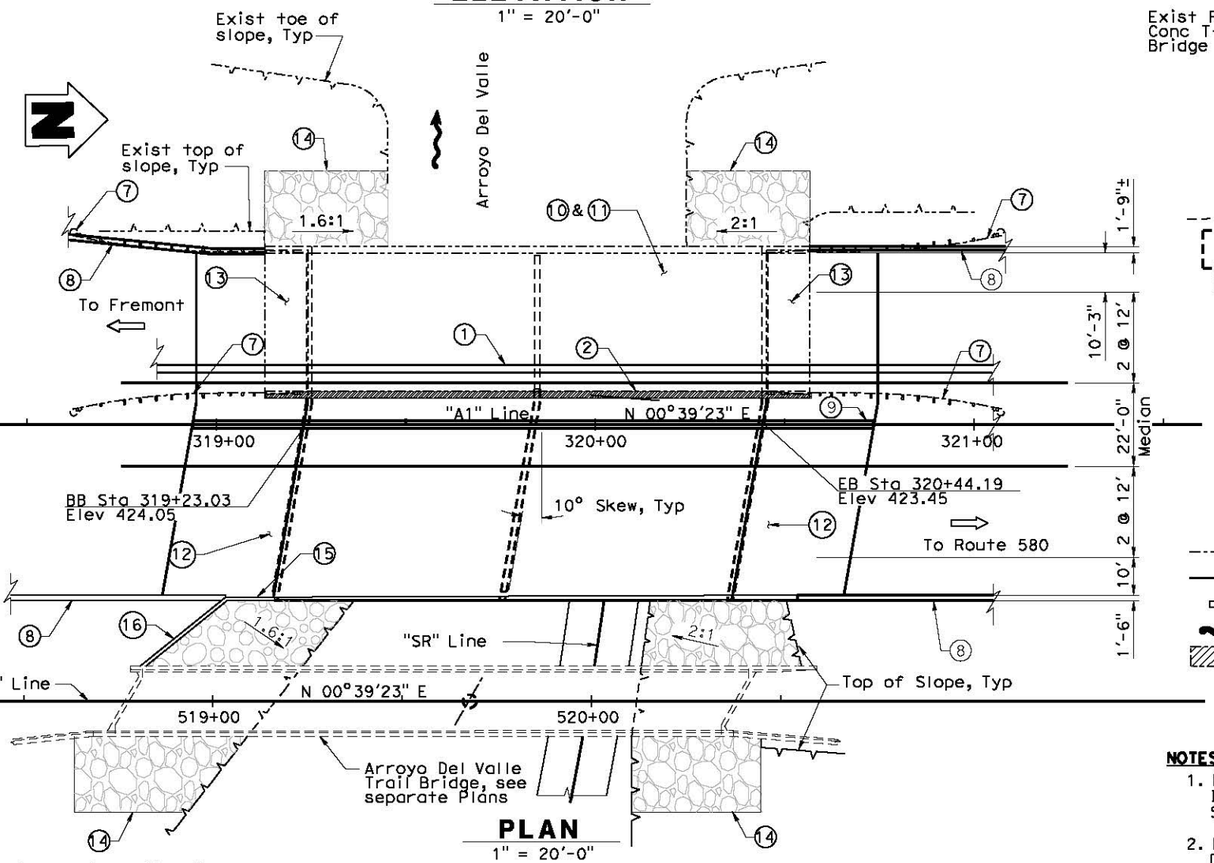


PROFILE GRADE

No Scale

ELEVATION

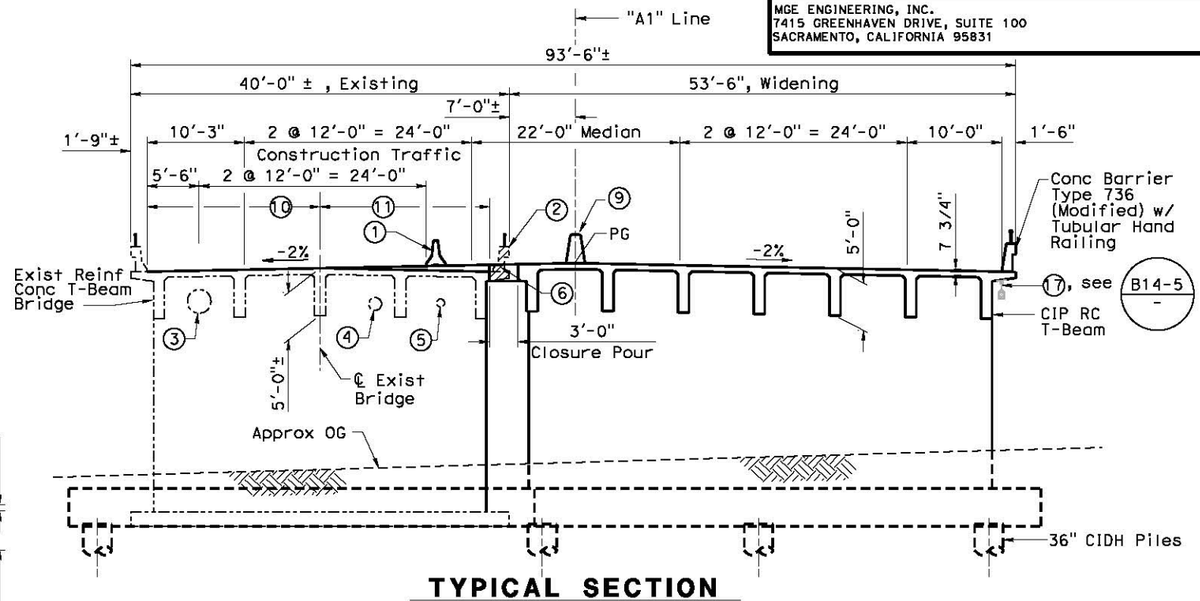
1" = 20'-0"



PLAN

1" = 20'-0"

Note:
The Contractor must verify all controlling field dimensions before ordering or fabricating any material.



TYPICAL SECTION

1/8" = 1'-0"

LEGEND

- Indicates Exist Structure
- Indicates New Construction
- Indicates Direction of Travel
- Indicates Direction of Flow
- Indicates Bridge Removal (Portion)

NOTES:

1. For General Notes, Quantities and Index to Plans, see "GENERAL NOTES" Sheet.
2. For Pile Data Table, Spread Footing Data Table and Hydrologic Summary, see "FOUNDATION PLAN" sheet.

NOTES:

1. Temporary Railing (Type K), see "Roadway Plans"
2. Remove Existing Barrier, Railing & Overhang
3. Existing 30" ø Steel Casing to remain
4. Existing 16"ø DIP Sewer Line to be relocated by others
5. Existing 12"ø Water Line to remain
6. Existing 2 - 3"ø Conduits to be relocated by others
7. Existing Metal Beam Guard Rail to be removed, see "Roadway Plans"
8. Concrete Barrier, see "Roadway 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 (Varies, 10" max in Thickness) and place 3/4" Polyester Concrete Overlay
12. Structure Approach, Type N (30D)
13. Remove Exist Approach Slab and replace with Structure Approach, Type R (30D)
14. Rock Slope Protection , See "ROCK SLOPE PROTECTION" Sheet.
15. Paint "Bridge No. 33-0710" & "Arroyo Del Valle Bridge"
16. Retaining Wall, Type 1
17. 2" Supply Line (Bridge)
18. "SR" road, see "Roadway Plans"

DESIGN OVERSIGHT	DESIGN	BY X. Fu	CHECKED D. Wang	LOAD & RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 W/"LOW-BOY"; PERMIT DESIGN VEHICLE		
SIGN OFF DATE	DETAILS	BY K. Wang	CHECKED D. Wang	LAYOUT	BY X. Fu	CHECKED D. Wang	
	QUANTITIES	BY W. Sennett	CHECKED R. Huang	SPECIFICATIONS	BY R. E. Sennett	PLANS AND SPECS COMPARED X. Fu	

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Xiangyang Fu
PROJECT ENGINEER

BRIDGE NO.	POST MILES
33-0710	24.8

ARROYO DEL VALLE BRIDGE (WIDEN)

GENERAL PLAN

UNIT: 0733
PROJECT NUMBER & PHASE: 04000205811 CONTRACT NO.: 04-297624

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES				SHEET	OF
03/28/08	10/21/10	05/28/14	11/17/14	1	19

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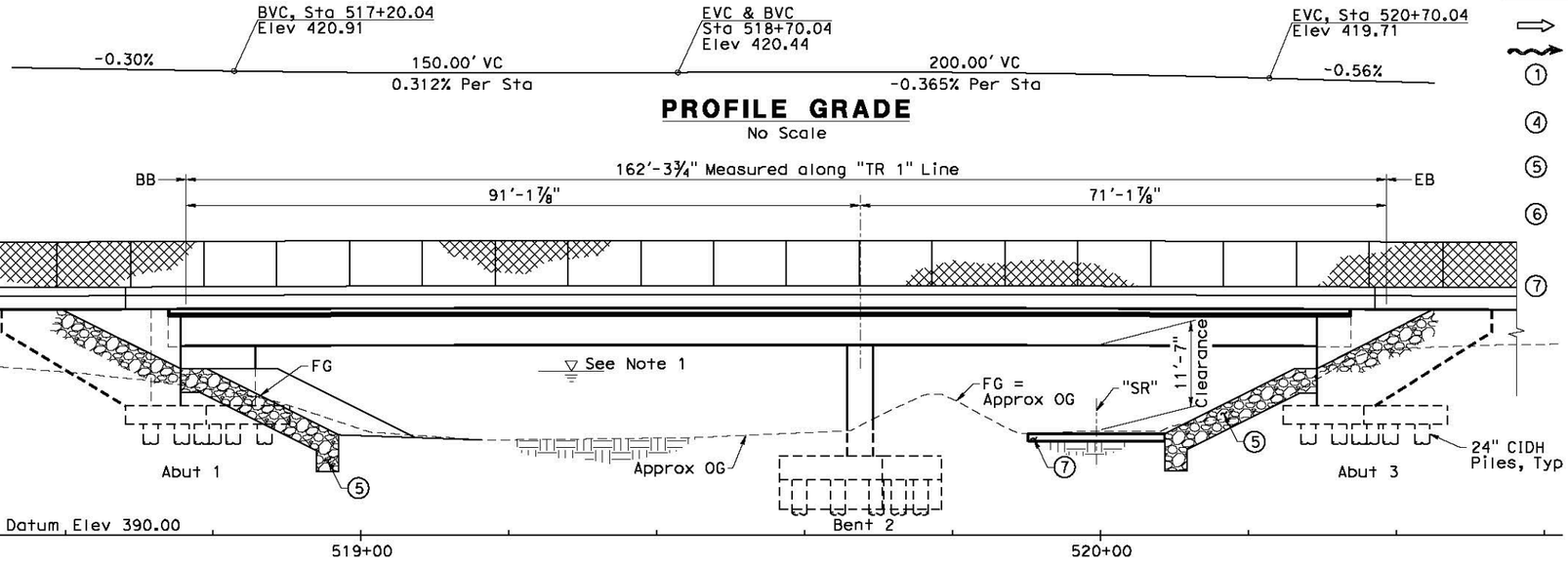

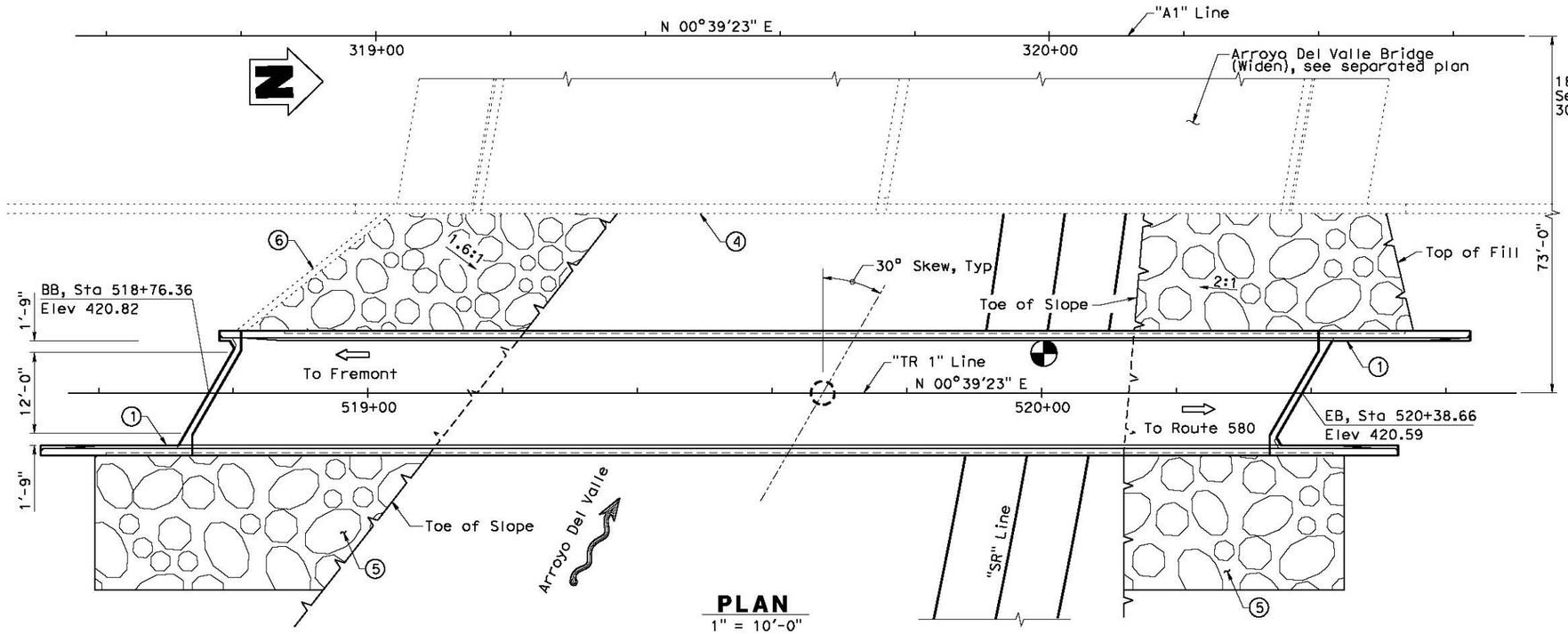

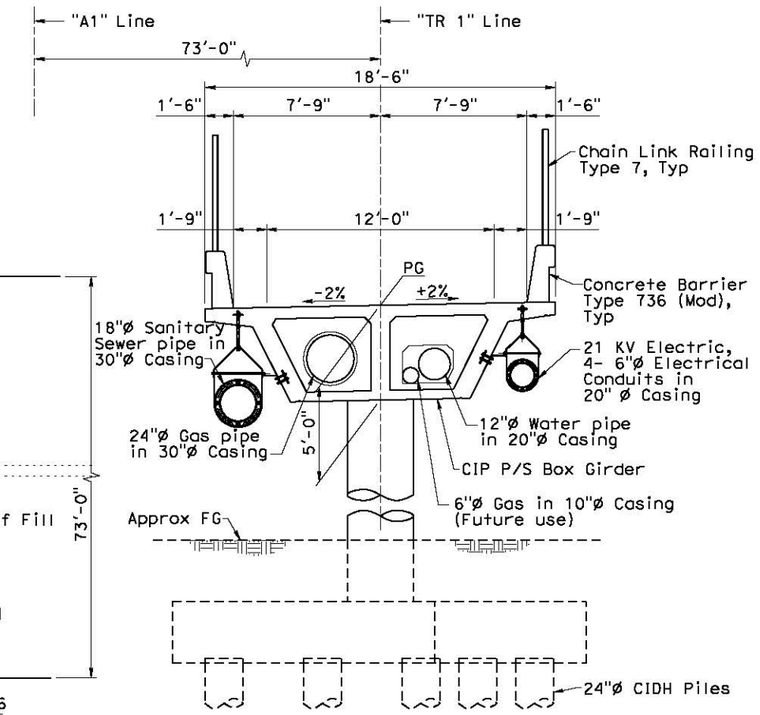

TYPICAL SECTION
¼" = 1'-0"

LEGEND

- ⇨ Indicates Direction of Travel
- ⇝ Indicates Direction of Flow
- ① Paint "Arroyo Del Valle Trail Bridge"
- ④ Arroyo Del Valle Bridge (Widen) Bridge No. 33-0710
- ⑤ Rock Slope Protection, See "ROCK SLOPE PROTECTION" SHEET
- ⑥ Type 1 Retaining Wall, see "Arroyo Del Valle Bridge (Widen)" plans
- ⑦ "SR" Road, see "Roadway Plans"

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

Xiangyang Fu 11/17/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

XIANGYANG FU No. C 72514 Exp. 06/30/16 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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NOTES:

1. For General Notes, Quantities, Pile Data Table and Hydrologic Summary, see "FOUNDATION PLAN" sheet.
2. For Index to Plans, see "DECK CONTOURS" sheet.
3. For alignment and details of Sanitary Sewer, see "Sanitary Sewer Plan", SS-2.
4. For alignment and details of Water pipe, see "Utility Plan", U-10.
5. For alignment and detail of Gas pipes and Electrical Conduits, see "Joint Utility Trench" sheets.

DESIGN OVERSIGHT	DESIGN	BY X. Fu	CHECKED D. Wang	LOAD & RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 AND PERMIT DESIGN VEHICLE		
SIGN OFF DATE	DETAILS	BY K. Wang	CHECKED D. Wang	LAYOUT	BY X. Fu	CHECKED D. Wang	
	QUANTITIES	BY W. Sennett	CHECKED R. Huang	SPECIFICATIONS	BY R. E. Sennett	PLANS AND SPECS COMPARED X. Fu	

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Xiangyang Fu
PROJECT ENGINEER

BRIDGE NO.	ARROYO DEL VALLE TRAIL BRIDGE
N/A	
POST MILES	GENERAL PLAN
N/A	

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0733
PROJECT NUMBER & PHASE: 04000205811 CONTRACT NO.: 04-297624

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES				SHEET	OF
02/09/06	10/27/10	05/27/14	11/17/14	1	18

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VII. Section 5. Hydraulic Analysis

Because updated topo was provided by URS Corporation on November 3 for existing original grade and on November 11 for proposed finished grade, new existing and proposed HEC-RAS models were performed. Table 9 of the original report has been updated by this memorandum's Table 1 and Table 11 of the original report has been updated by this memorandum's Table 2:

Table 1. Arroyo del Valle Water Surface Elevations (ft)

River Station	D/S Length	100-year			50-year		
		Ex	Prop	Change	Ex	Prop	Change
2112	330	413.74	413.19	-0.55	412.40	411.93	-0.47
1782	20	412.91	412.07	-0.84	411.62	410.83	-0.79
1762	0.5	412.88	412.04	-0.84	411.59	410.79	-0.80
U/S Trail Bridge	18.5	N/A	411.93	N/A	N/A	410.71	N/A
D/S Trail Bridge	11	N/A	410.75	N/A	N/A	409.76	N/A
1732	0.5	411.90	410.84	-1.06	410.77	409.83	-0.94
U/S Prop SR 84 Bridge	53.5	N/A	410.52	N/A	N/A	409.59	N/A
U/S Ex SR 84 Bridge	40	409.79	N/A	N/A	409.12	N/A	N/A
D/S Ex / Prop SR 84 Bridge	56	410.20	410.20	0	409.25	409.25	0
1582	55	408.81	408.81	0	407.96	407.96	0
1527	39	407.99	407.99	0	407.46	407.46	0
1488	488	407.89	407.89	0	407.31	407.31	0
1000	0	404.27	404.27	0	404.27	404.27	0

Table 2. Arroyo del Valle Flow Velocities (ft/s)

River Station	D/S Length	100-year			50-year		
		Ex	Prop	Change	Ex	Prop	Change
2112	330	4.97	5.72	+0.75	5.48	6.24	+0.76
1782	20	5.89	6.60	+0.71	5.45	6.18	+0.73
1762	0.5	5.78	6.50	+0.72	5.35	6.06	+0.71
U/S Trail Bridge	18.5	N/A	6.97	N/A	N/A	6.42	N/A
D/S Trail Bridge	11	N/A	10.72	N/A	N/A	9.70	N/A
1732	0.5	9.23	10.09	+0.86	8.45	9.14	+0.69
U/S Prop SR 84 Bridge	53.5	N/A	10.96	N/A	N/A	9.85	N/A
U/S Ex SR 84 Bridge	40	13.23	N/A	N/A	11.63	N/A	N/A
D/S Ex / Prop SR 84 Bridge	56	10.24	10.24	0	9.31	9.31	0
1582	55	12.74	12.74	0	11.78	11.78	0
1527	39	12.25	12.25	0	10.67	10.67	0
1488	488	10.46	10.46	0	9.22	9.22	0
1000	0	5.91	5.91	0	5.43	5.43	0

Generally, there are minimal changes between the existing and proposed conditions. There is no change downstream of the SR 84 Bridge. Upstream of the SR 84 Bridge, flow velocities increase and

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water surface elevations decrease due to the new Trail Bridge and widened SR 84 Bridge. For detailed HEC-RAS results, see Attachment A. Figure 8 of the original report has been updated with this memorandum's Figure 3.

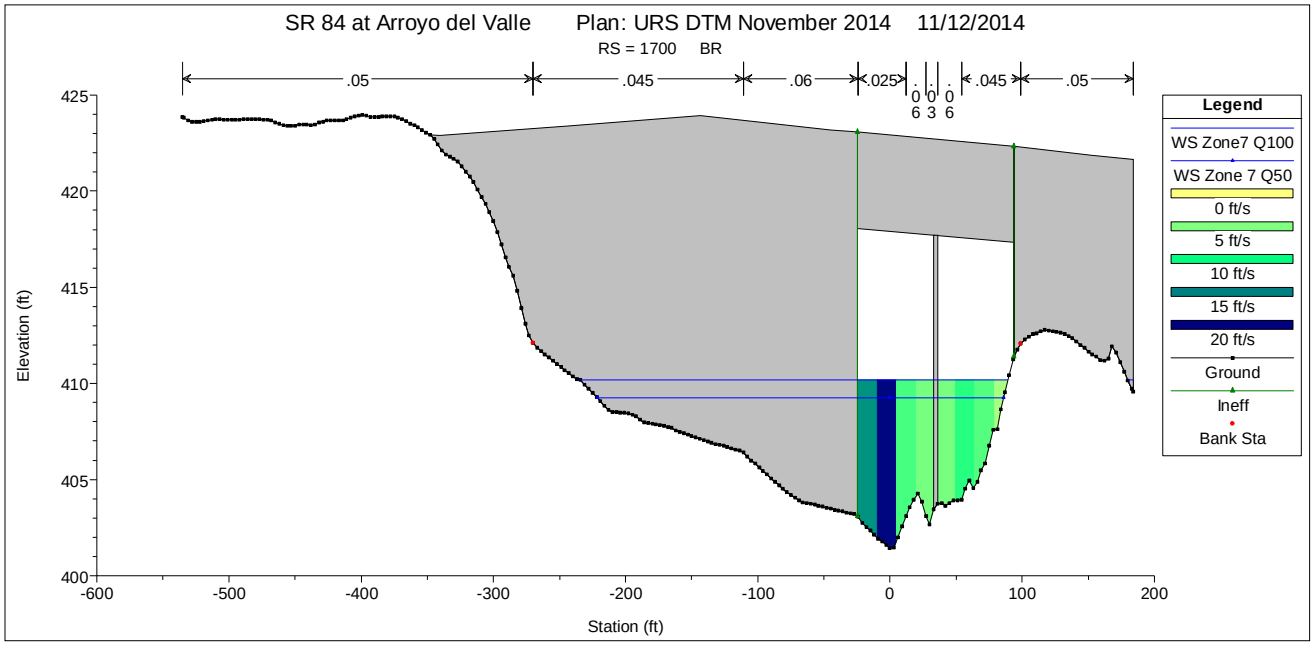

Figure 3. SR 84 Expressway Arroyo del Valle Bridge Cross-Section

Figure 9 of the original report has been updated with this memorandum's Figure 4.

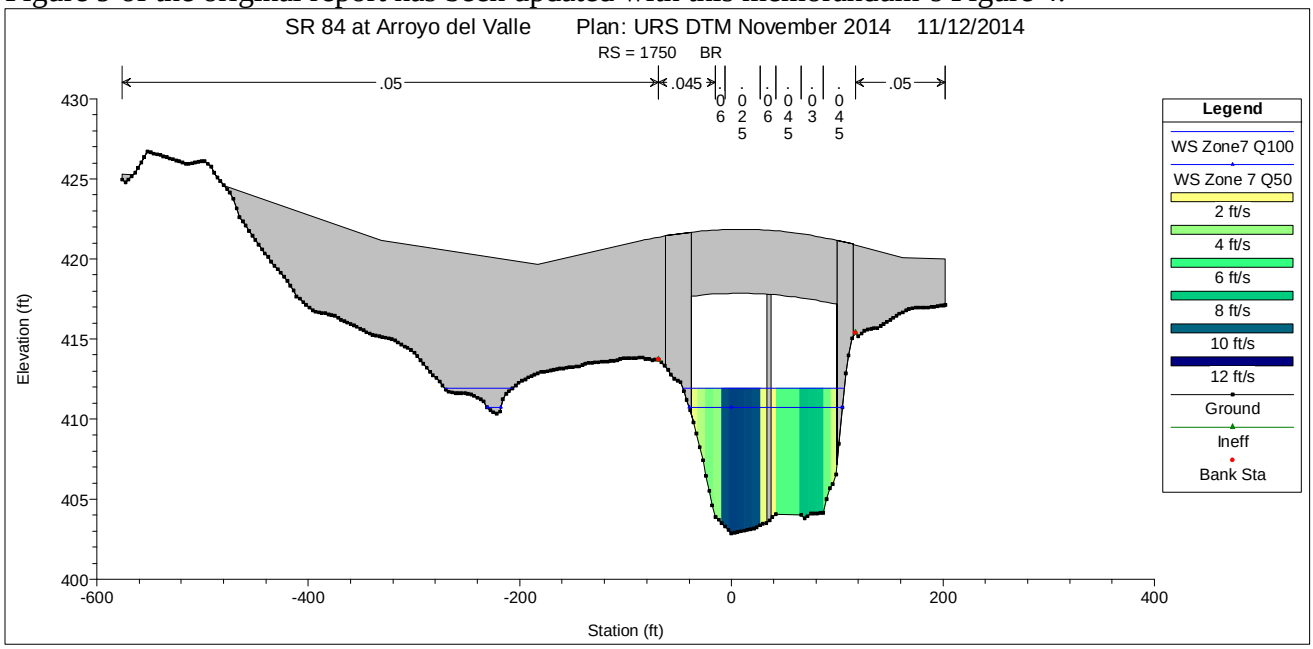

Figure 4. Arroyo del Valle Trail Bridge Cross-Section

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VIII. Section 6. Scour Analysis

To address long term-bed change, two cross sections were compared from the Caltrans Bridge Inspection Reports on 07/20/1999 (Table 3) and 10/18/2011 (Table 4). These cross sections were obtained from the bridge upstream face. Although the thalweg (lowest point of the channel) has increased 1.5 ft, the overall channel bed is stable. See comparison in Figure 5.

Table 3. SR 84 Bridge at Arroyo del Valle BIR 7/20/1999 (measured from top of concrete [2.66 ft])

Location	Horizontal (ft)	Vertical (ft)	Comments
A1	0.00	-14.11	
RSP toe	21.10	-21.69	
EOW	32.84	-24.38	
TW	39.01	-24.51	
EOW	48.85	-22.60	
P2/ top of berm	59.09	-16.63	
Edge of compacted channel	67.36	-22.93	
midpoint of access road	82.09	-22.87	
Edge of compacted channel	95.11	-22.38	
RSP toe	100.46	-20.51	
A3	117.95	-8.92	

Table 4. SR 84 Bridge at Arroyo del Valle BIR 10/18/2011 (measured from top of rail H=2.82 ft)

Location	Horizontal (ft)	Vertical (ft)	Comments
Abutment 1	0.00	-10.05	Face of A1 (top of RSP)
	14.11	-19.89	Toe RSP (EOW)
	31.17	-25.14	Thalweg
	39.80	-23.83	EOW
Pier 2	63.98	-21.86	center P2
	71.52	-22.19	Edge of haul road
	90.75	-22.71	Edge of haul road
	97.77	-20.87	Toe RSP
Abutment 3	118.83	-12.01	Face of A3

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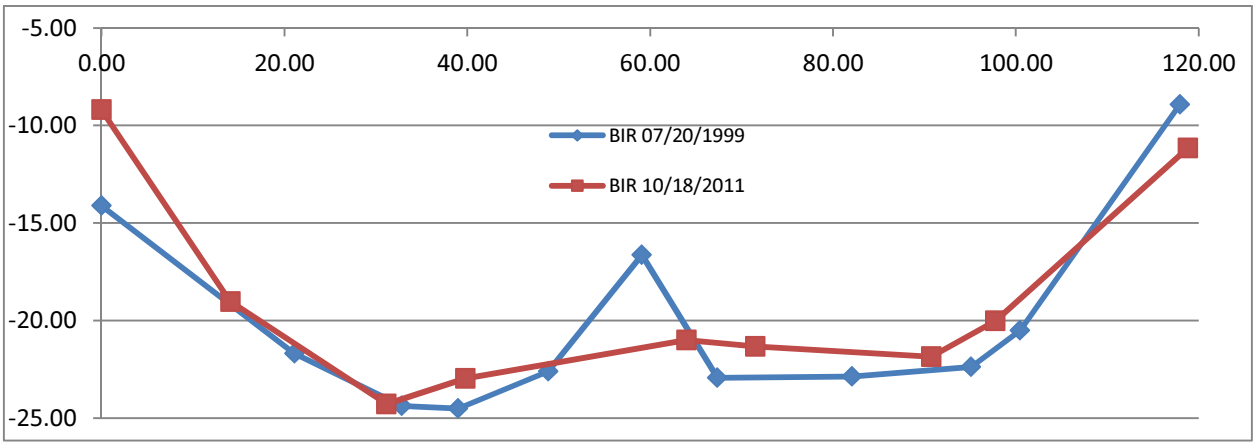

Figure 5. Comparison of BIR Cross-Sections from 07/20/1999 and 10/18/2011 (upstream face)

No berm was surveyed on 10/18/2011. However, Photo 1 shows the berm to the left of the haul road. The berm is necessary for maintaining the haul road and for Arroyo del Valle's flows to be contained on the other side of the berm.

Photo 1. Haul Road and Berm at Arroyo del Valle (taken on 8/25/2014)

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Complex pier scour calculations were performed per the Federal Highway Administration the *HEC-18 Manual* "Evaluating Scour at Bridges," Fifth Edition (April 2012), and the scour analysis was re-evaluated for the SR 84 Expressway Bridge widening at Arroyo del Valle and the new Arroyo del Valle Trail Bridge.

Using the live-bed contraction scour equation at the channel, the calculated contraction scour depths at the channel are:

- 0.2 ft (SR 84 Expressway Bridge at Arroyo del Valle)
- 0.1 ft (Trail Bridge at Arroyo del Valle)

The complex pier scour equations were utilized to determine pier scour at the following locations:

- 1.3 ft (SR 84 Bridge at Arroyo del Valle with 5 ft pile cap overhang extension upstream)
- 4.4 ft (Trail Bridge at Arroyo del Valle)

Using the Froelich Equation to determine live-bed abutment scour, the calculated abutment scour depths are:

- 9.6 ft (Left Abutment) at Arroyo del Valle SR 84 Expressway Bridge
- 1.1 ft (Left Abutment) Trail Bridge at Arroyo del Valle
- 1.2 ft (Right Abutment) Trail Bridge at Arroyo del Valle

The itemized total scour depth for the abutments and piers of the proposed bridge is shown in the following tables and supercede Tables 3 and 4 of the Executive Summary and Tables 13 and 14 of the original report.

Summary of Scour at Proposed SR 84 Expressway Bridge at Arroyo del Valle

Location	Long-term Bed Change	Contraction Scour	Local Scour	Total Scour Depth
Abutment 1	Negligible	0.2 ft	9.6 ft	9.8 ft
Pier 2	Negligible	0.2 ft	1.3 ft	1.5 ft

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	0.1 ft	1.1 ft	1.2 ft
Pier 2	Negligible	0.1 ft	4.4 ft	4.5 ft
Abutment 3	Negligible	0.1 ft	1.2 ft	1.3 ft

For detailed scour calculations, see hand calculations in Attachment B.

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Active gravel mining will be ongoing until 2030 with permits allowing up to 50 feet from the existing State right-of-way. However, we cannot determine the future elevations of the channel flow line at this time, because the CEMEX plans show that Arroyo del Valle will be realigned and relocated to create Lake A and Lake B, but there is no detailed information at the bridge crossing. There is no guarantee that a grade control structure will be built in the future. If the grade control structure is constructed in the future as part of the Zone 7 Reclamation Plan, the permittee would be required to provide justification that further degradation would not occur and the integrity of the bridge would be maintained.

As mentioned in the BDHS' Appendix G, 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 scope of the highway widening project. This matter should be referred to Zone 7 for further action.

To reiterate the BDHS' Appendix G, because the future spillway could block fish passage, its construction may be prohibited by environmental resource agencies. This issue should be further investigated by Zone 7.

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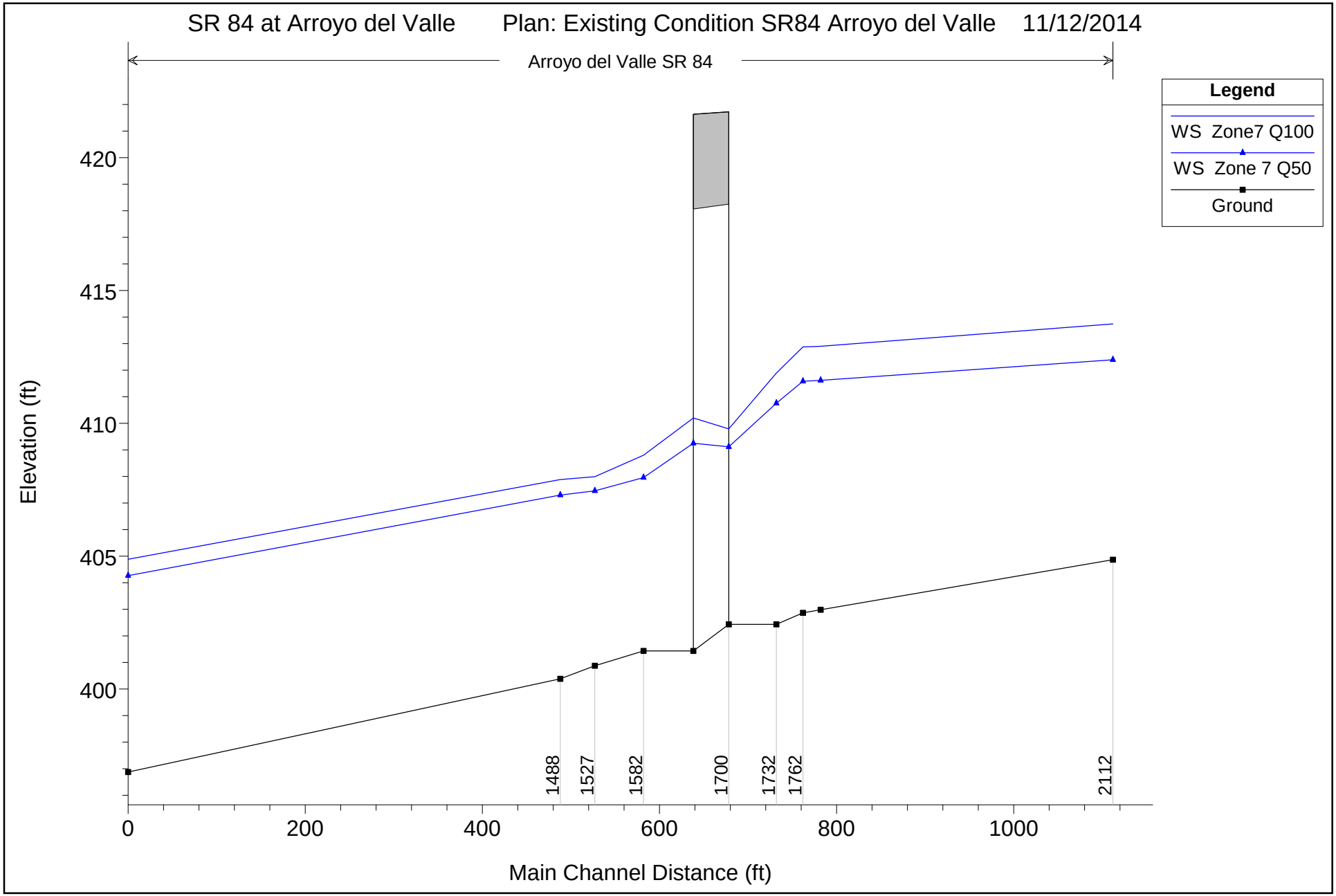
Attachment A:

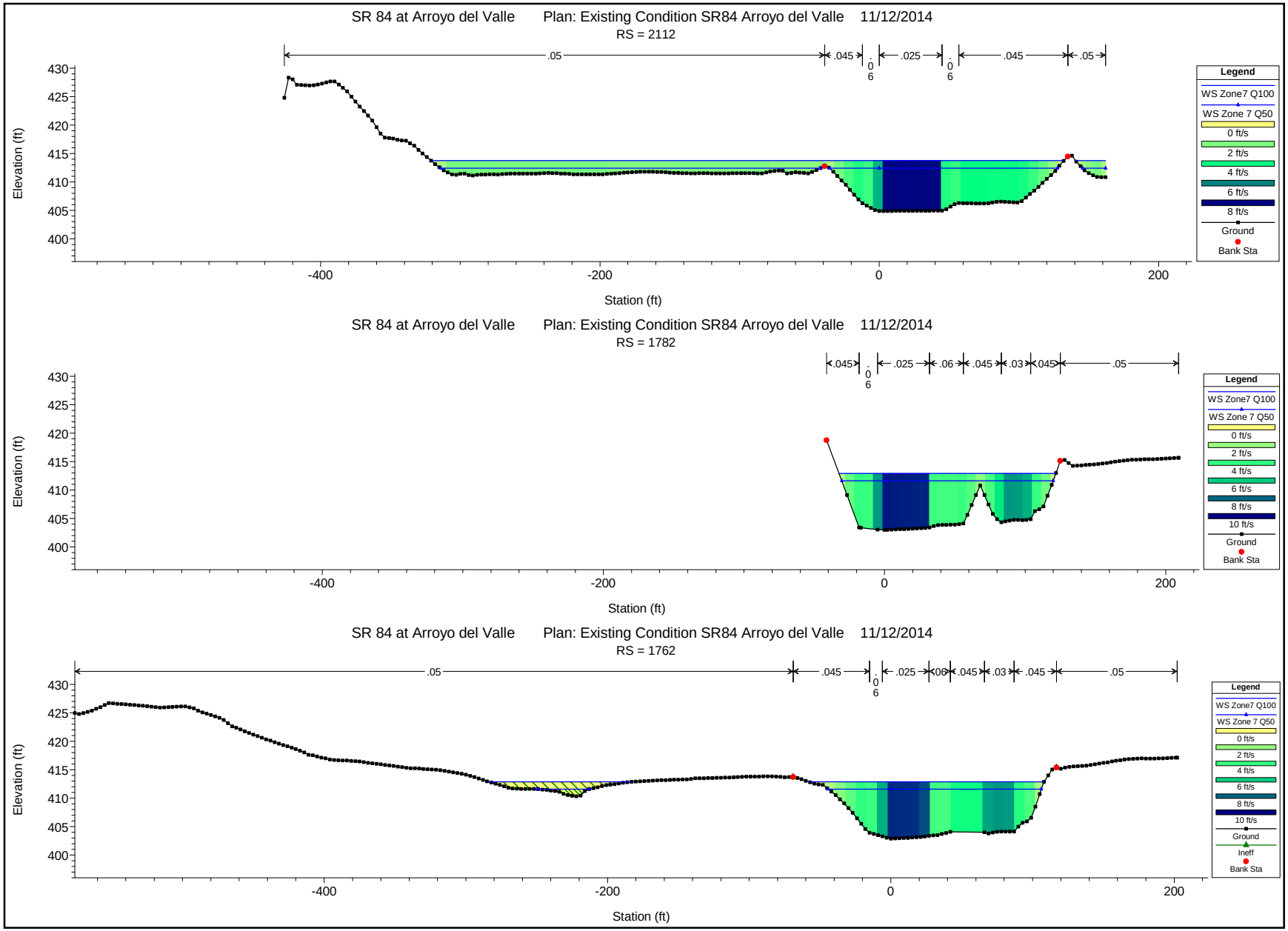
HEC-RAS Results

HEC-RAS Plan: exist River: Arroyo del Valle Reach: SR 84

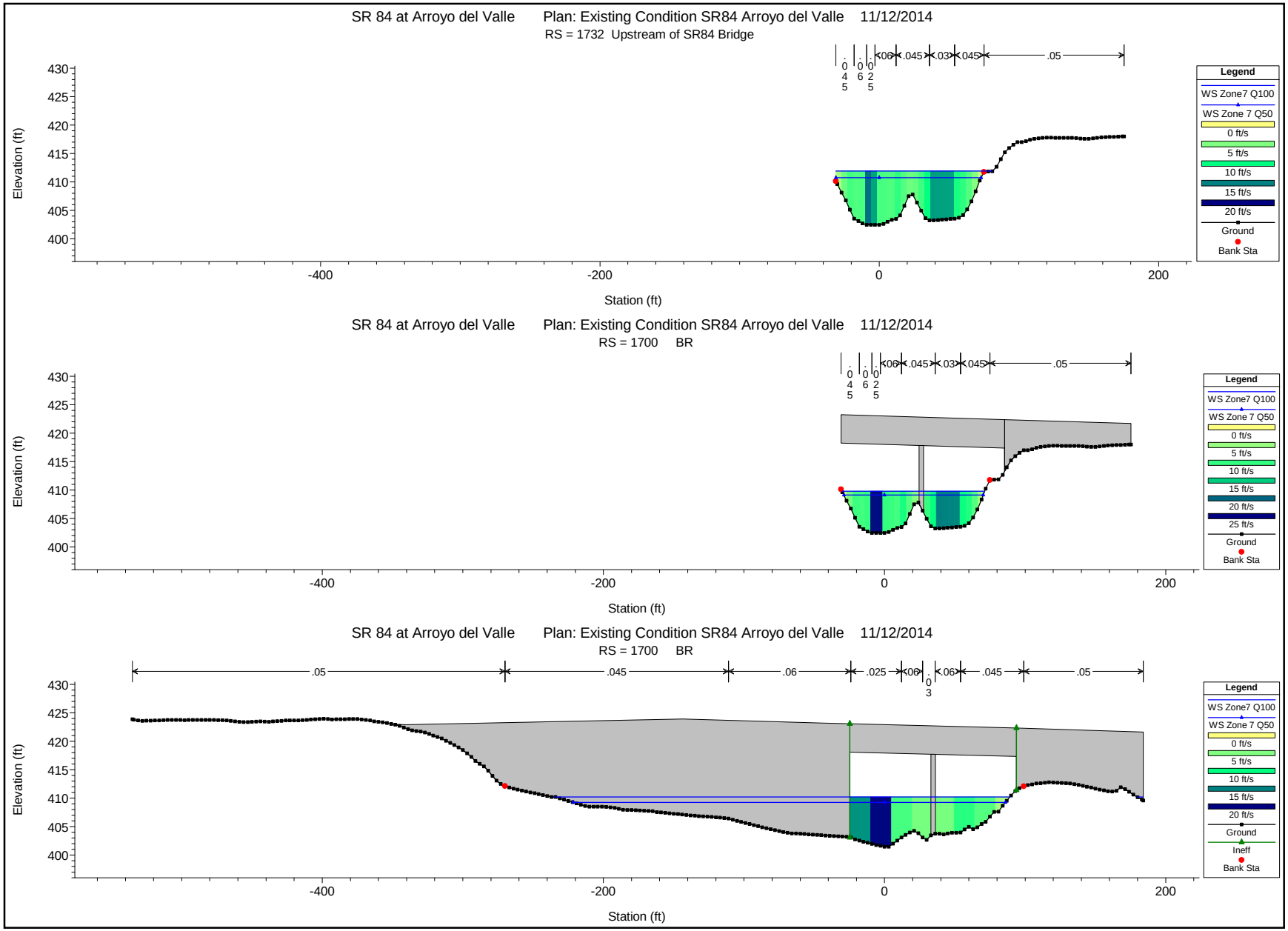
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
SR 84	2112	Zone7 Q100	7000.00	404.87	413.74		414.07	0.001629	4.97	1800.42	474.53	0.34		330.00
SR 84	2112	Zone 7 Q50	5400.00	404.87	412.40		412.84	0.002480	5.48	1174.41	451.35	0.41		330.00
SR 84	1782	Zone7 Q100	7000.00	402.99	412.91		413.45	0.002045	5.89	1187.57	154.26	0.37		20.00
SR 84	1782	Zone 7 Q50	5400.00	402.99	411.62		412.08	0.002133	5.45	991.23	150.48	0.37		20.00
SR 84	1762	Zone7 Q100	7000.00	402.87	412.88		413.40	0.001947	5.78	1212.09	267.23	0.38		30.00
SR 84	1762	Zone 7 Q50	5400.00	402.87	411.59		412.03	0.001836	5.35	1009.67	187.13	0.36		30.00
SR 84	1732	Zone7 Q100	7000.00	402.44	411.90	409.77	413.22	0.006292	9.23	758.57	112.07	0.61	7.33	53.80
SR 84	1732	Zone 7 Q50	5400.00	402.44	410.77	408.84	411.87	0.006363	8.45	639.13	104.04	0.60	6.40	53.80
SR 84	1700		Bridge											
SR 84	1582	Zone7 Q100	7000.00	401.44	408.81	408.81	411.33	0.008384	12.74	549.36	300.05	1.00	7.37	55.00
SR 84	1582	Zone 7 Q50	5400.00	401.44	407.96	407.96	410.12	0.008403	11.78	458.26	267.45	1.00	6.52	55.00
SR 84	1527	Zone7 Q100	7000.00	400.88	407.99	407.99	410.32	0.015899	12.25	571.41	123.91	1.01	7.11	39.00
SR 84	1527	Zone 7 Q50	5400.00	400.88	407.46	407.22	409.23	0.013774	10.67	506.14	121.84	0.92	6.34	39.00
SR 84	1488	Zone7 Q100	7000.00	400.39	407.89	407.41	409.58	0.011615	10.46	669.23	145.70	0.86	7.02	488.00
SR 84	1488	Zone 7 Q50	5400.00	400.39	407.31		408.63	0.010413	9.22	585.81	142.68	0.80		488.00
SR 84	1000	Zone7 Q100	7000.00	396.88	404.89	403.40	405.43	0.005606	5.91	1184.80	316.13	0.54	6.52	
SR 84	1000	Zone 7 Q50	5400.00	396.88	404.27	402.76	404.73	0.005601	5.43	995.19	300.38	0.53	5.88	



1 in Horiz. = 150 ft 1 in Vert. = 5 ft



1 in Horiz. = 100 ft 1 in Vert. = 25 ft



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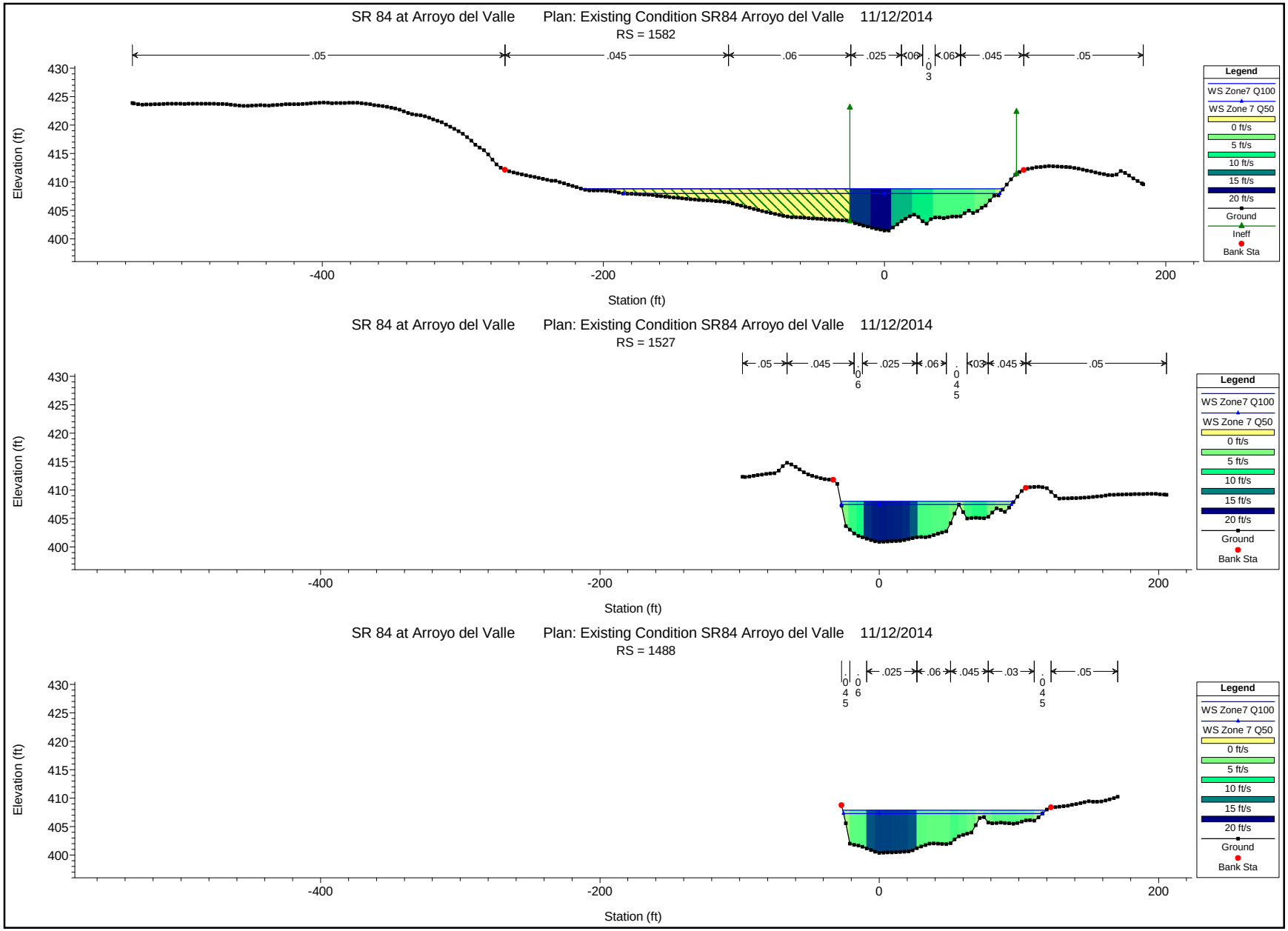
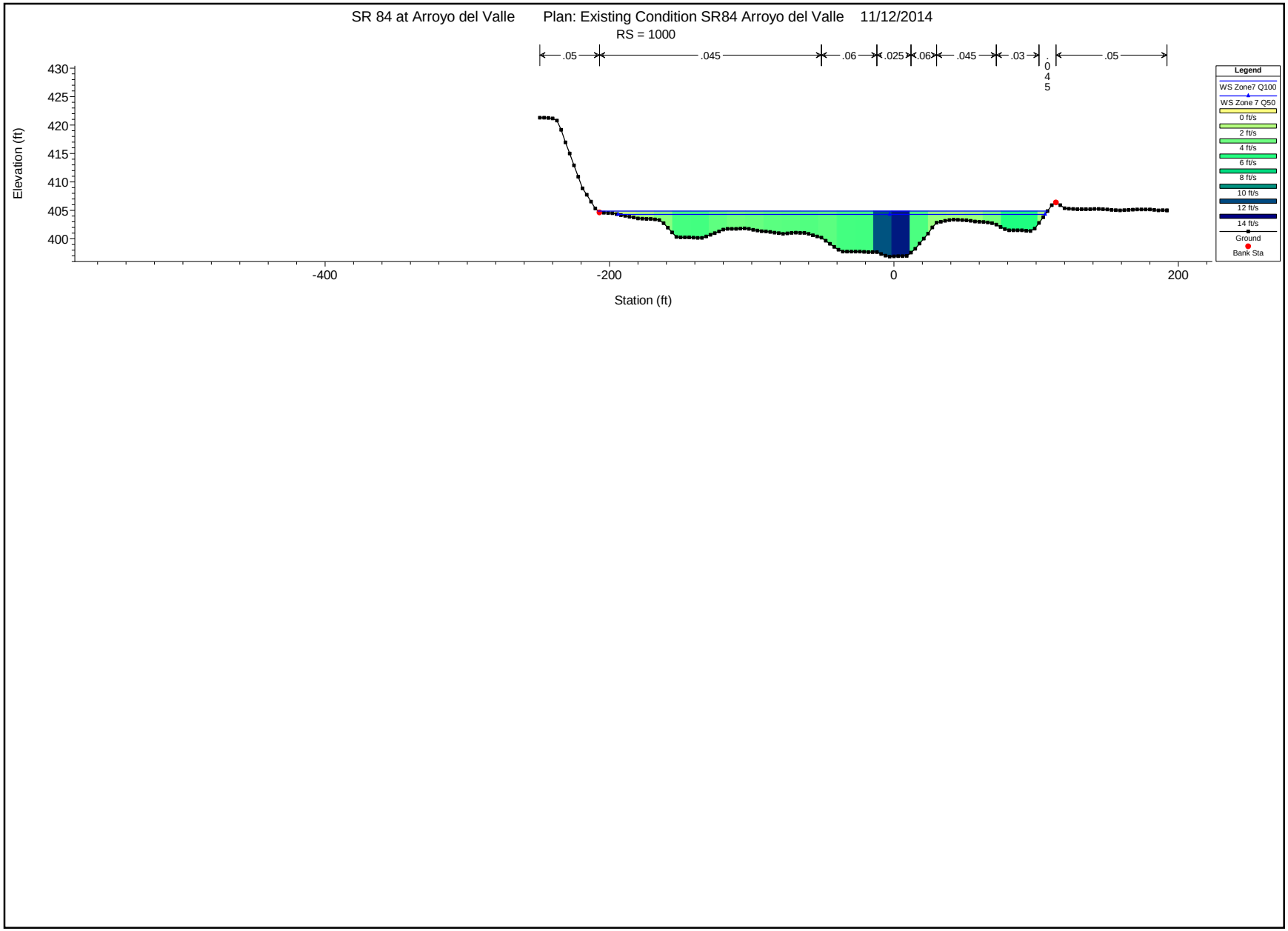


1 in Horiz. = 100 ft 1 in Vert. = 25 ft



1 in Horiz. = 100 ft 1 in Vert. = 25 ft

Plan: exist Arroyo del Valle SR 84 RS: 1700 Profile: Zone7 Q100

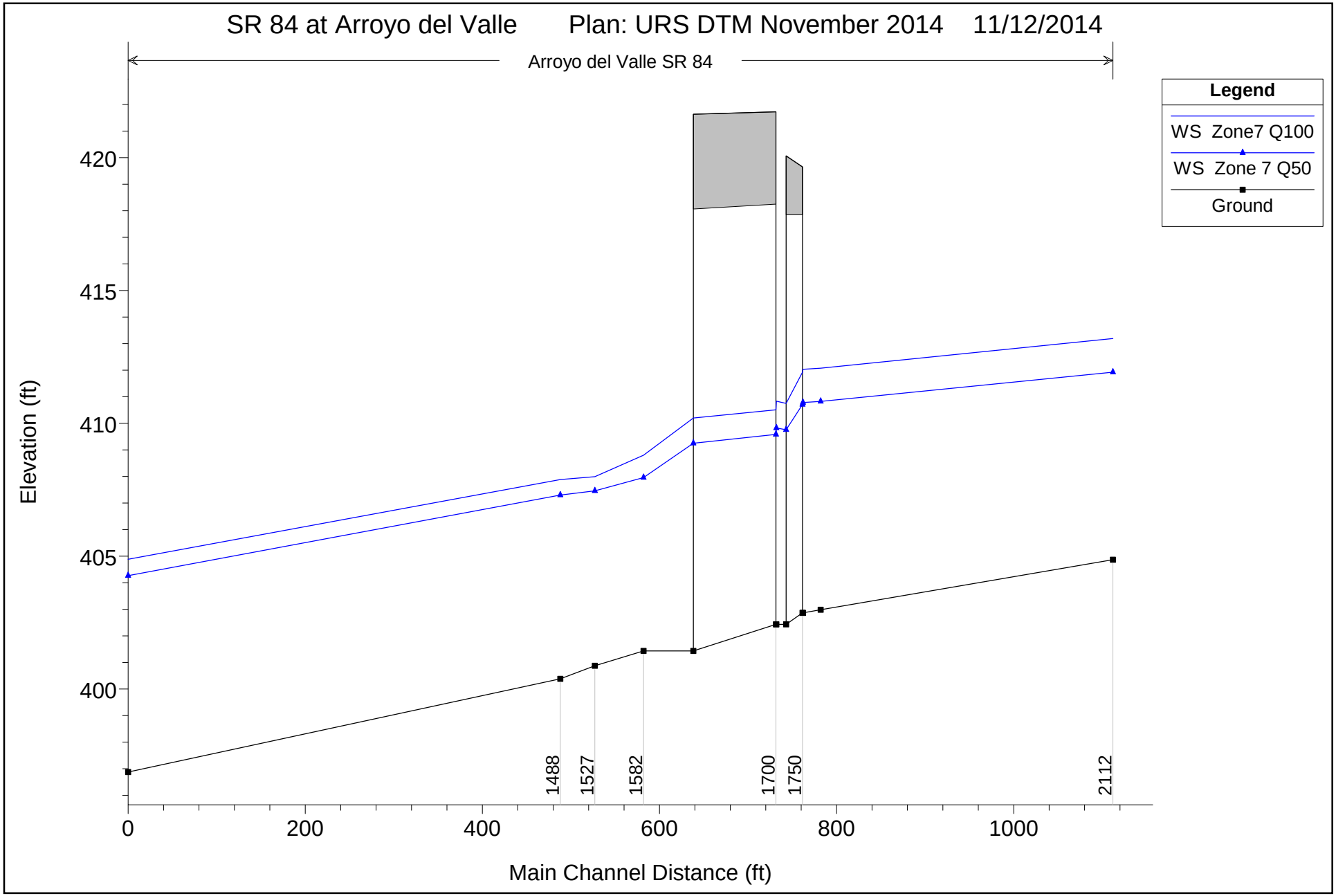
E.G. US. (ft)	413.22	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	411.90	E.G. Elev (ft)	412.51	411.83
Q Total (cfs)	7000.00	W.S. Elev (ft)	409.79	410.20
Q Bridge (cfs)	7000.00	Crit W.S. (ft)	409.79	408.92
Q Weir (cfs)		Max Chl Dpth (ft)	7.35	8.76
Weir Sta Lft (ft)		Vel Total (ft/s)	13.23	10.24
Weir Sta Rgt (ft)		Flow Area (sq ft)	529.17	683.56
Weir Submerg		Froude # Chl	1.01	0.73
Weir Max Depth (ft)		Specif Force (cu ft)	4476.72	4564.40
Min El Weir Flow (ft)	422.34	Hydr Depth (ft)	5.38	6.18
Min El Prs (ft)	418.26	W.P. Total (ft)	109.01	132.30
Delta EG (ft)	1.89	Conv. Total (cfs)	47308.0	87144.8
Delta WS (ft)	3.09	Top Width (ft)	98.42	110.60
BR Open Area (sq ft)	1410.12	Frctn Loss (ft)		0.41
BR Open Vel (ft/s)	13.23	C & E Loss (ft)		0.09
Coef of Q		Shear Total (lb/sq ft)	6.64	2.08
Br Sel Method	Energy only	Power Total (lb/ft s)	-31.00	-535.00

Plan: exist Arroyo del Valle SR 84 RS: 1700 Profile: Zone 7 Q50

E.G. US. (ft)	411.87	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	410.77	E.G. Elev (ft)	411.22	410.60
Q Total (cfs)	5400.00	W.S. Elev (ft)	409.12	409.25
Q Bridge (cfs)	5400.00	Crit W.S. (ft)	408.88	408.06
Q Weir (cfs)		Max Chl Dpth (ft)	6.68	7.81
Weir Sta Lft (ft)		Vel Total (ft/s)	11.63	9.31
Weir Sta Rgt (ft)		Flow Area (sq ft)	464.21	580.04
Weir Submerg		Froude # Chl	0.93	0.71
Weir Max Depth (ft)		Specif Force (cu ft)	3220.04	3299.82
Min El Weir Flow (ft)	422.34	Hydr Depth (ft)	4.83	5.40
Min El Prs (ft)	418.26	W.P. Total (ft)	104.92	126.15
Delta EG (ft)	1.76	Conv. Total (cfs)	38995.2	68871.1
Delta WS (ft)	2.80	Top Width (ft)	96.03	107.44
BR Open Area (sq ft)	1410.12	Frctn Loss (ft)	0.40	0.40
BR Open Vel (ft/s)	11.63	C & E Loss (ft)	0.23	0.08
Coef of Q		Shear Total (lb/sq ft)	5.30	1.76
Br Sel Method	Energy only	Power Total (lb/ft s)	-31.00	-535.00

HEC-RAS Plan: URS DTM Nove River: Arroyo del Valle Reach: SR 84

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)
SR 84	2112	Zone7 Q100	7000.00	404.87	413.19		413.64	0.002377	5.72	1541.01	468.03	0.40		330.00
SR 84	2112	Zone 7 Q50	5400.00	404.87	411.93		412.52	0.003483	6.24	964.69	432.99	0.48		330.00
SR 84	1782	Zone7 Q100	7000.00	402.99	412.07		412.75	0.002906	6.60	1060.27	151.82	0.44		20.00
SR 84	1782	Zone 7 Q50	5400.00	402.99	410.83		411.42	0.003170	6.18	873.39	148.15	0.45		20.00
SR 84	1762	Zone7 Q100	7000.00	402.87	412.04	408.59	412.69	0.002562	6.50	1077.21	220.56	0.43	5.72	0.50
SR 84	1762	Zone 7 Q50	5400.00	402.87	410.79	407.86	411.36	0.002639	6.06	891.06	158.88	0.43	4.99	0.50
SR 84	1750		Bridge											
SR 84	1732	Zone7 Q100	7000.00	402.44	410.84	409.21	412.42	0.007112	10.09	693.82	103.72	0.69	6.77	0.50
SR 84	1732	Zone 7 Q50	5400.00	402.44	409.83	408.25	411.12	0.006830	9.14	590.67	99.95	0.66	5.81	0.50
SR 84	1700		Bridge											
SR 84	1582	Zone7 Q100	7000.00	401.44	408.81	408.81	411.33	0.008384	12.74	549.36	300.05	1.00	7.37	55.00
SR 84	1582	Zone 7 Q50	5400.00	401.44	407.96	407.96	410.12	0.008404	11.78	458.26	267.45	1.00	6.52	55.00
SR 84	1527	Zone7 Q100	7000.00	400.88	407.99	407.99	410.32	0.015899	12.25	571.41	123.91	1.01	7.11	39.00
SR 84	1527	Zone 7 Q50	5400.00	400.88	407.46	407.22	409.23	0.013774	10.67	506.14	121.84	0.92	6.34	39.00
SR 84	1488	Zone7 Q100	7000.00	400.39	407.89	407.41	409.58	0.011615	10.46	669.23	145.70	0.86	7.02	488.00
SR 84	1488	Zone 7 Q50	5400.00	400.39	407.31		408.63	0.010413	9.22	585.81	142.68	0.80		488.00
SR 84	1000	Zone7 Q100	7000.00	396.88	404.89	403.40	405.43	0.005606	5.91	1184.80	316.13	0.54	6.52	
SR 84	1000	Zone 7 Q50	5400.00	396.88	404.27	402.76	404.73	0.005601	5.43	995.19	300.38	0.53	5.88	



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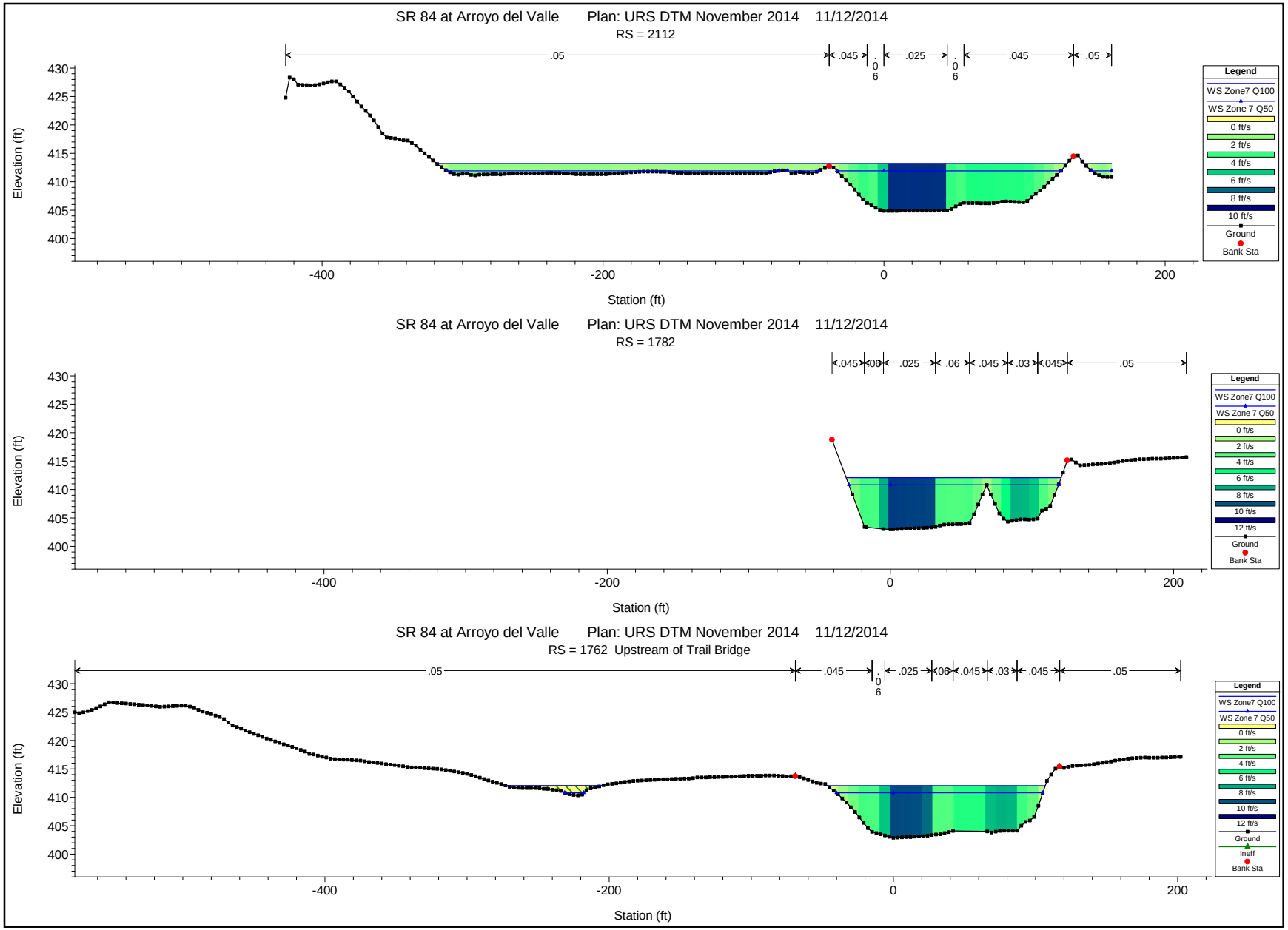

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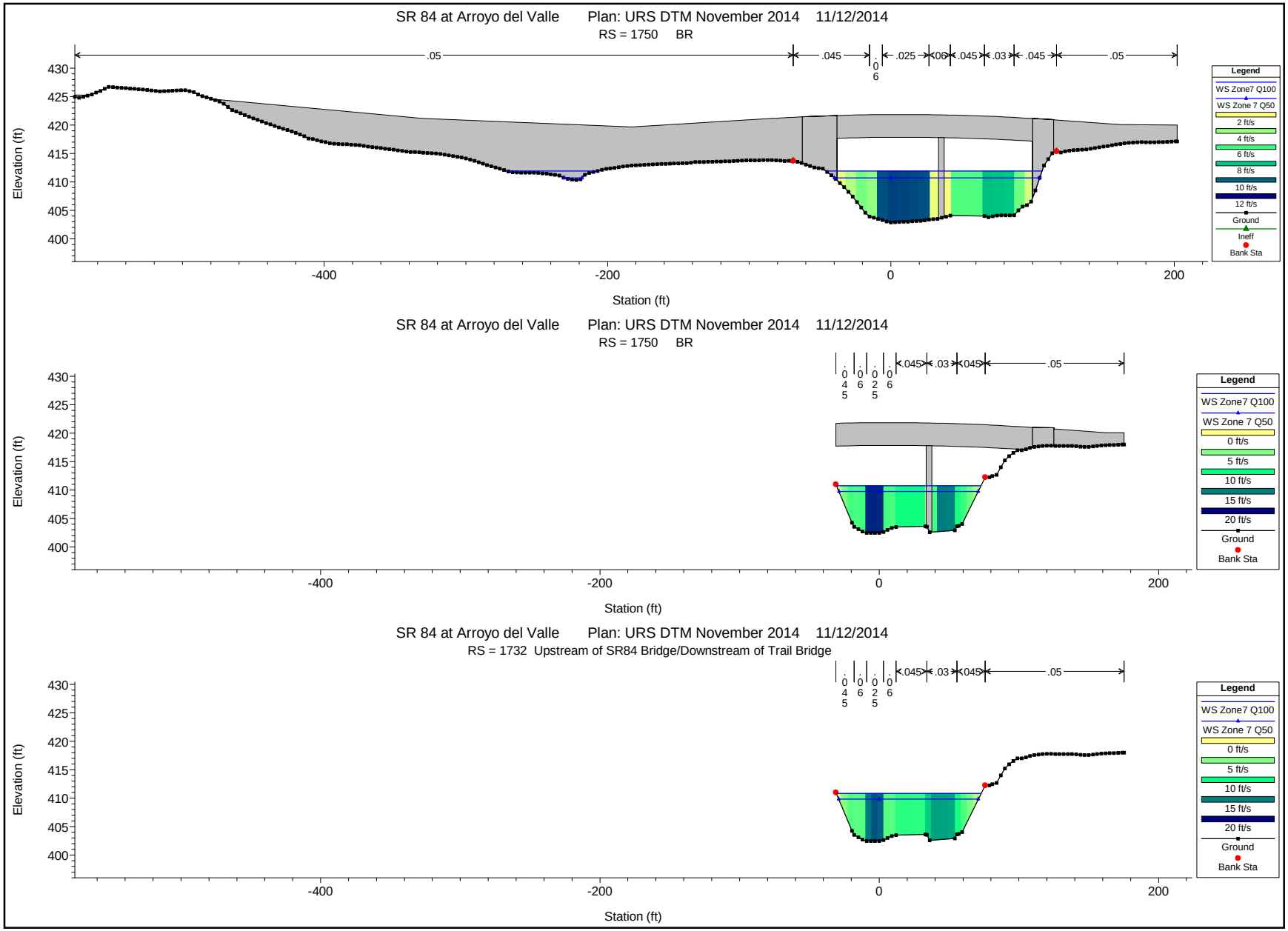

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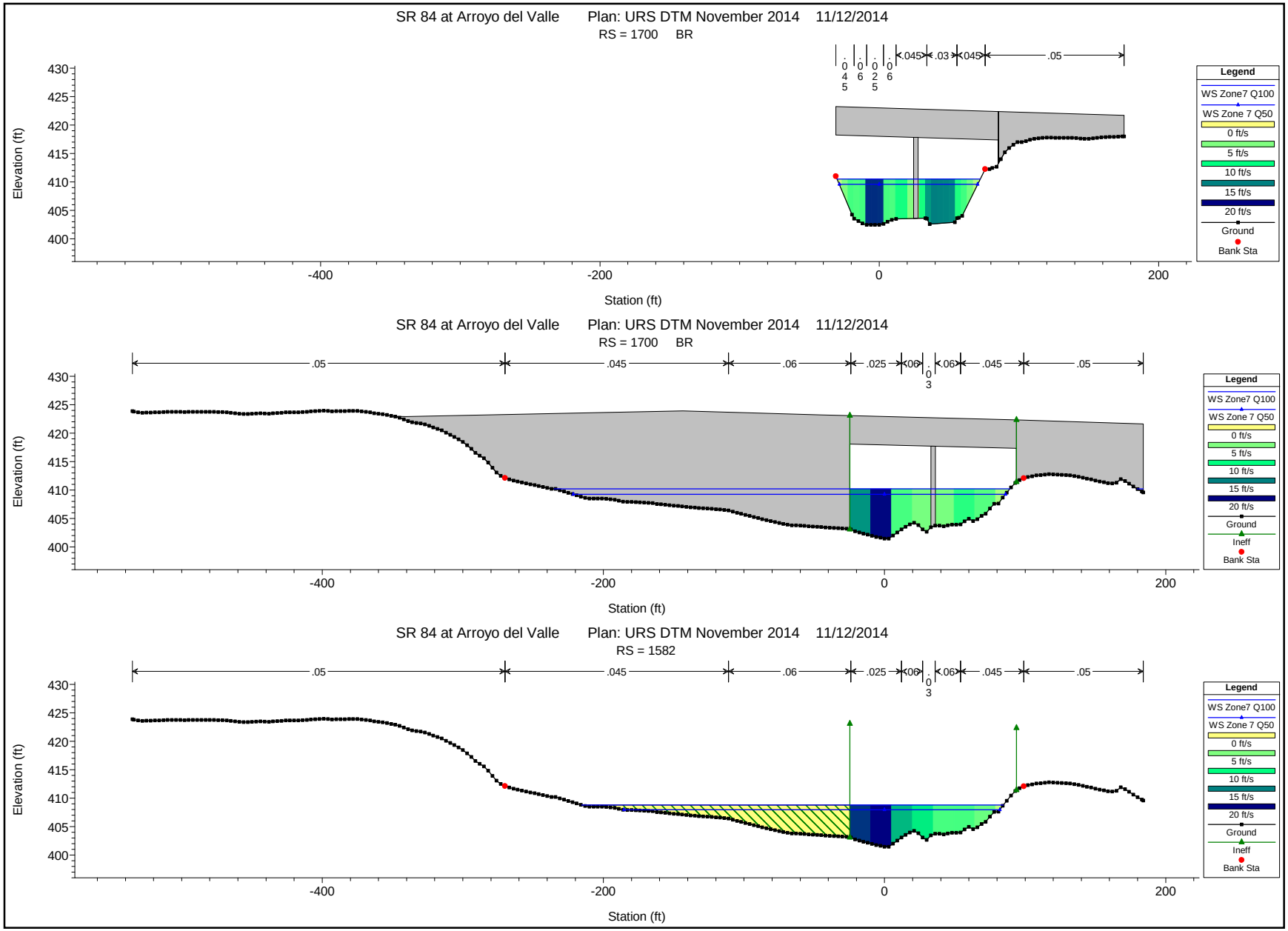

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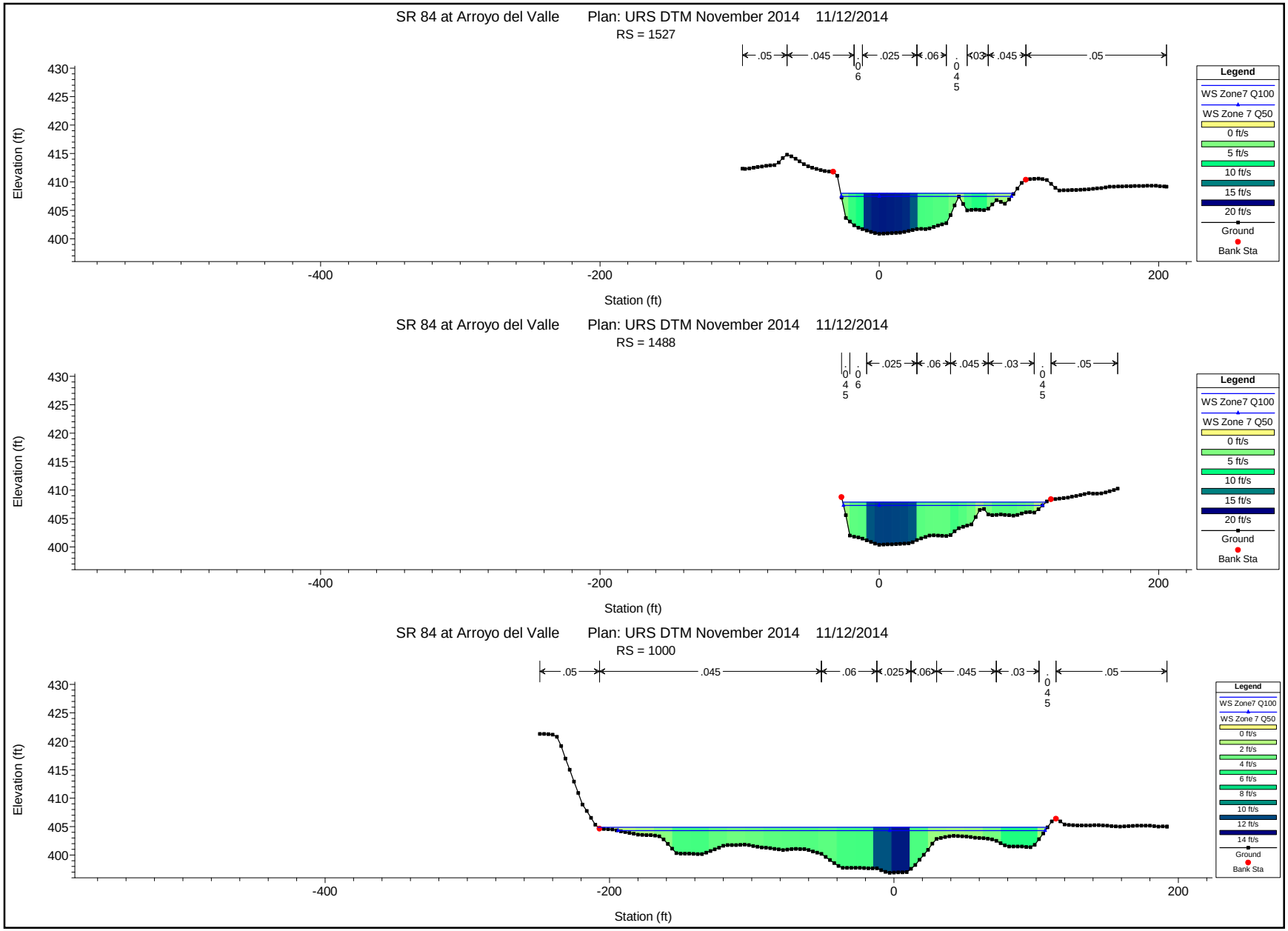

1 in Horiz. = 100 ft 1 in Vert. = 25 ft

Plan: URS DTM Nove Arroyo del Valle SR 84 RS: 1750 Profile: Zone7 Q100

E.G. US. (ft)	412.69	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	412.04	E.G. Elev (ft)	412.68	412.54
Q Total (cfs)	7000.00	W.S. Elev (ft)	411.93	410.75
Q Bridge (cfs)	7000.00	Crit W.S. (ft)	408.71	409.42
Q Weir (cfs)		Max Chl Dpth (ft)	9.06	8.31
Weir Sta Lft (ft)		Vel Total (ft/s)	6.97	10.72
Weir Sta Rgt (ft)		Flow Area (sq ft)	1004.41	652.90
Weir Submerg		Froude # Chl	0.45	0.74
Weir Max Depth (ft)		Specif Force (cu ft)	5463.55	4705.04
Min El Weir Flow (ft)	420.08	Hydr Depth (ft)	7.50	6.57
Min El Prs (ft)	417.85	W.P. Total (ft)	156.66	118.43
Delta EG (ft)	0.27	Conv. Total (cfs)	187484.5	112313.4
Delta WS (ft)	1.20	Top Width (ft)	133.94	99.30
BR Open Area (sq ft)	1441.45	Frctn Loss (ft)	0.04	0.06
BR Open Vel (ft/s)	10.72	C & E Loss (ft)	0.10	0.06
Coef of Q		Shear Total (lb/sq ft)	0.56	1.34
Br Sel Method	Energy only	Power Total (lb/ft s)	-576.00	-31.00

Plan: URS DTM Nove Arroyo del Valle SR 84 RS: 1750 Profile: Zone 7 Q50

E.G. US. (ft)	411.36	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	410.79	E.G. Elev (ft)	411.35	411.23
Q Total (cfs)	5400.00	W.S. Elev (ft)	410.71	409.76
Q Bridge (cfs)	5400.00	Crit W.S. (ft)	407.96	408.46
Q Weir (cfs)		Max Chl Dpth (ft)	7.84	7.32
Weir Sta Lft (ft)		Vel Total (ft/s)	6.42	9.70
Weir Sta Rgt (ft)		Flow Area (sq ft)	841.65	556.69
Weir Submerg		Froude # Chl	0.45	0.71
Weir Max Depth (ft)		Specif Force (cu ft)	3902.92	3404.33
Min El Weir Flow (ft)	420.08	Hydr Depth (ft)	6.28	5.82
Min El Prs (ft)	417.85	W.P. Total (ft)	153.12	112.28
Delta EG (ft)	0.23	Conv. Total (cfs)	141884.8	89352.8
Delta WS (ft)	0.96	Top Width (ft)	133.94	95.63
BR Open Area (sq ft)	1441.45	Frctn Loss (ft)	0.04	0.05
BR Open Vel (ft/s)	9.70	C & E Loss (ft)	0.08	0.05
Coef of Q		Shear Total (lb/sq ft)	0.50	1.13
Br Sel Method	Energy only	Power Total (lb/ft s)	-576.00	-31.00

Plan: URS DTM Nove Arroyo del Valle SR 84 RS: 1700 Profile: Zone7 Q100

E.G. US. (ft)	412.42	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	410.84	E.G. Elev (ft)	412.38	411.83
Q Total (cfs)	7000.00	W.S. Elev (ft)	410.52	410.20
Q Bridge (cfs)	7000.00	Crit W.S. (ft)	409.32	408.92
Q Weir (cfs)		Max Chl Dpth (ft)	8.08	8.76
Weir Sta Lft (ft)		Vel Total (ft/s)	10.96	10.24
Weir Sta Rgt (ft)		Flow Area (sq ft)	638.50	683.56
Weir Submerg		Froude # Chl	0.76	0.73
Weir Max Depth (ft)		Specif Force (cu ft)	4647.69	4564.40
Min El Weir Flow (ft)	422.34	Hydr Depth (ft)	6.43	6.18
Min El Prs (ft)	418.26	W.P. Total (ft)	117.09	132.30
Delta EG (ft)	1.09	Conv. Total (cfs)	107506.6	87144.8
Delta WS (ft)	2.03	Top Width (ft)	99.32	110.60
BR Open Area (sq ft)	1443.62	Frctn Loss (ft)	0.48	0.41
BR Open Vel (ft/s)	10.96	C & E Loss (ft)	0.07	0.09
Coef of Q		Shear Total (lb/sq ft)	1.44	2.08
Br Sel Method	Energy only	Power Total (lb/ft s)	-31.00	-535.00

Plan: URS DTM Nove Arroyo del Valle SR 84 RS: 1700 Profile: Zone 7 Q50

E.G. US. (ft)	411.12	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	409.83	E.G. Elev (ft)	411.10	410.60
Q Total (cfs)	5400.00	W.S. Elev (ft)	409.59	409.25
Q Bridge (cfs)	5400.00	Crit W.S. (ft)	408.37	408.06
Q Weir (cfs)		Max Chl Dpth (ft)	7.15	7.81
Weir Sta Lft (ft)		Vel Total (ft/s)	9.85	9.31
Weir Sta Rgt (ft)		Flow Area (sq ft)	548.09	580.05
Weir Submerg		Froude # Chl	0.73	0.71
Weir Max Depth (ft)		Specif Force (cu ft)	3367.30	3299.83
Min El Weir Flow (ft)	422.34	Hydr Depth (ft)	5.72	5.40
Min El Prs (ft)	418.26	W.P. Total (ft)	111.32	126.15
Delta EG (ft)	1.00	Conv. Total (cfs)	86260.8	68871.6
Delta WS (ft)	1.86	Top Width (ft)	95.88	107.44
BR Open Area (sq ft)	1443.62	Frctn Loss (ft)	0.45	0.40
BR Open Vel (ft/s)	9.85	C & E Loss (ft)	0.05	0.08
Coef of Q		Shear Total (lb/sq ft)	1.20	1.76
Br Sel Method	Energy only	Power Total (lb/ft s)	-31.00	-535.00

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Attachment B:

Detailed Scour Calculations

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SR84 Widening
Alameda County, California
Contraction Scour

100-year Flow
Calculation guideline from HEC-18 5th Edition
Input from HEC-RAS for URS DTM Nov2014, Proposed Condition

Units = (SI or English)	English	
Ku = constant = 6.19 (SI) or 11.17 (English)	11.17	
g = acceleration due to gravity =	32.2	ft/s^2

Channel

Vchannel = Mean velocity of flow in main channel just upstream of bridge =	10.1	ft/s
D50channel = grain size in channel for which 50% of bed material is finer =	0.0082	ft
Yochannel = existing depth in the contracted channel section before scour =	6.3	ft
Ychannel = depth of flow just upstream of bridge in channel =	6.6	ft
VcD50channel = Ku*(Ychannel^(1/6))*(D50channel^(1/3))	3.1	ft/s
Contraction scour equation for channel =	**Live Bed Equation**	

Live Bed Equation

Q1 channel = Flow in the upstream channel transporting sediment =	7000	ft^3/s
Q2 channel = Flow in the contracted channel = transporting sediment =	7000	ft^3/s
W1 channel = top width of the upstream channel that is transporting bed material =	100	ft
W2 channel = top width of the contracted channel section less pier widths =	103	ft
ω channel = fall velocity of bed material based on D50 =	0.59	ft/s
S channel = slope of energy grade line in main channel =	0.007	ft/ft
V* channel = shear velocity in the upstream channel section = (Ychannel*g*S channel)^.5 =	1.3	ft/s
V* channel/ω channel =	2.1	
k1 channel = (if V*/ω <0.5, 0.59, if(0.5<=V*/ω<=2,0.64,0.69)) =	0.69	
Y2channel = average depth in contracted section after scour = Ychannel*((Q2 channel/Q1 channel)^(6/7))*((W1 channel/W2 channel)^k1 channel) =	6.5	ft
Ys channel = Y2 channel - Yo channel =	**0.2**	**ft**

Clear Water Equation

Ku = constant = 0.0077 (English) or 0.025 (SI) =	0.0077	
Q = Discharge through bridge associated with the width W =	7000	ft^3/s
Dm = Diameter of the smallest non transportable particle in the bed material in contracted section = 1.25*d50 =	0.010253	ft
W = Bottom width of contracted section less pier widths =		ft
Y2channel = average depth in contracted section after scour = ((Ku*(Q^2))/((Dm^(2/3))*(W^2)))^(3/7) =	n/a	ft
Ys channel = Y2 channel - Yo channel =	**n/a**	**ft**

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SR84 Widening

Alameda County, California

Local Scour at Piers - Cohesionless

100-year Flow
Calculation guideline from HEC-18 5th Edition
Input from HEC-RAS for URS DTM Nov2014, Proposed Condition

Units = (SI or English) =	English	
Complex Pier Scour? (Yes or No)	Yes	

Pier Scour component

Water Surface Elevation	410.5	ft
f = distance between front edge of cap/footing and pier =	5.00	ft
T = thickness of pile cap or footing (enter n/a for no pile cap) =	4	ft
Top of Pile Cap Elevation (enter n/a for no pile cap)	402.67	ft
Bottom of Pile Cap Elevation (enter n/a for no pile cap)	398.67	ft
Ground Elevation at Pier	403.6	ft
Contraction Scour Depth	0.2	ft
ho = height of pile cap above bed at beginning of computation (negative indicates partially or entirely submerged pile cap) =	-4.8	ft
a = pier width =	1.5	ft
S = spacing between columns of piles, center to center =	n/a	ft
h1 = ho+T=height of the pier stem above the bed before scour (negative indicates top of pile cap is below bed elevation) =	-0.8	ft
y1 = Approach flow depth at the beginning of computations =	6.9	ft
V1 = Approach velocity used at the beginning of computations	8.8	ft/s
Khpier = coefficient to account for the height of the pier stem above the bed and the shielding effect by the pile cap overhang distance "f" in front of the pier stem	0.27	
Θ = angle of attack of flow =	0	degrees
Pier shape	uare nose	
K1 = correction factor for pier nose shape =	1.1	
L = length of pier =		ft
L/a (if L/a is larger than 12, then use 12 as a maximum)	0	
K2 = correction factor for angle of attack = (cosΘ+(L/a)*sinΘ)^0.65	1.0	
K3 = correction factor for bed condition =	1.1	
D50 = grain size for which 50% of bed material is finer =	0.0082	ft
D95 = grain size for which 95% of bed material is finer =	0.0131	ft
Ku = constant = 6.19 (SI) or 11.17 (English)	11.17	
VcD50 = Ku*(y1^(1/6))*(D50^(1/3))	3.1	ft/s
VcD95 = Ku*(y1^(1/6))*(D95^(1/3))	3.6	ft/s
g = acceleration due to gravity =	32.2	ft/s^2
Yspier = scour component for the pier stem in the flow = y1*(Khpier*(2*K1*K2*K3*((a/y1)^0.65)*((V1/((g*y1)^0.5))^0.43)) =	**1.3**	**ft**

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Pile cap/footing component scour

Case Type = (Case 1 or Case 2 from ho)	Case 2
apc = width of pile cap =	15 ft
y2 = y1 + Yspier/2 = adjusted flow depth for pile cap computations =	7.54 ft
V2 = V1*(y1/y2) = adjusted velocity for pile cap computations =	7.97 ft/s
h2 = ho +Yspier/2 = height of pile group after the pier stem scour component has been computed =	-4.10 ft
Kw = wide pier correction factor (The correction factor should be applied when the ratio of depth of flow (y) to pier width (a) is less than 0.8 (y/a < 0.8); the ratio of pier width (a) to the median diameter of the bed material (D50) is greater than 50 (	0.77

Case 1: Pile cap/footing in the flow above the bed (entire depth of cap exposed to flow)

K1 = correction factor for pier nose (pile cap nose) shape =	1.1
a'pc = equivalent full depth solid pier width of pile cap = apc*exp(-2.705 + 0.51*LN(T/y2) - 2.783*((h2/y2)^3) + 1.751/(exp(h2/y2))) = (if y2 > 3.5*apc, then y2 = 3.5*apc) =	n/a ft
Yspc = scour component for the pier cap/footing in the flow = y2*((2*K1*K2*K3*K4*Kw*((a'pc/y2)^0.65)*((V2/((g*y2)^0.5))^0.43)) =	**n/a ft**

Case 2: Bottom of Pile Cap (footing) located on or below the bed

Ks = grain roughness of the bed (D84 of the bed material) =	0.0098 ft
yf = h1 + Yspier/2 = distance from the bed (after degradation, contraction scour and pier stem scour) to the top of the footing (negative indicates entirely submerged pile cap)	-0.10 ft
Vf = average velocity in the flow zone below the top of the footing = V2*((LN((10.93*(yf/Ks))+1)))/(LN((10.93*(y2/Ks))+1))) =	n/a ft/s
Yspc = scour component for the pier cap/footing in the flow = yf*(2*K1*K2*K3*K4*Kw*((apc/yf)^0.65)*((Vf/((g*yf)^0.5))^0.43) =	**0.00 ft**

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Pile group scour component

h3 = ho + Yspier/2 + Yspc/2 = height of the pile group after the pier stem and pile cap scour components have been computed =	-4.10	ft
y3 = y1 + Yspier/2 + Ypc/2 = adjusted flow depth for pile group computations =	7.54	ft
V3 = V1*(y1/y3) = adjusted velocity for pile group computations =	7.97	ft/s
S = Spacing of piles (center to center)	9.00	ft
a = width of single pile	3.00	ft
aproj = sum of non-overlapping projected widths of piles =	6.00	ft
Ksp = coefficient for pile spacing = 1-(4/3)*((1-(1/(aproj/a)))*(1-((S/a)^-0.6)) =	0.68	
m = number of rows of piles in direction of flow =	4.00	
Km = coefficient for number of aligned rows = 0.9+0.1*m-0.0714*(m-1)*(2.4-1.1*(S/a)+0.1*((S/a)^2)) =	1.30	ft
a'pg = effective width of an equivalent full depth pier = aproj*Ksp*Km =	5.29	ft
Khpg = pile group height factor = (3.08*(h3/y3)-5.23*((h3/y3)^2)+5.25*((h3/y3)^3)-2.1*((h3/y3)^4))^(1/0.65) = (note that y3max = 3.5*a'pg) =	0.0000	
Yspg = scour component for the piles exposed to the flow = y3*Khpg*(2*K1*K3*K4*Kw*((a'pg/y3)^0.65)*((V3/((g*y3)^0.5))^0.43) =	**0.00**	**ft**

Total Scour

Ys = Yspier + Yspc + Yspg = total scour from superposition of components =	**1.3**	**ft**

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SR84 Widening

Alameda County, California

Local Scour at Abutments - Froehlich or HIRE

100-year Flow
Calculation guideline from HEC-18 5th Edition
Input from HEC-RAS for URS DTM Nov2014, Proposed Condition

Units = (SI or English)	English	
g = acceleration due to gravity =	32.2	ft/s^2

Left Overbank = Abutment 1 (South Bank)

y1 = depth of flow at abutment on the overbank or in the main channel =	4.5	ft
L = length of embankment projected normal to flow =	8.0	ft
Ratio of projected embankment length to flow depth = L/y1 =	1.771E+00	
Abutment scour equation to be used =	Froehlich	

Froehlich's Live Bed Abutment Scour Equation

L' = length of active flow obstructed by the embankment =	7.2	ft
Ae = flow area of the approach cross section obstructed by the embankment =	16.2	ft^2
ya = average depth of flow on the flood plain = Ae/L'	2.25	ft
Qe = flow obstructed by the abutment and approach embankment =	107	ft^3/s
Ve = flow velocity = Qe/Ae =	6.6	ft/s
Fr = Froude Number of approach flow upstream of the abutment =	0.78	
Θ = abutment skew =	100	degrees
K1 = coefficient for abutment shape =	1	
K2 = coefficient for angle of embankment shape = (Θ/90)^0.13 =	1.01	
Ys = abutment scour = ya*(2.27*k1*k2*((L'/ya)^0.43)*(Fr^0.61)+1) =	**9.6**	**ft**

HIRE Live Bed Abutment Scour Equation

V = velocity of flow at upstream face of abutment =		ft/s
Fr = Froude Number = V/((g*y1)^.5) =	n/a	
Θ = abutment skew =		degrees
K1 = coefficient for abutment shape =		
K2 = coefficient for angle of embankment shape = (Θ/90)^0.13 =	n/a	
Ys = abutment scour = y1*(4*(Fr^0.33)*(K1/0.55)*K2) =	**n/a**	**ft**

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SR84 Widening
Alameda County, California
Contraction Scour

100-year Flow
Calculation guideline from HEC-18 5th Edition
Input from HEC-RAS for Proposed Alternative x

Units = (SI or English)	English	
Ku = constant = 6.19 (SI) or 11.17 (English)	11.17	
g = acceleration due to gravity =	32.2	ft/s^2

Channel

Vchannel = Mean velocity of flow in main channel just upstream of bridge =	6.6	ft/s
D50channel = grain size in channel for which 50% of bed material is finer =	0.0007	ft
Yochannel = existing depth in the contracted channel section before scour =	7.5	ft
Ychannel = depth of flow just upstream of bridge in channel =	7.0	ft
VcD50channel = Ku*(Ychannel^(1/6))*(D50channel^(1/3))	1.3	ft/s
Contraction scour equation for channel =	**Live Bed Equation**	

Live Bed Equation

Q1 channel = Flow in the upstream channel transporting sediment =	7000	ft^3/s
Q2 channel = Flow in the contracted channel = transporting sediment =	7000	ft^3/s
W1 channel = top width of the upstream channel that is transporting bed material =	152	ft
W2 channel = top width of the contracted channel section less pier widths =	135	ft
ω channel = fall velocity of bed material based on D50 =	0.08	ft/s
S channel = slope of energy grade line in main channel =	0.003	ft/ft
V* channel = shear velocity in the upstream channel section = (Ychannel*g*S channel)^.5 =	0.8	ft/s
V* channel/ω channel =	9.8	
k1 channel = (if V*/ω <0.5, 0.59, if(0.5<=V*/ω<=2,0.64,0.69)) =	0.69	
Y2channel = average depth in contracted section after scour = Ychannel*((Q2 channel/Q1 channel)^(6/7))*((W1 channel/W2 channel)^k1 channel) =	7.6	ft
Ys channel = Y2 channel - Yo channel =	**0.1**	**ft**

Clear Water Equation

Ku = constant = 0.0077 (English) or 0.025 (SI) =	0.0077	
Q = Discharge through bridge associated with the width W =	7000	ft^3/s
Dm = Diameter of the smallest non transportable particle in the bed material in contracted section = 1.25*d50 =	0.000820	ft
W = Bottom width of contracted section less pier widths =		ft
Y2channel = average depth in contracted section after scour = ((Ku*(Q^2))/((Dm^(2/3))*(W^2)))^(3/7) =	n/a	ft
Ys channel = Y2 channel - Yo channel =	**n/a**	**ft**

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SR84 Widening
Alameda County, California
Local Scour at Piers - Cohesionless

100-year Flow
Calculation guideline from HEC-18 5th Edition
Input from HEC-RAS for Proposed Alternative x

Units = (SI or English) =	English	
Complex Pier Scour? (Yes or No)	Yes	

Pier Scour component

Water Surface Elevation	412.0	ft
f = distance between front edge of cap/footing and pier =	6.25	ft
T = thickness of pile cap or footing (enter n/a for no pile cap) =	3.25	ft
Top of Pile Cap Elevation (enter n/a for no pile cap)	400.75	ft
Bottom of Pile Cap Elevation (enter n/a for no pile cap)	397.5	ft
Ground Elevation at Pier	404.1	ft
Contraction Scour Depth	0.1	ft
ho = height of pile cap above bed at beginning of computation (negative indicates partially or entirely submerged pile cap) =	-6.49	ft
a = pier width =	3.5	ft
S = spacing between columns of piles, center to center =	n/a	ft
h1 = ho+T=height of the pier stem above the bed before scour (negative indicates top of pile cap is below bed elevation) =	-3.24	ft
y1 = Approach flow depth at the beginning of computations =	7.9	ft
V1 = Approach velocity used at the beginning of computations	5.2	ft/s
Khpier = coefficient to account for the height of the pier stem above the bed and the shielding effect by the pile cap overhang distance "f" in front of the pier stem	0.63	
Θ = angle of attack of flow =	0	degrees
Pier shape	uare nose	
K1 = correction factor for pier nose shape =	1.1	
L = length of pier =		ft
L/a (if L/a is larger than 12, then use 12 as a maximum)	0	
K2 = correction factor for angle of attack = (cosΘ+(L/a)*sinΘ)^0.65	1.0	
K3 = correction factor for bed condition =	1.1	
D50 = grain size for which 50% of bed material is finer =	0.0007	ft
D95 = grain size for which 95% of bed material is finer =	0.0066	ft
Ku = constant = 6.19 (SI) or 11.17 (English)	11.17	
VcD50 = Ku*(y1^(1/6))*(D50^(1/3))	1.4	ft/s
VcD95 = Ku*(y1^(1/6))*(D95^(1/3))	2.9	ft/s
g = acceleration due to gravity =	32.2	ft/s^2
Yspier = scour component for the pier stem in the flow = y1*(Khpier*(2*K1*K2*K3*((a/y1)^0.65)*((V1/((g*y1)^0.5))^0.43)) =	**4.4**	**ft**

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Pile cap/footing component scour

Case Type = (Case 1 or Case 2 from ho)	Case 2	
apc = width of pile cap =	16	ft
y2 = y1 + Yspier/2 = adjusted flow depth for pile cap computations =	10.05	ft
V2 = V1*(y1/y2) = adjusted velocity for pile cap computations =	4.07	ft/s
h2 = ho +Yspier/2 = height of pile group after the pier stem scour component has been computed =	-4.31	ft
Kw = wide pier correction factor (The correction factor should be applied when the ratio of depth of flow (y) to pier width (a) is less than 0.8 (y/a < 0.8); the ratio of pier width (a) to the median diameter of the bed material (D50) is greater than 50 (	0.65	

Case 1: Pile cap/footing in the flow above the bed (entire depth of cap exposed to flow)

K1 = correction factor for pier nose (pile cap nose) shape =	1.1	
a'pc = equivalent full depth solid pier width of pile cap = apc*exp(-2.705 + 0.51*LN(T/y2) - 2.783*((h2/y2)^3) + 1.751/(exp(h2/y2))) = (if y2 > 3.5*apc, then y2 = 3.5*apc) =	n/a	ft
Yspc = scour component for the pier cap/footing in the flow = y2*((2*K1*K2*K3*K4*Kw*((a'pc/y2)^0.65)*((V2/((g*y2)^0.5))^0.43)) =	**n/a**	**ft**

Case 2: Bottom of Pile Cap (footing) located on or below the bed

Ks = grain roughness of the bed (D84 of the bed material) =	0.0033	ft
yf = h1 + Yspier/2 = distance from the bed (after degradation, contraction scour and pier stem scour) to the top of the footing (negative indicates entirely submerged pile cap)	-1.06	ft
Vf = average velocity in the flow zone below the top of the footing = V2*((LN((10.93*(yf/Ks))+1)))/(LN((10.93*(y2/Ks))+1))) =	n/a	ft/s
Yspc = scour component for the pier cap/footing in the flow = yf*(2*K1*K2*K3*K4*Kw*((apc/yf)^0.65)*((Vf/((g*yf)^0.5))^0.43) =	**0.00**	**ft**

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Pile group scour component

h3 = ho + Yspier/2 + Yspc/2 = height of the pile group after the pier stem and pile cap scour components have been computed =	-4.31	ft
y3 = y1 + Yspier/2 + Ypc/2 = adjusted flow depth for pile group computations =	10.05	ft
V3 = V1*(y1/y3) = adjusted velocity for pile group computations =	4.07	ft/s
S = Spacing of piles (center to center)	6.00	ft
a = width of single pile	2.00	ft
aproj = sum of non-overlapping projected widths of piles =	6.00	ft
Ksp = coefficient for pile spacing = 1-(4/3)*((1-(1/(aproj/a)))*(1-((S/a)^-0.6)) =	0.57	
m = number of rows of piles in direction of flow =	3.00	
Km = coefficient for number of aligned rows = 0.9+0.1*m-0.0714*(m-1)*(2.4-1.1*(S/a)+0.1*((S/a)^2)) =	1.20	ft
a'pg = effective width of an equivalent full depth pier = aproj*Ksp*Km =	4.11	ft
Khpg = pile group height factor = (3.08*(h3/y3)-5.23*((h3/y3)^2)+5.25*((h3/y3)^3)-2.1*((h3/y3)^4))^(1/0.65) = (note that y3max = 3.5*a'pg) =	0.0000	
Yspg = scour component for the piles exposed to the flow = y3*Khpg*(2*K1*K3*K4*Kw*((a'pg/y3)^0.65)*((V3/((g*y3)^0.5))^0.43) =	**0.00**	**ft**

Total Scour

Ys = Yspier + Yspc + Yspg = total scour from superposition of components =	**4.4**	**ft**

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SR84 Widening

Alameda County, California

Local Scour at Abutments - Froehlich or HIRE

100-year Flow
Calculation guideline from HEC-18 5th Edition
Input from HEC-RAS for Proposed Alternative x

Units = (SI or English)	English	
g = acceleration due to gravity =	32.2	ft/s^2

Left Overbank = Abutment x (Cardinal Direction)

y1 = depth of flow at abutment on the overbank or in the main channel =	0.5	ft
L = length of embankment projected normal to flow =	0.8	ft
Ratio of projected embankment length to flow depth = L/y1 =	1.600E+00	
Abutment scour equation to be used =	Froehlich	

Froehlich's Live Bed Abutment Scour Equation

L' = length of active flow obstructed by the embankment =	0.8	ft
Ae = flow area of the approach cross section obstructed by the embankment =	0.20	ft^2
ya = average depth of flow on the flood plain = Ae/L'	0.25	ft
Qe = flow obstructed by the abutment and approach embankment =	0	ft^3/s
Ve = flow velocity = Qe/Ae =	2.4	ft/s
Fr = Froude Number of approach flow upstream of the abutment =	0.85	
Θ = abutment skew =	100	degrees
K1 = coefficient for abutment shape =	1	
K2 = coefficient for angle of embankment shape = (Θ/90)^0.13 =	1.01	
Ys = abutment scour = ya*(2.27*k1*k2*((L'/ya)^0.43)*(Fr^0.61)+1) =	**1.1**	**ft**

HIRE Live Bed Abutment Scour Equation

V = velocity of flow at upstream face of abutment =		ft/s
Fr = Froude Number = V/((g*y1)^.5) =	n/a	
Θ = abutment skew =		degrees
K1 = coefficient for abutment shape =		
K2 = coefficient for angle of embankment shape = (Θ/90)^0.13 =	n/a	
Ys = abutment scour = y1*(4*(Fr^0.33)*(K1/0.55)*K2) =	**n/a**	**ft**

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SR84 Widening

Alameda County, California

Local Scour at Abutments - Froehlich or HIRE

100-year Flow
Calculation guideline from HEC-18 5th Edition
Input from HEC-RAS for Proposed Alternative x

Units = (SI or English)	English	
g = acceleration due to gravity =	32.2	ft/s^2

Right Overbank = Abutment x (Cardinal Direction)

y1 = depth of flow at abutment on the overbank or in the main channel =	0.5	ft
L = length of embankment projected normal to flow =	1.0	ft
Ratio of projected embankment length to flow depth =	2.000E+00	
Abutment scour equation to be used =	Froehlich	

Froehlich's Live Bed Abutment Scour Equation

L' = length of active flow obstructed by the embankment =	1.0	ft
Ae = flow area of the approach cross section obstructed by the embankment =	0.3	ft^2
ya = average depth of flow on the flood plain = ae/L	0.25	ft
Qe = flow obstructed by the abutment and approach embankment =	1	ft^3/s
Ve = flow velocity = Qe/Ae =	2.4	ft/s
Fr = Froude Number of approach flow upstream of the abutment =	0.85	
Θ = abutment skew =	80	degrees
K1 = coefficient for abutment shape =	1	
K2 = coefficient for angle of embankment shape = (Θ/90)^0.13 =	0.98	
Ys = abutment scour = ya*(2.27*k1*k2*((L'/ya)^0.43)*(Fr^0.61)+1) =	**1.2**	**ft**

HIRE Live Bed Abutment Scour Equation

V = velocity of flow at upstream face of abutment =		ft/s
Fr = Froude Number = V/((g*y1)^.5) =	n/a	
Θ = abutment skew =		degrees
K1 = coefficient for abutment shape =		
K2 = coefficient for angle of embankment shape = (Θ/90)^0.13 =	n/a	
Ys = abutment scour = y1*(4*(Fr^0.33)*(K1/0.55)*K2) =	**n/a**	**ft**

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Attachment C:

Original Bridge Design Hydraulic Study Report (May 2009)

The following table presents correlation between the borehole identification shown on LOTBs and discussed throughout the report text with the borehole identification shown on liquefaction calculation spreadsheets.

Borehole Identification on LOTBs	Borehole Identification for Laboratory Test Results
R-07-011	NB11
R-07-012	NB12
R-07-013	NB13
R-07-014	NB14
R-08-037	NB37

LIQUEFACTION ANALYSIS

Project: Route 84 Widening
Project No.: 28649640
Boring No.: R-08-037

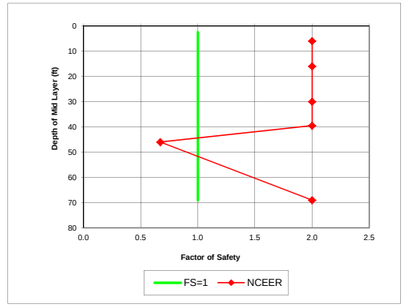
PGA = 0.61
M_w = 6.8
GWT during drilling = 3.0 ft
GWT during EQ = 0.0 ft

Sampler:	Symbol	Corr. Factor
SPT	S	1
Mod.Cal	M	0.8
California	C	0.7

Mag. Weighting Factor($CSR_M/CSR_{M=}$ 0.75

Note: Cells in Red must be input

			C_E	Code	C_E
Hammer type :	Type				3
	Donut		0.75	1	
	Safety		1	2	
	Auto		1.16	3	
Borehole Diameter:	(inch)	(mm)	C_B		C_B
	2.5-4.5	65-115	1	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		



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	at drilling u	at drilling σ'_o	EQ u	EQ σ'_o	r_d	EQ CSR	N raw	Sampler	N SPT	Fines Content	$N_{60\text{-cs}}$	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60\text{-cs}}$	$CRR^*_{7.5,1tsf}$	Magnitude Scaling Factor NCEER K_m			Overburde n K_σ	Above GWT?	F.S.	Liquefy ?	F.S.=1.0
	(USCS)	pcf	ft	m	ft	m	psf	psf	psf	psf	psf						%	FC< 5%	EQ					during EQ	Critical	Lower	Upper	Middle			NCEER	NCEER	
1	SM	130	5.0	1.52	2.5	0.76	325	0	325	156	169	0.996	0.760													1.28	1.38	1.33		N			1
2	CL	128	7.0	2.13	6.0	1.83	778	187	591	374	404	0.988	0.755													1.28	1.38	1.33		N	2.00	N	1
3	SC	144	25.0	7.62	16.0	4.88	2,202	811	1,391	998	1,204	0.966	0.701	51	M	40.8	15	45.3	1.23	1.16	1.00	0.85	1.00	55	0.459	1.28	1.38	1.33	1.000	N	2.00	N	1
4	SC	136	35.0	10.67	30.0	9.14	4,178	1,685	2,493	1,872	2,306	0.921	0.661	43	S	43	15	47.6	0.92	1.16	1.00	0.95	1.20	58	0.459	1.28	1.38	1.33	0.986	N	2.00	N	1
5	SC	144	44.0	13.41	39.5	12.04	5,506	2,278	3,228	2,465	3,041	0.855	0.614	78	M	62.4	15	67.9	0.81	1.16	1.00	1.00	1.00	64	0.459	1.28	1.38	1.33	0.943	N	2.00	N	1
6	ML	110	48.0	14.63	46.0	14.02	6,374	2,683	3,691	2,870	3,504	0.794	0.572	17	S	17	55	25.4	0.76	1.16	1.00	1.00	1.20	27	0.315	1.28	1.38	1.33	0.918	N	0.67	Liquef	1
7	SC	140	90.0	27.43	69.0	21.03	9,534	4,118	5,416	4,306	5,228	0.597	0.432	59	M	47.2	15	52.0	0.63	1.16	1.00	1.00	1.00	38	0.459	1.28	1.38	1.33	0.837	N	2.00	N	1

Layer Number	Depth to Bot. Layer	Thickness	σ_o	u	σ'_o	r_d	$(N_1)_{60\text{-cs}}$	Liquefy ?	τ_{cyc}	$CSR_{M=7.5}$ τ_{cyc}/σ'_o	CSR_M τ_{cyc}/σ'_o	Volumetric Strain** %		Settl.
	ft	ft	psf	psf	psf			NCEER	psf					in
1	5.0	5.0	325	156	169	0.996		N	128.4	0.760	0.57			0.00
2	7.0	2.0	778	374	404	0.988		N	304.8	0.755	0.57			0.00
3	25.0	18.0	2,202	998	1,204	0.966	55.0	N	843.7	0.701	0.53			0.00
4	35.0	10.0	4,178	1,872	2,306	0.921	58.0	N	1525.0	0.661	0.50			0.00
5	44.0	9.0	5,506	2,465	3,041	0.855	63.8	N	1867.4	0.614	0.46			0.00
6	48.0	4.0	6,374	2,870	3,504	0.794	26.8	Liquef	2005.6	0.572	0.43		1.1	0.50
7	90.0	42.0	9,534	4,306	5,228	0.597	37.7	N	2258.4	0.432	0.32			0.00

Total Settlement (inch) = 0.50

* 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.

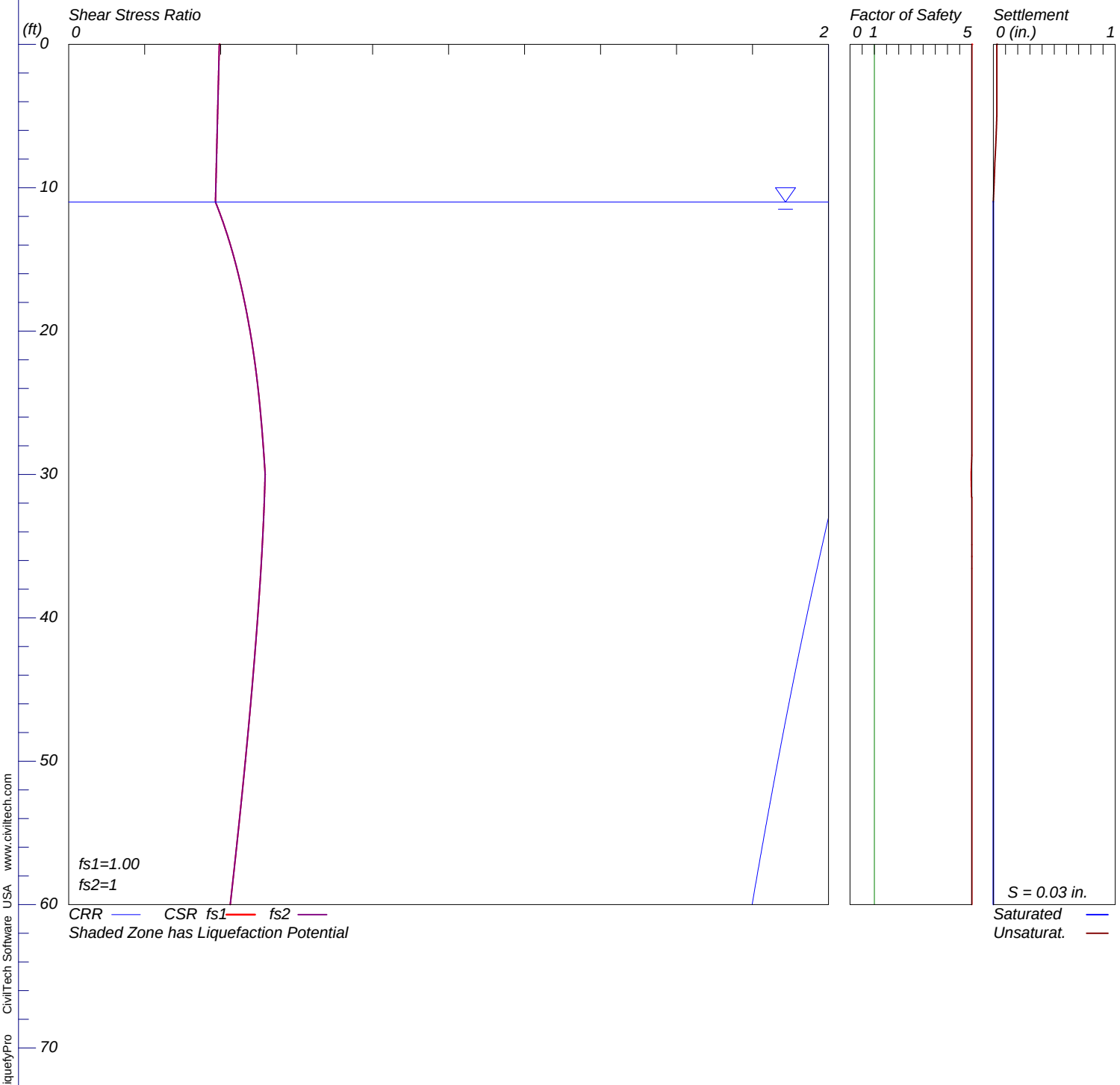
** Note: These values were obtained from a chart for estimation of volumetric strain in saturated sands based on a cyclic stress ratio and standard penetration resistance (Tokimatsu and Seed, 1987).
See figure 9.53 from "Geotechnical Earthquake Engineering" by S. Kramer.

LIQUEFACTION ANALYSIS

Route 84 Expressway Widening

Hole No.=NB11 Water Depth=11 ft Surface Elev.=412

Magnitude=6.8
Acceleration=0.61g



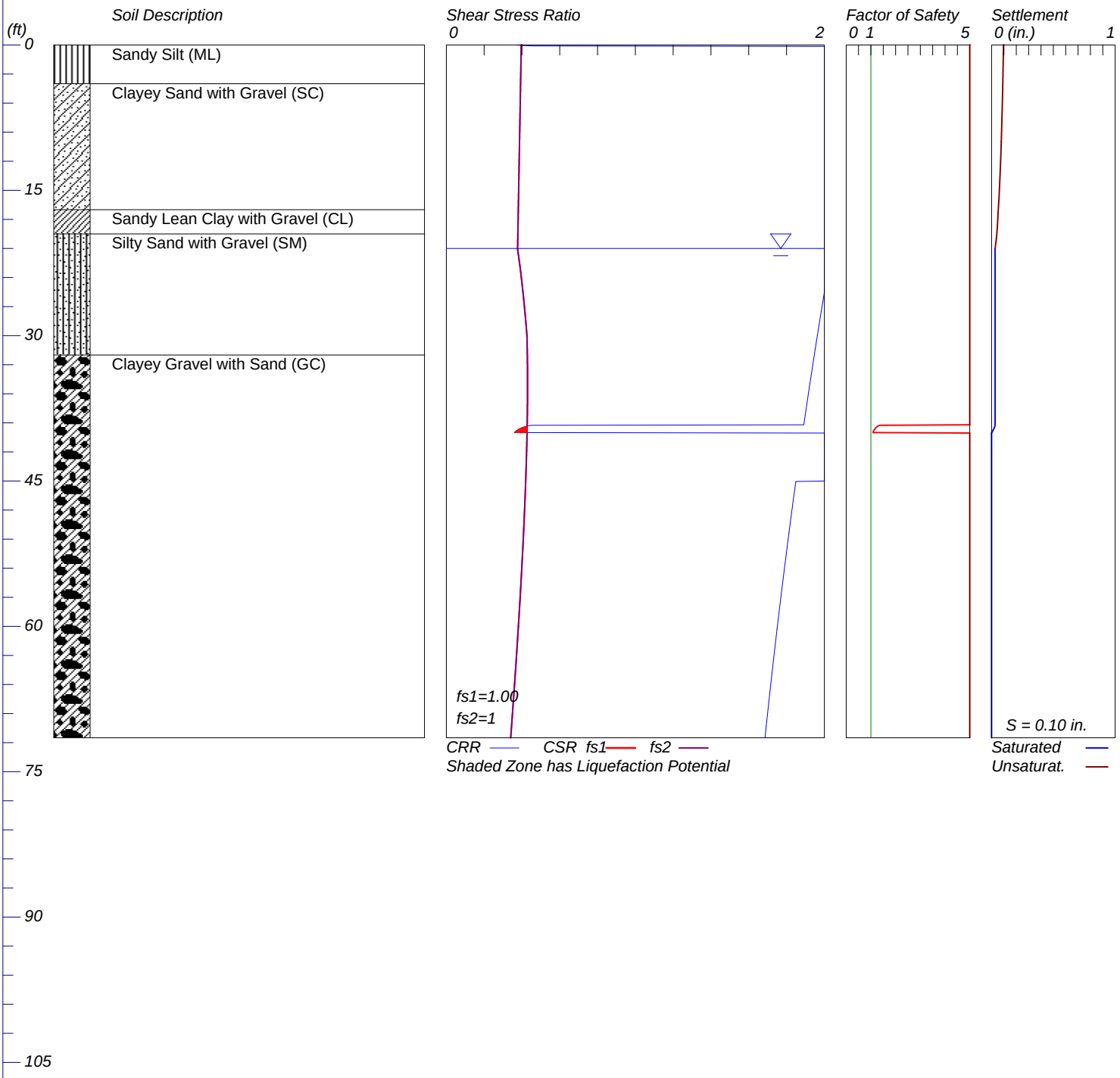
LiquefyPro CivilTech Software USA www.civiltech.com

LIQUEFACTION ANALYSIS

Route 84 Expressway Widening

Hole No.=NB12 Water Depth=21 ft Surface Elev.=422

Magnitude=6.8
Acceleration=0.61g



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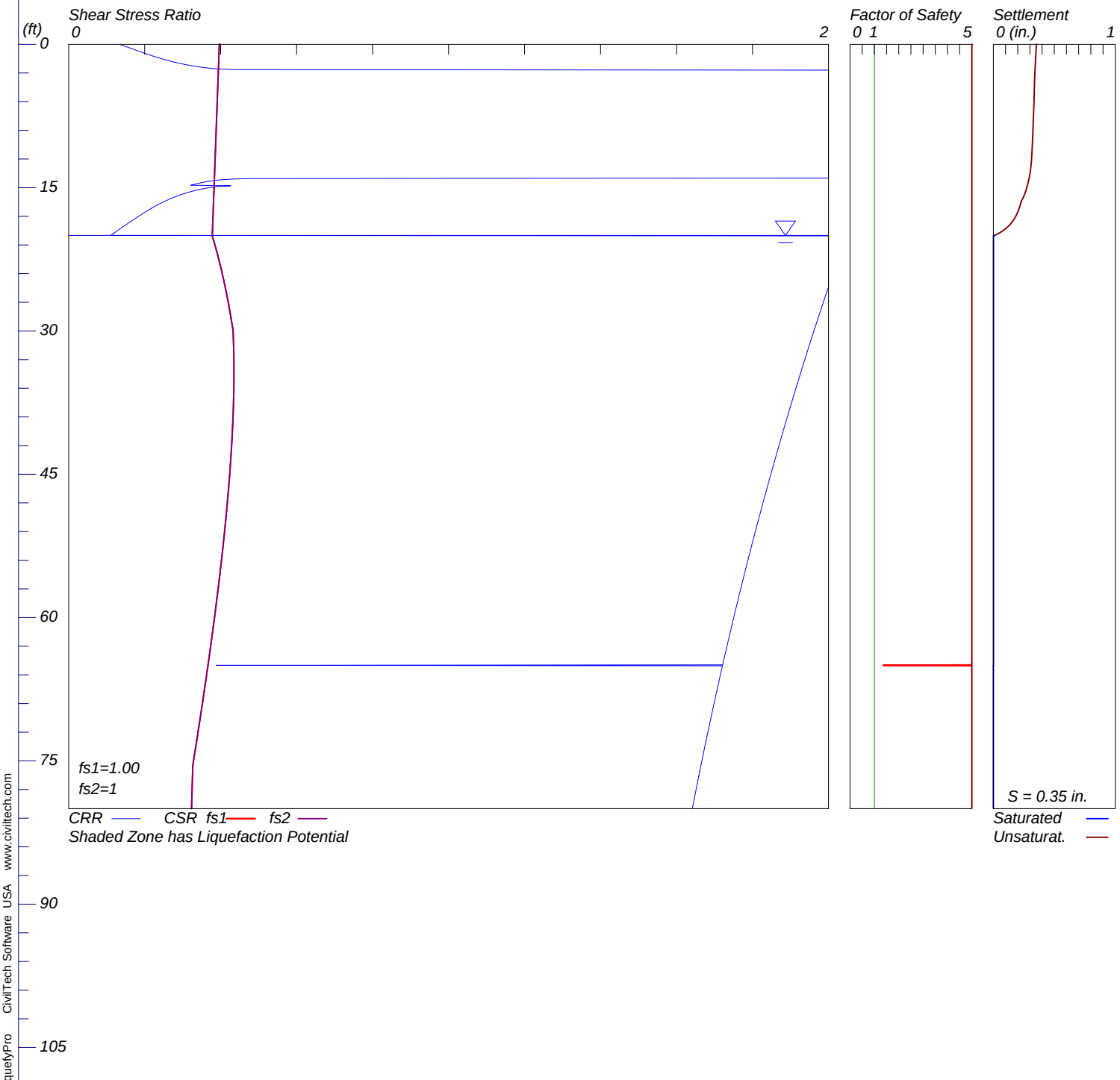
LIQUEFACTION ANALYSIS

Route 84 Expressway Widening

Hole No.=NB13 Water Depth=20 ft Surface Elev.=421

Magnitude=6.8
Acceleration=0.61g



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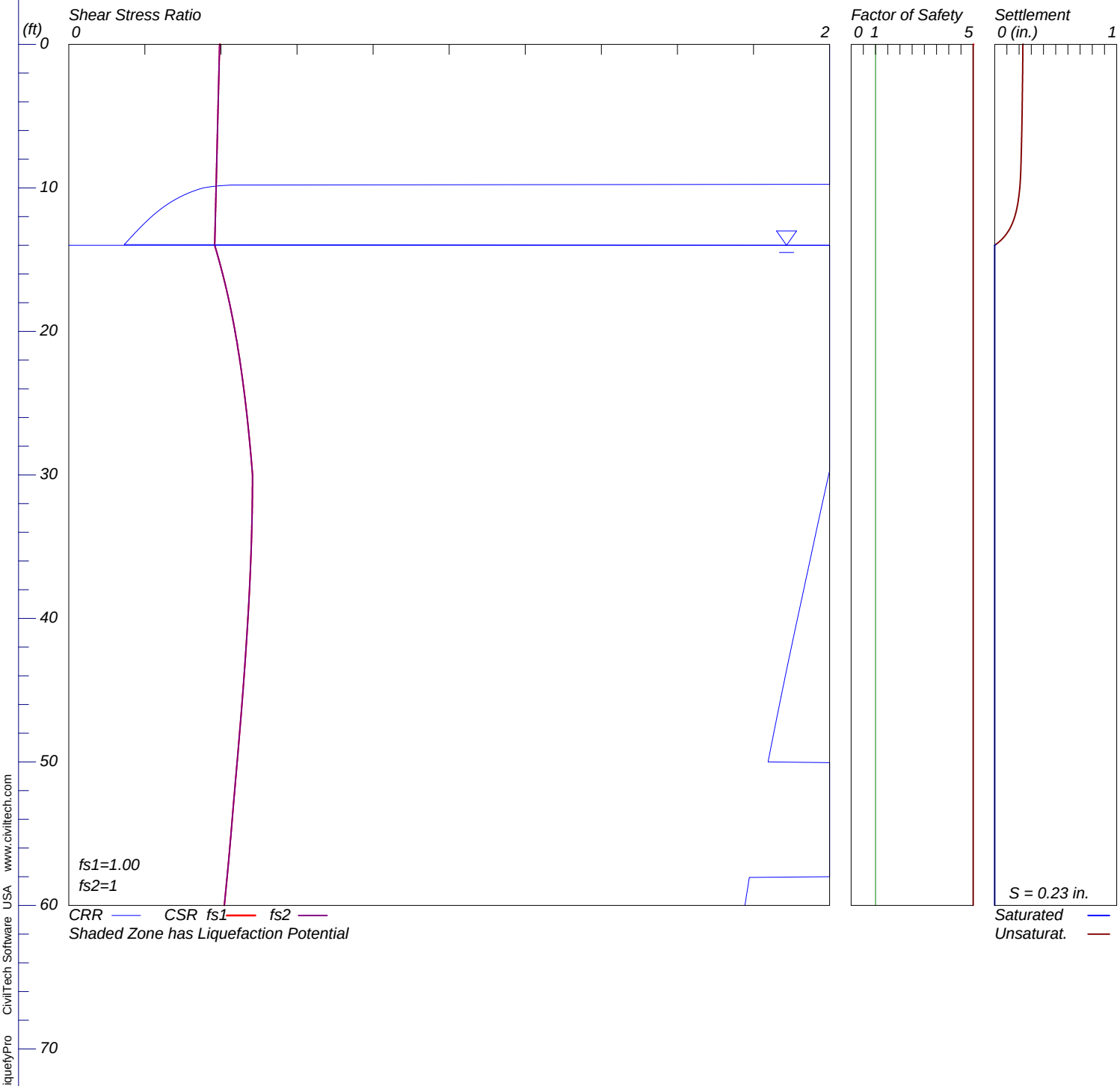
LIQUEFACTION ANALYSIS

Route 84 Expressway Widening

Hole No.=NB14 Water Depth=14 ft Surface Elev.=415

Magnitude=6.8
Acceleration=0.61g



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The following table presents correlation between the borehole identification shown on LOTBs and discussed throughout the report text with the borehole identification referenced in the corrosion report.

Borehole Identification on LOTBs	Borehole Identification for Laboratory Test Results
R-07-011	NB11
R-07-012	NB12
R-07-013	NB13
R-07-014	NB14

ROUTE 84 EXPRESSWAY WIDENING PROJECT

LIVERMORE, CA.

RUBY HILL DRIVE TO JACK LONDON BOULEVARD

Proposed Arroyo del Valle 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_A del V 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 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 the existing Arroyo del Valle 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 soil samples selected from four borings at the Arroyo del Valle Bridge ranged from 7,255 ohm-cm to 10,586 ohm-cm. The soil pH ranged from 7.4 to 8.6 and the water-soluble chloride concentrations were below the detection limit of 2 mg/kg. The water-soluble sulfate concentrations were below the detection limit of 5 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.

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 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 and 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 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.

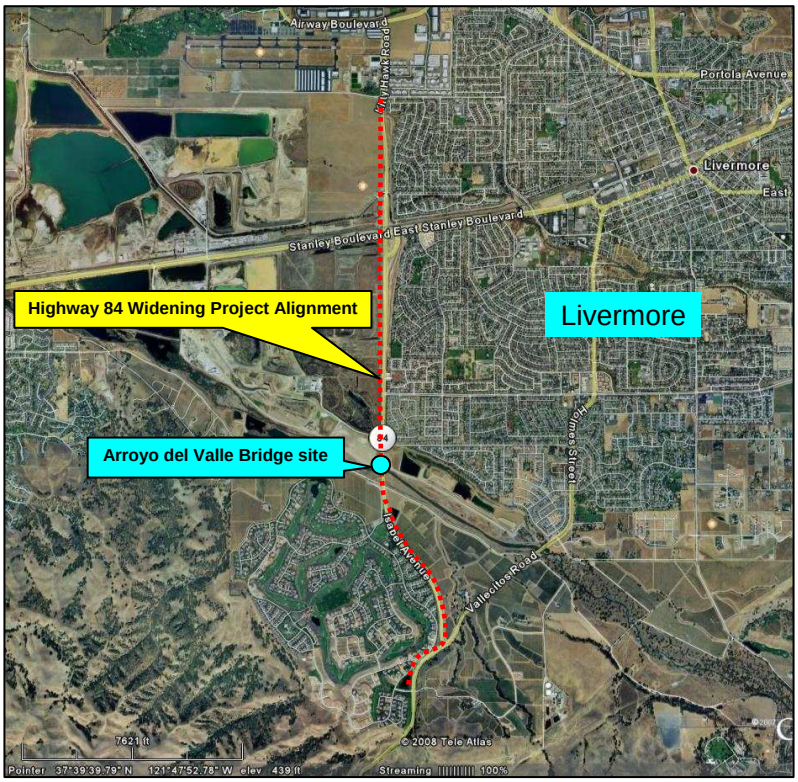


Figure 1. Vicinity Map for Arroyo del Valle Bridge Foundation Investigation, Livermore, CA.

Figure 2. In-Situ Soil Resistivity Test Site and Soil Boring Locations

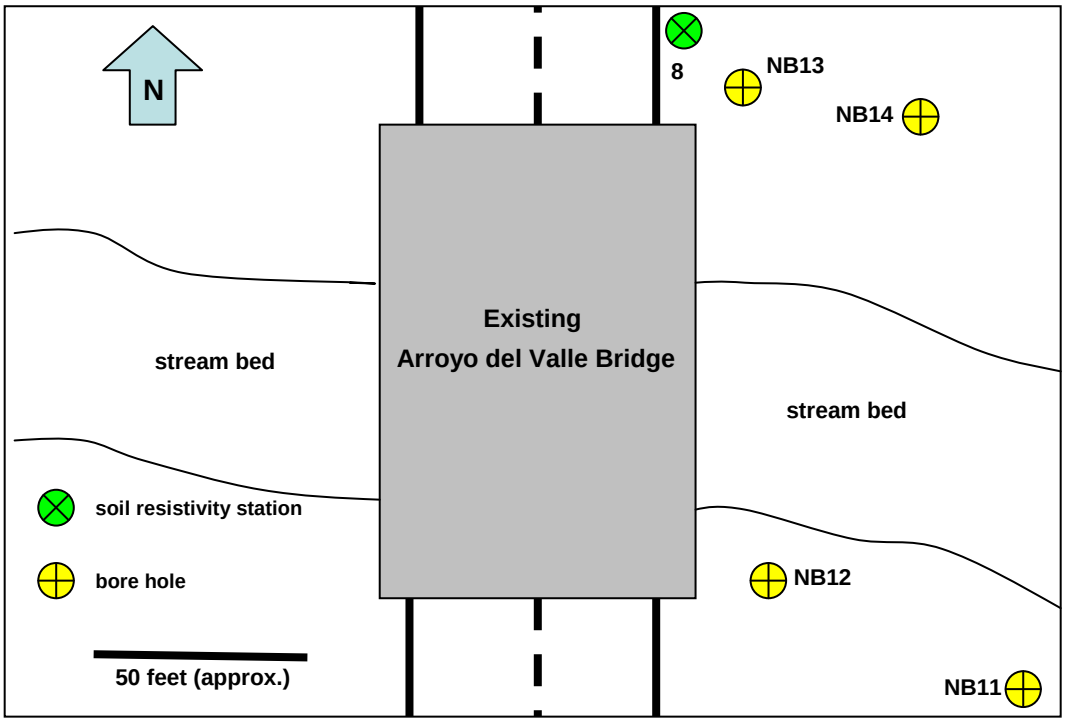


Figure 3. Sketch Map of In-Situ Soil Resistivity Test Site and Soil Boring Locations.

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 4).

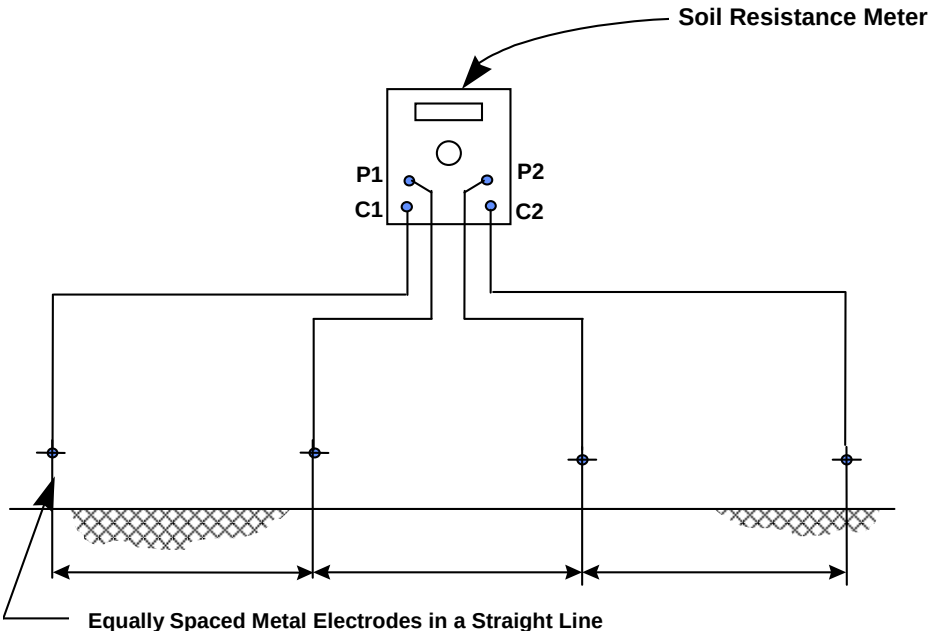


Figure 4. Wenner Electrode Method for Soil Resistivity Measurement

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 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 del Valle 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 NB11, NB12, NB13 and NB14 for laboratory soil resistivity analysis. A Soil Box was used in accordance with California Test Method 643. This apparatus is shown in Figure 5.

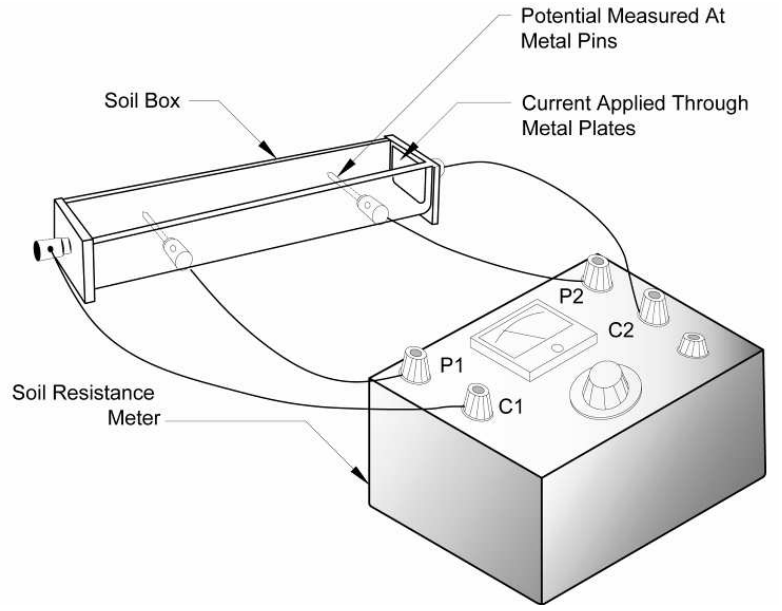


Figure 5. Soil Resistivity Measurement Using the Soil Box Method

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. 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 Arroyo del Valle Bridge and the calculated Barnes-Layer resistivities. Table 2 lists minimum resistivities and chemical analyses for the soil and water samples.

Table 1. Field Soil Resistivity Data

Site	Survey Station	Depth (meters)	Resistivity (ohm-cm)	Layer (meters)	Layer Resistivity (ohm-cm)
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

Table 2. Laboratory Soil Resistivity and Chemical Data

Item No.	Boring No.	Station	Sample No.	Depth (meters)	Minimum Soil Resistivity (ohm-cm)	Chemical Data		
						pH	Sulfate (mg/kg)	Chloride (mg/kg)
1	NB11	318+50	5-3	6.1 - 6.6	7,255	7.4	<5	<2
2	NB12	319+00	2-X	1.5 - 2.0	10,028	8.6	<5	<2
3	NB13	321+00	6-3	7.6 - 8.1	7,992	8.3	<5	<2
4	NB14	321+00	2-3	1.5 - 2.0	10,586	8.5	<5	<2
Arroyo del Valle	N/A	320+00	water	N/A	1,686**	8.3	19.9*	63.7*

* The chloride and sulfate results for the Arroyo del Valle water sample are in mg/L.
** 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.												

The following table presents correlation between the borehole identification shown on LOTBs and discussed throughout the report text with the borehole identification used in the shear wave velocity spreadsheets.

Borehole Identification on LOTBs	Borehole Identification for Laboratory Test Results
R-07-011	NB11
R-07-012	NB12
R-07-013	NB13
R-07-014	NB14
R-08-037	NB37
R-08-038	NB38

Project: Route 84
Project Location: Livermore, CA

Boring Number: NB-11
Arroyo Del Valle

Modified to calculate stresses correctly
Extrapolates Vs values when boring depth is less than 30m
Warning: UCLA Vs30 calculates correctly only when Sand,Clay or Silt soil present.

Depth ft	Depth m	Total Unit Weight, pcf	Depth to Phreatic Surface, feet	σ_v kN/m²	σ'_v kN/m²	Type	N_{60} (2)	Undrained shear strength (3), psf	Vs (m/s) All Soils: Seed et al 1983	All Soils: Imai & Tonouchi 1982	All Soils: Sisman 1995	Gravel: Ohta & Goto 1978
1	0.3048	130	4	6.2	6.2	Sand	48	6330.4382	386	326	235	#N/A
5	1.524	130	0	31.1	31.1	Sand	27	3630.6925	293	274	177	#N/A
10	3.048	130	-5	62.2	47.3	Sand	36	4840.9234	338	300	205	#N/A
15	4.572	130	-10	93.4	63.5	Sand	54	7168.2904	411	339	251	#N/A
20	6.096	130	-15	124.5	79.6	Sand	49	6516.6276	392	329	239	#N/A
25	7.62	130	-20	155.6	95.8	Sand	44	5833.9333	371	318	226	#N/A
30	9.144	130	-25	186.7	112.0	Sand	70	9309.468	469	368	286	#N/A
35	10.668	130	-30	217.9	128.2	Sand	68	9030.184	461	365	282	#N/A
40	12.192	130	-35	249.0	144.3	Sand	77	10302.478	493	380	302	#N/A
45	13.716	130	-40	280.1	160.5	Sand	56	7447.5744	419	343	256	#N/A
50	15.24	130	-45	311.2	176.7	Sand	85	11295.488	516	391	316	#N/A
55	16.764	130	-50	342.3	192.8	Sand	97	12909.129	552	408	338	#N/A
58.5	17.8308	130	-53.5	364.1	204.2	Sand	85	11295.488	516	391	316	#N/A
60	18.288			0.0	0.0			0	0	0	0	#N/A
				0.0	0.0			0	0	0	0	#N/A
				0.0	0.0			0	0	0	0	#N/A
				0.0	0.0			0	0	0	0	#N/A
				0.0	0.0			0	0	0	0	#N/A
				0.0	0.0			0	0	0	0	#N/A
				0.0	0.0			0	0	0	0	#N/A
				0.0	0.0			0	0	0	0	#N/A

Depth ft	Sand: Lee 1992	Sand: Sykora & Stokoe 1983	Sand: Imai 1977	Sand: UCLA 2010	Silt: Lee 1992	Silt: Pitilakis 1999	Silt: UCLA 2010	Clay: Pitilakis 1999	Clay: Ohta & Goto 1978	Clay: Imai 1977	Clay: Dickerson 1994	Clay: UCLA 2010	Young Sed Rock: Imai & Tonouchi 1982
1	383	308	289	127	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5	287	262	241	177	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
10	330	285	265	200	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
15	413	319	302	223	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
20	389	311	292	233	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
25	365	301	282	241	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
30	489	345	329	261	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
35	479	342	326	269	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
40	524	355	340	280	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
45	423	323	305	279	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
50	560	364	351	297	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
55	617	379	366	307	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
58.5	560	364	351	307	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
60	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

Depth ft	All mean	Sand mean	Silt mean	Clay mean	Selected Value	UCLA Value	top	bot	Layer thickness, t	Selected Mean t / Vs	UCLA t/Vs
1	316	277	#N/A	#N/A	277	127	0	0.9144	0.9144	0.003302	0.007177
5	248	242	#N/A	#N/A	242	177	0.9144	2.286	1.3716	0.005679	0.007767
10	281	270	#N/A	#N/A	270	200	2.286	3.81	1.524	0.005645	0.007606
15	334	314	#N/A	#N/A	314	223	3.81	5.334	1.524	0.004851	0.006833
20	320	306	#N/A	#N/A	306	233	5.334	6.858	1.524	0.004974	0.006536
25	305	297	#N/A	#N/A	297	241	6.858	8.382	1.524	0.005129	0.006324
30	374	356	#N/A	#N/A	356	261	8.382	9.906	1.524	0.004281	0.005828
35	369	354	#N/A	#N/A	354	269	9.906	11.43	1.524	0.004307	0.005662
40	392	375	#N/A	#N/A	375	280	11.43	12.954	1.524	0.004065	0.005436
45	339	332	#N/A	#N/A	332	279	12.954	14.478	1.524	0.004585	0.00547
50	408	393	#N/A	#N/A	393	297	14.478	16.002	1.524	0.003879	0.005137
55	433	417	#N/A	#N/A	417	307	16.002	17.2974	1.2954	0.003104	0.004223
58.5	408	395	#N/A	#N/A	395	307	17.2974	18.0594	0.762	0.001927	0.002483
60	0	#N/A	#N/A	#N/A	NA	NA	18.0594	30	NA	NA	NA
	0	#N/A	#N/A	#N/A	NA	NA	30	0	NA	NA	NA
	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA
	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA
	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA
	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA
	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA
	0	#N/A	#N/A	#N/A	NA	NA	0	30	NA	NA	NA
								sums	18.0594	0.055729	0.076484

Vs(d)= 324.1 236.1 m/s
Vs30= 382.1 278.4 m/s

Notes:
1. Reference: DeJong, J.T., 2007. *Site Characterization - Guidelines for Estimating Vs Based on In-Situ Tests* . State 1 - Interim Report. Soil Innteractions Laboratory, UC Davis. December 19.
Reference: Caltrans 2012. *Methodology for Developing Design Response Spectrum for Use in Seismic Design Recommendations* . http://dap3.dot.ca.gov/shake_stable/v2/technical.php. November.
2. Do not correct N_{60} for overburden pressure effect. Limit N_{60} to 100 blows per foot.
3. If undrained shear strength of clay sample has not been measured, try estimating it as 133 times N_{60}.

Project: Route 84 Boring Number: NB-12
Project Location: Livermore, CA Arroyo Del Valle

Modified to calculate stresses correctly
Extrapolates Vs values when boring depth is less than 30m
Warning: UCLA Vs30 calculates correctly only when Sand,Clay or Silt soil present.

Depth ft	Depth m	Total Unit Weight, pcf	Depth to Phreatic Surface, feet	σ_v kN/m²	σ'_v kN/m²	Type	N_{60} (2)	Undrained shear strength (3), psf
1	0.3048	130	7	6.2	6.2	Silt	24	3227.4482
5	1.524	130	3	31.1	31.1	Sand	72	9620.2784
10	3.048	130	-2	62.2	56.3	Sand	73	9682.3447
15	4.572	130	-7	93.4	72.4	Sand	91	12040.865
20	6.096	130	-12	124.5	88.6	Sand	41	5492.8686
25	7.62	130	-17	155.6	104.8	Sand	70	9309.9468
30	9.144	130	-22	186.7	121.0	Sand	53	7075.5596
35	10.668	130	-27	217.9	137.1	Sand	25	3351.5808
36.5	11.1252	130	-28.5	227.2	142.0	Sand	31	4189.4761
40	12.192	130	-32	249.0	153.3	Sand	38	5027.3713
45	13.716	130	-37	280.1	169.5	Sand	52	6982.4601
50	15.24	130	-42	311.2	185.6	Sand	112	14895.915
60	18.288	130	-52	373.5	218.0	Sand	82	10923.671
70	21.336	130	-62	435.7	250.3	Sand	91	12164.997
75	22.86			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

Vs in meters per second

Depth ft	All Soils: Seed et al 1983	All Soils: Imai & Tonouchi 1982	All Soils: Sisman 1995	Gravel: Ohta & Goto 1978	Sand: Lee 1992	Sand: Sykora & Stokoe 1983	Sand: Imai 1977	Sand: UCLA 2010	Silt: Lee 1992	Silt: Pitilakis 1999	Silt: UCLA 2010	Clay: Pitilakis 1999	Clay: Ohta & Goto 1978	Clay: Imai 1977	Clay: Dickerson 1994	Clay: UCLA 2010	Young Sed Rock: Imai & Tonouchi 1982
1	276	264	167	#N/A	#N/A	#N/A	#N/A	#N/A	306	256	118	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5	476	372	291	#N/A	500	348	332	194	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
10	478	373	292	#N/A	502	348	333	223	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
15	533	399	326	#N/A	586	371	358	242	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
20	360	312	219	#N/A	353	296	276	235	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
25	469	368	286	#N/A	489	345	329	257	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
30	408	338	249	#N/A	409	318	300	259	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
35	281	267	170	#N/A	277	256	235	249	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
36.5	314	287	191	#N/A	306	273	253	256	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
40	344	303	209	#N/A	336	288	268	265	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
45	406	336	247	#N/A	406	317	299	280	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
50	593	427	364	#N/A	688	395	384	308	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
60	508	387	311	#N/A	546	361	347	311	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
70	536	401	328	#N/A	591	372	359	324	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
75	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

Depth ft	All mean	Sand mean	Silt mean	Clay mean	Selected Value	UCLA Value	top	bot	Layer thickness, t	Selected Mean t / Vs	UCLA t/Vs	
1	236	#N/A	227	#N/A	227	118	0	0.9144	0.9144	0.004035	0.007731	
5	380	344	#N/A	#N/A	344	194	0.9144	2.286	1.3716	0.003992	0.007074	
10	381	352	#N/A	#N/A	352	223	2.286	3.81	1.524	0.004333	0.00683	
15	420	389	#N/A	#N/A	389	242	3.81	5.334	1.524	0.003914	0.006302	
20	297	290	#N/A	#N/A	290	235	5.334	6.858	1.524	0.005255	0.006479	
25	374	355	#N/A	#N/A	355	257	6.858	8.382	1.524	0.004294	0.00592	
30	332	322	#N/A	#N/A	322	259	8.382	9.906	1.524	0.004736	0.005876	
35	239	254	#N/A	#N/A	254	249	9.906	10.8966	0.9906	0.0039	0.003984	
36.5	264	272	#N/A	#N/A	272	256	10.8966	11.6586	0.762	0.0028	0.002975	
40	286	290	#N/A	#N/A	290	265	11.6586	12.954	1.2954	0.004474	0.00488	
45	330	326	#N/A	#N/A	326	280	12.954	14.478	1.524	0.00468	0.005433	
50	461	444	#N/A	#N/A	444	308	14.478	16.764	2.286	0.005151	0.007417	
60	402	391	#N/A	#N/A	391	311	16.764	19.812	3.048	0.007791	0.009809	
70	421	412	#N/A	#N/A	412	324	19.812	22.098	2.286	0.005553	0.007047	
75	0	#N/A	#N/A	#N/A	NA	NA	22.098	11.43	NA	NA	NA	
	0	#N/A	#N/A	#N/A	NA	NA	11.43	0	NA	NA	NA	
	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA	
	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA	
	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA	
	0	#N/A	#N/A	#N/A	NA	NA	0	30	NA	NA	NA	
								sums	22.098	0.064909	0.087758	
									Vs(d)=	340.4	251.8	m/s
									Vs30=	380.8	281.7	m/s

Notes:

1. Reference: DeJong, J.T., 2007. *Site Characterization - Guidelines for Estimating Vs Based on In-Situ Tests* . State 1 - Interim Report. Soil Innteractions Laboratory, UC Davis. December 19.
   Reference: Caltrans 2012. *Methodology for Developing Design Response Spectrum for Use in Seismic Design Recommendations* . http://dap3.dot.ca.gov/shake_stable/v2/technical.php. November.
2. Do not correct N_{60} for overburden pressure effect. Limit N_{60} to 100 blows per foot.
3. If undrained shear strength of clay sample has not been measured, try estimating it as 133 times N_{60}.

Project: Route 84
Project Location: Livermore, CA

Boring Number: NB-13
Arroyo Del Valle

Modified to calculate stresses correctly
Extrapolates Vs values when boring depth is less than 30m
Warning: UCLA Vs30 calculates correctly only when Sand,Clay or Silt soil present.

Depth ft	Depth m	Total Unit Weight, pcf	Depth to Phreatic Surface, feet	σ_v kN/m^2	σ'_v kN/m^2	Type	N_{60} (2)	Undrained shear strength (3), psf
1	0.3048	130	13	6.2	6.2	Silt	7	993.00992
5	1.524	130	9	31.1	31.1	Sand	39	5213.3021
10	3.048	130	4	62.2	62.2	Sand	57	7602.7322
15	4.572	130	-1	93.4	90.4	Sand	34	4499.5762
20	6.096	130	-6	124.5	106.5	Clay	9	1241.2624
25	7.62	130	-11	155.6	122.7	Sand	72	9557.7205
30	9.144	130	-16	186.7	138.9	Sand	65	8688.8368
35	10.668	130	-21	217.9	155.1	Sand	55	7292.4166
40	12.192	130	-26	249.0	171.2	Sand	42	5585.6808
45	13.716	130	-31	280.1	187.4	Sand	64	8533.679
50	15.24	130	-36	311.2	203.6	Sand	91	12040.245
55	16.764	130	-41	342.3	219.8	Sand	70	9309.468
60	18.288	130	-46	373.5	235.9	Sand	115	15267.528
65	19.812	130	-51	404.6	252.1	Sand	59	7819.9531
70	21.336	130	-56	435.7	268.3	Sand	207	27556.025
75	22.86	130	-61	466.8	284.4	Sand	119	15764.032
78.5	23.9268	130	-64.5	488.6	295.8	Sand	187	24825.248
85	25.908			0.0	0.0			0
	0			0.0	0.0			0
	0			0.0	0.0			0

Vs in meters per second

Depth ft	All Soils: Seed et al 1983	All Soils: Imai & Tonouchi 1982	All Soils: Sisman 1995	Gravel: Ohta & Goto 1978	Sand: Lee 1992	Sand: Sykora & Stokoe 1983	Sand: Imai 1977	Sand: UCLA 2010	Silt: Lee 1992	Silt: Pitilakis 1999	Silt: UCLA 2010	Clay: Pitilakis 1999	Clay: Ohta & Goto 1978	Clay: Imai 1977	Clay: Dickerson 1994	Clay: UCLA 2010	Young Sed Rock: Imai & Tonouchi 1982
1	153	182	91	#N/A	#N/A	#N/A	#N/A	#N/A	212	207	96	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5	351	307	213	#N/A	343	291	271	183	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
10	423	346	258	#N/A	428	325	308	223	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
15	326	293	198	#N/A	317	279	259	232	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
20	171	196	102	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	242	183	154	158	195	#N/A
25	475	371	290	#N/A	498	347	332	268	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
30	453	360	276	#N/A	467	338	321	273	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
35	415	341	253	#N/A	417	321	303	276	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
40	363	314	221	#N/A	356	297	278	275	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
45	449	358	274	#N/A	461	336	320	293	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
50	533	399	326	#N/A	586	371	358	309	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
55	469	368	286	#N/A	489	345	329	307	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
60	600	430	368	#N/A	701	398	387	327	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
65	429	349	262	#N/A	436	328	310	311	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
70	806	518	498	#N/A	1,139	472	471	357	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
75	610	434	375	#N/A	719	401	392	343	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
78.5	765	501	472	#N/A	1,042	458	455	361	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
85	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

Depth ft	All mean	Sand mean	Silt mean	Clay mean	Selected Value	UCLA Value	top	bot	Layer thickness, t	Selected Mean t / Vs	UCLA t/Vs
1	142	#N/A	172	#N/A	172	96	0	0.9144	0.9144	0.005321	0.009536
5	290	272	#N/A	#N/A	272	183	0.9144	2.286	1.3716	0.005041	0.007502
10	342	321	#N/A	#N/A	321	223	2.286	3.81	1.524	0.004748	0.006826
15	272	272	#N/A	#N/A	272	232	3.81	5.334	1.524	0.005609	0.006574
20	156	#N/A	#N/A	186	186	195	5.334	6.858	1.524	0.008179	0.007797
25	379	361	#N/A	#N/A	361	268	6.858	8.382	1.524	0.00422	0.005689
30	363	350	#N/A	#N/A	350	273	8.382	9.906	1.524	0.004357	0.005576
35	336	329	#N/A	#N/A	329	276	9.906	11.43	1.524	0.004628	0.005525
40	299	302	#N/A	#N/A	302	275	11.43	12.954	1.524	0.005054	0.005537
45	360	352	#N/A	#N/A	352	293	12.954	14.478	1.524	0.004325	0.005205
50	419	406	#N/A	#N/A	406	309	14.478	16.002	1.524	0.003753	0.004938
55	374	367	#N/A	#N/A	367	307	16.002	17.526	1.524	0.00415	0.004971
60	466	453	#N/A	#N/A	453	327	17.526	19.05	1.524	0.003362	0.004662
65	347	346	#N/A	#N/A	346	311	19.05	20.574	1.524	0.004401	0.004894
70	607	610	#N/A	#N/A	610	357	20.574	22.098	1.524	0.0025	0.004273
75	473	464	#N/A	#N/A	464	343	22.098	23.3934	1.2954	0.002794	0.00378
78.5	579	579	#N/A	#N/A	579	361	23.3934	24.9174	1.524	0.002632	0.004218
85	0	#N/A	#N/A	#N/A	NA	NA	24.9174	12.954	NA	NA	NA
	0	#N/A	#N/A	#N/A	NA	NA	12.954	0	NA	NA	NA
	0	#N/A	#N/A	#N/A	NA	NA	0	30	NA	NA	NA
								sums	24.9174	0.075072	0.097503

Vs(d)= 331.9 255.6 m/s
Vs30= 357.2 275.0 m/s

Notes:

1. Reference: DeJong, J.T., 2007. *Site Characterization - Guidelines for Estimating Vs Based on In-Situ Tests* . State 1 - Interim Report. Soil Innteractions Laboratory, UC Davis. December 19.
   Reference: Caltrans 2012. *Methodology for Developing Design Response Spectrum for Use in Seismic Design Recommendations* . http://dap3.dot.ca.gov/shake_stable/v2/technical.php. November.
2. Do not correct N_{60} for overburden pressure effect. Limit N_{60} to 100 blows per foot.
3. If undrained shear strength of clay sample has not been measured, try estimating it as 133 times N_{60}.

Project: Route 84
Project Location: Livermore, CA

Boring Number: NB-14
Arroyo Del Valle

Modified to calculate stresses correctly
Extrapolates Vs values when boring depth is less than 30m
Warning: UCLA Vs30 calculates correctly only when Sand,Clay or Silt soil present.

Depth ft	Depth m	Total Unit Weight, pcf	Depth to Phreatic Surface, feet	σ_v kN/m²	σ'_v kN/m²	Type	N_{60} (2)	Undrained shear strength (3), psf
1	0.3048	130	13	6.2	6.2	Silt	37	4965.0496
5	1.524	130	9	31.1	31.1	Sand	63	8316.4581
10	3.048	130	4	62.2	62.2	Sand	24	3227.2822
15	4.572	130	-1	93.4	90.4	Sand	12	1613.6411
20	6.096	130	-6	124.5	106.5	Clay	45	5958.0595
25	7.62	130	-11	155.6	122.7	Sand	66	8812.963
30	9.144	130	-16	186.7	138.9	Sand	51	6826.9432
35	10.668	130	-21	217.9	155.1	Sand	61	8099.2372
40	12.192	130	-26	249.0	171.2	Sand	50	6702.817
45	13.716	130	-31	280.1	187.4	Sand	28	3723.7872
50	15.24	130	-36	311.2	203.6	Sand	187	24825.248
55	16.764	130	-41	342.3	219.8	Sand	32	4220.2922
58.5	17.8308	130	-44.5	364.1	231.1	Sand	61	8068.2056
60	18.288		-46	0.0	-137.5			0
	0		14	0.0	0.0			0
	0		14	0.0	0.0			0
	0		14	0.0	0.0			0
	0			0.0	0.0			0
	0			0.0	0.0			0
	0			0.0	0.0			0

Vs in meters per second

Depth ft	Depth m	All Soils: Seed et al 1983	All Soils: Imai & Tonouchi 1982	All Soils: Sisman 1995	Gravel: Ohta & Goto 1978	Sand: Lee 1992	Sand: Sykora & Stokoe 1983	Sand: Imai 1977	Sand: UCLA 2010	Silt: Lee 1992	Silt: Pitilakis 1999	Silt: UCLA 2010	Clay: Pitilakis 1999	Clay: Ohta & Goto 1978	Clay: Imai 1977	Clay: Dickerson 1994	Clay: UCLA 2010	Young Sed Rock: Imai & Tonouchi 1982
1	0.3048	342	302	208	#N/A	#N/A	#N/A	#N/A	#N/A	351	276	128	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5	1.524	443	355	270	#N/A	454	333	317	191	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
10	3.048	276	264	167	#N/A	272	253	232	206	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
15	4.572	195	212	117	#N/A	215	207	184	210	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
20	6.096	375	320	228	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	370	308	243	332	280	#N/A
25	7.62	456	362	278	#N/A	471	339	323	266	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
30	9.144	401	334	244	#N/A	400	315	297	267	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
35	10.668	437	352	267	#N/A	446	331	314	279	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
40	12.192	398	332	242	#N/A	396	313	295	280	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
45	13.716	296	276	179	#N/A	290	264	243	270	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
50	15.24	765	501	472	#N/A	1,042	458	455	331	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
55	16.764	315	287	191	#N/A	308	274	253	284	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
58.5	17.8308	436	352	266	#N/A	445	331	314	306	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
60	18.288	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

Depth ft	Depth m	All mean	Sand mean	Silt mean	Clay mean	Selected Value	UCLA Value	top	bot	Layer thickness, t	Selected Mean t / Vs	UCLA t/Vs
1	0.3048	284	#N/A	252	#N/A	252	128	0	0.9144	0.9144	0.003632	0.00716
5	1.524	356	324	#N/A	#N/A	324	191	0.9144	2.286	1.3716	0.004237	0.007173
10	3.048	236	241	#N/A	#N/A	241	206	2.286	3.81	1.524	0.006332	0.007411
15	4.572	175	204	#N/A	#N/A	204	210	3.81	5.334	1.524	0.007469	0.007254
20	6.096	308	#N/A	#N/A	307	307	280	5.334	6.858	1.524	0.004968	0.005435
25	7.62	365	350	#N/A	#N/A	350	266	6.858	8.382	1.524	0.004357	0.005734
30	9.144	327	320	#N/A	#N/A	320	267	8.382	9.906	1.524	0.004766	0.005707
35	10.668	352	342	#N/A	#N/A	342	279	9.906	11.43	1.524	0.004452	0.00547
40	12.192	324	321	#N/A	#N/A	321	280	11.43	12.954	1.524	0.004746	0.005441
45	13.716	251	267	#N/A	#N/A	267	270	12.954	14.478	1.524	0.005712	0.005636
50	15.24	579	571	#N/A	#N/A	571	331	14.478	16.002	1.524	0.002667	0.004607
55	16.764	265	280	#N/A	#N/A	280	284	16.002	17.2974	1.2954	0.004632	0.004559
58.5	17.8308	351	349	#N/A	#N/A	349	306	17.2974	18.0594	0.762	0.002185	0.00249
60	18.288	0	#N/A	#N/A	#N/A	NA	NA	18.0594	9.144	NA	NA	NA
	0	0	#N/A	#N/A	#N/A	NA	NA	9.144	0	NA	NA	NA
	0	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA
	0	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA
	0	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA
	0	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA
	0	0	#N/A	#N/A	#N/A	NA	NA	0	30	NA	NA	NA
									sums	18.0594	0.060154	0.074078
										Vs(d)=	300.2	243.8 m/s
										Vs30=	354.0	287.5 m/s

Notes:
1. Reference: DeJong, J.T., 2007. *Site Characterization - Guidelines for Estimating Vs Based on In-Situ Tests* . State 1 - Interim Report. Soil Innteractions Laboratory, UC Davis. December 19.
Reference: Caltrans 2012. *Methodology for Developing Design Response Spectrum for Use in Seismic Design Recommendations* . http://dap3.dot.ca.gov/shake_stable/v2/technical.php. November.
2. Do not correct N_{60} for overburden pressure effect. Limit N_{60} to 100 blows per foot.
3. If undrained shear strength of clay sample has not been measured, try estimating it as 133 times N_{60}.

Project: Route 84
Project Location: Livermore, CA

Boring Number: NB-37
Arroyo Del Valle

Modified to calculate stresses correctly
Extrapolates Vs values when boring depth is less than 30m
Warning: UCLA Vs30 calculates correctly only when Sand,Clay or Silt soil present.

Depth		Total	Depth to					Undrained	Vs in meters per second																
									All Soils			Gravel	Sand				Silt			Clay					Young Sed Rock
ft	m	Unit Weight, pcf	Phreatic Surface, feet	σ_v kN/m^2	σ'_v kN/m^2	Type	N_{60} (2)	shear strength(3), psf	Seed et al 1983	Imai & Tonouchi 1982	Sisman 1995	Ohta & Goto 1978	Lee 1992	Sykora & Stokoe 1983	Imai 1977	UCLA 2010	Lee 1992	Pitilakis 1999	UCLA 2010	Pitilakis 1999	Ohta & Goto 1978	Imai 1977	Dickerson 1994	UCLA 2010	Imai & Tonouchi 1982
1	0.3048	130	2.5	6.2	6.2	Sand	54	7199.6922	412	340	251	#N/A	414	320	302	129	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5	1.524	130	-1.5	31.1	26.6	Sand	17	2234.3872	230	235	138	#N/A	237	228	205	162	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
10	3.048	130	-6.5	62.2	42.8	Sand	49	6454.8964	390	328	238	#N/A	387	310	291	201	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
15	4.572	130	-11.5	93.4	59.0	Sand	82	10861.605	506	387	310	#N/A	544	360	346	228	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
20	6.096	130	-16.5	124.5	75.2	Sand	48	6330.7638	386	326	235	#N/A	383	308	289	229	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
25	7.62	130	-21.5	155.6	91.3	Sand	56	7447.9574	419	343	256	#N/A	423	323	305	244	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
30	9.144	130	-26.5	186.7	107.5	Sand	50	6672.1285	397	332	242	#N/A	395	313	295	251	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
35	10.668	130	-31.5	217.9	123.7	Sand	73	9682.3447	478	373	292	#N/A	502	348	333	269	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
40	12.192	130	-36.5	249.0	139.8	Sand	93	12413.262	541	403	332	#N/A	600	375	362	283	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
45	13.716	130	-41.5	280.1	156.0	Silt	20	2637.8183	249	248	151	#N/A	#N/A	#N/A	#N/A	#N/A	287	247	240	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
50	15.24	130	-46.5	311.2	172.2	Sand	55	7323.8248	416	342	253	#N/A	418	321	304	283	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
55	16.764	130	-51.5	342.3	188.4	Sand	77	10240.941	491	379	301	#N/A	522	354	339	298	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
60	18.288	130	-56.5	373.5	204.5	Sand	91	12164.997	536	401	328	#N/A	591	372	359	309	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
65	19.812	130	-61.5	404.6	220.7	Sand	90	11947.765	531	398	325	#N/A	583	370	357	314	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
70	21.336	130	-66.5	435.7	236.9	Sand	113	15020.048	595	428	365	#N/A	692	396	385	327	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
75	22.86	130	-71.5	466.8	253.0	Sand	98	13033.926	554	409	340	#N/A	622	380	368	327	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
80	24.384	130	-76.5	498.0	269.2	Sand	111	14771.782	590	426	362	#N/A	684	394	383	336	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
85	25.908	130	-81.5	529.1	285.4	Sand	120	15982.075	614	436	377	#N/A	727	403	393	343	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
88.5	26.9748	130	-85	550.9	296.7	Sand	103	13654.589	567	415	348	#N/A	644	385	373	341	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
90	27.432			0.0	0.0			0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

ft	All mean	Sand mean	Silt mean	Clay mean	Selected Value	UCLA Value	top	bot	Layer thickness, t	Selected Mean t / Vs	UCLA t/Vs
1	334	291	#N/A	#N/A	291	129	0	0.9144	0.9144	0.003141	0.007089
5	201	208	#N/A	#N/A	208	162	0.9144	2.286	1.3716	0.006594	0.008442
10	319	297	#N/A	#N/A	297	201	2.286	3.81	1.524	0.005125	0.007575
15	401	370	#N/A	#N/A	370	228	3.81	5.334	1.524	0.004122	0.006681
20	316	302	#N/A	#N/A	302	229	5.334	6.858	1.524	0.005039	0.006645
25	339	324	#N/A	#N/A	324	244	6.858	8.382	1.524	0.004708	0.006248
30	323	313	#N/A	#N/A	313	251	8.382	9.906	1.524	0.004865	0.006076
35	381	363	#N/A	#N/A	363	269	9.906	11.43	1.524	0.004197	0.005672
40	425	405	#N/A	#N/A	405	283	11.43	12.954	1.524	0.003765	0.00538
45	216	#N/A	258	#N/A	258	240	12.954	14.478	1.524	0.00591	0.006346
50	337	332	#N/A	#N/A	332	283	14.478	16.002	1.524	0.004597	0.005388
55	390	379	#N/A	#N/A	379	298	16.002	17.526	1.524	0.004026	0.005108
60	421	408	#N/A	#N/A	408	309	17.526	19.05	1.524	0.003736	0.004928
65	418	406	#N/A	#N/A	406	314	19.05	20.574	1.524	0.003752	0.004848
70	463	450	#N/A	#N/A	450	327	20.574	22.098	1.524	0.003386	0.004665
75	435	424	#N/A	#N/A	424	327	22.098	23.622	1.524	0.003593	0.004655
80	459	449	#N/A	#N/A	449	336	23.622	25.146	1.524	0.003393	0.004533
85	476	467	#N/A	#N/A	467	343	25.146	26.4414	1.2954	0.002776	0.003772
88.5	444	436	#N/A	#N/A	436	341	26.4414	27.2034	0.762	0.001748	0.002232
90	0	#N/A	#N/A	#N/A	NA	NA	27.2034	30	NA	NA	NA
								sums	27.2034	0.078471	0.106282
									Vs(d)=	346.7	256.0 m/s
									Vs30=	361.2	266.7 m/s

Notes:

1. Reference: DeJong, J.T., 2007. *Site Characterization - Guidelines for Estimating Vs Based on In-Situ Tests* . State 1 - Interim Report. Soil Innteractions Laboratory, UC Davis. December 19.
   Reference: Caltrans 2012. *Methodology for Developing Design Response Spectrum for Use in Seismic Design Recommendations* . http://dap3.dot.ca.gov/shake_stable/v2/technical.php. November.
2. Do not correct N_{60} for overburden pressure effect. Limit N_{60} to 100 blows per foot.
3. If undrained shear strength of clay sample has not been measured, try estimating it as 133 times N_{60}.

Project: Route 84
Project Location: Livermore, CA

Boring Number: NB-38
Arroyo Del Valle

Modified to calculate stresses correctly
Extrapolates Vs values when boring depth is less than 30m
Warning: UCLA Vs30 calculates correctly only when Sand,Clay or Silt soil present.

Depth ft	Depth m	Total Unit Weight, pcf	Depth to Phreatic Surface, feet	σ_v kN/m²	σ'_v kN/m²	Type	N_{60} (2)	Undrained shear strength(3), psf
1	0.3048	130	2.5	6.2	6.2	Sand	47	6206.6312
5	1.524	130	-1.5	31.1	26.6	Sand	81	10799.538
10	3.048	130	-6.5	62.2	42.8	Sand	43	5741.1339
15	4.572	130	-11.5	93.4	59.0	Sand	40	5337.7028
20	6.096	130	-16.5	124.5	75.2	Sand	65	8689.2837
25	7.62	130	-21.5	155.6	91.3	Sand	106	14151.119
30	9.144	130	-26.5	186.7	107.5	Sand	48	6361.797
35	10.668	130	-31.5	217.9	123.7	Sand	149	19861.22
40	12.192	130	-36.5	249.0	139.8	Sand	72	9620.2784
45	13.716	130	-41.5	280.1	156.0	Sand	78	10427.14
50	15.24	130	-46.5	311.2	172.2	Sand	64	8534.1179
55	16.764	130	-51.5	342.3	188.4	Sand	106	14151.119
60	18.288	130	-56.5	373.5	204.5	Sand	77	10240.941
65	19.812	130	-61.5	404.6	220.7	Sand	86	11420.201
70	21.336	130	-66.5	435.7	236.9	Sand	108	14430.418
75	22.86	130	-71.5	466.8	253.0	Sand	105	14026.987
80	24.384	130	-76.5	498.0	269.2	Sand	150	20016.386
85	25.908	130	-81.5	529.1	285.4	Sand	86	11420.201
88.5	26.9748	130	-85	550.9	296.7	Sand	107	14275.252
90	27.432			0.0	0.0			0

Vs in meters per second

Depth ft	All Soils: Seed et al 1983	All Soils: Imai & Tonouchi 1982	All Soils: Sisman 1995	Gravel: Ohta & Goto 1978	Sand: Lee 1992	Sand: Sykora & Stokoe 1983	Sand: Imai 1977	Sand: UCLA 2010
1	383	324	233	#N/A	378	306	288	127
5	505	386	309	#N/A	542	360	345	189
10	368	316	224	#N/A	362	299	280	199
15	355	309	216	#N/A	347	293	274	213
20	453	360	276	#N/A	467	338	321	236
25	578	420	354	#N/A	661	389	378	259
30	387	327	236	#N/A	384	309	290	250
35	684	467	421	#N/A	865	429	423	288
40	476	372	291	#N/A	500	348	332	276
45	496	382	303	#N/A	529	356	341	286
50	449	358	274	#N/A	461	336	320	287
55	578	420	354	#N/A	661	389	378	308
60	491	379	301	#N/A	522	354	339	304
65	519	393	318	#N/A	564	366	352	313
70	583	423	358	#N/A	671	391	380	325
75	575	419	353	#N/A	657	388	377	330
80	687	468	423	#N/A	870	430	424	346
85	519	393	318	#N/A	564	366	352	333
88.5	580	421	356	#N/A	666	390	379	343
90	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A

Depth ft	Silt: Lee 1992	Silt: Pitilakis 1999	Silt: UCLA 2010	Clay: Pitilakis 1999	Clay: Ohta & Goto 1978	Clay: Imai 1977	Clay: Dickerson 1994	Clay: UCLA 2010	Young Sed Rock: Imai & Tonouchi 1982
1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
10	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
15	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
20	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
25	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
30	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
35	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
40	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
45	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
50	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
55	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
60	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
65	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
70	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
75	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
80	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
85	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
88.5	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
90	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

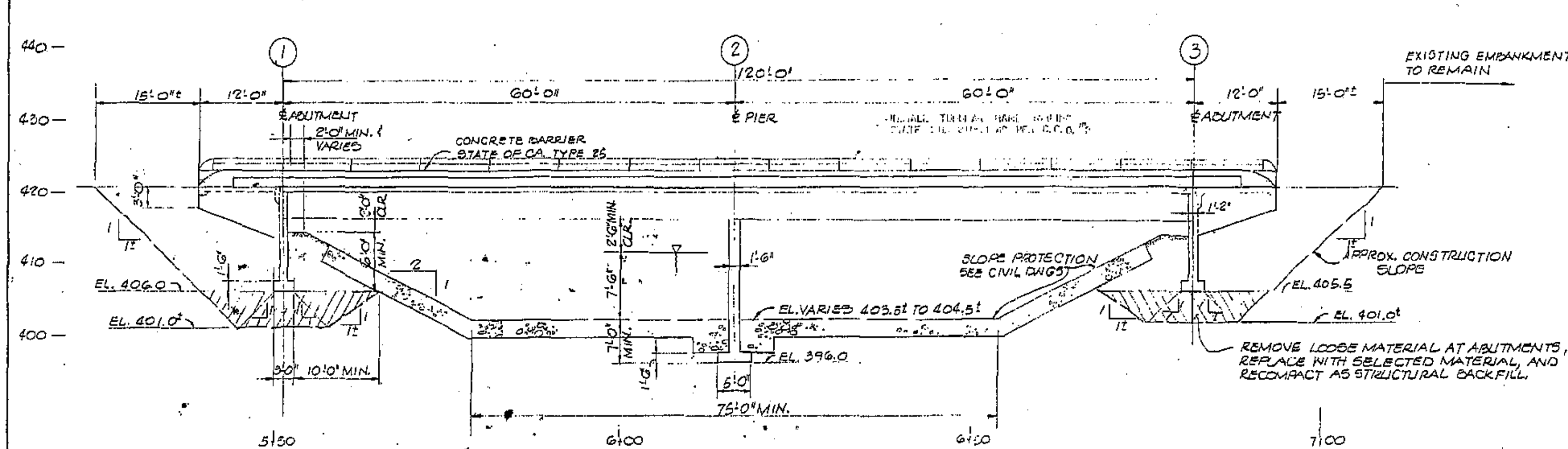
Depth ft	All mean	Sand mean	Silt mean	Clay mean	Selected Value	UCLA Value	top	bot	Layer thickness, t	Selected Mean t / Vs	UCLA t/Vs
1	313	275	#N/A	#N/A	275	127	0	0.9144	0.9144	0.003327	0.007191
5	400	359	#N/A	#N/A	359	189	0.9144	2.286	1.3716	0.00382	0.007257
10	303	285	#N/A	#N/A	285	199	2.286	3.81	1.524	0.005345	0.00766
15	293	282	#N/A	#N/A	282	213	3.81	5.334	1.524	0.005408	0.007152
20	363	341	#N/A	#N/A	341	236	5.334	6.858	1.524	0.004474	0.006446
25	451	422	#N/A	#N/A	422	259	6.858	8.382	1.524	0.003612	0.005875
30	317	308	#N/A	#N/A	308	250	8.382	9.906	1.524	0.004948	0.006104
35	524	501	#N/A	#N/A	501	288	9.906	11.43	1.524	0.003041	0.005294
40	380	364	#N/A	#N/A	364	276	11.43	12.954	1.524	0.004185	0.005513
45	394	378	#N/A	#N/A	378	286	12.954	14.478	1.524	0.004031	0.005331
50	360	351	#N/A	#N/A	351	287	14.478	16.002	1.524	0.004342	0.00531
55	451	434	#N/A	#N/A	434	308	16.002	17.526	1.524	0.003511	0.004952
60	390	380	#N/A	#N/A	380	304	17.526	19.05	1.524	0.004011	0.00501
65	410	399	#N/A	#N/A	399	313	19.05	20.574	1.524	0.003823	0.004869
70	455	442	#N/A	#N/A	442	325	20.574	22.098	1.524	0.003447	0.004683
75	449	438	#N/A	#N/A	438	330	22.098	23.622	1.524	0.003481	0.004623
80	526	518	#N/A	#N/A	518	346	23.622	25.146	1.524	0.002944	0.004403
85	410	404	#N/A	#N/A	404	333	25.146	26.4414	1.2954	0.00321	0.003895
88.5	452	444	#N/A	#N/A	444	343	26.4414	27.2034	0.762	0.001715	0.002222
90	0	#N/A	#N/A	#N/A	NA	NA	27.2034	30	NA	NA	NA
								sums	27.2034	0.072676	0.10379

	Selected Mean	UCLA	
Vs(d)=	374.3	262.1	m/s
Vs30=	390.0	273.1	m/s

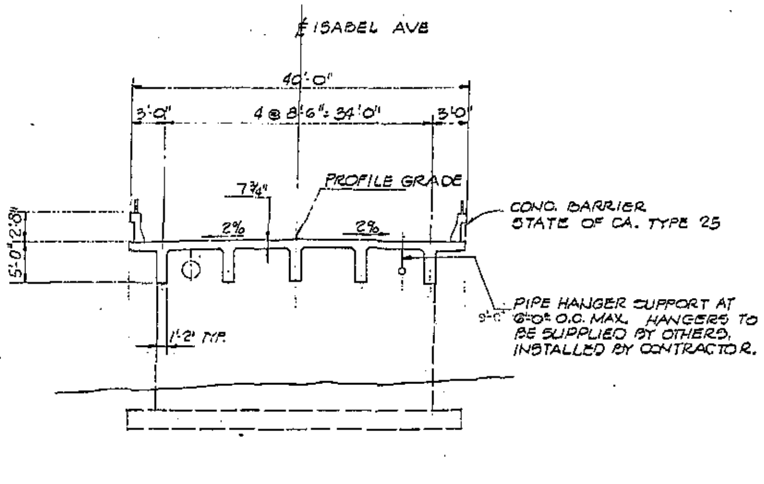
Notes:
1. Reference: DeJong, J.T., 2007. *Site Characterization - Guidelines for Estimating Vs Based on In-Situ Tests* . State 1 - Interim Report. Soil Innteractions Laboratory, UC Davis. December 19.
Reference: Caltrans 2012. *Methodology for Developing Design Response Spectrum for Use in Seismic Design Recommendations* . http://dap3.dot.ca.gov/shake_stable/v2/technical.php. November.
2. Do not correct N_{60} for overburden pressure effect. Limit N_{60} to 100 blows per foot.
3. If undrained shear strength of clay sample has not been measured, try estimating it as 133 times N_{60}.

As-Built Plans

Print/copy from full size



ELEVATION
1" = 10'



TYPICAL SECTION
1" = 10'

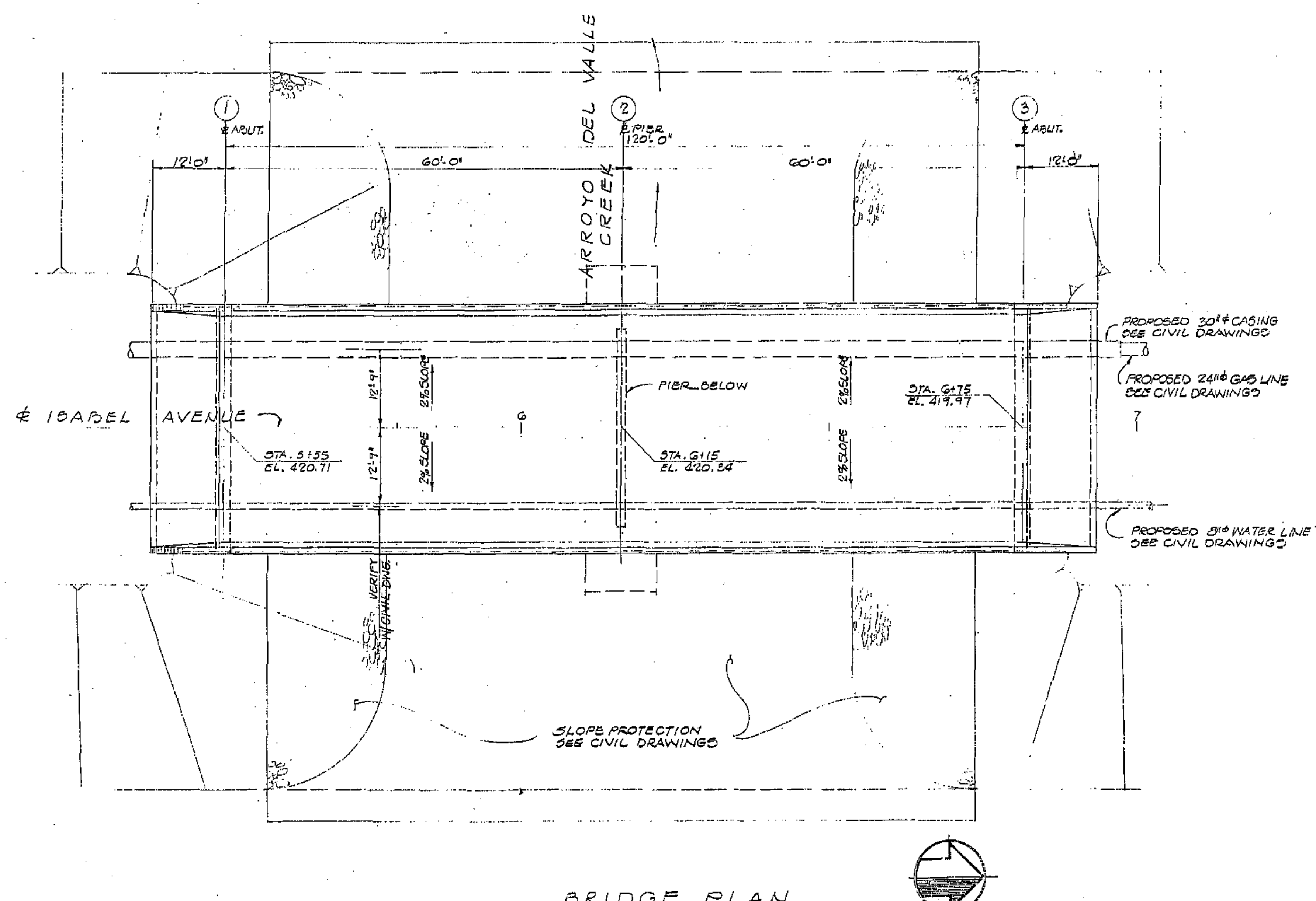
ITEM	UNIT	QUANTITY
STRUCTURAL EXCAVATION (BRIDGE)	C.Y.	225
STRUCTURAL BACKFILL (BRIDGE)	C.Y.	140
PERVIOUS MATERIAL	C.Y.	26
CONCRETE (BRIDGE)	C.Y.	342
CONCRETE (FOOTING)	C.Y.	21
CONCRETE (APPROACH SLAB)	C.Y.	34
BAR STEEL (REINFORCING)	LBS.	86,600
BARRIER RAIL	L.F.	288
TYPE AL JOINT SEAL	L.F.	48

BRIDGE DESIGN CRITERIA

1. AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES THROUGH 1982 REVISIONS AS AMENDED BY THE STATE OF CALIFORNIA DEPT. OF TRANSPORTATION DATED JAN. 1983.
2. DEAD LOAD: INCLUDES 35 P.S.F. FOR FUTURE WEARING SURFACE.
3. LIVE LOAD: HS 20-44
4. REINFORCED CONCRETE:
   SERVICE LOAD DESIGN (TRANSVERSE DECK FLEXURE)
   f_c = 1,200 psi
   f_s = 20,000 psi
   n = 9
   LOAD FACTOR DESIGN
   f'_c = 3,500 psi
   f_y = 60,000 psi, EXCEPT
   50,000 psi, STIRRUPS
5. FOUNDATION ALLOWABLE BEARING PRESSURE
   ABUTMENT: DL 4000 PSF
   DL+LL 6000 PSF
   ALL 8000 PSF
   PIER: DL 6000 PSF
   DL+LL 8500 PSF
   ALL 11,000 PSF

NOTES:

1. FALSEWORK FOR BRIDGE SHALL REMAIN IN PLACE UNTIL CONCRETE HAS OBTAINED SPECIFIED STRENGTH WITH A MINIMUM ELAPSED TIME OF 21 DAYS AFTER LAST CONCRETE (EXCLUDING CONCRETE ABOVE THE BRIDGE DECK) PLACEMENT.
2. THE REQUIRED 28 DAY COMPRESSIVE STRENGTH FOR ALL BRIDGE STRUCTURAL CONCRETE AND FOOTING CONCRETE SHALL BE 3500 PSI.



BRIDGE PLAN
1" = 10'

COUNTY OF ALAMEDA PUBLIC WORKS AGENCY ROAD DIVISION

APPROVAL RECOMMENDED
APPROVED Ronald E. Sorensen

REV.	DATE	DESCRIPTION	BY
1	6-83	RELEASED FOR BIDDING	SAB
0	5-9-83	RELEASED FOR APPROVAL	SAB

DESIGNED BY: FLM
DRAWN BY: DJC
CHECKED BY: SAB
SCALE: AS SHOWN

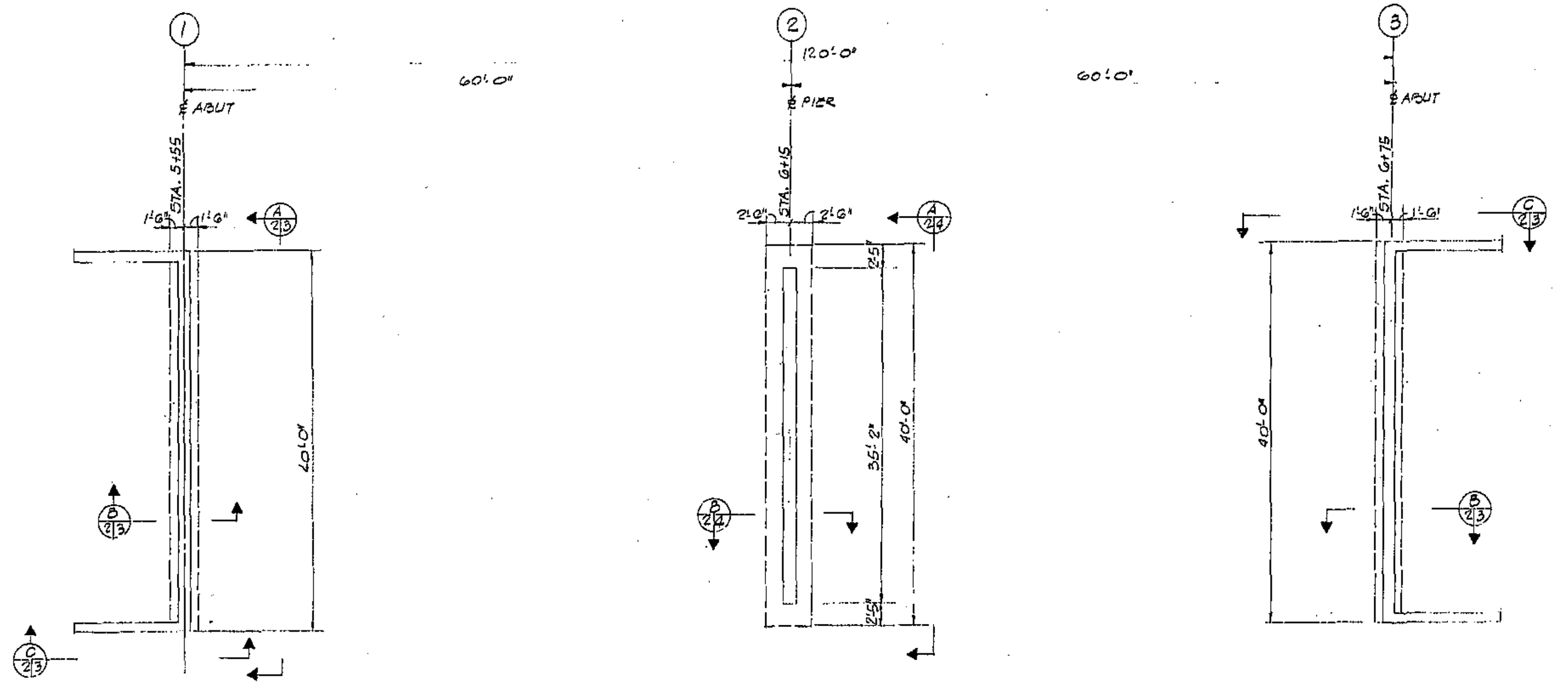
CREEGAN & D'ANGELO
CONSULTING ENGINEERS

GENERAL PLAN
PROPOSED ISABEL AVE. BRIDGE AT ARROYO DEL VALLE CREEK

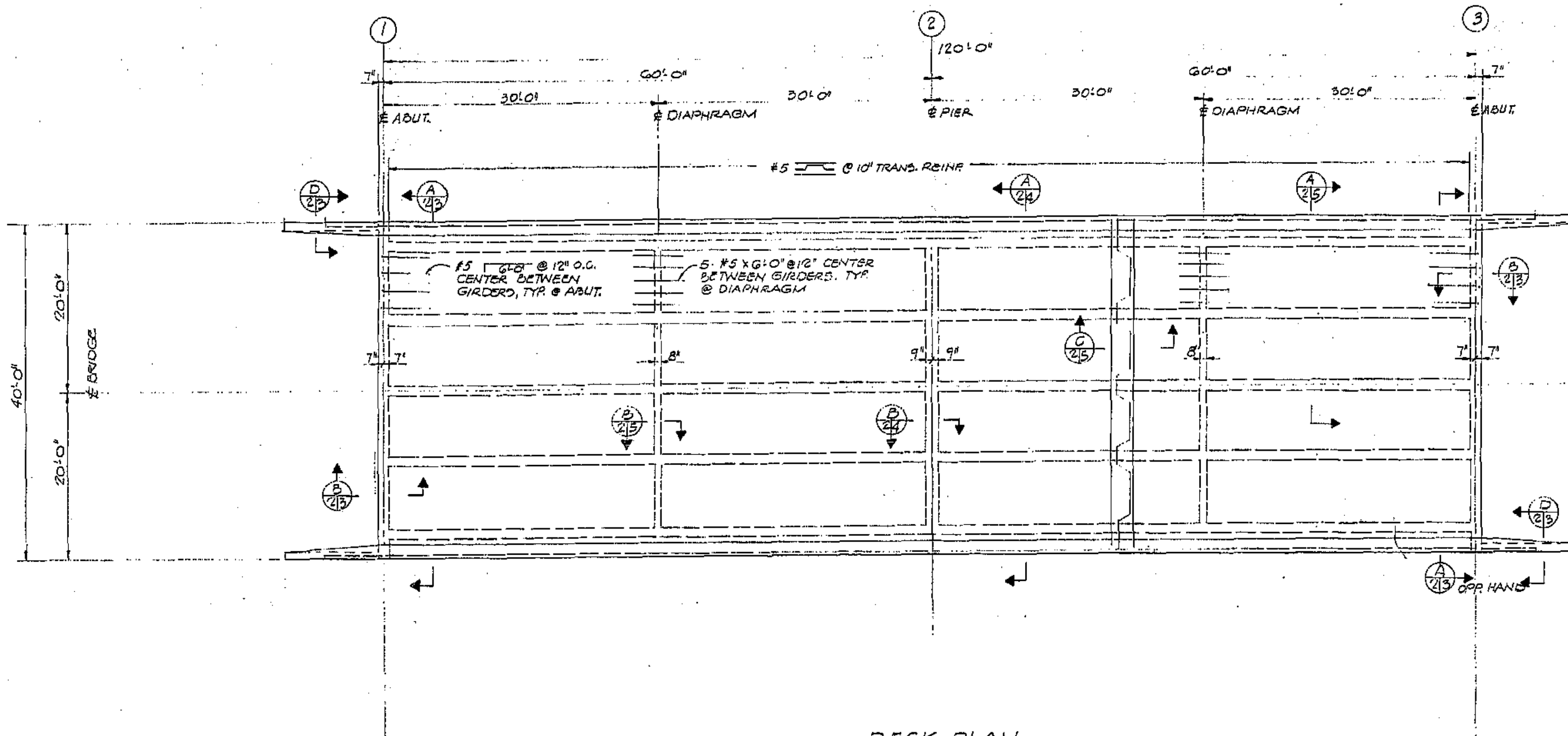
SHEET NUMBER S-1
OF 5 SHEETS
DRAWING NO. 283001.2-1
283001

SPECIFICATION No. 1475

H-659-1
SHEET 5 OF 10



FOUNDATION PLAN
1/8" = 1'-0"



DECK PLAN
1/8" = 1'-0"

H-659-1

SPECIFICATION No. 1475 SHEET 6 OF 10

COUNTY OF ALAMEDA PUBLIC WORKS AGENCY ROAD DIVISION

APPROVAL RECOMMENDED

APPROVED

REV.	DATE	DESCRIPTION	BY
1	6-6-83	RELEASED FOR BIDDING	SAD
0	5-18-83	RELEASED FOR APPROVAL	SAD

DESIGNED BY: FLM
DRAWN BY: BJC
CHECKED BY: SAD
SCALE: AS SHOWN

CREEGAN & D'ANGELO
CONSULTING ENGINEERS

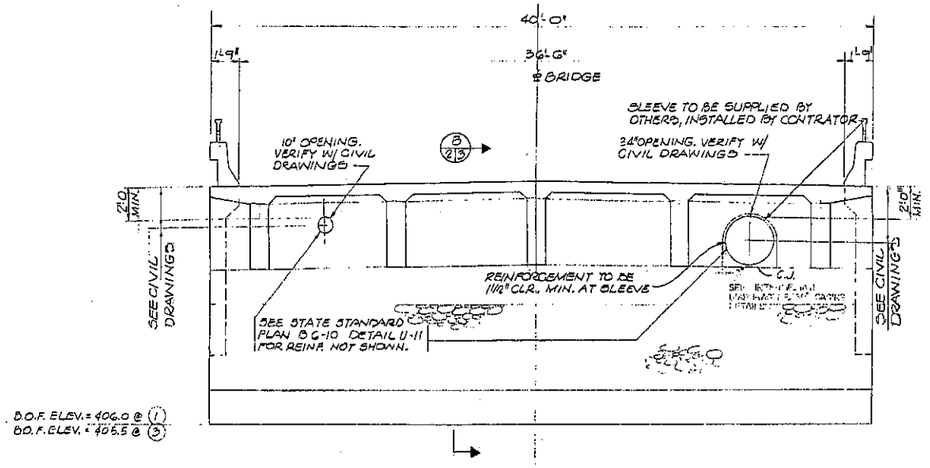
FOUNDATION & DECK PLAN

PROPOSED ISABEL AVE. BRIDGE AT ARROYO DEL VALLE CREEK

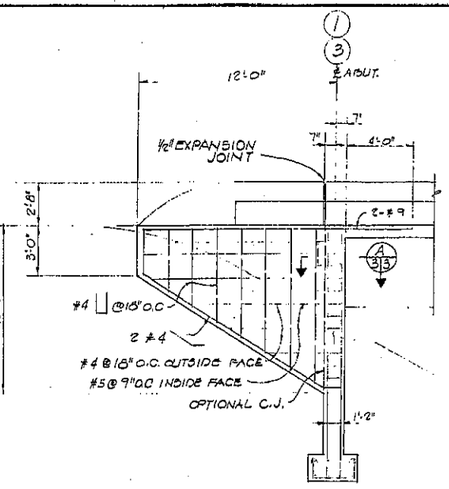
SHEET NUMBER S-2 OF 5 SHEETS

DRAWING NO. 283001.2-2

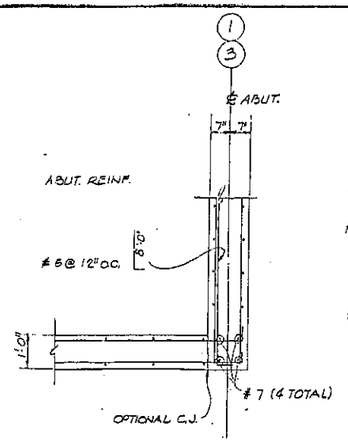
283001



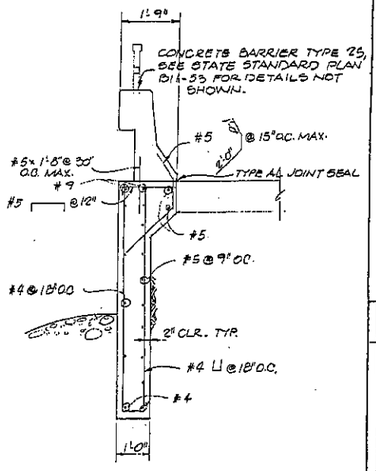
SECTION A 2/3
1/4" = 1'-0"



SECTION C 2/3
1/4" = 1'-0"

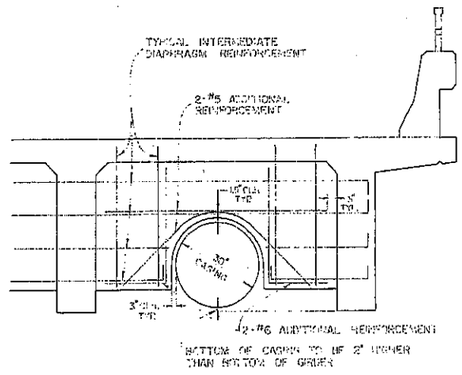


SECTION A 3/3
1/2" = 1'-0"



SECTION D 2/3
1/2" = 1'-0"

SECTION B 2/3
1/2" = 1'-0"



INTERMEDIATE DIAPHRAGM @ 30" ∅ CASING
SCALE: 1/2" = 1'-0"

COUNTY OF ALAMEDA PUBLIC WORKS AGENCY ROAD DIVISION

APPROVAL RECOMMENDED
APPROVED

NO.	DATE	DESCRIPTION	BY
1	6/88	RELEASED FOR BIDDING	SAB
2	5/89	RELEASED FOR APPROVAL	SAB

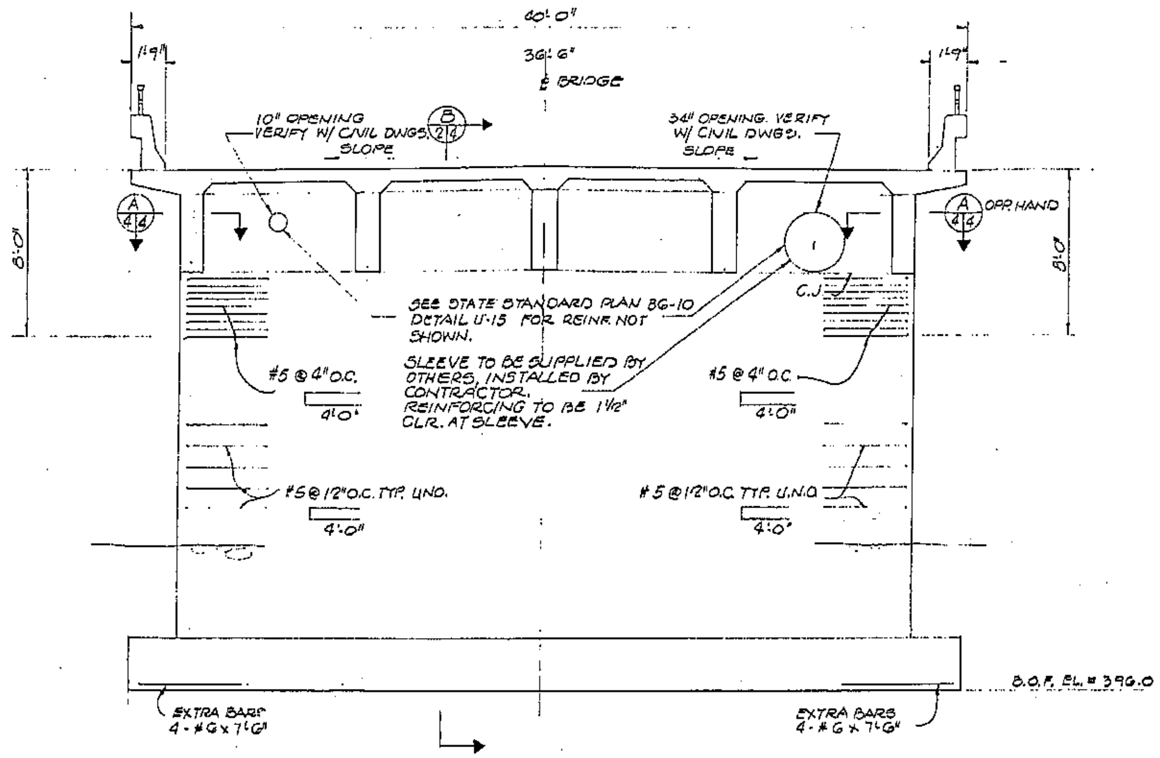
DESIGNED BY: FLM
DRAWN BY: BJC
CHECKED BY: SAB
SCALE: AS SHOWN
DATE: 6/88

CREEGAN & D'ANGELO
CONSULTING ENGINEERS
SAN JOSE • DUBLIN • FREMONT • FAIRFIELD • REDWOOD COVE, NEVADA
1946 N. MAIN STREET • P.O. BOX 5335 • SAN JOSE, CALIFORNIA 95150 • (408) 298-2381
PREPARED BY: R.E. NO. SE 12774 DATE: 6/1/88

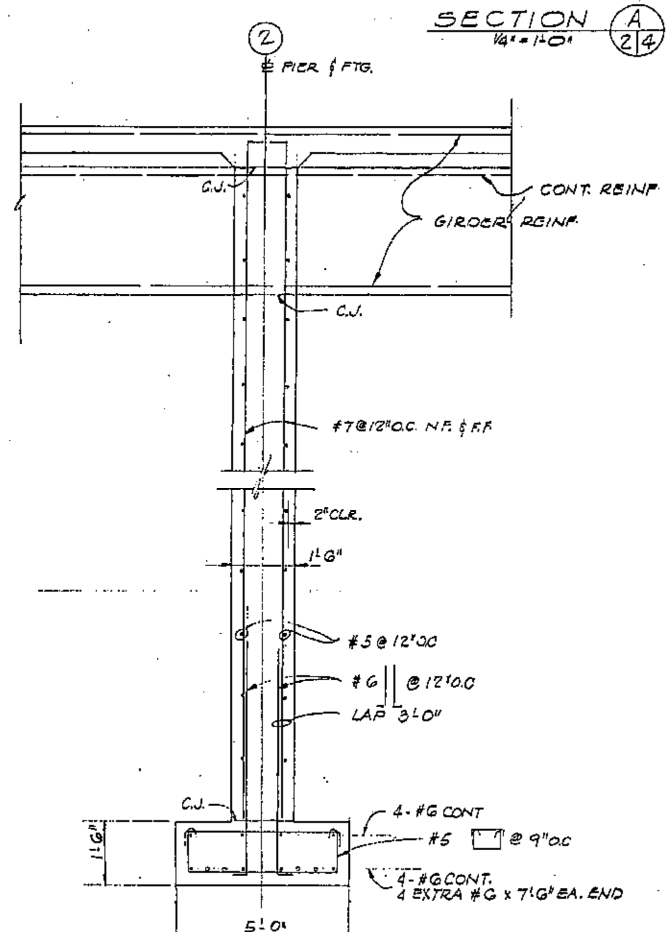
ABUTMENT DETAILS
PROPOSED ISABEL AVE. BRIDGE AT ARROYO OEL VALLE CREEK

SHEET NUMBER S-3 OF 5 SHEETS
DRAWING NO. 283001.2-3
283001

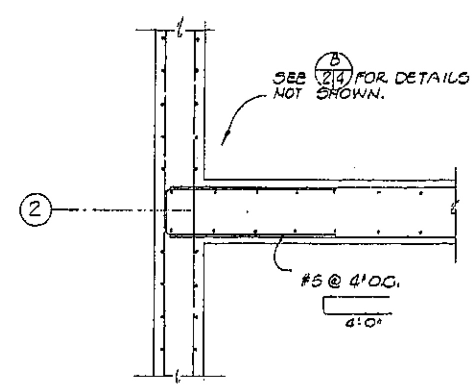
SPECIFICATION NO. 1475
H-659-1
SHEET 7 OF 10



SECTION (A 2|4)
¼" = 1'-0"



SECTION (B 2|4)
½" = 1'-0"



SECTION (A 4|4)
½" = 1'-0"

COUNTY OF ALAMEDA PUBLIC WORKS AGENCY ROAD DIVISION

APPROVAL RECOMMENDED
APPROVED Ronald E. [signature]

REV.	DATE	DESCRIPTION	BY
1	6-6-83	RELEASED FOR BIDDING	SAB
0	5-9-83	RELEASED FOR APPROVAL	SAB

DESIGNED BY: FLM
DRAWN BY: BJC
CHECKED BY: SAB
SCALE: AS SHOWN

CREEGAN & D'ANGELO
CONSULTING ENGINEERS

APPROVED BY: [signature] R.E. NO. 22778 DATE 6/6/83

PIER DETAILS

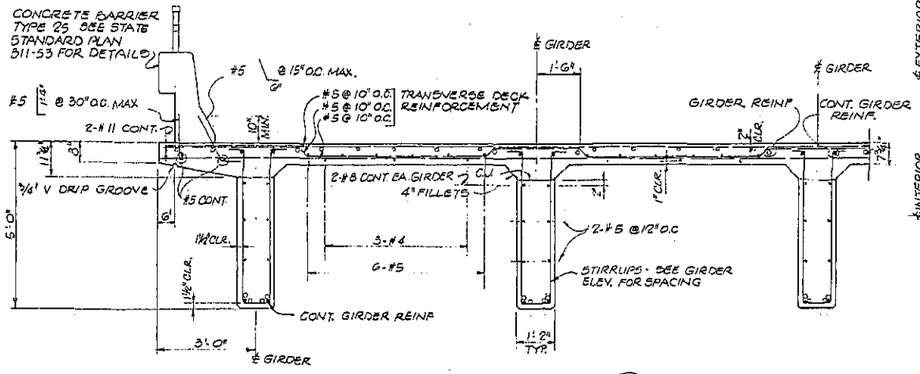
PROPOSED ISABEL AVE. BRIDGE AT ARROYO DEL VALLE CREEK

SHEET NUMBER S-4 OF 5 SHEETS

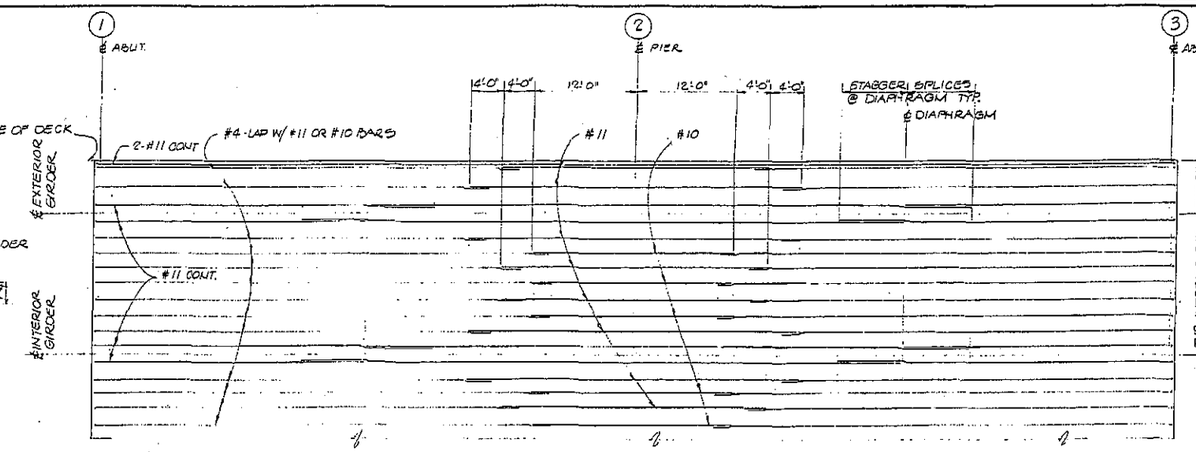
DRAWING NO. 283001.2-4

H-659-1

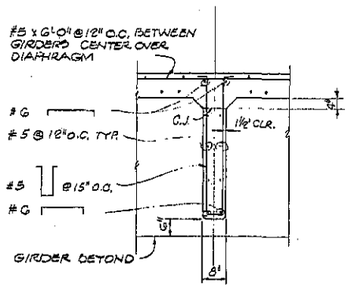
SPECIFICATION NO. 1475 SHEET 8 OF 10



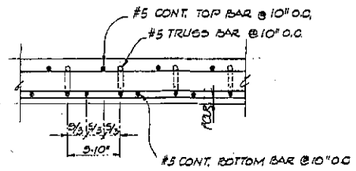
SECTION (A) 2|5
1/2" = 1'-0"



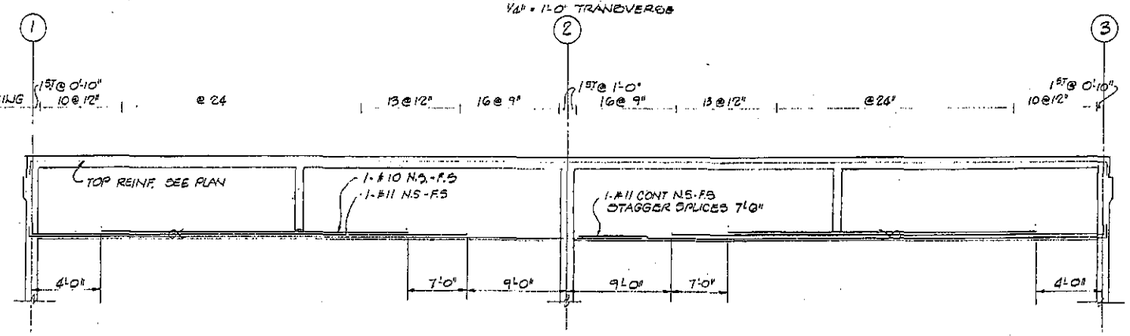
TOP REINFORCEMENT PLAN
1/8" = 1'-0" LONGITUDINAL
1/4" = 1'-0" TRANSVERSE



SECTION (B) 2|5
1/2" = 1'-0"

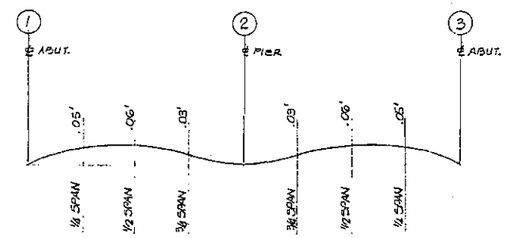


SECTION (C) 2|5
1" = 1'-0"



TYPICAL GIRDER ELEVATION
1/8" = 1'-0" HORIZ.
1/4" = 1'-0" VERT.

GIRDER REINFORCEMENT



CAMBER DIAGRAM

NOTE:
1. CAMBER DIAGRAM DOES NOT INCLUDE FALSEWORK SETTLEMENT.
2. MAXIMUM DEFLECTION WILL OCCUR APPROXIMATELY 4 YEARS AFTER FALSEWORK REMOVAL.

NOTES:
1. ALL BARS ARE #11 EXCEPT AS NOTED.
2. ⟨⟨ INDICATES RUNDLED BARS
3. BAR LAP SPLICE TO BE 60 DIA. FOR ALL #11 BARS & 45 DIA. FOR ALL BARS #10 & SMALLER

COUNTY OF ALAMEDA PUBLIC WORKS AGENCY
ROAD DIVISION

APPROVAL RECOMMENDED — DATE 5/15
APPROVED — DATE 5/15

NO.	DATE	DESCRIPTION	BY
1	6/15	RELISTED FOR BIDDING	
0	4/15	RELISTED FOR FINAL	

DESIGNED BY: FLM
DRAWN BY: BJC
CHECKED BY: SAB
SCALE: AS SHOWN
DATE: 6/26/63

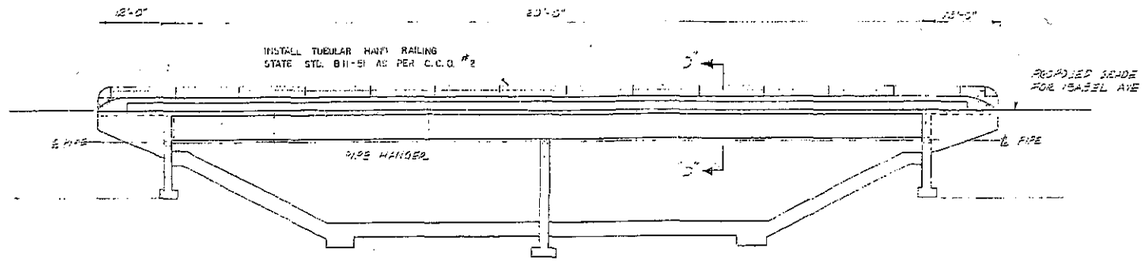
CREEGAN & D'ANGELO
CONSULTING ENGINEERS
SAN JOSE • DUBLIN • FREMONT • FAIRFIELD • ESPARTO COVE, NEVADA
SAN JOSE, SILVER STATE • P.O. BOX 27627 • SAN JOSE, CALIFORNIA 95159 • (408) 292-6220
REGISTERED ENGINEER — CIVIL — STATE OF CALIFORNIA
Stanley C. Biggs — R.C.E. NO. 6271 — DATE 6/26/63

DECK & GIRDER DETAILS
PROPOSED ISABEL AVE. BRIDGE AT ARROYO DEL VALLE CREEK

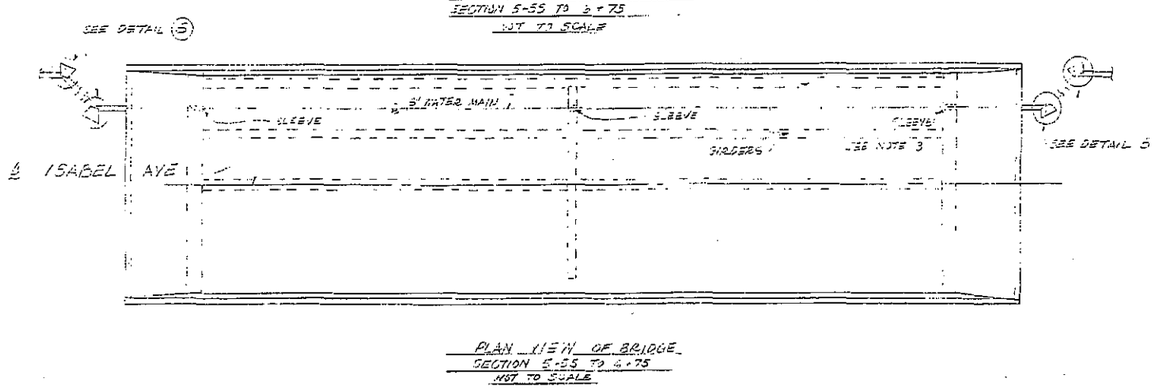
SHEET NUMBER 5-5 OF 5 SHEETS
DRAWING NO. 28300I.2-5
28300I

SPECIFICATION NO. 1475

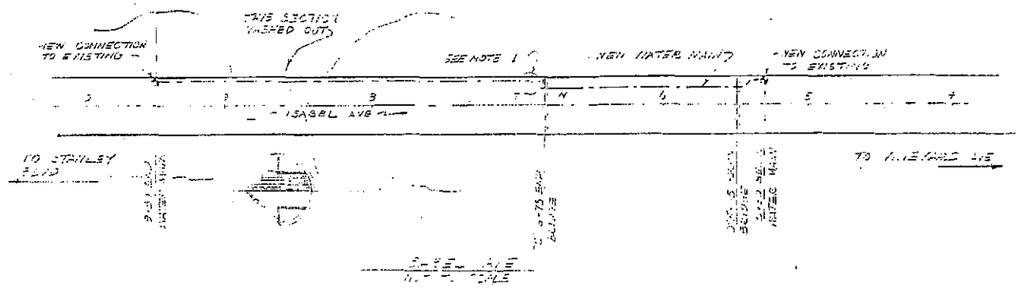
H-659-1
SHEET 9 OF 10

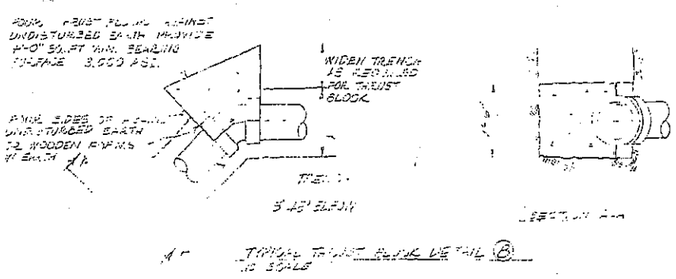


ELEVATION VIEW OF BRIDGE
SECTION 5+55 TO 6+75
NOT TO SCALE

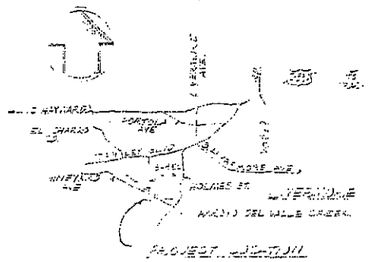


PLAN VIEW OF BRIDGE
SECTION 5+55 TO 6+75
NOT TO SCALE

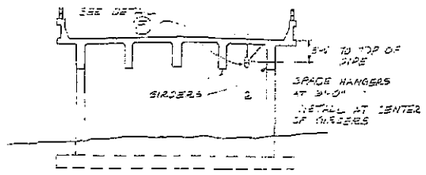




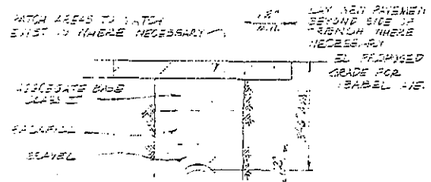
TYPICAL THRUST BLOCK DETAIL ⑧
NO SCALE



PROJECT LOCATION

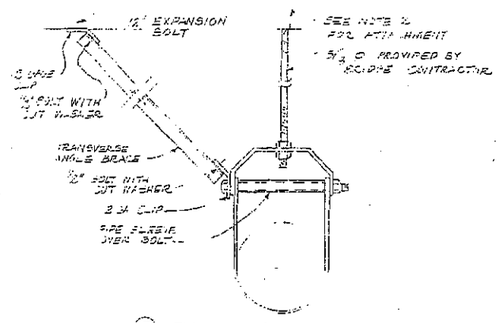


TYPICAL SECTION "D-D"
1"=10'-0"



TYPICAL TRENCH SECTION & PIPE BEDDING
WHERE PAVEMENT IS REPLACED

NOTE: WHERE PIPE IS LAID IN GRAVED AREAS FILL AS SHOWN AND BRING BACKFILL UP TO ORIGINAL GRADE



DETAIL ⑨ — ANCHOR DETAIL
NO SCALE

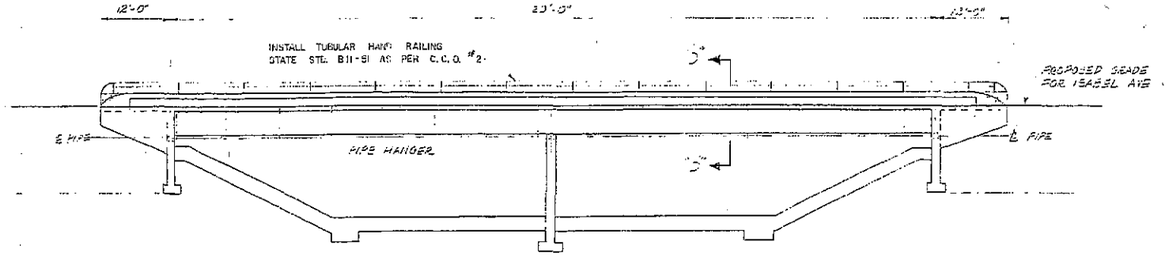
GENERAL NOTES

1. CONTRACTOR TO FIELD VERIFY ALL DIMENSIONS & LOCATIONS
2. CONCRETE INSERTS PROVIDED BY VETERANS ADMINISTRATION AND INSTALLED BY BRIDGE CONTRACTOR.
   CONCRETE INSERTS TO BE UNISTRUT SERIES M26 WITH RIGID NUT M 2812 OR EQUAL
3. SLEEVE PROVIDED BY BRIDGE CONTRACTOR
4. MECHANICAL JOINT DUCTILE IRON
5. LENGHT OF 8" Ø PIPE — 5 FEET
6. SUPPORT AT NO LESS THEN 18" FROM JOINTS ON BELL SIDE
7. THICKNESS OF PIPE 0.36 INCHES
8. ALL WORK TO BE INSTALLED IN ACCORDANCE WITH THE UNIFORM PLUMBING CODE

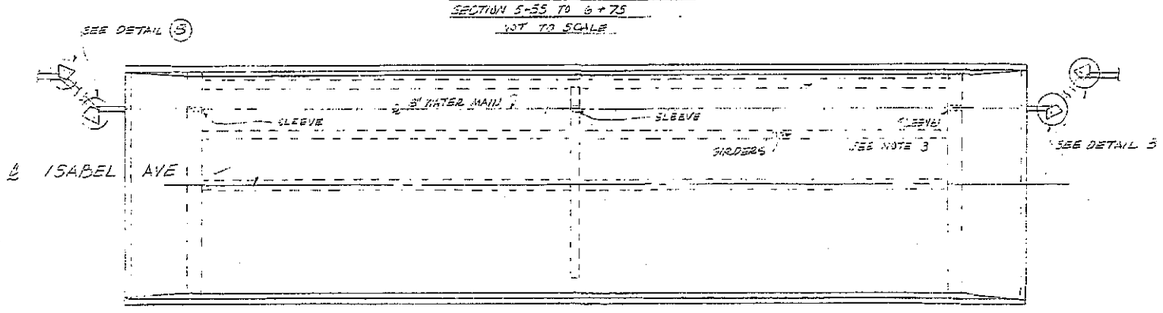
Revisions	Date

Drawing Title: CONSTRUCTION DETAILS		Project Title: REPLACE WATER MAIN (EMERGENCY)	Date: 5-9-85
Approved: Division Chief	Drawn	Building Number: H-659-1	Project No.
Approved: Service Director	Checked	Location: ISABEL AVE.	DRAWING No. 1

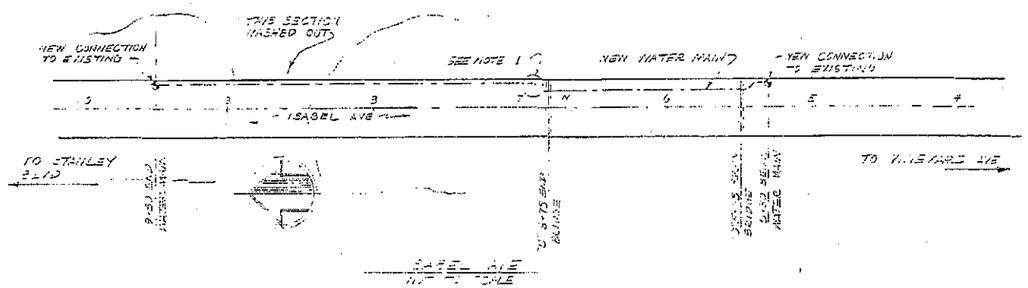
Veterans

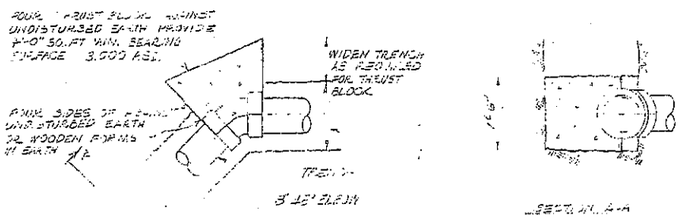


ELEVATION VIEW OF BRIDGE
SECTION 5+55 TO 6+75
NOT TO SCALE

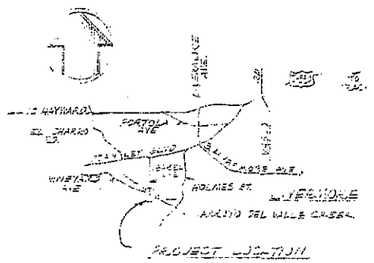


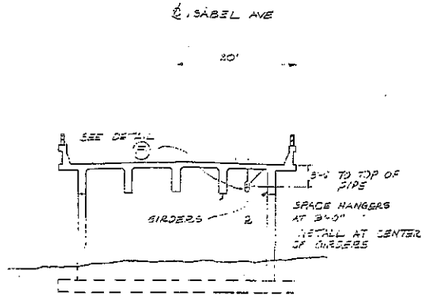
PLAN VIEW OF BRIDGE
SECTION 5+55 TO 6+75
NOT TO SCALE



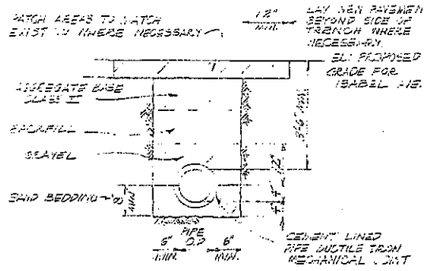


TYPICAL THRUST BLOCK DETAIL (B)
NO SCALE



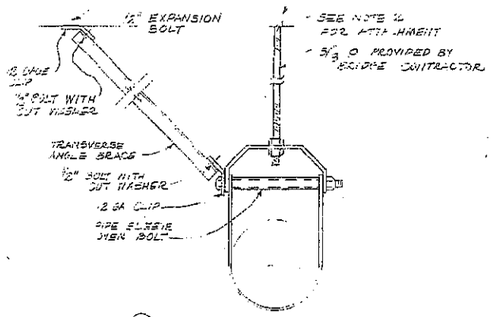


TYPICAL SECTION "D"-"D"
1"=10'-0"



TYPICAL TRENCH SECTION & PIPE BEDDING
WHERE PAVEMENT IS REPLACED

NOTE: WHERE PIPE IS LAID IN UNPAVED AREAS BED AS SHOWN AND BOND BACKFILL UP TO ORIGINAL GRADE



DETAIL (F) PIPE HANGER
NO SCALE

PIPE SIZE	ANGLE SIZE	BOLT TO ANGLE
8"	2 1/2 x 2 x 1/4	5/8"

GENERAL NOTES

1. CONTRACTOR TO FIELD VERIFY ALL DIMENSIONS & LOCATIONS
2. CONCRETE INSERTS PROVIDED BY VETERANS ADMINISTRATION AND INSTALLED BY BRIDGE CONTRACTOR. CONCRETE INSERTS TO BE UNISTRUT SERIES M26 WITH RIGID NUT M, 3/8-12 OR EQUAL
3. SLEEVE PROVIDED BY BRIDGE CONTRACTOR
4. MECHANICAL JOINT DUCTILE IRON
5. LENGHT OF 5" Ø PIPE - 3 FOOT
6. SUPPORT AT NO LESS THEN 18" FROM JOINTS ON BELL SIDE
7. THICKNESS OF PIPE 0.36 INCHES
8. ALL WORK TO BE INSTALLED IN ACCORDANCE WITH THE UNIFORM PLUMBING CODE

LEGEND

- CENTER LINE
- ℄ NEW CONNECTION TO EXISTING
- HIDDEN LINE

Revisions	Date

Drawing Title	CONSTRUCTION DETAILS
Project Title	REPLACE WATER MAIN (EMERGENCY)
Date	5-9-88
Project No.	
Approved: Division Chief	
Approved: Service Director	
Drawn	R. TORRES
Checked	
Building Number	H-659-1
Location	STATE, CA.
DRAWING NO.	1
Dwg. / Of	

Veterans

The following table presents correlation between the borehole identification shown on LOTBs and discussed throughout the report text with the borehole identification used in the axial pile capacity spreadsheets.

Borehole Identification on LOTBs	Borehole Identification for Laboratory Test Results
R-08-037	NB37
R-08-038	NB38

Route 84 Arroyo Del Valle Bridge (Widening)

1/12/2015

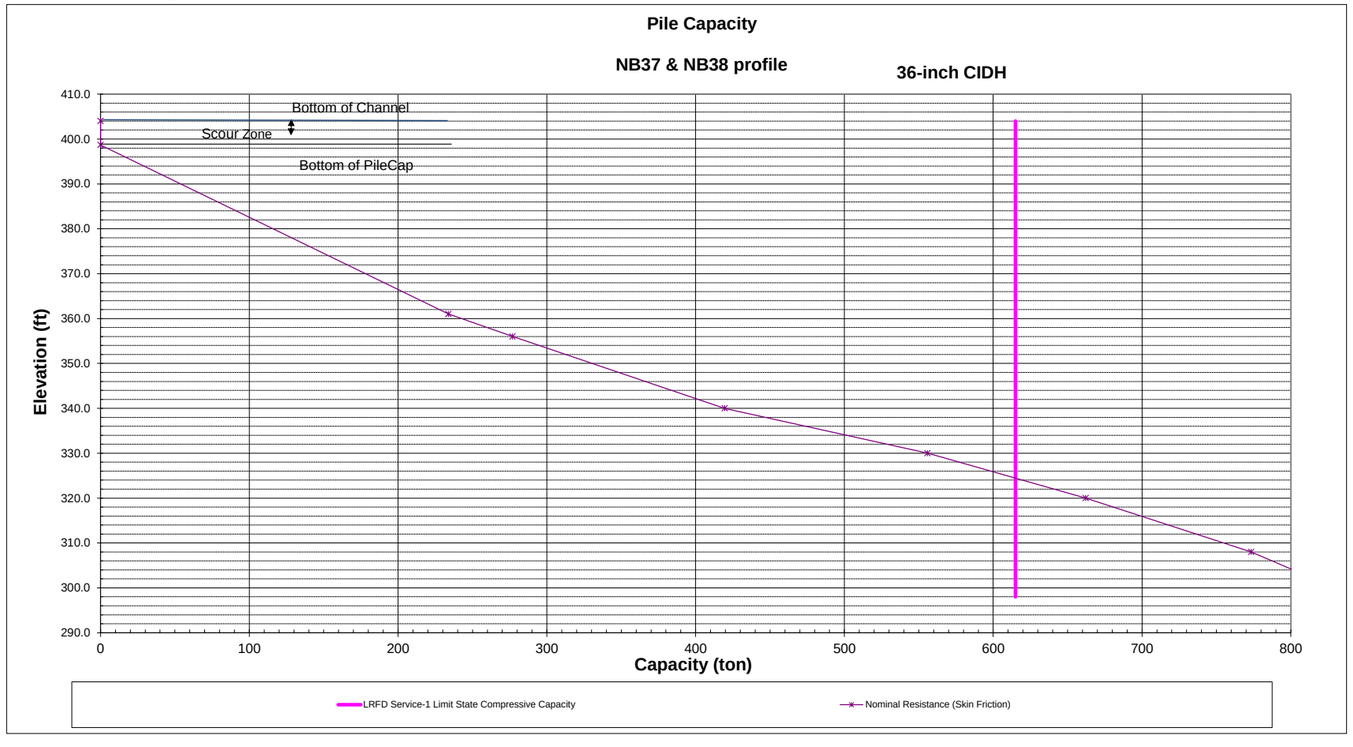
CIDH Pile Design Spreadsheet NB37 & NB38 Bent 2

Caltrans Design Method For CIDH Pile

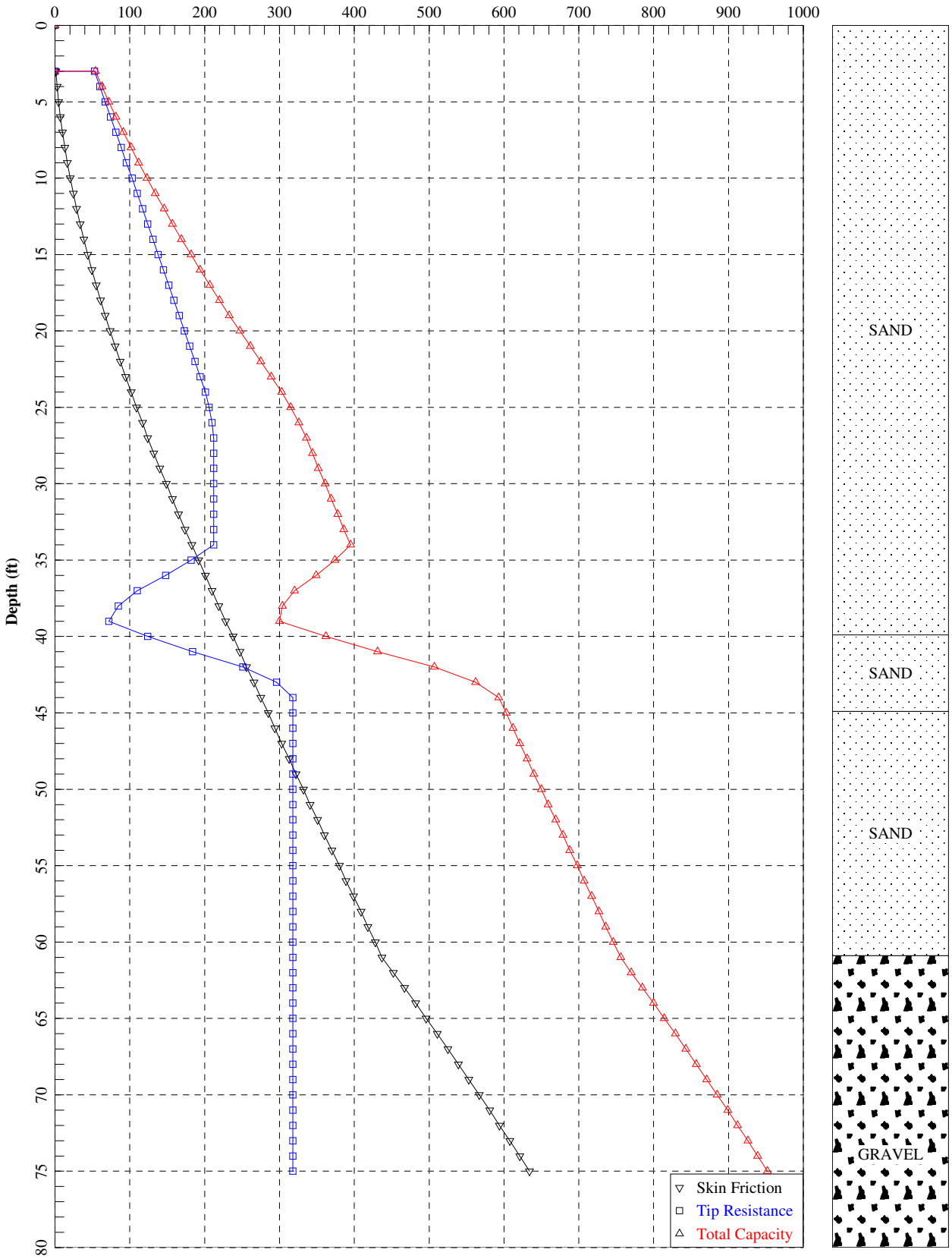
Project Name:	Isabel Road Rt 84	LRFD service-1 limit state compressive capacity	615	ton					
Project Number:	28649640	LRFD service-1 limit state compressive capacity	5474	kN	Pile Type	CIDH			
Bridge Name:	Arroyo Del Valle Bridge Widening	Pile Diameter	36	inch	Pile Shape	Circular			
Boring Surface El. (m)	123.1	Pile Diameter	914	mm	Pile Surface Area	2.87	sq. m/m	Pile Tip Area	0.66 sq. m
Boring Surface El. (ft)	404.0	Pile Diameter	3.00	ft	Pile Surface Area	9.42	sq. ft/ft	Pile Tip Area	7.07 sq. ft.
Design GWS El. (ft)	401.0								
Unit Weight of Water (pcf)	62.4								
Depth with no strength									
Convert. Factor	3.281								
		Estimated specified tip =	323						
Bottom of Pile Cap El. (m)	121.5	Pile Length/Pile Diameter (L/D) =	25.2						
Bottom of Pile Cap El. (ft)	398.7								
Bottom of Fill El. (ft)	N/A								
Local Scour El. (ft)	401.2								
General Scour El. (ft)	402.3								

																				Compression						Tension			
															Soil	delta		q_T	z/B	Nc	q_T	Bearing	Elevation	Cumulative				LRFD service-1		Cumulative		LRFD service-1	
Layer	Layer Elevation				Lateral	Unit	N_{SPT}	Cohesion	Adhesion	Ult. Load	Layer	Depth to	Effective	β	f_{max}	Type	Lat. Res.								Axial Res.				Limit State		Axial Res.		Limit State	
No.	Top		Bot.		Resists?	Wt			Factor	Transfer	Thickness	Layer Center	Vert. Stress			G= gran.	Cohesive	Friction		(granular)		(cohesive)	(cohesive)	Capacity	to	(skin)		(Tot)		Compressive		(Skin)		Compressive	
								c	α	f_{si}			(Cen. Lay.)			C=cohes.		(comp)	(tensile)					(B.C.)	midlayer					Capacity				Capacity	
(-)	(m)	(feet)	(m)	(feet)		(pcf)	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)
			123.13	404.0																						0	0	0.0	0	615	5474	0	0	308	2737
1	123.13	404.0	121.52	398.7	n		40	0	0.55	0	5.3	2.65	0.0	0.0	0	g	0.0	0.0	0.0	48000	0.0	6.00	0	170	401.4	0.0	0	0.0	0	615	5474	0.0	0	308	2737
2	121.52	398.7	110.03	361.0	Y	140	50	0	0.55	0	37.7	24.15	1462.8	0.9	1316	g	0.0	233.9	163.7	60000	12.6	9.00	0	212	379.9	233.9	2082	233.9	2082	615	5474	163.7	1456	308	2737
3	110.03	361.0	108.5	356.0	Y	110	17	0	0.55	0	5.0	45.5	3044.5	0.6	1827	g	0.0	43.0	30.1	20400	14.2	9.00	0	72	358.5	276.9	2465	276.9	2465	615	5474	193.8	1724	308	2737
4	108.5	356.0	103.63	340.0	Y	140	75	0	0.55	0	16.0	56	3784.3	0.5	1892	g	0.0	142.7	99.9	90000	19.6	9.00	0	318	348.0	419.6	3734	419.6	3734	615	5474	293.7	2613	308	2737
5	103.63	340.0	100.58	330.0	Y	145	85	0	0.55	0	10.0	69	4818.1	0.6	2891	g	0.0	136.2	95.4	90000	22.9	9.00	0	318	335.0	555.8	4947	555.8	4947	615	5474	95.4	848	308	2737
6	100.58	330.0	97.53	320.0	Y	145	85	0	0.55	0	10.0	79	5644.1	0.4	2258	g	0.0	106.4	74.5	90000	26.2	9.00	0	318	325.0	662.2	5894	662.2	5894	615	5474	238.2	2119	308	2737
7	97.53	320.0	93.87	308.0	Y	145	85	0	0.55	0	12.0	90	6552.7	0.3	1966	g	0.0	111.2	77.8	90000	30.2	9.00	0	318	314.0	773.4	6883	773.4	6883	615	5474	271.7	2417	308	2737
8	93.87	308.0	90.83	298.0	Y	145	85	0	0.55	0	10.0	101	7461.3	0.2	1492	g	0.0	70.3	49.2	90000	33.6	9.00	0	318	303.0	843.7	7509	843.7	7509	615	5474	342.9	3051	308	2737
Bottom	90.83	298.0																																	

Note: β calculated using the equation in section 10.8.3.5.2b for gravelly sand and gravel in AASHTO LRFD Bridge Design Specifications.
Effective vertical stress was calculated assuming the ground surface as the bottom of pile cap or bottom of scour, whichever is deeper.



ArroyoDelValle_Bridge_36-inch_Scour 400.9_Profile start 400.9_CO 398.7
Ultimate Axial Capacity (tons)



ArroyoDelValle_Bridge_36-inch_Scour 400.9_Profile start 400.9_CO 398.7.sfo

SHAFT for Windows, Version 2012.7.9

Serial Number : 158118679

VERTICALLY LOADED DRILLED SHAFT ANALYSIS
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Path to file locations : L:\Shiva\Analysis\Madhu\11_7_14\
Name of input data file : ArroyoDelValle_Bridge_36-inch_Scour 400.9_Profile start 400.9_CO 398.7.sfd
Name of output file : ArroyoDelValle_Bridge_36-inch_Scour 400.9_Profile start 400.9_CO 398.7.sfo
Name of plot output file : ArroyoDelValle_Bridge_36-inch_Scour 400.9_Profile start 400.9_CO 398.7.sfp
Name of runtime file : ArroyoDelValle_Bridge_36-inch_Scour 400.9_Profile start 400.9_CO 398.7.sfr

Time and Date of Analysis

Date: November 11, 2014 Time: 10:08:46

ArroyoDelValle_Bridge_36-inch_Scour 400.9_Profile start 400.9_CO 398.7

PROPOSED DEPTH = 75.0 FT

NUMBER OF LAYERS = 4

WATER TABLE DEPTH = 0.0 FT.

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.500E+02
SOIL UNIT WEIGHT, LB/CU FT	= 0.140E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.647E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.500E+02
SOIL UNIT WEIGHT, LB/CU FT	= 0.140E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.399E+02
LRFD RESISTANCE FACTOR (SIDE FRICTION)	= 0.700E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE)	= 0.500E+00

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.647E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.170E+02
SOIL UNIT WEIGHT, LB/CU FT	= 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.399E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.595E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00

INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.170E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.449E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.700E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.595E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.750E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.140E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.449E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.446E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.750E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.140E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.609E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.700E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO 4----GRAVEL

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.702E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.850E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.145E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.609E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.358E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.850E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.145E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.869E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.700E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 3.000 FT.
DIAMETER OF BASE = 3.000 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 2.200 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 10.180 SQ.IN.
ELASTIC MODULUS, Ec = 0.350E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
LRFD QS = TOTAL SIDE FRICTION USING LRFD RESISTANCE FACTOR
TO THE ULTIMATE SIDE RESISTANCE;
LRFD QB = TOTAL BASE BEARING USING LRFD RESISTANCE FACTOR

TO THE ULTIMATE BASE RESISTANCE
LRFD QU = TOTAL CAPACITY WITH LRFD RESISTANCE FACTOR.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	LRFD QS (TONS)	LRFD QB (TONS)	LRFD QU (TONS)
3.0	0.79	1.18	53.04	54.23	0.83	26.52	27.35
4.0	1.05	2.81	60.11	62.92	1.97	30.06	32.02
5.0	1.31	4.86	67.18	72.04	3.40	33.59	36.99
6.0	1.57	7.28	74.25	81.54	5.10	37.13	42.22
7.0	1.83	10.07	81.32	91.39	7.05	40.66	47.71
8.0	2.09	13.21	88.39	101.60	9.25	44.20	53.44
9.0	2.36	16.68	95.46	112.14	11.67	47.73	59.40
10.0	2.62	20.47	102.53	123.00	14.33	51.26	65.59
11.0	2.88	24.57	109.60	134.17	17.20	54.80	72.00
12.0	3.14	28.97	116.67	145.64	20.28	58.33	78.61
13.0	3.40	33.66	123.74	157.40	23.56	61.87	85.43
14.0	3.67	38.63	130.81	169.44	27.04	65.40	92.44
15.0	3.93	43.86	137.88	181.74	30.70	68.94	99.64
16.0	4.19	49.36	144.95	194.30	34.55	72.47	107.02
17.0	4.45	55.10	152.02	207.11	38.57	76.01	114.58
18.0	4.71	61.08	159.09	220.16	42.76	79.54	122.30
19.0	4.97	67.29	166.15	233.45	47.10	83.08	130.18
20.0	5.24	73.73	173.22	246.95	51.61	86.61	138.22
21.0	5.50	80.38	180.29	260.67	56.26	90.15	146.41
22.0	5.76	87.23	187.36	274.60	61.06	93.68	154.75
23.0	6.02	94.29	194.43	288.72	66.00	97.22	163.22
24.0	6.28	101.53	201.20	302.74	71.07	100.60	171.68
25.0	6.55	108.96	206.43	315.39	76.27	103.21	179.49
26.0	6.81	116.57	209.90	326.47	81.60	104.95	186.55
27.0	7.07	124.34	211.57	335.91	87.04	105.79	192.82
28.0	7.33	132.27	212.09	344.36	92.59	106.04	198.63
29.0	7.59	140.36	212.09	352.44	98.25	106.04	204.29
30.0	7.86	148.59	212.09	360.68	104.02	106.04	210.06
31.0	8.12	156.97	212.09	369.05	109.88	106.04	215.92
32.0	8.38	165.48	212.09	377.56	115.84	106.04	221.88
33.0	8.64	174.12	212.09	386.20	121.88	106.04	227.92
34.0	8.90	182.87	212.09	394.96	128.01	106.04	234.05
35.0	9.16	191.74	182.39	374.14	134.22	91.20	225.42
36.0	9.43	200.72	148.46	349.18	140.51	74.23	214.74
37.0	9.69	209.80	110.28	320.09	146.86	55.14	202.01
38.0	9.95	218.98	84.83	303.82	153.29	42.42	195.70
39.0	10.21	228.25	72.11	300.36	159.77	36.05	195.83
40.0	10.47	237.60	124.29	361.90	166.32	62.15	228.47
41.0	10.74	247.02	183.94	430.95	172.91	91.97	264.88
42.0	11.00	256.42	251.03	507.45	179.49	125.52	305.01
43.0	11.26	265.80	295.76	561.56	186.06	147.88	333.94
44.0	11.52	275.16	318.13	593.29	192.61	159.06	351.68
45.0	11.78	284.50	318.13	602.63	199.15	159.06	358.22
46.0	12.04	293.86	318.13	611.98	205.70	159.06	364.76
47.0	12.31	303.26	318.13	621.39	212.28	159.06	371.35
48.0	12.57	312.71	318.13	630.84	218.90	159.06	377.96
49.0	12.83	322.21	318.13	640.33	225.54	159.06	384.61
50.0	13.09	331.73	318.13	649.86	232.21	159.06	391.28
51.0	13.35	341.29	318.13	659.42	238.91	159.06	397.97
52.0	13.62	350.88	318.13	669.00	245.61	159.06	404.68
53.0	13.88	360.48	318.13	678.61	252.33	159.06	411.40
54.0	14.14	370.10	318.13	688.22	259.07	159.06	418.13
55.0	14.40	379.72	318.13	697.85	265.81	159.06	424.87
56.0	14.66	389.35	318.13	707.48	272.55	159.06	431.61
57.0	14.92	398.98	318.13	717.11	279.29	159.06	438.35
58.0	15.19	408.61	318.13	726.73	286.02	159.06	445.09
59.0	15.45	418.22	318.13	736.35	292.75	159.06	451.82
60.0	15.71	427.82	318.13	745.95	299.47	159.06	458.54
61.0	15.97	437.40	318.13	755.52	306.18	159.06	465.24
62.0	16.23	452.31	318.13	770.44	316.62	159.06	475.68
63.0	16.50	467.11	318.13	785.24	326.98	159.06	486.04
64.0	16.76	481.78	318.13	799.91	337.25	159.06	496.31
65.0	17.02	496.32	318.13	814.45	347.42	159.06	506.49
66.0	17.28	510.73	318.13	828.85	357.51	159.06	516.57
67.0	17.54	525.00	318.13	843.13	367.50	159.06	526.56
68.0	17.80	539.13	318.13	857.26	377.39	159.06	536.46
69.0	18.07	553.13	318.13	871.26	387.19	159.06	546.25
70.0	18.33	566.98	318.13	885.11	396.89	159.06	555.95
71.0	18.59	580.69	318.13	898.82	406.48	159.06	565.55
72.0	18.85	594.25	318.13	912.38	415.98	159.06	575.04
73.0	19.11	607.67	318.13	925.80	425.37	159.06	584.43
74.0	19.38	620.94	318.13	939.06	434.66	159.06	593.72
75.0	19.64	634.05	318.13	952.18	443.84	159.06	602.90

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1124E+00	0.4202E-04	0.3093E-02	0.1000E-04
0.5619E+00	0.2101E-03	0.1546E-01	0.5000E-04
0.1124E+01	0.4202E-03	0.3093E-01	0.1000E-03
0.5651E+02	0.2106E-01	0.1546E+01	0.5000E-02
0.8498E+02	0.3165E-01	0.2320E+01	0.7500E-02
0.1134E+03	0.4225E-01	0.3093E+01	0.1000E-01

ArroyoDelValle_Bridge_36-inch_Scour 400.9_Profile start 400.9_CO 398.7.sfo

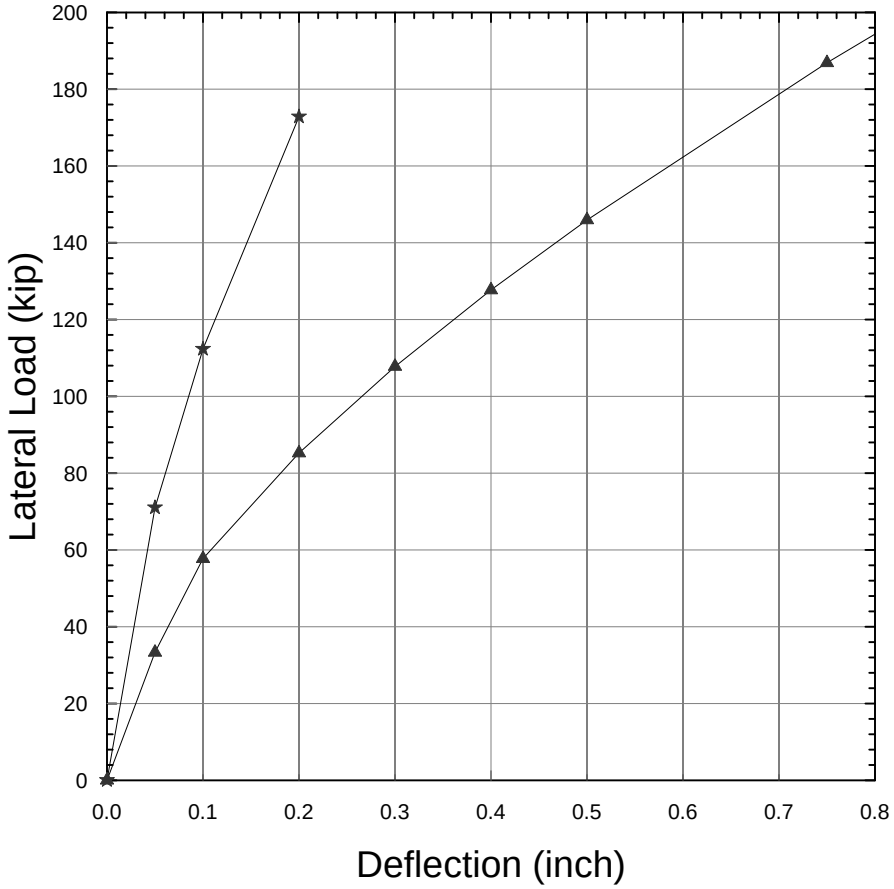
0.2645E+03	0.1031E+00	0.7732E+01	0.2500E-01
0.4090E+03	0.1761E+00	0.1546E+02	0.5000E-01
0.4921E+03	0.2306E+00	0.2320E+02	0.7500E-01
0.5542E+03	0.2788E+00	0.3093E+02	0.1000E+00
0.6727E+03	0.4756E+00	0.7670E+02	0.2500E+00
0.7362E+03	0.7575E+00	0.1444E+03	0.5000E+00
0.7501E+03	0.8899E+00	0.1659E+03	0.6250E+00
0.7801E+03	0.1181E+01	0.2036E+03	0.9000E+00
0.8980E+03	0.2140E+01	0.3229E+03	0.1800E+01

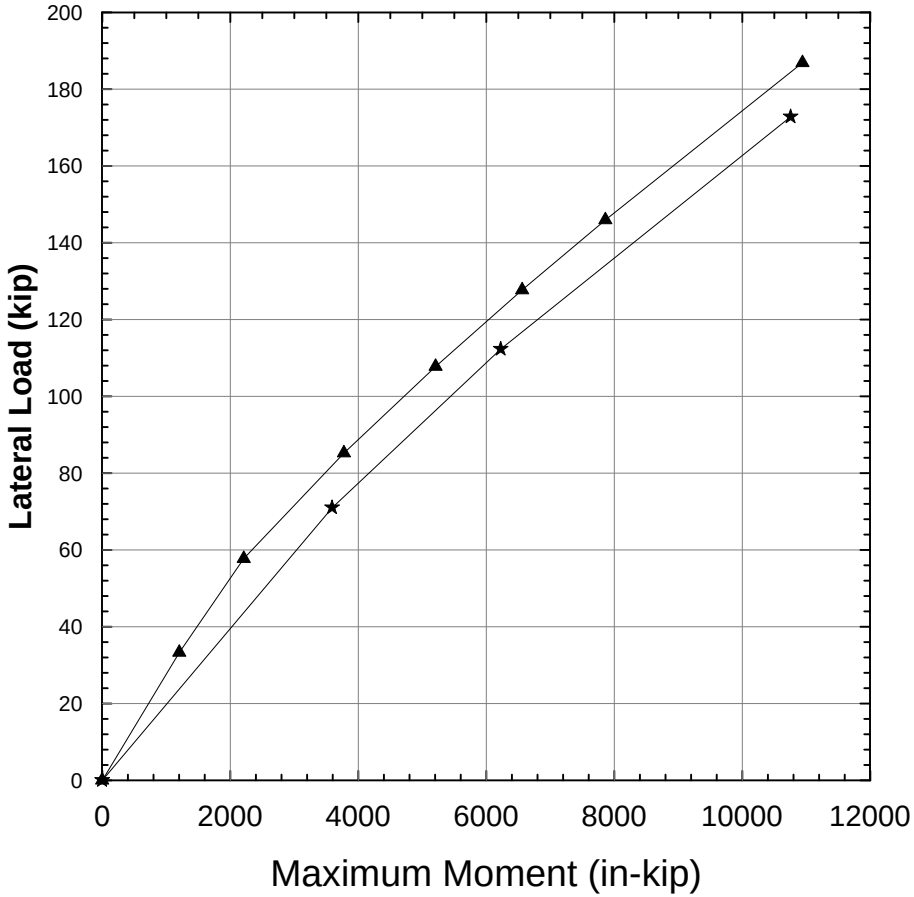
RESULT FROM UPPER-BOUND LINE

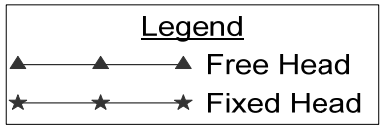
TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1824E+00	0.5975E-04	0.4418E-02	0.1000E-04
0.9120E+00	0.2988E-03	0.2209E-01	0.5000E-04
0.1824E+01	0.5975E-03	0.4418E-01	0.1000E-03
0.9221E+02	0.3006E-01	0.2209E+01	0.5000E-02
0.1384E+03	0.4519E-01	0.3314E+01	0.7500E-02
0.1827E+03	0.6017E-01	0.4418E+01	0.1000E-01
0.3963E+03	0.1418E+00	0.1105E+02	0.2500E-01
0.5489E+03	0.2218E+00	0.2209E+02	0.5000E-01
0.6130E+03	0.2716E+00	0.3314E+02	0.7500E-01
0.6458E+03	0.3100E+00	0.4418E+02	0.1000E+00
0.7376E+03	0.5029E+00	0.1080E+03	0.2500E+00
0.8214E+03	0.7955E+00	0.1997E+03	0.5000E+00
0.8349E+03	0.9277E+00	0.2199E+03	0.6250E+00
0.8524E+03	0.1212E+01	0.2418E+03	0.9000E+00
0.9542E+03	0.2163E+01	0.3436E+03	0.1800E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.5903E-01	0.2750E-04	0.1767E-02	0.1000E-04
0.2952E+00	0.1375E-03	0.8837E-02	0.5000E-04
0.5903E+00	0.2750E-03	0.1767E-01	0.1000E-03
0.2952E+02	0.1375E-01	0.8837E+00	0.5000E-02
0.4441E+02	0.2064E-01	0.1326E+01	0.7500E-02
0.5930E+02	0.2755E-01	0.1767E+01	0.1000E-01
0.1458E+03	0.6864E-01	0.4418E+01	0.2500E-01
0.2624E+03	0.1302E+00	0.8837E+01	0.5000E-01
0.3537E+03	0.1852E+00	0.1326E+02	0.7500E-01
0.4262E+03	0.2345E+00	0.1767E+02	0.1000E+00
0.6061E+03	0.4478E+00	0.4542E+02	0.2500E+00
0.6472E+03	0.7177E+00	0.8908E+02	0.5000E+00
0.6609E+03	0.8502E+00	0.1120E+03	0.6250E+00
0.7077E+03	0.1149E+01	0.1654E+03	0.9000E+00
0.8418E+03	0.2118E+01	0.3022E+03	0.1800E+01

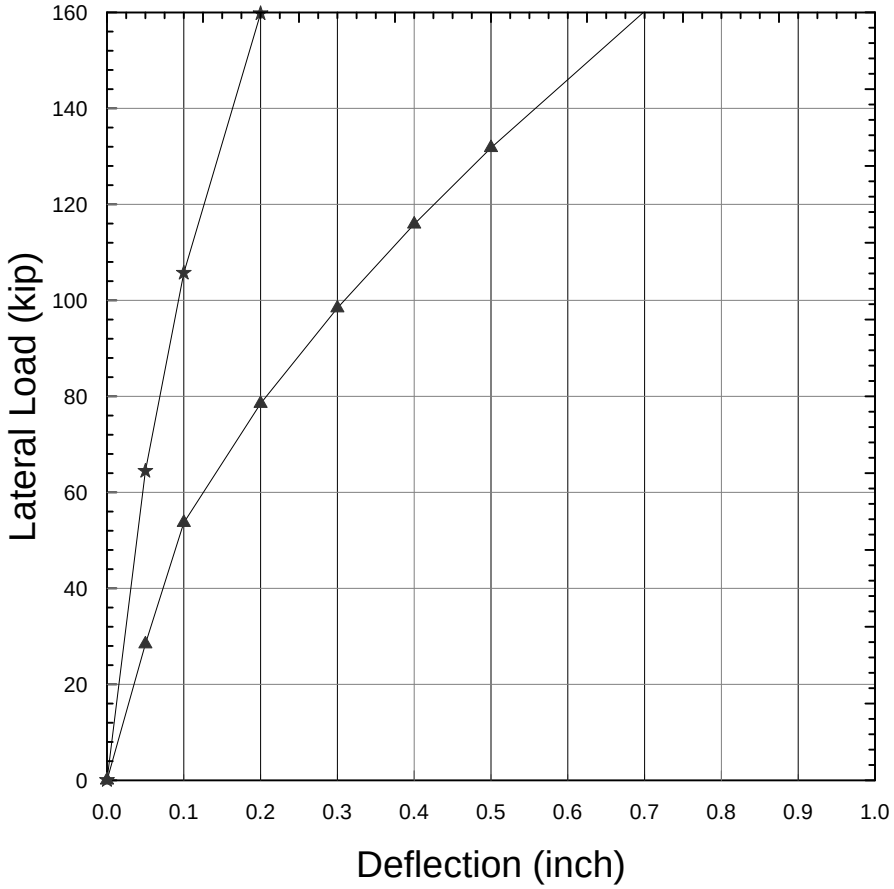


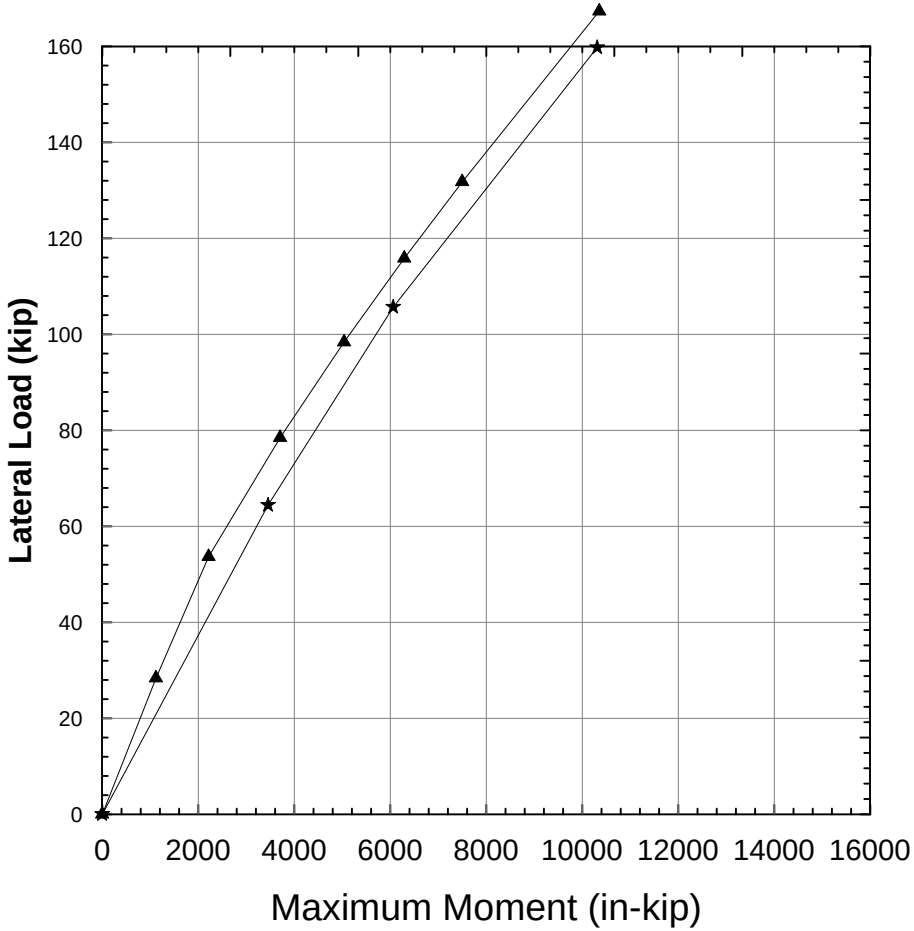




Project No. 28649640	SR 84-ISABEL AVENUE Livermore, California	**Arroyo Del Valle Bridge (Widen) Bent 2 Pile Lateral Resistance 36 inch CIDH Pile**
URS		

X:/Route 84-Isabel Avenue/geotech/Analysis/Pile Design/Lateral/Arroyo Del Valle Trial Bridge/Arroyo Del Valle_Abutment 3.grf





Project No. 28649640	SR 84-ISABEL AVENUE Livermore, California	**Arroyo Del Valle Bridge (Widen)** **Bent 2 Pile Lateral Resistance** **(Include Total Scour - Service Loads)** **36 inch CIDH Pile**
URS		

X:/Route 84-Isabel Avenue/geotech/Analysis/Pile Design/Lateral/Arroyo Del Valle Trial Bridge/Arroyo Del Valle_Abutment 3.grf

Extreme Load

```
================================================================================

               LPILE Plus for Windows, Version 5.0 (5.0.41)

             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:

Geotech SJ
URS

Path to file locations:      X:\Route 84 - Isabel
Avenue\geotech\Analysis\pile\lateral\Arroyo Del Valle Widening\20141024\
Name of input data file:     Arroyo Del Valle Widening_Bent 2_ Free_.lpd
Name of output file:         Arroyo Del Valle Widening_Bent 2_ Free_.lpo
Name of plot output file:    Arroyo Del Valle Widening_Bent 2_ Free_.lpp
Name of runtime file:        Arroyo Del Valle Widening_Bent 2_ Free_.lpr


--------------------------------------------------------------------------------
                         Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  November  5, 2014     Time:  16:12:12


--------------------------------------------------------------------------------
                               Problem Title
--------------------------------------------------------------------------------

SR84 Isabel Bent 2- Arroyo Del Valle Widening - 36 inch CIDH pile-revised scour


--------------------------------------------------------------------------------
                               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            =          152
- 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                                 =     912.00 in

Depth of ground surface below top of pile =     -64.00 in

Slope angle of ground surface               =       0.00 deg.

Structural properties of pile defined using  2 points

Point    Depth         Pile      Moment of       Pile      Modulus of
           X         Diameter     Inertia       Area      Elasticity
           in           in         in**4       Sq.in      lbs/Sq.in
-----  ---------   -----------   ----------   ----------   -----------
  1       0.0000   36.00000000   82448.0000    1018.0000      3600000.
  2     912.0000   36.00000000   82448.0000    1018.0000      3600000.


--------------------------------------------------------------------------------
                      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    =      -64.000 in
Distance from top of pile to bottom of layer =      660.000 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  2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      660.000 in
Distance from top of pile to bottom of layer =      720.000 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  3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      720.000 in
Distance from top of pile to bottom of layer =      912.000 in
p-y subgrade modulus k for top of soil layer =      175.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      175.000 lbs/in**3

Layer  4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      912.000 in
Distance from top of pile to bottom of layer =     1504.000 in
p-y subgrade modulus k for top of soil layer =      200.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      200.000 lbs/in**3


(Depth of lowest layer extends  592.00 in below pile tip)


--------------------------------------------------------------------------------
                    Effective Unit Weight of Soil vs. Depth
--------------------------------------------------------------------------------

Effective unit weight of soil with depth defined using  8 points

Point        Depth X    Eff. Unit Weight
 No.           in          lbs/in**3
-----      ----------   ----------------
  1          -64.00         0.04490
  2          660.00         0.04490
  3          660.00         0.02750
  4          720.00         0.02750
  5          720.00         0.04490
  6          912.00         0.04490
  7          912.00         0.04780
  8         1504.00         0.04780
```

Shear Strength of Soils

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	-64.000	0.00000	38.00	------	------
2	660.000	0.00000	38.00	------	------
3	660.000	0.00000	32.00	------	------
4	720.000	0.00000	32.00	------	------
5	720.000	0.00000	40.00	------	------
6	912.000	0.00000	40.00	------	------
7	912.000	0.00000	42.00	------	------
8	1504.000	0.00000	42.00	------	------

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.

Loading Type

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 = 0.050 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 843000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.100 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 843000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.200 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 843000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.300 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 843000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.400 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 843000.000 lbs

Load Case Number 6

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.500 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 843000.000 lbs

Load Case Number 7

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.750 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 843000.000 lbs

Load Case Number 8

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 1.000 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 843000.000 lbs

Load Case Number 9

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 1.250 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 843000.000 lbs

Load Case Number 10

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 2.000 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 843000.000 lbs

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 = 0.100000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 843000.000 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	Es*h F/L lbs/in
0.000	0.100000	0.0000	57732.4722	-0.0010464	828.0943	-728.1023	21843.0692
6.000	0.093722	338582.	53256.3698	-0.0010430	902.0132	-763.9318	48906.3708
12.000	0.087485	649627.	48580.2850	-0.0010330	969.9205	-794.7631	54507.6508
18.000	0.081326	931994.	43743.3777	-0.0010170	1031.5668	-817.5393	60315.5731
24.000	0.075281	1184835.	38808.4047	-0.0009956	1086.7668	-827.4517	65949.1862
30.000	0.069379	1407767.	33854.1213	-0.0009694	1135.4371	-823.9761	71258.4776
36.000	0.063648	1600891.	28963.7593	-0.0009390	1177.5999	-806.1446	75993.6523
42.000	0.058112	1764830.	24224.6515	-0.0009049	1213.3910	-773.5580	79869.5767
48.000	0.052789	1900741.	19680.7875	-0.0008679	1243.0630	-741.0634	84229.4263
54.000	0.047697	2009779.	15345.8119	-0.0008284	1266.8682	-703.9285	88550.4303
60.000	0.042848	2093271.	11265.8903	-0.0007869	1285.0960	-656.0454	91865.0563
66.000	0.038254	2152930.	7501.8287	-0.0007440	1298.1208	-598.6418	93894.9321
72.000	0.033921	2190819.	4105.6815	-0.0007001	1306.3926	-533.4072	94351.0620
78.000	0.029853	2209281.	1117.9879	-0.0006556	1310.4232	-462.4907	92953.7441
84.000	0.026053	2210867.	-1551.5541	-0.0006109	1310.7695	-427.3567	98419.0752
90.000	0.022522	2196842.	-4057.9453	-0.0005664	1307.7076	-408.1070	108723.
96.000	0.019257	2167901.	-6437.7244	-0.0005223	1301.3892	-385.1527	120006.
102.000	0.016255	2124873.	-8669.4553	-0.0004789	1291.9953	-358.7576	132427.

108.000	0.013510	2068712.	-10733.4059	-0.0004365	1279.7343	-329.2259	146212.
114.000	0.011017	2000487.	-12603.5200	-0.0003954	1264.8396	-294.1454	160200.
120.000	0.008766	1921469.	-14211.7669	-0.0003557	1247.5883	-241.9369	165600.
126.000	0.006748	1833545.	-15514.5337	-0.0003178	1228.3927	-192.3187	171000.
132.000	0.004953	1738509.	-16528.3103	-0.0002817	1207.6447	-145.6068	176400.
138.000	0.003368	1638054.	-17271.2873	-0.0002475	1185.7134	-102.0522	181800.
144.000	0.001982	1533758.	-17762.9762	-0.0002155	1162.9434	-61.8441	187200.
150.000	0.000782	1427078.	-18023.8475	-0.0001856	1139.6532	-25.1130	192600.
156.000	-0.000244	1319349.	-18074.9883	-0.0001578	1116.1338	8.0660	198000.
162.000	-0.001111	1211775.	-17937.7850	-0.0001322	1092.6483	37.6684	203400.
168.000	-0.001831	1105433.	-17633.6310	-0.0001088	1069.4317	63.7162	208800.
174.000	-0.002417	1001272.	-17183.6630	-8.7494E-05	1046.6913	86.2731	214200.
180.000	-0.002881	900114.	-16608.5254	-6.8276E-05	1024.6067	105.4394	219600.
186.000	-0.003236	802660.	-15928.1651	-5.1066E-05	1003.3306	121.3473	225000.
192.000	-0.003494	709493.	-15161.6550	-3.5782E-05	982.9903	134.1560	230400.
198.000	-0.003665	621082.	-14327.0467	-2.2333E-05	963.6886	144.0467	235800.
204.000	-0.003762	537794.	-13441.2522	-1.0620E-05	945.5052	151.2181	241200.
210.000	-0.003793	459895.	-12519.9517	-5.3596E-07	928.4982	155.8820	246600.
216.000	-0.003768	387560.	-11577.5279	8.0296E-06	912.7062	158.2592	252000.
222.000	-0.003696	320883.	-10627.0242	1.5190E-05	898.1493	158.5754	257400.
228.000	-0.003586	259882.	-9680.1246	2.1060E-05	884.8316	157.0578	262800.
234.000	-0.003444	204508.	-8747.1543	2.5754E-05	872.7425	153.9322	268200.
240.000	-0.003277	154656.	-7837.0983	2.9384E-05	861.8586	149.4198	273600.
246.000	-0.003091	110166.	-6957.6354	3.2061E-05	852.1457	143.7346	279000.
252.000	-0.002892	70839.5850	-6115.1864	3.3890E-05	843.5600	137.0818	284400.
258.000	-0.002684	36440.8999	-5314.9740	3.4975E-05	836.0501	129.6557	289800.
264.000	-0.002472	6706.0940	-4561.0917	3.5411E-05	829.5584	121.6384	295200.
270.000	-0.002259	-18650.4140	-3856.5802	3.5290E-05	832.1661	113.1987	300600.
276.000	-0.002049	-39929.8615	-3203.5105	3.4698E-05	836.8118	104.4912	306000.
282.000	-0.001843	-57443.5436	-2603.0692	3.3714E-05	840.6353	95.6559	311400.
288.000	-0.001644	-71507.7389	-2055.6469	3.2410E-05	843.7058	86.8182	316800.
294.000	-0.001454	-82439.1692	-1560.9276	3.0854E-05	846.0924	78.0883	322200.
300.000	-0.001274	-90550.9920	-1117.9763	2.9106E-05	847.8633	69.5621	327600.
306.000	-0.001105	-96149.3191	-725.3259	2.7219E-05	849.0856	61.3213	333000.
312.000	-0.000947	-99530.2480	-381.0607	2.5241E-05	849.8237	53.4338	338400.
318.000	-0.000802	-100977.	-82.8961	2.3214E-05	850.1396	45.9544	343800.
324.000	-0.000669	-100760.	171.7458	2.1175E-05	850.0921	38.9262	349200.
330.000	-0.000548	-99130.6448	385.6660	1.9155E-05	849.7364	32.3805	354600.
336.000	-0.000439	-96325.6174	561.8232	1.7179E-05	849.1241	26.3386	360000.
342.000	-0.000342	-92562.5531	703.2750	1.5270E-05	848.3025	20.8120	365400.
348.000	-0.000256	-88040.7912	813.1241	1.3445E-05	847.3153	15.8043	370800.
354.000	-0.000180	-82941.0719	894.4710	1.1717E-05	846.2019	11.3113	376200.
360.000	-0.000115	-77425.6646	950.3725	1.0096E-05	844.9978	7.3225	381600.
366.000	-5.93E-05	-71638.7298	983.8060	8.5891E-06	843.7344	3.8220	387000.
372.000	-1.21E-05	-65706.8797	997.6391	7.2009E-06	842.4394	0.7890695	392400.
378.000	2.72E-05	-59739.9048	994.6051	5.9329E-06	841.1367	-1.8004	397800.
384.000	5.91E-05	-53831.6355	977.2834	4.7850E-06	839.8468	-3.9735	403200.
390.000	8.46E-05	-48060.9091	948.0841	3.7551E-06	838.5869	-5.7596	408600.
396.000	0.000104	-42492.6134	909.2377	2.8399E-06	837.3713	-7.1892	414000.
402.000	0.000119	-37178.7849	862.7883	2.0346E-06	836.2112	-8.2939	419400.
408.000	0.000129	-32159.7359	810.5904	1.3338E-06	835.1154	-9.1054	424800.
414.000	0.000135	-27465.1921	754.3091	7.3114E-07	834.0905	-9.6551	430200.
420.000	0.000137	-23115.4231	695.4223	2.1990E-07	833.1408	-9.9738	435600.
426.000	0.000137	-19122.3487	635.2266	-2.0701E-07	832.2691	-10.0914	441000.
432.000	0.000135	-15490.6101	574.8434	-5.5686E-07	831.4762	-10.0363	446400.
438.000	0.000131	-12218.5943	515.2284	-8.3693E-07	830.7619	-9.8354	451800.
444.000	0.000125	-9299.4028	457.1808	-1.0544E-06	830.1245	-9.5138	457200.
450.000	0.000118	-6721.7581	401.3545	-1.2164E-06	829.5618	-9.0949	462600.
456.000	0.000110	-4470.8438	348.2696	-1.3295E-06	829.0704	-8.6001	468000.
462.000	0.000102	-2529.0743	298.3238	-1.4002E-06	828.6464	-8.0485	473400.
468.000	9.35E-05	-876.7929	251.8053	-1.4347E-06	828.2857	-7.4577	478800.
474.000	8.48E-05	507.1025	208.9039	-1.4384E-06	828.2050	-6.8428	484200.
480.000	7.62E-05	1644.6046	169.7232	-1.4166E-06	828.4534	-6.2174	489600.
486.000	6.78E-05	2558.1121	134.2921	-1.3742E-06	828.6528	-5.5930	495000.
492.000	5.97E-05	3270.0112	102.5754	-1.3153E-06	828.8082	-4.9793	500400.
498.000	5.20E-05	3802.3215	74.4840	-1.2438E-06	828.9244	-4.3845	505800.
504.000	4.48E-05	4176.4017	49.8852	-1.1631E-06	829.0061	-3.8151	511200.
510.000	3.81E-05	4412.7106	28.6108	-1.0763E-06	829.0577	-3.2764	516600.
516.000	3.19E-05	4530.6196	10.4656	-9.8592E-07	829.0834	-2.7720	522000.
522.000	2.62E-05	4548.2716	-4.7652	-8.9416E-07	829.0873	-2.3049	527400.
528.000	2.11E-05	4482.4822	-17.3097	-8.0288E-07	829.0729	-1.8766	532800.
534.000	1.66E-05	4348.6776	-27.4030	-7.1362E-07	829.0437	-1.4879	538200.
540.000	1.26E-05	4160.8648	-35.2830	-6.2761E-07	829.0027	-1.1388	543600.
546.000	9.06E-06	3931.6308	-41.1851	-5.4582E-07	828.9527	-0.8286129	549000.
552.000	6.02E-06	3672.1647	-45.3395	-4.6896E-07	828.8960	-0.5561921	554400.
558.000	3.43E-06	3392.3003	-47.9677	-3.9756E-07	828.8349	-0.3198606	559800.
564.000	1.25E-06	3100.5740	-49.2802	-3.3194E-07	828.7712	-0.1176235	565200.
570.000	-5.55E-07	2804.2963	-49.4747	-2.7225E-07	828.7065	0.0527732	570600.
576.000	-2.02E-06	2509.6316	-48.7351	-2.1854E-07	828.6422	0.1937640	576000.
582.000	-3.18E-06	2221.6859	-47.2301	-1.7072E-07	828.5793	0.3078936	581400.
588.000	-4.07E-06	1944.5972	-45.1132	-1.2861E-07	828.5188	0.3977559	586800.
594.000	-4.72E-06	1681.6288	-42.5221	-9.1960E-08	828.4614	0.4659403	592200.
600.000	-5.17E-06	1435.2624	-39.5793	-6.0456E-08	828.4076	0.5149868	597600.
606.000	-5.45E-06	1207.2888	-36.3923	-3.3747E-08	828.3579	0.5473478	603000.
612.000	-5.58E-06	998.8962	-33.0542	-1.1448E-08	828.3124	0.5653570	608400.
618.000	-5.58E-06	810.7544	-29.6445	6.8427E-09	828.2713	0.5712047	613800.
624.000	-5.49E-06	643.0930	-26.2301	2.1537E-08	828.2347	0.5669189	619200.
630.000	-5.33E-06	495.7749	-22.8663	3.3048E-08	828.2025	0.5543508	624600.
636.000	-5.10E-06	368.3628	-19.5978	4.1782E-08	828.1747	0.5351661	630000.
642.000	-4.82E-06	260.1790	-16.4598	4.8135E-08	828.1511	0.5108390	635400.
648.000	-4.52E-06	170.3588	-13.4793	5.2487E-08	828.1315	0.4826501	640800.
654.000	-4.19E-06	97.8966	-10.6763	5.5198E-08	828.1157	0.4516876	646200.
660.000	-3.86E-06	41.6852	-8.6524	5.6609E-08	828.1034	0.2229307	346811.
666.000	-3.51E-06	-6.5050	-7.3704	5.6965E-08	828.0957	0.2044172	348971.
672.000	-3.17E-06	-47.3356	-6.2000	5.6421E-08	828.1046	0.1857035	351131.
678.000	-2.84E-06	-81.4759	-5.1417	5.5119E-08	828.1121	0.1670821	353291.
684.000	-2.51E-06	-109.5930	-4.1940	5.3187E-08	828.1182	0.1488044	355451.
690.000	-2.20E-06	-132.3419	-3.3543	5.0742E-08	828.1232	0.1310844	357611.
696.000	-1.90E-06	-150.3583	-2.6188	4.7885E-08	828.1271	0.1141019	359771.
702.000	-1.62E-06	-164.2516	-1.9824	4.4705E-08	828.1302	0.0980060	361931.
708.000	-1.37E-06	-174.5999	-1.4397	4.1280E-08	828.1324	0.0829188	364091.
714.000	-1.13E-06	-181.9452	-0.9841012	3.7676E-08	828.1340	0.0689382	366251.
720.000	-9.14E-07	-186.7902	-0.3262103	3.3949E-08	828.1351	0.1503587	986672.
726.000	-7.22E-07	-186.2032	0.4833144	3.0179E-08	828.1350	0.1194828	992972.
732.000	-5.52E-07	-181.2957	1.1177	2.6465E-08	828.1339	0.0919643	999272.
738.000	-4.04E-07	-173.0590	1.5969	2.2883E-08	828.1321	0.0677745	1005572.
744.000	-2.78E-07	-162.3648	1.9406	1.9493E-08	828.1297	0.0468141	1011872.
750.000	-1.70E-07	-149.9686	2.1679	1.6336E-08	828.1270	0.0289293	1018172.
756.000	-8.16E-08	-136.5156	2.2964	1.3440E-08	828.1241	0.0139254	1024472.
762.000	-9.19E-09	-122.5473	2.3429	1.0822E-08	828.1211	0.0015792	1030772.
768.000	4.83E-08	-108.5097	2.3226	8.4866E-09	828.1180	-0.0083498	1037072.
774.000	9.26E-08	-94.7616	2.2493	6.4321E-09	828.1150	-0.0161109	1043372.
780.000	1.25E-07	-81.5837	2.1351	4.6497E-09	828.1121	-0.0219544	1049672.
786.000	1.48E-07	-69.1879	1.9908	3.1258E-09	828.1094	-0.0261254	1055972.
792.000	1.63E-07	-57.7256	1.8259	1.8430E-09	828.1069	-0.0288588	1062272.
798.000	1.71E-07	-47.2962	1.6482	7.8155E-10	828.1046	-0.0303760	1068572.
804.000	1.72E-07	-37.9555	1.4644	-8.0126E-11	828.1026	-0.0308813	1074872.
810.000	1.70E-07	-29.7227	1.2801	-7.6418E-10	828.1008	-0.0305609	1081172.
816.000	1.63E-07	-22.5871	1.0996	-1.2929E-09	828.0992	-0.0295812	1087472.
822.000	1.54E-07	-16.5140	0.9266258	-1.6881E-09	828.0979	-0.0280888	1093772.
828.000	1.43E-07	-11.4505	0.7637297	-1.9707E-09	828.0968	-0.0262099	1100072.
834.000	1.30E-07	-7.3293	0.6129452	-2.1606E-09	828.0959	-0.0240516	1106372.
840.000	1.17E-07	-4.0733	0.4756840	-2.2758E-09	828.0952	-0.0217021	1112672.
846.000	1.03E-07	-1.5981	0.3528805	-2.3331E-09	828.0947	-0.0192324	1118972.
852.000	8.90E-08	0.1848974	0.2450922	-2.3474E-09	828.0943	-0.0166971	1125272.
858.000	7.50E-08	1.3668	0.1525918	-2.3317E-09	828.0946	-0.0141364	1131572.
864.000	6.10E-08	2.0396	0.0754499	-2.2973E-09	828.0947	-0.0115776	1137872.
870.000	4.74E-08	2.2954	0.0136068	-2.2535E-09	828.0948	-0.0090368	1144172.
876.000	3.40E-08	2.2257	-0.0330655	-2.2078E-09	828.0948	-0.0065206	1150472.
882.000	2.09E-08	1.9210	-0.0647128	-2.1659E-09	828.0947	-0.0040285	1156772.
888.000	8.02E-09	1.4710	-0.0814599	-2.1316E-09	828.0946	-0.0015539	1163072.
894.000	-4.68E-09	0.9649985	-0.0833828	-2.1070E-09	828.0945	0.0009129	1169372.
900.000	-1.73E-08	0.4917421	-0.0704936	-2.0923E-09	828.0944	0.0033835	1175672.
906.000	-2.98E-08	0.1402411	-0.0427369	-2.0859E-09	828.0943	0.0058687	1181972.
912.000	-4.23E-08	0.0000	0.0000	-2.0844E-09	828.0943	0.0083769	594136.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	0.10000000 in
Computed slope at pile head	=	-0.00104637
Maximum bending moment	=	2210867. lbs-in
Maximum shear force	=	57732.47217 lbs
Depth of maximum bending moment	=	84.00000000 in

Depth of maximum shear force = 0.00000 in
Number of iterations = 6
Number of zero deflection points = 5

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 = 0.500000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 843000.000 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	Es*h F/L lbs/in
0.000	0.500000	0.0000	145914.	-0.0043157	828.0943	-1215.2676	7291.6056
6.000	0.474106	875439.	138386.	-0.0043069	1019.2196	-1294.0640	16376.9044
12.000	0.448318	1704202.	130411.	-0.0042808	1200.1548	-1364.4607	18261.0821
18.000	0.422736	2483671.	122050.	-0.0042385	1370.3278	-1422.4160	20188.7057
24.000	0.397456	3211678.	113398.	-0.0041809	1529.2660	-1461.7142	22066.0540
30.000	0.372565	3886735.	104533.	-0.0041092	1676.6441	-1493.2937	24048.8339
36.000	0.348146	4507637.	95520.2124	-0.0040243	1812.1990	-1510.8168	26037.6319
42.000	0.324274	5073688.	86467.8543	-0.0039275	1935.7789	-1506.6359	27877.1201
48.000	0.301017	5584981.	77421.9551	-0.0038197	2047.4042	-1508.6639	30071.3825
54.000	0.278437	6041392.	68378.8041	-0.0037022	2147.0475	-1505.7198	32446.5678
60.000	0.256590	6442979.	59412.4542	-0.0035760	2234.7217	-1483.0635	34679.3976
66.000	0.235524	6790516.	50643.0908	-0.0034423	2310.5960	-1440.0576	36685.5764
72.000	0.215282	7085518.	42193.2624	-0.0033020	2375.0005	-1376.5518	38365.0018
78.000	0.195900	7330239.	34184.6068	-0.0031563	2428.4279	-1293.0001	39601.8537
84.000	0.177406	7527663.	26525.3591	-0.0030062	2471.5293	-1260.0825	42616.7868
90.000	0.159826	7678954.	18992.0496	-0.0028525	2504.5590	-1251.0207	46964.3227
96.000	0.143177	7784423.	11541.6971	-0.0026962	2527.5850	-1232.4302	51646.4135
102.000	0.127472	7844728.	4231.4189	-0.0025382	2540.7509	-1204.3292	56686.6912
108.000	0.112719	7860876.	-2882.1581	-0.0023794	2544.2762	-1166.8631	62111.9173
114.000	0.098919	7834213.	-9743.6687	-0.0022208	2538.4552	-1120.3071	67953.1393
120.000	0.086069	7766418.	-16358.1134	-0.0020631	2523.6541	-1084.5078	75602.6558
126.000	0.074161	7658786.	-22763.8135	-0.0019072	2500.1561	-1050.7255	85008.7428
132.000	0.063182	7512545.	-28943.9088	-0.0017539	2468.2289	-1009.3062	95846.9539
138.000	0.053115	7329201.	-34852.2485	-0.0016039	2428.2014	-960.1404	108460.
144.000	0.043936	7110543.	-40441.9039	-0.0014579	2380.4640	-903.0781	123327.
150.000	0.035620	6858647.	-45664.7823	-0.0013167	2325.4702	-837.8814	141138.
156.000	0.028135	6575886.	-50470.8549	-0.0011809	2263.7379	-764.1428	162958.
162.000	0.021448	6264943.	-54806.6921	-0.0010512	2195.8531	-681.1362	190542.
168.000	0.015521	5928839.	-58470.5325	-0.0009279	2122.4750	-540.1439	208800.
174.000	0.010313	5572683.	-61195.5391	-0.0008117	2044.7193	-368.1916	214200.
180.000	0.005782	5202703.	-62934.9238	-0.0007027	1963.9455	-211.6032	219600.
186.000	0.001881	4824573.	-63781.2961	-0.0006014	1881.3924	-70.5209	225000.
192.000	-0.001435	4443411.	-63827.5200	-0.0005077	1798.1773	55.1129	230400.
198.000	-0.004212	4063779.	-63165.5765	-0.0004217	1715.2962	165.5349	235800.
204.000	-0.006496	3689691.	-61885.5483	-0.0003434	1633.6254	261.1411	241200.
210.000	-0.008332	3324626.	-60074.7285	-0.0002725	1553.9247	342.4655	246600.
216.000	-0.009766	2971550.	-57816.8539	-0.0002088	1476.8414	410.1594	252000.
222.000	-0.010838	2632936.	-55191.4619	-0.0001522	1402.9154	464.9713	257400.
228.000	-0.011592	2310792.	-52273.3675	-0.0001022	1332.5851	507.7269	262800.
234.000	-0.012065	2006690.	-49132.2555	-5.8580E-05	1266.1937	539.3105	268200.
240.000	-0.012295	1721798.	-45832.3822	-2.0895E-05	1203.9962	560.6473	273600.
246.000	-0.012316	1456913.	-42432.3797	1.1234E-05	1146.1667	572.6869	279000.
252.000	-0.012160	1212496.	-38985.1541	3.8215E-05	1092.8056	576.3883	284400.
258.000	-0.011857	988704.	-35537.8703	6.0463E-05	1043.9477	572.7063	289800.
264.000	-0.011435	785429.	-32132.0138	7.8395E-05	999.5688	562.5792	295200.
270.000	-0.010917	602327.	-28803.5208	9.2421E-05	959.5940	546.9185	300600.
276.000	-0.010325	438852.	-25582.9668	0.0001029	923.9043	526.5995	306000.
282.000	-0.009681	294290.	-22495.8058	0.0001104	892.3436	502.4542	311400.
288.000	-0.009001	167786.	-19562.6500	0.0001150	864.7253	475.2644	316800.
294.000	-0.008301	58374.7189	-16799.5830	0.0001173	840.8386	445.7579	322200.
300.000	-0.007593	-34995.4814	-14218.4965	0.0001175	835.7345	414.6042	327600.
306.000	-0.006890	-113436.	-11827.4453	0.0001160	852.8597	382.4128	333000.
312.000	-0.006201	-178099.	-9631.0119	0.0001131	866.9767	349.7317	338400.
318.000	-0.005533	-230153.	-7630.6749	0.0001090	878.3411	317.0473	343800.
324.000	-0.004893	-270769.	-5825.1761	0.0001039	887.2085	284.7856	349200.
330.000	-0.004286	-301106.	-4210.8803	9.8131E-05	893.8316	253.3130	354600.
336.000	-0.003716	-322293.	-2782.1244	9.1830E-05	898.4570	222.9390	360000.
342.000	-0.003184	-335420.	-1531.5519	8.5183E-05	901.3231	193.9186	365400.
348.000	-0.002693	-341533.	-450.4289	7.8340E-05	902.6576	166.4558	370800.
354.000	-0.002244	-341618.	471.0591	7.1435E-05	902.6761	140.7069	376200.
360.000	-0.001836	-336603.	1243.5333	6.4580E-05	901.5812	116.7845	381600.
366.000	-0.001469	-327349.	1878.1700	5.7870E-05	899.5609	94.7611	387000.
372.000	-0.001142	-314650.	2386.4743	5.1381E-05	896.7885	74.6737	392400.
378.000	-0.000853	-299231.	2780.0768	4.5176E-05	893.4222	56.5272	397800.
384.000	-0.000600	-281746.	3070.5553	3.9304E-05	889.6050	40.2990	403200.
390.000	-0.000381	-262782.	3269.2808	3.3800E-05	885.4647	25.9428	408600.
396.000	-0.000194	-242857.	3387.2854	2.8689E-05	881.1147	13.3921	414000.
402.000	-3.67E-05	-222425.	3435.1533	2.3987E-05	876.6539	2.5639	419400.
408.000	9.38E-05	-201878.	3422.9323	1.9698E-05	872.1681	-6.6376	424800.
414.000	0.000200	-181549.	3360.0651	1.5823E-05	867.7299	-14.3182	430200.
420.000	0.000284	-161717.	3255.3378	1.2353E-05	863.4002	-20.5909	435600.
426.000	0.000348	-142610.	3116.8460	9.2771E-06	859.2288	-25.5730	441000.
432.000	0.000395	-124409.	2951.9750	6.5782E-06	855.2551	-29.3840	446400.
438.000	0.000427	-107253.	2767.3930	4.2367E-06	851.5096	-32.1434	451800.
444.000	0.000446	-91242.6866	2569.0560	2.2305E-06	848.0144	-33.9690	457200.
450.000	0.000454	-76446.4088	2362.2231	5.3557E-07	844.7840	-34.9754	462600.
456.000	0.000452	-62901.4275	2151.4790	-8.7288E-07	841.8269	-35.2727	468000.
462.000	0.000443	-50619.8306	1940.7646	-2.0203E-06	839.1456	-34.9655	473400.
468.000	0.000428	-39591.8146	1733.4122	-2.9321E-06	836.7380	-34.1520	478800.
474.000	0.000408	-29789.2234	1532.1849	-3.6333E-06	834.5979	-32.9237	484200.
480.000	0.000384	-21168.8405	1339.3199	-4.1484E-06	832.7159	-31.3646	489600.
486.000	0.000358	-13675.4189	1156.5726	-4.5006E-06	831.0799	-29.5512	495000.
492.000	0.000330	-7244.4412	985.2622	-4.7120E-06	829.6759	-27.5523	500400.
498.000	0.000302	-1804.6052	826.3177	-4.8035E-06	828.4883	-25.4292	505800.
504.000	0.000273	2719.9628	680.3224	-4.7942E-06	828.6881	-23.2359	511200.
510.000	0.000244	6407.7617	547.5584	-4.7020E-06	829.4932	-21.0188	516600.
516.000	0.000216	9338.2283	428.0483	-4.5428E-06	830.1330	-18.8179	522000.
522.000	0.000190	11590.2960	321.5952	-4.3313E-06	830.6247	-16.6665	527400.
528.000	0.000164	13241.1864	227.8205	-4.0803E-06	830.9851	-14.5918	532800.
534.000	0.000141	14365.4181	146.1980	-3.8013E-06	831.2306	-12.6157	538200.
540.000	0.000119	15034.0160	76.0864	-3.5041E-06	831.3765	-10.7548	543600.
546.000	9.86E-05	15313.9029	16.7580	-3.1974E-06	831.4376	-9.0213	549000.
552.000	8.03E-05	15267.4567	-32.5756	-2.8883E-06	831.4275	-7.4232	554400.
558.000	6.39E-05	14952.2132	-72.7405	-2.5829E-06	831.3587	-5.9650	559800.
564.000	4.93E-05	14420.6992	-104.5802	-2.2860E-06	831.2426	-4.6482	565200.
570.000	3.65E-05	13720.3763	-128.9388	-2.0015E-06	831.0897	-3.4714	570600.
576.000	2.53E-05	12893.6809	-146.6466	-1.7325E-06	830.9092	-2.4312	576000.
582.000	1.57E-05	11978.1431	-158.5078	-1.4812E-06	830.7094	-1.5225	581400.
588.000	7.55E-06	11006.5710	-165.2908	-1.2488E-06	830.4973	-0.7385304	586800.
594.000	7.26E-07	10007.2865	-167.7214	-1.0364E-06	830.2791	-0.0716469	592200.
600.000	-4.89E-06	9004.3994	-166.4764	-8.4428E-07	830.0601	0.4866311	597600.
606.000	-9.41E-06	8018.1105	-162.1808	-6.7223E-07	829.8448	0.9452512	603000.
612.000	-1.30E-05	7065.0307	-155.4048	-5.1978E-07	829.6367	1.3134	608400.
618.000	-1.56E-05	6158.5108	-146.6638	-3.8612E-07	829.4388	1.6003	613800.
624.000	-1.76E-05	5308.9706	-136.4184	-2.7022E-07	829.2534	1.8149	619200.
630.000	-1.89E-05	4524.2234	-125.0758	-1.7083E-07	829.0820	1.9660	624600.
636.000	-1.96E-05	3809.7886	-112.9926	-8.6594E-08	828.9261	2.0618	630000.
642.000	-1.99E-05	3169.1885	-100.4772	-1.6055E-08	828.7862	2.1100	635400.
648.000	-1.98E-05	2604.2247	-87.7940	4.2299E-08	828.6629	2.1177	640800.
654.000	-1.94E-05	2115.2321	-75.1673	9.0001E-08	828.5561	2.0912	646200.
660.000	-1.87E-05	1701.3066	-65.6426	1.2858E-07	828.4657	1.0837	346811.
666.000	-1.79E-05	1326.2206	-59.2727	1.5918E-07	828.3838	1.0396	348971.
672.000	-1.68E-05	988.4241	-53.1977	1.8257E-07	828.3101	0.9854228	351131.
678.000	-1.57E-05	686.0018	-47.4710	1.9950E-07	828.2441	0.9234545	353291.
684.000	-1.44E-05	416.7537	-42.1335	2.1064E-07	828.1853	0.8557252	355451.
690.000	-1.32E-05	178.2691	-37.2140	2.1666E-07	828.1332	0.7840914	357611.
696.000	-1.18E-05	-32.0064	-32.7311	2.1813E-07	828.1013	0.7102329	359771.
702.000	-1.05E-05	-216.7103	-28.6934	2.1562E-07	828.1416	0.6356648	361931.
708.000	-9.26E-06	-378.5081	-25.1011	2.0960E-07	828.1769	0.5617509	364091.
714.000	-8.02E-06	-520.0441	-21.9467	2.0052E-07	828.2078	0.4897172	366251.
720.000	-6.85E-06	-643.8972	-17.0977	1.8876E-07	828.2349	1.1266	986672.
726.000	-5.76E-06	-727.1259	-10.8593	1.7490E-07	828.2530	0.9528510	992972.
732.000	-4.75E-06	-775.9776	-5.6263	1.5971E-07	828.2637	0.7914679	999272.
738.000	-3.84E-06	-796.2572	-1.3207	1.4382E-07	828.2681	0.6437473	1005572.
744.000	-3.03E-06	-793.2804	2.1418	1.2775E-07	828.2675	0.5104005	1011872.
750.000	-2.31E-06	-771.8481	4.8480	1.1193E-07	828.2628	0.3916704	1018172.
756.000	-1.68E-06	-736.2367	6.8853	9.6688E-08	828.2550	0.2874162	1024472.

762.000	-1.15E-06	-690.2031	8.3391	8.2270E-08	828.2450	0.1971908	1030772.
768.000	-6.96E-07	-637.0000	9.2916	6.8856E-08	828.2334	0.1203104	1037072.
774.000	-3.22E-07	-579.4007	9.8203	5.6561E-08	828.2208	0.0559166	1043372.
780.000	-1.73E-08	-519.7291	9.9971	4.5452E-08	828.2078	0.0030305	1049672.
786.000	2.24E-07	-459.8952	9.8880	3.5551E-08	828.1947	-0.0394002	1055972.
792.000	4.09E-07	-401.4328	9.5524	2.6845E-08	828.1819	-0.0724617	1062272.
798.000	5.46E-07	-345.5379	9.0433	1.9295E-08	828.1697	-0.0972414	1068572.
804.000	6.41E-07	-293.1084	8.4072	1.2840E-08	828.1583	-0.1148002	1074872.
810.000	7.00E-07	-244.7817	7.6843	7.4031E-09	828.1477	-0.1261520	1081172.
816.000	7.30E-07	-200.9714	6.9091	2.8977E-09	828.1382	-0.1322473	1087472.
822.000	7.35E-07	-161.9015	6.1105	-7.6996E-10	828.1296	-0.1339611	1093772.
828.000	7.20E-07	-127.6377	5.3124	-3.6964E-09	828.1222	-0.1320856	1100072.
834.000	6.91E-07	-98.1159	4.5341	-5.9782E-09	828.1157	-0.1273251	1106372.
840.000	6.49E-07	-73.1678	3.7913	-7.7094E-09	828.1103	-0.1202949	1112672.
846.000	5.98E-07	-52.5428	3.0958	-8.9801E-09	828.1058	-0.1115218	1118972.
852.000	5.41E-07	-35.9272	2.4569	-9.8743E-09	828.1021	-0.1014471	1125272.
858.000	4.79E-07	-22.9600	1.8813	-1.0469E-08	828.0993	-0.0904307	1131572.
864.000	4.15E-07	-13.2460	1.3737	-1.0835E-08	828.0972	-0.0787572	1137872.
870.000	3.49E-07	-6.3659	0.9375099	-1.1034E-08	828.0957	-0.0666425	1144172.
876.000	2.83E-07	-1.8842	0.5748575	-1.1117E-08	828.0947	-0.0542416	1150472.
882.000	2.16E-07	0.6448842	0.2871624	-1.1130E-08	828.0944	-0.0416568	1156772.
888.000	1.49E-07	1.6743	0.0753518	-1.1106E-08	828.0947	-0.0289468	1163072.
894.000	8.28E-08	1.6615	-0.0598970	-1.1072E-08	828.0947	-0.0161362	1169372.
900.000	1.65E-08	1.0675	-0.1179818	-1.1045E-08	828.0945	-0.0032254	1175672.
906.000	-4.97E-08	0.3574030	-0.0982604	-1.1030E-08	828.0944	0.0097992	1181972.
912.000	-1.16E-07	0.0000	0.0000	-1.1027E-08	828.0943	0.0229542	594136.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

```
Pile-head deflection             =     0.50000000 in
Computed slope at pile head      =    -0.00431572
Maximum bending moment           =       7860876. lbs-in
Maximum shear force              =   145914.15750 lbs
Depth of maximum bending moment  =      108.00000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =              8
Number of zero deflection points =              5
```

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   =        1.000000 in
Specified moment at pile head       =           0.000 in-lbs
Specified axial load at pile head   =      843000.000 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	Es*h F/L lbs/in
0.000	1.000000	0.0000	224210.	-0.0080302	828.0943	-1561.1635	4683.4905
6.000	0.951819	1357778.	214537.	-0.0080165	1124.5237	-1663.3771	10485.4669
12.000	0.903802	2655536.	204284.	-0.0079759	1407.8495	-1754.1713	11645.2824
18.000	0.856107	3889873.	193533.	-0.0079098	1677.3291	-1829.4983	12821.9800
24.000	0.808884	5057949.	182395.	-0.0078194	1932.3429	-1883.1549	13968.5347
30.000	0.762275	6157715.	170936.	-0.0077060	2172.4431	-1936.5975	15243.2980
36.000	0.716413	7187134.	159186.	-0.0075711	2397.1852	-1980.0737	16583.2419
42.000	0.671422	8144535.	147243.	-0.0074161	2606.2045	-2000.9347	17880.8752
48.000	0.627419	9029070.	135130.	-0.0072426	2799.3157	-2036.8342	19478.2275
54.000	0.584511	9839356.	122801.	-0.0070519	2976.2168	-2072.7528	21276.7904
60.000	0.542797	1.0574E+07	110323.	-0.0068455	3136.6074	-2086.6728	23065.8027
66.000	0.502365	1.1232E+07	97833.9318	-0.0066251	3280.3619	-2076.1905	24797.0163
72.000	0.463295	1.1815E+07	85486.2804	-0.0063922	3407.5477	-2039.6934	26415.4790
78.000	0.425659	1.2323E+07	73439.2242	-0.0061482	3518.4389	-1975.9920	27853.2014
84.000	0.389517	1.2759E+07	61621.9869	-0.0058947	3613.5247	-1963.0871	30238.8179
90.000	0.354922	1.3122E+07	49810.8050	-0.0056331	3692.8967	-1973.9736	33370.2471
96.000	0.321919	1.3413E+07	37974.6911	-0.0053649	3756.4615	-1971.3977	36743.3233
102.000	0.290543	1.3632E+07	26195.4520	-0.0050915	3804.2326	-1955.0153	40372.9508
108.000	0.260821	1.3779E+07	14556.4785	-0.0048145	3836.3340	-1924.6425	44275.0626
114.000	0.232769	1.3855E+07	3141.7482	-0.0045352	3853.0010	-1880.2676	48466.8735
120.000	0.206399	1.3863E+07	-8036.5055	-0.0042550	3854.5809	-1845.8170	53657.8409
126.000	0.181709	1.3802E+07	-19009.5287	-0.0039754	3841.3440	-1811.8574	59827.1838
132.000	0.158694	1.3675E+07	-29745.6826	-0.0036977	3813.5588	-1766.8605	66802.6779
138.000	0.137337	1.3482E+07	-40178.4392	-0.0034232	3771.5817	-1710.7250	74738.4995
144.000	0.117615	1.3227E+07	-50240.7099	-0.0031532	3715.8582	-1643.3652	83834.2714
150.000	0.099498	1.2911E+07	-59864.8699	-0.0028890	3646.9234	-1564.6881	94354.9197
156.000	0.082947	1.2538E+07	-68982.6048	-0.0026318	3565.4028	-1474.5569	106663.
162.000	0.067916	1.2110E+07	-77524.4806	-0.0023827	3472.0129	-1372.7350	121273.
168.000	0.054355	1.1632E+07	-85419.0600	-0.0021427	3367.5638	-1258.7914	138953.
174.000	0.042204	1.1107E+07	-92591.2381	-0.0019129	3252.9615	-1131.9346	160924.
180.000	0.031400	1.0540E+07	-98959.1160	-0.0016941	3129.2148	-990.6913	189304.
186.000	0.021875	9936597.	-104392.	-0.0014871	2997.4465	-820.3035	225000.
192.000	0.013555	9302493.	-108415.	-0.0012927	2859.0093	-520.4987	230400.
198.000	0.006363	8648700.	-110726.	-0.0011112	2716.2735	-250.0594	235800.
204.000	0.000220	7985020.	-111503.	-0.0009431	2571.3793	-8.8441	241200.
210.000	-0.004954	7320205.	-110919.	-0.0007884	2426.2374	203.6233	246600.
216.000	-0.009241	6661973.	-109143.	-0.0006471	2282.5324	388.1145	252000.
222.000	-0.012719	6017031.	-106342.	-0.0005189	2141.7291	545.6572	257400.
228.000	-0.015468	5391118.	-102673.	-0.0004036	2005.0801	677.4961	262800.
234.000	-0.017563	4789043.	-98284.9153	-0.0003007	1873.6355	785.0540	268200.
240.000	-0.019077	4214741.	-93320.0666	-0.0002097	1748.2542	869.8956	273600.
246.000	-0.020079	3671324.	-87909.3058	-0.0001300	1629.6157	933.6914	279000.
252.000	-0.020637	3161145.	-82173.6757	-6.0955E-05	1518.2336	978.1853	284400.
258.000	-0.020811	2685857.	-76223.6277	-1.8575E-06	1414.4690	1005.1640	289800.
264.000	-0.020659	2246480.	-70158.8509	4.7996E-05	1318.5445	1016.4283	295200.
270.000	-0.020235	1843465.	-64068.2601	8.9334E-05	1230.5585	1013.7686	300600.
276.000	-0.019587	1476757.	-58030.1277	0.0001229	1150.4991	998.9422	306000.
282.000	-0.018760	1145860.	-52112.3399	0.0001494	1078.2579	973.6537	311400.
288.000	-0.017794	849898.	-46372.7626	0.0001696	1013.6435	939.5387	316800.
294.000	-0.016725	587672.	-40859.6979	0.0001841	956.3945	898.1495	322200.
300.000	-0.015585	357719.	-35612.4162	0.0001937	906.1913	850.9444	327600.
306.000	-0.014401	158364.	-30661.7466	0.0001989	862.6682	799.2788	333000.
312.000	-0.013199	-12233.7845	-26030.7120	0.0002004	830.7652	744.3994	338400.
318.000	-0.011997	-156032.	-21735.1945	0.0001987	862.1590	687.4398	343800.
324.000	-0.010815	-275066.	-17784.6173	0.0001943	888.1465	629.4192	349200.
330.000	-0.009666	-371412.	-14182.6336	0.0001878	909.1809	571.2420	354600.
336.000	-0.008562	-447157.	-10927.8099	0.0001795	925.7173	513.6993	360000.
342.000	-0.007512	-504362.	-8014.2955	0.0001699	938.2063	457.4722	365400.
348.000	-0.006523	-545047.	-5432.4709	0.0001593	947.0886	403.1360	370800.
354.000	-0.005601	-571163.	-3169.5670	0.0001480	952.7902	351.1653	376200.
360.000	-0.004747	-584578.	-1210.2514	0.0001363	955.7191	301.9399	381600.
366.000	-0.003965	-587064.	462.8244	0.0001245	956.2619	255.7520	387000.
372.000	-0.003254	-580283.	1868.5181	0.0001127	954.7814	212.8126	392400.
378.000	-0.002613	-565782.	3026.7343	0.0001011	951.6155	173.2595	397800.
384.000	-0.002041	-544985.	3958.0060	8.9846E-05	947.0751	137.1644	403200.
390.000	-0.001535	-519195.	4683.1225	7.9090E-05	941.4446	104.5410	408600.
396.000	-0.001092	-489588.	5222.8012	6.8894E-05	934.9808	75.3519	414000.
402.000	-0.000708	-457218.	5597.4047	5.9324E-05	927.9139	49.5160	419400.
408.000	-0.000380	-423019.	5826.6998	5.0427E-05	920.4476	26.9157	424800.
414.000	-0.000103	-387808.	5929.6570	4.2232E-05	912.7603	7.4034	430200.
420.000	0.000127	-352290.	5924.2895	3.4752E-05	905.0061	-9.1925	435600.
426.000	0.000314	-317068.	5827.5269	2.7986E-05	897.3164	-23.0617	441000.
432.000	0.000462	-282643.	5655.1226	2.1925E-05	889.8008	-34.4065	446400.
438.000	0.000577	-249428.	5421.5907	1.6547E-05	882.5493	-43.4375	451800.
444.000	0.000661	-217751.	5140.1706	1.1825E-05	875.6337	-50.3692	457200.
450.000	0.000719	-187866.	4822.8145	7.7251E-06	869.1090	-55.4161	462600.
456.000	0.000754	-159956.	4480.1969	4.2095E-06	863.0157	-58.7897	468000.
462.000	0.000769	-134146.	4121.7413	1.2369E-06	857.3810	-60.6955	473400.
468.000	0.000769	-110507.	3755.6623	-1.2359E-06	852.2202	-61.3309	478800.
474.000	0.000754	-89065.4456	3389.0198	-3.2531E-06	847.5390	-60.8833	484200.
480.000	0.000730	-69806.2195	3027.7832	-4.8588E-06	843.3344	-59.5289	489600.
486.000	0.000696	-52682.8955	2676.9033	-6.0969E-06	839.5960	-57.4311	495000.
492.000	0.000656	-37621.7035	2340.3893	-7.0096E-06	836.3079	-54.7403	500400.
498.000	0.000612	-24527.3143	2021.3890	-7.6378E-06	833.4491	-51.5932	505800.
504.000	0.000565	-13287.7721	1722.2709	-8.0200E-06	830.9953	-48.1128	511200.
510.000	0.000516	-3778.9336	1444.7066	-8.1925E-06	828.9193	-44.4086	516600.
516.000	0.000466	4131.5829	1189.7519	-8.1889E-06	828.9963	-40.5764	522000.
522.000	0.000418	10580.9283	957.9250	-8.0402E-06	830.4043	-36.6993	527400.

528.000	0.000370	15708.0174	749.2825	-7.7745E-06	831.5237	-32.8482	532800.
534.000	0.000324	19650.9651	563.4909	-7.4171E-06	832.3845	-29.0823	538200.
540.000	0.000281	22544.9397	399.8935	-6.9906E-06	833.0163	-25.4501	543600.
546.000	0.000240	24520.4037	257.5724	-6.5149E-06	833.4476	-21.9902	549000.
552.000	0.000203	25701.7132	135.4057	-6.0073E-06	833.7055	-18.7320	554400.
558.000	0.000168	26206.0415	32.1185	-5.4827E-06	833.8156	-15.6970	559800.
564.000	0.000137	26142.5977	-53.6706	-4.9536E-06	833.8017	-12.8993	565200.
570.000	0.000109	25612.1046	-123.4092	-4.4304E-06	833.6859	-10.3469	570600.
576.000	8.38E-05	24706.5057	-178.5757	-3.9219E-06	833.4882	-8.0420	576000.
582.000	6.17E-05	23508.8702	-220.6486	-3.4345E-06	833.2267	-5.9824	581400.
588.000	4.26E-05	22093.4660	-251.0816	-2.9736E-06	832.9177	-4.1620	586800.
594.000	2.61E-05	20525.9715	-271.2823	-2.5428E-06	832.5755	-2.5716	592200.
600.000	1.20E-05	18863.8023	-282.5951	-2.1447E-06	832.2126	-1.1994	597600.
606.000	3.18E-07	17156.5266	-286.2890	-1.7806E-06	831.8399	-0.0319334	603000.
612.000	-9.33E-06	15446.3470	-283.5480	-1.4511E-06	831.4665	0.9456189	608400.
618.000	-1.71E-05	13768.6304	-275.4645	-1.1558E-06	831.1003	1.7489	613800.
624.000	-2.32E-05	12152.4655	-263.0365	-8.9383E-07	830.7474	2.3938	619200.
630.000	-2.78E-05	10621.2339	-247.1666	-6.6364E-07	830.4131	2.8962	624600.
636.000	-3.12E-05	9193.1799	-228.6628	-4.6337E-07	830.1014	3.2717	630000.
642.000	-3.34E-05	7881.9677	-208.2422	-2.9079E-07	829.8151	3.5351	635400.
648.000	-3.46E-05	6697.2148	-186.5354	-1.4343E-07	829.5564	3.7005	640800.
654.000	-3.51E-05	5644.9942	-164.0922	-1.8682E-08	829.3267	3.7806	646200.
660.000	-3.49E-05	4728.2979	-146.7032	8.6165E-08	829.1266	2.0157	346811.
666.000	-3.41E-05	3883.6838	-134.7115	1.7321E-07	828.9422	1.9815	348971.
672.000	-3.28E-05	3110.0073	-123.0094	2.4390E-07	828.7733	1.9192	351131.
678.000	-3.11E-05	2405.1032	-111.7508	2.9964E-07	828.6194	1.8337	353291.
684.000	-2.92E-05	1765.9669	-101.0603	3.4180E-07	828.4798	1.7298	355451.
690.000	-2.70E-05	1188.9220	-91.0359	3.7167E-07	828.3539	1.6117	357611.
696.000	-2.47E-05	669.7758	-81.7508	3.9045E-07	828.2405	1.4834	359771.
702.000	-2.24E-05	203.9625	-73.2552	3.9928E-07	828.1388	1.3485	361931.
708.000	-1.99E-05	-213.3253	-65.5783	3.9919E-07	828.1409	1.2104	364091.
714.000	-1.76E-05	-587.0157	-58.7304	3.9110E-07	828.2225	1.0722	366251.
720.000	-1.53E-05	-922.0469	-47.9885	3.7585E-07	828.2956	2.5085	986672.
726.000	-1.31E-05	-1166.6795	-33.9816	3.5474E-07	828.3490	2.1605	992972.
732.000	-1.10E-05	-1333.4141	-22.0054	3.2947E-07	828.3854	1.8315	999272.
738.000	-9.10E-06	-1434.0773	-11.9348	3.0149E-07	828.4074	1.5253	1005572.
744.000	-7.38E-06	-1479.6819	-3.6254	2.7204E-07	828.4173	1.2445	1011872.
750.000	-5.84E-06	-1480.3340	3.0795	2.4213E-07	828.4175	0.9904695	1018172.
756.000	-4.47E-06	-1445.1777	8.3425	2.1256E-07	828.4098	0.7638761	1024472.
762.000	-3.29E-06	-1382.3742	12.3277	1.8398E-07	828.3961	0.5645333	1030772.
768.000	-2.27E-06	-1299.1062	15.1964	1.5687E-07	828.3779	0.3916766	1037072.
774.000	-1.40E-06	-1201.6049	17.1036	1.3160E-07	828.3566	0.2440780	1043372.
780.000	-6.87E-07	-1095.1940	18.1963	1.0838E-07	828.3334	0.1201649	1049672.
786.000	-1.03E-07	-984.3451	18.6112	8.7365E-08	828.3092	0.0181250	1055972.
792.000	3.62E-07	-872.7432	18.4736	6.8595E-08	828.2848	-0.0640037	1062272.
798.000	7.20E-07	-763.3561	17.8968	5.2058E-08	828.2610	-0.1282557	1068572.
804.000	9.86E-07	-658.5082	16.9820	3.7687E-08	828.2381	-0.1766745	1074872.
810.000	1.17E-06	-559.9532	15.8182	2.5371E-08	828.2166	-0.2112599	1081172.
816.000	1.29E-06	-468.9463	14.4826	1.4972E-08	828.1967	-0.2339269	1087472.
822.000	1.35E-06	-386.3129	13.0414	6.3275E-09	828.1786	-0.2464736	1093772.
828.000	1.37E-06	-312.5130	11.5503	-7.3583E-10	828.1625	-0.2505586	1100072.
834.000	1.34E-06	-247.7012	10.0556	-6.3981E-09	828.1484	-0.2476848	1106372.
840.000	1.29E-06	-191.7808	8.5950	-1.0840E-08	828.1362	-0.2391904	1112672.
846.000	1.21E-06	-144.4516	7.1987	-1.4239E-08	828.1258	-0.2262459	1118972.
852.000	1.12E-06	-105.2525	5.8904	-1.6762E-08	828.1173	-0.2098545	1125272.
858.000	1.01E-06	-73.5975	4.6882	-1.8570E-08	828.1104	-0.1908577	1131572.
864.000	8.96E-07	-48.8057	3.6058	-1.9807E-08	828.1050	-0.1699435	1137872.
870.000	7.74E-07	-30.1270	2.6530	-2.0605E-08	828.1009	-0.1476570	1144172.
876.000	6.49E-07	-16.7608	1.8368	-2.1079E-08	828.0980	-0.1244141	1150472.
882.000	5.21E-07	-7.8718	1.1620	-2.1328E-08	828.0960	-0.1005158	1156772.
888.000	3.93E-07	-2.6006	0.6319972	-2.1434E-08	828.0949	-0.0761647	1163072.
894.000	2.64E-07	-0.0710045	0.2490559	-2.1461E-08	828.0943	-0.0514824	1169372.
900.000	1.35E-07	0.6052002	0.0150247	-2.1455E-08	828.0944	-0.0265280	1175672.
906.000	6.69E-09	0.3263347	-0.0685124	-2.1446E-08	828.0944	-0.0013177	1181972.
912.000	-1.22E-07	0.0000	0.0000	-2.1443E-08	828.0943	0.0241551	594136.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 8:

Pile-head deflection = 1.00000000 in

Computed slope at pile head = -0.00803023
Maximum bending moment = 13862654. lbs-in
Maximum shear force = 224210.39771 lbs
Depth of maximum bending moment = 120.00000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 8
Number of zero deflection points = 5

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= 0.050000	M= 0.000	843000.	0.0500000	1204640.	33302.3684
4	y= 0.100000	M= 0.000	843000.	0.1000000	2210867.	57732.4722
4	y= 0.200000	M= 0.000	843000.	0.2000000	3777345.	85218.0445
4	y= 0.300000	M= 0.000	843000.	0.3000000	5208471.	107751.
4	y= 0.400000	M= 0.000	843000.	0.4000000	6561956.	127676.
4	y= 0.500000	M= 0.000	843000.	0.5000000	7860876.	145914.
4	y= 0.750000	M= 0.000	843000.	0.7500000	1.0942E+07	186854.
4	y= 1.000000	M= 0.000	843000.	1.0000000	1.3863E+07	224210.
4	y= 1.250	M= 0.000	843000.	1.2500	1.6689E+07	259866.
4	y= 2.000	M= 0.000	843000.	2.0000	2.4743E+07	351530.

Pile-head Deflection vs. Pile Length

Boundary Condition Type 4, Deflection and Moment

Deflection = 0.05000 in
Moment = 0. in-lbs
Axial Load = 843000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
912.000	0.05000000	1204640.	33302.36836
866.400	0.05000000	1203653.	33302.89151
820.800	0.05000000	1204530.	33303.38818
775.200	0.05000000	1204816.	33303.85829
729.600	0.05000000	1204870.	33304.30181
684.000	0.05000000	1204856.	33304.71873
638.400	0.05000000	1204607.	33305.10788
592.800	0.05000000	1204787.	33305.46016
547.200	0.05000000	1204635.	33305.76706
501.600	0.05000000	1204765.	33306.06590

This analysis ended normally.

```
================================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.41)

              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:

Geotech SJ
URS

Path to file locations:      X:\Route 84 - Isabel
Avenue\geotech\Analysis\pile\lateral\Arroyo Del Valle Widening\20141024\
Name of input data file:     Arroyo Del Valle Widening_Bent 2_ Fixed_.lpd
Name of output file:         Arroyo Del Valle Widening_Bent 2_ Fixed_.lpo
Name of plot output file:    Arroyo Del Valle Widening_Bent 2_ Fixed_.lpp
Name of runtime file:        Arroyo Del Valle Widening_Bent 2_ Fixed_.lpr


--------------------------------------------------------------------------------
                         Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  November  5, 2014     Time:  16:16:47


--------------------------------------------------------------------------------
                                Problem Title
--------------------------------------------------------------------------------

SR84 Isabel Bent 2- Arroyo Del Valle Widening - 36 inch CIDH pile-revised scour


--------------------------------------------------------------------------------
                                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           =          152
- 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                                =     912.00 in

Depth of ground surface below top of pile =     -64.00 in

Slope angle of ground surface              =       0.00 deg.

Structural properties of pile defined using  2 points

Point    Depth         Pile      Moment of       Pile      Modulus of
           X         Diameter     Inertia       Area      Elasticity
           in           in         in**4       Sq.in      lbs/Sq.in
-----  ---------   -----------   ----------   ----------   -----------
  1       0.0000   36.00000000   82448.0000    1018.0000      3600000.
  2     912.0000   36.00000000   82448.0000    1018.0000      3600000.


--------------------------------------------------------------------------------
                      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    =      -64.000 in
Distance from top of pile to bottom of layer =      660.000 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  2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      660.000 in
Distance from top of pile to bottom of layer =      720.000 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  3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      720.000 in
Distance from top of pile to bottom of layer =      912.000 in
p-y subgrade modulus k for top of soil layer =      175.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      175.000 lbs/in**3

Layer  4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      912.000 in
Distance from top of pile to bottom of layer =     1504.000 in
p-y subgrade modulus k for top of soil layer =      200.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      200.000 lbs/in**3


(Depth of lowest layer extends  592.00 in below pile tip)


--------------------------------------------------------------------------------
                  Effective Unit Weight of Soil vs. Depth
--------------------------------------------------------------------------------

Effective unit weight of soil with depth defined using  8 points

Point        Depth X    Eff. Unit Weight
 No.           in          lbs/in**3
-----      ----------   ----------------
  1          -64.00         0.04490
  2          660.00         0.04490
  3          660.00         0.02750
  4          720.00         0.02750
  5          720.00         0.04490
  6          912.00         0.04490
  7          912.00         0.04780
  8         1504.00         0.04780
```

Shear Strength of Soils

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	-64.000	0.00000	38.00	------	------
2	660.000	0.00000	38.00	------	------
3	660.000	0.00000	32.00	------	------
4	720.000	0.00000	32.00	------	------
5	720.000	0.00000	40.00	------	------
6	912.000	0.00000	40.00	------	------
7	912.000	0.00000	42.00	------	------
8	1504.000	0.00000	42.00	------	------

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.

Loading Type

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 = 0.050 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 843000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 0.100 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 843000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 0.200 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 843000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 0.300 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 843000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 0.400 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 843000.000 lbs

Load Case Number 6

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 0.500 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 843000.000 lbs

Load Case Number 7

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 0.750 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 843000.000 lbs

Load Case Number 8

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 1.000 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 843000.000 lbs

Load Case Number 9

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 1.250 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 843000.000 lbs

Load Case Number 10

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 2.000 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 843000.000 lbs

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 = 0.100000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 843000.000 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	Es*h F/L lbs/in
0.000	0.100000	-6227744.	112319.	0.0000	2187.7317	-728.1023	21843.0692
6.000	0.099622	-5567535.	-100.5019	-0.0001192	2043.5953	-779.2460	46932.0113
12.000	0.098569	-4934809.	102826.	-0.0002254	1905.4590	-826.7460	50324.7224
18.000	0.096918	-4331342.	97744.3257	-0.0003190	1773.7105	-867.1598	53684.2045
24.000	0.094741	-3758650.	92457.4521	-0.0004008	1648.6806	-895.1314	56689.1396
30.000	0.092108	-3217798.	87039.5155	-0.0004713	1530.6022	-910.8475	59333.2340
36.000	0.089085	-2709408.	81568.5189	-0.0005312	1419.6107	-912.8180	61479.3508
42.000	0.085734	-2233602.	76131.7380	-0.0005812	1315.7331	-899.4422	62946.6888
48.000	0.082111	-1789948.	70770.7476	-0.0006218	1218.8747	-887.5546	64855.0796
54.000	0.078272	-1378063.	65493.8338	-0.0006539	1128.9522	-871.4167	66799.4902
60.000	0.074265	-997408.	60350.9128	-0.0006779	1045.8477	-842.8903	68098.7868
66.000	0.070137	-646994.	55415.5327	-0.0006945	969.3458	-802.2364	68628.7633
72.000	0.065931	-325396.	50758.4949	-0.0007043	899.1345	-750.1095	68263.3242
78.000	0.061685	-30767.5306	46445.3512	-0.0007079	834.8115	-687.6051	66882.0816
84.000	0.057436	239110.	42380.7122	-0.0007058	880.2966	-667.2746	69706.5817
90.000	0.053215	484941.	38377.3920	-0.0006985	933.9664	-667.1654	75222.5821
96.000	0.049054	706705.	34389.0075	-0.0006865	982.3817	-662.2961	81008.6863
102.000	0.044978	904553.	30444.0535	-0.0006702	1025.5759	-652.6886	87068.0563
108.000	0.041012	1078813.	26570.6877	-0.0006501	1063.6201	-638.4333	93402.7150
114.000	0.037176	1229978.	22796.3207	-0.0006268	1096.6225	-619.6890	100013.

120.000	0.033490	1358709.	19104.4029	-0.0006006	1124.7269	-610.9502	109456.
126.000	0.029969	1465307.	15454.4908	-0.0005721	1147.9993	-605.6871	121263.
132.000	0.026625	1549950.	11846.9362	-0.0005416	1166.4786	-596.8311	134496.
138.000	0.023470	1612949.	8303.3436	-0.0005096	1180.2324	-584.3665	149393.
144.000	0.020510	1654746.	4845.3525	-0.0004766	1189.3575	-568.2972	166253.
150.000	0.017750	1675915.	1494.5373	-0.0004429	1193.9790	-548.6412	185453.
156.000	0.015194	1677161.	-1655.6200	-0.0004091	1194.2512	-501.4113	198000.
162.000	0.012842	1660185.	-4465.8523	-0.0003753	1190.5450	-435.3328	203400.
168.000	0.010690	1627368.	-6887.9319	-0.0003421	1183.3803	-372.0271	208800.
174.000	0.008737	1580991.	-8939.6998	-0.0003097	1173.2553	-311.8956	214200.
180.000	0.006974	1523224.	-10641.1827	-0.0002783	1160.6437	-255.2654	219600.
186.000	0.005397	1456112.	-12014.1536	-0.0002482	1145.9918	-202.3916	225000.
192.000	0.003996	1381565.	-13081.7092	-0.0002195	1129.7167	-153.4603	230400.
198.000	0.002763	1301352.	-13867.8693	-0.0001924	1112.2046	-108.5931	235800.
204.000	0.001688	1217096.	-14397.2024	-0.0001669	1093.8100	-67.8513	241200.
210.000	0.000760	1130274.	-14694.4795	-0.0001432	1074.8550	-31.2411	246600.
216.000	-3.05E-05	1042211.	-14784.3589	-0.0001212	1055.6292	1.2813	252000.
222.000	-0.000695	954088.	-14691.1033	-0.0001011	1036.3902	29.8039	257400.
228.000	-0.001243	866940.	-14438.3310	-8.2655E-05	1017.3642	54.4535	262800.
234.000	-0.001687	781664.	-14048.7995	-6.5991E-05	998.7467	75.3903	268200.
240.000	-0.002035	699022.	-13544.2228	-5.1026E-05	980.7044	92.8019	273600.
246.000	-0.002299	619649.	-12945.1218	-3.7697E-05	963.3758	106.8985	279000.
252.000	-0.002487	544062.	-12270.7043	-2.5935E-05	946.8736	117.9074	284400.
258.000	-0.002610	472663.	-11538.7766	-1.5659E-05	931.2859	126.0685	289800.
264.000	-0.002675	405755.	-10765.6816	-6.7803E-06	916.6785	131.6298	295200.
270.000	-0.002691	343544.	-9966.2630	7.9315E-07	903.0966	134.8430	300600.
276.000	-0.002666	286152.	-9153.8534	7.1577E-06	890.5668	135.9601	306000.
282.000	-0.002606	233625.	-8340.2834	1.2411E-05	879.0992	135.2299	311400.
288.000	-0.002517	185943.	-7535.9090	1.6652E-05	868.6892	132.8949	316800.
294.000	-0.002406	143026.	-6749.6561	1.9977E-05	859.3196	129.1894	322200.
300.000	-0.002277	104745.	-5989.0786	2.2481E-05	850.9622	124.3365	327600.
306.000	-0.002136	70929.4319	-5260.4278	2.4257E-05	843.5796	118.5471	333000.
312.000	-0.001986	41374.3956	-4568.7313	2.5392E-05	837.1271	112.0184	338400.
318.000	-0.001831	15847.7899	-3917.8793	2.5970E-05	831.5542	104.9323	343800.
324.000	-0.001674	-5902.8728	-3310.7154	2.6071E-05	829.3830	97.4557	349200.
330.000	-0.001518	-24144.5281	-2749.1311	2.5767E-05	833.3655	89.7391	354600.
336.000	-0.001365	-39153.1071	-2234.1618	2.5127E-05	836.6422	81.9173	360000.
342.000	-0.001217	-51208.6589	-1766.0824	2.4214E-05	839.2741	74.1091	365400.
348.000	-0.001075	-60591.0469	-1344.5022	2.3084E-05	841.3225	66.4176	370800.
354.000	-0.000940	-67576.2050	-968.4563	2.1789E-05	842.8475	58.9310	376200.
360.000	-0.000813	-72432.9374	-636.4944	2.0374E-05	843.9078	51.7230	381600.
366.000	-0.000695	-75420.2369	-346.7645	1.8879E-05	844.5600	44.8536	387000.
372.000	-0.000587	-76785.0938	-97.0923	1.7341E-05	844.8580	38.3704	392400.
378.000	-0.000487	-76760.7638	114.9462	1.5789E-05	844.8527	32.3090	397800.
384.000	-0.000397	-75565.4598	291.9564	1.4249E-05	844.5917	26.6944	403200.
390.000	-0.000316	-73401.4316	436.6648	1.2744E-05	844.1193	21.5417	408600.
396.000	-0.000244	-70454.3958	551.8633	1.1290E-05	843.4759	16.8577	414000.
402.000	-0.000181	-66893.2773	640.3609	9.9013E-06	842.6984	12.6414	419400.
408.000	-0.000125	-62870.2271	704.9413	8.5898E-06	841.8201	8.8853	424800.
414.000	-7.78E-05	-58520.8763	748.3263	7.3628E-06	840.8705	5.5764	430200.
420.000	-3.71E-05	-53964.7932	773.1457	6.2259E-06	839.8759	2.6968	435600.
426.000	-3.06E-06	-49306.1092	781.9113	5.1821E-06	838.8588	0.2251185	441000.
432.000	2.50E-05	-44634.2795	776.9978	4.2326E-06	837.8388	-1.8629	446400.
438.000	4.77E-05	-40024.9519	760.6272	3.3769E-06	836.8325	-3.5939	451800.
444.000	6.56E-05	-35540.9136	734.8579	2.6131E-06	835.8536	-4.9959	457200.
450.000	7.91E-05	-31233.0921	701.5777	1.9382E-06	834.9131	-6.0975	462600.
456.000	8.88E-05	-27141.5877	662.5011	1.3482E-06	834.0198	-6.9280	468000.
462.000	9.53E-05	-23296.7176	619.1679	8.3841E-07	833.1804	-7.5164	473400.
468.000	9.89E-05	-19720.0543	572.9465	4.0362E-07	832.3996	-7.8908	478800.
474.000	0.000100	-16425.4427	525.0381	3.8285E-08	831.6803	-8.0787	484200.
480.000	9.93E-05	-13419.9847	476.4832	-2.6337E-07	831.0241	-8.1063	489600.
486.000	9.69E-05	-10704.9797	428.1700	-5.0721E-07	830.4314	-7.9981	495000.
492.000	9.33E-05	-8276.8135	380.8432	-6.9907E-07	829.9013	-7.7774	500400.
498.000	8.86E-05	-6127.7892	335.1145	-8.4466E-07	829.4321	-7.4655	505800.
504.000	8.31E-05	-4246.8954	291.4729	-9.4952E-07	829.0215	-7.0817	511200.
510.000	7.72E-05	-2620.5094	250.2962	-1.0189E-06	828.6664	-6.6438	516600.
516.000	7.09E-05	-1233.0333	211.8620	-1.0579E-06	828.3635	-6.1676	522000.
522.000	6.45E-05	-67.4636	176.3587	-1.0710E-06	828.1090	-5.6669	527400.
528.000	5.80E-05	894.1057	143.8965	-1.0627E-06	828.2895	-5.1539	532800.
534.000	5.17E-05	1670.0439	114.5177	-1.0368E-06	828.4589	-4.6391	538200.
540.000	4.56E-05	2278.8054	88.2069	-9.9685E-07	828.5918	-4.1312	543600.
546.000	3.98E-05	2738.6111	64.9005	-9.4613E-07	828.6922	-3.6376	549000.
552.000	3.42E-05	3067.1830	44.4951	-8.8745E-07	828.7639	-3.1642	554400.
558.000	2.91E-05	3281.5302	26.8558	-8.2328E-07	828.8107	-2.7156	559800.
564.000	2.44E-05	3397.7813	11.8235	-7.5577E-07	828.8361	-2.2952	565200.
570.000	2.00E-05	3431.0577	-0.7785197	-6.8675E-07	828.8434	-1.9055	570600.
576.000	1.61E-05	3395.3862	-11.1387	-6.1775E-07	828.8356	-1.5479	576000.
582.000	1.26E-05	3303.6424	-19.4521	-5.5004E-07	828.8156	-1.2232	581400.
588.000	9.52E-06	3167.5248	-25.9160	-4.8464E-07	828.7858	-0.9314118	586800.
594.000	6.81E-06	2997.5525	-30.7261	-4.2232E-07	828.7487	-0.6719409	592200.
600.000	4.46E-06	2803.0839	-34.0733	-3.6369E-07	828.7063	-0.4437931	597600.
606.000	2.44E-06	2592.3521	-36.1414	-3.0916E-07	828.6603	-0.2455797	603000.
612.000	7.46E-07	2372.5144	-37.1050	-2.5898E-07	828.6123	-0.0756268	608400.
618.000	-6.64E-07	2149.7115	-37.1281	-2.1327E-07	828.5636	0.0679444	613800.
624.000	-1.81E-06	1929.1349	-36.3628	-1.7204E-07	828.5155	0.1871456	619200.
630.000	-2.73E-06	1715.0982	-34.9492	-1.3521E-07	828.4687	0.2840579	624600.
636.000	-3.44E-06	1511.1123	-33.0147	-1.0260E-07	828.4242	0.3607755	630000.
642.000	-3.96E-06	1319.9597	-30.6743	-7.3988E-08	828.3825	0.4193567	635400.
648.000	-4.32E-06	1143.7691	-28.0309	-4.9086E-08	828.3440	0.4617828	640800.
654.000	-4.55E-06	984.0857	-25.1758	-2.7579E-08	828.3091	0.4899231	646200.
660.000	-4.65E-06	841.9388	-22.8988	-9.1225E-09	828.2781	0.2690530	346811.
666.000	-4.66E-06	709.3919	-21.2789	6.5574E-09	828.2492	0.2709425	348971.
672.000	-4.58E-06	586.5263	-19.6626	1.9656E-08	828.2224	0.2677994	351131.
678.000	-4.42E-06	473.2415	-18.0780	3.0367E-08	828.1976	0.2604082	353291.
684.000	-4.21E-06	369.2830	-16.5483	3.8883E-08	828.1749	0.2495061	355451.
690.000	-3.96E-06	274.2690	-15.0924	4.5388E-08	828.1542	0.2357825	357611.
696.000	-3.67E-06	187.7152	-13.7254	5.0057E-08	828.1353	0.2198802	359771.
702.000	-3.36E-06	109.0578	-12.4586	5.3057E-08	828.1181	0.2023965	361931.
708.000	-3.03E-06	37.6755	-11.2997	5.4540E-08	828.1025	0.1838856	364091.
714.000	-2.70E-06	-27.0907	-10.2535	5.4647E-08	828.1002	0.1648619	366251.
720.000	-2.37E-06	-85.9191	-8.5874	5.3504E-08	828.1131	0.3904864	986672.
726.000	-2.06E-06	-130.6813	-6.3938	5.1315E-08	828.1228	0.3407136	992972.
732.000	-1.76E-06	-163.1644	-4.4930	4.8345E-08	828.1299	0.2929173	999272.
738.000	-1.48E-06	-185.0857	-2.8708	4.4825E-08	828.1347	0.2478078	1005572.
744.000	-1.22E-06	-198.0671	-1.5097	4.0953E-08	828.1375	0.2058958	1011872.
750.000	-9.87E-07	-203.6160	-0.3894192	3.6893E-08	828.1388	0.1675192	1018172.
756.000	-7.78E-07	-203.1133	0.5117444	3.2782E-08	828.1386	0.1328686	1024472.
762.000	-5.94E-07	-197.8067	1.2164	2.8729E-08	828.1375	0.1020114	1030772.
768.000	-4.33E-07	-188.8074	1.7472	2.4822E-08	828.1355	0.0749138	1037072.
774.000	-2.96E-07	-177.0919	2.1263	2.1124E-08	828.1330	0.0514616	1043372.
780.000	-1.80E-07	-163.5056	2.3751	1.7681E-08	828.1300	0.0314784	1049672.
786.000	-8.38E-08	-148.7694	2.5138	1.4525E-08	828.1268	0.0147418	1055972.
792.000	-5.64E-09	-133.4873	2.5610	1.1672E-08	828.1234	0.0009979	1062272.
798.000	5.63E-08	-118.1557	2.5339	9.1284E-09	828.1201	-0.0100266	1068572.
804.000	1.04E-07	-103.1729	2.4480	6.8913E-09	828.1168	-0.0186139	1074872.
810.000	1.39E-07	-88.8497	2.3170	4.9505E-09	828.1137	-0.0250462	1081172.
816.000	1.63E-07	-75.4190	2.1531	3.2901E-09	828.1108	-0.0295990	1087472.
822.000	1.78E-07	-63.0462	1.9667	1.8906E-09	828.1081	-0.0325354	1093772.
828.000	1.86E-07	-51.8382	1.7667	7.2944E-10	828.1056	-0.0341016	1100072.
834.000	1.87E-07	-41.8526	1.5609	-2.1753E-10	828.1034	-0.0345242	1106372.
840.000	1.83E-07	-33.1055	1.3553	-9.7516E-10	828.1015	-0.0340081	1112672.
846.000	1.76E-07	-25.5794	1.1550	-1.5683E-09	828.0999	-0.0327351	1118972.
852.000	1.65E-07	-19.2291	0.9642481	-2.0212E-09	828.0985	-0.0308637	1125272.
858.000	1.51E-07	-13.9880	0.7860689	-2.3570E-09	828.0974	-0.0285294	1131572.
864.000	1.36E-07	-9.7725	0.6229445	-2.5971E-09	828.0964	-0.0258454	1137872.
870.000	1.20E-07	-6.4864	0.4766962	-2.7614E-09	828.0957	-0.0229040	1144172.
876.000	1.03E-07	-4.0242	0.3486511	-2.8677E-09	828.0952	-0.0197777	1150472.
882.000	8.57E-08	-2.2736	0.2397528	-2.9313E-09	828.0948	-0.0165217	1156772.
888.000	6.80E-08	-1.1175	0.1506608	-2.9656E-09	828.0945	-0.0131756	1163072.
894.000	5.01E-08	-0.4356430	0.0818362	-2.9813E-09	828.0944	-0.0097659	1169372.
900.000	3.22E-08	-0.1053101	0.0336136	-2.9868E-09	828.0943	-0.0063083	1175672.
906.000	1.43E-08	-0.0020651	0.0062571	-2.9879E-09	828.0943	-0.0028106	1181972.
912.000	-3.66E-09	0.0000	0.0000	-2.9879E-09	828.0943	0.0007249	594136.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	0.10000000 in
Computed slope at pile head	=	-0.00000667
Maximum bending moment	=	-6227744. lbs-in
Maximum shear force	=	112319.4958 lbs
Depth of maximum bending moment	=	0.00000 in
Depth of maximum shear force	=	0.00000 in
Number of iterations	=	6

Number of zero deflection points = 5

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 = 0.500000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 843000.000 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	Es*h F/L lbs/in
0.000	0.500000	-2.2447E+07	313036.	0.0000	5728.7173	-1215.2676	7291.6056
6.000	0.498639	-2.0591E+07	-366.7094	-0.0004350	5323.5849	-1315.4655	15828.6806
12.000	0.494780	-1.8781E+07	296968.	-0.0008330	4928.3318	-1409.6978	17094.8465
18.000	0.488643	-1.7019E+07	288259.	-0.0011948	4543.7390	-1493.3727	18336.9691
24.000	0.480442	-1.5310E+07	279100.	-0.0015216	4170.5035	-1559.6451	19477.6156
30.000	0.470384	-1.3655E+07	269556.	-0.0018143	3809.1842	-1621.6732	20685.2889
36.000	0.458670	-1.2057E+07	259672.	-0.0020742	3460.3056	-1672.9199	21883.9445
42.000	0.445494	-1.0518E+07	249541.	-0.0023024	3124.3063	-1704.0892	22950.9977
48.000	0.431042	-9038917.	239188.	-0.0025000	2801.4654	-1746.9035	24316.4641
54.000	0.415494	-7622127.	228580.	-0.0026684	2492.1526	-1789.2173	25837.4556
60.000	0.399021	-6268969.	217771.	-0.0028088	2196.7320	-1813.6270	27271.1491
66.000	0.381788	-4980461.	206875.	-0.0029225	1915.4256	-1818.4341	28577.6599
72.000	0.363951	-3756907.	196013.	-0.0030108	1648.3001	-1802.1307	29709.4780
78.000	0.345658	-2597846.	185316.	-0.0030751	1395.2545	-1763.4818	30610.8869
84.000	0.327050	-1502004.	174689.	-0.0031165	1156.0110	-1778.8711	32634.8679
90.000	0.308260	-470049.	163889.	-0.0031364	930.7150	-1821.1381	35446.8369
96.000	0.289412	496394.	152866.	-0.0031362	936.4668	-1853.3946	38423.9437
102.000	0.270625	1396064.	141680.	-0.0031171	1132.8822	-1875.0373	41571.1900
108.000	0.252008	2228090.	130398.	-0.0030804	1314.5296	-1885.5670	44893.0543
114.000	0.233660	2992007.	119088.	-0.0030277	1481.3076	-1884.6021	48393.3527
120.000	0.215676	3687773.	107747.	-0.0029601	1633.2068	-1895.8060	52740.3997
126.000	0.198139	4314913.	96330.0936	-0.0028793	1770.1236	-1909.7444	57830.5199
132.000	0.181125	4872861.	84856.6798	-0.0027864	1891.9345	-1914.7269	63427.8504
138.000	0.164702	5361380.	73380.9347	-0.0026830	1998.5878	-1910.5215	69599.1958
144.000	0.148929	5780573.	61958.5104	-0.0025703	2090.1056	-1896.9533	76423.5599
150.000	0.133858	6130884.	50645.9382	-0.0024499	2166.5854	-1873.9042	83995.1596
156.000	0.119530	6413108.	39500.2923	-0.0023232	2228.2003	-1841.3111	92427.4363
162.000	0.105980	6628389.	28578.8696	-0.0021913	2275.2003	-1799.1631	101858.
168.000	0.093234	6778222.	17938.8922	-0.0020558	2307.9118	-1747.4960	112459.
174.000	0.081310	6864452.	7637.2494	-0.0019179	2326.7375	-1686.3849	124441.
180.000	0.070219	6889271.	-2269.7039	-0.0017789	2332.1559	-1615.9328	138077.
186.000	0.059963	6855211.	-11726.2645	-0.0016400	2324.7201	-1536.2540	153720.
192.000	0.050539	6765146.	-20677.3758	-0.0015023	2305.0570	-1447.4497	171842.
198.000	0.041935	6622280.	-29068.4366	-0.0013670	2273.8668	-1349.5706	193095.
204.000	0.034134	6430153.	-36844.8242	-0.0012351	2231.9217	-1242.5586	218412.
210.000	0.027114	6192637.	-43915.6192	-0.0011075	2180.0672	-1114.3730	246600.
216.000	0.020844	5914370.	-49885.0985	-0.0009851	2119.3161	-875.4534	252000.
222.000	0.015292	5603981.	-54479.5268	-0.0008687	2051.5523	-656.0227	257400.
228.000	0.010419	5269403.	-57816.7012	-0.0007588	1978.5074	-456.3688	262800.
234.000	0.006186	4917857.	-60015.3463	-0.0006559	1901.7581	-276.5129	268200.
240.000	0.002549	4555854.	-61193.5942	-0.0005601	1822.7257	-116.2364	273600.
246.000	-0.000535	4189200.	-61467.6276	-0.0004717	1742.6781	24.8919	279000.
252.000	-0.003112	3823014.	-60950.4876	-0.0003907	1662.7326	147.4881	284400.
258.000	-0.005224	3461747.	-59751.0473	-0.0003171	1583.8609	252.3253	289800.
264.000	-0.006917	3109210.	-57973.1485	-0.0002507	1506.8951	340.3076	295200.
270.000	-0.008232	2768605.	-55714.8954	-0.0001913	1432.5346	412.4434	300600.
276.000	-0.009212	2442566.	-53068.1006	-0.0001386	1361.3539	469.8215	306000.
282.000	-0.009896	2133190.	-50117.8737	-9.2360E-05	1293.8112	513.5875	311400.
288.000	-0.010321	1842086.	-46942.3426	-5.2181E-05	1230.2574	544.9228	316800.
294.000	-0.010522	1570410.	-43612.4992	-1.7689E-05	1170.9453	565.0249	322200.
300.000	-0.010533	1318915.	-40192.1553	1.1514E-05	1116.0390	575.0897	327600.
306.000	-0.010384	1087988.	-36737.9988	3.5842E-05	1065.6231	576.2958	333000.
312.000	-0.010103	877696.	-33299.7384	5.5710E-05	1019.7124	569.7910	338400.
318.000	-0.009715	687827.	-29920.3241	7.1533E-05	978.2603	556.6805	343800.
324.000	-0.009244	517928.	-26636.2313	8.3720E-05	941.1682	538.0171	349200.
330.000	-0.008711	367345.	-23477.7994	9.2668E-05	908.2930	514.7935	354600.
336.000	-0.008132	235257.	-20469.6109	9.8759E-05	879.4556	487.9359	360000.
342.000	-0.007525	120711.	-17630.9039	0.0001024	854.4479	458.2997	365400.
348.000	-0.006904	22651.1720	-14976.0055	0.0001038	833.0395	426.6664	370800.
354.000	-0.006280	-60051.0716	-12514.7795	0.0001034	841.2046	393.7422	376200.
360.000	-0.005663	-128572.	-10253.0796	0.0001015	856.1642	360.1577	381600.
366.000	-0.005062	-184115.	-8193.2008	9.8361E-05	868.2902	326.4686	387000.
372.000	-0.004483	-227886.	-6334.3227	9.4196E-05	877.8462	293.1575	392400.
378.000	-0.003931	-261080.	-4672.9403	8.9254E-05	885.0931	260.6367	397800.
384.000	-0.003411	-284864.	-3203.2758	8.3736E-05	890.2857	229.2514	403200.
390.000	-0.002926	-300366.	-1917.6705	7.7821E-05	893.6701	199.2837	408600.
396.000	-0.002478	-308663.	-806.9505	7.1665E-05	895.4815	170.9563	414000.
402.000	-0.002066	-310775.	139.2333	6.5404E-05	895.9424	144.4382	419400.
408.000	-0.001693	-307654.	932.0935	5.9154E-05	895.2612	119.8485	424800.
414.000	-0.001357	-300188.	1583.4246	5.3010E-05	893.6311	97.2618	430200.
420.000	-0.001057	-289189.	2105.3497	4.7053E-05	891.2300	76.7132	435600.
426.000	-0.000792	-275400.	2510.0979	4.1346E-05	888.2194	58.2029	441000.
432.000	-0.000560	-259486.	2809.8098	3.5940E-05	884.7452	41.7011	446400.
438.000	-0.000361	-242045.	3016.3713	3.0871E-05	880.9375	27.1527	451800.
444.000	-0.000190	-223602.	3141.2743	2.6164E-05	876.9110	14.4816	457200.
450.000	-4.66E-05	-204615.	3195.5024	2.1836E-05	872.7657	3.5944	462600.
456.000	7.20E-05	-185477.	3189.4404	1.7894E-05	868.5876	-5.6151	468000.
462.000	0.000168	-166523.	3132.8053	1.4336E-05	864.4494	-13.2632	473400.
468.000	0.000244	-148028.	3034.5979	1.1156E-05	860.4118	-19.4726	478800.
474.000	0.000302	-130220.	2903.0711	8.3441E-06	856.5239	-24.3697	484200.
480.000	0.000344	-113276.	2745.7151	5.8830E-06	852.8247	-28.0823	489600.
486.000	0.000373	-97331.1827	2569.2559	3.7543E-06	849.3436	-30.7374	495000.
492.000	0.000389	-82482.9331	2379.6666	1.9368E-06	846.1019	-32.4591	500400.
498.000	0.000396	-68794.7761	2182.1875	4.0780E-07	843.1135	-33.3673	505800.
504.000	0.000394	-56300.8079	1981.3560	-8.5659E-07	840.3859	-33.5765	511200.
510.000	0.000386	-45009.8388	1781.0421	-1.8806E-06	837.9208	-33.1947	516600.
516.000	0.000372	-34909.2783	1584.4902	-2.6883E-06	835.7157	-32.3226	522000.
522.000	0.000353	-25968.7617	1394.3633	-3.3037E-06	833.7638	-31.0530	527400.
528.000	0.000332	-18143.4992	1212.7913	-3.7495E-06	832.0554	-29.4709	532800.
534.000	0.000308	-11377.3355	1041.4197	-4.0479E-06	830.5782	-27.6529	538200.
540.000	0.000283	-5605.5146	881.4585	-4.2196E-06	829.3181	-25.6674	543600.
546.000	0.000258	-757.1486	733.7318	-4.2839E-06	828.2596	-23.5748	549000.
552.000	0.000232	3242.6027	598.7251	-4.2587E-06	828.8022	-21.4274	554400.
558.000	0.000207	6470.6344	476.6314	-4.1606E-06	829.5070	-19.2705	559800.
564.000	0.000182	9004.2681	367.3948	-4.0042E-06	830.0601	-17.1418	565200.
570.000	0.000158	10919.8780	270.7515	-3.8028E-06	830.4783	-15.0727	570600.
576.000	0.000136	12291.7546	186.2679	-3.5682E-06	830.7778	-13.0885	576000.
582.000	0.000116	13191.1883	113.3757	-3.3106E-06	830.9742	-11.2089	581400.
588.000	9.66E-05	13685.7526	51.4032	-3.0389E-06	831.0822	-9.4486	586800.
594.000	7.92E-05	13838.7684	-0.3959754	-2.7607E-06	831.1156	-7.8178	592200.
600.000	6.35E-05	13708.9286	-42.8179	-2.4823E-06	831.0872	-6.3228	597600.
606.000	4.94E-05	13350.0648	-76.6865	-2.2088E-06	831.0089	-4.9667	603000.
612.000	3.70E-05	12811.0348	-102.8349	-1.9444E-06	830.8912	-3.7494	608400.
618.000	2.61E-05	12135.7156	-122.0893	-1.6922E-06	830.7438	-2.6687	613800.
624.000	1.67E-05	11363.0820	-135.2563	-1.4547E-06	830.5751	-1.7203	619200.
630.000	8.63E-06	10527.3556	-143.1125	-1.2335E-06	830.3926	-0.8984101	624600.
636.000	1.87E-06	9658.2101	-146.3961	-1.0295E-06	830.2029	-0.1961171	630000.
642.000	-3.72E-06	8781.0169	-145.8015	-8.4309E-07	830.0114	0.3942938	635400.
648.000	-8.25E-06	7917.1205	-141.9756	-6.7431E-07	829.8228	0.8810226	640800.
654.000	-1.18E-05	7084.1313	-135.5151	-5.2269E-07	829.6409	1.2725	646200.
660.000	-1.45E-05	6296.2271	-129.1795	-3.8745E-07	829.4689	0.8393718	346811.
666.000	-1.65E-05	5537.8964	-123.7886	-2.6784E-07	829.3033	0.9576002	348971.
672.000	-1.77E-05	4813.4732	-117.8021	-1.6321E-07	829.1452	1.0379	351131.
678.000	-1.84E-05	4125.9229	-111.4340	-7.2859E-08	828.9951	1.0848	353291.
684.000	-1.86E-05	3477.0027	-104.8722	3.9868E-09	828.8534	1.1025	355451.
690.000	-1.84E-05	2867.4165	-98.2791	6.8112E-08	828.7203	1.0952	357611.
696.000	-1.78E-05	2296.9639	-91.7930	1.2031E-07	828.5958	1.0669	359771.
702.000	-1.69E-05	1764.6840	-85.5283	1.6136E-07	828.4796	1.0213	361931.
708.000	-1.59E-05	1268.9916	-79.5778	1.9203E-07	828.3713	0.9621831	364091.
714.000	-1.46E-05	807.8081	-74.0126	2.1302E-07	828.2707	0.8928642	366251.
720.000	-1.33E-05	378.6850	-64.7727	2.2501E-07	828.1770	2.1871	986672.
726.000	-1.19E-05	28.2598	-52.2897	2.2912E-07	828.1005	1.9739	992972.
732.000	-1.06E-05	-251.1093	-41.0967	2.2687E-07	828.1491	1.7571	999272.
738.000	-9.20E-06	-467.1955	-31.1973	2.1961E-07	828.1963	1.5426	1005572.
744.000	-7.92E-06	-627.6990	-22.5648	2.0854E-07	828.2313	1.3349	1011872.
750.000	-6.70E-06	-740.0830	-15.1483	1.9472E-07	828.2559	1.1373	1018172.
756.000	-5.58E-06	-811.4483	-8.8788	1.7904E-07	828.2715	0.9525217	1024472.
762.000	-4.55E-06	-848.4400	-3.6744	1.6226E-07	828.2795	0.7822874	1030772.
768.000	-3.63E-06	-857.1825	0.5555290	1.4502E-07	828.2814	0.6276874	1037072.

774.000	-2.81E-06	-843.2407	3.9063	1.2783E-07	828.2784	0.4892304	1043372.
780.000	-2.10E-06	-811.6003	6.4748	1.1111E-07	828.2715	0.3669478	1049672.
786.000	-1.48E-06	-766.6668	8.3571	9.5155E-08	828.2617	0.2604865	1055972.
792.000	-9.56E-07	-712.2774	9.6462	8.0207E-08	828.2498	0.1691917	1062272.
798.000	-5.18E-07	-651.7243	10.4303	6.6420E-08	828.2366	0.0921814	1068572.
804.000	-1.59E-07	-587.7861	10.7921	5.3892E-08	828.2226	0.0284121	1074872.
810.000	1.29E-07	-522.7649	10.8075	4.2667E-08	828.2084	-0.0232646	1081172.
816.000	3.53E-07	-458.5277	10.5455	3.2749E-08	828.1944	-0.0640537	1087472.
822.000	5.22E-07	-396.5496	10.0679	2.4106E-08	828.1809	-0.0951755	1093772.
828.000	6.43E-07	-337.9573	9.4288	1.6682E-08	828.1681	-0.1178332	1100072.
834.000	7.22E-07	-283.5725	8.6758	1.0400E-08	828.1562	-0.1331858	1106372.
840.000	7.67E-07	-233.9533	7.8492	5.1695E-09	828.1454	-0.1423273	1112672.
846.000	7.84E-07	-189.4340	6.9834	8.9020E-10	828.1357	-0.1462717	1118972.
852.000	7.78E-07	-150.1611	6.1068	-2.5422E-09	828.1271	-0.1459424	1125272.
858.000	7.54E-07	-116.1267	5.2425	-5.2337E-09	828.1197	-0.1421654	1131572.
864.000	7.15E-07	-87.1985	4.4090	-7.2888E-09	828.1133	-0.1356661	1137872.
870.000	6.66E-07	-63.1453	3.6208	-8.8084E-09	828.1081	-0.1270692	1144172.
876.000	6.10E-07	-43.6602	2.8889	-9.8879E-09	828.1038	-0.1169008	1150472.
882.000	5.48E-07	-28.3790	2.2214	-1.0616E-08	828.1005	-0.1055924	1156772.
888.000	4.82E-07	-16.8962	1.6241	-1.1074E-08	828.0980	-0.0934867	1163072.
894.000	4.15E-07	-8.7773	1.1011	-1.1333E-08	828.0962	-0.0808442	1169372.
900.000	3.46E-07	-3.5678	0.6550621	-1.1458E-08	828.0951	-0.0678515	1175672.
906.000	2.77E-07	-0.8006018	0.2876192	-1.1502E-08	828.0945	-0.0546295	1181972.
912.000	2.08E-07	0.0000	0.0000	-1.1510E-08	828.0943	-0.0412435	594136.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection = 0.50000000 in
Computed slope at pile head = -0.00001876
Maximum bending moment = -22447031. lbs-in
Maximum shear force = 313036.16758 lbs
Depth of maximum bending moment = 0.00000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 8
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 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 = 843000.000 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	Es*h F/L lbs/in
0.000	1.000000	-3.9567E+07	502532.	0.0000	9466.3503	-1561.1635	4683.4905
6.000	0.997600	-3.6580E+07	-648.8161	-0.0007697	8814.3067	-1698.0348	10212.7141
12.000	0.990764	-3.3651E+07	481771.	-0.0014795	8174.7922	-1826.2007	11059.3463
18.000	0.979846	-3.0784E+07	470471.	-0.0021308	7548.8796	-1940.3679	11881.6659
24.000	0.965195	-2.7984E+07	458551.	-0.0027248	6937.5301	-2033.0805	12638.3634
30.000	0.947149	-2.5254E+07	446064.	-0.0032629	6341.5349	-2129.2541	13488.3982
36.000	0.926040	-2.2598E+07	433020.	-0.0037465	5761.7109	-2218.6903	14375.3357
42.000	0.902191	-2.0020E+07	419505.	-0.0041773	5198.8202	-2286.1822	15204.2044
48.000	0.875913	-1.7522E+07	405522.	-0.0045567	4653.4509	-2375.0052	16268.7755
54.000	0.847510	-1.5108E+07	390990.	-0.0048865	4126.3568	-2468.9189	17478.8662
60.000	0.817275	-1.2781E+07	375950.	-0.0051684	3618.3299	-2544.6068	18681.1641
66.000	0.785489	-1.0544E+07	360516.	-0.0054042	3130.0171	-2599.8778	19859.3040
72.000	0.752425	-8399657.	344819.	-0.0055956	2661.9027	-2632.5959	20992.8967
78.000	0.718342	-6349400.	328999.	-0.0057447	2214.2916	-2640.6921	22056.5697
84.000	0.683488	-4393558.	312974.	-0.0058533	1787.2933	-2700.8407	23709.3186
90.000	0.648102	-2534497.	296510.	-0.0059233	1381.4242	-2787.0906	25802.3224
96.000	0.612409	-775512.	279562.	-0.0059568	997.4037	-2862.3535	28043.5595
102.000	0.576621	880507.	262199.	-0.0059557	1020.3261	-2925.4888	30441.0138
108.000	0.540940	2431119.	244501.	-0.0059222	1358.8547	-2973.8441	32985.2711
114.000	0.505554	3874423.	226560.	-0.0058585	1673.9562	-3006.3232	35679.5193
120.000	0.470638	5209104.	208401.	-0.0057667	1965.3430	-3046.7382	38841.7693
126.000	0.436354	6433570.	190002.	-0.0056490	2232.6676	-3086.3038	42437.5927
132.000	0.402850	7546271.	171404.	-0.0055077	2475.5919	-3113.0204	46364.9166
138.000	0.370262	8546132.	152685.	-0.0053451	2693.8809	-3126.4433	50663.2411
144.000	0.338710	9432567.	133927.	-0.0051633	2887.4068	-3126.2061	55378.5069
150.000	0.308302	1.0205E+07	115213.	-0.0049648	3056.1518	-3112.0223	60564.4877
156.000	0.279131	1.0865E+07	96625.6597	-0.0047519	3200.2100	-3083.6856	66284.5778
162.000	0.251279	1.1413E+07	78251.3955	-0.0045267	3319.7895	-3041.0691	72614.1200
168.000	0.224811	1.1850E+07	60175.8193	-0.0042916	3415.2129	-2984.1229	79643.4814
174.000	0.199780	1.2179E+07	42484.8407	-0.0040487	3486.9181	-2912.8699	87482.1929
180.000	0.176227	1.2401E+07	25264.0344	-0.0038003	3535.4578	-2827.3989	96264.6293
186.000	0.154177	1.2520E+07	8598.2732	-0.0035484	3561.4987	-2727.8548	106158.
192.000	0.133646	1.2540E+07	-7428.5635	-0.0032951	3565.8205	-2614.4241	117374.
198.000	0.114636	1.2464E+07	-22733.7755	-0.0030424	3549.3143	-2487.3133	130185.
204.000	0.097138	1.2298E+07	-37235.8708	-0.0027921	3512.9809	-2346.7185	144952.
210.000	0.081131	1.2046E+07	-50854.3640	-0.0025460	3457.9289	-2192.7792	162166.
216.000	0.066585	1.1713E+07	-63509.2210	-0.0023059	3385.3739	-2025.5065	182518.
222.000	0.053461	1.1307E+07	-75119.7439	-0.0020732	3296.6379	-1844.6678	207031.
228.000	0.041707	1.0833E+07	-85602.5082	-0.0018494	3193.1514	-1649.5869	237311.
234.000	0.031267	1.0299E+07	-94744.2346	-0.0016358	3076.4581	-1397.6552	268200.
240.000	0.022077	9712630.	-101957.	-0.0014336	2948.5501	-1006.7091	273600.
246.000	0.014064	9089520.	-106939.	-0.0012435	2812.5131	-653.9985	279000.
252.000	0.007154	8441936.	-109919.	-0.0010663	2671.1330	-339.1219	284400.
258.000	0.001268	7781281.	-111120.	-0.0009024	2526.8992	-61.2620	289800.
264.000	-0.003674	7117625.	-110761.	-0.0007518	2382.0101	180.7588	295200.
270.000	-0.007753	6459749.	-109054.	-0.0006145	2238.3829	388.4251	300600.
276.000	-0.011049	5815195.	-106198.	-0.0004905	2097.6643	563.4755	306000.
282.000	-0.013639	5190332.	-102384.	-0.0003792	1961.2445	707.8519	311400.
288.000	-0.015599	4590420.	-97789.7263	-0.0002804	1830.2723	823.6517	316800.
294.000	-0.017003	4019691.	-92579.5237	-0.0001934	1705.6710	913.0825	322200.
300.000	-0.017920	3481422.	-86905.0149	-0.0001175	1588.1564	978.4205	327600.
306.000	-0.018414	2978020.	-80903.8355	-5.2256E-05	1478.2540	1021.9727	333000.
312.000	-0.018547	2511105.	-74699.7892	3.2250E-06	1376.3173	1046.0427	338400.
318.000	-0.018375	2081590.	-68402.9602	4.9645E-05	1282.5459	1052.9003	343800.
324.000	-0.017951	1689767.	-62109.9946	8.7764E-05	1197.0033	1044.7549	349200.
330.000	-0.017322	1335382.	-55904.5288	0.0001183	1119.6342	1023.7337	354600.
336.000	-0.016531	1017716.	-49857.7413	0.0001421	1050.2814	991.8621	360000.
342.000	-0.015617	735652.	-44029.0066	0.0001598	988.7014	951.0494	365400.
348.000	-0.014613	487750.	-38466.6288	0.0001722	934.5797	903.0765	370800.
354.000	-0.013550	272310.	-33208.6361	0.0001799	887.5449	849.5877	376200.
360.000	-0.012454	87427.0430	-28283.6173	0.0001835	847.1813	792.0852	381600.
366.000	-0.011348	-68949.8869	-23711.5830	0.0001837	843.1474	731.9262	387000.
372.000	-0.010250	-198970.	-19504.8372	0.0001810	871.5334	670.3224	392400.
378.000	-0.009176	-304839.	-15668.8436	0.0001759	894.6466	608.3421	397800.
384.000	-0.008139	-388776.	-12203.0778	0.0001689	912.9717	546.9132	403200.
390.000	-0.007149	-452985.	-9101.8517	0.0001604	926.9896	486.8289	408600.
396.000	-0.006214	-499621.	-6355.1038	0.0001508	937.1713	428.7538	414000.
402.000	-0.005340	-530771.	-3949.1474	0.0001404	943.9719	373.2317	419400.
408.000	-0.004530	-548431.	-1867.3713	0.0001294	947.8273	320.6937	424800.
414.000	-0.003786	-554489.	-90.8888	0.0001183	949.1500	271.4672	430200.
420.000	-0.003110	-550718.	1400.8679	0.0001071	948.3267	225.7851	435600.
426.000	-0.002501	-538762.	2629.6091	9.6116E-05	945.7166	183.7954	441000.
432.000	-0.001957	-520135.	3617.7067	8.5414E-05	941.6499	145.5705	446400.
438.000	-0.001476	-496214.	4387.7686	7.5141E-05	936.4274	111.1168	451800.
444.000	-0.001055	-468242.	4962.2696	6.5393E-05	930.3206	80.3835	457200.
450.000	-0.000691	-437328.	5363.2349	5.6240E-05	923.5715	53.2716	462600.
456.000	-0.000380	-404452.	5611.9753	4.7732E-05	916.3940	29.6419	468000.
462.000	-0.000118	-370467.	5728.8698	3.9899E-05	908.9745	9.3230	473400.
468.000	9.88E-05	-336109.	5733.1939	3.2758E-05	901.4734	-7.8816	478800.
474.000	0.000275	-302000.	5642.9886	2.6308E-05	894.0268	-22.1868	484200.
480.000	0.000414	-268659.	5474.9677	2.0540E-05	886.7479	-33.8202	489600.
486.000	0.000521	-236508.	5244.4579	1.5434E-05	879.7287	-43.0164	495000.
492.000	0.000600	-205882.	4965.3705	1.0963E-05	873.0423	-50.0127	500400.
498.000	0.000653	-177035.	4650.1976	7.0925E-06	866.7445	-55.0449	505800.
504.000	0.000685	-150151.	4310.0323	3.7855E-06	860.8753	-58.3435	511200.
510.000	0.000698	-125353.	3954.6074	1.0009E-06	855.4613	-60.1314	516600.
516.000	0.000697	-102706.	3592.3500	-1.3042E-06	850.5171	-60.6211	522000.
522.000	0.000683	-82231.4185	3230.4483	-3.1734E-06	846.0470	-60.0128	527400.
528.000	0.000659	-63908.7050	2874.9287	-4.6505E-06	842.0468	-58.4937	532800.
534.000	0.000627	-47685.2293	2530.7398	-5.7785E-06	838.5049	-56.2360	538200.

540.000	0.000589	-33481.3722	2201.8409	-6.5988E-06	835.4039	-53.3970	543600.
546.000	0.000548	-21196.3847	1891.2931	-7.1515E-06	832.7219	-50.1189	549000.
552.000	0.000504	-10713.5108	1601.3514	-7.4740E-06	830.4333	-46.5283	554400.
558.000	0.000458	-1904.5614	1333.5555	-7.6015E-06	828.5101	-42.7370	559800.
564.000	0.000412	5366.0523	1088.8188	-7.5666E-06	829.2658	-38.8419	565200.
570.000	0.000367	11237.8074	867.5134	-7.3987E-06	830.5477	-34.9265	570600.
576.000	0.000324	15851.0591	669.5515	-7.1249E-06	831.5549	-31.0608	576000.
582.000	0.000282	19344.5013	494.4610	-6.7692E-06	832.3176	-27.3027	581400.
588.000	0.000242	21853.0682	341.4563	-6.3528E-06	832.8653	-23.6989	586800.
594.000	0.000206	23506.2420	209.5029	-5.8943E-06	833.2262	-20.2856	592200.
600.000	0.000172	24426.7302	97.3757	-5.4099E-06	833.4271	-17.0901	597600.
606.000	0.000141	24729.4768	3.7116	-4.9130E-06	833.4932	-14.1313	603000.
612.000	0.000113	24520.9691	-72.9447	-4.4152E-06	833.4477	-11.4208	608400.
618.000	8.76E-05	23898.8052	-134.0998	-3.9258E-06	833.3119	-8.9642	613800.
624.000	6.55E-05	22951.4854	-181.2779	-3.4523E-06	833.1051	-6.7618	619200.
630.000	4.62E-05	21758.3944	-215.9913	-3.0004E-06	832.8446	-4.8094	624600.
636.000	2.95E-05	20389.9420	-239.7170	-2.5744E-06	832.5458	-3.0992	630000.
642.000	1.53E-05	18907.8326	-253.8776	-2.1772E-06	832.2222	-1.6210	635400.
648.000	3.39E-06	17365.4349	-259.8268	-1.8106E-06	831.8855	-0.3620689	640800.
654.000	-6.42E-06	15808.2271	-258.8386	-1.4753E-06	831.5455	0.6914459	646200.
660.000	-1.43E-05	14274.2951	-254.2823	-1.1712E-06	831.2107	0.8273180	346811.
666.000	-2.05E-05	12768.6870	-248.2279	-8.9788E-07	830.8820	1.1908	348971.
672.000	-2.51E-05	11304.6436	-240.2508	-6.5456E-07	830.5623	1.4682	351131.
678.000	-2.83E-05	9892.2983	-230.8421	-4.4031E-07	830.2540	1.6681	353291.
684.000	-3.04E-05	8538.9925	-220.4401	-2.5402E-07	829.9585	1.7992	355451.
690.000	-3.14E-05	7249.5866	-209.4319	-9.4439E-08	829.6770	1.8702	357611.
696.000	-3.15E-05	6026.7650	-198.1542	3.9750E-08	829.4101	1.8891	359771.
702.000	-3.09E-05	4871.3338	-186.8951	1.4990E-07	829.1578	1.8640	361931.
708.000	-2.97E-05	3782.5075	-175.8954	2.3737E-07	828.9201	1.8026	364091.
714.000	-2.81E-05	2758.1880	-165.3505	3.0348E-07	828.6965	1.7124	366251.
720.000	-2.61E-05	1795.2311	-147.3552	3.4950E-07	828.4862	4.2861	986672.
726.000	-2.39E-05	986.3902	-122.6517	3.7762E-07	828.3097	3.9484	992972.
732.000	-2.15E-05	319.5911	-100.0480	3.9082E-07	828.1641	3.5862	999272.
738.000	-1.92E-05	-218.1394	-79.6520	3.9184E-07	828.1419	3.2125	1005572.
744.000	-1.68E-05	-640.1968	-61.4993	3.8317E-07	828.2341	2.8384	1011872.
750.000	-1.46E-05	-960.0071	-45.5666	3.6699E-07	828.3039	2.4725	1018172.
756.000	-1.24E-05	-1190.7088	-31.7837	3.4525E-07	828.3543	2.1218	1024472.
762.000	-1.04E-05	-1344.9047	-20.0444	3.1963E-07	828.3879	1.7914	1030772.
768.000	-8.59E-06	-1434.4744	-10.2155	2.9153E-07	828.4075	1.4849	1037072.
774.000	-6.93E-06	-1470.4402	-2.1461	2.6217E-07	828.4153	1.2049	1043372.
780.000	-5.44E-06	-1462.8795	4.3263	2.3252E-07	828.4137	0.9525737	1049672.
786.000	-4.14E-06	-1420.8766	9.3691	2.0338E-07	828.4045	0.7283649	1055972.
792.000	-3.00E-06	-1352.5072	13.1500	1.7535E-07	828.3896	0.5319239	1062272.
798.000	-2.03E-06	-1264.8503	15.8327	1.4889E-07	828.3704	0.3623167	1068572.
804.000	-1.22E-06	-1164.0207	17.5741	1.2434E-07	828.3484	0.2181554	1074872.
810.000	-5.42E-07	-1055.2185	18.5218	1.0191E-07	828.3247	0.0977196	1081172.
816.000	5.17E-09	-942.7904	18.8121	8.1716E-08	828.3001	-0.0009378	1087472.
822.000	4.38E-07	-830.2997	18.5696	6.3795E-08	828.2756	-0.0798995	1093772.
828.000	7.71E-07	-720.6006	17.9060	4.8119E-08	828.2516	-0.1413068	1100072.
834.000	1.02E-06	-615.9147	16.9202	3.4611E-08	828.2288	-0.1872959	1106372.
840.000	1.19E-06	-517.9086	15.6984	2.3151E-08	828.2074	-0.2199462	1112672.
846.000	1.29E-06	-427.7676	14.3149	1.3592E-08	828.1877	-0.2412392	1118972.
852.000	1.35E-06	-346.2674	12.8321	5.7690E-09	828.1699	-0.2530274	1125272.
858.000	1.36E-06	-273.8408	11.3020	-4.9865E-10	828.1541	-0.2570117	1131572.
864.000	1.34E-06	-210.6387	9.7668	-5.3955E-09	828.1403	-0.2547258	1137872.
870.000	1.30E-06	-156.5851	8.2600	-9.1071E-09	828.1285	-0.2475268	1144172.
876.000	1.23E-06	-111.4265	6.8076	-1.1816E-08	828.1186	-0.2365915	1150472.
882.000	1.16E-06	-74.7738	5.4291	-1.3698E-08	828.1106	-0.2229158	1156772.
888.000	1.07E-06	-46.1384	4.1384	-1.4920E-08	828.1044	-0.2073190	1163072.
894.000	9.77E-07	-24.9618	2.9451	-1.5639E-08	828.0998	-0.1904495	1169372.
900.000	8.82E-07	-10.6388	1.8554	-1.5999E-08	828.0966	-0.1727929	1175672.
906.000	7.85E-07	-2.5352	0.8729662	-1.6132E-08	828.0949	-0.1546818	1181972.
912.000	6.88E-07	0.0000	0.0000	-1.6157E-08	828.0943	-0.1363069	594136.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 8:

Pile-head deflection = 1.00000000 in
Computed slope at pile head = -0.00003019
Maximum bending moment = -39567052. lbs-in
Maximum shear force = 502531.91253 lbs
Depth of maximum bending moment = 0.00000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 9
Number of zero deflection points = 4

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
5	y= 0.050000	S= 0.000	843000.	0.0500000	-3593170.	70995.2828
5	y= 0.100000	S= 0.000	843000.	0.1000000	-6227744.	112319.
5	y= 0.200000	S= 0.000	843000.	0.2000000	-1.0758E+07	172805.
5	y= 0.300000	S= 0.000	843000.	0.3000000	-1.4871E+07	224009.
5	y= 0.400000	S= 0.000	843000.	0.4000000	-1.8742E+07	270175.
5	y= 0.500000	S= 0.000	843000.	0.5000000	-2.2447E+07	313036.
5	y= 0.750000	S= 0.000	843000.	0.7500000	-3.1218E+07	411004.
5	y= 1.000000	S= 0.000	843000.	1.0000000	-3.9567E+07	502532.
5	y= 1.250	S= 0.000	843000.	1.2500	-4.7688E+07	591159.
5	y= 2.000	S= 0.000	843000.	2.0000	-7.0280E+07	810389.

Pile-head Deflection vs. Pile Length

Boundary Condition Type 5, Deflection and Slope

Deflection = 0.05000 in
Slope = 0.00000
Axial Load = 843000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
912.000	0.05000000	-3593170.	70995.28281
866.400	0.05000000	-3592981.	70978.18654
820.800	0.05000000	-3593967.	70982.78597
775.200	0.05000000	-3595047.	70990.07959
729.600	0.05000000	-3595197.	70981.05549
684.000	0.05000000	-3595750.	70981.16574
638.400	0.05000000	-3595758.	70967.58753
592.800	0.05000000	-3596627.	70974.62064
547.200	0.05000000	-3596845.	70968.93195
501.600	0.05000000	-3597186.	70966.86294

This analysis ended normally.

Service Load

```
================================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.41)

              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:

Geotech SJ
URS

Path to file locations:      X:\Route 84 - Isabel
Avenue\geotech\Analysis\pile\lateral\Arroyo Del Valle Widening\20141024\
Name of input data file:     Arroyo Del Valle Widening_Bent 2_ Free_scour.lpd
Name of output file:         Arroyo Del Valle Widening_Bent 2_ Free_scour.lpo
Name of plot output file:    Arroyo Del Valle Widening_Bent 2_ Free_scour.lpp
Name of runtime file:        Arroyo Del Valle Widening_Bent 2_ Free_scour.lpr


--------------------------------------------------------------------------------
                          Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  December 11, 2014     Time:  15:42:07


--------------------------------------------------------------------------------
                               Problem Title
--------------------------------------------------------------------------------

SR84 Isabel Bent 2- ADV Wide-36 inch CIDH pile-total scour 1.5ft


--------------------------------------------------------------------------------
                               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            =          152
- 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                                 =     912.00 in

Depth of ground surface below top of pile =     -45.00 in

Slope angle of ground surface               =       0.00 deg.

Structural properties of pile defined using  2 points

Point    Depth         Pile      Moment of       Pile      Modulus of
          X         Diameter     Inertia       Area      Elasticity
          in           in         in**4        Sq.in      lbs/Sq.in
-----  ---------   -----------   ----------   ----------   -----------
  1       0.0000   36.00000000   82448.0000    1018.0000      3600000.
  2     912.0000   36.00000000   82448.0000    1018.0000      3600000.


--------------------------------------------------------------------------------
                       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    =      -45.000 in
Distance from top of pile to bottom of layer =      660.000 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  2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      660.000 in
Distance from top of pile to bottom of layer =      720.000 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  3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      720.000 in
Distance from top of pile to bottom of layer =      912.000 in
p-y subgrade modulus k for top of soil layer =      175.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      175.000 lbs/in**3

Layer  4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      912.000 in
Distance from top of pile to bottom of layer =     1504.000 in
p-y subgrade modulus k for top of soil layer =      200.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      200.000 lbs/in**3


(Depth of lowest layer extends  592.00 in below pile tip)


--------------------------------------------------------------------------------
                    Effective Unit Weight of Soil vs. Depth
--------------------------------------------------------------------------------

Effective unit weight of soil with depth defined using  8 points

Point        Depth X    Eff. Unit Weight
 No.           in          lbs/in**3
-----      ----------   ----------------
  1          -45.00         0.04490
  2          660.00         0.04490
  3          660.00         0.02750
  4          720.00         0.02750
  5          720.00         0.04490
  6          912.00         0.04490
  7          912.00         0.04780
  8         1504.00         0.04780
```

Shear Strength of Soils

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	-45.000	0.00000	38.00	------	------
2	660.000	0.00000	38.00	------	------
3	660.000	0.00000	32.00	------	------
4	720.000	0.00000	32.00	------	------
5	720.000	0.00000	40.00	------	------
6	912.000	0.00000	40.00	------	------
7	912.000	0.00000	42.00	------	------
8	1504.000	0.00000	42.00	------	------

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.

Loading Type

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 = 0.050 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 843000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.100 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 843000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.200 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 843000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.300 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 843000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.400 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 843000.000 lbs

Load Case Number 6

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.500 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 843000.000 lbs

Load Case Number 7

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.750 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 843000.000 lbs

Load Case Number 8

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 1.000 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 843000.000 lbs

Load Case Number 9

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 1.250 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 843000.000 lbs

Load Case Number 10

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 2.000 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 843000.000 lbs

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 = 0.100000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 843000.000 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	Es*h F/L lbs/in
0.000	0.100000	0.0000	53660.5375	-0.0010410	828.0943	-523.9349	15718.0469
6.000	0.093754	317798.	50348.1682	-0.0010378	897.4758	-580.1882	37130.5233
12.000	0.087546	614677.	46717.7732	-0.0010284	962.2901	-629.9435	43173.3199
18.000	0.081413	888814.	42808.4624	-0.0010132	1022.1397	-673.1601	49610.6630
24.000	0.075388	1138628.	38674.9829	-0.0009927	1076.6788	-704.6664	56083.2507
30.000	0.069501	1362956.	34373.3750	-0.0009674	1125.6541	-729.2029	62952.0996
36.000	0.063779	1560894.	29942.4482	-0.0009379	1168.8679	-747.7727	70346.7283
42.000	0.058246	1731753.	25436.8385	-0.0009046	1206.1697	-754.0972	77680.0980
48.000	0.052924	1875287.	20959.6827	-0.0008681	1237.5059	-738.2881	83700.0000
54.000	0.047829	1992051.	16614.0437	-0.0008290	1262.9978	-710.2583	89100.0000
60.000	0.042975	2083042.	12452.6804	-0.0007878	1282.8629	-676.8628	94500.0000
66.000	0.038375	2149453.	8505.2785	-0.0007451	1297.3617	-638.9378	99900.0000
72.000	0.034035	2192643.	4796.5447	-0.0007012	1306.7908	-597.3068	105300.
78.000	0.029960	2214105.	1346.3136	-0.0006566	1311.4765	-552.7703	110700.
84.000	0.026155	2215441.	-1820.7037	-0.0006119	1311.7682	-502.9022	115367.
90.000	0.022618	2198446.	-4645.8211	-0.0005673	1308.0578	-438.8036	116404.
96.000	0.019348	2165430.	-7075.1781	-0.0005232	1300.8497	-370.9820	115046.
102.000	0.016340	2118836.	-9167.9146	-0.0004798	1290.6774	-326.5968	119924.

108.000	0.013590	2060269.	-11060.2356	-0.0004376	1277.8910	-304.1769	134299.
114.000	0.011089	1990540.	-12766.1756	-0.0003967	1262.6679	-264.4698	143100.
120.000	0.008830	1911087.	-14215.1827	-0.0003572	1245.3218	-218.5326	148500.
126.000	0.006802	1823572.	-15394.2034	-0.0003195	1226.2155	-174.4743	153900.
132.000	0.004996	1729589.	-16315.5424	-0.0002836	1205.6972	-132.6388	159300.
138.000	0.003399	1630654.	-16993.3897	-0.0002496	1184.0978	-93.3103	164700.
144.000	0.002001	1528193.	-17443.4662	-0.0002177	1161.7286	-56.7152	170100.
150.000	0.000787	1423534.	-17682.6834	-0.0001878	1138.8795	-23.0239	175500.
156.000	-0.000254	1317901.	-17728.8174	-0.0001601	1115.8178	7.6459	180900.
162.000	-0.001134	1212409.	-17600.2024	-0.0001346	1092.7867	35.2258	186300.
168.000	-0.001868	1108060.	-17315.4463	-0.0001111	1070.0053	59.6929	191700.
174.000	-0.002468	1005747.	-16893.1690	-8.9742E-05	1047.6685	81.0662	197100.
180.000	-0.002945	906250.	-16351.7664	-7.0417E-05	1025.9463	99.4014	202500.
186.000	-0.003313	810238.	-15709.2004	-5.3067E-05	1004.9851	114.7873	207900.
192.000	-0.003582	718276.	-14982.8146	-3.7618E-05	984.9080	127.3413	213300.
198.000	-0.003764	630825.	-14189.1774	-2.3982E-05	965.8157	137.2044	218700.
204.000	-0.003870	548249.	-13343.9509	-1.2065E-05	947.7877	144.5377	224100.
210.000	-0.003909	470820.	-12461.7846	-1.7647E-06	930.8834	149.5177	229500.
216.000	-0.003891	398725.	-11556.2340	7.0241E-06	915.1438	152.3325	234900.
222.000	-0.003825	332074.	-10639.7025	1.4411E-05	900.5925	153.1780	240300.
228.000	-0.003718	270903.	-9723.4037	2.0505E-05	887.2377	152.2549	245700.
234.000	-0.003579	215186.	-8817.3447	2.5418E-05	875.0735	149.7648	251100.
240.000	-0.003413	164838.	-7930.3267	2.9259E-05	864.0816	145.9079	256500.
246.000	-0.003227	119726.	-7069.9622	3.2135E-05	854.2327	140.8803	261900.
252.000	-0.003027	79673.1100	-6242.7060	3.4151E-05	845.4885	134.8718	267300.
258.000	-0.002818	44467.7579	-5453.8989	3.5406E-05	837.8025	128.0639	272700.
264.000	-0.002603	13868.1605	-4707.8214	3.5995E-05	831.1220	120.6286	278100.
270.000	-0.002386	-12390.2265	-4007.7562	3.6010E-05	830.7993	112.7265	283500.
276.000	-0.002170	-34589.1929	-3356.0572	3.5535E-05	835.6458	104.5065	288900.
282.000	-0.001959	-53022.3880	-2754.2234	3.4650E-05	839.6701	96.1048	294300.
288.000	-0.001755	-67990.3901	-2202.9763	3.3427E-05	842.9379	87.6442	299700.
294.000	-0.001558	-79796.2480	-1702.3398	3.1933E-05	845.5154	79.2346	305100.
300.000	-0.001371	-88741.5010	-1251.7192	3.0229E-05	847.4683	70.9723	310500.
306.000	-0.001195	-95122.6793	-849.9812	2.8371E-05	848.8614	62.9404	315900.
312.000	-0.001031	-99228.2765	-495.5310	2.6407E-05	849.7578	55.2096	321300.
318.000	-0.000879	-101336.	-186.3878	2.4379E-05	850.2180	47.8381	326700.
324.000	-0.000738	-101712.	79.7442	2.2327E-05	850.2999	40.8726	332100.
330.000	-0.000611	-100605.	305.4079	2.0282E-05	850.0584	34.3487	337500.
336.000	-0.000495	-98251.8341	493.3304	1.8272E-05	849.5446	28.2921	342900.
342.000	-0.000391	-94869.9924	646.3646	1.6320E-05	848.8063	22.7193	348300.
348.000	-0.000299	-90660.5560	767.4370	1.4445E-05	847.8873	17.6382	353700.
354.000	-0.000218	-85806.8765	859.4991	1.2662E-05	846.8276	13.0492	359100.
360.000	-0.000147	-80474.6515	925.4860	1.0981E-05	845.6635	8.9464	364500.
366.000	-8.63E-05	-74812.1269	968.2793	9.4114E-06	844.4272	5.3180	369900.
372.000	-3.43E-05	-68950.5050	990.6753	7.9583E-06	843.1475	2.1473	375300.
378.000	9.24E-06	-63004.5291	995.3588	6.6246E-06	841.8494	-0.5861805	380700.
384.000	4.52E-05	-57073.2136	984.8811	5.4109E-06	840.5545	-2.9064	386100.
390.000	7.42E-05	-51240.6922	961.6434	4.3161E-06	839.2811	-4.8396	391500.
396.000	9.70E-05	-45577.1555	927.8832	3.3376E-06	838.0447	-6.4138	396900.
402.000	0.000114	-40139.8564	885.6663	2.4712E-06	836.8576	-7.6585	402300.
408.000	0.000127	-34974.1580	836.8809	1.7120E-06	835.7298	-8.6034	407700.
414.000	0.000135	-30114.6047	783.2352	1.0541E-06	834.6689	-9.2785	413100.
420.000	0.000139	-25585.9985	726.2591	4.9112E-07	833.6802	-9.7136	418500.
426.000	0.000141	-21404.4643	667.3060	1.6173E-08	832.7673	-9.9375	423900.
432.000	0.000139	-17578.4900	607.5593	-3.7784E-07	831.9320	-9.9781	429300.
438.000	0.000136	-14109.9305	548.0385	-6.9813E-07	831.1748	-9.8621	434700.
444.000	0.000131	-10994.9655	489.6082	-9.5187E-07	830.4947	-9.6146	440100.
450.000	0.000125	-8225.0034	432.9871	-1.1461E-06	829.8900	-9.2590	445500.
456.000	0.000117	-5787.5260	378.7590	-1.2878E-06	829.3578	-8.8170	450900.
462.000	0.000109	-3666.8688	327.3831	-1.3833E-06	828.8949	-8.3083	456300.
468.000	0.000101	-1844.9352	279.2058	-1.4390E-06	828.4971	-7.7508	461700.
474.000	9.20E-05	-301.8424	234.4715	-1.4607E-06	828.1602	-7.1606	467100.
480.000	8.32E-05	983.5001	193.3346	-1.4538E-06	828.3090	-6.5517	472500.
486.000	7.45E-05	2032.8798	155.8697	-1.4234E-06	828.5381	-5.9366	477900.
492.000	6.61E-05	2868.3352	122.0830	-1.3738E-06	828.7205	-5.3257	483300.
498.000	5.80E-05	3511.7734	91.9221	-1.3093E-06	828.8610	-4.7280	488700.
504.000	5.04E-05	3984.6462	65.2859	-1.2336E-06	828.9642	-4.1508	494100.
510.000	4.32E-05	4307.6830	42.0332	-1.1498E-06	829.0348	-3.6001	499500.
516.000	3.66E-05	4500.6754	21.9914	-1.0607E-06	829.0769	-3.0805	504900.
522.000	3.05E-05	4582.3096	4.9637	-9.6892E-07	829.0947	-2.5954	510300.
528.000	2.50E-05	4570.0418	-9.2636	-8.7641E-07	829.0920	-2.1471	515700.
534.000	2.00E-05	4480.0126	-20.9155	-7.8494E-07	829.0724	-1.7369	521100.
540.000	1.56E-05	4326.9965	-30.2227	-6.9592E-07	829.0390	-1.3655	526500.
546.000	1.16E-05	4124.3807	-37.4169	-6.1050E-07	828.9947	-1.0326	531900.
552.000	8.24E-06	3884.1699	-42.7270	-5.2955E-07	828.9423	-0.7374485	537300.
558.000	5.29E-06	3617.0139	-46.3757	-4.5374E-07	828.8840	-0.4787766	542700.
564.000	2.79E-06	3332.2521	-48.5766	-3.8350E-07	828.8218	-0.2548849	548100.
570.000	6.91E-07	3037.9738	-49.5326	-3.1911E-07	828.7576	-0.0637719	553500.
576.000	-1.04E-06	2741.0890	-49.4335	-2.6070E-07	828.6927	0.0967961	558900.
582.000	-2.44E-06	2447.4086	-48.4555	-2.0826E-07	828.6286	0.2292107	564300.
588.000	-3.54E-06	2161.7296	-46.7600	-1.6167E-07	828.5663	0.3359565	569700.
594.000	-4.38E-06	1887.9239	-44.4935	-1.2074E-07	828.5065	0.4195531	575100.
600.000	-4.99E-06	1629.0292	-41.7873	-8.5194E-08	828.4500	0.4825056	580500.
606.000	-5.40E-06	1387.3381	-38.7580	-5.4706E-08	828.3972	0.5272621	585900.
612.000	-5.64E-06	1164.4865	-35.5077	-2.8914E-08	828.3485	0.5561780	591300.
618.000	-5.75E-06	961.5383	-32.1247	-7.4254E-09	828.3042	0.5714871	596700.
624.000	-5.73E-06	779.0654	-28.6844	1.0168E-08	828.2644	0.5752782	602100.
630.000	-5.62E-06	617.2228	-25.2501	2.4280E-08	828.2291	0.5694772	607500.
636.000	-5.44E-06	475.8182	-21.8742	3.5328E-08	828.1982	0.5558342	612900.
642.000	-5.20E-06	354.3751	-18.5989	4.3719E-08	828.1717	0.5359145	618300.
648.000	-4.92E-06	252.1886	-15.4579	4.9850E-08	828.1494	0.5110933	623700.
654.000	-4.60E-06	168.3757	-12.4770	5.4101E-08	828.1311	0.4825542	629100.
660.000	-4.27E-06	101.9176	-10.3061	5.6833E-08	828.1166	0.2410834	338956.
666.000	-3.92E-06	44.1280	-8.9142	5.8309E-08	828.1039	0.2228817	341116.
672.000	-3.57E-06	-5.6423	-7.6332	5.8698E-08	828.0955	0.2041239	343276.
678.000	-3.22E-06	-48.0636	-6.4653	5.8155E-08	828.1048	0.1851516	345436.
684.000	-2.87E-06	-83.8146	-5.4111	5.6822E-08	828.1126	0.1662637	347596.
690.000	-2.53E-06	-113.5714	-4.4691	5.4827E-08	828.1191	0.1477193	349756.
696.000	-2.21E-06	-137.9988	-3.6368	5.2284E-08	828.1244	0.1297411	351916.
702.000	-1.91E-06	-157.7414	-2.9100	4.9295E-08	828.1287	0.1125186	354076.
708.000	-1.62E-06	-173.4172	-2.2838	4.5948E-08	828.1322	0.0962123	356236.
714.000	-1.36E-06	-185.6116	-1.7523	4.2319E-08	828.1348	0.0809562	358396.
720.000	-1.11E-06	-194.8726	-0.9717612	3.8473E-08	828.1368	0.1792151	966424.
726.000	-8.94E-07	-197.6619	0.0005100	3.4506E-08	828.1375	0.1448753	972724.
732.000	-6.99E-07	-195.2155	0.7770979	3.0535E-08	828.1369	0.1139873	979024.
738.000	-5.27E-07	-188.6456	1.3788	2.6655E-08	828.1355	0.0865781	985324.
744.000	-3.79E-07	-178.9396	1.8263	2.2940E-08	828.1334	0.0625905	991624.
750.000	-2.52E-07	-166.9621	2.1398	1.9444E-08	828.1308	0.0419008	997924.
756.000	-1.45E-07	-153.4590	2.3385	1.6205E-08	828.1278	0.0243342	1004224.
762.000	-5.75E-08	-139.0643	2.4405	1.3248E-08	828.1247	0.0096786	1010524.
768.000	1.36E-08	-124.3068	2.4626	1.0586E-08	828.1214	-0.0023032	1016824.
774.000	6.96E-08	-109.6196	2.4201	8.2221E-09	828.1182	-0.0118633	1023124.
780.000	1.12E-07	-95.3483	2.3268	6.1504E-09	828.1151	-0.0192597	1029424.
786.000	1.43E-07	-81.7605	2.1947	4.3603E-09	828.1122	-0.0247496	1035724.
792.000	1.65E-07	-69.0554	2.0348	2.8359E-09	828.1094	-0.0285825	1042024.
798.000	1.77E-07	-57.3722	1.8560	1.5581E-09	828.1068	-0.0309966	1048324.
804.000	1.83E-07	-46.7990	1.6664	5.0517E-10	828.1045	-0.0322145	1054624.
810.000	1.83E-07	-37.3808	1.4724	-3.4566E-10	828.1025	-0.0324410	1060924.
816.000	1.79E-07	-29.1266	1.2795	-1.0179E-09	828.1007	-0.0318616	1067224.
822.000	1.71E-07	-22.0164	1.0920	-1.5348E-09	828.0991	-0.0306409	1073524.
828.000	1.61E-07	-16.0070	0.9133071	-1.9191E-09	828.0978	-0.0289231	1079824.
834.000	1.48E-07	-11.0373	0.7460426	-2.1925E-09	828.0967	-0.0268317	1086124.
840.000	1.34E-07	-7.0323	0.5921363	-2.3751E-09	828.0958	-0.0244704	1092424.
846.000	1.20E-07	-3.9076	0.4529536	-2.4857E-09	828.0952	-0.0219238	1098724.
852.000	1.05E-07	-1.5718	0.3294045	-2.5411E-09	828.0946	-0.0192592	1105024.
858.000	8.92E-08	0.0709332	0.2220448	-2.5562E-09	828.0943	-0.0165274	1111324.
864.000	7.39E-08	1.1186	0.1311677	-2.5442E-09	828.0945	-0.0137650	1117624.
870.000	5.87E-08	1.6707	0.0568853	-2.5160E-09	828.0947	-0.0109958	1123924.
876.000	4.37E-08	1.8267	-0.0008007	-2.4807E-09	828.0947	-0.0082329	1130224.
882.000	2.89E-08	1.6862	-0.0419405	-2.4452E-09	828.0947	-0.0054804	1136524.
888.000	1.44E-08	1.3482	-0.0665894	-2.4145E-09	828.0946	-0.0027359	1142824.
894.000	-4.13E-11	0.9115208	-0.0747733	-2.3916E-09	828.0945	7.9147E-06	1149124.
900.000	-1.43E-08	0.4750737	-0.0664675	-2.3776E-09	828.0944	0.0027607	1155424.
906.000	-2.86E-08	0.1379625	-0.0415886	-2.3714E-09	828.0943	0.0055323	1161724.
912.000	-4.28E-08	0.0000	0.0000	-2.3700E-09	828.0943	0.0083306	584012.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	0.10000000 in
Computed slope at pile head	=	-0.00104103
Maximum bending moment	=	2215441. lbs-in
Maximum shear force	=	53660.53746 lbs
Depth of maximum bending moment	=	84.00000000 in

Depth of maximum shear force = 0.00000 in
Number of iterations = 5
Number of zero deflection points = 5

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 = 0.500000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 843000.000 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	Es*h F/L lbs/in
0.000	0.500000	0.0000	131769.	-0.0042113	828.0943	-851.5537	5109.3222
6.000	0.474732	796588.	126354.	-0.0042033	1002.0049	-953.4135	12049.9179
12.000	0.449561	1558771.	120349.	-0.0041795	1168.4044	-1048.4115	13992.4849
18.000	0.424578	2283053.	113793.	-0.0041407	1326.5291	-1136.7440	16064.0951
24.000	0.399873	2966178.	106754.	-0.0040876	1475.6685	-1209.7772	18152.4346
30.000	0.375527	3605448.	99307.5438	-0.0040212	1615.2336	-1272.2873	20328.0282
36.000	0.351619	4198547.	91515.8988	-0.0039423	1744.7186	-1324.9277	22608.4906
42.000	0.328219	4743519.	83462.1395	-0.0038519	1863.6966	-1359.6587	24855.1749
48.000	0.305396	5239058.	75235.2678	-0.0037510	1971.8825	-1382.6319	27164.0786
54.000	0.283207	5684287.	66907.2658	-0.0036406	2069.0846	-1393.3688	29519.7691
60.000	0.261708	6078774.	58577.9398	-0.0035217	2155.2087	-1383.0732	31708.7338
66.000	0.240947	6422848.	50317.5074	-0.0033954	2230.3268	-1370.4043	34125.5032
72.000	0.220964	6716931.	42131.9316	-0.0032625	2294.5309	-1358.1210	36878.0698
78.000	0.201796	6961435.	34076.7111	-0.0031243	2347.9109	-1326.9525	39454.2657
84.000	0.183472	7157457.	26265.9179	-0.0029816	2390.7063	-1276.6452	41749.4386
90.000	0.166017	7306788.	18813.5199	-0.0028354	2423.3081	-1207.4875	43639.6710
96.000	0.149448	7411902.	11829.7986	-0.0026866	2446.2566	-1120.4196	44982.4165
102.000	0.133777	7475924.	5272.1371	-0.0025362	2460.2337	-1065.4676	47786.8894
108.000	0.119014	7500824.	-1069.9031	-0.0023848	2465.6698	-1048.5458	52861.7048
114.000	0.105160	7487209.	-7284.4189	-0.0022333	2462.6975	-1022.9594	58365.8476
120.000	0.092214	7436003.	-13319.8180	-0.0020825	2451.5181	-988.8402	64339.6368
126.000	0.080171	7348438.	-19125.6491	-0.0019330	2432.4010	-946.4368	70831.6743
132.000	0.069018	7226049.	-24653.2999	-0.0017857	2405.6812	-896.1134	77902.4035
138.000	0.058742	7070662.	-29895.2652	-0.0016412	2371.7572	-851.2083	86943.5792
144.000	0.049324	6883909.	-34885.1158	-0.0015002	2330.9853	-812.0752	98785.2632
150.000	0.040740	6667216.	-39618.5143	-0.0013632	2283.6772	-765.7243	112772.
156.000	0.032965	6422277.	-44051.3716	-0.0012309	2230.2020	-711.8948	129572.
162.000	0.025969	6151052.	-48137.5609	-0.0011038	2170.9884	-650.1683	150216.
168.000	0.019720	5855792.	-51827.5522	-0.0009825	2106.5274	-579.8288	176423.
174.000	0.014180	5539060.	-54964.4688	-0.0008673	2037.3786	-465.8101	197100.
180.000	0.009312	5204992.	-57304.7513	-0.0007587	1964.4451	-314.2841	202500.
186.000	0.005076	4859078.	-58775.2158	-0.0006570	1888.9253	-175.8708	207900.
192.000	0.001429	4506335.	-59455.1778	-0.0005623	1811.9148	-50.7832	213300.
198.000	-0.001672	4151304.	-59424.6870	-0.0004748	1734.4045	60.9468	218700.
204.000	-0.004269	3798042.	-58763.4907	-0.0003945	1657.2806	159.4519	224100.
210.000	-0.006406	3450132.	-57550.1002	-0.0003212	1581.3252	245.0116	229500.
216.000	-0.008123	3110690.	-55860.9637	-0.0002549	1507.2183	318.0339	234900.
222.000	-0.009464	2782379.	-53769.7476	-0.0001953	1435.5417	379.0381	240300.
228.000	-0.010467	2467429.	-51346.7254	-0.0001423	1366.7819	428.6360	245700.
234.000	-0.011171	2167657.	-48658.2720	-9.5409E-05	1301.3360	467.5151	251100.
240.000	-0.011612	1884495.	-45766.4612	-5.4452E-05	1239.5161	496.4218	256500.
246.000	-0.011825	1619011.	-42728.7599	-1.9041E-05	1181.5558	516.1453	261900.
252.000	-0.011841	1371942.	-39597.8150	1.1190E-05	1127.6159	527.5030	267300.
258.000	-0.011690	1143724.	-36421.3260	3.6617E-05	1077.7914	531.3267	272700.
264.000	-0.011401	934516.	-33241.9958	5.7622E-05	1032.1173	528.4501	278100.
270.000	-0.010999	744237.	-30097.5531	7.4590E-05	990.5756	519.6975	283500.
276.000	-0.010506	572591.	-27020.8377	8.7900E-05	953.1020	505.8743	288900.
282.000	-0.009944	419098.	-24039.9417	9.7923E-05	919.5914	487.7577	294300.
288.000	-0.009331	283121.	-21178.3973	0.0001050	889.9051	466.0904	299700.
294.000	-0.008684	163894.	-18455.4057	0.0001095	863.8756	441.5735	305100.
300.000	-0.008017	60547.8344	-15886.0968	0.0001118	841.3131	414.8628	310500.
306.000	-0.007342	-27869.8326	-13481.8147	0.0001121	834.1788	386.5646	315900.
312.000	-0.006671	-102368.	-11250.4215	0.0001108	850.4433	357.2332	321300.
318.000	-0.006012	-163996.	-9196.6125	0.0001081	863.8978	327.3698	326700.
324.000	-0.005373	-213822.	-7322.2379	0.0001043	874.7757	297.4217	332100.
330.000	-0.004761	-252918.	-5626.6251	9.9593E-05	883.3112	267.7825	337500.
336.000	-0.004178	-282348.	-4106.8977	9.4183E-05	889.7365	238.7933	342900.
342.000	-0.003630	-303154.	-2758.2860	8.8265E-05	894.2786	210.7440	348300.
348.000	-0.003119	-316341.	-1574.4266	8.2003E-05	897.1576	183.8758	353700.
354.000	-0.002646	-322876.	-547.6473	7.5542E-05	898.5844	158.3839	359100.
360.000	-0.002213	-323677.	330.7642	6.9007E-05	898.7592	134.4199	364500.
366.000	-0.001818	-319605.	1070.3109	6.2506E-05	897.8703	112.0956	369900.
372.000	-0.001463	-311465.	1681.0558	5.6127E-05	896.0932	91.4860	375300.
378.000	-0.001145	-300000.	2173.4138	4.9947E-05	893.5902	72.6333	380700.
384.000	-0.000863	-285890.	2557.9630	4.4025E-05	890.5096	55.5498	386100.
390.000	-0.000616	-269750.	2845.2791	3.8409E-05	886.9860	40.2222	391500.
396.000	-0.000402	-252135.	3045.7897	3.3134E-05	883.1402	26.6146	396900.
402.000	-0.000219	-233536.	3169.6500	2.8225E-05	879.0797	14.6721	402300.
408.000	-6.36E-05	-214385.	3226.6385	2.3698E-05	874.8986	4.3240	407700.
414.000	6.56E-05	-195056.	3226.0711	1.9560E-05	870.6788	-4.5132	413100.
420.000	0.000171	-175870.	3176.7333	1.5810E-05	866.4900	-11.9328	418500.
426.000	0.000255	-157095.	3086.8293	1.2445E-05	862.3912	-18.0352	423900.
432.000	0.000320	-138954.	2963.9456	9.4528E-06	858.4306	-22.9260	429300.
438.000	0.000369	-121623.	2815.0287	6.8190E-06	854.6470	-26.7130	434700.
444.000	0.000402	-105242.	2646.3752	4.5260E-06	851.0707	-29.5049	440100.
450.000	0.000423	-89912.4975	2463.6327	2.5535E-06	847.7239	-31.4093	445500.
456.000	0.000433	-75704.3882	2271.8098	8.7954E-07	844.6220	-32.5316	450900.
462.000	0.000434	-62659.6775	2075.2946	-5.1895E-07	841.7741	-32.9734	456300.
468.000	0.000427	-50795.6036	1877.8794	-1.6657E-06	839.1840	-32.8316	461700.
474.000	0.000414	-40108.2750	1682.7911	-2.5845E-06	836.8507	-32.1978	467100.
480.000	0.000396	-30575.9655	1492.7259	-3.2989E-06	834.7696	-31.1573	472500.
486.000	0.000374	-22162.1921	1309.8867	-3.8320E-06	832.9327	-29.7891	477900.
492.000	0.000350	-14818.5613	1136.0229	-4.2057E-06	831.3295	-28.1655	483300.
498.000	0.000324	-8487.3724	972.4715	-4.4413E-06	829.9473	-26.3516	488700.
504.000	0.000296	-3103.9744	820.1987	-4.5585E-06	828.7720	-24.4060	494100.
510.000	0.000269	1401.1259	679.8406	-4.5757E-06	828.4002	-22.3801	499500.
516.000	0.000241	5100.4002	551.7436	-4.5100E-06	829.2078	-20.3189	504900.
522.000	0.000215	8067.6719	436.0035	-4.3769E-06	829.8556	-18.2611	510300.
528.000	0.000189	10376.7190	332.5025	-4.1904E-06	830.3597	-16.2392	515700.
534.000	0.000164	12100.0923	240.9439	-3.9633E-06	830.7360	-14.2803	521100.
540.000	0.000141	13308.1376	160.8849	-3.7065E-06	830.9997	-12.4060	526500.
546.000	0.000120	14068.2055	91.7668	-3.4297E-06	831.1657	-10.6333	531900.
552.000	0.000100	14444.0347	32.9421	-3.1416E-06	831.2477	-8.9749	537300.
558.000	8.22E-05	14495.2909	-16.3007	-2.8491E-06	831.2589	-7.4394	542700.
564.000	6.60E-05	14277.2469	-56.7154	-2.5582E-06	831.2113	-6.0321	548100.
570.000	5.15E-05	13840.5858	-89.0782	-2.2741E-06	831.1160	-4.7555	553500.
576.000	3.87E-05	13231.3130	-114.1718	-2.0004E-06	830.9830	-3.6091	558900.
582.000	2.75E-05	12490.7607	-132.7707	-1.7404E-06	830.8213	-2.5906	564300.
588.000	1.79E-05	11655.6708	-145.6297	-1.4964E-06	830.6390	-1.6958	569700.
594.000	9.59E-06	10758.3421	-153.4740	-1.2698E-06	830.4431	-0.9190066	575100.
600.000	2.62E-06	9826.8291	-156.9918	-1.0618E-06	830.2397	-0.2536173	580500.
606.000	-3.15E-06	8885.1812	-156.8289	-8.7265E-07	830.0341	0.3079245	585900.
612.000	-7.85E-06	7953.7100	-153.5842	-7.0245E-07	829.8308	0.7736564	591300.
618.000	-1.16E-05	7049.2773	-147.8075	-5.5081E-07	829.6333	1.1519	596700.
624.000	-1.45E-05	6185.5923	-139.9985	-4.1704E-07	829.4447	1.4511	602100.
630.000	-1.66E-05	5373.5134	-130.6070	-3.0021E-07	829.2674	1.6795	607500.
636.000	-1.81E-05	4621.3456	-120.0333	-1.9918E-07	829.1032	1.8451	612900.
642.000	-1.90E-05	3935.1285	-108.6312	-1.1270E-07	828.9534	1.9556	618300.
648.000	-1.94E-05	3318.9116	-96.7097	-3.9382E-08	828.8189	2.0182	623700.
654.000	-1.95E-05	2775.0101	-84.5372	2.2212E-08	828.7001	2.0393	629100.
660.000	-1.91E-05	2304.2410	-75.1739	7.3549E-08	828.5974	1.0817	338956.
666.000	-1.86E-05	1872.1792	-68.7618	1.1576E-07	828.5030	1.0556	341116.
672.000	-1.78E-05	1477.9279	-62.5468	1.4962E-07	828.4170	1.0161	343276.
678.000	-1.68E-05	1120.1035	-56.6018	1.7588E-07	828.3388	0.9656064	345436.
684.000	-1.56E-05	796.9265	-50.9853	1.9526E-07	828.2683	0.9065731	347596.
690.000	-1.44E-05	506.3046	-45.7423	2.0843E-07	828.2048	0.8410965	349756.
696.000	-1.31E-05	245.9104	-40.9056	2.1603E-07	828.1480	0.7711399	351916.
702.000	-1.18E-05	13.2521	-36.4967	2.1865E-07	828.0972	0.6985006	354076.
708.000	-1.05E-05	-194.2615	-32.5267	2.1682E-07	828.1367	0.6248219	356236.
714.000	-9.23E-06	-379.2617	-28.9974	2.1103E-07	828.1771	0.5516054	358396.
720.000	-7.99E-06	-544.3653	-23.4811	2.0169E-07	828.2131	1.2872	966424.
726.000	-6.81E-06	-663.0747	-16.3053	1.8949E-07	828.2391	1.1047	972724.
732.000	-5.72E-06	-741.9460	-10.1923	1.7529E-07	828.2563	0.9329372	979024.
738.000	-4.71E-06	-787.1557	-5.0727	1.5983E-07	828.2662	0.7736162	985324.
744.000	-3.80E-06	-804.4347	-0.8679220	1.4374E-07	828.2699	0.6279600	991624.
750.000	-2.99E-06	-799.0248	2.5058	1.2754E-07	828.2687	0.4966178	997924.
756.000	-2.27E-06	-775.6551	5.1350	1.1162E-07	828.2636	0.3797872	1004224.

762.000	-1.65E-06	-738.5337	7.1063	9.6317E-08	828.2555	0.2772960	1010524.
768.000	-1.11E-06	-691.3541	8.5042	8.1865E-08	828.2452	0.1886777	1016824.
774.000	-6.64E-07	-637.3115	9.4099	6.8435E-08	828.2334	0.1132386	1023124.
780.000	-2.92E-07	-579.1271	9.9000	5.6140E-08	828.2207	0.0501182	1029424.
786.000	9.61E-09	-519.0792	10.0454	4.5040E-08	828.2076	-0.0016583	1035724.
792.000	2.48E-07	-459.0379	9.9110	3.5154E-08	828.1945	-0.0431343	1042024.
798.000	4.31E-07	-400.5026	9.5555	2.6466E-08	828.1817	-0.0753839	1048324.
804.000	5.66E-07	-344.6401	9.0309	1.8935E-08	828.1695	-0.0994798	1054624.
810.000	6.59E-07	-292.3237	8.3830	1.2497E-08	828.1581	-0.1164668	1060924.
816.000	7.16E-07	-244.1701	7.6516	7.0743E-09	828.1476	-0.1273420	1067224.
822.000	7.44E-07	-200.5760	6.8705	2.5790E-09	828.1381	-0.1330388	1073524.
828.000	7.47E-07	-161.7507	6.0681	-1.0831E-09	828.1296	-0.1344153	1079824.
834.000	7.31E-07	-127.7478	5.2681	-4.0092E-09	828.1222	-0.1322474	1086124.
840.000	6.99E-07	-98.4928	4.4897	-6.2959E-09	828.1158	-0.1272242	1092424.
846.000	6.55E-07	-73.8077	3.7482	-8.0374E-09	828.1104	-0.1199467	1098724.
852.000	6.02E-07	-53.4332	3.0556	-9.3235E-09	828.1060	-0.1109286	1105024.
858.000	5.43E-07	-37.0467	2.4210	-1.0238E-08	828.1024	-0.1005994	1111324.
864.000	4.79E-07	-24.2779	1.8513	-1.0858E-08	828.0996	-0.0893090	1117624.
870.000	4.13E-07	-14.7218	1.3513	-1.1252E-08	828.0975	-0.0773332	1123924.
876.000	3.44E-07	-7.9482	0.9246808	-1.1481E-08	828.0960	-0.0648812	1130224.
882.000	2.75E-07	-3.5095	0.5737281	-1.1597E-08	828.0951	-0.0521030	1136524.
888.000	2.05E-07	-0.9461710	0.3001251	-1.1642E-08	828.0945	-0.0390980	1142824.
894.000	1.35E-07	0.2097494	0.1050578	-1.1649E-08	828.0943	-0.0259244	1149124.
900.000	6.55E-08	0.4323682	-0.0105425	-1.1643E-08	828.0944	-0.0126090	1155424.
906.000	-4.35E-09	0.2010191	-0.0458403	-1.1637E-08	828.0943	0.0008431	1161724.
912.000	-7.42E-08	0.0000	0.0000	-1.1635E-08	828.0943	0.0144370	584012.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection = 0.50000000 in
Computed slope at pile head = -0.00421134
Maximum bending moment = 7500824. lbs-in
Maximum shear force = 131769.14418 lbs
Depth of maximum bending moment = 108.00000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 8
Number of zero deflection points = 5

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 = 1.000000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 843000.000 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	Es*h F/L lbs/in
0.000	1.000000	0.0000	199523.	-0.0077871	828.0943	-1080.7311	3242.1934
6.000	0.953277	1217075.	192654.	-0.0077748	1093.8054	-1208.9664	7609.3281
12.000	0.906702	2390503.	185039.	-0.0077384	1349.9875	-1329.5489	8798.1434
18.000	0.860417	3515823.	176721.	-0.0076787	1595.6667	-1443.2258	10064.1420
24.000	0.814558	4588827.	167772.	-0.0075968	1829.9243	-1539.5363	11340.1640
30.000	0.769255	5605938.	158284.	-0.0074937	2051.9796	-1623.2415	12660.8786
36.000	0.724633	6564040.	148329.	-0.0073707	2261.1518	-1695.0341	14034.9723
42.000	0.680807	7460450.	138004.	-0.0072290	2456.8554	-1746.8105	15394.7685
48.000	0.637885	8293211.	127388.	-0.0070697	2638.6633	-1791.6963	16852.8349
54.000	0.595970	9060623.	116521.	-0.0068943	2806.2044	-1830.6697	18430.4903
60.000	0.555153	9761205.	105488.	-0.0067041	2959.1550	-1846.9074	19961.0490
66.000	0.515521	1.0394E+07	94353.9943	-0.0065004	3097.3720	-1864.4920	21700.2924
72.000	0.477149	1.0959E+07	83100.2192	-0.0062845	3220.7029	-1886.7664	23725.5048
78.000	0.440106	1.1455E+07	71779.4502	-0.0060580	3328.9602	-1886.8233	25723.1991
84.000	0.404453	1.1882E+07	60529.5782	-0.0058221	3422.1323	-1863.1341	27639.3231
90.000	0.370241	1.2240E+07	49496.5020	-0.0055783	3500.3959	-1814.5580	29406.1328
96.000	0.337513	1.2532E+07	38831.4054	-0.0053279	3564.1247	-1740.4742	30940.5570
102.000	0.306306	1.2760E+07	28516.7499	-0.0050723	3613.8945	-1697.7443	33255.8901
108.000	0.276646	1.2926E+07	18334.5147	-0.0048127	3650.0361	-1696.3341	36790.7516
114.000	0.248554	1.3029E+07	8198.2617	-0.0045503	3672.5567	-1682.4170	40612.9779
120.000	0.222042	1.3070E+07	-1816.4493	-0.0042865	3681.5636	-1655.8200	44743.4841
126.000	0.197115	1.3050E+07	-11633.4904	-0.0040225	3677.2649	-1616.5270	49205.5760
132.000	0.173771	1.2971E+07	-21177.1316	-0.0037595	3659.9697	-1564.6867	54025.7071
138.000	0.152001	1.2834E+07	-30423.0588	-0.0034987	3630.0873	-1517.2890	59892.6428
144.000	0.131787	1.2642E+07	-39402.9754	-0.0032412	3587.9933	-1476.0165	67200.0675
150.000	0.113107	1.2394E+07	-48104.7703	-0.0029881	3534.0163	-1424.5818	75570.2770
156.000	0.095929	1.2095E+07	-56467.0782	-0.0027406	3468.5662	-1362.8542	85241.1950
162.000	0.080219	1.1744E+07	-64427.6603	-0.0024997	3392.1347	-1290.6732	96536.2912
168.000	0.065933	1.1347E+07	-71923.0862	-0.0022663	3305.2970	-1207.8021	109912.
174.000	0.053023	1.0904E+07	-78888.0488	-0.0020414	3208.7134	-1113.8521	126041.
180.000	0.041436	1.0421E+07	-85254.0514	-0.0018259	3103.1320	-1008.1488	145980.
186.000	0.031113	9899715.	-90946.9379	-0.0016205	2989.3944	-889.4801	171531.
192.000	0.021991	9345713.	-95882.0502	-0.0014259	2868.4450	-755.5574	206147.
198.000	0.014002	8763555.	-99679.8295	-0.0012429	2741.3487	-510.3691	218700.
204.000	0.007076	8162128.	-102004.	-0.0010718	2610.0455	-264.2852	224100.
210.000	0.001140	7550353.	-102927.	-0.0009130	2476.4829	-43.6010	229500.
216.000	-0.003880	6936235.	-102603.	-0.0007666	2342.4092	151.9156	234900.
222.000	-0.008059	6326877.	-101178.	-0.0006325	2209.3745	322.7751	240300.
228.000	-0.011471	5728493.	-98800.9119	-0.0005107	2078.7355	469.7326	245700.
234.000	-0.014188	5146433.	-95610.4538	-0.0004008	1951.6605	593.7535	251100.
240.000	-0.016280	4585222.	-91741.2536	-0.0003024	1829.1372	695.9799	256500.
246.000	-0.017817	4048597.	-87320.2209	-0.0002152	1711.9816	777.6977	261900.
252.000	-0.018862	3539555.	-82466.2135	-0.0001385	1600.8480	840.3048	267300.
258.000	-0.019478	3060403.	-77289.4542	-7.1748E-05	1496.2397	885.2816	272700.
264.000	-0.019723	2612808.	-71891.1215	-1.4406E-05	1398.5210	914.1626	278100.
270.000	-0.019651	2197855.	-66363.1013	3.4217E-05	1307.9288	928.5108	283500.
276.000	-0.019312	1816104.	-60787.8880	7.4787E-05	1224.5852	929.8937	288900.
282.000	-0.018754	1467644.	-55238.6187	0.0001080	1148.5095	919.8628	294300.
288.000	-0.018017	1152149.	-49779.2272	0.0001345	1079.6307	899.9344	299700.
294.000	-0.017140	868933.	-44464.7029	0.0001549	1017.7993	871.5737	305100.
300.000	-0.016158	617005.	-39341.4381	0.0001699	962.7986	836.1812	310500.
306.000	-0.015101	395117.	-34447.6519	0.0001801	914.3560	795.0809	315900.
312.000	-0.013996	201811.	-29813.8731	0.0001862	872.1536	749.5120	321300.
318.000	-0.012867	35467.3597	-25463.4716	0.0001886	835.8375	700.6218	326700.
324.000	-0.011734	-105658.	-21413.2236	0.0001879	851.1615	649.4608	332100.
330.000	-0.010613	-223392.	-17673.9001	0.0001845	876.8650	596.9803	337500.
336.000	-0.009519	-319611.	-14250.8660	0.0001790	897.8717	544.0310	342900.
342.000	-0.008464	-396213.	-11144.6826	0.0001718	914.5954	491.3635	348300.
348.000	-0.007458	-455086.	-8351.7019	0.0001632	927.4483	439.6301	353700.
354.000	-0.006506	-498085.	-5864.6478	0.0001536	936.8359	389.3879	359100.
360.000	-0.005615	-527015.	-3673.1751	0.0001432	943.1519	341.1029	364500.
366.000	-0.004788	-543611.	-1764.4028	0.0001324	946.7752	295.1545	369900.
372.000	-0.004026	-549527.	-123.4160	0.0001213	948.0667	251.8411	375300.
378.000	-0.003332	-546320.	1266.2663	0.0001103	947.3665	211.3863	380700.
384.000	-0.002703	-535447.	2422.2605	9.9327E-05	944.9928	173.9451	386100.
390.000	-0.002140	-518257.	3362.9264	8.8677E-05	941.2400	139.6102	391500.
396.000	-0.001639	-495989.	4107.0145	7.8425E-05	936.3783	108.4192	396900.
402.000	-0.001199	-469767.	4673.3538	6.8664E-05	930.6535	80.3606	402300.
408.000	-0.000815	-440603.	5080.5778	5.9463E-05	924.2866	55.3807	407700.
414.000	-0.000485	-409401.	5346.8900	5.0871E-05	917.4746	33.3900	413100.
420.000	-0.000205	-376955.	5489.8657	4.2923E-05	910.3910	14.2686	418500.
426.000	3.01E-05	-343957.	5526.2893	3.5637E-05	903.1868	-2.1274	423900.
432.000	0.000223	-311000.	5472.0248	2.9017E-05	895.9917	-15.9608	429300.
438.000	0.000378	-278586.	5341.9161	2.3058E-05	888.9151	-27.4087	434700.
444.000	0.000500	-247131.	5149.7170	1.7744E-05	882.0477	-36.6576	440100.
450.000	0.000591	-216969.	4908.0454	1.3053E-05	875.4629	-43.8996	445500.
456.000	0.000656	-188366.	4628.3611	8.9562E-06	869.2183	-49.3285	450900.
462.000	0.000699	-161519.	4320.9637	5.4198E-06	863.3571	-53.1373	456300.
468.000	0.000721	-136569.	3995.0078	2.4069E-06	857.9100	-55.5147	461700.
474.000	0.000728	-113604.	3658.5332	-1.2167E-07	852.8962	-56.6435	467100.
480.000	0.000720	-92665.7012	3318.5078	-2.2065E-06	848.3250	-56.6983	472500.
486.000	0.000701	-73759.3264	2980.8802	-3.8886E-06	844.1974	-55.8442	477900.
492.000	0.000673	-56855.8010	2650.6411	-5.2088E-06	840.5070	-54.2355	483300.
498.000	0.000639	-41898.9410	2331.8892	-6.2070E-06	837.2417	-52.0151	488700.
504.000	0.000599	-28810.3413	2027.9025	-6.9216E-06	834.3842	-49.3138	494100.
510.000	0.000556	-17494.0913	1741.2115	-7.3897E-06	831.9136	-46.2499	499500.
516.000	0.000510	-7841.0488	1473.6731	-7.6457E-06	829.8062	-42.9296	504900.
522.000	0.000464	267.3306	1226.5445	-7.7223E-06	828.1527	-39.4467	510300.

528.000	0.000417	6955.6032	1000.5552	-7.6493E-06	829.6128	-35.8831	515700.
534.000	0.000372	12351.3736	795.9777	-7.4541E-06	830.7908	-32.3094	521100.
540.000	0.000328	16582.7419	612.6934	-7.1617E-06	831.7146	-28.7854	526500.
546.000	0.000286	19776.1420	450.2560	-6.7942E-06	832.4118	-25.3604	531900.
552.000	0.000247	22054.5443	307.9504	-6.3714E-06	832.9092	-22.0748	537300.
558.000	0.000210	23535.9997	184.8465	-5.9106E-06	833.2327	-18.9598	542700.
564.000	0.000176	24332.4941	79.8491	-5.4268E-06	833.4066	-16.0393	548100.
570.000	0.000144	24549.0860	-8.2580	-4.9327E-06	833.4538	-13.3297	553500.
576.000	0.000116	24283.2979	-80.7718	-4.4391E-06	833.3958	-10.8416	558900.
582.000	9.12E-05	23624.7311	-139.0358	-3.9549E-06	833.2520	-8.5798	564300.
588.000	6.89E-05	22654.8760	-184.4097	-3.4872E-06	833.0403	-6.5448	569700.
594.000	4.94E-05	21447.0911	-218.2434	-3.0414E-06	832.7766	-4.7331	575100.
600.000	3.24E-05	20066.7224	-241.8561	-2.6218E-06	832.4753	-3.1378	580500.
606.000	1.79E-05	18571.3401	-256.5188	-2.2313E-06	832.1488	-1.7497	585900.
612.000	5.66E-06	17011.0683	-263.4405	-1.8716E-06	831.8081	-0.5575060	591300.
618.000	-4.54E-06	15428.9871	-263.7582	-1.5437E-06	831.4628	0.4516071	596700.
624.000	-1.29E-05	13861.5861	-258.5296	-1.2477E-06	831.1206	1.2913	602100.
630.000	-1.95E-05	12339.2541	-248.7285	-9.8287E-07	830.7882	1.9757	607500.
636.000	-2.47E-05	10886.7866	-235.2436	-7.4812E-07	830.4711	2.5192	612900.
642.000	-2.85E-05	9523.8990	-218.8779	-5.4182E-07	830.1736	2.9360	618300.
648.000	-3.12E-05	8265.7324	-200.3515	-3.6201E-07	829.8989	3.2395	623700.
654.000	-3.28E-05	7123.3428	-180.3048	-2.0647E-07	829.6495	3.4427	629100.
660.000	-3.36E-05	6104.1633	-164.2751	-7.2771E-08	829.4270	1.9005	338956.
666.000	-3.37E-05	5152.7780	-152.8244	4.1007E-08	829.2193	1.9164	341116.
672.000	-3.31E-05	4269.8560	-141.3855	1.3625E-07	829.0265	1.8966	343276.
678.000	-3.21E-05	3454.7743	-130.1561	2.1432E-07	828.8485	1.8465	345436.
684.000	-3.06E-05	2705.8146	-119.3021	2.7659E-07	828.6850	1.7714	347596.
690.000	-2.88E-05	2020.3505	-108.9593	3.2436E-07	828.5354	1.6762	349756.
696.000	-2.67E-05	1395.0214	-99.2354	3.5888E-07	828.3989	1.5652	351916.
702.000	-2.44E-05	825.8958	-90.2117	3.8133E-07	828.2746	1.4427	354076.
708.000	-2.21E-05	308.6236	-81.9454	3.9279E-07	828.1617	1.3127	356236.
714.000	-1.97E-05	-161.4229	-74.4710	3.9428E-07	828.1295	1.1788	358396.
720.000	-1.74E-05	-589.0172	-62.5374	3.8670E-07	828.2229	2.7991	966424.
726.000	-1.51E-05	-915.7834	-46.7991	3.7149E-07	828.2942	2.4470	972724.
732.000	-1.29E-05	-1154.3639	-33.1334	3.5056E-07	828.3463	2.1082	979024.
738.000	-1.09E-05	-1316.9306	-21.4452	3.2558E-07	828.3818	1.7879	985324.
744.000	-9.01E-06	-1414.9995	-11.6127	2.9797E-07	828.4032	1.4896	991624.
750.000	-7.31E-06	-1459.2969	-3.4957	2.6892E-07	828.4129	1.2160	997924.
756.000	-5.79E-06	-1459.6683	3.0577	2.3942E-07	828.4130	0.9684543	1004224.
762.000	-4.44E-06	-1425.0260	8.2056	2.1026E-07	828.4054	0.7475027	1010524.
768.000	-3.26E-06	-1363.3280	12.1071	1.8208E-07	828.3919	0.5530115	1016824.
774.000	-2.25E-06	-1281.5822	14.9189	1.5534E-07	828.3741	0.3842491	1023124.
780.000	-1.40E-06	-1185.8724	16.7918	1.3040E-07	828.3532	0.2400353	1029424.
786.000	-6.89E-07	-1081.4001	17.8685	1.0749E-07	828.3304	0.1188560	1035724.
792.000	-1.09E-07	-972.5383	18.2819	8.6728E-08	828.3066	0.0189634	1042024.
798.000	3.52E-07	-862.8945	18.1542	6.8177E-08	828.2827	-0.0615361	1048324.
804.000	7.09E-07	-755.3777	17.5958	5.1820E-08	828.2592	-0.1246085	1054624.
810.000	9.74E-07	-652.2696	16.7052	3.7592E-08	828.2367	-0.1722300	1060924.
816.000	1.16E-06	-555.2951	15.5695	2.5387E-08	828.2155	-0.2063364	1067224.
822.000	1.28E-06	-465.6919	14.2642	1.5068E-08	828.1960	-0.2287829	1073524.
828.000	1.34E-06	-384.2773	12.8539	6.4767E-09	828.1782	-0.2413133	1079824.
834.000	1.36E-06	-311.5107	11.3933	-5.5591E-10	828.1623	-0.2455371	1086124.
840.000	1.33E-06	-247.5516	9.9280	-6.2066E-09	828.1483	-0.2429145	1092424.
846.000	1.28E-06	-192.3120	8.4950	-1.0652E-08	828.1363	-0.2347470	1098724.
852.000	1.21E-06	-145.5037	7.1242	-1.4067E-08	828.1261	-0.2221739	1105024.
858.000	1.11E-06	-106.6788	5.8392	-1.6616E-08	828.1176	-0.2061733	1111324.
864.000	1.01E-06	-75.2652	4.6580	-1.8455E-08	828.1107	-0.1875668	1117624.
870.000	8.92E-07	-50.5963	3.5942	-1.9727E-08	828.1053	-0.1670274	1123924.
876.000	7.70E-07	-31.9353	2.6578	-2.0561E-08	828.1013	-0.1450899	1130224.
882.000	6.45E-07	-18.4942	1.8561	-2.1071E-08	828.0983	-0.1221637	1136524.
888.000	5.17E-07	-9.4491	1.1940	-2.1353E-08	828.0964	-0.0985470	1142824.
894.000	3.89E-07	-3.9507	0.6749834	-2.1489E-08	828.0952	-0.0744431	1149124.
900.000	2.60E-07	-1.1319	0.3017245	-2.1540E-08	828.0945	-0.0499766	1155424.
906.000	1.30E-07	-0.1121458	0.0761579	-2.1553E-08	828.0943	-0.0252123	1161724.
912.000	8.92E-10	0.0000	0.0000	-2.1554E-08	828.0943	-0.0001737	584012.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 8:

Pile-head deflection = 1.00000000 in

Computed slope at pile head = -0.00778714
Maximum bending moment = 13070158. lbs-in
Maximum shear force = 199523.48511 lbs
Depth of maximum bending moment = 120.00000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 9
Number of zero deflection points = 5

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 = 2.000000 in
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 843000.000 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	Es*h F/L lbs/in
0.000	2.000	0.0000	309376.	-0.0145376	828.0943	-1239.1160	1858.6740
6.000	1.913	1907482.	301409.	-0.0145183	1244.5347	-1416.3526	4442.8220
12.000	1.826	3763780.	292380.	-0.0144610	1649.8006	-1593.4002	5236.3386
18.000	1.739	5562331.	282285.	-0.0143668	2042.4592	-1771.6050	6111.6458
24.000	1.653	7296536.	271155.	-0.0142368	2421.0698	-1938.3763	7034.2373
30.000	1.568	8960212.	259048.	-0.0140725	2784.2827	-2097.5019	8024.1065
36.000	1.485	1.0547E+07	246010.	-0.0138753	3130.8104	-2248.4953	9087.8355
42.000	1.402	1.2053E+07	232118.	-0.0136469	3459.4305	-2381.8802	10194.2479
48.000	1.321	1.3471E+07	217495.	-0.0133889	3769.0613	-2492.4924	11323.1097
54.000	1.241	1.4798E+07	202354.	-0.0131032	4058.8016	-2554.7641	12349.5148
60.000	1.164	1.6032E+07	186919.	-0.0127916	4328.1323	-2590.2333	13357.3631
66.000	1.088	1.7170E+07	171243.	-0.0124560	4576.7473	-2635.0001	14534.8461
72.000	1.014	1.8213E+07	155256.	-0.0120984	4804.2692	-2693.8910	15939.6138
78.000	0.942551	1.9156E+07	138986.	-0.0117207	5010.2120	-2729.4957	17375.1667
84.000	0.873388	1.9999E+07	122577.	-0.0113249	5194.2746	-2740.1365	18824.1784
90.000	0.806652	2.0741E+07	106184.	-0.0109131	5356.3548	-2724.2564	20263.4372
96.000	0.742431	2.1384E+07	89969.8819	-0.0104873	5496.5606	-2680.4220	21661.9902
102.000	0.680804	2.1927E+07	73931.7479	-0.0100496	5615.2224	-2665.6227	23492.4358
108.000	0.621836	2.2372E+07	57856.6375	-0.0096018	5712.4442	-2692.7474	25981.9104
114.000	0.565582	2.2719E+07	41657.6650	-0.0091461	5788.0029	-2706.9101	28716.3847
120.000	0.512083	2.2965E+07	25426.5940	-0.0086843	5841.7796	-2703.4469	31675.8881
126.000	0.461370	2.3112E+07	9272.0633	-0.0082186	5873.7959	-2681.3967	34870.9166
132.000	0.413459	2.3159E+07	-6693.3986	-0.0077510	5884.2219	-2640.4240	38317.0495
138.000	0.368358	2.3110E+07	-22411.5258	-0.0072833	5873.3784	-2598.9517	42333.0113
144.000	0.326060	2.2964E+07	-37889.3245	-0.0068176	5841.5927	-2560.3145	47113.6994
150.000	0.286547	2.2724E+07	-53091.0502	-0.0063558	5789.1715	-2506.9274	52492.5112
156.000	0.249790	2.2391E+07	-67927.7671	-0.0058998	5716.5400	-2438.6449	58576.6794
162.000	0.215749	2.1968E+07	-82309.7672	-0.0054515	5624.2420	-2355.3552	65502.6639
168.000	0.184372	2.1459E+07	-96146.7082	-0.0050125	5512.9418	-2256.9585	73447.8099
174.000	0.155599	2.0865E+07	-109348.	-0.0045847	5383.4240	-2143.3328	82648.5427
180.000	0.129355	2.0193E+07	-121820.	-0.0041698	5236.5948	-2014.2823	93430.0797
186.000	0.105562	1.9446E+07	-133472.	-0.0037691	5073.4837	-1869.4546	106258.
192.000	0.084126	1.8629E+07	-144205.	-0.0033843	4895.2456	-1708.2018	121831.
198.000	0.064950	1.7750E+07	-153917.	-0.0030166	4703.1660	-1529.3319	141277.
204.000	0.047927	1.6813E+07	-162497.	-0.0026672	4498.6703	-1330.6215	166580.
210.000	0.032943	1.5827E+07	-169812.	-0.0023373	4283.3414	-1107.7205	201749.
216.000	0.019879	1.4799E+07	-175470.	-0.0020278	4058.9531	-778.2719	234900.
222.000	0.008610	1.3741E+07	-178839.	-0.0017393	3828.1175	-344.8268	240300.
228.000	-0.000993	1.2670E+07	-179752.	-0.0014724	3594.2651	40.6524	245700.
234.000	-0.009059	1.1599E+07	-178493.	-0.0012271	3360.4494	379.1030	251100.
240.000	-0.015718	1.0541E+07	-175340.	-0.0010033	3129.3542	671.9287	256500.
246.000	-0.021098	9505387.	-170561.	-0.0008007	2903.3048	920.9351	261900.
252.000	-0.025326	8502162.	-164413.	-0.0006187	2684.2814	1128.2650	267300.
258.000	-0.028522	7538685.	-157140.	-0.0004565	2473.9357	1296.3359	272700.
264.000	-0.030804	6621106.	-148967.	-0.0003134	2273.6103	1427.7800	278100.
270.000	-0.032283	5754249.	-140108.	-0.0001883	2084.3587	1525.3870	283500.
276.000	-0.033064	4941719.	-130755.	-8.0233E-05	1906.9675	1592.0512	288900.
282.000	-0.033246	4185997.	-121087.	1.2025E-05	1741.9787	1630.7220	294300.
288.000	-0.032920	3488552.	-111262.	8.9594E-05	1589.7131	1644.3596	299700.

294.000	-0.032171	2849948.	-101421.	0.0001537	1450.2934	1635.8947	305100.
300.000	-0.031076	2269945.	-91688.7828	0.0002054	1323.6675	1608.1931	310500.
306.000	-0.029706	1747605.	-82172.1274	0.0002460	1209.6305	1564.0254	315900.
312.000	-0.028124	1281391.	-72961.9291	0.0002766	1107.8469	1506.0407	321300.
318.000	-0.026387	869264.	-64133.5692	0.0002984	1017.8714	1436.7459	326700.
324.000	-0.024544	508770.	-55747.8679	0.0003123	939.1687	1358.4879	332100.
330.000	-0.022639	197130.	-47852.0797	0.0003194	871.1316	1273.4415	337500.
336.000	-0.020710	-68686.2746	-40480.9539	0.0003207	843.0899	1183.6004	342900.
342.000	-0.018790	-291886.	-33657.8380	0.0003171	891.8187	1090.7715	348300.
348.000	-0.016905	-475788.	-27395.8037	0.0003093	931.9681	996.5732	353700.
354.000	-0.015078	-623765.	-21698.7757	0.0002982	964.2743	902.4361	359100.
360.000	-0.013327	-739190.	-16562.6486	0.0002844	989.4738	809.6062	364500.
366.000	-0.011665	-825394.	-11976.3768	0.0002686	1008.2938	719.1510	369900.
372.000	-0.010103	-885624.	-7923.0240	0.0002513	1021.4432	631.9665	375300.
378.000	-0.008649	-923013.	-4380.7646	0.0002330	1029.6059	548.7866	380700.
384.000	-0.007307	-940551.	-1323.8260	0.0002142	1033.4348	470.1930	386100.
390.000	-0.006079	-941065.	1276.6333	0.0001952	1033.5472	396.6268	391500.
396.000	-0.004964	-927206.	3451.7142	0.0001763	1030.5213	328.4002	396900.
402.000	-0.003963	-901428.	5234.0406	0.0001578	1024.8936	265.7086	402300.
408.000	-0.003071	-865994.	6657.0963	0.0001400	1017.1575	208.6433	407700.
414.000	-0.002283	-822959.	7754.6366	0.0001229	1007.7623	157.2035	413100.
420.000	-0.001596	-774181.	8560.1732	0.0001068	997.1131	111.3087	418500.
426.000	-0.001002	-721317.	9106.5309	9.1635E-05	985.5718	70.8105	423900.
432.000	-0.000496	-665830.	9425.4736	7.7614E-05	973.4579	35.5037	429300.
438.000	-7.09E-05	-608996.	9547.3952	6.4729E-05	961.0501	5.1368	434700.
444.000	0.000281	-551916.	9501.0726	5.2995E-05	948.5883	-20.5777	440100.
450.000	0.000565	-495520.	9313.4766	4.2408E-05	936.2759	-41.9544	445500.
456.000	0.000789	-440583.	9009.6338	3.2947E-05	924.2822	-59.3266	450900.
462.000	0.000960	-387737.	8612.5378	2.4575E-05	912.7449	-73.0388	456300.
468.000	0.001084	-337481.	8143.1018	1.7245E-05	901.7730	-83.4399	461700.
474.000	0.001167	-290195.	7620.1496	1.0901E-05	891.4494	-90.8775	467100.
480.000	0.001215	-246150.	7060.4389	5.4795E-06	881.8336	-95.6927	472500.
486.000	0.001233	-205525.	6478.7127	9.1425E-07	872.9643	-98.2160	477900.
492.000	0.001226	-168414.	5887.7736	-2.8653E-06	864.8625	-98.7637	483300.
498.000	0.001199	-134842.	5298.5773	-5.9304E-06	857.5330	-97.6351	488700.
504.000	0.001155	-104772.	4720.3414	-8.3523E-06	850.9680	-95.1103	494100.
510.000	0.001098	-78113.8899	4160.6643	-1.0201E-05	845.1481	-91.4488	499500.
516.000	0.001033	-54740.3934	3625.6527	-1.1544E-05	840.0452	-86.8884	504900.
522.000	0.000960	-34489.2827	3120.0535	-1.2445E-05	835.6240	-81.6447	510300.
528.000	0.000883	-17173.8534	2647.3873	-1.2968E-05	831.8437	-75.9107	515700.
534.000	0.000804	-2589.4541	2210.0821	-1.3167E-05	828.6596	-69.8577	521100.
540.000	0.000725	9480.3329	1809.6034	-1.3098E-05	830.1640	-63.6352	526500.
546.000	0.000647	19258.2836	1446.5814	-1.2807E-05	832.2988	-57.3721	531900.
552.000	0.000571	26968.8687	1120.9316	-1.2340E-05	833.9821	-51.1778	537300.
558.000	0.000499	32834.2951	831.9687	-1.1736E-05	835.2627	-45.1431	542700.
564.000	0.000431	37071.2111	578.5135	-1.1029E-05	836.1877	-39.3419	548100.
570.000	0.000367	39888.0266	358.9905	-1.0251E-05	836.8026	-33.8324	553500.
576.000	0.000308	41482.7984	171.5183	-9.4287E-06	837.1508	-28.6584	558900.
582.000	0.000254	42041.6269	13.9894	-8.5845E-06	837.2728	-23.8512	564300.
588.000	0.000205	41737.5122	-115.8572	-7.7377E-06	837.2064	-19.4310	569700.
594.000	0.000161	40729.6155	-220.3734	-6.9042E-06	836.9864	-15.4078	575100.
600.000	0.000122	39162.8744	-301.9473	-6.0967E-06	836.6443	-11.7835	580500.
606.000	8.76E-05	37167.9218	-362.9569	-5.3252E-06	836.2088	-8.5530	585900.
612.000	5.79E-05	34861.2609	-405.7315	-4.5972E-06	835.7052	-5.7052	591300.
618.000	3.24E-05	32345.6492	-432.5202	-3.9179E-06	835.1560	-3.2244	596700.
624.000	1.09E-05	29710.6522	-445.4677	-3.2907E-06	834.5807	-1.0915	602100.
630.000	-7.07E-06	27033.3249	-446.5959	-2.7171E-06	833.9962	0.7154034	607500.
636.000	-2.17E-05	24378.9882	-437.7908	-2.1975E-06	833.4167	2.2196	612900.
642.000	-3.34E-05	21802.0652	-420.7953	-1.7307E-06	832.8541	3.4455	618300.
648.000	-4.25E-05	19346.9523	-397.2058	-1.3148E-06	832.3181	4.4176	623700.
654.000	-4.92E-05	17048.8961	-368.4729	-9.4694E-07	831.8164	5.1600	629100.
660.000	-5.39E-05	14934.8571	-343.8646	-6.2367E-07	831.3549	3.0428	338956.
666.000	-5.67E-05	12928.8301	-325.0661	-3.4204E-07	830.9169	3.2234	341116.
672.000	-5.80E-05	11037.5234	-305.4469	-9.9804E-08	830.5040	3.3164	343276.
678.000	-5.79E-05	9264.4772	-285.4983	1.0540E-07	830.1169	3.3332	345436.
684.000	-5.67E-05	7610.4778	-265.6443	2.7596E-07	829.7558	3.2848	347596.
690.000	-5.46E-05	6073.9539	-246.2444	4.1427E-07	829.4204	3.1818	349756.
696.000	-5.17E-05	4651.3544	-227.5967	5.2268E-07	829.1098	3.0341	351916.
702.000	-4.83E-05	3337.5059	-209.9415	6.0342E-07	828.8229	2.8510	354076.
708.000	-4.45E-05	2125.9516	-193.4644	6.5864E-07	828.5584	2.6414	356236.
714.000	-4.04E-05	1009.2701	-178.2993	6.9033E-07	828.3146	2.4137	358396.
720.000	-3.62E-05	-20.6230	-153.5639	7.0033E-07	828.0988	5.8315	966424.
726.000	-3.20E-05	-840.5813	-120.5041	6.9162E-07	828.2778	5.1885	972724.
732.000	-2.79E-05	-1473.6691	-91.2790	6.6823E-07	828.4160	4.5533	979024.
738.000	-2.40E-05	-1942.6887	-65.8027	6.3370E-07	828.5184	3.9388	985324.
744.000	-2.03E-05	-2269.7121	-43.9210	5.9112E-07	828.5898	3.3551	991624.
750.000	-1.69E-05	-2475.7204	-25.4276	5.4316E-07	828.6348	2.8094	997924.
756.000	-1.38E-05	-2580.3373	-10.0789	4.9206E-07	828.6576	2.3068	1004224.
762.000	-1.10E-05	-2601.6453	2.3927	4.3968E-07	828.6623	1.8504	1010524.
768.000	-8.51E-06	-2556.0728	12.2687	3.8755E-07	828.6523	1.4416	1016824.
774.000	-6.34E-06	-2458.3414	19.8348	3.3687E-07	828.6310	1.0805	1023124.
780.000	-4.46E-06	-2321.4624	25.3739	2.8855E-07	828.6011	0.7659070	1029424.
786.000	-2.87E-06	-2156.7733	29.1598	2.4329E-07	828.5652	0.4960336	1035724.
792.000	-1.54E-06	-1974.0065	31.4526	2.0154E-07	828.5253	0.2682508	1042024.
798.000	-4.55E-07	-1781.3809	32.4959	1.6358E-07	828.4832	0.0795097	1048324.
804.000	4.18E-07	-1585.7107	32.5138	1.2955E-07	828.4405	-0.0735423	1054624.
810.000	1.10E-06	-1392.5259	31.7099	9.9448E-08	828.3983	-0.1944210	1060924.
816.000	1.61E-06	-1206.1980	30.2666	7.3182E-08	828.3576	-0.2866881	1067224.
822.000	1.98E-06	-1030.0674	28.3449	5.0579E-08	828.3192	-0.3538552	1073524.
828.000	2.22E-06	-866.5703	26.0855	3.1409E-08	828.2835	-0.3993060	1079824.
834.000	2.35E-06	-717.3597	23.6088	1.5400E-08	828.2509	-0.4262368	1086124.
840.000	2.40E-06	-583.4202	21.0173	2.2523E-09	828.2217	-0.4376115	1092424.
846.000	2.38E-06	-465.1750	18.3961	-8.3462E-09	828.1959	-0.4361309	1098724.
852.000	2.30E-06	-362.5831	15.8150	-1.6713E-08	828.1735	-0.4242133	1105024.
858.000	2.18E-06	-275.2257	13.3304	-2.3159E-08	828.1544	-0.4039859	1111324.
864.000	2.03E-06	-202.3837	10.9866	-2.7987E-08	828.1385	-0.3772837	1117624.
870.000	1.85E-06	-143.1032	8.8178	-3.1479E-08	828.1255	-0.3456565	1123924.
876.000	1.65E-06	-96.2517	6.8497	-3.3898E-08	828.1153	-0.3103813	1130224.
882.000	1.44E-06	-60.5641	5.1011	-3.5483E-08	828.1075	-0.2724800	1136524.
888.000	1.22E-06	-34.6795	3.5854	-3.6446E-08	828.1019	-0.2327402	1142824.
894.000	1.00E-06	-17.1701	2.3120	-3.6970E-08	828.0981	-0.1917400	1149124.
900.000	7.78E-07	-6.5616	1.2872	-3.7209E-08	828.0957	-0.1498751	1155424.
906.000	5.55E-07	-1.3479	0.5153634	-3.7289E-08	828.0946	-0.1073881	1161724.
912.000	3.31E-07	0.0000	0.0000	-3.7303E-08	828.0943	-0.0643997	584012.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

```
Pile-head deflection             =     2.00000000 in
Computed slope at pile head      =    -0.01453763
Maximum bending moment           =      23159311. lbs-in
Maximum shear force              =   309375.78150 lbs
Depth of maximum bending moment  =      132.00000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =               9
Number of zero deflection points =               4
```

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

```
Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad
```

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= 0.050000	M= 0.000	843000.	0.0500000	1120019.	28386.3068
4	y= 0.100000	M= 0.000	843000.	0.1000000	2215441.	53660.5375
4	y= 0.200000	M= 0.000	843000.	0.2000000	3706122.	78476.9618
4	y= 0.300000	M= 0.000	843000.	0.3000000	5038004.	98373.1460
4	y= 0.400000	M= 0.000	843000.	0.4000000	6293139.	115847.
4	y= 0.500000	M= 0.000	843000.	0.5000000	7500824.	131769.
4	y= 0.750000	M= 0.000	843000.	0.7500000	1.0356E+07	167316.

```
  4  y=  1.000000 M=     0.000     843000.   1.0000000  1.3070E+07     199523.
  4  y=     1.250 M=     0.000     843000.      1.2500  1.5685E+07     230112.
  4  y=     2.000 M=     0.000     843000.      2.0000  2.3159E+07     309376.


--------------------------------------------------------------------------------
                     Pile-head Deflection vs. Pile Length
--------------------------------------------------------------------------------

Boundary Condition Type 4, Deflection and Moment

Deflection =         0.05000  in
Moment     =              0. in-lbs
Axial Load =         843000. lbs


   Pile       Pile Head       Maximum      Maximum
  Length      Deflection      Moment        Shear
    in           in           in-lbs         lbs
-----------  ------------  ------------  ------------
   912.000    0.05000000      1120019.   28386.30682
   866.400    0.05000000      1120882.   28387.57633
   820.800    0.05000000      1121126.   28388.78097
   775.200    0.05000000      1121111.   28389.92070
   729.600    0.05000000      1121124.   28390.99550
   684.000    0.05000000      1121162.   28392.00533
   638.400    0.05000000      1120939.   28392.94847
   592.800    0.05000000      1121106.   28393.81512
   547.200    0.05000000      1120828.   28394.60369
   501.600    0.05000000      1120955.   28395.34159


This analysis ended normally.
```

```
================================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.41)

              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:

Geotech SJ
URS

Path to file locations:      X:\Route 84 - Isabel
Avenue\geotech\Analysis\pile\lateral\Arroyo Del Valle Widening\20141024\
Name of input data file:     Arroyo Del Valle Widening_Bent 2_ Fixed_scour.lpd
Name of output file:         Arroyo Del Valle Widening_Bent 2_ Fixed_scour.lpo
Name of plot output file:    Arroyo Del Valle Widening_Bent 2_ Fixed_scour.lpp
Name of runtime file:        Arroyo Del Valle Widening_Bent 2_ Fixed_scour.lpr


--------------------------------------------------------------------------------
                         Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  December 11, 2014     Time:  15:44:13


--------------------------------------------------------------------------------
                                Problem Title
--------------------------------------------------------------------------------

SR84 Isabel Bent 2- ADV Widen-36 inch CIDH pile-scour 0.2ft


--------------------------------------------------------------------------------
                                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           =          152
- 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                                =     912.00 in

Depth of ground surface below top of pile =     -45.00 in

Slope angle of ground surface              =       0.00 deg.

Structural properties of pile defined using  2 points

Point    Depth         Pile      Moment of       Pile      Modulus of
           X         Diameter     Inertia       Area      Elasticity
           in           in         in**4       Sq.in      lbs/Sq.in
-----  ---------   -----------   ----------   ----------   -----------
  1       0.0000   36.00000000   82448.0000    1018.0000      3600000.
  2     912.0000   36.00000000   82448.0000    1018.0000      3600000.


--------------------------------------------------------------------------------
                      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    =      -45.000 in
Distance from top of pile to bottom of layer =      660.000 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  2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      660.000 in
Distance from top of pile to bottom of layer =      720.000 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  3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      720.000 in
Distance from top of pile to bottom of layer =      912.000 in
p-y subgrade modulus k for top of soil layer =      175.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      175.000 lbs/in**3

Layer  4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      912.000 in
Distance from top of pile to bottom of layer =     1504.000 in
p-y subgrade modulus k for top of soil layer =      200.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      200.000 lbs/in**3


(Depth of lowest layer extends  592.00 in below pile tip)


--------------------------------------------------------------------------------
                  Effective Unit Weight of Soil vs. Depth
--------------------------------------------------------------------------------

Effective unit weight of soil with depth defined using  8 points

Point        Depth X    Eff. Unit Weight
 No.           in          lbs/in**3
-----      ----------   ---------------
  1          -45.00        0.04490
  2          660.00        0.04490
  3          660.00        0.02750
  4          720.00        0.02750
  5          720.00        0.04490
  6          912.00        0.04490
  7          912.00        0.04780
  8         1504.00        0.04780
```

Shear Strength of Soils

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	-45.000	0.00000	38.00	------	------
2	660.000	0.00000	38.00	------	------
3	660.000	0.00000	32.00	------	------
4	720.000	0.00000	32.00	------	------
5	720.000	0.00000	40.00	------	------
6	912.000	0.00000	40.00	------	------
7	912.000	0.00000	42.00	------	------
8	1504.000	0.00000	42.00	------	------

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.

Loading Type

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 = 0.050 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 843000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 0.100 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 843000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 0.200 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 843000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 0.300 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 843000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 0.400 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 843000.000 lbs

Load Case Number 6

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 0.500 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 843000.000 lbs

Load Case Number 7

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 0.750 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 843000.000 lbs

Load Case Number 8

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 1.000 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 843000.000 lbs

Load Case Number 9

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 1.250 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 843000.000 lbs

Load Case Number 10

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 2.000 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 843000.000 lbs

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 = 0.100000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 843000.000 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	Es*h F/L lbs/in
0.000	0.100000	-6063975.	105677.	0.0000	2151.9778	-523.9349	15718.0469
6.000	0.099632	-5440242.	-98.0219	-0.0001163	2015.8048	-591.0929	35596.4758
12.000	0.098605	-4837232.	98396.0937	-0.0002202	1884.1561	-653.7102	39777.6423
18.000	0.096990	-4257262.	94300.1500	-0.0003121	1757.5373	-711.6043	44021.1275
24.000	0.094860	-3702474.	89888.0106	-0.0003925	1636.4162	-759.1088	48014.6010
30.000	0.092280	-3174635.	85208.5812	-0.0004620	1521.1788	-800.7010	52061.1670
36.000	0.089315	-2675297.	80295.2003	-0.0005212	1412.1635	-837.0926	56234.0077
42.000	0.086026	-2205820.	75199.9442	-0.0005705	1309.6677	-861.3261	60074.3314
48.000	0.082469	-1767126.	69997.2149	-0.0006107	1213.8923	-872.9170	63508.5446
54.000	0.078698	-1359676.	64765.3630	-0.0006423	1124.9381	-871.0336	66408.1979
60.000	0.074762	-983445.	59589.5001	-0.0006659	1042.7994	-854.2540	68557.7780
66.000	0.070707	-637866.	54523.8615	-0.0006823	967.3528	-834.2921	70795.9131
72.000	0.066574	-322256.	49580.0353	-0.0006920	898.4490	-813.6499	73330.2765
78.000	0.062402	-35904.5834	44795.5046	-0.0006957	835.9330	-781.1937	75111.9182
84.000	0.058226	222327.	40239.7268	-0.0006938	876.6327	-737.3989	75986.2244
90.000	0.054077	453990.	35978.0985	-0.0006869	927.2092	-683.1438	75796.6326
96.000	0.049983	661014.	32069.4326	-0.0006757	972.4064	-619.7448	74394.6304
102.000	0.045969	845659.	28457.2566	-0.0006604	1012.7180	-584.3139	76266.0560
108.000	0.042058	1009182.	24966.2185	-0.0006417	1048.4183	-579.3655	82652.7994
114.000	0.038269	1151745.	21517.8493	-0.0006198	1079.5425	-570.0909	89382.0174

120.000	0.034620	1273666.	18137.8242	-0.0005953	1106.1604	-556.5841	96462.8583
126.000	0.031125	1375421.	14851.0672	-0.0005686	1128.3754	-539.0016	103905.
132.000	0.027797	1457631.	11681.3759	-0.0005399	1146.3234	-517.5622	111717.
138.000	0.024646	1521059.	8622.6459	-0.0005098	1160.1711	-502.0145	122215.
144.000	0.021679	1566260.	5638.5918	-0.0004786	1170.0392	-492.6702	136354.
150.000	0.018902	1593564.	2720.2940	-0.0004467	1176.0003	-480.0958	152392.
156.000	0.016319	1603422.	-112.8452	-0.0004144	1178.1524	-464.2840	170703.
162.000	0.013930	1596401.	-2803.2799	-0.0003820	1176.6198	-432.5276	186300.
168.000	0.011735	1573647.	-5225.6360	-0.0003500	1171.6520	-374.9245	191700.
174.000	0.009730	1537234.	-7309.3288	-0.0003185	1163.7024	-319.6398	197100.
180.000	0.007912	1489157.	-9069.3672	-0.0002879	1153.2063	-267.0397	202500.
186.000	0.006275	1431315.	-10522.7633	-0.0002584	1140.5781	-217.4257	207900.
192.000	0.004811	1365498.	-11688.1480	-0.0002302	1126.2091	-171.0359	213300.
198.000	0.003513	1293385.	-12585.4001	-0.0002033	1110.4654	-128.0482	218700.
204.000	0.002372	1216530.	-13235.2934	-0.0001779	1093.6865	-88.5829	224100.
210.000	0.001378	1136362.	-13659.1639	-0.0001541	1076.1841	-52.7072	229500.
216.000	0.000522	1054179.	-13878.6021	-0.0001320	1058.2421	-20.4388	234900.
222.000	-0.000206	971154.	-13915.1700	-0.0001115	1040.1160	8.2495	240300.
228.000	-0.000816	888326.	-13790.1471	-9.2730E-05	1022.0330	33.4248	245700.
234.000	-0.001319	806610.	-13524.3045	-7.5599E-05	1004.1929	55.1894	251100.
240.000	-0.001723	726799.	-13137.7074	-6.0100E-05	986.7686	73.6763	256500.
246.000	-0.002040	649565.	-12649.5476	-4.6189E-05	969.9070	89.0437	261900.
252.000	-0.002278	575471.	-12078.0038	-3.3807E-05	953.7309	101.4710	267300.
258.000	-0.002446	504971.	-11440.1294	-2.2886E-05	938.3394	111.1538	272700.
264.000	-0.002552	438421.	-10751.7672	-1.3351E-05	923.8102	118.3002	278100.
270.000	-0.002606	376085.	-10027.4881	-5.1187E-06	910.2010	123.1261	283500.
276.000	-0.002614	318143.	-9280.5539	1.8982E-06	897.5511	125.8520	288900.
282.000	-0.002583	264699.	-8522.8998	7.7892E-06	885.8833	126.6994	294300.
288.000	-0.002520	215790.	-7765.1379	1.2646E-05	875.2054	125.8879	299700.
294.000	-0.002431	171390.	-7016.5766	1.6559E-05	865.5120	123.6325	305100.
300.000	-0.002322	131423.	-6285.2553	1.9620E-05	856.7865	120.1413	310500.
306.000	-0.002196	95768.2106	-5577.9919	2.1916E-05	849.0024	115.6132	315900.
312.000	-0.002059	64265.5495	-4900.4417	2.3533E-05	842.1247	110.2369	321300.
318.000	-0.001913	36724.8454	-4257.1641	2.4554E-05	836.1120	104.1890	326700.
324.000	-0.001764	12931.1902	-3651.6969	2.5056E-05	830.9174	97.6334	332100.
330.000	-0.001613	-7348.9848	-3086.6355	2.5113E-05	829.6987	90.7204	337500.
336.000	-0.001463	-24362.4749	-2563.7156	2.4792E-05	833.4131	83.5863	342900.
342.000	-0.001315	-38364.3680	-2083.8969	2.4158E-05	836.4700	76.3533	348300.
348.000	-0.001173	-49613.6199	-1647.4484	2.3269E-05	838.9259	69.1295	353700.
354.000	-0.001036	-58369.1360	-1254.0323	2.2177E-05	840.8374	62.0092	359100.
360.000	-0.000907	-64886.3534	-902.7856	2.0932E-05	842.2603	55.0730	364500.
366.000	-0.000785	-69414.3070	-592.3997	1.9574E-05	843.2488	48.3889	369900.
372.000	-0.000672	-72193.1617	-321.1955	1.8143E-05	843.8555	42.0125	375300.
378.000	-0.000567	-73452.1860	-87.1948	1.6671E-05	844.1303	35.9878	380700.
384.000	-0.000472	-73408.1408	111.8133	1.5186E-05	844.1207	30.3483	386100.
390.000	-0.000385	-72264.0519	278.2113	1.3714E-05	843.8709	25.1177	391500.
396.000	-0.000307	-70208.3362	414.4974	1.2274E-05	843.4221	20.3110	396900.
402.000	-0.000238	-67414.2472	523.2351	1.0883E-05	842.8121	15.9349	402300.
408.000	-0.000176	-64039.6074	607.0088	9.5544E-06	842.0754	11.9896	407700.
414.000	-0.000123	-60226.7932	668.3844	8.2984E-06	841.2430	8.4689	413100.
420.000	-7.69E-05	-56102.9403	709.8757	7.1226E-06	840.3427	5.3615	418500.
426.000	-3.75E-05	-51780.3371	733.9156	6.0322E-06	839.3990	2.6518	423900.
432.000	-4.48E-06	-47356.9747	742.8329	5.0301E-06	838.4333	0.3206548	429300.
438.000	2.28E-05	-42917.2267	738.8334	4.1177E-06	837.4640	-1.6538	434700.
444.000	4.49E-05	-38532.6289	723.9848	3.2945E-06	836.5067	-3.2957	440100.
450.000	6.24E-05	-34262.7357	700.2069	2.5587E-06	835.5745	-4.6303	445500.
456.000	7.56E-05	-30156.0298	669.2641	1.9076E-06	834.6779	-5.6840	450900.
462.000	8.53E-05	-26250.8638	632.7619	1.3375E-06	833.8254	-6.4834	456300.
468.000	9.17E-05	-22576.4161	592.1464	8.4394E-07	833.0232	-7.0551	461700.
474.000	9.54E-05	-19153.6448	548.7052	4.2216E-07	832.2759	-7.4253	467100.
480.000	9.68E-05	-15996.2245	503.5721	6.6885E-08	831.5866	-7.6191	472500.
486.000	9.62E-05	-13111.4563	457.7322	-2.2732E-07	830.9568	-7.6609	477900.
492.000	9.40E-05	-10501.1390	412.0290	-4.6598E-07	830.3869	-7.5735	483300.
498.000	9.06E-05	-8162.3950	367.1727	-6.5462E-07	829.8763	-7.3786	488700.
504.000	8.62E-05	-6088.4443	323.7494	-7.9866E-07	829.4235	-7.0959	494100.
510.000	8.10E-05	-4269.3225	282.2305	-9.0335E-07	829.0264	-6.7438	499500.
516.000	7.53E-05	-2692.5395	242.9829	-9.7371E-07	828.6821	-6.3388	504900.
522.000	6.93E-05	-1343.6772	206.2792	-1.0145E-06	828.3877	-5.8958	510300.
528.000	6.32E-05	-206.9261	172.3078	-1.0302E-06	828.1395	-5.4280	515700.
534.000	5.70E-05	734.4380	141.1831	-1.0248E-06	828.2546	-4.9469	521100.
540.000	5.09E-05	1497.6380	112.9548	-1.0023E-06	828.4213	-4.4625	526500.
546.000	4.49E-05	2100.0344	87.6176	-9.6593E-07	828.5528	-3.9832	531900.
552.000	3.93E-05	2558.8204	65.1198	-9.1884E-07	828.6529	-3.5161	537300.
558.000	3.39E-05	2890.7665	45.3712	-8.6376E-07	828.7254	-3.0668	542700.
564.000	2.89E-05	3112.0127	28.2512	-8.0308E-07	828.7737	-2.6399	548100.
570.000	2.43E-05	3237.9047	13.6151	-7.3890E-07	828.8012	-2.2388	553500.
576.000	2.00E-05	3282.8687	1.3008	-6.7299E-07	828.8110	-1.8660	558900.
582.000	1.62E-05	3260.3225	-8.8659	-6.0686E-07	828.8061	-1.5229	564300.
588.000	1.27E-05	3182.6168	-17.0664	-5.4174E-07	828.7891	-1.2106	569700.
594.000	9.69E-06	3061.0054	-23.4851	-4.7863E-07	828.7626	-0.9289842	575100.
600.000	7.01E-06	2905.6377	-28.3055	-4.1832E-07	828.7287	-0.6778211	580500.
606.000	4.67E-06	2725.5713	-31.7077	-3.6141E-07	828.6893	-0.4562367	585900.
612.000	2.67E-06	2528.8016	-33.8655	-3.0830E-07	828.6464	-0.2630304	591300.
618.000	9.73E-07	2322.3044	-34.9447	-2.5927E-07	828.6013	-0.0967212	596700.
624.000	-4.42E-07	2112.0877	-35.1018	-2.1445E-07	828.5554	0.0443762	602100.
630.000	-1.60E-06	1903.2526	-34.4824	-1.7386E-07	828.5098	0.1620827	607500.
636.000	-2.53E-06	1700.0579	-33.2213	-1.3744E-07	828.4655	0.2582941	612900.
642.000	-3.25E-06	1505.9879	-31.4416	-1.0504E-07	828.4231	0.3349269	618300.
648.000	-3.79E-06	1323.8213	-29.2552	-7.6437E-08	828.3833	0.3938710	623700.
654.000	-4.17E-06	1155.6988	-26.7627	-5.1375E-08	828.3466	0.4369499	629100.
660.000	-4.41E-06	1003.1882	-24.7052	-2.9555E-08	828.3133	0.2488813	338956.
666.000	-4.52E-06	859.5349	-23.1873	-1.0727E-08	828.2820	0.2570901	341116.
672.000	-4.53E-06	725.0488	-21.6378	5.2885E-09	828.2526	0.2594182	343276.
678.000	-4.46E-06	599.8277	-20.0895	1.8680E-08	828.2253	0.2566922	345436.
684.000	-4.31E-06	483.7862	-18.5703	2.9632E-08	828.1999	0.2496970	347596.
690.000	-4.10E-06	376.6843	-17.1037	3.8329E-08	828.1765	0.2391744	349756.
696.000	-3.85E-06	278.1542	-15.7087	4.4948E-08	828.1550	0.2258230	351916.
702.000	-3.56E-06	187.7253	-14.4003	4.9657E-08	828.1353	0.2102986	354076.
708.000	-3.25E-06	104.8479	-13.1898	5.2614E-08	828.1172	0.1932161	356236.
714.000	-2.93E-06	28.9156	-12.0847	5.3966E-08	828.1006	0.1751512	358396.
720.000	-2.61E-06	-40.7143	-10.2996	5.3847E-08	828.1032	0.4198629	966424.
726.000	-2.29E-06	-95.2249	-7.9282	5.2473E-08	828.1151	0.3706223	972724.
732.000	-1.98E-06	-136.3833	-5.8485	5.0132E-08	828.1241	0.3225931	979024.
738.000	-1.68E-06	-165.9145	-4.0509	4.7076E-08	828.1305	0.2766313	985324.
744.000	-1.41E-06	-185.4700	-2.5208	4.3525E-08	828.1348	0.2333811	991624.
750.000	-1.16E-06	-196.6048	-1.2408	3.9663E-08	828.1372	0.1933003	997924.
756.000	-9.36E-07	-200.7607	-0.1908297	3.5647E-08	828.1381	0.1566858	1004224.
762.000	-7.34E-07	-199.2553	0.6503204	3.1603E-08	828.1378	0.1236976	1010524.
768.000	-5.57E-07	-193.2765	1.3046	2.7636E-08	828.1365	0.0943815	1016824.
774.000	-4.03E-07	-183.8802	1.7938	2.3824E-08	828.1344	0.0686900	1023124.
780.000	-2.71E-07	-171.9923	2.1393	2.0227E-08	828.1319	0.0465013	1029424.
786.000	-1.60E-07	-158.4127	2.3618	1.6887E-08	828.1289	0.0276368	1035724.
792.000	-6.84E-08	-143.8220	2.4803	1.3833E-08	828.1257	0.0118763	1042024.
798.000	5.89E-09	-128.7890	2.5128	1.1077E-08	828.1224	-0.0010291	1048324.
804.000	6.45E-08	-113.7799	2.4757	8.6255E-09	828.1191	-0.0113447	1054624.
810.000	1.09E-07	-99.1676	2.3837	6.4732E-09	828.1160	-0.0193434	1060924.
816.000	1.42E-07	-85.2416	2.2497	4.6093E-09	828.1129	-0.0252969	1067224.
822.000	1.65E-07	-72.2174	2.0854	3.0178E-09	828.1101	-0.0294695	1073524.
828.000	1.78E-07	-60.2469	1.9007	1.6789E-09	828.1075	-0.0321129	1079824.
834.000	1.85E-07	-49.4262	1.7040	5.7039E-10	828.1051	-0.0334623	1086124.
840.000	1.85E-07	-39.8051	1.5024	-3.3150E-10	828.1030	-0.0337338	1092424.
846.000	1.81E-07	-31.3943	1.3018	-1.0511E-09	828.1012	-0.0331221	1098724.
852.000	1.73E-07	-24.1728	1.1070	-1.6128E-09	828.0996	-0.0317998	1105024.
858.000	1.62E-07	-18.0935	0.9218899	-2.0400E-09	828.0983	-0.0299173	1111324.
864.000	1.48E-07	-13.0894	0.7493304	-2.3552E-09	828.0972	-0.0276026	1117624.
870.000	1.33E-07	-9.0777	0.5916354	-2.5792E-09	828.0963	-0.0249624	1123924.
876.000	1.17E-07	-5.9637	0.4504974	-2.7312E-09	828.0956	-0.0220836	1130224.
882.000	1.00E-07	-3.6441	0.3271446	-2.8283E-09	828.0951	-0.0190340	1136524.
888.000	8.33E-08	-2.0094	0.2224470	-2.8855E-09	828.0947	-0.0158652	1142824.
894.000	6.59E-08	-0.9455733	0.1370110	-2.9154E-09	828.0945	-0.0126135	1149124.
900.000	4.83E-08	-0.3357558	0.0712612	-2.9283E-09	828.0944	-0.0093031	1155424.
906.000	3.07E-08	-0.0608166	0.0255077	-2.9323E-09	828.0943	-0.0059480	1161724.
912.000	1.31E-08	0.0000	0.0000	-2.9329E-09	828.0943	-0.0025545	584012.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	0.10000000 in
Computed slope at pile head	=	-0.00000630
Maximum bending moment	=	-6063975. lbs-in
Maximum shear force	=	105677.06002 lbs
Depth of maximum bending moment	=	0.00000 in
Depth of maximum shear force	=	0.00000 in
Number of iterations	=	6

Number of zero deflection points = 5

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 = 0.500000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 843000.000 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	Es*h F/L lbs/in
0.000	0.500000	-2.1195E+07	283728.	0.0000	5455.4615	-851.5537	5109.3222
6.000	0.498715	-1.9509E+07	-346.8259	-0.0004114	5087.3684	-967.9103	11644.8599
12.000	0.495063	-1.7856E+07	271776.	-0.0007891	4726.4470	-1080.3596	13093.6026
18.000	0.489246	-1.6240E+07	264968.	-0.0011337	4373.6181	-1189.0343	14582.0545
24.000	0.481458	-1.4665E+07	257546.	-0.0014461	4029.7719	-1284.7690	16010.9641
30.000	0.471893	-1.3135E+07	249576.	-0.0017271	3695.6960	-1371.8794	17443.1141
36.000	0.460734	-1.1653E+07	241109.	-0.0019776	3372.1092	-1450.5136	18889.6154
42.000	0.448161	-1.0222E+07	232222.	-0.0021987	3059.6625	-1511.9822	20242.4702
48.000	0.434349	-8843816.	222992.	-0.0023914	2758.8712	-1564.7502	21615.0944
54.000	0.419465	-7521485.	213469.	-0.0025568	2470.1805	-1609.3495	23020.0519
60.000	0.403668	-6256321.	203739.	-0.0026961	2193.9707	-1633.8926	24285.7114
66.000	0.387112	-5049337.	193857.	-0.0028103	1930.4628	-1660.3518	25734.4523
72.000	0.369944	-3901610.	183798.	-0.0029008	1679.8916	-1692.4644	27449.5530
78.000	0.352302	-2814413.	173601.	-0.0029687	1442.5354	-1706.4873	29062.9033
84.000	0.334319	-1788362.	163379.	-0.0030152	1218.5284	-1700.9488	30526.7771
90.000	0.316120	-823361.	153252.	-0.0030416	1007.8501	-1674.6260	31784.6618
96.000	0.297820	81436.3201	143349.	-0.0030491	845.8734	-1626.6335	32770.7959
102.000	0.279530	927667.	133631.	-0.0030389	1030.6220	-1612.6159	34614.1111
108.000	0.261353	1715749.	123866.	-0.0030122	1202.6756	-1642.2035	37700.7863
114.000	0.243384	2444536.	113954.	-0.0029701	1361.7839	-1662.0905	40974.5022
120.000	0.225712	3113237.	103952.	-0.0029140	1507.7745	-1671.8240	44441.4340
126.000	0.208417	3721435.	93923.1620	-0.0028449	1640.5559	-1671.0599	48107.3103
132.000	0.191573	4269094.	83931.2613	-0.0027641	1760.1205	-1659.5737	51977.2922
138.000	0.175247	4756572.	73989.2692	-0.0026729	1866.5464	-1654.4237	56643.1173
144.000	0.159498	5184004.	64053.1343	-0.0025724	1959.8631	-1657.6213	62356.3674
150.000	0.144378	5551232.	54122.7307	-0.0024639	2040.0361	-1652.5132	68674.4259
156.000	0.129931	5858402.	44248.3797	-0.0023486	2107.0973	-1638.9371	75683.3056
162.000	0.116195	6105971.	34481.2267	-0.0022277	2161.1464	-1616.7806	83486.3055
168.000	0.103199	6294712.	24872.9472	-0.0021023	2202.3522	-1585.9792	92208.8083
174.000	0.090967	6425714.	15475.4716	-0.0019738	2230.9524	-1546.5126	102005.
180.000	0.079514	6500384.	6340.7392	-0.0018431	2247.2544	-1498.3982	113067.
186.000	0.068850	6520447.	-2479.5040	-0.0017115	2251.6346	-1441.6828	125637.
192.000	0.058976	6487944.	-10933.8390	-0.0015800	2244.5384	-1376.4288	140033.
198.000	0.049889	6405225.	-18971.2095	-0.0014497	2226.4793	-1302.6947	156670.
204.000	0.041580	6274954.	-26540.8078	-0.0013215	2198.0387	-1220.5048	176121.
210.000	0.034031	6100104.	-33591.7310	-0.0011965	2159.8655	-1129.8030	199196.
216.000	0.027222	5883957.	-40072.2682	-0.0010753	2112.6764	-1030.3761	227105.
222.000	0.021127	5630115.	-45701.7926	-0.0009590	2057.2577	-846.1321	240300.
228.000	0.015715	5345236.	-50170.7250	-0.0008480	1995.0632	-643.5121	245700.
234.000	0.010951	5036645.	-53476.1070	-0.0007431	1927.6917	-458.2819	251100.
240.000	0.006797	4711040.	-55722.7289	-0.0006446	1856.6059	-290.5920	256500.
246.000	0.003216	4374492.	-57015.6089	-0.0005527	1783.1310	-140.3680	261900.
252.000	0.000165	4032444.	-57458.7146	-0.0004678	1708.4552	-7.3339	267300.
258.000	-0.002397	3689720.	-57153.8275	-0.0003897	1633.6318	108.9630	272700.
264.000	-0.004512	3350541.	-56199.5514	-0.0003186	1559.5824	209.1290	278100.
270.000	-0.006220	3018548.	-54690.4653	-0.0002542	1487.1019	293.8997	283500.
276.000	-0.007562	2696826.	-52716.4168	-0.0001964	1416.8639	364.1165	288900.
282.000	-0.008577	2387938.	-50361.9522	-0.0001450	1349.4275	420.7050	294300.
288.000	-0.009302	2093950.	-47705.8768	-9.9720E-05	1285.2443	464.6534	299700.
294.000	-0.009774	1816476.	-44820.9378	-6.0196E-05	1224.6663	496.9929	305100.
300.000	-0.010025	1556708.	-41773.6211	-2.6102E-05	1167.9538	518.7793	310500.
306.000	-0.010087	1315456.	-38624.0529	2.9282E-06	1115.2840	531.0767	315900.
312.000	-0.009990	1093189.	-35425.9963	2.7273E-05	1066.7588	534.9422	321300.
318.000	-0.009760	890069.	-32226.9315	4.7319E-05	1022.4136	531.4128	326700.
324.000	-0.009422	705988.	-29068.2104	6.3451E-05	982.2251	521.4942	332100.
330.000	-0.008998	540608.	-25985.2752	7.6051E-05	946.1196	506.1509	337500.
336.000	-0.008509	393395.	-23007.9291	8.5491E-05	913.9801	486.2979	342900.
342.000	-0.007972	263648.	-20160.6515	9.2132E-05	885.6538	462.7947	348300.
348.000	-0.007404	150535.	-17462.9469	9.6318E-05	860.9590	436.4402	353700.
354.000	-0.006817	53118.4403	-14929.7189	9.8377E-05	839.6911	407.9691	359100.
360.000	-0.006223	-29616.7334	-12571.6614	9.8614E-05	834.5602	378.0500	364500.
366.000	-0.005633	-98739.0779	-10395.6590	9.7317E-05	849.6510	347.2841	369900.
372.000	-0.005055	-155349.	-8405.1903	9.4749E-05	862.0100	316.2055	375300.
378.000	-0.004496	-200560.	-6600.7274	9.1151E-05	871.8804	285.2821	380700.
384.000	-0.003961	-235480.	-4980.1275	8.6744E-05	879.5041	254.9178	386100.
390.000	-0.003455	-261199.	-3539.0104	8.1724E-05	885.1191	225.4546	391500.
396.000	-0.002981	-278775.	-2271.1191	7.6266E-05	888.9562	197.1758	396900.
402.000	-0.002540	-289224.	-1168.6612	7.0525E-05	891.2375	170.3101	402300.
408.000	-0.002134	-293512.	-222.6263	6.4635E-05	892.1737	145.0348	407700.
414.000	-0.001764	-292549.	576.9194	5.8712E-05	891.9635	121.4804	413100.
420.000	-0.001430	-287183.	1240.5657	5.2852E-05	890.7919	99.7350	418500.
426.000	-0.001130	-278197.	1779.3153	4.7138E-05	888.8301	79.8482	423900.
432.000	-0.000864	-266308.	2204.3688	4.1634E-05	886.2345	61.8363	429300.
438.000	-0.000631	-252166.	2526.9349	3.6394E-05	883.1470	45.6858	434700.
444.000	-0.000428	-236353.	2758.0663	3.1456E-05	879.6948	31.3581	440100.
450.000	-0.000253	-219387.	2908.5205	2.6850E-05	875.9908	18.7933	445500.
456.000	-0.000105	-201722.	2988.6436	2.2594E-05	872.1342	7.9144	450900.
462.000	1.80E-05	-183752.	3008.2770	1.8697E-05	868.2109	-1.3699	456300.
468.000	0.000119	-165812.	2976.6834	1.5164E-05	864.2943	-9.1612	461700.
474.000	0.000200	-148185.	2902.4934	1.1991E-05	860.4460	-15.5688	467100.
480.000	0.000263	-131104.	2793.6672	9.1677E-06	856.7168	-20.7066	472500.
486.000	0.000310	-114754.	2657.4739	6.6827E-06	853.1473	-24.6912	477900.
492.000	0.000343	-99281.5050	2500.4822	4.5193E-06	849.7694	-27.6394	483300.
498.000	0.000364	-84793.9036	2328.5649	2.6588E-06	846.6065	-29.6664	488700.
504.000	0.000375	-71365.6225	2146.9124	1.0805E-06	843.6748	-30.8845	494100.
510.000	0.000377	-59041.8849	1960.0549	-2.3762E-07	840.9843	-31.4014	499500.
516.000	0.000372	-47842.5600	1771.8920	-1.3179E-06	838.5393	-31.3196	504900.
522.000	0.000361	-37765.8480	1585.7276	-2.1832E-06	836.3393	-30.7352	510300.
528.000	0.000346	-28791.7430	1404.3087	-2.8559E-06	834.3801	-29.7377	515700.
534.000	0.000327	-20885.2528	1229.8677	-3.3580E-06	832.6540	-28.4093	521100.
540.000	0.000306	-13999.3601	1064.1665	-3.7106E-06	831.1506	-26.8245	526500.
546.000	0.000283	-8077.7178	908.5410	-3.9338E-06	829.8578	-25.0507	531900.
552.000	0.000258	-3057.0735	763.9465	-4.0463E-06	828.7617	-23.1475	537300.
558.000	0.000234	1130.5734	631.0018	-4.0658E-06	828.3411	-21.1674	542700.
564.000	0.000210	4556.0773	510.0319	-4.0083E-06	829.0890	-19.1558	548100.
570.000	0.000186	7291.5048	401.1100	-3.8886E-06	829.6862	-17.1515	553500.
576.000	0.000163	9408.7342	304.0956	-3.7198E-06	830.1484	-15.1867	558900.
582.000	0.000141	10978.2818	218.6717	-3.5137E-06	830.4911	-13.2880	564300.
588.000	0.000121	12068.3395	144.3780	-3.2808E-06	830.7291	-11.4766	569700.
594.000	0.000102	12744.0058	80.6419	-3.0300E-06	830.8766	-9.7688	575100.
600.000	8.45E-05	13066.6941	26.8066	-2.7691E-06	830.9470	-8.1763	580500.
606.000	6.87E-05	13093.6979	-17.8445	-2.5047E-06	830.9529	-6.7074	585900.
612.000	5.45E-05	12877.8979	-54.0658	-2.2422E-06	830.9058	-5.3664	591300.
618.000	4.18E-05	12467.5904	-82.6305	-1.9860E-06	830.8162	-4.1552	596700.
624.000	3.06E-05	11906.4221	-104.3146	-1.7397E-06	830.6937	-3.0729	602100.
630.000	2.09E-05	11233.4132	-119.8833	-1.5058E-06	830.5468	-2.1167	607500.
636.000	1.26E-05	10483.0547	-130.0800	-1.2863E-06	830.3830	-1.2822	612900.
642.000	5.47E-06	9685.4649	-135.6178	-1.0824E-06	830.2088	-0.5637130	618300.
648.000	-4.37E-07	8866.5911	-137.1727	-8.9491E-07	830.0301	0.0454161	623700.
654.000	-5.27E-06	8048.4457	-135.3792	-7.2395E-07	829.8514	0.5524208	629100.
660.000	-9.12E-06	7249.3646	-132.1755	-5.6933E-07	829.6770	0.5154544	338956.
666.000	-1.21E-05	6468.0986	-128.5653	-4.3068E-07	829.5064	0.6879512	341116.
672.000	-1.43E-05	5710.9375	-124.0483	-3.0758E-07	829.3411	0.8177072	343276.
678.000	-1.58E-05	4982.6299	-118.8677	-1.9950E-07	829.1821	0.9091623	345436.
684.000	-1.67E-05	4286.5427	-113.2402	-1.0581E-07	829.0301	0.9666860	347596.
690.000	-1.71E-05	3624.8179	-107.3565	-2.5846E-08	828.8857	0.9945471	349756.
696.000	-1.70E-05	2998.5262	-101.3822	4.1099E-08	828.7489	0.9968915	351916.
702.000	-1.66E-05	2407.8160	-95.4583	9.5742E-08	828.6200	0.9777272	354076.
708.000	-1.58E-05	1852.0578	-89.7024	1.3880E-07	828.4986	0.9409151	356236.
714.000	-1.49E-05	1329.9832	-84.2092	1.7096E-07	828.3847	0.8901664	358396.
720.000	-1.38E-05	839.8186	-74.8722	1.9289E-07	828.2777	2.2221	966424.
726.000	-1.26E-05	429.5652	-62.0836	2.0572E-07	828.1881	2.0407	972724.
732.000	-1.13E-05	92.7346	-50.4165	2.1100E-07	828.1145	1.8483	979024.
738.000	-1.01E-05	-177.5667	-39.9174	2.1014E-07	828.1331	1.6514	985324.
744.000	-8.81E-06	-388.4006	-30.5974	2.0442E-07	828.1791	1.4553	991624.
750.000	-7.60E-06	-546.8032	-22.4380	1.9497E-07	828.2137	1.2645	997924.
756.000	-6.47E-06	-659.6284	-15.3978	1.8278E-07	828.2383	1.0822	1004224.
762.000	-5.41E-06	-733.4261	-9.4180	1.6870E-07	828.2544	0.9110518	1010524.
768.000	-4.44E-06	-774.3509	-4.4266	1.5346E-07	828.2634	0.7527346	1016824.

774.000	-3.57E-06	-788.0980	-0.3432260	1.3766E-07	828.2664	0.6084005	1023124.
780.000	-2.79E-06	-779.8622	2.9179	1.2182E-07	828.2646	0.4786315	1029424.
786.000	-2.11E-06	-754.3159	5.4444	1.0631E-07	828.2590	0.3635562	1035724.
792.000	-1.51E-06	-715.6044	7.3239	9.1453E-08	828.2505	0.2629344	1042024.
798.000	-1.01E-06	-667.3542	8.6414	7.7475E-08	828.2400	0.1762339	1048324.
804.000	-5.84E-07	-612.6912	9.4782	6.4537E-08	828.2281	0.1026996	1054624.
810.000	-2.34E-07	-554.2685	9.9106	5.2742E-08	828.2153	0.0414140	1060924.
816.000	4.86E-08	-494.2982	10.0088	4.2144E-08	828.2022	-0.0086490	1067224.
822.000	2.72E-07	-434.5887	9.8372	3.2755E-08	828.1892	-0.0485793	1073524.
828.000	4.42E-07	-376.5836	9.4529	2.4557E-08	828.1765	-0.0794913	1079824.
834.000	5.66E-07	-321.4017	8.9070	1.7502E-08	828.1645	-0.1024925	1086124.
840.000	6.52E-07	-269.8767	8.2435	1.1526E-08	828.1532	-0.1186576	1092424.
846.000	7.04E-07	-222.5957	7.5006	6.5479E-09	828.1429	-0.1290082	1098724.
852.000	7.30E-07	-179.9363	6.7100	2.4794E-09	828.1336	-0.1344974	1105024.
858.000	7.34E-07	-142.1004	5.8985	-7.7559E-10	828.1253	-0.1359984	1111324.
864.000	7.21E-07	-109.1459	5.0877	-3.3150E-09	828.1181	-0.1342973	1117624.
870.000	6.94E-07	-81.0150	4.2945	-5.2371E-09	828.1120	-0.1300886	1123924.
876.000	6.58E-07	-57.5589	3.5323	-6.6377E-09	828.1069	-0.1239733	1130224.
882.000	6.15E-07	-38.5600	2.8110	-7.6092E-09	828.1027	-0.1164593	1136524.
888.000	5.67E-07	-23.7497	2.1377	-8.2390E-09	828.0995	-0.1079635	1142824.
894.000	5.16E-07	-12.8237	1.5174	-8.6086E-09	828.0971	-0.0988152	1149124.
900.000	4.64E-07	-5.4537	0.9531867	-8.7934E-09	828.0955	-0.0892606	1155424.
906.000	4.10E-07	-1.2965	0.4470018	-8.8616E-09	828.0946	-0.0794677	1161724.
912.000	3.57E-07	0.0000	0.0000	-8.8747E-09	828.0943	-0.0695328	584012.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection = 0.50000000 in
Computed slope at pile head = -0.00001704
Maximum bending moment = -21195399. lbs-in
Maximum shear force = 283728.19216 lbs
Depth of maximum bending moment = 0.00000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 8
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 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 = 843000.000 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	Es*h F/L lbs/in
0.000	1.000000	-3.7076E+07	450005.	0.0000	8922.5375	-1080.7311	3242.1934
6.000	0.997752	-3.4396E+07	-608.9834	-0.0007224	8337.4966	-1232.2152	7409.9521
12.000	0.991331	-3.1757E+07	434776.	-0.0013910	7761.3725	-1379.9199	8351.9208
18.000	0.981059	-2.9165E+07	426063.	-0.0020068	7195.3850	-1524.1439	9321.4202
24.000	0.967249	-2.6624E+07	416531.	-0.0025707	6640.7255	-1653.2723	10255.5072
30.000	0.950211	-2.4141E+07	406258.	-0.0030838	6098.4655	-1771.0159	11182.8834
36.000	0.930244	-2.1718E+07	395314.	-0.0035473	5569.5860	-1877.0017	12106.5134
42.000	0.907643	-1.9361E+07	383797.	-0.0039625	5054.9739	-1962.0776	12970.3706
48.000	0.882694	-1.7072E+07	371782.	-0.0043308	4555.3506	-2042.9328	13886.5793
54.000	0.855674	-1.4856E+07	359287.	-0.0046535	4071.4027	-2122.1068	14880.2495
60.000	0.826852	-1.2714E+07	346382.	-0.0049321	3603.8018	-2179.6094	15816.1972
66.000	0.796488	-1.0649E+07	333107.	-0.0051683	3153.0478	-2245.4344	16915.0080
72.000	0.764833	-8664413.	319396.	-0.0053635	2719.7040	-2324.8181	18237.8513
78.000	0.732127	-6762314.	305264.	-0.0055194	2304.4387	-2385.9032	19553.2034
84.000	0.698600	-4945415.	290826.	-0.0056377	1907.7745	-2426.6878	20841.8635
90.000	0.664474	-3215372.	276210.	-0.0057202	1530.0724	-2445.2290	22079.6912
96.000	0.629957	-1573028.	261555.	-0.0057686	1171.5169	-2439.6529	23236.3626
102.000	0.595250	-18350.8657	246836.	-0.0057847	832.1007	-2466.8875	24865.7195
108.000	0.560541	1447520.	231822.	-0.0057703	1144.1161	-2537.5974	27162.3090
114.000	0.526007	2821890.	216423.	-0.0057271	1444.1677	-2595.6754	29608.0665
120.000	0.491816	4102527.	200715.	-0.0056571	1723.7555	-2640.1450	32208.9647
126.000	0.458122	5287699.	184784.	-0.0055622	1982.5016	-2670.1404	34970.7180
132.000	0.425069	6376205.	168719.	-0.0054443	2220.1437	-2684.9253	37898.6721
138.000	0.392790	7367402.	152557.	-0.0053054	2436.5413	-2702.4261	41280.4930
144.000	0.361404	8260558.	136273.	-0.0051474	2631.5347	-2725.6289	45250.6512
150.000	0.331020	9054748.	119886.	-0.0049724	2804.9216	-2736.7596	49605.8772
156.000	0.301735	9749488.	103469.	-0.0047824	2956.5968	-2735.4776	54394.9840
162.000	0.273632	1.0345E+07	87097.9863	-0.0045793	3086.5550	-2721.5139	59675.3642
168.000	0.246784	1.0841E+07	70849.4280	-0.0043651	3194.8925	-2694.6722	65515.0208
174.000	0.221250	1.1239E+07	54800.9319	-0.0041420	3281.8092	-2654.8266	71995.2343
180.000	0.197080	1.1540E+07	39030.6938	-0.0039117	3347.6094	-2601.9195	79214.1300
186.000	0.174309	1.1747E+07	23617.0658	-0.0036764	3392.7022	-2535.9565	87291.5354
192.000	0.152964	1.1861E+07	8638.2003	-0.0034377	3417.6014	-2456.9987	96375.7433
198.000	0.133057	1.1885E+07	-5828.2498	-0.0031977	3422.9251	-2365.1514	106653.
204.000	0.114591	1.1824E+07	-19705.3468	-0.0029581	3409.3946	-2260.5476	118363.
210.000	0.097560	1.1679E+07	-32916.9623	-0.0027205	3377.8334	-2143.3242	131816.
216.000	0.081945	1.1456E+07	-45387.6903	-0.0024867	3329.1660	-2013.5851	147435.
222.000	0.067719	1.1159E+07	-57042.4867	-0.0022581	3264.4172	-1871.3470	165804.
228.000	0.054847	1.0794E+07	-67805.8794	-0.0020362	3184.7113	-1716.4506	187771.
234.000	0.043284	1.0366E+07	-77600.4690	-0.0018223	3091.2741	-1548.4126	214638.
240.000	0.032979	9881583.	-86344.1725	-0.0016177	2985.4358	-1366.1552	248550.
246.000	0.023872	9346604.	-93568.6973	-0.0014233	2868.6395	-1042.0197	261900.
252.000	0.015899	8773157.	-98819.6452	-0.0012402	2743.4449	-708.2963	267300.
258.000	0.008990	8173314.	-102170.	-0.0010689	2612.4875	-408.5837	272700.
264.000	0.003072	7557927.	-103823.	-0.0009099	2478.1365	-142.3827	278100.
270.000	-0.001929	6936641.	-103977.	-0.0007634	2342.4977	91.1568	283500.
276.000	-0.006089	6317927.	-102824.	-0.0006294	2207.4205	293.1881	288900.
282.000	-0.009483	5709122.	-100549.	-0.0005079	2074.5066	465.1204	294300.
288.000	-0.012184	5116478.	-97327.8219	-0.0003985	1945.1208	608.5731	299700.
294.000	-0.014264	4545219.	-93326.1078	-0.0003008	1820.4039	725.3317	305100.
300.000	-0.015793	3999608.	-88698.1940	-0.0002144	1701.2863	817.3063	310500.
306.000	-0.016837	3483010.	-83586.7974	-0.0001388	1588.5031	886.4926	315900.
312.000	-0.017459	2997970.	-78122.5111	-7.3308E-05	1482.6094	934.9362	321300.
318.000	-0.017717	2546282.	-72423.6037	-1.7270E-05	1383.9970	964.6996	326700.
324.000	-0.017666	2129062.	-66596.0042	2.9985E-05	1292.9098	977.8336	332100.
330.000	-0.017357	1746826.	-60733.4518	6.9160E-05	1209.4604	976.3506	337500.
336.000	-0.016836	1399561.	-54917.7912	0.0001010	1133.6456	962.2030	342900.
342.000	-0.016146	1086791.	-49219.3911	0.0001261	1065.3620	937.2637	348300.
348.000	-0.015323	807652.	-43697.6676	0.0001452	1004.4205	903.3108	353700.
354.000	-0.014403	560950.	-38401.6916	0.0001591	950.5606	862.0146	359100.
360.000	-0.013414	345223.	-33370.8627	0.0001682	903.4632	814.9284	364500.
366.000	-0.012384	158798.	-28635.6329	0.0001733	862.7630	763.4816	369900.
372.000	-0.011335	-158.0714	-24218.2619	0.0001749	828.1288	708.9754	375300.
378.000	-0.010285	-133591.	-20133.5920	0.0001736	857.2598	652.5812	380700.
384.000	-0.009252	-243517.	-16389.8268	0.0001698	881.2588	595.3405	386100.
390.000	-0.008248	-331986.	-12989.3046	0.0001639	900.5733	538.1669	391500.
396.000	-0.007284	-401047.	-9929.2539	0.0001565	915.6507	481.8500	396900.
402.000	-0.006369	-452721.	-7202.5234	0.0001479	926.9320	427.0602	402300.
408.000	-0.005509	-488974.	-4798.2791	0.0001384	934.8468	374.3546	407700.
414.000	-0.004709	-511700.	-2702.6624	0.0001283	939.8084	324.1843	413100.
420.000	-0.003970	-522703.	-899.4047	0.0001178	942.2106	276.9016	418500.
426.000	-0.003295	-523685.	629.6056	0.0001072	942.4249	232.7685	423900.
432.000	-0.002683	-516233.	1903.8046	9.6737E-05	940.7980	191.9645	429300.
438.000	-0.002134	-501818.	2943.4854	8.6447E-05	937.6509	154.5958	434700.
444.000	-0.001646	-481786.	3769.3819	7.6505E-05	933.2775	120.7031	440100.
450.000	-0.001216	-457359.	4402.3019	6.7013E-05	927.9447	90.2703	445500.
456.000	-0.000841	-429636.	4862.8106	5.8048E-05	921.8922	63.2326	450900.
462.000	-0.000519	-399593.	5170.9607	4.9667E-05	915.3331	39.4841	456300.
468.000	-0.000245	-368087.	5346.0679	4.1907E-05	908.4548	18.8850	461700.
474.000	-1.63E-05	-335864.	5406.5290	3.4792E-05	901.4199	1.2687	467100.
480.000	0.000172	-303561.	5369.6791	2.8329E-05	894.3675	-13.5520	472500.
486.000	0.000324	-271714.	5251.6854	2.2515E-05	887.4148	-25.7792	477900.
492.000	0.000442	-240768.	5067.4738	1.7335E-05	880.6587	-35.6247	483300.
498.000	0.000532	-211080.	4830.6847	1.2768E-05	874.1771	-43.3051	488700.
504.000	0.000595	-182929.	4553.6552	8.7856E-06	868.0313	-49.0381	494100.
510.000	0.000637	-156525.	4247.4241	5.3547E-06	862.2667	-53.0389	499500.
516.000	0.000660	-132014.	3921.7559	2.4383E-06	856.9155	-55.5171	504900.
522.000	0.000666	-109488.	3585.1819	-2.6818E-09	851.9978	-56.6742	510300.
528.000	0.000660	-88991.9049	3245.0536	-2.0088E-06	847.5230	-56.7019	515700.
534.000	0.000642	-70527.5068	2907.6077	-3.6211E-06	843.4918	-55.7801	521100.

540.000	0.000616	-54063.9814	2578.0384	-4.8804E-06	839.8975	-54.0763	526500.
546.000	0.000584	-39541.6752	2260.5764	-5.8265E-06	836.7270	-51.7444	531900.
552.000	0.000546	-26878.1240	1958.5700	-6.4979E-06	833.9623	-48.9244	537300.
558.000	0.000506	-15973.1023	1674.5701	-6.9310E-06	831.5815	-45.7423	542700.
564.000	0.000463	-6713.1690	1410.4131	-7.1603E-06	829.5599	-42.3101	548100.
570.000	0.000420	1024.2886	1167.3045	-7.2178E-06	828.3179	-38.7261	553500.
576.000	0.000377	7367.5003	945.8989	-7.1329E-06	829.7028	-35.0757	558900.
582.000	0.000334	12447.2321	746.3771	-6.9327E-06	830.8118	-31.4315	564300.
588.000	0.000293	16394.1561	568.5192	-6.6412E-06	831.6735	-27.8544	569700.
594.000	0.000255	19336.6440	411.7725	-6.2800E-06	832.3159	-24.3944	575100.
600.000	0.000218	21398.9554	275.3151	-5.8683E-06	832.7661	-21.0914	580500.
606.000	0.000184	22699.7887	158.1127	-5.4226E-06	833.0501	-17.9761	585900.
612.000	0.000153	23351.1621	58.9712	-4.9571E-06	833.1923	-15.0711	591300.
618.000	0.000125	23457.5897	-23.4168	-4.4840E-06	833.2156	-12.3916	596700.
624.000	9.91E-05	23115.5202	-90.4318	-4.0133E-06	833.1409	-9.9467	602100.
630.000	7.64E-05	22413.0058	-143.4913	-3.5531E-06	832.9875	-7.7398	607500.
636.000	5.65E-05	21429.5672	-184.0200	-3.1100E-06	832.7728	-5.7697	612900.
642.000	3.91E-05	20236.2266	-213.4241	-2.6888E-06	832.5123	-4.0316	618300.
648.000	2.42E-05	18895.6785	-233.0711	-2.2933E-06	832.2196	-2.5174	623700.
654.000	1.16E-05	17462.5727	-244.2730	-1.9258E-06	831.9067	-1.2166	629100.
660.000	1.11E-06	15983.8836	-248.1106	-1.5878E-06	831.5839	-0.0625623	338956.
666.000	-7.45E-06	14501.3079	-247.0276	-1.2796E-06	831.2602	0.4235402	341116.
672.000	-1.42E-05	13032.4969	-243.3115	-1.0013E-06	830.9395	0.8151758	343276.
678.000	-1.95E-05	11591.6998	-237.5038	-7.5245E-07	830.6250	1.1207	345436.
684.000	-2.33E-05	10190.0626	-230.0961	-5.3230E-07	830.3190	1.3485	347596.
690.000	-2.59E-05	8835.9309	-221.5293	-3.3999E-07	830.0234	1.5071	349756.
696.000	-2.74E-05	7535.1500	-212.1944	-1.7452E-07	829.7394	1.6046	351916.
702.000	-2.79E-05	6291.3640	-202.4328	-3.4775E-08	829.4678	1.6493	354076.
708.000	-2.78E-05	5106.3084	-192.5378	8.0426E-08	829.2091	1.6491	356236.
714.000	-2.70E-05	3980.0971	-182.7553	1.7227E-07	828.9632	1.6117	358396.
720.000	-2.57E-05	2911.5016	-165.4979	2.4192E-07	828.7299	4.1407	966424.
726.000	-2.41E-05	1991.6751	-141.3643	2.9148E-07	828.5291	3.9038	972724.
732.000	-2.22E-05	1212.1813	-118.7809	3.2386E-07	828.3589	3.6240	979024.
738.000	-2.02E-05	563.0275	-97.9605	3.4181E-07	828.2172	3.3161	985324.
744.000	-1.81E-05	33.1970	-79.0339	3.4783E-07	828.1016	2.9928	991624.
750.000	-1.60E-05	-388.8977	-62.0626	3.4424E-07	828.1792	2.6643	997924.
756.000	-1.40E-05	-715.0370	-47.0515	3.3308E-07	828.2504	2.3394	1004224.
762.000	-1.20E-05	-956.8848	-33.9589	3.1618E-07	828.3032	2.0248	1010524.
768.000	-1.02E-05	-1125.7421	-22.7072	2.9513E-07	828.3401	1.7258	1016824.
774.000	-8.48E-06	-1232.3571	-13.1916	2.7130E-07	828.3634	1.4461	1023124.
780.000	-6.93E-06	-1286.7852	-5.2874	2.4583E-07	828.3752	1.1886	1029424.
786.000	-5.53E-06	-1298.2927	1.1425	2.1971E-07	828.3777	0.9547132	1035724.
792.000	-4.29E-06	-1275.2978	6.2424	1.9369E-07	828.3727	0.7452562	1042024.
798.000	-3.21E-06	-1225.3433	10.1588	1.6842E-07	828.3618	0.5602218	1048324.
804.000	-2.27E-06	-1155.0955	13.0366	1.4436E-07	828.3465	0.3990324	1054624.
810.000	-1.47E-06	-1070.3645	15.0156	1.2186E-07	828.3280	0.2606496	1060924.
816.000	-8.08E-07	-976.1406	16.2287	1.0118E-07	828.3074	0.1436866	1067224.
822.000	-2.60E-07	-876.6442	16.7992	8.2453E-08	828.2857	0.0465077	1073524.
828.000	1.82E-07	-775.3839	16.8407	6.5755E-08	828.2636	-0.0326861	1079824.
834.000	5.29E-07	-675.2210	16.4553	5.1093E-08	828.2417	-0.0957830	1086124.
840.000	7.95E-07	-578.4372	15.7338	3.8422E-08	828.2206	-0.1446987	1092424.
846.000	9.90E-07	-486.8035	14.7558	2.7655E-08	828.2006	-0.1813248	1098724.
852.000	1.13E-06	-401.6477	13.5893	1.8675E-08	828.1820	-0.2074873	1105024.
858.000	1.21E-06	-323.9203	12.2921	1.1342E-08	828.1650	-0.2249132	1111324.
864.000	1.26E-06	-254.2568	10.9118	5.4980E-09	828.1498	-0.2352051	1117624.
870.000	1.28E-06	-193.0346	9.4867	9.7707E-10	828.1364	-0.2398219	1123924.
876.000	1.27E-06	-140.4262	8.0470	-2.3933E-09	828.1250	-0.2400654	1130224.
882.000	1.25E-06	-96.4459	6.6156	-4.7875E-09	828.1154	-0.2370703	1136524.
888.000	1.22E-06	-60.9902	5.2090	-6.3788E-09	828.1076	-0.2317991	1142824.
894.000	1.18E-06	-33.8731	3.8385	-7.3376E-09	828.1017	-0.2250386	1149124.
900.000	1.13E-06	-14.8539	2.5112	-7.8301E-09	828.0975	-0.2173988	1155424.
906.000	1.08E-06	-3.6595	1.2311	-8.0172E-09	828.0951	-0.2093133	1161724.
912.000	1.03E-06	0.0000	0.0000	-8.0542E-09	828.0943	-0.2010409	584012.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 8:

Pile-head deflection = 1.00000000 in
Computed slope at pile head = -0.00002709
Maximum bending moment = -37076147. lbs-in
Maximum shear force = 450005.27905 lbs
Depth of maximum bending moment = 0.00000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 9
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 Slope (BC Type 5)
Specified deflection at pile head = 2.000000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 843000.000 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	Es*h F/L lbs/in
0.000	2.000	-6.5614E+07	722047.	0.0000	15153.0090	-1239.1160	1858.6740
6.000	1.996	-6.1304E+07	-1081.4145	-0.0012828	14212.0207	-1416.3523	4257.5276
12.000	1.985	-5.7039E+07	704520.	-0.0024790	13280.7958	-1593.3996	4817.2769
18.000	1.966	-5.2825E+07	694425.	-0.0035894	12360.8209	-1771.6041	5405.9748
24.000	1.942	-4.8669E+07	683295.	-0.0046152	11453.5908	-1938.3748	5990.2387
30.000	1.911	-4.4579E+07	671187.	-0.0055577	10560.5090	-2097.5000	6585.9344
36.000	1.875	-4.0559E+07	658150.	-0.0064183	9682.9173	-2248.4929	7195.7886
42.000	1.834	-3.6616E+07	644258.	-0.0071983	8822.0923	-2381.8772	7792.9469
48.000	1.788	-3.2755E+07	629545.	-0.0078995	7979.1703	-2522.5139	8462.6290
54.000	1.739	-2.8982E+07	613947.	-0.0085234	7155.3428	-2676.8213	9235.3117
60.000	1.686	-2.5302E+07	597464.	-0.0090721	6351.9068	-2817.6986	10026.3278
66.000	1.630	-2.1720E+07	580053.	-0.0095474	5570.0518	-2985.8088	10989.2728
72.000	1.572	-1.8244E+07	561521.	-0.0099513	4811.1789	-3191.4537	12184.1337
78.000	1.511	-1.4881E+07	541763.	-0.0102861	4076.9819	-3394.7972	13482.1443
84.000	1.448	-1.1639E+07	520794.	-0.0105542	3369.1342	-3594.8384	14893.9108
90.000	1.384	-8525059.	498637.	-0.0107580	2689.2803	-3790.5764	16431.3912
96.000	1.319	-5546615.	475521.	-0.0109002	2039.0281	-3914.8165	17807.0051
102.000	1.253	-2708537.	451791.	-0.0109837	1419.4206	-3995.4336	19126.9084
108.000	1.187	-14018.1411	427472.	-0.0110112	831.1547	-4110.6206	20773.3326
114.000	1.121	2532520.	402515.	-0.0109857	1380.9926	-4208.4014	22520.6717
120.000	1.055	4927297.	377026.	-0.0109103	1903.8189	-4287.9746	24376.1980
126.000	0.990286	7167203.	351116.	-0.0107881	2392.8339	-4348.7172	26348.2372
132.000	0.925993	9249822.	324899.	-0.0106221	2847.5101	-4390.1882	28446.3674
138.000	0.862821	1.1173E+07	298446.	-0.0104157	3267.4752	-4427.5702	30789.0351
144.000	0.801004	1.2937E+07	271768.	-0.0101720	3652.3923	-4465.1424	33446.5849
150.000	0.740757	1.4538E+07	244904.	-0.0098943	4001.9269	-4489.3942	36363.3162
156.000	0.682272	1.5975E+07	217933.	-0.0095859	4315.8526	-4501.0441	39582.8303
162.000	0.625725	1.7250E+07	190927.	-0.0092501	4594.0458	-4500.9648	43159.1648
168.000	0.571271	1.8360E+07	163957.	-0.0088902	4836.4786	-4488.8782	47146.2270
174.000	0.519043	1.9307E+07	137115.	-0.0085095	5043.2211	-4458.5215	51539.3021
180.000	0.469157	2.0092E+07	110514.	-0.0081112	5214.4910	-4408.7261	56382.6947
186.000	0.421708	2.0715E+07	84269.2505	-0.0076988	5350.6620	-4339.3662	61739.8198
192.000	0.376772	2.1181E+07	58499.9150	-0.0072753	5452.2653	-4250.4123	67686.7803
198.000	0.334404	2.1491E+07	33322.9012	-0.0068440	5519.9897	-4141.9256	74315.8812
204.000	0.294643	2.1650E+07	8854.9787	-0.0064080	5554.6809	-4014.0485	81740.4594
210.000	0.257508	2.1662E+07	-14788.1373	-0.0059702	5557.3404	-3866.9902	90101.6737
216.000	0.223001	2.1533E+07	-37492.1278	-0.0055336	5529.1238	-3701.0067	99578.3078
222.000	0.191105	2.1268E+07	-59144.2629	-0.0051010	5471.3385	-3516.3717	110401.
228.000	0.161788	2.0875E+07	-79633.3785	-0.0046751	5385.4414	-3313.3335	122877.
234.000	0.135004	2.0360E+07	-98849.5322	-0.0042583	5273.0373	-3092.0511	137421.
240.000	0.110689	1.9732E+07	-116683.	-0.0038531	5135.8767	-2852.4941	154622.
246.000	0.088767	1.8999E+07	-133023.	-0.0034616	4975.8565	-2594.2806	175355.
252.000	0.069149	1.8170E+07	-147756.	-0.0030859	4795.0224	-2316.3937	200991.
258.000	0.051735	1.7257E+07	-160755.	-0.0027279	4595.5771	-2016.6464	233880.
264.000	0.036415	1.6269E+07	-171868.	-0.0023890	4379.8967	-1687.8259	278100.
270.000	0.023067	1.5218E+07	-180201.	-0.0020708	4150.5877	-1089.9308	283500.
276.000	0.011566	1.4127E+07	-185142.	-0.0017742	3912.3726	-556.8870	288900.
282.000	0.001778	1.3015E+07	-187074.	-0.0014998	3669.4653	-87.1869	294300.
288.000	-0.006432	1.1898E+07	-186372.	-0.0012480	3425.5823	321.2840	299700.
294.000	-0.013199	1.0791E+07	-183394.	-0.0010187	3183.9588	671.1531	305100.
300.000	-0.018656	9707222.	-178485.	-0.0008115	2947.3694	965.4709	310500.

306.000	-0.022937	8657302.	-171965.	-0.0006259	2718.1514	1207.6239	315900.
312.000	-0.026167	7649971.	-164139.	-0.0004611	2498.2315	1401.2524	321300.
318.000	-0.028470	6692303.	-155284.	-0.0003161	2289.1539	1550.1739	326700.
324.000	-0.029960	5789756.	-145659.	-0.0001899	2092.1106	1658.3123	332100.
330.000	-0.030749	4946318.	-135495.	-8.1434E-05	1907.9715	1729.6336	337500.
336.000	-0.030938	4164640.	-125002.	1.0654E-05	1737.3161	1768.0882	342900.
342.000	-0.030621	3446187.	-114365.	8.7580E-05	1580.4639	1777.5600	348300.
348.000	-0.029887	2791375.	-103747.	0.0001506	1437.5056	1761.8220	353700.
354.000	-0.028814	2199702.	-93287.8164	0.0002011	1308.3320	1724.4990	359100.
360.000	-0.027474	1669887.	-83107.2099	0.0002402	1192.6630	1669.0365	364500.
366.000	-0.025931	1199986.	-73304.0726	0.0002692	1090.0746	1598.6759	369900.
372.000	-0.024244	787515.	-63958.7394	0.0002893	1000.0241	1516.4352	375300.
378.000	-0.022460	429555.	-55134.1469	0.0003016	921.8745	1425.0957	380700.
384.000	-0.020625	122854.	-46877.2798	0.0003072	854.9158	1327.1934	386100.
390.000	-0.018774	-136080.	-39220.6552	0.0003070	857.8032	1225.0148	391500.
396.000	-0.016940	-350899.	-32183.8189	0.0003021	904.7025	1120.5973	396900.
402.000	-0.015149	-525342.	-25774.8299	0.0002933	942.7866	1015.7324	402300.
408.000	-0.013421	-663164.	-19991.7150	0.0002812	972.8759	911.9726	407700.
414.000	-0.011774	-768087.	-14823.8743	0.0002668	995.7827	810.6410	413100.
420.000	-0.010220	-843749.	-10253.4246	0.0002505	1012.3011	712.8423	418500.
426.000	-0.008768	-893662.	-6256.4686	0.0002329	1023.1981	619.4764	423900.
432.000	-0.007425	-921183.	-2804.2810	0.0002146	1029.2064	531.2528	429300.
438.000	-0.006193	-929484.	135.5954	0.0001959	1031.0188	448.7060	434700.
444.000	-0.005074	-921537.	2598.3477	0.0001772	1029.2838	372.2115	440100.
450.000	-0.004067	-900096.	4620.9883	0.0001588	1024.6028	302.0021	445500.
456.000	-0.003169	-867691.	6241.5469	0.0001409	1017.5282	238.1841	450900.
462.000	-0.002377	-826623.	7498.3599	0.0001238	1008.5622	180.7535	456300.
468.000	-0.001684	-778963.	8429.4538	0.0001075	998.1570	129.6111	461700.
474.000	-0.001086	-726557.	9072.0198	9.2313E-05	986.7159	84.5775	467100.
480.000	-0.000577	-671033.	9461.9746	7.8187E-05	974.5937	45.4074	472500.
486.000	-0.000148	-613805.	9633.6032	6.5200E-05	962.0998	11.8022	477900.
492.000	0.000206	-556089.	9619.2773	5.3376E-05	949.4993	-16.5775	483300.
498.000	0.000492	-498913.	9449.2427	4.2713E-05	937.0167	-40.1007	488700.
504.000	0.000718	-443130.	9151.4710	3.3191E-05	924.8382	-59.1565	494100.
510.000	0.000891	-389431.	8751.5673	2.4776E-05	913.1147	-74.1447	499500.
516.000	0.001016	-338362.	8272.7281	1.7420E-05	901.9653	-85.4683	504900.
522.000	0.001100	-290335.	7735.7434	1.1065E-05	891.4800	-93.5266	510300.
528.000	0.001148	-245645.	7159.0353	5.6481E-06	881.7234	-98.7094	515700.
534.000	0.001167	-204483.	6558.7298	1.0985E-06	872.7370	-101.3924	521100.
540.000	0.001162	-166951.	5948.7527	-2.6558E-06	864.5430	-101.9333	526500.
546.000	0.001136	-133072.	5340.9470	-5.6882E-06	857.1464	-100.6686	531900.
552.000	0.001093	-102802.	4745.2062	-8.0723E-06	850.5380	-97.9117	537300.
558.000	0.001039	-76047.4140	4169.6183	-9.8800E-06	844.6969	-93.9510	542700.
564.000	0.000975	-52666.9608	3620.6175	-1.1181E-05	839.5925	-89.0493	548100.
570.000	0.000905	-32486.8972	3103.1397	-1.2042E-05	835.1868	-83.4433	553500.
576.000	0.000830	-15307.4716	2620.7782	-1.2525E-05	831.4362	-77.3438	558900.
582.000	0.000754	-910.8582	2175.9385	-1.2689E-05	828.2932	-70.9361	564300.
588.000	0.000678	10932.1490	1769.9874	-1.2587E-05	830.4810	-64.3809	569700.
594.000	0.000603	20456.3244	1403.3973	-1.2270E-05	832.5603	-57.8158	575100.
600.000	0.000531	27897.0412	1075.8825	-1.1781E-05	834.1848	-51.3559	580500.
606.000	0.000462	33486.0949	786.5267	-1.1161E-05	835.4050	-45.0961	585900.
612.000	0.000397	37448.2658	533.9013	-1.0444E-05	836.2700	-39.1124	591300.
618.000	0.000336	39998.5623	316.1737	-9.6612E-06	836.8268	-33.4635	596700.
624.000	0.000281	41340.0832	131.2050	-8.8391E-06	837.1196	-28.1927	602100.
630.000	0.000230	41662.4387	-23.3622	-8.0001E-06	837.1900	-23.3297	607500.
636.000	0.000185	41140.6658	-150.0269	-7.1632E-06	837.0761	-18.8919	612900.
642.000	0.000144	39934.5794	-251.3616	-6.3438E-06	836.8128	-14.8864	618300.
648.000	0.000109	38188.4996	-329.9555	-5.5541E-06	836.4316	-11.3115	623700.
654.000	7.78E-05	36031.2995	-388.3647	-4.8040E-06	835.9606	-8.1582	629100.
660.000	5.12E-05	33576.7202	-421.5114	-4.1004E-06	835.4248	-2.8907	338956.
666.000	2.86E-05	31014.6425	-435.0620	-3.4476E-06	834.8654	-1.6262	341116.
672.000	9.80E-06	28390.8515	-441.6224	-2.8471E-06	834.2926	-0.5606077	343276.
678.000	-5.56E-06	25743.9758	-442.3435	-2.3000E-06	833.7147	0.3202434	345436.
684.000	-1.78E-05	23105.9966	-438.2889	-1.8062E-06	833.1388	1.0313	347596.
690.000	-2.72E-05	20502.7804	-430.4320	-1.3655E-06	832.5705	1.5877	349756.
696.000	-3.42E-05	17954.6261	-419.6534	-9.7676E-07	832.0141	2.0051	351916.
702.000	-3.90E-05	15476.8208	-406.7409	-6.3885E-07	831.4732	2.2990	354076.
708.000	-4.19E-05	13080.1982	-392.3890	-3.5021E-07	830.9500	2.4849	356236.
714.000	-4.32E-05	10771.6950	-377.2000	-1.0913E-07	830.4460	2.5781	358396.
720.000	-4.32E-05	8554.9026	-348.6091	8.6207E-08	829.9620	6.9522	966424.
726.000	-4.21E-05	6587.5143	-307.2638	2.3926E-07	829.5325	6.8295	972724.
732.000	-4.03E-05	4865.3163	-267.0521	3.5501E-07	829.1565	6.5744	979024.
738.000	-3.79E-05	3379.2978	-228.6738	4.3835E-07	828.8321	6.2184	985324.
744.000	-3.50E-05	2116.7962	-192.6497	4.9390E-07	828.5564	5.7896	991624.
750.000	-3.19E-05	1062.5047	-159.3443	5.2603E-07	828.3263	5.3122	997924.
756.000	-2.87E-05	199.3429	-128.9878	5.3879E-07	828.1378	4.8067	1004224.
762.000	-2.55E-05	-490.7987	-101.6967	5.3584E-07	828.2015	4.2903	1010524.
768.000	-2.23E-05	-1026.4379	-77.4938	5.2050E-07	828.3184	3.7773	1016824.
774.000	-1.92E-05	-1425.9900	-56.3257	4.9572E-07	828.4056	3.2788	1023124.
780.000	-1.63E-05	-1707.3611	-38.0790	4.6405E-07	828.4671	2.8035	1029424.
786.000	-1.37E-05	-1887.6324	-22.5949	4.2771E-07	828.5064	2.3579	1035724.
792.000	-1.12E-05	-1982.8267	-9.6820	3.8859E-07	828.5272	1.9464	1042024.
798.000	-9.00E-06	-2007.7471	0.8727991	3.4826E-07	828.5326	1.5718	1048324.
804.000	-7.03E-06	-1975.8761	9.2945	3.0799E-07	828.5257	1.2354	1054624.
810.000	-5.30E-06	-1899.3287	15.8123	2.6882E-07	828.5090	0.9372121	1060924.
816.000	-3.80E-06	-1788.8474	20.6531	2.3155E-07	828.4848	0.6763695	1067224.
822.000	-2.52E-06	-1653.8340	24.0358	1.9675E-07	828.4554	0.4512013	1073524.
828.000	-1.44E-06	-1502.4082	26.1677	1.6485E-07	828.4223	0.2594440	1079824.
834.000	-5.44E-07	-1341.4888	27.2413	1.3610E-07	828.3872	0.0984048	1086124.
840.000	1.92E-07	-1176.8896	27.4318	1.1065E-07	828.3512	-0.0348960	1092424.
846.000	7.84E-07	-1013.4264	26.8963	8.8512E-08	828.3156	-0.1436017	1098724.
852.000	1.25E-06	-855.0292	25.7728	6.9627E-08	828.2810	-0.2309139	1105024.
858.000	1.62E-06	-704.8575	24.1800	5.3860E-08	828.2482	-0.3000040	1111324.
864.000	1.90E-06	-565.4139	22.2182	4.1021E-08	828.2177	-0.3539380	1117624.
870.000	2.11E-06	-438.6543	19.9695	3.0873E-08	828.1901	-0.3956148	1123924.
876.000	2.27E-06	-326.0919	17.4995	2.3143E-08	828.1655	-0.4277144	1130224.
882.000	2.39E-06	-228.8939	14.8584	1.7534E-08	828.1443	-0.4526553	1136524.
888.000	2.48E-06	-147.9680	12.0828	1.3725E-08	828.1266	-0.4725584	1142824.
894.000	2.55E-06	-84.0392	9.1975	1.1380E-08	828.1126	-0.4892161	1149124.
900.000	2.62E-06	-37.7135	6.2176	1.0149E-08	828.1025	-0.5040650	1155424.
906.000	2.68E-06	-9.5304	3.1509	9.6715E-09	828.0964	-0.5181609	1161724.
912.000	2.73E-06	0.0000	0.0000	9.5752E-09	828.0943	-0.5321549	584012.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

```
Pile-head deflection             =     2.00000000 in
Computed slope at pile head      =    -0.00004356
Maximum bending moment           =     -65614476. lbs-in
Maximum shear force              =   722047.42332 lbs
Depth of maximum bending moment  =        0.00000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =              9
Number of zero deflection points =              4
```

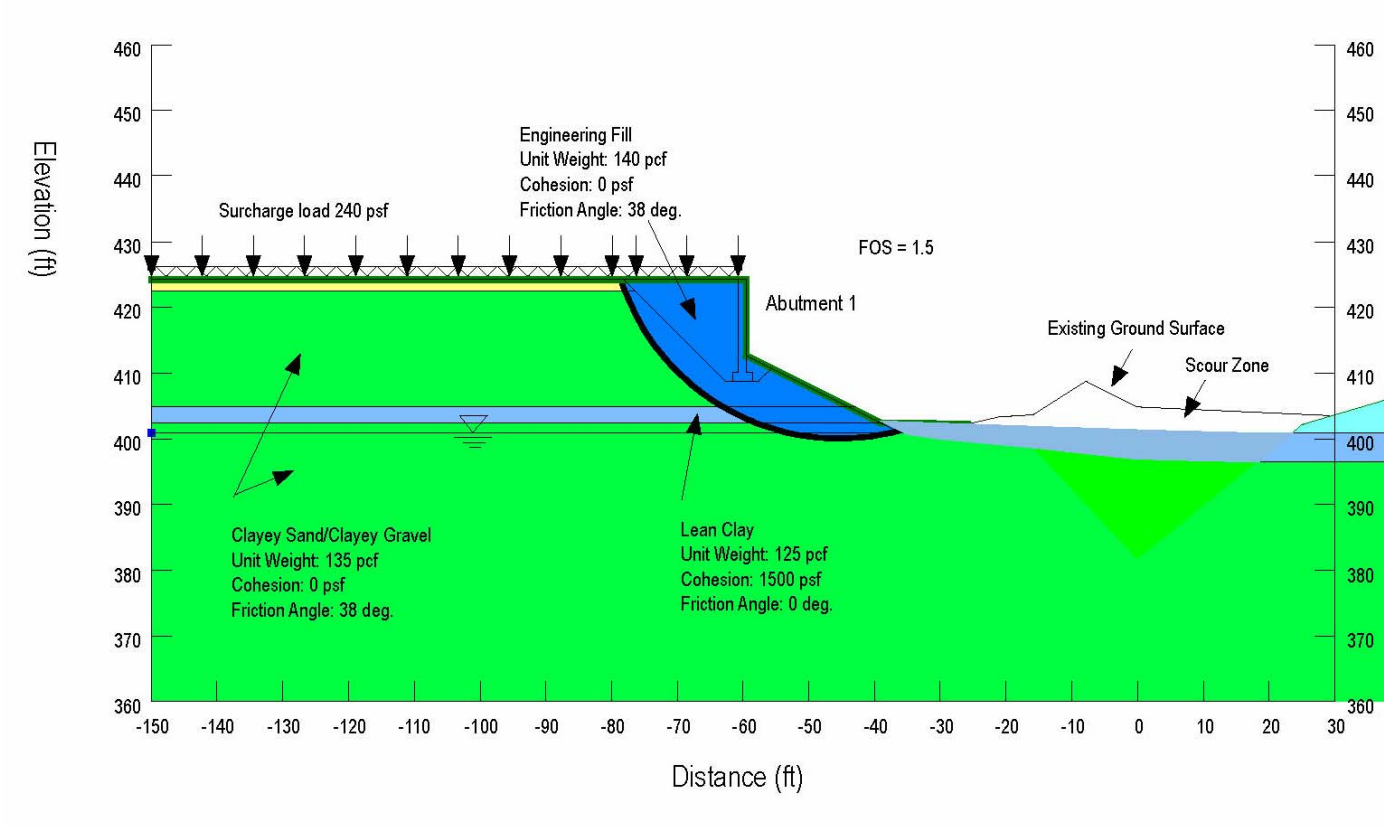
Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

```
Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad
```

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
5	y= 0.050000	S= 0.000	843000.	0.0500000	-3455742.	64410.2574
5	y= 0.100000	S= 0.000	843000.	0.1000000	-6063975.	105677.
5	y= 0.200000	S= 0.000	843000.	0.2000000	-1.0312E+07	159746.
5	y= 0.300000	S= 0.000	843000.	0.3000000	-1.4149E+07	205159.
5	y= 0.400000	S= 0.000	843000.	0.4000000	-1.7753E+07	245961.
5	y= 0.500000	S= 0.000	843000.	0.5000000	-2.1195E+07	283728.
5	y= 0.750000	S= 0.000	843000.	0.7500000	-2.9336E+07	369834.
5	y= 1.000000	S= 0.000	843000.	1.0000000	-3.7076E+07	450005.
5	y= 1.250	S= 0.000	843000.	1.2500	-4.4597E+07	527482.

```
  5  y=     2.000 S=     0.000     843000.      2.0000 -6.5614E+07     722047.

--------------------------------------------------------------------------------
                     Pile-head Deflection vs. Pile Length
--------------------------------------------------------------------------------

 Boundary Condition Type 5, Deflection and Slope

Deflection =         0.05000  in
Slope      =         0.00000
Axial Load =         843000. lbs


   Pile       Pile Head       Maximum      Maximum
  Length      Deflection      Moment        Shear
    in           in           in-lbs         lbs
-----------  ------------  ------------  ------------
   912.000    0.05000000     -3455742.   64410.25744
   866.400    0.05000000     -3456408.   64409.27369
   820.800    0.05000000     -3457313.   64413.05507
   775.200    0.05000000     -3457538.   64405.00372
   729.600    0.05000000     -3458004.   64401.68737
   684.000    0.05000000     -3458010.   64391.44789
   638.400    0.05000000     -3458696.   64393.01905
   592.800    0.05000000     -3459043.   64389.95193
   547.200    0.05000000     -3459344.   64386.50191
   501.600    0.05000000     -3459339.   64378.51793

This analysis ended normally.
```



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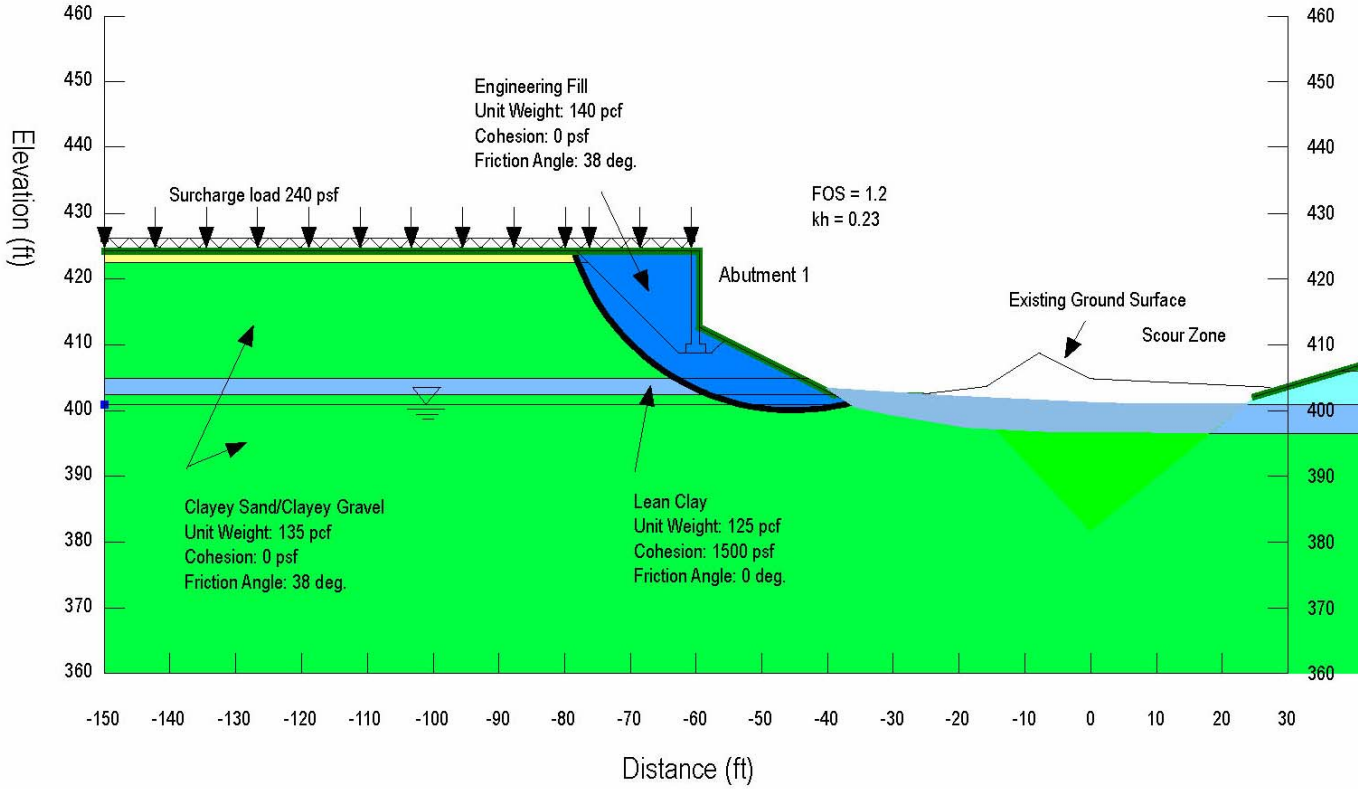
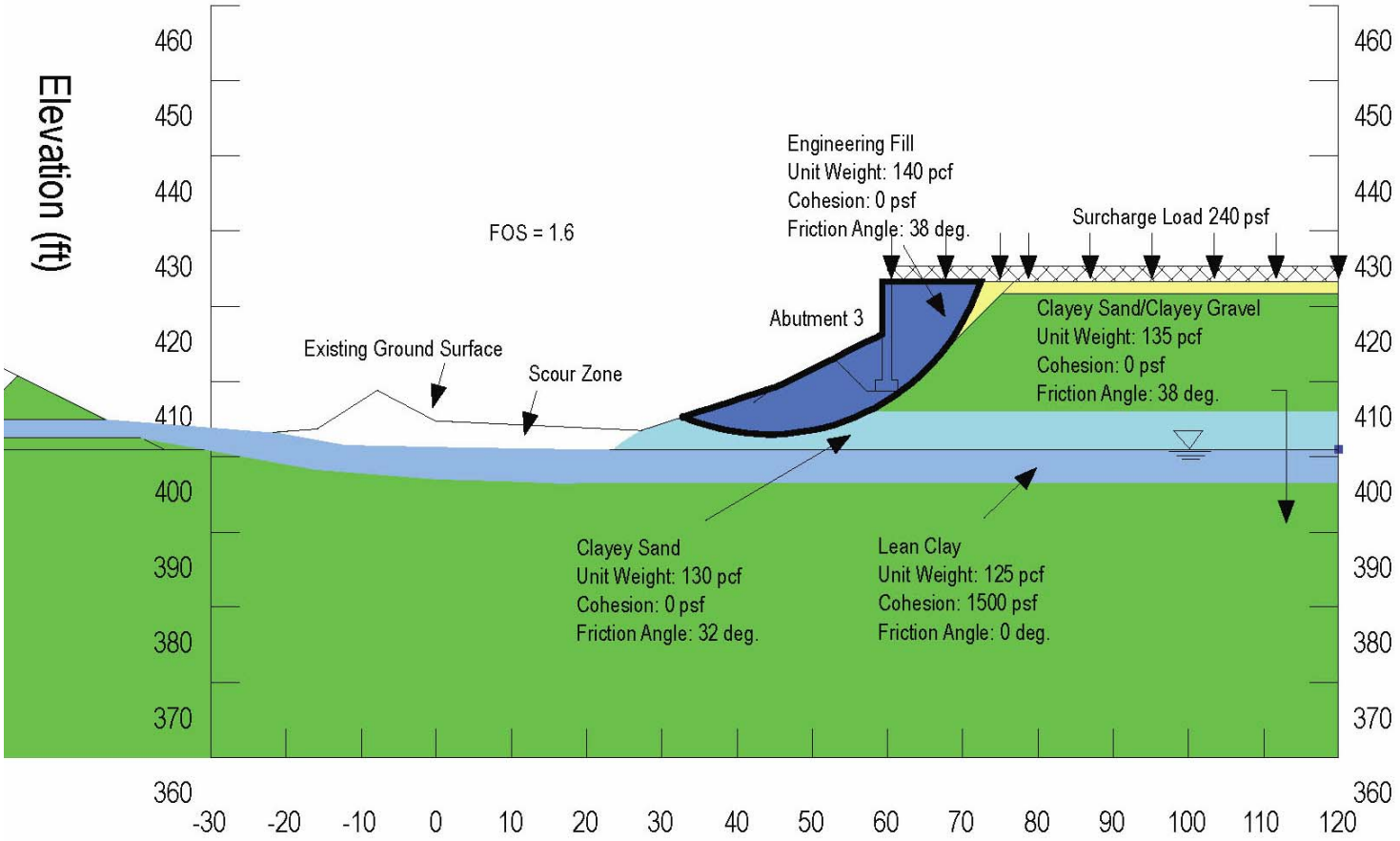
PROJECT No 28649640	CALCULATED BY M. Thummaluru	**ROUTE 84 WIDENING** **LIVERMORE, CA** SLOPE STABILITY ANALYSIS ARROYO DEL VALLE BRIDGE WIDENING ABUTMENT 1
Date March 19, 2009	CHECKED BY Stephen Huang	

FIGURE

J-1



URS 55 South Market Street, Suite 1500 San Jose, CA 95113 PHONE: (408) 297-9585 FAX: (408) 297-6962	PROJECT No 28649640	CALCULATED BY M. Thummaluru	**ROUTE 84 WIDENING** **LIVERMORE, CA** SLOPE STABILITY ANALYSIS ARROYO DEL VALLE BRIDGE WIDENING ABUTMENT 1	**FIGURE** **J-2**
	Date August 18, 2014	CHECKED BY Stephen Huang		



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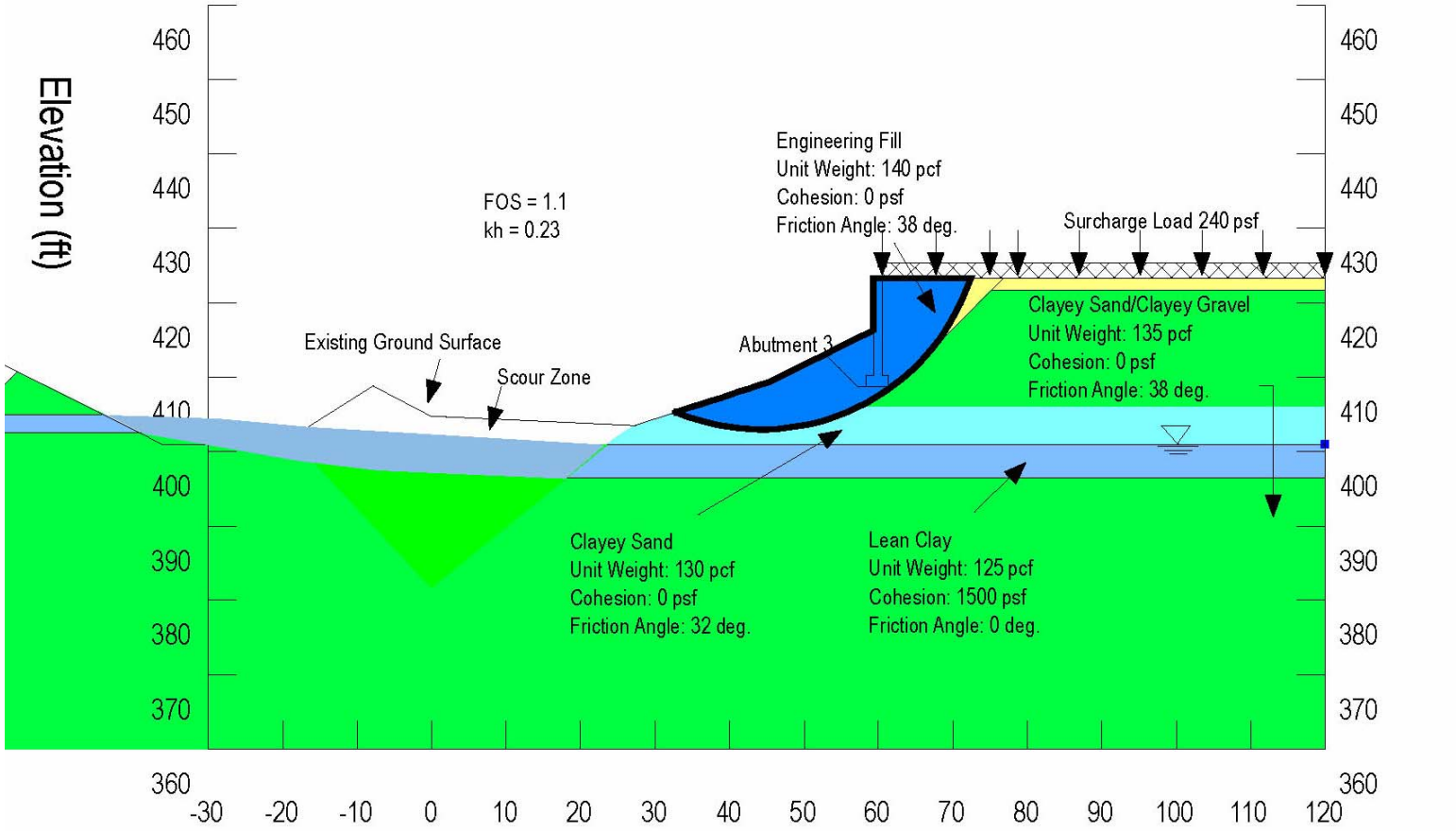
PROJECT No 28649640	CALCULATED BY M. Thummaluru	**ROUTE 84 WIDENING** **LIVERMORE, CA** SLOPE STABILITY ANALYSIS ARROYO DEL VALLE BRIDGE WIDENING ABUTMENT 3
Date August 18, 2014	CHECKED BY Stephen Huang	

FIGURE

J-3



URS 100 W San Fernando Street Suite 200 San Jose, CA 95113 PHONE: (408) 297-9585 FAX: (408) 297-6962	PROJECT No 28649640	CALCULATED BY M. Thummaluru	**ROUTE 84 WIDENING** **LIVERMORE, CA** SLOPE STABILITY ANALYSIS ARROYO DEL VALLE BRIDGE WIDENING ABUTMENT 3	**FIGURE** **J-4**
	Date August 18, 2014	CHECKED BY Stephen Huang		

FRICTION ANGLE OF BACKFILL : 38° (SEE ARROYO DEL VALLE WIDEN SLOPE-STABILITY RESULTS)

UNIT WEIGHT = 140 PCF

BACK SLOPE AT TOP OF WALL = 0°

$$K_a = \tan^2\left(45 - \frac{\phi}{2}\right)$$

$$= \tan^2\left(45 - \frac{38}{2}\right)$$

$$= 0.24$$

EQUIVALENT FLUID PRESSURE = $K_a \gamma$

$$= (0.24)(140)$$

$$= 33.6 \text{ PCF} \quad < 34 \text{ PCF (CALTRANS STANDARD WALLS DESIGN VALUE WITH } \phi = 34° \text{ and } \gamma = 120 \text{ PCF)}$$

— x —

BEARING CAPACITY:

NEAREST BORING: R-07-012

DESIGN WALL HEIGHT = 20' (MAXIMUM)

$$q_{ult} = CN_c + \gamma D N_q + \frac{\gamma B}{2} N_\gamma$$

TOE PRESSURE FOR 20' HIGH WALL = 2,400 PSF (SERVICE)

= 3,800 PSF (STRENGTH)

= 6,400 PSF (EXTREME)

(1) FOOTING PLACED ON CLAY LAYER. (R-07-012 CLAY LAYER IS SLIGHTLY ABOVE BOF) (R-07-013 CLAY LAYER IS BELOW BOF).

C = 1,500 PSF ; CONSERVATIVELY $\phi = 0°$

$N_c = 5.53$ $N_q = 1$ $N_\gamma = 0$

$q_{ult} = CN_c + \gamma D N_q$ — NEGLECT

$= (1,500)(5.53) = 8,295$

STRENGTH - FACTORED GROSS NOMINAL BEARING RESISTANCE = $\phi_b \times q_{ult}$

$= (0.55)(8,295)$

$\approx 4,560$ (> 3,800 PSF)

EXTREME EVENT GROSS NOMINAL BEARING RESISTANCE = $\phi_b \times q_{ult}$

$= (1.0)(8,295)$

$\approx 8,300$ (> 6,400 PSF).

(2) FOOTING PLACED ON SAND LAYER:

$\phi = 35^\circ$ $\gamma = 135$ PCF $C = 0$ $B' = 4.6$ ft (CALTRANS STANDARD PLANS + EXTREME I)

$\gamma' = (135 - 62.4) = 72.6$

$N_c = 50$ $N_q = 35$ $N_\gamma = 40$ (NAV FAC DM 7.2 - PAGE 131)

$$q_{ult} = \gamma' D N_q + \frac{\gamma' B'}{2} N_\gamma$$

$$= (72.6)(2_{MIN})(35) + \frac{(4.6)(72.6)}{2}(40)$$

$= 5,082 + 6,679$

$= 11,761$ PSF

STRENGTH - FACTORED GROSS NOMINAL BEARING RESISTANCE = $\phi_b \times q_{ult}$

$= (0.55)(11,761)$

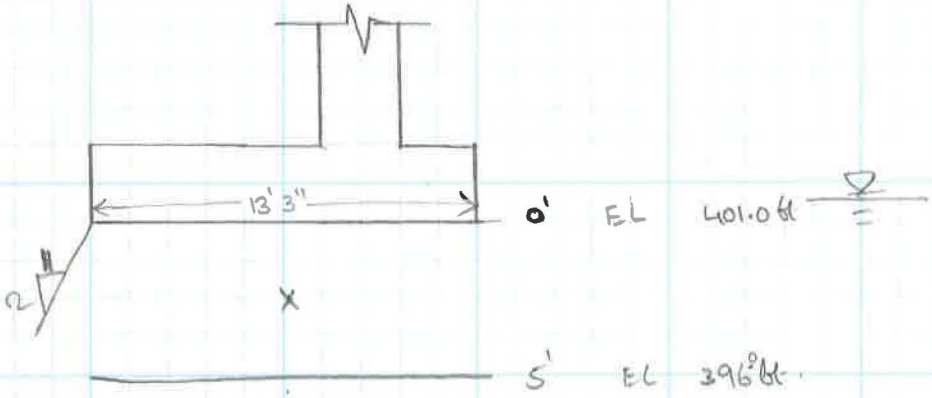
$\approx 6,470$ (> 3,800 PSF)

EXTREME - FACTORED GROSS NOMINAL BEARING RESISTANCE = $\phi_b \times q_{ult}$

$= (1.0)(11,761)$

≈ 11760 (> 6,400 PSF)

SETTLEMENT:



INITIAL PRESSURE AT CENTER OF CLAY LAYER (P_0) = $(125-62.4)(2.5) + (120)(5) = 760$ psf (5 ft above TOE)

TOE PRESSURE = 2,400 PSF

$\Delta P = \frac{(2400)(13.25)}{(13.25+1.25+1.25)} = 2,019$ PSF (CALCULATED BASED ON A 2:1 STRESS DISTRIBUTION)

$P_f = P_0 + \Delta P = 760 + 2019 = 2779$ PSF

CONSOLIDATION SETTLEMENT $\Delta H = \frac{C_c H}{1+e_0} \log\left(\frac{P_0+\Delta P}{P_0}\right)$ - OC CLAY (NAVFAC DM 7.1 - PAGE 206)

FROM LAMBE & WHITMAN PAGE 321

FOR WC = 23 % $\frac{C_c}{1+e_0} = 6\% = 0.06$

$\frac{C_r}{1+e_0}$ IS GENERALLY 1/5 TO 1/10 OF $\frac{C_c}{1+e_0}$.

$\frac{C_r}{1+e_0} = \left(\frac{1}{5}\right)(0.06) = 0.012$

$$\Delta H = (0.012)(5)\log\left(\frac{760+209}{760}\right)$$

$$= (0.012)(5)(0.563)$$

$$= 0.034 \text{ FT}$$

$$\approx 0.4 \text{ in} \quad < 1 \text{ in ok.}$$

—x—

SLOPE STABILITY RESULTS FOR THE ARROYO DEL VALLE (LOIDEN) ABUTMENT WALL ARE APPLICABLE TO THE RETAINING WALL ALSO. AS THE BOF AT MAX WALL HEIGHT IS SAME AS ABUTMENT WALL.

Office of Special Funded Projects
Comment & Response Form

(Revised 08/2011)

General Project Information (OSFP Liaison to complete)		**Review Phase** (OSFP Liaison to complete)	**Reviewer Information** (Reviewer Liaison to complete)	
Dist:	**04**	☐ PSR/PDS (Review No.)	Reviewer Name:	**B. Lee/ T. Nguyen/ H.Salimi/ R.Nashed**
Proj ID (Phase):	**0400020581**	☐ APS/PSR (Review No.)	Functional Unit:	**Geotechnical Design- West**
EA:	**297621**	☐ APS/PR (Review No.)	Cost Center:	**59-3660**
Project Name:	**Route 84, PM 22.9/25.7-Livermore**	☐ Type Selection	Phone Number:	**510-286-4825**
OSFP Liaison:	**David Soon**	☐ 65% PS&E Unchecked Details	e-mail:	**Betty_lee@dot.ca.gov**
Phone:	**916-227-5671**	☑ PS&E (Review No. 3)	Date of Review:	**10-10-2014/11-26-2014**
E-mail:		☐ Construction	Structure Name*:	**Arroyo Del Valle Bridge (Widen)**
		☑ Other:_ FR (3RD REVIEW)	Br No*:	**33-0710**
			(*Use if necessary to when comment sheets are by individual structure)	

Consultant Information (to be filled in by Consultant)				
Consultant Lead (First and Last Name)	Consultant Firm	Phone Number	E-mail	Response Date
Stephen Huang	**URS Corporation**	**408-297-9585**	**Stephen.huang@urs.com**	**9-12-2014/12-18-2014**

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	2nd Review Comments	Consultant Responses	3rd Review Comments
			When making revisions, please indicate the page numbers where revisions will be found.	Page, section or figure numbers for revisions are provided in following responses.	**The referenced pages and appendices in your responses are inconsistent with the actual FR. Please PROOF-READ your reports before you send them to us.**	Understood.	
1	FR		Abutments in this report are done using working stress design, WSD. So I assume this project is done using the AASHTO	Only criteria from AASHTO LRFD 4th edition used for design.			

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)

Submittal Data (Reviewer to complete)
Project ID: 0400020581 Reviewer**:** Str Name*: Arroyo Del Valle Bridge (Widen)
Date of Review: Functional Unit: Br No*. 33-0710___ *=if applicable

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	2nd Review Comments	Consultant Responses	3rd Review Comments
			LRFD 4th edition criteria. If this is the case, then everything in this project should be designed with the 4th edition criteria (no mixing with the 6th edition).				
2	FR	Pg. 3-8	Where is the location of Boring NB37?	Boring NB37 (R-08-37) was drilled in the Arroyo Del Valle creek bed as shown on Figure 3-3.			
3	FR	Pg.3-7	Have borehole labeling been changed? Please have consistent borehole labeling in LOTBs, FR texts, figures, and calculations.	Borehole labels have been changed in text, figures, axial pile calculations, and LOTBs. Because laboratory testing was performed by an outside consultant, we were not able to update the borehole labels for some of the figures presented in Appendix B. We have included a table in Appendix B for reference, presenting borehole ID from lab test with Caltrans 2007 borehole ID.	Many boring IDs should be corrected. Is Borehole R-8-014 the same as NB14 or R-7-014? There is no R-8-014 in the revised legend that was emailed me separately from the FR.	Boring IDs corrected in text of FR and on LOTBs to be consistent with those provided for GDR. Boring NB14 is R-07-014 and Boring NB11 is R-07-011.	
4	FR	Pg.3-8	The description of groundwater is not consistent with the info on LOTBs. The FR reads, "…free groundwater was not	We revised the liquefaction section of the report to reflect shallower groundwater depths encountered in the creekbed borings	Regarding the liquefaction analyses, you assumed that the groundwater would remain at Elev 400 ft. Groundwater actually	Boring R-08-037 was drilled in the creekbed with a top of boring elevation of 404 feet. We reran the liquefaction analysis for	

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			encountered above a depth of 20 feet bgs in borings performed during this study…" However, LOTBs show that groundwater was encountered within the top 4 ft of three borings, and as for the rest of the boreholes, groundwater was in fact not measured.	drilled in 2008.	fluctuates. What is the liquefaction potential when it rises above Elev 400 ft?	a GWT at the ground surface and the CSR value increased from 0.45 to 0.48. Based on published relationships, the volumetric strain (an corresponding settlement) in the potentially liquefiable ML layer does not change due to the slight increase in CSR.	
5	FR	Pg. 7-3	L/D = 31>30. Bottom of borings are about 9 ft above the tip of CIDH pile. We suggest using larger diameter pile. (Designer used 3 ft-diameter CIDH pile.)	We revised the tip elevation for CIDH piles at Pier 2 to Elevation 315 feet based on the presence of gravel encountered in Borings R-08-037 and R-08-038 below Elevation 340 feet. This revised tip elevation results in an L/D ratio of about 28 for the 36-inch diameter CIDH piles.	Noted		
6	FR	Pg. 7-3	Design tip elevation is 356.0 ft based on lateral demand. However lateral demand is not specified in the Foundation Report. Please clarify.	The lateral load applied at the top of the CIDH pile is 124 kips; which results in a maximum bending moment of 25,000 kip-inches for the fixed head condition as shown on the figures included in Appendix I	The design tip elevation +356 ft is not appropriate according to the LPILE output. Moreover, according to the Appendix I, 124 kips lateral load will produce excessive deflection. Please clarify the allowable deflection.	According to AASHTO LRFD Bridge Design Spec (4th Edition), Section 3.4.1 Load Factors and Load Combinations for Extreme Event I (page 3-9, attached), local pier scour and contraction scour	Lateral loading analysis for static condition with scour consideration should also be performed. URS agreed to include this analysis per telephone conversation with CT on 11/24/2014. Please also include graphs of

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				of the Foundation Report. As part of the analysis, the computer program LPILE generates a plot of pile length vs applied load to determine the minimum required pile length.		depths should not be included in the design. In addition, scour analysis has been updated per review comments from Caltrans Structure Hydraulics & Hydrology; results are presented in Appendix C of FR. As such, we revised the LPILE analysis and the results indicate a top of pile deflection less than 0.1 inch for fixed head condition and 0.4 inch for free head condition for an applied lateral load of 124 kips. The maximum bending moment developed in the pile for this applied lateral load is about 438 kip-feet.	deflection, bending moment, and shear vs. depth in the report for both static and seismic cases. Will include LPILE results for condition with local scour for static case. LPILE results for contraction scour only (seismic case) provided in previous submittal.
7	FR	Appdx G	Effective vertical stresses are not corresponding to soil unit weights presented in Figure 3-5.	The vertical effective stress profile is assumed to start with 0 psf at Elevation 381 feet, the depth of local scour at the bridge pier. The effective stress profile with depth presented on the axial capacity calculations is consistent with the	Unit weight for each layer in CIDH pile design spreadsheet is not shown. Unit weights are inconsistently used for all three analyses: CIDH pile design spreadsheet, SHAFT 2012 program, and lateral loaded pile analysis. Moreover, please clarify local scour depth of 381 ft in the	We added a column to the excel spreadsheet to show unit weights for each layer. The input to SHAFT includes total unit weight and depth to groundwater; the program uses this information to calculate effective unit weights. The input to LPILE is effective unit weight.	The response is not adequate. URS agreed to revise spreadsheets with appropriate soil unit weights per telephone conversation with CT on 11/24/2014. As noted, the updated FR includes additional information on unit weights of analyzed soil profile.

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				values presented on the Generalized Soil Profile.	response, which is not consistent with the analyses and Bridge Design Hydraulic Study Report – Executive Summary.	The values assigned to the four soil layers identified in each analysis are consistent. The total scour depth down to Elevation 400.9 feet was based on updated hydraulic calculations. We revised the SHAFT analysis for a ground surface at Elevation 398.7 feet, corresponding to the bottom of pile cap since depth of scour is above bottom of pile cap; this results in a specified pile tip at Elevation 323 feet. The revised SHAFT analysis output and revised PDT are included in FR. Figure 3-5 also revised to be consistent with SHAFT and LPILE unit weight input parameters.	
8	P	Pg. 2 of 21	Please clarify magnitude group.	Plan updated per latest FR.	Under General Notes Seismic Loading Magnitude Group 7.25 ± 0.25 is outdated and needs to be removed.	This note has been removed from the plan.	
9	P	Pg. 2 of 21	Please use PGA provided in FR of May 31, 2014.	Plan updated per latest FR.	Peak Rock Acceleration is shown as 0.7. According to our calculations, the Peak Rock Acceleration is 0.61	This note and the FR have been revised to refer to PGA of 0.61g.	The Plans still show Peak ROCK Acceleration. If you mean Peak GROUND Acceleration, please

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					g (PSHA) and 0.41 g (DSHA).		correct. Plans have been revised to use "Peak Ground Acceleration".
10	FR		Skin axial resistances for bridge calculated by spreadsheet are much higher than that by Shaft 6.0 Program.	SHAFT version 2012 7.8 output for Pier 2 is included with the axial pile capacity calculations in Appendix G and is consistent with the pile capacity spreadsheet, which was revised to consider gravel encountered in both creekbed borings below Elevation 340 feet.	Noted. See also comment #7.	Please see response to Comment #7.	See #7.
11	FR		According to Caltrans ARS online version 2.3.06, Pleasanton Fault is located just over 2 miles west of the site, but neither of the three reports show the fault. Please refer to Arroyo Del Valle Bridge (widen) Bridge No. 33-0710 report pages 3-2 and 5-1.	Discussion about the Pleasanton fault is included in Section 3.1 of the revised report.			
12	FR		The Acceleration Response Spectrum shown for all three reports indicate a Vs30=331 m/s was used. The reports do not show how this	Shear wave velocity calculations spreadsheets are presented in Appendix J of the revised report. Based on these calculations, the ARS			

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			number was achieved. I assume that a correlation was used to generate this number from SFT blow counts. The details for this correlation/calculation have to be shown with input/output parameters.	curve has been revised to a Vs30 value of 360 m/sec.			
13	FR		Current Caltrans SDC call for 5% probability of exceedance in 50 years corresponding to a 975 year return period. Section 5.4 (page 5-2) shows a 2% in 50 years. I assume this is a typo. Please correct the report to reflect the current Caltrans criteria.	Report was corrected to indicate 5% probability of exceedance in 50 years.			
14	FR				What are the parameters used for determining the ARS curve for each structure? Are the underlying soil profiles the same for all 4 structures as to use the same ARS Curve although the locations are not the same?	Latitude and longitude for each structure, and a shear wave velocity value of 360 m/sec were the input parameters used to develop the ARS curves for the structures. The average shear wave velocity was calculated for the upper 30 meters of soil profile at 12 borings and ranges from 354 to 422 m/sec. The borings are located between Stations 100	A)It is inappropriate to use a shear wave velocity averaged over such a lateral geographical extent for all of the structures for this project. Please use the appropriate localized shear wave velocity to do seismic analyses and to determine the specific ARS curve for each structure. b) In Appendix F, the Vs you used differ from

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						and 320. In recognition of the scatter in calculated shear wave velocity among the 10 methods considered in the excel spreadsheets (See Appendix F of FR), an average shear wave velocity of 360 m/sec was judged appropriate for development of the ARS curves for these four structures along the South Segment alignment.	the UCLA Vs by about 100 m/s. Please explain. c) Vs=360 m/s? You said it was changed to Vs=331 m/s. The calculated "mean" values of Vs for the six borings located at Arroyo Del Valle bridges range from 354 to 390 m/sec and are based on the average of several correlations for different soil types, including the UCLA values (See Appendix F of FR). We judged a value of 360 m/sec to be appropriate for the project site, consistent with published values of Vs for stiff soil and soft rock sites as presented in Figure B.12 of Caltrans SDC 1.7 (June 2013).
15	FR				Tables 7-4 and 7-5 are now changed. Have the load demands changed?	The foundation design loads increased at Pier 2 for the service limit, strength limit and extreme limit states. To note, the axial pile analysis based on SHAFT was refined to include effects of gravel	

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						(below Elevation 340 feet) that resulted in shorter pile embedment needed to mobilize required skin friction; therefore, specified pile tip elevation presented in the 9/12/2014 FR is 10 feet higher than that presented in the 5/231/2014 FR. With the revised scour depth discussed in Comment #7, the specified pile tip elevation for Pier 2 is now 323 feet.	
			Geology Comments				
1					Livermore fault is not shown in the geologic map Figure 3-1 as stated in the text.	Text revised; no longer includes reference to the location of the Livermore Fault being shown on Figure 3-1.	Ok
14	FR	3.2.2 Field Exploration Page 3-5	As indicated in The LOTB's Figures 3-4a and 3-4b, the logging method used in accordance with the Caltrans Soil and Rock Logging , Classification and Presentation Manual, June 2007 Edition and Not 2010 Edition as stated in the text. Please be	The text of Section 3.2.2 has been revised to reference the June 2007 edition.			

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			consistent.				
15	FR	3.2.5 Ground -water Page 3-6	What is the water elevation of the water surface in Arroyo Del Valle Creek? That may help in defining the groundwater elevation in case of the absence of accurate groundwater level.	Water flow in Arroyo Del Valle is regulated by release of water from Lake Del Valle which is operated by the Department of Water Resources. As noted in the companion hydraulic study, the 100 year WSE is about Elevation 411 feet at the bridge; the 50 year WSE is about Elevation 410 feet. Information regarding the average non-storm related water surface elevation in Arroyo Del Valle was not available. Free groundwater was encountered at about Elevation 401 feet in borings performed in the creekbed in December 2008 and at about Elevation 398 in a hollow stem boring, A-07-010, drilled at a location approximately 300 feet from Arroyo Del Valle. Our recommendations for design groundwater level at			

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				the bridge structure are based on this information.			
16	FR	8.2 Construction Dewatering Page 8-1	To provide the estimate of dewatering of groundwater during excavation, seepage rate (flow rate) study should be provided.	Seepage estimates will be provided in a separate technical memorandum.			Please provide us this technical memorandum. Will provide.
17	FR	Figure 3-1	Please show the exact location of the bridge on the Geologic Map, not the whole alignment.	The bridge location at Arroyo Del Valle has been added to the Geologic Map.			

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18	FR	App. D			CRR = 0.315 for ML soil with $(N_1)_{60\text{-}cs}$ = 27 and 55% fines is not adequate. Provide any reference for this CRR value.	The equation used to calculate CRR is taken from the "Proceedings of the NCEER Workshop on Evaluation of the Liquefaction Resistance of Soils" 1997.	Noted.
19	FR	APP. F, Page F-1			Boring IDs are incorrect.	Corrected. Please see response to Comment #3.	

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Office of Special Funded Projects
Comment & Response Form

(Revised 08/2011)

General Project Information (OSFP Liaison to complete)		**Review Phase** (OSFP Liaison to complete)	**Reviewer Information** (Reviewer Liaison to complete)	
Dist:	**04**	☐ PSR/PDS (Review No.)	Reviewer Name:	**B. Lee/ T. Nguyen/ H.Salimi/ R.Nashed**
Proj ID (Phase):	**0400020581**	☐ APS/PSR (Review No.)	Functional Unit:	**Geotechnical Design- West**
EA:	**297621**	☐ APS/PR (Review No.)	Cost Center:	**59-3660**
Project Name:	**Route 84, PM 22.9/25.7-Livermore**	☐ Type Selection	Phone Number:	**510-286-4825**
OSFP Liaison:	**David Soon**	☐ 65% PS&E Unchecked Details	e-mail:	**Betty_lee@dot.ca.gov**
Phone:	**916-227-5671**	☑ PS&E (Review No. 1)	Date of Review:	**10-10-2014**
E-mail:		☐ Construction	Structure Name*:	**Arroyo Del Valle Bridge (Widen)**
		☐ Other:	Br No*:	**33-0710**
			(*Use if necessary to when comment sheets are by individual structure)	

Consultant Information (to be filled in by Consultant)

Consultant Lead (First and Last Name)	Consultant Firm	Phone Number	E-mail	Response Date
Stephen Huang	**URS Corporation**	**408-297-9585**	**Stephen.huang@urs.com**	**9-12-2014**

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			When making revisions, please indicate the page numbers where revisions will be found.	Page, section or figure numbers for revisions are provided in following responses.	**The referenced pages and appendices in your responses are inconsistent with the actual FR. Please PROOF-READ your reports before you send them to us.**	Understood.
1	FR		Abutments in this report are done using working stress design, WSD. So I assume this project is done using the AASHTO LRFD 4th edition criteria. If this is the	Only criteria from AASHTO LRFD 4th edition used for design.		

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			case, then everything in this project should be designed with the 4th edition criteria (no mixing with the 6th edition).			
2	FR	Pg. 3-8	Where is the location of Boring NB37?	Boring NB37 (R-08-37) was drilled in the Arroyo Del Valle creek bed as shown on Figure 3-3.		
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4	FR	Pg.3-8	The description of groundwater is not consistent with the info on LOTBs. The FR reads, "…free groundwater was not encountered above a depth of 20 feet bgs in borings performed during this study…" However, LOTBs show that groundwater was encountered within the top 4 ft of three borings, and as for the rest of the boreholes, groundwater was in fact not measured.	We revised the liquefaction section of the report to reflect shallower groundwater depths encountered in the creekbed borings drilled in 2008.	Regarding the liquefaction analyses, you assumed that the groundwater would remain at Elev 400 ft. Groundwater actually fluctuates. What is the liquefaction potential when it rises above Elev 400 ft?	Boring R-08-037 was drilled in the creekbed with a top of boring elevation of 404 feet. We reran the liquefaction analysis for a GWT at the ground surface and the CSR value increased from 0.45 to 0.48. Based on published relationships, the volumetric strain (an corresponding settlement) in the potentially liquefiable ML layer does not

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						change due to the slight increase in CSR.
5	FR	Pg. 7-3	L/D = 31>30. Bottom of borings are about 9 ft above the tip of CIDH pile. We suggest using larger diameter pile. (Designer used 3 ft-diameter CIDH pile.)	We revised the tip elevation for CIDH piles at Pier 2 to Elevation 315 feet based on the presence of gravel encountered in Borings R-08-037 and R-08-038 below Elevation 340 feet. This revised tip elevation results in an L/D ratio of about 28 for the 36-inch diameter CIDH piles.	Noted	
6	FR	Pg. 7-3	Design tip elevation is 356.0 ft based on lateral demand. However lateral demand is not specified in the Foundation Report. Please clarify.	The lateral load applied at the top of the CIDH pile is 124 kips; which results in a maximum bending moment of 25,000 kip-inches for the fixed head condition as shown on the figures included in Appendix I of the Foundation Report. As part of the analysis, the computer program LPILE generates a plot of pile length vs applied load to determine the minimum required pile length.	The design tip elevation +356 ft is not appropriate according to the LPILE output. Moreover, according to the Appendix I, 124 kips lateral load will produce excessive deflection. Please clarify the allowable deflection.	According to AASHTO LRFD Bridge Design Spec (4th Edition), Section 3.4.1 Load Factors and Load Combinations for Extreme Event I, local pier scour and contraction scour depths should not be included in the design. In addition, scour analysis has been updated per review comments from Caltrans Structure Hydraulics & Hydrology; results are presented in Appendix C of FR. As such, we revised the LPILE analysis and the results indicate a top of pile deflection

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						slightly more than 0.1 inch for fixed head condition and less than 0.4 inch for free head condition for an applied lateral load of 124 kips. The maximum bending moment developed in the pile for this applied lateral load is about 583 kip-feet. See page 7-3.
7	FR	Appdx G	Effective vertical stresses are not corresponding to soil unit weights presented in Figure 3-5.	The vertical effective stress profile is assumed to start with 0 psf at Elevation 381 feet, the depth of local scour at the bridge pier. The effective stress profile with depth presented on the axial capacity calculations is consistent with the values presented on the Generalized Soil Profile.	Unit weight for each layer in CIDH pile design spreadsheet is not shown. Unit weights are inconsistently used for all three analyses: CIDH pile design spreadsheet, SHAFT 2012 program, and lateral loaded pile analysis. Moreover, please clarify local scour depth of 381 ft in the response, which is not consistent with the analyses and Bridge Design Hydraulic Study Report – Executive Summary.	We added a column to the excel spreadsheet to show unit weights for each layer. The input to SHAFT includes total unit weight and depth to groundwater; the program uses this information to calculate effective unit weights. The input to LPILE is effective unit weight. The values assigned to the four soil layers identified in each analysis are consistent. The total scour depth down to Elevation 400.9 feet was based on updated hydraulic calculations. We revised the SHAFT analysis for a

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						ground surface at Elevation 398.7 feet, corresponding to the bottom of pile cap since depth of scour is above bottom of pile cap; this results in a specified pile tip at Elevation 323 feet. The revised SHAFT analysis output and revised PDT are included in FR. Figure 3-4 also revised to be consistent with SHAFT and LPILE unit weight input parameters.
8	P	Pg. 2 of 21	Please clarify magnitude group.	Plan updated per latest FR.	Under General Notes Seismic Loading Magnitude Group 7.25 ± 0.25 is outdated and needs to be removed.	This note has been removed from the plan.
9	P	Pg. 2 of 21	Please use PGA provided in FR of May 31, 2014.	Plan updated per latest FR.	Peak Rock Acceleration is shown as 0.7. According to our calculations, the Peak Rock Acceleration is 0.61 g (PSHA) and 0.41 g (DSHA).	This note and the FR have been revised to refer to PGA of 0.61g.
10	FR		Skin axial resistances for bridge calculated by spreadsheet are much higher than that by Shaft 6.0 Program.	SHAFT version 2012 7.8 output for Pier 2 is included with the axial pile capacity calculations in Appendix G and is consistent with the pile capacity spreadsheet, which was revised to consider gravel	Noted. See also comment #7.	Please see response to Comment #7.

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(for Reviewer's use)

Submittal Data (Reviewer to complete)
Project ID: 0400020581 Reviewer: Str Name*: Arroyo Del Valle Bridge (Widen)
Date of Review: Functional Unit: Br No*. 33-0710___ *=if applicable

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	2nd Review Comments	Consultant Responses
				encountered in both creekbed borings below Elevation 340 feet.		
11	FR		According to Caltrans ARS online version 2.3.06, Pleasanton Fault is located just over 2 miles west of the site, but neither of the three reports show the fault. Please refer to Arroyo Del Valle Bridge (widen) Bridge No. 33-0710 report pages 3-2 and 5-1.	Discussion about the Pleasanton fault is included in Section 3.1 of the revised report.		
12	FR		The Acceleration Response Spectrum shown for all three reports indicate a Vs30=331 m/s was used. The reports do not show how this number was achieved. I assume that a correlation was used to generate this number from SFT blow counts. The details for this correlation/calculation have to be shown with input/output parameters.	Shear wave velocity calculations spreadsheets are presented in Appendix J of the revised report. Based on these calculations, the ARS curve has been revised to a Vs30 value of 360 m/sec.		
13	FR		Current Caltrans SDC call for 5% probability of exceedance in 50 years corresponding to a 975 year return period. Section 5.4 (page 5-2) shows a 2% in 50 years. I assume this is a typo. Please correct the report to reflect the current Caltrans criteria.	Report was corrected to indicate 5% probability of exceedance in 50 years.		
14	FR				What are the parameters used for determining the ARS curve for each structure? Are the underlying soil profiles the same for all 4 structures as to use the same ARS Curve although the locations are not the same?	Latitude and longitude for each structure, and a shear wave velocity value of 360 m/sec were the input parameters used to develop the ARS curves for the structures. The average shear wave velocity was

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#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	2nd Review Comments	Consultant Responses
						calculated for the upper 30 meters of soil profile at 12 borings and ranges from 354 to 422 m/sec. The borings are located between "A1" Line Stations 230 and 320. In recognition of the scatter in calculated shear wave velocity among the 10 methods considered in the excel spreadsheets (See Appendix F of FR), an average shear wave velocity of 360 m/sec was judged appropriate for development of the ARS curves for these four structures along the South Segment alignment.
15	FR				Tables 7-4 and 7-5 are now changed. Have the load demands changed?	The foundation design loads increased at Pier 2 for the service limit, strength limit and extreme limit states. To note, the axial pile analysis based on SHAFT was refined to include effects of gravel (below Elevation 340 feet)

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#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	2nd Review Comments	Consultant Responses
						that resulted in shorter pile embedment needed to mobilize required skin friction; therefore, specified pile tip elevation presented in the 9/12/2014 FR is 10 feet higher than that presented in the 5/231/2014 FR. With the revised scour depth discussed in Comment #7, the specified pile tip elevation for Pier 2 is now 323 feet. See page 7-3.
			Geology Comments			
1					Livermore fault is not shown in the geologic map Figure 3-1 as stated in the text.	Text revised; no longer includes reference to the location of the Livermore Fault being shown on Figure 3-1. See page 3-1.
14	FR	3.2.2 Field Exploration Page 3-5	As indicated in The LOTB's Figures 3-4a and 3-4b, the logging method used in accordance with the Caltrans Soil and Rock Logging , Classification and Presentation Manual, June 2007 Edition and Not 2010 Edition as stated in the text. Please be consistent.	The text of Section 3.2.2 has been revised to reference the June 2007 edition.		

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Submittal Data (Reviewer to complete)
Project ID: 0400020581 Reviewer**:** Str Name*: Arroyo Del Valle Bridge (Widen)
Date of Review: Functional Unit: Br No*. 33-0710___ *=if applicable

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	2nd Review Comments	Consultant Responses
15	FR	3.2.5 Ground-water Page 3-6	What is the water elevation of the water surface in Arroyo Del Valle Creek? That may help in defining the groundwater elevation in case of the absence of accurate groundwater level.	Water flow in Arroyo Del Valle is regulated by release of water from Lake Del Valle which is operated by the Department of Water Resources. As noted in the companion hydraulic study, the 100 year WSE is about Elevation 411 feet at the bridge; the 50 year WSE is about Elevation 410 feet. Information regarding the average non-storm related water surface elevation in Arroyo Del Valle was not available. Free groundwater was encountered at about Elevation 401 feet in borings performed in the creekbed in December 2008 and at about Elevation 398 in a hollow stem boring, A-07-010, drilled at a location approximately 300 feet from Arroyo Del Valle. Our recommendations for design groundwater level at the bridge structure are based on this information.		
16	FR	8.2 Construction Dewatering Page 8-1	To provide the estimate of dewatering of groundwater during excavation, seepage rate (flow rate) study should be provided.	Seepage estimates will be provided in a separate technical memorandum.		
17	FR	Figure 3-1	Please show the exact location of the bridge on the Geologic Map, not the whole alignment.	The bridge location at Arroyo Del Valle has been added to the Geologic Map.		

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Date of Review: Functional Unit: Br No*. 33-0710___ *=if applicable

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	2nd Review Comments	Consultant Responses
18	FR	App. D			CRR = 0.315 for ML soil with $(N_1)_{60\text{-}cs}$ = 27 and 55% fines is not adequate. Provide any reference for this CRR value.	The equation used to calculate CRR is taken from the "Proceedings of the NCEER Workshop on Evaluation of the Liquefaction Resistance of Soils" 1997.
19	FR	APP. F, Page F-1			Boring IDs are incorrect.	Corrected. Please see response to Comment #3.

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Office of Special Funded Projects
Comment & Response Form

(Revised 08/2011)

General Project Information (OSFP Liaison to complete)		**Review Phase** (OSFP Liaison to complete)	**Reviewer Information** (Reviewer Liaison to complete)	
Dist:	**04**	☐ PSR/PDS (Review No.)	Reviewer Name:	**B. Lee/ T. Nguyen/ H.Salimi/ R.Nashed**
Proj ID (Phase):	**0400020581**	☐ APS/PSR (Review No.)	Functional Unit:	**Geotechnical Design- West**
EA:	**297621**	☐ APS/PR (Review No.)	Cost Center:	**59-3660**
Project Name:	**Route 84, PM 22.9/25.7-Livermore**	☐ Type Selection	Phone Number:	**510-286-4825**
OSFP Liaison:	**David Soon**	☐ 65% PS&E Unchecked Details	e-mail:	**Betty_lee@dot.ca.gov**
Phone:	**916-227-5671**	☑ PS&E (Review No. 1)	Date of Review:	**7-7-2014**
E-mail:		☐ Construction	Structure Name*:	**Arroyo Del Valle Bridge (Widen)**
		☐ Other:	Br No*:	**33-0710**
			(*Use if necessary to when comment sheets are by individual structure)	

Consultant Information (to be filled in by Consultant)

Consultant Lead (First and Last Name)	Consultant Firm	Phone Number	E-mail	Response Date
Stephen Huang	**URS Corporation**	**408-297-9585**	**Stephen.huang@urs.com**	**8/20/14**

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
			When making revisions, please indicate the <u>page numbers</u> where revisions will be found.	Page, section or figure numbers for revisions are provided in following responses.	
1	FR		Abutments in this report are done using working stress design, WSD. So I assume this project is done using the AASHTO LRFD 4th edition criteria. If this is the case, then everything in this project should be designed with the 4th edition criteria (no mixing with the 6th edition).	Only criteria from AASHTO LRFD 4th edition used for design.	
2	FR	Pg. 3-8	Where is the location of Boring NB37?	Boring NB37 (R-08-37) was drilled in the Arroyo Del Valle creek bed as shown on Figure 3-3.	

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Project ID: Reviewer**:** Str Name*:

Date of Review: Functional Unit: Br No*. ___ *=if applicable

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
3	FR		Have borehole labeling been changed? Please have consistent borehole labeling in LOTBs, FR texts, figures, and calculations.	Borehole labels have been changed in text, figures, axial pile calculations, and LOTBs. Because laboratory testing was performed by an outside consultant, we were not able to update the borehole labels for some of the figures presented in Appendix B. We have included a table in Appendix B for reference, presenting borehole ID from lab test with Caltrans 2007 borehole ID.	
4	FR	Pg.3-8	The description of groundwater is not consistent with the info on LOTBs. The FR reads, "…free groundwater was not encountered above a depth of 20 feet bgs in borings performed during this study…" However, LOTBs show that groundwater was encountered within the top 4 ft of three borings, and as for the rest of the boreholes, groundwater was in fact not measured.	We revised the liquefaction section of the report to reflect shallower groundwater depths encountered in the creekbed borings drilled in 2008.	
5	FR	Pg. 7-3	L/D = 31>30. Bottom of borings are about 9 ft above the tip of CIDH pile. We suggest using larger diameter pile. (Designer used 3 ft-diameter CIDH pile.)	We revised the tip elevation for CIDH piles at Pier 2 to Elevation 315 feet based on the presence of gravel encountered in Borings R-08-037 and R-08-038 below Elevation 340 feet. This revised tip elevation results in an L/D ratio of about 28 for the 36-inch diameter CIDH piles.	
6	FR	Pg. 7-3	Design tip elevation is 356.0 ft based on lateral demand. However lateral demand is not specified in the Foundation Report. Please clarify.	The lateral load applied at the top of the CIDH pile is 124 kips;which results in a maximum bending moment of 25,000 kip-inches for the fixed head condition as shown on the figures included in Appendix I of the Foundation Report. As part of the analysis, the computer	

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				program LPILE generates a plot of pile length vs applied load to determine the minimum required pile length.	
7	FR	Appdx G	Effective vertical stresses are not corresponding to soil unit weights presented in Figure 3-5.	The vertical effective stress profile is assumed to start with 0 psf at Elevation 381 feet, the depth of local scour at the bridge pier. The effective stress profile with depth presented on the axial capacity calculations is consistent with the values presented on the Generalized Soil Profile.	
8	P	Pg. 20 of 21	Please clarify magnitude group.	Plan updated per latest FR.	
9	P	Pg. 20 of 21	Please use PGA provided in FR of May 31, 2014.	Plan updated per latest FR.	
10	FR		Skin axial resistances for bridge calculated by spreadsheet are much higher than that by Shaft 6.0 Program.	SHAFT version 2012 7.8 output for Pier 2 is included with the axial pile capacity calculations in Appendix G and is consistent with the pile capacity spreadsheet, which was revised to consider gravel encountered in both creekbed borings below Elevation 340 feet.	
11	FR		According to Caltrans ARS online version 2.3.06, Pleasanton Fault is located just over 2 miles west of the site, but neither of the three reports show the fault. Please refer to Arroyo Del Valle Bridge (widen) Bridge No. 33-0710 report pages 3-2 and 5-1.	Discussion about the Pleasanton fault is included in Section 3.1 of the revised report.	

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			Geology Comments		
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16	FR	8.2 Construction Dewatering Page 8-1	To provide the estimate of dewatering of groundwater during excavation, seepage rate (flow rate) study should be provided.	Seepage estimates will be provided in a separate technical memorandum.	
17	FR	Figure 3-1	Please show the exact location of the bridge on the Geologic Map, not the whole alignment.	The bridge location at Arroyo Del Valle has been added to the Geologic Map.	

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Foundation Report Arroyo Del Valle Trail Bridge – Dated 01/16/2015

04-ALA-84, PM24.8
EA 297624
PID 0400020581

JANUARY 16, 2015

FOUNDATION REPORT

ARROYO DEL VALLE TRAIL BRIDGE LIVERMORE, CALIFORNIA

Prepared for
Alameda County Transportation Commission (ACTC)
1111 Broadway, Suite 800
Oakland, CA 94607

URS

100 West San Fernando Street, Suite 200
San Jose, California 95113

URS

January 16, 2015
Project 28649640

File No.04-ALA-84-PM 24.8
EA 297624
Project ID 0400020581

Mr. Gary Sidhu
Project Coordinator
Alameda County Transportation Commission
1111 Broadway, Suite 800
Oakland, CA 94607

Subject: **Foundation Report**
Arroyo Del Valle Trail Bridge
Route 84 Expressway Widening
Livermore, California

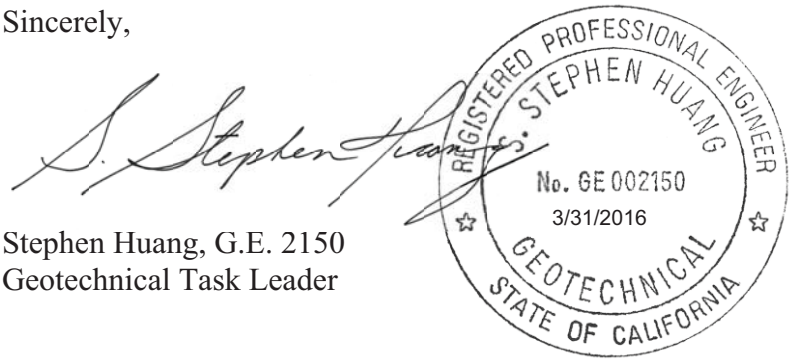
Dear Mr. Sidhu:

URS has completed the accompanying Foundation Report for the Arroyo Del Valle Trail Bridge in Livermore, California. The report was updated to incorporate comments from Caltrans dated January 6, 2015, and was prepared in accordance with Caltrans Guidelines for Foundation Report Preparation for Bridge Foundations, dated December 2009 and generally with 2010 Caltrans Standard Specifications.

This Foundation Report presents our engineering opinions and recommendations regarding the geotechnical factors influencing the design and construction of the proposed trail bridge. The opinions and recommendations are based upon the results of our field investigation, laboratory testing, engineering judgment and local experience. Mr. Allen Moore, G.E., and Mr. Madhu Thummaluru, G.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 portions of 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 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. In addition, the project also proposes to improve pedestrian and bicycle access along this section of SR 84 by connecting multi-use trails.

The south segment of SR 84 will be widened from two to four lanes between Ruby Hill Drive and Concannon Boulevard. The widening will 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 will be limited to intersections to improve traffic flow and safety. Signalized intersections at Ruby Hill Drive, Vallecitos Road, Vineyard Avenue, and Concannon Boulevard will be widened and upgraded to accommodate future traffic movements.

Improvements to the south segment of SR 84 will include widening of one existing bridge structure, constructing one new bridge structure, and constructing 6 retaining walls. The bridge structures include:

- Arroyo Del Valle Bridge (existing Isabel Avenue SR84 Bridge at Arroyo Del Valle creek crossing, Bridge No. 33-0710)
- Arroyo Del Valle Trail Bridge (new structure)

The subject of this Foundation Report (FR) is design and construction of a new trail bridge to the east of the Arroyo Del Valle Bridge (widen) located at PM 24.8 in Livermore, California. Figure 1-1 shows the location of this proposed new structure.

1.2 SCOPE OF INVESTIGATION

The geotechnical services performed for the Arroyo Del Valle Trail Bridge were as follows:

- Review existing plans for the existing Isabel Avenue (SR84) Bridge at Arroyo Del Valle creek crossing
- Geotechnical field investigation including six exploratory borings, R-07-011, R-07-012, R-07-013 and R-07-014, R-08-037 and R-08-038; R-07-011 and R-07-014 were drilled specifically for the proposed trail bridge
- Laboratory testing to estimate pertinent engineering properties
- Design recommendations and opinions for the following topics:
  - Cast in drilled hole (CIDH) 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

Reviews related to environmental and hazardous waste issues were performed by Baseline Environmental and the findings are presented in a separate report.

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. The south segment will require widening of an existing bridge at Arroyo Del Valle. The location of the Arroyo Del Valle Trail Bridge is shown on Figure 1-1. The existing two-span bridge at Arroyo Del Valle is to be widened approximately 53 feet to the east, and a new, separate trail bridge across Arroyo Del Valle is to be constructed just east of the SR84 widening with a 30 degree skew. The trail bridge is to be a cast-in-place prestressed concrete box girder bridge, supported on two abutments and one center bent. The trail bridge is to have a deck at about Elevation 420.6 feet and soffit at about Elevation 415.6 feet. The bridge will have an overall length of 160 feet with a clear width of 15 feet between concrete barriers. We understand that 24-inch-diameter cast-in-drilled-hole (CIDH) piles are currently planned to support the structural elements. Bottom of pile cap is planned to be at Elevation 405.00 feet for Abutments 1 and 3; bottom of pile cap at Bent 2 is planned to be at Elevation 397.50 feet. Excavation depths at the pile caps are estimated to be in the range of 5 to 10 feet below existing grade.

Flow in the channel will pass along both sides of the center bent. Based on the bridge design hydraulic study report (Wreco, 2009), the 100-year water surface is estimated at about Elevation 411.7 feet.

We understand that rock slope protection having side slope inclinations of 2:1 (horizontal:vertical) is currently planned beneath the proposed trail bridge to mitigate scour. An existing unpaved maintenance road will cross under the northern portion of the bridge. In addition, a 16-inch-diameter sanitary sewer main, a 24-inch-diameter gas line, and an 18-inch-diameter recycled water line will be attached to or housed within the bridge box girder.

The plan and elevation sections for the proposed trail bridge are shown on the General Plan in Appendix A. The Foundation Plan for the proposed trail bridge is also included in Appendix A.

3.1 GEOLOGIC SETTING

3.1.1 Regional Geology

The SR 84 alignment lies within the Livermore Valley, in 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; Graymer et al., 1996). More recent mapping by Witter and others (2006) subdivides the alluvium into latest Holocene alluvial fan deposits, Holocene alluvial fan deposits, and historic stream channel deposits. The geologic map (Figure 3-1) 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 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 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 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 in the borings between the gravelly alluvium soils and the older Livermore Gravels Formation.

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 Calaveras and Pleasanton faults. 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. These faults are included as Alquist-Priolo (A-P) zoned faults. 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.

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). Other nearby mapped faults include the southwest extension of the Las Positas fault, located about 1.7 miles (2.8 km) southeast of the southern end of the project alignment. The project alignment does not cross either the Los Positas fault or the Livermore fault.

The following are brief descriptions of the nearby active faults.

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 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. The Calaveras fault has a Maximum Magnitude, Mmax, equal to 6.9.

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 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).

The Las Positas fault is a strike-slip fault with Mmax equal to 6.4.

Pleasanton Fault

The Pleasanton fault is located about 2.1 miles southwest of the southern end of the project alignment. The Pleasanton fault is a strike-slip fault that is located at the base of the hills on the north side of the Vallecitos Valley (CGS, 2000). It is a predominantly vertical fault with Mmax equal to 6.6.

3.1.3 Local Geology

Based on a review of the borings completed along the project alignment, the soil profile typically consists of a few feet of fill overlying alluvium. The fill, where encountered, ranges from about 2 to 3 feet thick to as much as 12 feet thick in Boring R-07-013, drilled near the north abutment of the existing Isabel Avenue (SR84) Bridge at Arroyo Del Valle Creek. The fill consists of locally derived silt, sand and clay with gravel and occasionally contains asphalt and concrete fragments. Alluvium was encountered in all of the borings underlying the road base and fill materials. 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. In general the alluvium encountered south of Arroyo Del Valle, where the road alignment gradually climbs a gentle alluvial fan, was more dense/stiff compared with the alluvium north of the drainage. The uncorrected N-values from borings located south of the drainage were nearly all above 40 blows per foot and most were well above 50 blows per foot, even in the silts and clays. North of Arroyo Del Valle, the alluvium is less dense/stiff with N-values typically in the 10 to 30 blows per foot range for the upper 20 to 30 feet of the soil profile and increasing with depth.

3.2 SITE AND SUBSURFACE CONDITIONS

3.2.1 Site Topography

The south segment of SR 84 alignment between Concannon 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 Concannon Boulevard at "A1" Line Station 448+00 to the drainage crossing of Arroyo Del Valle at "A1" Line Station 320+00. The incised Arroyo Del Valle drainage crossing is 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 "A1" Line 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 "A1" Line Station 314+00 north of Vineyard Avenue to "A1" Line Station 415+00 at the Arroyo Mocho bridge crossing, north of the south segment. The majority of the gravel quarries are located along the west side of SR 84.

3.2.2 Field Exploration

Plans for the existing Isabel Avenue (SR84) Bridge at Arroyo Del Valle Creek, provided by the County Public Works, did not include subsurface data.

We performed a subsurface investigation at abutments for widening of the existing bridge at Arroyo Del Valle and for the new trail bridge on December 19 and 20, 2007, and January 3 and 18, 2008. Pursuant to Caltrans requirements for scour critical structures and the status of the existing bridge to be widened, two additional borings were drilled on December 11 and 15, 2008, in the creek bed. Our investigation included six rotary wash borings, R-07-011, R-07-012, R-07-013 and R-07-014, R-08-037, and R-08-038, which extended to terminal depths of 60 to 90 feet. A 4-inch-diameter solid flight auger was used initially to drill to depths of about 4 to 12 feet below ground surface (bgs) so the depth to groundwater could be measured. Thereafter, the drilling method was switched to 4⅞-inch-diameter rotary wash. Locations of the borings are shown on Figure 3-3.

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. Descriptions of the soils encountered in the borings are presented on Figures 3-4a and 3-4b. The logging method used in preparing the LOTBs is consistent with Caltrans Soil and Rock Logging, Classification and Presentation Manual, 2007 edition. 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 unit weight, plastic and liquid limits, grain size distribution, and unconfined compressive strength 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 depths on the LOTBs. 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 generally consist of loose to medium dense sandy silt and silty sand encountered in Boring R-07-012 to a depth of about 4 feet below ground surface (bgs) and in Boring R-07-013 to a depth of about 11½ feet bgs. More details regarding the fills are presented on the LOTBs. Fill was not encountered in Borings R-07-011 or R-07-014, or in channel borings R-08-037 and R-08-038.

3.2.4.2 Native

Beginning at the ground surface in Borings R-07-011 and R-07-014 and underlying the fill in Borings R-07-012 and R-07-013, are predominantly granular soils consisting of very dense silty sand, clayey sand, clayey gravel, and silty gravel. The silty sand and clayey sand deposits contain numerous gravel pieces, whereas the gravel deposits contain occasional cobbles. A layer of cobbles and boulders was encountered at a depth of about 11½ to 15 feet bgs in Boring R-07-013. The alluvial deposits contain several fine-grained interbeds consisting of medium stiff to stiff sandy lean clay between depths of 17 to 19½ feet bgs in Boring R-07-012, sandy fat clay between depths of 20 to 24½ feet bgs in Boring R-07-013, lean clay between depths of 14 to 18 feet bgs in Boring R-07-014, and lean clay between depths of 55 to 58 feet bgs in Boring R-07-014.

Borings R-08-037 and R-08-038, drilled near the center of Arroyo Del Valle, encountered predominantly granular soils consisting of dense to very dense clayey sand with gravel and clayey gravel with sand to a depth of 90 feet, the terminal depth of both borings. Stiff lean clay was encountered in Boring R-08-037 between depths of about 5 to 7 feet bgs; medium dense sandy silt was encountered in Boring R-08-037 between depths of about 43 and 48 feet bgs.

3.2.5 Groundwater

Free groundwater was not encountered in Borings R-07-011, R-07-012, R-07-013 and R-07-014 at time of drilling to depths of 7 feet bgs in Boring R-07-011, 4 feet bgs in Boring R-07-012, and 12 feet bgs in Borings R-07-013 and R-07-014, after which the drilling method was switched to rotary wash, thereby precluding groundwater measurement. Free groundwater was encountered at the time of drilling in Boring R-08-038 at a depth of about 3 feet (Elevation 401 feet). Free groundwater was not initially encountered in Boring R-08-037 to a depth of about 5 feet where the drilling method was switched to rotary wash; however, drilling fluid was observed in this boring at a depth of about 3.5 feet (Elevation 400.5 feet), two days after drilling was temporarily stopped.

Free groundwater was encountered at a depth of about 23 feet (Elevation 398½ feet) in a nearby hollow-stem auger boring, Boring A-07-010, drilled approximately 300 feet from the site for proposed retaining wall structures near Arroyo Del Valle.

None of the shallow borings completed along the project alignment for pavement design 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 401 feet would be appropriate for the Arroyo Del Valle 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 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 landslides.

3.3.3 Scour

Based on the project bridge design hydraulic report (Wreco, May 2009), the rock slope protection currently overlying the side slopes beneath the existing Isabel Avenue (SR84) Bridge at Arroyo Del Valle Creek is substandard and will need to be replaced. The channel bottom is unlined. Based on the project hydraulic analysis (Wreco, November 2014), we understand the total scour depth is estimated to be 4.5 feet at Bent 2, extending to about Elevation 397.95 feet. The executive summary section of the hydraulic report and the addendum memorandum (Wreco, 2014) is presented 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 Federal Emergency Management Agency flood hazard zone maps (Association of Bay Area Governments, 2007).

3.3.5 Subsidence and Seismic Compression

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).

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 granular soils encountered in the upper 4 feet bgs in Borings R-07-012 and R-07-013, the cohesionless granular materials are dense to very dense at the Arroyo Del Valle crossing. For design, we estimated the potential post-earthquake settlement at Borings R-07-011, R-07-012, R-07-013 and R-07-014, and R-08-037 using the computer program Liquefy Pro. In our analyses, we used a peak ground acceleration (PGA) of 0.61g and design earthquake moment magnitude (Mw) of 6.8. The results of these studies indicate the magnitude of seismic compression settlement at abutments to be less than about ¼ inch. We believe that settlement of the native soils due to seismic densification during strong ground shaking at Bent 2 will be negligible. Copies of these calculations are included in Appendix D.

3.3.6 Liquefaction Potential and Lateral Spreading

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 ("A1" Line Station 401+00) is mapped as having "high" liquefaction susceptibility. Between Stanley Boulevard and Arroyo Del Valle ("A1" Line Station 321+00) the alluvium is mapped as having "moderate" liquefaction susceptibility. From Arroyo Del Valle extending south about 1,500 feet to "A1" Line 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.

Borings R-07-013 and R-07-014 completed outside of the Arroyo Del Valle creek bed in 2007 and 2008 encountered several discontinuous layers of medium dense clayey sand and clayey gravel within the upper 20 feet of the soil profile, extending to about Elevation 400 feet. These granular soils could be subject to liquefaction if saturated; however, free groundwater was encountered at depths of about 3 to 4 feet in borings drilled in the creek bed in 2008,

corresponding to about Elevation 401 to 400 feet. On this basis, the potential for liquefaction of these medium granular soils is considered low. The granular soils encountered below a depth of 20 feet are mostly dense to very dense, and therefore the potential for liquefaction of these materials to occur is also considered to be low. However, a potentially liquefiable sandy silt layer was encountered in R-08-037 at a depth of 44 feet bgs. We analyzed post-liquefaction settlement of the medium dense sandy silt layer for a PGA of 0.61g and design earthquake moment magnitude, Mw, of 6.8 by correcting the measured driving resistance (blow counts) in the field for hammer type, sample size, overburden pressure, rod length, and fines content. The values of PGA and Mw were determined utilizing the tool on USGS Probabilistic Seismic Hazard Analysis (PSHA) Interaction Deaggregation web site based on a probability of exceedance of 5 percent in 50 years.

The magnitude of settlement is estimated to be less than ½ inch. Copies of these calculations are included in Appendix D.

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. Plasticity Index tests and particle size 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 in situ 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 one 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 one 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 E. 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 the proposed Arroyo Del Valle Trail Bridge 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:

- The chloride concentration is 500 ppm (mg/kg) or greater;
- The sulfate concentration is 2,000 mg/kg or greater; or
- 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, and 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 and water samples collected by URS during the geotechnical investigation were forwarded to Cooper Testing Laboratory in Palo Alto, California for chemical analysis. The soil and water 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 Table 4-1.

Table 4-1 Soil Corrosion Test Results Summary

Sample ID	Minimum Soil Resistivity (ohm-cm)	pH	Chloride Content (mg/kg)	Sulfate Content (mg/kg)
R-07-011, 5-3	7,255	7.4	<2	<5
R-07-012, 2-X	10,028	8.6	<2	<5
R-07-013, 6-3	7,992	8.3	<2	<5
R-07-014, 2-3	10,586	8.5	<2	<5
Water	1,686**	8.3	19.9*	63.7*

*The chloride and sulfate results for the water sample are in milligrams/liter (mg/L)
Boring R-07-011 corresponds to Boring NB11, Boring R-07-012 corresponds to Boring NB12, etc. in the corrosion report.
** Water resistivity in ohm-cm

As shown above, the pH of the soil samples analyzed ranged from 7.4 to 8.6. The water soluble chloride ion concentrations were below the minimum detection level of 2 milligrams per kilogram (mg/kg). The water soluble sulfate ion concentrations of the soil samples were below the minimum detection level of 5 mg/kg. The minimum (saturated) resistivity of the four samples selected from the borings ranged from 7,255 ohm-cm to 10,586 ohm-cm.

As shown above, the pH of the water sample collected from the creek was 8.3 with water soluble chloride and sulfate ion concentrations of 19.9 mg/L and 63.7 mg/L. The minimum resistivity of the water sample was 1,686 ohm-cm.

4.3 CONCLUSIONS

Soil samples were obtained for corrosion analysis from Borings R-07-011 through R-07-014. As shown in the preceding Table 4-1, the soil and water 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. In addition, the proposed bridge structure is not located within 1,000 feet (300 meters) of salt or brackish water. Therefore, according to the Guidelines, the soil and water at the site are considered non-corrosive.

4.4 RECOMMENDATIONS

4.4.1 Buried Reinforced Concrete Structures and CIDH Piles

Buried concrete structures and 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. Sand and water 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. At this time, driven steel 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 1.7, April 2013
- Foundation Report Preparation for Bridge Foundations, dated December 2009
- Caltrans ARS Online (v2.3.06)

5.2 GROUND MOTION

The active faults close to the SR84 alignment between Ruby Hill Drive and Jack London Boulevard are the Calaveras, Pleasanton and Las Positas faults. These faults are designated with Maximum magnitudes ranging from 6.4 to 6.9. The SR84 alignment is roughly parallel to the Calaveras fault, and the distance from the site to the Calaveras fault is approximately 5.2 miles.

Table 5-1 Seismic Source Parameters

Fault	Type	M_{Max}	Distance (miles)[1]	Near Field Effects?
Calaveras	strike-slip	6.9	5.2	Y
Pleasanton	strike-slip	6.6	3.3	Y
Las Positas	strike-slip	6.4	2.2	Y

1. Note the horizontal distance provided for each fault is the horizontal distance to the fault trace or surface projection of the top of rupture plane.

Average shear wave velocity, Vs_{30}, in the upper 30 meters of the soil profile is estimated to be 360 meters per second. The Vs_{30} values are based on National Earthquake Hazards Reduction Program (NEHRP) recommendations and correlations based on in-situ SPT data. This Vs_{30} value corresponds to Soil Profile Type D. Shear wave velocity calculations are presented in Appendix F.

5.3 FAULT TYPE, NEAR-FIELD, AND SPECTRAL ACCELERATION INCREASES

The 2007 fault database that accompanies the 2007 Caltrans Deterministic PGA Map indicates the nearby active faults have strike-slip displacement. Therefore, in accordance with Caltrans design procedures referenced above, no increase in design spectral accelerations is required for fault type. However, the project site is located less than 9.3 miles from the nearest active fault, the design spectral accelerations should be modified to account for near-field 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

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 DESIGN ACCELERATION RESPONSE SPECTRA

Based on Caltrans ARS Online, the design seismic response spectrum for the site is presented graphically on Figure 5-1, along with tabulated spectral acceleration values corresponding with varying periods.

Based on plans prepared by the County of Alameda Public Works Agency, Road Division, dated June 1983, the existing Isabel Avenue Bridge (SR 84) Bridge at the Arroyo Del Valle creek crossing is a two-span bridge supported at abutments on the north and south ends (Abutment 1 and Abutment 3) and a middle bent (Bent 2). The abutments and bent are supported on spread footings. Table 6-1 below presents a summary of the design capacities and bottom of footing elevations taken from the plans:

Table 6-1 Spread Footing Data Table, Isabel Avenue Bridge at Arroyo Del Valle

Location	Footing Dimensions	Allowable Bearing Pressure (psf)			Bottom of Footing Elevation (feet)[4]
		DL[1]	DL+LL[2]	ALL[3]	
Abutment 1	3 feet wide by 40 feet long	4,000	6,000	8,000	408.5
Bent 2	5 feet wide by 32 feet long	6,000	8,500	11,000	398.5
Abutment 3	3 feet wide by 40 feet long	4,000	6,000	8,000	408.0

Notes:
1. DL = Dead load only;
2. DL+LL = Dead plus live loads;
3. ALL = All loads including wind and seismic
4. Bottom of footing elevation converted from project plans (datum NGVD29) to current project datum based on NGVD88

Pertinent available as-built plans for the bridge are provided in Appendix G. Notes on the General Plan (1983) indicate that footings at Abutments 1 and 3 were to be overexcavated to depths of about 5 and 4½ feet, respectively, to remove loose subgrade material. The resulting excavations were to be backfilled with compacted select material. Overexcavation was not required on the plans for the footing at the center bent.

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,
- Projected scour at the bridge bent and abutments, and
- Settlement of underlying soils due to new structural dead and live loads.

Based on the available subsurface data, deep foundations consisting of CIDH piles would be appropriate for support of the proposed trail bridge. We believe that installation of CIDH piles in gravel and cobbles will be less problematic than driving precast concrete piles or larger diameter steel pipe piles. The following sections present the geotechnical design parameters for CIDH piles that are consistent with design procedure adopted by Caltrans.

7.2 PILE DESIGN CAPACITY AND TIP ELEVATION

7.2.1 Axial Pile Capacity Analysis

We understand the Structural Engineer has elected to use 24-inch-diameter CIDH piles for support of the abutments and bent of the proposed trail bridge. Current Caltrans practice is to design abutments in accordance with working stress design (WSD) methodology and bent in accordance with the LRFD. Table 7-1 presents a summary of the foundation design data provided by the Structural Engineer.

Table 7-1 Foundation Design Data Table for Trail Bridge at Arroyo Del Valle

Location	Design Method	Pile Type	Finished Grade Elevation (ft)	Cut-off Elevation (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (inch)	No. of Piles per Support
					B	L		
Abut 1	WSD	24-inch CIDH	412.00	405.00	10.00	23.67	1.00	6
Bent 2	LRFD	24-inch CIDH	405.00	397.50	16.00	16.00	1.00	9
Abut 3	WSD	24-inch CIDH	413.00	405.00	10.00	23.67	1.00	6

The design loading conditions and nominal resistance were in accordance with the LRFD approach. Loads from LRFD service-I Limit State are used as design loads for WSD of the abutments. Table 7-2 presents the foundation design loads.

Table 7-2 Foundation Design Loads for Arroyo Del Valle Trail 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	810	160	700	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bent 2	1,120	N/A	1,020	1,610	240	0	0	910	320	0	130
Abut 3	700	145	600	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 developed in the subgrade soils that underlie the site.

Table 7-3 Pile Data Table for Arroyo Del Valle Trail Bridge

Location	Pile Type	Nominal Resistance (kips)		Design Tip Elevation (ft)	Specified Tip Elevation (ft)
		Compression	Tension		
Abut 1	24-inch CIDH	320	0	359.0 (a) 374.0 (c)	359.0
Bent 2	24-inch CIDH	350	130	356.0 (a) 371.0 (b) 374.0 (c)	356.0
Abut 3	24-inch CIDH	290	0	365.0 (a) 374.0 (c)	365.0

Design tip elevation is controlled by the following demands:
(a) Compression, (b) Tension, (c) Lateral

Since local scour zone is estimated to be above the bottom of pile cap, the vertical supporting capacity of soils below the pile cap (Elevation 397.5 feet) is included in determining the design tip elevations. The results of the axial pile capacity analysis, which form the basis for the design tip elevations provided above, are presented in Appendix H. The pile lengths corresponding to the specified tip elevations of 359 feet at Abutment 1, 356 feet at Bent 2, and 365 feet at Abutment 3 are consistent with Caltrans' construction guidelines for CIDH piles since the length to diameter ratios of the piles are less than 30.

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 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 determined assuming that all soils in potential scour

zone have been removed. We used LPILE 5.0 (Reese et al., July 2004) to assist in determining the lateral load resistance of 24-inch-diameter CIDH piles.

Output files for laterally loaded piles at the abutments and bents are presented in Appendix I and include deflection versus depth, bending moment versus depth, shear versus depth, and total stress versus depth. Charts showing lateral load versus deflection and lateral load versus maximum bending moment for free and fixed head condition at top of pile are included in Appendix I.

California Amendment to AASHTO LRFD Bridge Design Specifications recommends that a P-multplier (Pm) be applied to the lateral capacity of individual piles to account for pile group efficiency. Table 10-6 presents the Caltrans recommended Pm for the corresponding rows of piles within a group based on Caltrans Amendments of AASHTO LRFD, Section 10.7.2.4. Row 1 refers to the leading row of piles in the direction of loading.

Table 7-4 Pile P-Multiplier, Pm for Multiple Row Shading

Pile Center-to-Center Spacing (in the direction of loading)	Group Efficiency Factor (P-Multiplier, Pm)		
	Row 1	Row 2	Row 3 and higher
2 x Pile Width/Diameter (B)	0.60	0.35	0.25
3 B	0.75	0.55	0.4
5 B	1.0	0.85	0.7
7 B	1.0	1.0	0.9

If additional lateral capacity is needed beyond the lateral load capacity of the PCPS piles at abutments, passive resistance against the abutment walls or pile cap can be utilized, provided that abutment backfill meets the requirements for Caltrans structure backfill. For abutments, Caltrans limits the soil resistance at the back wall to a 5.5 foot wall height and a maximum uniform soil pressure of 5,000 pounds per square foot (psf). For wall heights less than 5.5 feet, the average unit pressure should be reduced linearly in proportion to the height. The uniform soil pressure of 5,000 psf is an ultimate value, and should be used with an appropriate load resistance factor for the service limit-state consistent with the LRFD approach.

7.3 CIDH PILE INSTALLATION

All CIDH piles should be installed in accordance with Section 49 of the Caltrans Standard Specifications, Piling and the project special provisions.

Based on Borings R-07-011 through R-07-014, R-08-037, and R-08-038, we anticipate that proposed CIDH piles will be drilled through predominantly granular soils consisting of very dense clayey sand and clayey gravel. The clayey sand deposits contain numerous gravel pieces. Since groundwater is relatively shallow, some sloughing and caving can be expected in CIDH pile excavations. Therefore, we recommend the Contractor have casing 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 5 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 Caltrans standards may be used to facilitate CIDH pile construction. The Contractor should

anticipate some difficulty during auguring and casing installation due to the gravels encountered at the site.

Concrete should be placed by the tremie method. Concrete placement operations should be controlled to confirm 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 trail bridge approach will be approximately 5 to 8 feet in height; we estimate that settlement due to the weight of new fills will be less than about ½ 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 the existing slopes along Arroyo Del Valle at the proposed trail bridge are inclined at about 2:1 (horizontal:vertical). The General Plan (Appendix A) for the structure indicates that rock slope protection is to be placed along the slope at an inclination of 2:1. The embankment soils consist primarily of medium dense to very dense silty and clayey sands and gravels with thin interbeds of lean clay, which in our opinion, are sufficiently strong to support the proposed 2:1 slopes.

Because liquefaction potential at the abutments is considered to be low, we believe that potential for lateral spreading is also low. Based on the bridge hydraulic report, slopes as steep as 1:1 could form at the center bent due to scour during the design flood event. For that reason, we recommend that Caltrans inspect the condition of channel bed and slopes following any flood event (flood refers to return period greater than 10 years), and perform maintenance work as necessary.

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 FOUNDATION EXCAVATION

Pile caps should be excavated as required to bring those areas to their finish subgrade elevations. All loose soil should be removed prior to pile cap construction. Because shallow groundwater could be encountered during excavation for pile caps at abutments and center bent, we recommend the type of excavation be classified as a "Structure Excavation Type D" in accordance with the Bridge Design Details, 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 5 to 10 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

The bottom of pile cap at the center bent is planned at Elevation 397.50 feet and the bottom of pile cap at Abutments 1 and 3 is planned at Elevation 405.00 feet. Free groundwater was encountered in Boring R-08-038 at a depth of about 3 feet (Elevation 401 feet). Free groundwater was also encountered at about Elevation 398 feet in Boring A-07-010, located about 300 feet south of Arroyo Del Valle. Drilling fluid was measured at Elevation 400.5 feet in Boring R-08-037, two days after drilling was temporarily stopped. Therefore, it is likely that groundwater will be encountered in the CIDH pile and pile cap excavations.

A temporary cofferdam may be necessary to divert creek flow around the excavations.

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 are located in close proximity to existing bridge foundations, underpinning of the existing footings could be required.

We reviewed comments prepared by Caltrans (June 2, 2008) for the Arroyo Del Valle Trail Bridge FR (April 11, 2008), 65% FR submittal (March 23, 2009), and 95% FR submittal (April 27, 2010). We also reviewed comments prepared by Caltrans (July 7 and October 5, 2014) for the 100% PS&E submittal FR and dated November 26, 2014 for the November 14, 2014 subsequent submittal. Our responses to these comments are incorporated into this report and are presented in Appendix J.

The recommendations presented in this FR are based on information obtained from new explorations made at widely separated locations, site reconnaissance, 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 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, CIDH 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 LOTBs for borings performed by URS are based on interpolation from spot and contour elevations shown on available topographic maps.

The opinions and recommendations presented in this FR 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

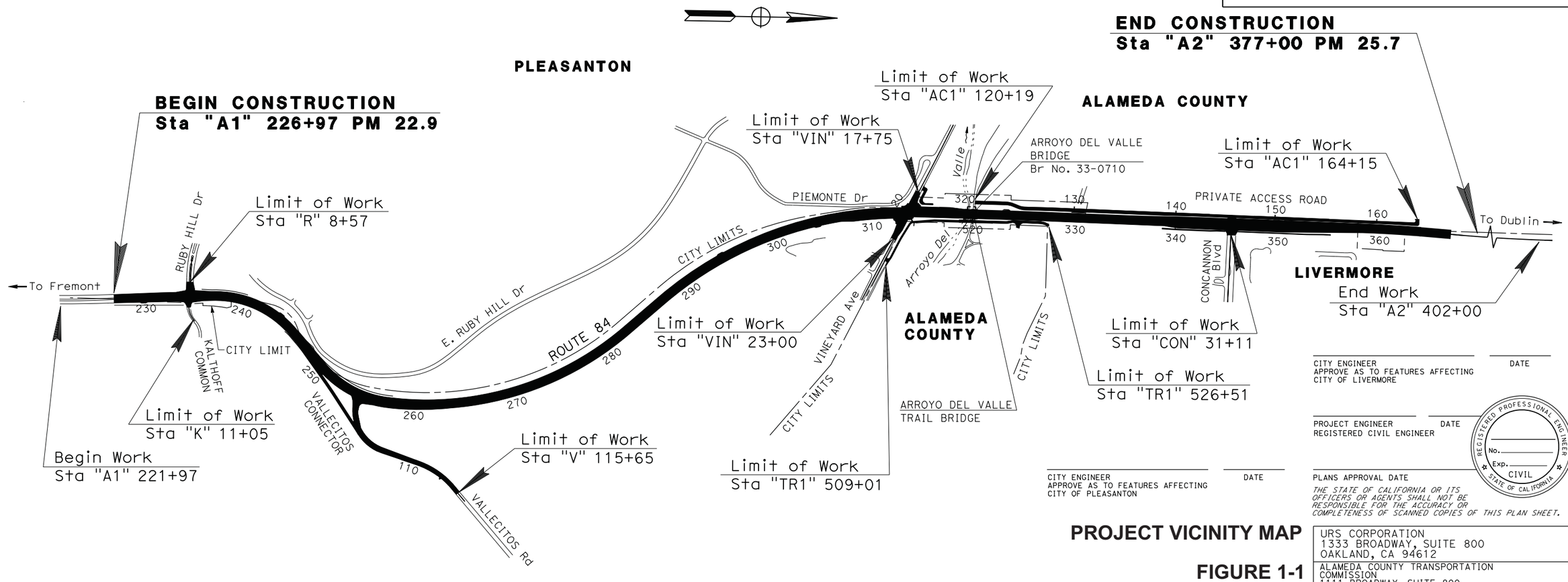
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

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 0.6 MILE NORTH OF CONCANNON BOULEVARD

TO BE SUPPLEMENTED BY STANDARD PLANS DATED 2010

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

LOCATION MAP



CITY ENGINEER
APPROVE AS TO FEATURES AFFECTING
CITY OF LIVERMORE — DATE

PROJECT ENGINEER — DATE
REGISTERED CIVIL ENGINEER

CITY ENGINEER
APPROVE AS TO FEATURES AFFECTING
CITY OF PLEASANTON — DATE

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.

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

PROJECT VICINITY MAP

FIGURE 1-1

THE CONTRACTOR SHALL POSSESS THE CLASS (OR CLASSES) OF LICENSE AS SPECIFIED IN THE "NOTICE TO BIDDERS."

NO SCALE

APPROVED AS TO IMPACT ON STATE FACILITIES AND CONFORMANCE WITH APPLICABLE STATE STANDARDS AND PRACTICES AND THAT TECHNICAL OVERSIGHT WAS PERFORMED.

CONSULTANT DESIGN ENGINEER: RAMSEY J. HISSEN — REGISTRATION No. 39838 — LICENSE Exp DATE 12-31-15 — DATE SIGNED

CALTRANS DESIGN OVERSIGHT APPROVAL: NESTOR P. PEREZ — DATE SIGNED

URS CORPORATION
1333 BROADWAY, SUITE 800
OAKLAND, CA 94612

ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 BROADWAY, SUITE 800
OAKLAND, CA 94607

CONTRACT No.	04-297624
PROJECT ID	04000205811

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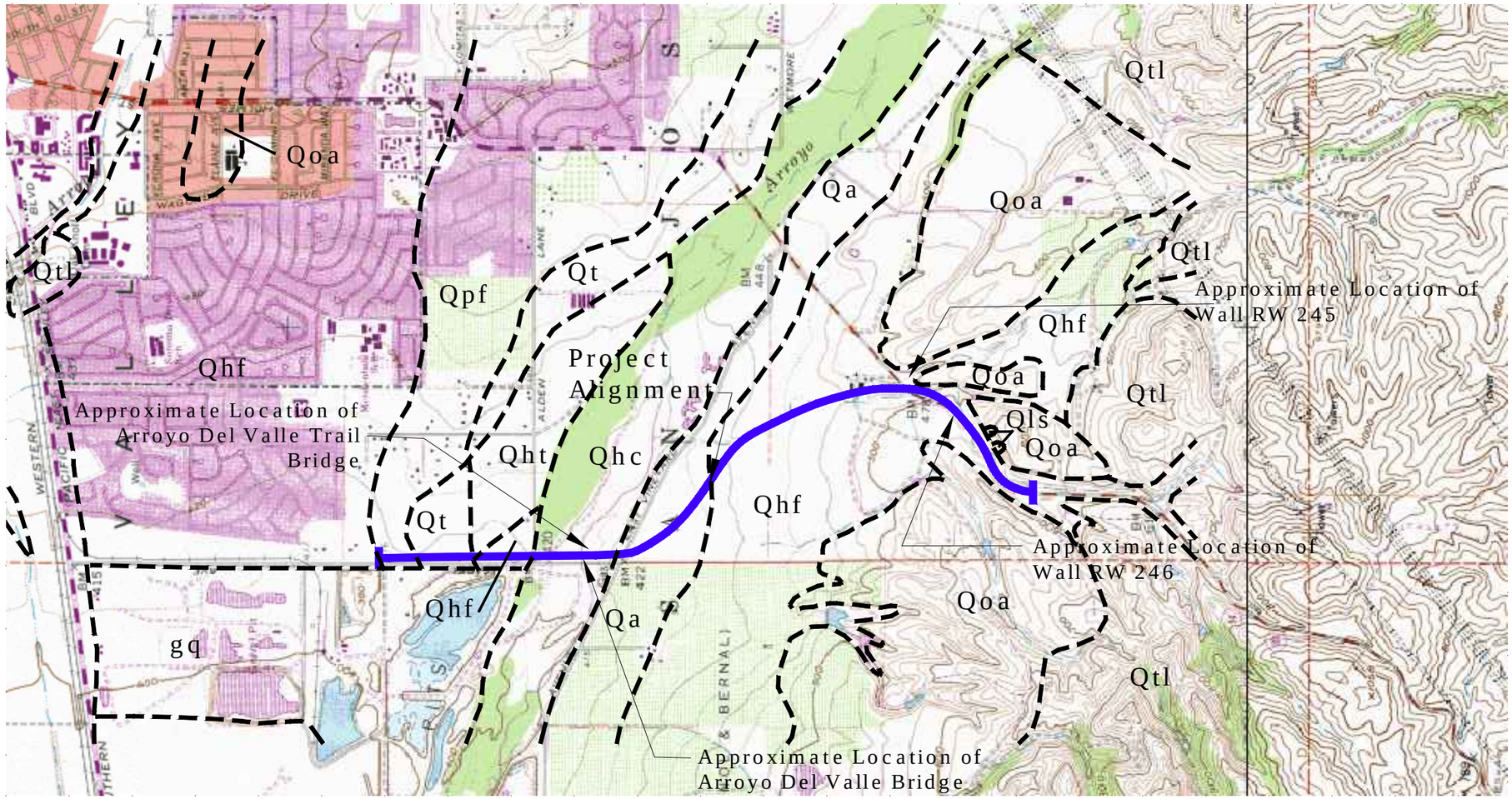


LEGEND:

Approximate geologic contact

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

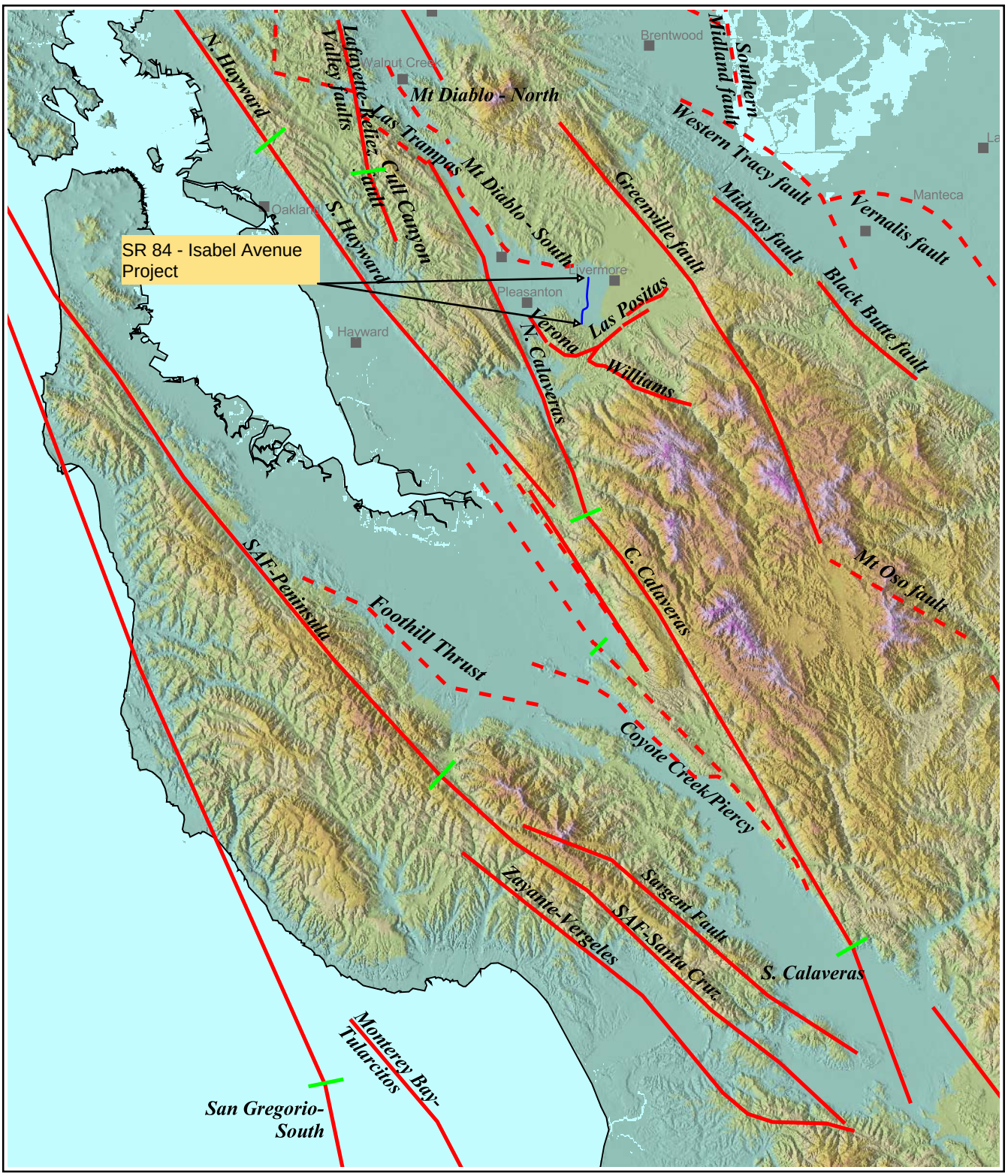
URS

SR 84 Isabel Ave
Livermore, California
Alameda County

SITE AND GEOLOGIC MAP

SCALE
Figure
3-1
November 2014

X:\Route 84 - Isabel Avenue\geotech\seismic\geologic_map\G-GEO-03_1_ArroyoDelValle_.dwg, 11/14/2014 12:24:25 AM, DWG To PDF.pc3



Fault Sources: URS Seismic Hazard Model

URS	28649640 SR 84 - Isabel Ave Livermore, CA	REGIONAL FAULT MAP	Figure **3-2**

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

REGISTERED CIVIL ENGINEER _____ DATE _____

Stephen Huang
No. C 42289
Exp. 3-31-16
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

PLANS APPROVAL DATE _____

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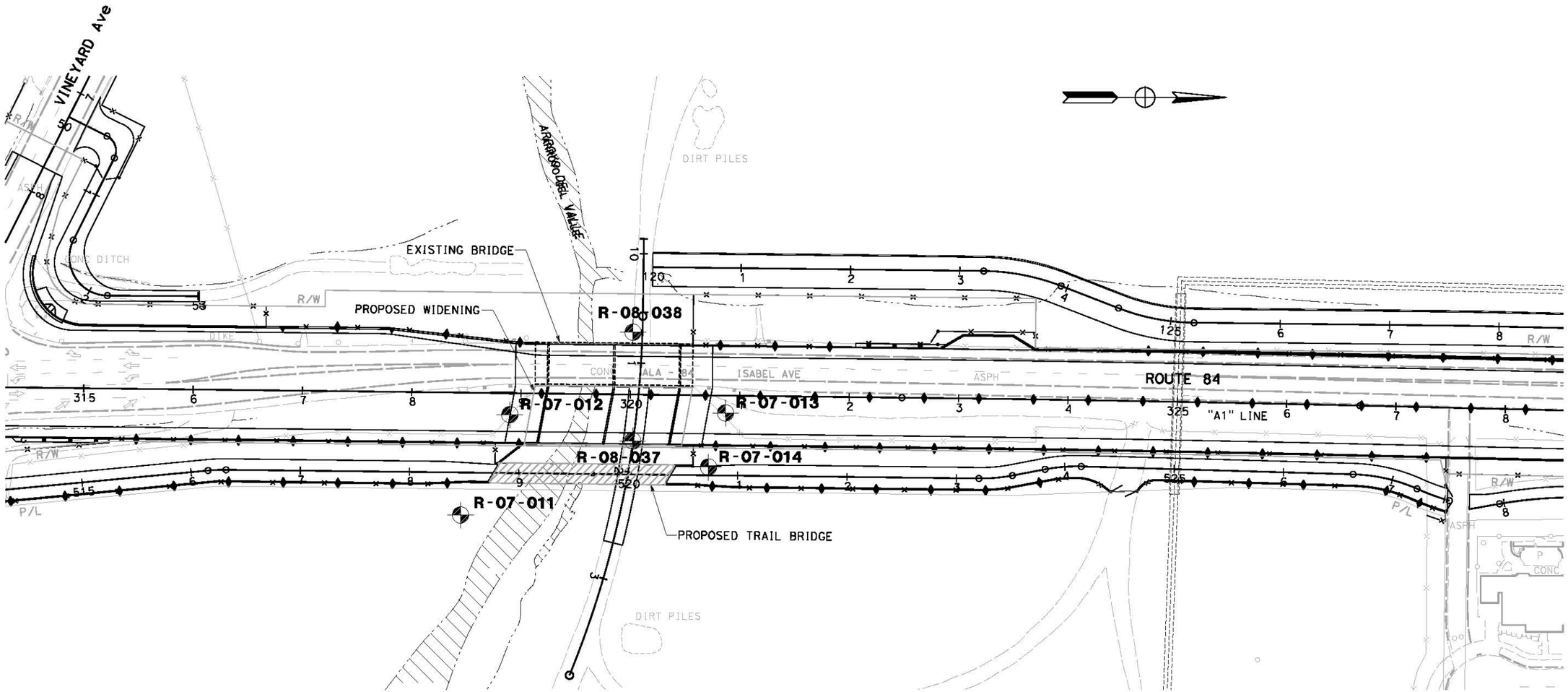
URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION COMMISION
1111 Broadway, Suite 800
Oakland, CA 94607

NOTE:

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.



LEGEND:

EXPLORATORY BORING FROM CURRENT STUDY
R-08-038

ARROYO DEL VALLE TRAIL BRIDGE
SITE AND BORING LOCATION PLAN

SCALE 1"=100'

FIGURE 3-3

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
CALCULATED-DESIGNED BY
CHECKED BY
XXXX | DATE REVISED
XXXX | REVISED BY

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TIME PLOTTED => $TIME
LAST REVISION 5-30-14

BORDER LAST REVISED 7/2/2010
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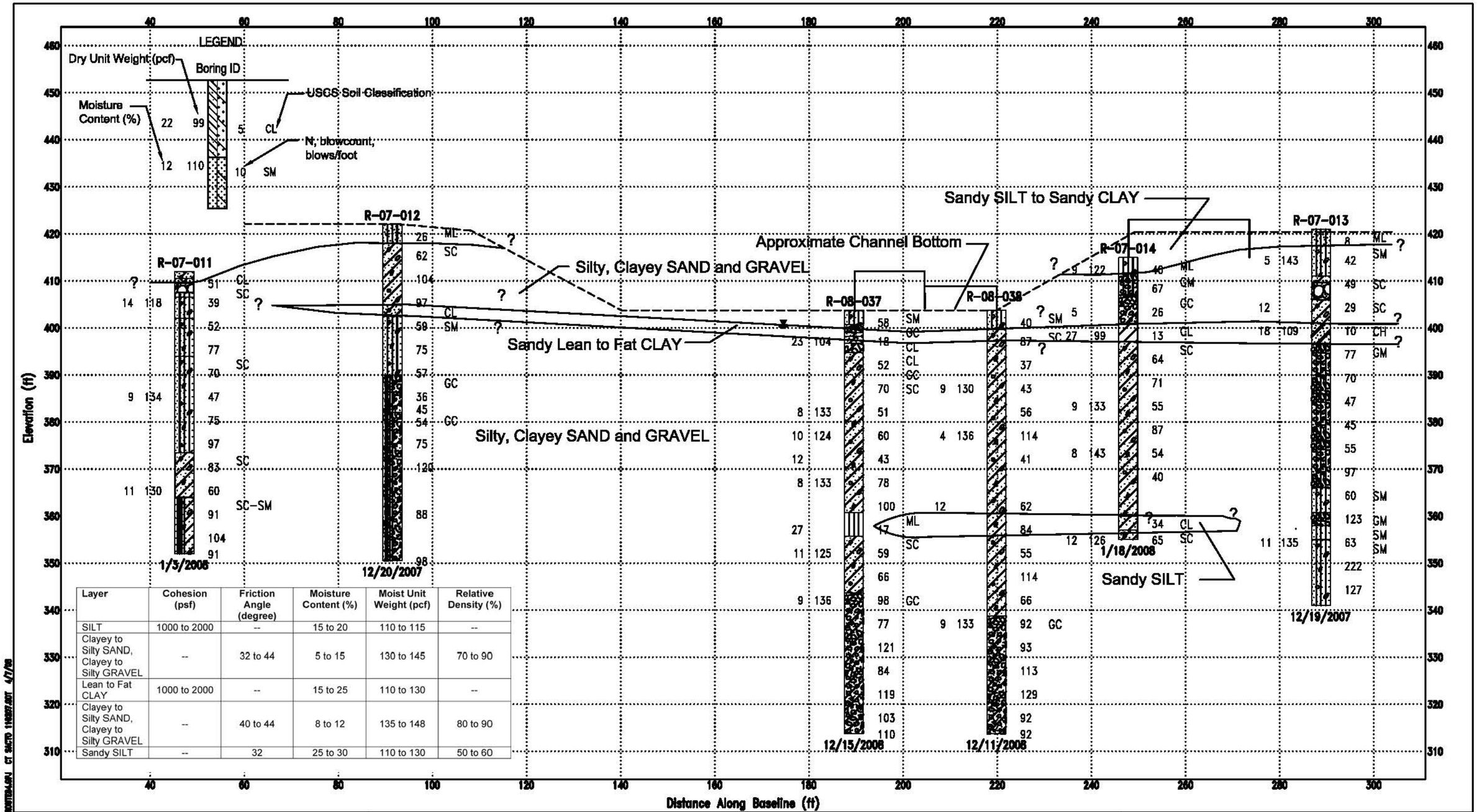
UNIT 0733
PROJECT NUMBER & PHASE 04000205811



Layer	Cohesion (psf)	Friction Angle (degree)	Moisture Content (%)	Moist Unit Weight (pcf)	Relative Density (%)
SILT	1000 to 2000	--	15 to 20	110 to 115	--
Clayey to Silty SAND, Clayey to Silty GRAVEL	--	32 to 44	5 to 15	130 to 145	70 to 90
Lean to Fat CLAY	1000 to 2000	--	15 to 25	110 to 130	--
Clayey to Silty SAND, Clayey to Silty GRAVEL	--	40 to 44	8 to 12	135 to 148	80 to 90
Sandy SILT	--	32	25 to 30	110 to 130	50 to 60

URS Corporation – San Jose

Project Number: 28649640

LITHOLOGY GRAPHICS

USCS Sandy Lean Clay with gravel; USCS Clayey Sand with gravel; Boulders and cobbles; USCS Silty Sand with gravel; USCS Silty, Clayey Sand with gravel

USCS Sandy Silt; USCS Silty, Clayey Gravel with sand; Asphalt; USCS Sandy Fat Clay; USCS Silty Gravel with sand

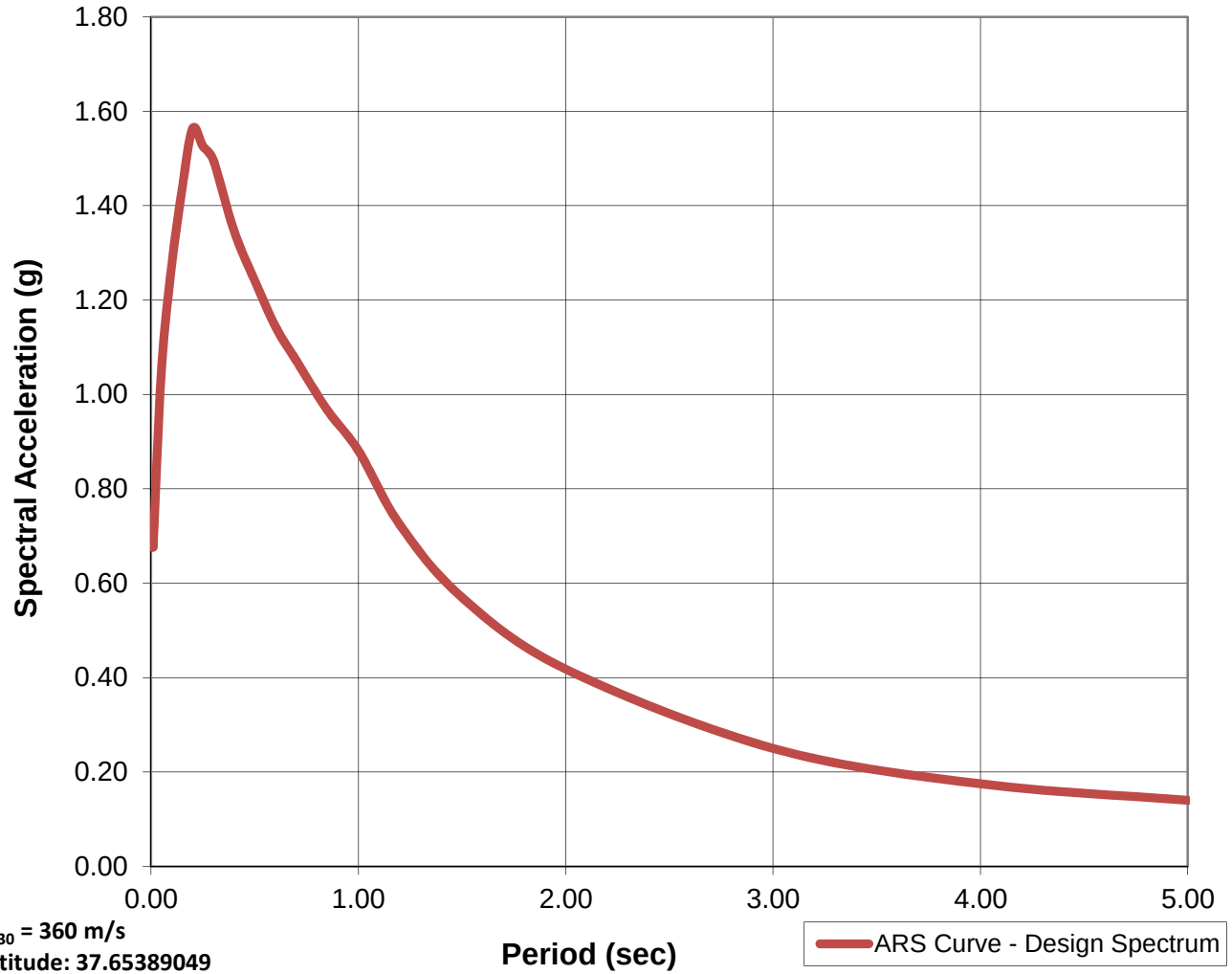
USCS Silty Sand; USCS Silt with gravel; USCS Silty Gravel (poorly graded); USCS Clayey Gravel with sand; USCS Lean Clay

GENERALIZED SOIL PROFILE
ARROYO DEL VALLE CREEK CROSSING
Route 84 Expressway Widening
Alameda County, California

Figure 3-4

SIMPLE FORCE 2 – 8 SIZE 28649640-ROUTE84.PLN CT 04/07/08 10:09:27 4/7/08

Probabilistic ARS Curve (5% Damping) 975 Year Return Period - Design Spectrum



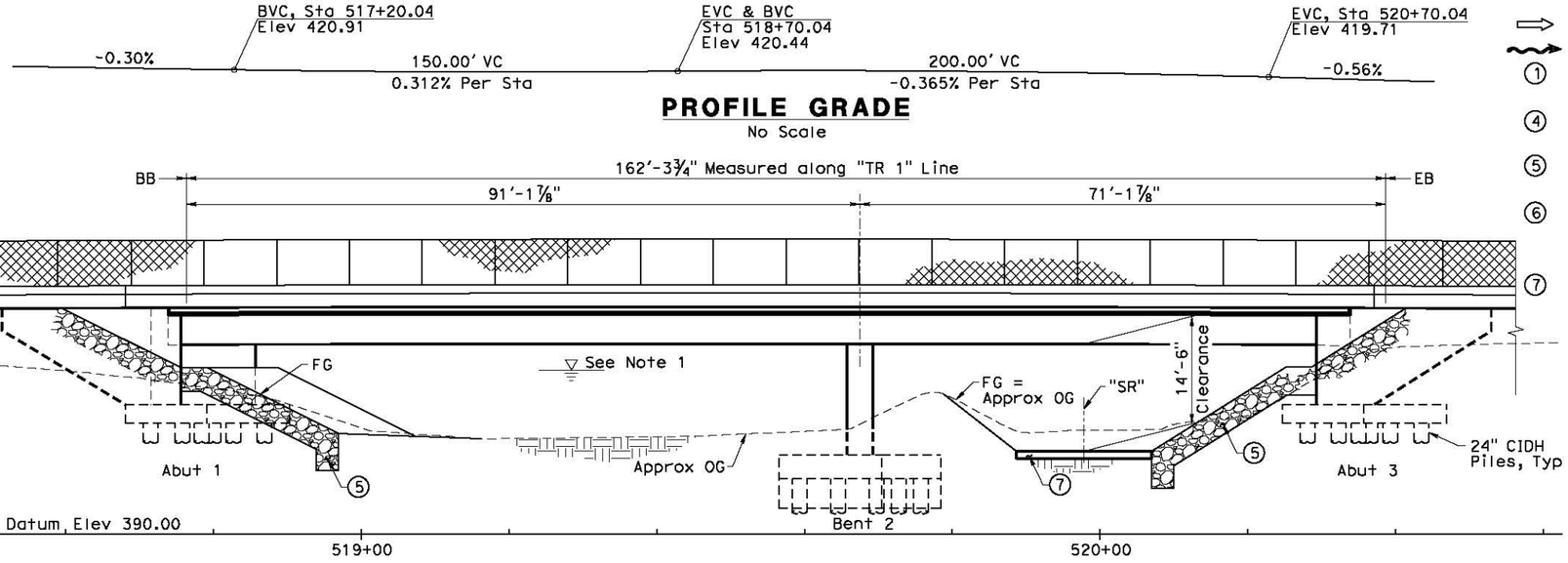
V_{s30} = 360 m/s
Latitude: 37.65389049
Longitude: -121.80558756

Envelope

Period (sec)	SA (g)
0.01	0.68
0.05	1.05
0.10	1.28
0.15	1.44
0.20	1.56
0.25	1.53
0.30	1.50
0.40	1.35
0.50	1.24
0.60	1.14
0.70	1.07
0.85	0.97
1.00	0.88
1.20	0.72
1.50	0.57
2.00	0.42
3.00	0.25
4.00	0.18
5.00	0.14

ARS Curve for ARROYO DEL VALLE TRAIL BRIDGE

Project No. 28649640	Date: April 2014	Project: SR 84 ISABEL - SEGMENT B	Figure 5-1	URS

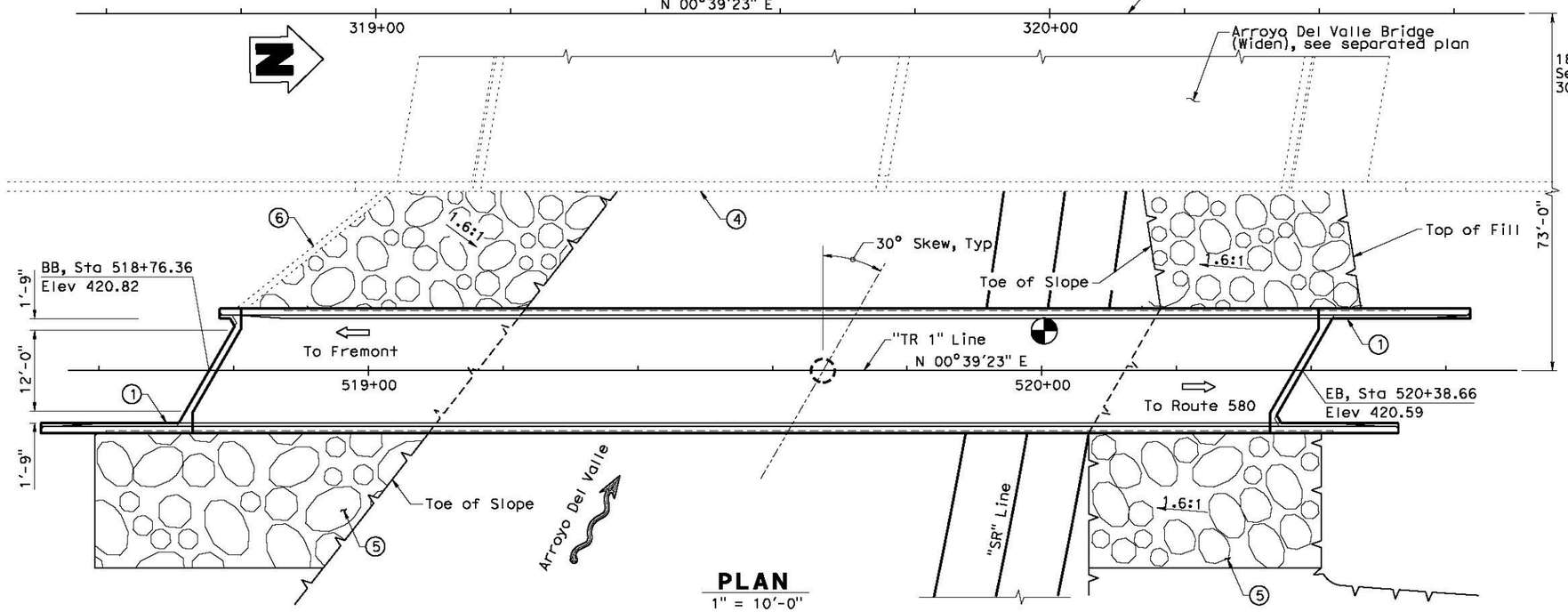


PROFILE GRADE

No Scale

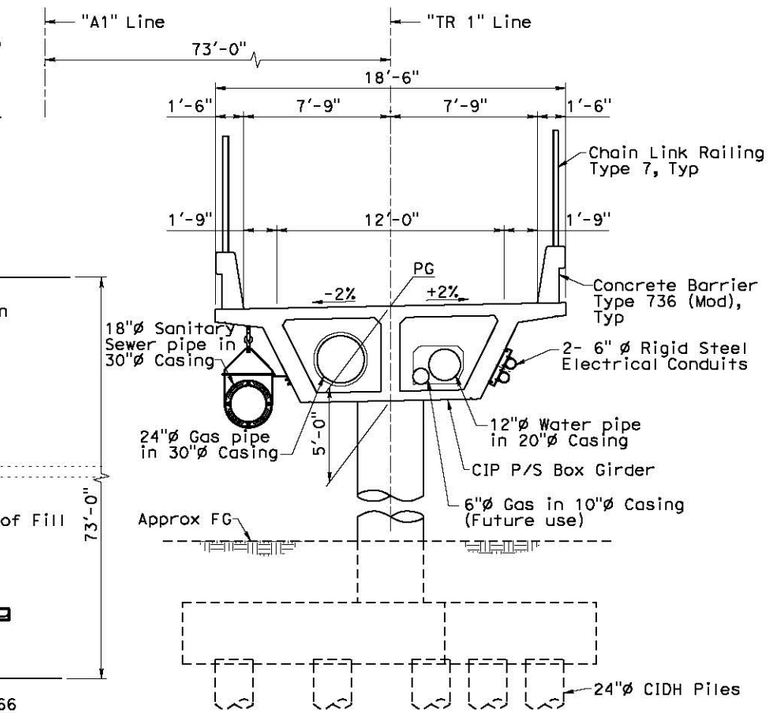
ELEVATION

1" = 10'-0"



PLAN

1" = 10'-0"



TYPICAL SECTION

¼" = 1'-0"

NOTES:

1. For General Notes, Quantities, Pile Data Table and Hydrologic Summary, see "FOUNDATION PLAN" sheet.
2. For Index to Plans, see "DECK CONTOURS" sheet.
3. For alignment and details of Sanitary Sewer, see "Sanitary Sewer Plan", SSD-4.
4. For alignment and details of Water pipe, see "Utility Plan", U-23.
5. For alignment and detail of Gas pipes and Electrical Conduits, see "Joint Utility Trench" sheets.
6. For utility Hanger Details not Shown, See "BRIDGE UTILITY DETAILS" Sheet.

LEGEND

- ⇨ Indicates Direction of Travel
- ⇝ Indicates Direction of Flow
- ① Paint "Arroyo Del Valle Trail Bridge"
- ④ Arroyo Del Valle Bridge (Widen) Bridge No. 33-0710
- ⑤ Rock Slope Protection, See "ROCK SLOPE PROTECTION" SHEET
- ⑥ Type 1 Retaining Wall, see "Arroyo Del Valle Bridge (Widen)" plans
- ⑦ "SR" Road, see "Roadway Plans"

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

Xiangyang Fu 12/22/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — XIANGYANG FU — No. C 72514 — Exp. 06/30/16 — CIVIL — STATE OF CALIFORNIA

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ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 BROADWAY, SUITE 800
OAKLAND, CA 94607

MGE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831

DESIGN OVERSIGHT	DESIGN	BY X. Fu	CHECKED D. Wang	LOAD & RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 AND PERMIT DESIGN VEHICLE		
SIGN OFF DATE	DETAILS	BY K. Wang	CHECKED D. Wang	LAYOUT	BY X. Fu	CHECKED D. Wang	
	QUANTITIES	BY R. Huang	CHECKED W. Sennett	SPECIFICATIONS	BY R. E. Sennett	PLANS AND SPECS COMPARED X. Fu	

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Xiangyang Fu
PROJECT ENGINEER

BRIDGE NO. N/A
POST MILES N/A

ARROYO DEL VALLE TRAIL BRIDGE
GENERAL PLAN

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0733
PROJECT NUMBER & PHASE: 04000205811 CONTRACT NO.: 04-297624

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES				SHEET	OF
03/26/08	10/27/10	05/27/14	12/22/14	1	19

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DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

Xiangyang Fu 12/22/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — XIANGYANG FU — No. C 72514 — Exp. 06/30/16 — CIVIL — STATE OF CALIFORNIA

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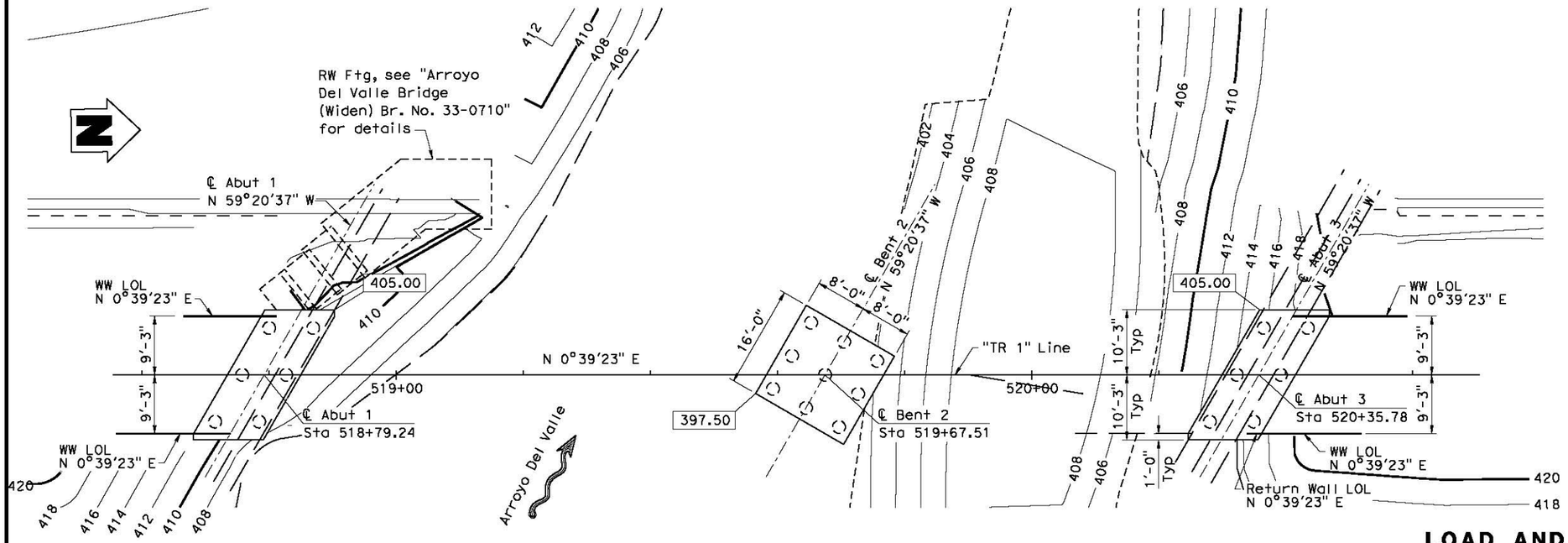
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831



FOUNDATION PLAN

1" = 10'-0"

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	320	0	359.0 (a) 374.0 (c)	359.0
Bent 2	24" CIDH	350	130	356.0 (a) 371.0 (b) 374.0 (c)	356.0
Abut 3	24" CIDH	290	0	365.0 (a) 374.0 (c)	365.0

Design tip elevation is controlled by the following demands:
(a) Compression, (b) Tension, (c) Lateral

HYDROLOGIC SUMMARY

Drainage Area 160 square miles

	Design Flood	Base Flood	Overtopping Flood/Flood of Record
Frequency (Years)	50	100	N/A
Discharge (Cubic feet per second)	5,400	7,000	N/A
Water Surface (Elevation at bridge)	410.55	411.71	N/A

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.

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 VINEYARD, 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

LEGEND

- Indicates Direction of Flow
- XXX.XX Indicates Bottom of Footing Elevation
- Indicates 24" CIDH Piles

GENERAL NOTES
LOAD AND RESISTANCE FACTOR DESIGN

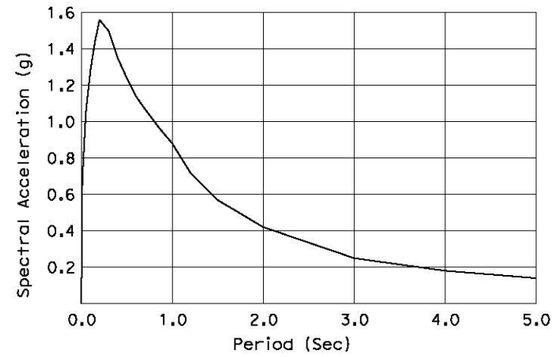
DESIGN: AASHTO LRFD Bridge Design Specifications, 4th Edition and the Caltrans Amendments, Preface dated November 2011; except that Abutments and Concrete Barrier Type 736 are designed using Bridge Design Specifications ('96 AASHTO w/ Revisions by Caltrans)

SEISMIC DESIGN: Caltrans Seismic Design Criteria (SDC) Version 1.7 dated April 2013

DEAD LOAD: Includes 35 psf for future wearing surface

LIVE LOADING: HL93 and Permit Design Vehicle

SEISMIC LOADING: Modified Caltrans SDC ARS Curve
Peak Ground Acceleration = 0.61g
V_{S30} = 360 m/s



ARS CURVE

CONCRETE: fy = 60 ksi
f'c = 3.6 ksi
n = 8
See "Prestressing Notes" on "GIRDER LAYOUT" sheet.

Stephen Hugg 12/22/2014
GEOTECHNICAL PROFESSIONAL APPROVAL DATE

DESIGN OVERSIGHT

SIGN OFF DATE

	BY	CHECKED
DESIGN	X. Fu	D. Wang
DETAILS	K. Wang	D. Wang
QUANTITIES	R. Huang	W. Sennett

PREPARED FOR THE STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

Xiangyang Fu
PROJECT ENGINEER

BRIDGE NO. N/A
POST MILES N/A

ARROYO DEL VALLE TRAIL BRIDGE
FOUNDATION PLAN

DESIGN DETAIL SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0733
PROJECT NUMBER & PHASE: 4000205811 CONTRACT NO.: 04-297624

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES				SHEET	OF
03/08/08	10/21/10	05/27/14	12/22/14	3	19

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DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

GEOTECHNICAL PROFESSIONAL — 11-14-14 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Stephen Huang No. C 42289 Exp. 3-31-16 GEOTECHNICAL STATE OF CALIFORNIA

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URS CORPORATION
1333 BROADWAY, SUITE 800
OAKLAND, CA 94612

ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 BROADWAY, SUITE 800
OAKLAND, CA 94607

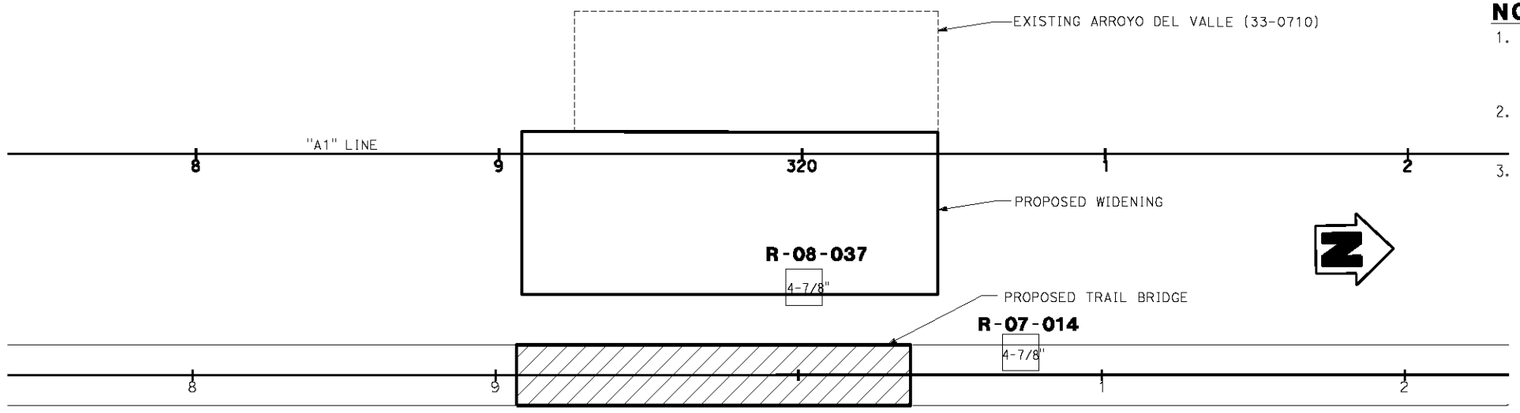
NOTES

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. 400.5 feet in NB37, 2 days after temporyily stopped drilling.
3. Design groundwater level at El. 401 feet.

BENCH MARK

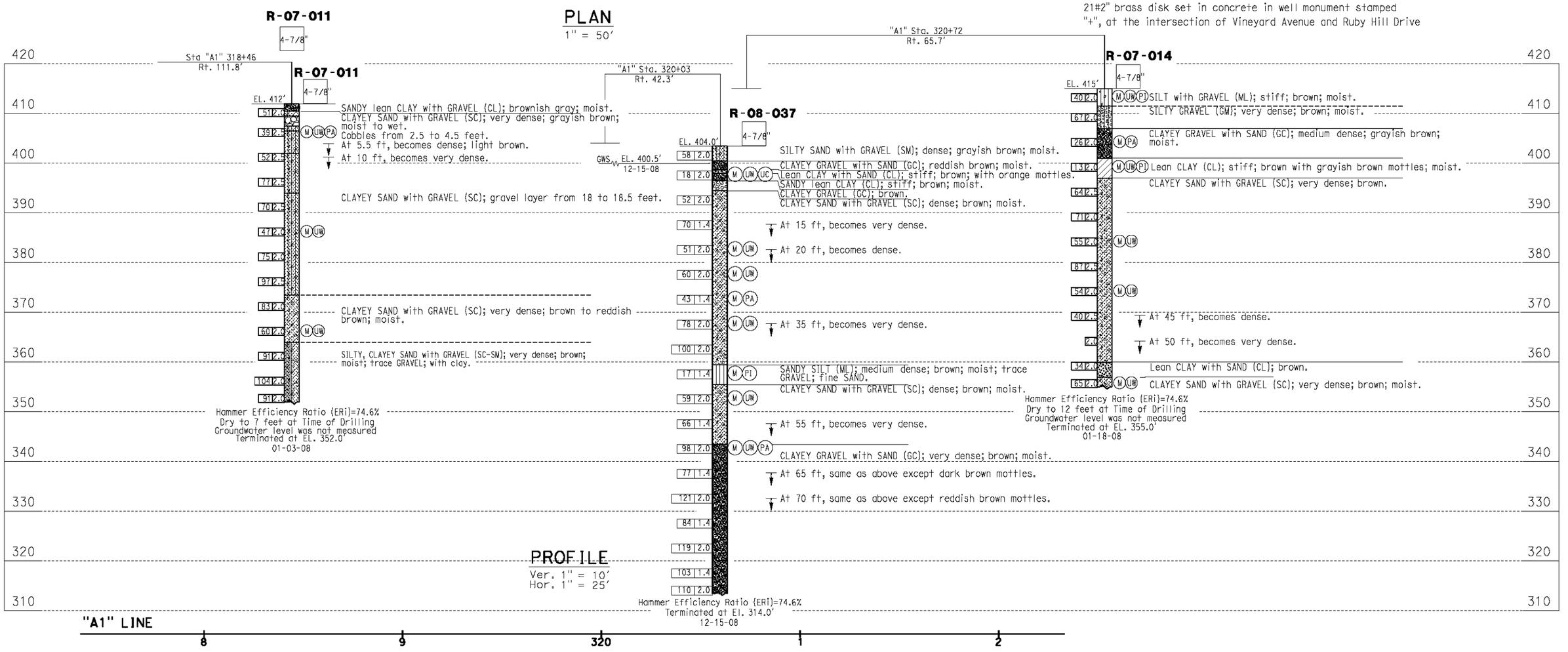
All elevations based on vertical datum NAVD88.
All stations and offsets based on horizontal datum NAD83.

B.M Elev. 415.27
Northing: 2063428.6750
Easting: 6181960.7750
21#2" brass disk set in concrete in well monument stamped "+", at the intersection of Vineyard Avenue and Ruby Hill Drive



PLAN
1" = 50'

PROFILE
Ver. 1" = 10'
Hor. 1" = 25'



DESIGN OVERSIGHT	DRAWN BY	A. Cheung	C. Rambo		PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Stephen Huang	BRIDGE NO. N/A	ARROYO DEL VALLE TRAIL BRIDGE
SIGN OFF DATE	CHECKED BY	A. M. Moore	FIELD INVESTIGATION BY: DATE: Dec 2007-Jan 2008			PROJECT ENGINEER	POST MILES 24.8	LOG OF TEST BORINGS

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0733
PROJECT NUMBER & PHASE: 04000205811 CONTRACT NO.: 04-297624

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES | SHEET | OF

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USERNAME => bmh_huang DATE PLOTTED => 12/10/2014 TIME PLOTTED => 11:37:07 AM

FIELD EXPLORATION PROGRAM

The geotechnical field investigation consisted of six geotechnical borings extending to depths of 60 to 90 feet below the existing ground surface. The borings were performed in December 2007 and December 2008. All explorations were performed by Pitcher Drilling of East Palo Alto, 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 (R-08-011, R-07-012, R-07-013, R-08-014, R-08-037, and R-08-038)

Six rotary wash borings were performed at the proposed bridge location during the current study. At the time of the exploration, borings were designated NB11 through NB14, NB37 and NB38. Boring designations were revised to R-08-011, R-07-012, R-07-013, R-08-014, R-08-037 and R-08-038 in accordance with Caltrans 2007 guidelines.

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. All explorations were advanced 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 12 inches 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 sample were covered with plastic caps, and carefully transported to URS' laboratory in San Jose, California.

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. These tests were performed at the URS laboratory.

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 plastic limit, liquid limit, gradation analyses, moisture content and dry density determinations. Liquid and plastic limit 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 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.

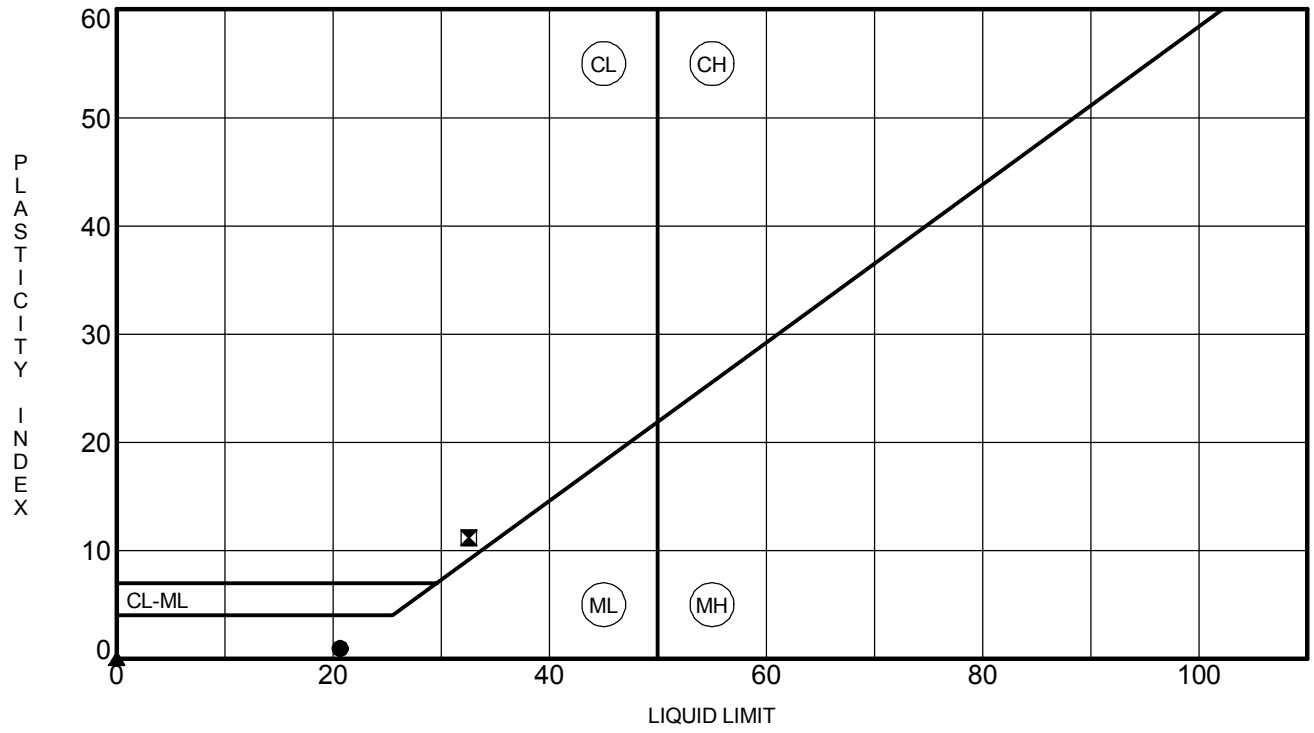
Boring Designation Correlation

The correlation between original and revised boring designations is presented in the following table and is provided for reference with laboratory test data presented in Table B-1 and on Figures B-1 and B-2.

Boring Number (Old)	Boring Number (New)*		Boring Number (Old)	Boring Number (New)*
NB11	R-08-011		NB14	R-08-014
NB12	R-07-012		NB37	R-08-037
NB13	R-07-013		NB38	R-08-038

TABLE B-1
SUMMARY OF LABORATORY TEST RESULTS

Boring or Sample No.	Date Sampled	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)
NB11	2-Jan-08	5		100	98	89	84	62	46	29	19	15	13	12						14	118
NB11		25																		8.7	134
NB11		45																		10.7	130
NB13	18-Dec-07	5																		4.6	143
NB13		15	100	94	94	83	77	57	42	31	23	18	15	13						12	
NB13		20	100	94	100	92	91	88	80	71	65	62	60	53						17.8	109
NB13		65																		11.2	135
NB14	18-Jan-08	1														21	20	1		8.8	122
NB14		10			96	83	75	56	44	34	26	21	16	14						4.8	
NB14		15														33	21	12		27	99
NB14		30																		9.5	133
NB14		40																		7.9	143
NB14		58.5																		12.5	126
NB37	12-Dec-08	5																	1900	23	104
NB37		20																		8.3	133
NB37		25																		10	124
NB37		30	100	92	84	80	75	60	46	34	25	19	15	12						11.8	
NB37		35																		8.4	133
NB37		45														NP	NP	NP		26.6	
NB37		50																		11	125
NB37		60	87	83	79	71	66	52	41	33	26	20	17	15						9.2	136
NB38	11-Dec-08	15																		9.3	130
NB38		25																		4.3	136
NB38		40	100	100	95	87	76	58	42	31	24	19	15	13						12.3	
NB38		65	100	93	81	75	68	57	47	38	31	25	21	18						9.4	133



Sample Identification/Depth (ft)			LL	PL	PI	Fines	Classification
●	**NB14**	**1.0**	**21**	**20**	**1**		**Silty SAND (SM) with gravel (SM)**
⊠	**NB14**	**15.0**	**33**	**21**	**12**		**Lean CLAY (CL) with sand (CL)**
▲	**NB37**	**45.0**	**NP**	**NP**	**NP**		**Sandy SILT (ML) (ML)**

URS

San Jose office

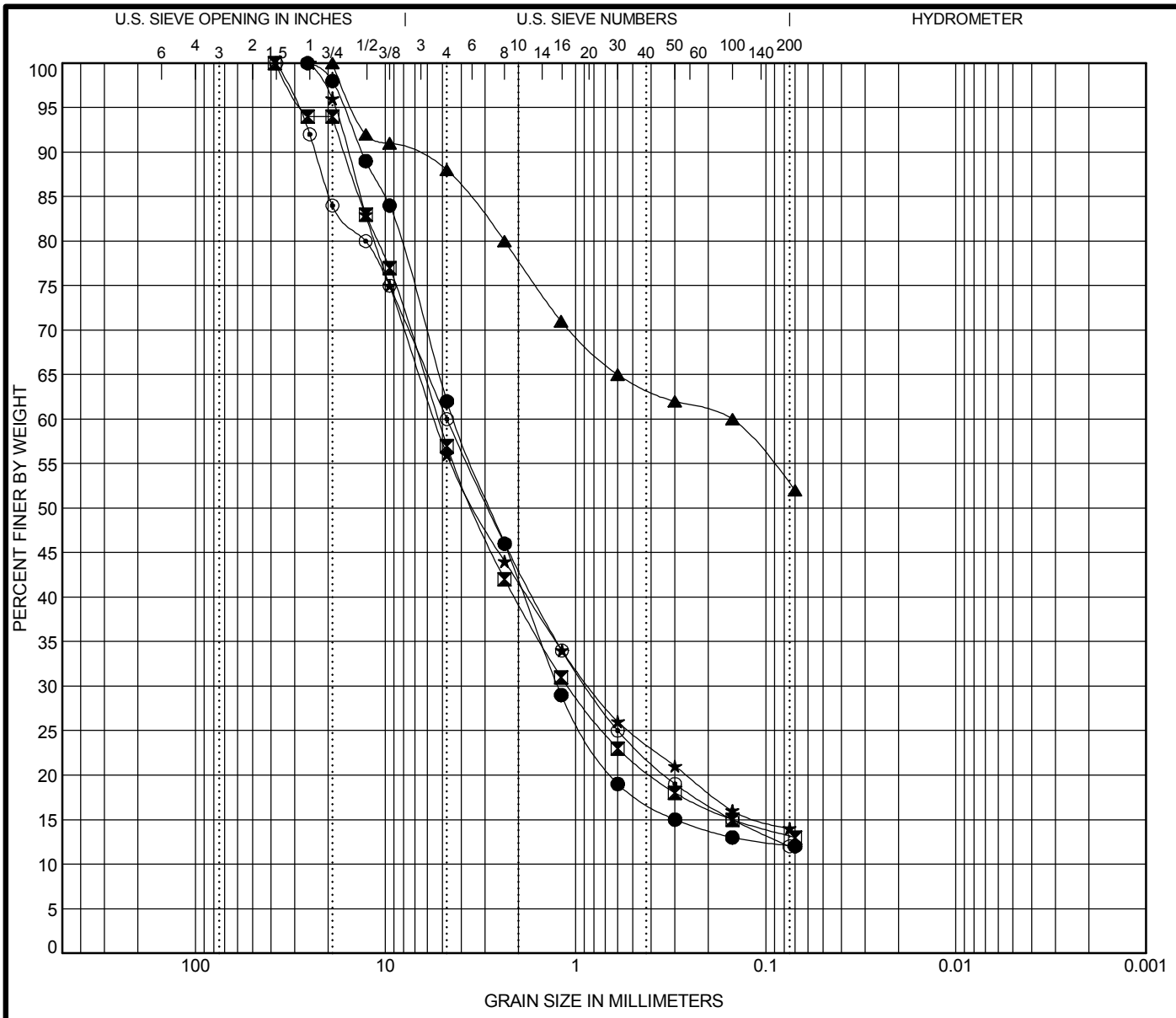
100 W. San Fernando St, Suite 200
San Jose, CA 95113

PLASTICITY CHART

Project Name: SR 84 Expy Widen (URS 28649640)
Location: Alameda 84 22.9/27.1
Number: 297601

Figure B-1

URS PLASTICITY CHART 28649640-ROUTE84.GPJ SNJ_CT.GLB 5/30/14



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample Identification/Depth (ft)		Classification	LL	PL	PI	Cc	Cu
●	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					
⊙	NB37	30.0	Clayey SAND (SC) with gravel				3.40	100.54

	Sample Identification/Depth (ft)		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	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	
⊙	NB37	30.0	37.5	4.75	0.874		40.0	48.0	12.0	

URS

San Jose Office

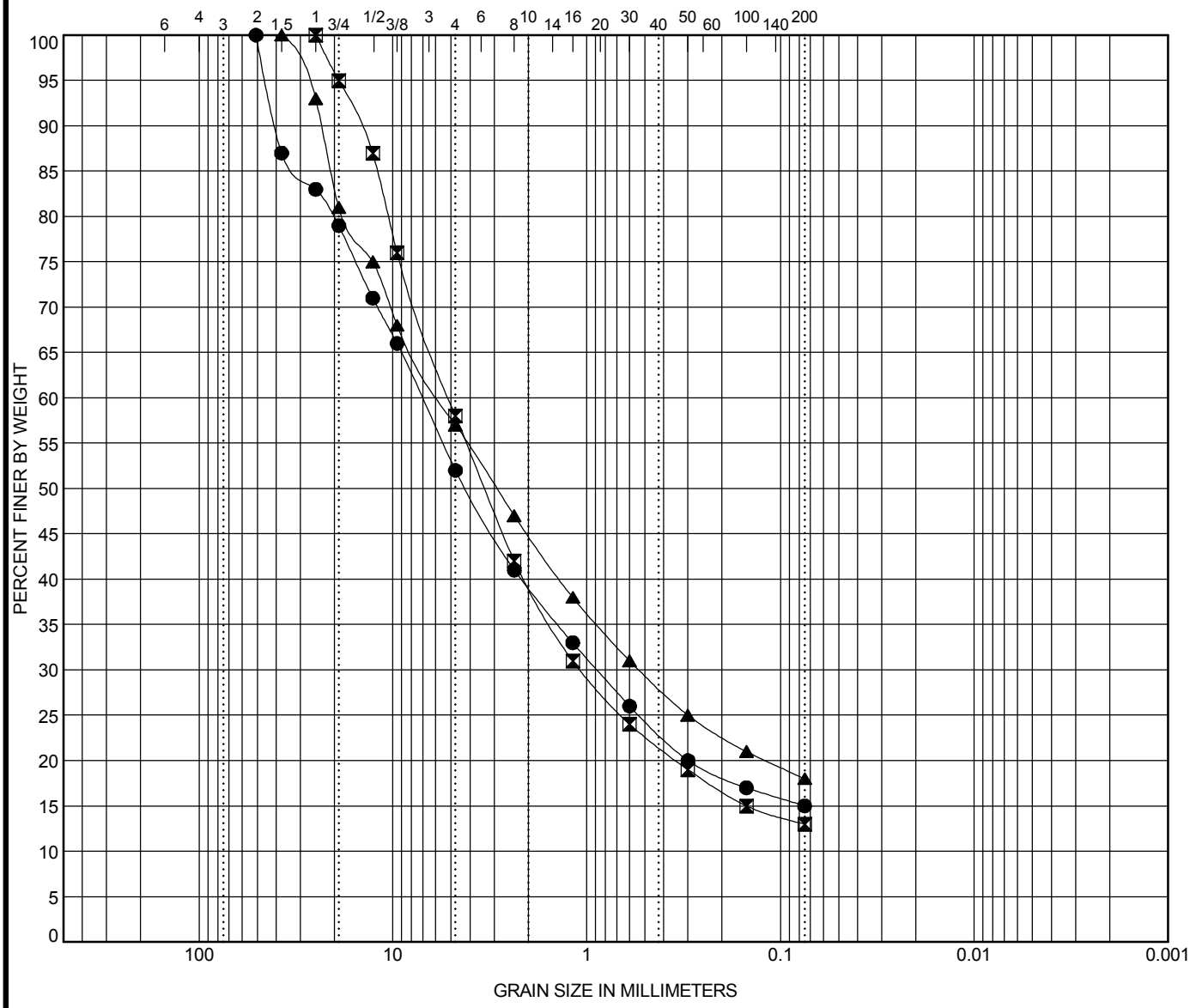
100 W. San Fernando, Ste 200
San Jose, CA 95113

GRAIN SIZE DISTRIBUTION

Project Name: SR 84 Expy Widen (URS 28649640)
Location: Alameda 84 22.9/27.1
Number: 297601

Figure B-2

URS GRAIN SIZE 28649640-ROUTE84.GPJ SNJ_CT.GLB 5/30/14



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample Identification/Depth (ft)		Classification	LL	PL	PI	Cc	Cu
●	**NB37**	**60.0**	**Clayey GRAVEL (GC) with sand**					
⊠	**NB38**	**40.0**	**Clayey SAND (SC) with gravel**					
▲	**NB38**	**65.0**	**Clayey GRAVEL (GC) with sand**					

	Sample Identification/Depth (ft)		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**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

San Jose Office

100 W. San Fernando, Ste 200
San Jose, CA 95113

GRAIN SIZE DISTRIBUTION

Project Name: SR 84 Expy Widen (URS 28649640)
Location: Alameda 84 22.9/27.1
Number: 297601

Figure B-3

URS GRAIN SIZE 28649640-ROUTE84.GPJ SNJ_CT.GLB 5/30/14

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Memorandum

Date: **November 13, 2014**

To: **Tony Nedwick – Hydraulic Engineer, Structure Hydraulics & Hydrology**

Cc: **David Soon – Structure Liaison Engineer, Division of Engineering Services**

From: **Analette Ochoa, P.E. & Jeff Tudd – WRECO**

Subject: **EA 04-297624 State Route 84 Expressway Widening Project – Bridge Design Hydraulic Study Report Amendment**

I. Introduction

This memorandum is an amendment to the State Route 84 Expressway Widening Project (EA 04-297601) *Bridge Design Hydraulic Study Report*. The Bridge Design Hydraulic Study Report was signed by the Registered Civil Engineer for the bridge design on 05/20/2009 (see Attachment C). The current project EA is 04-297624 and the Project ID is 0400020581. On July 3, 2014, Structure Hydraulics & Hydrology comments were provided to the Office of Special Funded Projects, Program Project and Resource Management, Division of Engineering Services. Since then, WRECO has coordinated with URS Corporation and MGE Engineering to address these comments.

The following sections provide amendments to the original report.

II. Executive Summary

The fourth sentence of the first paragraph is as follows: "The piles of the piers for the widened SR 84 Expressway Bridge at Arroyo del Valle and the Trail Bridge at Arroyo Mocho should have tip elevations deeper than the estimated total scour, taking into account the estimated total scour during pile design."

III. Section 1. General Description

The Project Description for EA 04-297624 is amended as follows:

The State Route (SR) 84 Expressway Widening Project (Project), located in Livermore and Pleasanton in Alameda County, proposes to widen and upgrade 2.8 miles of SR 84 from 0.1 mile south of Ruby Hill Drive to 0.6 mile north of Concannon Boulevard to expressway standards (55 miles per hour [mph]). 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, and Concannon Boulevard will be widened and upgraded to accommodate future traffic movements. A connector access will be constructed at the SR 84/Vallecitos Road intersection to accommodate the high volume of traffic moving from northbound SR 84 to the City of Livermore. 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 southward to Vineyard Avenue; a Trail Bridge crossing will be included at Arroyo del Valle. The Project will also construct a new access bridge at Arroyo del

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Valle for local utility and maintenance facilities and widen the existing bridge across Arroyo del Valle. The Project will construct retaining walls where right-of-way is restricted.

The roadway cross section will consist of 12-ft-wide travel lanes and 10-ft-wide shoulders separated by a concrete median barrier. Roadway slopes will vary in steepness depending on safety requirements. Where practical, side slopes will be 4:1 or flatter to provide a clear recovery zone (CRZ) for errant vehicles. Outside the CRZ, side slopes will be 2:1 or flatter. The roadway median area at intersections will be widened up to 36 ft to accommodate left-turn lanes.

IV. Section 2. Description of Watershed

There are no revisions to this section.

V. Section 3. Description of Stream and Site

Section 3.3 Proposed Action of the proposed bridge at Arroyo del Valle is amended to match the alternative founded on 36-in. CIDH piles. The body of the text shall be revised to indicate foundation specifics used in the study and scour analysis. The foundation of the pier is on bridge footing consisting of structural concrete, and below the bridge footing are 36-in. CIDH concrete piles. The bottom of footing elevation is 398.67 ft and the pier wall thickness is 1.5 ft. Although the foundations differ between the latest May 2014 General Plan and the previous version of the General Plan, the bridge length, bridge width, and pier width are the same.

A new bridge General Plan for the SR 84 Expressway at Arroyo del Valle was prepared for the Project dated November 2014 (see Figure 1).

A new bridge General Plan for the Trail Bridge at Arroyo del Valle was prepared for the Project dated November 2014 (see Figure 2).

VI. Section 4. Hydrology

There are no revisions to this section.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

Xiangyang Fu 11/17/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — XIANGYANG FU — No. C 72514 — Exp. 06/30/16 — CIVIL — STATE OF CALIFORNIA

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OAKLAND, CA 94607

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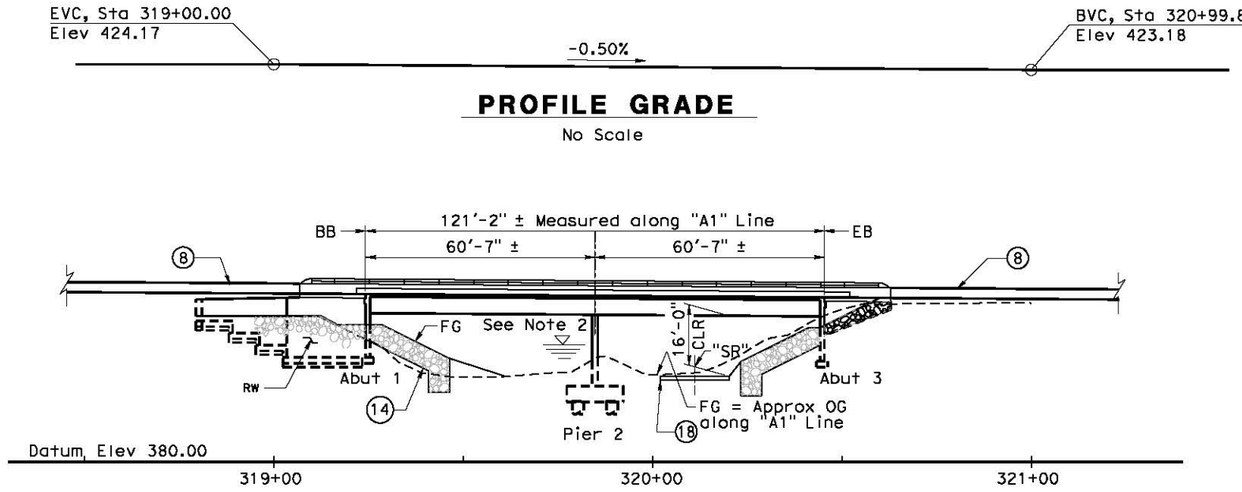
SACRAMENTO, CALIFORNIA 95831

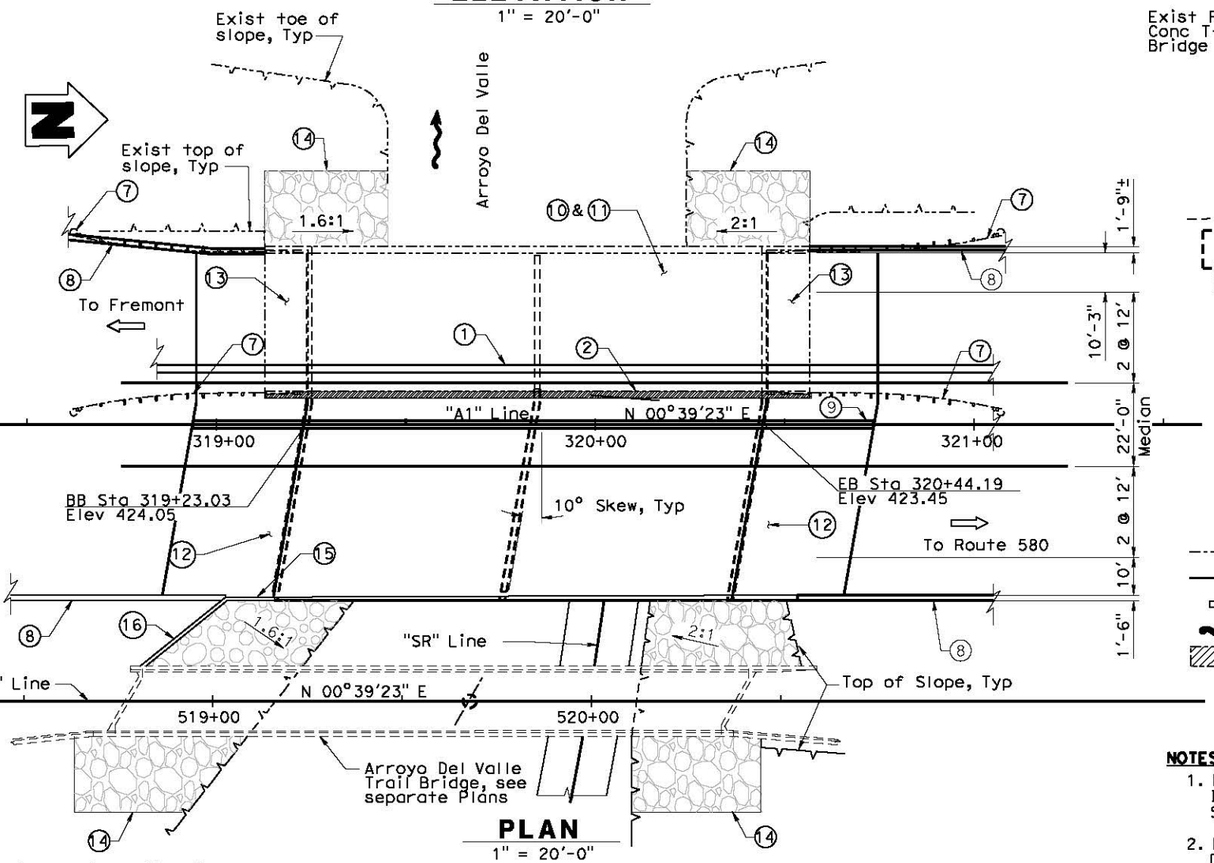


PROFILE GRADE

No Scale

ELEVATION

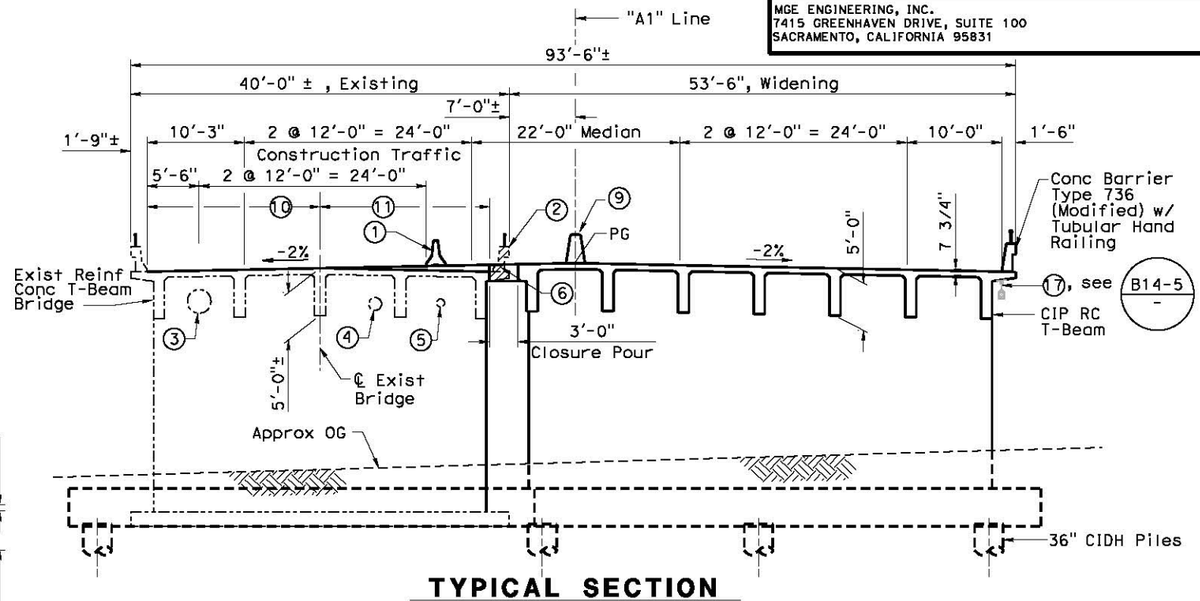
1" = 20'-0"



PLAN

1" = 20'-0"

Note:
The Contractor must verify all controlling field dimensions before ordering or fabricating any material.



TYPICAL SECTION

1/8" = 1'-0"

LEGEND

- Indicates Exist Structure
- Indicates New Construction
- Indicates Direction of Travel
- Indicates Direction of Flow
- Indicates Bridge Removal (Portion)

NOTES:

1. For General Notes, Quantities and Index to Plans, see "GENERAL NOTES" Sheet.
2. For Pile Data Table, Spread Footing Data Table and Hydrologic Summary, see "FOUNDATION PLAN" sheet.

NOTES:

1. Temporary Railing (Type K), see "Roadway Plans"
2. Remove Existing Barrier, Railing & Overhang
3. Existing 30" ø Steel Casing to remain
4. Existing 16"ø DIP Sewer Line to be relocated by others
5. Existing 12"ø Water Line to remain
6. Existing 2 - 3"ø Conduits to be relocated by others
7. Existing Metal Beam Guard Rail to be removed, see "Roadway Plans"
8. Concrete Barrier, see "Roadway 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 (Varies, 10" max in Thickness) and place 3/4" Polyester Concrete Overlay
12. Structure Approach, Type N (30D)
13. Remove Exist Approach Slab and replace with Structure Approach, Type R (30D)
14. Rock Slope Protection , See "ROCK SLOPE PROTECTION" Sheet.
15. Paint "Bridge No. 33-0710" & "Arroyo Del Valle Bridge"
16. Retaining Wall, Type 1
17. 2" Supply Line (Bridge)
18. "SR" road, see "Roadway Plans"

DESIGN OVERSIGHT	DESIGN	BY X. Fu	CHECKED D. Wang	LOAD & RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 W/"LOW-BOY"; PERMIT DESIGN VEHICLE		
SIGN OFF DATE	DETAILS	BY K. Wang	CHECKED D. Wang	LAYOUT	BY X. Fu	CHECKED D. Wang	
	QUANTITIES	BY W. Sennett	CHECKED R. Huang	SPECIFICATIONS	BY R. E. Sennett	PLANS AND SPECS COMPARED X. Fu	

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Xiangyang Fu
PROJECT ENGINEER

BRIDGE NO.	POST MILES
33-0710	24.8

ARROYO DEL VALLE BRIDGE (WIDEN)

GENERAL PLAN

UNIT: 0733
PROJECT NUMBER & PHASE: 04000205811 CONTRACT NO.: 04-297624

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES				SHEET	OF
03/28/08	10/21/10	05/28/14	11/17/14	1	19

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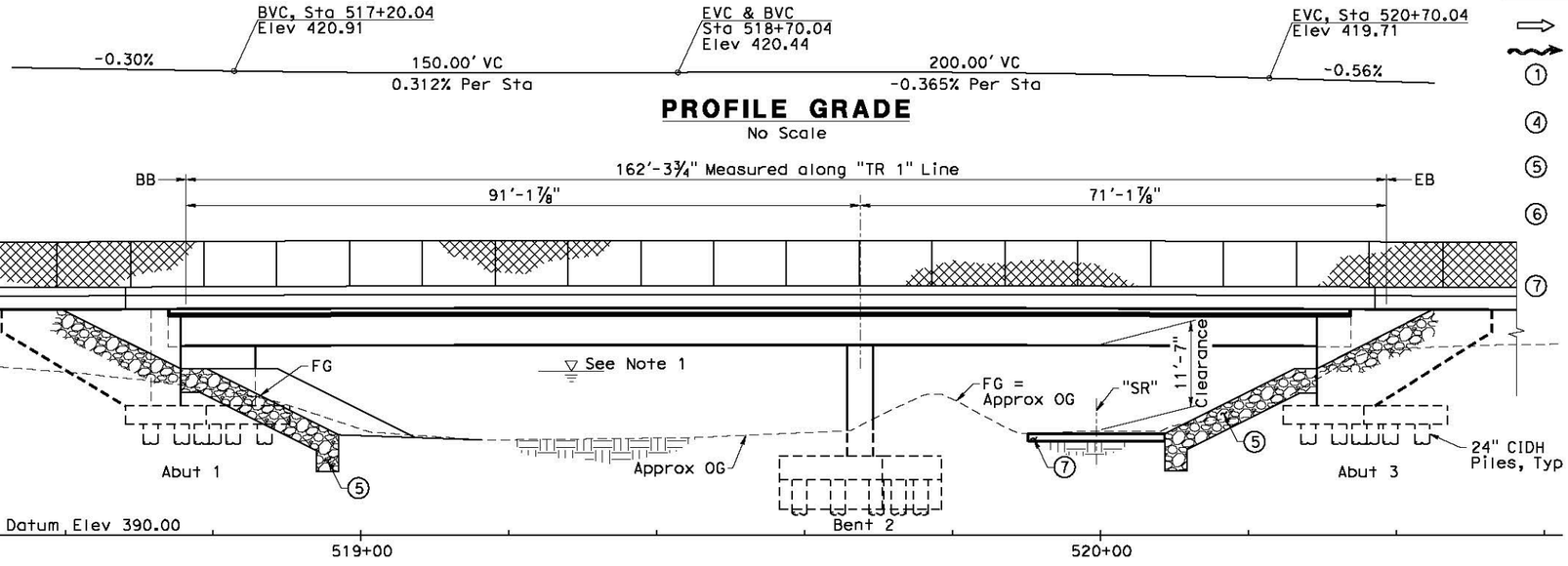

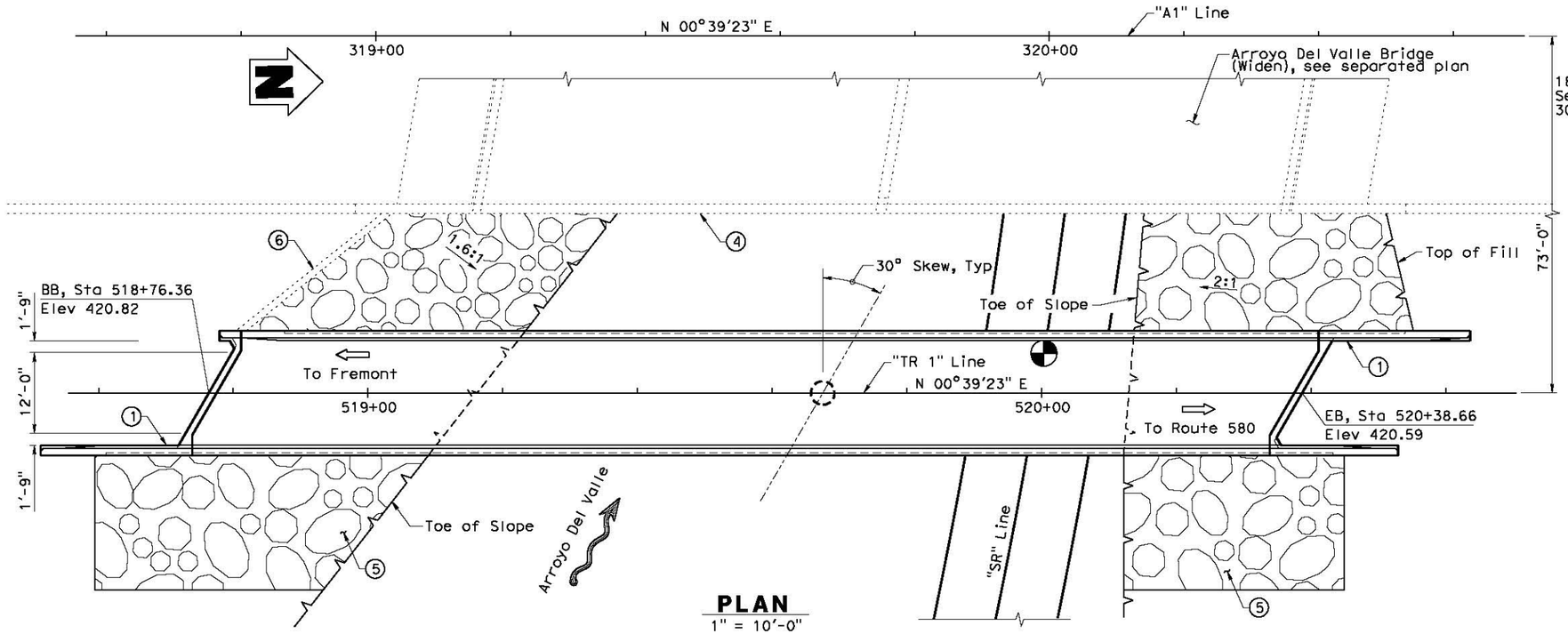

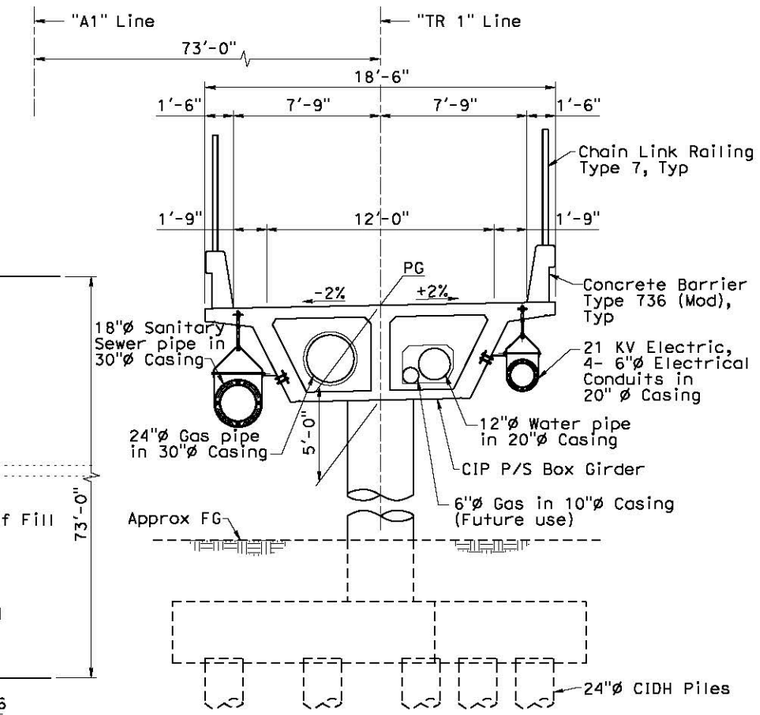

TYPICAL SECTION
¼" = 1'-0"

LEGEND

- ⇨ Indicates Direction of Travel
- ⇝ Indicates Direction of Flow
- ① Paint "Arroyo Del Valle Trail Bridge"
- ④ Arroyo Del Valle Bridge (Widen) Bridge No. 33-0710
- ⑤ Rock Slope Protection, See "ROCK SLOPE PROTECTION" SHEET
- ⑥ Type 1 Retaining Wall, see "Arroyo Del Valle Bridge (Widen)" plans
- ⑦ "SR" Road, see "Roadway Plans"

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

Xiangyang Fu 11/17/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

XIANGYANG FU No. C 72514 Exp. 06/30/16 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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NOTES:

1. For General Notes, Quantities, Pile Data Table and Hydrologic Summary, see "FOUNDATION PLAN" sheet.
2. For Index to Plans, see "DECK CONTOURS" sheet.
3. For alignment and details of Sanitary Sewer, see "Sanitary Sewer Plan", SS-2.
4. For alignment and details of Water pipe, see "Utility Plan", U-10.
5. For alignment and detail of Gas pipes and Electrical Conduits, see "Joint Utility Trench" sheets.

DESIGN OVERSIGHT	DESIGN	BY X. Fu	CHECKED D. Wang	LOAD & RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 AND PERMIT DESIGN VEHICLE		
SIGN OFF DATE	DETAILS	BY K. Wang	CHECKED D. Wang	LAYOUT	BY X. Fu	CHECKED D. Wang	
	QUANTITIES	BY W. Sennett	CHECKED R. Huang	SPECIFICATIONS	BY R. E. Sennett	PLANS AND SPECS COMPARED X. Fu	

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Xiangyang Fu
PROJECT ENGINEER

BRIDGE NO.	ARROYO DEL VALLE TRAIL BRIDGE
N/A	
POST MILES	GENERAL PLAN
N/A	

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0733
PROJECT NUMBER & PHASE: 04000205811 CONTRACT NO.: 04-297624

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES				SHEET	OF
02/09/06	10/27/10	05/27/14	11/17/14	1	18

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VII. Section 5. Hydraulic Analysis

Because updated topo was provided by URS Corporation on November 3 for existing original grade and on November 11 for proposed finished grade, new existing and proposed HEC-RAS models were performed. Table 9 of the original report has been updated by this memorandum's Table 1 and Table 11 of the original report has been updated by this memorandum's Table 2:

Table 1. Arroyo del Valle Water Surface Elevations (ft)

River Station	D/S Length	100-year			50-year		
		Ex	Prop	Change	Ex	Prop	Change
2112	330	413.74	413.19	-0.55	412.40	411.93	-0.47
1782	20	412.91	412.07	-0.84	411.62	410.83	-0.79
1762	0.5	412.88	412.04	-0.84	411.59	410.79	-0.80
U/S Trail Bridge	18.5	N/A	411.93	N/A	N/A	410.71	N/A
D/S Trail Bridge	11	N/A	410.75	N/A	N/A	409.76	N/A
1732	0.5	411.90	410.84	-1.06	410.77	409.83	-0.94
U/S Prop SR 84 Bridge	53.5	N/A	410.52	N/A	N/A	409.59	N/A
U/S Ex SR 84 Bridge	40	409.79	N/A	N/A	409.12	N/A	N/A
D/S Ex / Prop SR 84 Bridge	56	410.20	410.20	0	409.25	409.25	0
1582	55	408.81	408.81	0	407.96	407.96	0
1527	39	407.99	407.99	0	407.46	407.46	0
1488	488	407.89	407.89	0	407.31	407.31	0
1000	0	404.27	404.27	0	404.27	404.27	0

Table 2. Arroyo del Valle Flow Velocities (ft/s)

River Station	D/S Length	100-year			50-year		
		Ex	Prop	Change	Ex	Prop	Change
2112	330	4.97	5.72	+0.75	5.48	6.24	+0.76
1782	20	5.89	6.60	+0.71	5.45	6.18	+0.73
1762	0.5	5.78	6.50	+0.72	5.35	6.06	+0.71
U/S Trail Bridge	18.5	N/A	6.97	N/A	N/A	6.42	N/A
D/S Trail Bridge	11	N/A	10.72	N/A	N/A	9.70	N/A
1732	0.5	9.23	10.09	+0.86	8.45	9.14	+0.69
U/S Prop SR 84 Bridge	53.5	N/A	10.96	N/A	N/A	9.85	N/A
U/S Ex SR 84 Bridge	40	13.23	N/A	N/A	11.63	N/A	N/A
D/S Ex / Prop SR 84 Bridge	56	10.24	10.24	0	9.31	9.31	0
1582	55	12.74	12.74	0	11.78	11.78	0
1527	39	12.25	12.25	0	10.67	10.67	0
1488	488	10.46	10.46	0	9.22	9.22	0
1000	0	5.91	5.91	0	5.43	5.43	0

Generally, there are minimal changes between the existing and proposed conditions. There is no change downstream of the SR 84 Bridge. Upstream of the SR 84 Bridge, flow velocities increase and

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water surface elevations decrease due to the new Trail Bridge and widened SR 84 Bridge. For detailed HEC-RAS results, see Attachment A. Figure 8 of the original report has been updated with this memorandum's Figure 3.

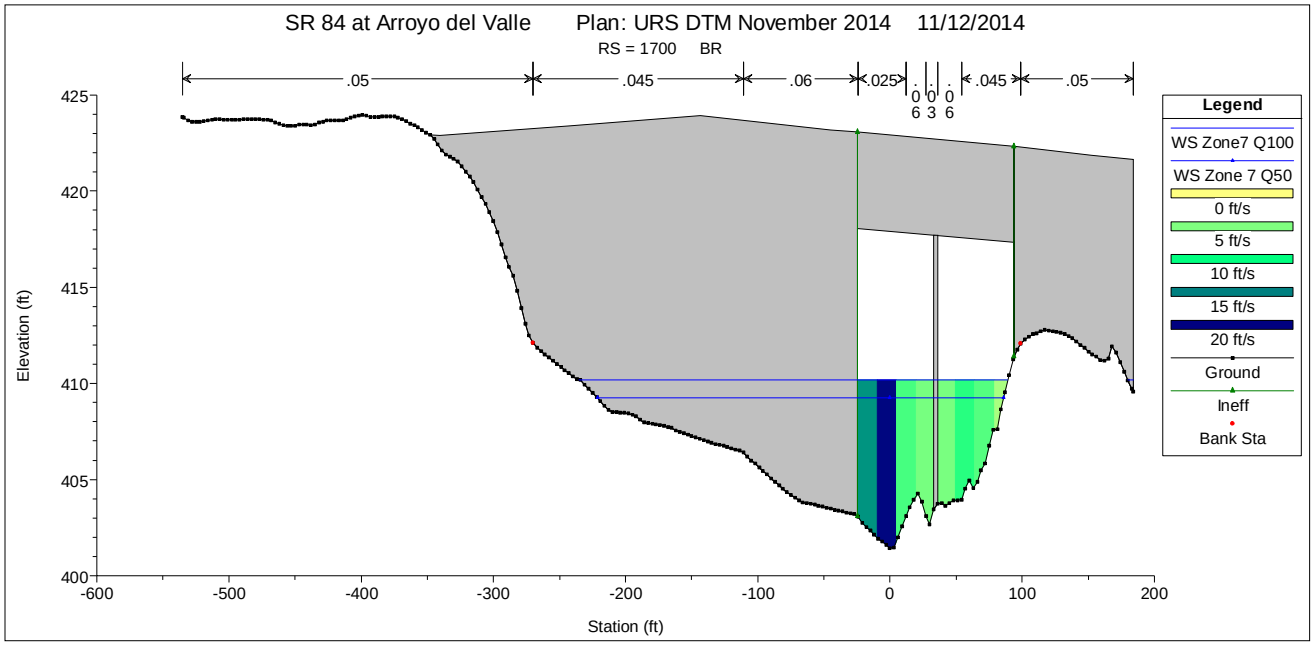

Figure 3. SR 84 Expressway Arroyo del Valle Bridge Cross-Section

Figure 9 of the original report has been updated with this memorandum's Figure 4.

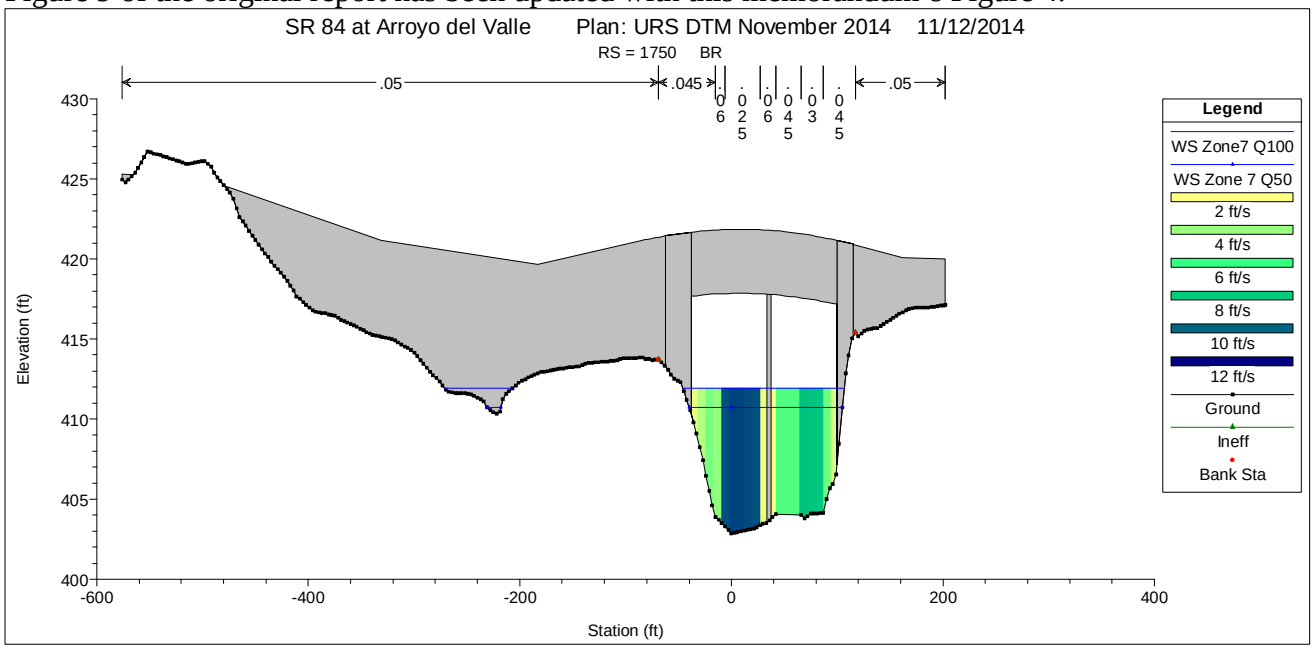

Figure 4. Arroyo del Valle Trail Bridge Cross-Section

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VIII. Section 6. Scour Analysis

To address long term-bed change, two cross sections were compared from the Caltrans Bridge Inspection Reports on 07/20/1999 (Table 3) and 10/18/2011 (Table 4). These cross sections were obtained from the bridge upstream face. Although the thalweg (lowest point of the channel) has increased 1.5 ft, the overall channel bed is stable. See comparison in Figure 5.

Table 3. SR 84 Bridge at Arroyo del Valle BIR 7/20/1999 (measured from top of concrete [2.66 ft])

Location	Horizontal (ft)	Vertical (ft)	Comments
A1	0.00	-14.11	
RSP toe	21.10	-21.69	
EOW	32.84	-24.38	
TW	39.01	-24.51	
EOW	48.85	-22.60	
P2/ top of berm	59.09	-16.63	
Edge of compacted channel	67.36	-22.93	
midpoint of access road	82.09	-22.87	
Edge of compacted channel	95.11	-22.38	
RSP toe	100.46	-20.51	
A3	117.95	-8.92	

Table 4. SR 84 Bridge at Arroyo del Valle BIR 10/18/2011 (measured from top of rail H=2.82 ft)

Location	Horizontal (ft)	Vertical (ft)	Comments
Abutment 1	0.00	-10.05	Face of A1 (top of RSP)
	14.11	-19.89	Toe RSP (EOW)
	31.17	-25.14	Thalweg
	39.80	-23.83	EOW
Pier 2	63.98	-21.86	center P2
	71.52	-22.19	Edge of haul road
	90.75	-22.71	Edge of haul road
	97.77	-20.87	Toe RSP
Abutment 3	118.83	-12.01	Face of A3

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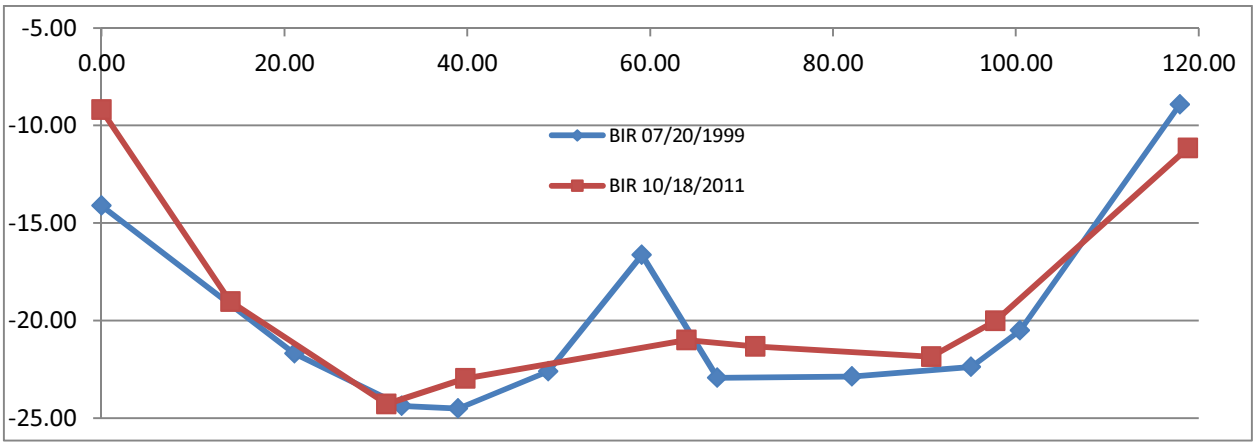

Figure 5. Comparison of BIR Cross-Sections from 07/20/1999 and 10/18/2011 (upstream face)

No berm was surveyed on 10/18/2011. However, Photo 1 shows the berm to the left of the haul road. The berm is necessary for maintaining the haul road and for Arroyo del Valle's flows to be contained on the other side of the berm.

Photo 1. Haul Road and Berm at Arroyo del Valle (taken on 8/25/2014)

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Complex pier scour calculations were performed per the Federal Highway Administration the *HEC-18 Manual* "Evaluating Scour at Bridges," Fifth Edition (April 2012), and the scour analysis was re-evaluated for the SR 84 Expressway Bridge widening at Arroyo del Valle and the new Arroyo del Valle Trail Bridge.

Using the live-bed contraction scour equation at the channel, the calculated contraction scour depths at the channel are:

- 0.2 ft (SR 84 Expressway Bridge at Arroyo del Valle)
- 0.1 ft (Trail Bridge at Arroyo del Valle)

The complex pier scour equations were utilized to determine pier scour at the following locations:

- 1.3 ft (SR 84 Bridge at Arroyo del Valle with 5 ft pile cap overhang extension upstream)
- 4.4 ft (Trail Bridge at Arroyo del Valle)

Using the Froelich Equation to determine live-bed abutment scour, the calculated abutment scour depths are:

- 9.6 ft (Left Abutment) at Arroyo del Valle SR 84 Expressway Bridge
- 1.1 ft (Left Abutment) Trail Bridge at Arroyo del Valle
- 1.2 ft (Right Abutment) Trail Bridge at Arroyo del Valle

The itemized total scour depth for the abutments and piers of the proposed bridge is shown in the following tables and supercede Tables 3 and 4 of the Executive Summary and Tables 13 and 14 of the original report.

Summary of Scour at Proposed SR 84 Expressway Bridge at Arroyo del Valle

Location	Long-term Bed Change	Contraction Scour	Local Scour	Total Scour Depth
Abutment 1	Negligible	0.2 ft	9.6 ft	9.8 ft
Pier 2	Negligible	0.2 ft	1.3 ft	1.5 ft

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	0.1 ft	1.1 ft	1.2 ft
Pier 2	Negligible	0.1 ft	4.4 ft	4.5 ft
Abutment 3	Negligible	0.1 ft	1.2 ft	1.3 ft

For detailed scour calculations, see hand calculations in Attachment B.

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Active gravel mining will be ongoing until 2030 with permits allowing up to 50 feet from the existing State right-of-way. However, we cannot determine the future elevations of the channel flow line at this time, because the CEMEX plans show that Arroyo del Valle will be realigned and relocated to create Lake A and Lake B, but there is no detailed information at the bridge crossing. There is no guarantee that a grade control structure will be built in the future. If the grade control structure is constructed in the future as part of the Zone 7 Reclamation Plan, the permittee would be required to provide justification that further degradation would not occur and the integrity of the bridge would be maintained.

As mentioned in the BDHS' Appendix G, 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 scope of the highway widening project. This matter should be referred to Zone 7 for further action.

To reiterate the BDHS' Appendix G, because the future spillway could block fish passage, its construction may be prohibited by environmental resource agencies. This issue should be further investigated by Zone 7.

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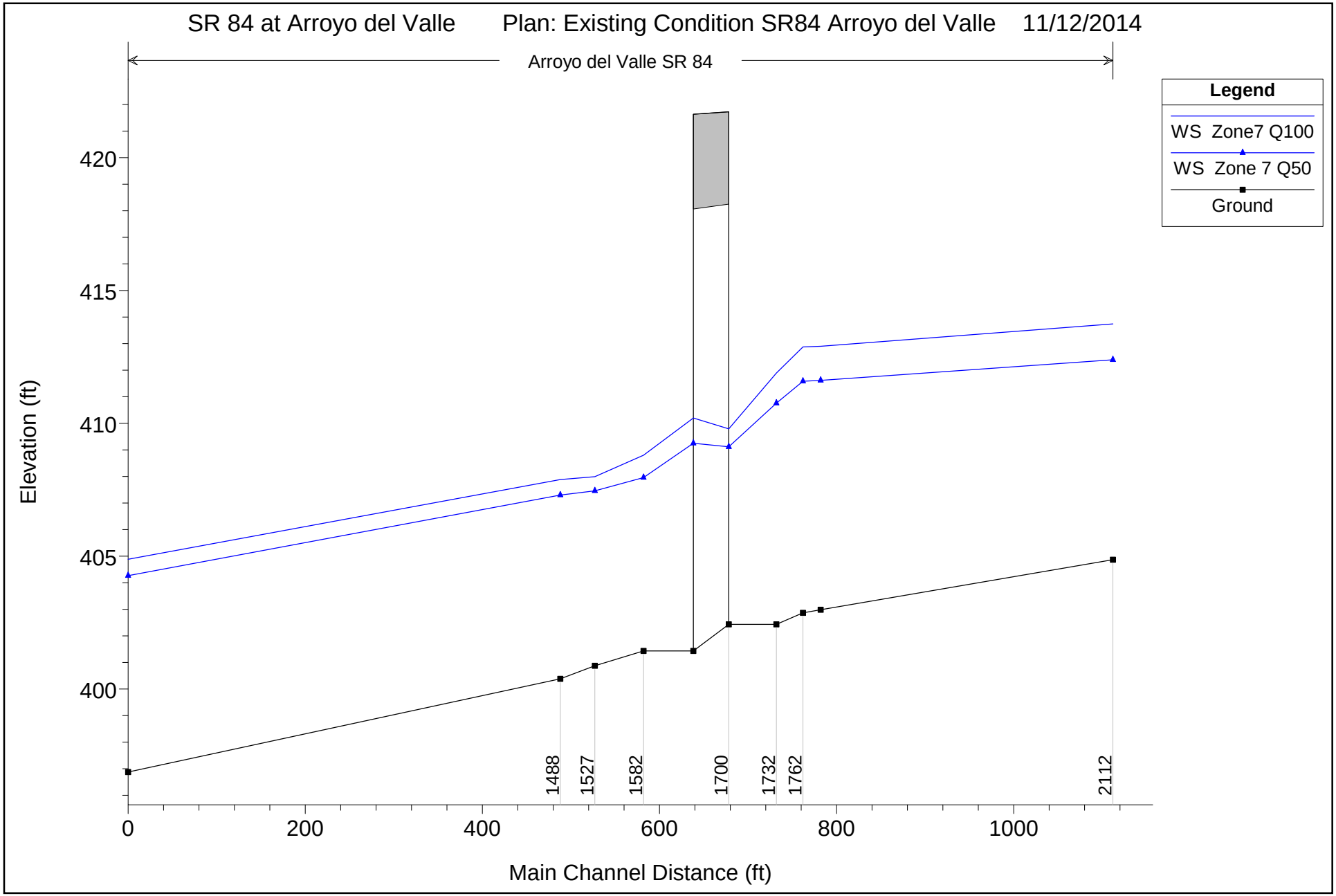
Attachment A:

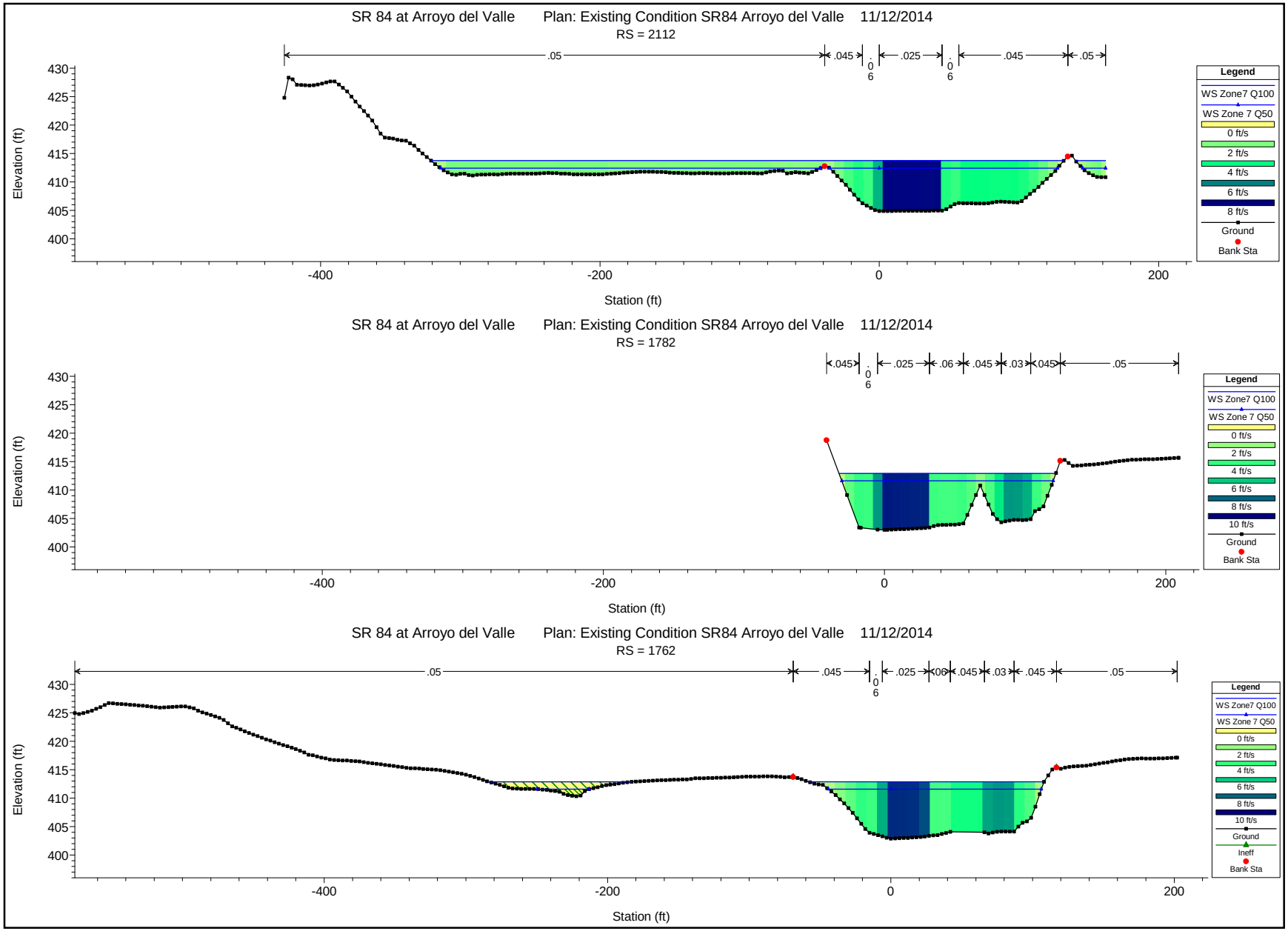
HEC-RAS Results

HEC-RAS Plan: exist River: Arroyo del Valle Reach: SR 84

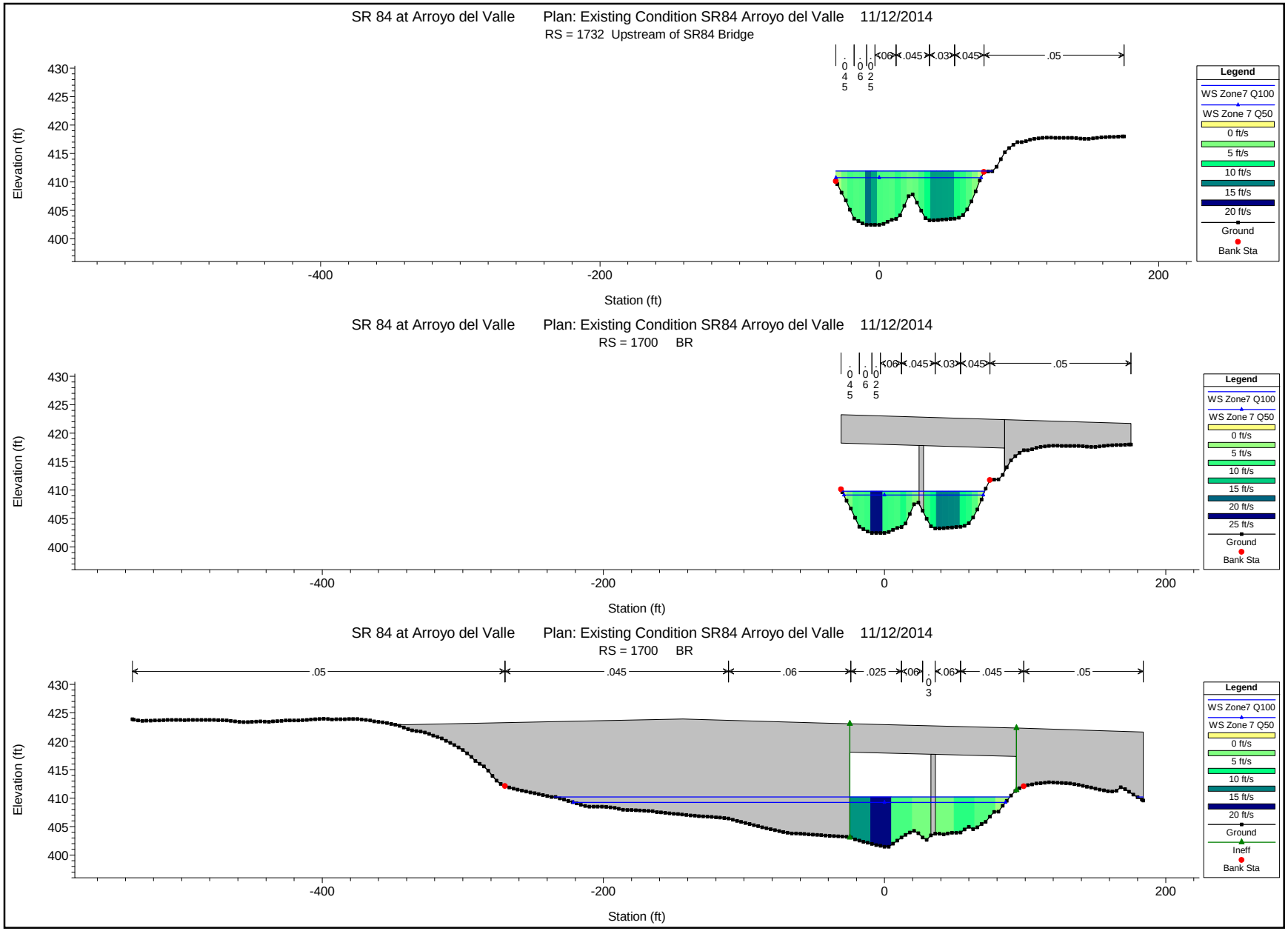
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
SR 84	2112	Zone7 Q100	7000.00	404.87	413.74		414.07	0.001629	4.97	1800.42	474.53	0.34		330.00
SR 84	2112	Zone 7 Q50	5400.00	404.87	412.40		412.84	0.002480	5.48	1174.41	451.35	0.41		330.00
SR 84	1782	Zone7 Q100	7000.00	402.99	412.91		413.45	0.002045	5.89	1187.57	154.26	0.37		20.00
SR 84	1782	Zone 7 Q50	5400.00	402.99	411.62		412.08	0.002133	5.45	991.23	150.48	0.37		20.00
SR 84	1762	Zone7 Q100	7000.00	402.87	412.88		413.40	0.001947	5.78	1212.09	267.23	0.38		30.00
SR 84	1762	Zone 7 Q50	5400.00	402.87	411.59		412.03	0.001836	5.35	1009.67	187.13	0.36		30.00
SR 84	1732	Zone7 Q100	7000.00	402.44	411.90	409.77	413.22	0.006292	9.23	758.57	112.07	0.61	7.33	53.80
SR 84	1732	Zone 7 Q50	5400.00	402.44	410.77	408.84	411.87	0.006363	8.45	639.13	104.04	0.60	6.40	53.80
SR 84	1700		Bridge											
SR 84	1582	Zone7 Q100	7000.00	401.44	408.81	408.81	411.33	0.008384	12.74	549.36	300.05	1.00	7.37	55.00
SR 84	1582	Zone 7 Q50	5400.00	401.44	407.96	407.96	410.12	0.008403	11.78	458.26	267.45	1.00	6.52	55.00
SR 84	1527	Zone7 Q100	7000.00	400.88	407.99	407.99	410.32	0.015899	12.25	571.41	123.91	1.01	7.11	39.00
SR 84	1527	Zone 7 Q50	5400.00	400.88	407.46	407.22	409.23	0.013774	10.67	506.14	121.84	0.92	6.34	39.00
SR 84	1488	Zone7 Q100	7000.00	400.39	407.89	407.41	409.58	0.011615	10.46	669.23	145.70	0.86	7.02	488.00
SR 84	1488	Zone 7 Q50	5400.00	400.39	407.31		408.63	0.010413	9.22	585.81	142.68	0.80		488.00
SR 84	1000	Zone7 Q100	7000.00	396.88	404.89	403.40	405.43	0.005606	5.91	1184.80	316.13	0.54	6.52	
SR 84	1000	Zone 7 Q50	5400.00	396.88	404.27	402.76	404.73	0.005601	5.43	995.19	300.38	0.53	5.88	



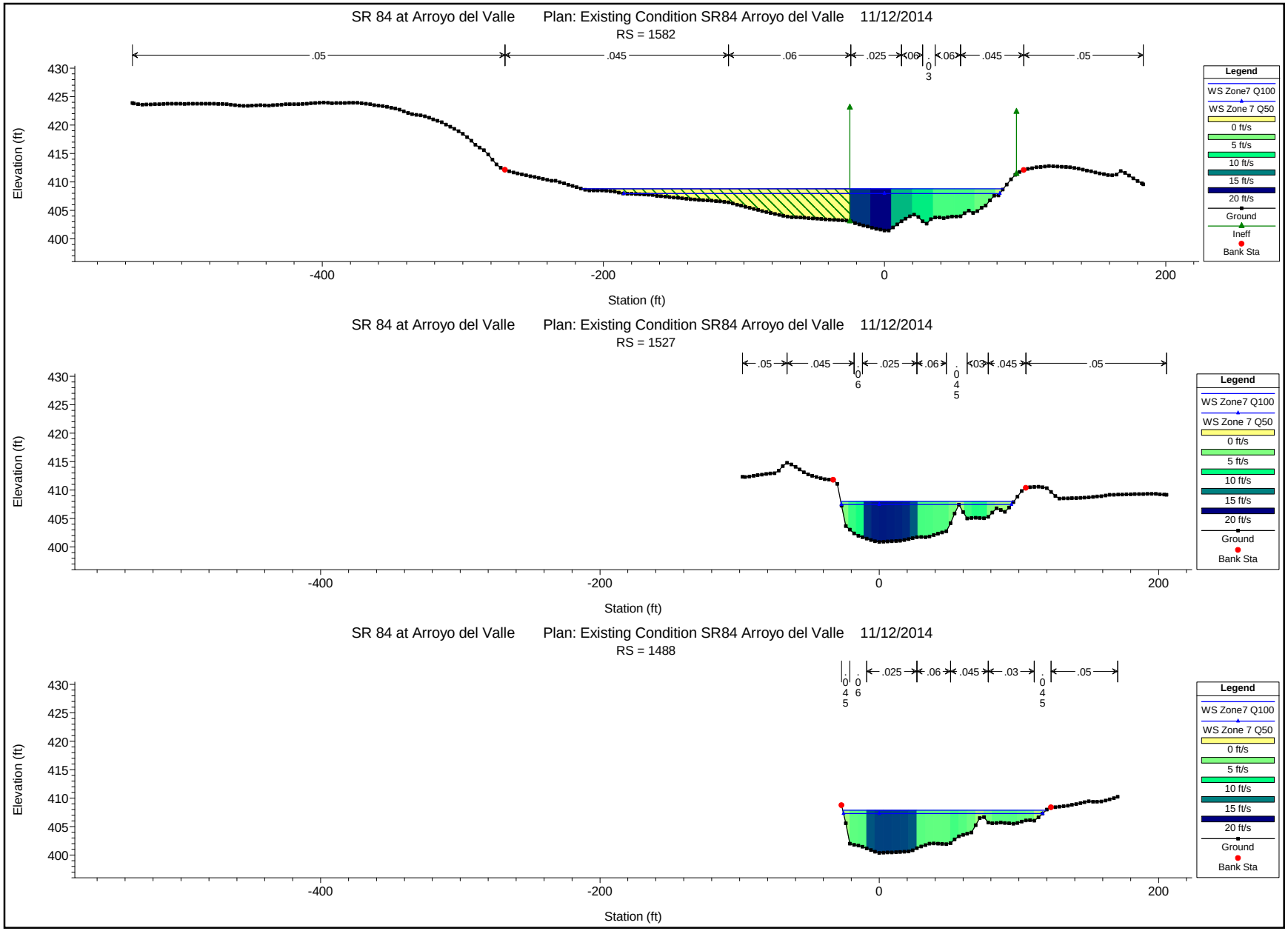
1 in Horiz. = 150 ft 1 in Vert. = 5 ft



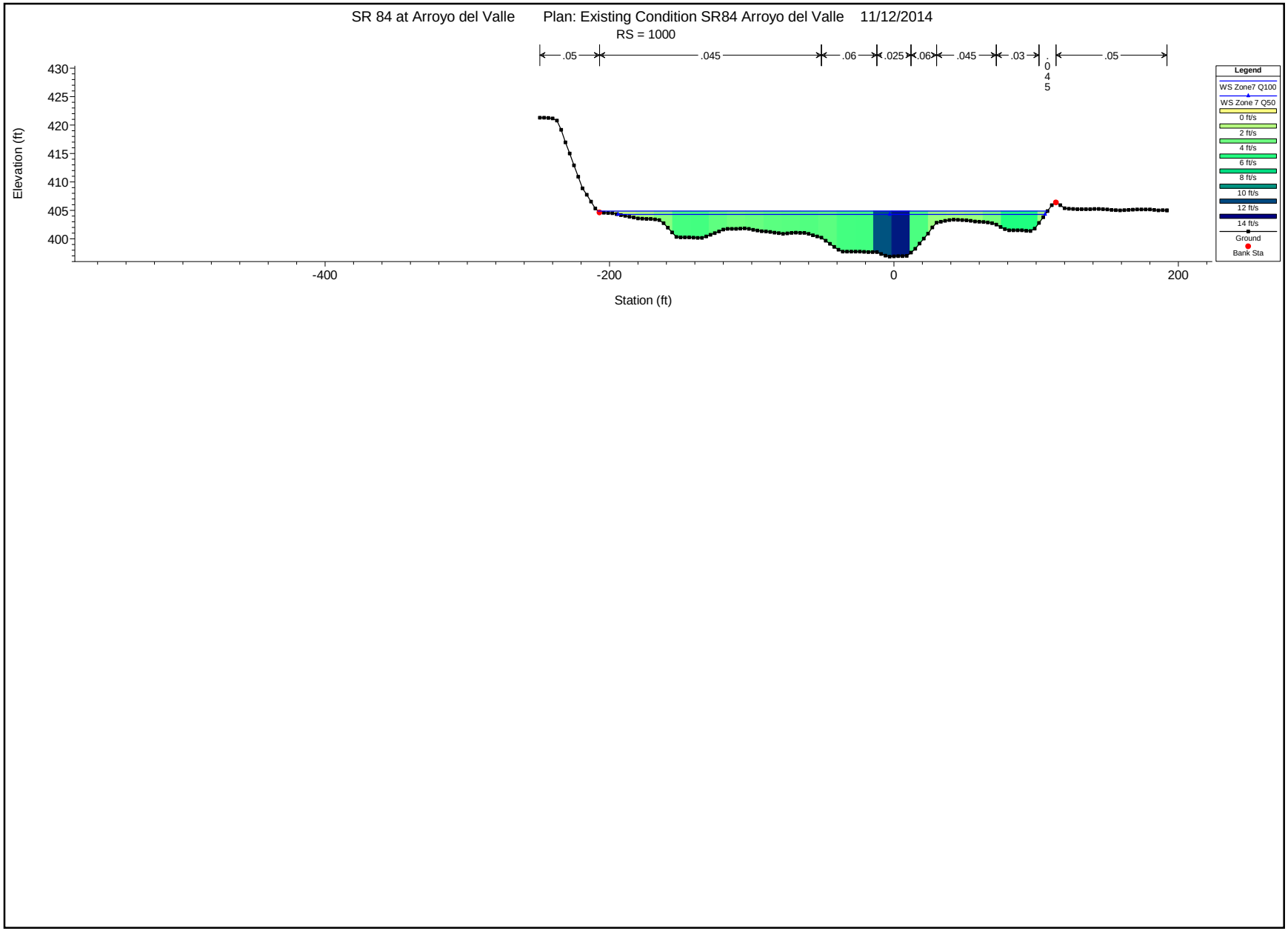
1 in Horiz. = 100 ft 1 in Vert. = 25 ft



1 in Horiz. = 100 ft 1 in Vert. = 25 ft



1 in Horiz. = 100 ft 1 in Vert. = 25 ft



1 in Horiz. = 100 ft 1 in Vert. = 25 ft

Plan: exist Arroyo del Valle SR 84 RS: 1700 Profile: Zone7 Q100

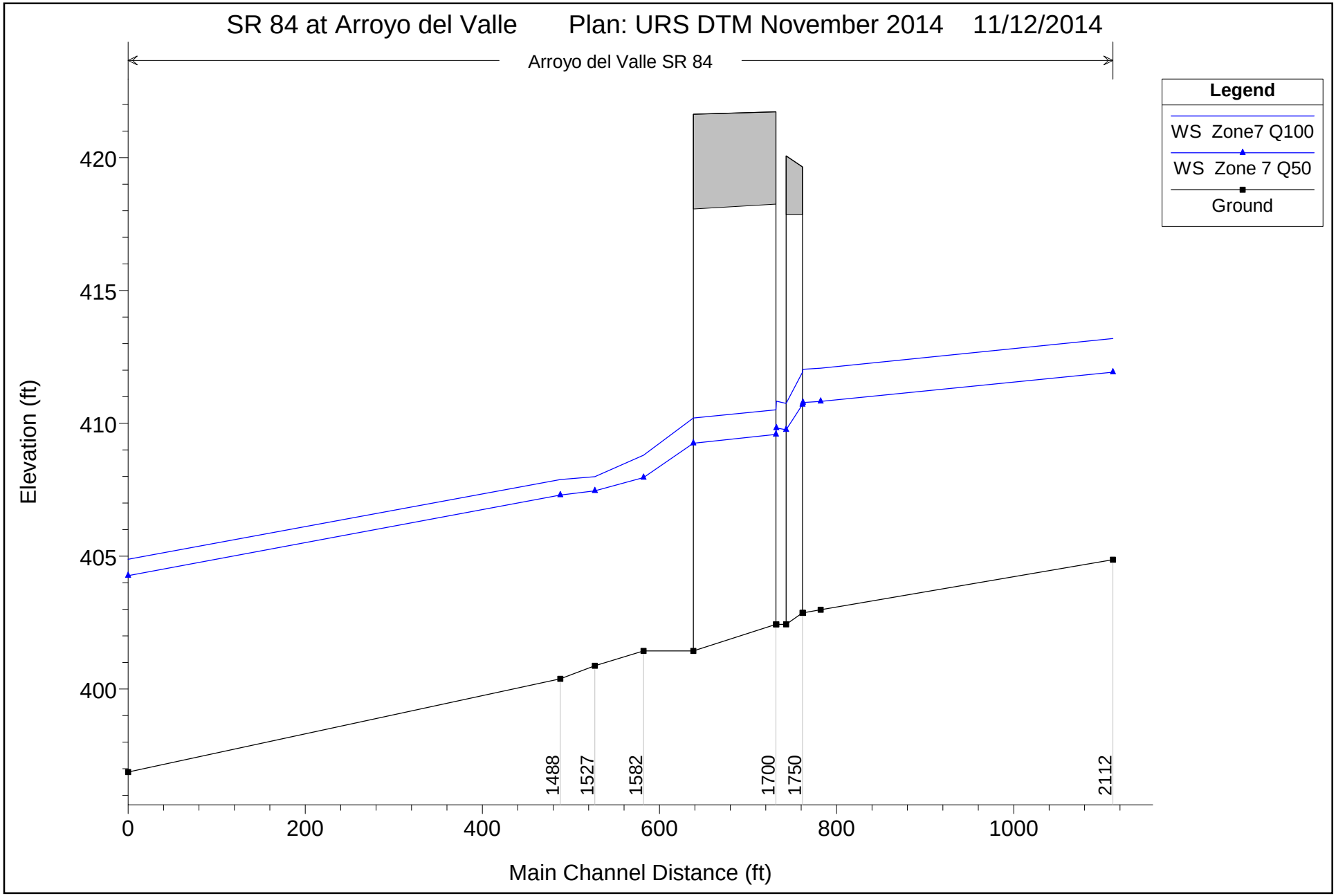
E.G. US. (ft)	413.22	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	411.90	E.G. Elev (ft)	412.51	411.83
Q Total (cfs)	7000.00	W.S. Elev (ft)	409.79	410.20
Q Bridge (cfs)	7000.00	Crit W.S. (ft)	409.79	408.92
Q Weir (cfs)		Max Chl Dpth (ft)	7.35	8.76
Weir Sta Lft (ft)		Vel Total (ft/s)	13.23	10.24
Weir Sta Rgt (ft)		Flow Area (sq ft)	529.17	683.56
Weir Submerg		Froude # Chl	1.01	0.73
Weir Max Depth (ft)		Specif Force (cu ft)	4476.72	4564.40
Min El Weir Flow (ft)	422.34	Hydr Depth (ft)	5.38	6.18
Min El Prs (ft)	418.26	W.P. Total (ft)	109.01	132.30
Delta EG (ft)	1.89	Conv. Total (cfs)	47308.0	87144.8
Delta WS (ft)	3.09	Top Width (ft)	98.42	110.60
BR Open Area (sq ft)	1410.12	Frctn Loss (ft)		0.41
BR Open Vel (ft/s)	13.23	C & E Loss (ft)		0.09
Coef of Q		Shear Total (lb/sq ft)	6.64	2.08
Br Sel Method	Energy only	Power Total (lb/ft s)	-31.00	-535.00

Plan: exist Arroyo del Valle SR 84 RS: 1700 Profile: Zone 7 Q50

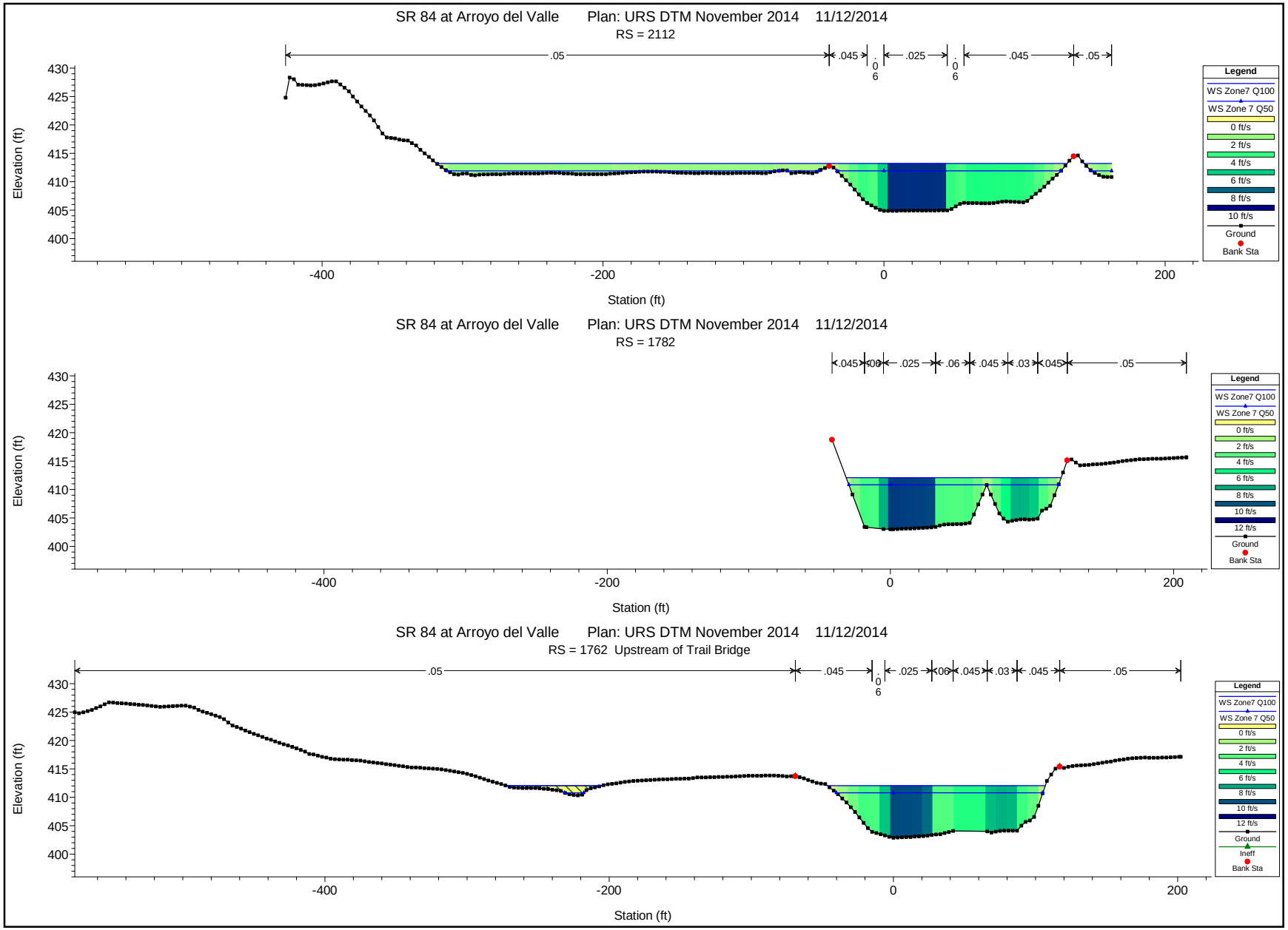
E.G. US. (ft)	411.87	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	410.77	E.G. Elev (ft)	411.22	410.60
Q Total (cfs)	5400.00	W.S. Elev (ft)	409.12	409.25
Q Bridge (cfs)	5400.00	Crit W.S. (ft)	408.88	408.06
Q Weir (cfs)		Max Chl Dpth (ft)	6.68	7.81
Weir Sta Lft (ft)		Vel Total (ft/s)	11.63	9.31
Weir Sta Rgt (ft)		Flow Area (sq ft)	464.21	580.04
Weir Submerg		Froude # Chl	0.93	0.71
Weir Max Depth (ft)		Specif Force (cu ft)	3220.04	3299.82
Min El Weir Flow (ft)	422.34	Hydr Depth (ft)	4.83	5.40
Min El Prs (ft)	418.26	W.P. Total (ft)	104.92	126.15
Delta EG (ft)	1.76	Conv. Total (cfs)	38995.2	68871.1
Delta WS (ft)	2.80	Top Width (ft)	96.03	107.44
BR Open Area (sq ft)	1410.12	Frctn Loss (ft)	0.40	0.40
BR Open Vel (ft/s)	11.63	C & E Loss (ft)	0.23	0.08
Coef of Q		Shear Total (lb/sq ft)	5.30	1.76
Br Sel Method	Energy only	Power Total (lb/ft s)	-31.00	-535.00

HEC-RAS Plan: URS DTM Nove River: Arroyo del Valle Reach: SR 84

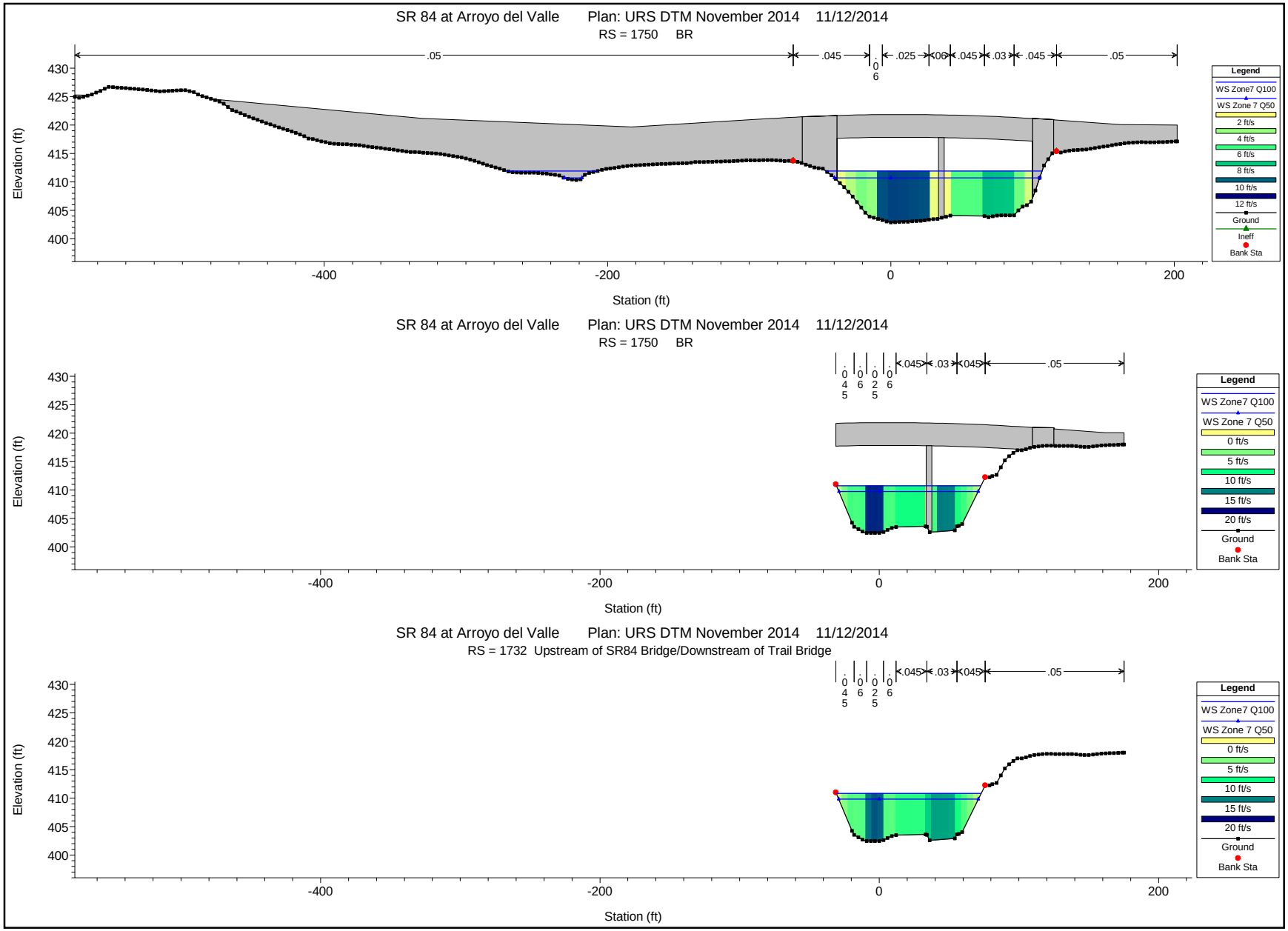
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Crit Depth	Length Chnl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)	(ft)
SR 84	2112	Zone7 Q100	7000.00	404.87	413.19		413.64	0.002377	5.72	1541.01	468.03	0.40		330.00
SR 84	2112	Zone 7 Q50	5400.00	404.87	411.93		412.52	0.003483	6.24	964.69	432.99	0.48		330.00
SR 84	1782	Zone7 Q100	7000.00	402.99	412.07		412.75	0.002906	6.60	1060.27	151.82	0.44		20.00
SR 84	1782	Zone 7 Q50	5400.00	402.99	410.83		411.42	0.003170	6.18	873.39	148.15	0.45		20.00
SR 84	1762	Zone7 Q100	7000.00	402.87	412.04	408.59	412.69	0.002562	6.50	1077.21	220.56	0.43	5.72	0.50
SR 84	1762	Zone 7 Q50	5400.00	402.87	410.79	407.86	411.36	0.002639	6.06	891.06	158.88	0.43	4.99	0.50
SR 84	1750		Bridge											
SR 84	1732	Zone7 Q100	7000.00	402.44	410.84	409.21	412.42	0.007112	10.09	693.82	103.72	0.69	6.77	0.50
SR 84	1732	Zone 7 Q50	5400.00	402.44	409.83	408.25	411.12	0.006830	9.14	590.67	99.95	0.66	5.81	0.50
SR 84	1700		Bridge											
SR 84	1582	Zone7 Q100	7000.00	401.44	408.81	408.81	411.33	0.008384	12.74	549.36	300.05	1.00	7.37	55.00
SR 84	1582	Zone 7 Q50	5400.00	401.44	407.96	407.96	410.12	0.008404	11.78	458.26	267.45	1.00	6.52	55.00
SR 84	1527	Zone7 Q100	7000.00	400.88	407.99	407.99	410.32	0.015899	12.25	571.41	123.91	1.01	7.11	39.00
SR 84	1527	Zone 7 Q50	5400.00	400.88	407.46	407.22	409.23	0.013774	10.67	506.14	121.84	0.92	6.34	39.00
SR 84	1488	Zone7 Q100	7000.00	400.39	407.89	407.41	409.58	0.011615	10.46	669.23	145.70	0.86	7.02	488.00
SR 84	1488	Zone 7 Q50	5400.00	400.39	407.31		408.63	0.010413	9.22	585.81	142.68	0.80		488.00
SR 84	1000	Zone7 Q100	7000.00	396.88	404.89	403.40	405.43	0.005606	5.91	1184.80	316.13	0.54	6.52	
SR 84	1000	Zone 7 Q50	5400.00	396.88	404.27	402.76	404.73	0.005601	5.43	995.19	300.38	0.53	5.88	



1 in Horiz. = 150 ft 1 in Vert. = 5 ft



1 in Horiz. = 100 ft 1 in Vert. = 25 ft



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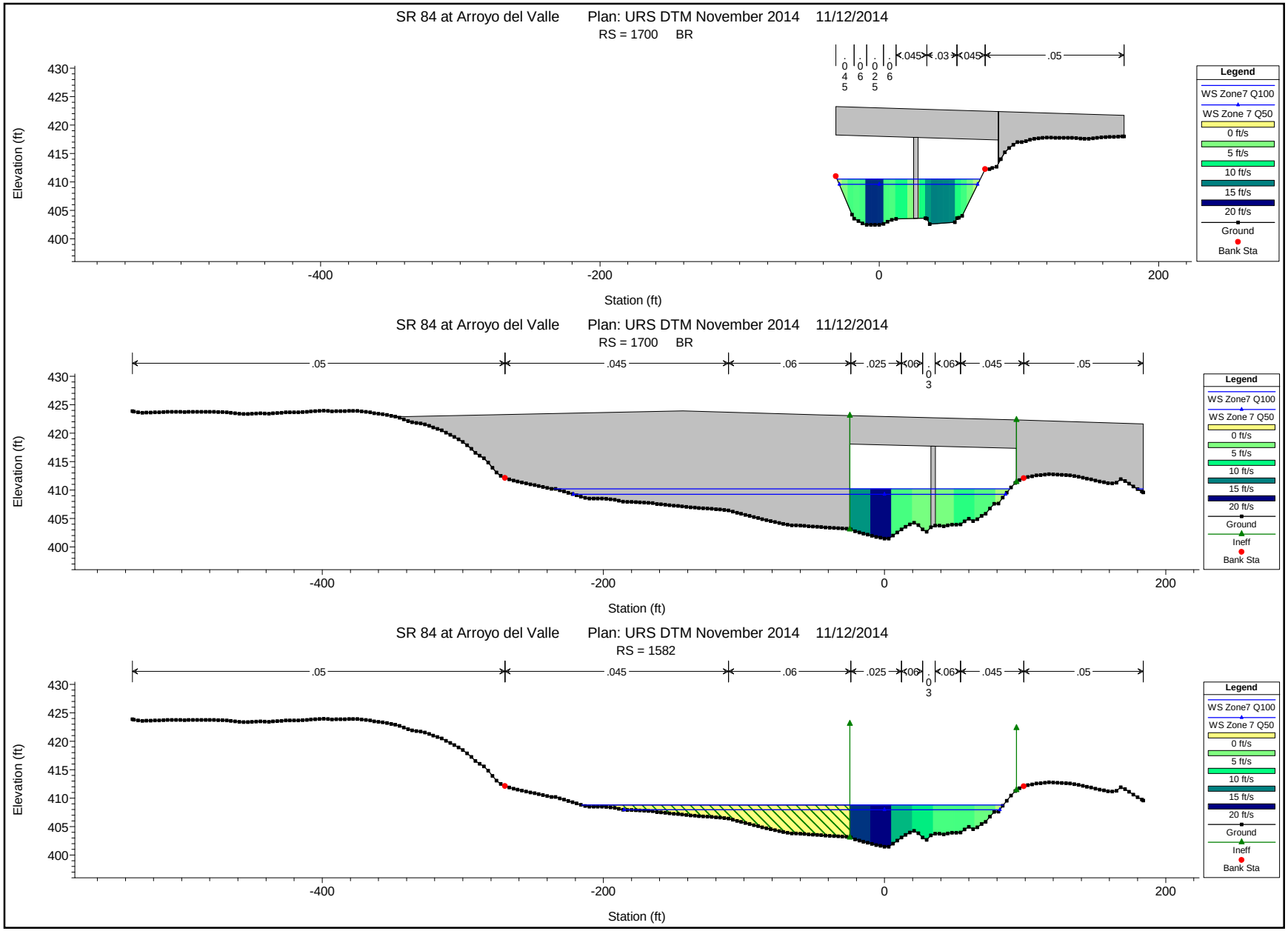
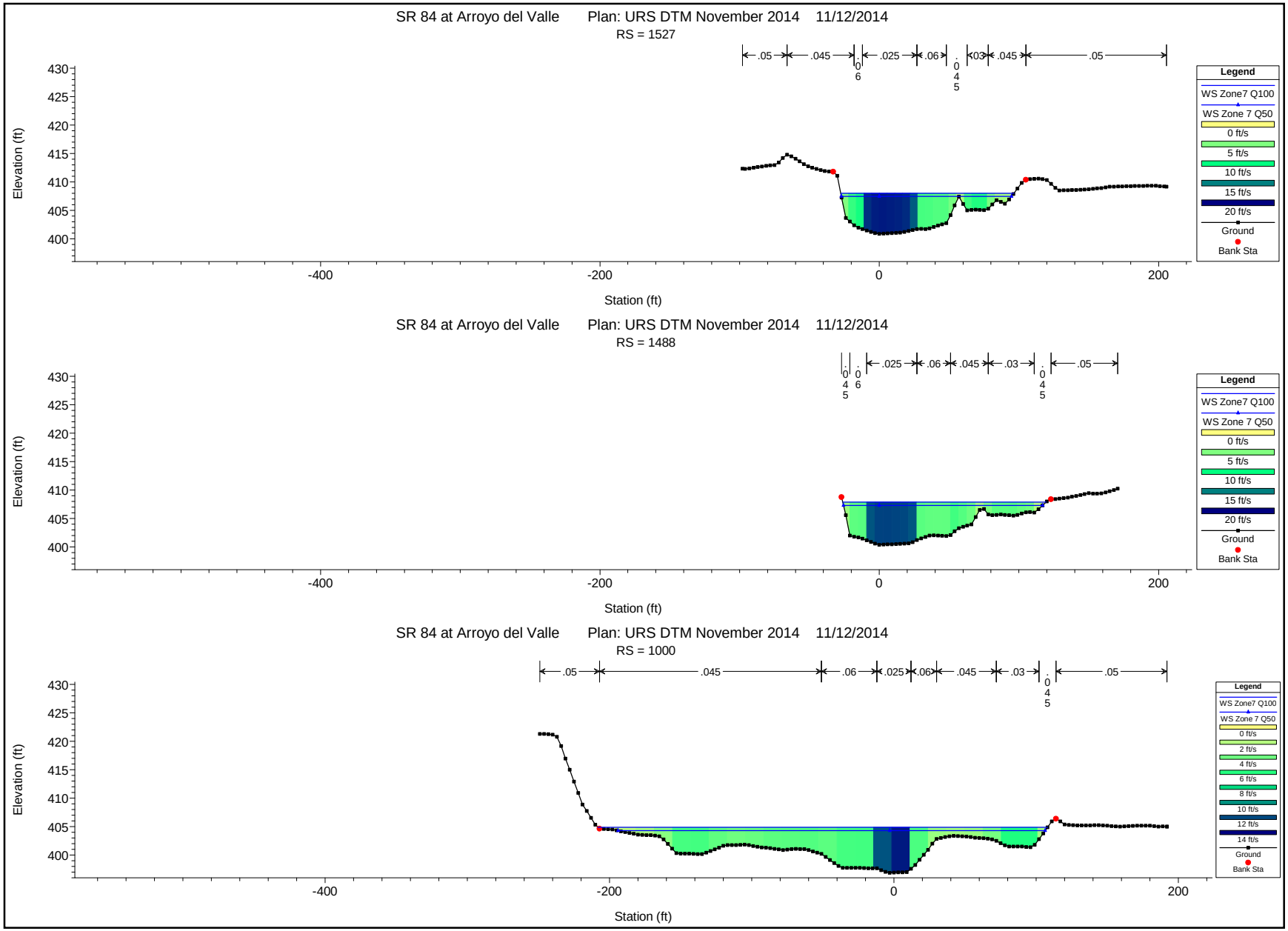


1 in Horiz. = 100 ft 1 in Vert. = 25 ft



1 in Horiz. = 100 ft 1 in Vert. = 25 ft

Plan: URS DTM Nove Arroyo del Valle SR 84 RS: 1750 Profile: Zone7 Q100

E.G. US. (ft)	412.69	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	412.04	E.G. Elev (ft)	412.68	412.54
Q Total (cfs)	7000.00	W.S. Elev (ft)	411.93	410.75
Q Bridge (cfs)	7000.00	Crit W.S. (ft)	408.71	409.42
Q Weir (cfs)		Max Chl Dpth (ft)	9.06	8.31
Weir Sta Lft (ft)		Vel Total (ft/s)	6.97	10.72
Weir Sta Rgt (ft)		Flow Area (sq ft)	1004.41	652.90
Weir Submerg		Froude # Chl	0.45	0.74
Weir Max Depth (ft)		Specif Force (cu ft)	5463.55	4705.04
Min El Weir Flow (ft)	420.08	Hydr Depth (ft)	7.50	6.57
Min El Prs (ft)	417.85	W.P. Total (ft)	156.66	118.43
Delta EG (ft)	0.27	Conv. Total (cfs)	187484.5	112313.4
Delta WS (ft)	1.20	Top Width (ft)	133.94	99.30
BR Open Area (sq ft)	1441.45	Frctn Loss (ft)	0.04	0.06
BR Open Vel (ft/s)	10.72	C & E Loss (ft)	0.10	0.06
Coef of Q		Shear Total (lb/sq ft)	0.56	1.34
Br Sel Method	Energy only	Power Total (lb/ft s)	-576.00	-31.00

Plan: URS DTM Nove Arroyo del Valle SR 84 RS: 1750 Profile: Zone 7 Q50

E.G. US. (ft)	411.36	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	410.79	E.G. Elev (ft)	411.35	411.23
Q Total (cfs)	5400.00	W.S. Elev (ft)	410.71	409.76
Q Bridge (cfs)	5400.00	Crit W.S. (ft)	407.96	408.46
Q Weir (cfs)		Max Chl Dpth (ft)	7.84	7.32
Weir Sta Lft (ft)		Vel Total (ft/s)	6.42	9.70
Weir Sta Rgt (ft)		Flow Area (sq ft)	841.65	556.69
Weir Submerg		Froude # Chl	0.45	0.71
Weir Max Depth (ft)		Specif Force (cu ft)	3902.92	3404.33
Min El Weir Flow (ft)	420.08	Hydr Depth (ft)	6.28	5.82
Min El Prs (ft)	417.85	W.P. Total (ft)	153.12	112.28
Delta EG (ft)	0.23	Conv. Total (cfs)	141884.8	89352.8
Delta WS (ft)	0.96	Top Width (ft)	133.94	95.63
BR Open Area (sq ft)	1441.45	Frctn Loss (ft)	0.04	0.05
BR Open Vel (ft/s)	9.70	C & E Loss (ft)	0.08	0.05
Coef of Q		Shear Total (lb/sq ft)	0.50	1.13
Br Sel Method	Energy only	Power Total (lb/ft s)	-576.00	-31.00

Plan: URS DTM Nove Arroyo del Valle SR 84 RS: 1700 Profile: Zone7 Q100

E.G. US. (ft)	412.42	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	410.84	E.G. Elev (ft)	412.38	411.83
Q Total (cfs)	7000.00	W.S. Elev (ft)	410.52	410.20
Q Bridge (cfs)	7000.00	Crit W.S. (ft)	409.32	408.92
Q Weir (cfs)		Max Chl Dpth (ft)	8.08	8.76
Weir Sta Lft (ft)		Vel Total (ft/s)	10.96	10.24
Weir Sta Rgt (ft)		Flow Area (sq ft)	638.50	683.56
Weir Submerg		Froude # Chl	0.76	0.73
Weir Max Depth (ft)		Specif Force (cu ft)	4647.69	4564.40
Min El Weir Flow (ft)	422.34	Hydr Depth (ft)	6.43	6.18
Min El Prs (ft)	418.26	W.P. Total (ft)	117.09	132.30
Delta EG (ft)	1.09	Conv. Total (cfs)	107506.6	87144.8
Delta WS (ft)	2.03	Top Width (ft)	99.32	110.60
BR Open Area (sq ft)	1443.62	Frctn Loss (ft)	0.48	0.41
BR Open Vel (ft/s)	10.96	C & E Loss (ft)	0.07	0.09
Coef of Q		Shear Total (lb/sq ft)	1.44	2.08
Br Sel Method	Energy only	Power Total (lb/ft s)	-31.00	-535.00

Plan: URS DTM Nove Arroyo del Valle SR 84 RS: 1700 Profile: Zone 7 Q50

E.G. US. (ft)	411.12	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	409.83	E.G. Elev (ft)	411.10	410.60
Q Total (cfs)	5400.00	W.S. Elev (ft)	409.59	409.25
Q Bridge (cfs)	5400.00	Crit W.S. (ft)	408.37	408.06
Q Weir (cfs)		Max Chl Dpth (ft)	7.15	7.81
Weir Sta Lft (ft)		Vel Total (ft/s)	9.85	9.31
Weir Sta Rgt (ft)		Flow Area (sq ft)	548.09	580.05
Weir Submerg		Froude # Chl	0.73	0.71
Weir Max Depth (ft)		Specif Force (cu ft)	3367.30	3299.83
Min El Weir Flow (ft)	422.34	Hydr Depth (ft)	5.72	5.40
Min El Prs (ft)	418.26	W.P. Total (ft)	111.32	126.15
Delta EG (ft)	1.00	Conv. Total (cfs)	86260.8	68871.6
Delta WS (ft)	1.86	Top Width (ft)	95.88	107.44
BR Open Area (sq ft)	1443.62	Frctn Loss (ft)	0.45	0.40
BR Open Vel (ft/s)	9.85	C & E Loss (ft)	0.05	0.08
Coef of Q		Shear Total (lb/sq ft)	1.20	1.76
Br Sel Method	Energy only	Power Total (lb/ft s)	-31.00	-535.00

1243 Alpine Road, Suite 108
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Attachment B:

Detailed Scour Calculations

1243 Alpine Road, Suite 108
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SR84 Widening
Alameda County, California
Contraction Scour

100-year Flow
Calculation guideline from HEC-18 5th Edition
Input from HEC-RAS for URS DTM Nov2014, Proposed Condition

Units = (SI or English)	English	
Ku = constant = 6.19 (SI) or 11.17 (English)	11.17	
g = acceleration due to gravity =	32.2	ft/s^2

Channel

Vchannel = Mean velocity of flow in main channel just upstream of bridge =	10.1	ft/s
D50channel = grain size in channel for which 50% of bed material is finer =	0.0082	ft
Yochannel = existing depth in the contracted channel section before scour =	6.3	ft
Ychannel = depth of flow just upstream of bridge in channel =	6.6	ft
VcD50channel = Ku*(Ychannel^(1/6))*(D50channel^(1/3))	3.1	ft/s
Contraction scour equation for channel =	**Live Bed Equation**	

Live Bed Equation

Q1 channel = Flow in the upstream channel transporting sediment =	7000	ft^3/s
Q2 channel = Flow in the contracted channel = transporting sediment =	7000	ft^3/s
W1 channel = top width of the upstream channel that is transporting bed material =	100	ft
W2 channel = top width of the contracted channel section less pier widths =	103	ft
ω channel = fall velocity of bed material based on D50 =	0.59	ft/s
S channel = slope of energy grade line in main channel =	0.007	ft/ft
V* channel = shear velocity in the upstream channel section = (Ychannel*g*S channel)^.5 =	1.3	ft/s
V* channel/ω channel =	2.1	
k1 channel = (if V*/ω <0.5, 0.59, if(0.5<=V*/ω<=2,0.64,0.69)) =	0.69	
Y2channel = average depth in contracted section after scour = Ychannel*((Q2 channel/Q1 channel)^(6/7))*((W1 channel/W2 channel)^k1 channel) =	6.5	ft
Ys channel = Y2 channel - Yo channel =	**0.2**	**ft**

Clear Water Equation

Ku = constant = 0.0077 (English) or 0.025 (SI) =	0.0077	
Q = Discharge through bridge associated with the width W =	7000	ft^3/s
Dm = Diameter of the smallest non transportable particle in the bed material in contracted section = 1.25*d50 =	0.010253	ft
W = Bottom width of contracted section less pier widths =		ft
Y2channel = average depth in contracted section after scour = ((Ku*(Q^2))/((Dm^(2/3))*(W^2)))^(3/7) =	n/a	ft
Ys channel = Y2 channel - Yo channel =	**n/a**	**ft**

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SR84 Widening

Alameda County, California

Local Scour at Piers - Cohesionless

100-year Flow
Calculation guideline from HEC-18 5th Edition
Input from HEC-RAS for URS DTM Nov2014, Proposed Condition

Units = (SI or English) =	English	
Complex Pier Scour? (Yes or No)	Yes	

Pier Scour component

Water Surface Elevation	410.5	ft
f = distance between front edge of cap/footing and pier =	5.00	ft
T = thickness of pile cap or footing (enter n/a for no pile cap) =	4	ft
Top of Pile Cap Elevation (enter n/a for no pile cap)	402.67	ft
Bottom of Pile Cap Elevation (enter n/a for no pile cap)	398.67	ft
Ground Elevation at Pier	403.6	ft
Contraction Scour Depth	0.2	ft
ho = height of pile cap above bed at beginning of computation (negative indicates partially or entirely submerged pile cap) =	-4.8	ft
a = pier width =	1.5	ft
S = spacing between columns of piles, center to center =	n/a	ft
h1 = ho+T=height of the pier stem above the bed before scour (negative indicates top of pile cap is below bed elevation) =	-0.8	ft
y1 = Approach flow depth at the beginning of computations =	6.9	ft
V1 = Approach velocity used at the beginning of computations	8.8	ft/s
Khpier = coefficient to account for the height of the pier stem above the bed and the shielding effect by the pile cap overhang distance "f" in front of the pier stem	0.27	
Θ = angle of attack of flow =	0	degrees
Pier shape	uare nose	
K1 = correction factor for pier nose shape =	1.1	
L = length of pier =		ft
L/a (if L/a is larger than 12, then use 12 as a maximum)	0	
K2 = correction factor for angle of attack = (cosΘ+(L/a)*sinΘ)^0.65	1.0	
K3 = correction factor for bed condition =	1.1	
D50 = grain size for which 50% of bed material is finer =	0.0082	ft
D95 = grain size for which 95% of bed material is finer =	0.0131	ft
Ku = constant = 6.19 (SI) or 11.17 (English)	11.17	
VcD50 = Ku*(y1^(1/6))*(D50^(1/3))	3.1	ft/s
VcD95 = Ku*(y1^(1/6))*(D95^(1/3))	3.6	ft/s
g = acceleration due to gravity =	32.2	ft/s^2
Yspier = scour component for the pier stem in the flow = y1*(Khpier*(2*K1*K2*K3*((a/y1)^0.65)*((V1/((g*y1)^0.5))^0.43)) =	**1.3**	**ft**

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Pile cap/footing component scour

Case Type = (Case 1 or Case 2 from ho)	Case 2
apc = width of pile cap =	15 ft
y2 = y1 + Yspier/2 = adjusted flow depth for pile cap computations =	7.54 ft
V2 = V1*(y1/y2) = adjusted velocity for pile cap computations =	7.97 ft/s
h2 = ho +Yspier/2 = height of pile group after the pier stem scour component has been computed =	-4.10 ft
Kw = wide pier correction factor (The correction factor should be applied when the ratio of depth of flow (y) to pier width (a) is less than 0.8 (y/a < 0.8); the ratio of pier width (a) to the median diameter of the bed material (D50) is greater than 50 (	0.77

Case 1: Pile cap/footing in the flow above the bed (entire depth of cap exposed to flow)

K1 = correction factor for pier nose (pile cap nose) shape =	1.1
a'pc = equivalent full depth solid pier width of pile cap = apc*exp(-2.705 + 0.51*LN(T/y2) - 2.783*((h2/y2)^3) + 1.751/(exp(h2/y2))) = (if y2 > 3.5*apc, then y2 = 3.5*apc) =	n/a ft
Yspc = scour component for the pier cap/footing in the flow = y2*((2*K1*K2*K3*K4*Kw*((a'pc/y2)^0.65)*((V2/((g*y2)^0.5))^0.43)) =	**n/a ft**

Case 2: Bottom of Pile Cap (footing) located on or below the bed

Ks = grain roughness of the bed (D84 of the bed material) =	0.0098 ft
yf = h1 + Yspier/2 = distance from the bed (after degradation, contraction scour and pier stem scour) to the top of the footing (negative indicates entirely submerged pile cap)	-0.10 ft
Vf = average velocity in the flow zone below the top of the footing = V2*((LN((10.93*(yf/Ks))+1)))/(LN((10.93*(y2/Ks))+1))) =	n/a ft/s
Yspc = scour component for the pier cap/footing in the flow = yf*(2*K1*K2*K3*K4*Kw*((apc/yf)^0.65)*((Vf/((g*yf)^0.5))^0.43) =	**0.00 ft**

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Pile group scour component

h3 = ho + Yspier/2 + Yspc/2 = height of the pile group after the pier stem and pile cap scour components have been computed =	-4.10	ft
y3 = y1 + Yspier/2 + Ypc/2 = adjusted flow depth for pile group computations =	7.54	ft
V3 = V1*(y1/y3) = adjusted velocity for pile group computations =	7.97	ft/s
S = Spacing of piles (center to center)	9.00	ft
a = width of single pile	3.00	ft
aproj = sum of non-overlapping projected widths of piles =	6.00	ft
Ksp = coefficient for pile spacing = 1-(4/3)*((1-(1/(aproj/a)))*(1-((S/a)^-0.6)) =	0.68	
m = number of rows of piles in direction of flow =	4.00	
Km = coefficient for number of aligned rows = 0.9+0.1*m-0.0714*(m-1)*(2.4-1.1*(S/a)+0.1*((S/a)^2)) =	1.30	ft
a'pg = effective width of an equivalent full depth pier = aproj*Ksp*Km =	5.29	ft
Khpg = pile group height factor = (3.08*(h3/y3)-5.23*((h3/y3)^2)+5.25*((h3/y3)^3)-2.1*((h3/y3)^4))^(1/0.65) = (note that y3max = 3.5*a'pg) =	0.0000	
Yspg = scour component for the piles exposed to the flow = y3*Khpg*(2*K1*K3*K4*Kw*((a'pg/y3)^0.65)*((V3/((g*y3)^0.5))^0.43) =	**0.00**	**ft**

Total Scour

Ys = Yspier + Yspc + Yspg = total scour from superposition of components =	**1.3**	**ft**

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SR84 Widening

Alameda County, California

Local Scour at Abutments - Froehlich or HIRE

100-year Flow
Calculation guideline from HEC-18 5th Edition
Input from HEC-RAS for URS DTM Nov2014, Proposed Condition

Units = (SI or English)	English	
g = acceleration due to gravity =	32.2	ft/s^2

Left Overbank = Abutment 1 (South Bank)

y1 = depth of flow at abutment on the overbank or in the main channel =	4.5	ft
L = length of embankment projected normal to flow =	8.0	ft
Ratio of projected embankment length to flow depth = L/y1 =	1.771E+00	
Abutment scour equation to be used =	Froehlich	

Froehlich's Live Bed Abutment Scour Equation

L' = length of active flow obstructed by the embankment =	7.2	ft
Ae = flow area of the approach cross section obstructed by the embankment =	16.2	ft^2
ya = average depth of flow on the flood plain = Ae/L'	2.25	ft
Qe = flow obstructed by the abutment and approach embankment =	107	ft^3/s
Ve = flow velocity = Qe/Ae =	6.6	ft/s
Fr = Froude Number of approach flow upstream of the abutment =	0.78	
Θ = abutment skew =	100	degrees
K1 = coefficient for abutment shape =	1	
K2 = coefficient for angle of embankment shape = (Θ/90)^0.13 =	1.01	
Ys = abutment scour = ya*(2.27*k1*k2*((L'/ya)^0.43)*(Fr^0.61)+1) =	**9.6**	**ft**

HIRE Live Bed Abutment Scour Equation

V = velocity of flow at upstream face of abutment =		ft/s
Fr = Froude Number = V/((g*y1)^.5) =	n/a	
Θ = abutment skew =		degrees
K1 = coefficient for abutment shape =		
K2 = coefficient for angle of embankment shape = (Θ/90)^0.13 =	n/a	
Ys = abutment scour = y1*(4*(Fr^0.33)*(K1/0.55)*K2) =	**n/a**	**ft**

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SR84 Widening
Alameda County, California
Contraction Scour

100-year Flow
Calculation guideline from HEC-18 5th Edition
Input from HEC-RAS for Proposed Alternative x

Units = (SI or English)	English	
Ku = constant = 6.19 (SI) or 11.17 (English)	11.17	
g = acceleration due to gravity =	32.2	ft/s^2

Channel

Vchannel = Mean velocity of flow in main channel just upstream of bridge =	6.6	ft/s
D50channel = grain size in channel for which 50% of bed material is finer =	0.0007	ft
Yochannel = existing depth in the contracted channel section before scour =	7.5	ft
Ychannel = depth of flow just upstream of bridge in channel =	7.0	ft
VcD50channel = Ku*(Ychannel^(1/6))*(D50channel^(1/3))	1.3	ft/s
Contraction scour equation for channel =	**Live Bed Equation**	

Live Bed Equation

Q1 channel = Flow in the upstream channel transporting sediment =	7000	ft^3/s
Q2 channel = Flow in the contracted channel = transporting sediment =	7000	ft^3/s
W1 channel = top width of the upstream channel that is transporting bed material =	152	ft
W2 channel = top width of the contracted channel section less pier widths =	135	ft
ω channel = fall velocity of bed material based on D50 =	0.08	ft/s
S channel = slope of energy grade line in main channel =	0.003	ft/ft
V* channel = shear velocity in the upstream channel section = (Ychannel*g*S channel)^.5 =	0.8	ft/s
V* channel/ω channel =	9.8	
k1 channel = (if V*/ω <0.5, 0.59, if(0.5<=V*/ω<=2,0.64,0.69)) =	0.69	
Y2channel = average depth in contracted section after scour = Ychannel*((Q2 channel/Q1 channel)^(6/7))*((W1 channel/W2 channel)^k1 channel) =	7.6	ft
Ys channel = Y2 channel - Yo channel =	**0.1**	**ft**

Clear Water Equation

Ku = constant = 0.0077 (English) or 0.025 (SI) =	0.0077	
Q = Discharge through bridge associated with the width W =	7000	ft^3/s
Dm = Diameter of the smallest non transportable particle in the bed material in contracted section = 1.25*d50 =	0.000820	ft
W = Bottom width of contracted section less pier widths =		ft
Y2channel = average depth in contracted section after scour = ((Ku*(Q^2))/((Dm^(2/3))*(W^2)))^(3/7) =	n/a	ft
Ys channel = Y2 channel - Yo channel =	**n/a**	**ft**

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SR84 Widening
Alameda County, California
Local Scour at Piers - Cohesionless

100-year Flow
Calculation guideline from HEC-18 5th Edition
Input from HEC-RAS for Proposed Alternative x

Units = (SI or English) =	English	
Complex Pier Scour? (Yes or No)	Yes	

Pier Scour component

Water Surface Elevation	412.0	ft
f = distance between front edge of cap/footing and pier =	6.25	ft
T = thickness of pile cap or footing (enter n/a for no pile cap) =	3.25	ft
Top of Pile Cap Elevation (enter n/a for no pile cap)	400.75	ft
Bottom of Pile Cap Elevation (enter n/a for no pile cap)	397.5	ft
Ground Elevation at Pier	404.1	ft
Contraction Scour Depth	0.1	ft
ho = height of pile cap above bed at beginning of computation (negative indicates partially or entirely submerged pile cap) =	-6.49	ft
a = pier width =	3.5	ft
S = spacing between columns of piles, center to center =	n/a	ft
h1 = ho+T=height of the pier stem above the bed before scour (negative indicates top of pile cap is below bed elevation) =	-3.24	ft
y1 = Approach flow depth at the beginning of computations =	7.9	ft
V1 = Approach velocity used at the beginning of computations	5.2	ft/s
Khpier = coefficient to account for the height of the pier stem above the bed and the shielding effect by the pile cap overhang distance "f" in front of the pier stem	0.63	
Θ = angle of attack of flow =	0	degrees
Pier shape	uare nose	
K1 = correction factor for pier nose shape =	1.1	
L = length of pier =		ft
L/a (if L/a is larger than 12, then use 12 as a maximum)	0	
K2 = correction factor for angle of attack = (cosΘ+(L/a)*sinΘ)^0.65	1.0	
K3 = correction factor for bed condition =	1.1	
D50 = grain size for which 50% of bed material is finer =	0.0007	ft
D95 = grain size for which 95% of bed material is finer =	0.0066	ft
Ku = constant = 6.19 (SI) or 11.17 (English)	11.17	
VcD50 = Ku*(y1^(1/6))*(D50^(1/3))	1.4	ft/s
VcD95 = Ku*(y1^(1/6))*(D95^(1/3))	2.9	ft/s
g = acceleration due to gravity =	32.2	ft/s^2
Yspier = scour component for the pier stem in the flow = y1*(Khpier*(2*K1*K2*K3*((a/y1)^0.65)*((V1/((g*y1)^0.5))^0.43)) =	**4.4**	**ft**

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Pile cap/footing component scour

Case Type = (Case 1 or Case 2 from ho)	Case 2	
apc = width of pile cap =	16	ft
y2 = y1 + Yspier/2 = adjusted flow depth for pile cap computations =	10.05	ft
V2 = V1*(y1/y2) = adjusted velocity for pile cap computations =	4.07	ft/s
h2 = ho +Yspier/2 = height of pile group after the pier stem scour component has been computed =	-4.31	ft
Kw = wide pier correction factor (The correction factor should be applied when the ratio of depth of flow (y) to pier width (a) is less than 0.8 (y/a < 0.8); the ratio of pier width (a) to the median diameter of the bed material (D50) is greater than 50 (	0.65	

Case 1: Pile cap/footing in the flow above the bed (entire depth of cap exposed to flow)

K1 = correction factor for pier nose (pile cap nose) shape =	1.1	
a'pc = equivalent full depth solid pier width of pile cap = apc*exp(-2.705 + 0.51*LN(T/y2) - 2.783*((h2/y2)^3) + 1.751/(exp(h2/y2))) = (if y2 > 3.5*apc, then y2 = 3.5*apc) =	n/a	ft
Yspc = scour component for the pier cap/footing in the flow = y2*((2*K1*K2*K3*K4*Kw*((a'pc/y2)^0.65)*((V2/((g*y2)^0.5))^0.43)) =	**n/a**	**ft**

Case 2: Bottom of Pile Cap (footing) located on or below the bed

Ks = grain roughness of the bed (D84 of the bed material) =	0.0033	ft
yf = h1 + Yspier/2 = distance from the bed (after degradation, contraction scour and pier stem scour) to the top of the footing (negative indicates entirely submerged pile cap)	-1.06	ft
Vf = average velocity in the flow zone below the top of the footing = V2*((LN((10.93*(yf/Ks))+1)))/(LN((10.93*(y2/Ks))+1))) =	n/a	ft/s
Yspc = scour component for the pier cap/footing in the flow = yf*(2*K1*K2*K3*K4*Kw*((apc/yf)^0.65)*((Vf/((g*yf)^0.5))^0.43) =	**0.00**	**ft**

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Pile group scour component

h3 = ho + Yspier/2 + Yspc/2 = height of the pile group after the pier stem and pile cap scour components have been computed =	-4.31	ft
y3 = y1 + Yspier/2 + Ypc/2 = adjusted flow depth for pile group computations =	10.05	ft
V3 = V1*(y1/y3) = adjusted velocity for pile group computations =	4.07	ft/s
S = Spacing of piles (center to center)	6.00	ft
a = width of single pile	2.00	ft
aproj = sum of non-overlapping projected widths of piles =	6.00	ft
Ksp = coefficient for pile spacing = 1-(4/3)*((1-(1/(aproj/a)))*(1-((S/a)^-0.6)) =	0.57	
m = number of rows of piles in direction of flow =	3.00	
Km = coefficient for number of aligned rows = 0.9+0.1*m-0.0714*(m-1)*(2.4-1.1*(S/a)+0.1*((S/a)^2)) =	1.20	ft
a'pg = effective width of an equivalent full depth pier = aproj*Ksp*Km =	4.11	ft
Khpg = pile group height factor = (3.08*(h3/y3)-5.23*((h3/y3)^2)+5.25*((h3/y3)^3)-2.1*((h3/y3)^4))^(1/0.65) = (note that y3max = 3.5*a'pg) =	0.0000	
Yspg = scour component for the piles exposed to the flow = y3*Khpg*(2*K1*K3*K4*Kw*((a'pg/y3)^0.65)*((V3/((g*y3)^0.5))^0.43) =	**0.00**	**ft**

Total Scour

Ys = Yspier + Yspc + Yspg = total scour from superposition of components =	**4.4**	**ft**

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SR84 Widening

Alameda County, California

Local Scour at Abutments - Froehlich or HIRE

100-year Flow
Calculation guideline from HEC-18 5th Edition
Input from HEC-RAS for Proposed Alternative x

Units = (SI or English)	English	
g = acceleration due to gravity =	32.2	ft/s^2

Left Overbank = Abutment x (Cardinal Direction)

y1 = depth of flow at abutment on the overbank or in the main channel =	0.5	ft
L = length of embankment projected normal to flow =	0.8	ft
Ratio of projected embankment length to flow depth = L/y1 =	1.600E+00	
Abutment scour equation to be used =	Froehlich	

Froehlich's Live Bed Abutment Scour Equation

L' = length of active flow obstructed by the embankment =	0.8	ft
Ae = flow area of the approach cross section obstructed by the embankment =	0.20	ft^2
ya = average depth of flow on the flood plain = Ae/L'	0.25	ft
Qe = flow obstructed by the abutment and approach embankment =	0	ft^3/s
Ve = flow velocity = Qe/Ae =	2.4	ft/s
Fr = Froude Number of approach flow upstream of the abutment =	0.85	
Θ = abutment skew =	100	degrees
K1 = coefficient for abutment shape =	1	
K2 = coefficient for angle of embankment shape = (Θ/90)^0.13 =	1.01	
Ys = abutment scour = ya*(2.27*k1*k2*((L'/ya)^0.43)*(Fr^0.61)+1) =	**1.1**	**ft**

HIRE Live Bed Abutment Scour Equation

V = velocity of flow at upstream face of abutment =		ft/s
Fr = Froude Number = V/((g*y1)^.5) =	n/a	
Θ = abutment skew =		degrees
K1 = coefficient for abutment shape =		
K2 = coefficient for angle of embankment shape = (Θ/90)^0.13 =	n/a	
Ys = abutment scour = y1*(4*(Fr^0.33)*(K1/0.55)*K2) =	**n/a**	**ft**

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SR84 Widening

Alameda County, California

Local Scour at Abutments - Froehlich or HIRE

100-year Flow
Calculation guideline from HEC-18 5th Edition
Input from HEC-RAS for Proposed Alternative x

Units = (SI or English)	English	
g = acceleration due to gravity =	32.2	ft/s^2

Right Overbank = Abutment x (Cardinal Direction)

y1 = depth of flow at abutment on the overbank or in the main channel =	0.5	ft
L = length of embankment projected normal to flow =	1.0	ft
Ratio of projected embankment length to flow depth =	2.000E+00	
Abutment scour equation to be used =	Froehlich	

Froehlich's Live Bed Abutment Scour Equation

L' = length of active flow obstructed by the embankment =	1.0	ft
Ae = flow area of the approach cross section obstructed by the embankment =	0.3	ft^2
ya = average depth of flow on the flood plain = ae/L	0.25	ft
Qe = flow obstructed by the abutment and approach embankment =	1	ft^3/s
Ve = flow velocity = Qe/Ae =	2.4	ft/s
Fr = Froude Number of approach flow upstream of the abutment =	0.85	
Θ = abutment skew =	80	degrees
K1 = coefficient for abutment shape =	1	
K2 = coefficient for angle of embankment shape = (Θ/90)^0.13 =	0.98	
Ys = abutment scour = ya*(2.27*k1*k2*((L'/ya)^0.43)*(Fr^0.61)+1) =	**1.2**	**ft**

HIRE Live Bed Abutment Scour Equation

V = velocity of flow at upstream face of abutment =		ft/s
Fr = Froude Number = V/((g*y1)^.5) =	n/a	
Θ = abutment skew =		degrees
K1 = coefficient for abutment shape =		
K2 = coefficient for angle of embankment shape = (Θ/90)^0.13 =	n/a	
Ys = abutment scour = y1*(4*(Fr^0.33)*(K1/0.55)*K2) =	**n/a**	**ft**

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Attachment C:

Original Bridge Design Hydraulic Study Report (May 2009)

The following table presents correlation between the borehole identification shown on LOTBs and discussed throughout the report text with the borehole identification shown on liquefaction calculation spreadsheets.

Borehole Identification on LOTBs	Borehole Identification for Laboratory Test Results
R-08-011	NB11
R-07-012	NB12
R-07-013	NB13
R-08-014	NB14
R-08-037	NB37

LIQUEFACTION ANALYSIS

Project: Route 84 Widening
Project No.: 28649640
Boring No.: R-08-037

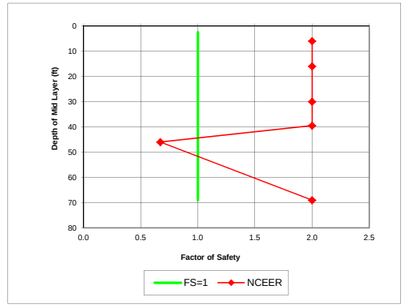
PGA = 0.61
M_w = 6.8
GWT during drilling = 3.0 ft
GWT during EQ = 0.0 ft

Sampler:	Symbol	Corr. Factor
SPT	S	1
Mod.Cal	M	0.8
California	C	0.7

Mag. Weighting Factor($CSR_M/CSR_{M=}$ 0.75

Note: Cells in Red must be input

			C_E	Code	C_E
Hammer type :	Type				3
	Donut		0.75	1	
	Safety		1	2	
	Auto		1.16	3	
Borehole Diameter:	(inch)	(mm)	C_B		C_B
	2.5-4.5	65-115	1	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		



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	at drilling u	at drilling σ'_o	EQ u	EQ σ'_o	r_d	EQ CSR	N raw	Sampler	N SPT	Fines Content	$N_{60\text{-cs}}$	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60\text{-cs}}$	$CRR^*_{7.5,1tsf}$	Magnitude Scaling Factor NCEER K_m			Overburde n K_σ	Above GWT?	F.S.	Liquefy ?	F.S.=1.0
	(USCS)	pcf	ft	m	ft	m	psf	psf	psf	psf	psf						%	FC< 5%	EQ					during EQ	Critical	Lower	Upper	Middle			NCEER	NCEER	
1	SM	130	5.0	1.52	2.5	0.76	325	0	325	156	169	0.996	0.760													1.28	1.38	1.33		N			1
2	CL	128	7.0	2.13	6.0	1.83	778	187	591	374	404	0.988	0.755													1.28	1.38	1.33		N	2.00	N	1
3	SC	144	25.0	7.62	16.0	4.88	2,202	811	1,391	998	1,204	0.966	0.701	51	M	40.8	15	45.3	1.23	1.16	1.00	0.85	1.00	55	0.459	1.28	1.38	1.33	1.000	N	2.00	N	1
4	SC	136	35.0	10.67	30.0	9.14	4,178	1,685	2,493	1,872	2,306	0.921	0.661	43	S	43	15	47.6	0.92	1.16	1.00	0.95	1.20	58	0.459	1.28	1.38	1.33	0.986	N	2.00	N	1
5	SC	144	44.0	13.41	39.5	12.04	5,506	2,278	3,228	2,465	3,041	0.855	0.614	78	M	62.4	15	67.9	0.81	1.16	1.00	1.00	1.00	64	0.459	1.28	1.38	1.33	0.943	N	2.00	N	1
6	ML	110	48.0	14.63	46.0	14.02	6,374	2,683	3,691	2,870	3,504	0.794	0.572	17	S	17	55	25.4	0.76	1.16	1.00	1.00	1.20	27	0.315	1.28	1.38	1.33	0.918	N	0.67	Liquef	1
7	SC	140	90.0	27.43	69.0	21.03	9,534	4,118	5,416	4,306	5,228	0.597	0.432	59	M	47.2	15	52.0	0.63	1.16	1.00	1.00	1.00	38	0.459	1.28	1.38	1.33	0.837	N	2.00	N	1

Layer Number	Depth to Bot. Layer	Thickness	σ_o	u	σ'_o	r_d	$(N_1)_{60\text{-cs}}$	Liquefy ?	τ_{cyc}	$CSR_{M=7.5}$ τ_{cyc}/σ'_o	CSR_M τ_{cyc}/σ'_o	Volumetric Strain** %		Settl.
	ft	ft	psf	psf	psf			NCEER	psf					in
1	5.0	5.0	325	156	169	0.996		N	128.4	0.760	0.57			0.00
2	7.0	2.0	778	374	404	0.988		N	304.8	0.755	0.57			0.00
3	25.0	18.0	2,202	998	1,204	0.966	55.0	N	843.7	0.701	0.53			0.00
4	35.0	10.0	4,178	1,872	2,306	0.921	58.0	N	1525.0	0.661	0.50			0.00
5	44.0	9.0	5,506	2,465	3,041	0.855	63.8	N	1867.4	0.614	0.46			0.00
6	48.0	4.0	6,374	2,870	3,504	0.794	26.8	Liquef	2005.6	0.572	0.43		1.1	0.50
7	90.0	42.0	9,534	4,306	5,228	0.597	37.7	N	2258.4	0.432	0.32			0.00

Total Settlement (inch) = 0.50

* 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.

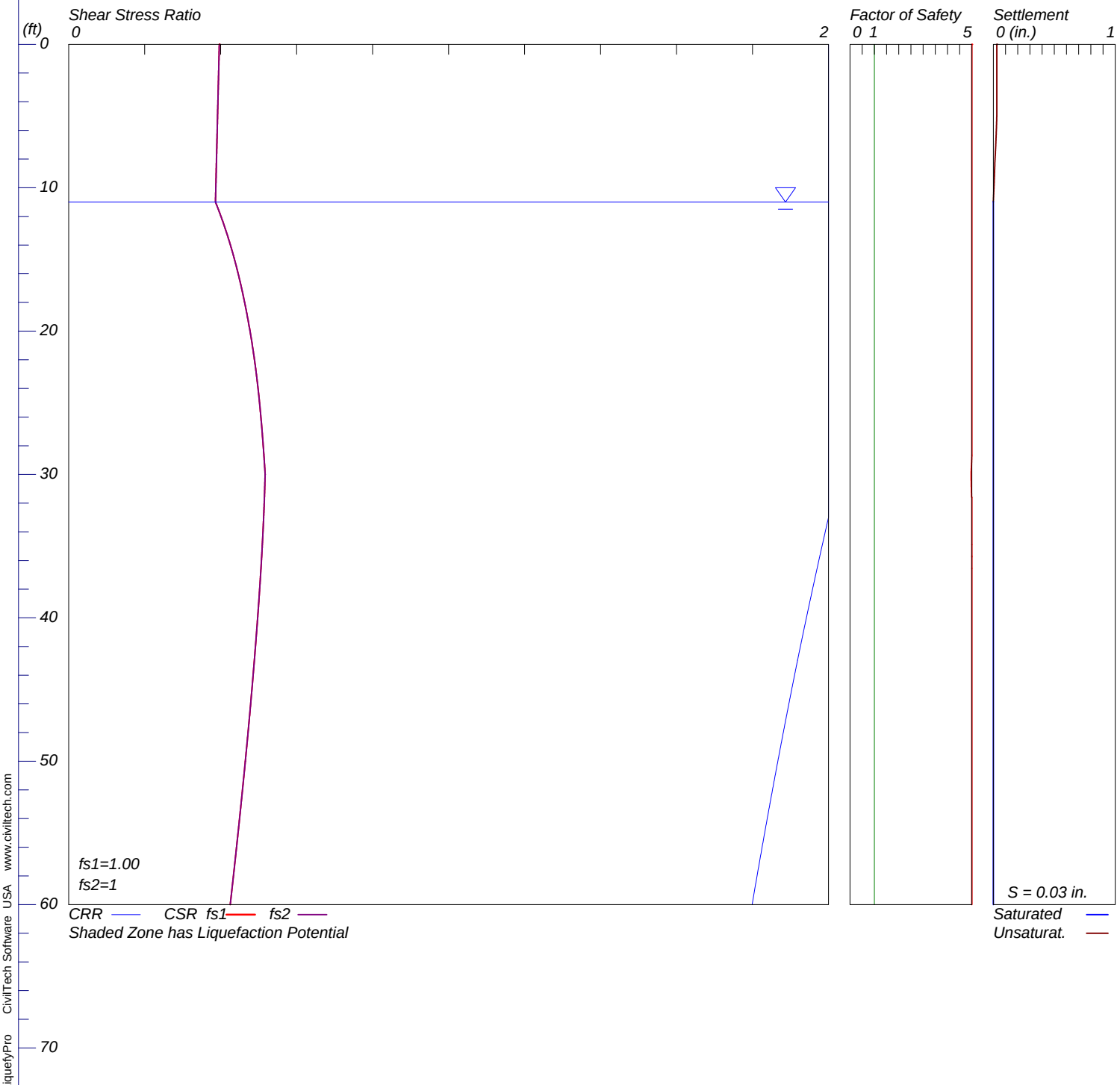
** Note: These values were obtained from a chart for estimation of volumetric strain in saturated sands based on a cyclic stress ratio and standard penetration resistance (Tokimatsu and Seed, 1987).
See figure 9.53 from "Geotechnical Earthquake Engineering" by S. Kramer.

LIQUEFACTION ANALYSIS

Route 84 Expressway Widening

Hole No.=NB11 Water Depth=11 ft Surface Elev.=412

Magnitude=6.8
Acceleration=0.61g



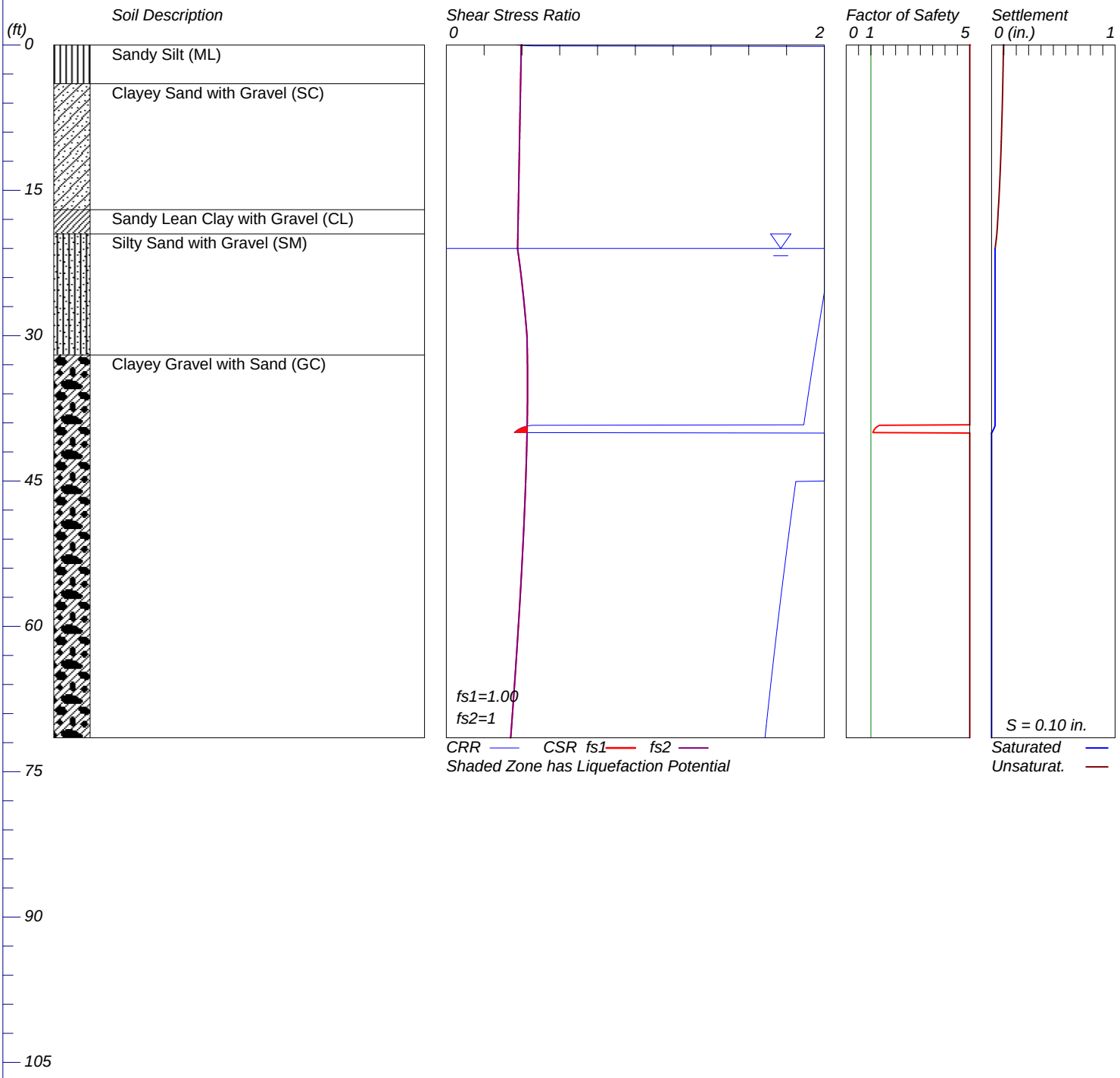
LiquefyPro CivilTech Software USA www.civiltech.com

LIQUEFACTION ANALYSIS

Route 84 Expressway Widening

Hole No.=NB12 Water Depth=21 ft Surface Elev.=422

Magnitude=6.8
Acceleration=0.61g



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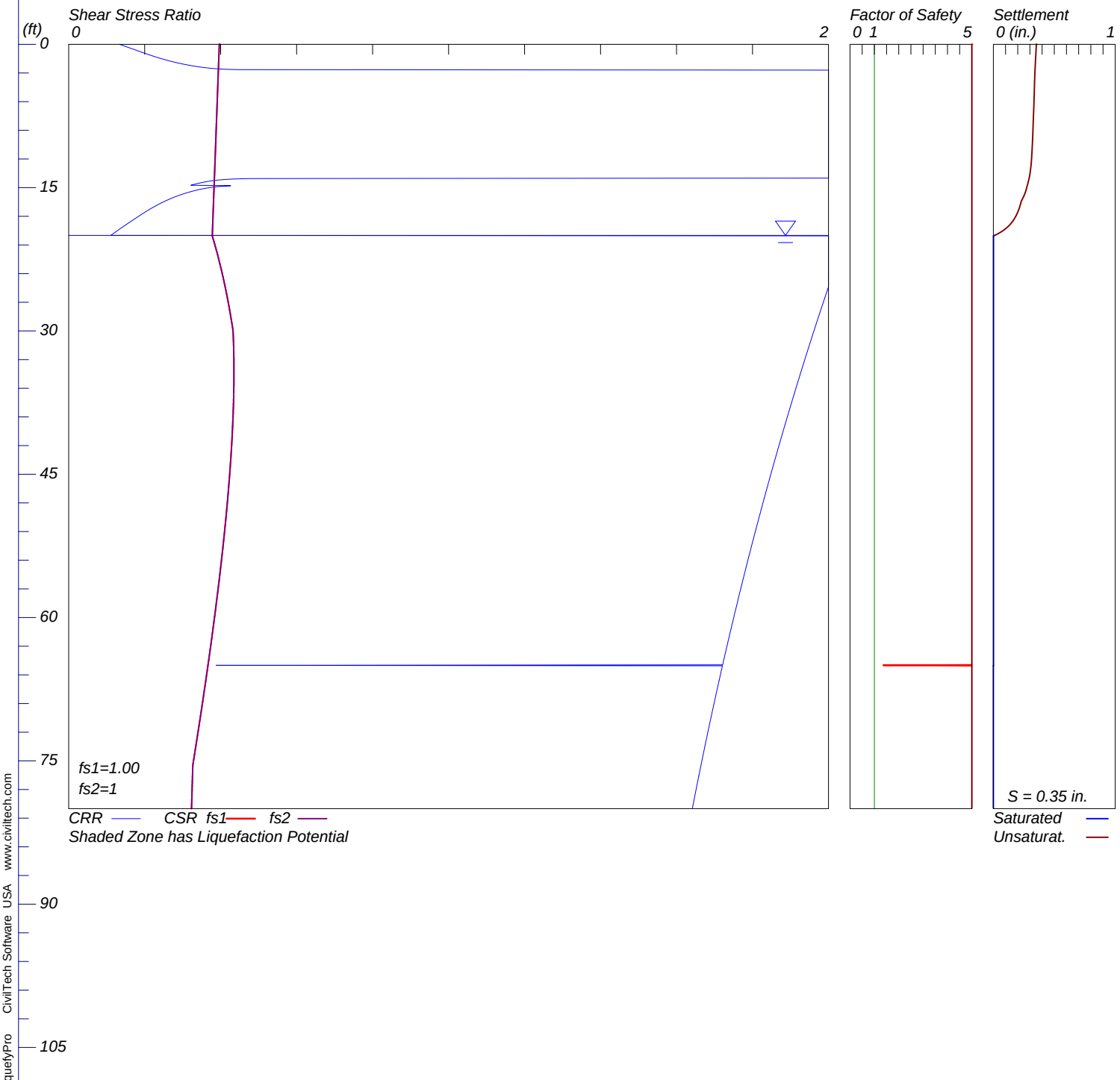
LIQUEFACTION ANALYSIS

Route 84 Expressway Widening

Hole No.=NB13 Water Depth=20 ft Surface Elev.=421

Magnitude=6.8
Acceleration=0.61g



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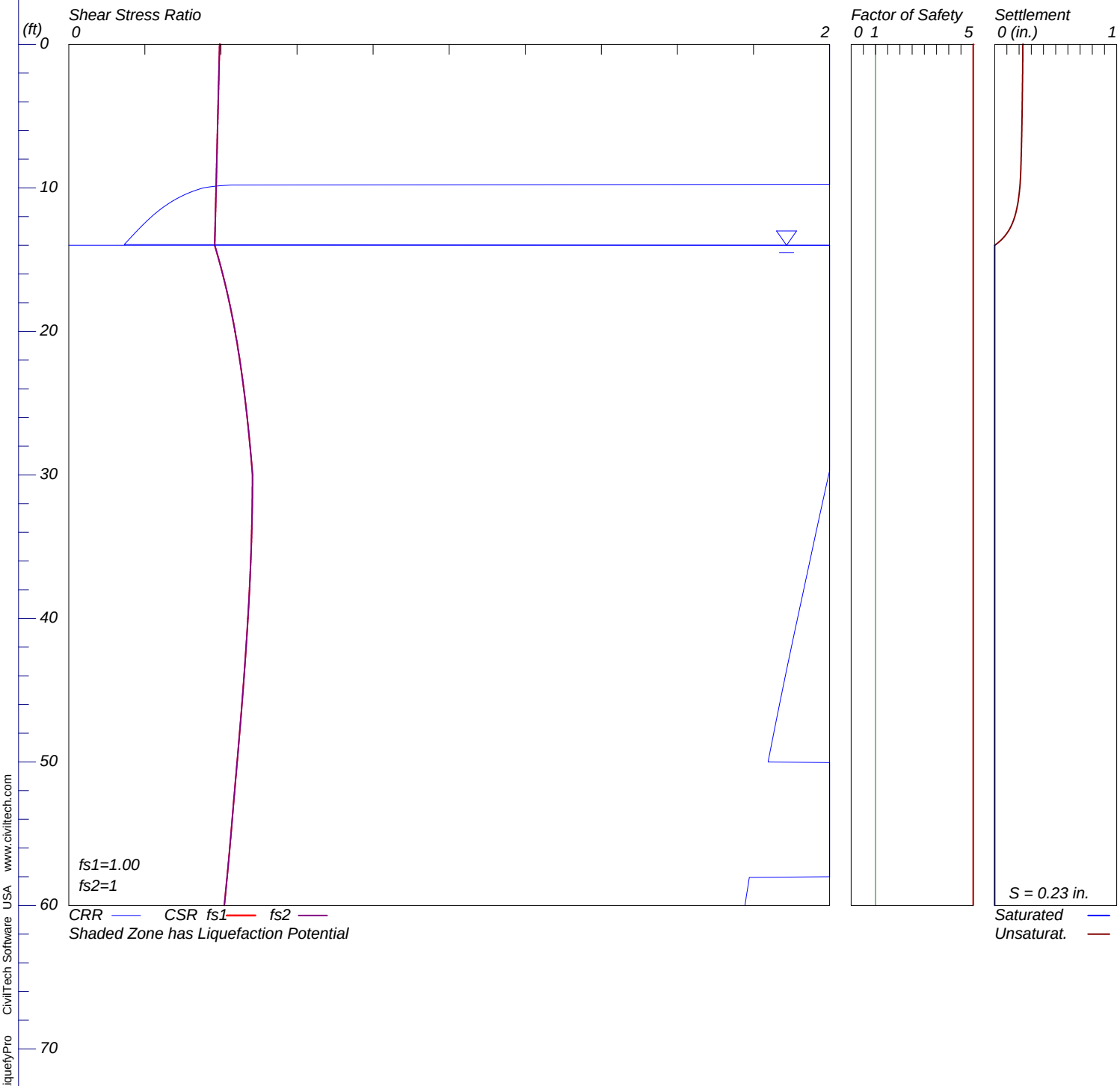
LIQUEFACTION ANALYSIS

Route 84 Expressway Widening

Hole No.=NB14 Water Depth=14 ft Surface Elev.=415

Magnitude=6.8
Acceleration=0.61g



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The following table presents correlation between the borehole identification shown on LOTBs and discussed throughout the report text with the borehole identification referenced in the corrosion report.

Borehole Identification on LOTBs	Borehole Identification for Laboratory Test Results
R-07-011	NB11
R-07-012	NB12
R-07-013	NB13
R-07-014	NB14

ROUTE 84 EXPRESSWAY WIDENING PROJECT

LIVERMORE, CA.

RUBY HILL DRIVE TO JACK LONDON BOULEVARD

Proposed Arroyo del Valle Trail 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_A del V Trail 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 proposed Arroyo del Valle Trail Bridge 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 soil samples selected from four borings at the Arroyo del Valle Bridge ranged from 7,255 ohm-cm to 10,586 ohm-cm. The soil pH ranged from 7.4 to 8.6 and the water-soluble chloride concentrations were below the detection limit of 2 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.

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. According to the Guidelines, all of these values are *non-corrosive* to metallic or concrete structures.

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 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.

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 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.

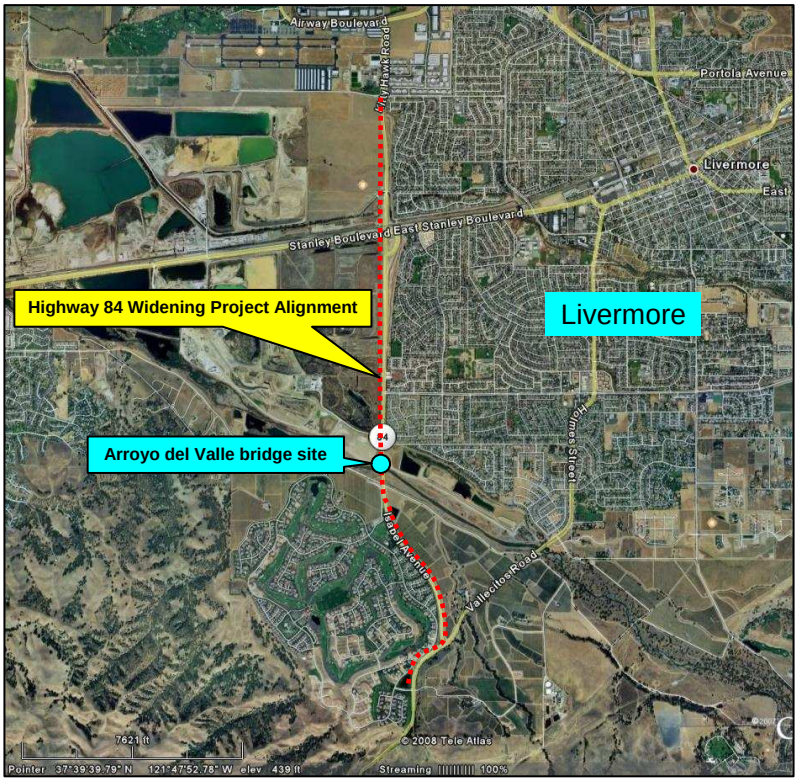


Figure 1. Project Site Map for Arroyo del Valle Bridge Foundation Investigation, Livermore, CA.

Figure 2. In-Situ Soil Resistivity Test and Soil Boring Locations

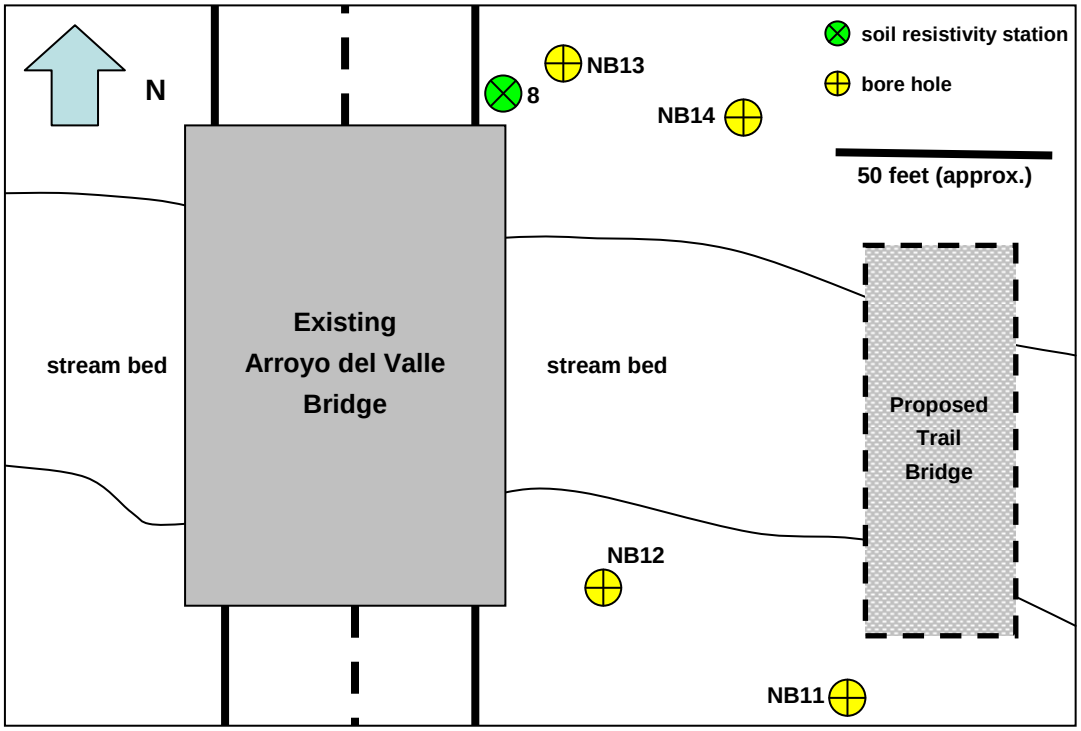


Figure 3. In-Situ Soil Resistivity Test Site and Soil Bore Locations for the Proposed Trail Bridge.

In-situ soil resistivity measurements were conducted by the Wenner Electrode Method, utilizing 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).

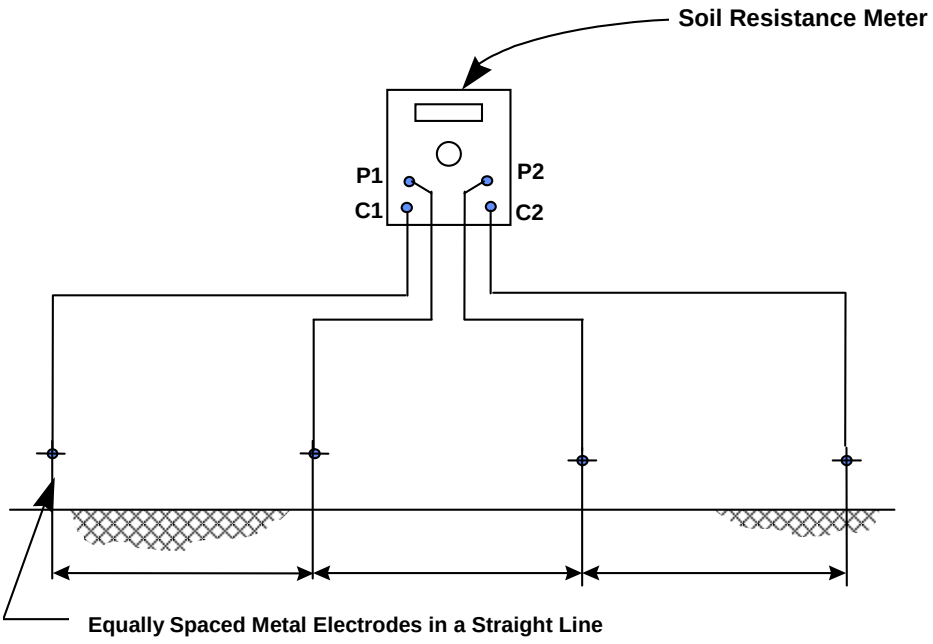


Figure 4. Wenner Electrode Method for Soil Resistivity Measurement

An alternating current from the Soil Resistance Meter causes a current to flow through the soil between the outside electrodes, C1 and C2. Due to the resistance of the soil, the current 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 then 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 del Valle 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 NB11, NB12, NB13 and NB14 for laboratory soil resistivity analysis. A Soil Box was used in accordance with California Test Method 643. This apparatus is shown in Figure 5.

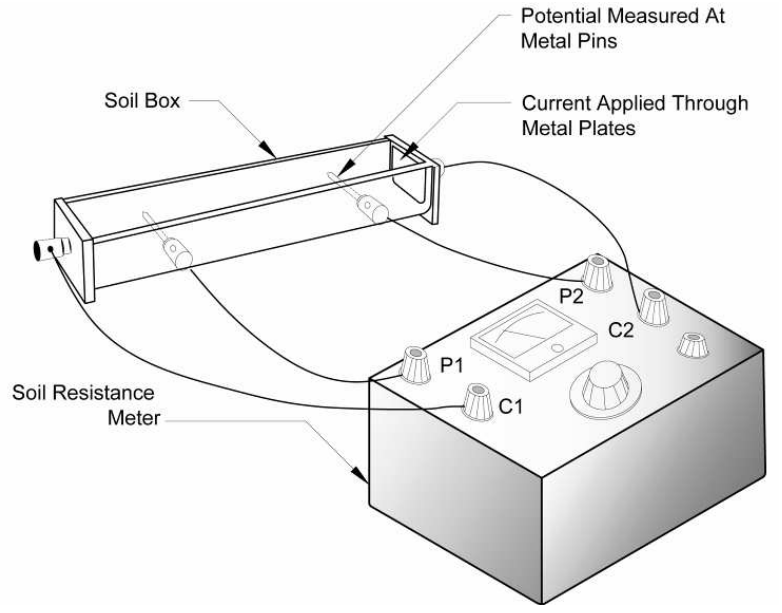


Figure 5. Soil Resistivity Measurement Using the Soil Box Method

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 field soil resistivity measurements from the Arroyo del Valle Bridge site and the calculated Barnes-Layer resistivities. Table 2 lists the minimum resistivities and chemical analyses for the soil boring samples, as well as a water sample taken from Arroyo del Valle.

Table 1. Field Soil Resistivity Data

Site	Survey Station	Depth (meters)	Resistivity (ohm-cm)	Layer (meters)	Layer Resistivity (ohm-cm)
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

Table 2. Laboratory Soil Resistivity and Chemical Data

Item No.	Boring No.	Station	Sample No.	Depth (meters)	Minimum Soil Resistivity (ohm-cm)	Chemical Data		
						pH	Sulfate (mg/kg)	Chloride (mg/kg)
1	NB11	318+50	5-3	6.1 - 6.6	7,255	7.4	<5	<2
2	NB12	319+00	2-X	1.5 - 2.0	10,028	8.6	<5	<2
3	NB13	321+00	6-3	7.6 - 8.1	7,992	8.3	<5	<2
4	NB14	321+00	2-3	1.5 - 2.0	10,586	8.5	<5	<2
Arroyo del Valle	N/A	320+00	water	N/A	1,686**	8.3	19.9*	63.7*

* The chloride and sulfate results for the Arroyo del Valle water sample are in mg/L.
** Water resistivity in ohm-cm.

Based on the Guidelines, the analyzed soil samples and water sample are considered *non-corrosive* to buried metallic objects and reinforced concrete structures in regards 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.

The following table presents correlation between the borehole identification shown on LOTBs and discussed throughout the report text with the borehole identification referenced in the shear wave velocity calculations.

Borehole Identification on LOTBs	Borehole Identification for Laboratory Test Results
R-07-011	NB11
R-07-012	NB12
R-07-013	NB13
R-07-014	NB14
R-08-037	NB37
R-08-038	NB38

Project: Route 84
Project Location: Livermore, CA

Boring Number: NB-11
Arroyo Del Valle

Modified to calculate stresses correctly
Extrapolates Vs values when boring depth is less than 30m
Warning: UCLA Vs30 calculates correctly only when Sand,Clay or Silt soil present.

Depth		Total Unit Weight,	Depth to Phreatic Surface,	σ_v	σ'_v			Undrained shear strength(3),	Vs in meters per second: All Soils			Gravel	Sand			
ft	m	pcf	feet	kN/m^2	kN/m^2	Type	N_{60}(2)	psf	Seed et al 1983	Imai & Tonouchi 1982	Sisman 1995	Ohta & Goto 1978	Lee 1992	Sykora & Stokoe 1983	Imai 1977	UCLA 2010
1	0.3048	130	4	6.2	6.2	Sand	48	6330.4382	386	326	235	#N/A	383	308	289	127
5	1.524	130	0	31.1	31.1	Sand	27	3630.6925	293	274	177	#N/A	287	262	241	177
10	3.048	130	-5	62.2	47.3	Sand	36	4840.9234	338	300	205	#N/A	330	285	265	200
15	4.572	130	-10	93.4	63.5	Sand	54	7168.2904	411	339	251	#N/A	413	319	302	223
20	6.096	130	-15	124.5	79.6	Sand	49	6516.6276	392	329	239	#N/A	389	311	292	233
25	7.62	130	-20	155.6	95.8	Sand	44	5833.9333	371	318	226	#N/A	365	301	282	241
30	9.144	130	-25	186.7	112.0	Sand	70	9309.468	469	368	286	#N/A	489	345	329	261
35	10.668	130	-30	217.9	128.2	Sand	68	9030.184	461	365	282	#N/A	479	342	326	269
40	12.192	130	-35	249.0	144.3	Sand	77	10302.478	493	380	302	#N/A	524	355	340	280
45	13.716	130	-40	280.1	160.5	Sand	56	7447.5744	419	343	256	#N/A	423	323	305	279
50	15.24	130	-45	311.2	176.7	Sand	85	11295.488	516	391	316	#N/A	560	364	351	297
55	16.764	130	-50	342.3	192.8	Sand	97	12909.129	552	408	338	#N/A	617	379	366	307
58.5	17.8308	130	-53.5	364.1	204.2	Sand	85	11295.488	516	391	316	#N/A	560	364	351	307
60	18.288			0.0	0.0			0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A
				0.0	0.0			0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A
				0.0	0.0			0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A
				0.0	0.0			0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A
				0.0	0.0			0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A
				0.0	0.0			0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A
				0.0	0.0			0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A

Depth	Silt			Clay					Young Sed Rock										Selected Mean	UCLA
ft	Lee 1992	Pitilakis 1999	UCLA 2010	Pitilakis 1999	Ohta & Goto 1978	Imai 1977	Dickerson 1994	UCLA 2010	Imai & Tonouchi 1982	All mean	Sand mean	Silt mean	Clay mean	Selected Value	UCLA Value	top	bot	Layer thickness, t	t / Vs	t/Vs
1	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	316	277	#N/A	#N/A	277	127	0	0.9144	0.9144	0.003302	0.007177
5	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	248	242	#N/A	#N/A	242	177	0.9144	2.286	1.3716	0.005679	0.007767
10	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	281	270	#N/A	#N/A	270	200	2.286	3.81	1.524	0.005645	0.007606
15	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	334	314	#N/A	#N/A	314	223	3.81	5.334	1.524	0.004851	0.006833
20	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	320	306	#N/A	#N/A	306	233	5.334	6.858	1.524	0.004974	0.006536
25	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	305	297	#N/A	#N/A	297	241	6.858	8.382	1.524	0.005129	0.006324
30	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	374	356	#N/A	#N/A	356	261	8.382	9.906	1.524	0.004281	0.005828
35	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	369	354	#N/A	#N/A	354	269	9.906	11.43	1.524	0.004307	0.005662
40	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	392	375	#N/A	#N/A	375	280	11.43	12.954	1.524	0.004065	0.005436
45	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	339	332	#N/A	#N/A	332	279	12.954	14.478	1.524	0.004585	0.00547
50	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	408	393	#N/A	#N/A	393	297	14.478	16.002	1.524	0.003879	0.005137
55	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	433	417	#N/A	#N/A	417	307	16.002	17.2974	1.2954	0.003104	0.004223
58.5	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	408	395	#N/A	#N/A	395	307	17.2974	18.0594	0.762	0.001927	0.002483
60	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	#N/A	#N/A	#N/A	NA	NA	18.0594	30	NA	NA	NA
	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	#N/A	#N/A	#N/A	NA	NA	30	0	NA	NA	NA
	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA
	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA
	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA
	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA
	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	#N/A	#N/A	#N/A	NA	NA	0	30	NA	NA	NA
																	sums	18.0594	0.055729	0.076484

Vs(d)= 324.1 236.1 m/s
Vs30= 382.1 278.4 m/s

Notes:
1. Reference: DeJong, J.T., 2007. *Site Characterization - Guidelines for Estimating Vs Based on In-Situ Tests* . State 1 - Interim Report. Soil Innteractions Laboratory, UC Davis. December 19.
Reference: Caltrans 2012. *Methodology for Developing Design Response Spectrum for Use in Seismic Design Recommendations* . http://dap3.dot.ca.gov/shake_stable/v2/technical.php. November.
2. Do not correct N_{60} for overburden pressure effect. Limit N_{60} to 100 blows per foot.
3. If undrained shear strength of clay sample has not been measured, try estimating it as 133 times N_{60}.

Project: Route 84
Project Location: Livermore, CA

Boring Number: NB-12
Arroyo Del Valle

Modified to calculate stresses correctly
Extrapolates Vs values when boring depth is less than 30m
Warning: UCLA Vs30 calculates correctly only when Sand,Clay or Silt soil present.

Depth ft	Depth m	Total Unit Weight, pcf	Depth to Phreatic Surface, feet	σ_v kN/m^2	σ'_v kN/m^2	Type	N_{60} (2)	Undrained shear strength (3), psf
1	0.3048	130	7	6.2	6.2	Silt	24	3227.4482
5	1.524	130	3	31.1	31.1	Sand	72	9620.2784
10	3.048	130	-2	62.2	56.3	Sand	73	9682.3447
15	4.572	130	-7	93.4	72.4	Sand	91	12040.865
20	6.096	130	-12	124.5	88.6	Sand	41	5492.8686
25	7.62	130	-17	155.6	104.8	Sand	70	9309.9468
30	9.144	130	-22	186.7	121.0	Sand	53	7075.5596
35	10.668	130	-27	217.9	137.1	Sand	25	3351.5808
36.5	11.1252	130	-28.5	227.2	142.0	Sand	31	4189.4761
40	12.192	130	-32	249.0	153.3	Sand	38	5027.3713
45	13.716	130	-37	280.1	169.5	Sand	52	6982.4601
50	15.24	130	-42	311.2	185.6	Sand	112	14895.915
60	18.288	130	-52	373.5	218.0	Sand	82	10923.671
70	21.336	130	-62	435.7	250.3	Sand	91	12164.997
75	22.86			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

Vs in meters per second

Depth ft	All Soils: Seed et al 1983	All Soils: Imai & Tonouchi 1982	All Soils: Sisman 1995	Gravel: Ohta & Goto 1978	Sand: Lee 1992	Sand: Sykora & Stokoe 1983	Sand: Imai 1977	Sand: UCLA 2010	Silt: Lee 1992	Silt: Pitilakis 1999	Silt: UCLA 2010	Clay: Pitilakis 1999	Clay: Ohta & Goto 1978	Clay: Imai 1977	Clay: Dickerson 1994	Clay: UCLA 2010	Young Sed Rock: Imai & Tonouchi 1982
1	276	264	167	#N/A	#N/A	#N/A	#N/A	#N/A	306	256	118	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5	476	372	291	#N/A	500	348	332	194	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
10	478	373	292	#N/A	502	348	333	223	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
15	533	399	326	#N/A	586	371	358	242	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
20	360	312	219	#N/A	353	296	276	235	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
25	469	368	286	#N/A	489	345	329	257	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
30	408	338	249	#N/A	409	318	300	259	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
35	281	267	170	#N/A	277	256	235	249	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
36.5	314	287	191	#N/A	306	273	253	256	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
40	344	303	209	#N/A	336	288	268	265	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
45	406	336	247	#N/A	406	317	299	280	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
50	593	427	364	#N/A	688	395	384	308	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
60	508	387	311	#N/A	546	361	347	311	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
70	536	401	328	#N/A	591	372	359	324	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
75	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

Depth ft	All mean	Sand mean	Silt mean	Clay mean	Selected Value	UCLA Value	top	bot	Layer thickness, t	Selected Mean t / Vs	UCLA t/Vs
1	236	#N/A	227	#N/A	227	118	0	0.9144	0.9144	0.004035	0.007731
5	380	344	#N/A	#N/A	344	194	0.9144	2.286	1.3716	0.003992	0.007074
10	381	352	#N/A	#N/A	352	223	2.286	3.81	1.524	0.004333	0.00683
15	420	389	#N/A	#N/A	389	242	3.81	5.334	1.524	0.003914	0.006302
20	297	290	#N/A	#N/A	290	235	5.334	6.858	1.524	0.005255	0.006479
25	374	355	#N/A	#N/A	355	257	6.858	8.382	1.524	0.004294	0.00592
30	332	322	#N/A	#N/A	322	259	8.382	9.906	1.524	0.004736	0.005876
35	239	254	#N/A	#N/A	254	249	9.906	10.8966	0.9906	0.0039	0.003984
36.5	264	272	#N/A	#N/A	272	256	10.8966	11.6586	0.762	0.0028	0.002975
40	286	290	#N/A	#N/A	290	265	11.6586	12.954	1.2954	0.004474	0.00488
45	330	326	#N/A	#N/A	326	280	12.954	14.478	1.524	0.00468	0.005433
50	461	444	#N/A	#N/A	444	308	14.478	16.764	2.286	0.005151	0.007417
60	402	391	#N/A	#N/A	391	311	16.764	19.812	3.048	0.007791	0.009809
70	421	412	#N/A	#N/A	412	324	19.812	22.098	2.286	0.005553	0.007047
75	0	#N/A	#N/A	#N/A	NA	NA	22.098	11.43	NA	NA	NA
	0	#N/A	#N/A	#N/A	NA	NA	11.43	0	NA	NA	NA
	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA
	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA
	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA
	0	#N/A	#N/A	#N/A	NA	NA	0	30	NA	NA	NA
								sums	22.098	0.064909	0.087758
									Vs(d)=	340.4	251.8 m/s
									Vs30=	380.8	281.7 m/s

Notes:

1. Reference: DeJong, J.T., 2007. *Site Characterization - Guidelines for Estimating Vs Based on In-Situ Tests* . State 1 - Interim Report. Soil Innteractions Laboratory, UC Davis. December 19.
   Reference: Caltrans 2012. *Methodology for Developing Design Response Spectrum for Use in Seismic Design Recommendations* . http://dap3.dot.ca.gov/shake_stable/v2/technical.php. November.
2. Do not correct N_{60} for overburden pressure effect. Limit N_{60} to 100 blows per foot.
3. If undrained shear strength of clay sample has not been measured, try estimating it as 133 times N_{60}.

Project: Route 84
Project Location: Livermore, CA

Boring Number: NB-13
Arroyo Del Valle

Modified to calculate stresses correctly
Extrapolates Vs values when boring depth is less than 30m
Warning: UCLA Vs30 calculates correctly only when Sand,Clay or Silt soil present.

Depth ft	Depth m	Total Unit Weight, pcf	Depth to Phreatic Surface, feet	σ_v kN/m²	σ'_v kN/m²	Type	N_{60} (2)	Undrained shear strength (3), psf
1	0.3048	130	13	6.2	6.2	Silt	7	993.00992
5	1.524	130	9	31.1	31.1	Sand	39	5213.3021
10	3.048	130	4	62.2	62.2	Sand	57	7602.7322
15	4.572	130	-1	93.4	90.4	Sand	34	4499.5762
20	6.096	130	-6	124.5	106.5	Clay	9	1241.2624
25	7.62	130	-11	155.6	122.7	Sand	72	9557.7205
30	9.144	130	-16	186.7	138.9	Sand	65	8688.8368
35	10.668	130	-21	217.9	155.1	Sand	55	7292.4166
40	12.192	130	-26	249.0	171.2	Sand	42	5585.6808
45	13.716	130	-31	280.1	187.4	Sand	64	8533.679
50	15.24	130	-36	311.2	203.6	Sand	91	12040.245
55	16.764	130	-41	342.3	219.8	Sand	70	9309.468
60	18.288	130	-46	373.5	235.9	Sand	115	15267.528
65	19.812	130	-51	404.6	252.1	Sand	59	7819.9531
70	21.336	130	-56	435.7	268.3	Sand	207	27556.025
75	22.86	130	-61	466.8	284.4	Sand	119	15764.032
78.5	23.9268	130	-64.5	488.6	295.8	Sand	187	24825.248
85	25.908			0.0	0.0			0
	0			0.0	0.0			0
	0			0.0	0.0			0

Vs in meters per second

Depth ft	All Soils: Seed et al 1983	All Soils: Imai & Tonouchi 1982	All Soils: Sisman 1995	Gravel: Ohta & Goto 1978	Sand: Lee 1992	Sand: Sykora & Stokoe 1983	Sand: Imai 1977	Sand: UCLA 2010	Silt: Lee 1992	Silt: Pitilakis 1999	Silt: UCLA 2010	Clay: Pitilakis 1999	Clay: Ohta & Goto 1978	Clay: Imai 1977	Clay: Dickerson 1994	Clay: UCLA 2010	Young Sed Rock: Imai & Tonouchi 1982
1	153	182	91	#N/A	#N/A	#N/A	#N/A	#N/A	212	207	96	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5	351	307	213	#N/A	343	291	271	183	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
10	423	346	258	#N/A	428	325	308	223	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
15	326	293	198	#N/A	317	279	259	232	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
20	171	196	102	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	242	183	154	158	195	#N/A
25	475	371	290	#N/A	498	347	332	268	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
30	453	360	276	#N/A	467	338	321	273	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
35	415	341	253	#N/A	417	321	303	276	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
40	363	314	221	#N/A	356	297	278	275	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
45	449	358	274	#N/A	461	336	320	293	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
50	533	399	326	#N/A	586	371	358	309	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
55	469	368	286	#N/A	489	345	329	307	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
60	600	430	368	#N/A	701	398	387	327	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
65	429	349	262	#N/A	436	328	310	311	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
70	806	518	498	#N/A	1,139	472	471	357	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
75	610	434	375	#N/A	719	401	392	343	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
78.5	765	501	472	#N/A	1,042	458	455	361	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
85	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

Depth ft	All mean	Sand mean	Silt mean	Clay mean	Selected Value	UCLA Value	top	bot	Layer thickness, t	Selected Mean t / Vs	UCLA t/Vs
1	142	#N/A	172	#N/A	172	96	0	0.9144	0.9144	0.005321	0.009536
5	290	272	#N/A	#N/A	272	183	0.9144	2.286	1.3716	0.005041	0.007502
10	342	321	#N/A	#N/A	321	223	2.286	3.81	1.524	0.004748	0.006826
15	272	272	#N/A	#N/A	272	232	3.81	5.334	1.524	0.005609	0.006574
20	156	#N/A	#N/A	186	186	195	5.334	6.858	1.524	0.008179	0.007797
25	379	361	#N/A	#N/A	361	268	6.858	8.382	1.524	0.00422	0.005689
30	363	350	#N/A	#N/A	350	273	8.382	9.906	1.524	0.004357	0.005576
35	336	329	#N/A	#N/A	329	276	9.906	11.43	1.524	0.004628	0.005525
40	299	302	#N/A	#N/A	302	275	11.43	12.954	1.524	0.005054	0.005537
45	360	352	#N/A	#N/A	352	293	12.954	14.478	1.524	0.004325	0.005205
50	419	406	#N/A	#N/A	406	309	14.478	16.002	1.524	0.003753	0.004938
55	374	367	#N/A	#N/A	367	307	16.002	17.526	1.524	0.00415	0.004971
60	466	453	#N/A	#N/A	453	327	17.526	19.05	1.524	0.003362	0.004662
65	347	346	#N/A	#N/A	346	311	19.05	20.574	1.524	0.004401	0.004894
70	607	610	#N/A	#N/A	610	357	20.574	22.098	1.524	0.0025	0.004273
75	473	464	#N/A	#N/A	464	343	22.098	23.3934	1.2954	0.002794	0.00378
78.5	579	579	#N/A	#N/A	579	361	23.3934	24.9174	1.524	0.002632	0.004218
85	0	#N/A	#N/A	#N/A	NA	NA	24.9174	12.954	NA	NA	NA
	0	#N/A	#N/A	#N/A	NA	NA	12.954	0	NA	NA	NA
	0	#N/A	#N/A	#N/A	NA	NA	0	30	NA	NA	NA
								sums	24.9174	0.075072	0.097503

Vs(d)= 331.9 255.6 m/s
Vs30= 357.2 275.0 m/s

Notes:
1. Reference: DeJong, J.T., 2007. *Site Characterization - Guidelines for Estimating Vs Based on In-Situ Tests* . State 1 - Interim Report. Soil Innteractions Laboratory, UC Davis. December 19.
Reference: Caltrans 2012. *Methodology for Developing Design Response Spectrum for Use in Seismic Design Recommendations* . http://dap3.dot.ca.gov/shake_stable/v2/technical.php. November.
2. Do not correct N_{60} for overburden pressure effect. Limit N_{60} to 100 blows per foot.
3. If undrained shear strength of clay sample has not been measured, try estimating it as 133 times N_{60}.

Project: Route 84
Project Location: Livermore, CA

Boring Number: NB-14
Arroyo Del Valle

Modified to calculate stresses correctly
Extrapolates Vs values when boring depth is less than 30m
Warning: UCLA Vs30 calculates correctly only when Sand,Clay or Silt soil present.

Depth ft	Depth m	Total Unit Weight, pcf	Depth to Phreatic Surface, feet	σ_v kN/m^2	σ'_v kN/m^2	Type	N_{60} (2)	Undrained shear strength (3), psf	Vs in meters per second: All Soils – Seed et al 1983	All Soils – Imai & Tonouchi 1982	All Soils – Sisman 1995	Gravel – Ohta & Goto 1978	Sand – Lee 1992	Sand – Sykora & Stokoe 1983	Sand – Imai 1977	Sand – UCLA 2010
1	0.3048	130	13	6.2	6.2	Silt	37	4965.0496	342	302	208	#N/A	#N/A	#N/A	#N/A	#N/A
5	1.524	130	9	31.1	31.1	Sand	63	8316.4581	443	355	270	#N/A	454	333	317	191
10	3.048	130	4	62.2	62.2	Sand	24	3227.2822	276	264	167	#N/A	272	253	232	206
15	4.572	130	-1	93.4	90.4	Sand	12	1613.6411	195	212	117	#N/A	215	207	184	210
20	6.096	130	-6	124.5	106.5	Clay	45	5958.0595	375	320	228	#N/A	#N/A	#N/A	#N/A	#N/A
25	7.62	130	-11	155.6	122.7	Sand	66	8812.963	456	362	278	#N/A	471	339	323	266
30	9.144	130	-16	186.7	138.9	Sand	51	6826.9432	401	334	244	#N/A	400	315	297	267
35	10.668	130	-21	217.9	155.1	Sand	61	8099.2372	437	352	267	#N/A	446	331	314	279
40	12.192	130	-26	249.0	171.2	Sand	50	6702.817	398	332	242	#N/A	396	313	295	280
45	13.716	130	-31	280.1	187.4	Sand	28	3723.7872	296	276	179	#N/A	290	264	243	270
50	15.24	130	-36	311.2	203.6	Sand	187	24825.248	765	501	472	#N/A	1,042	458	455	331
55	16.764	130	-41	342.3	219.8	Sand	32	4220.2922	315	287	191	#N/A	308	274	253	284
58.5	17.8308	130	-44.5	364.1	231.1	Sand	61	8068.2056	436	352	266	#N/A	445	331	314	306
60	18.288		-46	0.0	-137.5			0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A
	0		14	0.0	0.0			0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A
	0		14	0.0	0.0			0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A
	0		14	0.0	0.0			0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A
	0			0.0	0.0			0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A
	0			0.0	0.0			0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A
	0			0.0	0.0			0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A

Depth ft	Depth m	Silt – Lee 1992	Silt – Pitilakis 1999	Silt – UCLA 2010	Clay – Pitilakis 1999	Clay – Ohta & Goto 1978	Clay – Imai 1977	Clay – Dickerson 1994	Clay – UCLA 2010	Young Sed Rock – Imai & Tonouchi 1982	All mean	Sand mean	Silt mean	Clay mean	Selected Value	UCLA Value	top	bot	Layer thickness, t	Selected Mean t / Vs	UCLA t/Vs
1	0.3048	351	276	128	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	284	#N/A	252	#N/A	252	128	0	0.9144	0.9144	0.003632	0.00716
5	1.524	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	356	324	#N/A	#N/A	324	191	0.9144	2.286	1.3716	0.004237	0.007173
10	3.048	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	236	241	#N/A	#N/A	241	206	2.286	3.81	1.524	0.006332	0.007411
15	4.572	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	175	204	#N/A	#N/A	204	210	3.81	5.334	1.524	0.007469	0.007254
20	6.096	#N/A	#N/A	#N/A	370	308	243	332	280	#N/A	308	#N/A	#N/A	307	307	280	5.334	6.858	1.524	0.004968	0.005435
25	7.62	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	365	350	#N/A	#N/A	350	266	6.858	8.382	1.524	0.004357	0.005734
30	9.144	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	327	320	#N/A	#N/A	320	267	8.382	9.906	1.524	0.004766	0.005707
35	10.668	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	352	342	#N/A	#N/A	342	279	9.906	11.43	1.524	0.004452	0.00547
40	12.192	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	324	321	#N/A	#N/A	321	280	11.43	12.954	1.524	0.004746	0.005441
45	13.716	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	251	267	#N/A	#N/A	267	270	12.954	14.478	1.524	0.005712	0.005636
50	15.24	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	579	571	#N/A	#N/A	571	331	14.478	16.002	1.524	0.002667	0.004607
55	16.764	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	265	280	#N/A	#N/A	280	284	16.002	17.2974	1.2954	0.004632	0.004559
58.5	17.8308	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	351	349	#N/A	#N/A	349	306	17.2974	18.0594	0.762	0.002185	0.00249
60	18.288	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	#N/A	#N/A	#N/A	NA	NA	18.0594	9.144	NA	NA	NA
	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	#N/A	#N/A	#N/A	NA	NA	9.144	0	NA	NA	NA
	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA
	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA
	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA
	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	#N/A	#N/A	#N/A	NA	NA	0	0	NA	NA	NA
	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	#N/A	#N/A	#N/A	NA	NA	0	30	NA	NA	NA
																		sums	18.0594	0.060154	0.074078
																			Vs(d)=	300.2	243.8 m/s
																			Vs30=	354.0	287.5 m/s

Notes:
1. Reference: DeJong, J.T., 2007. *Site Characterization - Guidelines for Estimating Vs Based on In-Situ Tests* . State 1 - Interim Report. Soil Innteractions Laboratory, UC Davis. December 19.
   Reference: Caltrans 2012. *Methodology for Developing Design Response Spectrum for Use in Seismic Design Recommendations* . http://dap3.dot.ca.gov/shake_stable/v2/technical.php. November.
2. Do not correct N_{60} for overburden pressure effect. Limit N_{60} to 100 blows per foot.
3. If undrained shear strength of clay sample has not been measured, try estimating it as 133 times N_{60}.

Project: Route 84
Project Location: Livermore, CA

Boring Number: NB-37
Arroyo Del Valle

Modified to calculate stresses correctly
Extrapolates Vs values when boring depth is less than 30m
Warning: UCLA Vs30 calculates correctly only when Sand,Clay or Silt soil present.

Depth ft	Depth m	Total Unit Weight, pcf	Depth to Phreatic Surface, feet	σ_v kN/m^2	σ'_v kN/m^2	Type	N_{60} (2)	Undrained shear strength (3), psf
1	0.3048	130	2.5	6.2	6.2	Sand	54	7199.6922
5	1.524	130	-1.5	31.1	26.6	Sand	17	2234.3872
10	3.048	130	-6.5	62.2	42.8	Sand	49	6454.8964
15	4.572	130	-11.5	93.4	59.0	Sand	82	10861.605
20	6.096	130	-16.5	124.5	75.2	Sand	48	6330.7638
25	7.62	130	-21.5	155.6	91.3	Sand	56	7447.9574
30	9.144	130	-26.5	186.7	107.5	Sand	50	6672.1285
35	10.668	130	-31.5	217.9	123.7	Sand	73	9682.3447
40	12.192	130	-36.5	249.0	139.8	Sand	93	12413.262
45	13.716	130	-41.5	280.1	156.0	Silt	20	2637.8183
50	15.24	130	-46.5	311.2	172.2	Sand	55	7323.8248
55	16.764	130	-51.5	342.3	188.4	Sand	77	10240.941
60	18.288	130	-56.5	373.5	204.5	Sand	91	12164.997
65	19.812	130	-61.5	404.6	220.7	Sand	90	11947.765
70	21.336	130	-66.5	435.7	236.9	Sand	113	15020.048
75	22.86	130	-71.5	466.8	253.0	Sand	98	13033.926
80	24.384	130	-76.5	498.0	269.2	Sand	111	14771.782
85	25.908	130	-81.5	529.1	285.4	Sand	120	15982.075
88.5	26.9748	130	-85	550.9	296.7	Sand	103	13654.589
90	27.432			0.0	0.0			0

Vs in meters per second

Depth ft	All Soils: Seed et al 1983	All Soils: Imai & Tonouchi 1982	All Soils: Sisman 1995	Gravel: Ohta & Goto 1978	Sand: Lee 1992	Sand: Sykora & Stokoe 1983	Sand: Imai 1977	Sand: UCLA 2010	Silt: Lee 1992	Silt: Pitilakis 1999	Silt: UCLA 2010	Clay: Pitilakis 1999	Clay: Ohta & Goto 1978	Clay: Imai 1977	Clay: Dickerson 1994	Clay: UCLA 2010	Young Sed Rock: Imai & Tonouchi 1982
1	412	340	251	#N/A	414	320	302	129	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5	230	235	138	#N/A	237	228	205	162	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
10	390	328	238	#N/A	387	310	291	201	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
15	506	387	310	#N/A	544	360	346	228	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
20	386	326	235	#N/A	383	308	289	229	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
25	419	343	256	#N/A	423	323	305	244	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
30	397	332	242	#N/A	395	313	295	251	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
35	478	373	292	#N/A	502	348	333	269	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
40	541	403	332	#N/A	600	375	362	283	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
45	249	248	151	#N/A	#N/A	#N/A	#N/A	#N/A	287	247	240	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
50	416	342	253	#N/A	418	321	304	283	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
55	491	379	301	#N/A	522	354	339	298	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
60	536	401	328	#N/A	591	372	359	309	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
65	531	398	325	#N/A	583	370	357	314	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
70	595	428	365	#N/A	692	396	385	327	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
75	554	409	340	#N/A	622	380	368	327	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
80	590	426	362	#N/A	684	394	383	336	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
85	614	436	377	#N/A	727	403	393	343	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
88.5	567	415	348	#N/A	644	385	373	341	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
90	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

Depth ft	All mean	Sand mean	Silt mean	Clay mean	Selected Value	UCLA Value	top	bot	Layer thickness, t	Selected Mean t / Vs	UCLA t/Vs
1	334	291	#N/A	#N/A	291	129	0	0.9144	0.9144	0.003141	0.007089
5	201	208	#N/A	#N/A	208	162	0.9144	2.286	1.3716	0.006594	0.008442
10	319	297	#N/A	#N/A	297	201	2.286	3.81	1.524	0.005125	0.007575
15	401	370	#N/A	#N/A	370	228	3.81	5.334	1.524	0.004122	0.006681
20	316	302	#N/A	#N/A	302	229	5.334	6.858	1.524	0.005039	0.006645
25	339	324	#N/A	#N/A	324	244	6.858	8.382	1.524	0.004708	0.006248
30	323	313	#N/A	#N/A	313	251	8.382	9.906	1.524	0.004865	0.006076
35	381	363	#N/A	#N/A	363	269	9.906	11.43	1.524	0.004197	0.005672
40	425	405	#N/A	#N/A	405	283	11.43	12.954	1.524	0.003765	0.00538
45	216	#N/A	258	#N/A	258	240	12.954	14.478	1.524	0.00591	0.006346
50	337	332	#N/A	#N/A	332	283	14.478	16.002	1.524	0.004597	0.005388
55	390	379	#N/A	#N/A	379	298	16.002	17.526	1.524	0.004026	0.005108
60	421	408	#N/A	#N/A	408	309	17.526	19.05	1.524	0.003736	0.004928
65	418	406	#N/A	#N/A	406	314	19.05	20.574	1.524	0.003752	0.004848
70	463	450	#N/A	#N/A	450	327	20.574	22.098	1.524	0.003386	0.004665
75	435	424	#N/A	#N/A	424	327	22.098	23.622	1.524	0.003593	0.004655
80	459	449	#N/A	#N/A	449	336	23.622	25.146	1.524	0.003393	0.004533
85	476	467	#N/A	#N/A	467	343	25.146	26.4414	1.2954	0.002776	0.003772
88.5	444	436	#N/A	#N/A	436	341	26.4414	27.2034	0.762	0.001748	0.002232
90	0	#N/A	#N/A	#N/A	NA	NA	27.2034	30	NA	NA	NA
								sums	27.2034	0.078471	0.106282
									Vs(d)=	346.7	256.0 m/s
									Vs30=	361.2	266.7 m/s

Notes:

1. Reference: DeJong, J.T., 2007. *Site Characterization - Guidelines for Estimating Vs Based on In-Situ Tests* . State 1 - Interim Report. Soil Innteractions Laboratory, UC Davis. December 19.
   Reference: Caltrans 2012. *Methodology for Developing Design Response Spectrum for Use in Seismic Design Recommendations* . http://dap3.dot.ca.gov/shake_stable/v2/technical.php. November.
2. Do not correct N_{60} for overburden pressure effect. Limit N_{60} to 100 blows per foot.
3. If undrained shear strength of clay sample has not been measured, try estimating it as 133 times N_{60}.

Project: Route 84
Project Location: Livermore, CA

Boring Number: NB-38
Arroyo Del Valle

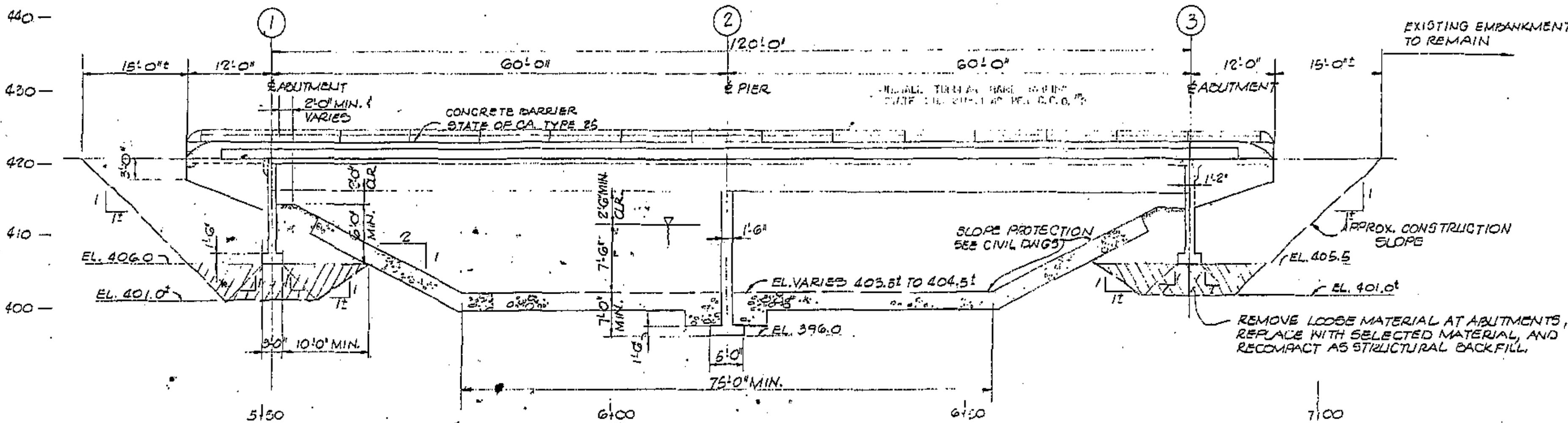
Modified to calculate stresses correctly
Extrapolates Vs values when boring depth is less than 30m
Warning: UCLA Vs30 calculates correctly only when Sand,Clay or Silt soil present.

Depth		Total Unit Weight, pcf	Depth to Phreatic Surface, feet	σ_v kN/m²	σ'_v kN/m²	Type	N_{60} (2)	Undrained shear strength (3), psf	Vs in meters per second: All Soils			Gravel	Sand				Silt			Clay					Young Sed Rock
ft	m								Seed et al 1983	Imai & Tonouchi 1982	Sisman 1995	Ohta & Goto 1978	Lee 1992	Sykora & Stokoe 1983	Imai 1977	UCLA 2010	Lee 1992	Pitilakis 1999	UCLA 2010	Pitilakis 1999	Ohta & Goto 1978	Imai 1977	Dickerson 1994	UCLA 2010	Imai & Tonouchi 1982
1	0.3048	130	2.5	6.2	6.2	Sand	47	6206.6312	383	324	233	#N/A	378	306	288	127	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
5	1.524	130	-1.5	31.1	26.6	Sand	81	10799.538	505	386	309	#N/A	542	360	345	189	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
10	3.048	130	-6.5	62.2	42.8	Sand	43	5741.1339	368	316	224	#N/A	362	299	280	199	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
15	4.572	130	-11.5	93.4	59.0	Sand	40	5337.7028	355	309	216	#N/A	347	293	274	213	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
20	6.096	130	-16.5	124.5	75.2	Sand	65	8689.2837	453	360	276	#N/A	467	338	321	236	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
25	7.62	130	-21.5	155.6	91.3	Sand	106	14151.119	578	420	354	#N/A	661	389	378	259	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
30	9.144	130	-26.5	186.7	107.5	Sand	48	6361.797	387	327	236	#N/A	384	309	290	250	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
35	10.668	130	-31.5	217.9	123.7	Sand	149	19861.22	684	467	421	#N/A	865	429	423	288	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
40	12.192	130	-36.5	249.0	139.8	Sand	72	9620.2784	476	372	291	#N/A	500	348	332	276	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
45	13.716	130	-41.5	280.1	156.0	Sand	78	10427.14	496	382	303	#N/A	529	356	341	286	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
50	15.24	130	-46.5	311.2	172.2	Sand	64	8534.1179	449	358	274	#N/A	461	336	320	287	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
55	16.764	130	-51.5	342.3	188.4	Sand	106	14151.119	578	420	354	#N/A	661	389	378	308	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
60	18.288	130	-56.5	373.5	204.5	Sand	77	10240.941	491	379	301	#N/A	522	354	339	304	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
65	19.812	130	-61.5	404.6	220.7	Sand	86	11420.201	519	393	318	#N/A	564	366	352	313	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
70	21.336	130	-66.5	435.7	236.9	Sand	108	14430.418	583	423	358	#N/A	671	391	380	325	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
75	22.86	130	-71.5	466.8	253.0	Sand	105	14026.987	575	419	353	#N/A	657	388	377	330	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
80	24.384	130	-76.5	498.0	269.2	Sand	150	20016.386	687	468	423	#N/A	870	430	424	346	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
85	25.908	130	-81.5	529.1	285.4	Sand	86	11420.201	519	393	318	#N/A	564	366	352	333	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
88.5	26.9748	130	-85	550.9	296.7	Sand	107	14275.252	580	421	356	#N/A	666	390	379	343	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
90	27.432			0.0	0.0			0	0	0	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

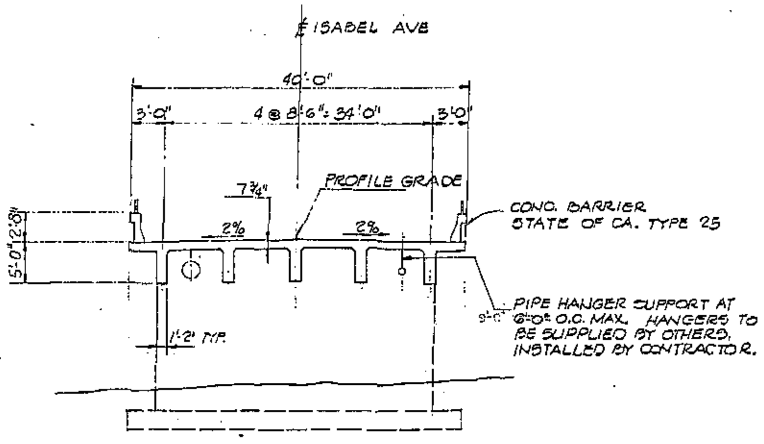
Depth ft	All mean	Sand mean	Silt mean	Clay mean	Selected Value	UCLA Value	top	bot	Layer thickness, t	Selected Mean t / Vs	UCLA t/Vs	
1	313	275	#N/A	#N/A	275	127	0	0.9144	0.9144	0.003327	0.007191	
5	400	359	#N/A	#N/A	359	189	0.9144	2.286	1.3716	0.00382	0.007257	
10	303	285	#N/A	#N/A	285	199	2.286	3.81	1.524	0.005345	0.00766	
15	293	282	#N/A	#N/A	282	213	3.81	5.334	1.524	0.005408	0.007152	
20	363	341	#N/A	#N/A	341	236	5.334	6.858	1.524	0.004474	0.006446	
25	451	422	#N/A	#N/A	422	259	6.858	8.382	1.524	0.003612	0.005875	
30	317	308	#N/A	#N/A	308	250	8.382	9.906	1.524	0.004948	0.006104	
35	524	501	#N/A	#N/A	501	288	9.906	11.43	1.524	0.003041	0.005294	
40	380	364	#N/A	#N/A	364	276	11.43	12.954	1.524	0.004185	0.005513	
45	394	378	#N/A	#N/A	378	286	12.954	14.478	1.524	0.004031	0.005331	
50	360	351	#N/A	#N/A	351	287	14.478	16.002	1.524	0.004342	0.00531	
55	451	434	#N/A	#N/A	434	308	16.002	17.526	1.524	0.003511	0.004952	
60	390	380	#N/A	#N/A	380	304	17.526	19.05	1.524	0.004011	0.00501	
65	410	399	#N/A	#N/A	399	313	19.05	20.574	1.524	0.003823	0.004869	
70	455	442	#N/A	#N/A	442	325	20.574	22.098	1.524	0.003447	0.004683	
75	449	438	#N/A	#N/A	438	330	22.098	23.622	1.524	0.003481	0.004623	
80	526	518	#N/A	#N/A	518	346	23.622	25.146	1.524	0.002944	0.004403	
85	410	404	#N/A	#N/A	404	333	25.146	26.4414	1.2954	0.00321	0.003895	
88.5	452	444	#N/A	#N/A	444	343	26.4414	27.2034	0.762	0.001715	0.002222	
90	0	#N/A	#N/A	#N/A	NA	NA	27.2034	30	NA	NA	NA	
								sums	27.2034	0.072676	0.10379	
									Vs(d)=	374.3	262.1	m/s
									Vs30=	390.0	273.1	m/s

Notes:
1. Reference: DeJong, J.T., 2007. *Site Characterization - Guidelines for Estimating Vs Based on In-Situ Tests* . State 1 - Interim Report. Soil Innteractions Laboratory, UC Davis. December 19.
Reference: Caltrans 2012. *Methodology for Developing Design Response Spectrum for Use in Seismic Design Recommendations* . http://dap3.dot.ca.gov/shake_stable/v2/technical.php. November.
2. Do not correct N_{60} for overburden pressure effect. Limit N_{60} to 100 blows per foot.
3. If undrained shear strength of clay sample has not been measured, try estimating it as 133 times N_{60}.

As-Built Plans



ELEVATION
1" = 10'



TYPICAL SECTION
1" = 10'

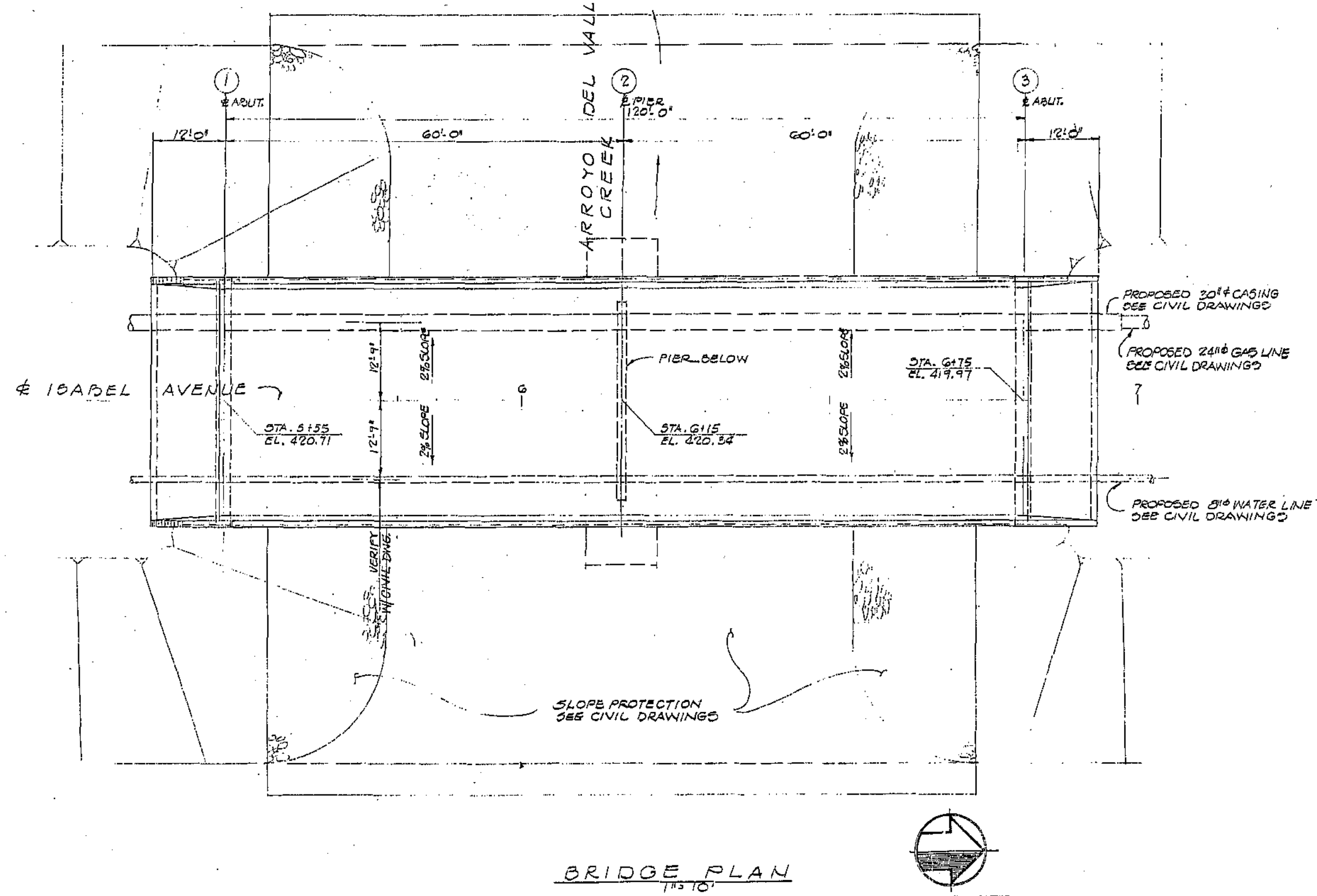
ITEM	UNIT	QUANTITY
STRUCTURAL EXCAVATION (BRIDGE)	C.Y.	225
STRUCTURAL BACKFILL (BRIDGE)	C.Y.	140
PERVIOUS MATERIAL	C.Y.	26
CONCRETE (BRIDGE)	C.Y.	342
CONCRETE (FOOTING)	C.Y.	21
CONCRETE (APPROACH SLAB)	C.Y.	34
BAR STEEL (REINFORCING)	LBS.	86,600
BARRIER RAIL	L.F.	288
TYPE AL JOINT SEAL	L.F.	48

BRIDGE DESIGN CRITERIA

1. AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES THROUGH 1982 REVISIONS AS AMENDED BY THE STATE OF CALIFORNIA DEPT. OF TRANSPORTATION DATED JAN. 1983.
2. DEAD LOAD: INCLUDES 35 P.S.F. FOR FUTURE WEARING SURFACE.
3. LIVE LOAD: HS 20-44
4. REINFORCED CONCRETE:
   SERVICE LOAD DESIGN (TRANSVERSE DECK FLEXURE)
   f_c = 1,200 psi
   f_s = 20,000 psi
   n = 9
   LOAD FACTOR DESIGN
   f'_c = 3,500 psi
   f_y = 60,000 psi, EXCEPT
   50,000 psi, STIRRUPS
5. FOUNDATION ALLOWABLE BEARING PRESSURE
   ABUTMENT: DL 4000 PSF
   DL+LL 6000 PSF
   ALL 8000 PSF
   PIER: DL 6000 PSF
   DL+LL 8500 PSF
   ALL 11,000 PSF

NOTES:

1. FALSEWORK FOR BRIDGE SHALL REMAIN IN PLACE UNTIL CONCRETE HAS OBTAINED SPECIFIED STRENGTH WITH A MINIMUM ELAPSED TIME OF 21 DAYS AFTER LAST CONCRETE (EXCLUDING CONCRETE ABOVE THE BRIDGE DECK) PLACEMENT.
2. THE REQUIRED 28 DAY COMPRESSIVE STRENGTH FOR ALL BRIDGE STRUCTURAL CONCRETE AND FOOTING CONCRETE SHALL BE 3500 PSI.



BRIDGE PLAN
1" = 10'

COUNTY OF ALAMEDA PUBLIC WORKS AGENCY ROAD DIVISION

CREEGAN & D'ANGELO CONSULTING ENGINEERS

GENERAL PLAN
PROPOSED ISABEL AVE. BRIDGE AT ARROYO DEL VALLE CREEK

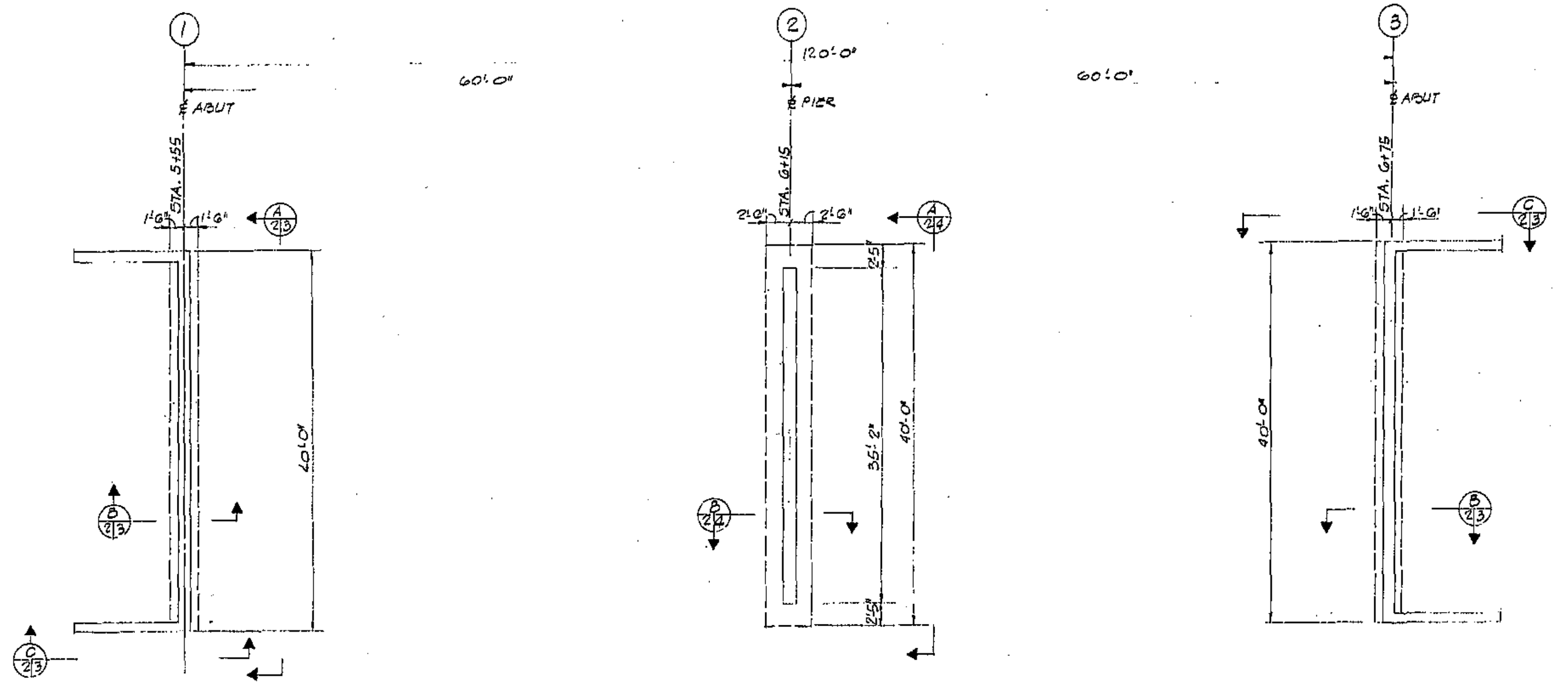
DESIGNED BY: FLM
DRAWN BY: DJC
CHECKED BY: SAB
SCALE: AS SHOWN

SHEET NUMBER S-1 OF 5 SHEETS
DRAWING NO. 283001-2-1

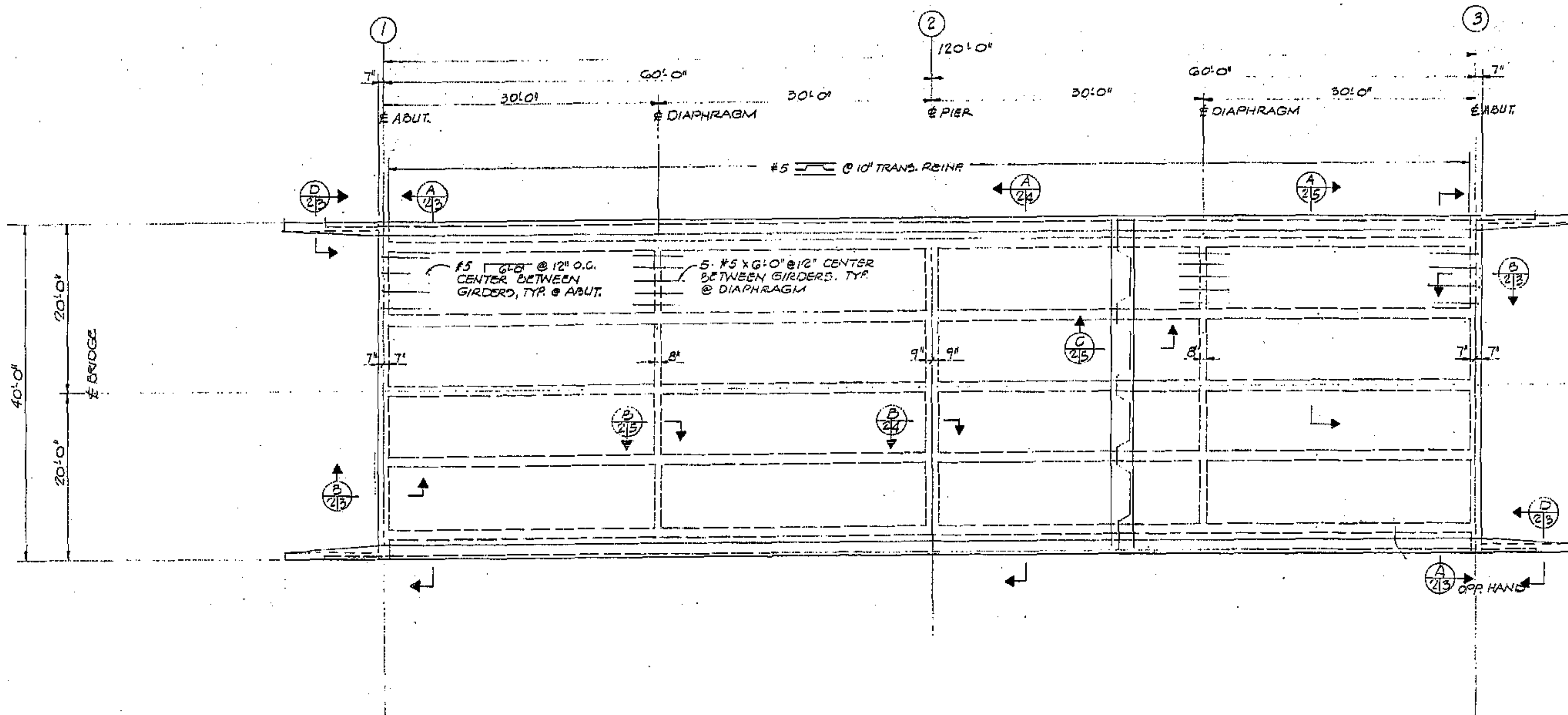
SPECIFICATION No. 1475

H-659-1
SHEET 5 OF 10

Print/copy from full size



FOUNDATION PLAN
1/8" = 1'-0"



DECK PLAN
1/8" = 1'-0"

H-659-1

SPECIFICATION No. 1475 SHEET 6 OF 10

COUNTY OF ALAMEDA PUBLIC WORKS AGENCY ROAD DIVISION

APPROVAL RECOMMENDED
APPROVED

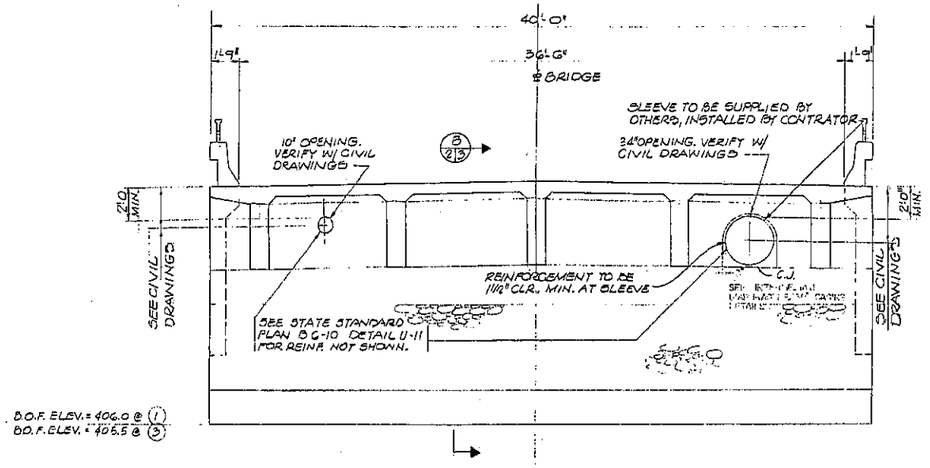
REV.	DATE	DESCRIPTION	BY
1	6/83	RELEASED FOR BIDDING	SAD
0	5/83	RELEASED FOR APPROVAL	SAD

DESIGNED BY: FLM
DRAWN BY: BJC
CHECKED BY: SAD
SCALE: AS SHOWN

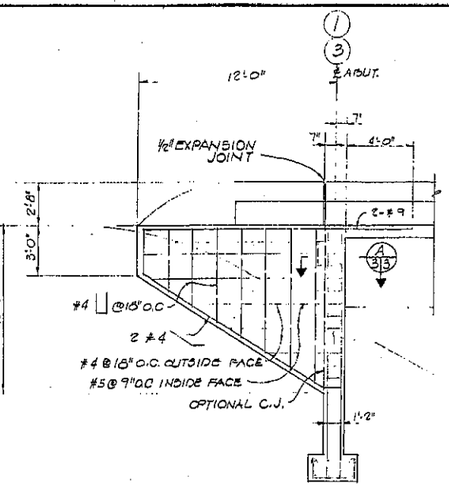
CREEGAN & D'ANGELO
CONSULTING ENGINEERS

FOUNDATION & DECK PLAN
PROPOSED ISABEL AVE. BRIDGE AT ARROYO DEL VALLE CREEK

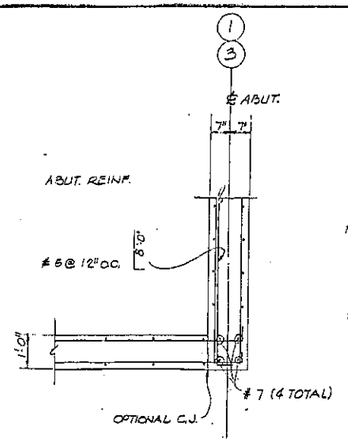
SHEET NUMBER S-2
OF 5 SHEETS
DRAWING NO. 283001.2-2
283001



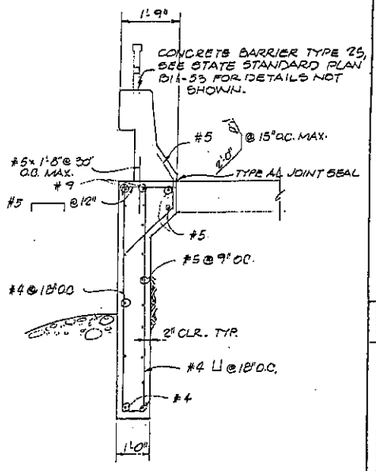
SECTION A 2/3
1/4" = 1'-0"



SECTION C 2/3
1/4" = 1'-0"

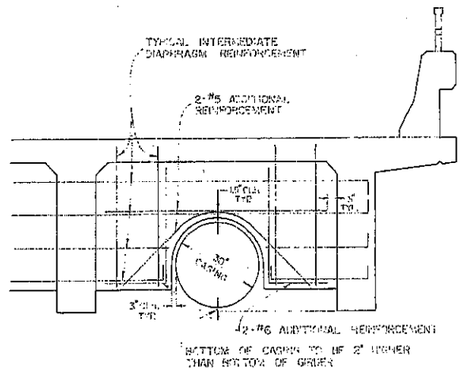


SECTION A 3/3
1/2" = 1'-0"



SECTION D 2/3
1/2" = 1'-0"

SECTION B 2/3
1/2" = 1'-0"



INTERMEDIATE DIAPHRAGM @ 30" ∅ CASING
SCALE: 1/2" = 1'-0"

COUNTY OF ALAMEDA PUBLIC WORKS AGENCY ROAD DIVISION

APPROVAL RECOMMENDED
APPROVED

NO.	DATE	DESCRIPTION	BY
1	6/88	RELEASED FOR BIDDING	SAB
2	5/89	RELEASED FOR APPROVAL	SAB

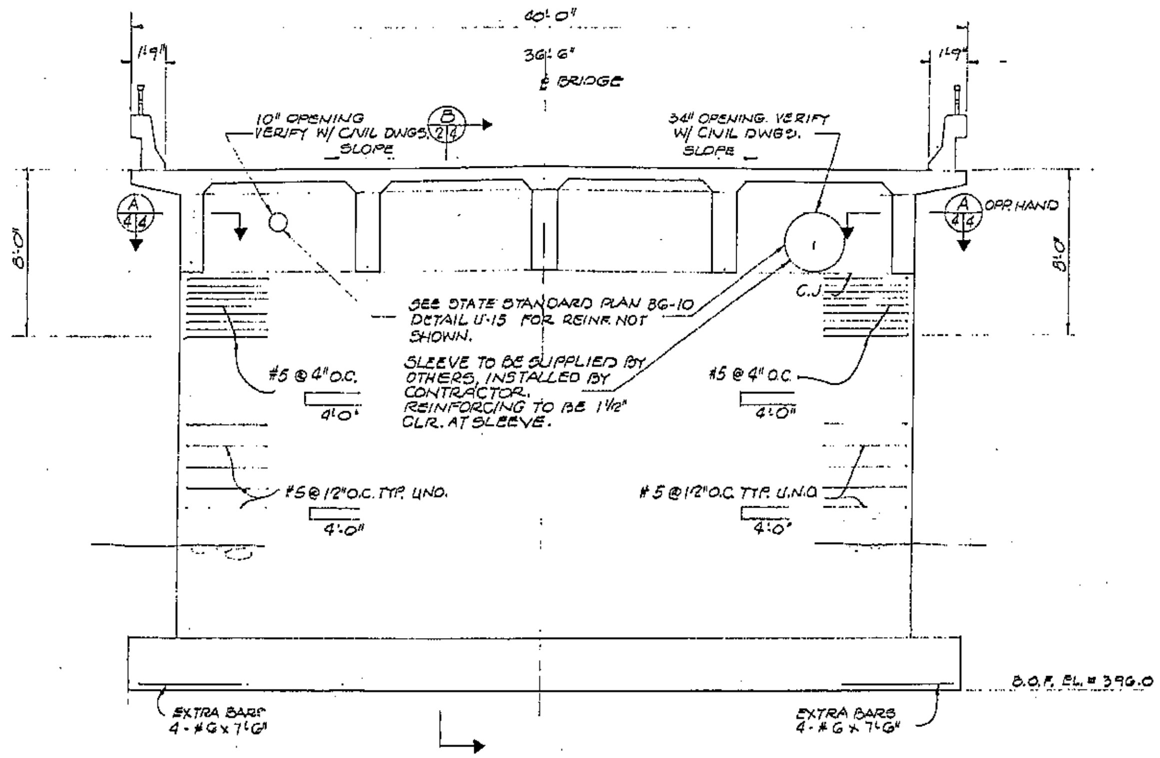
DESIGNED BY: FLM
DRAWN BY: BJC
CHECKED BY: SAB
SCALE: AS SHOWN
DATE: 6/88

CREEGAN & D'ANGELO
CONSULTING ENGINEERS
SAN JOSE • DUBLIN • FREMONT • FAIRFIELD • REDWOOD COVE, NEVADA
1946 N. MAIN STREET • P.O. BOX 5335 • SAN JOSE, CALIFORNIA 95150 • (408) 298-2381
PREPARED BY: R.E. NO. SE 12774 DATE: 6/1/88

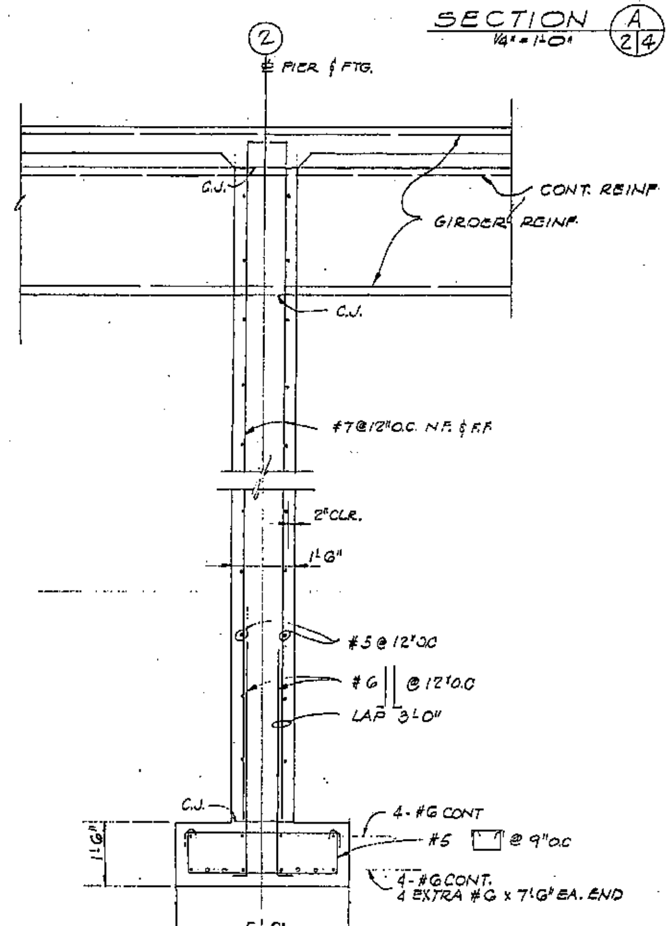
ABUTMENT DETAILS
PROPOSED ISABEL AVE. BRIDGE AT ARROYO OEL VALLE CREEK

SHEET NUMBER S-3 OF 5 SHEETS
DRAWING NO. 283001.2-3
283001

SPECIFICATION NO. 1475
H-659-1
SHEET 7 OF 10



SECTION A/2|4
1/4" = 1'-0"



SECTION B/2|4
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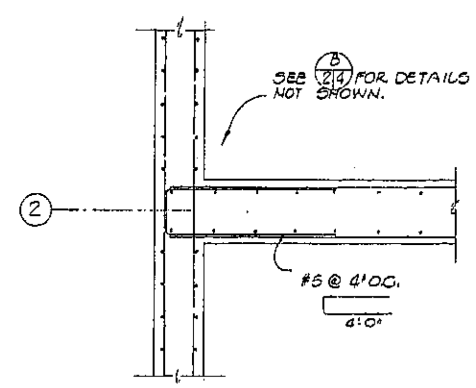


SECTION A/4|4
1/2" = 1'-0"

COUNTY OF ALAMEDA PUBLIC WORKS AGENCY ROAD DIVISION

APPROVAL RECOMMENDED
APPROVED

REV.	DATE	DESCRIPTION	BY
1	6-6-83	RELEASED FOR BIDDING	SAB
0	5-9-83	RELEASED FOR APPROVAL	SAB

CREEGAN & D'ANGELO
CONSULTING ENGINEERS

DESIGNED BY: FLM
DRAWN BY: BJC
CHECKED BY: SAB
SCALE: AS SHOWN

APPROVED BY: R.E. NO. 22772 DATE 6/6/83

PIER DETAILS

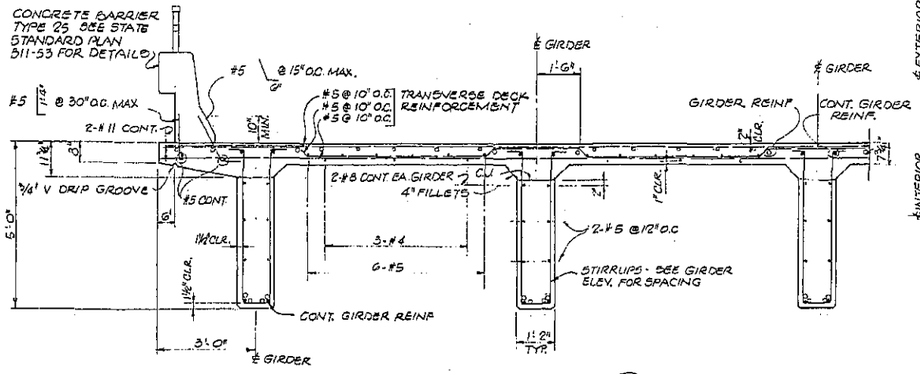
PROPOSED ISABEL AVE. BRIDGE AT ARROYO DEL VALLE CREEK

SHEET NUMBER S-4 OF 5 SHEETS

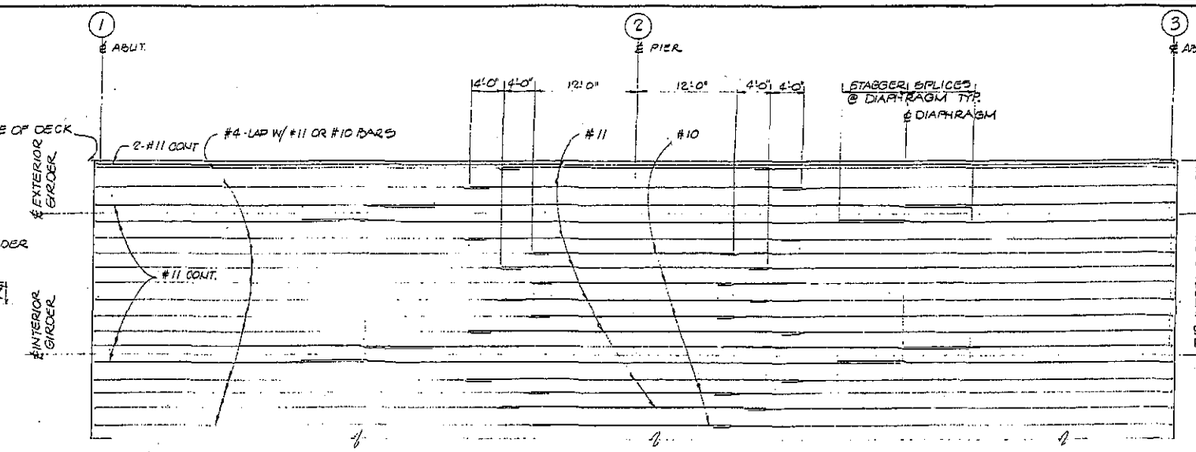
DRAWING NO. 283001.2-4

H-659-1

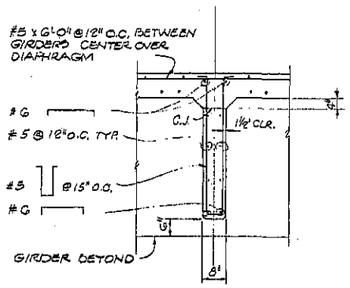
SPECIFICATION NO. 1475 SHEET 8 OF 10



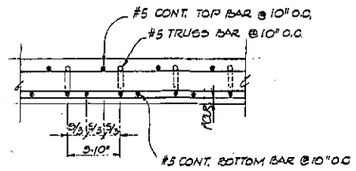
SECTION (A) 2|5
1/2" = 1'-0"



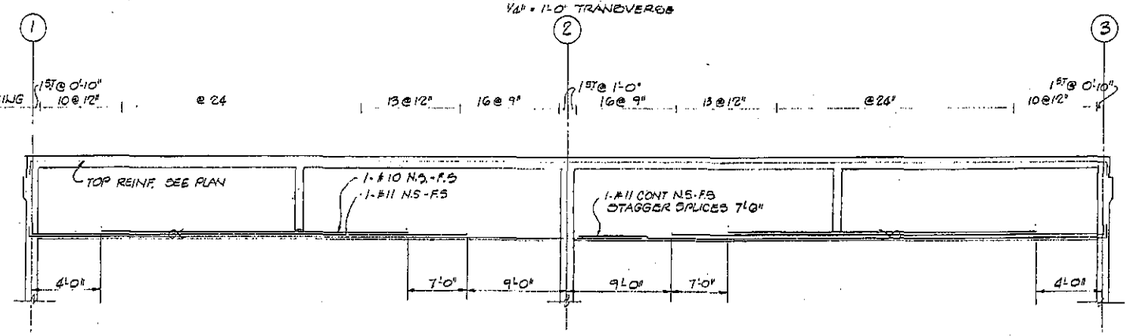
TOP REINFORCEMENT PLAN
1/8" = 1'-0" LONGITUDINAL
1/4" = 1'-0" TRANSVERSE



SECTION (B) 2|5
1/2" = 1'-0"

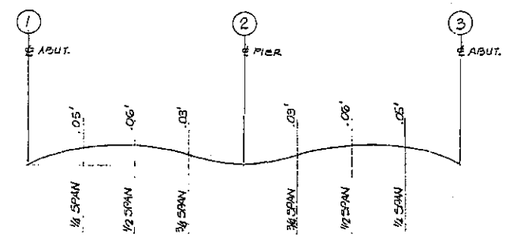


SECTION (C) 2|5
1" = 1'-0"



TYPICAL GIRDER ELEVATION
1/8" = 1'-0" HORIZ.
1/4" = 1'-0" VERT.

GIRDER REINFORCEMENT



CAMBER DIAGRAM

NOTE:
1. CAMBER DIAGRAM DOES NOT INCLUDE FALSEWORK SETTLEMENT.
2. MAXIMUM DEFLECTION WILL OCCUR APPROXIMATELY 4 YEARS AFTER FALSEWORK REMOVAL.

NOTES:
1. ALL BARS ARE #11 EXCEPT AS NOTED.
2. ⟨⟨ INDICATES RUNDLED BARS
3. BAR LAP SPLICE TO BE 60 DIA. FOR ALL #11 BARS & 45 DIA. FOR ALL BARS #10 & SMALLER

COUNTY OF ALAMEDA PUBLIC WORKS AGENCY
ROAD DIVISION

APPROVAL RECOMMENDED — DATE 5/15
APPROVED — DATE 5/15

NO.	DATE	DESCRIPTION	BY
1	6/15	RELISTED FOR BIDDING	
0	4/15	RELISTED FOR FINAL	

DESIGNED BY: FLM
DRAWN BY: BJC
CHECKED BY: SAB
SCALE: AS SHOWN
DATE: 6/26/63

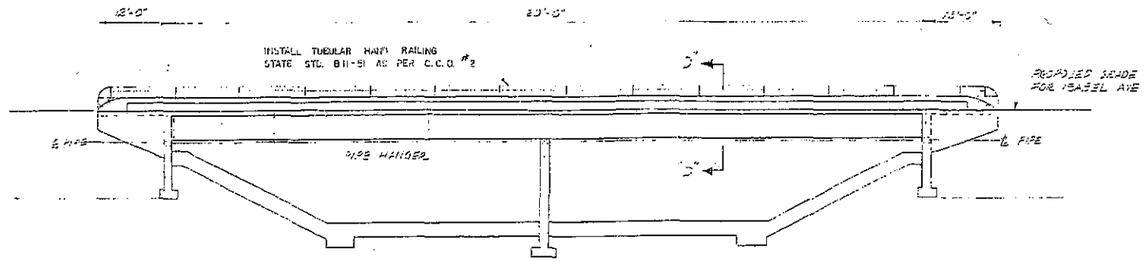
CREEGAN & D'ANGELO
CONSULTING ENGINEERS
SAN JOSE • DUBLIN • FREMONT • FAIRFIELD • ESPARTO COVE, NEVADA
SAN JOSE, SILVER STATE • P.O. BOX 27627 • SAN JOSE, CALIFORNIA 95159 • (408) 292-6220
REGISTERED ENGINEER — CIVIL — STATE OF CALIFORNIA
Stanley C. Biggs — R.C.E. NO. 6271 — DATE 6/26/63

DECK & GIRDER DETAILS
PROPOSED ISABEL AVE. BRIDGE AT ARROYO DEL VALLE CREEK

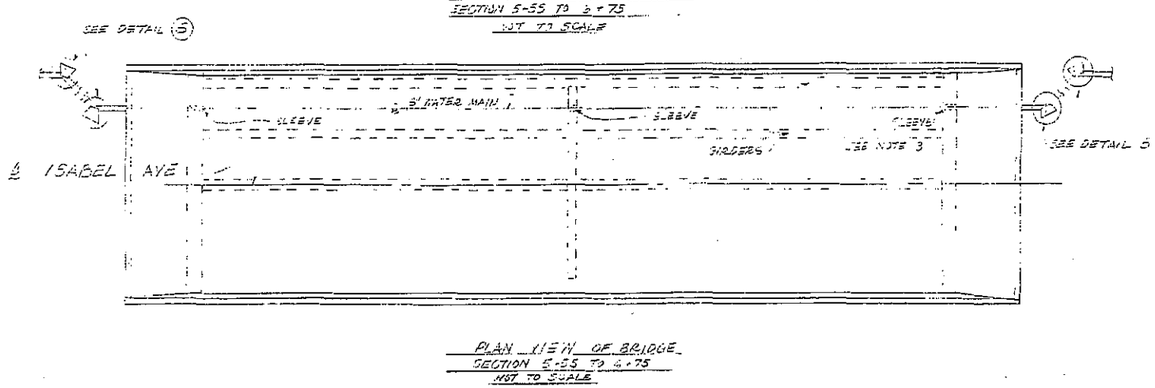
SHEET NUMBER 5-5 OF 5 SHEETS
DRAWING NO. 28300I.2-5
28300I

SPECIFICATION NO. 1475

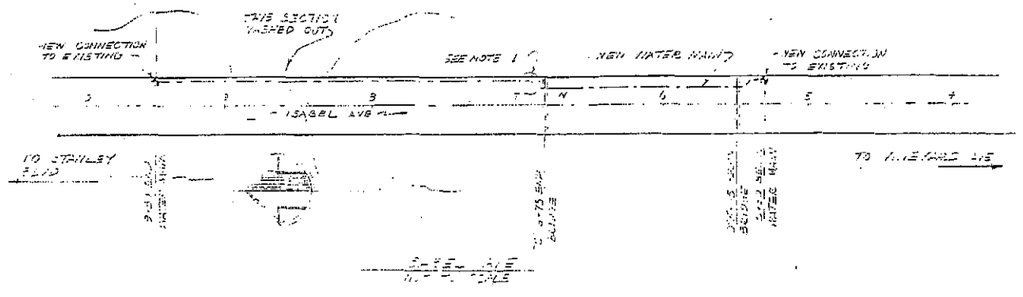
H-659-1
SHEET 9 OF 10

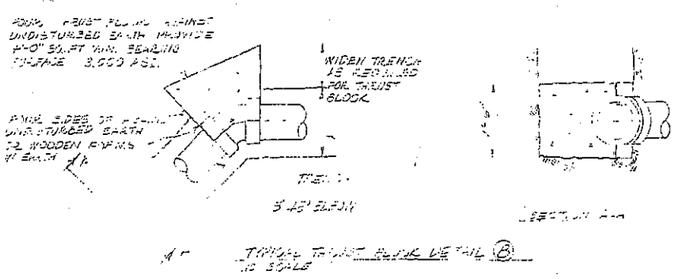


ELEVATION VIEW OF BRIDGE
SECTION 5+55 TO 6+75
NOT TO SCALE

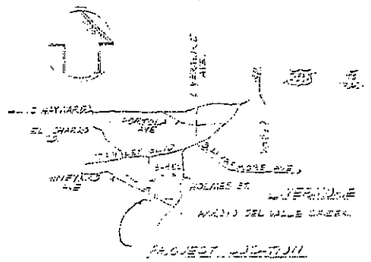


PLAN VIEW OF BRIDGE
SECTION 5+55 TO 6+75
NOT TO SCALE

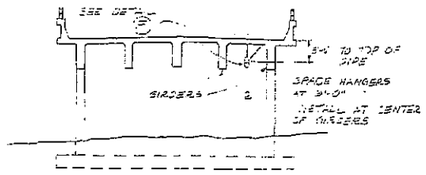




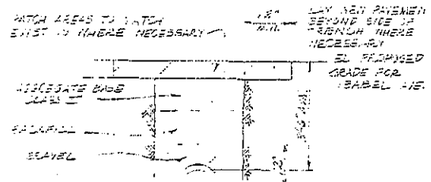
TYPICAL THRUST BLOCK DETAIL ⑧
NO SCALE



PROJECT LOCATION

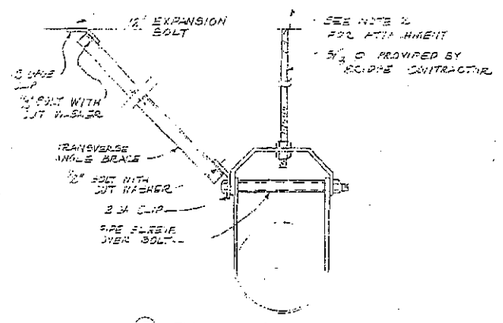


TYPICAL SECTION "D-D"
1"=10'-0"



TYPICAL TRENCH SECTION & PIPE BEDDING
WHERE PAVEMENT IS REPLACED

NOTE: WHERE PIPE IS LAID IN GRAVED AREAS FILL AS SHOWN AND BRING BACKFILL UP TO ORIGINAL GRADE



DETAIL ⑨ — ANCHOR DETAIL
NO SCALE

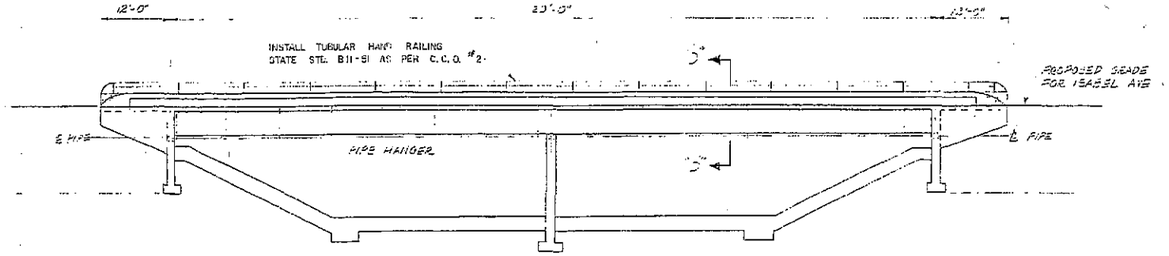
GENERAL NOTES

1. CONTRACTOR TO FIELD VERIFY ALL DIMENSIONS & LOCATIONS
2. CONCRETE INSERTS PROVIDED BY VETERANS ADMINISTRATION AND INSTALLED BY BRIDGE CONTRACTOR.
   CONCRETE INSERTS TO BE UNISTRUT SERIES M26 WITH RIGID NUT M 2812 OR EQUAL
3. SLEEVE PROVIDED BY BRIDGE CONTRACTOR
4. MECHANICAL JOINT DUCTILE IRON
5. LENGHT OF 8" Ø PIPE — 5 FEET
6. SUPPORT AT NO LESS THEN 18" FROM JOINTS ON BELL SIDE
7. THICKNESS OF PIPE 0.36 INCHES
8. ALL WORK TO BE INSTALLED IN ACCORDANCE WITH THE UNIFORM PLUMBING CODE

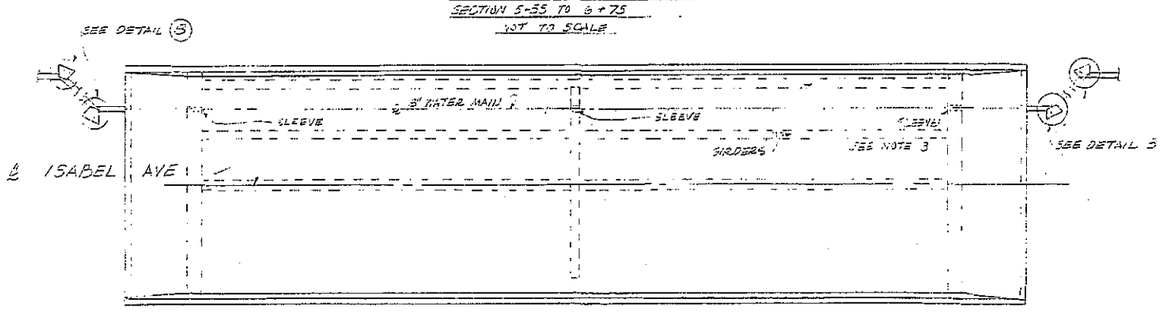
Revisions	Date

Drawing Title: CONSTRUCTION DETAILS		Project Title: REPLACE WATER MAIN (EMERGENCY)	Date: 5-9-85
Approved: Division Chief	Drawn	Building Number: H-659-1	Project No.
Approved: Service Director	Checked	Location: ISABEL AVE.	DRAWING No. 1

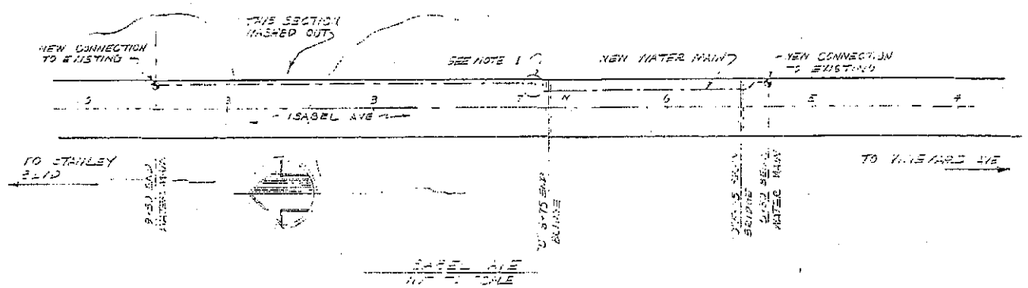
Veterans

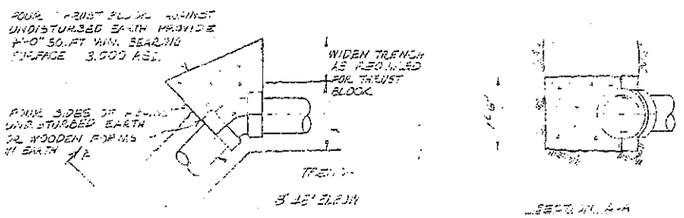


ELEVATION VIEW OF BRIDGE
SECTION 5+55 TO 6+75
NOT TO SCALE

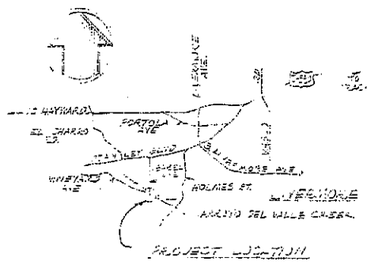


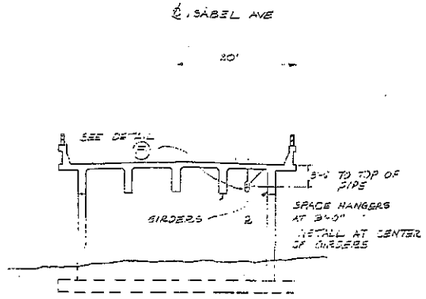
PLAN VIEW OF BRIDGE
SECTION 5+55 TO 6+75
NOT TO SCALE



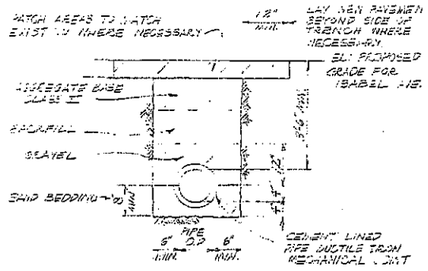


TYPICAL THRUST BLOCK DETAIL (B)
NO SCALE



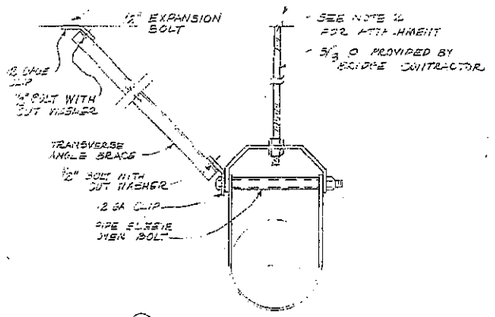


TYPICAL SECTION "D"-"D"
1"=10'-0"



TYPICAL TRENCH SECTION & PIPE BEDDING
WHERE PAVEMENT IS REPLACED

NOTE: WHERE PIPE IS LAID IN UNPAVED AREAS BED AS SHOWN AND BOND BACKFILL UP TO ORIGINAL GRADE



DETAIL (F) PIPE HANGER
NO SCALE

PIPE SIZE	ANGLE SIZE	BOLT TO ANGLE
8"	2 1/2 x 2 x 1/4	5/8"

GENERAL NOTES

1. CONTRACTOR TO FIELD VERIFY ALL DIMENSIONS & LOCATIONS
2. CONCRETE INSERTS PROVIDED BY VETERANS ADMINISTRATION AND INSTALLED BY BRIDGE CONTRACTOR. CONCRETE INSERTS TO BE UNISTRUT SERIES M26 WITH RIGID NUT M, 3/8-12 OR EQUAL
3. SLEEVE PROVIDED BY BRIDGE CONTRACTOR
4. MECHANICAL JOINT DUCTILE IRON
5. LENGHT OF 5" Ø PIPE - 3 FOOT
6. SUPPORT AT NO LESS THEN 18" FROM JOINTS ON BELL SIDE
7. THICKNESS OF PIPE 0.36 INCHES
8. ALL WORK TO BE INSTALLED IN ACCORDANCE WITH THE UNIFORM PLUMBING CODE

LEGEND

- CENTER LINE
- ℄ NEW CONNECTION TO EXISTING
- HIDDEN LINE

Revisions	Date

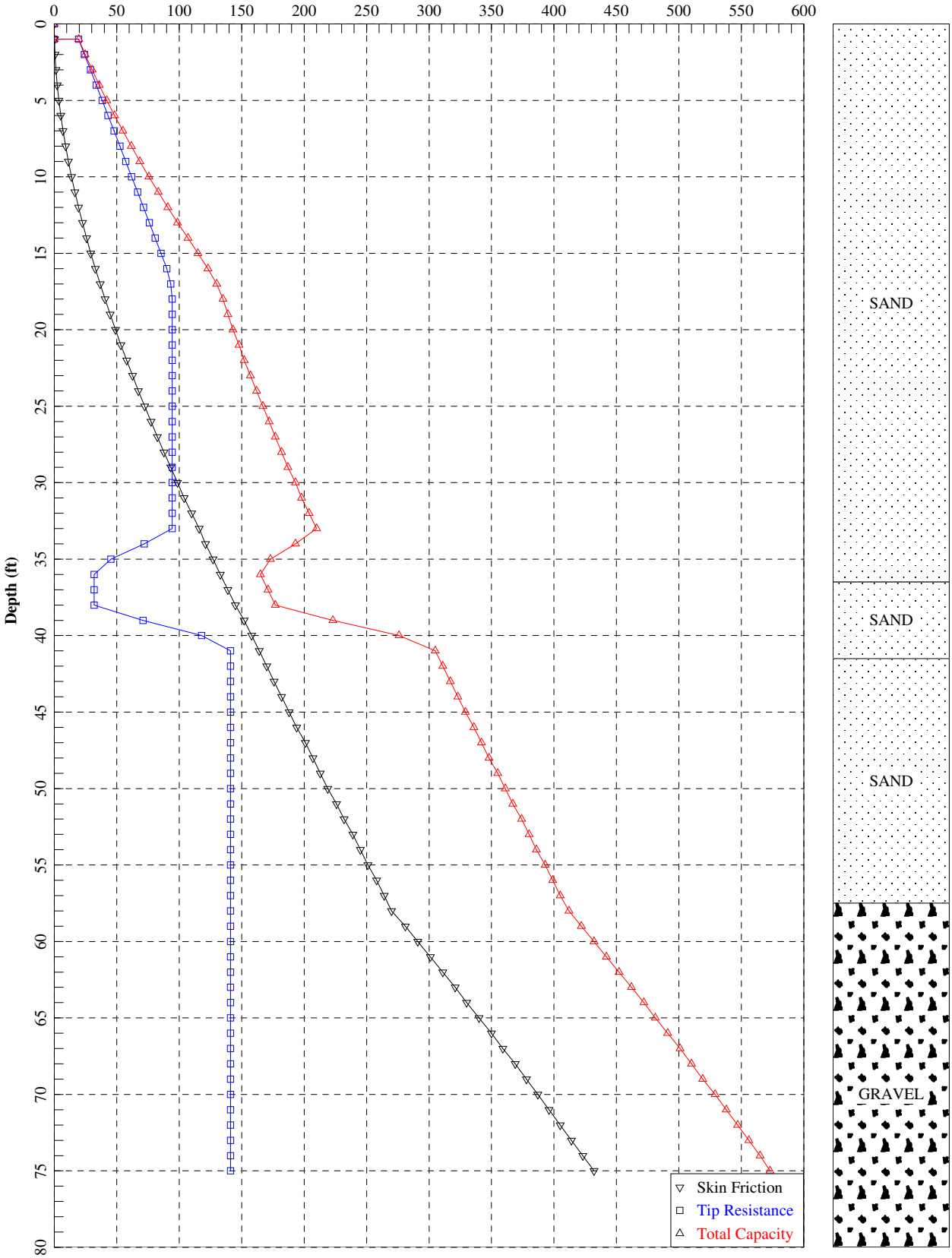
Drawing Title	CONSTRUCTION DETAILS
Project Title	REPLACE WATER MAIN (EMERGENCY)
Date	5-9-88
Project No.	
Approved: Division Chief	
Approved: Service Director	
Drawn	R. TORRES
Checked	
Building Number	H-659-1
Location	STATE, CA.
DRAWING NO.	1
Dwg. / Of	

Veterans

The following table presents correlation between the borehole identification shown on LOTBs and discussed throughout the report text with the borehole identification referenced in the axial pile capacity calculations.

Borehole Identification on LOTBs	Borehole Identification for Laboratory Test Results
R-07-011	NB11
R-07-014	NB14
R-08-037	NB37
R-08-038	NB38

ArroyoDelValle_Trail_24-inch_Scour 397.5_Profile start 397.5_CO 397.5
Ultimate Axial Capacity (tons)



ArroyoDelValle_Trail_24-inch_Scour 397.5_Profile start 397.5_CO 397.5.sfo

SHAFT for Windows, Version 2012.7.9

Serial Number : 158118679

VERTICALLY LOADED DRILLED SHAFT ANALYSIS
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Path to file locations : L:\Shiva\Analysis\Madhu\11_7_14\
Name of input data file : ArroyoDelValle_Trail_24-inch_Scour 397.5_Profile start 397.5_CO 397.5.sfd
Name of output file : ArroyoDelValle_Trail_24-inch_Scour 397.5_Profile start 397.5_CO 397.5.sfo
Name of plot output file : ArroyoDelValle_Trail_24-inch_Scour 397.5_Profile start 397.5_CO 397.5.sfp
Name of runtime file : ArroyoDelValle_Trail_24-inch_Scour 397.5_Profile start 397.5_CO 397.5.sfr

Time and Date of Analysis

Date: November 11, 2014 Time: 11:05:44

ArroyoDelValle_Trail_24-inch_Scour 397.5_Profile start 397.5_CO 397.5

PROPOSED DEPTH = 75.0 FT

NUMBER OF LAYERS = 4

WATER TABLE DEPTH = 0.0 FT.

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.500E+02
SOIL UNIT WEIGHT, LB/CU FT	= 0.140E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.684E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.500E+02
SOIL UNIT WEIGHT, LB/CU FT	= 0.140E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.365E+02
LRFD RESISTANCE FACTOR (SIDE FRICTION)	= 0.700E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE)	= 0.500E+00

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.684E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.170E+02
SOIL UNIT WEIGHT, LB/CU FT	= 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.365E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.630E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00

INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.170E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.415E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.700E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.630E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.750E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.140E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.415E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.476E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.750E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.140E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.575E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.700E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

LAYER NO 4----GRAVEL

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.766E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.850E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.145E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.575E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.401E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.850E+02
SOIL UNIT WEIGHT, LB/CU FT = 0.145E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.825E+02

LRFD RESISTANCE FACTOR (SIDE FRICTION) = 0.700E+00
LRFD RESISTANCE FACTOR (TIP RESISTANCE) = 0.500E+00

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 2.000 FT.
DIAMETER OF BASE = 2.000 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 0.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 4.524 SQ.IN.
ELASTIC MODULUS, Ec = 0.350E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
LRFD QS = TOTAL SIDE FRICTION USING LRFD RESISTANCE FACTOR
TO THE ULTIMATE SIDE RESISTANCE;
LRFD QB = TOTAL BASE BEARING USING LRFD RESISTANCE FACTOR

TO THE ULTIMATE BASE RESISTANCE
LRFD QU = TOTAL CAPACITY WITH LRFD RESISTANCE FACTOR.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	LRFD QS (TONS)	LRFD QB (TONS)	LRFD QU (TONS)
1.0	0.12	0.15	19.53	19.67	0.10	9.76	9.87
2.0	0.23	0.59	24.24	24.82	0.41	12.12	12.53
3.0	0.35	1.32	28.95	30.27	0.92	14.48	15.40
4.0	0.47	2.34	33.66	36.00	1.64	16.83	18.47
5.0	0.58	3.66	38.38	42.03	2.56	19.19	21.75
6.0	0.70	5.22	43.09	48.31	3.66	21.55	25.20
7.0	0.81	7.03	47.80	54.84	4.92	23.90	28.83
8.0	0.93	9.08	52.52	61.60	6.36	26.26	32.61
9.0	1.05	11.35	57.23	68.58	7.94	28.61	36.56
10.0	1.16	13.83	61.94	75.78	9.68	30.97	40.66
11.0	1.28	16.53	66.66	83.18	11.57	33.33	44.90
12.0	1.40	19.42	71.37	90.79	13.60	35.68	49.28
13.0	1.51	22.51	76.08	98.59	15.76	38.04	53.80
14.0	1.63	25.79	80.79	106.58	18.05	40.40	58.45
15.0	1.75	29.24	85.51	114.75	20.47	42.75	63.22
16.0	1.86	32.87	90.22	123.09	23.01	45.11	68.12
17.0	1.98	36.66	93.25	129.91	25.66	46.63	72.29
18.0	2.09	40.62	94.26	134.88	28.43	47.13	75.56
19.0	2.21	44.73	94.26	138.99	31.31	47.13	78.44
20.0	2.33	48.99	94.26	143.25	34.29	47.13	81.42
21.0	2.44	53.40	94.26	147.66	37.38	47.13	84.51
22.0	2.56	57.94	94.26	152.20	40.56	47.13	87.69
23.0	2.68	62.62	94.26	156.88	43.83	47.13	90.96
24.0	2.79	67.42	94.26	161.68	47.20	47.13	94.33
25.0	2.91	72.35	94.26	166.61	50.65	47.13	97.78
26.0	3.03	77.40	94.26	171.66	54.18	47.13	101.31
27.0	3.14	82.56	94.26	176.82	57.79	47.13	104.92
28.0	3.26	87.83	94.26	182.09	61.48	47.13	108.61
29.0	3.37	93.20	94.26	187.46	65.24	47.13	112.37
30.0	3.49	98.67	94.26	192.93	69.07	47.13	116.20
31.0	3.61	104.23	94.26	198.49	72.96	47.13	120.09
32.0	3.72	109.89	94.26	204.15	76.92	47.13	124.05
33.0	3.84	115.63	94.26	209.89	80.94	47.13	128.07
34.0	3.96	121.45	72.04	193.49	85.02	36.02	121.04
35.0	4.07	127.35	45.38	172.73	89.15	22.69	111.84
36.0	4.19	133.32	32.05	165.37	93.33	16.02	109.35
37.0	4.31	139.36	32.05	171.41	97.55	16.02	113.58
38.0	4.42	145.44	32.05	177.49	101.81	16.02	117.83
39.0	4.54	151.51	71.10	222.61	106.06	35.55	141.61
40.0	4.65	157.58	117.96	275.54	110.31	58.98	169.29
41.0	4.77	163.65	141.39	305.04	114.55	70.69	185.25
42.0	4.89	169.71	141.39	311.10	118.80	70.69	189.49
43.0	5.00	175.79	141.39	317.18	123.05	70.69	193.75
44.0	5.12	181.92	141.39	323.31	127.34	70.69	198.04
45.0	5.24	188.09	141.39	329.48	131.66	70.69	202.35
46.0	5.35	194.29	141.39	335.68	136.01	70.69	206.70
47.0	5.47	200.54	141.39	341.93	140.38	70.69	211.07
48.0	5.59	206.81	141.39	348.20	144.77	70.69	215.46
49.0	5.70	213.11	141.39	354.50	149.18	70.69	219.87
50.0	5.82	219.44	141.39	360.83	153.61	70.69	224.30
51.0	5.93	225.78	141.39	367.17	158.05	70.69	228.74
52.0	6.05	232.15	141.39	373.54	162.50	70.69	233.20
53.0	6.17	238.52	141.39	379.91	166.97	70.69	237.66
54.0	6.28	244.91	141.39	386.30	171.44	70.69	242.13
55.0	6.40	251.30	141.39	392.69	175.91	70.69	246.61
56.0	6.52	257.70	141.39	399.09	180.39	70.69	251.08
57.0	6.63	264.09	141.39	405.48	184.87	70.69	255.56
58.0	6.75	270.49	141.39	411.88	189.34	70.69	260.04
59.0	6.87	280.66	141.39	422.05	196.46	70.69	267.16
60.0	6.98	290.76	141.39	432.15	203.53	70.69	274.23
61.0	7.10	300.79	141.39	442.18	210.55	70.69	281.25
62.0	7.21	310.73	141.39	452.12	217.51	70.69	288.21
63.0	7.33	320.59	141.39	461.98	224.42	70.69	295.11
64.0	7.45	330.37	141.39	471.76	231.26	70.69	301.96
65.0	7.56	340.07	141.39	481.46	238.05	70.69	308.74
66.0	7.68	349.67	141.39	491.06	244.77	70.69	315.46
67.0	7.80	359.18	141.39	500.57	251.43	70.69	322.12
68.0	7.91	368.61	141.39	510.00	258.02	70.69	328.72
69.0	8.03	377.93	141.39	519.32	264.55	70.69	335.25
70.0	8.15	387.17	141.39	528.56	271.02	70.69	341.71
71.0	8.26	396.31	141.39	537.70	277.41	70.69	348.11
72.0	8.38	405.35	141.39	546.74	283.74	70.69	354.44
73.0	8.50	414.29	141.39	555.68	290.00	70.69	360.70
74.0	8.61	423.14	141.39	564.53	296.19	70.69	366.89
75.0	8.73	431.88	141.39	573.27	302.32	70.69	373.01

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1900E+00	0.1148E-03	0.2062E-02	0.1000E-04
0.9502E+00	0.5738E-03	0.1031E-01	0.5000E-04
0.1900E+01	0.1148E-02	0.2062E-01	0.1000E-03
0.9373E+02	0.5764E-01	0.1031E+01	0.5000E-02

ArroyoDelValle_Trail_24-inch_Scour 397.5_Profile start 397.5_CO 397.5.sfo

0.1332E+03	0.8457E-01	0.1546E+01	0.7500E-02
0.1667E+03	0.1095E+00	0.2062E+01	0.1000E-01
0.2888E+03	0.2169E+00	0.5155E+01	0.2500E-01
0.3637E+03	0.3053E+00	0.1031E+02	0.5000E-01
0.4026E+03	0.3659E+00	0.1546E+02	0.7500E-01
0.4169E+03	0.4040E+00	0.2062E+02	0.1000E+00
0.4555E+03	0.5953E+00	0.5043E+02	0.2500E+00
0.4703E+03	0.8644E+00	0.8136E+02	0.5000E+00
0.4819E+03	0.1003E+01	0.9314E+02	0.6250E+00
0.4972E+03	0.1176E+01	0.1086E+03	0.7812E+00
0.5315E+03	0.1635E+01	0.1435E+03	0.1200E+01

RESULT FROM UPPER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.3568E+00	0.1930E-03	0.2946E-02	0.1000E-04
0.1784E+01	0.9649E-03	0.1473E-01	0.5000E-04
0.3568E+01	0.1930E-02	0.2946E-01	0.1000E-03
0.1616E+03	0.9393E-01	0.1473E+01	0.5000E-02
0.2146E+03	0.1326E+00	0.2209E+01	0.7500E-02
0.2559E+03	0.1662E+00	0.2946E+01	0.1000E-01
0.3795E+03	0.2880E+00	0.7364E+01	0.2500E-01
0.4248E+03	0.3561E+00	0.1473E+02	0.5000E-01
0.4428E+03	0.3992E+00	0.2209E+02	0.7500E-01
0.4554E+03	0.4375E+00	0.2946E+02	0.1000E+00
0.4968E+03	0.6345E+00	0.7011E+02	0.2500E+00
0.5155E+03	0.9075E+00	0.1022E+03	0.5000E+00
0.5232E+03	0.1041E+01	0.1098E+03	0.6250E+00
0.5365E+03	0.1213E+01	0.1231E+03	0.7812E+00
0.5661E+03	0.1665E+01	0.1527E+03	0.1200E+01

RESULT FROM LOWER-BOUND LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.8441E-01	0.6041E-04	0.1178E-02	0.1000E-04
0.4220E+00	0.3021E-03	0.5891E-02	0.5000E-04
0.8441E+00	0.6041E-03	0.1178E-01	0.1000E-03
0.4264E+02	0.3040E-01	0.5891E+00	0.5000E-02
0.6336E+02	0.4555E-01	0.8837E+00	0.7500E-02
0.8314E+02	0.6039E-01	0.1178E+01	0.1000E-01
0.1794E+03	0.1397E+00	0.2946E+01	0.2500E-01
0.2806E+03	0.2392E+00	0.5891E+01	0.5000E-01
0.3384E+03	0.3112E+00	0.8837E+01	0.7500E-01
0.3694E+03	0.3625E+00	0.1178E+02	0.1000E+00
0.4145E+03	0.5563E+00	0.3075E+02	0.2500E+00
0.4251E+03	0.8213E+00	0.6056E+02	0.5000E+00
0.4406E+03	0.9642E+00	0.7647E+02	0.6250E+00
0.4579E+03	0.1140E+01	0.9416E+02	0.7812E+00
0.4969E+03	0.1604E+01	0.1343E+03	0.1200E+01

Route 84 Arroyo Del Valle Trail Bridge

1/12/2015

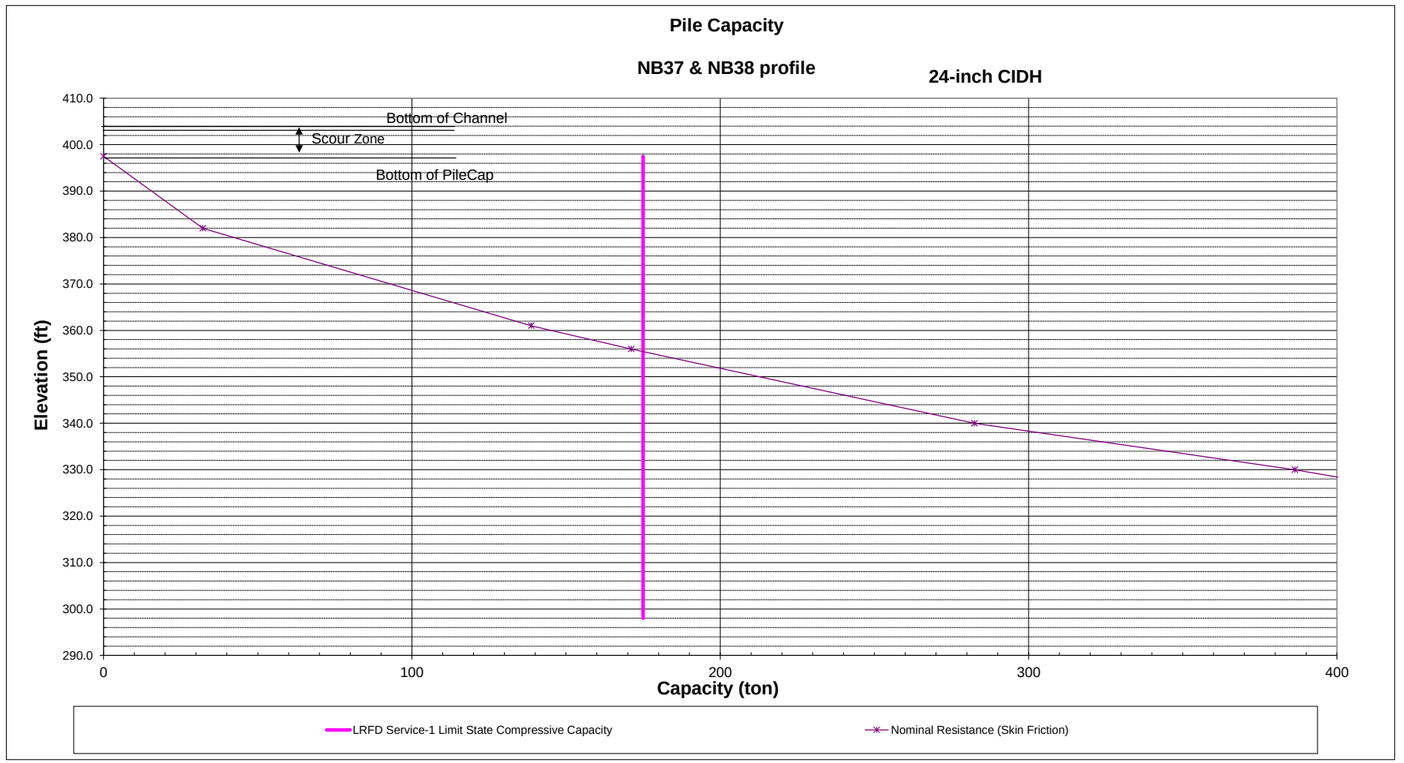
CIDH Pile Design Spreadsheet NB37 & NB38 Bent 2

Caltrans Design Method For CIDH Pile

Project Name:	Isabel Road Rt 84	LRFD service-1 limit state compressive capacity	175	ton	tension	65	ton				
Project Number:	28649640	LRFD service-1 limit state compressive capacity	1558	kN		Pile Type		CIDH			
Bridge Name:	Arroyo Del Valle Bridge Trail Bridge	Pile Diameter	24	inch		Pile Shape		Circular			
Boring Surface El. (m)	123.1	Pile Diameter	610	mm		Pile Surface Area	1.92	sq. m/m	Pile Tip Area	0.29	sq. m
Boring Surface El. (ft)	404.0	Pile Diameter	2.00	ft		Pile Surface Area	6.28	sq. ft/ft	Pile Tip Area	3.14	sq. ft.
Design GWS El. (ft)	401.5										
Unit Weight of Water (pcf)	62.4										
Depth with no strength											
Convert. Factor	3.281	Estimated tip (tension)=	369								
		Estimated tip (compression)=	355								
Bottom of Pile Cap El. (m)	121.2	Pile Length/Pile Diameter (L/D) =	21.3								
Bottom of Pile Cap El. (ft)	397.5										
Bottom of Fill El. (ft)	N/A										
Local Scour El. (ft)	398.5										
General Scour El. (ft)	402.8										

																					Compression					Tension		
																Soil	delta			q_T	z/B	Nc	q_T	Bearing	Elevation	Cumulative			LRFD service-1	Cumulative	LRFD s
Layer	Layer Elevation				Lateral	Unit	N_{SPT}	Cohesion	Adhesion	Ult. Load	Layer	Depth to	Effective	β	f_{max}	Type	Lat. Res.								to	Axial Res.			Limit State	Axial Res.	Limit
No.	Top		Bot.		Resists?	Wt			Factor	Transfer	Thickness	Layer Center	Vert. Stress			G= gran.	Cohesive	Friction		(granular)		(cohesive)	(cohesive)	Capacity	midlayer	(skin)		(Tot)		Compressive	(Skin)	Compr
								c	α	f_{si}			(Cen. Lay.)			C=cohes.		(comp)	(tensile)					(B.C.)						Capacity		Capa
(-)	(m)	(feet)	(m)	(feet)		(pcf)	blows/ft	(psf)		(psf)	(feet)	(feet)	(psf)		(psf)		(ton)	(ton)	(ton)	(psf)	(-)	(-)	(psf)	(ton)	(ft)	(ton)	(kN)	(ton)	(kN)	(ton)	(kN)	(ton)
			121.15	397.5																					0	0	0.0	0	175	1558	0	0	88
1	121.15	397.5	116.43	382.0	y	140	40	0	0.55	0	15.5	7.75	601.4	1.1	662	g	0.0	32.2	22.5	48000	7.8	9.00	0	75	389.8	32.2	287	32.2	287	175	1558	22.5	201	88
2	116.43	382.0	110.03	361.0	Y	140	50	0	0.55	0	21.0	26.0	2017.6	0.8	1614	g	0.0	106.5	74.5	60000	18.3	9.00	0	94	371.5	138.7	1234	138.7	1234	175	1558	97.1	864	88
3	110.03	361.0	108.5	356.0	Y	110	17	0	0.55	0	5.0	39.0	2951.4	0.7	2066	g	0.0	32.5	22.7	20400	20.8	9.00	0	32	358.5	171.2	1523	171.2	1523	175	1558	119.8	1066	88
4	108.5	356.0	103.63	340.0	Y	140	75	0	0.55	0	16.0	49.5	3691.2	0.6	2215	g	0.0	111.3	77.9	90000	28.8	9.00	0	141	348.0	282.5	2514	282.5	2514	175	1558	197.7	1759	88
5	103.63	340.0	100.58	330.0	Y	145	85	0	0.55	0	10.0	62.5	4725.0	0.7	3308	g	0.0	103.9	72.7	90000	33.8	9.00	0	141	335.0	386.4	3439	386.4	3439	175	1558	270.5	2406	88
6	100.58	330.0	97.53	320.0	Y	145	85	0	0.55	0	10.0	72.5	5551.0	0.5	2776	g	0.0	87.2	61.0	90000	38.8	9.00	0	141	325.0	473.6	4215	473.6	4215	175	1558	331.5	2949	88
7	97.53	320.0	93.87	308.0	Y	145	85	0	0.55	0	12.0	83.5	6459.6	0.3	1938	g	0.0	73.1	51.1	90000	44.8	9.00	0	141	314.0	546.6	4865	546.6	4865	175	1558	382.6	3404	88
8	93.87	308.0	90.83	298.0	Y	145	85	0	0.55	0	10.0	94.5	7368.2	0.3	2210	g	0.0	69.4	48.6	90000	49.8	9.00	0	141	303.0	616.1	5483	616.1	5483	175	1558	431.3	3836	88
Bottom	90.83	298.0																															

Note: β calculated using the equation in section 10.8.3.5.2b for gravelly sand and gravel in AASHTO LRFD Bridge Design Specifications
Effective vertical stress was calculated assuming the ground surface as the bottom of pile cap or bottom of scour, whichever is deeper.



Route 84 Arroyo Del Valle Trail Bridge

1/12/2015

CIDH Pile Design Spreadsheet NB11 abutment 1

Caltrans Design Method For CIDH Pile

Project Name: Isabel Road Rt 84
Project Number: 28649640
Bridge Name: Arroyo Del Valle Trial Bridge
Boring Surface El. (m) 125.6
Boring Surface El. (ft) 412.0
Design GWS El. (ft) 401.0
Unit Weight of Water (pcf) 62.4
Depth with no strength
Convert. Factor 3.281

Bottom of Pile Cap El. (m) 123.4
Bottom of Pile Cap El. (ft) 405.0
Bottom of Fill El. (ft) N/A
Scour El. (ft) 398.0 (Based on Bent 2)

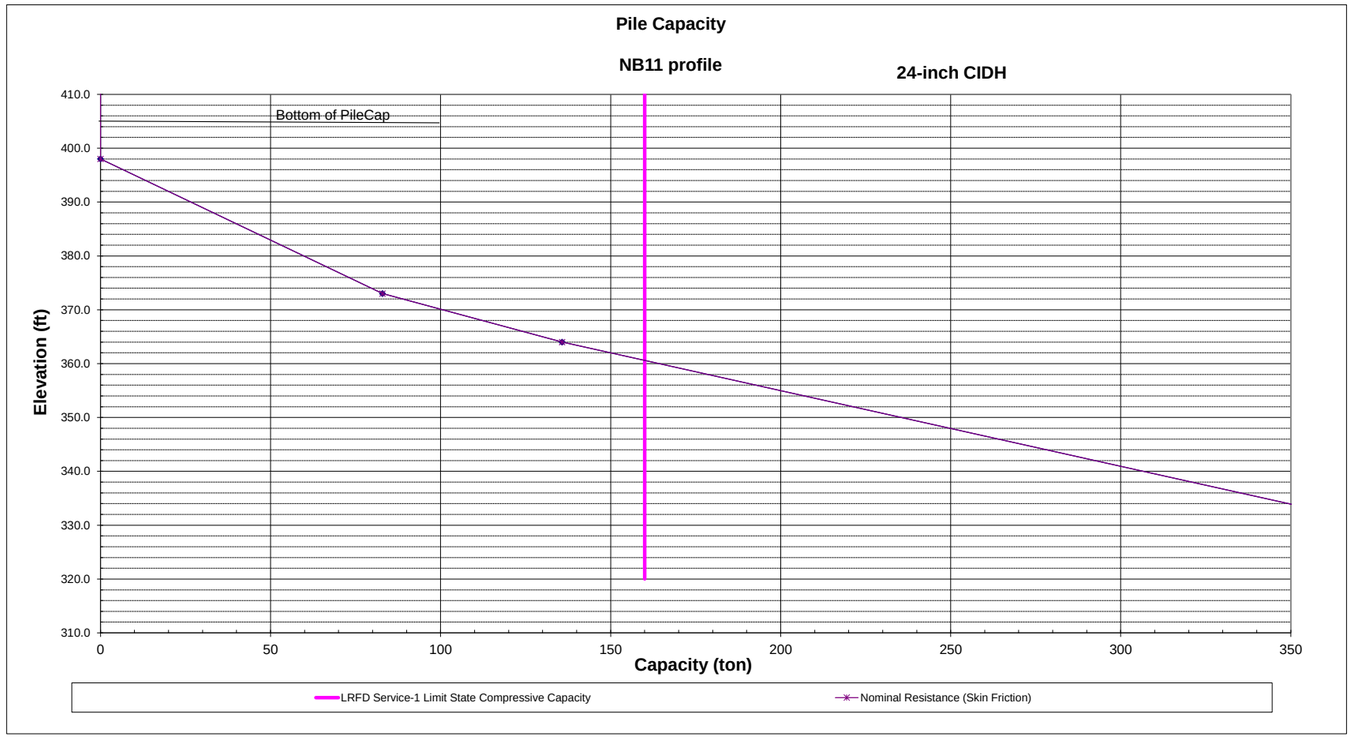
LRFD service-1 limit state compressive capacity 160 ton tension 0
LRFD service-1 limit state compressive capacity 1424 kN Pile Type CIDH
Pile Diameter 24 inch Pile Shape Circular
Pile Diameter 610 mm Pile Surface Area 1.92 sq. m/m Pile Tip Area 0.29 sq. m
Pile Diameter 2.00 ft Pile Surface Area 6.28 sq. ft/ft Pile Tip Area 3.14 sq. ft.

Estimated tip (tension)= NA
Estimated tip (compression)= 361
Pile Length/Pile Diameter (L/D) = 22

Soil parameters below El. 352 are taken from borings NB37 and NB38

																							Compression						Tension	
Layer	Layer Elevation				Lateral	Unit	N_{SPT}	Cohesion	Adhesion	Ult. Load	Layer	Depth to	Effective	β	f_{max}	Soil Type	delta			q_T	z/B	Nc	q_T	Bearing	Elevation	Cumulative				LRFD service-1	Cumulative	LRFD service-1
No.	Top		Bot.		Resists?	Wt			Factor	Transfer	Thickness	Layer Cente	Vert. Stress			G= gran.	Lat. Res.			(granular)		(cohesive)	(cohesive)	Capacity	to	Axial Res.				Limit State	Axial Res.	Limit State
								c	α	f_{si}			(Cen. Lay.)			C=cohes.	Cohesive	Friction						(B.C.)	midlayer	(skin)		(Tot)		Compressive	(Skin)	Compressive
																		(comp)	(tensile)										Capacity		Capacity
(-)	(m)	(feet)	(m)	(feet)		pcf	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)
			125.57	412.0																					0	0	0.0	0	160	1424	0	0	80	712
1	125.57	412.0	121.3	398.0	N		35	0	0.55	0	14.0	7	0.0	0.0	0	g	0.0	0.0	0.0	42000	3.5	9.00	0	66	405.0	0.0	0	0.0	0	160	1424	0.0	0	80	712
2	121.3	398.0	113.68	373.0	Y	145	45	0	0.55	0	25.0	26.5	1032.5	1.0	1056	g	0.0	82.9	58.1	54000	16.0	9.00	0	85	385.5	82.9	738	82.9	738	160	1424	58.1	516	80	712
3	113.68	373.0	110.94	364.0	Y	145	50	0	0.55	0	9.0	43.5	2436.7	0.8	1868	g	0.0	52.8	37.0	60000	20.5	9.00	0	94	368.5	135.8	1208	135.8	1208	160	1424	95.0	845	80	712
4	110.94	364.0	97.53	320.0	Y	145	75	0	0.55	0	44.0	70	4625.6	0.5	2265	g	0.0	313.1	219.2	90000	42.5	9.00	0	141	342.0	448.9	3995	448.9	3995	160	1424	314.2	2795	80	712
Bottom	97.53	320.0																																	

Note: β calculated using the equation in section 10.8.3.5.2b for gravelly sand and gravel in AASHTO LRFD Bridge Design Specifications
Effective vertical stress was calculated assuming the ground surface as the bottom of pile cap or bottom of scour, whichever is deeper.



Route 84 Arroyo Del Valle Trail Bridge

1/12/2015

CIDH Pile Design Spreadsheet NB14 abutment 3

Caltrans Design Method For CIDH Pile

Project Name: Isabel Road Rt 84
Project Number: 28649640
Bridge Name: Arroyo Del Valle Trial Bridge
Boring Surface El. (m) 125.9
Boring Surface El. (ft) 413.0
Design GWS El. (ft) 401.0
Unit Weight of Water (pcf) 62.4
Depth with no strength
Convert. Factor 3.281

Bottom of Pile Cap El. (m) 123.4
Bottom of Pile Cap El. (ft) 405.0
Bottom of Fill El. (ft) N/A
Scour El. (ft) 398.0 Based on Bent 2

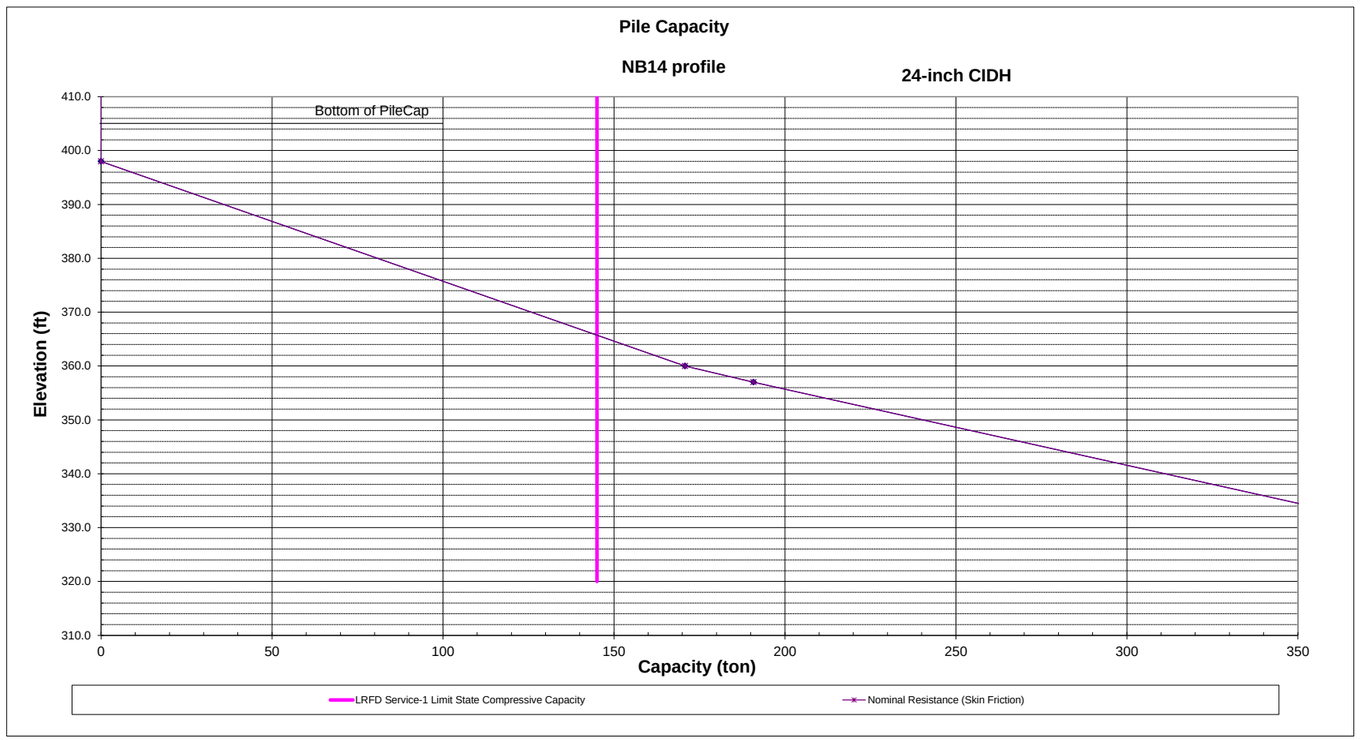
LRFD service-1 limit state compressive capacity 145 ton tension 0
LRFD service-1 limit state compressive capacity 1291 kN Pile Type CIDH
Pile Diameter 24 inch Pile Shape Circular
Pile Diameter 610 mm Pile Surface Area 1.92 sq. m/m Pile Tip Area 0.29 sq. m
Pile Diameter 2.00 ft Pile Surface Area 6.28 sq. ft/ft Pile Tip Area 3.14 sq. ft.

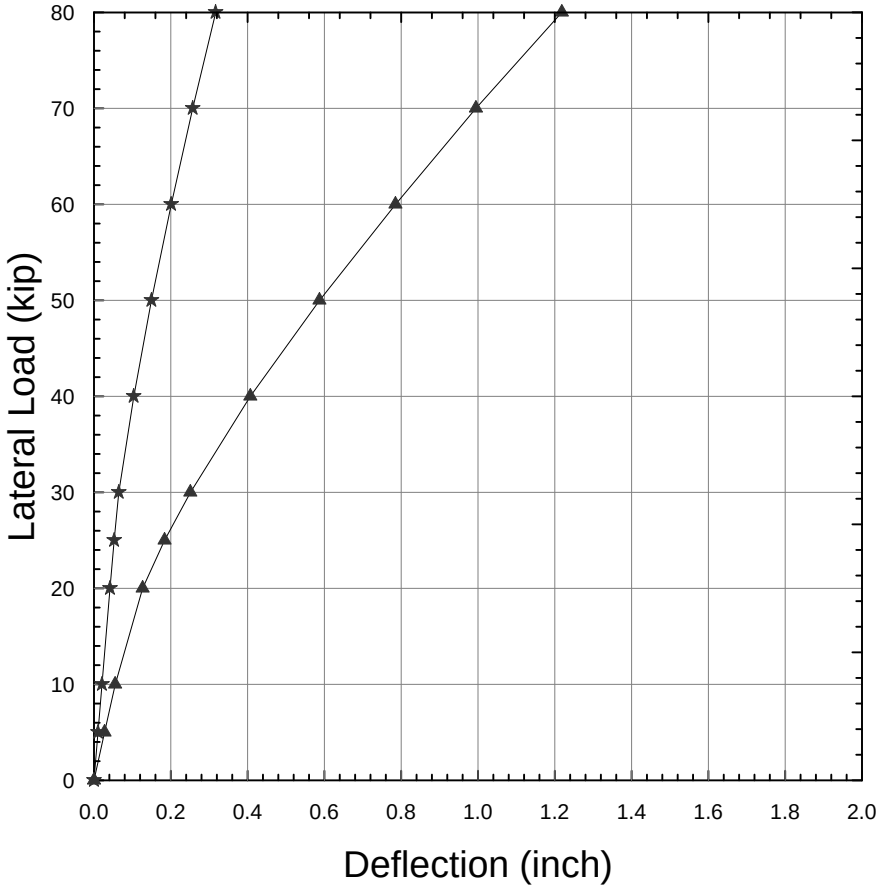
Estimated tip (tension)= NA
Estimated tip (compression)= 366
Pile Length/Pile Diameter (L/D) = 19.5

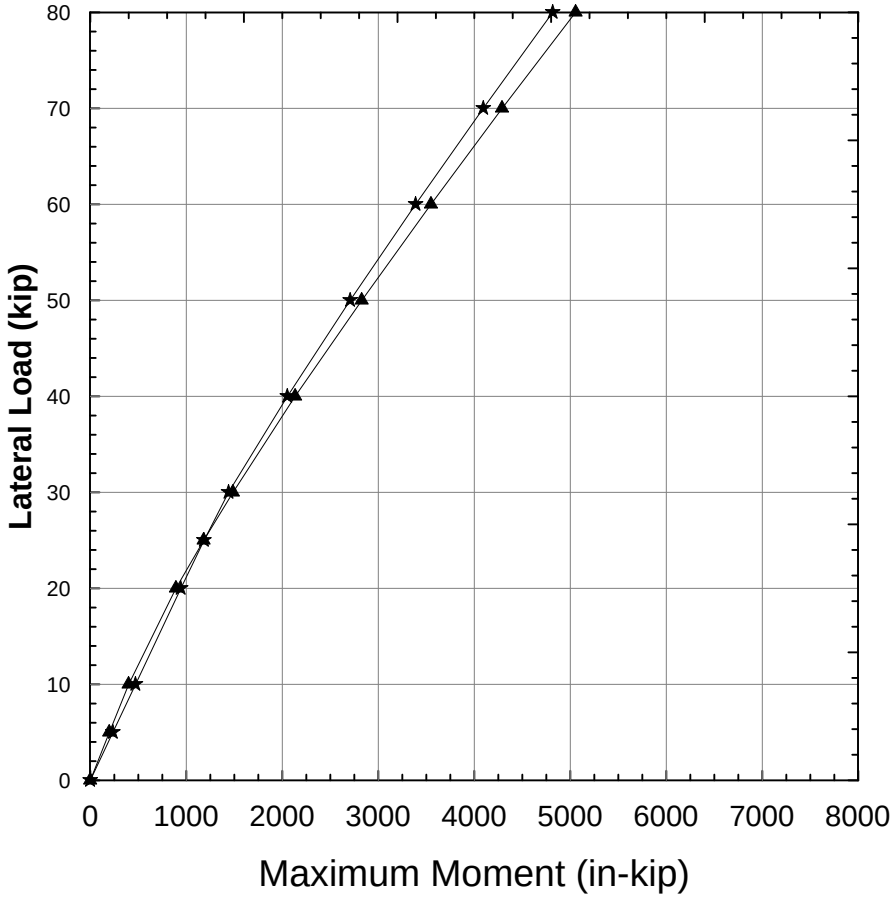
Soil parameters below El. 352 are taken from borings NB37 and NB38

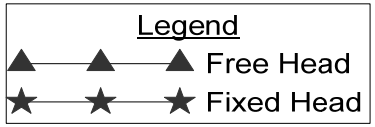
Layer No.	Layer Elevation Top (m)	Top (feet)	Bot. (m)	Bot. (feet)	Lateral Resists?	Unit Wt (pcf)	N_{SPT} blows/ft	Cohesion c (psf)	Adhesion Factor α	Ult. Load Transfer f_{si} (psf)	Layer Thickness (feet)	Depth to Layer Cente (feet)	Effective Vert. Stress (Cen. Lay.) (psf)	β	f_{max} (psf)	Soil Type G= gran. C=cohes.	delta Lat. Res. Cohesive (ton)	Friction (comp) (ton)	Friction (tensile) (ton)	q_T (granular) (psf)	z/B (-)	Nc (cohesive) (-)	q_T (cohesive) (psf)	Bearing Capacity (B.C.) (ton)	Elevation to midlayer (ft)	Compression Cumulative Axial Res. (skin) (ton)	(skin) (kN)	(Tot) (ton)	(Tot) (kN)	Compression LRFD service-1 Limit State Compressive Capacity (ton)	Compression LRFD service-1 Limit State Compressive Capacity (kN)	Tension Cumulative Axial Res. (Skin) (ton)	Tension Cumulative Axial Res. (Skin) (kN)	Tension LRFD service-1 Limit State Compressive Capacity (ton)	Tension LRFD service-1 Limit State Compressive Capacity (kN)
(-)	(m)	(feet)	(m)	(feet)		(pcf)	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)
			125.88	413.0																						0	0	0.0	0	145	1291	0	0	73	645
1	125.88	413.0	121.3	398.0	n	145	30	0	0.55	0	15.0	7.5	0.0	0.0	0	g	0.0	0.0	0.0	36000	3.5	9.00	0	57	405.5	0.0	0	0.0	0	145	1291	0.0	0	73	645
2	121.3	398.0	109.72	360.0	Y	145	45	0	0.55	0	38.0	34	1569.4	0.9	1431	g	0.0	170.8	119.5	54000	22.5	9.00	0	85	379.0	170.8	1520	170.8	1520	145	1291	119.5	1064	73	645
3	109.72	360.0	108.81	357.0	Y	145	27	0	0.55	0	3.0	54.5	3262.7	0.7	2126	g	0.0	20.0	14.0	32400	24.0	9.00	0	51	358.5	190.8	1698	190.8	1698	145	1291	133.6	1188	73	645
4	108.81	357.0	97.53	320.0	Y	145	75	0	0.55	0	37.0	74.5	4914.7	0.5	2254	g	0.0	262.0	183.4	90000	42.5	9.00	0	141	338.5	452.8	4030	452.8	4030	145	1291	317.0	2820	73	645
Bottom	97.53	320.0																																	

Note: β calculated using the equation in section 10.8.3.5.2b for gravelly sand and gravel in AASHTO LRFD Bridge Design Specifications
Effective vertical stress was calculated assuming the ground surface as the bottom of pile cap or bottom of scour, whichever is deeper.



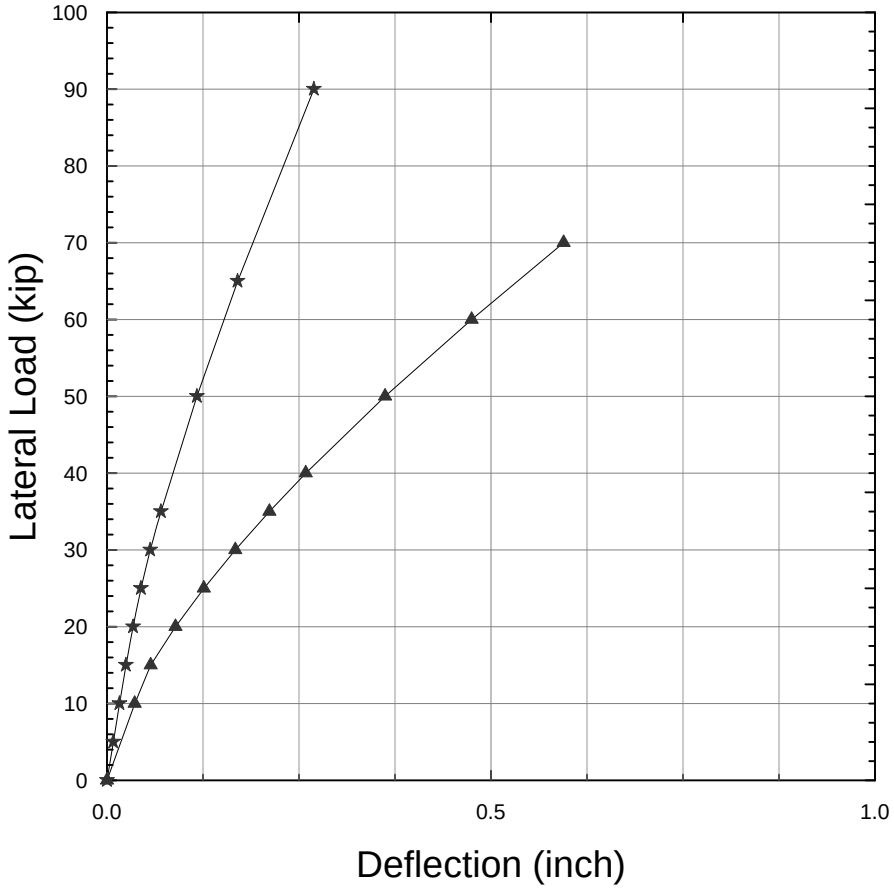


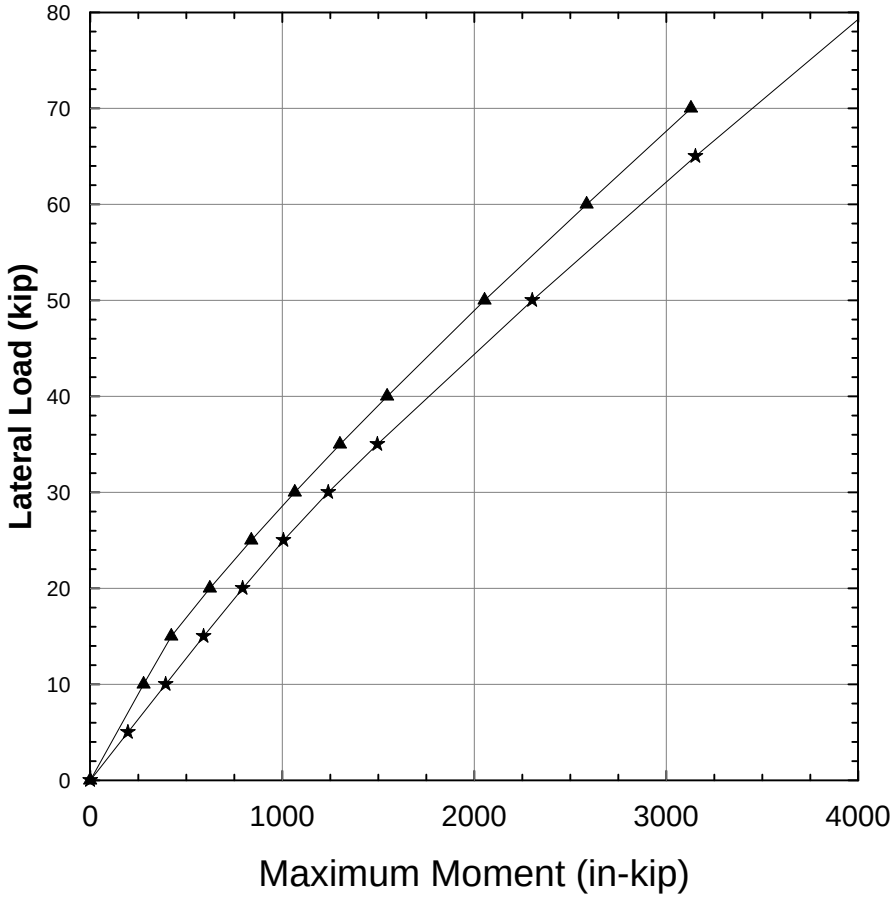


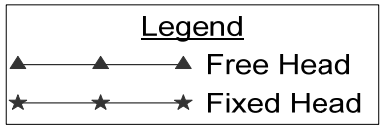


Project No. 28649640	SR 84-ISABEL AVENUE Livermore, California	**Arroyo Del Valle Trail Bridge Abutment 1 Pile Lateral Resistance 24 inch CIDH Pile**	Figure I-1
	URS		

X:/Route 84-Isabel Avenue/geotech/Analysis/Pile Design/Lateral/Arroyo Del Valle Trial Bridge/Arroyo Del Valle_Abutment 1.grf

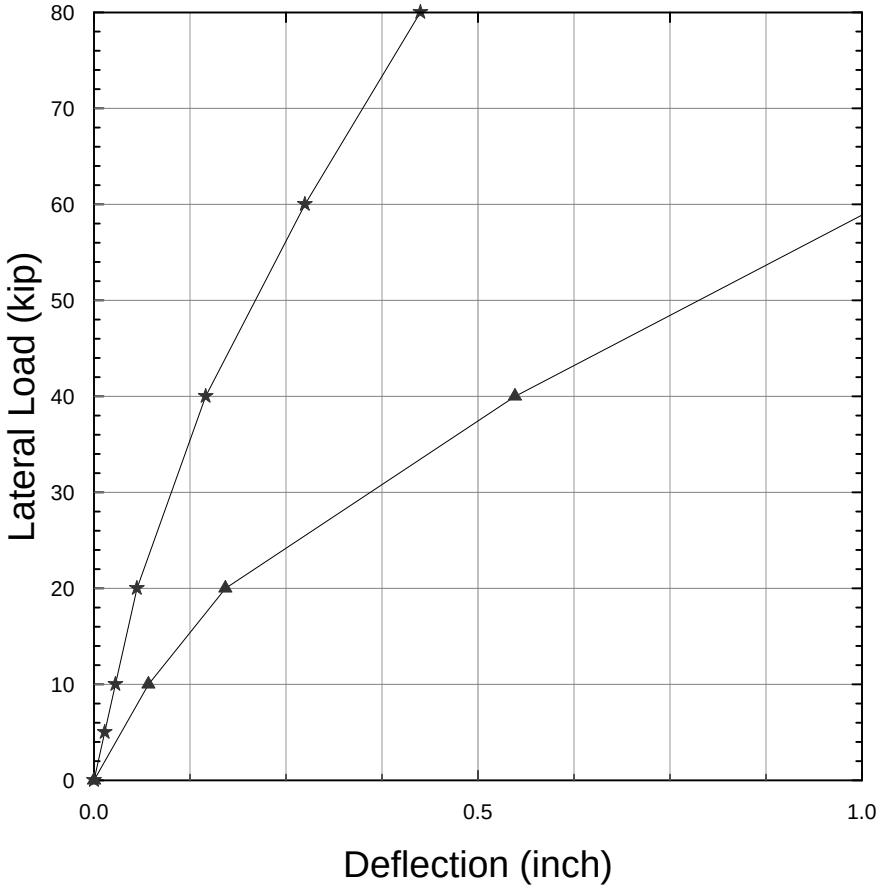


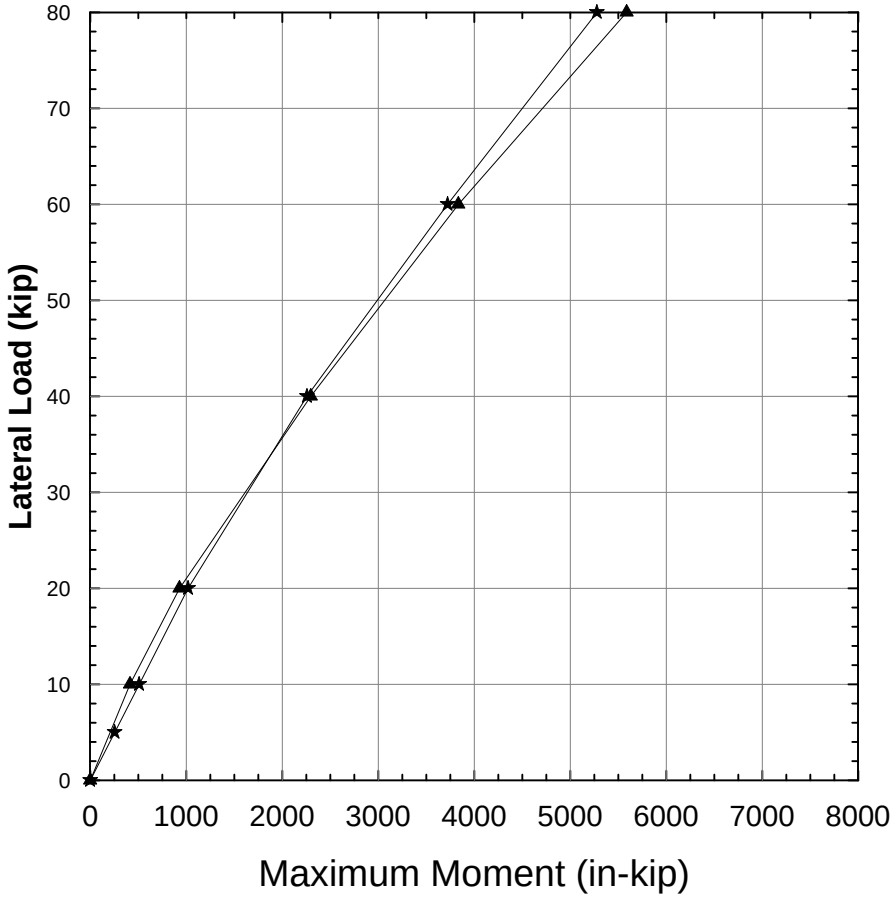


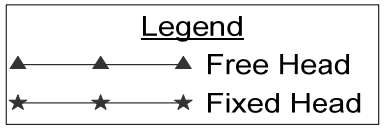


Project No. 28649640	SR 84-ISABEL AVENUE Livermore, California	**Arroyo Del Valle Trail Bridge Bent 2 Pile Lateral Resistance 24 inch CIDH Pile**	Figure I-2
	URS		

X:/Route 84-Isabel Avenue/geotech/Analysis/Pile Design/Lateral/Arroyo Del Valle Trial Bridge/Arroyo Del Valle_Abutment 3.grf

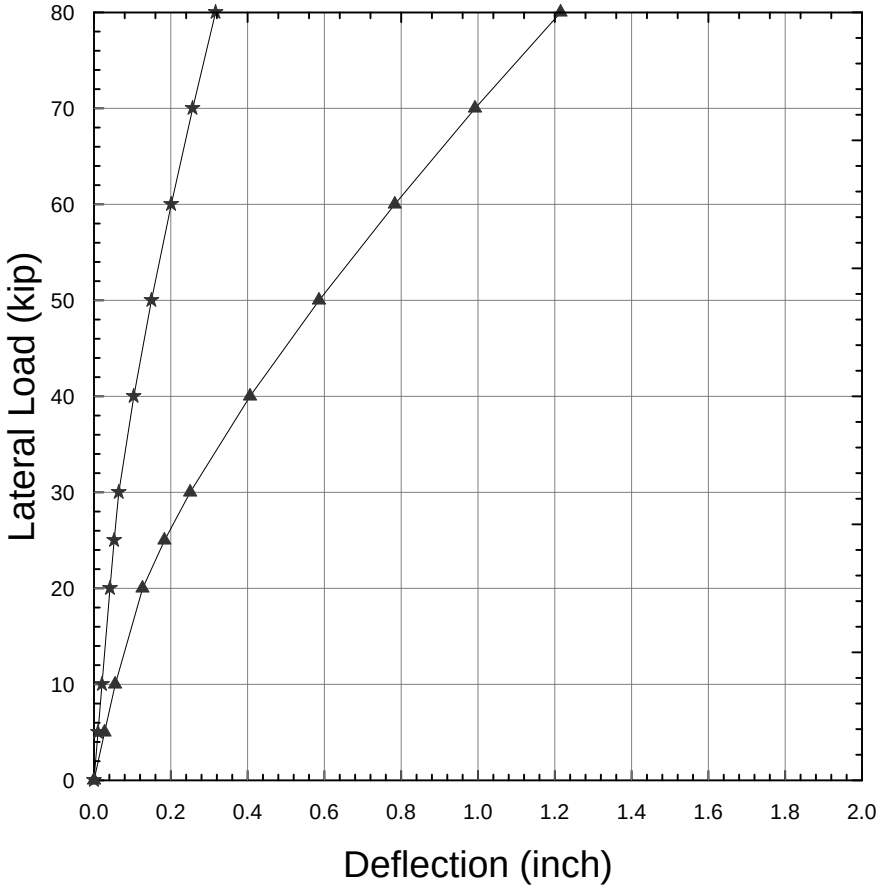


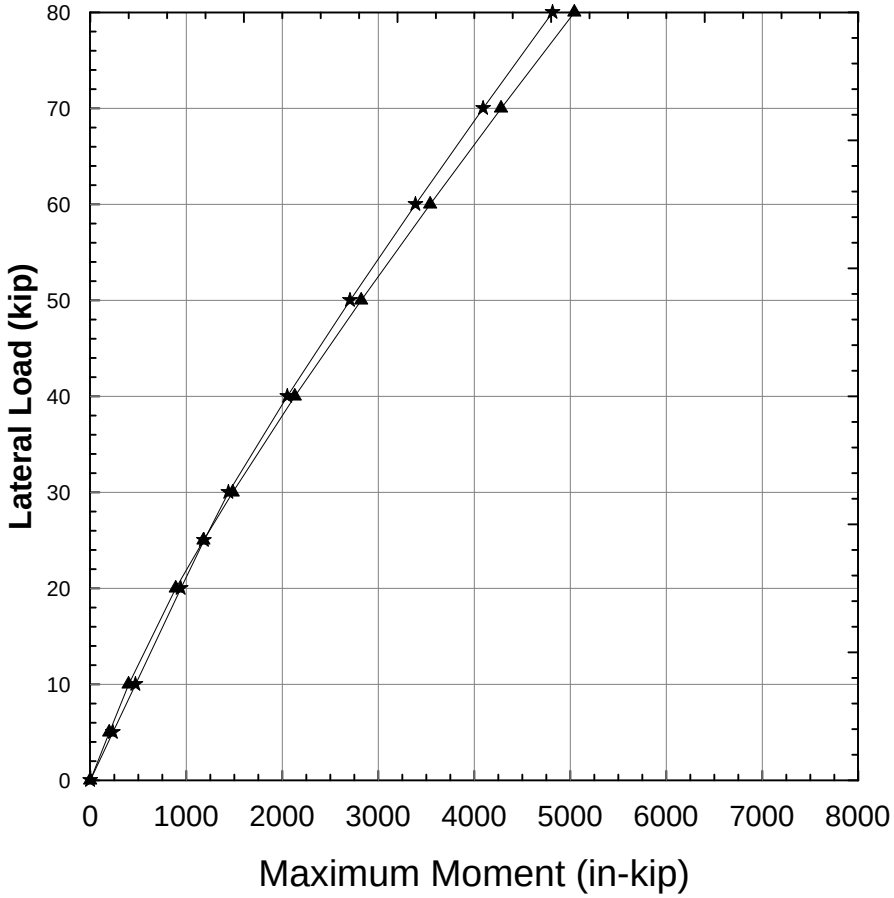




Project No. 28649640	SR 84-ISABEL AVENUE Livermore, California	**Arroyo Del Valle Trail Bridge Bent 2 Pile Lateral Resistance (Include Total Scour for Service Loads) 24 inch CIDH Pile**	Figure I-2b
	URS		

X:/Route 84-Isabel Avenue/geotech/Analysis/Pile Design/Lateral/Arroyo Del Valle Trial Bridge/Arroyo Del Valle_Abutment 3.grf





Project No. 28649640	SR 84-ISABEL AVENUE Livermore, California	**Arroyo Del Valle Trail Bridge Abutment 3 Pile Lateral Resistance 24 inch CIDH Pile**	Figure I-3
	URS		

X:/Route 84-Isabel Avenue/geotech/Analysis/Pile Design/Lateral/Arroyo Del Valle Trial Bridge/Arroyo Del Valle_Abutment 3.grf

ABUT 1

LPILE Plus for Windows, Version 5.0 (5.0.41)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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Geotech SJ
URS

Path to file locations: X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\Arroyo Del Valle Trial Bridge\
Name of input data file: Arroyo Del Valle Trial Bridge_Abut1_ Free_reduced_scour_rev2.lpd
Name of output file: Arroyo Del Valle Trial Bridge_Abut1_ Free_reduced_scour_rev2.lpo
Name of plot output file: Arroyo Del Valle Trial Bridge_Abut1_ Free_reduced_scour_rev2.lpp
Name of runtime file: Arroyo Del Valle Trial Bridge_Abut1_ Free_reduced_scour_rev2.lpr

Time and Date of Analysis

Date: December 11, 2014 Time: 14:04:05

Problem Title

SR84 Isabel Abut 1- ADV Trail-24" CIDH, scour at BOF

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 = 92
- 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 = 552.00 in

Depth of ground surface below top of pile = 0.00 in

Slope angle of ground surface = 0.00 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	24.00000000	16286.0000	452.4000	3600000.
2	552.0000	24.00000000	16286.0000	452.4000	3600000.

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 0.000 in
Distance from top of pile to bottom of layer = 456.000 in
p-y subgrade modulus k for top of soil layer = 175.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 175.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 456.000 in
Distance from top of pile to bottom of layer = 700.000 in
p-y subgrade modulus k for top of soil layer = 200.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 200.000 lbs/in**3

(Depth of lowest layer extends 148.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 4 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	0.00	0.04780
2	456.00	0.04780
3	456.00	0.04780
4	700.00	0.04780

Shear Strength of Soils

Shear strength parameters with depth defined using 4 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	0.000	0.00000	40.00	------	------
2	456.000	0.00000	40.00	------	------
3	456.000	0.00000	42.00	------	------

4	700.000	0.00000	42.00	------	------

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.

Loading Type

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 Shear and Moment (BC Type 1)
Shear force at pile head = 5000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 160000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 2

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 10000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 160000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 3

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 20000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 160000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 4

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 25000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 160000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 5

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 30000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 160000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 6

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 40000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 160000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 7

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 50000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 160000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 8

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 60000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 160000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 9

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 70000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 160000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 10

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 80000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 160000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Specified shear force at pile head = 10000.000 lbs
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 160000.000 lbs

(Zero moment for this load indicates free-head conditions)

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	Es*h F/L lbs/in
0.000	0.055137	-1.1301E-08	10000.0000	-0.0007251	353.6693	0.0000	0.0000
6.000	0.050786	60696.1153	9869.9945	-0.0007220	398.3920	-43.3352	5119.7228
12.000	0.046473	119826.	9465.5756	-0.0007128	441.9608	-91.4711	11809.6612
18.000	0.042233	175652.	8792.0620	-0.0006977	483.0945	-133.0334	18900.0000
24.000	0.038101	226670.	7912.8918	-0.0006771	520.6867	-160.0234	25200.0000
30.000	0.034108	271906.	6895.6213	-0.0006516	554.0178	-179.0668	31500.0000
36.000	0.030282	310669.	5786.0897	-0.0006218	582.5792	-190.7771	37800.0000
42.000	0.026647	342533.	4626.1931	-0.0005883	606.0577	-195.8551	44100.0000
48.000	0.023222	367313.	3453.4296	-0.0005520	624.3161	-195.0661	50400.0000
54.000	0.020023	385034.	2300.5825	-0.0005135	637.3737	-189.2163	56700.0000
60.000	0.017060	395906.	1195.5421	-0.0004735	645.3842	-179.1305	63000.0000
66.000	0.014340	400290.	161.2592	-0.0004328	648.6145	-165.6305	69300.0000

72.000	0.011866	398672.	-784.1800	-0.0003919	647.4224	-149.5159	75600.0000
78.000	0.009637	391632.	-1627.3702	-0.0003515	642.2353	-131.5475	81900.0000
84.000	0.007648	379818.	-2359.3109	-0.0003120	633.5305	-112.4327	88200.0000
90.000	0.005893	363919.	-2975.0539	-0.0002740	621.8158	-92.8149	94500.0000
96.000	0.004361	344644.	-3473.2926	-0.0002377	607.6128	-73.2647	100800.
102.000	0.003041	322696.	-3855.9102	-0.0002036	591.4414	-54.2746	107100.
108.000	0.001918	298764.	-4127.5034	-0.0001718	573.8070	-36.2565	113400.
114.000	0.000980	273496.	-4294.8976	-0.0001425	555.1892	-19.5415	119700.
120.000	0.000209	247498.	-4366.6673	-0.0001158	536.0333	-4.3817	126000.
126.000	-0.000410	221318.	-4352.6739	-9.1826E-05	516.7432	9.0461	132300.
132.000	-0.000893	195443.	-4263.6323	-7.0501E-05	497.6771	20.6344	138600.
138.000	-0.001256	170290.	-4110.7123	-5.1787E-05	479.1441	30.3389	144900.
144.000	-0.001515	146213.	-3905.1835	-3.5592E-05	461.4036	38.1707	151200.
150.000	-0.001683	123496.	-3658.1056	-2.1791E-05	444.6650	44.1886	157500.
156.000	-0.001776	102358.	-3380.0686	-1.0235E-05	429.0896	48.4905	163800.
162.000	-0.001806	82955.1705	-3080.9807	-7.5247E-07	414.7931	51.2055	170100.
168.000	-0.001785	65387.6327	-2769.9063	6.8380E-06	401.8488	52.4860	176400.
174.000	-0.001724	49703.1658	-2454.9488	1.2727E-05	390.2921	52.4999	182700.
180.000	-0.001633	35903.8114	-2143.1768	1.7107E-05	380.1243	51.4241	189000.
186.000	-0.001519	23952.1984	-1840.5892	2.0170E-05	371.3180	49.4384	195300.
192.000	-0.001390	13778.0138	-1552.1148	2.2101E-05	363.8214	46.7198	201600.
198.000	-0.001254	5284.3872	-1281.6402	2.3076E-05	357.5630	43.4384	207900.
204.000	-0.001114	-1645.9753	-1032.0633	2.3262E-05	354.8821	39.7539	214200.
210.000	-0.000974	-7145.0360	-805.3646	2.2813E-05	358.9340	35.8123	220500.
216.000	-0.000840	-11354.1508	-602.6939	2.1866E-05	362.0354	31.7446	226800.
222.000	-0.000712	-14419.3457	-424.4657	2.0547E-05	364.2939	27.6648	233100.
228.000	-0.000593	-16487.1903	-270.4608	1.8966E-05	365.8176	23.6702	239400.
234.000	-0.000485	-17701.2898	-139.9290	1.7216E-05	366.7121	19.8404	245700.
240.000	-0.000387	-18199.3943	-31.6910	1.5379E-05	367.0792	16.2389	252000.
246.000	-0.000300	-18111.1108	55.7644	1.3521E-05	367.0141	12.9129	258300.
252.000	-0.000224	-17556.1832	124.1890	1.1696E-05	366.6052	9.8953	264600.
258.000	-0.000160	-16643.3002	175.4920	9.9464E-06	365.9326	7.2057	270900.
264.000	-0.000105	-15469.3767	211.6657	8.3033E-06	365.0676	4.8522	277200.
270.000	-6.00E-05	-14119.2544	234.7210	6.7893E-06	364.0728	2.8329	283500.
276.000	-2.36E-05	-12665.7606	246.6327	5.4187E-06	363.0018	1.1377	289800.
282.000	5.07E-06	-11170.0655	249.2954	4.1991E-06	361.8997	-0.2501539	296100.
288.000	2.68E-05	-9682.2786	244.4876	3.1321E-06	360.8035	-1.3524	302400.
294.000	4.27E-05	-8242.2280	233.8467	2.2149E-06	359.7424	-2.1945	308700.
300.000	5.34E-05	-6880.3711	218.8505	1.4411E-06	358.7390	-2.8042	315000.
306.000	5.99E-05	-5618.7884	200.8075	8.0153E-07	357.8094	-3.2102	321300.
312.000	6.30E-05	-4472.2196	180.8525	2.8519E-07	356.9646	-3.4415	327600.
318.000	6.34E-05	-3449.1054	159.9486	-1.2014E-07	356.2107	-3.5265	333900.
324.000	6.16E-05	-2552.6063	138.8927	-4.2724E-07	355.5502	-3.4921	340200.
330.000	5.82E-05	-1781.5729	118.3258	-6.4901E-07	354.9820	-3.3635	346500.
336.000	5.38E-05	-1131.4504	98.7448	-7.9807E-07	354.5030	-3.1635	352800.
342.000	4.87E-05	-595.1035	80.5163	-8.8641E-07	354.1078	-2.9126	359100.
348.000	4.32E-05	-163.5530	63.8922	-9.2523E-07	353.7898	-2.6287	365400.
354.000	3.76E-05	173.3800	49.0251	-9.2473E-07	353.7971	-2.3270	371700.
360.000	3.21E-05	426.5233	35.9832	-8.9403E-07	353.9836	-2.0203	378000.
366.000	2.68E-05	606.8952	24.7662	-8.4115E-07	354.1165	-1.7187	384300.
372.000	2.20E-05	725.3328	15.3185	-7.7299E-07	354.2038	-1.4305	390600.
378.000	1.76E-05	792.2012	7.5425	-6.9534E-07	354.2530	-1.1615	396900.
384.000	1.36E-05	817.1778	1.3102	-6.1299E-07	354.2714	-0.9159217	403200.
390.000	1.02E-05	809.1010	-3.5265	-5.2977E-07	354.2655	-0.6963381	409500.
396.000	7.27E-06	775.8764	-7.1275	-4.4867E-07	354.2410	-0.5039865	415800.
402.000	4.82E-06	724.4322	-9.6565	-3.7190E-07	354.2031	-0.3389967	422100.
408.000	2.81E-06	660.7129	-11.2753	-3.0103E-07	354.1562	-0.2006140	428400.
414.000	1.21E-06	589.7065	-12.1394	-2.3704E-07	354.1038	-0.0874048	434700.
420.000	-3.48E-08	515.4957	-12.3939	-1.8049E-07	354.0492	0.0025573	441000.
426.000	-9.59E-07	441.3263	-12.1716	-1.3153E-07	353.9945	0.0715289	447300.
432.000	-1.61E-06	369.6885	-11.5912	-9.0033E-08	353.9417	0.1219559	453600.
438.000	-2.04E-06	302.4049	-10.7563	-5.5643E-08	353.8921	0.1563562	459900.
444.000	-2.28E-06	240.7204	-9.7555	-2.7852E-08	353.8467	0.1772250	466200.
450.000	-2.37E-06	185.3923	-8.6630	-6.0483E-09	353.8059	0.1869600	472500.
456.000	-2.35E-06	136.7765	-7.4773	1.0437E-08	353.7701	0.2082603	530945.
462.000	-2.25E-06	95.6447	-6.2474	2.2329E-08	353.7398	0.2017018	538145.
468.000	-2.09E-06	61.7648	-5.0736	3.0384E-08	353.7148	0.1895543	545345.
474.000	-1.88E-06	34.7028	-3.9844	3.5320E-08	353.6949	0.1735222	552545.
480.000	-1.66E-06	13.8841	-2.9988	3.7806E-08	353.6795	0.1550192	559745.
486.000	-1.43E-06	-1.3552	-2.1282	3.8447E-08	353.6703	0.1351765	566945.
492.000	-1.20E-06	-11.7280	-1.3781	3.7778E-08	353.6780	0.1148588	574145.
498.000	-9.77E-07	-17.9648	-0.7494545	3.6258E-08	353.6826	0.0946862	581345.
504.000	-7.65E-07	-20.7911	-0.2402153	3.4275E-08	353.6846	0.0750602	588545.
510.000	-5.66E-07	-20.9132	0.1535443	3.2141E-08	353.6847	0.0561930	595745.
516.000	-3.80E-07	-19.0103	0.4365369	3.0098E-08	353.6833	0.0381379	602945.
522.000	-2.05E-07	-15.7325	0.6134178	2.8321E-08	353.6809	0.0208224	610145.
528.000	-3.97E-08	-11.7037	0.6881293	2.6917E-08	353.6779	0.0040814	617345.
534.000	1.18E-07	-7.5267	0.6634505	2.5933E-08	353.6749	-0.0123077	624545.
540.000	2.72E-07	-3.7920	0.5407597	2.5354E-08	353.6721	-0.0285892	631745.
546.000	4.22E-07	-1.0862	0.3200199	2.5104E-08	353.6701	-0.0449907	638945.
552.000	5.73E-07	0.0000	0.0000	2.5048E-08	353.6693	-0.0616826	323073.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	0.05513687 in
Computed slope at pile head	=	-0.00072512
Maximum bending moment	=	400289.79532 lbs-in
Maximum shear force	=	10000.00000 lbs
Depth of maximum bending moment	=	66.00000000 in
Depth of maximum shear force	=	0.00000 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 6

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Specified shear force at pile head = 40000.000 lbs
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 160000.000 lbs

(Zero moment for this load indicates free-head conditions)

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	Es*h F/L lbs/in
0.000	0.407001	2.7122E-07	40000.0000	-0.0044695	353.6693	0.0000	0.0000
6.000	0.380184	244291.	39776.1132	-0.0044570	533.6698	-74.6289	1177.7797
12.000	0.353517	485871.	39063.7967	-0.0044196	711.6731	-162.8099	2763.2569
18.000	0.327149	721542.	37802.3518	-0.0043578	885.3225	-257.6717	4725.7700
24.000	0.301223	947866.	35976.0917	-0.0042724	1052.0847	-351.0817	6993.1185
30.000	0.275880	1161458.	33605.1134	-0.0041645	1209.4656	-439.2444	9552.9551
36.000	0.251249	1359123.	30744.6772	-0.0040355	1355.1110	-514.2343	12280.2565
42.000	0.227453	1538142.	27453.4172	-0.0038873	1487.0176	-582.8523	15375.0761
48.000	0.204602	1696028.	23806.9060	-0.0037218	1603.3521	-632.6514	18552.6424
54.000	0.182792	1830971.	19890.4287	-0.0035413	1702.7823	-672.8411	22085.4620
60.000	0.162106	1941512.	15797.3249	-0.0033483	1784.2322	-691.5269	25595.3139
66.000	0.142613	2026968.	11634.4948	-0.0031452	1847.1983	-696.0832	29285.6100
72.000	0.124364	2087165.	7520.3787	-0.0029347	1891.5534	-675.2889	32579.7171
78.000	0.107396	2122847.	3518.4222	-0.0027193	1917.8449	-658.6967	36799.9852
84.000	0.091732	2134607.	-317.5980	-0.0025014	1926.5102	-619.9767	40551.2689
90.000	0.077379	2123839.	-3857.3390	-0.0022835	1918.5755	-559.9369	43417.7240
96.000	0.064330	2092703.	-6980.8362	-0.0020678	1895.6343	-481.2288	44883.8641
102.000	0.052566	2044039.	-9809.9907	-0.0018561	1859.7766	-461.8227	52713.7897
108.000	0.042057	1978547.	-12493.7513	-0.0016503	1811.5207	-432.7642	61740.2975
114.000	0.032762	1897282.	-14975.5011	-0.0014520	1751.6421	-394.4857	72244.9577
120.000	0.024633	1801629.	-17201.9058	-0.0012627	1681.1622	-347.6492	84678.5719
126.000	0.017610	1693284.	-19175.3498	-0.0010839	1601.3301	-310.1654	105678.
132.000	0.011627	1573606.	-20893.7476	-0.0009167	1513.1480	-262.6338	135532.
138.000	0.006610	1444319.	-22160.5251	-0.0007623	1417.8855	-159.6253	144900.
144.000	0.002480	1309143.	-22826.8539	-0.0006214	1318.2842	-62.4843	151200.
150.000	-0.000847	1171590.	-22947.6191	-0.0004944	1216.9307	22.2292	157500.
156.000	-0.003454	1034721.	-22598.0645	-0.0003816	1116.0820	94.2889	163800.
162.000	-0.005425	901145.	-21853.7637	-0.0002825	1017.6595	153.8113	170100.
168.000	-0.006844	773018.	-20788.7108	-0.0001968	923.2517	201.2063	176400.

174.000	-0.007787	652059.	-19473.7117	-0.0001239	834.1252	237.1267	182700.
180.000	-0.008331	539572.	-17975.0815	-6.2937E-05	751.2414	262.4167	189000.
186.000	-0.008543	436479.	-16353.6408	-1.2994E-05	675.2795	278.0635	195300.
192.000	-0.008487	343353.	-14663.9992	2.6909E-05	606.6617	285.1504	201600.
198.000	-0.008220	260459.	-12954.1050	5.7805E-05	545.5830	284.8144	207900.
204.000	-0.007793	187793.	-11265.0365	8.0742E-05	492.0404	278.2085	214200.
210.000	-0.007251	125123.	-9631.0047	9.6753E-05	445.8639	266.4688	220500.
216.000	-0.006632	72034.8174	-8079.5391	0.0001068	406.7467	250.6865	226800.
222.000	-0.005969	27963.8331	-6631.8216	0.0001120	374.2739	231.8860	233100.
228.000	-0.005288	-7762.0012	-5303.1399	0.0001130	359.3886	211.0079	239400.
234.000	-0.004613	-35890.7900	-4103.4278	0.0001108	380.1147	188.8961	245700.
240.000	-0.003959	-57215.7913	-3037.8654	0.0001060	395.8276	166.2913	252000.
246.000	-0.003341	-72548.6837	-2107.5118	9.9354E-05	407.1253	143.8265	258300.
252.000	-0.002767	-82696.6937	-1309.9495	9.1411E-05	414.6027	122.0276	264600.
258.000	-0.002244	-88443.5860	-639.9182	8.2654E-05	418.8371	101.3162	270900.
264.000	-0.001775	-90534.4068	-89.9238	7.3496E-05	420.3777	82.0153	277200.
270.000	-0.001362	-89663.7833	349.1918	6.4275E-05	419.7362	64.3566	283500.
276.000	-0.001004	-86467.5134	687.7299	5.5263E-05	417.3811	48.4894	289800.
282.000	-0.000699	-81517.1287	936.6693	4.6667E-05	413.7335	34.4904	296100.
288.000	-0.000444	-75317.0821	1107.2608	3.8642E-05	409.1651	22.3734	302400.
294.000	-0.000235	-68304.1921	1210.6824	3.1293E-05	403.9978	12.1004	308700.
300.000	-6.84E-05	-60848.9758	1257.7567	2.4685E-05	398.5046	3.5910	315000.
306.000	6.10E-05	-53258.5058	1258.7258	1.8846E-05	392.9117	-3.2679	321300.
312.000	0.000158	-45780.4497	1223.0825	1.3778E-05	387.4017	-8.6131	327600.
318.000	0.000226	-38607.9694	1159.4517	9.4601E-06	382.1168	-12.5971	333900.
324.000	0.000271	-31885.1927	1075.5171	5.8530E-06	377.1633	-15.3811	340200.
330.000	0.000297	-25713.0017	977.9880	2.9058E-06	372.6154	-17.1286	346500.
336.000	0.000306	-20154.9157	872.5989	5.5881E-07	368.5200	-18.0011	352800.
342.000	0.000303	-15242.8880	764.1372	-1.2525E-06	364.9007	-18.1528	359100.
348.000	0.000291	-10982.8649	656.4927	-2.5944E-06	361.7618	-17.7287	365400.
354.000	0.000272	-7359.9949	552.7233	-3.5330E-06	359.0924	-16.8611	371700.
360.000	0.000249	-4343.4017	455.1328	-4.1318E-06	356.8697	-15.6691	378000.
366.000	0.000223	-1890.4684	365.3547	-4.4508E-06	355.0623	-14.2570	384300.
372.000	0.000195	49.4002	284.4406	-4.5450E-06	353.7057	-12.7144	390600.
378.000	0.000168	1531.5452	212.9476	-4.4641E-06	354.7978	-11.1166	396900.
384.000	0.000142	2613.3430	151.0238	-4.2520E-06	355.5949	-9.5247	403200.
390.000	0.000117	3351.9950	98.4885	-3.9468E-06	356.1392	-7.9871	409500.
396.000	9.44E-05	3802.7829	54.9067	-3.5807E-06	356.4713	-6.5402	415800.
402.000	7.41E-05	4017.7501	19.6560	-3.1805E-06	356.6297	-5.2100	422100.
408.000	5.62E-05	4044.7618	-8.0140	-2.7680E-06	356.6496	-4.0133	428400.
414.000	4.08E-05	3926.8964	-28.9312	-2.3601E-06	356.5628	-2.9591	434700.
420.000	2.79E-05	3702.1186	-43.9578	-1.9697E-06	356.3971	-2.0498	441000.
426.000	1.72E-05	3403.1849	-53.9554	-1.6061E-06	356.1769	-1.2828	447300.
432.000	8.61E-06	3057.7379	-59.7574	-1.2755E-06	355.9223	-0.6512655	453600.
438.000	1.90E-06	2688.5448	-62.1482	-9.8150E-07	355.6503	-0.1456489	459900.
444.000	-3.16E-06	2313.8443	-61.8477	-7.2554E-07	355.3742	0.2457985	466200.
450.000	-6.81E-06	1947.7652	-59.5023	-5.0748E-07	355.1045	0.5359948	472500.
456.000	-9.25E-06	1600.7905	-55.4379	-3.2590E-07	354.8488	0.8188200	530945.
462.000	-1.07E-05	1283.1361	-50.0978	-1.7834E-07	354.6148	0.9612270	538145.
468.000	-1.14E-05	999.9598	-44.1075	-6.1513E-08	354.4061	1.0355	545345.
474.000	-1.15E-05	753.9646	-37.8361	2.8233E-08	354.2249	1.0549	552545.
480.000	-1.11E-05	545.8727	-31.5775	9.4744E-08	354.0715	1.0313	559745.
486.000	-1.03E-05	374.8529	-25.5587	1.4186E-07	353.9455	0.9749887	566945.
492.000	-9.35E-06	238.8960	-19.9490	1.7326E-07	353.8453	0.8949120	574145.
498.000	-8.24E-06	135.1324	-14.8693	1.9240E-07	353.7689	0.7983037	581345.
504.000	-7.04E-06	60.0944	-10.4018	2.0239E-07	353.7136	0.6908854	588545.
510.000	-5.81E-06	9.9224	-6.5983	2.0597E-07	353.6766	0.5769331	595745.
516.000	-4.57E-06	-19.4809	-3.4893	2.0548E-07	353.6837	0.4594099	602945.
522.000	-3.34E-06	-32.3436	-1.0907	2.0283E-07	353.6932	0.3401299	610145.
528.000	-2.14E-06	-32.9585	0.5895608	1.9949E-07	353.6936	0.2199486	617345.
534.000	-9.51E-07	-25.6519	1.5463	1.9649E-07	353.6882	0.0989768	624545.
540.000	2.20E-07	-14.7797	1.7737	1.9442E-07	353.6802	-0.0231848	631745.
546.000	1.38E-06	-4.7406	1.2626	1.9342E-07	353.6728	-0.1471906	638945.
552.000	2.54E-06	0.0000	0.0000	1.9318E-07	353.6693	-0.2736717	323073.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection = 0.40700139 in

Computed slope at pile head = -0.00446949
Maximum bending moment = 2134607. lbs-in
Maximum shear force = 40000.00000 lbs
Depth of maximum bending moment = 84.00000000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 17
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 Shear and Moment (BC Type 1)
Specified shear force at pile head = 80000.000 lbs
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 160000.000 lbs

(Zero moment for this load indicates free-head conditions)

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	Es*h F/L lbs/in
0.000	1.218	-3.9778E-06	80000.0000	-0.0117998	353.6693	0.0000	0.0000
6.000	1.147	491328.	79696.4092	-0.0117747	715.6940	-101.1969	529.1820
12.000	1.077	978964.	78707.2587	-0.0116995	1074.9988	-228.5199	1273.2104
18.000	1.007	1458278.	76905.7195	-0.0115748	1428.1711	-371.9932	2216.4375
24.000	0.938002	1924057.	74220.2426	-0.0114017	1771.3703	-523.1658	3346.4688
30.000	0.870183	2370812.	70653.8026	-0.0111819	2100.5529	-665.6476	4589.7094
36.000	0.803819	2793371.	66321.1504	-0.0109177	2411.9069	-778.5699	5811.5317
42.000	0.739170	3187628.	61331.3592	-0.0106116	2702.4065	-884.6939	7181.2444
48.000	0.676479	3549722.	55777.8102	-0.0102669	2969.2082	-966.4891	8572.2295
54.000	0.615968	3876674.	49779.4255	-0.0098869	3210.1159	-1032.9725	10061.9501
60.000	0.557836	4166058.	43465.0431	-0.0094754	3423.3425	-1071.8217	11528.3462
66.000	0.502263	4416447.	36915.0023	-0.0090362	3607.8365	-1111.5253	13278.2029
72.000	0.449402	4626388.	30212.6050	-0.0085735	3762.5267	-1122.6071	14988.0212
78.000	0.399381	4795460.	23382.1880	-0.0080914	3887.1039	-1154.1986	17339.8082
84.000	0.352305	4922509.	16444.5940	-0.0075941	3980.7179	-1158.3328	19727.2183
90.000	0.308251	5007376.	9580.4098	-0.0070860	4043.2497	-1129.7286	21989.7552
96.000	0.267272	5051080.	2992.9263	-0.0065714	4075.4521	-1066.0992	23932.8683
102.000	0.229395	5055908.	-3415.6258	-0.0060542	4079.0096	-1070.0848	27988.8849
108.000	0.194622	5021716.	-9795.1231	-0.0055385	4053.8163	-1056.4143	32568.1968
114.000	0.162932	4949000.	-16038.3077	-0.0050284	4000.2371	-1024.6472	37732.7267
120.000	0.134282	4838911.	-22036.7233	-0.0045275	3919.1200	-974.8246	43557.3143
126.000	0.108602	4693252.	-27773.5818	-0.0040398	3811.7946	-937.4615	51792.4470
132.000	0.085804	4513384.	-33242.0207	-0.0035687	3679.2625	-885.3515	61909.5550
138.000	0.065778	4301200.	-38352.1211	-0.0031177	3522.9190	-818.0153	74616.1176
144.000	0.048393	4059145.	-43010.2845	-0.0026899	3344.5655	-734.7058	91093.3261
150.000	0.033500	3790241.	-47116.3366	-0.0022882	3146.4296	-633.9782	113550.
156.000	0.020934	3498142.	-50556.1132	-0.0019153	2931.2024	-512.6140	146924.
162.000	0.010516	3187245.	-52988.3500	-0.0015732	2702.1245	-298.1316	170100.
168.000	0.002055	2865302.	-54064.0326	-0.0012635	2464.9077	-60.4292	176400.
174.000	-0.004646	2540903.	-53820.9162	-0.0009869	2225.8805	141.4680	182700.
180.000	-0.009787	2221346.	-52471.6347	-0.0007432	1990.4220	308.2925	189000.
186.000	-0.013564	1912670.	-50222.2080	-0.0005317	1762.9804	441.5164	195300.
192.000	-0.016167	1619700.	-47268.0233	-0.0003509	1547.1119	543.2118	201600.
198.000	-0.017775	1346127.	-43790.6511	-0.0001992	1345.5353	615.9123	207900.
204.000	-0.018557	1094595.	-39955.4680	-7.4270E-05	1160.1989	662.4821	214200.
210.000	-0.018666	866804.	-35910.0417	2.6092E-05	992.3561	685.9934	220500.
216.000	-0.018244	663624.	-31783.2131	0.0001044	842.6472	689.6162	226800.
222.000	-0.017414	485205.	-27684.8026	0.0001632	711.1828	676.5207	233100.
228.000	-0.016286	331093.	-23705.8571	0.0002050	597.6287	649.7945	239400.
234.000	-0.014954	200342.	-19919.3507	0.0002321	501.2869	612.3743	245700.
240.000	-0.013500	91615.5507	-16381.2533	0.0002471	421.1743	566.9915	252000.
246.000	-0.011989	3292.1747	-13131.8802	0.0002519	356.0951	516.1328	258300.
252.000	-0.010476	-66450.7435	-10197.4440	0.0002487	402.6322	462.0126	264600.
258.000	-0.009005	-119555.	-7591.7324	0.0002392	441.7607	406.5580	270900.
264.000	-0.007606	-158011.	-5317.8468	0.0002250	470.0963	351.4039	277200.
270.000	-0.006305	-183801.	-3369.9426	0.0002075	489.0991	297.8974	283500.

276.000	-0.005116	-198849.	-1734.9233	0.0001879	500.1867	247.1090	289800.
282.000	-0.004050	-204981.	-394.0462	0.0001673	504.7051	199.8501	296100.
288.000	-0.003109	-203898.	675.5889	0.0001463	503.9075	156.6950	302400.
294.000	-0.002294	-197155.	1499.6923	0.0001258	498.9386	118.0061	308700.
300.000	-0.001599	-186143.	2105.5917	0.0001062	490.8252	83.9604	315000.
306.000	-0.001019	-172091.	2521.2039	8.7872E-05	480.4713	54.5770	321300.
312.000	-0.000545	-156058.	2774.1702	7.1081E-05	468.6572	29.7451	327600.
318.000	-0.000166	-138938.	2891.1537	5.5986E-05	456.0428	9.2494	333900.
324.000	0.000127	-121471.	2897.2898	4.2662E-05	443.1730	-7.2041	340200.
330.000	0.000346	-104252.	2815.7794	3.1112E-05	430.4854	-19.9661	346500.
336.000	0.000500	-87741.7472	2667.6113	2.1288E-05	418.3200	-29.4233	352800.
342.000	0.000601	-72281.8243	2471.3990	1.3099E-05	406.9287	-35.9808	359100.
348.000	0.000658	-58110.1106	2243.3150	6.4274E-06	396.4865	-40.0472	365400.
354.000	0.000678	-45374.3855	1997.1091	1.1322E-06	387.1025	-42.0215	371700.
360.000	0.000671	-34146.9754	1744.1925	-2.9368E-06	378.8298	-42.2841	378000.
366.000	0.000643	-24438.4368	1493.7741	-5.9345E-06	371.6763	-41.1887	384300.
372.000	0.000600	-16210.2914	1253.0355	-8.0144E-06	365.6135	-39.0575	390600.
378.000	0.000547	-9386.6234	1027.3311	-9.3242E-06	360.5857	-36.1773	396900.
384.000	0.000488	-3864.4163	820.4040	-1.0002E-05	356.5167	-32.7984	403200.
390.000	0.000427	477.4288	634.6070	-1.0176E-05	354.0211	-29.1340	409500.
396.000	0.000366	3770.4046	471.1211	-9.9582E-06	356.4475	-25.3613	415800.
402.000	0.000307	6150.0019	330.1661	-9.4506E-06	358.2008	-21.6237	422100.
408.000	0.000253	7750.5425	211.1972	-8.7393E-06	359.3801	-18.0326	428400.
414.000	0.000203	8701.1480	113.0858	-7.8975E-06	360.0806	-14.6712	434700.
420.000	0.000158	9122.7352	34.2800	-6.9855E-06	360.3912	-11.5974	441000.
426.000	0.000119	9125.9205	-27.0539	-6.0517E-06	360.3936	-8.8473	447300.
432.000	8.52E-05	8809.7080	-72.9115	-5.1340E-06	360.1606	-6.4386	453600.
438.000	5.71E-05	8260.8397	-105.3501	-4.2605E-06	359.7561	-4.3742	459900.
444.000	3.40E-05	7553.6869	-126.4078	-3.4513E-06	359.2351	-2.6450	466200.
450.000	1.57E-05	6750.5725	-138.0406	-2.7194E-06	358.6433	-1.2326	472500.
456.000	1.41E-06	5902.4203	-142.1125	-2.0719E-06	358.0184	-0.1246641	530945.
462.000	-9.21E-06	5049.2003	-140.0082	-1.5115E-06	357.3897	0.8261069	538145.
468.000	-1.67E-05	4225.2242	-132.9681	-1.0370E-06	356.7826	1.5206	545345.
474.000	-2.17E-05	3455.5735	-122.4239	-6.4396E-07	356.2155	1.9942	552545.
480.000	-2.45E-05	2757.3733	-109.5966	-3.2605E-07	355.7010	2.2816	559745.
486.000	-2.56E-05	2141.0409	-95.5041	-7.5406E-08	355.2469	2.4158	566945.
492.000	-2.54E-05	1611.4685	-80.9759	1.1660E-07	354.8567	2.4269	574145.
498.000	-2.42E-05	1169.1067	-66.6702	2.5888E-07	354.5308	2.3416	581345.
504.000	-2.23E-05	810.9286	-53.0962	3.6020E-07	354.2668	2.1831	588545.
510.000	-1.98E-05	531.2609	-40.6356	4.2888E-07	354.0608	1.9705	595745.
516.000	-1.71E-05	322.4774	-29.5664	4.7256E-07	353.9069	1.7193	602945.
522.000	-1.42E-05	175.5567	-20.0843	4.9805E-07	353.7987	1.4414	610145.
528.000	-1.11E-05	80.5099	-12.3237	5.1115E-07	353.7286	1.1454	617345.
534.000	-8.04E-06	26.6904	-6.3766	5.1663E-07	353.6890	0.8369711	624545.
540.000	-4.93E-06	2.9992	-2.3075	5.1815E-07	353.6715	0.5193766	631745.
546.000	-1.82E-06	-1.9948	-0.1670167	5.1820E-07	353.6708	0.1941268	638945.
552.000	1.29E-06	0.0000	0.0000	5.1810E-07	353.6693	-0.1384546	323073.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

```
Pile-head deflection             =     1.21819569 in
Computed slope at pile head      =    -0.01179985
Maximum bending moment           =      5055908. lbs-in
Maximum shear force              =    80000.00000 lbs
Depth of maximum bending moment  =      102.00000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =             17
Number of zero deflection points =              4
```

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

```
Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad
```

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
1	V= 5000.000	M= 0.000	160000.	0.0273329	198522.	5000.0000
1	V= 10000.	M= 0.000	160000.	0.0551369	400290.	10000.0000
1	V= 20000.	M= 0.000	160000.	0.1266165	892395.	20000.0000
1	V= 25000.	M= 0.000	160000.	0.1836466	1181824.	25000.0000
1	V= 30000.	M= 0.000	160000.	0.2508625	1486445.	30000.0000
1	V= 40000.	M= 0.000	160000.	0.4070014	2134607.	40000.0000
1	V= 50000.	M= 0.000	160000.	0.5872713	2828189.	50000.0000
1	V= 60000.	M= 0.000	160000.	0.7850612	3548890.	60000.0000
1	V= 70000.	M= 0.000	160000.	0.9944482	4290108.	70000.0000
1	V= 80000.	M= 0.000	160000.	1.2182	5055908.	80000.0000

Pile-head Deflection vs. Pile Length

Boundary Condition Type 1, Shear and Moment

```
Shear      =           5000. lbs
Moment     =              0. in-lbs
Axial Load =         160000. lbs
```

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
552.000	0.02733292	198521.74490	5000.00000
524.400	0.02732310	198460.56012	5000.00000
496.800	0.02731378	198191.00140	5000.00000
469.200	0.02730497	198336.27637	5000.00000
441.600	0.02729668	198312.01492	5000.00000
414.000	0.02728891	198251.37818	5000.00000
386.400	0.02728164	198197.74967	5000.00000
358.800	0.02727492	198105.88482	5000.00000
331.200	0.02726974	198041.67594	5000.00000
303.600	0.02726927	197950.85386	5000.00000

This analysis ended normally.

```
================================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.41)

              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:

Geotech SJ
URS

Path to file locations:      X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\Arroyo
Del Valle Trial Bridge\
Name of input data file:     Arroyo Del Valle Trial Bridge_Abut1_ Fixed_reduced_scour_rev2.lpd
Name of output file:         Arroyo Del Valle Trial Bridge_Abut1_ Fixed_reduced_scour_rev2.lpo
Name of plot output file:    Arroyo Del Valle Trial Bridge_Abut1_ Fixed_reduced_scour_rev2.lpp
Name of runtime file:        Arroyo Del Valle Trial Bridge_Abut1_ Fixed_reduced_scour_rev2.lpr


--------------------------------------------------------------------------------
                          Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  December 11, 2014     Time:  14:01:59


--------------------------------------------------------------------------------
                               Problem Title
--------------------------------------------------------------------------------

SR84 Isabel Abut1- ADV Trail-24" CIDH pile, scour above BOF


--------------------------------------------------------------------------------
                               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            =          92
- 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                                =     552.00 in

Depth of ground surface below top of pile =       0.00 in

Slope angle of ground surface              =       0.00 deg.

Structural properties of pile defined using  2 points

Point    Depth          Pile       Moment of       Pile       Modulus of
           X          Diameter      Inertia        Area       Elasticity
          in             in          in**4        Sq.in       lbs/Sq.in
-----  ---------   -----------   -----------   ----------   -----------
  1       0.0000   24.00000000   16286.0000     452.4000      3600000.
  2     552.0000   24.00000000   16286.0000     452.4000      3600000.


--------------------------------------------------------------------------------
                     Soil and Rock Layering Information
--------------------------------------------------------------------------------

The soil profile is modelled using  2 layers

Layer  1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =        0.000 in
Distance from top of pile to bottom of layer =      456.000 in
p-y subgrade modulus k for top of soil layer =      175.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      175.000 lbs/in**3

Layer  2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      456.000 in
Distance from top of pile to bottom of layer =      700.000 in
p-y subgrade modulus k for top of soil layer =      200.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      200.000 lbs/in**3


(Depth of lowest layer extends  148.00 in below pile tip)


--------------------------------------------------------------------------------
                  Effective Unit Weight of Soil vs. Depth
--------------------------------------------------------------------------------

Effective unit weight of soil with depth defined using  4 points

Point        Depth X    Eff. Unit Weight
 No.           in          lbs/in**3
-----      ----------   ----------------
  1            0.00         0.04780
  2          456.00         0.04780
  3          456.00         0.04780
  4          700.00         0.04780



--------------------------------------------------------------------------------
                           Shear Strength of Soils
--------------------------------------------------------------------------------

Shear strength parameters with depth defined using  4 points

Point    Depth X     Cohesion c     Angle of Friction     E50 or      RQD
 No.       in         lbs/in**2           Deg.            k_rm         %
-----   --------     ----------     ------------------    ------    ------
  1       0.000        0.00000           40.00           ------    ------
  2     456.000        0.00000           40.00           ------    ------
  3     456.000        0.00000           42.00           ------    ------
  4     700.000        0.00000           42.00           ------    ------
```

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.

Loading Type

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 Shear and Slope (BC Type 2)
Shear force at pile head = 5000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 160000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 2

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 10000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 160000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 3

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 20000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 160000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 4

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 25000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 160000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 5

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 30000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 160000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 6

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 40000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 160000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 7

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 50000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 160000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 8

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 60000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 160000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 9

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 70000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 160000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 10

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 80000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 160000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Specified shear force at pile head = 10000.000 lbs
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 160000.000 lbs

(Zero slope for this load indicates fixed-head conditions)

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	Es*h F/L lbs/in
0.000	0.020749	-471517.	10000.0000	2.8912E-19	701.0967	0.0000	0.0000
6.000	0.020604	-411494.	9935.0982	-4.5182E-05	656.8698	-21.6339	6300.0000
12.000	0.020206	-352209.	9742.8965	-8.4260E-05	613.1871	-42.4333	12600.0000
18.000	0.019593	-294417.	9430.4462	-0.0001173	570.6044	-61.7168	18900.0000
24.000	0.018798	-238818.	9008.4389	-0.0001446	529.6375	-78.9523	25200.0000
30.000	0.017857	-186038.	8490.3335	-0.0001664	490.7477	-93.7495	31500.0000
36.000	0.016802	-136615.	7891.5327	-0.0001829	454.3311	-105.8507	37800.0000
42.000	0.015662	-90988.6220	7228.6229	-0.0001945	420.7124	-115.1192	44100.0000
48.000	0.014467	-49497.8147	6518.6873	-0.0002017	390.1408	-121.5260	50400.0000
54.000	0.013242	-12377.0795	5778.7020	-0.0002049	362.7891	-125.1358	56700.0000
60.000	0.012009	20239.9821	5025.0175	-0.0002045	368.5827	-126.0923	63000.0000
66.000	0.010788	48315.7309	4272.9317	-0.0002010	389.2698	-124.6029	69300.0000
72.000	0.009597	71901.0280	3536.3513	-0.0001948	406.6481	-120.9239	75600.0000
78.000	0.008450	91126.0011	2827.5403	-0.0001865	420.8136	-115.3464	81900.0000

84.000	0.007359	106190.	2156.9519	-0.0001764	431.9129	-108.1831	88200.0000
90.000	0.006334	117348.	1533.1352	-0.0001649	440.1348	-99.7558	94500.0000
96.000	0.005380	124904.	962.7125	-0.0001525	445.7021	-90.3851	100800.
102.000	0.004503	129194.	450.4150	-0.0001395	448.8629	-80.3807	107100.
108.000	0.003706	130577.	-0.8296054	-0.0001263	449.8821	-70.0341	113400.
114.000	0.002988	129426.	-389.7680	-0.0001130	449.0342	-59.6120	119700.
120.000	0.002350	126116.	-716.6607	-9.9875E-05	446.5956	-49.3522	126000.
126.000	0.001790	121018.	-983.0978	-8.7229E-05	442.8388	-39.4602	132300.
132.000	0.001303	114487.	-1191.8010	-7.5179E-05	438.0265	-30.1075	138600.
138.000	0.000887	106861.	-1346.4182	-6.3852E-05	432.4073	-21.4315	144900.
144.000	0.000537	98452.3066	-1451.3197	-5.3347E-05	426.2119	-13.5356	151200.
150.000	0.000247	89547.1245	-1511.3991	-4.3727E-05	419.6503	-6.4909	157500.
156.000	1.24E-05	80399.4731	-1531.8874	-3.5031E-05	412.9100	-0.3385347	163800.
162.000	-0.000173	71231.7358	-1518.1806	-2.7272E-05	406.1549	4.9075	170100.
168.000	-0.000315	62233.6697	-1475.6866	-2.0443E-05	399.5249	9.2572	176400.
174.000	-0.000418	53562.7474	-1409.6922	-1.4518E-05	393.1359	12.7410	182700.
180.000	-0.000489	45345.2375	-1325.2507	-9.4571E-06	387.0810	15.4062	189000.
186.000	-0.000532	37677.8968	-1227.0912	-5.2089E-06	381.4315	17.3136	195300.
192.000	-0.000552	30630.1439	-1119.5498	-1.7137E-06	376.2385	18.5335	201600.
198.000	-0.000552	24246.5894	-1006.5197	1.0943E-06	371.5349	19.1431	207900.
204.000	-0.000538	18549.8061	-891.4210	3.2841E-06	367.3374	19.2231	214200.
210.000	-0.000513	13543.2320	-777.1866	4.9263E-06	363.6484	18.8550	220500.
216.000	-0.000479	9214.1089	-666.2635	6.0907E-06	360.4585	18.1193	226800.
222.000	-0.000440	5536.3756	-560.6267	6.8455E-06	357.7487	17.0930	233100.
228.000	-0.000397	2473.4453	-461.8029	7.2554E-06	355.4918	15.8483	239400.
234.000	-0.000353	-19.1890	-370.9031	7.3809E-06	353.6835	14.4516	245700.
240.000	-0.000309	-1991.5628	-288.6609	7.2781E-06	355.1368	12.9624	252000.
246.000	-0.000266	-3497.0933	-215.4749	6.9972E-06	356.2461	11.4329	258300.
252.000	-0.000225	-4590.6959	-151.4533	6.5834E-06	357.0519	9.9076	264600.
258.000	-0.000187	-5327.1727	-96.4592	6.0759E-06	357.5945	8.4237	270900.
264.000	-0.000152	-5759.8718	-50.1551	5.5086E-06	357.9134	7.0110	277200.
270.000	-0.000120	-5939.6105	-12.0457	4.9099E-06	358.0458	5.6922	283500.
276.000	-9.28E-05	-5913.8473	18.4824	4.3034E-06	358.0268	4.4838	289800.
282.000	-6.88E-05	-5726.0847	42.1240	3.7078E-06	357.8885	3.3967	296100.
288.000	-4.83E-05	-5415.4787	59.6230	3.1377E-06	357.6596	2.4363	302400.
294.000	-3.12E-05	-5016.6331	71.7440	2.6039E-06	357.3657	1.6040	308700.
300.000	-1.71E-05	-4559.5502	79.2482	2.1139E-06	357.0289	0.8973787	315000.
306.000	-5.81E-06	-4069.7137	82.8736	1.6724E-06	356.6680	0.3110917	321300.
312.000	2.98E-06	-3568.2780	83.3195	1.2815E-06	356.2985	-0.1624506	327600.
318.000	9.57E-06	-3072.3400	81.2346	9.4173E-07	355.9331	-0.5325110	333900.
324.000	1.43E-05	-2595.2706	77.2087	6.5173E-07	355.5816	-0.8094540	340200.
330.000	1.74E-05	-2147.0865	71.7676	4.0907E-07	355.2514	-1.0043	346500.
336.000	1.92E-05	-1734.8447	65.3706	2.1044E-07	354.9476	-1.1281	352800.
342.000	1.99E-05	-1363.0430	58.4107	5.1921E-08	354.6736	-1.1919	359100.
348.000	1.98E-05	-1034.0161	51.2161	-7.0734E-08	354.4312	-1.2063	365400.
354.000	1.91E-05	-748.3145	44.0537	-1.6193E-07	354.2207	-1.1811	371700.
360.000	1.79E-05	-505.0607	37.1338	-2.2607E-07	354.0415	-1.1255	378000.
366.000	1.64E-05	-302.2745	30.6151	-2.6738E-07	353.8920	-1.0474	384300.
372.000	1.47E-05	-137.1660	24.6105	-2.8986E-07	353.7704	-0.9541207	390600.
378.000	1.29E-05	-6.3924	19.1931	-2.9721E-07	353.6740	-0.8516776	396900.
384.000	1.11E-05	93.7214	14.4023	-2.9274E-07	353.7384	-0.7452299	403200.
390.000	9.36E-06	166.9977	10.2498	-2.7940E-07	353.7924	-0.6389609	409500.
396.000	7.74E-06	217.2551	6.7244	-2.5974E-07	353.8294	-0.5361699	415800.
402.000	6.25E-06	248.1889	3.7978	-2.3592E-07	353.8522	-0.4393508	422100.
408.000	4.91E-06	263.2818	1.4289	-2.0975E-07	353.8633	-0.3502800	428400.
414.000	3.73E-06	265.7387	-0.4322453	-1.8268E-07	353.8651	-0.2701090	434700.
420.000	2.71E-06	258.4456	-1.8409	-1.5586E-07	353.8597	-0.1994579	441000.
426.000	1.86E-06	243.9466	-2.8548	-1.3015E-07	353.8491	-0.1385068	447300.
432.000	1.15E-06	224.4374	-3.5316	-1.0619E-07	353.8347	-0.0870826	453600.
438.000	5.84E-07	201.7712	-3.9271	-8.4377E-08	353.8180	-0.0447389	459900.
444.000	1.39E-07	177.4746	-4.0938	-6.4972E-08	353.8001	-0.0108283	466200.
450.000	-1.96E-07	152.7707	-4.0800	-4.8073E-08	353.7819	0.0154336	472500.
456.000	-4.38E-07	128.6074	-3.9175	-3.3676E-08	353.7641	0.0387165	530945.
462.000	-6.00E-07	105.8252	-3.6399	-2.1680E-08	353.7473	0.0538225	538145.
468.000	-6.98E-07	84.9703	-3.2882	-1.1917E-08	353.7319	0.0634127	545345.
474.000	-7.43E-07	66.3899	-2.8927	-4.1724E-09	353.7182	0.0684324	552545.
480.000	-7.48E-07	50.2665	-2.4781	1.7968E-09	353.7064	0.0697581	559745.
486.000	-7.22E-07	36.6495	-2.0643	6.2442E-09	353.6963	0.0681785	566945.
492.000	-6.73E-07	25.4833	-1.6666	9.4234E-09	353.6881	0.0643826	574145.
498.000	-6.08E-07	16.6324	-1.2966	1.1578E-08	353.6816	0.0589537	581345.
504.000	-5.34E-07	9.9021	-0.9626100	1.2936E-08	353.6766	0.0523685	588545.
510.000	-4.53E-07	5.0562	-0.6705024	1.3702E-08	353.6730	0.0450007	595745.
516.000	-3.69E-07	1.8298	-0.4241185	1.4054E-08	353.6707	0.0371273	602945.
522.000	-2.85E-07	-0.0602093	-0.2259209	1.4144E-08	353.6694	0.0289386	610145.
528.000	-2.00E-07	-0.9084159	-0.0774552	1.4095E-08	353.6700	0.0205500	617345.
534.000	-1.15E-07	-1.0167	0.0202422	1.3996E-08	353.6701	0.0120158	624545.
540.000	-3.18E-08	-0.6923829	0.0663248	1.3909E-08	353.6698	0.0033451	631745.
546.000	5.15E-08	-0.2475418	0.0599163	1.3861E-08	353.6695	-0.0054812	638945.
552.000	1.35E-07	0.0000	0.0000	1.3848E-08	353.6693	-0.0144909	323073.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	0.02074852 in
Computed slope at pile head	=	2.891206E-19
Maximum bending moment	=	-471516.80563 lbs-in
Maximum shear force	=	10000.00000 lbs
Depth of maximum bending moment	=	0.00000 in
Depth of maximum shear force	=	0.00000 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 6

Pile-head boundary conditions are Shear and Slope (BC Type 2)

Specified shear force at pile head	=	40000.000 lbs
Specified slope at pile head	=	0.000E+00 in/in
Specified axial load at pile head	=	160000.000 lbs

(Zero slope for this load indicates fixed-head conditions)

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	Es*h F/L lbs/in
0.000	0.103436	-2053275.	40000.0000	-2.3130E-18	1866.5822	0.0000	0.0000
6.000	0.102806	-1813174.	39842.7197	-0.0001978	1689.6688	-52.4268	3059.7505
12.000	0.101062	-1574782.	39343.2336	-0.0003712	1514.0149	-114.0686	6772.1744
18.000	0.098352	-1340343.	38455.2279	-0.0005204	1341.2728	-181.9333	11098.9540
24.000	0.094818	-1112321.	37161.4311	-0.0006459	1173.2596	-249.3323	15777.5366
30.000	0.090601	-893165.	35471.7496	-0.0007485	1011.7796	-313.8949	20787.4469
36.000	0.085836	-685222.	33422.6093	-0.0008292	858.5612	-369.1519	25803.9328
42.000	0.080650	-490502.	31056.6775	-0.0008894	715.0854	-419.4921	31208.1967
48.000	0.075163	-310835.	28431.0460	-0.0009304	582.7014	-455.7184	36378.2426
54.000	0.069485	-147543.	25604.0856	-0.0009539	462.3832	-486.6017	42017.5580
60.000	0.063717	-1754.2677	22639.8808	-0.0009615	354.9619	-501.4666	47221.2889
66.000	0.057947	125982.	19634.7492	-0.0009551	446.4963	-500.2440	51796.2880
72.000	0.052255	235697.	16694.8121	-0.0009366	527.3375	-479.7351	55083.6264
78.000	0.046708	328118.	13870.7822	-0.0009078	595.4361	-461.6082	59297.3422
84.000	0.041362	403889.	11201.1878	-0.0008703	651.2665	-428.2565	62123.4499
90.000	0.036264	464203.	8773.2129	-0.0008259	695.7077	-381.0684	63049.3365
96.000	0.031451	510753.	6661.9105	-0.0007760	730.0072	-322.6990	61562.5051
102.000	0.026952	545636.	4747.2591	-0.0007220	755.7099	-315.5181	70241.2512
108.000	0.022787	569107.	2892.1476	-0.0006649	773.0036	-302.8524	79742.7369
114.000	0.018972	581618.	1128.5565	-0.0006061	782.2228	-285.0113	90134.7851
120.000	0.015515	583813.	-513.8928	-0.0005464	783.8397	-262.4718	101506.
126.000	0.012415	576501.	-2053.6818	-0.0004870	778.4520	-250.7912	121201.
132.000	0.009670	560104.	-3476.1902	-0.0004289	766.3701	-223.3783	138600.
138.000	0.007269	535610.	-4672.9418	-0.0003728	748.3224	-175.5389	144900.
144.000	0.005196	504744.	-5592.3920	-0.0003196	725.5796	-130.9444	151200.
150.000	0.003434	469115.	-6255.6252	-0.0002698	699.3269	-90.1333	157500.
156.000	0.001959	430195.	-6686.4784	-0.0002237	670.6493	-53.4845	163800.
162.000	0.000749	389307.	-6910.6152	-0.0001818	640.5219	-21.2278	170100.
168.000	-0.000223	347616.	-6954.6705	-0.0001441	609.8032	6.5427	176400.
174.000	-0.000980	306127.	-6845.4816	-0.0001106	579.2329	29.8536	182700.
180.000	-0.001550	265683.	-6609.4159	-8.1389E-05	549.4324	48.8350	189000.

186.000	-0.001957	226971.	-6271.8018	-5.6181E-05	520.9079	63.7031	195300.
192.000	-0.002224	190529.	-5856.4645	-3.4818E-05	494.0569	74.7427	201600.
198.000	-0.002375	156760.	-5385.3658	-1.7047E-05	469.1746	82.2902	207900.
204.000	-0.002429	125938.	-4878.3436	-2.5822E-06	446.4639	86.7172	214200.
210.000	-0.002406	98224.8059	-4352.9433	8.8879E-06	426.0442	88.4162	220500.
216.000	-0.002322	73685.2800	-3824.3347	1.7684E-05	407.9628	87.7867	226800.
222.000	-0.002194	52298.8356	-3305.3023	2.4131E-05	392.2046	85.2241	233100.
228.000	-0.002033	33975.3210	-2806.3003	2.8545E-05	378.7033	81.1099	239400.
234.000	-0.001851	18568.4249	-2335.5597	3.1234E-05	367.3511	75.8036	245700.
240.000	-0.001658	5888.6356	-1899.2379	3.2485E-05	358.0082	69.6369	252000.
246.000	-0.001461	-4284.8023	-1501.5999	3.2567E-05	356.8265	62.9091	258300.
252.000	-0.001267	-12193.0925	-1145.2203	3.1724E-05	362.6535	55.8841	264600.
258.000	-0.001081	-18088.3569	-831.1992	3.0175E-05	366.9973	48.7896	270900.
264.000	-0.000905	-22225.4187	-559.3814	2.8112E-05	370.0457	41.8163	277200.
270.000	-0.000743	-24854.9086	-328.5742	2.5703E-05	371.9831	35.1194	283500.
276.000	-0.000597	-26217.6591	-136.7572	2.3090E-05	372.9873	28.8197	289800.
282.000	-0.000466	-26540.3265	18.7214	2.0390E-05	373.2250	23.0065	296100.
288.000	-0.000352	-26032.1509	140.9633	1.7700E-05	372.8506	17.7408	302400.
294.000	-0.000254	-24882.7508	233.3582	1.5095E-05	372.0037	13.0575	308700.
300.000	-0.000171	-23260.8344	299.4416	1.2631E-05	370.8086	8.9702	315000.
306.000	-0.000102	-21313.7042	342.7731	1.0351E-05	369.3739	5.4736	321300.
312.000	-4.67E-05	-19167.4299	366.8361	8.2791E-06	367.7924	2.5474	327600.
318.000	-2.87E-06	-16927.5665	374.9567	6.4322E-06	366.1420	0.1594518	333900.
324.000	3.05E-05	-14680.2998	370.2417	4.8149E-06	364.4862	-1.7311	340200.
330.000	5.49E-05	-12493.9108	355.5346	3.4244E-06	362.8752	-3.1712	346500.
336.000	7.16E-05	-10420.4591	333.3864	2.2519E-06	361.3474	-4.2115	352800.
342.000	8.19E-05	-8497.5973	306.0403	1.2839E-06	359.9306	-4.9039	359100.
348.000	8.70E-05	-6750.4404	275.4281	5.0368E-07	358.6432	-5.3002	365400.
354.000	8.80E-05	-5193.4267	243.1765	-1.0747E-07	357.4960	-5.4504	371700.
360.000	8.57E-05	-3832.1166	210.6202	-5.6930E-07	356.4929	-5.4017	378000.
366.000	8.11E-05	-2664.8909	178.8224	-9.0174E-07	355.6329	-5.1976	384300.
372.000	7.49E-05	-1684.5162	148.5978	-1.1243E-06	354.9105	-4.8773	390600.
378.000	6.77E-05	-879.5590	120.5393	-1.2555E-06	354.3174	-4.4755	396900.
384.000	5.99E-05	-235.6343	95.0461	-1.3126E-06	353.8429	-4.0222	403200.
390.000	5.19E-05	263.5142	72.3516	-1.3111E-06	353.8635	-3.5426	409500.
396.000	4.41E-05	635.1024	52.5511	-1.2652E-06	354.1373	-3.0576	415800.
402.000	3.67E-05	896.5561	35.6276	-1.1868E-06	354.3299	-2.5836	422100.
408.000	2.99E-05	1064.9127	21.4767	-1.0864E-06	354.4540	-2.1334	428400.
414.000	2.37E-05	1156.3629	9.9281	-9.7275E-07	354.5214	-1.7162	434700.
420.000	1.82E-05	1185.9172	0.7650548	-8.5290E-07	354.5431	-1.3382	441000.
426.000	1.35E-05	1167.1812	-6.2582	-7.3250E-07	354.5293	-1.0029	447300.
432.000	9.42E-06	1112.2255	-11.4025	-6.1586E-07	354.4888	-0.7118715	453600.
438.000	6.06E-06	1031.5332	-14.9322	-5.0617E-07	354.4294	-0.4646969	459900.
444.000	3.34E-06	934.0105	-17.1054	-4.0559E-07	354.3575	-0.2596935	466200.
450.000	1.20E-06	827.0470	-18.1669	-3.1548E-07	354.2787	-0.0941411	472500.
456.000	-4.44E-07	716.6132	-18.3316	-2.3650E-07	354.1973	0.0392500	530945.
462.000	-1.64E-06	607.5220	-17.7719	-1.6874E-07	354.1170	0.1473190	538145.
468.000	-2.47E-06	503.6746	-16.6568	-1.1188E-07	354.0404	0.2243603	545345.
474.000	-2.99E-06	407.8547	-15.1591	-6.5242E-08	353.9698	0.2749031	552545.
480.000	-3.25E-06	321.8912	-13.4244	-2.7902E-08	353.9065	0.3033228	559745.
486.000	-3.32E-06	246.8158	-11.5733	1.1978E-09	353.8512	0.3137055	566945.
492.000	-3.24E-06	183.0095	-9.7029	2.3191E-08	353.8042	0.3097507	574145.
498.000	-3.04E-06	130.3362	-7.8895	3.9225E-08	353.7654	0.2947090	581345.
504.000	-2.77E-06	88.2596	-6.1914	5.0410E-08	353.7344	0.2713483	588545.
510.000	-2.44E-06	55.9429	-4.6515	5.7789E-08	353.7105	0.2419458	595745.
516.000	-2.07E-06	32.3308	-3.3008	6.2306E-08	353.6931	0.2083005	602945.
522.000	-1.69E-06	16.2143	-2.1606	6.4790E-08	353.6813	0.1717630	610145.
528.000	-1.30E-06	6.2797	-1.2454	6.5941E-08	353.6739	0.1332802	617345.
534.000	-8.98E-07	1.1425	-0.5652363	6.6320E-08	353.6702	0.0934511	624545.
540.000	-5.00E-07	-0.6304843	-0.1271014	6.6347E-08	353.6698	0.0525939	631745.
546.000	-1.02E-07	-0.5100648	0.0631465	6.6288E-08	353.6697	0.0108221	638945.
552.000	2.96E-07	0.0000	0.0000	6.6262E-08	353.6693	-0.0318709	323073.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection = 0.10343638 in
Computed slope at pile head = -2.312965E-18
Maximum bending moment = -2053275. lbs-in
Maximum shear force = 40000.00000 lbs
Depth of maximum bending moment = 0.00000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 13
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 Shear and Slope (BC Type 2)
Specified shear force at pile head = 80000.000 lbs
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 160000.000 lbs

(Zero slope for this load indicates fixed-head conditions)

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	Es*h F/L lbs/in
0.000	0.316791	-4817542.	80000.0000	-3.7007E-17	3903.3751	0.0000	0.0000
6.000	0.315312	-4337306.	79787.1429	-0.0004684	3549.5228	-70.9524	1350.1363
12.000	0.311170	-3859197.	79103.2473	-0.0008878	3197.2385	-157.0128	3027.5344
18.000	0.304658	-3386362.	77874.9758	-0.0012586	2848.8397	-252.4110	4971.0383
24.000	0.296067	-2922281.	76069.8691	-0.0015814	2506.8913	-349.2913	7078.6349
30.000	0.285681	-2470487.	73690.3056	-0.0018573	2173.9965	-443.8965	9322.9106
36.000	0.273779	-2034431.	70774.4756	-0.0020878	1852.6977	-528.0468	11572.4201
42.000	0.260627	-1617185.	67364.6027	-0.0022747	1545.2584	-608.5775	14010.3142
48.000	0.246482	-1221689.	63521.5171	-0.0024200	1253.8452	-672.4511	16369.1578
54.000	0.231587	-850281.	59319.0937	-0.0025260	980.1808	-728.3567	18870.3709
60.000	0.216170	-505010.	54843.4090	-0.0025953	725.7752	-763.5382	21192.6676
66.000	0.200443	-187177.	50186.7707	-0.0026307	491.5865	-788.6745	23607.8879
72.000	0.184602	102283.	45453.4073	-0.0026351	429.0341	-789.1133	25648.1034
78.000	0.168822	363324.	40688.8928	-0.0026113	621.3768	-799.0582	28398.7733
84.000	0.153266	595563.	35930.9788	-0.0025622	792.4975	-786.9131	30805.7036
90.000	0.138076	799415.	31316.1292	-0.0024908	942.7015	-751.3701	32650.2811
96.000	0.123377	976139.	26985.0777	-0.0024000	1072.9169	-692.3137	33668.3330
102.000	0.109276	1127844.	22805.0290	-0.0022923	1184.6975	-701.0359	38491.5220
108.000	0.095869	1254200.	18603.8339	-0.0021704	1277.8008	-699.3625	43769.9678
114.000	0.083231	1355257.	14444.6275	-0.0020369	1352.2622	-687.0396	49527.4779
120.000	0.071426	1431447.	10391.1796	-0.0018943	1408.4011	-664.1097	55787.2175
126.000	0.060500	1483588.	6428.2730	-0.0017452	1446.8204	-656.8592	65143.4690
132.000	0.050484	1511937.	2533.7848	-0.0015919	1467.7085	-641.3035	76218.3247
138.000	0.041397	1517050.	-1241.9986	-0.0014369	1471.4760	-617.2909	89468.6304
144.000	0.033242	1499792.	-4848.0563	-0.0012825	1458.7596	-584.7283	105542.
150.000	0.026007	1461336.	-8232.8495	-0.0011310	1430.4241	-543.5361	125398.
156.000	0.019670	1403169.	-11344.1541	-0.0009844	1387.5652	-493.5654	150557.
162.000	0.014194	1327096.	-14032.0361	-0.0008447	1331.5124	-402.3952	170100.
168.000	0.009533	1236406.	-16080.0268	-0.0007136	1264.6896	-280.2684	176400.
174.000	0.005631	1135506.	-17435.2441	-0.0005922	1190.3430	-171.4707	182700.
180.000	0.002427	1028320.	-18178.9830	-0.0004815	1111.3658	-76.4422	189000.
186.000	-0.000146	918282.	-18394.0200	-0.0003819	1030.2865	4.7632	195300.
192.000	-0.002156	808325.	-18162.4499	-0.0002935	949.2671	72.4268	201600.
198.000	-0.003668	700896.	-17563.8337	-0.0002163	870.1103	127.1119	207900.
204.000	-0.004751	597975.	-16673.6682	-0.0001498	794.2745	169.6100	214200.
210.000	-0.005466	501100.	-15562.1750	-9.3585E-05	722.8945	200.8878	220500.
216.000	-0.005874	411408.	-14293.4000	-4.6893E-05	656.8069	222.0372	226800.
222.000	-0.006029	329669.	-12924.6021	-8.9733E-06	596.5793	234.2287	233100.
228.000	-0.005982	256330.	-11505.9087	2.1011E-05	542.5409	238.6691	239400.
234.000	-0.005777	191558.	-10080.2074	4.3929E-05	494.8149	236.5647	245700.
240.000	-0.005455	135283.	-8683.2428	6.0653E-05	453.3501	229.0902	252000.
246.000	-0.005049	87242.7075	-7343.8842	7.2040E-05	417.9523	217.3627	258300.
252.000	-0.004590	47018.4865	-6084.5324	7.8910E-05	388.3139	202.4213	264600.
258.000	-0.004102	14076.8117	-4921.6314	8.2036E-05	364.0415	185.2124	270900.
264.000	-0.003606	-12198.5993	-3866.2552	8.2132E-05	362.6576	166.5797	277200.
270.000	-0.003117	-32475.9444	-2924.7420	7.9846E-05	377.5985	147.2581	283500.
276.000	-0.002647	-47448.8078	-2099.3497	7.5756E-05	388.6310	127.8727	289800.
282.000	-0.002207	-57813.5937	-1388.9120	7.0370E-05	396.2681	108.9399	296100.

288.000	-0.001803	-64250.8625	-789.4750	6.4124E-05	401.0112	90.8724	302400.
294.000	-0.001438	-67410.4131	-294.9021	5.7387E-05	403.3393	73.9852	308700.
300.000	-0.001114	-67899.8722	102.5675	5.0464E-05	403.6999	58.5046	315000.
306.000	-0.000832	-66276.4942	411.8123	4.3598E-05	402.5038	44.5770	321300.
312.000	-0.000591	-63041.8333	642.3810	3.6981E-05	400.1204	32.2793	327600.
318.000	-0.000389	-58638.9256	804.1061	3.0755E-05	396.8762	21.6291	333900.
324.000	-0.000222	-53451.6097	906.7787	2.5019E-05	393.0540	12.5951	340200.
330.000	-8.84E-05	-47805.6179	959.8847	1.9838E-05	388.8939	5.1068	346500.
336.000	1.59E-05	-41971.0830	972.3966	1.5244E-05	384.5948	-0.9362108	352800.
342.000	9.45E-05	-36166.1283	952.6199	1.1246E-05	380.3176	-5.6560	359100.
348.000	0.000151	-30561.2364	908.0867	7.8319E-06	376.1877	-9.1884	365400.
354.000	0.000188	-25284.1247	845.4914	4.9744E-06	372.2994	-11.6767	371700.
360.000	0.000211	-20424.8898	770.6638	2.6355E-06	368.7190	-13.2659	378000.
366.000	0.000220	-16041.2196	688.5717	7.6957E-07	365.4890	-14.0981	384300.
372.000	0.000220	-12163.5067	603.3495	-6.7363E-07	362.6317	-14.3093	390600.
378.000	0.000212	-8799.7320	518.3448	-1.7463E-06	360.1532	-14.0257	396900.
384.000	0.000199	-5940.0164	436.1799	-2.5005E-06	358.0461	-13.3626	403200.
390.000	0.000182	-3560.7721	358.8230	-2.9866E-06	356.2930	-12.4230	409500.
396.000	0.000163	-1628.4061	287.6644	-3.2522E-06	354.8692	-11.2965	415800.
402.000	0.000143	-102.5549	223.5955	-3.3407E-06	353.7449	-10.0598	422100.
408.000	0.000123	1061.1546	167.0868	-3.2917E-06	354.4512	-8.7765	428400.
414.000	0.000103	1908.8061	118.2625	-3.1397E-06	355.0758	-7.4983	434700.
420.000	8.52E-05	2486.3326	76.9715	-2.9148E-06	355.5013	-6.2654	441000.
426.000	6.85E-05	2838.0606	42.8513	-2.6424E-06	355.7605	-5.1080	447300.
432.000	5.35E-05	3005.6217	15.3856	-2.3434E-06	355.8839	-4.0472	453600.
438.000	4.04E-05	3027.1873	-6.0454	-2.0347E-06	355.8998	-3.0965	459900.
444.000	2.91E-05	2936.9830	-22.1224	-1.7295E-06	355.8334	-2.2625	466200.
450.000	1.96E-05	2765.0395	-33.5507	-1.4377E-06	355.7067	-1.5469	472500.
456.000	1.19E-05	2537.1356	-41.3414	-1.1664E-06	355.5388	-1.0500	530945.
462.000	5.65E-06	2271.1819	-46.0107	-9.2040E-07	355.3428	-0.5064063	538145.
468.000	8.21E-07	1986.7745	-47.7538	-7.0252E-07	355.1332	-0.0746245	545345.
474.000	-2.78E-06	1699.4854	-47.2085	-5.1390E-07	354.9215	0.2563933	552545.
480.000	-5.35E-06	1421.2595	-44.9432	-3.5422E-07	354.7165	0.4987122	559745.
486.000	-7.03E-06	1160.8476	-41.4529	-2.2209E-07	354.5247	0.6647181	566945.
492.000	-8.01E-06	924.2515	-37.1590	-1.1540E-07	354.3503	0.7665701	574145.
498.000	-8.42E-06	715.1612	-32.4120	-3.1515E-08	354.1963	0.8157781	581345.
504.000	-8.39E-06	535.3685	-27.4959	3.2473E-08	354.0638	0.8228926	588545.
510.000	-8.03E-06	385.1475	-22.6354	7.9574E-08	353.9531	0.7972942	595745.
516.000	-7.43E-06	263.5911	-18.0023	1.1277E-07	353.8635	0.7470686	602945.
522.000	-6.68E-06	168.9034	-13.7242	1.3490E-07	353.7938	0.6789546	610145.
528.000	-5.82E-06	98.6414	-9.8923	1.4859E-07	353.7420	0.5983515	617345.
534.000	-4.89E-06	49.9104	-6.5691	1.5619E-07	353.7061	0.5093769	624545.
540.000	-3.94E-06	19.5120	-3.7961	1.5974E-07	353.6837	0.4149631	631745.
546.000	-2.98E-06	4.0504	-1.6003	1.6095E-07	353.6723	0.3169876	638945.
552.000	-2.01E-06	0.0000	0.0000	1.6116E-07	353.6693	0.2164296	323073.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

```
Pile-head deflection             =     0.31679104 in
Computed slope at pile head      =  -3.700743E-17
Maximum bending moment           =      -4817542. lbs-in
Maximum shear force              =    80000.00000 lbs
Depth of maximum bending moment  =        0.00000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =             15
Number of zero deflection points =              3
```

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
2	V= 5000.000	S= 0.000	160000.	0.0103743	-235758.	5000.0000
2	V= 10000.	S= 0.000	160000.	0.0207485	-471517.	10000.0000
2	V= 20000.	S= 0.000	160000.	0.0415378	-943583.	20000.0000
2	V= 25000.	S= 0.000	160000.	0.0523668	-1185229.	25000.0000
2	V= 30000.	S= 0.000	160000.	0.0645378	-1440789.	30000.0000
2	V= 40000.	S= 0.000	160000.	0.1034364	-2053275.	40000.0000
2	V= 50000.	S= 0.000	160000.	0.1495810	-2707701.	50000.0000
2	V= 60000.	S= 0.000	160000.	0.2009705	-3389651.	60000.0000
2	V= 70000.	S= 0.000	160000.	0.2568820	-4094112.	70000.0000
2	V= 80000.	S= 0.000	160000.	0.3167910	-4817542.	80000.0000

Pile-head Deflection vs. Pile Length

Boundary Condition Type 2, Shear and Slope

```
Shear      =          5000. lbs
Slope      =       0.00000
Axial Load =        160000. lbs
```

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
552.000	0.01037426	-235758.40281	5000.00000
524.400	0.01037082	-235740.06093	5000.00000
496.800	0.01036756	-235722.67624	5000.00000
469.200	0.01036447	-235706.25124	5000.00000
441.600	0.01036157	-235690.80887	5000.00000
414.000	0.01035884	-235676.34019	5000.00000
386.400	0.01035630	-235662.59519	5000.00000
358.800	0.01035404	-235649.46179	5000.00000
331.200	0.01035243	-235640.62187	5000.00000
303.600	0.01035171	-235648.05894	5000.00000

This analysis ended normally.

BENT 2
EXTREME

```
================================================================================

               LPILE Plus for Windows, Version 5.0 (5.0.41)

             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:

Geotech SJ
URS

Path to file locations:      X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\Arroyo
Del Valle Trial Bridge\
Name of input data file:     Arroyo Del Valle Trial Bridge_Bent 2_ Free_scour_rev 3
20141105.lpd
Name of output file:         Arroyo Del Valle Trial Bridge_Bent 2_ Free_scour_rev 3
20141105.lpo
Name of plot output file:    Arroyo Del Valle Trial Bridge_Bent 2_ Free_scour_rev 3
20141105.lpp
Name of runtime file:        Arroyo Del Valle Trial Bridge_Bent 2_ Free_scour_rev 3
20141105.lpr


--------------------------------------------------------------------------------
                         Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  December 18, 2014     Time:  12:01:08


--------------------------------------------------------------------------------
                               Problem Title
--------------------------------------------------------------------------------

SR84 Isabel Bent 2- Arroyo Del Valle Trial Bridge- 24 inch CIDH 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
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments           =          83
- 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                                 =     498.00 in

Depth of ground surface below top of pile =     -60.00 in

Slope angle of ground surface               =       0.00 deg.

Structural properties of pile defined using  2 points

Point    Depth          Pile       Moment of       Pile       Modulus of
           X          Diameter      Inertia        Area       Elasticity
          in             in          in**4        Sq.in        lbs/Sq.in
-----  ---------   -----------   ----------   ----------   -----------
  1       0.0000   24.00000000   16286.0000     452.4000      3600000.
  2     498.0000   24.00000000   16286.0000     452.4000      3600000.


--------------------------------------------------------------------------------
                      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    =      -60.000 in
Distance from top of pile to bottom of layer =      468.000 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    =      468.000 in
Distance from top of pile to bottom of layer =      528.000 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  3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      528.000 in
Distance from top of pile to bottom of layer =      708.000 in
p-y subgrade modulus k for top of soil layer =      175.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      175.000 lbs/in**3

Layer  4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      708.000 in
Distance from top of pile to bottom of layer =     1194.000 in
p-y subgrade modulus k for top of soil layer =      200.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      200.000 lbs/in**3


(Depth of lowest layer extends  696.00 in below pile tip)


--------------------------------------------------------------------------------
                    Effective Unit Weight of Soil vs. Depth
--------------------------------------------------------------------------------

Effective unit weight of soil with depth defined using  8 points

Point        Depth X    Eff. Unit Weight
 No.           in          lbs/in**3
-----      ----------   ----------------
  1          -60.00        0.03620
```

2	468.00	0.03620
3	468.00	0.02750
4	528.00	0.02750
5	528.00	0.04490
6	708.00	0.04490
7	708.00	0.04780
8	1194.00	0.04780

Shear Strength of Soils

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	-60.000	0.00000	38.00	------	------
2	468.000	0.00000	38.00	------	------
3	468.000	0.00000	32.00	------	------
4	528.000	0.00000	32.00	------	------
5	528.000	0.00000	40.00	------	------
6	708.000	0.00000	40.00	------	------
7	708.000	0.00000	42.00	------	------
8	1194.000	0.00000	42.00	------	------

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.

Loading Type

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 Shear and Moment (BC Type 1)
Shear force at pile head = 60000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 240000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 2

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 10000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 240000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 3

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 15000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 240000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 4

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 20000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 240000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 5

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 25000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 240000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 6

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 30000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 240000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 7

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 35000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 240000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 8

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 40000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 240000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 9

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 50000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 240000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 10

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 70000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 240000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Computed Values of Load Distribution and Deflection

for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Specified shear force at pile head = 60000.000 lbs
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 240000.000 lbs

(Zero moment for this load indicates free-head conditions)

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	Es*h F/L lbs/in
0.000	0.474759	1.6273E-06	60000.0000	-0.0053894	530.5040	-650.9026	4113.0517
6.000	0.442422	356045.	55997.7159	-0.0053712	792.8480	-683.1921	9265.2503
12.000	0.410304	687442.	51851.5923	-0.0053178	1037.0311	-698.8490	10219.4760
18.000	0.378608	993579.	47570.2113	-0.0052318	1262.6020	-728.2780	11541.3936
24.000	0.347523	1273352.	43158.5831	-0.0051158	1468.7468	-742.2647	12815.2514
30.000	0.317219	1526216.	38716.1028	-0.0049726	1655.0641	-738.5620	13969.4600
36.000	0.287852	1752266.	34354.3441	-0.0048048	1821.6247	-715.3576	14910.9575
42.000	0.259561	1952306.	29992.3512	-0.0046152	1969.0196	-738.6401	17074.3770
48.000	0.232469	2125466.	25516.8282	-0.0044066	2096.6095	-753.2009	19440.0554
54.000	0.206682	2271198.	20982.0285	-0.0041816	2203.9893	-758.3990	22016.4291
60.000	0.182289	2389294.	16445.4814	-0.0039432	2291.0052	-753.7834	24810.5685
66.000	0.159364	2479900.	11905.2316	-0.0036940	2357.7670	-759.6332	28599.9455
72.000	0.137961	2542795.	7352.2008	-0.0034370	2404.1096	-758.0438	32967.6819
78.000	0.118120	2578025.	2831.8584	-0.0031750	2430.0684	-748.7370	38032.7179
84.000	0.099862	2585921.	-1608.8429	-0.0029107	2435.8863	-731.4967	43950.6365
90.000	0.083191	2567102.	-5921.8029	-0.0026471	2422.0198	-706.1566	50930.2269
96.000	0.068097	2522483.	-10058.0089	-0.0023866	2389.1432	-672.5787	59260.8259
102.000	0.054551	2453280.	-13967.5944	-0.0021320	2338.1520	-630.6164	69360.2460
108.000	0.042512	2361012.	-17599.5897	-0.0018857	2270.1668	-580.0487	81865.3902
114.000	0.031923	2247515.	-20839.4816	-0.0016499	2186.5389	-499.9153	93960.0000
120.000	0.022714	2115690.	-23443.1178	-0.0014266	2089.4063	-367.9635	97200.0000
126.000	0.014804	1970307.	-25290.4451	-0.0012175	1982.2834	-247.8123	100440.
132.000	0.008103	1815711.	-26453.9533	-0.0010238	1868.3732	-140.0238	103680.
138.000	0.002518	1655808.	-27008.6232	-0.0008462	1750.5515	-44.8662	106920.
144.000	-0.002051	1494045.	-27030.2509	-0.0006850	1631.3599	37.6570	110160.
150.000	-0.005702	1333418.	-26593.9520	-0.0005403	1513.0050	107.7760	113400.
156.000	-0.008535	1176474.	-25772.8584	-0.0004119	1397.3642	165.9219	116640.
162.000	-0.010645	1025330.	-24637.0108	-0.0002992	1285.9968	212.6939	119880.
168.000	-0.012126	881691.	-23252.4508	-0.0002017	1180.1600	248.8261	123120.
174.000	-0.013065	746881.	-21680.5048	-0.0001183	1080.8277	275.1559	126360.
180.000	-0.013546	621866.	-19977.2538	-4.8297E-05	988.7131	292.5944	129600.
186.000	-0.013645	507293.	-18193.1765	9.4805E-06	904.2923	302.0980	132840.
192.000	-0.013432	403521.	-16372.9507	5.6086E-05	827.8299	304.6439	136080.
198.000	-0.012972	310656.	-14555.3986	9.2629E-05	759.4045	301.2068	139320.
204.000	-0.012321	228589.	-12773.5573	0.0001202	698.9352	292.7403	142560.
210.000	-0.011529	157027.	-11054.8570	0.0001400	646.2062	280.1598	145800.
216.000	-0.010641	95527.8660	-9421.3894	0.0001529	600.8917	264.3294	149040.
222.000	-0.009695	43530.2793	-7890.2469	0.0001600	562.5784	246.0514	152280.
228.000	-0.008721	384.1281	-6473.9179	0.0001622	530.7870	226.0583	155520.
234.000	-0.007748	-34623.9825	-5180.7201	0.0001605	556.0159	205.0077	158760.
240.000	-0.006796	-62246.7139	-4015.2579	0.0001555	576.3692	183.4797	162000.
246.000	-0.005881	-83255.0028	-2978.8912	0.0001481	591.8487	161.9759	165240.
252.000	-0.005019	-98419.8917	-2070.2027	0.0001388	603.0226	140.9203	168480.
258.000	-0.004216	-108497.	-1285.4549	0.0001282	610.4478	120.6623	171720.
264.000	-0.003480	-114215.	-619.0273	0.0001168	614.6606	101.4802	174960.
270.000	-0.002814	-116262.	-63.8278	0.0001050	616.1691	83.5863	178200.
276.000	-0.002220	-115283.	388.3271	9.3164E-05	615.4478	67.1320	181440.
282.000	-0.001696	-111870.	746.3674	8.1541E-05	612.9333	52.2147	184680.
288.000	-0.001241	-106561.	1019.6614	7.0364E-05	609.0215	38.8833	187920.
294.000	-0.000852	-99836.9714	1217.7469	5.9803E-05	604.0668	27.1452	191160.
300.000	-0.000524	-92120.6356	1350.1008	4.9981E-05	598.3812	16.9727	194400.
306.000	-0.000252	-83779.7063	1425.9461	4.0980E-05	592.2353	8.3090	197640.
312.000	-3.21E-05	-75127.3055	1454.0961	3.2849E-05	585.8600	1.0743	200880.
318.000	0.000142	-66425.1580	1442.8326	2.5606E-05	579.4480	-4.8288	204120.
324.000	0.000275	-57887.0595	1399.8151	1.9245E-05	573.1569	-9.5103	207360.
330.000	0.000373	-49682.8025	1332.0196	1.3741E-05	567.1117	-13.0882	210600.
336.000	0.000440	-41942.3974	1245.7025	9.0525E-06	561.4084	-15.6842	213840.
342.000	0.000482	-34760.4438	1146.3865	5.1277E-06	556.1165	-17.4211	217080.
348.000	0.000502	-28200.5276	1038.8661	1.9061E-06	551.2830	-18.4190	220320.
354.000	0.000504	-22299.5398	927.2289	-6.7791E-07	546.9349	-18.7934	223560.
360.000	0.000493	-17071.8284	814.8890	-2.6925E-06	543.0830	-18.6532	226800.
366.000	0.000472	-12513.1178	704.6311	-4.2063E-06	539.7240	-18.0994	230040.
372.000	0.000443	-8604.1411	598.6619	-5.2869E-06	536.8438	-17.2237	233280.
378.000	0.000409	-5313.9494	498.6658	-5.9990E-06	534.4195	-16.1083	236520.
384.000	0.000371	-2602.8746	405.8643	-6.4041E-06	532.4219	-14.8255	239760.
390.000	0.000332	-425.1335	321.0761	-6.5591E-06	530.8172	-13.4373	243000.
396.000	0.000292	1268.9290	244.7765	-6.5159E-06	531.4390	-11.9960	246240.
402.000	0.000254	2530.9499	177.1553	-6.3214E-06	532.3689	-10.5444	249480.
408.000	0.000216	3412.9986	118.1725	-6.0173E-06	533.0188	-9.1165	252720.
414.000	0.000181	3966.3492	67.6091	-5.6397E-06	533.4265	-7.7379	255960.
420.000	0.000149	4240.5498	25.1153	-5.2198E-06	533.6285	-6.4267	259200.
426.000	0.000119	4282.7656	-9.7469	-4.7836E-06	533.6596	-5.1941	262440.
432.000	9.14E-05	4137.3637	-37.4656	-4.3528E-06	533.5525	-4.0455	265680.
438.000	6.65E-05	3845.7143	-58.5457	-3.9443E-06	533.3376	-2.9812	268920.
444.000	4.40E-05	3446.1747	-73.4809	-3.5712E-06	533.0432	-1.9972	272160.
450.000	2.37E-05	2974.2282	-82.7306	-3.2427E-06	532.6955	-1.0860	275400.
456.000	5.12E-06	2462.7463	-86.7017	-2.9645E-06	532.3186	-0.2376710	278640.
462.000	-1.19E-05	1942.3454	-85.7357	-2.7391E-06	531.9352	0.5596695	281880.
468.000	-2.78E-05	1441.8064	-80.6375	-2.5659E-06	531.5663	1.1397	246416.
474.000	-4.27E-05	982.0847	-71.9108	-2.4419E-06	531.2276	1.7692	248576.
480.000	-5.71E-05	585.9091	-59.4505	-2.3616E-06	530.9357	2.3842	250736.
486.000	-7.10E-05	275.4797	-43.3145	-2.3176E-06	530.7070	2.9944	252896.
492.000	-8.49E-05	72.8096	-23.5086	-2.2997E-06	530.5576	3.6075	255056.
498.000	-9.86E-05	0.0000	0.0000	-2.2960E-06	530.5040	4.2287	128608.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.47475886 in
Computed slope at pile head = -0.00538944
Maximum bending moment = 2585921. lbs-in
Maximum shear force = 60000.00000 lbs
Depth of maximum bending moment = 84.00000000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 14
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 Shear and Moment (BC Type 1)
Specified shear force at pile head = 30000.000 lbs
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 240000.000 lbs

(Zero moment for this load indicates free-head conditions)

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	Es*h F/L lbs/in
0.000	0.167024	-9.0405E-07	30000.0000	-0.0020765	530.5040	-452.8012	8133.0062
6.000	0.154565	174840.	27249.7416	-0.0020676	659.3310	-463.9516	18010.0161
12.000	0.142213	332951.	24477.4815	-0.0020416	775.8323	-460.1351	19413.2321
18.000	0.130066	474449.	21712.6911	-0.0020003	880.0920	-461.4617	21287.4901
24.000	0.118210	599265.	18978.9002	-0.0019453	972.0596	-449.8020	22830.7192
30.000	0.106722	707799.	16355.2238	-0.0018784	1052.0306	-424.7568	23880.2465
36.000	0.095668	800937.	13920.9200	-0.0018012	1120.6578	-386.6778	24251.1360
42.000	0.085107	880037.	11587.7098	-0.0017152	1178.9411	-391.0590	27569.5176
48.000	0.075086	944930.	9244.6754	-0.0016218	1226.7556	-389.9525	31160.6294
54.000	0.065645	995644.	6925.0254	-0.0015226	1264.1237	-383.2641	35030.8105
60.000	0.056815	1032415.	4662.0996	-0.0014188	1291.2173	-371.0444	39184.4836
66.000	0.048619	1055676.	2441.6778	-0.0013119	1308.3565	-369.0962	45549.3367
72.000	0.041072	1065493.	245.7417	-0.0012034	1315.5905	-362.8826	53011.9198
78.000	0.034179	1062090.	-1899.7488	-0.0010945	1313.0830	-352.2809	61842.4549

84.000	0.027937	1045849.	-3968.1518	-0.0009867	1301.1157	-337.1867	72416.0795
90.000	0.022339	1017314.	-5884.4219	-0.0008811	1280.0906	-301.5700	81000.0000
96.000	0.017364	977773.	-7520.5138	-0.0007790	1250.9557	-243.7940	84240.0000
102.000	0.012990	929311.	-8820.0934	-0.0006814	1215.2477	-189.3992	87480.0000
108.000	0.009187	873894.	-9805.0165	-0.0005892	1174.4149	-138.9085	90720.0000
114.000	0.005920	813348.	-10499.8815	-0.0005028	1129.8025	-92.7132	93960.0000
120.000	0.003153	749344.	-10931.2623	-0.0004229	1082.6425	-51.0804	97200.0000
126.000	0.000846	683391.	-11126.9876	-0.0003496	1034.0462	-14.1613	100440.
132.000	-0.001042	616827.	-11115.4762	-0.0002830	985.0000	17.9985	103680.
138.000	-0.002550	550820.	-10925.1382	-0.0002233	936.3643	45.4475	106920.
144.000	-0.003721	486368.	-10583.8462	-0.0001702	888.8743	68.3165	110160.
150.000	-0.004593	424304.	-10118.4811	-0.0001236	843.1436	86.8052	113400.
156.000	-0.005204	365302.	-9554.5525	-8.3208E-05	799.6695	101.1710	116640.
162.000	-0.005591	309889.	-8915.8935	-4.8659E-05	758.8393	111.7154	119880.
168.000	-0.005788	258452.	-8224.4274	-1.9578E-05	720.9389	118.7733	123120.
174.000	-0.005826	211252.	-7500.0024	4.4566E-06	686.1609	122.7017	126360.
180.000	-0.005735	168439.	-6760.2892	2.3885E-05	654.6148	123.8694	129600.
186.000	-0.005540	130060.	-6020.7359	3.9159E-05	626.3361	122.6483	132840.
192.000	-0.005265	96077.4250	-5294.5746	5.0730E-05	601.2966	119.4054	136080.
198.000	-0.004931	66379.1449	-4592.8709	5.9043E-05	579.4141	114.4958	139320.
204.000	-0.004556	40792.9320	-3924.6119	6.4526E-05	560.5614	108.2572	142560.
210.000	-0.004157	19097.9665	-3296.8244	6.7591E-05	544.5759	101.0053	145800.
216.000	-0.003745	1036.3773	-2714.7171	6.8621E-05	531.2676	93.0305	149040.
222.000	-0.003333	-13676.2682	-2181.8403	6.7974E-05	540.5811	84.5951	152280.
228.000	-0.002929	-25341.4731	-1700.2574	6.5978E-05	549.1763	75.9325	155520.
234.000	-0.002541	-34269.3740	-1270.7231	6.2928E-05	555.7547	67.2456	158760.
240.000	-0.002174	-40771.3824	-892.8630	5.9088E-05	560.5455	58.7078	162000.
246.000	-0.001832	-45153.9035	-565.3510	5.4691E-05	563.7747	50.4629	165240.
252.000	-0.001518	-47713.1049	-286.0803	4.9939E-05	565.6604	42.6273	168480.
258.000	-0.001233	-48730.6931	-52.3265	4.5005E-05	566.4102	35.2907	171720.
264.000	-0.000978	-48470.6361	139.1019	4.0031E-05	566.2186	28.5188	174960.
270.000	-0.000753	-47176.7595	291.7244	3.5137E-05	565.2652	22.3554	178200.
276.000	-0.000556	-45071.1367	409.2645	3.0417E-05	563.7137	16.8246	181440.
282.000	-0.000388	-42353.1851	495.5394	2.5943E-05	561.7110	11.9337	184680.
288.000	-0.000245	-39199.3801	554.3655	2.1770E-05	559.3872	7.6750	187920.
294.000	-0.000126	-35763.4967	589.4783	1.7934E-05	556.8556	4.0292	191160.
300.000	-2.98E-05	-32177.2913	604.4664	1.4458E-05	554.2131	0.9667959	194400.
306.000	4.70E-05	-28551.5395	602.7193	1.1351E-05	551.5416	-1.5492	197640.
312.000	0.000106	-24977.3499	587.3882	8.6116E-06	548.9080	-3.5612	200880.
318.000	0.000150	-21527.6823	561.3580	6.2320E-06	546.3662	-5.1155	204120.
324.000	0.000181	-18259.0018	527.2296	4.1961E-06	543.9577	-6.2606	207360.
330.000	0.000201	-15213.0117	487.3118	2.4834E-06	541.7134	-7.0454	210600.
336.000	0.000211	-12418.4127	443.6207	1.0696E-06	539.6542	-7.5183	213840.
342.000	0.000214	-9892.6441	397.8861	-7.2066E-08	537.7932	-7.7265	217080.
348.000	0.000210	-7643.5716	351.5634	-9.6937E-07	536.1360	-7.7144	220320.
354.000	0.000202	-5671.0917	305.8490	-1.6507E-06	534.6826	-7.5237	223560.
360.000	0.000190	-3968.6298	261.7001	-2.1439E-06	533.4282	-7.1926	226800.
366.000	0.000176	-2524.5156	219.8562	-2.4762E-06	532.3641	-6.7554	230040.
372.000	0.000161	-1323.2246	180.8615	-2.6730E-06	531.4790	-6.2428	233280.
378.000	0.000144	-346.4791	145.0894	-2.7585E-06	530.7593	-5.6813	236520.
384.000	0.000127	425.7922	112.7652	-2.7544E-06	530.8177	-5.0935	239760.
390.000	0.000111	1014.6363	83.9901	-2.6807E-06	531.2516	-4.4983	243000.
396.000	9.53E-05	1441.3937	58.7626	-2.5550E-06	531.5660	-3.9109	246240.
402.000	8.04E-05	1727.1458	36.9998	-2.3929E-06	531.7766	-3.3433	249480.
408.000	6.66E-05	1892.2829	18.5567	-2.2077E-06	531.8983	-2.8044	252720.
414.000	5.39E-05	1956.1843	3.2436	-2.0108E-06	531.9454	-2.3000	255960.
420.000	4.25E-05	1936.9971	-9.1580	-1.8116E-06	531.9312	-1.8339	259200.
426.000	3.22E-05	1851.5053	-18.8817	-1.6177E-06	531.8682	-1.4074	262440.
432.000	2.30E-05	1715.0752	-26.1642	-1.4352E-06	531.7677	-1.0201	265680.
438.000	1.50E-05	1541.6683	-31.2351	-1.2686E-06	531.6399	-0.6701920	268920.
444.000	7.81E-06	1343.9072	-34.3091	-1.1209E-06	531.4942	-0.3544755	272160.
450.000	1.50E-06	1133.1870	-35.5793	-9.9419E-07	531.3389	-0.0689259	275400.
456.000	-4.12E-06	919.8185	-35.2127	-8.8914E-07	531.1817	0.1911285	278640.
462.000	-9.17E-06	713.1950	-33.3472	-8.0558E-07	531.0295	0.4307158	281880.
468.000	-1.38E-05	521.9723	-30.3569	-7.4238E-07	530.8886	0.5660433	246416.
474.000	-1.81E-05	351.0501	-26.4121	-6.9771E-07	530.7626	0.7489046	248576.
480.000	-2.22E-05	207.0368	-21.3878	-6.6915E-07	530.6565	0.9258497	250736.
486.000	-2.61E-05	96.3236	-15.3091	-6.5363E-07	530.5750	1.1004	252896.
492.000	-3.00E-05	25.2095	-8.1823	-6.4741E-07	530.5226	1.2752	255056.
498.000	-3.39E-05	0.0000	0.0000	-6.4612E-07	530.5040	1.4522	128608.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection	=	0.16702356 in
Computed slope at pile head	=	-0.00207651
Maximum bending moment	=	1065493. lbs-in
Maximum shear force	=	30000.00000 lbs
Depth of maximum bending moment	=	72.00000000 in
Depth of maximum shear force	=	0.00000 in
Number of iterations	=	12
Number of zero deflection points	=	3

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1		Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
1	V= 60000.	M=	0.000	240000.	0.4747589	2585921.	60000.0000
1	V= 10000.	M=	0.000	240000.	0.0361150	277769.	10000.0000
1	V= 15000.	M=	0.000	240000.	0.0568350	422198.	15000.0000
1	V= 20000.	M=	0.000	240000.	0.0891189	623125.	20000.0000
1	V= 25000.	M=	0.000	240000.	0.1261326	838672.	25000.0000
1	V= 30000.	M=	0.000	240000.	0.1670236	1065493.	30000.0000
1	V= 35000.	M=	0.000	240000.	0.2113734	1301008.	35000.0000
1	V= 40000.	M=	0.000	240000.	0.2588185	1546577.	40000.0000
1	V= 50000.	M=	0.000	240000.	0.3620003	2053862.	50000.0000
1	V= 70000.	M=	0.000	240000.	0.5945448	3129243.	70000.0000

Pile-head Deflection vs. Pile Length

Boundary Condition Type 1, Shear and Moment

Shear	=	60000. lbs
Moment	=	0. in-lbs
Axial Load	=	240000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
498.000	0.47475886	2585921.	60000.00000
473.100	0.47427993	2581954.	60000.00000
448.200	0.47421137	2583412.	60000.00000
423.300	0.47426833	2584451.	60000.00000
398.400	0.47408684	2583477.	60000.00000
373.500	0.47427447	2583591.	60000.00000
348.600	0.47422504	2583249.	60000.00000
323.700	0.47442222	2583389.	60000.00000
298.800	0.47462804	2583300.	60000.00000
273.900	0.47460263	2583273.	60000.00000

This analysis ended normally.

```
=============================================================================

               LPILE Plus for Windows, Version 5.0 (5.0.41)

              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:

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Path to file locations:      X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\Arroyo
Del Valle Trial Bridge\
Name of input data file:     Arroyo Del Valle Trial Bridge_Bent 2_ Fixed_scour_rev 3
20141105.lpd
Name of output file:         Arroyo Del Valle Trial Bridge_Bent 2_ Fixed_scour_rev 3
20141105.lpo
Name of plot output file:    Arroyo Del Valle Trial Bridge_Bent 2_ Fixed_scour_rev 3
20141105.lpp
Name of runtime file:        Arroyo Del Valle Trial Bridge_Bent 2_ Fixed_scour_rev 3
20141105.lpr


-----------------------------------------------------------------------------
                          Time and Date of Analysis
-----------------------------------------------------------------------------

               Date:  December 18, 2014     Time:  12:07:09


-----------------------------------------------------------------------------
                                Problem Title
-----------------------------------------------------------------------------

SR84 Isabel Bent 2- Arroyo Del Valle Trial Bridge- 24 inch CIDH 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
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments            =          83
- 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                                 =     498.00 in

Depth of ground surface below top of pile =     -60.00 in

Slope angle of ground surface               =       0.00 deg.

Structural properties of pile defined using  2 points

Point    Depth          Pile      Moment of       Pile      Modulus of
           X          Diameter     Inertia        Area      Elasticity
           in           in         in**4        Sq.in      lbs/Sq.in
-----  ---------   -----------   ----------   ----------   -----------
  1       0.0000   24.00000000   16286.0000     452.4000      3600000.
  2     498.0000   24.00000000   16286.0000     452.4000      3600000.


-----------------------------------------------------------------------------
                      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    =      -60.000 in
Distance from top of pile to bottom of layer =      468.000 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    =      468.000 in
Distance from top of pile to bottom of layer =      528.000 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  3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      528.000 in
Distance from top of pile to bottom of layer =      708.000 in
p-y subgrade modulus k for top of soil layer =      175.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      175.000 lbs/in**3

Layer  4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      708.000 in
Distance from top of pile to bottom of layer =     1194.000 in
p-y subgrade modulus k for top of soil layer =      200.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      200.000 lbs/in**3


(Depth of lowest layer extends  696.00 in below pile tip)


-----------------------------------------------------------------------------
                  Effective Unit Weight of Soil vs. Depth
-----------------------------------------------------------------------------

Effective unit weight of soil with depth defined using  8 points

Point        Depth X    Eff. Unit Weight
 No.           in          lbs/in**3
-----      ----------   ----------------
  1          -60.00         0.03620
  2          468.00         0.03620
  3          468.00         0.02750
  4          528.00         0.02750
  5          528.00         0.04490
```

6	708.00	0.04490
7	708.00	0.04780
8	1194.00	0.04780

Shear Strength of Soils

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	-60.000	0.00000	38.00	------	------
2	468.000	0.00000	38.00	------	------
3	468.000	0.00000	32.00	------	------
4	528.000	0.00000	32.00	------	------
5	528.000	0.00000	40.00	------	------
6	708.000	0.00000	40.00	------	------
7	708.000	0.00000	42.00	------	------
8	1194.000	0.00000	42.00	------	------

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.

Loading Type

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 Shear and Slope (BC Type 2)
Shear force at pile head = 5000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 2

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 10000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 3

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 15000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 4

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 20000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 5

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 25000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 6

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 30000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 7

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 35000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 8

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 50000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 9

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 65000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 10

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 90000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Shear and Slope (BC Type 2)

Specified shear force at pile head = 10000.000 lbs
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head conditions)

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	Es*h F/L lbs/in
0.000	0.016317	-392869.	10000.0000	-2.8912E-19	819.9810	-88.1105	16200.0000
6.000	0.016196	-334426.	9447.0530	-3.7215E-05	776.9186	-96.2051	35640.0000
12.000	0.015870	-279397.	8849.9212	-6.8623E-05	736.3717	-102.8388	38880.0000
18.000	0.015373	-228029.	8217.6562	-9.4587E-05	698.5224	-107.9162	42120.0000
24.000	0.014735	-180512.	7559.7148	-0.0001155	663.5109	-111.3976	45360.0000
30.000	0.013987	-136980.	6885.6434	-0.0001317	631.4347	-113.2928	48600.0000
36.000	0.013154	-97505.3744	6204.8059	-0.0001437	602.3488	-113.6530	51840.0000
42.000	0.012262	-62108.1295	5526.1531	-0.0001519	576.2671	-112.5646	55080.0000
48.000	0.011331	-30754.0564	4858.0343	-0.0001567	553.1645	-110.1417	58320.0000
54.000	0.010382	-3360.5514	4208.0490	-0.0001584	532.9801	-106.5201	61560.0000
60.000	0.009431	20198.7248	3582.9358	-0.0001575	545.3870	-101.8509	64800.0000
66.000	0.008492	40088.3905	2988.4984	-0.0001545	560.0423	-96.2949	68040.0000
72.000	0.007577	56505.5334	2429.5626	-0.0001495	572.1389	-90.0171	71280.0000
78.000	0.006697	69673.7348	1909.9636	-0.0001431	581.8416	-83.1826	74520.0000
84.000	0.005861	79837.0945	1432.5581	-0.0001354	589.3303	-75.9525	77760.0000
90.000	0.005073	87254.3983	999.2596	-0.0001269	594.7956	-68.4803	81000.0000
96.000	0.004338	92193.5522	611.0905	-0.0001177	598.4349	-60.9094	84240.0000
102.000	0.003661	94926.3823	268.2503	-0.0001081	600.4485	-53.3707	87480.0000
108.000	0.003041	95723.8778	-29.8061	-9.8343E-05	601.0361	-45.9814	90720.0000
114.000	0.002480	94851.9366	-284.2808	-8.8591E-05	600.3937	-38.8435	93960.0000
120.000	0.001978	92567.6506	-496.9423	-7.9001E-05	598.7105	-32.0436	97200.0000
126.000	0.001532	89116.1521	-670.0311	-6.9705E-05	596.1674	-25.6526	100440.
132.000	0.001142	84728.0268	-806.1667	-6.0809E-05	592.9341	-19.7259	103680.
138.000	0.000803	79617.2826	-908.2569	-5.2400E-05	589.1683	-14.3042	106920.
144.000	0.000513	73979.8560	-979.4114	-4.4541E-05	585.0145	-9.4140	110160.
150.000	0.000268	67992.6229	-1022.8612	-3.7276E-05	580.6029	-5.0693	113400.
156.000	6.54E-05	61812.8769	-1041.8850	-3.0634E-05	576.0495	-1.2720	116640.
162.000	-9.94E-05	55578.2295	-1039.7433	-2.4627E-05	571.4556	1.9859	119880.
168.000	-0.000230	49406.8846	-1019.6208	-1.9255E-05	566.9084	4.7216	123120.
174.000	-0.000330	43398.2354	-984.5776	-1.4507E-05	562.4811	6.9595	126360.
180.000	-0.000404	37633.7323	-937.5085	-1.0360E-05	558.2336	8.7302	129600.
186.000	-0.000455	32177.9710	-881.1111	-6.7882E-06	554.2136	10.0689	132840.
192.000	-0.000486	27079.9495	-817.8616	-3.7561E-06	550.4573	11.0142	136080.
198.000	-0.000500	22374.4489	-749.9989	-1.2256E-06	546.9901	11.6067	139320.
204.000	-0.000500	18083.4923	-679.5144	8.4461E-07	543.8284	11.8881	142560.
210.000	-0.000490	14217.8435	-608.1493	2.4974E-06	540.9801	11.9003	145800.
216.000	-0.000470	10778.5086	-537.3963	3.7765E-06	538.4459	11.6841	149040.
222.000	-0.000444	7758.2117	-468.5071	4.7250E-06	536.2205	11.2790	152280.
228.000	-0.000414	5142.8155	-402.5029	5.3851E-06	534.2934	10.7224	155520.
234.000	-0.000380	2912.6682	-340.1884	5.7973E-06	532.6501	10.0491	158760.
240.000	-0.000344	1043.8587	-282.1685	5.9997E-06	531.2731	9.2909	162000.
246.000	-0.000308	-490.6335	-228.8666	6.0280E-06	530.8655	8.4765	165240.
252.000	-0.000272	-1719.9010	-180.5433	5.9149E-06	531.7713	7.6313	168480.
258.000	-0.000237	-2674.1886	-137.3171	5.6901E-06	532.4744	6.7774	171720.
264.000	-0.000203	-3384.0941	-99.1836	5.3801E-06	532.9975	5.9337	174960.
270.000	-0.000172	-3879.8867	-66.0352	5.0084E-06	533.3628	5.1157	178200.
276.000	-0.000143	-4190.9412	-37.6799	4.5954E-06	533.5920	4.3360	181440.
282.000	-0.000117	-4345.2805	-13.8586	4.1586E-06	533.7057	3.6044	184680.
288.000	-9.35E-05	-4369.2214	5.7383	3.7127E-06	533.7233	2.9279	187920.
294.000	-7.25E-05	-4287.1134	21.4563	3.2698E-06	533.6628	2.3114	191160.
300.000	-5.42E-05	-4121.1629	33.6633	2.8396E-06	533.5406	1.7576	194400.
306.000	-3.85E-05	-3891.3321	42.7380	2.4296E-06	533.3712	1.2673	197640.
312.000	-2.51E-05	-3615.3037	49.0602	2.0455E-06	533.1678	0.8400627	200880.
318.000	-1.39E-05	-3308.5002	53.0020	1.6912E-06	532.9418	0.4738517	204120.
324.000	-4.80E-06	-2984.1505	54.9209	1.3692E-06	532.7028	0.1657935	207360.
330.000	2.50E-06	-2653.3924	55.1549	1.0807E-06	532.4591	-0.0878114	210600.
336.000	8.17E-06	-2325.4046	54.0177	8.2597E-07	532.2174	-0.2912329	213840.
342.000	1.24E-05	-2007.5584	51.7967	6.0426E-07	531.9832	-0.4491180	217080.
348.000	1.54E-05	-1705.5847	48.7504	4.1426E-07	531.7607	-0.5663199	220320.
354.000	1.74E-05	-1423.7471	45.1082	2.5414E-07	531.5530	-0.6477506	223560.
360.000	1.85E-05	-1165.0187	41.0701	1.2168E-07	531.3624	-0.6982547	226800.
366.000	1.88E-05	-931.2558	36.8079	1.4414E-08	531.1902	-0.7225072	230040.
372.000	1.86E-05	-723.3660	32.4655	-7.0251E-08	531.0370	-0.7249297	233280.
378.000	1.80E-05	-541.4670	28.1619	-1.3497E-07	530.9029	-0.7096278	236520.
384.000	1.70E-05	-385.0348	23.9920	-1.8238E-07	530.7877	-0.6803453	239760.
390.000	1.58E-05	-253.0383	20.0296	-2.1503E-07	530.6904	-0.6404335	243000.
396.000	1.44E-05	-144.0601	16.3298	-2.3535E-07	530.6101	-0.5928358	246240.
402.000	1.30E-05	-56.4028	12.9311	-2.4560E-07	530.5455	-0.5400828	249480.
408.000	1.15E-05	11.8198	9.8579	-2.4789E-07	530.5127	-0.4842983	252720.
414.000	1.00E-05	62.6060	7.1234	-2.4408E-07	530.5501	-0.4272131	255960.
420.000	8.57E-06	98.0033	4.7312	-2.3586E-07	530.5762	-0.3701862	259200.
426.000	7.18E-06	120.0594	2.6779	-2.2470E-07	530.5924	-0.3142306	262440.
432.000	5.87E-06	130.7855	0.9551040	-2.1187E-07	530.6003	-0.2600434	265680.
438.000	4.64E-06	132.1308	-0.4491442	-1.9841E-07	530.6013	-0.2080393	268920.
444.000	3.49E-06	125.9672	-1.5484	-1.8521E-07	530.5968	-0.1583857	272160.
450.000	2.42E-06	114.0832	-2.3567	-1.7292E-07	530.5880	-0.1110405	275400.
456.000	1.42E-06	98.1849	-2.8872	-1.6206E-07	530.5763	-0.0657900	278640.
462.000	4.74E-07	79.9037	-3.1514	-1.5295E-07	530.5629	-0.0222891	281880.
468.000	-4.19E-07	60.8083	-3.1667	-1.4575E-07	530.5488	0.0171969	246416.
474.000	-1.27E-06	42.3230	-2.9567	-1.4047E-07	530.5352	0.0528040	248576.
480.000	-2.10E-06	25.7324	-2.5345	-1.3699E-07	530.5229	0.0879414	250736.
486.000	-2.92E-06	12.3039	-1.9016	-1.3504E-07	530.5130	0.1230102	252896.
492.000	-3.72E-06	3.3020	-1.0575	-1.3425E-07	530.5064	0.1583440	255056.
498.000	-4.53E-06	0.0000	0.0000	-1.3408E-07	530.5040	0.1941716	128608.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection = 0.01631677 in
Computed slope at pile head = -2.891206E-19
Maximum bending moment = -392868.60114 lbs-in
Maximum shear force = 10000.00000 lbs
Depth of maximum bending moment = 0.00000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 5
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 Shear and Slope (BC Type 2)
Specified shear force at pile head = 30000.000 lbs
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head conditions)

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	Es*h F/L lbs/in
0.000	0.056336	-1239775.	30000.0000	-6.9389E-18	1444.0060	-304.2128	16200.0000
6.000	0.055955	-1065159.	28128.6064	-0.0001179	1315.3442	-319.5851	34268.7485
12.000	0.054920	-901892.	26221.3042	-0.0002186	1195.0440	-316.1823	34542.5954
18.000	0.053332	-749874.	24326.7099	-0.0003031	1083.0329	-315.3491	35477.6796
24.000	0.051283	-609098.	22465.1215	-0.0003726	979.3052	-305.1804	35705.3779
30.000	0.048860	-479219.	20692.6167	-0.0004283	883.6066	-285.6546	35078.1835
36.000	0.046143	-359553.	19063.6444	-0.0004713	795.4332	-257.3362	33461.5199
42.000	0.043205	-249098.	17494.6607	-0.0005024	714.0468	-265.6584	36892.5872
48.000	0.040114	-148170.	15885.7149	-0.0005227	639.6802	-270.6569	40482.8610
54.000	0.036932	-56964.1604	14257.2010	-0.0005332	572.4768	-272.1810	44218.1902
60.000	0.033716	24451.8240	12630.1473	-0.0005349	548.5208	-270.1702	48079.2159
66.000	0.030514	96138.0782	10985.4592	-0.0005287	601.3413	-278.0592	54675.3818
72.000	0.027371	157800.	9300.6744	-0.0005157	646.7756	-283.5358	62153.7975
78.000	0.024325	209231.	7590.6322	-0.0004969	684.6718	-286.4783	70662.2003
84.000	0.021408	250319.	5898.8637	-0.0004734	714.9462	-277.4445	77760.0000
90.000	0.018644	281381.	4311.4462	-0.0004462	737.8339	-251.6947	81000.0000

96.000	0.016053	303341.	2880.2049	-0.0004163	754.0147	-225.3858	84240.0000
102.000	0.013648	317143.	1607.0648	-0.0003846	764.1840	-198.9943	87480.0000
108.000	0.011439	323734.	491.2315	-0.0003518	769.0403	-172.9501	90720.0000
114.000	0.009427	324051.	-470.5155	-0.0003186	769.2739	-147.6322	93960.0000
120.000	0.007615	319005.	-1283.5086	-0.0002857	765.5562	-123.3655	97200.0000
126.000	0.005999	309471.	-1954.8673	-0.0002535	758.5314	-100.4207	100440.
132.000	0.004573	296277.	-2493.1710	-0.0002226	748.8094	-79.0139	103680.
138.000	0.003328	280194.	-2908.1381	-0.0001931	736.9592	-59.3085	106920.
144.000	0.002256	261935.	-3210.3173	-0.0001653	723.5054	-41.4179	110160.
150.000	0.001344	242146.	-3410.7983	-0.0001395	708.9246	-25.4091	113400.
156.000	0.000582	221407.	-3520.9441	-0.0001158	693.6434	-11.3062	116640.
162.000	-4.53E-05	200229.	-3552.1501	-9.4230E-05	678.0383	0.9042095	119880.
168.000	-0.000549	179053.	-3515.6311	-7.4822E-05	662.4354	11.2688	123120.
174.000	-0.000943	158257.	-3422.2382	-5.7563E-05	647.1120	19.8622	126360.
180.000	-0.001240	138152.	-3282.3053	-4.2396E-05	632.2983	26.7821	129600.
186.000	-0.001452	118991.	-3105.5256	-2.9238E-05	618.1800	32.1445	132840.
192.000	-0.001591	100970.	-2900.8562	-1.7983E-05	604.9015	36.0787	136080.
198.000	-0.001668	84232.5276	-2676.4504	-8.5065E-06	592.5690	38.7233	139320.
204.000	-0.001693	68876.8873	-2439.6143	-6.7205E-07	581.2545	40.2221	142560.
210.000	-0.001676	54959.0909	-2196.7872	5.6645E-06	570.9994	40.7203	145800.
216.000	-0.001625	42499.1275	-1953.5406	1.0651E-05	561.8186	40.3619	149040.
222.000	-0.001548	31485.9283	-1714.5965	1.4437E-05	553.7037	39.2862	152280.
228.000	-0.001452	21882.3912	-1483.8592	1.7168E-05	546.6276	37.6262	155520.
234.000	-0.001342	13630.1743	-1264.4601	1.8985E-05	540.5471	35.5068	158760.
240.000	-0.001224	6654.1936	-1058.8110	2.0023E-05	535.4070	33.0429	162000.
246.000	-0.001102	866.7765	-868.6656	2.0408E-05	531.1426	30.3389	165240.
252.000	-0.000979	-3828.5677	-695.1848	2.0256E-05	533.3250	27.4880	168480.
258.000	-0.000859	-7533.7785	-539.0050	1.9675E-05	536.0551	24.5719	171720.
264.000	-0.000743	-10353.2905	-400.3072	1.8759E-05	538.1326	21.6607	174960.
270.000	-0.000633	-12391.4923	-278.8854	1.7596E-05	539.6344	18.8133	178200.
276.000	-0.000532	-13750.5904	-174.2121	1.6258E-05	540.6358	16.0778	181440.
282.000	-0.000438	-14528.8608	-85.5017	1.4811E-05	541.2093	13.4923	184680.
288.000	-0.000354	-14819.2662	-11.7683	1.3309E-05	541.4232	11.0855	187920.
294.000	-0.000279	-14708.4111	48.1201	1.1798E-05	541.3416	8.8773	191160.
300.000	-0.000212	-14275.8041	95.3937	1.0315E-05	541.0228	6.8805	194400.
306.000	-0.000155	-13593.3951	131.3377	8.8893E-06	540.5200	5.1008	197640.
312.000	-0.000106	-12725.3526	157.2558	7.5426E-06	539.8804	3.5385	200880.
318.000	-6.43E-05	-11728.0485	174.4380	6.2913E-06	539.1455	2.1889	204120.
324.000	-3.02E-05	-10650.2158	184.1352	5.1463E-06	538.3514	1.0435	207360.
330.000	-2.59E-06	-9533.2470	187.5381	4.1135E-06	537.5284	0.0907863	210600.
336.000	1.92E-05	-8411.6050	185.7611	3.1953E-06	536.7019	-0.6831349	213840.
342.000	3.58E-05	-7313.3163	179.8306	2.3907E-06	535.8926	-1.2937	217080.
348.000	4.79E-05	-6260.5225	170.6778	1.6961E-06	535.1169	-1.7573	220320.
354.000	5.61E-05	-5270.0673	159.1341	1.1061E-06	534.3871	-2.0907	223560.
360.000	6.11E-05	-4354.0993	145.9301	6.1364E-07	533.7122	-2.3107	226800.
366.000	6.35E-05	-3520.6735	131.6973	2.1070E-07	533.0981	-2.4336	230040.
372.000	6.37E-05	-2774.3379	116.9716	-1.1141E-07	532.5482	-2.4750	233280.
378.000	6.21E-05	-2116.6931	102.1984	-3.6168E-07	532.0636	-2.4494	236520.
384.000	5.93E-05	-1546.9159	87.7391	-5.4914E-07	531.6438	-2.3703	239760.
390.000	5.55E-05	-1062.2418	73.8792	-6.8265E-07	531.2867	-2.2497	243000.
396.000	5.11E-05	-658.3989	60.8357	-7.7069E-07	530.9891	-2.0982	246240.
402.000	4.63E-05	-329.9934	48.7659	-8.2126E-07	530.7471	-1.9251	249480.
408.000	4.13E-05	-70.8432	37.7757	-8.4177E-07	530.5562	-1.7383	252720.
414.000	3.62E-05	125.7389	27.9282	-8.3897E-07	530.5966	-1.5442	255960.
420.000	3.12E-05	266.7116	19.2518	-8.1888E-07	530.7005	-1.3479	259200.
426.000	2.64E-05	359.1189	11.7476	-7.8686E-07	530.7686	-1.1535	262440.
432.000	2.18E-05	409.9484	5.3965	-7.4751E-07	530.8060	-0.9635378	265680.
438.000	1.74E-05	426.0302	0.1661992	-7.0473E-07	530.8179	-0.7799091	268920.
444.000	1.33E-05	413.9724	-3.9838	-6.6175E-07	530.8090	-0.6034385	272160.
450.000	9.46E-06	380.1299	-7.0968	-6.2112E-07	530.7841	-0.4342097	275400.
456.000	5.85E-06	330.5998	-9.2144	-5.8475E-07	530.7476	-0.2716695	278640.
462.000	2.44E-06	271.2409	-10.3737	-5.5396E-07	530.7038	-0.1147673	281880.
468.000	-7.98E-07	207.7104	-10.6198	-5.2945E-07	530.6570	0.0327554	246416.
474.000	-3.91E-06	145.3284	-10.0355	-5.1138E-07	530.6111	0.1620088	248576.
480.000	-6.93E-06	88.7574	-8.6801	-4.9941E-07	530.5694	0.2897744	250736.
486.000	-9.90E-06	42.6052	-6.5585	-4.9268E-07	530.5354	0.4174200	252896.
492.000	-1.28E-05	11.4738	-3.6680	-4.8992E-07	530.5124	0.5460913	255056.
498.000	-1.58E-05	0.0000	0.0000	-4.8933E-07	530.5040	0.6765795	128608.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection	=	0.05633570 in
Computed slope at pile head	=	-6.938894E-18
Maximum bending moment	=	-1239775. lbs-in
Maximum shear force	=	30000.00000 lbs
Depth of maximum bending moment	=	0.00000 in
Depth of maximum shear force	=	0.00000 in
Number of iterations	=	9
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 Shear and Slope (BC Type 2)
Specified shear force at pile head = 90000.000 lbs
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head conditions)

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	Es*h F/L lbs/in
0.000	0.269327	-4636261.	90000.0000	2.3130E-17	3946.6367	-533.7276	5945.1185
6.000	0.267904	-4105527.	86695.7859	-0.0004473	3555.5760	-567.6771	12713.7453
12.000	0.263960	-3594624.	83231.0806	-0.0008413	3179.1276	-587.2247	13348.0557
18.000	0.257808	-3104331.	79615.2511	-0.0011841	2817.8656	-618.0518	14383.9916
24.000	0.249751	-2635831.	75851.0871	-0.0014778	2472.6608	-636.6695	15295.3285
30.000	0.240075	-2189862.	72017.7339	-0.0017247	2144.0581	-641.1149	16022.8966
36.000	0.229054	-1766651.	68205.4124	-0.0019272	1832.2236	-629.6590	16493.7385
42.000	0.216948	-1365847.	64315.9438	-0.0020875	1536.8996	-666.8306	18442.1009
48.000	0.204004	-988847.	60221.3871	-0.0022080	1259.1155	-698.0216	20529.6218
54.000	0.190453	-636831.	55960.1810	-0.0022911	999.7397	-722.3804	22757.7620
60.000	0.176511	-310727.	51575.5396	-0.0023396	759.4564	-739.1667	25125.9712
66.000	0.162377	-11186.4738	47053.0245	-0.0023561	538.7465	-768.3383	28390.8206
72.000	0.148237	260695.	42372.3307	-0.0023433	722.5918	-791.8929	32052.3363
78.000	0.134258	504030.	37568.5499	-0.0023042	901.8882	-809.3673	36170.8031
84.000	0.120587	718154.	32679.3296	-0.0022417	1059.6607	-820.3728	40818.9225
90.000	0.107358	902638.	27744.4126	-0.0021587	1195.5941	-824.5995	46085.1812
96.000	0.094682	1057304.	22805.1573	-0.0020584	1309.5564	-821.8189	52078.4406
102.000	0.082656	1182228.	17904.0503	-0.0019438	1401.6044	-811.8834	58934.3292
108.000	0.071356	1277751.	13084.2288	-0.0018180	1471.9881	-794.7238	66824.3943
114.000	0.060841	1344475.	8389.0318	-0.0016838	1521.1523	-770.3419	75969.6240
120.000	0.051151	1383269.	3861.6111	-0.0015442	1549.7366	-738.7983	86661.2095
126.000	0.042310	1395262.	-455.3549	-0.0014020	1558.5734	-700.1904	99293.9225
132.000	0.034326	1381842.	-4335.3994	-0.0012599	1548.6856	-593.1578	103680.
138.000	0.027191	1346865.	-7568.4951	-0.0011203	1522.9137	-484.5408	106920.
144.000	0.020882	1294247.	-10172.3215	-0.0009852	1484.1427	-383.4014	110160.
150.000	0.015369	1227635.	-12193.9318	-0.0008561	1435.0612	-290.4687	113400.
156.000	0.010609	1150385.	-13684.0431	-0.0007345	1378.1414	-206.2351	116640.
162.000	0.006555	1065542.	-14695.6698	-0.0006211	1315.6261	-130.9739	119880.
168.000	0.003156	975826.	-15282.8726	-0.0005166	1249.5209	-64.7604	123120.
174.000	0.000356	883635.	-15499.6373	-0.0004215	1181.5920	-7.4945	126360.
180.000	-0.001902	791044.	-15398.8929	-0.0003358	1113.3683	41.0760	129600.
186.000	-0.003673	699815.	-15031.6729	-0.0002595	1046.1483	81.3307	132840.
192.000	-0.005016	611411.	-14446.4209	-0.0001924	981.0097	113.7533	136080.
198.000	-0.005982	527012.	-13688.4367	-0.0001341	918.8221	138.9081	139320.
204.000	-0.006625	447536.	-12799.4578	-8.4281E-05	860.2619	157.4182	142560.
210.000	-0.006994	373662.	-11817.3674	-4.2261E-05	805.8287	169.9453	145800.
216.000	-0.007132	305850.	-10776.0190	-7.4916E-06	755.8630	177.1708	149040.
222.000	-0.007084	244371.	-9705.1664	2.0662E-05	710.5636	179.7800	152280.
228.000	-0.006885	189328.	-8630.4851	4.2854E-05	670.0065	178.4471	155520.
234.000	-0.006569	140682.	-7573.6744	5.9740E-05	634.1624	173.8232	158760.
240.000	-0.006168	98272.0671	-6552.6256	7.1967E-05	602.9137	166.5265	162000.
246.000	-0.005706	61842.9157	-5581.6437	8.0160E-05	576.0716	157.1342	165240.

252.000	-0.005206	31061.4817	-4671.7110	8.4914E-05	553.3910	146.1767	168480.
258.000	-0.004687	5537.8318	-3830.7805	8.6787E-05	534.5844	134.1334	171720.
264.000	-0.004164	-15157.8309	-3064.0889	8.6295E-05	541.6727	121.4304	174960.
270.000	-0.003651	-31479.7636	-2374.4785	8.3908E-05	553.6992	108.4397	178200.
276.000	-0.003157	-43893.2289	-1762.7217	8.0051E-05	562.8458	95.4793	181440.
282.000	-0.002691	-52862.9721	-1227.8385	7.5101E-05	569.4550	82.8151	184680.
288.000	-0.002256	-58843.5802	-767.4027	6.9385E-05	573.8616	70.6634	187920.
294.000	-0.001858	-62271.6325	-377.8310	6.3187E-05	576.3875	59.1938	191160.
300.000	-0.001498	-63559.5321	-54.6511	5.6749E-05	577.3365	48.5329	194400.
306.000	-0.001177	-63090.8819	207.2536	5.0268E-05	576.9912	38.7687	197640.
312.000	-0.000895	-61217.2610	413.4243	4.3908E-05	575.6106	29.9549	200880.
318.000	-0.000650	-58256.2436	569.6339	3.7794E-05	573.4289	22.1150	204120.
324.000	-0.000441	-54490.5015	681.7203	3.2025E-05	570.6542	15.2471	207360.
330.000	-0.000266	-50167.8326	755.4459	2.6670E-05	567.4691	9.3281	210600.
336.000	-0.000121	-45501.9602	796.3823	2.1775E-05	564.0312	4.3174	213840.
342.000	-4.46E-06	-40673.9553	809.8189	1.7365E-05	560.4737	0.1614263	217080.
348.000	8.72E-05	-35834.1451	800.6927	1.3450E-05	556.9076	-3.2035	220320.
354.000	0.000157	-31104.3803	773.5392	1.0025E-05	553.4226	-5.8476	223560.
360.000	0.000208	-26580.5468	732.4609	7.0735E-06	550.0893	-7.8451	226800.
366.000	0.000242	-22335.2206	681.1111	4.5705E-06	546.9612	-9.2715	230040.
372.000	0.000262	-18420.3767	622.6916	2.4851E-06	544.0766	-10.2017	233280.
378.000	0.000272	-14870.0786	559.9619	7.8166E-07	541.4607	-10.7082	236520.
384.000	0.000272	-11703.0846	495.2577	-5.7805E-07	539.1272	-10.8599	239760.
390.000	0.000265	-8925.3216	430.5161	-1.6336E-06	537.0804	-10.7206	243000.
396.000	0.000252	-6532.1867	367.3075	-2.4245E-06	535.3171	-10.3489	246240.
402.000	0.000236	-4510.6489	306.8705	-2.9896E-06	533.8276	-9.7968	249480.
408.000	0.000216	-2841.1309	250.1496	-3.3658E-06	532.5974	-9.1102	252720.
414.000	0.000195	-1499.1604	197.8343	-3.5878E-06	531.6086	-8.3283	255960.
420.000	0.000173	-456.7862	150.3980	-3.6879E-06	530.8406	-7.4838	259200.
426.000	0.000151	316.2374	108.1364	-3.6951E-06	530.7370	-6.6034	262440.
432.000	0.000129	851.4926	71.2038	-3.6354E-06	531.1314	-5.7075	265680.
438.000	0.000107	1181.1527	39.6478	-3.5314E-06	531.3743	-4.8112	268920.
444.000	8.65E-05	1337.4360	13.4407	-3.4025E-06	531.4894	-3.9245	272160.
450.000	6.65E-05	1352.2399	-7.4919	-3.2649E-06	531.5003	-3.0530	275400.
456.000	4.73E-05	1256.9354	-23.2466	-3.1313E-06	531.4301	-2.1985	278640.
462.000	2.89E-05	1082.2993	-33.9207	-3.0117E-06	531.3014	-1.3595	281880.
468.000	1.12E-05	858.5603	-39.3794	-2.9123E-06	531.1366	-0.4600206	246416.
474.000	-6.01E-06	618.1340	-40.0126	-2.8368E-06	530.9594	0.2489653	248576.
480.000	-2.28E-05	386.5793	-36.4022	-2.7854E-06	530.7888	0.9544817	250736.
486.000	-3.94E-05	189.3291	-28.5525	-2.7559E-06	530.6435	1.6621	252896.
492.000	-5.59E-05	51.8869	-16.4359	-2.7436E-06	530.5422	2.3767	255056.
498.000	-7.24E-05	0.0000	0.0000	-2.7409E-06	530.5040	3.1019	128608.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

```
Pile-head deflection             =     0.26932733 in
Computed slope at pile head      =   2.312965E-17
Maximum bending moment           =      -4636261. lbs-in
Maximum shear force              =    90000.00000 lbs
Depth of maximum bending moment  =        0.00000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =             12
Number of zero deflection points =              3
```

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

```
Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
```

Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
2	V= 5000.000	S= 0.000	240000.	0.0081584	-196434.	5000.0000
2	V= 10000.	S= 0.000	240000.	0.0163168	-392869.	10000.0000
2	V= 15000.	S= 0.000	240000.	0.0246168	-590446.	15000.0000
2	V= 20000.	S= 0.000	240000.	0.0338813	-794241.	20000.0000
2	V= 25000.	S= 0.000	240000.	0.0442279	-1006890.	25000.0000
2	V= 30000.	S= 0.000	240000.	0.0563357	-1239775.	30000.0000
2	V= 35000.	S= 0.000	240000.	0.0702388	-1495380.	35000.0000
2	V= 50000.	S= 0.000	240000.	0.1170558	-2302579.	50000.0000
2	V= 65000.	S= 0.000	240000.	0.1700350	-3152145.	65000.0000
2	V= 90000.	S= 0.000	240000.	0.2693273	-4636261.	90000.0000

Pile-head Deflection vs. Pile Length

Boundary Condition Type 2, Shear and Slope

```
Shear      =           5000. lbs
Slope      =        0.00000
Axial Load =         240000. lbs
```

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
498.000	0.00815838	-196434.30057	5000.00000
473.100	0.00815639	-196448.72939	5000.00000
448.200	0.00815449	-196462.42926	5000.00000
423.300	0.00815270	-196475.28818	5000.00000
398.400	0.00815104	-196487.04090	5000.00000
373.500	0.00814957	-196497.81361	5000.00000
348.600	0.00814845	-196509.97291	5000.00000
323.700	0.00814771	-196529.55161	5000.00000
298.800	0.00814697	-196558.38464	5000.00000
273.900	0.00814590	-196564.42440	5000.00000

This analysis ended normally.

BENT 2
SERVICE LOAD

```
================================================================================

               LPILE Plus for Windows, Version 5.0 (5.0.41)

             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:

Geotech SJ
URS

Path to file locations:      X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\Arroyo
Del Valle Trial Bridge\
Name of input data file:     Arroyo Del Valle Trial Bridge_Bent 2_ Free_scour_rev 3 total.lpd
Name of output file:         Arroyo Del Valle Trial Bridge_Bent 2_ Free_scour_rev 3 total.lpo
Name of plot output file:    Arroyo Del Valle Trial Bridge_Bent 2_ Free_scour_rev 3 total.lpp
Name of runtime file:        Arroyo Del Valle Trial Bridge_Bent 2_ Free_scour_rev 3 total.lpr


--------------------------------------------------------------------------------
                         Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  December 18, 2014     Time:  12:05:13


--------------------------------------------------------------------------------
                               Problem Title
--------------------------------------------------------------------------------

SR84 Isabel Bent 2- Arroyo Del Valle Trial Bridge- 24 inch CIDH pile scour 4.5ft


--------------------------------------------------------------------------------
                               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            =          83
- 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                                =     498.00 in

Depth of ground surface below top of pile =      -7.00 in

Slope angle of ground surface              =       0.00 deg.

Structural properties of pile defined using  2 points

Point    Depth          Pile       Moment of       Pile       Modulus of
           X          Diameter      Inertia        Area       Elasticity
           in            in          in**4        Sq.in       lbs/Sq.in
-----  ---------   -----------   ----------   ----------   -----------
  1       0.0000   24.00000000   16286.0000     452.4000      3600000.
  2     498.0000   24.00000000   16286.0000     452.4000      3600000.


--------------------------------------------------------------------------------
                      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    =       -7.000 in
Distance from top of pile to bottom of layer =      468.000 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    =      468.000 in
Distance from top of pile to bottom of layer =      528.000 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  3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      528.000 in
Distance from top of pile to bottom of layer =      708.000 in
p-y subgrade modulus k for top of soil layer =      175.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      175.000 lbs/in**3

Layer  4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      708.000 in
Distance from top of pile to bottom of layer =     1194.000 in
p-y subgrade modulus k for top of soil layer =      200.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      200.000 lbs/in**3


(Depth of lowest layer extends  696.00 in below pile tip)


--------------------------------------------------------------------------------
                  Effective Unit Weight of Soil vs. Depth
--------------------------------------------------------------------------------

Effective unit weight of soil with depth defined using  8 points

Point        Depth X    Eff. Unit Weight
 No.           in          lbs/in**3
-----      ----------   ----------------
  1           -7.00         0.03620
  2          468.00         0.03620
  3          468.00         0.02750
  4          528.00         0.02750
  5          528.00         0.04490
```

6	708.00	0.04490
7	708.00	0.04780
8	1194.00	0.04780

Shear Strength of Soils

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	-7.000	0.00000	38.00	------	------
2	468.000	0.00000	38.00	------	------
3	468.000	0.00000	32.00	------	------
4	528.000	0.00000	32.00	------	------
5	528.000	0.00000	40.00	------	------
6	708.000	0.00000	40.00	------	------
7	708.000	0.00000	42.00	------	------
8	1194.000	0.00000	42.00	------	------

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.

Loading Type

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 Shear and Moment (BC Type 1)
Shear force at pile head = 120000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 240000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 2

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 10000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 240000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 3

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 20000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 240000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 4

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 40000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 240000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 5

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 60000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 240000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 6

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 80000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 240000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 7

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 90000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 240000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 8

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 100000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 240000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 9

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 140000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 240000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 10

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 160000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 240000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Computed Values of Load Distribution and Deflection for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)

Specified shear force at pile head = 120000.000 lbs
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 240000.000 lbs

(Zero moment for this load indicates free-head conditions)

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	Es*h F/L lbs/in
0.000	3.249	1.9528E-05	120000.	-0.0266696	530.5040	-81.3590	75.1132
6.000	3.089	756940.	119253.	-0.0266308	1088.2392	-167.6948	325.6804
12.000	2.930	1507731.	117962.	-0.0265149	1641.4441	-262.7428	538.0611
18.000	2.771	2248841.	116089.	-0.0263227	2187.5157	-361.4520	782.5732
24.000	2.614	2976608.	113624.	-0.0260553	2723.7553	-460.1721	1056.2434
30.000	2.459	3687369.	110580.	-0.0257144	3247.4653	-554.5027	1353.2193
36.000	2.305	4377625.	106966.	-0.0253017	3756.0662	-650.1880	1692.1409
42.000	2.155	5043830.	102804.	-0.0248196	4246.9450	-737.2120	2052.5879
48.000	2.008	5682751.	98137.2914	-0.0242707	4717.7209	-818.2818	2445.5472
54.000	1.864	6291377.	93014.2430	-0.0236580	5166.1742	-889.4010	2863.3023
60.000	1.724	6867057.	87429.1992	-0.0229847	5590.3522	-972.2802	3384.3797
66.000	1.588	7406723.	81358.1923	-0.0222544	5987.9940	-1051.3888	3972.7331
72.000	1.457	7907448.	74718.3479	-0.0214708	6356.9425	-1161.8927	4785.8655
78.000	1.330	8365179.	67421.6521	-0.0206381	6694.2123	-1270.3392	5729.7407
84.000	1.209	8775946.	59484.0805	-0.0197610	6996.8769	-1375.5179	6826.4036
90.000	1.093	9135900.	50899.9536	-0.0188445	7262.1018	-1485.8577	8155.6432
96.000	0.982864	9441017.	41503.1341	-0.0178939	7486.9210	-1646.4154	10050.7223
102.000	0.878399	9685472.	31221.0045	-0.0169153	7667.0426	-1780.9611	12165.0514
108.000	0.779881	9864385.	20524.8628	-0.0159149	7798.8709	-1784.4194	13728.4016
114.000	0.687420	9977606.	9851.8296	-0.0148996	7882.2949	-1773.2583	15477.5153
120.000	0.601085	1.0026E+07	-750.6591	-0.0138761	7917.5984	-1760.9047	17577.2555
126.000	0.520907	1.0009E+07	-11247.8000	-0.0128510	7905.1037	-1738.1423	20020.5851
132.000	0.446873	9927555.	-21581.6061	-0.0118309	7845.4165	-1706.4597	22911.9889
138.000	0.378936	9783655.	-31701.7866	-0.0108223	7739.3861	-1666.9338	26393.9082
144.000	0.317006	9578302.	-41540.1764	-0.0098316	7588.0765	-1612.5295	30520.4818
150.000	0.260957	9313487.	-50999.1151	-0.0088649	7392.9532	-1540.4501	35418.4306
156.000	0.210627	8991844.	-59971.5471	-0.0079282	7155.9568	-1450.3606	41315.4372
162.000	0.165819	8616662.	-68348.0336	-0.0070272	6879.5120	-1341.8016	48551.8926
168.000	0.126301	8191906.	-76015.3921	-0.0061671	6566.5391	-1213.9846	57671.1370
174.000	0.091813	7722239.	-82853.5077	-0.0053528	6220.4748	-1065.3873	69623.4004
180.000	0.062067	7213080.	-88728.2056	-0.0045886	5845.3116	-892.8454	86311.6464
186.000	0.036749	6670715.	-93321.7523	-0.0038782	5445.6818	-638.3369	104220.
192.000	0.015528	6104388.	-96071.0897	-0.0032245	5028.3952	-278.1089	107460.
198.000	-0.001945	5527149.	-96797.7677	-0.0026294	4603.0687	35.8829	110700.
204.000	-0.016024	4950387.	-95777.2271	-0.0020932	4178.0938	304.2973	113940.
210.000	-0.027064	4383851.	-93278.6774	-0.0016156	3760.6532	528.5526	117180.
216.000	-0.035411	3835696.	-89560.9002	-0.0011950	3356.7568	710.7065	120420.
222.000	-0.041404	3312562.	-84868.7759	-0.0008293	2971.2961	853.3350	123660.
228.000	-0.045362	2819659.	-79430.5216	-0.0005155	2608.1111	959.4165	126900.
234.000	-0.047590	2360880.	-73455.6108	-0.0002504	2270.0693	1032.2205	130140.
240.000	-0.048367	1938913.	-67133.3362	-3.0384E-05	1959.1516	1075.2044	133380.
246.000	-0.047954	1555367.	-60631.9645	0.0001484	1676.5441	1091.9195	136620.
252.000	-0.046586	1210902.	-54098.4255	0.0002900	1422.7318	1085.9268	139860.
258.000	-0.044475	905351.	-47658.4742	0.0003982	1197.5932	1060.7236	143100.
264.000	-0.041807	637853.	-41417.2590	0.0004772	1000.4929	1019.6814	146340.
270.000	-0.038748	406970.	-35460.2315	0.0005307	830.3712	965.9944	149580.
276.000	-0.035439	210802.	-29854.3319	0.0005623	685.8292	902.6388	152820.
282.000	-0.032001	47098.4610	-24649.3866	0.0005755	565.2075	832.3429	156060.
288.000	-0.028534	-86647.8454	-19879.6606	0.0005735	594.3486	757.5657	159300.
294.000	-0.025119	-193109.	-15565.5082	0.0005591	672.7923	680.4851	162540.
300.000	-0.021824	-275044.	-11715.0728	0.0005352	733.1646	602.9934	165780.
306.000	-0.018697	-335231.	-8325.9929	0.0005040	777.5121	526.6999	169020.
312.000	-0.015776	-376408.	-5387.0751	0.0004675	807.8521	452.9393	172260.
318.000	-0.013087	-401223.	-2879.9032	0.0004278	826.1365	382.7846	175500.
324.000	-0.010643	-412198.	-780.3571	0.0003861	834.2238	317.0641	178740.
330.000	-0.008453	-411699.	939.9789	0.0003440	833.8558	256.3813	181980.
336.000	-0.006516	-401909.	2312.5328	0.0003023	826.6424	201.1367	185220.
342.000	-0.004825	-384819.	3370.5962	0.0002621	814.0501	151.5511	188460.
348.000	-0.003371	-362217.	4148.3165	0.0002239	797.3960	107.6890	191700.
354.000	-0.002139	-335684.	4679.8302	0.0001882	777.8460	69.4823	194940.
360.000	-0.001113	-306601.	4998.5362	0.0001553	756.4164	36.7531	198180.
366.000	-0.000275	-276149.	5136.5031	0.0001255	733.9787	9.2359	201420.
372.000	0.000393	-245324.	5124.0041	9.8786E-05	711.2660	-13.4022	204660.
378.000	0.000910	-214946.	4989.1711	7.5235E-05	688.8821	-31.5422	207900.
384.000	0.001296	-185671.	4757.7548	5.4736E-05	667.3116	-45.5966	211140.
390.000	0.001567	-158010.	4452.9840	3.7150E-05	646.9304	-55.9937	214380.
396.000	0.001742	-132342.	4095.5078	2.2293E-05	628.0174	-63.1650	217620.
402.000	0.001835	-108928.	3703.4124	9.9474E-06	610.7655	-67.5334	220860.
408.000	0.001861	-87929.6517	3292.2993	-1.2556E-07	595.2931	-69.5043	224100.
414.000	0.001833	-69420.2737	2875.4131	-8.1770E-06	581.6549	-69.4578	227340.
420.000	0.001763	-53401.1450	2463.8103	-1.4462E-05	569.8515	-67.7432	230580.
426.000	0.001660	-39812.9008	2066.5565	-1.9231E-05	559.8393	-64.6748	233820.
432.000	0.001532	-28547.0807	1690.9451	-2.2729E-05	551.5383	-60.5291	237060.
438.000	0.001387	-19456.0997	1342.7274	-2.5185E-05	544.8398	-55.5435	240300.
444.000	0.001230	-12361.8184	1026.3478	-2.6813E-05	539.6125	-49.9163	243540.
450.000	0.001065	-7062.7032	745.1770	-2.7807E-05	535.7080	-43.8073	246780.
456.000	0.000896	-3339.6094	501.7361	-2.8340E-05	532.9647	-37.3397	250020.
462.000	0.000725	-960.2520	297.9081	-2.8560E-05	531.2115	-30.6030	253260.
468.000	0.000553	317.5392	143.0313	-2.8593E-05	530.7380	-21.0226	227943.
474.000	0.000382	838.4696	36.0244	-2.8533E-05	531.1218	-14.6463	230103.
480.000	0.000211	832.0086	-32.4141	-2.8448E-05	531.1170	-8.1665	232263.
486.000	4.05E-05	531.4299	-61.6646	-2.8378E-05	530.8956	-1.5836	234423.
492.000	-0.000130	173.7629	-51.0879	-2.8342E-05	530.6320	5.1092	236583.
498.000	-0.000300	0.0000	0.0000	-2.8333E-05	530.5040	11.9202	119372.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection = 3.24945435 in
Computed slope at pile head = -0.02666956
Maximum bending moment = 10025518. lbs-in
Maximum shear force = 120000.00000 lbs
Depth of maximum bending moment = 120.00000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 22
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 Shear and Moment (BC Type 1)
Specified shear force at pile head = 40000.000 lbs
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 240000.000 lbs

(Zero moment for this load indicates free-head conditions)

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	Es*h F/L lbs/in
0.000	0.548225	0.0000	40000.0000	-0.0054095	530.5040	-66.8268	365.6902
6.000	0.515768	246587.	39397.9834	-0.0053968	712.1963	-133.8454	1557.0425
12.000	0.483463	488319.	38383.1938	-0.0053592	890.3115	-204.4178	2536.9223
18.000	0.451457	722620.	36948.9298	-0.0052973	1062.9512	-273.6702	3637.1595
24.000	0.419895	946962.	35111.3961	-0.0052118	1228.2532	-338.8411	4841.7948
30.000	0.388915	1158967.	32906.3255	-0.0051041	1384.4643	-396.1825	6112.1216
36.000	0.358646	1356538.	30370.7472	-0.0049754	1530.0405	-449.0103	7511.7552
42.000	0.329210	1537745.	27553.4599	-0.0048273	1663.5591	-490.0854	8932.0170
48.000	0.300719	1701082.	24513.3052	-0.0046616	1783.9107	-523.2995	10440.9727
54.000	0.273272	1845330.	21314.2713	-0.0044801	1890.1966	-543.0452	11923.1894
60.000	0.246958	1969756.	18019.0563	-0.0042849	1981.8774	-555.3598	13492.8283
66.000	0.221853	2073899.	14690.7435	-0.0040780	2058.6130	-554.0778	14984.9774
72.000	0.198022	2157789.	11360.3677	-0.0038614	2120.4260	-556.0475	16848.0329
78.000	0.175516	2221344.	8065.6031	-0.0036374	2167.2550	-542.2074	18535.3046
84.000	0.154374	2265052.	4903.3764	-0.0034078	2199.4604	-511.8682	19894.6134
90.000	0.134623	2289999.	1943.9528	-0.0031747	2217.8420	-474.6063	21152.7559

96.000	0.116277	2297523.	-899.5508	-0.0029400	2223.3857	-473.2283	24418.9547
102.000	0.099343	2287671.	-3712.1043	-0.0027054	2216.1271	-464.2896	28041.6800
108.000	0.083813	2260769.	-6448.2252	-0.0024726	2196.3044	-447.7507	32053.5861
114.000	0.069671	2217414.	-9070.8623	-0.0022435	2164.3593	-426.4617	36726.3525
120.000	0.056891	2158380.	-11586.3348	-0.0020196	2120.8611	-412.0291	43454.5090
126.000	0.045436	2084194.	-13996.2093	-0.0018025	2066.1992	-391.2623	51667.4035
132.000	0.035261	1995616.	-16261.5288	-0.0015937	2000.9323	-363.8442	61911.2780
138.000	0.026311	1893646.	-18340.9900	-0.0013947	1925.7975	-329.3096	75094.9528
144.000	0.018524	1779541.	-20084.1615	-0.0012068	1841.7219	-251.7476	81540.0000
150.000	0.011830	1656111.	-21340.8851	-0.0010310	1750.7752	-167.1603	84780.0000
156.000	0.006153	1526420.	-22113.1489	-0.0008681	1655.2147	-90.2610	88020.0000
162.000	0.001413	1393254.	-22448.3892	-0.0007187	1557.0941	-21.4858	91260.0000
168.000	-0.002472	1259109.	-22396.0421	-0.0005830	1458.2523	38.9348	94500.0000
174.000	-0.005584	1126180.	-22006.3680	-0.0004610	1360.3066	90.9566	97740.0000
180.000	-0.008004	996360.	-21329.3954	-0.0003524	1264.6513	134.7009	100980.
186.000	-0.009812	871243.	-20413.9966	-0.0002568	1172.4609	170.4320	104220.
192.000	-0.011085	752132.	-19307.0958	-0.0001737	1084.6967	198.5349	107460.
198.000	-0.011897	640058.	-18053.0147	-0.0001025	1002.1172	219.4922	110700.
204.000	-0.012315	535791.	-16692.9507	-4.2324E-05	925.2904	233.8625	113940.
210.000	-0.012404	439864.	-15264.5843	7.5985E-06	854.6088	242.2596	117180.
216.000	-0.012224	352594.	-13801.8072	4.8148E-05	790.3055	245.3327	120420.
222.000	-0.011827	274104.	-12334.5631	8.0215E-05	732.4717	243.7486	123660.
228.000	-0.011261	204348.	-10888.7894	0.0001047	681.0737	238.1759	126900.
234.000	-0.010570	143137.	-9486.4484	0.0001225	635.9714	229.2710	130140.
240.000	-0.009792	90158.1298	-8145.6368	0.0001344	596.9351	217.6662	133380.
246.000	-0.008957	45002.0998	-6880.7595	0.0001413	563.6628	203.9596	136620.
252.000	-0.008096	7181.9849	-5702.7563	0.0001440	535.7959	188.7081	139860.
258.000	-0.007229	-23845.6969	-4619.3700	0.0001431	548.0742	172.4206	143100.
264.000	-0.006378	-48662.7214	-3635.4437	0.0001394	566.3601	155.5548	146340.
270.000	-0.005556	-67872.6019	-2753.2368	0.0001335	580.5145	138.5142	149580.
276.000	-0.004776	-82085.9699	-1972.7514	0.0001258	590.9873	121.6476	152820.
282.000	-0.004047	-91907.9275	-1292.0598	0.0001169	598.2244	105.2496	156060.
288.000	-0.003373	-97927.3557	-707.6253	0.0001072	602.6597	89.5619	159300.
294.000	-0.002760	-100708.	-214.6111	9.7021E-05	604.7087	74.7761	162540.
300.000	-0.002209	-100782.	192.8278	8.6711E-05	604.7632	61.0368	165780.
306.000	-0.001720	-98643.9178	521.2746	7.6507E-05	603.1877	48.4454	169020.
312.000	-0.001291	-94747.1532	777.8047	6.6611E-05	600.3164	37.0646	172260.
318.000	-0.000920	-89502.1019	969.7652	5.7183E-05	596.4517	26.9223	175500.
324.000	-0.000605	-83274.6587	1104.5829	4.8343E-05	591.8632	18.0170	178740.
330.000	-0.000340	-76386.3334	1189.5986	4.0173E-05	586.7877	10.3216	181980.
336.000	-0.000123	-69115.1740	1231.9288	3.2728E-05	581.4301	3.7885	185220.
342.000	5.24E-05	-61697.4439	1238.3544	2.6034E-05	575.9645	-1.6466	188460.
348.000	0.000190	-54329.9002	1215.2330	2.0097E-05	570.5358	-6.0605	191700.
354.000	0.000294	-47172.5284	1168.4351	1.4904E-05	565.2621	-9.5388	194940.
360.000	0.000369	-40351.6008	1103.3012	1.0425E-05	560.2362	-12.1725	198180.
366.000	0.000419	-33962.9383	1024.6171	6.6225E-06	555.5289	-14.0555	201420.
372.000	0.000448	-28075.2681	936.6069	3.4481E-06	551.1907	-15.2813	204660.
378.000	0.000460	-22733.5861	842.9390	8.4824E-07	547.2547	-15.9414	207900.
384.000	0.000458	-17962.4433	746.7450	-1.2341E-06	543.7392	-16.1233	211140.
390.000	0.000445	-13769.0922	650.6478	-2.8578E-06	540.6494	-15.9091	214380.
396.000	0.000424	-10146.4396	556.7975	-4.0815E-06	537.9802	-15.3743	217620.
402.000	0.000396	-7075.7669	466.9133	-4.9628E-06	535.7176	-14.5871	220860.
408.000	0.000364	-4529.1869	382.3287	-5.5566E-06	533.8412	-13.6078	224100.
414.000	0.000330	-2471.8202	304.0394	-5.9148E-06	532.3253	-12.4886	227340.
420.000	0.000293	-863.6796	232.7527	-6.0855E-06	531.1404	-11.2736	230580.
426.000	0.000257	338.7383	168.9355	-6.1123E-06	530.7536	-9.9988	233820.
432.000	0.000220	1181.1500	112.8618	-6.0346E-06	531.3743	-8.6925	237060.
438.000	0.000184	1710.4591	64.6574	-5.8866E-06	531.7643	-7.3757	240300.
444.000	0.000149	1973.9918	24.3419	-5.6981E-06	531.9585	-6.0628	243540.
450.000	0.000116	2018.9719	-8.1333	-5.4938E-06	531.9916	-4.7622	246780.
456.000	8.34E-05	1892.2141	-32.8511	-5.2936E-06	531.8982	-3.4770	250020.
462.000	5.23E-05	1640.0039	-49.9001	-5.1129E-06	531.7124	-2.2060	253260.
468.000	2.21E-05	1308.1375	-59.0354	-4.9620E-06	531.4679	-0.8391234	227943.
474.000	-7.28E-06	945.8699	-60.7149	-4.8467E-06	531.2009	0.2793015	230103.
480.000	-3.61E-05	593.5178	-55.6878	-4.7679E-06	530.9413	1.3964	232263.
486.000	-6.45E-05	291.3483	-43.9387	-4.7227E-06	530.7187	2.5200	234423.
492.000	-9.27E-05	79.8547	-25.4079	-4.7037E-06	530.5628	3.6570	236583.
498.000	-0.000121	0.0000	0.0000	-4.6996E-06	530.5040	4.8123	119372.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

```
Pile-head deflection             =     0.54822462 in
Computed slope at pile head      =    -0.00540946
Maximum bending moment           =     2297523. lbs-in
Maximum shear force              =    40000.00000 lbs
Depth of maximum bending moment  =    96.00000000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =             16
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 Shear and Moment (BC Type 1)
Specified shear force at pile head  =       80000.000 lbs
Specified moment at pile head       =           0.000 in-lbs
Specified axial load at pile head   =      240000.000 lbs
```

(Zero moment for this load indicates free-head conditions)

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	Es*h F/L lbs/in
0.000	1.610	5.4243E-06	80000.0000	-0.0142592	530.5040	-81.3591	151.5850
6.000	1.525	499069.	79252.8379	-0.0142336	898.2324	-167.6950	659.9513
12.000	1.439	992027.	77961.5240	-0.0141573	1261.4583	-262.7430	1095.2466
18.000	1.355	1475380.	76088.9381	-0.0140311	1617.6071	-361.4523	1600.8525
24.000	1.271	1945504.	73624.0638	-0.0138560	1964.0078	-460.1725	2172.3485
30.000	1.188	2398774.	70580.0369	-0.0136337	2297.9908	-554.5031	2799.4561
36.000	1.107	2831729.	66965.9616	-0.0133661	2617.0047	-650.1886	3522.8293
42.000	1.028	3240860.	62803.7578	-0.0130554	2918.4643	-737.2127	4302.5519
48.000	0.950721	3622974.	58137.2722	-0.0127042	3200.0168	-818.2825	5164.1784
54.000	0.875609	3975095.	53053.6558	-0.0123154	3459.4702	-876.2563	6004.4365
60.000	0.802937	4295086.	47687.4749	-0.0118922	3695.2486	-912.4707	6818.4983
66.000	0.732902	4581595.	42146.9903	-0.0114380	3906.3566	-934.3575	7649.2381
72.000	0.665681	4833791.	36431.8558	-0.0109562	4092.1824	-970.6873	8749.1210
78.000	0.601428	5050331.	30552.4354	-0.0104505	4251.7351	-989.1194	9867.7132
84.000	0.540276	5230518.	24622.2080	-0.0099244	4384.5021	-987.6230	10967.9931
90.000	0.482335	5374380.	18735.7047	-0.0093818	4490.5037	-974.5448	12122.8391
96.000	0.427694	5482366.	12818.6681	-0.0088262	4570.0710	-997.8008	13997.8586
102.000	0.376420	5553623.	6790.5780	-0.0082615	4622.5756	-1011.5626	16123.9443
108.000	0.328556	5587646.	718.6932	-0.0076915	4647.6445	-1012.3990	18488.1654
114.000	0.284123	5584399.	-5325.6378	-0.0071198	4645.2520	-1002.3780	21167.8676
120.000	0.243118	5544243.	-11321.9754	-0.0065504	4615.6642	-996.4012	24590.5371
126.000	0.205518	5467400.	-17249.4866	-0.0059869	4559.0440	-979.4358	28594.1371
132.000	0.171275	5354492.	-23041.1882	-0.0054332	4475.8497	-951.1314	33319.3922
138.000	0.140320	5206553.	-28628.0941	-0.0048928	4366.8445	-911.1706	38961.0699
144.000	0.112562	5025046.	-33939.2713	-0.0043692	4233.1044	-859.2218	45799.9238
150.000	0.087889	4811866.	-38901.4971	-0.0038659	4076.0270	-794.8535	54262.7966
156.000	0.066171	4569362.	-43438.1845	-0.0033859	3897.3429	-717.3757	65047.1768
162.000	0.047259	4300359.	-47466.8584	-0.0029320	3699.1338	-625.5156	79415.5903
168.000	0.030987	4008204.	-50807.5440	-0.0025069	3483.8653	-488.0462	94500.0000
174.000	0.017176	3697888.	-53111.0913	-0.0021126	3255.2158	-279.8029	97740.0000
180.000	0.005636	3376955.	-54235.0741	-0.0017506	3018.7427	-94.8580	100980.
186.000	-0.003830	3052109.	-54320.0495	-0.0014216	2779.3867	66.5329	104220.
192.000	-0.011423	2729208.	-53506.7015	-0.0011258	2541.4642	204.5831	107460.
198.000	-0.017340	2413271.	-51933.2079	-0.0008626	2308.6721	319.9148	110700.
204.000	-0.021774	2108494.	-49732.9728	-0.0006313	2084.1040	413.4969	113940.
210.000	-0.024915	1818293.	-47032.7301	-0.0004303	1870.2752	486.5840	117180.
216.000	-0.026938	1545341.	-43951.0139	-0.0002582	1669.1561	540.6548	120420.
222.000	-0.028013	1291624.	-40596.9848	-0.0001131	1482.2105	577.3549	123660.
228.000	-0.028295	1058502.	-37069.5939	7.1963E-06	1310.4395	598.4421	126900.
234.000	-0.027927	846769.	-33457.0589	0.0001047	1154.4277	605.7363	130140.
240.000	-0.027039	656716.	-29836.6262	0.0001816	1014.3917	601.0746	133380.
246.000	-0.025748	488206.	-26274.5859	0.0002402	890.2284	586.2721	136620.

252.000	-0.024156	340729.	-22826.5076	0.0002826	781.5634	563.0873	139860.
258.000	-0.022356	213474.	-19537.6626	0.0003110	687.7978	533.1943	143100.
264.000	-0.020425	105382.	-16443.5996	0.0003273	608.1524	498.1600	146340.
270.000	-0.018429	15208.1312	-13570.8397	0.0003335	541.7098	459.4266	149580.
276.000	-0.016423	-58428.5327	-10937.6609	0.0003312	573.5558	418.2996	152820.
282.000	-0.014454	-116998.	-8554.9424	0.0003223	616.7114	375.9399	156060.
288.000	-0.012556	-162016.	-6427.0415	0.0003080	649.8821	333.3604	159300.
294.000	-0.010758	-195009.	-4552.6815	0.0002897	674.1925	291.4263	162540.
300.000	-0.009079	-217483.	-2925.8271	0.0002686	690.7515	250.8585	165780.
306.000	-0.007534	-230893.	-1536.5322	0.0002457	700.6326	212.2398	169020.
312.000	-0.006131	-236629.	-371.7443	0.0002218	704.8588	176.0228	172260.
318.000	-0.004873	-235992.	583.9452	0.0001976	704.3901	142.5403	175500.
324.000	-0.003760	-230190.	1347.6143	0.0001737	700.1148	112.0160	178740.
330.000	-0.002789	-220321.	1937.3922	0.0001507	692.8432	84.5766	181980.
336.000	-0.001952	-207375.	2371.9141	0.0001288	683.3042	60.2640	185220.
342.000	-0.001243	-192229.	2669.8492	0.0001083	672.1442	39.0477	188460.
348.000	-0.000652	-175649.	2849.5026	8.9511E-05	659.9274	20.8368	191700.
354.000	-0.000169	-158293.	2928.4882	7.2424E-05	647.1390	5.4917	194940.
360.000	0.000217	-140716.	2923.4693	5.7124E-05	634.1876	-7.1647	198180.
366.000	0.000516	-123376.	2849.9629	4.3610E-05	621.4110	-17.3374	201420.
372.000	0.000740	-106642.	2722.2017	3.1841E-05	609.0809	-25.2496	204660.
378.000	0.000899	-90801.2613	2553.0491	2.1738E-05	597.4090	-31.1346	207900.
384.000	0.001001	-76068.0016	2353.9596	1.3199E-05	586.5531	-35.2285	211140.
390.000	0.001057	-62591.7598	2134.9808	6.1043E-06	576.6234	-37.7644	214380.
396.000	0.001074	-50465.8121	1904.7879	3.1933E-07	567.6887	-38.9666	217620.
402.000	0.001061	-39735.2244	1670.7474	-4.2961E-06	559.7821	-39.0469	220860.
408.000	0.001023	-30404.4709	1439.0025	-7.8851E-06	552.9069	-38.2013	224100.
414.000	0.000966	-22444.4852	1214.5763	-1.0589E-05	547.0417	-36.6074	227340.
420.000	0.000896	-15799.0575	1001.4864	-1.2546E-05	542.1452	-34.4226	230580.
426.000	0.000816	-10390.5151	802.8675	-1.3886E-05	538.1600	-31.7837	233820.
432.000	0.000729	-6124.6553	621.0977	-1.4731E-05	535.0168	-28.8062	237060.
438.000	0.000639	-2894.9170	457.9249	-1.5193E-05	532.6370	-25.5847	240300.
444.000	0.000547	-585.8008	314.5904	-1.5371E-05	530.9356	-22.1935	243540.
450.000	0.000454	924.4355	191.9455	-1.5354E-05	531.1851	-18.6881	246780.
456.000	0.000363	1761.7632	90.5613	-1.5216E-05	531.8021	-15.1066	250020.
462.000	0.000272	2054.9937	10.8269	-1.5021E-05	532.0182	-11.4715	253260.
468.000	0.000182	1934.9458	-44.3624	-1.4817E-05	531.9297	-6.9249	227943.
474.000	9.40E-05	1565.3177	-75.9486	-1.4638E-05	531.6574	-3.6039	230103.
480.000	6.63E-06	1065.7185	-87.5300	-1.4503E-05	531.2892	-0.2565540	232263.
486.000	-8.01E-05	556.7264	-78.9153	-1.4420E-05	530.9142	3.1281	234423.
492.000	-0.000166	160.2642	-49.8459	-1.4383E-05	530.6221	6.5617	236583.
498.000	-0.000253	0.0000	0.0000	-1.4375E-05	530.5040	10.0536	119372.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

```
Pile-head deflection             =     1.61016704 in
Computed slope at pile head      =    -0.01425916
Maximum bending moment           =       5587646. lbs-in
Maximum shear force              =    80000.00000 lbs
Depth of maximum bending moment  =      108.00000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =             18
Number of zero deflection points =              3
```

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

```
Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad
```

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
1	V= 1.20E+05	M= 0.000	240000.	3.2495	1.0026E+07	120000.
1	V= 10000.	M= 0.000	240000.	0.0709056	414509.	10000.0000
1	V= 20000.	M= 0.000	240000.	0.1710947	930299.	20000.0000
1	V= 40000.	M= 0.000	240000.	0.5482246	2297523.	40000.0000
1	V= 60000.	M= 0.000	240000.	1.0268	3835181.	60000.0000
1	V= 80000.	M= 0.000	240000.	1.6102	5587646.	80000.0000
1	V= 90000.	M= 0.000	240000.	1.9579	6586712.	90000.0000
1	V= 1.00E+05	M= 0.000	240000.	2.3455	7658801.	100000.0000
1	V= 1.40E+05	M= 0.000	240000.	4.3398	1.2655E+07	140000.
1	V= 1.60E+05	M= 0.000	240000.	5.6318	1.5504E+07	160000.

Pile-head Deflection vs. Pile Length

Boundary Condition Type 1, Shear and Moment

```
Shear      =         120000. lbs
Moment     =              0. in-lbs
Axial Load =         240000. lbs
```

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
498.000	3.24945435	10025518.	120000.00000
473.100	3.24861911	10022580.	120000.00000
448.200	3.24875346	10019124.	120000.00000
423.300	3.24794917	10022252.	120000.00000
398.400	3.24792765	10020049.	120000.00000
373.500	3.25001059	10022052.	120000.00000
348.600	3.25013876	10020502.	120000.00000
323.700	3.25016615	10020432.	120000.00000
298.800	3.25755295	10018393.	120000.00000
273.900	3.32453423	10015642.	120000.00000

This analysis ended normally.

```
================================================================================

               LPILE Plus for Windows, Version 5.0 (5.0.41)

              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:

Geotech SJ
URS

Path to file locations:      X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\Arroyo
Del Valle Trial Bridge\
Name of input data file:     Arroyo Del Valle Trial Bridge_Bent 2_ Fixed_scour_rev 3 total.lpd
Name of output file:         Arroyo Del Valle Trial Bridge_Bent 2_ Fixed_scour_rev 3 total.lpo
Name of plot output file:    Arroyo Del Valle Trial Bridge_Bent 2_ Fixed_scour_rev 3 total.lpp
Name of runtime file:        Arroyo Del Valle Trial Bridge_Bent 2_ Fixed_scour_rev 3 total.lpr


--------------------------------------------------------------------------------
                          Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  December 18, 2014     Time:  12:06:07


--------------------------------------------------------------------------------
                               Problem Title
--------------------------------------------------------------------------------

SR84 Isabel Bent 2- Arroyo Del Valle Trial Bridge- 24 inch CIDH pile (4.5' scour


--------------------------------------------------------------------------------
                               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            =          83
- 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                                =     498.00 in

Depth of ground surface below top of pile =      -7.00 in

Slope angle of ground surface              =       0.00 deg.

Structural properties of pile defined using  2 points

Point    Depth         Pile      Moment of       Pile      Modulus of
          X          Diameter     Inertia        Area      Elasticity
          in            in         in**4        Sq.in      lbs/Sq.in
-----  ---------   -----------   ----------   ----------   ----------
  1       0.0000   24.00000000   16286.0000     452.4000      3600000.
  2     498.0000   24.00000000   16286.0000     452.4000      3600000.


--------------------------------------------------------------------------------
                     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    =       -7.000 in
Distance from top of pile to bottom of layer =      468.000 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    =      468.000 in
Distance from top of pile to bottom of layer =      528.000 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  3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      528.000 in
Distance from top of pile to bottom of layer =      708.000 in
p-y subgrade modulus k for top of soil layer =      175.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      175.000 lbs/in**3

Layer  4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      708.000 in
Distance from top of pile to bottom of layer =     1194.000 in
p-y subgrade modulus k for top of soil layer =      200.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      200.000 lbs/in**3


(Depth of lowest layer extends  696.00 in below pile tip)


--------------------------------------------------------------------------------
                  Effective Unit Weight of Soil vs. Depth
--------------------------------------------------------------------------------

Effective unit weight of soil with depth defined using  8 points

Point        Depth X    Eff. Unit Weight
 No.           in          lbs/in**3
-----      ----------   ----------------
  1           -7.00         0.03620
  2          468.00         0.03620
  3          468.00         0.02750
  4          528.00         0.02750
  5          528.00         0.04490
  6          708.00         0.04490
  7          708.00         0.04780
  8         1194.00         0.04780
```

Shear Strength of Soils

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	-7.000	0.00000	38.00	------	------
2	468.000	0.00000	38.00	------	------
3	468.000	0.00000	32.00	------	------
4	528.000	0.00000	32.00	------	------
5	528.000	0.00000	40.00	------	------
6	708.000	0.00000	40.00	------	------
7	708.000	0.00000	42.00	------	------
8	1194.000	0.00000	42.00	------	------

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.

Loading Type

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 Shear and Slope (BC Type 2)
Shear force at pile head = 5000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 2

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 10000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 3

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 20000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 4

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 40000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 5

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 60000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 6

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 80000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 7

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 100000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 8

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 120000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 9

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 140000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 10

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 160000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Computed Values of Load Distribution and Deflection for Lateral Loading for Load Case Number 4

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Specified shear force at pile head = 40000.000 lbs
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head conditions)

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	Es*h F/L lbs/in
0.000	0.145415	-2257962.	40000.0000	0.0000	2194.2361	-46.0894	950.8495
6.000	0.144722	-2018625.	39584.0903	-0.0002188	2017.8858	-92.5472	3836.8898
12.000	0.142789	-1782323.	38877.8235	-0.0004133	1843.7712	-142.8751	6003.5996
18.000	0.139762	-1550901.	37870.4875	-0.0005839	1673.2530	-192.9035	8281.3502
24.000	0.135783	-1326195.	36569.7590	-0.0007311	1507.6832	-240.6726	10634.8813
30.000	0.130989	-1109958.	34999.4828	-0.0008557	1348.3535	-282.7528	12951.5692
36.000	0.125514	-903737.	33187.3604	-0.0009588	1196.4036	-321.2880	15358.6646
42.000	0.119484	-708949.	31169.8403	-0.0010413	1052.8780	-351.2187	17636.7940
48.000	0.113018	-526700.	28986.6840	-0.0011045	918.5917	-376.5000	19987.8958
54.000	0.106230	-357927.	26684.1763	-0.0011498	794.2353	-391.0026	22084.4020
60.000	0.099221	-203178.	24323.3377	-0.0011785	680.2116	-395.9436	23943.1665
66.000	0.092087	-62653.1466	21965.6186	-0.0011921	576.6686	-389.9627	25408.1991
72.000	0.084916	63842.4872	19639.5072	-0.0011920	577.5450	-385.4077	27232.2994
78.000	0.077783	176454.	17374.7917	-0.0011798	660.5205	-369.4974	28502.2121
84.000	0.070759	275738.	15239.2907	-0.0011566	733.6755	-342.3362	29028.5361
90.000	0.063904	362657.	13274.4731	-0.0011239	797.7199	-312.6030	29350.7667
96.000	0.057271	438268.	11390.0399	-0.0010830	853.4329	-315.5415	33057.6102
102.000	0.050908	502456.	9501.1166	-0.0010348	900.7282	-314.0996	37019.7098
108.000	0.044853	555262.	7634.0732	-0.0009807	939.6372	-308.2482	41234.2335
114.000	0.039139	596889.	5808.2776	-0.0009218	970.3094	-300.3504	46043.0955
120.000	0.033792	627616.	4006.6555	-0.0008591	992.9498	-300.1904	53300.5284
126.000	0.028830	647443.	2215.8739	-0.0007939	1007.5591	-296.7368	61755.1938
132.000	0.024266	656493.	455.9523	-0.0007271	1014.2270	-289.9037	71681.5909
138.000	0.020105	655009.	-1200.8581	-0.0006600	1013.1337	-262.3664	78300.0000
144.000	0.016346	643983.	-2654.3695	-0.0005936	1005.0097	-222.1374	81540.0000
150.000	0.012982	624866.	-3871.0893	-0.0005286	990.9234	-183.4359	84780.0000
156.000	0.010002	599053.	-4861.5878	-0.0004660	971.9035	-146.7303	88020.0000
162.000	0.007390	567869.	-5638.9818	-0.0004063	948.9264	-112.4011	91260.0000
168.000	0.005127	532555.	-6218.4127	-0.0003500	922.9061	-80.7426	94500.0000
174.000	0.003190	494256.	-6616.5396	-0.0002974	894.6862	-51.9664	97740.0000
180.000	0.001557	454013.	-6851.0585	-0.0002489	865.0342	-26.2066	100980.
186.000	0.000203	412760.	-6940.2545	-0.0002046	834.6377	-3.5255	104220.
192.000	-0.000898	371319.	-6902.5940	-0.0001645	804.1030	16.0790	107460.
198.000	-0.001770	330403.	-6756.3605	-0.0001285	773.9543	32.6656	110700.
204.000	-0.002440	290613.	-6519.3374	-9.6772E-05	744.6363	46.3421	113940.
210.000	-0.002932	252449.	-6208.5397	-6.8984E-05	716.5160	57.2571	117180.
216.000	-0.003268	216309.	-5839.9931	-4.4998E-05	689.8871	65.5918	120420.
222.000	-0.003472	182499.	-5428.5608	-2.4592E-05	664.9746	71.5523	123660.
228.000	-0.003563	151238.	-4987.8156	-7.5147E-06	641.9402	75.3627	126900.
234.000	-0.003562	122667.	-4529.9543	6.5006E-06	620.8885	77.2577	130140.
240.000	-0.003485	96859.4163	-4065.7503	1.7733E-05	601.8728	77.4769	133380.
246.000	-0.003349	73826.8260	-3604.5422	2.6467E-05	584.9017	76.2591	136620.
252.000	-0.003168	53528.6837	-3154.2523	3.2984E-05	569.9455	73.8376	139860.
258.000	-0.002953	35880.8052	-2721.4312	3.7559E-05	556.9420	70.4361	143100.
264.000	-0.002717	20763.3402	-2311.3251	4.0457E-05	545.8030	66.2659	146340.
270.000	-0.002468	8028.3872	-1927.9599	4.1930E-05	536.4195	61.5225	149580.
276.000	-0.002214	-2492.9387	-1574.2388	4.2214E-05	532.3408	56.3845	152820.
282.000	-0.001961	-10984.0542	-1252.0493	4.1524E-05	538.5974	51.0120	156060.
288.000	-0.001715	-17637.1194	-962.3759	4.0060E-05	543.4995	45.5458	159300.
294.000	-0.001481	-22647.9366	-705.4158	3.7998E-05	547.1916	40.1076	162540.
300.000	-0.001259	-26211.5444	-480.6938	3.5498E-05	549.8174	34.7998	165780.
306.000	-0.001055	-28518.4968	-287.1743	3.2698E-05	551.5172	29.7067	169020.
312.000	-0.000867	-29751.8052	-123.3691	2.9716E-05	552.4260	24.8950	172260.
318.000	-0.000698	-30084.5085	12.5617	2.6654E-05	552.6711	20.4153	175500.
324.000	-0.000547	-29677.8292	122.7168	2.3596E-05	552.3715	16.3031	178740.
330.000	-0.000415	-28679.8649	209.3687	2.0610E-05	551.6361	12.5809	181980.
336.000	-0.000300	-27224.7620	274.8892	1.7750E-05	550.5640	9.2592	185220.
342.000	-0.000202	-25432.3143	321.6828	1.5055E-05	549.2433	6.3386	188460.
348.000	-0.000119	-23407.9279	352.1315	1.2556E-05	547.7516	3.8110	191700.
354.000	-5.11E-05	-21242.8978	368.5478	1.0272E-05	546.1564	1.6611	194940.
360.000	3.98E-06	-19014.9366	373.1368	8.2116E-06	544.5147	-0.1314662	198180.
366.000	4.74E-05	-16788.9060	367.9675	6.3796E-06	542.8745	-1.5916	201420.
372.000	8.05E-05	-14617.6998	354.9514	4.7726E-06	541.2747	-2.7471	204660.
378.000	0.000105	-12543.2336	335.8285	3.3828E-06	539.7462	-3.6273	207900.
384.000	0.000121	-10597.5004	312.1592	2.1987E-06	538.3125	-4.2625	211140.
390.000	0.000131	-8803.6560	285.3225	1.2060E-06	536.9908	-4.6830	214380.
396.000	0.000136	-7177.1032	256.5188	3.8824E-07	535.7923	-4.9182	217620.
402.000	0.000136	-5726.5484	226.7759	-2.7202E-07	534.7235	-4.9961	220860.
408.000	0.000132	-4455.0084	196.9595	-7.9300E-07	533.7866	-4.9427	224100.
414.000	0.000126	-3360.7506	167.7850	-1.1929E-06	532.9803	-4.7821	227340.
420.000	0.000118	-2438.1530	139.8321	-1.4896E-06	532.3005	-4.5355	230580.
426.000	0.000108	-1678.4754	113.5601	-1.7003E-06	531.7407	-4.2218	233820.
432.000	9.76E-05	-1070.5348	89.3242	-1.8409E-06	531.2928	-3.8569	237060.
438.000	8.62E-05	-601.2834	67.3915	-1.9265E-06	530.9470	-3.4540	240300.
444.000	7.45E-05	-256.2884	47.9576	-1.9704E-06	530.6928	-3.0239	243540.
450.000	6.26E-05	-20.1171	31.1618	-1.9845E-06	530.5188	-2.5747	246780.
456.000	5.07E-05	123.3689	17.1017	-1.9792E-06	530.5949	-2.1121	250020.
462.000	3.88E-05	190.8030	5.8462	-1.9632E-06	530.6446	-1.6398	253260.
468.000	2.71E-05	199.1777	-2.1648	-1.9432E-06	530.6507	-1.0306	227943.
474.000	1.55E-05	170.4222	-7.0432	-1.9243E-06	530.6296	-0.5955515	230103.
480.000	4.04E-06	120.2017	-9.2985	-1.9094E-06	530.5925	-0.1562254	232263.
486.000	-7.38E-06	64.3394	-8.9017	-1.9000E-06	530.5514	0.2884922	234423.
492.000	-1.88E-05	18.8534	-5.8166	-1.8957E-06	530.5179	0.7398742	236583.
498.000	-3.01E-05	0.0000	0.0000	-1.8948E-06	530.5040	1.1990	119372.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

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Pile-head deflection             =     0.14541539 in
Computed slope at pile head      =        0.00000
Maximum bending moment           =      -2257962. lbs-in
Maximum shear force              =    40000.00000 lbs
Depth of maximum bending moment  =        0.00000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =             12
Number of zero deflection points =              3
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Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 6

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Specified shear force at pile head = 80000.000 lbs
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head conditions)

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	Es*h F/L lbs/in
0.000	0.424971	-5278459.	80000.0000	0.0000	4419.8266	-61.7350	435.8064
6.000	0.423350	-4799181.	79437.6841	-0.0005157	4066.6808	-125.7037	1781.5561
12.000	0.418783	-4323722.	78474.4899	-0.0009825	3716.3483	-195.3611	2798.9842
18.000	0.411561	-3854658.	77090.8201	-0.0014009	3370.7284	-265.8622	3875.9147
24.000	0.401971	-3394597.	75290.2990	-0.0017719	3031.7422	-334.3114	4990.0776
30.000	0.390298	-2946071.	73097.5084	-0.0020963	2701.2553	-396.6188	6097.1689
36.000	0.376816	-2511390.	70539.2283	-0.0023756	2380.9691	-456.1413	7263.0960
42.000	0.361791	-2092759.	67654.2174	-0.0026112	2072.5098	-505.5290	8383.7726
48.000	0.345482	-1692019.	64492.6959	-0.0028048	1777.2328	-548.3115	9522.5580
54.000	0.328133	-1310769.	61111.6288	-0.0029585	1496.3166	-578.7109	10581.8776
60.000	0.309980	-950159.	57562.7951	-0.0030742	1230.6088	-604.2337	11695.6016
66.000	0.291243	-611162.	53896.9392	-0.0031541	980.8256	-617.7183	12725.8216
72.000	0.272131	-294312.	50129.4912	-0.0032004	747.3616	-638.0977	14068.8917
78.000	0.252839	-390.5447	46283.2352	-0.0032155	530.7917	-643.9876	15282.1795
84.000	0.233546	270347.	42450.1801	-0.0032017	729.7038	-633.6974	16280.2545
90.000	0.214419	518232.	38700.9051	-0.0031613	912.3527	-616.0609	17238.9943
96.000	0.195610	743863.	34940.7499	-0.0030967	1078.6038	-637.3242	19548.8045
102.000	0.177258	946440.	31074.8124	-0.0030102	1227.8685	-651.3217	22046.5372
108.000	0.159487	1125430.	27148.3141	-0.0029042	1359.7536	-657.5111	24735.9101
114.000	0.142408	1280584.	23199.8476	-0.0027811	1474.0755	-658.6444	27750.3805

120.000	0.126114	1411838.	19218.3077	-0.0026433	1570.7872	-668.5356	31806.1996
126.000	0.110688	1518816.	15195.7307	-0.0024934	1649.6122	-672.3234	36444.3621
132.000	0.096194	1601367.	11169.5216	-0.0023337	1710.4382	-669.7463	41774.8602
138.000	0.082683	1659572.	7178.4627	-0.0021669	1753.3248	-660.6067	47937.7901
144.000	0.070191	1693750.	3262.3415	-0.0019953	1778.5081	-644.7670	55115.1000
150.000	0.058740	1704466.	-538.3783	-0.0018214	1786.4044	-622.1395	63548.8318
156.000	0.048335	1692535.	-4182.8041	-0.0016476	1777.6129	-592.6691	73570.8014
162.000	0.038969	1659018.	-7629.7217	-0.0014761	1752.9165	-556.3035	85653.7443
168.000	0.030622	1605229.	-10745.5037	-0.0013091	1713.2836	-482.2905	94500.0000
174.000	0.023260	1533842.	-13329.0976	-0.0011484	1660.6832	-378.9075	97740.0000
180.000	0.016840	1448587.	-15316.0942	-0.0009958	1597.8654	-283.4247	100980.
186.000	0.011310	1352916.	-16755.7447	-0.0008525	1527.3723	-196.4588	104220.
192.000	0.006611	1249974.	-17700.3165	-0.0007193	1451.5210	-118.3985	107460.
198.000	0.002679	1142584.	-18203.7821	-0.0005969	1372.3933	-49.4234	110700.
204.000	-0.000552	1033247.	-18320.6261	-0.0004855	1291.8306	10.4754	113940.
210.000	-0.003148	924135.	-18104.7829	-0.0003854	1211.4336	61.4724	117180.
216.000	-0.005176	817100.	-17608.7126	-0.0002963	1132.5668	103.8844	120420.
222.000	-0.006703	713684.	-16882.6187	-0.0002179	1056.3670	138.1469	123660.
228.000	-0.007791	615136.	-15973.8084	-0.0001500	983.7541	164.7899	126900.
234.000	-0.008502	522430.	-14926.1902	-9.1747E-05	915.4456	184.4161	130140.
240.000	-0.008892	436286.	-13779.9046	-4.2690E-05	851.9721	197.6791	133380.
246.000	-0.009015	357194.	-12571.0772	-2.0891E-06	793.6949	205.2634	136620.
252.000	-0.008918	285439.	-11331.6851	3.0794E-05	740.8237	207.8673	139860.
258.000	-0.008645	221125.	-10089.5249	5.6714E-05	693.4354	206.1861	143100.
264.000	-0.008237	164201.	-8868.2690	7.6430E-05	651.4923	200.8992	146340.
270.000	-0.007728	114486.	-7687.5977	9.0690E-05	614.8604	192.6579	149580.
276.000	-0.007149	71688.9577	-6563.3947	0.0001002	583.3265	182.0765	152820.
282.000	-0.006525	35436.3713	-5507.9920	0.0001057	556.6145	169.7244	156060.
288.000	-0.005880	5288.6423	-4530.4541	0.0001078	534.4008	156.1215	159300.
294.000	-0.005232	-19239.4909	-3636.8875	0.0001071	544.6802	141.7340	162540.
300.000	-0.004595	-38662.3649	-2830.7675	0.0001041	558.9915	126.9727	165780.
306.000	-0.003983	-53508.5249	-2113.2714	9.9389E-05	569.9306	112.1927	169020.
312.000	-0.003403	-64307.8625	-1483.6107	9.3361E-05	577.8879	97.6942	172260.
318.000	-0.002862	-71580.7321	-939.3549	8.6407E-05	583.2468	83.7244	175500.
324.000	-0.002366	-75828.9752	-476.7410	7.8865E-05	586.3770	70.4803	178740.
330.000	-0.001916	-77528.7540	-90.9637	7.1018E-05	587.6294	58.1121	181980.
336.000	-0.001514	-77125.0707	223.5557	6.3104E-05	587.3320	46.7277	185220.
342.000	-0.001159	-75027.8255	472.9273	5.5319E-05	585.7867	36.3962	188460.
348.000	-0.000850	-71609.2610	663.5757	4.7815E-05	583.2678	27.1533	191700.
354.000	-0.000585	-67202.6263	802.0514	4.0713E-05	580.0208	19.0053	194940.
360.000	-0.000361	-62101.8964	894.8701	3.4096E-05	576.2625	11.9342	198180.
366.000	-0.000176	-56562.3821	948.3780	2.8024E-05	572.1808	5.9017	201420.
372.000	-2.50E-05	-50802.0705	968.6437	2.2531E-05	567.9364	0.8535038	204660.
378.000	9.46E-05	-45003.5463	961.3741	1.7628E-05	563.6639	-3.2767	207900.
384.000	0.000187	-39316.3511	931.8532	1.3314E-05	559.4734	-6.5636	211140.
390.000	0.000254	-33859.6526	884.9003	9.5696E-06	555.4528	-9.0873	214380.
396.000	0.000301	-28725.1076	824.8479	6.3672E-06	551.6695	-10.9302	217620.
402.000	0.000331	-23979.8151	755.5339	3.6704E-06	548.1730	-12.1745	220860.
408.000	0.000345	-19669.2719	680.3082	1.4369E-06	544.9969	-12.9007	224100.
414.000	0.000348	-15820.2550	602.0509	-3.7902E-07	542.1608	-13.1851	227340.
420.000	0.000341	-12443.5695	523.1989	-1.8252E-06	539.6728	-13.0989	230580.
426.000	0.000326	-9536.6121	445.7800	-2.9499E-06	537.5308	-12.7073	233820.
432.000	0.000305	-7085.7137	371.4527	-3.8005E-06	535.7249	-12.0684	237060.
438.000	0.000280	-5068.2347	301.5484	-4.4224E-06	534.2384	-11.2330	240300.
444.000	0.000252	-3454.3968	237.1165	-4.8585E-06	533.0493	-10.2443	243540.
450.000	0.000222	-2208.8437	178.9698	-5.1483E-06	532.1315	-9.1380	246780.
456.000	0.000191	-1291.9318	127.7284	-5.3274E-06	531.4559	-7.9425	250020.
462.000	0.000158	-660.7600	83.8624	-5.4273E-06	530.9908	-6.6795	253260.
468.000	0.000125	-269.9524	49.5231	-5.4749E-06	530.7029	-4.7670	227943.
474.000	9.25E-05	-50.7153	24.5748	-5.4913E-06	530.5413	-3.5492	230103.
480.000	5.96E-05	40.7599	7.0080	-5.4918E-06	530.5340	-2.3064	232263.
486.000	2.66E-05	49.1975	-3.0341	-5.4872E-06	530.5402	-1.0410	234423.
492.000	-6.27E-06	20.1534	-5.4159	-5.4837E-06	530.5188	0.2470447	236583.
498.000	-3.92E-05	0.0000	0.0000	-5.4827E-06	530.5040	1.5582	119372.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection = 0.42497067 in

Computed slope at pile head = 0.00000
Maximum bending moment = -5278459. lbs-in
Maximum shear force = 80000.00000 lbs
Depth of maximum bending moment = 0.00000 in
Depth of maximum shear force = 0.00000 in
Number of iterations = 14
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 Shear and Slope (BC Type 2)
Specified shear force at pile head = 160000.000 lbs
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 240000.000 lbs

(Zero slope for this load indicates fixed-head conditions)

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	Es*h F/L lbs/in
0.000	1.142	-1.1915E+07	160000.	7.4015E-17	9310.0321	-81.3592	213.7069
6.000	1.138	-1.0956E+07	159253.	-0.0011703	8603.1082	-167.6953	883.8040
12.000	1.128	-1.0001E+07	157962.	-0.0022426	7899.4430	-262.7435	1397.4847
18.000	1.112	-9053872.	156089.	-0.0032176	7201.6614	-361.4529	1951.0852
24.000	1.089	-8118544.	153624.	-0.0040963	6512.4845	-460.1733	2534.3223
30.000	1.062	-7198586.	150580.	-0.0048801	5834.6325	-554.5041	3131.6462
36.000	1.031	-6297530.	146966.	-0.0055706	5170.7076	-650.1898	3784.2140
42.000	0.995541	-5418952.	142804.	-0.0061702	4523.3457	-737.2140	4443.0971
48.000	0.956856	-4566115.	138137.	-0.0066811	3894.9506	-818.2840	5131.0794
54.000	0.915368	-3742063.	133014.	-0.0071062	3287.7654	-889.4035	5829.8122
60.000	0.871581	-2949479.	127482.	-0.0074486	2703.7661	-954.7690	6572.6659
66.000	0.825984	-2190832.	121619.	-0.0077116	2144.7726	-999.5500	7260.7917
72.000	0.779042	-1467845.	115430.	-0.0078988	1612.0551	-1063.1904	8188.4455
78.000	0.731198	-782917.	108907.	-0.0080140	1107.3802	-1111.3480	9119.3974
84.000	0.682874	-137882.	102149.	-0.0080611	632.0998	-1141.3883	10028.6890
90.000	0.634465	466083.	95242.1316	-0.0080443	873.9273	-1160.7846	10977.2954
96.000	0.586342	1028191.	88112.7667	-0.0079679	1288.1050	-1215.6704	12439.8781
102.000	0.538850	1546383.	80683.2548	-0.0078361	1669.9243	-1260.8336	14039.1505
108.000	0.492308	2018958.	73014.0909	-0.0076537	2018.1311	-1295.5544	15789.5477
114.000	0.447006	2444595.	65160.5788	-0.0074253	2331.7529	-1322.2830	17748.5259
120.000	0.403205	2822270.	57127.9703	-0.0071558	2610.0347	-1355.2532	20167.2226
126.000	0.361136	3150739.	48922.7023	-0.0068502	2852.0607	-1379.8361	22924.9056
132.000	0.321003	3429071.	40602.6481	-0.0065135	3057.1433	-1393.5153	26046.8011
138.000	0.282974	3656730.	32234.7972	-0.0061509	3224.8894	-1395.7684	29594.9362
144.000	0.247192	3833603.	23888.9113	-0.0057677	3355.2145	-1386.1936	33646.6238
150.000	0.213763	3960008.	15636.8386	-0.0053689	3448.3533	-1364.4973	38299.4202
156.000	0.182765	4036707.	7551.8813	-0.0049597	3504.8677	-1330.4884	43678.6122
162.000	0.154246	4064914.	-291.7785	-0.0045451	3525.6514	-1284.0648	49948.5707
168.000	0.128224	4046296.	-7819.5470	-0.0041301	3511.9329	-1225.1913	57330.6860
174.000	0.104685	3982974.	-14956.7059	-0.0037192	3465.2757	-1153.8616	66133.1413
180.000	0.083593	3877527.	-21628.3940	-0.0033170	3387.5789	-1070.0344	76803.4510
186.000	0.064881	3732987.	-27759.0670	-0.0029276	3281.0775	-973.5232	90028.6005
192.000	0.048461	3552850.	-33271.0118	-0.0025548	3148.3472	-863.7917	106946.
198.000	0.034223	3341092.	-37756.6441	-0.0022021	2992.3184	-631.4190	110700.
204.000	0.022037	3106112.	-40906.3317	-0.0018722	2819.1778	-418.4768	113940.
210.000	0.011757	2855608.	-42850.6263	-0.0015671	2634.5995	-229.6213	117180.
216.000	0.003231	2596418.	-43734.0558	-0.0012881	2443.6202	-64.8551	120420.
222.000	-0.003700	2334509.	-43699.8374	-0.0010358	2250.6386	76.2613	123660.
228.000	-0.009198	2075003.	-42887.4142	-0.0008102	2059.4265	194.5465	126900.
234.000	-0.013423	1822194.	-41430.3713	-0.0006108	1873.1495	291.1345	130140.
240.000	-0.016528	1579597.	-39454.7317	-0.0004367	1694.3973	367.4120	133380.
246.000	-0.018663	1349995.	-37077.6205	-0.0002868	1525.2195	424.9584	136620.
252.000	-0.019969	1135492.	-34406.2800	-0.0001596	1367.1675	465.4885	139860.
258.000	-0.020579	937579.	-31537.4122	-5.3554E-05	1221.3396	490.8008	143100.
264.000	-0.020612	757197.	-28556.8203	3.3165E-05	1088.4289	502.7298	146340.
270.000	-0.020181	594802.	-25539.3185	0.0001023	968.7713	503.1041	149580.

276.000	-0.019384	450431.	-22548.8756	0.0001558	862.3943	493.7102	152820.
282.000	-0.018311	323766.	-19638.9586	0.0001954	769.0646	476.2621	156060.
288.000	-0.017039	214200.	-16853.0419	0.0002230	688.3329	452.3768	159300.
294.000	-0.015635	120888.	-14225.2475	0.0002401	619.5776	423.5547	162540.
300.000	-0.014157	42805.6305	-11781.0863	0.0002485	562.0444	391.1657	165780.
306.000	-0.012653	-21200.8865	-9538.2680	0.0002496	546.1254	356.4404	169020.
312.000	-0.011162	-72372.4263	-7507.5540	0.0002448	583.8301	320.4643	172260.
318.000	-0.009715	-111997.	-5693.6279	0.0002354	613.0263	284.1777	175500.
324.000	-0.008338	-141374.	-4095.9626	0.0002224	634.6724	248.3774	178740.
330.000	-0.007047	-161789.	-2709.6651	0.0002069	649.7146	213.7218	181980.
336.000	-0.005855	-174486.	-1526.2840	0.0001897	659.0701	180.7386	185220.
342.000	-0.004770	-180650.	-534.5678	0.0001715	663.6125	149.8335	188460.
348.000	-0.003797	-181394.	278.8359	0.0001530	664.1607	121.3011	191700.
354.000	-0.002934	-177745.	928.7469	0.0001346	661.4717	95.3359	194940.
360.000	-0.002181	-170637.	1430.8875	0.0001168	656.2345	72.0443	198180.
366.000	-0.001533	-160911.	1801.3905	9.9827E-05	649.0677	51.4567	201420.
372.000	-0.000983	-149308.	2056.3774	8.3953E-05	640.5185	33.5390	204660.
378.000	-0.000525	-136476.	2211.6075	6.9330E-05	631.0634	18.2044	207900.
384.000	-0.000151	-122968.	2282.1934	5.6054E-05	621.1107	5.3242	211140.
390.000	0.000147	-109251.	2282.3798	4.4172E-05	611.0034	-5.2621	214380.
396.000	0.000379	-95707.0721	2225.3800	3.3685E-05	601.0237	-13.7378	217620.
402.000	0.000551	-82643.5272	2123.2654	2.4559E-05	591.3981	-20.3004	220860.
408.000	0.000673	-70298.6167	1986.9019	1.6733E-05	582.3021	-25.1541	224100.
414.000	0.000752	-58848.8948	1825.9273	1.0125E-05	573.8656	-28.5041	227340.
420.000	0.000795	-48416.6475	1648.7636	4.6359E-06	566.1788	-30.5505	230580.
426.000	0.000808	-39077.0835	1462.6586	1.5899E-07	559.2971	-31.4845	233820.
432.000	0.000797	-30865.2026	1273.7517	-3.4199E-06	553.2464	-31.4844	237060.
438.000	0.000767	-23782.2134	1087.1580	-6.2161E-06	548.0274	-30.7135	240300.
444.000	0.000722	-17801.4038	907.0657	-8.3439E-06	543.6206	-29.3173	243540.
450.000	0.000667	-12873.3947	736.8433	-9.9135E-06	539.9895	-27.4235	246780.
456.000	0.000603	-8930.7335	579.1521	-1.1029E-05	537.0844	-25.1403	250020.
462.000	0.000534	-5891.8054	436.0601	-1.1788E-05	534.8452	-22.5571	253260.
468.000	0.000462	-3664.0637	315.7493	-1.2277E-05	533.2038	-17.5465	227943.
474.000	0.000387	-2067.4576	218.5752	-1.2570E-05	532.0273	-14.8448	230103.
480.000	0.000311	-1004.9596	137.9207	-1.2727E-05	531.2445	-12.0401	232263.
486.000	0.000234	-375.7558	74.3311	-1.2798E-05	530.7808	-9.1565	234423.
492.000	0.000157	-76.1294	28.2360	-1.2821E-05	530.5601	-6.2086	236583.
498.000	8.05E-05	0.0000	0.0000	-1.2825E-05	530.5040	-3.2034	119372.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

```
Pile-head deflection             =     1.14211376 in
Computed slope at pile head      =   7.401487E-17
Maximum bending moment           =     -11915283. lbs-in
Maximum shear force              =   160000.00000 lbs
Depth of maximum bending moment  =        0.00000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =             15
Number of zero deflection points =              2
```

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

```
Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad
```

Load Type	Pile-Head Condition	Pile-Head Condition	Axial Load	Pile-Head Deflection	Maximum Moment	Maximum Shear
1	2	lbs	in	in-lbs	lbs	
2	V= 5000.000	S= 0.000	240000.	0.0139334	-254882.	5000.0000
2	V= 10000.	S= 0.000	240000.	0.0278668	-509764.	10000.0000
2	V= 20000.	S= 0.000	240000.	0.0559295	-1019537.	20000.0000
2	V= 40000.	S= 0.000	240000.	0.1454154	-2257962.	40000.0000
2	V= 60000.	S= 0.000	240000.	0.2746035	-3722413.	60000.0000
2	V= 80000.	S= 0.000	240000.	0.4249707	-5278459.	80000.0000
2	V= 1.00E+05	S= 0.000	240000.	0.5903082	-6889245.	100000.
2	V= 1.20E+05	S= 0.000	240000.	0.7642868	-8521036.	120000.
2	V= 1.40E+05	S= 0.000	240000.	0.9439438	-1.0166E+07	140000.
2	V= 1.60E+05	S= 0.000	240000.	1.1421	-1.1915E+07	160000.

Pile-head Deflection vs. Pile Length

Boundary Condition Type 2, Shear and Slope

```
Shear      =          5000. lbs
Slope      =       0.00000
Axial Load =       240000. lbs
```

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
498.000	0.01393341	-254882.16708	5000.00000
473.100	0.01392996	-254872.74415	5000.00000
448.200	0.01392668	-254863.70553	5000.00000
423.300	0.01392361	-254854.80116	5000.00000
398.400	0.01392092	-254846.43015	5000.00000
373.500	0.01391888	-254841.80852	5000.00000
348.600	0.01391763	-254848.32786	5000.00000
323.700	0.01391647	-254868.66631	5000.00000
298.800	0.01391448	-254870.51864	5000.00000
273.900	0.01391741	-254759.29827	5000.00000

This analysis ended normally.

ABUT 3

LPILE Plus for Windows, Version 5.0 (5.0.41)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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Path to file locations: X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\Arroyo Del Valle Trial Bridge\
Name of input data file: Arroyo Del Valle Trial Bridge_Abut3_ Free_r_scour_rev2_total.lpd
Name of output file: Arroyo Del Valle Trial Bridge_Abut3_ Free_r_scour_rev2_total.lpo
Name of plot output file: Arroyo Del Valle Trial Bridge_Abut3_ Free_r_scour_rev2_total.lpp
Name of runtime file: Arroyo Del Valle Trial Bridge_Abut3_ Free_r_scour_rev2_total.lpr

Time and Date of Analysis

Date: December 11, 2014 Time: 14:14:19

Problem Title

SR84 Isabel Abut 3- ADV Trial - 24' CIDH pile - scour=4.5 ft

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 = 80
- 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 = 480.00 in

Depth of ground surface below top of pile = 0.00 in

Slope angle of ground surface = 0.00 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	24.00000000	16286.0000	452.4000	3600000.
2	480.0000	24.00000000	16286.0000	452.4000	3600000.

Soil and Rock Layering Information

The soil profile is modelled using 3 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 0.000 in
Distance from top of pile to bottom of layer = 540.000 in
p-y subgrade modulus k for top of soil layer = 175.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 175.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 540.000 in
Distance from top of pile to bottom of layer = 576.000 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 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 576.000 in
Distance from top of pile to bottom of layer = 700.000 in
p-y subgrade modulus k for top of soil layer = 200.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 200.000 lbs/in**3

(Depth of lowest layer extends 220.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 6 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	0.00	0.04780
2	540.00	0.04780
3	540.00	0.02750
4	576.00	0.02750
5	576.00	0.04780
6	700.00	0.04780

Shear Strength of Soils

Shear strength parameters with depth defined using 6 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	0.000	0.00000	40.00	------	------
2	540.000	0.00000	40.00	------	------
3	540.000	0.00000	32.00	------	------
4	576.000	0.00000	32.00	------	------
5	576.000	0.00000	42.00	------	------
6	700.000	0.00000	42.00	------	------

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.

Loading Type

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 Shear and Moment (BC Type 1)
Shear force at pile head = 5000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 145000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 2

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 10000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 145000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 3

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 20000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 145000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 4

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 25000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 145000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 5

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 30000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 145000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 6

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 40000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 145000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 7

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 50000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 145000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 8

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 60000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 145000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 9

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 70000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 145000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 10

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 80000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 145000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Specified shear force at pile head = 10000.000 lbs
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 145000.000 lbs

(Zero moment for this load indicates free-head conditions)

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	Es*h F/L lbs/in
0.000	0.055089	1.0171E-07	10000.0000	-0.0007244	320.5128	0.0000	0.0000
6.000	0.050743	60630.2322	9870.0243	-0.0007213	365.1869	-43.3252	5122.8993

12.000	0.046434	119695.	9465.7006	-0.0007121	408.7079	-91.4494	11816.7396
18.000	0.042198	175458.	8792.5804	-0.0006970	449.7951	-132.9240	18900.0000
24.000	0.038070	226419.	7914.1246	-0.0006764	487.3450	-159.8946	25200.0000
30.000	0.034081	271604.	6897.6622	-0.0006509	520.6386	-178.9262	31500.0000
36.000	0.030259	310324.	5788.9880	-0.0006211	549.1683	-190.6318	37800.0000
42.000	0.026627	342153.	4629.9585	-0.0005878	572.6210	-195.7113	44100.0000
48.000	0.023206	366906.	3458.0368	-0.0005515	590.8597	-194.9292	50400.0000
54.000	0.020010	384609.	2305.9767	-0.0005130	603.9038	-189.0908	56700.0000
60.000	0.017050	395470.	1201.6441	-0.0004731	611.9068	-179.0200	63000.0000
66.000	0.014332	399852.	167.9709	-0.0004324	615.1352	-165.5377	69300.0000
72.000	0.011861	398238.	-776.9701	-0.0003916	613.9464	-149.4426	75600.0000
78.000	0.009633	391209.	-1619.7823	-0.0003512	608.7673	-131.4948	81900.0000
84.000	0.007646	379412.	-2351.4691	-0.0003118	600.0746	-112.4008	88200.0000
90.000	0.005892	363534.	-2967.0821	-0.0002737	588.3755	-92.8035	94500.0000
96.000	0.004361	344283.	-3465.3108	-0.0002375	574.1908	-73.2727	100800.
102.000	0.003042	322364.	-3848.0311	-0.0002034	558.0399	-54.3007	107100.
108.000	0.001921	298461.	-4119.8304	-0.0001716	540.4275	-36.2990	113400.
114.000	0.000982	273224.	-4287.5222	-0.0001424	521.8326	-19.5983	119700.
120.000	0.000212	247258.	-4359.6681	-0.0001158	502.7000	-4.4504	126000.
126.000	-0.000407	221110.	-4346.1160	-9.1790E-05	483.4330	8.9678	132300.
132.000	-0.000890	195265.	-4257.5664	-7.0485E-05	464.3895	20.5488	138600.
138.000	-0.001253	170142.	-4105.1751	-5.1787E-05	445.8782	30.2483	144900.
144.000	-0.001511	146093.	-3900.1981	-3.5606E-05	428.1581	38.0774	151200.
150.000	-0.001680	123401.	-3653.6825	-2.1816E-05	411.4385	44.0945	157500.
156.000	-0.001773	102286.	-3376.2064	-1.0268E-05	395.8804	48.3975	163800.
162.000	-0.001803	82904.7029	-3077.6678	-7.9229E-07	381.5994	51.1153	170100.
168.000	-0.001782	65355.7711	-2767.1219	6.7940E-06	368.6689	52.3999	176400.
174.000	-0.001721	49687.4183	-2452.6647	1.2681E-05	357.1240	52.4191	182700.
180.000	-0.001630	35901.7301	-2141.3588	1.7060E-05	346.9663	51.3495	189000.
186.000	-0.001517	23961.4283	-1839.1985	2.0123E-05	338.1683	49.3706	195300.
192.000	-0.001389	13796.3333	-1551.1094	2.2055E-05	330.6784	46.6591	201600.
198.000	-0.001252	5309.7390	-1280.9764	2.3033E-05	324.4252	43.3852	207900.
204.000	-0.001112	-1615.4612	-1031.6967	2.3222E-05	321.7031	39.7081	214200.
210.000	-0.000973	-7111.0275	-805.2513	2.2775E-05	325.7524	35.7737	220500.
216.000	-0.000839	-11318.1061	-602.7914	2.1832E-05	328.8523	31.7129	226800.
222.000	-0.000711	-14382.5122	-424.7335	2.0517E-05	331.1103	27.6397	233100.
228.000	-0.000593	-16450.6087	-270.8613	1.8940E-05	332.6341	23.6511	239400.
234.000	-0.000484	-17665.8027	-140.4277	1.7194E-05	333.5295	19.8268	245700.
240.000	-0.000386	-18165.6591	-32.2570	1.5360E-05	333.8978	16.2301	252000.
246.000	-0.000300	-18079.6146	55.1583	1.3506E-05	333.8344	12.9083	258300.
252.000	-0.000224	-17527.2603	123.5662	1.1684E-05	333.4274	9.8943	264600.
258.000	-0.000160	-16617.1506	174.8721	9.9368E-06	332.7568	7.2077	270900.
264.000	-0.000105	-15446.0853	211.0646	8.2961E-06	331.8939	4.8565	277200.
270.000	-6.01E-05	-14098.8103	234.1511	6.7844E-06	330.9012	2.8390	283500.
276.000	-2.37E-05	-12648.0763	246.1033	5.4158E-06	329.8323	1.1450	289800.
282.000	4.90E-06	-11154.9947	248.8122	4.1978E-06	328.7321	-0.2420447	296100.
288.000	2.67E-05	-9669.6336	244.0541	3.1322E-06	327.6377	-1.3440	302400.
294.000	4.25E-05	-8231.7956	233.4635	2.2162E-06	326.5782	-2.1862	308700.
300.000	5.33E-05	-6871.9272	218.5163	1.4434E-06	325.5763	-2.7962	315000.
306.000	5.98E-05	-5612.1113	200.5188	8.0460E-07	324.6480	-3.2029	321300.
312.000	6.29E-05	-4467.1016	180.6042	2.8886E-07	323.8043	-3.4353	327600.
318.000	6.33E-05	-3445.3633	159.7341	-1.1601E-07	323.0515	-3.5214	333900.
324.000	6.15E-05	-2550.0905	138.7044	-4.2279E-07	322.3918	-3.4885	340200.
330.000	5.82E-05	-1780.1748	118.1550	-6.4436E-07	321.8245	-3.3613	346500.
336.000	5.38E-05	-1131.1089	98.5820	-7.9333E-07	321.3463	-3.1630	352800.
342.000	4.87E-05	-595.8101	80.3516	-8.8169E-07	320.9518	-2.9138	359100.
348.000	4.32E-05	-165.3553	63.7154	-9.2064E-07	320.6347	-2.6316	365400.
354.000	3.76E-05	170.3761	48.8256	-9.2038E-07	320.6384	-2.3316	371700.
360.000	3.22E-05	422.1531	35.7510	-8.9006E-07	320.8239	-2.0266	378000.
366.000	2.70E-05	600.9367	24.4916	-8.3771E-07	320.9556	-1.7266	384300.
372.000	2.21E-05	717.5098	14.9928	-7.7025E-07	321.0415	-1.4397	390600.
378.000	1.77E-05	782.1905	7.1584	-6.9351E-07	321.0892	-1.1718	396900.
384.000	1.38E-05	804.6179	0.8625191	-6.1232E-07	321.1057	-0.9268782	403200.
390.000	1.04E-05	793.6061	-4.0405	-5.3054E-07	321.0976	-0.7074766	409500.
396.000	7.43E-06	757.0545	-7.7069	-4.5119E-07	321.0706	-0.5146481	415800.
402.000	4.95E-06	701.9082	-10.2959	-3.7654E-07	321.0300	-0.3483486	422100.
408.000	2.91E-06	634.1588	-11.9638	-3.0817E-07	320.9801	-0.2076248	428400.
414.000	1.25E-06	558.8784	-12.8592	-2.4713E-07	320.9246	-0.0908204	434700.
420.000	-5.76E-08	480.2788	-13.1189	-1.9396E-07	320.8667	0.0042355	441000.
426.000	-1.07E-06	401.7889	-12.8660	-1.4882E-07	320.8089	0.0800599	447300.
432.000	-1.84E-06	326.1453	-12.2078	-1.1157E-07	320.7531	0.1393674	453600.
438.000	-2.41E-06	255.4900	-11.2348	-8.1813E-08	320.7011	0.1849410	459900.
444.000	-2.83E-06	191.4697	-10.0214	-5.8942E-08	320.6539	0.2195208	466200.
450.000	-3.12E-06	135.3352	-8.6258	-4.2220E-08	320.6125	0.2457083	472500.
456.000	-3.33E-06	88.0342	-7.0910	-3.0791E-08	320.5777	0.2658837	478800.
462.000	-3.49E-06	50.2971	-5.4469	-2.3712E-08	320.5499	0.2821335	485100.
468.000	-3.62E-06	22.7123	-3.7120	-1.9977E-08	320.5296	0.2961851	491400.
474.000	-3.73E-06	5.7882	-1.8954	-1.8518E-08	320.5171	0.3093463	497700.
480.000	-3.84E-06	0.0000	0.0000	-1.8222E-08	320.5128	0.3224459	252000.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	0.05508944 in
Computed slope at pile head	=	-0.00072440
Maximum bending moment	=	399851.71942 lbs-in
Maximum shear force	=	10000.00000 lbs
Depth of maximum bending moment	=	66.00000000 in
Depth of maximum shear force	=	0.00000 in
Number of iterations	=	5
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 Shear and Moment (BC Type 1)
Specified shear force at pile head = 40000.000 lbs
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 145000.000 lbs

(Zero moment for this load indicates free-head conditions)

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	Es*h F/L lbs/in
0.000	0.406203	3.6162E-07	40000.0000	-0.0044610	320.5128	0.0000	0.0000
6.000	0.379438	243881.	39776.2321	-0.0044485	500.2115	-74.5893	1179.4712
12.000	0.352822	485055.	39064.3078	-0.0044112	677.9156	-162.7188	2767.1569
18.000	0.326503	720328.	37803.5784	-0.0043495	851.2717	-257.5243	4732.4044
24.000	0.300627	946266.	35978.3777	-0.0042642	1017.7494	-350.8759	7002.8708
30.000	0.275333	1159489.	33608.8062	-0.0041565	1174.8578	-438.9813	9566.2052
36.000	0.250750	1356804.	30750.1071	-0.0040277	1320.2458	-513.9184	12297.1685
42.000	0.227000	1535498.	27460.9021	-0.0038797	1451.9126	-582.4832	15396.0470
48.000	0.204193	1693086.	23816.7429	-0.0037145	1568.0278	-632.2365	18577.6337
54.000	0.182425	1827762.	19902.8680	-0.0035344	1667.2614	-672.3885	22114.9640
60.000	0.161780	1938070.	15812.5590	-0.0033417	1748.5394	-691.0478	25629.1247
66.000	0.142325	2023327.	11652.7116	-0.0031390	1811.3596	-695.5680	29323.0450
72.000	0.124112	2083364.	7541.7559	-0.0029288	1855.5965	-674.7506	32619.6334
78.000	0.107179	2118925.	3543.1226	-0.0027138	1881.7984	-658.1272	36842.6993
84.000	0.091547	2130604.	-289.4392	-0.0024964	1890.4039	-619.3934	40595.2927
90.000	0.077222	2119795.	-3825.7024	-0.0022789	1882.4398	-559.3610	43461.0374
96.000	0.064200	2088661.	-6945.8416	-0.0020636	1859.4990	-480.6854	44923.9699
102.000	0.052460	2040036.	-9771.7730	-0.0018523	1823.6706	-461.2918	52759.4791
108.000	0.041972	1974622.	-12452.4254	-0.0016469	1775.4723	-432.2590	61791.9897
114.000	0.032697	1893472.	-14931.2621	-0.0014489	1715.6783	-394.0199	72303.0553
120.000	0.024585	1797968.	-17155.0313	-0.0012601	1645.3085	-347.2365	84743.4273
126.000	0.017577	1689804.	-19126.1635	-0.0010816	1565.6099	-309.8075	105756.
132.000	0.011606	1570336.	-20842.6270	-0.0009148	1477.5826	-262.3470	135627.
138.000	0.006599	1441284.	-22107.7935	-0.0007607	1382.4932	-159.3752	144900.
144.000	0.002478	1306367.	-22773.2435	-0.0006201	1283.0818	-62.4415	151200.
150.000	-0.000842	1169084.	-22894.2939	-0.0004934	1181.9283	22.0913	157500.
156.000	-0.003443	1032494.	-22546.0268	-0.0003808	1081.2842	93.9977	163800.
162.000	-0.005411	899195.	-21803.8513	-0.0002819	983.0657	153.3941	170100.
168.000	-0.006826	771338.	-20741.5990	-0.0001964	888.8571	200.6900	176400.
174.000	-0.007768	650637.	-19429.9196	-0.0001237	799.9213	236.5365	182700.
180.000	-0.008310	538394.	-17934.9808	-6.2840E-05	717.2173	261.7765	189000.

186.000	-0.008522	435527.	-16317.4673	-1.3006E-05	641.4217	277.3947	195300.
192.000	-0.008466	342607.	-14631.8668	2.6810E-05	572.9557	284.4721	201600.
198.000	-0.008200	259898.	-12926.0202	5.7640E-05	512.0131	284.1434	207900.
204.000	-0.007775	187395.	-11240.9135	8.0527E-05	458.5906	277.5588	214200.
210.000	-0.007234	124867.	-9610.6818	9.6505E-05	412.5183	265.8518	220500.
216.000	-0.006617	71898.4327	-8062.7931	0.0001066	373.4897	250.1111	226800.
222.000	-0.005955	27927.7545	-6618.3833	0.0001117	341.0908	231.3588	233100.
228.000	-0.005277	-7716.4917	-5292.7072	0.0001127	326.1986	210.5332	239400.
234.000	-0.004603	-35780.8563	-4095.6785	0.0001105	346.8772	188.4764	245700.
240.000	-0.003951	-57056.8860	-3032.4682	0.0001057	362.5540	165.9271	252000.
246.000	-0.003334	-72354.4617	-2104.1365	9.9118E-05	373.8257	143.5169	258300.
252.000	-0.002761	-82478.9880	-1308.2746	9.1195E-05	381.2857	121.7704	264600.
258.000	-0.002239	-88212.4361	-639.6385	8.2461E-05	385.5103	101.1083	270900.
264.000	-0.001772	-90298.1318	-90.7555	7.3327E-05	387.0471	81.8527	277200.
270.000	-0.001359	-89429.0906	347.5069	6.4130E-05	386.4068	64.2348	283500.
276.000	-0.001002	-86239.6357	685.4213	5.5142E-05	384.0567	48.4034	289800.
282.000	-0.000698	-81299.9815	933.9358	4.6569E-05	380.4170	34.4348	296100.
288.000	-0.000443	-75113.4354	1104.2695	3.8565E-05	375.8586	22.3431	302400.
294.000	-0.000235	-68115.8515	1207.5684	3.1236E-05	370.7026	12.0899	308700.
300.000	-6.85E-05	-60676.9663	1254.6233	2.4646E-05	365.2214	3.5951	315000.
306.000	6.08E-05	-53103.2565	1255.6455	1.8824E-05	359.6408	-3.2543	321300.
312.000	0.000157	-45641.9745	1220.0981	1.3772E-05	354.1432	-8.5948	327600.
318.000	0.000226	-38486.0422	1156.5777	9.4669E-06	348.8705	-12.5786	333900.
324.000	0.000271	-31779.5146	1072.7417	5.8715E-06	343.9289	-15.3667	340200.
330.000	0.000296	-25623.3579	975.2749	2.9343E-06	339.3929	-17.1223	346500.
336.000	0.000306	-20081.3218	869.8893	5.9564E-07	335.3093	-18.0062	352800.
342.000	0.000304	-15185.7226	761.3525	-1.2089E-06	331.7021	-18.1727	359100.
348.000	0.000292	-10942.9883	653.5369	-2.5459E-06	328.5759	-17.7658	365400.
354.000	0.000273	-7338.8499	549.4863	-3.4814E-06	325.9203	-16.9177	371700.
360.000	0.000250	-4343.0957	451.4935	-4.0791E-06	323.7129	-15.7465	378000.
366.000	0.000224	-1913.8305	361.1859	-4.3993E-06	321.9230	-14.3560	384300.
372.000	0.000197	-1.2105	279.6137	-4.4973E-06	320.5137	-12.8347	390600.
378.000	0.000170	1449.3595	207.3393	-4.4232E-06	321.5808	-11.2568	396900.
384.000	0.000144	2494.5573	144.5233	-4.2214E-06	322.3509	-9.6819	403200.
390.000	0.000120	3190.9840	91.0071	-3.9304E-06	322.8640	-8.1568	409500.
396.000	9.69E-05	3593.4810	46.3888	-3.5833E-06	323.1606	-6.7159	415800.
402.000	7.65E-05	3753.8846	10.0926	-3.2073E-06	323.2788	-5.3828	422100.
408.000	5.84E-05	3720.1732	-18.5700	-2.8249E-06	323.2540	-4.1714	428400.
414.000	4.26E-05	3535.9598	-40.3468	-2.4536E-06	323.1182	-3.0875	434700.
420.000	2.90E-05	3240.2808	-55.9994	-2.1069E-06	322.9004	-2.1300	441000.
426.000	1.73E-05	2867.6324	-66.2662	-1.7943E-06	322.6258	-1.2922	447300.
432.000	7.45E-06	2448.2090	-71.8320	-1.5223E-06	322.3167	-0.5630629	453600.
438.000	-9.34E-07	2008.2973	-73.3063	-1.2943E-06	321.9926	0.0716231	459900.
444.000	-8.08E-06	1570.7853	-71.2072	-1.1112E-06	321.6702	0.6280969	466200.
450.000	-1.43E-05	1155.7449	-65.9520	-9.7164E-07	321.3644	1.1236	472500.
456.000	-1.97E-05	781.0522	-57.8545	-8.7254E-07	321.0883	1.5755	478800.
462.000	-2.47E-05	463.0088	-47.1276	-8.0888E-07	320.8540	2.0001	485100.
468.000	-2.94E-05	216.9288	-33.8913	-7.7409E-07	320.6727	2.4120	491400.
474.000	-3.40E-05	57.6599	-18.1876	-7.6004E-07	320.5553	2.8226	497700.
480.000	-3.86E-05	0.0000	0.0000	-7.5709E-07	320.5128	3.2399	252000.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection	=	0.40620349 in
Computed slope at pile head	=	-0.00446097
Maximum bending moment	=	2130604. lbs-in
Maximum shear force	=	40000.00000 lbs
Depth of maximum bending moment	=	84.00000000 in
Depth of maximum shear force	=	0.00000 in
Number of iterations	=	17
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 Shear and Moment (BC Type 1)
Specified shear force at pile head = 80000.000 lbs
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 145000.000 lbs

(Zero moment for this load indicates free-head conditions)

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	Es*h F/L lbs/in
0.000	1.215	-1.4465E-06	80000.0000	-0.0117715	320.5128	0.0000	0.0000
6.000	1.145	490241.	79696.4092	-0.0117464	681.7368	-101.1969	530.4688
12.000	1.074	976796.	78707.2587	-0.0116713	1040.2444	-228.5199	1276.3084
18.000	1.005	1455036.	76905.7196	-0.0115469	1392.6261	-371.9932	2221.8338
24.000	0.935722	1919756.	74220.2428	-0.0113742	1735.0450	-523.1658	3354.6215
30.000	0.868066	2365470.	70656.1563	-0.0111550	2063.4605	-664.8631	4595.4760
36.000	0.801863	2787039.	66328.5452	-0.0108913	2374.0848	-777.6739	5819.0036
42.000	0.737371	3180364.	61344.4270	-0.0105860	2663.8977	-883.6988	7190.6741
48.000	0.674831	3541592.	55797.0538	-0.0102420	2930.0612	-965.4256	8583.7044
54.000	0.614467	3867750.	49805.1591	-0.0098629	3170.3836	-1031.8727	10075.7880
60.000	0.556477	4156415.	43497.3877	-0.0094523	3383.0810	-1070.7178	11544.6076
66.000	0.501039	4406165.	36954.0811	-0.0090142	3567.1040	-1110.3844	13296.9783
72.000	0.448307	4615549.	30258.5729	-0.0085525	3721.3840	-1121.4516	15009.1591
78.000	0.398409	4784150.	23435.2250	-0.0080716	3845.6138	-1152.9976	17364.0403
84.000	0.351448	4910816.	16505.1619	-0.0075755	3938.9455	-1157.0234	19752.9548
90.000	0.307503	4995393.	9649.0868	-0.0070686	4001.2640	-1128.3349	22016.0776
96.000	0.266625	5038905.	3070.1129	-0.0065552	4033.3248	-1064.6564	23958.5048
102.000	0.228841	5043640.	-3329.6882	-0.0060392	4036.8141	-1068.6107	28017.9660
108.000	0.194154	5009457.	-9700.3236	-0.0055248	4011.6267	-1054.9345	32600.9301
114.000	0.162543	4936850.	-15934.6963	-0.0050159	3958.1276	-1023.1897	37769.2911
120.000	0.133963	4826968.	-21924.5234	-0.0045163	3877.1637	-973.4193	43597.8456
126.000	0.108348	4681614.	-27653.1562	-0.0040298	3770.0623	-936.1250	51840.1087
132.000	0.085606	4502142.	-33113.8574	-0.0035598	3637.8223	-884.1088	61965.6420
138.000	0.065630	4290441.	-38216.8633	-0.0031099	3481.8352	-816.8932	74682.1823
144.000	0.048287	4048951.	-42868.7429	-0.0026832	3303.8979	-733.7333	91171.1407
150.000	0.033431	3780685.	-46969.5115	-0.0022826	3106.2320	-633.1895	113641.
156.000	0.020896	3489288.	-50405.2417	-0.0019106	2891.5223	-512.0539	147028.
162.000	0.010504	3179147.	-52834.7673	-0.0015694	2663.0009	-297.7880	170100.
168.000	0.002064	2858002.	-53910.1583	-0.0012605	2426.3720	-60.6757	176400.
174.000	-0.004622	2534418.	-53670.0110	-0.0009845	2187.9460	140.7248	182700.
180.000	-0.009751	2215675.	-52326.4037	-0.0007415	1953.0867	307.1443	189000.
186.000	-0.013519	1907791.	-50084.8167	-0.0005305	1726.2292	440.0514	195300.
192.000	-0.016116	1615580.	-47140.1251	-0.0003502	1510.9193	541.5125	201600.
198.000	-0.017722	1342719.	-43673.4232	-0.0001988	1309.8676	614.0548	207900.
204.000	-0.018502	1091845.	-39849.6550	-7.4254E-05	1125.0160	660.5346	214200.
210.000	-0.018613	864653.	-35816.0026	2.5858E-05	957.6141	684.0161	220500.
216.000	-0.018192	662008.	-31700.9724	0.0001040	808.2996	687.6606	226800.
222.000	-0.017365	484060.	-27614.1014	0.0001626	677.1824	674.6297	233100.
228.000	-0.016241	330356.	-23646.2043	0.0002043	563.9286	648.0027	239400.
234.000	-0.014914	199950.	-19870.0724	0.0002314	467.8419	610.7080	245700.
240.000	-0.013464	91512.1759	-16341.5393	0.0002463	387.9417	565.4697	252000.
246.000	-0.011957	3423.0061	-13100.8274	0.0002512	323.0350	514.7676	258300.
252.000	-0.010449	-66134.8352	-10174.0949	0.0002480	369.2429	460.8099	264600.
258.000	-0.008982	-119098.	-7575.1101	0.0002385	408.2674	405.5184	270900.
264.000	-0.007587	-157451.	-5306.9846	0.0002244	436.5274	350.5234	277200.
270.000	-0.006289	-183172.	-3363.9100	0.0002069	455.4792	297.1681	283500.
276.000	-0.005104	-198178.	-1732.8465	0.0001874	466.5363	246.5198	289800.
282.000	-0.004040	-204292.	-395.1250	0.0001668	471.0412	199.3874	296100.
288.000	-0.003102	-203210.	672.0680	0.0001460	470.2438	156.3436	302400.
294.000	-0.002289	-196481.	1494.3462	0.0001255	465.2860	117.7492	308700.
300.000	-0.001596	-185496.	2098.9351	0.0001060	457.1918	83.7804	315000.
306.000	-0.001017	-171478.	2513.6445	8.7709E-05	446.8631	54.4561	321300.
312.000	-0.000543	-155485.	2766.0076	7.0978E-05	435.0787	29.6650	327600.
318.000	-0.000165	-138410.	2882.5794	5.5940E-05	422.4972	9.1923	333900.
324.000	0.000128	-120991.	2888.3892	4.2667E-05	409.6628	-7.2557	340200.
330.000	0.000347	-103823.	2806.5353	3.1163E-05	397.0129	-20.0289	346500.
336.000	0.000502	-87367.2246	2657.9085	2.1380E-05	384.8875	-29.5133	352800.
342.000	0.000603	-71965.7242	2461.0307	1.3228E-05	373.5393	-36.1127	359100.
348.000	0.000661	-57857.8727	2231.9906	6.5846E-06	363.1442	-40.2340	365400.
354.000	0.000682	-45193.2945	1984.4641	1.3116E-06	353.8126	-42.2748	371700.

360.000	0.000676	-34046.5852	1729.8008	-2.7430E-06	345.5993	-42.6130	378000.
366.000	0.000649	-24430.9124	1477.1630	-5.7352E-06	338.5142	-41.5996	384300.
372.000	0.000608	-16310.6498	1233.7049	-7.8199E-06	332.5310	-39.5531	390600.
378.000	0.000556	-9612.8466	1004.7774	-9.1463E-06	327.5958	-36.7561	396900.
384.000	0.000498	-4237.4068	794.1489	-9.8550E-06	323.6351	-33.4534	403200.
390.000	0.000437	-65.9119	604.2337	-1.0075E-05	320.5614	-29.8517	409500.
396.000	0.000377	3030.9287	436.3180	-9.9235E-06	322.7461	-26.1202	415800.
402.000	0.000318	5187.1710	290.7791	-9.5030E-06	324.3349	-22.3927	422100.
408.000	0.000263	6536.8128	167.2921	-8.9031E-06	325.3293	-18.7696	428400.
414.000	0.000211	7210.1680	65.0210	-8.1997E-06	325.8255	-15.3208	434700.
420.000	0.000164	7331.3321	-17.2099	-7.4556E-06	325.9148	-12.0895	441000.
426.000	0.000122	7016.6221	-80.7636	-6.7215E-06	325.6829	-9.0951	447300.
432.000	8.38E-05	6373.8644	-127.0604	-6.0363E-06	325.2093	-6.3372	453600.
438.000	4.96E-05	5502.4007	-157.4692	-5.4286E-06	324.5671	-3.7991	459900.
444.000	1.87E-05	4493.6795	-173.2213	-4.9171E-06	323.8239	-1.4516	466200.
450.000	-9.44E-06	3432.3011	-175.3456	-4.5116E-06	323.0418	0.7434881	472500.
456.000	-3.55E-05	2397.3827	-164.6268	-4.2133E-06	322.2793	2.8294	478800.
462.000	-6.00E-05	1464.1107	-141.5854	-4.0157E-06	321.5916	4.8510	485100.
468.000	-8.36E-05	705.3449	-106.4809	-3.9047E-06	321.0325	6.8505	491400.
474.000	-0.000107	193.1343	-59.3383	-3.8587E-06	320.6551	8.8637	497700.
480.000	-0.000130	0.0000	0.0000	-3.8488E-06	320.5128	10.9157	252000.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

```
Pile-head deflection             =     1.21524216 in
Computed slope at pile head      =    -0.01177149
Maximum bending moment           =       5043640. lbs-in
Maximum shear force              =    80000.00000 lbs
Depth of maximum bending moment  =      102.00000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =             17
Number of zero deflection points =              3
```

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

```
Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad
```

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
1	V= 5000.000	M= 0.000	145000.	0.0273108	198314.	5000.0000
1	V= 10000.	M= 0.000	145000.	0.0550894	399852.	10000.0000
1	V= 20000.	M= 0.000	145000.	0.1264555	891151.	20000.0000
1	V= 25000.	M= 0.000	145000.	0.1833497	1180054.	25000.0000
1	V= 30000.	M= 0.000	145000.	0.2504239	1484000.	30000.0000
1	V= 40000.	M= 0.000	145000.	0.4062035	2130604.	40000.0000
1	V= 50000.	M= 0.000	145000.	0.5860281	2822369.	50000.0000
1	V= 60000.	M= 0.000	145000.	0.7833277	3541141.	60000.0000
1	V= 70000.	M= 0.000	145000.	0.9921912	4280408.	70000.0000
1	V= 80000.	M= 0.000	145000.	1.2152	5043640.	80000.0000

Pile-head Deflection vs. Pile Length

Boundary Condition Type 1, Shear and Moment

```
Shear      =           5000. lbs
Moment     =              0. in-lbs
Axial Load =         145000. lbs
```

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
480.000	0.02731076	198313.71224	5000.00000
456.000	0.02730095	198253.19481	5000.00000
432.000	0.02729166	197983.08501	5000.00000
408.000	0.02728289	198128.53983	5000.00000
384.000	0.02727461	198104.62790	5000.00000
360.000	0.02726689	198043.65928	5000.00000
336.000	0.02726034	197984.74280	5000.00000
312.000	0.02725691	197874.74802	5000.00000
288.000	0.02725904	197776.85945	5000.00000
264.000	0.02726427	197687.92401	5000.00000

This analysis ended normally.

```
================================================================================

               LPILE Plus for Windows, Version 5.0 (5.0.41)

              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:

Geotech SJ
URS

Path to file locations:      X:\Route 84 - Isabel Avenue\geotech\Analysis\pile\lateral\Arroyo
Del Valle Trial Bridge\
Name of input data file:     Arroyo Del Valle Trial Bridge_Abut3_
Fixed_re_scour_rev2_total.lpd
Name of output file:         Arroyo Del Valle Trial Bridge_Abut3_
Fixed_re_scour_rev2_total.lpo
Name of plot output file:    Arroyo Del Valle Trial Bridge_Abut3_
Fixed_re_scour_rev2_total.lpp
Name of runtime file:        Arroyo Del Valle Trial Bridge_Abut3_
Fixed_re_scour_rev2_total.lpr


--------------------------------------------------------------------------------
                         Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  December 11, 2014     Time:  14:11:13


--------------------------------------------------------------------------------
                                Problem Title
--------------------------------------------------------------------------------

SR84 Isabel Abut3- ADV Trail - 24" CIDH pile (scour =4.5ft)


--------------------------------------------------------------------------------
                                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           =          80
- 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                                 =     480.00 in

Depth of ground surface below top of pile =       0.00 in

Slope angle of ground surface               =       0.00 deg.

Structural properties of pile defined using  2 points

Point    Depth          Pile      Moment of       Pile      Modulus of
           X          Diameter     Inertia       Area      Elasticity
           in           in         in**4       Sq.in       lbs/Sq.in
-----  ---------   -----------   ----------   ----------   -----------
  1       0.0000   24.00000000   16286.0000     452.4000      3600000.
  2     480.0000   24.00000000   16286.0000     452.4000      3600000.


--------------------------------------------------------------------------------
                      Soil and Rock Layering Information
--------------------------------------------------------------------------------

The soil profile is modelled using  3 layers

Layer  1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =        0.000 in
Distance from top of pile to bottom of layer =      540.000 in
p-y subgrade modulus k for top of soil layer =      175.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      175.000 lbs/in**3

Layer  2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      540.000 in
Distance from top of pile to bottom of layer =      576.000 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  3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      576.000 in
Distance from top of pile to bottom of layer =      700.000 in
p-y subgrade modulus k for top of soil layer =      200.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      200.000 lbs/in**3


(Depth of lowest layer extends  220.00 in below pile tip)


--------------------------------------------------------------------------------
                  Effective Unit Weight of Soil vs. Depth
--------------------------------------------------------------------------------

Effective unit weight of soil with depth defined using  6 points

Point        Depth X    Eff. Unit Weight
 No.           in          lbs/in**3
-----      ----------   ----------------
  1            0.00         0.04780
  2          540.00         0.04780
  3          540.00         0.02750
  4          576.00         0.02750
  5          576.00         0.04780
  6          700.00         0.04780



--------------------------------------------------------------------------------
                            Shear Strength of Soils
```

Shear strength parameters with depth defined using 6 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	0.000	0.00000	40.00	------	------
2	540.000	0.00000	40.00	------	------
3	540.000	0.00000	32.00	------	------
4	576.000	0.00000	32.00	------	------
5	576.000	0.00000	42.00	------	------
6	700.000	0.00000	42.00	------	------

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.

Loading Type

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 Shear and Slope (BC Type 2)
Shear force at pile head = 5000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 145000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 2

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 10000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 145000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 3

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 20000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 145000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 4

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 25000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 145000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 5

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 30000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 145000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 6

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 40000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 145000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 7

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 50000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 145000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 8

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 60000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 145000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 9

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 70000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 145000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Load Case Number 10

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 80000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 145000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 2

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Specified shear force at pile head = 10000.000 lbs
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 145000.000 lbs

(Zero slope for this load indicates fixed-head conditions)

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	Es*h F/L lbs/in

0.000	0.020744	-471412.	10000.0000	1.1565E-18	667.8631	0.0000	0.0000
6.000	0.020599	-411391.	9935.1136	-4.5172E-05	623.6379	-21.6288	6300.0000
12.000	0.020202	-352112.	9742.9575	-8.4239E-05	579.9595	-42.4232	12600.0000
18.000	0.019588	-294329.	9430.5814	-0.0001173	537.3832	-61.7022	18900.0000
24.000	0.018794	-238741.	9008.6739	-0.0001446	496.4243	-78.9337	25200.0000
30.000	0.017853	-185974.	8490.6902	-0.0001663	457.5436	-93.7276	31500.0000
36.000	0.016798	-136564.	7892.0287	-0.0001828	421.1368	-105.8263	37800.0000
42.000	0.015659	-90951.0871	7229.2708	-0.0001945	387.5282	-115.0930	44100.0000
48.000	0.014464	-49473.8983	6519.4947	-0.0002017	356.9666	-121.4990	50400.0000
54.000	0.013239	-12366.2690	5779.6708	-0.0002048	329.6246	-125.1089	56700.0000
60.000	0.012006	20238.5397	5026.1450	-0.0002044	335.4252	-126.0664	63000.0000
66.000	0.010786	48303.1575	4274.2100	-0.0002009	356.1040	-124.5786	69300.0000
72.000	0.009595	71878.6448	3537.7684	-0.0001948	373.4751	-120.9019	75600.0000
78.000	0.008449	91095.2624	2829.0804	-0.0001864	387.6345	-115.3274	81900.0000
84.000	0.007358	106152.	2158.5959	-0.0001763	398.7287	-108.1674	88200.0000
90.000	0.006333	117305.	1534.8619	-0.0001649	406.9467	-99.7439	94500.0000
96.000	0.005380	124857.	964.4990	-0.0001525	412.5113	-90.3771	100800.
102.000	0.004503	129145.	452.2375	-0.0001395	415.6703	-80.3767	107100.
108.000	0.003706	130527.	1.0052	-0.0001262	416.6888	-70.0340	113400.
114.000	0.002988	129376.	-387.9443	-0.0001129	415.8410	-59.6158	119700.
120.000	0.002350	126068.	-714.8701	-9.9850E-05	413.4034	-49.3595	126000.
126.000	0.001790	120972.	-981.3608	-8.7210E-05	409.6482	-39.4707	132300.
132.000	0.001304	114443.	-1190.1360	-7.5164E-05	404.8381	-30.1210	138600.
138.000	0.000888	106821.	-1344.8411	-6.3842E-05	399.2214	-21.4474	144900.
144.000	0.000538	98416.3935	-1449.8437	-5.3340E-05	393.0289	-13.5535	151200.
150.000	0.000248	89515.3941	-1510.0348	-4.3724E-05	386.4704	-6.5102	157500.
156.000	1.31E-05	80372.0561	-1530.6423	-3.5031E-05	379.7333	-0.3589333	163800.
162.000	-0.000172	71208.6407	-1517.0596	-2.7275E-05	372.9814	4.8865	170100.
168.000	-0.000314	62214.7994	-1474.6920	-2.0448E-05	366.3545	9.2360	176400.
174.000	-0.000418	53547.9158	-1408.8237	-1.4524E-05	359.9685	12.7201	182700.
180.000	-0.000488	45334.1874	-1324.5056	-9.4647E-06	353.9164	15.3859	189000.
186.000	-0.000531	37670.3166	-1226.4652	-5.2174E-06	348.2694	17.2942	195300.
192.000	-0.000551	30625.6837	-1119.0365	-1.7228E-06	343.0787	18.5153	201600.
198.000	-0.000552	24244.8762	-1006.1115	1.0848E-06	338.3772	19.1263	207900.
204.000	-0.000538	18550.4577	-891.1092	3.2746E-06	334.1813	19.2078	214200.
210.000	-0.000513	13545.8683	-776.9616	4.9169E-06	330.4938	18.8414	220500.
216.000	-0.000479	9218.3627	-666.1154	6.0818E-06	327.3052	18.1073	226800.
222.000	-0.000440	5541.9007	-560.5453	6.8370E-06	324.5963	17.0827	233100.
228.000	-0.000397	2479.9230	-461.7779	7.2475E-06	322.3401	15.8397	239400.
234.000	-0.000353	-12.0450	-370.9247	7.3738E-06	320.5217	14.4447	245700.
240.000	-0.000309	-1984.0033	-288.7195	7.2716E-06	321.9747	12.9570	252000.
246.000	-0.000265	-3489.3320	-215.5617	6.9916E-06	323.0839	11.4289	258300.
252.000	-0.000225	-4582.9093	-151.5602	6.5785E-06	323.8896	9.9049	264600.
258.000	-0.000187	-5319.5008	-96.5789	6.0718E-06	324.4324	8.4222	270900.
264.000	-0.000152	-5752.4206	-50.2812	5.5053E-06	324.7514	7.0104	277200.
270.000	-0.000120	-5932.4548	-12.1729	4.9074E-06	324.8840	5.6924	283500.
276.000	-9.29E-05	-5907.0346	18.3584	4.3016E-06	324.8653	4.4847	289800.
282.000	-6.89E-05	-5719.6394	42.0064	3.7067E-06	324.7272	3.3980	296100.
288.000	-4.84E-05	-5409.4072	59.5141	3.1372E-06	324.4986	2.4379	302400.
294.000	-3.12E-05	-5010.9293	71.6448	2.6040E-06	324.2050	1.6057	308700.
300.000	-1.71E-05	-4554.2011	79.1586	2.1146E-06	323.8685	0.8989441	315000.
306.000	-5.83E-06	-4064.7054	82.7926	1.6736E-06	323.5078	0.3123825	321300.
312.000	2.96E-06	-3563.6020	83.2449	1.2832E-06	323.1386	-0.1616144	327600.
318.000	9.57E-06	-3067.9994	81.1631	9.4390E-07	322.7734	-0.5323075	333900.
324.000	1.43E-05	-2591.2868	77.1360	6.5432E-07	322.4222	-0.8100589	340200.
330.000	1.74E-05	-2143.5056	71.6883	4.1205E-07	322.0922	-1.0058	346500.
336.000	1.92E-05	-1731.7437	65.2784	2.1376E-07	321.7888	-1.1308	352800.
342.000	2.00E-05	-1360.5365	58.2982	5.5528E-08	321.5153	-1.1959	359100.
348.000	1.99E-05	-1032.2618	51.0751	-6.6909E-08	321.2734	-1.2118	365400.
354.000	1.92E-05	-747.5188	43.8753	-1.5798E-07	321.0636	-1.1882	371700.
360.000	1.80E-05	-505.4829	36.9085	-2.2209E-07	320.8853	-1.1341	378000.
366.000	1.65E-05	-304.2304	30.3329	-2.6352E-07	320.7370	-1.0577	384300.
372.000	1.48E-05	-141.0291	24.2616	-2.8631E-07	320.6167	-0.9660603	390600.
378.000	1.31E-05	-12.5935	18.7679	-2.9417E-07	320.5221	-0.8651424	396900.
384.000	1.13E-05	84.6981	13.8925	-2.9048E-07	320.5752	-0.7600064	403200.
390.000	9.59E-06	154.6220	9.6484	-2.7823E-07	320.6268	-0.6547053	409500.
396.000	7.97E-06	200.9626	6.0271	-2.6004E-07	320.6609	-0.5523782	415800.
402.000	6.47E-06	227.3998	3.0040	-2.3812E-07	320.6804	-0.4553260	422100.
408.000	5.11E-06	237.4250	0.5427370	-2.1433E-07	320.6878	-0.3650963	428400.
414.000	3.90E-06	234.2856	-1.4003	-1.9020E-07	320.6854	-0.2825751	434700.
420.000	2.83E-06	220.9526	-2.8722	-1.6690E-07	320.6756	-0.2080799	441000.
426.000	1.90E-06	200.1091	-3.9208	-1.4536E-07	320.6603	-0.1414534	447300.
432.000	1.09E-06	174.1555	-4.5917	-1.2621E-07	320.6411	-0.0821554	453600.
438.000	3.83E-07	145.2287	-4.9262	-1.0987E-07	320.6198	-0.0293516	459900.
444.000	-2.32E-07	115.2323	-4.9602	-9.6538E-08	320.5977	0.0180013	466200.
450.000	-7.76E-07	85.8738	-4.7230	-8.6248E-08	320.5761	0.0610729	472500.
456.000	-1.27E-06	58.7062	-4.2366	-7.8850E-08	320.5561	0.1010789	478800.
462.000	-1.72E-06	35.1722	-3.5157	-7.4046E-08	320.5387	0.1392018	485100.
468.000	-2.16E-06	16.6464	-2.5686	-7.1395E-08	320.5251	0.1765116	491400.
474.000	-2.58E-06	4.4735	-1.3974	-7.0314E-08	320.5161	0.2138839	497700.
480.000	-3.00E-06	0.0000	0.0000	-7.0085E-08	320.5128	0.2519142	252000.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 2:

Pile-head deflection	=	0.02074359 in
Computed slope at pile head	=	1.156482E-18
Maximum bending moment	=	-471412.28682 lbs-in
Maximum shear force	=	10000.00000 lbs
Depth of maximum bending moment	=	0.00000 in
Depth of maximum shear force	=	0.00000 in
Number of iterations	=	5
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 Shear and Slope (BC Type 2)
Specified shear force at pile head = 40000.000 lbs
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 145000.000 lbs

(Zero slope for this load indicates fixed-head conditions)

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	Es*h F/L lbs/in
0.000	0.103391	-2052618.	40000.0000	6.9389E-18	1832.9419	0.0000	0.0000
6.000	0.102761	-1812527.	39842.7384	-0.0001978	1656.0356	-52.4205	3060.7358
12.000	0.101018	-1574161.	39343.3142	-0.0003711	1480.4008	-114.0542	6774.3212
18.000	0.098308	-1339762.	38455.4220	-0.0005202	1307.6882	-181.9099	11102.4632
24.000	0.094776	-1111791.	37161.7948	-0.0006456	1139.7130	-249.2992	15782.5070
30.000	0.090561	-892697.	35472.3405	-0.0007482	978.2777	-313.8522	20793.9789
36.000	0.085797	-684821.	33423.4829	-0.0008289	825.1091	-369.1003	25812.0015
42.000	0.080614	-490173.	31057.8872	-0.0008890	681.6863	-419.4316	31217.8735
48.000	0.075129	-310580.	28432.6412	-0.0009300	549.3570	-455.6504	36389.3813
54.000	0.069454	-147363.	25606.1081	-0.0009534	429.0939	-486.5273	42030.2928
60.000	0.063688	-1647.4653	22642.3623	-0.0009611	321.7267	-501.3879	47235.3869
66.000	0.057921	126018.	19637.7164	-0.0009547	413.3665	-500.1607	51811.1571
72.000	0.052232	235666.	16698.2847	-0.0009362	494.1586	-479.6499	55098.6421
78.000	0.046687	328026.	13874.7738	-0.0009073	562.2122	-461.5205	59312.4602
84.000	0.041344	403742.	11205.7042	-0.0008699	618.0020	-428.1694	62138.0118
90.000	0.036248	464008.	8778.2392	-0.0008255	662.4077	-380.9856	63062.6141
96.000	0.031438	510518.	6667.4098	-0.0007756	696.6771	-322.6242	61573.7806
102.000	0.026941	545367.	4753.1977	-0.0007216	722.3550	-315.4465	70253.2582
108.000	0.022779	568812.	2898.5002	-0.0006646	739.6297	-302.7860	79755.2474
114.000	0.018966	581305.	1135.2850	-0.0006057	748.8355	-284.9524	90147.4535
120.000	0.015510	583489.	-506.8393	-0.0005461	750.4445	-262.4224	101519.
126.000	0.012412	576173.	-2046.3614	-0.0004868	745.0542	-250.7517	121213.
132.000	0.009668	559780.	-3468.6244	-0.0004287	732.9748	-223.3360	138600.
138.000	0.007268	535296.	-4665.2025	-0.0003726	714.9344	-175.5234	144900.
144.000	0.005197	504446.	-5584.6324	-0.0003194	692.2030	-130.9533	151200.
150.000	0.003435	468836.	-6247.9834	-0.0002696	665.9649	-90.1637	157500.
156.000	0.001961	429939.	-6679.0752	-0.0002236	637.3044	-53.5336	163800.
162.000	0.000751	389076.	-6903.5533	-0.0001817	607.1956	-21.2925	170100.
168.000	-0.000220	347413.	-6948.0337	-0.0001441	576.4965	6.4657	176400.

174.000	-0.000978	305951.	-6839.3350	-0.0001106	545.9461	29.7672	182700.
180.000	-0.001547	265533.	-6603.8064	-8.1379E-05	516.1653	48.7423	189000.
186.000	-0.001954	226846.	-6266.7591	-5.6185E-05	487.6599	63.6068	195300.
192.000	-0.002222	190430.	-5852.0023	-3.4833E-05	460.8269	74.6454	201600.
198.000	-0.002372	156683.	-5381.4837	-1.7072E-05	435.9615	82.1941	207900.
204.000	-0.002426	125882.	-4875.0282	-2.6134E-06	413.2660	86.6244	214200.
210.000	-0.002403	98187.2756	-4350.1707	8.8519E-06	392.8601	88.3281	220500.
216.000	-0.002320	73664.0853	-3822.0723	1.7645E-05	374.7907	87.7047	226800.
222.000	-0.002192	52291.7056	-3303.5106	2.4090E-05	359.0429	85.1492	233100.
228.000	-0.002031	33980.0416	-2804.9347	2.8505E-05	345.5503	81.0428	239400.
234.000	-0.001850	18582.8914	-2334.5724	3.1194E-05	334.2052	75.7447	245700.
240.000	-0.001657	5910.8944	-1898.5797	3.2448E-05	324.8681	69.5863	252000.
246.000	-0.001460	-4256.5238	-1501.2212	3.2532E-05	323.6492	62.8666	258300.
252.000	-0.001266	-12160.3664	-1145.0730	3.1692E-05	329.4729	55.8495	264600.
258.000	-0.001080	-18052.5442	-831.2373	3.0146E-05	333.8145	48.7624	270900.
264.000	-0.000905	-22187.6684	-559.5623	2.8087E-05	336.8613	41.7959	277200.
270.000	-0.000743	-24816.1639	-328.8597	2.5682E-05	338.7981	35.1050	283500.
276.000	-0.000596	-26178.6713	-137.1136	2.3073E-05	339.8020	28.8104	289800.
282.000	-0.000466	-26501.6736	18.3221	2.0377E-05	340.0400	23.0015	296100.
288.000	-0.000352	-25994.2623	140.5434	1.7691E-05	339.6662	17.7389	302400.
294.000	-0.000254	-24845.9357	232.9337	1.5090E-05	338.8200	13.0579	308700.
300.000	-0.000171	-23225.3142	299.0220	1.2630E-05	337.6259	8.9716	315000.
306.000	-0.000102	-21279.6476	342.3614	1.0353E-05	336.1923	5.4749	321300.
312.000	-4.67E-05	-19134.9903	366.4284	8.2846E-06	334.6120	2.5474	327600.
318.000	-2.82E-06	-16896.9216	374.5421	6.4409E-06	332.9630	0.1571192	333900.
324.000	3.06E-05	-14651.6922	369.8025	4.8266E-06	331.3086	-1.7370	340200.
330.000	5.51E-05	-12467.6896	355.0462	3.4390E-06	329.6994	-3.1818	346500.
336.000	7.19E-05	-10397.1217	332.8173	2.2690E-06	328.1737	-4.2278	352800.
342.000	8.23E-05	-8477.8303	305.3525	1.3032E-06	326.7595	-4.9271	359100.
348.000	8.75E-05	-6735.1593	274.5776	5.2475E-07	325.4755	-5.3312	365400.
354.000	8.86E-05	-5183.8118	242.1138	-8.5123E-08	324.3324	-5.4901	371700.
360.000	8.65E-05	-3829.6453	209.2916	-5.4633E-07	323.3346	-5.4507	378000.
366.000	8.21E-05	-2671.3624	177.1707	-8.7898E-07	322.4812	-5.2563	384300.
372.000	7.60E-05	-1702.0672	146.5648	-1.1028E-06	321.7670	-4.9457	390600.
378.000	6.88E-05	-910.6661	118.0680	-1.2365E-06	321.1838	-4.5532	396900.
384.000	6.11E-05	-283.1002	92.0837	-1.2975E-06	320.7214	-4.1082	403200.
390.000	5.33E-05	196.5965	68.8539	-1.3020E-06	320.6577	-3.6351	409500.
396.000	4.55E-05	545.4122	48.4871	-1.2640E-06	320.9147	-3.1538	415800.
402.000	3.81E-05	780.6408	30.9859	-1.1961E-06	321.0880	-2.6799	422100.
408.000	3.12E-05	919.3241	16.2725	-1.1092E-06	321.1902	-2.2246	428400.
414.000	2.48E-05	977.8412	4.2121	-1.0121E-06	321.2333	-1.7956	434700.
420.000	1.90E-05	971.6304	-5.3667	-9.1233E-07	321.2287	-1.3973	441000.
426.000	1.38E-05	915.0288	-12.6530	-8.1579E-07	321.1870	-1.0315	447300.
432.000	9.22E-06	821.2134	-17.8389	-7.2695E-07	321.1179	-0.6971786	453600.
438.000	5.11E-06	702.2264	-21.1061	-6.4900E-07	321.0302	-0.3918628	459900.
444.000	1.43E-06	569.0699	-22.6159	-5.8395E-07	320.9321	-0.1114200	466200.
450.000	-1.89E-06	431.8516	-22.5025	-5.3273E-07	320.8310	0.1492304	472500.
456.000	-4.96E-06	299.9671	-20.8677	-4.9528E-07	320.7338	0.3957113	478800.
462.000	-7.84E-06	182.3015	-17.7793	-4.7061E-07	320.6471	0.6337347	485100.
468.000	-1.06E-05	87.4342	-13.2722	-4.5681E-07	320.5772	0.8686375	491400.
474.000	-1.33E-05	23.8300	-7.3516	-4.5111E-07	320.5304	1.1049	497700.
480.000	-1.60E-05	0.0000	0.0000	-4.4989E-07	320.5128	1.3456	252000.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection	=	0.10339083 in
Computed slope at pile head	=	6.938894E-18
Maximum bending moment	=	-2052618. lbs-in
Maximum shear force	=	40000.00000 lbs
Depth of maximum bending moment	=	0.00000 in
Depth of maximum shear force	=	0.00000 in
Number of iterations	=	13
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 Shear and Slope (BC Type 2)
Specified shear force at pile head = 80000.000 lbs
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 145000.000 lbs

(Zero slope for this load indicates fixed-head conditions)

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	Es*h F/L lbs/in
0.000	0.316610	-4815510.	80000.0000	-1.3878E-17	3868.7211	0.0000	0.0000
6.000	0.315132	-4335296.	79787.1758	-0.0004682	3514.8851	-70.9414	1350.7002
12.000	0.310991	-3857249.	79103.3899	-0.0008874	3162.6465	-156.9872	3028.7781
18.000	0.304482	-3384511.	77875.3215	-0.0012580	2814.3191	-252.3689	4973.0726
24.000	0.295895	-2920556.	76070.5206	-0.0015806	2472.4640	-349.2314	7081.5181
30.000	0.285515	-2468914.	73691.3703	-0.0018564	2139.6809	-443.8187	9326.6945
36.000	0.273619	-2033030.	70776.0593	-0.0020867	1818.5085	-527.9517	11577.0911
42.000	0.260474	-1615971.	67366.8113	-0.0022735	1511.2071	-608.4643	14015.9211
48.000	0.246337	-1220672.	63524.4538	-0.0024186	1219.9398	-672.3215	16375.6298
54.000	0.231451	-849469.	59322.8505	-0.0025245	946.4262	-728.2129	18877.7658
60.000	0.216043	-504405.	54848.0623	-0.0025938	692.1734	-763.3832	21200.8676
66.000	0.200325	-186779.	50192.4011	-0.0026292	458.1369	-788.5039	23616.7033
72.000	0.184493	102478.	45460.0990	-0.0026335	396.0217	-788.9301	25657.2461
78.000	0.168723	363325.	40696.7340	-0.0026097	588.2210	-798.8582	28408.3115
84.000	0.153177	595380.	35940.0589	-0.0025606	759.2060	-786.7002	30815.3130
90.000	0.137996	799061.	31326.5086	-0.0024892	909.2841	-751.1499	32659.5578
96.000	0.123306	975629.	26996.7792	-0.0023984	1039.3849	-692.0932	33676.8093
102.000	0.109215	1127195.	22818.0648	-0.0022908	1151.0633	-700.8116	38500.8011
108.000	0.095816	1253432.	18618.2139	-0.0021690	1244.0781	-699.1387	43780.0064
114.000	0.083187	1354388.	14460.3346	-0.0020356	1318.4654	-686.8211	49538.1995
120.000	0.071389	1430498.	10408.1674	-0.0018931	1374.5454	-663.9013	55798.5027
126.000	0.060470	1482580.	6446.4760	-0.0017440	1412.9210	-656.6625	65156.0493
132.000	0.050461	1510890.	2553.1196	-0.0015909	1433.7808	-641.1230	76232.1555
138.000	0.041380	1515986.	-1221.6441	-0.0014360	1437.5352	-617.1316	89483.5225
144.000	0.033229	1498729.	-4826.8245	-0.0012817	1424.8202	-584.5952	105557.
150.000	0.025999	1460294.	-8210.9152	-0.0011303	1396.4999	-543.4350	125413.
156.000	0.019665	1402165.	-11321.7281	-0.0009838	1353.6688	-493.5027	150569.
162.000	0.014193	1326145.	-14009.3467	-0.0008442	1297.6551	-402.3702	170100.
168.000	0.009535	1235522.	-16057.4175	-0.0007132	1230.8812	-280.3201	176400.
174.000	0.005635	1134697.	-17413.1426	-0.0005919	1156.5906	-171.5883	182700.
180.000	0.002432	1027594.	-18157.7505	-0.0004812	1077.6739	-76.6143	189000.
186.000	-0.000140	917641.	-18373.9505	-0.0003817	996.6576	4.5477	195300.
192.000	-0.002148	807771.	-18143.7714	-0.0002934	915.7017	72.1787	201600.
198.000	-0.003661	700426.	-17546.7115	-0.0002162	836.6075	126.8413	207900.
204.000	-0.004743	597586.	-16658.2084	-0.0001498	760.8318	169.3264	214200.
210.000	-0.005458	500789.	-15548.4303	-9.3618E-05	689.5085	200.5997	220500.
216.000	-0.005866	411168.	-14281.3753	-4.6955E-05	623.4734	221.7520	226800.
222.000	-0.006022	329494.	-12914.2607	-9.0561E-06	563.2935	233.9528	233100.
228.000	-0.005975	256213.	-11497.1794	2.0914E-05	509.2978	238.4076	239400.
234.000	-0.005771	191491.	-10072.9908	4.3822E-05	461.6092	236.3219	245700.
240.000	-0.005449	135261.	-8677.4181	6.0542E-05	420.1767	228.8690	252000.
246.000	-0.005044	87256.9442	-7339.3156	7.1928E-05	384.8063	217.1651	258300.
252.000	-0.004586	47063.5614	-6081.0750	7.8801E-05	355.1906	202.2484	264600.
258.000	-0.004099	14146.9310	-4919.1366	8.1933E-05	330.9367	185.0644	270900.
264.000	-0.003603	-12108.6411	-3864.5760	8.2037E-05	329.4348	166.4558	277200.
270.000	-0.003114	-32370.7256	-2923.7373	7.9761E-05	344.3645	147.1571	283500.
276.000	-0.002646	-47332.2730	-2098.8885	7.5683E-05	355.3886	127.7925	289800.
282.000	-0.002206	-57689.0755	-1388.8766	7.0309E-05	363.0198	108.8781	296100.
288.000	-0.001802	-64121.1300	-789.7646	6.4076E-05	367.7591	90.8259	302400.
294.000	-0.001437	-67277.7433	-295.4349	5.7353E-05	370.0850	73.9507	308700.
300.000	-0.001114	-67766.1421	101.8518	5.0442E-05	370.4449	58.4782	315000.
306.000	-0.000832	-66143.2914	410.9507	4.3591E-05	369.2491	44.5547	321300.
312.000	-0.000591	-62910.5815	641.3854	3.6987E-05	366.8672	32.2568	327600.
318.000	-0.000388	-58511.0242	802.9620	3.0774E-05	363.6255	21.6020	333900.
324.000	-0.000221	-53328.5838	905.4447	2.5051E-05	359.8069	12.5588	340200.
330.000	-8.76E-05	-47689.2769	958.2912	1.9882E-05	355.6517	5.0566	346500.
336.000	1.71E-05	-41863.6850	970.4460	1.5300E-05	351.3592	-1.0050	352800.
342.000	9.60E-05	-36070.5466	950.1870	1.1312E-05	347.0907	-5.7480	359100.

348.000	0.000153	-30481.1245	905.0192	7.9069E-06	342.9722	-9.3079	365400.
354.000	0.000191	-25224.0742	841.6124	5.0566E-06	339.0987	-11.8277	371700.
360.000	0.000214	-20390.5746	765.7743	2.7225E-06	335.5372	-13.4517	378000.
366.000	0.000224	-16039.5192	682.4559	8.5844E-07	332.3312	-14.3211	384300.
372.000	0.000224	-12202.5971	595.7805	-5.8668E-07	329.5041	-14.5707	390600.
378.000	0.000217	-8889.1321	509.0936	-1.6659E-06	327.0626	-14.3250	396900.
384.000	0.000204	-6090.5754	425.0268	-2.4324E-06	325.0005	-13.6973	403200.
390.000	0.000187	-3784.5786	345.5721	-2.9377E-06	323.3014	-12.7876	409500.
396.000	0.000169	-1938.5990	272.1622	-3.2305E-06	321.9412	-11.6823	415800.
402.000	0.000149	-513.0106	205.7537	-3.3560E-06	320.8908	-10.4538	422100.
408.000	0.000128	536.2848	146.9094	-3.3548E-06	320.9080	-9.1609	428400.
414.000	0.000108	1255.7392	95.8789	-3.2631E-06	321.4381	-7.8492	434700.
420.000	8.91E-05	1692.5093	52.6743	-3.1123E-06	321.7599	-6.5523	441000.
426.000	7.10E-05	1893.2458	17.1398	-2.9288E-06	321.9078	-5.2925	447300.
432.000	5.40E-05	1903.2827	-10.9854	-2.7345E-06	321.9152	-4.0825	453600.
438.000	3.82E-05	1766.1792	-32.0122	-2.5467E-06	321.8142	-2.9264	459900.
444.000	2.34E-05	1523.5674	-46.2555	-2.3784E-06	321.6354	-1.8213	466200.
450.000	9.64E-06	1215.2517	-53.9965	-2.2383E-06	321.4083	-0.7589887	472500.
456.000	-3.42E-06	879.5042	-55.4550	-2.1311E-06	321.1609	0.2728039	478800.
462.000	-1.59E-05	553.4994	-50.7716	-2.0578E-06	320.9207	1.2884	485100.
468.000	-2.81E-05	273.8259	-39.9994	-2.0154E-06	320.7146	2.3024	491400.
474.000	-4.01E-05	77.0128	-23.1085	-1.9975E-06	320.5696	3.3280	497700.
480.000	-5.21E-05	0.0000	0.0000	-1.9935E-06	320.5128	4.3748	252000.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 10:

```
Pile-head deflection             =     0.31661007 in
Computed slope at pile head      =  -1.387779E-17
Maximum bending moment           =      -4815510. lbs-in
Maximum shear force              =    80000.00000 lbs
Depth of maximum bending moment  =        0.00000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =             15
Number of zero deflection points =              3
```

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

```
Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad
```

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
2	V= 5000.000	S= 0.000	145000.	0.0103718	-235706.	5000.0000
2	V= 10000.	S= 0.000	145000.	0.0207436	-471412.	10000.0000
2	V= 20000.	S= 0.000	145000.	0.0415278	-943372.	20000.0000
2	V= 25000.	S= 0.000	145000.	0.0523535	-1184954.	25000.0000
2	V= 30000.	S= 0.000	145000.	0.0645178	-1440416.	30000.0000
2	V= 40000.	S= 0.000	145000.	0.1033908	-2052618.	40000.0000
2	V= 50000.	S= 0.000	145000.	0.1495088	-2706750.	50000.0000
2	V= 60000.	S= 0.000	145000.	0.2008668	-3388369.	60000.0000
2	V= 70000.	S= 0.000	145000.	0.2567418	-4092468.	70000.0000
2	V= 80000.	S= 0.000	145000.	0.3166101	-4815510.	80000.0000

Pile-head Deflection vs. Pile Length

Boundary Condition Type 2, Shear and Slope

```
Shear      =          5000. lbs
Slope      =       0.00000
Axial Load =       145000. lbs
```

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
480.000	0.01037180	-235706.14341	5000.00000
456.000	0.01036836	-235687.85291	5000.00000
432.000	0.01036510	-235670.55007	5000.00000
408.000	0.01036202	-235654.18841	5000.00000
384.000	0.01035912	-235638.54136	5000.00000
360.000	0.01035650	-235623.59533	5000.00000
336.000	0.01035439	-235611.71275	5000.00000
312.000	0.01035303	-235610.51145	5000.00000
288.000	0.01035194	-235625.26782	5000.00000
264.000	0.01035015	-235622.51140	5000.00000

This analysis ended normally.

Office of Special Funded Projects
Comment & Response Form

(Revised 08/2011)

General Project Information (OSFP Liaison to complete)		**Review Phase** (OSFP Liaison to complete)	**Reviewer Information** (Reviewer Liaison to complete)	
Dist:	**04**	☐ PSR/PDS (Review No.)	Reviewer Name:	**B. Lee/ T. Nguyen /H.Salimi/ R.Nashed**
Proj ID (Phase):	**0400020581**	☐ APS/PSR (Review No.)	Functional Unit:	**Geotechnical Design- West**
EA:	**297621**	☐ APS/PR (Review No.)	Cost Center:	**59-3660**
Project Name:	**Route 84, PM 22.9/25.7-Livermore**	☐ Type Selection	Phone Number:	**510-286-4825**
OSFP Liaison:	**David Soon**	☐ 65% PS&E Unchecked Details	e-mail:	**Betty_lee@dot.ca.gov**
Phone:	**916-227-5671**	☑ PS&E (Review No. 4)	Date of Review:	**10-10-2014/11-26-2014/1-6-2015**
E-mail:		☐ Construction	Structure Name*:	**Arroyo Del Valle Trail Bridge**
		☑ Other: FR (4TH REVIEW)	Br No*:	
			(*Use if necessary to when comment sheets are by individual structure)	

Consultant Information (to be filled in by Consultant)

Consultant Lead (First and Last Name)	Consultant Firm	Phone Number	E-mail	Response Date
Stephen Huang	**URS Corporation**	**408-297-9585**	**Stephen.huang@urs.com**	**9-12-2014/11-5-2014 /12-18-2014/1-16-2015**

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	2nd Review Comments	Consultant Responses	3rd Review Comments	4th Review Comments	Consultant Responses
			When making revisions, please indicate the page numbers where revisions will be found.	Page, section or figures numbers for revisions are provided in following responses.	**The referenced pages and appendices in your responses are inconsistent with the actual FR. Please PROOF-READ your reports before you send them to us.**	Understood.			

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✓= Comment Resolved
(for Reviewer's use)

Submittal Data (Reviewer to complete)
Project ID: 0400020581 Reviewer: Str Name*: Arroyo Del Valle Trial Bridge
Date of Review: 12-31-2014 Functional Unit: Br No*. ___ *=if applicable

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1	FR		Abutments in this report are done using working stress design, WSD. So I assume this project is done using the AASHTO LRFD 4th edition criteria. If this is the case, then everything in this project should be designed with the 4th edition criteria (no mixing with the 6th edition).	Only criteria from AASHTO LRFT 4th edition used for design.	Noted.				
2	FR	7-2	Please clarify lateral load demand to come up with design tip	The lateral load applied at the top of the CIDH pile is 60 kips, which results in a maximum bending moment	The design tip elevations +371 and +368 ft are not appropriate according to the LPILE outputs. Moreover,	According to AASHTO LRFD Bridge Design Spec (4th Edition), Section 3.4.1 Load Factors	Lateral loading analysis for static condition with scour consideration should also be performed. URS	What is the lateral load demand? If this load is not established, why bridge is not designed for lateral loading?	The lateral demand is 5 kips per pile at Bent 2 and 20 kips per pile at the abutments for the service load

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			elevations.	in the pile of about 10,000 kip-inches for the fixed head condition as shown on the figures included in Appendix I of the Foundation report. As part of the analyses, the computer program LPILE generates a plot of pile length vs. applied load to determine the minimum required pile length.	According to the appendix I, 60 kips lateral load will produce excessive deflection. Please clarify the allowable deflection.	and Load Combinations for Extreme Event I (page 3-9, attached), local pier scour and contraction scour depths should not be included in the design. As such, we revised the LPILE analysis and the results indicate a top of pile deflection less than 0.2 inch for fixed head condition and about 0.5 inch for free head condition for an applied lateral load of 60 kips. The maximum bending moment developed in the pile for this applied lateral load is about 215 kip-feet. The revised LPILE results	agreed to include this analysis per telephone conversation with CT on 11/24/2014. Please also include graphs of deflection, bending moment, and shear vs. depth in the report for both static and seismic cases. Have included LPILE results for condition with local scour for static case. LPILE results for contraction scour only (seismic case) provided in previous submittal.	Please clarify.	condition.

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						are included in the FR.			
3	FR	Appdx G	Effective vertical stresses are not corresponding to soil unit weights presented in Figure 3-5.	The vertical effective stress profile is assumed to start with 0 psf at Elevation 382 feet, the depth of local scour at the bridge pier an at the depths of local scour at the abutments. The effective stress profile with depth presented on the axial capacity calculations is consistent with the values presented on the Generalized Soil Profile.	Unit weight for each layer in CIDH pile design spreadsheet is not shown. Unit weights are inconsistently used for all three analyses: CIDH pile design spreadsheet, SHAFT 2012 program, and lateral loaded pile analysis. Moreover, please clarify local scour depth of 382 ft, which is not consistent with the analyses and Bridge Design Hydraulic Study Report – Executive Summary	We added a column to the excel spreadsheet to show unit weights for each layer. The input to SHAFT includes total unit weight and depth to groundwater; the program uses this information to calculate effective unit weights. The input to LPILE is effective unit weight. The values assigned to the four soil layers identified in each analysis are consistent. The total scour depth down to Elevation 381 feet was based on an interim document and	The response is not adequate. URS agreed to revise spreadsheets with appropriate soil unit weights per telephone conversation with CT on 11/24/2014. As noted, the updated FR includes additional information on unit weights of analyzed soil profile.	The soil unit weights were revised in spreadsheets to match with other analyses. However, the effective stresses are incorrectly computed from these unit weights.	The effective stresses presented on the spreadsheets were calculated to the nearest foot of depth. Revised spreadsheets in the updated report reflect the proper depths.

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						has been revised to Elevation 398 feet per comments from Caltrans Structure Hydraulics & Hydrology. We revised the SHAFT analysis for a ground surface at Elevation 397.5 feet, corresponding to bottom of pile cap (lower than bottom of scoured hole); this results in a specified pile tip at Elevation 356 feet. The revised SHAFT analysis output and revised PDT are included in FR. Figure 3-5 also revised to be consistent with SHAFT and LPILE unit weight input parameters.			

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4	FR		Titles and numbers of some figures should be corrected.	Corrected where discrepancies were found.	Noted.				
5	P	Pg 3 of 19	Please clarify magnitude group.	Plan updated per latest FR	Under General Notes Seismic Loading Magnitude Group 7.25 ± 0.25 is outdated and needs to be removed.	This note has been removed from the plan.			
6	P	Pg 3 of 19	Please use PGA provided in FR of May 31, 2014.	Plan updated per latest FR	Peak Rock Acceleration is shown as 0.7. According to our calculations, the Peak Rock Acceleration is 0.61 g (PSHA) and 0.41 g (DSHA).	We understand based on Comment No. 15 that a PGA of 0.61g was determined using the USGS deaggregation tool. This note and the FR have been revised to refer to PGA of 0.61g. The value of PGA presented in the September FR of 0.68g was derived using the Caltrans ARS	The Plans still show Peak ROCK acceleration. If you mean Peak GROUND Acceleration, please change it. *The Foundation Plan, Sheet 3 of 18, shows Peak Ground Acceleration consistent with the Foundation Report.*	Will check Plans when provided. Plan update verified by DSoon 1/8/15. No action needed.	

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						on-line tool and likely represents a conservative estimate of PGA at the site. Our understanding is that Caltrans does not have a formal policy regarding method for determining PGA; please let us know if a formal policy has been established by Caltrans.			
7	P	Pg. 18 and 19 of 19	LOTBs should be updated per FR of May 31, 2014.	Plan updated per latest FR	Noted.				
8	FR		Skin axial resistances for bridge calculated by spreadsheet are much higher than	SHAFT version 2012 7.8 output for Pier 2 is included with the axial pile capacity calculations in Appendix G and is consistent with the pile capacity	Noted. See also comment #3.	Please see response to comment #3.	See #3.		

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			that by Shaft 6.0 Program.	spreadsheet.					
9	FR		According to Caltrans ARS online version 2.3.06, Pleasanton Fault is located just over 2 miles west of the site, but neither of the three reports show the fault. Please refer to Arroyo Del Valle Bridge (widen) Bridge No. 33-0710 report pages 3-2 and 5-1.	Discussion about the Pleasanton fault is included in Section 3.1 of the revised report.					

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Submittal Data (Reviewer to complete)
Project ID: 0400020581 Reviewer: Str Name*: Arroyo Del Valle Trial Bridge
Date of Review: 12-31-2014 Functional Unit: Br No*. ___ *=if applicable

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10	FR		The Acceleration Response Spectrum shown for all three reports indicate a Vs30=331 m/s was used. The reports do not show how this number was achieved. I assume that a correlation was used to generate this number from SFT blow counts. The details for this correlation/ calculation have to be shown with input/output	Shear wave velocity calculations spreadsheets are presented in Appendix J of the revised report. Based on these calculations, the ARS curve has been revised to a Vs30 value of 360 m/sec.			It is inappropriate to use a shear wave velocity averaged over such a large lateral geographical extent for all of the structures for this project. Please use the appropriate localized shear wave velocity to do seismic analyses and to determine the specific ARS curve for each structure. B) In Appendix F, The Vs you calculated differ from the UCLA Vs by 100 m/s. Please explain. The calculated "mean" values of Vs for the six borings located at Arroyo Del Valle bridges range from 354 to 390 m/sec and are based on the	Ok, as per H. Salimi.	

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			parameters .				average of several correlations for different soil types, including the UCLA values (See Appendix F of FR). We judged a value of 360 m/sec to be appropriate for the project site, consistent with published values of Vs for stiff soil and soft rock sites as presented in Figure B.12 of Caltrans SDC 1.7 (June 2013).		
11	FR		Current Caltrans SDC call for 5% probability of exceedanc e in 50 years correspond ing to a 975 year return period.	Report was corrected to indicate 5% probability of exceedance in 50 years.					

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Submittal Data (Reviewer to complete)
Project ID: 0400020581 Reviewer: Str Name*: Arroyo Del Valle Trial Bridge
Date of Review: 12-31-2014 Functional Unit: Br No*. ___ *=if applicable

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	2nd Review Comments	Consultant Responses	3rd Review Comments	4th Review Comments	Consultant Responses
			Section 5.4 (page 5-2) shows a 2% in 50 years. I assume this is a typo. Please correct the report to reflect the current Caltrans criteria.						
12	FR	Pg. 3-3			Under Pleasant Fault, the word "moment" needs to be taken out. It should be "Maximum Magnitude" Mmax=6.6"	Corrected.			
13	FR	Pg. 3-2			To be consistent, the same applies to Calaveras Fault and Las Positas Fault as above. A line added about the type of fault and Maximum Magnitude.	Corrected.			

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14	FR	Pg. 5-1			Seismic Source Parameters Table. According to ARS on-line Version 2.3.06, the distance for Pleasant Fault is 3.3, not 2.8 miles; and Las Positas is 2.2 miles, not 1.1 mile. Furthermore, the following note should be added to the bottom of the table: "Please note that the distance provided for each fault is the horizontal distance to the fault trace or surface projection of the top of rupture plane."	Fault distances revised and note added as suggested.			
15	FR	Pg 5-2			I ran the USGS Interactive Deaggregation site for Vs30=360 m/s and came up with PGA=0.61, not 0.68. Also, I am not sure what Magnitude 6.8"	Please see response to Comment No. 6. Magnitude 6.8 removed from text.			

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					means. This needs to be either clarified or removed.				
16	FR				Arroyo Del Valle Bridge (Widen) General Plan (Sheet 2 of 22), Under General Notes Seismic Loading "Magnitude Group 7.25 +- 0.25" is outdated and needs to be removed. Also, Peak Rock Acceleration is shown as 0.7. According to my calculations, the Peak Rock Acceleration is 0.61g (PSHA) and 0.41g (DSHA).	Note regarding "Magnitude Group" deleted from structural plans for trail bridge and bridge widen as suggested. Note regarding PGA and FR revised to refer to PGA of 0.61g. Please see response to Comment No. 6.			
17	FR				The average shear wave velocity based on the 6 borings provided in the report is 371 m/s, not 360 m/s. The method used to determine the Vs30 shall be	The average shear wave velocity was calculated for the upper 30 meters of soil profile at 12 borings and ranges from 354 to 422	It is inappropriate to use a shear wave velocity averaged over such a large lateral geographical extent for all of the structures for this project.	Ok, as per H. Salimi.	

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					explained since it seems to apply to both bridges as well as the retaining walls.	m/sec. The borings are located between Stations 100 and 320. In recognition of the scatter in calculated shear wave velocity among the 10 methods considered in the excel spreadsheets, an average shear wave velocity of 360 m/sec was judged appropriate for development of ARS curves for the four structures along the South Segment alignment.	Please use the appropriate localized shear wave velocity to do seismic analyses and to determine the specific ARS curve for each structure. B) In Appendix F, The Vs you calculated differ from the UCLA Vs by 100 m/s. Please explain. The calculated "mean" values of Vs for the six borings located at Arroyo Del Valle bridges range from 354 to 390 m/sec and are based on the average of several correlations for different soil types, including the UCLA values (See Appendix F of FR). We judged a value of 360 m/sec to be		

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							appropriate for the project site, consistent with published values of Vs for stiff soil and soft rock sites as presented in Figure B.12 of Caltrans SDC 1.7 (June 2013)		
18	FR				I did not find anywhere in the documents provided explaining about the seismic parameters used for the design of the retaining walls. This discussion needs to be included.	We will include seismic parameters for design of the retaining wall connecting the bridge widen to trail bridge in the bridge widen FR. This information will be consistent with that provided for Caltrans Standard retaining walls in the companion GDMR.	Seismic parameters not found. Caltrans standard retaining walls are designed for a Kh value of 0.2g, which is applicable to the project site. For this reason, no seismic design parameters need to be included in the FR.	Whether they are Standard or Specially-designed walls, the FR and GDR must discuss the reasons they are chosen, and thus must discuss seismic parameters. Please revise.	Updated FR for Bridge (Widen) presents a horizontal seismic coefficient of 0.2g for the wall.
19	FR	Pg. 7-, Table 7-3					Why are pile tip elevations changed when loadings did not		

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							change? *Scour depths in Arroyo Del Valle were reduced based on the revised BDHS, resulting in shallower specified pile tip elevations.*		
			Geology Comments						
14	FR	3.2.2 Field Exploration Page 3-5	As indicated in The LOTB's Figures 3-4a and 3-4b, the logging method used in accordance with the Caltrans Soil and Rock Logging , Classification and Presentation Manual, June 2007	The text of Section 3.2.2 has been revised to reference the June 2007 edition.					

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			Edition and Not 2010 Edition as stated in the text. Please be consistent.						
15	FR	3.2.5 Ground -water Page 3-6	What is the water elevation of the water surface in Arroyo Del Valle Creek? That may help in defining the groundwat er elevation in case of the absence of accurate groundwat er level.	Water flow in Arroyo Del Valle is regulated by release of water from Lake Del Valle which is operated by the Department of Water Resources. As noted in the companion hydraulic study, the 100 year WSE is about Elevation 411 feet at the bridge; the 50 year WSE is about Elevation 410 feet. Information regarding the average non-storm related water surface elevation in Arroyo Del Valle was not available. Free					

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				groundwater was encountered at about Elevation 401 feet in borings performed in the creekbed in December 2008 and at about Elevation 398 in a hollow stem boring, A-07-010, drilled at a location approximately 300 feet from Arroyo Del Valle. Our recommendations for design groundwater level at the bridge structure are based on this information.					
16	FR	8.2 Construction Dewatering Page 8-1	To provide the estimate of groundwater dewatering during excavation, seepage rate (flow rate) study	Seepage estimates will be provided in a separate technical memorandum.					

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			should be provided.						
17	FR	Figure 3-1	Please show the exact location of the Trail bridge on the Geologic Map, not the whole alignment.	The bridge location at Arroyo Del Valle has been added to the Geologic Map.					
18	FR	App. D			CRR = 0.315 for ML soil with $(N_1)_{60\text{-}cs}$ = 27 and 55% fines is not adequate. Provide any reference for this CRR value.	The equation used to calculate CRR is taken from the "Proceedings of the NCEER Workshop on Evaluation of the Liquefaction Resistance of Soils" 1997.	Noted.		
19	FR	3.1.2 Regional Tectonic Setting and Seismi			Livermore fault is not shown in the geologic map Figure 3-1 as stated in the text.	Text revised; no longer includes reference to the location of the Livermore Fault being shown on Figure 3-1.			

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Project ID: 0400020581 Reviewer**:** Str Name*: Arroyo Del Valle Trial Bridge
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		city							

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Office of Special Funded Projects
Comment & Response Form

(Revised 08/2011)

General Project Information (OSFP Liaison to complete)		**Review Phase** (OSFP Liaison to complete)	**Reviewer Information** (Reviewer Liaison to complete)	
Dist:	**04**	☐ PSR/PDS (Review No.)	Reviewer Name:	**B. Lee/ T. Nguyen /H.Salimi/ R.Nashed**
Proj ID (Phase):	**0400020581**	☐ APS/PSR (Review No.)	Functional Unit:	**Geotechnical Design- West**
EA:	**297621**	☐ APS/PR (Review No.)	Cost Center:	**59-3660**
Project Name:	**Route 84, PM 22.9/25.7-Livermore**	☐ Type Selection	Phone Number:	**510-286-4825**
OSFP Liaison:	**David Soon**	☐ 65% PS&E Unchecked Details	e-mail:	**Betty_lee@dot.ca.gov**
Phone:	**916-227-5671**	☑ PS&E (Review No. 1)	Date of Review:	**7-7-2014**
E-mail:		☐ Construction	Structure Name*:	**Arroyo Del Valle Trail Bridge**
		☐ Other:	Br No*:	
			(*Use if necessary to when comment sheets are by individual structure)	

Consultant Information (to be filled in by Consultant)

Consultant Lead (First and Last Name)	Consultant Firm	Phone Number	E-mail	Response Date
Stephen Huang	**URS Corporation**	**408-297-9585**	**Stephen.huang@urs.com**	**8/20/14**

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
			When making revisions, please indicate the page numbers where revisions will be found.	Page, section or figures numbers for revisions are provided in following responses.	
1	FR		Abutments in this report are done using working stress design, WSD. So I assume this project is done using the AASHTO LRFD 4th edition criteria. If this is the case, then everything in this project should be designed with the 4th edition criteria (no mixing with the 6th edition).	Only criteria from AASHTO LRFT 4th edition used for design.	
2	FR	7-2	Please clarify lateral load demand to come up with design tip elevations.	The lateral load applied at the top of the CIDH pile is 60 kips, which results in a maximum bending moment in the pile of	

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				about 10,000 kip-inches for the fixed head condition as shown on the figures included in Appendix I of the Foundation report. As part of the analyses, the computer program LPILE generates a plot of pile length vs. applied load to determine the minimum required pile length.	
3	FR	Appdx G	Effective vertical stresses are not corresponding to soil unit weights presented in Figure 3-5.	The vertical effective stress profile is assumed to start with 0 psf at Elevation 382 feet, the depth of local scour at the bridge pier an at the depths of local scour at the abutments. The effective stress profile with depth presented on the axial capacity calculations is consistent with the values presented on the Generalized Soil Profile.	
4	FR		Titles and numbers of some figures should be corrected.	Corrected where discrepancies were found.	
5	P	Pg 3 of 19	Please clarify magnitude group.	Plan updated per latest FR	
6	P	Pg 3 of 19	Please use PGA provided in FR of May 31, 2014.	Plan updated per latest FR	
7	P	Pg. 18 and 19 of 19	LOTBs should be updated per FR of May 31, 2014.	Plan updated per latest FR	
8	FR		Skin axial resistances for bridge calculated by spreadsheet are much higher than that by Shaft 6.0 Program.	SHAFT version 2012 7.8 output for Pier 2 is included with the axial pile capacity calculations in	

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				Appendix G and is consistent with the pile capacity spreadsheet.	
9	FR		According to Caltrans ARS online version 2.3.06, Pleasanton Fault is located just over 2 miles west of the site, but neither of the three reports show the fault. Please refer to Arroyo Del Valle Bridge (widen) Bridge No. 33-0710 report pages 3-2 and 5-1.	Discussion about the Pleasanton fault is included in Section 3.1 of the revised report.	
10	FR		The Acceleration Response Spectrum shown for all three reports indicate a Vs30=331 m/s was used. The reports do not show how this number was achieved. I assume that a correlation was used to generate this number from SFT blow counts. The details for this correlation/calculation have to be shown with input/output parameters.	Shear wave velocity calculations spreadsheets are presented in Appendix J of the revised report. Based on these calculations, the ARS curve has been revised to a Vs30 value of 360 m/sec.	
11	FR		Current Caltrans SDC call for 5% probability of exceedance in 50 years corresponding to a 975 year return period. Section 5.4 (page 5-2) shows a 2% in 50 years. I assume this is a typo. Please correct the report to reflect the current Caltrans criteria.	Report was corrected to indicate 5% probability of exceedance in 50 years.	
			Geology Comments		
14	FR	3.2.2 Field Exploration Page 3-5	As indicated in The LOTB's Figures 3-4a and 3-4b, the logging method used in accordance with the Caltrans Soil and Rock Logging , Classification and Presentation Manual, June 2007 Edition and Not 2010 Edition as stated in the text. Please be consistent.	The text of Section 3.2.2 has been revised to reference the June 2007 edition.	
15	FR	3.2.5 Ground-water Page 3-6	What is the water elevation of the water surface in Arroyo Del Valle Creek? That may help in defining the groundwater elevation in case of the absence of accurate groundwater level.	Water flow in Arroyo Del Valle is regulated by release of water from Lake Del Valle which is operated by the Department of Water Resources. As noted in the companion hydraulic study, the 100 year WSE is about	

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				Elevation 411 feet at the bridge; the 50 year WSE is about Elevation 410 feet. Information regarding the average non-storm related water surface elevation in Arroyo Del Valle was not available. Free groundwater was encountered at about Elevation 401 feet in borings performed in the creekbed in December 2008 and at about Elevation 398 in a hollow stem boring, A-07-010, drilled at a location approximately 300 feet from Arroyo Del Valle. Our recommendations for design groundwater level at the bridge structure are based on this information.	
16	FR	8.2 Construction Dewatering Page 8-1	To provide the estimate of groundwater dewatering during excavation, seepage rate (flow rate) study should be provided.	Seepage estimates will be provided in a separate technical memorandum.	
17	FR	Figure 3-1	Please show the exact location of the Trail bridge on the Geologic Map, not the whole alignment.	The bridge location at Arroyo Del Valle has been added to the Geologic Map.	

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Foundation Report Retaining Wall Nos. 245 and 246 – Dated 01/16/2015

04-ALA-84, PM22.9/25.7
EA 297624
PID 0400020581

JANUARY 16, 2015

FOUNDATION REPORT

RETAINING WALL NOS. 245 AND 246 SR 84 EXPRESSWAY WIDENING LIVERMORE, CALIFORNIA

Prepared for
Alameda County Transportation Commission (ACTA)
1111 Broadway, Suite 800
Oakland, CA 94607

URS

100 West San Fernando Street, Suite 200
San Jose, California 95113

URS

January 16, 2015
Project 28649640

File No.04-ALA-84-PM 22.9/25.7
EA297624
Project ID 0400020581

Mr. Gary Sidhu
Project Coordinator
Alameda County Transportation Commission (ACTC)
1111 Broadway, Suite 800
Oakland, CA 94607

Subject: **Foundation Report**
Retaining Wall Nos. 246 and 245
Route 84 Expressway Widening
Pleasanton and Livermore, California

Dear Mr. Sidhu:

URS has completed the Foundation Report for Retaining Wall Nos. 246 and 245 in Pleasanton and Livermore, California. The report was prepared in accordance with Caltrans Guidelines for Foundation Report Preparation for Bridge Foundations, dated December 2009 and generally with 2010 State Standard Specifications. This report includes revisions based on comments received from Caltrans dated January 6, 2015. URS also prepared a separate Geotechnical Design and Materials Report for the SR84 widening and two Foundation Reports for the Arroyo Del Valle Bridge (widen) and Arroyo Del Valle Trail Bridge.

This 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. Madhu Thummaluru, Project 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. Paul Boddie, G.E., provided review, consultation and guidance for the project.

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

REGISTERED PROFESSIONAL ENGINEER
S. STEPHEN HUANG
Exp 3/31/2016
No. GE 002150
GEOTECHNICAL
STATE OF CALIFORNIA

URS Corporation
100 W. San Fernando Street, Suite 200
San Jose, CA 95113
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Appendix E Corrosion Investigation

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. The project will be carried out in two segments: Segment A – from 0.6 mile north of Concannon Boulevard to Jack London Boulevard, and Segment B – from 0.1 mile south of Ruby Hill Driver to 0.6 mile north of Concannon Boulevard.

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 in Segment B, two non-standard (special) retaining walls (RW) are proposed at the following locations:

- Ruby Hill Drive to Vallecitos Road Improvements: A retaining wall (RW246) will be required on the west side of SR 84 to retain a cut required adjacent to the Ruby Hill development.
- Vallecitos Road off-ramp modifications: A fill embankment as high as 26 feet will be required to accommodate the realignment of the off-ramp, including a retaining wall (RW245) along the southeastern edge of the off-ramp.

This foundation report (FR) presents geotechnical recommendations for RW245 and RW246 for this project.

1.1 PURPOSE AND SCOPE OF THIS STUDY

The purpose of this FR is to document subsurface conditions and provide 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
- Geotechnical field investigation including nine borings located in close proximity to the two retaining walls
- Laboratory testing to estimate pertinent engineering properties. 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;
  - Engineering analyses for foundation recommendations; and
  - Discussion of construction considerations.

1.2 CALTRANS REVIEW COMMENTS

Our responses to Caltrans comments dated October 10, 2014 and November 26, 2014 for retaining walls are incorporated into this report. Copies of the review comments and our responses are presented in Appendix A.

2.1 GENERAL

Two non-standard retaining walls, RW245 and RW246 are planned at the locations shown on the Location Map, Figure 2-1. Profile, elevation, and typical sections for these retaining walls are presented in Appendix B.

2.2 RETAINING WALL 246

RW246 is to be located along the west side of SR 84 between Ruby Hill Drive and Vallecitos Road, and is required as a result of roadway widening between Station 246+00 and 258+26. Caltrans Type 1 and Type 5 walls are considered to be infeasible at RW246 since the cut would extend into East Ruby Hill Drive and temporary shoring would be cost prohibitive. Therefore, a soil nail wall is proposed for RW246 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 expected to be about 34 feet.

An existing 24-inch-diameter gas line is located behind RW246 along East Ruby Hill Drive.

2.3 RETAINING WALL 245

RW245 is to be located along the modified off-ramp embankment to Vallecitos Road. The wall will start at the right offset of "VEX" Line Station 50+33, and will be about 1,500 feet long. The height of fill to be retained is expected to range from about 3 to 20 feet, measured from original ground surface. The maximum wall height, H, is expected to be 29 feet, taken from top of leveling pad to top of barrier slab. This retaining wall will be a mechanically stabilized embankment (MSE) wall.

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 available topographic information, the existing ground surface along the top of most of the wall ranges from approximately Elevation 540 to 555 feet. East Ruby Hill Drive and neighboring residential development roughly parallel proposed RW246 and are located as close as 20 feet to the northwest of the planned wall.

4.2 SUBSURFACE CONDITIONS

4.2.1 Field Exploration

The locations of borings drilled along the proposed alignment of RW246 are presented on the plan portion of Log of Test Borings (LOTB) sheets presented in Appendix B. Borings R-07-003, R-07-005 and R-07-006 were drilled in December 2007 using a rotary wash drill rig, whereas Boring A-07-004 was drilled in November 2007 with a hollow-stem auger. Boring A-08-005 was drilled in March 2008 using a solid-flight auger mounted on a portable rig capable of drilling on steep hillsides. These borings extended to depths ranging from 25 to 80 feet below ground surface (bgs). During drilling, visual classifications of the soils encountered were made from cuttings and soil samples. The subsurface conditions encountered are presented on the LOTBs.

Consistent with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (2007), the Unified Soil Classification System, as well as guidelines summarizing soil consistency and relative density, were used in preparation of the LOTBs for RW246.

A representative of URS supervised the drilling operations and soil sampling. The collected soil samples 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.

4.2.2 Soil Conditions

Fill

A structural pavement section was encountered in Boring R-07-005, drilled in the outside shoulder, consisting of 9 inches of asphalt concrete overlying 9 inches of aggregate base.

Fill was encountered in Borings R-07-003, A-07-004 and R-07-005 to depths of 3 to 3½ feet below ground surface (bgs). The fill generally consisted of stiff and very dense gravelly silt, sandy silt, silty sand and chunks of asphalt concrete. Fill was not encountered in Borings A-08-005 and R-07-006.

Native Soils

The native soils encountered below fill in Borings R-07-003, A-07-004 and R-07-005, and beginning at the ground surface in Boring A-08-005 consist of stiff to hard lean clay to a depth of about 5 to 6 feet bgs. Underlying these lean clays are interbedded heterogeneous granular and cohesive layers to the terminal depths of the 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 soils consist of very stiff to hard silt, sandy silt, lean clay and sandy lean clay.

Very dense clayey sand, clayey gravel and poorly graded gravel were encountered in Boring R-07-006 to a depth of about 39 feet bgs, underlain by hard lean clay to a depth of about 60 feet bgs. Very dense clayey sand and clayey gravel were encountered below the clay to the terminal depth of the boring.

Cobbles were encountered in Boring R-07-003 at a depth of about 7 feet bgs and in Boring R-07-006 at a depth of about 31 feet bgs.

4.2.3 Groundwater

Free groundwater was not encountered in Boring A-07-004 to the terminal boring depth of 25 feet (Elevation 503 feet) and or in Boring A-08-005 to the terminal boring depth of 35 feet (Elevation 511 feet). Since the rotary wash drilling method was used for Borings R-07-003, R-07-005, and R-07-006, groundwater level measurements could not be made.

5.1 SITE CONDITIONS

RW245 will support the eastern edge of the planned off ramp embankment fill at Vallecitos Road. Available topographic information indicates the existing ground surface at the base of embankment, along the wall layout line, ranges from approximately Elevation 517 to 530 feet.

5.2 SUBSURFACE CONDITIONS

5.2.1 Field Exploration

The locations of borings drilled along the proposed alignment of RW245 are presented on the plan portion of the LOTBs (Appendix B). Borings A-08-030, A-08-031, A-08-032, and A-08-033 were drilled in 2007 and 2008 with a hollow stem auger rig; these borings extended to depths ranging from 30 to 50 feet bgs. During drilling, visual classifications of the soils encountered were made from cuttings and soil samples. The subsurface conditions encountered are presented on the LOTBs.

Consistent with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (2007), the Unified Soil Classification System, as well as guidelines summarizing soil consistency and relative density, were used in preparation of the LOTBs for RW245.

A representative of URS supervised the drilling operations and soil sampling. The collected soil samples 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.

5.2.2 Soil Conditions

Fill

A structural pavement section was encountered in Boring A-08-032 consisting of 8 inches of asphalt concrete overlying 4 feet of aggregate base.

Native Soils

The native soils encountered below the pavement section and fill in Boring A-08-032, and beginning at ground surface in Borings A-08-030, A-08-031 and A-08-033 consist of dense to very dense silty gravel, silty sand and gravelly silt to depths of about 22 to 27 feet bgs. Underlying the sands, gravels and silts are very stiff to hard lean clays and sandy clays to the terminal depths of borings.

5.2.3 Groundwater

Free groundwater was encountered in Boring A-08-030 at a depth of 24 feet bgs (Elevation 503 feet) and in Boring A-08-031 at a depth of about 28 feet bgs (Elevation 490 feet). Borings A-08-032 and A-08-033 were dry to the terminal depths explored at each location.

6.1 REGIONAL GEOLOGY

The SR 84 alignment lies within the Livermore Valley, in 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; Graymer et al., 1996). More recent mapping by Witter and others (2006) subdivides the alluvium into latest Holocene alluvial fan deposits, Holocene alluvial fan deposits, and historic stream channel deposits. The geologic map (Figure 6-1) 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 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 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 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 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 Formation 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 in the borings between the gravelly alluvium soils and the older Livermore Gravels Formation.

7.1 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 1.7, April 2013
- Foundation Report Preparation for Bridge Foundations, dated December 2009
- Caltrans ARS Online (v2.3.06)

7.2 GROUND MOTION

The active faults close to the SR 84 alignment between Ruby Hill Drive and Jack London Boulevard are the Calaveras, Pleasanton and Las Positas faults. These faults are designated with maximum magnitudes (M_{Max}) ranging from of 6.4 to 6.9. The SR 84 alignment is roughly parallel to the Calaveras fault; the distance from the site to the Calaveras fault is approximately 5 miles.

Table 7-1 Seismic Source Parameters

Fault	Type	M_{Max}	Distance* (miles)	Near Field Effects?
Las Positas	Strike-slip	6.4	1.1	Y
Pleasanton	Strike-slip	6.6	2.4	Y
Calaveras	strike-slip	6.9	5.2	Y

*To the approximate mid-point of the retaining walls.

Based on Caltrans ARS Online and interpolation of spectral values at ground level, the following ground motion parameters have been established for walls RW 245 and RW 246 based on a an average shear wave velocity, $V_{s30,}$ in the upper 30 meters of 360 meters/second and probability of exceedance of 5 percent in 50 years:

- RW 245 (Latitude 37.63708597, Longitude -121.79831743)
  - Peak ground acceleration (PGA) = 0.61g

- RW 246 (Latitude 37.63704812, Longitude -121.79959953)
  - Peak ground acceleration (PGA) = 0.61g

8.1 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 Calaveras and Pleasanton faults. 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. These faults are included as Alquist-Priolo (A-P) zoned faults. The project alignment does not cross any mapped A-P zoned faults. Figure 8-1 shows active faults within the site region relative to the project.

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). Other nearby mapped faults include the southwest extension of the Las Positas fault, located about 1.7 miles (2.8 km) southeast of the southern end of the project alignment. The project alignment does not cross either the Los Positas fault or the Livermore fault.

The following are brief descriptions of the nearby active faults.

8.1.1 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 5.2 miles 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. The Calaveras fault has a Maximum Magnitude, M_{max}, equal to 6.9.

8.1.2 Pleasanton Fault

The Pleasanton fault is located about 2.1 miles southwest of the southern end of the project alignment. The Pleasanton fault is a strike-slip fault that is located at the base of the hills on the north side of the Vallecitos Valley (CGS, 2000). It is predominantly a vertical fault with a M_{max} equal to 6.6.

8.1.3 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 the 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 northeast of the end of the project alignment (CGS, 2000).

The Las Positas fault is a strike-slip fault with M_{max} equal to 6.4.

8.2 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, Greenville, Las Positas and Pleasanton 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 7.2 includes a discussion of the anticipated seismic shaking from these more distant faults.

8.2.1 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. 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 A-07-004 was drilled about 100 feet west and northwest of the toe of these landslides. 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.

8.2.2 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 (in the vicinity of RW245 and RW246), 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 review of the borings completed at or near RW246 and RW245, 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). For analysis we used a peak ground acceleration of 0.61g and design earthquake moment magnitude of 6.8. The results of these analyses are presented in Appendix D. Based on the analyses, we estimate liquefaction induced settlement of less than ¼ inch at RW245 and RW246.

8.2.3 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 unaware of subsidence in the area from agricultural pumping. Moreover, 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 consolidation settlement, as soft, geologically young sediments were not encountered.

Seismic compression 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 two borings (R-07-003 and R-07-006) using the NCERR Workshop procedure. In our analyses we used a peak ground acceleration of 0.61g and design earthquake moment magnitude of 6.8. The results of these analyses are presented in Appendix D. Based on our analyses, we estimate seismic compression of less than ¼ inch at RW246 and RW245.

8.2.4 Flooding

With the exception of the active channels of Arroyo Del Valle and Arroyo Mocho, the SR84 project alignment is located outside of the 100-year flood zone as shown on the FEMA flood hazard zone maps (ABAG, 2007).

8.2.5 Scour

The nearest creek to the proposed retaining walls is more than 50 feet away; therefore, scour is not a potential geologic hazard.

9.1 INTRODUCTION

Two non-standard retaining walls are proposed for the SR 84 Expressway project. RW246 is expected to be a soil nail wall and RW245 is expected to be a MSE wall. Geotechnical recommendations for each wall are presented in the following sections of this report.

9.2 RW246

9.2.1 Anticipated Soil Conditions

The exposed face of the excavation for RW246 is expected to consist of stiff to hard clays and silts, as well as interbedded 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 the General Plan in Appendix B, the maximum wall height is expected to be about 34 feet and wall length is 1,800 feet.

9.2.2 Soil Nail Wall Construction

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 about 3 feet, followed by 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 spacing is 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 unsuitable 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.
- Soil nailing below the water table.

Since the soils in borings drilled along RW246 do not fall within these categories, we believe a soil nail wall is feasible.

There is an existing 24-inch-diameter gas line along East Ruby Hill Drive behind proposed RW246. The wall designer should confirm that the soil nails have sufficient clearance from the gas line. As part of final design, soil nails and the existing gas line should be located in cross-section to verify there is no interference. If there is interference, the soil nails may need to be steepened in excess of 15 degrees from horizontal to avoid the gas line.

9.2.3 Geotechnical Design Parameters

Lateral earth pressure on the soil wall (face loadings) should be based on published case histories of soil nail walls (FHWA, 1998). We recommend the nail head service load, $t_{F,}$ be determined 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

We recommend the following geotechnical design parameters be used to determine the nail resistance for design of the soil nail wall, RW246.

Table 9-1 Soil Nail Wall Design Parameters

Moist Unit Weight (pcf)	Effective Friction Angle (degrees)		Effective Cohesion (psf)		Ka
	Cohesive[1]	Granular	Cohesive[1]	Granular	
130	32	36	0	0	0.42

[1]Assumes long-term drained conditions for cohesive soil.

An ultimate soil-grout bond stress of 1,000 psf with an appropriate factor of safety should be used in design of the soil nail wall.

The soil nail system should be designed to be relatively rigid.

The design of the soil nail wall should also account for surcharge load imposed by traffic on East Ruby Hill Drive; we recommend a surcharge equivalent of 2 feet of soil, i.e., 240 pounds per square foot vertical pressure.

9.2.4 Earthquake Loading

The effects of an earthquake should be considered in accordance with 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:

$$\Delta P_{ae} = 12 \cdot H^2$$

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.

9.2.5 Ground Movements Associated with Soil Nail Wall Construction

During construction of a soil nail wall, beginning at the top of the wall and progressing downward, 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. Therefore, maximum horizontal movement occurs at the top of the wall and decreases progressively towards the toe of the wall. Settlement at the facing can also occur, and tends to be on the same order of magnitude as the horizontal movement at the top of the wall. Displacement of the wall depends 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
- 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, where H is the height of the wall. 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 on the order ¾ to 1 inch will occur along the ground surface behind the wall between approximately Station 246+50 and 258+00.

The construction displacements tend to decrease in magnitude with distance behind the wall facing. Based on FHWA (1998) recommended procedures, we estimate the zone of ground surface movement to be negligible beyond a distance of 35 to 45 feet from the wall face. On this basis, we expect some settlement and cracking of the East Ruby Hill Drive during construction. Therefore, a bid item should be included to repair/repave East Ruby Hill Drive, if necessary.

In addition, the effect of ground movement on existing underground utilities located within or adjacent to East Ruby Hill Drive should be considered. The existing 24-inch gas line located just off the roadway lies within the estimated zone of ground surface settlement and could undergo

settlement on the order of about ½ inch; the owner should be advised. Furthermore, the locations of other existing buried utilities should be verified in advance of so the nails can be installed at the design locations. If unknown obstructions or buried utilities are encountered, then delays and claims by the Contractor could result.

We believe it would be prudent to require the Contractor to perform videotaped preconstruction and post-construction condition surveys of the East Ruby Hill Drive pavement surface, buried utilities and nearby houses abutting East Ruby Hill Drive. This survey should extend for the full length of RW246 and be performed by a Registered Civil Engineer retained by the Contractor. The videotaped survey should include a verbal narrative of observations. 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, URS would be pleased to review the appropriateness of geotechnical design parameters selected.

9.2.6 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 5 to 10 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.

9.2.7 Construction Dewatering

Free groundwater was not encountered in Borings A-07-004 and A-08-005 to the terminal depth of borings, corresponding to Elevation 503 and 511 feet. However, groundwater was measured at Elevation 503 feet in nearby Boring A-08-030. Since bottom of wall is expected to range from

about Elevation 519 to 537 feet, it is likely the groundwater level will be at least 8 feet below the bottom of the wall. If groundwater is encountered near the base of the wall during construction, normal sumping procedures are anticipated to be adequate to remove accumulated water.

9.2.8 Overbreak

Silty sand and cobbles were encountered in nearby explorations, and could therefore, 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. Difficult drilling conditions could be encountered where cobbles are encountered in the soil nail holes. The Contractor should refer to the LOTB sheets and understand the potential presence of silty sand and/or cobbles in the vicinity of the soil nail wall location.

9.2.9 Global Stability

The global stability of RW246 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 at Station 251+80, which coincides with the maximum wall height, and in our opinion, represents the critical section for the retaining wall. A design groundwater level at Elevation 503 feet was used for the analysis.

Caltrans requires a minimum factor of safety of 1.3 for retaining walls under static loading conditions (Bridge Design Specifications, Section 5.2.2.3, August 2004), and a minimum factor of safety of 1.1 under seismic conditions. The results of our analyses are summarized in the following paragraphs. A copy of the global slope stability calculations is presented in Appendix D.

Static, 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.

Seismic, Pseudo-Static Conditions

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, Kh, of 0.23g.

Results

The results of our analyses for RW246 are summarized in the following table.

Table 9-2 Results of Global Slope Stability Calculations

Loading Conditions	Minimum Calculated Factor of Safety	Minimum Required Factor of Safety
End of Construction	2.6	1.3
Pseudo-static (Seismic)	1.7	1.1

In the analyses we assumed the critical slip circle falls outside the terminal ends of the soil nails, which are assumed to extend 25 feet from the wall face. Based on our analyses, the computed minimum (critical) factors of safety exceed the minimum required values for static and pseudo-static loading conditions.

9.3 RW245

The wall layout, profiles and design details for MSE RW245 are presented on the General Plan and LOTBs in Appendix B. Recommendations for the geotechnical aspects of the design details are summarized in the following sections.

9.3.1 Materials for MSE Wall Construction

The MSE wall should be constructed with compacted, relatively clean, granular imported material meeting the requirements of Caltrans Standard Specifications Section 19-3 and the following criteria.

- Particle size ≤150 mm
- Amount passing the 76 mm Sieve, 78 to 100%
- Amount passing the 0.074 mm (No. 200 Sieve) ≤ 25%
- Plasticity Index < 10
- Angle of Internal Friction, $\phi \geq 34$ degrees
- Sand equivalent ≥ 20

9.3.2 Lateral Pressures

RW245 should be designed to resist lateral earth pressures imposed by the adjacent backfill. We recommend that the wall be designed to resist a minimum equivalent fluid pressure of 40 pounds per cubic foot (lb/ft^3) for horizontal backfill, and 64 lb/ft^3 for a 2:1 (H :V) backfill slope. These recommendations are based on clean granular material (ϕ =30°) placed in the retained zone behind the MSE wall.

Consideration was given to reusing the excavated wall material as backfill behind the MSE wall. This excavated material would vary considerably in composition from lean and fat clays to silty sands. The lean and fat clays would require considerable processing to be recompacted.

Furthermore, the use of existing embankment materials would result in a higher equivalent fluid pressure. For that reason, clean granular material with the minimum internal friction angles of 34 and 30 degrees are recommended in the reinforced zone and retained zone, respectively.

The design of RW245 should also account for surcharge load imposed by traffic on the Vallecitos off-ramp; we recommend a surcharge equivalent of 2 feet of soil, i.e. 240 pounds per square foot vertical pressure.

The recommended pressures assume that no hydrostatic pressures will develop behind the retaining walls. The buildup of hydrostatic pressure behind the walls should be prevented by the inclusion of a positive drainage system. We recommend that the 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 12 inches behind the MSE wall in accordance with Caltrans Standard Detail Sheet (Mechanically Stabilized Embankment, Detail No. 7). Positive drainage for water collected in the backfill should be provided by means of drain pipe leading to a free draining outlet.

9.3.3 Earthquake Loading

The effects of an earthquake should be considered in accordance with 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:

$$\Delta P_{ae} = 12 \cdot H^2$$

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.

9.3.4 Global Stability

Parameters

The following Table 9-3 presents geotechnical parameters that were used for stability analysis of RW245.

Table 9-3 MSE Wall Geotechnical Design Parameters

Engineering Property	Granular MSE Backfill		Foundation Soil	
	Retained Soil	Reinforced Soil	Clayey Sand	Lean Clay
Friction Angle, ϕ (degrees)	30	34	36	0
Cohesion, C (lb/ft^2)	0	0	0	2,500
Total Unit Weight, γ (lb/ft^2)	120	120	130	130

Analysis and Results

The global stability of RW245 was evaluated using a limit equilibrium method based on Spencer's procedure of slices as coded in the program SLOPE/W. In Spencer's procedure, all forces are assumed to have the same inclination, and all requirements for static equilibrium are satisfied. The trial and error solution involves successive assumptions for the factor of safety and side force inclination until force equilibrium and moment equilibrium are satisfied.

We performed the analyses at "V" Line Station 54+56, which coincides with the maximum wall height, and in our opinion, represents the critical section for the retaining wall. The end of construction case represents the condition immediately following construction when excess pore pressures have been induced by the construction, and not enough time has passed for them to dissipate. For this reason, undrained conditions exist for impervious clay soils, whereas drained strengths were used for granular soils. Strength results from laboratory unconfined compressive strength tests were used for the fine grained soils and the estimated friction angle was used for the granular soils.

The results are summarized in Table 9-4 and include the following cases: end of construction condition and pseudo-static condition (Kh of 0.23g). A copy of the global slope stability calculations is presented in Appendix D. A design groundwater at Elevation 503 feet was used for the analysis.

Table 9-4 Slope Stability Factor of Safety Criteria

Loading Condition	Required Minimum FOS	Estimated Minimum FOS
Static, end of construction	1.3	2.4
Pseudo-static (seismic)	1.1	1.6

9.3.5 Bearing Capacity

The nominal bearing resistance was estimated using the equations in AASHTO LRFD Bridge Design Specifications, Section 10 (AASHTO, 2007) using the soil parameters presented in Table 9-3. In accordance with Caltrans Amendments to AASHTO LRFD, Table 11.5.6-1 for MSE walls resistance factors of 0.65 and 1.0 are used for strength and extreme limit states, respectively. Equivalent base width, defined as L-2e, where L is the length of soil reinforcement and e is the eccentricity.

A summary of the calculated factored nominal bearing resistances for the strength and extreme limit state for RW 245 is presented in Table 9-5; these values are based on the geotechnical parameters for foundation soil presented in Table 9-3.

Table 9-5 MSE Wall Bearing Resistance

Maximum Wall Height (ft)	Strength Limit State			Extreme Event State		
	Equivalent Base Width (ft)[(1)]	Factored Nominal Bearing Resistance, φ=0.65 (ksf)	Applied Bearing Stress (ksf)	Equivalent Base Width (ft)	Factored Nominal Bearing Resistance, φ=1.00 (ksf)	Applied Bearing Stress (ksf)
26.67	13.82	11.7	6.52	7.66	18.0	8.63

[1] Equivalent base width from Caltrans Bridge Design Aids 3-8, Attachment No. 2 for Load Case 1, April 2013.

The coefficient of sliding resistance is equal to tan ϕ', where ϕ' is the effective angle of friction of the foundation soil. The resistance factor is taken as 0.9 for the strength limit case and 1.0 for extreme limit case.

9.3.6 Settlement

The total settlement of the MSE wall will be due to the settlement of the embankment itself and the settlement of the supporting soils. Given the composition and the degree of compaction of the embankment materials, we anticipate that fill settlement will be negligible and will occur during construction.

We estimate that the weight of the MSE wall will induce settlement of about ½ inch in the supporting clays. We estimated that settlement of the dense sands and gravels that underlie the wall will be negligible.

9.3.7 Leveling Pad

To provide a uniform bearing pad and sliding resistance (along the soil block-foundation interface), we recommend soil be subexcavated to a depth of 12 inches below the bottom of the leveling pad and the resulting excavation backfilled with material conforming to the requirements for structure backfill in accordance with Caltrans' Standard Specifications. The subexcavation area should extend laterally at least 12 inches on both sides of the leveling pad.

9.3.8 Construction Dewatering

Free groundwater was encountered in Borings A-08-030 at a depth of about 24 feet bgs (Elevation 503 feet) and in Boring A-08-031 at a depth of about 28 feet bgs (Elevation 490 feet). Since bottom of wall is expected to range from about Elevation 508 to 526 feet, it is likely the groundwater level will be at least 5 feet below the bottom of the wall.

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 E. The following paragraphs include their summary and recommendations.

10.1 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 two proposed retaining walls between the Ruby Hill Drive and Vallecitos Road intersections. 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, R-07-003 and R-07-005, 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.

10.2 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 sites near the Vallecitos Road intersection are considered non-corrosive.

10.3 RECOMMENDATIONS

The test data and a review of the project requirements were used to make recommendations for the structural foundation material listed below.

10.3.1 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 use in design of RW245 and RW246 only. The opinions, conclusions and recommendations presented herein are based on available subsurface information developed by widely spaced 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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3	RETAINING WALL No. 245	STRUCTURAL PLAN No. 1
4	RETAINING WALL No. 245	STRUCTURAL PLAN No. 2
5	RETAINING WALL No. 245	STRUCTURAL PLAN No. 3
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STANDARD PLANS 2010

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RSP A10B	ABBREVIATIONS (SHEET 2 OF 2)
A10C	LINES AND SYMBOLS (SHEET 1 OF 3)
A10D	LINES AND SYMBOLS (SHEET 2 OF 3)
A10E	LINES AND SYMBOLS (SHEET 3 OF 3)
A10F	LEGEND - SOIL (SHEET 1 OF 2)
A10G	LEGEND - SOIL (SHEET 2 OF 2)
RSP B11-56	CONCRETE BARRIER TYPE 736
RSP D73	DRAINAGE INLETS

STANDARD PLAN SHEET No.

DETAIL No.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	ALA	84	22.9/25.7		

05-30-14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
CHAO GONG
No. No. C53837
Exp. 9-30-15
CIVIL
STATE OF CALIFORNIA

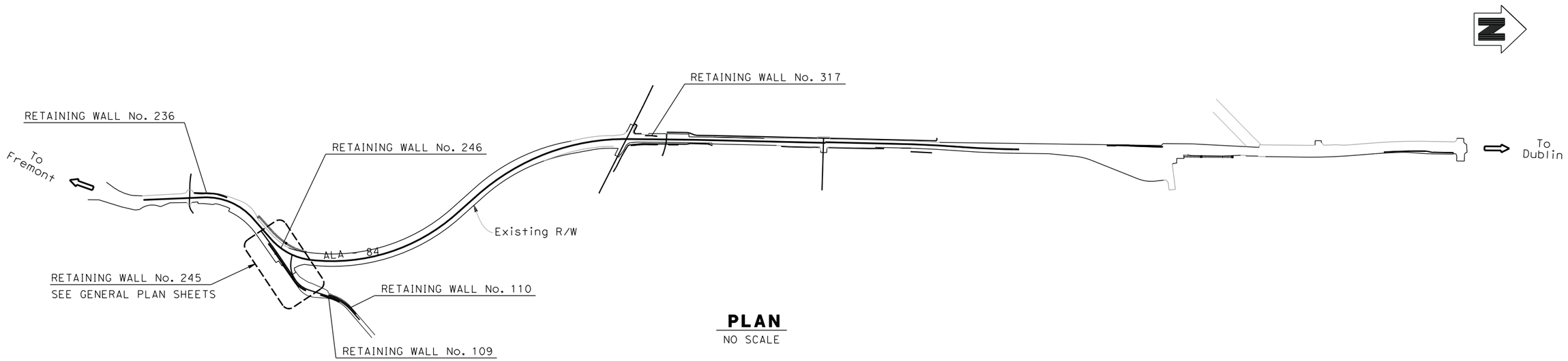
The State of California or its officers or agents shall not be responsible for the accuracy or completeness of scanned copies of this plan sheet.

ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 BROADWAY, SUITE 800
OAKLAND, CA 94607

URS CORPORATION
1333 BROADWAY, SUITE 800
OAKLAND, CA 94612-1924

ALAMEDA COUNTY

PLEASANTON **LIVERMORE**



PLAN
NO SCALE

DESIGN OVERSIGHT -	DESIGN	BY H. HAKIMI	CHECKED G. CARROLL	LOAD & RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 DESIGN VEHICLE		
- SIGN OFF DATE	DETAILS	BY N. HUTTON	CHECKED C. GONG	LAYOUT	BY A. BHOI	CHECKED E. Abi-Jaoude	
	QUANTITIES	BY H. HAKIMI	CHECKED G. CARROLL	SPECIFICATIONS	BY M. SEDGHI	PLANS AND SPECS COMPARED C. GONG	

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. GONG
PROJECT ENGINEER

BRIDGE NO. -
POST MILES -

FIGURE 2-1
LOCATION PLAN

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

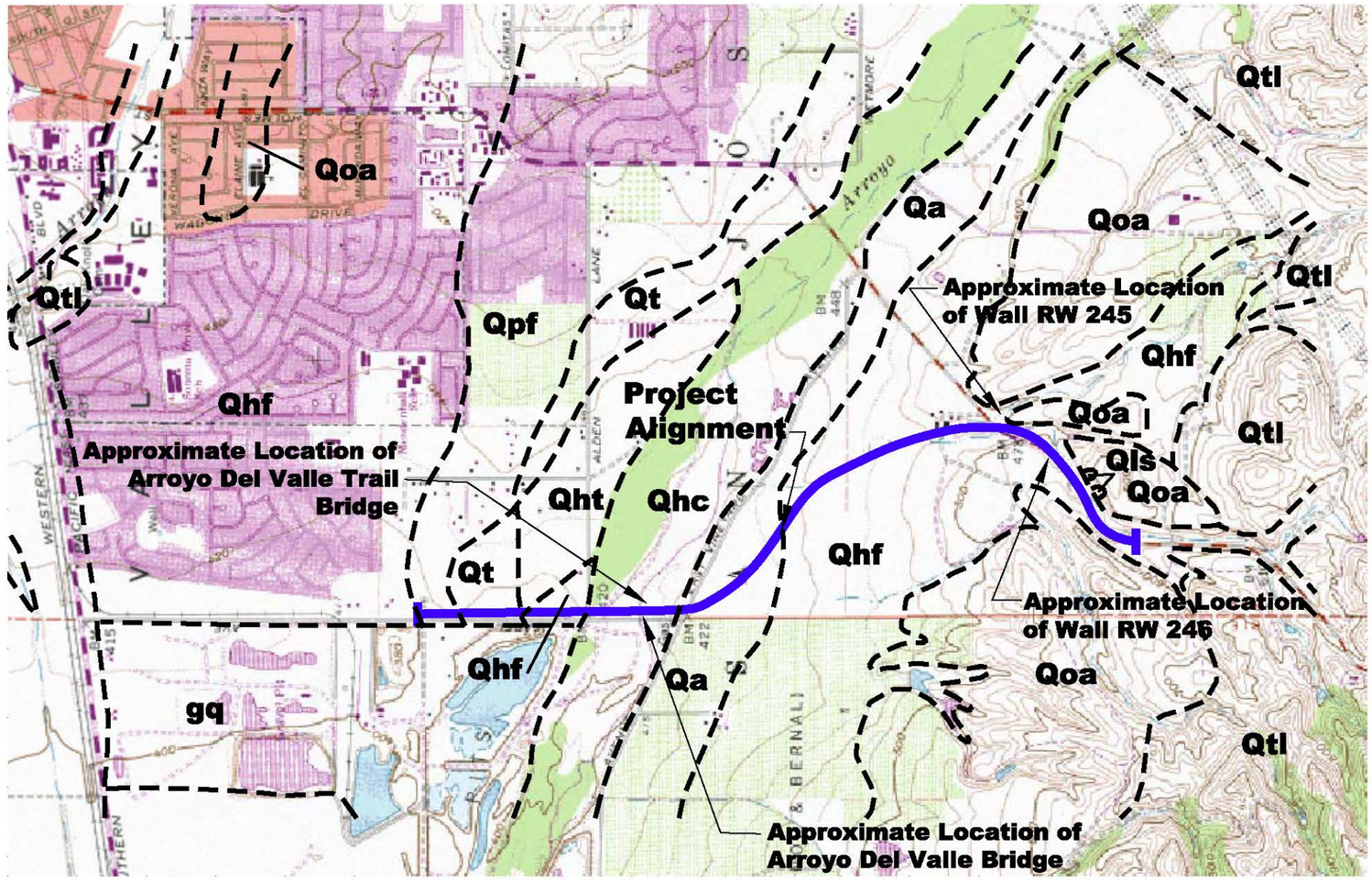
UNIT: 0733
PROJECT NUMBER & PHASE: 04000205811 CONTRACT NO.: 429760

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES				SHEET	OF
05-30-14				1	14

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME



LEGEND:

- Approximate geologic contact

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

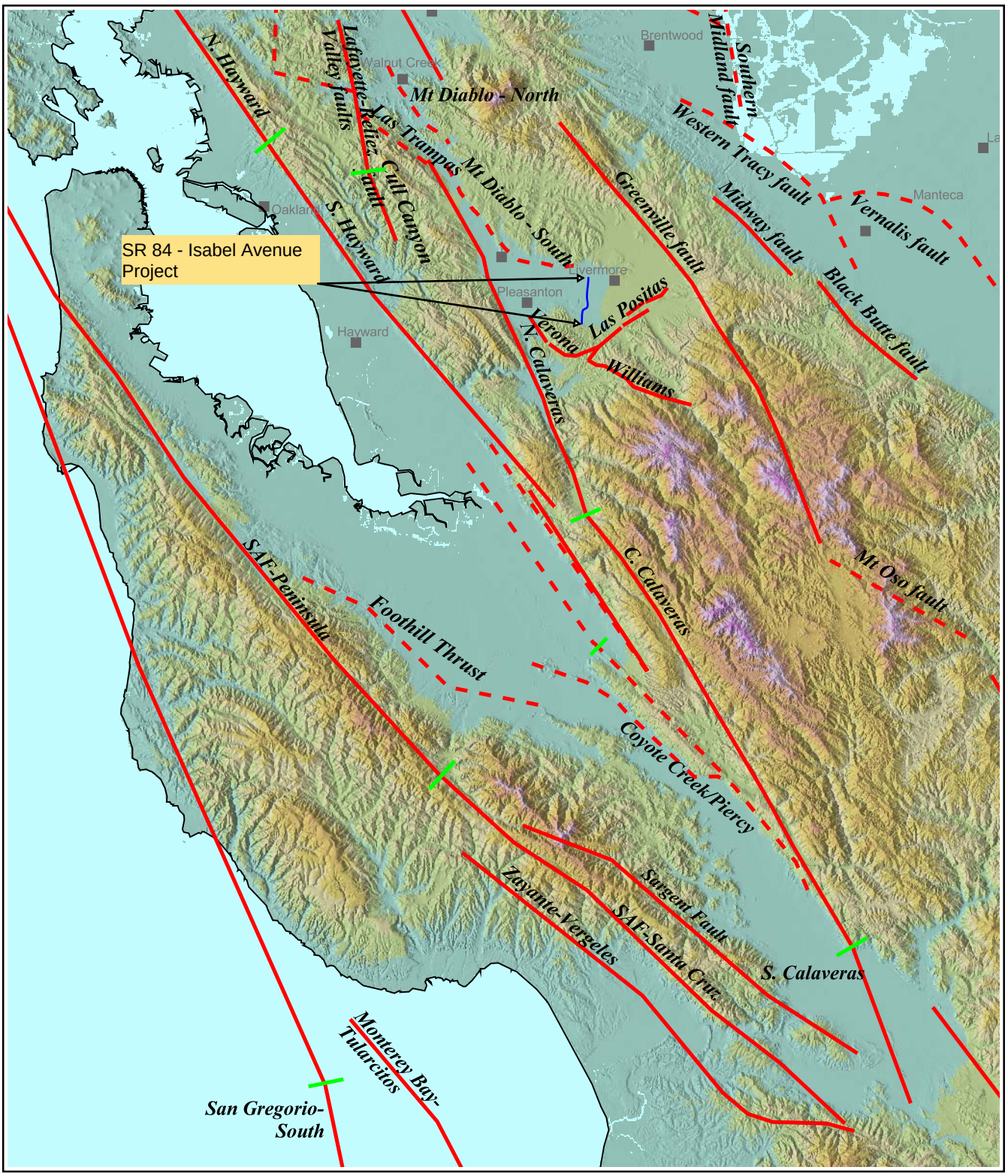
Geologic map modified from Dibblee, T.W., 1980 and Witter, R.C., et al, 2006

URS

SR 84 Isabel Ave
Livermore, California
Alameda County

SITE AND GEOLOGIC MAP

SCALE
Figure 6-1
November 2014



Fault Sources: URS Seismic Hazard Model

URS	28649640 SR 84 - Isabel Ave Livermore, CA	ACTIVE FAULTS IN THE SITE REGION	Figure 8-1

Office of Special Funded Projects
Comment & Response Form

(Revised 08/2011)

General Project Information (OSFP Liaison to complete)		**Review Phase** (OSFP Liaison to complete)	**Reviewer Information** (Reviewer Liaison to complete)	
Dist:	**04**	☐ PSR/PDS (Review No.)	Reviewer Name:	**Betty Lee/Tung Nguyen / H. Salimi/ Rifaat Nashed**
Proj ID (Phase):	**0400020581**	☐ APS/PSR (Review No.)	Functional Unit:	**Geotechnical Design- West**
EA:	**297621**	☐ APS/PR (Review No.)	Cost Center:	**59-3660**
Project Name:	**Route 84, PM 22.9/25.7-Livermore**	☐ Type Selection	Phone Number:	**510-286-4825**
OSFP Liaison:	**David Soon**	☐ 65% PS&E Unchecked Details	e-mail:	**Betty_lee@dot.ca.gov**
Phone:	**916-227-5671**	☑ PS&E (Review No. 4)	Date of Review:	**10-10-2014/ 11-26-2014/1-6-2015**
E-mail:		☐ Construction	Structure Name*:	**RW 245**
		☑ Other: FR (4TH REVIEW)	Br No*:	
			(*Use if necessary to when comment sheets are by individual structure)	

Consultant Information (to be filled in by Consultant)

Consultant Structure Lead (First and Last Name)	Structure Consultant Firm	Phone Number	E-mail	Response Date
Stephen Huang	**URS**	**408-297-9585**	**Stephen.huang@urs.com**	**9-12-2014/12-8-2014/1-16-2015**

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	3rd Review Comments	4th Review Comments	Consultant Responses
1			**When making revisions, please indicate the page numbers where revisions will be found. The referenced pages and appendices in your responses are inconsistent with the actual FR. Please**				

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✓= Comment Resolved
(for Reviewer's use)

Submittal Data (Reviewer to complete)
Project ID: Reviewer**:** Str Name*: RW 245
Date of Review: 12/31/2014 Functional Unit: Br No*. ___ *=if applicable

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	3rd Review Comments	4th Review Comments	Consultant Responses
			PROOF-READ your reports before you send them to us.				
2a	FR		2a) Sections 10.3.4 and 10.3.8 not found in FR.	Section 10 of the FR, Corrosion Investigation, consists of only Sections 10.1 through 10.3 and 10.3.1. Search of document did not find reference to Section 10.3.4 or 10.3.8.			
2b	FR	Pg. 9-8	2b) Text says used maximum fill height of 20 ft for slope stability analysis. Is this correct?	The text is correct. The maximum MSE wall height, H1, shown on the plans is 26'-8" which is measured from the top of the leveling pad to the top of the wall. The maximum fill height of 20 feet used for the global stability analysis was scaled from Structural Plan No. 2 of the retaining wall plan set at approximate Station 17+00, measured from OG/FG to the top of the wall.	If the maximum wall height in the Plans is 26'-8", why was that height not used in the slope stability analysis? Using H=20" would be unconservative. The cross section used for the slope stability analysis shown on Figure D-1 was cut at a location coincident with the maximum wall height and is based on existing/proposed topography at the toe of the wall (OG/FG) and top of the wall. For this reason the wall configuration used in the stability analysis is appropriate for the MSE wall as designed. For clarity, we revised the	Consultant's explanation does not make sense. Why was the maximum height of 26'-8" not used in the slope stability analysis?	The design height, H1, of 26'8" shown on the plan includes a portion of the wall embedded below finish pavement at the toe. The soil and pavement adjacent to this embedded portion of wall provide a resisting force, rather than a driving force, for stability analyses. The cross-section used in the stability analysis was taken where the design height is 26'8", and where the net elevation difference between finish grade at the bottom of wall and finish grade at top of wall is a maximum; this maximum difference in net elevation of 22'6"

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					text of the FR (page 9-8) to refer to stability analyses performed for maximum wall design height.		occurs at Station 54+56. Finish grade is the same as original grade along the toe of the wall; therefore, no additional excavation in front of the bottom most wall panel is anticipated.
10	FR	Table 9-3	Friction angle 30 degrees for MSE backfill should be corrected.	A friction angle of 30 degrees was used in the slope stability analyses for the retained soil mass (MSE backfill) as described in Section 9.3.2 of the FR. The friction angle of 34 degrees for the reinforced soil in the MSE wall is not provided in Table 9-3. No revision needed.	Friction angle 30 degrees for MSE backfill should be corrected. Consistent with terminology presented in Caltrans Memo to Designers 5-5 (April 2014), soil backfill for the MSE wall consists of two components - reinforced soil (located immediately behind the wall facing) and retained soil (located behind the reinforced soil zone). For consistency, we will revise Table 9-3 of the FR to refer to reinforced backfill having an internal friction angle of 34 degrees and retained backfill having an internal friction angle of 30 degrees. These values are consistent with those shown in Appendix D for slope	Noted.	

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					stability analyses.		
11	FR	Appdx D	Friction angle 34 degrees of retained fill used in sliding and overturning analyses is not consistent with the slope stability analyses and Structural Plans.	The internal friction angle of reinforced soil is shown as 34 degrees as described in Section 9.3.2 of the FR. The internal friction angle of retained backfill is assumed to be 30 degrees as presented in Table 9-3; these values are consistent with those used in the slope stability analyses in Appendix D. The General Plan for RW245 will be revised to indicate a friction angle of 36 degrees for the clayey sand foundation soils used in evaluation of sliding resistance and overturning, consistent with Table 9-3 of the FR.	In Table 9-3, internal friction angle of MSE backfill is shown as 30 degrees, therefore, it needs to be corrected as required in comment #10. Please see response to Comment #10. The internal friction angle for the retained portion of MSE backfill is correct as shown in the table as 30 degrees.		
12	P	1 of 15	Friction angle and unit wt should be shown.	The design unit weight of 120 pcf is currently provided on the General Plan for the retained backfill and reinforced soil. The unit weight for the foundation soil, 130 pcf, will be added to General Plan along with the corrected friction	All * in General Notes #3 should be placed with friction angle and unit wt. The General Plan for RW245 currently shows friction and friction angle for reinforced backfill (used for evaluating internal MSE wall stability), retained		

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				angle of 36 degrees.	backfill (used for evaluating external MSE wall stability) and foundation soil (used for evaluating external MSE wall stability). No change needed.		
13	P		Please indicate Hammer Efficiency on the LOTB's.	Hammer efficiencies not provided during time of drilling program and therefore not included on LOTBs.	It should have been noted. Otherwise, SPT blowcounts could not be corrected for hammer efficiency. We located the calibration report for the Failing 1500 automatic hammer used for all rotary wash borings; that hammer efficiency of 74.6% has been added to the LOTBs. Auger boring A-08-005 was sampled with an automatic hammer while the remaining auger borings were sampled with a safety hammer. Calibration reports were not prepared at the time of exploration for either of the auger borings so the hammer efficiencies will be listed as 60% for the safety hammer and 70% for the automatic hammer, consistent with published values.	Please indicate in LOTB's each hammer's efficiency. For the 60% and 70% "published values", please indicate on LOTB's that they are "published values". (Please do this to ALL boreholes of this project, not just for RW 245.) For future reference, hammer efficiencies must be recorded at the time of drilling. Each drill rig hammer has its own unique efficiency; using "published values" is inaccurate. Plan update verified by DSoon 1/8/15. No action needed.	A note referencing the use of published values for similar types of hammers is added to updated LOTBs.

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Submittal Data (Reviewer to complete)
Project ID: Reviewer**:** Str Name*: RW 245
Date of Review: 12/31/2014 Functional Unit: Br No*. ___ *=if applicable

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			Geology Comments				
1	FR	2.1 GENERAL Pg. 2-1	Location map of Retaining wall RW245 and RW 246 (Figure 2-1) is missing.	Figure 2-1 mislabeled as Figure 1-1. The figure number corrected in revised report and locations of RW245 and RW246 added.			
2	FR	4.1 Site Conditions & 5.1 Site Conditions	No difference between 4.1 label and 5.1 label. To differentiate should add "for Rw246" to the first and "for RW 245" to the second.	The section headers at top of each page differentiate Section 4 for RW246 and Section 5 for RW245. No change needed.			
3	FR	6.1 Regional Geology Pg. 6-1	Site location should be added to describe the geology specifically for the location of retaining walls RW246 & RW245.	The locations of RW245 and RW246 added to the geologic map, Figure 6-1, in revised report.			
4	FR	Figures 3-3 and 3-4	These two figures should be removed from this report for two reasons: 1- This report is dedicated for retaining walls	Agreed. Figures removed.			

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			RW246 & RW245 only. 2- They were not used or mentioned in the report text.				
5	FR	Appendix A	On comment response No. 8 dated August 20, 2014, The Figure 6-1 is not included in the report. Please include.	Figure 6-1, geologic map, mislabeled as Figure 3-1. Corrected in revised report.			

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Office of Special Funded Projects
Comment & Response Form

(Revised 08/2011)

General Project Information (OSFP Liaison to complete)		**Review Phase** (OSFP Liaison to complete)	**Reviewer Information** (Reviewer Liaison to complete)	
Dist:	**04**	☐ PSR/PDS (Review No.)	Reviewer Name:	**Kumi J**
Proj ID (Phase):	**04000205811**	☐ APS/PSR (Review No.)	Functional Unit:	**OSFP**
Project Name:		☐ APS/PR (Review No.)	Cost Center:	
OSFP Liaison:	**David Soon**	☐ Type Selection	Phone Number:	**916-227-8903**
Phone:	**916-227-5671**	☐ 65% PS&E Unchecked Details	e-mail:	**Kumi_jayananth@dot.ca.gov**
E-mail:	**David_soon@dot.ca.gov**	☑ PS&E (Review No. 2)	Date of Review:	**12/1/2014**
		☐ Construction	Structure Name*:	**Retaining Wall No 245**
		☐ Other: CCO	Br No*:	**33E0405**
			(*Use if necessary to when comment sheets are by individual structure)	

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	FR		FR Table 9-5: Verify the equivalent base width for extreme event state. Equivalent base width should be from the designer calculation not from the BDA. Because applied bearing stress is calculated based on the equivalent base width.	Table 9-5 was revised with equivalent base width and applied bearing stress consistent with structure design calculations.	
2					
3					
4					
5					
6					

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(Revised 08/2011)

General Project Information (OSFP Liaison to complete)		**Review Phase** (OSFP Liaison to complete)	**Reviewer Information** (Reviewer Liaison to complete)	
Dist:	**04**	☐ PSR/PDS (Review No.)	Reviewer Name:	**Betty Lee/Tung Nguyen/Hossain Salimi/Rifaat Nashed**
Proj ID (Phase):	**0400020581**	☐ APS/PSR (Review No.)	Functional Unit:	**Geotechnical Design- West**
EA:	**297621**	☐ APS/PR (Review No.)	Cost Center:	**59-3660**
Project Name:	**Route 84, PM 22.9/25.7-Livermore**	☐ Type Selection	Phone Number:	**510-286-4825**
OSFP Liaison:	**David Soon**	☐ 65% PS&E Unchecked Details	e-mail:	**Betty_lee@dot.ca.gov**
Phone:		☑ PS&E (Review No. 4)	Date of Review:	**10-10-2014/ 11-26-2014/1-6-2015**
E-mail:		☐ Construction	Structure Name*:	**RW 246**
		☑ Other:_ FR (4TH REVIEW)	Br No*:	
			(*Use if necessary to when comment sheets are by individual structure)	

Consultant Information (to be filled in by Consultant)

Consultant Lead (First and Last Name)	Consultant Firm	Phone Number	E-mail	Response Date
Stephen Huang	**URS Corporation**	**408-297-9585**	**Stephen.huang@urs.com**	**11-3-2014 and 12/8/14/1/16/2015**

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	2nd Review Comments	Consultant Responses	3rd Review Comments	4th Review Comments	Consultant Responses
			When making revisions, please indicate the page numbers where revisions will be found.	Page, section or figure numbers for revisions are provided in following responses.	**The referenced pages and appendices in your responses are inconsistent with the actual FR. Please PROOF-**				

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Submittal Data (Reviewer to complete)
Project ID: 0400020581 Reviewer: Str Name*: RW 246
Date of Review: Functional Unit: Br No*. 33E0075

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	2nd Review Comments	Consultant Responses	3rd Review Comments	4th Review Comments	Consultant Responses
					READ your reports before you send then to us.				
1	FR, P	LOTB	The LOTBs are for vertical borings done at the bottom elevation of the proposed soil nail wall. Soil nail wall design requires horizontal borings into the wall face. Please explain how these vertical borings are representative of the wall slope.	One vertical boring, A-08-005, was drilled on the existing slope between East Ruby Hill Drive and SR 84 using specialized drilling equipment to characterize the subsurface conditions within the reinforced and retained zones for the soil nail wall, and several additional borings were drilled at the toe of the slope to characterize the foundation soils. Due to access constraints on the hillside, horizontal borings could not be performed as part of the study. In addition, permission to drill vertical borings at the top of the proposed wall along East Ruby Hill Drive was denied by the homeowner's association. The Non-Standard Special	What page of the Special Provisions is this on?	Please see Section 46 of the NSSP. Since page numbers for the NSSP are updated frequently, we have included this section of the NSSP as written for your review.	Please provide NSSP when it is ready. Must check for its inclusion. NSSP provided as pdf via email delivery to Betty Lee on 11/16/2014.	Noted. Will be checking for its inclusion in Final NSSP.	

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Project ID: 0400020581 Reviewer: Str Name*: RW 246
Date of Review: Functional Unit: Br No*. 33E0075

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				Provisions (NSSP) of the Project Specifications will include the following statement*: Prior to final design, submittal of working drawings and construction of the soil nail wall, the Contractor must make at least three horizontal borings into the slope, one at each wall zone and report the findings in a test boring report as defined in the Section 46-3.01C of the Standard Specifications.*					
2	FR	Pg. 10-1	Since this is a cut wall, bedding plane orientation is important to the slope stability. Please discuss the bedding plane orientation/stability.	Bedrock was not encountered in the soil boring performed on the slope near the maximum cut location. For this reason, horizontal bedding of alluvial soil layers within the retained and reinforced soil zones was assumed for slope stability analyses included with the Foundation Report.	Which borings are these?	Boring A-08-005 was drilled on the hillside using portable drilling equipment.	Boring A-08-005 shows alternating layers of clay, sand, and silt. The orientation of these layers may still pose a problem. It is unconservative to assume the layer orientation is horizontal. Since there are no mapped landslides at the	Noted.	

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							site and since there was no surficial evidence of slope instability based on the site reconnaissance conducted by a CEG to suggest adverse bedding conditions at RW246, we assumed horizontal stratigraphy and used conservative values of shear strength for the very stiff to hard clays in the slope stability analyses. For these reasons, we believe the design of wall 246 is appropriate.		
3	FR	Appdx D	Since horizontal borings are not done, how does the designer	See response to Comment No. 2. Three horizontal borings required as part of the project specifications will be used to confirm	What page of the Special Provisions is this on?	Please see Section 46 of the NSSP. Since page numbers for the NSSP are	Please provide NSSP. Must check for its inclusion. NSSP provided as pdf via email	Noted.	

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Date of Review: Functional Unit: Br No*. 33E0075

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			decide on the soil profile layers used for the slope stability analysis model?	assumptions used in slope stability analysis.		updated frequently, we have included this section of the NSSP as written for your review.	delivery to Betty Lee on 11/16/2014.		
4	SP		Is there a bid item in the PS&E to provide for repairing/repaving East Ruby Hill Dr. as recommended by FR, page 10-4? FR indicates expectation of settlement and cracking of this street.	The cost for potential repair/repaving of East Ruby Hill Drive is included in the supplemental work items of the project specifications.	What page of the Special Provisions is this on?	Item 43 in the risk register allows for $180K for this work			
5	SP		Is there provision for the expected ½ inch settlement of the exiting gas line in the vicinity of East Ruby Hill Dr. as indicated on pg. 10-4 of the Foundation Report?	SSP 46.303A_A05-20-11 will be included in the project specifications to address the need for monitoring/repair of the existing gas line behind the proposed soil nail wall.	What page of the Special Provisions is this on?	Please see Section 46 of the NSSP. Since page numbers for the NSSP are updated frequently, we have included this section of the NSSP as written for your review.	Please provide NSSP. Must check for its inclusion. NSSP provided as pdf via email delivery to Betty Lee on 11/16/2014.	Noted. Will check for its inclusion in Final NSSP.	

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6	P FR	Pg. 2 of 21 Section 10.2.3	Kh (0.17) is not consistent the FR (0.23).	Structural plans will be revised for a Kh value of 0.23, consistent with the Foundation Report.	Noted.			Please see comment No. 13 and check Qd.	
7	SP	Pg. 161, Section 46-3.03A	What is the "minimum clearance" required between the soil nail and existing gas line. Where is this information found?	The minimum clearance required around the existing PG&E gas line is 5 feet. This is included in the SSP. See response to Item No. 5 above.	What page of the SSP?	Please see Section 46 of the NSSP. Since page numbers for the NSSP are updated frequently, we have included this section of the NSSP as written for your review.	Please provide NSSP. Must check for its inclusion. NSSP provided as pdf via email delivery to Betty Lee on 11/16/2014.	Noted.	
8	SP		Foundation Report recommended that "Contractor perform a videotaped preconstruction and post construction condition survey of the Ruby Hill Dr. pavement surface, buried utilities and nearby houses abutting Ruby Hill Dr." and	The requirement for the contractor to perform pre- and post-construction surveys of the pavement surface along East Ruby Hill Drive is included in the SSP. See response to Item No. 5 above.	What page of the SSP?	Please see Section 46 of the NSSP. Since page numbers for the NSSP are updated frequently, we have included this section of the NSSP as written for your review.	Please provide NSSP. Must check for its inclusion. NSSP provided as pdf via email delivery to Betty Lee on 11/16/2014.	Noted.	

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			should extend for the full length of RW 246. Is this in the Special Provisions?						
9	P	Pg.13 of 21	Location for the proof test soil nail is not shown.	Proof test locations are indicated on plans by a square; see legend on Soil Nail Wall Details Sheets. In addition to the soil nails indicated on the plans to be proof tested, the contractor is to install 20 additional proof test soil nails to be located by the engineer. See SSP Section 46.	The number of proof tests is about 4.5% of total soil nails. It requires more proof tests especially for the soil nail zone in soil nail wall details No. 10 sheet.	Per FHWA-IF-03-017 Report, Section 8.5.4 recommends 5% of the total nails to be proof tested. The specifications (Section 46-3.01D(2)(b)(iii)) call out an additional 20 nails to be tested. The combined amount is about 6%.	Noted (two more soil nails were added to be tested).		
10	P	Pg. 8, 9 of 21	Inclinations of 18 and 20 degrees are not consistent with soil nail design calculations.	The most critical cross section with nail inclination of 18 degrees was evaluated using the Soil Nail Program SNAILZ. See Section 249+42.5. Will add section with top row having an inclination of 20	Revised calculation package is not provided to review.	Will provide. Results for section at Station 249+62.5 having top row nail inclination of 20 degrees is presented in revised	Noted.		

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RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant. Calcs	

✓= Comment Resolved
(for Reviewer's use)

Submittal Data (Reviewer to complete)
Project ID: 0400020581 Reviewer: Str Name*: RW 246
Date of Review: Functional Unit: Br No*. 33E0075

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	2nd Review Comments	Consultant Responses	3rd Review Comments	4th Review Comments	Consultant Responses
				degrees.		calculations package.			
11	DC	Pg. 1	Kh of 0.17 is not consistent with FR.	Will update, see response to comment 6.	Calculation package with the new k_h should be revised and provided to review.	Revised calculation package includes Kh of 0.23g based on a PGA of 0.68g; this represents a conservative value of PGA. As discussed in comments from Caltrans for the companion Arroyo Del Valle bridge widen and trail bridge FRs, a PGA value of 0.61g is calculated using the USGS deaggregation tool.	Factor of safety 1.1 is not meet under seismic condition. Please also clarify 100 kips punching shear used in soil nail program which is not consistent with the calculations. URS agreed to perform additional analyses per telephone conversation with CT on 11/24/2014. DCs have been updated to include SNAILZ using bond stress for static as 0.75 times ultimate bond strength (1000 psf) and for pseudo-static as 0.73 times 1000 psf. Revised SNAILZ runs	Factor of safety is less than 1.1 under seismic condition.	December 2014 Design Calculations (DC) were based on a conservative, simplified soil profile with a single layer of silty sand. Updated design calculations are based on soil profile consistent with global stability analysis presented in Foundation Report. Analysis results indicate factors of safety for both static and seismic (pseudo-static) conditions meeting criteria.

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							indicated a Factor of Safety greater than 1.1 for pseudo-static and greater than 1.5 for static. The selection of using 100 kips punching shear for SNAILZ was to ensure "pull out" mode control. Please see Section 7B of calculations where the punching shear capacity is checked.		
12	DC	Pg. 6	For temporary construction stage, FS should be 1.3	Calculated FS for DL+LL are all above 1.5, therefore Temporary Construction FS of 1.3 is met.	Revised calculation package with correction is not provided to review.	Revised note at bottom of Table 2 on Sheet 6 of the calculations for FS=1.3 for temporary construction stage.	Noted.	For temporary construction stage, FS should be 1.3. It was corrected for 92% PSE package!	Updated DC include FS of 1.3 for temporary construction stage.
13	DC	Pg. 15	Qd of 2.09 klf is not consistent with ultimate ground grout bond stress of 6.944 psi provided on	The ultimate nail resistance of 2.09klf is directly calculated from the ultimate Grout Ground Bond Stress of 6.944psi for an 8in hole.	Revised calculation package is not provided to review. The bond stress used in soil	Agreed, the ASD Factors of safety are applied to all the output values from the SNAILZ	The response is not adequate. URS agreed to perform additional analyses per telephone	Noted. Qd specified in the plans and for soil nail testing should be computed	Revised plan indicates Qd based on 5.2 psi bond stress.

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Submittal Data (Reviewer to complete)
Project ID: 0400020581 Reviewer: Str Name*: RW 246
Date of Review: Functional Unit: Br No*. 33E0075

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	2nd Review Comments	Consultant Responses	3rd Review Comments	4th Review Comments	Consultant Responses
			page 4.	Ultimate Bond Stress specified in FR, Qu=1000psf (Table 10-1, pg. 10-2). 1000psf/144=6.944psi x pi x 8" x 12"/1000 =2.09klf.	nail program should be allowable bond stress, not ultimate bond stress. Furthermore, the Qd (design pullout resistance) presented in the plans and specifications should be calculated from allowable bond stress.	program in the calculations. See FHWA-IF-017 Section 5.5.2 for FS used to convert Ultimate Bond Stress to Allowable. Example: Pullout Resistance, FSp=2.0 qall=qu/FSp Please see Calculations.	conversation with CT on 11/24/2014. As noted in item 11, the updated DCs include SNAILZ runs that used appropriate reduced bond stress for static and pseudo-static cases satisfying the minimum global factors of safety of 1.5 for static and 1.1 for pseudo-static.	from bond stress 5.2 psi used in soil nail program. See also comment No.11.	
14	DC	19	Page 19 is missing.	Intended to have page 19 showing design forces for DL+EQ calculated from SNAILZ output. Will add to calculations.	Revised calculation package is not provided to review.	Page 19 included in calculations package. Will provide.	Noted.		
15	DC		Soil nail program input: Bond stress 6.9 psi is not consistent with ultimate bond stress provided on page 4.	See response to comment 13. Bond Stress of 6.944psi was input into the Soil Nail program, however when the program prints out its summary report it rounds up the 100th (showing 6.9psi).	Revised calculation package is not provided to review. See comment #13.	See response to comment #13 please. ASD Factors of Safety used in design.	The response is not adequate. Please refer to updated response to comment 13.		

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Date of Review: Functional Unit: Br No*. 33E0075

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16	FR		According to Caltrans ARS online version 2.3.06, Pleasanton Fault is located just over 2 miles west of the site, but neither of the three reports show the fault. Please refer to Arroyo Del Valle Bridge (widen) Bridge No. 33-0710 report pages 3-2 and 5-1.	Discussion of the Pleasanton fault is included in Section 8.1.3 of the revised report.					
17	FR		The Acceleration Response Spectrum shown for all three reports indicate a Vs30=331 m/s was used. The reports do not show how this number was achieved. I assume that a correlation was used to	Shear wave velocity calculation spreadsheets are presented in Appendix C of the revised report. Based on these calculations, the ARS curve has been revised to a Vs30 value of 360 m/sec.			It is inappropriate to use one shear wave velocity averaged over such a large lateral geographical extent for all the structures in this project. Please use the appropriate localized shear wave velocity to do seismic	Ok, per H. Salimi.	

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			generate this number from SPT blow counts. The details for this correlation/calculation have to be shown with input/output parameters.				analyses and to determine the specific ARS curve for each structure. No ARS curve is required for design of the special walls, RW245 and RW246. We judged a value of 360 m/sec to be appropriate for use in determining the PGA of 0.61g for both retaining walls (see Section 7.2 of the FR), consistent with published values of Vs for stiff soil and soft rock sites as presented in Figure B.12 of Caltrans SDC 1.7 (June 2013).		

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Date of Review: Functional Unit: Br No*. 33E0075

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18	FR		Current Caltrans SDC call for 5% probability of exceedance in 50 years corresponding to a 975 year return period. Section 5.4 (page 5-2) shows a 2% in 50 years. I assume this is a typo. Please correct the report to reflect the current Caltrans criteria.	Report was corrected to indicate 5% probability of exceedance in 50 years.					
19	FR	Pg. 10-5, Section 10.3.2 Construction Dewatering	FR states, "…we estimate the groundwater to be below Elevations 503 and 511…". Please explain how this was determined when the LOTBs indicate that groundwater was not in fact	Borings A-08-005 and A-07-004 were drilled using flight augers. No groundwater was encountered in these borings to the terminal depths, which correspond to Elevation 503 feet for Boring A-07-004 and Elevation 511 feet for Boring A-08-005. Free groundwater was encountered in nearby Boring A-08-030 at					

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			measured.	Elevation 503 feet.					
			Geology Comments						
20	FR	4.2.1 Field Exploration Page 4-1	1-As indicated in The LOTB's sheets 1-2 and 2-2, the logging method used in accordance with the Caltrans Soil and Rock Logging , Classification and Presentation Manual, June 2007 Edition and Not 2010 Edition as stated in the text. Please be consistent. 2- The Borehole Identification numbers should be in consistent with LOTB's	Borehole labels have been changed in text, figures, and LOTBs. Tables have been added to the cover pages of Appendix C, Appendix D and Appendix E to provide a correlation between the borehole identification used for laboratory test reporting, the corrosion report and liquefaction calculations.					

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21	FR	Figure 6-1	Please show the exact location of the soil nail wall on the Geologic Map, not the whole alignment.	The geologic map has been revised to show the approximate locations of RW245 and RW246.					
22	FR	2.1 GENERAL Pg. 2-1			Location map of Retaining wall RW245 and RW 246 (Figure 2-1) is missing.	Figure 2-1 mislabeled as Figure 1-1. The figure number corrected in revised report and locations of RW245 and RW246 added.			
23	FR	4.1 Site Conditions & 5.1 Site Conditions			No difference between 4.1 label and 5.1 label. To differentiate should add "for Rw246" to the first and "for RW 245" to the second.	The section headers at top of each page differentiate Section 4 for RW246 and Section 5 for RW245. No change needed.			
24	FR	6.1 Regional Geology Pg. 6-1			Site location should be added to describe the geology specifically for	The locations of RW245 and RW246 added to the geologic map, Figure 6-1, in revised			

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#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	2nd Review Comments	Consultant Responses	3rd Review Comments	4th Review Comments	Consultant Responses
					the location of retaining walls RW246 & RW245.	report.			
25	FR	Figures 3-3 and 3-4			These two figures should be removed from this report for two reasons: 1- This report is dedicated for retaining walls RW246 & RW245 only. 2- They were not used or mentioned in the report text.	Agreed. Figures removed.			
26	FR	Appen dix A			On comment response No. 8 dated August 20, 2014, The Figure 6-1 is not included in the report. Please include.	Figure 6-1, geologic map, mislabeled as Figure 3-1. Corrected in revised report.			

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OSFP Rev Form 12/2010

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

W Sennett 12/22/14
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER
WESLEY SENNETT
No. C 82031
Exp. 03/31/16
CIVIL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

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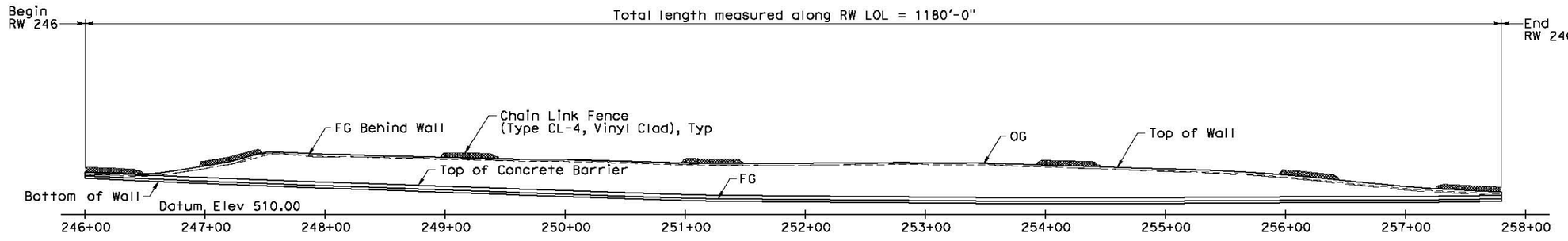


DEVELOPED ELEVATION

1" = 50'-0"

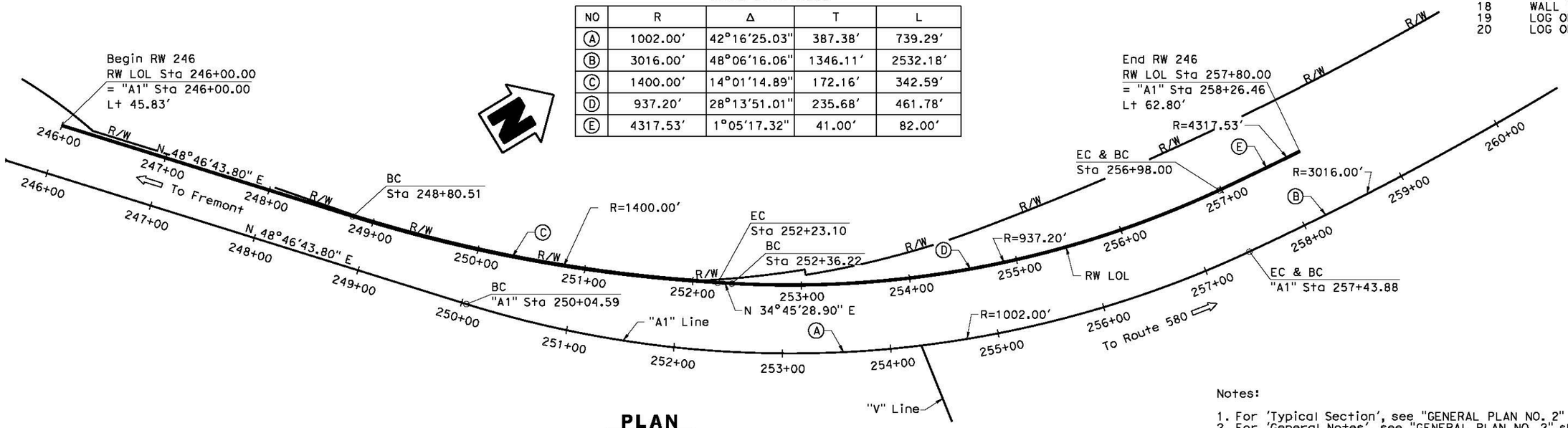
(Architectural Treatment not shown, see Note 3)

INDEX TO PLANS

SHEET NO.	TITLE
1	GENERAL PLAN NO. 1
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	WALL DRAIN DETAILS
19	LOG OF TEST BORINGS (1 OF 2)
20	LOG OF TEST BORINGS (2 OF 2)

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"

Notes:

1. For 'Typical Section', see "GENERAL PLAN NO. 2" sheet.
2. For 'General Notes', see "GENERAL PLAN NO. 2" sheet.
3. For Architectural Treatment, see "SOIL NAIL WALL DETAILS NO.14" sheet.

DESIGN OVERSIGHT	DESIGN	BY W. Sennett	CHECKED R. Huang	LOAD & RESISTANCE FACTOR DESIGN	Live Load Surcharge = 250 psf		
SIGN OFF DATE	DETAILS	BY X. Sun	CHECKED R. Huang	LAYOUT	BY W. Sennett	CHECKED R. Huang	
	QUANTITIES	BY W. Sennett	CHECKED R. Huang	SPECIFICATIONS	BY K. Chen	PLANS AND SPECS COMPARED R. Sennett	

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

R. Sennett
PROJECT ENGINEER

UNIT: 0733
PROJECT NUMBER & PHASE: 04000205811 CONTRACT NO.: 04-297624

BRIDGE NO. 33E0075
POST MILES 22.9

RETAINING WALL 246

GENERAL PLAN No. 1

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES				SHEET	OF
02/05/09	10/21/10	05/30/14	12/22/14	1	20

FILE => P:\397 Route 84 Widenings\Segment B PS&E\RW246\CADD\33e0075-a-gp01.dgn

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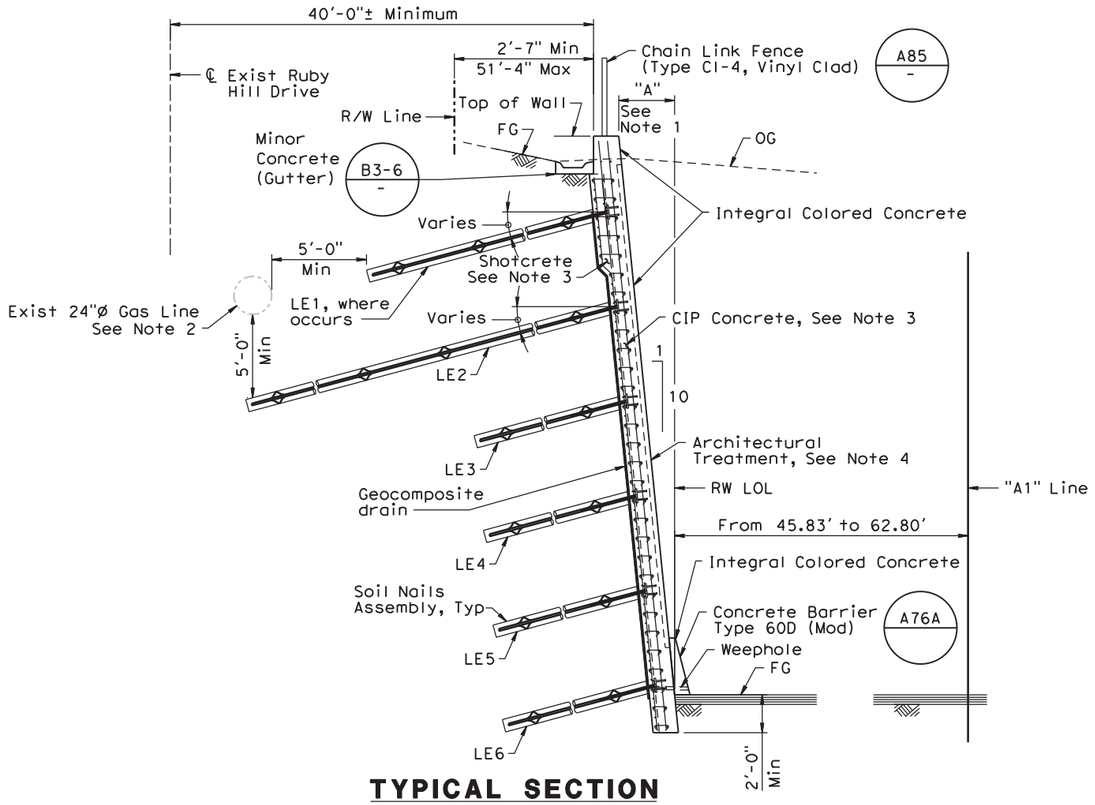
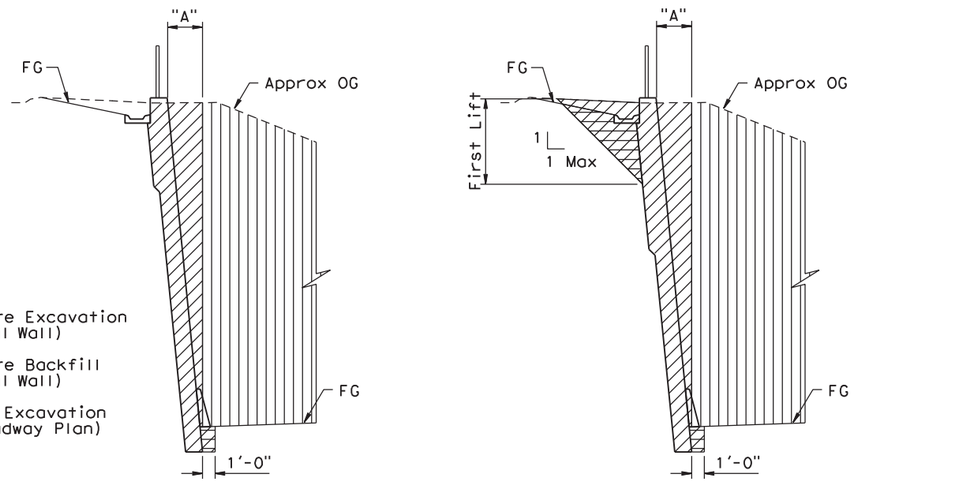


TYPICAL SECTION

1/4" = 1'-0"



LEGEND

- Structure Excavation (Soil Nail Wall)
- Structure Backfill (Soil Nail Wall)
- Roadway Excavation (see Roadway Plan)

Section for Sta from 246+00 to 247+60 and from 252+10 to 257+80

Section for Sta from 247+60 to 252+10

SOIL NAIL WALL EXCAVATION AND BACKFILL PAY LIMITS

NO SCALE

GENERAL NOTES

DESIGN:	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)
LIVE LOAD:	Surcharge = 250 psf
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
HEADED STUD:	ASTM Designation: A307 fy = 36,000 psi
DESIGN PARAMETERS: (Soil)	ø = 36° C = 0 psf γ = 130 pcf Qd = 1.57 k/ft
PSEUDE-STATIC SEISMIC ACCELERATION:	Coefficient = 0.23 g

STANDARD PLANS

Dated 2010

A10A	Abbreviations (Sheet 1 of 2)
A10B	Abbreviations (Sheet 2 of 2)
A10C	Lines and Symbols (Sheet 1 of 3)
A10D	Lines and Symbols (Sheet 2 of 3)
A10E	Lines and Symbols (Sheet 3 of 3)
A10F	Legend - Soil (Sheet 1 of 2)
A10G	Legend - Soil (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
B3-6	Retaining Wall Details No. 2

Standard Plan sheet No.

Detail No.

ABBREVIATION LIST

LE# - Soil Nail Layer No.

Notes:

1. For offset dimension "A", see 'Soil Nail Wall Profile' table on "SOIL NAIL WALL DETAILS NO. 1" thru "SOIL NAIL WALL DETAILS NO. 10" sheets.
2. Provide 5'-0" min clearance.
3. See "Typical Section 1" & "Typical Section 2" on "SOIL NAIL WALL DETAILS NO. 11" sheet for CIP concrete & shotcrete limits.
4. Refer to "Road Plans" for Architectural Treatment Details and Formliner Pattern.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

W Sennett 12/22/14
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REGISTERED PROFESSIONAL ENGINEER — WESLEY SENNETT No. C 82031 Exp. 03/31/16 CIVIL — STATE OF CALIFORNIA

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SACRAMENTO, CALIFORNIA 95831

DESIGN OVERSIGHT

SIGN OFF DATE

DESIGN DETAIL SHEET (ENGLISH) (REV. 03/14/12)

	BY	CHECKED
DESIGN	W. Sennett	R. Huang
DETAILS	X. Sun	R. Huang
QUANTITIES	W. Sennett	R. Huang

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

R. Sennett
PROJECT ENGINEER

BRIDGE NO. 33E0075
POST MILES 22.9

UNIT: 0733
PROJECT NUMBER & PHASE: 04000205811 CONTRACT NO.: 04-297624

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES: 02/05/09 10/27/10 05/30/14 12/22/14

RETAINING WALL 246
GENERAL PLAN No. 2

SHEET 2 OF 20

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DATE PLOTTED => 12/18/2014 TIME PLOTTED => 9:51:36 AM USERNAME => Koi

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

W Sennett 11/17/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
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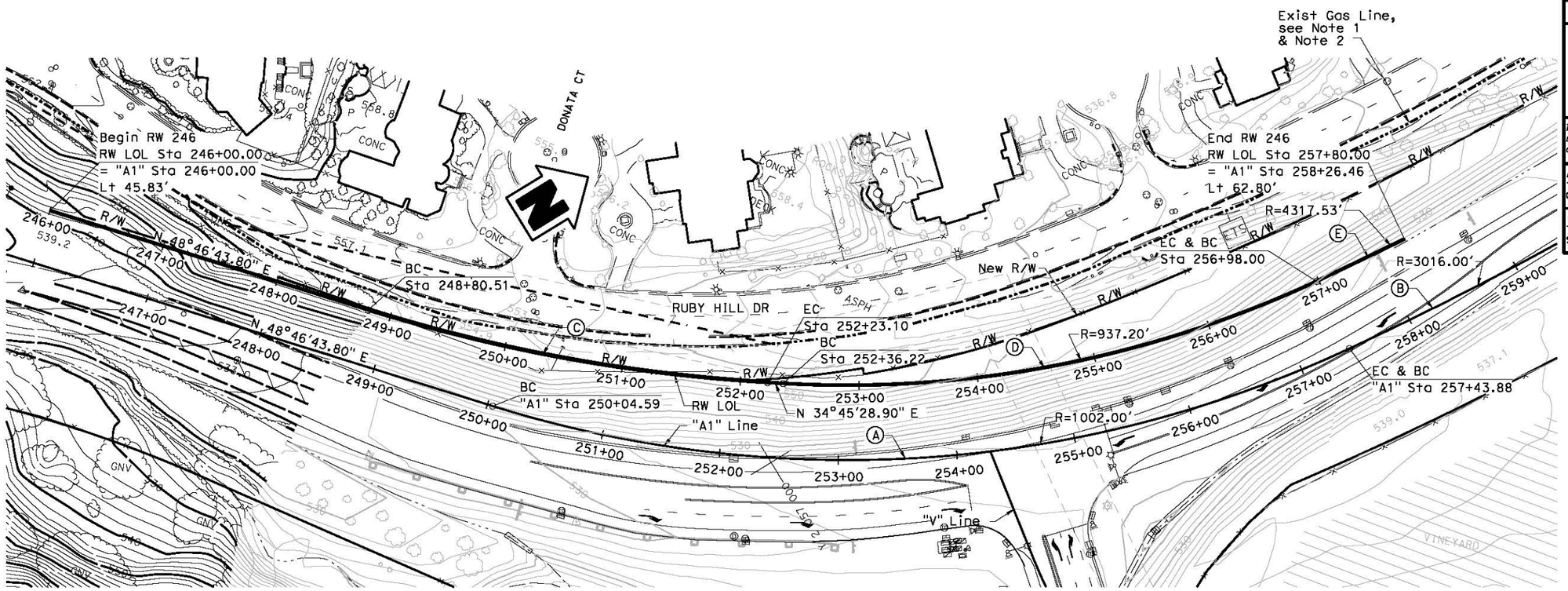

FOUNDATION PLAN
1" = 50'-0"

CURVE DATA TABLE

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Ⓑ	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:

1. For elevation of existing Gas Line, see 'Road Plans'.
2. Contractor must verify location of exist Gas Line before installing soil nail assembly.

Stephen Huang 11/15/2014
GEOTECHNICAL PROFESSIONAL APPROVAL DATE

DESIGN OVERSIGHT
SIGN OFF DATE

SCALE: 1"=50' | VERT.DATUM NAVD88 | HORZ.DATUM NAD83
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

	BY	CHECKED
DESIGN	W. Sennett	R. Huang
DETAILS	X. Sun	R. Huang
QUANTITIES	W. Sennett	R. Huang

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

R. Sennett
PROJECT ENGINEER

BRIDGE NO. 33E0075
POST MILES 22.9

RETAINING WALL 246
FOUNDATION PLAN

FOUNDATION PLAN SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0733
PROJECT NUMBER & PHASE: 04000205811 CONTRACT NO.: 04-297624

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES				SHEET	OF
02/20/09	10/27/10	05/30/14	11/17/14	3	19

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USERNAME => KGI
DATE PLOTTED => 11/13/2014 TIME PLOTTED => 2:49:54 PM

33e0075-e-fdpl01.dgn 11/13/2014 2:49:55 PM

NOTES

1. This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (June 2007).
2. Hammer efficiency ratio of 8-inch auger boring (A-07-004) is based on published values for a similar hammer type.

BENCH MARK

B.M Elev. 415.27
Northing: 2063428.6750
Easting: 6181960.7750
21/2" Brass disk set in concrete in well monument stamped "+", at the intersection of Vineyard Avenue and Ruby Hill Drive

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

GEOTECHNICAL PROFESSIONAL — 11-14-14 DATE

PLANS APPROVAL DATE

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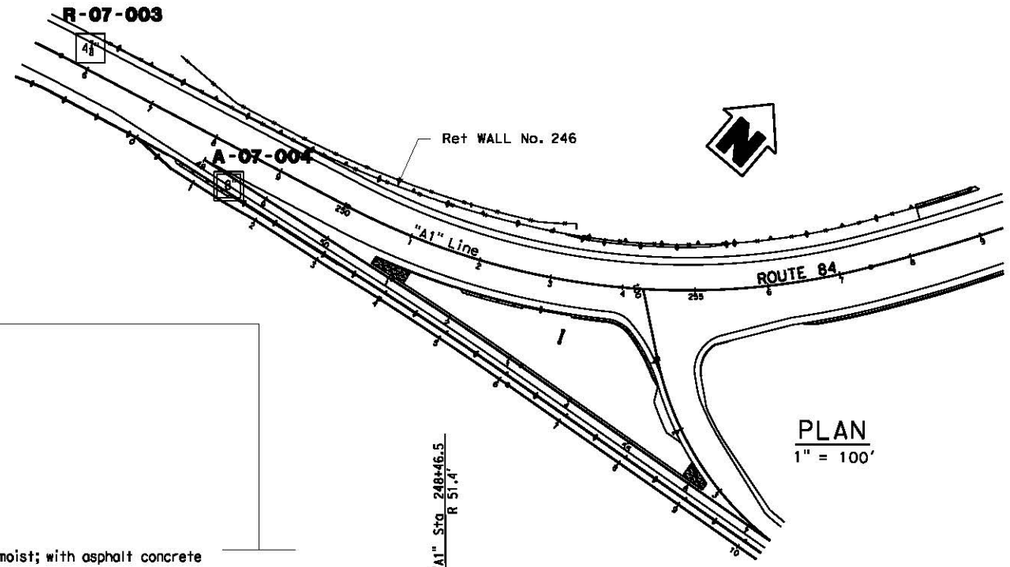
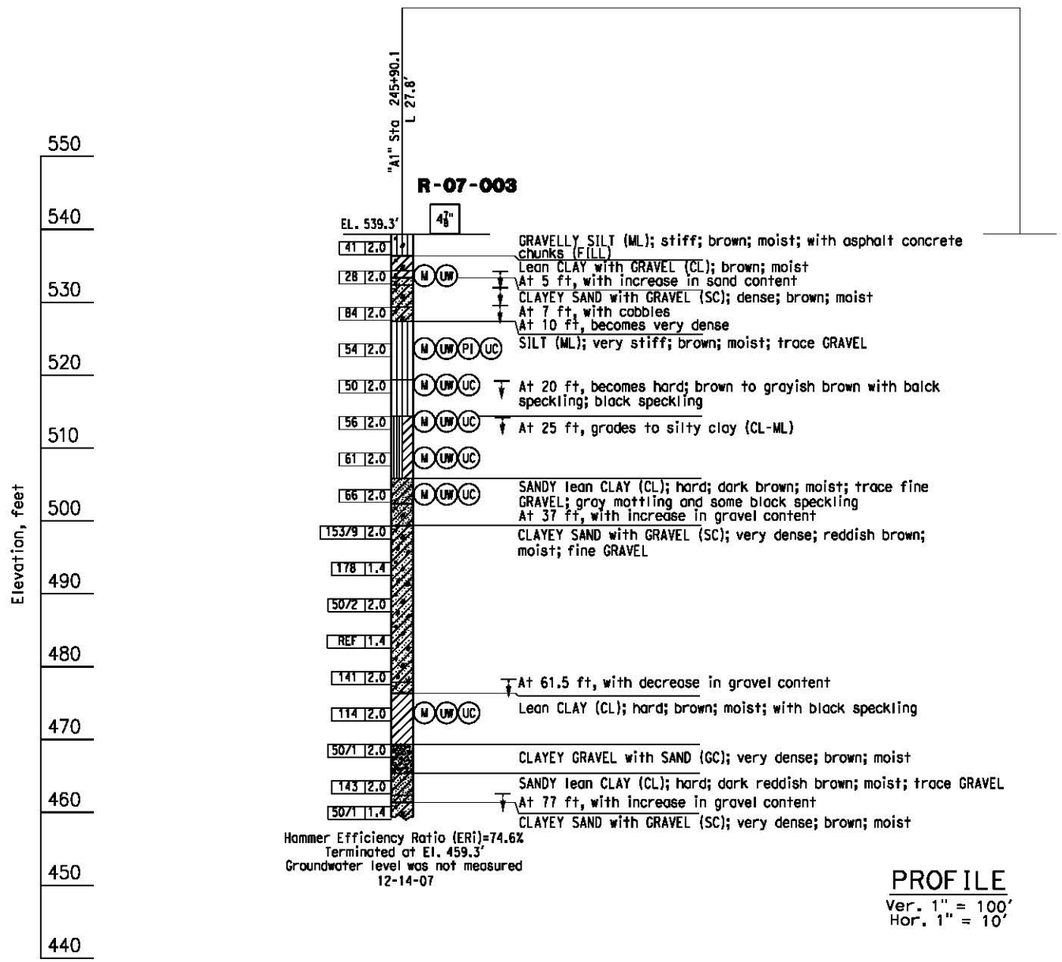
REGISTERED PROFESSIONAL ENGINEER — Stephen Huang — No. C 42289 — Exp. 3-31-16 — GEOTECHNICAL — STATE OF CALIFORNIA

URS CORPORATION
1333 BROADWAY, SUITE 800
OAKLAND, CA 94612

ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 BROADWAY, SUITE 800
OAKLAND, CA 94607



PLAN
1" = 100'



PROFILE
Ver. 1" = 100'
Hor. 1" = 10'

DESIGN OVERSIGHT	DRAWN BY	B. Vuong	C. Rambo	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Stephen Huang	BRIDGE NO. 33E0075	RETAINING WALL 246
SIGN OFF DATE	CHECKED BY	M. Larson	FIELD INVESTIGATION BY: DATE: Nov-Dec 2007		PROJECT ENGINEER	POST MILES 22.9	LOG OF TEST BORINGS (1 OF 2)

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0733
PROJECT NUMBER & PHASE: 04000205811 CONTRACT NO.: 04-297624

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES				SHEET	OF
				20	21

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TIME PLOTTED => $TIME
USERNAME => $USER

NOTES

1. This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (June 2007)
2. Hammer efficiency of 8-inch auger boring (A-08-005) is based on published values for a similar hammer type.

BENCH MARK

B.M Elev. 415.27
Northing: 2063428.6750
Easting: 6181960.7750
2 1/2" Brass disk set in concrete in well monument stamped "+", at the intersection of Vineyard Avenue and Ruby Hill Drive

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

S Huang 11-14-14
GEOTECHNICAL PROFESSIONAL DATE

REGISTERED PROFESSIONAL ENGINEER — Stephen Huang — No. C 42289 — Exp. 3-31-16 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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URS CORPORATION
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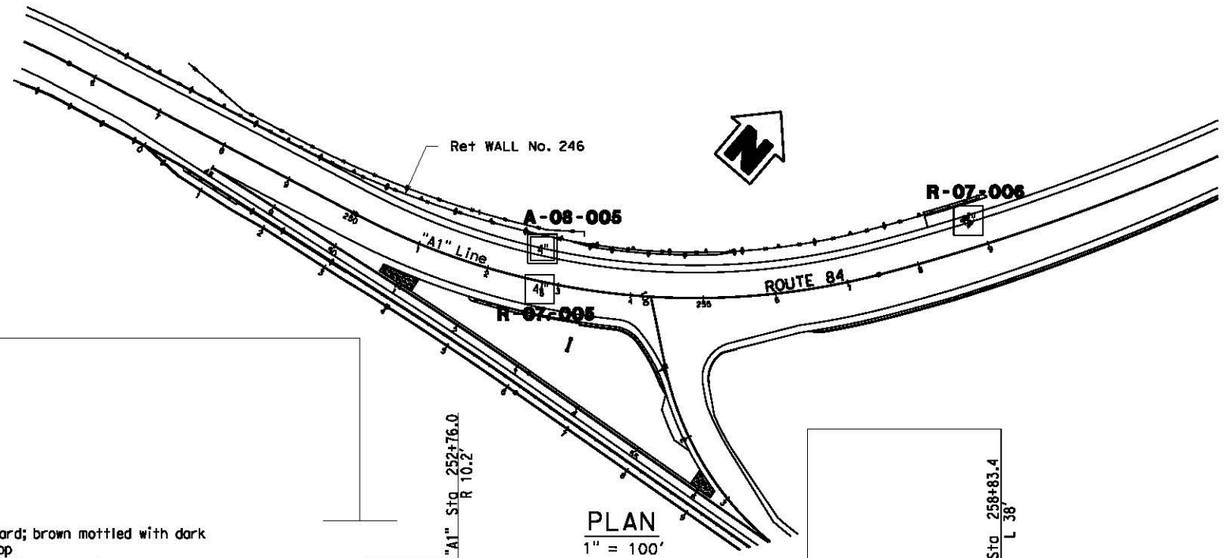
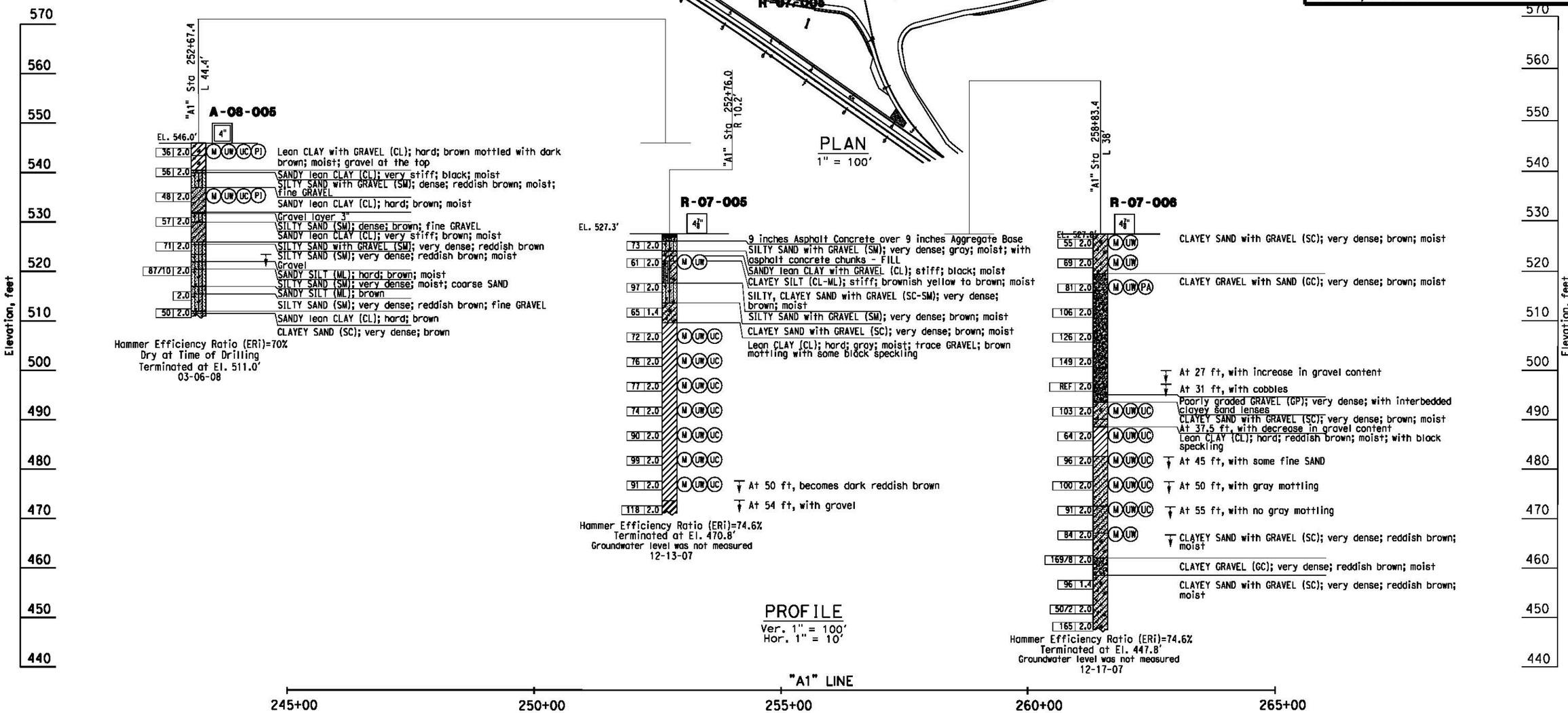
OAKLAND, CA 94612

ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 BROADWAY, SUITE 800
OAKLAND, CA 94607





DESIGN OVERSIGHT	DRAWN BY	B. Vuong	C. Rambo	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Stephen Huong	BRIDGE NO. 33E0075	RETAINING WALL 246
SIGN OFF DATE	CHECKED BY	M. Larson	FIELD INVESTIGATION BY: DATE: Dec 2007-Mar 2008		PROJECT ENGINEER	POST MILES 22.9	LOG OF TEST BORINGS (2 OF 2)

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0733
PROJECT NUMBER & PHASE: 04000205811 CONTRACT NO.: 04-297624

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES | SHEET | OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME
FILE => $REQUEST

GENERAL NOTES
LOAD AND RESISTANCE FACTOR DESIGN

1. DESIGN: AASHTO LRFD Bridge Design Specifications, 4th Edition with California Amendments (November 2011)
2. DESIGN LOAD:
   Soil Pressure: 40 pcf Equivalent Fluid Pressure For Horizontal Backfill
   Live Load: Surcharge = 240 lb/ft^2
3. SOIL PARAMETERS:
   MSE: Internal design Φ = 34°, γ = 120 lb/ft^3
   External design Φ (Retained Backfill) = 30°, γ = 120 lb/ft^3
   Φ (Foundation) = 36°, γ = 130 lb/ft^3
   K_h= 0.23, K_v= 0.0
   Nominal Bearing Capacity = 18,000 psf
   Coefficient of Sliding Resistance = 0.73
4. PRECAST CONCRETE PANELS:
   f'c = 4,000 psi (Concrete compressive strength at 28 days)
   fy = 60,000 psi (Yield strength of reinforcement)
5. SOIL REINFORCEMENT:
   Welded wire mats: fy = 65,000 psi (Yield strength)
   Coupler: fy = 36,000 psi (Yield strength)
   Corrosion rate = 1.1 mils/year
6. REINFORCED CONCRETE:
   f'c = 3,600 psi, except as noted
   (Concrete compressive strength at 28 days)
   fy = 60,000 psi (Yield strength of reinforcement)

MSE = Mechanically Stabilized Embankment

INDEX TO PLANS

SHEET NO.	TITLE
1	GENERAL PLAN
2	STRUCTURAL PLAN No. 1
3	STRUCTURAL PLAN No. 2
4	STRUCTURAL PLAN No. 3
5	STRUCTURAL PLAN No. 4
6	DETAILS No. 1
7	DETAILS No. 2
8	DETAILS No. 3
9	DETAILS No. 4
10	DETAILS No. 5
11	DETAILS No. 6
12	LOG OF TEST BORINGS 1 of 2
13	LOG OF TEST BORINGS 2 of 2

STANDARD PLANS 2010

	A10A	ABBREVIATIONS (SHEET 1 OF 2)	RSP B11-56 CONCRETE BARRIER TYPE 736
RSP	A10B	ABBREVIATIONS (SHEET 2 OF 2)	RSP D73 DRAINAGE INLETS
	A10C	LINES AND SYMBOLS (SHEET 1 OF 3)	
	A10D	LINES AND SYMBOLS (SHEET 2 OF 3)	
	A10E	LINES AND SYMBOLS (SHEET 3 OF 3)	
	A10F	LEGEND - SOIL (SHEET 1 OF 2)	
	A10G	LEGEND - SOIL (SHEET 2 OF 2)	

STANDARD PLAN SHEET No.
DETAIL No.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	ALA	84			

11-17-14
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER CHAO GONG No. No. C53837 Exp. 9-30-15 CIVIL STATE OF CALIFORNIA

PLANS APPROVAL DATE

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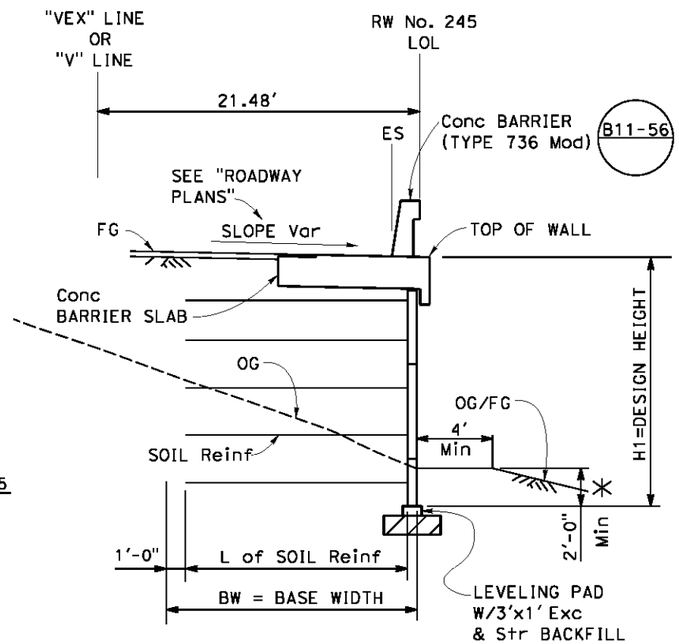
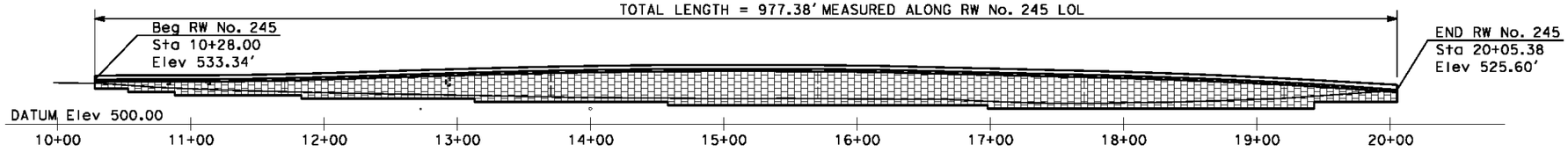
ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 BROADWAY, SUITE 800
OAKLAND, CA 94607

URS CORPORATION
1333 BROADWAY, SUITE 800
OAKLAND, CA 94612-1924

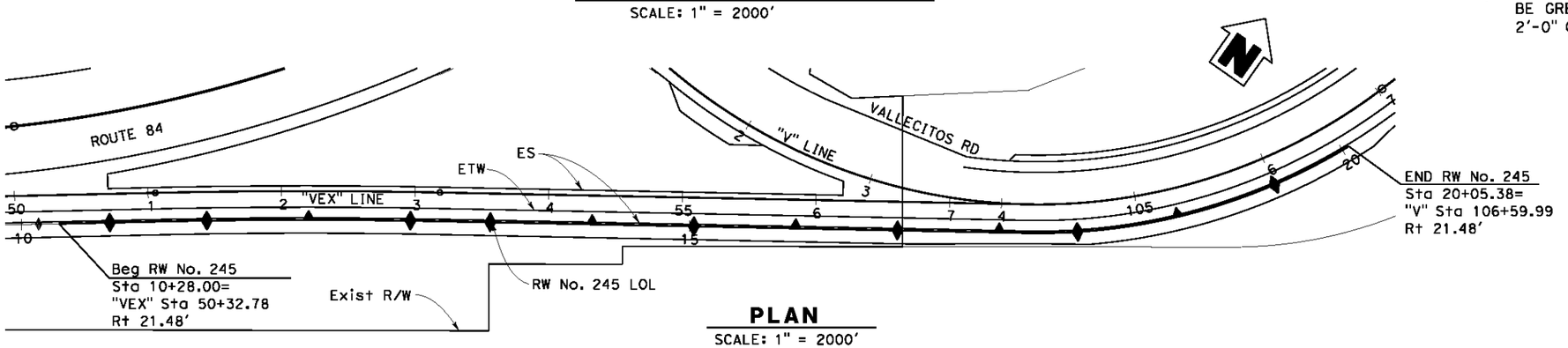


✳ EMBEDMENT MUST BE GREATER OF 2'-0" OR 0.1 x H1

TYPICAL SECTION
SCALE: 1/16" = 1'-0"



DEVELOPED ELEVATION
SCALE: 1" = 2000'



PLAN
SCALE: 1" = 2000'

QUANTITIES

EXCAVATION	3,778	CY
BACKFILL	388	CY
MECHANICALLY STABILIZED EMBANKMENT	19,878	SF
STRUCTURAL CONCRETE, BARRIER SLAB	480	CY
CONCRETE BARRIER (TYPE 736 Mod)	978	LF
18" DIA WELDED STEEL PIPE (t=0.375")	70	LF
4" PLASTIC PIPE	90	LF
4" PLASTIC PIPE UNDERDRAIN	977	LF

DESIGN OVERSIGHT	DESIGN	BY H. HAKIMI	CHECKED G. CARROLL	LOAD & RESISTANCE FACTOR DESIGN	LIVE LOADING: 240 psf Live load surcharge		
SIGN OFF DATE	DETAILS	BY N. HUTTON	CHECKED G. CARROLL	LAYOUT	BY A. BHOI	CHECKED E. Abi-Jaoude	
	QUANTITIES	BY H. HAKIMI	CHECKED G. CARROLL	SPECIFICATIONS	BY M. SEDGHI	PLANS AND SPECS COMPARED C. GONG	

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. GONG
PROJECT ENGINEER

BRIDGE NO. 33E0405
POST MILES 23.3

RETAINING WALL No. 245
GENERAL PLAN

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 03/14/12)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0733
PROJECT NUMBER & PHASE: 04000205811 CONTRACT NO.: 04-297624

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES: 5-30-14 | 8-21-14 | 9-30-14 | 11-17-14

SHEET 1 OF 13

FILE => ...\dgn\1-General Plan.dgn

USERNAME => nadine_hu PLOTTED => 11/13/2014 TIME PLOTTED => 11:10:15 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

GEOTECHNICAL PROFESSIONAL — DATE: 12-22-14

Stephen Huang No. C 42289 Exp. 3-31-16 GEOTECHNICAL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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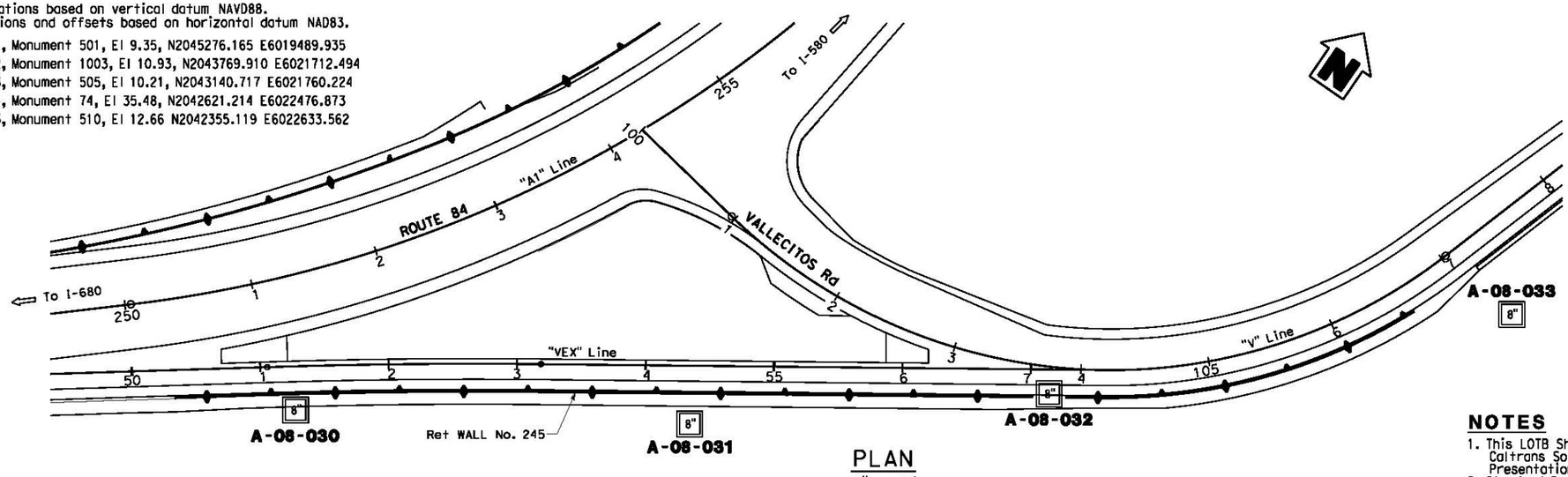
OAKLAND, CA 94612

ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 BROADWAY, SUITE 800
OAKLAND, CA 94607

BENCH MARK

All elevations based on vertical datum NAVD88.
All stations and offsets based on horizontal datum NAD83.

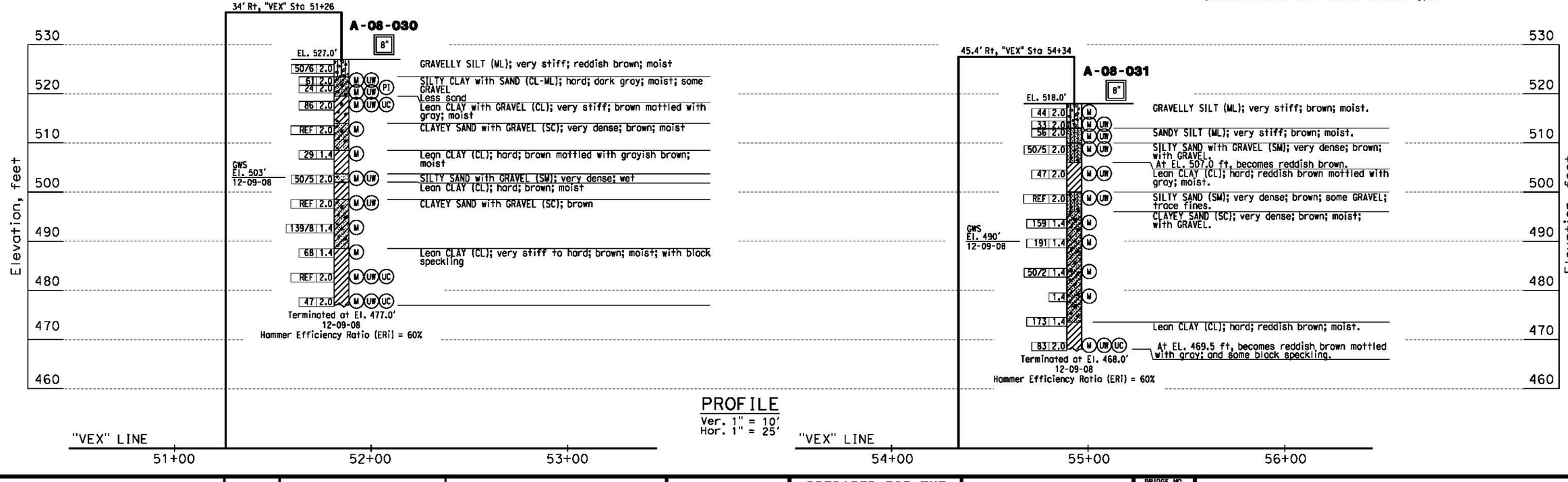
BM No. 1, Monument 501, El 9.35, N2045276.165 E6019489.935
BM No. 2, Monument 1003, El 10.93, N2043769.910 E6021712.494
BM No. 3, Monument 505, El 10.21, N2043140.717 E6021760.224
BM No. 4, Monument 74, El 35.48, N2042621.214 E6022476.873
BM No. 5, Monument 510, El 12.66 N2042355.119 E6022633.562



PLAN
1" = 50'

NOTES

1. This LOTB Sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010).
2. Standard Penetration test sampler I.D. = 1.44 inch (1.4)
   Modified California sampler I.D. = 1.96 inch (2.0)
   Thin-walled Shelby tube sampler I.D. = 2.97 inch (3.0)
3. UC and UU values reported are undrained shear strengths in tsf.
4. Hammer efficiency ratio for 8-inch auger boring is based on published values for a similar hammer type.



PROFILE
Ver. 1" = 10'
Hor. 1" = 25'

DESIGN OVERSIGHT	DRAWN BY	B. Vuong	C. Rambo		PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Stephen Huang	BRIDGE NO. 33E0405	RETAINING WALL No. 245
SIGN OFF DATE	CHECKED BY	M. Larson	FIELD INVESTIGATION BY: DATE: Dec 2008			PROJECT ENGINEER	POST MILES 23.3	LOG OF TEST BORINGS 1 OF 2

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0733
PROJECT NUMBER & PHASE: 040002058 11 CONTRACT NO.: 04-297624

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 12-22-14 | 8-21-14 | 9-30-14 | 11-17-14

SHEET 12 OF 13

FILE => 33E0405-z-ltb01.dgn

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DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84			

GEOTECHNICAL PROFESSIONAL — DATE: 12-22-14

REGISTERED PROFESSIONAL ENGINEER — Stephen Huang — No. C 42289 — Exp. 3-31-16 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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URS CORPORATION
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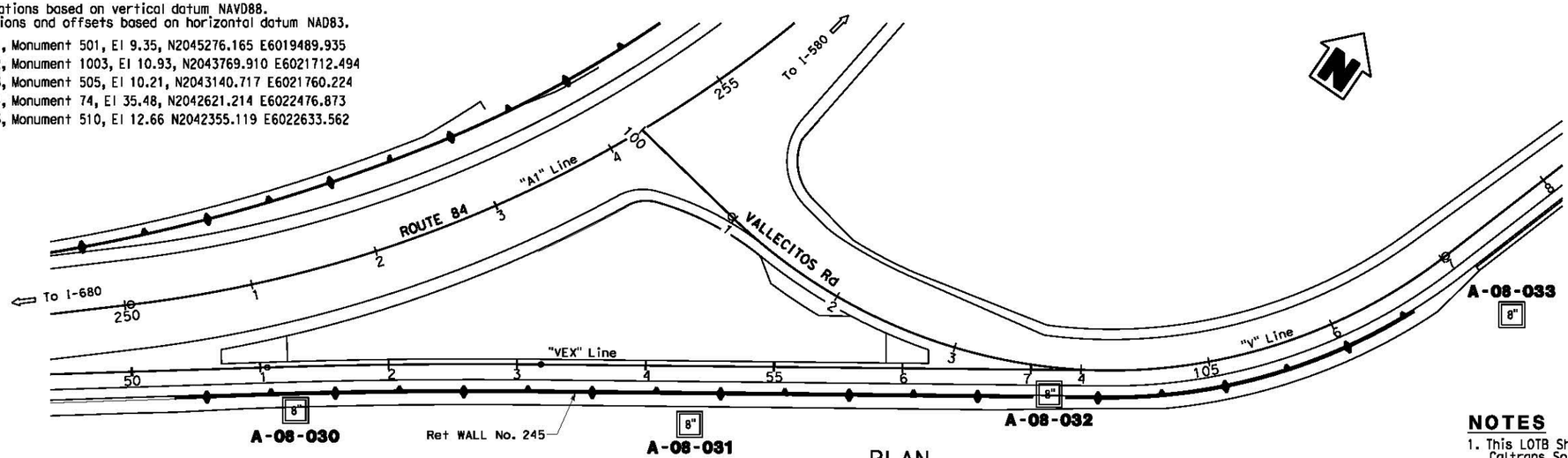
OAKLAND, CA 94612

ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 BROADWAY, SUITE 800
OAKLAND, CA 94607

BENCH MARK

All elevations based on vertical datum NAVD88.
All stations and offsets based on horizontal datum NAD83.

BM No. 1, Monument 501, El 9.35, N2045276.165 E6019489.935
BM No. 2, Monument 1003, El 10.93, N2043769.910 E6021712.494
BM No. 3, Monument 505, El 10.21, N2043140.717 E6021760.224
BM No. 4, Monument 74, El 35.48, N2042621.214 E6022476.873
BM No. 5, Monument 510, El 12.66 N2042355.119 E6022633.562



PLAN
1" = 50'

NOTES

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2. Standard Penetration test sampler I.D. = 1.44 inch (1.4)
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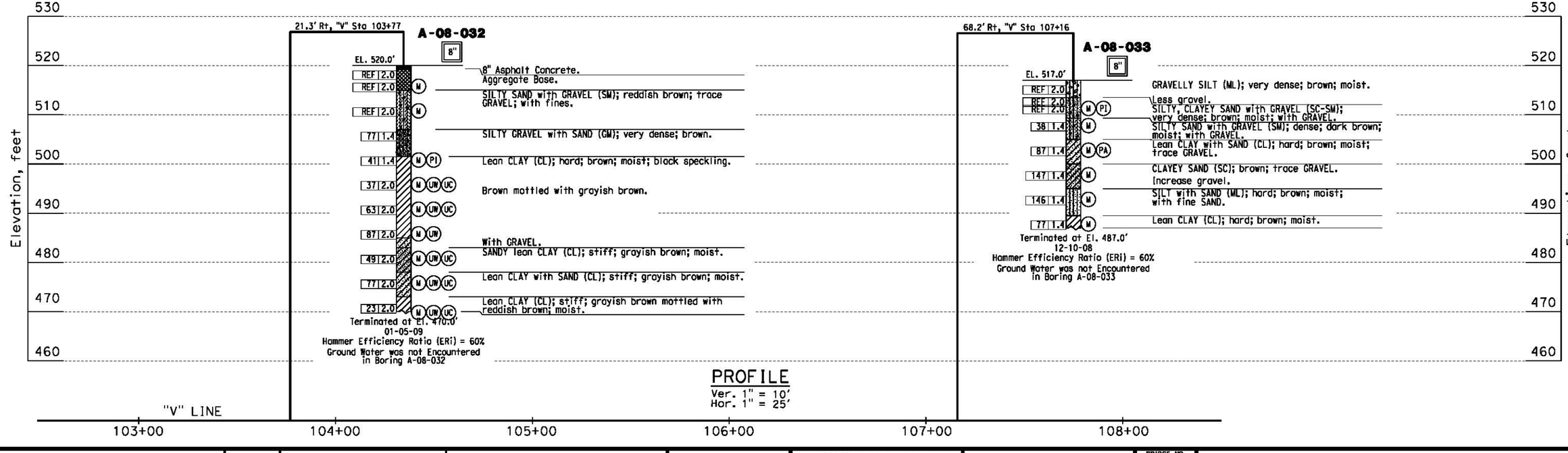

PROFILE
Ver. 1" = 10'
Hor. 1" = 25'

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY	B. Vuong	C. Rambo	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Stephen Huong	BRIDGE NO. 33E0405	RETAINING WALL No. 245
	CHECKED BY	M. Larson	FIELD INVESTIGATION BY: DATE: Dec 2008 - Jan 2009		PROJECT ENGINEER	POST MILES 23.3	LOG OF TEST BORINGS 2 OF 2

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0733
PROJECT NUMBER & PHASE: 04000205811 CONTRACT NO.: 04-297624

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES: 12-22-14 | 8-27-14 | 3-18-14 | 11-13-14

SHEET 13 OF 13

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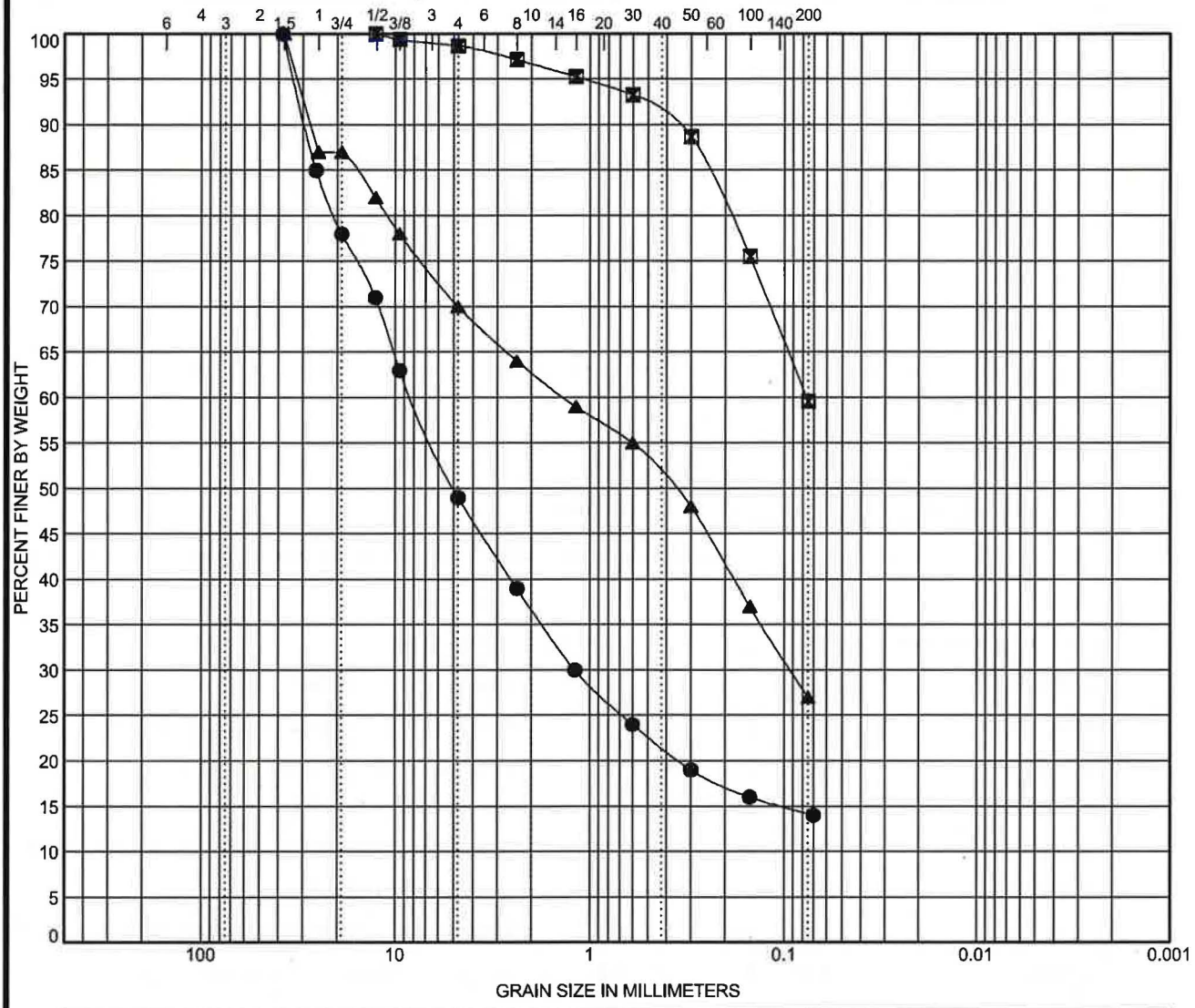
The following table presents correlation between the borehole identification shown on LOTBs and discussed throughout the report text with the borehole identification used to report laboratory test data.

Borehole Identification on LOTBs	Borehole Identification for Laboratory Test Results
R-07-003	NB03
A-07-004	NB04
R-07-005	NB05
A-08-005	NB05A
R-07-006	NB06
A-08-030	NB30
A-08-031	NB31
A-08-032	NB32
A-08-033	NB33



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample Identification/Depth (ft)		Classification	LL	PL	PI	Cc	Cu
●	NB06	10.0	Clayey GRAVEL (GC) with sand					
⊠	NB33	13.5	Sandy lean CLAY (CL)					
▲	NB35	8.5	Clayey SAND (SC) with gravel					

	Sample Identification/Depth (ft)		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	NB06	10.0	38.1	8.196	1.19		51.0	34.8	14.2	
⊠	NB33	13.5	12.7	0.076			1.3	39.1	59.6	
▲	NB35	8.5	37.5	1.355	0.092		30.0	43.0	27.0	

URS

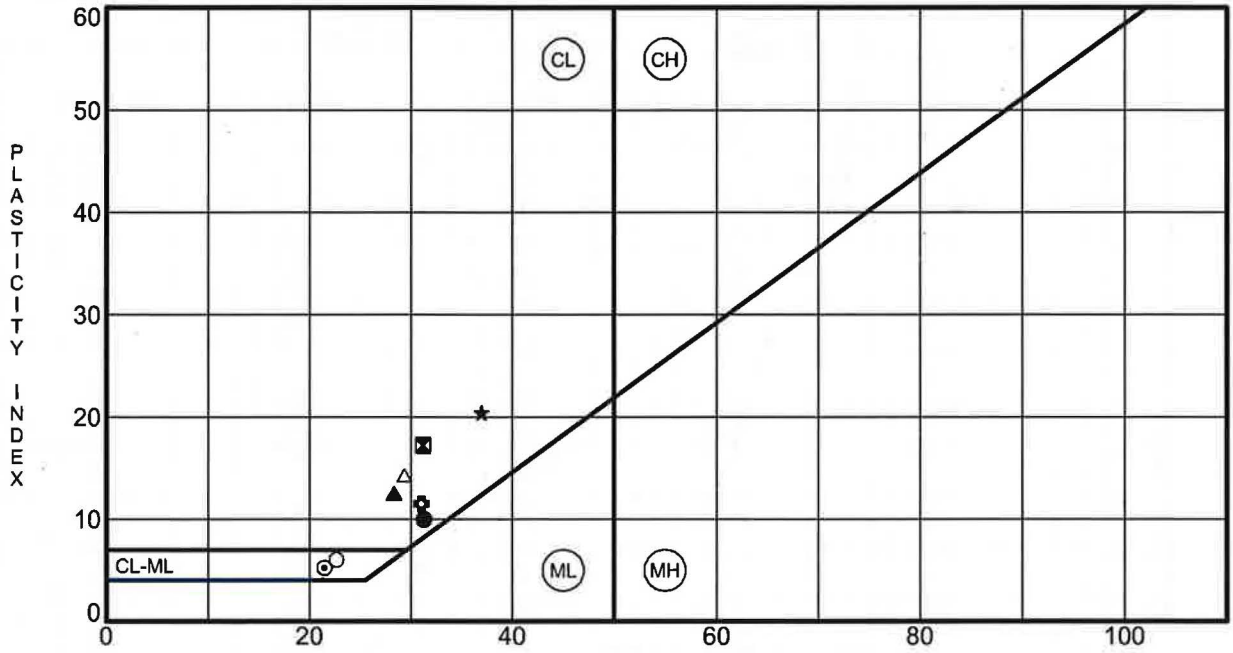
San Jose Office

100 W. San Fernando, Ste 200
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 5/31/14



Sample Identification/Depth (ft)			LL	PL	PI	Fines	Classification
●	NB03	15.0	31	21	10		Lean CLAY (CL) (CL)
⊠	NB04	3.5	31	14	17		Sandy lean CLAY (CL) with gravel (CL)
▲	NB05A	1.0	28	16	12		Lean CLAY (CL) with sand (CL)
★	NB05A	10.0	37	17	20		Lean CLAY (CL) (CL)
⊙	NB30	5.0	21	16	5		Silty, clayey SAND (SC-SM) with gravel (SC-SM)
✿	NB32	18.5	31	20	11		Lean CLAY (CL) (CL)
○	NB33	5.0	23	17	6		Silty, clayey SAND (SC-SM) with gravel (SC-SM)
△	NB34	5.0	29	15	14		Clayey SAND (SC) with gravel (SC)

URS

San Jose office

100 W. San Fernando St, Suite 200
San Jose, CA 95113

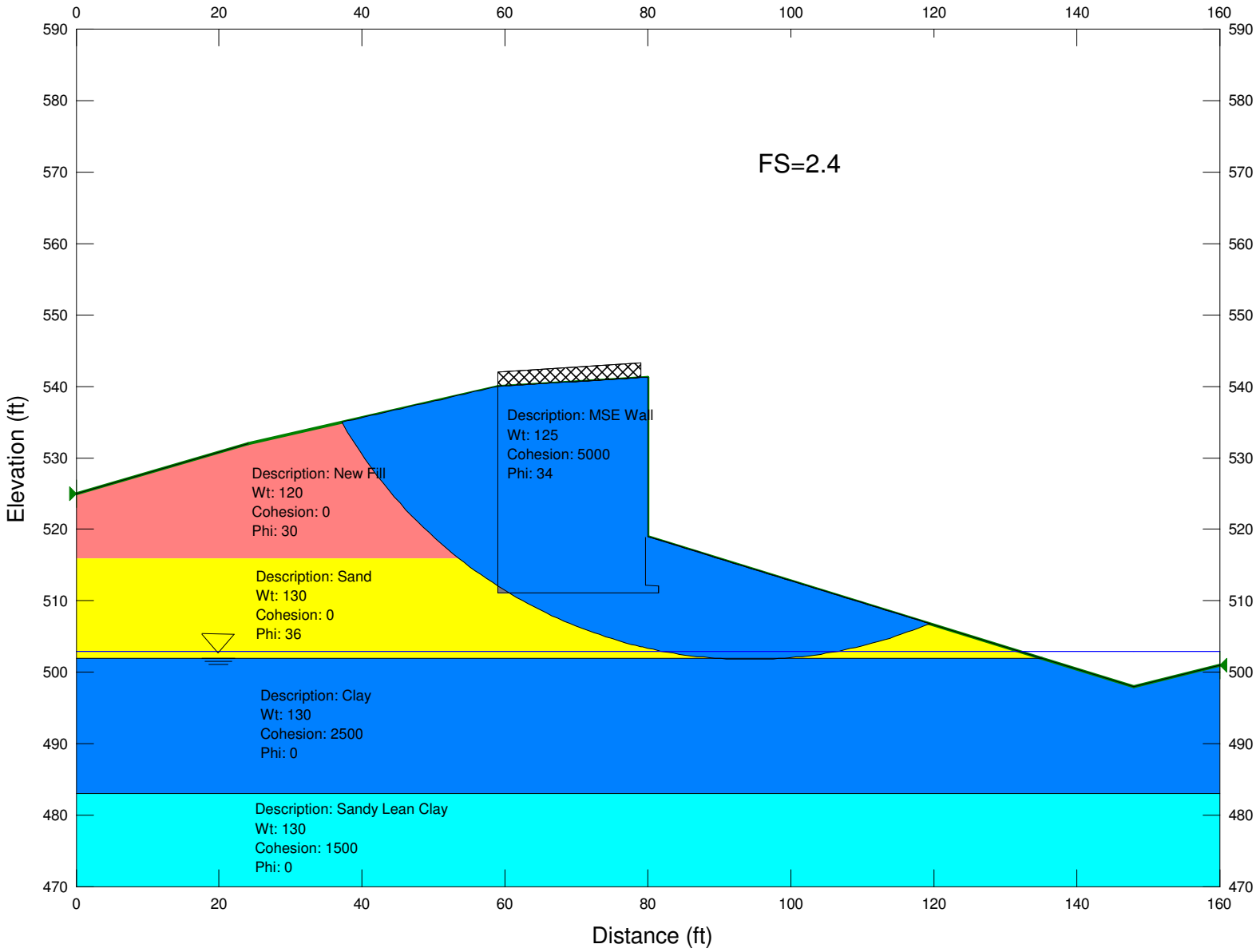
PLASTICITY CHART

Project Name: SR 84 Expy Widen (URS 28649640)
Location: Alameda 84 22.9/27.1
Number: 297601

URS PLASTICITY CHART 28649640-ROUTE84.GPJ SNJ_CT.GLB 5/31/14

The following table presents correlation between the borehole identification shown on LOTBs and discussed throughout the report text with the borehole identification shown on liquefaction calculation spreadsheets.

Borehole Identification on LOTBs	Borehole Identification for Laboratory Test Results
R-07-003	NB03
R-07-006	NB06

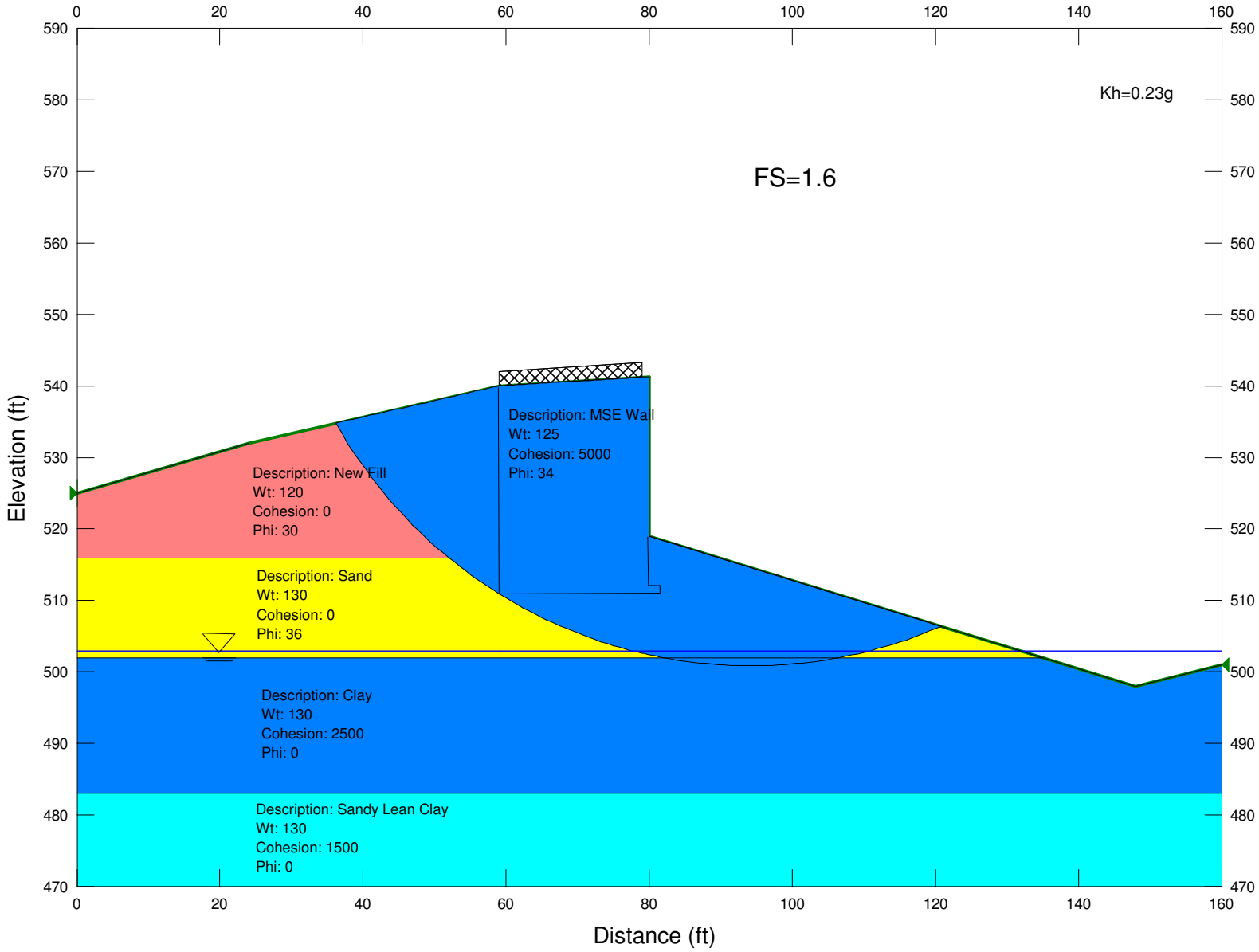


URS
55 South Market Street,
Suite 1500
San Jose, CA 95113
PHONE: (408) 297-9585
FAX: (408) 297-6962

PROJECT No 28649640	CALCULATED BY S. Huang	
Date August 15, 2014	CHECKED BY A. Moore	

ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
STATIC – END OF CONSTRUCTION
RW 245 (V-Sta.# 54+56)

FIGURE
D-1



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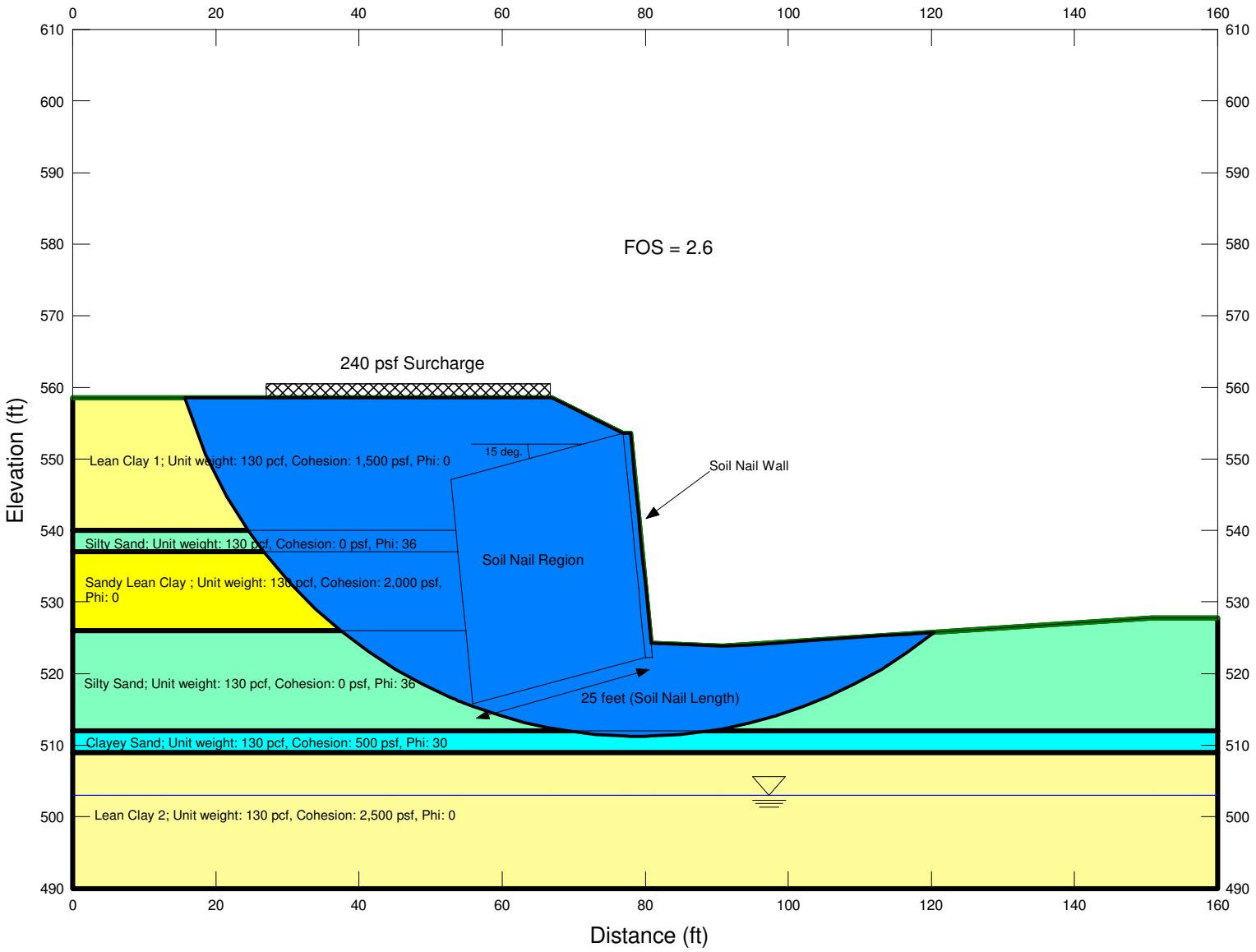
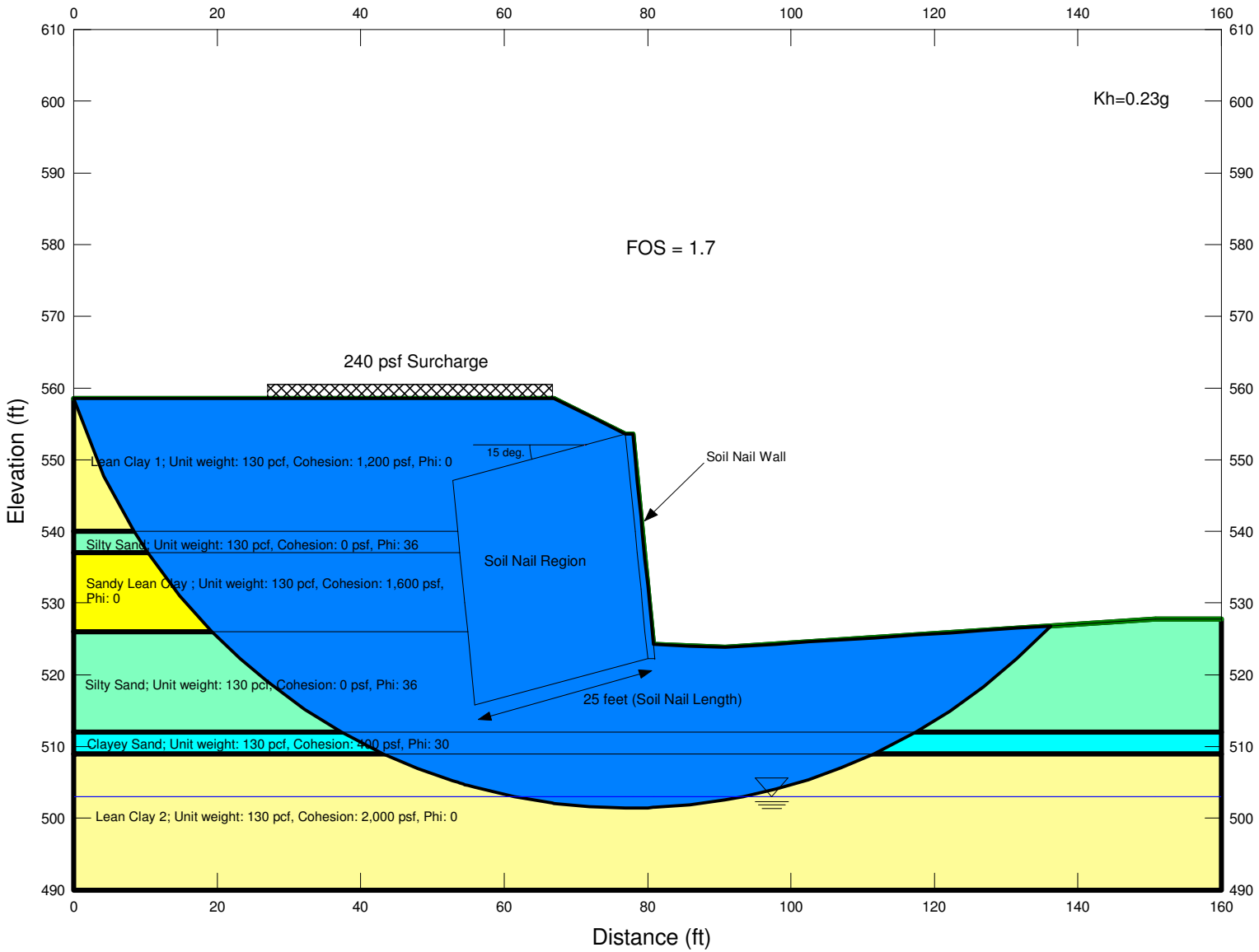
ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
PSEUDO STATIC
RW 245 (V-Sta.# 54+56)

FIGURE
D-2



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 – END OF CONSTRUCTION **RW 246 (A1-Sta.# 251+80)**	**FIGURE** **D-3**
	Date February 12, 2009	CHECKED BY Michael Larson		



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Date February 12, 2009	CHECKED BY Michael Larson	

ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
PSEUDO STATIC
RW 246 (A1-Sta.# 251+80)

FIGURE
D-4

Sliding and Overturning -- External Stability of an MSE Wall

Subject: Retaining Wall 245, Max Height
w/ 3 feet of water pressure at the top of wall

Reference: Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines U.S. Department of Transportation Federal Highway Administration Publication No. FHWA-NHI-00-043, March 2001

Input:

Geometry						
Wall Height, H	**26.67**	ft	**8.12**	meters		
Live Surcharge Loading	**240.00**	psf	11.49	kpa		
Surcharge Slope Angle, β	0.020	radians	1.15	degrees	**2.0**	% gradient
Length of Reinforcement, L	18.7	ft	**5.68**	meters	**0.70**	xH
Seismic						
Peak Horizontal Ground Acceleration, PGA	**0.68**	g				
Acceration Coefficient, A	0.23	g				
Soil Properties						
Reincforced Soil Mass						
Unit Weight γ_f	**120**	pcf	18.84	kN/m^3		
Friction Ange ϕ_f	0.59	radians	**34**	degrees		
Retained Fill						
Unit Weight γ_f	**120**	pcf	18.84	kN/m^3		
Friction Ange ϕ_f	0.52	radians	**30**	degrees		
Foundation Soils						
Unit Weight γ_f	**130**	pcf	20.41	kN/m^3		
Friction Ange ϕ_f	0.62832	radians	**36**	degrees		
Cohesion c	**100**	psf	4.8	kpa		

Calculation					
Static					
Active Earth Pressure Coef, ka	0.33				
Height, h	27.04	ft			
Total Earth Force, Ft	14636	lbs			
Horizontal Force Surcharge	2165	lbs			
Weight of Reinforced Soil Mass, V_1	59748	lbs			
Weight of Slope Wedge Mass, V_2	418	lbs			
Horizontal Force from 1m of Water at Top	336	lbs			
Eccentricity e	2.74	ft			
Eccentricity Check e<L/6	**Yes. Eccentricity Ok**				L/6= 3.1115
Equivalent Base Width (L-2e)	13.19	ft	4.02	m	
Equiv Uniform Vertical Stress sv	4582	psf			
Driving Force for Sliding, Pd	17133	lbs			
Resisting Force for Sliding, Pr	34906	lbs			
Factor of Safety Sliding, Pr/Pd	**2.0**				
Check FS Sliding >=1.5	**Yes. Sliding Ok**				
Overturning Moment, Mo	140250	lb-ft			
Resisting Moment, Mr	568389	lb-ft			
Factor of Safety Against Overturning, Mr/Mo	**4.1**				
Check FS Overturning >=2.0	**Yes. Overturning Ok**				

Figure D-5

Sliding and Overturning -- External Stability of an MSE Wall

Subject: Retaining Wall 245, Max Height

Reference: Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes
U.S. Department of Transportation Federal Highway
Administration Publication No. FHWA-NHI-00-024, November 2009

Input:					
Geometry					
Wall Height, H	26.67	ft	8.12	meters	
Live Surcharge Loading	240.00	psf	11.49	kpa	
Surcharge Slope Angle, β	0.02000	radians	1.15	degrees	2.00 % gradient
Length of Reinforcement, L	18.67	ft	5.68	meters	0.70 xH
Service Limit Resistance factor=	**1.00**				
Service Limit Load Factor=	**1.00**				
Seismic					
Peak Horizontal Ground Acceleration, PGA	0.68	g			
Acceration Coefficient, A	0.23	g			
Extreme Limit Load Factor=	**1.00**				
Soil Properties					
Reinforced Soil Mass					
Unit Weight γ_r	120	pcf	19	kN/m^3	
Friction Ange ϕ_r	0.59341	radians	34	degrees	
Retained Fill					
Unit Weight γ_f	120	pcf	19	kN/m^3	
Friction Ange ϕ_f	0.52360	radians	30	degrees	
Foundation Soils					
Unit Weight γ_f	130	pcf	20.4	kN/m^3	
Friction Ange ϕ_f	0.62832	radians	36.0	degrees	
Cohesion c	100	psf	4.8	kpa	
Calculation					
Service					
Active Earth Pressure Coef, ka	0.33				
Height, h	27.04	ft			
Total Earth Force, Ft	14636	lbs			
Horizontal Force Surcharge	2165	lbs			
Weight of Reinforced Soil Mass, V_1	59748	lbs			
Weight of Slope Wedge Mass, V_2	418	lbs			
Horizontal Force from Water at Top	0	lbs			
Eccentricity e	2.60	ft			
Eccentricity Check e<L/4	**Yes. Eccentricity Ok**				L/6= 3.1115
Equivalent Base Width (L-2e)	13.47	ft	4.11	m	
Equiv Uniform Vertical Stress sv	4488	psf			
Driving Force for Sliding, Pd	16798	lbs			
Resisting Force for Sliding, Pr	34906	lbs			
Capacity Demand Ratio Sliding, Pr/Pd	**2.1**				
Check CDR Sliding >=1.0	**Yes. Sliding Ok**				
Overturing Moment, Mo	131906	lb-ft			
Resisting Moment, Mr	568389	lb-ft			
Factor of Safety Against Overturning, Mr/Mo	**4.3**				
Check CDR Overturing >=1.0	**Yes. Overturning Ok**				
Seismic-Extreme					
Max Acceleration in Wall, Am	0.28	g			
Wall Height for Inertial Forces, H_2	26.94	ft			
Horizontal Inertia Force Reinforced Zone P_{ir}	11953	lbs			
Horizontal Inertia Force Slope Zone Pis	218	lbs			
Total Horizontal Inertia Forces P_{IR}	12171	lbs			
atan (kh/(1-Kv)) , ξ	0.27049	radians			
Total Seismic Earth Pressure Coefficient K_{AE}	0.55				
ΔK_{AE}	0.22				
P_{AE} total	9618.58	lbs			
P_{AE} horizontal	9616.66				
Moment Arm Pir	13.335				
Moment Arm Pis	26.76				
Moment Arm 50 % P_{AE} Horizontal	16.16				
Eccentricity e for seismic	6.11	ft			
Eccentricity Check e<L/3 seismic	**Yes. Eccentricity Ok**				L/3= 6.223
Equivalent Base Width (L-2e)	6.45		1.97	m	
Driving Force for Sliding, Pd seismic	33777	lbs			
Resisting Force for Sliding, Pr Seismic	34906	lbs			
Capacity Demand Ratio Sliding, Pr/Pd Seismic	**1.033**				
Check CDR Sliding >=1.0	**Yes. Sliding Ok**				
Overturing Moment, Mo	374852				
Resisting Moment, Mr	570184				
Factor of Safety Against Overturning, Mr/Mo	**1.5**				
Check CDR Overturing >=1.0	**Yes. Overturning Ok**				

Figure D-6

Sliding and Overturning -- External Stability of an MSE Wall

Subject: Retaining Wall 245, Max Height

Reference: Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes
U.S. Department of Transportation Federal Highway
Administration Publication No. FHWA-NHI-00-024, November 2009
AASHTO LRFD 2012

Input:						
Geometry						
Wall Height, H	26.67	ft	8.12	meters		
Live Surcharge Loading	240.00	psf	11.49	kpa		
Surcharge Slope Angle, β	0.02000	radians	1.15	degrees	2.00	% gradient
Length of Reinforcement, L	18.67	ft	5.68	meters	0.70	xH
Resistance Factor (strength limit)=	**0.90**					
Load Factor (surcharge)=	**1.75**					
Load Factor (Vertical Earth Pressure)	**1.00**					
Seismic						
Peak Horizontal Ground Acceleration, PGA	0.68	g				
Acceration Coefficient, A	0.23	g				
Resistance Factor=	1					
Soil Properties						
Reinforced Soil Mass						
Unit Weight γ_r	120	pcf	19	kN/m^3		
Friction Ange ϕ_r	0.59341	radians	34	degrees		
Retained Fill						
Unit Weight γ_f	120	pcf	19	kN/m^3		
Friction Ange ϕ_f	0.52360	radians	30	degrees		
Foundation Soils						
Unit Weight γ_f	130	pcf	20.4	kN/m^3		
Friction Ange ϕ_f	0.62832	radians	36.0	degrees		
Cohesion c	100	psf	4.8	kpa		
Calculation						
Strength						
Active Earth Pressure Coef, ka	0.33					
Height, h	27.04	ft				
Total Earth Force, Ft	14636	lbs				
Horizontal Force Surcharge	3788	lbs				
Weight of Reinforced Soil Mass, V_1	59748	lbs				
Weight of Slope Wedge Mass, V_2	418	lbs				
Horizontal Force from Water at Top	0	lbs				
Eccentricity e	2.96	ft				
Eccentricity Check e<L/4	**Yes. Eccentricity Ok**				**L/4= 4.66725**	
Equivalent Base Width (L-2e)	12.74	ft	3.88	m		
Equiv Uniform Vertical Stress sv	4744	psf				
Driving Force for Sliding, Pd	18421	lbs				
Resisting Force for Sliding, Pr	31416	lbs				
Capacity Demand Ratio Sliding, Pr/Pd	**1.7**					
Check CDR Sliding >=1.0	**Yes. Sliding Ok**					
Overturning Moment, Mo	131906	lb-ft				
Resisting Moment, Mr	568389	lb-ft				
Capacity Demand Ratio Against Overturning, Mr/Mo	**4.3**					
Check CDR Overturing >=1.0	**Yes. Overturning Ok**					

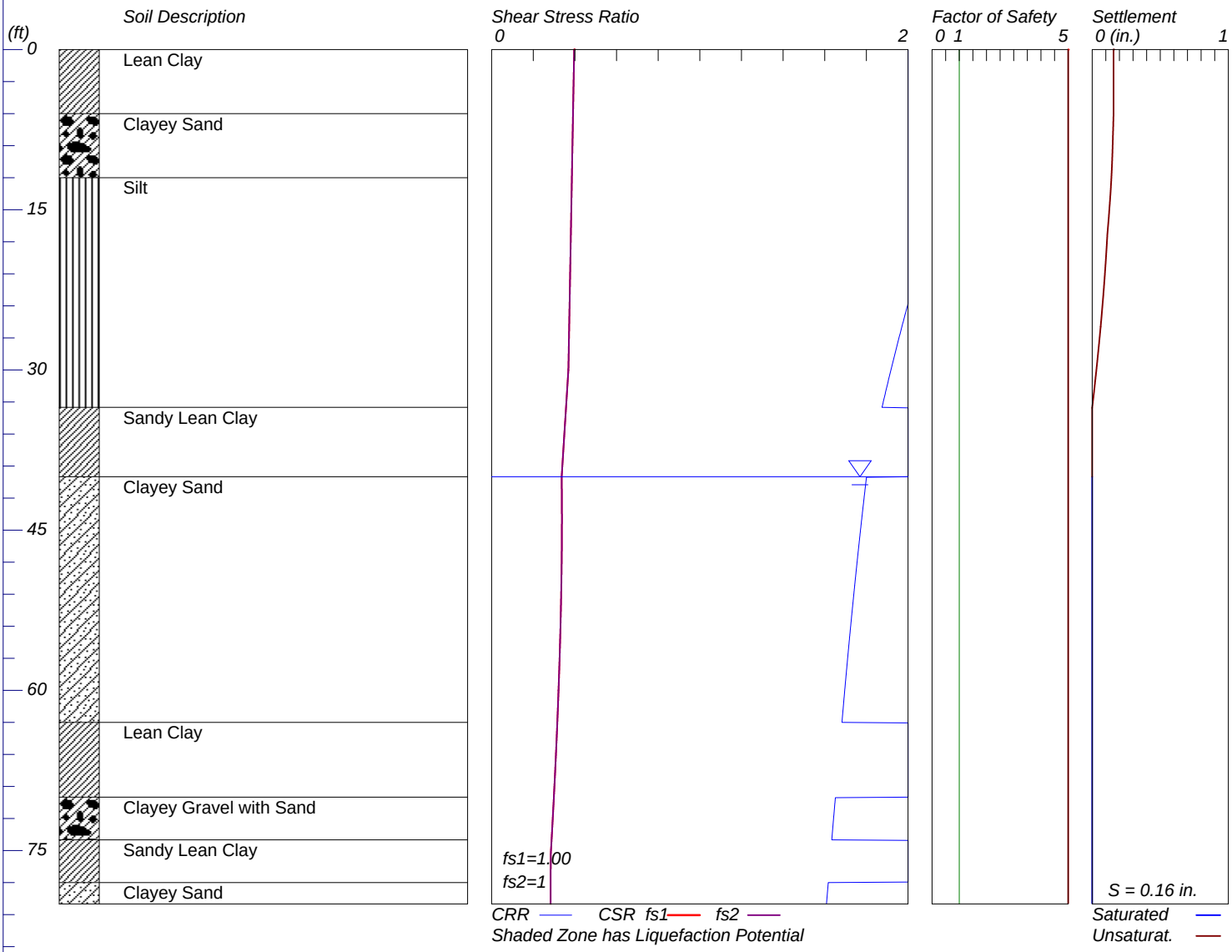
Figure D-7

LIQUEFACTION ANALYSIS

SR 84 Isabel Ave Improvements

Hole No.=NB03 Water Depth=40 ft Surface Elev.=539

Magnitude=6.8
Acceleration=0.61g



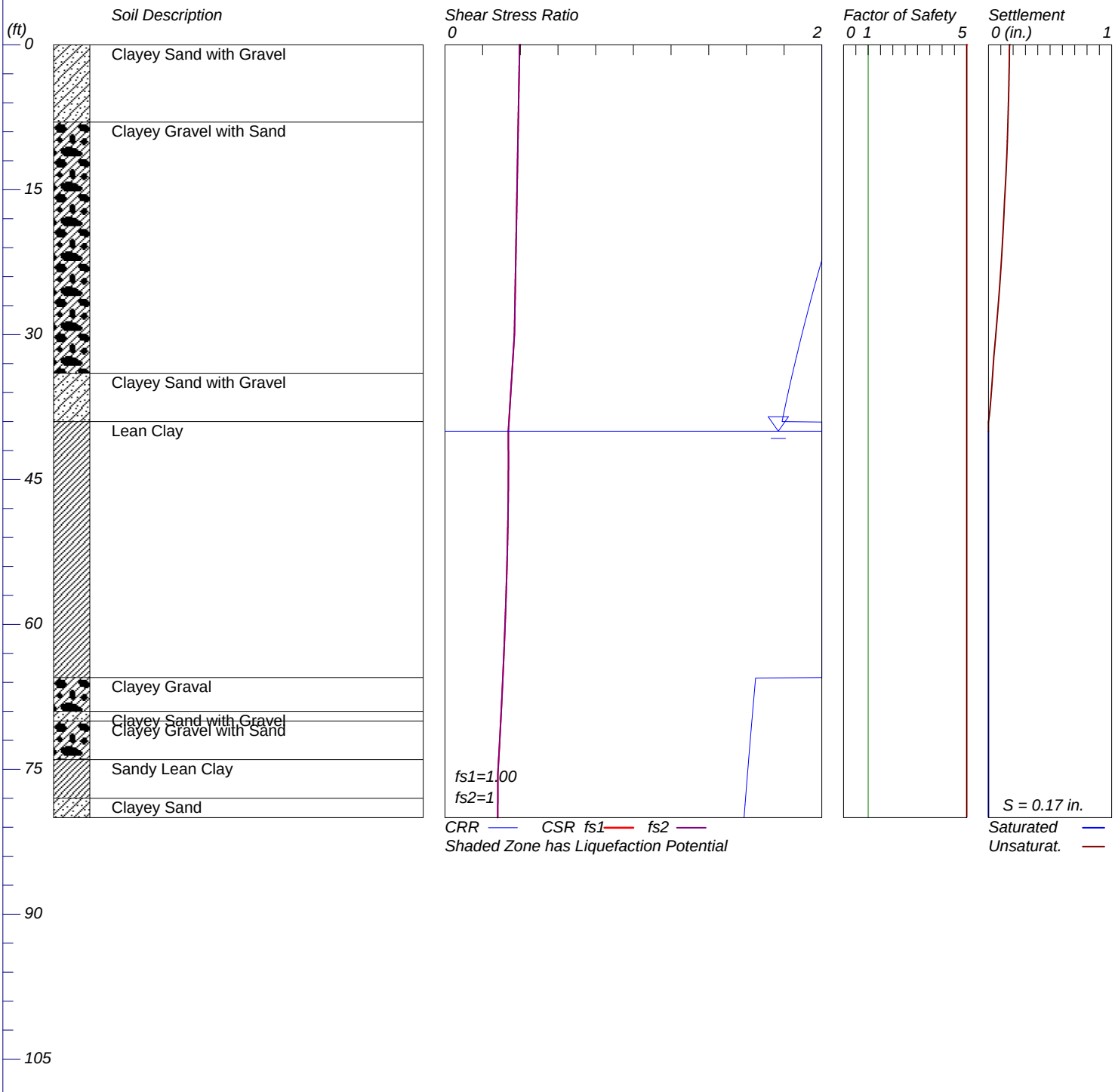
LiquefyPro CivilTech Software USA www.civiltech.com

LIQUEFACTION ANALYSIS

SR 84 Isabel Ave Improvements

Hole No.=NB06 Water Depth=40 ft Surface Elev.=528

Magnitude=6.8
Acceleration=0.61g



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The following table presents correlation between the borehole identification shown on LOTBs and discussed throughout the report text with the borehole identification used in the corrosion report.

Borehole Identification on LOTBs	Borehole Identification for Laboratory Test Results
R-07-003	NB03
R-07-005	NB05

ROUTE 84 EXPRESSWAY WIDENING PROJECT

LIVERMORE, CA.
RUBY HILL DRIVE TO JACK LONDON BOULEVARD

MATERIALS REPORT

Prepared for:

URS Corporation
55 South Market Street, Suite 1500
San Jose, CA 95113

Prepared By:

V&A
Lake Merritt Tower
155 Grand Ave., Suite 700
Oakland, CA 94612

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.

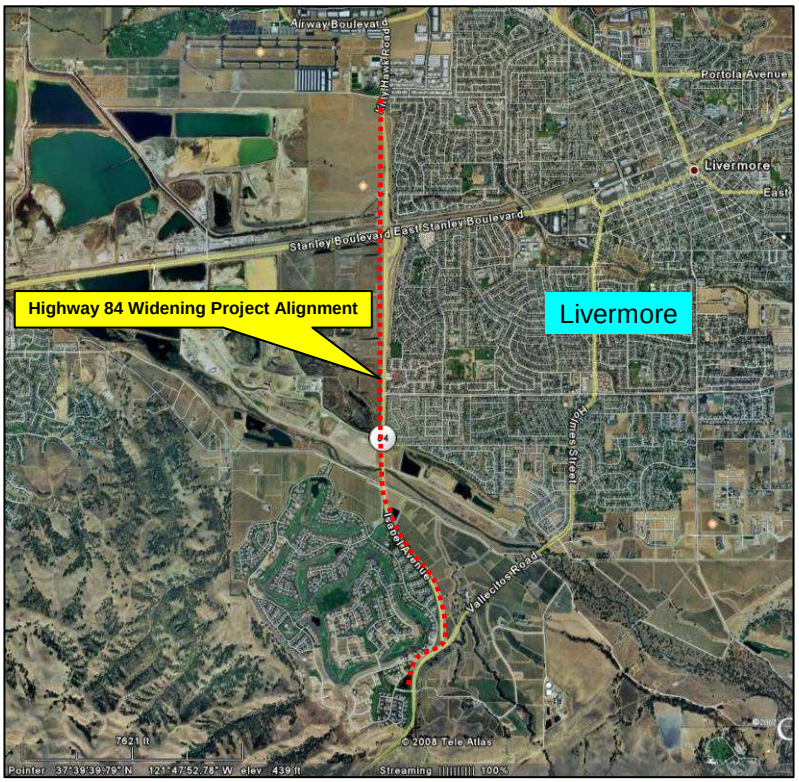

Figure 1. Vicinity and Project Site Map, Livermore, CA.

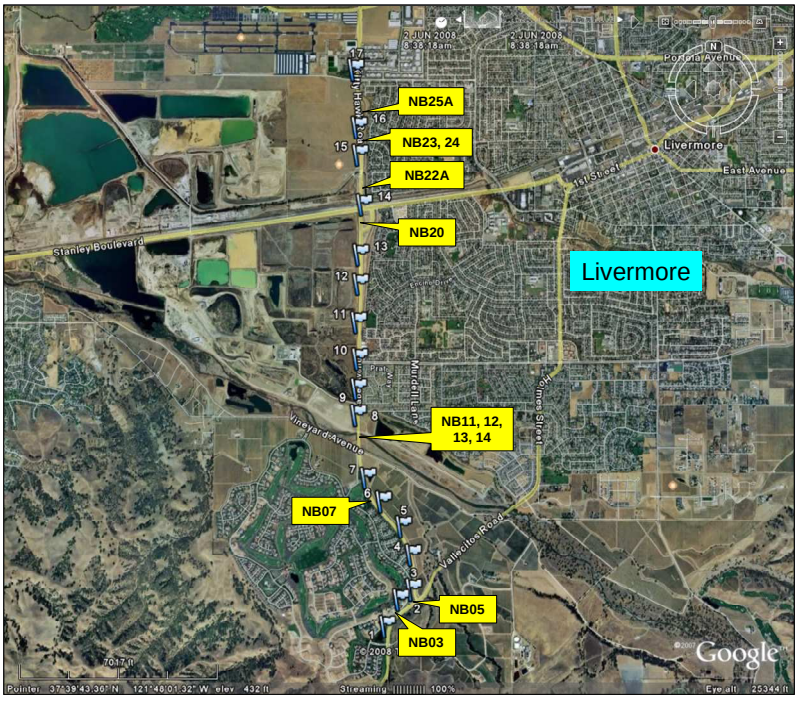

Figure 2. In-Situ Soil Resistivity Test Sites (flags) and Soil Bore Locations (NB-series)

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).

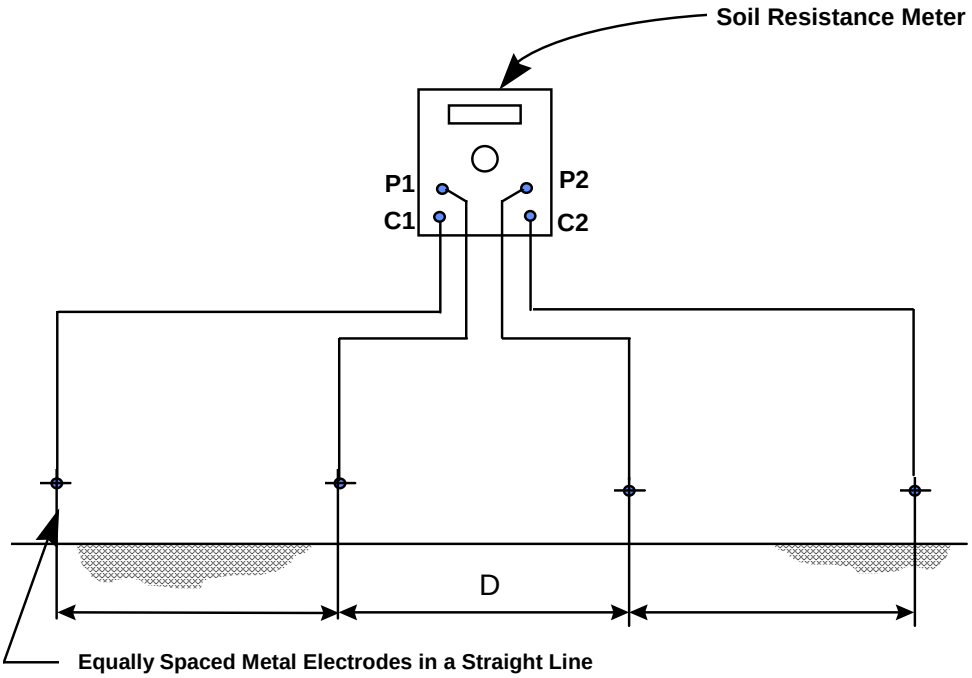

Figure 3. Wenner Electrode Method for Measurement of Soil Resistivity

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.

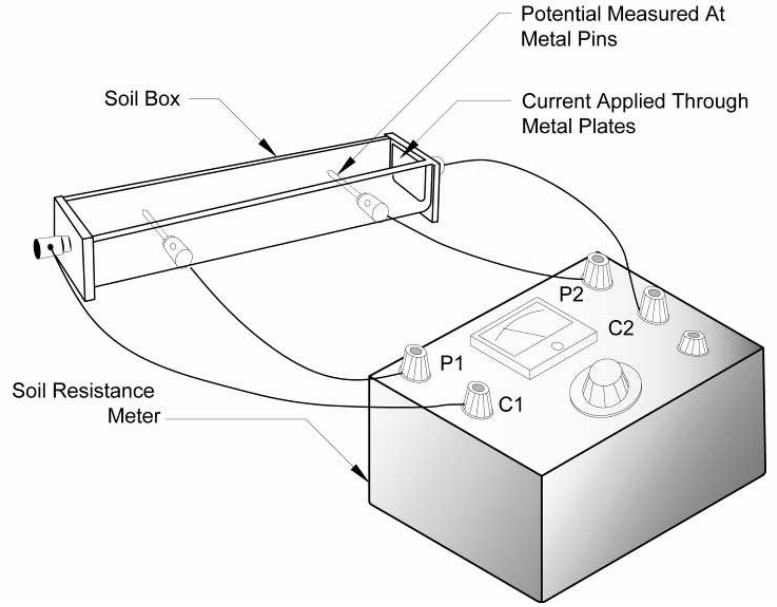

Figure 4. Soil Resistivity Measurement Using the Soil Box Method

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

Geotechnical Design and Materials Report - Dated 01/21/2015

04-ALA-84-PM22.9/25.7

EA297624
PID 0400020581

JANUARY 21, 2015

GEOTECHNICAL DESIGN REPORT AND MATERIALS REPORT

STATE ROUTE 84 EXPRESSWAY WIDENING – SOUTH SEGMENT LIVERMORE, CALIFORNIA

Prepared for
Alameda County Transportation Commission
1111 Broadway, Suite 800
Oakland, CA 94607

URS

100 W. San Fernando Street, Suite 200
San Jose, California 95113

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URS

January 21, 2015
Project 28649640

File No.04-ALA-84-PM 22.9/25.7
EA297601

Mr. Gary Sidhu
Project Coordinator
Alameda County Transportation Commission (ACTC)
1111 Broadway, Suite 800
Oakland, CA 94607

Subject: **Geotechnical Design Report (GDR) and Materials Report**
State Route 84 Expressway Widening – South Segment
Pleasanton and Livermore, California

Dear Mr. Sidhu:

URS completed a geotechnical investigation and the GDR/Materials Report for the proposed modifications to Route 84 in Pleasanton and Livermore, California. The accompanying report was prepared in accordance with Caltrans GDR Guidelines, dated December 2006 and Corrosion Guidelines, dated November 2012.

The report presents our engineering opinions and recommendations regarding the geotechnical factors influencing the design and construction of the proposed roadways and standard retaining walls. The opinions and recommendations were based upon the results of our field investigation, laboratory testing, engineering judgment and local experience. Mr. Madhu Thummaluru, G.E., performed engineering calculations and assisted in preparation of this report.
Mr. Mark Schmoll, CEG, contributed to the seismic source characterization and the evaluation of geologic conditions along the project alignment.

Since the south segment report dated August 1, 2014 was issued, we received review comments from Caltrans dated October 17, 2014. This report was updated to incorporate Caltrans comments.

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

REGISTERED PROFESSIONAL ENGINEER
STEPHEN HUANG
Exp 3/31/2016
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STATE OF CALIFORNIA

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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 north of Concannon Boulevard (PM 22.9/25.7) in the cities of Pleasanton and Livermore, California. The project will conform to the Pigeon Pass Project (EA 172400) to the south and the north segment project currently under construction.

SR 84 follows a discontinuous route consisting of two segments: an east-west segment running from Livermore to Fremont in Alameda County, crossing the 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. SR 84 follows Isabel Avenue and Vallecitos Road between I-580 in Livermore and I-680 in Sunol, California (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 for the south segment are shown on the Key Map, Sheet K-1 in Appendix A.

1.1.2 General

The project proposes to widen and upgrade SR 84 to expressway standards (55 mph) from south of Ruby Hill Drive to north of Concannon 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 would be widened from two to four lanes within the south segment project limits. 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 and Concannon Boulevard would be widened and upgraded to accommodate future traffic movements.

The roadway cross section would consist of 12-foot-wide traveled lanes and 10-foot-wide shoulders separated by a concrete median barrier. Where practical, side slopes would be 4:1 (horizontal:vertical) or flatter to provide a clear recovery zone for errant vehicles. Outside the clear recovery zone, 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. Retaining walls 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 cuts 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 two abutments and pile cap at 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 two abutments and one center bent on cast in drilled hole (CIDH) piles, is planned just east of the existing Arroyo Del Valle Bridge. About 2 feet of fill would be needed to raise the bridge soffit above the estimated 100-year flood water level. Excavations to the bottom of spread footings at the 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 proposed 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 Concannon Boulevard, and on the east side of SR 84 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 SR 84 and the crossing would become a concrete spillway between the two lakes. Therefore, the SR 84 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 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. Outfalls for the future Zone 7 basins would be addressed by this 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 requires additional right-of-way at a number of locations.

1.1.7 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
Route 84 Expressway Widening – North Segment	On SR 84 just north of Concannon Boulevard and Jack London Boulevard	Upgrade SR 84 within the project limits to expressway design standards and widening the existing 2 lane highway to 6 lanes.	Begin Construction May 2012, Open to traffic July 2014
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	Construct 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	On SR 84 between Ruby Hill	Upgrade SR 84 within the project	Begin

Table 1-2 Regional Project Summary

Project	Location	Description	Anticipated Schedule
Realignment and Widening (Pigeon Pass "SHOPP Project")	Drive intersection and the Vallecitos Hills/Pigeon Pass area, directly south of the SR 84 Expressway Widening Project	limits to expressway design standards, involving realignment of horizontal and vertical curves, and addition of climbing lanes in the Pigeon Pass area.	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
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 from 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 ACTC 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 SR 84 in the project area).	Draft EIR completed in 2004

1.1.8 Retaining Walls

Six 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[1] (ft)	Height (ft)
236	Route 84	Lt (SB)	"A1" 235+16	"A1" 240+30	536	6 to 14
246	Route 84	Lt (SB)	"A1" 246+00	"A1" 258+26	1,180	3 to 32
245	Vallecitos Rd Connector	Rt (NB)	"VEX" 50+33	"V" 106+60	977	7 to 29
109	Vallecitos Rd	Rt (SB)	"V" 109+05	"V" 112+30	163 (Type 1) 158 (Type 5)	14 (Type 1) 6 to 12 (Type 5)
110	Vallecitos Rd	Lt (SB)	"V" 110+30	"V" 115+65	546	6 to 12
317	Route 84	Lt (SB)	"A1" 316+66	"A1" 318+56	190	6 to 10

[1] Length measured along retaining wall layout line

Walls RW245 and RW246 are considered special walls (non-standard). Geotechnical design parameters and recommendations for these walls are presented in a separate Foundation Report.

1.2 EXISTING STRUCTURES

Figures 1-3 through 1-6 present the general plan and foundation plan for each 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

(1) All loads including wind and seismic
(2) Nominal resistance

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 from 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 an average daily low 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 on 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 SR 84 between Concannon 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 Concannon Boulevard at Station 345+00 to the drainage crossing of Arroyo Del Valle at Station 320+00. The incised Arroyo Del Valle drainage crossing is 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, with the majority of them located along the west side of SR 84, between about Station 314+00 north of Vineyard Avenue to about ¼ mile north of the project limits.

1.3.3 Surface Drainage

Watershed

Major streams within or in the vicinity of the project include, from north to south:

- Arroyo Mocho (¼ mile north of project)
- Arroyo Del Valle (crossed by project)

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 Arroyo Del Valle bridge site in the Del Valle Regional Park (State Recreation Area).

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 bridge site, the area consists 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 watershed, 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, 2009). 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 Flood Insurance Study (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 in 1955 was mostly downstream of the project area. (Arroyo Mocho to Alamo Canal, I-580 to downtown Pleasanton)

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 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) subdivides the alluvium into latest Holocene alluvial fan deposits, Holocene alluvial fan deposits and historic stream channel deposits within the active channels of Arroyo Mocho and Arroyo Del Valle. The geologic map (Figure 1-7) 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 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 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.

1.3.5 Local Geology

Based on a review of the borings completed along the project alignment, the soil profile typically consists of a few feet of fill overlying alluvium. The fill, where encountered, ranged from about 2 to 3 feet thick to as much as 12 feet thick in Boring R-07-013, drilled near the north abutment of the existing Isabel Avenue (SR 84) Bridge at Arroyo Del Valle Creek. The fill consists of locally derived silt, sand and clay with gravel and occasionally contains asphalt and concrete fragments. Alluvium was encountered in all of the borings underlying the road base and fill

materials. 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. In general the alluvium encountered south of Arroyo Del Valle, where the road alignment gradually climbs a gentle alluvial fan, was more dense/stiff compared with the alluvium north of the drainage. The uncorrected N-values from borings located south of the drainage were nearly all above 40 blows per foot and most were well above 50 blows per foot, even in the silts and clays. North of Arroyo Del Valle, the alluvium is less dense/stiff with N-values typically in the 10 to 30 blows per foot range for the upper 20 to 30 feet of the soil profile and increasing with depth.

1.4 PREVIOUS INVESTIGATIONS NEAR SITE

No foundation investigation report is available for the existing Arroyo Del Valle Creek bridge.

1.5 REVIEW COMMENTS

URS submitted a Geotechnical Design and Materials Report dated April 28, 2008, for the proposed SR 84 Expressway Widening Project, which included both north and south segments. Caltrans subsequently reviewed that report and provided comments dated June 2 and June 23, 2008. The 65% report for both segments was issued on September 17, 2008, followed by Caltrans review comments dated October 23, 2009. The 95% report for both segments was issued on February 25, 2010, followed by comments dated May 24, 2010. During review of south segment PS&E submittal, Caltrans directed URS in comments dated June 26, 2014, to prepare a report specific to the south segment and consistent with the Caltrans latest standards (2010). Caltrans prepared subsequent review comments dated August 1, 2014 and October 17, 2014. We have incorporated all of these review comments in this report. Copies of the review comments and responses are included in Appendix N.

2.1 ORIGINAL CONSTRUCTION

Existing structural pavement sections are shown on as-built (existing) Typical Cross Section drawings presented in Appendix B. The as-built 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 Hill 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 SR 84 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 SR 84 extend from Station "RH" 4+60 to Station "I" 101+60.

Information from the following design drawings was 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 (Type A)
- Asphalt treated permeable material is ATPB
- Class 2 aggregate base is CL 2 AB
- 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
- Hot mix asphalt is HMA

2.2 EXISTING STRUCTURAL SECTIONS

According to Typical Cross Sections presented in the record drawings discussed in Section 2.1, the existing pavement sections for SR 84 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
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

Table 2-1 Existing Typical Structural Sections

Direction	Station	Traveled Way Section (feet)	Shoulder Section (feet)	Record Drawings
NB/SB	333+11 to 377+00	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

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 measured 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 measured in the shoulder explorations appear to be less than those shown on the record drawings. Therefore, it is conservative to consider the combined AC thickness between Station 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 STRUCTURAL PAVEMENT SECTION

The existing pavement structural sections were measured where project boring locations coincided with the existing pavement. Approximate measurements of the existing sections 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)	
R-07-005	"A1" 252+76	10	9	0.75	9	0.75	Travelled Lane
A-07-016	"A1" 348+18	52	7	0.58	17	1.42	Shoulder
A-07-017	"A1" 354+12	52	7	0.58	17	1.42	Shoulder
A-07-018	"A1" 359+40	51	8	0.67	16	1.33	Shoulder
A-07-101	"A1" 230+68	-6	8	0.67	6.5	0.54	Travelled Lane
A-07-102	"A1" 238+10	76	8	0.67	9	0.75	Shoulder
A-07-104	"A1" 253+70	68	9	0.75	Not Encountered	Not Encountered	Shoulder
A-07-106	"A1" 264+70	5	5	0.42	4	0.33	Travelled Lane
A-07-107	"A1" 270+16	-8	6	0.50	4	0.33	Travelled Lane
A-07-108	"A1" 278+11	-33	5	0.42	4	0.33	Shoulder
A07-109	"A1" 280+36	-33	5.5	0.46	6.5	0.54	Shoulder
A-07-110	"A1" 284+94	-3	5.5	0.46	5	0.42	Travelled Lane
A-07-111	"A1" 289+94	-6	6.5	0.54	2	0.17	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
A-07-112	"A1" 295+52	-33	7	0.58	10	0.83	Shoulder
A-07-113	"A1" 300+54	-10	6	0.50	4	0.33	Travelled Lane
A-07-114	"A1" 305+99	11	6	0.50	12	1.00	Travelled Lane
A-07-115	"A1" 312+66	-3	6	0.50	Not Encountered	Not Encountered	Median
A-07-116	"A1" 324+39	-30	6	0.50	Not Encountered	Not Encountered	Shoulder
A-07-118	"A1" 332+97	-31	5.5	0.46	6.5	0.54	Shoulder
A-07-119	"A1" 341+68	-11	8	0.67	10	0.83	Travelled Lane
A-07-120	"A2" 359+00	12	8	0.67	Not Encountered	Not Encountered	Travelled Lane
A-07-123	"A2" 364+95	50	7	0.58	26	2.17	Shoulder
A-08-141	"A3" 230+21	0	8.5	0.71	9.5	0.80	Median
A-08-142	"A3" 237+41	30	7	0.58	17	1.41	Shoulder
A-08-143	"A3" 247+57	30	4	0.33	>56	>4½	Shoulder

Borings A-07-141 and A-07-142, drilled in January 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 borings drilled by URS for the entire SR 84 south segment project are presented in Figures 3-1 through 3-14. The locations of the borings are presented on Boring Records in Appendix C.

Twenty-five roadway borings were drilled primarily to evaluate the existing roadway structural pavement section and subgrade to depths of 9.5 to 15.0 feet, and typically about 10 feet. Two roadway borings were shallower, drilled to a depth of 5 feet. All roadway borings were drilled with a hollow stem auger.

Twenty-six multi-purpose borings were drilled to evaluate subsurface conditions for proposed retaining walls, signs and bridges, as well as for proposed modifications to existing bridges. These borings were drilled with either rotary wash or hollow stem auger drilling equipment to depths ranging from 14 to 101½ feet. Three additional borings were drilled on hillsides using a solid flight auger mounted on a portable rig.

The initial field investigation was conducted between November 19 and December 27, 2007, and January 2 through 18, 2008. A subsequent phase of field investigation was conducted between December 9, 2008, and January 7, 2009.

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 check 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, 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. The pavement sections encountered in the 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 the portion of the alignment consists of several feet of fill overlying alluvium. The fill, where encountered, ranges from about 3 to 12 feet thick; 25 feet of fill was also encountered in the boring drilled on the hillside between SR 84 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 and 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 channel. The uncorrected N-values in the borings south of the drainage channel 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; coarse grained soils (sands and gravels) are typically medium dense to very dense in relative density, and occasionally loose. Fat clays (CH) were encountered in Borings A-07-113, A-07-114 and R-07-013 and elastic silt (MH) was encountered in A-07-107. Cobbles were encountered in Borings R-07-003 (at 7 feet bgs) and in Boring R-07-006 (at 31 feet bgs).

North of Arroyo Del Valle the fine grained soils are generally medium stiff to hard. Coarse grained soils are typically medium dense to very dense in relative density. Cobbles and/or boulders were encountered in Boring R-07-013 (at 11½ to 15 feet bgs and at 25 feet). North of the drainage channel 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 roadway 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 multi-purpose borings are summarized in the following table.

Table 3-2 Groundwater Measurements

Boring Number	Water Depth (feet)	Total Boring Depth (feet)	Drilling Method	Comments
A-08-001	20	25.0	Auger	Hillside boring
A-08-002	Dry	30.0	Auger	Hillside boring
R-07-003	Not Measured	80.0	Rotary Wash	Dry to 7 feet
A-07-004	Dry	25.0	Hollow Stem Auger	

Table 3-2 Groundwater Measurements

Boring Number	Water Depth (feet)	Total Boring Depth (feet)	Drilling Method	Comments
R-07-005	Not Measured	56.5	Rotary Wash	Dry to 7 feet
A-08-005	Dry	35.0		Hillside boring
R-07-006	Not Measured	80.0	Rotary Wash	Dry to 7 feet
A-07-007	Dry	20.0	Hollow Stem Auger	
A-08-007A	Dry	20.0	Hollow Stem Auger	
A-08-008	Dry	31.5	Hollow Stem Auger	
A-07-009	Dry	30.0	Hollow Stem Auger	
A-08-010	23½	30.0	Hollow Stem Auger	
R-07-011	Not Measured	60.0	Rotary Wash	5 feet to drilling fluid upon completion of drilling
R-07-012	Not Measured	71.5	Rotary Wash	8 feet to drilling fluid level on 2nd day of drilling
R-07-013	Not Measured	80.0	Rotary Wash	14 feet to drilling fluid level on 2nd day of drilling
R-07-014	Not Measured	60.0	Rotary Wash	Dry to 11½ feet
A-07-015	Dry	14.0	Hollow Stem Auger	
A-07-016	Dry	15.5	Hollow Stem Auger	
A-07-017	Dry	20.0	Hollow Stem Auger	
A-07-018	Dry	20.0	Hollow Stem Auger	
A-08-030	24	50.0	Hollow Stem Auger	
A-08-031	28	50.0	Hollow Stem Auger	
A-08-032	Dry	50.0	Hollow Stem Auger	
A-08-033	Dry	30.0	Hollow Stem Auger	
A-08-034	Dry	35.0	Hollow Stem Auger	
A-08-035	14½	50.0	Hollow Stem Auger	
A-08-036	Dry	50.0	Hollow Stem Auger	
R-08-037	3½	90.0	Rotary Wash	
R-08-038	3	90.0	Rotary Wash	

Multi-purpose borings advanced using rotary wash drilling equipment were 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. The depth to groundwater was recorded, where encountered, in multi-purpose borings advanced using hollow stem auger drilling equipment; these borings ranged from about 15 to 50 feet in depth and free groundwater was encountered in some of these borings at depths ranging from 14½ to 28 feet bgs.

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 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 Pleasanton faults. 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 project alignment does not cross any mapped A-P zoned faults.

The geologic map (Figure 1-7) shows the location of the Livermore fault as mapped by Dibblee (1980) and Alameda 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). Other nearby mapped faults include the southwest extension of the Las Positas fault, located about 1.7 miles (2.8 km) southeast of the southern end of the project alignment. The project alignment does not cross either the Los Positas fault or the Livermore fault.

4.2 PEAK GROUND ACCELERATION

The seismic design methodology adopted for this project is based on Caltrans Seismic Design Criteria (SDC), v. 1.7, April 2013.

The active faults close to the SR 84 alignment between Ruby Hill Drive and Concannon Boulevard are the Calaveras, Pleasanton and Las Positas faults. The Calaveras fault, Pleasanton fault and Las Positas fault are designated with Maximum Magnitudes (M_{Max}) of 6.9, 6.6, and 6.4, respectively. The Las Positas fault is located about 1.7 miles east of the project site. The Pleasanton fault is located about 2.8 miles west of the site. More distant active faults include the

Hayward fault located 10.5 miles southwest of the southern end of the project alignment, and the San Andreas fault located 29 miles southwest of the southern end of the project alignment. The SR 84 alignment is roughly parallel to the Calaveras fault, and the distance from the site to the Calaveras fault is approximately 2.8 miles.

Fault	Type	M_{Max}	Distance (miles)
Calaveras	strike-slip	6.9	5.1
Pleasanton	strike-slip	6.6	2.8
Las Positas	strike-slip	6.4	1.7

Average shear wave velocity, V_{s30}, in the upper 30 meters of the soil profile is estimated to be 360 meters per second. The V_{s30} values are based on National Earthquake Hazards Reduction Program (NEHRP) recommendations and correlations based on in-situ SPT data. This V_{s30} value corresponds to Soil Profile Type D.

Based on Caltrans ARS Online and utilizing the tool on USGS Probabilistic Seismic Hazard Analysis (PSHA) Interaction Deaggregation tool, the following ground motion parameters have been established for this based on a probability of exceeding of 5 percent in 50 years:

- Peak ground acceleration (PGA) = 0.61g

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, Pleasanton, Las Positas 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.

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. 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 (see Qls on Figure 1-7), 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. 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 Arroyo Del Valle 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 A-08-001(20 feet bgs) and A-08-010 (23.5 feet bgs) drilled in March 2008, as well as Borings A-08-030 (24 feet bgs), A-08-031 (28 feet bgs), and A-08-035 (14.5 feet bgs) drilled in December 2009. 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 R-08-037 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 (R-07-003, R-07-006 and A-07-017) 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 0.61 g and design earthquake moment magnitude of 6.8. 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 channel of Arroyo Del Valle, 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 are not lined with stone riprap or concrete. Based on a hydraulic analysis (Wreco, 2009 report and 2014 addendum), the estimated scour depth is up to about 10 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.

4.5 CORROSION

Results of a site specific study and recommendations regarding the corrostivity of soils and groundwater at new and existing structures and underground utilities 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 May 7, 2012, Chapters 600-670 "Pavement Engineering", and in particular Chapter 630 "Flexible Pavement".

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 asphalt treated permeable base (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 SR 84 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 Vallecitos Road.

5.2 SUBGRADE CONDITIONS

Eighteen bulk samples were retrieved from the borings along SR 84 and two bulk samples were retrieved from borings along Vallecitos Road; all were submitted for R-value testing. The test results are summarized in the following table and presented in Appendix F.

Table 5-1 Summary of R-value Test Results

Boring	R-Value	Plasticity Index	Soil Description	Control Line Designation	Stationing (feet)	Offset (feet)[2]
A-07-101	1 and 3 (1)	21	CL	A1	230+68	5½ Lt
A-08-141	5	15	CL	A1	230+17	7 Rt
A-08-142	7		CL	A1	237+88	30.5 Lt
A-07-103	65		CL	A1	243+42	27½ Rt
A-07-104	69		SP	A1	253+70	68 Rt
A-07-105	11	5	CL	A1	260+11	4 Rt
A-07-107	45		GP-GM	A1	270+16	7¾ Lt
A-07-110	12	15	CL	A1	284+94	3¼ Lt
A-07-111	31		SC	A1	289+94	6 Lt
A-07-112	31		CL-GM	A1	295+52	32¾ Lt
A-07-114	35		SM	A1	305+99	10¾ Rt
A-07-116	51		GW-GM	A1	324+39	30 Lt
A-07-118	59		SM	A1	332+97	31 Lt
A-07-121	29		GM	A2	356+49	11¾ Lt
A-07-124	25		ML	A2	369+58	49¼ Lt
A-07-125	54		SM	A2	374+38	9½ Rt
A-08-030	15[3]		CL	VEX	51+26	34 Rt
A-08-036	58[3]		SP-SC	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, the samples from A-07-101, A-07-110, A-08-141 and A-08-142 are considered expansive.

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 Table 5-1, with the exception

of A-07-101, the results of the tests range from an R-value of 5 to 69 for the eighteen soil samples. To assign design R-values, we plotted the numerical distribution of R-values in Figure 5-1 and the geographical 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 69. 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 "A1" Line Station Limits (feet)		Segment Length (feet)	Design R-value	Boring Number
	From	To			
1	227+00	246+80 (Ruby Hill Drive)	700	5	A-08-141, A-08-142
2	246+80	290+00	5,600	10	A-07-103, A-07-104, A-07-105, A-07-107, A-07-110
3	290+00	377+00	8,700	25	A-07-111, A-07-112, A-07-114, A-07-116, A-07-118, A-07-121, A-07-124, A-07-125
		Total	**15,000**		

We understand an R-value of 5 was used for original design in Segment 1. R-value tests at Borings A-08-141 and A-08-142 are 5 and 7, respectively; these results confirm the presence of clay subgrade soils in this area. Although two soil samples at A-07-101 (about Station 230+68) had R-values of less than 5, the lack of pavement distress along this segment of Isabel Avenue suggests a structural pavement section based on a design R-value of 5 is appropriate. For these reasons, we recommend new pavements for Segment 1 be designed with an R-value of 5. Alternatively, consideration was given to excavating the subgrade soils 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 the overexcavation and replacement alternative.

For the SR 84 portion of the project (excluding Vallecitos Road), the estimated cut quantities are very large when compared to the estimated fill quantities. Similarly, between Station 290+00 and 377+00, where high soil R-values of 25 are present, the estimated cut quantities are also very large when compared to the estimated fill quantities. Since there is excess high R-value cut

material available between Station 290+00 and 377+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 SR 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 Station 290+00 and 377+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 SR 84 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 Section 6.3, "Storm Drainage System", all cuts for new pavements require an underdrain system consisting of a layer of permeable material with toe (underdrains) drains. The approximate station limits of proposed cuts are summarized as follows:

- Between "A1" Line Station 247+00 to 262+00
- Between "A1" Line Station 290+00 to 277+00

In addition, existing underdrain systems should be extended under the widened roadway.

There is an existing drainage ditch on the west side of SR 84 beginning at "A1" Line Station 230+00 and terminating at "A1" Line 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 SR 84. From the east side of SR 84, another drainage ditch continues northward. As shown on Sheet X-3, a new embankment is also planned on the west side of SR 84; fill will be placed in the existing drainage ditch. We anticipate some overexcavation of unsuitable material (see Standard Specifications Section 19-2, Roadway Excavation) below the ditch bottom will be required.

The elevation of the ATPB layer may be adjusted during construction in order to match the elevation of the existing ATPB layer.

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.

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 2010 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 5-4 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 RHMA-G, Type A and B ($55^{o}F$) on Figure 5-4. Assuming the average of all daily average temperatures is the appropriate temperature criteria, we offer the following conclusions based on Figure 5-4:

- For RHMA-G, Type A and Type B, a minimum atmospheric temperature of $55^{o}F$ is required; in Livermore (Figure 5-4), the expected placement period is between about April 1 and November 1, which is a relatively large window of time.

In general, 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 is about 1 mile) indicated they can set up a mobile plant to manufacture RHMA-G.

RHMA-G is locally available but will require setting up a temporary plant for this project.

5.4.3 Recommended SPCS

Based on our pavement analysis, we developed the following Structural pavement Cross Sections (SPCS) for the mainline and shoulder of SR 84, and for Vallecitos Road, the trails and quarry access roads. SPCS Nos. 3, 5, 7 through 9 are for the mainline and shoulder of SR 84, and SPCS Nos. 10, 11A and 13 are for Vallecitos Road, the trails and quarry access roads. SPCS Nos. 1, 2, 4, 6, and 12 were developed for the SR 84 expressway widening project which includes Segments A and B; these SPC sections are not used for Segment B. The recommended sections were developed using the Caltrans Highway Design Manual (HDM) method, and then optimized to reduce the total required number of sections following the guidelines presented in Section 5.1. Figure 5-3 presents schematically the beginning and end stations of each SPCS and corresponding design plan Typical Cross Section (TCS) numbers shown on X-sheets of the project plan set. Detailed descriptions of the SPCS components and the corresponding TCS follow.

Table 5-4 Structural Pavement Cross Section versus Design Plan Typical Cross Section

Structural Pavement Cross Section	Design Plan Typical Cross Section
SPCS 3	TCS 6
SPCS 5	TCS 9
SPCS 7	TCS 4
SPCS 8	TCS 5
SPCS 9	TCS 3
SPCS 10	TCS 8
SPCS 11A	TCS 10

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**

Note: Increased pavement thickness to minimize the number of grade changes along the project alignment.

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 to 1.8	1.83 (based on 0.75 feet HMA)
ATPB 0.25	0.35
Class 2 AB 0.85	0.93
Class 4 AS 0.75	0.75
Total	**3.86 (based on 0.75 feet HMA)**

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 to 1.65	1.31 (based on 0.55 feet HMA)
ATPB 0.25	0.35
Class 2 AB 0.60	0.66
Class 4 AS 1.00	1.00
Total	**3.32 (based on 0.55 feet HMA)**

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 access roads to the 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 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.

Alternatively, SPCS 8 can be used for the Vallecitos Road, which would provide thicker HMA and AB layers resulting in a higher gravel equivalent. We understand that using SPCS 13 alone could have construction implications, primarily regarding where to change the pavement section from SPCS 13 to SPCS 8 near the intersection of Vallecitos Road and SR 84.

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 SR 84 mainline and outside shoulders. Testing was performed 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 record 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 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 summarizes design recommendations provided by CHEC for each of five pavement segments.

Table 5-5 Summary of AC Overlay Recommendations along SR 84

Segment Number	From	To	CTM Structural Requirement	Overlay Design Recommendations
1	Stanley Blvd.	Concannon Blvd.	0.00 ft HMA Overlay	0.15 ft. RHMA-G Overlay (surface layer)(1)
2	Concannon Blvd.	Vineyard Ave.	0.00 ft HMA Overlay	0.15 ft. RHMA-G Overlay (surface layer)(2)
3	Vineyard Ave.	Pavement Change North of Vallecitos Road	0.00 ft HMA Overlay	0.15 ft. RHMA-G Overlay (surface layer)(2)
4	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)
5	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 Number 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) indicates 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 (CHEC) 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 Caltrans 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 subgrade should be prepared in accordance with Caltrans Standard Specifications. 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 Section 19 of Caltrans Standard Specifications Section. Relative compaction of not less than 90 percent should be achieved in all fill materials, except where 95 percent relative compaction is required.

6.2 ESTIMATED SETTLEMENT ALONG MAINLINE

6.2.1 General

Based on the profile sheets (in Appendix I) along the SR 84 "A1", "A2" and "A3" lines, new fills are generally less than 2 feet in height. Exceptions to this for fill include: (1) maximum fill height of about 3 feet between Station 227+00 and 230+00, (2) maximum fill height of about 4

feet between Station 241+00 and 245+00, and (3) maximum fill height of about 2 feet at approach embankments at Arroyo Del Valle bridge between Station 317+00 and 322+00.

6.2.2 Fill Areas

Most new fill depths are less than 2 feet. In these areas, it is our opinion that immediate settlement of well-compacted fill should be less than ¼ inch and that long-term consolidation settlement should be negligible.

6.2.3 Maximum Fill Area

The maximum fill height along the alignment is about 4 feet between Station 241+00 and 245+00. We estimate immediate settlement at this location should be about ¼ inch and long-term settlement should be negligible.

We estimate immediate settlement should be less than ¼ inch and long-term settlement should be negligible at the approach embankments for the Arroyo Del Valle Bridge (Widen) and Trail Bridge.

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 since groundwater is relatively deep and since clays below the groundwater are generally hard and relatively incompressible (indicative of over-consolidation). Considering that the estimated settlements are relatively small, surcharging of the fills is unnecessary. As directed by Caltrans, settlement monitoring is required for the fills associated with RW 109, RW 110, RW 245, Arroyo Del Valle Bridge (Widen) and Trail Bridge.

6.3 STORM DRAINAGE SYSTEM

To intercept and transmit storm water, new and realigned storm drains, and raising some existing drain inlets are planned as shown in Drainage Plan drawings in Appendix J.

Retaining wall drainage systems are typically separated from underdrain systems. 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 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. 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. Underdrain pipes should have a minimum diameter of 8 inches.

6.5 UTILITY CROSSINGS

6.5.1 General

Crossings for new and relocated underground utilities are planned on SR 84, Vineyard Avenue and Concannon Boulevard, including, relocation (by others) of an existing 24 inch PG&E gas line near Station 323+80. Horizontal directional drilling (HDD) and bore and jack methods are currently being considered for installation of new utilities where conventional open cut trenching is not practical.

We estimate that existing and new underground utilities subject to loading from new fills will, in general, undergo settlements of less than about ¼-inch. Settlement on order of about ¼ inch could also occur in the vicinity of the existing PG&E gas line along East Ruby Hill Drive; this settlement would be related to top down construction of the soil nail wall, RW246, rather than to placement of new fill. Provisions for monitoring of this utility during construction are included in Section 46 of the NSSP.

6.5.1.1 Discussion

Where open cut trenching is not practical at roadway crossings, the Contractor should submit a trenchless construction method plan based on anticipated soil and groundwater conditions, existing underground utilities and surface constraints along the alignment. Potential trenchless construction methods that could be considered include pipe ramming, pipe jacking, microtunneling, and HDD, 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 obstructions (such as gravel encountered in project borings) or improperly aligned pipes may cause significant deviations from the desired lines and grades.

Pipe Jacking

Pipe jacking is performed 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.

Microtunneling

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.

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.

Microtunneling machines can generally be divided into two categories: slurry machines and auger machines. In a slurry machine, soil excavated by the cutter head of the machine passes through slots or ports where it is mixed with slurry in a chamber at the front of the machine. The spoils-slurry mixture is pumped to the jacking pit through slurry discharge pipes, installed inside the jacking pipe string and discharged to a surface separation plant to remove spoils.

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 spoils into the chamber and compacting the spoils.

Horizontal Directional Drilling

Another trenchless construction method that is commonly used is 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 into the hole in a single operation. HDD is not generally feasible in soils having gravel content of more than about 50 percent, soils with cobbles and boulders, or in hard rock having unconfined compressive strength greater than about 12,000 psi.

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.

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 cutter heads that can be used to adapt these machines to a wide range of ground conditions, including sands and gravels, stiff clays, cobbles and boulders, and rock. For these reasons, we recommend that additional field exploration be performed near/at the proposed pipeline alignments to adequately characterize the subsurface conditions. 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

Based on the general site surface and subsurface conditions across the project segment, we offer the following comments:

- Pipe ramming is not advisable because significant deviations from desired line and grade may result. There is also a risk that the existing utilities could be damaged.
- HDD is not advisable because of the high gravel content of soils encountered in many of the borings.
- Either pipe jacking or microtunneling are likely feasible methods from a geotechnical point of view; cost may be a key consideration.

6.5.1.2 Jacking and Receiving Pits

Crossings will require construction of two access shafts (jacking and receiving) or pits to provide an area to mobilize equipment for trenchless operations, to remove spoils and install the pipelines. These access shafts should be located in accordance with applicable right-of-way requirements.

The design of the shoring systems 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.

6.5.1.3 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.

6.5.1.4 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.

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.

Unsuitable material encountered in the drainage between Station 240+00 and 246+00 on the west side of SR 84 should be overexcavated and replaced; 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 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 A-07-113 at about Station 300+54, CH ranging in depth from 3 to terminal depth of 10 feet bgs.
- At Boring A-07-114 at approximate Station 305+99, CH ranging in depth from 2½ to 4½ feet bgs.
- At Boring R-07-013 at approximate Station 320+87, CH ranging in depth from 20 to 24½ feet bgs.
- At Boring A-07-107 at about Station 270+16, MH ranging in depth from 8½ to 12 feet bgs.

In our opinion CH materials should not be reused as engineered fill due to their expansive nature, i.e. potential to shrink and swell with moisture changes. If used in embankments, CH soils will tend to slough where exposed. The in-situ moisture content of these soils is about 12 percent and is close to optimum moisture content. At A-07-107, the MH material is below a depth of 8½ feet and is likely to be left in place based on the proposed grading.

The explorations were completed during the relatively dry months of November and December 2007, and in January 2008, which was relatively 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, traveled way, shoulders, and into the hillsides. It appears the groundwater levels encountered in the borings 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 foundation excavations.

6.6.2 Gravel Mining Excavations

As discussed 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 SR 84.

Two slope stability studies (Shannon & Wilson, 1978; Geomatrix, 2004) were performed previously for side slopes that could result from 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 feet to more than 50 feet from the Caltrans right-of-way. These slope stability studies indicate a 1½:1(H:V) slope inclination would meet County permit requirements. However, we understand the current quarry permit approved a 2:1(H:V) side slope inclination. 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.

6.7 EMBANKMENT FILLS

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, "Earthwork."

Consistent with Caltrans standards, the proposed slope inclinations of new embankments throughout the project are 2:1(H:V), and 1½:1(H:V) 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."

Embankment fill 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 Standard Specifications and current Special Provisions.

The high R-value material excavated between "A1" Station 290+00 and 377+00 shall be placed as fill exclusively within 4 feet of the grading plane between Station 290+00 and 377+00 and along Vallecitos Road.

6.8 UNSUITABLE MATERIALS

Unsuitable materials should be removed in accordance with Caltrans Standard Specifications Section 16, "Clearing and Grubbing."

Unsuitable material was observed in an existing drainage ditch on the west side of SR 84 between "A1" Station 240+00 and 246+00. This unsuitable material shall be removed and hauled off site.

Expansive fat clay (CH) and elastic silt (MH) were encountered in borings identified in the following Table 6-1.

Table 6-1 Summary of Potentially Expansive Soil Locations

Boring	Boring Station (feet)	Estimated Depths of CH or MH Soils (feet)	Estimated Limits of CH or MH Materials Station (feet)	
			From	To
A-07-113	300+54	3-10	299+00	303+00
A-07-114	305+99	2½- 4½	303+00	308+00
R-07-013	320+87	20-24½	320+50	322+00
A-07-107	270+16	8½ -12	268+00	273+00

Excavated CH and MH soils should be hauled off site.

6.9 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.

Earthwork shall conform to the applicable portions of Section 19 of the Standard Specifications and to the current Special Provisions.

6.10 RETAINING WALLS

Six retaining walls are planned. Geotechnical recommendations for the two non-standard walls, RW245 and RW246, are summarized in a companion Foundation Report. Drawings and details for the four Caltrans' standard retaining walls are presented in Appendix L. Table 6-2 presents a summary of wall configurations of the four proposed standard walls.

Table 6-2 Summary of Wall Configurations

Wall ID	Station Limits	Length (feet)	Wall Height (feet)	Approximate Depth of Cut from Original Ground (feet)	Approximate Fill Height from Original Ground (feet)
236	"A1" 235+16 to 240+30	536	6 to 14	9 to 13	-
109	"V"109+05 to 112+30	321	6 to 14	-	1½ to 9
110	"V" 110+30 to 115+65	546	6 to 12	-	1½ to 9
317	"A1" 316+66 to 318+56	190	6 to 10	-	0 to 5½

Based on the project quantity estimates, we understand there could be excess material generated by the proposed cuts and fills. Therefore, we assume that any on-site soils which meet Caltrans' material requirements for fill will be used as embankment fill and wall backfill. Based on exploratory boring data at the proposed cut slopes, we expect that fills consisting of on-site materials will be primarily clayey sands, silty sands, clayey gravels and silty gravels, having an average as compacted moist unit weight of 130 pounds per cubic foot (pcf) and internal friction angle, ϕ', of at least 34 degrees. The resulting equivalent fluid pressure of the wall backfill based on these parameters would be equal to or less than 36 pounds per square foot per lineal foot of wall. Therefore, the standard plan Type 1 wall soil design parameters are applicable.

Table 6-3 below presents a summary of the gross uniform bearing stress for Caltrans' Standard Plan Type 1 and Type 5 walls, as applicable, for the maximum proposed wall heights. The factored gross nominal bearing resistance is also presented for each retaining wall based on bottom of footing elevation and subsurface conditions encountered in explorations.

Table 6-3 Bearing Capacity Analyses for Standard Retaining Walls

Wall No. (Wall Type)	Wall Design Height (ft)	Footing Width	Bottom of Footing Elevation (ft)	Strength Limit State		Extreme Event State	
				Factored Gross Nominal Bearing Resistance $\varphi b = 0.55$ (ksf)	Gross Uniform Bearing Stress[1] (ksf)	Factored Gross Nominal Bearing Resistance $\varphi b = 1.0$ (ksf)	Gross Uniform Bearing Stress[1] (ksf)
236 (Type 1)	14	9'-7"	557.62 to 563.32	5.0	3.8	9.0	5.3

109 (Type 1)	14	9’-7”	480.65 to 492.62	7.4	3.8	13.5	5.3
109 (Type 5)	12	10’-6”	480.99 to 481.16	7.4	4.0	13.5	4.8
110 (Type 1)	12	8’-4”	482.15 to 486.75	5.8	4.0	10.5	4.8
317 (Type 1)	10	7’-7”	413.38 to 417.63	3.9	3.3	7.0	3.4

1 Gross uniform bearing stress values are from 2010 Caltrans Standard Plans.

6.11 GEOTECHNICAL CALCULATIONS

Geotechnical engineering calculations for estimated settlement and bearing capacity for the standard retaining walls are presented in Appendix M.

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 in Pleasanton 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 new and existing bridge structures at Arroyo del Valle and Arroyo Mocho stream crossing 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. 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. 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. 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)
R-07-003 (5 to 6.5 feet)	A1	245+90.1	27.8 Lt	80.0	18" APC				18	3,302	7.5	<5	6
R-07-005 (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				
A-07-007 (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				
R-07-011 (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				
R-07-012 (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				
R-07-013 (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				
R-07-014 (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				
					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 the water pH is 8.3. The soluble chloride concentration is 63.7 mg/L and the soluble sulfate concentration 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 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. 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 American Concrete Institute (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 Version 6.08. The results are presented in V&A's Appendix 2 (Appendix O of this GDMR). Using soil boring sample data from sites in closest proximity to the new or modified drainage systems proposed along SR 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

All metallic soil reinforcement must be galvanized in accordance with requirements in California Department of Transportation Standard Specification 75-1.05.

Soil Borings R-07-003 at Station 246+00 and R-07-005 at Station 293+00 were used to evaluate site corrosivity at the Ruby Hill Drive/Vallecitos Road Retaining Wall:

- R-07-003 has a pH of 7.5 and a minimum resistivity of 3,302 ohm-cm
- R-07-005 has a pH of 8.4 and a minimum resistivity of 7,312 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).

Materials available for the project construction are summarized in Table 8-1.

9.1 TEMPORARY CONSTRUCTION EXCAVATION

We anticipate that excavation into the native soils for construction of the Arroyo Del Valle bridges and Caltrans' Standard Plan retaining wall foundations will result in temporary near vertical unsupported soil faces as high as about 15 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 the borings at Arroyo Del Valle, the soils are considered to be OSHA Type C. The alluvium encountered along the project alignment consists of complexly interbedded sand, silt and clay with gravel and extensive channel deposits of silty gravel, clayey gravel and poorly-graded sand and gravel mixtures. The stiff to hard clays would be considered Type A soils, while the silts, sands and gravels would be considered Type C soils.

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 those permitted above for the existing soil conditions are planned, shoring will be required. The Contractor should retain an experienced Registered Civil Engineer to design the shoring system.

9.2 CONSTRUCTION DEWATERING

Based on groundwater levels encountered in the borings, in our opinion, it is possible that groundwater could be encountered during excavation of pier caps and footings for the proposed bridge structures, depending upon the extent of overexcavation required. Since the subsurface soils encountered in the borings near the bottom of footing and pile cap elevations consist primarily of clays, clayey gravels and clayey sands, it is likely that dewatering of these excavations can be accomplished by sumping. A temporary cofferdam should be specified to divert creek flow around the excavations. The bottom of the footing and pile cap excavations should include a seal course with a minimum thickness of 2 feet. The actual thickness of the seal course should be based on water head at the bottom of excavation during construction.

Free groundwater was encountered within approximately 4 feet of bottom of footing elevation in the hillside boring located near RW 236; free groundwater was encountered at least 8 feet below bottom of footing elevation in borings near RW109, RW 110 and RW317. Since groundwater levels may vary considerably in the area with seasonal rainfall, it is possible that free

groundwater could be encountered in wall foundation excavations. Since the subsurface soils encountered in the borings near the bottom of footing elevations consist primarily of clays and clayey sands, it is likely that dewatering of these excavations can be accomplished by sumping.

9.3 EFFECTS OF CONSTRUCTION WORK ON ADJACENT STRUCTURES

Efforts should be made to minimize effects of construction work on adjacent structures and underground utilities. If excavations are located in close proximity to existing shallow foundations, underpinning could be required.

We recommend the Contractor perform a preconstruction survey of existing structures prior to any excavation and the Contractor monitor any existing structures for signs of movement during construction to confirm that existing structures are not adversely affected by construction operations.

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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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	363+50	Cut	Cut	**Northbound:** Cut most likely over estimated for these stations, see note 1.

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)
A-08-001	7-Mar-08	235+62.1	A1	Lt. 65.5	1																	6,580	9.9	123
A-08-001	7-Mar-08	235+62.1	A1	Lt. 65.5	10																		12.5	
A-08-002	7-Mar-08	240+01.8	A1	Lt. 64.4	2																	1,240	13.9	116
A-08-002	7-Mar-08	240+01.8	A1	Lt. 64.4	5														27	17	10		10.9	
A-08-002	7-Mar-08	240+01.8	A1	Lt. 64.4	10																	3,220	9.2	125
R-07-003	14-Dec-07	245+90.1	A1	Lt. 27.8	5																		6	123
R-07-003	14-Dec-07	245+90.1	A1	Lt. 27.8	15														31	21	10	7,140	17.9	114
R-07-003	14-Dec-07	245+90.1	A1	Lt. 27.8	20																	11,800	19.3	112
R-07-003	14-Dec-07	245+90.1	A1	Lt. 27.8	25																	11,340	18.5	113
R-07-003	14-Dec-07	245+90.1	A1	Lt. 27.8	30																	19,850	18.1	114
R-07-003	14-Dec-07	245+90.1	A1	Lt. 27.8	35																	16,120	16.1	117
R-07-003	14-Dec-07	245+90.1	A1	Lt. 27.8	65																	10,580	14.2	121
A-07-004	27-Nov-07	248+46.5	A1	Rt. 51.4	3.5														31	14	17	13,650	9.9	120
A-07-004	27-Nov-07	248+46.5	A1	Rt. 51.4	8.5																	5,970	16.3	113
A-07-004	27-Nov-07	248+46.5	A1	Rt. 51.4	13.5																	21,250	15.5	119
R-07-005	13-Dec-07	252+76.0	A1	Rt. 10.2	5																		4.4	124
R-07-005	13-Dec-07	252+76.0	A1	Rt. 10.2	20																	19,720	13.8	121
R-07-005	13-Dec-07	252+76.0	A1	Rt. 10.2	25																	14,220	15.3	118
R-07-005	13-Dec-07	252+76.0	A1	Rt. 10.2	30																	15,660	15.8	117
R-07-005	13-Dec-07	252+76.0	A1	Rt. 10.2	35																	12,750	19.9	110
R-07-005	13-Dec-07	252+76.0	A1	Rt. 10.2	40																	15,860	15.5	119
R-07-005	13-Dec-07	252+76.0	A1	Rt. 10.2	45																	15,880	15.8	116
R-07-005	13-Dec-07	252+76.0	A1	Rt. 10.2	50																	15,080	18.1	113
A-08-005	6-Mar-08	256+67	A1	Lt. 44.4	1																	3,560	11.9	113
A-08-005	6-Mar-08	256+67	A1	Lt. 44.4	10																	8,300	15.5	114
R-07-006	17-Dec-07	258+83.4	A1	Lt. 38	1																		6.2	132
R-07-006	17-Dec-07	258+83.4	A1	Lt. 38	5																		8.2	130
R-07-006	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
R-07-006	17-Dec-07	258+83.4	A1	Lt. 38	35																	7,380	10.7	127
R-07-006	17-Dec-07	258+83.4	A1	Lt. 38	40																	13,500	19.8	109
R-07-006	17-Dec-07	258+83.4	A1	Lt. 38	45																	14,910	15.4	118
R-07-006	17-Dec-07	258+83.4	A1	Lt. 38	50																	17,980	16.3	116
R-07-006	17-Dec-07	258+83.4	A1	Lt. 38	55																	22,170	15.8	117
R-07-006	17-Dec-07	258+83.4	A1	Lt. 38	60																		14.5	121
A-07-007	10-Dec-07	293+10.8	A1	Lt. 53.8	1																	8,780	7.4	126
A-07-007	10-Dec-07	293+10.8	A1	Lt. 53.8	3																	10,570	13	120
A-07-007	10-Dec-07	293+10.8	A1	Lt. 53.8	5																	10,590	14.9	118
A-07-007	10-Dec-07	293+10.8	A1	Lt. 53.8	8.5																	12,920	15.7	117
A-07-009	26-Nov-07	314+51.4	A1	Rt. 63.7	1														22	19	3		5.1	
R-07-011	2-Jan-08	318+45.8	A1	Rt. 111.8	5		100	98	89	84	62	46	29	19	15	13	12						14	118
R-07-011	2-Jan-08	318+45.8	A1	Rt. 111.8	25																		8.7	134
R-07-011	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)
R-07-013	18-Dec-07	320+87.3	A1	Rt. 15.7	5																		4.6	143
R-07-013	18-Dec-07	320+87.3	A1	Rt. 15.7	15	100	94	94	83	77	57	42	31	23	18	15	13						12	
R-07-013	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
R-07-013	18-Dec-07	320+87.3	A1	Rt. 15.7	65																		11.2	135
R-07-014	18-Jan-08	320+72.1	A1	Rt. 65.7	1														21	20	1		8.8	122
R-07-014	18-Jan-08	320+72.1	A1	Rt. 65.7	10			96	83	75	56	44	34	26	21	16	14						4.8	
R-07-014	18-Jan-08	320+72.1	A1	Rt. 65.7	15														33	21	12	1,680	27	99
R-07-014	18-Jan-08	320+72.1	A1	Rt. 65.7	30																		9.5	133
R-07-014	18-Jan-08	320+72.1	A1	Rt. 65.7	40																		7.9	143
R-07-014	18-Jan-08	320+72.1	A1	Rt. 65.7	58.5																		12.5	126
A-07-017	26-Nov-07	354+11.8	A1	Rt. 51.5	8.5		77	72	65	62	54	46	40	34	28	20	15							
A-07-018	26-Nov-07	359+40.0	A1	Rt. 51.3	1																		9.4	124
A-08-030	9-Dec-08	51+26.5	VEX	Rt. 34	3.5													15					5.8	123
A-08-030	9-Dec-08	51+26.5	VEX	Rt. 34	5														21	16	5		9.5	127
A-08-030	9-Dec-08	51+26.5	VEX	Rt. 34	8.5																	14,540	17.2	116
A-08-030	9-Dec-08	51+26.5	VEX	Rt. 34	13.5																		8.3	
A-08-030	9-Dec-08	51+26.5	VEX	Rt. 34	18.5																		21.3	
A-08-030	9-Dec-08	51+26.5	VEX	Rt. 34	23.5																		10.7	127
A-08-030	9-Dec-08	51+26.5	VEX	Rt. 34	28.5																		12.9	121
A-08-030	9-Dec-08	51+26.5	VEX	Rt. 34	33.5																		10.5	
A-08-030	9-Dec-08	51+26.5	VEX	Rt. 34	38.5																		19.3	
A-08-030	9-Dec-08	51+26.5	VEX	Rt. 34	43.5																	16,900	13.6	122
A-08-030	9-Dec-08	51+26.5	VEX	Rt. 34	48.5																	14,510	16.8	117
A-08-031	9-Dec-08	54+34.8	VEX	Rt. 45.4	1																		4.1	
A-08-031	9-Dec-08	54+34.8	VEX	Rt. 45.4	3.5																		6.4	115
A-08-031	9-Dec-08	54+34.8	VEX	Rt. 45.4	5																		8.2	123
A-08-031	9-Dec-08	54+34.8	VEX	Rt. 45.4	8.5																		5.1	125
A-08-031	9-Dec-08	54+34.8	VEX	Rt. 45.4	13.5																		18.7	111
A-08-031	9-Dec-08	54+34.8	VEX	Rt. 45.4	18.5																		7.4	110
A-08-031	9-Dec-08	54+34.8	VEX	Rt. 45.4	23.5																		11	
A-08-031	9-Dec-08	54+34.8	VEX	Rt. 45.4	27.5																		11	
A-08-031	9-Dec-08	54+34.8	VEX	Rt. 45.4	33.5																		13.8	
A-08-031	9-Dec-08	54+34.8	VEX	Rt. 45.4	38.5																		11.5	
A-08-031	9-Dec-08	54+34.8	VEX	Rt. 45.4	48.5																	9,660	20.5	110
A-08-032	5-Jan-09	103+77	V1	Rt. 21.3	3.5																		7.2	
A-08-032	5-Jan-09	103+77	V1	Rt. 21.3	8.5																		8.6	
A-08-032	5-Jan-09	103+77	V1	Rt. 21.3	18.5														31	20	11		20.8	
A-08-032	5-Jan-09	103+77	V1	Rt. 21.3	23.5																	9,390	23.8	106
A-08-032	5-Jan-09	103+77	V1	Rt. 21.3	28.5																	10,940	15.1	119
A-08-032	5-Jan-09	103+77	V1	Rt. 21.3	33.5																		18	109
A-08-032	5-Jan-09	103+77	V1	Rt. 21.3	38.5																	2,920	20.1	109
A-08-032	5-Jan-09	103+77	V1	Rt. 21.3	43.5																	3,930	20.3	108

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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)
A-08-032	5-Jan-09	103+77	V1	Rt. 21.3	49.5																	3,290	31.1	90
A-08-033	10-Dec-08	107+16.6	V1	Rt. 68.2	5														23	17	6		4.9	
A-08-033	10-Dec-08	107+16.6	V1	Rt. 68.2	8.5																		4.9	
A-08-033	10-Dec-08	107+16.6	V1	Rt. 68.2	13.5				100	99	99	97	95	93	89	76	60						10.1	
A-08-033	10-Dec-08	107+16.6	V1	Rt. 68.2	18.5																		9.6	
A-08-033	10-Dec-08	107+16.6	V1	Rt. 68.2	23.5																		13.4	
A-08-033	10-Dec-08	107+16.6	V1	Rt. 68.2	28.5																		20.5	
A-08-034	10-Dec-08	108+22.3	V1	Rt. 41.2	1																		6	
A-08-034	10-Dec-08	108+22.3	V1	Rt. 41.2	3.5																		10.9	
A-08-034	10-Dec-08	108+22.3	V1	Rt. 41.2	5														29	15	14		10.3	125
A-08-034	10-Dec-08	108+22.3	V1	Rt. 41.2	8.5																		9.7	111
A-08-034	10-Dec-08	108+22.3	V1	Rt. 41.2	18.5																		7.2	131
A-08-034	10-Dec-08	108+22.3	V1	Rt. 41.2	23.5																	14,900	15.3	119
A-08-034	10-Dec-08	108+22.3	V1	Rt. 41.2	28.5																	19,600	16.5	117
A-08-034	10-Dec-08	108+22.3	V1	Rt. 41.2	33.5																	13,150	15.7	120
A-08-035	6-Jan-09	111+44.2	V1	Lt. 12.6	2.5																		7.4	116
A-08-035	6-Jan-09	111+44.2	V1	Lt. 12.6	8.5		88	87	82	78	70	64	59	55	48	37	27						4.9	
A-08-035	6-Jan-09	111+44.2	V1	Lt. 12.6	13.5														25	15	10		17.5	117
A-08-035	6-Jan-09	111+44.2	V1	Lt. 12.6	23.5																		8.9	134
A-08-035	6-Jan-09	111+44.2	V1	Lt. 12.6	28.5																		9.1	129
A-08-035	6-Jan-09	111+44.2	V1	Lt. 12.6	33.5																	10,250	13.9	121
A-08-035	6-Jan-09	111+44.2	V1	Lt. 12.6	38.5																		11.2	127
A-08-035	6-Jan-09	111+44.2	V1	Lt. 12.6	43.5																		12	124
A-08-036	5-Jan-09	116+12	V1	Lt. 13.7	3.5													58					4.9	
A-08-036	5-Jan-09	116+12	V1	Lt. 13.7	8.5																		7.5	
A-08-036	5-Jan-09	116+12	V1	Lt. 13.7	18.5																		17.3	
A-08-036	5-Jan-09	116+12	V1	Lt. 13.7	23.5																	9,310	13.1	122
A-08-036	5-Jan-09	116+12	V1	Lt. 13.7	28.5																	8,490	15.9	120
A-08-036	5-Jan-09	116+12	V1	Lt. 13.7	33.5																	12,470	18.1	116
A-08-036	5-Jan-09	116+12	V1	Lt. 13.7	38.5																	18,670	12.8	126
A-08-036	5-Jan-09	116+12	V1	Lt. 13.7	43.5																		14.3	124
A-08-036	5-Jan-09	116+12	V1	Lt. 13.7	48.5																		13.2	127
R-08-037	12-Dec-08	319+95.6	A1	Rt. 23.1	5																	1,900	23	104
R-08-037	12-Dec-08	319+95.6	A1	Rt. 23.1	20																		8.3	133
R-08-037	12-Dec-08	319+95.6	A1	Rt. 23.1	25																		9.7	124
R-08-037	12-Dec-08	319+95.6	A1	Rt. 23.1	30		93	84	80	75	60	46	34	25	19	15	12						11.8	
R-08-037	12-Dec-08	319+95.6	A1	Rt. 23.1	35																		8.4	133
R-08-037	12-Dec-08	319+95.6	A1	Rt. 23.1	45														NP	NP	NP		26.6	
R-08-037	12-Dec-08	319+95.6	A1	Rt. 23.1	50																		11	125
R-08-037	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
R-08-038	11-Dec-08	320+02	A1	Lt. 64.5	15																		9.3	130
R-08-038	11-Dec-08	320+02	A1	Lt. 64.5	25																		4.3	136

TABLE 3-1
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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)
R-08-038	11-Dec-08	320+02	A1	Lt. 64.5	40			95	87	76	58	42	31	24	19	15	13						12.3	
R-08-038	11-Dec-08	320+02	A1	Lt. 64.5	65		93	81	75	68	57	47	38	31	25	21	18						9.4	133
A-07-101	4-Dec-07	230+68.3	A1	Lt. 5.6	1											71	56		37	16	21	7,750	14.4	119
A-07-101	4-Dec-07	230+68.3	A1	Lt. 5.6	3													1					12.6	121
A-07-101	4-Dec-07	230+68.3	A1	Lt. 5.6	5																		12.1	127
A-07-101	7-Mar-08	230+70	A1	Rt. 62	1.5													3						
A-07-102	4-Dec-07	238+09.6	A1	Rt. 75.9	5														30	16	14	1,340	12.5	124
A-07-103	27-Nov-07	243+42.4	A1	Rt. 27.6	1																	4,210	10.9	116
A-07-103	27-Nov-07	243+42.4	A1	Rt. 27.6	3.5													65					6.8	120
A-07-104	10-Dec-07	253+70.5	A1	Rt. 68	1																			
A-07-105	19-Nov-07	260+11.3	A1	Rt. 4.1	1													69	21	16	5	2,700	7.1	121
A-07-105	19-Nov-07	260+11.3	A1	Rt. 4.1	3																	8,840	10.1	114
A-07-105	19-Nov-07	260+11.3	A1	Rt. 4.1	5																		9.2	122
A-07-105	19-Nov-07	260+11.3	A1	Rt. 4.1	8.5																		8.5	123
A-07-106	19-Nov-07	264+70	A1	Rt. 5	8.5																	6,930	14	117
A-07-107	19-Nov-07	270+16.4	A1	Lt. 7.8	1													11						
A-07-107	19-Nov-07	270+16.4	A1	Lt. 7.8	8.5														17	16	1	1,620	12.1	115
A-07-107	19-Nov-07	270+16.4	A1	Lt. 7.8	12																	10,070	15.5	116
A-07-108	27-Nov-07	278+11.0	A1	Lt. 33.1	3.5																	2,180	9.9	125
A-07-108	27-Nov-07	278+11.0	A1	Lt. 33.1	8.5																		11.3	123
A-07-108	27-Nov-07	278+11.0	A1	Lt. 33.1	13.5													45					1.4	
A-07-109	27-Nov-07	280+36.2	A1	Lt. 33	1																	4,940	7.8	126
A-07-109	27-Nov-07	280+36.2	A1	Lt. 33	3.5																		7.2	124
A-07-109	27-Nov-07	280+36.2	A1	Lt. 33	8.5																		23.9	108
A-07-109	27-Nov-07	280+36.2	A1	Lt. 33	13.5																	2,390	13.4	112
A-07-110	19-Nov-07	284+94.3	A1	Lt. 3.2	1																			
A-07-110	19-Nov-07	284+94.3	A1	Lt. 3.2	3														32	17	15		16.2	
A-07-110	19-Nov-07	284+94.3	A1	Lt. 3.2	5																	8,200	15.3	117
A-07-110	19-Nov-07	284+94.3	A1	Lt. 3.2	8.5																		6.8	116
A-07-111	19-Nov-07	289+94.0	A1	Lt. 6.1	1																			
A-07-111	19-Nov-07	289+94.0	A1	Lt. 6.1	5																		15.1	116
A-07-111	19-Nov-07	289+94.0	A1	Lt. 6.1	10																		14.8	
A-07-112	20-Nov-07	295+52.0	A1	Lt. 32.7	1													12					8.2	
A-07-112	20-Nov-07	295+52.0	A1	Lt. 32.7	8.5																	4,970	11.2	124
A-07-113	19-Nov-07	300+54.3	A1	Lt. 10.1	3														26	18	8		12.2	122
A-07-113	19-Nov-07	300+54.3	A1	Lt. 10.1	5														43	20	23	4,430	22	104
A-07-113	19-Nov-07	300+54.3	A1	Lt. 10.1	8.5													31				3,520	15.2	113
A-07-114	19-Nov-07	305+98.7	A1	Rt. 10.8	1																			
A-07-114	19-Nov-07	305+98.7	A1	Rt. 10.8	3																		11.8	114
A-07-115	10-Dec-07	312+65.8	A1	Lt. 3	1													31					12.1	
A-07-116	10-Dec-07	324+38.9	A1	Lt. 30	1																			

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						%<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)
A-07-116	10-Dec-07	324+38.9	A1	Lt. 30	5																		12.3	125
A-07-117	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	
A-07-118	5-Dec-07	332+96.7	A1	Lt. 31.1	1																			
A-07-118	5-Dec-07	332+96.7	A1	Lt. 31.1	8.5													35					7.5	
A-07-119	3-Dec-07	341+68.3	A1	Lt. 11.3	8.5																		20.8	102
A-07-120	5-Dec-07	358+99.5	A1	Rt. 11.9	1																		19.9	97
A-07-121	19-Nov-07	356+49.4	A1	Lt. 11.8	1													51						
A-07-123	10-Dec-07	364+94.7	A1	Rt. 49.5	1																		20.8	99
A-07-123	10-Dec-07	364+94.7	A1	Rt. 49.5	3																		14.4	120
A-07-123	10-Dec-07	364+94.7	A1	Rt. 49.5	5																		13.3	124
A-07-123	10-Dec-07	364+94.7	A1	Rt. 49.5	8.5													59					3.5	131
A-07-124	20-Nov-07	369+58.3	A1	Lt. 49.2	1																		9.8	130
A-07-124	20-Nov-07	369+58.3	A1	Lt. 49.2	3																	2,010	6.1	124
A-07-124	20-Nov-07	369+58.3	A1	Lt. 49.2	8.5																	3,870	11	121
A-07-125	20-Nov-07	374+38.4	A1	Rt. 9.5	1													29						
A-07-125	20-Nov-07	374+38.4	A1	Rt. 9.5	3																		7.3	125
A-08-141	6-Jan-09	230+16.7	A1	Rt. 6.8	2														30	15	15		13.4	
A-08-141	6-Jan-09	230+16.7	A1	Rt. 6.8	1 to 5													5						
A-08-142	6-Jan-09	237+41	A1	Rt. 30.5	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

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7	1	814

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 0.6 MILE NORTH OF CONCANNON BOULEVARD

TO BE SUPPLEMENTED BY STANDARD PLANS DATED 2010

INDEX OF PLANS

SHEET No.	
1	TITLE
2-17	TYPICAL CROSS SECTIONS
18	KEY MAP AND LINE INDEX
19-23	PROJECT CONTROL AND MONUMENTATION
24-37	LAYOUT
38-40	PROFILE
41-55	PROFILE AND SUPERELEVATION DIAGRAM
56-129	CONSTRUCTION DETAILS
130-144	TEMPORARY WATER POLLUTION CONTROL AND QUANTITIES
145-158	CONTOUR GRADING
159-278	DRAINAGE PLAN, PROFILES, DETAILS AND QUANTITIES
279-293	SUBSURFACE DRAIN PLAN, DETAILS AND QUANTITIES
294-310	SANITARY SEWER PLAN, PROFILES, DETAILS AND QUANTITIES
311-356	UTILITY PLAN AND DETAILS
357-362	CONSTRUCTION AREA SIGNS
363-428	STAGE CONSTRUCTION AND DETAILS
429-432	STAGE CONSTRUCTION AND TRAFFIC HANDLING QUANTITIES
433-461	PAVEMENT DELINEATION PLAN, DETAILS AND QUANTITIES
462-492	SIGN PLAN, DETAILS AND QUANTITIES
493-499	SUMMARY OF QUANTITIES
500-520	RETAINING WALL PLANS
521-529	PLANT AND TREE REMOVAL PLAN
530-545	IRRIGATION SPRINKLER SCHEDULE, REMOVAL PLAN, DETAILS AND QUANTITIES
546-554	PLANT LIST, PLATING PLAN, DETAILS AND QUANTITIES
555-571	EROSION CONTROL LEGEND, PLAN, DETAILS AND QUANTITIES
572-642	ELECTRICAL NOTES, ABBREVIATIONS, LEGEND AND INDEX
643-742	RSP

STRUCTURE PLANS

743-762	ARROYO DEL VALLE BRIDGE (WIDEN)
763-781	ARROYO DEL VALLE TRAIL BRIDGE
782-794	RETAINING WALL 245
795-814	RETAINING WALL 246

THE STANDARD PLANS LIST APPLICABLE TO THIS CONTRACT IS INCLUDED IN THE NOTICE TO BIDDERS AND SPECIAL PROVISIONS BOOK

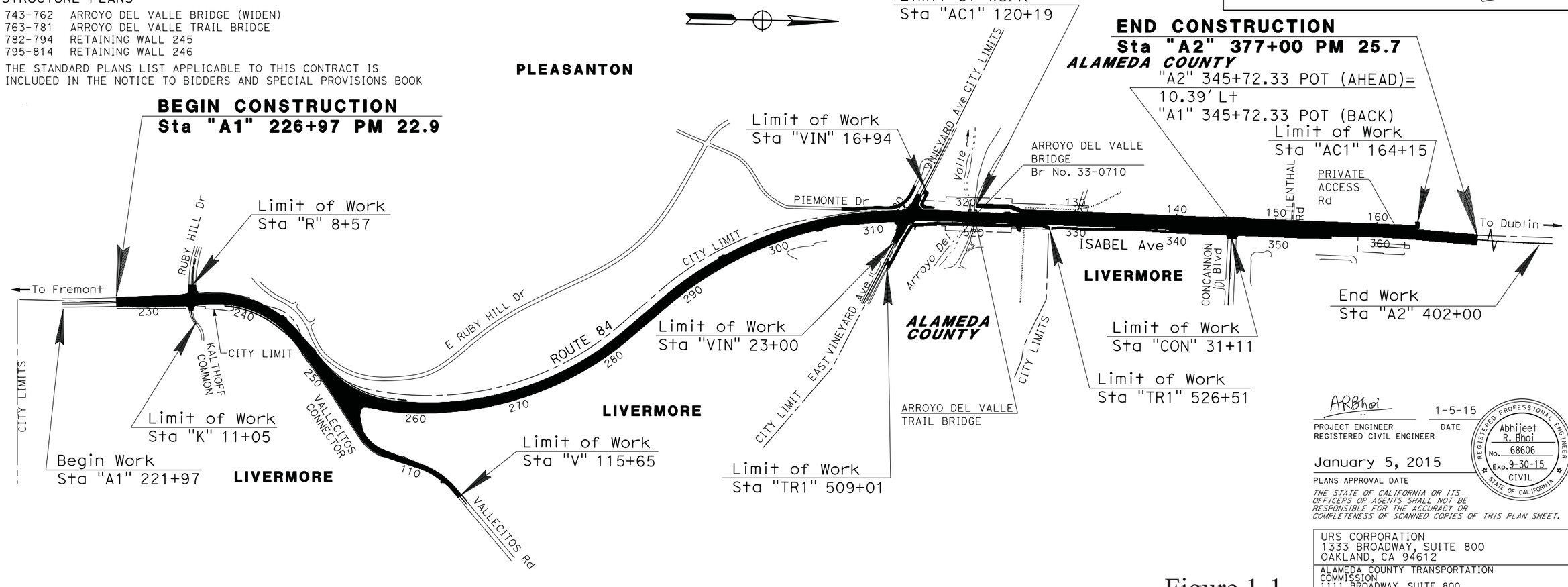

Figure 1-1

ARBhoi
PROJECT ENGINEER
REGISTERED CIVIL ENGINEER

1-5-15
DATE

REGISTERED PROFESSIONAL ENGINEER
Abhijeet R. Bhoi
No. 68606
Exp. 9-30-15
CIVIL
STATE OF CALIFORNIA

January 5, 2015
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 COMMISSION
1111 BROADWAY, SUITE 800
OAKLAND, CA 94607

CONTRACT No.	04-297624
PROJECT ID	04000205811

LAST REVISION 12-30-14
DATE PLOTTED => 09-JAN-2015
TIME PLOTTED => 11:44

THE CONTRACTOR SHALL POSSESS THE CLASS (OR CLASSES) OF LICENSE AS SPECIFIED IN THE "NOTICE TO BIDDERS."

NO SCALE

APPROVED AS TO IMPACT ON STATE FACILITIES AND CONFORMANCE WITH APPLICABLE STATE STANDARDS AND PRACTICES AND THAT TECHNICAL OVERSIGHT WAS PERFORMED.

CONSULTANT DESIGN MANAGER: RAMSEY J. HISSEN
CALTRANS DESIGN OVERSIGHT APPROVAL: NESTOR P. PEREZ
REGISTRATION No.: 39838
LICENSE Exp DATE: 12-31-15
DATE SIGNED:

BORDER LAST REVISED 10/4/2013 | CALTRANS WEB SITE IS: HTTP//WWW.DOT.CA.GOV/ | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | USERNAME => Shruti_Shah | DGN FILE => 0400020581ab001.dgn | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

05/30/14
REGISTERED CIVIL ENGINEER DATE

Anthony E. Silva No. 75053 Exp. 12-31-13 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 COMMISSION
1111 Broadway, Suite 800
Oakland, CA 94607

INDEX TO PLANS

SHEET No.	TITLE
R-1	RETAINING WALL KEY MAP - GENERAL PLAN
R-2	RETAINING WALL No. 236 - RETAINING WALL PLAN No. 1 OF 2
R-3	RETAINING WALL No. 236 - RETAINING WALL PLAN No. 2 OF 2
R-4	RETAINING WALL No. 317 - RETAINING WALL PLAN No. 1 OF 1
R-5	RETAINING WALL No. 109 - RETAINING WALL PLAN No. 1 OF 1
R-6	RETAINING WALL No. 110 - RETAINING WALL PLAN No. 1 OF 2
R-7	RETAINING WALL No. 110 - RETAINING WALL PLAN No. 2 OF 2
R-8	RETAINING WALL DETAILS
R-9	RETAINING WALL DETAILS
R-10	RETAINING WALL AESTHETICS - RETAINING WALL PLAN No. 246
R-11	RETAINING WALL AESTHETICS - RETAINING WALL PLAN No. 246
R-12	RETAINING WALL DETAILS - RETAINING WALL AESTHETICS
R-13	RETAINING WALL DETAILS - RETAINING WALL AESTHETICS
R-14	RETAINING WALL DETAILS - RETAINING WALL AESTHETICS
R-15	RETAINING WALL AESTHETICS - RETAINING WALL PLAN No. 236
R-16	RETAINING WALL DETAILS - RETAINING WALL AESTHETICS
R-17	RETAINING WALL DETAILS - RETAINING WALL AESTHETICS

LEGEND

B0-3 / 3-1	STANDARD PLAN SHEET No. STANDARD PLAN DETAIL No.
R-13	Ret WALL PLAN SHEET No.
TCE	TEMPORARY CONSTRUCTION EASEMENT
ESA	ENVIRONMENTALLY SENSITIVE AREA
TFESA	TEMPORARY FENCE ENVIRONMENTALLY SENSITIVE AREA

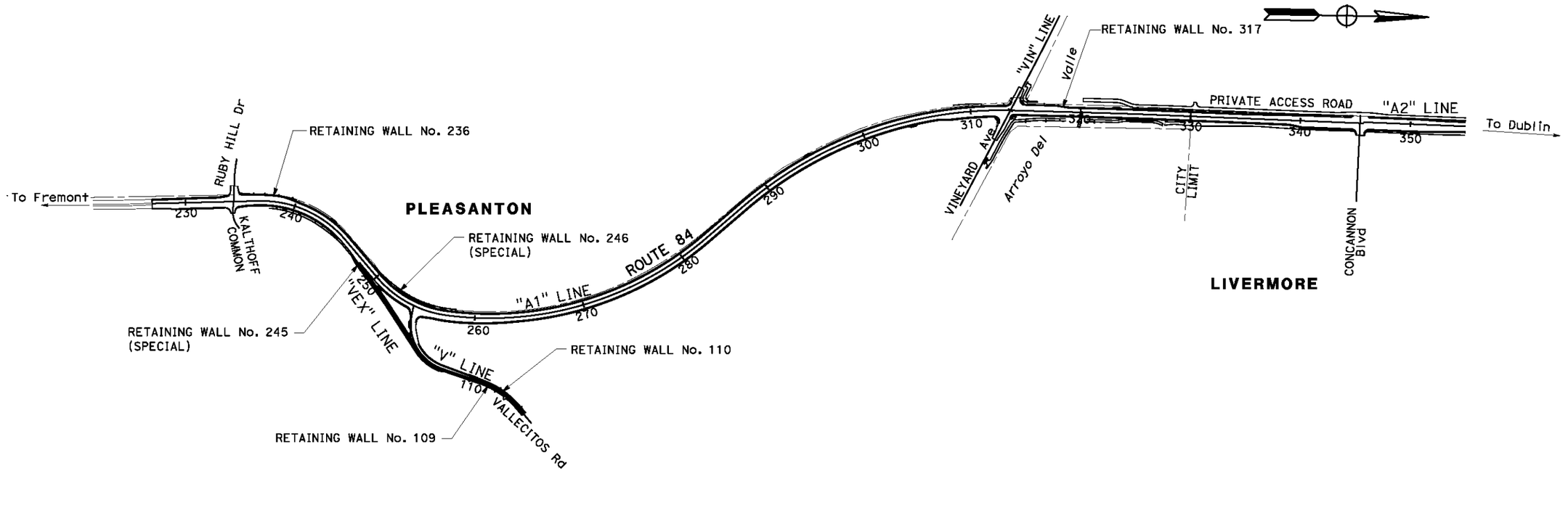

Figure 1-2

RETAINING WALL KEY MAP GENERAL PLAN

SCALE: 1" = 500'

R-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
CALCULATED-DESIGNED BY: ANTHONY SILVA
CHECKED BY: ELIE ABI-JAOUDE
REVISED BY: AS
DATE REVISED: 5/30/14

LAST REVISION 5-30-14
DATE PLOTTED => 01-JUL-2014
TIME PLOTTED => 11:38

BORDER LAST REVISED 7/2/2010
USERNAME => Kevin_Kramer
DGN FILE => 429760qa001.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		

Sean Fu. 05/29/14
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER — XIANGYANG FU — No. C 72514 — Exp. 06/30/16 — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 BROADWAY, SUITE 300
OAKLAND, CA 94612

MCE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831

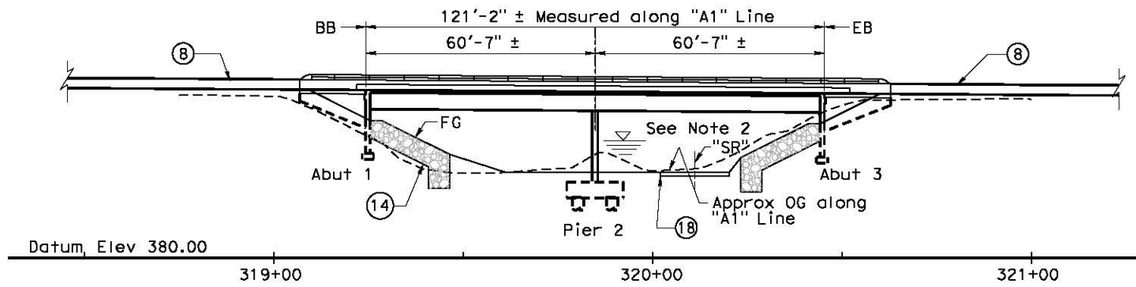
EVC, Sta 319+00.00
Elev 424.17

-0.50%

BVC, Sta 320+99.85
Elev 423.18

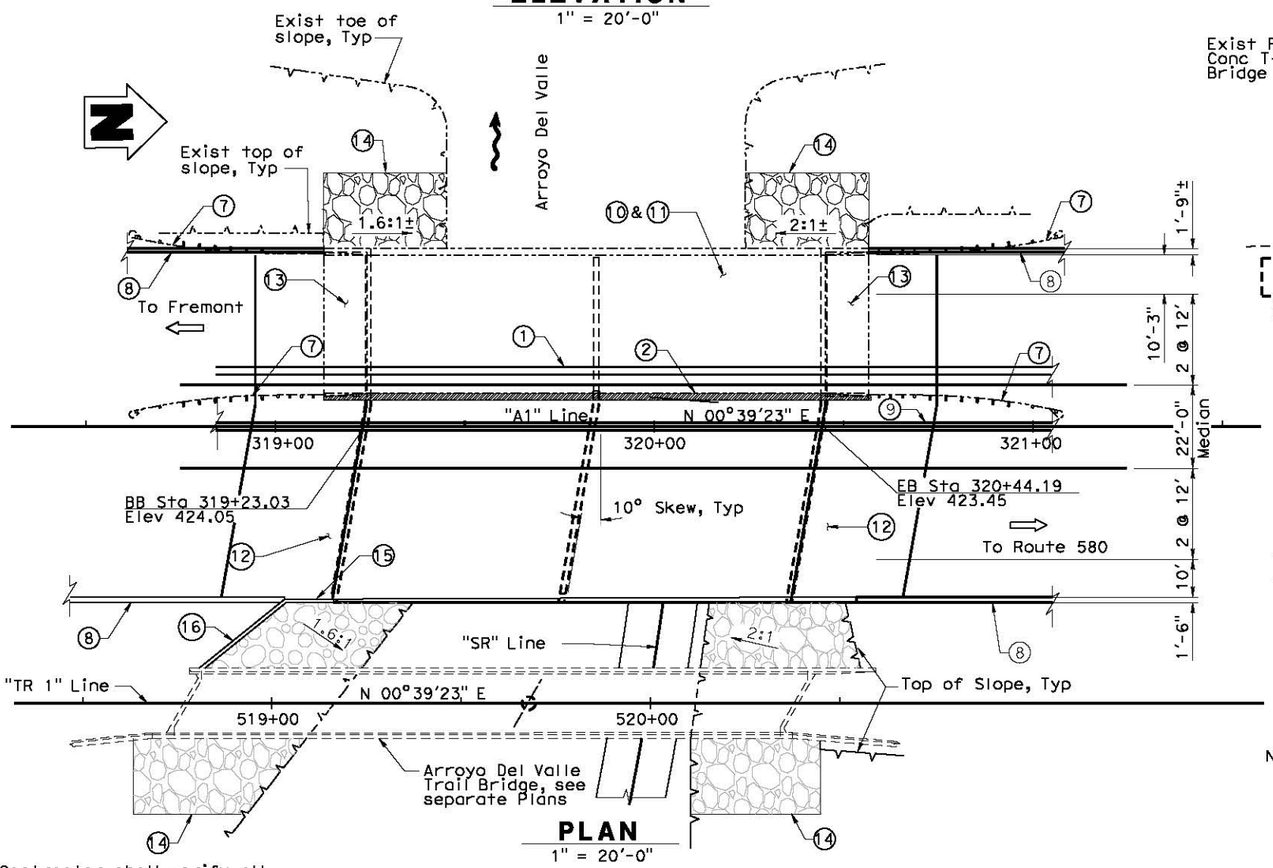
PROFILE GRADE

No Scale



ELEVATION

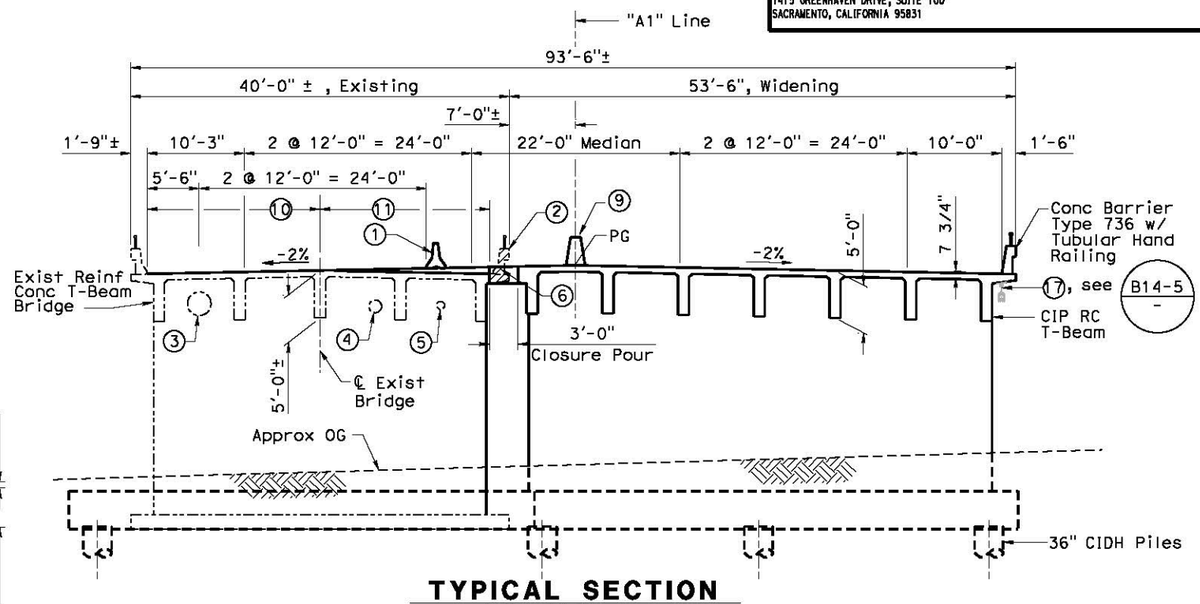
1" = 20'-0"



PLAN

1" = 20'-0"

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.



TYPICAL SECTION

1/8" = 1'-0"

LEGEND

- Indicates Exist Structure
- Indicates New Construction
- Indicates Direction of Travel
- Indicates Direction of Flow
- Indicates Concrete Removal

Notes:

1. For General Notes and Index to Plans, see "INDEX TO PLANS".
2. For Pile Data Table, Spread Footing Data Table and Hydrologic Summary, see "FOUNDATION PLAN" sheet.

(18) "SR" road, see "Road Plans"

NOTES:

(1) Temporary Railing (Type K), see "Road Plans"
(2) Remove Existing Barrier, Railing & Overhang
(3) Existing 30" ∅ Steel Casing to remain
(4) Existing 16"∅ D.I.P. Sewer Line to be relocated by others
(5) Existing 12"∅ Water Line to remain
(6) Existing 2 - 3"∅ Conduits to be relocated by others
(7) Existing Metal Beam Guard Rail to be removed , see "Road Plan"
(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 (30D)
(13) Remove Exist Approach Slab and replace with Structure Approach, Type R (30D)
(14) Rock Slope Protection (1-Ton, Method B)
(15) Paint "Bridge No. 33-0710" & "Arroyo Del Valle Bridge"
(16) Retaining Wall, Type 1
(17) 2" Supply Line (Bridge)

DESIGN OVERSIGHT	DESIGN	BY S. Fu	CHECKED D. Wang	LOAD & RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 W/"LOW-BOY"; AND PERMIT DESIGN VEHICLE		
SIGN OFF DATE	DETAILS	BY K. Wang	CHECKED D. Wang	LAYOUT	BY S. Fu	CHECKED D. Wang	
	QUANTITIES	BY W. Sennett	CHECKED R. Huang	SPECIFICATIONS	BY R. E. Sennett	PLANS AND SPECS COMPARED S. Fu	

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 06-01-09)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

PREPARED FOR THE STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

Xiangyang Fu
PROJECT ENGINEER

CU 0733
EA 297621

BRIDGE NO. 33-0710
POST MILES 24.8

ARROYO DEL VALLE BRIDGE (WIDEN)
GENERAL PLAN

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 07/07/08 | 08/07/08 | 09/07/08 | 10/14/08 | 12/16/08 | 05/07/09 | 01/27/10 | 08/16/10 | 10/27/10 | 05/29/14

SHEET 1 OF 21

FILE => P:\397 Route 84 Widenings\Segment B PS&E\Arroyo Del Valle Widen\CADD\33-0710-a-gp01.dgn

USERNAME => Kai
DATE PLOTTED => 6/2/2014
TIME PLOTTED => 9:53:42 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84	25.5/27.1		

Sean Fu. 05/29/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — XIANGYANG FU — No. C 72514 — Exp. 06/30/16 — CIVIL — STATE OF CALIFORNIA

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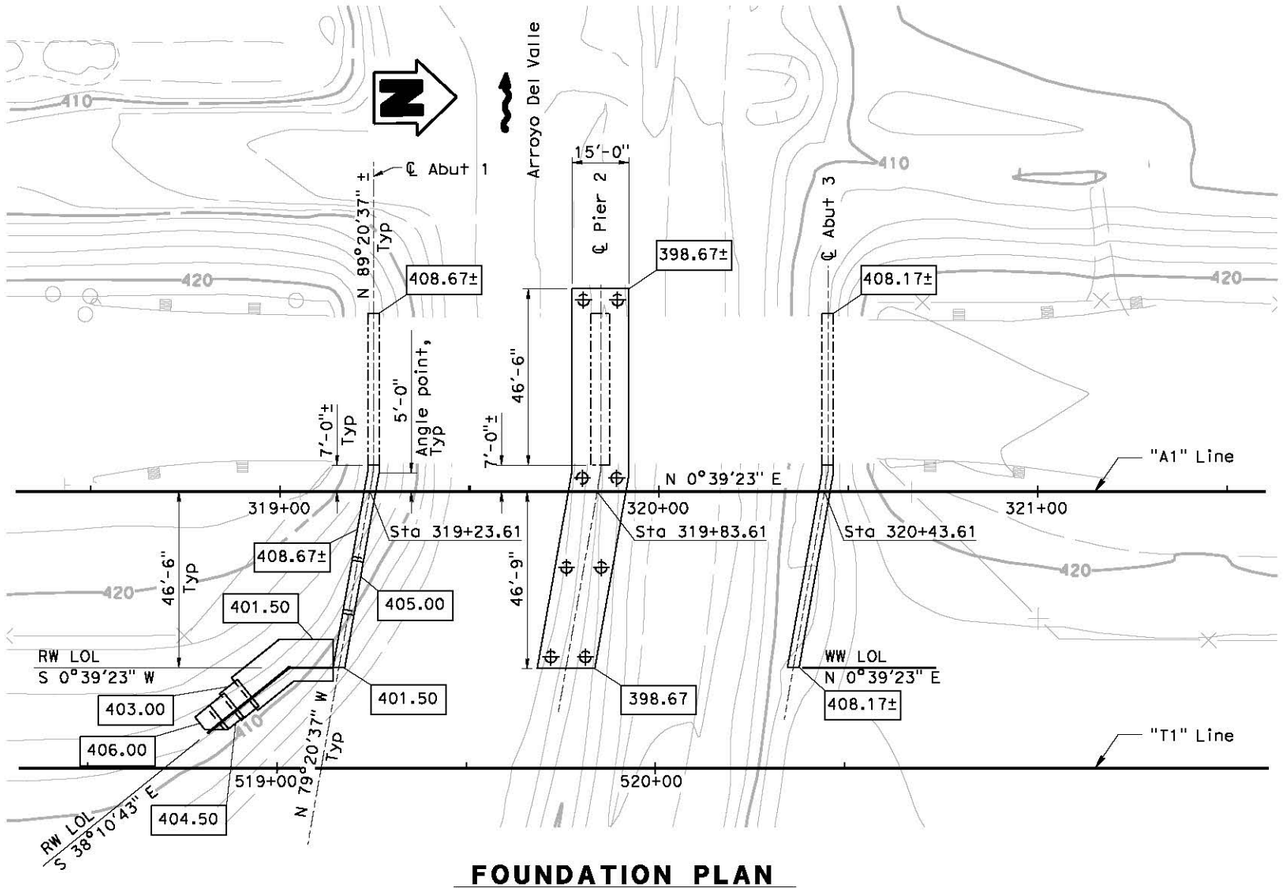
ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 BROADWAY, SUITE 300
OAKLAND, CA 94612

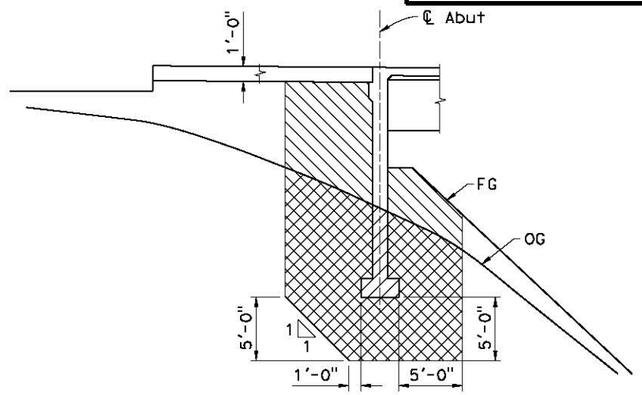
MCE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831



FOUNDATION PLAN
1" = 20'-0"

LEGEND

- Indicates Existing Structure
- Indicates New Construction
- Indicates Direction of Flow
- XXX.xx — Indicates Bottom of Footing Elevation
- Indicates 36" CIDH Piles
- Indicates structure excavation (Bridge)
- Indicates structure backfill (Bridge)



LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL (BRIDGE)
No Scale

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 1	9.00	6.00	N/A	N/A	N/A
Abut 3	7.50	6.00	N/A	N/A	N/A

HYDROLOGIC SUMMARY

Drainage Area: 160 square miles

	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.

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

BENCHMARK DATA

B-31 - MONUMENT GTS205 MONUMENT IS A SET ⅝" 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 ⅝" 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

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.

Stephen Huang — GEOTECHNICAL PROFESSIONAL — APPROVAL DATE 08/18/2010

DESIGN OVERSIGHT	SCALE: 1"=20'-0"	VERT.DATUM NAVD88	HORZ.DATUM NAD83	DESIGN	BY S. Fu	CHECKED D. Wang	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Xiangyang Fu PROJECT ENGINEER	BRIDGE NO. 33-0710
	PHOTOGRAMMETRY AS OF: 11/10/2005	ALIGNMENT TIES		DETAILS	BY K. Wang	CHECKED D. Wang			POST MILE 24.8
SIGN OFF DATE	SURVEYED BY Dan Scott	DRAFTED BY Abhijeet Bhoi		QUANTITIES	BY W. Sennett	CHECKED R. Huang		CU 0733 EA 297621	
	FIELD CHECKED BY Dan Scott	CHECKED BY							

ARROYO DEL VALLE BRIDGE (WIDEN)
FOUNDATION PLAN

FOUNDATION PLAN SHEET (ENGLISH) (REV. 06-01-09)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 05/28/08 | 06/27/08 | 09/26/08 | 10/24/08 | 12/24/08 | 05/28/09 | 01/24/10 | 05/28/10 | 10/27/10 | 05/25/14

SHEET 3 OF 21

FILE => P:\397 Route 84 Widenings\Segment B PS&E\Arroyo Del Valle Widen\CADD\33-0710-e-fpl.dgn

USERNAME => Kai

DATE PLOTTED => 5/25/2014 TIME PLOTTED => 11:03:40 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Sean Fu. 05/27/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

XIANGYANG FU No. C 72514 Exp. 06/30/16 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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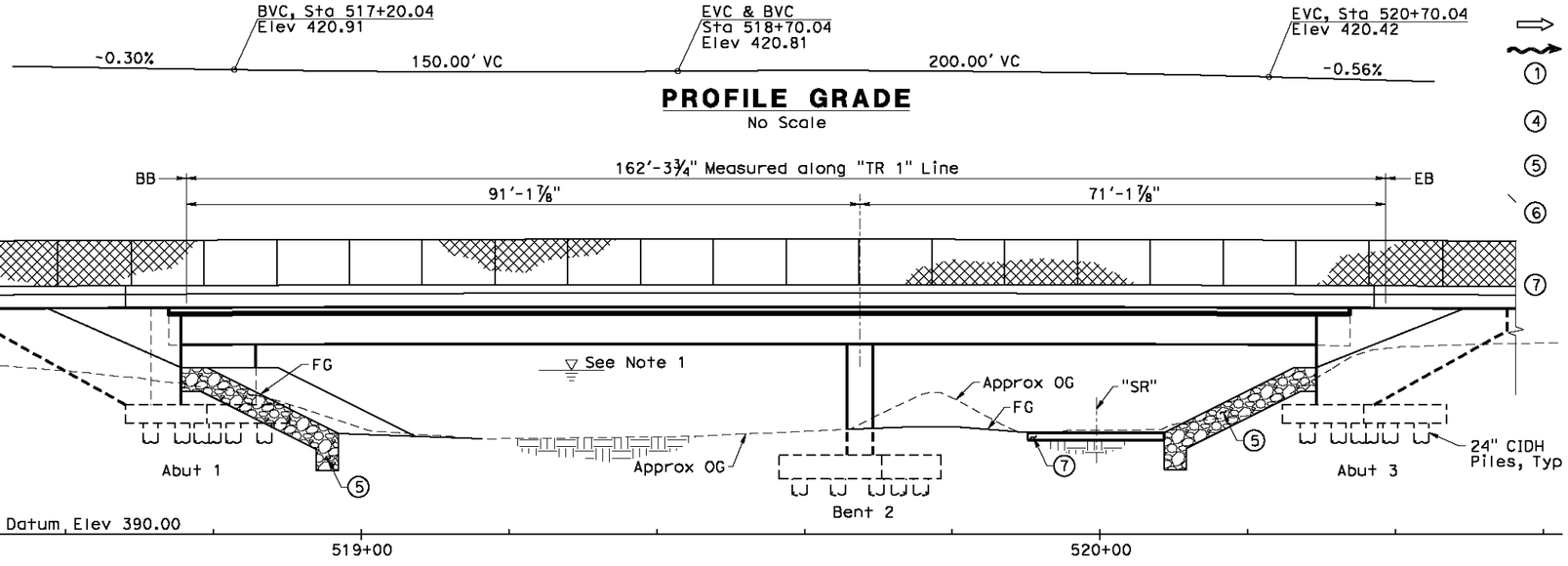
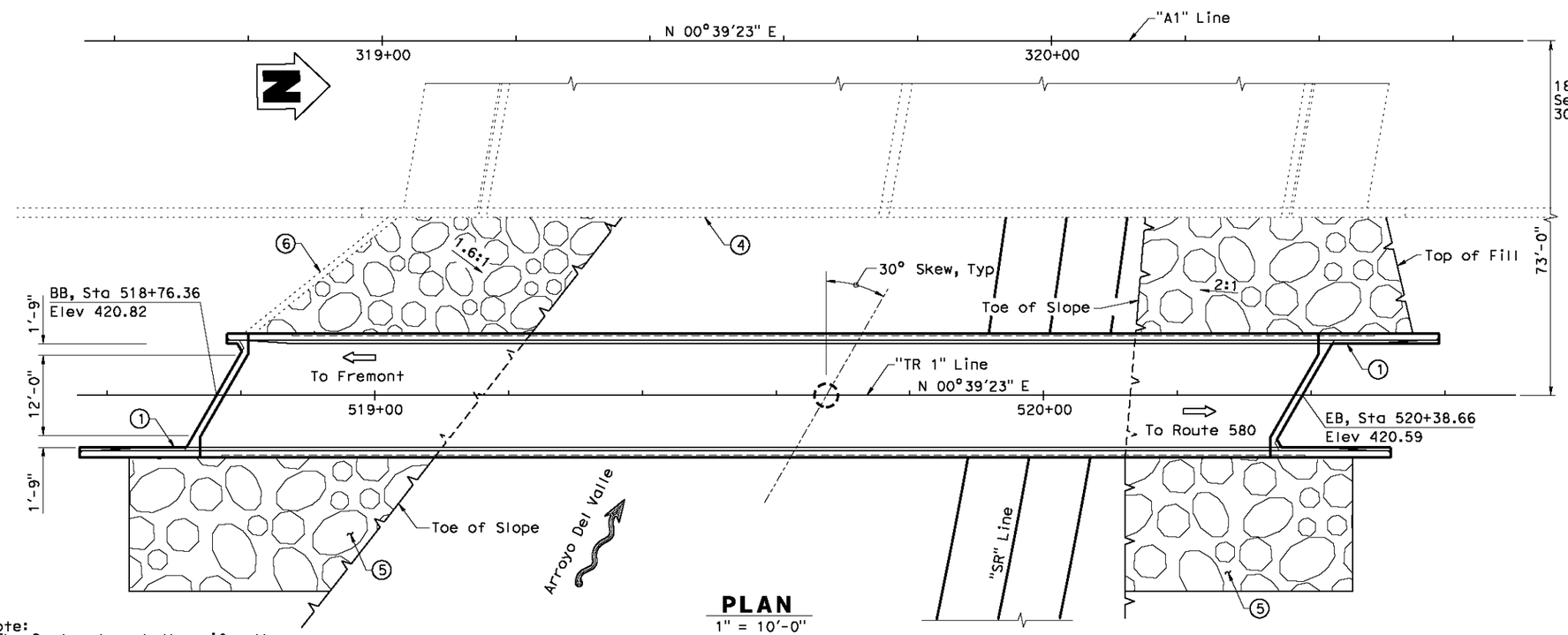
ALAMEDA COUNTY TRANSPORTATION IMPROVEMENT AUTHORITY (ACTIA)
1333 BROADWAY, SUITE 300
OAKLAND, CA 94612

MCE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831

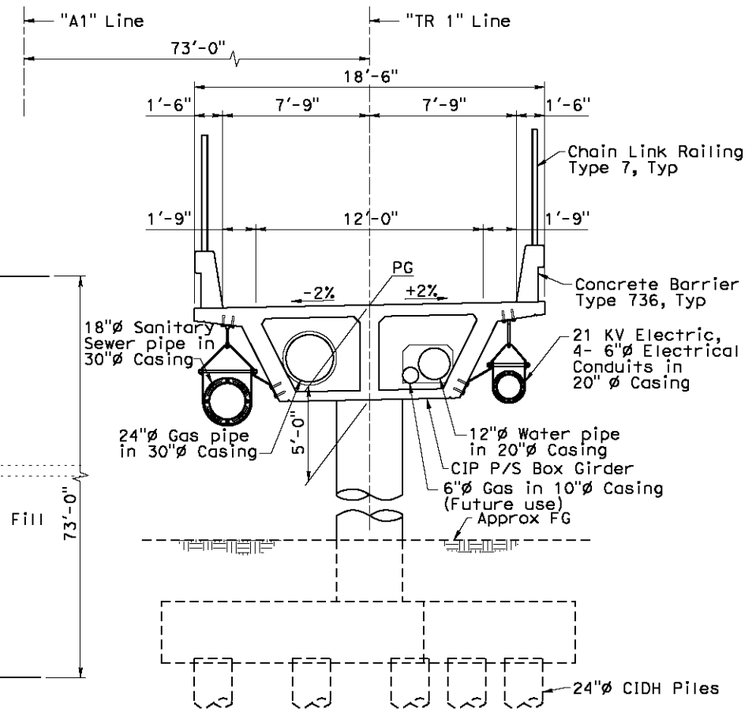
LEGEND

- Indicates Direction of Travel
- Indicates Direction of Flow
- (1) Paint "Arroyo Del Valle Trail Bridge"
- (4) Arroyo Del Valle Bridge (Widen) Bridge No. 33-0710
- (5) Rock Slope Protection (1/4-Ton, Method B)
- (6) Type 1 Retaining Wall, see "Arroyo Del Valle Bridge (Widen)" plans
- (7) "SR" Road, see "Road Plans"





Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.



TYPICAL SECTION
¼" = 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.

DESIGN OVERSIGHT	DESIGN	BY S. Fu	CHECKED D. Wang	LOAD & RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 and Permit Design Vehicle	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Xiangyang Fu PROJECT ENGINEER
SIGN OFF DATE	DETAILS	BY K. Wang	CHECKED D. Wang	LAYOUT	BY S. Fu / CHECKED D. Wang		
	QUANTITIES	BY W. Sennett	CHECKED R. Huang	SPECIFICATIONS	BY R. E. Sennett / PLANS AND SPECS COMPARED S. Fu		

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 06-01-09)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 0733
EA 297621

BRIDGE NO. N/A
POST MILES N/A

DISREGARD PRINTS BEARING EARLIER REVISION DATES

ARROYO DEL VALLE TRAIL BRIDGE
GENERAL PLAN

REVISION DATES (PRELIMINARY STAGE ONLY): 07/09/08 | 04/07/08 | 05/05/08 | 11/06/08 | 12/05/08 | 05/14/09 | 01/26/10 | 08/18/10 | 12/21/10 | 05/27/14

SHEET 1 OF 19

FILE => P:\397 Route 84 Widenings\Segment B PS&E\Arroyo Del Valle Trail Bridge\CADD\00-Trail-a-gp01.dgn

DATE PLOTTED => 6/2/2014 TIME PLOTTED => 9:40:00 AM USERNAME => KoI

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Sean Fu. 05/27/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
XIANGYANG FU
No. C 72514
Exp. 06/30/16
CIVIL
STATE OF CALIFORNIA

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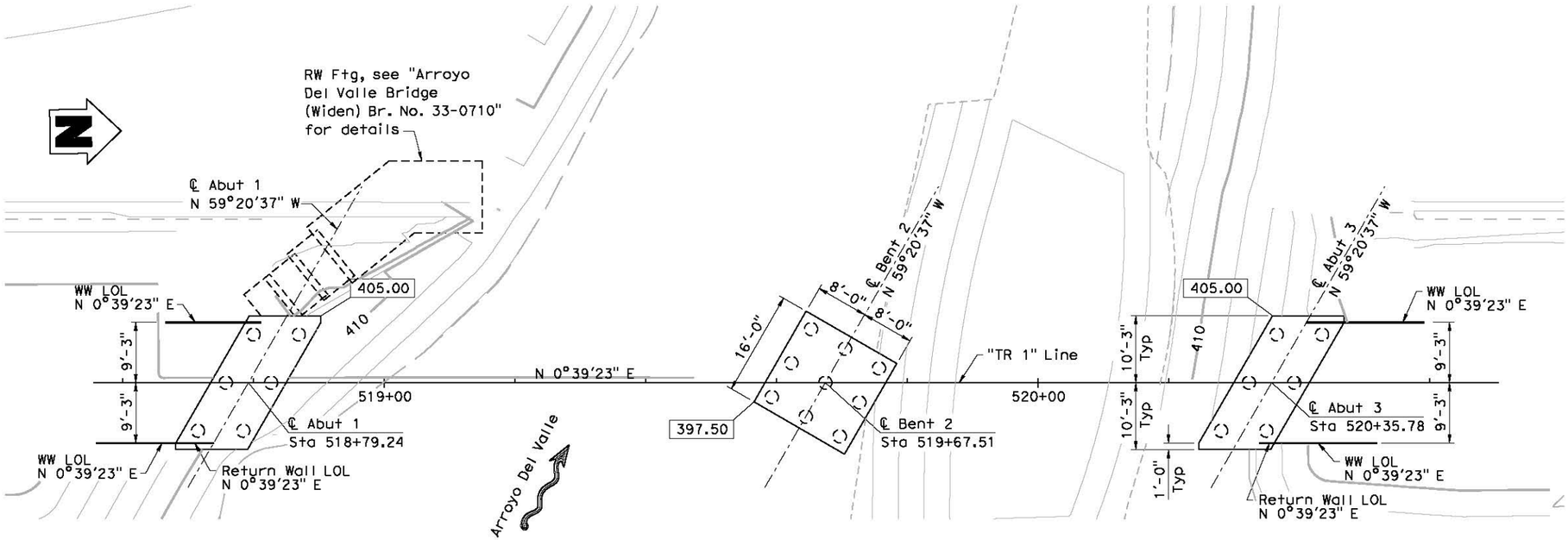
MCE ENGINEERING, INC.
7415 GREENHAVEN DRIVE, SUITE 100
SACRAMENTO, CALIFORNIA 95831



FOUNDATION PLAN
1" = 10'-0"

LEGEND

Indicates Direction of Flow

405.00 Indicates Bottom of Footing Elevation

Indicates 24" CIDH Piles

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	320	0	354.0 (a) 371.0 (c)	354.0
Bent 2	24" CIDH	350	120	338.0 (a) 356.0 (b) 358.0 (c)	338.0
Abut 3	24" CIDH	290	0	357.0 (a) 371.0 (c)	357.0

Design tip elevation is controlled by the following demands:
(a) Compression, (b) Tension, (c) Lateral

HYDROLOGIC SUMMARY

Drainage Area 160 square miles

	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.

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

Stephen Huang 08/18/2010
GEOTECHNICAL PROFESSIONAL APPROVAL DATE

QUANTITIES

Structure Excavation (Bridge)	263	CY
Structure Excavation (Type D)	90	CY
Structure Backfill (Bridge)	146	CY
24" Cast-inDrilled-Hole Concrete Piling	1135	LF
Prestressing Cast-in-Place Concrete	1	LS
Structural Concrete (Bridge Footing)	74	CY
Structural Concrete (Bridge)	254	CY
Joint Seal (MR 1")	43	LF
Bar Reinforcing Steel (Bridge)	75773	LB
10" Welded Steel Pipe Casing (Bridge)	206	LF
20" Welded Steel Pipe Casing (Bridge)	412	LF
30" Welded Steel Pipe Casing (Bridge)	206	LF
Rock Slope Protection (1/4 Ton, Method B)	540	CY
Rock Slope Protection (No. 2, Method B)	173	CY
Rock Slope Protection Fabric (Class 8)	614	SY
Miscellaneous Metal (Bridge)	67	LB
Concrete Barrier (Type 736)	369	LF
Chain Link Railing (Type 7)	369	LF

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 VINEYARD, 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

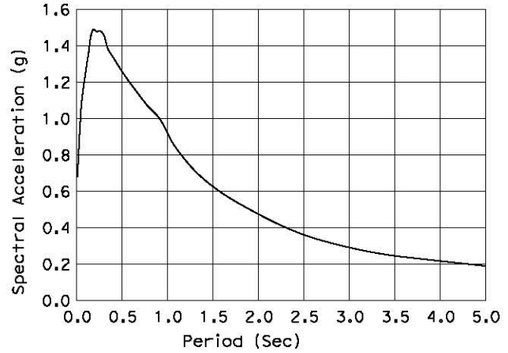
DESIGN: AASHTO LRFD Bridge Design Specifications, 6th Edition and the Caltrans Amendments, Preface dated January 2014; except that Abutments and Concrete Barrier Type 736 are designed using Bridge Design Specifications ('96 AASHTO w/ Revisions by Caltrans)

SEISMIC DESIGN: Caltrans Seismic Design Criteria (SDC) Version 1.7 dated April 2013

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 = 0.7g
Vs30 = 331 m/s



ARS CURVE

CONCRETE: f_y = 60 ksi
f'_c = 3.6 ksi
n = 8
See "Prestressing Notes" on "Girder Layout" sheet.

DESIGN OVERSIGHT	SCALE: 1"=10'-0"	VERT.DATUM NAVD88	HORZ.DATUM NAD83	DESIGN	BY S. Fu	CHECKED D. Wang	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Xiangyang Fu PROJECT ENGINEER	BRIDGE NO. N/A	ARROYO DEL VALLE TRAIL BRIDGE
	PHOTOGRAMMETRY AS OF: 11/10/2005	ALIGNMENT TIES Dist. Traverse Sheet		DETAILS	BY K. Wang	CHECKED D. Wang			POST MILE N/A	FOUNDATION PLAN
	SURVEYED BY Dan Scott	DRAFTED BY Abhijeet Bhoi		QUANTITIES	BY W. Sennett	CHECKED S. Fu				
SIGN OFF DATE	FIELD CHECKED BY Dan Scott	CHECKED BY								

FOUNDATION PLAN SHEET (ENGLISH) (REV. 06-01-09)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 0733
EA 297621

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 05/28/08 | 06/27/08 | 09/26/08 | 10/24/08 | 12/26/08 | 01/26/10 | 09/15/10 | 10/27/10 | 05/27/14

SHEET 3 OF 19

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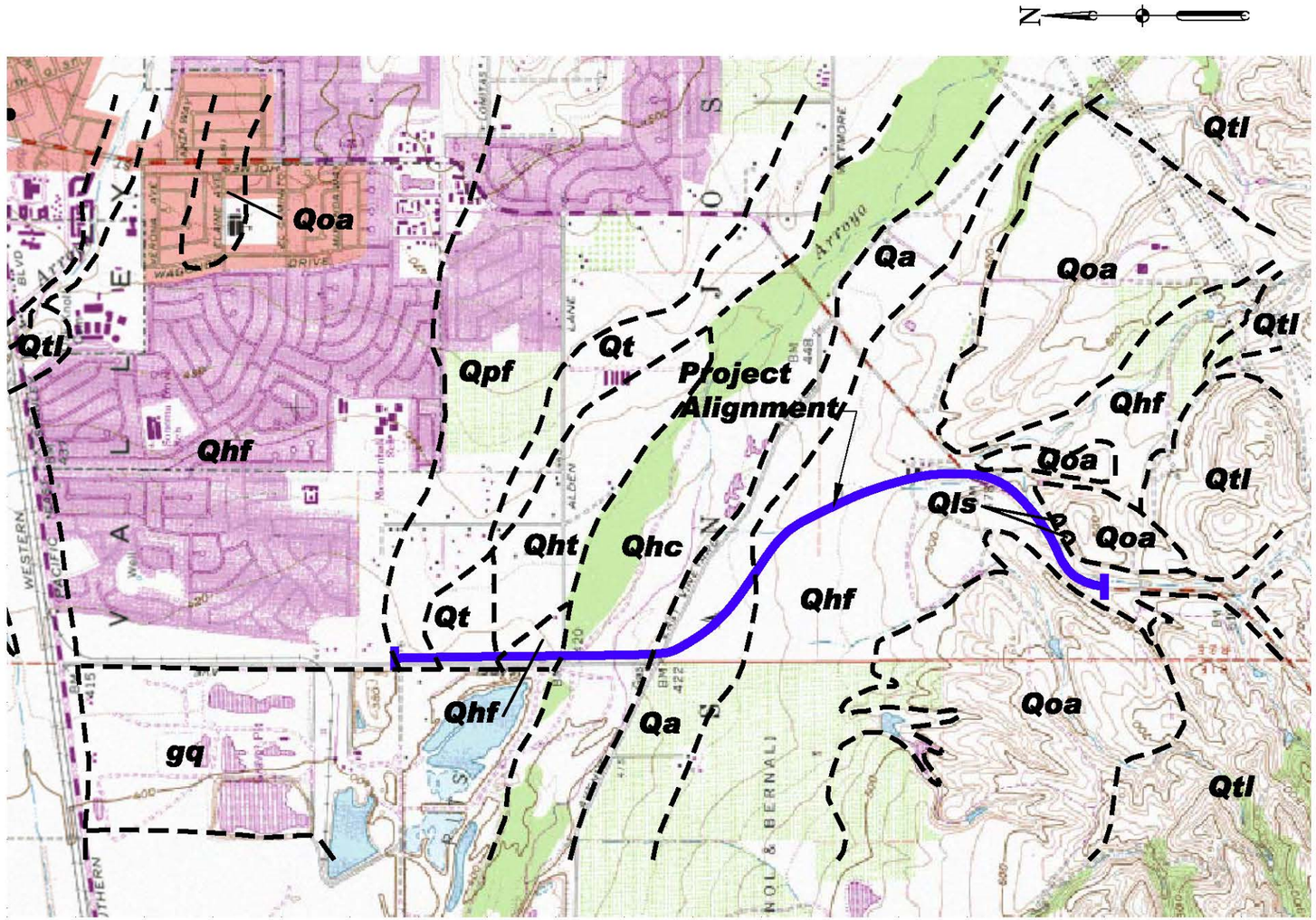


LEGEND:

- 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

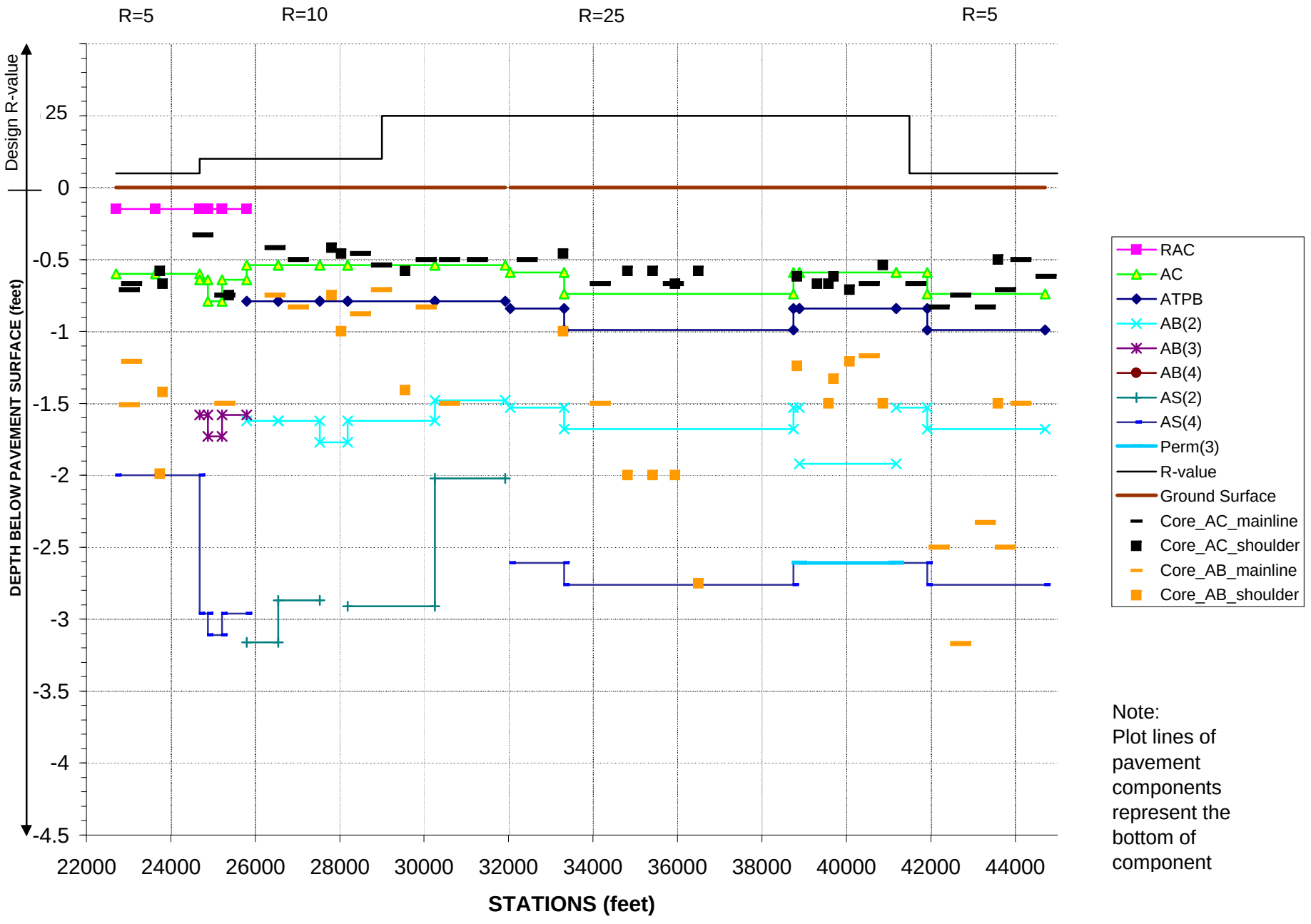
SR 84 Isabel Ave
Livermore, California
Alameda County

SITE AND GEOLOGIC MAP

SCALE
Figure ***1-7***
December 2014

X:\Route 84 - Isabel Avenue\geotech\seismic\geologic_map\G-GEO-001.dwg

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	22.9/25.7		

ARBhoi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Registered Professional Engineer — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-15 — CIVIL — State of California

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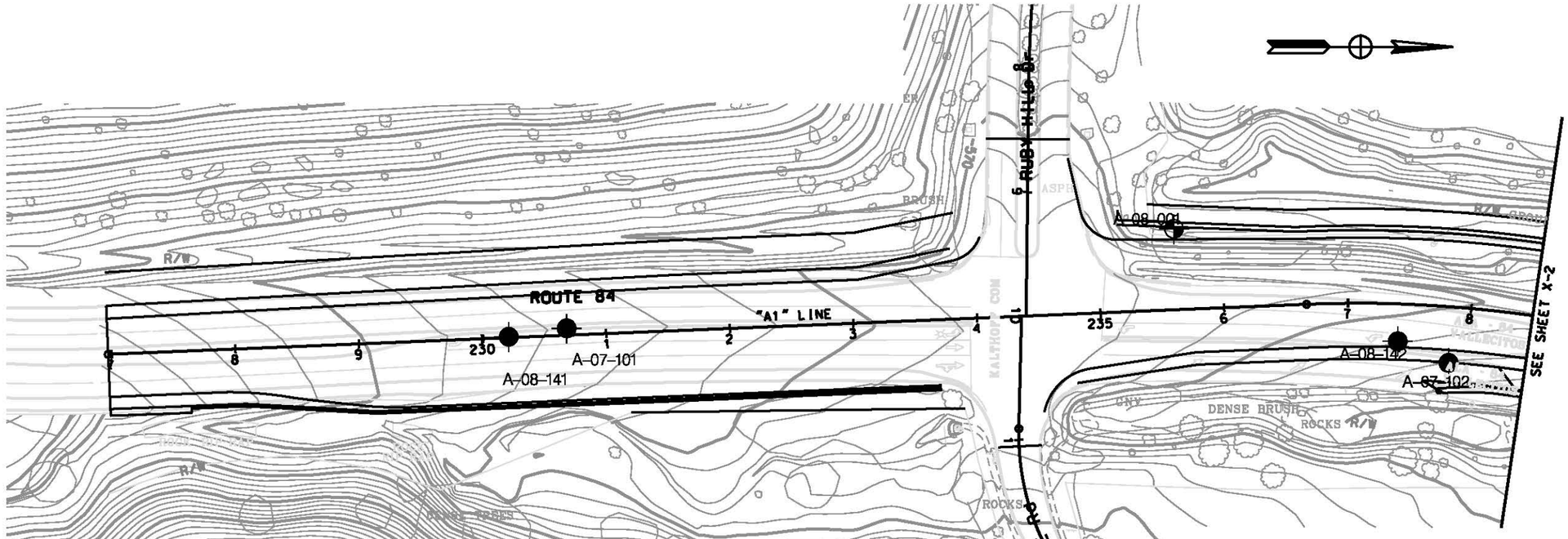

LEGEND:

- 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

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: BEN RAZEGHI
CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE
REVISED BY
DATE REVISED
Parsons

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UNIT 04256
PROJECT NUMBER & PHASE 297601

· FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

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PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER * Abhijeet R. Bhoi * No. 68606 Exp. 09-30-11 CIVIL * STATE OF CALIFORNIA *

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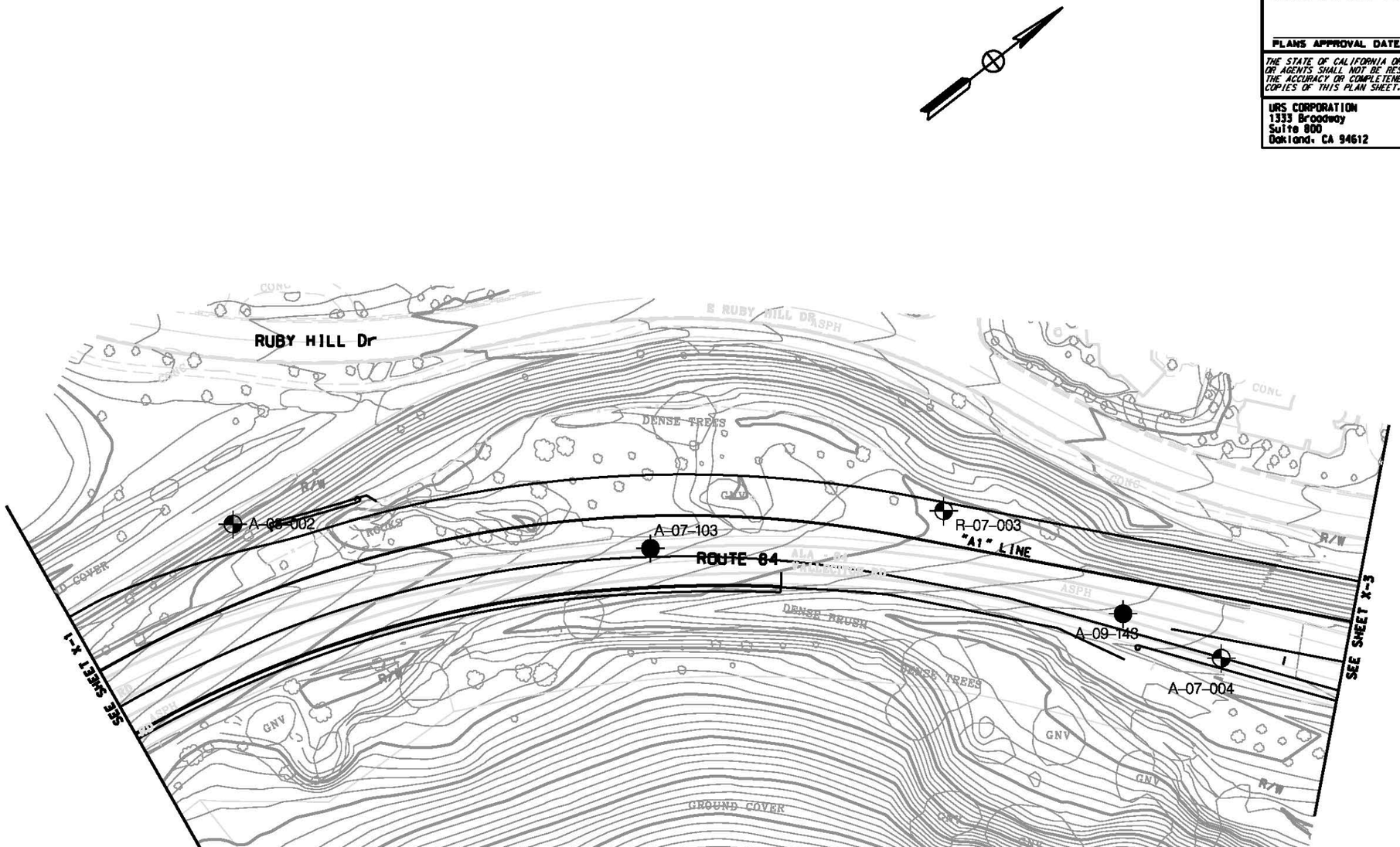

FIELD EXPLORATION LOCATION PLAN 3-2
SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

X-2

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CHECKED BY
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ELIE ABI-JAOUDE
REVISED BY
DATE REVISED
CONSULTANT FUNCTIONAL SUPERVISOR
BEN RAZEGHI
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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DGN FILE =>REQUEST
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UNIT 04256
PROJECT NUMBER & PHASE 297601

FOR NOTES. ABBREVIATIONS
AND LEGEND. SEE SHEET X-1.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

REGISTERED CIVIL ENGINEER DATE

Abhijeet R. Bhoi
No. 68606
09-30-15
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

PLANS APPROVAL DATE

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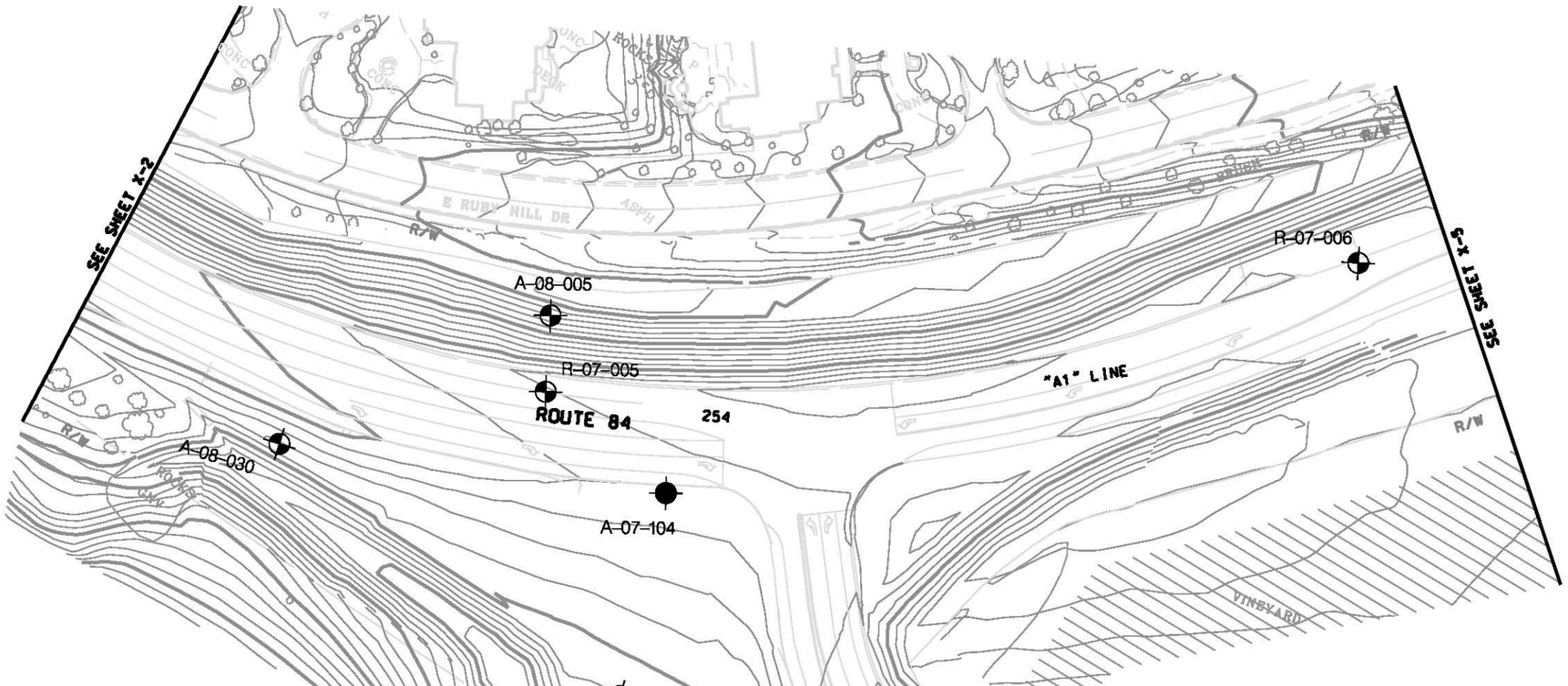

FIELD EXPLORATION LOCATION PLAN 3-3
SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

X-3

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CHECKED BY	ELIE ABI-JAOUDE	DATE REVISED			
CONSULTANT FUNCTIONAL SUPERVISOR	BEN RAZEGHI				
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION					

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Abhijeet R. Bhoi No. 68606 Exp. 09-30-15 CIVIL STATE OF CALIFORNIA REGISTERED PROFESSIONAL ENGINEER

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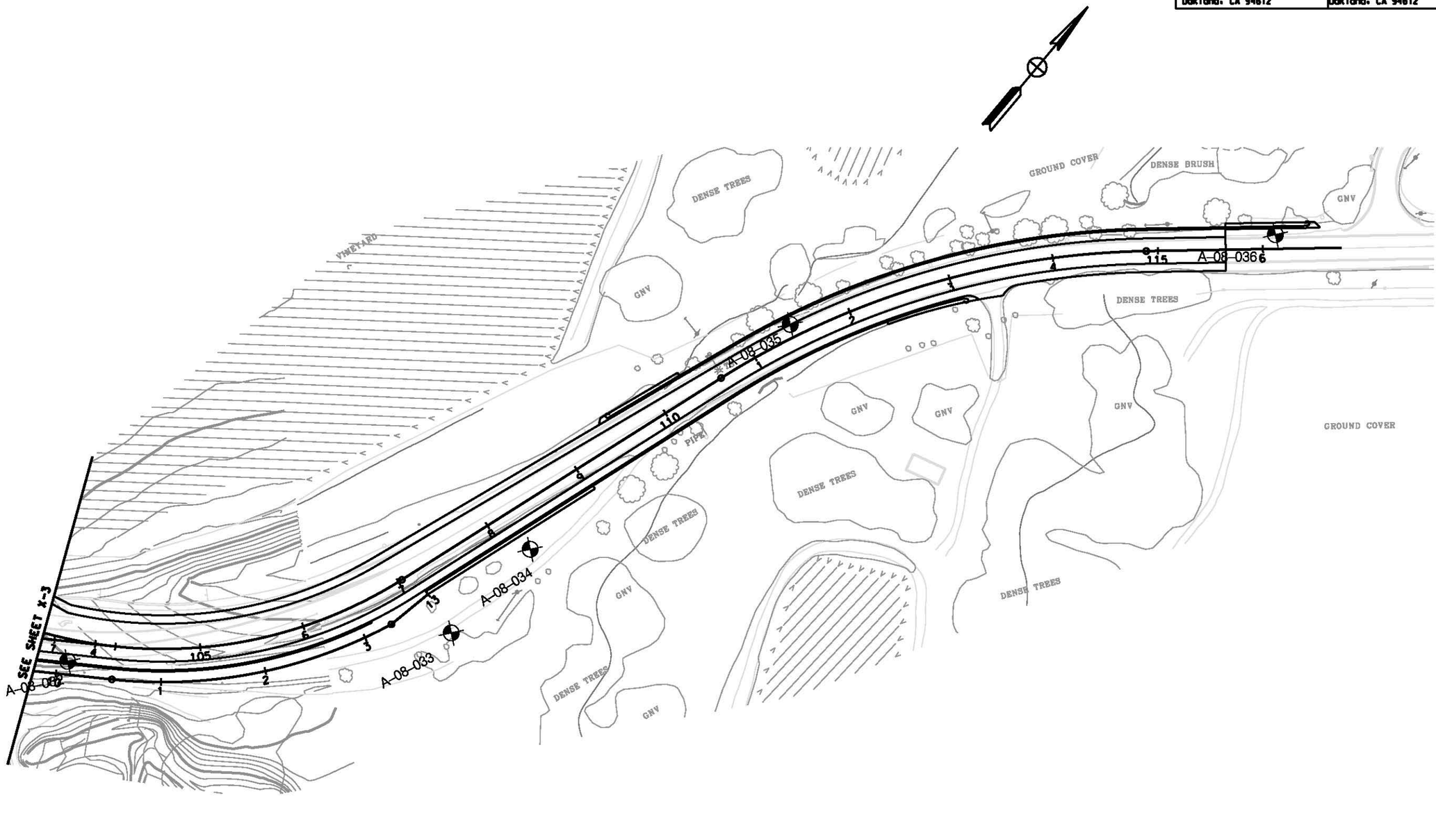

FIELD EXPLORATION LOCATION PLAN 3-4
SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

X-4

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UNIT 04256
PROJECT NUMBER & PHASE 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
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ARBhoi 10/21/10
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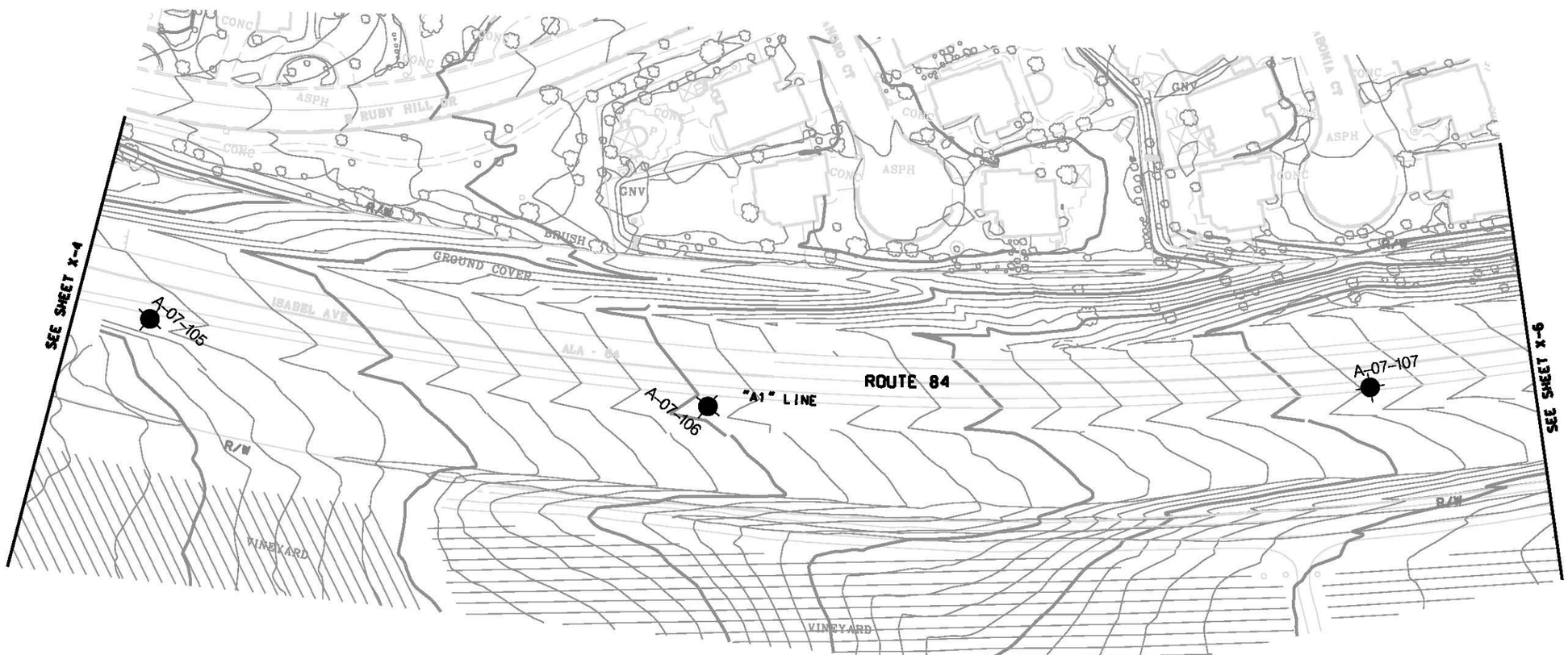

FIELD EXPLORATION LOCATION PLAN 3-5
SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

X-5

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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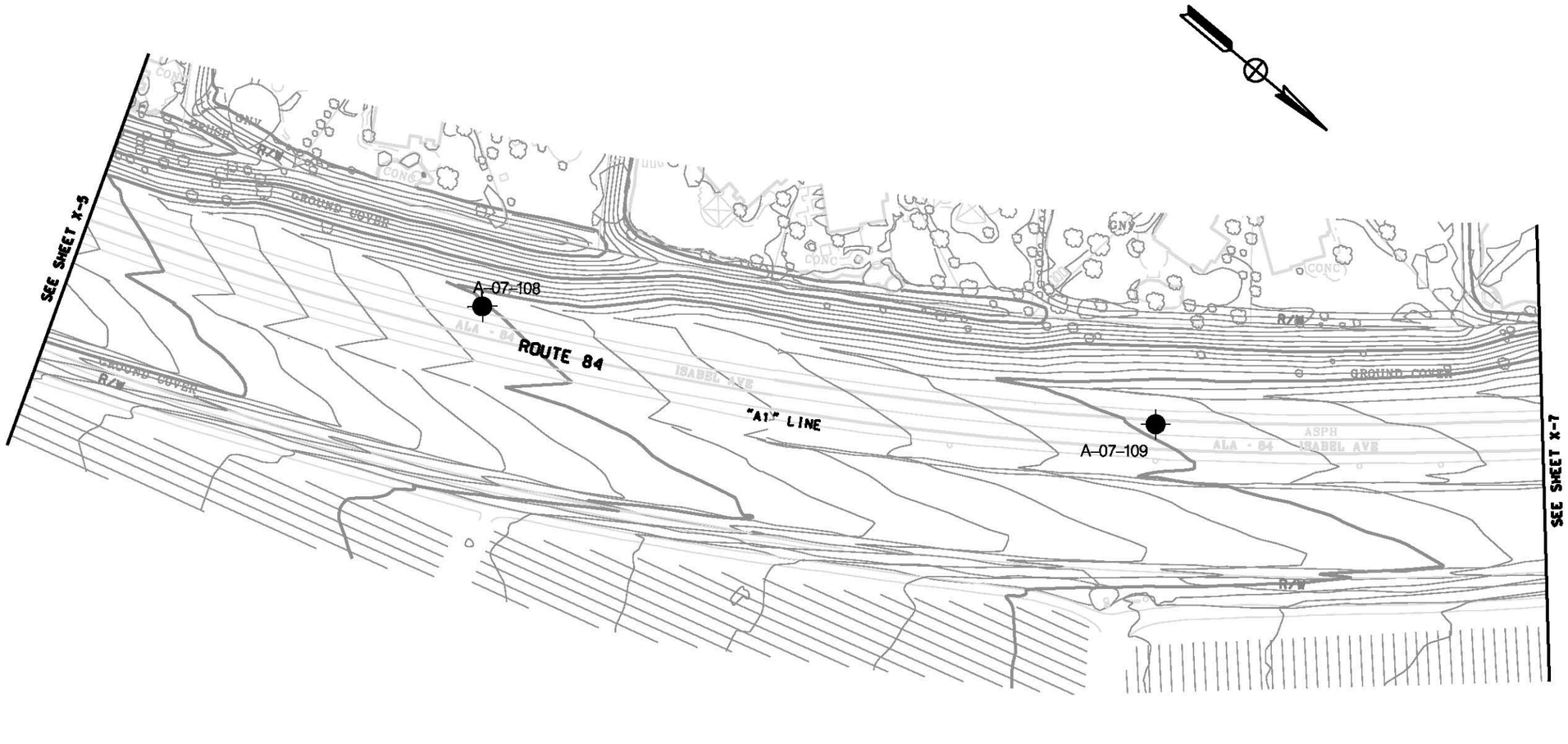

FIELD EXPLORATION LOCATION PLAN 3-6
SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

X-6

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FIELD EXPLORATION LOCATION PLAN 3-7
SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

X-7

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CONSULTANT FUNCTIONAL SUPERVISOR	BEN RAZEGHI	

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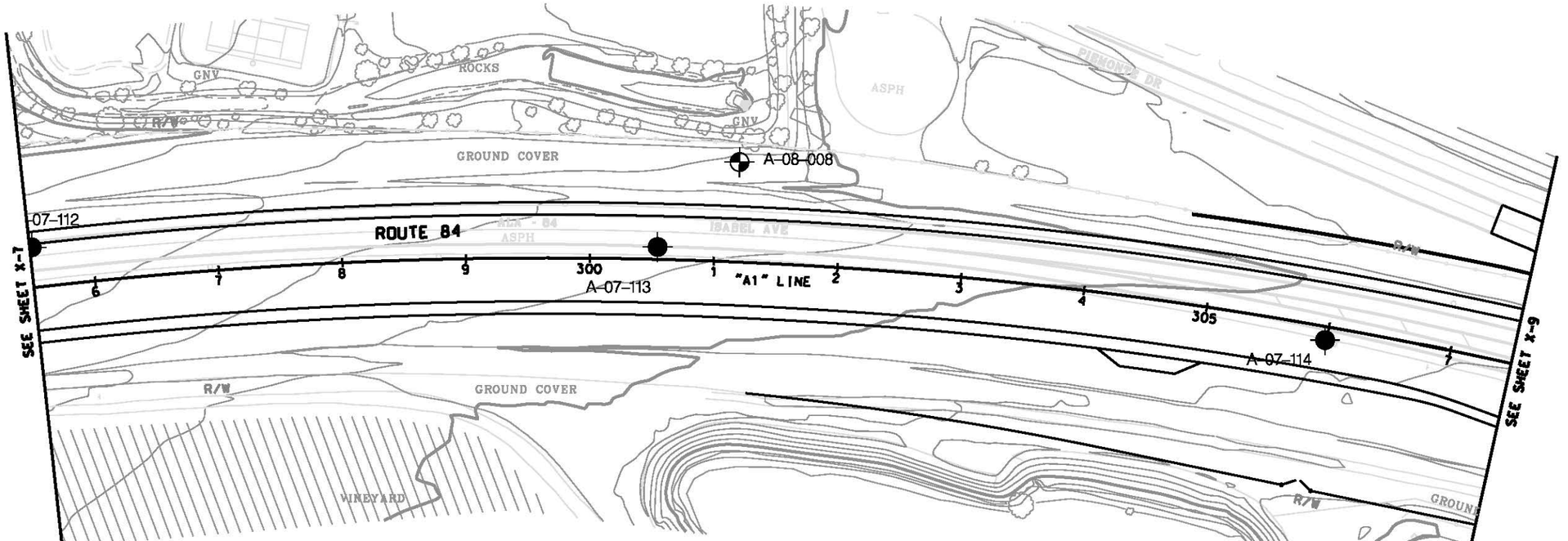

FIELD EXPLORATION LOCATION PLAN 3-8
SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

X-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	22.9/25.7		

ARBhoi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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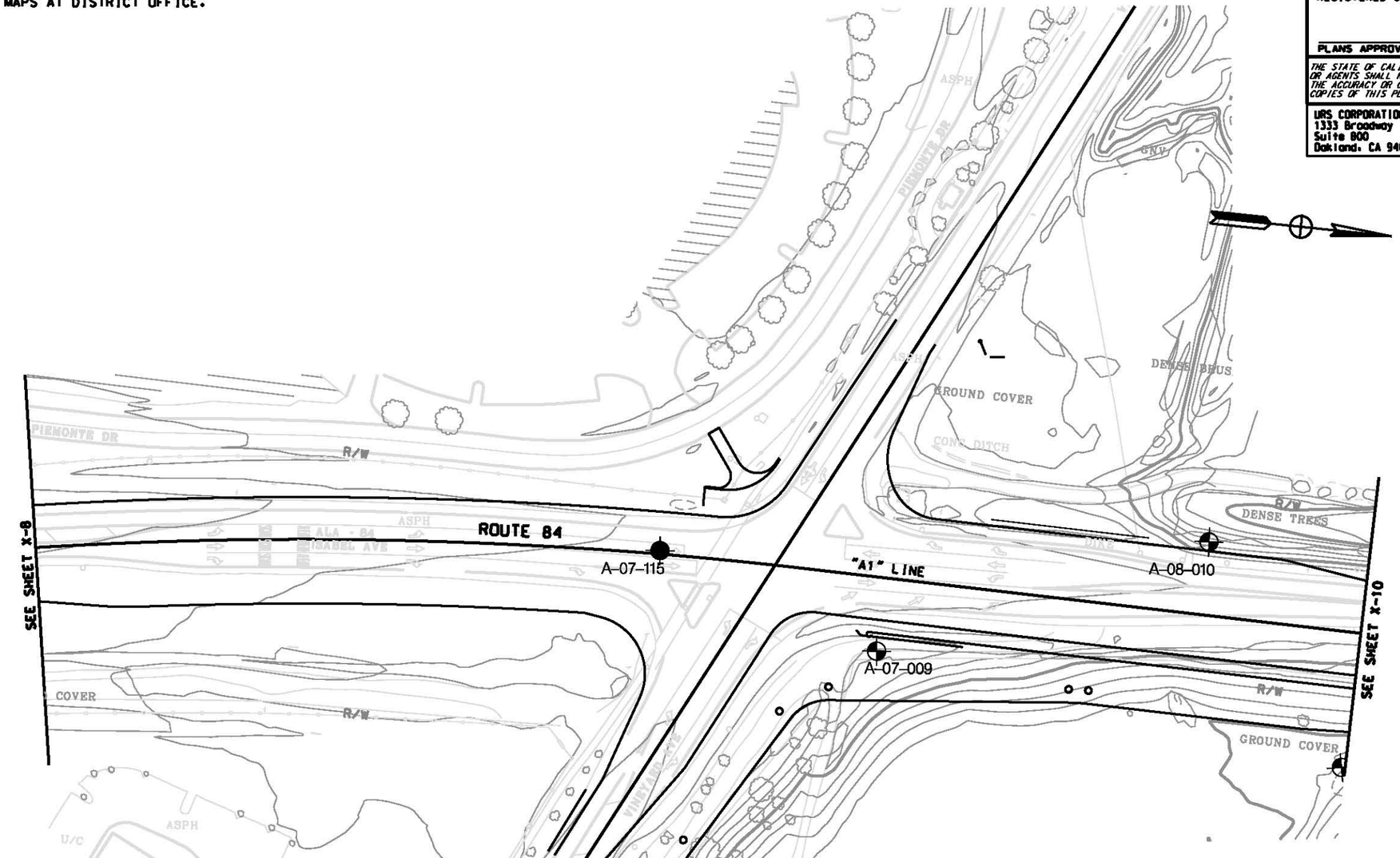

FIELD EXPLORATION LOCATION PLAN 3-9
SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET
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X-9

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		CHECKED BY: ELIE ABI-JAOUDE	DATE REVISED

LAST REVISION 08-31-10 — DATE PLOTTED =$DATE — TIME PLOTTED =$TIME

BORDER LAST REVISED 7/2/2010 | USERNAME =$USER | DGN FILE =$REQUEST | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 04256 | PROJECT NUMBER & PHASE 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	22.9/25.7		

ARBhoi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-15 CIVIL STATE OF CALIFORNIA REGISTERED PROFESSIONAL ENGINEER

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1333 Broadway
Suite 800
Oakland, CA 94612

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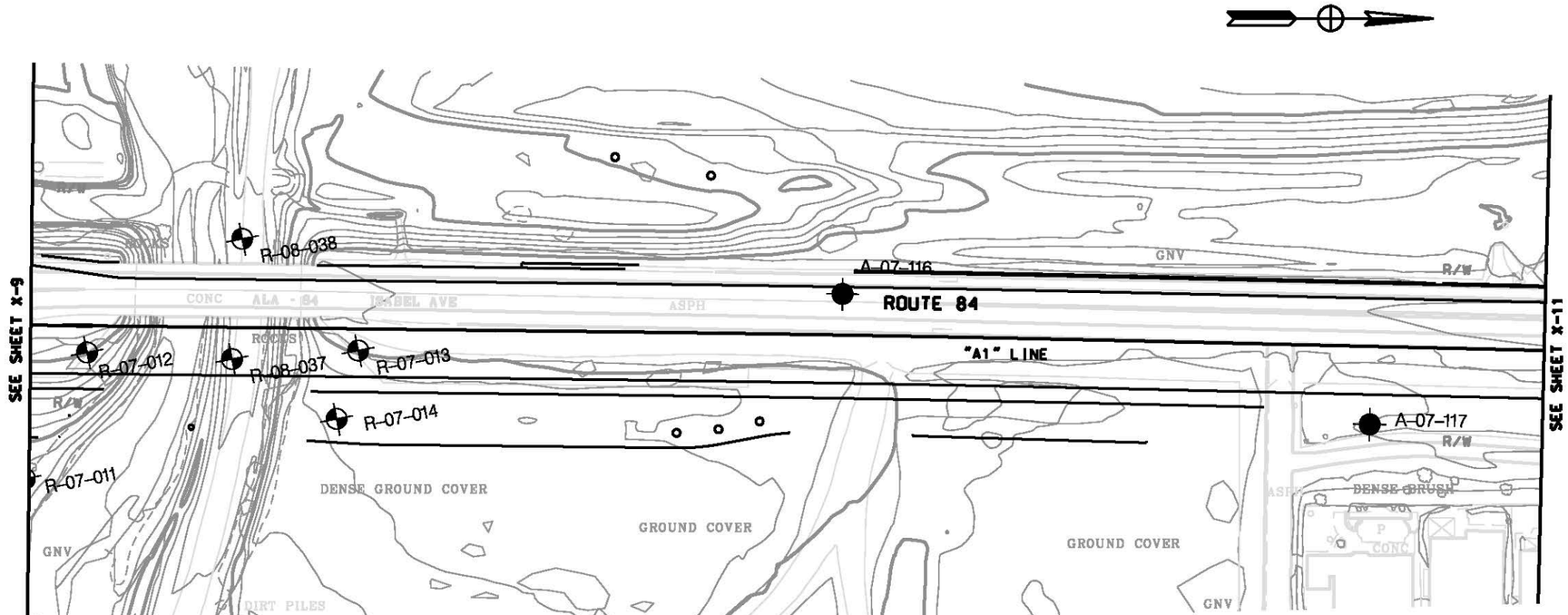
1333 Broadway, Suite 300
Oakland, CA 94612



FIELD EXPLORATION LOCATION PLAN 3-10
SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

X-10

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
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 =$DATE
TIME PLOTTED =$TIME

BORDER LAST REVISED 7/2/2010
USERNAME =$USER
DGN FILE =$REQUEST
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 04256
PROJECT NUMBER & PHASE 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	22.9/25.7		

ARBhoi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-15 — CIVIL — STATE OF CALIFORNIA

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1333 Broadway, Suite 300
Oakland, CA 94612

FIELD EXPLORATION LOCATION PLAN 3-11
SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

X-11

REVISED BY	DATE REVISED

CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE

CONSULTANT FUNCTIONAL SUPERVISOR: BEN RAZEGHI

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION DATE PLOTTED =$DATE 08-31-10
TIME PLOTTED =$TIME

BORDER LAST REVISED 7/2/2010 | USERNAME =$USER | OGN FILE =$REQUEST | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 04256 | PROJECT NUMBER & PHASE 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	22.9/25.7		

ARBhoi 10/21/10
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-15 — CIVIL — STATE OF CALIFORNIA

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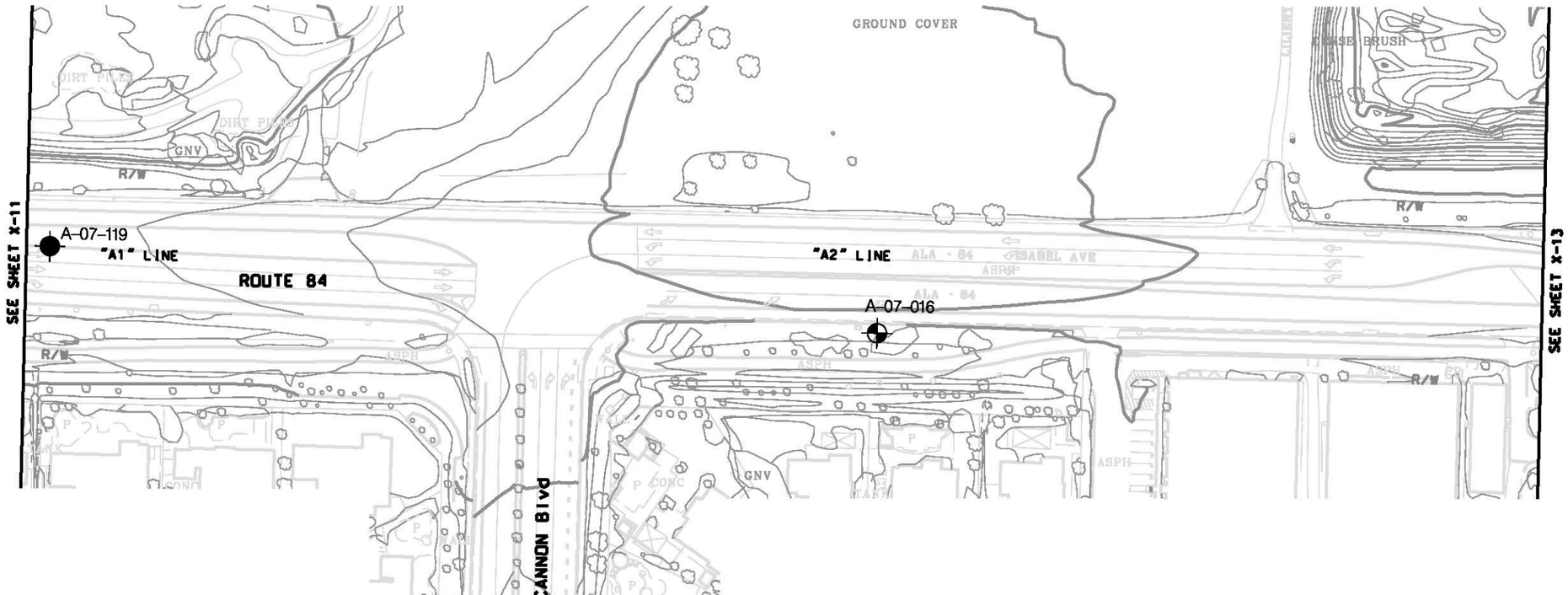
1333 Broadway, Suite 300
Oakland, CA 94612



FIELD EXPLORATION LOCATION PLAN 3-12
SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

X-12

REVISED BY | DATE REVISED
ABHIJEET BHOI | ELIE ABI-JAOUDE
CALCULATED-DESIGNED BY | CHECKED BY
CONSULTANT FUNCTIONAL SUPERVISOR: BEN RAZEGHI
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION DATE PLOTTED =>DATE
08-31-10 TIME PLOTTED =>TIME

BORDER LAST REVISED 7/2/2010 | USERNAME =>$USER | OGN FILE =>$REQUEST | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 04256 | PROJECT NUMBER & PHASE 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	22.9/25.7		

ARBhoi 10/21/10
REGISTERED CIVIL ENGINEER DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-15 CIVIL
REGISTERED PROFESSIONAL ENGINEER * STATE OF CALIFORNIA *

PLANS APPROVAL DATE

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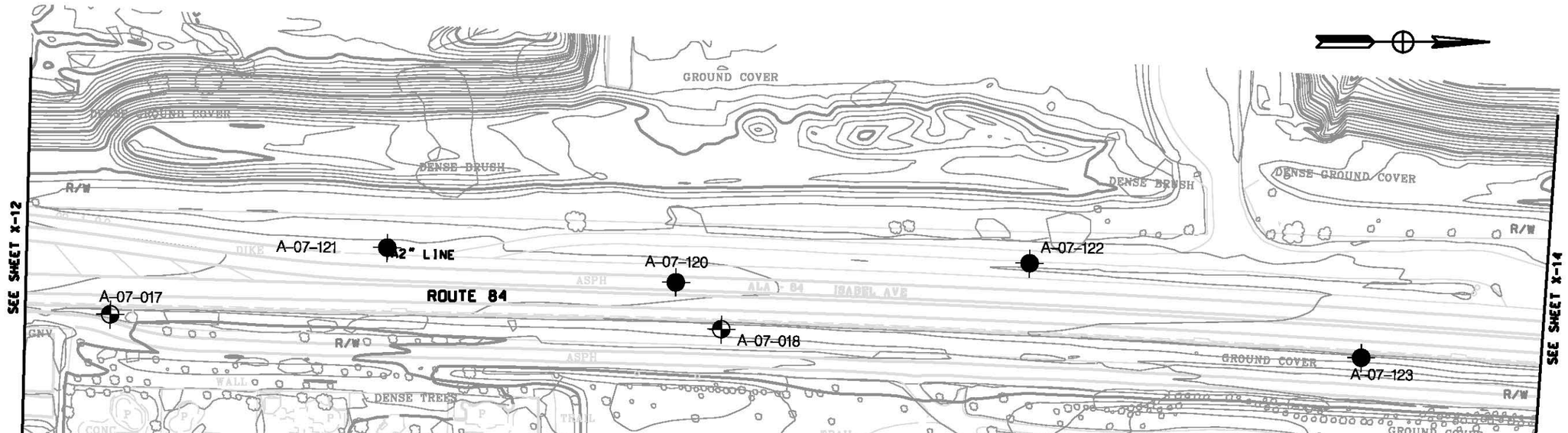
Oakland, CA 94612



FIELD EXPLORATION LOCATION PLAN 3-13
SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET UNLESS OTHERWISE SHOWN

X-13

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR: BEN RAZEGHI	CALCULATED-DESIGNED BY: ABHIJEET BHOI	CHECKED BY: ELIE ABI-JAOUDE	REVISED BY	DATE REVISED

BORDER LAST REVISED 7/2/2010 | USERNAME => $USER | DGN FILE => $REQUEST | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 04256 | PROJECT NUMBER & PHASE 297601

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TIME PLOTTED => !TIME
08-31-10

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. 09-30-15 CIVIL STATE OF CALIFORNIA REGISTERED PROFESSIONAL ENGINEER

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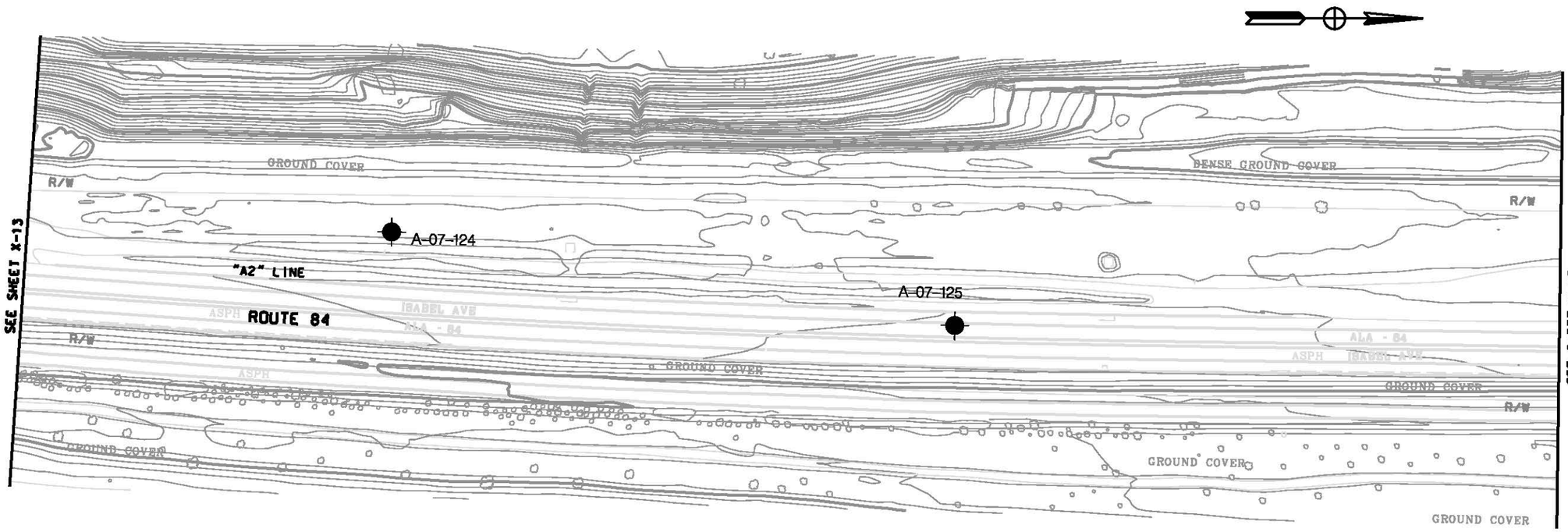
1333 Broadway, Suite 300
Oakland, CA 94612

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA.
SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.



FIELD EXPLORATION LOCATION PLAN 3–14
SCALE 1"=50'

ALL DIMENSIONS ARE IN FEET
UNLESS OTHERWISE SHOWN

X–14

CALCULATED-DESIGNED BY
CHECKED BY
ABHIJEET BHOI
ELIE ABI-JAOUDE
REVISED BY
DATE REVISED
CONSULTANT FUNCTIONAL SUPERVISOR
BEN RAZEGHI
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Gibbons

LAST REVISION DATE PLOTTED $DATE
08-31-10 TIME PLOTTED $TIME

BORDER LAST REVISED 7/2/2010
USERNAME $USER
DGN FILE $REQUEST
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 04256
PROJECT NUMBER & PHASE 297601

R-value Distribution
Route 84 Expressway Widening
Rubyhill Drive to Jack London Blvd
Livermore, California

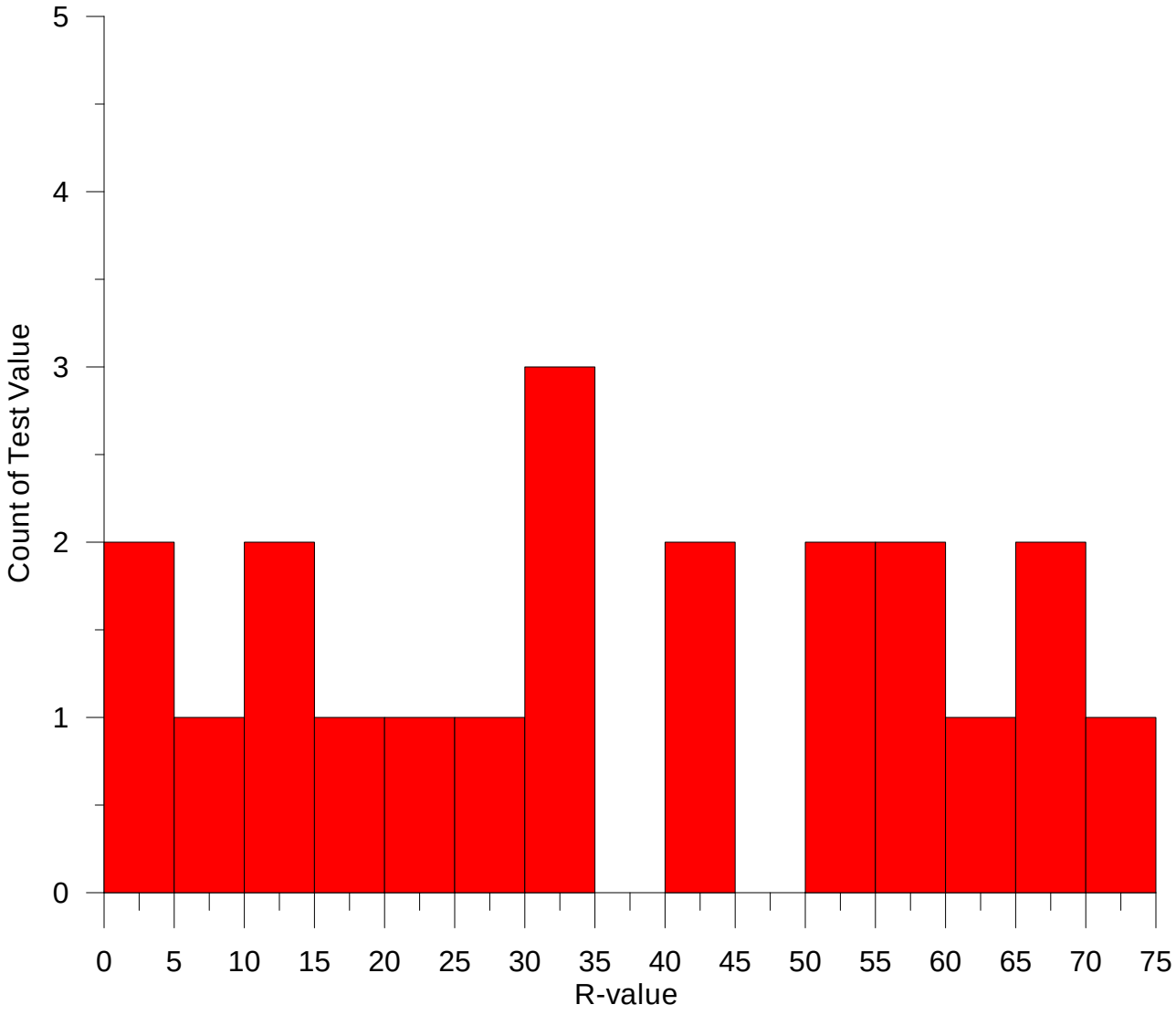


FIGURE 5-1

R-value Distribution along Project Alignment
Route 84 Highway Expansion Project
Ruby Hill Drive to Jack London Blvd
Livermore, California

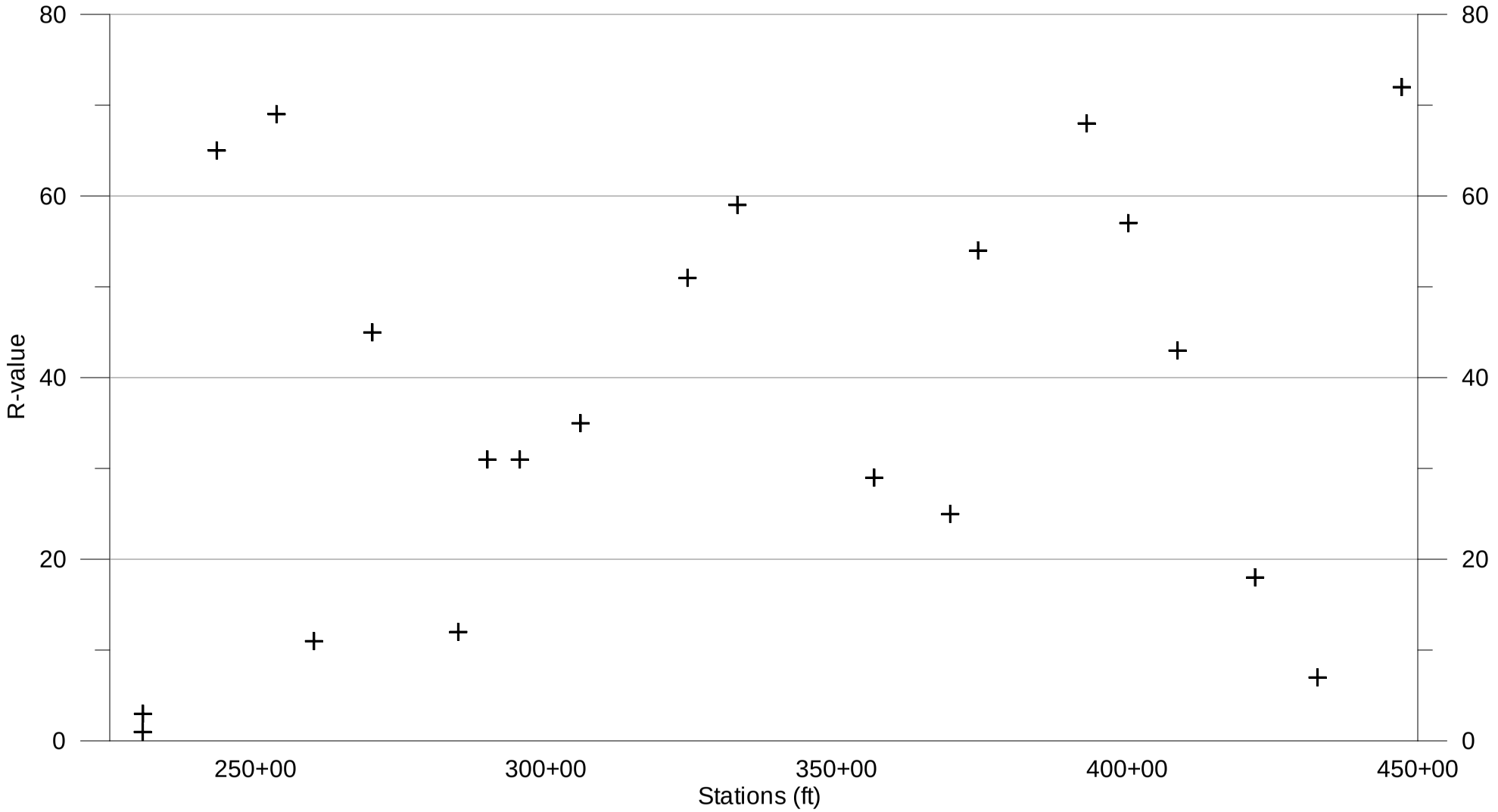


FIGURE 5-2

LEGEND:

- RHMA-G
- HMA (TYPE A)
- ATPB
- CLASS 3 AB
- CLASS 3 Perm
- CLASS 4 AS

SPCS - STRUCTURAL PAVEMENT CROSS SECTION

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' - 1.65' 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

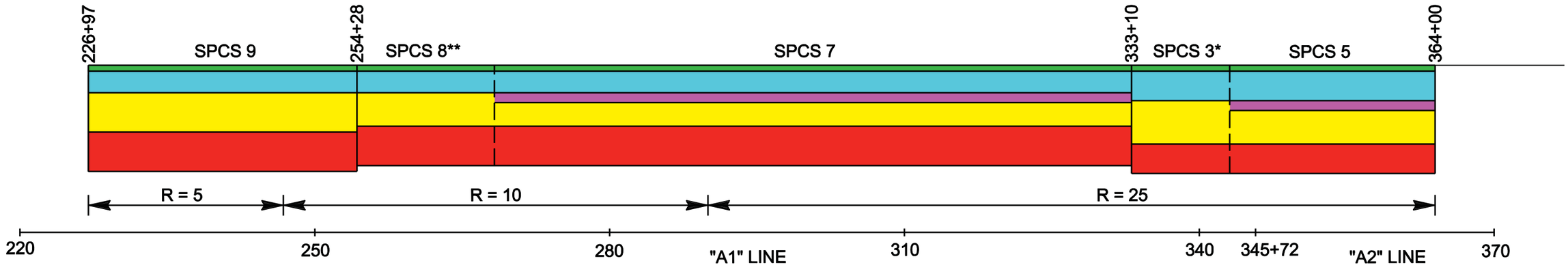
SPCS 9 TRAVELED WAY AND Shld (Typ)

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.



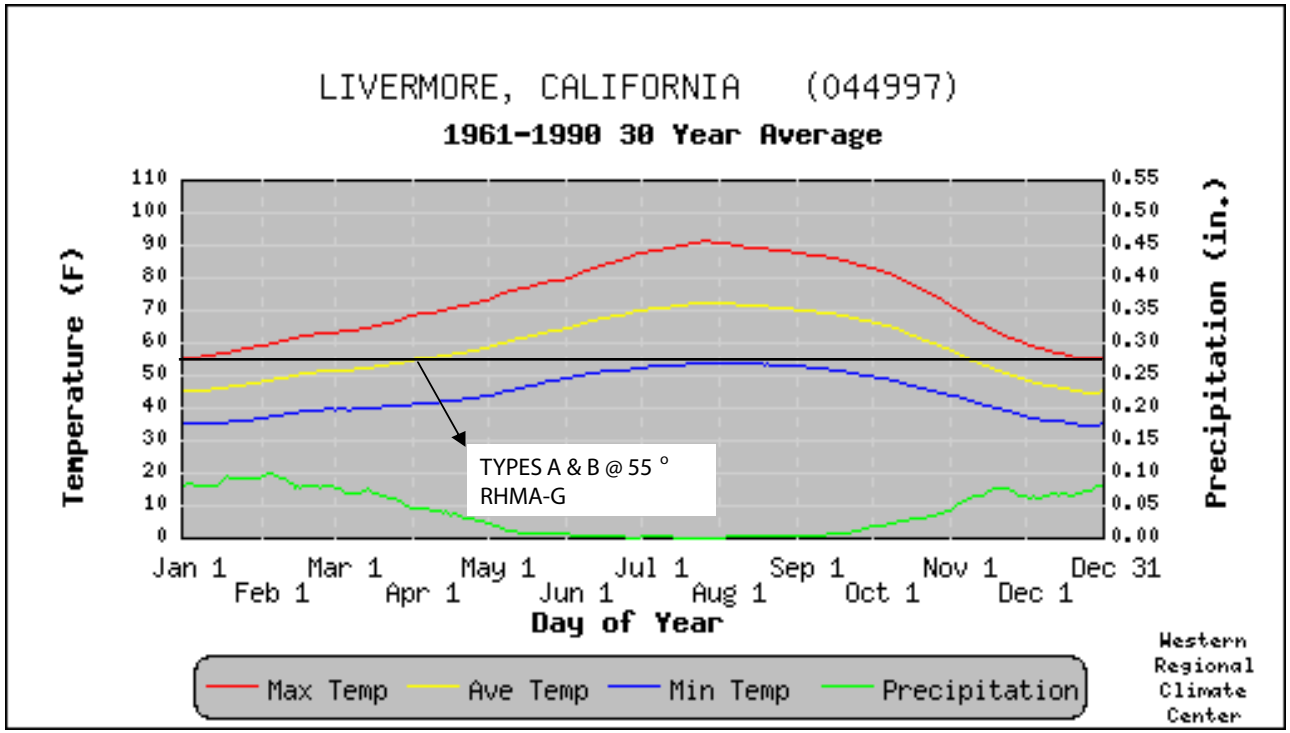
SR 84 - South Segment
Structure Pavement Sections Profile

Figure 5-3

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 5-4

NOTE:

1. SAME NUMBER AND ORIENTATION FOR ALL PLAN VIEW SHEETS.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi
REGISTERED CIVIL ENGINEER — 05/30/14 DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-15 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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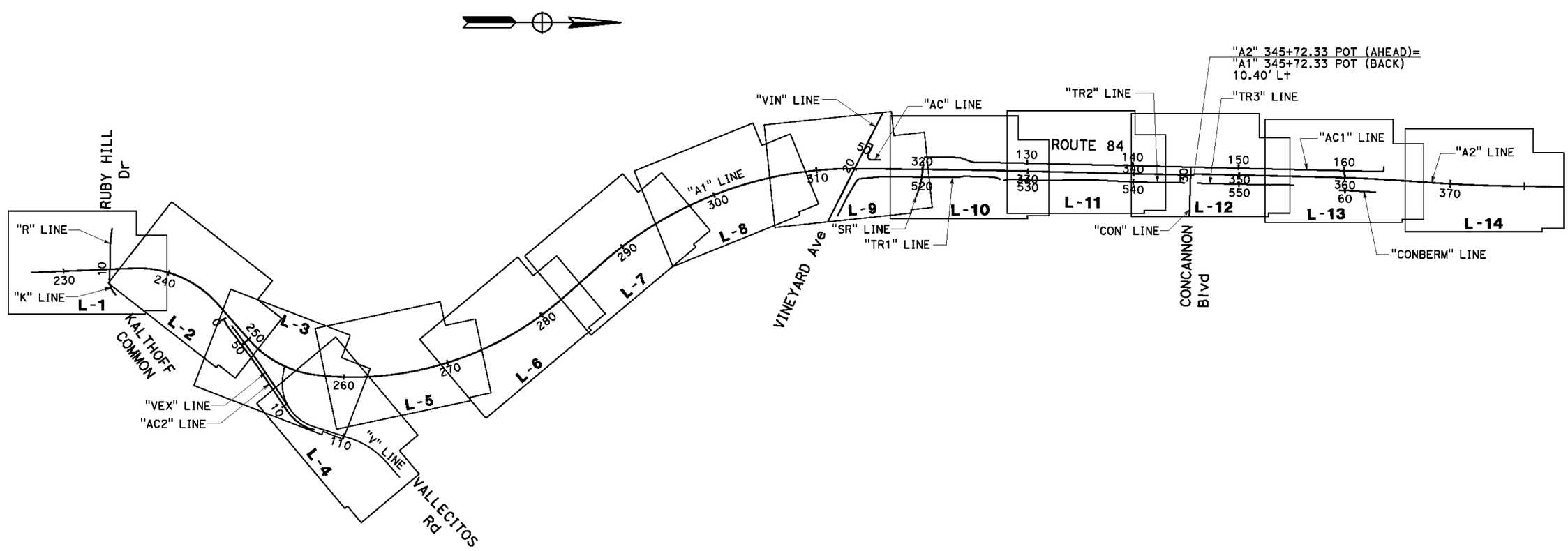
ALAMEDA COUNTY TRANSPORTATION COMMISION
1111 Broadway, Suite 800
Oakland, CA 94607



KEY MAP AND LINE INDEX

NO SCALE

K-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE
REVISED BY: AG
DATE REVISED: 9/12/14

LAST REVISION DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:08

BORDER LAST REVISED 7/2/2010
USERNAME => Shruti_Shah
DGN FILE => 429762da001.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205811

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.

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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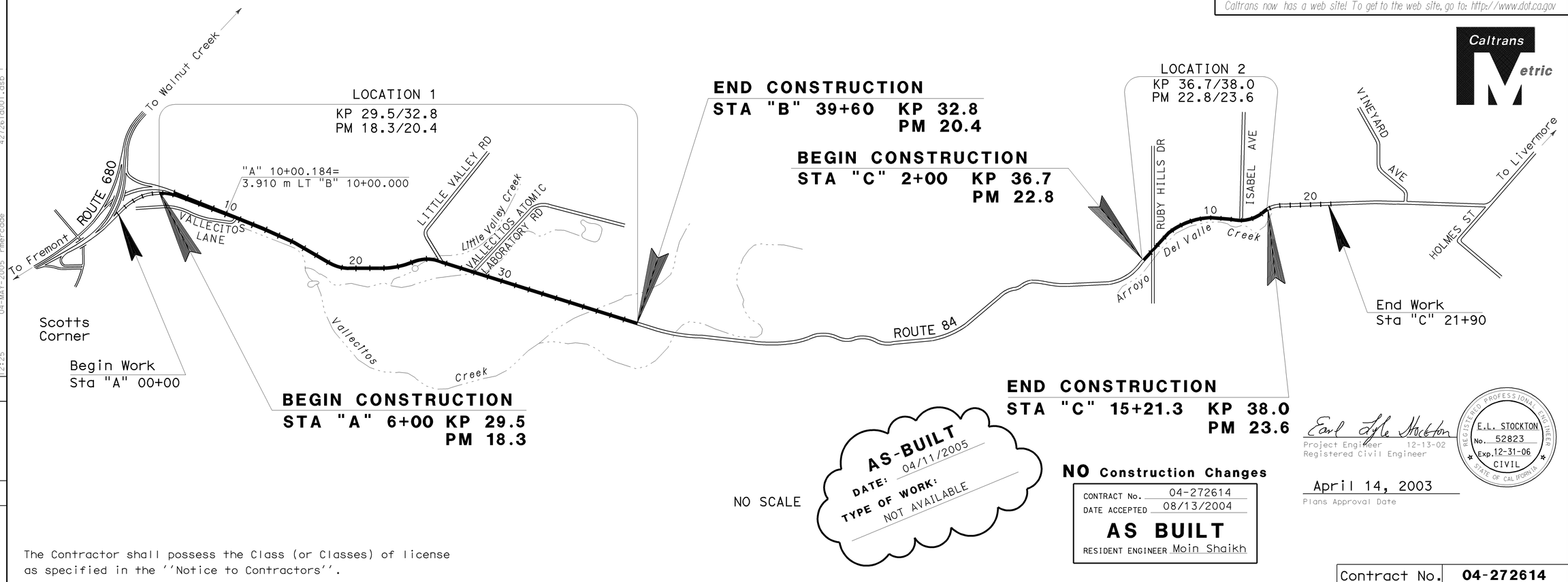
Caltrans Metric



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

FORM DC-OE-93-PF (REV. 3/88)

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

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DGN FILE => 427261a001.asb

CU 03258 EA 272611

04-MAY-2005 rmercade 12:25 427261a001.asb

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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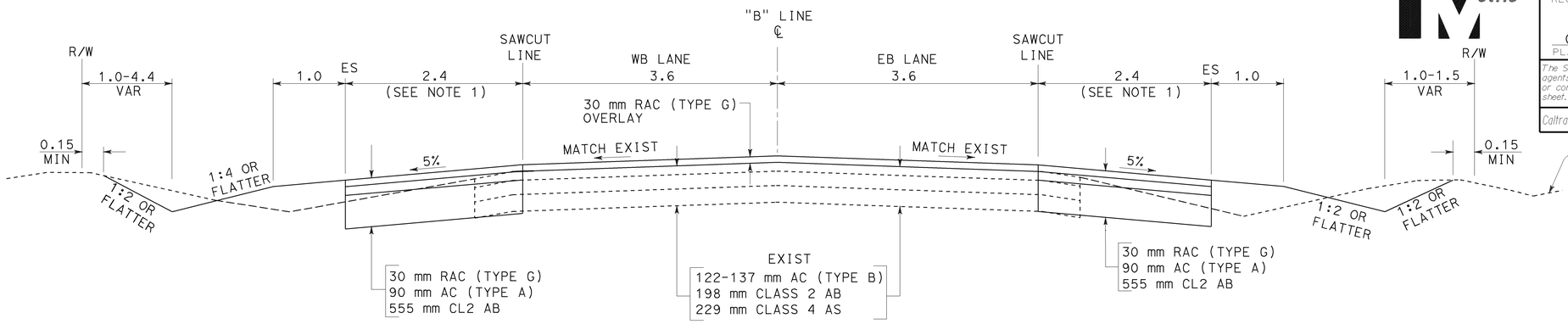
Caltrans Metric

LEGEND

RAC RUBBERIZED ASPHALT CONCRETE



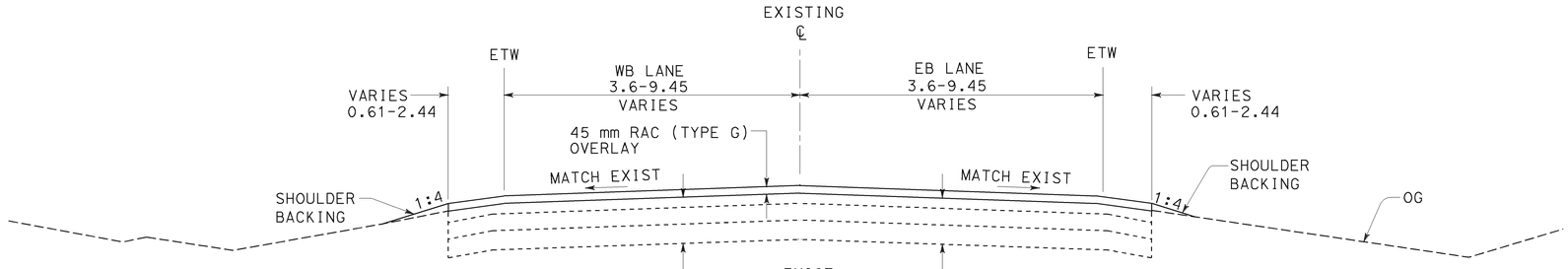
NOTES:

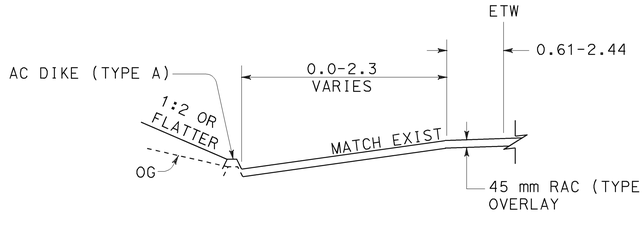
1. CONSTRUCT OUTSIDE SHOULDER WIDENING PRIOR TO PLACING RAC OVERLAY
2. DIMENSIONS OF THE STRUCTURAL SECTIONS ARE SUBJECT TO TOLERANCES SPECIFIED IN THE STANDARD SPECIFICATIONS.
3. SUPERELEVATION AS SHOWN OR AS DIRECTED BY THE ENGINEER.

ROUTE 84

OUTSIDE SHOULDER WIDENING AND RAC OVERLAY

STA "B" 30+10 TO 39+60



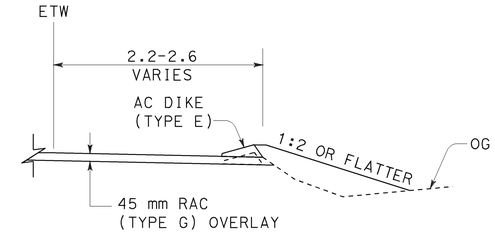


STA "B" LT 10+00 TO 13+43.7
STA "B" LT 22+75.5 TO 24+13.2

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
DESIGN BRANCH 8

Caltrans

04-MAY-2005 rmercade 427261b001.asb 12:26

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TIME PLOTTED => 12:26

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DGN FILE => 427261b001.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

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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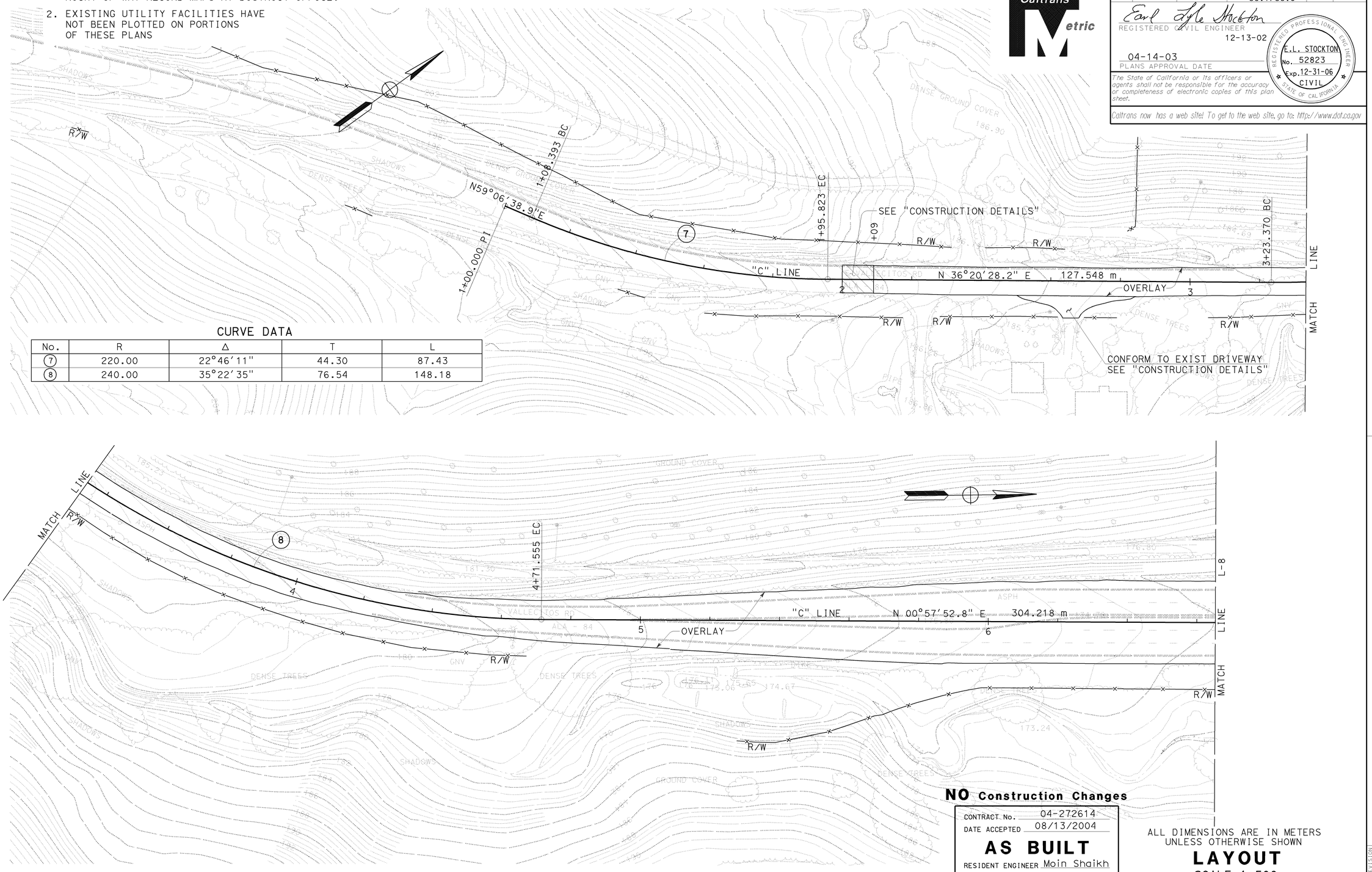

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(8)	240.00	35°22'35"	76.54	148.18

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

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
NORTH REGION
OFFICE OF DESIGN, WEST
DESIGN BRANCH S8

PROJECT ENGINEER
E.L. STOCKTON

DATE REVISED BY | DATE REVISED
CALCULATED/DESIGNED BY | CHECKED BY

LAST REVISION 00-00-00
DATE PLOTTED => 04-MAY-2005
TIME PLOTTED => 13:46

04-MAY-2005 rmercade 427261e007.asb 13:46

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => rmercade
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"

MATCH L-7 LINE

+87.8

+57.7

R/W

304.218 m

"C" LINE

N 00°57'52.8" E

OVERLAY

7+75.773 BC

+33.1

+97.6

"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-9 LINE

+99.1

11+22.869 EC

DIKE CONFORM SEE "CONSTRUCTION DETAILS"

4.3

2.9

"C" LINE

N 55°20'12.2" E 262.606 m

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)

DENSE GROUND COVER

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
CALCULATED/ DESIGNED BY		
CHECKED BY		

PROJECT ENGINEER
E.L. STOCKTON

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
NORTH REGION
OFFICE OF DESIGN, WEST
DESIGN BRANCH 58

Caltrans

04-MAY-2005 rmercade 427261e008.asb 14:04

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

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

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

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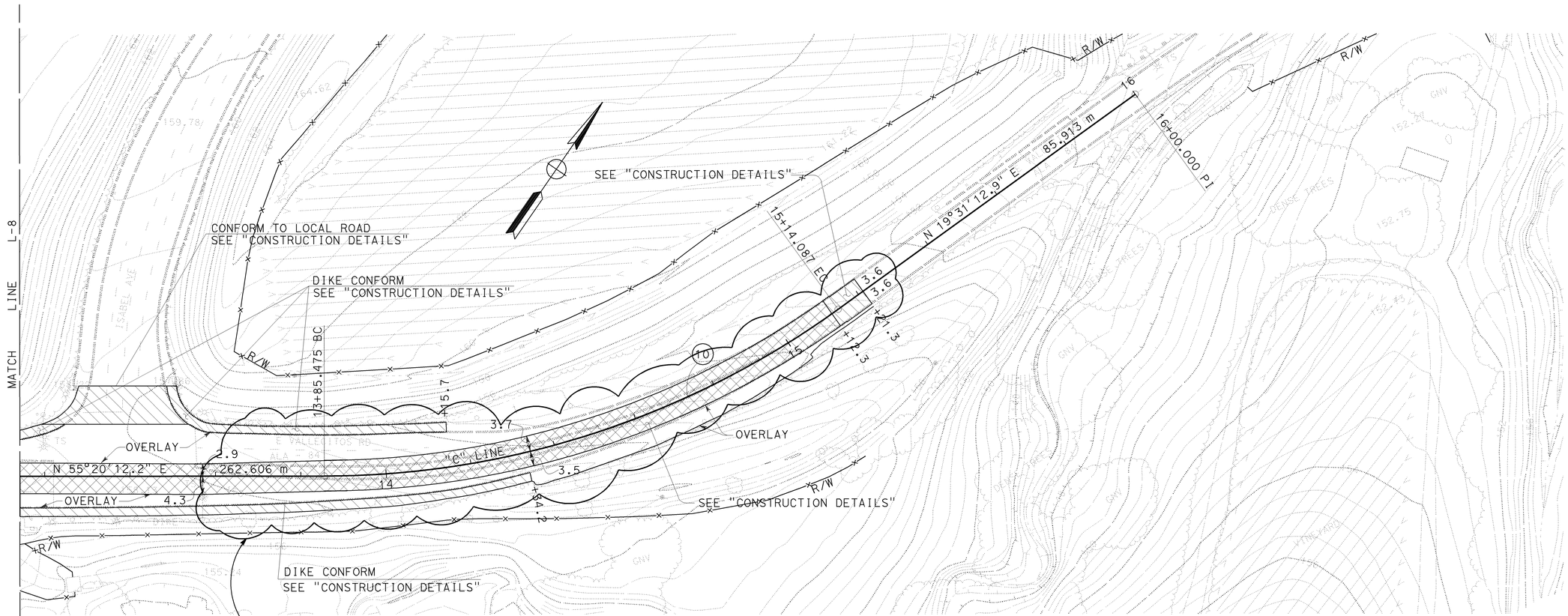
(10)	205.74	35°48'57"	66.48	128.61



Resident Engineer Responsible for *Construction Changes*

CONTRACT No. 04-272614
DATE ACCEPTED 08/13/2004
AS BUILT
RESIDENT ENGINEER Moin Shaikh
SIGNATURE 01/11/05 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
CALCULATED/DESIGNED BY | CHECKED BY
PROJECT ENGINEER: E.L. STOCKTON
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
NORTH REGION
OFFICE OF DESIGN, WEST
DESIGN BRANCH S8
Caltrans

427261e009.asb 04-MAY-2005 rmercade 14:58

LAST REVISION 00-00-00 DATE PLOTTED => 04-MAY-2005 TIME PLOTTED => 14:58

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => rmercade
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
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
E.L. STOCKTON
No. 52823
Exp.12-31-06
CIVIL
STATE OF CALIFORNIA

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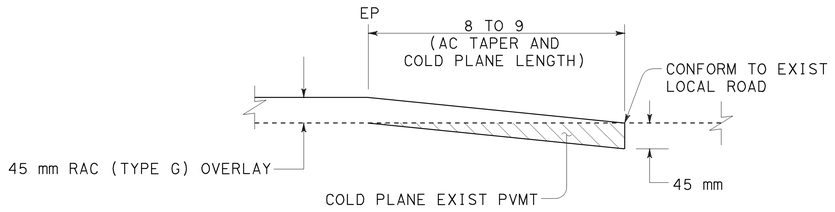
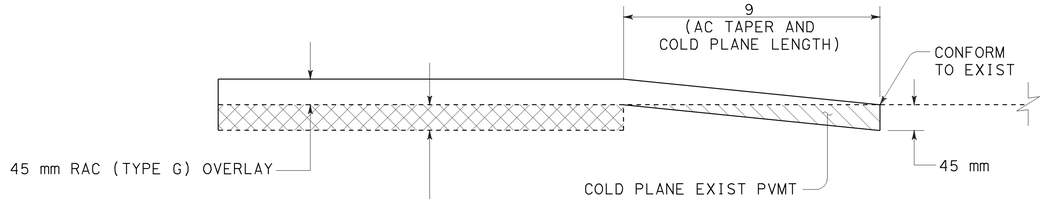
NOTE: CONTRACTOR SHALL VERIFY THE EXACT LOCATIONS OF PAVEMENT REMOVAL. NEW AC OVERLAY SHALL CONFORM TO EXISTNG AC. PAVEMENT TRANSITION SHALL BE PROVIDED BEFORE OPENING TRAFFIC LANES TO THE PUBLIC DURING ANY STAGE CONSTRUCTION.

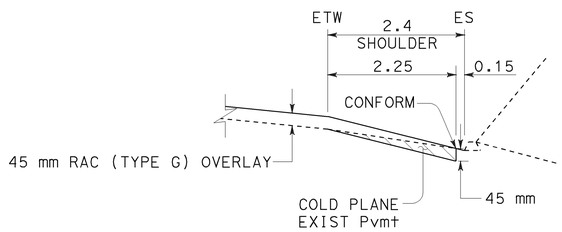


CONFORM TO LOCAL ROADS

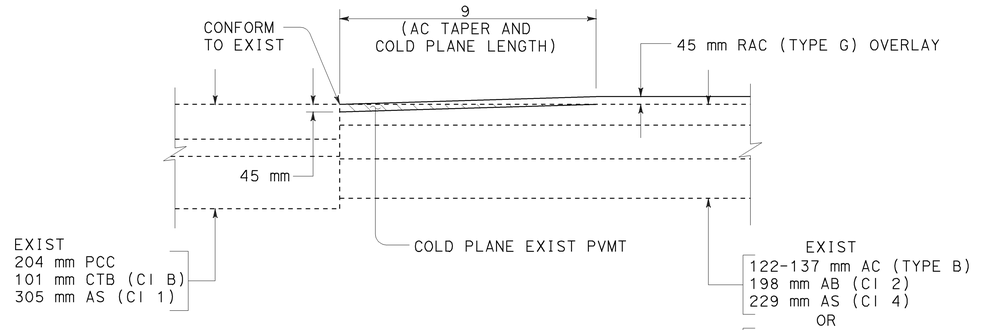


*COLD PLANE EXISTING AC PAVEMENT 45 mm DEEP AND PAVE WITH 45 mm AC (TYPE A) PRIOR TO RAC OVERLAY. SEE LAYOUT SHEETS FOR LIMITS.

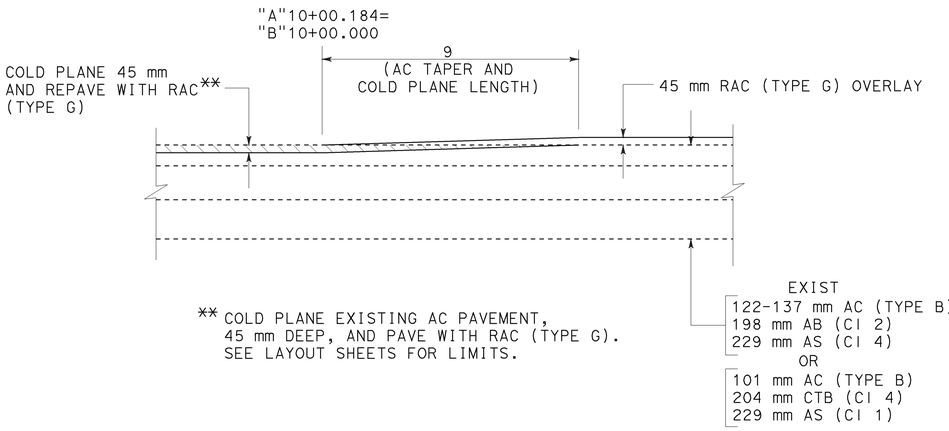
STA "C" 12+10.6 TO 15+21.3



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

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
DESIGN BRANCH 8

04-MAY-2005 14:58 rmercade 427261g001.asb

LAST REVISION 00-00-00 | DATE PLOTTED => 04-MAY-2005 | TIME PLOTTED => 14:58

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => rmercade
DGN FILE => 427261g001.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	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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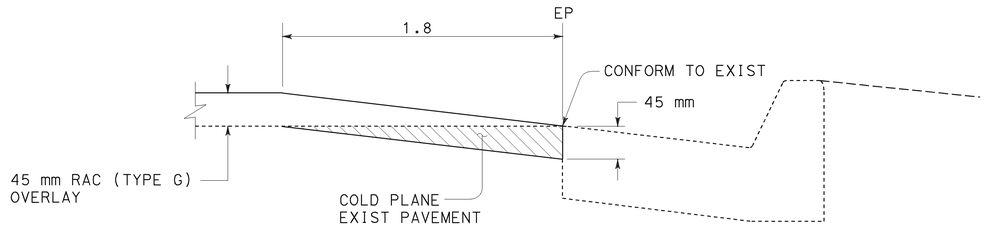
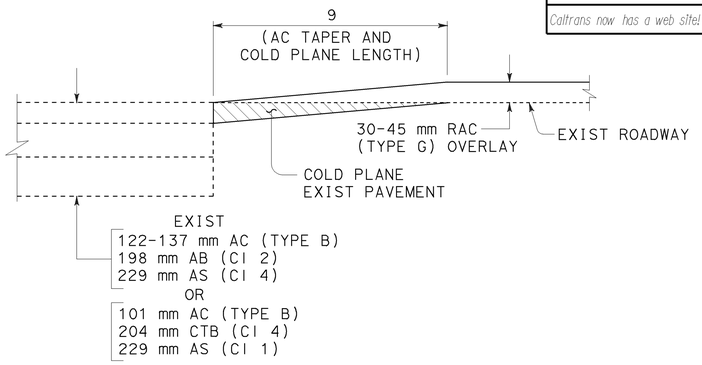
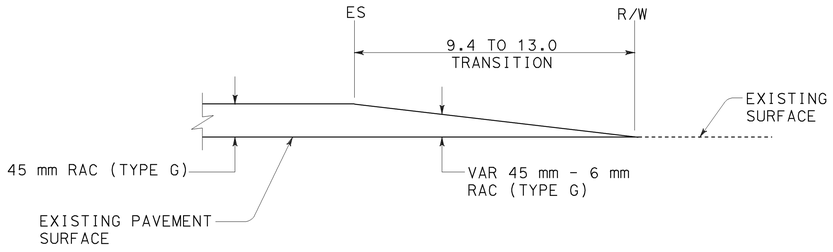


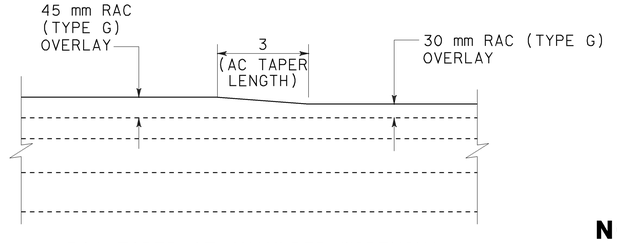
CURB & GUTTER CONFORM



CONFORM TO EXIST ROADWAY
STA "B" 39+60 TO 39+69
STA "C" 2+00 TO 2+09



CONFORM TO EXIST DRIVEWAY



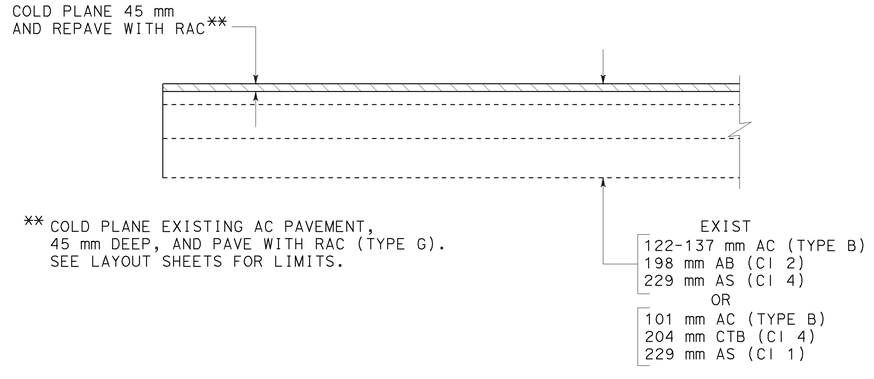
RAC TAPER AT SHOULDER WIDENING
STA "B" 30+07 TO 30+10

NO Construction Changes

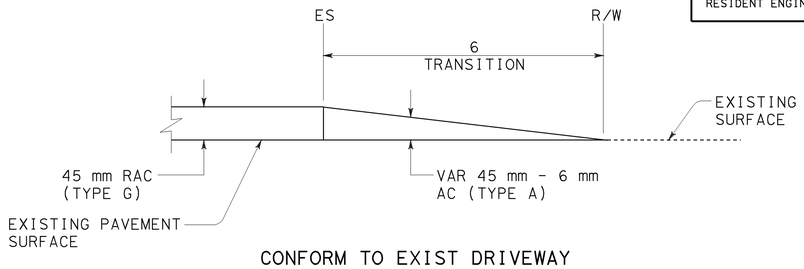
CONTRACT No. 04-272614
DATE ACCEPTED 08/13/2004

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
CALCULATED/ DESIGNED BY | CHECKED BY
PROJECT ENGINEER | E.L. STOCKTON
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
NORTH REGION
OFFICE OF DESIGN, WEST
DESIGN BRANCH S8
Caltrans

04-MAY-2005 rmercade 427261g002.asb 15:00

LAST REVISION 00-00-00 DATE PLOTTED => 04-MAY-2005 TIME PLOTTED => 15:00

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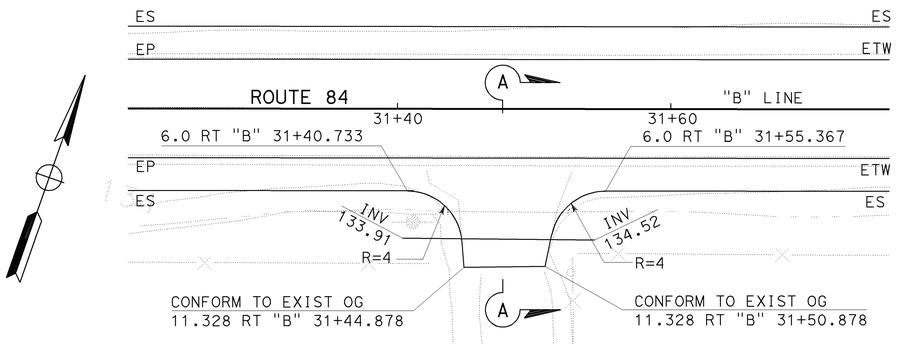
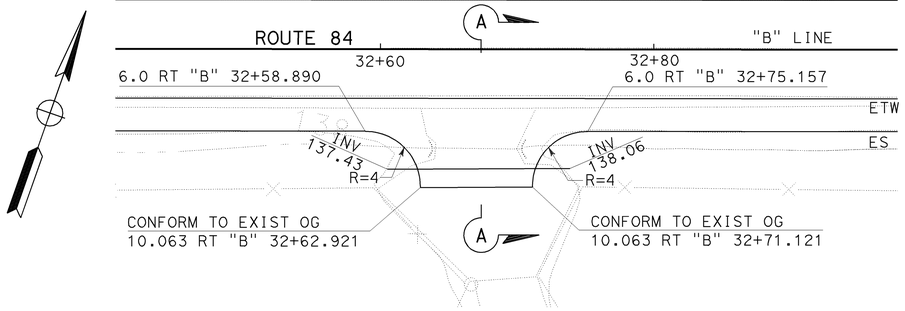
USERNAME => rmercade
DGN FILE => 427261g002.asb

CU 03258

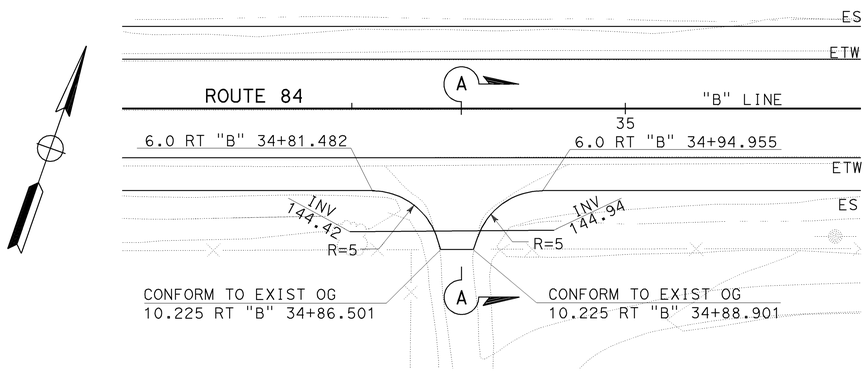
EA 272611



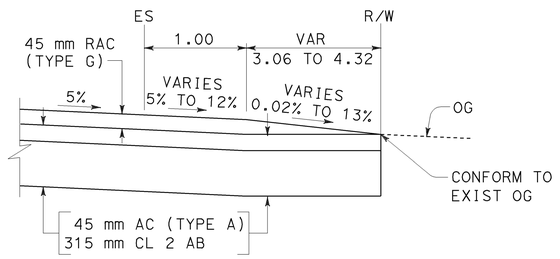
PLAN



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
UNLESS OTHERWISE SHOWN

CONSTRUCTION DETAILS

NO SCALE

C-3

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
CIVIL
STATE OF CALIFORNIA

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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
DESIGN BRANCH S8

Caltrans

427261g003.asb
04-MAY-2005 rmercade
15:01

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USERNAME => rmercade
DGN FILE => 427261g003.asb

CU 03258

EA 272611

LAST REVISION 00-00-00
DATE PLOTTED => 04-MAY-2005
TIME PLOTTED => 15:01

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO	TOTAL SHEETS
04	Ala	84	29.5/32.8, 36.7/38.0	15	40

Caltrans Metric

Earl Lyle Stockton
REGISTERED CIVIL ENGINEER
12-13-02

04-14-03
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
E.L. STOCKTON
No. 52823
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STATE OF CALIFORNIA

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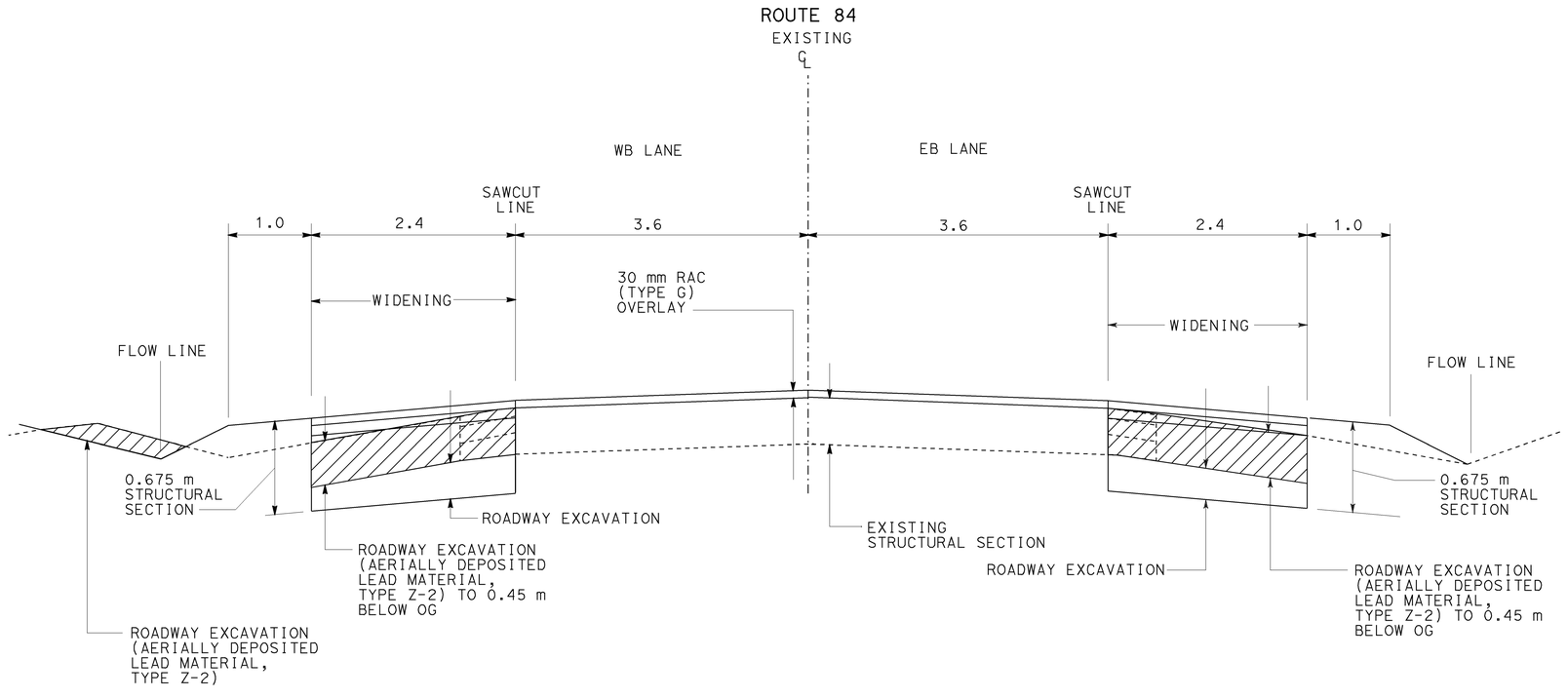
LEGEND

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
UNLESS OTHERWISE SHOWN

CONSTRUCTION DETAILS

NO SCALE

C-4

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
DESIGN BRANCH S8

Caltrans

04-MAY-2005 rmercade 427261g004.dsb 15:02

LAST REVISION 00-00-00 DATE PLOTTED => 04-MAY-2005 TIME PLOTTED => 15:02

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => rmercade
DGN FILE => 427261g004.asb

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

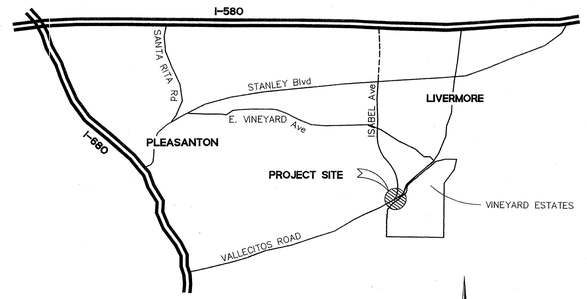
PROJECT PLANS FOR CONSTRUCTION ON

ISABEL AVENUE / VALLECITOS ROAD INTERSECTION REALIGNMENT

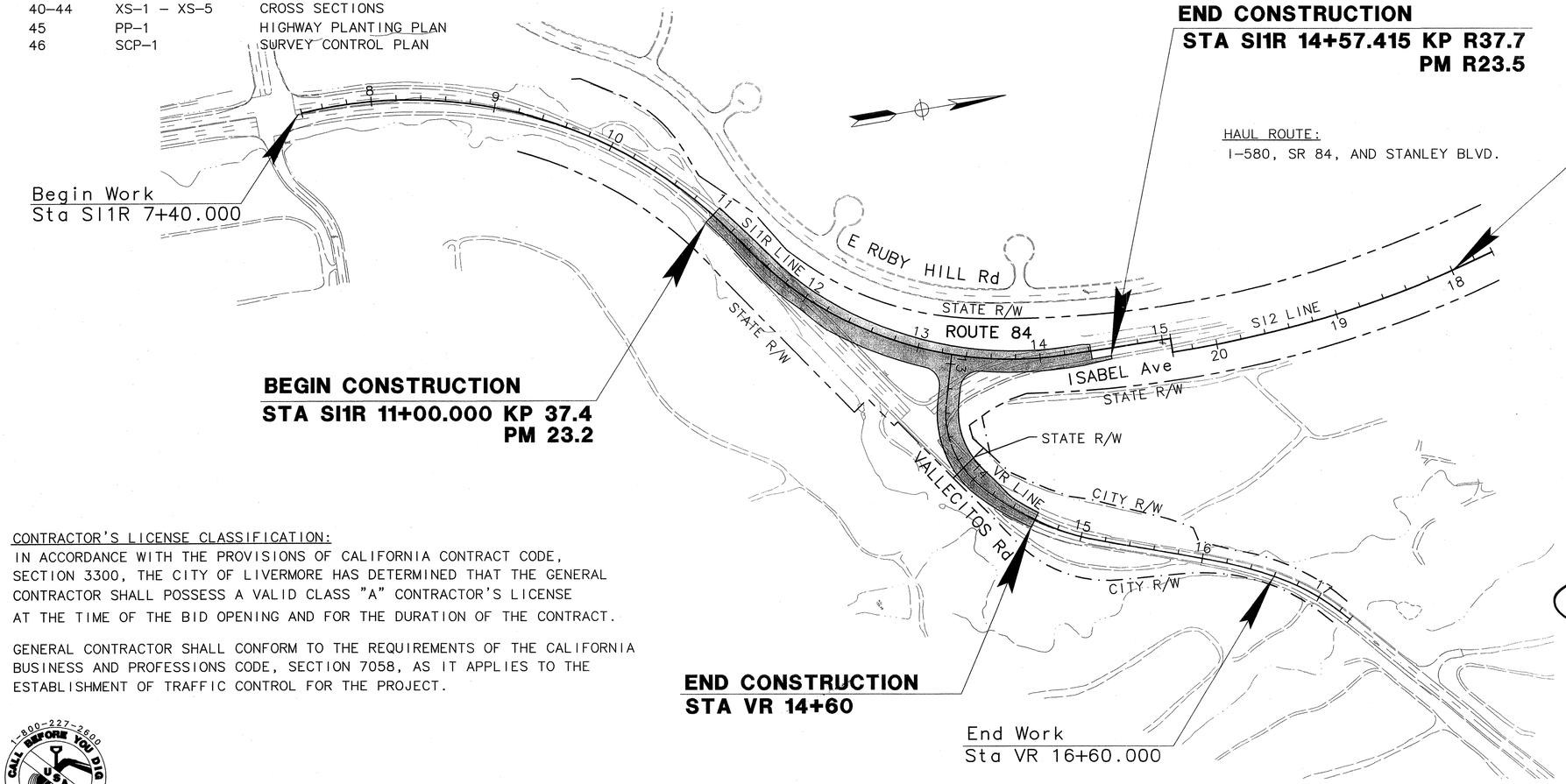
PROJECT No. 1999-13

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 MP 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 Stamm
DATE 7-31-07

1-800-227-2600 CALL BEFORE YOU DIG — 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

P:\Eng\47045\DWG\TITLE\T-1.dwg 27 Feb 2006 1:33:27pm eahu

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	
	GUARD RAILING	
	TRAFFIC SIGNAL	
	SIGNAL	
	ELECTRICAL BOX	
	TREE	
	FLARED END SECTION	
	MANHOLE	

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.

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

RECORD DRAWING
CITY OF LIVERMORE ENGINEERING DIVISION
BY
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

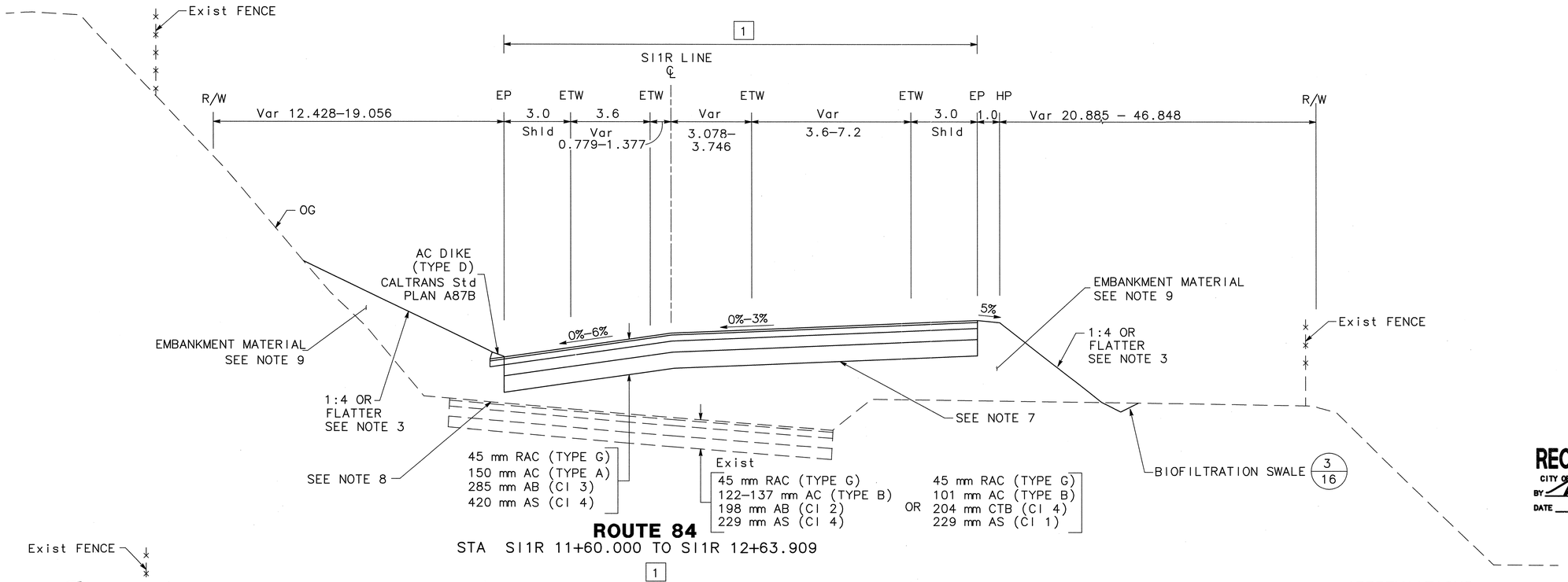
PROJECT ENGINEER ______ DATE
CHECKED ______ DATE

ISABEL AVENUE / VALLECITOS ROAD
INTERSECTION REALIGNMENT PROJECT
NOTES/ABBREVIATION/LEGEND
X–1

CITY OF LIVERMORE, CALIFORNIA – INCORPORATED 1876 – COUNTY OF ALAMEDA

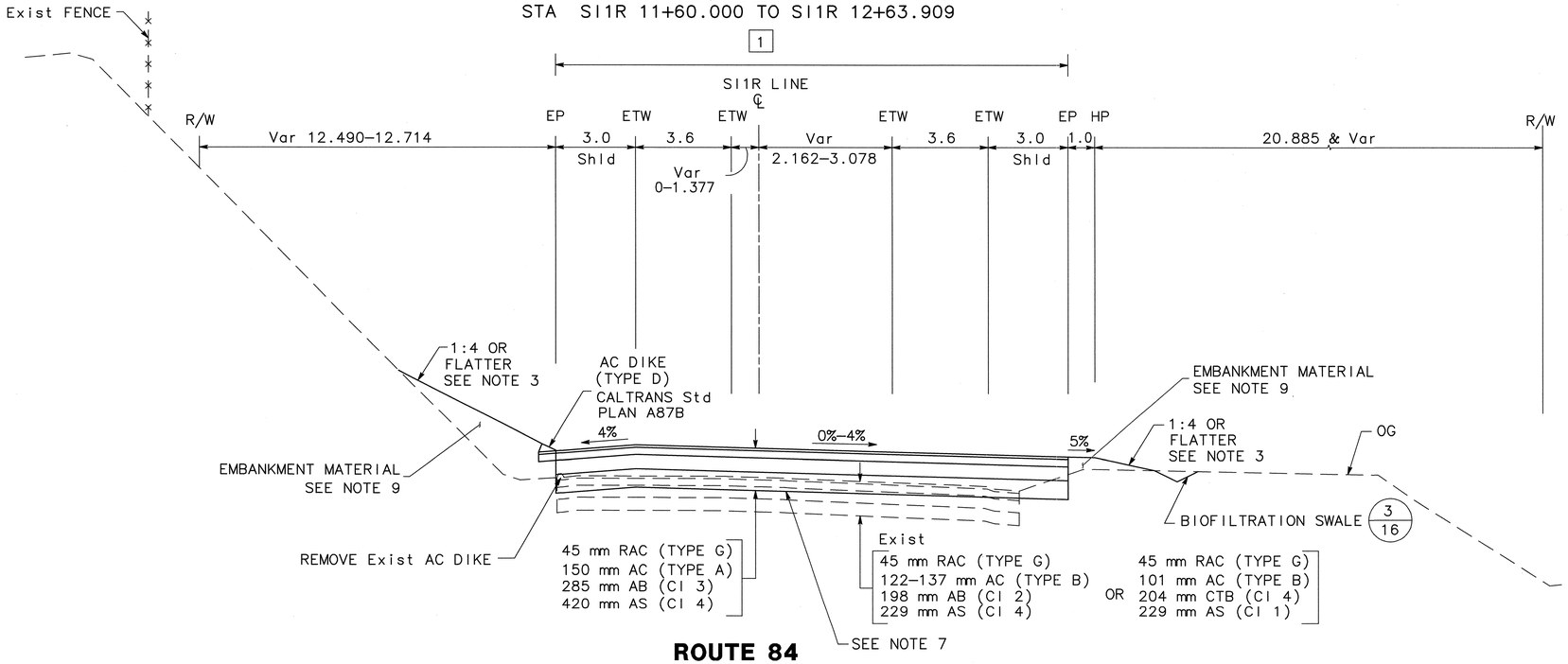
CITY OF LIVERMORE
COMMUNITY DEVELOPMENT DEPARTMENT
ENGINEERING DIVISION

SCALE: NO SCALE	DATE: 03/16/06	SHEET	OF
DRAWN:	PROJECT NO.	2	46



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 — GUY L. BERNARD — 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, 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.	3	46

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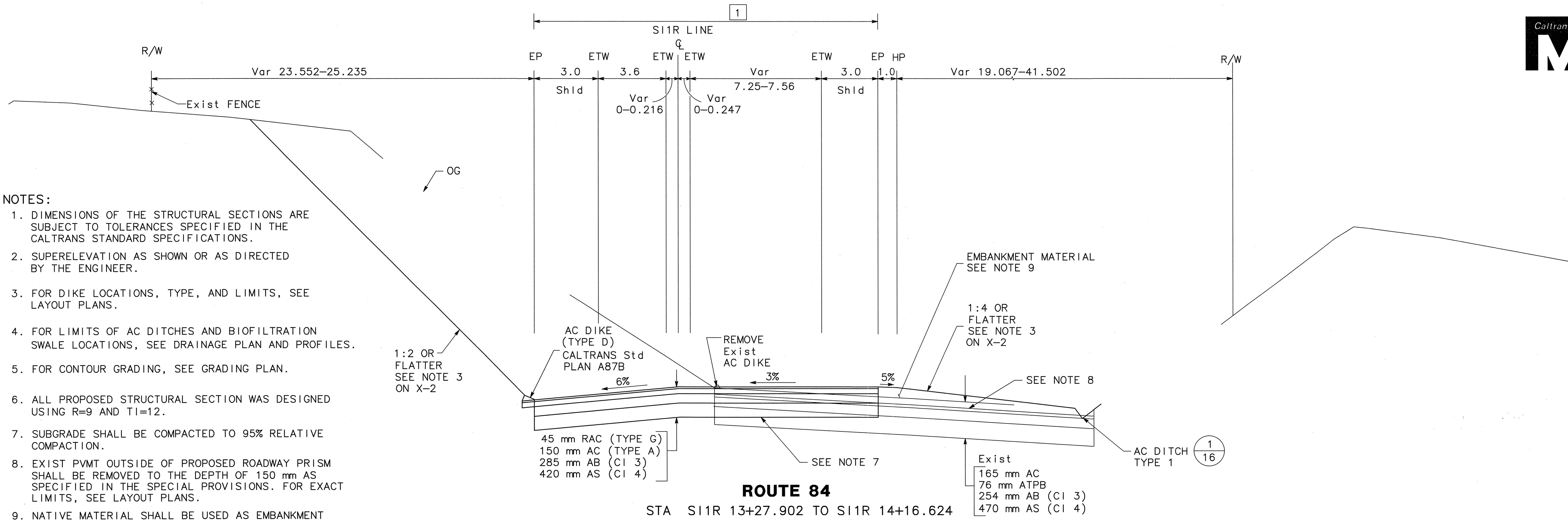

NOTES:

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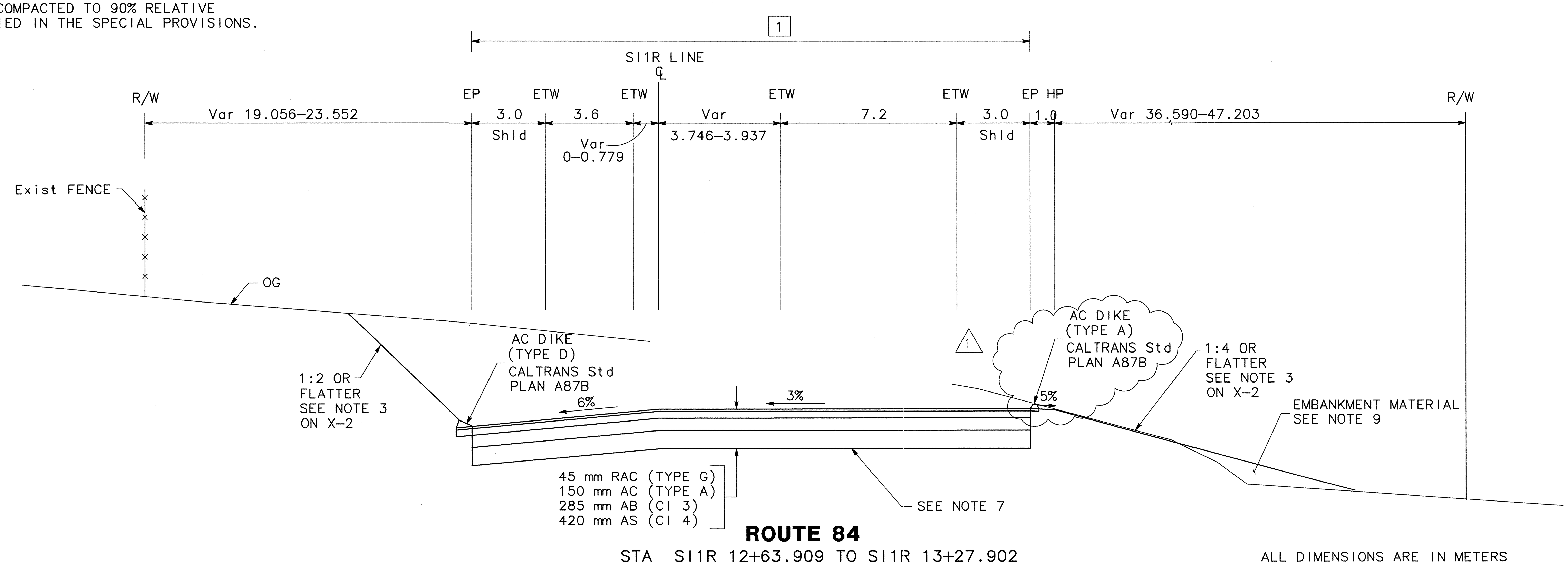

FOR NOTES, LEGEND AND ABBREVIATIONS, SEE SHEETS 2 & 3.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

1-800-227-2600 CALL BEFORE YOU DIG — UNDERGROUND SERVICE ALERT

RECORD DRAWING
CITY OF LIVERMORE ENGINEERING DIVISION
BY [signature]
DATE 7·31·07

BKF ENGINEERS | SURVEYORS | PLANNERS
4780 CHABOT DRIVE, SUITE 104
PLEASANTON, CA.
(925) 396-7700

⚠1 ADDENDUM NO. 1	3/16/06	
REVISIONS	DATE	BY

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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NOTES:

1. DIMENSIONS OF THE STRUCTURAL SECTIONS ARE SUBJECT TO TOLERANCES SPECIFIED IN THE CALTRANS STANDARD SPECIFICATIONS.
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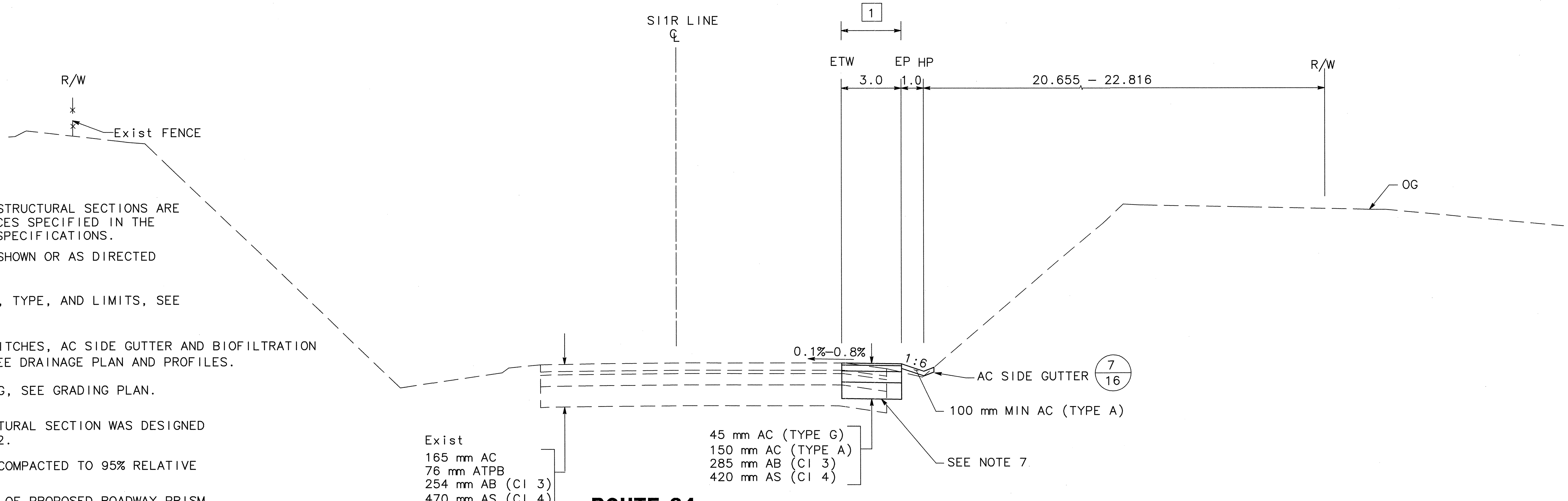
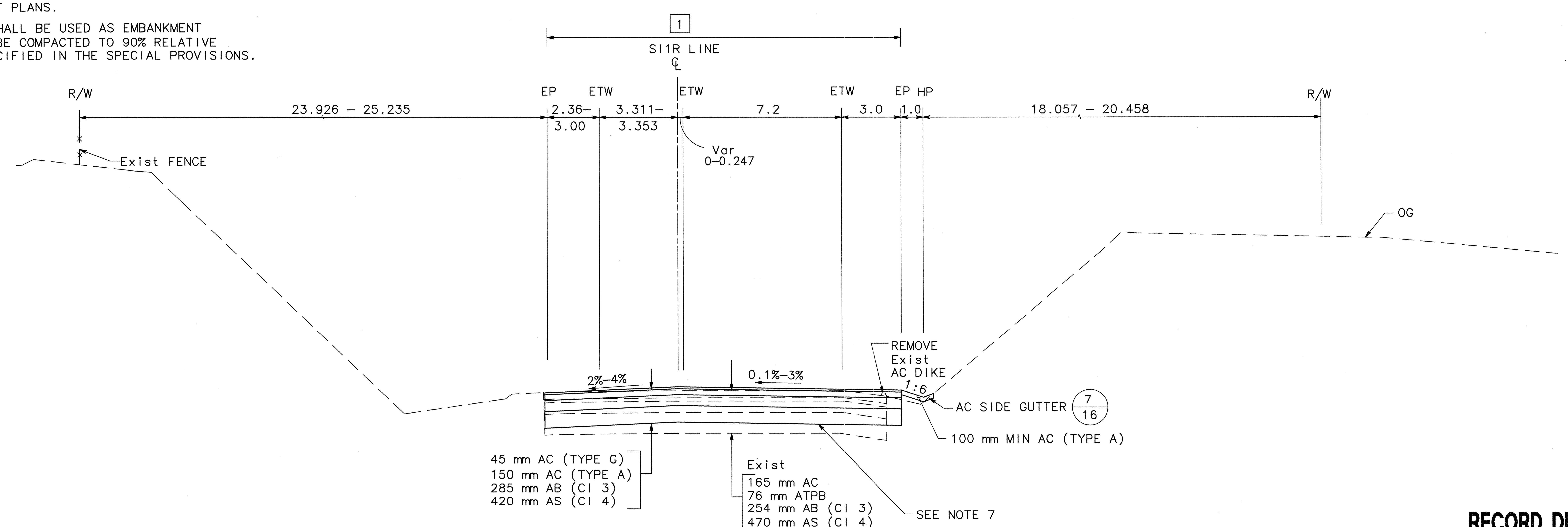


ROUTE 84

STA SI1R 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

Caltrans Metric

RECORD DRAWING
CITY OF LIVERMORE ENGINEERING DIVISION
BY [signature]
DATE 7-31-07

V. BERNARDO, No. 45407, Exp. 9/30/0?, 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-4

CITY OF LIVERMORE
COMMUNITY DEVELOPMENT DEPARTMENT
ENGINEERING DIVISION

SCALE: NO SCALE	DATE: 03/16/06	SHEET	OF
DRAWN:	PROJECT NO.	5	46

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NOTES:

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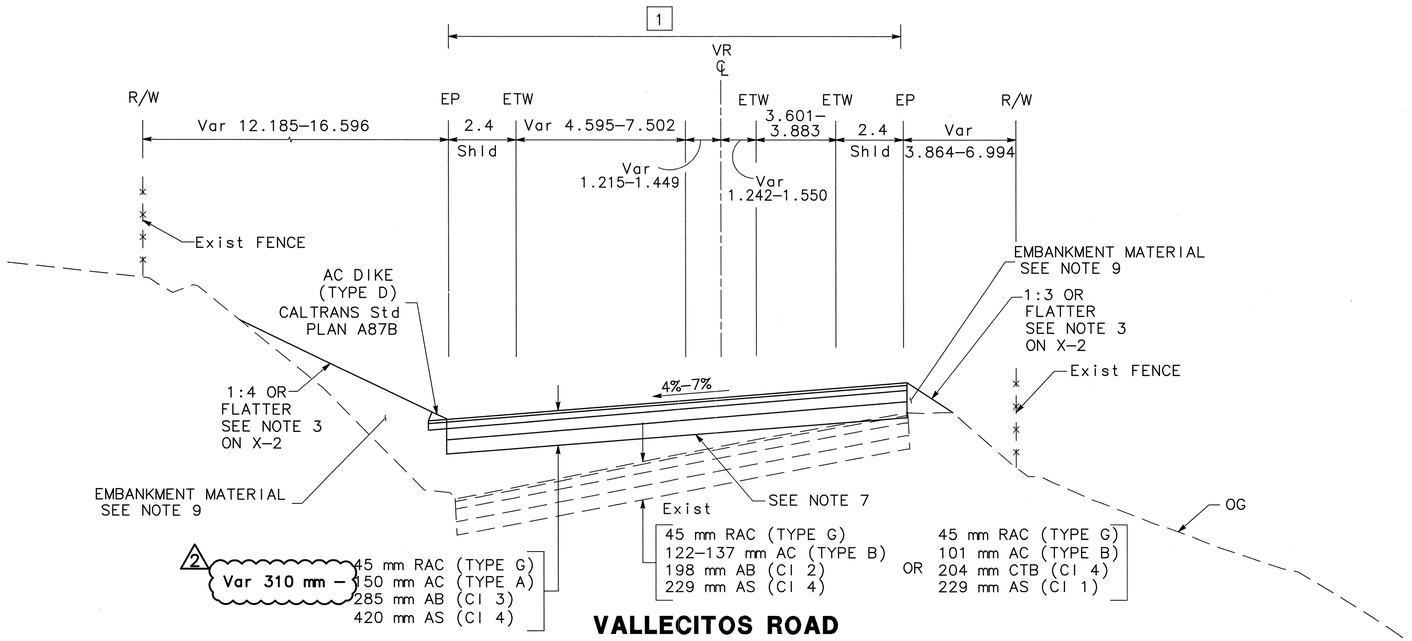
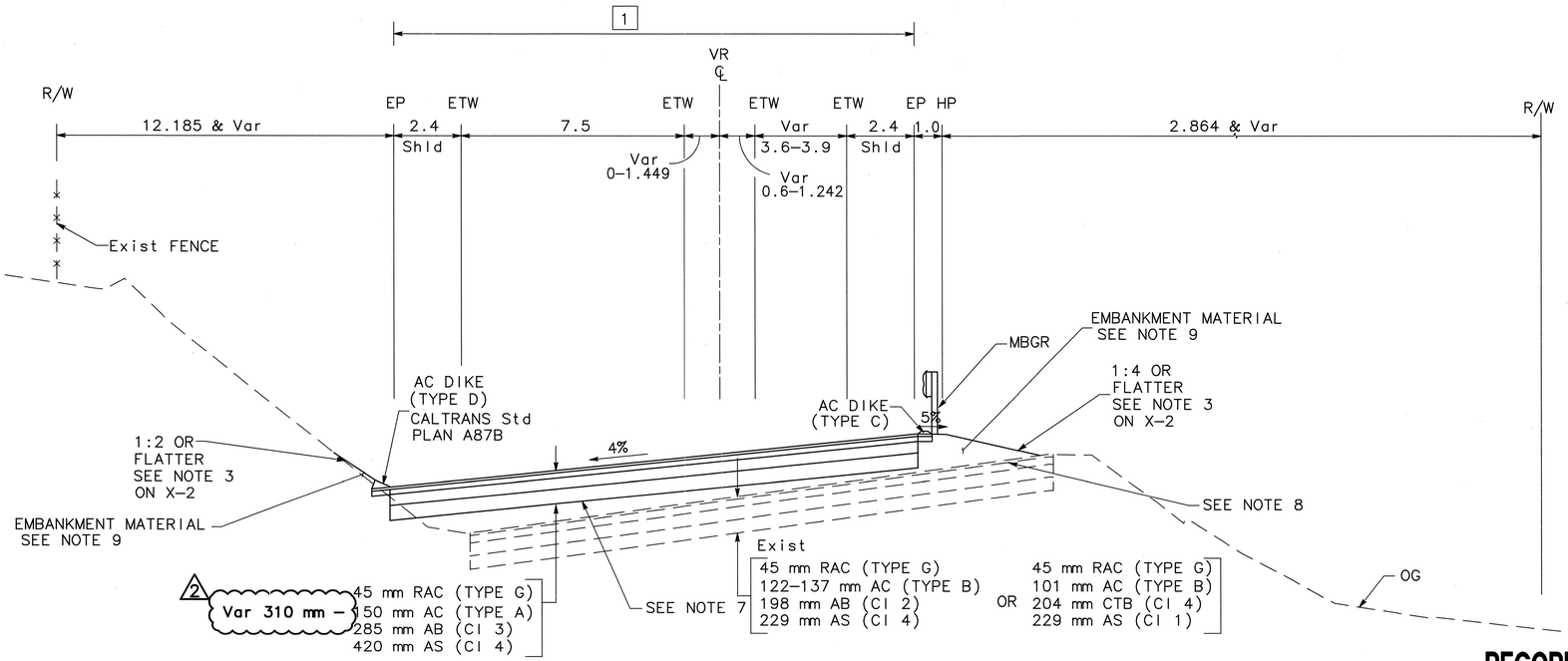


VALLECITOS ROAD

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 Mark Steen
DATE 7-31-07

CALL BEFORE YOU DIG 1-800-227-2600 USA UNDERGROUND SERVICE ALERT

REGISTERED PROFESSIONAL ENGINEER — No. 25407 — V. BERNARDO — CIVIL — STATE OF CALIFORNIA — 9/30/06

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, 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.	6	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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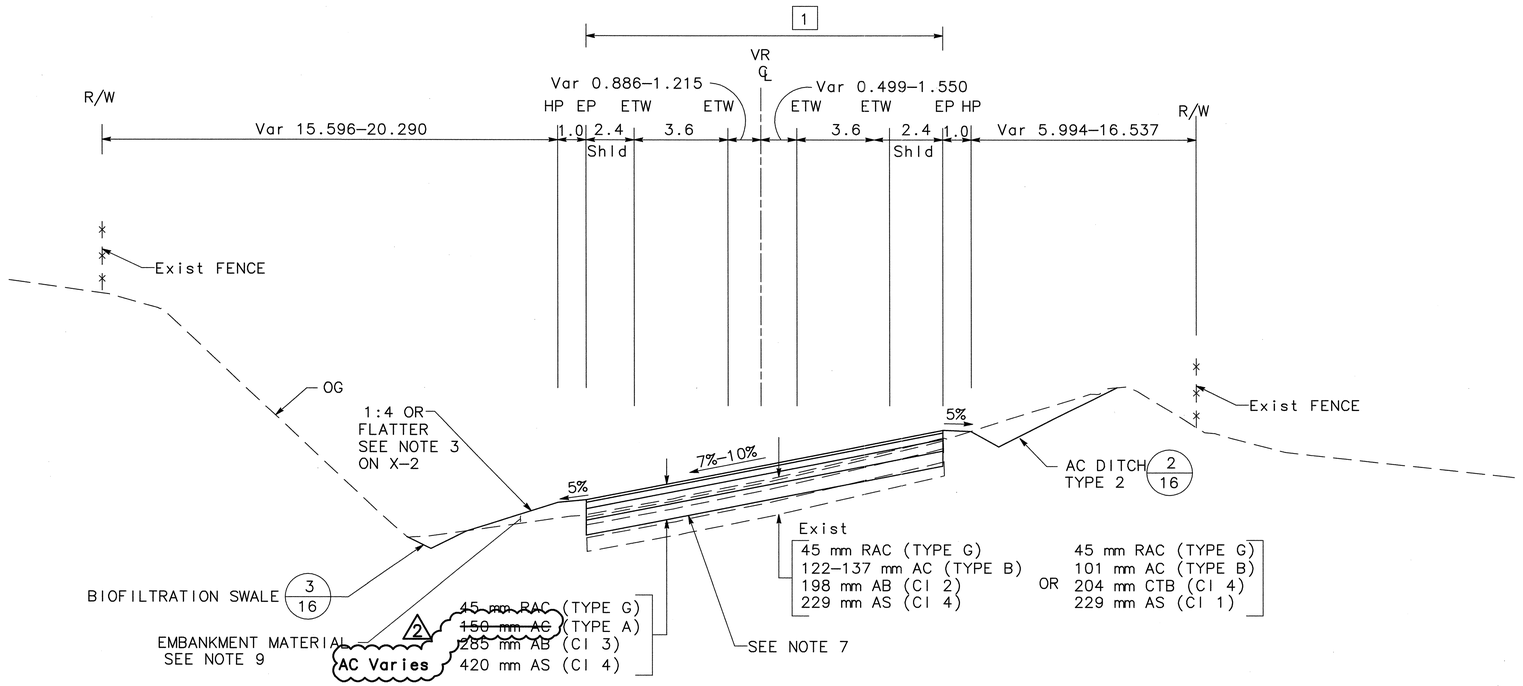
3. FOR DIKE LOCATIONS, TYPE, AND LIMITS, SEE LAYOUT PLANS.
4. FOR LIMITS OF AC DITCHES AND BIOFILTRATION SWALE LOCATIONS, SEE DRAINAGE PLAN AND PROFILES.
5. FOR CONTOUR GRADING, SEE GRADING PLAN.
6. ALL PROPOSED STRUCTURAL SECTION WAS DESIGNED USING R=9 AND TI=12.
7. SUBGRADE SHALL BE COMPACTED TO 95% 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 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

CALL BEFORE YOU DIG 1-800-227-2600 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\04704AS-BUILTS - 07230T\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
SI1R LINE
13.774 Rt SI1R 12+29.786
END 36 m BAY TAPER
NEW MBGR
REMOVE RAIL
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 11E 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 11E 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
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
EC
AC DIKE (TYPE C)
VR 13+75.616
END MBGR (TYPE 11E LAYOUT)
TERMINAL SYSTEM (TYPE SRT)
CALTRANS Std PLAN A77E2
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
5.506 Lt SI1R 14+41.397
CONFORM
SI2 20+36.360 BC
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
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
CONFORM LIMIT
15+06.876
S 00°50'19" W 84.999
ISABEL AVENUE
SI1R 15+06.876 POT=
20+36.360
11.099 Rt SI2 20+36.360 BC
ROUTE 84
STATE R/W
CITY R/W
VALLECITOS ROAD
VR LINE
ESA
TFESA
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)
CONFORM LIMIT
RECORD DRAWING
CITY OF LIVERMORE ENGINEERING DIVISION
BY Mike Stern
DATE 7-31-07
ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN
FOR NOTES, LEGEND AND ABBREVIATIONS, SEE SHEET 2.
1-800-227-2600 CALL BEFORE YOU DIG UNDERGROUND SERVICE ALERT
P:\Engdv\04704\AS-BUILTS - 07350\SHEETS\LAYOUTV-1.dwg 23 Jul 2007 6:13:28pm clem

REVISIONS	DATE	BY
1 ADDENDUM NO. 1	3/16/06	
2 AS-BUILT CHANGES	7/23/07	DN

PROJECT ENGINEER _____ DATE
CHECKED _____ DATE

REGISTERED PROFESSIONAL ENGINEER — N. C. BERNARDI — No. 45407 — Exp. 9/30/08 — CIVIL — STATE OF CALIFORNIA

BKF ENGINEERS / SURVEYORS / PLANNERS
4780 CHABOT DRIVE, SUITE 104
PLEASANTON, CA.
(925) 396-7700

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

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.

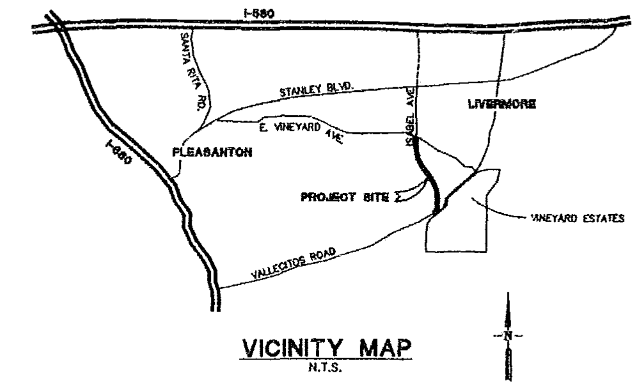
ELEVATION = 456.680 FEET (N.G.V.D. 1929)
ELEVATION = 139.196 meters (N.G.V.D. 1929)

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	SD
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.)	
WM	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	

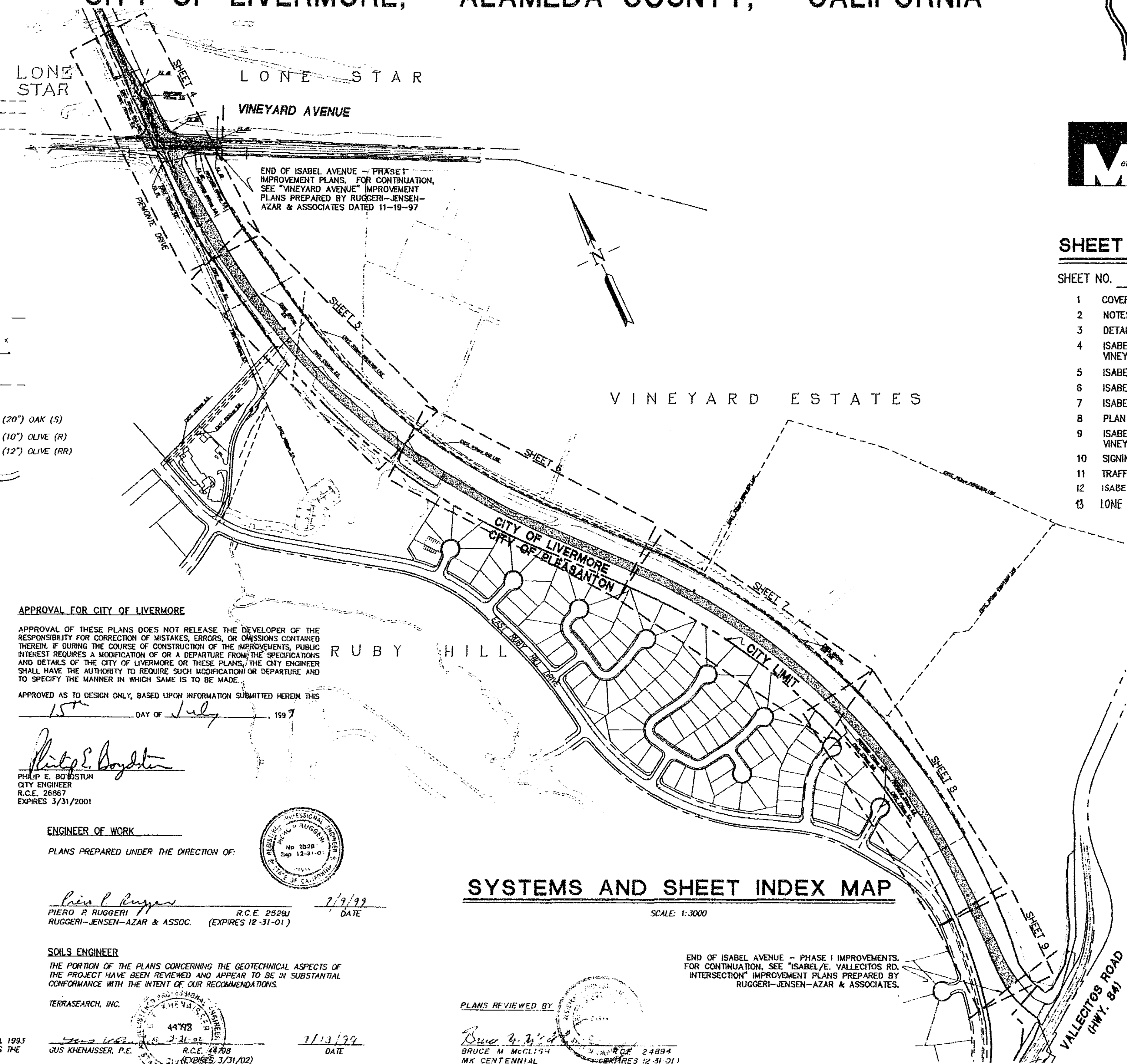
BASIS OF BEARINGS

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.



VICINITY MAP
N.T.S.

METRIC DIMENSIONS
DIMENSIONS SHOWN HEREON ARE IN METERS.
1 METER = 3.280833333 U.S. SURVEY FEET.



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
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 — 7/9/99
PIERO P. RUGGERI R.C.E. 25291 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)

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
R.C.E. 21155
EXPIRES 9-30-01

Ruggeri-Jensen-Azar & Associates
6601 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 — DRAWN — CHECKED — PROJ. MGR.

SHEET NO. 1 OF 11 SHEETS
JOB NO. 971038

123308

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

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

PERMIT # 8929
AS-BUILT

IMPROVEMENT PLAN NOTES

ISABEL AVENUE - PHASE I

CITY OF LIVERMORE, ALAMEDA COUNTY, CALIFORNIA
FOR: RUBY HILL DEVELOPMENT JOINT VENTURE, L.P.

Ruggeri - Jensen - Azar & Associates
8601 OWENS DRIVE, SUITE 155 • PLEASANTON, CA 94588
PHONE: (925) 227-9100 • FAX: (925) 227-9300

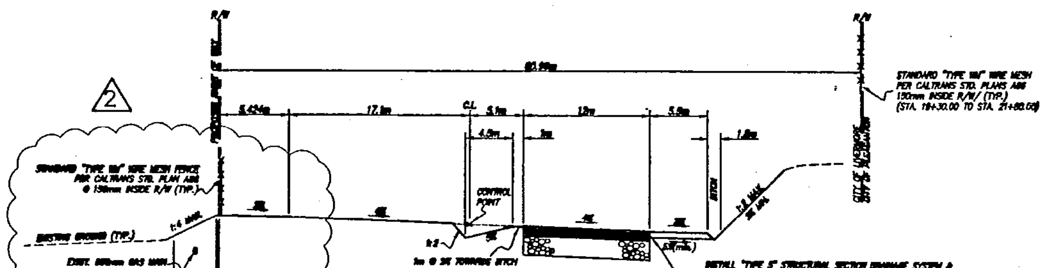
SHEET NO. 2 OF 12 SHEETS
JOB NO. 971038

123308

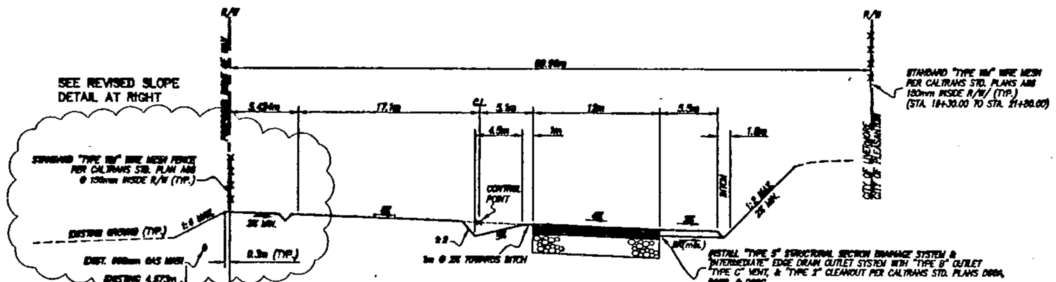
METRIC DIMENSIONS

DIMENSIONS SHOWN HEREON ARE IN METERS.
1 METER = 3.280833333 U.S. SURVEY FEET.

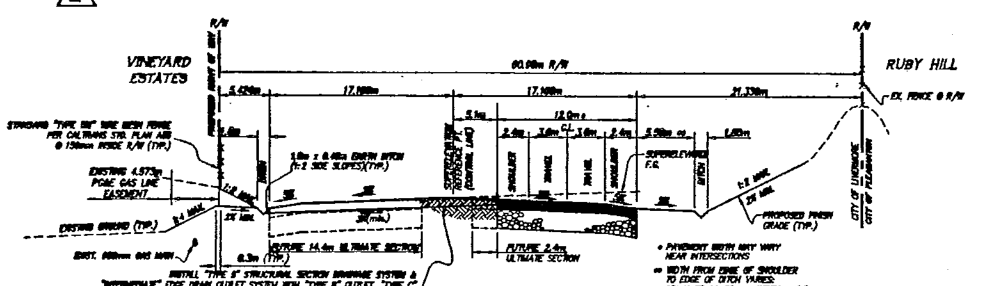
NOTE:
ALL SLOPES (i.e. 1:2) ARE REFERENCED AS A RATIO OF VERTICAL TO HORIZONTAL.



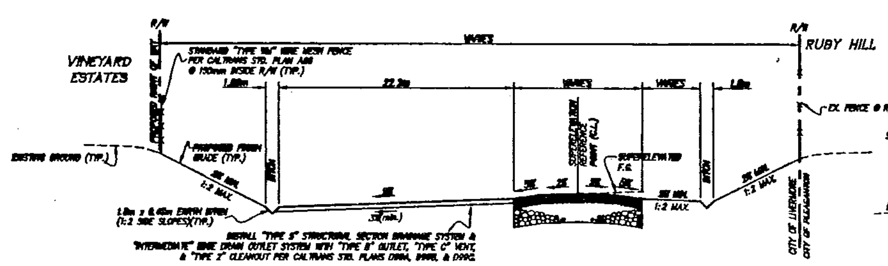
ISABEL AVENUE
NOT TO SCALE
STA. 16+80.000 TO STA. 19+59.211



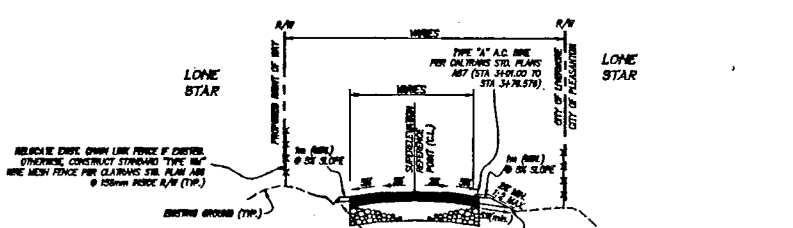
ISABEL AVENUE
NOT TO SCALE
STA. 12+77.540 TO STA. 16+80.000



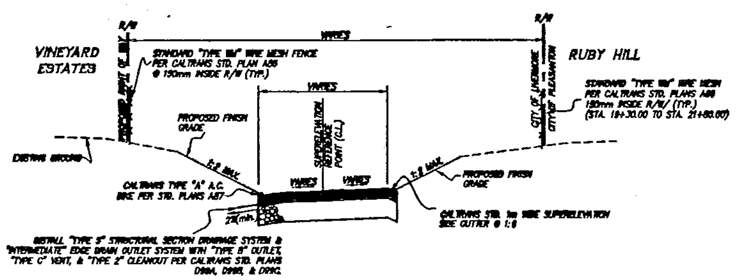
ISABEL AVENUE
NOT TO SCALE
STA. 7+48.802 TO STA. 12+77.540



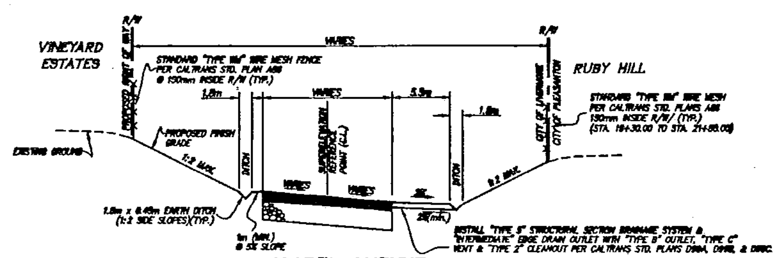
ISABEL AVENUE
NOT TO SCALE
STA. 4+01.000 TO STA. 7+48.802



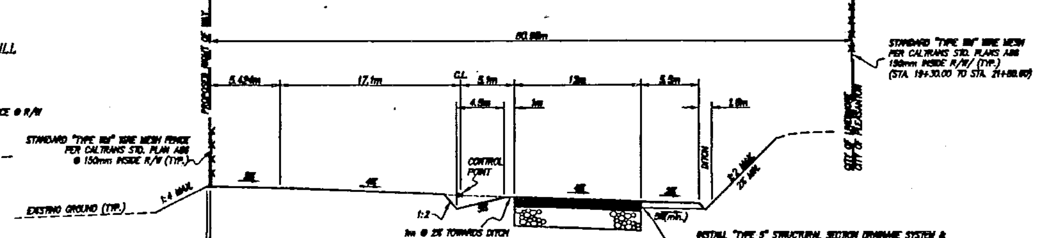
ISABEL AVENUE
NOT TO SCALE
STA. 2+41.183 TO STA. 4+01.000



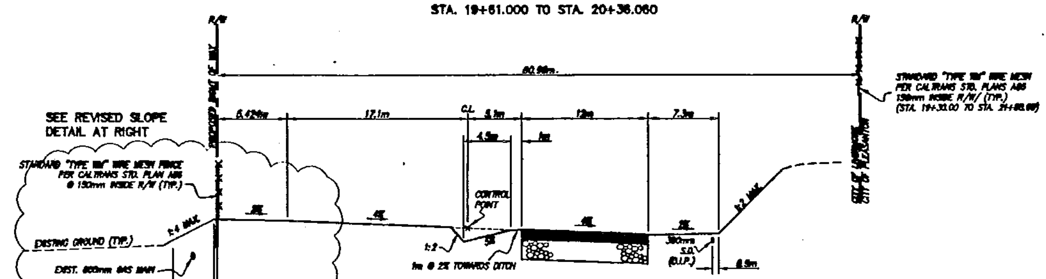
ISABEL AVENUE
NOT TO SCALE
STA. 21+07.775 TO STA. 21+80.00



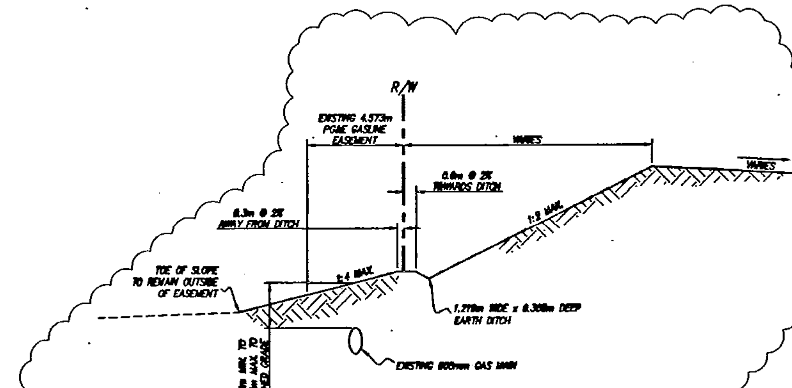
ISABEL AVENUE
NOT TO SCALE
STA. 20+36.060 TO STA. 21+07.775



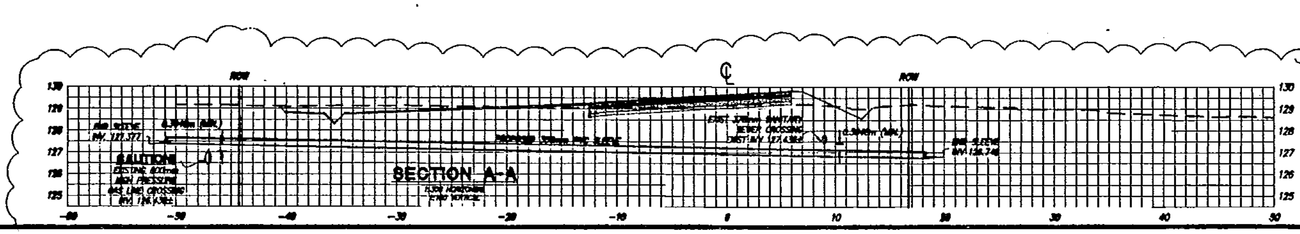
ISABEL AVENUE
NOT TO SCALE
STA. 19+61.000 TO STA. 20+36.060



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)



SECTION A-A

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+80.00 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+03.700	6	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 (m^3)	FILL (m^3)	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

REGISTERED PROFESSIONAL ENGINEER — PIERO P. RUGGERI — No. 25281 — Exp. 12-31-01 — CIVIL — STATE OF CALIFORNIA

Ruggeri-Jensen-Azar & Associates
6601 OWENS DRIVE, SUITE 155 • PLEASANTON, CA 94588
PHONE: (925) 227-9100 • FAX: (925) 227-9300

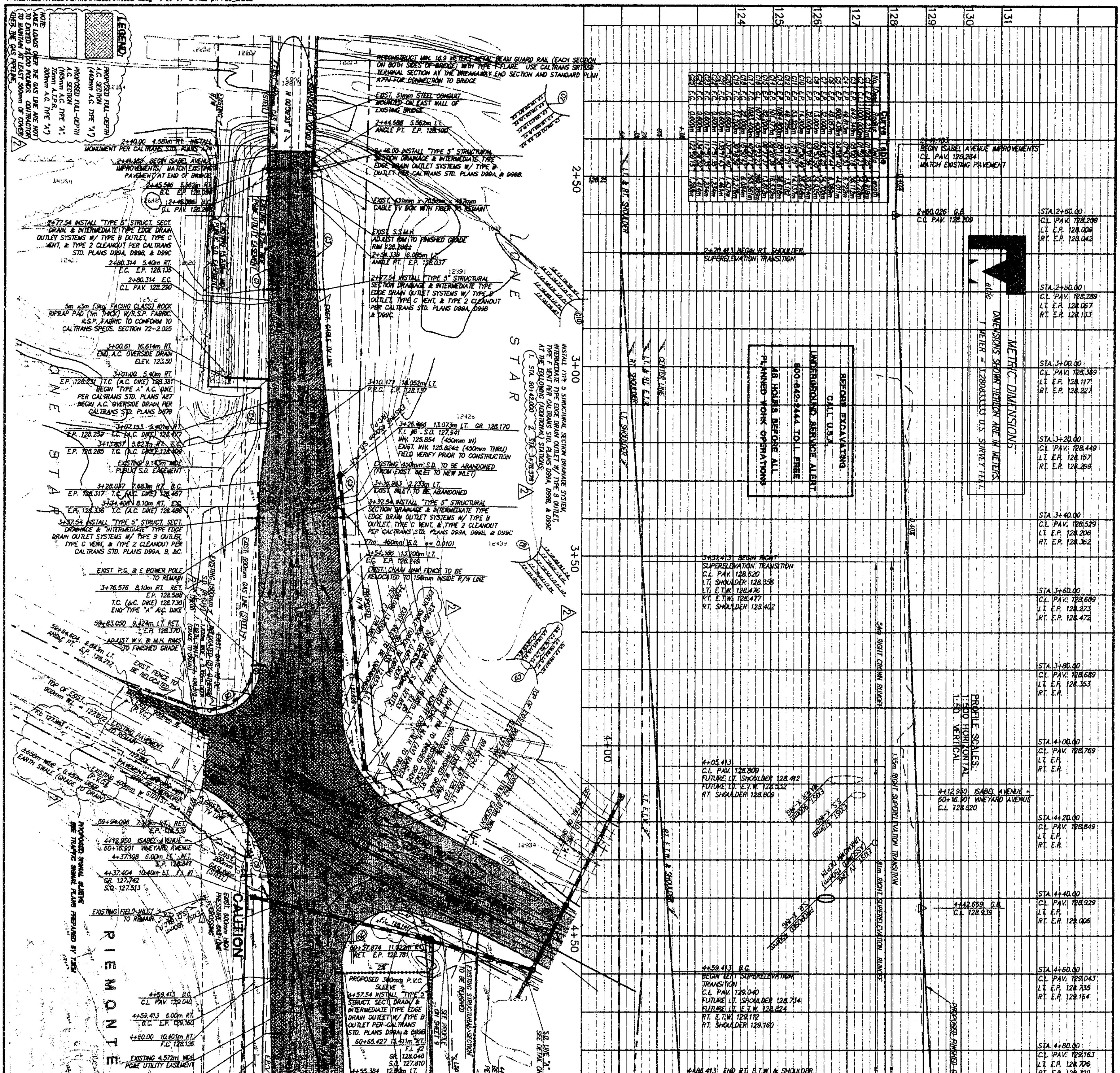
IMPROVEMENT PLAN
DETAILS
ISABEL AVENUE - PHASE I
CITY OF LIVERMORE, ALAMEDA COUNTY, CALIFORNIA
FOR: RUBY HILL DEVELOPMENT JOINT VENTURE, L.P.

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 R.F.C./B.V.
CHECKED
PROJ. MGR. J.A.A.

SHEET NO. 3 OF 12 SHEETS
JOB NO. 971038

123307



DATE	MK	SHEET REVISIONS	BY	CK
7/26/99	1	ADDED WATER SERVICE & SLEEVE	BV	
9/29/99	2	REVISED PAVEMENT SECTION & STORM DRAIN LINE, ADDED EARTH SWALE, REVISED CURB RETURNS PROFILE.		

SCALE: AS SHOWN
DATE: 7-7-99
DRAWN: R.F.C./B.V.
CHECKED
PROJ. MGR. J.H.A.

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.

Ruggeri - Jensen - Azar & Associates
6601 OWENS DRIVE, SUITE 155 • PLEASANTON, CA 94588
PHONE: (925) 227-9100 • FAX: (925) 227-9300

SHEET NO. 4 OF 12 SHEETS
JOB NO. 971038

BEFORE EXCAVATING
CALL U.S.A.
UNDERGROUND SERVICE ALERT
800-642-2444 TOLL FREE
48 HOURS BEFORE ALL
PLANNED WORK OPERATIONS

C.L. PAV. = PAVEMENT ELEVATION AT CENTERLINE
C.L. = FINISHED GRADE ELEVATION AT CONTROL LINE

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.

PROFILE SCALES:
1:500 HORIZONTAL
1:50 VERTICAL

INTERIM SECTION ◄ ► FULL ULTIMATE SECTION

NOTE:
INSTALL "TYPE S" STRUCTURAL SECTION DRAINAGE SYSTEM AND "INTERMEDIATE TYPE" EDGE DRAIN OUTLET SYSTEM WITH "TYPE B" OUTLET, "TYPE C" VENT, & "TYPE 2" CLEANOUT PER CALTRANS STD. PLANS D94A, D96B, & D99C RESPECTIVELY AT THE FOLLOWING LOCATIONS:
1. STA. 6+77.54 — 2. STA. 6+97.54
3. STA. 7+17.54 — 4. STA. 8+17.54
5. STA. 8+77.54 — 6. STA. 9+37.54

CAUTION
EXISTING 600mm GAS LINE

CAUTION
EXISTING 600mm GAS LINE (STEEL)

EXISTING DETENTION POND

VINEYARD ESTATES

RUBY HILL

RUBY HILL

METRIC DIMENSIONS
DIMENSIONS SHOWN HEREON ARE IN METERS.
1 METER = 3.280833333 U.S. SURVEY FEET.

0 10 20 30
(IN METERS)
SCALE 1:500

Curve Table				
No.	Desc.	Radius	Delta	Length
C16	C.L.	1077.400m	15°03'21"	283.169m
C17	C.P.	1083.400m	40°39'16"	765.561m
C18	C.L.	1068.300m	23°03'20"	467.070m
C19	E.P.	1071.400m	23°05'37"	469.230m
C21	E.P.	1069.311m	08°54'39"	160.071m

ENGINEER OF WORK

PLANS PREPARED UNDER THE DIRECTION OF:

Piero P. Ruggeri — 7/7/99
PIERO P. RUGGERI R.C.E. 25281 — DATE
RUGGERI-JENSEN-AZAR & ASSOC. (EXPIRES 12-31-01)

REGISTERED PROFESSIONAL ENGINEER PIERO P. RUGGERI No. 25281 Exp. 12-31-01 CIVIL STATE OF CALIFORNIA

Ruggeri - Jensen - Azar & Associates
5801 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	BY	CK	SHEET REVISIONS	SCALE AS SHOWN
6/16/99	JS		ADDED ACTIVE	DATE 7/7/99
				DRAWN PJC/RJK
				CHECKED
				PROJ. MGR. JAA

SHEET NO. 5
OF 12 SHEETS
JOB NO. 971038

123309

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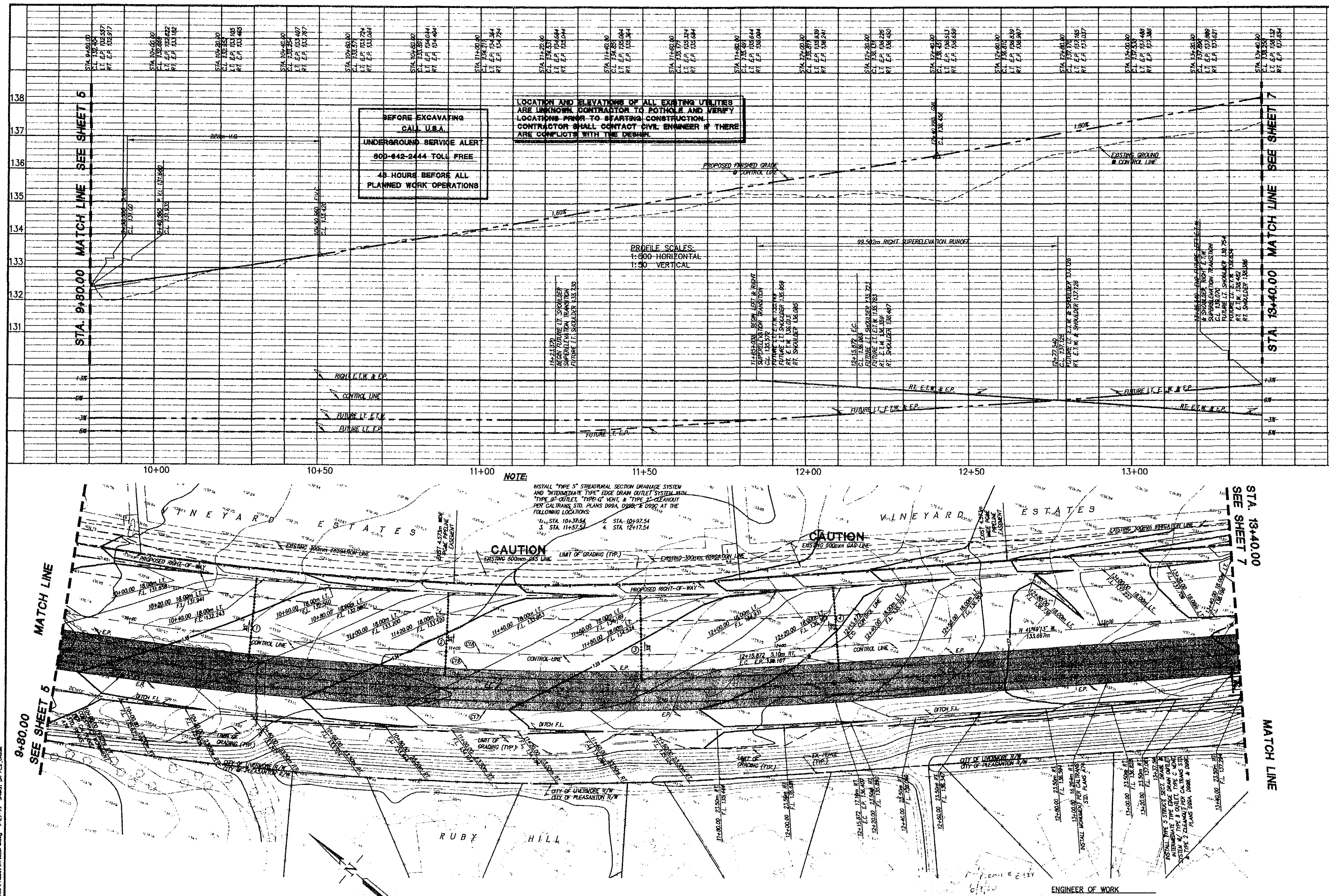

METRIC DIMENSIONS

DIMENSIONS SHOWN HEREON ARE IN METERS.
1 METER = 3.280833333 U.S. SURVEY FEET.

(IN METERS)
SCALE 1:500

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

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

123310

Ruggeri - Jensen - Azar & Associates
8801 OWENS DRIVE, SUITE 155 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
4/24/01	1	ADDED NOTE		

SCALE AS SHOWN
DATE 7-7-99
DRAWN R.F.C./B.V.
CHECKED
PROJ. MGR. J.A.A.

SHEET NO. 6
OF 12 SHEETS
JOB NO. 971038

STA. 13+40.00 MATCH LINE SEE SHEET 6

STA. 17+00.00 MATCH LINE SEE SHEET 8

PROPOSED FINISHED GRADE @ CONTROL LINE

EXISTING GROUND @ CONTROL LINE

1.50%

4.00%

1.00%

100m LEFT & RIGHT SUPERELEVATION RUNOFF

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. PAVT. = PAVEMENT ELEVATION AT CENTERLINE
C.L. = FINISHED GRADE ELEVATION AT CONTROL LINE

PROFILE SCALES:
1:500 HORIZONTAL
1:50 VERTICAL

220.000m V.C.

CAUTION
EXISTING 600mm GAS LINE

EXISTING 457m WIDE GAS PIPELINE EASEMENT

PROPOSED RIGHT-OF-WAY

CONTROL LINE

DITCH F.L.

LIMIT OF GRADING (TYP.)

EX. FENCE (TYP.)

CITY OF LIVERMORE R/W
CITY OF PLEASANTON R/W

VINEYARD ESTATES

RUBY HILL

MATCH LINE

STA. 13+40.00 SEE SHEET 6

STA. 17+00.00 SEE SHEET 8

Curve Table				
No.	Desc.	Radius	Delta	Length
C20	S.D.	917.706m	38°42'24"	619.660m
C21	C.L.	922.356m	42°59'45"	686.520m
C22	E.P.	905.256m	42°59'45"	673.791m

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

123311

Ruggeri - Jensen - Azar & Associates
4690 CHABOT DRIVE, SUITE 153, PLEASANTON, CA 94588
PHONE: (925) 227-9100 FAX: (925) 227-9300

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.

DATE	MK	SHEET REVISIONS	BY	CK
9/29/99	A	REVISED MATCH LINE		

SCALE AS SHOWN
DATE 7-99
DRAWN ACC/MK
CHECKED
PROJ. MGR. JAA

SHEET NO. 7
OF 12 SHEETS
JOB NO. 971038

BEFORE EXCAVATING
CALL U.S.A.
UNDERGROUND SERVICE ALERT
800-642-2444 TOLL FREE
48 HOURS BEFORE ALL
PLANNED WORK OPERATIONS

STA. 17+00.00 MATCH LINE SEE SHEET 7

STA. 20+60.00 MATCH LINE SEE SHEET 9

PROFILE SCALES:
1:500 HORIZONTAL
1:50 VERTICAL

S.D. LINE "A"
NOT TO SCALE

S.D. LINE "B"
NOT TO SCALE

CAUTION !!
600mm HIGH PRESSURE
GAS LINE CROSSING

FULL ULTIMATE SECTION ◄► INTERIM SECTION

17+00 17+50 18+00 18+50 19+00 19+50 20+00 20+50

N

(IN METERS)
SCALE 1:600

V I N E Y A R D E S T A T E S

R U B Y H I L L

LIMIT OF GRADING (TYP.)

CONTROL LINE

CAUTION
EXISTING 600mm
GAS LINE (STEEL)

CAUTION
EXISTING 600mm
GAS LINE
(STEEL)

PROPOSED RIGHT-OF-WAY

PROPOSED FINISHED GRADE @ CENTER LINE

PROPOSED FINISHED GRADE @ CONTROL LINE

EXISTING GROUND @ CONTROL LINE

FINISH GRADE

FILTER FABRIC

EXIST. GROUND

CROSSING GROUND @ CONTROL LINE

PG&E UTILITY EASEMENT

CITY OF LIVERMORE S/W
CITY OF PLEASANTON H/W

NOTE
BERM HEIGHT MAY CHANGE
PENDING CITY REVIEW OF
SOUND STUDY

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+30.683

Curve Table				
No.	Desc.	Radius	Delta	Length
C20	E.P.	917.256m	18°42'24"	619.660m
C21	S.C.	922.356m	43°58'45"	686.520m
C22	E.P.	908.256m	42°59'05"	673.780m
C23	E.P.	917.251m	03°56'24"	63.074m

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.

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

ASSISTANT/PROJECT CIVIL ENGINEER
PIERO P RUGGERI
No. 25281
Exp 12-31-01
CIVIL
STATE OF CALIFORNIA

123312

Ruggeri - Jensen - Azar & Associates
5601 DUBLIN DRIVE, SUITE 150, PLEASANTON, CA 94588
PHONE: (925) 227-9100 • FAX: (925) 227-9300

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.

SCALE	AS SHOWN
DATE	7-7-99
DESIGNED	A.F.C./P.M.
DRAWN	A.F.C./P.M.
CHECKED	
PROJ. MGR.	J.A.L.

DATE	MK	SHEET REVISIONS	BY	CK
7/29/99	A	RAISED BERM NOTE, REVISED STREET GRADES	BY	
9/29/99	A	REVISED MATCH SLOPE	BY	

SHEET NO. 8
OF 12 SHEETS
JOB NO. 971038

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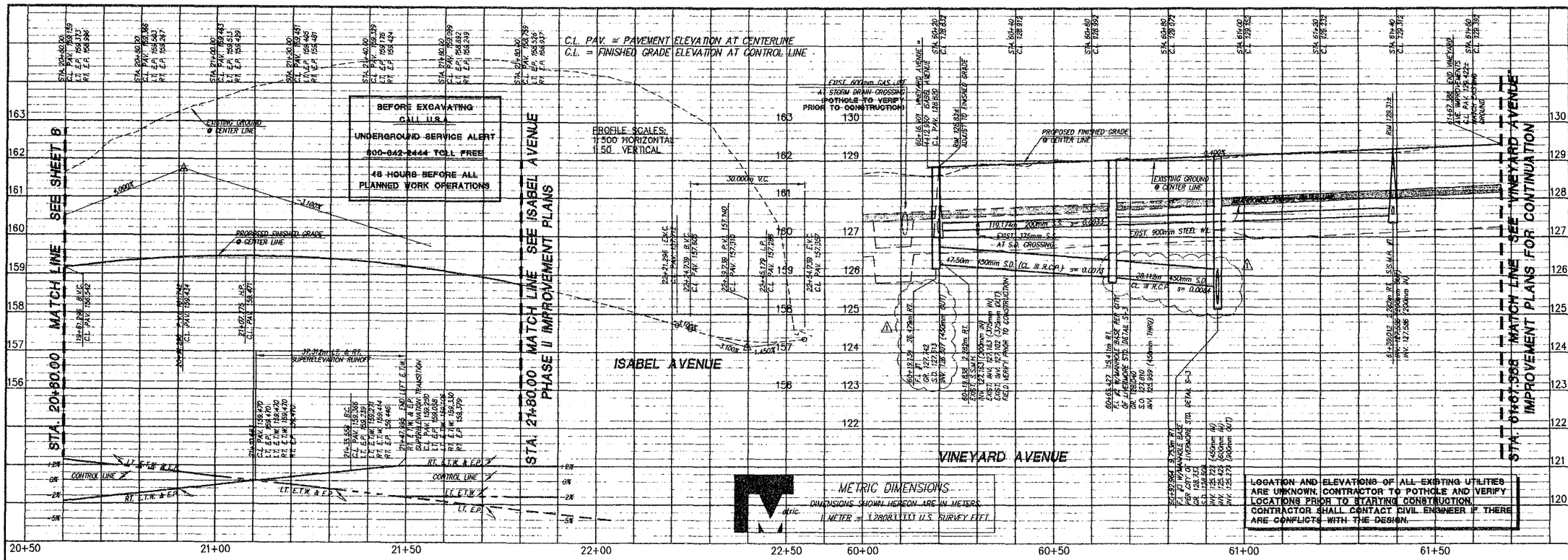
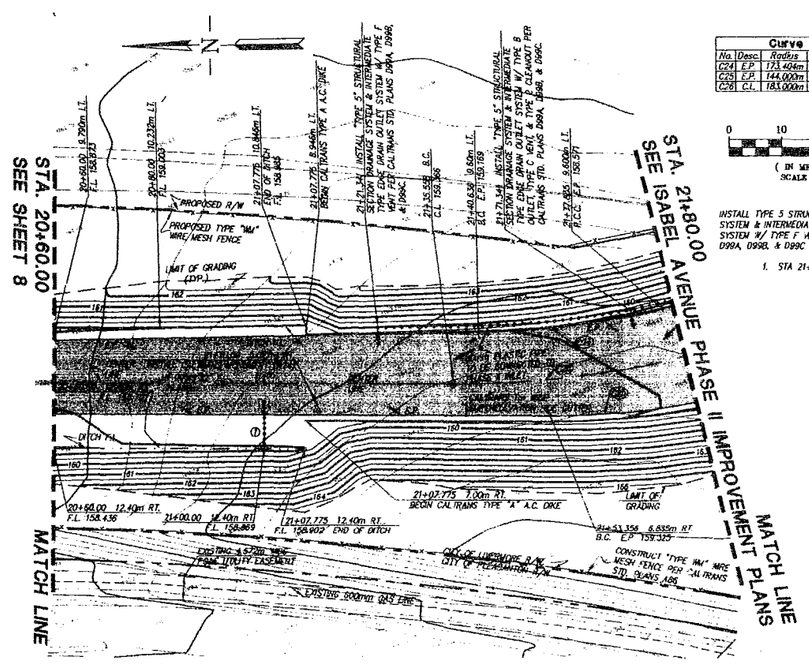


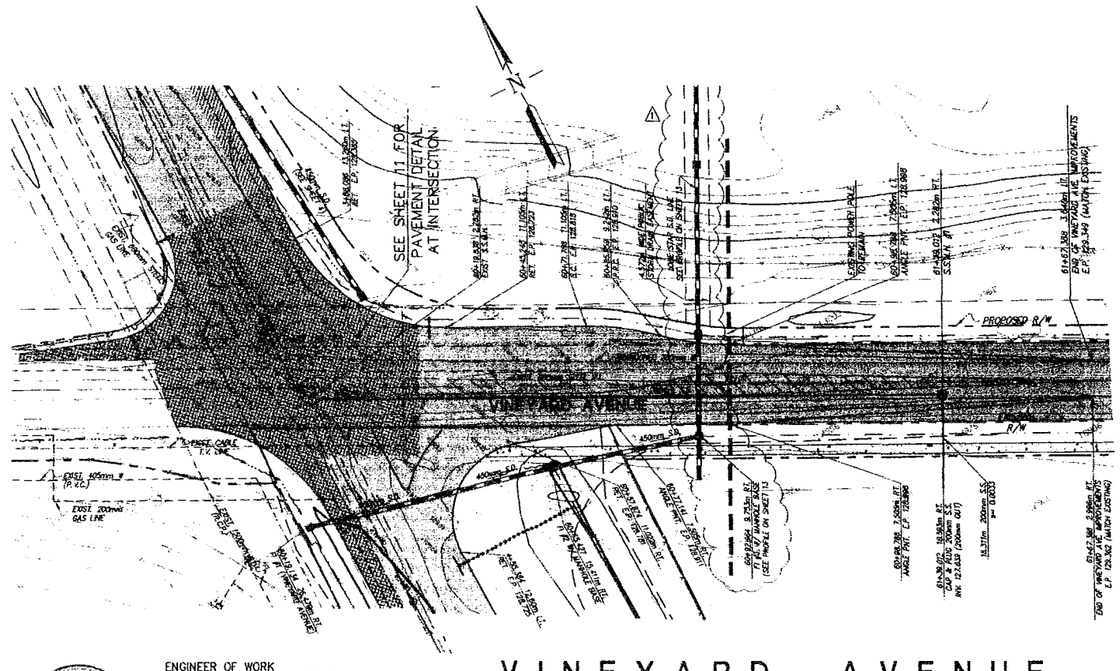


Curve Table			
No.	Desc	Radius	Delta	Length
C24	E.P.	123.456m	11°56'44"	38.245m
C25	E.P.	144.000m	29°44'58"	24.501m
C26	C.L.	183.000m	35°48'06"	114.402m

0 10 20 30
(IN METERS)
SCALE 1:600

INSTALL TYPE 5 STRUCTURAL SECTION DRAINAGE SYSTEM & INTERMEDIATE TYPE EDGE DRAIN OUTLET SYSTEM W/ TYPE F VENT PER CALTRANS STD. PLANS D79A, D98B, & D89C 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

VINEYARD AVENUE

Ruggeri - Jensen - Azar & Associates
2600 CHAINS 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	BY	CK	SHEET REVISIONS
7/26/99	MK		REVISED STORM SYSTEM
8/18/99	MK		REVISED PAVEMENT SECTION & STORM DRAIN LINE, ADDED EARTH SWALE

SCALE: AS SHOWN
DATE: 7-26-99
DRAWN: A.F.C./M.K.
CHECKED:
PROJ. MGR.: A.A.

SHEET NO. 9 OF 12 SHEETS

JOB NO. 971038

123313 123314

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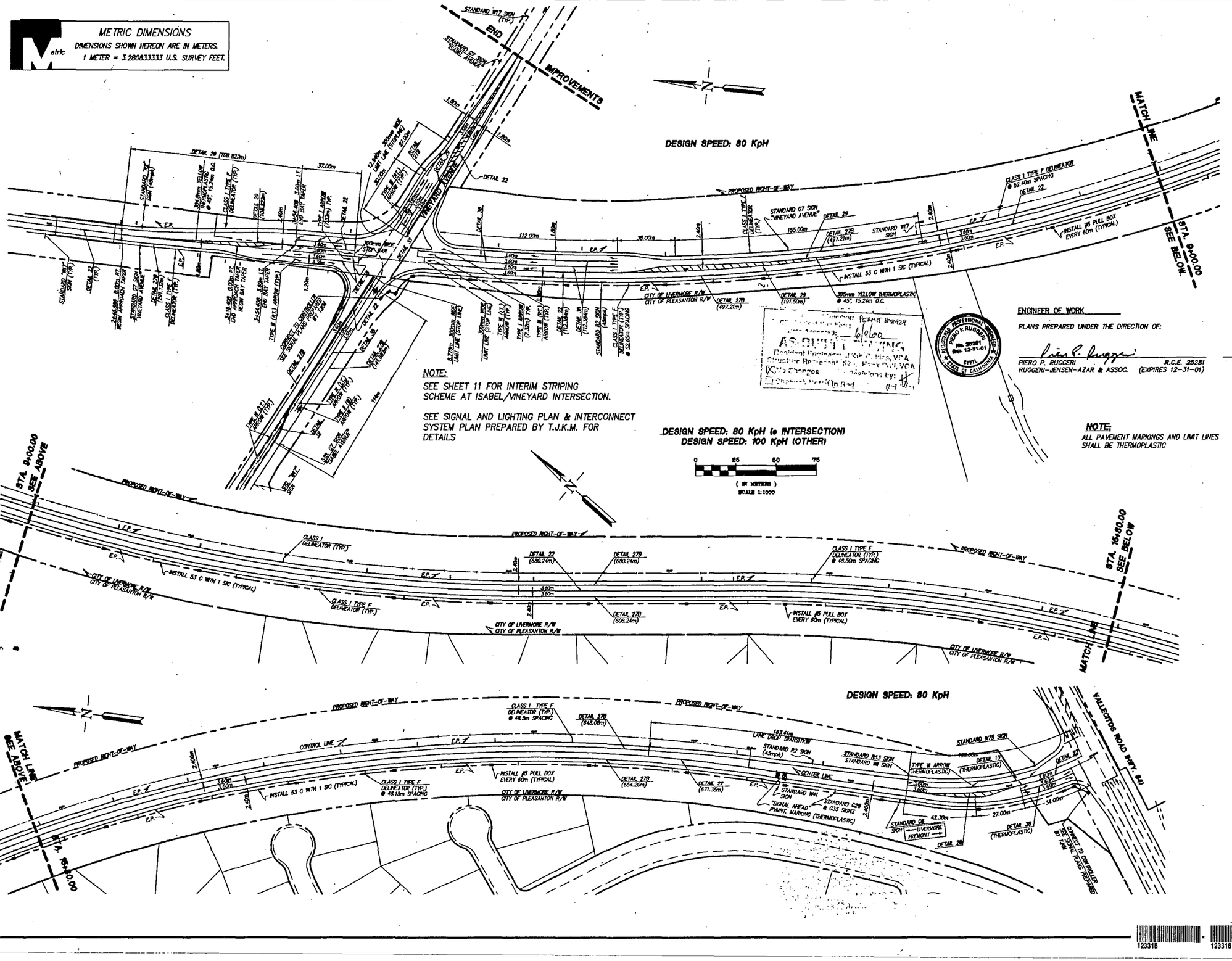
METRIC DIMENSIONS
DIMENSIONS SHOWN HEREON ARE IN METERS.
1 METER = 3.280833333 U.S. SURVEY FEET.



Ruggeri - Jensen - Azar & Associates
4690 CHABOT DRIVE, SUITE 150, 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: 7-17-00
DESIGNED: P.P.R.
DRAWN: J.M.K.
CHECKED:
PROJ. MGR.: J.M.K.

SHEET NO. 10 OF 12 SHEETS
JOB NO. 971038

123315 123316

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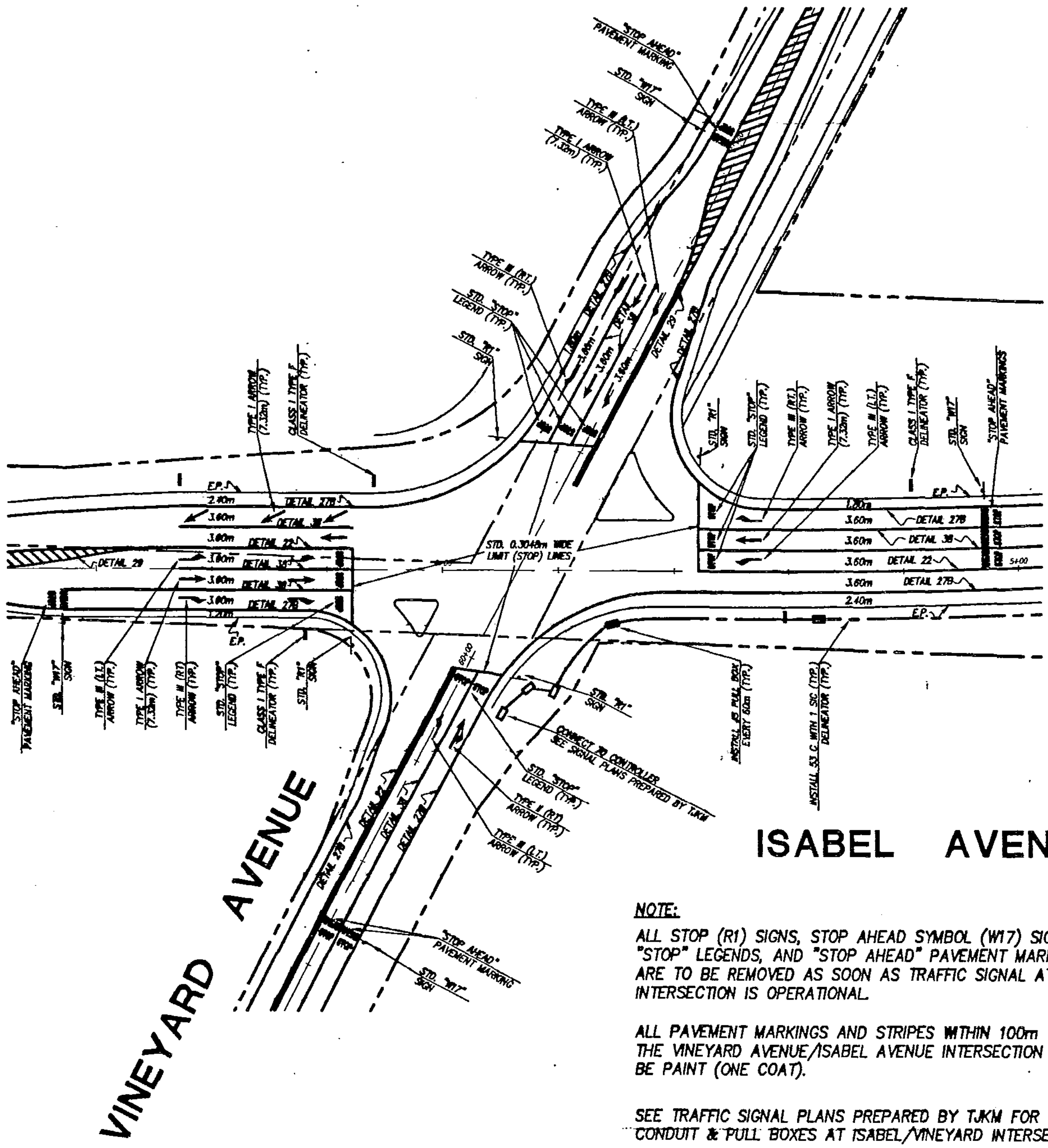


NOTE:

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.

N

0 10 20 30
(IN METERS)
SCALE 1:500

METRIC DIMENSIONS
DIMENSIONS SHOWN HEREON ARE IN METERS.
1 METER = 3.2808333333 U.S. SURVEY FEET.

AS-BUILT DRAWING
Contract Number: Permit #8429
Date Accepted: 6/9/00

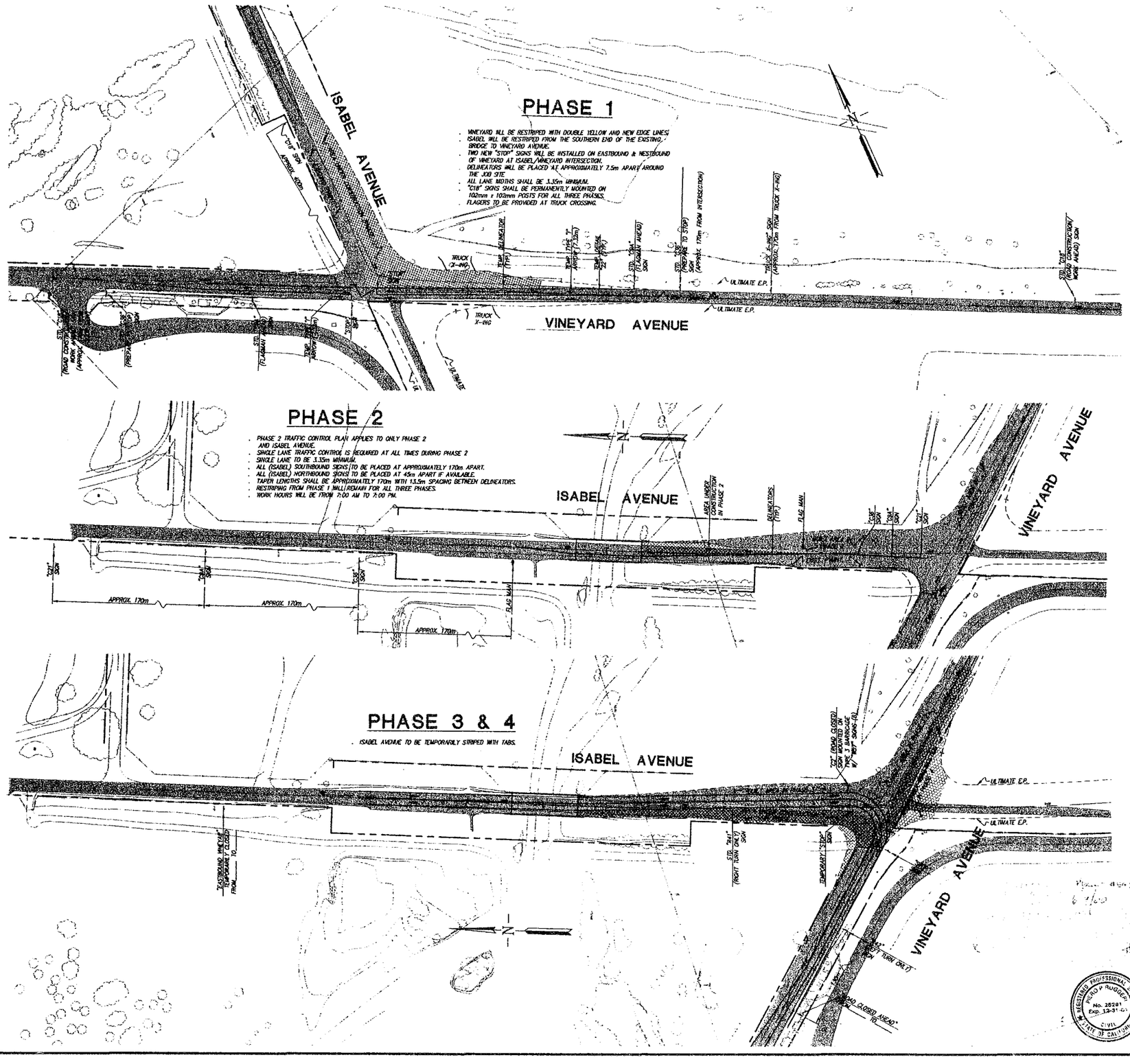
ENGINEER OF WORK
PLANS PREPARED UNDER THE DIRECTION OF:
PIERO P. RUGGERI R.C.E. 25281
RUGGERI-JENSEN-AZAR & ASSOC. (EXPIRES 12-31-01)
7/7/99
DATE

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.

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
SHEET 11 OF 12 SHEETS
JOB NO. 971038

123317 123318



- VINEYARD WILL BE RESTRIPED WITH DOUBLE YELLOW AND NEW EDGE LINES.
- ISABEL WILL BE RESTRIPED FROM THE SOUTHERN END OF THE EXISTING BRIDGE TO VINEYARD AVENUE.
- TWO NEW "STOP" SIGNS WILL BE INSTALLED ON EASTBOUND & WESTBOUND OF VINEYARD AT ISABEL/VINEYARD INTERSECTION.
- DELINEATORS WILL BE PLACED AT APPROXIMATELY 7.5m APART AROUND THE JOG SITE.
- ALL LANE WIDTHS SHALL BE 3.35m MINIMUM.
- "C18" SIGNS SHALL BE PERMANENTLY MOUNTED ON 102mm x 102mm POSTS FOR ALL THREE PHASES.
- FLAGGERS TO BE PROVIDED AT TRUCK CROSSING.

PHASE 2

- PHASE 2 TRAFFIC CONTROL PLAN APPLIES TO ONLY PHASE 2 AND ISABEL AVENUE.
- SINGLE LANE TRAFFIC CONTROL IS REQUIRED AT ALL TIMES DURING PHASE 2
- SINGLE LANE TO BE 3.35m MINIMUM.
- ALL (ISABEL) SOUTHBOUND SIGNS TO BE PLACED AT APPROXIMATELY 170m APART.
- ALL (ISABEL) NORTHBOUND SIGNS TO BE PLACED AT 45m APART IF AVAILABLE.
- TAPER LENGTHS SHALL BE APPROXIMATELY 170m WITH 13.5m SPACING BETWEEN DELINEATORS.
- RESTRIPING FROM PHASE 1 WILL REMAIN FOR ALL THREE PHASES.
- WORK HOURS WILL BE FROM 7:00 AM TO 7:00 PM.

PHASE 3 & 4

- ISABEL AVENUE TO BE TEMPORARILY STRIPED WITH TABS.

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
4690 CHABOT DRIVE, SUITE 155 • PLEASANTON, CA 94588
PHONE (925) 227-9100 • FAX (925) 227-9300

IMPROVEMENT PLAN
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 7-9-99
DRAWN A.F.C./B.V.
CHECKED
PROJ. MGR. A.A.A.

SHEET NO. 12 OF 12 SHEETS
JOB NO. 971038

F:\RUBYHILL\971038\WORK\PROC\Phase1\971038T12.dwg 7-9-99 4:30:54 pm PLS_CADD2

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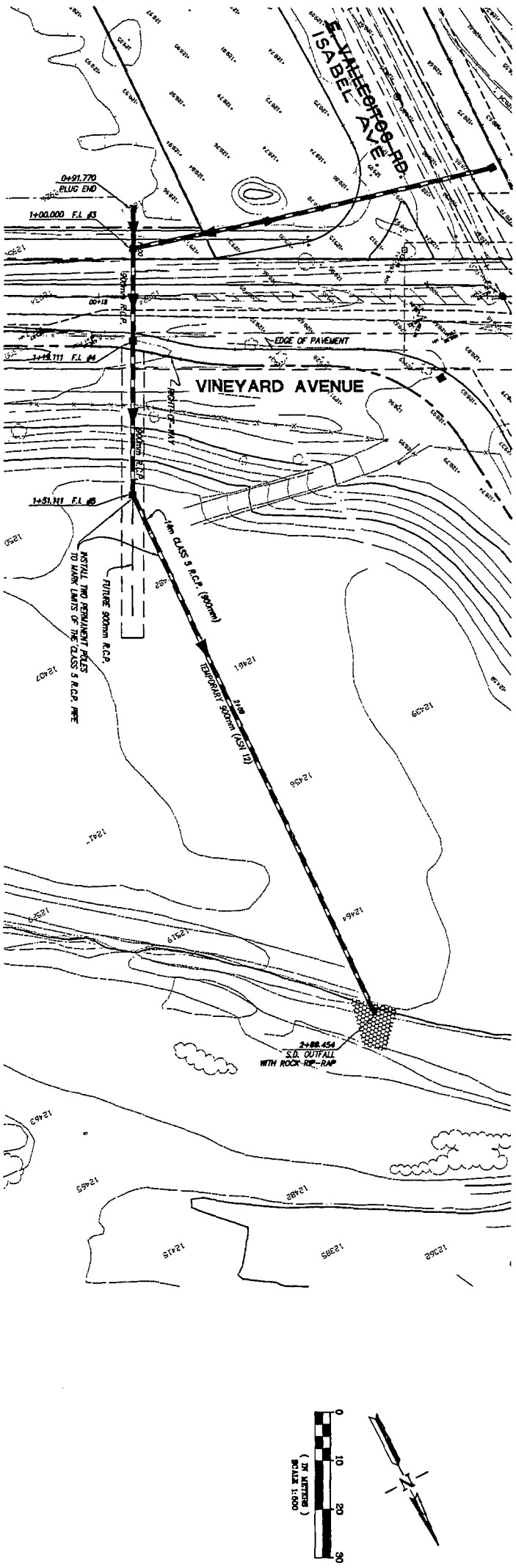

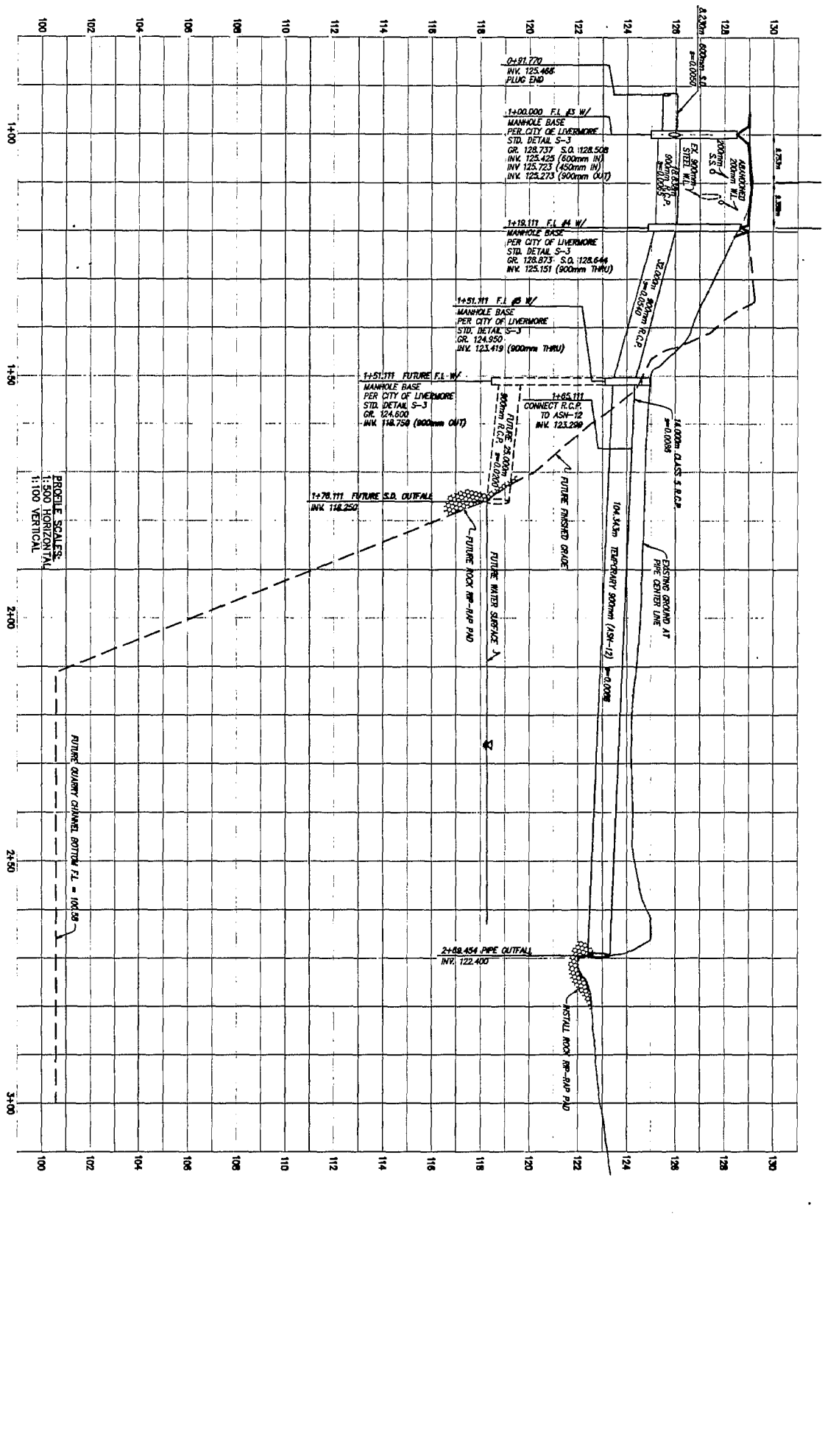

123321
123322

DATE	MK	SHEET REVISIONS	℄	BY	CK

SCALE: AS SHOWN
DATE: 7-7-99
DRAWN: A.P.M.
CHECKED: R.F.C.
PROJ. MGR.: J.M.A.

JOB NO. 971038
SHEET NO. 13
OF 13 SHEETS

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

OF SHEETS

	NAME	DESCRIPTION
1	XI-X10	TYPICAL CROSS SECTONS
2-14	-	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-CH12	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
264-297A	--	HIGHWAY PLANTING
298-322	EI-E25	ELECTRICAL PLANS

STRUCTURE PLANS

323-324	RWI-RW2	RETAINING WALL PLANS
325-327	RRI-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

DIST	COUNTY	ROUTE	POST MILE TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		1A	407

LOCATION MAP

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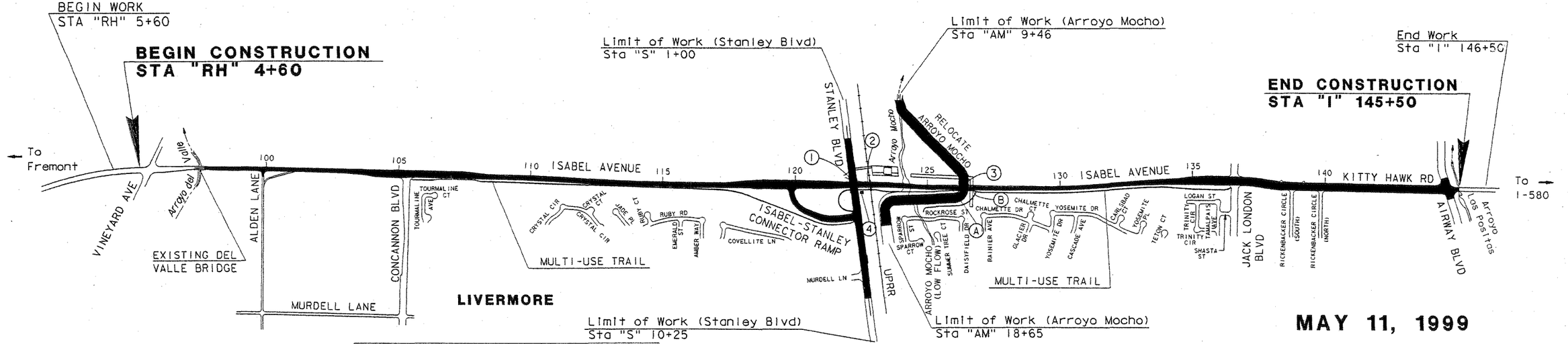

MAY 11, 1999

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
Vail 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 A.F. Rodriguez
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

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 | 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

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

323-324	RWI-RW2	RETAINING WALL PLANS
325-327	RRI-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

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

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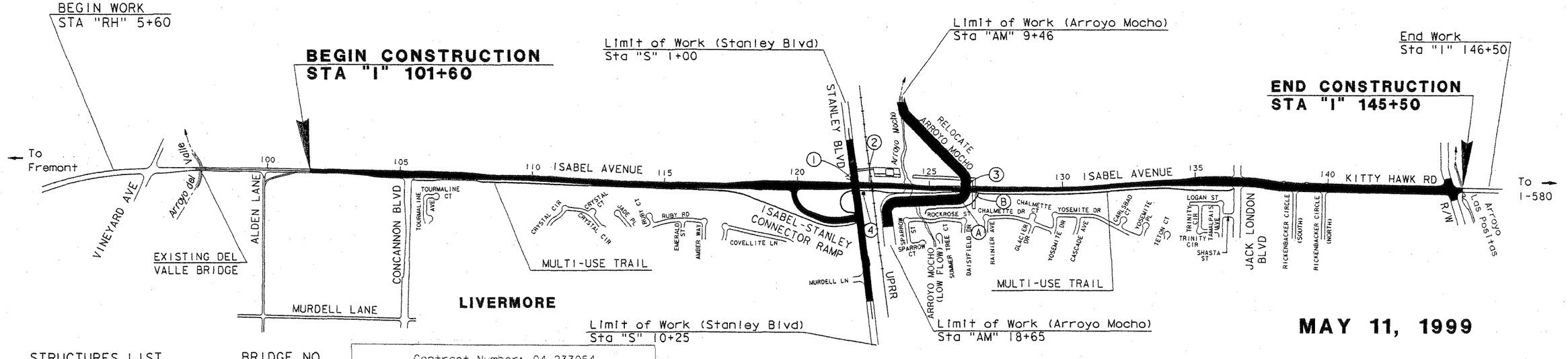

MAY 11, 1999

STRUCTURES LIST	BRIDGE NO.
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(B) RETAINING WALL NO. 2	
(1) ISABEL AVENUE UNDERCROSSING	33C-0406
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(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:

Phillip E. Boydstun City Engineer, RCE 26867
City of Livermore 5/6/99

REGISTERED PROFESSIONAL ENGINEER
Phillip 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 05 00 00 TIME PLOTTED => Fri May 7 11:46:53 1999

FOR REDUCED PLANS ORIGINAL SCALE IN MILLIMETERS 0 20 40 60 80

USERNAME => pauser

DIST	COUNTY	ROUTE	POST MILE TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	ALA	84		1C	207

INDEX OF SHEETS

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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
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PROJECT 2

CITY PROJECT # 96-91

(FOR FUNDING INFORMATION PURPOSES)

LOCATION MAP

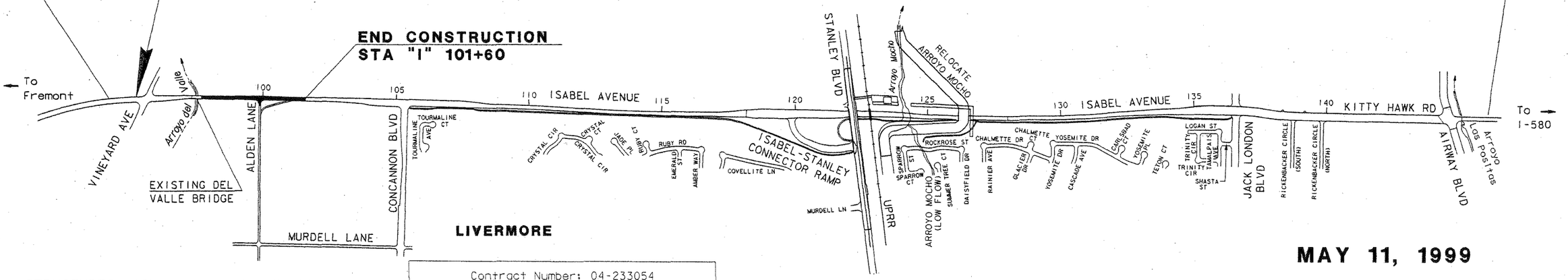
The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

BEGIN WORK
STA "RH" 5+60

BEGIN CONSTRUCTION
STA "RH" 4+60

END CONSTRUCTION
STA "I" 101+60

End Work
Sta "I" 146+50



MAY 11, 1999

STRUCTURES LIST

		BRIDGE NO.
(A)	RETAINING WALL NO. 1	
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(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 Revisions by: MPW (Initials)
☐ Changes As Noted

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''.

PROJECT ENGINEER	DATE	PROJECT MANAGER	DATE

Contract No. 04-233054

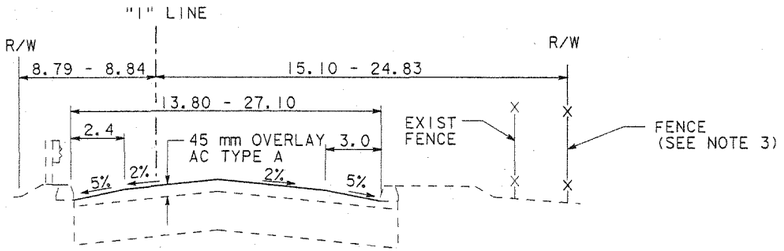
FOR REDUCED PLANS 0 20 40 60 80

USERNAME => pouser

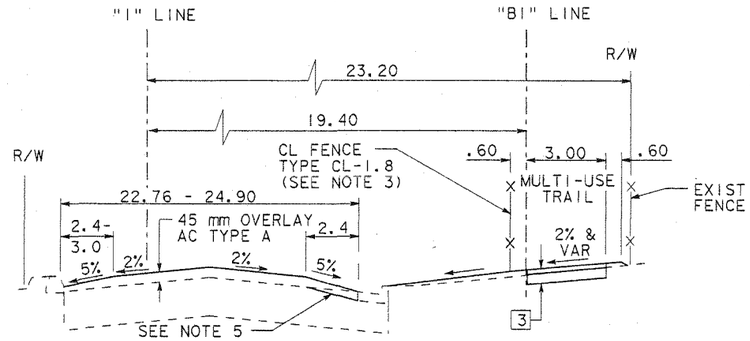
LAST REVISION => TIME PLOTTED => Fri May 7 11:39:36 1999

NOTES:

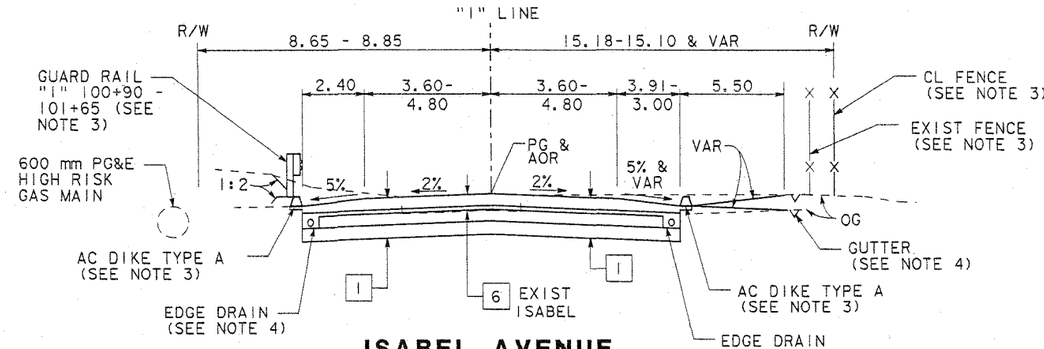
1. DIMENSIONS OF THE STRUCTURAL SECTIONS ARE SUBJECT TO TOLERANCES SPECIFIED IN THE STANDARD SPECIFICATIONS.
2. SUPERELEVATION AS SHOWN OR AS DIRECTED BY THE ENGINEER.
3. FOR LOCATION OF CURB & GUTTER, OVERLAY, COLD PLANE, FENCE, GUARD RAIL, K-RAIL, CONCRETE BARRIER, AND AC DIKE, SEE LAYOUT SHEETS.
4. 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.



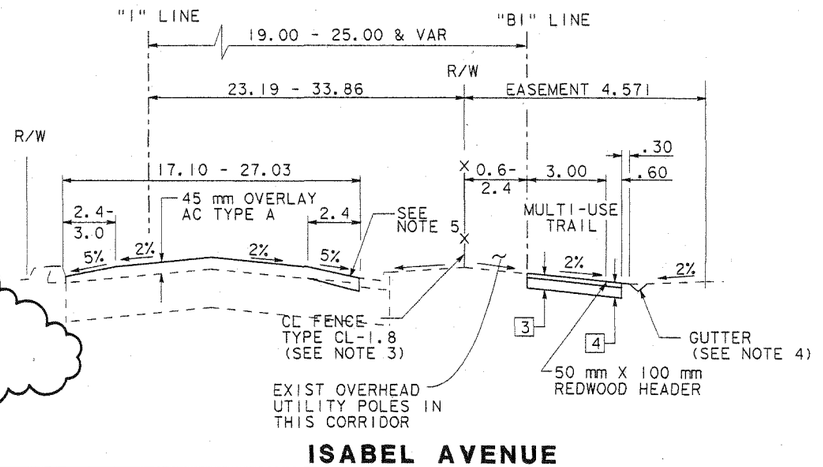
ISABEL AVENUE
"I" 101+60 - 105+49



ISABEL AVENUE
"I" 106+62 - 107+82
"BI" 11+17 - 12+37



ISABEL AVENUE
STA "I" 97+71 - 101+60



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 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 CI 2 AB 330 mm AS CI 4
2	390 mm AC (TYPE A)
3	75 mm AC (TYPE A) 150 mm CI 2 AB
4	75 mm DECOMPOSED GRANITE 150 mm CL 2 AB
5	210 mm AC(TYPE A) 600 mm CI 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 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-1

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

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DESIGN OVERSIGHT	CALCULATED/ DESIGNED BY	CHECKED BY	DATE	REVISED BY	DATE REVISED
	OR	RA	5/99	OR	6/99
				OR	6/99

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 00-00-00

TIME PLOTTED => $$$$$$$SYYTIME$$$$$$

NOTES:

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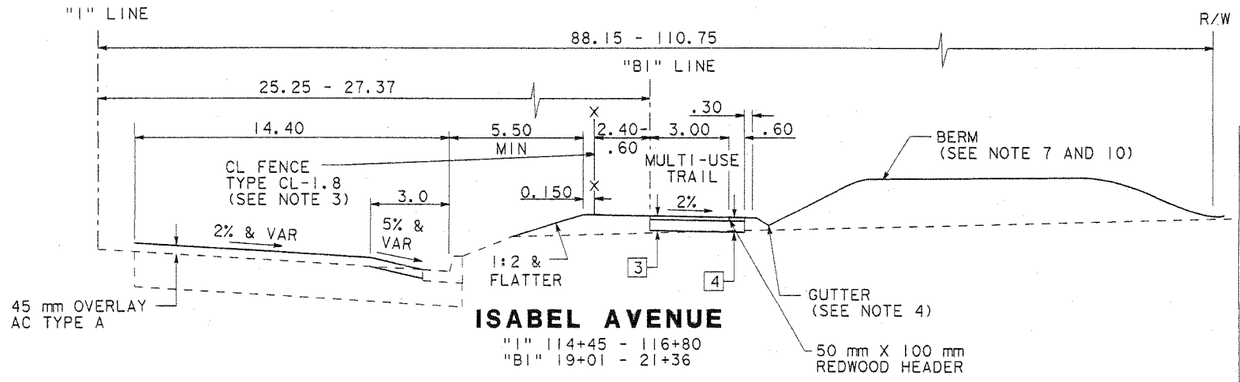
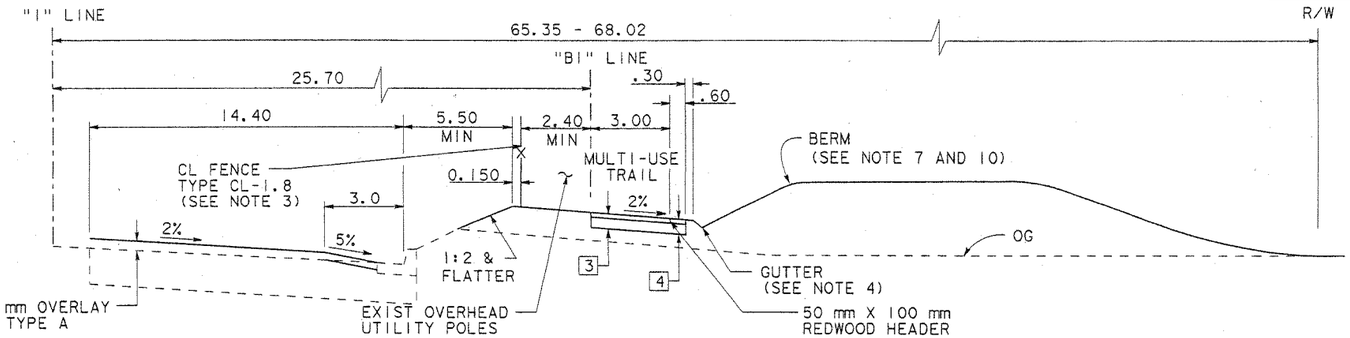
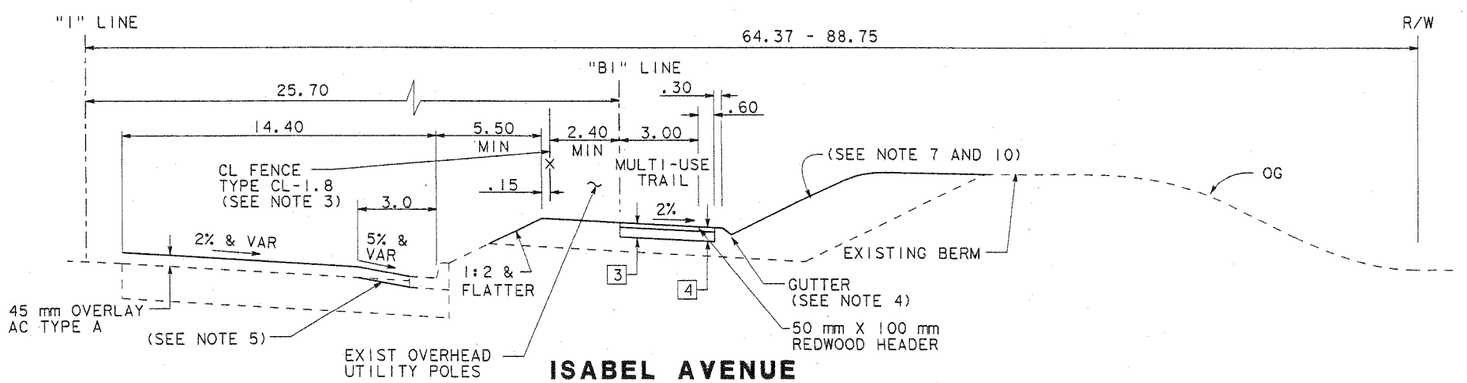


ISABEL AVENUE
"I" 114+45 - 116+80
"BI" 19+01 - 21+36



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
REGISTERED PROFESSIONAL ENGINEER
No. 53594
Exp. 6-30-03
CIVIL
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 Choi

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

	DATE	REVISED BY
OR	6/99	DATE REVISED
OR	6/99	

CALCULATED/DESIGNED BY	DATE	CHECKED BY
OR	5/99	RA

DESIGN OVERSIGHT

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 00-00-00
TIME PLOTTED => $$$$$$SYSTIME$$$$$$

NOTES:

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5. SEE CONSTRUCTION DETAILS.
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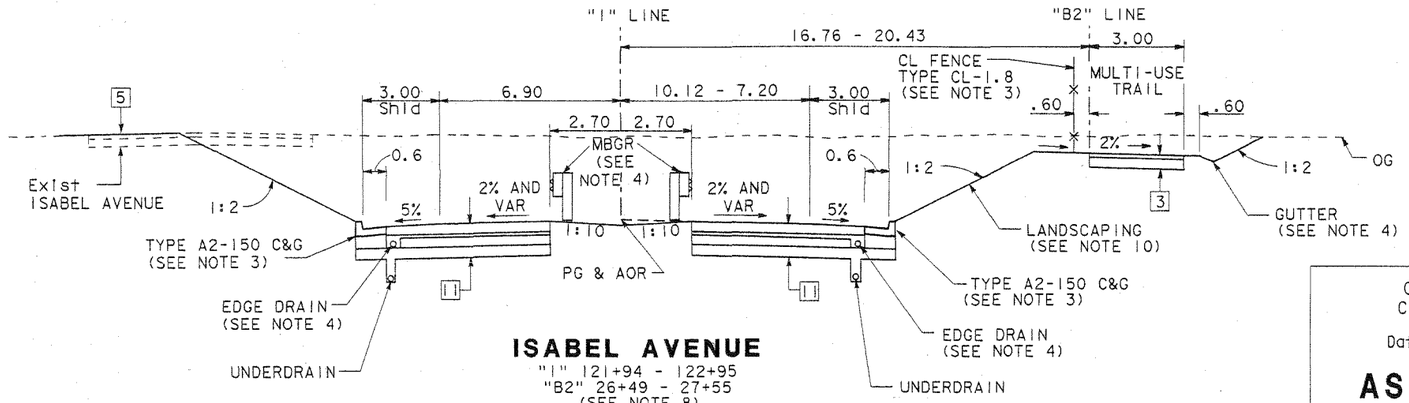
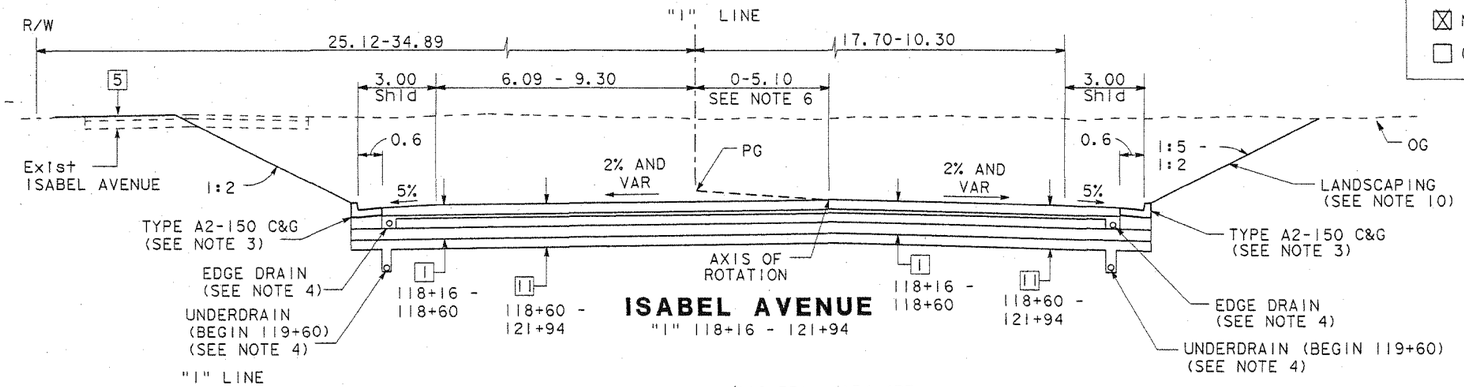
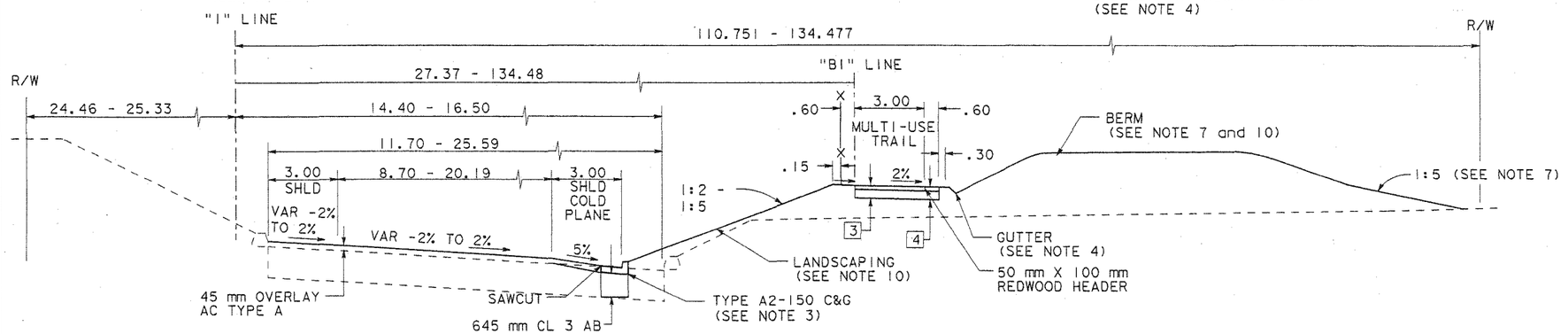


ISABEL AVENUE
"1" 121+94 - 122+95
"B2" 26+49 - 27+55
(SEE NOTE 8)



ISABEL AVENUE
"1" 118+16 - 121+94



ISABEL AVENUE
"1" 116+80 - 118+16
"B1" 21+36 - 22+75

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO	TOTAL SHEETS
04	Ala	84		4	407

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
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 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

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-3

DESIGN OVERSIGHT	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

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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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	Ala	84		5	407

Olga A. Rodriguez
REGISTERED CIVIL ENGINEER

5/11/99
PLANS APPROVAL DATE

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No. 53594
Exp. 6-30-03
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STATE OF CALIFORNIA

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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.
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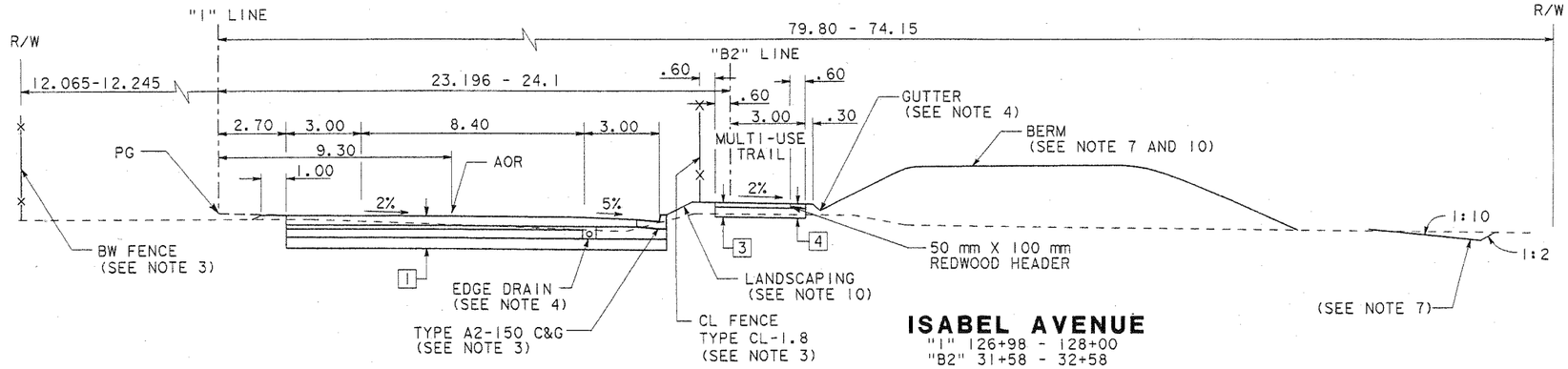
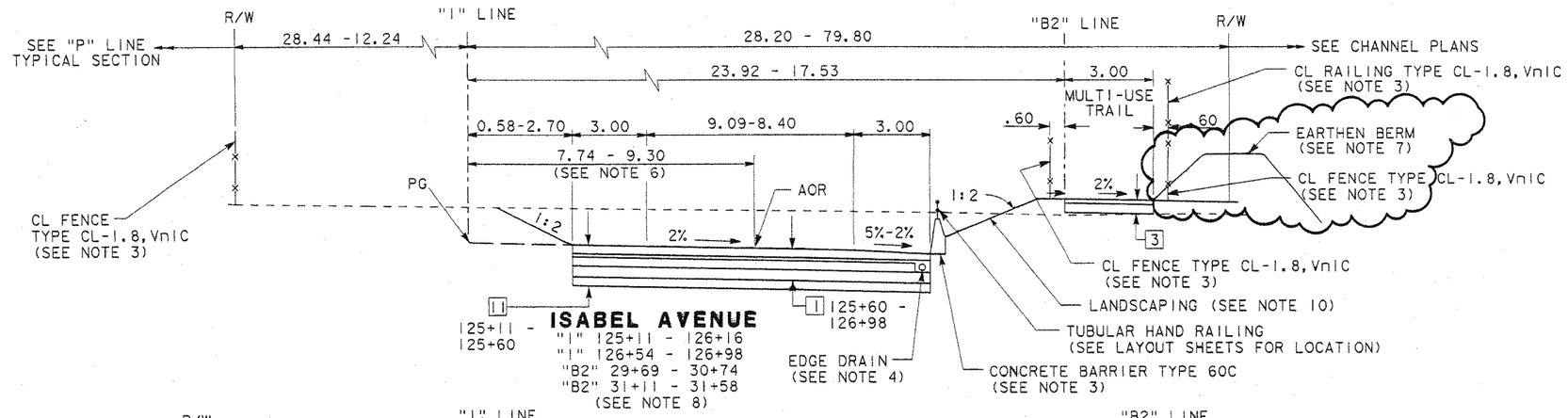
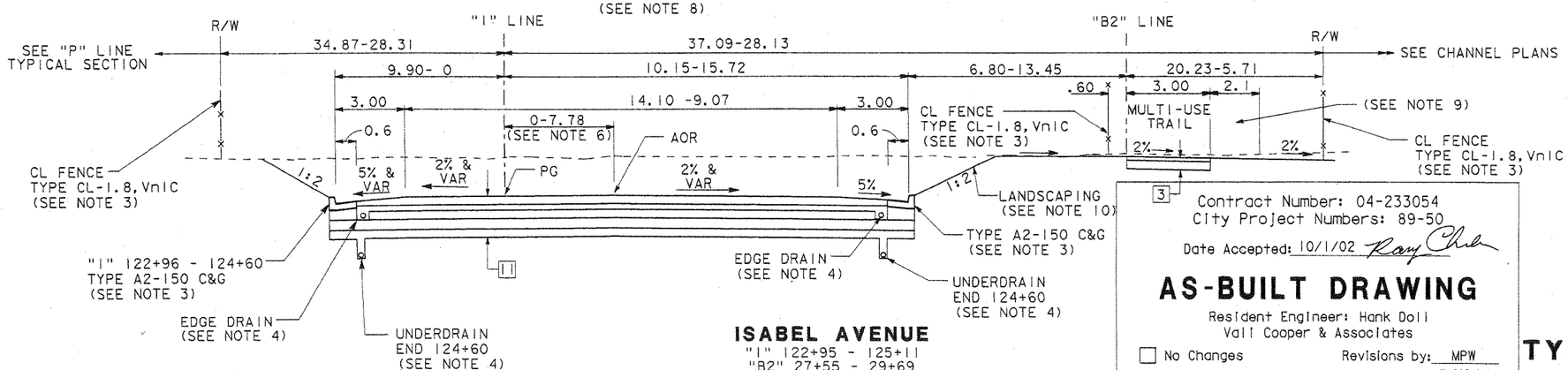
9. OVERHEAD UTILITY CORRIDOR, SEE UTILITY PLANS.
10. FOR LANDSCAPING & IRRIGATION, SEE LANDSCAPING & IRRIGATION PLANS.



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

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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
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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)

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 CROSS SECTIONS

NO SCALE

X-4

DESIGN OVERSIGHT	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

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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CU 04356 EA 233051

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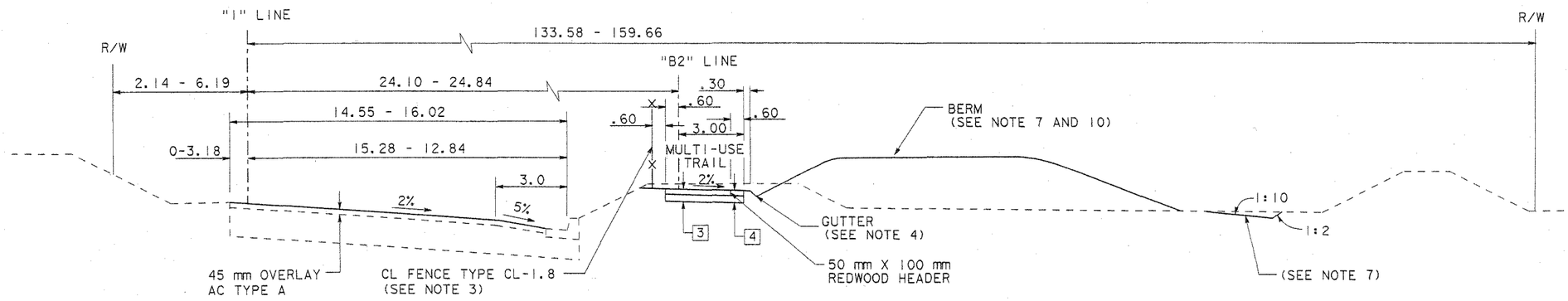
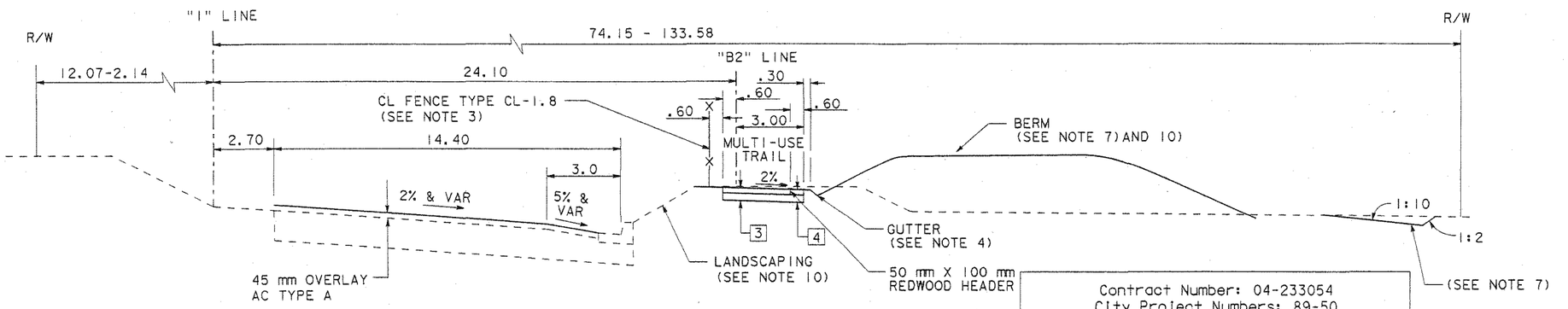


ISABEL AVENUE
"1" 133+40 - 134+00
"B2" 38+00 - 38+58



ISABEL AVENUE
"1" 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)

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
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ABBREVIATIONS

VAR	VARIABLE
SHLD	SHOULDER
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TEMP	TEMPORARY
SW	SIDEWALK
AOR	AXIS OF ROTATION (SEE NOTE 6)

TYPICAL CROSS SECTIONS

NO SCALE

X-5

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
DESIGN OVERSIGHT
Caltrans

DATE	REVISED BY	DATE REVISED	
5/99	OR	6/99	OR
			6/99

CALCULATED/DESIGNED BY
CHECKED BY
OR RA 5/99

LAST REVISION 00-00-00
TIME PLOTTED => $$$$$$SYSTIME$$$$$$

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Ala	84		7	407

Olga A. F. 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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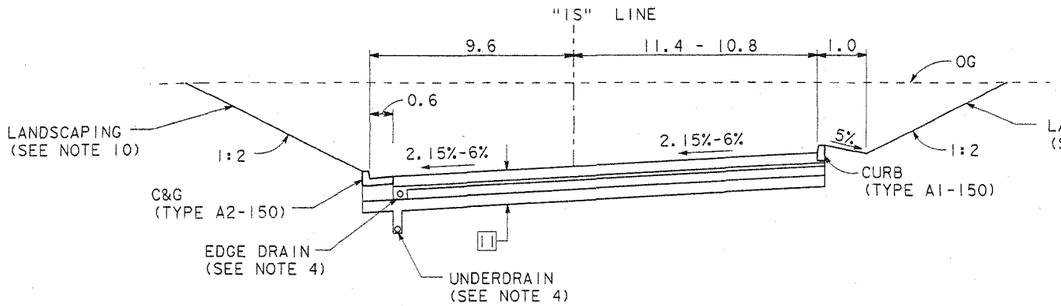
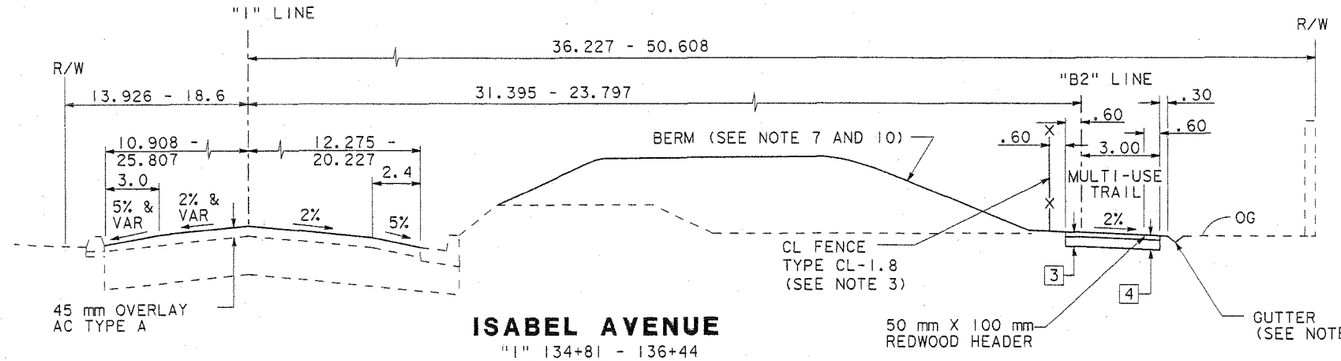
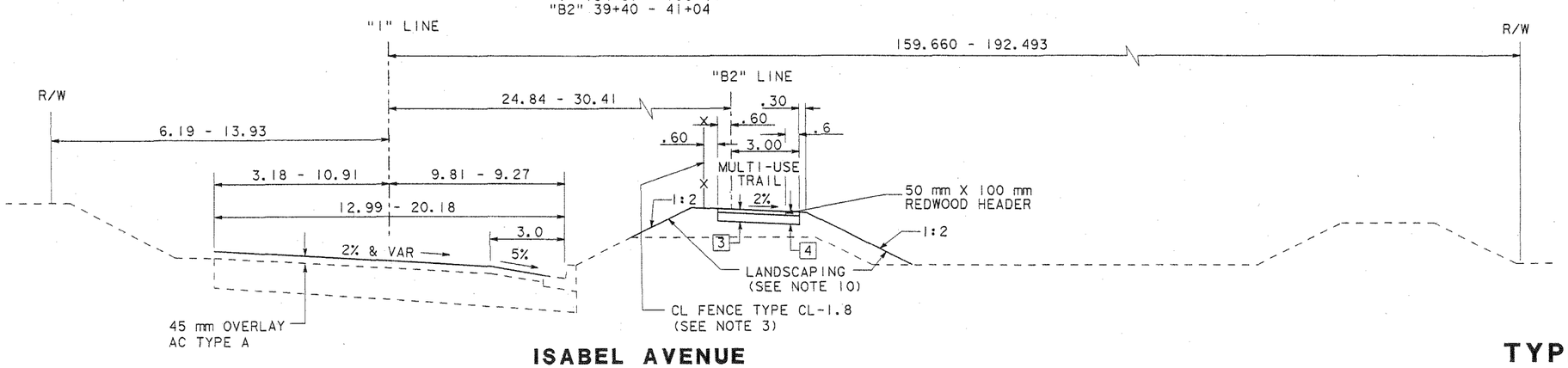


ISABEL AVENUE CONNECTOR
"IS" 20+12 - 20+76



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
☐ Changes As Noted
Revisions by: MPW (Initials)

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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

REVISED BY	DATE REVISED
OR	6/99
OR	6/99
DATE	5/99
OR	RA 5/99
CALCULATED/ DESIGNED BY	CHECKED BY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
DESIGN OVERSIGHT

LAST REVISION 00-00-00
TIME PLOTTED => $$$$$$$SYSTIME$$$$$$

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USERNAME => $$$$$$USER$$$$$$

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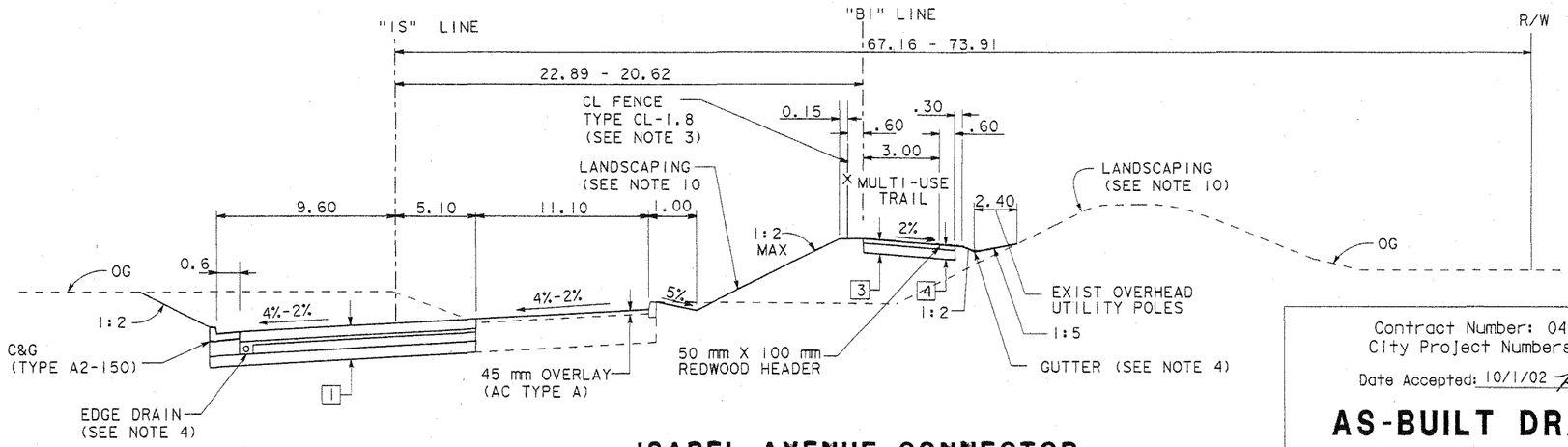
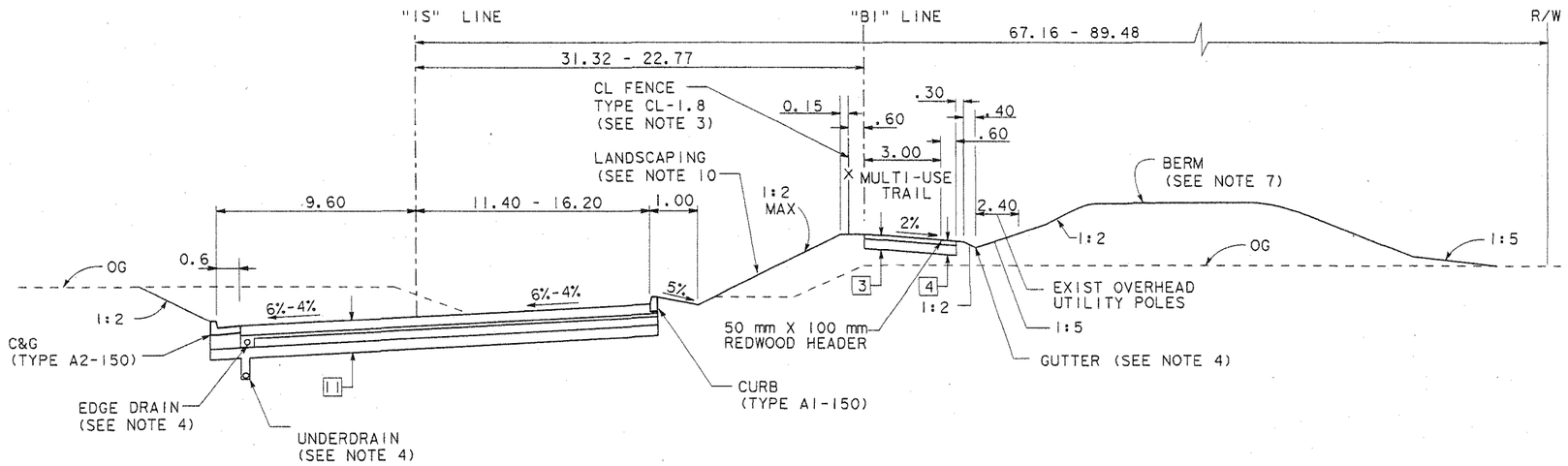


ISABEL AVENUE CONNECTOR

"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

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)

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
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Olga A. Z. 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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ABBREVIATIONS

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TYPICAL CROSS SECTIONS

NO SCALE

X-7

DESIGN OVERSIGHT
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

	CALCULATED/ DESIGNED BY	DATE	REVISED BY	DATE REVISED
	CHECKED BY	5/99	OR	6/99
	RA	5/99	OR	6/99

LAST REVISION 00-00-00 TIME PLOTTED => $$$$$$$SYTIME$$$$$$

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DGN FILE => $$$$$$$$$$DGNSPEC$$$$$$$$$$

CU 04256 EA 233051

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
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Olga A. Rodriguez
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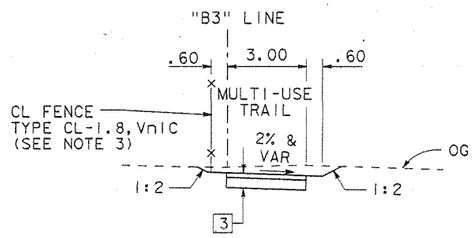
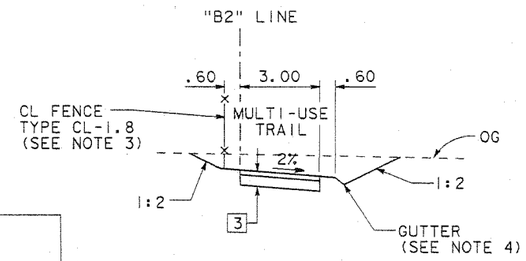


MULTI-USE TRAIL
"B3" 10+00 - 12+33



MULTI-USE TRAIL
"B2" 25+22 - 26+48

Contract Number: 04-233054
City Project Numbers: 89-50

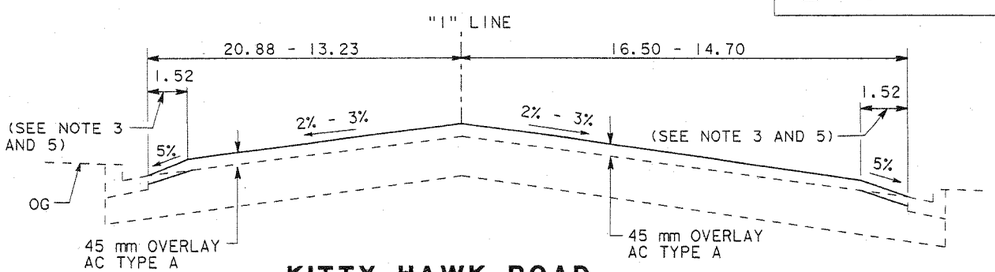
Date Accepted: 10/1/02 Ray Chan

AS-BUILT DRAWING

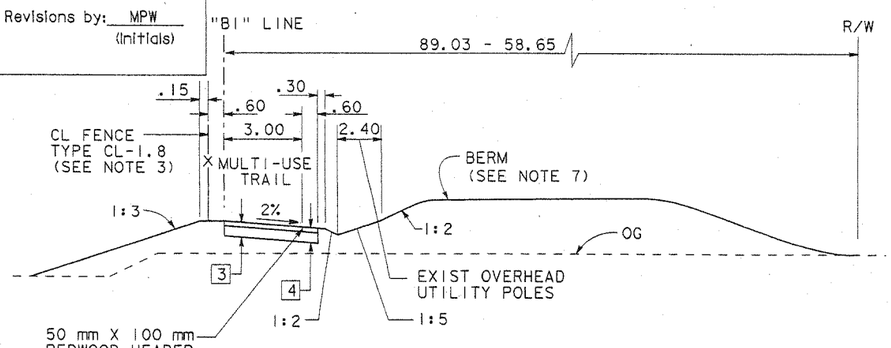
Resident Engineer: Hank Doll
Vail Cooper & Associates

☐ No Changes
☒ Changes As Noted

Revisions by: MPW (Initials)



KITTY HAWK ROAD
"I" 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 CI 2 AB 330 mm AS CI 4
2	390 mm AC (TYPE A)
3	75 mm AC (TYPE A) 150 mm CI 2 AB
4	75 mm DECOMPOSED GRANITE 150 mm CL 2 AB
5	210 mm AC (TYPE A) 600 mm CI 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 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)

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

TYPICAL CROSS SECTIONS

NO SCALE

X-8

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
DESIGN OVERSIGHT
Caltrans

CALCULATED/ DESIGNED BY			
CHECKED BY	OR	RA	5/99
DATE	5/99		
REVISED BY	OR	OR	
DATE REVISED	6/99	6/99	

LAST REVISION 00-00-00
TIME PLOTTED => $$$$$$$SYTIME$$$$$$

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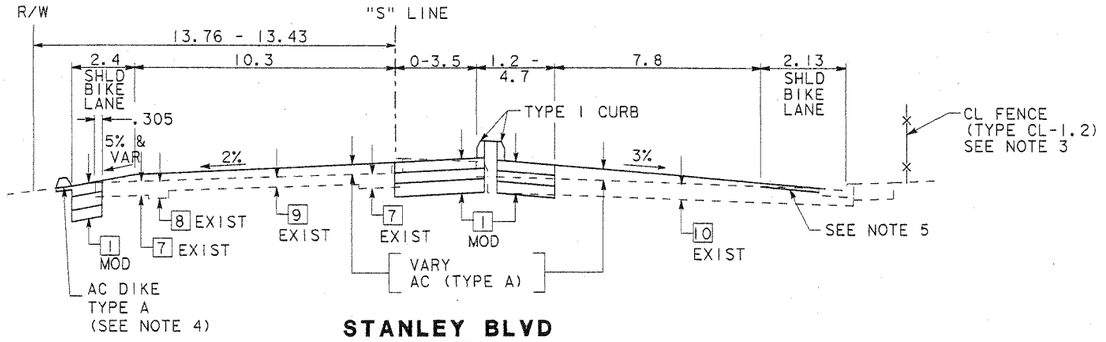
FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => $$$$$$USER$$$$$$

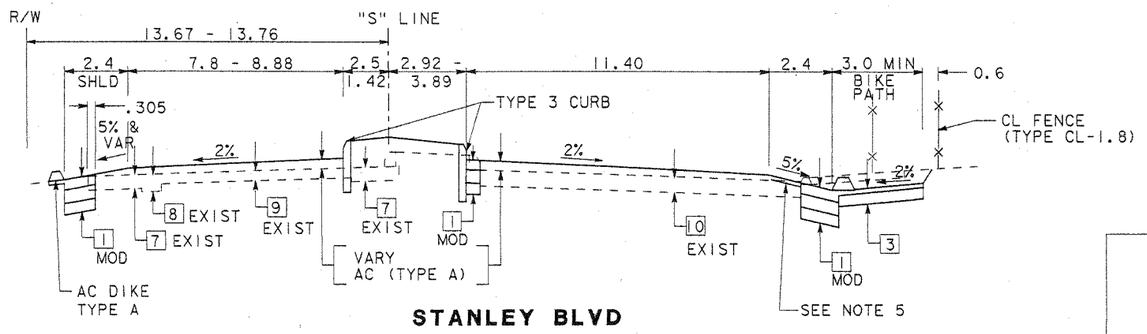
CU 04256 EA 237051

NOTES:

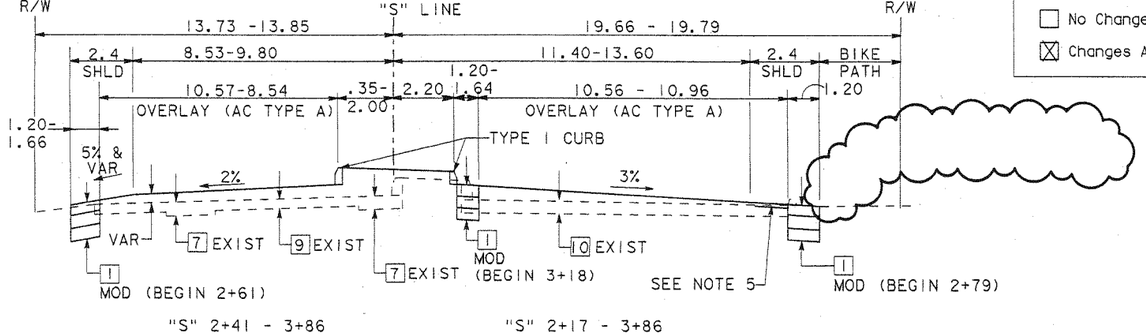
1. DIMENSIONS OF THE STRUCTURAL SECTIONS ARE SUBJECT TO TOLERANCES SPECIFIED IN THE STANDARD SPECIFICATIONS.
2. SUPERELEVATION AS SHOWN OR AS DIRECTED BY THE ENGINEER.
3. FOR LOCATION OF CURB & GUTTER, OVERLAY, COLD PLANE, FENCE, GUARD RAIL, K-RAIL, CONCRETE BARRIER, AND AC DIKE, SEE LAYOUT SHEETS.
4. 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.



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

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO	TOTAL SHEETS
04	Ala	84		10	407

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
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 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

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-9

REVISED BY	DATE REVISED
OR	6/99
OR	6/99

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CHECKED BY	5/99
OR	RA

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
DESIGN OVERSIGHT

LAST REVISION 00-00-00
TIME PLOTTED => $$$$$$$SYSTIME$$$$$$$

NOTES:

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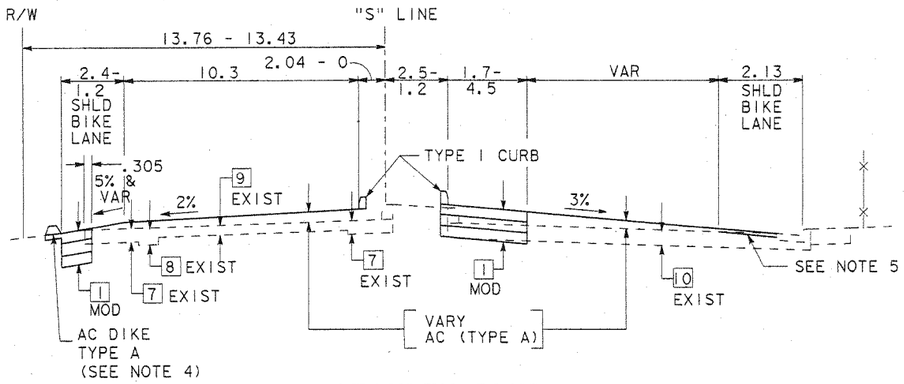
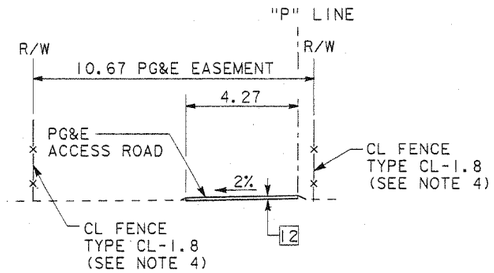
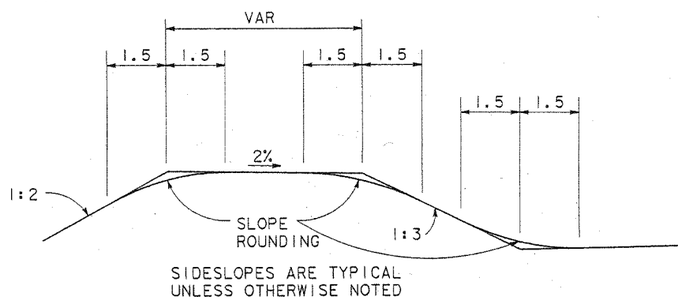


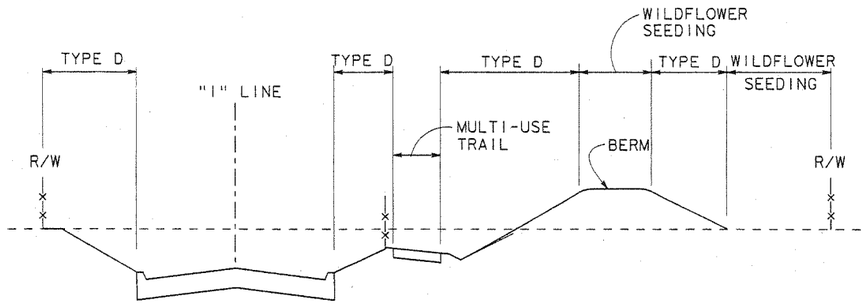
STANLEY BLVD
"S" 6+98 TO 7+49



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

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

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   75 mm ATPB (OMIT FOR 1 MOD)
   210 mm Cl 2 AB
   330 mm AS Cl 4
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9. EXISTING SECTION
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    75 mm ATPB
    330 mm Cl 2 AB
    210 mm Cl 3 PERMEABLE MATERIAL
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ABBREVIATIONS

VAR	VARIABLE
SHLD	SHOULDER
EXIST	EXISTING
TEMP	TEMPORARY
SW	SIDEWALK
AOR	AXIS OF ROTATION (SEE NOTE 6)

TYPICAL CROSS SECTIONS

NO SCALE

X-10

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84		11	407

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
PLANS APPROVAL DATE

CITY OF LIVERMORE
DEPARTMENT OF PUBLIC WORKS
3589 Pacific Avenue
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MK CENTENNIAL
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	DATE	REVISED BY
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	6/99	OR
	6/99	OR

DATE REVISED

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
DESIGN OVERSIGHT
Caltrans

LAST REVISION 00-00-00 TIME PLOTTED => $$$$$$SYSTIME$$$$$$

Project borings were drilled in 2007-2008 and in 2008-2009. The following table provides a correlation between boring identification numbers used during the subsurface exploration programs and the current Caltrans standards.

Multi-Purpose Borings			**Roadway Borings**	
Boring Number (Old)	**Boring Number (New)**		**Boring Number (Old)**	**Boring Number (New)**
NB01	A-08-001		RB01	A-07-101
NB02	A-08-002		RB02	A-07-102
NB03	R-07-003		RB03	A-07-103
NB04	A-07-004		RB04	A-07-104
NB05	R-07-005		RB05	A-07-105
NB05A	A-08-005		RB06	A-07-106
NB06	R-07-006		RB07	A-07-107
NB07	A-07-007		RB08	A-07-108
NB07A	A-08-007A		RB09	A-07-109
NB08	A-08-008		RB10	A-07-110
NB09	A-07-009		RB11	A-07-111
NB10	A-08-010		RB12	A-07-112
NB11	R-07-011		RB13	A-07-113
NB12	R-07-012		RB14	A-07-114
NB13	R-07-013		RB15	A-07-115
NB14	R-07-014		RB16	A-07-116
NB15	A-07-015		RB17	A-07-117
NB16	A-07-016		RB18	A-07-118
NB17	A-07-017		RB19	A-07-119
NB18	A-07-018		RB20	A-07-120
NB30	A-08-030		RB21	A-07-121
NB31	A-08-031		RB22	A-07-122
NB32	A-08-032		RB23	A-07-123
NB33	A-08-033		RB24	A-07-124
NB34	A-08-034		RB25	A-07-125
NB35	A-08-035		RB41	A-08-141
NB36	A-08-036		RB42	A-08-142
NB37	R-08-037		RB43	A-08-143
NB38	R-08-038			

Multi-purpose Borings NB19 through NB26 and roadway Borings RB26 through RB140 located outside of south segment project limits.

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 20 ft AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement				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														
	9		SANDY lean CLAY with GRAVEL (CL); hard; brown; moist.												
565.00	10				3	12 19 33	52			12					
	11														
563.00	12														
	13														
561.00	14		CLAYEY SAND with GRAVEL (SC); very dense; brown; moist; coarse GRAVEL.												
	15				4	31 47 50/5"	97/ 11"								Sampler advanced 17 in.
559.00	16														
	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_GEN.GLB 12/16/14

URS

San Jose Office

100 W. San Fernando St, Suite 200
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

100 W. San Fernando St, Suite 200
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_GEN.GLB 12/16/14

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.												
	31														
541.00	32														
	33														
539.00	34														
	35														
537.00	36														
	37														
535.00	38														
	39														
533.00	40														
	41														
531.00	42														
	43														
529.00	44														
	45														
527.00	46														
	47														
525.00	48														
	49														
523.00	50														
	51														
521.00	52														
	53														
519.00	54														
	55														

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_GEN.GLB 12/16/14

URS

San Jose Office

100 W. San Fernando St, Suite 200
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**	**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	74.6%
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		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)

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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_GEN.GLB 12/16/14

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													Extra casing added.
503.30	36				8	15 28 38	66	80		16	117	UC = 8.1		
	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)

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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													

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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**	**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; brownish red; moist.		7	80 50/2"	50/ 2"								
	23														Sampler advanced 8 in.
503.70	24		CLAYEY GRAVEL with SAND (GC); very dense; brownish 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				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**	**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	74.6%
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)	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 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													Some fluid loss.
	13													
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

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_GEN.GLB 12/16/14

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)*.											
501.30	26				6	17 29 47	76	80		15	118	UC = 7.1		
	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 **BORING RECORD**					HOLE ID **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		Bottom of Borehole at 56.5 ft.												
	57														
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. **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 **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														

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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								
	35		SANDY lean CLAY (CL); hard; brown. CLAYEY SAND (SC); very dense; brown.												
510.00	36		Boring dry ATD. Bottom of Borehole at 35.0 ft.												
	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				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**	**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	74.6%
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													
525.80	2				1	14 27 28	55	95		6	132			4" solid flight augered to 7 feet.
	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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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. Lean CLAY (CL) *(continued)*.		12	25 41 50	91	80		16	117	UC = 11.1		
471.80	56													
	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													

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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**	**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.												
	21		Boring dry ATD. Bottom of Borehole at 20.0 ft.												
421.00	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														

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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														

(continued)

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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.												
400.90	33														
	34														
398.90	35														
	36														
396.90	37														
	38														
394.90	39														
	40														
392.90	41														
	42														
390.90	43														
	44														
388.90	45														
	46														
386.90	47														
	48														
384.90	49														
	50														
382.90	51														
	52														
380.90	53														
	54														
	55														

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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**	**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														

(continued)

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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

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				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**	**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)

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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

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_GEN.GLB 12/16/14

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	32														
387.90	34														
385.90	36														
383.90	38														
381.90	40														
379.90	42														
377.90	44														
375.90	46														
373.90	48														
371.90	50														
369.90	52														
367.90	54														
	55														

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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**	**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	74.6%
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		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

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													

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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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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	74.6%
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Not measured	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													Fluid level observed at 8 ft prior to start of drilling on 12/20/07.
	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													

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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													Suspended drilling on 12/19/07; resumed on 12/20/07.
	27													
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: **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**	**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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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**	**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	74.6%
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		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

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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

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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		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)

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REPORT TITLE **BORING RECORD**					HOLE ID **NB13**
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 **12-21-07**	SHEET **2 of 3**	

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
	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			13	35 48 75	123							
	61	SILTY GRAVEL with SAND (GM); very dense; brown; moist.											
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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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**	**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	74.6%
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
413.00	2														4" solid flight augered to 11.5 feet.
	3														
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														

(continued)

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_GEN.GLB 12/16/14

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San Jose Office

100 W. San Fernando St, Suite 200
San Jose, CA 95113

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													

(continued)

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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**	**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														
	59		CLAYEY SAND with GRAVEL (SC); very dense; brown; moist.		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														

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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**	**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														Refusal at 14 feet.
	15		Boring dry ATD. Bottom of Borehole at 14.0 ft.												
403.00	16														
	17														
401.00	18														
	19														
399.00	20														
	21														
397.00	22														
	23														
395.00	24														
	25														

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_GEN.GLB 12/16/14

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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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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														

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_GEN.GLB 12/16/14

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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.												
392.50	21														
	22														
390.50	23														
	24														
	25														

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_GEN.GLB 12/16/14

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San Jose, CA 95113

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	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 PI
521.00	6		Less sand.												
	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														
			SILTY SAND with GRAVEL (SM); very dense; wet.												
503.00	24				7	33 50/5"	50/ 5"	65		11	127				Sampler advanced 11 in.
	25														

(continued)

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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

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_GEN.GLB 12/16/14

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				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**	**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	

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.												

(continued)

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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

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.	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**	**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														
483.00	33														
	34														
481.00	35														
	36														
479.00	37														
	38														
477.00	39														
	40														
475.00	41														
	42														
473.00	43														
	44														
471.00	45														
	46														
469.00	47														
	48														
467.00	49														
	50														
465.00	51														
	52														
463.00	53														
	54														
	55														

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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**	**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							Sampler advanced 12 in.
	15		SILTY SAND with GRAVEL (SM); very dense; reddish brown; moist; with GRAVEL.												
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

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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)*.												
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				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**	**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						
481.00	6		Poorly graded SAND with GRAVEL (SP); very dense; dark gray; layer.											Sampler advanced 8 in.
	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													
471.00	16													HSA sealed off first aquifer at 19' Hit second one at 49'. H_2O quickly up to 15'
	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.												
435.00	51														
	52														
433.00	53														
	54														
	55														

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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.												
490.00	2				1	50/4"	REF	30							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)

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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

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_GEN.GLB 12/16/14

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				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**	**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**	**74.6%**
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**

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.											
348.00	56		CLAYEY SAND with GRAVEL (SC) *(continued)*.		12	14 27 39	66	75						
	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				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**	**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	74.6%
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			3 ft	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

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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	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													
348.00	56				12	53 56 58	114	55						
	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													
328.00	76				16	36 48 65	113	65						
	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				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**	**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				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**	**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														
572.00	2		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
	3														
570.00	4		GRAVELLY lean CLAY with SAND (CL); hard; brown; moist.		2	14 21 36	57	45		13	121				
	5														
568.00	6				3	24 23 33	56	80		12	127				
	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.												
	11														
562.00	12														
	13														
560.00	14														
	15														
558.00	16														
	17														
556.00	18														
	19														
554.00	20														
	21														
552.00	22														
	23														
550.00	24														
	25														

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_GEN.GLB 12/16/14

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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	12														
540.10	14														
538.10	16														
536.10	18														
534.10	20														
532.10	22														
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

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_GEN.GLB 12/16/14

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			X	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			X	2	7 13 15	28	90		7	120				
	5		SILTY GRAVEL with SAND (GM); very dense; light brownish yellow; moist.	X	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			X	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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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.		1	20 21 18	39	70		7	121	UC = 1.4			LL=21 PI=5 PI, R Bag sample 1 to 5 feet.
525.20	2														
	3		SANDY lean CLAY (CL); very stiff; dark reddish brown; moist.		2	11 15 28	43	70		10	114	UC = 4.4			
523.20	4														
	5		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				
521.20	6														
	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.												
515.20	11														
	12														
513.20	13														
	14														
511.20	15														
	16														
509.20	17														
	18														
507.20	19														
	20														
505.20	21														
	22														
503.20	23														
	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

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				2	10 19 21	40	60							
502.30	4		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.												
	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_GEN.GLB 12/16/14

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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	
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 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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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	12														
410.20	14														
408.20	16														
406.20	18														
404.20	20														
402.20	22														
400.20	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.												
	1		SILTY SAND with GRAVEL (SM); dense; dark grayish brown; moist.		1	22 22 23	45	45							Bag sample 1 to 5 feet. R
419.20	2														
	3		At EL. 418.2 ft, becomes medium dense.		2	8 17 19	36	0							No recovery.
417.20	4														
	5		SILTY SAND with GRAVEL (SM); dense; light brown; moist.		3	18 22 22	44	55							
415.20	6														
	7														
413.20	8														
	9		At EL. 412.7 ft, becomes dark brown.		4	21 24 22	46	100		7					
411.20	10		Boring dry ATD. Bottom of Borehole at 10.0 ft.												
	11														
409.20	12														
	13														
407.20	14														
	15														
405.20	16														
	17														
403.20	18														
	19														
401.20	20														
	21														
399.20	22														
	23														
397.20	24														
	25														

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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.												
403.20	12														
401.20	14														
399.20	16														
397.20	18														
395.20	20														
393.20	22														
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.												
406.80	11														
	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.												
399.30	11														
	12														
397.30	13														
	14														
395.30	15														
	16														
393.30	17														
	18														
391.30	19														
	20														
389.30	21														
	22														
387.30	23														
	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				1	17 19 19	38	35		10	130				Bag sample 1 to 5 feet. R
415.00	2														
	3		At EL. 414.0 ft, observed increase in sand content.		2	11 10 11	21	35		6	124				
413.00	4														
	5				3	7 9 11	20	45							
411.00	6														
	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

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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	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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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														
546.00	12														
544.00	14														
542.00	16														
540.00	18														
538.00	20														
536.00	22														
534.00	24														
	25														

URS BORING RECORD 200802 28649640-ROUTE84.GPJ SNJ_GEN.GLB 12/16/14

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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_GEN.GLB 12/16/14

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San Jose Office

100 W. San Fernando St, Suite 200
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.

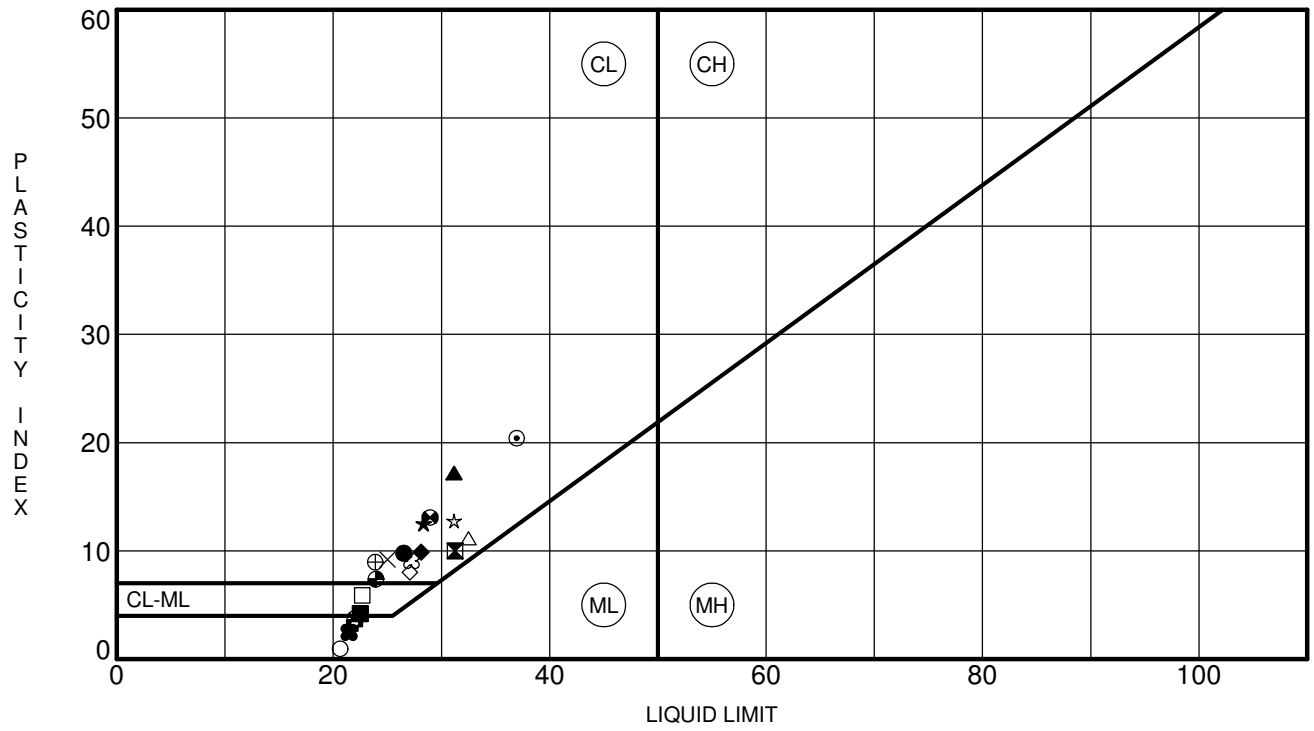
Atterberg limit tests were performed on cohesive samples to determine the plasticity characteristics. The results of these tests are presented in this appendix.

Gradations were performed on granular samples to determine the grain size distributions; the results of these tests are presented in this appendix.

Project borings were drilled in 2007-2008 and in 2008-2009. The following table provides a correlation between boring identification numbers used during the subsurface exploration programs and the current Caltrans standards.

Multi-Purpose Borings			**Roadway Borings**	
Boring Number (Old)	**Boring Number (New)**		**Boring Number (Old)**	**Boring Number (New)**
NB01	A-08-001		RB01	A-07-101
NB02	A-08-002		RB02	A-07-102
NB03	R-07-003		RB03	A-07-103
NB04	A-07-004		RB04	A-07-104
NB05	R-07-005		RB05	A-07-105
NB05A	A-08-005		RB06	A-07-106
NB06	R-07-006		RB07	A-07-107
NB07	A-07-007		RB08	A-07-108
NB07A	A-08-007A		RB09	A-07-109
NB08	A-08-008		RB10	A-07-110
NB09	A-07-009		RB11	A-07-111
NB10	A-08-010		RB12	A-07-112
NB11	R-07-011		RB13	A-07-113
NB12	R-07-012		RB14	A-07-114
NB13	R-07-013		RB15	A-07-115
NB14	R-07-014		RB16	A-07-116
NB15	A-07-015		RB17	A-07-117
NB16	A-07-016		RB18	A-07-118
NB17	A-07-017		RB19	A-07-119
NB18	A-07-018		RB20	A-07-120
NB30	A-08-030		RB21	A-07-121
NB31	A-08-031		RB22	A-07-122
NB32	A-08-032		RB23	A-07-123
NB33	A-08-033		RB24	A-07-124
NB34	A-08-034		RB25	A-07-125
NB35	A-08-035		RB41	A-08-141
NB36	A-08-036		RB42	A-08-142
NB37	R-08-037		RB43	A-08-143
NB38	R-08-038			

Multi-purpose Borings NB19 through NB26 and roadway Borings RB26 through RB140 located outside of south segment project limits.



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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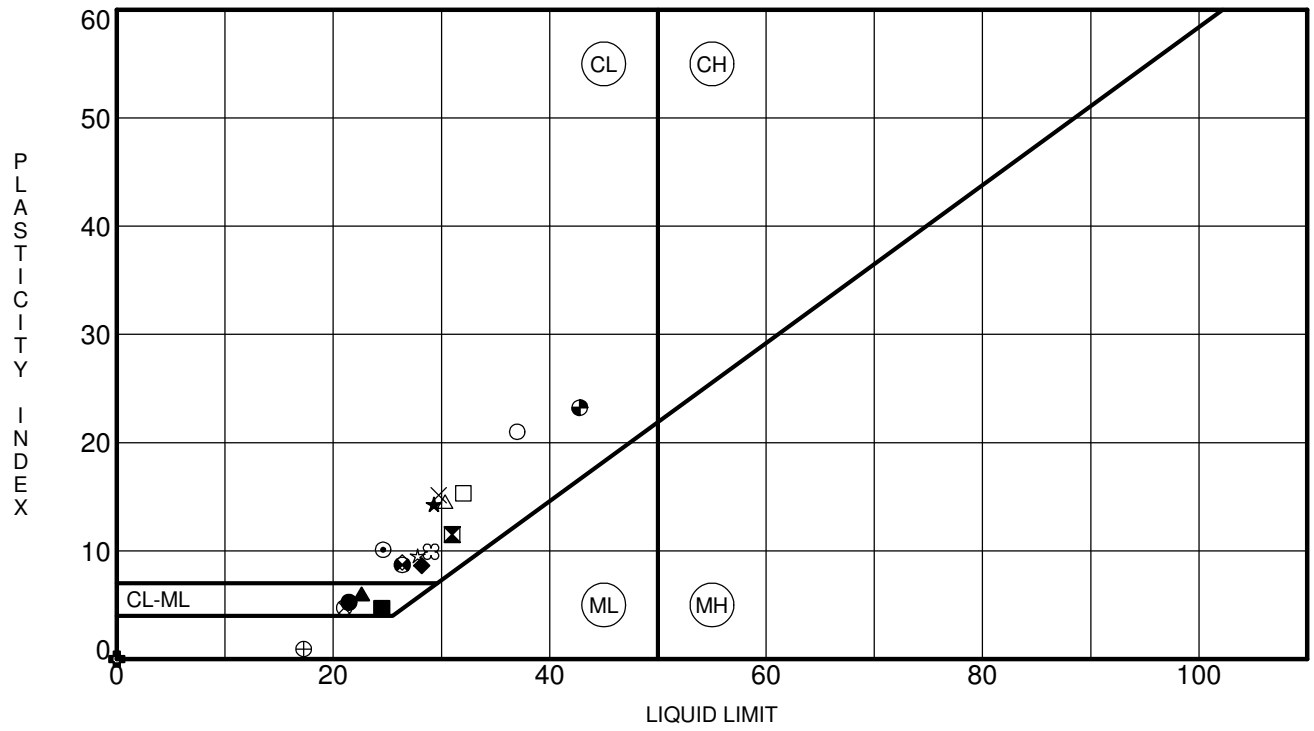
55 S. Market St, Ste 1500
San Jose, CA 95113

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)

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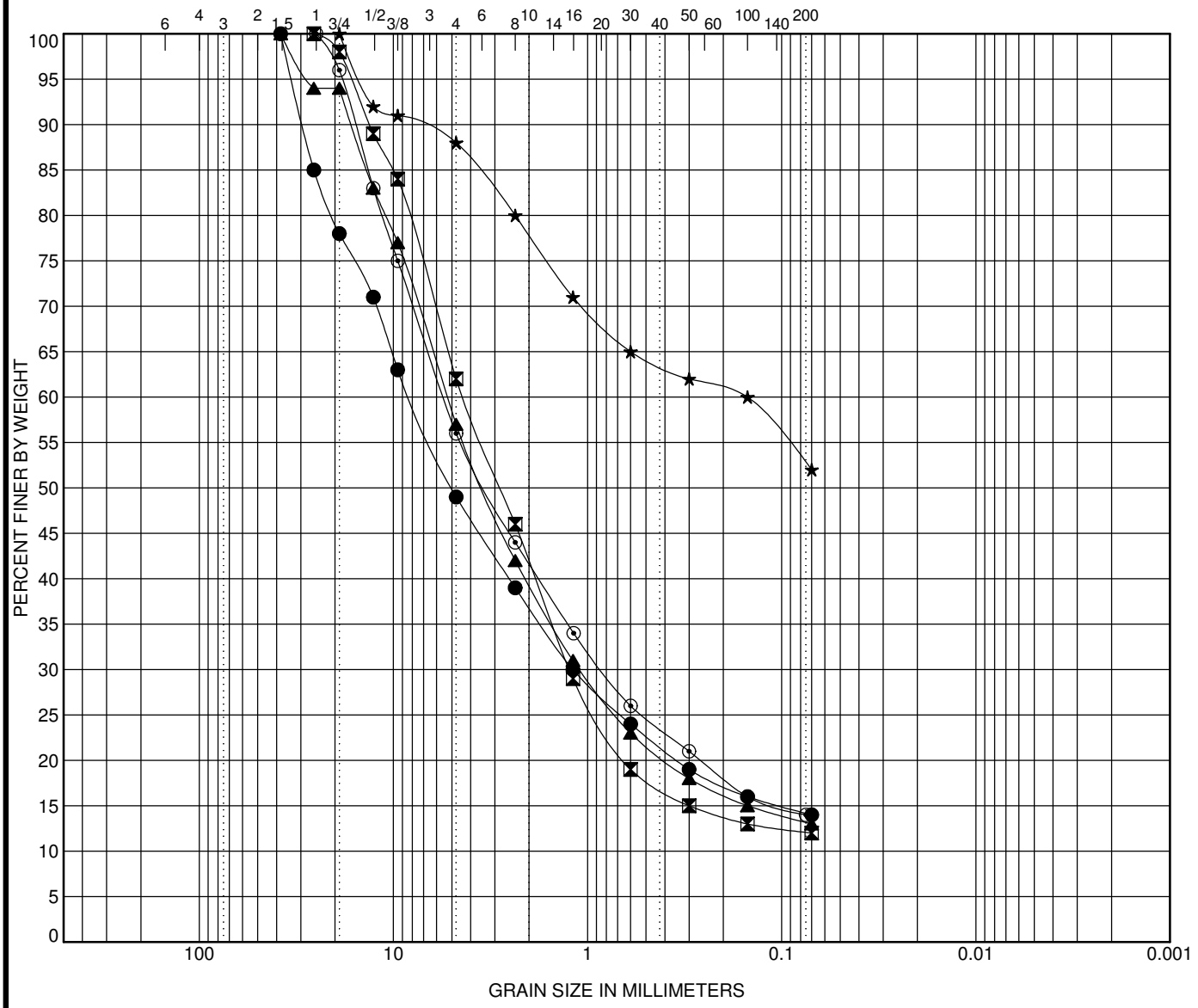
55 S. Market St, Ste 1500
San Jose, CA 95113

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



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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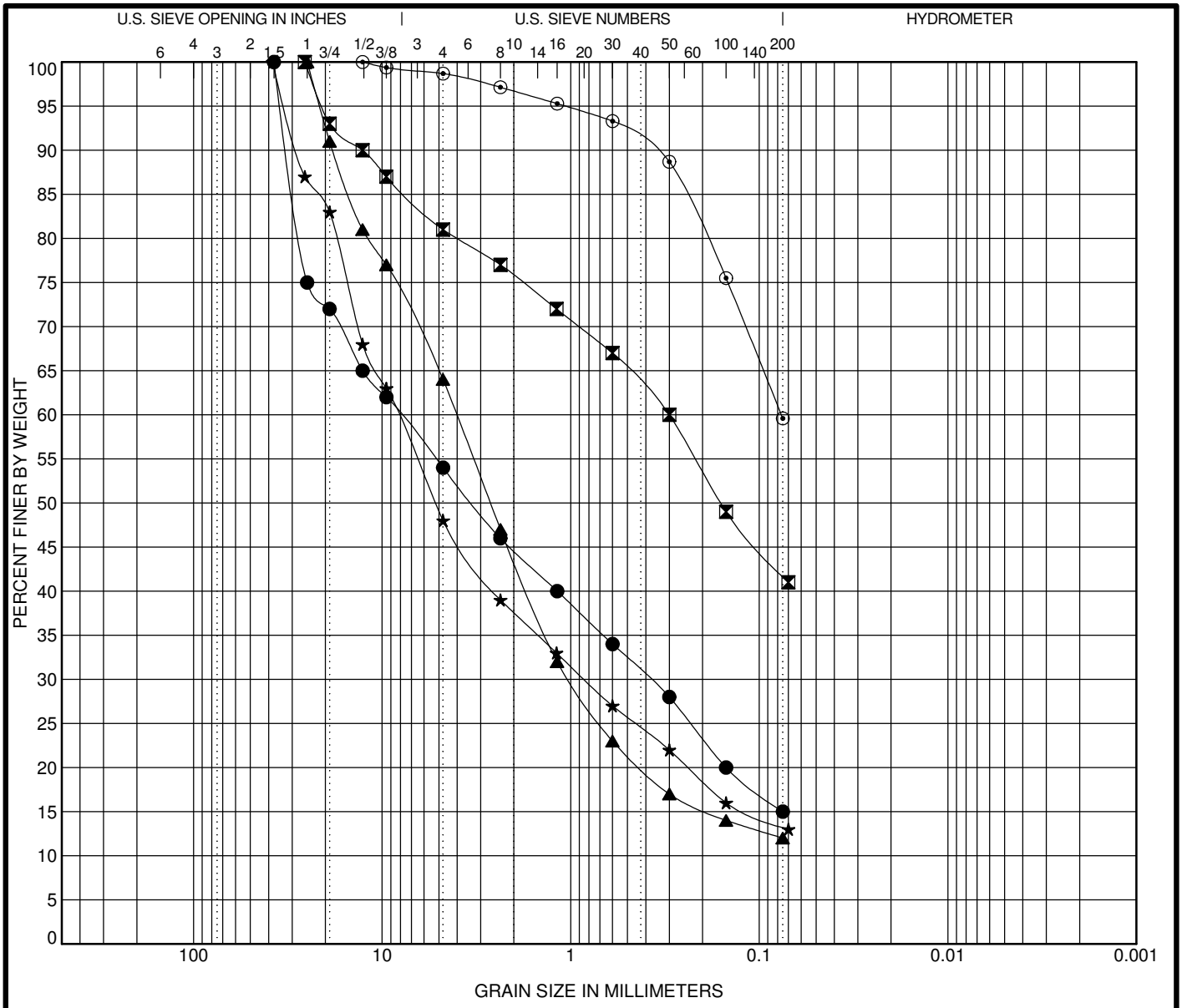
55 S. Market St, Ste 1500
San Jose, CA 95113

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
San Jose, CA 95113

GRAIN SIZE DISTRIBUTION

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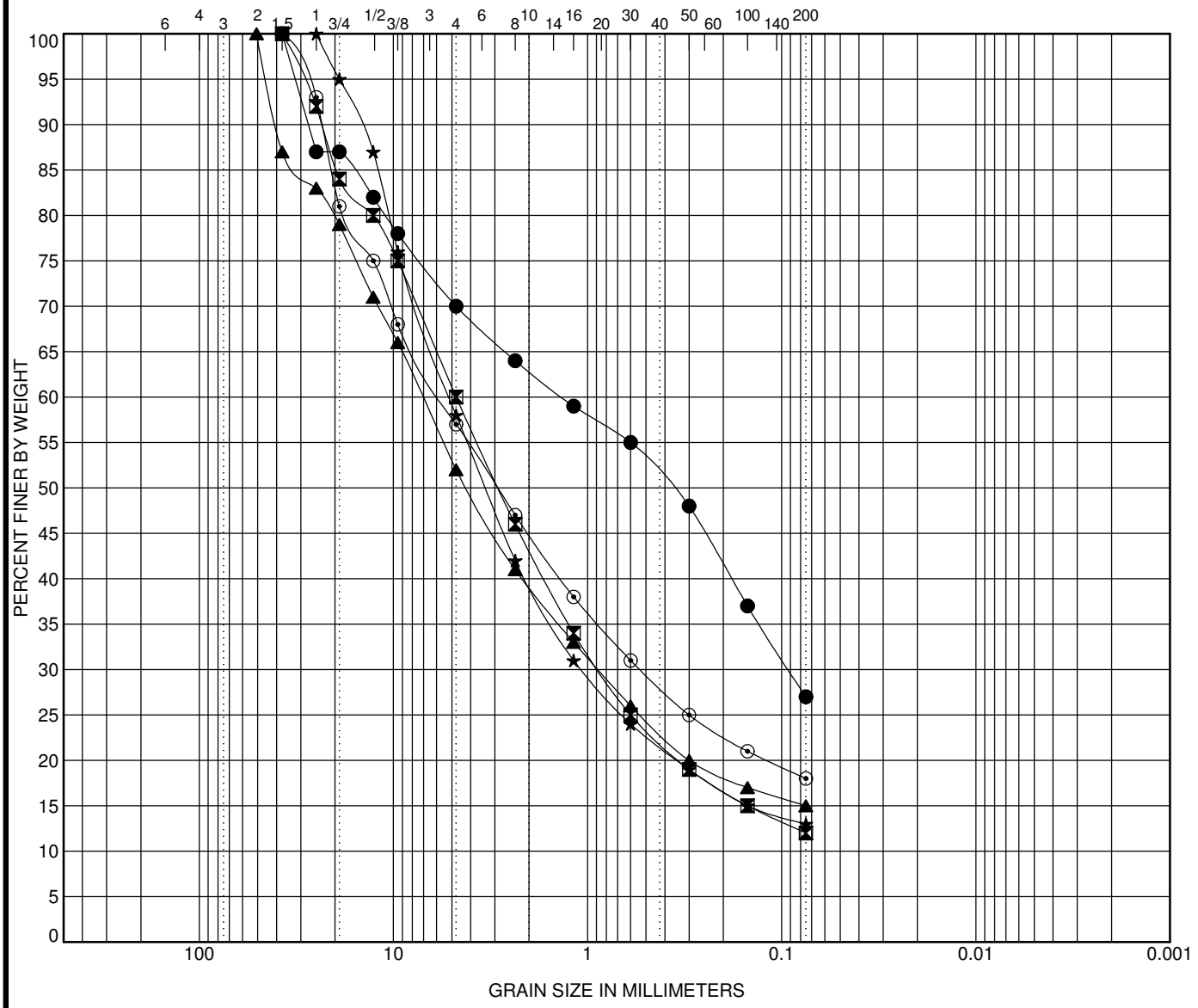
Number: 297601

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	

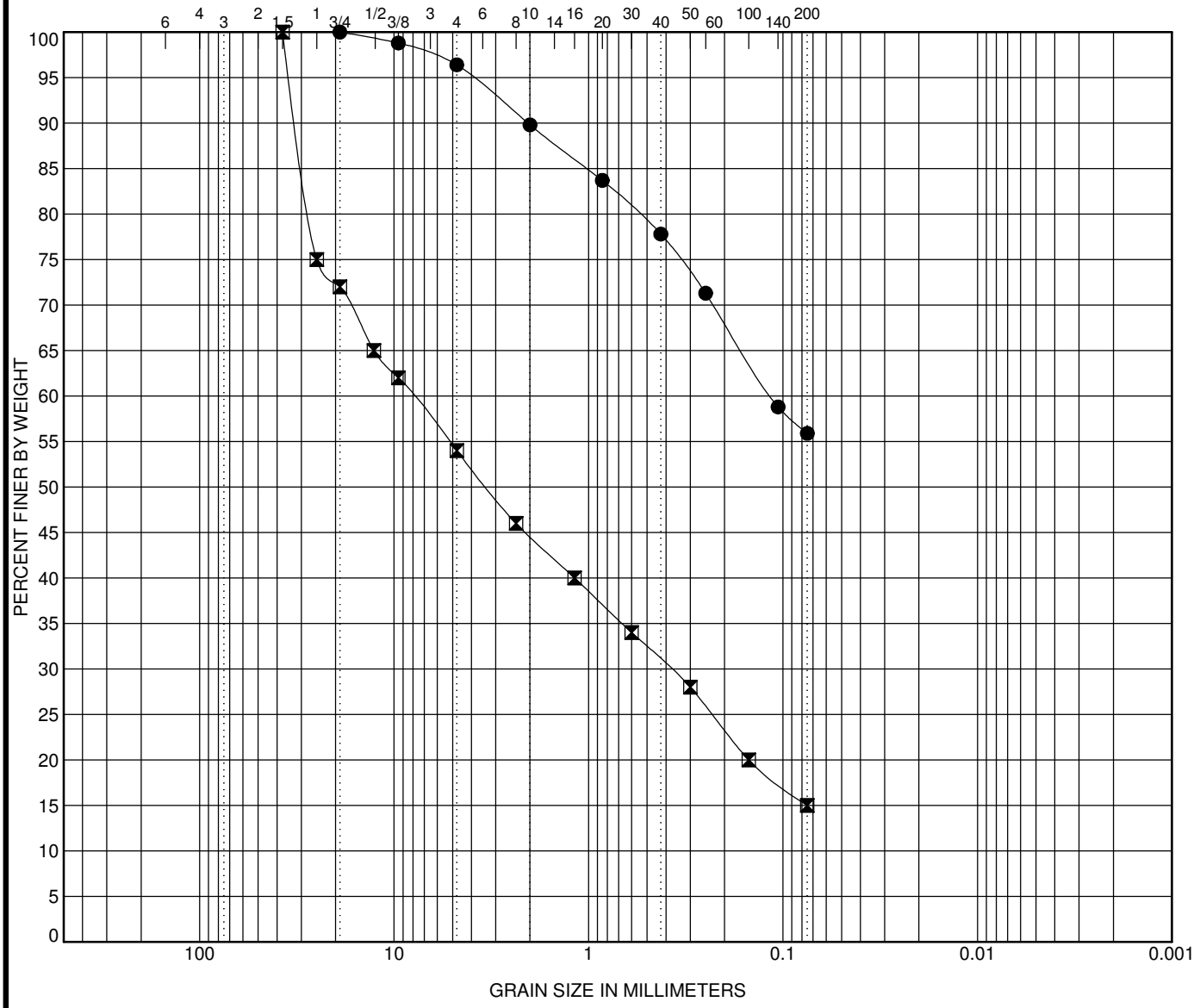
URS

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
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

Project borings were drilled in 2007-2008 and in 2008-2009. The following table provides a correlation between boring identification numbers used during the subsurface exploration programs and the current Caltrans standards.

Multi-Purpose Borings			**Roadway Borings**	
Boring Number (Old)	**Boring Number (New)**		**Boring Number (Old)**	**Boring Number (New)**
NB01	A-08-001		RB01	A-07-101
NB02	A-08-002		RB02	A-07-102
NB03	R-07-003		RB03	A-07-103
NB04	A-07-004		RB04	A-07-104
NB05	R-07-005		RB05	A-07-105
NB05A	A-08-005		RB06	A-07-106
NB06	R-07-006		RB07	A-07-107
NB07	A-07-007		RB08	A-07-108
NB07A	A-08-007A		RB09	A-07-109
NB08	A-08-008		RB10	A-07-110
NB09	A-07-009		RB11	A-07-111
NB10	A-08-010		RB12	A-07-112
NB11	R-07-011		RB13	A-07-113
NB12	R-07-012		RB14	A-07-114
NB13	R-07-013		RB15	A-07-115
NB14	R-07-014		RB16	A-07-116
NB15	A-07-015		RB17	A-07-117
NB16	A-07-016		RB18	A-07-118
NB17	A-07-017		RB19	A-07-119
NB18	A-07-018		RB20	A-07-120
NB30	A-08-030		RB21	A-07-121
NB31	A-08-031		RB22	A-07-122
NB32	A-08-032		RB23	A-07-123
NB33	A-08-033		RB24	A-07-124
NB34	A-08-034		RB25	A-07-125
NB35	A-08-035		RB41	A-08-141
NB36	A-08-036		RB42	A-08-142
NB37	R-08-037		RB43	A-08-143
NB38	R-08-038			

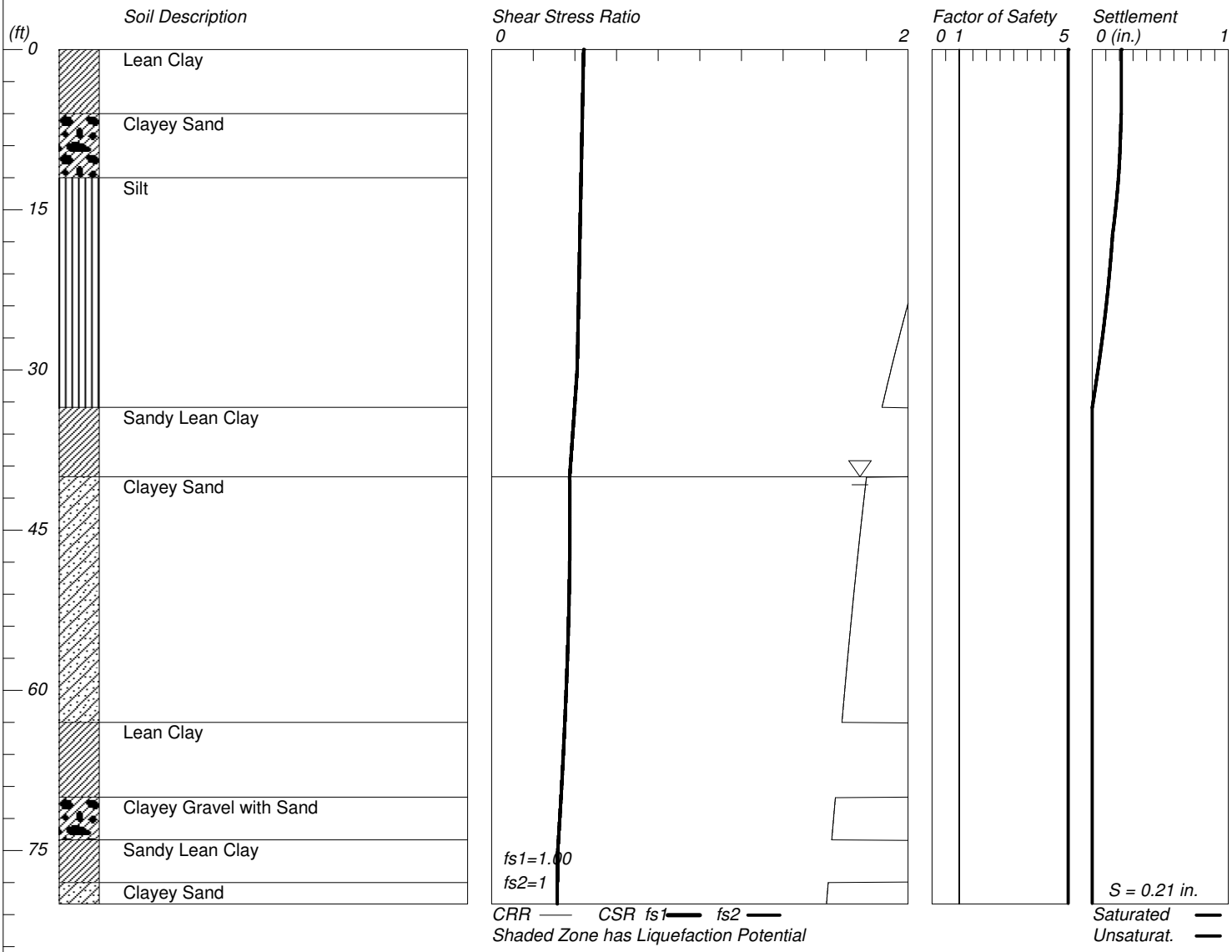
Multi-purpose Borings NB19 through NB26 and roadway Borings RB26 through RB140 located outside of south segment project limits.

LIQUEFACTION ANALYSIS

SR 84 Isabel Ave Improvements

Hole No.=NB03 Water Depth=40 ft Surface Elev.=539

Magnitude=6.8
Acceleration=0.68g



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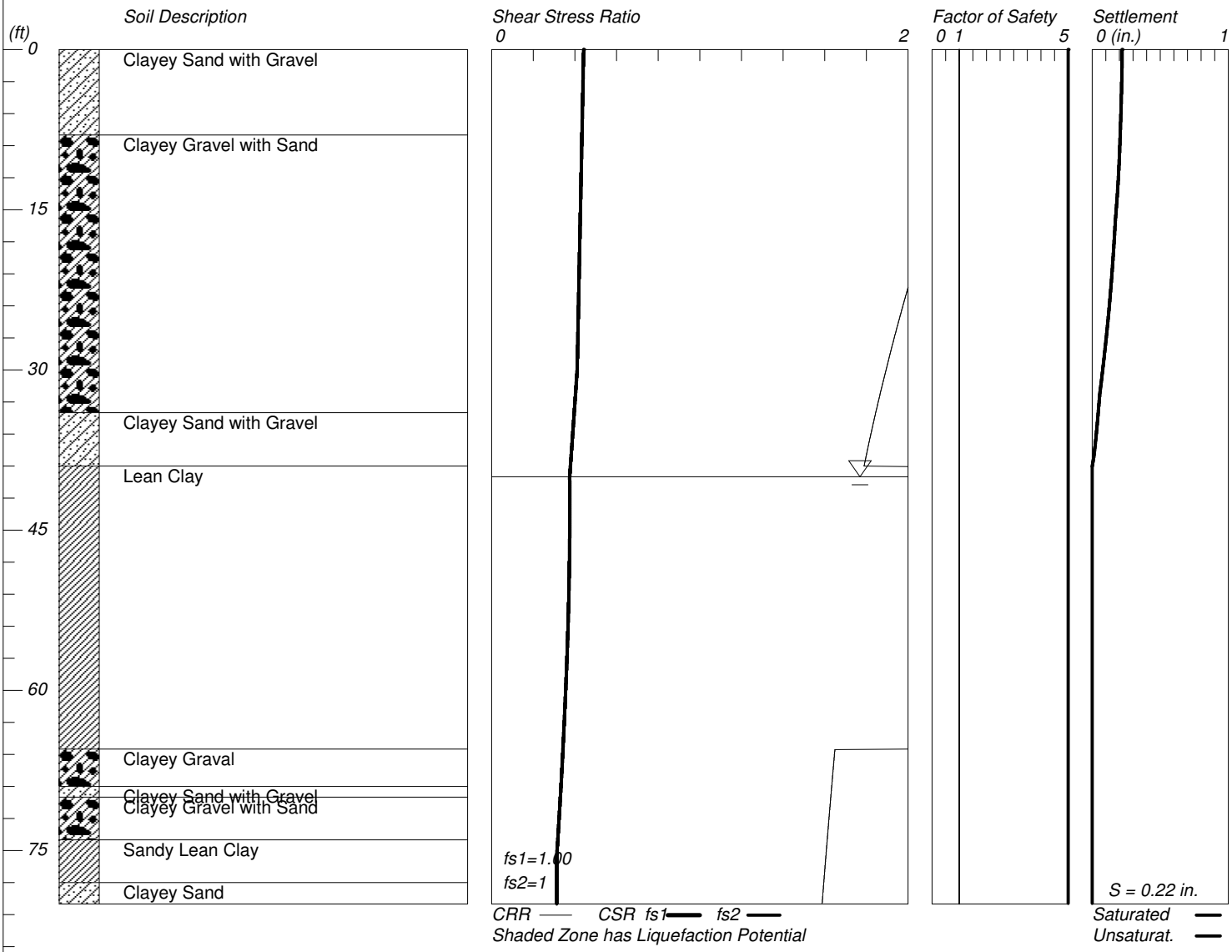
LIQUEFACTION ANALYSIS

SR 84 Isabel Ave Improvements

Hole No.=NB06 Water Depth=40 ft Surface Elev.=528

Magnitude=6.8
Acceleration=0.68g



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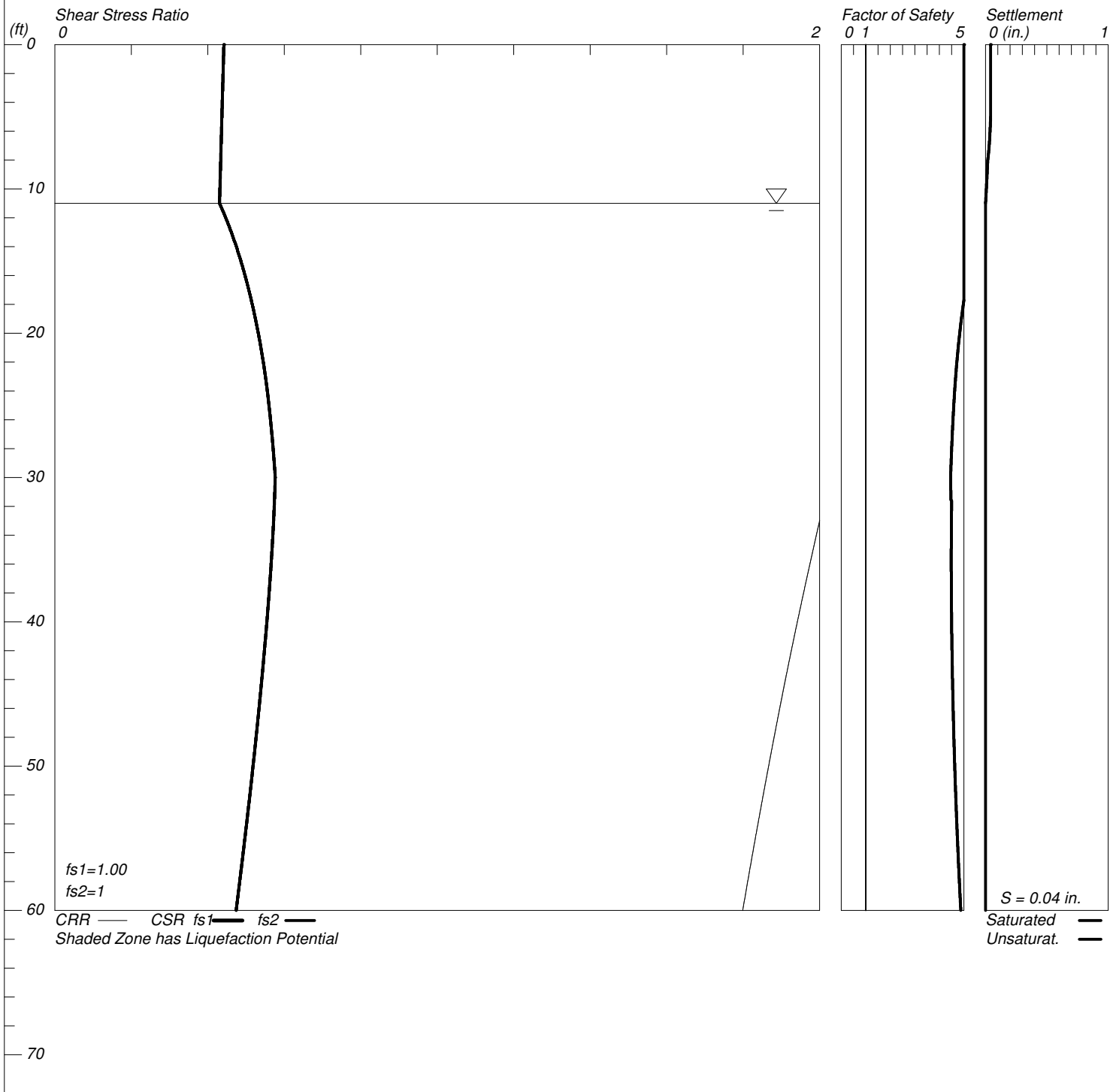
LIQUEFACTION ANALYSIS

Route 84 Expressway Widening

Hole No.=NB11 Water Depth=11 ft Surface Elev.=412

Magnitude=6.8
Acceleration=0.68g



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URS

Arroyo Del Valle Widening & Trail Bridge

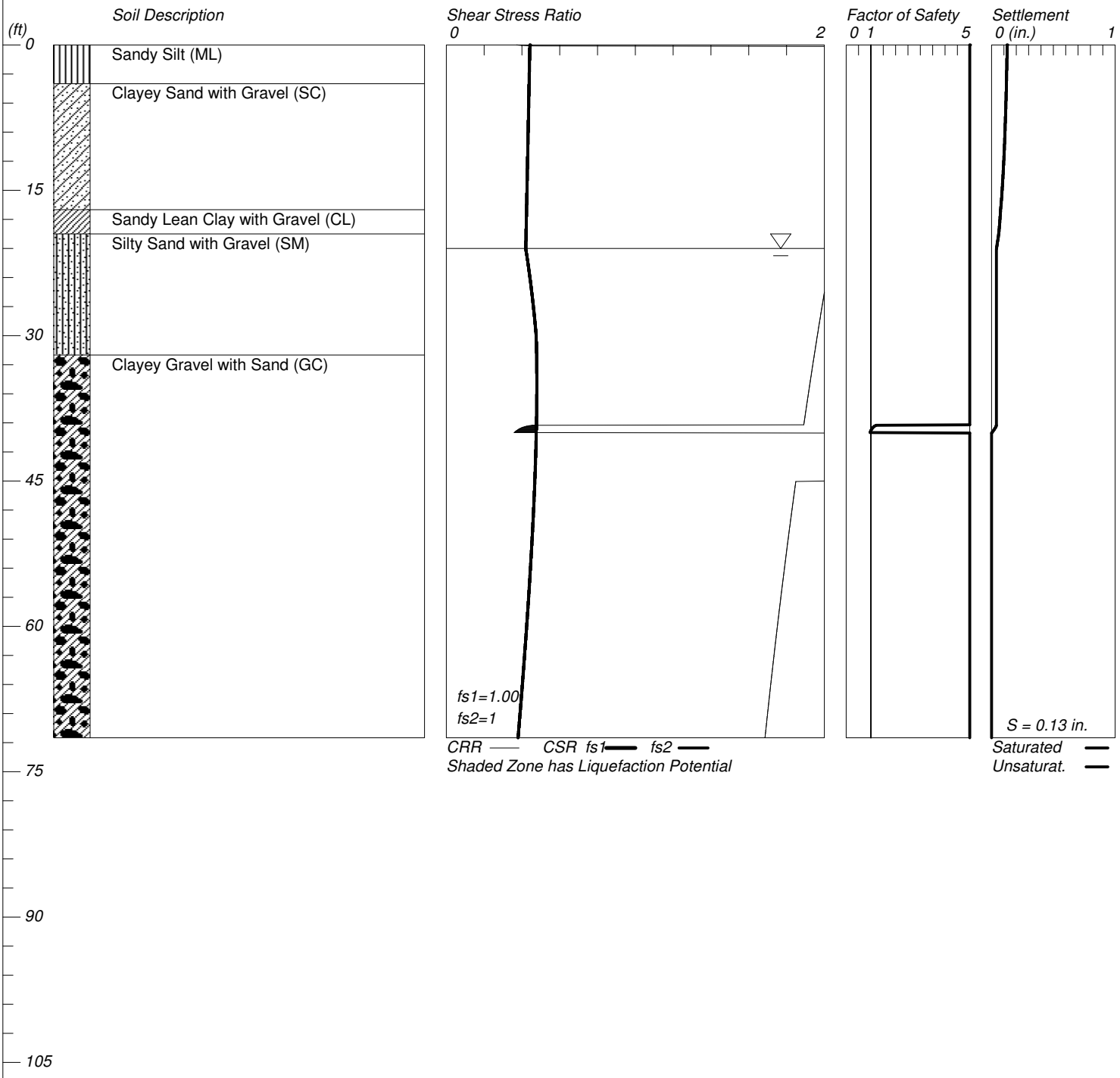
Figure D-5

LIQUEFACTION ANALYSIS

Route 84 Expressway Widening

Hole No.=NB12 Water Depth=21 ft Surface Elev.=422

Magnitude=6.8
Acceleration=0.68g



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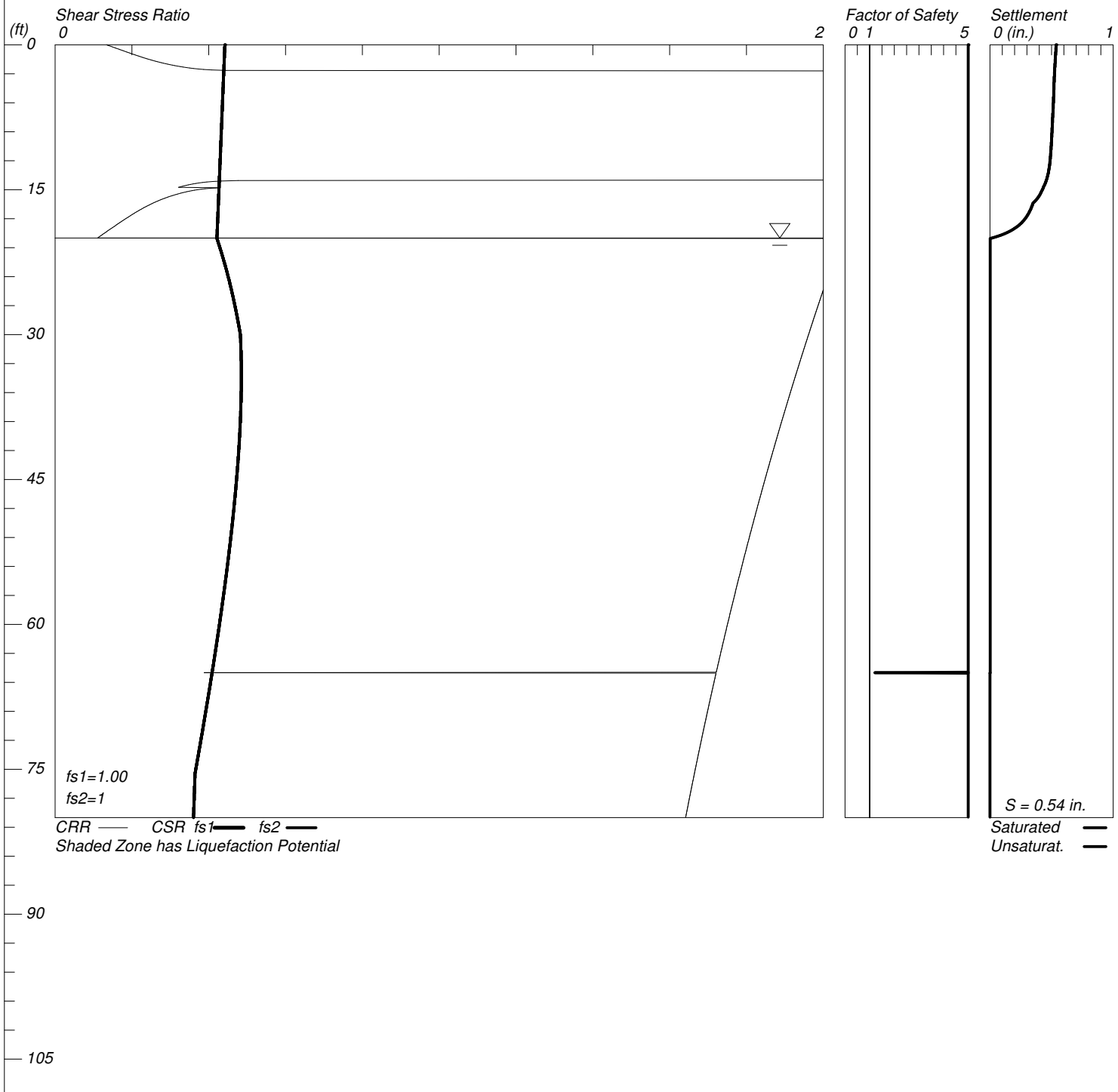
LIQUEFACTION ANALYSIS

Route 84 Expressway Widening

Hole No.=NB13 Water Depth=20 ft Surface Elev.=421

Magnitude=6.8
Acceleration=0.68g



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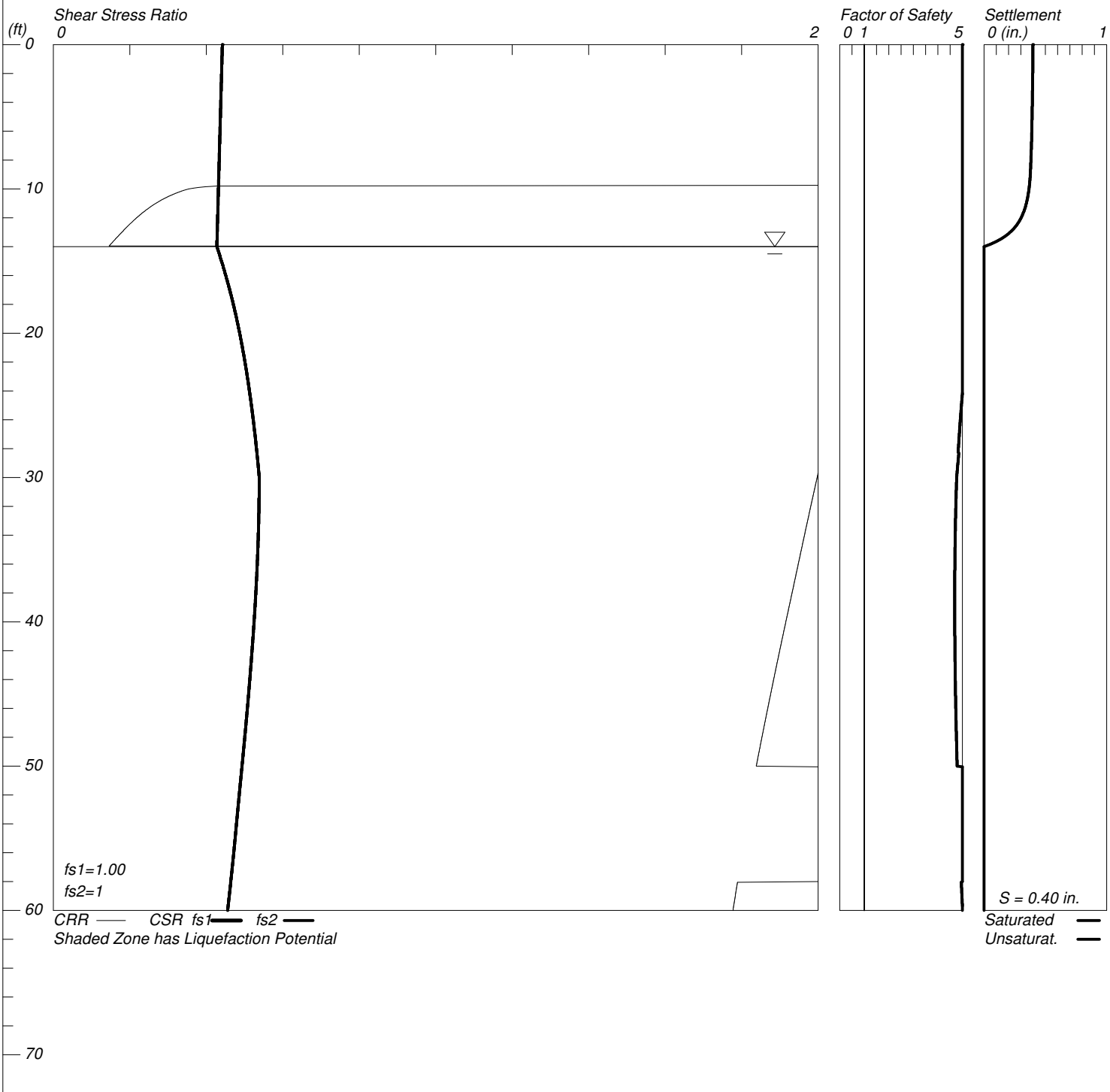
LIQUEFACTION ANALYSIS

Route 84 Expressway Widening

Hole No.=NB14 Water Depth=14 ft Surface Elev.=415

Magnitude=6.8
Acceleration=0.68g



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LIQUEFACTION ANALYSIS

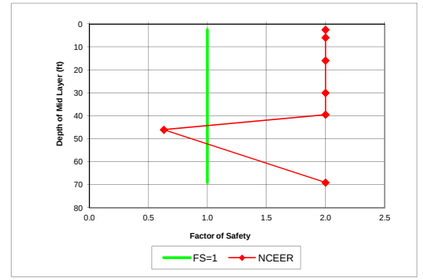
Project: Route 84 Widening
Project No.: 28649640
Boring No.: R-08-037

Original Boring ID NB-37

PGA =	0.68	
M_w =	6.8	
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($CSR_M/CSR_{M=7.5}$)		0.75

Note: Cells in Red must be input

			C_E	Code	C_E
Hammer type :	Type				
	Donut		0.75	1	3
	Safety		1	2	
	Auto		1.16	3	
Borehole Diameter:	(inch)	(mm)	C_B		C_B
	2.5-4.5	65-115	1	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		



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	0.440													1.28	1.38	1.33		Y	2.00	N	1
2	CL	128	7.0	2.13	6.0	1.83	778	187	591	0.988	0.575													1.28	1.38	1.33		N	2.00	N	1
3	SC	144	25.0	7.62	16.0	4.88	2,202	811	1,391	0.966	0.676	51	M	40.8	15	45.3	1.23	1.16	1.00	0.85	1.00	55	0.459	1.28	1.38	1.33	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	0.682	43	S	43	15	47.6	0.92	1.16	1.00	0.95	1.20	58	0.459	1.28	1.38	1.33	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	0.645	78	M	62.4	15	67.9	0.81	1.16	1.00	1.00	1.00	64	0.459	1.28	1.38	1.33	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	0.606	17	S	17	55	25.4	0.76	1.16	1.00	1.00	1.20	27	0.315	1.28	1.38	1.33	0.909	N	0.63	Liquef	1
7	SC	140	90.0	27.43	69.0	21.03	9,534	4,118	5,416	0.597	0.465	59	M	47.2	15	52.0	0.63	1.16	1.00	1.00	1.00	38	0.459	1.28	1.38	1.33	0.829	N	2.00	N	1

Layer Number	Depth to Bot. Layer	Thickness	σ_o	u	σ'_o	r_d	$(N_1)_{60-cs}$	Liquefy ?	τ_{cyc}	$CSR_{M=7.5}$	CSR_M	Volumetric Strain**			Settl.
		ft	psf	psf	psf			NCEER	psf	τ_{cyc}/σ'_o	τ_{cyc}/σ'_o		%		in
1	5.0	5.0	325	0	325	0.996		N	143.1	0.440	0.33				0.00
2	7.0	2.0	778	187	591	0.988		N	339.7	0.575	0.43				0.00
3	25.0	18.0	2,202	811	1,391	0.966	55.0	N	940.6	0.676	0.51				0.00
4	35.0	10.0	4,178	1,685	2,493	0.921	58.0	N	1700.0	0.682	0.51				0.00
5	44.0	9.0	5,506	2,278	3,228	0.855	63.8	N	2081.7	0.645	0.48				0.00
6	48.0	4.0	6,374	2,683	3,691	0.794	26.8	Liquef	2235.7	0.606	0.45		1.0		0.48
7	90.0	42.0	9,534	4,118	5,416	0.597	37.7	N	2517.6	0.465	0.35				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.

Figure D-9

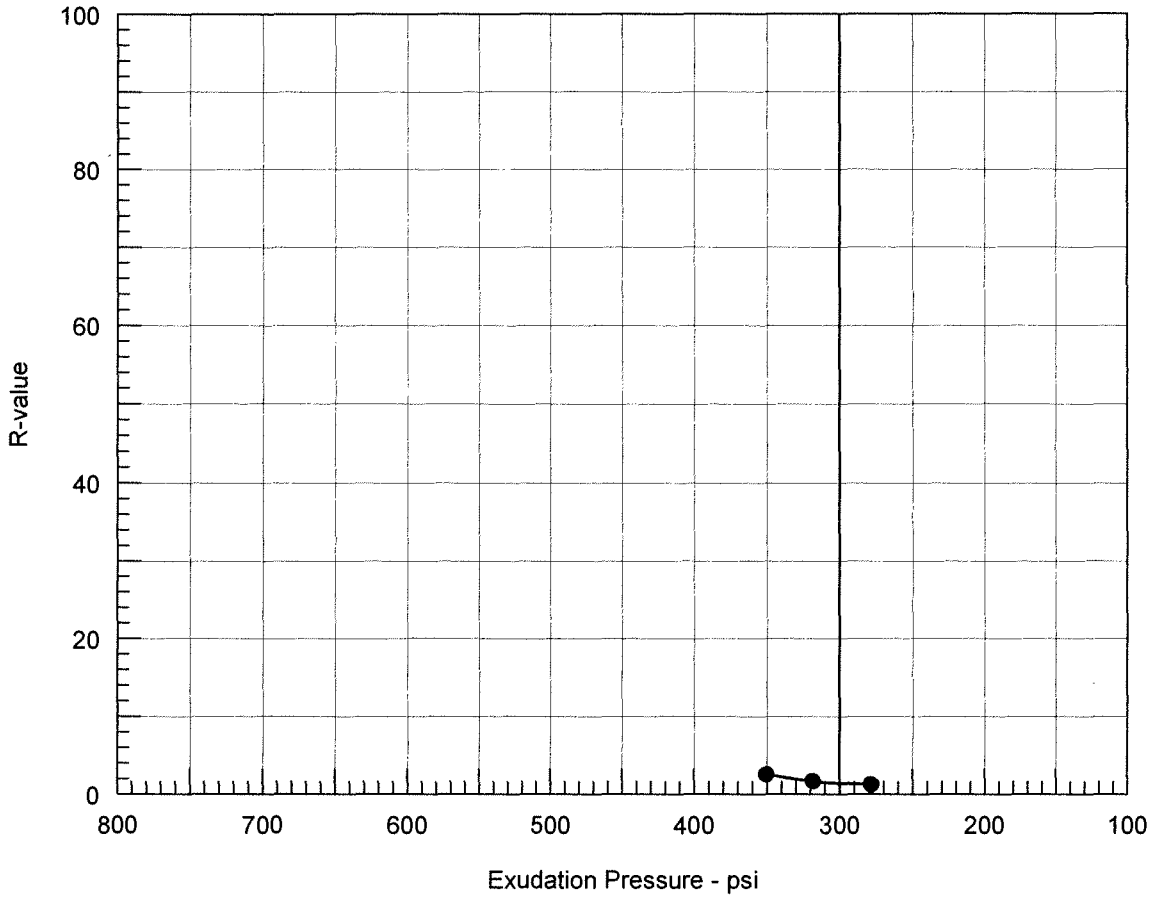
Resistance value (R-value) tests were performed on nineteen (19) bulk samples of near surface soils at borings. The results of these tests are presented herein.

Project borings were drilled in 2007-2008 and in 2008-2009. The following table provides a correlation between boring identification numbers used during the subsurface exploration programs and the current Caltrans standards.

Multi-Purpose Borings			**Roadway Borings**	
Boring Number (Old)	**Boring Number (New)**		**Boring Number (Old)**	**Boring Number (New)**
NB01	A-08-001		RB01	A-07-101
NB02	A-08-002		RB02	A-07-102
NB03	R-07-003		RB03	A-07-103
NB04	A-07-004		RB04	A-07-104
NB05	R-07-005		RB05	A-07-105
NB05A	A-08-005		RB06	A-07-106
NB06	R-07-006		RB07	A-07-107
NB07	A-07-007		RB08	A-07-108
NB07A	A-08-007A		RB09	A-07-109
NB08	A-08-008		RB10	A-07-110
NB09	A-07-009		RB11	A-07-111
NB10	A-08-010		RB12	A-07-112
NB11	R-07-011		RB13	A-07-113
NB12	R-07-012		RB14	A-07-114
NB13	R-07-013		RB15	A-07-115
NB14	R-07-014		RB16	A-07-116
NB15	A-07-015		RB17	A-07-117
NB16	A-07-016		RB18	A-07-118
NB17	A-07-017		RB19	A-07-119
NB18	A-07-018		RB20	A-07-120
NB30	A-08-030		RB21	A-07-121
NB31	A-08-031		RB22	A-07-122
NB32	A-08-032		RB23	A-07-123
NB33	A-08-033		RB24	A-07-124
NB34	A-08-034		RB25	A-07-125
NB35	A-08-035		RB41	A-08-141
NB36	A-08-036		RB42	A-08-142
NB37	R-08-037		RB43	A-08-143
NB38	R-08-038			

Multi-purpose Borings NB19 through NB26 and roadway Borings RB26 through RB140 located outside of south segment project limits.

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:

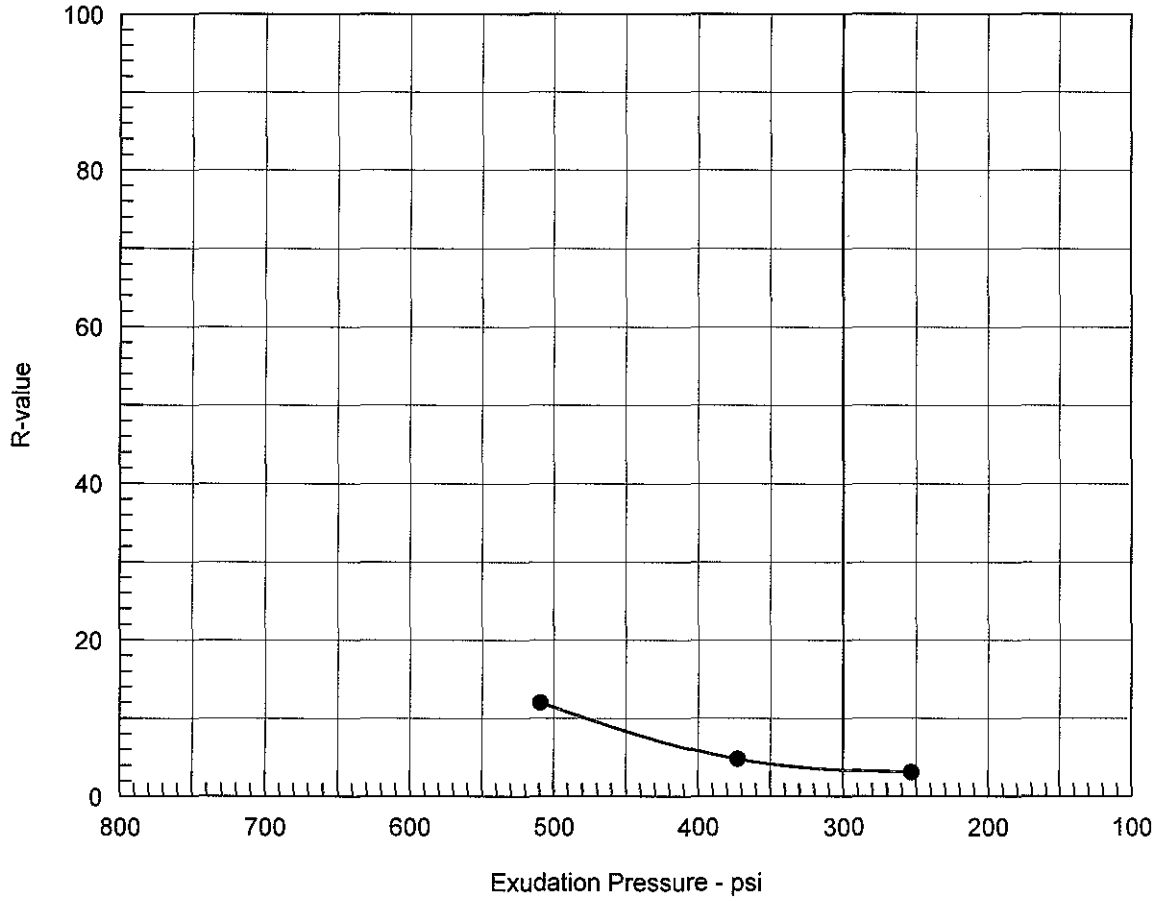
Remarks:

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

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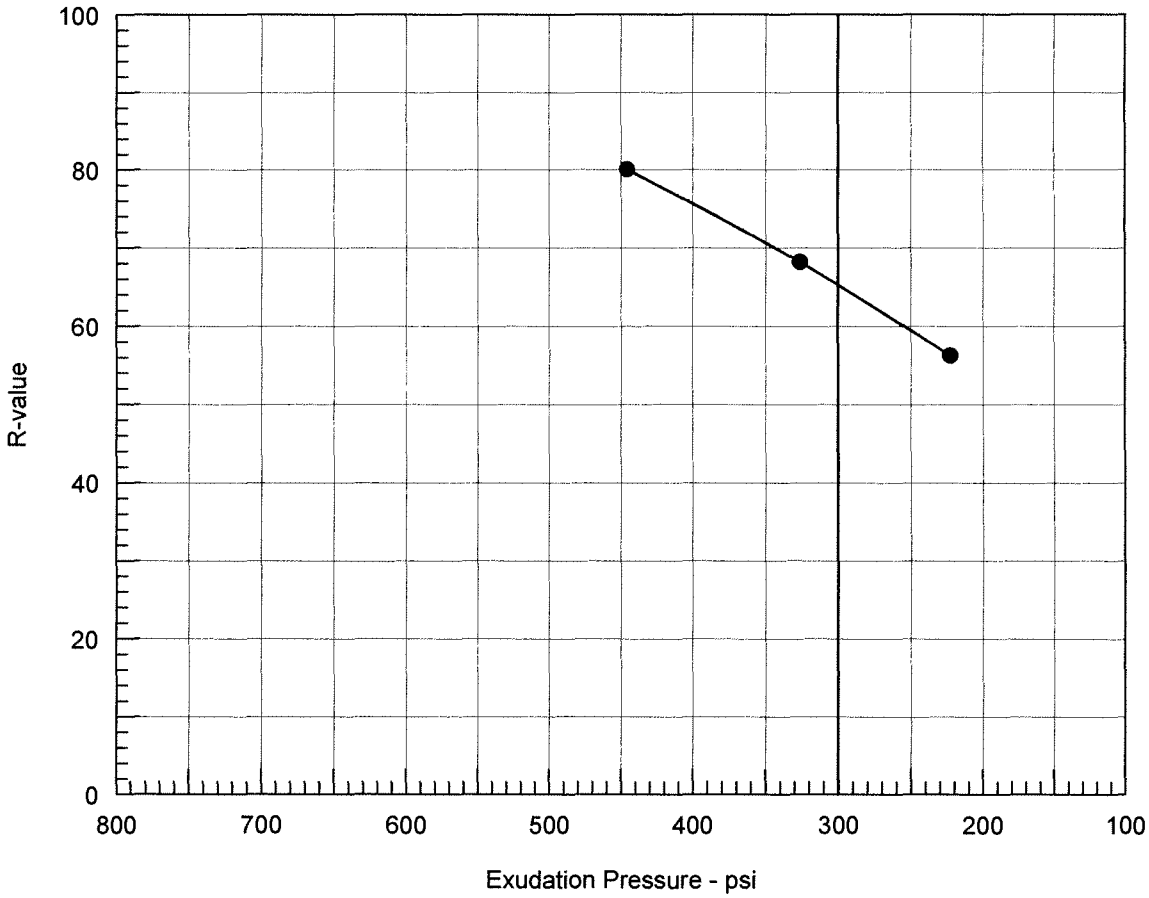
Figure _____

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	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

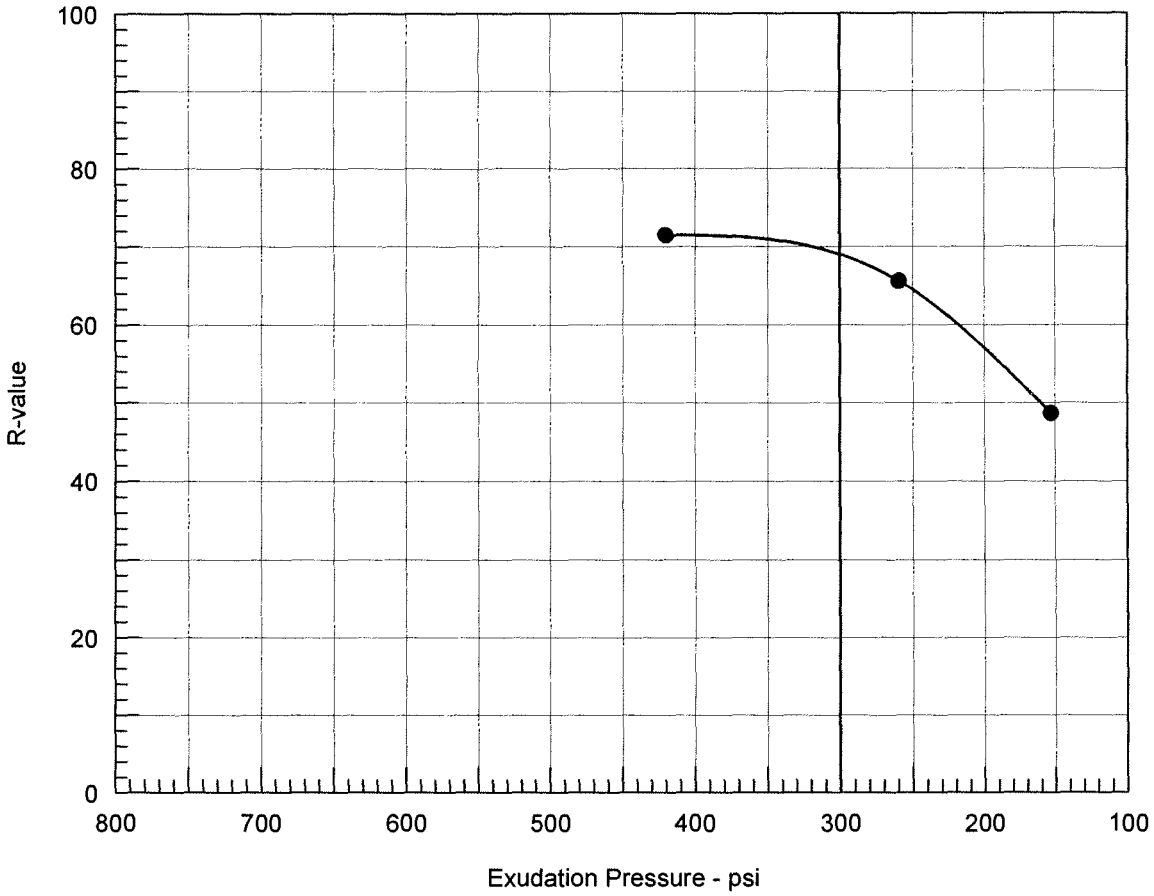
Tested by:
Checked by:
Remarks:

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:

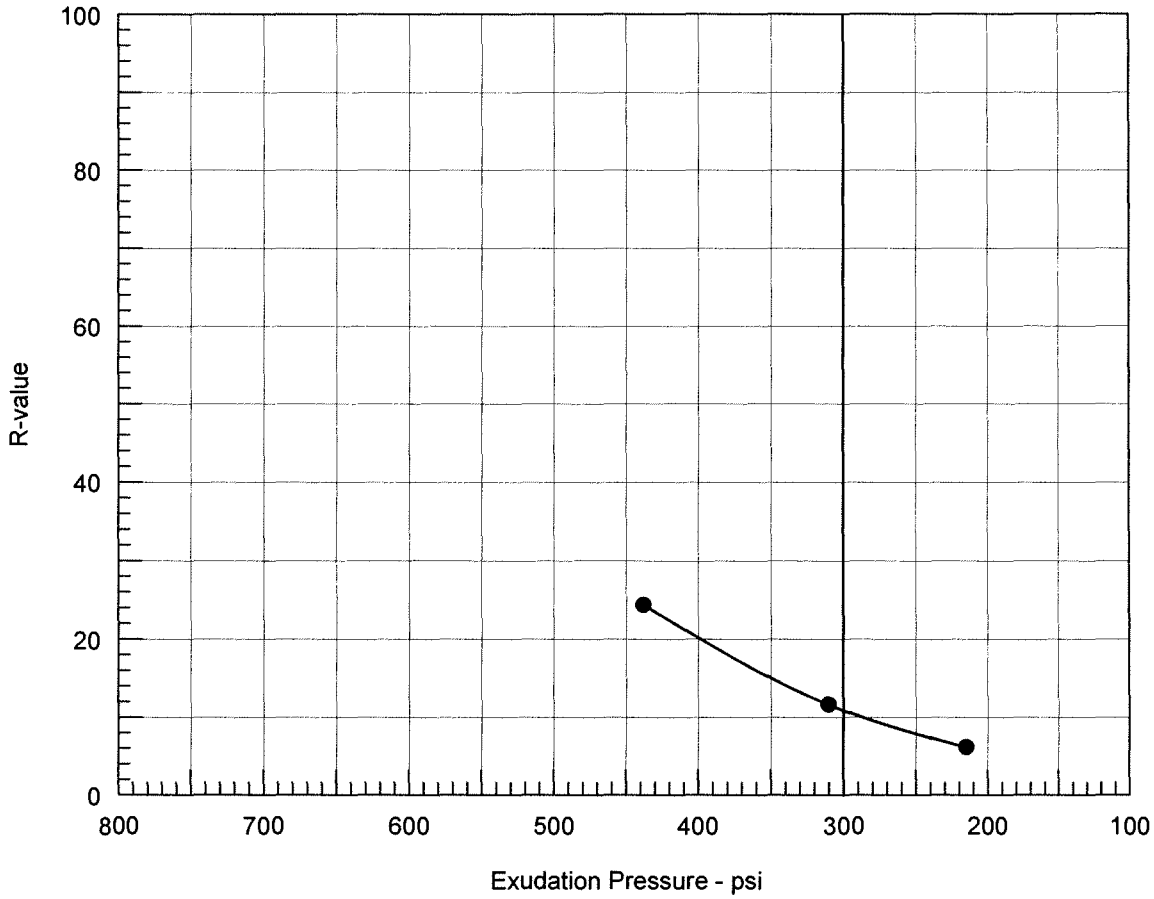
Remarks:

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

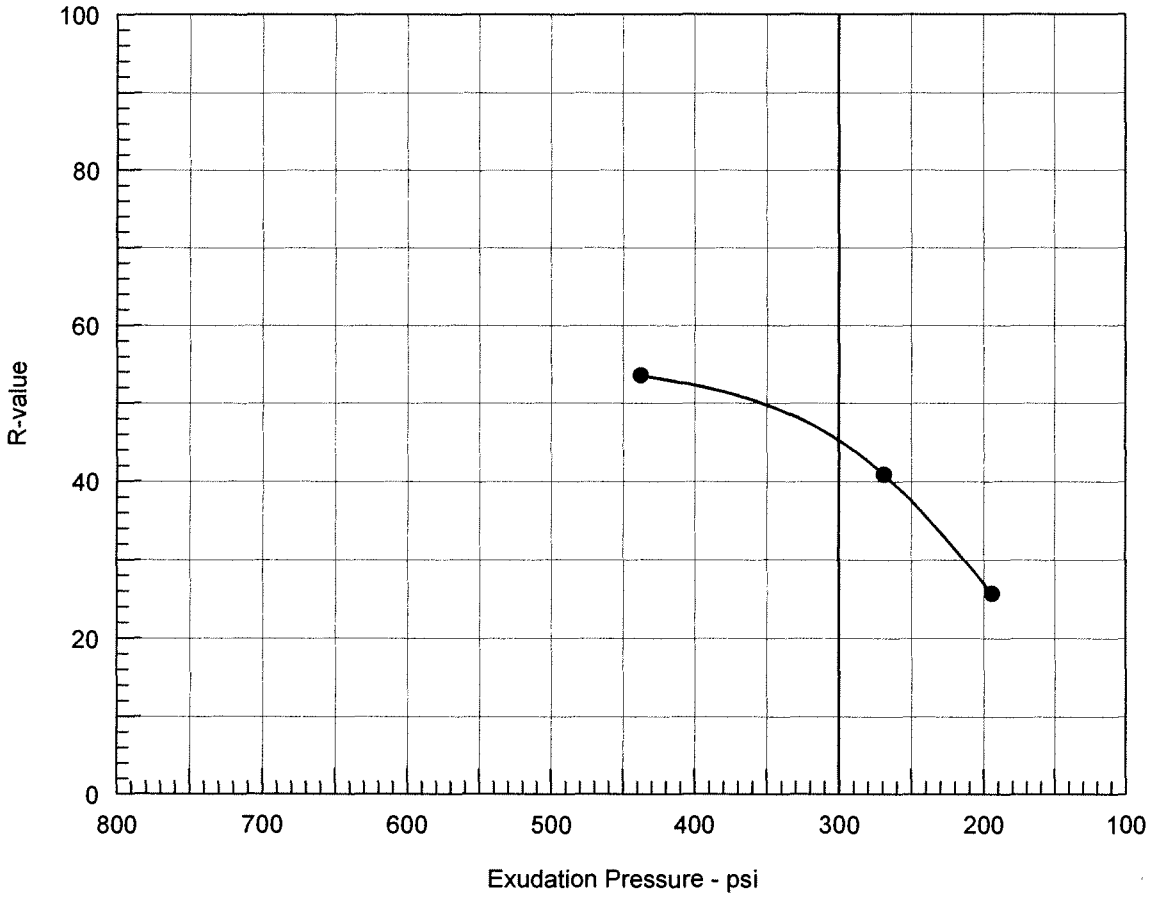
Tested by:
Checked by:
Remarks:

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

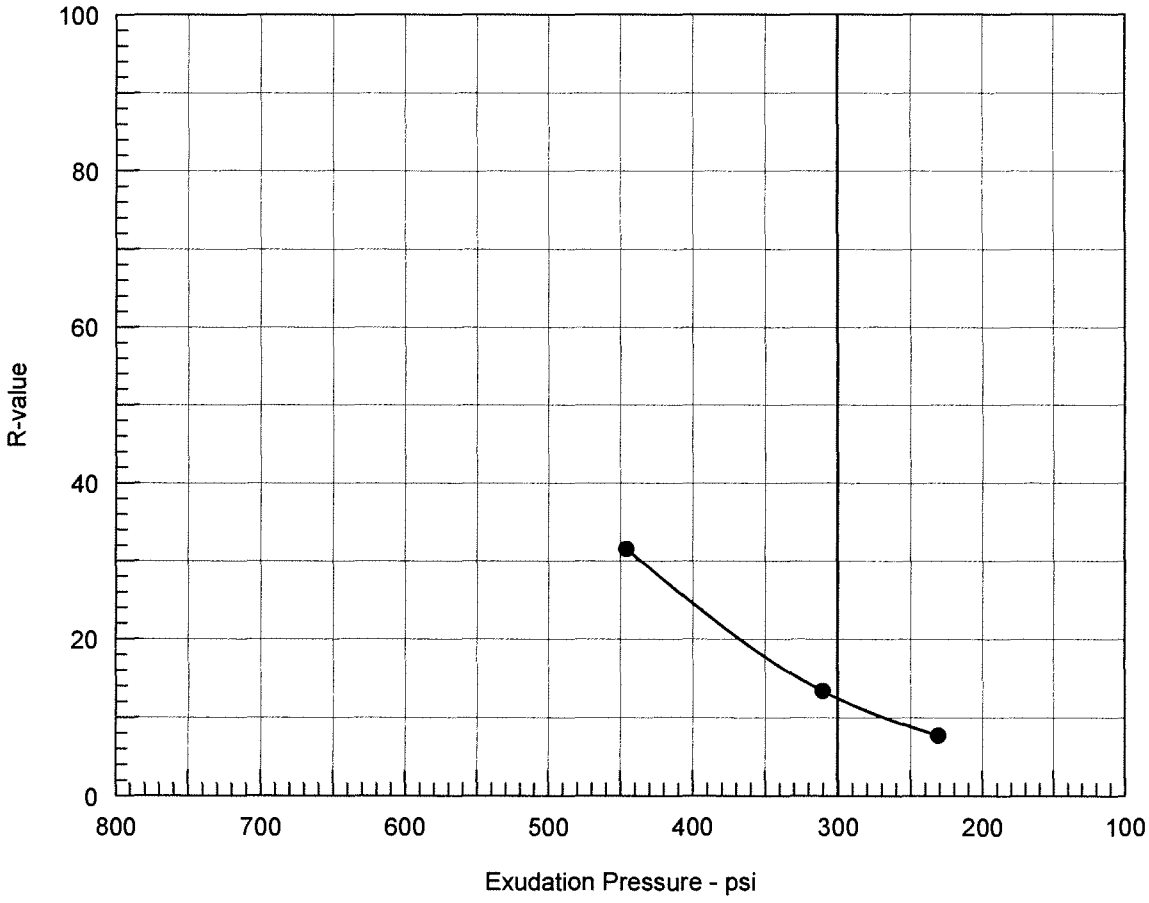
Tested by:
Checked by:
Remarks:

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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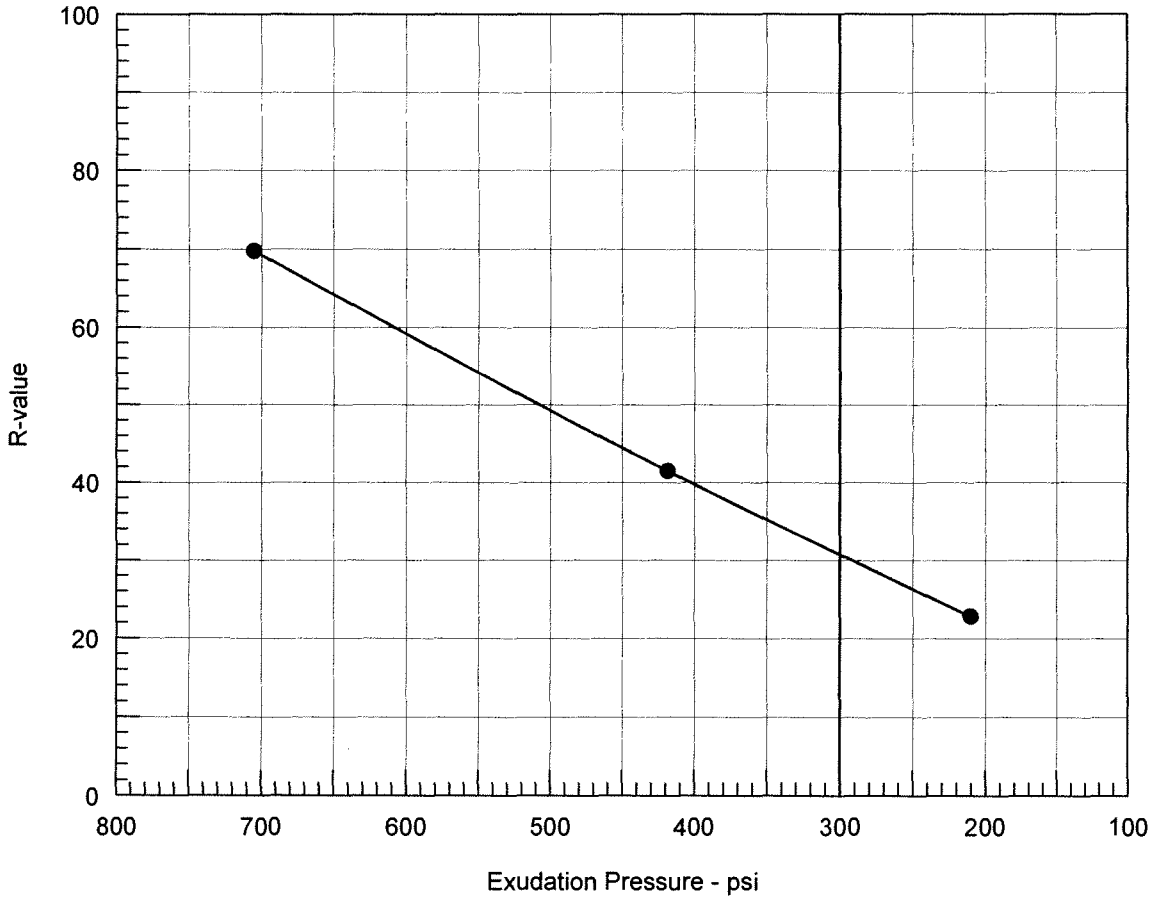
Figure _____

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:

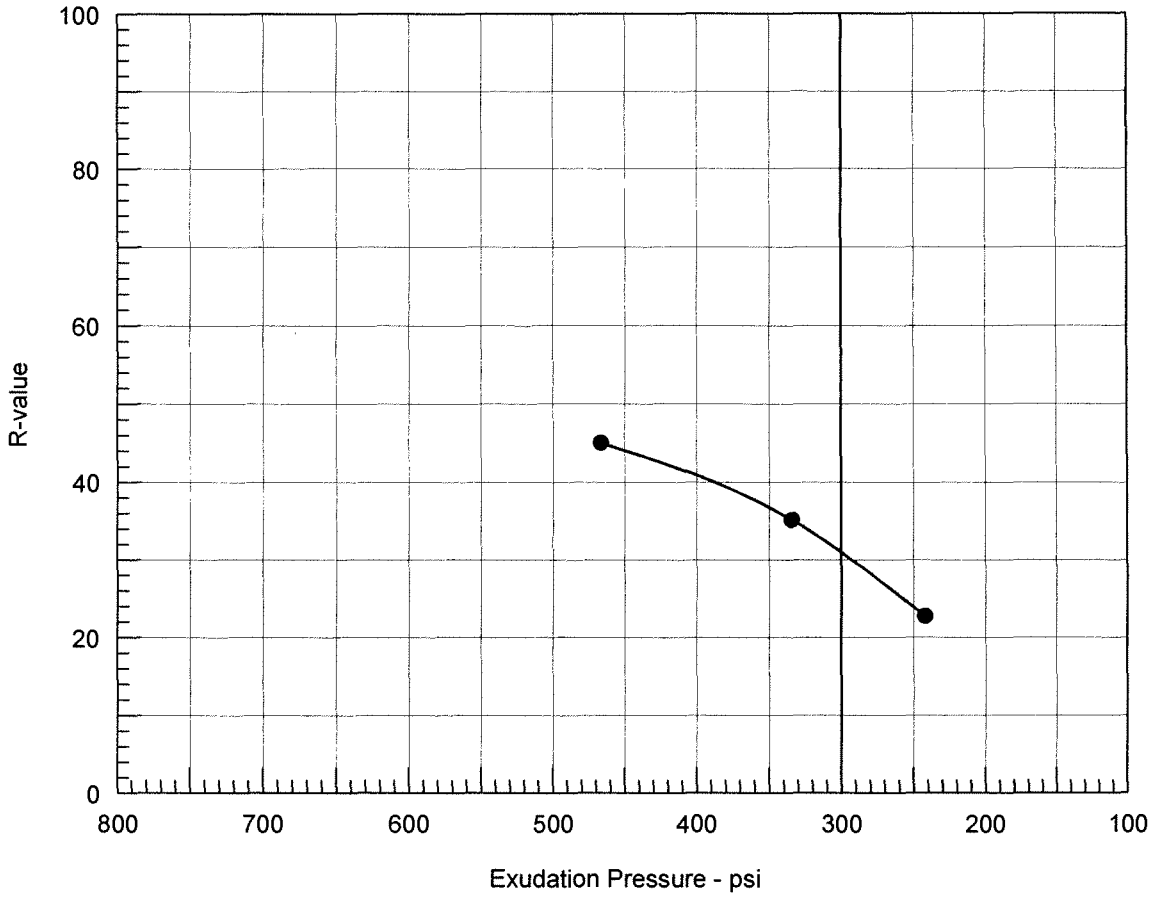
Remarks:

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

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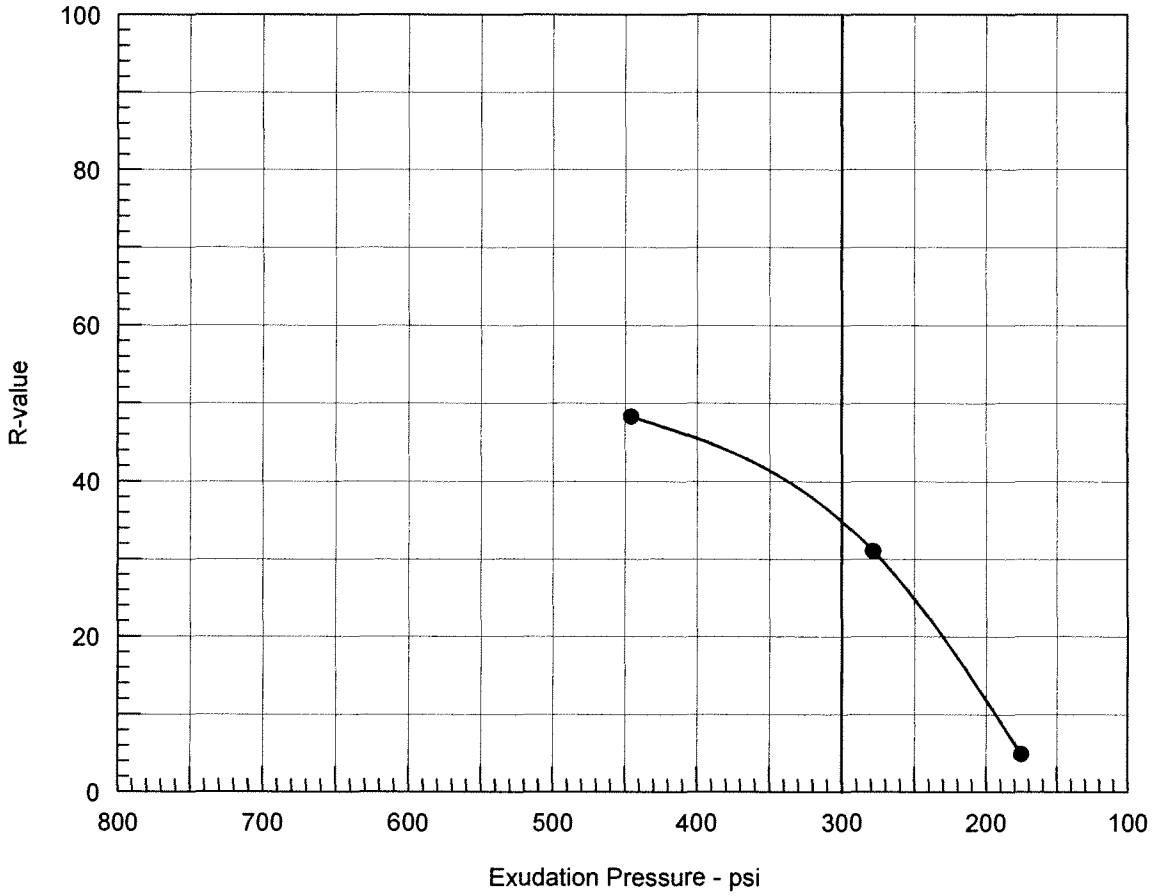
Figure _____

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	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

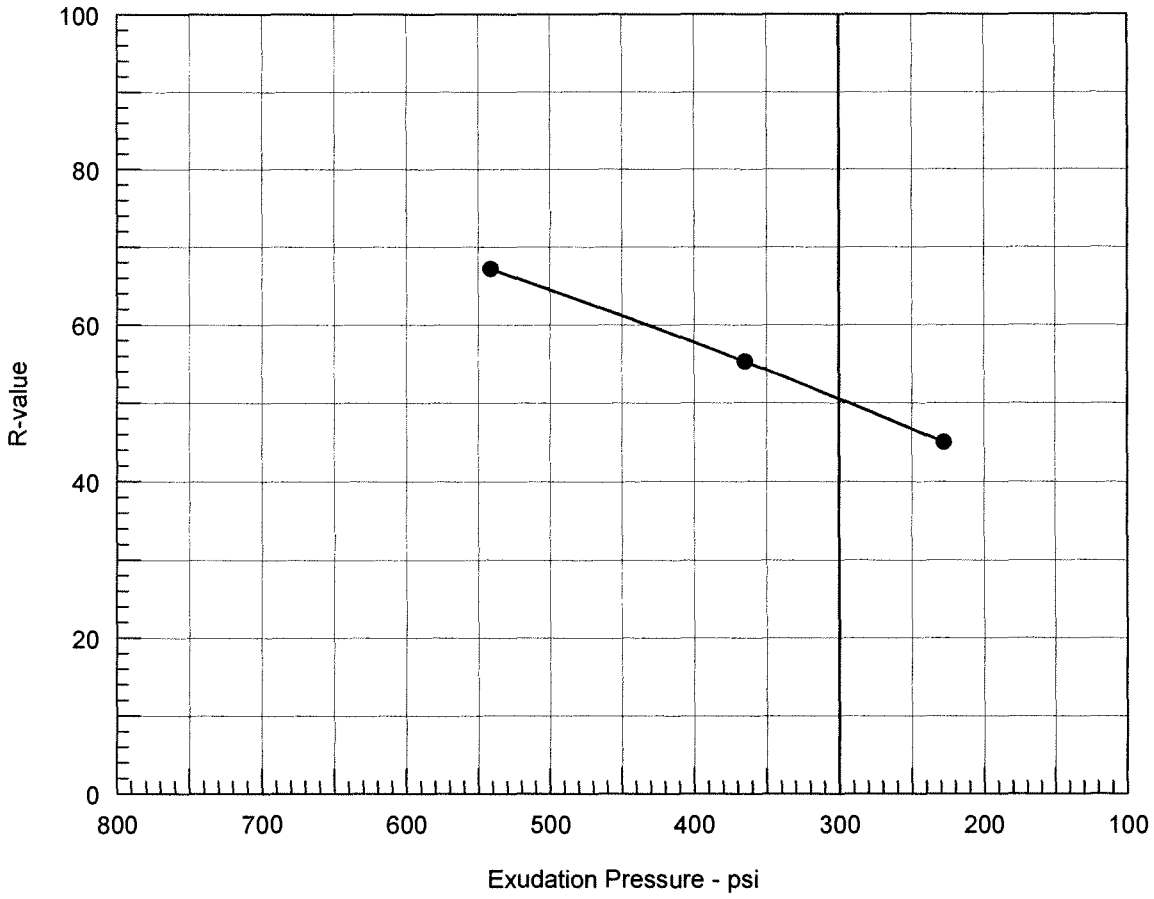
Tested by:
Checked by:
Remarks:

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

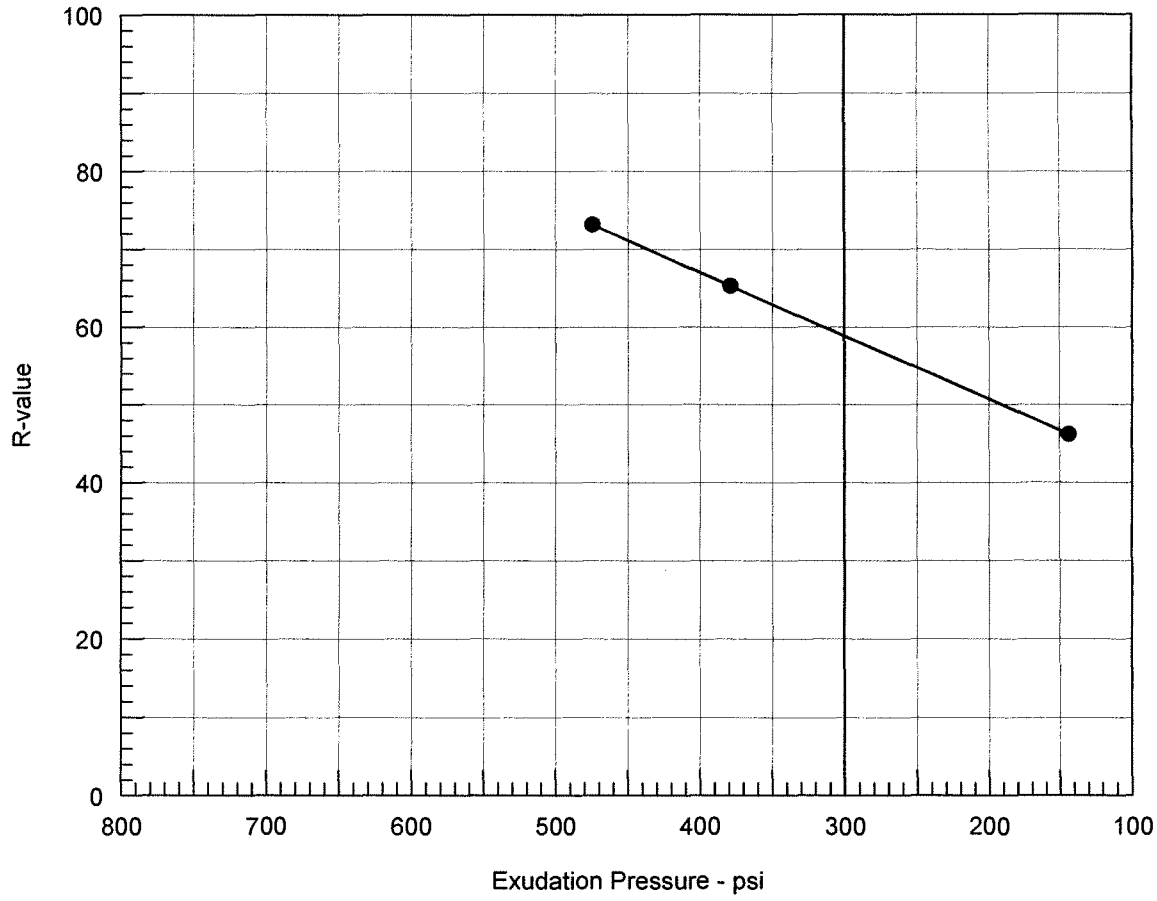
Tested by:
Checked by:
Remarks:

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:

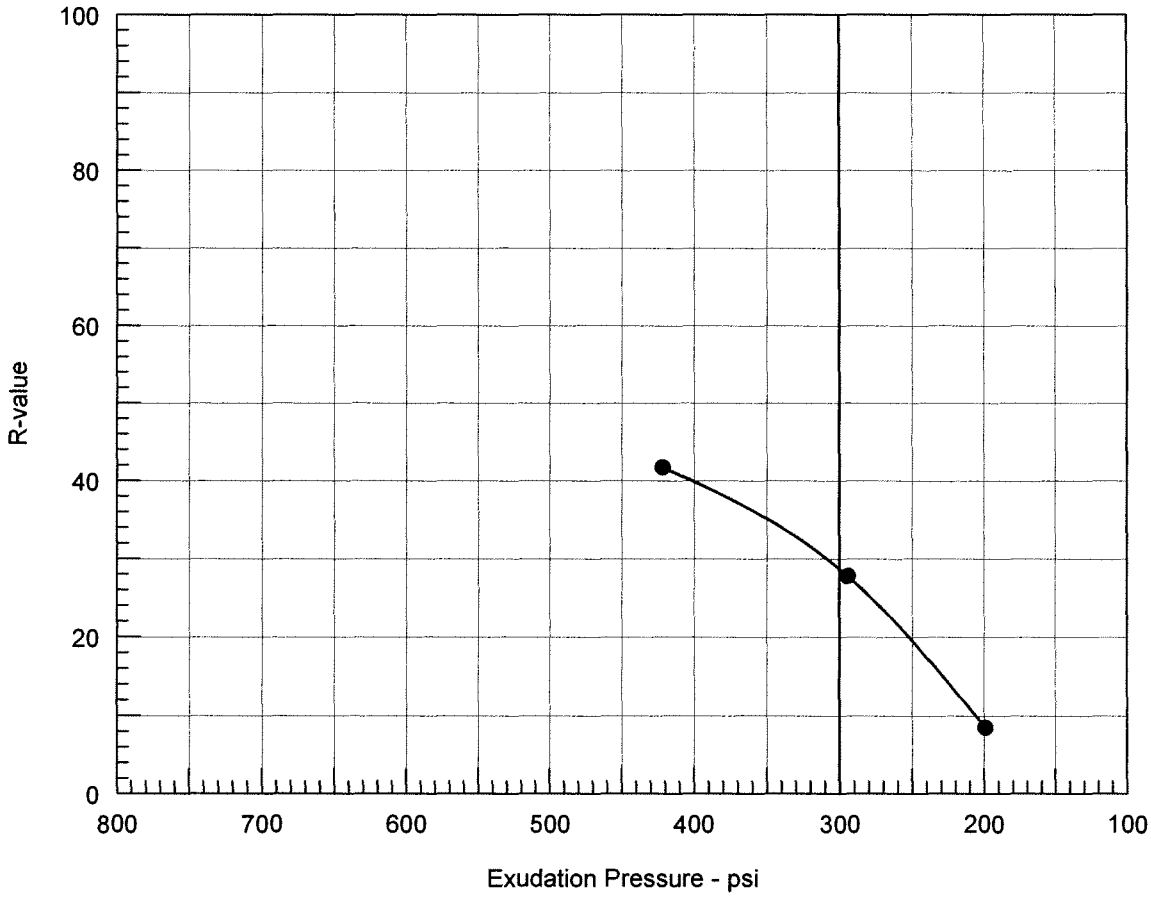
Remarks:

R-VALUE TEST REPORT

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	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

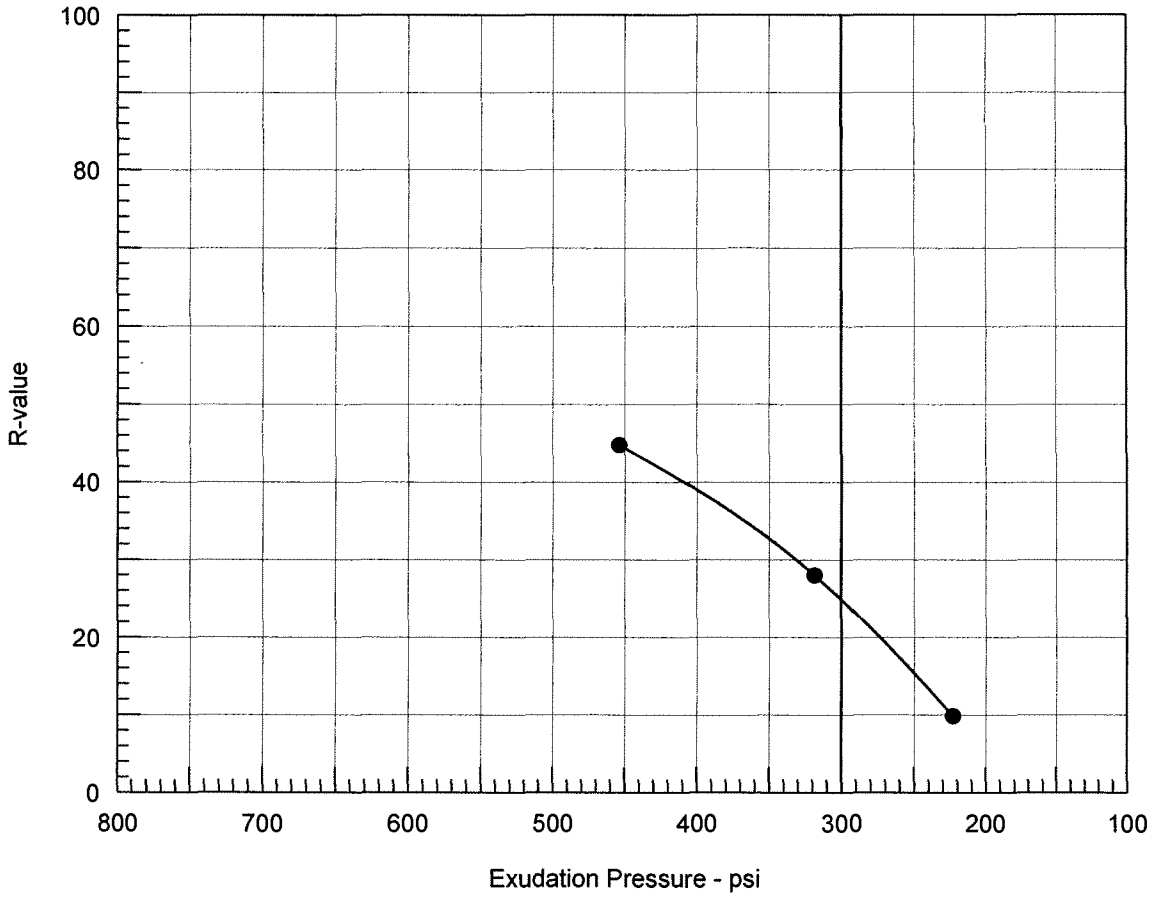
Tested by:
Checked by:
Remarks:

R-VALUE TEST REPORT

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	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

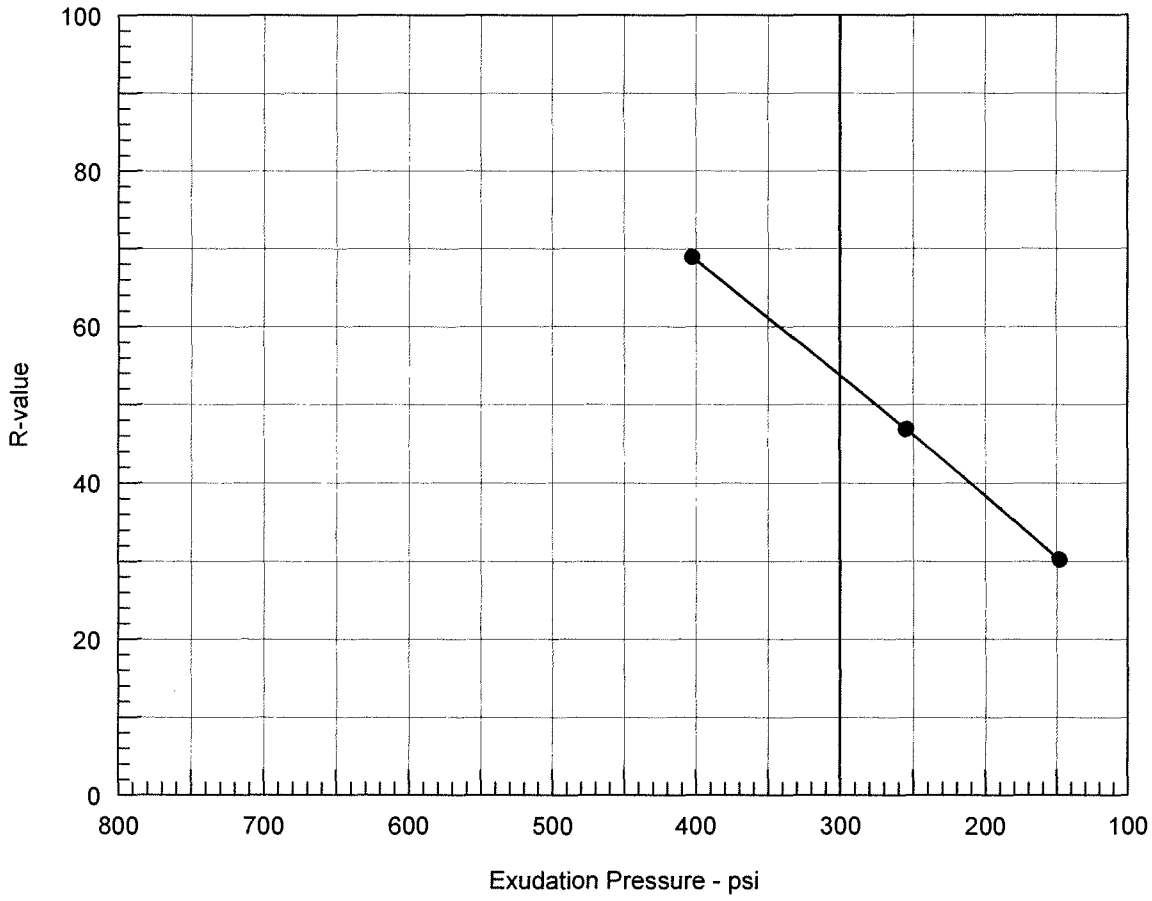
Tested by:
Checked by:
Remarks:

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

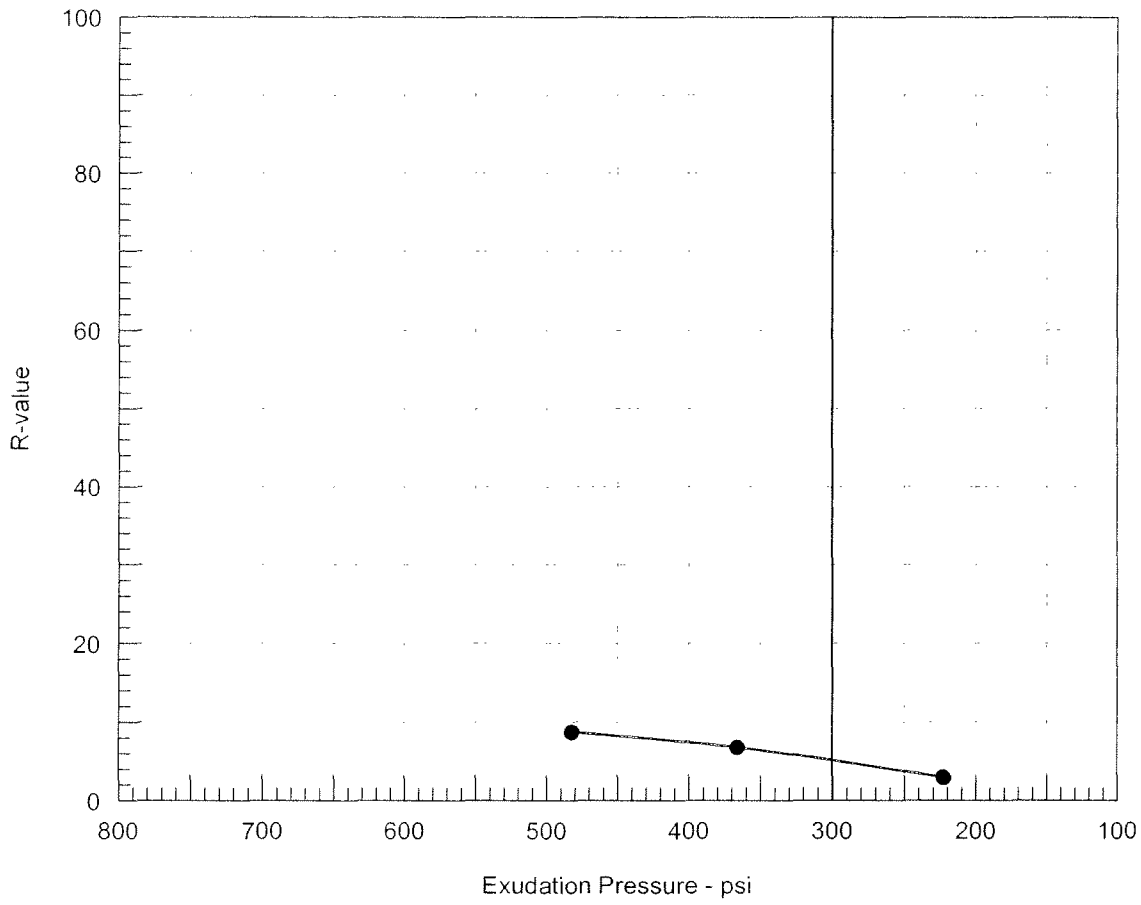
Tested by:
Checked by:
Remarks:

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	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

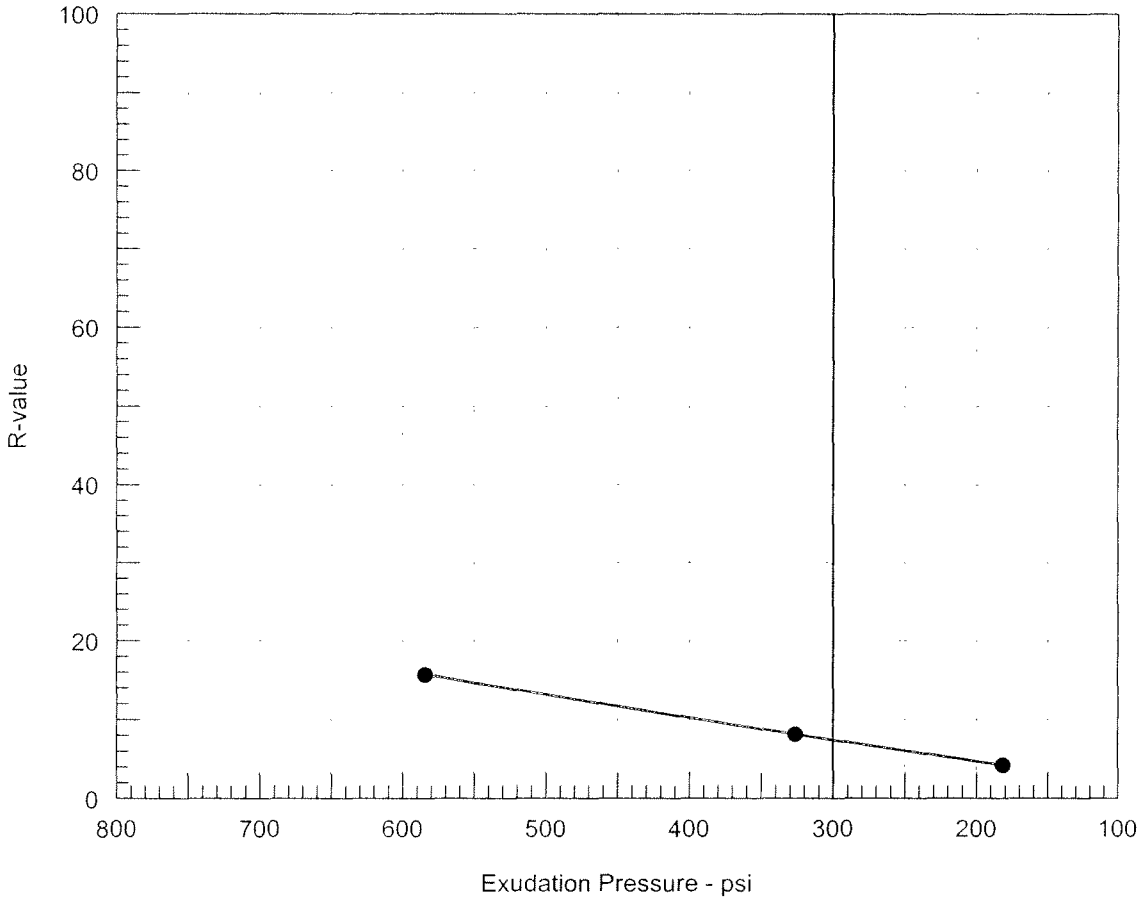
Remarks:
RB-41

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

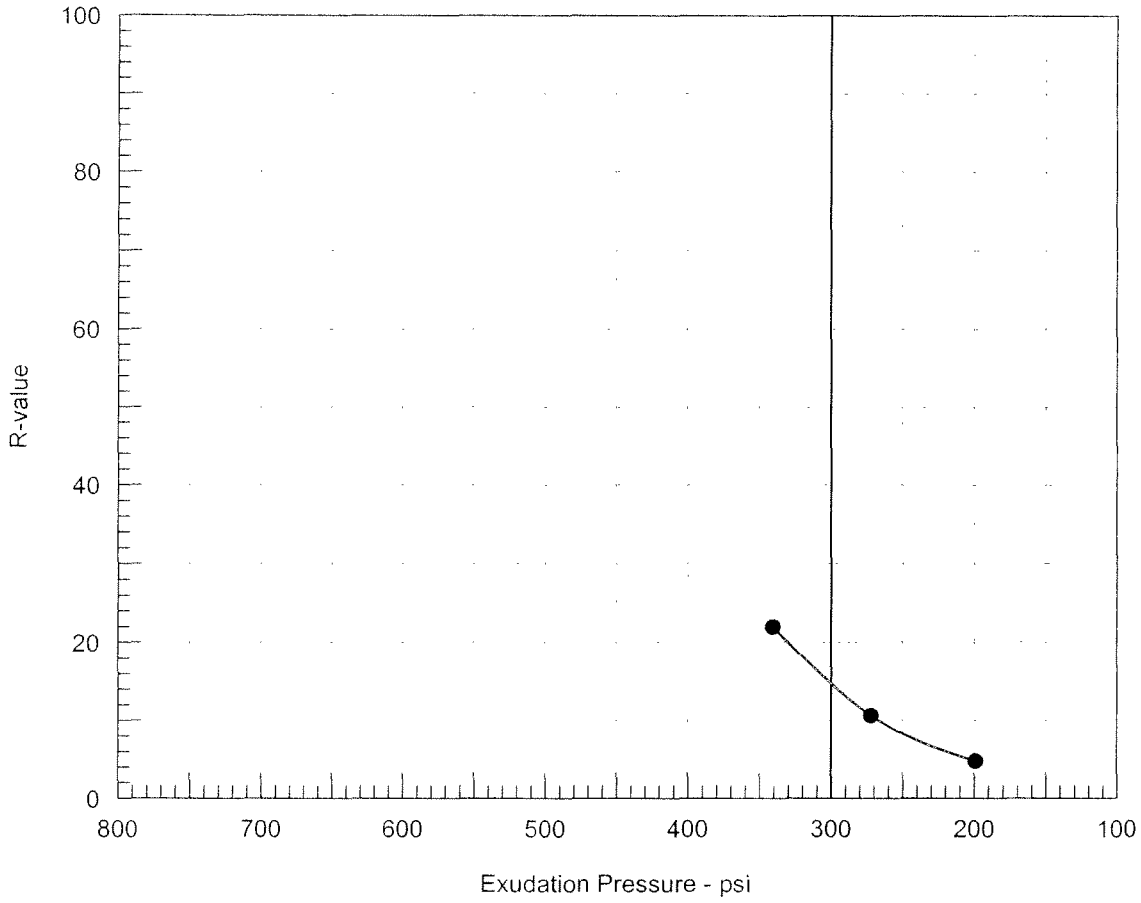
Remarks:
RB-42

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

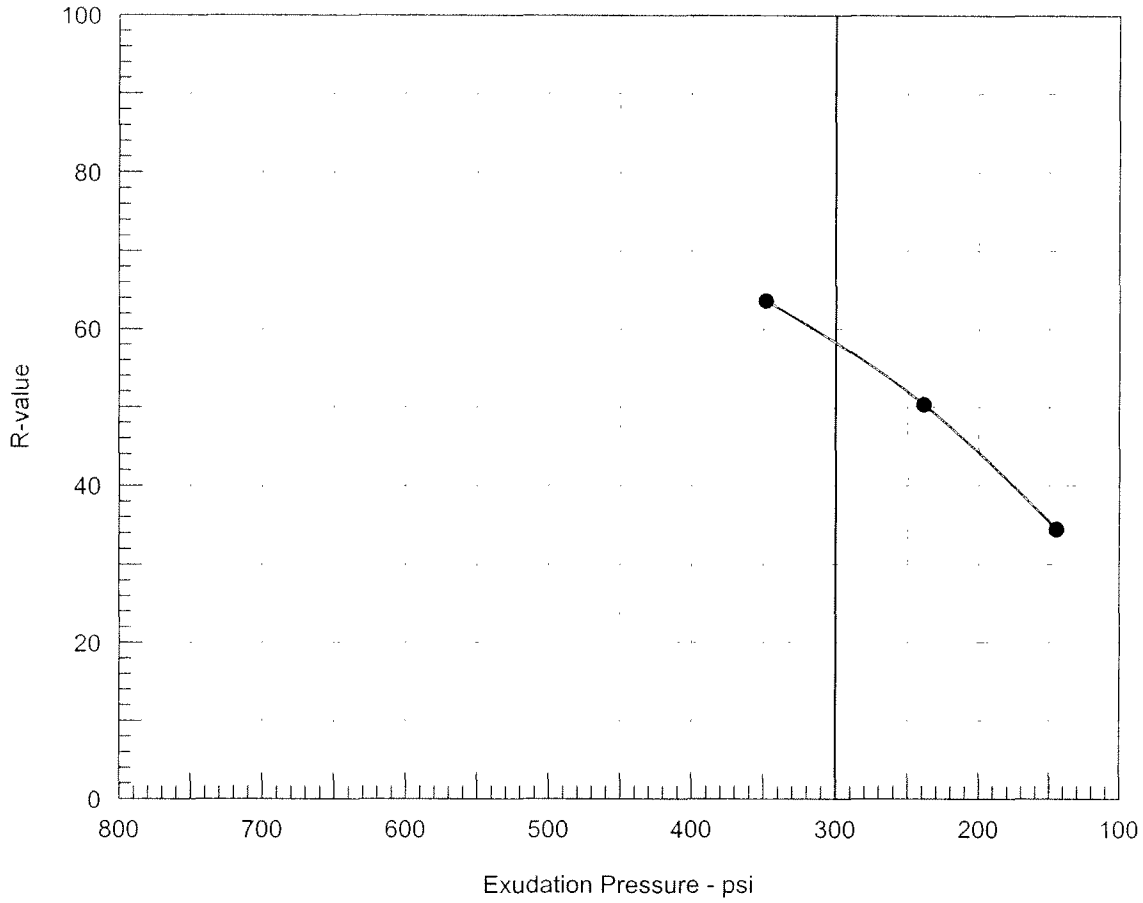
Remarks:
NB-30

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 _____

South Segment Plans

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi 05/30/14
REGISTERED CIVIL ENGINEER DATE

Abhijeet R. Bhoi No. 68606 Exp 09-30-15 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 COMMISSION
1111 Broadway, Suite 800
Oakland, CA 94607

NOTES:

1. DIMENSIONS OF PAVEMENT STRUCTURE SECTIONS ARE SUBJECT TO TOLERANCES SPECIFIED IN THE STANDARD SPECIFICATIONS.
2. SUPERELEVATION AS SHOWN OR AS DIRECTED BY THE ENGINEER.
3. EXTEND SUBBASE MATERIAL TO FILL SLOPE WHENEVER FILL SLOPE IS STEEPER THAN 2:1.
4. PLACE 0.33' (Min) HMA (TYPE A) UNDER DIKES AND CONCRETE BARRIERS, UNLESS OTHERWISE NOTED ON PLANS.
5. FOR LOCATIONS AND LIMITS OF HMA DIKES AND CURBS SEE LAYOUT AND SUMMARY OF QUANTITIES SHEETS.
6. FOR EXACT LOCATIONS AND LIMITS OF EDGE DRAINS, SEE SUBSURFACE DRAINS PLANS.
7. FOR HMA OVERLAY CONFORM DETAILS, SEE CONSTRUCTION DETAILS.
8. FOR LOCATIONS, LIMITS AND DETAILS OF RETAINING WALLS, SEE RETAINING WALL OR STRUCTURES PLANS.
9. FOR LOCATIONS OF DITCH, GUTTER, AND BIOFILTRATION SWALES, SEE DRAINAGE PLANS. FOR LOCATIONS OF BIOFILTRATION STRIPS, SEE EROSION CONTROL PLANS.
10. Var DEPTH OF HMA IS DETERMINED BY MATCHING THE LAYER OF EXISTING ATPB AT SAWCUT LOCATION.
11. APPLICATION OF PRIME COAT ON AGGREGATE BASE IS REQUIRED BEFORE PLACING HMA PAVEMENT.

ABBREVIATIONS:

Cl 3 Perm	CLASS 3 PERMEABLE MATERIAL
RHMA-G	RUBBERIZED HMA - GAP GRADED
RS	RUMBLE STRIP
w/	WITH
WICF	WOOD IMITATION CONCRETE FENCE
VEG CTRL	VEGETATION CONTROL
GB	GRADE BREAK

DESIGN DESIGNATION:

SR 84 BETWEEN STANLEY Blvd AND VALLECITOS Rd

ADT (2015)	18,600	D	= 52%
ADT (2035)	26,100	T	= 52%
DHV	2,610	V	= 55 MPH
ESAL	3,065,019	TI	= 10.5

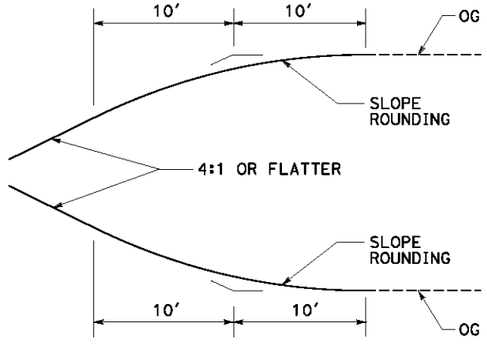
SR 84 SOUTH OF VALLECITOS Rd

ADT (2015)	27,500	D	= 51%
ADT (2035)	38,600	T	= 51%
DHV	3,860	V	= 55 MPH
ESAL	4,445,768	TI	= 10.5

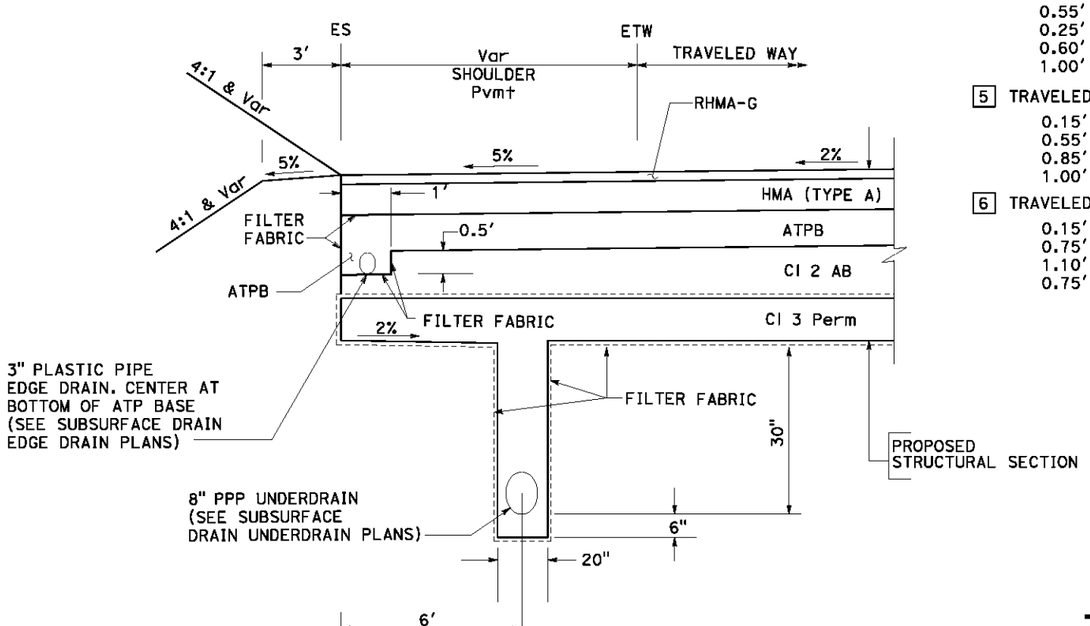
PAVEMENT CLIMATE REGION: INLAND VALLEY

EXISTING PAVEMENT STRUCTURE SECTIONS:

1. TRAVELED WAY AND Shld
   0.15' RAC (TYPE G)
   0.25' AC (TYPE A)
   0.64' AB (3)
   0.98' AS (4)
2. TRAVELED WAY AND Shld
   0.15' RAC (TYPE G)
   0-1.13' AC
   0.65' CLASS 2 AB
   0.75' CLASS 4 AS
3. TRAVELED WAY AND Shld
   0.10' RAC (TYPE G)
   0.45' AC
   0.65' CLASS 2 AB
   0.75' CLASS 4 AS
4. TRAVELED WAY AND Shld
   0.15' RAC (TYPE G)
   0.30' AC (TYPE A)
   0.25' ATPB
   0.45' AC (TYPE A)
   0.60' AS (CL 4)
5. TRAVELED WAY AND Shld
   0.15' RAC (TYPE G)
   0.49' AC (TYPE A)
   0.94' AB (CL 3)
   1.38' AS (CL 4)
6. TRAVELED WAY AND Shld
   0.15' RAC (TYPE G)
   0.64' AC (TYPE A)
   0.94' AB (CL 3)
   1.38' AS (CL 4)
7. TRAVELED WAY AND Shld
   0.15' RAC (TYPE G)
   0.49' AC (TYPE A)
   0.94' AB (CL 3)
   1.38' AS (CL 4)
8. TRAVELED WAY AND Shld
   0.15' RAC (TYPE G)
   0.54' AC
   0.25' ATPB
   0.83' AB (CL 2)
   1.54' ASB (CL 2)
9. TRAVELED WAY AND Shld
   0.54' AC
   0.25' ATPB
   0.83' AB (CL 2)
   1.54' ASB (CL 2)
10. TRAVELED WAY AND Shld (Typ)
    0.54' AC
    0.25' ATPB
    0.83' AB (CL 2)
    1.25' ASB (CL 2)
11. TRAVELED WAY AND Shld (Typ)
    0.54' AC
    0.25' ATPB
    0.98' AB (CL 2)
12. TRAVELED WAY AND Shld (Typ)
    0.54' AC
    0.25' ATPB
    0.83' AB (CL 2)
    1.29' ASB (CL 2)
13. TRAVELED WAY AND Shld (Typ)
    0.54' AC
    0.25' ATPB
    0.69' AB (CL 2)
    0.54' ASB (CL 2)
14. TRAVELED WAY AND Shld (Typ)
    0.59' AC (TYPE A)
    0.25' ATPB
    0.69' CL 2 AB
    1.08' AS CL 4
15. TRAVELED WAY AND Shld (Typ)
    0.74' AC (TYPE A)
    0.25' ATPB
    0.69' CL 2 AB
    1.08' AS CL 4
16. TRAVELED WAY AND Shld (Typ)
    0.15' RHMA-G
    0.74' AC (TYPE A)
    0.25' ATPB
    0.69' CL 2 AB
    1.08' AS CL 4
17. TRAVELED WAY AND Shld (Typ)
    0.15' RHMA-G
    0.75' AC (TYPE A)
    1.10' CL 2 AB
    0.75' CL 3 Perm
18. 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
19. TRAVELED WAY AND Shld (Typ)
    0.25' AC
    0.85' AB



TYPICAL SLOPE ROUNDING DETAIL



TYPICAL UNDERDRAIN AND EDGE DRAIN DETAIL

PROPOSED PAVEMENT STRUCTURE SECTIONS:

1. OVERLAY
   0.15' RHMA-G
2. OVERLAY
   0.15' RHMA-G
   0.1' TO 2.0' HMA (TYPE A)
3. TRAVELED WAY AND Shld (Typ)
   0.15' RHMA-G
   0.55' HMA (TYPE A)
   1.00' Cl 2 AB
   1.00' Cl 3 AS
4. TRAVELED WAY AND Shld (Typ)
   0.15' RHMA-G
   0.55' TO 1.65' HMA (TYPE A)
   0.25' ATPB
   0.60' Cl 2 AB
   1.00' Cl 4 AS
5. TRAVELED WAY AND Shld (Typ)
   0.15' RHMA-G
   0.55' HMA (TYPE A)
   0.85' Cl 2 AB
   1.00' Cl 4 AS
6. TRAVELED WAY AND Shld (Typ)
   0.15' RHMA-G
   0.75' HMA (TYPE A)
   1.10' Cl 2 AB
   0.75' Cl 4 AS
7. OVERLAY
   0.15' HMA (TYPE A)
8. ACCESS ROAD, TRAIL AND EXTENDED Pvmt
   0.60' HMA (TYPE A)
9. TRAVELED WAY AND Shld (Typ)
   0.15' RHMA-G
   0.75 TO 1.8' HMA (TYPE A)
   0.25' ATPB
   0.85' Cl 2 AB
   1.75' Cl 4 AS
10. ACCESS ROAD AND TRAIL
    1.10' HMA (TYPE A)
11. SLIVER WIDENING
    0.15' RHMA-G
    1.50' HMA (TYPE A)
12. ACCESS ROAD
    1.35' Cl 2 AB
13. MVP
    0.75' HMA (TYPE A)
    0' TO 0.5' Cl 2 AB
14. ACCESS ROAD
    1.50' AB

TYPICAL CROSS SECTIONS

NO SCALE

X-1

REVISED BY	DATE REVISED
AB	9/12/14

CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 9-12-14
DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:37

BORDER LAST REVISED 7/2/2010
USERNAME => Shruti_Shah
DGN FILE => 429762ca001.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 — 05/30/14 DATE

Abhijeet R. Bhoi, No. 68606, Exp 09-30-15, CIVIL, REGISTERED PROFESSIONAL ENGINEER, STATE OF CALIFORNIA

PLANS APPROVAL DATE

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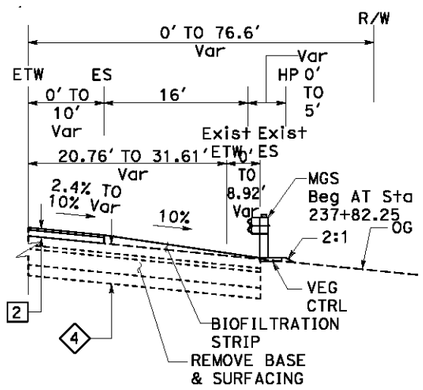
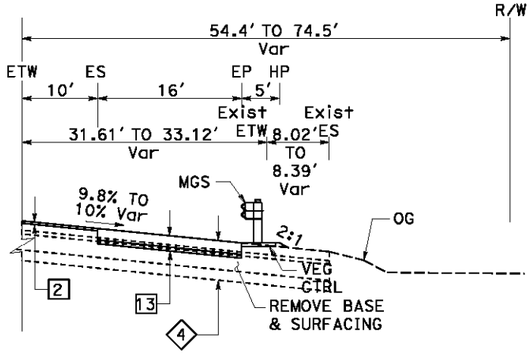
URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 94612

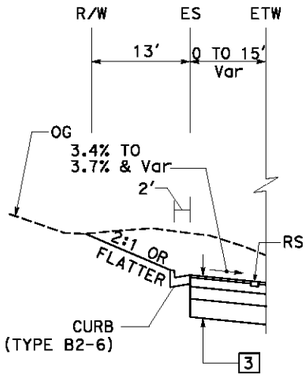
ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 Broadway, Suite 800
Oakland, CA 94607



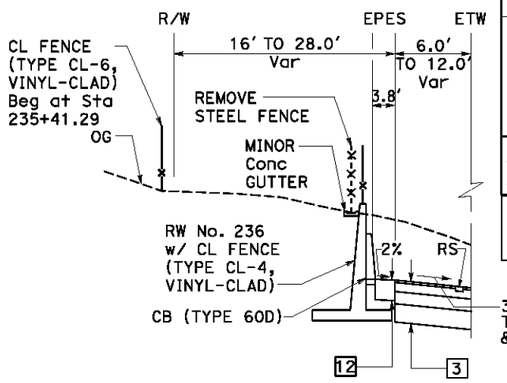
"A1" 234+64.27 TO "A1" 238+27.59
"A1" 239+31.38 TO "A1" 240+29.55
NORTHBOUND SHOULDER DETAILS



"A1" 238+27.59 TO "A1" 239+31.38
NORTHBOUND SHOULDER DETAILS

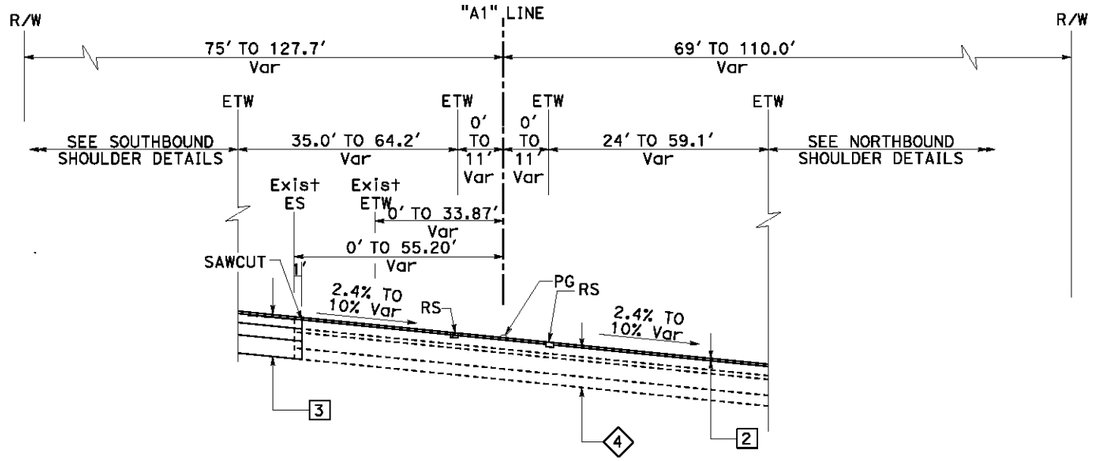


"A1" 235+02.40 TO "A1" 235+16.43
SOUTHBOUND SHOULDER DETAILS

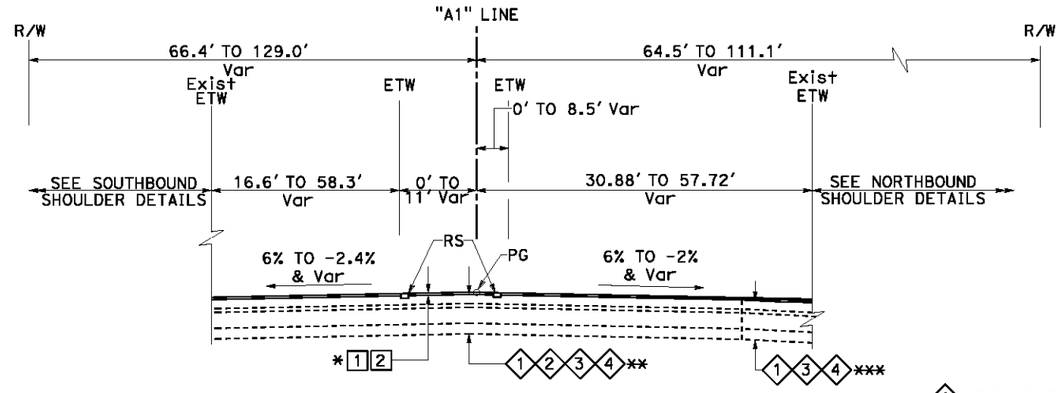


"A1" 235+16.43 TO "A1" 240+29.55
SOUTHBOUND SHOULDER DETAILS

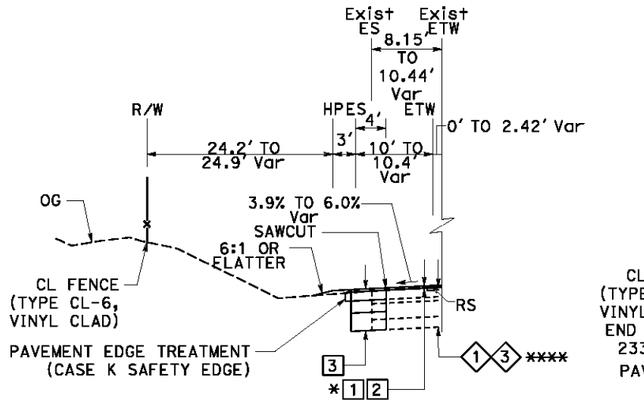
**** 1 END AT Sta 232+17.83
3 Beg AT Sta 232+17.83
***** 3 END AT Sta 233+95.00
4 Beg AT Sta 233+95.00
****** 5 END AT Sta 249+03.95
6 Beg AT Sta 249+03.95



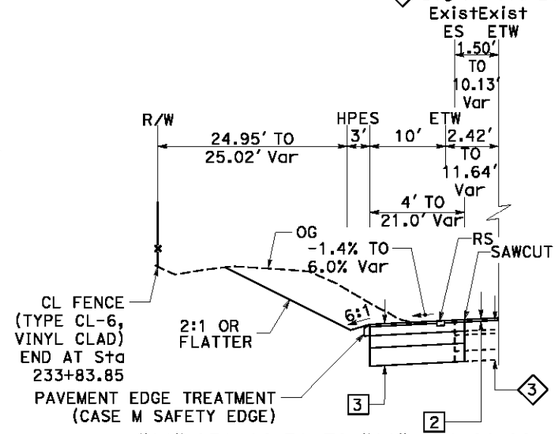
"A1" 234+50.00 TO "A1" 240+29.28
ROUTE 84



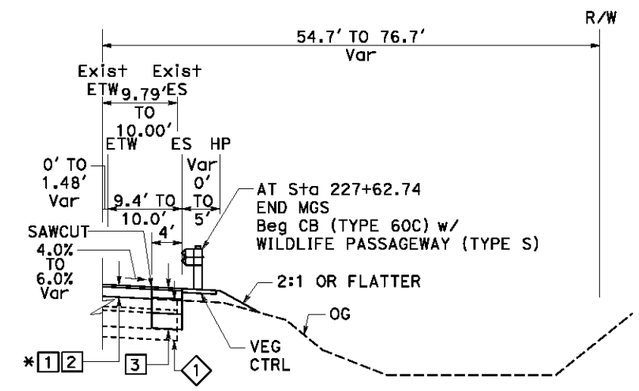
"A1" 226+97.10 TO "A1" 234+50.00
ROUTE 84



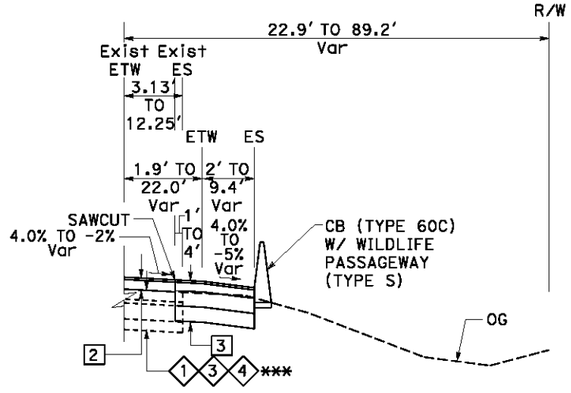
"A1" 226+97.10 TO "A1" 231+26.72
SOUTHBOUND SHOULDER DETAILS



"A1" 231+26.72 TO "A1" 234+02.20
SOUTHBOUND SHOULDER DETAILS



"A1" 226+97.10 TO "A1" 228+03.78
NORTHBOUND SHOULDER DETAILS



"A1" 228+03.78 TO "A1" 233+69.77
NORTHBOUND SHOULDER DETAILS

FOR NOTES AND ABBREVIATIONS, SEE SHEET X-1

*1 END AT Sta 227+35.00
2 Beg AT Sta 227+35.00

**1 END AT Sta 230+14.42
2 Beg AT Sta 230+14.42 END AT Sta 232+17.83
3 Beg AT Sta 233+17.83 END AT Sta 233+95.00
4 Beg AT Sta 233+95.00

*** 1 END AT Sta 233+68.75
3 Beg AT Sta 233+68.75 END AT Sta 233+95.00
4 Beg AT Sta 233+95.00

TYPICAL CROSS SECTIONS

NO SCALE

X-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: 9/12/14
Gibbs

LAST REVISION — DATE PLOTTED => 12-SEP-2014 — TIME PLOTTED => 16:37
9-12-14

BORDER LAST REVISED 7/2/2010 | USERNAME => Shruti_Shah | DGN FILE => 429762ca002.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 05/30/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp 09-30-15 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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URS CORPORATION
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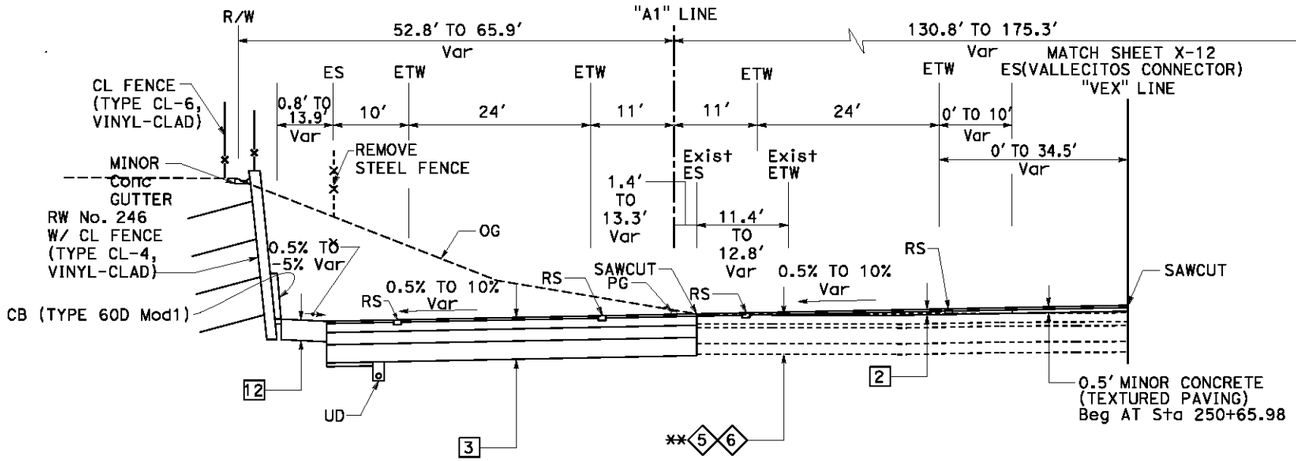
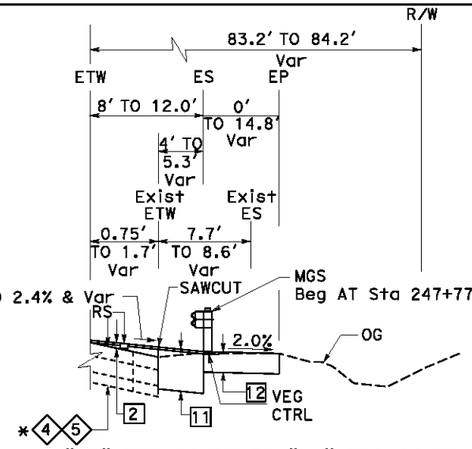
Suite 800
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 Broadway, Suite 800
Oakland, CA 94607

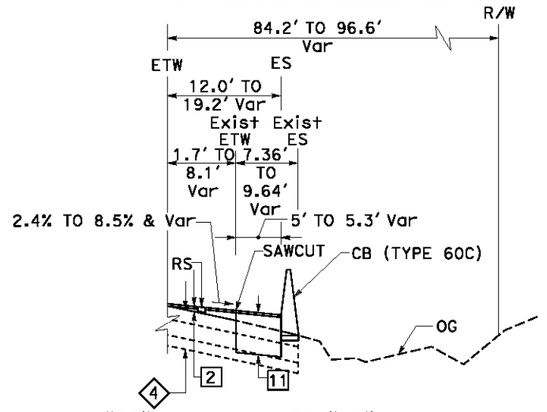


"A1" 248+00.00 TO "A1" 251+17.43
ROUTE 84

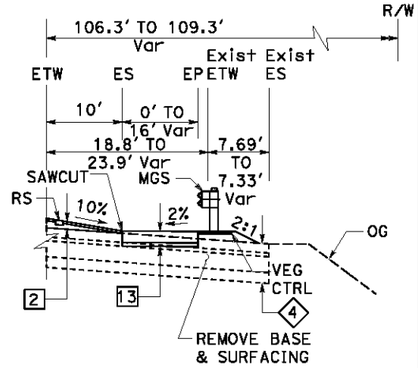
*4 END AT Sta "A1" 247+07.10
5 Beg AT Sta "A1" 247+07.10
**5 END AT Sta "A1" 249+03.95
6 Beg AT Sta "A1" 249+03.95



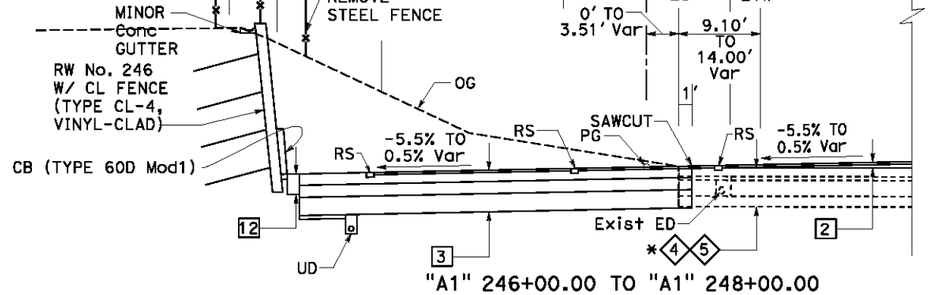
"A1" 247+02.67 TO "A1" 248+00.00
NORTHBOUND SHOULDER DETAILS



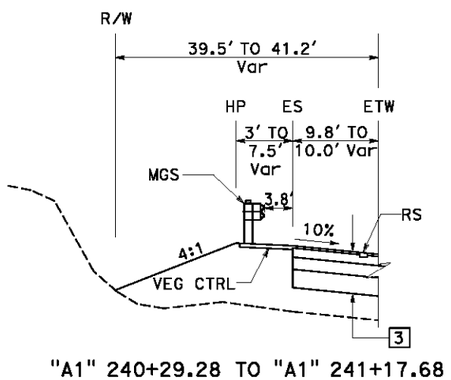
"A1" 245+00.13 TO "A1" 247+02.67
NORTHBOUND SHOULDER DETAILS



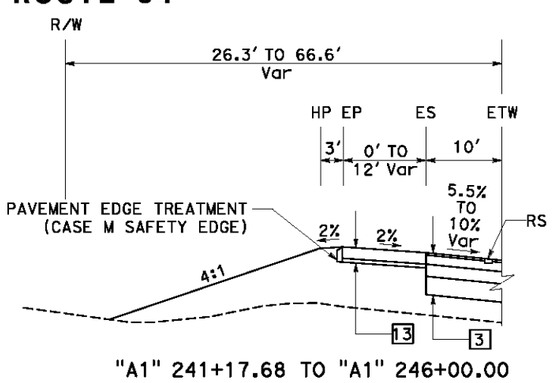
"A1" 242+24.48 TO "A1" 243+28.37
NORTHBOUND SHOULDER DETAILS



"A1" 246+00.00 TO "A1" 248+00.00
ROUTE 84

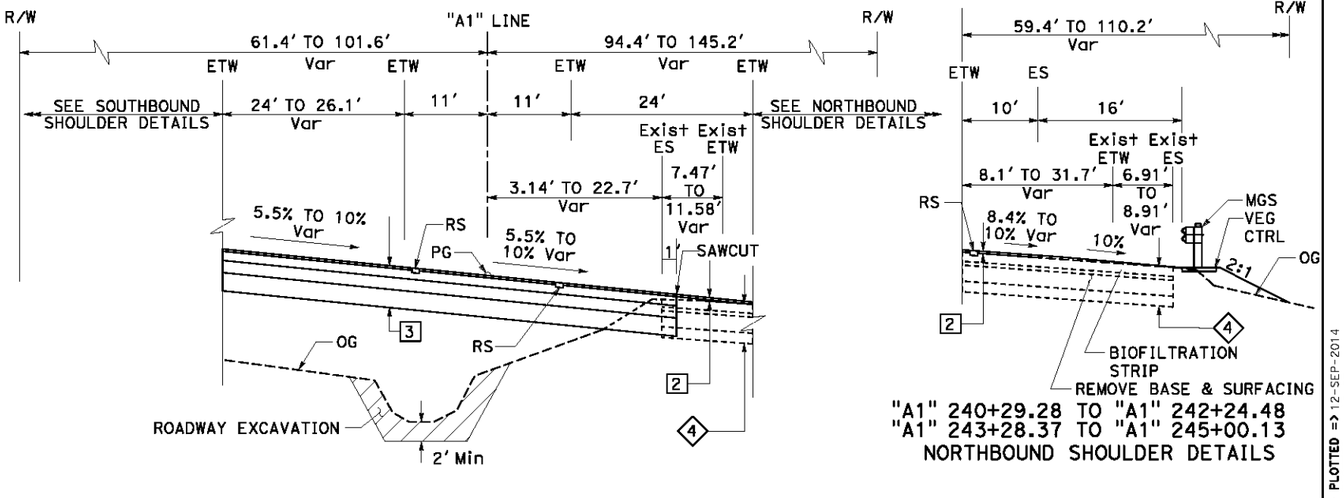


"A1" 240+29.28 TO "A1" 241+17.68
SOUTHBOUND SHOULDER DETAILS



"A1" 241+17.68 TO "A1" 246+00.00
SOUTHBOUND SHOULDER DETAILS

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1



"A1" 240+29.28 TO "A1" 246+00.00
ROUTE 84

"A1" 240+29.28 TO "A1" 242+24.48
"A1" 243+28.37 TO "A1" 245+00.13
NORTHBOUND SHOULDER DETAILS

TYPICAL CROSS SECTIONS

NO SCALE

X-3

REVISED BY	DATE REVISED
AB	9/12/14

ABHIJEET BHOI — CALCULATED-DESIGNED BY
ELIE ABI-JAOUDE — CHECKED BY
RAMSEY J. HISSEN — CONSULTANT FUNCTIONAL SUPERVISOR
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 9-12-14
DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:37

BORDER LAST REVISED 7/2/2010
USERNAME => Shruti_Shah
DGN FILE => 429762ca003.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 05/30/14
REGISTERED CIVIL ENGINEER DATE

Abhijeet R. Bhoi No. 68606 Exp 09-30-15 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

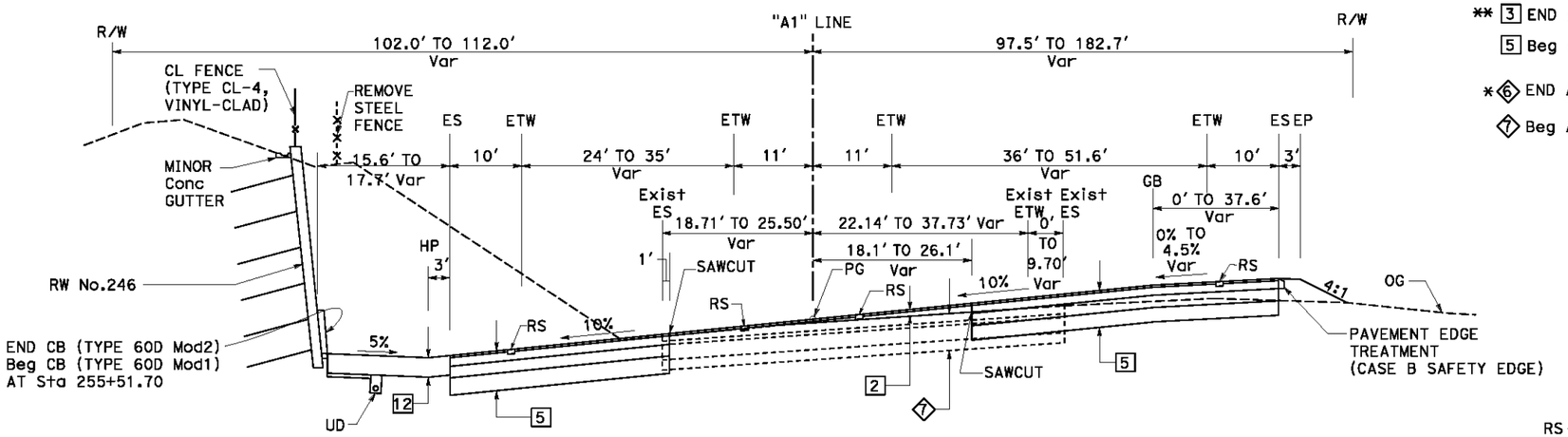
PLANS APPROVAL DATE

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.

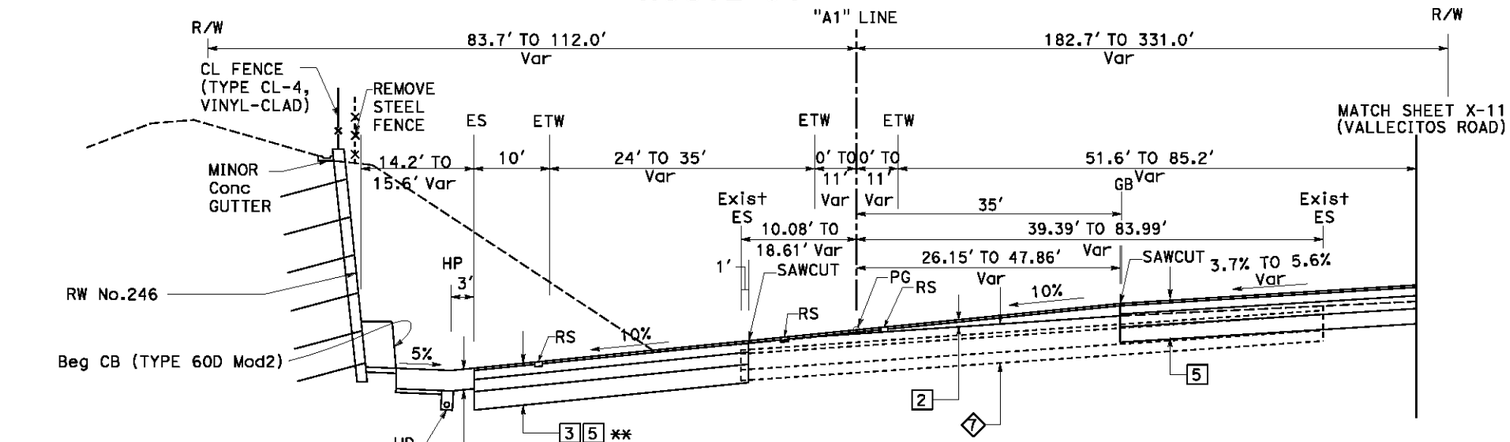
URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 Broadway, Suite 800
Oakland, CA 94607

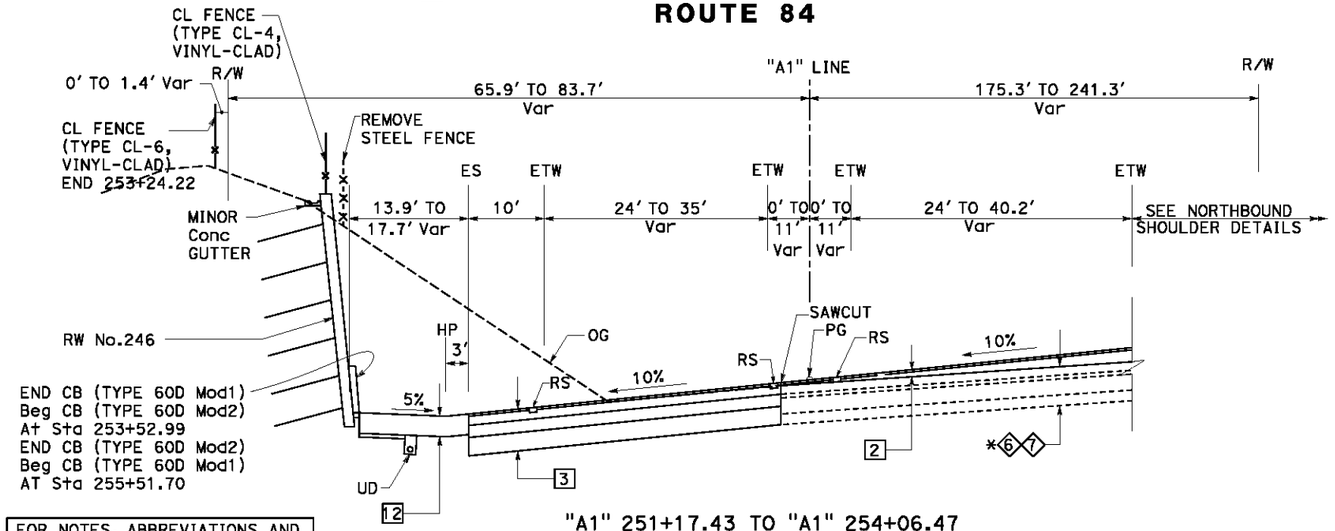
** [3] END AT "A1" Sta 254+28.00
[5] Beg AT "A1" Sta 254+28.00
*<6> END AT "A1" Sta 252+44.86
<7> Beg AT "A1" Sta 252+44.86



"A1" 255+33.76 TO "A1" 256+36.16
ROUTE 84

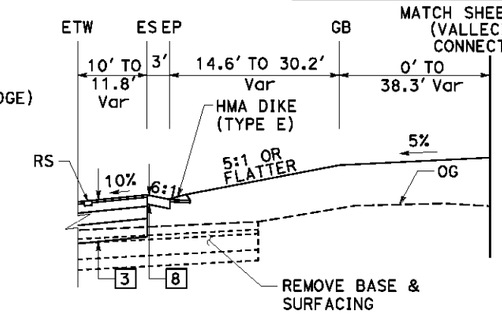


"A1" 254+06.47 TO "A1" 255+33.76
ROUTE 84

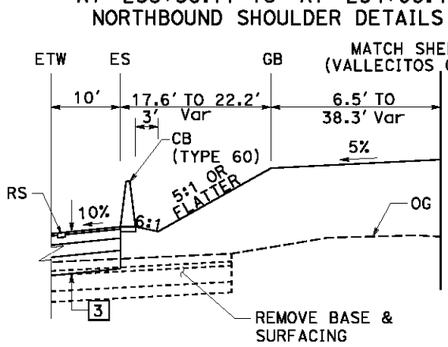


"A1" 251+17.43 TO "A1" 254+06.47
ROUTE 84

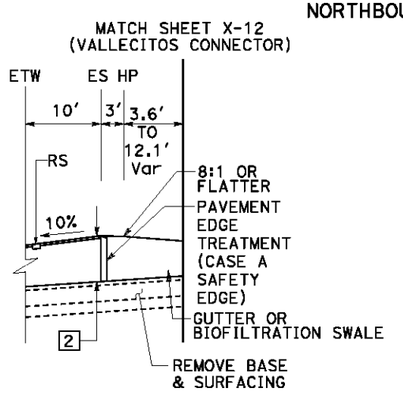
FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1



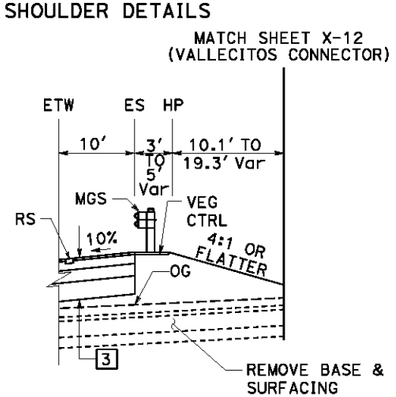
"A1" 253+36.77 TO "A1" 254+06.47
NORTHBOUND SHOULDER DETAILS



"A1" 252+71.66 TO "A1" 253+36.77
NORTHBOUND SHOULDER DETAILS



"A1" 251+17.43 TO "A1" 251+87.14
NORTHBOUND SHOULDER DETAILS



"A1" 251+87.14 TO "A1" 252+71.66
NORTHBOUND SHOULDER DETAILS

TYPICAL CROSS SECTIONS

NO SCALE

X-4

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	9/12/14

LAST REVISION 9-12-14
DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:37

BORDER LAST REVISED 7/2/2010
USERNAME => Shruti_Shah
DGN FILE => 429762ca004.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 05/30/14
REGISTERED CIVIL ENGINEER DATE

Abhijeet R. Bhoi No. 68606 Exp 09-30-15 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 94612

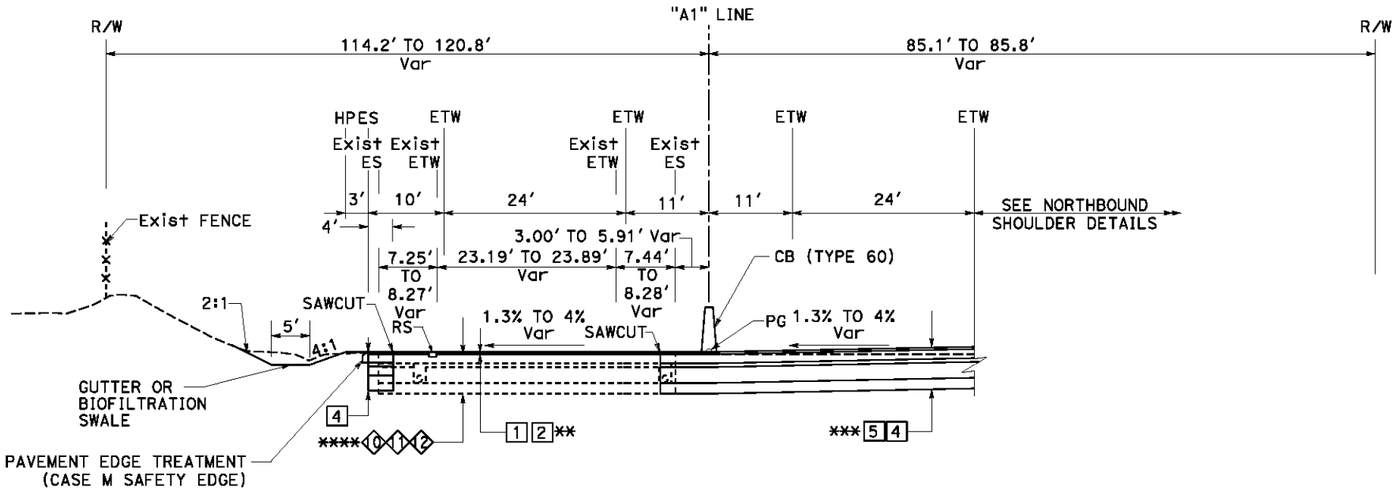
ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 Broadway, Suite 800
Oakland, CA 94607

***** 7 END AT "A1" Sta 258+47.82
8 Beg AT "A1" Sta 258+47.82
END AT "A1" Sta 265+04.07
9 Beg AT "A1" Sta 265+04.07
END AT "A1" Sta 265+48.65
0 Beg AT "A1" Sta 265+48.65

**** 0 END AT "A1" Sta 275+32.90
1 Beg AT "A1" Sta 275+32.90
END AT "A1" Sta 281+89.07
2 Beg AT "A1" Sta 281+89.07

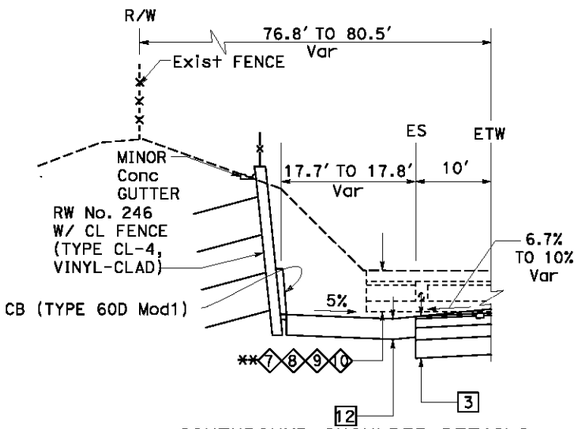
*** 5 END AT Sta "A1" 282+75.00
4 Beg AT Sta "A1" 282+75.00

** 1 END AT Sta "A1" 280+50.12
2 Beg AT Sta "A1" 282+75.00
END AT Sta "A1" 283+80.00

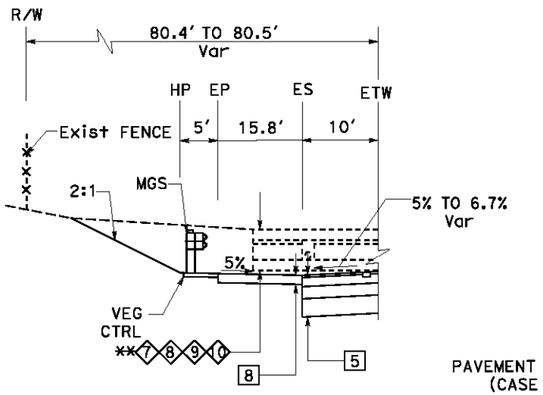


"A1" 265+49.87 TO "A1" 284+06.90

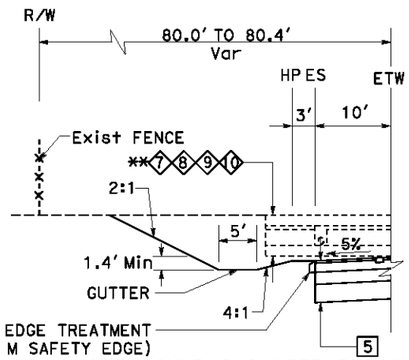
ROUTE 84



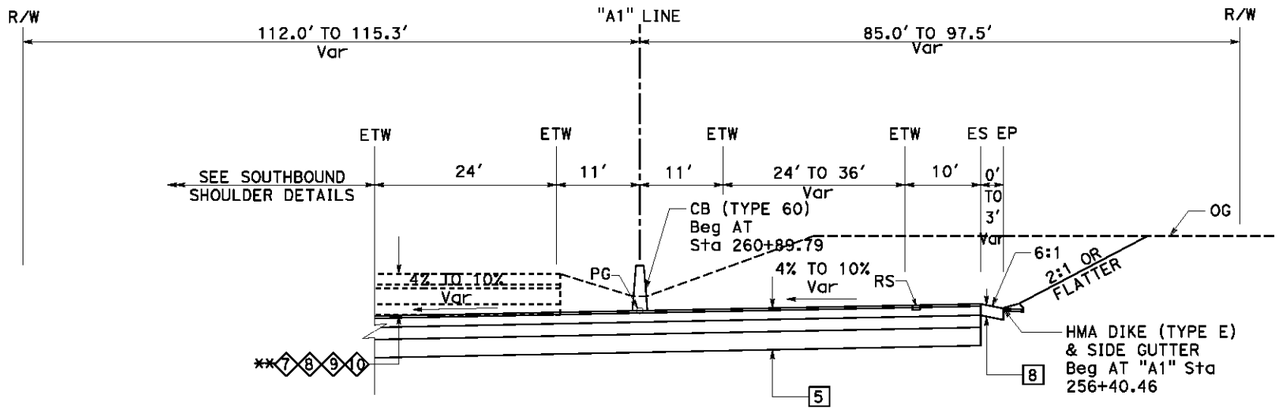
SOUTHBOUND SHOULDER DETAILS
"A1" 256+36.16 TO "A1" 258+26.46



SOUTHBOUND SHOULDER DETAILS
"A1" 258+26.46 TO "A1" 259+17.78

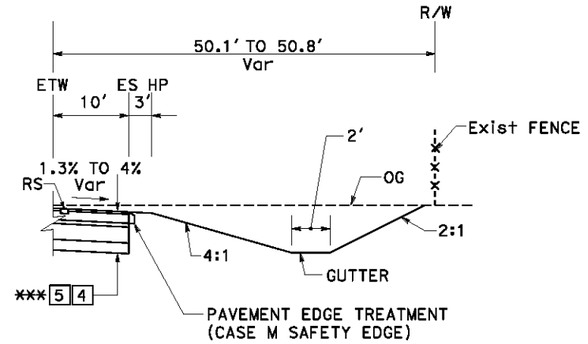


SOUTHBOUND SHOULDER DETAILS
"A1" 259+17.78 TO "A1" 265+49.87

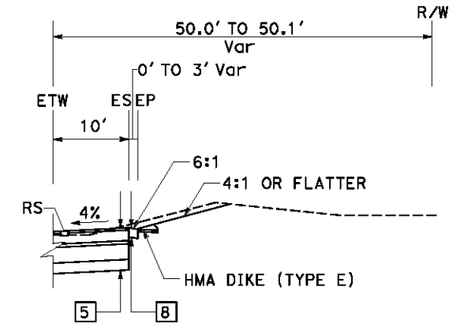


"A1" 256+36.16 TO "A1" 265+49.87

ROUTE 84



NORTHBOUND SHOULDER DETAILS
"A1" 267+42.74 TO "A1" 284+06.90



NORTHBOUND SHOULDER DETAILS
"A1" 265+49.87 TO "A1" 267+42.74

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

TYPICAL CROSS SECTIONS

NO SCALE

X-5

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: 9/12/14

LAST REVISION 9-12-14
DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:37

BORDER LAST REVISED 7/2/2010
USERNAME => Shruti_Shah
DGN FILE => 429762ca005.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 05/30/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp 09-30-15 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 Broadway, Suite 800
Oakland, CA 94607

R/W
74.5' TO 120.2' Var
"A1" LINE
115.1' TO 291.9' Var
R/W
HP ES ETW 1' ETW ETW 2' ETW ES HP
3' 10' 24' TO 52.5' Var 0' TO 11' Var 0' TO 10.3' Var 25.7' TO 61.0' Var 8' TO 10' Var 3'
Exist ES Exist ETW 7.38' TO 46.73' Var 28.59' TO 46.73' Var 5.03' TO 56.18' Var Exist ETW ES 5.52' TO 7.24' Var
2:1 OR FLATTER 4:1 OR FLATTER 5' 1.4' Min RS SAWCUT 3% PG 3% SAWCUT 3% RS 5% PAVEMENT EDGE TREATMENT (CASE M SAFETY EDGE) OG 2:1 5' 4:1 ED
5 11 **** *** 1 2 3 4 Exist ED
CL FENCE (TYPE CL-6, VINYL-CLAD) WICF
PAVEMENT EDGE TREATMENT (CASE M SAFETY EDGE)
GUTTER END AT 307+35.00
CB (TYPE 60) END AT Sta 306+75.00
BIO-STRIP
GUTTER OR BIOFILTRATION SWALE

CL FENCE (TYPE CL-6, VINYL-CLAD) END AT Sta 311+93.38
WICF Beg AT Sta "A1" 309+35.15 END AT "VIN" Sta 22+24.95

* 1 END AT Sta 289+00.00
2 Beg AT Sta 289+00.00
** 2 END AT Sta 298+29.95
1 Beg AT Sta 298+29.95
1 END AT Sta 302+00.00
2 Beg AT Sta 302+00.00
2 END AT Sta 304+89.99
2 Beg AT Sta 304+89.99
*** 1 END AT Sta 308+70.00
2 Beg AT Sta 308+70.00
**** 5 END AT Sta 313+38.39
11 Beg AT Sta 313+38.39

* 1 END AT Sta 281+89.07
2 Beg AT Sta 281+89.07
* 2 END AT Sta 302+56.00
3 Beg AT Sta 302+56.00

"A1" 306+73.63 TO "A1" 313+61.81
ROUTE 84

R/W
28.0' TO 54.4' Var
1' ES ETW
HP 3' 10'
Exist ES
1' TO 7' Var
CL FENCE (TYPE CL-6, VINYL-CLAD) Beg AT Sta 304+77.68
2:1 5' 3% SAWCUT RS 2 1 ** 5
WICF Beg AT Sta 304+77.68
4:1
GUTTER OR BIOFILTRATION SWALE
PAVEMENT EDGE TREATMENT (CASE M SAFETY EDGE)

SOUTH BOUND SHOULDER DETAILS
"A1" 300+40.32 TO "A1" 306+73.63

R/W
54.4' TO 73.0' Var
HPEP ES ETW
3' 0' TO 9.7' Var 10' 4'
PAVEMENT EDGE TREATMENT (CASE M SAFETY EDGE)
Exist FENCE
2:1 5' 2% 3% SAWCUT RS 2 1 ** 3 1
GUTTER OR BIOFILTRATION SWALE
4:1

SOUTH BOUND SHOULDER DETAILS
"A1" 294+86.45 TO "A1" 300+40.32

R/W
74.5' TO 118.1' Var
"A1" LINE
2'
82.0' TO 133.6' Var
R/W
ETW ETW ETW ETW ES EP HP
SEE SOUTHBOUND SHOULDER DETAILS
24' 11' 10.3' TO 11' Var 24' TO 25.7' Var 9' TO 10' Var 0' TO 12' Var 3'
Exist ETW 0' TO 5.03' Var Exist ETW ES
28.59' TO 37.12' Var 6.68' TO 8.17' Var
CL FENCE (TYPE CL-6, VINYL-CLAD) Beg AT Sta 301+30.58
PAVEMENT EDGE TREATMENT (CASE M SAFETY EDGE)
3% PG SAWCUT 3% RS 5% OG
2 3 ** ** 1 2 4 ED 4:1 13 5' 2:1
CB (TYPE 60)
Exist ED
BIOFILTRATION STRIP
GUTTER OR BIOFILTRATION SWALE

"A1" 294+86.45 TO "A1" 306+73.63
ROUTE 84

R/W
114.5' TO 118.1' Var
"A1" LINE
79.1' TO 85.3' Var
R/W
Exist ES/ ES HPEP ES ETW ETW 2' ETW ETW ETW ES HP
3' 0' TO 12' Var 10' 24' 11' 11' 24' 10' 3'
Exist FENCE
Exist ETW 22.99' TO 23.57' Var Exist ETW ES 7.18' TO 8.22' Var 5.73' TO 7.09' Var
CB (TYPE 60)
PAVEMENT EDGE TREATMENT (CASE M SAFETY EDGE)
BIOFILTRATION STRIP 2' OG
Exist FENCE
2:1 5' 2% RS 1.33% TO -3% Var SAWCUT PG 1.33% TO -3% Var RS -5% TO 1.33% Var
* 1 2 1 2 * 13 4 ED Beg ℄ Sta 285+20.00
4:1 2:1
GUTTER OR BIOFILTRATION SWALE
PAVEMENT EDGE TREATMENT (CASE M SAFETY EDGE)
Exist ED FROM Sta 285+20.00

"A1" 284+06.90 TO "A1" 294+86.45
ROUTE 84

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

TYPICAL CROSS SECTIONS

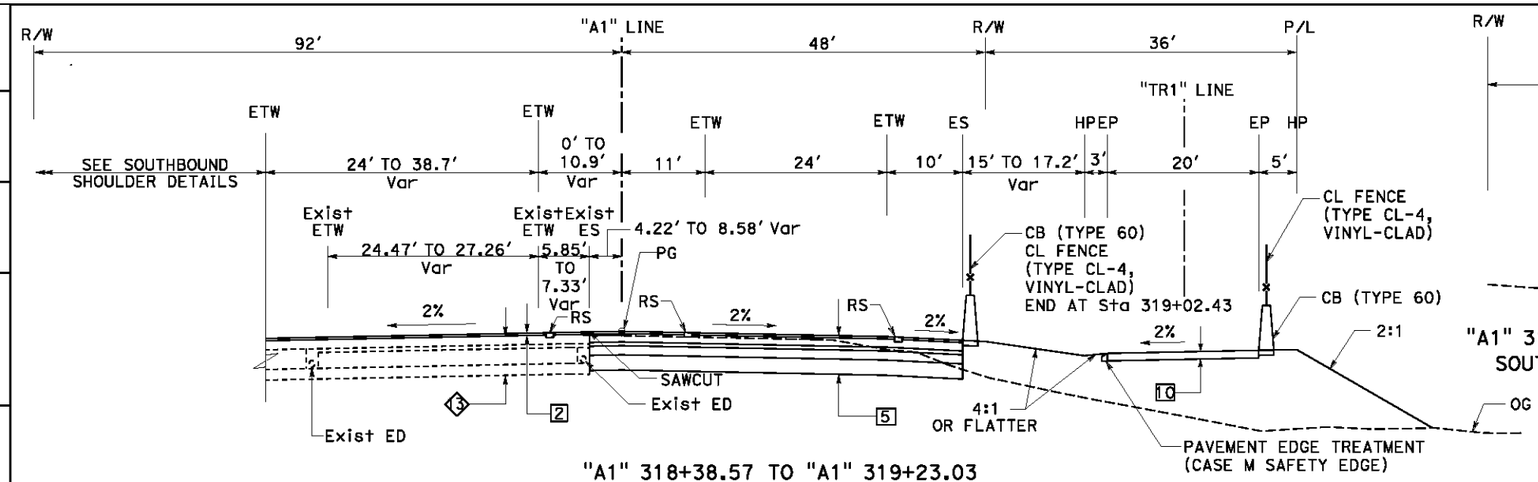
NO SCALE

X-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: 9/12/14
Gibans

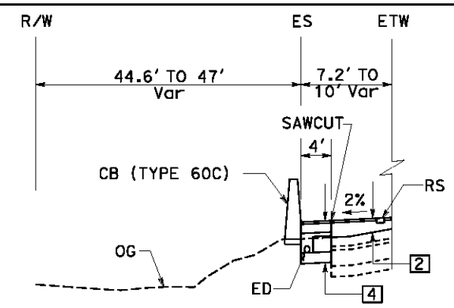
LAST REVISION DATE PLOTTED => 12-SEP-2014
9-12-14 TIME PLOTTED => 16:37

BORDER LAST REVISED 7/2/2010 | USERNAME => Shruti_Shah | DGN FILE => 429762ca006.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

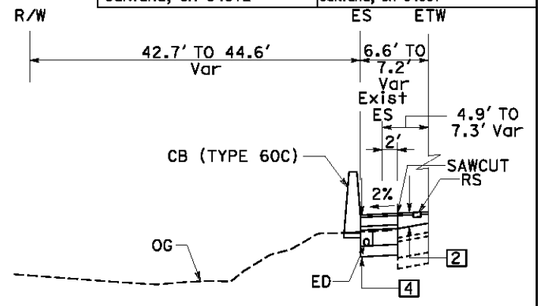


"A1" 318+38.57 TO "A1" 319+23.03

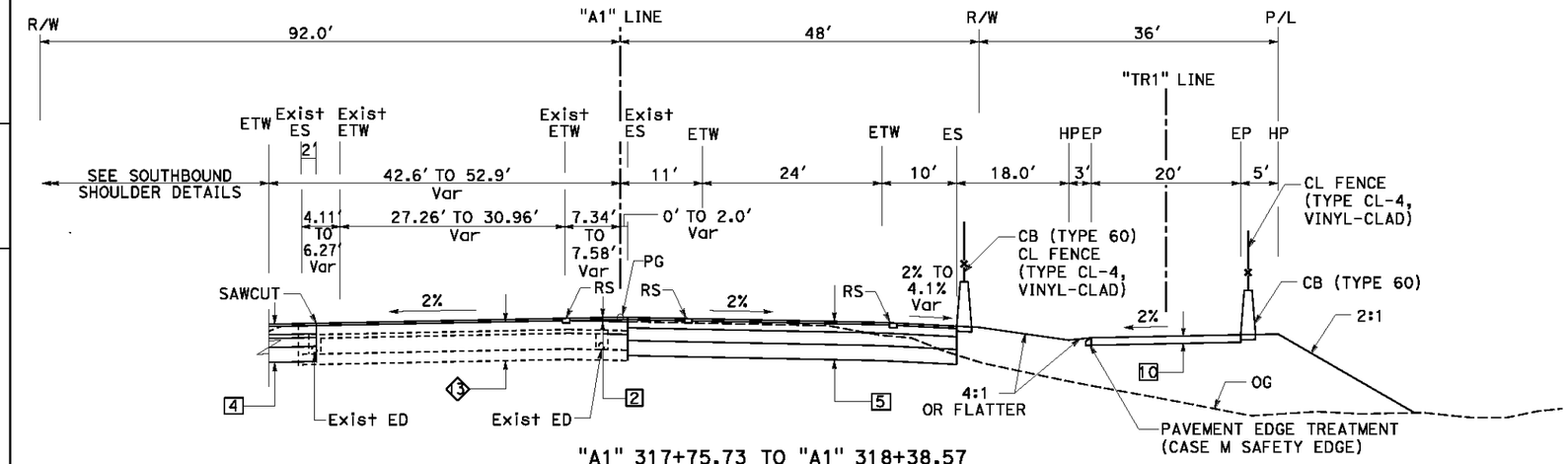
ROUTE 84



"A1" 318+74.16 TO "A1" 319+23.03
SOUTHBOUND SHOULDER DETAILS

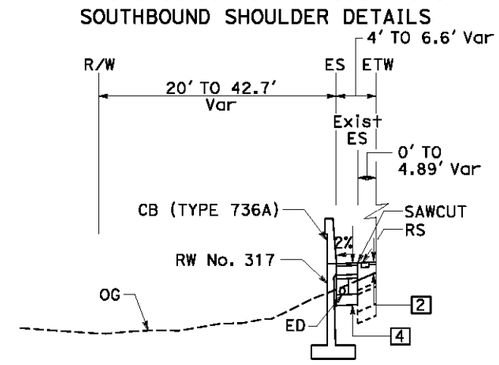


"A1" 318+55.90 TO "A1" 318+74.16
SOUTHBOUND SHOULDER DETAILS

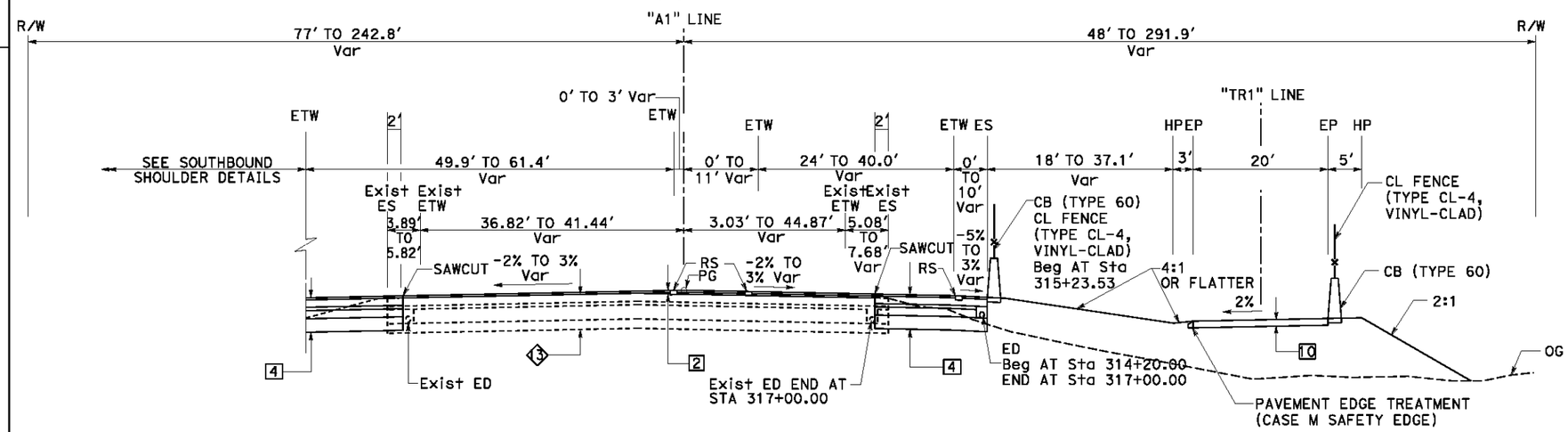


"A1" 317+75.73 TO "A1" 318+38.57

ROUTE 84

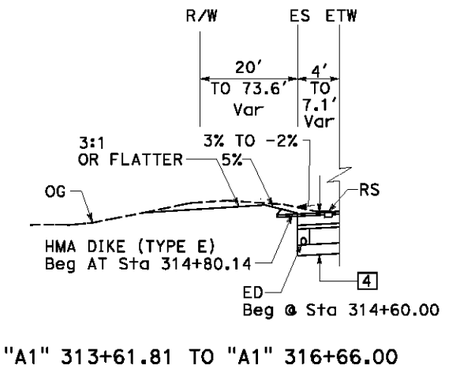


"A1" 316+66.00 TO "A1" 318+55.90
SOUTHBOUND SHOULDER DETAILS



"A1" 313+61.81 TO "A1" 317+75.73

ROUTE 84



"A1" 313+61.81 TO "A1" 316+66.00
SOUTHBOUND SHOULDER DETAILS

TYPICAL CROSS SECTIONS

NO SCALE

X-7

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi 05/30/14
REGISTERED CIVIL ENGINEER DATE

Abhijeet R. Bhoi No. 68606 Exp 09-30-15 CIVIL STATE OF CALIFORNIA

PLANS APPROVAL DATE

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URS CORPORATION
1333 Broadway
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Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 Broadway, Suite 800
Oakland, CA 94607

REVISED BY	DATE REVISED
AB	9/12/14

ABHIJEET BHOI
ELIE ABI-JAOUDE
CALCULATED-DESIGNED BY
CHECKED BY
CONSULTANT FUNCTIONAL SUPERVISOR
RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 9-12-14
DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:37

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi 05/30/14
REGISTERED CIVIL ENGINEER DATE

Abhijeet R. Bhoi No. 68606 Exp 09-30-15 CIVIL STATE OF CALIFORNIA

PLANS APPROVAL DATE

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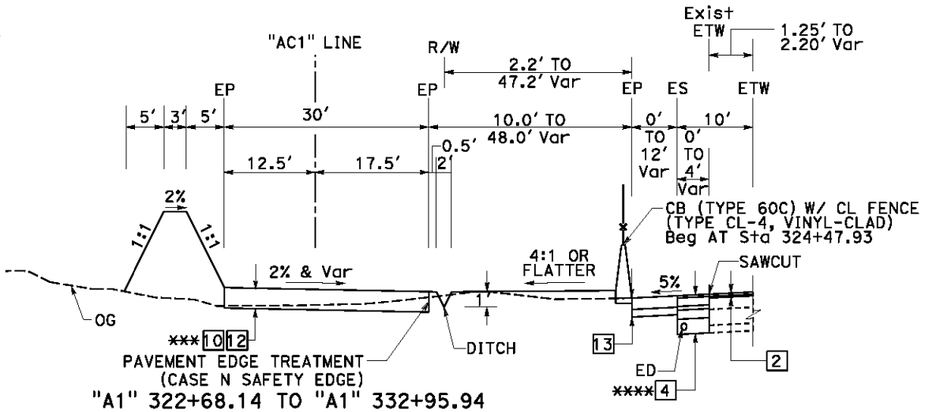
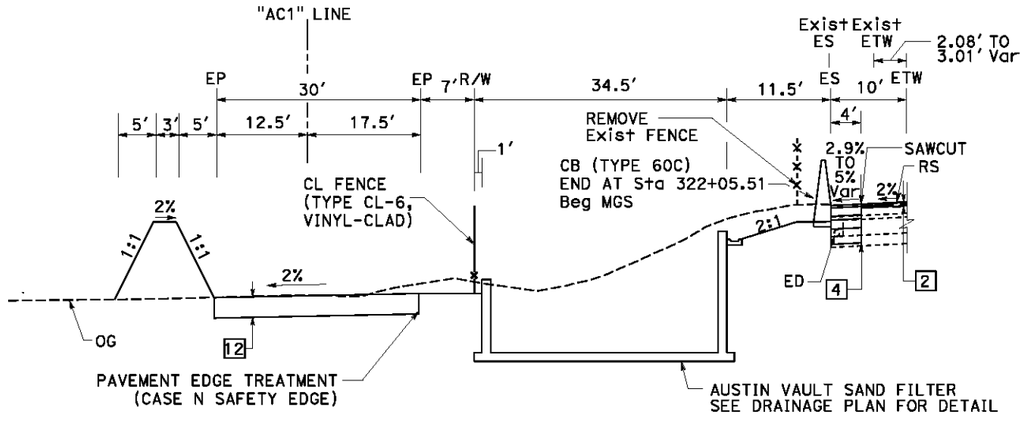


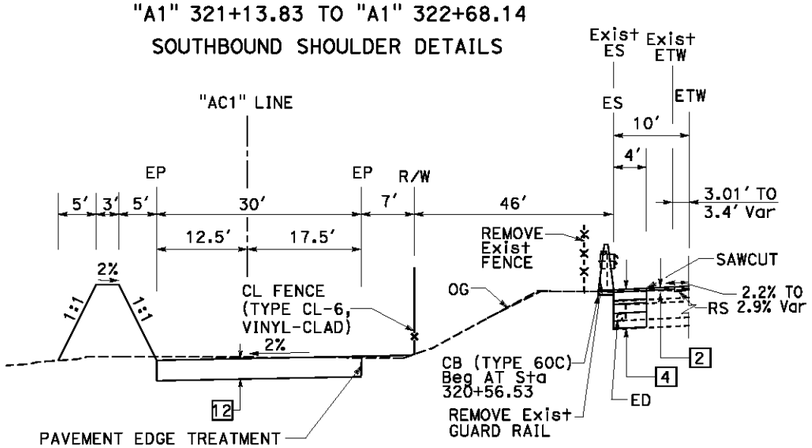
"A1" 322+68.14 TO "A1" 332+95.94

SOUTHBOUND SHOULDER DETAILS



"A1" 321+13.83 TO "A1" 322+68.14

SOUTHBOUND SHOULDER DETAILS

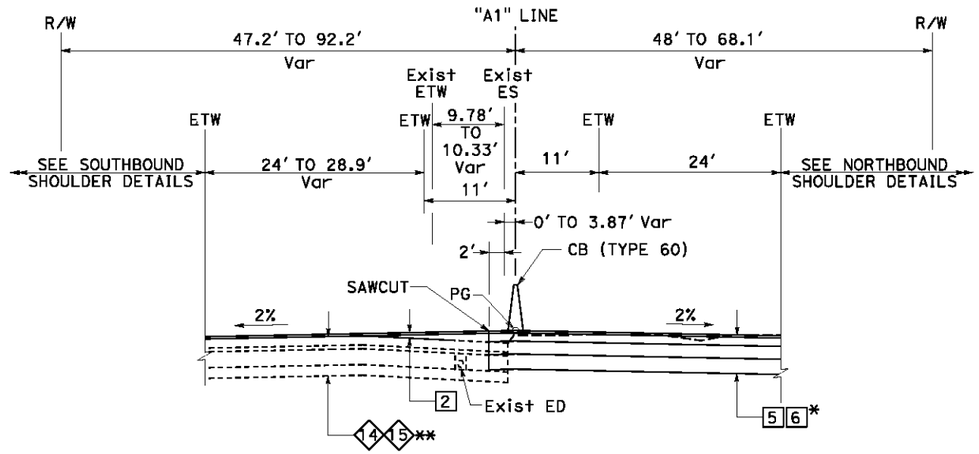


"A1" 320+56.17 TO "A1" 321+13.83

SOUTHBOUND SHOULDER DETAILS

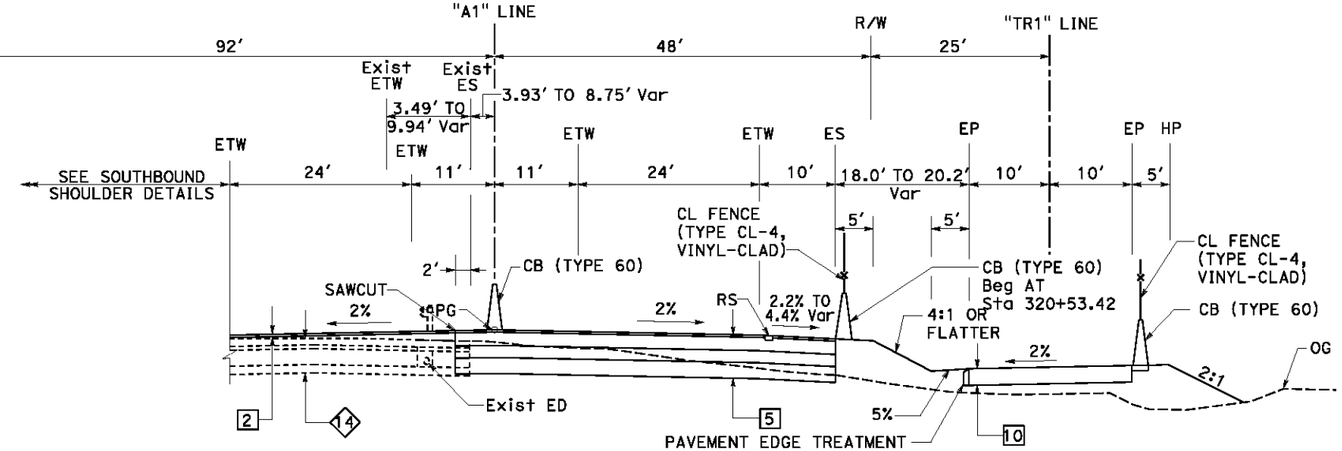
FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

*5 END AT Sta 333+10.00
6 Beg AT Sta 333+10.00
**14 END AT Sta 333+20.44
15 Beg AT Sta 333+20.44
***12 END AT "AC1" Sta 130+00.00
10 Beg AT "AC1" Sta 130+00.00
****4 END AT "A1" Sta 328+37.47
Beg AT "A1" Sta 331+66.17
END AT "A1" Sta 332+95.94



"A1" 321+98.86 TO "A1" 337+50.97

ROUTE 84



"A1" 320+44.19 TO "A1" 321+98.86

ROUTE 84

ARROYO DEL VALLE Cr BRIDGE
Br No. 33-0710
(SEE STRUCTURE PLAN)
"A1" 319+23.03 TO "A1" 320+44.19

TYPICAL CROSS SECTIONS

NO SCALE

X-8

REVISED BY	AB	
DATE REVISED	9/12/14	
ABHIJEET BHOI	ELIE ABI-JAOUDE	
CALCULATED-DESIGNED BY	CHECKED BY	
CONSULTANT FUNCTIONAL SUPERVISOR	RAMSEY J. HISSEN	

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:37
LAST REVISION 9-12-14

BORDER LAST REVISED 7/2/2010 | USERNAME => Shruti_Shah | DGN FILE => 429762ca008.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 05/30/14
REGISTERED CIVIL ENGINEER DATE

Abhijeet R. Bhoi No. 68606 Exp 09-30-15 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.

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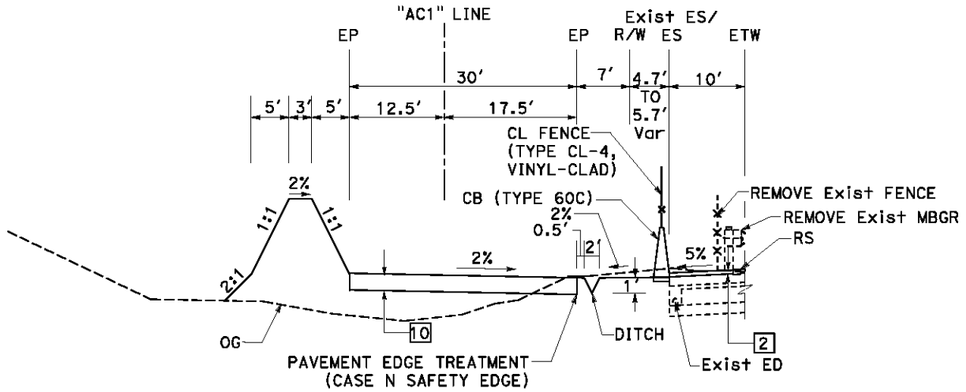
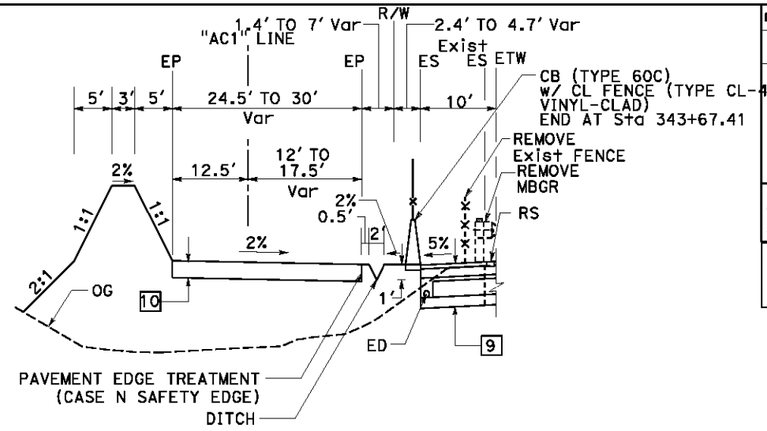
Oakland, CA 94612

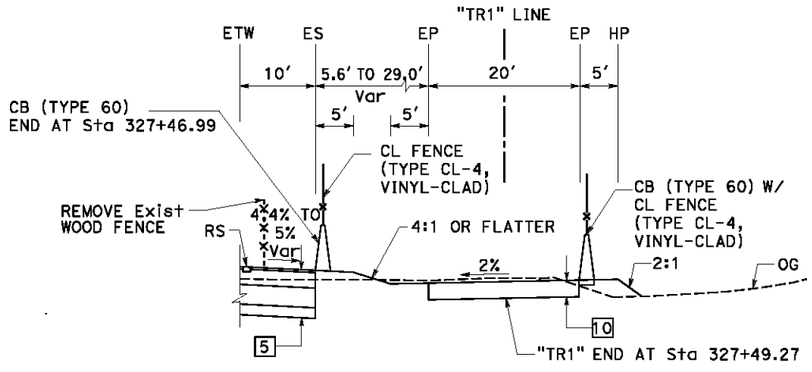
ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 Broadway, Suite 800
Oakland, CA 94607



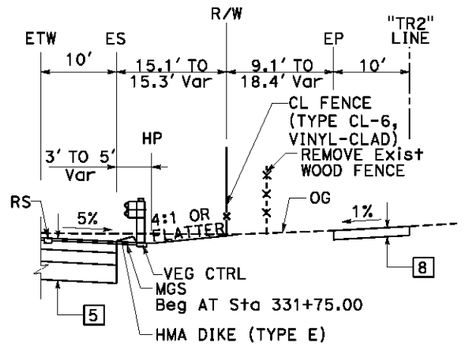
"A1" 332+95.94 TO "A1" 335+79.43
SOUTHBOUND SHOULDER DETAILS



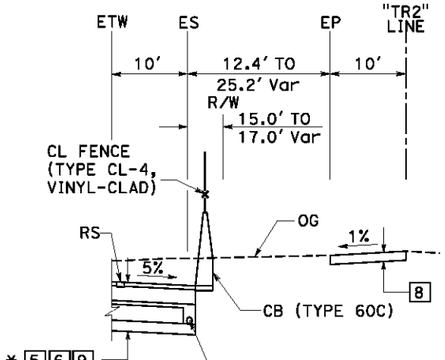
"A1" 335+79.43 TO "A1" 343+31.66
SOUTHBOUND SHOULDER DETAILS



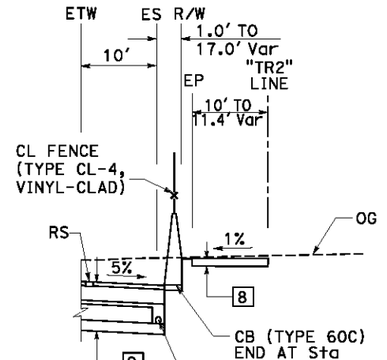
"A1" 321+98.86 TO "A1" 327+50.88
NORTHBOUND SHOULDER DETAILS



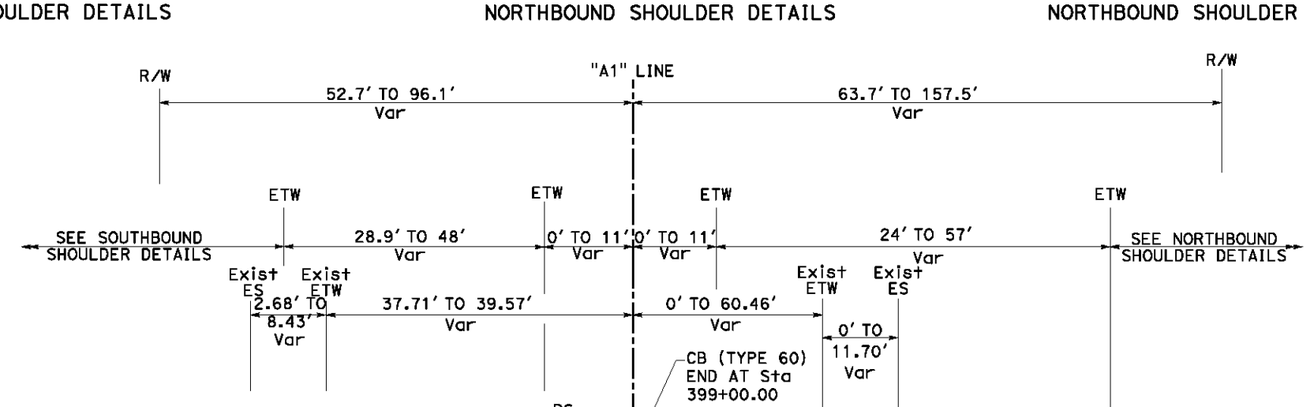
"A1" 327+50.88 TO "A1" 332+50.00
NORTHBOUND SHOULDER DETAILS



"A1" 332+50.00 TO "A1" 338+60.53
NORTHBOUND SHOULDER DETAILS



"A1" 338+60.53 TO "A1" 345+72.33
NORTHBOUND SHOULDER DETAILS



"A1" 337+50.97 TO "A1" 345+72.33
ROUTE 84

* 5 END AT "A1" Sta 333+10.00
6 Beg AT "A1" Sta 333+10.00
END AT "A1" Sta 337+50.97
9 Beg AT "A1" Sta 337+50.97

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

TYPICAL CROSS SECTIONS

NO SCALE

X-9

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	9/12/14

LAST REVISION 9-12-14
DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:37

BORDER LAST REVISED 7/2/2010
USERNAME => Shruti_Shah
DGN FILE => 429762ca009.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 — 05/30/14 DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp 09-30-15 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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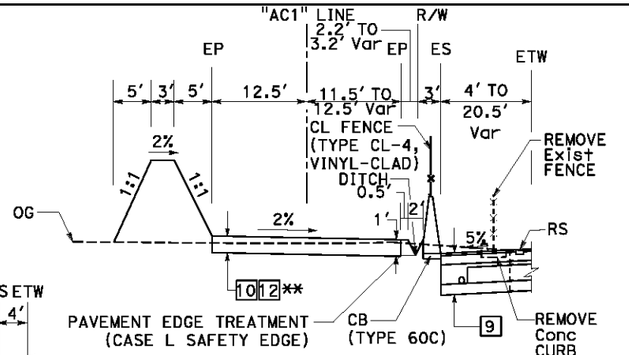
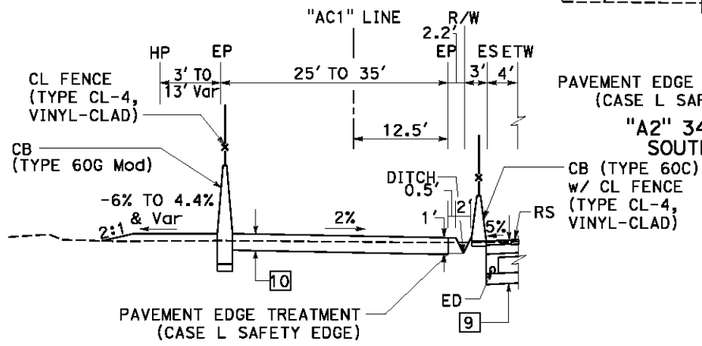
Oakland, CA 94607

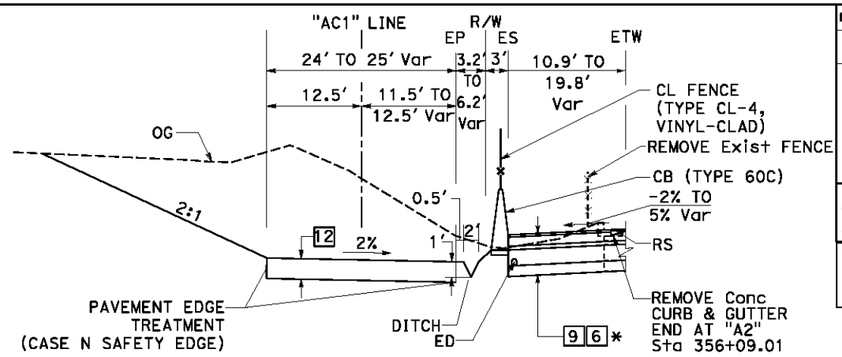
**10 END AT "AC1" Sta 148+00.00
12 Beg AT "AC1" Sta 148+00.00
*6 END AT "A2" Sta 357+90.15
3 Beg AT "A2" Sta 357+90.15
***1 END AT Sta 357+20.00
2 Beg AT Sta 357+20.00



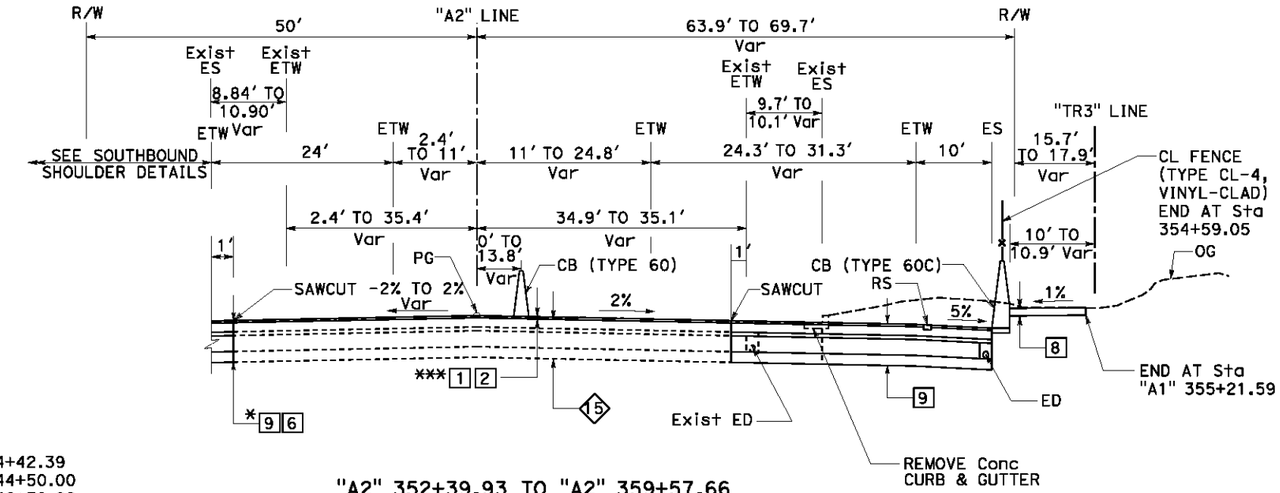
"A2" 347+82.95 TO "A2" 352+92.33
SOUTHBOUND SHOULDER DETAILS



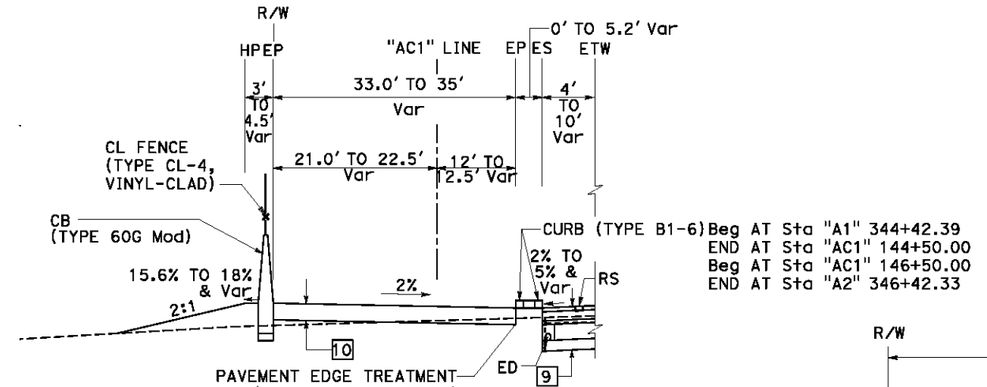
"A2" 346+42.33 TO "A2" 347+82.95
SOUTHBOUND SHOULDER DETAILS



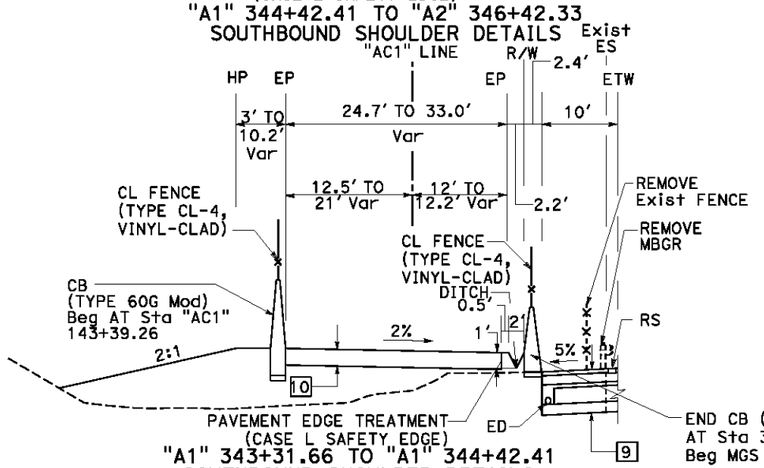
"A2" 352+92.33 TO "A2" 363+81.27
SOUTHBOUND SHOULDER DETAILS



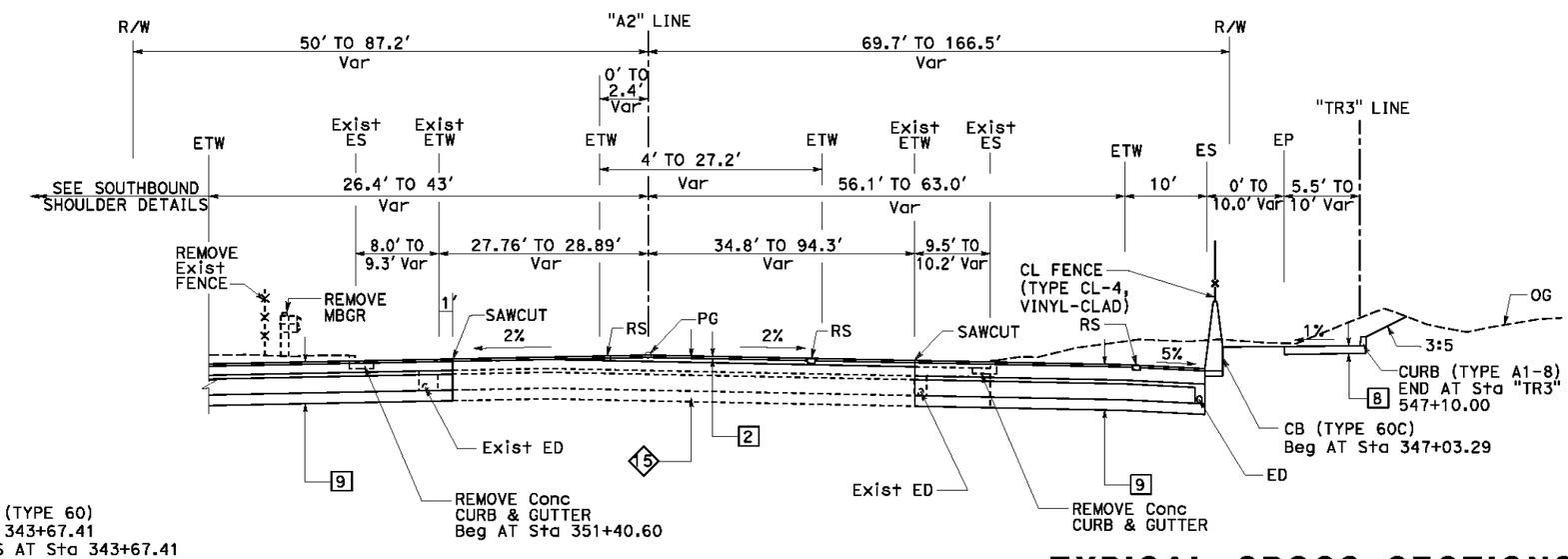
"A2" 352+39.93 TO "A2" 359+57.66
ROUTE 84



"A1" 344+42.41 TO "A2" 346+42.33
SOUTHBOUND SHOULDER DETAILS



"A1" 343+31.66 TO "A1" 344+42.41
SOUTHBOUND SHOULDER DETAILS



"A2" 345+72.33 TO "A2" 352+39.93
ROUTE 84

TYPICAL CROSS SECTIONS

NO SCALE

X-10

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

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: 9/12/14

DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:37
LAST REVISION 9-12-14

BORDER LAST REVISED 7/2/2010 | USERNAME => Shruti_Shah | DGN FILE => 429762ca010.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 05/30/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 68606 — Exp 09-30-15 — CIVIL — STATE OF CALIFORNIA

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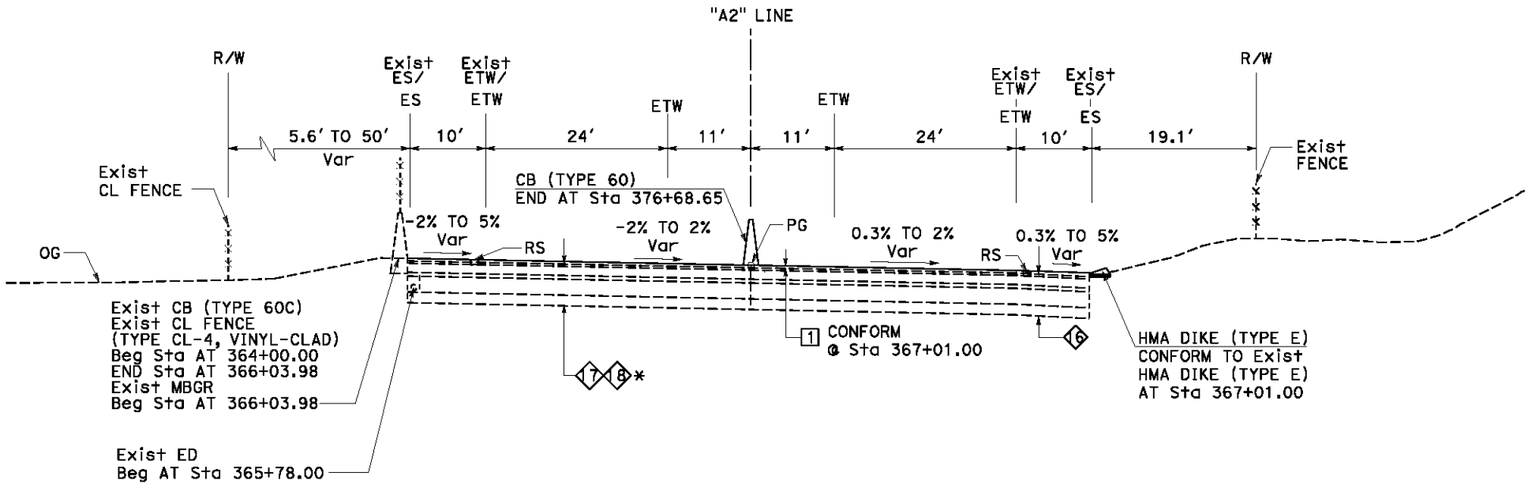
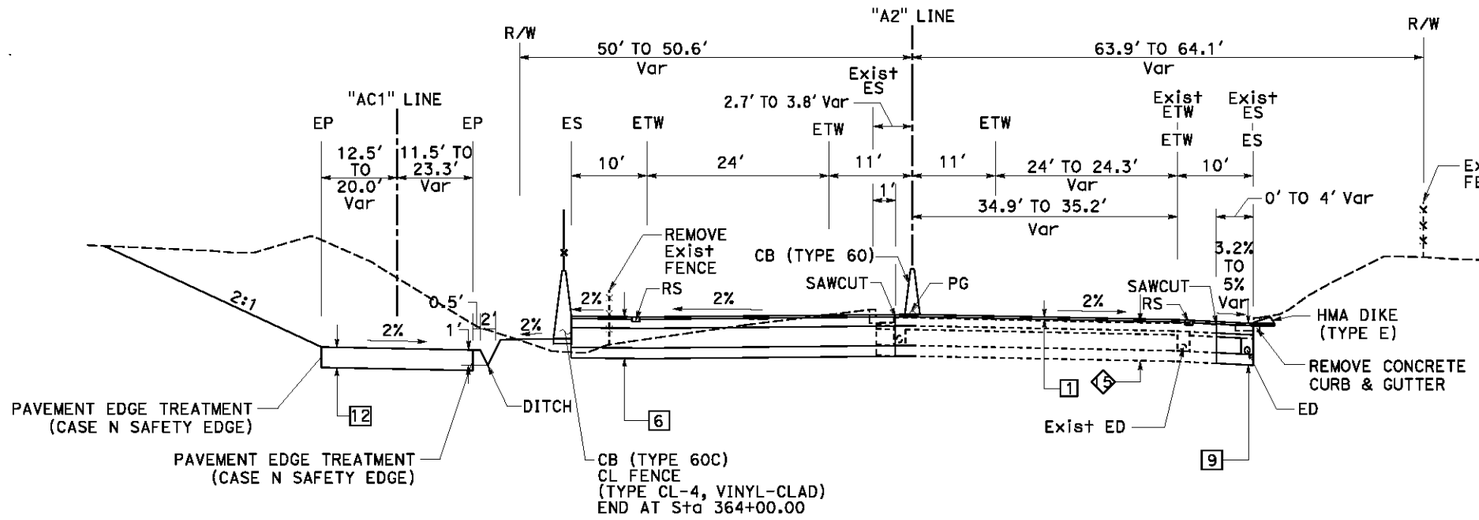
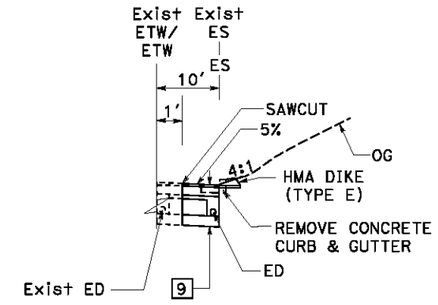


"A2" 364+00.00 TO "A2" 377+00.00
ROUTE 84

* 7 END @ Sta 365+77.93
8 Beg @ Sta 365+77.93
End @ Sta 377+00.00



"A2" 359+57.66 TO "A2" 364+00.00
ROUTE 84



"A2" 359+57.66 TO "A2" 360+07.07
NORTHBOUND SHOULDER DETAILS

TYPICAL CROSS SECTIONS

NO SCALE

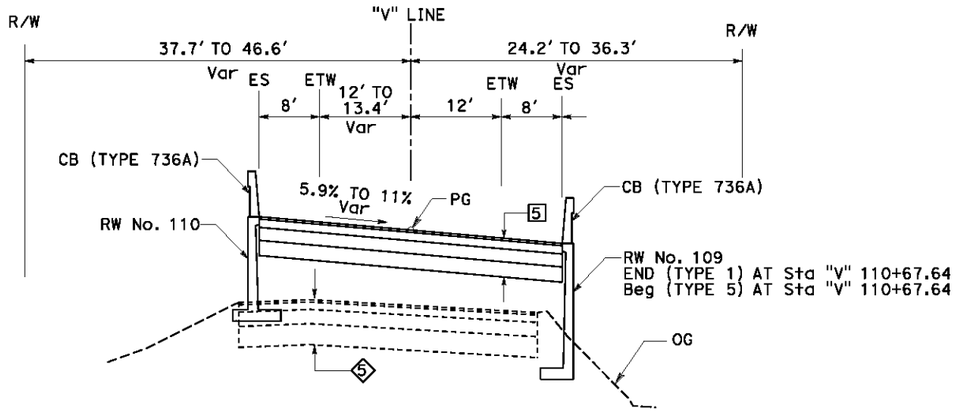
X-11

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

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: 9/12/14

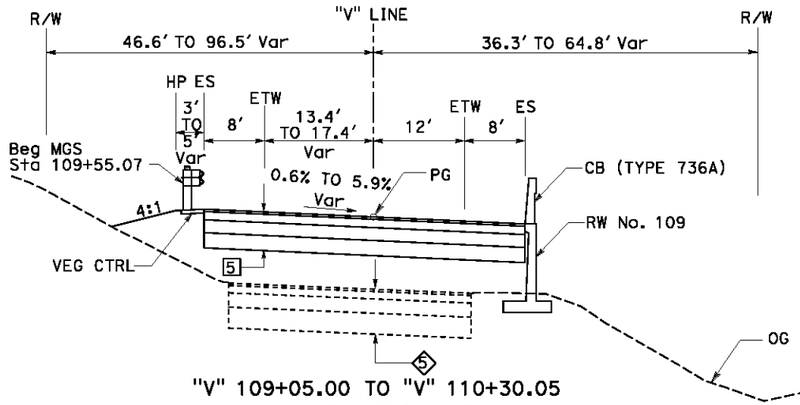
LAST REVISION 9-12-14
DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:37

BORDER LAST REVISED 7/2/2010
USERNAME => Shruti_Shah
DGN FILE => 429762ca011.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205811



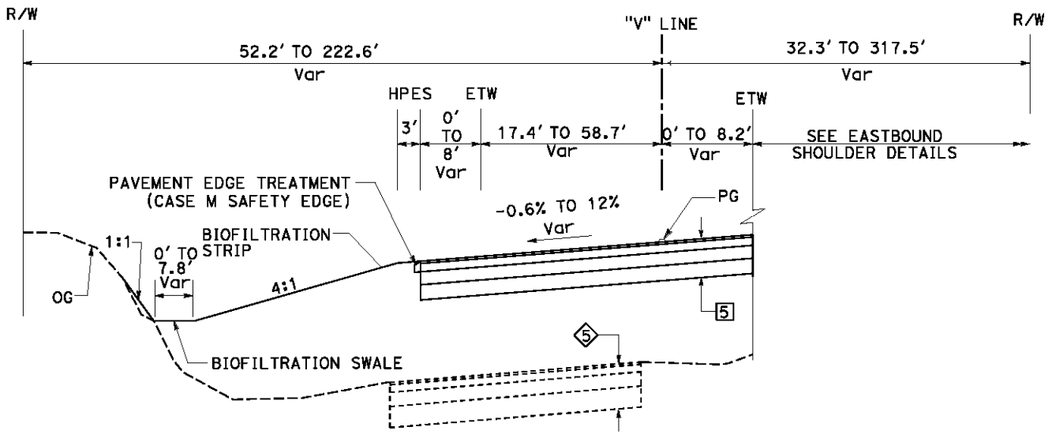
"V" 110+30.05 TO "V" 112+30.19

VALLECITOS ROAD



"V" 109+05.00 TO "V" 110+30.05

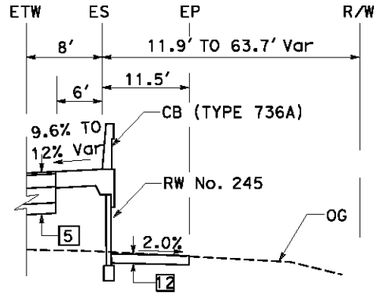
VALLECITOS ROAD



"V" 100+83.74 TO "V" 109+05.00

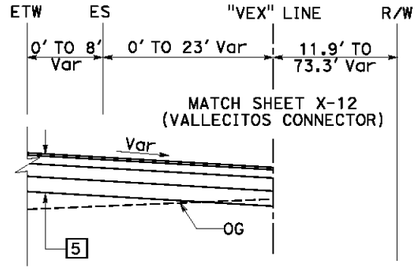
VALLECITOS ROAD

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1



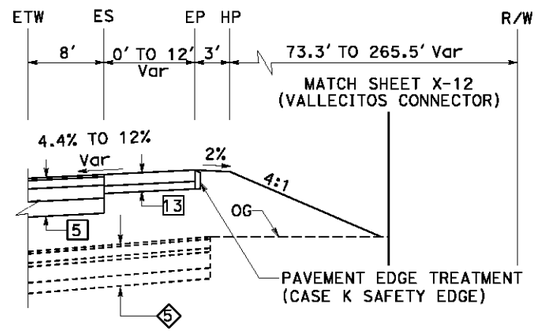
"V" 104+19.17 TO "V" 106+59.99

EASTBOUND SHOULDER DETAILS



"V" 102+46.66 TO "V" 104+19.17

EASTBOUND SHOULDER DETAILS

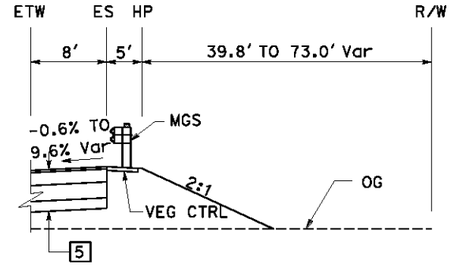


"V" 101+33.31 TO "V" 102+46.66

EASTBOUND SHOULDER DETAILS

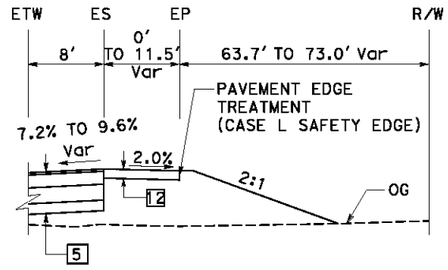
"V" 100+83.74 TO "V" 101+33.31

EASTBOUND SHOULDER DETAILS



"V" 107+17.50 TO "V" 109+05.00

EASTBOUND SHOULDER DETAILS



"V" 106+59.99 TO "V" 107+17.50

EASTBOUND SHOULDER DETAILS

TYPICAL CROSS SECTIONS

NO SCALE

X-12

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi 05/30/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Registered Professional Engineer — Abhijeet R. Bhoi — No. 68606 — Exp 09-30-15 — CIVIL — State of California

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URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 Broadway, Suite 800
Oakland, CA 94607

REVISED BY	DATE REVISED
AB	9/12/14

CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:37
LAST REVISION 9-12-14

BORDER LAST REVISED 7/2/2010 | USERNAME => Shruti_Shah | DGN FILE => 429762ca012.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
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ARBhoi 05/30/14
REGISTERED CIVIL ENGINEER DATE

Abhijeet R. Bhoi No. 68606 Exp 09-30-15 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 Broadway, Suite 800
Oakland, CA 94607

* (5) END AT "VEX" Sta 48+98.96
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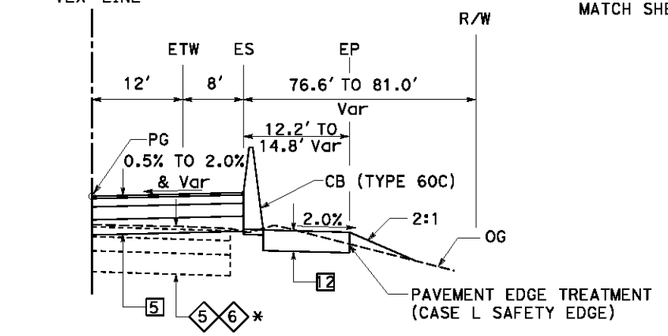

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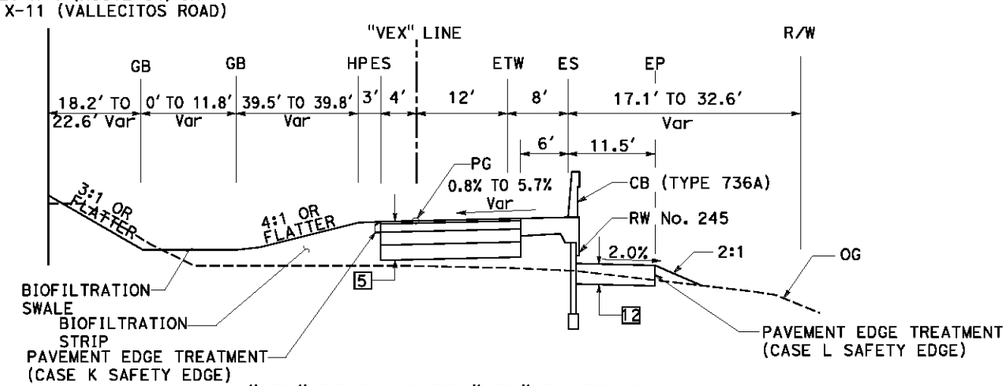

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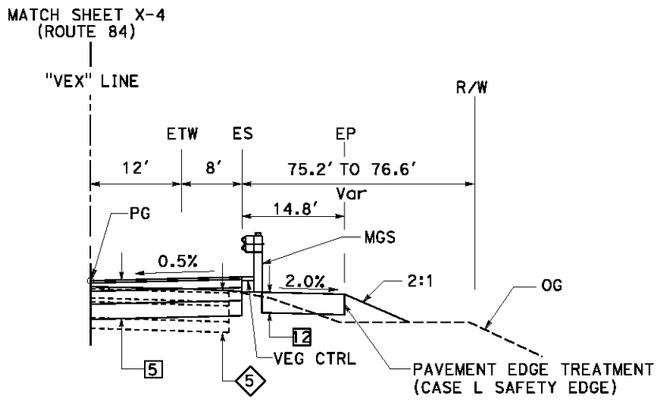

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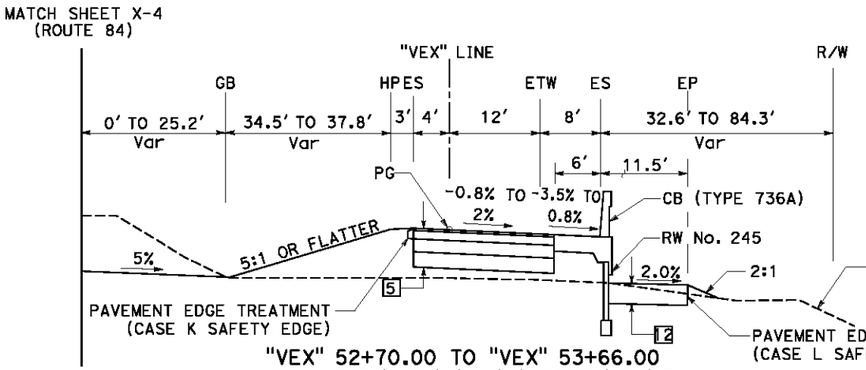

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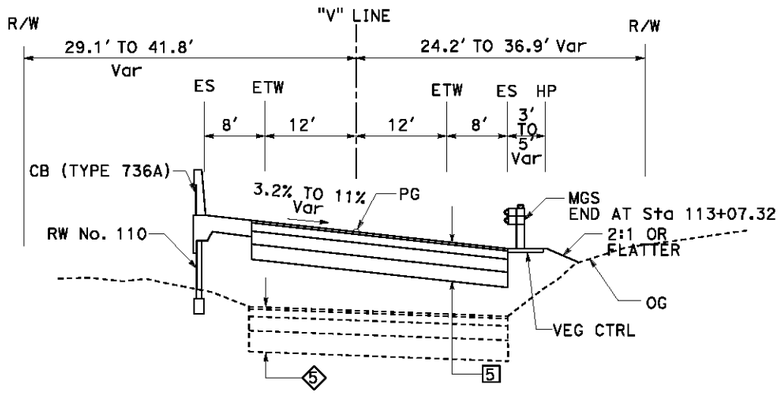

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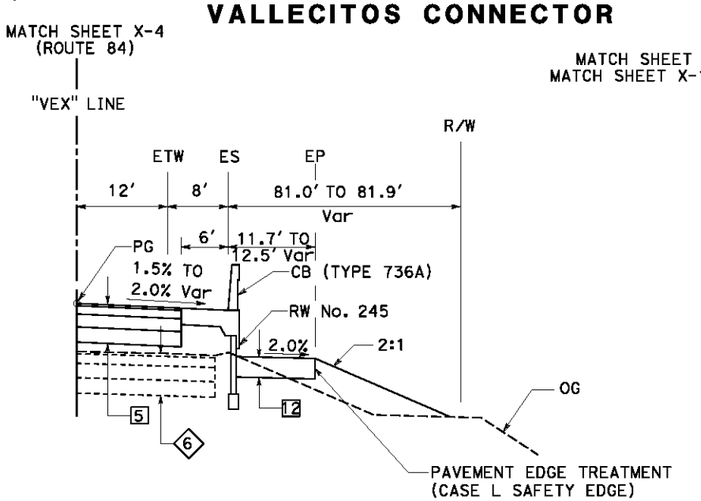

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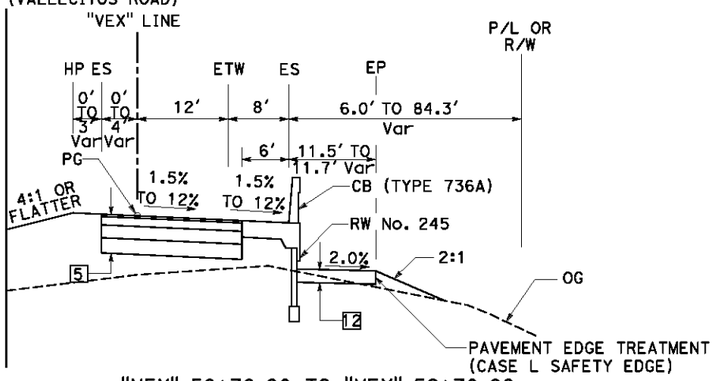

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"VEX" 54+77.00 TO "VEX" 57+58.08
VALLECITOS CONNECTOR

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

TYPICAL CROSS SECTIONS

NO SCALE

X-13

REVISED BY	DATE REVISED
AB	9/12/14

ABHIJEET BHOI — CALCULATED-DESIGNED BY
ELIE ABI-JAOUDE — CHECKED BY
RAMSEY J. HISSEN — CONSULTANT FUNCTIONAL SUPERVISOR
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 9-12-14
DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:37

BORDER LAST REVISED 7/2/2010
USERNAME => Shruti_Shah
DGN FILE => 429762ca013.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 05/30/14
REGISTERED CIVIL ENGINEER DATE

Abhijeet R. Bhoi No. 68606 Exp 09-30-15 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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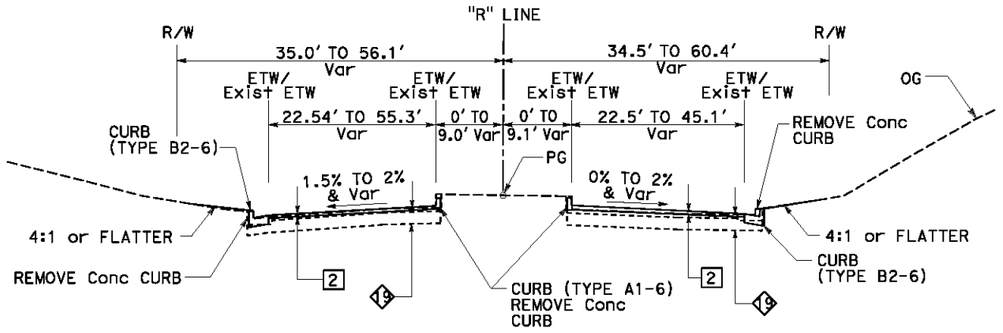
URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 Broadway, Suite 800
Oakland, CA 94607



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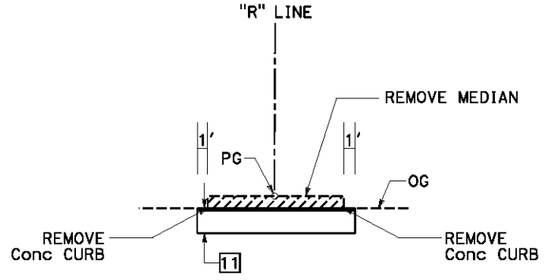

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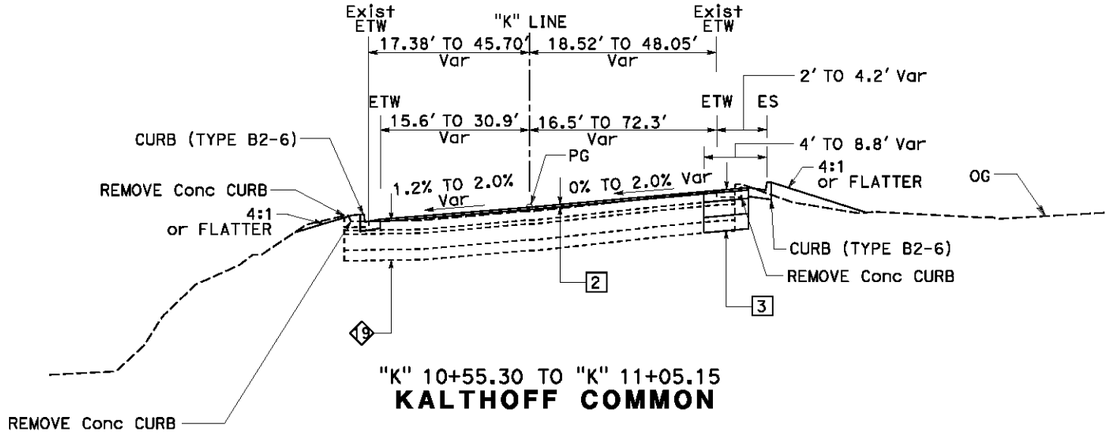

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KALTHOFF COMMON

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

TYPICAL CROSS SECTIONS

NO SCALE

X-14

CALCULATED-DESIGNED BY			
CHECKED BY			
DRAWN BY	ABHIJEET BHOI	REVISED BY	AB
CHECKED BY	ELIE ABI-JAOUDE	DATE REVISED	9/12/14

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 9-12-14
DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:37

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi 05/30/14
REGISTERED CIVIL ENGINEER DATE

Abhijeet R. Bhoi No. 68606 Exp 09-30-15 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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Oakland, CA 94607

* 4 END AT "VIN" Sta 21+53.71
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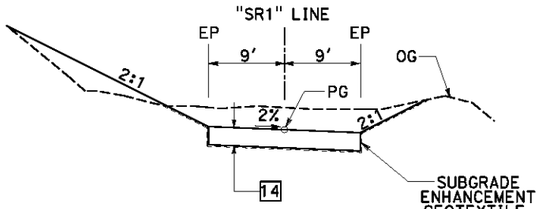

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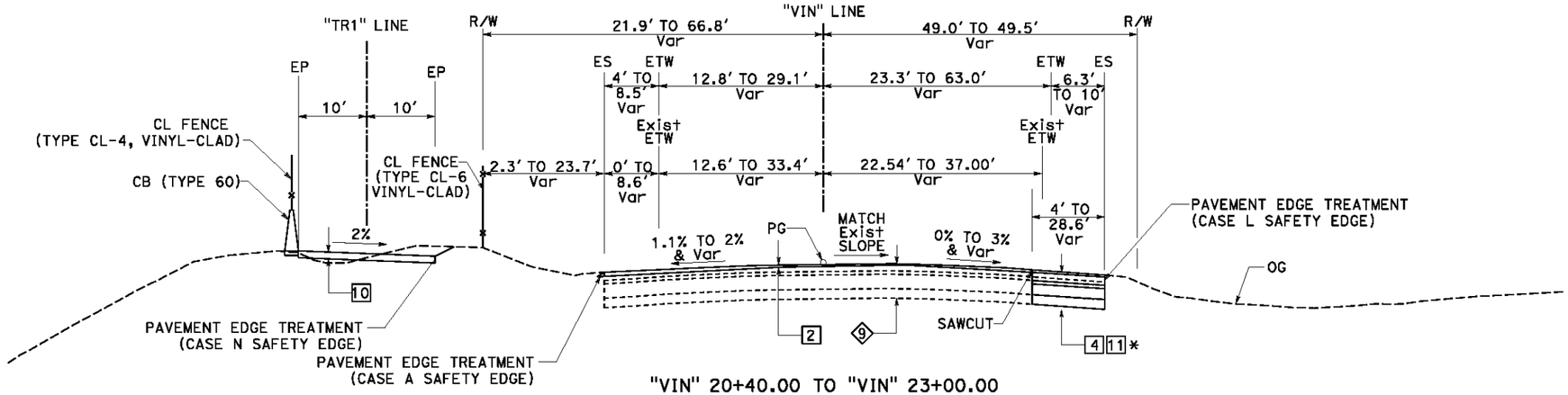

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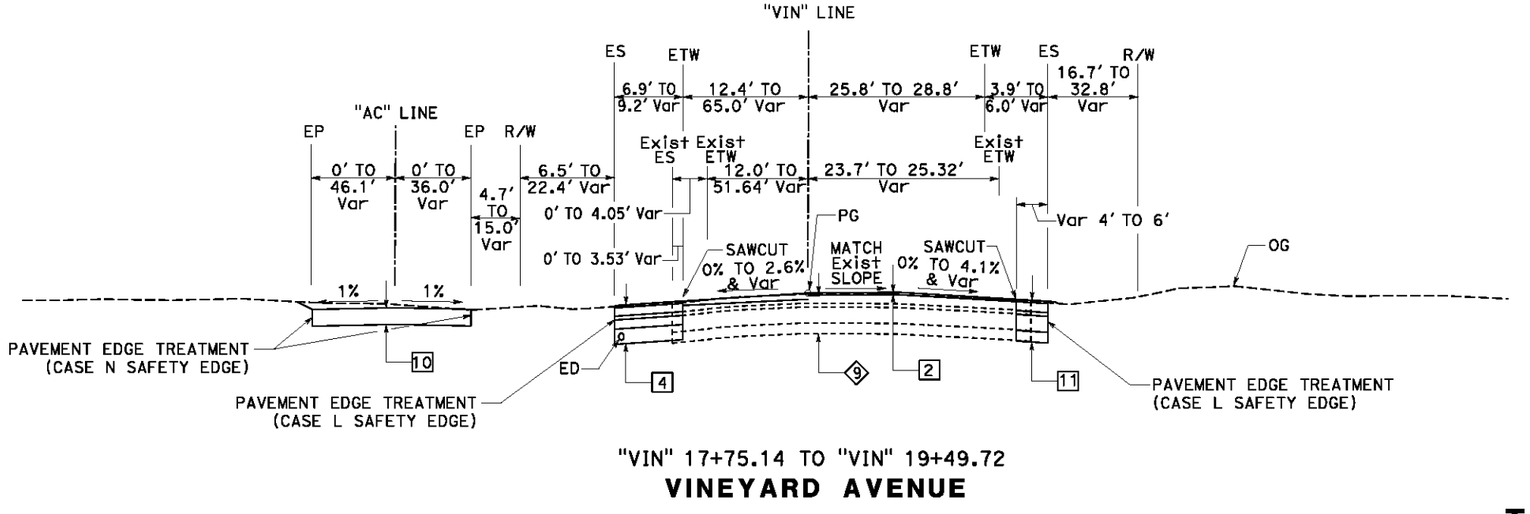

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VINEYARD AVENUE

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET X-1

TYPICAL CROSS SECTIONS

NO SCALE

X-15

REVISED BY	AB		
DATE REVISED	9/12/14		
CALCULATED-DESIGNED BY	ABHIJEET BHOI		
CHECKED BY	ELIE ABI-JAOUDE		
CONSULTANT FUNCTIONAL SUPERVISOR	RAMSEY J. HISSEN		

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:37
LAST REVISION 9-12-14

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)

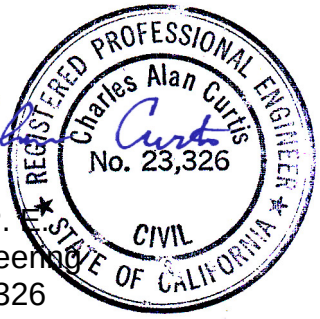
The design recommendations labeled as “Alternate Design B” will replace the RAC Designs found in the report dated March 20th, 2008. As stated in the formal report, reflective cracking is the controlling factor for the designs. These designs meet the requirements for controlling the reflective cracks 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.

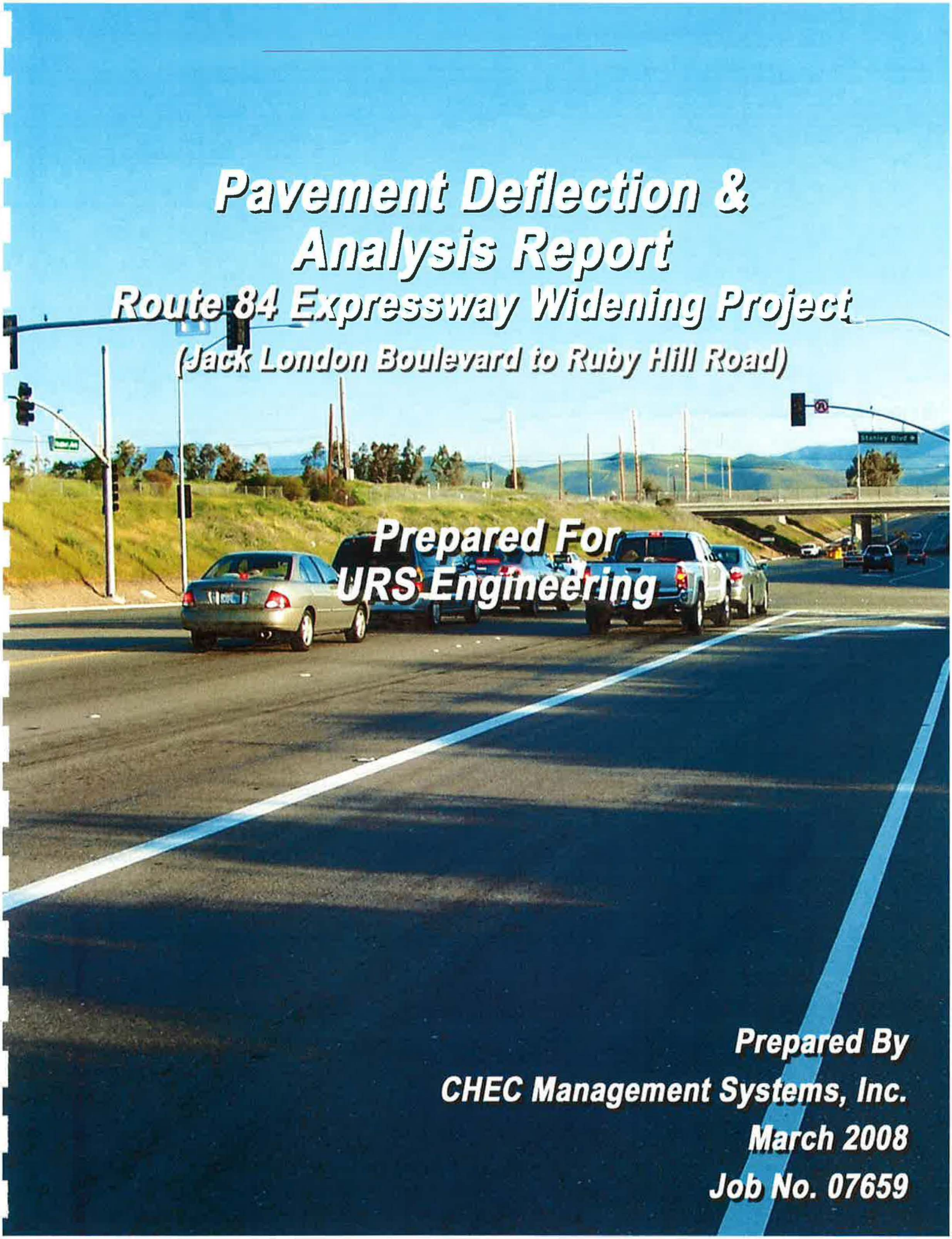
Very truly yours,
CHEC MANAGEMENT SYSTEMS, INC.

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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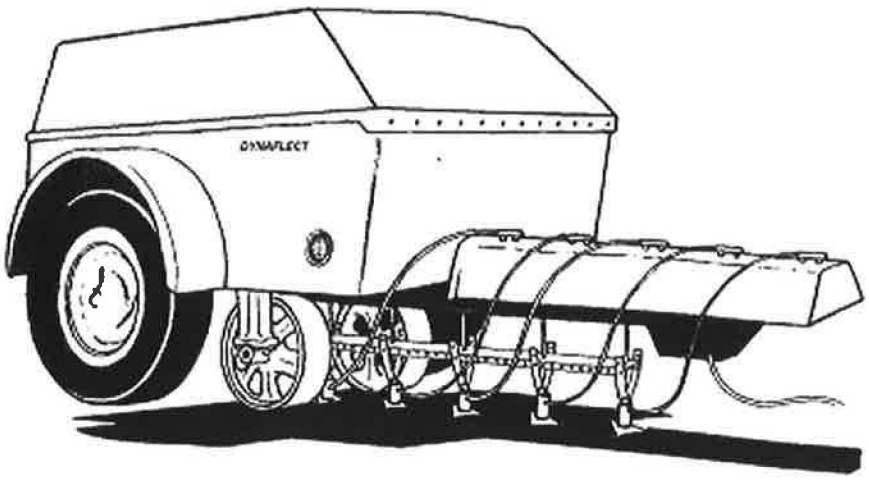
APPENDIX

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.

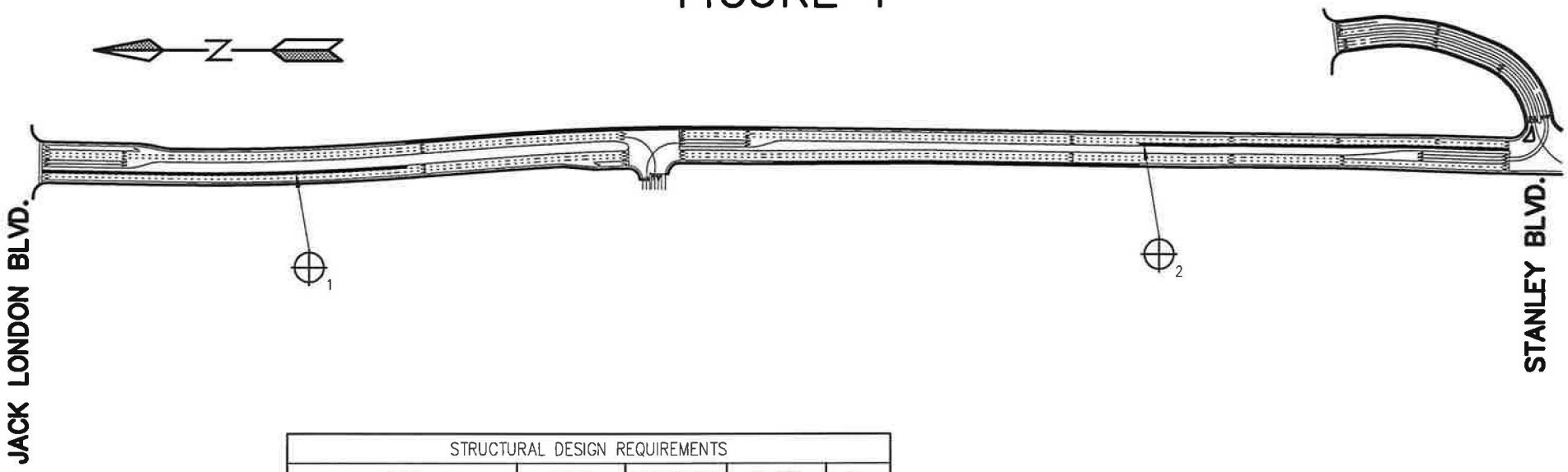
CHEC's Alternate Design B

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

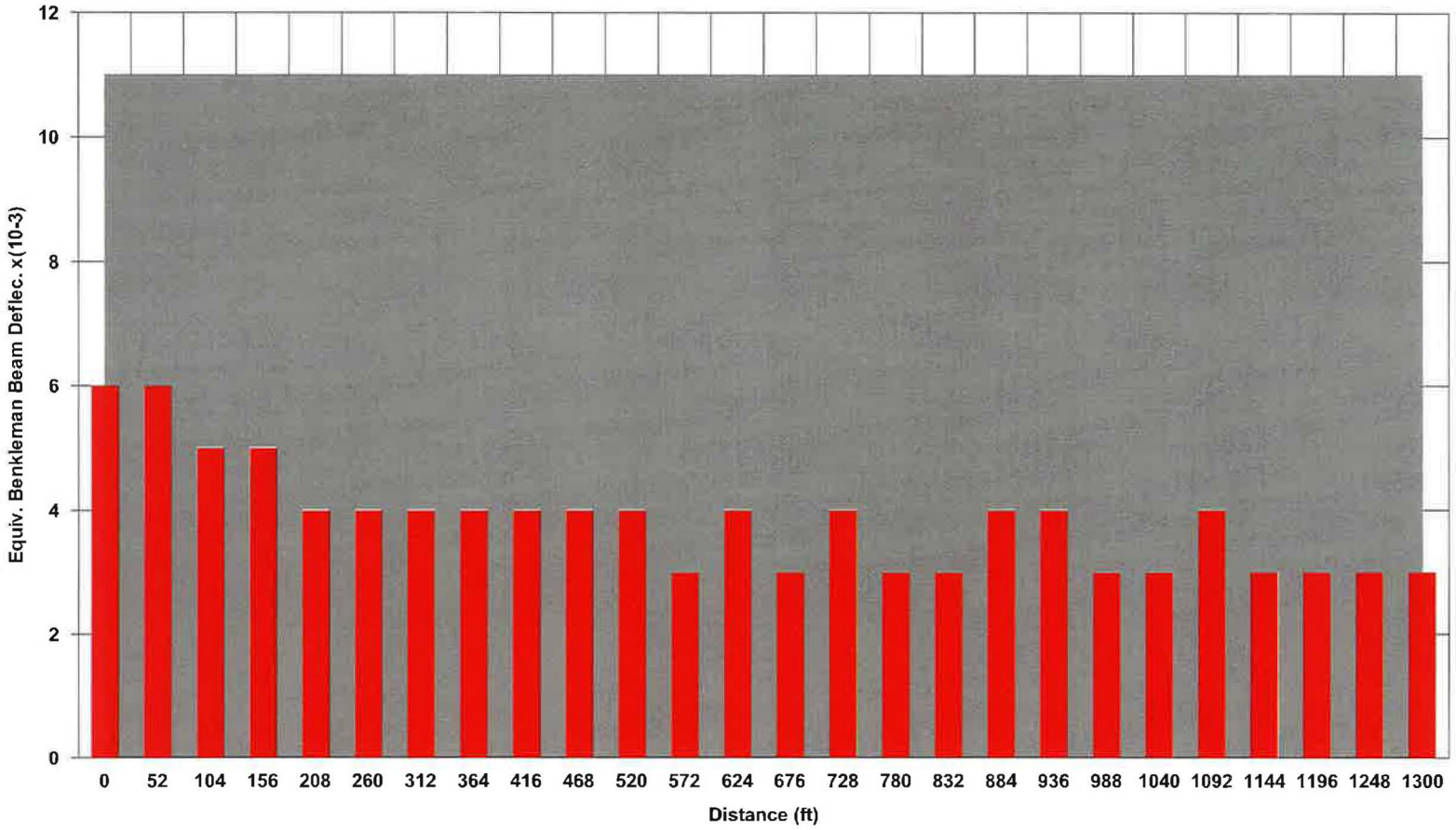
80th %	90th %	Mean	Min	Max
5	5	4	3	6

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

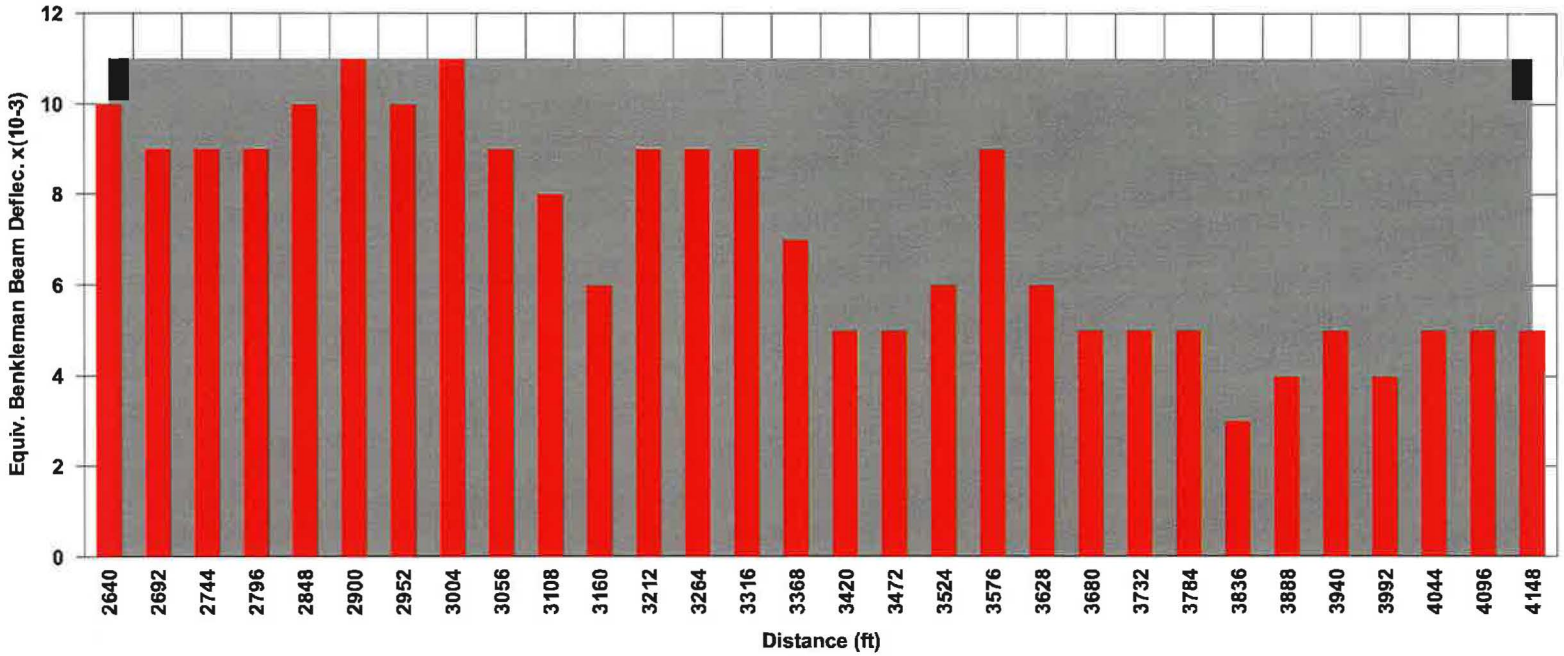
80th %	90th %	Mean	Min	Max
9	10	7	3	11

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

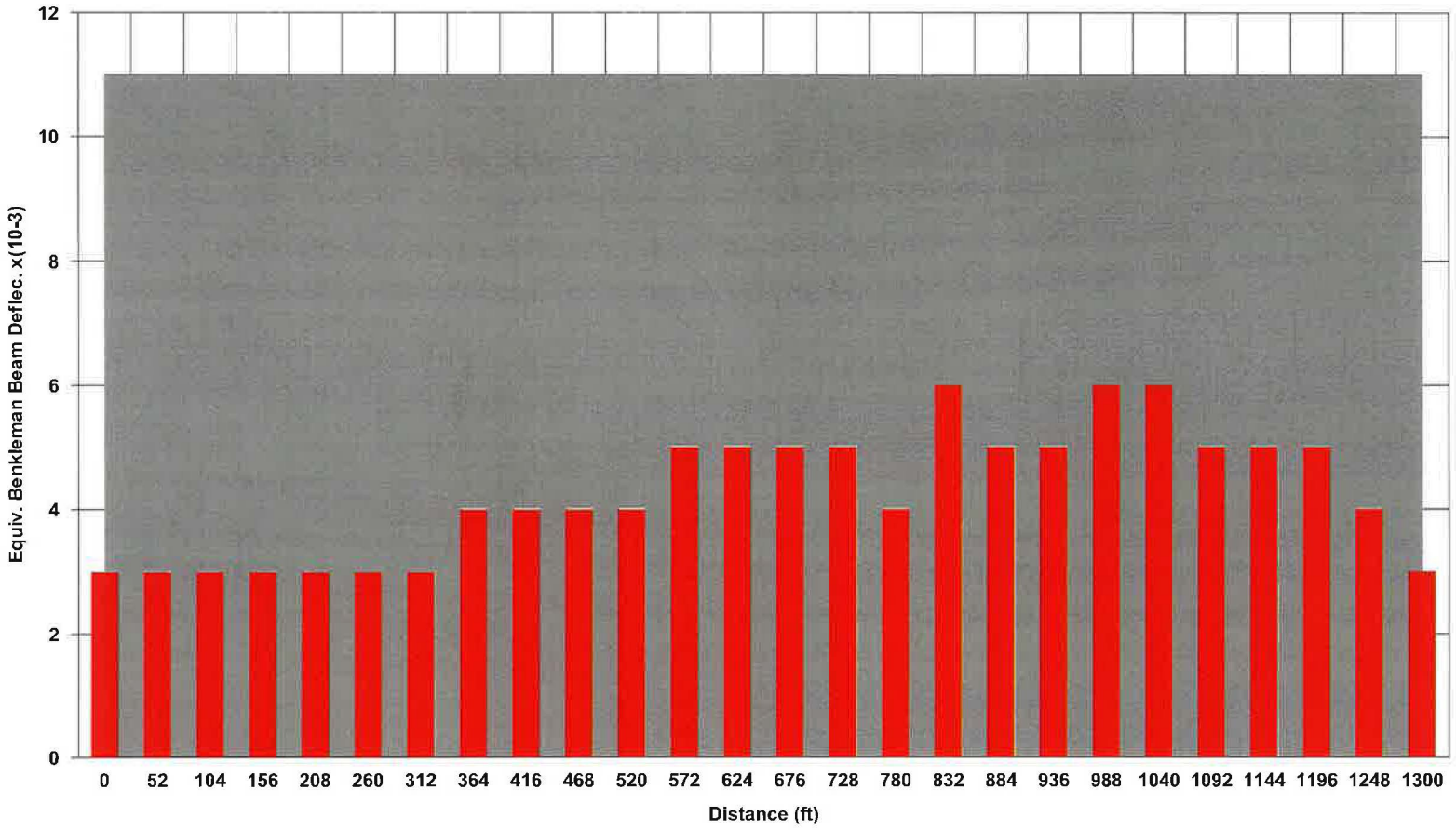
80th %	90th %	Mean	Min	Max
5	6	4	3	6

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

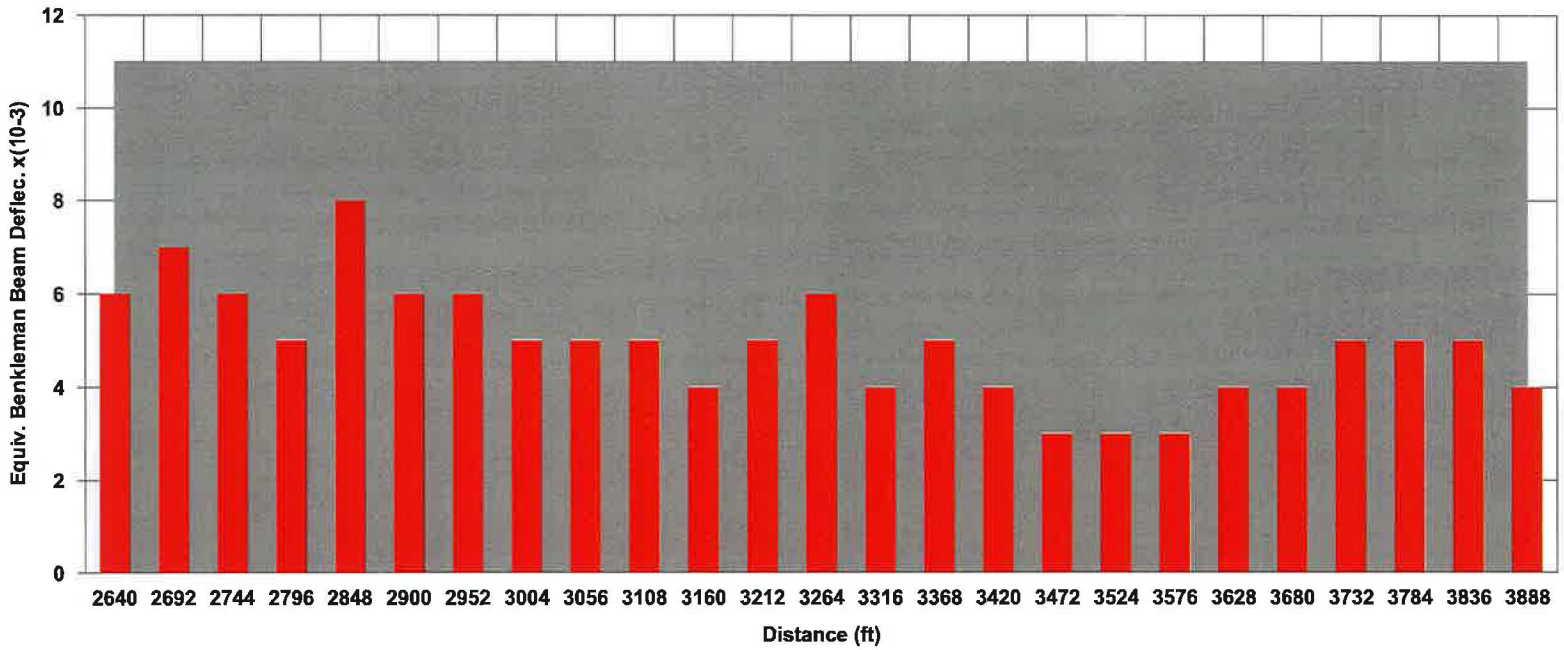
80th %	90th %	Mean	Min	Max
6	6	5	3	8

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.

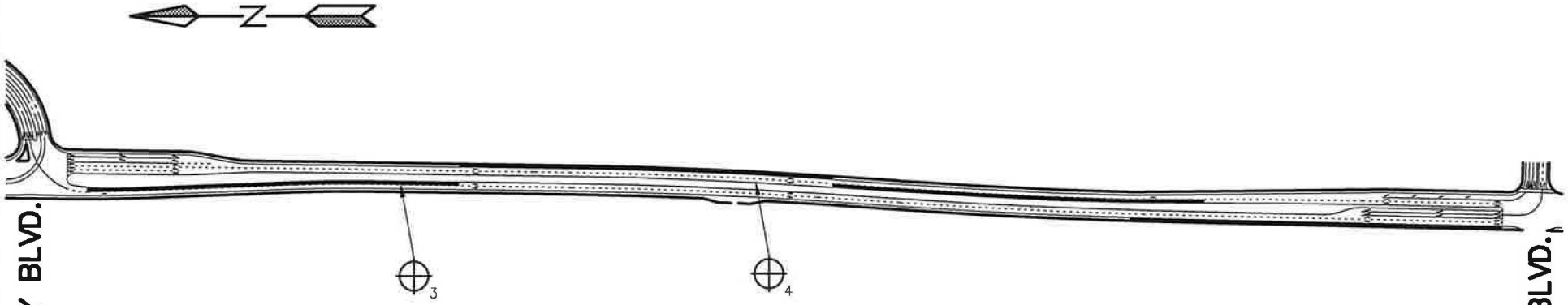
CHEC's Alternate Design B

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

Ⓐ = ALTERNATE DESIGN "A"

Ⓑ = ALTERNATE DESIGN "B"

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'

#	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

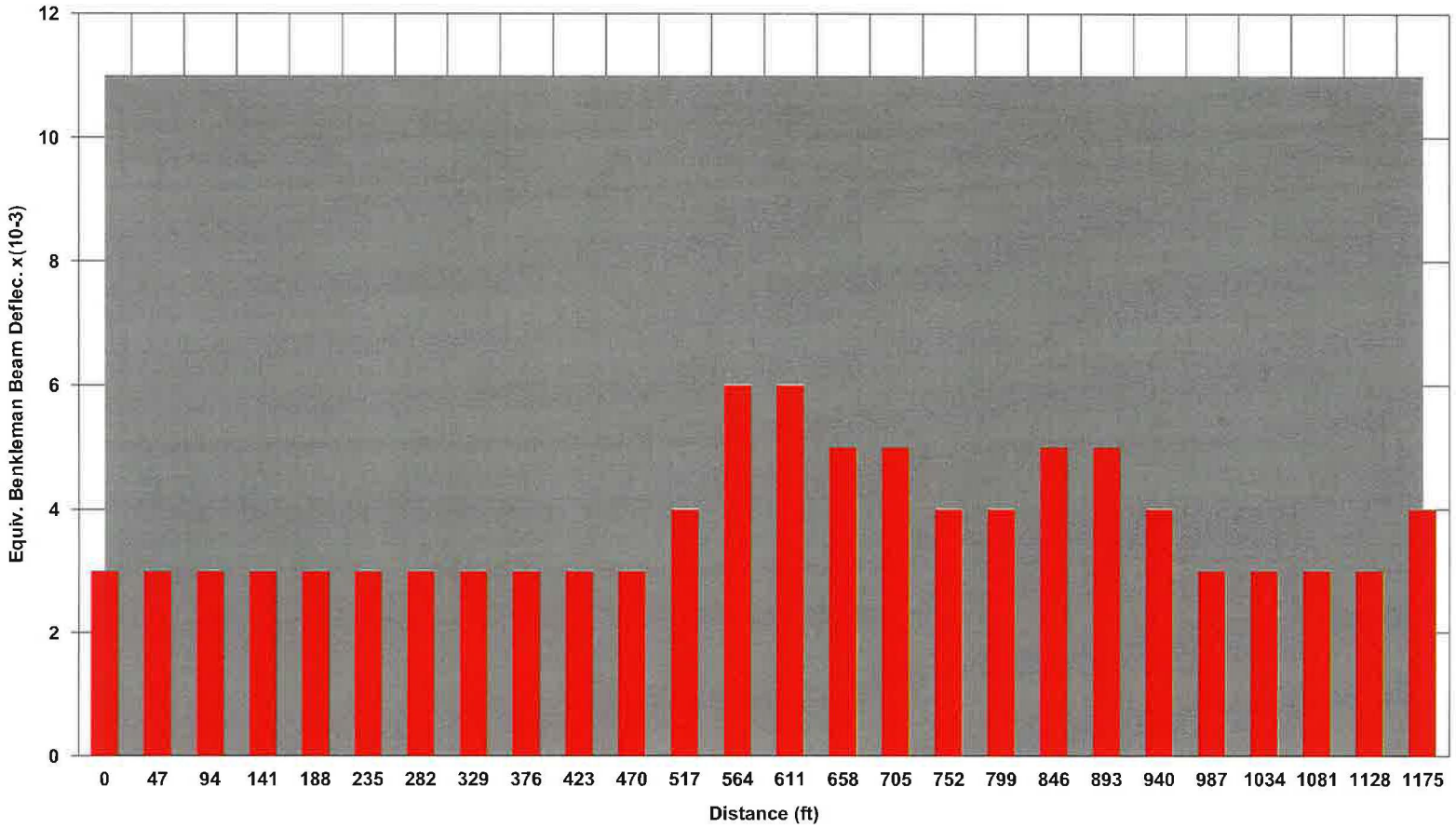
80th %	90th %	Mean	Min	Max
4	5	4	3	6

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

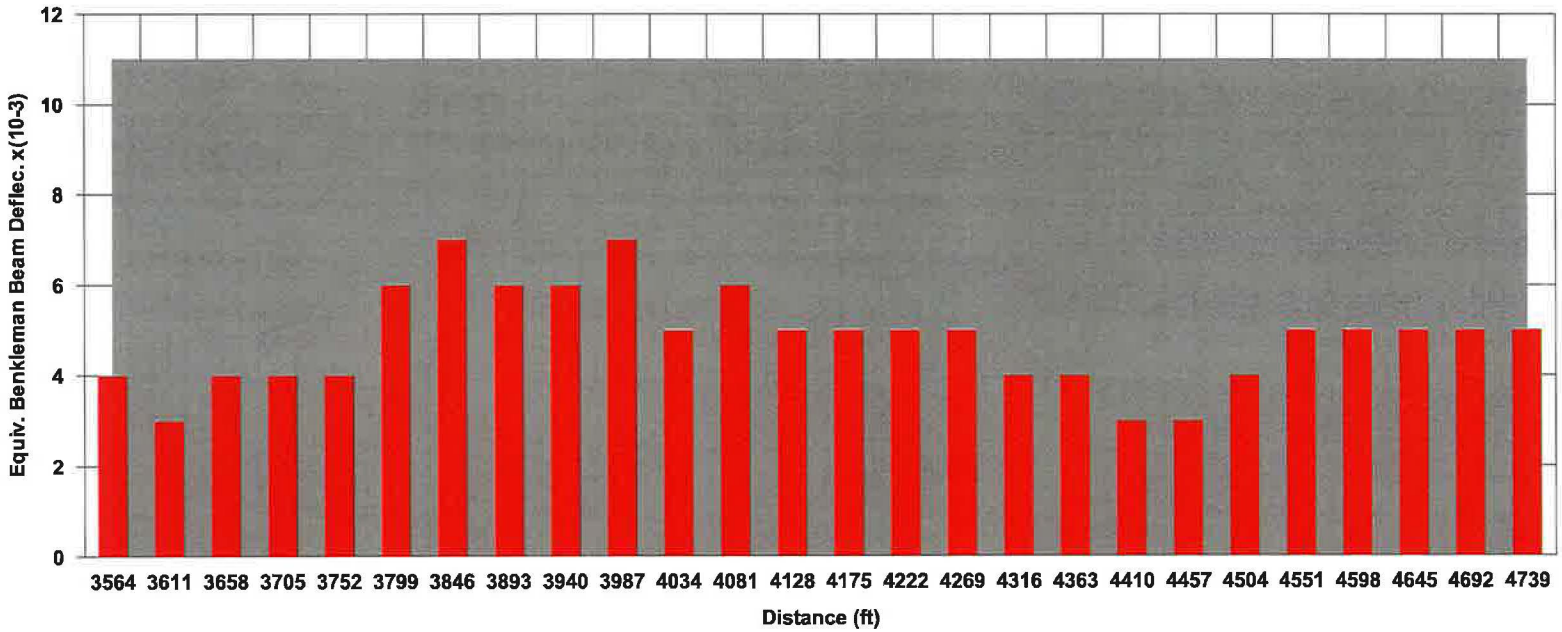
80th %	90th %	Mean	Min	Max
6	6	5	3	7

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

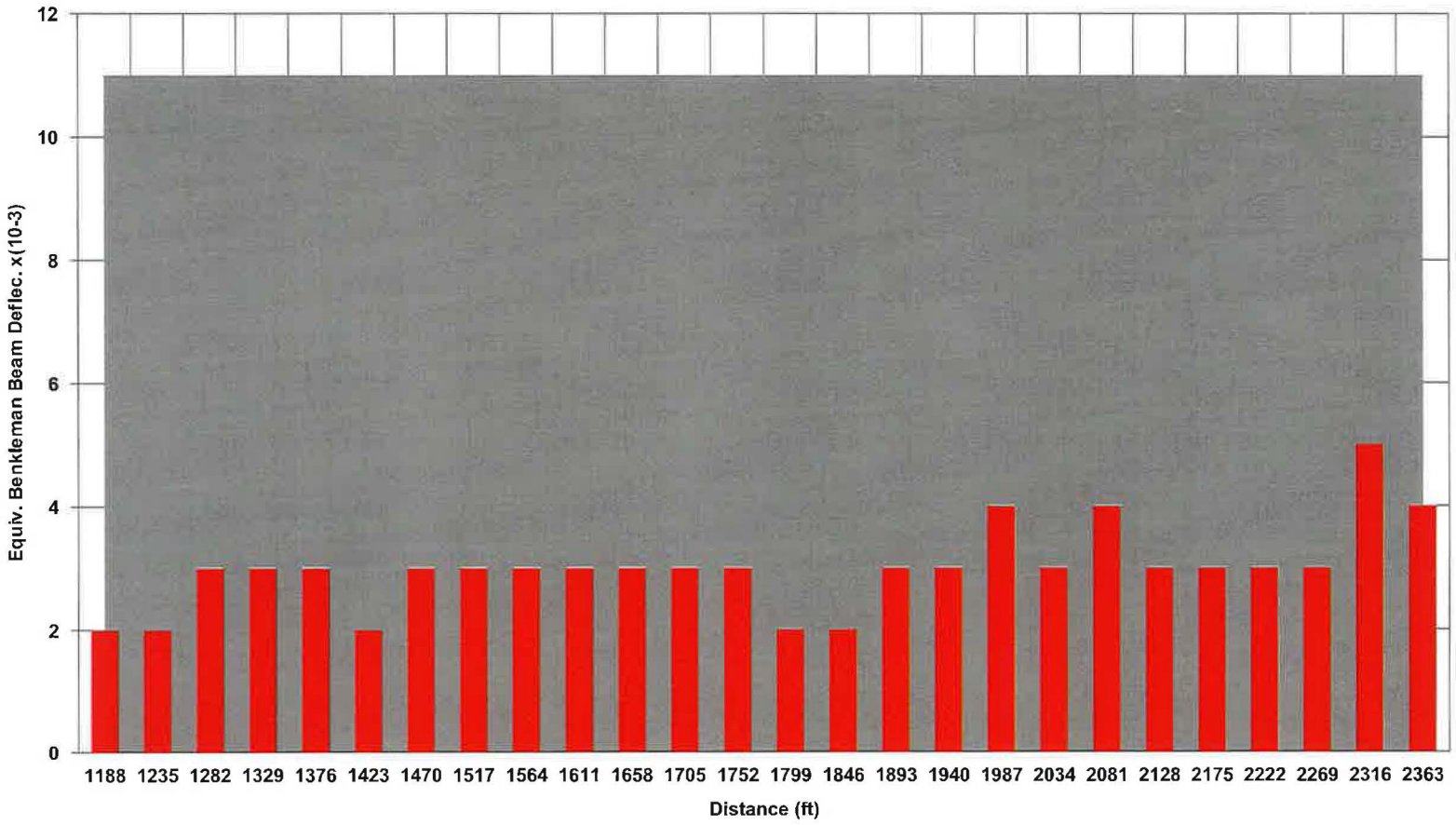
80th %	90th %	Mean	Min	Max
4	4	3	2	5

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

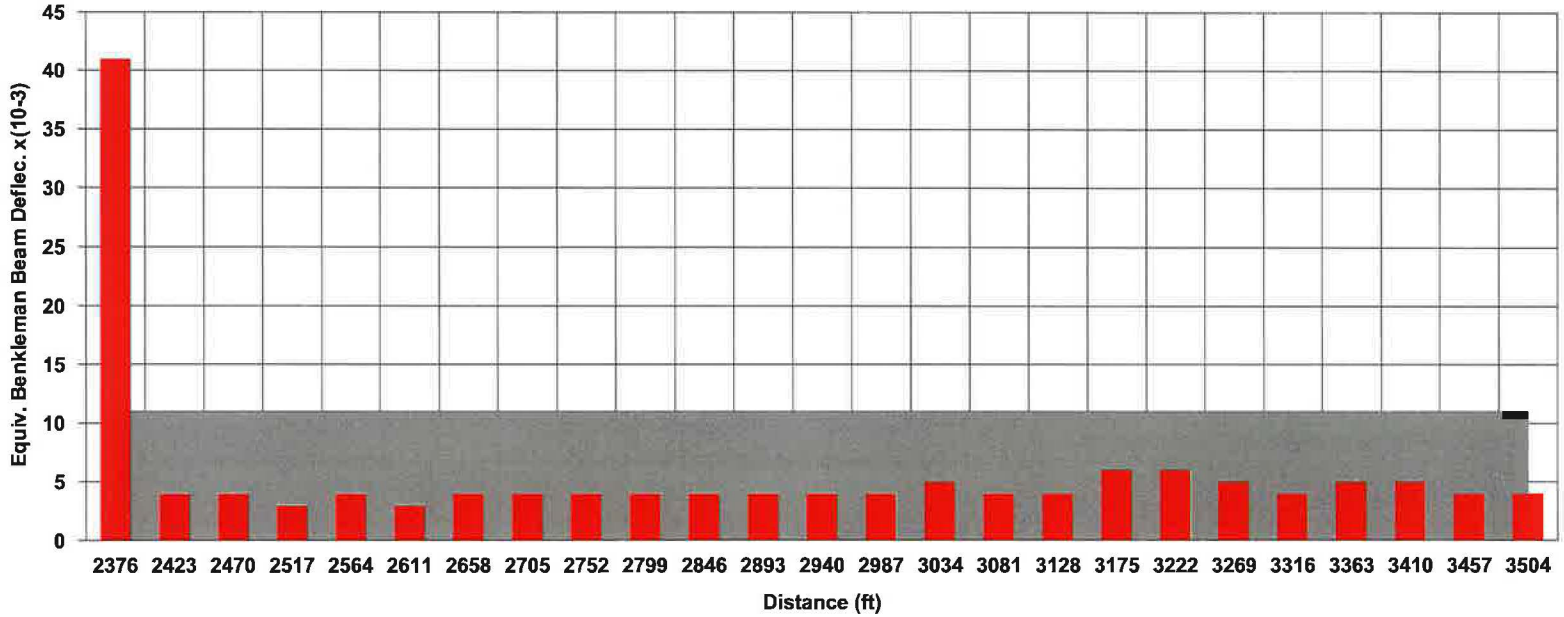
80th %	90th %	Mean	Min	Max
12	15	6	3	41

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.

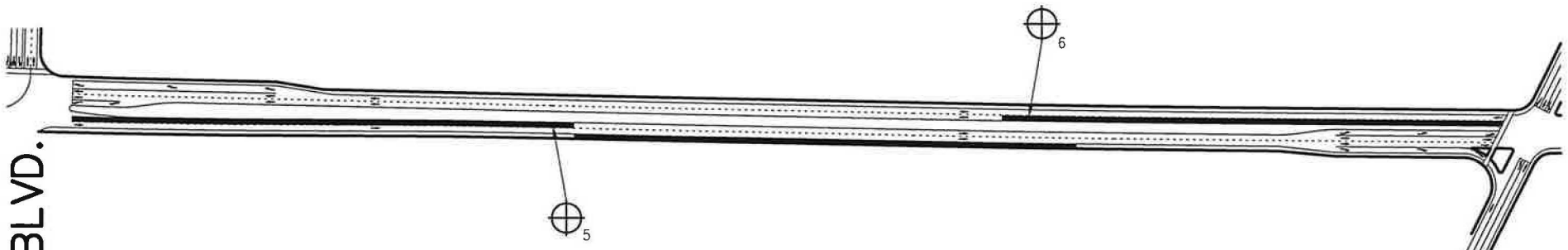
CHEC's Alternate Design B

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

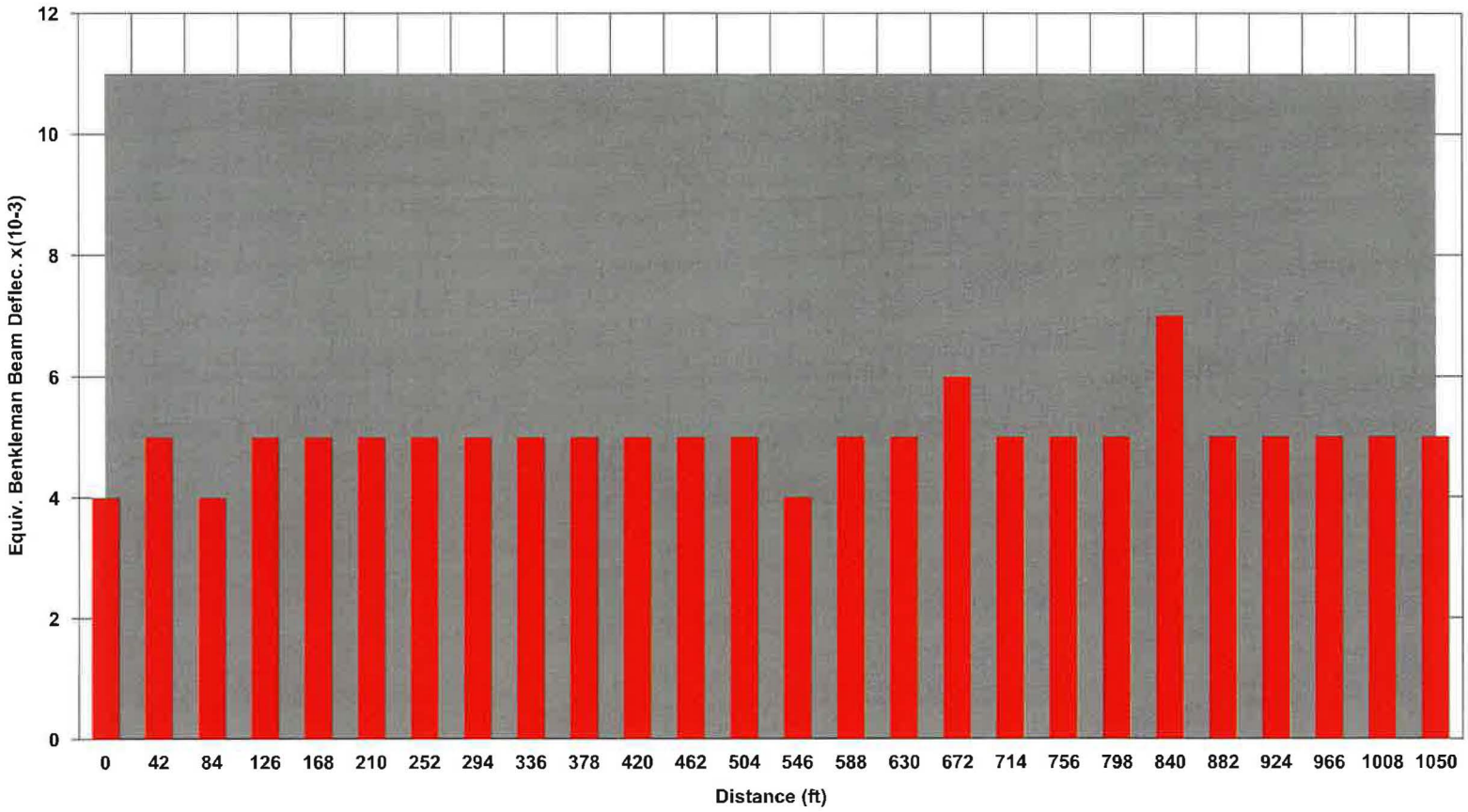
80th %	90th %	Mean	Min	Max
5	6	5	4	7

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

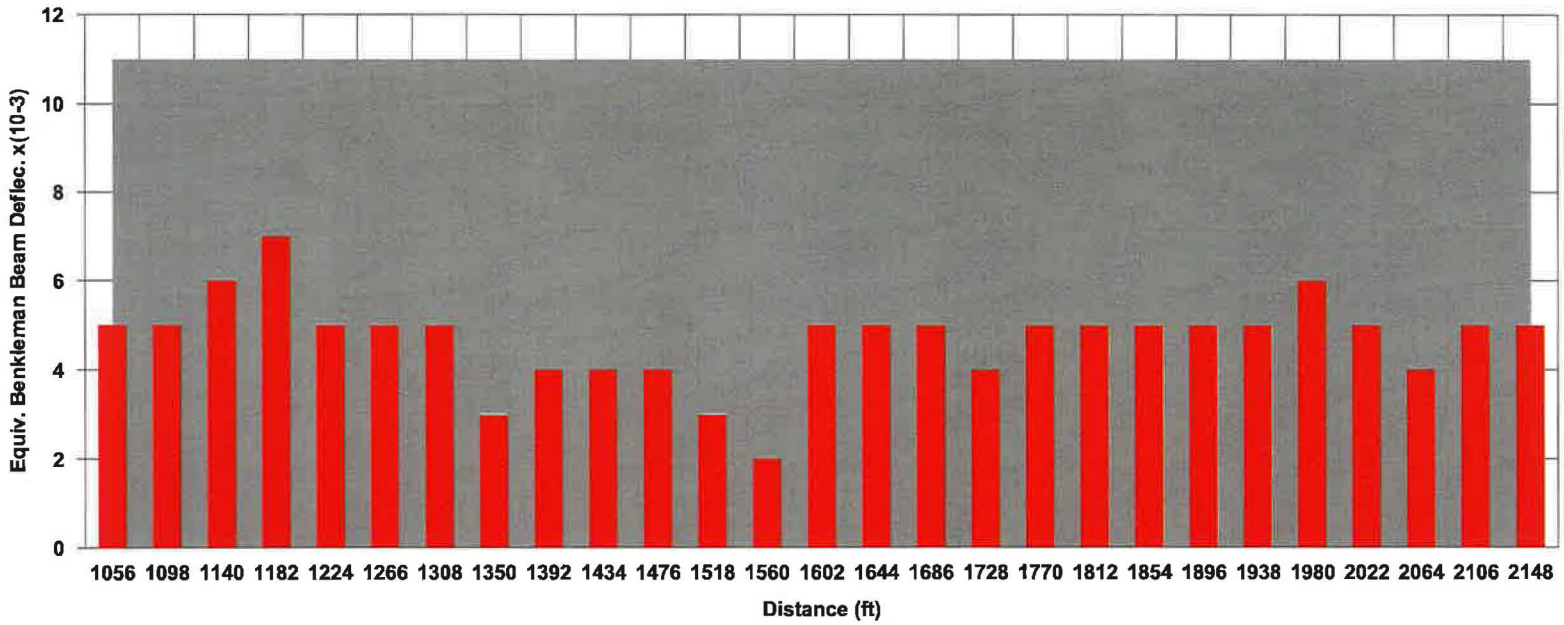
80th %	90th %	Mean	Min	Max
6	6	5	2	7

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

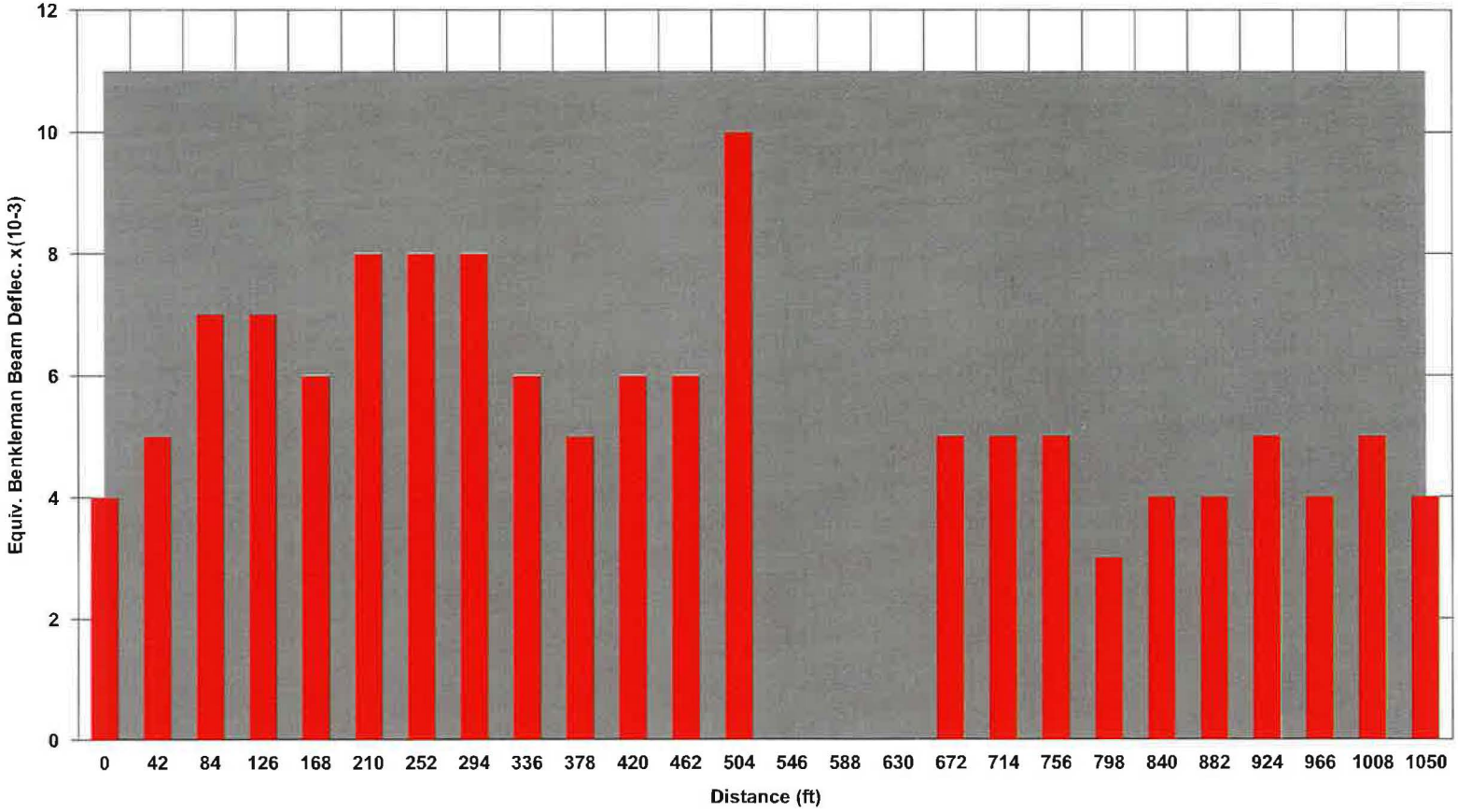
80th %	90th %	Mean	Min	Max
7	8	6	3	10

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

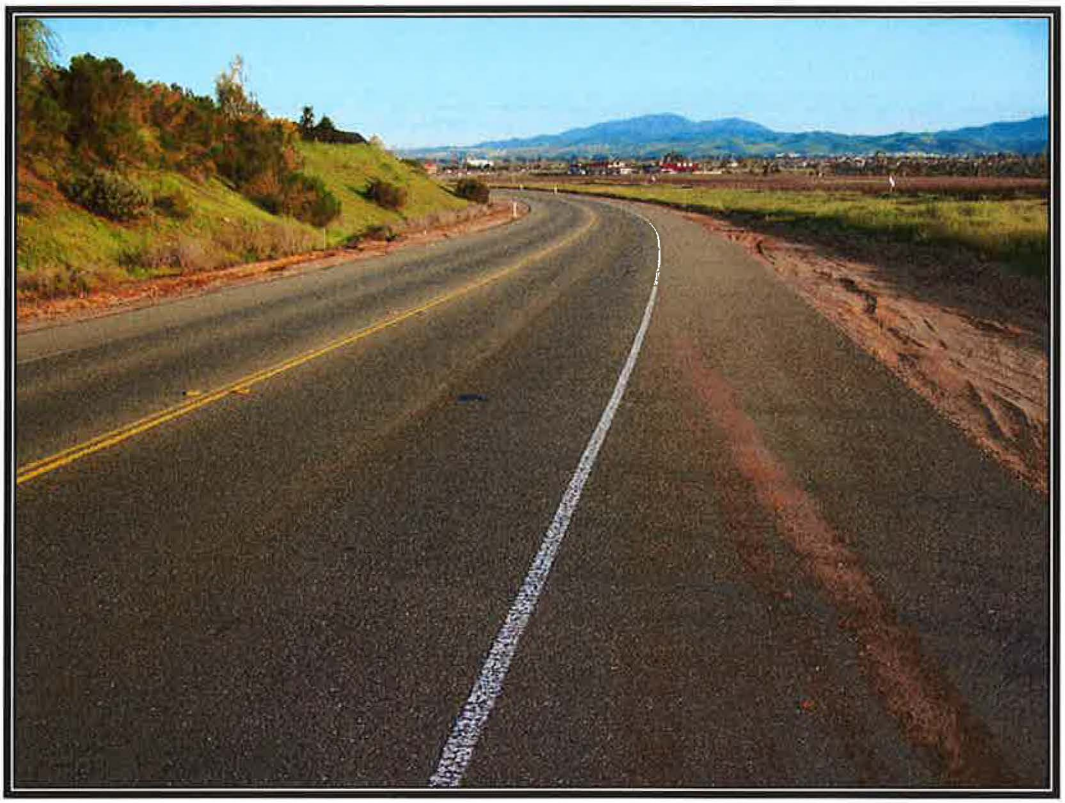
STATISTICAL ANALYSIS AS TESTED 80th %: 7 90th %: 8 Mean: 6 Min: 3 Max: 10

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.

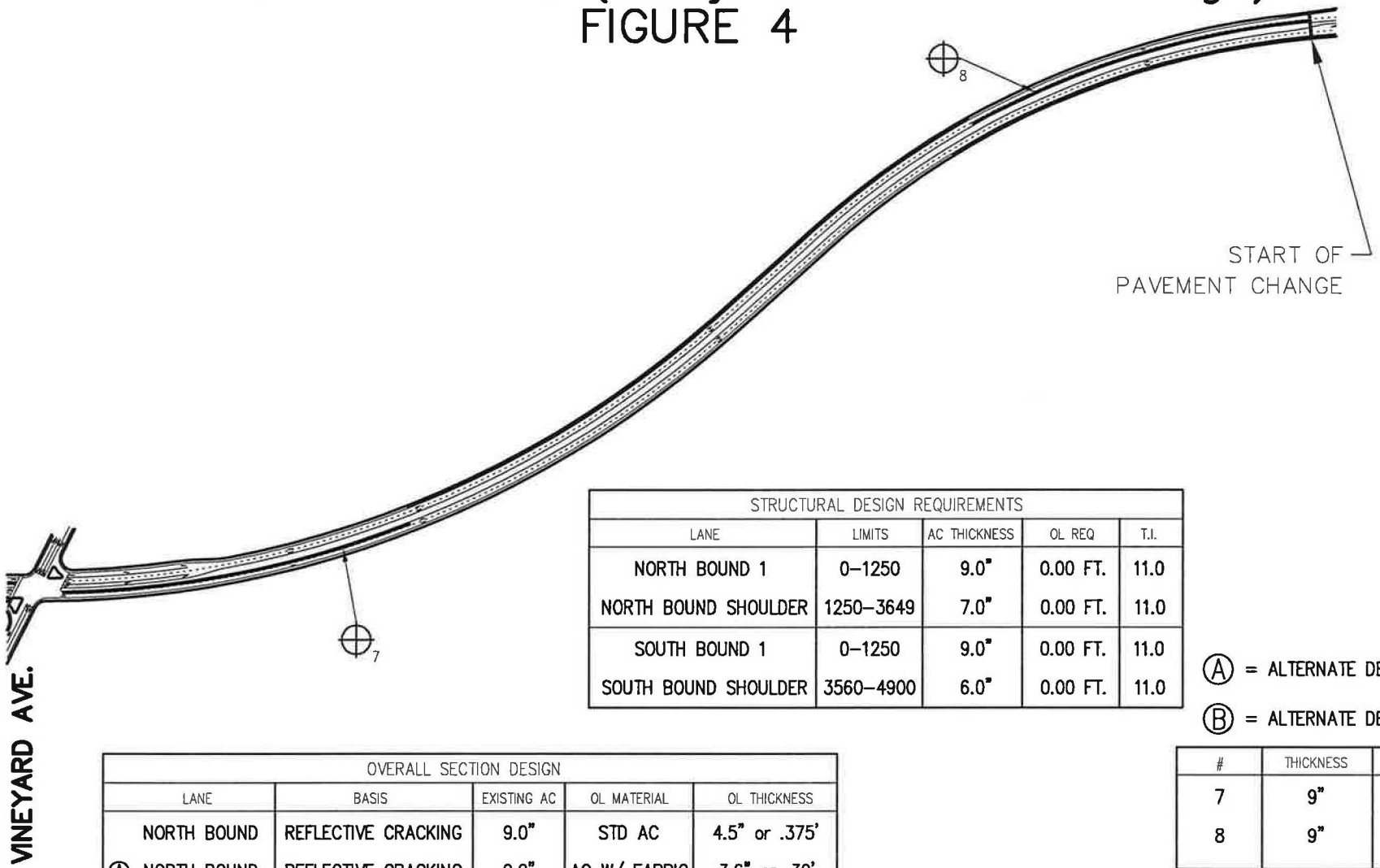
CHEC's Alternate Design B

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

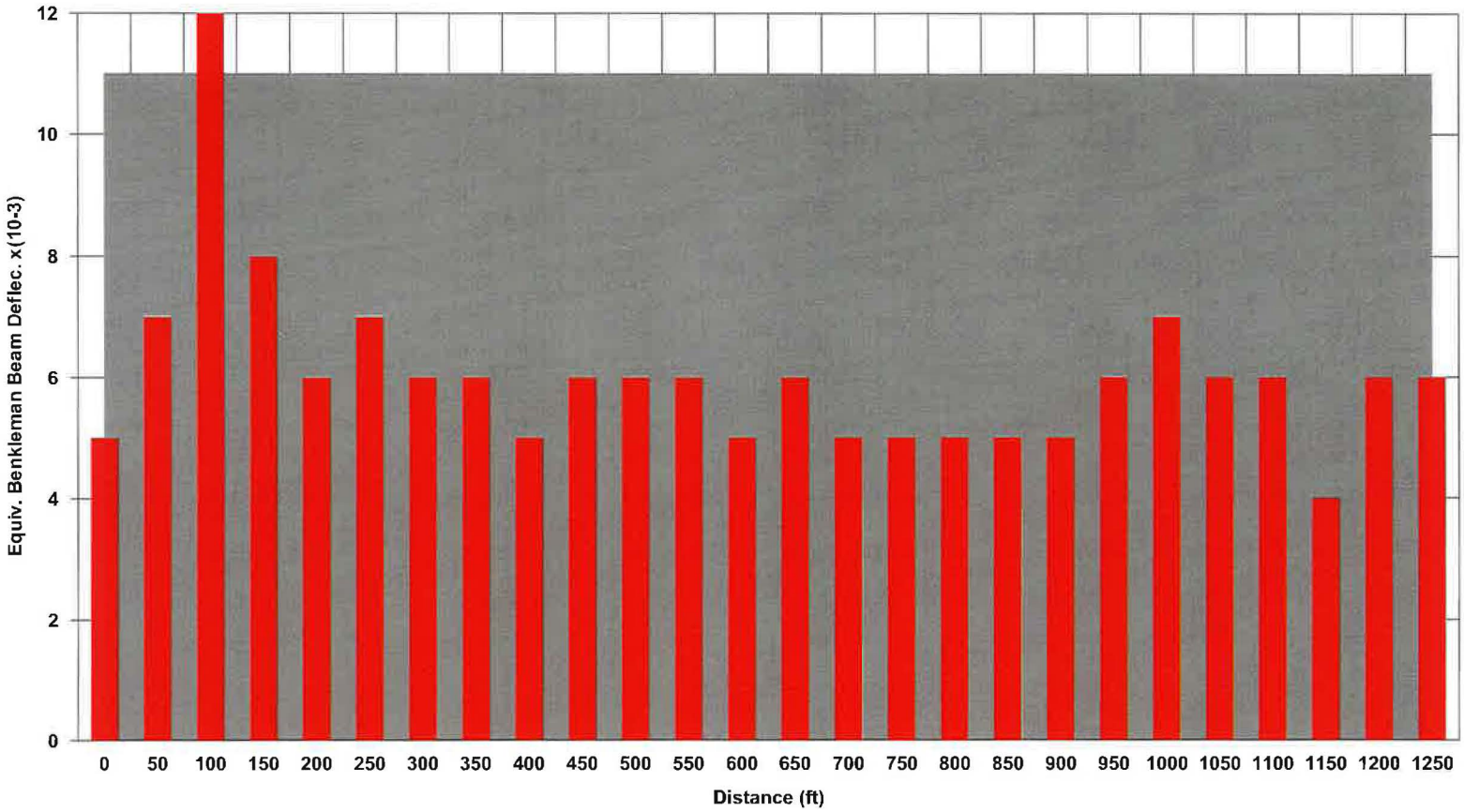
80th %	90th %	Mean	Min	Max
7	8	6	4	12

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

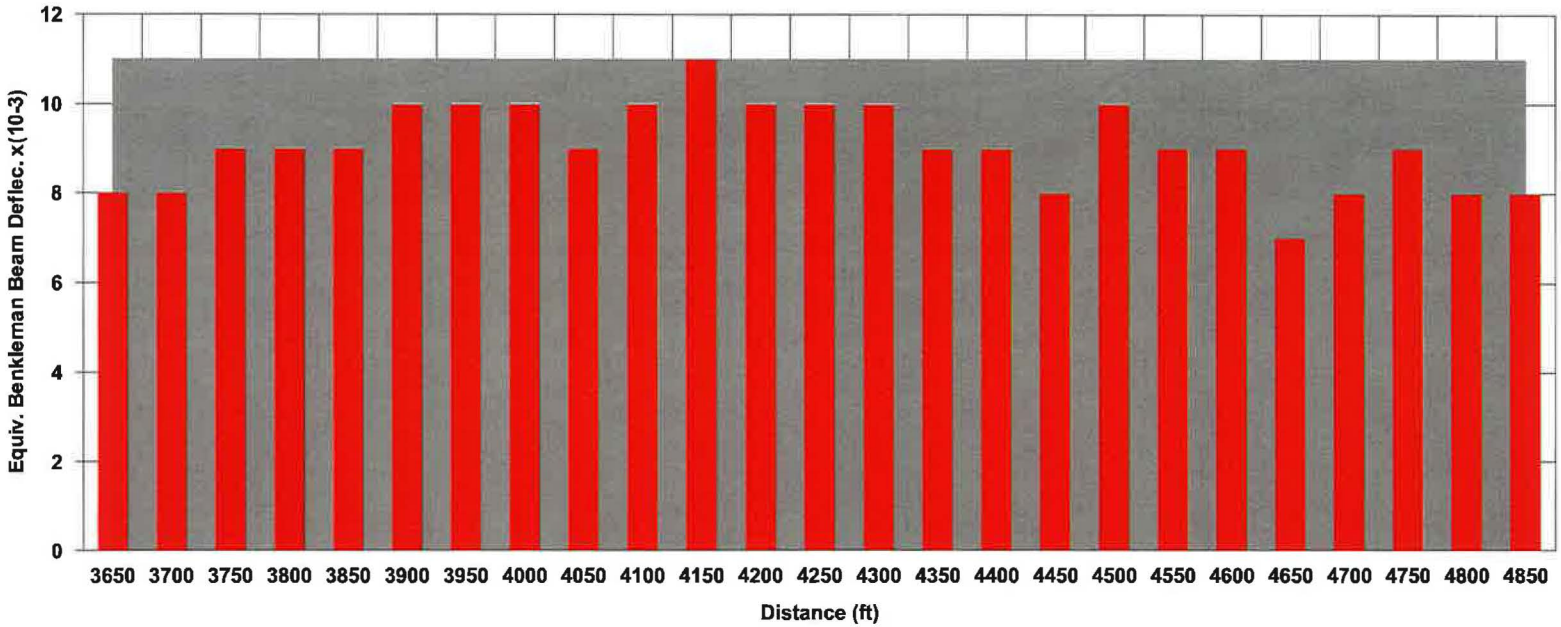
80th %	90th %	Mean	Min	Max
10	10	9	7	11

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

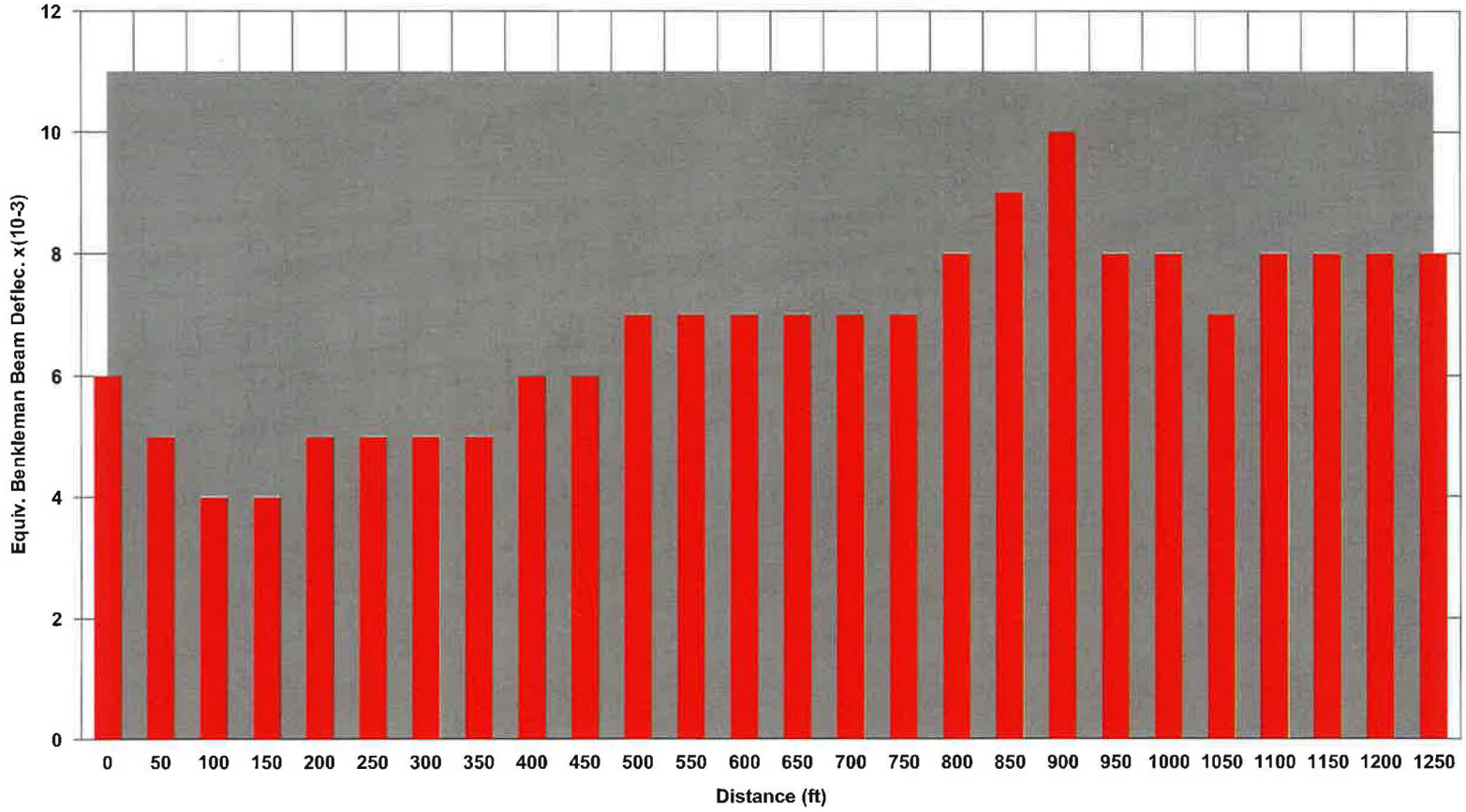
80th %	90th %	Mean	Min	Max
8	9	7	4	10

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

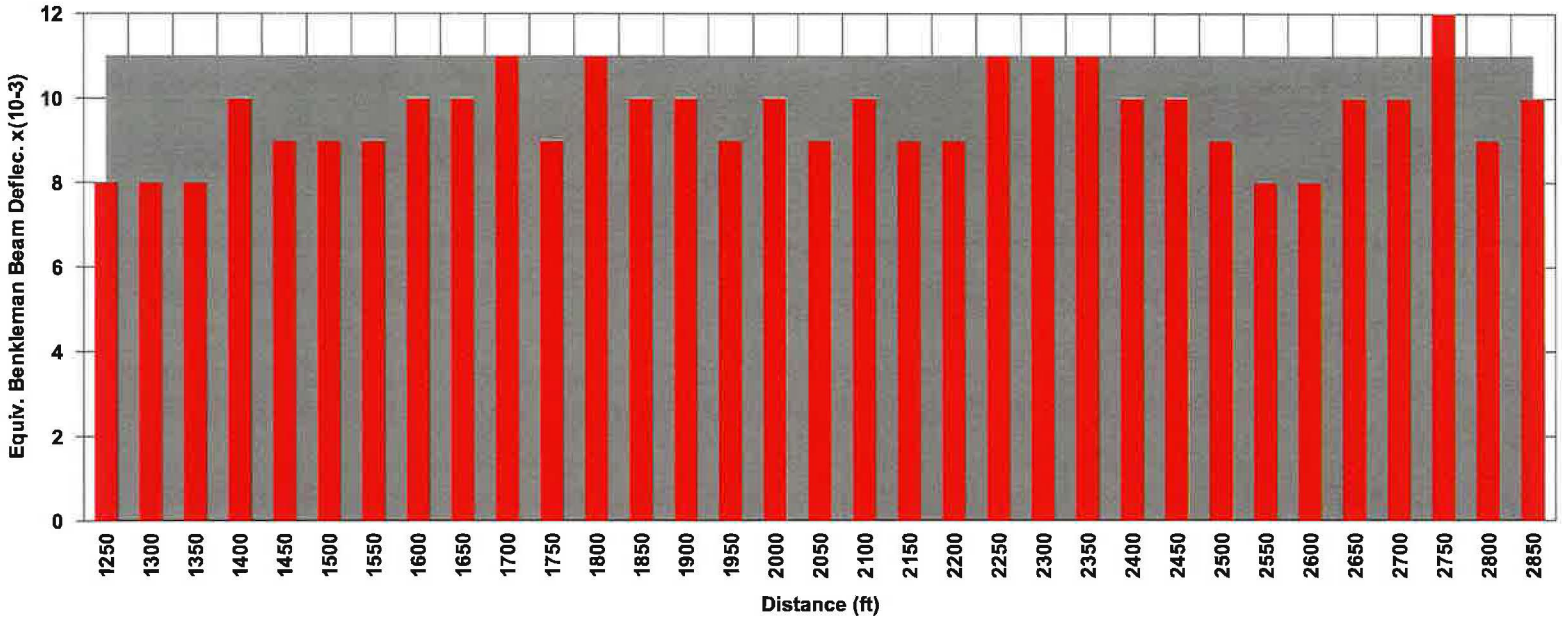
80th %	90th %	Mean	Min	Max
10	11	10	8	12

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.

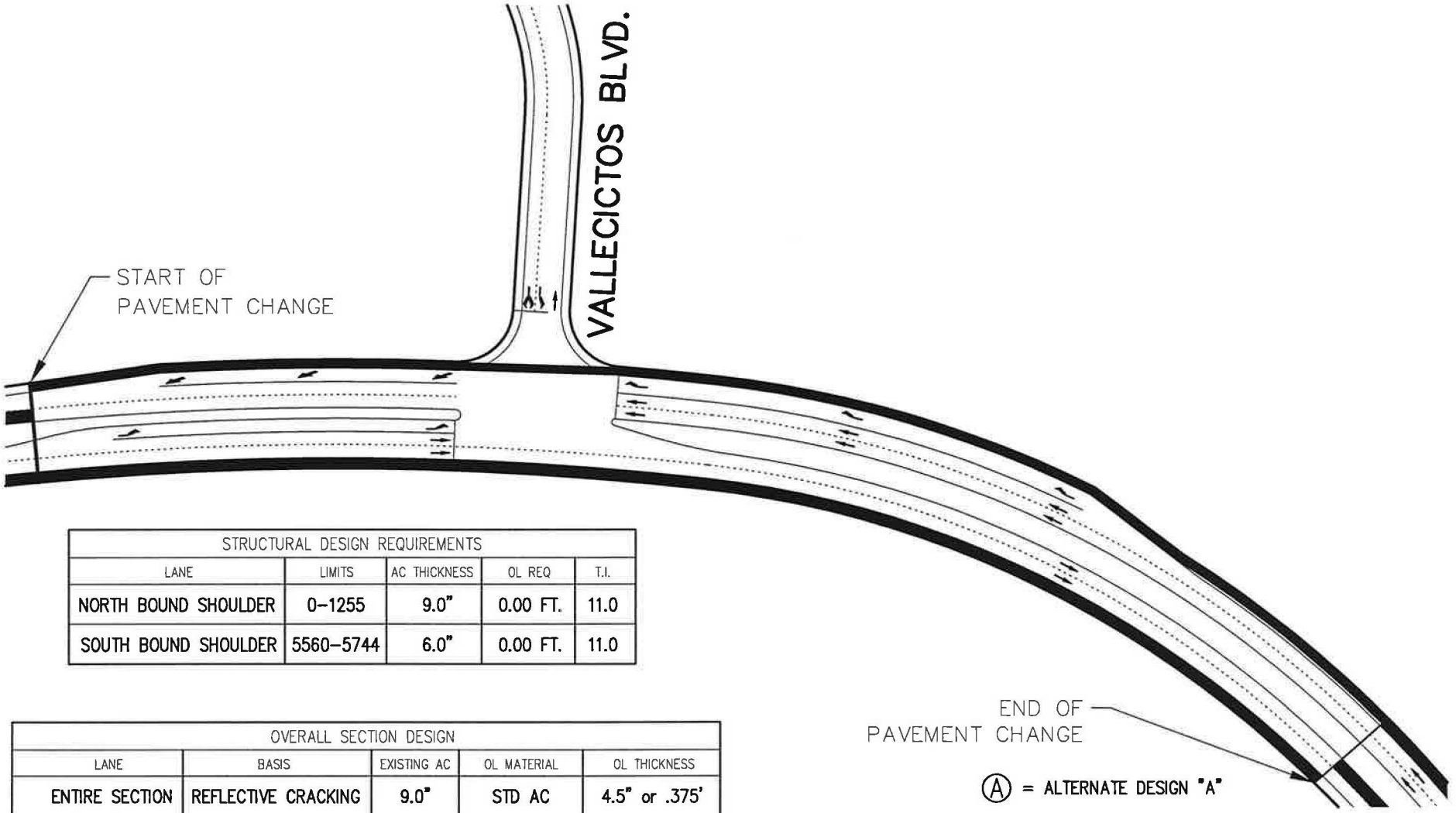
CHEC's Alternate Design B

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

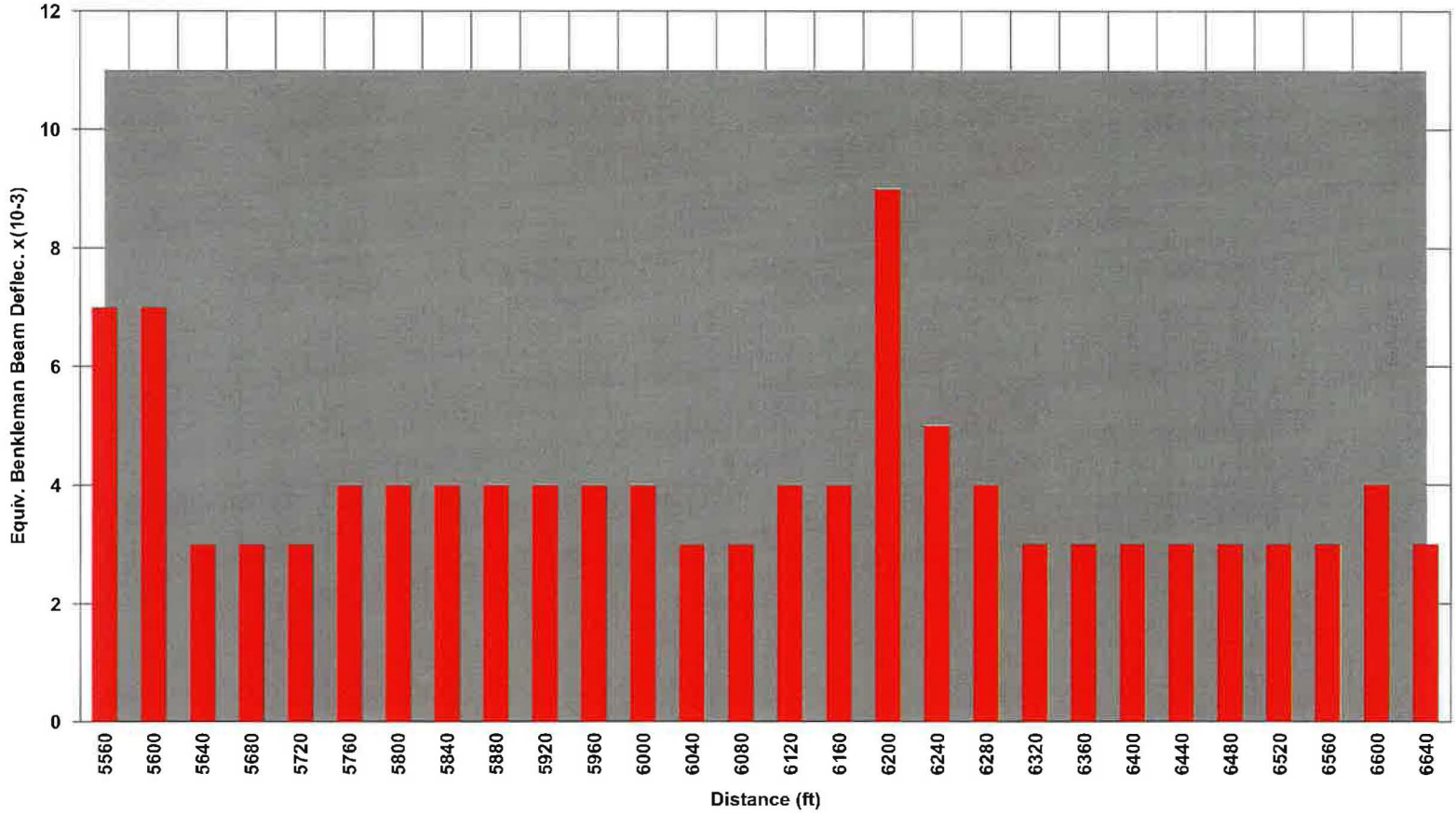
80th %	90th %	Mean	Min	Max
5	6	4	3	9

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

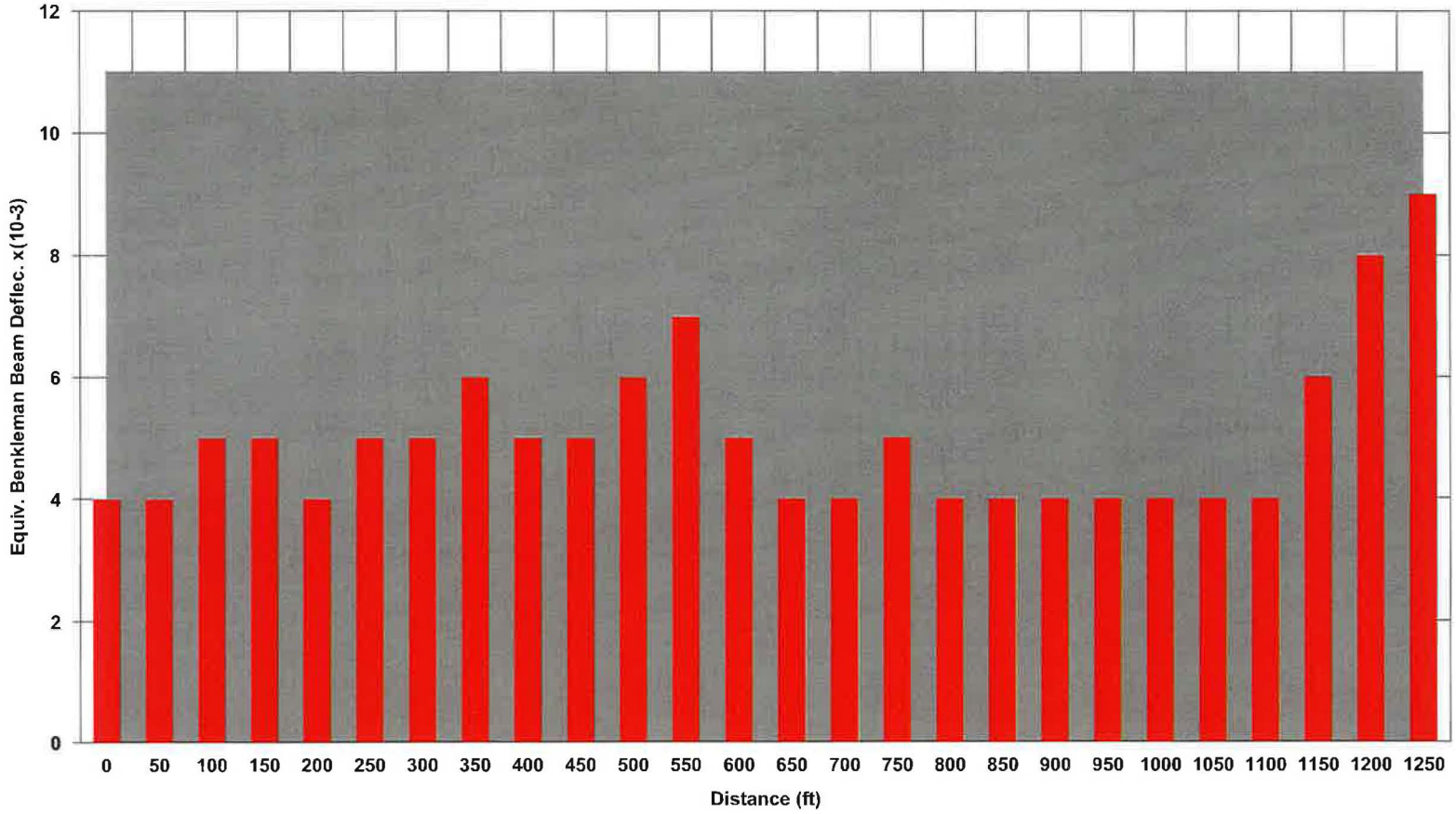
80th %	90th %	Mean	Min	Max
6	7	5	4	9

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.

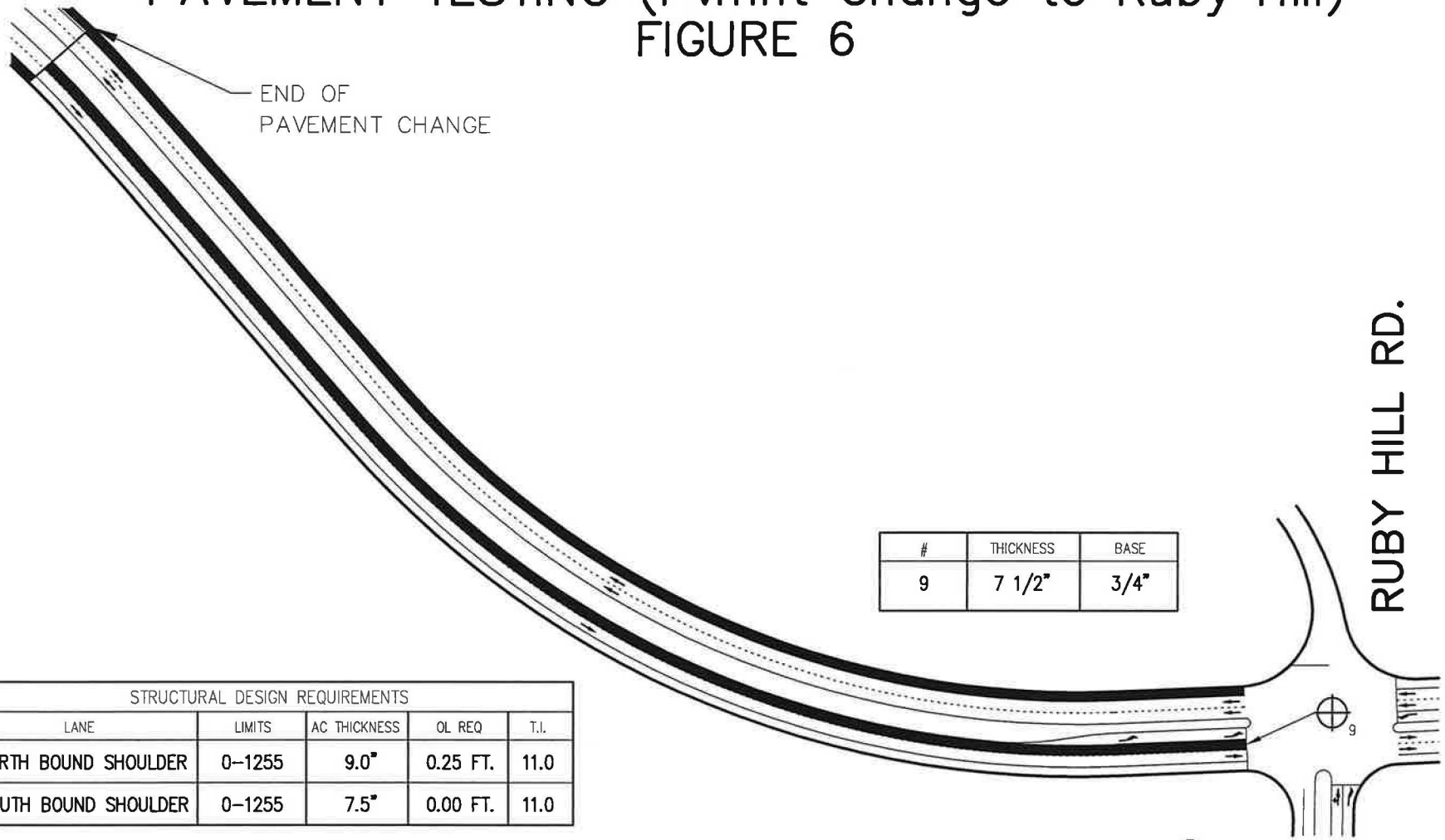
The TruPave fabric is recommended because of the recycling capabilities, and the fact that disposal of the asphalt with TruPave fabric does not have an increase in cost over asphalt alone, saving future rehabilitation dollars.

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

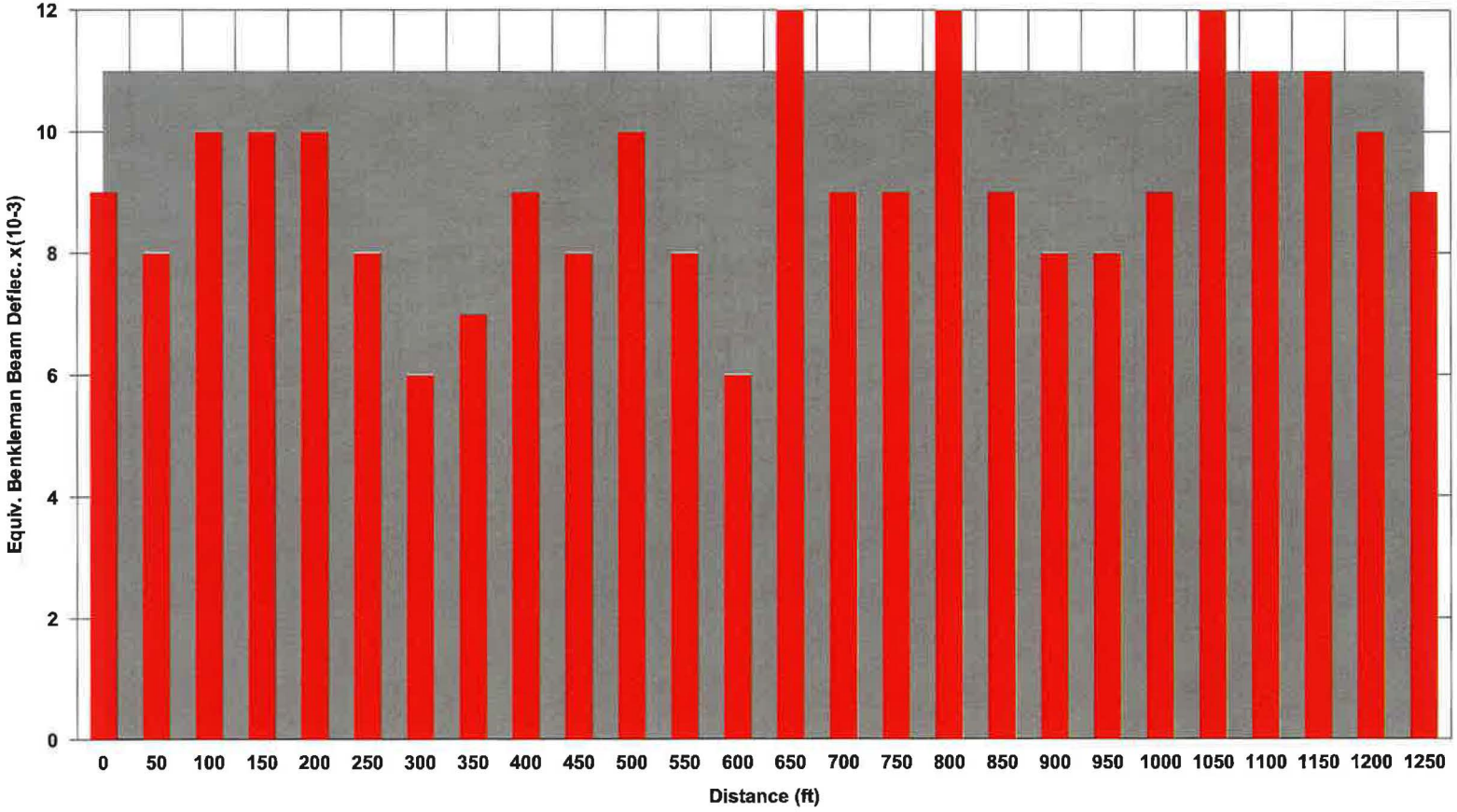
80th %	90th %	Mean	Min	Max
11	11	9	6	12

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

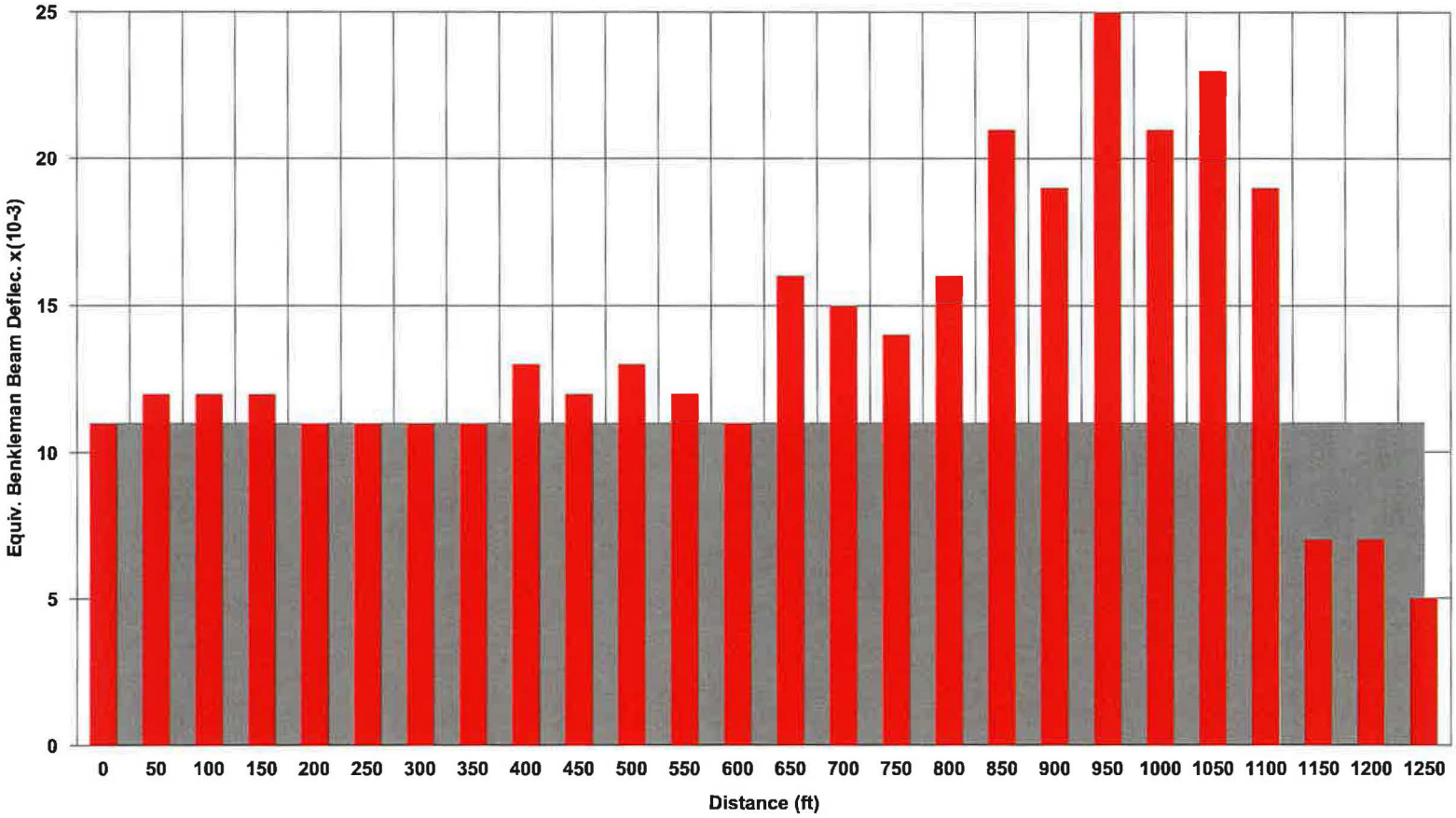
80th %	90th %	Mean	Min	Max
18	20	14	5	25

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

South Segment

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi 05/30/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

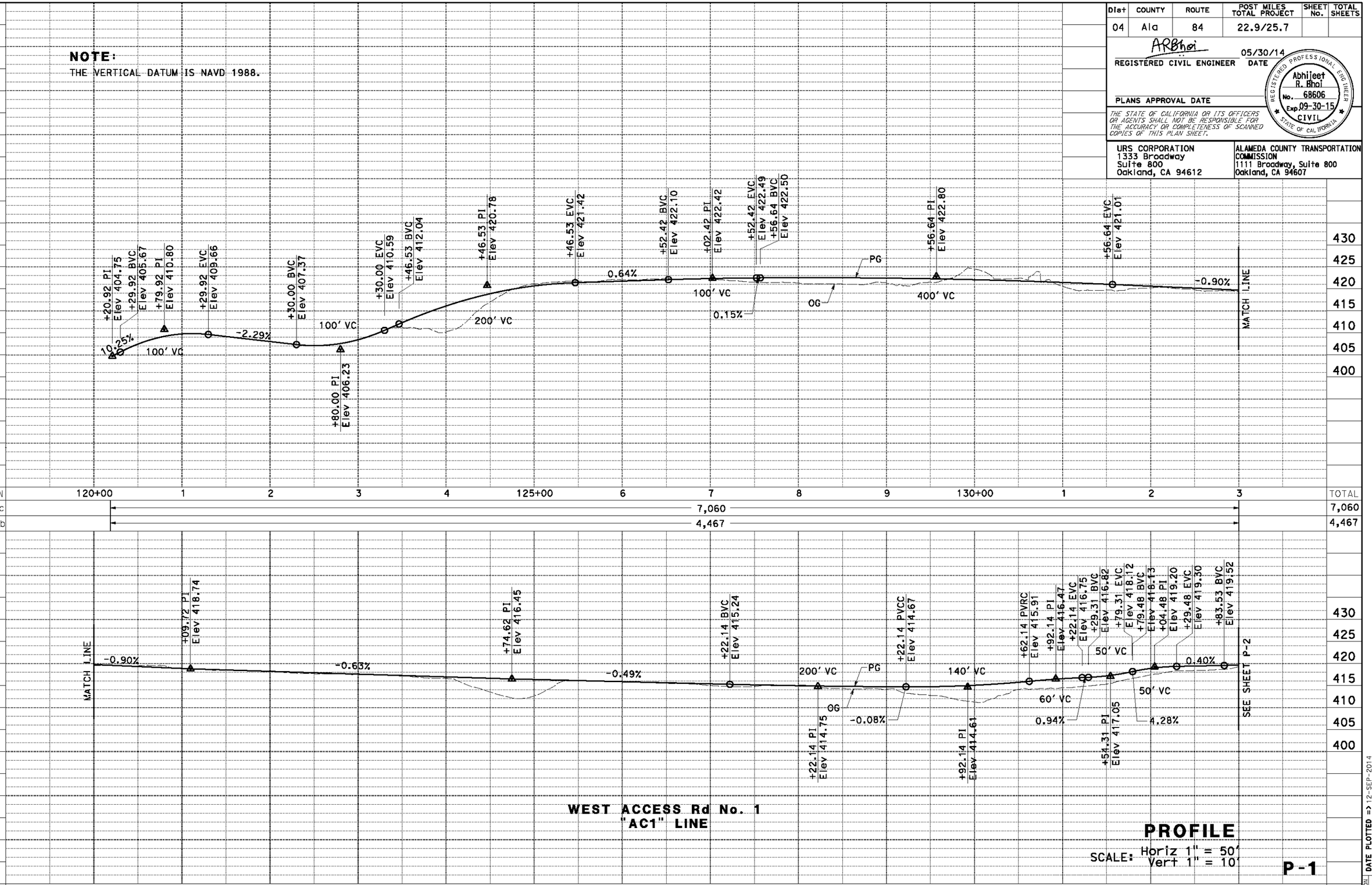
Abhijeet R. Bhoi No. 68606 Exp. 09-30-15 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 94612

ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 Broadway, Suite 800
Oakland, CA 94607

NOTE:
THE VERTICAL DATUM IS NAVD 1988.



STATION		120+00	1	2	3	4	125+00	6	7	8	9	130+00	1	2	3	TOTAL
CY	Exc	7,060														7,060
	Emb	4,467														4,467

STATION		3	4	135	6	7	8	9	140	1	2	3	4	145	6	TOTAL
CY	Exc	1,002														1,002
	Emb	14,033														14,033

WEST ACCESS Rd No. 1
"AC1" LINE

PROFILE

SCALE: Horiz 1" = 50'
Vert 1" = 10'

P-1

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: 9/12/14
DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:11
LAST REVISION 9-12-14

BORDER LAST REVISED 7/2/2010
USERNAME => Shruti_Shah
DGN FILE => 429762fa001.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 05/30/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-15 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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ALAMEDA COUNTY TRANSPORTATION COMMISSION
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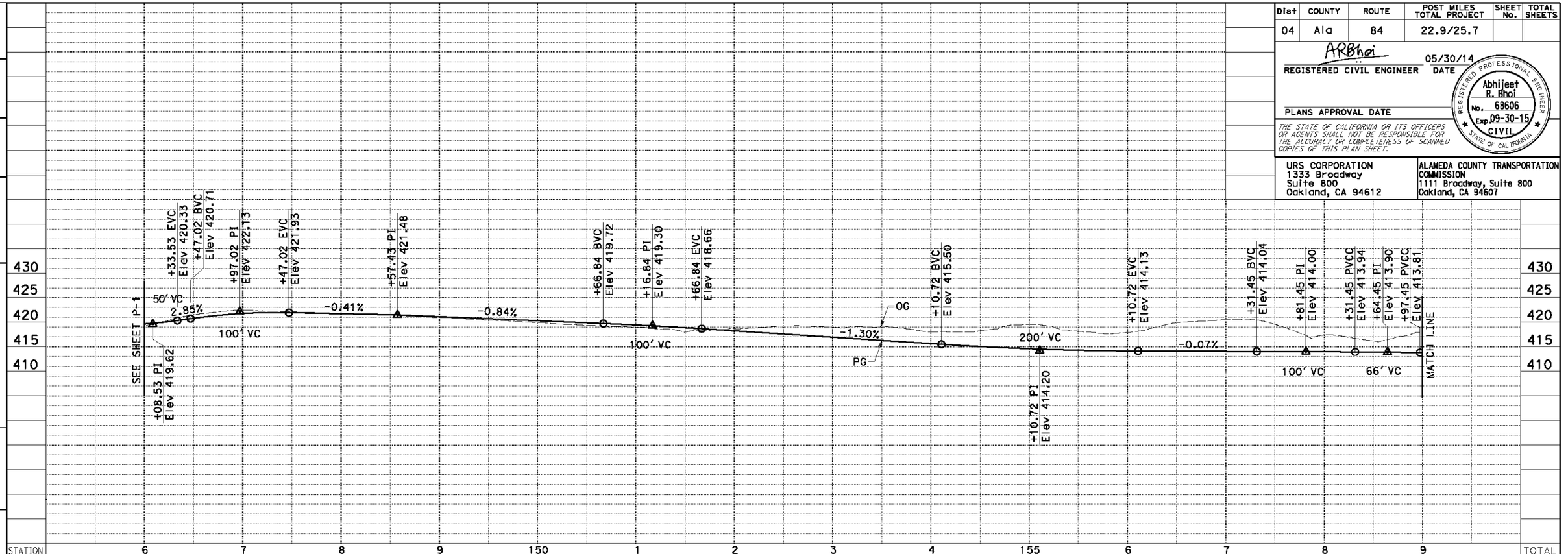
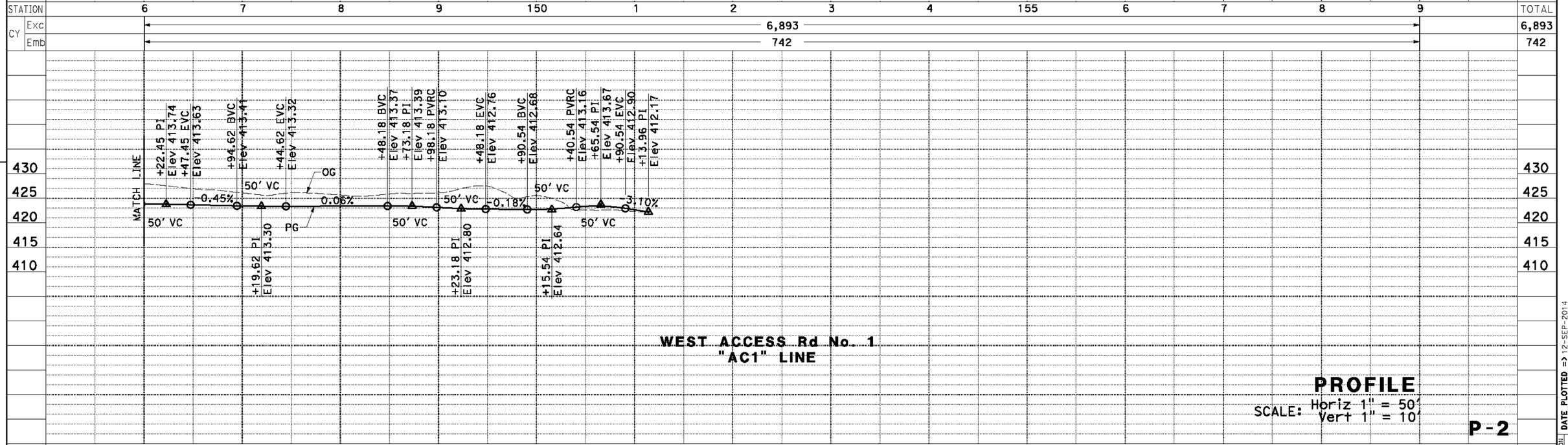


STATION	6	7	8	9	150	1	2	3	4	155	6	7	8	9	TOTAL
CY Exc	6,893														6,893
CY Emb	742														742



STATION	9	160	1	2	3	4	165	TOTAL
CY Exc	3,237							3,237
CY Emb	85							85

WEST ACCESS Rd No. 1
"AC1" LINE

PROFILE

SCALE: Horiz 1" = 50'
Vert 1" = 10'

P-2

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
Gibbons

REVISED BY	DATE REVISED
AB	9/12/14

ABHIJEET BHOI
ELIE ABI-JAOUDE
CALCULATED-DESIGNED BY
CHECKED BY

LAST REVISION DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:11
9-12-14

BORDER LAST REVISED 7/2/2010
USERNAME => Shruti_Shah
DGN FILE => 429762fa002.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 05/30/14
REGISTERED CIVIL ENGINEER DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-15 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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Oakland, CA 94607

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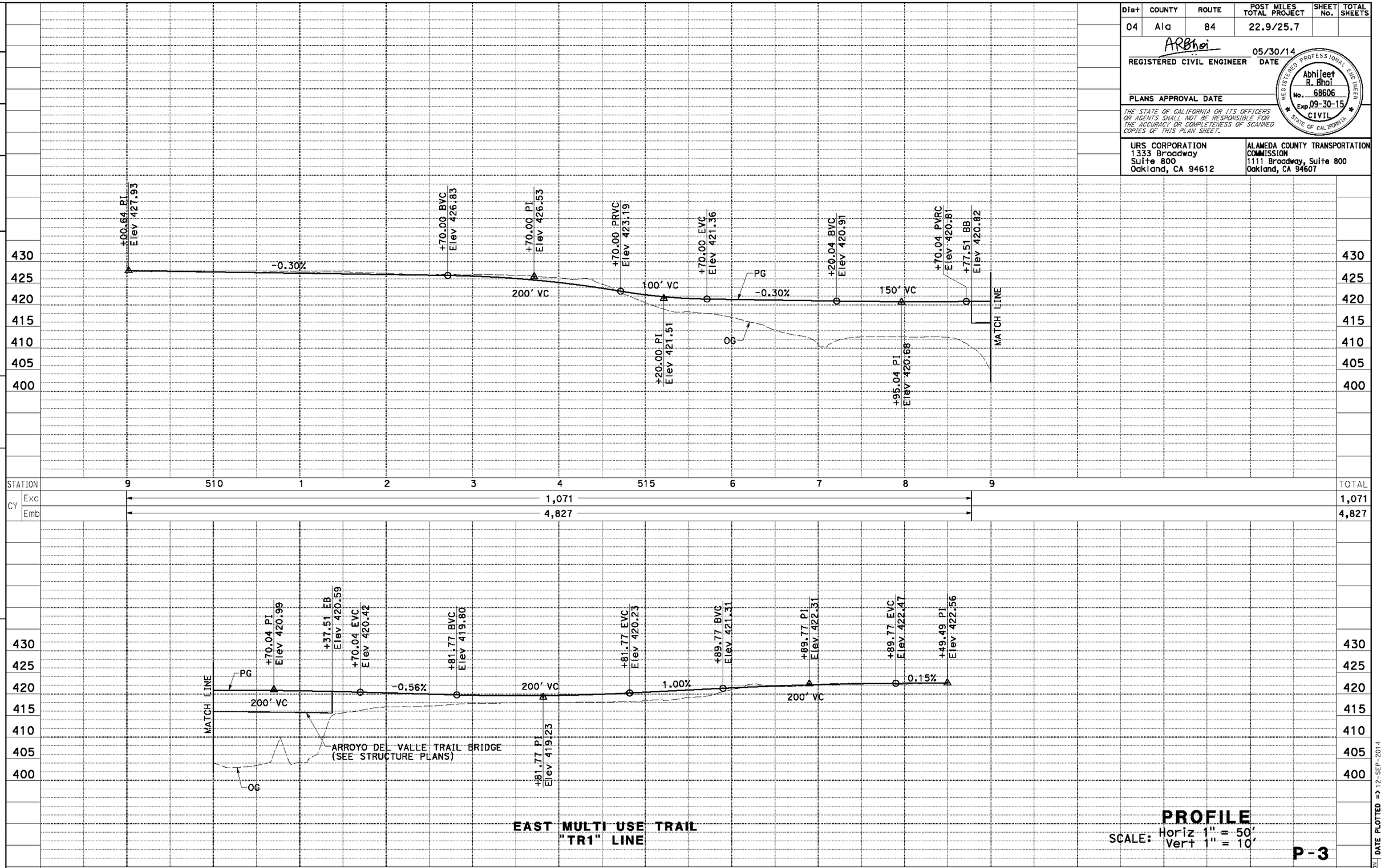
CALCULATED-DESIGNED BY: ABHIJEET BHOI
CHECKED BY: ELIE ABI-JAOUDE

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION



STATION	9	510	1	2	3	4	515	6	7	8	9	TOTAL
CY Exc	1,071											1,071
CY Emb	4,827											4,827

EAST MULTI USE TRAIL
"TR1" LINE

PROFILE
SCALE: Horiz 1" = 50'
Vert 1" = 10'

P-3

STATION	9	520	1	2	3	4	525	6	7	8	TOTAL
CY Exc	770										770
CY Emb	3,209										3,209

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DGN FILE => 429762fa003.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 05/30/14
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Abhijeet R. Bhoi No. 68606 Exp. 09-30-15 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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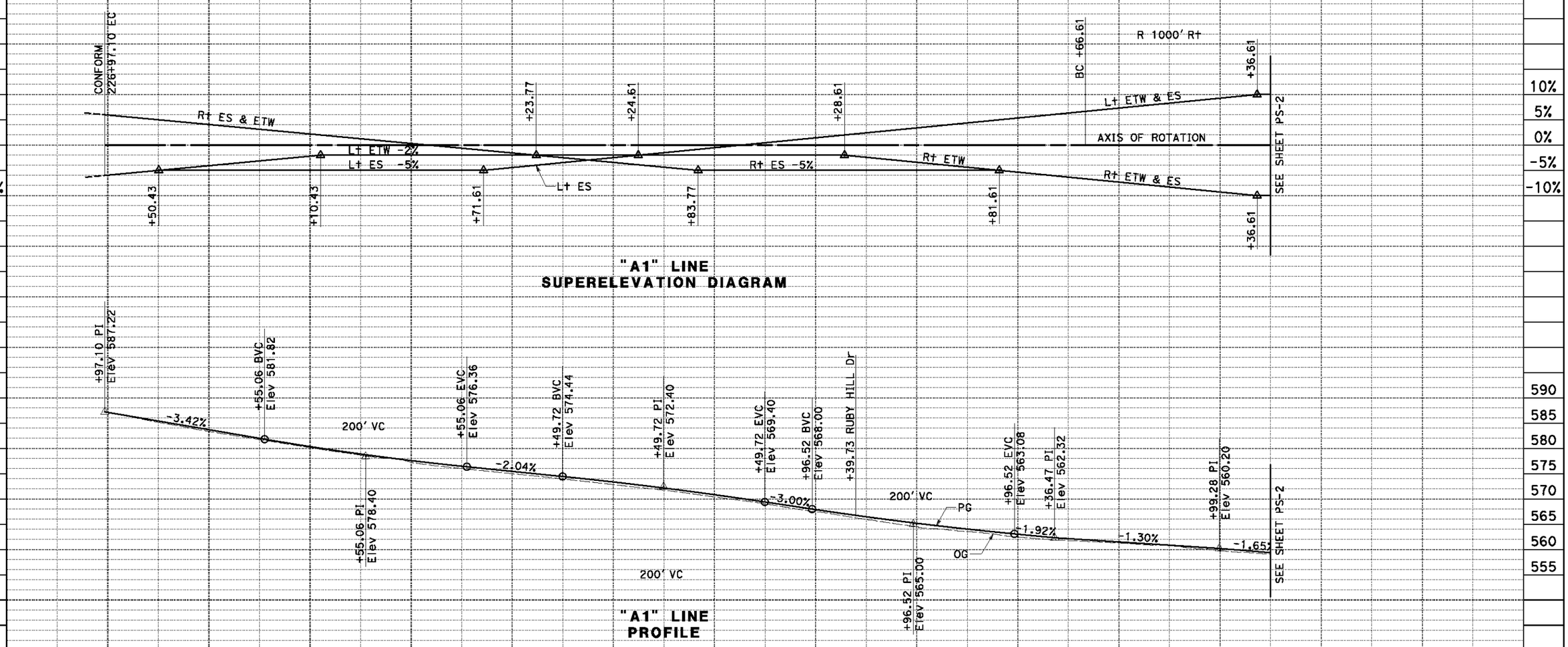
NOTES:

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.



"A1" LINE SUPERELEVATION DIAGRAM

"A1" LINE PROFILE

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: Horiz 1" = 50'
Vert 1" = 10'

PS-1

STATION	7	8	9	230	1	2	3	4	235	6	7	8	TOTAL
CY Exc							6,177						6,177
CY Emb							132						132

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: 9/12/14
LAST REVISION: 9-12-14
DATE PLOTTED => 12-SEP-2014
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USERNAME => Shruti_Shah
DGN FILE => 429762fb001.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 00000
PROJECT NUMBER & PHASE 04000205811

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi 05/30/14
REGISTERED CIVIL ENGINEER DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-15 CIVIL STATE OF CALIFORNIA — REGISTERED PROFESSIONAL ENGINEER

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R 1000' Rt

EC +59.62

+48.38

Lt ETW & ES 10%

SEE SHEET PS-1

10%
5%
0%
-5%
-10%

AXIS OF ROTATION

Rt ETW & ES

Lt ETW & ES

SEE SHEET PS-3

Rt ETW & ES -10%

+48.38

"A1" LINE
SUPERELEVATION DIAGRAM

SEE SHEET PS-1
+65.13 PI
Elev 559.12

+00.00 BVC
Elev 554.16

+00.00 PI
Elev 552.05

+00.00 EVC
Elev 549.14

+39.83 PI
Elev 545.07

+00.00 BVC
Elev 539.63

+00.00 PI
Elev 536.23

+00.00 PRVC
Elev 534.14

+00.00 PI
Elev 532.06

SEE SHEET PS-3

-2.11%
-2.91%
-3.40%

PG
OG

200' VC
200' VC
200' VC

560 555 550 545 540 535 530 525 520

"A1" LINE
PROFILE

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: Horiz 1" = 50'
Vert 1" = 10'

PS-2

STATION	9	240	1	2	3	4	245	6	7	8	9	TOTAL
CY Exc	← 10,761 →											10,761
CY Emb	← 5,230 →											5,230

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CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

BORDER LAST REVISED 7/2/2010

USERNAME => Shruti_Shah
DGN FILE => 429762fb002.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 00000

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 — 05/30/14 DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-15 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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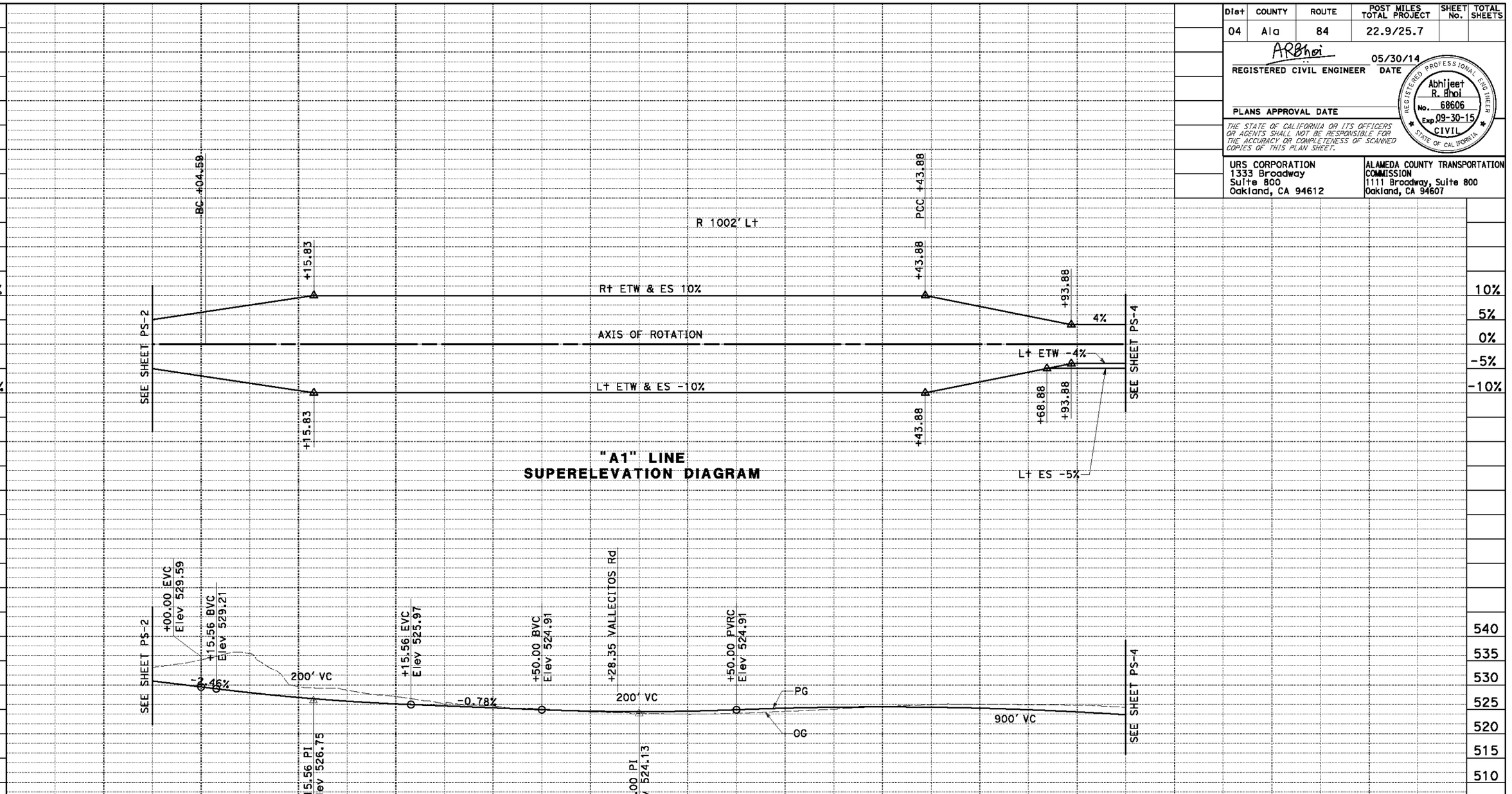

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: Horiz 1" = 50'
Vert 1" = 10'

PS-3

STATION	250	1	2	3	4	255	6	7	8	9	TOTAL
CY Exc				34,551							34,551
CY Emb				2,766							2,766

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
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TIME PLOTTED => 16:11

BORDER LAST REVISED 7/2/2010

USERNAME => Shruti_Shah
DGN FILE => 429762fb003.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 00000

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 — 05/30/14 DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-15 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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AB	9/12/14

ABHIJEET BHOI
ELIE ABI-JAOUDE
CALCULATED-DESIGNED BY
CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR
RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

R 3016' L+

10%
5%
0%
-5%
-10%

SEE SHEET PS-3

R+ ETW & ES 4%
AXIS OF ROTATION
L+ ETW -4%
L+ ES -5%

SEE SHEET PS-5

"A1" LINE
SUPERELEVATION DIAGRAM

SEE SHEET PS-3

+00.00 PI
Elev 528.41

OG
PG

+50.00 EVC
Elev 510.92

+94.72 PI
Elev 505.30

+00.00 PI
Elev 496.90

+64.66 PI
Elev 486.18

SEE SHEET PS-5

-3.89%
-4.09%
-4.05%
-3.60%

900' VC

530 525 520 515 510 505 500 495 490 485 480

"A1" LINE
PROFILE

PROFILE AND
SUPERELEVATION DIAGRAM

SCALE: Horiz 1" = 50'
Vert 1" = 10'

PS-4

STATION	260	1	2	3	4	265	6	7	8	9	270	1	TOTAL
CY Exc	←					13,370						→	13,370
CY Emb	←					34						→	34

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BORDER LAST REVISED 7/2/2010
USERNAME => Shruti_Shah
DGN FILE => 429762fb004.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 00000
PROJECT NUMBER & PHASE 04000205811

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi 05/30/14
REGISTERED CIVIL ENGINEER DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-15 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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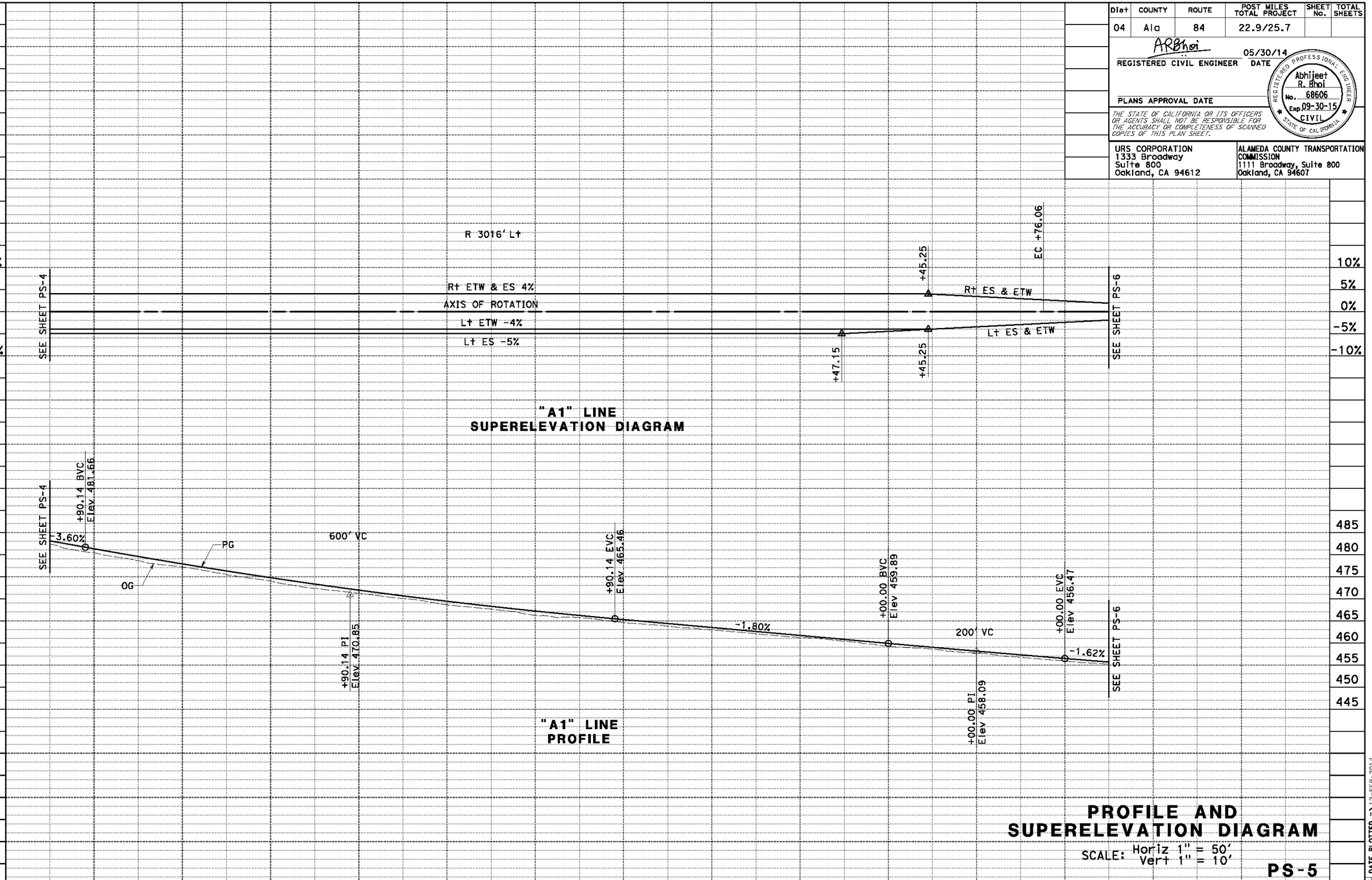
ABHIJEET BHOI — ELIE ABI-JAOUDE

CALCULATED-DESIGNED BY

CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION



PROFILE AND SUPERELEVATION DIAGRAM

SCALE: Horiz 1" = 50'
Vert 1" = 10'

PS-5

STATION	2	3	4	275	6	7	8	9	280	1	2	3	TOTAL
CY Exc				9,684									9,684
CY Emb				115									115

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DATE PLOTTED => 12-SEP-2014
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USERNAME => Shruti_Shah
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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 00000

PROJECT NUMBER & PHASE 04000205811

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi 05/30/14
REGISTERED CIVIL ENGINEER DATE

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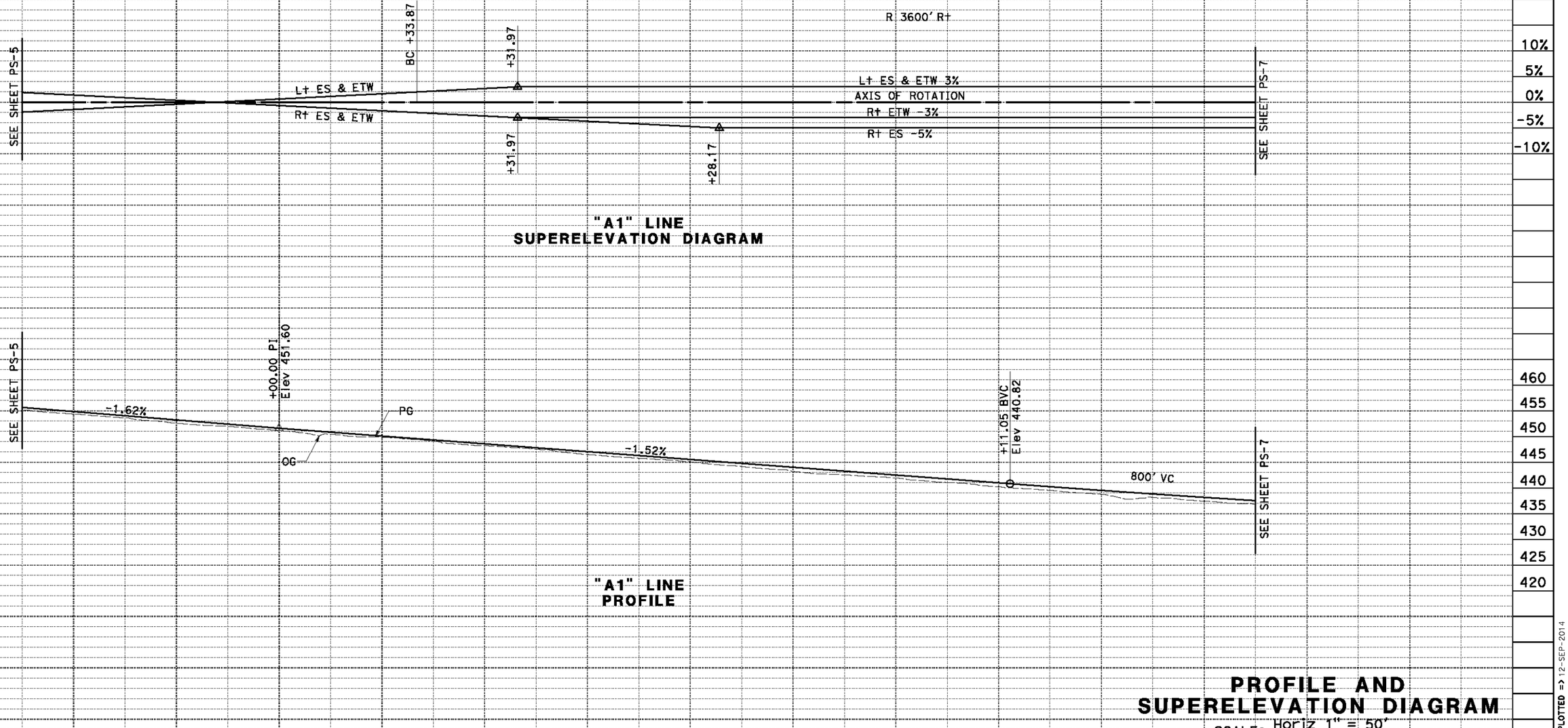

"A1" LINE
SUPERELEVATION DIAGRAM

"A1" LINE
PROFILE

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: Horiz 1" = 50'
Vert 1" = 10'

PS-6

STATION	4	285	6	7	8	9	290	1	2	3	4	295	TOTAL
CY Exc						9,720							9,720
CY Emb						195							195

ABHIJEET BHOI
ELIE ABI-JAOUDE
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CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR
RAMSEY J. HISSEN

REVISED BY AB
DATE REVISED 9/12/14

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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USERNAME => Shruti_Shah
DGN FILE => 429762fb006.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 00000
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 — 05/30/14 DATE

PLANS APPROVAL DATE

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ABHIJEET BHOI
ELIE ABI-JAOUDE

CALCULATED-DESIGNED BY
CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR
RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

R 3600' R+

10%
5%
0%
-5%
-10%

SEE SHEET PS-6

L+ ES & ETW 3%
AXIS OF ROTATION
R+ ETW -3%
R+ ES -5%

SEE SHEET PS-8

"A1" LINE SUPERELEVATION DIAGRAM

445
440
435
430
425
420

SEE SHEET PS-6

800' VC

PG

OG

+11.05 PT
Elev 434.75

+11.05 EVC
Elev 432.42

+98.91 PI
Elev 431.33

+00.00 PI
Elev 430.10

-0.58%

-0.61%

-0.57%

SEE SHEET PS-8

"A1" LINE PROFILE

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: Horiz 1" = 50'
Vert 1" = 10'

PS-7

STATION	6	7	8	9	300	1	2	3	4	305	6	7	TOTAL
CY Exc						8,471							8,471
CY Emb						890							890

LAST REVISION
9-12-14

DATE PLOTTED => 12-SEP-2014
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BORDER LAST REVISED 7/2/2010

USERNAME => Shruti_Shah
DGN FILE => 429762fb007.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 00000

PROJECT NUMBER & PHASE 04000205811

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi 05/30/14
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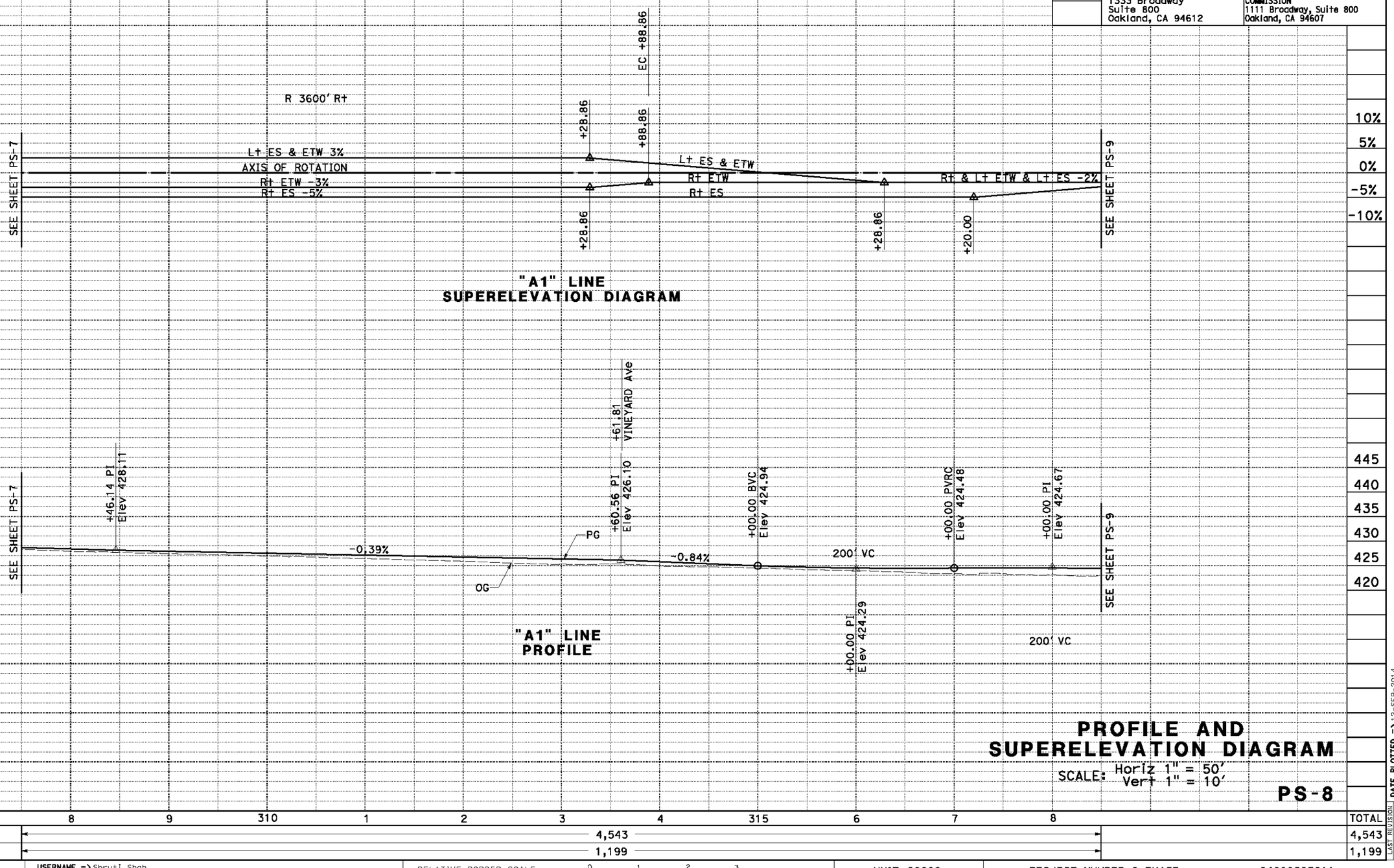

STATION	8	9	310	1	2	3	4	315	6	7	8	TOTAL
CY Exc					4,543							4,543
CY Emb					1,199							1,199

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: 9/12/14

LAST REVISION DATE PLOTTED => 12-SEP-2014
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BORDER LAST REVISED 7/2/2010

USERNAME => Shruti_Shah
DGN FILE => 429762fb008.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 00000

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 — 05/30/14 DATE

PLANS APPROVAL DATE

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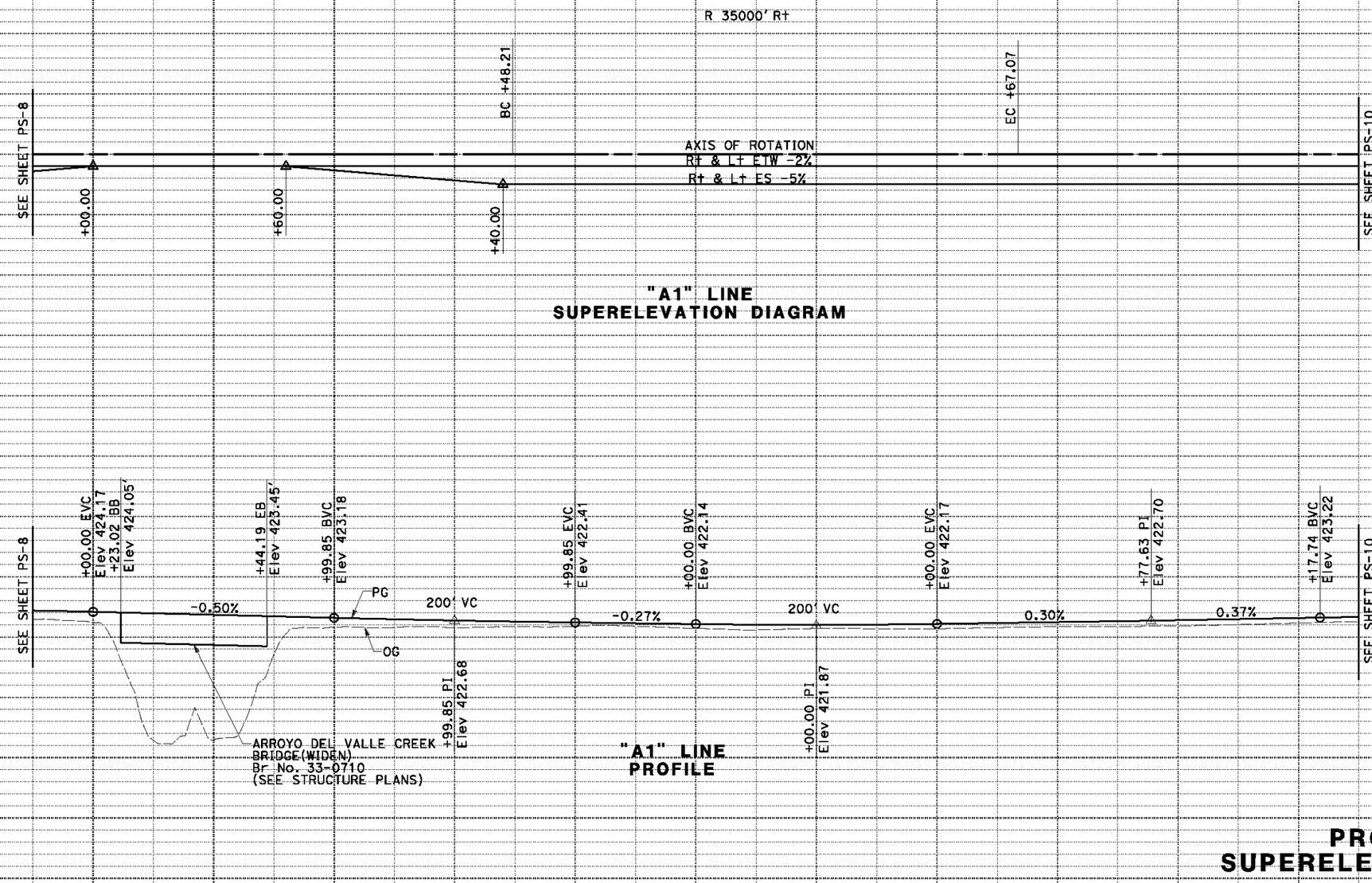

"A1" LINE
SUPERELEVATION DIAGRAM

"A1" LINE
PROFILE

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: Horiz 1" = 50'
Vert 1" = 10'

PS-9

STATION	9	320	1	2	3	4	325	6	7	8	9	TOTAL
CY Exc		57				3,218						3,218
CY Emb		544				1,645						1,645

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REVISED BY	DATE REVISED
AB	9/12/14

ABHIJEET BHOI
ELIE ABI-JAOUDE
CALCULATED-DESIGNED BY
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STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

BORDER LAST REVISED 7/2/2010

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DGN FILE => 429762fb009.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 00000

PROJECT NUMBER & PHASE 04000205811

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi
05/30/14
REGISTERED CIVIL ENGINEER DATE

Abhijeet R. Bhoi
No. 68606
Exp. 09-30-15
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

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ABHIJEET BHOI
ELIE ABI-JAOUDE

CALCULATED-DESIGNED BY
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CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

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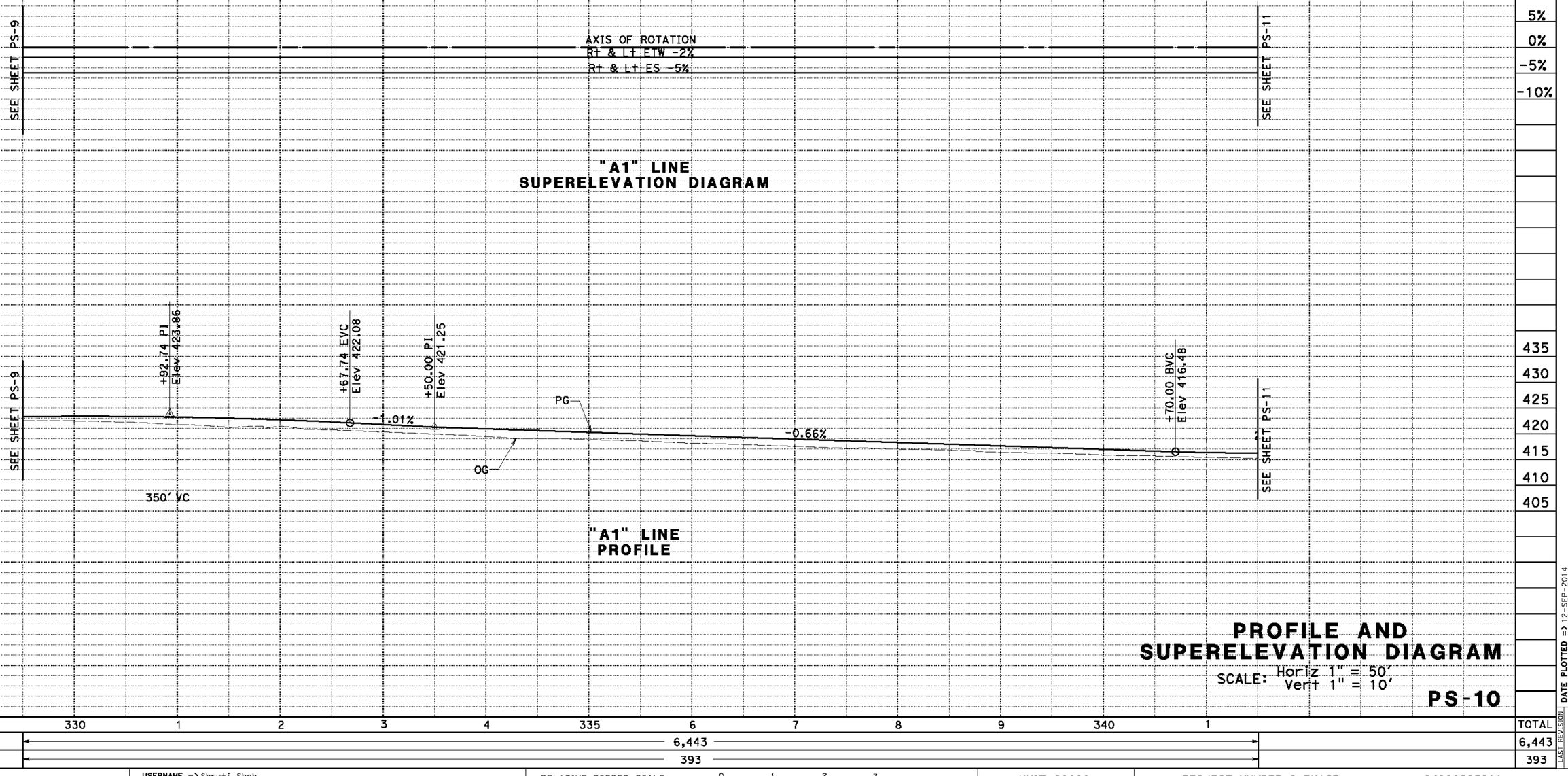

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: Horiz 1" = 50'
Vert 1" = 10'

PS-10

STATION	330	1	2	3	4	335	6	7	8	9	340	1	TOTAL
CY Exc				6,443									6,443
CY Emb				393									393

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BORDER LAST REVISED 7/2/2010
USERNAME => Shruti_Shah
DGN FILE => 429762fb010.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 00000
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 — 05/30/14 DATE

PLANS APPROVAL DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-15 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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1111 Broadway, Suite 800
Oakland, CA 94607

REVISED BY	DATE REVISED
AB	9/12/14

ABHIJEET BHOI
ELIE ABI-JAOUDE

CALCULATED-DESIGNED BY
CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR
RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

10%
5%
0%
-5%
-10%

SEE SHEET PS-10

AXIS OF ROTATION
Rt & Lt ETW -2%
Rt & Lt ES -5%

+16.15

SEE SHEET PS-12

"A1", "A2" LINE
SUPERELEVATION DIAGRAM

+41.07 CONCANNON Blvd
END "A1" LINE
Beg "A2" LINE

+70.00 PI
Elev 415.81

+70.00 EVC
Elev 417.11

+72.33 BVC
Elev 418.45

PG

+72.33 PI
Elev 419.75

+72.33 EVC
Elev 420.67

+72.33 PVI
Elev 420.48

+25.00 BVC
Elev 420.93

+75.00 PI
Elev 422.20

+25.00 EVC
Elev 421.42

+00.75 PI
Elev 420.00

SEE SHEET PS-10

200' VC

1.30%

OG

200' VC

0.85%

300' VC

-0.52%

-0.51%

SEE SHEET PS-12

430
425
420
415
410
405
400

"A1", "A2" LINE
PROFILE

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: Horiz 1" = 50'
Vert 1" = 10'

PS-11

STATION	2	3	4	345	6	7	8	9	350	1	2	3	TOTAL
CY Exc		2,335			6,253								8,588
CY Emb		94			134								228

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DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:11

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UNIT 00000
PROJECT NUMBER & PHASE 04000205811

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi 05/30/14
REGISTERED CIVIL ENGINEER DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-15 CIVIL STATE OF CALIFORNIA — REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

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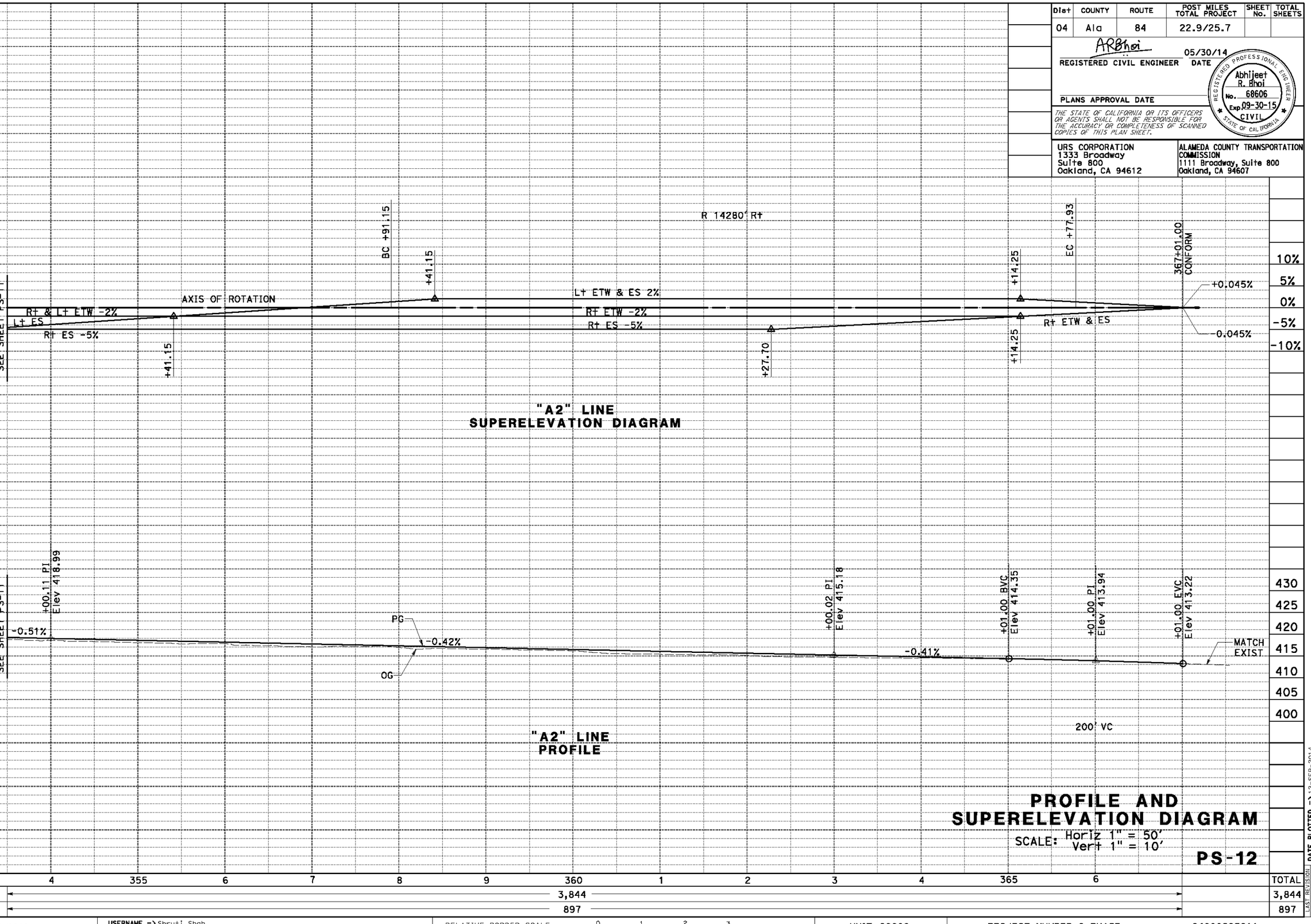

"A2" LINE
SUPERELEVATION DIAGRAM

"A2" LINE
PROFILE

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: Horiz 1" = 50'
Vert 1" = 10'

PS-12

STATION	4	355	6	7	8	9	360	1	2	3	4	365	6	TOTAL
CY Exc							3,844							3,844
CY Emb							897							897

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DATE REVISED: 9/12/14
ABHIJEET BHOI
ELIE ABI-JAOUDE
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CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

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UNIT 00000
PROJECT NUMBER & PHASE 04000205811

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi 05/30/14
REGISTERED CIVIL ENGINEER DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-15 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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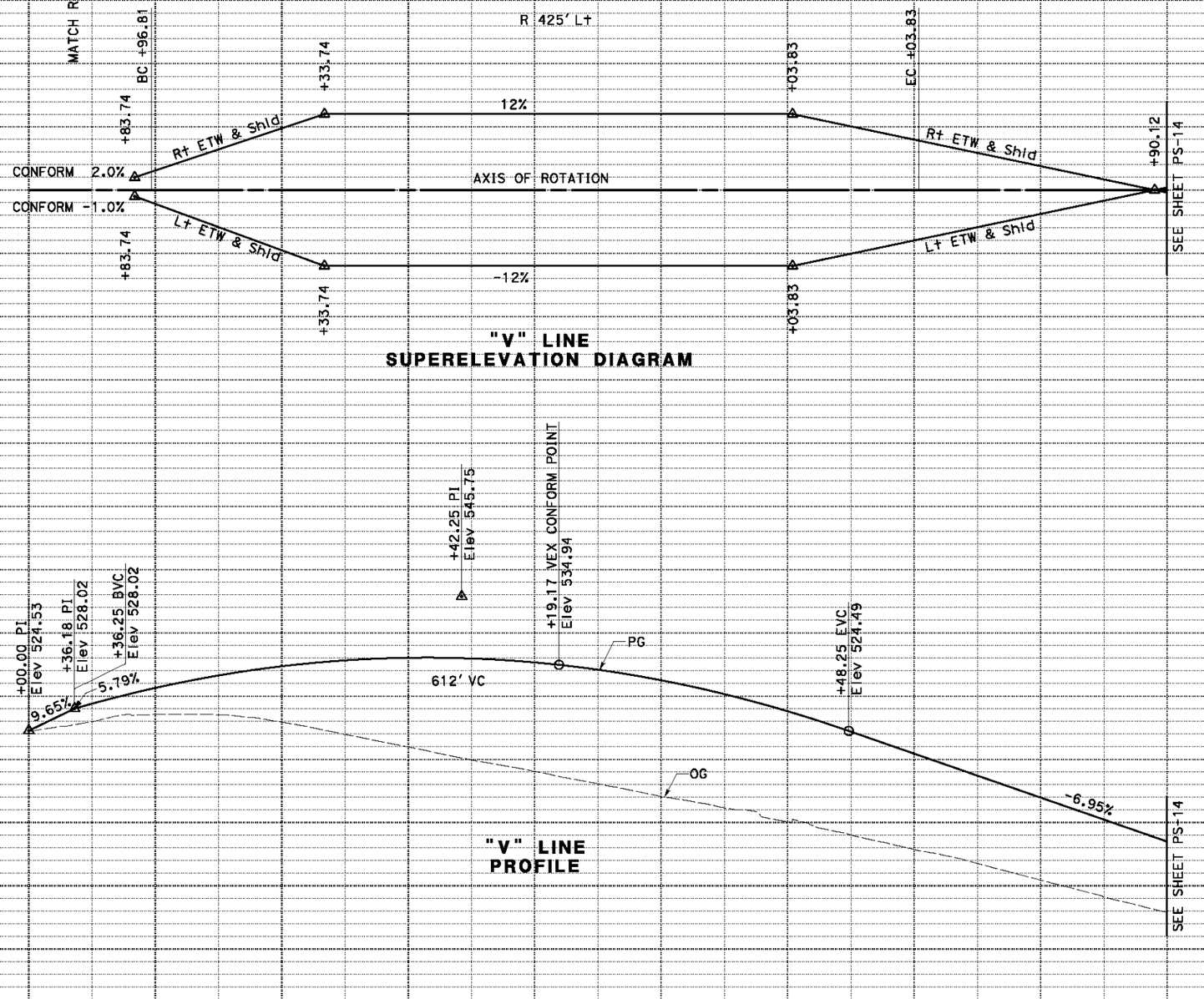

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: Horiz 1" = 50'
Vert 1" = 10'

PS-13

STATION	100	1	2	3	4	105	6	7	8	9	TOTAL
CY Exc	← 19 →										19
CY Emb	← 26,471 →										26,471

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UNIT 00000
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 — 05/30/14 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Abhijeet R. Bhoi — No. 68606 — Exp. 09-30-15 — CIVIL — STATE OF CALIFORNIA

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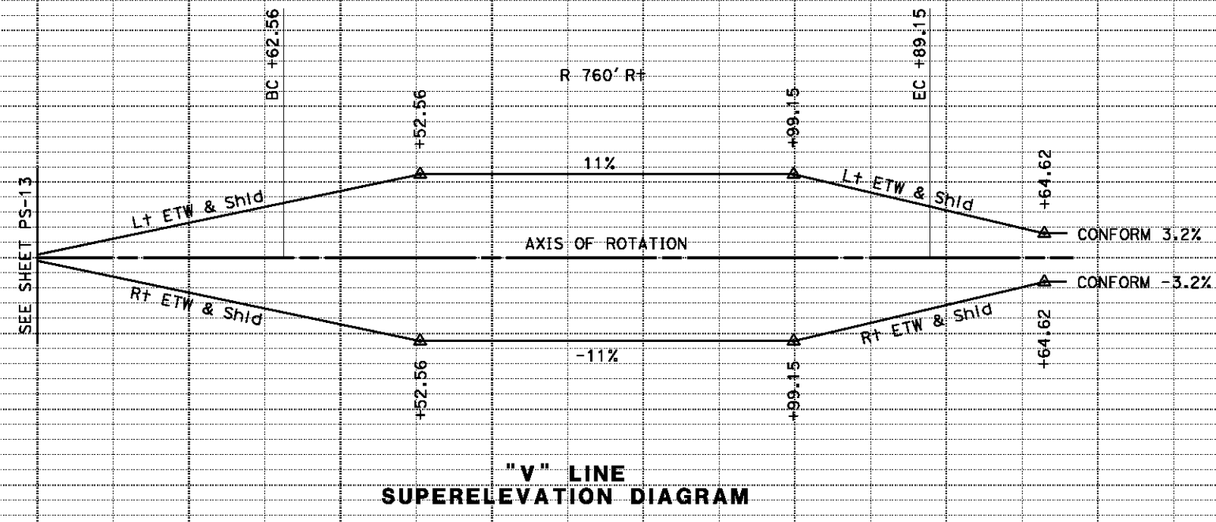
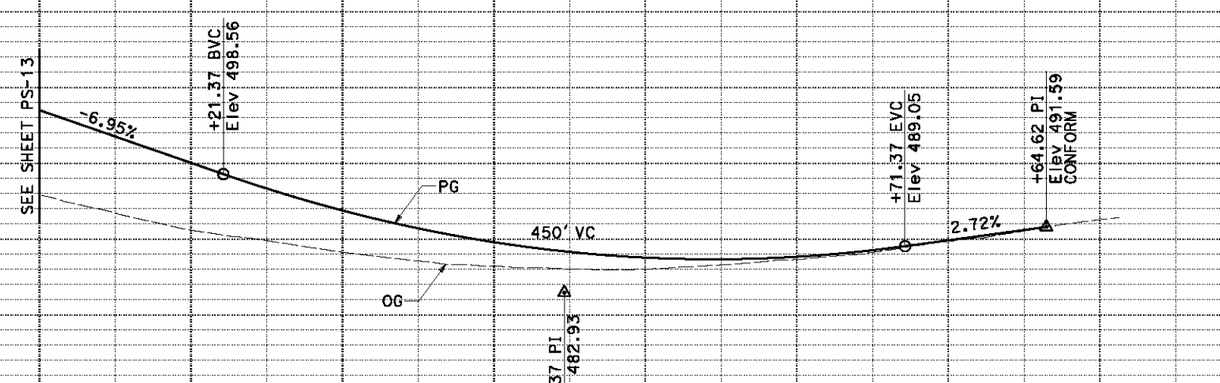


"V" LINE
SUPERELEVATION DIAGRAM



"V" LINE
PROFILE

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: Horiz 1" = 50'
Vert 1" = 10'

PS-14

STATION	9	110	1	2	3	4	115	6	TOTAL
CY Exc	←		1,519					→	1,519
CY Emb	←		2,755					→	2,755

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USERNAME => Shruti_Shah
DGN FILE => 429762fb014.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 00000
PROJECT NUMBER & PHASE 04000205811

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

ARBhoi 05/30/14
REGISTERED CIVIL ENGINEER DATE

Abhijeet R. Bhoi No. 68606 Exp. 09-30-15 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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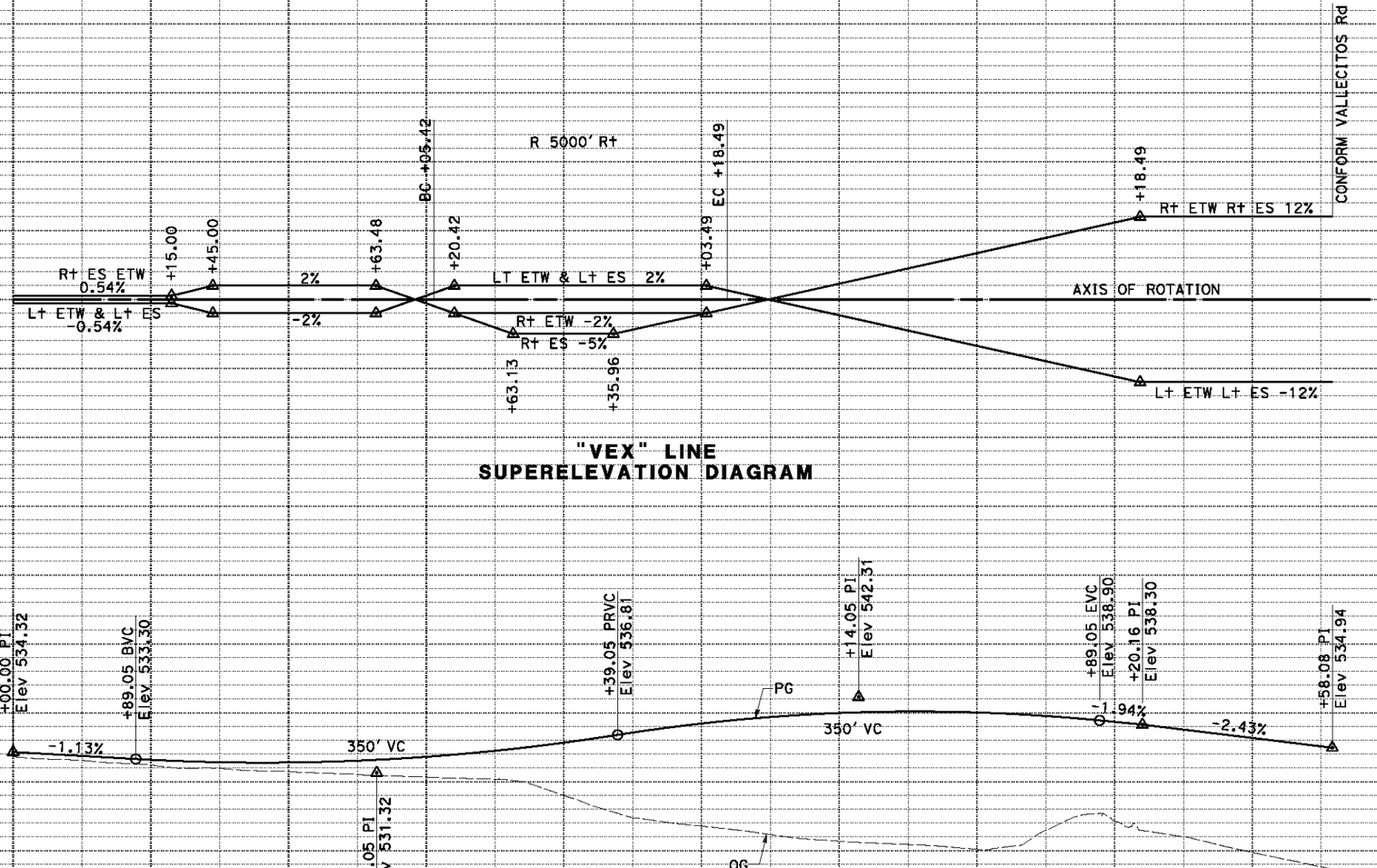

"VEX" LINE
SUPERELEVATION DIAGRAM

"VEX" LINE
PROFILE

PROFILE AND SUPERELEVATION DIAGRAM

SCALE: Horiz 1"=50'
Vert 1"=10'

PS-15

STATION	8	9	50	1	2	3	4	55	6	7	8	TOTAL
CY Exc			320									320
CY Emb			15,034									15,034

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CHECKED BY: ABHIJEET BHOI
REVISED BY: AB
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USERNAME => Shruti_Shah
DGN FILE => 429762fb015.dgn
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UNIT 00000
PROJECT NUMBER & PHASE 04000205811

South Segment Plans and Profile Sheets

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 9/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/14 — CIVIL — STATE OF CALIFORNIA

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FOR ACCURATE RIGHT OF WAY DATA,
CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

NOTES:

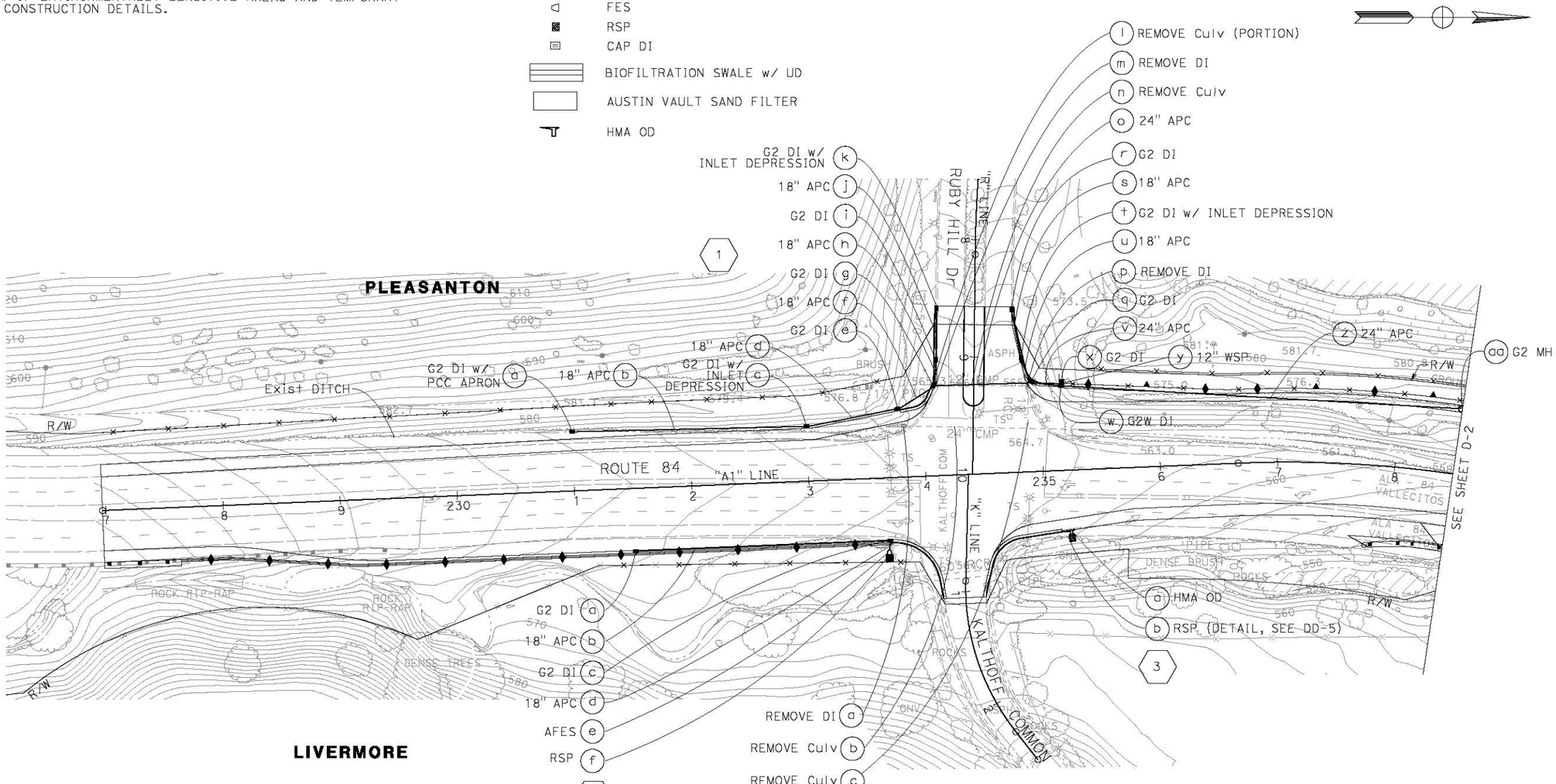
1. FOR UTILITIES, SEE EXISTING UTILITIES PLAN SHEETS.
2. STATION & OFFSET TIES TO DRAINAGE STRUCTURES ARE MEASURED PER DETAILS ON SHEET DD-1.
3. FOR FINISHED GRADE, SEE PROFILES, CONSTRUCTION DETAILS AND PAVEMENT ELEVATION SHEETS.
4. LOCATIONS OF EXISTING DRAINAGE FACILITIES ARE APPROXIMATE. VERIFY LOCATION AND ELEVATION OF EXISTING DRAINAGE FACILITIES PRIOR TO MODIFYING.
4. FOR LOACTIONS OF ENVIRONMENTALLY SENSITIVE AREAS AND TEMPORARY FENCING, SEE CONSTRUCTION DETAILS.

LEGEND:

- Exist SD
- PROPOSED SD
- Gtr/DITCH FL
- (No.) DRAINAGE SYSTEM No.
- (x) DRAINAGE UNIT
- GRADE TO DRAIN
- DI
- OMP/GMP DI
- Exist DI
- FES
- RSP
- CAP DI
- BIOFILTRATION SWALE w/ UD
- AUSTIN VAULT SAND FILTER
- HMA OD

ABBREVIATIONS:

COL	CITY OF LIVERMORE
OD	OVERSIDE DRAIN
TC	TOP OF COVER
TW	TOP OF WALL
w/	WITH
WQ	WATER QUALITY



DRAINAGE PLAN

SCALE: 1'' = 50'

APPROVED FOR DRAINAGE WORK ONLY

D-1

AC	09/10/14		
AC	05/30/14		
EC	12/28/10		
REVISED BY	DATE REVISED		
JENNIFER ABRAMS	ANALETTE OCHOA		
CALCULATED-DESIGNED BY	CHECKED BY		

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa
REGISTERED CIVIL ENGINEER — 9/10/14 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/14 — CIVIL — STATE OF CALIFORNIA

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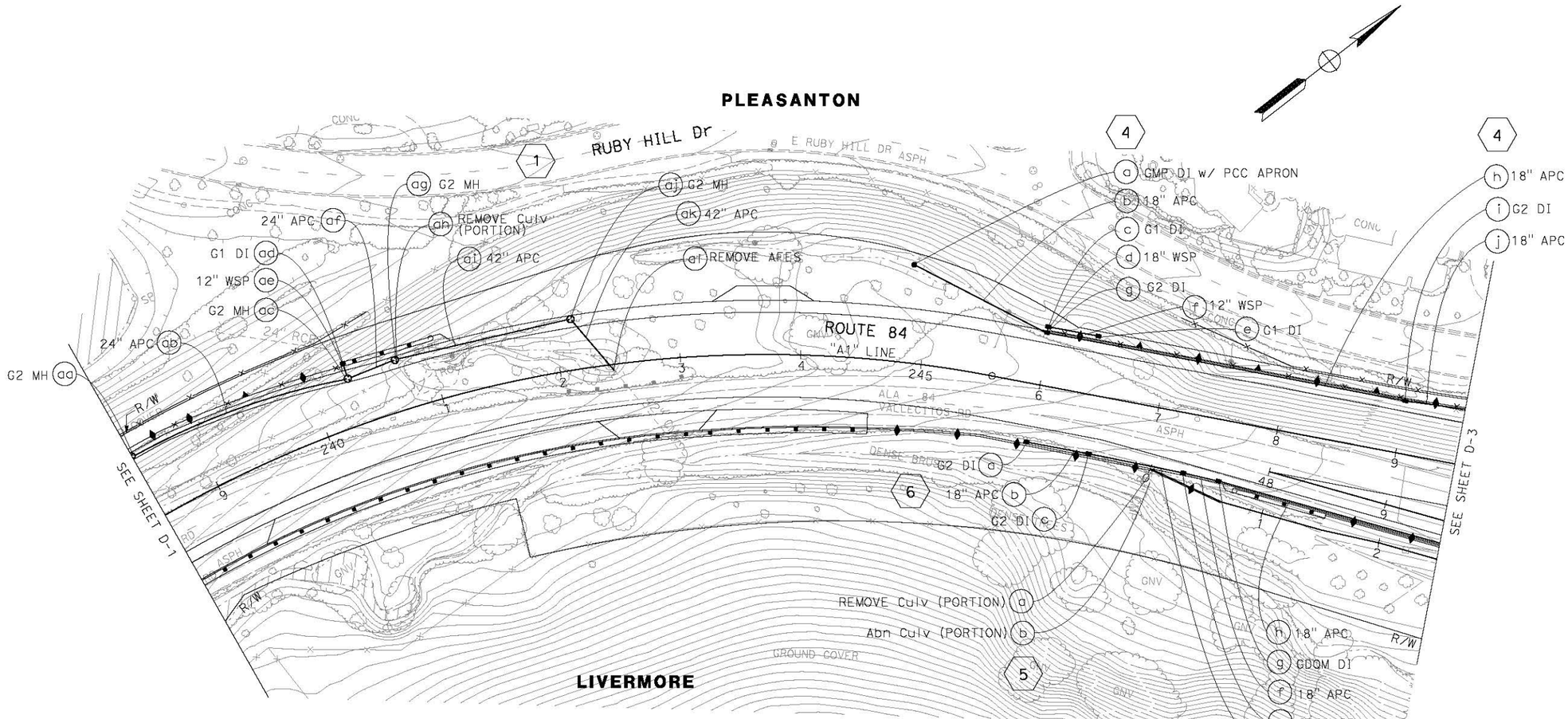

DRAINAGE PLAN

SCALE: 1'' = 50'

APPROVED FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-2

AC	AC	EC	REVISED BY
09/10/14	05/30/14	12/28/10	DATE REVISED
JENNIFER ABRAMS			
ANALETTE OCHOA			
CALCULATED-DESIGNED BY			
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CONSULTANT FUNCTIONAL SUPERVISOR			
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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 9/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/14 — CIVIL — STATE OF CALIFORNIA

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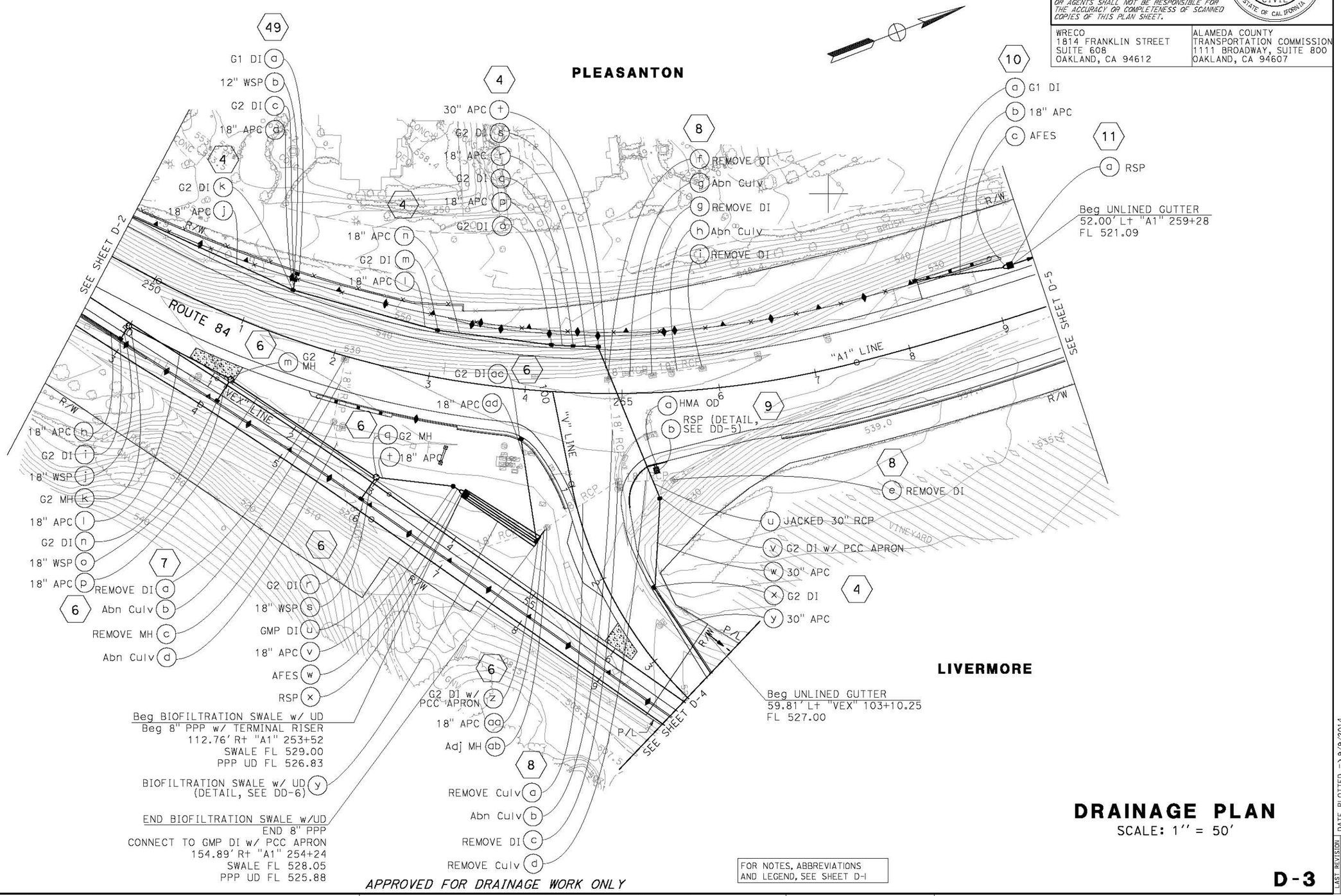

APPROVED FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

DRAINAGE PLAN
SCALE: 1'' = 50'

D-3

	DATE REVISED	REVISED BY	EC	AC	AC
	12/28/10	JENNIFER ABRAMS	05/30/14	09/10/14	
CALCULATED-DESIGNED BY		ANALETTE OCHOA			
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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
04	Ala	84	22.9/25.7		

Analette Ochoa
REGISTERED CIVIL ENGINEER — 9/10/14 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/14 — CIVIL — STATE OF CALIFORNIA

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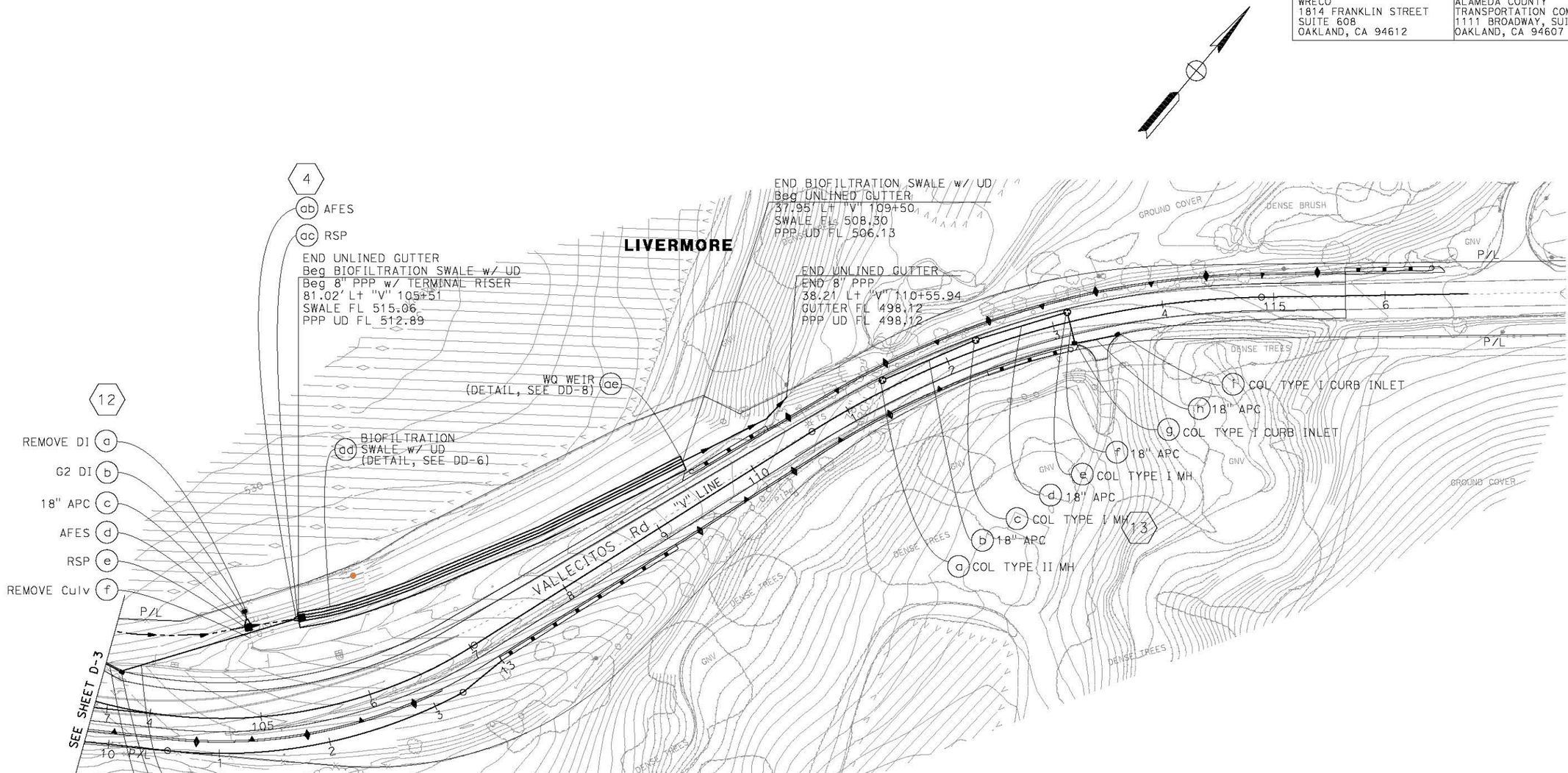

DRAINAGE PLAN
SCALE: 1'' = 50'

APPROVED FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-4

JENNIFER ABRAMS	ANALETTE OCHOA	EC	12/28/10	AC	05/30/14	AC	09/10/14

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 9/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/14
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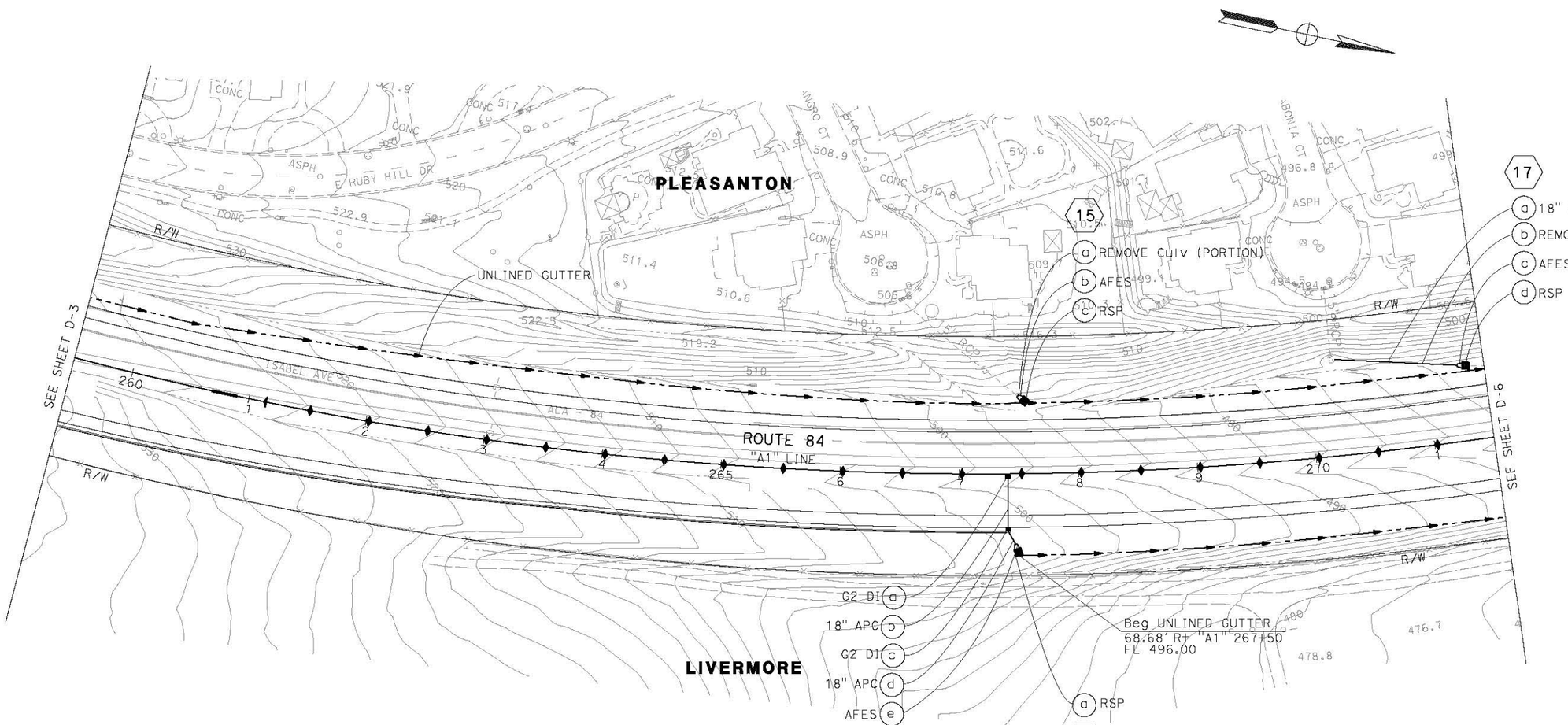

DRAINAGE PLAN

SCALE: 1'' = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

APPROVED FOR DRAINAGE WORK ONLY

D-5

JENNIFER ABRAMS	ANALETTE OCHOA	EC	12/28/10
		AC	05/30/14
		AC	09/10/14

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REVISED BY
DATE REVISED

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 9/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/14
CIVIL
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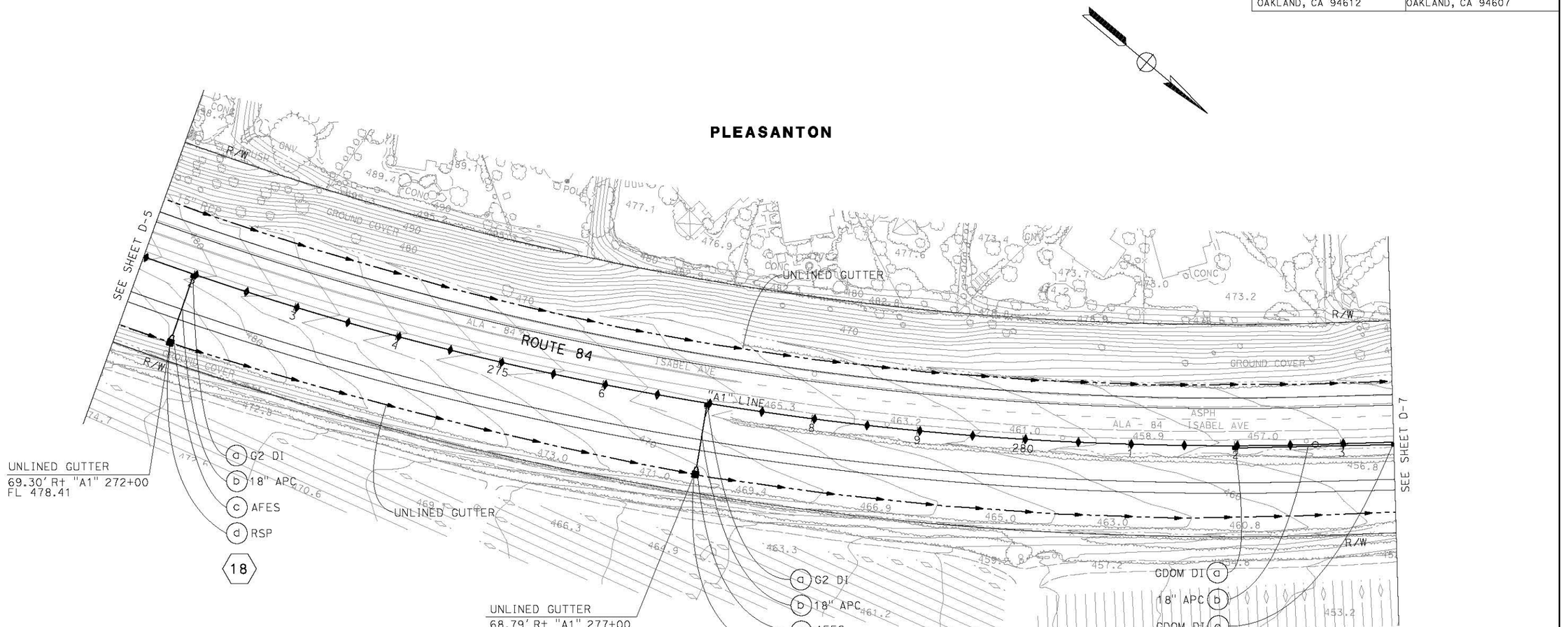

DRAINAGE PLAN

SCALE: 1'' = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-6

CALCULATED-DESIGNED BY	JENNIFER ABRAMS	AC 09/10/14
CHECKED BY	ANALETTE OCHOA	AC 05/30/14
		EC 12/28/10
		REVISED BY / DATE REVISED

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa
REGISTERED CIVIL ENGINEER — 9/10/14 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/14 — CIVIL — STATE OF CALIFORNIA

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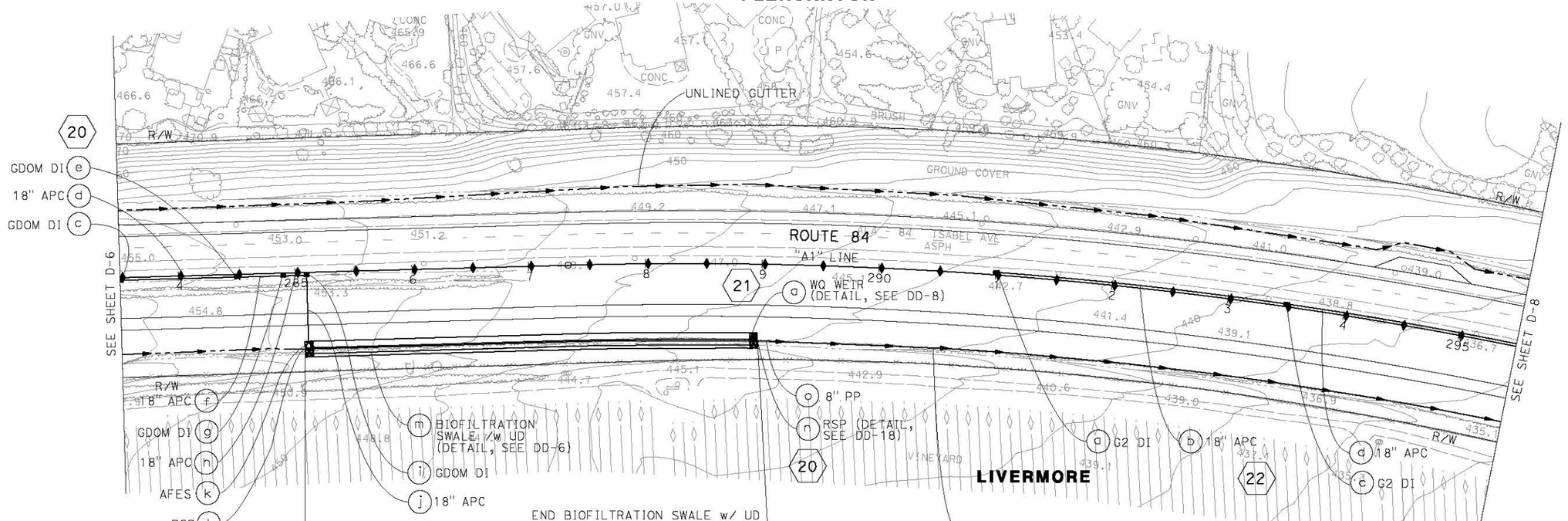

DRAINAGE PLAN

SCALE: 1'' = 50'

APPROVED FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-7

CALCULATED-DESIGNED BY	JENNIFER ABRAMS		
CHECKED BY	ANALETTE OCHOA	12/28/10	09/10/14
CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG	05/30/14	AC
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION			

LAST REVISION DATE PLOTTED => 9/9/2014
09-10-14 TIME PLOTTED => 4:36:00 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\pl\429760id007.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		

Analette Ochoa 9/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/14 — CIVIL — STATE OF CALIFORNIA

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REVISED BY	DATE REVISED
AC	09/10/14
AC	05/30/14
EC	12/28/10
JENNIFER ABRAMS	ANALETTE OCHOA

CALCULATED-DESIGNED BY
CHECKED BY

SUPERVISOR
CONSULTANT FUNCTIONAL SUPERVISOR
HAN-BIN LIANG

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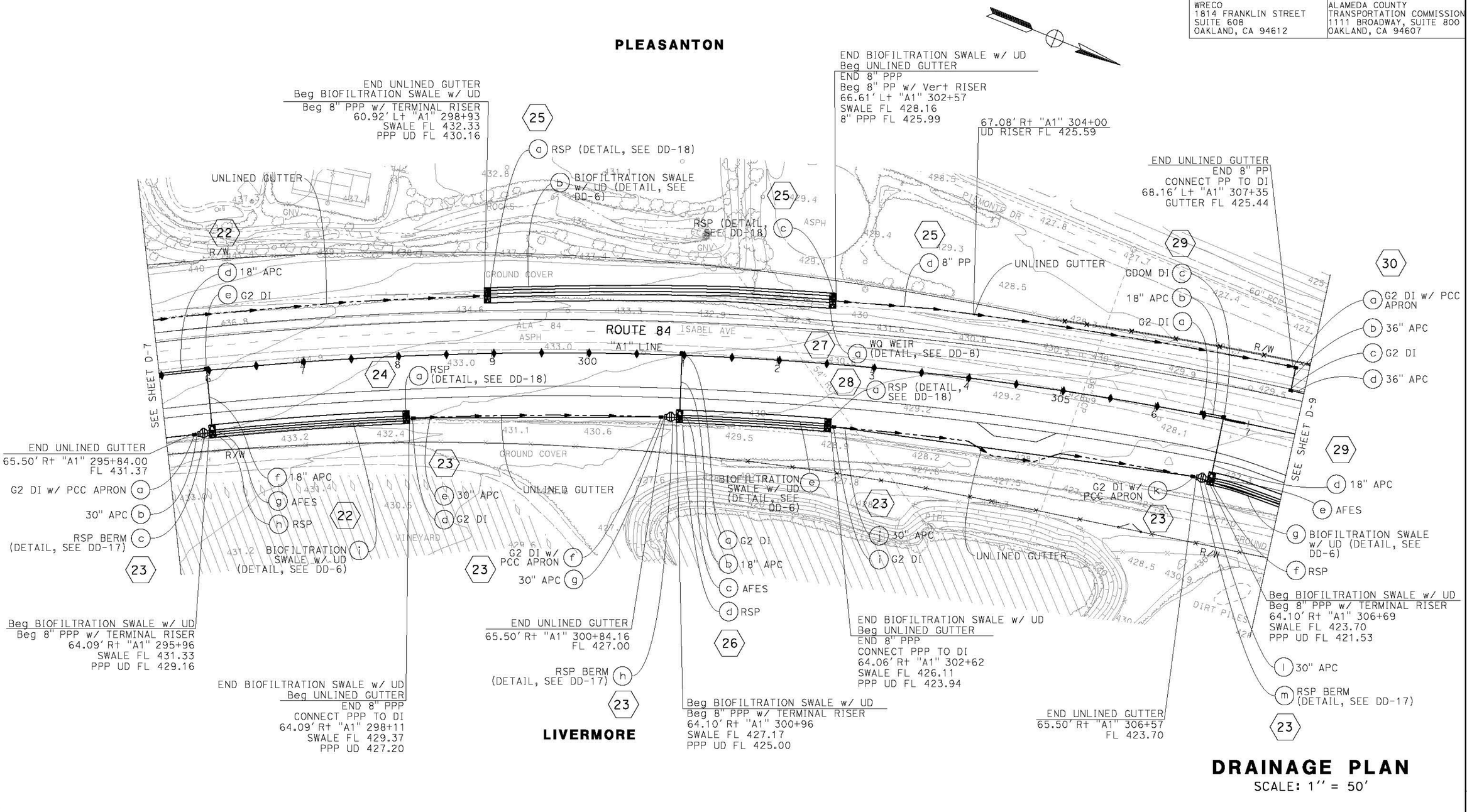

DRAINAGE PLAN

SCALE: 1'' = 50'

APPROVED FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-8

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DATE PLOTTED => 9/9/2014
TIME PLOTTED => 4136:14 PM

BORDER LAST REVISED 7/2/2010
USERNAME => andrew_chin
DGN FILE => ...\Dwg\pl\429760ia008.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 9/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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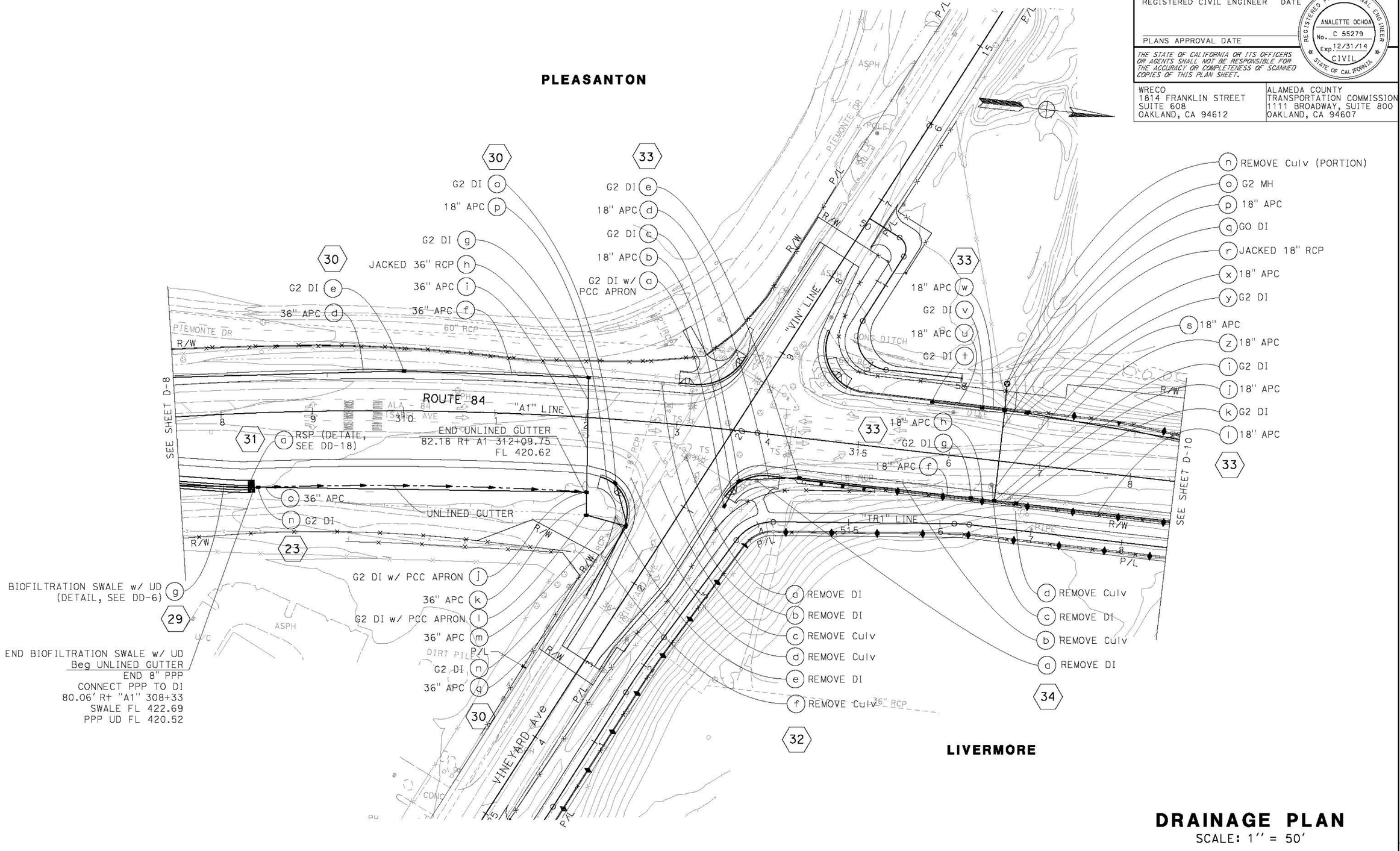
PLEASANTON

LIVERMORE



DRAINAGE PLAN

SCALE: 1'' = 50'

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FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-9

	DATE	REVISED BY	REVISION	CALCULATED-DESIGNED BY	CHECKED BY
AC	09/10/14	JENNIFER ABRAMS	ANALETTE OCHOA		
AC	05/30/14				
EC	12/28/10				

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 9/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/14 — CIVIL — STATE OF CALIFORNIA

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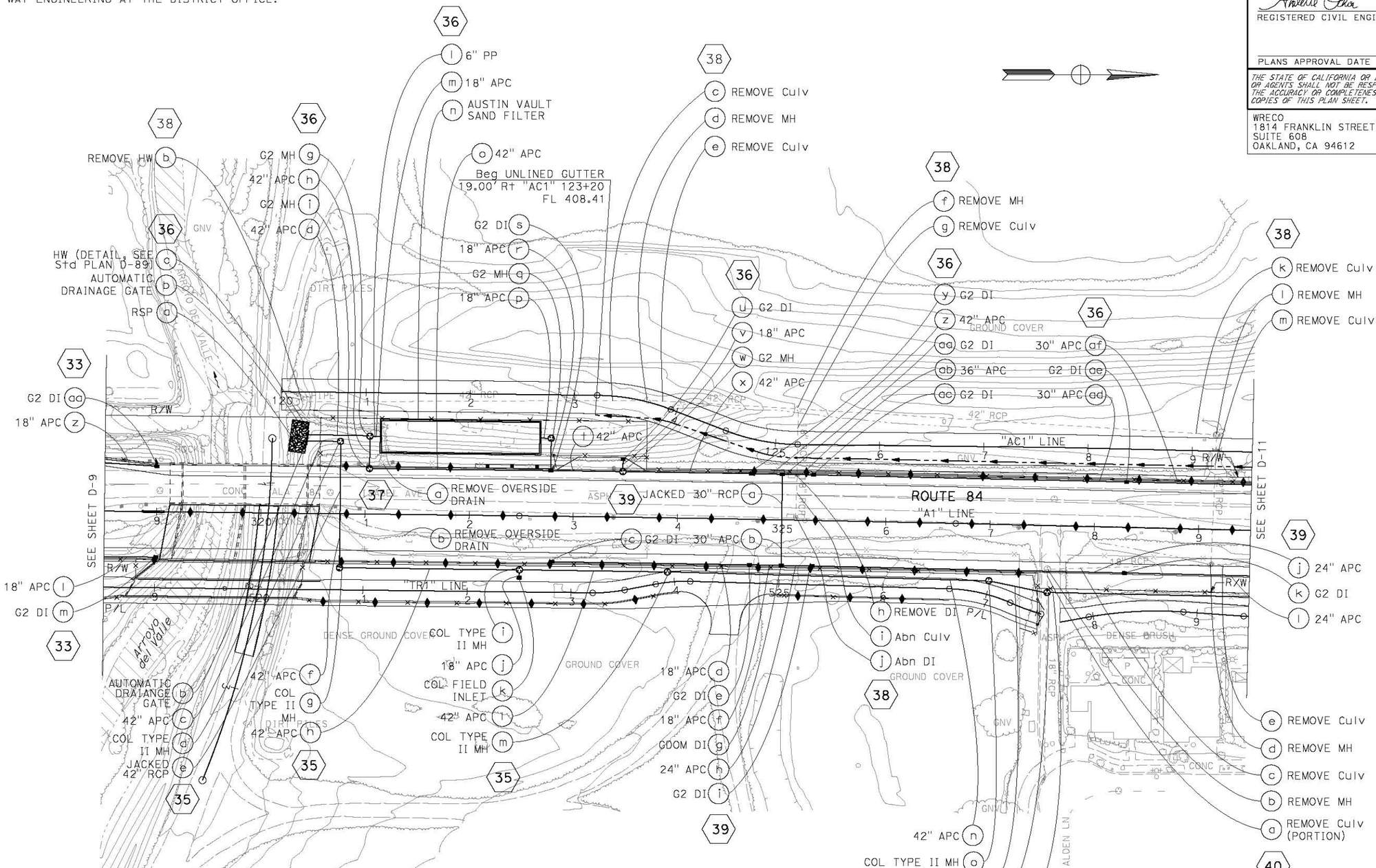

DRAINAGE PLAN
SCALE: 1'' = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

APPROVED FOR DRAINAGE WORK ONLY

D-10

REVISED BY	DATE REVISED
AC	09/10/14
AC	05/30/14
EC	12/28/10
JENNIFER ABRAMS	
ANALETTE OCHOA	

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 9/12/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
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Exp. 12/31/14
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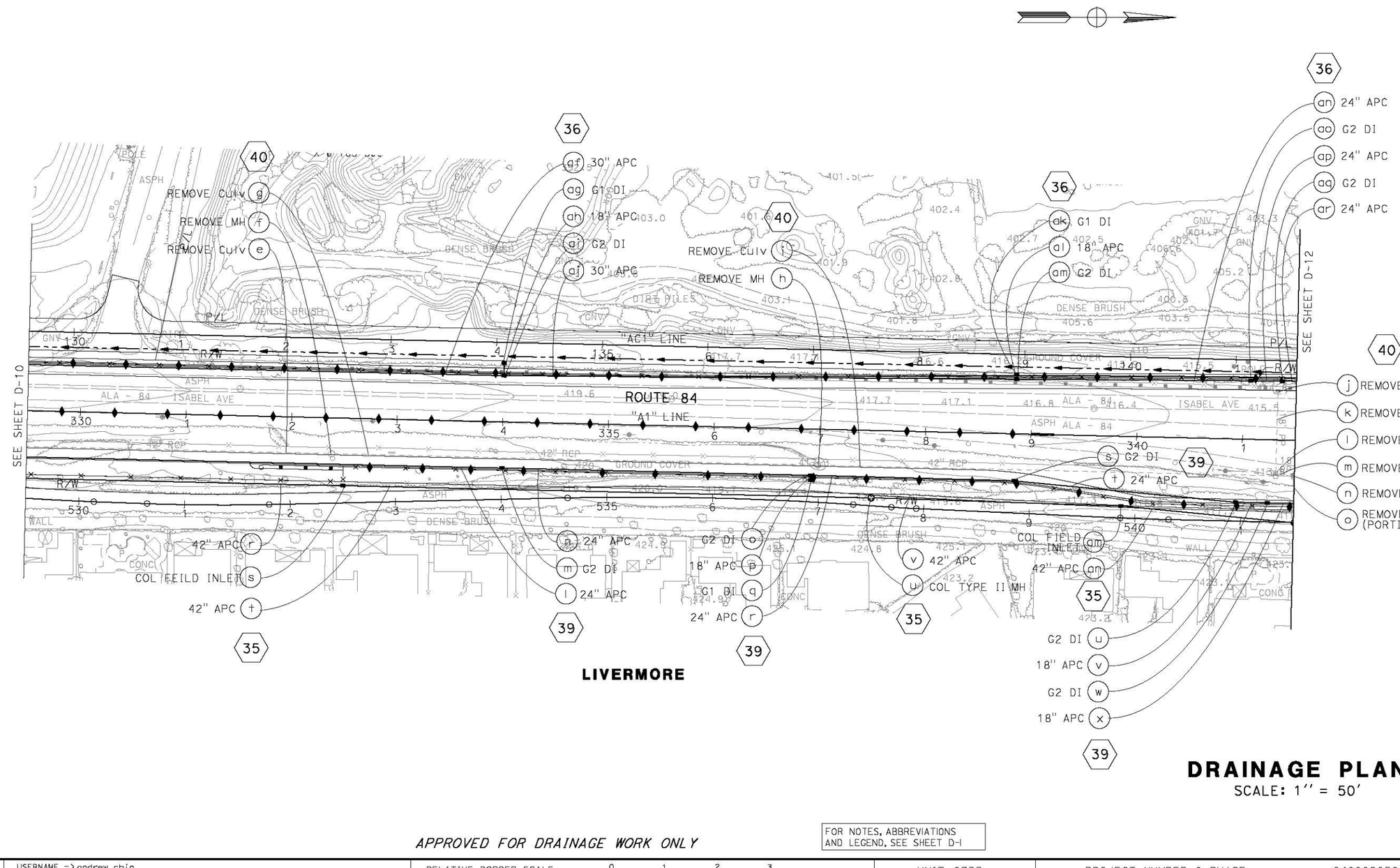

DRAINAGE PLAN
SCALE: 1'' = 50'

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FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-11

CALCULATED- DESIGNED BY	JENNIFER ABRAMS	REVISED BY	EC	AC	AC
CHECKED BY	ANALETTE OCHOA	DATE REVISED	12/28/10	05/30/14	09/12/14

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 9/12/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/14 — CIVIL — STATE OF CALIFORNIA

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DATE REVISED	REVISED BY	EC	AC	AC
12/28/10	ANALETTE OCHOA	05/30/14	09/12/14	

CALCULATED-DESIGNED BY: JENNIFER ABRAMS
CHECKED BY: ANALETTE OCHOA
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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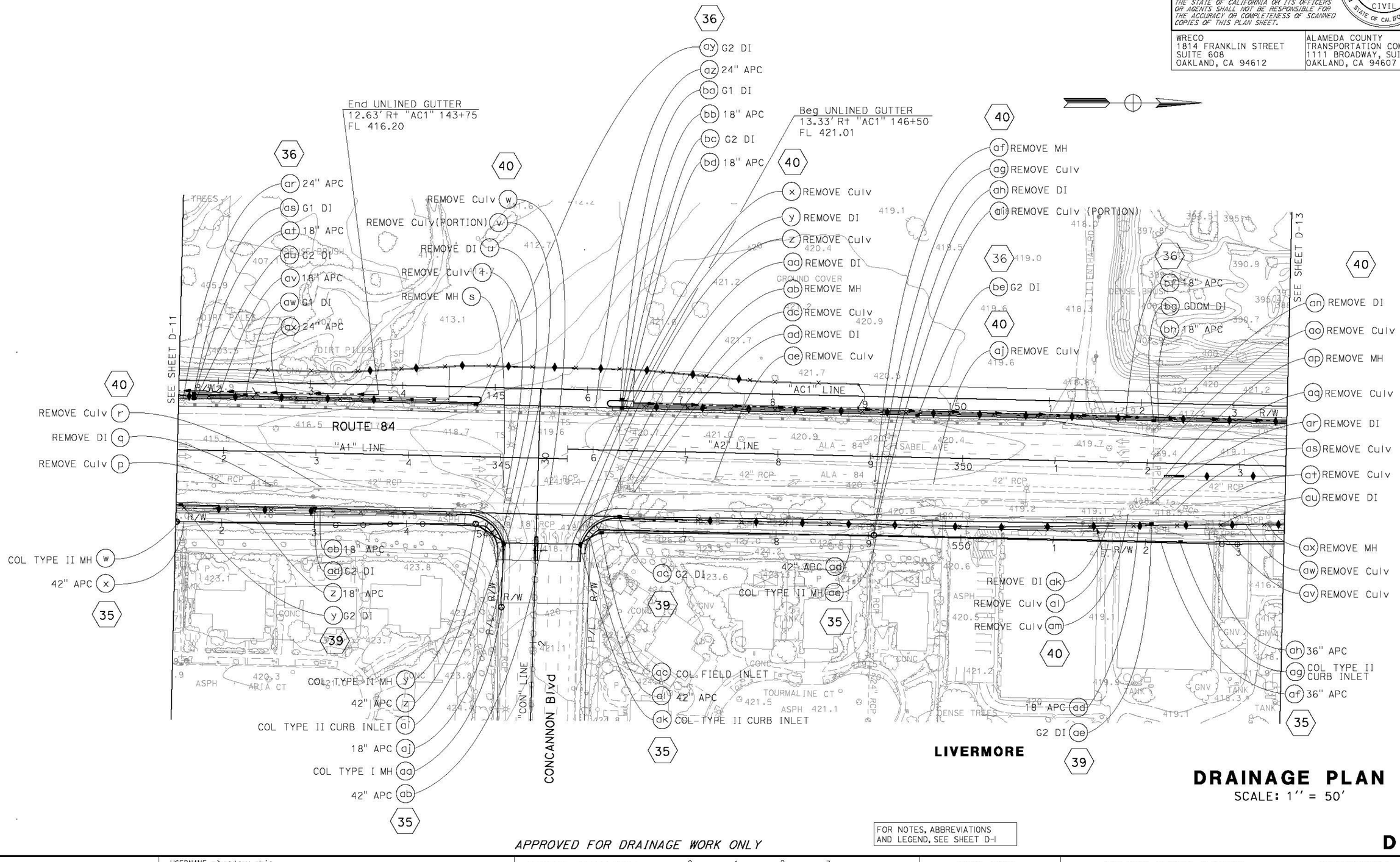

DRAINAGE PLAN

SCALE: 1'' = 50'

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

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D-12

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DATE PLOTTED => 9/12/2014
TIME PLOTTED => 2:18:55 PM

BORDER LAST REVISED 7/2/2010
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DGN FILE => ...\Dwg\pl\429760id012.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		

Analette Ochoa 9/12/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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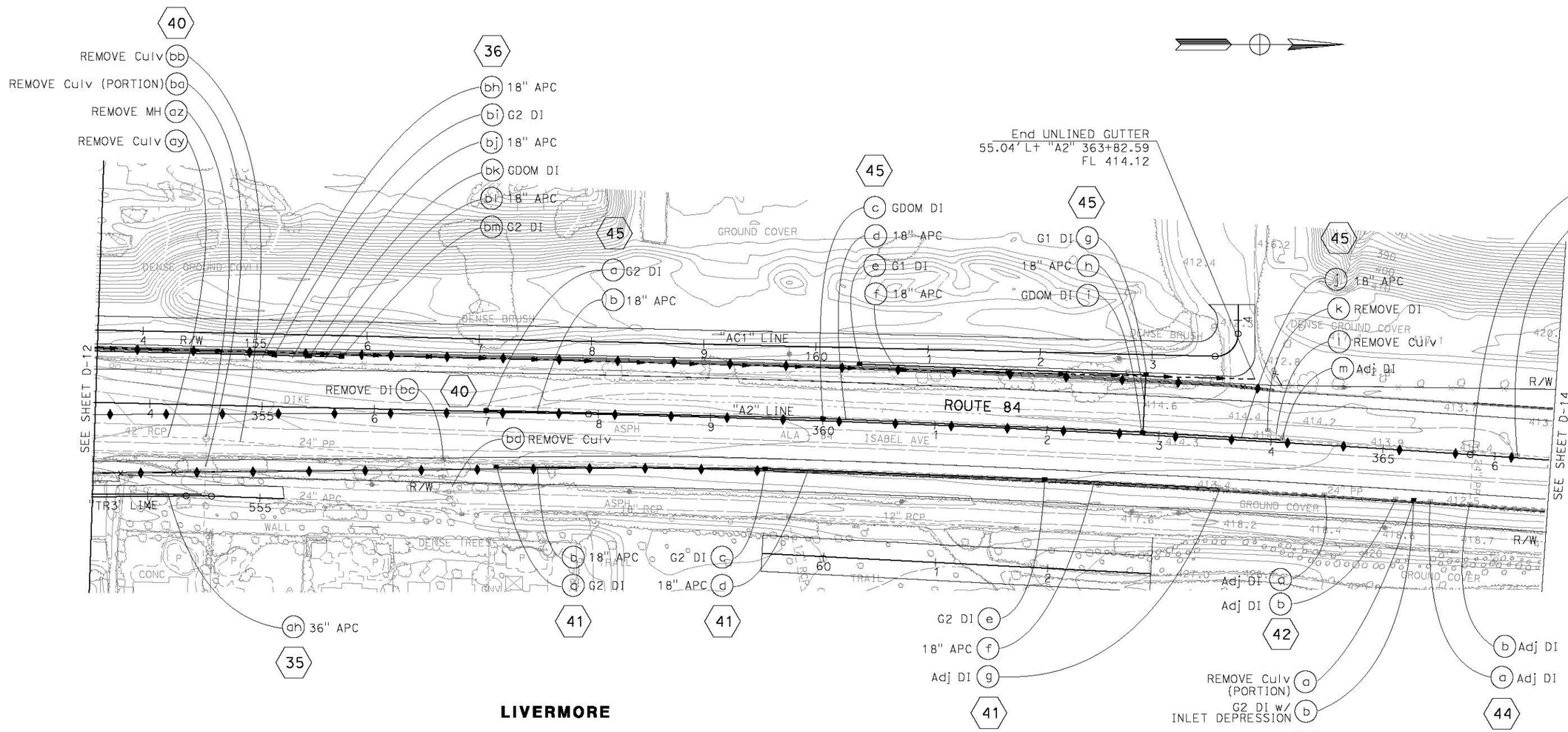

LIVERMORE

DRAINAGE PLAN

SCALE: 1'' = 50'

APPROVED FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-13

CALCULATED-DESIGNED BY	JENNIFER ABRAMS	REVISED BY	EC	AC	AC
CHECKED BY	ANALETTE OCHOA	DATE REVISED	12/28/10	05/30/14	09/12/14

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 9/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/14
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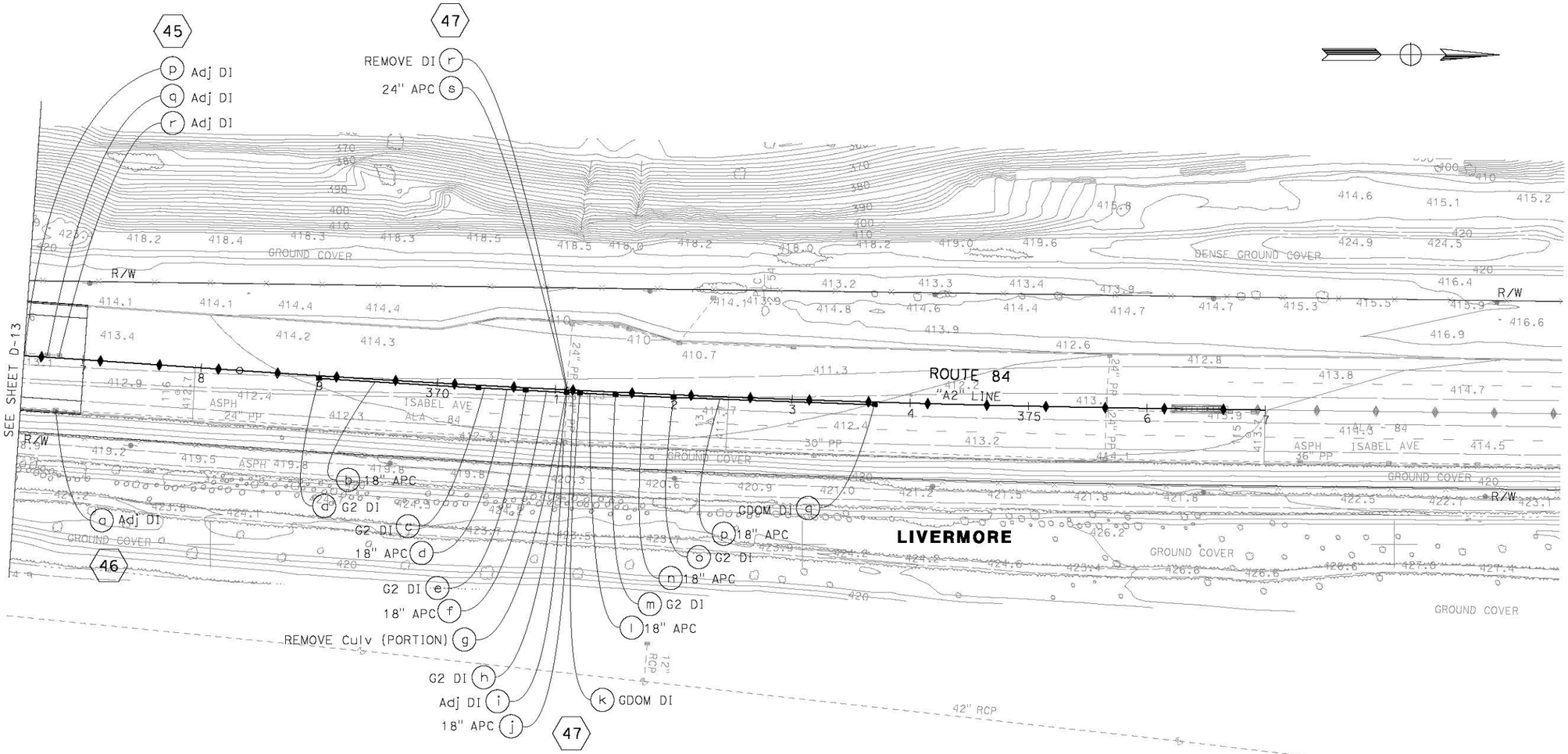

DRAINAGE PLAN

SCALE: 1'' = 50'

APPROVED FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-1

D-14

AC	09/10/14	JENNIFER ABRAMS	CALCULATED-DESIGNED BY	STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
AC	05/30/14	ANALETTE OCHOA	CHECKED BY	
EC	12/28/10	HAN-BIN LIANG	CONSULTANT FUNCTIONAL SUPERVISOR	
REVISED BY	DATE REVISED			

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 9/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp. 12/31/14 — CIVIL — STATE OF CALIFORNIA

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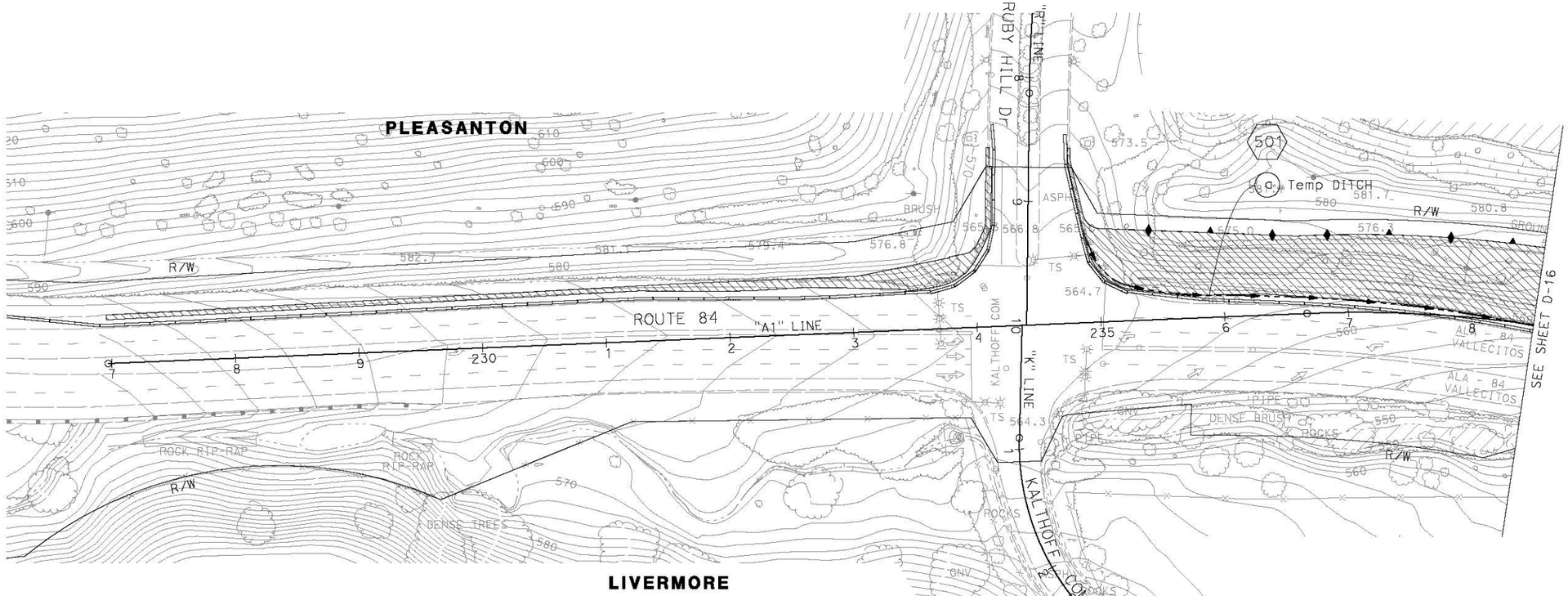
NOTES:

1. DO NOT REMOVE EXISTING OUTFALLS BEFORE NEW OUTFALLS HAVE BEEN CONSTRUCTED.
2. SEE SHEET D-1 FOR NOTES, LEGEND, AND ABBREVIATION NOT SHOWN.

LEGEND:

- TEMPORARY RAILING (TYPE K)
- CONSTRUCTION THIS STAGE
- HMA OVERLAY CONFORM THIS STAGE
- PAVEMENT REMOVAL
- TEMPORARY PAVEMENT
- TEMPORARY DI
- Temp Gtr/DITCH FL



DRAINAGE PLAN TEMPORARY DRAINAGE (STAGE 1)

SCALE: 1'' = 50'

APPROVED FOR DRAINAGE WORK ONLY

D-15

AC	AC	EC	JENNIFER ABRAMS	CALCULATED-DESIGNED BY	CONSULTANT FUNCTIONAL SUPERVISOR
09/10/14	05/30/14	12/28/10	ANALETTE OCHOA	CHECKED BY	HAN-BIN LIANG
DATE REVISED	DATE REVISED	DATE REVISED	REVISED BY	STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	Caltrans

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BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\pl\429760ia015.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 9/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/14
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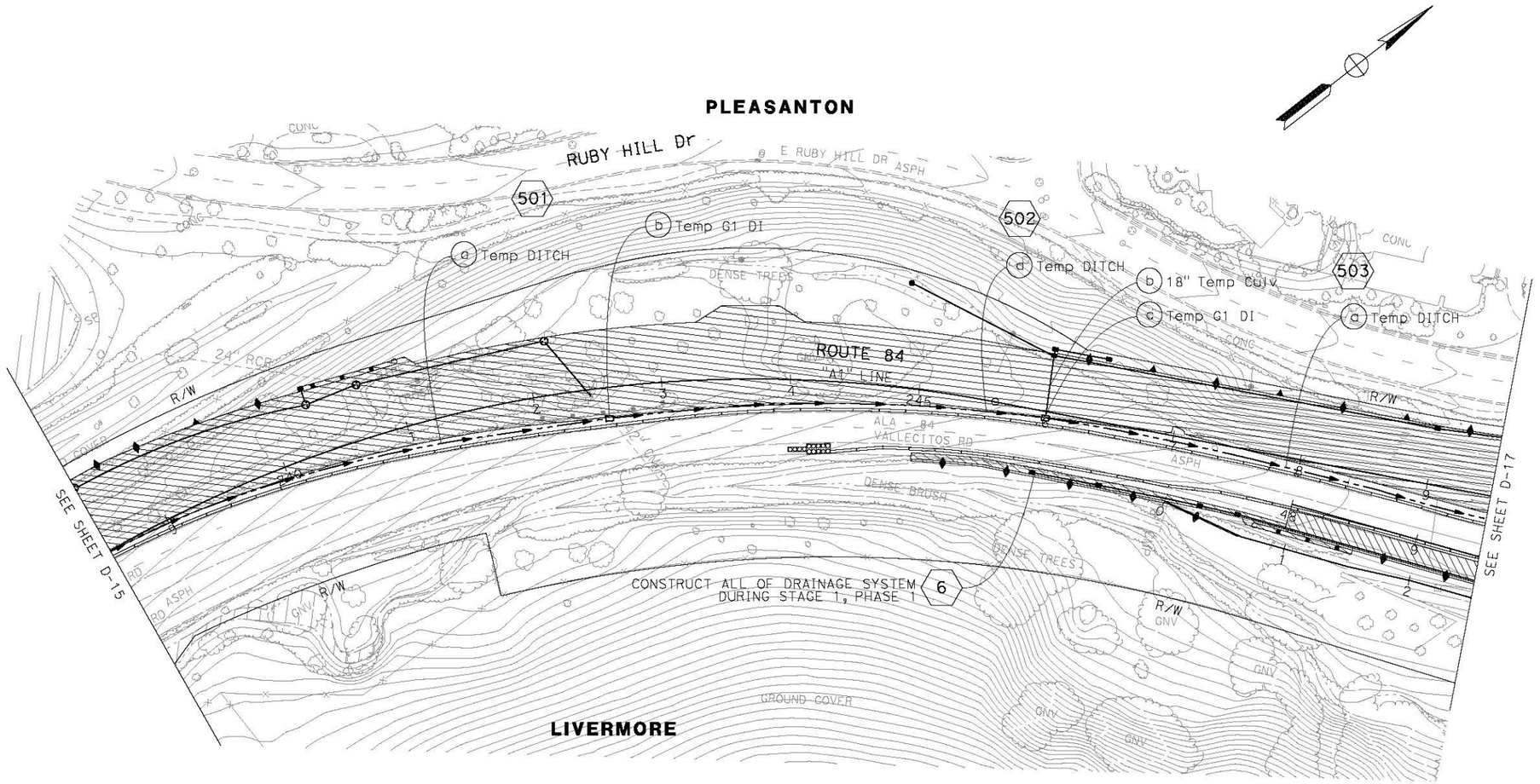

DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1'' = 50'

APPROVED FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-15

D-16

AC	09/10/14						
AC	05/30/14						
EC	12/28/10						
REVISED BY	DATE REVISED						
JENNIFER ABRAMS	ANALETTE OCHOA						
CALCULATED-DESIGNED BY	CHECKED BY						

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 9/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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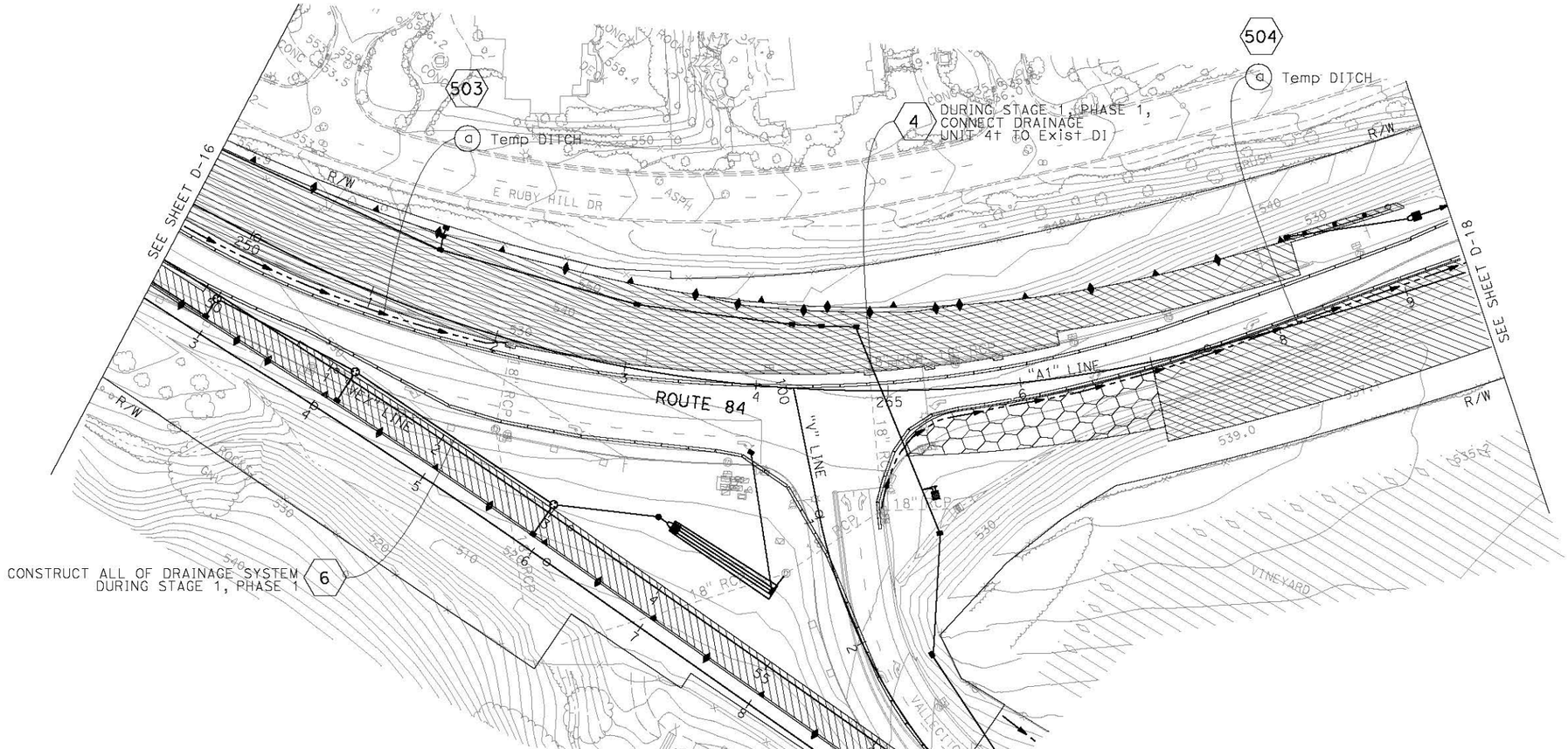

LIVERMORE

DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1'' = 50'

APPROVED FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS
AND LEGEND, SEE SHEET D-15

D-17

AC	09/10/14		
AC	05/30/14		
EC	12/28/10		
REVISED BY	DATE REVISED		
JENNIFER ABRAMS	ANALETTE OCHOA		
CALCULATED-DESIGNED BY	CHECKED BY		
CONSULTANT FUNCTIONAL SUPERVISOR			
HAN-BIN LIANG			

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BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\pl\429760id017.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
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PLANS APPROVAL DATE

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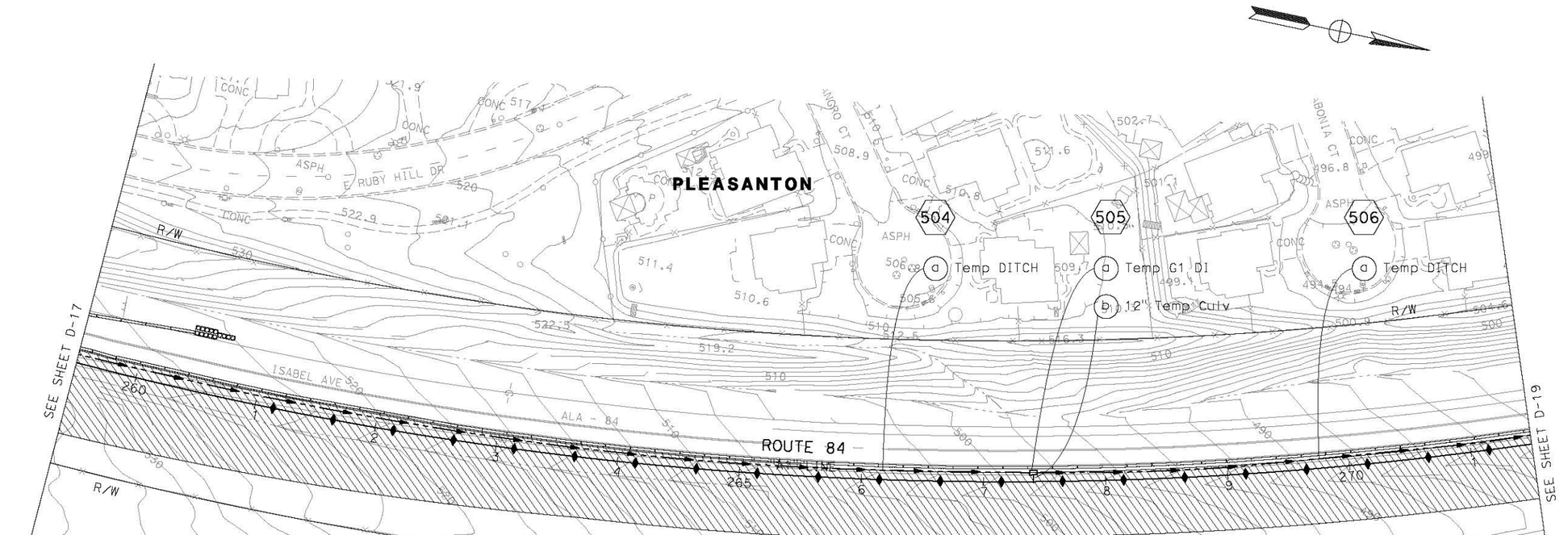

APPROVED FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-15

DRAINAGE PLAN TEMPORARY DRAINAGE (STAGE 1)

SCALE: 1'' = 50'

D-18

CALCULATED-DESIGNED BY	JENNIFER ABRAMS	REVISED BY	EC
CHECKED BY	ANALETTE OCHOA	DATE REVISED	12/28/10
			AC
			05/30/14
			AC
			09/10/14

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CONSULTANT FUNCTIONAL SUPERVISOR
HAN-BIN LIANG

LAST REVISION
DATE PLOTTED => 9/9/2014
TIME PLOTTED => 4:54:31 PM
09-10-14

BORDER LAST REVISED 7/2/2010

USERNAME => andrew_chin
DGN FILE => ...\Dwg\pl\429760id018.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		

Analette Ochoa 9/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/14
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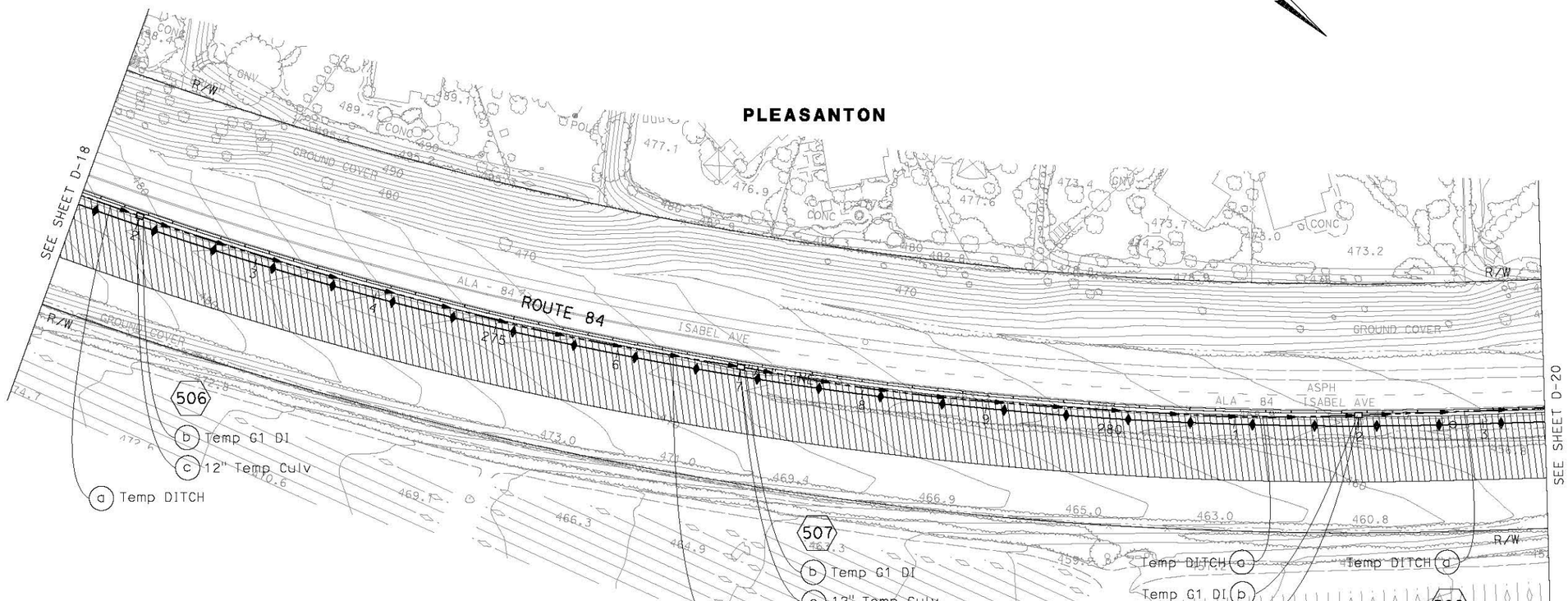

APPROVED FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-15

DRAINAGE PLAN TEMPORARY DRAINAGE (STAGE 1)

SCALE: 1'' = 50'

D-19

AC	09/10/14	
AC	05/30/14	
EC	12/28/10	
REVISED BY	DATE REVISED	
JENNIFER ABRAMS	ANALETTE OCHOA	
CALCULATED-DESIGNED BY	CHECKED BY	
CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG	

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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 9/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
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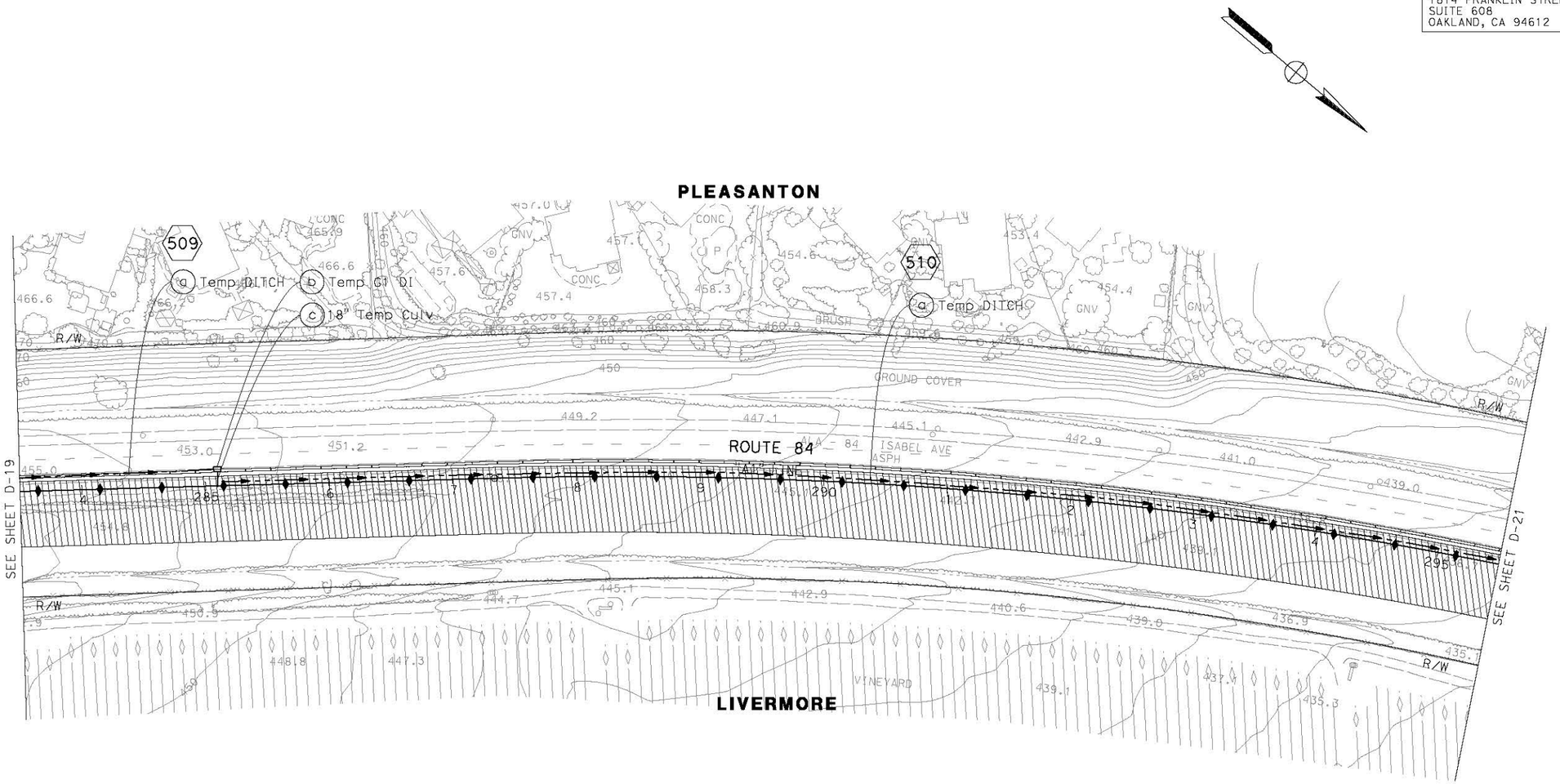

DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1'' = 50'

APPROVED FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-15

D-20

	DATE	REVISED BY	DATE REVISED
AC	09/10/14	JENNIFER ABRAMS	ANALETTE OCHOA
AC	05/30/14	EC	12/28/10

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CONSULTANT FUNCTIONAL SUPERVISOR
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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 9/10/14
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/14
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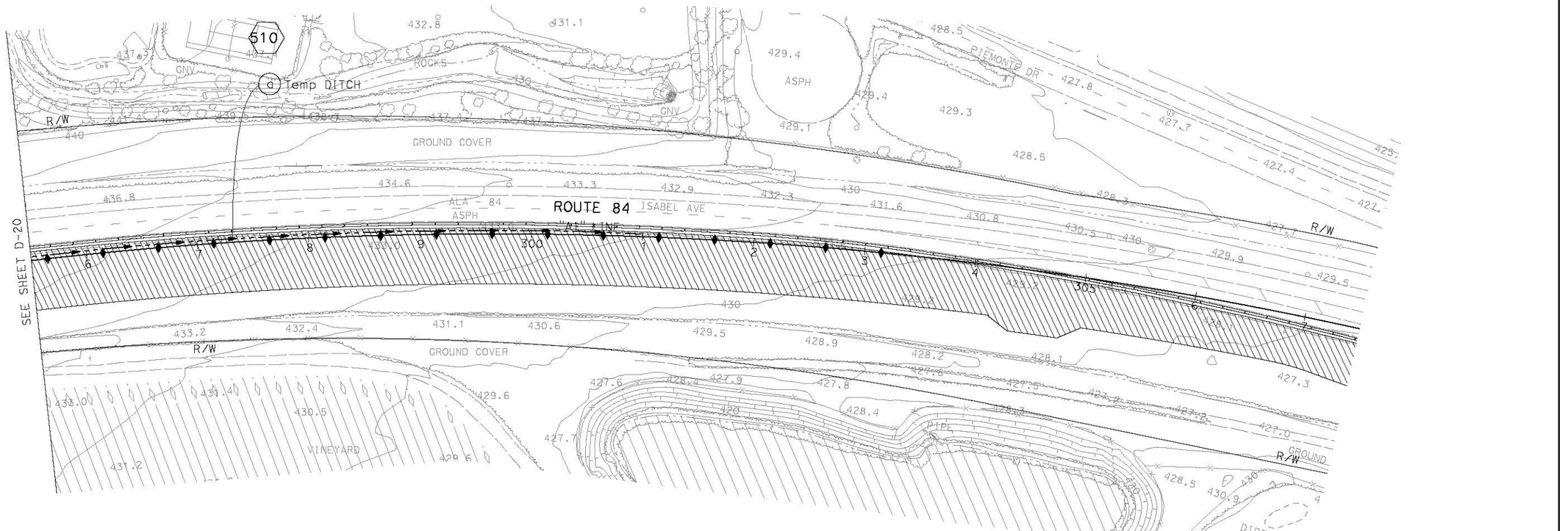
PLEASANTON



LIVERMORE

DRAINAGE PLAN TEMPORARY DRAINAGE (STAGE 1)

SCALE: 1'' = 50'

APPROVED FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-15

D-21

CALCULATED-DESIGNED BY	JENNIFER ABRAMS	REVISED BY	EC	AC	AC
CHECKED BY	ANALETTE OCHOA	DATE REVISED	12/28/10	05/30/14	09/10/14

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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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 9/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/14
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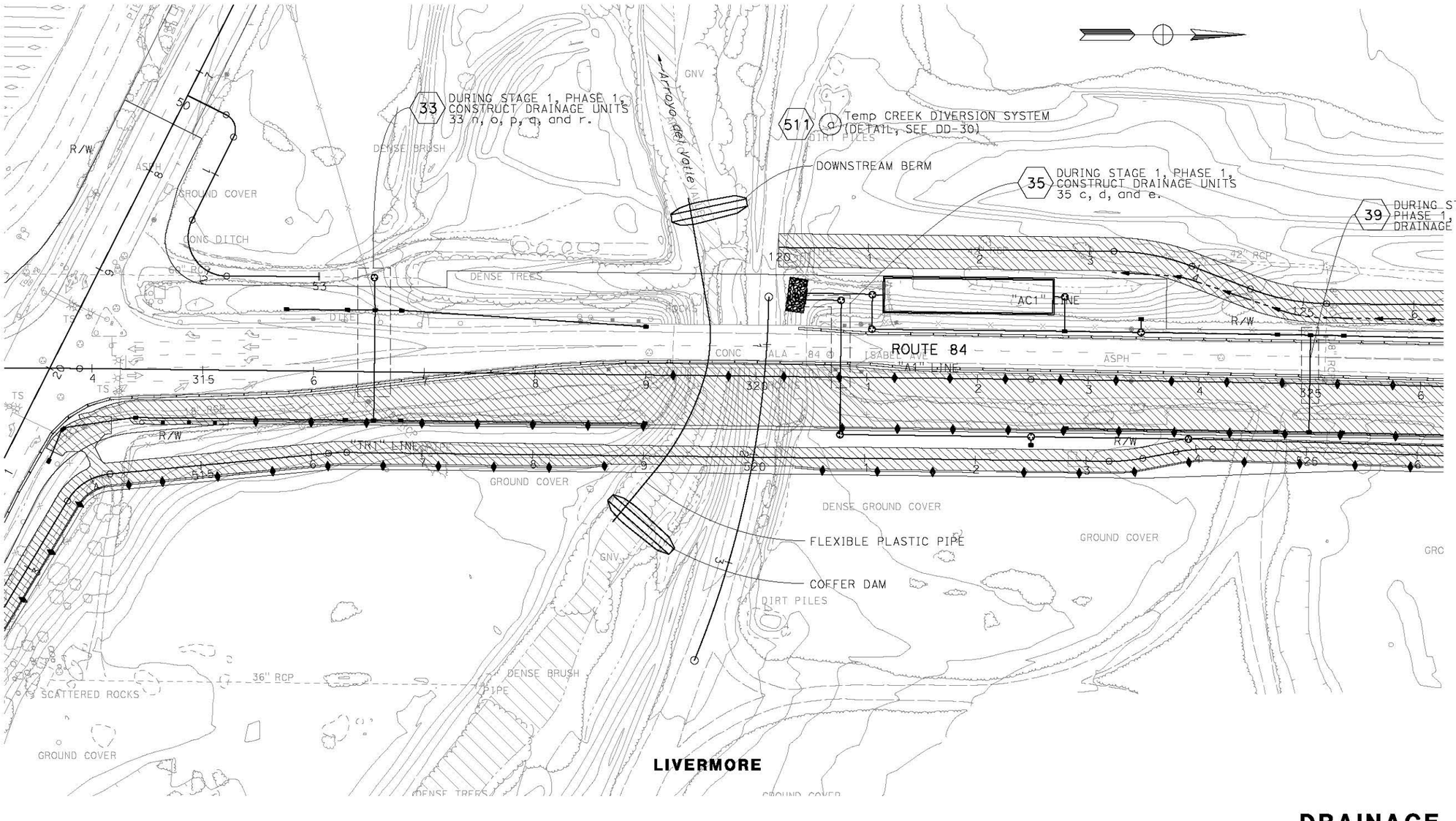

DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1'' = 50'

APPROVED FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-15

D-22

AC	09/10/14	JENNIFER ABRAMS	CALCULATED-DESIGNED BY
AC	05/30/14	ANALETTE OCHOA	CHECKED BY
EC	12/28/10	HAN-BIN LIANG	CONSULTANT FUNCTIONAL SUPERVISOR
REVISED BY	DATE REVISED		

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 9/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
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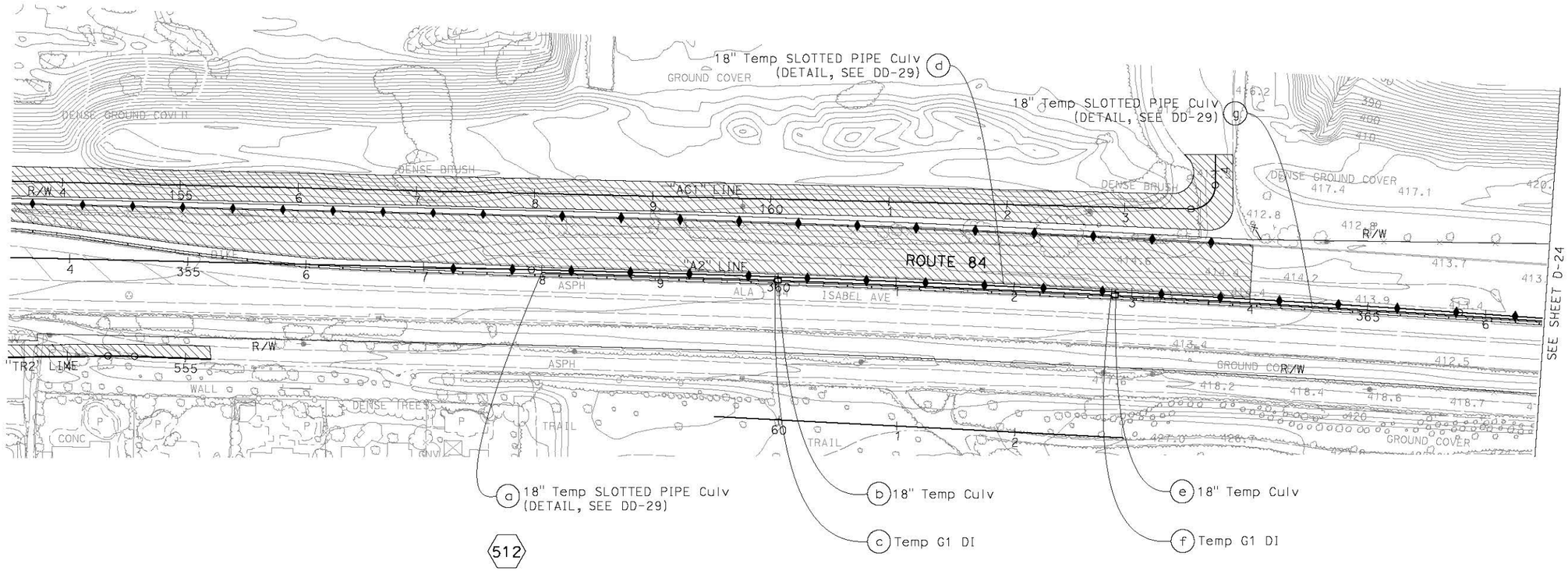

LIVERMORE

DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1'' = 50'

APPROVED FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-15

D-23

CALCULATED-DESIGNED BY	JENNIFER ABRAMS
CHECKED BY	ANALETTE OCHOA
CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG
REVISED BY	EC / AC / AC
DATE REVISED	12/28/10 / 05/30/14 / 09/10/14

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 9/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/14
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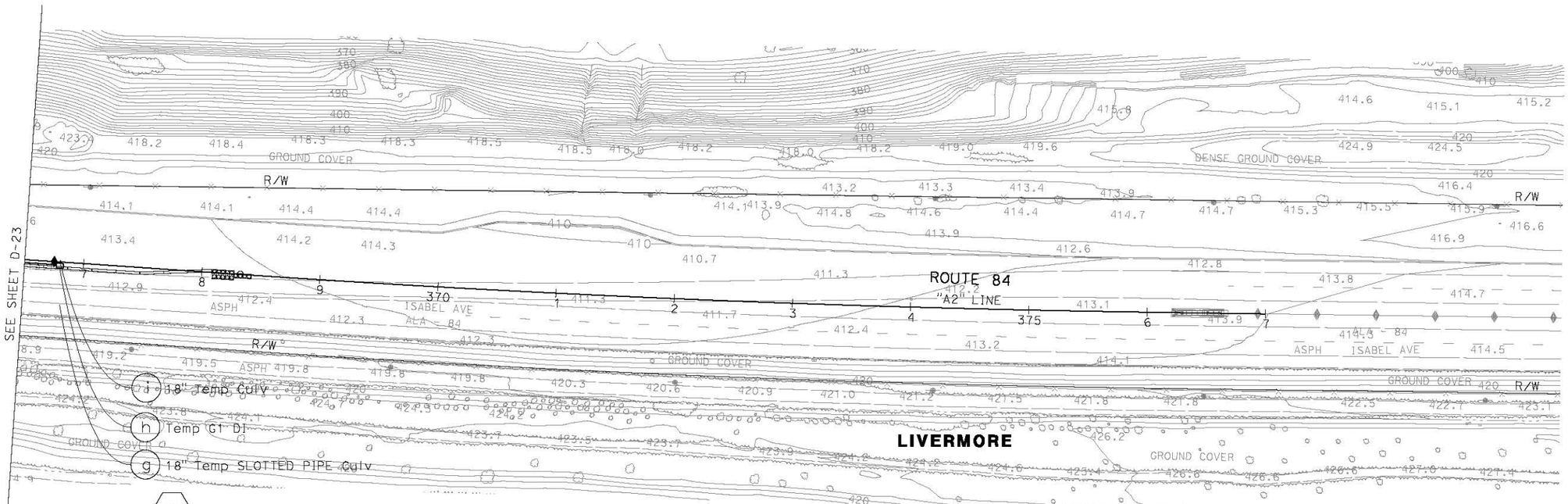

DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 1)

SCALE: 1'' = 50'

APPROVED FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-15

D-24

REVISED BY	AC	AC	EC	JENNIFER ABRAMS	CALCULATED-DESIGNED BY
DATE REVISED	09/10/14	05/30/14	12/28/10	ANALETTE OCHOA	CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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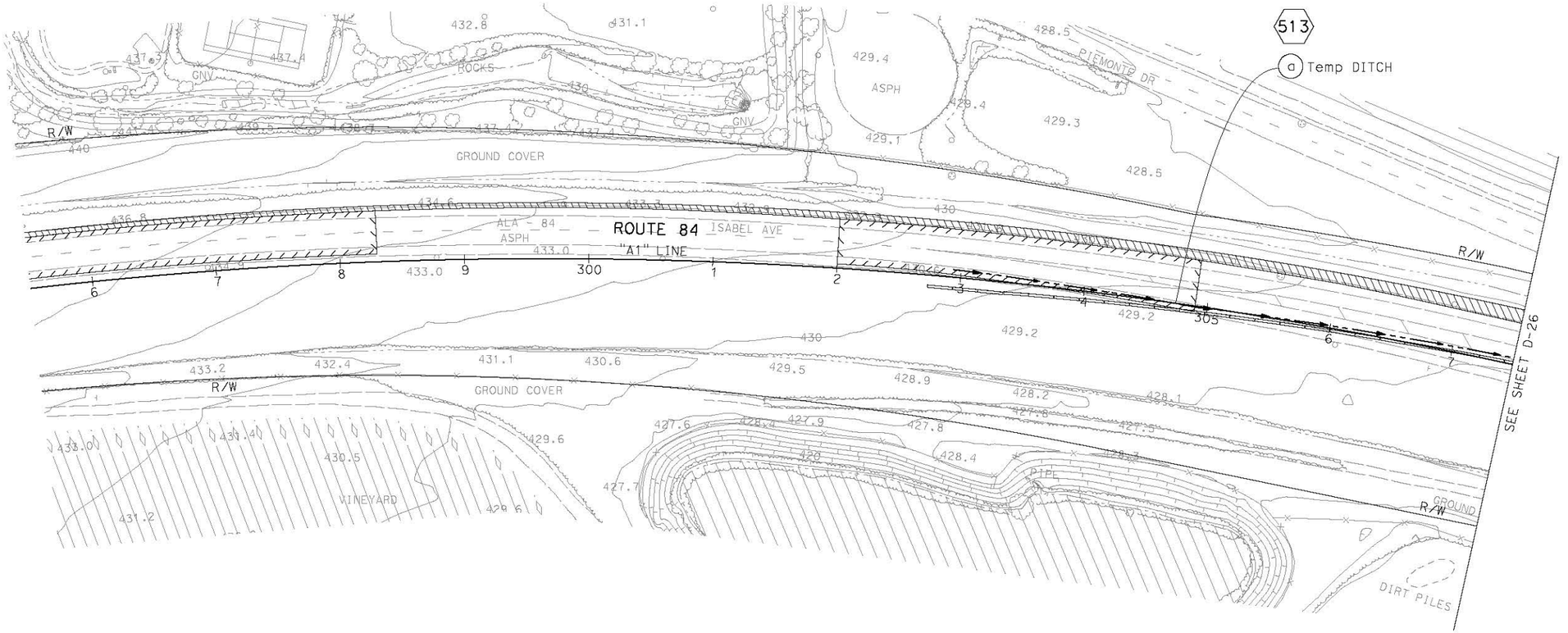

LIVERMORE

DRAINAGE PLAN TEMPORARY DRAINAGE (STAGE 3)

SCALE: 1'' = 50'

APPROVED FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-15

D-25

AC	AC	EC
09/10/14	05/30/14	12/28/10

REVISED BY: JENNIFER ABRAMS
DATE REVISED: ANALETTE OCHOA
CALCULATED-DESIGNED BY:
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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
04	Ala	84	22.9/25.7		

Analette Ochoa 9/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp. 12/31/14
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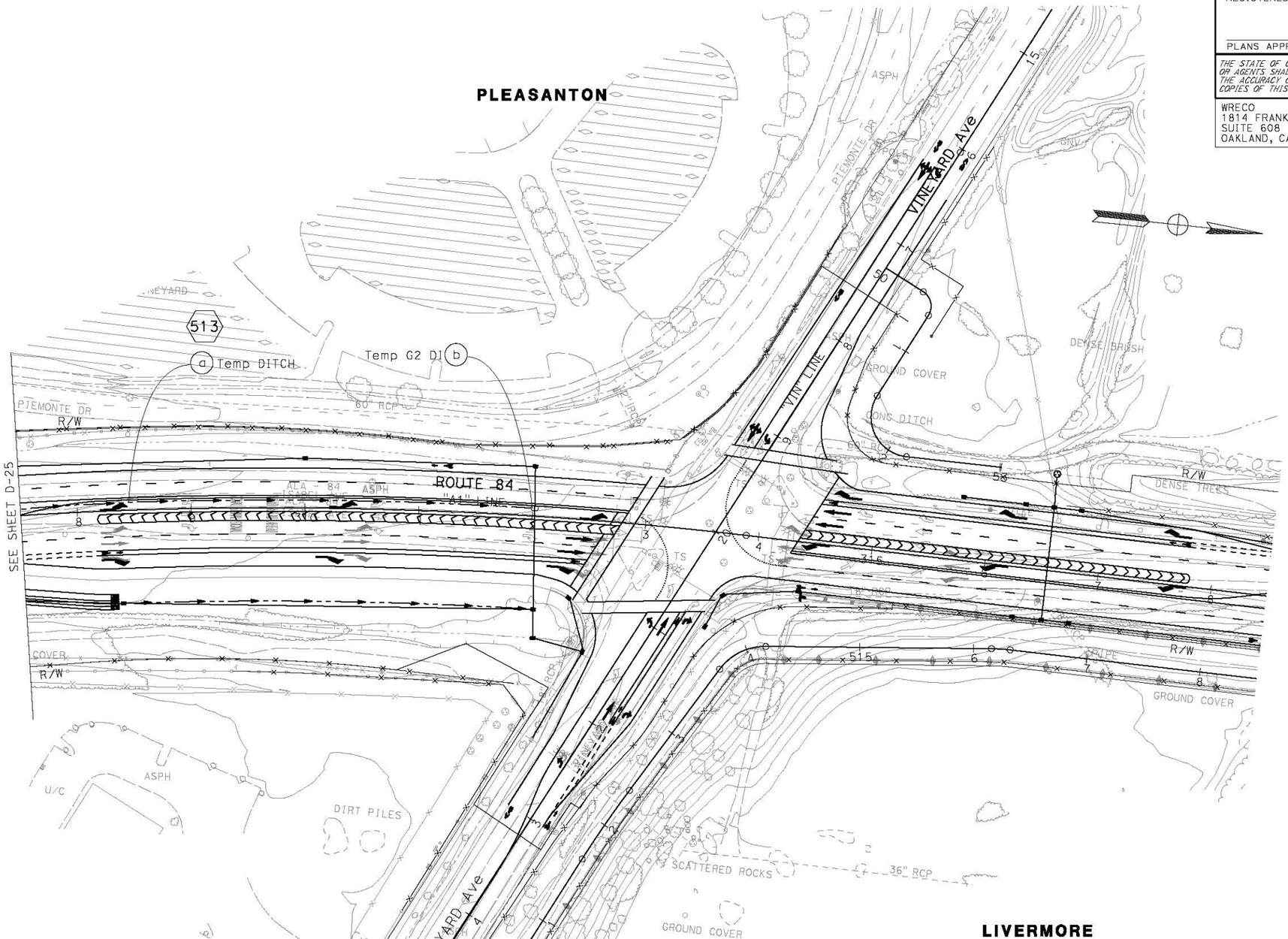

DRAINAGE PLAN
TEMPORARY DRAINAGE
(STAGE 3)

SCALE: 1'' = 50'

APPROVED FOR DRAINAGE WORK ONLY

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET D-15

D-26

CALCULATED-DESIGNED BY	JENNIFER ABRAMS	REVISED BY	EC	AC	AC
CHECKED BY	ANALETTE OCHOA	DATE REVISED	12/28/10	05/30/14	09/10/14

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 09/10/14
REGISTERED CIVIL ENGINEER — DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

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DATE REVISED	REVISED BY	CHECKED BY	CALCULATED-DESIGNED BY
09/10/14	AC	ANALETTE OCHOA	JENNIFER ABRAMS
05/30/14	AC		
10/19/10	IL		

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

50.41' Lt "A1" 231+00
TG 573.78
Exist DITCH
OG
a G2 DI W/ PCC APRON
GRATE TYPE 24-12X
FG
OG
1.89%
FL 568.74
b 18" x 197.1' APC (A)

46.70' Lt "A1" 233+00
TG 570.53
c G2 DI W/
INLET DEPRESSION
GRATE TYPE 24-12X
FG
OG
2.47%
FL 565.02
FL 564.92
d 18" x 76.0' APC (A)

58.39' Lt "A1" 233+78
TG 569.06
G2 DI
e
GRATE TYPE 24-12X
2.52%
FL 563.04
FL 562.94
18" x 34.1' APC (A) f

35.10' Rt "R" 9+24
TG 567.92
G2 DI
g
GRATE TYPE 24-12X
m REMOVE DI
0.60%
FL 562.08
FL 561.98
n

33.86' Rt "R" 8+59
TG 568.69
G2 DI W/
INLET DEPRESSION
GRATE TYPE 24-12X
k
OG
1.79%
FL 563.26
18" x 40.8' APC (A) j

33.84' Rt "R" 9+03
TG 567.31
G2 DI
l
GRATE TYPE 24-12X
FG
1.86%
FL 562.53
FL 562.43
24" HP GAS
FL 562.08
h 18" x 18.8' APC (A)

IDENTICAL

32.92' Lt "R" 8+59
TG 568.61
G2 DI
r
GRATE TYPE 24-12X
OG
3.33%
FL 563.18
18" x 40.8' APC (A) s

41.51' Lt "R" 9+02
TG 566.70
G2 DI W/ INLET DEPRESSION
GRATE TYPE 24-12X
t
FG
1.33%
FL 561.82
FL 561.72
24" HP GAS
FL 561.48
18" x 18.1' APC (A) u

74.04' Lt "A1" 234+94
TG 567.34
"R" LINE
G2 DI
q
GRATE TYPE 24-12X
FG
OG
0.60%
FL 561.48
FL 561.34
o 24" x 83.9' APC (B)

70.35' Lt "A1" 235+18
TG 567.26
G2W DI
w
GRATE TYPE 24=12X
(DETAIL SEE DD-10)
1.00%
FL 561.14
1.12%
FL 561.04
24" x 20.1' APC (A) v

55.96' Lt "A1" 238+50
TG 564.96
gg G2 MH
FRAME AND COVER
TYPE U45
(DETAIL SEE DD-4)
FG
OG
0.97%
FL 557.32
FL 557.22
z 24" x 332.3' APC (A)

IDENTICAL

52.90' Lt "A1" 240+31
TG 560.47
C1 D1
ad
GRATE TYPE 24-12X
(SEE DD-7)
7.87%
OG
FL 556.50
af
12" x 8.9' WSP ae
FL 555.80

IDENTICAL

76.28' Lt "A1" 235+18
TG 571.22
RW #236
G2 D1
x
GRATE TYPE 24-12X
(SEE DD-7)
w
OG
FL 567.51
z
12" x 5.7' WSP y
FL 565.00

IDENTICAL, SEE SHEET DP-2

39.74' Lt "A1" 240+31
TG 560.24
ac G2 MH
FRAME AND COVER
TYPE U45
(DETAIL SEE DD-4)
FG
OG
0.97%
FL 555.42
FL 555.32
ab 24" x 185.3' APC (A)
24" x 36.0' APC (A) af
FL 554.48
Exist 24" RCP

45.00' Lt "A1" 240+72
TG 558.96
gg G2 MH
FRAME AND COVER
TYPE U45
(DETAIL SEE DD-4)
2.33%
FL 546.50

45.00' Lt "A1" 242+15
TG 555.67
G2 MH
aj
FRAME AND COVER TYPE U45
(DETAIL SEE DD-4)
FG
OG
5.58%
FL 538.55
ak
ai 42" x 142.5' APC

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DRAINAGE SYSTEM No. 1

DP-1

LAST REVISION DATE PLOTTED => 9/9/2014
09-10-14 TIME PLOTTED => 4:56:53 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 09/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

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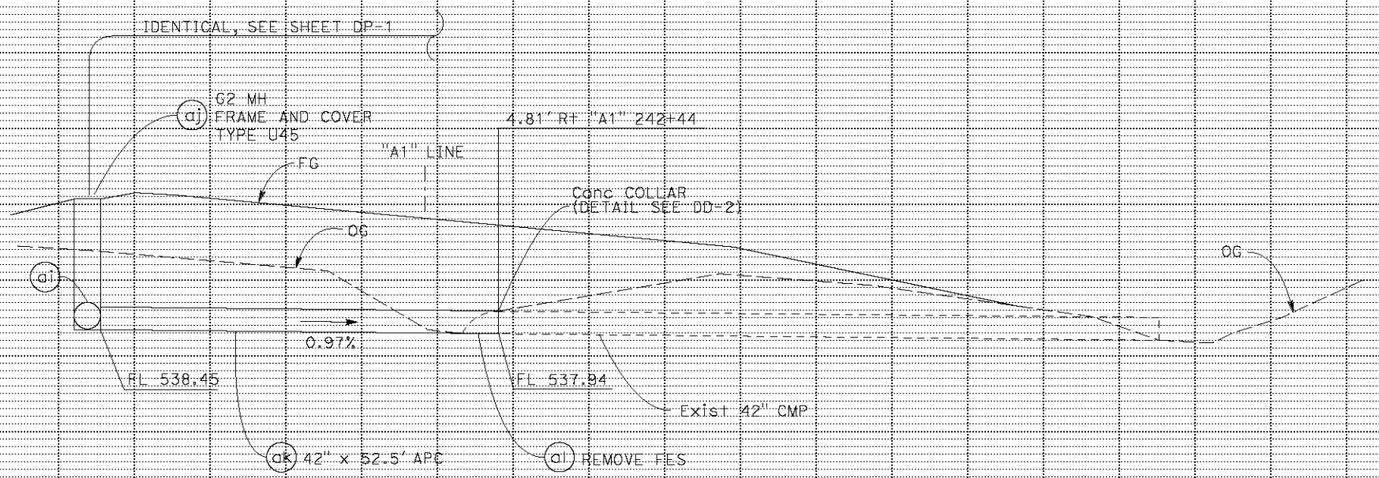
REVISED BY	DATE REVISED
IL	10/19/10
AC	05/30/14
AC	09/10/14

CALCULATED-DESIGNED BY: JENNIFER ABRAMS
CHECKED BY: ANALETTE OCHOA

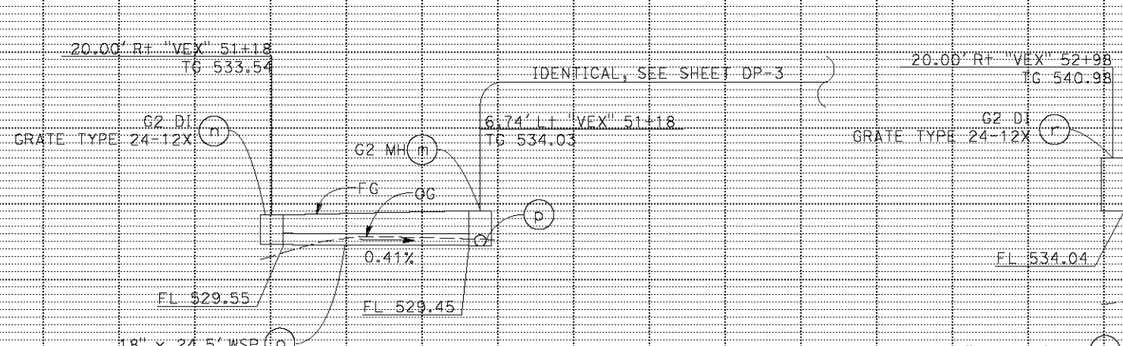
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

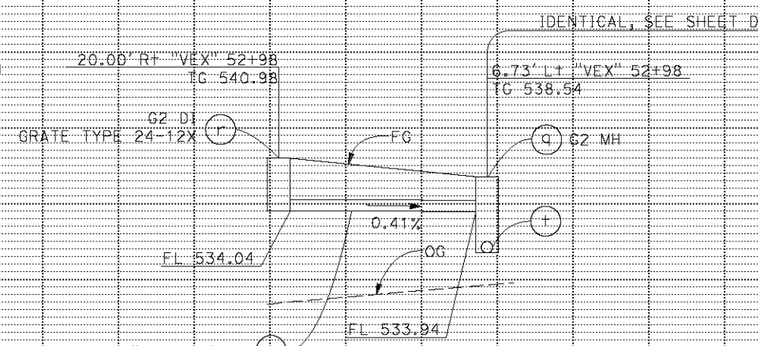
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

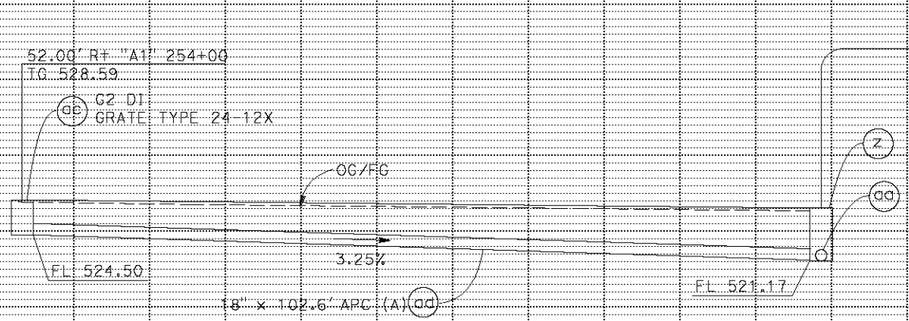
Caltrans

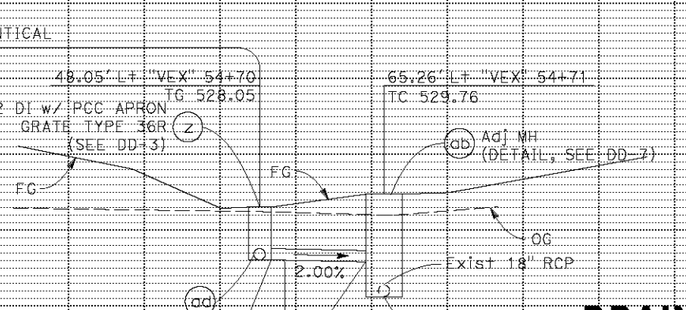


DRAINAGE SYSTEM No. 1









DRAINAGE SYSTEM No. 6

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-2

LAST REVISION DATE PLOTTED => 9/9/2014
09-10-14 TIME PLOTTED => 4:57:24 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib002.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		

Analette Ochoa
REGISTERED CIVIL ENGINEER — 09/10/14 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

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ALAMEDA COUNTY
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OAKLAND, CA 94607

REVISED BY	DATE REVISED
JENNIFER ABRAMS	10/19/10
ANALETTE OCHOA	05/30/14
	09/10/14

CALCULATED-DESIGNED BY: AC
CHECKED BY: IL, AC

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

49.70' Rt "A1" 245+98
TG 536.94
(a) G2 DI
GRATE TYPE 24-12X
FG
OG
0.51%
FL 532.64
FL 532.39
18" x 49.1' APC (B) (b)

49.70' Rt "A1" 246+50
TG 536.06
(c) G2 DI
GRATE TYPE 24-12X
FG
Conc Bkf 57'
0.51%
OG
FL 532.29
(d) 18" x 77.1' APC (B)
w/ Conc Bkf
(DETAIL, SEE DD-4)

30.63' Rt "A1" 247+30
TG 534.97
(e) GDOM DI
GRATE TYPE 24-12X
(DETAIL, SEE DD-3)
FG
OG
FL 531.90
FL 531.80
0.48%
18" x 27.1' APC (B) (f)
w/ Conc Bkf
(DETAIL, SEE DD-4)

51.87' Rt "A1" 247+60
TG 534.68
(g) GDOM DI
GRATE TYPE 24-12X
(DETAIL, SEE DD-3)
FG
OG
FL 531.57
FL 531.67
0.50%
18" x 236.9' APC (B) (h)
w/ Conc Bkf
(DETAIL, SEE DD-4)

A
A

20.00' Rt "VEX" 50+00
TG 533.20
FG
OG
(n) G2 DI
GRATE TYPE 24-12X
0.50%
FL 530.38
(n) 18" x 236.9' APC (B)
w/ Conc Bkf
(DETAIL, SEE DD-4)

3.17' Rt "VEX" 50+00
TG 533.53
IDENTICAL
(k) G2 MH
FG
OG
FL 530.26
1.30%
18" x 11.5' WSP
w/ Conc Bkf (j)
(DETAIL, SEE DD-4)
FL 530.13

IDENTICAL, SEE SHEET DP-2

6.95' Lt "VEX" 51+18
TG 534.03
G2 MH (m)
(k)
FG
OG
0.52%
FL 530.03
FL 529.45
18" x 112.3' APC (B) (l)

IDENTICAL, SEE SHEET DP-2

6.73' Rt "VEX" 52+98
TG 538.54
G2 MH (q)
FG
OG
0.15%
FL 529.35
18" x 177.1' APC (B) (p)
FL 529.08

IDENTICAL

45.12' Lt "VEX" 53+76
(w) 18" AFES
(x) RSP
(DETAIL, SEE DD-5)
(r)
FG
OG
0.14%
(y) BIOFILTRATION SWALE
(DETAIL, SEE DD-6)
FL 529.01
FL 529.00
(v) 18" x 7.0' APC (B)

IDENTICAL

44.92' Lt "VEX" 53+67
TG 533.38
(u) CMP DI
w/ PCC APRON
GRATE TYPE 24-12X
FG
OG
0.09%
FL 529.10
(t) 18" x 74.8' APC (B)
FL 529.08

IDENTICAL

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DRAINAGE SYSTEM No. 6

DP-3

LAST REVISION | DATE PLOTTED => 9/9/2014
09-10-14 | TIME PLOTTED => 4:58:04 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib003.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		

Analette Ochoa — 09/10/14
REGISTERED CIVIL ENGINEER — DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

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OAKLAND, CA 94607

DATE REVISED	REVISED BY	CALCULATED-DESIGNED BY	CHECKED BY
09/10/14	AC	JENNIFER ABRAMS	ANALETTE OCHOA
05/30/14	AC		
10/19/10	IL		

CONSULTANT FUNCTIONAL SUPERVISOR — HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

IDENTICAL

48.65' Lt "A1" 245+98
TG 543.42
G1 DI
GRATE TYPE 24-12
(DETAIL, SEE DD-7)
FL 538.90
18" x 2.9' WSP
FL 535.11

45.00' Lt "A1" 245+98
TG 542.20
G2 DI
GRATE TYPE 24-12X
FG
OG
FL 538.93
30.0%

IDENTICAL

48.77' Lt "A1" 246+40
TG 542.15
G1 DI
GRATE TYPE 24-12
(DETAIL, SEE DD-7)
FL 540.15
0.46%
12" x 39.2' WSP
FL 538.90
FL 539.97

81.25' Lt "A1" 244+85
TG 539.31
GMP DI w/ PCC APRON
GRATE TYPE 36R
(DETAIL, SEE DD-3)
0.50%
0.50%
3.28%
FL 535.81
FL 535.21
FL 535.11
18" x 120.3' APC (B)

45.00' Lt "A1" 249+00
TG 530.37
G2 DI
GRATE TYPE 24-12X
3.28%
3.34%
FL 525.30
FL 525.20
18" x 299.3' APC (A)

48.00' Lt "A1" 251+38
TG 522.33
G2 DI
GRATE TYPE 24-12X
3.34%
0.31%
FL 517.60
FL 517.50
18" x 227.6' APC (A)

48.00' Lt "A1" 253+00
TG 520.81
G2 DI
GRATE TYPE 24-12X
0.31%
0.31%
FL 517.04
FL 516.94
18" x 150.2' APC (B)

48.00' Lt "A1" 254+75
TG 519.96
48.00' Lt "A1" 254+47
TG 519.93
48.00' Lt "A1" 254+25
TG 519.95
G2 DI
GRATE TYPE 24-12X
0.31%
0.33%
0.31%
FL 516.59
FL 516.49
FL 516.43
FL 516.33
Conc Bkf
12'
8" PP & 8" PPP UD
(SEE SB SHT)
18" x 18.3' APC (B)
w/ Conc Bkf
(DETAIL, SEE DD-4)
18" x 22.3' APC (B)
w/ Conc Bkf
(DETAIL, SEE DD-4)
FL 516.26

IDENTICAL

17.00' Lt "A1" 254+87
RW No. 246
"A1" LINE
Conc Bkf
5'
0.14%
0.14%
FL 516.16
30" x 32.6' APC (B)
w/ Conc Bkf
(DETAIL, SEE DD-4)

168.77' Rt "A1" 255+34
TG 522.55
G2 DI w/ PCC APRON
GRATE TYPE 24-12X
(DETAIL, SEE DD-3)
30" x 133' JACKED RCP
FL 515.92
FL 515.82

44.00' Lt "V" 102+34
TG 530.12
G2 DI
GRATE TYPE 24-12X
0.16%
0.15%
30" x 89.7' APC (B)
FL 515.68
FL 515.58

32.46' Lt "V" 103+67
TC 531.90
G2 DI
GRATE TYPE 24-12X
0.15%
0.15%
0.15%
0.15%
30" x 118' APC (B)
FL 515.40
FL 515.30
30" x 161' APC (B)

82.39' Lt "V" 105+46
30" AFES
RSP
(DETAIL, SEE DD-5)
BIOFILTRATION SWALE
(DETAIL, SEE DD-6, DD-8)
FL 515.06

DRAINAGE SYSTEM No. 4

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-4

LAST REVISION DATE PLOTTED => 9/9/2014
09-10-14 TIME PLOTTED => 4:58:19 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib004.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		

Analette Ochoa — REGISTERED CIVIL ENGINEER — 09/10/14 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

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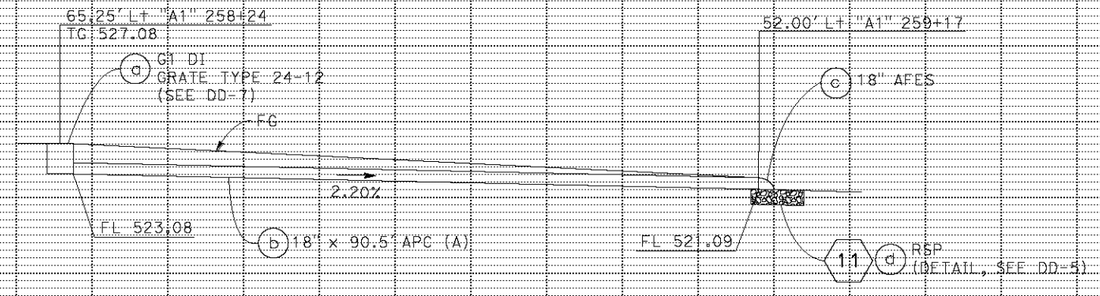
OAKLAND, CA 94607

DATE REVISED	REVISED BY	CALCULATED-DESIGNED BY	CHECKED BY
09/10/14	AC	JENNIFER ABRAMS	ANALETTE OCHOA
05/30/14	AC		
10/19/10	IL		

CONSULTANT FUNCTIONAL SUPERVISOR — HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans



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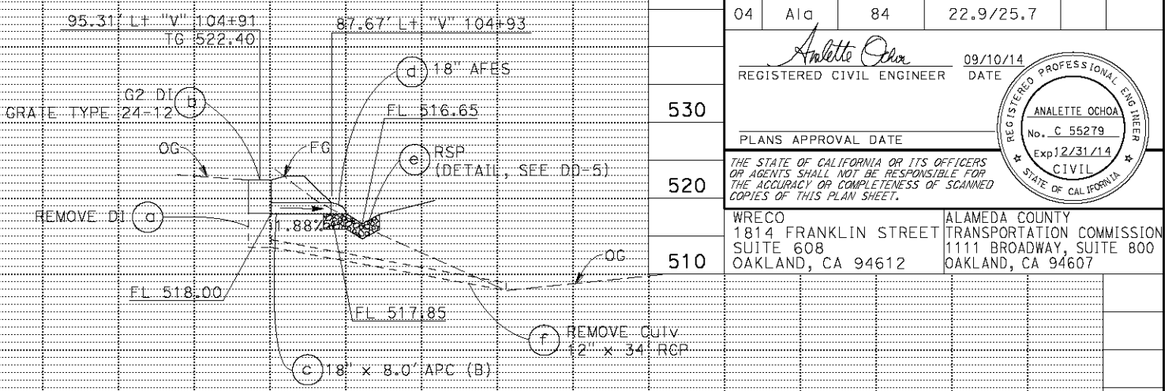

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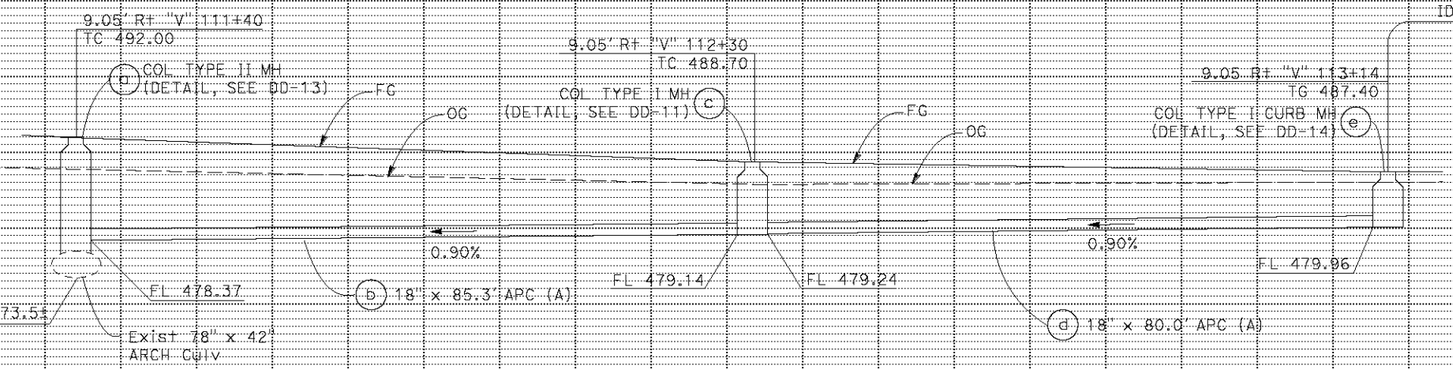

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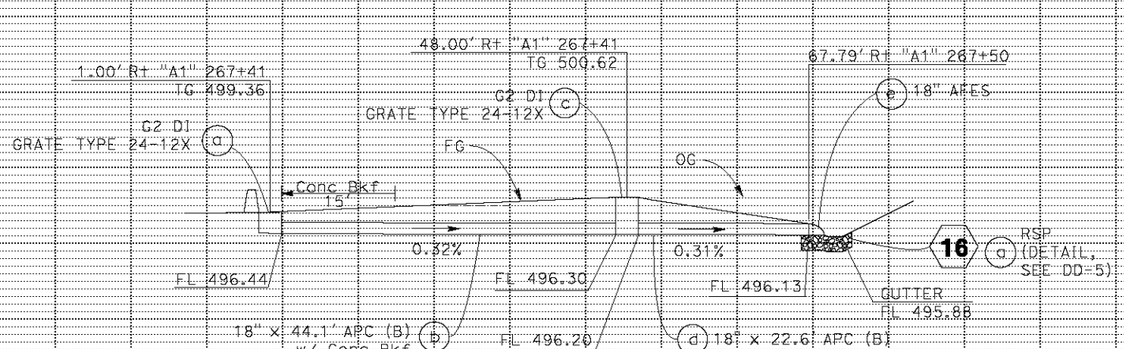

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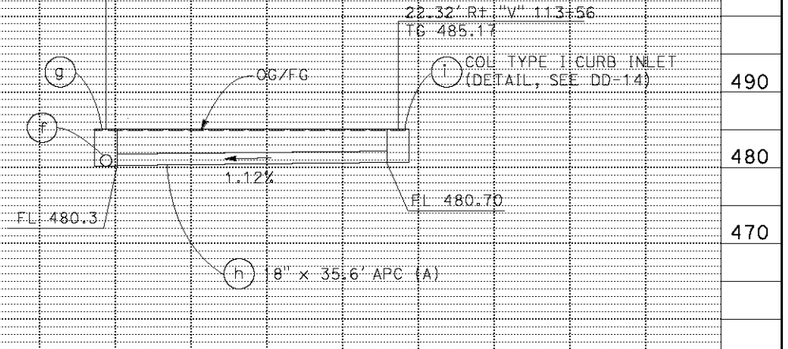

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-5

LAST REVISION DATE PLOTTED => 9/9/2014
09-10-14 TIME PLOTTED => 4:59:28 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib005.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		

Analette Ochoa — 09/10/14
REGISTERED CIVIL ENGINEER — DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

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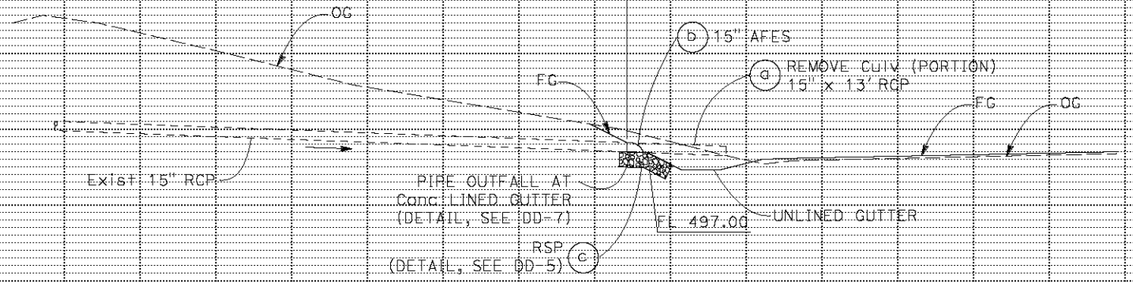
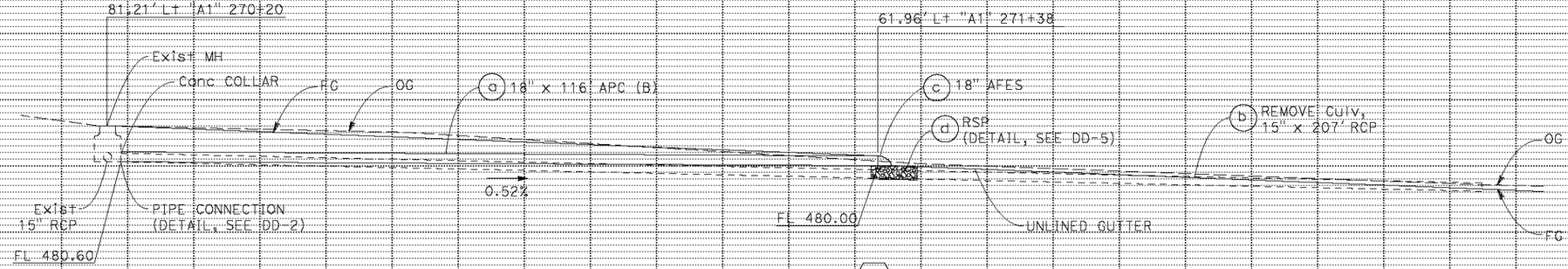
66.70' Lt "A1" 267+47



DRAINAGE SYSTEM No. 15

81.21' Lt "A1" 270+20

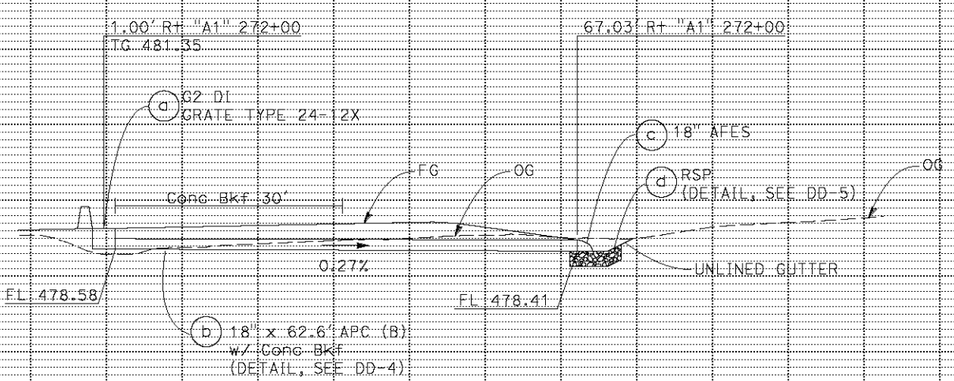
61.96' Lt "A1" 271+38



DRAINAGE SYSTEM No. 17

1.00' Rt "A1" 272+00
TG 481.35

67.03' Rt "A1" 272+00



DRAINAGE SYSTEM No. 18

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-6

DESIGNED BY	DRAWN BY	CHECKED BY	DATE REVISED	REVISED BY
JENNIFER ABRAMS	ANALETTE OCHOA	IL	10/19/10	AC 05/30/14
				AC 09/10/14

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Gibbons

LAST REVISION DATE PLOTTED => 9/9/2014
09-10-14 TIME PLOTTED => 4:59:42 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib006.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		

Analette Ochoa — 09/10/14
REGISTERED CIVIL ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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REVISED BY	DATE REVISED
JENNIFER ABRAMS	10/19/10
ANALETTE OCHOA	05/30/14
IL	09/10/14
AC	
AC	

CALCULATED-DESIGNED BY
CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR
HAN-BIN LIANG

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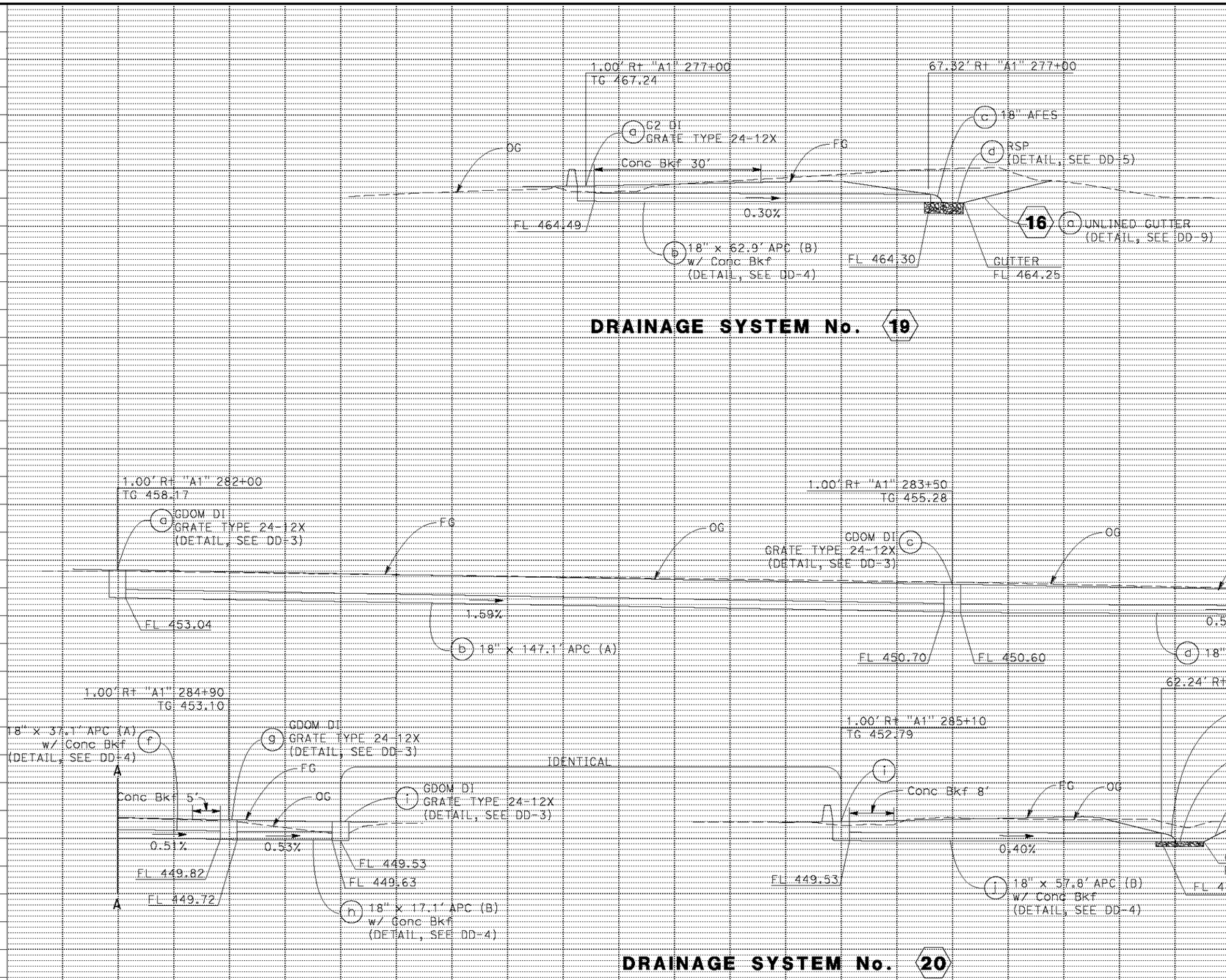
Caltrans



DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-7

LAST REVISION DATE PLOTTED => 9/9/2014
09-10-14 TIME PLOTTED => 4:59:55 PM

BORDER LAST REVISED 7/2/2010
USERNAME => andrew_chin
DGN FILE => ...\Dwg\prof\429760ib007.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		

Analette Ochoa 09/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

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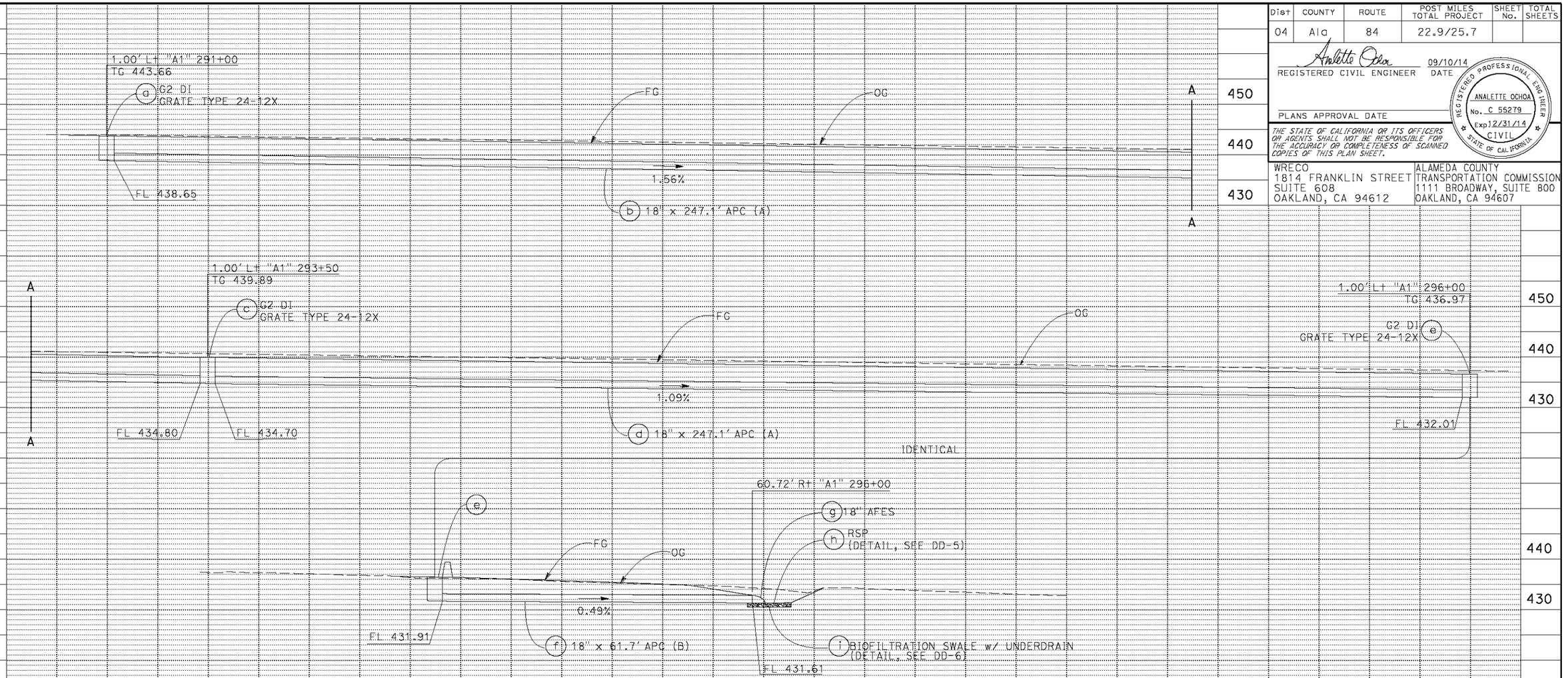

DRAINAGE SYSTEM No. 22

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-8

REVISED BY	DATE REVISED
JENNIFER ABRAMS	10/19/10
ANALETTE OCHOA	05/30/14
	09/10/14

CALCULATED-DESIGNED BY: AC
CHECKED BY: AC

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 09-10-14
DATE PLOTTED => 9/9/2014
TIME PLOTTED => 5:00:07 PM

BORDER LAST REVISED 7/2/2010
USERNAME => andrew_chin
DGN FILE => ...\Dwg\prof\429760ib008.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		

Analette Ochoa 09/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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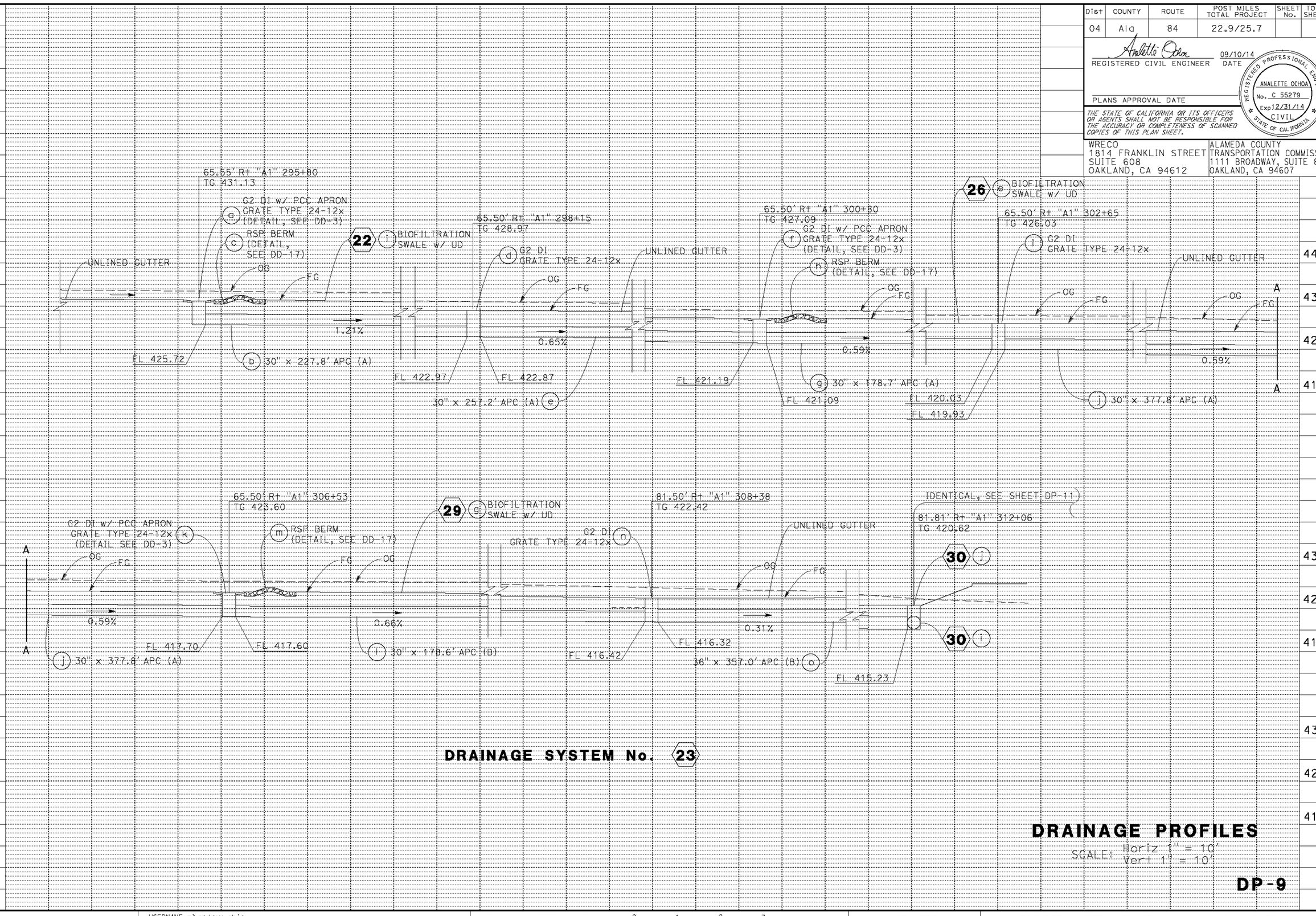
REVISED BY	DATE REVISED
AC	09/10/14
AC	05/30/14
IL	10/19/10

JENNIFER ABRAMS
ANALETTE OCHOA
CALCULATED-DESIGNED BY
CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR
HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans



DRAINAGE SYSTEM No. 23

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-9

LAST REVISION 09-10-14 | DATE PLOTTED => 9/9/2014 | TIME PLOTTED => 5100:27 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib009.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		

Analette Ochoa 09/10/14
REGISTERED CIVIL ENGINEER — DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

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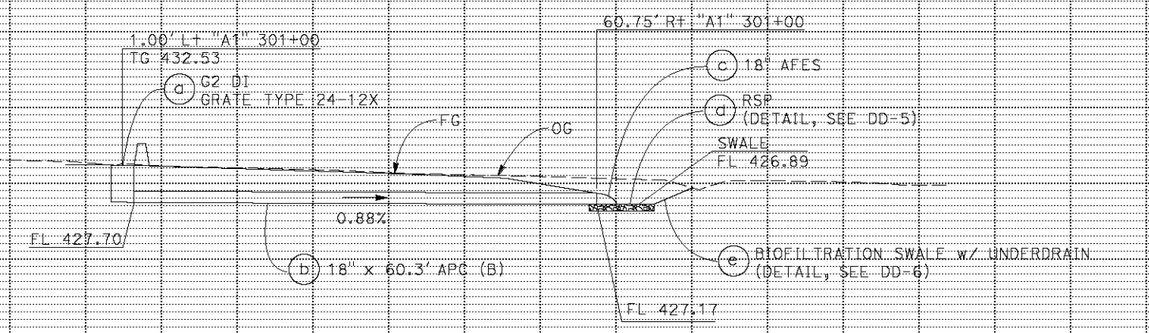
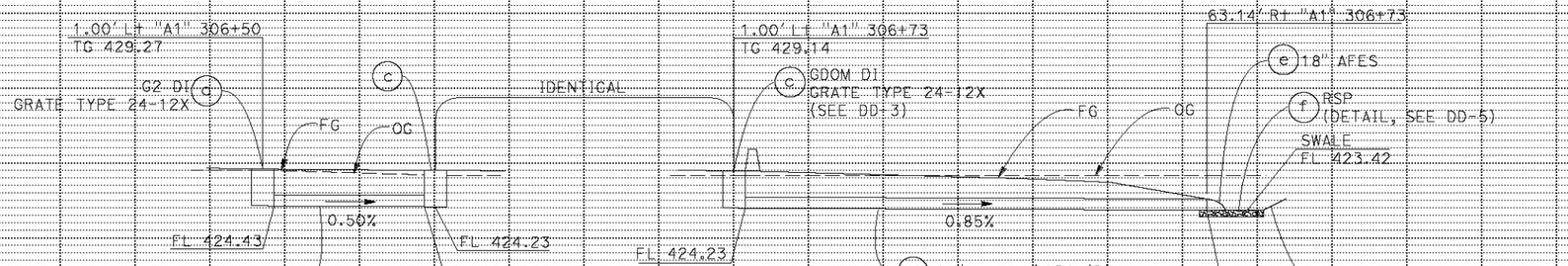


DRAINAGE SYSTEM No. 26



DRAINAGE SYSTEM No. 29

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-10

REVISED BY	DATE REVISED
JENNIFER ABRAMS	10/19/10
IL	05/30/14
AC	09/10/14
AC	

CALCULATED-DESIGNED BY: ANALETTE OCHOA
CHECKED BY:

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION DATE PLOTTED => 9/9/2014
09-10-14 TIME PLOTTED => 3:00:40 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib010.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		

Analette Ochoa — 09/10/14
REGISTERED CIVIL ENGINEER — DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

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DATE REVISED	REVISED BY	CALCULATED-DESIGNED BY	CHECKED BY
09/10/14	AC	JENNIFER ABRAMS	ANALETTE OCHOA
05/30/14	AC		
10/19/10	IL		

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

68.15' Lt "A1" 307+36
TG 425.44
c G2 DI
GRATE TYPE 24-12X
d G2 DI w/ PCC APRON GRATE TYPE 24-12X (DETAIL SEE DD-3)
0.51%
FL 420.60
FL 420.71
b 36" x 21.5' APC (A)

45.00' Lt "A1" 307+36
TG 429.89
c
IDENTICAL
FL 420.50
FG
OG
0.50%
d 36" x 264.2' APC (A)

45.00' Lt "A1" 310+00
TG 428.86
e G2 DI
GRATE TYPE 24-12X
FL 419.18
FL 419.08
0.50%
f 36" x 199.5' APC (A)

45.00' Lt "A1" 312+00
TG 428.01
2" PG&E GAS LINE
g G2 DI
GRATE TYPE 24-12X
0.50%
IDENTICAL
FL 418.08
f 36" x 199.5' APC (A)

"A1" LINE
32.40' Rt "A1" 312+04
g
FL 417.98
h 36" x 78.0' JACKED RCP

IDENTICAL, SEE SHEET DP-9
81.81' Rt "A1" 312+06
TG 420.62
G2 DI w/ PCC APRON GRATE TYPE 24-12X (DETAIL SEE DD-3)
j
2.23%
2.23%
FL 416.24
FL 415.23
36" x 45.1' APC (A) j
FL 415.13
36" x 22.0' APC (A) k

106.85' Rt "A1" 312+07
TG 420.50
j G2 DI w/ PCC APRON GRATE TYPE 24-12X (DETAIL SEE DD-3)
m
1.32%
FL 414.84
FL 414.74

IDENTICAL

42.80' Rt "VIN" 21+52
TG 425.31
l PROPOSED 18" SEWER
G2 DI
GRATE TYPE 24-12X
k
0.50%
FL 414.74
FL 414.53
FL 414.43
36" x 42.3' APC (A) m

71.64' Rt "VIN" 21+21
TG 424.26
o G2 DI
GRATE TYPE 24-12X
n
1.22%
FL 420.51
FL 420.01
18" x 41.0' APC (A) p
IDENTICAL
FL 414.43

PIPE CONNECTION (DETAIL, SEE DD-2)
4" GAS
24" GAS
PROPOSED 18" SEWER
0.50%
FL 414.00
FL 413.07±
g 36" x 86.0' APC (A)

37.15' Rt "VIN" 22+41
Exist DI
Exist 36" RCP
Exist 18" RCP

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DRAINAGE SYSTEM No. 30

DP-11

LAST REVISION | DATE PLOTTED => 9/9/2014
09-10-14 | TIME PLOTTED => 5101:37 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib011.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		

Analette Ochoa — 09/10/14
REGISTERED CIVIL ENGINEER — DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

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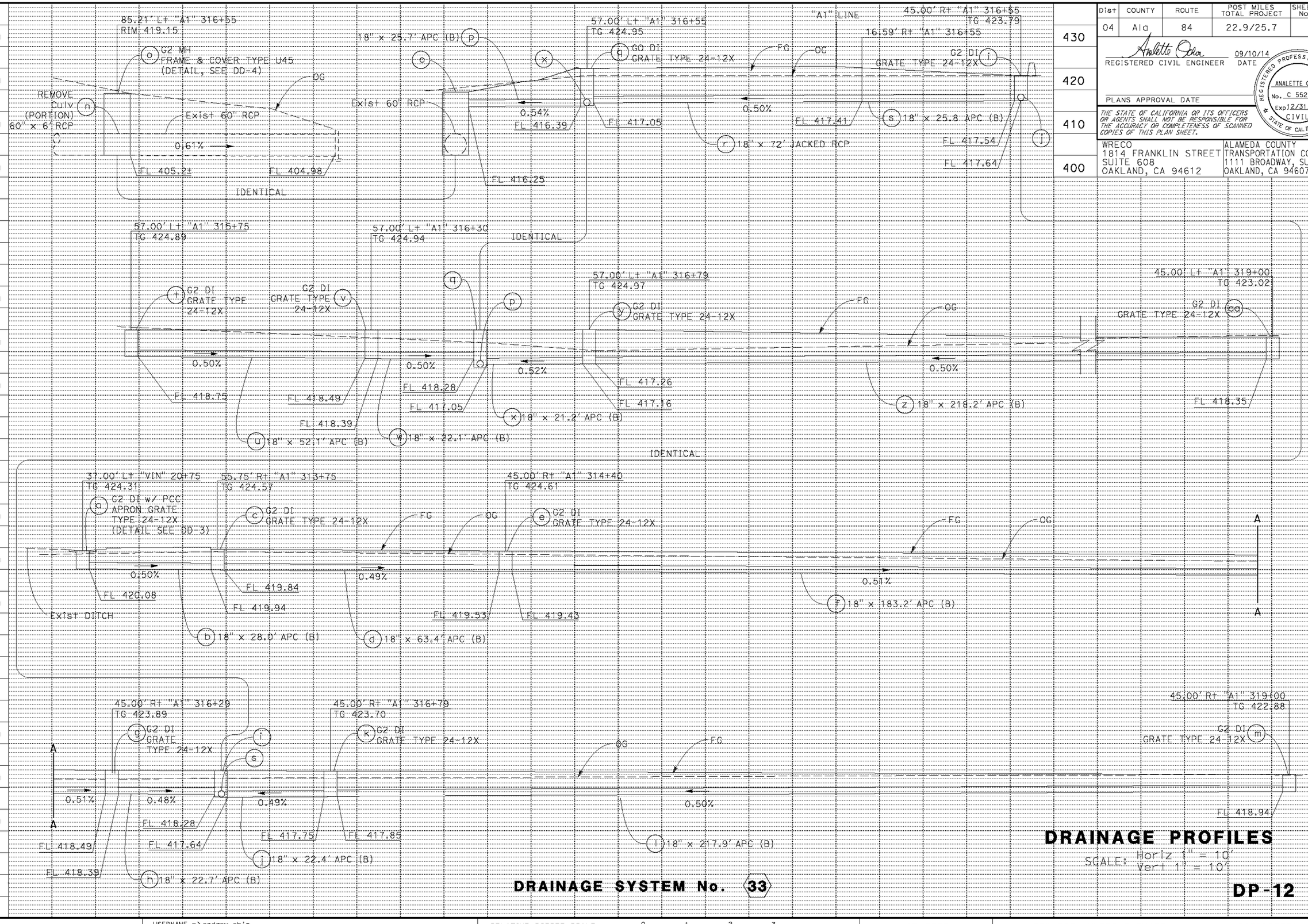

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DRAINAGE SYSTEM No. 33

DP-12

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
CALCULATED-DESIGNED BY: JENNIFER ABRAMS
CHECKED BY: ANALETTE OCHOA

DATE REVISED	REVISED BY
09/10/14	AC
05/30/14	AC
10/19/10	IL

LAST REVISION DATE PLOTTED => 9/9/2014
09-10-14 TIME PLOTTED => 5101:50 PM

BORDER LAST REVISED 7/2/2010
USERNAME => andrew_chin
DGN FILE => ...\Dwg\prof\429760ib012.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		

Analette Ochoa — 09/10/14
REGISTERED CIVIL ENGINEER — DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

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REVISED BY	DATE REVISED
AC	09/10/14
AC	05/30/14
IL	10/19/10

JENNIFER ABRAMS
ANALETTE OCHOA

CALCULATED-DESIGNED BY
CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR
HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

AUTOMATIC DRAINAGE GATE (DETAIL, SEE DD-16)
RSP (DETAIL, SEE DD-16)
69.65' Lt "A1" 320+43
FW 411.43
69.46' Lt "A1" 320+76
TC 421.70
3.10' Lt "A1" 320+76
51.75' Rt "A1" 320+76
TC 423.70
COL TYPE II MH (DETAIL, SEE DD-13)
HW
FG
OG
0.10%
0.11%
FL 404.18
FL 404.21
FL 404.34
a 42" x 30.2' APC
e 42" x 58.4' JACKED RCP
f 42" x 56.9' APC
42" x 168.6' APC h
51.75' Rt "A1" 322+48
TC 419.89
51.90' Rt "A1" 323+91
TC 420.32
i COL TYPE II MH (DETAIL, SEE DD-13)
m COL TYPE II MH (DETAIL, SEE DD-13)
h 42" x 168.6' APC
FL 404.51
i 42" x 136.2' APC
24" GAS MAIN
FL 404.65
n 42" x 304.4' APC
IDENTICAL
54.18' Rt "A1" 327+00
TC 422.37
64.07' Rt "A1" 327+56
TC 422.78
COL TYPE II MH (DETAIL, SEE DD-13) o
40
d
q COL TYPE II MH (DETAIL, SEE DD-13)
n 42" x 304.4' APC
FL 404.95
p 42" x 51.2' APC
FL 405.00
r 42" x 487.9' APC
63.90' Rt "A1" 332+50
TC 422.04
b COL FIELD INLET (DETAIL, SEE SHEET DD-12)
r 42" x 487.9' APC
FL 405.49
FL 405.59
t 42" x 494.1' APC
PROPOSED 18" SEWER
58.00' Rt "A1" 322+48
TC 419.14
k COL FIELD INLET (DETAIL, SEE DD-12)
63.72' Rt "A1" 337+50
TC 419.78
u COL TYPE II MH (DETAIL, SEE DD-13)
2.12%
FL 417.25
j 18" x 3.3' APC (A)
FL 417.18
t 42" x 494.1' APC
FL 406.08
FL 406.18
v 42" x 232.3' APC
MATCH LINE SEE SHEET DP-14
IDENTICAL

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DRAINAGE SYSTEM No. 35

DP-13

LAST REVISION 09-10-14 DATE PLOTTED => 9/9/2014 TIME PLOTTED => 5:02:22 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib013.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		

Analette Ochoa 09/12/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

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REVISED BY	DATE REVISED
JENNIFER ABRAMS	10/19/10
ANALETTE OCHOA	05/30/14
AC	09/12/14

CALCULATED-DESIGNED BY
CHECKED BY

SUPERVISOR HAN-BIN LIANG — CONSULTANT FUNCTIONAL

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

65.86' Rt "A1" 339+86
TC 418.00
(am) COL FIELD INLET (DETAIL, SEE DD-12)
MATCH LINE SEE SHEET DP-13
FG
OG
0.10%
FL 406.42
(v) 42" x 232.3' APC
(an) 42" x 161.2' APC

77.90' Rt "A1" 341+51
TC 415.00
(w) COL TYPE II MH (DETAIL, SEE DD-13)
FL 406.58
FL 406.68
0.09%
(o) 40
(x) 42" x 319.7' APC

72.67' Rt "A1" 344+75
TC 418.89
COL TYPE II MH (DETAIL, SEE DD-13) (y)
COL TYPE II CURB INLET (DETAIL, SEE DD-15) (ai)
FL 406.97
FL 407.07
FL 407.10
(aj)
(z) 42" x 32.8' APC
(x) 42" x 319.7' APC

36.29' Rt "CON" 30+94
TC 417.60
"CON" LINE

49.26' Rt "CON" 30+92
TC 418.60
COL TYPE II CURB INLET (DETAIL, SEE DD-15) (ak)
FL 407.17
(ab) 42" x 80.5' APC
42" x 23.3' APC (ai)

89.40' Rt "A2" 346+11
TC 418.61
(ac) COL FIELD INLET (DETAIL, SEE DD-12)
FL 407.29
(ad) 42" x 290.4' APC
FL 407.19

IDENTICAL
PROPOSED 18" SEWER
(ad) 42" x 290.4' APC

85.27' Rt "A2" 349+06
TC 422.21
(ae) COL TYPE II MH (DETAIL, SEE DD-13)
FL 407.55
FL 407.65
(ai) 40
(af) 36" x 328.0' APC (B)

84.77' Rt "A2" 352+38
TC 417.62
(ag) COL TYPE II CURB INLET (DETAIL, SEE DD-15)
FL 408.34
FL 408.44
(af) 36" x 328.0' APC (B)

79.35' Rt "A2" 354+51
TC 419.81±
PIPE CONNECTION (DETAIL, SEE DD-2)
Exist MH
(ah) 36" x 209.1' APC (B)
FL 408.88
40 (dd)
Exist 24" Culv.

IDENTICAL
40 (y)
(ah)
PG&E 6" GAS
35.30' Rt "CON" 31+62
TC 419.39
(ag) COL TYPE I MH (DETAIL, SEE DD-11)
2.09%
Exist 12" RCP
3.36%
(z)
FL 407.10
FL 407.20
(x) REMOVE Culv. 40
FL 409.36
(aj) 18" x 64.3' APC (A)

DRAINAGE SYSTEM No. 35

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-14

LAST REVISION 09-12-14 DATE PLOTTED => 9/12/2014 TIME PLOTTED => 2120:35 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib014.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		

Analette Ochoa 09/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp 12/31/14
CIVIL
STATE OF CALIFORNIA

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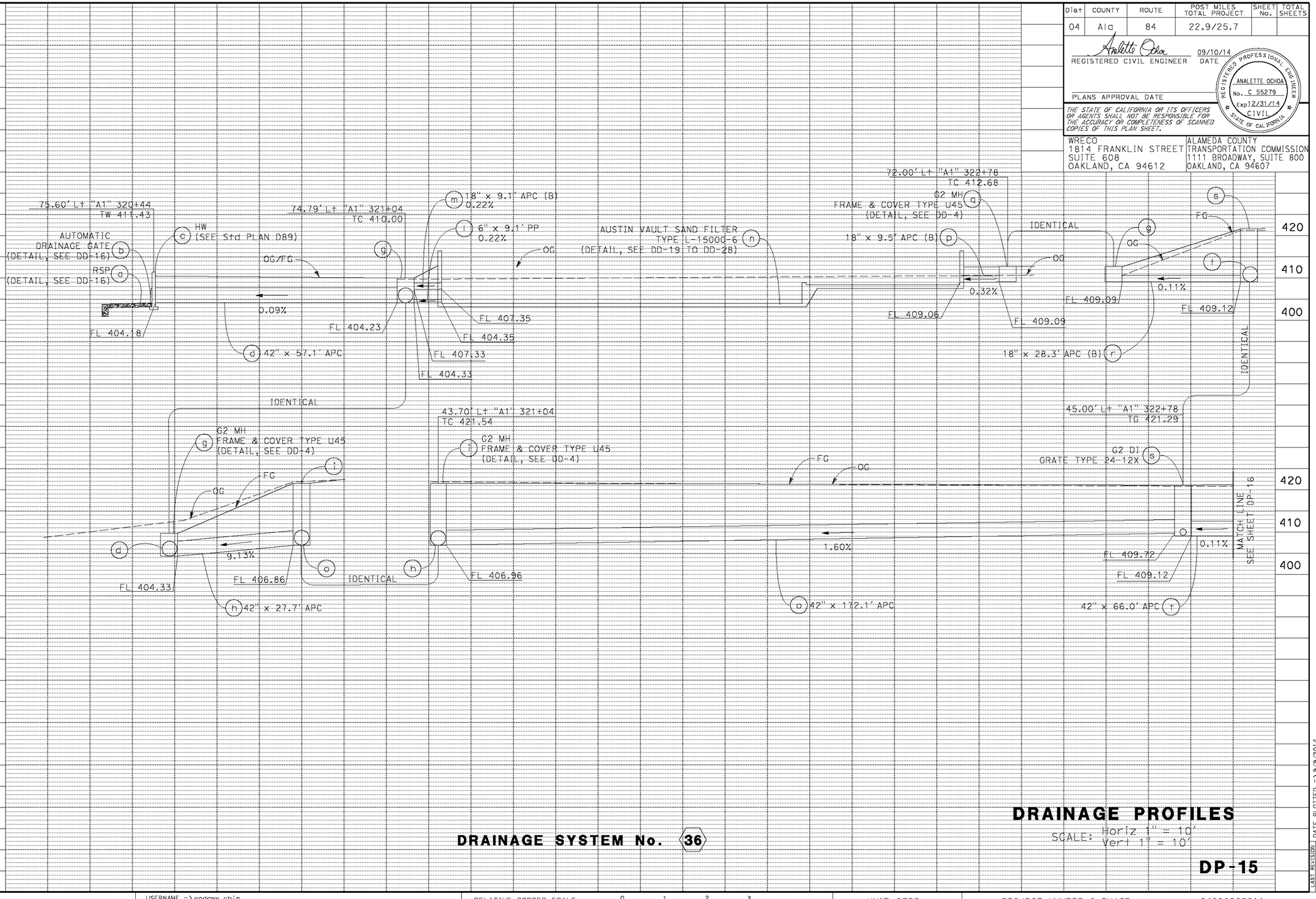

DRAINAGE SYSTEM No. 36

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-15

CALCULATED-DESIGNED BY	CHECKED BY	REVISED BY	DATE REVISED
JENNIFER ABRAMS	ANALETTE OCHOA	IL	10/19/10
		AC	05/30/14
		AC	09/10/14

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

LAST REVISION 09-10-14 | DATE PLOTTED => 9/9/2014 | TIME PLOTTED => 5102:52 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib015.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		

Analette Ochoa — REGISTERED CIVIL ENGINEER — 09/10/14 DATE

PLANS APPROVAL DATE

ANALETTE OCHOA No. C 55279 Exp12/31/14 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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OAKLAND, CA 94607

DATE REVISED	REVISED BY
10/19/10	IL
05/30/14	AC
09/10/14	AC

CALCULATED-DESIGNED BY: JENNIFER ABRAMS
CHECKED BY: ANALETTE OCHOA
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

45.00' Lt "A1" 323+47
TG 421.16

v — w G2 MH FRAME & COVER TYPE U45 (DETAIL, SEE DD-4)

MATCH LINE SEE SHEET DP-15

0.11%

t 42" x 66.0' APC

FL 409.19

IDENTICAL

IDENTICAL, SEE SHEET DP-20

45.00' Lt "A1" 325+00
TG 420.73

aa G2 DI GRATE TYPE 24-12X

g REMOVE Culv

45.00' Lt "A1" 325+30
TG 420.74

n REMOVE DI

ac G2 DI GRATE TYPE 24-12X

39 — 38

A — A

q

FG — OG

0.11% — 0.11% — 0.10%

FL 409.37

ab 36" x 27.2' APC (B)

ad 30" x 297.3' APC (B)

42" x 26.9' APC z

FL 409.34

PG&E 24" GAS MAIN — FG — OG

0.10%

x 42" x 120.3' APC

45.00' Lt "A1" 324+70
TG 421.01

y G2 DI GRATE TYPE 24-12X

A — A

0.11%

FL 409.31

z 42" x 26.9' APC

38

m REMOVE Culv

45.00' Lt "A1" 328+30
TG 421.56

G2 DI GRATE TYPE 24-12X ae

B — B

0.10% — 0.10%

FL 409.67

ad 30" x 297.3' APC (B)

af 30" x 567.1' APC (B)

IDENTICAL

57.00' Lt "A1" 323+47
TG 420.49

G2 DI GRATE TYPE 24-12X u

FG — OG

w

2.07%

FL 416.44

xi

18" x 9.2' APC (A) v

FL 416.25

FL 409.19

19.50' Rt "AC1" 134+08
TG 417.39

G2 DI GRATE TYPE 24-12 ag

ai

FG — OG

aj

2.02%

FL 413.40

18" x 10.4' APC (A) ah

FL 413.19

FL 410.24

IDENTICAL

B — B

45.00' Lt "A1" 334+00
TG 419.72

ah — ai G2 DI GRATE TYPE 24-12X

0.10% — 0.10%

af 30" x 567.1' APC (B)

aj 30" x 482.1' APC (B)

MATCH LINE SEE SHEET DP-17

DRAINAGE SYSTEM No. 36

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-16

LAST REVISION DATE PLOTTED => 9/9/2014
09-10-14 TIME PLOTTED => 5:05:03 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib016.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		

Analette Ochoa 09/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

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OAKLAND, CA 94607

DATE REVISED	REVISED BY
09/10/14	AC
05/30/14	AC
10/19/10	IL

CALCULATED-DESIGNED BY: JENNIFER ABRAMS
CHECKED BY: ANALETTE OCHOA

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

MATCH LINE SEE SHEET DP-16

OG FG 0.10% (ai) 30" x 482.1' APC (B)

52.90' Lt "A1" 338+85
TG 416.36
G2 DI GRATE TYPE 24-12X (am)
(ai) FL 410.72
0.10%
(an) 24" x 218.7' APC (B)

19.50' Rt "AC1" 138+93
TG 414.50
G1 DI GRATE TYPE 24-12 (ak)
(am)
FL 410.83
2.03%
18" x 5.4' APC (A) (al)
FL 410.72
(an)

IDENTICAL

57.00' Lt "A1" 341+37
TG 414.22
56.66' Lt "A1" 341+07
TG 414.23
G2 DI GRATE TYPE 24-12X (ao)
G2 DI GRATE TYPE 24-12X (aq)
(DETAIL SEE DD-3)
FG (ap) 24" x 27.1' APC (B)
FL 410.94
0.11%
FL 410.97
FL 411.07
24" x 27.1' APC (B) W/ Conc Bkf (ar)
(DETAIL SEE DD-4)
(at)
FL 411.10
0.11%

57.27' Lt "A1" 341+67
TG 414.20
(au) G2 DI GRATE TYPE 24-12X
Conc Bkf 20'
OG FG
0.10%
FL 411.20
(ax) 24" x 302.3' APC (B) w/ Conc Bkf (DETAIL SEE DD-4)
MATCH LINE SEE SHEET DP-18

IDENTICAL

14.50' Rt "AC1" 142+30
TG 413.39
G1 DI GRATE TYPE 24-12 (aw)
(as)
OG FG
0.13%
FL 411.11
FL 411.18
(av) 18" x 52.8' APC (B)

IDENTICAL

14.50' Rt "AC1" 141+74
TG 413.46
G1 DI GRATE TYPE 24-12 (as)
(au)
(av)
FG OG
(ax)
FL 411.11
0.12%
FL 411.10
(at) 18" x 8.3' APC (A)

DRAINAGE SYSTEM No. 36

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-17

LAST REVISION 09-10-14 | DATE PLOTTED => 9/9/2014 | TIME PLOTTED => 5105:14 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib017.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		

Analette Ochoa — 09/10/14
REGISTERED CIVIL ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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ALAMEDA COUNTY
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OAKLAND, CA 94607

MATCH LINE SEE SHEET DP-17

58.00' Lt "A2" 344+72
TG 416.61
(ay) G2 DI GRATE TYPE 24-12X
FL 411.61
FL 411.51
FG
OG
0.15%
(az) 24" x 154' APC (B)

OG
FG
0.10%
(ax) 24" x 302.3' APC (B) w/ Conc Bkf (DETAIL SEE DD-4)

45.00' Lt "A2" 346+30
TG 419.65
(bb)
(bc) G2 DI GRATE TYPE 24-12X
FG
OG
0.26%
FL 411.84
FL 411.94
(bd)

10.71' Rt "AC1" 146+38
TG 419.95
C1 DI GRATE TYPE 24-12 (ba)
FG
(bc)
FL 417.37
1.00%
FL 417.45
24" PG&E GAS
(bd)
18" x 8.0' APC (A) (bb)
IDENTICAL

FG
OG
0.26%
(bd) 18" x 316.2' APC (B)

45.00' Lt "A2" 349+50
TG 420.06
(be) G2 DI GRATE TYPE 24-12X (DETAIL, SEE DD-3)
OG
FG
FL 412.76
FL 412.86
0.26%
(bf) 18" x 253.1' APC (B)

45.00' Lt "A2" 352+06
TG 418.77
(bg) GOOM DI GRATE TYPE 24-12X (DETAIL, SEE DD-3)
FG
OG
0.26%
FL 413.51
FL 413.61
(bh) 18" x 302.2' APC (B) w/ Conc Bkf (DETAIL SEE DD-4)

MATCH LINE SEE SHEET DP-19

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DRAINAGE SYSTEM No. 36

DP-18

LAST REVISION 09-10-14 DATE PLOTTED => 9/9/2014 TIME PLOTTED => 5:05:36 PM

DESIGNED BY	DRAWN BY	CHECKED BY	CALCULATED-DESIGNED BY	DATE REVISED	REVISED BY
JENNIFER ABRAMS	ANALETTE OCHOA			10/19/10	IL
				05/30/14	AC
				09/10/14	AC

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib018.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		

Analette Ochoa
REGISTERED CIVIL ENGINEER — 09/10/14 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp 12/31/14
CIVIL
STATE OF CALIFORNIA

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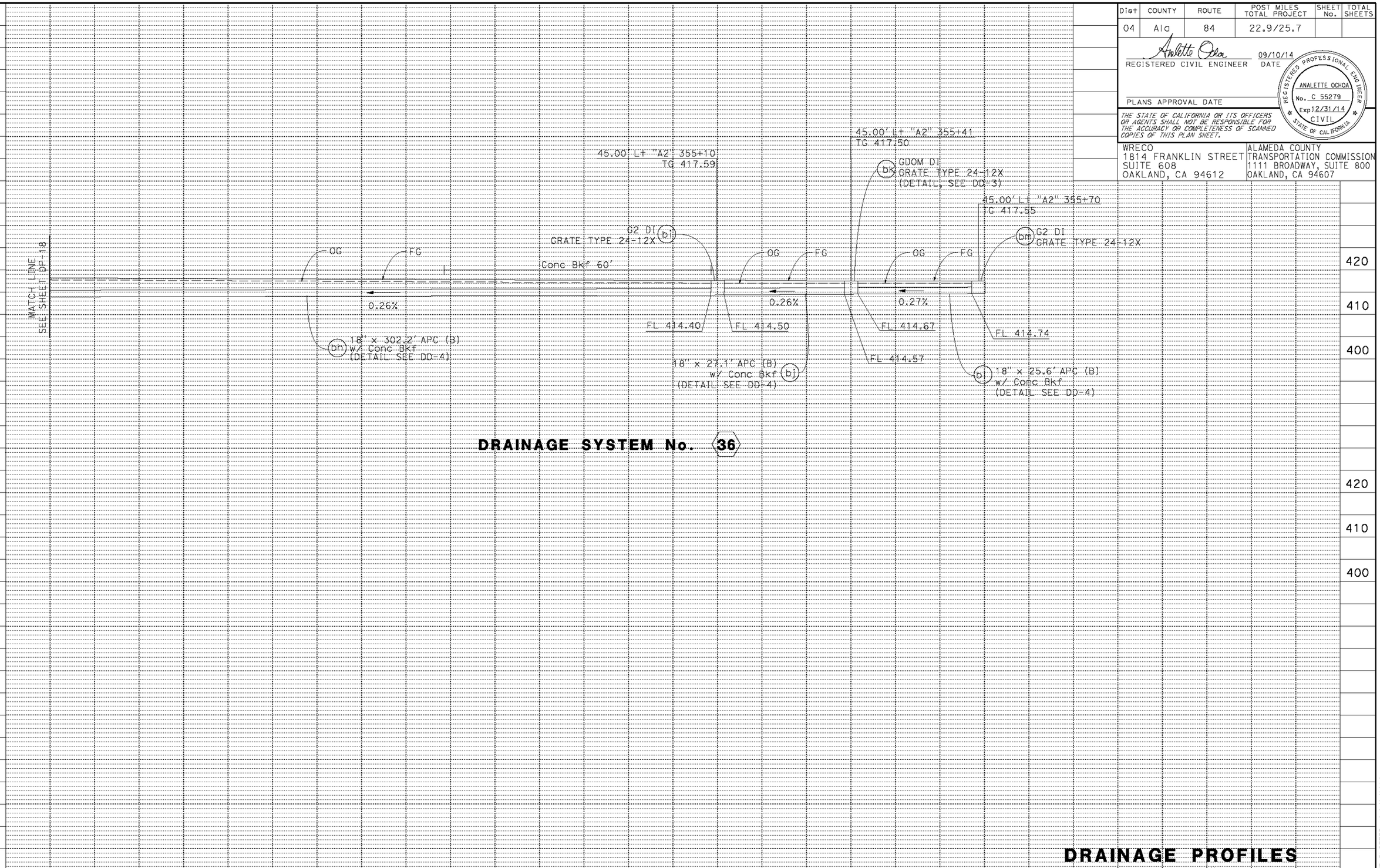

DRAINAGE SYSTEM No. 36

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-19

REVISED BY	DATE REVISED
JENNIFER ABRAMS	09/10/14
ANALETTE OCHOA	05/30/14
	10/19/10

CALCULATED-DESIGNED BY: AC
CHECKED BY: AC

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION DATE PLOTTED => 9/9/2014
09-10-14 TIME PLOTTED => 5105:49 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib019.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		

Analette Ochoa — 09/10/14
REGISTERED CIVIL ENGINEER — DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

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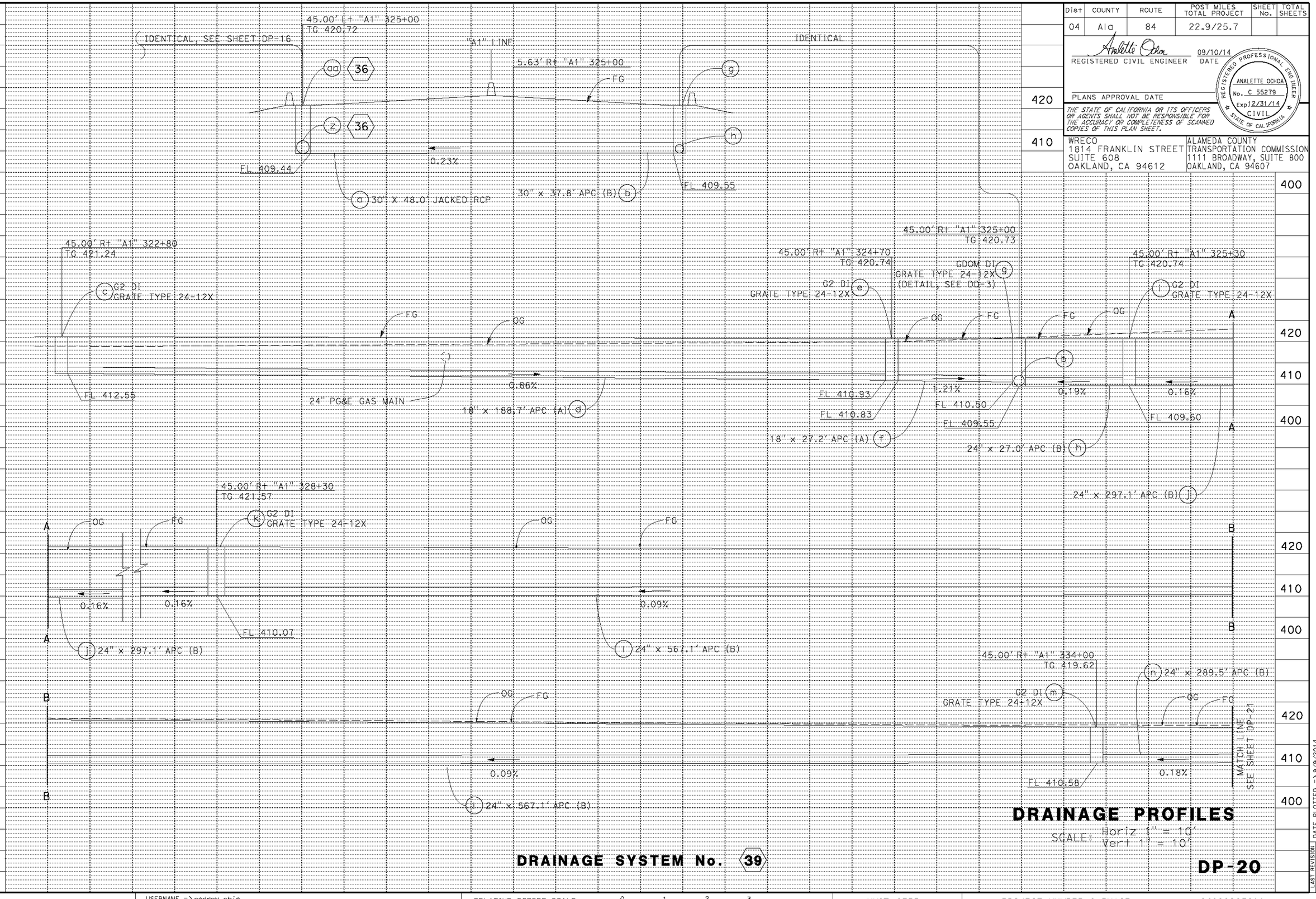
DATE REVISED	REVISED BY	CALCULATED-DESIGNED BY	CHECKED BY
09/10/14	AC	JENNIFER ABRAMS	ANALETTE OCHOA
05/30/14	AC		
10/19/10	IL		

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans



DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DRAINAGE SYSTEM No. 39

DP-20

LAST REVISION DATE PLOTTED => 9/9/2014
09-10-14 TIME PLOTTED => 5:06:01 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib020.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		

Analette Ochoa
REGISTERED CIVIL ENGINEER — 09/10/14 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

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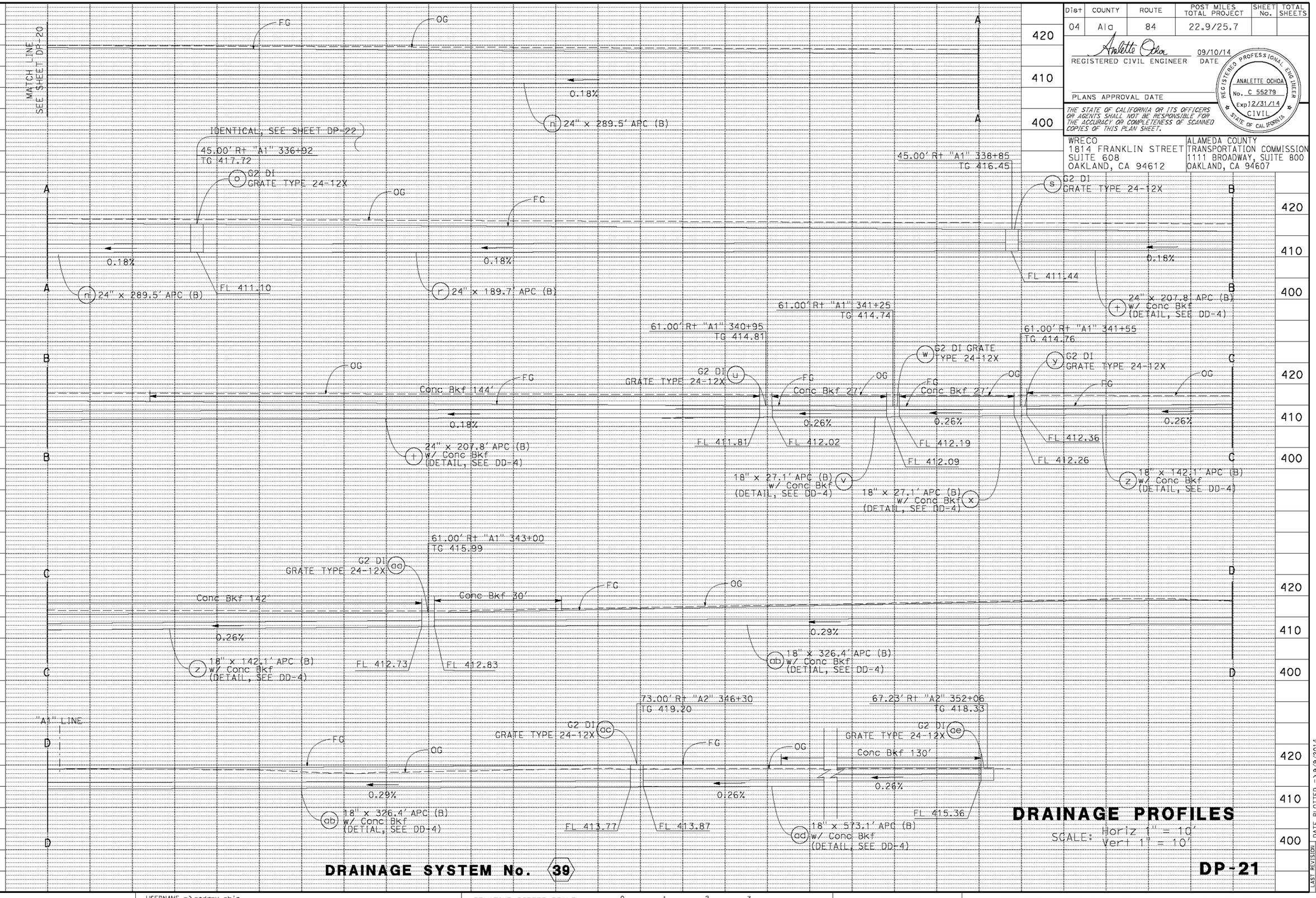
DATE REVISED	REVISED BY	CALCULATED-DESIGNED BY	CHECKED BY
09/10/14	AC	JENNIFER ABRAMS	ANALETTE OCHOA
05/30/14	AC		
10/19/10	IL		

CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans



DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DRAINAGE SYSTEM No. 39

DP-21

LAST REVISION DATE PLOTTED => 9/9/2014
09-10-14 TIME PLOTTED => 5106:13 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib021.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

REVISED BY	DATE REVISED
AC	09/10/14
AC	05/30/14
IL	10/19/10

CALCULATED-DESIGNED BY: JENNIFER ABRAMS
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
04	Ala	84	22.9/25.7		

Analette Ochoa
REGISTERED CIVIL ENGINEER — 09/10/14 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

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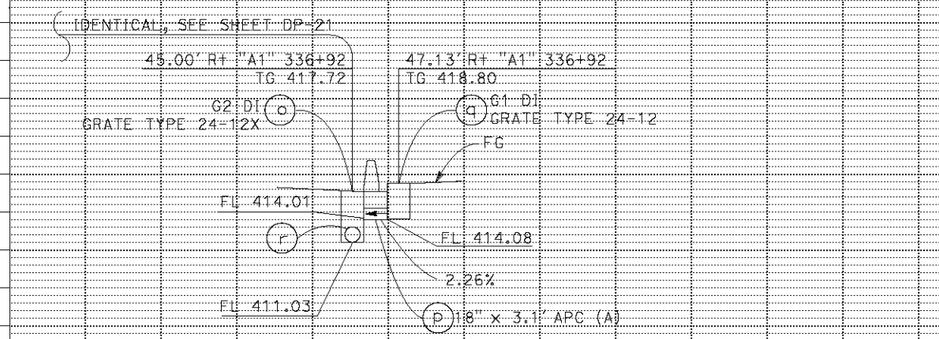
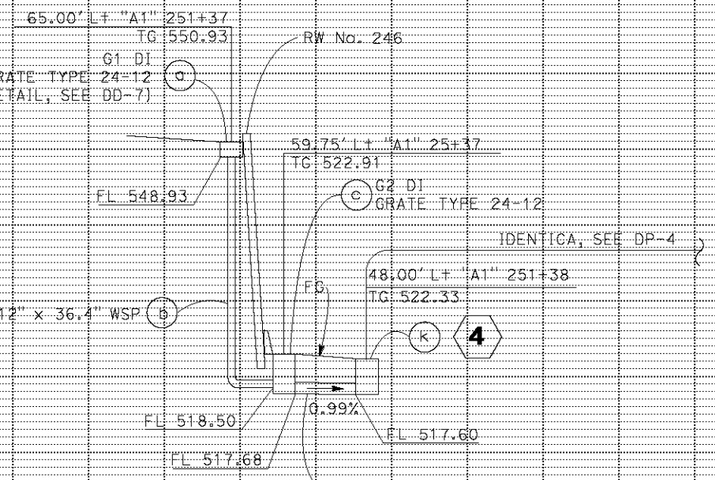


DRAINAGE SYSTEM No. 39



DRAINAGE SYSTEM No. 49

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-22

LAST REVISION 09-10-14 | DATE PLOTTED => 9/9/2014 | TIME PLOTTED => 5106:50 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib022.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		

Analette Ochoa 09/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

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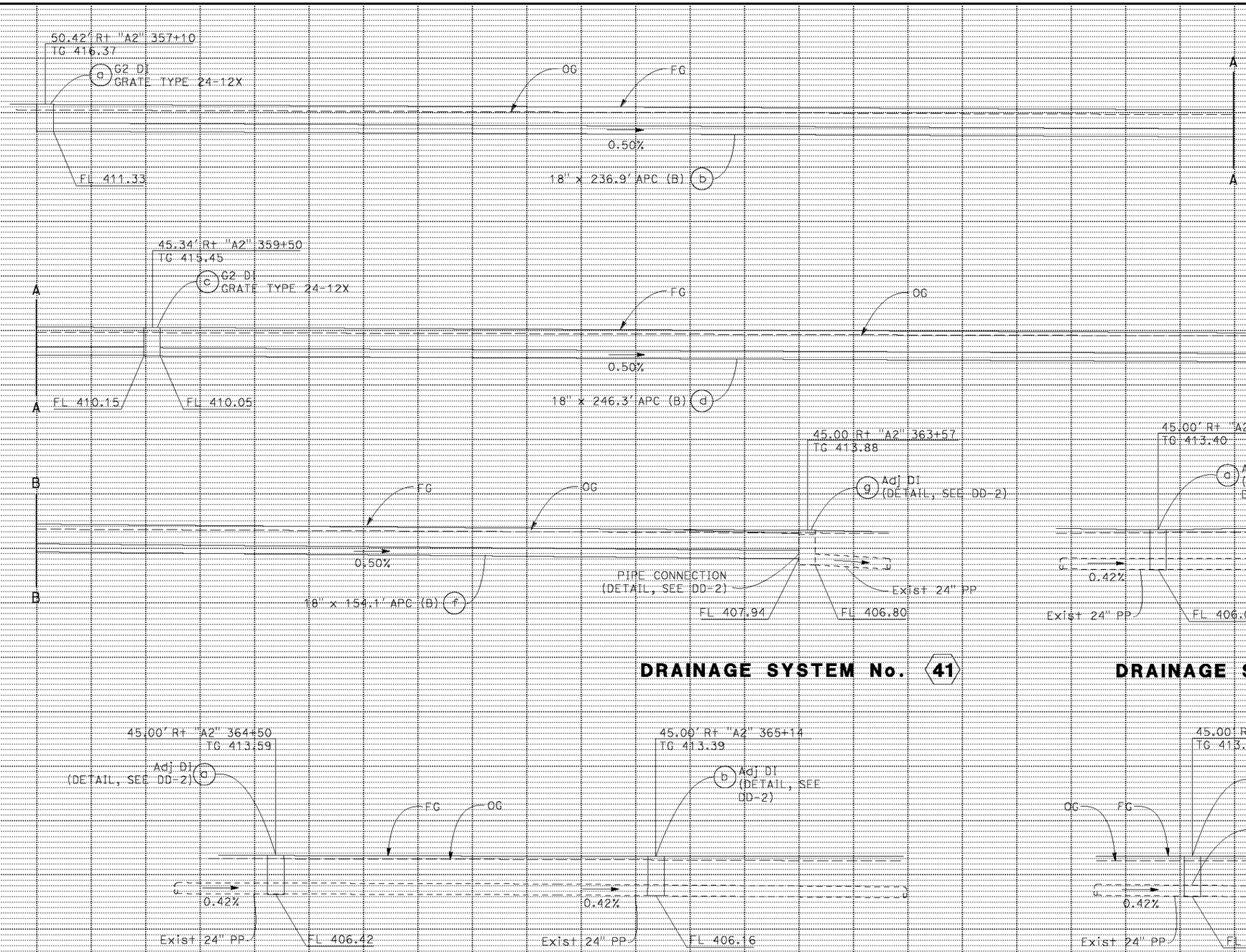
REVISED BY	DATE REVISED
AC	09/10/14
AC	05/30/14
IL	10/19/10

CALCULATED-DESIGNED BY: JENNIFER ABRAMS
CHECKED BY: ANALETTE OCHOA

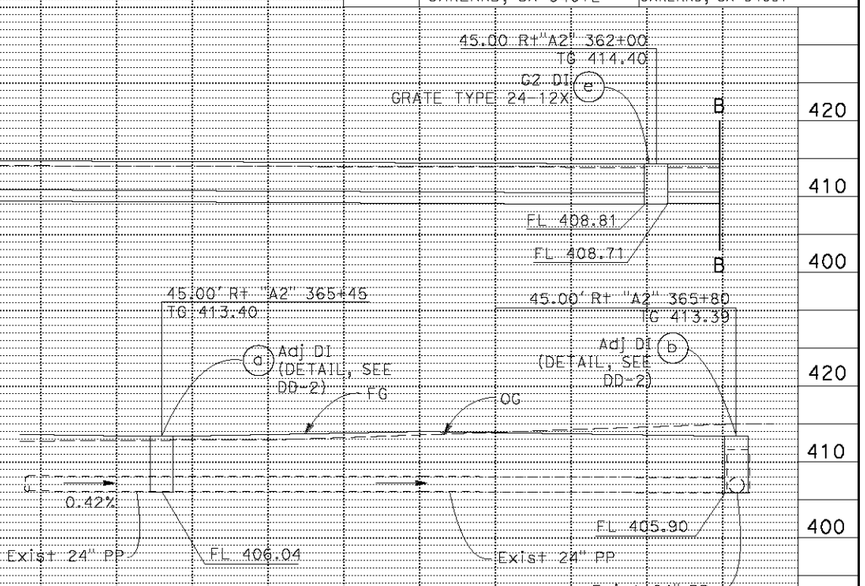
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

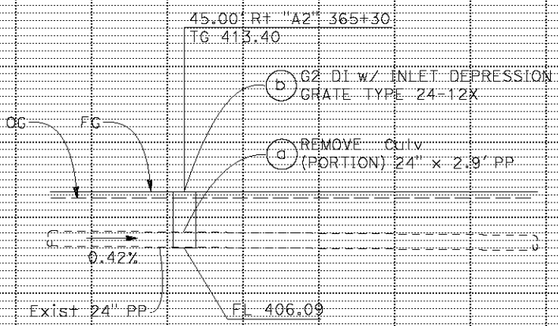


DRAINAGE SYSTEM No. 41



DRAINAGE SYSTEM No. 44

DRAINAGE SYSTEM No. 42



DRAINAGE SYSTEM No. 43

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-23

LAST REVISION DATE PLOTTED => 9/9/2014
09-10-14 TIME PLOTTED => 5:07:01 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib023.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		

Analette Ochoa
REGISTERED CIVIL ENGINEER — 09/10/14 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

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DATE REVISED	REVISED BY
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05/30/14	AC
10/19/10	IL

JENNIFER ABRAMS
ANALETTE OCHOA

CALCULATED-DESIGNED BY
CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR
HAN-BIN LIANG

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1.00' Lt "A2" 357+00
TG 417.72
(a) G2 DI
GRATE TYPE 24-12X

1.00' Lt "A2" 360+00
TG 416.47
(c) GDOM DI
GRATE TYPE 24-12X
(DETAIL, SEE DD-3)

0.50%
FL 411.14
FL 409.66
FL 409.56

18" x 297.1' APC (A) (b)

1.00' Lt "A2" 362+86
TG 415.26
(i) GDOM DI
GRATE TYPE 24-12X
(DETAIL, SEE DD-3)

FG OG
FL 408.15
FL 408.05

(h)

1.00' Lt "A2" 364+10
TG 414.75
(m) Adj DI
(DETAIL, SEE DD-2)

18" x 121.6' APC (B) (j)
PIPE CONNECTION
(SEE DD-2)
IDENTICAL
FL 407.34
FL 407.44

18" x 282.6' APC (A) (d)
FG OG
0.50%

1.00' Lt "A2" 365+80
TG 413.99
(n) Adj DI
(DETAIL, SEE DD-2)
FG OG
FL 406.50
FL 407.70
FL 406.14

1.00' Lt "A2" 366+20
TG 413.76
(p) Adj DI
(DETAIL, SEE DD-2)

1.00' Lt "A2" 366+50
TG 413.57
(p) Adj DI
(DETAIL, SEE DD-2)

1.00' Lt "A2" 366+70
TG 413.44
(g) Adj DI
(DETAIL, SEE DD-2)

1.00' Lt "A2" 366+80
TG 413.37
(r) Adj DI
(DETAIL, SEE DD-2)

0.50%
FL 407.88
FL 407.98
FL 408.12
FL 408.22
FL 408.31
FL 408.41
FL 408.44

16.64' Rt "AC1" 162+95
TC 412.35
Conc Bkf 4'
FG OG
0.50%
FL 408.15
FL 408.39
(h) 18" x 48.4' APC (B)
w/ Conc Bkf
(DETAIL, SEE DD-4)
IDENTICAL

14.50' Rt "AC1" 160+39
TG 412.06
(e) G1 DI
GRATE TYPE 24-12
OG FG
FL 409.37
(f) 18" x 252.3' APC (B)
w/ Conc Bkf
(DETAIL, SEE DD-4)
Conc Bkf 252.3'
0.35%
G1 DI (g)
GRATE TYPE 24-12
FL 408.49

DRAINAGE SYSTEM No. 45

45.00' Rt "A2" 366+80
TC 413.25
(a) Adj DI
(DETAIL, SEE DD-2)
FG OG
0.38%
FL 405.90
Exist 24" PP
44 (b)

DRAINAGE SYSTEM No. 46

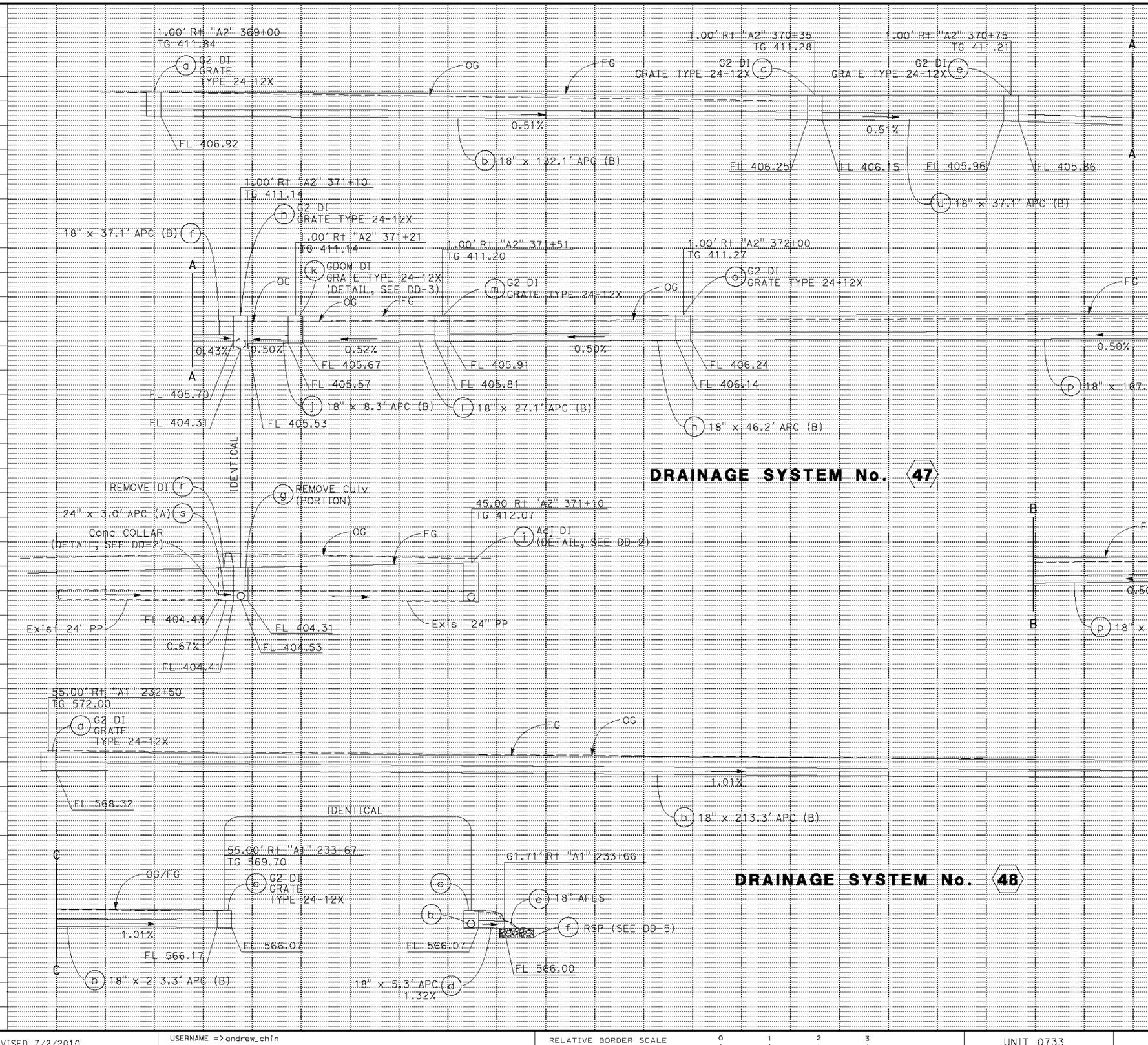
DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-24

LAST REVISION DATE PLOTTED => 9/9/2014
09-10-14 TIME PLOTTED => 5:07:12 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib024.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		

Analette Ochoa 09/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ANALETTE OCHOA
No. C 55279
Exp 12/31/14
CIVIL
STATE OF CALIFORNIA

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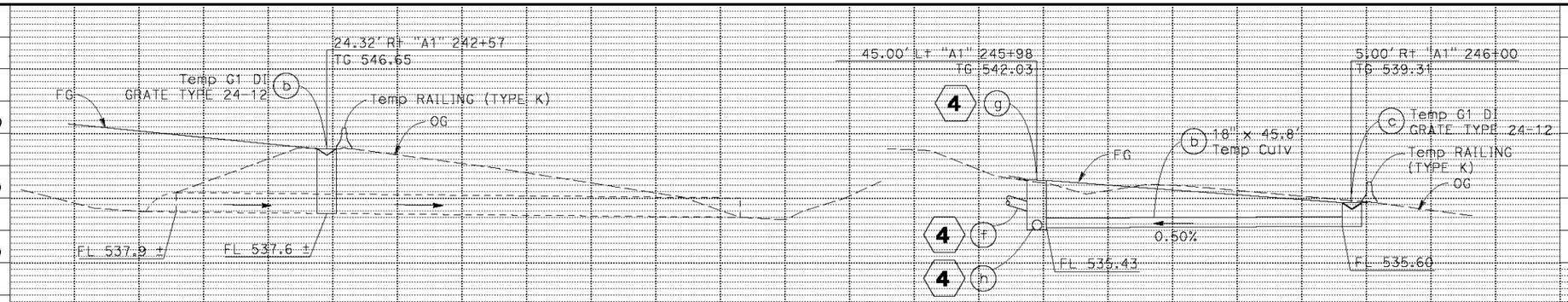
OAKLAND, CA 94607

DATE REVISED	REVISED BY
10/19/10	IL
05/30/14	AC
09/10/14	AC

CALCULATED-DESIGNED BY: JENNIFER ABRAMS
CHECKED BY: ANALETTE OCHOA
CONSULTANT FUNCTIONAL SUPERVISOR: HAN-BIN LIANG
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

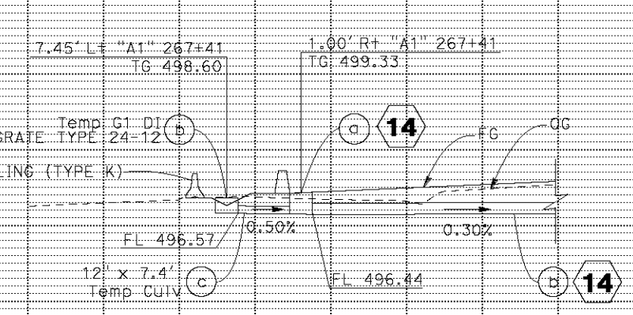
LAST REVISION 09-10-14
DATE PLOTTED => 9/9/2014
TIME PLOTTED => 5:07:27 PM

BORDER LAST REVISED 7/2/2010
USERNAME => andrew_chin
DGN FILE => ...\Dwg\prof\429760ib025.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205811

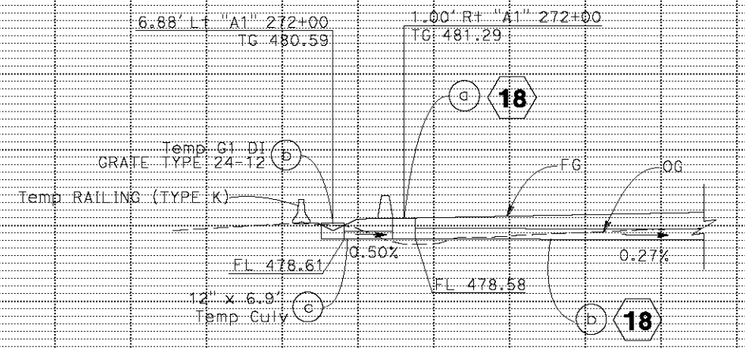


TEMPORARY DRAINAGE SYSTEM No. 501

TEMPORARY DRAINAGE SYSTEM No. 502



TEMPORARY DRAINAGE SYSTEM No. 505



TEMPORARY DRAINAGE SYSTEM No. 506

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-26

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

Analette Ochoa 09/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

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DATE REVISED	REVISED BY
09/10/14	AC
05/30/14	AC
10/19/10	IL

JENNIFER ABRAMS
ANALETTE OCHOA

CALCULATED-DESIGNED BY
CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR
HAN-BIN LIANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 09-10-14
DATE PLOTTED => 9/9/2014
TIME PLOTTED => 5:07:40 PM

BORDER LAST REVISED 7/2/2010
USERNAME => andrew_chin
DGN FILE => ...\Dwg\prof\429760ib026.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		

Analette Ochoa 09/10/14
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

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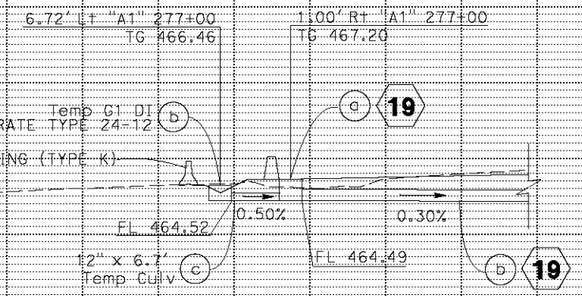
OAKLAND, CA 94607

REVISED BY	DATE REVISED
JENNIFER ABRAMS	10/19/10
ANALETTE OCHOA	05/30/14
	09/10/14

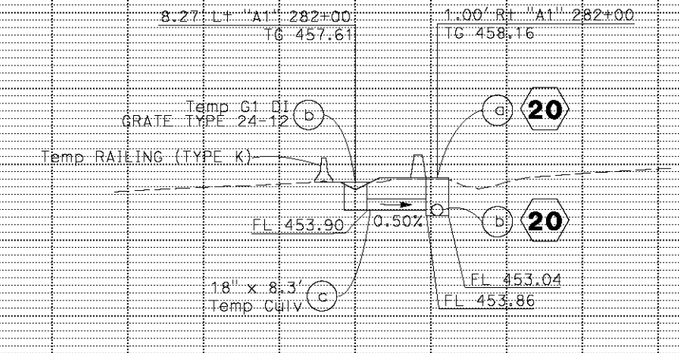
CALCULATED-DESIGNED BY: AC
CHECKED BY: AC

SUPERVISOR: HAN-BIN LIANG
CONSULTANT FUNCTIONAL SUPERVISOR

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans



TEMPORARY DRAINAGE SYSTEM No. 507



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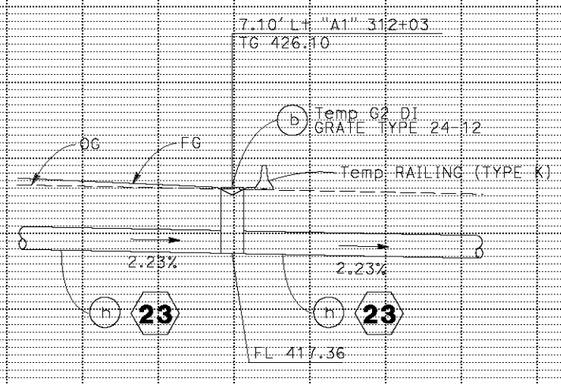

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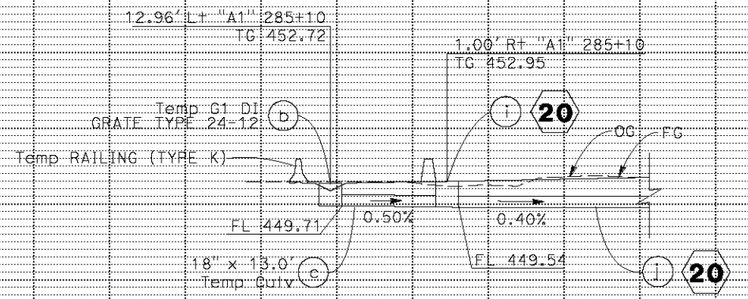

TEMPORARY DRAINAGE SYSTEM No. 513

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-27

LAST REVISION 09-10-14 | DATE PLOTTED => 9/9/2014 | TIME PLOTTED => 5107:52 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib027.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		

Analette Ochoa
REGISTERED CIVIL ENGINEER — 09/10/14 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ANALETTE OCHOA — No. C 55279 — Exp 12/31/14 — CIVIL — STATE OF CALIFORNIA

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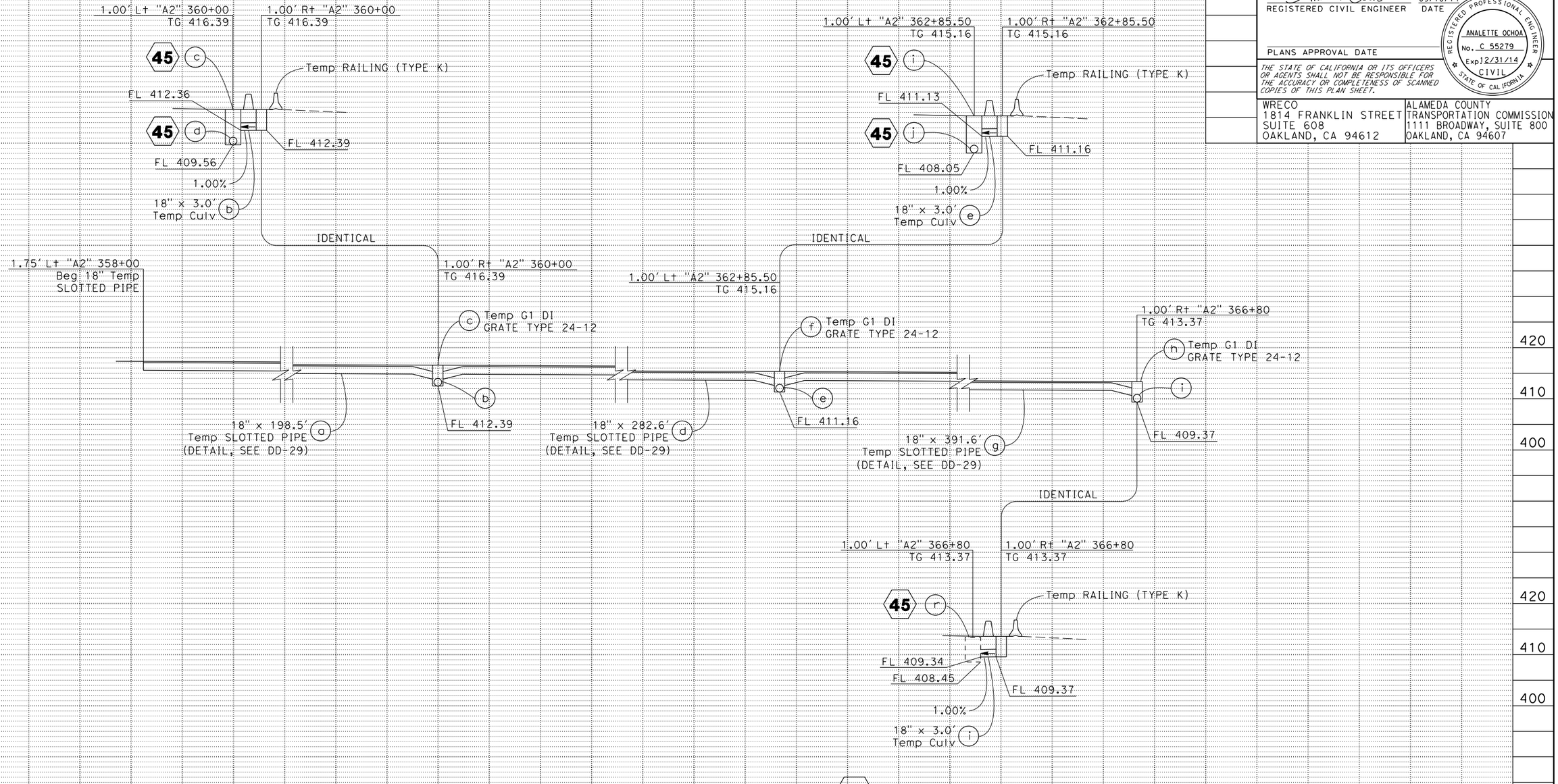

TEMPORARY DRAINAGE SYSTEM No. 512

DRAINAGE PROFILES

SCALE: Horiz 1" = 10'
Vert 1" = 10'

DP-28

REVISED BY	JENNIFER ABRAMS
DATE REVISED	ANALETTE OCHOA
CALCULATED-DESIGNED BY	
CHECKED BY	
CONSULTANT FUNCTIONAL SUPERVISOR	HAN-BIN LIANG

AC	09/10/14	
AC	05/30/14	
IL	10/19/10	

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 09-10-14 | DATE PLOTTED => 9/9/2014 | TIME PLOTTED => 5:08:05 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => andrew_chin | DGN FILE => ...\Dwg\prof\429760ib028.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		

REGISTERED CIVIL ENGINEER — 05/30/14 DATE

PLANS APPROVAL DATE

Sang Kim No. 66289 Exp 06-30-16 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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Oakland, CA 94607

NOTES:

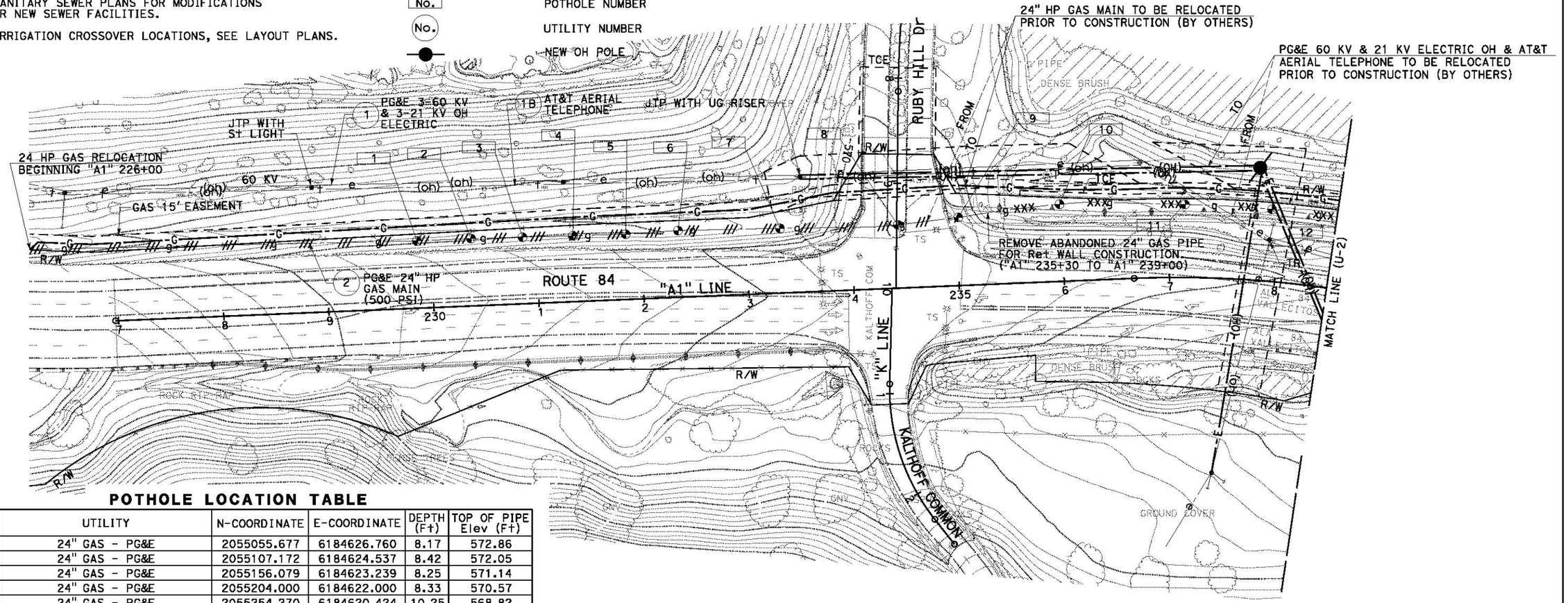
1. FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.
2. LOCATIONS OF UTILITY FACILITIES SHOWN ON THESE PLANS ARE APPROXIMATE AND SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION.
3. UTILITY OWNERSHIP ON THIS PROJECT:
   GAS - PG&E
   WATER - CALWATER,
   ZONE 7, CITY OF PLEASANTON.
   ELECTRIC - PG&E
   TELEPHONE - AT&T
   FIBER OPTICS - COMCAST, MCI
   SEWER - CITY OF LIVERMORE
   CABLE TV- COMCAST
   IRRIGATION MAIN - CITY OF LIVERMORE,
   PRIVATE (RUBY HILL)
4. ALL ELEVATIONS SHOWN REFER TO THE TOP OF PIPE ELEVATION UNLESS OTHERWISE INDICATED.
5. THE EXISTING SANITARY SEWER FACILITIES SHOWN ON THESE PLANS ARE FOR INFORMATION ONLY, SEE SANITARY SEWER PLANS FOR MODIFICATIONS AND/OR NEW SEWER FACILITIES.
6. FOR IRRIGATION CROSSOVER LOCATIONS, SEE LAYOUT PLANS.

LEGEND:

—e— —(oh)—	Exist ELECTRICAL OVERHEAD LINE
—e— —e—	Exist UG ELECTRIC
—fo— —(oh)—	Exist FIBER OPTIC OVERHEAD LINE
—tv— —tv—	Exist UG CABLE TV
—w— —w—	Exist WATER LINE
—g— —g—	Exist GAS LINE
—t— —t—	Exist UG TELEPHONE LINE
—s— —s—	Exist SANITARY SEWER
—t— —(oh)—	Exist AERIAL TELEPHONE
—E— —(OH)—	PROPOSED ELECTRICAL OVERHEAD LINE
—JT— —JT—	PROPOSED JOINT TRENCH
—W— —W—	PROPOSED WATER
—G— —G—	PROPOSED GAS LINE
—T— —(OH)—	PROPOSED AERIAL TELEPHONE
/// /// /// /// ///	ABANDONED UTILITIES
XXX XXX XXX XXX	REMOVE PIPE
ETS	ELECTROLYSIS TEST STATION
	POTHOLE LOCATION
No.	POTHOLE NUMBER
No.	UTILITY NUMBER

ABBREVIATIONS:

ABND	ABANDONED
CALWATER	CALIFORNIA WATER SERVICE Co.
COP	CITY OF PLEASANTON
DIP	DUCTILE IRON PIPE
F/O	FIBER OPTIC CABLE
HP	HIGH PRESSURE GAS/HIGH RISK
JT	JOINT TRENCH
JTP	JOINT TRANSMISSION POLE
KV	KILOVOLTS
LIV	CITY OF LIVERMORE
LP	LOW PRESSURE GAS/LOW RISK
PG&E	PACIFIC GAS & ELECTRIC
PL	PLASTIC
SOPP	SOLELY OWN POWER POLE
TP	TRANSMISSION POLE
TV	CABLE TELEVISION
UG	UNDERGROUND
UNK	UNKNOWN
ZONE 7	ZONE 7 WATER AGENCY



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

APPROVED FOR UTILITY WORK ONLY

UTILITY PLAN

SCALE: 1" = 50'

U-1

REVISED BY	DATE REVISED
SK	9/12/14

CALCULATED-DESIGNED BY: JASON HOM
CHECKED BY: SANG KIM
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 9-12-14
DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:41

BORDER LAST REVISED 7/2/2010 | USERNAME => Shruti_Shah | DGN FILE => 429760ka001.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		

REGISTERED CIVIL ENGINEER — DATE: 05/30/14

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp 06-30-16 — CIVIL — STATE OF CALIFORNIA

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ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 Broadway, Suite 800
Oakland, CA 94607

NOTE:

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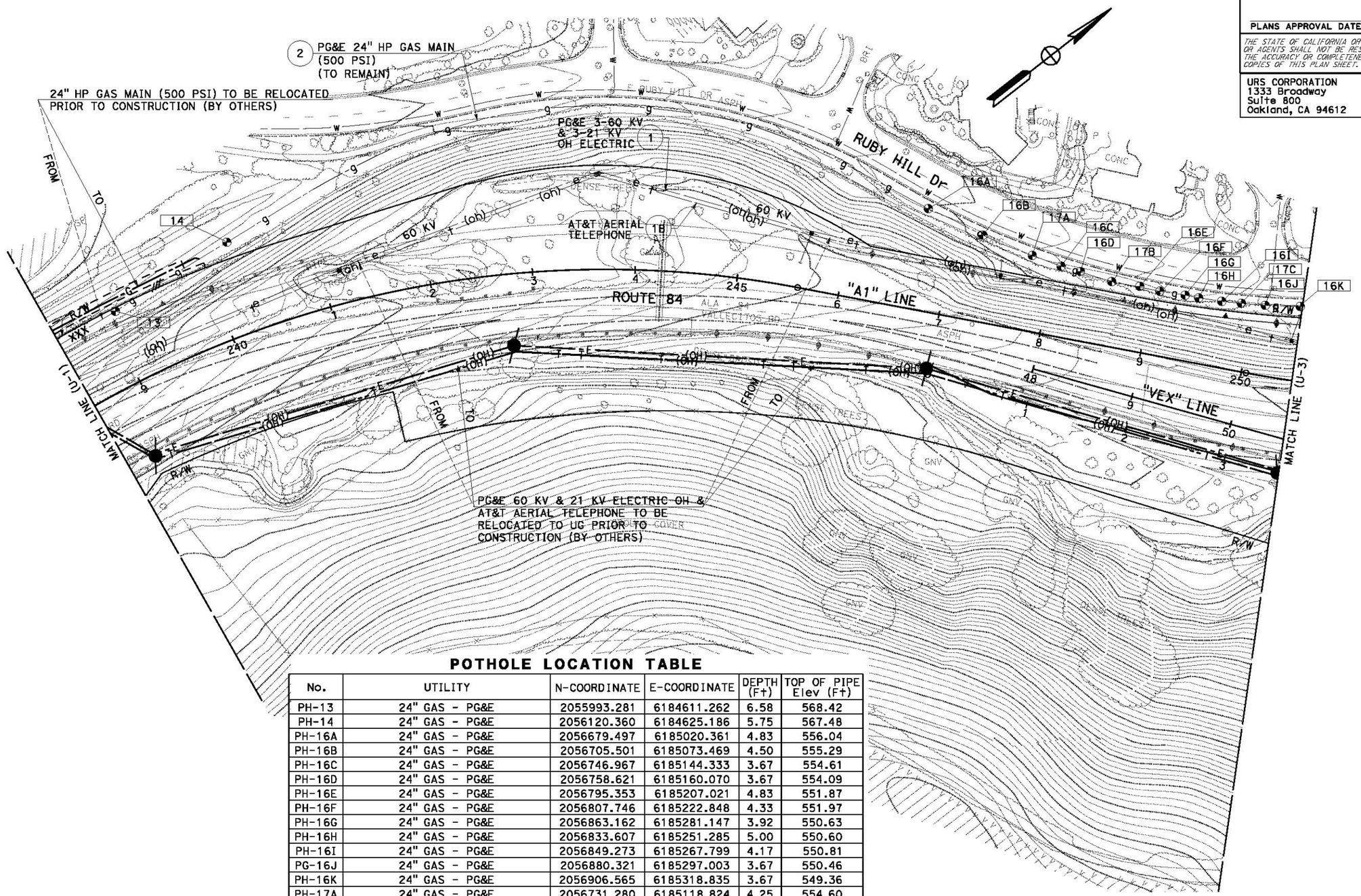

POTHOLE LOCATION TABLE

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-16A	24" GAS - PG&E	2056679.497	6185020.361	4.83	556.04
PH-16B	24" GAS - PG&E	2056705.501	6185073.469	4.50	555.29
PH-16C	24" GAS - PG&E	2056746.967	6185144.333	3.67	554.61
PH-16D	24" GAS - PG&E	2056758.621	6185160.070	3.67	554.09
PH-16E	24" GAS - PG&E	2056795.353	6185207.021	4.83	551.87
PH-16F	24" GAS - PG&E	2056807.746	6185222.848	4.33	551.97
PH-16G	24" GAS - PG&E	2056863.162	6185281.147	3.92	550.63
PH-16H	24" GAS - PG&E	2056833.607	6185251.285	5.00	550.60
PH-16I	24" GAS - PG&E	2056849.273	6185267.799	4.17	550.81
PG-16J	24" GAS - PG&E	2056880.321	6185297.003	3.67	550.46
PH-16K	24" GAS - PG&E	2056906.565	6185318.835	3.67	549.36
PH-17A	24" GAS - PG&E	2056731.280	6185118.824	4.25	554.60
PH-17B	24" GAS - PG&E	2056776.578	6185186.546	4.75	552.26
PH-17C	24" GAS - PG&E	2056824.908	6185241.149	5.08	550.63

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET U-1

APPROVED FOR UTILITY WORK ONLY

UTILITY PLAN

SCALE: 1" = 50'

U-2

REVISED BY	DATE REVISED
SK	9/12/14

JASON HOM — SANG KIM — CALCULATED-DESIGNED BY — CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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LAST REVISION — DATE PLOTTED => 12-SEP-2014 — TIME PLOTTED => 16:41

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

REGISTERED CIVIL ENGINEER — 05/30/14 DATE

PLANS APPROVAL DATE

Sang Kim No. 66289 Exp 06-30-16 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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NOTE:

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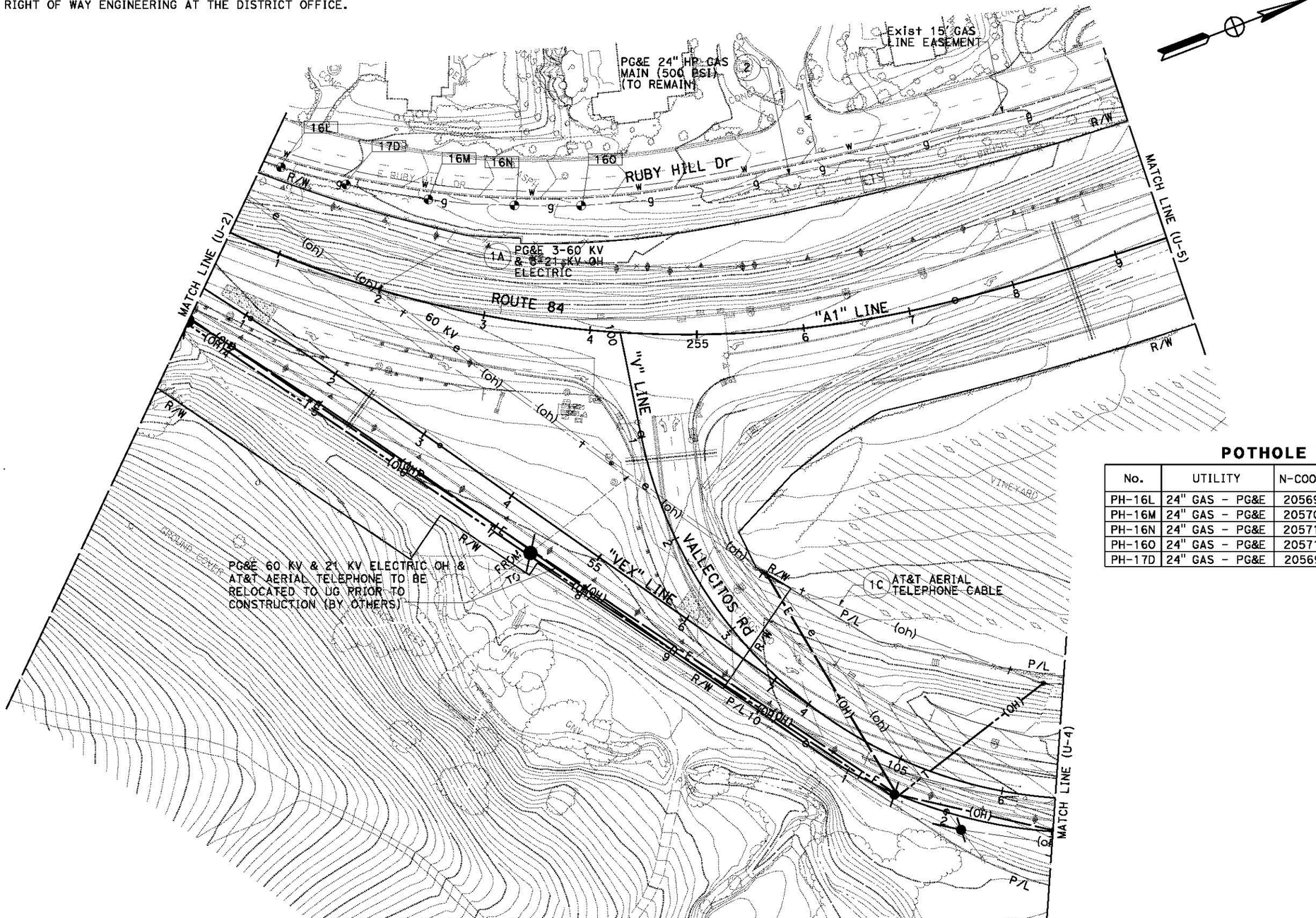

POTHOLE LOCATION TABLE

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-16L	24" GAS - PG&E	2056921.760	6185330.805	3.00	549.50
PH-16M	24" GAS - PG&E	2057039.549	6185408.230	5.00	543.10
PH-16N	24" GAS - PG&E	2057112.608	6185442.161	4.50	541.24
PH-16O	24" GAS - PG&E	2057170.714	6185464.728	4.17	539.51
PH-17D	24" GAS - PG&E	2056972.731	6185367.708	4.58	545.82

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET U-1

APPROVED FOR UTILITY WORK ONLY

UTILITY PLAN

SCALE: 1" = 50'

U-3

LAST REVISION DATE PLOTTED => 12-SEP-2014
9-12-14 TIME PLOTTED => 16:41

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SK	9/12/14

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CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

REGISTERED CIVIL ENGINEER — 05/30/14 DATE

PLANS APPROVAL DATE

Sang Kim No. 66289 Exp 06-30-16 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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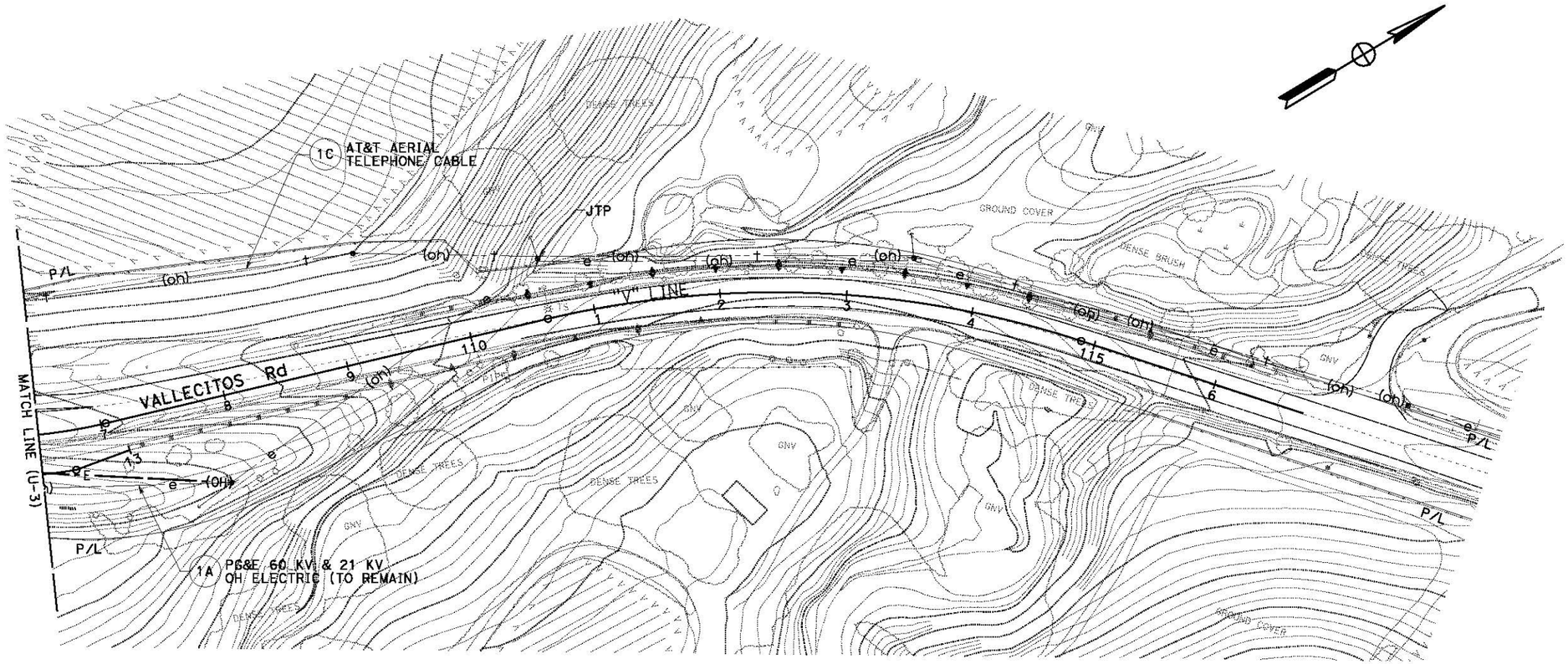

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET U-1

APPROVED FOR UTILITY WORK ONLY

UTILITY PLAN

SCALE: 1" = 50'

U-4

REVISED BY	DATE REVISED
SK	9/12/14

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CHECKED BY: SANG KIM
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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TIME PLOTTED => 16:41

BORDER LAST REVISED 7/2/2010
USERNAME => Shruti_Shah
DGN FILE => 429760ka004.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		

05/30/14
REGISTERED CIVIL ENGINEER DATE

Sang Kim
No. 66289
Exp 06-30-16
CIVIL
STATE OF CALIFORNIA

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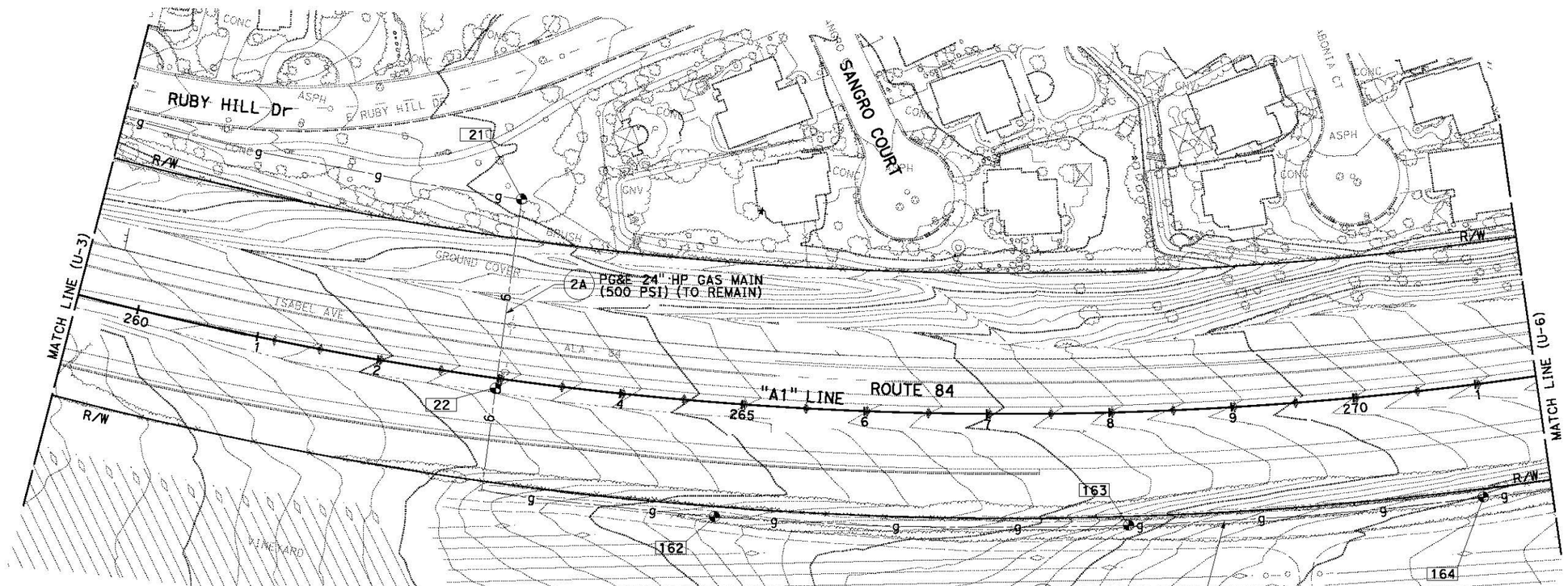
Oakland, CA 94607

NOTE:

FOR ACCURATE RIGHT OF WAY 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

APPROVED FOR UTILITY WORK ONLY

UTILITY PLAN

SCALE: 1" = 50'

U-5

REVISED BY	DATE REVISED
SK	9/12/14

CALCULATED-DESIGNED BY: JASON HOM
CHECKED BY: SANG KIM

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

REGISTERED CIVIL ENGINEER — 05/30/14 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp 06-30-16 — CIVIL — STATE OF CALIFORNIA

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NOTE:

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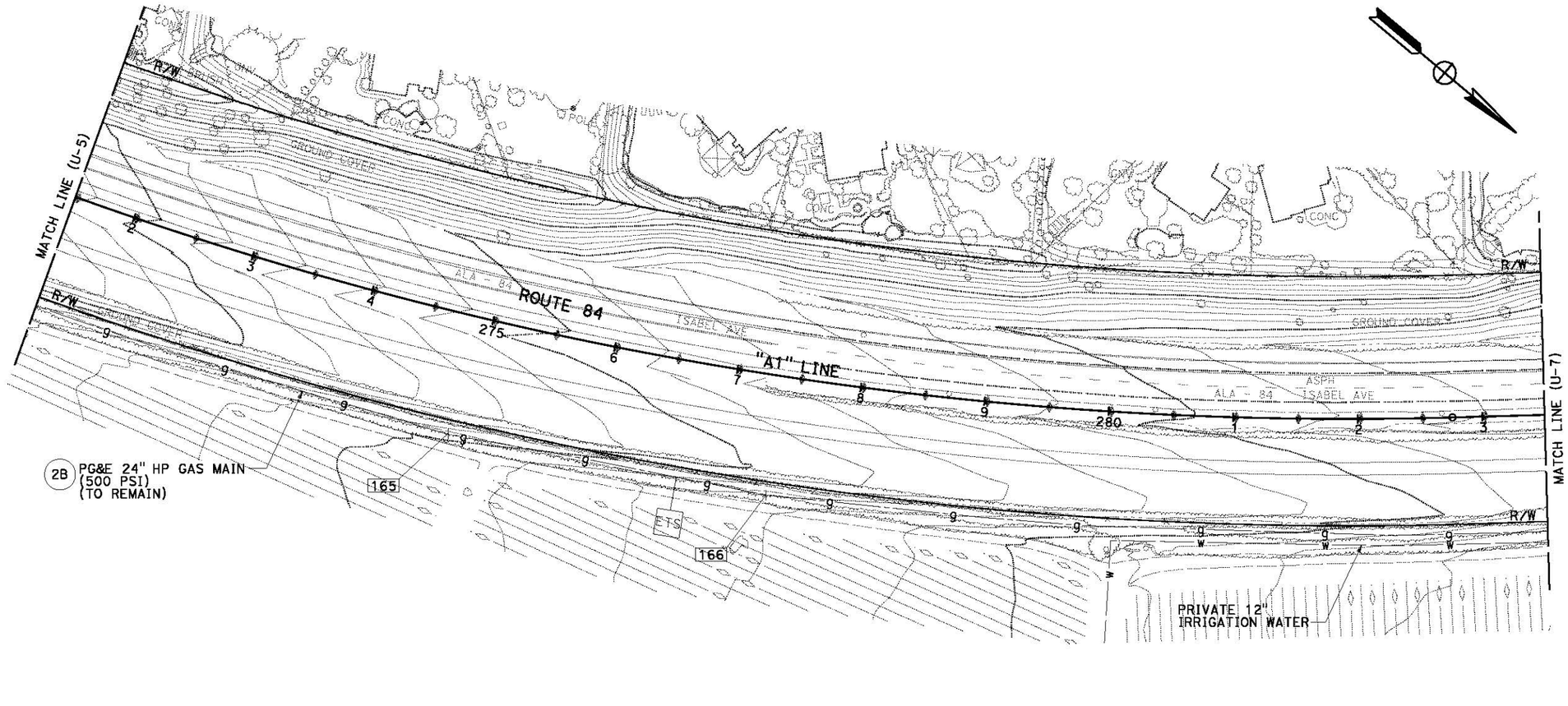
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

POTHOLE LOCATION TABLE

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-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

APPROVED FOR UTILITY WORK ONLY

UTILITY PLAN

SCALE: 1" = 50'

U-6

REVISED BY: SK — DATE REVISED: 9/12/14

CALCULATED-DESIGNED BY: JASON HOM

CHECKED BY: SANG KIM

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

05/30/14
REGISTERED CIVIL ENGINEER DATE

Sang Kim
No. 66289
Exp 06-30-16
CIVIL
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

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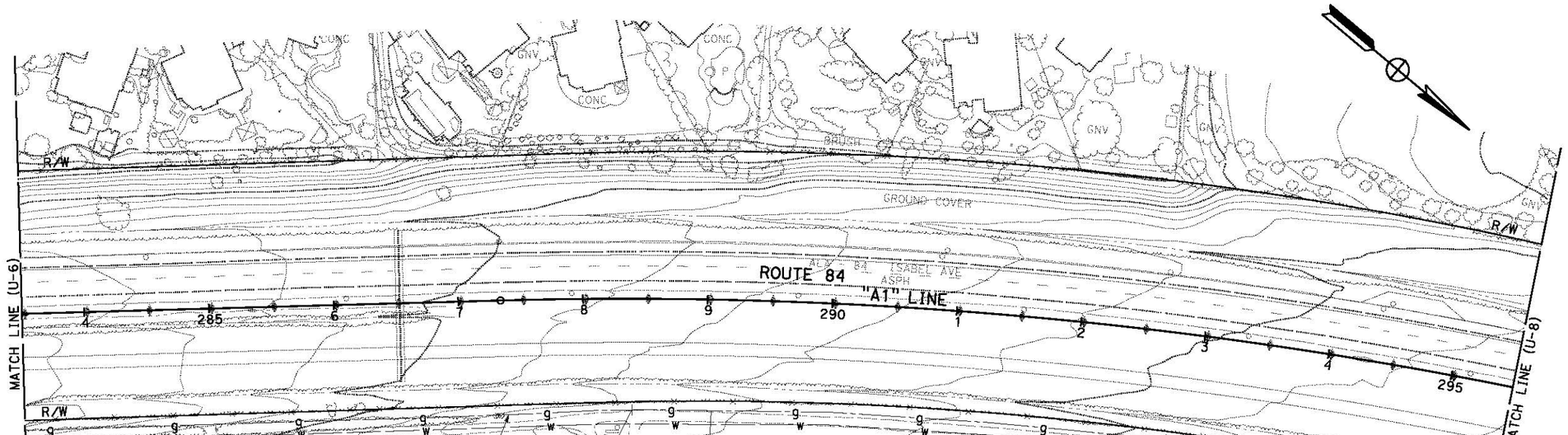
Oakland, CA 94607

NOTE:

FOR ACCURATE RIGHT OF WAY 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

APPROVED FOR UTILITY WORK ONLY

UTILITY PLAN

SCALE: 1" = 50'

U-7

REVISED BY	DATE REVISED
SK	9/12/14

CALCULATED-DESIGNED BY: JASON HOM
CHECKED BY: SANG KIM

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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TIME PLOTTED => 16:41

BORDER LAST REVISED 7/2/2010
USERNAME => Shruti_Shah
DGN FILE => 429760ka007.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		

REGISTERED CIVIL ENGINEER — DATE 05/30/14

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp 06-30-16 — CIVIL — STATE OF CALIFORNIA

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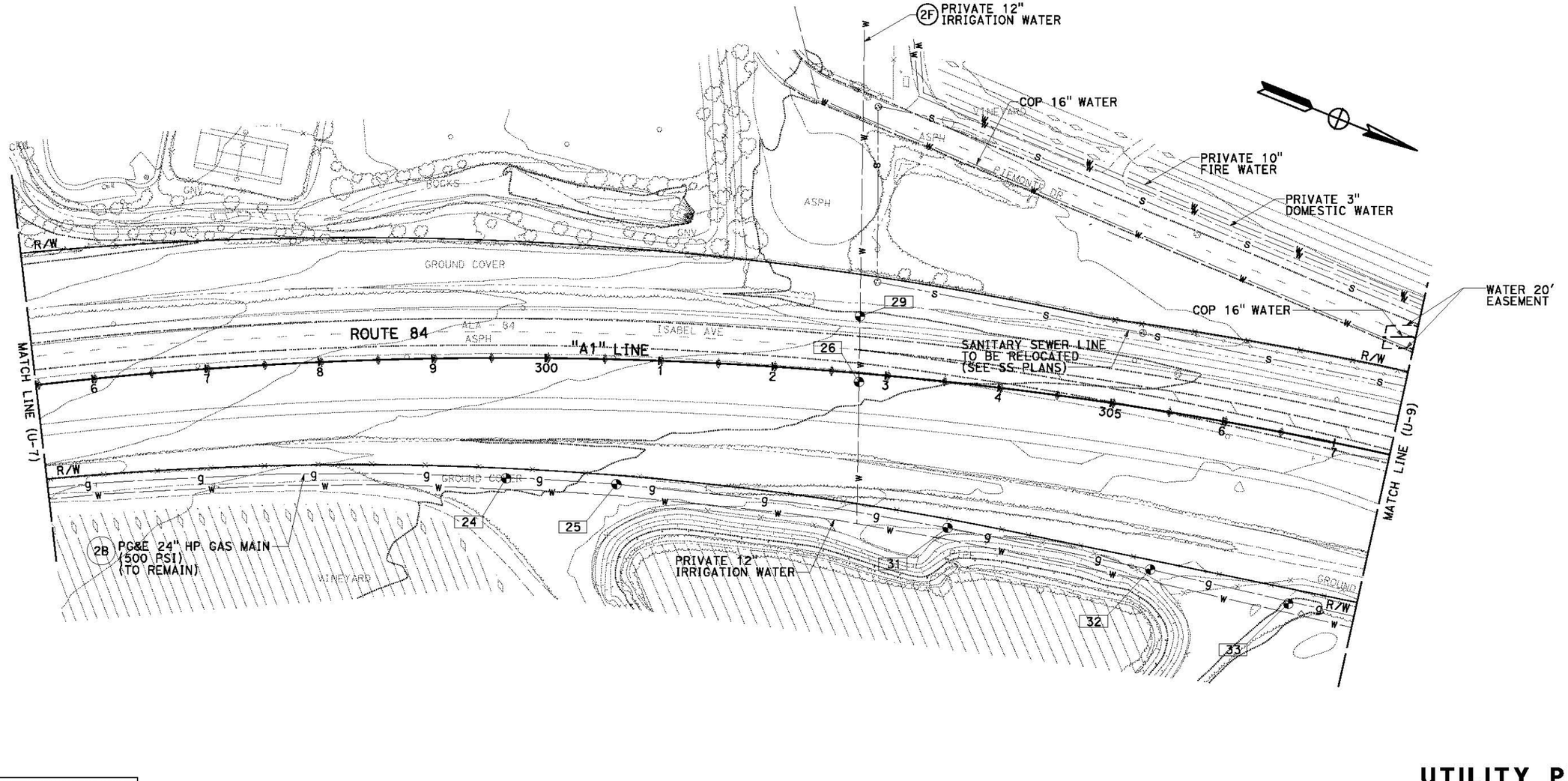
Oakland, CA 94607

NOTE:

FOR ACCURATE RIGHT OF WAY 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

APPROVED FOR UTILITY WORK ONLY

UTILITY PLAN

SCALE: 1" = 50'

U-8

REVISED BY	DATE REVISED
SK	9/12/14

JASON HOM — CALCULATED-DESIGNED BY
SANG KIM — CHECKED BY
RAMSEY J. HISSEN — CONSULTANT FUNCTIONAL SUPERVISOR

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:41
9-12-14

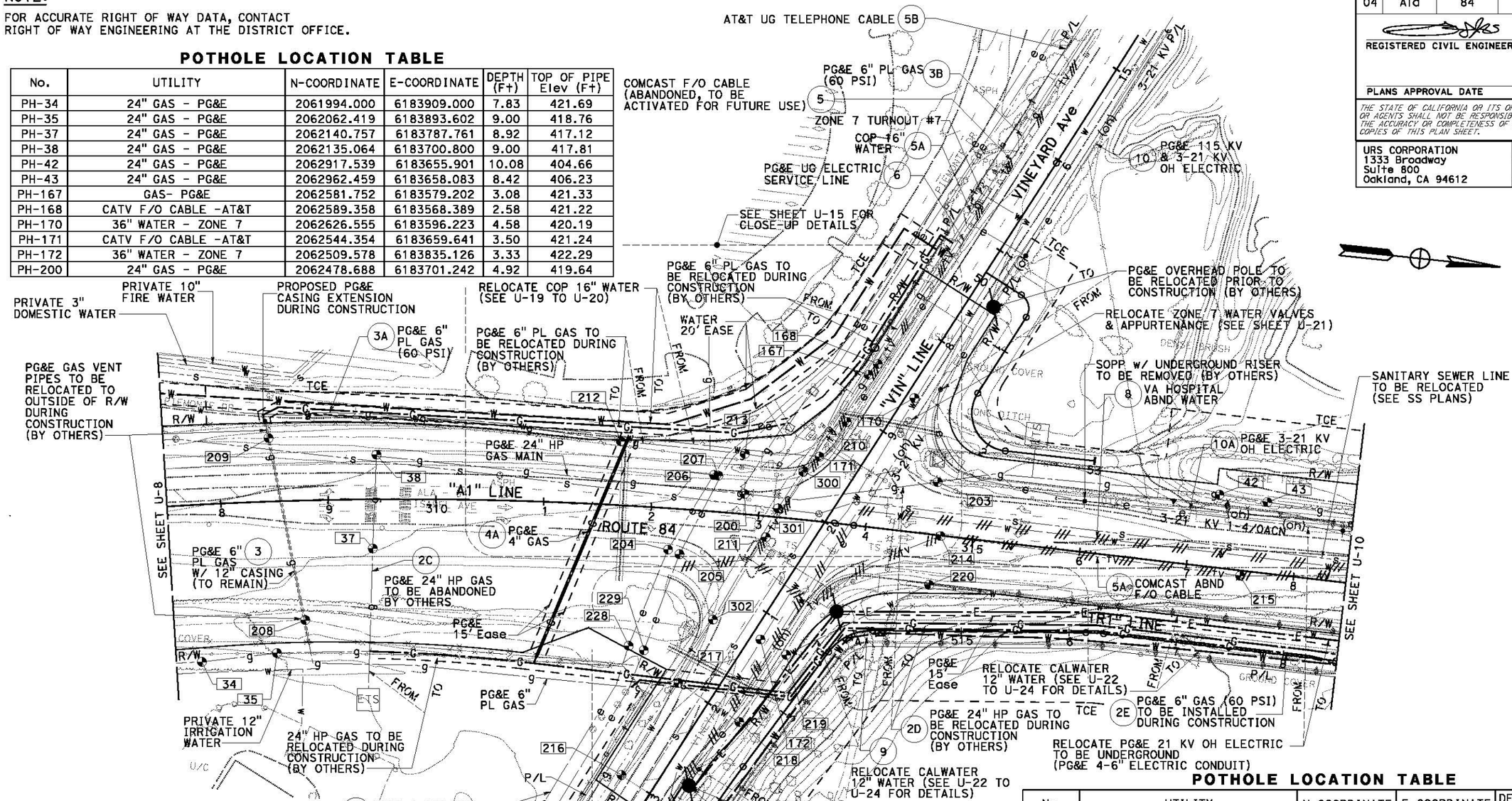
BORDER LAST REVISED 7/2/2010 | USERNAME => Shruti_Shah | DGN FILE => 429760ka008.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

NOTE:

FOR ACCURATE RIGHT OF WAY 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	230 KV U/G Elec - PG&E	2062413.578	6183760.119	10.50	413.95
PH-205	230 KV U/G Elec - PG&E	2062424.577	6183763.218	10.50	413.92
PH-206	230 KV U/G Elec - PG&E	2062448.911	6183686.764	6.50	418.84
PH-207	230 KV 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

APPROVED 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	22.9/25.7		

REGISTERED CIVIL ENGINEER 05/30/14 DATE

PLANS APPROVAL DATE

Registered Professional Engineer — Sang Kim — No. 66289 — Exp 06-30-16 — CIVIL — State of California

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1111 Broadway, Suite 800
Oakland, CA 94607

REVISED BY	DATE REVISED
SK	9/12/14

JASON HOM — SANG KIM — CALCULATED-DESIGNED BY — CHECKED BY

RAMSEY J. HISSEN — CONSULTANT FUNCTIONAL SUPERVISOR

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:41
LAST REVISION 9-12-14

BORDER LAST REVISED 7/2/2010 | USERNAME => Shruti_Shah | DGN FILE => 429760ka009.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		

REGISTERED CIVIL ENGINEER — 05/30/14 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp 06-30-16 — CIVIL — STATE OF CALIFORNIA

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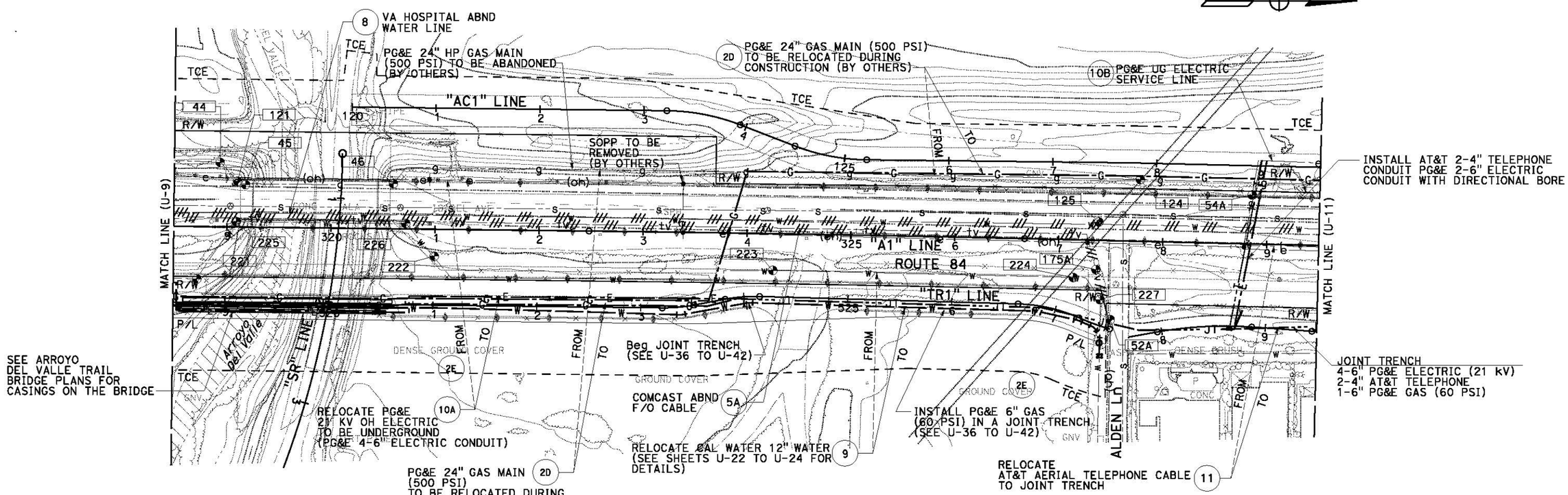
Oakland, CA 94607

NOTE:

FOR ACCURATE RIGHT OF WAY 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	230 KV U/G Elec - PG&E	2062386.538	6183852.726	5.17	419.62
PH-229	230 KV 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

APPROVED FOR UTILITY WORK ONLY

UTILITY PLAN

SCALE: 1" = 50'

U-10

REVISED BY	DATE REVISED
SK	9/12/14

CALCULATED-DESIGNED BY: JASON HOM
CHECKED BY: SANG KIM

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION: DATE PLOTTED => 12-SEP-2014 TIME PLOTTED => 16:41

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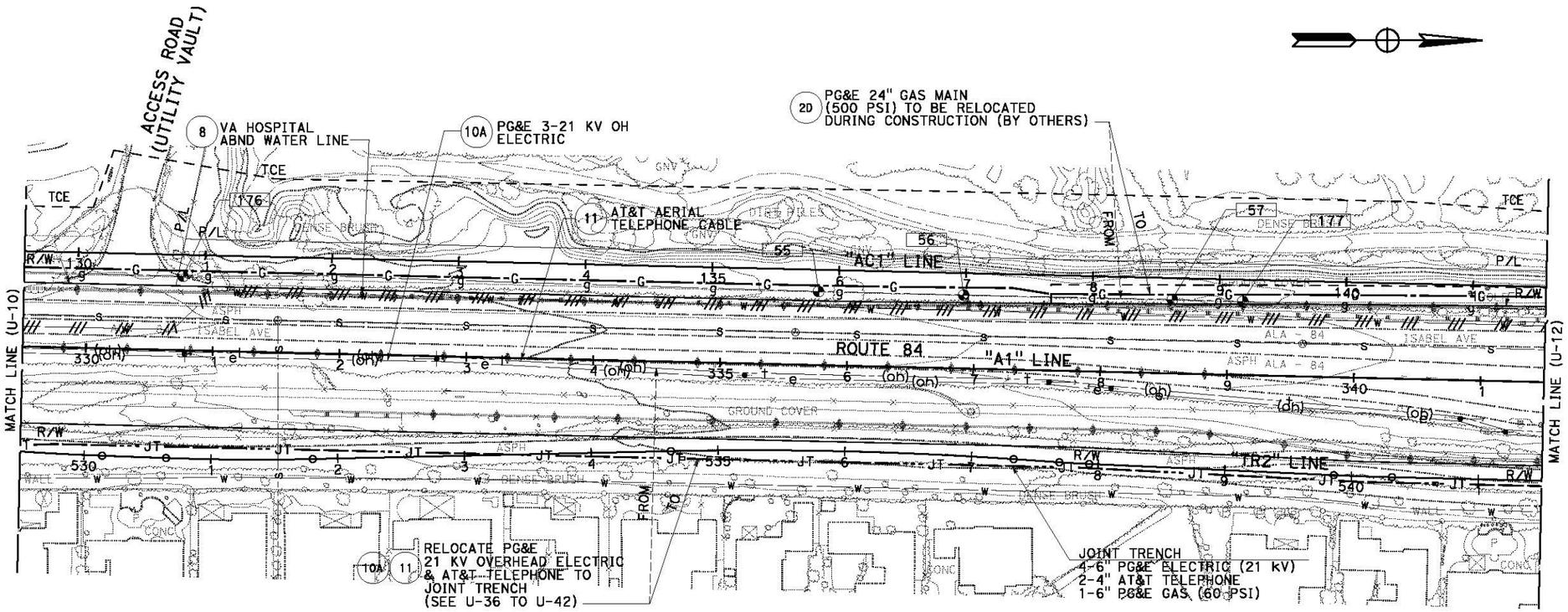
NOTE:

FOR ACCURATE RIGHT OF WAY 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-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

APPROVED FOR UTILITY WORK ONLY

UTILITY PLAN

SCALE: 1" = 50'

U-11

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

05/30/14
REGISTERED CIVIL ENGINEER DATE

Sang Kim No. 66289 Exp 06-30-16 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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REVISED BY	DATE REVISED
SK	9/12/14

JASON HOM
SANG KIM

CALCULATED-DESIGNED BY
CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR
RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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LAST REVISION 9-12-14

BORDER LAST REVISED 7/2/2010 | USERNAME => Shruti_Shah | DGN FILE => 429760ka011.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		

05/30/14
REGISTERED CIVIL ENGINEER DATE

Sang Kim
No. 66289
Exp 06-30-16
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

PLANS APPROVAL DATE

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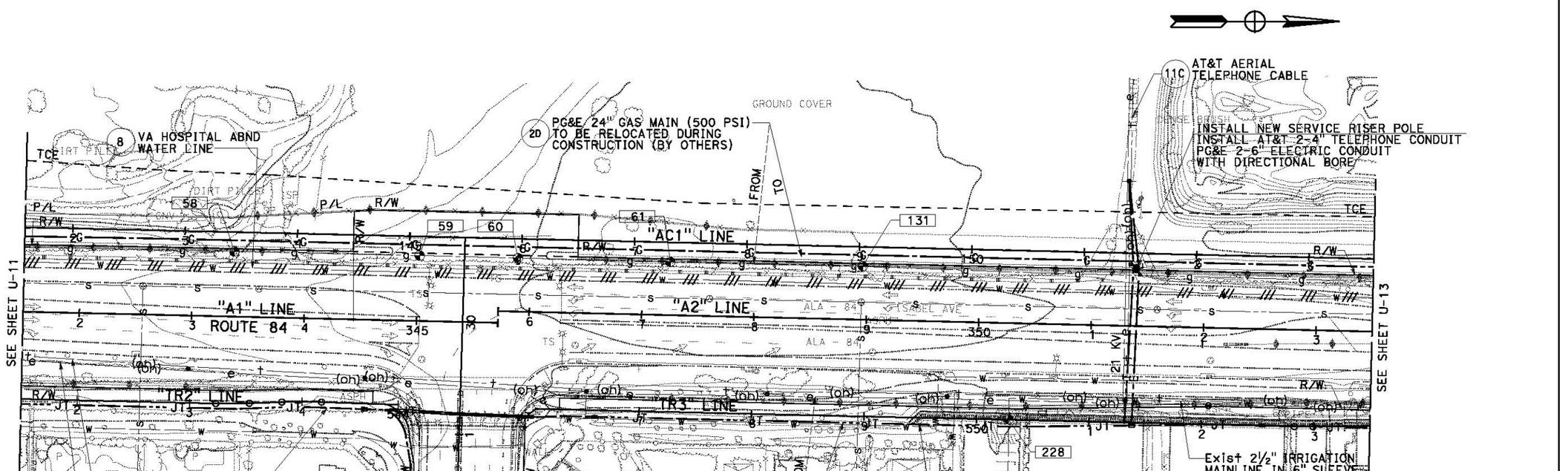
NOTE:

FOR ACCURATE RIGHT OF WAY 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

APPROVED FOR UTILITY WORK ONLY

UTILITY PLAN

SCALE: 1" = 50'

U-12

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
CALCULATED-DESIGNED BY: JASON HOM
CHECKED BY: SANG KIM
REVISED BY: SK
DATE REVISED: 9/12/14

LAST REVISION 9-12-14
DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:41

BORDER LAST REVISED 7/2/2010
USERNAME => Shruti_Shah
DGN FILE => 429760ka012.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		

REGISTERED CIVIL ENGINEER — 05/30/14 DATE

PLANS APPROVAL DATE

Sang Kim No. 66289 Exp 06-30-16 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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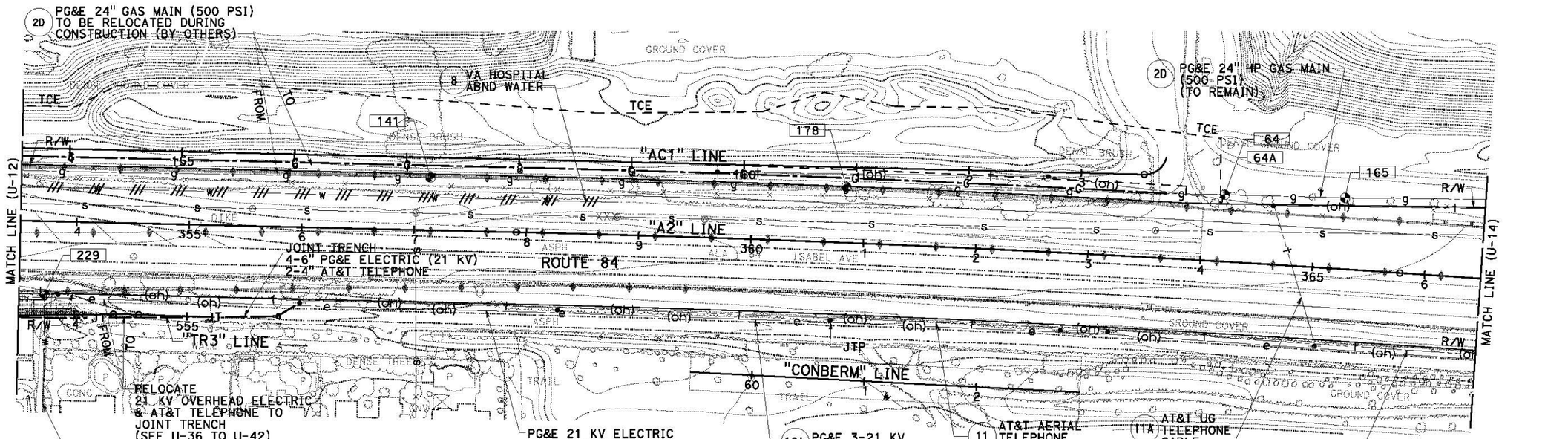
NOTE:

FOR ACCURATE RIGHT OF WAY 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
PH-229	IRRIGATION WATER-PRIVATE	NOT FOUND			



FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET U-1

APPROVED FOR UTILITY WORK ONLY

UTILITY PLAN

SCALE: 1" = 50'

U-13

REVISED BY	DATE REVISED
SK	9/12/14

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CHECKED BY: SANG KIM

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

REGISTERED CIVIL ENGINEER 05/30/14 DATE

PLANS APPROVAL DATE

Sang Kim No. 66289 Exp 06-30-16 CIVIL STATE OF CALIFORNIA — REGISTERED PROFESSIONAL ENGINEER

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NOTE:

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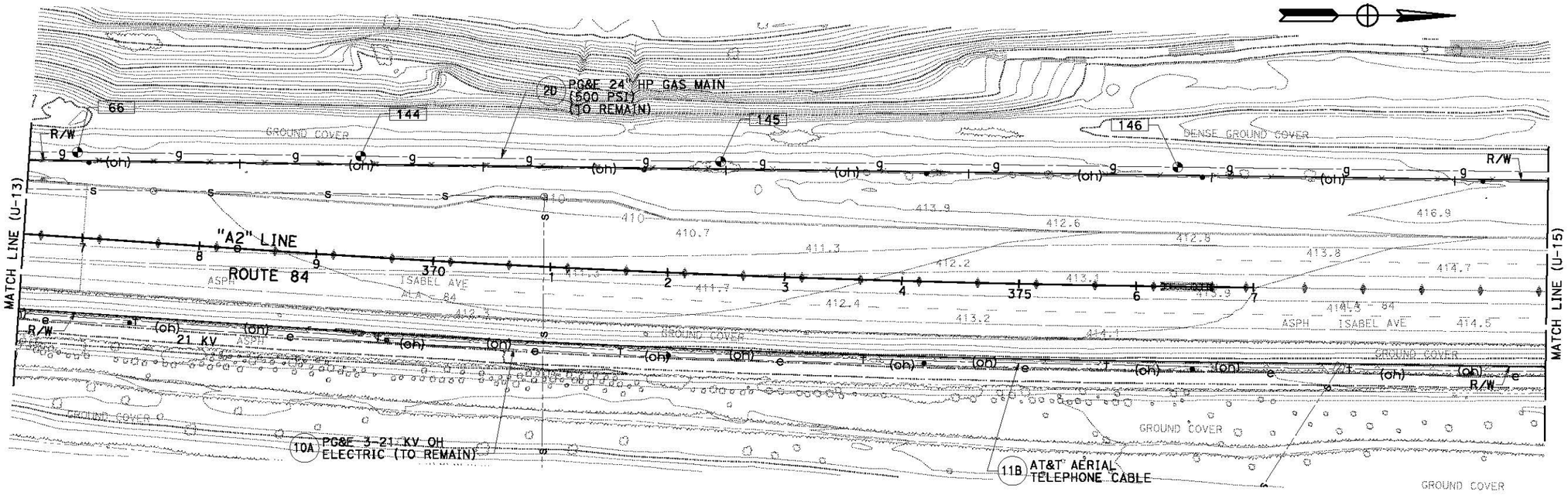
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

POTHOLE LOCATION TABLE

No.	UTILITY	N-COORDINATE	E-COORDINATE	DEPTH (Ft)	TOP OF PIPE Elev (Ft)
PH-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



FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET U-1

APPROVED FOR UTILITY WORK ONLY

UTILITY PLAN

SCALE: 1" = 50'

U-14

CALCULATED-DESIGNED BY	JASON HOM		
CHECKED BY	SANG KIM		
REVISED BY	SK	LAST REVISION	DATE PLOTTED => 12-SEP-2014
DATE REVISED	9/12/14	9-12-14	TIME PLOTTED => 16:41

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

BORDER LAST REVISED 7/2/2010 | USERNAME => Shruti_Shah | DGN FILE => 429760ka014.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
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REGISTERED CIVIL ENGINEER — 05/30/14 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Sang Kim — No. 66289 — Exp 06-30-16 — CIVIL — STATE OF CALIFORNIA

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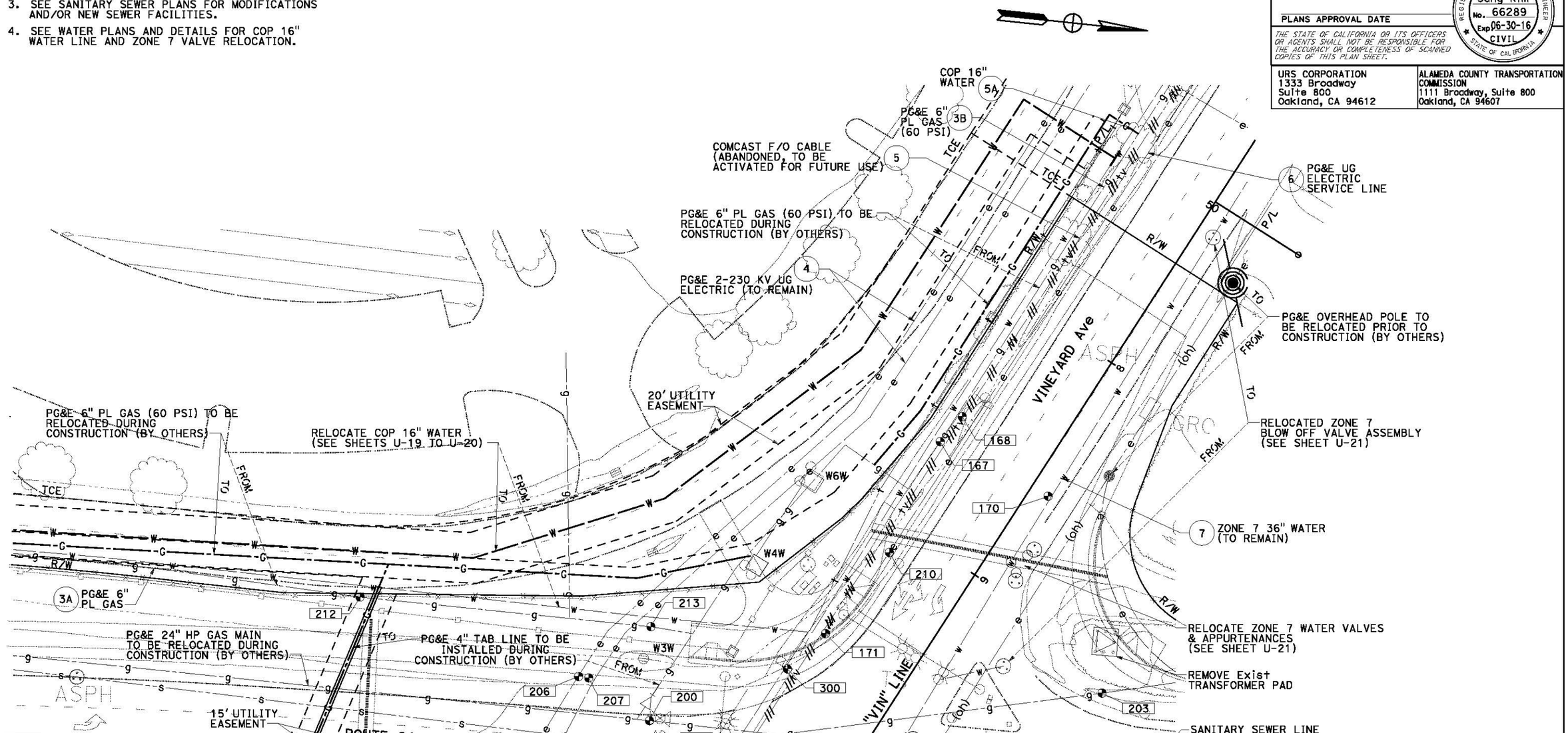
Oakland, CA 94607

NOTES:

1. FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.
2. SEE SHEET U-9 FOR POTHOLES INFORMATION.
3. SEE SANITARY SEWER PLANS FOR MODIFICATIONS AND/OR NEW SEWER FACILITIES.
4. 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

APPROVED FOR UTILITY WORK ONLY

UTILITY PLAN

SCALE: 1" = 20'

U-15

REVISED BY	DATE REVISED
SK	9/12/14

CALCULATED-DESIGNED BY: JASON HOM
CHECKED BY: SANG KIM
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 9-12-14
DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 16:41

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

05/30/14
REGISTERED CIVIL ENGINEER DATE

Sang Kim
No. 66289
Exp 06-30-16
CIVIL
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

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1111 Broadway, Suite 800
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NOTE:

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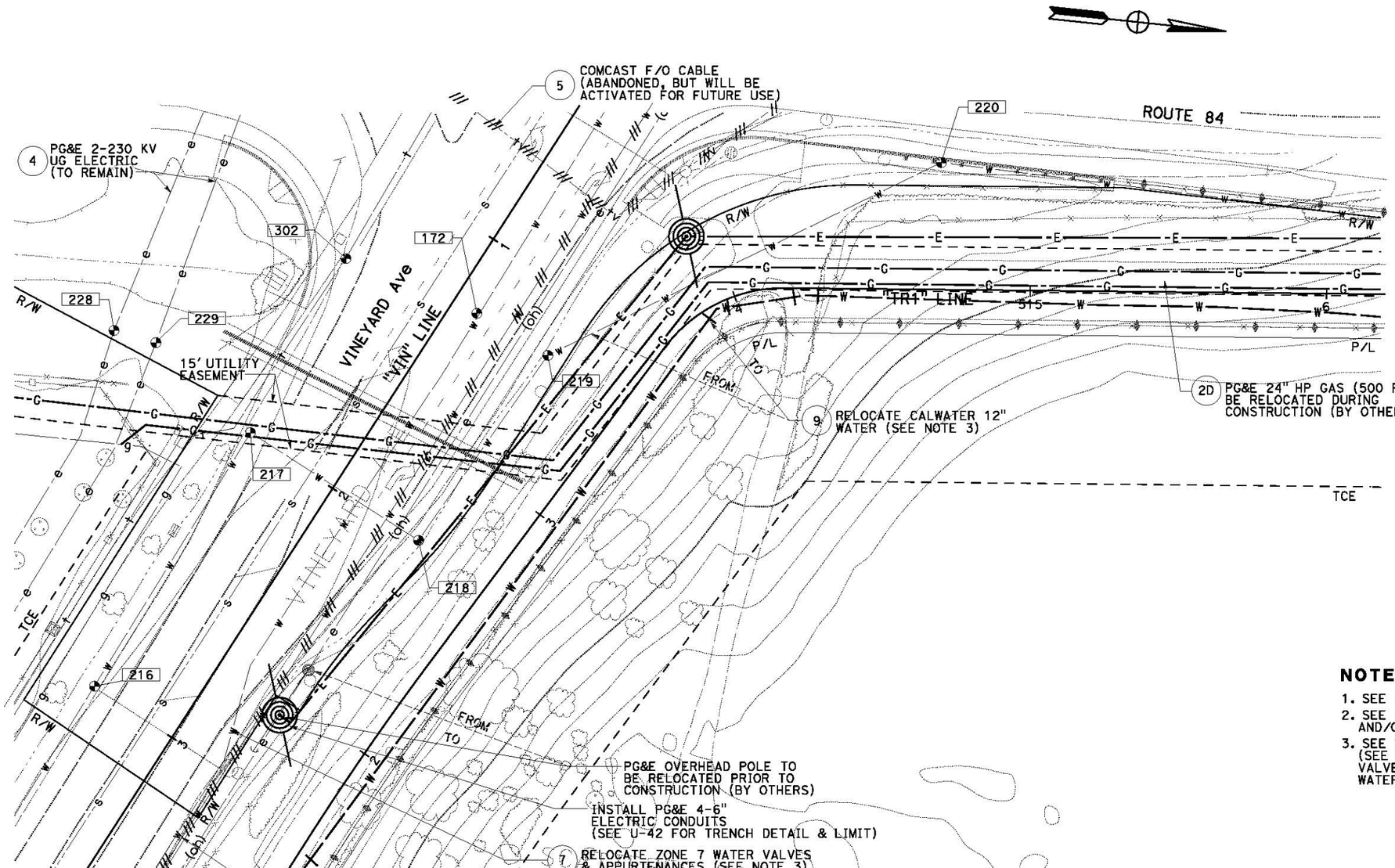

NOTES:

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 (SEE SHEETS U-18 TO U-33) FOR ZONE 7 VALVE AND APPURTENANCE AND CALWATER 12" WATER RELOCATION.

ROUTE 84 / VINEYARD Ave INTERSECTION (EAST)

FOR NOTES, ABBREVIATIONS AND LEGEND, SEE SHEET U-1

APPROVED FOR UTILITY WORK ONLY

UTILITY PLAN
SCALE: 1" = 20'

U-16

REVISED BY	DATE REVISED
SK	9/12/14

CALCULATED-DESIGNED BY: JASON HOM
CHECKED BY: SANG KIM
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 9-12-14
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TIME PLOTTED => 16:41

BORDER LAST REVISED 7/2/2010
USERNAME => Shruti_Shah
DGN FILE => 429760ka016.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
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REGISTERED CIVIL ENGINEER — DATE 05/30/14

PLANS APPROVAL DATE

Sang Kim No. 66289 Exp 06-30-16 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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UTILITY INFORMATION

UTILITY No.	SHEET No.	OWNER	DESCRIPTION	LOCATION
1	U-1, U-2	PG&E	3-60 KV & 3-12 KV Overhead Electric Line	"A1" 227+00 to 250+40
1A	U-3, U-4	PG&E	3-60 KV & 3-12 KV 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	2-230 KV 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	3-21 KV Overhead Electric Line	"VIN" 25+50 to 15+00
10A	U-9 to U-16	PG&E	3-21 KV 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	21 KV 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" 21 KV 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: SK — DATE REVISED: 9/12/14
CALCULATED-DESIGNED BY: JASON HOM — CHECKED BY: SANG KIM
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

UTILITY PLAN

U-17

LAST REVISION: DATE PLOTTED => 12-SEP-2014 TIME PLOTTED => 16:41
9-12-14

BORDER LAST REVISED 7/2/2010 | USERNAME => Shruti_Shah | DGN FILE => 429760ka017.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		

05/30/14
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER
Anthony E. Silva
No. 75053
Exp. 12-31-15
CIVIL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

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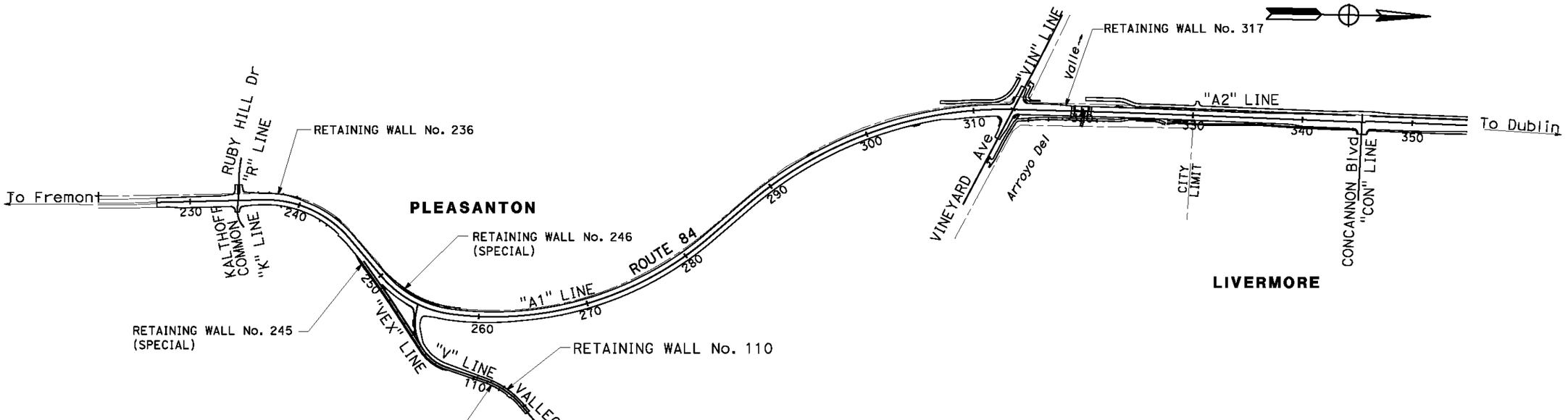
INDEX TO PLANS

SHEET No.	TITLE
R-1	RETAINING WALL KEY MAP - GENERAL PLAN
R-2	RETAINING WALL No. 236 - RETAINING WALL PLAN No. 1 OF 2
R-3	RETAINING WALL No. 236 - RETAINING WALL PLAN No. 2 OF 2
R-4	RETAINING WALL No. 317 - RETAINING WALL PLAN No. 1 OF 1
R-5	RETAINING WALL No. 109 - RETAINING WALL PLAN No. 1 OF 1
R-6	RETAINING WALL No. 110 - RETAINING WALL PLAN No. 1 OF 2
R-7	RETAINING WALL No. 110 - RETAINING WALL PLAN No. 2 OF 2
R-8	RETAINING WALL DETAILS
R-9	RETAINING WALL DETAILS
R-10	RETAINING WALL AESTHETICS - RETAINING WALL PLAN No. 246
R-11	RETAINING WALL AESTHETICS - RETAINING WALL PLAN No. 246
R-12	RETAINING WALL DETAILS - RETAINING WALL AESTHETICS
R-13	RETAINING WALL DETAILS - RETAINING WALL AESTHETICS
R-14	RETAINING WALL DETAILS - RETAINING WALL AESTHETICS
R-15	RETAINING WALL AESTHETICS - RETAINING WALL PLAN No. 236
R-16	RETAINING WALL DETAILS - RETAINING WALL AESTHETICS
R-17	RETAINING WALL DETAILS - RETAINING WALL AESTHETICS

LEGEND

BX-X / X-X	STANDARD PLAN SHEET No. STANDARD PLAN DETAIL No.
R-XX	Ret WALL PLAN SHEET No.
TCE	TEMPORARY CONSTRUCTION EASEMENT



RETAINING WALL KEY MAP GENERAL PLAN

SCALE: 1" = 500'

R-1

CALCULATED-DESIGNED BY: ANTHONY SILVA
CHECKED BY: ELIE ABI-JAOUDE
REVISED BY: AS
DATE REVISED: 9/14/15
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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BORDER LAST REVISED 7/2/2010
USERNAME => Shruti_Shah
DGN FILE => 429760qa001.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0733
PROJECT NUMBER & PHASE 04000205811

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REGISTERED CIVIL ENGINEER — 05/30/14 DATE

Anthony E. Silva No. 75053 Exp. 12-31-15 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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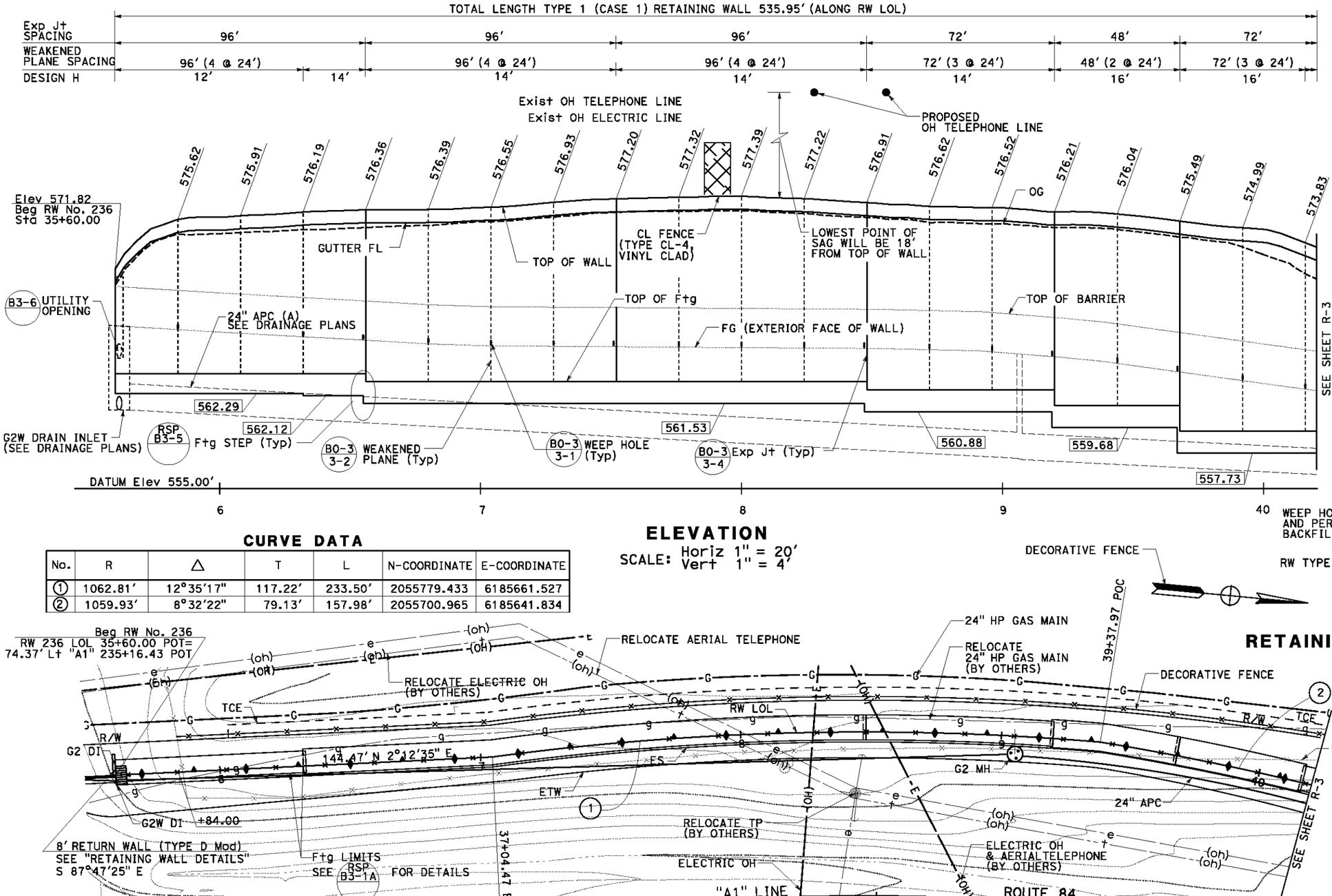
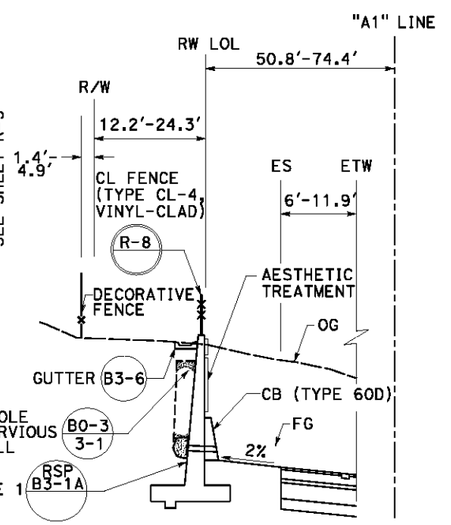


ELEVATION
SCALE: Horiz 1" = 20'
Vert 1" = 4'

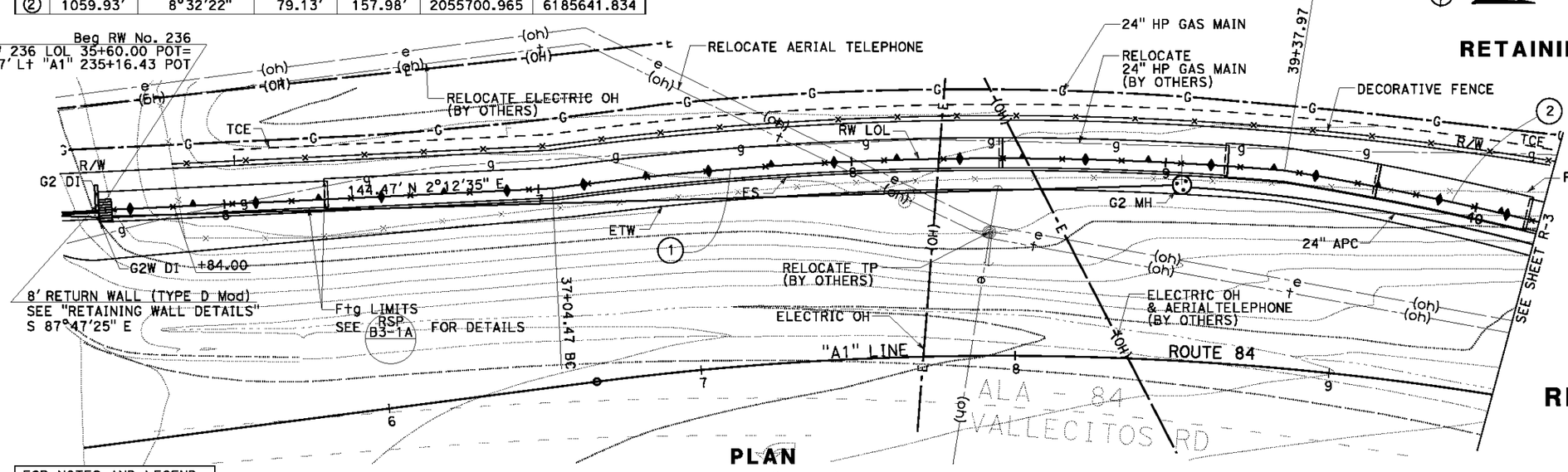


FOR DETAILS NOT SHOWN SEE STANDARD PLANS

RETAINING WALL TYPE 1 (CASE 1) TYPICAL SECTION
NO SCALE

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
①	1062.81'	12°35'17"	117.22'	233.50'	2055779.433	6185661.527
②	1059.93'	8°32'22"	79.13'	157.98'	2055700.965	6185641.834



PLAN
SCALE: 1" = 20'

FOR NOTES AND LEGEND, SEE SHEET R-1

APPROVED FOR RETAINING WALL WORK ONLY

RETAINING WALL PLAN
RW No. 236
TYPE 1 CASE 1
SHEET 1 of 2
SCALE AS SHOWN

R-2

REVISED BY	DATE REVISED
AS	9/15/14

ANTHONY SILVA — ELIE ABI-JAOUDE — CALCULATED-DESIGNED BY — CHECKED BY

RAMSEY J. HISSEN — CONSULTANT FUNCTIONAL SUPERVISOR

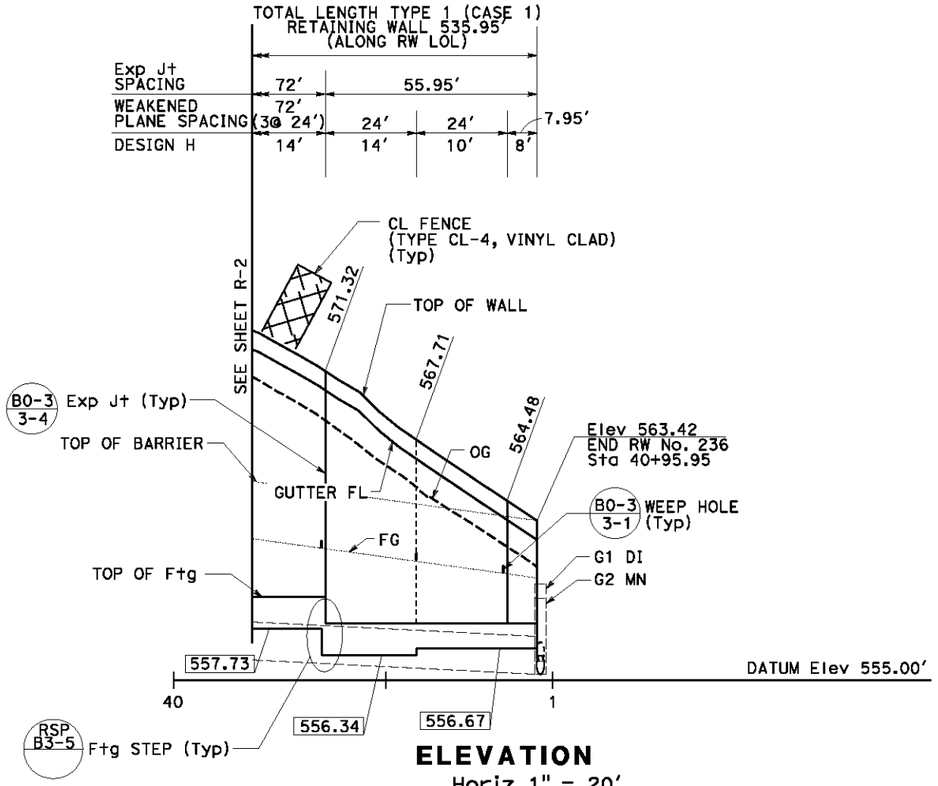
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 08:17

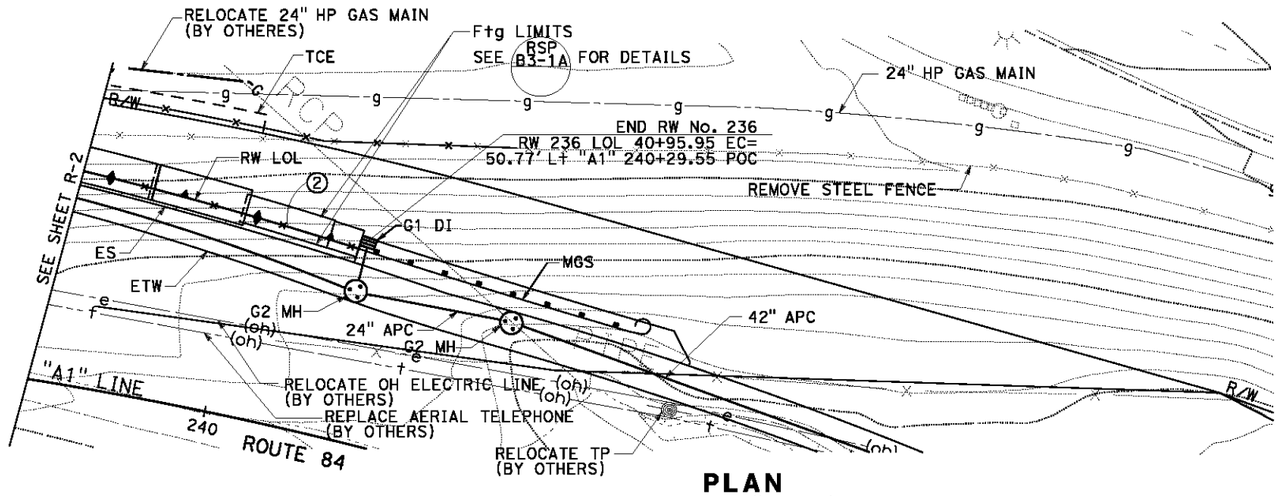
LAST REVISION 9-15-14

BORDER LAST REVISED 7/2/2010 | USERNAME => Shruti_Shah | DGN FILE => 429760qa002.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.



ELEVATION
SCALE: Horiz 1" = 20'
Vert 1" = 4'



PLAN
SCALE: 1" = 20'

CURVE DATA

No.	R	△	T	L	N-COORDINATE	E-COORDINATE
②	1059.93'	8°32'22"	79.13'	157.98'	2055700.965	6185641.834

FOR NOTES AND LEGEND,
SEE SHEET R-1

APPROVED FOR RETAINING WALL WORK ONLY

RETAINING WALL PLAN
RW No. 236
TYPE 1 CASE 1
SHEET 2 OF 2
SCALE AS SHOWN

R-3

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	84	22.9/25.7		

05/30/14
REGISTERED CIVIL ENGINEER DATE

Anthony E. Silva
No. 75053
Exp. 12-31-15
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

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CALCULATED-DESIGNED BY: ANTHONY SILVA
CHECKED BY: ELIE ABI-JAOUDE

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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FOR ACCURATE RIGHT OF WAY DATA, CONTACT
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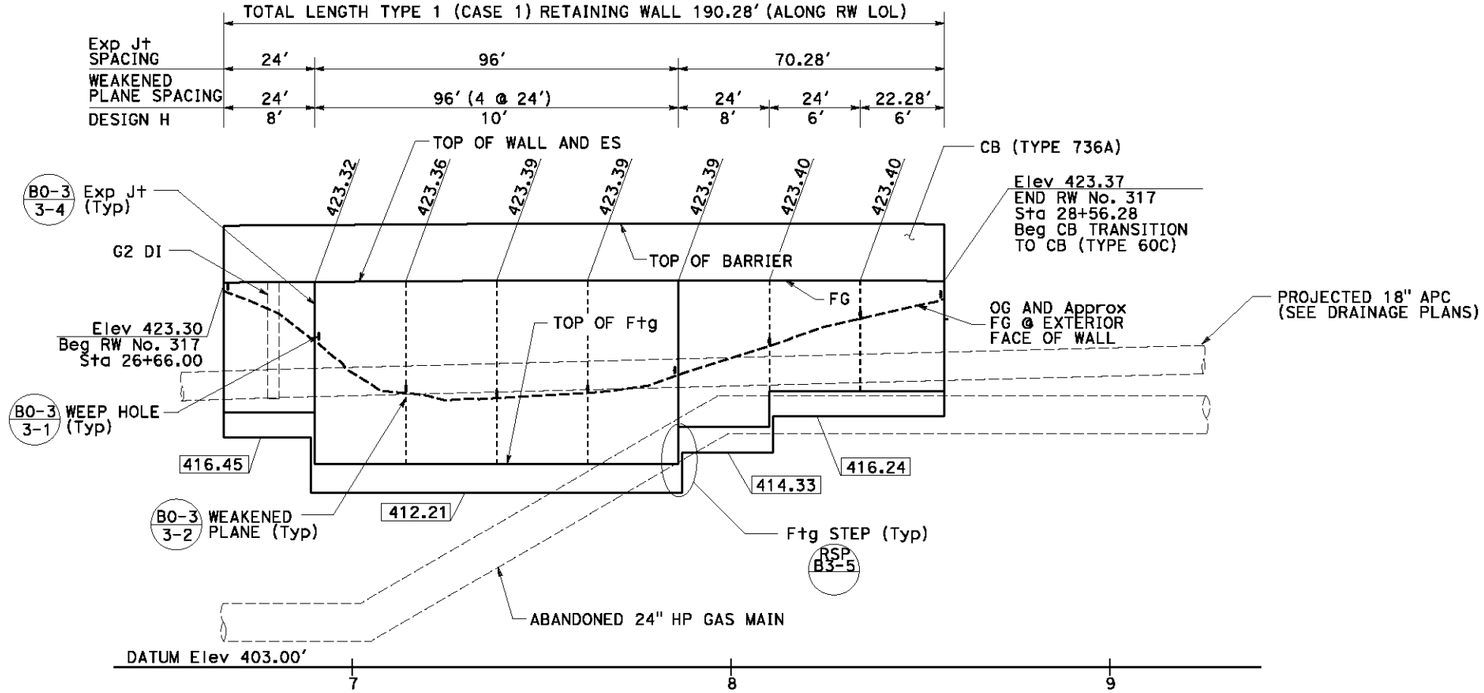
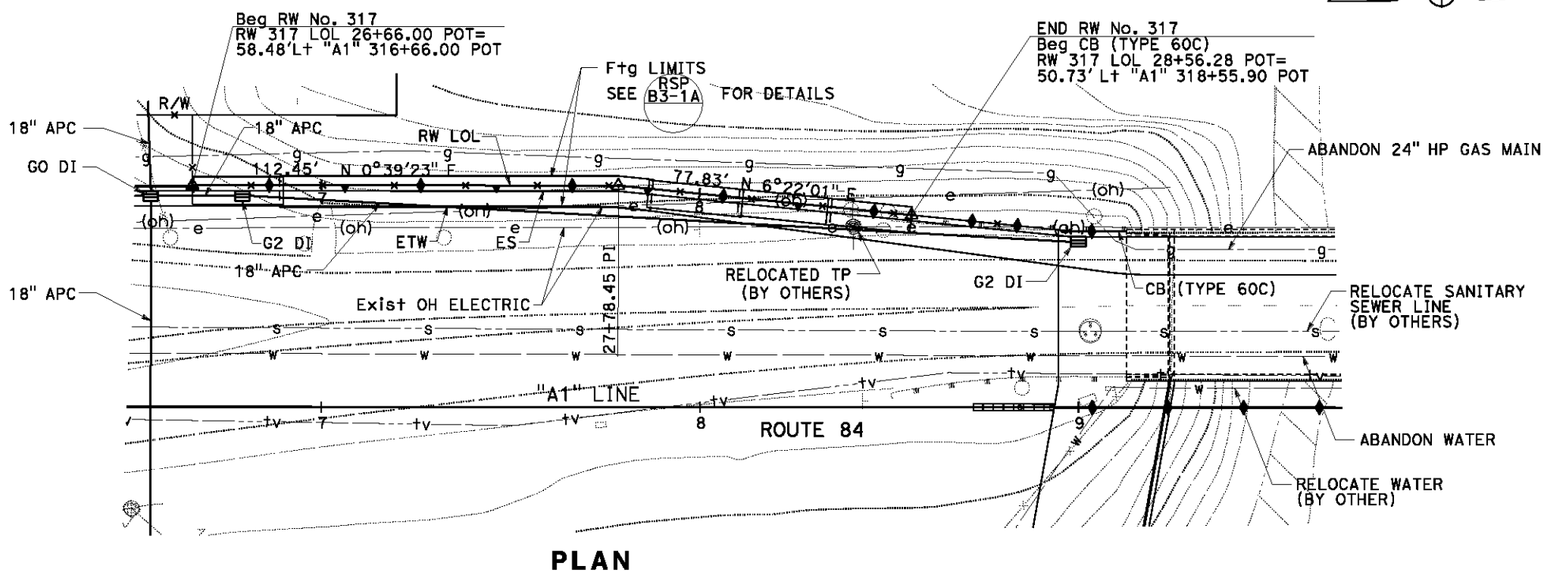


MIRRORED ELEVATION
SCALE: Horiz 1" = 20'
Vert 1" = 4'



PLAN
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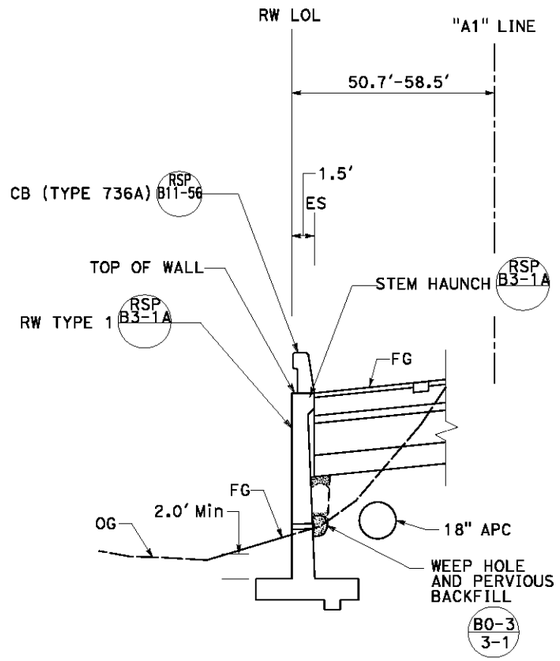

FOR DETAILS NOT SHOWN SEE
STANDARD PLANS

RETAINING WALL TYPE 1 (CASE 1)
TYPICAL SECTION
NO SCALE

FOR NOTES AND LEGEND,
SEE SHEET R-1

APPROVED FOR RETAINING WALL WORK ONLY

RETAINING WALL PLAN
RW No. 317
TYPE 1 CASE 1
SHEET 1 of 1
SCALE AS SHOWN

R-4

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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05/30/14
REGISTERED CIVIL ENGINEER DATE

Anthony E. Silva No. 75053 Exp. 12-31-15 CIVIL
REGISTERED PROFESSIONAL ENGINEER * STATE OF CALIFORNIA *

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Oakland, CA 94607

REVISED BY	DATE REVISED
AS	9/15/14

CALCULATED-DESIGNED BY: ANTHONY SILVA
CHECKED BY: ELIE ABI-JAOUDE
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 9-15-14
DATE PLOTTED => 12-SEP-2014
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BORDER LAST REVISED 7/2/2010
USERNAME => Shruti_Shah
DGN FILE => 429760qa004.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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Anthony E. Silva No. 75053 Exp. 12-31-15 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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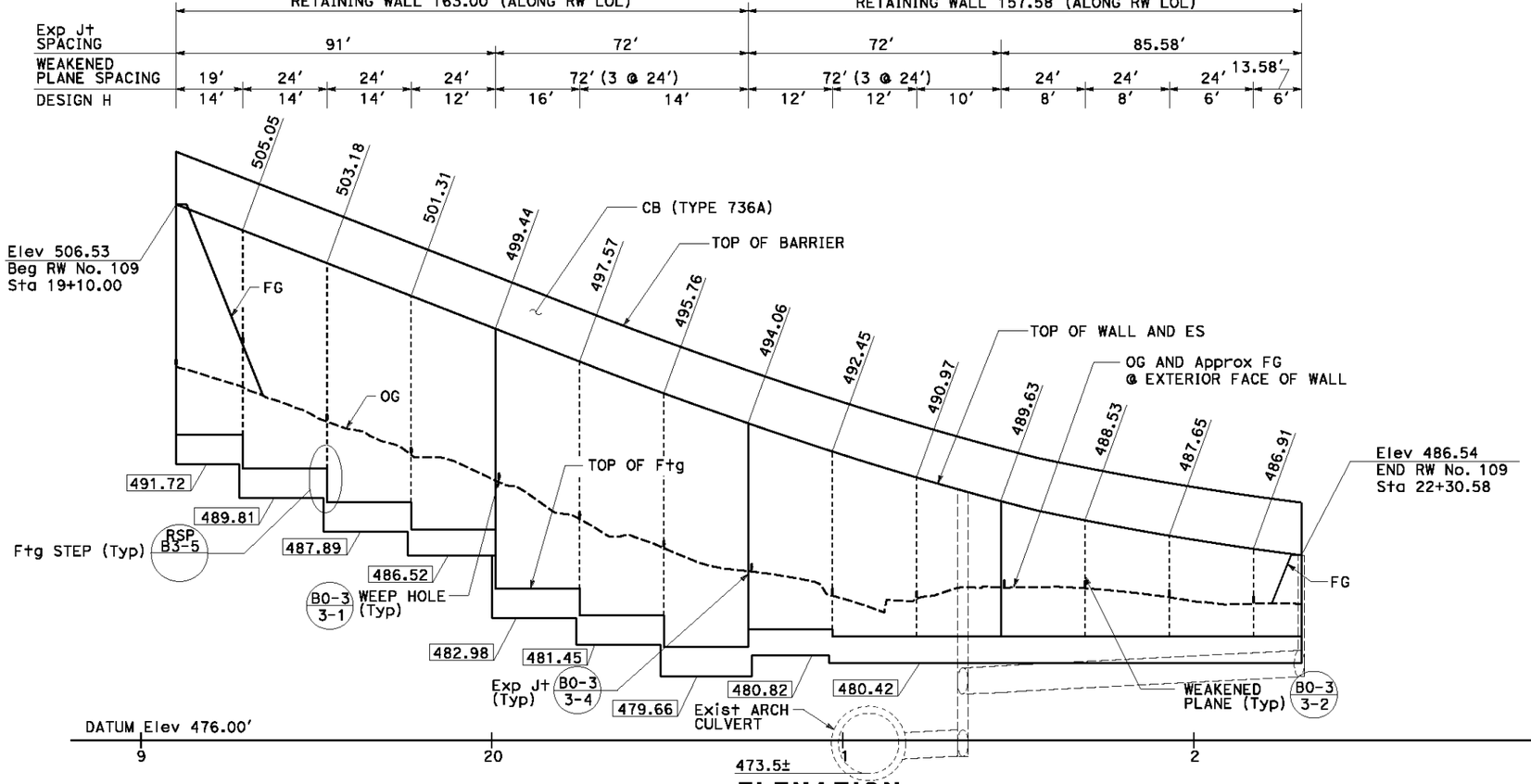
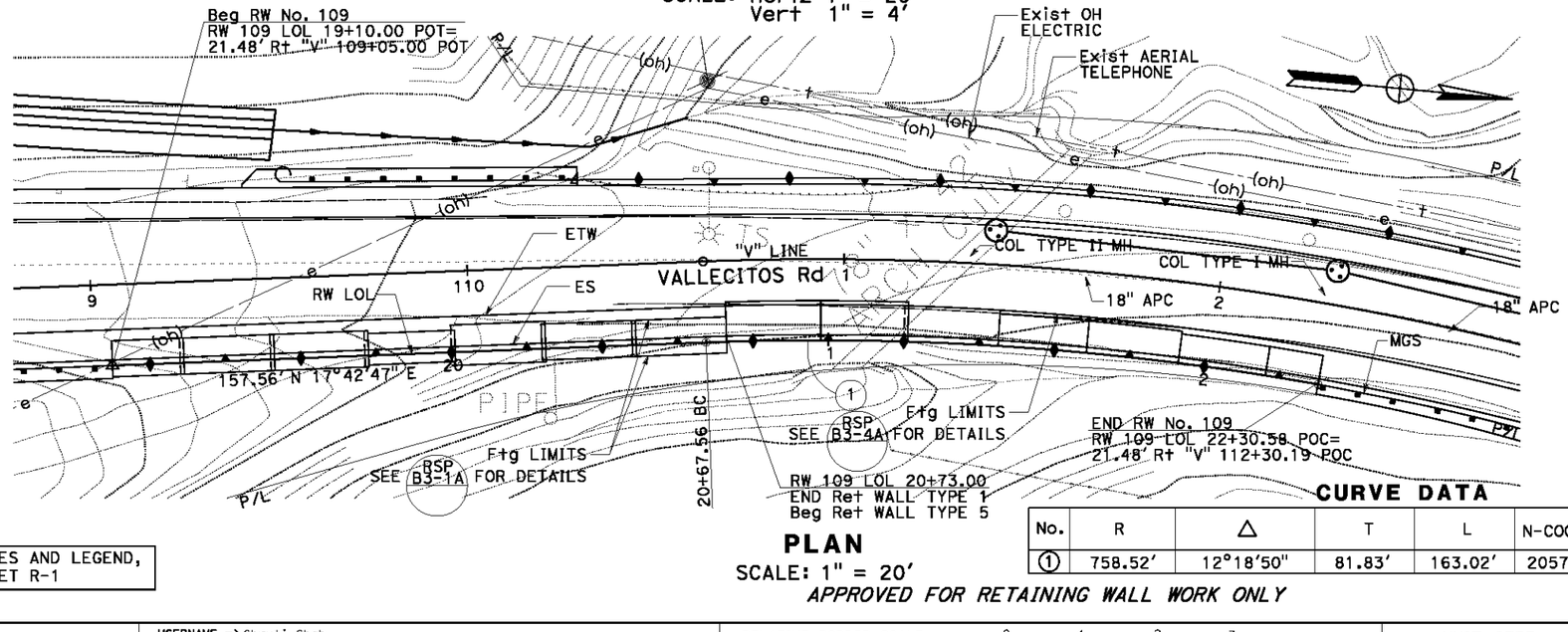


ELEVATION
SCALE: Horiz 1" = 20'
Vert 1" = 4'



PLAN
SCALE: 1" = 20'

FOR NOTES AND LEGEND, SEE SHEET R-1

CURVE DATA

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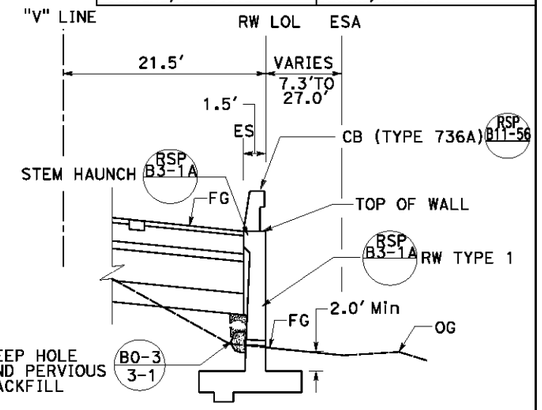
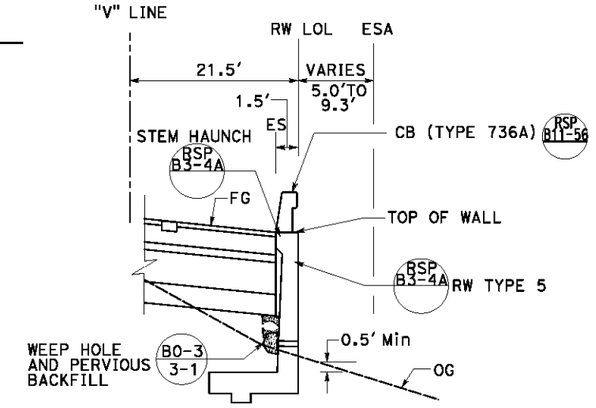
APPROVED FOR RETAINING WALL WORK ONLY



FOR DETAILS NOT SHOWN SEE STANDARD PLANS

RETAINING WALL TYPE 1 (CASE 1) TYPICAL SECTION
NO SCALE



FOR DETAILS NOT SHOWN SEE STANDARD PLANS

RETAINING WALL TYPE 5 (CASE 1) TYPICAL SECTION
NO SCALE

RETAINING WALL PLAN RW No. 109 TYPE 1 CASE 1 / TYPE 5 CASE 1 SHEET 1 of 1
SCALE AS SHOWN

R-5

REVISED BY	DATE REVISED
AS	9/15/14

CALCULATED-DESIGNED BY: ANTHONY SILVA
CHECKED BY: ELIE ABI-JAOUDE
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION: 9-15-14
DATE PLOTTED => 12-SEP-2014
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REGISTERED CIVIL ENGINEER — 05/30/14 DATE

PLANS APPROVAL DATE

Registered Professional Engineer — Anthony E. Silva — No. 75053 — Exp. 12-31-15 — CIVIL — State of California

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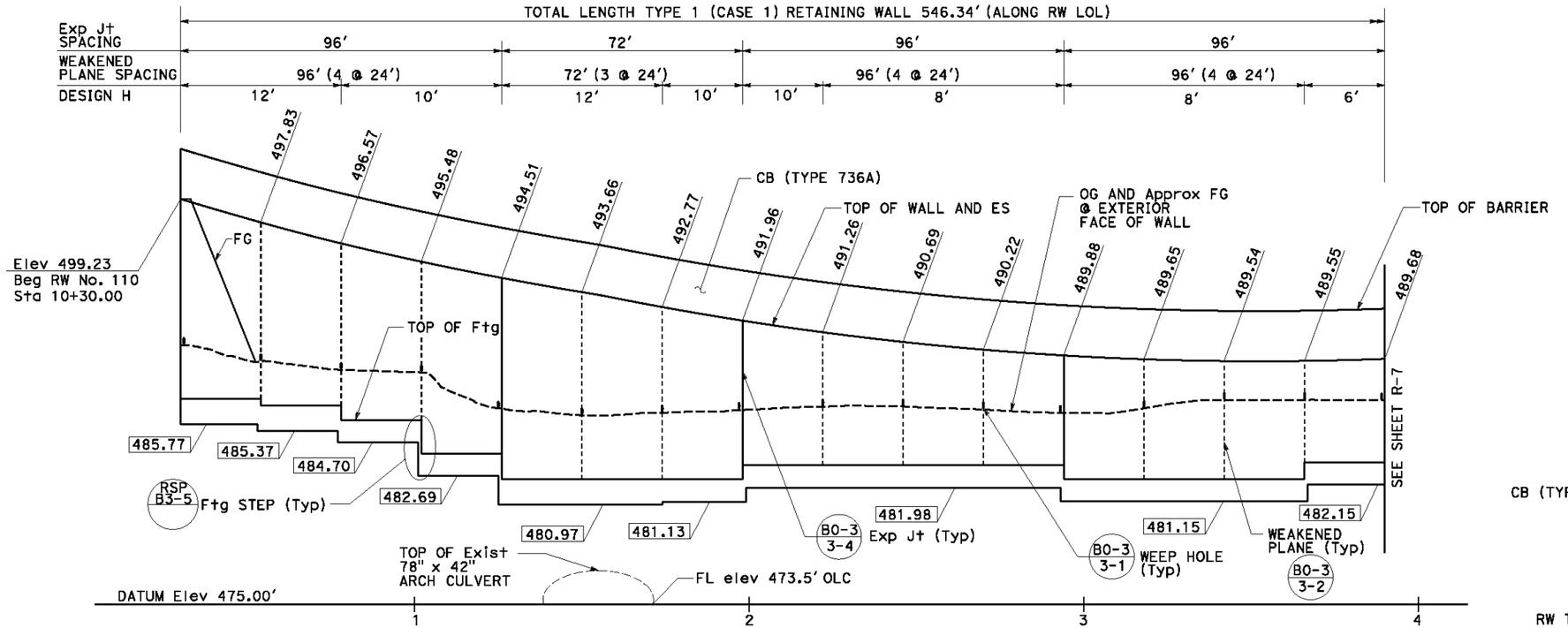
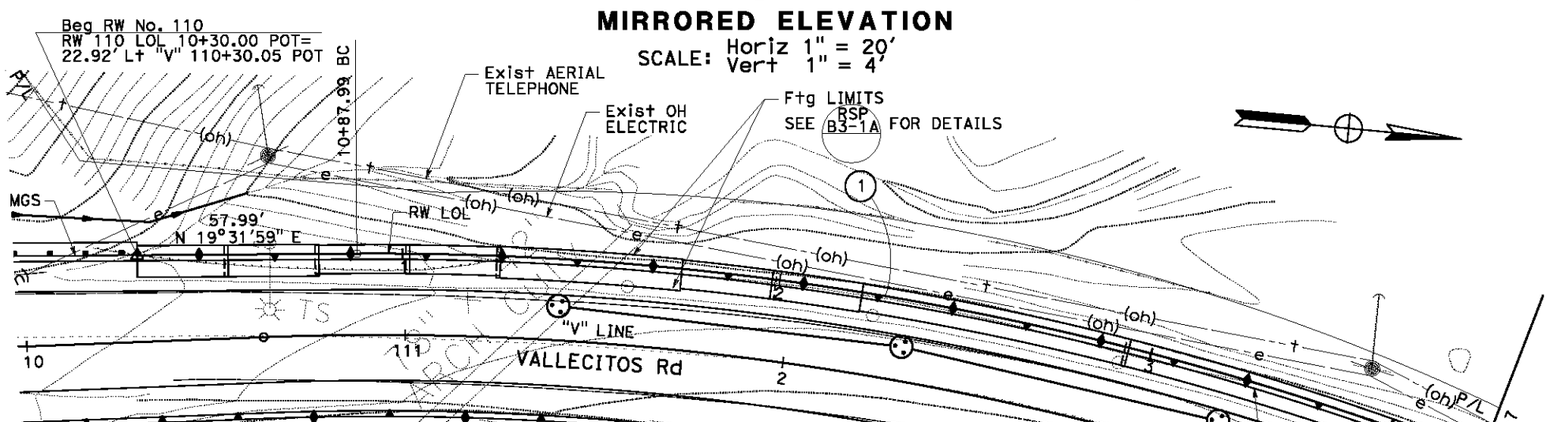
Oakland, CA 94607

FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.



MIRRORED ELEVATION
SCALE: Horiz 1" = 20'
Vert 1" = 4'

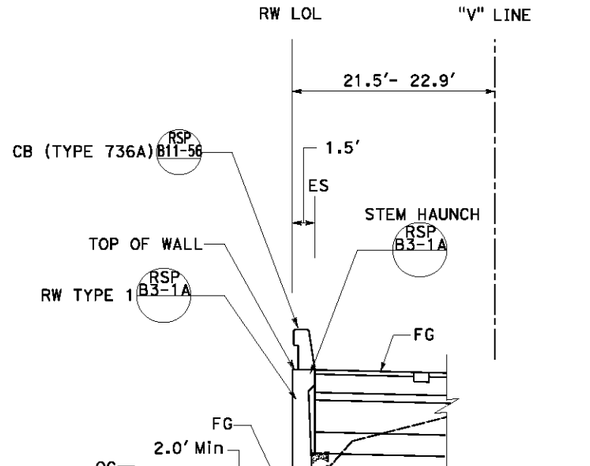


PLAN
SCALE: 1" = 20'

CURVE DATA

No.	R	Δ	T	L	N-COORDINATE	E-COORDINATE
①	801.48'	29°30'58"	211.13'	412.89'	2057540.376	6187011.385

FOR NOTES AND LEGEND, SEE SHEET R-1



FOR DETAILS NOT SHOWN SEE STANDARD PLANS

RETAINING WALL TYPE 1 (CASE 1) TYPICAL SECTION
NO SCALE

APPROVED FOR RETAINING WALL WORK ONLY

RETAINING WALL PLAN
RW No. 110
TYPE 1 CASE 1
SHEET 1 of 2
SCALE AS SHOWN

R-6

REVISED BY	DATE REVISED
AS	9/15/14

CALCULATED-DESIGNED BY: ANTHONY SILVA
CHECKED BY: ELIE ABI-JAOUDE
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY J. HISSEN
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 9-15-14
DATE PLOTTED => 12-SEP-2014
TIME PLOTTED => 08:17

BORDER LAST REVISED 7/2/2010
USERNAME => Shruti_Shah
DGN FILE => 429760qa006.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		

REGISTERED CIVIL ENGINEER — 05/30/14 DATE

PLANS APPROVAL DATE

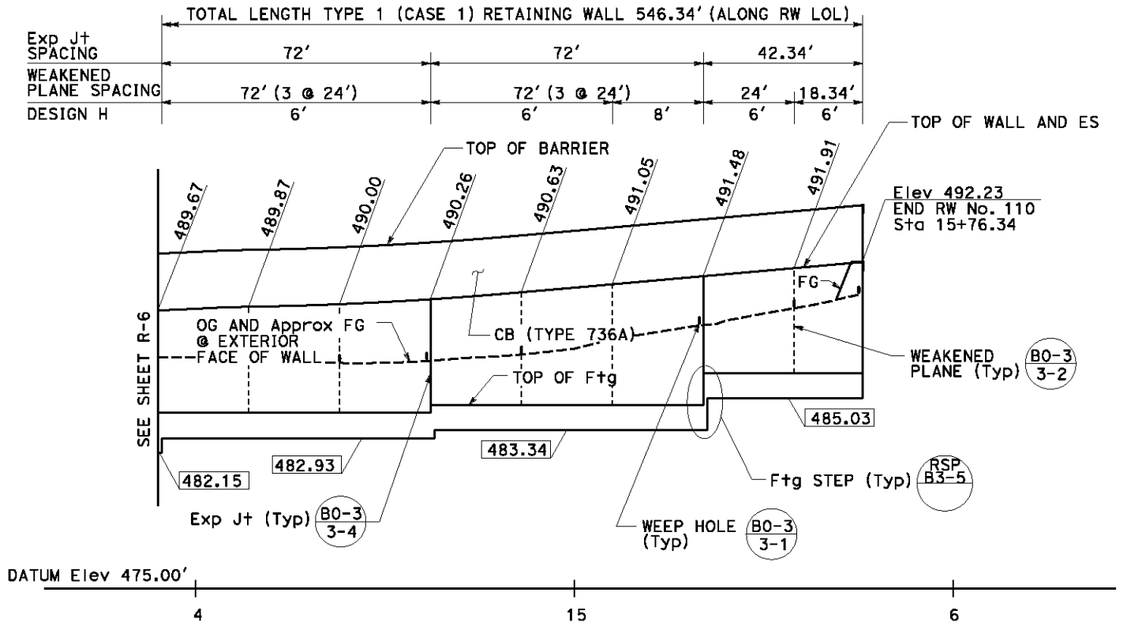
Anthony E. Silva, No. 75053, Exp. 12-31-15, CIVIL, REGISTERED PROFESSIONAL ENGINEER, STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

URS CORPORATION
1333 Broadway
Suite 800
Oakland, CA 94612

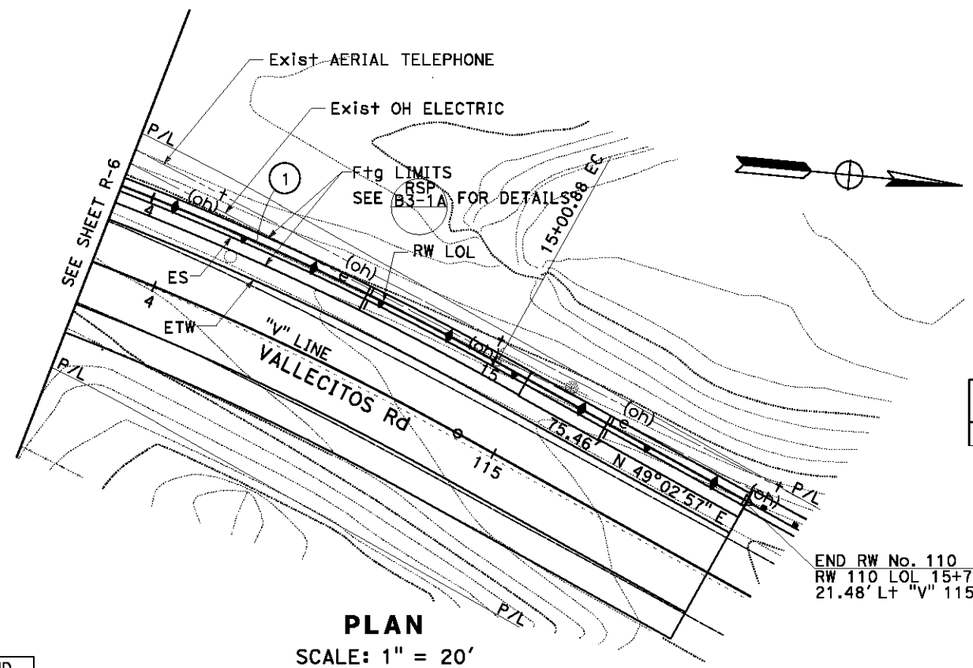
ALAMEDA COUNTY TRANSPORTATION COMMISSION
1111 Broadway, Suite 800
Oakland, CA 94607

FOR ACCURATE RIGHT OF WAY DATA, CONTACT
RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.



MIRRORED ELEVATION

SCALE: Horiz 1" = 20'
Vert 1" = 4'



PLAN

SCALE: 1" = 20'

CURVE DATA

No.	R	△	T	L	CURVE CENTER	
					N-COORDINATE	E-COORDINATE
①	801.48'	29°30'58"	211.13'	412.89'	2057540.376	6187011.385

FOR NOTES AND LEGEND, SEE SHEET R-1

APPROVED FOR RETAINING WALL WORK ONLY

RETAINING WALL PLAN
RW No. 110
TYPE 1 CASE 1
SHEET 2 of 2

SCALE AS SHOWN

R-7

REVISED BY	AS	
DATE REVISED	9/15/14	
CALCULATED-DESIGNED BY	ANTHONY SILVA	
CHECKED BY	ELIE ABI-JAOUDE	
CONSULTANT FUNCTIONAL SUPERVISOR	RAMSEY J. HISSEN	

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 9-15-14 DATE PLOTTED => 12-SEP-2014 TIME PLOTTED => 08:17

BORDER LAST REVISED 7/2/2010 | USERNAME => Shruti_Shah | DGN FILE => 429760qa007.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0733 | PROJECT NUMBER & PHASE 04000205811

Project borings were drilled in 2007-2008 and in 2008-2009. The following table provides a correlation between boring identification numbers used during the subsurface exploration programs and the current Caltrans standards.

Multi-Purpose Borings			**Roadway Borings**	
Boring Number (Old)	**Boring Number (New)**		**Boring Number (Old)**	**Boring Number (New)**
NB01	A-08-001		RB01	A-07-101
NB02	A-08-002		RB02	A-07-102
NB03	R-07-003		RB03	A-07-103
NB04	A-07-004		RB04	A-07-104
NB05	R-07-005		RB05	A-07-105
NB05A	A-08-005		RB06	A-07-106
NB06	R-07-006		RB07	A-07-107
NB07	A-07-007		RB08	A-07-108
NB07A	A-08-007A		RB09	A-07-109
NB08	A-08-008		RB10	A-07-110
NB09	A-07-009		RB11	A-07-111
NB10	A-08-010		RB12	A-07-112
NB11	R-07-011		RB13	A-07-113
NB12	R-07-012		RB14	A-07-114
NB13	R-07-013		RB15	A-07-115
NB14	R-07-014		RB16	A-07-116
NB15	A-07-015		RB17	A-07-117
NB16	A-07-016		RB18	A-07-118
NB17	A-07-017		RB19	A-07-119
NB18	A-07-018		RB20	A-07-120
NB30	A-08-030		RB21	A-07-121
NB31	A-08-031		RB22	A-07-122
NB32	A-08-032		RB23	A-07-123
NB33	A-08-033		RB24	A-07-124
NB34	A-08-034		RB25	A-07-125
NB35	A-08-035		RB41	A-08-141
NB36	A-08-036		RB42	A-08-142
NB37	R-08-037		RB43	A-08-143
NB38	R-08-038			

Multi-purpose Borings NB19 through NB26 and roadway Borings RB26 through RB140 located outside of south segment project limits.

URS

Page 1 of ____

Job ROUTE 99 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.

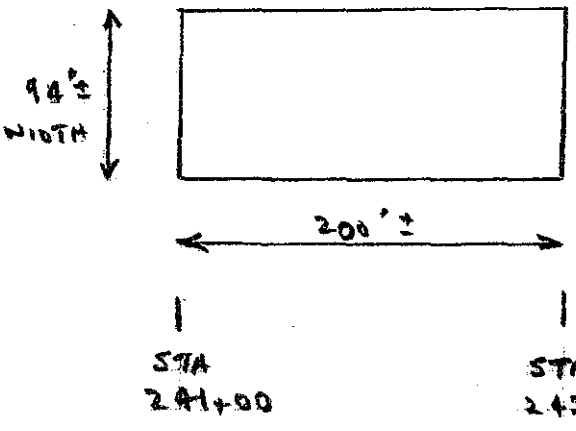
∴ USE NB03 FOR ESTIMATING SETTLEMENT.

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	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 ML	539.3 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Rotary Wash			Falling 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		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 = 0.8 x 41						
	3		Lean CLAY with GRAVEL (CL); brown; moist.			22								
535.30	4							22 = 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 84						
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							100 = 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 3/5/08

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	22.5/27.3	04-28649640
PROJECT OR BRIDGE NAME				
Route 84 Expressway Widening				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-14-07	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		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													
	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.				53 = .8 × 66							
	35				8	15 28 38	66	80		16	117	UC = 8.1		Extra casing added.
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 8 in.
	51													
487.30	52													
	53													
485.30	54													
	55													

(continued)

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 200802 28649640-ROUTE84.GPJ CT SACTO 053107.GDT 3/6/08

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"		35						Sampler advanced 5 in.
483.30	56													
	57							50+						
481.30	58													
	59													
479.30	60				13	53 75 66	141	85						
	61													
477.30	62		At 61.5 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							50+						
469.30	70		CLAYEY GRAVEL with SAND (GC); very dense; brown; moist.		15	69 50/1"		35						Sampler advanced 7 in.
	71													
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 77 ft, with increase in gravel content.											
461.30	78		CLAYEY SAND with GRAVEL (SC); very dense; brown; moist.					50+						
	79				17	68 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 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				NB03
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.5/27.3	04-28649640
PROJECT OR BRIDGE NAME				
Route 84 Expressway Widening				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-14-07	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			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Exploration Geoservices, Inc			27.6' Rt Sta 243+42.4 ML	547.8 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.
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"	50+	56							Sampler advanced 10 in.
541.80	6														
	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 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				HOLE ID
BORING RECORD				RB03
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Alameda	84	22.5/27.3	04-28649640
PROJECT OR BRIDGE NAME				
Route 84 Expressway Widening				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	M.Thummaluru		12-3-07	1 of 1

URS

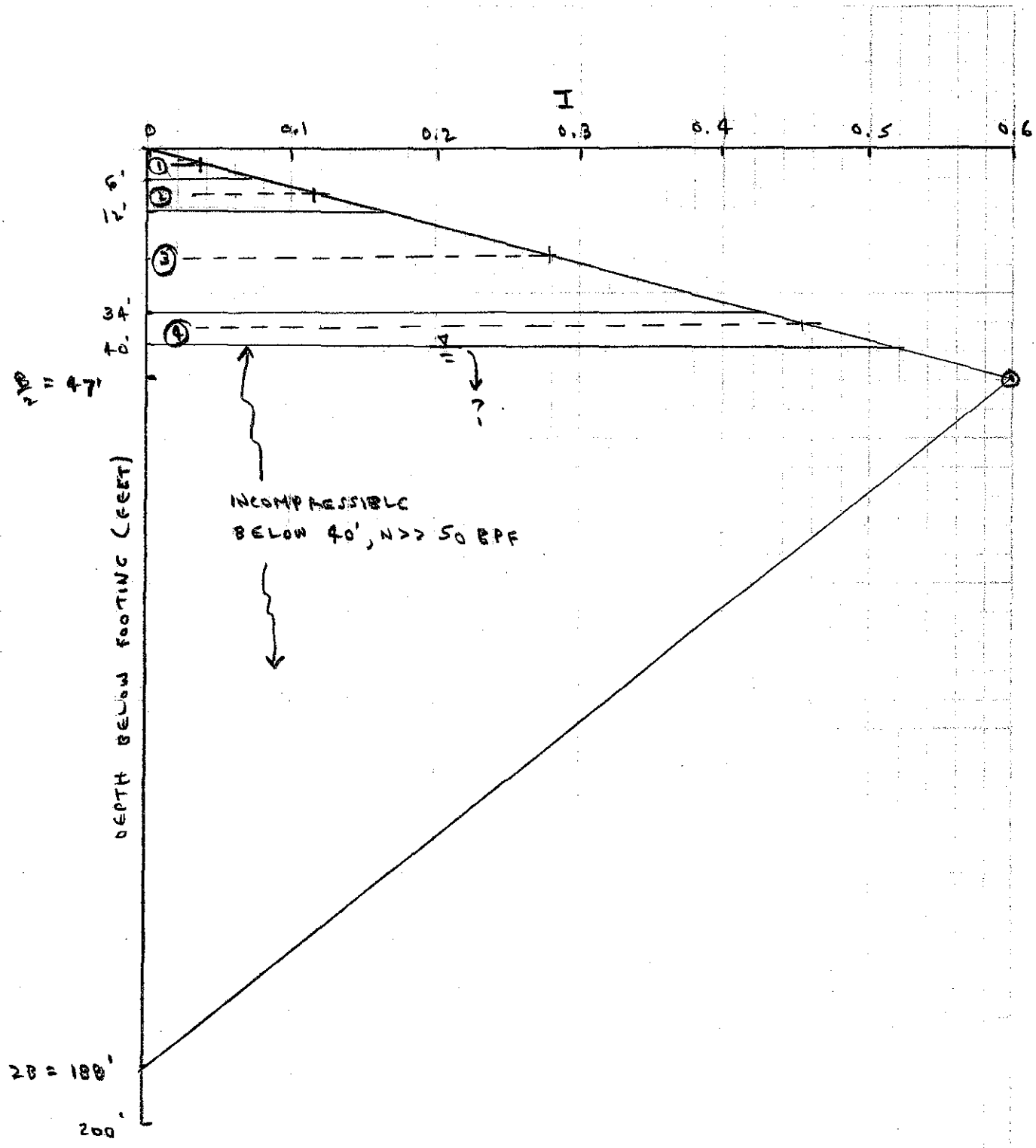
Page 6 of ____

Job ROUTE 84 Project No. 28649640 Sheet ____ of ____

Description MAXIMUM ROADWAY SETTLEMENT Computed by M. LARSON Date 03/25/08

Checked by A. Moore Date ____

Reference



LAYER ①	0 - 6'	6'
②	6' - 12'	6'
③	12' - 34'	22'
④	34' - 40'	6'

URS

Page 7 of ____

Job ROUTE 84 Project No. 26496640 Sheet ____ of ____

Description MAXIMUM BROADWAY SETTLEMENT Computed by M. LARSON Date 03/25/09

Checked by A. Moore Date ____

Reference

LAYER	ΔZ (FEET)	(INCH)	N	$\frac{E_s}{N}$ (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	0.28	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 $= (4\ \text{FT})\left(\frac{130\ \text{LBS}}{\text{FT}^3}\right) = 520\ \text{PSF}$

$\Delta p = \frac{520}{2{,}000} = 0.26\ \text{TSF}$

$\Delta H = C_1 C_2 (0.26\ \text{TSF})\left(0.7402\ \frac{\text{INCH}}{\text{TSF}}\right)$

$\Delta H = C_1 C_2\ 0.192$ 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

$\beta_z = 1.09$ $\quad \frac{L}{B} = \frac{200}{94} \cong 2$ $\quad \nu = 0.4$

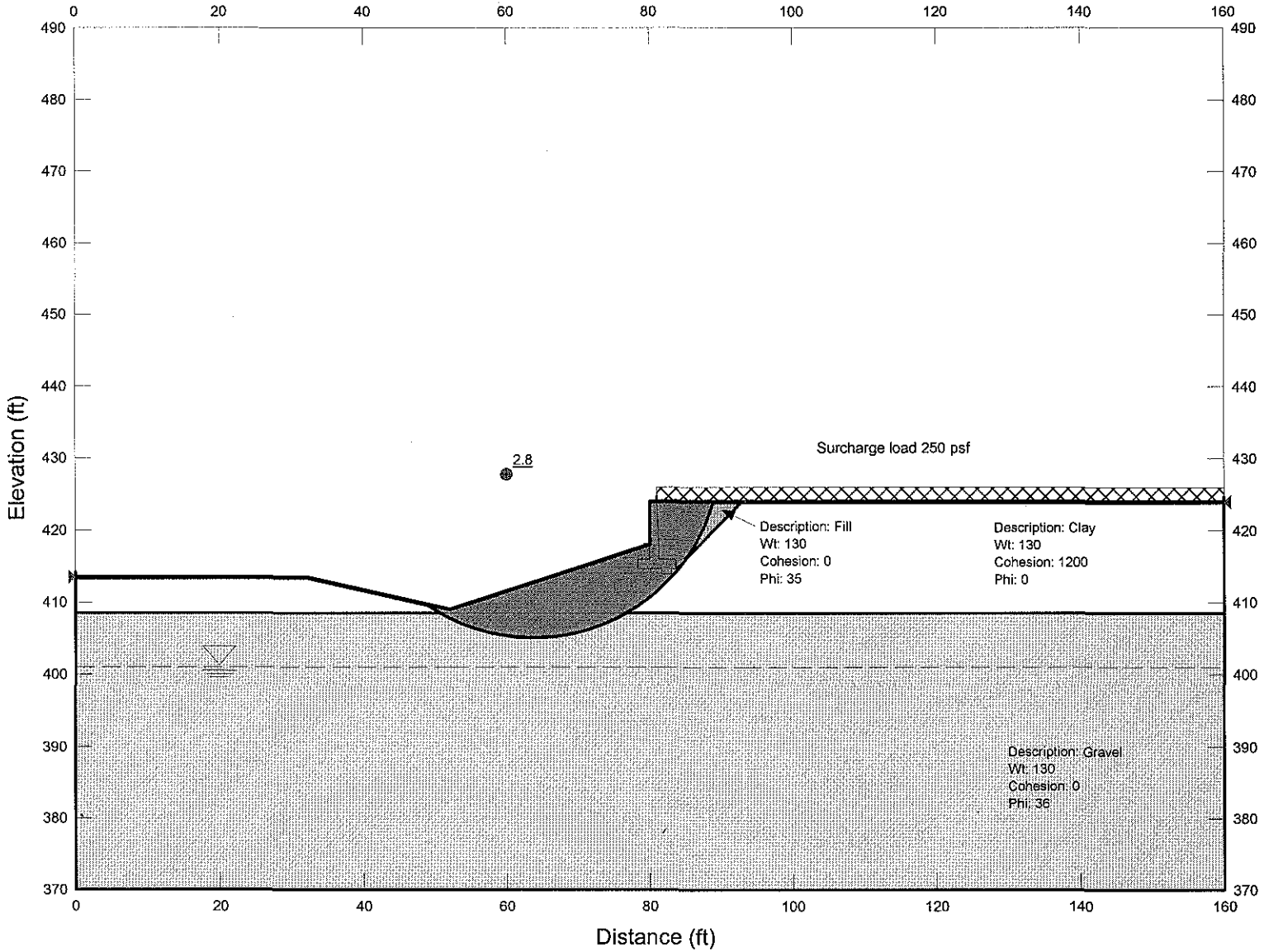
$A = (94)(200)\ FT^2 = 18{,}800\ FT.^2$

$q_0 = (4\ FT)\left(130 \frac{LBS}{FT.^3}\right) = 520 \frac{LBS}{FT^2} = 0.520$ KSF

$$S_e = \left\{ 0.520\ \text{KSF} (1 - .4^2) \sqrt{18{,}800\ FT.^2} \right\} / (2{,}000\ \text{KSF})(1.09)$$

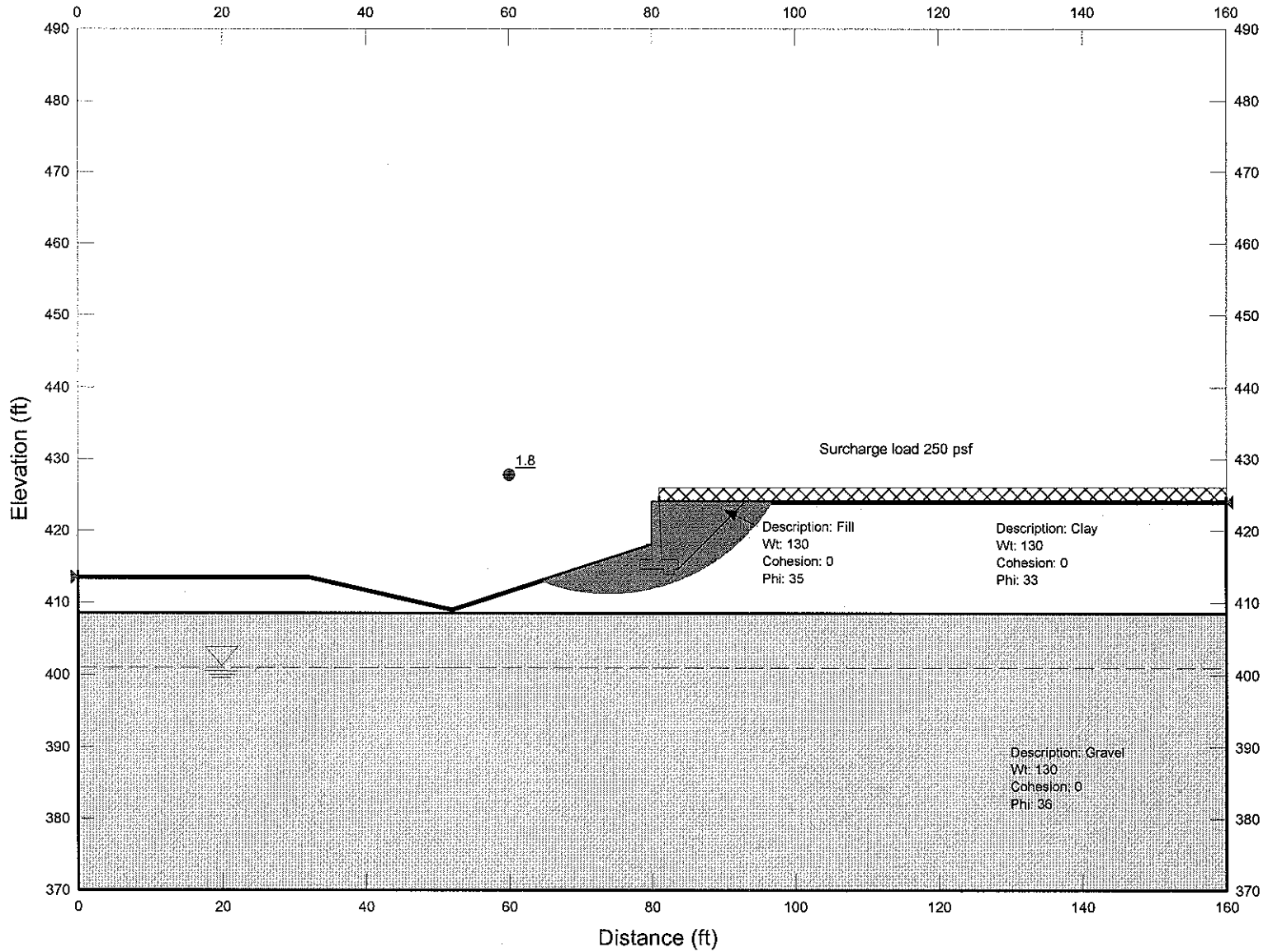
$$S_e = \left\{ 0.520 (1 - .16) (137.11\ FT) \right\} / 2{,}180$$

$$S_e = \frac{59.8896}{2{,}180}\ FT = 0.0275\ FT. = 0.33\ IN \cong 1/3\ \text{INCH}$$



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 – END OF CONSTRUCTION **RW 317 (A1-Sta.# 317+50)**
	Date March 11, 2009	CHECKED BY Stephen Huang	

FIGURE



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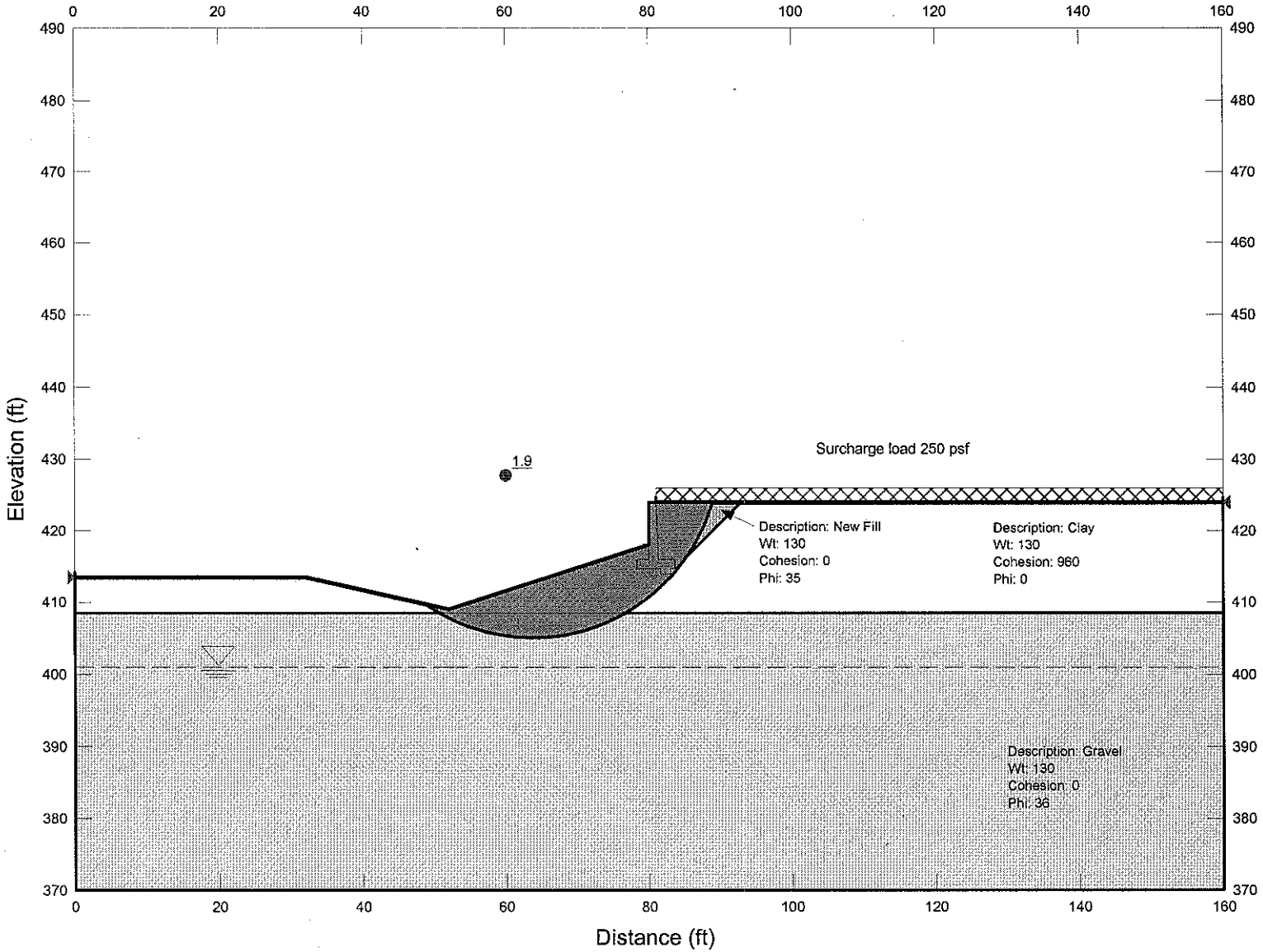
PROJECT No 28649640	CALCULATED BY S. Manoharan	
Date March 11, 2009	CHECKED BY Stephen Huang	

ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
STATIC – LONG TERM
RW 317 (A1-Sta.# 317+50)

FIGURE



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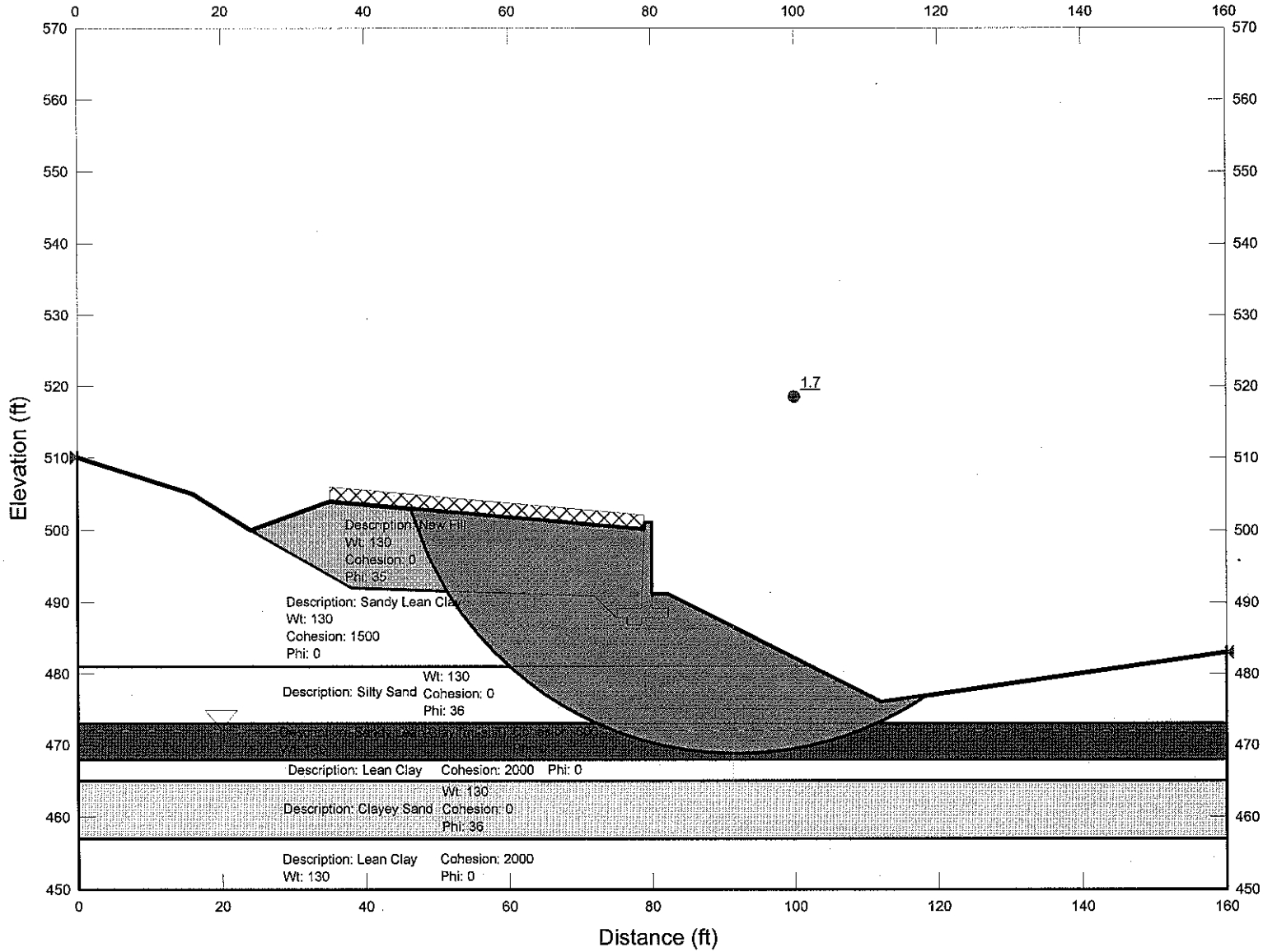
Date March 11, 2009	CHECKED BY Stephen Huang

ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
PSEUDO STATIC
RW 317 (A1-Sta.# 317+50)

FIGURE



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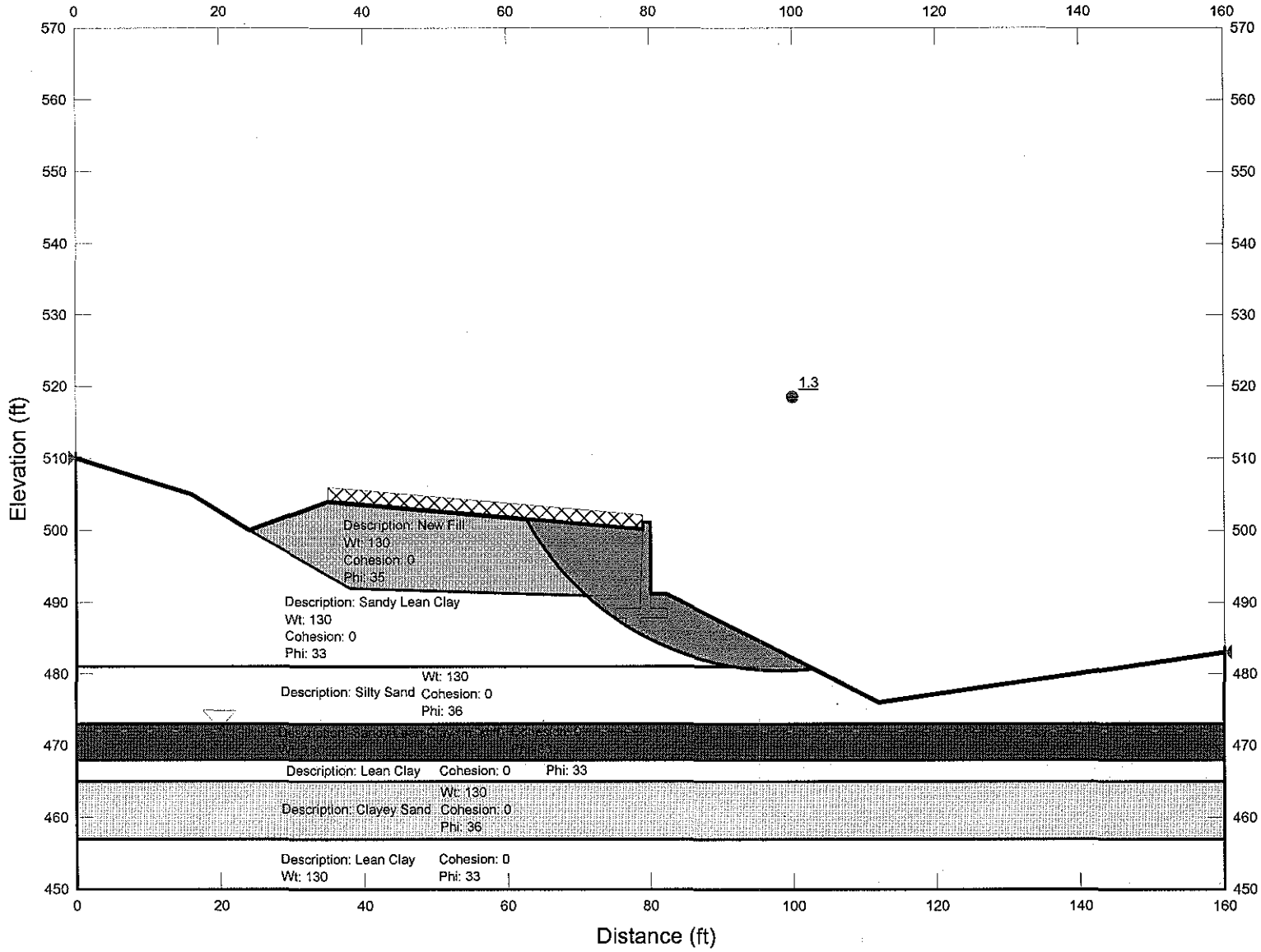
Date February 26, 2009	CHECKED BY Stephen Huang	

ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
STATIC – END OF CONSTRUCTION
RW 109 (V-Sta.# 110+00)

FIGURE



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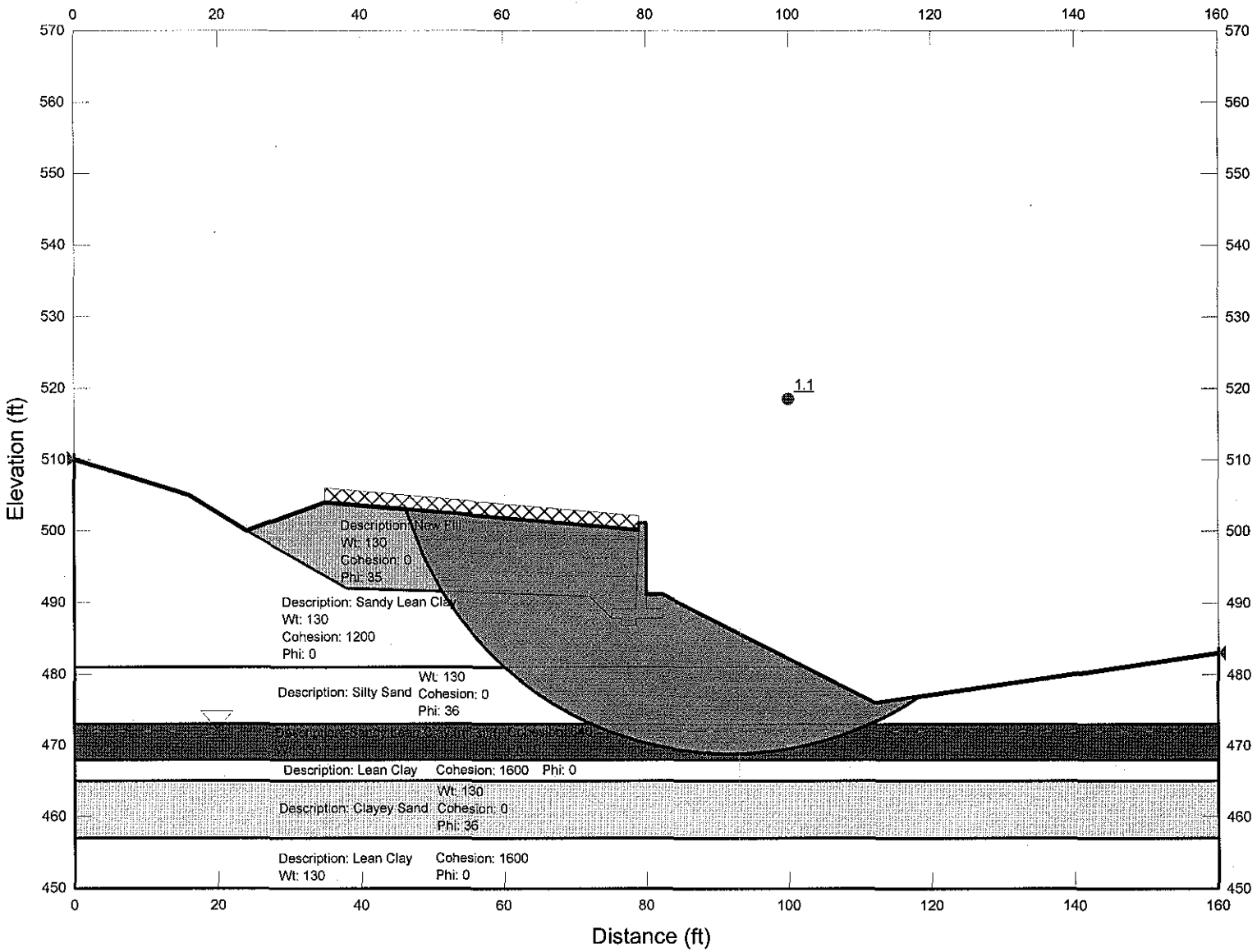
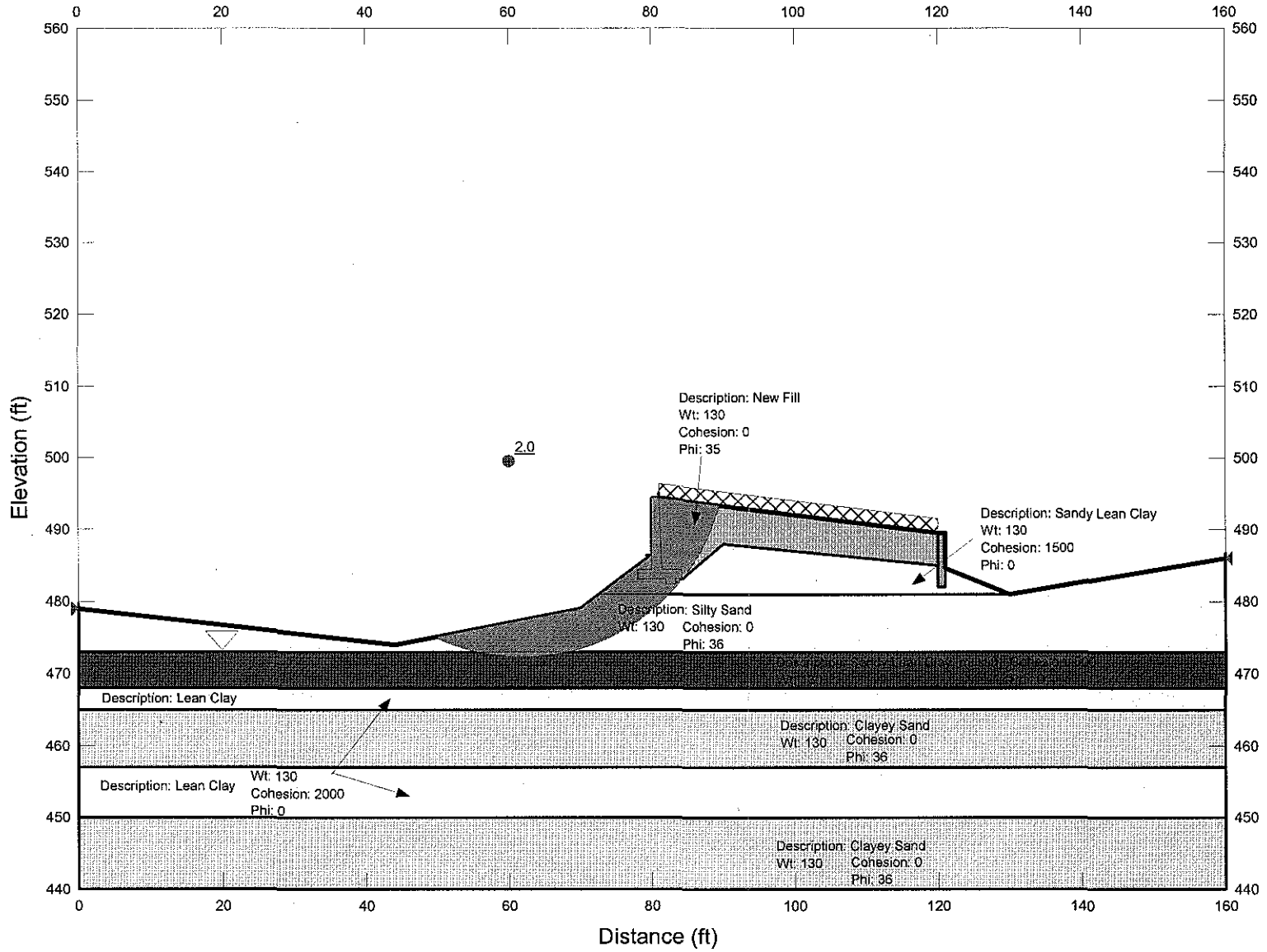
ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
STATIC – LONG TERM
RW 109 (V-Sta.# 110+00)

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 PSEUDO STATIC **RW 109 (V-Sta.# 110+00)**
	Date February 26, 2009	CHECKED BY Stephen Huang	**FIGURE**



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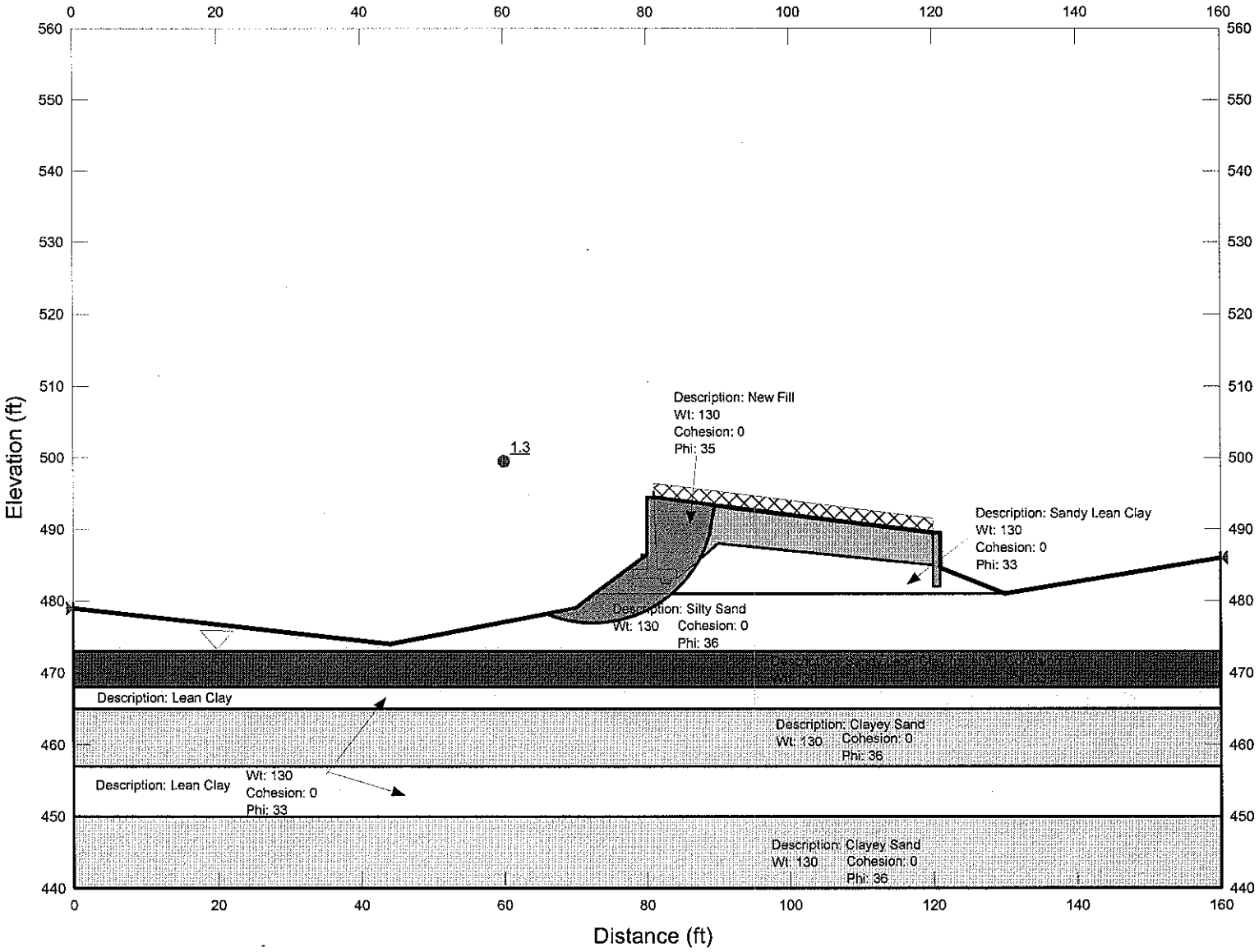
	Date February 26, 2009	CHECKED BY Stephen Huang	

FIGURE



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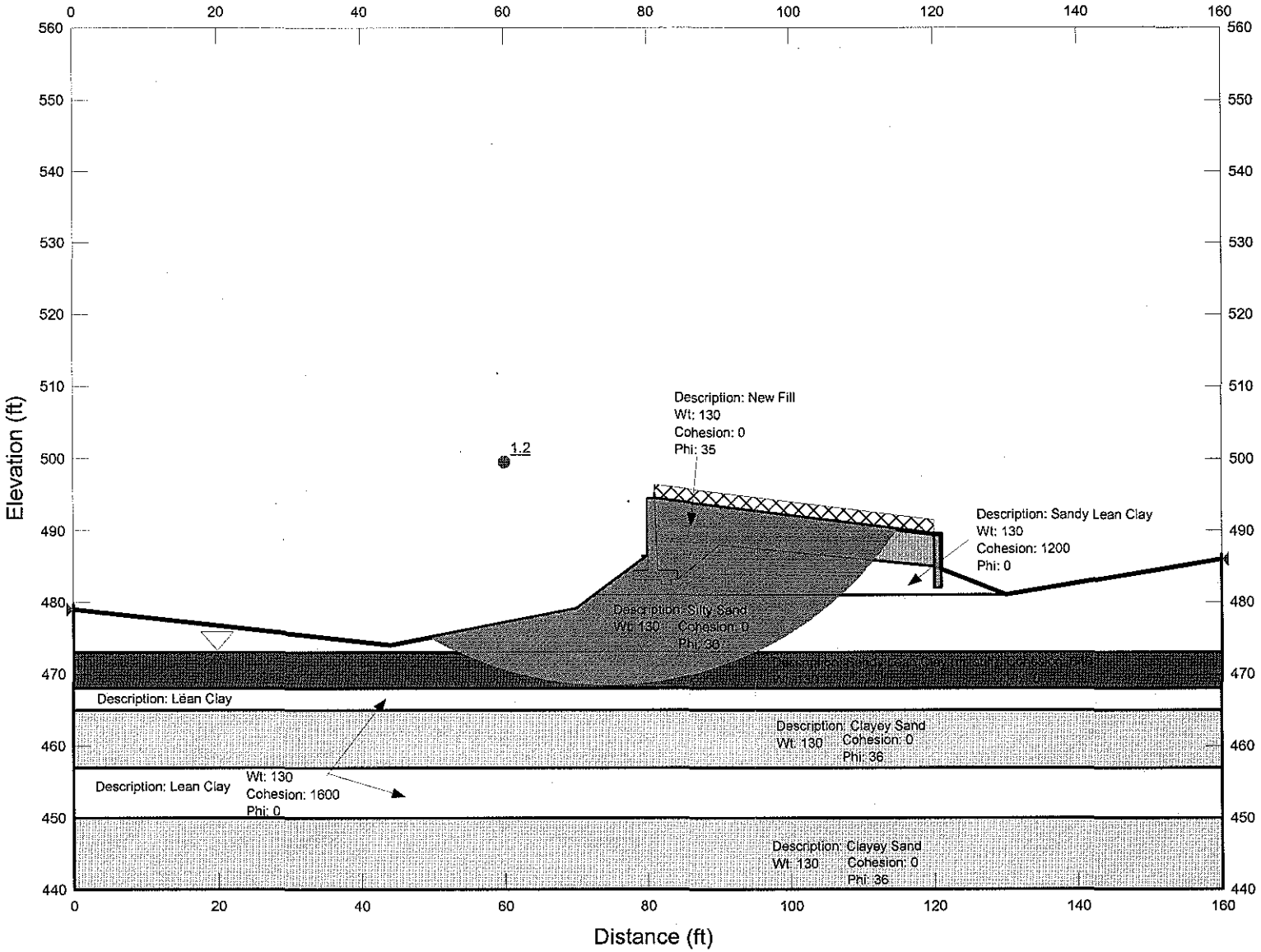
Date February 26, 2009	CHECKED BY Stephen Huang	

ROUTE 84 WIDENING
LIVERMORE, CA
SLOPE STABILITY ANALYSIS
STATIC – LONG TERM
RW 110 (V-Sta.# 111+50)

FIGURE



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	Date February 26, 2009	CHECKED BY Stephen Huang	

FIGURE

URS

Job R84 | Project No. 28649610 | Page 01 of ____
Description RW236 | Computed by Mano | Sheet ____ of ____
Bearing Capacity | Checked by MM | Date 2/05/09
Reference | Date 5/16/09

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 Ka

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 826 | Computed by Mano | Sheet ____ of ____
Bearing Capacity | Checked by MW | 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. (BASED ON 2006 STANDARD PLANS)

B = 7 ft. D = 3 ft.

γ_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. $\Rightarrow q_{ult}/3 = 2.9 > 2.8$ OK (BASED ON 2006 STANDARD PLANS)

(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 x 3 x 28 + 130 x 3.5 x 28

= 23,660

Toe Pressure, 2.8 tsf, < $q_{ult}/3 = 7.9$ ksf. OK

(BASED ON 2006 STANDARD PLANS)

Summary.

Clay q_{ult} = 8685

Sand q_{ult} = 23,660

Say q_{ult} = 9000 psf for design

q_{all} = 9000/3 = 3000 psf.

UPDATES BASED ON 2010 STANDARD PLANS:- (CALCS BY: MT 12/16/14; CHECKED BY: SH 12/17/14

q_{ult} = 8,700 psf.

STRENGTH - FACTORED GROSS NOMINAL BEARING RESISTANCE = $\phi_b \times q_{ult}$

= (0.55)(8,700)

≅ 4,750 psf (>4,000psf)

EXTREME EVENT - GROSS NOMINAL BEARING RESISTANCE = $\phi_b \times q_{ult}$

= (1.0)(8,700)

= 8,700 psf (>4.8 psf)

SERVICE - FACTORED GROSS NOMINAL BEARING RESISTANCE = q_{ult}/FS

= 8,700/3

= 2,900 psf (>2,000psf)

URS

Job SR84 Project No. Page 3 of
Description RW23C 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 (SM), $\phi' = 40$

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
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 RW317 - Type 1 Std Wall Computed by Mano Date 2/06/09 Sheet ____ of ____

Checked by MSB Date 02/19/09

Reference

Retaining Wall No. 317 — Type 1 Standard Wall

Long = 192 ft

Maximum height = 7.1 ft.

Design height = 8 ft.

Available Boring ⇒ NB10 & NB12

Ground Water Elevation — see page 2

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 = 32°

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. 28649640 Page 2 of ____

Description ____ Computed by Mano Sheet ____ of ____

Checked by Mall 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 27	404	3.5	400.5	} New borings.
NB 28	404	3	401	
NB09	425	Dry	Dry upto 395 ft.	

Say Ground water Elevation 401 ft.

** see page

URS

Page 3 of ____

Job R 8H | Project No. 28649640 | Sheet ____ of ____

Description RW 317 | Computed by Mano | Date 2/10/09

Bearing Capacity | Checked by MM | Date 02/19/09

Reference

1. 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

$N_c = 5.53$, $N_q = 1$

$$q_{ult} = CN_c + \gamma D N_q + \frac{\gamma B}{2} N_\gamma$$

($N_\gamma = 0$)

$= 1200 \times 5.53 + 130 \times 3 \times 1$

$= 7,096$ 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

FROM 2006 STANDARD PLANS

[Toe pressure = 2.2 ksf for H = 8]

URS

Job RW84 Project No. 25649640 Page 34 of ____

Description RW317 Computed by Mano Date 2/17/09 Sheet ____ of ____

Bearing Capacity Checked by MM Date 02/19/09

Reference

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 Pressure = 2.2) FROM 2006 STANDARD PLANS

UPDATES BASED ON 2010 STANDARD PLANS: (CALCS BY: MT 12/16/14; CHECKED BY: SH 12/17/14

q_{vult} = 7,000 psf

STRENGTH - FACTORED GROSS NOMINAL BEARING RESISTANCE = $\phi_b \times q_{vult}$

= (0.55)(7,000)

= 3,850 psf (> 2,300 psf)

EXTREME EVENT - GROSS NOMINAL BEARING RESISTANCE = $\phi_b \times q_{vult}$

= (1.0)(7,000)

= 7,000 psf (> 3,100 psf)

SERVICE - FACTORED GROSS NOMINAL BEARING RESISTANCE = $q_{vult}/F.S$

= 7,000/3

= 2,300 (>1,300 psf)

URS

Job R84 Project No. 28649610 Page 1 of ____

Description RW109 Computed by Mano Sheet 1 of ____

Checked by MV 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 drilly

NB35 ⇒ 472.5 ft during drilly.

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

$K_a = \tan^2(45 - \phi/2)$

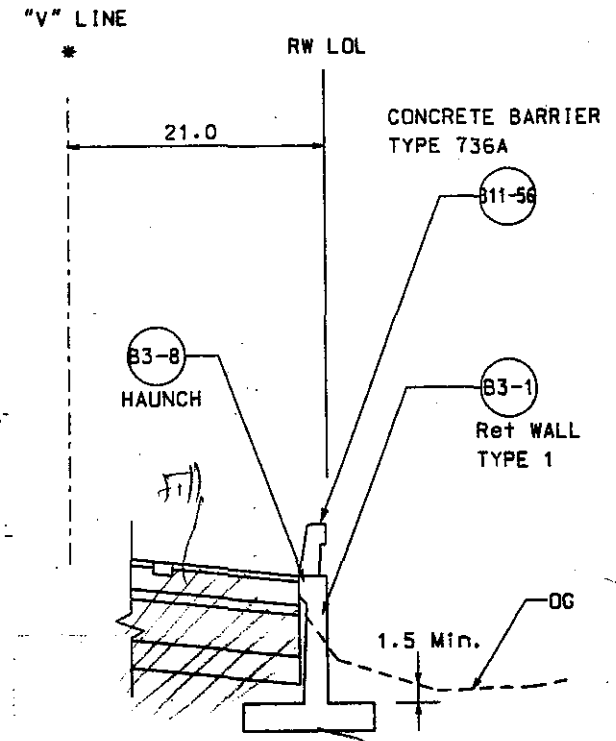
$= 0.295$

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

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 (FROM 2006 STANDARD PLANS)

$B = 8'$, $D = 3$ ft.

$N_q = 28$, $N_\gamma = 28$

$$q_{ult} = 0 + 130 \times 3 \times 28 + \frac{130 \times 8 \times 28}{2}$$

$$= 25,480 \text{ psf}. \checkmark$$

FROM 2006 STANDARD PLANS

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 ✓

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

— x —

UPDATES TO BEARING CAPACITY CALCULATIONS BASED ON 2010 STANDARD PLANS

(CALCS BY: MT 12/16/14 ; CHECKED BY: SH 12/17/14

q_{ult} = 13,500 psf

STRENGTH - FACTORED GROSS NOMINAL BEARING RESISTANCE = $\phi_b \times q_{ult}$

= (0.55)(13,500)

≈ 7,400 psf (> 3,800 psf)

EXTREME - GROSS NOMINAL BEARING RESISTANCE = $\phi_b \times q_{ult}$

= (1.0)(13,500)

= 13,500 psf (> 5,300 psf)

SERVICE - FACTORED GROSS NOMINAL BEARING RESISTANCE = q_{ult}/FS

= 13,500/3

= 4,500 psf (> 2,100 psf)

LIQUEFACTION ANALYSIS

Project Route 84 Widening (RW 109)
Project No. 28649640
Boring No. NB35

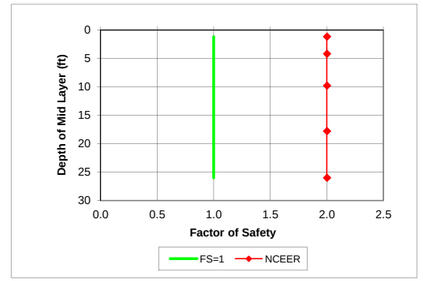
PGA = 0.68
M_w = 6.8
GWT during EQ 9.0 ft

Sampler:	Symbol	Corr. Factor
SPT	S	1
Mod.Cal	M	0.8
California	C	0.7

Mag. Weighting Factor($CSR_M/CSR_{M=7.5}$) 0.75

Note: Cells in Red must be input

			C_E	Code	C_E
Hammer type :	Type				
	Donut		0.75	1	3
	Safety		1	2	
	Auto		1.16	3	
Borehole Diameter:	(inch)	(mm)	C_B		C_B
	2.5-4.5	65-115	1	1	3
	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		



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		EQ σ_o	EQ u	EQ σ'_o	r_d	EQ CSR	N raw	Sampler	N SPT	Fines Content	$N_{60\text{-cs}}$	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60\text{-cs}}$	$CRR^*_{7.5,1tsf}$	Magnitude Scaling Factor NCEER K_m			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	Lower	Upper	Middle			NCEER	NCEER	
1	Pavement	140	2.3	0.70	1.15	0.35	161	0	161	0.999	0.442			0		0.0	2.00	1.16	1.15	0.75	1.00	0		1.28	1.38	1.33	1.000	Y	2.00	N	1
2	CL	125	6.0	1.83	4.2	1.26	553	0	553	0.992	0.439			0		0.0	1.96	1.16	1.15	0.75	1.00	0		1.28	1.38	1.33	1.000	Y	2.00	N	1
3	SM	130	13.5	4.11	9.8	2.97	1,272	47	1,225	0.980	0.450	34	M	27.2	27	35.2	1.31	1.16	1.15	0.75	1.00	46	0.459	1.28	1.38	1.33	1.000	N	2.00	N	1
4	CL	137	22.0	6.71	17.8	5.41	2,342	546	1,796	0.962	0.555			0		0.0	1.09	1.16	1.15	0.85	1.00	0		1.28	1.38	1.33	1.000	N	2.00	N	1
5	SC	141	30.0	9.14	26.0	7.92	3,488	1,061	2,427	0.938	0.596	75	M	60		60.0	0.93	1.16	1.15	0.95	1.00	71	0.459	1.28	1.38	1.33	0.979	N	2.00	N	1
6	CL	138	37.0	11.28	33.5	10.21	4,535	1,529	3,006	0.901	0.601			0		0.0	0.84	1.16	1.15	1.00	1.00	0		1.28	1.38	1.33	0.945	N	2.00	N	1
7	SC	140	50.0	15.24	43.5	13.26	5,928	2,153	3,775	0.818	0.568	90	M	72		72.0	0.75	1.16	1.15	1.00	1.00	72	0.459	1.28	1.38	1.33	0.904	N	2.00	N	1
8																															
9																															
10																															

Layer Number	Depth to Bot. Layer	Thickness	σ_o	u	σ'_o	r_d	$(N_1)_{60\text{-cs}}$	Liquefy ?	τ_{cyc}	$CSR_{M=7.5}$	CSR_M	Volumetric Strain**			Settl.
		ft	psf	psf	psf			NCEER	psf	τ_{cyc}/σ'_o	τ_{cyc}/σ'_o		%		in
1	2.3	2.3	161	0	161	0.999	0.0	N	71.1	0.442	0.33				0.00
2	6.0	3.7	553	0	553	0.992	0.0	N	242.6	0.439	0.33				0.00
3	13.5	7.5	1,272	47	1,225	0.980	46.3	N	550.8	0.450	0.34				0.00
4	22.0	8.5	2,342	546	1,796	0.962	0.0	N	996.1	0.555	0.42				0.00
5	30.0	8.0	3,488	1,061	2,427	0.938	71.0	N	1446.4	0.596	0.45				0.00
6	37.0	7.0	4,535	1,529	3,006	0.901	0.0	N	1805.3	0.601	0.45				0.00
7	50.0	13.0	5,928	2,153	3,775	0.818	71.9	N	2144.5	0.568	0.43				0.00
8															
9															
10															

Total Settlement (inch) =	0.00

* 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.

URS

Job R84 | Project No. 28649640 | Page 1 of ____
Description RW110 | Computed by Mano | Sheet ____ of ____
Checked by MM | Date 2/06/09 | Date 02/19/09
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)

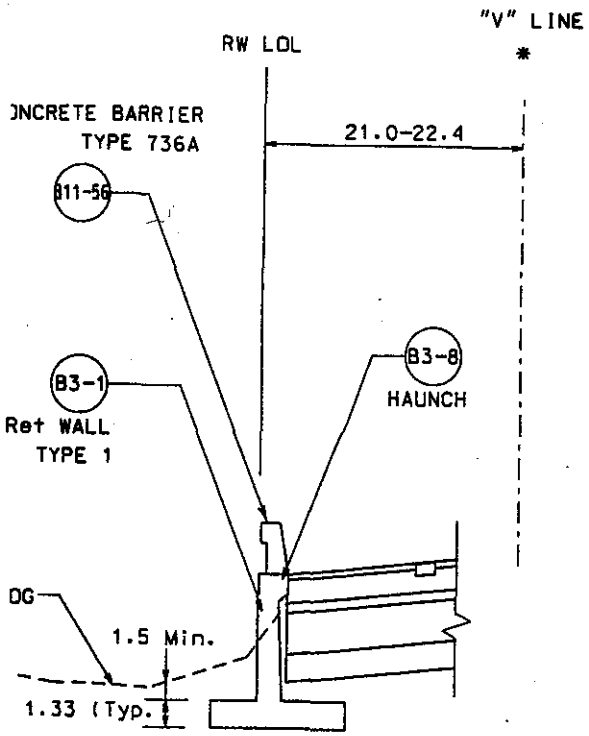
$= K_a \gamma$

$= 0.295 \times 130$

$= 38.4$ pcf.

If fill – $\phi = 35°$, $\gamma = 120$

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 Stal Plan (2006)

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 NB35.

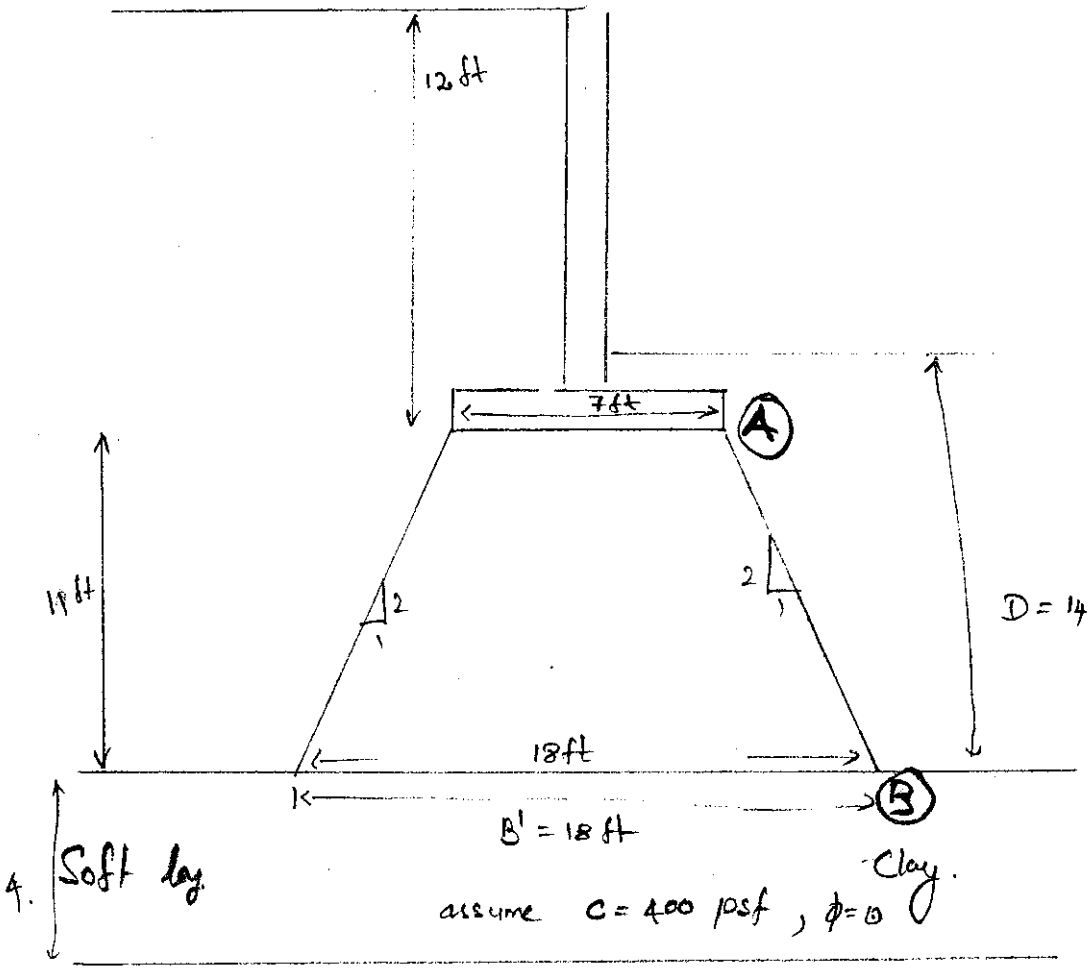
(A) Assume $c = 2000$ psf $\phi = 0$

$N_c = 5.53$, $N_q = 1$ $N_\gamma = 0$

$q_{ult} = 5.53 \times 2000 + 130 \times 3 \times 1 + 0$

$= 11,450$ psf ← based on the soil directly under footing

(B) Consider Soft Clay layer in NB35.



assume $c = 400$ psf, $\phi = 0$

$$= cN_c + \gamma D N_q + \frac{1}{2}\gamma B' N_\gamma$$

$N_\gamma = 0$
$N_q = 1$, $N_c = 5.53$

$$(q_{ult})_{Point\ B} = 400 \times 5.53 + 130 \times 14 \times 1 + 0$$

$$= 4032 \text{ psf}$$

$$(q_{all})_B = q_{ult}/3 = 1344 \text{ psf}$$

$$(q_{all}) \times 18 = (q_{all})_A \times 7.$$

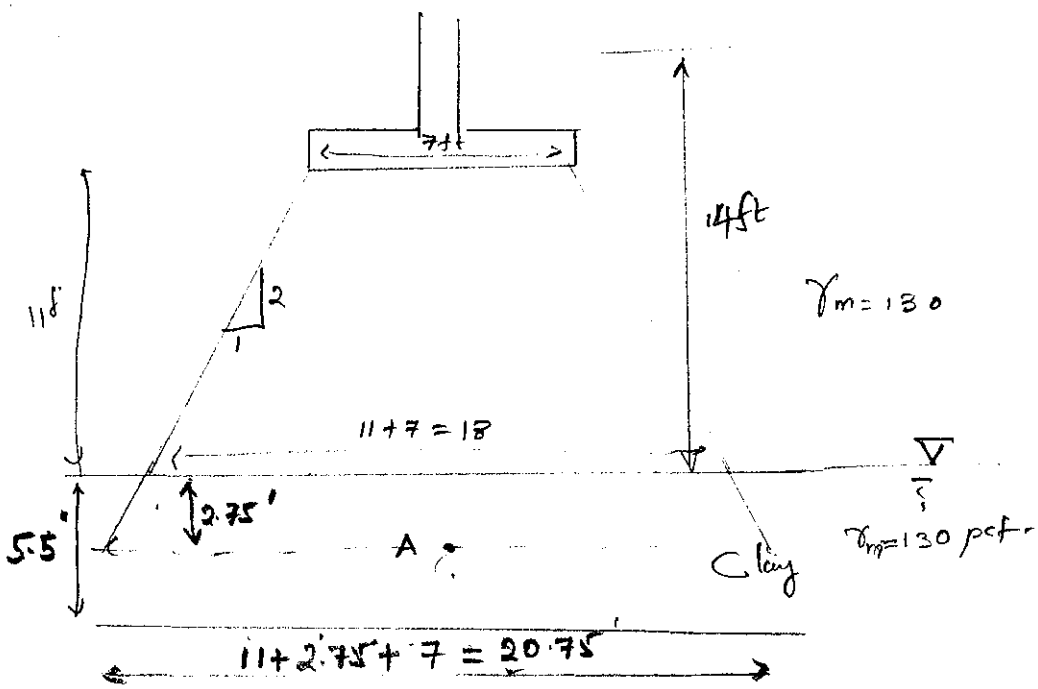
$$(q_{all})_A = 3,458$$

$$(q_{ult})_A = 10,366 \text{ psf}.$$

Say $q_{ult\ min.} = 10,366$

Say $q_{ult} = 10,300$

$q_{all} = 3500$ 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) $\frac{C_c}{1+e_o} = 0.04$ (L & W) ← 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

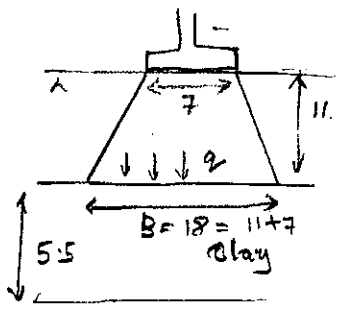
$= 0.2$ inch $\leq \frac{1}{4}$"

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

Job SR84 Project No. 28649640 Sheet ____ of ____

Description RW 210 Computed by Mano Date 2/11/09

Settlement Checked by NM Date 02/19/09

Reference

$q = \frac{12800 \times 7}{18} = 1088.9$ (Toe Press 2.8 tsf)

$= 1089$ psf

$\delta_v = \frac{(1089)(18)(1-0.5^2)0.024}{240{,}000}$

$= 0.00147$ ft.

$= 0.02$ inch.

Total Settlement = Consolidation + Immediate.

$= 0.2 + 0.02$

$= 0.22$ inch $< \frac{1}{4}$ inch.

UPDATES BASED ON 2010 STANDARD PLANS (CALCS BY: MT 12/16/14 ; CHECKED BY: SH 12/17/14

$q_{ult} = 10{,}500$ psf (see PAGE 3)

STRENGTH - FACTORED GROSS NOMINAL BEARING RESISTANCE = $\phi_b \times q_{ult}$

$= (0.55)(10{,}500) = 5{,}750$ (>4,000 psf)

EXTREME EVENT - GROSS NOMINAL BEARING RESISTANCE = $\phi_b \times q_{ult}$

$= (1.0)(10{,}500)$

$= 10{,}500$ psf (>4,800 psf)

SERVICE - FACTORED GROSS NOMINAL BEARING RESISTANCE = q_{ult} / FS

$= 10{,}500/3$

$= 3{,}500$ psf (> 2,000 psf)

URS

Page 6a of ____

Job SR 84 | Project No. 28649640 | Sheet 1 of 2

Description RW 110 | Computed by S HUANG | Date 9/11/2014

SETTLEMENT OF RETAINED FILL | Checked by AMM | Date 9/11/2014

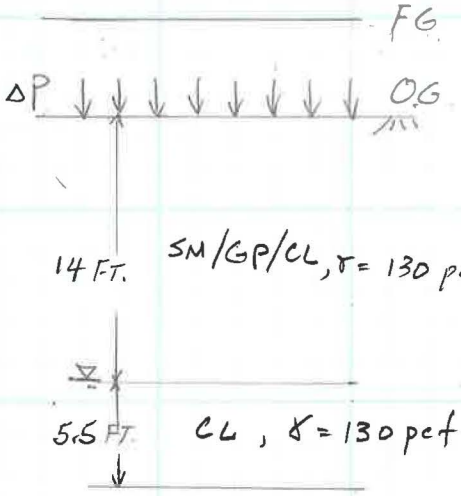
Reference

MAXIMUM DESIGN H_{11} = 12 FEET @ STA. 11+50 (WALL LOL)
SEE CROSS-SECTION ON SHEET 2

RETAINED FILL HEIGHT, h = 5 FT.

γ = 125 pcf

INDUCED STRESS, ΔP = 5 x 125 = 625 psf



AT MID-DEPTH OF CLAY,,

P_o = 14 x 130 + 2.75 x (130 - 62.4)

= 2006 psf ✓

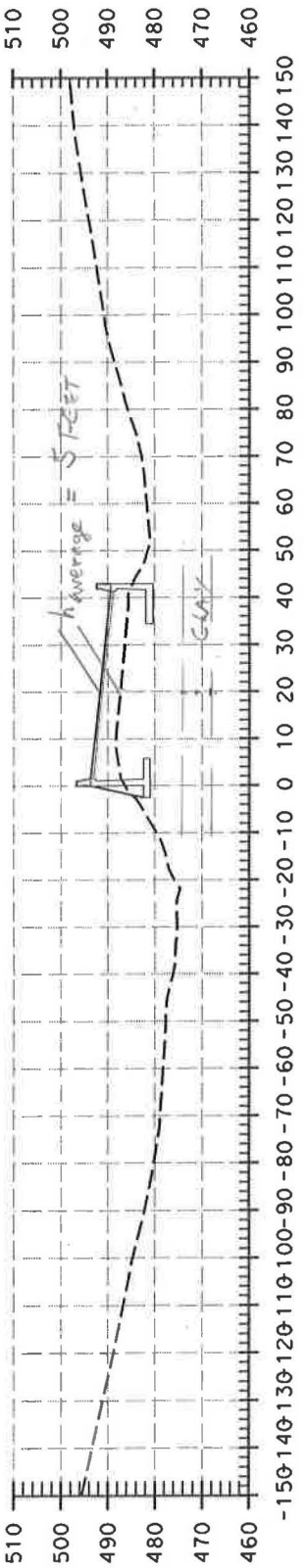
CONSOLIDATION SETTLEMENT FOR OVER-CONSOLIDATED CLAY

$$\delta = \frac{C_r}{1+e_o} \cdot D \cdot \log\left(\frac{P_o + \Delta P}{P_o}\right)$$

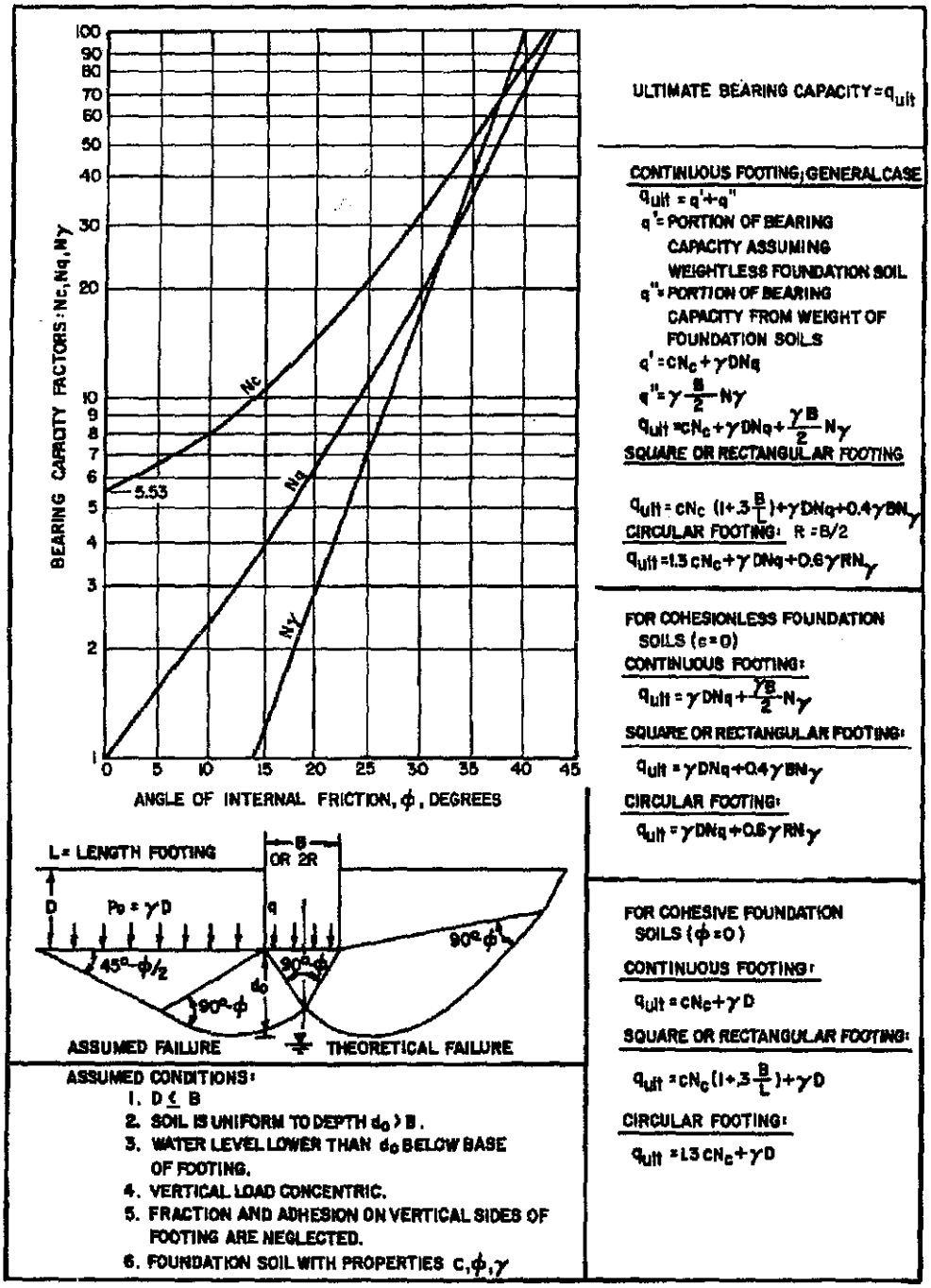
$$\delta = (0.018)(5.5) \log\left(\frac{2006+625}{2006}\right)$$

= 0.012 ft

OR 0.14 inch < 1/4 inch


510
500
490
480
470
460
-150 -140 -130 -120 -110 -100 -90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
h average = STREET
GAS

11+50



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

$q_{ult} = cN_c \left(1 + 3\frac{B}{L}\right) + \gamma D N_q + 0.4\gamma B N_\gamma$

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:

$q_{ult} = cN_c \left(1 + 3\frac{B}{L}\right) + \gamma D$

CIRCULAR FOOTING:

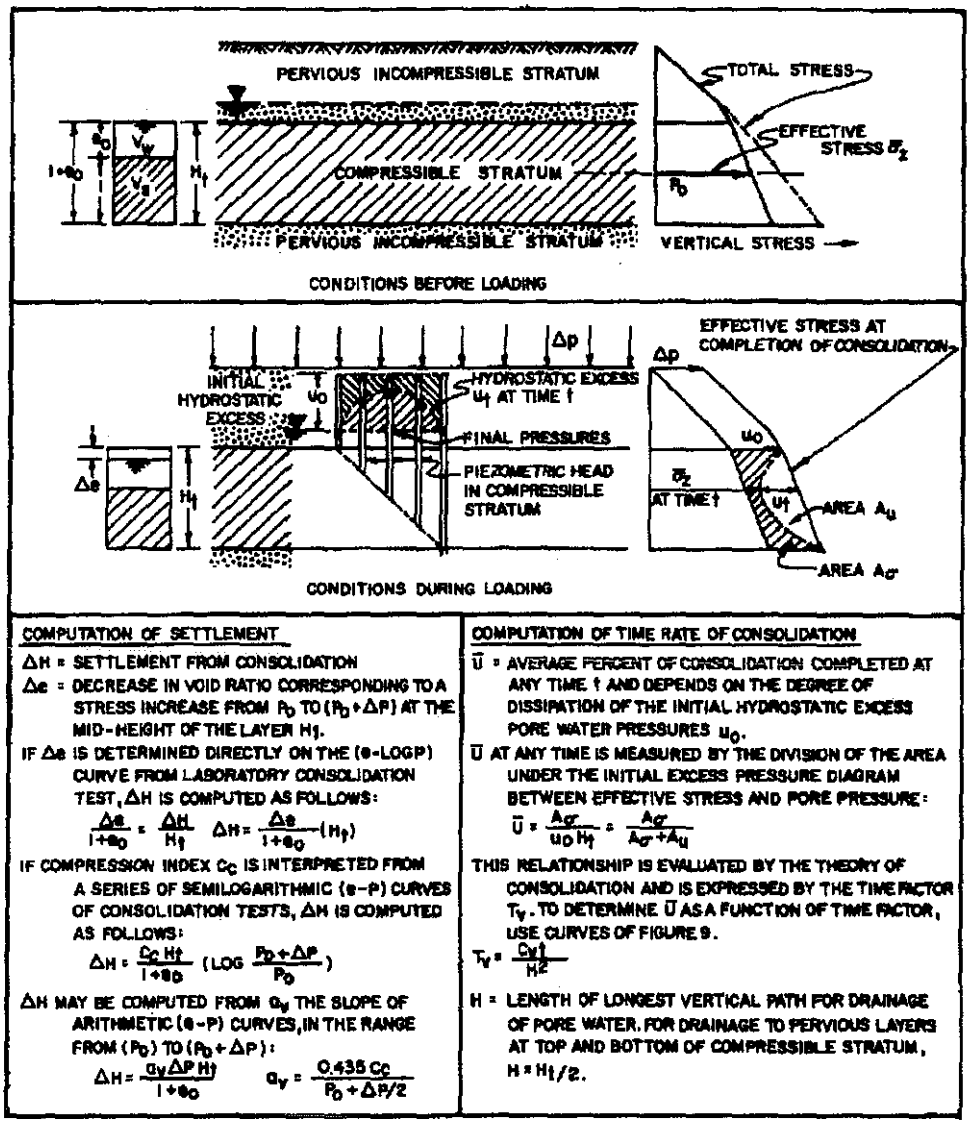
$q_{ult} = 1.3\, cN_c + \gamma D$

ASSUMED CONDITIONS:

1. $D \leq B$
2. SOIL IS UNIFORM TO DEPTH $d_0 > B$.
3. WATER LEVEL LOWER THAN d_0 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

7.2-131



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:

$$\frac{\Delta e}{1+e_0} = \frac{\Delta H}{H_t} \quad \Delta H = \frac{\Delta e}{1+e_0}(H_t)$$

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.

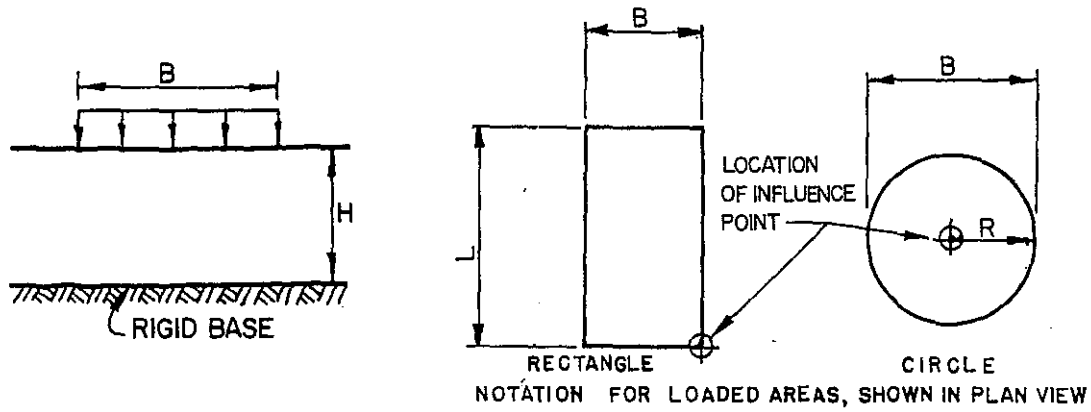
TABLE 1 (continued)
Shape and Rigidity Factors I for Calculating Settlements
of Points on Loaded Areas at the Surface of an Elastic Half-Space

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

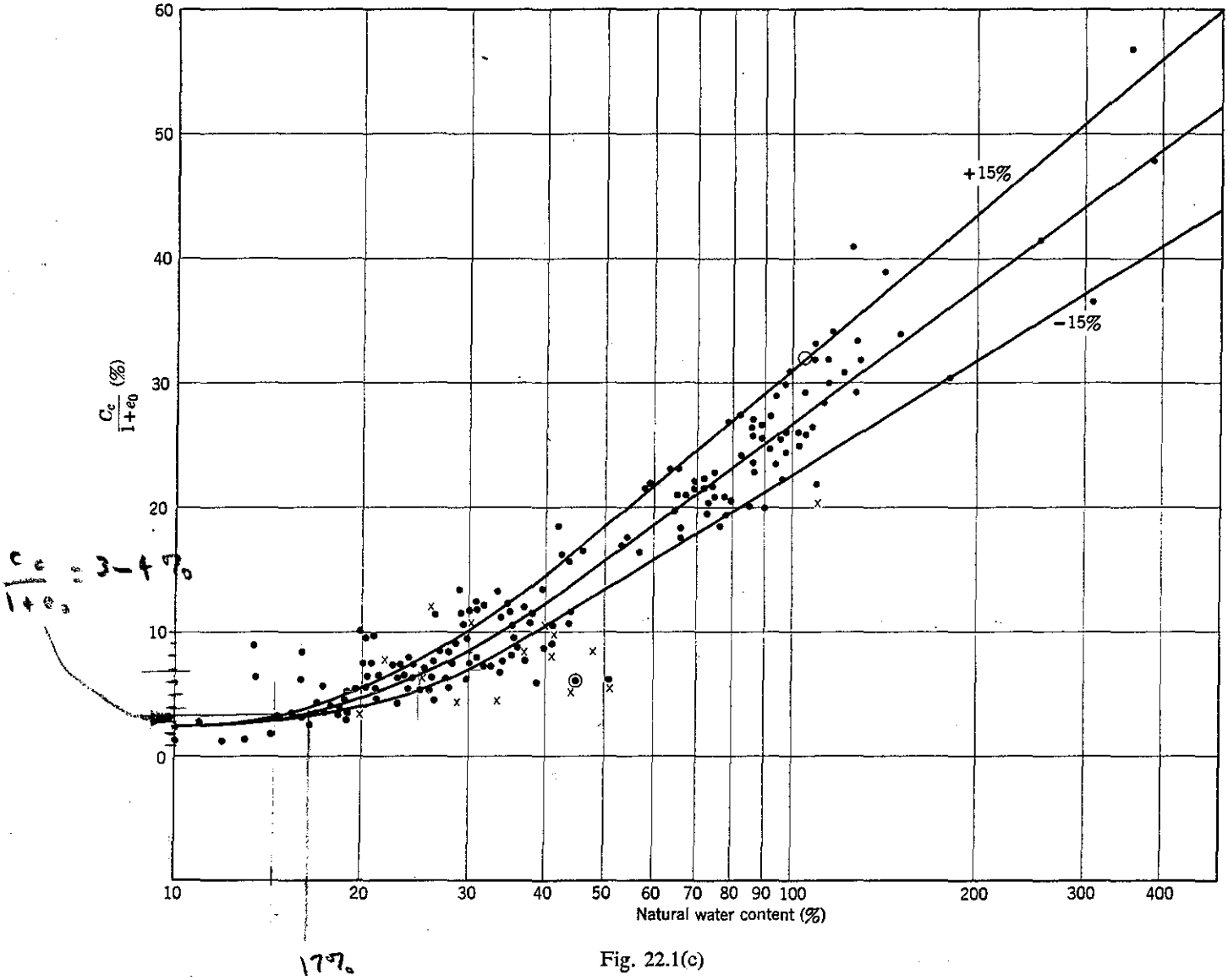


Fig. 22.1(c)

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

Geotechnical Design Report
Comment & Response Form

(Revised 08/2011)

General Project Information		Review Phase	Reviewer Information	
Dist:	**04**	☐ PSR/PDS (Review No.)	Reviewer Name:	**Betty Lee/Tung Nguyen / Rifaat Nashed**
Proj ID (Phase):	**0400020581**	☐ APS/PSR (Review No.)	Functional Unit:	**Geotechnical Design- West**
EA:	**297621**	☐ APS/PR (Review No.)	Cost Center:	**59-3660**
Project Name:	**Route 84, PM 22.9/25.7-Livermore**	☐ Type Selection	Phone Number:	**510-286-4825**
Project Engineer:	**Carlos Carbajal**	☐ 65% PS&E Unchecked Details	e-mail:	**Betty_lee@dot.ca.gov**
Phone:	**510-622-5935**	☐ PS&E (Review No. 1)	Date of Review:	**10-17-2014**
E-mail:		☐ Construction	Structure Name*:	**GDR (9-15-14)**
		☑ Other: **GDR (9-15-14)**	Br No*:	
			(*Use if necessary to when comment sheets are by individual structure)	

Consultant Information (to be filled in by Consultant)

Consultant Structure Lead (First and Last Name)	Structure Consultant Firm	Phone Number	E-mail	Response Date
Stephen Huang	**URS Corporation**	**408-297-9585**	**Stephen.huang@urs.com**	

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
1			**When making revisions, please indicate the page numbers where revisions will be found. The referenced pages and appendices in your responses are inconsistent with the actual report. Please PROOF-READ your reports before you send them to us.**		
4	GDR	Appdx M, page 4	The print provided is too small and not legible. Please provide a legible copy.	Presumably the referenced page 4 refers to the liquefaction analysis of boring drilled for RW 109. Will provide a cleaner copy of this page on a 11x17 page.	
5	GDR	Appdx E	We are unable to identify the borings. Please check your boring IDs.	Will correct.	

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)

Submittal Data (Reviewer to complete)

Project ID: Reviewer: Str Name*:

Date of Review: Functional Unit: Br No*. ___ *=if applicable

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
6	GDR	Pg 4-4	Unable to identify the borings. Please check your boring IDs.	Will correct.	
7	GDR	Pg. 6-3, Section 6.5; Plan U-2 in Appdx K	Please state your response in the GDR. (And indicate page number.)	This comment pertains specifically to the existing PG&E line on E Ruby Hill Drive as shown on Sheet U-2. The following text will be added to Section 6.5.1 of the GDMR, page 6-3: *Settlement on order of about ¼ inch could also occur in the vicinity of the existing PG&E gas line along East Ruby Hill Drive; this settlement would be related to top down construction of the soil nail wall, RW246, rather than to placement of new fill. Provisions for monitoring of this utility during construction are included in Section 46 of the NSSP.*	
8	GDR	Pg. 6-3; Appdx K, sheet U-10	a) Please do not revise Section 6.5 to describe generalities. Each utility must be **specifically** addressed. b) The Plans are still inconsistent with the GDR. The GDR states a "proposed" pipe; while the Plans indicate a "relocate" pipe.	a) Section 6.5 of the GDMR provides descriptions of potential construction techniques that could be used to install underground utilities where open cut trenching is not practical. This section also provides discussion of geotechnical concerns associated with these techniques as related to subsurface conditions. Discussion of construction methods as they pertain to each specific underground utility (new and relocated) is beyond the scope of the GDMR. The following two non-standard specifications pertaining to trenchless construction are included in the project special provisions: Section 77-3 *Jacked Pipe Casing for Drainage and Sewer* and Section 78-2 *Pipe Jacking* (used in conjunction with Section 78-1 *Trenchless Culvert Installation*). b) The first sentence of Section 6.5.1 of the GDMR notes that new underground utilities are proposed to cross SR84, Vineyard and Concannon. For clarity, this sentence will be revised as follows: *As shown on Utility Plan Sheets, crossings for new and relocated underground utilities are planned on SR84, Vineyard Avenue and Concannon Boulevard.*	

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)

Submittal Data (Reviewer to complete)

Project ID: Reviewer**:** Str Name*:

Date of Review: Functional Unit: Br No*. ___ *=if applicable

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
9	GDR	Pg. 6-12	Consultant's response does not make sense. However, the revised text in the GDR is ok.	Noted.	
13	GDR	Pg. 6-13	The revised text in GDR is even more unclear. There appears to be more typos. Please rewrite.	The paragraph below Table 6-3 deleted. Please see response to Comment 20.	
14	GDR	Pg. 9-3	Monitoring **is** needed, especially in vicinities of utilities and other sensitive structures. Please provide monitoring locations on Plans and instructions on SSP's.	Since RW246 will be a soil nail wall, built using top down construction, relatively small movements proportional to the wall height, could occur. For this reason, the NSSP includes requirements for monitoring of vertical and lateral movement in vicinity of the existing gas line on E. Ruby Hill Drive during soil nail wall construction. In addition, the NSSP for RW246 includes requirements for pre- and post-construction surveys of four houses located within 100 feet of the RW LOL. As noted in Section 6.7 of the GDR, embankment fills will generally be on the order of about 4 feet or less, with the exception of sliver fills associated with retaining walls and bridge approaches that will range to a maximum of about 9 feet and fills for RW245 that will be a maximum of 20 feet. Because the subsurface conditions generally consist of dense to very dense granular soil and stiff to hard clay, settlements due to these new fills are expected to be less than about ¼ inch. For this reason, settlement monitoring, other than as described above for the soil nail wall, is not necessary.	

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17	GDR		Borehole IDs are still inconsistent (This is true even for the revised ID list emailed separately.) This includes boring numbers in the flysheet for NB11 and NB14.	Will correct.	
18	GDR	Pg 4-3	CRR = 0.315 for ML soil with $(N_1)_{60\text{-}cs}$ = 27 and 55% fines is not adequate. Provide any reference for this CRR value.	The equation used to calculate CRR is taken from the "Proceedings of the NCEER Workshop on Evaluation of the Liquefaction Resistance of Soils"1997.	
20	GDR	Pg. 6-3	Your statement does not conform with Table 6-3.	As discussed in responses to comments on the companion project FRs, the USGS deaggregation tool indicates a PGA of 0.61g for the project alignment; this is lower than the PGA of 0.68g estimated from the ARS curve for project bridge structures. This lower value of PGA is consistent with the Kh value of about 0.2g shown on the Caltrans Standard Plans for Type 1 and Type 5 retaining walls. For this reason, the paragraph following Table 6-3, which provides justification for use of standard plan walls for a Kh value of more than 0.2g, has been deleted.	
21	GDR	Appdx M	Noted for N_q and $N_{\square}$, but other items are not complied.	Calculations presented in Appendix M have been updated to confirm that nominal bearing resistance exceeds gross uniform bearing stress for the strength and extreme event limit states.	
22	GDR	Appdx M	Noted for N_q and $N_{\square}$, but other items are not complied.	Calculations presented in Appendix M have been updated to confirm that nominal bearing resistance exceeds gross uniform bearing stress for the strength and extreme event limit states.	
23	GDR	Appdx M	Required toe pressure of 3.3 ksf is not correct.	Calculations presented in Appendix M have been updated to confirm that nominal bearing resistance exceeds gross uniform bearing stress for the strength and extreme event limit states.	
24	GDR	Appdx M	Required toe pressure of 2.8 ksf is not correct.	Calculations presented in Appendix M have been updated to confirm that nominal bearing resistance exceeds gross uniform bearing stress for the strength and extreme event limit states.	
27	Plans		Noted. However, elevation shown in RW No. 317 LOTB	The drilling method at Boring R-07-012 was switched from flight auger to mud rotary at a depth of 3.5 feet bgs and the	

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			should be corrected.	hole was dry at that time. Drilling was suspended overnight and resumed the following day (12/20/2007). At the beginning of the second day, water was measured in the boring on the second day of drilling at a depth of approximately 8 feet bgs; however, since the boring was filled with drilling fluid at that time, the water level is not considered to be an accurate estimate of the groundwater table elevation. The boring record for NB12 (R-07-012) will be corrected.	
28	General		We provided comments for all structures on 10/10/2014.	Acknowledged.	
30	GDR	1.3.4 Regional Geology Page 1-8	3) I agree that Qpf and Qhf are located south of Concanon Blvd, but the northern side of Concanon Blvd also is underlain by Qpf and Qhf.	We concur. Will revise text on page 1-8 to refer to geologic map with respect to location of Qpf and Qhf.	
31	GDR	3.1 Field Exploration	Where is this located on the NSSP? Please provide.	Section 46 of the NSSP pertains to the soil nail wall, RW246.	
33	GDR	Pg. 3-3	It is our opinion that the drilling/exploration plan should have been better thought out. Groundwater measurement should have been given a priority. Piezometers should have been installed and measured over a period of time to determine the stabilized GW level. Boreholes should have been better located at areas of significance, ie. by structures, embankments, etc.	Acknowledged.	

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Geotechnical Design Report
Comment & Response Form
(Revised 08/2011)

General Project Information		**Review Phase**	**Reviewer Information**	
Dist:	**04**	☐ PSR/PDS (Review No.)	Reviewer Name:	**Betty Lee/Tung Nguyen / Rifaat Nashed**
Proj ID (Phase):	**0400020581**	☐ APS/PSR (Review No.)	Functional Unit:	**Geotechnical Design- West**
EA:	**297621**	☐ APS/PR (Review No.)	Cost Center:	**59-3660**
Project Name:	**Route 84, PM 22.9/25.7-Livermore**	☐ Type Selection	Phone Number:	**510-286-4825**
Project Engineer:	**Carlos Carbajal**	☐ 65% PS&E Unchecked Details	e-mail:	**Betty_lee@dot.ca.gov**
Phone:	**510-622-5935**	☐ PS&E (Review No. 1)	Date of Review:	**8-25-2014**
E-mail:		☐ Construction	Structure Name*:	
		☑ Other: GDR (8-1-14)	Br No*:	
			(*Use if necessary to when comment sheets are by individual structure)	

Consultant Information (to be filled in by Consultant)

Consultant Geotechnical Lead (First and Last Name)	Geotechnical Consultant Firm	Phone Number	E-mail	Response Date
Stephen Huang	**URS Corporation**	**408-297-9585**	**Stephen.huang@urs.com**	**9/13/14**

#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
			When making revisions, please indicate the <u>page numbers</u> where revisions will be found.		

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1	GDR	Pg 4.2	What is the seismic soil classification?	Soil profile Type D based on average shear wave velocity of 360 m/sec. We revised Section 4.2 to include this information.	
2	GDR	Pg. 4-3, Section 4.3.4	How is the settlement magnitude determined? No consolidation test data is provided. a) Groundwater was not measured at the area of maximum fill. b) No test data was shown for soils in Boreholes RB-3 and NB-3 (the nearest boreholes for the maximum fill area.	Due to the presence of gravel encountered in the borings, Shelby tubes could not be pushed to collect undisturbed samples for consolidation testing. In areas where clays were encountered below the groundwater table, correlations with index properties were used in consolidation settlement calculations. Please see page 1 of the calculations presented in Appendix M for assumptions used in settlement estimates for Boring NB-03 (R-07-003). Free groundwater was encountered at Elevation 503 feet in Boring R-08-030 and at Elevation 490 feet in Boring R-08-031. In addition, free groundwater was not encountered to Elevation 502 feet in Boring NB-04 (R-07-004), the terminal depth of that boring. This groundwater depth information was used as a basis for liquefaction and settlement analyses performed in the vicinity of the area of maximum fill height. Laboratory tests were performed on samples collected from Borings RB-3 (A-07-003) and NB-03 (R-07-003); the test results are presented on the boring record for RB-3 and on Table 3-1 for NB-03.	
3	GDR	Appdx M	For the settlement calculation of RW110, no consolidation test results were shown.	Due to the presence of gravel encountered in the borings, Shelby tubes could not be pushed to collect undisturbed samples for consolidation testing. In areas where clays were encountered below the groundwater table, correlations with index properties were used in consolidation settlement calculations.	
4	GDR	Appdx M	For the liquefaction analysis of RW 109, page 4 is missing.	Page 4 is the calculation of liquefaction settlement for Boring NB35. We will include in revised GDR.	

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5	GDR	Appdx E	For the liquefaction analyses, why was groundwater depth chosen to be 40 ft. when groundwater was not measured in the nearest boreholes?	Free groundwater was encountered at Elevation 503 feet in Boring R-08-030 and at Elevation 490 feet in Boring R-08-031. In addition, free groundwater was not encountered to Elevation 502 feet in Boring NB-04 (R-07-004), the terminal depth of that boring. This groundwater depth information was used as a basis for selection of a groundwater depth of 40 feet for liquefaction analyses for Borings NB-03 and NB-06. As-built borings B-10 and B-12 are not located within the limits of the south segment, so will be deleted from the revised GDR.	
6	GDR	Pg. 4-4	For the liquefaction analyses, why were Boreholes NB-3, NB-6, NE-17, with non-liquefiable materials presented in these borings chosen? What are the special features at these areas? Groundwater was also not measured at these boreholes.	Upon completion of the initial drilling program between December 2007 and March 2008, engineers reviewed the boring records and did not identify any potentially liquefiable soils in the borings. Borings NB-3, NB-6, and NB-11 through NB-14 were selected for analysis of seismic settlement. Groundwater depth for liquefaction analysis of Borings NB-3 and NB-6 was based on groundwater elevation encountered in nearby borings as discussed in responses to Comment Nos. 2 and 5. A groundwater table at Elevation 401 feet was used for analysis at Borings NB-11 through NB-14 based on the groundwater table elevation encountered in Borings R-08-037 and R-08-038 drilled in the Arroyo Del Valle creekbed in December 2008. Boring NB-17 is located north of the south segment limits so calculations for this boring are not included in this GDR.	

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7	GDR	Pg. 6-3, Section 6.5; Plan U-2 in Appdx K	Report states that in the area of the existing 24" high pressure gas main (A1 Sta. 241+00 to 245+00), the soil settlement is expected to be 1/4 inch. Can this gas main tolerate a settlement of this magnitude? This may depend on the age and physical condition of the pipe. It may be best to check with PG&E.	The existing gas line is located uphill and at least 100 feet horizontally from the proposed fills in this area. For these reasons, we do not believe the existing gas line will be affected by the estimated settlement.	
8	GDR	Pg. 6-3; Appdx K, Sheet U-10	The proposed 24" high pressure gas main on Appdx K, Sheet U-10 is not labeled.	The proposed location of the gas line is shown on Sheet U-10 in bold and labeled "G." We understand that design of the proposed gas line at this location has been completed by others. As such, we revised Section 6.5.2 to more generally apply to construction of proposed utilities in areas where conventional trenching methods are not impractical.	
9	GDR	Pg. 6-12	Report states that, "…we assume that all embankment fill and wall backfill would be derived from onsite soil." This is not a good assumption. Soil used as backfill must meet the gradation requirements in the CT Standard Specifications.	We revised the report text to state that we assume embankment fills and wall backfills will meet material and gradation requirements in accordance with Caltrans Standard Specifications.	
10	GDR	Pg. 12, Section 6.9	Please put the stationing of the retaining walls in the tables.	We revised Table 6-2 to include station limits for the retaining walls.	
11	GDR	Pg. 6-13, Table 6-3	Why was resistance factor of 0.55 chosen? In the CA Amendments to AASHTO LRFD Bridge Design Specs, Revised Table 10.5.5.2.2-1, 0.55 is used for Plate Load Test.	The resistance factor for bearing resistance for permanent gravity retaining walls is 0.55 per Table 11.5.6-1. This is presented in Section 11: Abutments, Piers and Walls as part of the California amendments to AASHTO LRFD Bridge Design Specifications-Fourth Edition, September 2010.	
12	GDR	Pg. 6-13, Table 6-3	According to the 2010 Caltrans Revised Standard Plans, the Gross Uniform Bearing Stress for RW 317, it should be 3.4 (not 3.6). Please check.	We revised the table to show gross uniform bearing stress of 3.4 ksf in accordance with the 2010 standard plan for Extreme Event I for H=10 feet.	

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13	GDR	Pg. 6-13	If the resultant seismic force acts at 1/3 of the wall height from the wall bottom, it would create a HIGHER bearing stress than at 1/6 the wall height from the wall bottom. The report states the reverse. Please re-evaluate.	Agreed. There was a typo in the GDR. We revised the text to state that the resultant of the dynamic force is considered to act at a distance of 1/3H from the base of the wall (current) compared to 0.6H from the base of the wall (former), resulting in a smaller moment arm and lower bearing stress.	
14	GDR	Pg. 9-3	Regarding settlement monitoring, please show monitoring locations on Plans and instructions on SSP's.	As discussed in Section 6.2.4 of the report, since settlements are expected to be small along the alignment, no settlement monitoring is necessary. We deleted the requirement for settlement monitoring from Page 9-3.	
15			Geologist to check for landslides.	Two landsides were identified by the engineering geologist during reconnaissance of the site. The locations and limits of these features are shown as Qls on the Geology Map, Figure 1-7	
16	GDR	Page 1-5	Please check the end station of RW 317 shown in Table 1-3.	We revised Table 1-3 to indicate an end station at 318+56.	
17	GDR	Page 1-9	Comment No. 1 for 95% PS&E on April 27, 2010 about borehole identification was not incorporated in this GDR	We revised the borehole identifications presented in the report text, tables and figures for the main report per Caltrans 2007. We did not change the IDs on the boring records presented in Appendix C since these boring IDs relate back to laboratory test results from an outside laboratory (Appendices D and F), the soil corrosion report by others (Appendix O), and geotechnical calculations (Appendices E and M). We included a table at the beginning of each of these appendices with a correlation between the 2007/2008 boring IDs and current IDs used in report text.	
18	GDR	Page 4-3	In boring NB37, at a depth of 43 ft, material with 55% fines shown in liquefaction analysis spreadsheet content should not be classified as liquefiable. Please clarify.	Loose and medium dense cohesionless soils, such as the sandy silt encountered in Boring NB-37, are considered potentially liquefiable.	

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19	GDR	Page 6-10	Due to time restriction, we have not reviewed the proposed cut slope and deformation estimation presented in Section 6.6.2. Data from inclinometer monitoring program should also be provided to our Office.	We understand that installation and monitoring of inclinometers at the quarry is no longer proposed for the project. We revised this section of the report.	
20	GDR	Page 6-3	It stated that "The calculated bearing stress values were generally lower than the standard plan values,…" It contradicts with these values shown in Table 6-3. Please clarify	The calculated bearing stresses for wall heights of 16 feet or less for Kh of 0.23g are higher than for Kh of 0.20g, however, they are still lower than the gross uniform bearing stresses presented on the 2010 Caltrans Standard Plans. We revised the report to clarify.	
21	GDR	Appendix M	Page 2, RW 236: Maximum design height is 14 ft, not 12 ft. Please clarify. Please check the required toe pressures for all three states. Please provide reference for Nq and Nγ.	Nq and Nγ are from Navfac 7.2-131. We cited the reference for Nq and Nγ in Appendix M. The maximum height of RW 236 is 14 feet. We confirmed the nominal bearing resistance exceeds the gross uniform bearing stress for the strength limit and extreme event cases. Settlement is less than ½ inch for the net uniform bearing stress at the service limit state.	
22	GDR	Appendix M	Page 3, RW 317: Maximum design height is 10 ft, not 8 ft. Please clarify. Please check the required toe pressures for all three states. Please provide reference for Nq and Nγ.	The maximum height of RW317 is now 10 feet. We cited the reference for Nq and Nγ in Appendix M. We confirmed the nominal bearing resistance exceeds the gross uniform bearing stress for the strength limit and extreme event cases. Settlement is less than ½ inch for the net uniform bearing stress at the service limit state.	
23	GDR	Appendix M	Page 2, RW 109: Please check the required toe pressures for all three states.	We confirmed the nominal bearing resistance exceeds the gross uniform bearing stress for the strength limit and extreme event cases. Settlement is less than ½ inch for the net uniform bearing stress at the service limit state.	

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24	GDR	Appendix M	Page 2, RW 110: Please check the required toe pressures for all three states. Page 4, RW 110: Settlement of the other side of RW 110 with the fill is not checked.	We confirmed the nominal bearing resistance exceeds the gross uniform bearing stress for the strength limit and extreme event cases. Settlement is less than ½ inch for the net uniform bearing stress at the service limit state. Settlement at RW110 due to the height of new fills is less than ½ inch. Calculations for new fill loads are included with the revised.	
25	GDR	Appendix M	Page 5, RW 245: Cohesion of 4500 psf used for bearing capacity calculation is not consistent with the cohesion presented in the foundation report for retaining walls 246 and 245. Moreover, all calculations are not included in this section. Please clarify.	RW245 is an MSE wall. Design recommendations and applicable calculations for this wall are included in the companion FR for RW245 and RW246. Calculations for RW245 and RW246 are not included in revised GDR since these are not standard walls.	
26	GDR	General	Construction considerations, temporary cut slope or shoring system are not discussed in the GDR.	We revised report to include a discussion of construction considerations, temporary cut slope inclination and temporary shoring.	
27	Plans	General	Please include LOTB for all standard retaining walls in the project plans.	LOTBs are included with the project plan set.	
28		General	We previously provide geotechnical comments for Arroyo Del Valle trial bridge and bridge (widen), non-standard retaining walls 245 and 246. Please refer to these comments.	We complied.	
			Geology Comments		
29	GDR	1.1.8 Retaining Wall Page 1-5	In the paragraph below Table 1-3, the data information about Retaining wall 246 need to be corrected to be in consistent with the table matrix.	We revised the text, omitting discussion of wall lengths since already shown in preceding table.	

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#	Doc. (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
30	GDR	1.3.4 Regional Geology Page 1-8	1- The site Geology should be discussed under separate item . 2- The alignment that extends between Jack London Boulevard south to Stanley Boulevard is not included within the project limits. 3- As shown by the attached "Site Geologic Map" figure 1-7 , north of Concanon Boulevard is underlain by Pleistocene alluvium deposits (Qpf) and Holocene alluvial fan deposits. 4- It is preferable to use one recent Quaternary map (such as USGS, OFR 97-97) for the project area instead of modified map derived from two references (one old map 1980 and the other generalized map 2006)	We included a separate "local geology" section in the revised GDR. The north segment between Jack London to Concannon is not included in the project limits, however we include this area as part of the regional geology section. Qpf and Qhf ar located south of Concannon Boulevard on the geologic map and as written in the text. Geologic map provided adequately depicts conditions along the alignment so no change was made to this figure in revised GDR.	
31	GDR	3.1 Field Explora-tion	All boreholes (N01 through NB06) for Retaining Wall 246 (soil nail wall) are vertical. Horizontal borings should be drilled to represent the actual soils that will be encountered by the nails.	One vertical boring, A-08-005, was drilled on the existing slope between East Ruby Hill Drive and SR84 using specialized drilling equipment to characterize the subsurface conditions within the reinforced and retained zones for the soil nail wall. Due to access constraints on the hillside, horizontal borings could not be performed as part of the study. In addition, permission to drill vertical borings at the top of the proposed wall along East Ruby Hill Drive was denied by the homeowner's association. The non-standard Special Provisions (NSSP) of the project specifications will include the following statement: *Prior to final design, submittal of working drawings and construction of the soil nail wall, the Contractor must make at least three horizontal borings into the slope, one at each wall zone and report the findings in a test boring report as defined in Section 46-3.01C of the Standard Specifications.*	

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32	Plans		LOTB Identification numbers for Retaining Wall 245 are A-08-30 to A-08-33 and are not consistent with Report and Appendix C. Please correct.	Plans and calculations for RW245 were removed from GDR, and are included in the companion FR for RW245 and RW246.	
33	GDR	Pg.3-3	The groundwater levels indicated in the chart is inconsistent with info on the LOTBs. For many boreholes, the chart states that groundwater was not measured, when the LOTBs indicate that GW was in fact measured—after the day of drilling. This "stabilized" GW level is more significant than GW level during drilling. Please correct chart to reflect this. Please check ALL boreholes including NB11, NB12, and NB13.	It is our opinion that drilling fluid levels measured in Borings NB11 through NB13 do not accurately represent the groundwater elevation at the time of drilling. Analysis of liquefaction and foundation design using Borings NB11 through NB13 at Arroyo Del Valle is based on the groundwater level measured in borings drilled in the creekbed, corresponding to Elevation 401 and 400.5 feet.	

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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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					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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					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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				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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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		

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					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	**<u>Sheet X-11</u>** 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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				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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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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Title:	**Materials Branch**	

Revision Action Code: **A**-Will Comply; **B**-Consultant to Evaluate; **C**-Will Not Incorporate; **D**-CCTA to Evaluate

Item No.	Drawing or Page No.	Review Comments	Design Responses	Revision Action	JRT Disp.	Final Disp.
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		

Agency:	Caltrans	**Responded By:**	URS
Review Unit:	Materials Report	**Date Responded:**	
Comments By:	Maninder Kaur / Tinu Mishra	**JRT Meeting Date:**	
Date Reviewed:	10-23-09		

TECHNICAL COMMENT REVIEW AND RESPONSE

Title:	**Materials Branch**	

Revision Action Code: **A**-Will Comply; **B**-Consultant to Evaluate; **C**-Will Not Incorporate; **D**-CCTA to Evaluate

Item No.	Drawing or Page No.	Review Comments	Design Responses	Revision Action	JRT Disp.	Final Disp.
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		

Agency:	Caltrans	**Responded By:**	URS
Review Unit:	Materials Report	**Date Responded:**	
Comments By:	Maninder Kaur / Tinu Mishra	**JRT Meeting Date:**	
Date Reviewed:	10-23-09		

TECHNICAL COMMENT REVIEW AND RESPONSE

Title:	**Materials Branch**	

Revision Action Code: **A**-Will Comply; **B**-Consultant to Evaluate; **C**-Will Not Incorporate; **D**-CCTA to Evaluate

Item No.	Drawing or Page No.	Review Comments	Design Responses	Revision Action	JRT Disp.	Final Disp.
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		

Agency:	Caltrans	**Responded By:**	URS
Review Unit:	Materials Report	**Date Responded:**	
Comments By:	Maninder Kaur / Tinu Mishra	**JRT Meeting Date:**	
Date Reviewed:	10-23-09		

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.
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		

Agency:	Caltrans	**Responded By:**	URS
Review Unit:	Materials Report	**Date Responded:**	
Comments By:	Maninder Kaur / Tinu Mishra	**JRT Meeting Date:**	
Date Reviewed:	10-23-09		

TECHNICAL COMMENT REVIEW AND RESPONSE

Title:	**Materials Branch**	

Revision Action Code: **A**-Will Comply; **B**-Consultant to Evaluate; **C**-Will Not Incorporate; **D**-CCTA to Evaluate

Item No.	Drawing or Page No.	Review Comments	Design Responses	Revision Action	JRT Disp.	Final Disp.
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		

Agency:	Caltrans	**Responded By:**	URS
Review Unit:	Materials Report	**Date Responded:**	
Comments By:	Maninder Kaur / Tinu Mishra	**JRT Meeting Date:**	
Date Reviewed:	10-23-09		

TECHNICAL COMMENT REVIEW AND RESPONSE

Title:	**Materials Branch**	

Revision Action Code: **A**-Will Comply; **B**-Consultant to Evaluate; **C**-Will Not Incorporate; **D**-CCTA to Evaluate

Item No.	Drawing or Page No.	Review Comments	Design Responses	Revision Action	JRT Disp.	Final Disp.
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**	

95% PS&E Review Comments
Isabel Avenue Widening / State Route 84 Project_South Segment

Review Discipline:	Caltrans			By:	Various		
Reviewed By:	David Soon			QRT Meeting Date:			
Comments Due By:	7/23/2014			JRT Meeting Date:			
CODE: A-Will Comply; B-MTCo to Evaluate; C-Will Not Incorporate; D-City of Livermore to Evaluate; E-Caltrans to Evaluate							
Agency	Comment No.	Sheet/Page No. (If Applicable)	Comments	Design Responses	Code	JRT Disp.	Final Disp.
Caltrans, DES, OSFP		R-2 and Geotechnical Design Report &	**RW design:** In order to use Type 1 Retaining Walls in 2010 Standard Plans RSP B3-1a, b, or c the Geotechnical Design Report and Materials Report must provide PGA (Peak Ground Acceleration) for this retaining wall location.	PGA at the standard retaining wall locations is provided in page 4-2 of the revised Geotechnical Design Report and Materials Report (GDMR).	A		
Caltrans, DES, OSFP		R-4 and Geotechnical Design Report &	**RW design:** In order to use Type 1 Retaining Walls in 2010 Standard Plans RSP B3-1a, b, or c the Geotechnical Design Report and Materials Report must provide PGA (Peak Ground Acceleration) for this retaining wall location.	See response to Comment #1.	A		
		R-5 and Geotechnical Design Report & …	**RW design:** In order to use Type 1 and Type 5 Retaining Walls in 2010 Standard Plans RSP B3-1a, b, or c and RSP B3-4a, b, and c the Geotechnical Design Report and Materials Report must provide PGA (Peak Ground Acceleration) for this retaining wall location.	See response to Comment #1.	A		
Caltrans, DES, OSFP		R-5 and Geotechnical Design Report &	**RW design:** the Geotechnical Design Report and Materials Report does not recommend the Retaining Wall Type 5.	GDMR is updated to include the recommendations for the Type 5 retaining wall.	A		
Caltrans, DES, OSFP		R-6 and R-7 and Geotechnical Design Report &	**RW design:** In order to use Type 1 Retaining Walls in 2010 Standard Plans RSP B3-1a, b, or c the Geotechnical Design Report and Materials Report must provide PGA (Peak Ground Acceleration) for this retaining wall location.	See response to Comment #1.	A		
Caltrans, DES, OSFP		Geotechnical Design Report and Materials Reports	Update Geotech Design Report and Material Report for current design criteria and 2010 Standards.	GDMR is updated for current design criteria and 2010 standards.	A		
Caltrans, DES, OSFP		Geotechnical Design Report and Materials Reports	Update Geotech Design Report and Material Report for current Project scope. Delete information (Ret Walls) not in the south segment project.	GDMR is updated for the current project scope (south segment).	A		
Caltrans, DES, OSFP		Geotechnical Design Report and Materials Reports	Section 4 update to current Caltrans practice. Section 4.2, update to current Peak Bedrock Acceleration.	Section 4 is updated to current Caltrans practice and the Peak Ground Acceleration value is calculated using the latest ARS Online tool.	A		
Caltrans, DES, OSFP		Geotechnical Design Report and Materials Reports	Section 6.9 update to project scope and current design criteria.	Section 6.9 is updated to current project scope and design criteria.	A		
Caltrans, DES, OSFP		Geotechnical Design Report and Materials Reports	Update Table 6-2.	Table 6-2 is updated.	A		
Caltrans, DES, OSFP		Geotechnical Design Report and Materials Reports	Only Type 1 Ret Wall is recommended. Type 5 Ret Wall not recommended for RW 109.	GDMR is updated to include the recommendations for the Type 5 retaining wall.	A		
Caltrans, DES, OSFP		Geotechnical Design Report and Materials Reports	Update Table 6-3: Ret Walls in project, Max Wall Heigth, Bearing Pressures. Add PGA for each RW location.	GDMR is updated based on the latest retaining wall plans.	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

Project borings were drilled in 2007-2008 and in 2008-2009. The following table provides a correlation between boring identification numbers used during the subsurface exploration programs and the current Caltrans standards.

Multi-Purpose Borings			**Roadway Borings**	
Boring Number (Old)	**Boring Number (New)**		**Boring Number (Old)**	**Boring Number (New)**
NB01	A-08-001		RB01	A-07-101
NB02	A-08-002		RB02	A-07-102
NB03	R-07-003		RB03	A-07-103
NB04	A-07-004		RB04	A-07-104
NB05	R-07-005		RB05	A-07-105
NB05A	A-08-005		RB06	A-07-106
NB06	R-07-006		RB07	A-07-107
NB07	A-07-007		RB08	A-07-108
NB07A	A-08-007A		RB09	A-07-109
NB08	A-08-008		RB10	A-07-110
NB09	A-07-009		RB11	A-07-111
NB10	A-08-010		RB12	A-07-112
NB11	R-07-011		RB13	A-07-113
NB12	R-07-012		RB14	A-07-114
NB13	R-07-013		RB15	A-07-115
NB14	R-07-014		RB16	A-07-116
NB15	A-07-015		RB17	A-07-117
NB16	A-07-016		RB18	A-07-118
NB17	A-07-017		RB19	A-07-119
NB18	A-07-018		RB20	A-07-120
NB30	A-08-030		RB21	A-07-121
NB31	A-08-031		RB22	A-07-122
NB32	A-08-032		RB23	A-07-123
NB33	A-08-033		RB24	A-07-124
NB34	A-08-034		RB25	A-07-125
NB35	A-08-035		RB41	A-08-141
NB36	A-08-036		RB42	A-08-142
NB37	R-08-037		RB43	A-08-143
NB38	R-08-038			

Multi-purpose Borings NB19 through NB26 and roadway Borings RB26 through RB140 located outside of south segment project limits.

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.

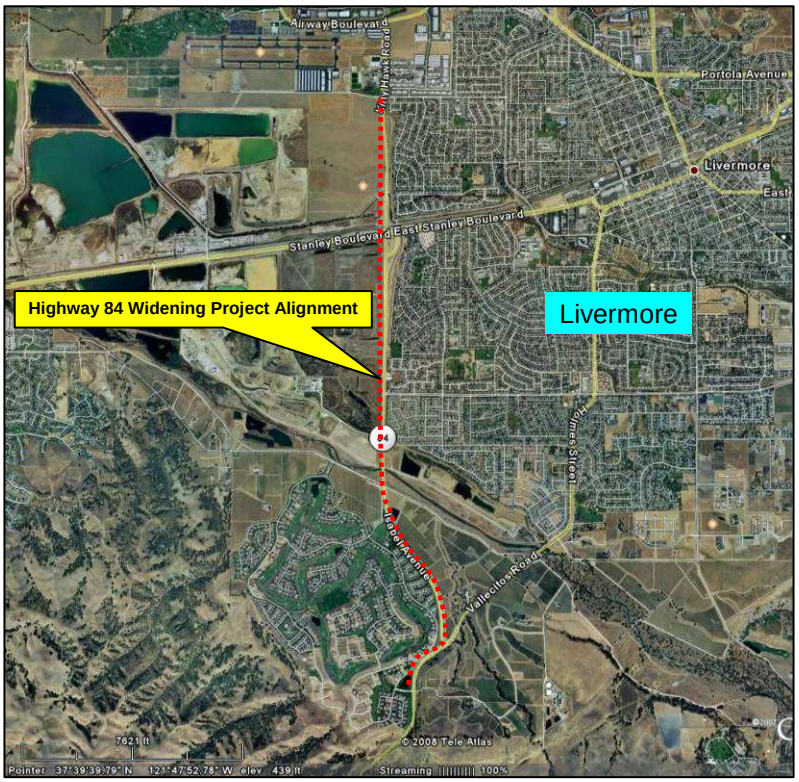


Figure 1. Vicinity and Project Site Map, Livermore, CA.

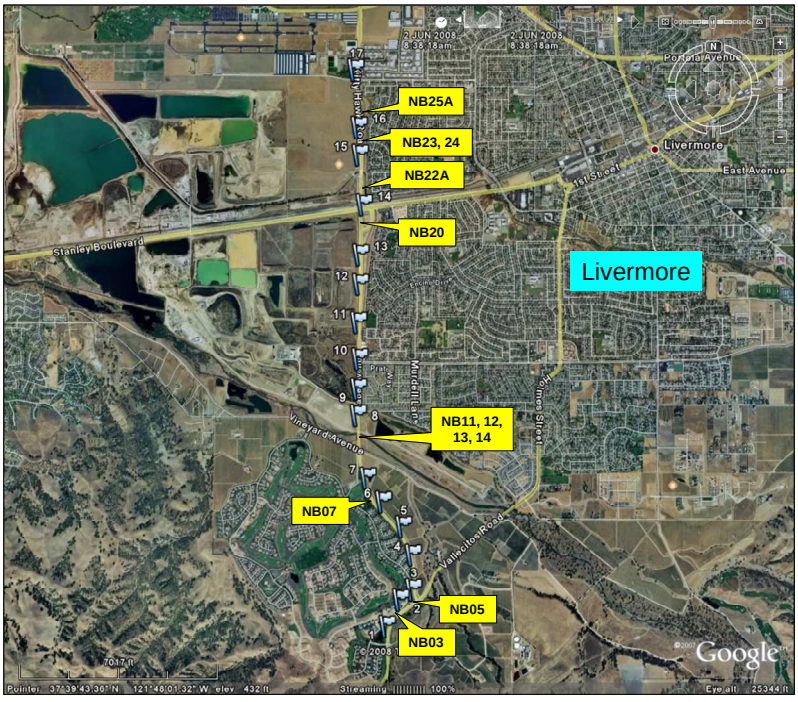


Figure 2. In-Situ Soil Resistivity Test Sites (flags) and Soil Bore Locations (NB-series)

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).

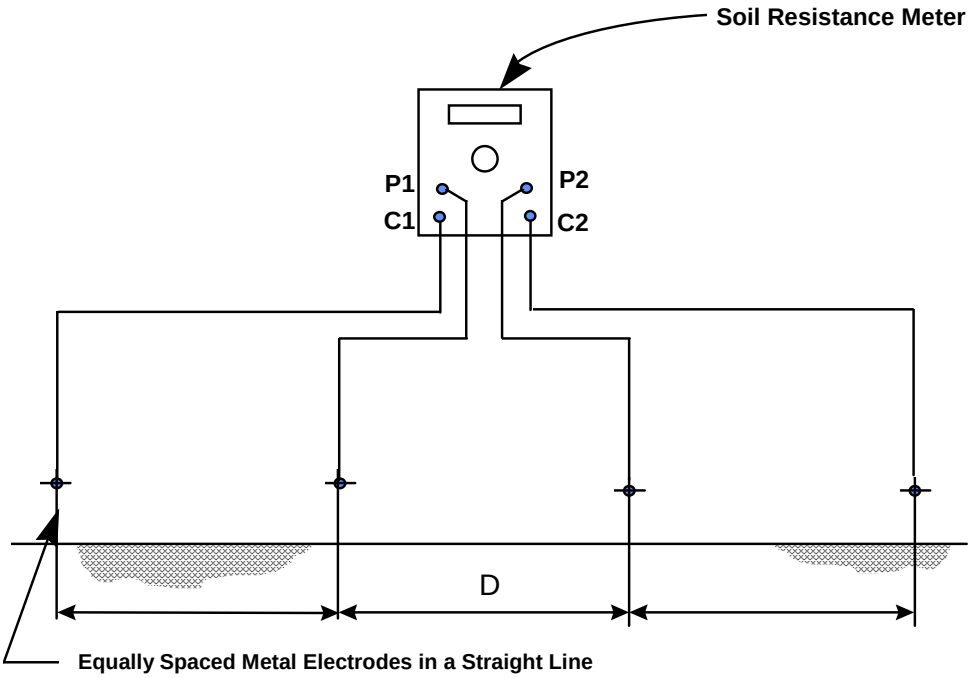


Figure 3. Wenner Electrode Method for Measurement of Soil Resistivity

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.

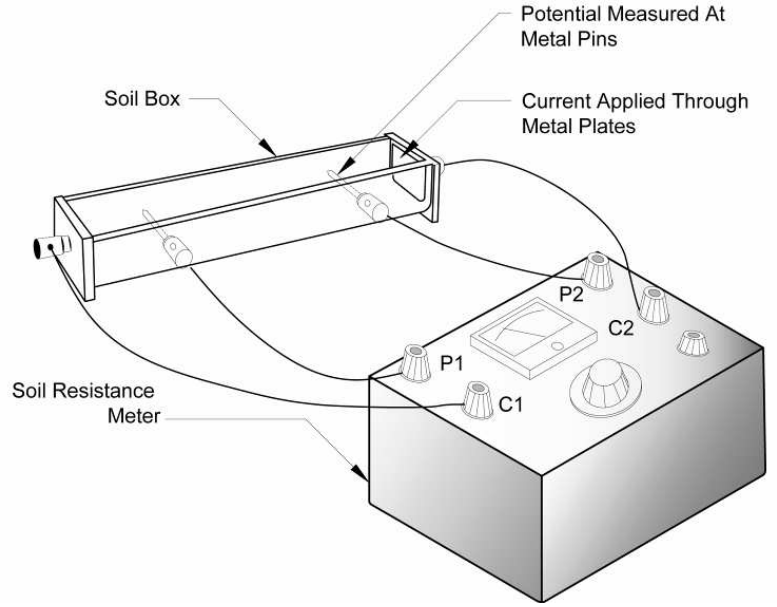


Figure 4. Soil Resistivity Measurement Using the Soil Box Method

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) mv	As Received %	
			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

Water Availability, City of Livermore, dated 03/27/2015

LIVERMORE
CALIFORNIA

March 27, 2015

Abhijeet Bhoi PE
URS Corporation
100 W. San Fernando Street, Suite #200
San Jose, CA 95113

Re: Route 84 Expressway Widening Project – Phase 2 (EA 04-297624)
Recycled Water Availability for Construction

Dear Mr. Bhoi,

I have reviewed your request for availability of about 1.4 million cubic feet of recycled water that will be needed for construction of the Route 84 Expressway Widening Project – South Segment (EA 04-297624) from October 2015 to June 2017. I determined that the City of Livermore will be able to provide the necessary amount of recycled water for the project's construction activities. Let me know if you have any questions.

Sincerely,

Darren Greenwood
Assistant Public Works Director
Water Resources Division/Public Works Dept.
(925) 960-8120

Cc: Kevin Kolte, Bob Follenfant, Roberto Escobar

WATER USE ESTIMATE

Project Information

Contract Number	04-297621
Project Identifier Number	9999990000
County/Route/PM	Ala/84/22.9-27.1

Estimate Prepared By

Estimate Date and Time: **4/1/2015 10:43**

Base Rates Used For Calculating Estimated Required Water

Bid Item / Work Activity	Base Rates	Unit of Measure
Roadway Excavation (Embankment)	30	Gal/CY
Aggregate Base & Subbase	15	Gal/CY
Dust Control	2	Gal/SQYD/Day
Subgrade Compaction	10	Gal/SQYD
Hot Mix Asphalt Compaction	7	Gal/Ton
Concrete	25	Gal/CY
Cold Planning Pavement	0.5	Gal/SQYD
Grind Concrete Pavement	6.5	Gal/SQYD
Groove Concrete Pavement	1.5	Gal/SQYD

Estimated Water Required for Bid Item / Work Activity

Bid Item / Work Activity	Estimated Quantity	Quantity Unit of Measure	Estimated Water Required (Gallons)
Roadway Excavation (Embankment)	150026	CY	4,500,780
Aggregate Base & Subbase	56030	CY	840,450
Dust Control Area	64795	SQYD	
Dust Control Days	28	days	3,628,539
Subgrade Compaction	73097	SQYD	730,968
Hot Mix Asphalt Compaction	83500	Ton	584,500
Concrete	5624	CY	140,600
Cold Planning Pavement	9210	SQYD	4,605
Grind Concrete Pavement	0	SQYD	0
Groove Concrete Pavement	0	SQYD	0

Note: Include only concrete that could be produced at a portable plant on the projects site.

Project Estimated Total Water Required	Unit of Measure
10,430,441	Gallons
1,394,347	CF
39,484	M^3
32.01	Acre-foot

PG&E Document #062288, Underground Conduits

Prepared by: ABB1

UNDERGROUND CONDUITS

062288

Asset Type:	Electric Distribution	**Function:**	Design and Construction
Issued by:	Lisseth Villareal (LDV2)	**Date:**	07-01-14

Rev. #14: This document replaces PG&E Document 062288, Rev. #13 For a description of the changes, see Page 22.

Purpose and Scope

This document covers steel and plastic conduit for underground installations, with or without concrete encasement.

General Information

1. Applications for underground conduit are as follows:
   A. Residential: All residential installations requiring conduit should be made without concrete encasement.
   B. Light Commercial, Industrial, and Underground Residential Distribution (URD) Feeder: Installation of circuits of this type, which are three-way or less, should normally be made without concrete encasement. In densely populated urban areas, conduit banks involving more than three primary conduits will normally require concrete encasement.
   C. Severe exposure to “dig-ins” and other hazards may require concrete encasement of conduit lines.
2. When conduit, including service conduit, is to be installed for PG&E by others, the following are acceptable alternatives to the American Society of Testing and Materials (ASTM) F512 (DB120) conduits listed in this document:
   A. PVC Schedule 40 or 80 UL 651 conduit that is so marked.
   B. Hot-dip galvanized rigid steel conduit conforming to American National Standards Institute (ANSI) Specification C80.1.

   It is the installer’s responsibility to use the proper fitting to join conduits. This transition may involve changes in both conduit type and size. If equal diameter conduits of different wall thicknesses are joined, the inside edge of the spigot end must be chamfered.
3. The current carrying capacity of an insulated cable is reduced if it is surrounded by other loaded cables. For this reason, conduit banks should be arranged so that each conduit is in an outside position.
4. Every effort should be made to obtain a straight, watertight conduit line.
5. In commercial distribution systems, consideration should be given to providing one or more spare conduits in the original construction for future load growth requirements. The addition of such conduits at a later time is much more costly.
6. A mandrel shall be used to prove that all conduits are free and clear of dirt, rocks, and other debris.
7. A pulling tape with sequential footage markings (code 560154) shall be installed in all conduits and attached to an end cap. The tape shall be proven free and not glued or caught on joints.
8. All conduits shall be capped. All conduits not terminating in a subsurface enclosure, pedestal, or vault are to be capped with unglued rigid caps (see Table 12 on Page 7). Conduits terminating in a subsurface enclosure, pedestal, or vault shall be capped with temporary plugs (see Table 12 on Page 7).
9. When the intrusion of water into buildings can be reasonably expected through lateral service ducts, PG&E is responsible for sealing both ends of the conduit (refer to Document 063927 and Document 063928). The Rayflate Duct Sealing System (RDSS) conduit sealing system can be ordered for this purpose with approval from electric standards personnel.

Material Specifications

10. Plastic conduits and fittings shall comply with the latest revision of ASTM Standard F512 for PVC. In addition, the conduit shall also meet the following specific requirements:
    A. Conduit cell classification of 12164-B or 12264-B, tensile modulus of 500,000 psi.
    B. Fittings cell classification of 12234-B.
    C. Marking shall conform to ASTM Standard F512 requirements.
    D. The inside edge of conduit ends (spigot-end only in the case of belled-end conduit) shall be beveled to eliminate sharp edges and minimize the possibility of cable damage.
    E. PVC conduit and fittings will be gray in color.

Application

11. Plastic conduit may be cut with a hacksaw or a fine-toothed wood saw. Clean off burrs. Bevel the inside to eliminate sharp edges.
12. Apply a thin, uniform coat of cement to both surfaces to be glued. Avoid excessive use of cement to prevent the formation of a bead of cement on the interior shoulder of the joint since, when hardened, the bead can cause cable damage during installation. Immediately after applying the coat of cement to the conduit, insert the conduit into the fitting socket until it bottoms at the fitting shoulder. Turn the conduit 1/4 turn during insertion to distribute the cement evenly. Hold the conduit in place for about 1 minute to prevent backing out in case of tight interference fit joints. Wipe any excess cement away from the outside of the joint. Weather conditions may vary the curing time. When using cement in confined areas, adequate ventilation must be provided.

Table 1 Cement for Use With Plastic Conduits

Application	Quantity	Code	Manufacturer	Part Number
PVC to PVC	1 Quart	490157	Oatey	30886
	1 Pint	490151	Oatey	30885

13. Backfill containing large rock, paving material, cinders, large amounts of sharply angular substance, or corrosive material shall not be placed in excavations where such material may damage conduits, prevent adequate compaction of the fill, or contribute to corrosion of the conduits.
14. End bells are to be used to terminate all conduits, unless the conduit has been terminated in an enclosure equipped with duct terminators. Cable protectors are to be used on reconstruction projects only, when end bells cannot be installed.
15. In applications where a conduit dead-ends, cap the end of the conduit and place a marker ball (material code 374947) at the location.
16. Conduits shown in Table 10 (HDPE) and Table 11 (Bore-Gard) on Page 6 are for directional boring applications only.
17. **Caution:** When pulling conduits in boring applications, be certain to cut the conduits allowing sufficient extra length for the conduit to relax. It may take as long as 72 hours for an excessively stretched conduit to fully relax.
18. **Caution:** Snap-N-Stac Combo Spacers should be used in concrete encased application.
19. Conduit shown on Table 19 through Table 27 (flexible conduit) on Page 10 through Page 16 are for use in areas with minor soil settlement issues, and for large radius sweeps or re-routes.

Underground Conduits

References	Location	Document
Underground Duct Lines Concrete Encased	FRO: UG Conduit	031792A
Underground Conduit Without Concrete Encasement	FRO: UG Conduit	031793A
Methods and Requirements for Installing Residential Underground Electric Services 0–600 V to Customer-Owned Facilities	UG-1: Services/Greenbook	063927
Methods and Requirements for Installing Commercial Underground Electric Services 0-600 Volts to Customer-Owned Facilities	UG-1: Services/Greenbook	063928
Engineering Material Specification 64, “Polyvinyl Chloride (PVC), Conduits, and Fittings”	TIL	EMS64
Engineering Material Specification 99, “Underground Electric Duct System (installed by applicant)”	TIL	EMS99
Engineering Material Specification 4123, “Backfill Sand”	TIL	EMS4123

Rigid Steel Conduit and Fittings

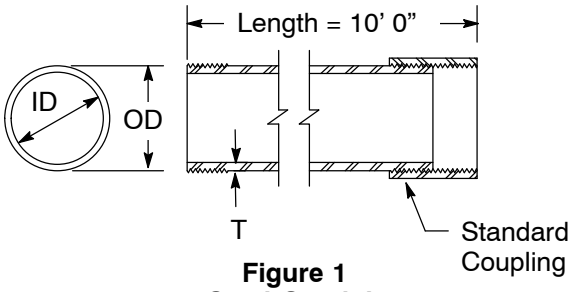


Figure 1
Steel Conduit

Table 2 Codes for Rigid Steel Conduit

Conduit Size (inches)	Dimensions (inches)			Weight (lbs.)[1]	Code
	OD	ID	T		
2	2.4	2.06	0.154	33	362103
3	3.5	3.06	0.216	69	362092
4	4.5	4.02	0.237	98	362093
5	5.6	5.04	0.258	134	362104
6	6.6	6.06	0.280	177	362141

[1] Weight for one 10-foot length, including one standard coupling furnished with each length.

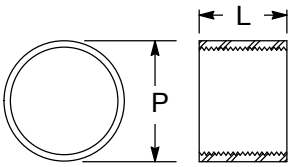


Figure 2
Steel Coupling

Table 3 Codes for Standard Steel Coupling

Conduit Size (inches)	Dimensions (inches)		Code
	P	L	
2	2.73	2.18	362105
3	4.00	3.25	362094
4	5.00	3.50	362095
5	6.29	3.75	362106
6	7.39	4.00	362142

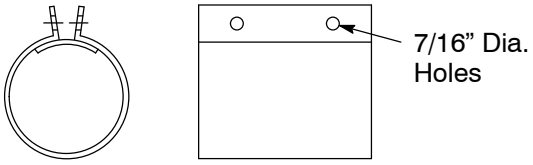


Figure 3
Split Coupling

Table 4 Codes for Galvanized Steel Split Coupling

Conduit Size (inches)	Code
2	362019
3	362021
4	362023
5	362107
6	362143

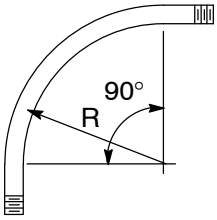


Figure 4
Conduit Sweep
Threaded Both Ends

Table 5 Codes for 90° Steel Conduit Sweeps, TBE

Conduit Size (inches)	Radius (inches)	Code
2	24	360081
3	36	362091
4	36	362090
	60	360812
5	36	362109
6	36	362144
	48	362145
	60	360813

Plastic Conduit and Fittings

Notes

1. The depth of all couplings, adapters, swedge reducers, and bell ends shall conform to the requirements listed in Table 2 of ASTM Standard F–512.

Table 6 Data and Codes for Rigid Plastic Conduit DB120 [1]

Conduit Size (inches)	Dimensions (inches)				Code
	Outside Diameter	Minimum ID	Wall Thickness		
			Minimum	Maximum	
2	2.375	2.161	0.077	0.107	016468
3	3.500	3.204	0.118	0.148	016471
4	4.500	4.132	0.154	0.184	016472
5	5.563	5.121	0.191	0.221	016473
6	6.625	6.111	0.227	0.257	016474

[1] See Note 10 on Page 2 for material specifications.

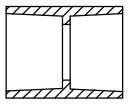


Figure 5
Standard Coupling

Table 7 Codes for Standard Couplings [1]

Standard Coupling		
Conduit Size (inches)	Code	Minimum Socket Depth
2	360321	1.75
3	360322	2.875
4	360323	3.375
5	360401	4.0
6	360482	5.0

[1] Standard couplings made from DB-60 conduit are acceptable.

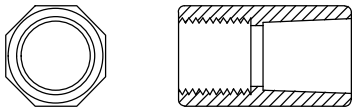


Figure 6
Plastic-to-Steel Adapter

Table 8 Codes for Plastic-to-Steel Adapters

Conduit Size (inches)	Code
2	360324
3	360325
4	360326
5	360402
6	360489

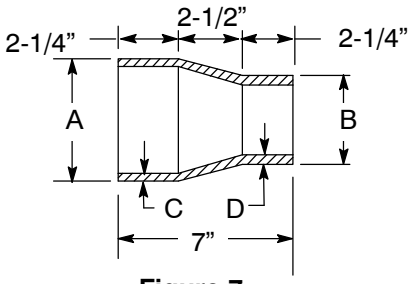


Figure 7
Swedge Reducer

Table 9 Data and Codes for Swedge Reducers

Reducer Size (inches)	Dimensions (inches)				Code
	OD		Min. Wall Thickness		
	A	B [1]	C	D	
3 x 2	3.500	2.375	0.60	0.60	018585
4 x 3	4.500	3.500	0.60	0.60	018584
4 x 2	4.500	2.375	0.60	0.60	018586
5 x 4	5.563	4.742	0.60	0.60	360777
6 x 5	6.625	5.563	0.60	0.60	360778
6 x 4	6.625	4.812	0.60	0.60	016476

[1] Dimensions shown are for a swedge reducer with a spigot end. A belled end may be substituted.

Plastic Conduit and Fittings (continued)

Table 10 High Density Polyethlene (HDPE) Conduit Directional Boring Conduit [1]

Conduit				Mechanical Couplings [2, 3]	
Size	Length (feet)	Description	Code	Size (inches)	Code
2” Sch 80	500	Coil [4]	360511	2	360690
2” Sch 80	40	Stick	360017		
3” Sch 80	500	Coil [4]	360644	3	360691
3” Sch 80	40	Stick	360018		
4” Sch 80	625	Coil [4]	360687	4	360692
4” Sch 80	625	Coil [5]	360014		
4” Sch 80	40	Stick	360015		
5” SDR 13.5	450	Coil [4]	360688	5	360694
5” SDR 13.5	450	Coil [5]	360012		
5” SDR 13.5	40	Stick	360013		
6” SDR 13.5	450	Coil [4]	360689	6	360695
6” SDR 13.5	450	Coil [5]	360010		
6” SDR 13.5	40	Stick	360011		

1 Color shall be black with at least 3 red longitudinal strips.
2 May be used to connect PE conduit to PVC conduit (except in directional drilling apps.)
3 Mechanical couplings are not designed for directional drilling. Fusion joints are required.
4 No reel.
5 With reel.

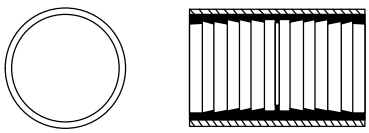


Figure 8
HDPE Coupling

Table 11 PVC (Bore-Gard) Directional Boring Conduit

Size (inches)	Description	Code
3	Conduit 10’, Schedule 40	360055
3	Conduit 20’, Schedule 40	360056
3	Replacement Locking Straps [1]	360058
3	Replacement Seal Gaskets [1]	360057
4	Conduit 10’, Schedule 40	360026
4	Conduit 20’, Schedule 40	360025
4	Replacement Locking Straps [1]	360031
4	Replacement Seal Gaskets [1]	360029
6	Conduit 10’, Schedule 40	360027
6	Conduit 20’, Schedule 40	360028
6	Replacement Locking Straps [1]	360032
6	Replacement Seal Gaskets [1]	360030

1 Package of 10.

Plastic Conduit and Fittings (continued)

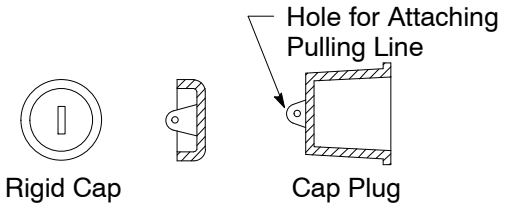


Figure 9
Plastic Conduit Caps

Table 12 Codes for Rigid Conduit Caps and Cap Plugs

Conduit Size (inches)	Codes	
	Rigid Cap	Cap Plug
2	360425	360440
3	360426	360441
4	360428	360443
5	360429	360444
6	360488	360494

Figure 10
End Bell

Table 13 Codes for End Bells

Conduit Size (inches)	Code
2	360420
3	360421
4	360423
5	360424
6	360487

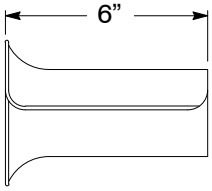


Figure 11
Cable Protector

Table 14 Codes for Cable Protectors [1]

Conduit Size (inches)	Code
2	382034
3	382032
4	
5	
6	

[1] Not for new installations; for replacement only.

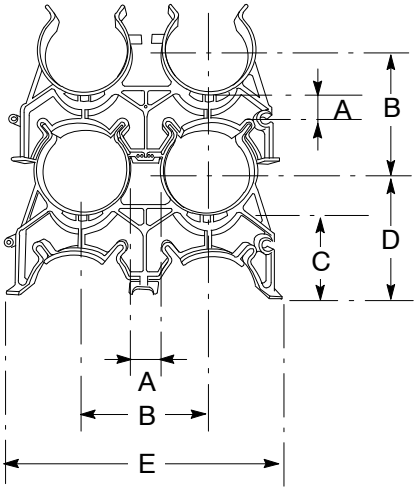


Figure 12
Snap-N-Stac Combo Spacers

Table 15 Codes for Snap-N-Stack Combo Spacers [1]

Conduit Size (inches)	Duct OD (inches)	Horizontal Duct Positions	Dimensions (inches)					Material Codes
			A	B	C	D	E	
3	3.5	2	2	5.5	3.63	5.38	11	360459
4	4.5	2	2	6.5	3.88	6.06	13	360460
5	5.5	2	2	7.56	4.38	7.25	15.12	360461
6	6.625	2	2	8.62	4.13	7.38	17.25	360491

[1] Cable spacers allow only for 2” separation between conduits. Cable spacers are used only where is required to route around existing obstructions. Thus, locations where cable spacers are needed are exempt from the requirement of maintaining 3” separation between 600 A distribution circuits.

Plastic Conduit and Fittings (continued)

Figure 13
5° Coupling

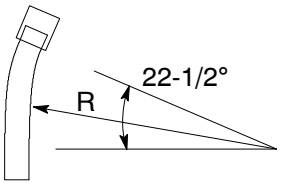


Figure 14
22-1/2° PVC Conduit Bend

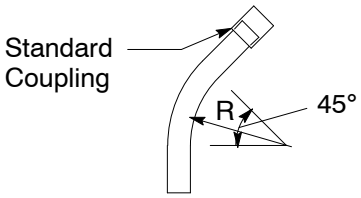


Figure 15
45° PVC Conduit Bend

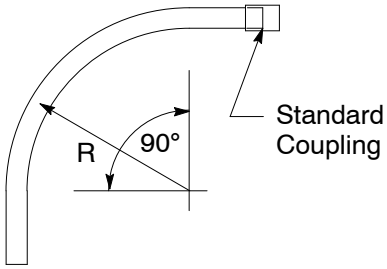


Figure 16
90° PVC Conduit Bend

Table 16 Codes for DB120 PVC Conduit Bends (sweeps)

Conduit Size (inches)	Sweep		Code
	Degree	Radius (inches)	
2	5	30	360458
	11-1/4	24	360797
		36	360798
	22-1/2	24	360795
		36	360796
	45	24	360391
		36	360794
	90	24	360393
		36	026491
3	5	36	360399
	11-1/4	36	360801
	22-1/2	36	360800
	45	36	360403
	90	24	360405
		36	360328
4	5	36	360400
	11-1/4	36	360804
		60	360805
	22-1/2	36	360760
		60	360761
	45	36	360412
		60	360413
	90	36	360414
		60	360415
5	5	48	360407
	11-1/4	36	360808
		60	360809
	22-1/2	36	360806
		60	360763
	45	36	360416
		60	360417
	90	36	360418
		60	360419
6	5	60	360495
	11-1/4	60	360811
	22-1/2	60	360765
	45	36	360485
		60	360486
	90	36	360483
		60	360484

Large Radius Sweeps

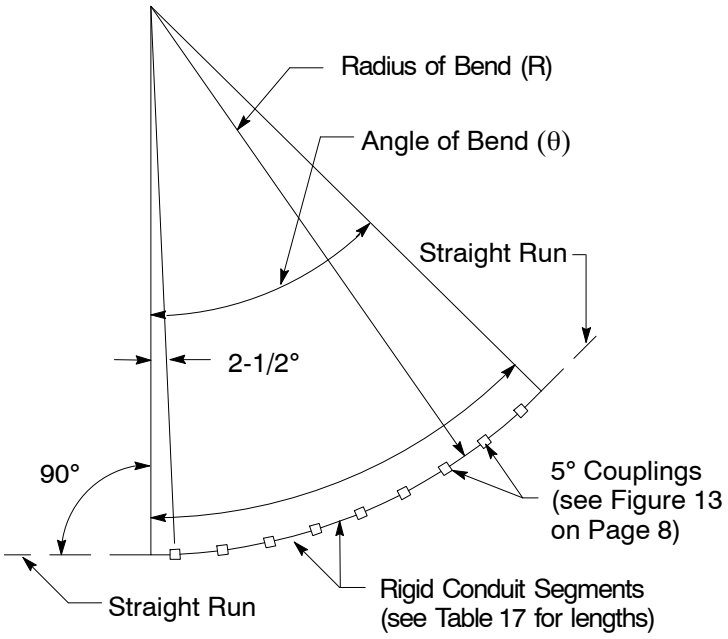


Figure 17
Typical Application of 5° Couplings

Table 17 Length of Rigid PVC Conduit Segments

Approximate Radius of Bend (R)	Length of Rigid Conduit Segments (feet)
11’ 6”	1
17’ 3”	1.5
23’ 0”	2
28’ 9”	2.5
34’ 6”	3
40’ 3”	3.5
46’ 0”	4
51’ 9”	4.5
57’ 6”	5
69’ 0”	6
80’ 6”	7
92’ 0”	8

Example

Radius Bend (R) = 60 Feet
Angle of Bend (θ) = 45°

From Table 17 The nearest value to 60-foot radius is 57’ 6”.
The length of conduit segments = 5 feet.

From Table 18 For a 45° angle bend:
The number of 5° couplings required = 9.
The number of conduit segments required = 8.

Table 18 Number of Couplings and Conduit Segments Required

Angle of Bend (θ)	Number of Couplings and Outside Diameter Conduit Segments Required	
	Coupling	Conduit
15°	3	2
30°	6	5
45°	9	8
60°	12	11
75°	15	14
90°	18	17

Flexible (HDPE) Conduit and Fittings

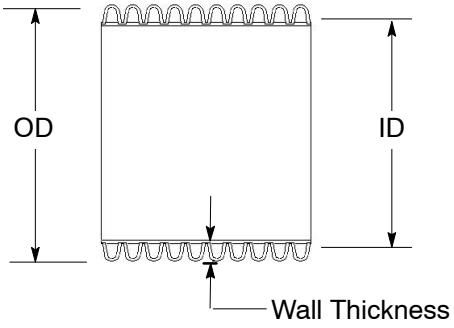


Figure 18
Smooth-Core Conduit

Table 19 Data and Codes for Smooth-Core Conduit w/Couplers (20' length) [1, 2]

Conduit Size (inches)	Dimension (inches)			Minimum Bending Radius (feet)	Code
	Outside Diameter	Inside Diameter	Wall Thickness		
3	3.5	2.975	.263	6	360094
4	4.965	4.124	.420	8	360335
6	6.890	5.860	.515	12	360128

1 Conduit can be used in areas with minor soil settlement issues or for large radius sweeps.
2 Inside wall is smooth.

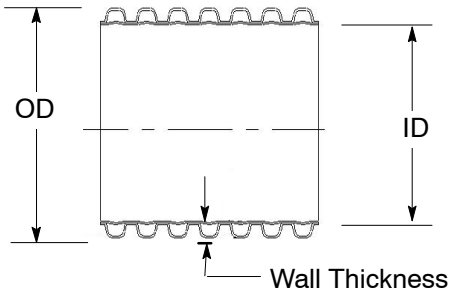


Figure 19
Corrugated Core Flex Conduit

Table 20 Data and Codes for Corrugated Core Flex Conduit With Couplers (250' coil) [1 2 3]

Conduit Size (inches)	Dimension (inches)			Code
	Outside Diameter	Inside Diameter	Wall Thickness	
2	2.375	2.050	.163	360095
3	3.500	2.950	.275	360096
4	4.750	3.975	.387	360097

1 Conduit can be used in areas minor soil settlement issues or for re-routes.
2 Inside wall is corrugated.
3 Minimum bending radius is 24 inches for all sizes.

Flexible (HDPE) Conduit and Fittings (continued)

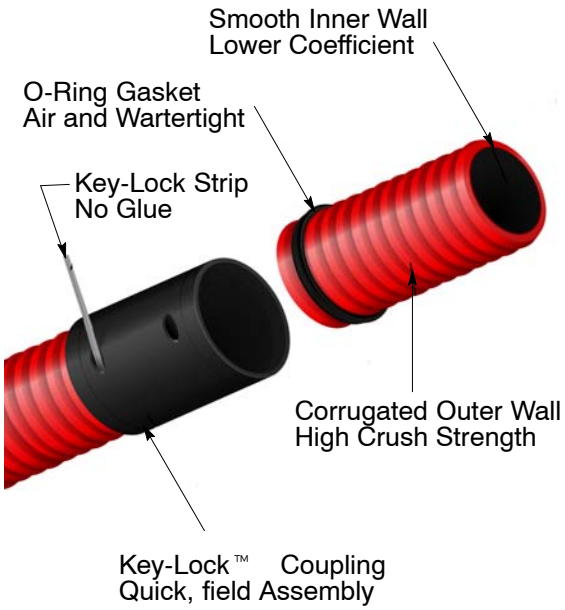


Table 21 Data and Codes for Key-Lock™ Couplers [1]

Conduit Size (inches)	Insertion Lengths (inches)	Code
2	2.725	360102
3	3.125	360103
4 [2]	2.875	360129
4 [3]	3.00	360104
4 [4]	2.875	360105
4	4.205	360130

1 Kit has coupler, two locks and two gaskets.
2 Coupler to connect smooth-core to smooth-core conduit.
3 Coupler to connect smooth-core to corrugated core flex conduit.
4 Coupler to connect corrugated core flex to corrugated core flex.

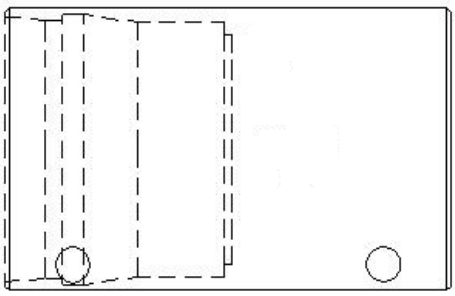


Figure 20
Key-Lock™ Couplers

Flexible (HDPE) Conduit and Fittings (continued)

Install the Key-Lock Coupler Following the Procedure Below

1. Make certain the elastomeric gasket is seated in the second corrugation on 4” conduit and the first corrugation on 6” conduit. Be sure the gasket is positioned as shown on Figure 21.

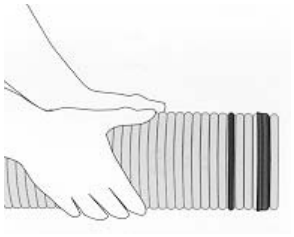


Figure 21
Key-Lock™ Couplers Gasket Position

2. Use only a water-based lubricant. Apply the lubricant to the outside surface of the gasket. A light coating of lubricant should also be applied to the chamfered leading edge of the coupler as shown on Figure 22.

Figure 22
Key-Lock™ Couplers Lubricant Application

3. Insert the gasketed end of the Smooth-Cor® conduit into the coupler. Note the black home-mark, which is used to identify proper coupling as shown on Figure 23.

Figure 23
Key-Lock™ Couplers Insertion

Flexible (HDPE) Conduit and Fittings (continued)

Install the Key-Lock Coupler Following the Procedure Below (continued)

4. Use a mallet and wood block to seat the coupler until the home-mark is covered. Note that the small lock ring on the inside surface of the coupler snaps into a matching corrugation as shown on Figure 24.

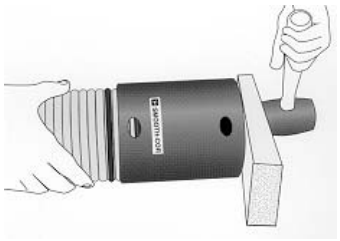


Figure 24
Key-Lock™ Couplers Locked in Place

5. Insert the Key-Lock™ strip following the directional arrow into the pre-drilled hole in the coupler. Apply a small amount of lubricant to aid in the insertion. Push the Key-Lock™ strip (in the direction of the arrow on the label) around the entire circumference, locking the grooves in the conduit and coupler securely together. Trim the excess Key-Lock™ strip material from the coupler (optional). See Figure 25 below.

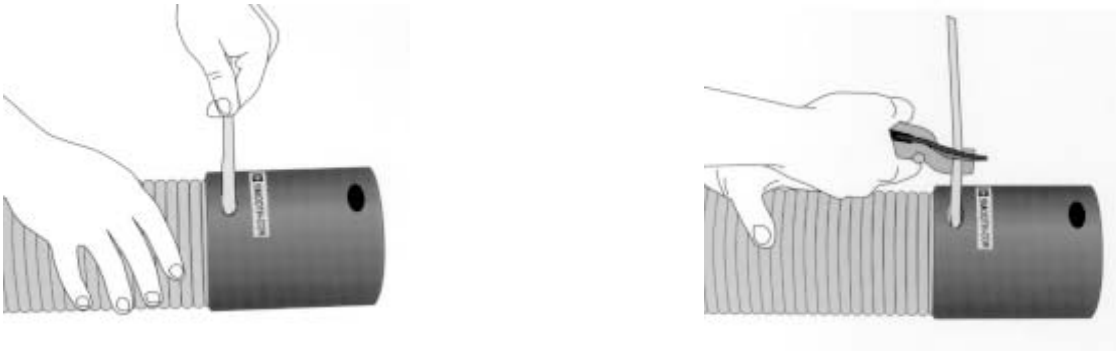


Figure 25
Key-Lock™ Couplers Strip Insertion

Flexible (HDPE) Conduit and Fittings (continued)

Install the Key-Lock Coupler Following the Procedure Below (continued)

Note: When cutting the Smooth-Cor® conduit in the field to a custom length, it necessary to follow the steps below:

1. Cut the conduit at the selected corrugation valley.
2. Place the gasket over the newly cut and cleaned end, making certain to seat the gasket on the second corrugation for 4” conduit and on the 6” conduit. The higher ridge of the elastomeric seal is positioned toward the body of the conduit and the lower ridge toward the end of the conduit. Using a felt marker, place a home-mark on the conduit to achieve proper coupling. When using 4” conduit, place the home-mark on the seventh corrugation; for the 6” conduit, place the home-mark on the fourth corrugation. Repeat steps 2-5 as shown on Page 12 and 13 to complete coupling. See Figure 26.

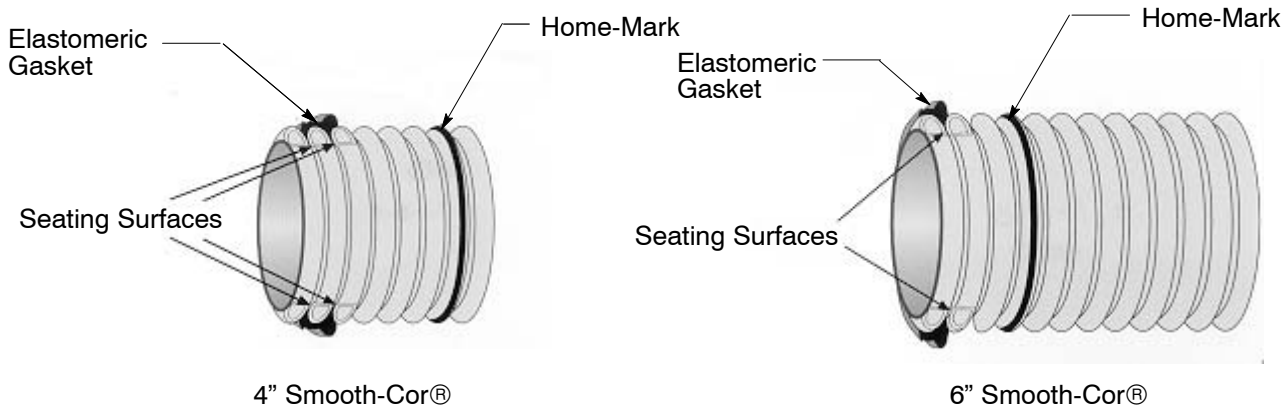
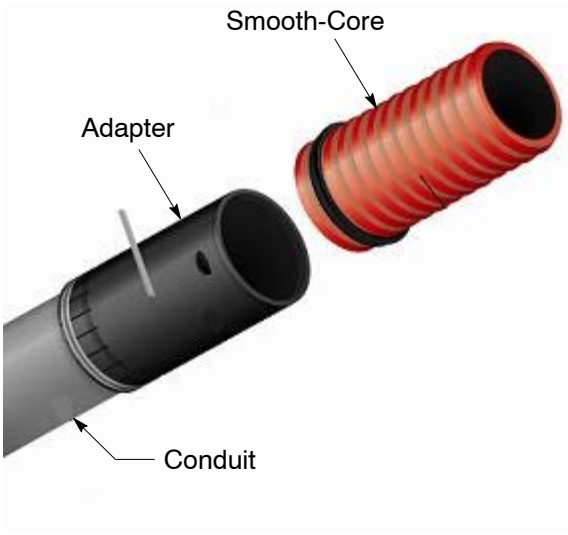


Figure 26
Key-Lock™ Couplers Cut at Customized Length

Flexible (HDPE) Conduit and Fittings (continued)



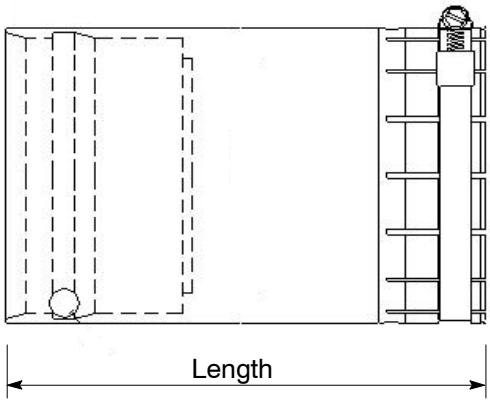


Figure 27
Key-Lock™ Adapter

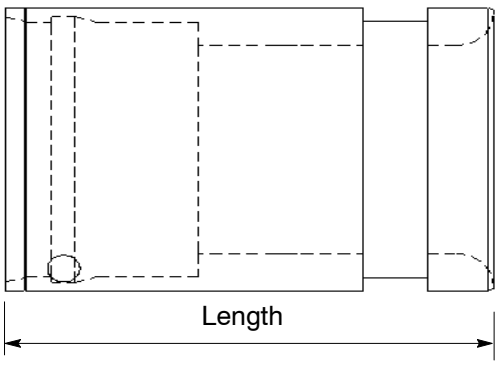


Figure 28
Key-Lock™ Bell End Adapter

Table 22 Data and Codes for Key-Lock™ Adapter Smooth-Core-Shur-Lock Kit™ [1]

Conduit Size (inches)	Dimension (inches)	Code
	Length	
2	6.7	360106
3	6.63	360107
4 [2]	8.0	360131
4 [3]	8.0	360108
6	11.63	360132

1 Kit has adapter, two locks, and two gaskets.
2 Adapter to connect smooth-core to smooth-core conduit.
3 Adapter to connect corrugated core flex to corrugated core flex conduit.

Table 23 Required Rigid PVC stub out length

Conduit Size (inches)	PVC Stub Out (inches)
2	14.8
3	14.5
4	15
6	17.5

1 Stub out length needed to provide enough space for the adapter to connect rigid PVC to flexible conduit.

Table 24 Data and Codes for Key-Lock™ Bell End Adapters Smooth-Core Bell

Conduit Size (inches)	Dimension (inches)	Code
	Length	
2	7.38	360109
3	7.25	360110
4 [1]	7.5	360133
4 [2]	7.5	360111
6	8.75	360134

1 Adapter to connect to smooth-core to smooth-core conduit.
2 Adapter to connect corrugated core flex to corrugated core flex conduit.

Flexible (HDPE) Conduit and Fittings (continued)

Figure 29
Tapered Plugs

Table 25 Codes for Tapered Plugs

Tapered Plug (inches)	Code
2	360112
3	360113
4	360114
6	360115

Table 26 Codes for Key-Lock™ Strip Replacement [1]

Key-Lock Strip (inches)	Color	Length (inches)	Bell Diameter (inches)	Code
2	Lime	12	2.75	360121
3	Lavender	16.5	4.37	360122
4	Gray	19.5	4.82	360123
6	Blue	28.5	7.0	360124

[1] See Figure 21 for Key-Lock™ picture.

Table 27 Codes for O-Ring Gasket Seals [1]

Tapered Plug (inches)	Code
2	360125
3	360126
4	360135
6	360136

[1] See Figure 21 for O-Ring Gasket Picture.

Figure 30
Pre-Formed Sweeps

Table 28 Pre-Formed Sweeps Smooth Wall HDPE

Conduit Size (inches)	Degree	Radius (inches)	Code
2	90	36	360116
3	90	36	360117
4	90	36	360118
4	90	48	360119
6	90	60	360120

Trench Requirements

Notes

1. Field conditions may require a minimum depth greater than shown.
2. Maintain 3-inch separation between ducts for primary and secondary distribution circuits.
3. Sharp turns, bends, or other irregularities in the conduit must be avoided.
4. If the bottom of a trench which will contain plastic conduit is rocky, use backfill material conforming to the requirements of Engineering Material Specification 4123. Before tamping in the area of plastic conduit, apply at least 6 inches of backfill over the top of the conduit to avoid breakage. Final backfill may then be placed in the trench and tamping employed to finish grade. In order to reduce costs, the soil originally removed from the trench should be used as backfill wherever possible (see Note 13 on Page 2).
5. Do not use salt-water sand backfill with steel conduit.
6. Other utility practices may require a greater minimum conduit separation.
7. Refer to state of California, Department of Industrial Relations; *Trench Construction Safety Orders* for trench construction requirements. These orders are issued by the Department of Occupational Safety and Health.
8. When crossing obstructions, such as shown in Figure 34 and Figure 35 on Page 18, maintain 6-inch minimum separation.

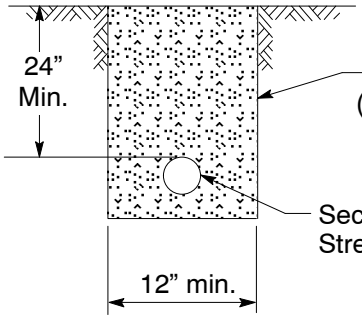


Figure 31
Secondary/Service or Streetlight Trench

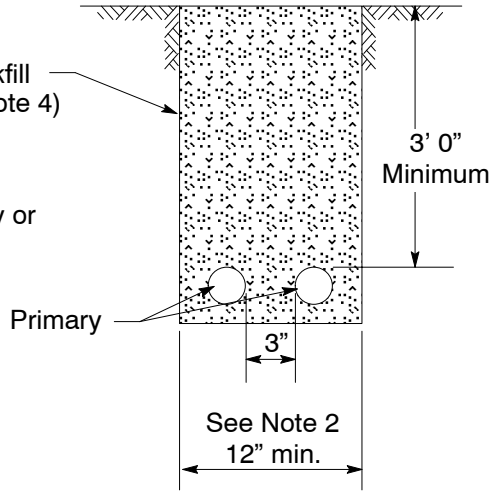
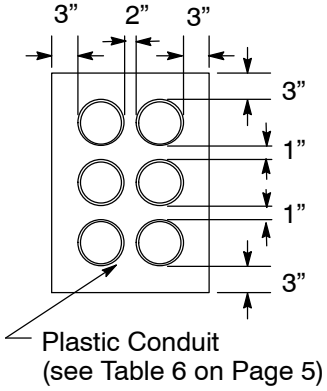


Figure 32
Primary Trench

Conduit Construction, Built-up Method



Section A-A

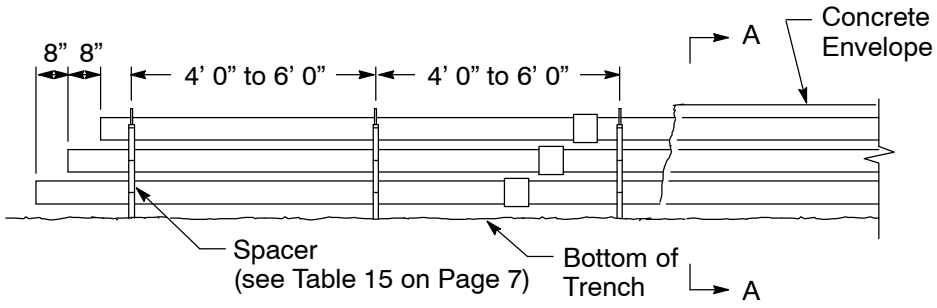


Figure 33
Typical Straight Run Installation
(5” conduit, 6-way shown)

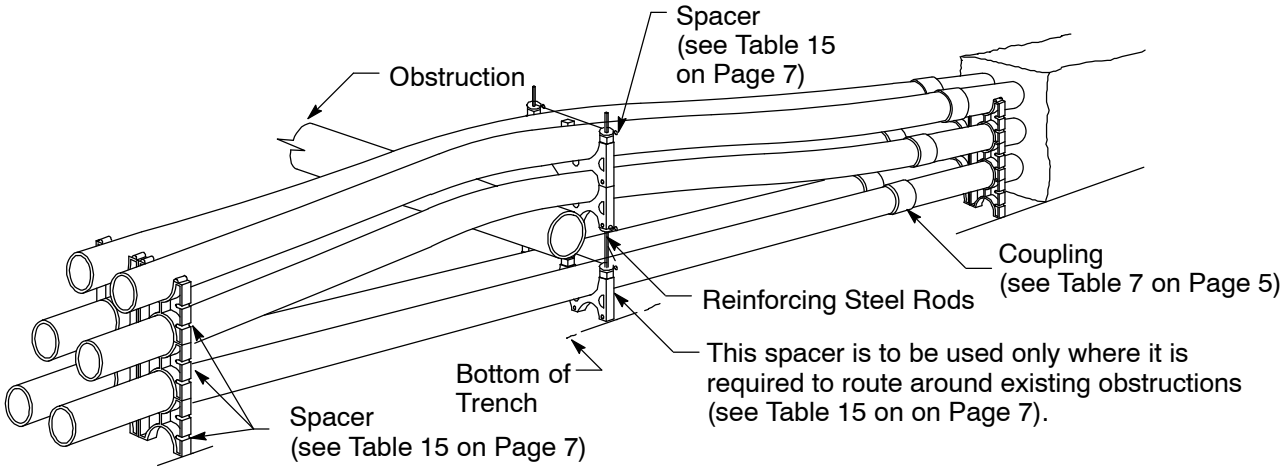


Figure 34
Typical Perspective View of
Installation Around Obstruction

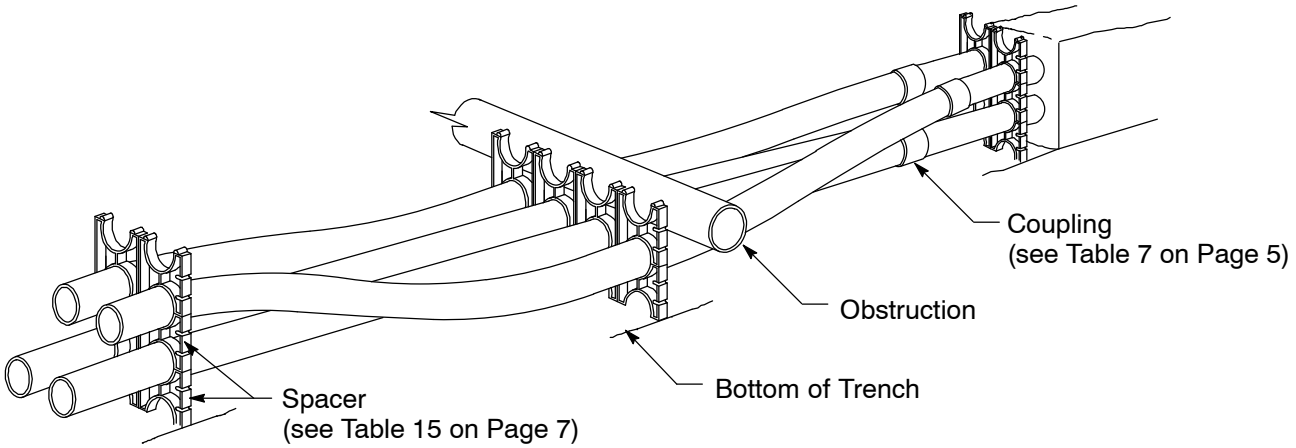


Figure 35
Typical Perspective View of
Installation Under Obstruction

Construction and Termination of Conduit Line

Notes

1. Slope the conduit sufficiently to provide adequate drainage. On level ground, slope the duct line from the center to each manhole.
2. Local city ordinances may require a minimum cover greater than PG&E's requirements of 24" for conduits containing circuits energized at 750 volts or less, and 36" for conduits containing circuits energized in excess of 750 volts. Depth may be reduced in either case if adequate mechanical protection – as defined in Section 3.3.6 of the Greenbook – is provided.
3. Where required, the depth of the conduit window may be increased. Where this is necessary, tie the conduit envelope concrete into the manhole reinforcing steel.
4. Vertical staggering of conduits at entrance shown in Detail A will assist in arranging for cable crossover if required.

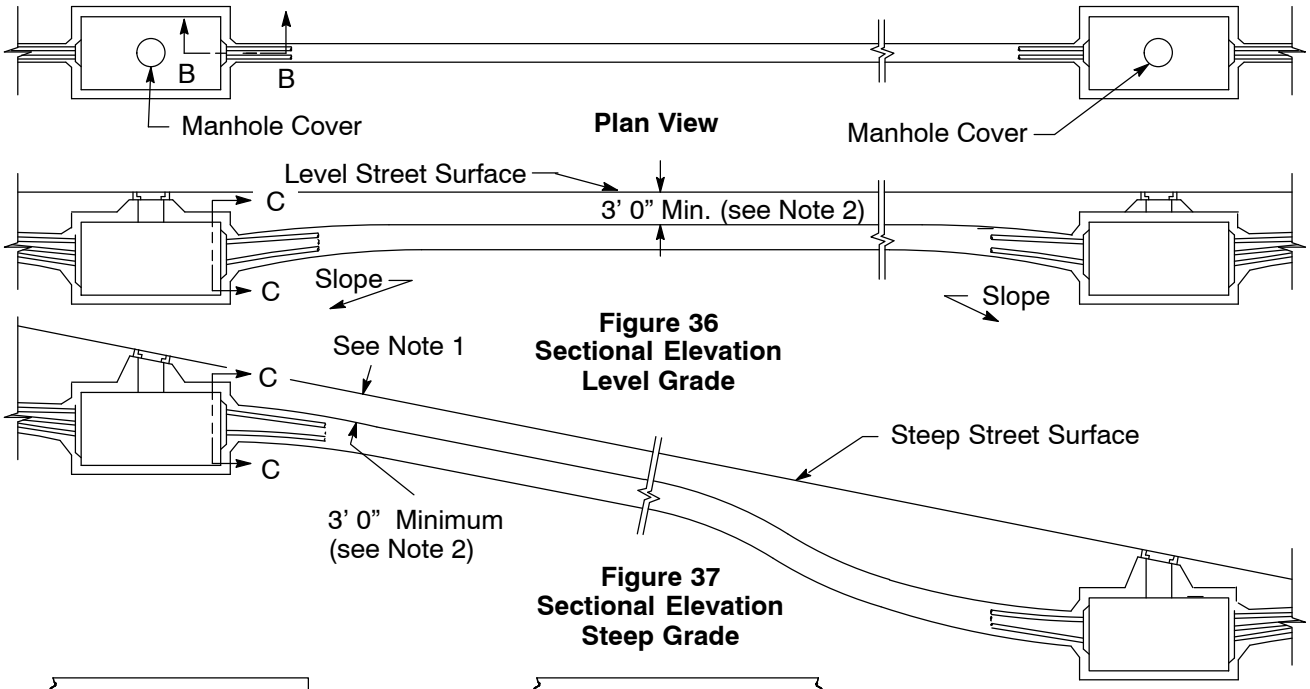
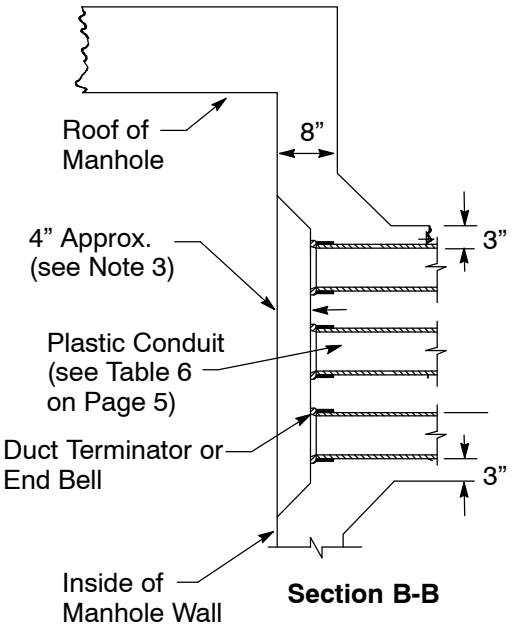
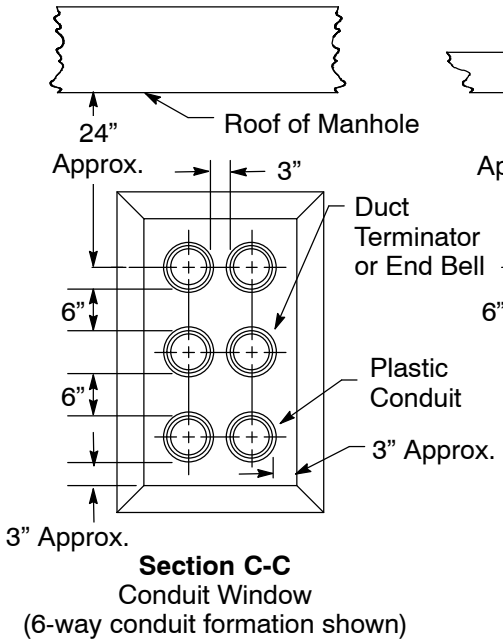


Figure 36
Sectional Elevation
Level Grade

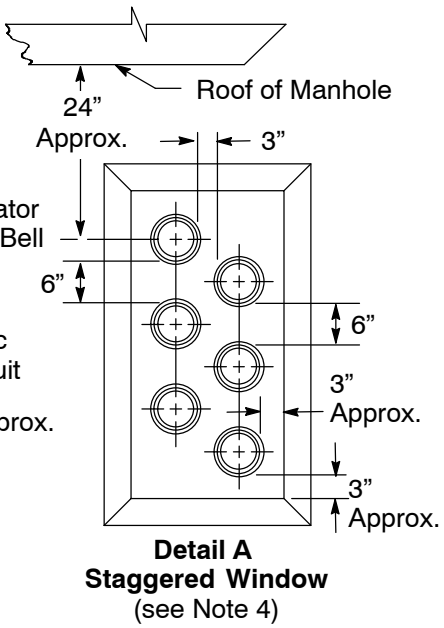
Figure 37
Sectional Elevation
Steep Grade



Section B-B



Section C-C
Conduit Window
(6-way conduit formation shown)



Detail A
Staggered Window
(see Note 4)

Conduit Configuration Tables

Notes

1. For conduit lines four-way and larger in fill areas or areas of known differential ground settlement, install #4 reinforcing bars in all four corners of the conduit envelope. Overlap bars 15 inches and install a minimum of 3 inches from the top or bottom and 1 inch from the side of the envelope.
2. Where the width of the trench is greater than the required width of the envelope, the horizontal spacing between conduits may be increased as long as 3-inch spacing between the conduit and the outside edge of the envelope is maintained.

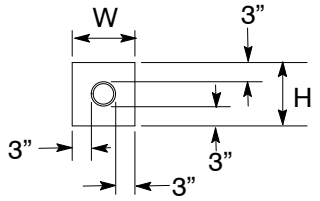


Figure 38
Single Conduit Configuration

Table 29 Dimensions for Single Conduit Configurations

Conduit		Envelope Dim.		Concrete Reqd. Cubic Yards per 100 ft. [1]
Description	Size	W	H	
Single	2”	8-1/2”	8-1/2”	1.9
	3”	9-1/2”	9-1/2”	2.3
	4”	10-1/2”	10-1/2”	2.8
	5”	11-1/2”	11-1/2”	3.1
	6”	12-1/2”	12-1/2”	3.4

[1] Quantities are approximate and include 10% added for variations encountered in construction.

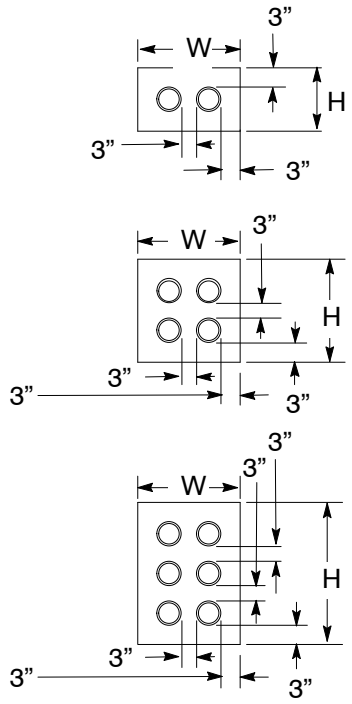


Figure 39
Two, Four, and Six-Way Conduit Configuration

Table 30 Dimensions for Multiple Conduit Configurations

Conduit		Envelope Dim.		Concrete Reqd. Cubic Yards per 100 ft. [1]
Description	Size	W	H	
2-way	3”	14-1/2”	9-1/2”	3.4
	4”	17”	10-1/2”	4.0
	5”	19”	11-1/2”	5.2
	6”	23-1/2”	12-1/2”	6.4
4-way	4”	17”	17”	6.2
	5”	19”	19”	8.2
	6”	23-1/2”	23-1/2”	11.7
6-way	4”	16-1/2”	24”	7.8
	5”	19”	27”	11.0
	6”	23-1/2”	30”	12.7
8-way	4”	17”	31”	9.7
	5”	19”	35”	13.8
	6”	23-1/2”	39”	15.1

[1] Quantities are approximate and include 10% added for variations encountered in construction.

Instructions for Sealing Conduit

Notes

1. Within minutes, polyurethane foam expands to form a water and gas barrier that can be easily removed in the future.
2. Consult the manufacturer's instructions included in each kit.

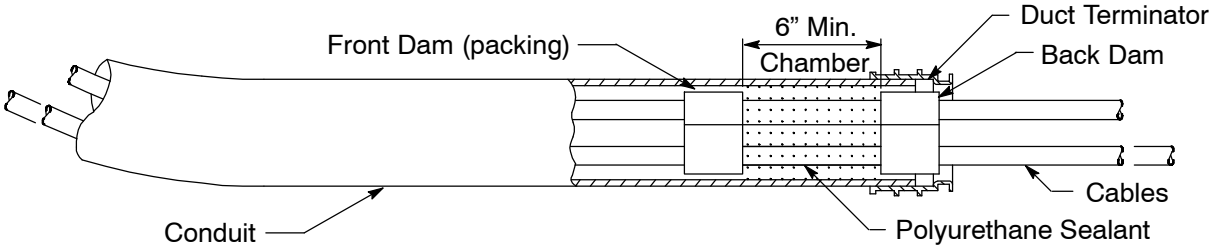


Figure 40
Details of a Polyurethane Seal

Step 1 Wipe off loose dirt and grime from cables.

Step 2 Install front dam (packing). Wind a strip of packing around each cable. Push the dam approximately 6 inches to 8 inches into the conduit. Install the back dam in the same manner as the front dam, and push it into the conduit until the dam is flush with the duct terminator.

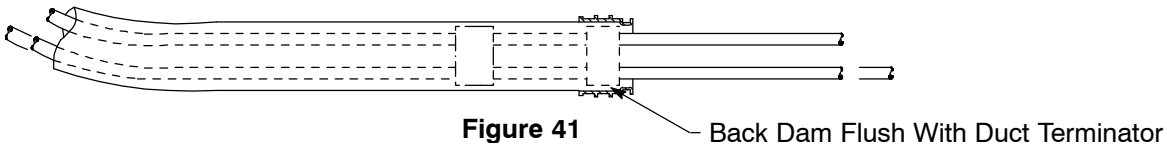


Figure 41

Step 3 Insert the nozzle into the chamber between the dams and inject polyurethane.

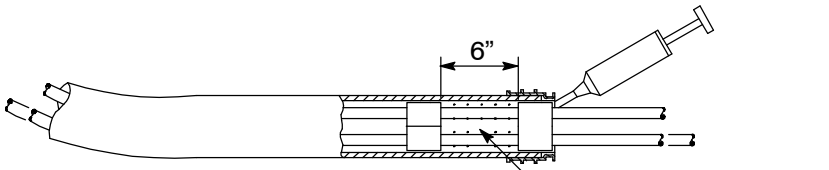


Figure 42

Table 31 Codes for Polyurethane Conduit Seal Kits

Conduit Size	Code	Manufacturer	Catalog Number
2" Through 6"	019178	Dura-Line (Arnco) Hydro Seal	S-60-C6P
	490813	Polywater	FST-250KIT-PGE

Instructions for Sealing Conduit (continued)

Termination Enclosure Riser Seal Method

Step 1 Place the residential riser seal on the cable and slowly push it into the mouth of the riser conduit. Turn the Allen screw until the neoprene gasket expands to form a tight seal.

Step 2 This riser seal is to be used to seal the riser conduit at the customer's service termination enclosure only. The top of the service riser is the preferred location. Belowground use is approved if an alternative to foam is needed.

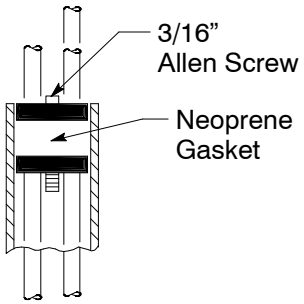


Figure 43
Termination Enclosure Riser Seal

Table 32 Codes for Termination Enclosure Riser Seals

Conduit Size	Cable Size	Code	Manufacturer and Catalog No. Environmental Solutions Cat.
2"	1/0 Triplex	019179	ESC – 103
	4/0 Triplex	019180	ESC – 403

Revision Notes

Revision 14 has the following changes:

1. Revised Note 19 on Page 2.
2. Revised Note 2 on Page17.
3. Revised table Footnote 1 for Table 19 and Table 20 on Page 10.
4. Added Table 23 on Page 15.
5. Revised Table 31 on Page 21.

PG&E Document #064309, Box-Pad for Pad-Mounted Transformers

Prepared by: EOB1

BOX-PAD FOR PAD-MOUNTED TRANSFORMERS 064309

Department: Electric T&D **Section:** T&D Engineering and Technical Support

Approved by: R. D. Kauzer (RDK6) Rich Kauzer **Date:** 10-28-05

Rev. #09: This document replaces PG&E Document 064309, Rev. #08. For a description of the changes, see Page 6.

This document is also included in the following manual:

- *Electric and Gas Service Requirements Manual* (Greenbook)

Purpose and Scope

This document shows the requirements for the box-pad used with single-phase Style DF (see Document 064307), duplex, and three-phase Style MTP (see Document 045290) transformers. This document applies to both radial and looped primary circuit arrangements.

Applicant Notes

1. Prior to setting a pad, the applicant will request an inspection by PG&E. PG&E shall determine the acceptability of each pad installation. The pad installation includes two ground rods and the interconnecting ground wire.
2. If required, the applicant shall provide suitable barriers for the protection of the transformer (refer to Document 051122).
3. The pads must be made by a PG&E-approved supplier. The approved suppliers are listed in Document 066211.

Fabrication Requirements

4. Box-pads are designed to fully encompass the transformer, including any radiators. Each pad shall hold the full kVA range of the indicated style. The pad dimensions are based on the allowed transformer dimensions shown in Document 064307.
5. The pads shall be permanently identified with manufacturer's name, month and year of fabrication, nominal weight, and PG&E code number in the area indicated in Figure 1 on Page 3.
6. The pads shall conform to Engineering Material Specification 21, "Box-Pad Style Transformer Pads".
7. The pads shall be designed to support transformers weighing 3,000 pounds.
8. Two 1/2"-13 UNC inserts for securing the transformer cabinet shall be provided as indicated. One 5/8"-11 UNC insert shall be provided at the center of gravity for lifting the pad.
9. The inserts shall be installed flush with the surface of the pad.
10. The edges shall be rounded. Refer to Engineering Material Specification 21, "Box-Pad Style Transformer Pads".
11. The corners may be rounded. Refer to Engineering Material Specification 21, "Box-Pad Style Transformer Pads".

Installation Requirements

12. The transformer pad shall be placed on a firm 10-inch rock base, on top of native or engineered fill material, which has been compacted to at least the requirements of Note 15 on Page 2.
13. The area under the pad shall be excavated to the required grade, or to a depth necessary to reach firm, undisturbed material, whichever is deeper. The material may be considered firm if it cannot be penetrated by thumb except with moderate effort.
14. If firm material has not been reached within a depth of 3 feet, excavate 3 feet beyond the perimeter of the pad, and backfill the entire excavated area to the required grade and to the requirements of Note 15 on Page 2.

15. In case it is necessary to excavate deeper than the required grade to reach firm material, backfill to the required grade in one of the following ways:
    A. Backfill with clean, non-expansive soil compacted to 90% of maximum density. The soil shall be placed in layers not more than 8 inches thick before compaction. Determine the maximum density and the in-place density by the California Test Method No. 216-6, Parts I and II respectively, or by ASTM D-1556 and D-1557 respectively. A copy of the test results may be required by PG&E.
    B. Backfill with soil or cement slurry consisting of one sack of Portland cement per cubic yard and clean native soil or sand.
16. In areas of known soft soil conditions, trenches within the pad excavation area for the installation of conduits shall be backfilled in one of the ways specified in Note 15.
17. In addition to the above requirements, the pads shall be placed on a 10-inch level rock base to provide uniform bearing.
18. A minimum distance of 6 feet shall be maintained between the ground rods.
19. In general, all equipment pads should be installed as level as practicable. Pads supporting oil-filled equipment must be leveled to within 1 inch in 8 feet in all directions.

Installation Procedure

Step 1. Excavate as required.

Step 2. Install the exterior ground rod and run the ground wire to the pad excavation.

Step 3. Place the primary conduit bends into the pad excavation.

Step 4. Place the secondary and the service conduit into the pad excavation.

Step 5. Compact and install the rock base. See "Installation Requirements", Notes 15, 16, and 17.

Step 6. The exposed ends of the conduit bends should be about 1 inch above the gravel base.

Step 7. Install end bell fittings.

Step 8. Temporarily cap or plug all the conduits.

Step 9. Route the ground wire through the pad opening.

Step 10. Place the box-pad and backfill to the appropriate level for the pad.

Step 11. Install the interior ground rod.

Table 1 Bill of Materials

Item	Quantity	Description	Code
1	1	Box-Pad, (as required – see Table 2 on Page 3)	–
2	As Reqd.	Wire, #2 AWG, Solid Bare Copper	290074
3	2	Ground Rod, 5/8" x 8'-0", Copperclad (see Document 013109)	187013
4	2	Clamp, Ground Rod, (see Document 013109)	187012
5	As Reqd.	Compacted Backfill	–
6	As Reqd.	Rock Base (compact 3/4" minus the rock base)	–

References **Document**

Corrosion Resistant Ground Rods and Ground Rod Clamps 013109
Engineering Material Specification No. 21, "Box-Pad Style Transformer Pads" EMS21
Engineering Material Specification No. 86, "Single-Phase and Three-Phase Pad-Mounted Distribution Transformers" EMS86
Location, Clearances, and Mechanical Protection Details for Pad-Mounted and Subsurface Equipment 051122
Loop-Style, Three-Phase, Pad-Mounted Transformers 045290
PG&E Approved Manufacturers 066211
Single-Phase, Dead-Front, and Duplex, Pad-Mounted Transformer 064307
Single-Phase, Dead-Front, and Duplex, Pad-Mounted Transformer Installations 064308

Box-Pad For Pad-Mounted Transformers

Box-pads

Table 2 Dimensions for Pad–Box

Transformer	Pad Code Number	Dimension in Inches						
		A	B	C	D	E	I	W
1-Wire, 2-Bushing Style DF-LB	360001	25	15	5.5	4	46	28	36
2-Wire, 4-Bushing Style DF-LB	360002	28	15	11	4	60	31	50
3-Wire, 6-Bushing Style DF-LB, Duplex and Style MTP	360003	37	15	6.5	4	60	40	50

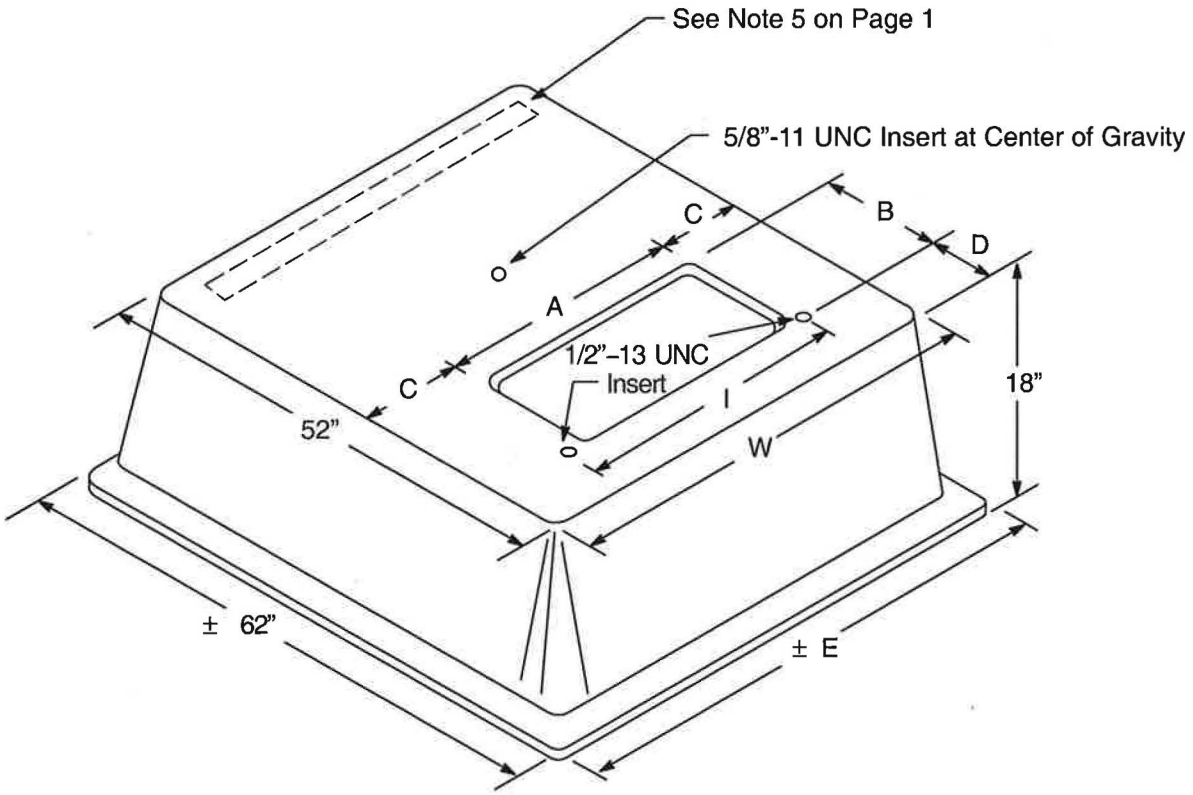


Figure 1
Box-Pad

Box-Pad For Pad-Mounted Transformers

Typical Box-Pad Installation

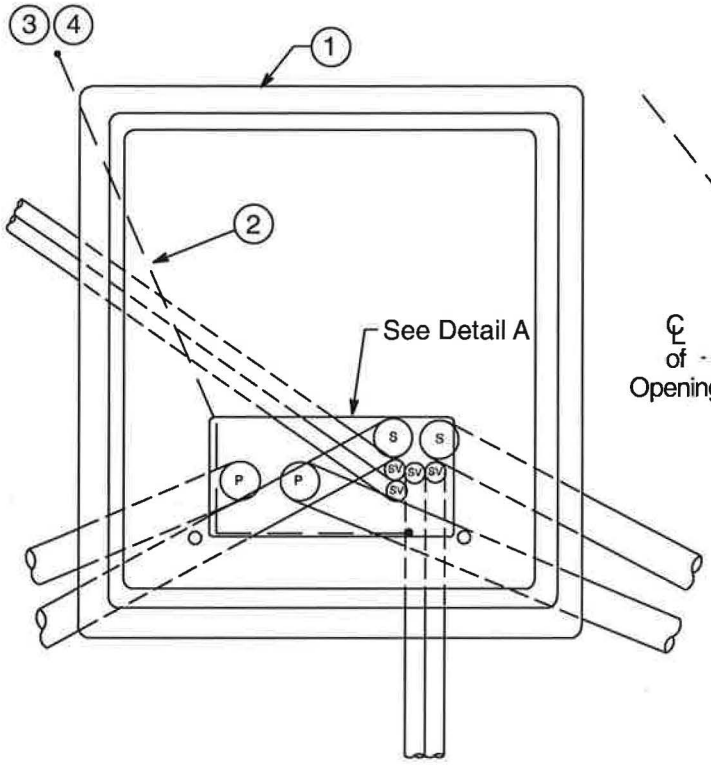
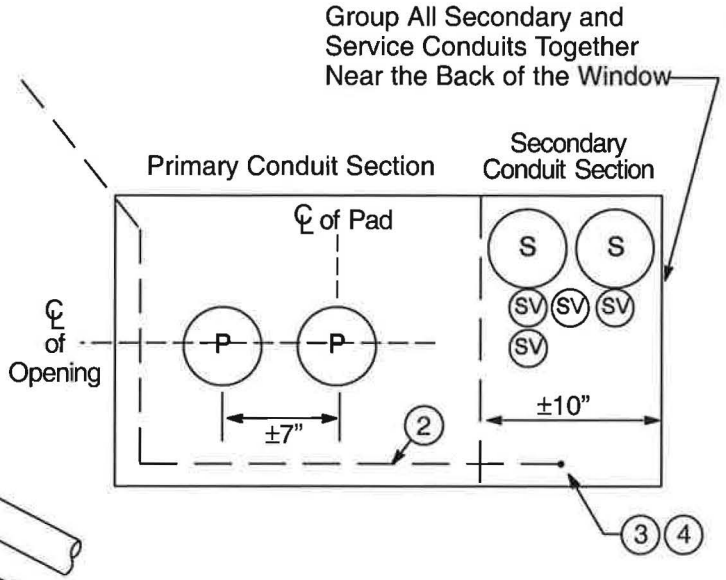
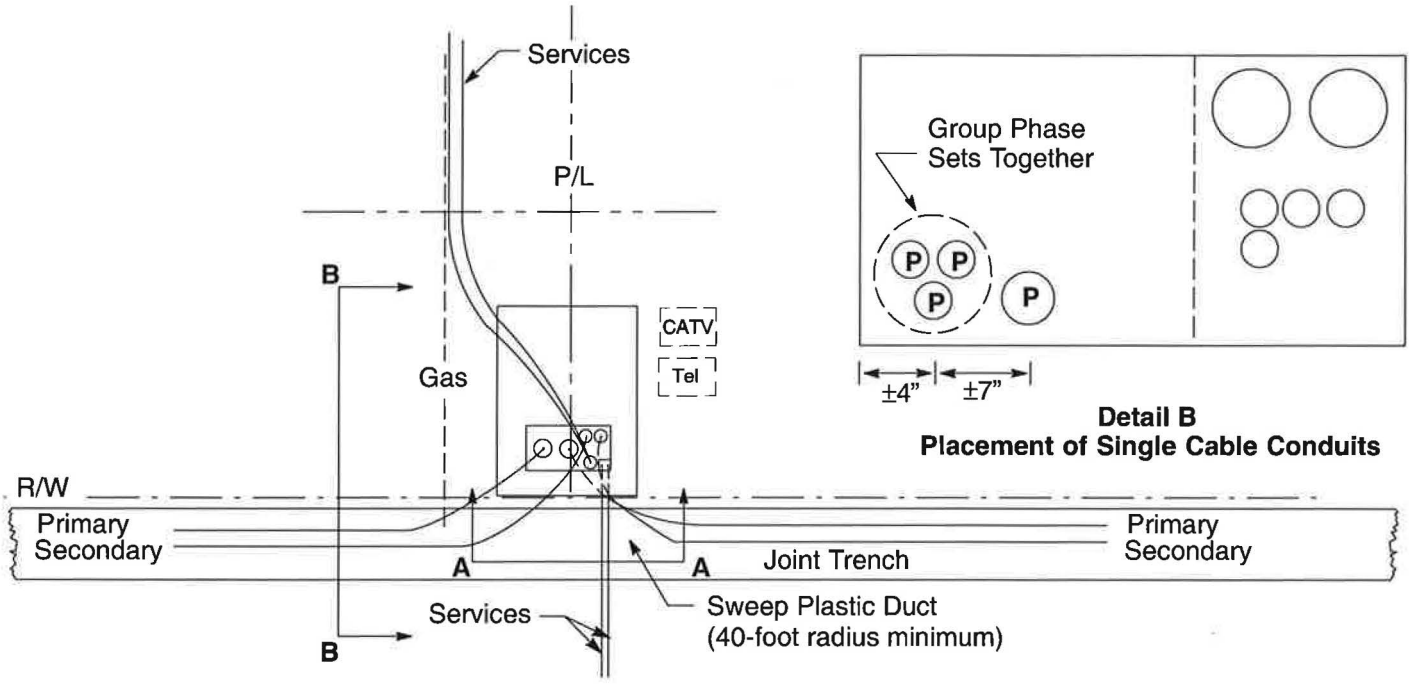


Figure 2
Pad Top View
(50" x 52" x 18" box-pad shown)



Detail A
Placement of Conduits

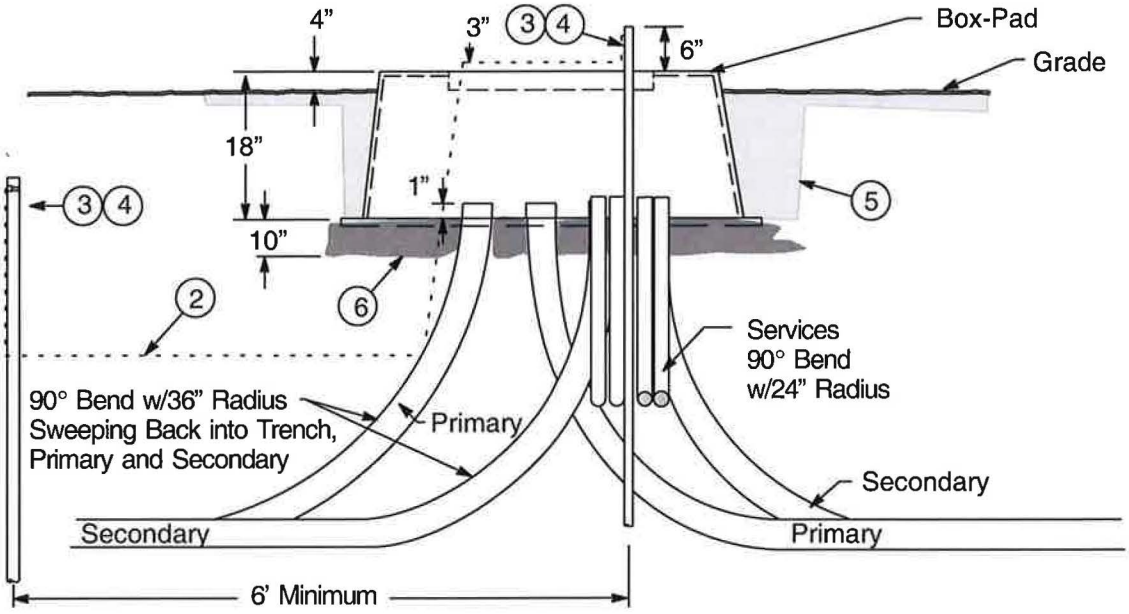


Detail B
Placement of Single Cable Conduits

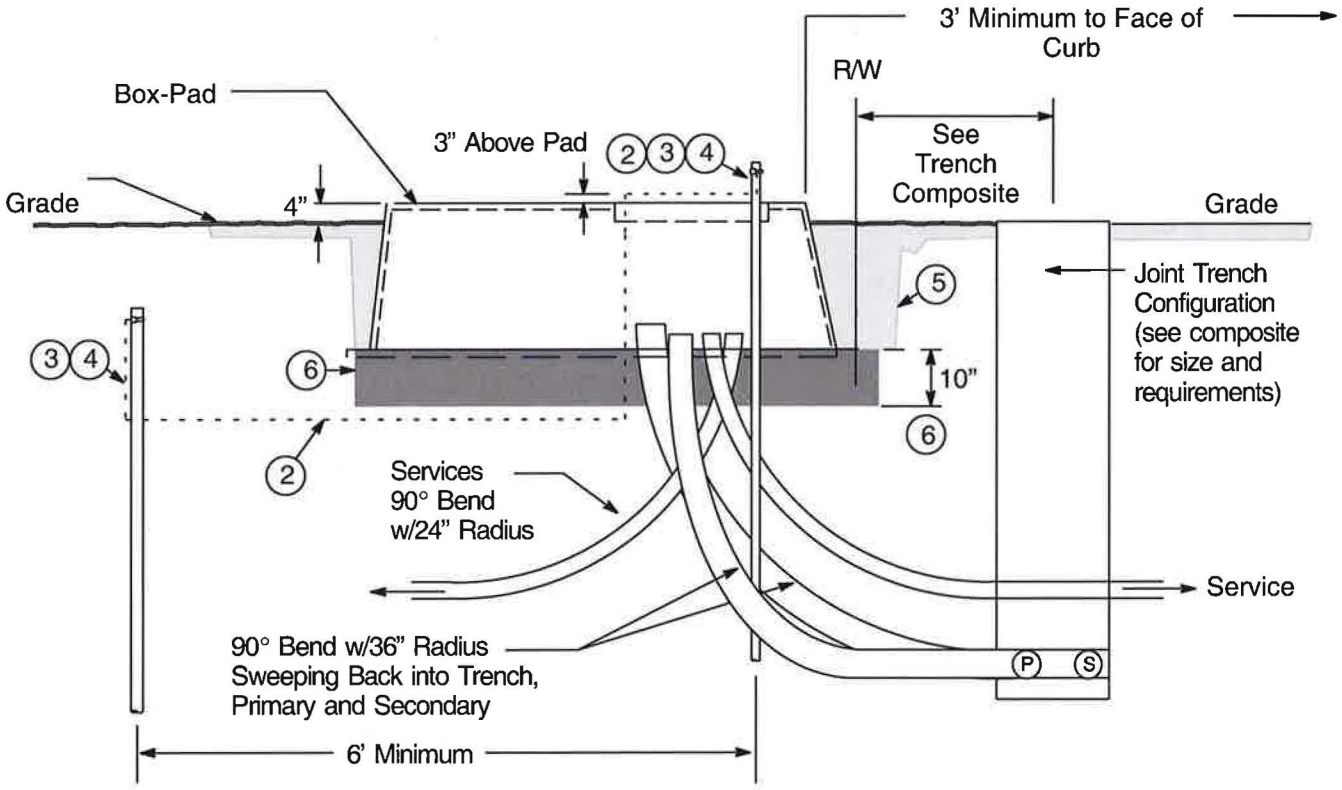
Figure 3
Facilities Plan View

Box-Pad For Pad-Mounted Transformers

Typical Box-Pad Installation (continued)



Section A-A
Pad Front View



Section B-B
Pad Side View

Box-Pad For Pad-Mounted Transformers

This document is also found in the *Electric and Gas Service Requirements Manual* (Greenbook). This document has been split. See Document 064309A in the "Transformers" section of the *For Reference Only Manual (FRO)* for its remainder.

Revision Notes

Revision 09 has the following changes:

1. Revised Step 6 on Page 2 in the "Installation Procedure" section.