FOR CONTRACT NO: **04-0A1854**

INFORMATION HANDOUT

MATERIALS

Foundation Report – Old Redwood Highway Overcrossing (Replace)
(Bridge No. 20-0291)
Dated September 19, 2011

Foundation Report – Retaining Walls 1 Through 7
Dated September 22, 2011

Storm Water Information Handout
Dated June, 2012

Non-Storm Water Information Package
Dated August, 2012

Hazardous Materials Site Investigation Report for U.S. 101/Old Redwood Highway Interchange Project
Dated April 17, 2012

"Ornamental Logo Concrete and Paint Coloring Required" Document

Hazardous Materials Report for U.S. 101/Old Redwood Highway Bridge
Dated April 17, 2012

Geotechnical Design Report and Materials Report
Dated March 19, 2012

PERMITS

Regional Water Quality Control Board Clean Water Act Section 401 Water Quality Certification
Dated February 29, 2012

U.S. Army Corps of Engineers Clean Water Act Section 404 Permit
Dated July 9, 2012

Foundation Report – Old Redwood Highway Overcrossing (Replace) (Bridge No. 20-0291) Dated September 19, 2011

04-SCL-101, PM7.4/8.1

EA#04-0A1854 (12276K)
SEPTEMBER 19, 2011

FOUNDATION REPORT

OLD REDWOOD HIGHWAY OVERCROSSING (REPLACE) (BRIDGE NO. 20-0291) PETALUMA, CALIFORNIA

Prepared for
City of Petaluma
Public Works
11 English Street
Petaluma, CA 94954

URS

100 West San Fernando Street, Suite 200
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Project No: 28645097

URS

September 19, 2011
Project 28645097

File No. 04-SON-101-PM 7.4/8.1
EA 04-0A1854 (12276K)

Ms. Susan Lackie
City of Petaluma
Public Works
11 English Street
Petaluma, California 94954

Subject: Foundation Report
Old Redwood Highway Overcrossing (Replace)
Caltrans Bridge No. 20-0291
Petaluma, California

Dear Ms. Lackie:

URS has completed the accompanying Foundation Report for the Old Redwood Highway Overcrossing (Replace) in Petaluma, California. The report was prepared in accordance with Caltrans Guidelines for Foundation Investigation Reports, Version 2.0, dated December 2009.

The Foundation Report presents our engineering opinions and recommendations regarding the geotechnical factors influencing the design and construction of the proposed bridge replacement. The opinions and recommendations have been based upon the results of our field investigation, laboratory testing, engineering judgment and local experience. Mr. Madhu Thummuluru, P.E., performed engineering calculations and assisted with the preparation of this report. Mr. Mark Schmoll, C.E.G, prepared the site geology and geologic hazards portion of this report. Mr. Michael Larson, G.E., provided review, consultation and guidelines for the project.

If any questions should arise, or if we can be of further service, please contact the undersigned at (408) 297-9585.

Sincerely,

Stephen Huang, G.E. 2150
Geotechnical Task Leader

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1.1 GENERAL

The City of Petaluma (City), located in Sonoma County within District 04 of the State of California Department of Transportation (Caltrans), proposes to reconstruct the Old Redwood Highway Interchange at U.S.101 Post Mile (PM) 7.65; it is approximately 4 miles north of the Petaluma River. The key component of the improvement is to replace the existing overcrossing (OC) structure to meet current design standards and current and future traffic requirements. The subject of this Foundation Report (FR) is the replacement of Old Redwood Highway OC (Bridge No. 20-0291) at PM 7.65 located in City of Petaluma, California. Figure 1-1 presents the location of the OC structure.

The proposed OC structure will accommodate six lanes of traffic and will include bicycle lanes and pedestrian sidewalks on both sides. The U.S.101/Old Redwood Highway interchange ramps will be reconfigured and widened accordingly. Other improvements include traffic operations system improvements and enhanced signalization improvements at the adjacent intersections. The project will accommodate the proposed Sonoma County Transportation Authority (SCTA) U.S.101 Central HOV lanes Project, which widens U.S.101 within the limits of the Old Redwood Highway Interchange Project.

The interchange will be reconstructed with a modified par-clo configuration. Existing ramps will be realigned and widened to accommodate storage for queuing vehicles.

The proposed design option includes the following:

- New OC where Old Redwood Highway crosses U.S.101.
- Traffic signals will be installed at ramp termini.
- Off-ramps will provide two left-turn lanes and two right turn lanes.
- Ramp metering facilities including HOV bypass lanes and CHP enforcement areas will be provided at on-ramps.
- Old Redwood Highway will be widened to accommodate two 12-foot wide through lanes, raised median, 6-foot wide shoulders, and 6-foot wide side walks in each direction between Stony Point Road and North McDowell Boulevard. Additional widening will be provided locally to accommodate turn lanes.
- A 6-foot wide landscape buffer will be provided between the sidewalk and travel lane where right of way is available.
- A new right-turn lane from eastbound Old Redwood Highway to east bound southbound North McDowell Boulevard will be added.
- Retaining walls will be constructed to maintain interchange improvement within existing right of way, where feasible.
- Adjoining driveways will be reconstructed to match proposed grades.

One soundwall is planned along a portion of the off-ramp from southbound U.S. 101 to Old Redwood Highway. It is continuation of the soundwall constructed as part of the U.S. 101 Central HOV Lanes Project (Segment B). Seven retaining walls are planned at the following locations:

Table 1-1: Retaining Wall Summary

Wall No.	Control Line	Station Reference		Length of Wall (feet)	Design Height (feet)
		From	To		
RW#1	"OSN"	86+84.95	90+12.22	325	10 – 12.5
RW#2	"OSN"	88+01.48	91+60.17	360	10 – 20
RW#3	"OSF"	61+53.71	64+39.15	360	10 – 17.5
RW#4	"ONN"	43+22.32	45+94.60	270	10 – 12.5
RW#5	"ONN"	43+22.32	44+96.84	175	10 – 12.5
RW#6	"ONF"	40+02.72	43+00.06	375	12.5 – 15
RW#7	"ORH"	17+58.46	19+02.17	145	12.5 – 20

1.2 SCOPE OF INVESTIGATION

The geotechnical services performed for the Old Redwood Highway OC (Replace) were as follows:

- Review existing subsurface information and as-built plans
- Geotechnical field investigation including three exploratory borings (A-09-004, A-09-005 and R-09-001) and one cone penetration test (CPT-09-003)
- Laboratory testing to estimate pertinent engineering properties
- Design recommendations and opinions were developed for the following topics:
  - Pile foundation design recommendations
    - Vertical capacity
    - Tip elevations
  - Resistance to lateral loads
  - Pile foundation and approach fill settlement
  - 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
    - Installation of pile foundations, as applicable

A review related to environmental and hazardous waste issues and the results of the associated technical evaluations are presented in a separate report entitled, "Site Investigation Report."

1.3 CALTRANS REVIEW COMMENTS

URS received comments prepared by Caltrans for a previous version of the Old Redwood Highway Overcrossing (Replace) Foundation Report (65% submittal) that was dated September 10, 2010. Our responses to those comments were incorporated into an updated Foundation Report dated May 13, 2011. For the May 13, 2011 Foundation Report, Caltrans Geotechnical Services issued a C1 approval (see review comment sheet in Appendix J). Since the submittal of the May 13, 2011 Foundation Report, the design team continued to optimize the structural design that necessitated minor modifications of the foundation system. This updated Foundation Report incorporates these modifications. Copies of the review comments and our responses are presented in Appendix J.

2.1 PROJECT DESCRIPTION

The official name of the existing structure is Denman OC, but Old Redwood Highway OC will be the name of the new structure. The proposed project will replace the existing Denman OC in Petaluma to meet current design standards and current and future traffic requirements. The proposed OC structure consists of a state-constructed structure that will accommodate six lanes of traffic, bicycle lanes, and pedestrian sidewalks.

The replacement OC structure will be a two-span cast-in-place prestressed concrete box girder on reinforced concrete columns. The planned substructure type is a seat-type abutment due to its height and desirable seismic characteristics. It is approximately 262 feet long and 86 feet wide. Planned finished grade of bridge profile will be about 25 feet above U.S.101; this will necessitate about 5 feet of additional fill above the existing Denman OC approach embankment; sliver fills ranging to about 22 feet thick are currently planned to widen the highway. The profile, elevation, and typical section for planned improvements at the replacement overcrossing structure are shown on Figures 2-1 and 2-2. The Foundation Plan is shown on Figure 2-3. A sound wall and seven retaining walls are currently planned to maintain the interchange improvement within existing right or way.

The bridge is to begin at 'ORH' Line Station 21+42.52 and end at 'ORH' Line Station 24+04.27 and have deck elevation ranging from 60.53 to 61.67 feet. Class 200 precast prestressed (PCPS) piles are currently proposed to support new bridge foundation elements at both abutments and center piers. Class 90 PCPS piles are currently proposed to support the abutment wingwalls (WW). Pile caps are planned as follows:

Location	Bottom of Pile Cap Elevation (ft)
Abutment 1	40.0
Bent 2	30.0
Abutment 3	39.5
Abutment 1 Lt WW	53.2
Abutment 1 Rt WW	51.9
Abutment 3 Lt WW	53.4
Abutment 3 Rt WW	54.3

Embankment slopes of 2:1 (horizontal:vertical) are currently planned along the highway embankment except the northeastern embankment will have a flatter slope of 4:1.

3.1 GEOLOGIC SETTING

3.1.1 Regional Geology

The Old Redwood Highway OC project is located in the Coast Range physiographic province, near the southern end of the Coast Range Thrust. The Coast Range province is characterized by north to northwest trending elongated mountain ranges and intervening valleys. This physiography reflects the influence of the San Andreas fault system, a domain of north-northwest oriented right-lateral strike-slip faulting that accommodates the majority of the plate motion between the Pacific and North American plates. In addition to the right-lateral strike-slip deformation, a component of convergence oriented normal to the plate boundary is accommodated by a series of folds and thrust faults, including the faults of the Coast Range-Sierran Block Boundary zone, oriented sub-parallel to the faults of the San Andreas system.

Late Cenozoic (last 30 million years) deformation associated with the transpressional plate boundary is reflected in the Coast Range geology, which typically consists of intensely folded and faulted Upper Jurassic (150 million years old) and younger rocks of the Franciscan Complex, a complex assemblage of metamorphosed oceanic crustal rocks and marine sediments. In the Neogene, compressional basins of deposition, *en echelon* folds, northwest-trending strike-slip faults, and lesser east-west-trending thrust faults that dip both east and west were formed. The region is now characterized by elongate topographic regions comprising fault-bounded slivers of different rock types. The majority of the reverse faults now appear to be either inactive or significantly less active than the northwest-striking, strike-slip faults of the San Andreas system, which offset them.

Information regarding the actual depth of the bedrock at the site is not available. Based on published information on geology of the site, the bedrock consists of rocks of the Pliocene age (1 to 13 million years old) Sonoma Volcanics and older marine siltstones, sandstones, and conglomerates of the Petaluma formation.

3.1.2 Site Geology

The geology at the Old Redwood Highway OC project site has been mapped by Fox *et al.* (1973) and reproduced in this report as Figure 3-1. The Quaternary (recent to 2 million years old) deposits in the project area include interfluvial marshlike basin sediments and alluvial fan deposits. These overlie Tertiary units including marine deposits of the Petaluma formation and Sonoma Volcanics.

The Pliocene age Sonoma Volcanics are characterized by ryolitic, basaltic and andesitic flows overlying tuff and agglomerate, though only andesitic and basaltic lava flows outcrop in the study area (Fox *et al*, 1973).

The Petaluma formation consists primarily of claystone and siltstone with thick lenses of sandstone and pebble conglomerate. Layers of tuff or tuffaceous siltstone and lenses of diatomite occur as interbeds. The diatomite is known to contain fresh-water and brackish-water mollusks as well as rare mammalian remains. The siliceous shale deposits are originally derived from the Franciscan assemblage as well as detritus from the Sonoma volcanics (Fox *et al*, 1973).

The sediments beneath the Old Redwood Highway OC are younger Quarternary alluvial fan deposits grading headward to terrace deposits (Qyf). The unit consists of moderately sorted fine sands and silts with gravel becoming more abundant toward fan heads (Fox *et a l.*, 1973).

3.2 SITE AND SUBSURFACE CONDITIONS

3.2.1 Site Topography

Construction of the overcrossing, on-ramps, and off-ramps require the placement of fill embankments at the project site. Current elevations along the proposed improvements in the vicinity of Old Redwood Highway range from about 35 feet at the embankment toe to about 54 feet on the bridge deck.

3.2.2 Field Exploration

The subsurface investigation for design of the existing bridge was performed in June 1952. At that time, subsurface information was obtained from one rotary wash boring (B-3) and three penetration borings (B-1, B-2 and B-4). The approximate locations of these borings are shown on the Site and Boring Location Plan, Figure 3-2.

To supplement available data, URS drilled two hollow-stem auger borings (A-09-004 and A-09-005), one rotary wash boring (R-09-001), and advanced one CPT (CPT-09-003). Borings A-09-004 and A-09-005 were drilled on the embankment to termination depths of 30 and 26½, respectively; R-09-001 was drilled to a depth of 95 feet and CPT-09-003 was advanced to a depth of approximately 96½ feet. The field exploration was performed on October 26, November 3 and 5, 2009. A detailed discussion of the field exploration program is presented in Appendix A. The locations of the explorations are shown on Figure 3-2. The Log of Test Borings (LOTBs) presented in Appendix B, provide descriptions of the soils encountered.

A representative of URS observed 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 and labeled immediately to preserve their natural moisture content. At completion of the exploration, samples were delivered to the laboratory for further examination and testing. The CPT and borings were then backfilled with a mixture of cement and bentonite in accordance with the requirements of the Sonoma County Health Department.

The Unified Soil Classification System, as well as guidelines summarizing soil consistency and relative density, are presented on the LOTB legend. The logging method is consistent with guidelines presented in Caltrans Soil & Rock Logging, Classification, and Presentation Manual, dated June 2007. The LOTBs also illustrate the notation used for the size of samplers and the methods of advancing them.

3.2.3 Laboratory Testing

The water content, dry density, Plasticity Index (PI), grain size distribution, 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 locations on the LOTBs. The results of sieve analysis and PI tests are graphically shown in Appendix A. Table A-1 also provides a summary of the laboratory test results.

3.2.4 Soil Conditions

Boring B-3 from 1952 investigation revealed stiff clay in the upper 9 feet underlain by a 5-foot thick layer of very dense sand and gravel. Below the sand and gravel deposits, soft sandy clay (about 5 feet thick) was found overlying stiff to very stiff, blue silt and silty clay that extended to approximately 45 feet in depth. Very dense sand and gravel deposits extended to about 60 feet, the terminal depth of the boring.

The embankment fills encountered in the explorations made for the current investigation can generally be classified as stiff to very stiff lean clay to sandy lean clay with gravel and medium dense clayey gravel. The fills are generally underlain by alluvial soils consisting of 9 feet of medium stiff to very stiff dark gray fat clay underlain by medium stiff to very stiff lean clay with sand interbeds to a depth of 49 feet. The sand interbeds are generally medium dense to dense and typically range from 1 to 4 feet thick. Below these clay deposits dense to very dense sand, silty and clayey sand were encountered to a depth of 96.5 feet, the maximum depth of exploration. The native soils encountered in the CPT can generally be characterized as sandy silt and clayey silt, sand and silty sand with similar thicknesses and elevations as those encountered in Boring R-09-001. Based on A-09-004, A-09-005, R-09-001 and CPT-09-003, the generalized soil profile is presented in Figure 3-3.

3.2.5 Groundwater

Groundwater was encountered at Elevation 24.5 feet, 25.1 feet and 25.5 feet (based on NGVD 1929 datum) in 1952 investigation Borings B-2, B-3 and B-4, respectively. Depth to groundwater ranged from 7 to 8.5 feet below ground surface. However, there was no indication of groundwater encountered or measured in B-1.

Free groundwater was encountered in Boring A-09-004 at approximately Elevation 25.5 feet. No groundwater was encountered in Boring A-09-005 to a terminal depth of 26.5 feet. A pore pressure dissipation record was compiled in CPT-09-003, to approximate the groundwater level. This record, included in Appendix A, suggests a groundwater depth of approximately 9.3 feet (Elevation 27.7 feet). Boring R-09-001 was drilled using rotary wash method starting at ground surface, thereby precluding a groundwater level measurement. Groundwater was reportedly encountered at Elevations 17 feet to 23.5 feet in borings drilled for the retaining walls.

Groundwater was measured as high as Elevation 32.7 feet in a monitoring well located in the 7-Eleven parking lot at 5200 Old Redwood Highway. We believe it is reasonable to assume a design groundwater level at Elevation 32 feet.

3.3 GEOLOGIC HAZARDS

3.3.1 Geologic Resources

Resources consulted for geologic hazard assessments included:

- Geologic maps of the California Geological Survey (CGS, formerly California Division of Mines and Geology).
- Alquist-Priolo Earthquake Fault Zone maps.
- California Geological Survey, Guidelines for Evaluation and Mitigating Seismic Hazards in California, Special Bulletin 117, updated version May 28, 2002.
- Knudsen, K.L., Sowers, J.M., Witter, R.C., Wentworth, C.M. and Helley, E.J., 2000, Preliminary maps of Quaternary deposits and liquefaction susceptibility, nine-county San Francisco Bay region: A digital database, U.S. Geological Survey, Open-File Report 00-444, 60 p.
- Preliminary Geologic Map of Eastern Sonoma County and Western Napa County, CA, U.S. Geological Survey, Miscellaneous Field Studies Map, MF-483, 4 plates.
- Shantz, T., Merriam, M., 2009, Caltrans Deterministic PGA Map, California Department of Transportation.
- Index to detailed maps of landslides in the San Francisco Bay region, California**,** U.S. Geological Survey, Open-File Report 97-745-D, 20 p.

3.3.2 Fault-Related Ground Rupture

Surface fault rupture tends to recur along existing fault traces. The highest potential for surface faulting is along existing fault traces that have had Holocene fault displacement. The California Geological Survey (formerly Division of Mines and Geology) has produced maps showing Alquist-Priolo Earthquake Fault Zones along faults with known Holocene activity that pose a potential surface faulting hazard. There are no Alquist-Priolo zones mapped in the vicinity of the project site. The closest active fault to the site is the Rodgers Creek fault, approximately 5 miles to the east. The San Andreas fault is located approximately 14 miles to the west. The potential for surface fault rupture at the site is considered remote.

3.3.3 Landslide and Slope Failure

Based on the relatively flat topography at the site, landsliding is not considered a hazard at the Old Redwood Highway OC.

3.3.4 Scour

The closest waterway is located more than 2,000 feet away from the proposed structure. Therefore, scour at this site is not a concern.

3.3.5 Flooding

The Federal Emergency Management Agency (FEMA) Flood Insurance Study for the City of Petaluma documents a history of flooding events in the project area. FEMA floodplain maps indicate that there are three floodplain zones in the project limits associated with Willow Brook Creek that cross the project limits and Petaluma River, which is adjacent to the project. The floodplains are designated as Flood Hazard Areas in Zones AE, AO, and X. The flood plains delineated on these maps represent the base floodplains. The base flood is a flood that has a 1 percent chance of being equaled or exceeded in any given year, and the area inundated by the base flood is the base floodplain. The FEMA Flood Insurance Rate Map is included as Figure 3-4.

We understand the City of Petaluma is awaiting final FEMA approval of revisions to the floodplain limits. According to the new study, floodplain delineation within the project limits is now designated as Flood Hazard Area Zone AE. Based on the new study, the 24-hour 100-yr storm event would not overtop U.S. 101. Other details are provided in the project hydraulic report. The executive summary section of hydraulic report by WRECO, dated January 2010 is presented in Appendix C.

3.3.6 Subsidence and Seismic Compaction

Subsidence typically occurs as a result of subsurface fluid extraction (e.g. groundwater, petroleum) or compression of soft, geologically young sediments. Groundwater extraction for high volume municipal and agricultural use has the potential to cause future ground subsidence in the region. However, we are not aware of subsidence in the area.

Compaction settlement, or seismic densification, occurs when loose granular soils above the groundwater table increase in density as a result of earthquake shaking. This soil densification can result in differential settlement because of variations in soil composition, thickness, and initial density. For design, we estimated the potential post-earthquake settlement at A-09-004 and A-09-005, using the computer program LIQUEFY PRO. In our analyses, we used a peak ground acceleration (PGA) of 0.54g and design earthquake moment magnitude (Mw) of 7.1. At Boring A-09-004, the soils above groundwater table are primarily lean clay and fat clay. At Boring A-09-005, the soils above groundwater table are primarily lean clay, fat clay and clayey gravel. Based on the results of the analysis, we expect seismic compaction settlement at the abutments and bent will be negligible.

3.3.7 Liquefaction Potential

Soil liquefaction is a phenomenon in which saturated cohesionless soils are subject to a temporary but essentially total loss of shear strength under the reversing, cyclic shear stresses associated with earthquake shaking. In extreme cases, the soil particles can be suspended in groundwater, resulting in the deposit becoming mobile and fluid-like. Three conditions are generally required for liquefaction to occur: 1) a cohesionless soil of loose to medium dense relative density; 2) a saturated condition; and 3) rapid, large strain cyclic loading normally induced by earthquake ground shaking. Liquefaction can result in loss of foundation bearing

capacity, differential settlements, and lateral spreading. Traditionally, a depth of 50 feet has been used as the depth of analysis for the evaluation of liquefaction.

Based on a liquefaction susceptibility map generated from the Association of Bay Area Governments (ABAG) geographic information systems (GIS) and reproduced in this report as Figure 3-5 (primarily based on Knudsen, et al., 2000 data, and Witter & others, 2006), the project alignment at Old Redwood Highway OC is mapped as an area of "moderate" liquefaction susceptibility.

Potentially liquefiable sands were encountered in recent Boring R-09-001 at depths of approximately 9, 16, and 45 feet; potentially liquefiable sands and silts were identified in CPT-09-003 at depths of approximately 15, 19.5, 22, 35.5 and 47 feet. These deposits range in thickness from 1 foot to 7 feet. Post-liquefaction ground surface settlement has been estimated based on the conditions revealed in the boring and CPT. The results are summarized in the following Table 3-1.

Table 3-1: Estimated Post Liquefaction Ground Surface Settlement (GSS) at Old Redwood Highway OC Bridge

Boring / CPT Number	Depth to Top of Layer (feet)	Layer Thickness (feet)	Estimated Ground Surface Settlement (inch)
R-09-001	9	2	< ½
	16	4	> ½
	45	1.5	¼
CPT-09-003	15	2	< ½
	19.5	1	¼
	22	7	1½
	35.5	2.5	½
	47	3	1

The total ground surface settlement (GSS) is estimated to be about 1¼ inches at R-09-001 and 3¾ inches at CPT-09-003. Since GSS exceeds ½ inch, downdrag on the PCPS piles is a design concern at these locations.

We estimated post-liquefaction settlement at CPT-09-003 using the computer program LIQUEFY PRO for a peak ground acceleration (PGA) of 0.54g and design earthquake moment magnitude, Mw, of 7.1. In addition, we analyzed post-liquefaction settlement of the medium dense sand layers encountered in Boring R-09-001 for the same PGA and design earthquake, correcting the measured driving resistance (blow counts) in the field for hammer type, sampler size, overburden pressure, rod length, and fines content. Copies of these calculations are included in Appendix D. Based on the depth and extent of these deposits, the likely consequence of liquefaction will be settlement; lateral spreading or other types of slope instability are unlikely.

3.4 GEOLOGICAL PROFILES AND ENGINEERING PARAMETERS

The LOTBs presented in Appendix B include borings from previous investigations and current field information and laboratory testing from our exploratory borings at the proposed foundation support locations. Geotechnical engineering soil parameters were selected, based on laboratory test results as well as engineering judgment and experience.

The undrained shear strength, internal friction angle (for granular soil), relative density, dry unit weight and moisture content are the geotechnical soil parameters used in our foundation design and analysis. Atterberg limits tests 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 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 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 inches outside diameter), a correction factor was applied to the observed blows per foot to estimate the Standard Penetration Resistance.

A generalized soil profile is presented in Figure 3-3 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 data from the borings drilled for this investigation and previous explorations by others.

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, and summarized below.

4.2 SUMMARY

V&A was retained by URS Corporation to perform a corrosivity investigation within the project limits with regards to overcrossing structure. The objective of this investigation was to measure various soil parameters and evaluate the results with respect to possible levels of corrosion at the proposed bridge site. Corrosivity was determined for materials of the project structure, if any, to depths ranging from 0 to 100 feet below grade.

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, and CALTRANS Memo to Designers 3-1, July 2008 (Memo). The Guidelines consider soil to be corrosive to structural elements (steel reinforced concrete) if one or more of the following conditions exist for water or soil samples:

1) The chloride concentration is 500 ppm (mg/kg) or greater,
2) The sulfate concentration is 2,000 mg/kg or greater, or
3) The pH is 5.5 or less.

A wide variety of soluble salts are 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. The 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 measure of corrosivity. The lower the pH (the more acidic the environment), the higher will be the corrosivity with respect to buried metallic and concrete structures. As pH increases above 7 (the neutral value), conditions become increasingly more alkaline and passive to buried structures.

Evaluation of the in-situ soil environment was made in terms of potential damage to structures due to corrosion. Soil resistivity measurements were conducted in the field during the initial stages of the work. In addition, soil samples collected by URS during the geotechnical investigation were forwarded to Cooper Testing Laboratory in Palo Alto, California for chemical analysis. The soil samples were analyzed for minimum resistivity, pH, water soluble chloride ion concentration, and water soluble sulfate ion concentration in accordance with the Guidelines.

The soil sample was selected from the Borings R-09-001, A-09-005, and A-09-111 at the general vicinity of Old Redwood Highway Overcrossing. The results are summarized in the following table.

Table 4-1: Soil Corrosion Test Results Summary

Sample ID	Minimum Resistivity (ohm-cm)	pH	Chloride Content (mg/kg)*	Sulfate Content (mg/kg)*
R-09-001	2,312	7.3	69	<5
A-09-005	3,934	7.8	19	<5
A-09-011	508	8.0	59	98

As shown above, the minimum (saturated) resistivity of soil sample measured 2,312, 3,934 and 508 ohm-cm, respectively. The soil pH measured 7.3, 7.8 and 8.0, while the water-soluble chloride concentrations measured 69, 19, and 59 mg/kg. The water-soluble sulfate concentrations range from less than 5 to 98 mg/kg. The pH, chloride and sulfate ion concentrations indicate the sampled soils are *non-corrosive*, as defined by the Corrosion Guidelines.

4.3 CONCLUSIONS

The minimum soil resistivity measured at Boring A-09-111 was 508 ohm-cm. According to both the Guidelines and Memo, a site is considered corrosive if the soil has a minimum resistivity of 1,000 ohm-cm or less and either contains a chloride concentration of 500 ppm or greater, or a sulfate concentration of 2,000 ppm or greater. All 3 soil samples chemical analysis gave pH values greater 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 tested at all 3 locations can be considered *non-corrosive* to concrete structures and piles. The OC structure site is not within 1,000 feet of salt or brackish water.

4.4 RECOMMENDATIONS

4.4.1 Buried Reinforced Concrete Structures and PCPS Piles

Buried concrete structures and PCPS 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. They should have a pH in the range of 6.5 to 8.0. Potable water should be used in concrete mixtures.

5.1 SEISMIC DESIGN METHODOLOGY AND RESOURCES

The seismic design methodology adopted for this project is based on the following current Caltrans standards:

1. Caltrans ARS Online, 2009
2. Seismic Design Criteria (SDC), v 1.5, August 2009
3. Guidelines for Foundation Investigations and Reports, v 2.0, dated December 2009
4. 2007 Caltrans Deterministic PGA Map

5.2 PEAK BEDROCK ACCELERATION

The closest active fault to this section of U.S. 101 is a portion of the Rodgers Creek fault (RCF). This fault is designated with a Maximum Moment Magnitude (MMax) moment magnitude of 7.1 in the Caltrans 2007 fault database. The location of this fault is obtained from the 2007 Caltrans Deterministic PGA Map. The horizontal distance from the site to the Rodgers Creek fault is about 5 miles, with a corresponding PGA [V_s=2,500 feet per second (fps)] contour of 0.4g based on the 2007 California Deterministic PGA Map and 0.45g based on work by others (Sadigh, et al, 1997).

Table 5-1: Seismic Source Parameters

Fault	Type	M_{Max}	Distance (miles)	Near Field Effects?	Design PGA for V_S=2,500 feet/sec (g)
Rodgers Creek	strike-slip	7.1	4.9	Y	0.4
San Andreas	strike-slip	7.9	13.9	N	0.4

The distances are based on Caltrans ARS Online (2009).

5.3 FAULT TYPE, NEAR-FIELD, AND SPECTRAL ACCELERATION INCREASES

The 2007 fault database that accompanies the 2007 Caltrans Deterministic PGA Map indicates that 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, since the project site is located less than 9.3 miles (15 km) from the nearest active fault, the design spectral accelerations should be modified to account for near-field effects as shown in Table 5-2:

Table 5-2 - Increase in Spectral Acceleration from near Field Effects

Period (sec)	Increase in Spectral Acceleration (%)
< 0.5	0
0.5 – 1.0	0 – 20 (determined by linear interpolation)
≥1	20

At the time of this study, no structure with fundamental period of vibration greater than 1.5 seconds are anticipated, and therefore no adjustments are required for long period effects.

5.4 SOIL PROFILE TYPE AND DEPTH TO ROCK-LIKE MATERIALS

Borings drilled by others and 2009 borings reveal that the soils at the site consist of fine and coarse-grained alluvial soils that become denser and stiffer with depth. A seismic CPT (CPT-09-114) was performed 500 feet to the northeast of the proposed OC structure with the intent of measuring the shear wave velocity and was advanced to a depth of 100 feet. Shear wave velocity was measured at 5 feet intervals starting at 10 feet bgs with values ranging from 650 to 1268 feet per second (fps). Based on material types and shear wave velocity measurements, this project site can be classified as a stiff soil site or Soil Profile Type D pursuant to the guidelines give in Figure 12 in the SDC.

Based on the material types and shear wave velocity measurements, we estimated the average shear wave velocity (V_s) to be about 282 meters per second (m/s) or 925 fps. This V_s value was input for the Caltrans ARS Online. It should be noted the V_s = 925 fps falls within the soil profile Type D V_s range of 600 to 1,200 fps.

5.5 DESIGN ACCELERATON RESPONSE SPECTRA

The design response spectrum for the site is estimated with spectral acceleration values generated using Caltrans ARS Online (2009). This method was developed by Caltrans Geo Research Group in partnership with United States Geological Survey (USGS), Pacific Earthquake Engineering Research (PEER) and California Department of Conservation. This web-based tool calculates both deterministic and probabilistic acceleration response spectra for any location in California based on criteria provided in Appendix B of Caltrans SDC.

The deterministic spectrum is determined as the average of median response spectra calculated using the Campbell-Bozorgnia (2008) and Chiou-Youngs (2008) ground motion prediction equations developed under the "Next Generation Attenuation" project coordinated through the PEER-Lifelines program. These equations are applied to all faults considered to be active in the last 750,000 years (late-Quaternary age) that are capable of producing a moment magnitude earthquake of 6.0 or greater. The probabilistic spectrum is obtained from the USGS (2008) National Hazard Map for 5% probability of exceedance in 50 years. Caltrans design spectrum is based on the larger of the deterministic and probabilistic spectral values. Both the deterministic and probabilistic spectra account for soil effects through incorporation of the parameter Vs30, the average shear wave velocity in the upper 30 meters (100 feet) of the soil profile.

The input values we selected for Caltrans ARS Online included:

- V_s30 of 925 fps (282 mps)
- Maximum Moment Magnitude (MMax) 7.1 (Rodgers Creek fault)
- No ARS increase for fault-type or long period structure
- ARS increase for near-field effects

The calculated spectra for both deterministic (for both faults) and probabilistic methods are presented in Figure 5-1. Since the maximum spectral acceleration curve is the USGS 5% in 50 years hazard, this curve is presented in Figure 5-2 as a design curve. Spectral values (from Figure 5-2) are provided below in Table 5-3.

Table 5-3 Recommended Spectral Acceleration Values

(V_s=282 mps, Lat. = 38.272082, Long. = 122.6700059)

Period (seconds)	Soil Profile Type D	
	Sa (g)	Sa* (g)
0.010	0.54	0.54
0.020	0.63	0.63
0.030	0.68	0.68
0.050	0.76	0.76
0.075	0.83	0.83
0.100	0.89	0.89
0.120	0.93	0.93
0.150	1.00	1.00
0.170	1.04	1.04
0.200	1.09	1.09
0.240	1.11	1.11
0.300	1.14	1.14
0.400	1.12	1.12
0.500	1.10	1.10
0.750	0.96	1.05
1.000	0.80	0.96
1.500	0.59	0.71
2.000	0.48	0.57
3.000	0.32	0.38
4.000	0.23	0.28

* Modified for near-fault effects as outlined in Section 5-2

6.1 AS-BUILT FOUNDATION DATA

Originally constructed in 1956, the Denman Overcrossing is a 272-foot long, two-span, reinforced concrete continuous deck slab structure as shown on the as-built drawings (Contract No. 54-4TC-63F). The plans indicate that the two abutments and two bents are supported on circular, reinforced concrete piles. As shown on the Standard Pile Details sheet, Cast-in-Place Concrete Piles, Alternative "Z," was used for the foundation piles. The concrete piles were installed by first driving a steel shell extending from the bottom of the pile cap to the pile tip elevation. Then, the steel shell was filled with concrete to form the pile. The steel shell tapered from a diameter of 15½ inches at the butt to a minimum diameter of 8 inches at the tip. The table below presents a summary of the design capacities and as-built pile elevations.

Table 6-1: As-built Pile Capacity

Location	Pile Type	Nominal Resistance (tons)		Pile Tip Elevation (ft)
		Compression	Tension	
Abutment 1	Concrete (cast-in-place)	32	0	-5 to -15
Bent 2	Concrete (cast-in-place)	32	0	-2 to -18
Abutment 3	Concrete (cast-in-place)	32	0	-6 to -21

The survey datum on the project profiles, Sheets 5 to 26 of the 1954 plan set, is listed as C.H.C. (3.4 feet above MLLW datum).

Copies of pertinent as-built structure plans are presented in Appendix F.

The proposed bridge is underlain predominantly by medium to very stiff lean and fat clay and medium dense to very dense sand, silty and clayey sand. The principal geotechnical issues at the site are:

- Selection of the type and depth of foundation that will be compatible with the underlying soils
- Construction issues associated with the proximity of proposed new piles to existing piles
- Post-liquefaction settlement of potentially liquefiable soils encountered near the bridge and
- Consolidation settlement of foundation soils due to new approach fills.

We understand that the project Structural Engineer has elected to use Class 200 Alternative "X" PCPS piles (T=14") at both abutments and modified Class 200 Alternative "X" PCPS piles (T=16") at center bent. Class 90 Alternative "X" PCPS piles are planned to support the wing walls at both abutments. All piles supporting the existing bridge are to be abandoned. Based on the current foundation plan, some new piles will be located in close proximity to existing abutment and bent piles. In order to avoid driving new piles into existing piles, we recommend that the locations of the existing piles, any potentially cut-off or abandoned piles, be identified in subsequent stages of design. In addition, we recommend (1) excavation to expose the tops of all previously abandoned piles, and (2) drilling of an undersized hole prior to driving each new pile to confirm the absence of the existing abandoned piles at depth.

Placement of the planned approach fills, which are expected to have a maximum height of 5 feet above the existing embankment and sliver fills up to 22 feet in height are proposed for the embankment widening; these fills will result in elastic and consolidation settlement of the native clays. We estimate that this settlement will be on the order of 3¾ inches. It is our understanding that the embankment area will be preloaded as discussed in Section 7.3. No potential downdrag force is anticipated from the consolidation settlement as the piles will be driven after 90% of consolidation settlement is completed.

Because pockets of potentially liquefiable soils were encountered in both explorations, consistent with Caltrans requirements, we have included the estimated average downdrag force down to approximately Elevation 10 feet associated with post-liquefaction settlement in the design pile tip elevations presented in Section 7.1. The maximum downdrag force is estimated to be approximately 106 tons at Abutments 1 and 3, and approximately 47 tons at Bent 2.

7.1 PILE DESIGN CAPACITY AND TIP ELEVATION

7.1.1 Axial Pile Capacity Analysis

Based on our review of the subsurface conditions encountered in the current borings and 1954 borings, in our opinion, the proposed replacement structure can be supported on Class 200 and Class 90 PCPS piles as planned. Current Caltrans practice is to design abutments in accordance with Working Stress Design (WSD) methodology and bents/piers in accordance with LRFD. Table 7-1 presents a summary of the foundation design data provided by the Structural Engineer.

Table 7-1: Foundation Design Data for Old Redwood Highway Overcrossing (Replace)

Location	Design Method	Pile Type	Finished Grade Elevation (ft)	Cut-off Elevation (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (in)	No. of Piles per Support
					B	L		
Abut 1	WSD	Class 200	46.2	40.25	9.75	106	1	36
Bent 2	LRFD	Class 200	38.5	30.25	17	107	1	88
Abut 3	WSD	Class 200	45.5	39.75	9.75	106	1	36

The design loading conditions and nominal resistance are developed in accordance with the LRFD approach. Loads from LRFD service-1 Limit State are used as design loads for WSD of abutments. Table 7-2 presents the design loads.

Table 7-2: Foundation Design Loads for Old Redwood Highway Overcrossing (Replace)

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	3828	193	3144	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bent 2	8932	125	6989	12159	170	0	0	7221	180	0	25
Abut 3	3945	199	3252	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

The specified tip elevations presented in the following Table 7-3 "Pile Data Table" are based on skin friction and end-bearing resistance developed in the dense to very dense sand stratum below Elevation -13 feet. The estimated pile embedment included additional penetration requirements to resist potential downdrag loads that would act on the piles due to post-construction liquefaction induced settlement.

Table 7-3: Pile Data Table for Old Redwood Highway Overcrossing (Replace)

Location	Pile Type	Nominal Resistance	Design Tip	Specified	Nominal

		(kips)		Elevation (ft)	Tip Elevation (ft)	Driving Resistance (kips)*
		Compression	Tension			
Abut 1	Class 200 Alt "X"	390	0	-14.0 (a) 20.0 (c)	-14.0	610
Bent 2	Class 200 Alt "X" (Modified)	250	25	-16.0 (a) 16.0 (b) 10.0 (c)	-16.0	340
Abut 3	Class 200 Alt "X"	400	0	-14.0 (a) 20.0 (c)	-14.0	620
Abut 1Lt WW	Class 90 Alt "X" (T = 14")	120	0	-14.0 (a) 37.0 (c)	-14.0	350
Abut 1 Rt WW	Class 90 Alt "X" (T = 14")	120	0	-14.0 (a) 37.0 (c)	-14.0	350
Abut 3 Lt WW	Class 90 Alt "X" (T = 14")	120	0	-14.0 (a) 37.0 (c)	-14.0	350
Abut 3 Rt WW	Class 90 Alt "X" (T = 14")	120	0	-14.0 (a) 37.0 (c)	-14.0	350

* Nominal driving resistance is the sum of nominal resistance and downdrag
Design tip elevation is controlled by the following demands: (a) Compression, (b) Tension, (c) Lateral

The results of our axial pile capacity analysis, which form the basis of our selection of the design tip elevations, are presented in Appendix G.

No group reduction factor needs to be applied to the single pile compression load capacities presented above provided a center to center spacing of at least three pile diameters is used.

7.1.2 Lateral Load Capacity

The driven pile foundations are capable of resisting lateral loads. Resistance to lateral loads can be developed by bending of the pile and by pile-soil interaction. The magnitude of the lateral load resistance that can develop depends upon several factors such as the pile size, the physical properties of the surrounding soils, and the structural design of the pile. We used LPILE 5.0 (Reese et al., July 2004) and GROUP 7.0 (Reese et al., July 2006) to assist in estimating the lateral load resistance of PCPS piles and the corresponding lateral pile group effects. Both programs model the soil response in the form of load-deflection (p-y) curves.

LPILE output files for laterally loaded piles at the abutments, bents and wing walls are presented in Appendix H and include deflection versus depth, bending moment versus depth, and shear versus depth. Charts showing load versus deflection for free and fixed head conditions at top of pile are included in Appendix H as Figures H-1 to H-3.

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 7-4 presents the Caltrans recommended Pm for the corresponding rows of piles within a group.

Table 7-4: Pile P-Multiplier, P_m for Multiple Row Shading

Pile Center-to-Center Spacing (in the direction of loading)	Group Efficiency Factor (P-Multiplier, P_m)		
	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

Table 7-4 is 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.

For Bent 2, the lateral capacity of the pile group was analyzed using GROUP 7.0 with the group efficiency factors shown in Table 7-4. Plots showing the deflection versus depth, bending moment versus depth, and shear versus depth for free head condition at top of pile group are included in Appendix H as Figures H-4 to H-6.

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. For abutments, Caltrans limits the soil resistance at the back wall to a 5.5 feet wall height and a maximum uniform soil pressure of 5,000 pounds per square foot. For wall heights less than 5.5 feet, the average unit pressure should be reduced linearly in proportion to the height. The 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. For bent, passive resistance against the embedded pile cap can be utilized. The mobilization of passive resistance depends on the amount of pile cap deflection/rotation. The ultimate passive resistance of the soil should be estimated using an equivalent fluid pressure as shown on Figure H-7 (Appendix H). Figure H-7 also presents plots of the percent of maximum fluid pressure versus pile cap movement.

7.1.3 Axial Pile Load-Deflection

Axial pile load-deflection curves are used by the Structural Engineer to develop vertical foundation stress-strain coefficients for use in the super structure analyses. The computer program TZPILE 2.0 (Ensoft, Inc. 2005) was used to model the axial pile load behavior. Axial load deflection curves were developed for 16-inch prestressed precast concrete piles. The results of TZPILE analysis are presented in Appendix I.

7.2 PILE INSTALLATION

All piles should be installed under the direct observation of the Geotechnical Engineer and in accordance with Section 49 of the Caltrans Standard Specifications, “Piling”. Specific additions and modifications to these requirements are discussed below.

The Contractor should submit evidence of compatibility of the proposed pile hammer with the pile type (14 inch and 16 inch, Class 90 and Class 200 PCPS, Alternative "X") and soil conditions at the site. The Contractor's hammer submittal should include, as a minimum, a dynamic analysis of the pile driving system that is based on wave equation analysis using computer programs such as WEAP. Acceptance criteria for driven piles should follow Caltrans Standard Specifications Section 49-1.08, Pile Driving Acceptance Criteria as well as Special Provisions 49-228, Redriving. Driven piles reaching refusal within 10 feet of the specified tip elevation and meeting the acceptance criteria may be cut-off above the tip elevation required by the compression loads. This assumes that the design lateral load and tension load tip elevations have been reached (see Pile Data Table). Preliminarily, we recommend that the refusal criteria be two times the minimum required blowcount. However, refusal criteria will be defined later based on the pile driving system proposed by the Contractor.

We anticipate that piles may encounter "hard driving" conditions within granular deposits found at approximate Elevation -13 to -17.5 feet. When required, and as approved by the Geotechnical Engineer, predrilling should be used to assist in the installation of piles to the required tip elevations. Predrilled holes should be no larger than the least dimension of the new pile, in conformance with the provisions of Section 49-1.05 of the Standard Specifications, Driving Equipment. The use of water in the predrilling process or jetting should not be allowed, unless approved in advance by the Geotechnical Engineer.

To prevent damage to new piles from contact with existing piles during installation, we recommend that the locations of the existing piles, as well as the locations of any potentially cut-off and abandoned piles be reviewed prior to design and installation of new piles.

7.3 APPROACH EMBANKMENT SETTLEMENT

Based on the profile sheets developed for the Old Redwood Highway OC, new fills ranging from 5 to 22 feet in height are planned. As discussed previously in "Section 3.2.4 Soil Conditions," native soils below fill consist of a maximum thickness of 9 feet of medium stiff to very stiff fat clay underlain by medium stiff to very stiff lean clay and sandy lean clay with sand interbeds to a depth of 18 feet. Beneath these cohesive deposits, the borings encountered primarily granular soils. Groundwater depths ranged from about 7 feet to more than 25 feet bgs. Consequently, a majority of the long term settlement at the site is attributed to consolidation of native fat clay in the upper 10 feet, and to a lesser degree, consolidation of interbeds of deeper lean clay. We estimated the settlement of the approach embankment due to placement of new fill to the grades shown on the 'ORH' Line profile. Based on our analysis, we estimate that ultimate settlement on the order of 3¾ inches could occur along the approach centerline at the abutments. The approach embankment will be built in 2 stages in order to maintain traffic flow and minimize the need for interchange closure during construction. The stage numbers presented in this report are consistent with construction and traffic handling plans. Differential settlement is expected to be on the order of less than ½ inch at the conformance line between the 2 stages.

We estimate that approximately 90 percent of this settlement would occur within 9 months of fill placement. Surcharging the fills may be required to reduce the settlement period so that post construction settlement would not induce downdrag on abutment piles. For the surcharge method, a temporary soil fill is placed on top of the design finished grade for a limited period of

time. Both Caltrans and URS have had good success in implementing the surcharge method to accelerate settlement. Based on our experience, surcharge height is typically 10 feet, but may occasionally be 5 or 15 feet. In our evaluation we estimated settlements for surcharge heights of 5 feet and 10 feet, and compared the settlements periods for the case of no surcharge. In Table 7-5 for soil fill we estimate settlement period for (1) no soil surcharge, (2) 5 feet or soil surcharge and (3) 10 feet of soil surcharge along control line ORH. As discussed above the bridge approach embankment will be constructed in 2 stages. Stage 1A requires surcharge and/or settlement period and is shown in parentheses. Stage 2 doesn't require any surcharge or settlement period due to the smaller magnitude of estimated settlement.

Table 7-5: Estimated Ground Surface Settlement (Soil Embankment Fill)

Control Line	Max. Ultimate Settlement (inches)	Settlement Period (months)			Post Construction Settlement (inches)
		No Surcharge	5 ft Surcharge	10 ft Surcharge	
"ORH"	3¾	9 (stage 1A)	3 (stage1A)	2 (stage 1A)	⅜

We recommend surcharging be implemented at the stage shown in parentheses for the corresponding settlement period. With a surcharge height of 10 ft, we estimate that 2 months would be required to achieve 90 percent consolidation of the underlying clay soils.

7.3.1 Monitoring Settlement

To facilitate the Resident Engineer in determining whether to increase or decrease the duration of settlement periods, we recommend the embankment construction at the interchange be monitored in accordance with California Test 112, "Method for Installation and Use of Embankment Settlement Devices." As a minimum, two settlement monitoring devices should be installed at each abutment along "ORH" Stations 20+75 and 24+50. One device should be installed near the toe of existing embankment slope, and the second one about half way between existing and proposed embankment toe. The approximate locations of these devices should be as follows:

Table 7-6: Proposed Locations of Embankment Settlement Devices

Control Line	Station	Offset (feet)
"ORH"	20+75	44 Rt
	20+75	64 Rt
"ORH"	24+50	48 Rt
	24+50	96 Rt

7.4 SLOPE STABILITY

Consistent with Caltrans standards, the proposed slope inclination of new embankments at the U.S.101/Old Redwood Highway separation is generally 2 to 1 (horizontal to vertical). The embankment soils and supporting soils are sufficiently strong, in our opinion, to support these typical slopes provided that the embankments are constructed in accordance with the recommendations of this report and Caltrans Standard Specifications. Stability analyses for the bridge approaches, were, therefore, not performed as part of this foundation report.

7.5 APPROACH FILL EARTHWORK

All earthwork should be completed in accordance with the applicable sections of the Caltrans Standard Specifications and as described in the companion Geotechnical Design and Materials Report for the Replacement of Old Redwood Highway Overcrossing Project, prepared by URS.

7.6 APPROACH FILLS AND ABUTMENT EXCAVATION

All earthwork should be completed in accordance with applicable section of the Caltrans Standard Specifications and as described in URS' companion Geotechnical Design and Materials Report for Old Redwood Highway project. The requirements of structural backfill and pervious backfill are setforth under Section 19-3.06 and 19-3.065, respectively, in the Standard Specifications (Caltrans 2006).

The proposed mitigation basin and all other excavations will likely encounter fat clays. The fat clays should not be used as engineered fill due to their expansive nature, i.e. potential to shrink and swell with moisture changes. Therefore, we recommend that the fat clay be hauled offsite and not be used in constructing the approach fill and abutment backfill.

Pile cap areas should be excavated as required to bring those areas to their finish subgrade elevations. All loose soil should be removed from the exposed subgrade prior to pile cap construction. Based on available groundwater information, we recommend the type of excavation be classified as a "Structure Excavation (Bridge)" at both abutments and at Bent 2 as "Structure Excavation Type D" in accordance with Section 11 of Bridge Design Aids, March 2005.

8.1 TEMPORARY CONSTRUCTION EXCAVATIONS

We anticipate that excavations into the embankment fills or native soils for construction of the abutments will result in temporary near vertical unsupported soil faces as high as about 20 feet. Safety standards set by California Code of Regulations (CCR), Title 8, Chapter 4, Subchapter 4, Article 6 "Excavations" limit the height of unshored vertical excavations to 5 feet if construction personnel will be working in the excavations. The set of requirements published by CCR, classifies soils in detail as Type A, B, or C. In general, Type A soils are stronger, Type B soils are intermediate, and Type C soils are weaker. Based on the soil type, depth, duration the excavation is open, and sequence of soils exposed in the excavation, CCR 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 to 1, 1 to 1, and 1½ to 1 for Type A, B, and C soils, respectively. For excavations greater than 20 feet in depth, they state that maximum allowable slopes should be designed by a Professional Engineer. Based on the strengths of the soils encountered in our borings, the existing embankment fills and native soils are considered to be CCR Type B.

For locations where excavation with sloping sides is not viable because of space limitations or in areas where temporary slopes steeper than 1:1 are planned, shoring will be required. The Contractor should retain an experienced Registered Civil Engineer to design the shoring system.

8.2 CONSTRUCTION DEWATERING

As discussed in Section 3.2.5 "Groundwater", maximum historic groundwater level at the project site was measured at Elevation 28 feet, which is 2 feet below the bottom of pile cap. However, groundwater was measured at elevations as high as 32.7 feet in the monitoring well located in the 7-Eleven parking lot at 5200 Old Redwood Highway. Therefore, it is likely that groundwater will be encountered in the pile cap excavations.

8.3 PILE CUTOFF

When driven piles develop the required compressive capacities before reaching the specified tip elevation, the Contractor may be given the option, with the Geotechnical Engineer's approval, to stop driving and cut off the piles. Pile cut-off should be approved only if the piles also have satisfied the tension and lateral demand requirements, and the structural capacity has not been compromised. For maximum pile cut-off length, refer to the Standard Plans (Caltrans, 2006).

8.4 EFFECTS OF CONSTRUCTION WORK ON ADJACENT STRUCTURES

Efforts should be made to minimize effects of construction work on adjacent structures, such as pile-driving vibrations, and settlement due to dewatering and excavations. A monitoring program should be required for pile driving at, or adjacent to, existing structures that are susceptible to damage or sensitive to noise and/or vibration.

The opinions, conclusions and recommendations presented in this Foundation Report are based on information obtained from new and previous explorations made at widely separated locations, site reconnaissance, review of available topographic information and historic data, and upon 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 and CPT. 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 presented in this report in order to meet the project needs.

The Geotechnical Engineer should review the final specifications and drawings to verify that these documents are consistent with the intent of the geotechnical recommendations. Geotechnical issues may arise during construction that are not apparent at this time. URS should be retained during construction to review the soil conditions encountered and the construction procedures. All earthwork and testing should be done under the direct observation of a representative of our firm.

The elevations shown on the new LOTBs are based on interpolation from spot and contour elevations shown on available topographic maps.

As-built drawings pertinent only to the geotechnical investigation are included.

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 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 SONOMA COUNTY
IN PETALUMA
ON ROUTE 101 AT OLD REDWOOD HIGHWAY OVERCROSSING

TO BE SUPPLEMENTED BY STANDARD PLANS DATED MAY 2006

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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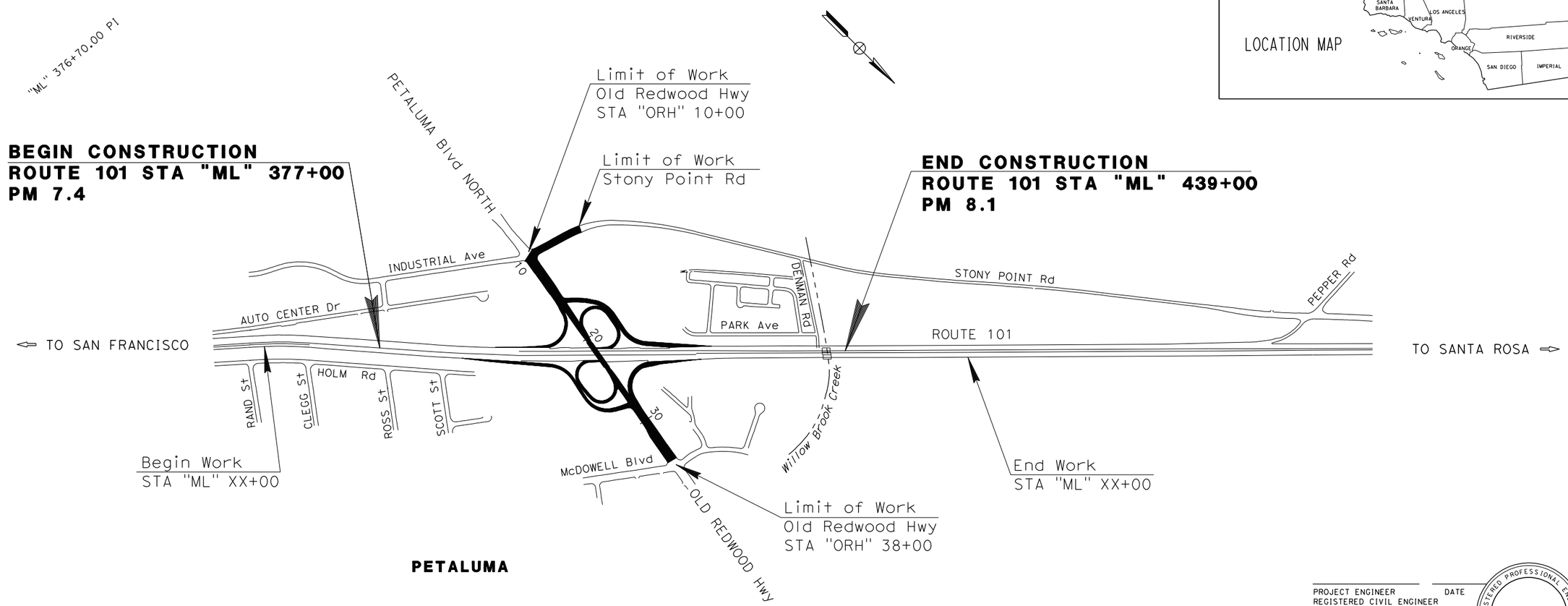

PROJECT ENGINEER DATE
REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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FIGURE 1-1

URS CORPORATION
55 South Market Street, Suite 1500
San Jose, CA 95113

CONTRACT No.

THE CONTRACTOR SHALL POSSESS THE CLASS (OR CLASSES) OF LICENSE AS SPECIFIED IN THE "NOTICE TO BIDDERS."

APPROVED AS TO IMPACT ON STATE FACILITIES AND CONFORMANCE WITH APPLICABLE STATE STANDARDS AND PRACTICES AND THAT TECHNICAL OVERSIGHT WAS PERFORMED.

CONSULTANT DESIGN ENGINEER | CALTRANS DESIGN OVERSIGHT APPROVAL | REGISTRATION No. | LICENSE Exp DATE | DATE SIGNED

LAST REVISION 00-00-00 | DATE PLOTTED => 1/20/2010 | TIME PLOTTED => 2:15:38 PM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101			

REGISTERED CIVIL ENGINEER — DATE 9-20-11

PLANS APPROVAL DATE

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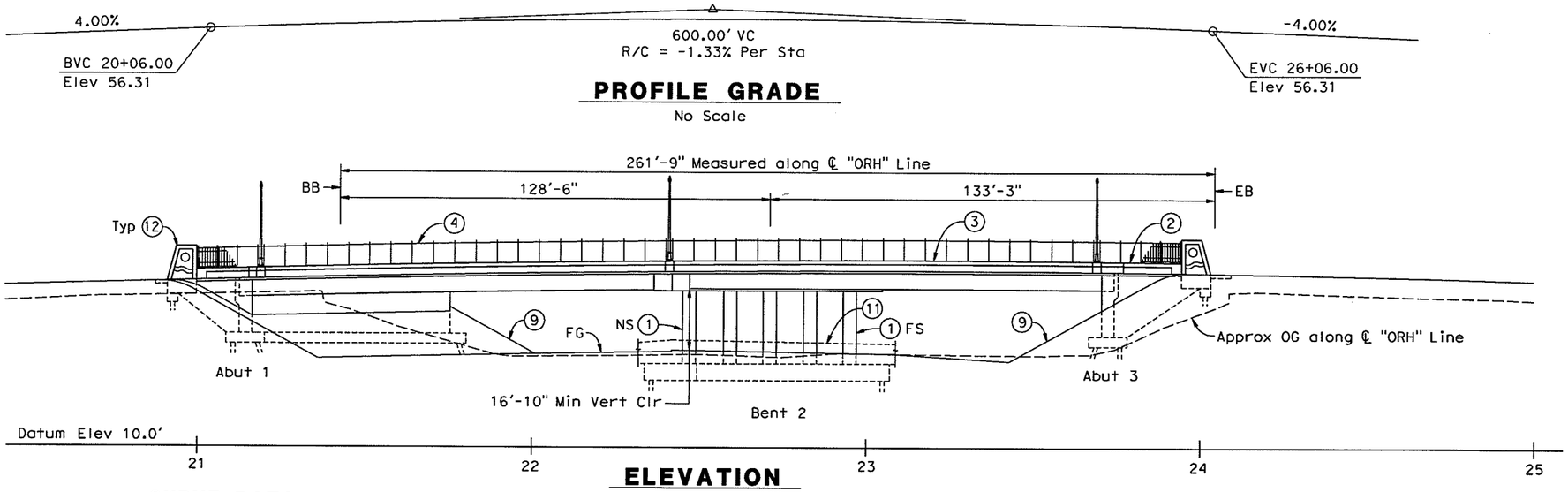
REGISTERED PROFESSIONAL ENGINEER — Jan M. Hueser — No. C050215 — Exp. 6/30/11 — CIVIL — STATE OF CALIFORNIA

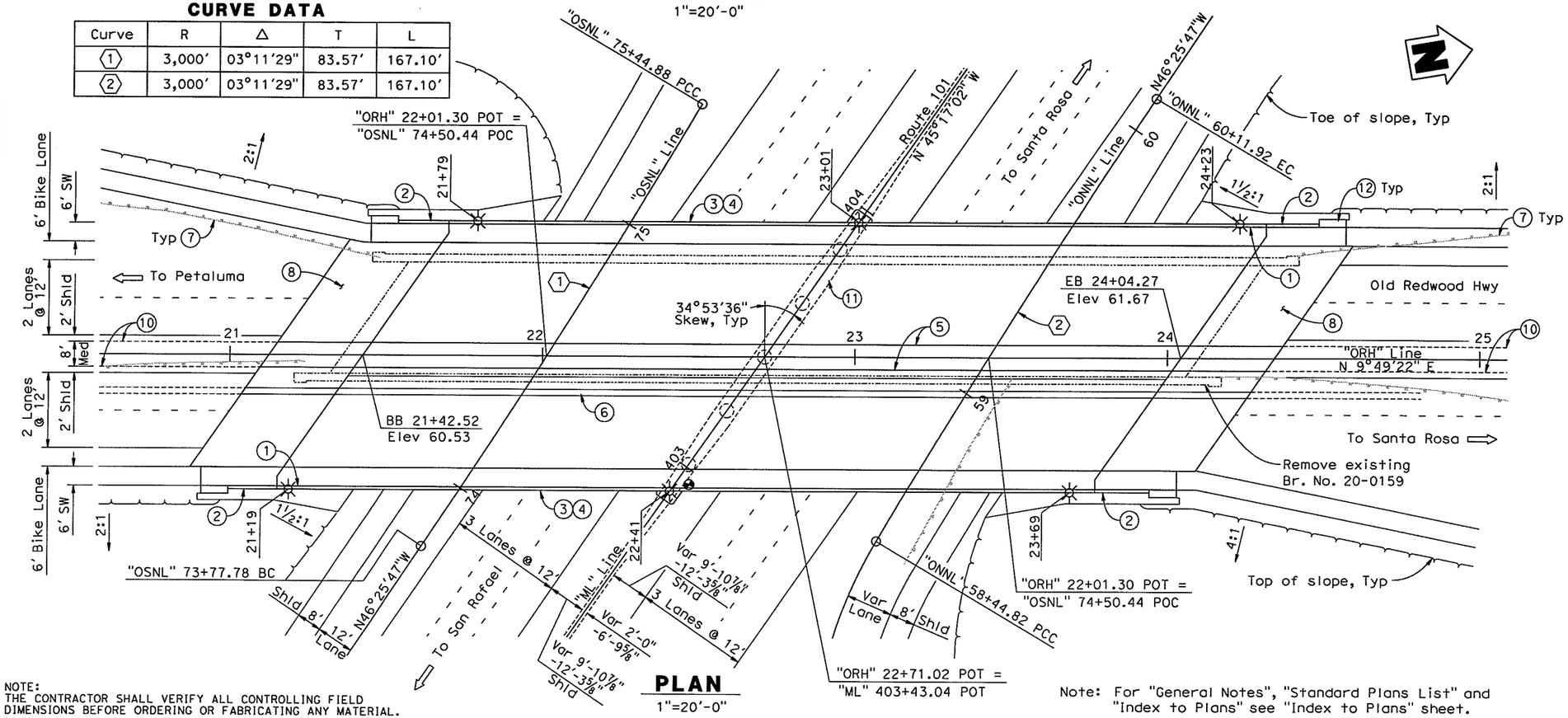
CITY OF PETALUMA PUBLIC WORKS
11 ENGLISH STREET
PETALUMA, CA 94954

URS CORPORATION
1380 LEAD HILL BLVD, SUITE 100
ROSEVILLE, CA 95661-2997



CURVE DATA

Curve	R	Δ	T	L
1	3,000'	03°11'29"	83.57'	167.10'
2	3,000'	03°11'29"	83.57'	167.10'



NOTES:

1. Paint Bridge No. 20-0291
   Paint Bridge Name and Year Completed
2. Concrete Barrier (Type 26A Modified) with Architectural Treatment
3. Concrete Barrier (Type 26 Modified) with Architectural Treatment
4. Ornamental Railing
5. Minor Concrete (Island Paving), see "Road Plans" for quantities
6. Temporary Railing (Type K), see "Road Plans"
7. Existing MBGR to be removed, see "Road Plans"
8. Structure Approach Type N (30S)
9. Slope Paving - Full Slope
10. Minor Concrete (Island Paving), see "Road Plans"
11. Median Barrier, see "Road Plans"
12. Corbel, see "Architectural Details No. 2" sheet

LEGEND:

- Indicates existing structure
- Indicates direction of traffic
- Point of minimum vertical clearance
- Indicates electrolier, see "Road Plans" and pedestal, see "Architectural Details"

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

Note: For "General Notes", "Standard Plans List" and "Index to Plans" see "Index to Plans" sheet.

FIGURE 2-1

DESIGN OVERSIGHT	DESIGN	BY S. Landis/J. Hueser	CHECKED G. Rowe	LOAD & RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 W/"LOW-BOY": PERMIT DESIGN VEHICLE
	DETAILS	BY L. Davis	CHECKED G. Rowe	LAYOUT	BY S. Landis/J. Hueser — CHECKED G. Rowe
SIGN OFF DATE	QUANTITIES	BY S. Landis	CHECKED L. Davis	SPECIFICATIONS	BY D. Harnagel — PLANS AND SPECS COMPARED D. Harnagel

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV.7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Walt LaFranchi
PROJECT ENGINEER

BRIDGE NO. 20-0291
POST MILES 7.65

OLD REDWOOD HWY OC (REPLACE)
GENERAL PLAN No. 1

UNIT:
PROJECT NUMBER & PHASE: 0400020652
CONTRACT NO.: 04-0A1854

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 09-16-10 5-13-11 8-8-11 9-20-11 — SHEET 1 OF 41

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DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101			

REGISTERED CIVIL ENGINEER — DATE 9-20-11

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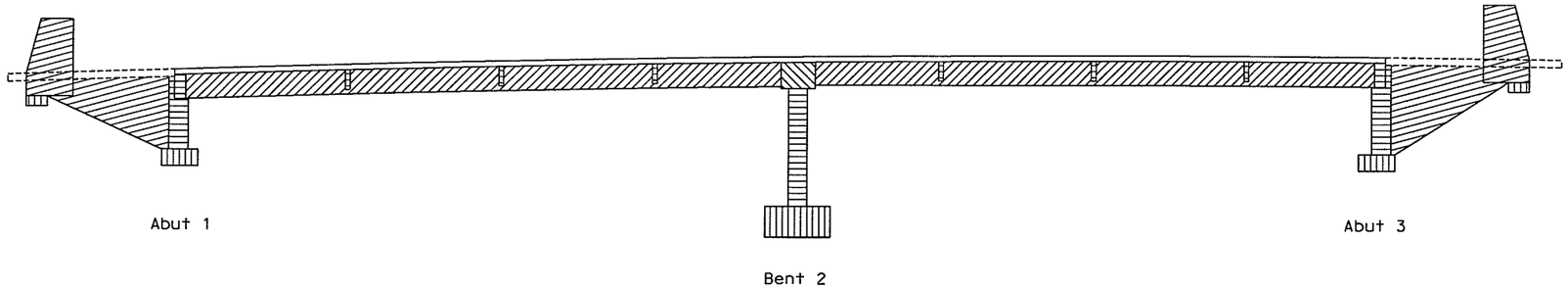
PETALUMA, CA 94954

URS CORPORATION
1380 LEAD HILL BLVD, SUITE 100
ROSEVILLE, CA 95661-2997



- Structural Concrete, Bridge (f'c = 5 ksi @ 28 days)
- Structural Concrete, Bridge (f'c = 4 ksi @ 28 days)
- Structural Concrete, Bridge
- Structural Concrete, Bridge, see "Bent Details No. 5" sheet
- Precast Prestressed CA Wide Flange Girders, see "Girder Details No. 1" sheet
- Structural Concrete, Bridge Footing (f'c = 4 ksi @ 28 days)
- Structural Concrete, Approach Slab

CONCRETE STRENGTH AND TYPE LIMITS

No Scale

NOTES:

(3) Concrete Barrier (Type 26 Modified) with Architectural Treatment

(4) Ornamental Railing

(5) Minor Concrete (Island Paving), see "Road Plans" for quantities

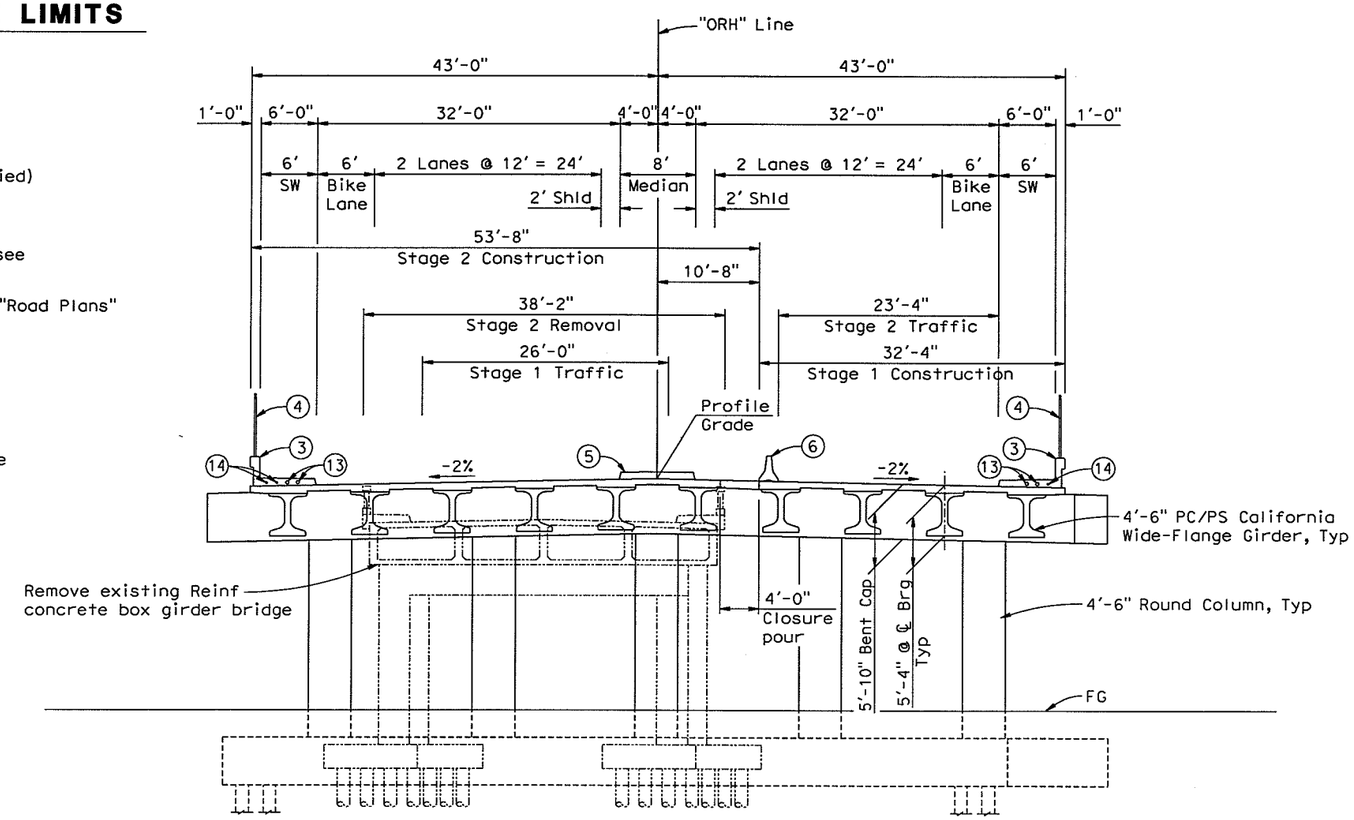
(6) Temporary Railing (Type K), see "Road Plans"

(13) 5" Dia Future Utility Opening

(14) 2" conduit, see "Road Plans"

LEGEND:

Indicates existing structure



TYPICAL SECTION

1/8" = 1'-0"

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

FIGURE 2-2

DESIGN OVERSIGHT	DESIGN	BY S. Landis/J. Hueser	CHECKED G. Rowe	LOAD & RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 W/"LOW-BOY"; PERMIT DESIGN VEHICLE
	DETAILS	BY L. Davis	CHECKED G. Rowe	LAYOUT	BY S. Landis/J. Hueser — CHECKED G. Rowe
SIGN OFF DATE	QUANTITIES	BY S. Landis	CHECKED L. Davis	SPECIFICATIONS	BY D. Harnagel — PLANS AND SPECS COMPARED D. Harnagel

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Walt LaFranchi
PROJECT ENGINEER

BRIDGE NO. 20-0291
POST MILES 7.65

OLD REDWOOD HWY OC (REPLACE)
GENERAL PLAN No. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV.7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE: 0400020652 CONTRACT NO.: 04-0A1854

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 09-14-10 5-13-11 9-9-11 9-20-11 — SHEET 2 OF 41

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DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101			

REGISTERED CIVIL ENGINEER — DATE 9-20-11

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PILE DATA TABLE

Location	Pile Type	Nominal Resistance (kips)		Design Tip Elevation (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance (kips)
		Compression	Tension			
Abut 1	Class 200 Alt "X"	390	0	-14.0 (a) 20.0 (c)	-14.0	610
Abut 1 Lt WW	Class 90 Alt "X" (T = 14")	120	0	-14.0 (a) 37.0 (c)	-14.0	350
Abut 1 Rt WW	Class 90 Alt "X" (T = 14")	120	0	-14.0 (a) 37.0 (c)	-14.0	350
Bent 2	Class 200 Alt "X" (Modified) *	250	25	-16.0 (a), 16.0 (b) 10.0 (c)	-16.0	340
Abut 3	Class 200 Alt "X"	400	0	-14.0 (a) 20.0 (c)	-14.0	620
Abut 3 Lt WW	Class 90 Alt "X" (T = 14")	120	0	-14.0 (a) 37.0 (c)	-14.0	350
Abut 3 Rt WW	Class 90 Alt "X" (T = 14")	120	0	-14.0 (a) 37.0 (c)	-14.0	350

Notes: Design tip elevation is controlled by the following demands: (a) Compression, (b) Tension, (c) Lateral. Nominal driving resistance is the sum of nominal resistance and downdrag.

* See "Bent Details No. 3" sheet

NOTES:

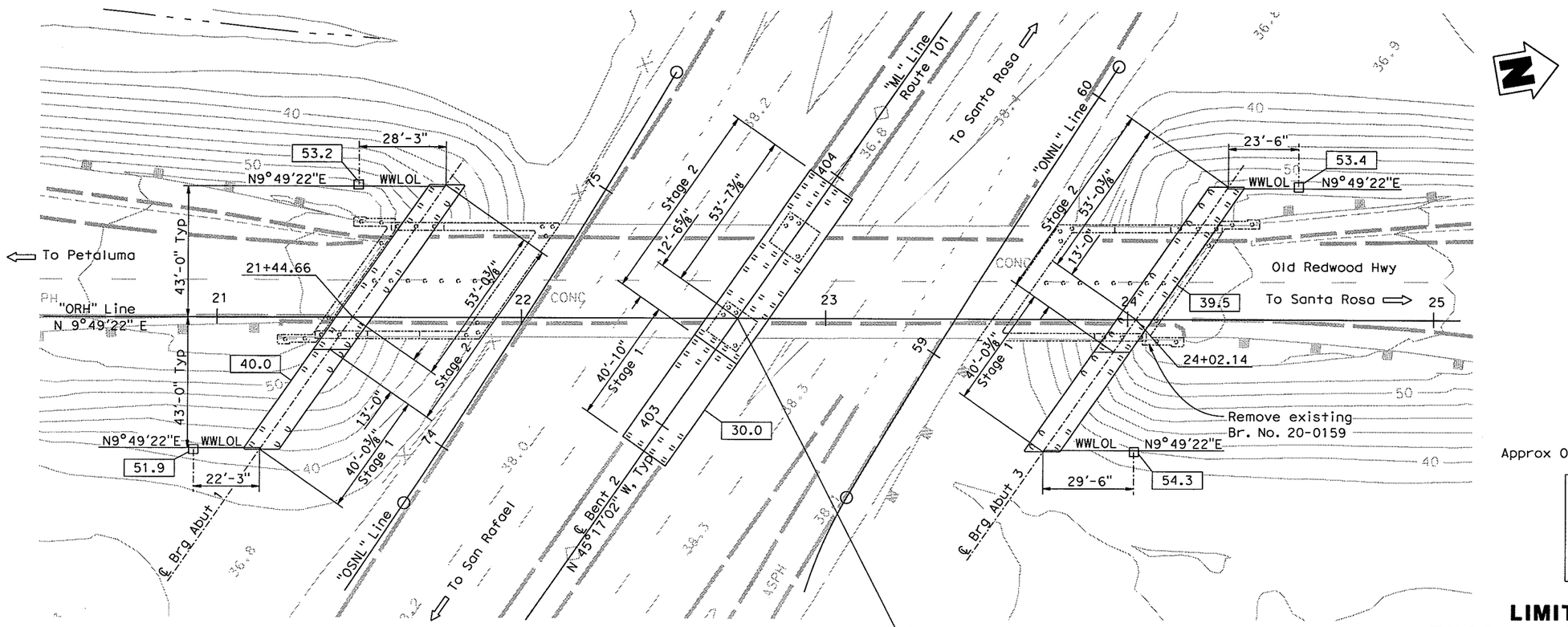
1. Verify all field dimensions prior to construction. Existing piles conflicting with new foundations shall be removed 2'-0" below bottom of proposed foundation.

LEGEND:

- Indicates existing structure
- Indicates direction of traffic
- Indicates bottom of footing elevation
- Indicates piles, not all shown

BENCH MARK

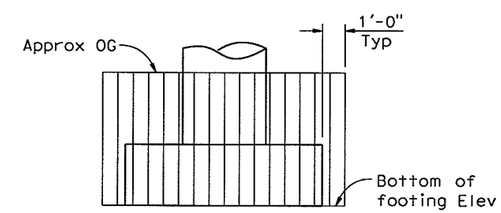
BENCH MARK	N	E	ELEV	DESCRIPTION
882	1860991.782	6370035.590	34.924	1" Iron pipe in shoulder of NB 101, 28 ft south-easterly from overhead exit sign for Old Redwood Hwy, Pengrove and 3.5 ft northerly from edge of shoulder
886	1862832.139	6368177.651	38.480	1" Iron pipe in right-of-way adjacent to NB 101 366 ft southerly from speed limit sign near post mile mark 8.0 and 10 ft easterly from edge of pavement



PLAN

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

FIGURE 2-3



LIMITS OF STRUCTURE EXCAVATION (TYPE D) AT BENT 2

No Scale

GEOTECHNICAL PROFESSIONAL — APPROVAL DATE 9-20-11

DESIGN OVERSIGHT	SCALE: 1"=20'	VERT.DATUM NAVD 1988	HORZ.DATUM NAD 83 1991.35	DESIGN	BY S. Landis/J. Hueser	CHECKED G. Rowe	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
	PHOTOGRAMMETRY AS OF:		ALIGNMENT TIES	DETAILS	BY L. Davis	CHECKED G. Rowe	
	SURVEYED	BY Caltrans	DRAFTED BY Caltrans	QUANTITIES	BY S. Landis	CHECKED L. Davis	
SIGN OFF DATE	FIELD CHECKED	BY Caltrans	CHECKED BY Caltrans				

Walt LaFranchi
PROJECT ENGINEER

BRIDGE NO. 20-0291
POST MILES 7.65

OLD REDWOOD HWY OC (REPLACE)
FOUNDATION PLAN

FOUNDATION PLAN SHEET (ENGLISH) (REV.7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE: 0400020652 CONTRACT NO.: 04-0A1854

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES				SHEET	OF
08-18-10	5-13-11	9-9-11	9-20-11	6	41

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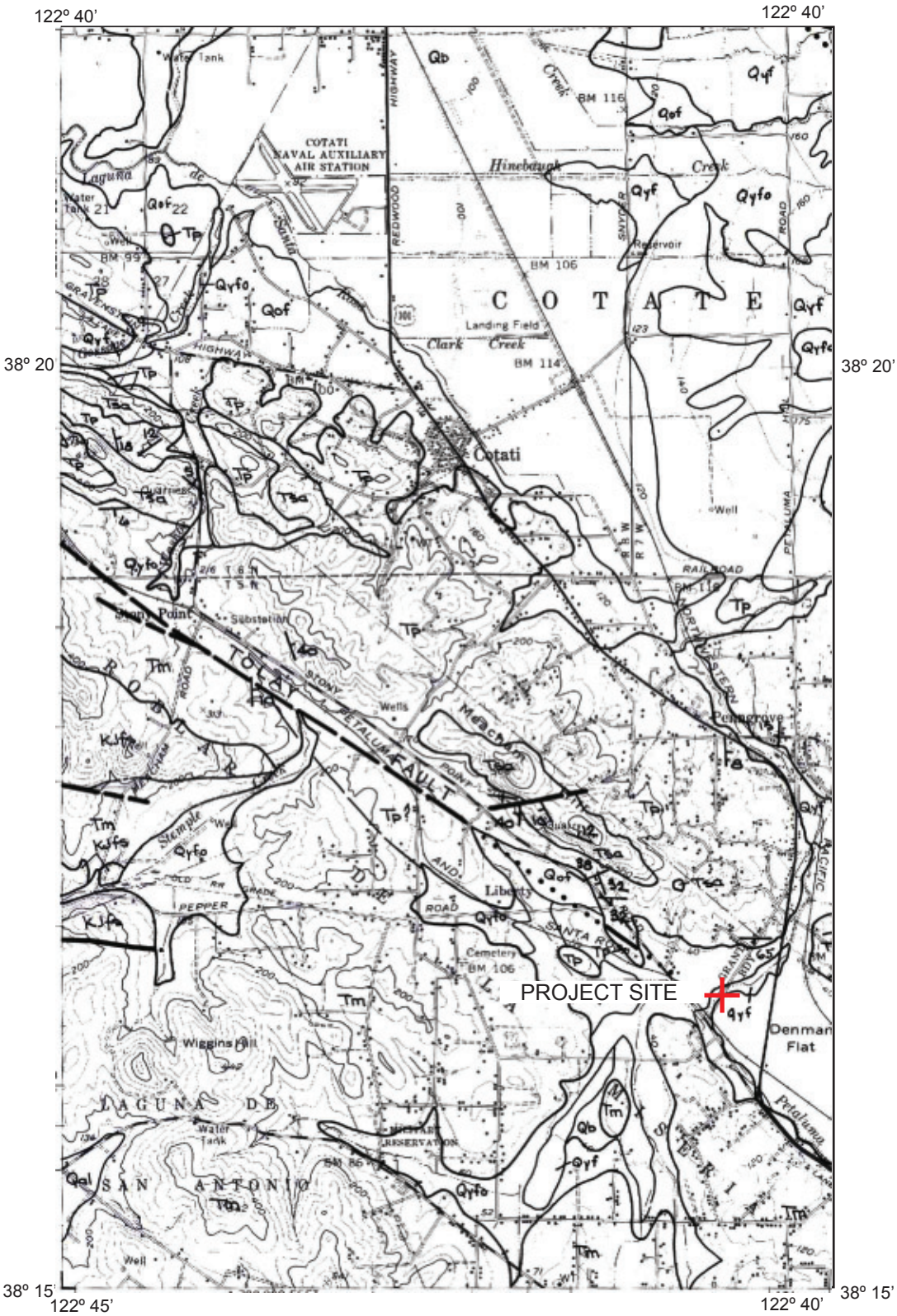

Modifed from: Fox et al, 1973

URS	Project N o. 28645097 Old Redwood HIghway Improvement Project	REGIONAL GEOLOGIC MAP	Figure 3-1

Pathname: C:\Terra\Highway101\Figures\For_Stephen\Geologic_Map.ai

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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URS CORPORATION
55 South Market Street
Suite 1500
San Jose, CA 95113

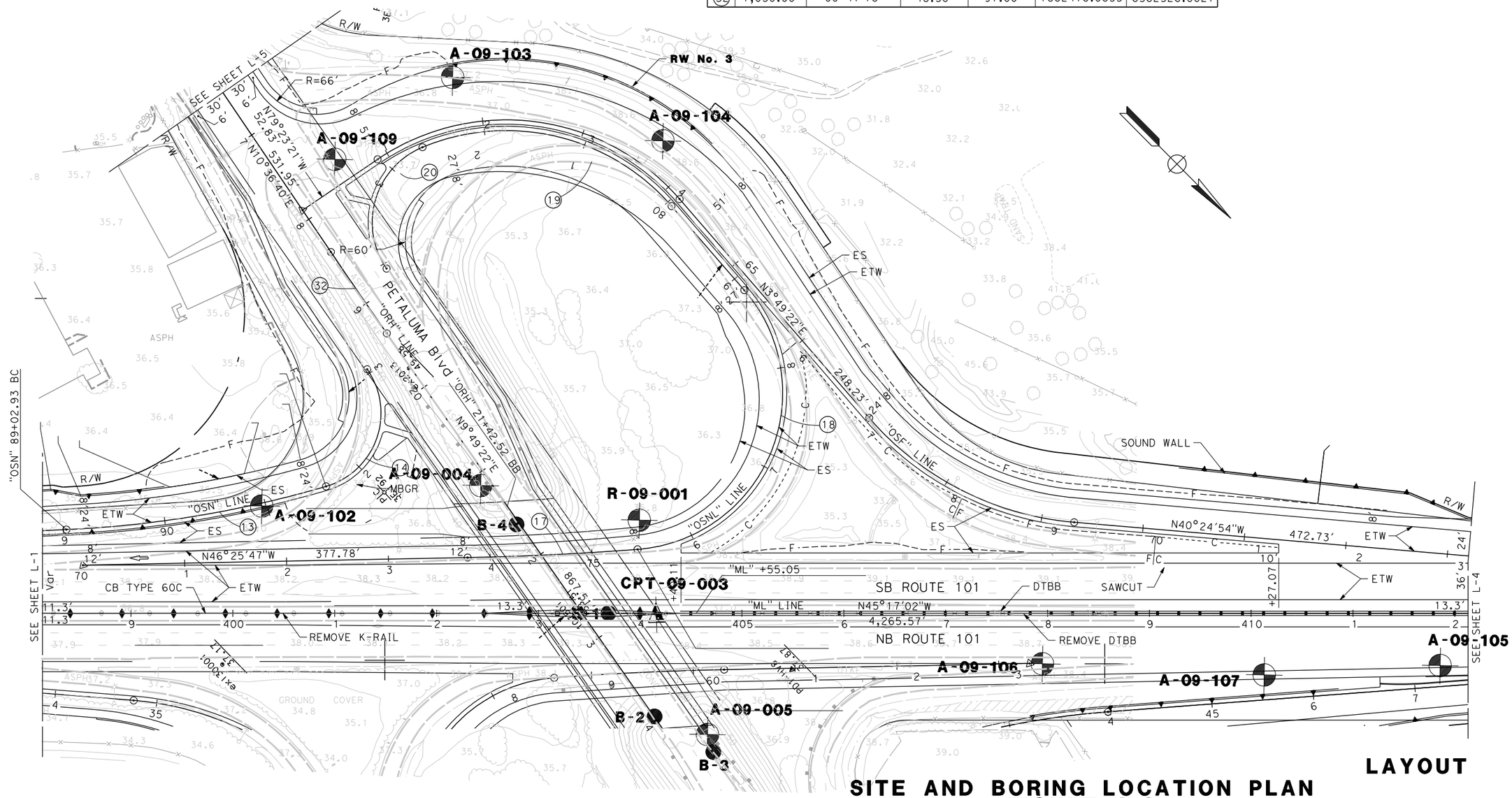
NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

LEGEND:

- 1952 Explorations
- 2009 Exploratory Borings
- 2009 Cone Penetration Test

CURVE DATA

No.	R	△	T	L	CURVE CENTER N	CURVE CENTER E
13	1,080.00′	13°44′59"	130.21′	259.18′	1860388.0866	6368907.1658
14	75.00′	108°42′53"	104.59′	142.31′	1861272.1808	6369385.0805
15	266.00′	83°12′42"	236.21′	386.32′	1861400.2431	6369243.3513
16	300.00′	44°14′16"	121.93′	231.63′	1861685.6579	6368695.1599
17	3,000.00′	03°11′29"	83.57′	167.10′	1859311.9843	6367303.4723
18	154.17′	126°33′22"	306.23′	340.53′	1861479.8773	6369147.1125
19	255.50′	62°02′48"	153.66′	276.69′	1861400.2431	6369243.3513
20	80.00′	111°36′00"	117.72′	155.82′	1861251.0481	6369150.9331
32	7,050.00′	00°47′18"	48.50′	97.00′	1862476.0655	6362326.0021



SEE SHEET L-3 FOR AREA NORTH OF "ML" LINE

SITE AND BORING LOCATION PLAN
FIGURE 3-2

LAYOUT

SCALE: 1"=50′

L-2

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

CONSULTANT FUNCTIONAL SUPERVISOR

CALCULATED-DESIGNED BY

CHECKED BY

REVISED BY

DATE REVISED

LAST REVISION 00-00-00

DATE PLOTTED => 1/20/2010
TIME PLOTTED => 2:17:01 PM

BORDER LAST REVISED 4/11/2008

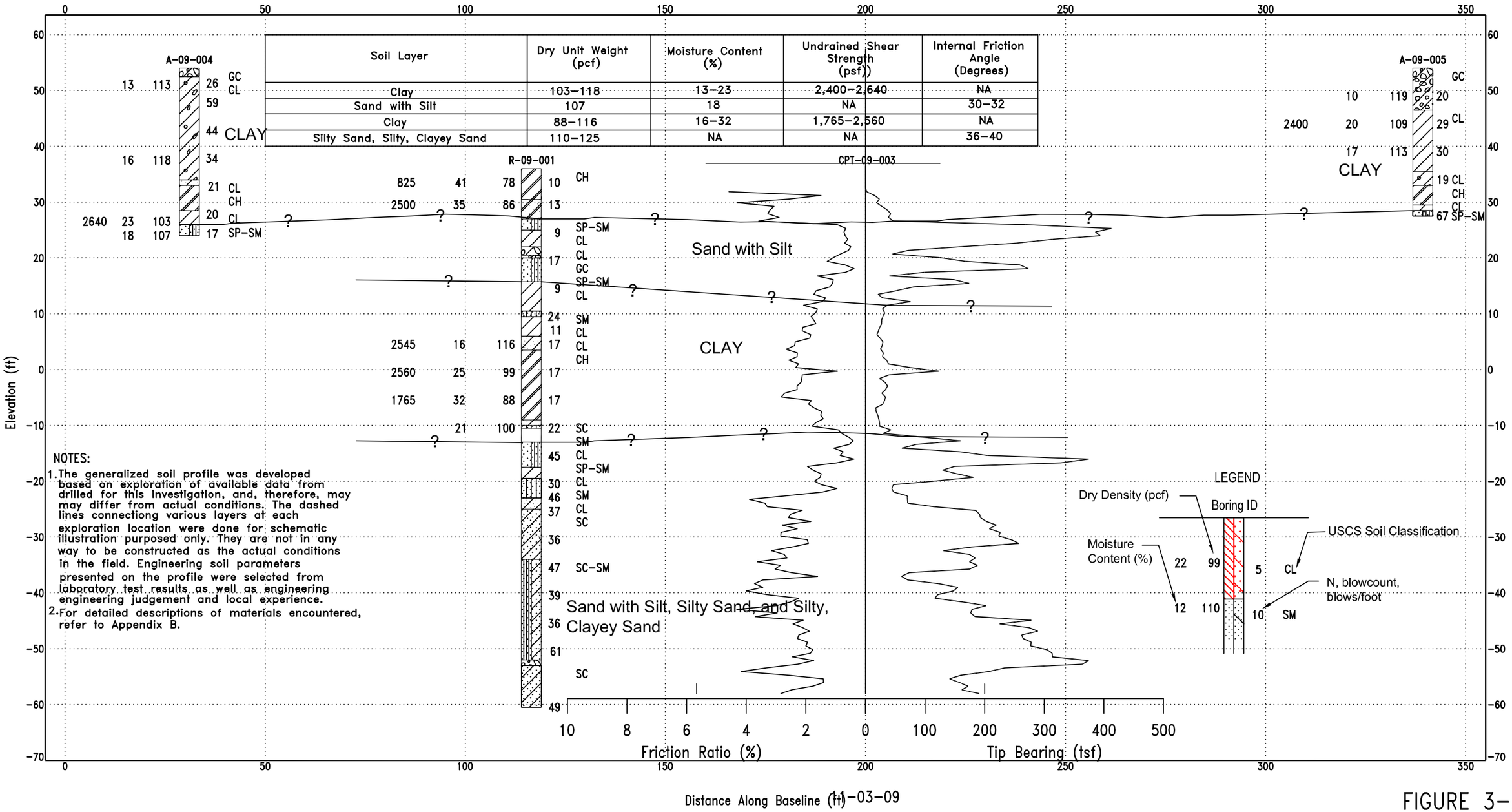
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => madhu_thummaluru
DGN FILE => ...\Site and Boring Location Plan Fig 3-2 .dgn

CU 00000

EA 04-0A1851

Soil Layer	Dry Unit Weight (pcf)	Moisture Content (%)	Undrained Shear Strength (psf))	Internal Friction Angle (Degrees)
Clay	103–118	13–23	2,400–2,640	NA
Sand with Silt	107	18	NA	30–32
Clay	88–116	16–32	1,765–2,560	NA
Silty Sand, Silty, Clayey Sand	110–125	NA	NA	36–40



NOTES:

1. The generalized soil profile was developed based on exploration of available data from drilled for this investigation, and, therefore, may may differ from actual conditions. The dashed lines connectiong various layers at each exploration location were done for schematic illustration purposed only. They are not in any way to be constructed as the actual conditions in the field. Engineering soil parameters presented on the profile were selected from laboratory test results as well as engineering engineering judgement and local experience.
2. For detailed descriptions of materials encountered, refer to Appendix B.

11-03-09

FIGURE 3-3

URS Corporation

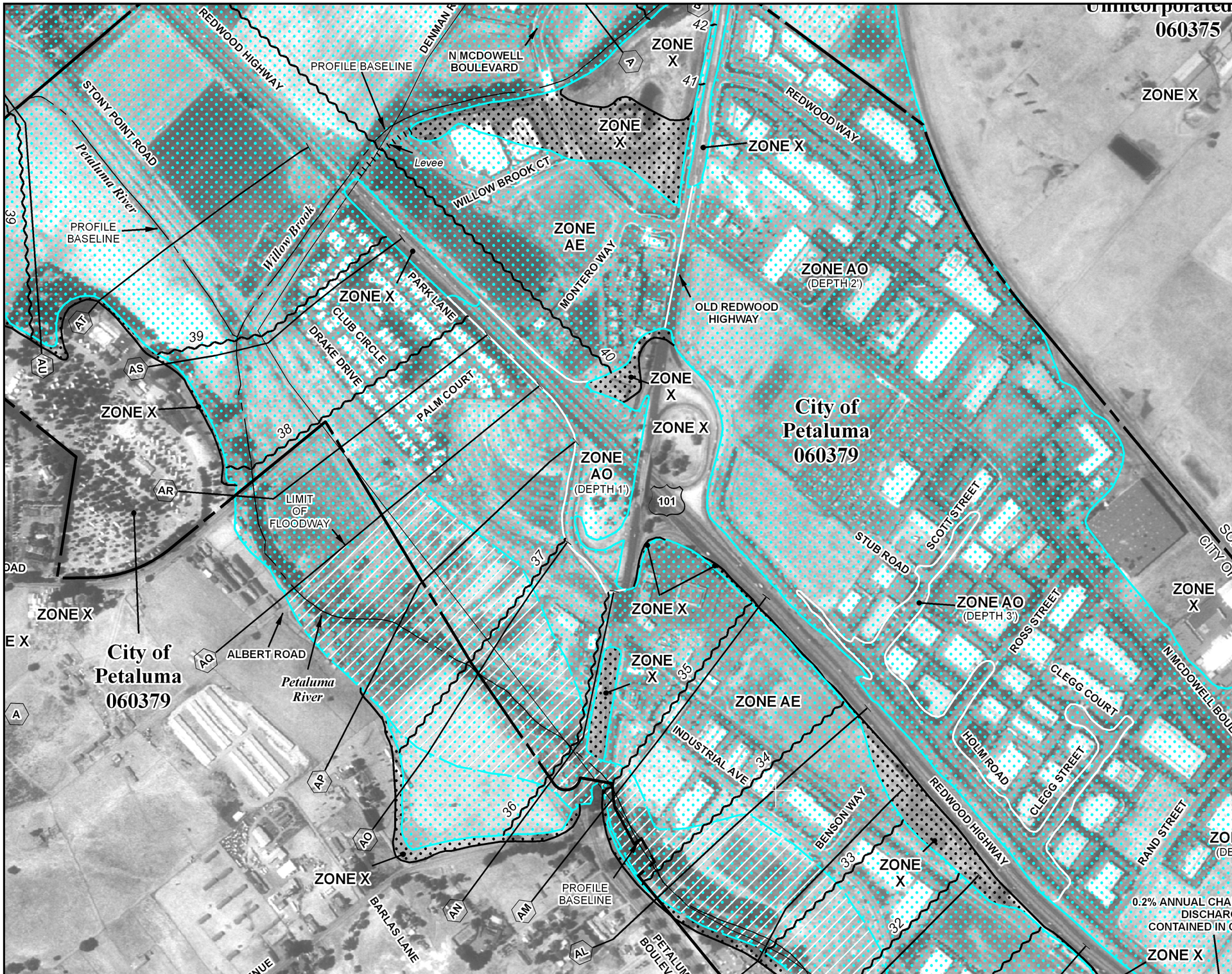
Project Number: 28645097

LITHOLOGY GRAPHICS

USCS Clayey Gravel; USCS Lean Clay with gravel; USCS Lean Clay with sand; USCS Fat Clay; USCS Lean Clay; USCS Poorly Graded Sand with silt; USCS Fat Clay with sand; USCS Gravelly Lean Clay; USCS Silty Sand; USCS Sandy Lean Clay; USCS Clayey Sand; USCS Silty, Clayey Sand; USCS Poorly Graded Gravel

GENERALIZED SOIL PROFILE
OLD REDWOOD HIGHWAY OC
PETALUMA, CALIFORNIA

SIMPLE FENCE B-SIZE - URS MODIFIED 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 2/1/10



MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0893E

FIRM

FLOOD INSURANCE RATE MAP

SONOMA COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 893 OF 1150

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
PETALUMA, CITY OF	060379	0893	E
SONOMA COUNTY	060375	0893	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06097C0893E

EFFECTIVE DATE
DECEMBER 2, 2008

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

FIGURE 3-4

Liquefaction Susceptibility Map

Susceptibility Level

- Very High
- High
- Moderate
- Low
- Very Low

Major Roads

Local Roads

Scale: 1 inch = 0.32 miles

This map is intended for planning use only and is not intended to be site-specific. Rather, it depicts the general risk within neighborhoods and the relative risk from community to community. More detailed maps are needed for site development decisions.

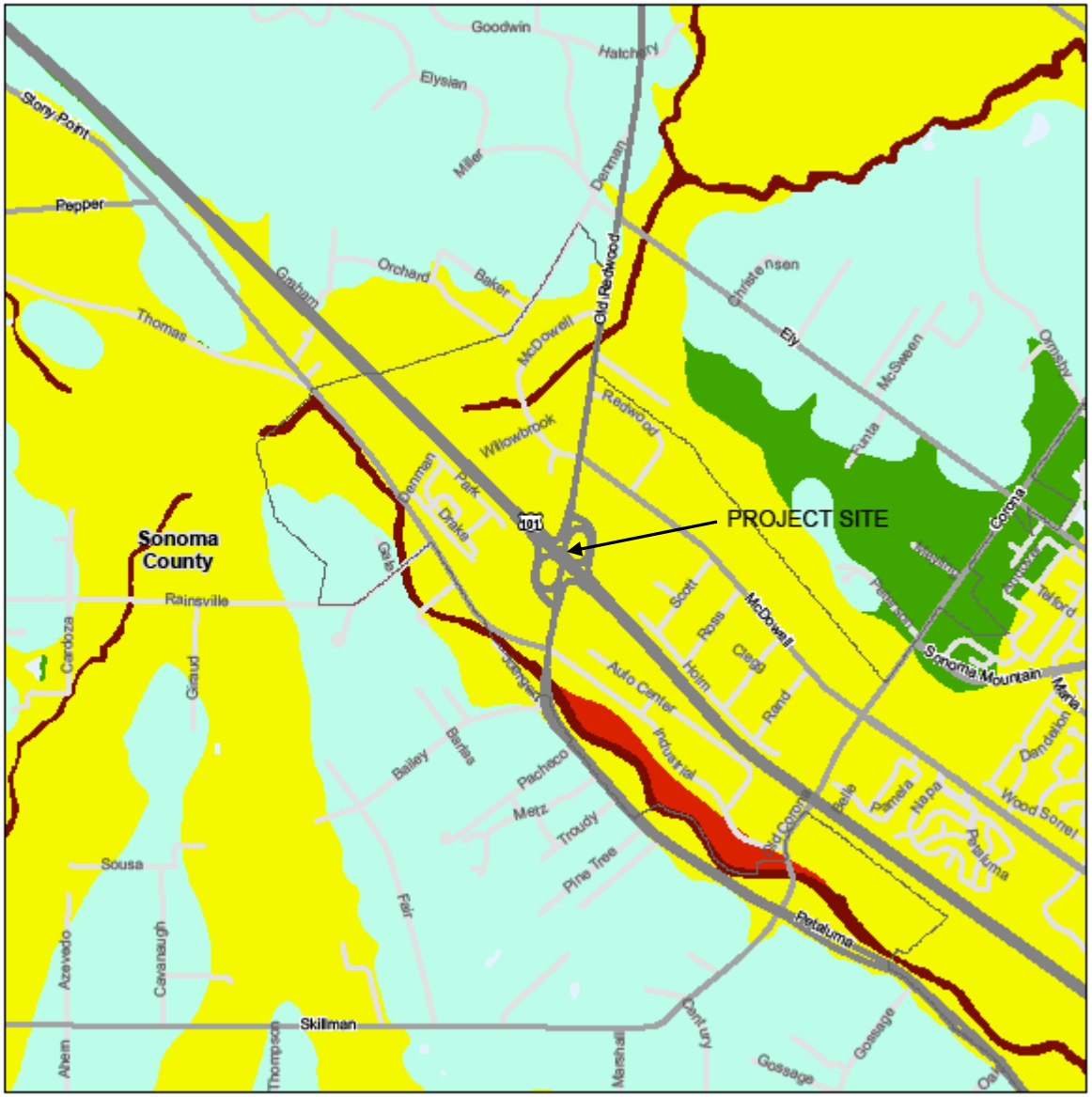
This map is available at http://quake.abag.ca.gov

Sources:
This map is based on work by William Lettis & Associates, Inc. and USGS. USGS Open-File Report 00-444, Knudsen & others, 2000 and USGS Open-File Report 2006-1037, Witter & others, 2006

For more information visit:
http://pubs.usgs.gov/of/2000/of00-444/
http://pubs.usgs.gov/of/2006/1037/

Map Prepared by the ABAG Earthquake Program. June 2009.

ABAG Geographic Information Systems



URS
55 South Market Street,
Suite 1500
San Jose, CA 95113
PHONE: (408) 297-9585
FAX: (408) 297-6962

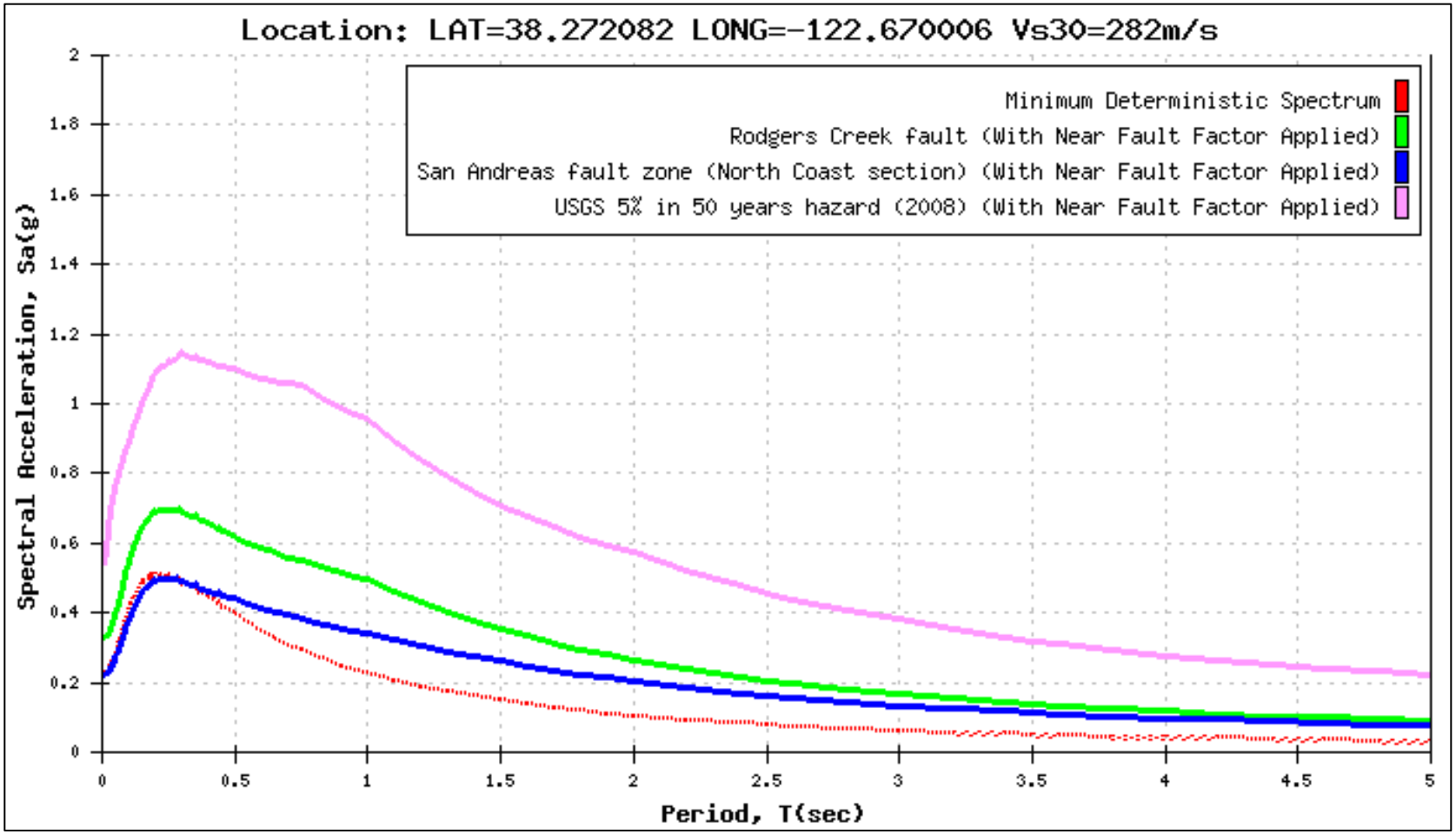
Old Redwood Highway
Petaluma, CA

Project No: 28645097

Liquefaction Susceptibility Map

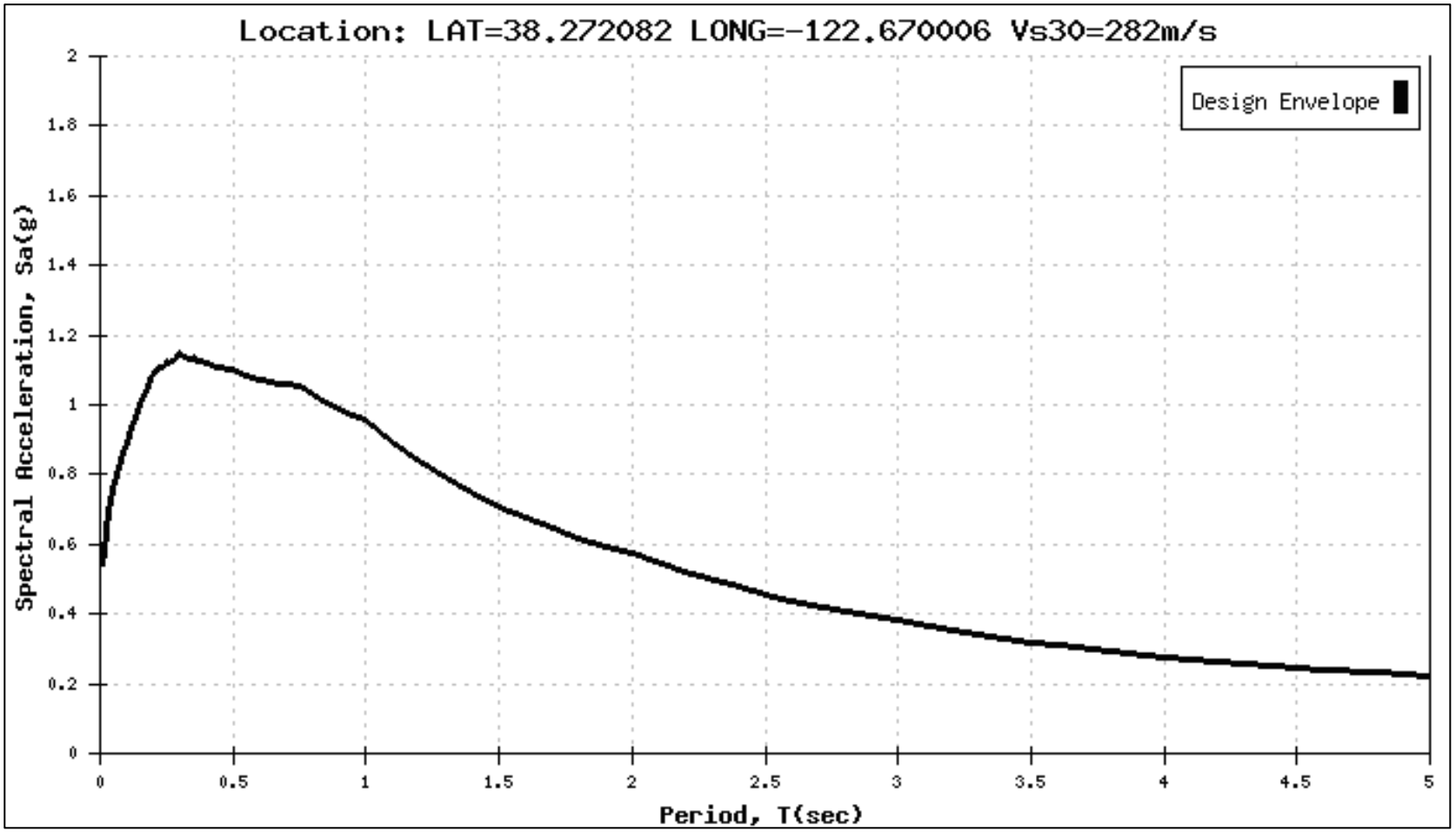
FIGURE 3-5

January, 2010



Reference: Caltrans ARS Online (2009)

URS 55 South Market Street, Suite 1500 San Jose, CA 95113 PHONE: (408) 297-9585 FAX: (408) 297-6962	PROJECT No 28645097	CALCULATED BY M. Thummaluru	**Calculated Spectra** **Old Redwood Highway** **Petaluma, CA**	**FIGURE 5-1**
	Date January 10, 2009	CHECKED BY S. Huang		



Reference: Caltrans ARS Online (2009)

URS 55 South Market Street, Suite 1500 San Jose, CA 95113 PHONE: (408) 297-9585 FAX: (408) 297-6962	PROJECT No 28645097	CALCULATED BY M. Thummaluru	**Recommended Acceleration Response Spectrum** **Old Redwood Highway** **Petaluma, CA**	**FIGURE 5-2**
	Date January 10, 2009	CHECKED BY S. Huang		

FIELD EXPLORATION PROGRAM

The geotechnical field investigation consisted of three geotechnical borings and one cone penetration test (CPT), extending to depths ranging from 26.5 to 96.5 feet below the existing ground surface. The explorations were performed on October 26, November 3 and 5, 2009, by Exploration Geoservices of San Jose, California (rotary wash boring), Clear Heart Drilling of Santa Rosa, California (hollow stem auger borings), and Gregg Drilling and Testing, Inc. of Martinez, California (CPT).

Boring and CPT locations were carefully selected to obtain supplemental subsurface information to provide 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 permits from the County of Sonoma, Permit and Resource Management Department, Well and Permit Section, and coordinated with appropriate personnel to accommodate the required inspection during and following exploration at each location.

Borings (R-09-001, A-09-004 and A-09-005)

The rotary wash and auger borings were drilled to provide the necessary information to evaluate the subsurface stratigraphy and to allow acquisition of soil samples for laboratory testing. The borings were drilled and sampled at the location indicated on the Site and Boring Location Plan, Figure 3-2. Borings A-09-004 and A-09-005 were advanced to a depth of 30 and 26.5 feet, respectively, and R-09-001 was advanced to a depth of 96.5 feet below existing ground surface using a truck-mounted drill rig under the supervision of a URS engineer who maintained a record of all field activities, classified the soils encountered using the Unified Soil Classification System (USCS), and prepared a log of the boring.

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 feet intervals and at changes in strata. Samples were obtained using the Modified California (MC) sampler and Standard Split Spoon sampler (SPT). A brief description of each of these samplers follows:

- **Modified California Sampler (MC):** The Modified California Sampler was used to obtain relatively undisturbed samples of cohesive materials. This sampler consists of a tube-lined barrel sampler with a nominal 2 inches inside diameter and 2½ inches outside diameter. A 140 lb hammer falling through a distance of 30 inches was used to drive the MC sampler. 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 inches drive.

- **Standard Split Spoon Sampler (SPT):** The Standard Spit Spoon Sampler was used to obtain disturbed samples of sand and gravel layers. The sampler consists of a split barrel with a nominal 1½ inches inside diameter and a 2 inches outside diameter. The standard penetration resistance of the soil is determined by the number of blows required to drive the sampler 18 inches into the soil with a 140 lb hammer falling through a distance of 30 inches. 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 inches drive.

One of the objectives of the field investigation was to obtain high-quality undisturbed samples for laboratory testing. An effort was made to minimize sample disturbance during sample handling and transportation. After careful withdrawal from the ground, the sample was placed upright and the ends of the sample were cleaned of disturbed soil. If possible, pocket penetrometer tests were performed on the bottom end of cohesive soil samples. Both ends of the samples were covered with plastic caps, and carefully transported to URS' laboratory.

Disposal of Cuttings

All drill cuttings and fluids generated during drilling of rotary wash boring were collected in drums for disposal in accordance with applicable local, state, and federal regulations.

Cone Penetration Test (CPT-09-003)

We also performed one CPT at the location shown on the Site and Boring Location Plan, Figure 3-2. The CPT was advanced to a depth of 96 feet below existing ground surface under the supervision of a URS representative.

The Cone Penetration Test (CPT) consists of pushing a cone-tipped probe into the soil while simultaneously recording the cone tip resistance and side friction resistance to penetration. The CPT was conducted in general accordance with ASTM specifications (ASTM D3441-79) using an electric cone penetrometer. The CPT equipment consists of a cone assembly mounted at the end of a series of hollow rods. A set of hydraulic rams is used to push the cone and rods into the soil while a continuous record of come and friction resistance versus depth is obtained in both analog and digital form at the ground surface.

The cone penetrometer assembly consists of a conical tip and a cylindrical friction sleeve. The conical tip has a 60-degree apex angle and a projected cross-sectional area of 15 cm^2. The cylindrical friction sleeve has a surface area of 225 cm^2. Both the conical tip and the cylindrical friction sleeve have outer diameters of 4.37 centimeters. The interior of the cone penetrometer is instrumented with strain gauges that allow simultaneous measurement of cone tip and friction sleeve resistance during penetration. Continuous electric signals from the strain gauges are transmitted by a cable in the sounding rods to analog and digital data recorders in the CPT truck.

Data obtained during a CPT consists of continuous stratigraphic information with close vertical resolution. Stratigraphic interpretation is based on relationships between cone tip resistance and friction resistance. The calculated friction ratio (CPT friction sleeve resistance divided by cone tip resistance) is used as an indicator of soil type. Granular soils typically have low friction ratios and high cone resistance, while cohesive or organic soils have high friction ratios and low cone resistance. These stratigraphic material categories form the basis for all subsequent calculations that utilize the CPT data. Soil interpretation presented on the CPT logs from this investigation was based on recent correlations developed by Robertson, 1990, presented on Figure A-1.

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.

Index Tests

Index tests were performed on both cohesive and cohesionless soil samples to aid in soil classification and in correlation with other engineering parameters. Index tests included Atterberg Limits, moisture content, dry density, and grain size distribution determinations. Atterberg Limits tests were performed in accordance with ASTM D 4318. The moisture content tests were performed in accordance with ASTM D 2216. Dry density was determined in accordance with ASTM D 2937. Gradation analyses were performed in accordance with ASTM D 422. The locations of these tests are indicated on the Logs of Test Borings adjacent to the appropriate sample depths. The results are summarized in Table B-1.

A plasticity chart graphically presenting the results of the Atterberg Limits tests is presented on Figure A-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 results of these tests are indicated on the Logs of Test Boring Sheet adjacent to the appropriate sample depths. The results are summarized in Table A-1.

TABLE A-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-09-004	11/5/2009	21+05	"ORH"	Rt. 26	1.5																		12.8	113
A-09-004	11/5/2009	21+05	"ORH"	Rt. 26	15																		16.2	118
A-09-004	11/5/2009	21+05	"ORH"	Rt. 26	26																	5280	22.9	103
A-09-004	11/5/2009	21+05	"ORH"	Rt. 26	28.5																		18.1	107
A-09-005	11/5/2009	24+39	"ORH"	Lt. 33	3.5																		10.5	119
A-09-005	11/5/2009	24+39	"C"	Lt. 33	8.5																	4800	20.4	109
A-09-005	11/5/2009	24+39	"C"	Lt. 33	13.5																		17.1	113
R-09-001	10/26/2009	22+07	"C"	Lt. 56	1																	1650	41.4	78
R-09-001	10/26/2009	22+07	"C"	Lt. 56	5																	5000	35.2	86
R-09-001	10/26/2009	22+07	"C"	Lt. 56	20														48	16	32		24	
R-09-001	10/26/2009	22+07	"C"	Lt. 56	30																	5090	16.1	116
R-09-001	10/26/2009	22+07	"C"	Lt. 56	35																	5120	24.9	99
R-09-001	10/26/2009	22+07	"C"	Lt. 56	40																	3530	32.4	88
R-09-001	10/26/2009	22+07	"C"	Lt. 56	45																		21.2	100

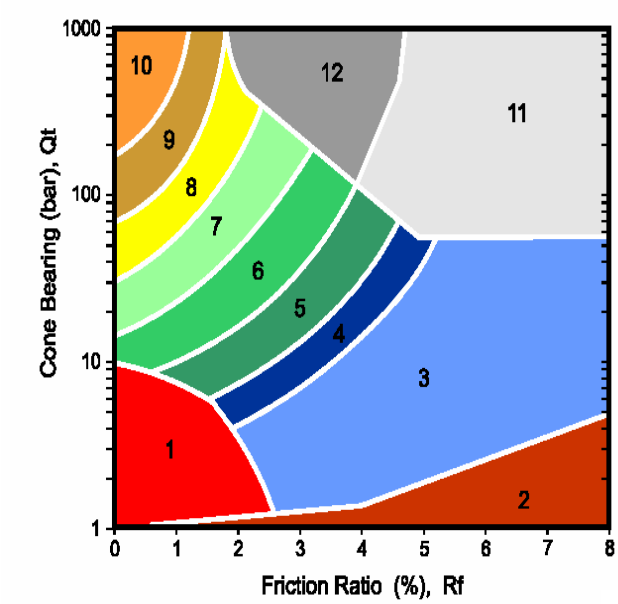
Cone Penetration Test Data & Interpretation

The Cone Penetration Test (CPT) data collected from your site are presented in graphical form in the attached report. The plots include interpreted Soil Behavior Type (SBT) based on the charts described by Robertson (1990). Typical plots display SBT based on the non-normalized charts of Robertson et al (1986). For CPT soundings extending greater than 50 feet, we recommend the use of the normalized charts of Robertson (1990) which can be displayed as SBTn, upon request. The report also includes spreadsheet output of computer calculations of basic interpretation in terms of SBT and SBTn and various geotechnical parameters using current published correlations based on the comprehensive review by Lunne, Robertson and Powell (1997), as well as recent updates by Professor Robertson. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg Drilling & Testing Inc. do not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and do not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software.

Some interpretation methods require input of the groundwater level to calculate vertical effective stress. An estimate of the in-situ groundwater level has been made based on field observations and/or CPT results, but should be verified by the user.

A summary of locations and depths is available in Table 1. Note that all penetration depths referenced in the data are with respect to the existing ground surface.

Note that it is not always possible to clearly identify a soil type based solely on q_t, f_s, and u_2. In these situations, experience, judgment, and an assessment of the pore pressure dissipation data should be used to infer the correct soil behavior type.



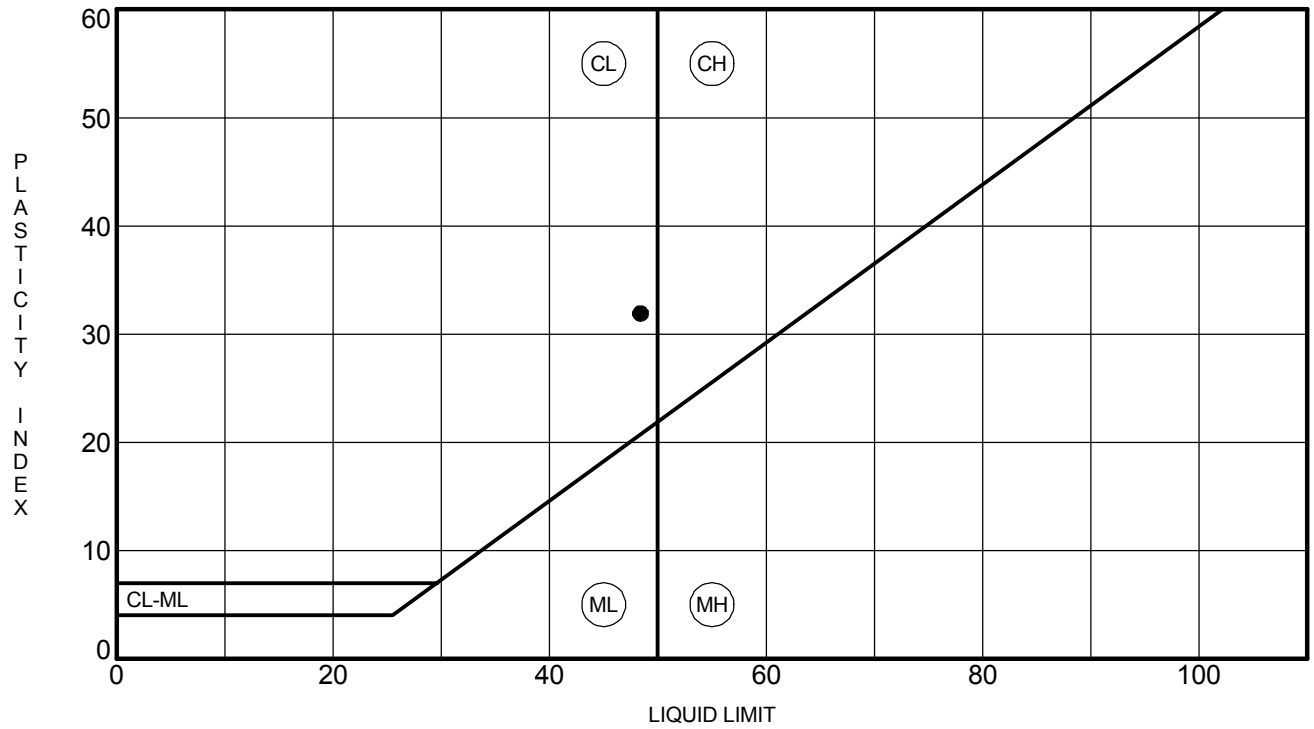
(After Robertson, et al., 1986)

ZONE		SBT
1		Sensitive, fine grained
2		Organic materials
3		Clay
4		Silty clay to clay
5		Clayey silt to silty clay
6		Sandy silt to clayey silt
7		Silty sand to sandy silt
8		Sand to silty sand
9		Sand
10		Gravely sand to sand
11		Very stiff fine grained*
12		Sand to clayey sand*

*over consolidated or cemented

Figure SBT

FIGURE A-1



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**R-09-001**	**20.0**	**48**	**16**	**32**		**Lean CLAY**

URS

55 S. Market St, Ste 1500
San Jose, CA 95113

ATTERBERG LIMITS' RESULTS

Project Name: Old Redwood Highway Intechange (28645097)
Location: Sonoma 101 7.4/8.1
Number: 12276K

FIGURE A-2

Pore Pressure Dissipation Tests (PPDT)

Pore Pressure Dissipation Tests (PPDT's) conducted at various intervals measured hydrostatic water pressures and determined the approximate depth of the ground water table. A PPDT is conducted when the cone is halted at specific intervals determined by the field representative. The variation of the penetration pore pressure (u) with time is measured behind the tip of the cone and recorded by a computer system.

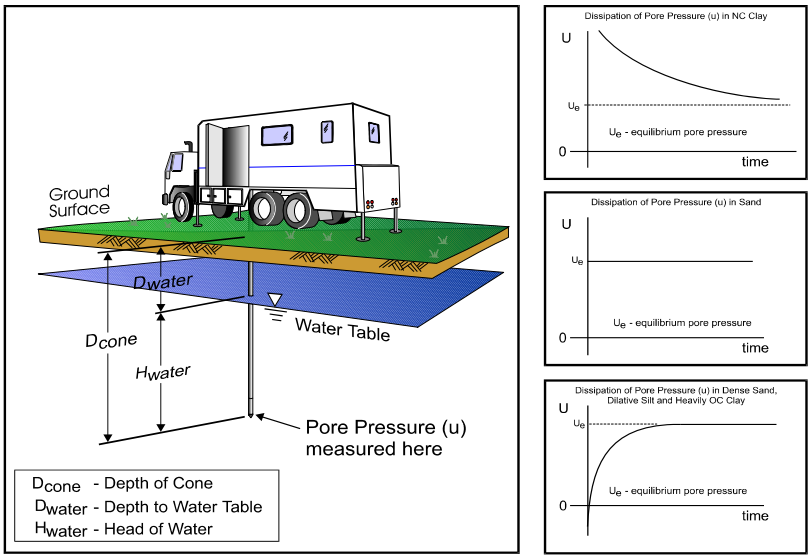
Pore pressure dissipation data can be interpreted to provide estimates of:

- Equilibrium piezometric pressure
- Phreatic Surface
- In situ horizontal coefficient of consolidation (c_h)
- In situ horizontal coefficient of permeability (k_h)

In order to correctly interpret the equilibrium piezometric pressure and/or the phreatic surface, the pore pressure must be monitored until such time as there is no variation in pore pressure with time, *Figure PPDT*. This time is commonly referred to as t_{100}, the point at which 100% of the excess pore pressure has dissipated.

A complete reference on pore pressure dissipation tests is presented by Robertson et al. 1992.

A summary of the pore pressure dissipation tests is summarized in Table 1.



Water Table Calculation

$$D_{water} = D_{cone} - H_{water}$$

where $H_{water} = U_e$ (depth units)

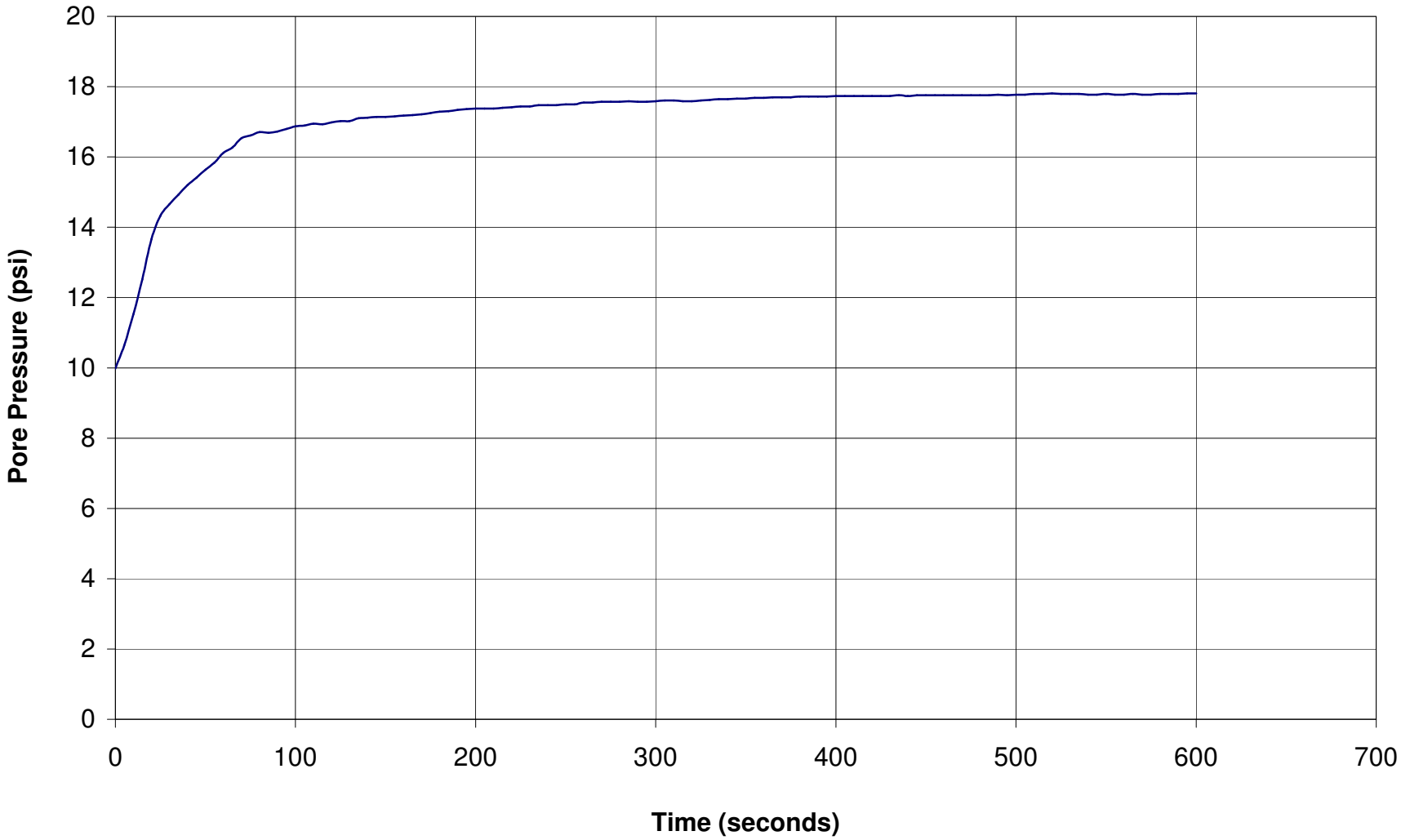
Useful Conversion Factors:
1psi = 0.704m = 2.31 feet (water)
1tsf = 0.958 bar = 13.9 psi
1m = 3.28 feet

Figure PPDT

GREGG DRILLING & TESTING

Pore Pressure Dissipation Test

Sounding: Cpt-09-003
Depth: 50.361
Site: OLD REDWOOD HWY
Engineer: C.RAMBO



REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER Stephen Huang No. C 42289 Exp. 03/31/12 CIVIL STATE OF CALIFORNIA

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100 W San Fernando St
Suite 200
San Jose, CA 95113

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

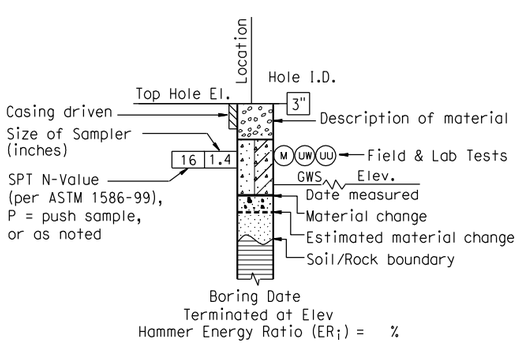
BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
⬚	O	Other

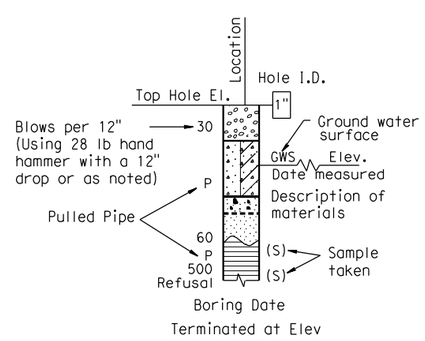
Note: Size in inches.

PLASTICITY OF FINE-GRAINED SOILS

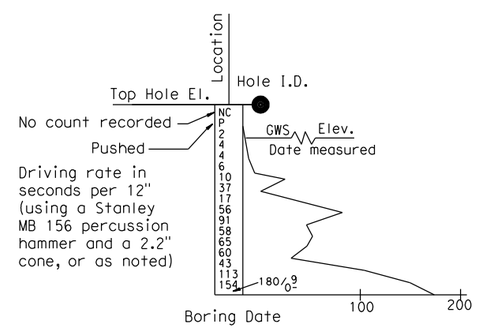
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



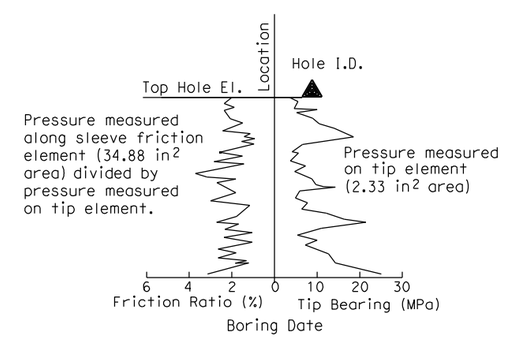
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. 20-0291	OLD REDWOOD HWY OC (REPLACE)
FUNCTIONAL SUPERVISOR	DRAWN BY: A. CHEUNG	FIELD INVESTIGATION BY:		POST MILES 7.65	LOG OF TEST BORINGS (1 OF 5)
NAME: S. HUANG	CHECKED BY: M. THUMMALURU	C. RAMBO			

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04
EA 0A1851

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES SHEET OF

FILE => ...\20-0159-z-ltb01.dgn

USERNAME => madhu_thummaluru DATE PLOTTED => 9/9/2010 TIME PLOTTED => 10:12:09 AM

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101	7.4/8.1		

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100 W San Fernando St
Suite 200
San Jose, CA 95113

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. 20-0291 POST MILES 7.65	OLD REDWOOD HWY OC (REPLACE) LOG OF TEST BORINGS (2 OF 5)
FUNCTIONAL SUPERVISOR NAME: S. HUANG	DRAWN BY: A. CHEUNG CHECKED BY: M. THUMMALURU	FIELD INVESTIGATION BY: C. RAMBO			

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04
EA 0A1851

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES SHEET OF

FILE => ...\20-0159-z-1tb02.dgn

USERNAME => madhu_thummaluru DATE PLOTTED => 9/9/2010 TIME PLOTTED => 10:12:20 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER Stephen Huang No. C 42289 Exp. 03/31/12 CIVIL STATE OF CALIFORNIA

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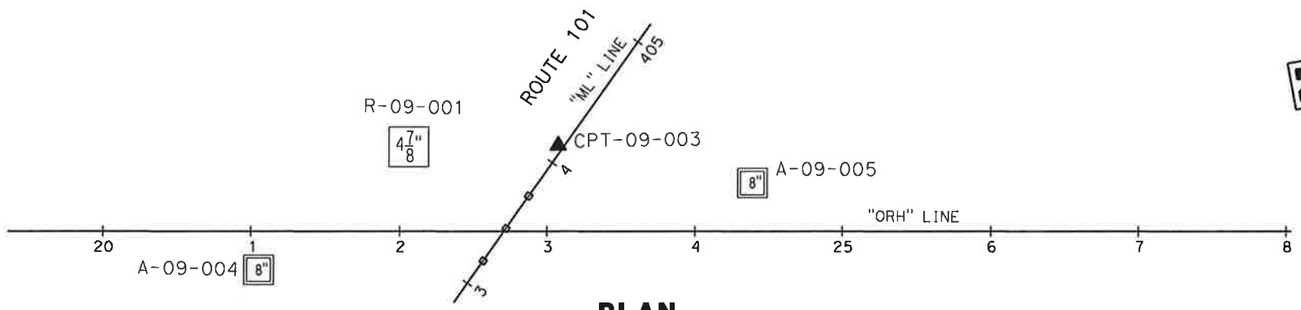
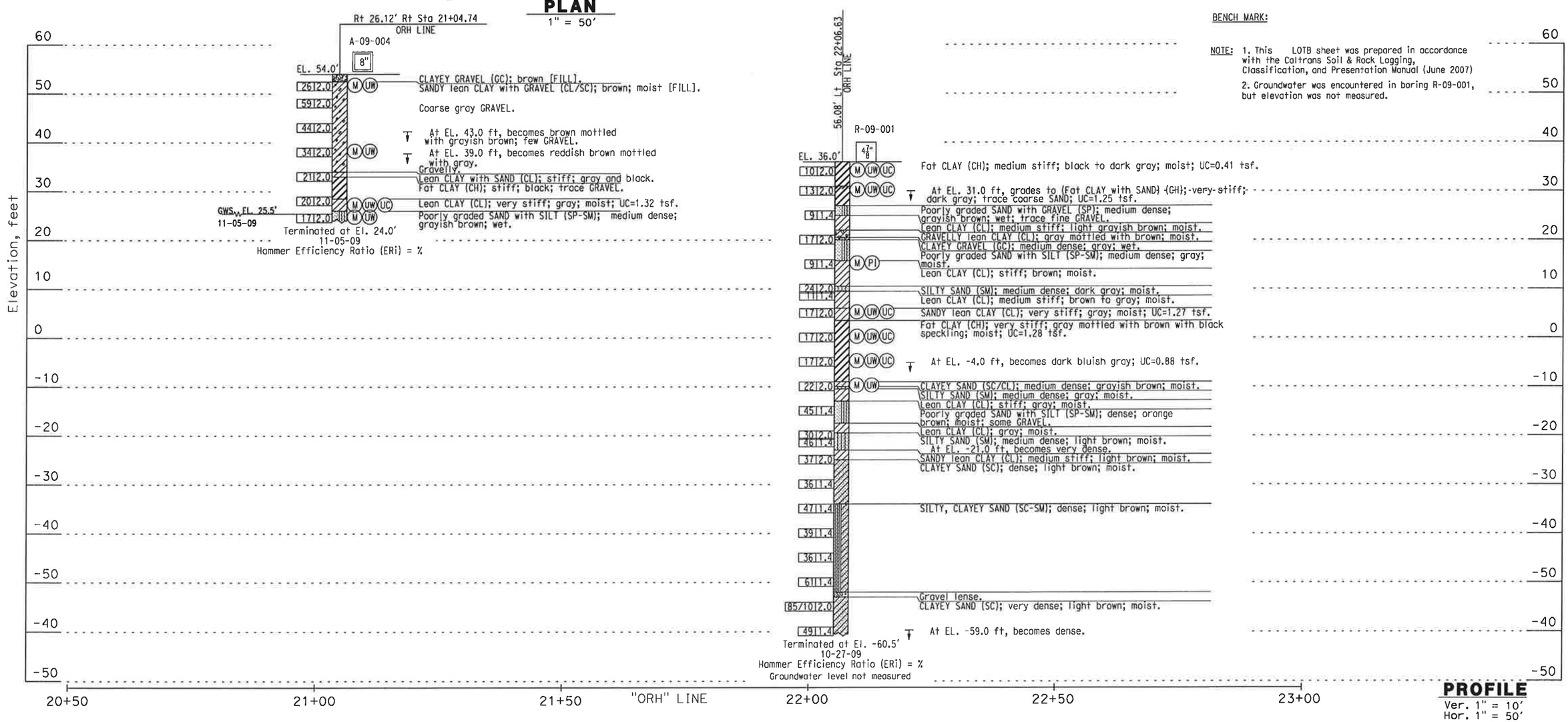
Oakland, CA 94612

URS CORPORATION
100 W San Fernando St
Suite 200
San Jose, CA 95113



PLAN
1" = 50'



BENCH MARK:

NOTE: 1. This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (June 2007)

2. Groundwater was encountered in boring R-09-001, but elevation was not measured.

PROFILE
Ver. 1" = 10'
Hor. 1" = 50'

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. 20-0291	OLD REDWOOD HWY OC (REPLACE)
FUNCTIONAL SUPERVISOR	DRAWN BY: A. CHEUNG	FIELD INVESTIGATION BY: C. RAMBO		POST MILES 7.65	LOG OF TEST BORINGS (3 OF 5)
NAME: S. HUANG	CHECKED BY: M. THUMMALURU				

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04
EA 0A1851

FILE => ...\20-0159-z-ltb03.dgn

DISREGARD PRINTS BEARING EARLIER REVISION DATES 1/14/10 9/9/10

REVISION DATES | SHEET | OF

USERNAME => madhu_thummaluru DATE PLOTTED => 9/9/2010 TIME PLOTTED => 10:23:02 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER Stephen Huang No. C 42289 Exp. 03/31/12 CIVIL STATE OF CALIFORNIA

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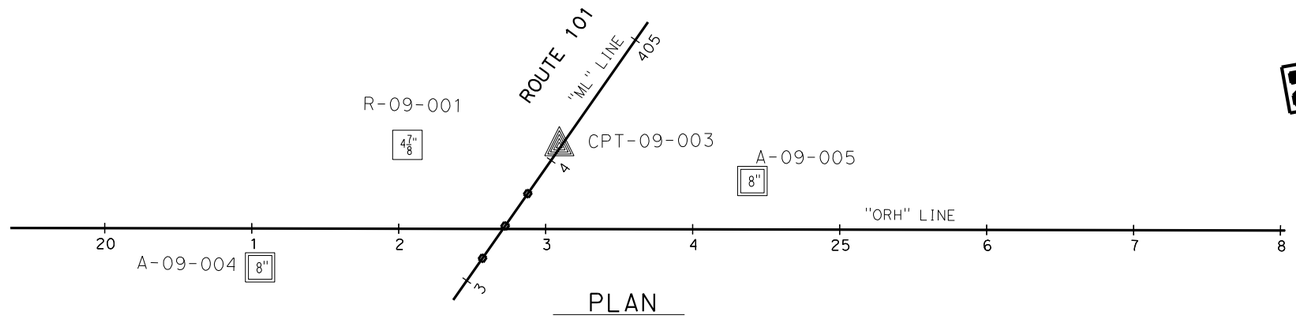
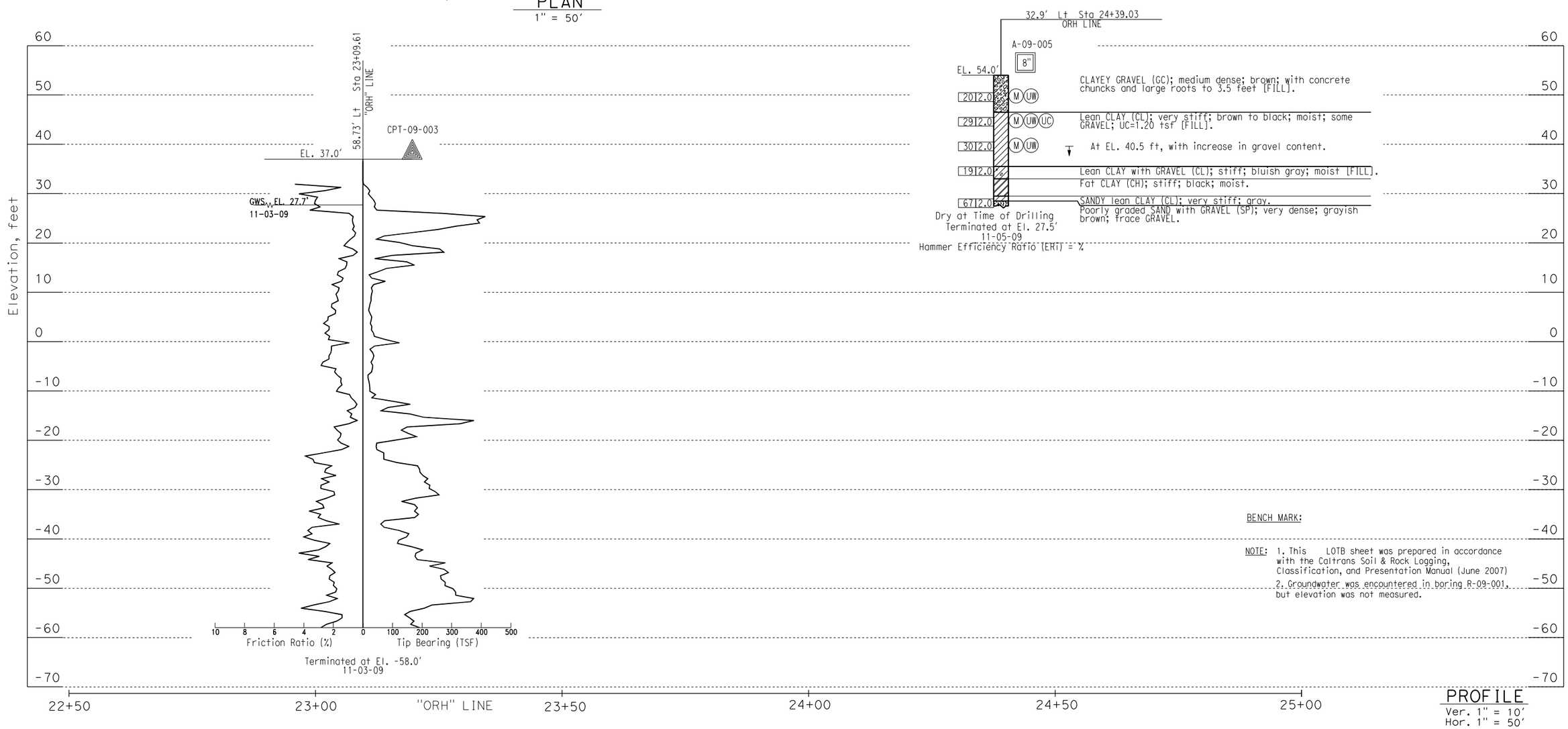
Oakland, CA 94612

URS CORPORATION
100 W San Fernando St
Suite 200
San Jose, CA 95113



PLAN
1" = 50'



BENCH MARK:

NOTE: 1. This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (June 2007)
2. Groundwater was encountered in boring R-09-001, but elevation was not measured.

PROFILE
Ver. 1" = 10'
Hor. 1" = 50'

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH	BRIDGE NO. 20-0291 / POST MILES 7.65	OLD REDWOOD HWY OC (REPLACE) LOG OF TEST BORINGS (4 OF 5)
FUNCTIONAL SUPERVISOR NAME: S. HUANG	DRAWN BY: A. CHEUNG / CHECKED BY: M. THUMMALURU / FIELD INVESTIGATION BY: C. RAMBO				

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 04
EA 0A1851

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 1/11/10 9/9/10

SHEET OF

FILE => ...\20-0159-z-1tb04.dgn

USERNAME => madhu_thummaluru DATE PLOTTED => 9/9/2010 TIME PLOTTED => 10:12:38 AM

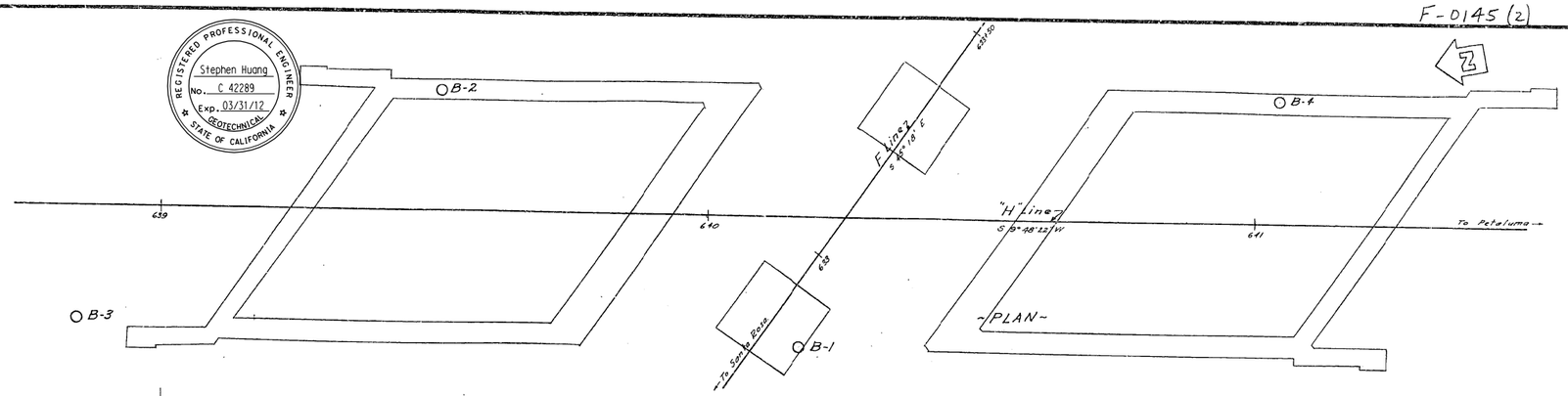
F-0145 (2)

93 154

IV Son 101 F -88-79

March 15, 1960

REGISTERED PROFESSIONAL ENGINEER
Stephen Huang
No. C 42289
Exp. 03/31/12
GEOTECHNICAL
STATE OF CALIFORNIA



DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.					
DIST.	COUNTY	ROUTE	MILE POST-TOTAL PROJECT	Sheet No.	Total Sheets
04	SCl	101	7.4/8.1		
REGISTERED GEOTECHNICAL ENGINEER				DATE	

DATE PLOTTED => 5/11/2011

OLD REDWOOD HWY OC (REPLACE)

LOG OF TEST BORINGS (5 OF 5)

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

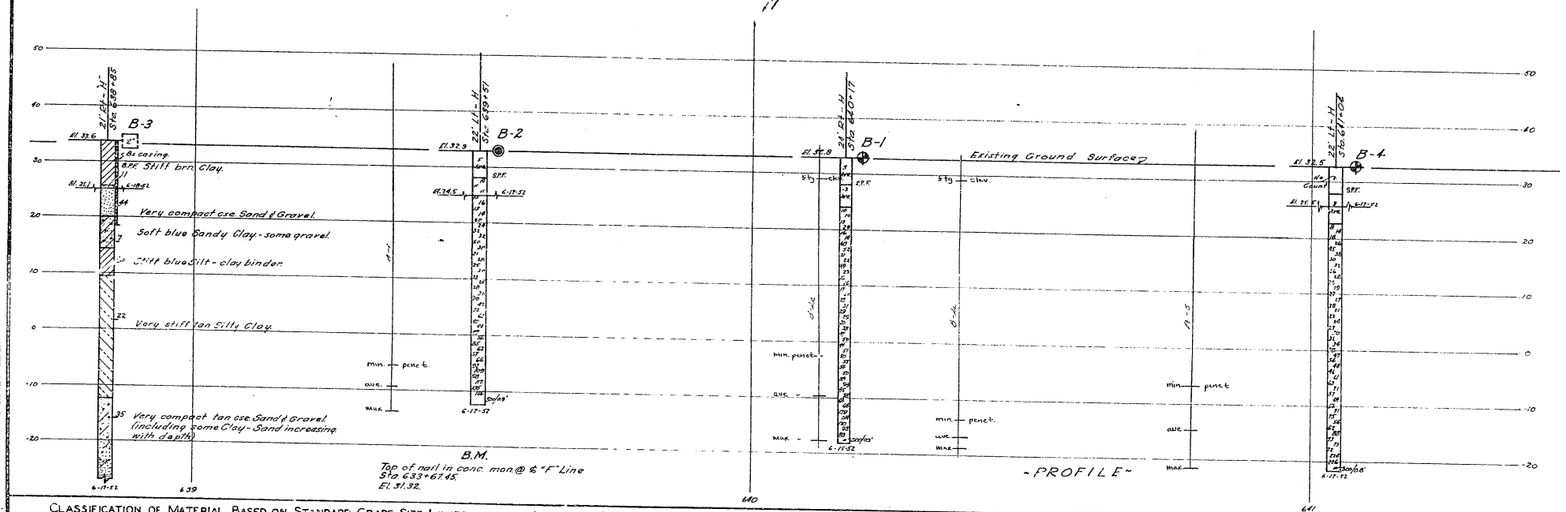
CU: 04
EA: 4A3301

BRIDGE No. 20-0291

Sheet ___ of ___

Boring	Station	Offset from A Line
B-1	22+86	21.4 Lt
B-2	23+96	0.6 Lt
B-3	24+56	27.7 Lt
B-4	21+62	2.0 Rt

AS BUILT PLANS
Contract No. 54-4TC63
Date Completed
Document No. 40002280



~Notes~

Relative rates of penetration were obtained as follows:
B-1, 2 & 4 (secs per foot) driving 1 3/8" A-Rod or 2 1/4" Cone Penetrometer with No. 2 Mission non-Terry air hammer at 115 p.s.i. gage pressure.
B-3 (blows per foot) driving 14" Sampler with 140 lb. hammer and a 30" free fall.

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

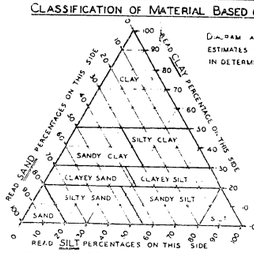


DIAGRAM AND TABLE SHOWING THE BASIS FOR ESTIMATES OF GRADE SIZE DISTRIBUTION USED IN DETERMINATION OF CLASS NAMES

GROUPING USED IN TRIANGULAR CLASSIFICATION			
CLASS NAME	PERCENTAGE OF SIZES PRESENT		
	SAND	SILT	CLAY
SAND	80-100	0-20	0-20
SILTY SAND	45-80	0-55	0-20
SANDY SILT	0-45	55-80	0-20
SILT	0-20	80-100	0-20
CLAYEY SAND	30-80	0-42	20-30
CLAYEY SILT	0-30	42-80	20-30
SANDY CLAY	50-70	0-40	30-50
SILTY CLAY	0-30	20-70	30-50
CLAY	0-50	0-30	50-100

IF GRAVEL IS PRESENT IN APPRECIABLE AMOUNTS THE TERM "GRAVELLY" MAY BE ADDED TO THE CLASS NAME, VIS "GRAVELLY SAND." THE TERMS "COARSE," "MEDIUM" AND "FINE" WHEN USED TO DESCRIBE GRAVEL, SAND AND SILT REFER TO STANDARD GRADE SIZE LIMITS

LEGEND OF BORING OPERATIONS

- PLAN OF AUG. BORING
- 1" SAMPLER BORING
- ROTARY WASH BORING
- 1" CLOSED SAMPLER DRIVEN
- CORE BORING
- 2 1/2" PENETROMETER DRIVEN
- 1 3/8" SAMPLER BORING
- 2" TO 5" AUGER BORING
- 6" TO 20" AUGER BORING
- CASING DRIVEN
- JET BORING
- SAMPLE TAKEN
- 1 3/8" A-ROD DRIVEN

THE APPROPRIATE BORING SYMBOLS DESIGNATING THE METHOD OF OPERATION ARE SHOWN AT THE UPPER RIGHT-HAND CORNER OF THE RESPECTIVE BORING. WHERE TOOL CHANGES WERE MADE DURING THE BORING OPERATION SYMBOLS ARE SHOWN AT THE POINT OF CHANGE.

LEGEND OF EARTH MATERIALS

- GRAVEL - G
- SAND - S
- SILT - SI
- CLAY - C
- SILTY SAND - SI S
- CLAYEY SAND - C S
- SANDY SILT - S SI
- CLAYEY SILT - C SI
- SANDY CLAY - SC
- SILTY CLAY - SI C
- PEAT AND/OR ORGANIC CLAY - O
- SANDSTONE - SS
- SHALE - SH
- BROKEN ROCK (FRAGMENTS) - BR
- ROCK - R
- FILL MATERIAL

ABBREVIATIONS

EL 69.4	ELEVATION OF GROUND AT TEST HOLE
bpf	BLOWS PER FOOT - (SEE NOTE ABOVE)
P	PULLED PIPE
M	MOISTURE AS % DRY WEIGHT
EL 54.3, 9-12-59	ELEVATION OF GROUND WATER AND DATE

NOTES

THE CONTRACTOR'S ATTENTION IS DIRECTED TO SECTION 2, ARTICLE (c) OF THE STANDARD SPECIFICATIONS AND TO THE SPECIAL PROVISIONS ACCOMPANYING THIS SET OF PLANS.

CLASSIFICATION OF EARTH MATERIAL, AS SHOWN ON THIS SHEET IS BASED UPON FIELD INSPECTION AND IS NOT TO BE CONSTRUED TO IMPLY MECHANICAL ANALYSIS.

CONTRACT NO. 54-4TC63
DATE ACCEPTED DEC 29 1958
AS BUILT
PROJECT ENGINEER
REVISIONS BY
DATE

DENMAN OVERCROSSING

LOG OF TEST BORINGS

SCALE 1" = 10'
FILE NO.
BRIDGE NO. 20-159
DRAWING NO. 2921-8

PREL. DRAWING NO. P-2921

XS-16-

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE ____ SIGNATURE ____ TITLE ____

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

04-SON-101
PM 7.4-8.1
EA 04-0A1851(12276K)

Old Redwood Highway Interchange Project
Sonoma County, California

Draft Location Hydraulic Study Report

Prepared for:

Prepared by:

January 2010

Executive Summary

The Sonoma County Transportation Authority (SCTA), in cooperation with the California Department of Transportation (Caltrans), has proposed the upgrade of the Old Redwood Highway Interchange along US 101 to relieve congestion on the freeway and the local transportation system. Improvements proposed for the Project would accommodate four lanes of traffic with a 12 ft median, class II bicycle lanes, and pedestrian sidewalks.

This Location Hydraulic Study evaluates and discusses the potential floodplain impacts that could result from the construction of the Project. It also proposes measures to mitigate these impacts.

The Federal Emergency Management Agency (FEMA) Flood Insurance Study for the City of Petaluma documents a history of flooding events in the Project study area. FEMA floodplain maps indicate that there are three floodplain zones in the Project limits associated with Willow Brook Creek that cross the Project limits and Petaluma River, which is adjacent to the Project. The floodplains are designated as Flood Hazard Areas in Zones AE, AO, and X. The floodplains delineated on these maps represent the base floodplains. The base flood is a flood that has a 1 percent chance of being equaled or exceeded in any given year, and the area inundated by the base flood is the base floodplain.

The City of Petaluma is currently undergoing a re-study of its floodplain. West Consultants, Inc (WCI) is performing the re-study, and as this report is being submitted, FEMA is in the final stages of approving WCI's study. WCI provided WRECO with their current results, which include updated base flood elevations (BFEs). The floodplain delineation within the Project limits is now designated as Flood Hazard Area Zone AE. WRECO received concurrence from Caltrans to use the BFEs from WCI's re-study, pending FEMA approval. On average, WCI's study indicates the BFEs are 2 ft below the existing Flood Insurance Rate Maps within the Project area. Based on WCI's re-study, the 24-hour 100-yr storm event would not overtop Redwood Highway (US 101).

Improvements proposed for the Project include removing the existing overcrossing and replacing it with a wider overcrossing, reconfiguring interchange ramps, adding additional turn lanes, and improving vehicle storage and traffic operations systems at the ramp. All of these improvements would encroach onto the base floodplain Zone AE, and loss of floodplain storage is expected. However, measures would be implemented to the maximum extent practical within the limited right-of-way to recover floodplain storage.

Calculations performed by URS indicated the Project will require 3.84 acre-ft (6,200 cy) of fill within the floodplain. The Project proposes to excavate 5.76 acre-ft (9,300 cy) storage volume basins and ditch to mitigate the amount of fill being added in the same floodplain zone.

The Project Team will propose drainage design improvements to accommodate increased peak storm water runoff from the roadway. Appropriate Best Management Practices are proposed to minimize storm water impacts.

As mentioned previously, the goal of the Project is to improve traffic operations and to relieve traffic congestion. The Project has considered practicable alternatives to minimize floodplain impacts while trying to accomplish this purpose.

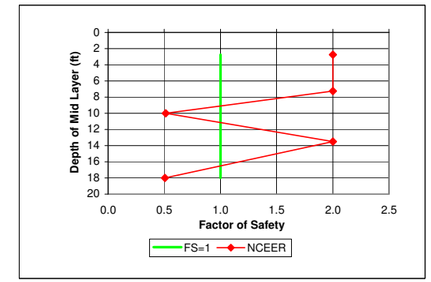
LIQUEFACTION ANALYSIS

Project	Replacement of Old Redwood Highway
Project No.	28645097
Boring No.	R-09-001

PGA =	0.53	
M_w =	7.1	
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($CSR_M/CSR_{M=7.5}$)		0.85

Note: Cells in Red must be input

Hammer type :	Type		C_E	Code	C_E
	Donut		0.75	1	3
	Safety		1	2	
	Auto		1.33	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. NCEER	Liquefy ? NCEER	F.S=1.0
	(USCS)	pcf	ft	m	ft	m	psf	psf	psf						%	FC< 5%	EQ					during EQ	Critical								
1	CH	110	5.5	1.68	2.75	0.84	303	0	303	0.996	0.343													1.15	1.20	1.17	1.000	Y	2.00	N	1
2	CL	115	9.0	2.74	7.3	2.21	806	265	541	0.985	0.506													1.15	1.20	1.17	1.000	N	2.00	N	1
3	SP-SM	115	11.0	3.35	10.0	3.05	1,123	437	686	0.979	0.552	14	S	14	10	15.2	1.46	1.33	1.00	0.75	1.00	22	0.241	1.15	1.20	1.17	1.000	N	0.51	Liquef	1
4	CL	115	16.0	4.88	13.5	4.11	1,525	655	870	0.972	0.587													1.15	1.20	1.17	1.000	N	2.00	N	1
5	SP-SM	125	20.0	6.10	18.0	5.49	2,063	936	1,127	0.962	0.607	20	M	16	10	17.2	1.21	1.33	1.00	0.85	1.00	24	0.262	1.15	1.20	1.17	1.000	N	0.51	Liquef	1
6	CL	115	25.5	7.77	22.8	6.93	2,629	1,232	1,396	0.949	0.616													1.15	1.20	1.17	1.000	N	2.00	N	1
7	SM	125	26.5	8.08	26.0	7.92	3,008	1,435	1,572	0.938	0.618	24	M	19.2	15	22.6	1.06	1.33	1.00	0.95	1.00	30	0.459	1.15	1.20	1.17	1.000	N	2.00	N	1
8	CL	115	45.0	13.72	35.8	10.90	4,134	2,044	2,090	0.885	0.603													1.15	1.20	1.17	1.000	N	2.00	N	1
9	SC	120	46.5	14.17	45.8	13.94	5,288	2,668	2,620	0.796	0.553	22	M	17.6	15	20.9	0.85	1.33	1.00	1.00	1.00	24	0.262	1.15	1.20	1.17	0.967	N	0.54	Liquef	1
10	CL	115	49.0	14.94	47.8	14.55	5,521	2,792	2,729	0.776	0.541													1.15	1.20	1.17	0.961	N	2.00	N	1
11	SM	125	53.5	16.31	51.3	15.62	5,946	3,011	2,935	0.740	0.516	45	S	45	15	49.7	0.81	1.33	1.00	1.00	1.00	53	0.459	1.15	1.20	1.17	0.949	N	2.00	N	1

Layer Number	Depth to Bot. Layer	Thickness	σ_o	u	σ'_o	r_d	$(N_1)_{60-cs}$	Liquefy ? NCEER	τ_{cyc}	$CSR_{M=7.5}$ τ_{cyc}/σ'_o	CSR_M τ_{cyc}/σ'_o	Volumetric Strain**			Settl.
		ft	psf	psf	psf				psf				%		in
1	5.5	5.5	303	0	303	0.996	0.0	N	103.7	0.343	0.29				
2	9.0	3.5	806	265	541	0.985	0.0	N	273.6	0.506	0.43				
3	11.0	2.0	1,123	437	686	0.979	22.0	Liquef	378.6	0.552	0.47		1.6		0.38
4	16.0	5.0	1,525	655	870	0.972	0.0	N	510.5	0.587	0.50				
5	20.0	4.0	2,063	936	1,127	0.962	23.6	Liquef	683.4	0.607	0.52		1.3		0.62
6	25.5	5.5	2,629	1,232	1,396	0.949	0.0	N	859.6	0.616	0.52				
7	26.5	1.0	3,008	1,435	1,572	0.938	30.3	N	972.0	0.618	0.53				
8	45.0	18.5	4,134	2,044	2,090	0.885	0.0	N	1260.7	0.603	0.51				
9	46.5	1.5	5,288	2,668	2,620	0.796	23.7	Liquef	1450.1	0.553	0.47		1.30		0.23
10	49.0	2.5	5,521	2,792	2,729	0.776	0.0	N	1475.5	0.541	0.46				

Total Settlement (inch) = 1.24

* 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.

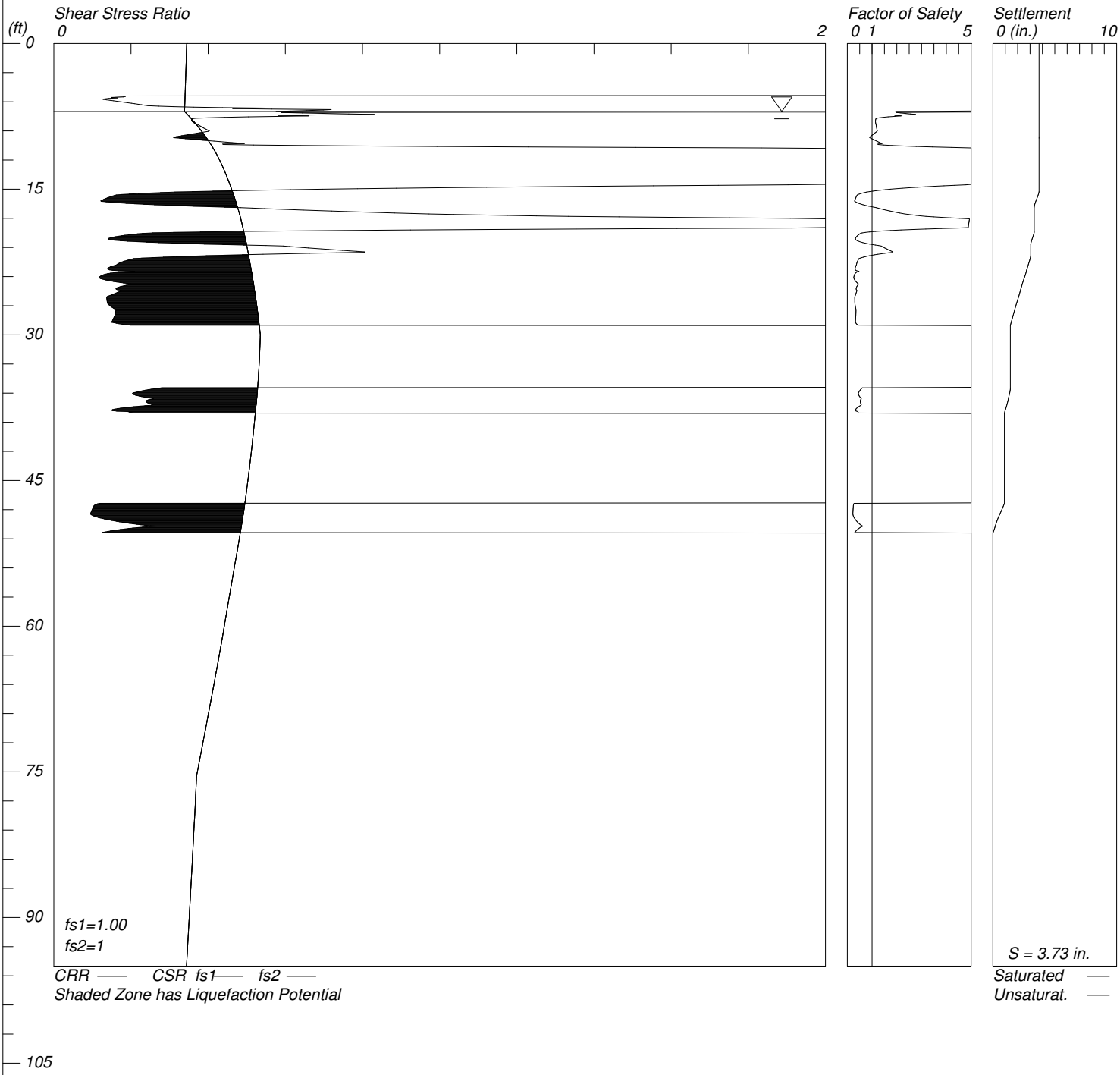
** Note: These values were obtained from a chart for estimation of volumetric strain in saturated sands based on a cyclic stress ratio and standard penetration resistance (Tokimatsu and Seed, 1987).
See figure 9.53 from "Geotechnical Earthquake Engineering" by S. Kramer.

LIQUEFACTION ANALYSIS

Replacement of Old Redwood Highway Overcrossing

Hole No.=CPT-09-003 Water Depth=7 ft

Magnitude=7.1
Acceleration=0.53g



US 101 CITY OF PETALUMA OLD REDWOOD HIGHWAY OVERCROSSING PROJECT

IN PETALUMA
FROM POST MILE 7.4 AT STATION 377+00 WEST TO POST MILE 8.1 AT STATION 439+00 ON US 101

OLD REDWOOD HIGHWAY OVERCROSSING
BRIDGE NO. 20-0159
FOUNDATION INVESTIGATION REPORT

Prepared for

URS

Prepared by

V&A

February 2010

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APPENDIX

Appendix A: Soil Sample Minimum Resistivities and Chemical Analysis

EXECUTIVE SUMMARY

The City of Petaluma located in Sonoma County, CA, is proposing to modify the overcrossing at the Old Redwood Highway at US 101 Interchange. In addition to the Interchange, this project will be constructing new retaining walls, a soundwall and extending the existing box culverts within the project limits from Post Mile 7.4 at Station 377+00 to Post Mile 8.1 at Station 439+00 on US 101 north of Petaluma River.

V&A was retained by the project designer URS Corporation to perform a soil corrosivity survey within the project limits with regards to the Overcrossing foundation. V&A performed in-situ soil resistivity testing at 12 locations (two of them specifically for the bridge) and interpreted the field data collected. In addition V&A interpreted the corrosivity test results from the analytical lab analysis performed by Cooper Testing Laboratory in Palo Alto, CA, on selected boring samples. The report includes the field data collected, the test methods used to perform the in-situ soil resistivity, field data analysis, laboratory analysis and test results, conclusions and recommendations.

In order to determine the soil corrosivity levels from the test results, CALTRANS Memo to Designers 3-1, July 2008 (the Memo), is used. Based on the results obtained and according to the Memo, the soil samples tested are considered to be *non-corrosive to* reinforced concrete structures and steel piles. This conclusion is made based on the values of minimum soil resistivity, pH, sulfates and chlorides.

The result of the minimum soil resistivity of one boring sample indicates that soil resistivity is well below 1,000 ohm-cm. According to the Memo, a site is considered corrosive when the soil has a minimum resistivity of less than 1,000 ohm-cm and either contains a chloride concentration of 500 ppm or greater, or a sulfate concentration of 2,000 ppm or greater. Therefore, this soil is considered *non-corrosive*, regardless of the very low soil resistivity test result.

Based on the findings and the Memo, this report makes recommendations for the following:

- Buried Reinforced Concrete Structures and Cast in Place Piles
- Prestressed Concrete Piles, and
- Steel Piles

INTRODUCTION

V&A was retained by URS Corporation to perform a corrosion survey on US 101, in Petaluma, CA, from Post Mile 7.4 at Station 377+00 to Post Mile 8.1 at Station 439+00. The objective of this 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 30.5 meters below existing grade. This report provides recommendations for corrosion control of structural foundation materials under consideration for the proposed Old Redwood Highway Overcrossing Bridge No. 20-0159 Project (Figure 1) on US 101 in Petaluma, CA. 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, Memo to Designers 3-1, July 2008. The Memo considers representative soil or water samples to be corrosive to reinforced concrete and steel if one or more of the following conditions exist:

- The chloride concentration is 500 ppm or greater
- The sulfate concentration is 2,000 ppm or greater
- 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 the geotechnical investigation were provided to V&A for laboratory testing. The soil sample was 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 soil samples selected from borings ranged from 434 to 3,934 ohm-cm. The soil pH ranged from 7.3 to 8.6. Water-soluble chloride concentration ranged from less than 2 to 333 mg/kg and water-soluble sulfate concentration ranged from less than 5 to 262 mg/kg. A minimum soil resistivity of less than 1,000 ohm-cm was measured at Boring Location A-09-111 (Appendix A).

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 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 concrete. 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 Locations No. 1 and 2 (Figure 2) along the US 101 City of Petaluma Old Redwood Highway Interchange Project at the proposed bridge and retaining wall locations. Locations 1 and 2 were specifically tested for soil resisitivity for the bridge foundation report. Tables 1 and 2 provide field resistivity data for Locations 1 and 2. Refer to Materials report and Retaining Wall Foundation report for the complete field resistivity data (12 Locations).

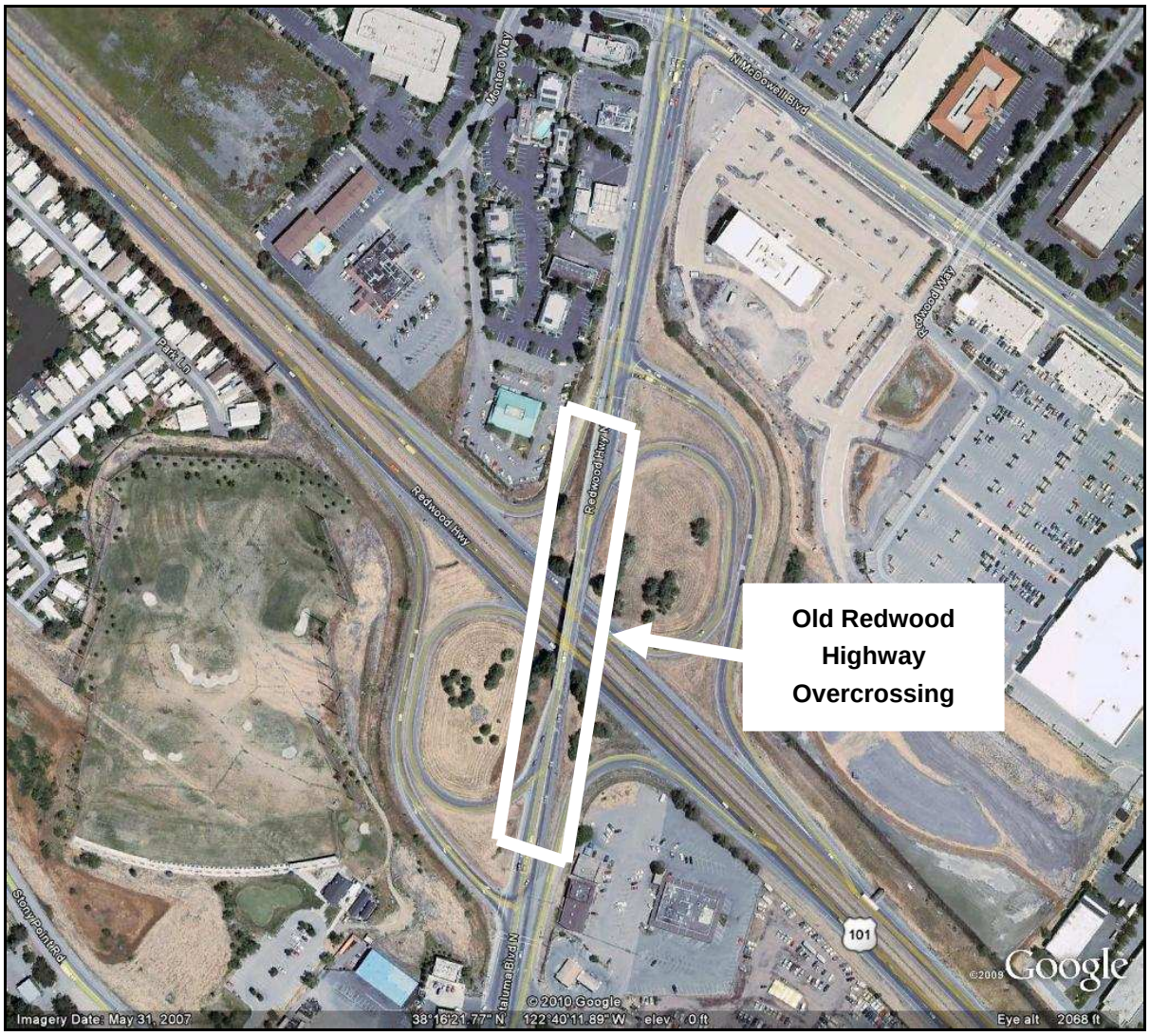


Figure 1. Project Site Map* for Old Redwood Highway Overcrossing Foundation Investigation

*www.google.com

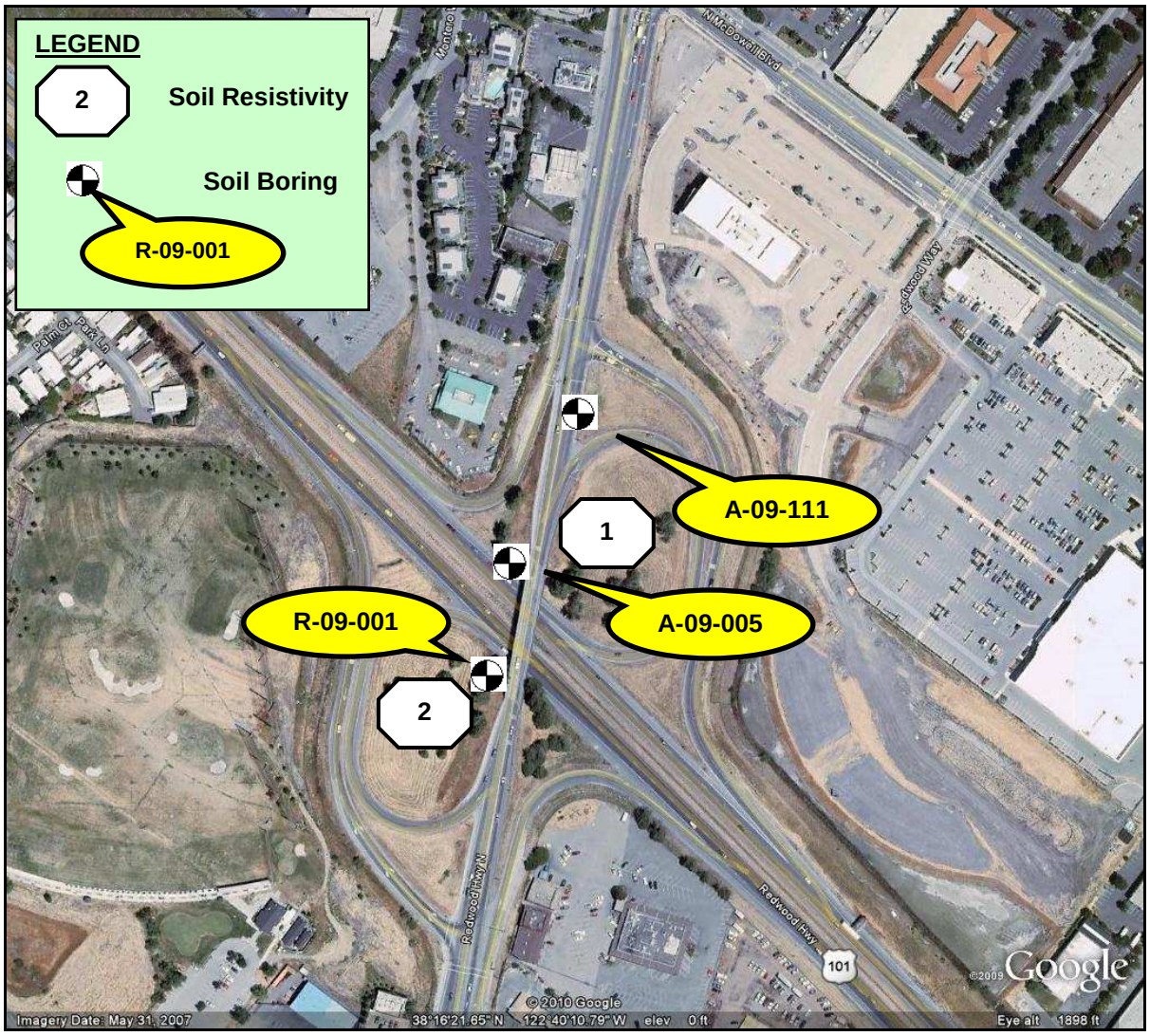


Figure 2. In-Situ Soil Resistivity Test and Boring Locations*

*Locations are approximate, map courtesy of www.google.com

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).

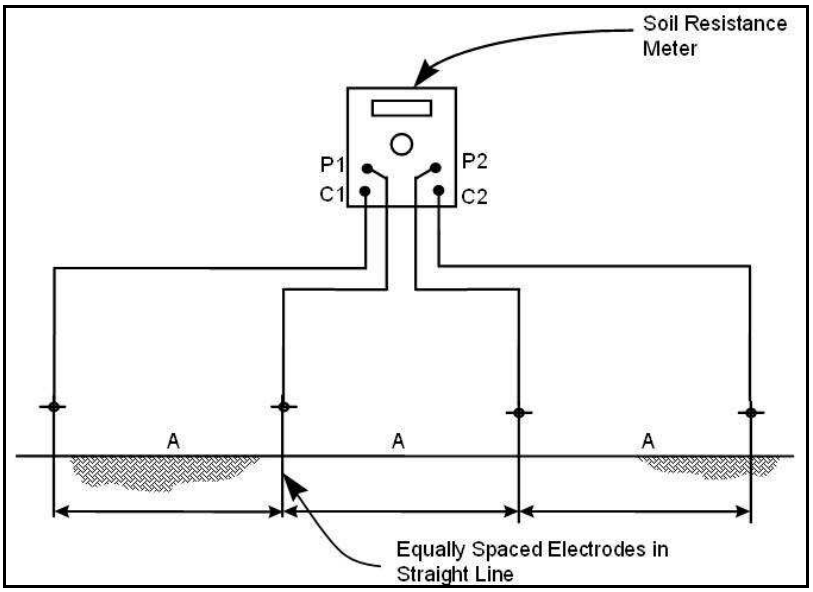


Figure 3. Wenner Four Electrode Method for Soil Resistivity Measurement

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:

$$\rho = 2 \cdot \pi \cdot A \cdot R$$

Where:

ρ	=	soil resistivity (ohm-cm)
A	=	distance between electrodes (cm)
R	=	soil resistance, instrument reading (ohms)
π	=	3.14 (approx.)

Soil resistance is measured with electrodes spaced 0.8, 1.5, 2.3, 3.1, 4.6, 7.6, 15.2, 23.0 and 30.5 meters (2.5, 5, 7.5, 10, 15, 25, 50, 75 and 100 feet) apart. Resistivity values obtained represent the average resistivity of the soil to a depth equal to the electrode spacing. An additional method of calculating the soil resistivity using the data from the Wenner Method is the Barnes-Layer resistivity calculation. The Barnes Layer calculation is used to determine the resistivity of the soil for each soil layer. While the Wenner Method at 3.1 meters will consider all 3.1 meters of soil below the surface, the Barnes-Layer method will only consider the resistivity of only the layer of soil between 2.3 meters

and 3.1 meters below the surface. This method assumes the soil layers are of a uniform thickness and parallel to the surface, which 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* (cm)
K	=	Layer constant (cm)
	=	$2\pi(b-a)$

Laboratory Soil Analysis

To supplement the field resistivity test data, soil samples were obtained from Soil Borings R-09-001, A-09-005, A-09-111 for laboratory soil resistivity analysis (see Table 3 and Appendix 1). The aforementioned Soil Borings, Samples R-09-001, A-09-005 and A-09-111 were specifically done for the bridge foundation report. A soil box was used in accordance with California Test Method 643. This apparatus is shown in Figure 4.

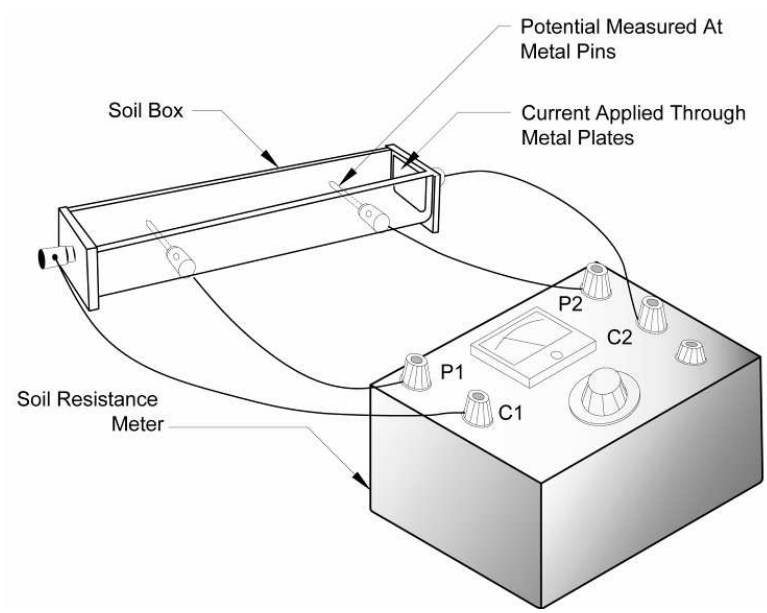


Figure 4. Soil Resistivity Measurement Using the Soil Box Method

This apparatus consists of a small plastic box with metal end plates for passing current through a tightly packed soil sample. Current is passed through the sample, causing a voltage drop across the sample. The soil resistivity is measured with a soil resistance meter, similar to the AEMC Model 4500.

Soil resistivity is first measured in the "as received" state. Distilled water is then added to the soil sample in 10-mL increments. The resistivity is measured after each addition of distilled water. 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 and Table 2 list the field soil resistivity measurements and the calculated Barnes-Layer resistivities. Table 3 lists the minimum resistivities and chemical analyses for the soil boring samples.

Table 1.
Field Soil Resistivity Data, Site 1

Test Location* No.	Site	Depth (meters)	Resistivity (ohm-cm)	Layer (meters)	Layer Resistivity (ohm-cm)
1	North of US 101	0.8	883	0 - 0.8	
		1.5	568	0.8 - 1.5	418
		2.3	463	1.5 - 2.3	337
		3.1	557	2.3 – 3.1	1,477
		4.6	853	3.1 - 4.6	13,793
		7.6	1,494	4.6 – 7.6	11,831
		15.2	2,107	7.6 – 15.2	3,572
		23.0	2,672	15.2 – 23.0	5,762
		30.5	3,217	23.0 – 30.5	8,312

*See Figure 2

Table 2.
Field Soil Resistivity Data, Site 2

Test Location* No.	Site	Depth (meters)	Resistivity (ohm-cm)	Layer (meters)	Layer Resistivity (ohm-cm)
2	South of US 101	0.8	748	0 - 0.8	
		1.5	548	0.8 - 1.5	432
		2.3	412	1.5 - 2.3	276
		3.1	458	2.3 – 3.1	684
		4.6	623	3.1 - 4.6	2,257
		7.6	1,235	4.6 – 7.6	2,615
		15.2	2,030	7.6 – 15.2	5,693
		23.0	2,844	15.2 – 23.0	14,355
		30.5	3,658	23.0 – 30.5	25,866

Table 3.
Laboratory Soil Resistivity and Chemical Data

Item No.	Boring No.*	Depth (meters)	Minimum Soil Resistivity (ohm-cm)	Chemical Data		
				pH	Sulfate (mg/kg)	Chloride (mg/kg)
1	A-09-005	7.6 – 8.2	3,934	7.8	<5	19
2	A-09-111	2.4 – 3.1	508	8.0	98	59
3	R-09-001	24.4 – 25.0	2,312	7.3	<5	69

According to the Memo, the analyzed soil samples at boring locations A-09-005, A-09-111 and R-09-001 are considered *non-corrosive* to reinforced concrete and steel structures in regards to the minimum soil resistivity, pH, chlorides and sulfate.

*See Figure 2

CONCLUSIONS

- The minimum soil resistivity measured at Boring Location A-09-111, indicates resistivity of 508 ohm-cm. According to the Memo, the minimum resistivity tested at this location indicates that the soil is *non-corrosive.* Although the Memo only considers a soil to be corrosive if a minimum soil resistivity of less than 1,000 ohm-cm is accompanied with either a chloride concentration of 500 ppm or greater or sulfate concentration of 2,000 ppm, V&A believes that a soil with only a minimum resistivity of 508 ohm-cm is considered *very corrosive* to steel structures and requires corrosion mitigation.
- The minimum soil resistivity measured at Boring Locations R-09-001 and A-09-005, indicates resistivies greater than 1,000ohm-cm, pH values greater than 5.5, soluble chloride concentration less than 500 ppm and sulfate concentration less than 2,000 ppm indicating *non-corrosive* soil.
- This structure is not within 300 meters (1,000 feet) of salt or brackish water.

RECOMMENDATIONS

The recommendations for each structural foundation material alternative are based on the test data and a review of the project requirements.

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 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.

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.

Steel Piles

According to the Memo, the soil tested at this site is considered *non-corrosive* therefore corrosion mitigation is not required.

APPENDIX A
SOIL SAMPLE MINIMUM RESISTIVITIES AND CHEMICAL ANALYSIS

(Only samples from the Boring Locations A-09-111, A-09-005 and R-09-001 are considered for the Bridge 20-0159 Foundation.)

COOPER

Corrosivity Test Summary

CTL # 632-009 Date: 2/2/2010 Tested By: PJ Checked: PJ
Client: V&A Project: URS Petaluma Proj. No: 09-0772
Remarks:

Sample Location or ID			Resistivity @ 15.5 °C (Ohm-cm)			Chloride	Sulfate		pH	ORP	Moisture	Soil Visual Description
Boring	Sample, No.	Depth, ft.	As Rec.	Minimum	Saturated	mg/kg Dry Wt.	mg/kg Dry Wt.	% Dry Wt.		(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	
R-09-01	-	80-82	-	2312	-	69	<5	<0.0005	7.3	-	25.0	Brown Silty SAND
A-09-005	-	25-27	-	3934	-	19	<5	<0.0005	7.8	-	12.6	Greenish Brown Clayey SAND w/ Gravel
A-09-101	-	10-12	-	635	-	333	262	0.0262	7.3	-	16.6	Greenish Brown Clayey SAND
A-09-105	-	10-12	-	2157	-	<2	<5	<0.0005	8.4	-	16.4	Greenish Brown Clayey SAND
A-09-107	-	10-12	-	824	-	149	136	0.0136	8.1	-	5.9	Greenish Gray Sandy CLAY
A-09-108	-	10-12	-	1161	-	6	<5	<0.0005	7.9	-	29.2	Greenish Gray Sandy CLAY
A-09-109	-	-	-	434	-	119	<5	<0.0005	7.6	-	34.4	Black CLAY
A-09-111	-	8-10	-	508	-	59	98	0.0098	8.0	-	33.9	Black Sandy CLAY
A-09-112	-	10-12	-	787	-	<2	<5	<0.0005	8.6	-	23.5	Greenish Gray Sandy CLAY
A-09-115	-	10-12	-	1104	-	15	<5	<0.0005	8.3	-	19.0	Greenish Gray Sandy CLAY

F-0145 (2)

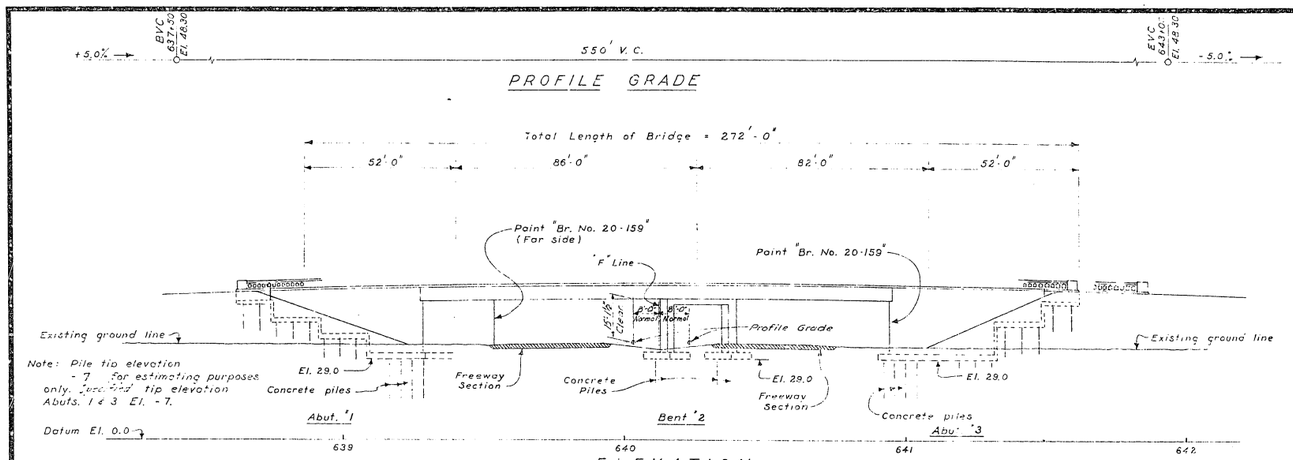
FED. ROAD DIV. NO.	STATE	PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
7	CAL.			86	159

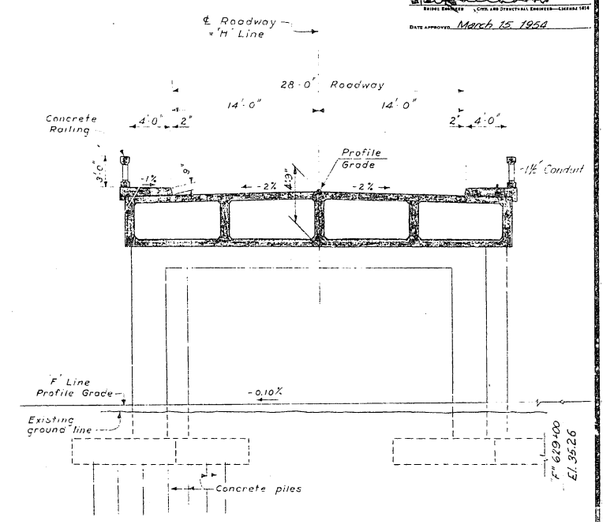
DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
IV	Son	161	F	B1-23	

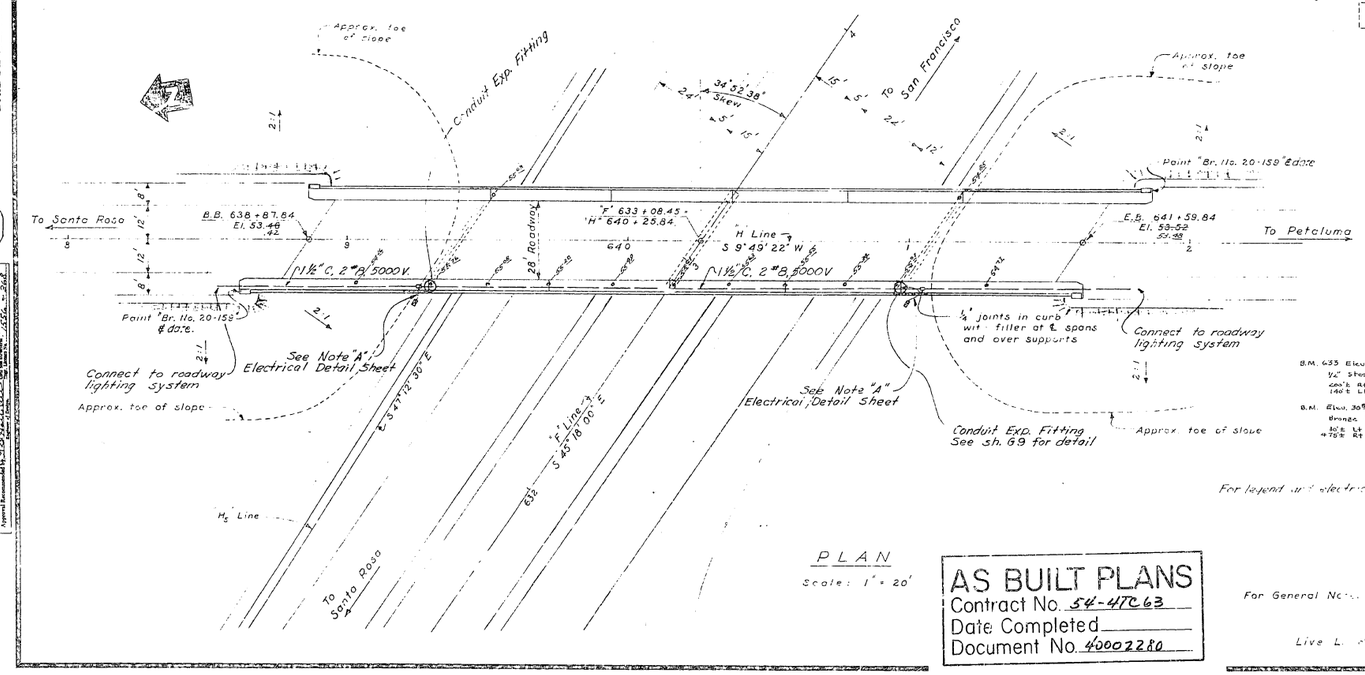
P.M. 7.7

DATE APPROVED March 15, 1954

BRIDGE DEPARTMENT







B.M. 633 Elev. 51.68
½" Steel rod in P.C.C.
Con's Rt. "F" 642+50
140± Lt. H₂ 4+00

B.M. Elev. 30.85
Orange disc S.E. end H.W.
10± Lt. H₂ 4+00
470± Rt. "F" 635+50

For legend and electrical details see Sh. 54.

For General Notes see Sheet "1"

Live Load H20-S16-44

APPROXIMATE QUANTITIES

STRUCTURE EXCAVATION	510 C.Y.
STRUCTURE BACKFILL (BRIDGES)	380 C.Y.
CLASS "A" P.C.C. (STRUCTURE)	1,180 C.Y.
CONCRETE RAILING	592 L.F.
MISCELLANEOUS IRON & STEEL	4,030 LBS.
FURNISH CONCRETE PILING	6,016 L.F.
DRIVING PILES	144 EA.
BAR REINFORCING STEEL	202,000 LBS.

CONTRACT No. 54-47C63-F
DATE ACCEPTED DEC 24 1956
AS BUILT
RESIDENT ENGINEER [illegible]
REVISIONS BY [illegible] DATE [illegible]

AS BUILT PLANS
Contract No. 54-47C63
Date Completed
Document No. 40002280

PETALUMA STRUCTURES

54-47C63

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

DENMAN OVERCROSSING
LOCATED ABOUT 3 MILES NORTH OF PETALUMA
IN SONOMA COUNTY

GENERAL PLAN

SCALE	BRIDGE	FILE	DRAWING
As Noted	20-159		B-24 1-8-57

PREL. DRAWING NO. P-2921 2 3 40

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE _____ SIGNATURE _____ TITLE _____

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM
SCALE 1" = 50' SCALE 1" = 20' SCALE 1" = 10' or 1" = 100' SCALE 1" = 40'

F-0145 (2)

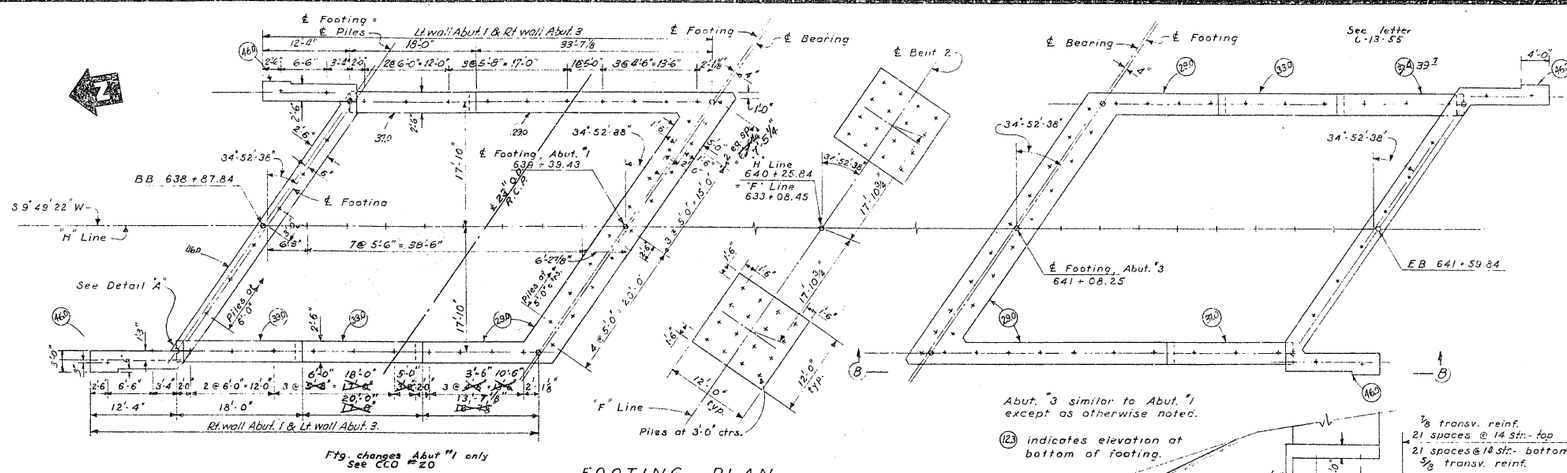
FED. ROAD DIV. NO.	STATE	PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
7	CAL.			82	154

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
IV	Son	101	E	82	73

BRIDGE ENGINEER — CIVIL ENGINEER

DATE APPROVED March 15 1954

BRIDGE DEPARTMENT



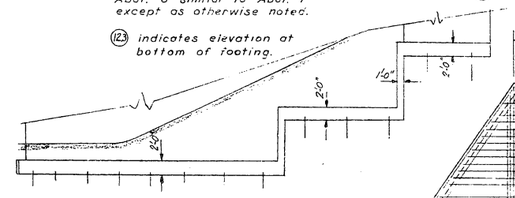
FOOTING PLAN

Scale: 1/8" = 1'-0"

B. M.
Top of nail in concrete monument on center line Sta. "F" 633 + 67.45
P.O.T. Elev. 31.32' (C.H.C.)

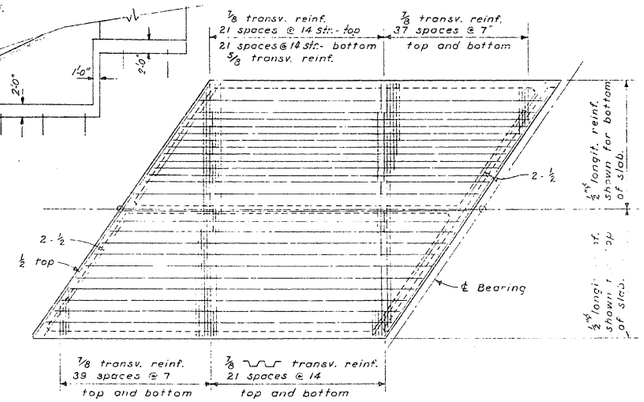
Abut. "3 similar to Abut. "1 except as otherwise noted.

(12) indicates elevation at bottom of footing.



PART ELEVATION B-B

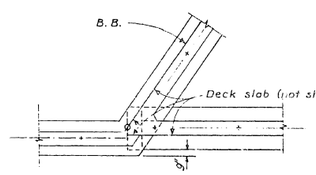
Scale 1/8" = 1'-0"



SLAB REINFORCEMENT - ABUTMENTS

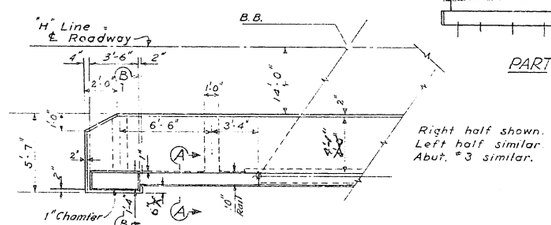
Abut. "1 shown. Abut. "3 similar.

Scale: 1/8" = 1'-0"



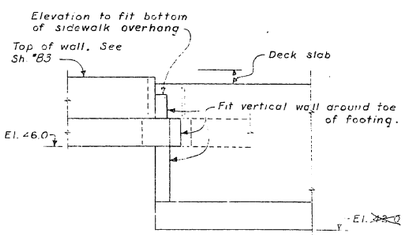
DETAIL "A" - PLAN (TYPICAL)

Scale: 1/4" = 1'-0"



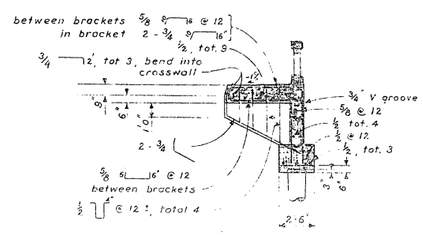
PLAN - END RETURN - ABUT. "1

Scale: 1/4" = 1'-0"



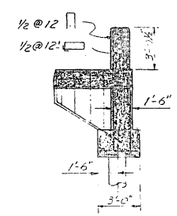
DETAIL "A" - ELEVATION

Scale: 1/4" = 1'-0"



SECTION A-A

Scale: 1/4" = 1'-0"



SECTION B-B

Scale: 1/4" = 1'-0"

CONTRACT No. 54-47C63-F
DATE ACCEPTED DEC. 8 & 1956
AS BUILT
RESIDENT ENGINEER
REVISIONS BY R.E.B. DATE 1/13/56

PETALUMA STRUCTURES

AS BUILT PLANS
Contract No. 54-47C63
Date Completed
Document No. 40002280

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

DENMAN OVERCROSSING

FOUNDATION PLAN

SCALE As Noted | BRIDGE 20-159 | FILE | DRAWING L-2321-2

PREL. DRAWING NO. P-2321 X 12

Submitted by	Date	Approved	Date
DESIGN			
DETAILS			
QUANTITIES			
SPECIFICATIONS			
HYDRAULIC DATA			

Spun 6-57

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE SIGNATURE TITLE

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

F-0145 (2)

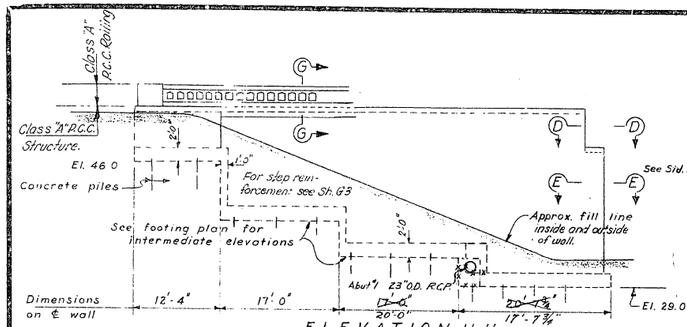
FED. ROAD DIST. NO.	STATE	PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
7	CAL.			88	154

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
11V	Son	1-1	E	~~83~~ 73	

DISTRICT ENGINEER — CIVIL ENGINEER - LICENSE

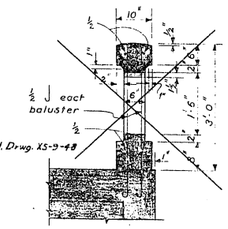
DATE APPROVED March 15, 1954

BRIDGE DEPARTMENT



ELEVATION H-H

Scale: 1/8" = 1'-0"



SECTION G-G

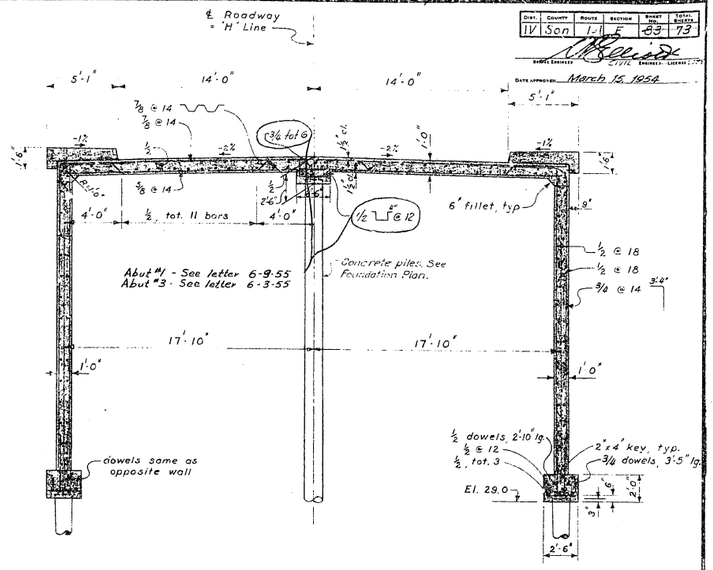
Scale: 3/4" = 1'-0"

Railing Notes:

Open joints in top of rail shall be placed at deck expansion joints, at curb joints and at 15'± centers between.

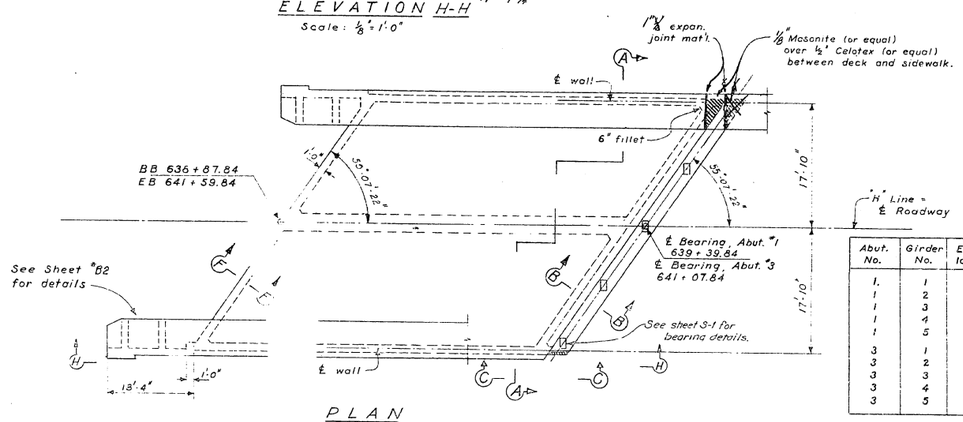
Expansion joints in base of rail shall be placed at deck expansion joints and at curb joints.

When structure is set on a grade, the balusters are to be set vertical and the bottoms of windows set horizontal.



SECTION A-A

Scale: 1/4" = 1'-0"



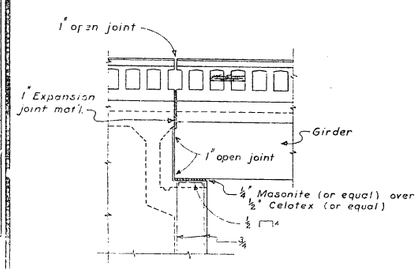
PLAN

Abut. #1 shown. Abut. #3 similar. Piles not shown. See Foundation Plan for pile layout.

Scale: 1/8" = 1'-0"

Abut. No.	Girder No.	Elev. - top of lower bearing plate
1.	1	49.36
1	2	49.28
1	3	49.18
1	4	49.09
1	5	49.00
3	1	49.03
3	2	49.13
3	3	49.22
3	4	49.31
3	5	49.39

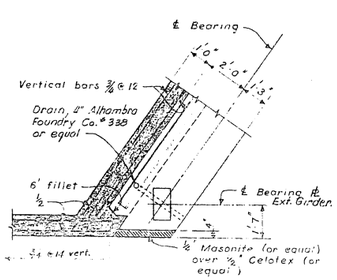
AS BUILT PLANS
Contract No. 54-47C63
Date Completed
Document No. 40002200



ELEVATION C-C

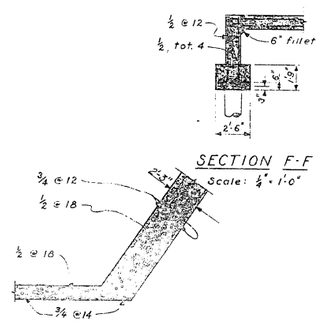
Girder and railing added.

Scale: 1/4" = 1'-0"



SECTION D-D

Scale: 3/8" = 1'-0"

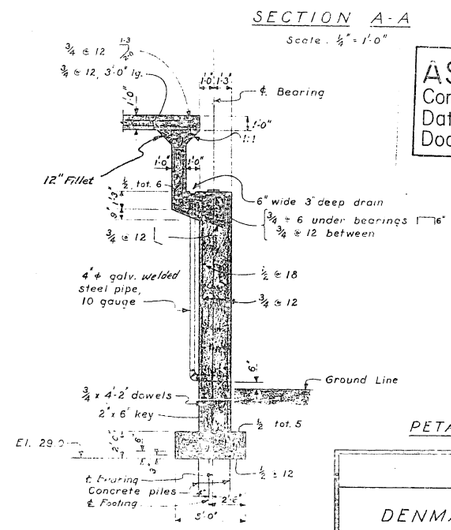


SECTION F-F

Scale: 1/4" = 1'-0"

SECTION E-E

Scale: 1/4" = 1'-0"



SECTION B-B

Scale: 1/4" = 1'-0"

CONTRACT No. 54-47C63-F
DATE ACCEPTED DEC 24 1956
AS BUILT
RESIDENT ENGINEER
REVISIONS BY R.E.A. DATE 1/13/56

PETALUMA STRUCTURES

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

DENMAN OVERCROSSING

ABUTMENTS

SCALE As Noted	BRIDGE 20-159	FILE	C-2921-3 DRAWING

PREL. DRAWING NO. P-2921 | 8 | X | 13 | 48

Submitted for Approval: Nov. 20, 1953
Approved: Nov. 20, 1953

DESIGN DETAILS	1-6-55	11-5-53	Checked		
QUANTITIES			Checked		
PROJECT ENGINEER			Chief Bridge Engineer		

Approved Recommended: Bridge Engineer

Scale 1" = 1'-0"

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE _____ SIGNATURE _____ TITLE _____

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM
SCALE 1" = 50' 0 50 100 200 300 400 500 600
SCALE 1" = 20' 0 10 20 30 40 50 100 200 300
SCALE 1" = 10' or 1" = 100' 0 10 20 30 40 50 60 70 80 90 100 150
SCALE 1" = 40' 0 20 40 60 80 100 200 300 400 500 600

F-0145 (2)

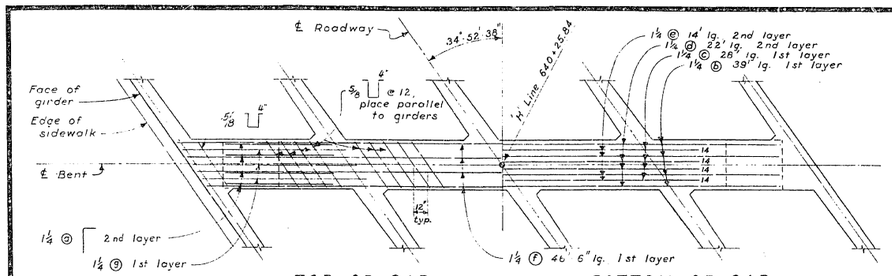
FED. ROAD DIV. NO.	STATE	PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
7	CAL.			89	154

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
1V	Son	101	E	84	79

BRIDGE ENGINEER — CHIEF ENGINEER—LICENSED

DATE APPROVED March 15, 1954

BRIDGE DEPARTMENT



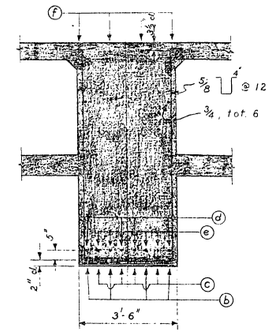
TOP OF CAP REINFORCEMENT

BOTTOM OF CAP REINFORCEMENT

CAP PLAN

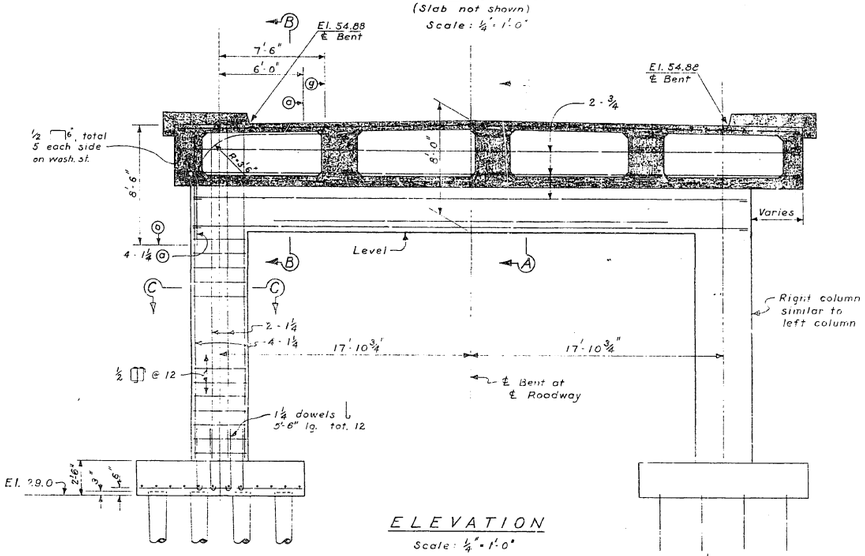
(Slab not shown)

Scale: ¼" = 1'-0"



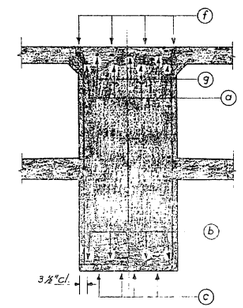
SECTION A-A

Scale: ½" = 1'-0"



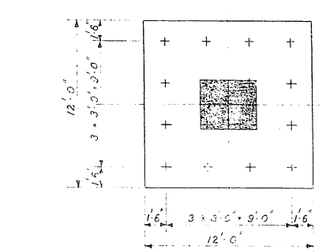
ELEVATION

Scale: ¼" = 1'-0"



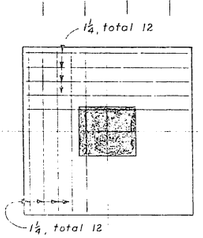
SECTION B-B

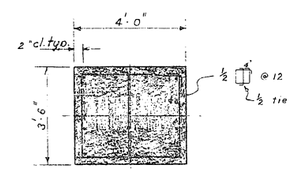
Scale: ½" = 1'-0"



FLOTING PLAN

Scale: ½" = 1'-0"





SECTION C-C

Scale: ½" = 1'-0"

Signed

DESIGN	By	Checked	
DETAILS	By	Checked	
QUANTITIES	By	Checked	
SPECIFICATIONS	By	Checked	

Submitted by ... Date 11-22-53

Approved Sacramento, Calif. ... Date March 1, 1954

Engineer of Bridges

Bridge Engineer

Chief Engineer

AS BUILT PLANS
Contract No. 54-4TC63
Date Completed
Document No. 40002280

CONTRACT No. 54-4TC63-C
DATE ACCEPTED DEC 24 1956
AS BUILT
RESIDENT ENGINEER
REVISIONS BY R.E.B. DATE 4/23/56

PETALUMA STRUCTURES

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

DENMAN OVERCROSSING

BENT 2

SCALE As Noted	BRIDGE 20-159	FILE	DRAWING V-2921-4

PREL DRAWING NO. V-2921 (8 of 17)

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE ____ SIGNATURE ____ TITLE ____

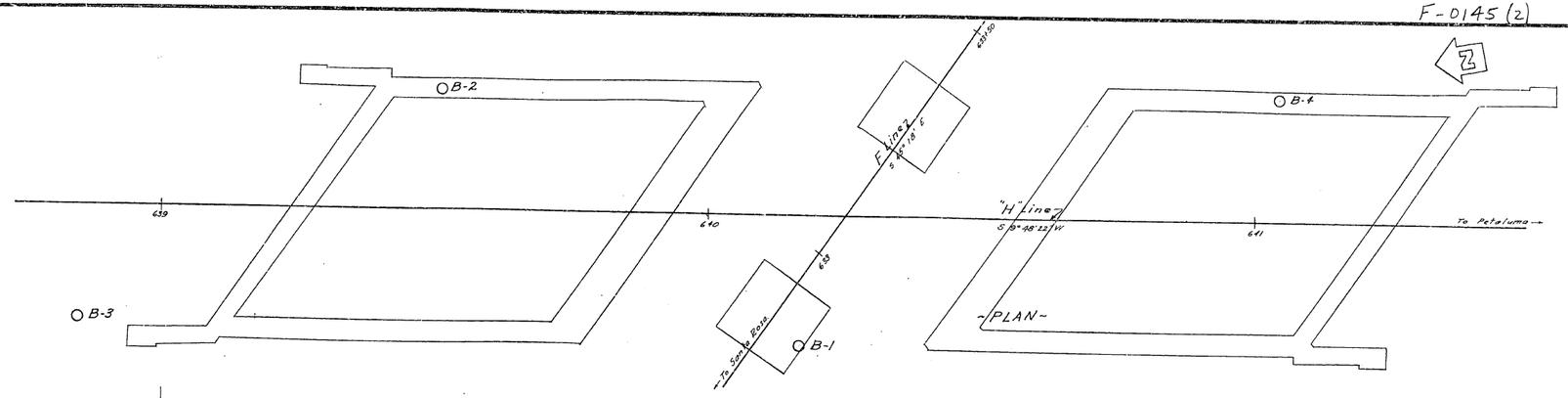
MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

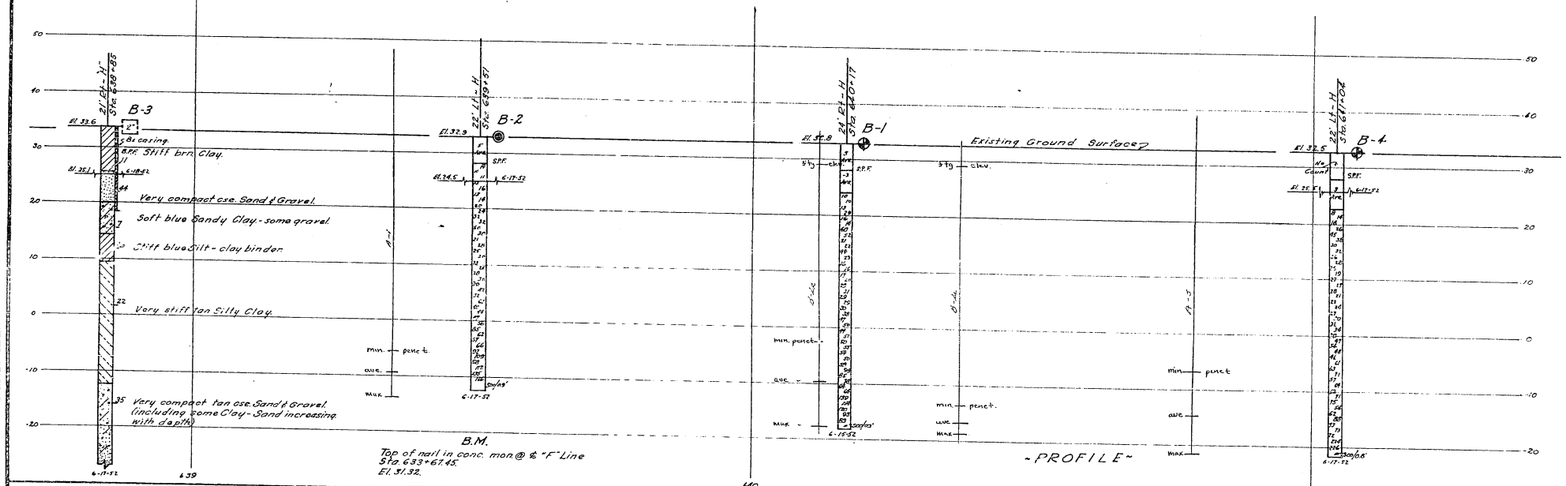
F-0145 (2)

93 154

W Son. 1-1 F -BB-73

March 15, 1962





AS BUILT PLANS

Contract No. 54-4TC63

Date Completed

Document No. 40007280

~Notes~

Relative rates of penetration were obtained as follows:
B-1, 2 & 4 (secs per foot) driving 1⅝" A-Rod or 2½" Core Penetrometer with 40.2" Mohr man-Terry air hammer at 115 p.s.i. gage pressure.
B-3 (blows per foot) driving 1⅞" Sampler with 140 lb. hammer and a 30" free fall.

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

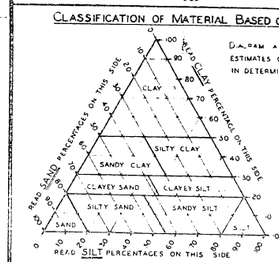


DIAGRAM AND TABLE SHOWING THE BASIS FOR ESTIMATES OF GRADE SIZE DISTRIBUTION USED IN DETERMINATION OF CLASS NAMES

GROUPING USED IN TRIANGULAR CLASSIFICATION			
CLASS NAME	PERCENTAGE OF SIZES PRESENT		
	SAND	SILT	CLAY
SAND	80-100	0-20	0-20
SILTY SAND	45-80	0-55	0-20
SANDY SILT	0-45	55-80	0-20
SILT	0-20	80-100	0-20
CLAYEY SAND	30-80	0-42	20-30
CLAYEY SILT	0-30	42-80	20-30
SANDY CLAY	50-70	0-40	30-50
SILTY CLAY	0-30	20-70	30-50
CLAY	0-50	0-50	50-100

IF GRAVEL IS PRESENT IN APPRECIABLE AMOUNTS THE TERM "GRAVELLY" MAY BE ADDED TO THE CLASS NAME, VIS "GRAVELLY SAND". THE TERMS "COARSE", "MEDIUM" AND "FINE" WHEN USED TO DESCRIBE GRAVEL, SAND AND SILT REFER TO STANDARD GRADE SIZE LIMITS.

LEGEND OF BORING OPERATIONS

- PLAN OF AUGER BORING
- 1" SAMPLER BORING
- ROTARY WASH BORING
- 1" CLOSED SAMPLER DRIVEN
- CORE BORING
- 2½" PENETROMETER DRIVEN
- 1⅜" SAMPLER BORING
- 2" TO 5" AUGER BORING
- 6" TO 20" AUGER BORING
- CASING DRIVEN
- JET BORING
- SAMPLE TAKEN
- 1⅝" A-ROD DRIVEN

THE APPROPRIATE BORING SYMBOLS DESIGNATING THE METHOD OF OPERATION ARE SHOWN AT THE UPPER RIGHT-HAND CORNER OF THE RESPECTIVE BORING. WHERE TOOL CHANGES WERE MADE DURING THE BORING OPERATION SYMBOLS ARE SHOWN AT THE POINT OF CHANGE.

LEGEND OF EARTH MATERIALS

- GRAVEL — G
- SAND — S
- SILT — SI
- CLAY — C
- SILTY SAND — SI S
- CLAYEY SAND — C S
- SANDY SILT — S SI
- CLAYEY SILT — C SI
- SANDY CLAY — SC
- SILTY CLAY — SI C
- PEAT AND/OR ORGANIC CLAY — O
- SANDSTONE — SS
- SHALE — SH
- BROKEN ROCK (FRAGMENTS) — BR
- ROCK — R
- FILL MATERIAL

ABBREVIATIONS

EL 69.4	ELEVATION OF GROUND AT TEST HOLE
bpf	BLOWS PER FOOT — (SEE NOTE ABOVE)
P	PILLED PIPE
M	MOISTURE AS % DRY WEIGHT
EL 64.3 8-12-49	ELEVATION OF GROUND WATER AND DATE

NOTES

THE CONTRACTOR'S ATTENTION IS DIRECTED TO SECTION 2, ARTICLE (C) OF THE STANDARD SPECIFICATIONS AND TO THE SPECIAL PROVISIONS ACCOMPANYING THIS SET OF PLANS.

CLASSIFICATION OF EARTH MATERIAL AS SHOWN ON THIS SHEET IS BASED UPON FIELD INSPECTION AND IS NOT TO BE CONSTRUED TO IMPLY MECHANICAL ANALYSIS.

CONTRACT No. 54-4TC63 P
DATE ACCEPTED DEC 24 1968
AS BUILT
RESIDENT ENGINEER
REVISIONS BY K.L.B. DATE 1/3/69

DENMAN OVERCROSSING

LOG OF TEST BORINGS

SCALE 1" = 10'

BRIDGE NO. 20-159

FILE NO.

DRAWING NO. 2921-8

PREL. DRAWING NO. P-2921

XS-16-

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE _____ SIGNATURE _____ TITLE _____

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

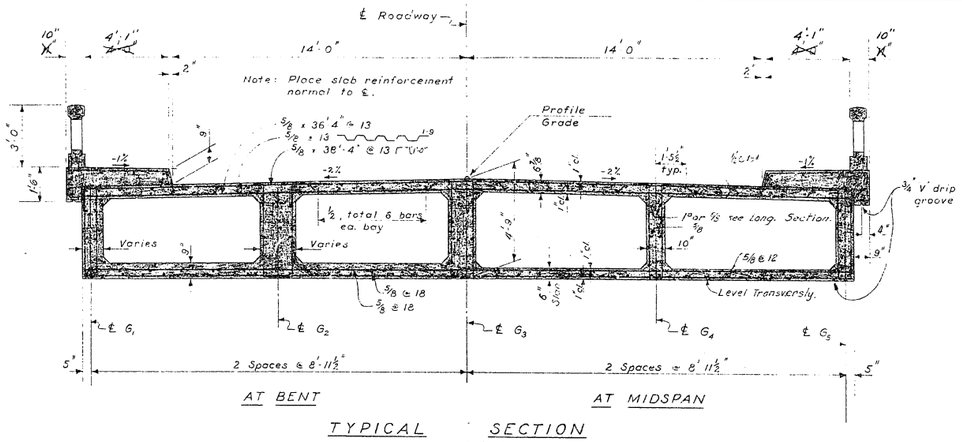
FED. ROAD DIV. NO.	STATE	PROJ. NO.	PARCEL YEAR	SHEET NO.	TOTAL SHEETS
7	CAL.			90	154

F-0145 (2)

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
IV	Son	101	F	85	73

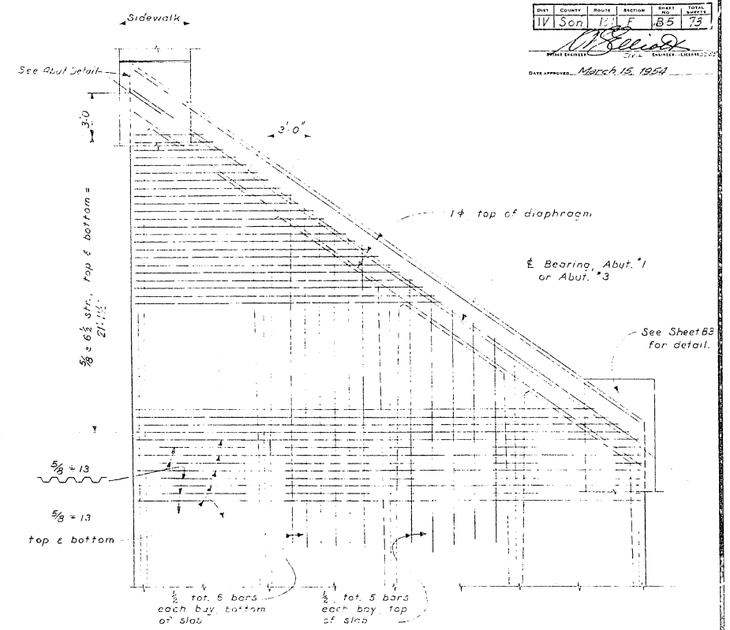
BRIDGE ENGINEER — CHIEF ENGINEER - LIBRARY

DATE APPROVED March 15, 1954



TYPICAL SECTION

Scale: 3/8" = 1'-0"



PART PLAN - DECK REINFORCEMENT

Scale: ½" = 1'-0"

BRIDGE DEPARTMENT

Submitted by			
DESIGN	R. G. M.	Date 10-53	Checked
DETAILS	R.		Checked
QUANTITIES	R.		Checked
SPECIFICATIONS	R.		Checked

Approved Recommended: Bridge Engineer — Chief Engineer — Director of Public Works

Squad

CONTRACT No. 54-417063-F
DATE ACCEPTED DEC 24 1956
AS BUILT
RESIDENT ENGINEER
REVISIONS BY R.E.B. DATE 1/15/56

AS BUILT PLANS
Contract No. 54-417063
Date Completed
Document No. 40002280

PETALUMA STRUCTURES

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

DENMAN OVERCROSSING

TYPICAL SECTION

SCALE As Noted	BRIDGE 20-159	FILE	DRAWING C-2921-5

PRELIM. DRAWING NO. P-2921 8

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE SIGNATURE TITLE

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM
SCALE 1" = 50' SCALE 1" = 20' SCALE 1" = 10' or 1" = 100' SCALE 1" = 40'

F-0145 (2)

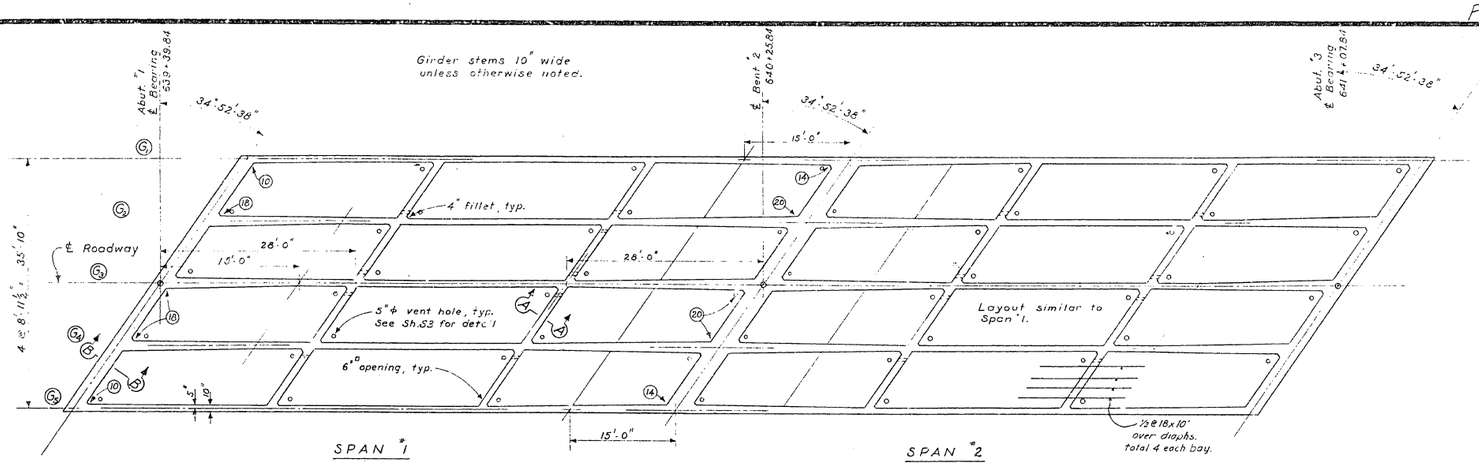
FED. ROAD DIST. NO.	STATE	PROJ. No.	FISCAL YEAR	SHEET No.	TOTAL SHEETS
7	CAL.			91	154

DIST.	COUNTY	ROUTE	SECTION	SHEET No.	TOTAL SHEETS
IV	Son	101		86	73

BRIDGE ENGINEER — ENGINEER - LOCATION

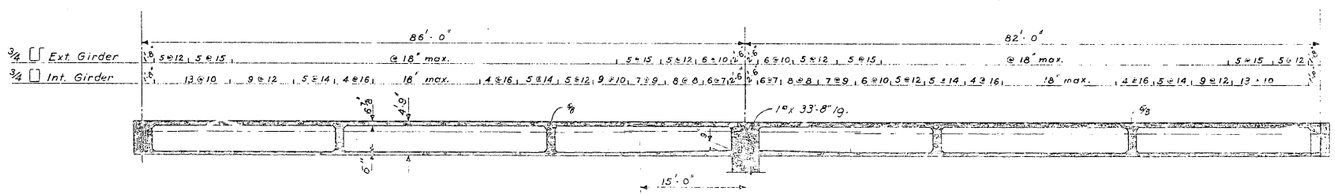
DATE APPROVED March 15, 1956

BRIDGE DEPARTMENT

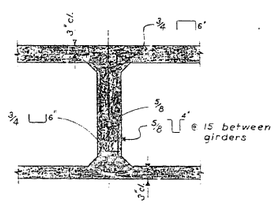


GIRDER LAYOUT

No Scale

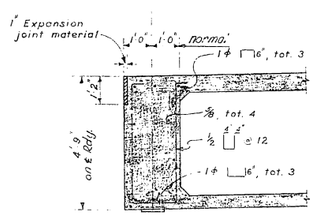


LONGITUDINAL SECTION



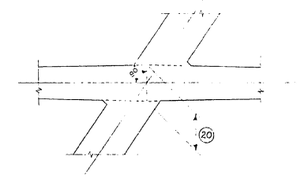
SECTION A-A

Scale: ½" = 1'-0"



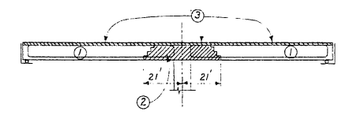
SECTION B-B

Scale: ½" = 1'-0"



TYPICAL FLARE

No scale. (20) etc. indicates flare dimension on ℄ bent or ℄ abutment bearing.



PLACING DIAGRAM

Numbers (1) and (2) indicate sequence of placing bottom slab and girder stems.

Top slab (3) may be placed as desired except no construction joints in area above (2).

Contractor may submit alternative scheme for Engineer's approval.

Submitted by	Date	Checked by	Date
DESIGN	6-24-55		
DETAILS	6-24-55		
QUANTITIES			
SPECIFICATIONS			

Project Engineer

Speed

AS BUILT PLANS
Contract No. 54-417663
Date Completed
Document No. 40002280

CONTRACT No. 54-417663
DATE ACCEPTED DEC 24 1956
AS BUILT
RESIDENT ENGINEER
REVISIONS BY R.E.B. DATE 1/12/56

PETALUMA STRUCTURES

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

DENMAN OVERCROSSING

GIRDER LAYOUT

SCALE	BRIDGE	FILE	DRAWING
As Noted	20-159		P-2921-6

PREL. DRAWING No. P-2921-8

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE _____ SIGNATURE _____ TITLE _____

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

F-0145 (2)

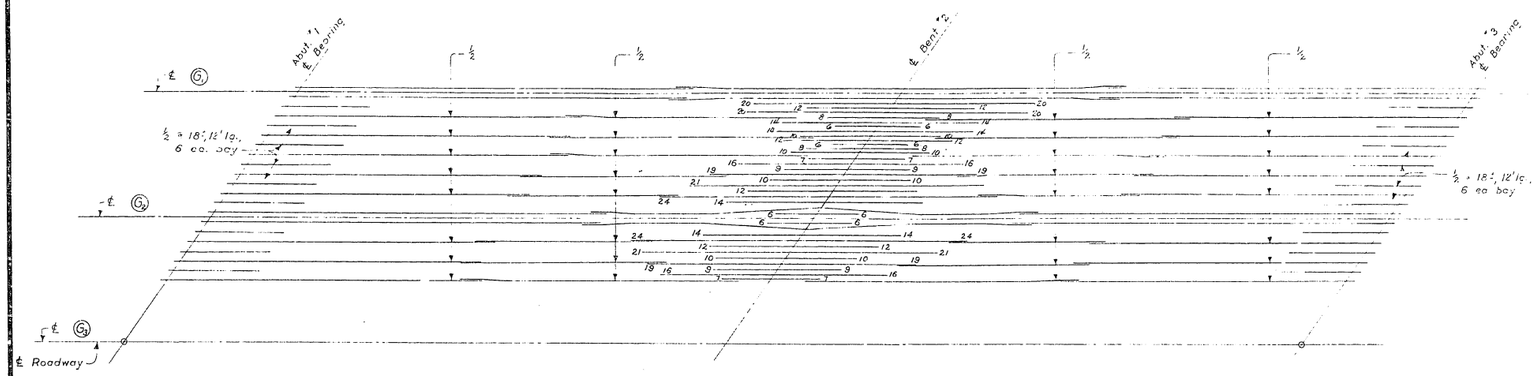
FED. ROAD DIV. NO.	STATE	PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
7	CAL.			92	154

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
IV	Son	1	F	87	73

Bridge Engineer — Chief Engineer - Licensee

Date approved March 15, 1956

BRIDGE DEPARTMENT

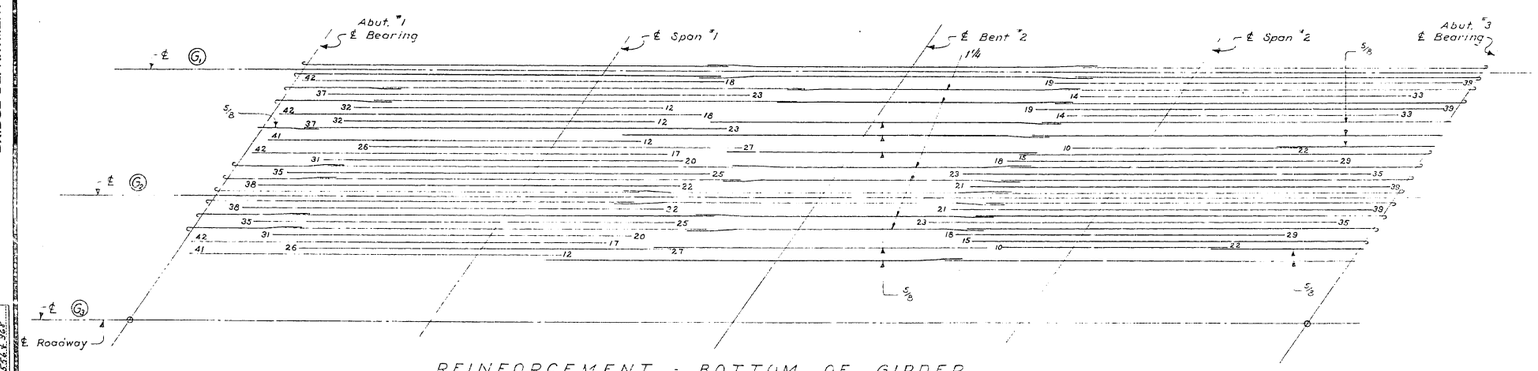


REINFORCEMENT - TOP OF GIRDER

No Scale

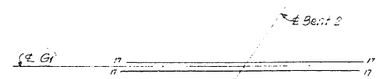
Notes:

G_1 & G_5 similar.
G_2 G_3 & G_4 similar.
All bars 1⅛ unless otherwise noted.
Numbers at ends of bars 17 indicate distance from ℄ Span or ℄ Bent to end of bar.



REINFORCEMENT - BOTTOM OF GIRDER

No Scale



SECOND LAYER - G_1 & G_5

TOP OF GIRDER

CONTRACT No. 54-47C63
DATE ACCEPTED DEC 23 1958
AS BUILT
RESIDENT ENGINEER
REVISIONS BY R.E.B. DATE 11/21/56

PETALUMA STRUCTURES

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

DENMAN OVERCROSSING

GIRDER REINFORCEMENT

SCALE 1"=5'-0"	BRIDGE 20-159	FILE	DRAWING

FED. DRAWING NO. 2021 | 4 | 15

Submitted by: [illegible]

DESIGN	R. G. C.	11-52	[illegible]
DETAILS	R. G. M.	11-52	[illegible]
QUANTITIES	R. [illegible]	[illegible]	[illegible]
SPECIFICATIONS	R. [illegible]	[illegible]	[illegible]

Approval Recommended by [illegible] Date approved 1956 R.E.P.

AS BUILT PLANS
Contract No. 54-47C63
Date Completed
Document No. 40002280

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE SIGNATURE TITLE

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

Old Redwood Highway Overcrossing - Abutments 1 and 3

9/13/2011

Pile Design Spreadsheet

Abut 1 & 3

NAVFAC Design Method For a Single Pile

Project Name:	Old Redwood Highway Overcrossing
Project Number:	28645097
Bridge Name:	Old Redwood Highway Overcrossing
Boring Surface El. (m)	12.2
Boring Surface El. (ft)	40.0
Design GWS El. (ft)	32.0
Unit Weight of Water (pcf)	62.4
Depth with no strength	
Convert. Factor	3.281
Bottom of Pile Cap El. (m)	12.19
Bottom of Pile Cap El. (ft)	40.00

Nominal axial compress. Capacity (ult.)	412	ton
Nominal axial compress. Capacity (ult.)	3667	kN
Pile Width	14	inch
Pile Width	356	mm
Pile Width	1.17	ft
Crit depth ratio	20	-
Crit depth	23.3	ft
Crit. Depth. Elev	16.7	ft
Crit. Depth. Elev	5.1	m
Crit. Eff. Vert. Str.	7437	psf

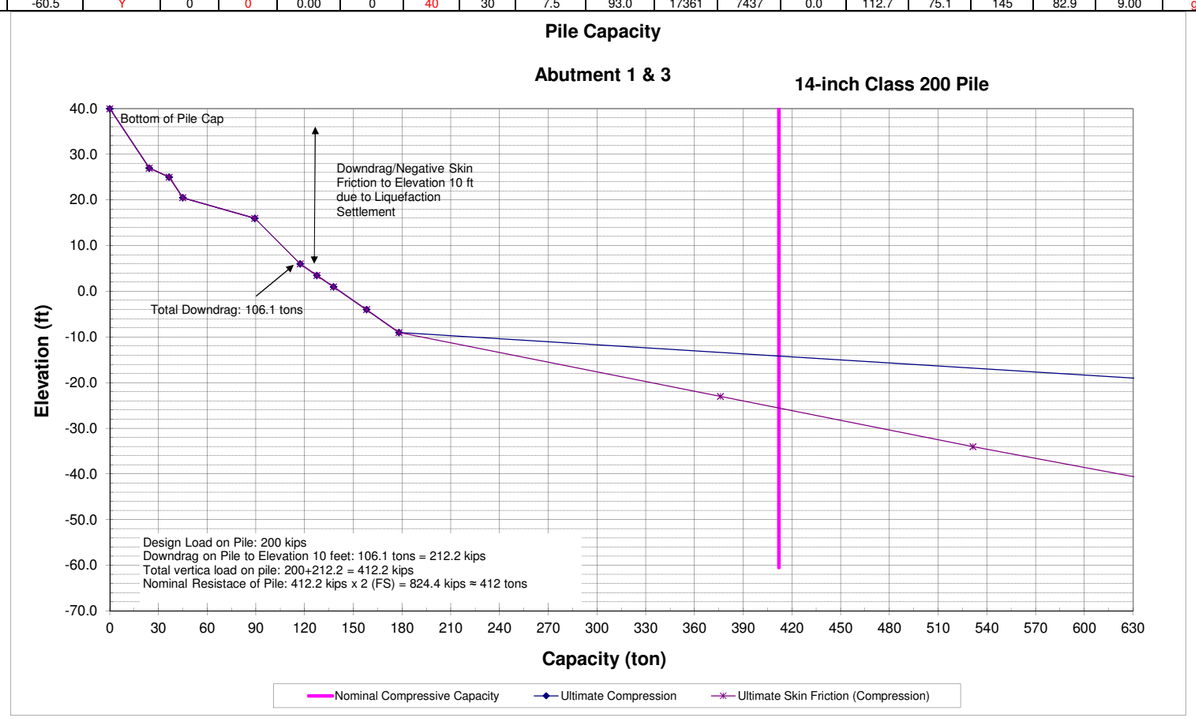
Skin Resistance (Friction) of Pile in Granular Material:

Type (Steel=S,Concrete=C,Timber=T)	C	
Earth Press. Coefficient * (Comp.)	1.5	
Earth Press. Coefficient * (Tens)	1.0	
Minimum Adhesion	500	psf

Pile Shape	Square	(Square, Circular or Octogonal)		
Pile Surface Area	1.42	sq. m/m	Pile Tip Area	0.13 sq. m
Pile Surface Area	4.67	sq. ft/ft	Pile Tip Area	1.36 sq. ft.

* Note: Appropriate tension/compresion ratios for skin friction for granular soils applied is 0.65 and 1.0 for cohesive soil.

Layer No.	Layer Elevation Top (m)	Top (feet)	Bot. (m)	Bot. (feet)	Lateral Resists?	Cohesion c (kPa)	Cohesion c (psf)	Adhesion Ratio c_a/c	Adhesion c_a (psf)	Friction Angle ϕ (deg)	Friction Angle δ (deg)	Layer Thickness (feet)	Internal Depth to Layer Top (feet)	Effective Vert. Stress (Bot. Lay.) (psf)	Design Effective Vert. Stress (Bot. Lay.) (psf)	delta Lat. Res. Cohesive (ton)	delta Lat. Res. Friction (comp) (ton)	delta Lat. Res. Friction (tensile) (ton)	Nq (granular) (-)	z/B (-)	Nc (cohesive) (-)	Soil Type G= gran. C=cohes.	Bearing Capacity (B.C.) (ton)	Include B.C.?	Elevation to midlayer (ft)	Compression Cumulative Axial Res. (skin) (ton)	Compression Cumulative Axial Res. (skin) (kN)	Compression Cumulative Axial Res. (Tot) (ton)	Compression Cumulative Axial Res. (Tot) (kN)	Compression Nominal Axial Capacity (ton)	Compression Nominal Axial Capacity (kN)	Tension Cumulative Axial Res. (Skin) (ton)	Tension Cumulative Axial Res. (Skin) (kN)	Tension Nominal Axial Capacity (ton)	Tension Nominal Axial Capacity (kN)
			12.19	40.0										0	0					0.0	6.25	c	0	n	40.0	0	0	0	0	412	3667	0	0	70	1833
1	12.19	40.0	8.23	27.0	Y	38	800	1.00	800	0	0	13.0	0.0	3583	3583	24.3	0.0	0.0	0	5.6	9.00	c	5	n	33.5	24.3	216	24.3	216	412	3667	24.3	216	70	1833
2	8.23	27.0	7.62	25.0	Y	0	0	0.00	0	30	22.5	2.0	13.0	4888	4888	0.0	12.3	8.2	21	12.0	9.00	g	70	n	26.0	36.5	325	36.5	325	412	3667	32.5	289	70	1833
3	7.62	25.0	6.25	20.5	Y	38	800	1.00	800	0	0	4.5	15.0	6145	6145	8.4	0.0	0.0	0	14.8	9.00	c	5	n	22.8	44.9	400	44.9	400	412	3667	40.9	363	70	1833
4	6.25	20.5	4.88	16.0	Y	0	0	0.00	0	30	22.5	4.5	19.5	7762	7437	0.0	44.3	29.5	21	18.6	9.00	g	106	n	18.3	89.3	794	89.3	794	412	3667	70.4	626	70	1833
5	4.88	16.0	1.83	6.0	Y	57	1200	1.00	1200	0	0	10.0	24.0	9538	7437	28.0	0.0	0.0	0	24.9	9.00	c	7	n	11.0	117.3	1044	117.3	1044	412	3667	98.4	875	70	1833
6	1.83	6.0	1.07	3.5	Y	120	2500	0.70	1750	0	0	2.5	34.0	10643	7437	10.2	0.0	0.0	0	30.2	9.00	c	15	n	4.8	127.5	1134	127.5	1134	412	3667	108.6	966	70	1833
7	1.07	3.5	0.3	1.0	Y	120	2500	0.70	1750	0	0	2.5	36.5	12263	7437	10.2	0.0	0.0	0	32.4	9.00	c	15	n	2.3	137.7	1225	137.7	1225	412	3667	118.8	1057	70	1833
8	0.3	1.0	-1.22	-4.0	Y	120	2500	0.70	1750	0	0	5.0	39.0	13751	7437	20.4	0.0	0.0	0	35.6	9.00	c	15	n	-1.5	158.1	1407	158.1	1407	412	3667	139.2	1239	70	1833
9	-1.22	-4.0	-2.74	-9.0	Y	84	1750	0.98	1706	0	0	5.0	44.0	15214	7437	19.9	0.0	0.0	0	39.9	9.00	c	11	n	-6.5	178.0	1584	178.0	1584	412	3667	159.1	1416	71	1833
10	-2.74	-9.0	-7.01	-23.0	Y	0	0	0.00	0	38	28.5	14.0	49.0	17361	7437	0.0	197.9	131.9	86	48.0	9.00	g	435	y	-16.0	375.9	3345	811.2	7219	412	3667	291.0	2589	72	1833
11	-7.01	-23.0	-10.36	-34.0	Y	0	0	0.00	0	38	28.5	11.0	63.0	17361	7437	0.0	155.5	103.6	86	58.7	9.00	g	435	y	-28.5	531.3	4729	966.6	8603	412	3667	394.7	3511	73	1833
12	-10.36	-34.0	-16.15	-53.0	Y	0	0	0.00	0	40	30	19.0	74.0	17361	7437	0.0	285.5	190.4	145	71.6	9.00	g	734	y	-43.5	816.9	7270	1550.8	13802	412	3667	585.1	5205	74	1833
13	-16.15	-53.0	-18.44	-60.5	Y	0	0	0.00	0	40	30	7.5	93.0	17361	7437	0.0	112.7	75.1	145	82.9	9.00	g	734	y	-56.8	929.6	8273	1663.5	14805	412	3667	660.2	5873	75	1833
Bottom	-18.44	-60.5																																	



Old Redwood Highway Overcrossing - Bent 2

9/13/2011

Pile Design Spreadsheet

Bent 2

NAVFAC Design Method For a Single Pile

Project Name:	Old Redwood Highway Overcrossing
Project Number:	28645097
Bridge Name:	Old Redwood Highway Overcrossing
Boring Surface El. (m)	11.0
Boring Surface El. (ft)	36.0
Design GWS El. (ft)	32.0
Unit Weight of Water (pcf)	62.4
Depth with no strength	
Convert. Factor	3.281
Bottom of Pile Cap El. (m)	9.14
Bottom of Pile Cap El. (ft)	30.00

Nominal axial compress. Capacity (ult.)	220	ton
Nominal axial compress. Capacity (ult.)	1958	kN
Pile Width	16	inch
Pile Width	406	mm
Pile Width	1.33	ft
Crit depth ratio	20	-
Crit depth	26.7	ft
Crit. Depth. Elev	9.3	ft
Crit. Depth. Elev	2.8	m
Crit. Eff. Vert. Str.	1647	psf

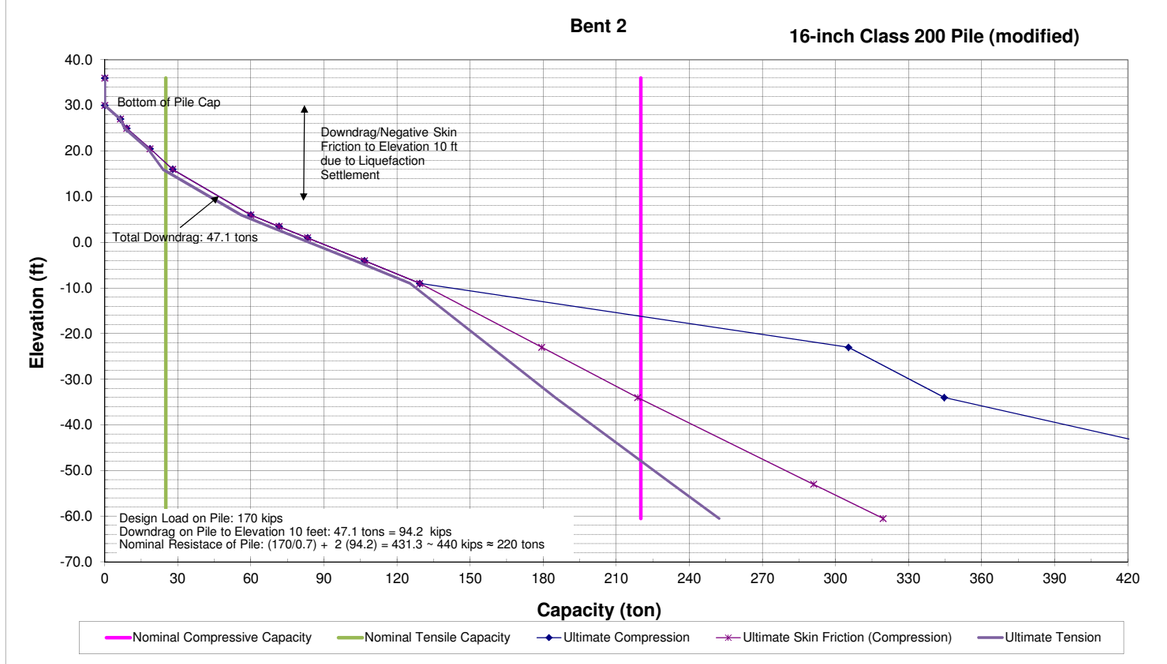
Skin Resistance (Friction) of Pile in Granular Material:

Type (Steel=S,Concrete=C,Timber=T)	C	
Earth Press. Coefficient * (Comp.)	1.5	
Earth Press. Coefficient * (Tens)	1.0	
Minimum Adhesion	500	psf

Pile Shape	Square	(Square, Circular or Octogonal)		
Pile Surface Area	1.63	sq. m/m	Pile Tip Area	0.17 sq. m
Pile Surface Area	5.33	sq. ft/ft	Pile Tip Area	1.78 sq. ft.

* Note: Appropriate tension/compresion ratios for skin friction for granular soils applied is 0.65 and 1.0 for cohesive soil.

Layer No.	Layer Elevation Top (m)	Top (feet)	Bot. (m)	Bot. (feet)	Lateral Resists?	Cohesion c (kPa)	Cohesion c (psf)	Adhesion Ratio c_a/c	Adhesion c_a (psf)	Friction Angle ϕ (deg)	Friction Angle δ (deg)	Layer Thickness (feet)	Internal Depth to Layer Top (feet)	Effective Vert. Stress (Bot. Lay.) (psf)	Design Effective Vert. Stress (Bot. Lay.) (psf)	delta Lat. Res. Cohesive (ton)	delta Lat. Res. Friction (comp) (ton)	delta Lat. Res. Friction (tensile) (ton)	Nq (granular) (-)	z/B (-)	Nc (cohesive) (-)	Soil Type G= gran. C=cohes.	Bearing Capacity (B.C.) (ton)	Include B.C.?	Elevation to midlayer (ft)	Compression Cumulative Axial Res. (skin) (ton)	Compression Cumulative Axial Res. (skin) (kN)	Compression Cumulative Axial Res. (Tot) (ton)	Compression Cumulative Axial Res. (Tot) (kN)	Compression Nominal Axial Capacity (ton)	Compression Nominal Axial Capacity (kN)	Tension Cumulative Axial Res. (Skin) (ton)	Tension Cumulative Axial Res. (Skin) (kN)	Tension Nominal Axial Capacity (ton)	Tension Nominal Axial Capacity (kN)
			10.97	36.0										0	0					0.0	6.25	c	0	n	36.0	0	0	0	0	220	1958	0	0	25	979
1	10.97	36.0	9.14	30.0	N	38	800	1.00	0	0	0	6.0	0.0	565	565	0.0	0.0	0.0	0	2.3	8.50	c	6	n	33.0	0.0	0	0.0	0	220	1958	0.0	0	25	979
2	9.14	30.0	8.23	27.0	Y	38	800	1.00	800	0	0	3.0	6.0	723	723	6.4	0.0	0.0	0	5.6	9.00	c	6	n	28.5	6.4	57	6.4	57	220	1958	6.4	57	25	979
3	8.23	27.0	7.62	25.0	Y	0	0	0.00	0	30	22.5	2.0	9.0	828	828	0.0	2.6	1.7	21	7.5	9.00	g	15	n	26.0	9.0	80	9.0	80	220	1958	8.1	72	25	979
4	7.62	25.0	6.25	20.5	Y	38	800	1.00	800	0	0	4.5	11.0	1019	1019	9.6	0.0	0.0	0	9.9	9.00	c	6	n	22.8	18.6	165	18.6	165	220	1958	17.7	158	25	979
5	6.25	20.5	4.88	16.0	Y	0	0	0.00	0	32	24	4.5	15.5	1302	1302	0.0	9.3	6.2	29	13.3	9.00	g	34	n	18.3	27.9	248	27.9	248	220	1958	23.9	213	25	979
6	4.88	16.0	1.83	6.0	Y	57	1200	1.00	1200	0	0	10.0	20.0	1878	1647	32.0	0.0	0.0	0	18.8	9.00	c	10	n	11.0	59.9	533	59.9	533	220	1958	55.9	497	25	979
7	1.83	6.0	1.07	3.5	Y	120	2500	0.70	1750	0	0	2.5	30.0	2023	1647	11.7	0.0	0.0	0	23.4	9.00	c	20	n	4.8	71.5	637	71.5	637	220	1958	67.6	601	25	979
8	1.07	3.5	0.3	1.0	Y	120	2500	0.70	1750	0	0	2.5	32.5	2203	1647	11.7	0.0	0.0	0	25.3	9.00	c	20	n	2.3	83.2	740	83.2	740	220	1958	79.2	705	25	979
9	0.3	1.0	-1.22	-4.0	Y	120	2500	0.70	1750	0	0	5.0	35.0	2491	1647	23.3	0.0	0.0	0	28.1	9.00	c	20	n	-1.5	106.5	948	106.5	948	220	1958	102.6	913	25	979
10	-1.22	-4.0	-2.74	-9.0	Y	84	1750	0.98	1706	0	0	5.0	40.0	2754	1647	22.8	0.0	0.0	0	31.9	9.00	c	14	n	-6.5	129.3	1151	129.3	1151	220	1958	125.3	1115	25	979
11	-2.74	-9.0	-7.01	-23.0	Y	0	0	0.00	0	38	28.5	14.0	45.0	3701	1647	0.0	50.1	33.4	86	39.0	9.00	g	126	y	-16.0	179.4	1596	305.3	2717	220	1958	158.7	1412	25	979
12	-7.01	-23.0	-10.36	-34.0	Y	0	0	0.00	0	38	28.5	11.0	59.0	3991	1647	0.0	39.4	26.2	86	48.4	9.00	g	126	y	-28.5	218.7	1947	344.6	3067	220	1958	185.0	1645	25	979
13	-10.36	-34.0	-16.15	-53.0	Y	0	0	0.00	0	40	30	19.0	70.0	3991	1647	0.0	72.3	48.2	145	59.6	9.00	g	212	y	-43.5	291.0	2590	503.3	4479	220	1958	233.1	2074	25	979
14	-16.15	-53.0	-18.44	-60.5	Y	0	0	0.00	0	40	30	7.5	89.0	3991	1647	0.0	28.5	19.0	145	69.6	9.00	g	212	y	-56.8	319.5	2844	531.8	4733	220	1958	252.2	2243	25	979
Bottom	-18.44	-60.5																																	



Old Redwood Highway Overcrossing - Abutments 1 and 3 WW

9/13/2011

Pile Design Spreadsheet

Abut 1 & 3 WW

NAVFAC Design Method For a Single Pile

Project Name:	Old Redwood Highway Overcrossing
Project Number:	28645097
Bridge Name:	Old Redwood Highway Overcrossing
Boring Surface El. (m)	18.3
Boring Surface El. (ft)	60.0
Design GWS El. (ft)	32.0
Unit Weight of Water (pcf)	62.4
Depth with no strength	
Convert. Factor	3.281
Bottom of Pile Cap El. (m)	16.46
Bottom of Pile Cap El. (ft)	54.00

Nominal axial compress. Capacity (ult.)	283	ton
Nominal axial compress. Capacity (ult.)	2519	kN
Pile Width	14	inch
Pile Width	356	mm
Pile Width	1.17	ft
Crit depth ratio	20	-
Crit depth	23.3	ft
Crit. Depth. Elev	36.7	ft
Crit. Depth. Elev	11.2	m
Crit. Eff. Vert. Str.	2765	psf

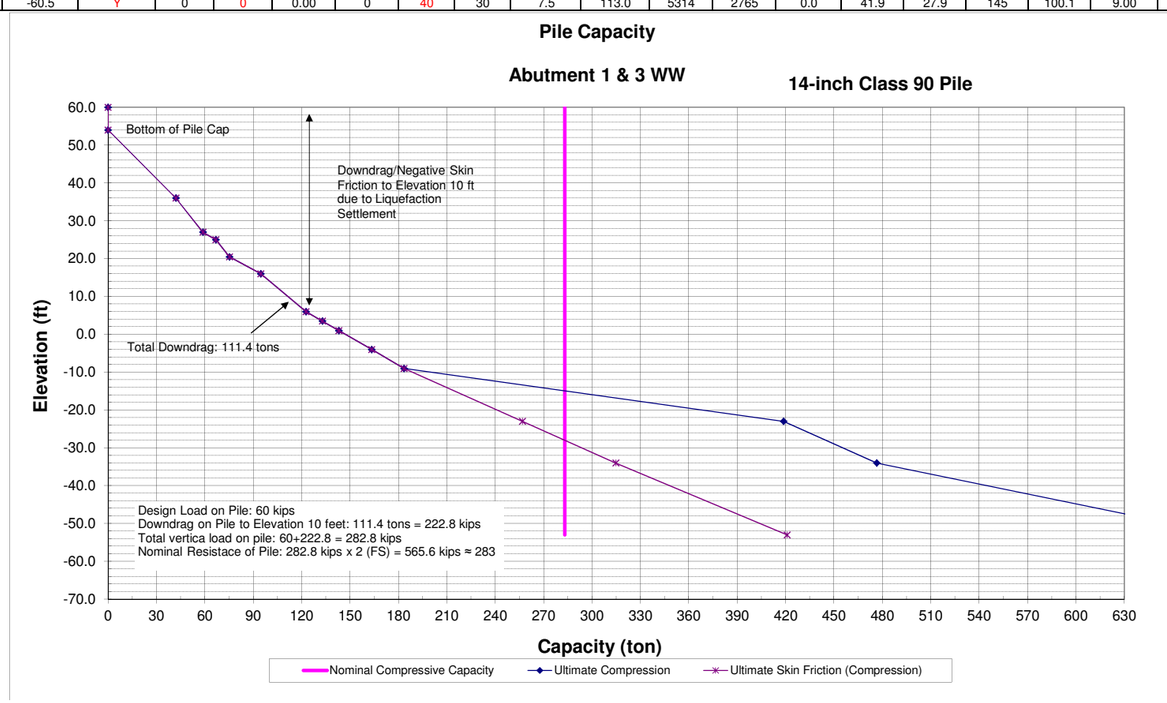
Skin Resistance (Friction) of Pile in Granular Material:

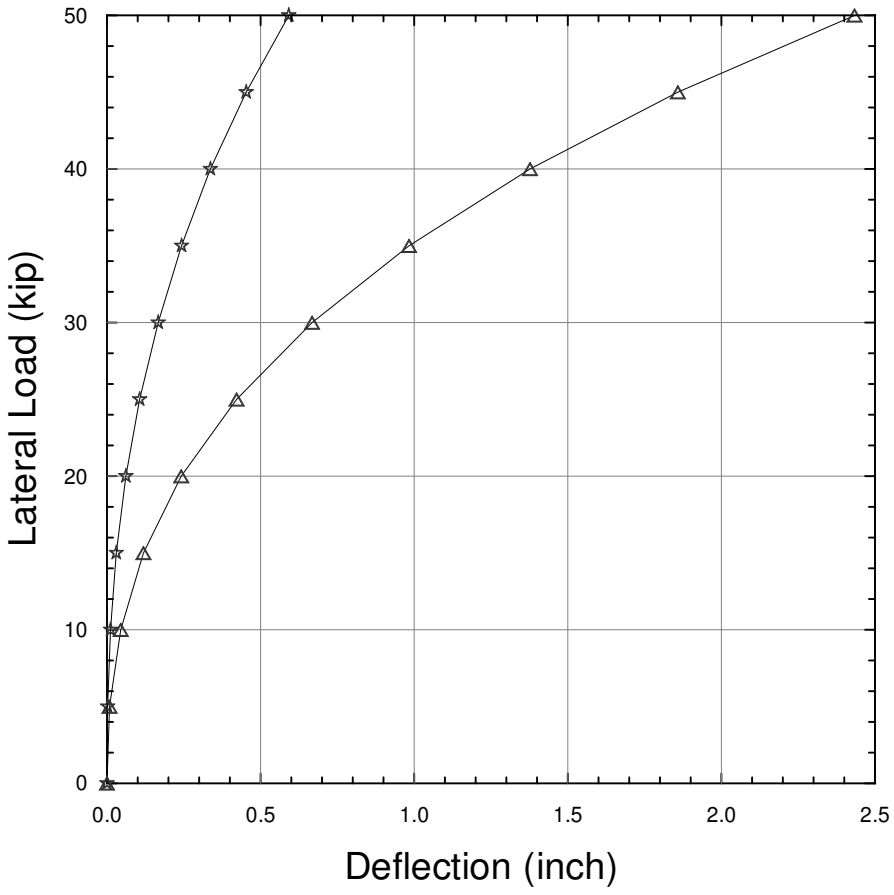
Type (Steel=S,Concrete=C,Timber=T)	C	
Earth Press. Coefficient * (Comp.)	1.5	
Earth Press. Coefficient * (Tens)	1.0	
Minimum Adhesion	500	psf

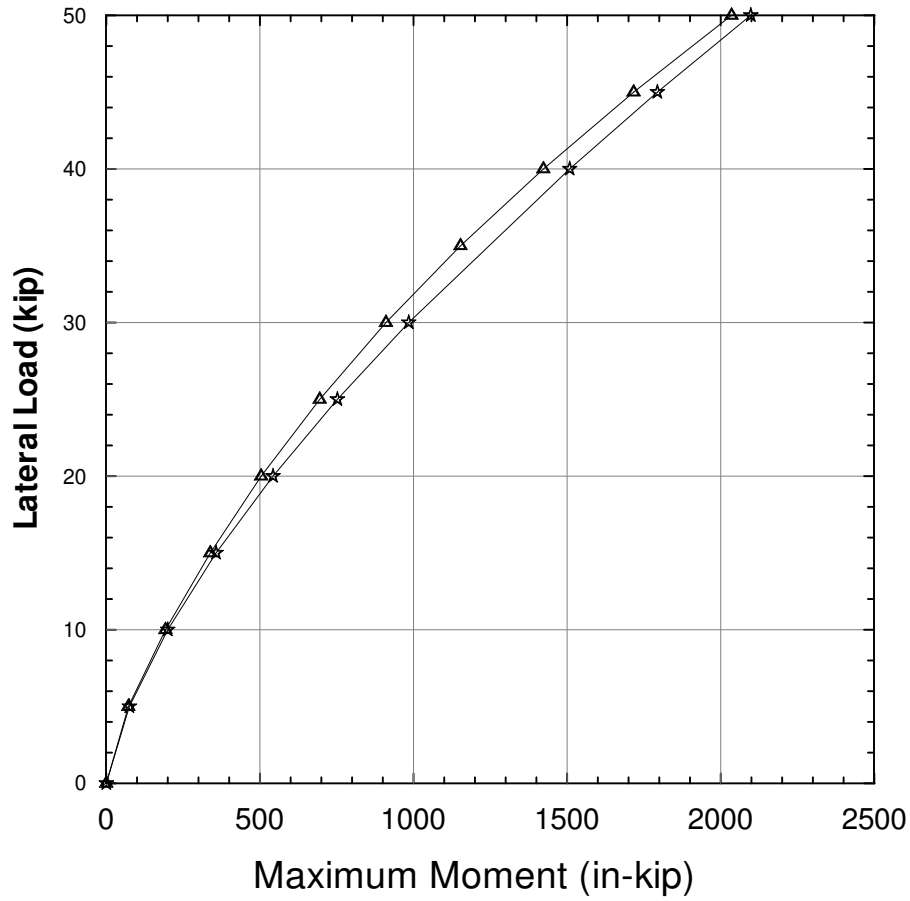
Pile Shape	Square	(Square, Circular or Octogonal)		
Pile Surface Area	1.42	sq. m/m	Pile Tip Area	0.13 sq. m
Pile Surface Area	4.67	sq. ft/ft	Pile Tip Area	1.36 sq. ft.

* Note: Appropriate tension/compresion ratios for skin friction for granular soils applied is 0.65 and 1.0 for cohesive soil.

Layer No.	Layer Elevation Top (m)	Layer Elevation Top (feet)	Layer Elevation Bot. (m)	Layer Elevation Bot. (feet)	Lateral Resists?	Cohesion c (kPa)	Cohesion c (psf)	Adhesion Ratio c_a/c	Adhesion c_a (psf)	Friction Angle ϕ (deg)	Friction Angle δ (deg)	Layer Thickness (feet)	Internal Depth to Layer Top (feet)	Effective Vert. Stress (Bot. Lay.) (psf)	Design Effective Vert. Stress (Bot. Lay.) (psf)	delta Lat. Res. Cohesive (ton)	delta Lat. Res. Friction (comp) (ton)	delta Lat. Res. Friction (tensile) (ton)	Nq (granular) (-)	z/B (-)	Nc (cohesive) (-)	Soil Type G= gran. C=cohes.	Bearing Capacity (B.C.) (ton)	Include B.C.?	Elevation to midlayer (ft)	Compression Cumulative Axial Res. (skin) (ton)	Compression Cumulative Axial Res. (skin) (kN)	Compression Cumulative Axial Res. (Tot) (ton)	Compression Cumulative Axial Res. (Tot) (kN)	Compression Nominal Axial Capacity (ton)	Compression Nominal Axial Capacity (kN)	Tension Cumulative Axial Res. (Skin) (ton)	Tension Cumulative Axial Res. (Skin) (kN)	Tension Nominal Axial Capacity (ton)	Tension Nominal Axial Capacity (kN)
			18.29	60.0										0	0					0.0	6.25	c	0	n	60.0	0	0	0	0	283	2519	0	0	70	1259
1	18.29	60.0	16.46	54.0	N	0	0	0.00	0	36	27	6.0	0.0	810	810	0.0	0.0	0.0	62	2.6	8.63	g	34	n	57.0	0.0	0	0.0	0	283	2519	0.0	0	70	1259
2	16.46	54.0	10.97	36.0	Y	48	1000	1.00	1000	0	0	18.0	6.0	2880	2765	42.0	0.0	0.0	0	12.9	9.00	c	6	n	45.0	42.0	374	42.0	374	283	2519	42.0	374	70	1259
3	10.97	36.0	8.23	27.0	Y	38	800	1.00	800	0	0	9.0	24.0	3603	2765	16.8	0.0	0.0	0	24.4	9.00	c	5	n	31.5	58.8	523	58.8	523	283	2519	58.8	523	70	1259
4	8.23	27.0	7.62	25.0	Y	0	0	0.00	0	30	22.5	2.0	33.0	3708	2765	0.0	8.0	5.3	21	29.1	9.00	g	40	n	26.0	66.8	595	66.8	595	283	2519	64.1	571	70	1259
5	7.62	25.0	6.25	20.5	Y	38	800	1.00	800	0	0	4.5	35.0	3899	2765	8.4	0.0	0.0	0	31.9	9.00	c	5	n	22.8	75.2	669	75.2	669	283	2519	72.5	645	70	1259
6	6.25	20.5	4.88	16.0	Y	0	0	0.00	0	32	24	4.5	39.5	4182	2765	0.0	19.4	12.9	29	35.8	9.00	g	55	n	18.3	94.6	842	94.6	842	283	2519	85.5	760	70	1259
7	4.88	16.0	1.83	6.0	Y	57	1200	1.00	1200	0	0	10.0	44.0	4758	2765	28.0	0.0	0.0	0	42.0	9.00	c	7	n	11.0	122.6	1091	122.6	1091	283	2519	113.5	1009	70	1259
8	1.83	6.0	1.07	3.5	Y	120	2500	0.70	1750	0	0	2.5	54.0	4903	2765	10.2	0.0	0.0	0	47.4	9.00	c	15	n	4.8	132.8	1182	132.8	1182	283	2519	123.7	1100	70	1259
9	1.07	3.5	0.3	1.0	Y	120	2500	0.70	1750	0	0	2.5	56.5	5083	2765	10.2	0.0	0.0	0	49.5	9.00	c	15	n	2.3	143.0	1273	143.0	1273	283	2519	133.9	1191	71	1259
10	0.3	1.0	-1.22	-4.0	Y	120	2500	0.70	1750	0	0	5.0	59.0	5314	2765	20.4	0.0	0.0	0	52.7	9.00	c	15	n	-1.5	163.4	1455	163.4	1455	283	2519	154.3	1373	72	1259
11	-1.22	-4.0	-2.74	-9.0	Y	84	1750	0.98	1706	0	0	5.0	64.0	5314	2765	19.9	0.0	0.0	0	57.0	9.00	c	11	n	-6.5	183.3	1632	183.3	1632	283	2519	174.2	1550	73	1259
12	-2.74	-9.0	-7.01	-23.0	Y	0	0	0.00	0	38	28.5	14.0	69.0	5314	2765	0.0	73.6	49.0	86	65.1	9.00	g	162	y	-16.0	256.9	2286	418.7	3727	283	2519	223.3	1986	74	1259
13	-7.01	-23.0	-10.36	-34.0	Y	0	0	0.00	0	38	28.5	11.0	83.0	5314	2765	0.0	57.8	38.5	86	75.9	9.00	g	162	y	-28.5	314.7	2801	476.5	4241	283	2519	261.8	2329	75	1259
14	-10.36	-34.0	-16.15	-53.0	Y	0	0	0.00	0	40	30	19.0	94.0	5314	2765	0.0	106.2	70.8	145	88.7	9.00	g	273	y	-43.5	420.9	3746	693.7	6174	283	2519	332.6	2958	76	1259
15	-16.15	-53.0	-18.44	-60.5	Y	0	0	0.00	0	40	30	7.5	113.0	5314	2765	0.0	41.9	27.9	145	100.1	9.00	g	273	y	-56.8	462.8	4119	735.6	6547	283	2519	360.5	3207	77	1259
Bottom	-18.44	-60.5																																	





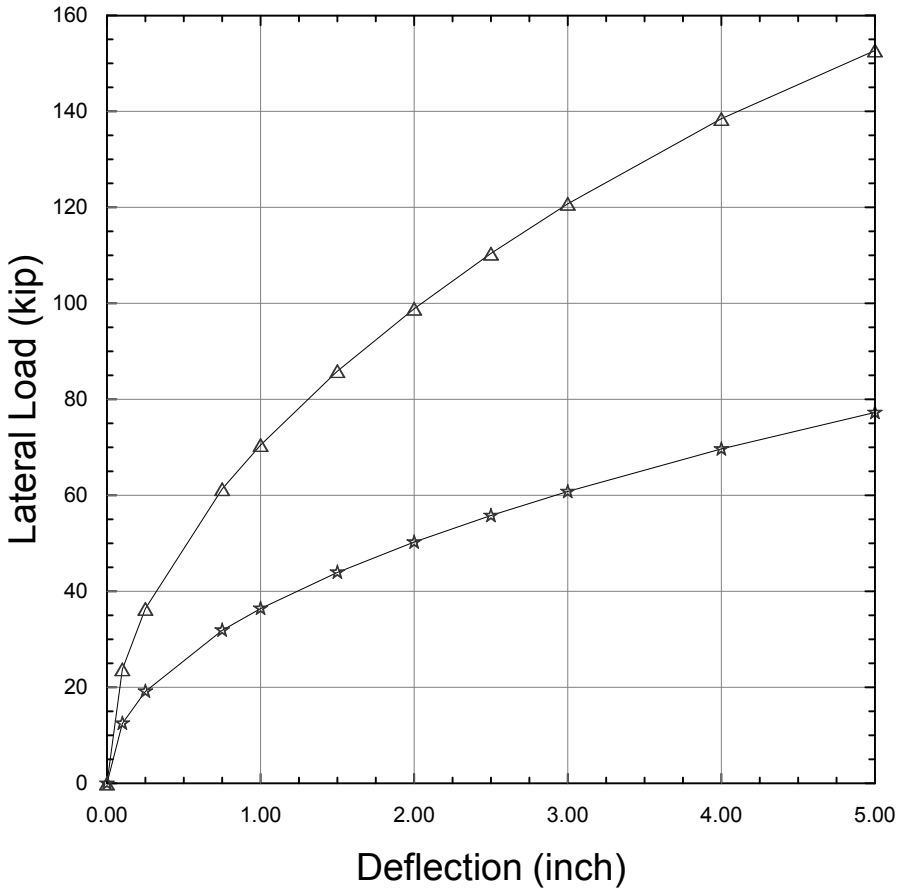


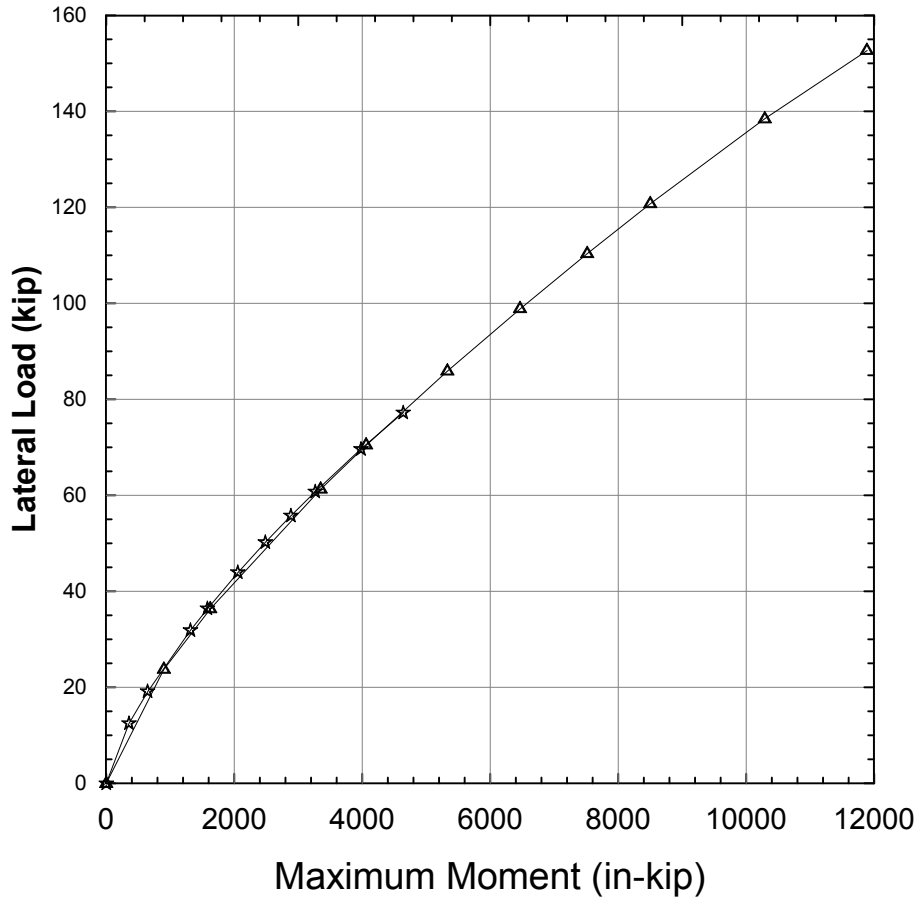
Legend
Free Head
Fixed Head

Notes:
Length of Pile: 54 feet

Project No. 28645097	Old Redwood Highway OC Petaluma, California	**Old Redwood Highway Overcrossing (Replace) Abutment Pile Lateral Resistance 14 inch Class 200 PCPS Pile**	Figure H-1
	URS		

X:/Old Redwood Interchage PSE/440 Materials/Analysis/Pile/Lateral/Bridge/Old Redwood Highway_Bridge_Abutments 1&3.GRF





Legend
Fixed Head
Free Head

Notes:
Length of Pile: 46 feet

Project No. 28645097	Old Redwood Highway OC Petaluma, California	**Old Redwood Highway Overcrossing (Replace)** **Bent Pile Lateral Resistance** **16 inch Class 200 (modified) PCPS Pile**	Figure H-2
	URS		

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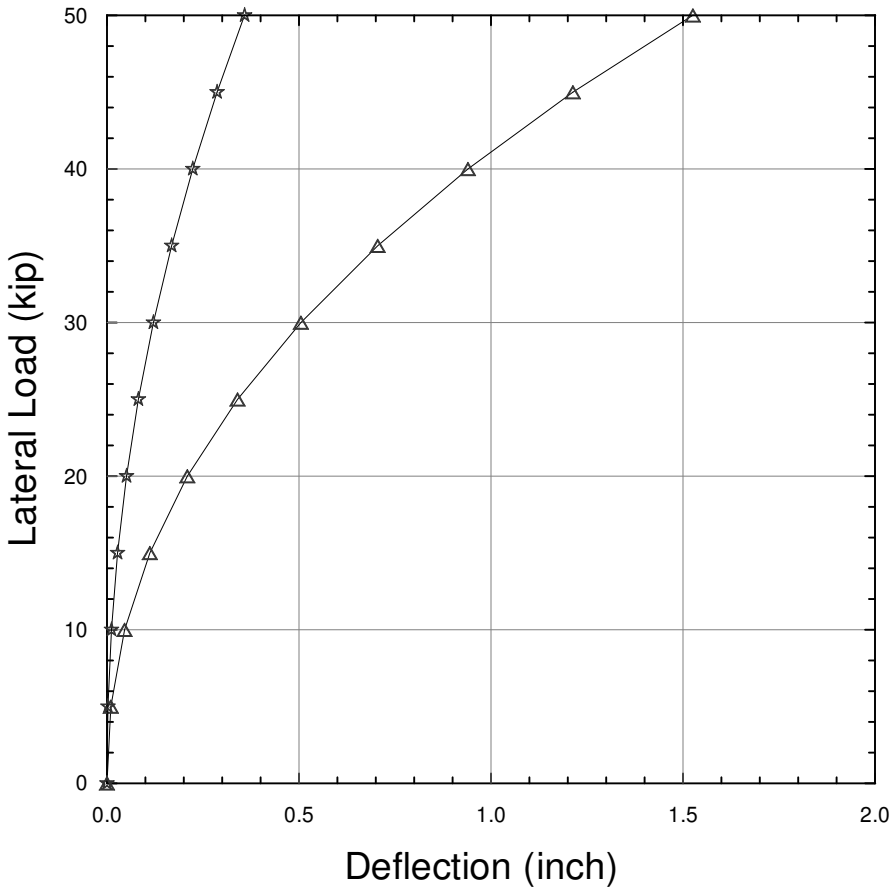

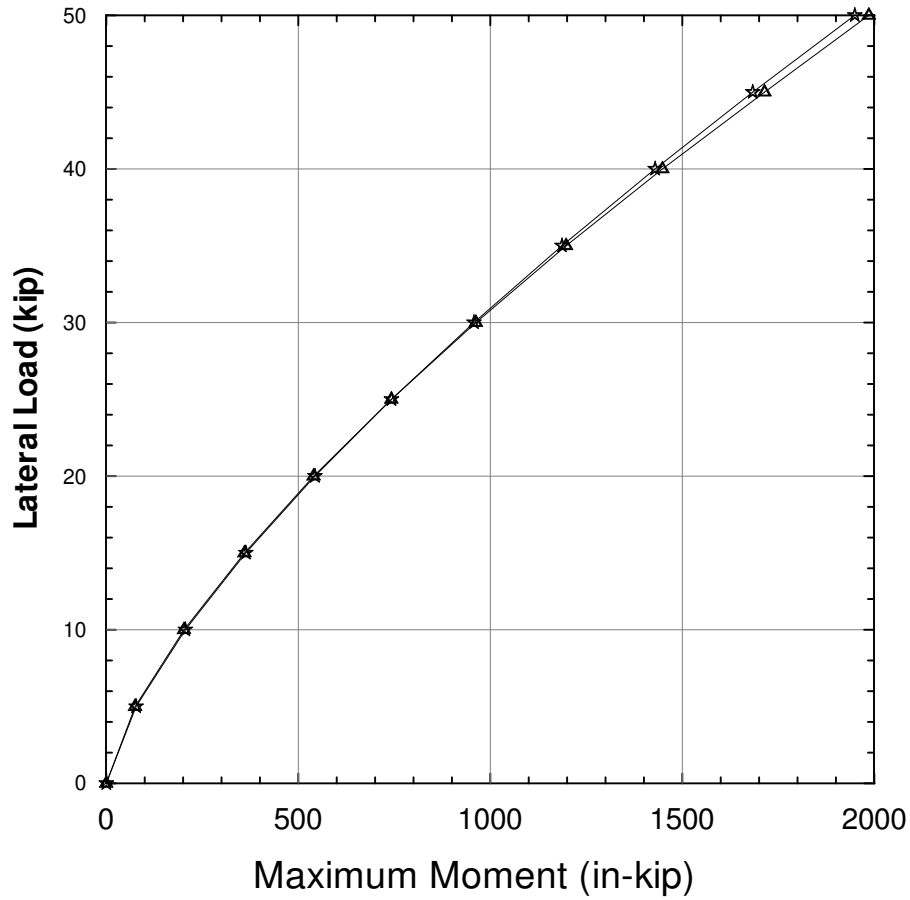

Legend
Free Head
Fixed Head

Notes:
Length of Pile: 66 to 68 feet

Project No. 28645097	Old Redwood Highway OC Petaluma, California	**Old Redwood Highway Overcrossing (Replace) Wing Wall Pile Lateral Resistance 14 inch Class 90 PCPS Pile**	Figure H-3
	URS		

X:/Old Redwood Interchage PSE/440 Materials/Analysis/Pile/Lateral/Bridge/Old Redwood Highway_Bridge_AbutWW.GRF

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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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Madhu Thummaluru
URS Corporation

Path to file locations: X:\Old Redwood Interchange PSE\440_Materials\Analysis\Pile\Lateral\Bridge\
Name of input data file: Old Redwood Bridge_Abutments_fixed.lpd
Name of output file: Old Redwood Bridge_Abutments_fixed.lpo
Name of plot output file: Old Redwood Bridge_Abutments_fixed.lpp
Name of runtime file: Old Redwood Bridge_Abutments_fixed.lpr

Time and Date of Analysis

Date: April 24, 2011 Time: 10:34:47

Problem Title

Old Redwood Highway Overcrossing (Replace)_Abutments 1 & 3_Fixed

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Program Options

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length

- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 648.00 in

Depth of ground surface below top of pile = -60.00 in

Slope angle of ground surface = 33.70 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	14.00000000	3201.0000	196.0000	3372000.
2	648.0000	14.00000000	3201.0000	196.0000	3372000.

Soil and Rock Layering Information

The soil profile is modelled using 13 layers

Layer 1 is stiff clay without free water
Distance from top of pile to top of layer = -60.000 in
Distance from top of pile to bottom of layer = 48.000 in

Layer 2 is stiff clay without free water
Distance from top of pile to top of layer = 48.000 in
Distance from top of pile to bottom of layer = 156.000 in

Layer 3 is liquefiable sand, by Rollins et al, 2004
Distance from top of pile to top of layer = 156.000 in
Distance from top of pile to bottom of layer = 180.000 in

Warning : The depth of this layer is deeper than the recommended depth limit for using the p-y criteria for liquefied sand.

Please consult the LPile Technical Manual for additional background information regarding limitations on the use of the liquefied sand criteria.

Layer 4 is stiff clay without free water
Distance from top of pile to top of layer = 180.000 in
Distance from top of pile to bottom of layer = 234.000 in

Layer 5 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 234.000 in
Distance from top of pile to bottom of layer = 288.000 in

Layer 6 is stiff clay without free water
Distance from top of pile to top of layer = 288.000 in
Distance from top of pile to bottom of layer = 408.000 in

Layer 7 is stiff clay without free water
Distance from top of pile to top of layer = 408.000 in
Distance from top of pile to bottom of layer = 528.000 in

Layer 8 is stiff clay without free water
Distance from top of pile to top of layer = 528.000 in
Distance from top of pile to bottom of layer = 588.000 in

Layer 9 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 588.000 in
Distance from top of pile to bottom of layer = 606.000 in

Layer 10 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 606.000 in
Distance from top of pile to bottom of layer = 756.000 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 11 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 756.000 in
Distance from top of pile to bottom of layer = 888.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 12 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 888.000 in
Distance from top of pile to bottom of layer = 1116.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 13 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 1116.000 in
Distance from top of pile to bottom of layer = 1206.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

(Depth of lowest layer extends 558.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 26 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-60.00	0.07230
2	48.00	0.07230
3	48.00	0.06370
4	156.00	0.06370
5	156.00	0.03040
6	180.00	0.03040
7	180.00	0.02750
8	234.00	0.02750
9	234.00	0.03330
10	288.00	0.03330
11	288.00	0.03330
12	408.00	0.03330
13	408.00	0.03330
14	528.00	0.03330
15	528.00	0.03040
16	588.00	0.03040
17	588.00	0.03330
18	606.00	0.03330
19	606.00	0.03910
20	756.00	0.03910
21	756.00	0.04200
22	888.00	0.04200
23	888.00	0.04200
24	1116.00	0.04200
25	1116.00	0.04490
26	1206.00	0.04490

Shear Strength of Soils

Shear strength parameters with depth defined using 26 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-60.000	16.67000	0.00	0.00500	0.0
2	48.000	16.67000	0.00	0.00500	0.0
3	48.000	5.56000	0.00	0.01000	0.0
4	156.000	5.56000	0.00	0.01000	0.0
5	156.000	0.00000	0.00	------	------
6	180.000	0.00000	0.00	------	------
7	180.000	5.56000	0.00	0.01000	0.0
8	234.000	5.56000	0.00	0.01000	0.0
9	234.000	6.94400	0.00	0.01000	0.0
10	288.000	6.94400	0.00	0.01000	0.0
11	288.000	8.68000	0.00	0.00700	0.0
12	408.000	8.68000	0.00	0.00700	0.0

13	408.000	17.36000	0.00	0.00500	0.0
14	528.000	17.36000	0.00	0.00500	0.0
15	528.000	12.15000	0.00	0.00700	0.0
16	588.000	12.15000	0.00	0.00700	0.0
17	588.000	8.33300	0.00	0.00900	0.0
18	606.000	8.33300	0.00	0.00900	0.0
19	606.000	0.00000	36.00	------	------
20	756.000	0.00000	36.00	------	------
21	756.000	0.00000	36.00	------	------
22	888.000	0.00000	36.00	------	------
23	888.000	0.00000	38.00	------	------
24	1116.000	0.00000	38.00	------	------
25	1116.000	0.00000	40.00	------	------
26	1206.000	0.00000	40.00	------	------

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 = 193000.000 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 = 193000.000 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     =      193000.000 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     =      193000.000 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     =      193000.000 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     =      193000.000 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     =      193000.000 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    =       40000.000 lbs
Slope at pile head          =           0.000 in/in
Axial load at pile head     =      193000.000 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    =       45000.000 lbs
Slope at pile head          =           0.000 in/in
Axial load at pile head     =      193000.000 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 = 50000.000 lbs
Slope at pile head = 0.000 in/in
Axial load at pile head = 193000.000 lbs

(Zero slope for this load indicates fixed-head condition)

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	193000.	0.0023540	-75092.0313	5000.0000
2	V= 10000.	S= 0.000	193000.	0.0113772	-200012.	10000.0000
2	V= 15000.	S= 0.000	193000.	0.0301439	-357650.	15000.0000
2	V= 20000.	S= 0.000	193000.	0.0610577	-542918.	20000.0000
2	V= 25000.	S= 0.000	193000.	0.1060478	-752745.	25000.0000
2	V= 30000.	S= 0.000	193000.	0.1662037	-985237.	30000.0000
2	V= 35000.	S= 0.000	193000.	0.2430918	-1237386.	35000.0000
2	V= 40000.	S= 0.000	193000.	0.3371720	-1508963.	40000.0000
2	V= 45000.	S= 0.000	193000.	0.4532853	-1794429.	45000.0000
2	V= 50000.	S= 0.000	193000.	0.5917493	-2097898.	50000.0000

Pile-head Deflection vs. Pile Length

Boundary Condition Type 2, Shear and Slope

Shear = 5000. lbs
Slope = 0.00000
Axial Load = 193000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
648.000	0.00235481	-75100.21023	5000.00000
615.600	0.00235445	-75126.20460	5000.00000
583.200	0.00233919	-75216.22847	5000.00000
550.800	0.00234443	-75220.78739	5000.00000

```
   518.400    0.00232933  -75302.99337    5000.00000
   486.000    0.00233856  -75294.98542    5000.00000
   453.600    0.00232789  -75354.93549    5000.00000
   421.200    0.00231931  -75398.75558    5000.00000
   388.800    0.00231687  -75422.82494    5000.00000
   356.400    0.00231515  -75447.90897    5000.00000


This analysis ended normally.


------------------------------------------------------------------------------
                          Summary of Warning Messages
------------------------------------------------------------------------------
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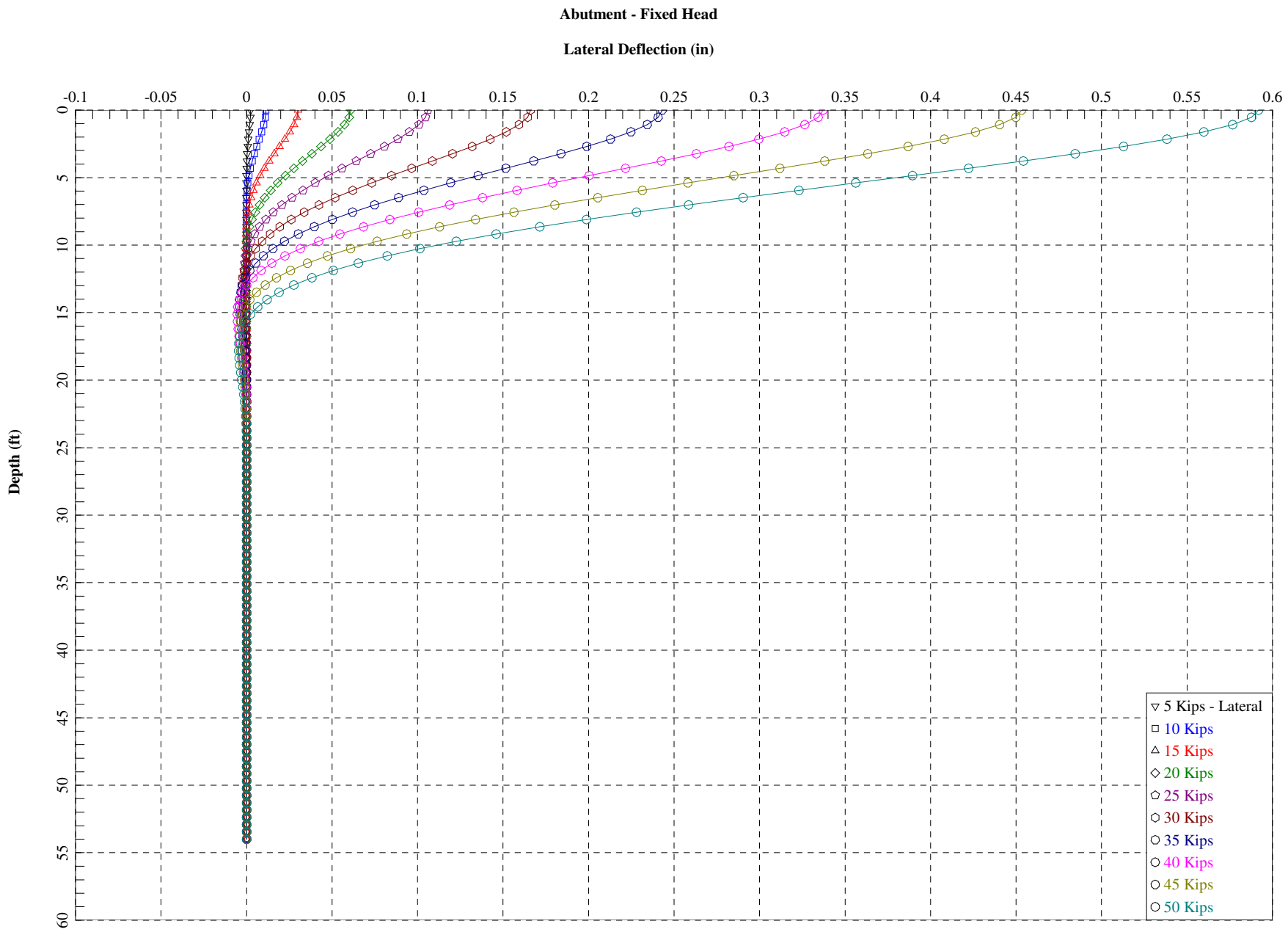
Abutment - Fixed Head
Lateral Deflection (in)
Depth (ft)
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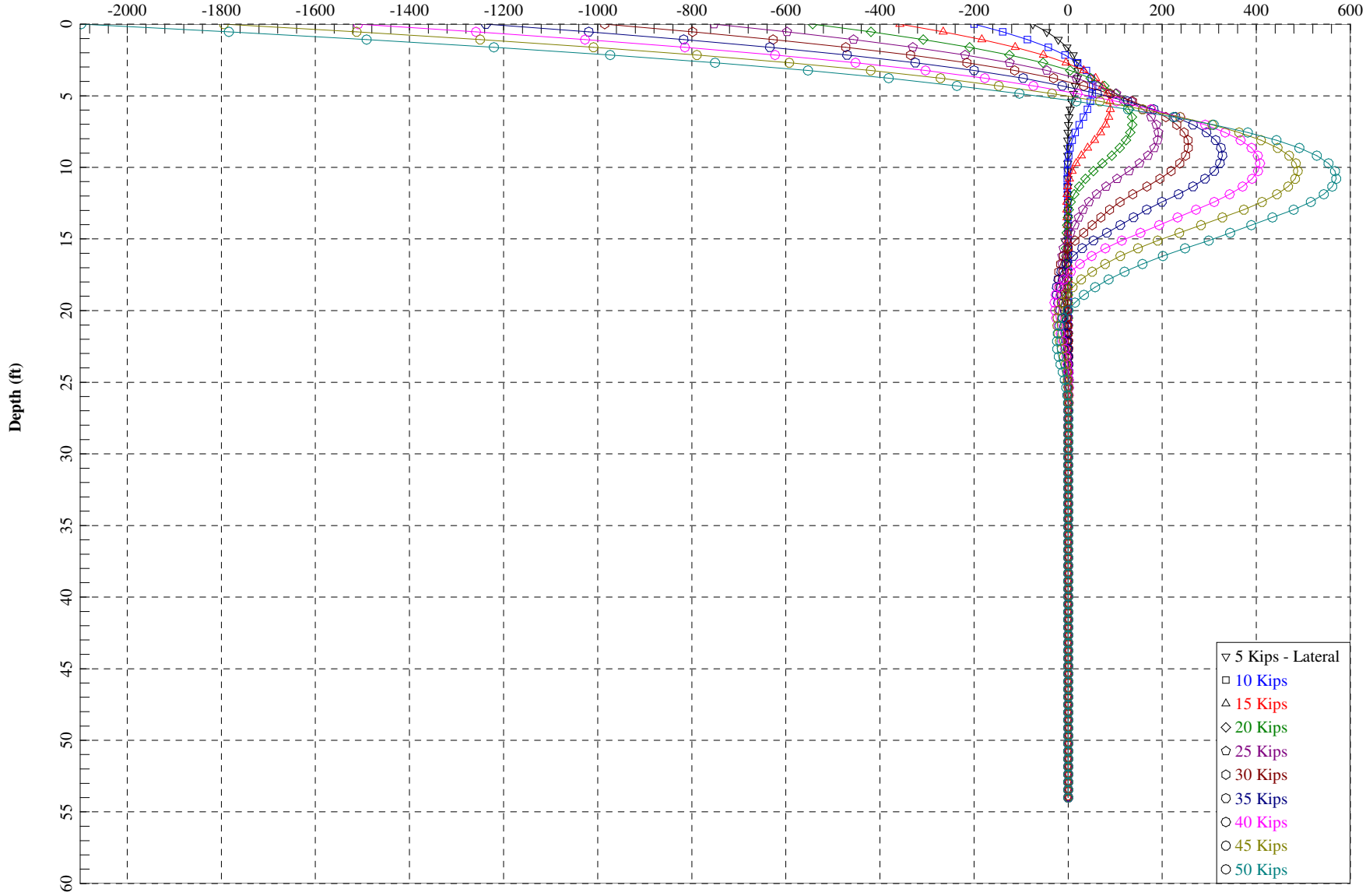
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0
5
10
15
20
25
30
35
40
45
50
55
60
5 Kips - Lateral
10 Kips
15 Kips
20 Kips
25 Kips
30 Kips
35 Kips
40 Kips
45 Kips
50 Kips

Abutment - Fixed Head

Bending Moment (in-kips)



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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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URS Corporation

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Name of output file: Old Redwood Bridge_Abutments_free.lpo
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Name of runtime file: Old Redwood Bridge_Abutments_free.lpr

Time and Date of Analysis

Date: April 24, 2011 Time: 10:35:08

Problem Title

Old Redwood Highway Overcrossing (Replace)_Abutments 1 & 3_Free

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Program Options

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis includes automatic computation of pile-top deflection vs. pile embedment length

- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 648.00 in

Depth of ground surface below top of pile = -60.00 in

Slope angle of ground surface = 33.70 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	14.00000000	3201.0000	196.0000	3372000.
2	648.0000	14.00000000	3201.0000	196.0000	3372000.

Soil and Rock Layering Information

The soil profile is modelled using 13 layers

Layer 1 is stiff clay without free water
Distance from top of pile to top of layer = -60.000 in
Distance from top of pile to bottom of layer = 48.000 in

Layer 2 is stiff clay without free water
Distance from top of pile to top of layer = 48.000 in
Distance from top of pile to bottom of layer = 156.000 in

Layer 3 is liquefiable sand, by Rollins et al, 2004
Distance from top of pile to top of layer = 156.000 in
Distance from top of pile to bottom of layer = 180.000 in

Warning : The depth of this layer is deeper than the recommended depth limit for using the p-y criteria for liquefied sand.

Please consult the LPile Technical Manual for additional background information regarding limitations on the use of the liquefied sand criteria.

Layer 4 is stiff clay without free water
Distance from top of pile to top of layer = 180.000 in
Distance from top of pile to bottom of layer = 234.000 in

Layer 5 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 234.000 in
Distance from top of pile to bottom of layer = 288.000 in

Layer 6 is stiff clay without free water
Distance from top of pile to top of layer = 288.000 in
Distance from top of pile to bottom of layer = 408.000 in

Layer 7 is stiff clay without free water
Distance from top of pile to top of layer = 408.000 in
Distance from top of pile to bottom of layer = 528.000 in

Layer 8 is stiff clay without free water
Distance from top of pile to top of layer = 528.000 in
Distance from top of pile to bottom of layer = 588.000 in

Layer 9 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 588.000 in
Distance from top of pile to bottom of layer = 606.000 in

Layer 10 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 606.000 in
Distance from top of pile to bottom of layer = 756.000 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 11 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 756.000 in
Distance from top of pile to bottom of layer = 888.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 12 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 888.000 in
Distance from top of pile to bottom of layer = 1116.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 13 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 1116.000 in
Distance from top of pile to bottom of layer = 1206.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

(Depth of lowest layer extends 558.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 26 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-60.00	0.07230
2	48.00	0.07230
3	48.00	0.06370
4	156.00	0.06370
5	156.00	0.03040
6	180.00	0.03040
7	180.00	0.02750
8	234.00	0.02750
9	234.00	0.03330
10	288.00	0.03330
11	288.00	0.03330
12	408.00	0.03330
13	408.00	0.03330
14	528.00	0.03330
15	528.00	0.03040
16	588.00	0.03040
17	588.00	0.03330
18	606.00	0.03330
19	606.00	0.03910
20	756.00	0.03910
21	756.00	0.04200
22	888.00	0.04200
23	888.00	0.04200
24	1116.00	0.04200
25	1116.00	0.04490
26	1206.00	0.04490

Shear Strength of Soils

Shear strength parameters with depth defined using 26 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-60.000	16.67000	0.00	0.00500	0.0
2	48.000	16.67000	0.00	0.00500	0.0
3	48.000	5.56000	0.00	0.01000	0.0
4	156.000	5.56000	0.00	0.01000	0.0
5	156.000	0.00000	0.00	------	------
6	180.000	0.00000	0.00	------	------
7	180.000	5.56000	0.00	0.01000	0.0
8	234.000	5.56000	0.00	0.01000	0.0
9	234.000	6.94400	0.00	0.01000	0.0
10	288.000	6.94400	0.00	0.01000	0.0
11	288.000	8.68000	0.00	0.00700	0.0
12	408.000	8.68000	0.00	0.00700	0.0
13	408.000	17.36000	0.00	0.00500	0.0
14	528.000	17.36000	0.00	0.00500	0.0

15	528.000	12.15000	0.00	0.00700	0.0
16	588.000	12.15000	0.00	0.00700	0.0
17	588.000	8.33300	0.00	0.00900	0.0
18	606.000	8.33300	0.00	0.00900	0.0
19	606.000	0.00000	36.00	------	------
20	756.000	0.00000	36.00	------	------
21	756.000	0.00000	36.00	------	------
22	888.000	0.00000	36.00	------	------
23	888.000	0.00000	38.00	------	------
24	1116.000	0.00000	38.00	------	------
25	1116.000	0.00000	40.00	------	------
26	1206.000	0.00000	40.00	------	------

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 = 193000.000 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 = 193000.000 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 = 193000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

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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     =      193000.000 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     =      193000.000 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     =      193000.000 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     =      193000.000 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     =      193000.000 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    =       45000.000 lbs
Bending moment at pile head =           0.000 in-lbs
Axial load at pile head     =      193000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Load Case Number 10
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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 = 193000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

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	193000.	0.0092205	71732.6842	5000.0000
1	V= 10000.	M= 0.000	193000.	0.0452055	192843.	10000.0000
1	V= 15000.	M= 0.000	193000.	0.1192769	339297.	15000.0000
1	V= 20000.	M= 0.000	193000.	0.2421713	504560.	20000.0000
1	V= 25000.	M= 0.000	193000.	0.4218354	695048.	25000.0000
1	V= 30000.	M= 0.000	193000.	0.6675029	910805.	30000.0000
1	V= 35000.	M= 0.000	193000.	0.9834780	1153842.	35000.0000
1	V= 40000.	M= 0.000	193000.	1.3770	1423360.	40000.0000
1	V= 45000.	M= 0.000	193000.	1.8582	1717148.	45000.0000
1	V= 50000.	M= 0.000	193000.	2.4333	2035316.	50000.0000

Pile-head Deflection vs. Pile Length

Boundary Condition Type 1, Shear and Moment

Shear = 5000. lbs
Moment = 0. in-lbs
Axial Load = 193000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
648.000	0.00919872	71669.88023	5000.00000
615.600	0.00918898	72197.92710	5000.00000
583.200	0.00920674	72302.14220	5000.00000
550.800	0.00917884	72095.79378	5000.00000
518.400	0.00920610	72112.28651	5000.00000
486.000	0.00919746	72338.80850	5000.00000
453.600	0.00920527	71964.25149	5000.00000

```
   421.200    0.00920580   72341.92416    5000.00000
   388.800    0.00920425   72143.46816    5000.00000
   356.400    0.00920565   72287.10642    5000.00000


This analysis ended normally.


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                          Summary of Warning Messages
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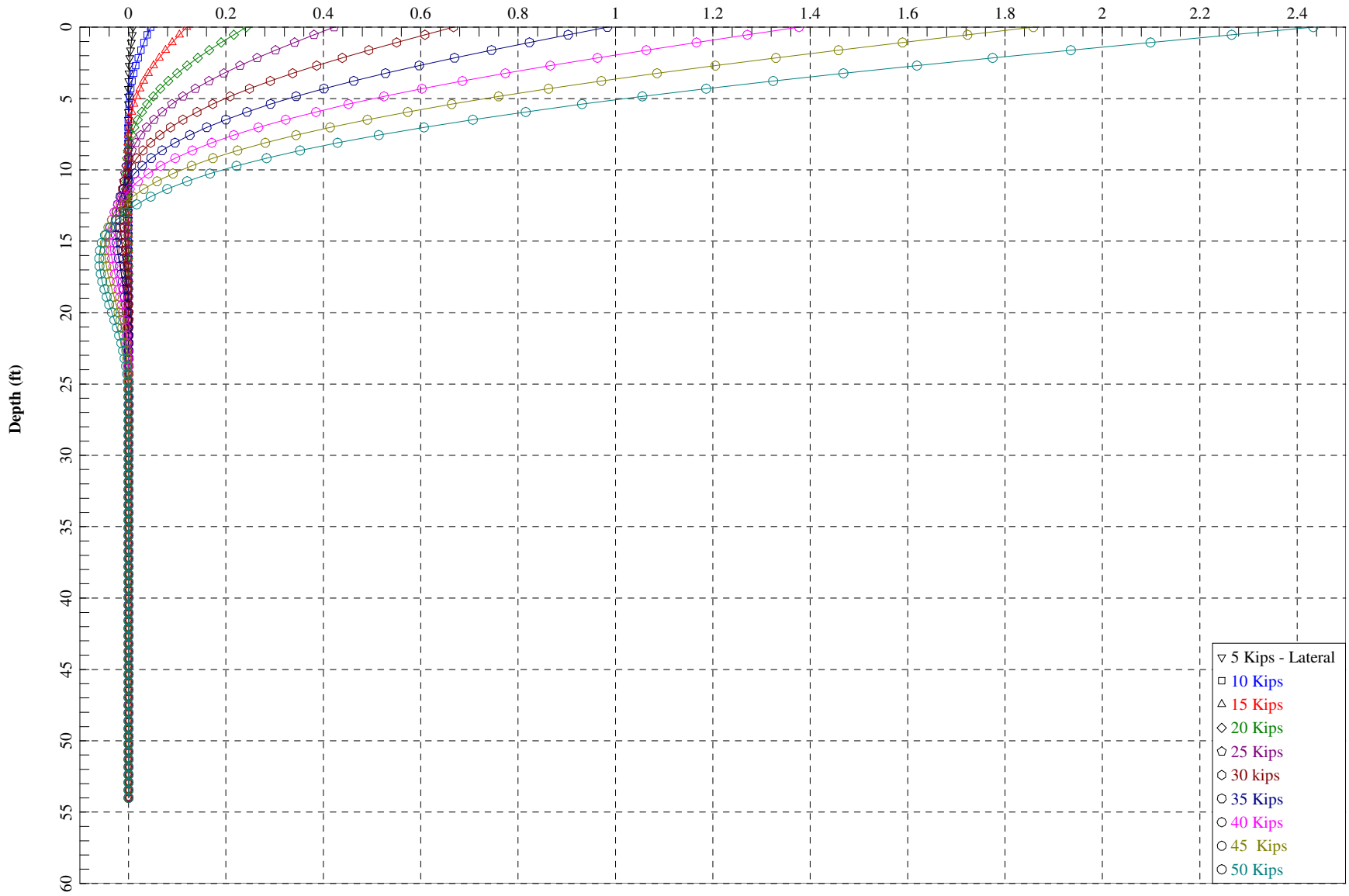
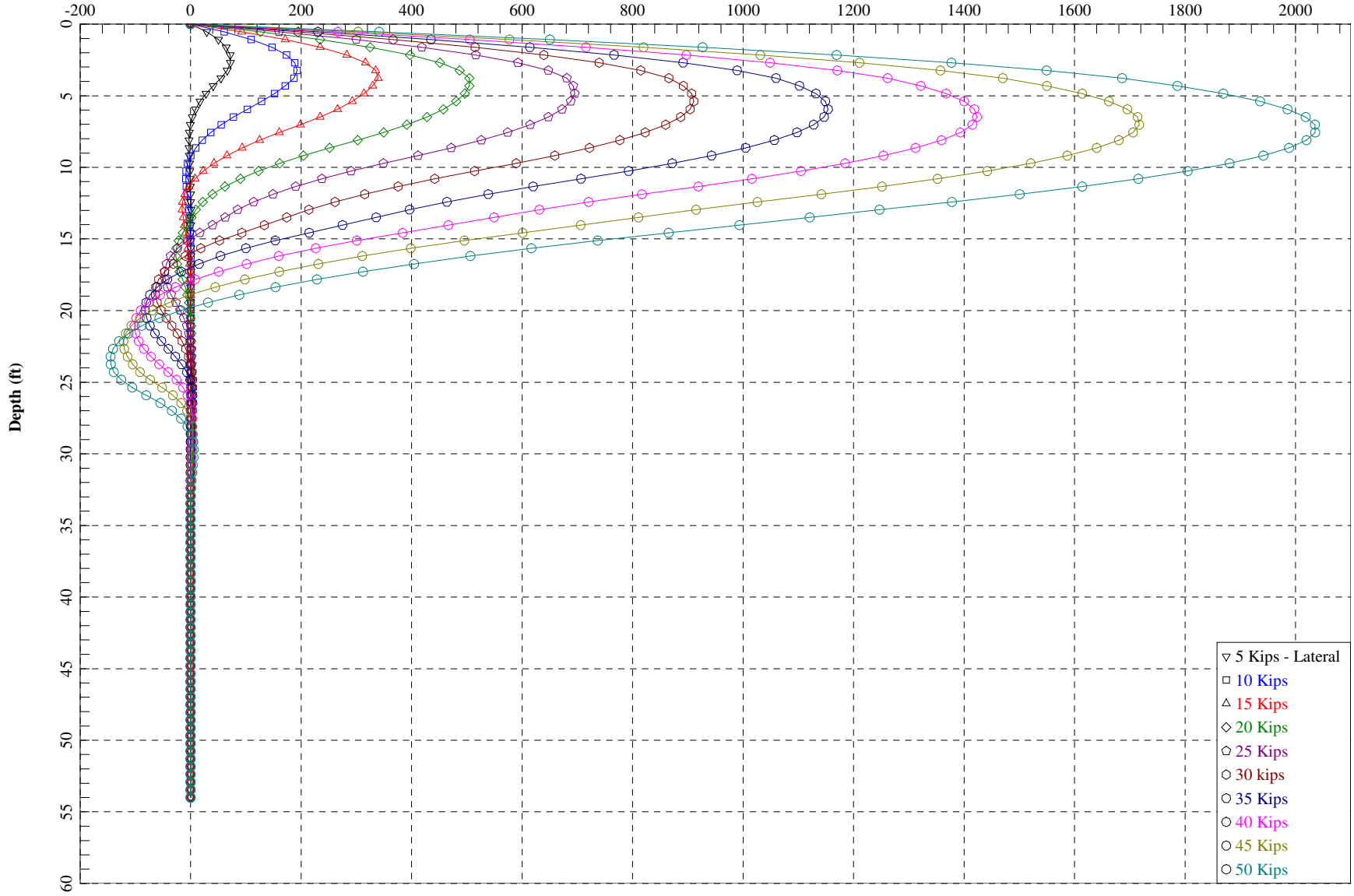
Abutment - Free Head

Lateral Deflection (in)



Abutment - Free Head

Bending Moment (in-kips)



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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:

Madhu Thummaluru
URS Corporation

Path to file locations: X:\Old Redwood Interchange PSE\440_Materials\Analysis\Pile\Lateral\Bridge\
Name of input data file: Old Redwood Bridge_Bent 2_16 in fixed.lpd
Name of output file: Old Redwood Bridge_Bent 2_16 in fixed.lpo
Name of plot output file: Old Redwood Bridge_Bent 2_16 in fixed.lpp
Name of runtime file: Old Redwood Bridge_Bent 2_16 in fixed.lpr

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Time and Date of Analysis

Date: September 13, 2011 Time: 12:47:06

Problem Title

Old Redwood Highway Overcrossing (Replace)_Bent 2_Fixed

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 = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 552.00 in

Depth of ground surface below top of pile = -96.00 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	16.00000000	5461.0000	256.0000	3372000.
2	552.0000	16.00000000	5461.0000	256.0000	3372000.

Soil and Rock Layering Information

The soil profile is modelled using 12 layers

Layer 1 is stiff clay without free water
Distance from top of pile to top of layer = -96.000 in
Distance from top of pile to bottom of layer = 36.000 in

Layer 2 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 36.000 in
Distance from top of pile to bottom of layer = 60.000 in

Layer 3 is stiff clay without free water
Distance from top of pile to top of layer = 60.000 in
Distance from top of pile to bottom of layer = 114.000 in

Layer 4 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 114.000 in
Distance from top of pile to bottom of layer = 168.000 in

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Layer  5 is stiff clay without free water
Distance from top of pile to top of layer    =      168.000 in
Distance from top of pile to bottom of layer =      288.000 in

Layer  6 is stiff clay without free water
Distance from top of pile to top of layer    =      288.000 in
Distance from top of pile to bottom of layer =      408.000 in

Layer  7 is stiff clay without free water
Distance from top of pile to top of layer    =      408.000 in
Distance from top of pile to bottom of layer =      468.000 in

Layer  8 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer    =      468.000 in
Distance from top of pile to bottom of layer =      486.000 in

Layer  9 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      486.000 in
Distance from top of pile to bottom of layer =      636.000 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 10 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      636.000 in
Distance from top of pile to bottom of layer =      768.000 in
p-y subgrade modulus k for top of soil layer =      125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      125.000 lbs/in**3

Layer 11 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      768.000 in
Distance from top of pile to bottom of layer =      996.000 in
p-y subgrade modulus k for top of soil layer =      125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      125.000 lbs/in**3

Layer 12 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      996.000 in
Distance from top of pile to bottom of layer =     1086.000 in
p-y subgrade modulus k for top of soil layer =      125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      125.000 lbs/in**3


(Depth of lowest layer extends  534.00 in below pile tip)


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                    Effective Unit Weight of Soil vs. Depth
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Effective unit weight of soil with depth defined using 24 points

Point        Depth X    Eff. Unit Weight
 No.           in          lbs/in**3
-----      ----------   ----------------
  1           -96.00        0.06370
  2            36.00        0.06370
  3            36.00        0.03040
```

4	60.00	0.03040
5	60.00	0.02750
6	114.00	0.02750
7	114.00	0.03330
8	168.00	0.03330
9	168.00	0.03330
10	288.00	0.03330
11	288.00	0.03330
12	408.00	0.03330
13	408.00	0.03040
14	468.00	0.03040
15	468.00	0.03330
16	486.00	0.03330
17	486.00	0.03910
18	636.00	0.03910
19	636.00	0.04200
20	768.00	0.04200
21	768.00	0.04200
22	996.00	0.04200
23	996.00	0.04490
24	1086.00	0.04490

Shear Strength of Soils

Shear strength parameters with depth defined using 24 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-96.000	5.56000	0.00	0.01000	0.0
2	36.000	5.56000	0.00	0.01000	0.0
3	36.000	6.94400	0.00	0.01000	0.0
4	60.000	6.94400	0.00	0.01000	0.0
5	60.000	5.56000	0.00	0.01000	0.0
6	114.000	5.56000	0.00	0.01000	0.0
7	114.000	6.94400	0.00	0.01000	0.0
8	168.000	6.94400	0.00	0.01000	0.0
9	168.000	8.68000	0.00	0.00700	0.0
10	288.000	8.68000	0.00	0.00700	0.0
11	288.000	17.36000	0.00	0.00500	0.0
12	408.000	17.36000	0.00	0.00500	0.0
13	408.000	12.15000	0.00	0.00700	0.0
14	468.000	12.15000	0.00	0.00700	0.0
15	468.000	8.33300	0.00	0.00900	0.0
16	486.000	8.33300	0.00	0.00900	0.0
17	486.000	0.00000	36.00	------	------
18	636.000	0.00000	36.00	------	------
19	636.000	0.00000	36.00	------	------
20	768.000	0.00000	36.00	------	------
21	768.000	0.00000	38.00	------	------
22	996.000	0.00000	38.00	------	------
23	996.000	0.00000	40.00	------	------
24	1086.000	0.00000	40.00	------	------

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 = 0.100 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 110000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 0.250 in
Slope at pile head = 0.000 in/in
Axial load at pile head = 110000.000 lbs

Load Case Number 3

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 = 110000.000 lbs

Load Case Number 4

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 = 110000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 1.500 in

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Slope at pile head          =           0.000 in/in
Axial load at pile head     =      110000.000 lbs

Load Case Number  6

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     =      110000.000 lbs

Load Case Number  7

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =           2.500 in
Slope at pile head          =           0.000 in/in
Axial load at pile head     =      110000.000 lbs

Load Case Number  8

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =           3.000 in
Slope at pile head          =           0.000 in/in
Axial load at pile head     =      110000.000 lbs

Load Case Number  9

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =           4.000 in
Slope at pile head          =           0.000 in/in
Axial load at pile head     =      110000.000 lbs

Load Case Number 10

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =           5.000 in
Slope at pile head          =           0.000 in/in
Axial load at pile head     =      110000.000 lbs


--------------------------------------------------------------------------------
                          Summary of Pile Response(s)
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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  Pile-Head    Pile-Head       Axial    Pile-Head    Maximum     Maximum
Type  Condition    Condition       Load     Deflection    Moment      Shear
          1            2            lbs         in        in-lbs       lbs
---- ------------ ------------ ----------- ----------- ----------- ---------
  5  y=  0.100000 S=     0.000     110000.   0.1000000    -900599.  23716.1927
  5  y=  0.250000 S=     0.000     110000.   0.2500000   -1622223.  36229.2369
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```
  5  y=  0.750000 S=     0.000     110000.   0.7500000   -3335922.  60879.6226
  5  y=  1.000000 S=     0.000     110000.   1.0000000   -4041878.  69935.7526
  5  y=     1.500 S=     0.000     110000.      1.5000   -5301780.  85144.2184
  5  y=     2.000 S=     0.000     110000.      2.0000   -6433997.  98014.6444
  5  y=     2.500 S=     0.000     110000.      2.5000   -7479390.     109381.
  5  y=     3.000 S=     0.000     110000.      3.0000   -8456190.     119640.
  5  y=     4.000 S=     0.000     110000.      4.0000 -1.0242E+07     137250.
  5  y=     5.000 S=     0.000     110000.      5.0000 -1.1843E+07     151608.
```

Pile-head Deflection vs. Pile Length

Boundary Condition Type 5, Deflection and Slope

```
Deflection =         0.10000  in
Slope      =         0.00000
Axial Load =         110000. lbs
```

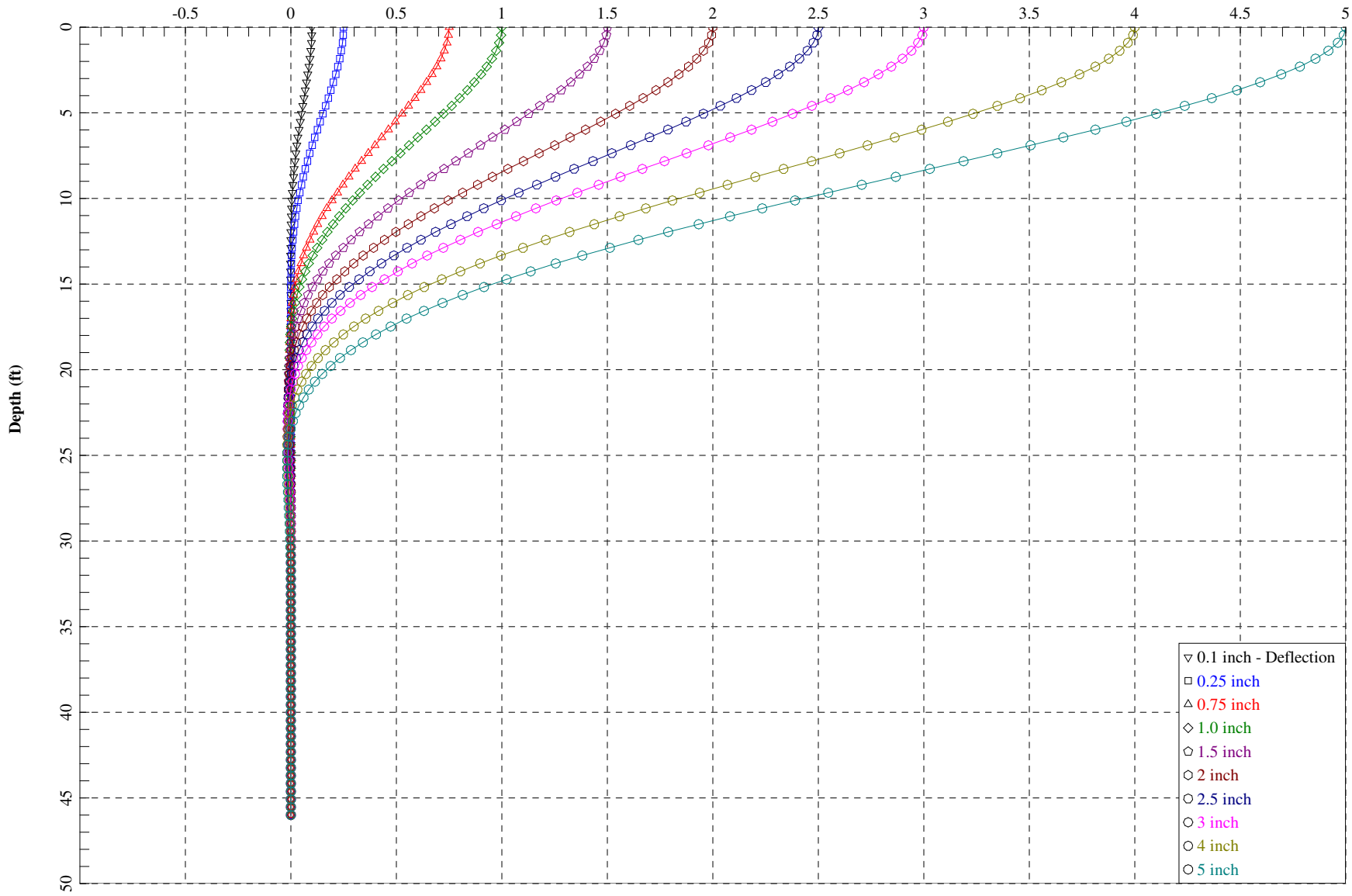
Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
552.000	0.10000000	-900599.12843	23716.19271
524.400	0.10000000	-901971.19171	23754.99850
496.800	0.10000000	-901578.55565	23734.16657
469.200	0.10000000	-901787.42362	23737.78096
441.600	0.10000000	-901388.63682	23714.93997
414.000	0.10000000	-902425.79608	23748.64445
386.400	0.10000000	-902214.08072	23732.86532
358.800	0.10000000	-901732.98564	23715.42835
331.200	0.10000000	-903408.01715	23767.01177
303.600	0.10000000	-902922.27543	23749.31495

This analysis ended normally.

Summary of Warning Messages

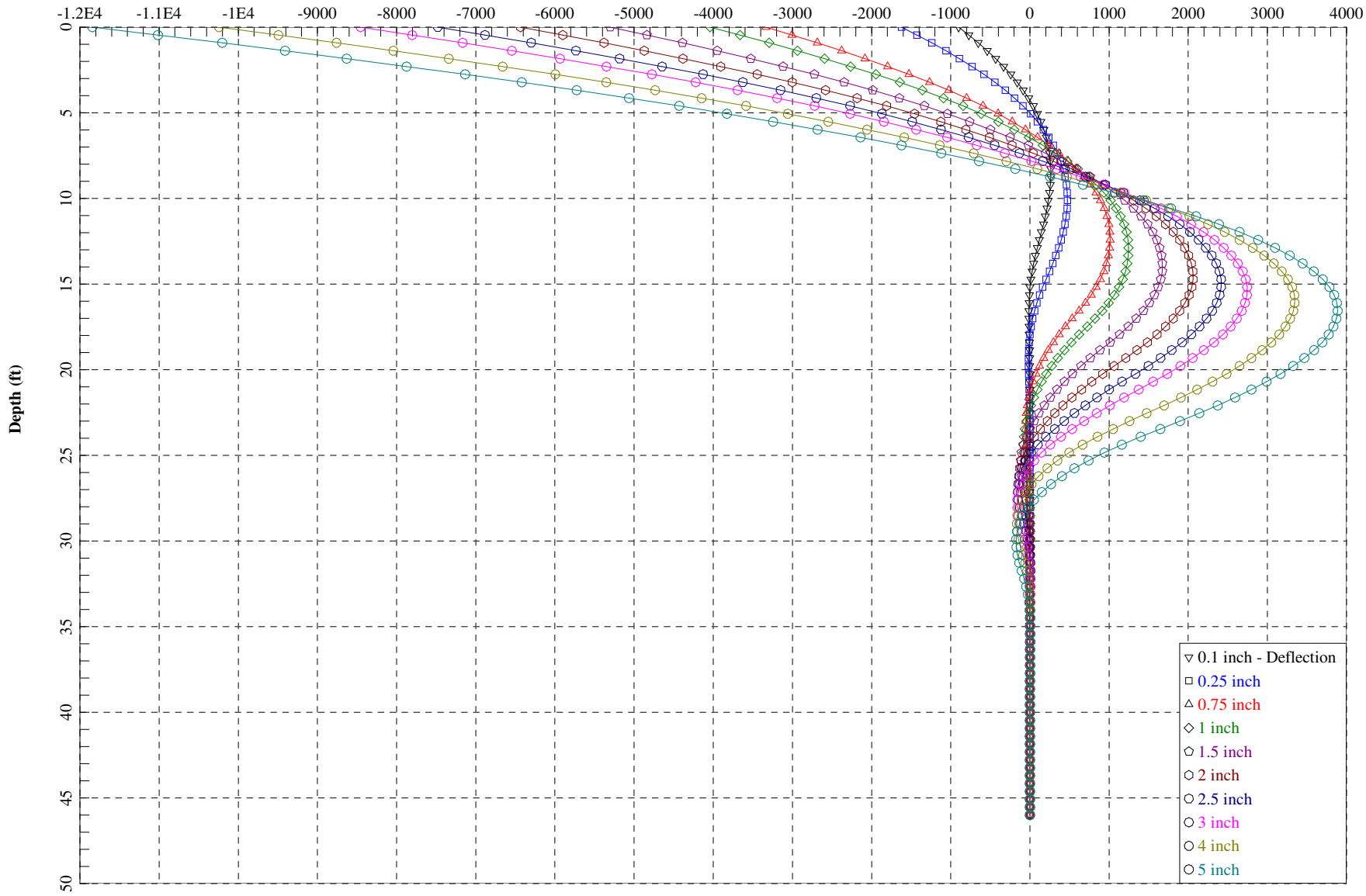
Bent 2 - Fixed Head

Lateral Deflection (in)



Bent 2 - Fixed Head

Bending Moment (in-kips)



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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:

Madhu Thummaluru
URS Corporation

Path to file locations: X:\Old Redwood Interchange PSE\440_Materials\Analysis\Pile\Lateral\Bridge\
Name of input data file: Old Redwood Bridge_Bent 2_16 in free.lpd
Name of output file: Old Redwood Bridge_Bent 2_16 in free.lpo
Name of plot output file: Old Redwood Bridge_Bent 2_16 in free.lpp
Name of runtime file: Old Redwood Bridge_Bent 2_16 in free.lpr

---

Time and Date of Analysis

Date: September 13, 2011 Time: 13:07:53

Problem Title

Old Redwood Highway Overcrossing (Replace)_Bent 2_Free

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 = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 552.00 in

Depth of ground surface below top of pile = -96.00 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	16.00000000	5461.0000	256.0000	3372000.
2	552.0000	16.00000000	5461.0000	256.0000	3372000.

Soil and Rock Layering Information

The soil profile is modelled using 12 layers

Layer 1 is stiff clay without free water
Distance from top of pile to top of layer = -96.000 in
Distance from top of pile to bottom of layer = 36.000 in

Layer 2 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 36.000 in
Distance from top of pile to bottom of layer = 60.000 in

Layer 3 is stiff clay without free water
Distance from top of pile to top of layer = 60.000 in
Distance from top of pile to bottom of layer = 114.000 in

Layer 4 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 114.000 in

```
Distance from top of pile to bottom of layer =      168.000 in

Layer  5 is stiff clay without free water
Distance from top of pile to top of layer    =      168.000 in
Distance from top of pile to bottom of layer =      288.000 in

Layer  6 is stiff clay without free water
Distance from top of pile to top of layer    =      288.000 in
Distance from top of pile to bottom of layer =      408.000 in

Layer  7 is stiff clay without free water
Distance from top of pile to top of layer    =      408.000 in
Distance from top of pile to bottom of layer =      468.000 in

Layer  8 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer    =      468.000 in
Distance from top of pile to bottom of layer =      486.000 in

Layer  9 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      486.000 in
Distance from top of pile to bottom of layer =      636.000 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 10 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      636.000 in
Distance from top of pile to bottom of layer =      768.000 in
p-y subgrade modulus k for top of soil layer =      125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      125.000 lbs/in**3

Layer 11 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      768.000 in
Distance from top of pile to bottom of layer =      996.000 in
p-y subgrade modulus k for top of soil layer =      125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      125.000 lbs/in**3

Layer 12 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      996.000 in
Distance from top of pile to bottom of layer =     1086.000 in
p-y subgrade modulus k for top of soil layer =      125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      125.000 lbs/in**3


(Depth of lowest layer extends  534.00 in below pile tip)


--------------------------------------------------------------------------------
                    Effective Unit Weight of Soil vs. Depth
--------------------------------------------------------------------------------

Effective unit weight of soil with depth defined using 24 points

Point        Depth X    Eff. Unit Weight
 No.           in          lbs/in**3
-----      ----------   ----------------
  1           -96.00        0.06370
  2            36.00        0.06370
```

3	36.00	0.03040
4	60.00	0.03040
5	60.00	0.02750
6	114.00	0.02750
7	114.00	0.03330
8	168.00	0.03330
9	168.00	0.03330
10	288.00	0.03330
11	288.00	0.03330
12	408.00	0.03330
13	408.00	0.03040
14	468.00	0.03040
15	468.00	0.03330
16	486.00	0.03330
17	486.00	0.03910
18	636.00	0.03910
19	636.00	0.04200
20	768.00	0.04200
21	768.00	0.04200
22	996.00	0.04200
23	996.00	0.04490
24	1086.00	0.04490

Shear Strength of Soils

Shear strength parameters with depth defined using 24 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-96.000	5.56000	0.00	0.01000	0.0
2	36.000	5.56000	0.00	0.01000	0.0
3	36.000	6.94400	0.00	0.01000	0.0
4	60.000	6.94400	0.00	0.01000	0.0
5	60.000	5.56000	0.00	0.01000	0.0
6	114.000	5.56000	0.00	0.01000	0.0
7	114.000	6.94400	0.00	0.01000	0.0
8	168.000	6.94400	0.00	0.01000	0.0
9	168.000	8.68000	0.00	0.00700	0.0
10	288.000	8.68000	0.00	0.00700	0.0
11	288.000	17.36000	0.00	0.00500	0.0
12	408.000	17.36000	0.00	0.00500	0.0
13	408.000	12.15000	0.00	0.00700	0.0
14	468.000	12.15000	0.00	0.00700	0.0
15	468.000	8.33300	0.00	0.00900	0.0
16	486.000	8.33300	0.00	0.00900	0.0
17	486.000	0.00000	36.00	------	------
18	636.000	0.00000	36.00	------	------
19	636.000	0.00000	36.00	------	------
20	768.000	0.00000	36.00	------	------
21	768.000	0.00000	38.00	------	------
22	996.000	0.00000	38.00	------	------
23	996.000	0.00000	40.00	------	------
24	1086.000	0.00000	40.00	------	------

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 = 0.100 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 110000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 0.250 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 110000.000 lbs

Load Case Number 3

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 = 110000.000 lbs

Load Case Number 4

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 = 110000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 1.500 in
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 110000.000 lbs

Load Case Number 6

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     =      110000.000 lbs

Load Case Number  7

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =           2.500 in
Bending moment at pile head =           0.000 in-lbs
Axial load at pile head     =      110000.000 lbs

Load Case Number  8

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =           3.000 in
Bending moment at pile head =           0.000 in-lbs
Axial load at pile head     =      110000.000 lbs

Load Case Number  9

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =           4.000 in
Bending moment at pile head =           0.000 in-lbs
Axial load at pile head     =      110000.000 lbs

Load Case Number 10

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =           5.000 in
Bending moment at pile head =           0.000 in-lbs
Axial load at pile head     =      110000.000 lbs

--------------------------------------------------------------------------------
                          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= 0.100000	M= 0.000	110000.	0.1000000	355797.	12494.0514
4	y= 0.250000	M= 0.000	110000.	0.2500000	647861.	19109.6102
4	y= 0.750000	M= 0.000	110000.	0.7500000	1310603.	31698.8699
4	y= 1.000000	M= 0.000	110000.	1.0000000	1575218.	36165.5599
4	y= 1.500	M= 0.000	110000.	1.5000	2049293.	43587.1923
4	y= 2.000	M= 0.000	110000.	2.0000	2478133.	49808.0867
4	y= 2.500	M= 0.000	110000.	2.5000	2876320.	55265.2351
4	y= 3.000	M= 0.000	110000.	3.0000	3256008.	60192.1688
4	y= 4.000	M= 0.000	110000.	4.0000	3961030.	68886.0616

```
  4  y=     5.000 M=     0.000     110000.      5.0000    4625618.  76457.8122
```

Pile-head Deflection vs. Pile Length

Boundary Condition Type 4, Deflection and Moment

```
Deflection =         0.10000  in
Moment     =              0. in-lbs
Axial Load =         110000. lbs
```

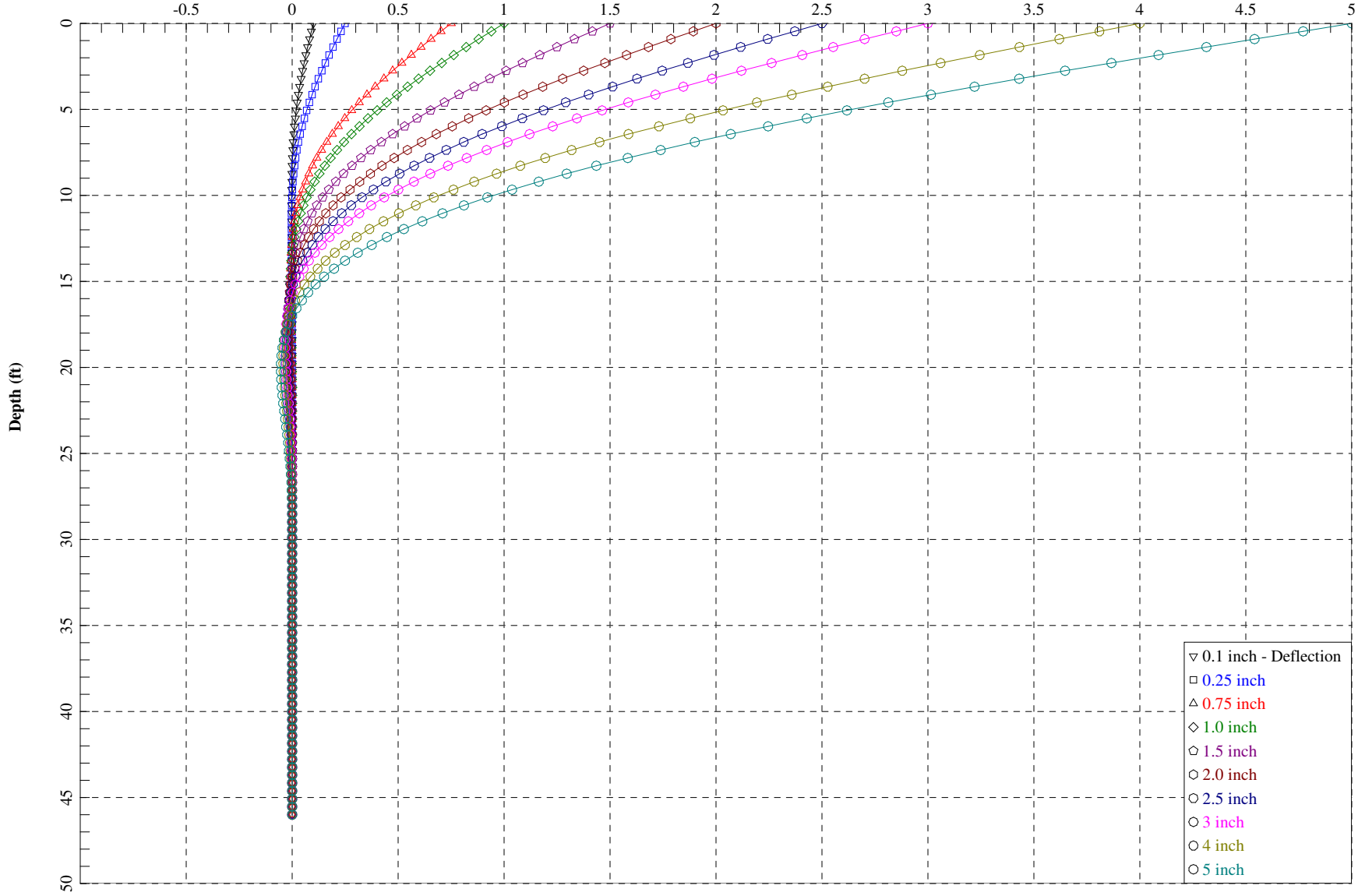
Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
552.000	0.10000000	355797.07065	12494.05136
524.400	0.10000000	355877.46038	12489.95419
496.800	0.10000000	355428.90102	12489.36170
469.200	0.10000000	356293.96018	12497.45979
441.600	0.10000000	355870.83723	12488.41066
414.000	0.10000000	356025.62761	12492.37467
386.400	0.10000000	355961.47818	12490.85303
358.800	0.10000000	356127.90733	12492.76302
331.200	0.10000000	355849.85724	12490.84837
303.600	0.10000000	356085.82923	12493.41329

This analysis ended normally.

Summary of Warning Messages

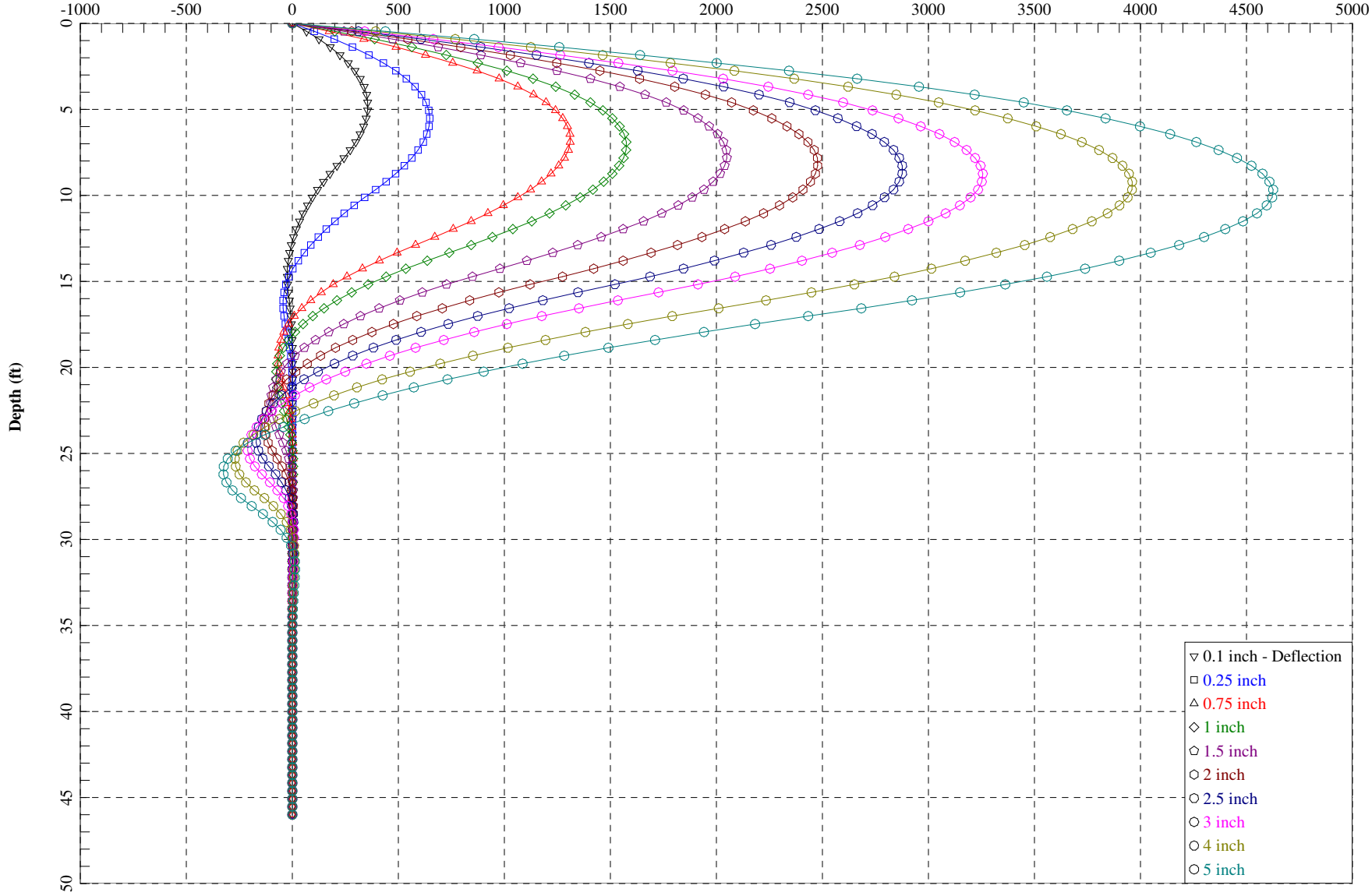
Bent 2 - Free Head

Lateral Deflection (in)



Bent 2 - Free Head

Bending Moment (in-kips)



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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:

Madhu Thummaluru
URS Corporation

Path to file locations: X:\Old Redwood Interchange PSE\440_Materials\Analysis\Pile\Lateral\Bridge\
Name of input data file: Old Redwood Bridge_AbutWW_fixed.lpd
Name of output file: Old Redwood Bridge_AbutWW_fixed.lpo
Name of plot output file: Old Redwood Bridge_AbutWW_fixed.lpp
Name of runtime file: Old Redwood Bridge_AbutWW_fixed.lpr

Time and Date of Analysis

Date: April 24, 2011 Time: 10:35:44

Problem Title

Old Redwood Highway Overcrossing (Replace)_Abutments 1 & 3 Wing Wall_Fixed

---

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 = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 816.00 in

Depth of ground surface below top of pile = -36.00 in

Slope angle of ground surface = 26.60 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	14.00000000	3201.0000	196.0000	3372000.
2	816.0000	14.00000000	3201.0000	196.0000	3372000.

Soil and Rock Layering Information

The soil profile is modelled using 13 layers

Layer 1 is stiff clay without free water
Distance from top of pile to top of layer = -36.000 in
Distance from top of pile to bottom of layer = 204.000 in

Layer 2 is stiff clay without free water
Distance from top of pile to top of layer = 204.000 in
Distance from top of pile to bottom of layer = 312.000 in

Layer 3 is liquefiable sand, by Rollins et al, 2004
Distance from top of pile to top of layer = 312.000 in
Distance from top of pile to bottom of layer = 336.000 in

Warning : The depth of this layer is deeper than the recommended depth limit for using the p-y criteria for liquefied sand.
Please consult the LPile Technical Manual for additional background information regarding limitations on the use of the liquefied sand criteria.

```
Layer  4 is stiff clay without free water
Distance from top of pile to top of layer    =      336.000 in
Distance from top of pile to bottom of layer =      390.000 in

Layer  5 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer    =      390.000 in
Distance from top of pile to bottom of layer =      444.000 in

Layer  6 is stiff clay without free water
Distance from top of pile to top of layer    =      444.000 in
Distance from top of pile to bottom of layer =      564.000 in

Layer  7 is stiff clay without free water
Distance from top of pile to top of layer    =      564.000 in
Distance from top of pile to bottom of layer =      684.000 in

Layer  8 is stiff clay without free water
Distance from top of pile to top of layer    =      684.000 in
Distance from top of pile to bottom of layer =      744.000 in

Layer  9 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer    =      744.000 in
Distance from top of pile to bottom of layer =      762.000 in

Layer 10 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      762.000 in
Distance from top of pile to bottom of layer =      912.000 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 11 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 =     1044.000 in
p-y subgrade modulus k for top of soil layer =      125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      125.000 lbs/in**3

Layer 12 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =     1044.000 in
Distance from top of pile to bottom of layer =     1272.000 in
p-y subgrade modulus k for top of soil layer =      125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      125.000 lbs/in**3

Layer 13 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =     1272.000 in
Distance from top of pile to bottom of layer =     1362.000 in
p-y subgrade modulus k for top of soil layer =      125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      125.000 lbs/in**3


(Depth of lowest layer extends  546.00 in below pile tip)

--------------------------------------------------------------------------------
                   Effective Unit Weight of Soil vs. Depth
--------------------------------------------------------------------------------

Effective unit weight of soil with depth defined using 26 points
```

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-36.00	0.07230
2	204.00	0.07230
3	204.00	0.06370
4	312.00	0.06370
5	312.00	0.03040
6	336.00	0.03040
7	336.00	0.02750
8	390.00	0.02750
9	390.00	0.03330
10	444.00	0.03330
11	444.00	0.03330
12	564.00	0.03330
13	564.00	0.03330
14	684.00	0.03330
15	684.00	0.03040
16	744.00	0.03040
17	744.00	0.03330
18	762.00	0.03330
19	762.00	0.03910
20	912.00	0.03910
21	912.00	0.04200
22	1044.00	0.04200
23	1044.00	0.04200
24	1272.00	0.04200
25	1272.00	0.04490
26	1362.00	0.04490

Shear Strength of Soils

Shear strength parameters with depth defined using 26 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-36.000	16.67000	0.00	0.00500	0.0
2	204.000	16.67000	0.00	0.00500	0.0
3	204.000	5.56000	0.00	0.01000	0.0
4	312.000	5.56000	0.00	0.01000	0.0
5	312.000	0.00000	0.00	------	------
6	336.000	0.00000	0.00	------	------
7	336.000	5.56000	0.00	0.01000	0.0
8	390.000	5.56000	0.00	0.01000	0.0
9	390.000	6.94400	0.00	0.01000	0.0
10	444.000	6.94400	0.00	0.01000	0.0
11	444.000	8.68000	0.00	0.00700	0.0
12	564.000	8.68000	0.00	0.00700	0.0
13	564.000	17.36000	0.00	0.00500	0.0
14	684.000	17.36000	0.00	0.00500	0.0
15	684.000	12.15000	0.00	0.00700	0.0
16	744.000	12.15000	0.00	0.00700	0.0
17	744.000	8.33300	0.00	0.00900	0.0

18	762.000	8.33300	0.00	0.00900	0.0
19	762.000	0.00000	36.00	------	------
20	912.000	0.00000	36.00	------	------
21	912.000	0.00000	36.00	------	------
22	1044.000	0.00000	36.00	------	------
23	1044.000	0.00000	38.00	------	------
24	1272.000	0.00000	38.00	------	------
25	1272.000	0.00000	40.00	------	------
26	1362.000	0.00000	40.00	------	------

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 = 60000.000 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 = 60000.000 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 = 60000.000 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     =       60000.000 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     =       60000.000 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     =       60000.000 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     =       60000.000 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    =       40000.000 lbs
Slope at pile head          =           0.000 in/in
Axial load at pile head     =       60000.000 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    =       45000.000 lbs
Slope at pile head          =           0.000 in/in
Axial load at pile head     =       60000.000 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    =       50000.000 lbs
```

Slope at pile head = 0.000 in/in
Axial load at pile head = 60000.000 lbs

(Zero slope for this load indicates fixed-head condition)

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	60000.0000	0.0026237	-77579.7934	5000.0000
2	V= 10000.	S= 0.000	60000.0000	0.0114992	-205828.	10000.0000
2	V= 15000.	S= 0.000	60000.0000	0.0274609	-363489.	15000.0000
2	V= 20000.	S= 0.000	60000.0000	0.0508980	-543602.	20000.0000
2	V= 25000.	S= 0.000	60000.0000	0.0820067	-742470.	25000.0000
2	V= 30000.	S= 0.000	60000.0000	0.1210314	-957555.	30000.0000
2	V= 35000.	S= 0.000	60000.0000	0.1681873	-1186984.	35000.0000
2	V= 40000.	S= 0.000	60000.0000	0.2235728	-1429275.	40000.0000
2	V= 45000.	S= 0.000	60000.0000	0.2869897	-1683712.	45000.0000
2	V= 50000.	S= 0.000	60000.0000	0.3586759	-1949451.	50000.0000

Pile-head Deflection vs. Pile Length

Boundary Condition Type 2, Shear and Slope

Shear = 5000. lbs
Slope = 0.00000
Axial Load = 60000. lbs

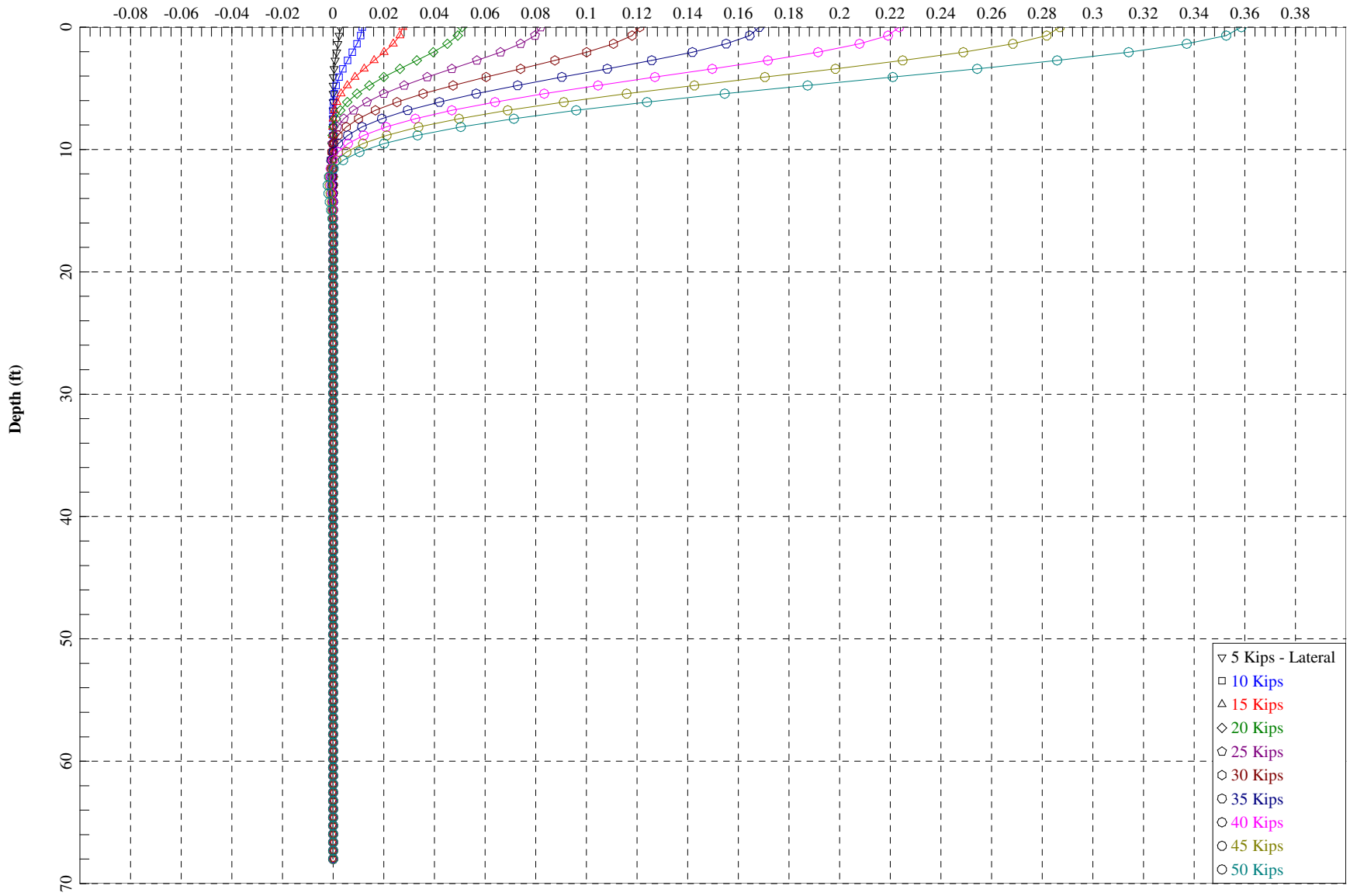
Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
816.000	0.00262587	-77600.49580	5000.00000
775.200	0.00261574	-77658.94747	5000.00000
734.400	0.00259258	-77687.01769	5000.00000
693.600	0.00259888	-77797.22170	5000.00000
652.800	0.00258851	-77853.76446	5000.00000
612.000	0.00257572	-77859.43672	5000.00000
571.200	0.00257451	-77962.62595	5000.00000
530.400	0.00256910	-78018.99174	5000.00000
489.600	0.00255409	-78010.35670	5000.00000
448.800	0.00255543	-78101.59263	5000.00000

This analysis ended normally.

Summary of Warning Messages

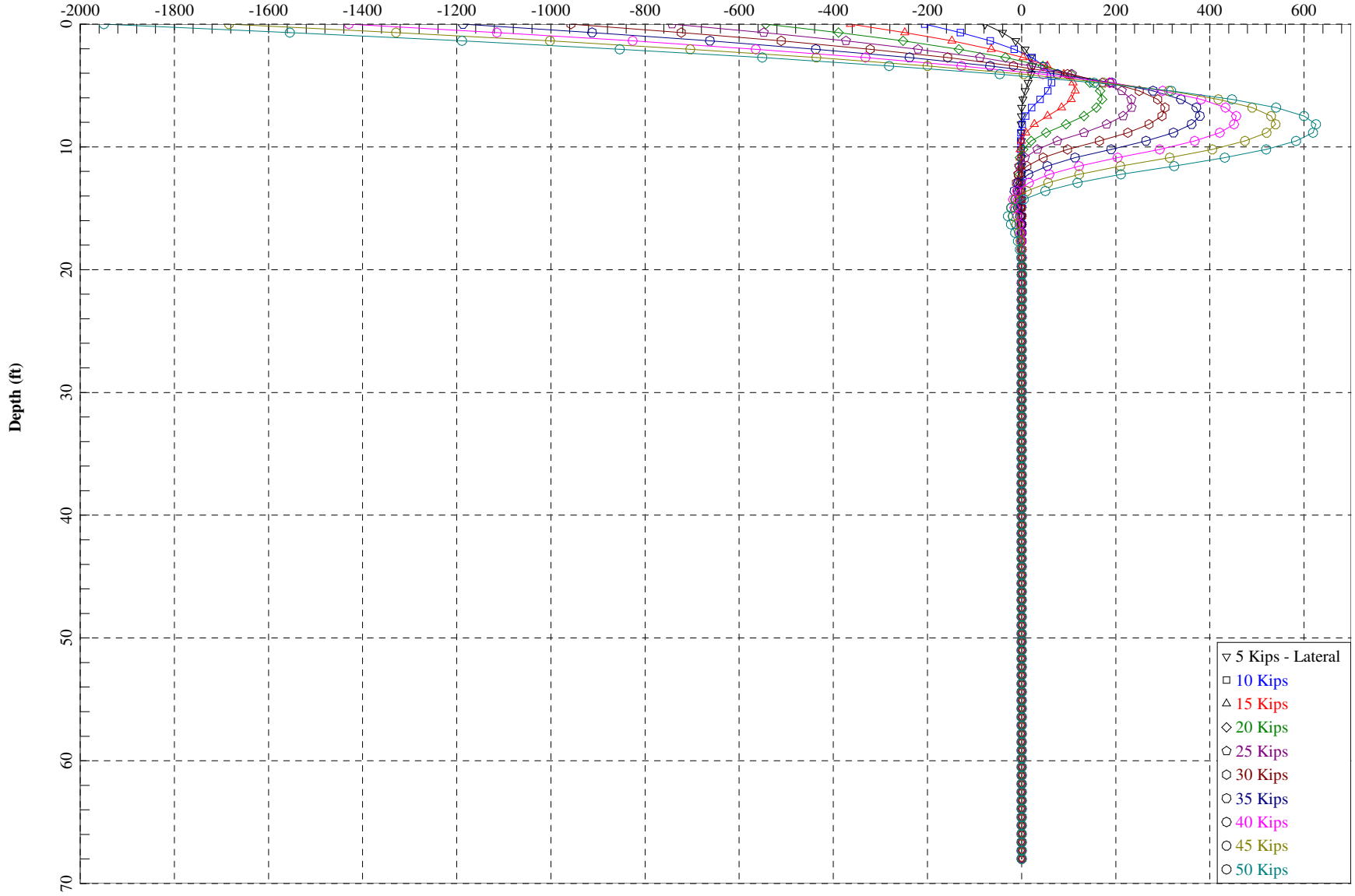
Abutment WW - Fixed Head

Lateral Deflection (in)



Abutment WW - Fixed Head

Bending Moment (in-kips)



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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:

Madhu Thummaluru
URS Corporation

Path to file locations: X:\Old Redwood Interchange PSE\440_Materials\Analysis\Pile\Lateral\Bridge\
Name of input data file: Old Redwood Bridge_AbutWW_free.lpd
Name of output file: Old Redwood Bridge_AbutWW_free.lpo
Name of plot output file: Old Redwood Bridge_AbutWW_free.lpp
Name of runtime file: Old Redwood Bridge_AbutWW_free.lpr

Time and Date of Analysis

Date: April 24, 2011 Time: 10:36:07

Problem Title

Old Redwood Highway Overcrossing (Replace)_Abutments 1 & 3 Wing Wall_Free

---

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 = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 816.00 in

Depth of ground surface below top of pile = -36.00 in

Slope angle of ground surface = 26.60 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	14.00000000	3201.0000	196.0000	3372000.
2	816.0000	14.00000000	3201.0000	196.0000	3372000.

Soil and Rock Layering Information

The soil profile is modelled using 13 layers

Layer 1 is stiff clay without free water
Distance from top of pile to top of layer = -36.000 in
Distance from top of pile to bottom of layer = 204.000 in

Layer 2 is stiff clay without free water
Distance from top of pile to top of layer = 204.000 in
Distance from top of pile to bottom of layer = 312.000 in

Layer 3 is liquefiable sand, by Rollins et al, 2004
Distance from top of pile to top of layer = 312.000 in
Distance from top of pile to bottom of layer = 336.000 in

Warning : The depth of this layer is deeper than the recommended depth limit for using the p-y criteria for liquefied sand.
Please consult the LPile Technical Manual for additional background information regarding limitations on the use of the liquefied sand criteria.

```
Layer  4 is stiff clay without free water
Distance from top of pile to top of layer    =      336.000 in
Distance from top of pile to bottom of layer =      390.000 in

Layer  5 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer    =      390.000 in
Distance from top of pile to bottom of layer =      444.000 in

Layer  6 is stiff clay without free water
Distance from top of pile to top of layer    =      444.000 in
Distance from top of pile to bottom of layer =      564.000 in

Layer  7 is stiff clay without free water
Distance from top of pile to top of layer    =      564.000 in
Distance from top of pile to bottom of layer =      684.000 in

Layer  8 is stiff clay without free water
Distance from top of pile to top of layer    =      684.000 in
Distance from top of pile to bottom of layer =      744.000 in

Layer  9 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer    =      744.000 in
Distance from top of pile to bottom of layer =      762.000 in

Layer 10 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =      762.000 in
Distance from top of pile to bottom of layer =      912.000 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 11 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 =     1044.000 in
p-y subgrade modulus k for top of soil layer =      125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      125.000 lbs/in**3

Layer 12 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =     1044.000 in
Distance from top of pile to bottom of layer =     1272.000 in
p-y subgrade modulus k for top of soil layer =      125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      125.000 lbs/in**3

Layer 13 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer    =     1272.000 in
Distance from top of pile to bottom of layer =     1362.000 in
p-y subgrade modulus k for top of soil layer =      125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =      125.000 lbs/in**3


(Depth of lowest layer extends  546.00 in below pile tip)

--------------------------------------------------------------------------------
                   Effective Unit Weight of Soil vs. Depth
--------------------------------------------------------------------------------

Effective unit weight of soil with depth defined using 26 points
```

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-36.00	0.07230
2	204.00	0.07230
3	204.00	0.06370
4	312.00	0.06370
5	312.00	0.03040
6	336.00	0.03040
7	336.00	0.02750
8	390.00	0.02750
9	390.00	0.03330
10	444.00	0.03330
11	444.00	0.03330
12	564.00	0.03330
13	564.00	0.03330
14	684.00	0.03330
15	684.00	0.03040
16	744.00	0.03040
17	744.00	0.03330
18	762.00	0.03330
19	762.00	0.03910
20	912.00	0.03910
21	912.00	0.04200
22	1044.00	0.04200
23	1044.00	0.04200
24	1272.00	0.04200
25	1272.00	0.04490
26	1362.00	0.04490

Shear Strength of Soils

Shear strength parameters with depth defined using 26 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-36.000	16.67000	0.00	0.00500	0.0
2	204.000	16.67000	0.00	0.00500	0.0
3	204.000	5.56000	0.00	0.01000	0.0
4	312.000	5.56000	0.00	0.01000	0.0
5	312.000	0.00000	0.00	------	------
6	336.000	0.00000	0.00	------	------
7	336.000	5.56000	0.00	0.01000	0.0
8	390.000	5.56000	0.00	0.01000	0.0
9	390.000	6.94400	0.00	0.01000	0.0
10	444.000	6.94400	0.00	0.01000	0.0
11	444.000	8.68000	0.00	0.00700	0.0
12	564.000	8.68000	0.00	0.00700	0.0
13	564.000	17.36000	0.00	0.00500	0.0
14	684.000	17.36000	0.00	0.00500	0.0
15	684.000	12.15000	0.00	0.00700	0.0
16	744.000	12.15000	0.00	0.00700	0.0
17	744.000	8.33300	0.00	0.00900	0.0

18	762.000	8.33300	0.00	0.00900	0.0
19	762.000	0.00000	36.00	------	------
20	912.000	0.00000	36.00	------	------
21	912.000	0.00000	36.00	------	------
22	1044.000	0.00000	36.00	------	------
23	1044.000	0.00000	38.00	------	------
24	1272.000	0.00000	38.00	------	------
25	1272.000	0.00000	40.00	------	------
26	1362.000	0.00000	40.00	------	------

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 = 60000.000 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 = 60000.000 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 = 60000.000 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     =       60000.000 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     =       60000.000 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     =       60000.000 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     =       60000.000 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     =       60000.000 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    =       45000.000 lbs
Bending moment at pile head =           0.000 in-lbs
Axial load at pile head     =       60000.000 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    =       50000.000 lbs
Bending moment at pile head =           0.000 in-lbs
```

Axial load at pile head = 60000.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

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	60000.0000	0.0100798	75056.0459	5000.0000
1	V= 10000.	M= 0.000	60000.0000	0.0459786	202356.	10000.0000
1	V= 15000.	M= 0.000	60000.0000	0.1116751	359738.	15000.0000
1	V= 20000.	M= 0.000	60000.0000	0.2091698	539127.	20000.0000
1	V= 25000.	M= 0.000	60000.0000	0.3399136	743271.	25000.0000
1	V= 30000.	M= 0.000	60000.0000	0.5051058	961313.	30000.0000
1	V= 35000.	M= 0.000	60000.0000	0.7046029	1199182.	35000.0000
1	V= 40000.	M= 0.000	60000.0000	0.9395598	1447163.	40000.0000
1	V= 45000.	M= 0.000	60000.0000	1.2149	1713645.	45000.0000
1	V= 50000.	M= 0.000	60000.0000	1.5241	1989001.	50000.0000

Pile-head Deflection vs. Pile Length

Boundary Condition Type 1, Shear and Moment

Shear = 5000. lbs
Moment = 0. in-lbs
Axial Load = 60000. lbs

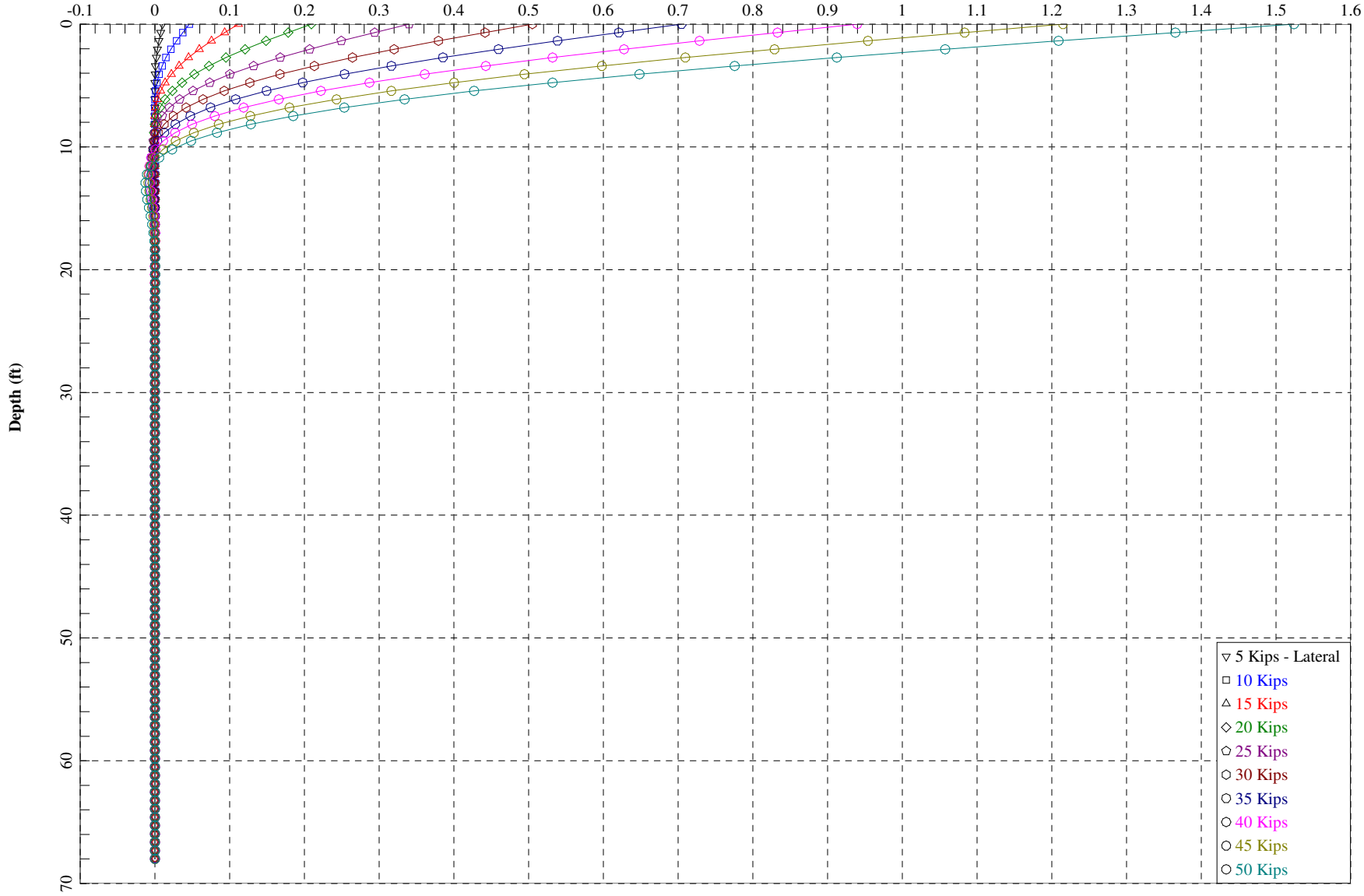
Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
816.000	0.01005814	75000.60166	5000.00000
775.200	0.01003141	75348.58577	5000.00000
734.400	0.01006240	75150.42382	5000.00000
693.600	0.01004385	74672.72229	5000.00000
652.800	0.01005223	75009.85870	5000.00000
612.000	0.01005276	75315.62945	5000.00000
571.200	0.01005557	74970.02016	5000.00000
530.400	0.01003994	75255.82843	5000.00000
489.600	0.01005184	75195.34719	5000.00000
448.800	0.01005337	75272.39441	5000.00000

This analysis ended normally.

Summary of Warning Messages

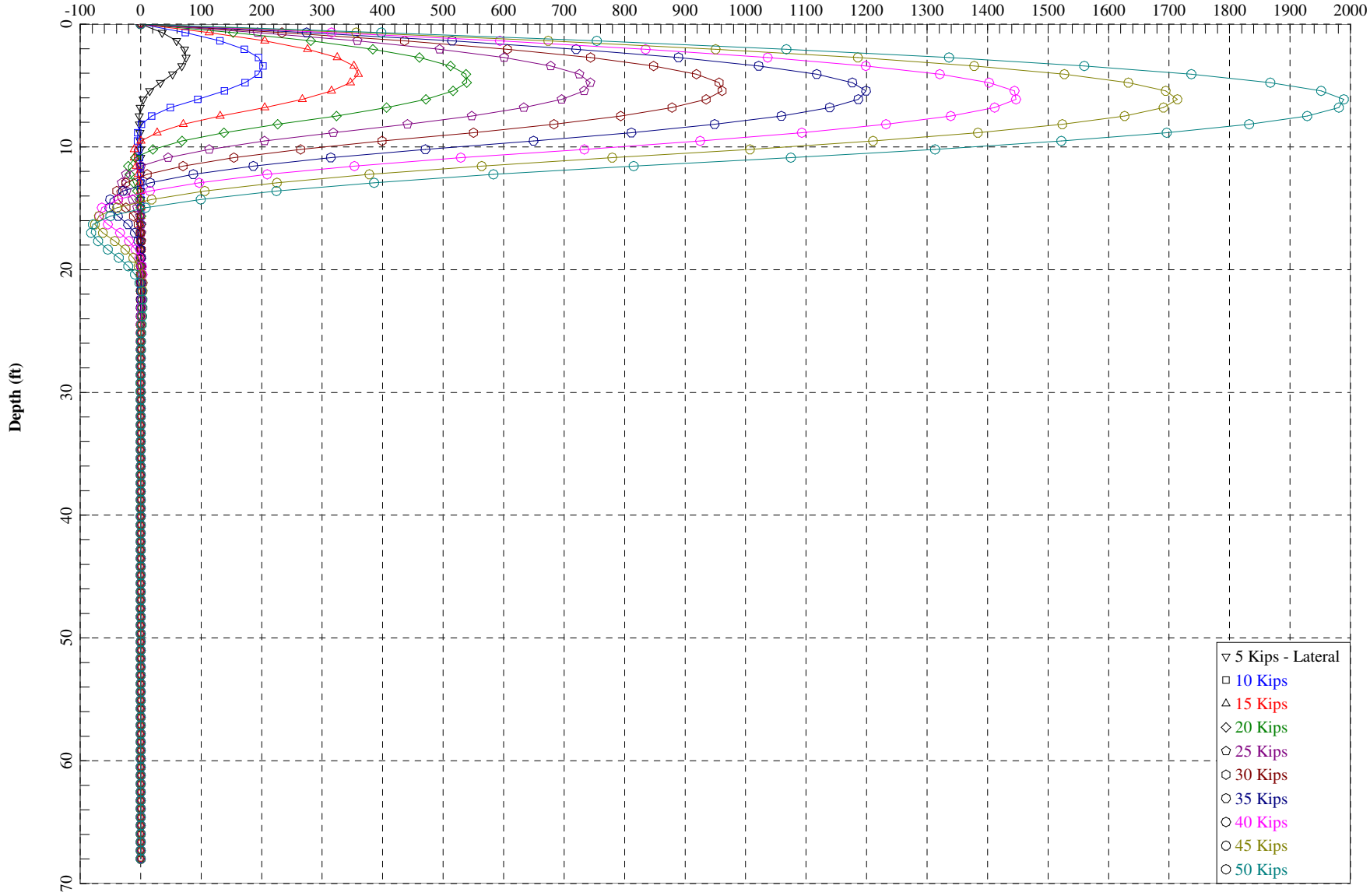
Abutment WW - Free Head

Lateral Deflection (in)



Abutment WW - Free Head

Bending Moment (in-kips)



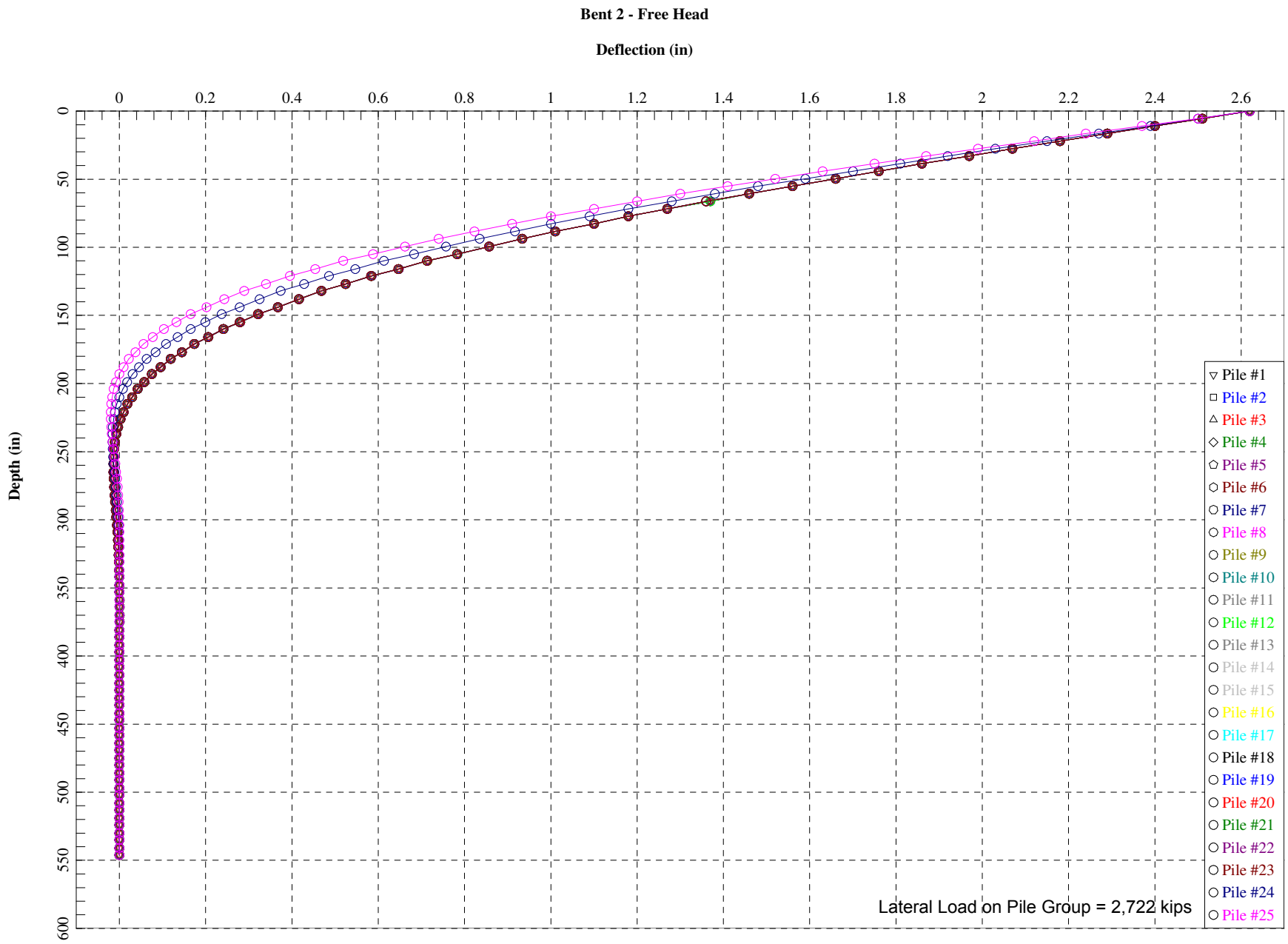

Bent 2 - Free Head
Deflection (in)
Depth (in)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
0
50
100
150
200
250
300
350
400
450
500
550
600
Pile #1
Pile #2
Pile #3
Pile #4
Pile #5
Pile #6
Pile #7
Pile #8
Pile #9
Pile #10
Pile #11
Pile #12
Pile #13
Pile #14
Pile #15
Pile #16
Pile #17
Pile #18
Pile #19
Pile #20
Pile #21
Pile #22
Pile #23
Pile #24
Pile #25
Lateral Load on Pile Group = 2,722 kips

FIGURE H-4

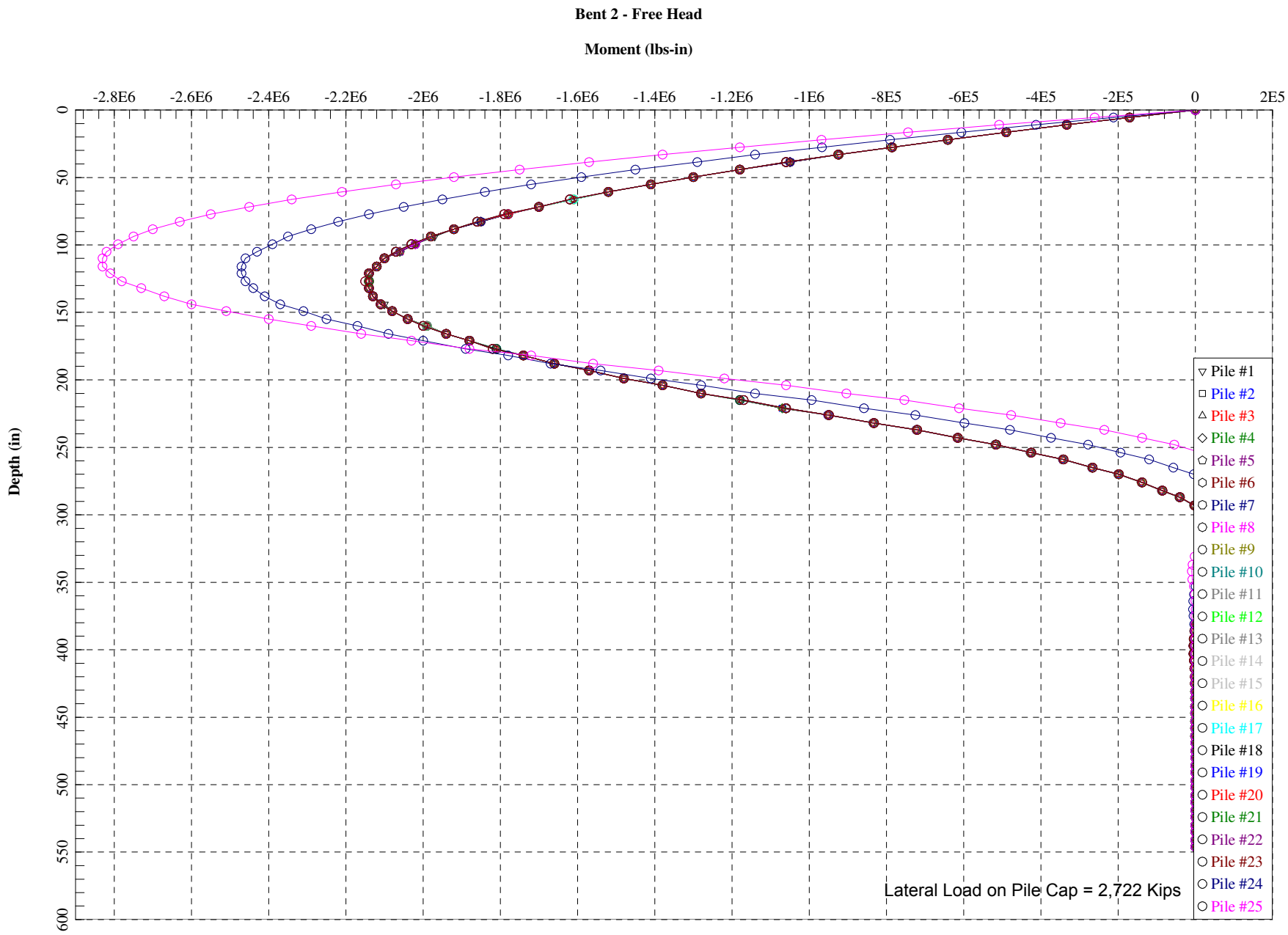

Bent 2 - Free Head
Moment (lbs-in)
-2.8E6
-2.6E6
-2.4E6
-2.2E6
-2E6
-1.8E6
-1.6E6
-1.4E6
-1.2E6
-1E6
-8E5
-6E5
-4E5
-2E5
0
2E5
Depth (in)
0
50
100
150
200
250
300
350
400
450
500
550
600
Pile #1
Pile #2
Pile #3
Pile #4
Pile #5
Pile #6
Pile #7
Pile #8
Pile #9
Pile #10
Pile #11
Pile #12
Pile #13
Pile #14
Pile #15
Pile #16
Pile #17
Pile #18
Pile #19
Pile #20
Pile #21
Pile #22
Pile #23
Pile #24
Pile #25
Lateral Load on Pile Cap = 2,722 Kips

FIGURE H-5

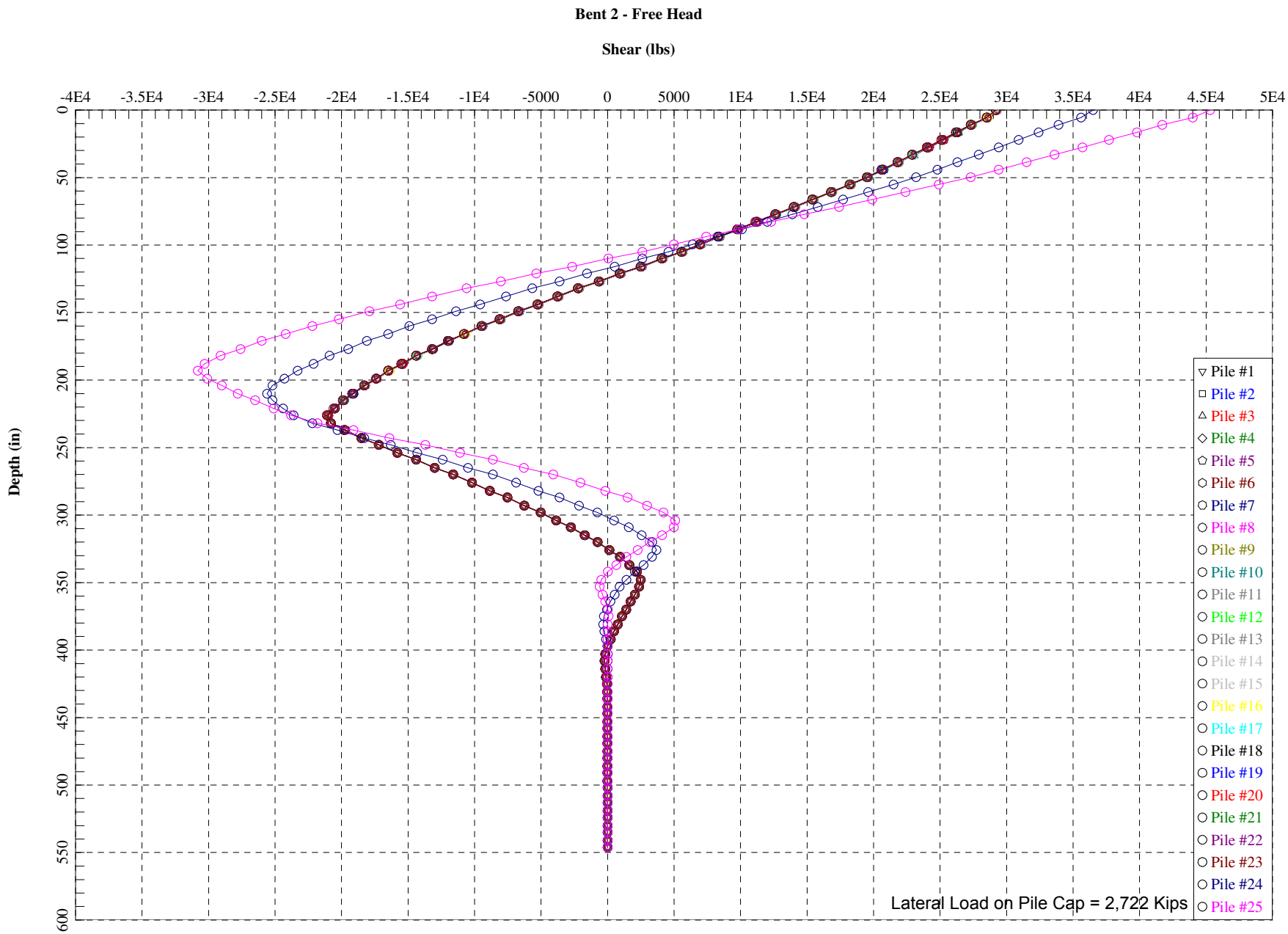

Bent 2 - Free Head
Shear (lbs)
-4E4
-3.5E4
-3E4
-2.5E4
-2E4
-1.5E4
-1E4
-5000
0
5000
1E4
1.5E4
2E4
2.5E4
3E4
3.5E4
4E4
4.5E4
5E4
Depth (in)
0
50
100
150
200
250
300
350
400
450
500
550
600
Pile #1
Pile #2
Pile #3
Pile #4
Pile #5
Pile #6
Pile #7
Pile #8
Pile #9
Pile #10
Pile #11
Pile #12
Pile #13
Pile #14
Pile #15
Pile #16
Pile #17
Pile #18
Pile #19
Pile #20
Pile #21
Pile #22
Pile #23
Pile #24
Pile #25
Lateral Load on Pile Cap = 2,722 Kips

FIGURE H-6

Old Redwood Highway Overcrossing
Pile Cap Passive Resistance

	1	2	3	4	5	6	7	8	9	10
Bent#	Ground Surface Eevation (ft)	Bottom Pile Cap Elevation (ft)	Soil Type	Unit Wt (pcf)	Su (psf)	ϕ	Kp	Equivalent Fluid Pressure (Pp) psf/ft	At-rest Pressure Coefficent Ko	At-rest Equivalent Fluid Pressure $Po = Ko\ \gamma$ psf/ft
Bent 2	38	30	Clay	115	1000	30	3	300	0.5	60

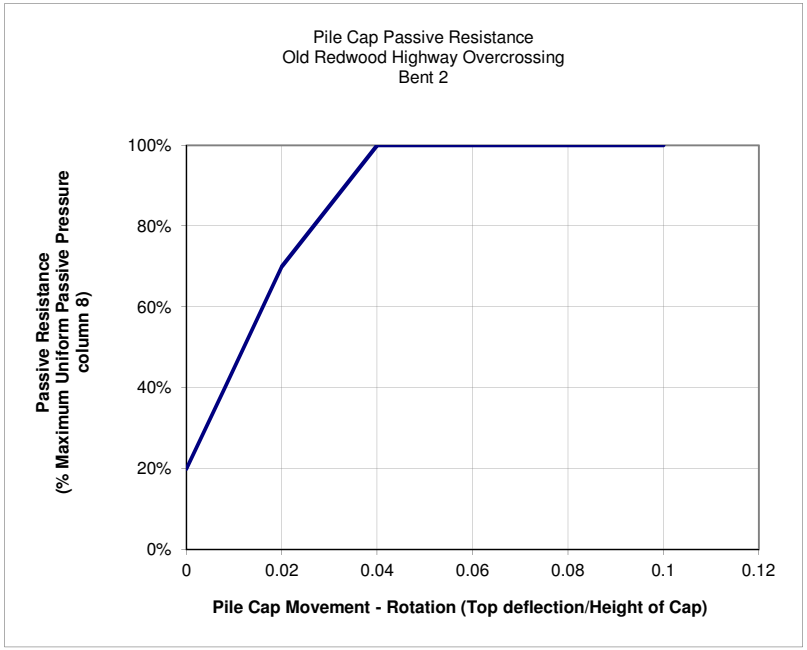
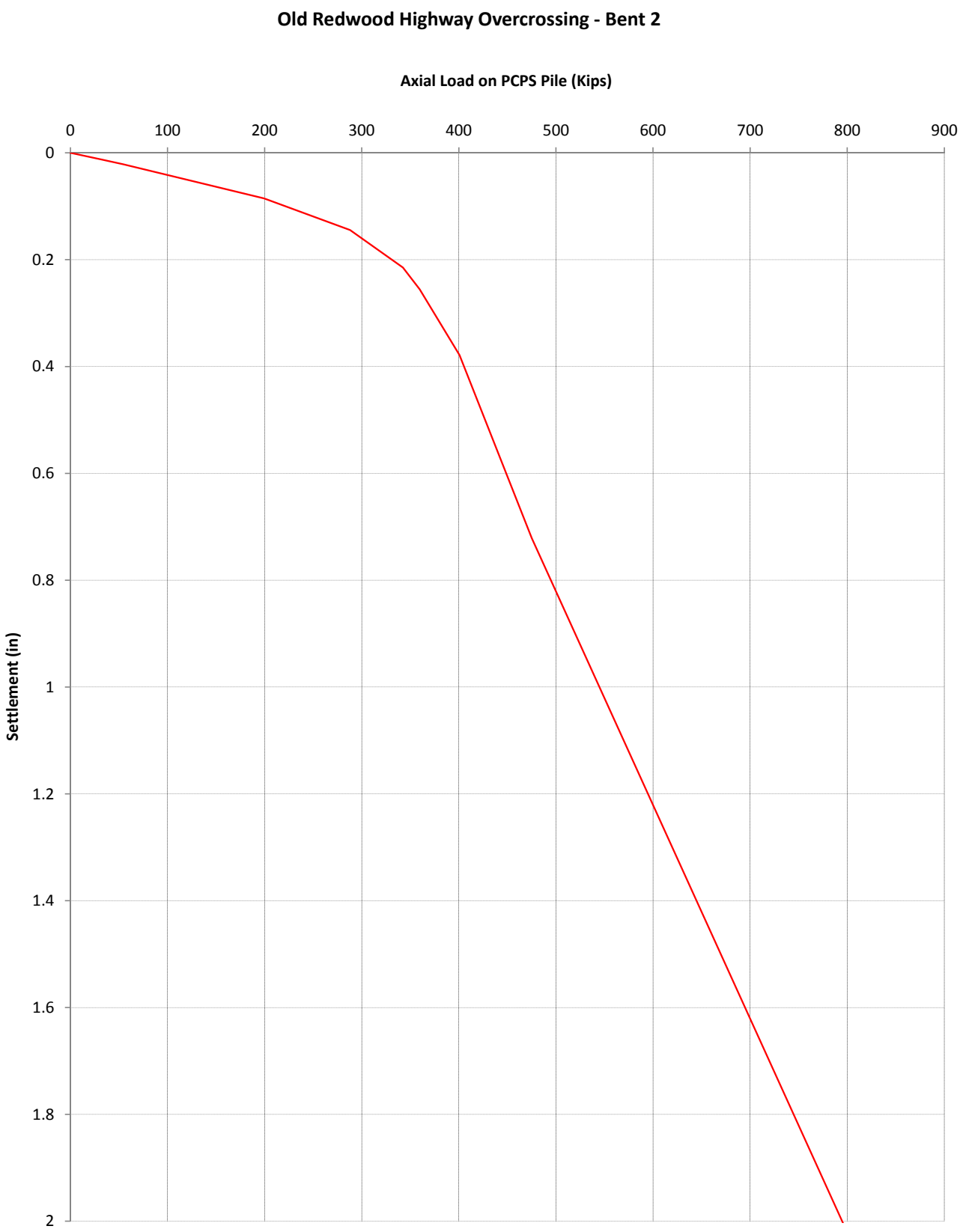


FIGURE H-7


Old Redwood Highway Overcrossing - Bent 2
Axial Load on PCPS Pile (Kips)
0
100
200
300
400
500
600
700
800
900
Settlement (in)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2

OSFP Review Comment & Response Form

General Project Information	Review Phase		Reviewer Information
Dist: 04 EA: 0A1851 **Project Name: Old Redwood Highway OC** **OSFP Liaison: Tracy Bertram** **Phone: 916-227-8379** **e-mail: TracyBertram/HQ/Caltrans/CAGov**	☐ PSR/PDS (Review No. _) ☐ APS/PSR (Review No. _) ☐ APS/PR (Review No. _) ☐ Type Selection	☐ 65% PS&E Unchecked Details ☒ PS&E (Review No. _) ☐ Construction Support ☐ Other: ____	**Reviewer Name: M.Zabolzadeh/ Hossain Salimi** **Functional Unit: GS-GDW** **Phone Number: ((510)2864831** **e-mail: Mohammadzabolzadeh@dot.ca.gov** **Date of Review: 6/15/2011**
	Structure Information (Use when necessary to document comments by individual structure) **Structure Name: Old Redwood HWY O. C.** **Br No: 20-0291**		

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	N/A	FR, Plans, SSP prepared by URS Corporation dated 5/13/2011.		
2	FR	N/A	All our previous comments have been incorporated into the report. We do not have any comment.		
3	FR	N/A	C1- Approved as submitted.		

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)

COMMENTS

Client: City of Petaluma Project No: 28645097

Project Name: Old Redwood Highway Interchange Improvement Project EA 04-0A1850 (12276K)

Document Being Checked/Revision Number: 95% PS&E

Originator: Caltrans Comments Date: 5/27/2011

No	Origin	Reference	Comment	Disposition	Response	Verification
167	Dist 4 Construction / Frank Guros/ 5-27-11	Foundation Report	Responses to these comments should be sent to the Constructability/PS&E Review Group per DCL 87 2. Responses need to be provided in an electronic file that can be copied into the CR/DOE database. 1. Foundation Report for Bridge No. 20-0291: Revise Section 8.1 to refer to conform to California Code of Regulations (CCR), Title 8, Chapter 4, Subchapter 4, Article 6 “Excavations”. Delete Paragraph 2, which does not conform to the CCRs. Do not refer to regulations as “guidelines”. Trenches are a subset of excavations – see definitions in Article 6.	A	Will revise section by (1) deleting paragraph 2 and (2) referring to CCR (not OSHA).	

Dispositions:
A = Will Incorporate; B = Will Evaluate; C = Disagree with Comment; D = Will Incorporate in next submittal; E = Clarify Comment; F = No Action Needed

OSFP Review Comment & Response Form

General Project Information	Review Phase		Reviewer Information
Dist: 04 EA: 0A1851 **Project Name: Old Redwood Highway** **OSFP Liaison: Tracy Bertram** **Phone: 916-227-8379** **e-mail: TracyBertram/HQ/Caltrans/CAGov**	☐ PSR/PDS (Review No. _) ☐ APS/PSR (Review No. _) ☐ APS/PR (Review No. _) ☐ Type Selection	☒ 65% PS&E Unchecked Details ☐ PS&E (Review No. _) ☐ Construction Support ☐ Other: ____	**Reviewer Name: M.Zabolzadeh/ Hossain Salimi** **Functional Unit: GS-GDW** **Phone Number: ((510)2864831** **e-mail: Mohammadzabolzadeh@dot.ca.gov** **Date of Review: 10/25/2010**
	Structure Information (Use when necessary to document comments by individual structure) **Structure Name: Old Redwood HWY O. C.** **Br No: 20-0159**		

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	N/A	FR prepared by URS Corporation dated 9/10/2010.	No comment.	
2	FR	N/A	Our previous comments dated 5/20/2010 have been incorporated into the report.	No comment.	
3	FR	Page 7-3	Foundation Data Table shows specified tip elevation of –22.0 for Abutment 1 and 3. Appendix G calculations reads –24. Check discrepancy	Will revise, including Appendix G calculations.	
4	FR	Figures	The seismic design methodology adopted for this structure is based on the latest Caltrans Seismic Design Criteria (SDC), and the ARS On-line tool. However, the latest Caltrans SDC requires that the spectrum based on the USGS interactive Deaggregation for a 975 year return period (5% probability of exceedance in 50 years) also be produced. Furthermore, the said spectrum has to be manually modified to	Spectral accelerations generated using ARS online were compared with 2008 USGS Deaggregation Tool (Beta) as per the procedure described in Section 1.1.17 in Geotechnical Services Design Manual, dated August 2009. Maximum difference of 9.8% was identified for periods greater than 0.5 sec, which is slightly less than 10%. Therefore, ARS online spectrum governs and is shown as Figure 5-2 with a title "Recommended Acceleration Response Spectrum".	

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)

Foundation Report – Retaining Walls 1 Through 7
Dated September 22, 2011

04-SON-101, PM 7.4/8.1

SEPTEMBER 22, 2011

FOUNDATION REPORT

RETAINING WALLS 1 THROUGH 7
OLD REDWOOD HIGHWAY INTERCHANGE
PETALUMA, CALIFORNIA

Prepared for
City of Petaluma
Public Works
11 English Street
Petaluma, CA 94954

URS

100 W. San Fernando Street, Suite 200
San Jose, California 95113

Project No: 28645097

URS

September 22, 2011
Project 28645097

File No. 04-SON-101-PM 7.4/8.1
EA 04-0A1851 (12276K)

Ms. Susan Lackie
City of Petaluma
Public Works
11 English Street
Petaluma, California 94954

Subject: **Foundation Report**
Retaining Walls 1 through 7
Old Redwood Highway Interchange
Petaluma, California

Dear Ms. Lackie:

URS has completed the accompanying Foundation Report for Retaining Walls 1 through 7 as part of the improvements planned at Old Redwood Highway Interchange in Petaluma, California. The report was prepared in accordance with Caltrans Guidelines for Foundation Investigation Reports, Version 2.0, dated December 2009.

The Foundation Report presents our engineering opinions and recommendations regarding the geotechnical factors influencing the design and construction of the proposed retaining walls. The opinions and recommendations have been based upon the results of our field investigation, laboratory testing, engineering judgment and local experience. Mr. Madhu Thummuluru, P.E., performed the engineering analysis and assisted with the preparation of this report. Mr. Mark Schmoll, C.E.G, prepared the earthquake analysis, geology and geologic hazards portions of this report. Mr. Michael Larson, G.E., provided review, consultation and guidelines for the project.

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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3/31/2012
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APPENDICES

Appendix A Retaining Wall Plans
Appendix B Log of Test Borings
Appendix C Laboratory Tests
Appendix D Liquefaction Work Sheets
Appendix E Settlement Analysis
Appendix F Corrosion Investigation
Appendix G Caltrans Review Comments

The City of Petaluma (City), located in Sonoma County within District 04 of the State of California Department of Transportation (Caltrans), proposes to reconstruct the Old Redwood Highway Interchange at U.S.101 Post Mile (PM) 7.65, located approximately 4 miles north of the Petaluma River. The key component of the project is to replace the existing overcrossing (OC) structure to meet current design standards and current and future traffic requirements.

The proposed OC structure will accommodate six lanes of traffic and will include bicycle lanes and pedestrian sidewalks on both sides. The U.S.101/Old Redwood Highway interchange ramps will be reconfigured and widened accordingly. Other improvements include traffic operations system improvements and enhanced signalization improvements at the adjacent intersections. This project will accommodate the proposed U.S. 101 Central HOV Lanes Project, which widens U.S.101 within the limits of the Old Redwood Highway Interchange Project.

The interchange will be reconstructed with a modified par-clo configuration. Existing ramps will be realigned and widened to accommodate storage for queuing vehicles.

Below is a summary of features for the proposed design option:

- New OC where Old Redwood Highway crosses U.S.101.
- Traffic signals will be installed at ramp termini.
- Off-ramps will provide two left-turn lanes and two right-turn lanes.
- Ramp metering facilities including HOV bypass lanes and CHP enforcement areas will be provided at on-ramps.
- Old Redwood Highway will be widened to accommodate two 12-foot wide through lanes, a raised median, 6-foot wide shoulders, and 6-foot wide sidewalks in each direction between Stony Point Road and North McDowell Boulevard. Additional widening will be provided locally to accommodate turn lanes.
- A 6-foot wide landscape buffer will be provided between the sidewalk and travel lane where right of way is available.
- A new right-turn lane from eastbound Old Redwood Highway to southbound North McDowell Boulevard will be added.
- Seven (7) retaining walls will be constructed to maintain interchange improvement within existing right of way, where feasible.
- Adjoining driveways will be reconstructed to match proposed grades.

The subject of this preliminary foundation report (PFR) is the foundation design issues for the non-standard retaining walls.

1.1 PURPOSE AND SCOPE OF THIS STUDY

The purpose of this FR is to document existing foundation conditions and make foundation recommendations. The scope of work for this study includes:

- Review of as-built bridge drawings, logs of test borings (LOTBs), geologic maps, and other existing information
- Preparation of this FR, which includes:
  - Development of seismic design criteria;
  - Description of site geology and evaluation of geologic hazards;

- Assessment of subsurface conditions based on existing information and new field exploration;
- Foundation recommendations; and
- Construction considerations.

1.2 CALTRANS REVIEW COMMENTS

URS reviewed comments prepared by Caltrans for the Retaining Walls 1 through 7 Foundation Report dated September 10, 2010 and May 16, 2011. Our responses to these comments are incorporated into this report. Copies of the review comments and our responses are presented in Appendix G.

2.1 INTERCHANGE IMPROVEMENTS

The proposed project will replace the existing Denman Overcrossing (OC) in Petaluma to meet current design standards and current and current and future traffic requirements. The new structure will be named as Old Redwood Highway OC. The proposed OC structure will consist of a State-constructed structure that will accommodate six lanes of traffic, bicycle lanes, and pedestrian sidewalks.

2.2 RETAINING WALLS

To support the ramp approach fills configured for the interchange improvements, seven (7) retaining walls are planned as outlined in Table 1.

Table 2-1 - Planned Retaining Walls

Wall No.	Control Line	Station Reference		Length of Wall (feet)	Design Height (feet)	Remarks
		From	To			
RW#1	"OSN"	86+84.95	90+12.22	325	10 - 12.5	Support U.S.101 SB on-ramp
RW#2	"OSN"	88+01.48	91+60.17	360	10 - 20	Support U.S.101 SB on-ramp
RW#3	"OSF"	61+53.71	64+39.15	360	10 - 17.5	Support U.S.101 SB off-ramp
RW#4	"ONN"	43+22.32	45+94.60	270	10 - 12.5	Support U.S.101 NB on-ramp
RW#5	ONN"	43+22.32	44+96.84	175	10 - 12.5	Support U.S.101 NB on-ramp
RW#6	"ONF"	40+02.72	43+00.06	375	12.5 - 15	Support U.S.101 NB off-ramp
RW#7	"ORH"	17+58.46	19+02.17	145	12.5 - 20	Support U.S. 101 SB on-ramp

RW#1, RW#7 and RW#2 will support the U.S.101 southbound (SB) on-ramp from Old Redwood Highway; RW#3 will support the off-ramp from U.S.101 SB to Old Redwood Highway; RW#4 and RW#5 will support the on-ramp from Old Redwood Highway to U.S.101 NB; RW#6 will support the off-ramp from U.S.101 NB to Old Redwood Highway. Because of retained fill height and anticipated ground settlement RW#1 through RW#7 are planned to be mechanically stabilized embankment (MSE) walls.

Figure 1, Location Map, and Figure 2, Site Plan, shows the location of the proposed OC structure and retaining walls. General Plans for the seven walls are presented in Appendix A for reference.

Pertinent project information provided by Caltrans includes the following as-built plans:

- Denmon Overcrossing, 1954, General Plan and Foundation Plan
- Denmon Overcrossing, 1954, Log of Test Boring (LOTB) (Borings B-1 to B-4)

4.1 SITE CONDITIONS

The topography in the vicinity of proposed improvement is relatively flat, ranging in elevation from approximately 35 to 40 feet. To accommodate the new OC Structure the ramp approaches and bridge embankments will have fill heights ranging from 3 to 20 feet.

4.2 SUBSURFACE CONDITIONS

4.2.1 Previous Field Exploration

Based on as-built information retrieved from Caltrans archive dated June 1952, exploratory Borings B-1, B-2, B-3 and B-4 were drilled on June 15 and 17, 1952, to investigate the site of Old Redwood Highway OC. The depths of these borings ranged from 44 to 59 feet. Based on LOTB, Drawing No. 2921-8, Boring B-3 revealed stiff clay in the upper 9 feet underlain by a 5-foot thick layer of very dense sand and gravel. Below the sand and gravel deposits, there is soft, sandy clay (about 5 feet thick) overlying stiff to very stiff, blue silt and silty clay extending to approximately 45 feet in depth. Very dense sand and gravel deposits extended to terminal depth of the boring. Copies of these LOTBs are included in Appendix B.

4.2.2 Field Exploration (2009)

To supplement the as-built subsurface data, seven hollow-stem auger Borings A-09-101 through A-09-107, and one Cone Penetration Test (CPT), CPT-09-114 (see Appendix B) were drilled and advanced at the approximate locations shown on Figures 3-1 to 3-3. The borings were drilled to depths of 46.5 feet and 51.5 feet, and the CPT was advanced to a depth of 100 feet below ground surface (bgs). The field exploration was performed on November 2, 3, 4, 6, 9 and 10, 2009.

4.2.3 Laboratory Testing

The water content, dry density, Plasticity Index (PI), grain size distribution, 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 locations on the LOTBs. The results of sieve analysis and PI tests are graphically shown in Appendix C. Table C-1 also provides a summary of the laboratory test results.

4.2.4 Soil Conditions

4.2.4.1 Fill

Boring A-09-101 encountered fill soils extending to depths of 1.5 feet. Borings A-09-103 through A-09-107 were drilled on the ramp shoulder and encountered asphalt concrete (AC) pavement of 5 to 10 inches thick underlain by 2 to 12 inches of aggregate base. Fill soils underlying the existing pavement section were encountered to depths ranging from 2 to 5 feet.

4.2.4.2 Native Soils

Below the fill and structural pavement materials, the native soils consist of 8 feet of medium stiff to very stiff fat clay underlain by medium stiff to very stiff lean clay and sandy lean clay to a depth of 18 feet bgs. Beneath these cohesive deposits, the borings encountered medium dense to very dense sand and silty sand to a depth of 26 feet, except in boring A-09-104 where alternating layers of sand and silty sand extended to the termination depth of 51.5 feet. These granular deposits were underlain by medium stiff to very stiff lean clay to a depth of 45 feet. Medium dense to very dense silty sand was encountered in all borings below depths of 45 feet and extended to the termination depth of borings.

4.2.5 Groundwater

Groundwater was encountered at Elevation 24.5 feet, 25.1 feet and 25.5 feet in Borings B-2, B-3 and B-4, respectively. These elevations were based on NGVD 1929 datum; the elevations were converted to current project datum (NGVD 1989) and are shown in Table 2. Depth to groundwater ranged from 7 to 8.5 feet bgs. There was no indication of groundwater in B-1.

All of the 2009 borings were drilled using hollow-stem augers. Groundwater was measured in all 2009 explorations at depths ranging from 12 to 20 feet bgs, except in boring A-09-103 and CPT-09-114. Water was added in the hole by the driller at 13 feet during drilling (A-09-103) thereby precluding a reliable groundwater measurement at this location. Pore pressure dissipation test conducted in CPT-09-003, advanced for the OC structure indicated groundwater depth at 9.3 feet bgs; no dissipation test was conducted while advancing CPT-09-114. A summary of the groundwater depth and corresponding elevations at each location are summarized in Table 4-1.

Table 4-1 – Groundwater Summary

Boring	Groundwater Depth (ft)	Approximate Groundwater Elevation (ft)*	Date Groundwater Measured
B-2	8.4	27.0	6/17/1952
B-3	8.5	27.6	6/18/1952
B-4	7.0	28.0	6/17/1952
A-09-101	20.0	17.0	11/3/2009
A-09-102	12.0	23.0	11/2/2009
A-09-104	15.0	23.5	11/4/2009
A-09-105	18.0	21.0	11/10/2009
A-09-106	15.0	23.5	11/9/2009
A-09-107	15.0	23.5	11/9/2009
CPT-09-003	9.3	27.7	11/3/2009

* Elevation based on NGVD 1989 datum

Groundwater was measured as high as Elevation 32.7 feet in a monitoring well located in the 7-Eleven parking lot at 5200 Old Redwood Highway.

5.1 REGIONAL GEOLOGY

The Old Redwood Highway OC project is located in the Coast Range physiographic province, near the southern end of the Coast Range Thrust. The Coast Range province is characterized by north to northwest trending elongated mountain ranges and intervening valleys. This physiography reflects the influence of the San Andreas fault system, a domain of north-northwest oriented right-lateral strike-slip faulting that accommodates the majority of the plate motion between the Pacific and North American plates. In addition to the right-lateral strike-slip deformation, a component of convergence oriented normal to the plate boundary is accommodated by a series of folds and thrust faults, including the faults of the Coast Range-Sierran Block Boundary zone, oriented sub-parallel to the faults of the San Andreas system.

Late Cenozoic (last 30 million years) deformation associated with the transpressional plate boundary is reflected in the Coast Range geology, which typically consists of intensely folded and faulted Upper Jurassic (150 million years old) and younger rocks of the Franciscan Complex, a complex assemblage of metamorphosed oceanic crustal rocks and marine sediments. In the Neogene, compressional basins of deposition, *en echelon* folds, northwest-trending strike-slip faults, and lesser east-west-trending thrust faults that dip both east and west were formed. The region is now characterized by elongate topographic regions comprising fault-bounded slivers of different rock types. The majority of the reverse faults now appear to be either inactive or significantly less active than the northwest-striking, strike-slip faults of the San Andreas system, which offset them.

Information regarding the actual depth of the bedrock at the site is not available. Based on published information on geology of the site, the bedrock consists of rocks of the Pliocene age (1 to 13 million years old) Sonoma Volcanics and older marine siltstones, sandstones, and conglomerates of the Petaluma formation.

6.1 SEISMIC DESIGN METHODOLOGY

The seismic design methodology adopted for this project is based on the following current Caltrans standards:

1. Caltrans ARS Online, 2009
2. Seismic Design Criteria (SDC), v 1.5, August 2009, Appendix B (2009 revisions)
3. Guidelines for Foundation Investigations and Reports, v 2.0, dated March 2006
4. 2007 Caltrans Deterministic PGA Map

6.2 PEAK BEDROCK ACCELERATION

The closest active faults to this section of U.S. 101 are Rodgers Creek fault (RCF) and San Andreas fault. The RCF fault is designated with a Maximum Credible Earthquake (MCE) moment magnitude of 7.0 by the Working Group on Northern California Earthquake Probabilities (WGNCEP, 2003). The locations of these faults were obtained from the 2007 Caltrans Deterministic PGA Map. The closest active fault to the site is the Rodgers Creek fault, approximately 5 miles to the east, with a corresponding PBA contour of 0.4g based on the 2007 California Deterministic PGA Map and 0.45g based on work by others (Sadigh, et al, 1997). The San Andreas fault is located approximately 14 miles to the west.

Table 6-1 - Seismic Source Parameters

Fault	Type	Mmax	Distance (miles)	Near Field Effects?	Design PBA (g)
Rodgers Creek	strike-slip	7.1	4.9	Y	0.4
San Andreas	strike-slip	7.9	13.9	N	0.4

The distances are based on Caltrans ARS Online (2009).

6.3 SITE SOIL PROFILE

Borings drilled by others and 2009 borings reveal that the soils at the site consist of fine and coarse-grained alluvial soils that become denser and stiffer with depth. A seismic CPT (CPT-09-114) was performed with the intent of measuring the shear wave velocity, and was advanced to a depth of 100 feet. Shear wave velocities were measured at 5 feet intervals starting at 10 feet bgs with values ranging from 650 to 1268 feet per second (fps). Shear wave velocity measurements are shown on the CPT plot in Appendix B. Based on material types and shear wave velocity measurements, this project site can be classified as a stiff soil site or Soil Profile Type D pursuant to the guidelines given in Figure 12 in the SDC.

Based on the material types and shear wave velocity measurements, we estimated the average shear wave velocity (V_s) to be about 925 fps or 282 meters per second (m/s). This V_s value was input for the Caltrans ARS Online. It should be noted the V_s = 925 fps falls within the soil profile Type D V_s range of 600 to 1,200 fps.

6.4 FAULT TYPE AND NEAR FIELD SPECTRAL ACCELERATION INCREASES

The 2007 fault database that accompanies the 2007 Caltrans Deterministic PGA Map indicates that 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, since the project site is located less than 9.3 miles (15 km) from the nearest active fault, the design spectral accelerations should be modified to account for near-field effects as shown in Table 6-2:

Table 6-2 - Increase in Spectral Acceleration from Near-Fault Effects

Period (sec)	Increase in Spectral Acceleration (%)
< 0.5	0
0.5 – 1.0	0 – 20 (determined by linear interpolation)
≥1	20

At the time of this study, no retaining wall with fundamental period of vibration greater than 1.5 seconds is anticipated, and therefore no adjustments are required for long period effects.

6.5 DESIGN ACCELERATION RESPONSE SPECTRUM

The design response spectrum for the site is estimated with spectral acceleration values generated using Caltrans ARS Online (2009). This method was developed by Caltrans Geo Research Group in partnership with the United States Geological Survey (USGS), the Pacific Earthquake Engineering Research (PEER) and the California Department of Conservation. This web-based tool calculates both deterministic and probabilistic acceleration response spectra for any location in California based on criteria provided in Appendix B of Caltrans SDC.

The deterministic spectrum is determined as the average of median response spectra calculated using the Campbell-Bozorgnia (2008) and Chiou-Youngs (2008) ground motion prediction equations developed under the "Next Generation Attenuation" project coordinated through the PEER-Lifelines program. These equations are applied to all faults considered to be active in the last 750,000 years (late-Quaternary age) that are capable of producing a moment magnitude earthquake of 6.0 or greater. The probabilistic spectrum is obtained from the USGS (2008) National Hazard Map for 5% probability of exceedance in 50 years. Caltrans design spectrum is based on the larger of the deterministic and probabilistic spectral values. Both the deterministic and probabilistic spectra account for soil effects through incorporation of the parameter Vs30, the average shear wave velocity in the upper 30 meters (100 feet) of the soil profile.

The input values we selected for Caltrans ARS Online included:

5. Vs30 of 925 fps (282 mps)
6. Maximum Credible Earthquake (MCE) Magnitude 6.75 (Rodgers Creek fault)
7. No ARS increase for fault-type or long period structure
8. ARS increase for near-field effects

The calculated spectra for both deterministic (for both faults) and probabilistic methods are presented in Figure 6-1. Since the maximum spectral acceleration curve is the USGS 5% in 50

years hazard, this curve is presented in Figure 6-2 as a design curve. Spectral values (from Figure 6-2) are provided in Table 6-3.

Table 6-3 – Recommended Spectral Acceleration Values

(V_s=925 fps, Lat. = 38.272082, Long. = 122.6700059)

Period (seconds)	Soil Profile Type D	
	Sa (g)	Sa* (g)
0.010	0.54	0.54
0.020	0.63	0.63
0.030	0.68	0.68
0.050	0.76	0.76
0.075	0.83	0.83
0.100	0.89	0.89
0.120	0.93	0.93
0.150	1.00	1.00
0.170	1.04	1.04
0.200	1.09	1.09
0.240	1.11	1.11
0.300	1.14	1.14
0.400	1.12	1.12
0.500	1.10	1.10
0.750	0.96	1.05
1.000	0.80	0.96
1.500	0.59	0.71
2.000	0.48	0.57
3.000	0.32	0.38
4.000	0.23	0.28

* Modified for near-fault effects as outlined in Section 3.4

7.1 SURFACE FAULT DISPLACEMENT AND GROUND SHAKING

Surface fault rupture tends to recur along existing fault traces. The highest potential for surface faulting is along existing fault traces that have had Holocene fault displacement. The California Geological Survey (formerly Division of Mines and Geology) has produced maps showing Alquist-Priolo Earthquake Fault Zones along faults with known Holocene activity that pose a potential surface faulting hazard. There are no Alquist-Priolo zones mapped in the vicinity of the project site. The closest active fault to the site is the Rodgers Creek fault, approximately 5 miles to the east. The San Andreas fault is located approximately 14 miles to the west. The potential for surface fault rupture at the site is considered remote.

7.2 LANDSLIDES

Based on the relatively flat topography at the site, landsliding is not considered a hazard at the project site.

7.3 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 porewater pressures within the sediments. The soil type most susceptible to liquefaction is loose, cohesionless, and granular, 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.

The project alignment at and around the Old Redwood Highway Interchange, is mapped as an area of “moderate” liquefaction susceptibility on a liquefaction susceptibility map prepared by the Association of Bay Area Governments (ABAG) geographic information systems (GIS) and reproduced in this report as Figure 7-1 (primarily based on Knudsen, et al, 2000 data and Witter & others, 2006).

We estimated post-liquefaction settlement at CPT-09-114 using the computer program LIQUEFY PRO for a peak ground acceleration (PGA) of 0.54g and design earthquake magnitude, Mw, of 7.1. In addition, we analyzed post-liquefaction settlement of the medium dense sand layers encountered in Borings A-09-101 through A-09-107 for the same PGA and design earthquake, correcting the measured driving resistance (blow counts) in the field, hammer type, sampler size, overburden pressure, rod length, and fines content (material passing the No. 200 sieve). Copies of these calculations are included in Appendix D. Estimated post-liquefaction ground surface settlements are summarized in Table 7-1.

Table 7-1 – Estimated Post-Liquefaction Ground Surface Settlement

Boring/CPT Number	Depth of Liquefiable Layer (feet)	Estimated Ground Surface Settlement (inch)
A-09-101	20–26.5	1¼
A-09-102	15–20	¾
A-09-103	3-5	½
A-09-104	20–25	¾
A-09-105	10–11, 45–50	¾
A-09-106	31-34, 45–51.5	1½
A-09-107	20–24.5	¾
CPT-09-114	9–15, 21–22, 27–30, 40-50	2¼

7.3.1 Subsidence, Consolidation Settlement and Seismic Compaction

Subsidence typically occurs as a result of subsurface fluid extraction (e.g. groundwater, petroleum) or compression of soft, geologically young sediments. Groundwater extraction for high volume municipal and agricultural use has the potential to cause future ground subsidence in the region. However, we are not aware of subsidence in the area.

Settlement can occur when soil is loaded by a structure or by the placement of fill on top of soil. It can occur quickly (elastic deformation) and/or gradually (consolidation) when soil pore pressures, increased by vertical loading, gradually dissipate over time. The fat and lean clays found at the site range from medium stiff to very stiff and are susceptible to settlement. With retaining walls planned to retain fills ranging 3 to 18 feet high, it is estimated that ultimate settlement on the order of 1¾ to 3 inches could occur along the wall alignments. Table 7-2 summarizes the estimates of settlement.

Table 7-2 – Estimated Consolidation Settlement

Control Line	Retaining Wall #	Fill Height Range (feet)	Ultimate Settlement (Consolidation + Immediate) (inches)
"OSN"	RW#1	4 to 12	2½
"OSN"	RW#2	4 to 18	3
"OSF"	RW#3	7 to 15	1¾
"ONN"	RW#4	3 to 10	2½
"ONN"	RW#5	3 to 9	2
"ONF"	RW#6	7 to 12	1¾
"ORH"	RW#7	7 to 18	2½

Compaction settlement, or seismic densification, occurs when loose granular soils above the groundwater table increase in density as a result of earthquake shaking. This soil densification can result in differential settlement because of variations in soil composition, thickness, and initial density. We believe that compaction settlement of the fine grained soils encountered above groundwater is nil.

7.3.2 Flooding

The Federal Emergency Management Agency (FEMA) Flood Insurance Study for the City of Petaluma documents a history of flooding events in the project area. FEMA floodplain maps indicate that there are three floodplain zones in the project limits associated with Willow Brook Creek that cross the project limits and Petaluma River, which is adjacent to the project. The floodplains are designated as Flood Hazard Areas in Zones AE, AO, and X. The flood plains delineated on these maps represent the base floodplains. The base flood is a flood that has a 1 percent chance of being equaled or exceeded in any given year, and the area inundated by the base flood is the base floodplain. FEMA Flood Insurance Rate Map is reproduced in this report as Figure 7-2.

We understand that the City of Petaluma is currently undergoing a re-study of its floodplain, which is in the final stages of approval by FEMA. According to the new study, floodplain delineation within the project limits is now designated as Flood Hazard Area Zone AE. Based on the new study, the 24-hour 100-yr storm event would not overtop U.S.101.

8.1 GENERAL

Based on the finished grades of RW#1 to RW#7 and results of the field exploration, it is anticipated the foundation soils consist of medium stiff to very stiff fat clays underlain by medium dense to very dense sand deposits. From a geotechnical point of view, it is considered feasible to support the proposed embankment using the MSE retaining wall method. The following sections present MSE wall geotechnical design parameters including wall materials, lateral pressures, stability, bearing capacity and settlement estimates.

8.2 MSE RETAINING WALL PARAMETERS

The wall layout and profiles of all 7 walls are presented on plan sheets 1 to 8 (Appendix A). Recommendations for the geotechnical aspects of the design details are summarized in the following sections.

8.2.1 Materials

The embankment behind the MSE walls is planned to be constructed more or less horizontal, or with slope inclinations to accommodate super-elevation of the ramps. 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

8.2.2 Lateral Pressures

The MSE Retaining Wall should be designed to resist lateral earth pressures imposed by the adjacent backfill. It is recommended that the walls be designed to resist a minimum equivalent fluid pressure of 36 pound per cubic foot (pcf) for a horizontal backfill, and 64 pcf for a 2 to 1 (H to V) backfill slope. These recommendations are based on a clean granular material (ϕ=34°) (1) backfill placed within the MSE wall and (2) backfill placed in the excavation 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 texture from lean and fat clays to silty sands. The lean and fat clays would require considerable aeration in order to be recompacted. Furthermore, the use of existing embankment materials would result in a higher equivalent fluid pressure of 45 pcf. For those reasons, clean granular material (ϕ=34°) is recommended within and behind the MSE wall.

Surcharge loads such as vehicular traffic would apply additional loads to the walls. For design purposes, a surcharge pressure equivalent to 2 feet of soil should be applied to account for traffic loads. A surcharge unit weight of 125 pcf can be assumed for design.

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. Positive drainage for water collected in the backfill should be provided by means of drain pipe leading to a free draining outlet.

8.2.3 Wall Stability

8.2.3.1 Wall Component Parameters

It is recommended that the stability of the MSE walls be evaluated during design using the following parameters:

Table 8-2 – MSE Wall Geotechnical Design Parameters

Engineering Property	Granular MSE Backfill	Foundation Soil		
		Fat Clay	Sand	Lean Clay
Friction Angle, ϕ (degrees)	34	0	32	0
Cohesion, C (psf)	0	850 to 3,000	-	1,800 to 2,600
Total density, γ (pcf)	120	110	125	125

8.2.3.2 Global Stability

The global stability of RW1 through 6 was evaluated using a limit equilibrium method based on Spencer's procedure of slices as coded in the program SLOPE/W (Version 4). In Spencer's procedure, all forces are assumed to have the same inclination, and all requirements for static equilibrium are satisfied. We performed the analyses using the maximum wall heights, which in our opinion, represents the critical section for each retaining wall. On this basis, the cross sections were selected at Stations "OSN" 90+00 (RW1), "OSN" 91+62 (RW2), "OSF" 63+00 (RW3), "ONN" 43+25 (RW4 and RW5), "ONF" 41+00 (RW6), "ORH" 18+50 (RW7). A design groundwater at Elevation 32 feet was used for all the retaining walls.

Caltrans requires minimum factors of safety of 1.3 for retaining walls under static loading conditions (Bridge Design Specifications, Section 5.2.2.3, August 2004). The results of our analyses are summarized in the following paragraphs and include the following cases: (1) end of construction, (2) long term, and (3) pseudo-static condition.

8.2.3.3 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.

8.2.3.4 Long Term Conditions

For the long term condition, the soil strengths typically increase over time with pore pressure dissipation. Therefore, we used both cohesion and friction angle to determine the strength of fine grained soils and formational deposits. Friction angle only was used for determining strength of granular soils.

8.2.3.5 Pseudo-Static Condition

For the earthquake (or pseudo static) loading, drained shear strengths for pervious materials and reduced undrained shear strengths for impervious materials were selected to evaluate the stability of the embankments during the potential earthquake. Undrained strengths for impervious materials were used because no significant dissipation of pore pressures is expected during the rapid earthquake loading. A reduction of undrained shear strengths on the order of 20 percent of the static undrained shear strengths was used to account for the strength loss of cohesive soils during cyclical loading. This reduction in strength is recommended in the report, "A Simplified Procedure for Estimating Earthquake Induced Deformations in Dams and Embankments" by Makdisi and Seed (1978). This is a conservative approach as soil strengths typically increase over time with pore pressure dissipation. To compute the factor of safety of the slope during earthquake loading, we applied a pseudo-static seismic coefficient of 0.2g to the center of the slice for the slip surface having the minimum computed static factor of safety. This pseudo-static seismic coefficient is equal to approximately one-third of the peak horizontal ground acceleration, 0.6 g, anticipated at the site. The seismic stability screening approach is consistent with Section 3.10 of the March 2006 Guidelines for Structure Foundation Reports.

8.2.3.6 Results

The results of our analyses for the seven retaining walls are summarized in the following table.

Table 8-3 Results of Global Slope Stability Calculations

Loading Conditions	Minimum Calculated Factor of Safety							Minimum Required Factor of Safety
	RW#1	RW#2	RW#3	RW#4	RW#5	RW#6	RW#7	
End of Construction	2.4	2.0	2.8	3.5	2.2	2.1	1.7	1.3
Long Term Steady State	1.7	1.7	1.8	2.9	1.7	1.7	1.3	1.3
Psuedo Static Seismic	1.5	1.2	1.5	1.8	1.5	1.2	1.2	1.1

Based on our analyses, the computed minimum (critical) factor of safety for end of construction for the seven walls ranges from 1.7 to 3.5, all of which exceed the minimum required value of 1.3.

Based on our analysis, the computed minimum (critical) factor of safety for long term steady state for the seven walls ranges from 1.3 to 2.9, all of which equal or exceed the minimum required value of 1.3.

Based on our analyses, the computed minimum (critical) factor of safety for the pseudo-static condition for the seven walls ranges from 1.2 to 1.8, all of which exceed or equal the minimum required value of 1.1 (See guidelines for Structures Foundation Reports, March 2006, Version 2.0, Section 3.10).

8.2.4 Bearing Capacity

Based on exploratory data, variable soft to medium stiff, expansive fat clays (CH) were encountered along the wall alignments. Ultimate bearing capacity of the soils encountered below the anticipated bottom of the footing elevation in the vicinity of retaining walls varies from 4,400 to 11,000 psf. In order to provide uniform subgrade support, it is recommended that the upper 1 foot of subgrade soils below the bottom of the wall base be removed and replaced with engineered fill, underlain by a subgrade-enhancement geotextile (SEG). The subgrade excavation should extend at least 1 foot below the base of the wall for the entire width of the MSE reinforcement. The type of SEG recommended for this application should meet the requirements of State Standard Special Provisions Class B1 SEG.

With the subgrade treated in accordance with the above recommendations, the average ultimate bearing capacity should be about 12,300 psf. For MSE walls with heights ranging from 10 to 20 feet, the toe pressure at the wall base is estimated to range from 1,800 to 3,400 psf. Considering a factor of safety of 3, the MSE walls should be designed with an allowable bearing capacity of 4.1 ksf. Table 8-4 summarizes the toe pressures and allowable bearing capacity for the corresponding wall heights.

Table 8-4 – Wall Bearing Resistance Summary

Wall Height (feet)	Toe Pressure (ksf)	Allowable Bearing Capacity (ksf)
10	1.8	4.1
15	2.7	
20	3.4	

A friction coefficient of 0.35 (ultimate) should be assumed to exist at the base of the wall to resist sliding.

8.2.5 Settlement

8.2.5.1 General

Based on the retaining wall plans, new fills ranging from 3 to 18 feet in height are planned at retaining walls. Majority of the long term ground surface settlement at the site is attributed to consolidation of the native fat clay in the upper 10 feet, and to a lesser degree, consolidation of interbeds of deeper lean clays. We evaluated settlement of the retaining walls due to the new fill and the estimates of settlement are summarized in Table 7-2.

Based on our discussions with Caltrans District 4 Geotechnical Engineer, it is Caltrans' experience that ramp embankments and MSE walls should be able to tolerate total settlements on the order of 1 to 2 inches and differential settlements on the order of ½ inch in 50 linear feet of wall. Therefore, the basis for settlement period for retaining walls should be 1 inch total consolidation settlement and ½ inch differential settlement.

Retaining wall settlement can be mitigated by using light weight aggregate (LWF) as backfill in lieu of general fill materials. For more details regarding this subject, please refer to Section 8.2.5.3 "Other Ground Improvement Methods." All retaining walls will be built in a single stage, except RW#2 which will be built in 2 different stages. Stage construction was necessary in order to maintain traffic flow and minimize the need for interchange closure during construction. Retaining walls built in each stage are shown on the construction and traffic handling plans (SC-1 through SC-47). Please note that our stage numbers are consistent with plans SC-1 through SC-47.

The moist unit weight of the soil fill is on the order of 125 pounds per cubic foot (pcf), whereas light weight aggregate is about 70 pcf. For example, using LWF as backfill for RW#2 reduces maximum ultimate ground surface settlement from order of 3 inches to 1½ inches. Based on Caltrans experience, LWF aggregate has been used in very few projects as retaining wall backfill and Caltrans do not recommend using LWF as MSE wall backfill. Furthermore, it was very expensive compared to traditional method of using soil fill and surcharge. Hence, no further consideration was given to LWF as backfill for retaining walls.

8.2.5.2 Surcharge

Surcharging the fills may be required to reduce the settlement period so that post construction settlement can be limited to less than 1 inch. For the surcharge method, a temporary soil fill is placed on top of the design finished grade for a limited period of time. Both Caltrans and URS have had good success in implementing the surcharge method to accelerate settlement. The actual settlement is actually measured and confirmed in the field by installing and monitoring settlement monitoring devices. Based on our experience, surcharge height is typically 10 feet, but occasionally is 5 or 15 feet. In our evaluation we estimated settlements for surcharge heights of 5 feet and compared the settlement periods for the case of no surcharge.

In Table 8-5 for soil fill we estimate settlement period for no soil surcharge and 5 feet soil surcharge for RW#1 through RW#7. As discussed in a previous section RW#2 will be constructed in 2 stages. Stages that require surcharge and/or settlement period are shown in parentheses.

Table 8-5: Estimated Ground Surface Settlement (Soil Embankment Fill)

Structure	Control Line	Max. Ultimate Settlement (inches)	Settlement Period (months)		Post Construction Settlement (inches)
			No Surcharge	5 ft Surcharge	
RW#1	"OSN"	2½	1 (stage 1)	<1 (stage 1)	~1
RW#2	"OSN"	3	1 (stage 1 & 2)	<1 (stage 1 & 2)	~1
RW#3	"OSF"	1¾	1 (stage 3)	<1 (stage 3)	~1
RW#4	"ONN"	2½	1 (stage 1)	<1 (stage 1)	~1
RW#5	"ONN"	2	1 (stage 1)	<1 (stage 1)	~1
RW#6	"ONF"	1¾	1 (stage 2A)	<1 (stage 2A)	<1
RW#7	"ORH"	2½	1 (stage 1A)	<1 (stage 1A)	~1

8.2.5.3 Removal of Compressible Soils

In this method, the compressible (native) clay soil is excavated, hauled offsite and replaced with compacted engineered fill. Although, it is possible to reuse this clay material, a designated staging area where the soil could be aerated (dried out) and processed will be required; then, the processed fill will have to be hauled back into the excavation and be recompacted. The extra processing and handling of the excavated soils would deem the reuse of the clays not feasible. Therefore, the excavated clay soils should be hauled offsite for this option. Considering (1) the close proximity of existing roadways, embankments and structures and (2) the need for temporary shoring for deeper excavations, we estimate a practival excavation depth to be about 4 to 5 feet. In addition, most of the compressible fat clays occur in the upper 10 feet. Therefore, replacing the upper 4 to 5 feet of compressible clays with engineered fill should reduce the ultimate surface settlement by one-half, for example from 3 inches to less than 1½ inches for RW#2. If the construction schedule does not permit a settlement period (no surcharge) of 1 month or less, replacing the upper 4 to 5 feet of fat clays with engineered fill should reduce the post construction consolidation settlements to less than 1 inch for all retaining walls.

8.2.5.4 Monitoring Settlement

To facilitate the Resident Engineer in determining whether to increase or decrease the duration of settlement periods, we recommend the retaining wall settlement be monitored in accordance with California Test 112, "Method for Installation and Use of Embankment Settlement Devices."

Settlement monitoring should be conducted along control lines "OSN (RW#2) and "ONN" (RW#4 and RW#5). The approximate locations of these devices should be as follows:

Table 8-6: Proposed Locations of Embankment Settlement Devices

Control Line	Station	Offset (feet)
"OSN"	91+00	0
"ONN"	43+25	0

8.3 EARTHWORK

8.3.1 General

All earthwork should be performed according to the current Standard Specifications of the State of California, Department of Transportation (Caltrans). Specifically, Section 16 "Clearing and Grubbing" and Section 19 "Earthwork" of these Specifications should be followed. Specific additions and modifications to those specification requirements are discussed in the following sections.

8.3.2 Site Preparation

Site preparation essentially consists of clearing and grubbing the site prior to construction of the retaining walls; these recommendations should be used in conjunction with the specifications presented in Section 16 of the Caltrans Standard Specifications.

All objectionable material within the retaining wall areas should be removed prior to grading operations. Areas to be filled should be cleared of existing structures. Also, tree stumps and roots over 1 inch in diameter should be excavated along with underground utilities. The resulting holes should be cleared of all loose soils and backfilled with engineered fill. Before placing fill, the area should be stripped to a sufficient depth to remove all surface vegetation, organic laden topsoil, and debris. We estimate that stripping depths could vary between approximately 2 to 4 inches and the actual stripping depth should be determined in the field at the time of construction. Any stripped organic material should not be used as engineered fill. After the site has been properly stripped, the exposed surfaces in all areas to be filled should be scarified to a minimum depth of 6 inches and recompacted to the requirements for engineered fill.

At all walls including the limits of the MSE wall reinforcement, majority of the anticipated subgrade is fat clay. Depending upon the time of year and other factors, the fat clay soil could experience pumping and rutting if subjected to construction equipment and traffic. Pumping is defined as temporary subgrade deflection. Rutting is defined as permanent deformation of the subgrade under wheel or track loads. Therefore, in these areas, we recommend that construction equipment be kept off the excavation bottom and excavation be performed with equipment operated from outside of the excavation to minimize disturbance. In addition, the backhoe bucket used to excavate to final grade should be fitted with a smooth cutting surface to eliminate disturbing the subgrade soils (which would be disturbed with conventional backhoe teeth).

These materials (1) should not be placed as backfill behind retaining walls, (2) should not be reused as fill for widening or raising existing embankments and (3) should be hauled offsite.

8.3.3 Fill Material

In general, materials intended for use as fill 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, no rock greater than 6 inches in largest dimension or soil having a PI of more than 15 should be allowed in the fill. All import material should meet these requirements and should be approved by the engineer prior to construction. Asphalt concrete and aggregate base that are broken down to meet the size requirements for fill material detailed above could be reused as fill.

8.3.4 Placement and Compaction of Fills

For embankment fill (excluding the MSE wall sections), the subgrade preparation should consist of moisture conditioning the exposed subgrade and compacting to a minimum relative compaction of 95 percent in accordance with the provisions of Section 19-5 of the Standard Specifications. All embankment fill, including MSE wall sections, should then be placed in thin lifts and compacted to a minimum of 95 percent relative compaction (ASTM D1557 or Caltrans 216, using the dry weight basis) in accordance with Sections 19-3, 19-5 and 19-6 of the Standard Specifications. We recommend that the relative compaction be measured on the basis of dry density.

8.3.5 Keying and Benching

Where fills are placed on slopes steeper than 6:1 (horizontal to vertical), the fill should be keyed and benched into the slope. All keying and benching should be performed in accordance with Section 19 of Caltrans Standard Specifications. In addition, the keyway at the toe of the embankment should extend at least 1 m below grubbing depth and should be at least 3 m wide (typical equipment width). As the embankment is brought up in layers, horizontal benches should be cut into the existing slope a minimum of 0.3 m wide and at least 0.3 m below the grubbing depth.

An assessment of the potential for corrosion of various buried foundation and pipe structures was performed by V&A Consulting Engineers (V&A). The results of their investigation are presented in Appendix G. The following paragraphs include their summary and recommendations.

9.1 SUMMARY

V&A was retained by the project designer URS Corporation to perform a soil corrosivity investigation within the project limits with regards to the proposed retaining wall foundation. V&A performed in-situ soil resistivity testing at 12 locations and interpreted the field data collected. In addition V&A interpreted the corrosivity test results from the analytical lab analysis performed on 10 bore samples by Cooper Testing Laboratory in Palo Alto, CA. The report includes the field data collected, the test methods used to perform the in-situ soil resistivity, field data analysis, laboratory analysis and test results, conclusions and recommendations.

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, and CALTRANS Memo to Designers 3-1, July 2008 (Memo). Based on the results obtained and according to the Guidelines and Memo, the soil samples tested are considered to be non-corrosive to reinforced concrete structures and steel piles. This conclusion is made based on the values of minimum soil resistivity, pH, sulfates and chlorides.

9.2 CONCLUSIONS

The result of the minimum soil resistivity of five boring samples indicates that soil resistivity is well below 1,000 ohm-cm. According to both the Guidelines and Memo, a site is considered corrosive if the soil minimum resistivity is less than 1,000 ohm-cm and either contains a chloride concentration of 500 ppm or greater, or a sulfate concentration of 2,000 ppm or greater. Therefore, the soils tested at five locations are considered *non-corrosive* to concrete structures and to steel piles, regardless of the very low soil resistivity test result.

9.3 RECOMMENDATIONS

The test data and a review of the project requirements were used to make recommendations for the structural foundation material listed below.

9.3.1 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.

9.3.2 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.
- The Corrosion Guidelines allow the use of mineral admixtures (such as fly ash, silica fume, metakaolin, etc.), reduced water content, and increased cementitious material content resulting in high density and durable Concrete.
- Sand and water used in concrete mixtures should contain a maximum of 100 ppm of watersoluble 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.

9.3.3 Steel Piles

According to the Guidelines and the Memo, this soil is considered *non-corrosive* to steel piles and does not require corrosion mitigation.

This study is intended for design purposes only. The opinions, conclusions and recommendations presented herein are based on available subsurface information developed by others and supplementary new borings. The recommendations presented in this report are based on the assumption that the soil and geologic conditions do not deviate substantially from those anticipated by the information contained in the logs of test borings.

Existing facilities, utilities, soils/bedrock conditions, road/structure distress, slope distress or groundwater/seepage conditions other than those noted herein have not been considered in the preparation of this report. Locating utilities and evaluating potential utility interference is outside the scope of this report. Individuals utilizing this report shall inform URS Corporation if they are aware of any additional facilities or site conditions so that their presence and impact upon the project (or vice-versa) can be properly evaluated and recommendations modified to address geotechnical issues as necessary.

The Geotechnical Engineer should be given the opportunity to review the final specifications and drawings to verify that those documents are consistent with the intent of the geotechnical recommendations.

Geotechnical issues may arise during construction that were not apparent at the time this report was prepared. The Geotechnical Engineer should be retained during construction to review the soil conditions encountered and the construction procedures used. All earthwork and wall construction and testing should be completed under the direct observation of the Geotechnical Engineer.

Specific review and investigation for environmental issues and subsurface environmental contamination were beyond the scope of our services.

The opinions and recommendations presented in this report were developed with the standard of care commonly used by other professionals practicing at the same time, within the same locality and under the same limitations. No other warranties are included, either express or implied, as to the professional advice included in this report.

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DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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CITY OF PETALUMA PUBLIC WORKS
11 ENGLISH STREET
PETALUMA, CA 94954

URS CORPORATION
1380 LEAD HILL BLVD, SUITE 100
ROSEVILLE, CA 95661-2997

GENERAL NOTES

DESIGN: Earth retaining systems and concrete barrier railings are designed by AASHTO LFD as set forth in AASHTO Bridge Design Specifications (BDS) 2000 and modified by Caltrans BDS 2004

DESIGN LOAD: Live Pressure: 240 lb/ft2 surcharge

ALLOWABLE BEARING PRESSURE: 4,100 lb/ft2

STANDARD PLANS DATED MAY, 2006

A10A	ACRONYMS AND ABBREVIATIONS (SHEET 1 OF 2)
A10B	ACRONYMS AND ABBREVIATIONS (SHEET 2 OF 2)
A10C	SYMBOLS (SHEET 1 OF 2)
A10D	SYMBOLS (SHEET 2 OF 2)
A62B	LIMIT OF PAYMENT FOR EXCAVATION AND BACKFILL BRIDGE SURCHARGE AND WALL
A85	CHAIN LINK FENCE TYPE CL-4
B3-9	RETAINING WALL DETAILS No. 2
B11-56	CONCRETE BARRIER TYPE 736

STANDARD PLAN SHEET No.

DETAIL No.

INDEX TO PLANS

SHEET No.	TITLE	
1	RETAINING WALLS No. 1 THRU No. 7	GENERAL NOTES
2	RETAINING WALL No. 1	GENERAL PLAN
3	RETAINING WALL No. 2	GENERAL PLAN
4	RETAINING WALL No. 3	GENERAL PLAN
5	RETAINING WALL No. 4	GENERAL PLAN
6	RETAINING WALL No. 5	GENERAL PLAN
7	RETAINING WALL No. 6	GENERAL PLAN
8	RETAINING WALL No. 7	GENERAL PLAN
9	RETAINING WALLS No. 1 AND No. 2	PANEL LAYOUT
10	RETAINING WALLS No. 3 THRU No. 5	PANEL LAYOUT
11	RETAINING WALLS No. 6 AND No. 7	PANEL LAYOUT
12	RETAINING WALLS No. 1 THRU No. 7	MECHANICALLY STABILIZED EMBANKMENT DETAIL No. 1
13	RETAINING WALLS No. 1 THRU No. 7	MECHANICALLY STABILIZED EMBANKMENT DETAIL No. 2
14	RETAINING WALLS No. 1 THRU No. 7	MECHANICALLY STABILIZED EMBANKMENT DETAIL No. 3
15	RETAINING WALLS No. 1 THRU No. 7	MECHANICALLY STABILIZED EMBANKMENT DETAIL No. 4
16	RETAINING WALLS No. 1 THRU No. 7	MECHANICALLY STABILIZED EMBANKMENT DETAIL No. 6
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19	RETAINING WALLS No. 1 THRU No. 7	LOG OF TEST BORINGS 1 OF 9
20	RETAINING WALLS No. 1 THRU No. 7	LOG OF TEST BORINGS 2 OF 9
21	RETAINING WALL No. 1	LOG OF TEST BORINGS 3 OF 9
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23	RETAINING WALL No. 3	LOG OF TEST BORINGS 5 OF 9
24	RETAINING WALL No. 4	LOG OF TEST BORINGS 6 OF 9
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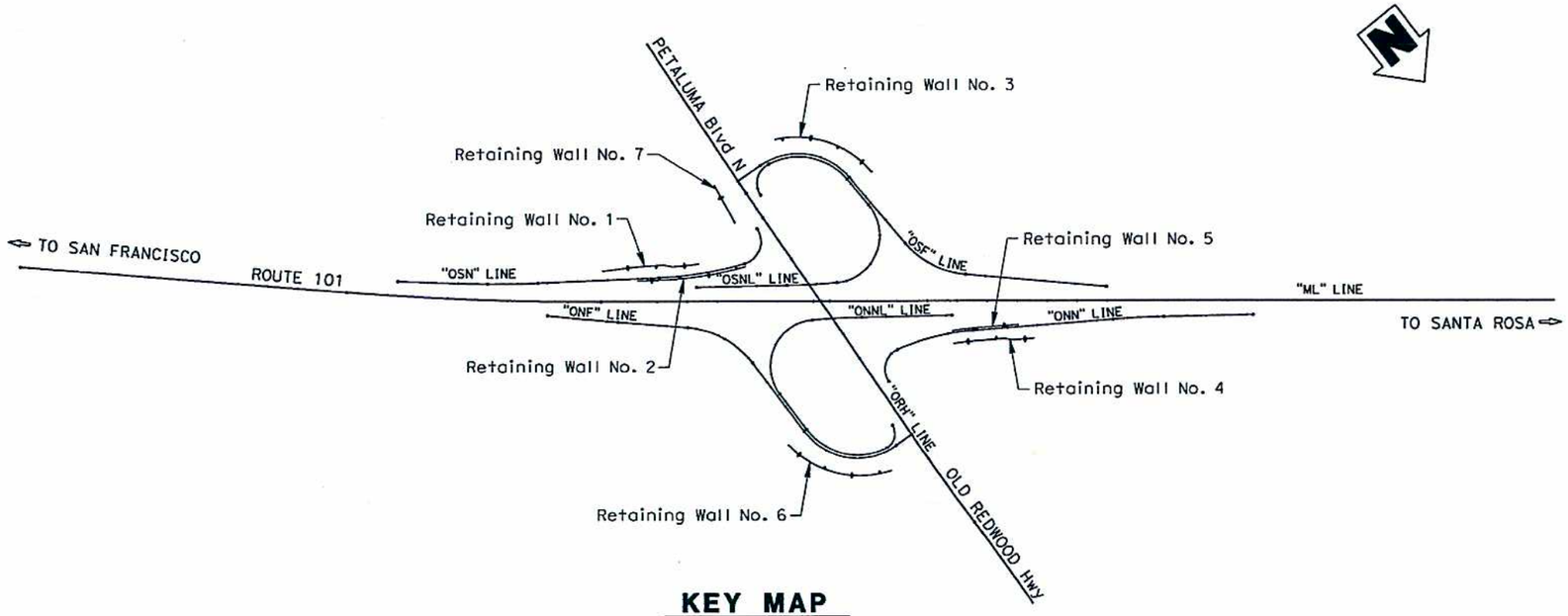
26	RETAINING WALL No. 6	LOG OF TEST BORINGS 8 OF 9
27	RETAINING WALL No. 7	LOG OF TEST BORINGS 9 OF 9



KEY MAP

FIGURE 2-1

DESIGN OVERSIGHT	DESIGN	BY D. Anderson	CHECKED	LOAD & RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 W/"LOW-BOY"; PERMIT DESIGN VEHICLE
	DETAILS	BY L. Davis	CHECKED	LAYOUT BY D. Anderson	CHECKED
SIGN OFF DATE	QUANTITIES	BY	CHECKED	SPECIFICATIONS BY D. Harnagel	PLANS AND SPECS COMPARED

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV.7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Walt LaFranchi
PROJECT ENGINEER

UNIT:
PROJECT NUMBER & PHASE: 04000200041

BRIDGE NO.

POST MILES

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 01-26-10 02-08-10 03-24-10 09-15-10

SHEET 1 OF 27

RETAINING WALLS No. 1 THRU No. 7
GENERAL NOTES

FILE => RW-a-genotes.dgn

CONTRACT NO.: 04-0A1854 PROJECT ID: 0400020004

NAME => Lynette_DGN PLOTTED => 1/20/2011 TIME PLOTTED => 9:21:33 AM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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Suite 1500
San Jose, CA 95113

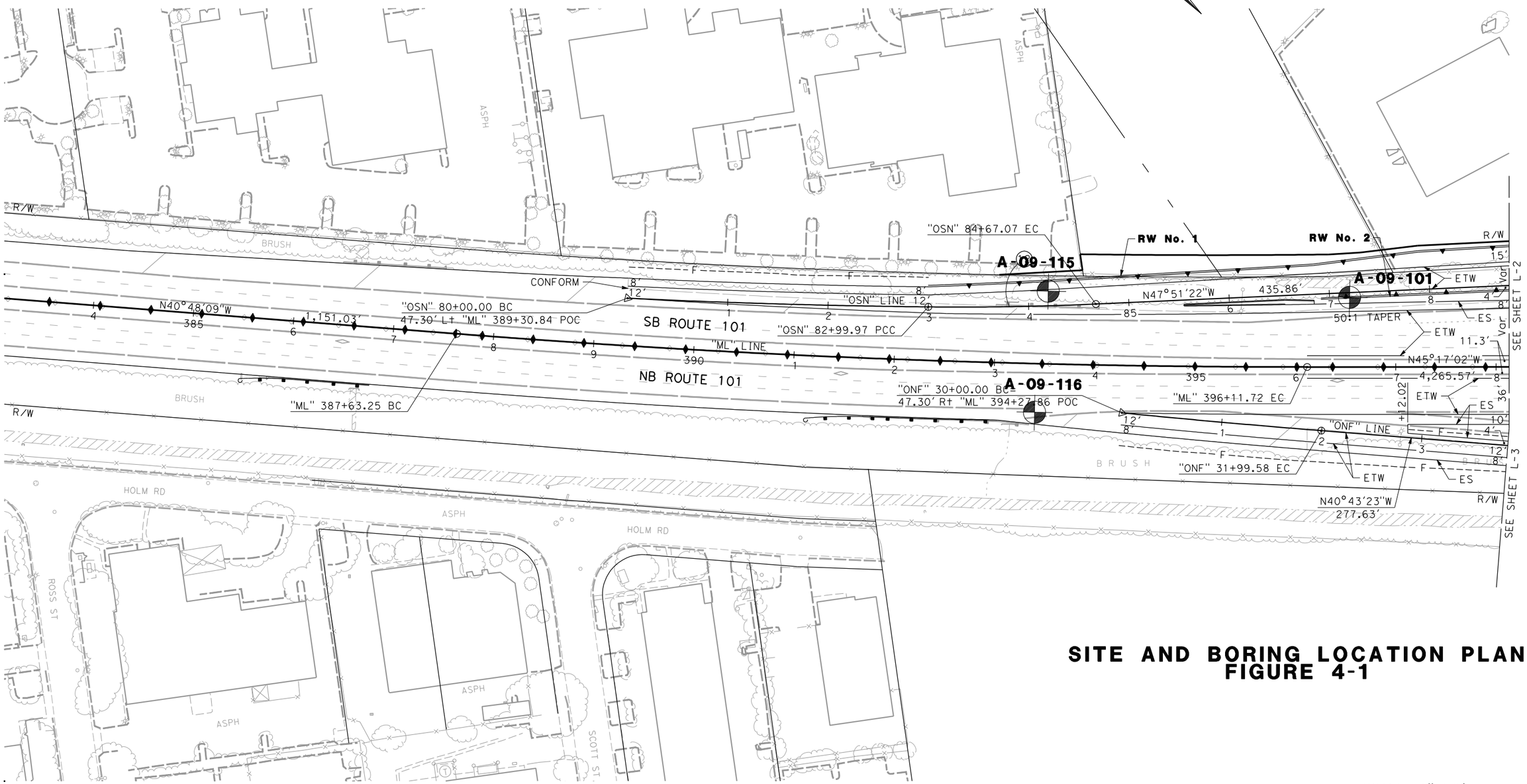
NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

LEGEND:

- 1952 Explorations
- 2009 Exploratory Borings
- 2009 Cone Penetration Test

CURVE DATA

No.	R	△	T	L	CURVE CENTER N	CURVE CENTER E
1	10,847.85′	04°28′53"	424.45′	848.47′	1853380.6395	6362217.0628
11	8,302.60′	02°04′12"	150.00′	299.97′	1854944.5282	6364170.6340
12	3,000.00′	03°11′29"	83.57′	167.10′	1858672.0213	6367942.0261
21	10,895.15′	01°02′58"	99.79′	199.58′	1854036.1366	6361626.9895



SITE AND BORING LOCATION PLAN
FIGURE 4-1

SCALE: 1"=50′

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

LAST REVISION 00-00-00
DATE PLOTTED => 9/10/2010
TIME PLOTTED => 6:38:11 AM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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Suite 1500
San Jose, CA 95113

NOTE:
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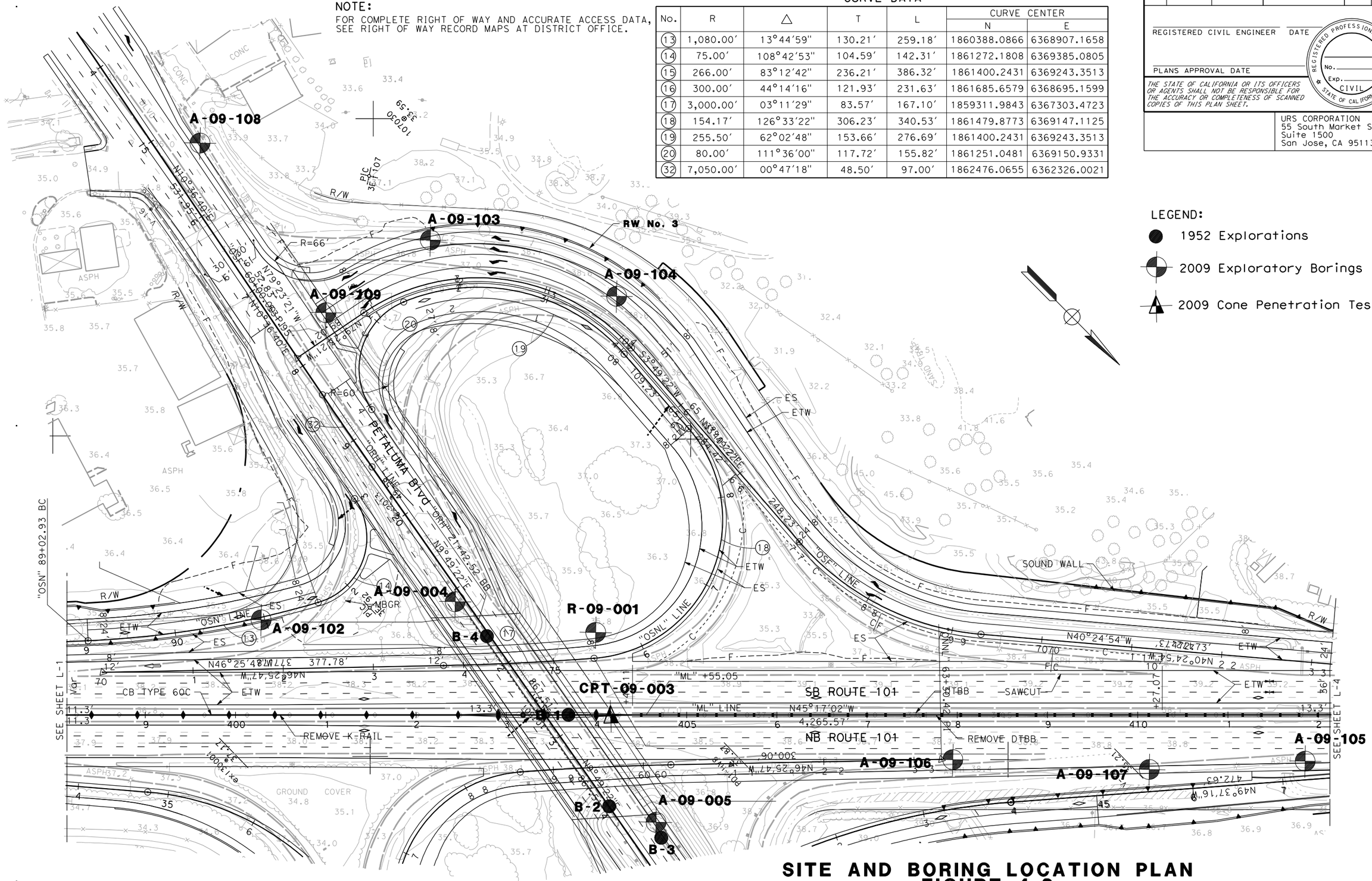
CURVE DATA

No.	R	△	T	L	CURVE CENTER N	CURVE CENTER E
13	1,080.00′	13°44′59"	130.21′	259.18′	1860388.0866	6368907.1658
14	75.00′	108°42′53"	104.59′	142.31′	1861272.1808	6369385.0805
15	266.00′	83°12′42"	236.21′	386.32′	1861400.2431	6369243.3513
16	300.00′	44°14′16"	121.93′	231.63′	1861685.6579	6368695.1599
17	3,000.00′	03°11′29"	83.57′	167.10′	1859311.9843	6367303.4723
18	154.17′	126°33′22"	306.23′	340.53′	1861479.8773	6369147.1125
19	255.50′	62°02′48"	153.66′	276.69′	1861400.2431	6369243.3513
20	80.00′	111°36′00"	117.72′	155.82′	1861251.0481	6369150.9331
32	7,050.00′	00°47′18"	48.50′	97.00′	1862476.0655	6362326.0021

LEGEND:
- 1952 Explorations
- 2009 Exploratory Borings
- 2009 Cone Penetration Test



SEE SHEET L-3 FOR AREA NORTH OF "ML" LINE

SITE AND BORING LOCATION PLAN
FIGURE 4-2

SCALE: 1"=50′

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

LAST REVISION 00-00-00
DATE PLOTTED => 9/10/2010
TIME PLOTTED => 6:39:13 AM

BORDER LAST REVISED 4/11/2008
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
USERNAME => madhu_thummaluru
DGN FILE => ...\Site and Boring Location Plan Fig 3-2 .dgn
CU 00000
EA 04-0A1851

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

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.

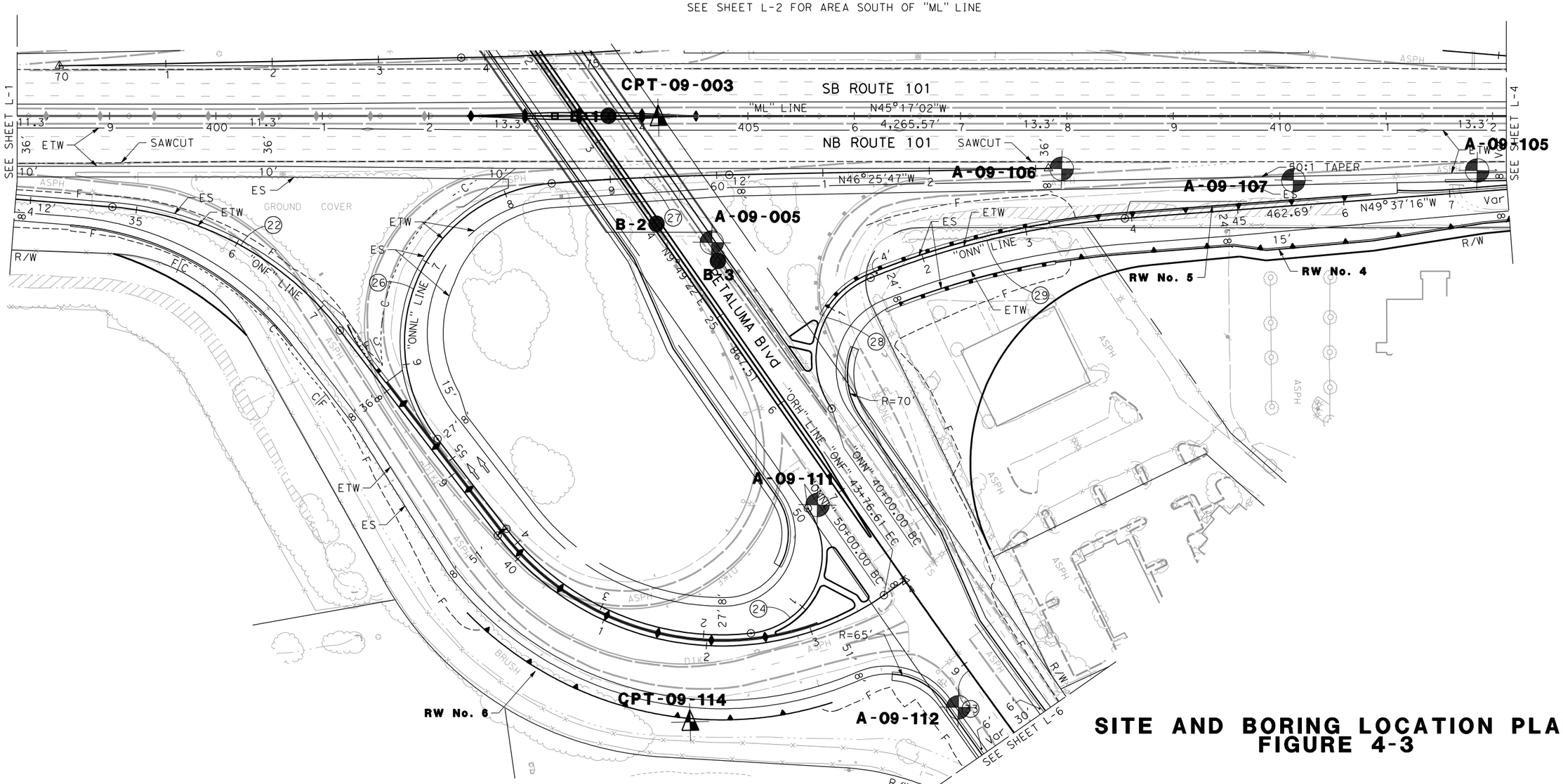
LEGEND:

- 1952 Explorations
- 2009 Exploratory Borings
- 2009 Cone Penetration Test

CURVE DATA

No.	R	Δ	T	L	CURVE CENTER N	CURVE CENTER E
22	300.00′	47°52′22"	133.17′	250.66′	1861550.3041	6369930.3472
23	266.00′	87°19′37"	253.87′	405.42′	1861862.1716	6369399.0311
24	75.00′	118°47′23"	126.79′	155.50′	1862003.2115	6369511.6721
25	255.50′	58°32′14"	143.20′	261.04′	1861862.1716	6369399.0311
26	149.64′	123°13′45"	276.92′	321.83′	1861743.3717	6369490.8210
27	3,000.00′	03°11′29"	83.57′	167.10′	1863914.7138	6371337.3954
28	82.00′	102°54′16"	102.91′	147.27′	1861979.0978	6369275.0901
29	800.00′	17°39′06"	124.22′	246.47′	1862641.3493	6369552.4832
33	7,050.00′	2°52′45"	177.17′	354.26′	1863330.8585	6362473.9989

SEE SHEET L-2 FOR AREA SOUTH OF "ML" LINE

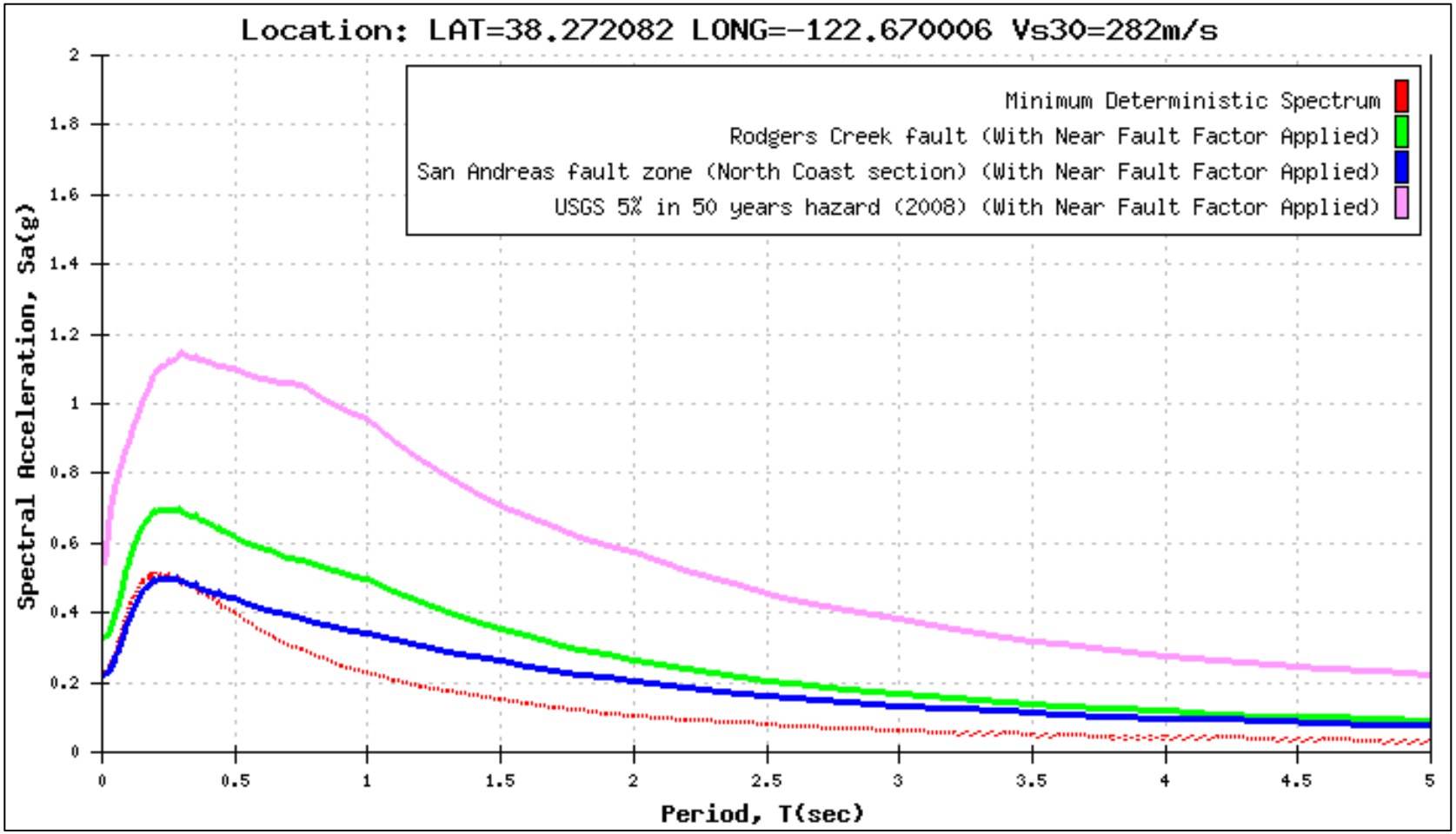


SITE AND BORING LOCATION PLAN
FIGURE 4-3

SCALE: 1"=50′

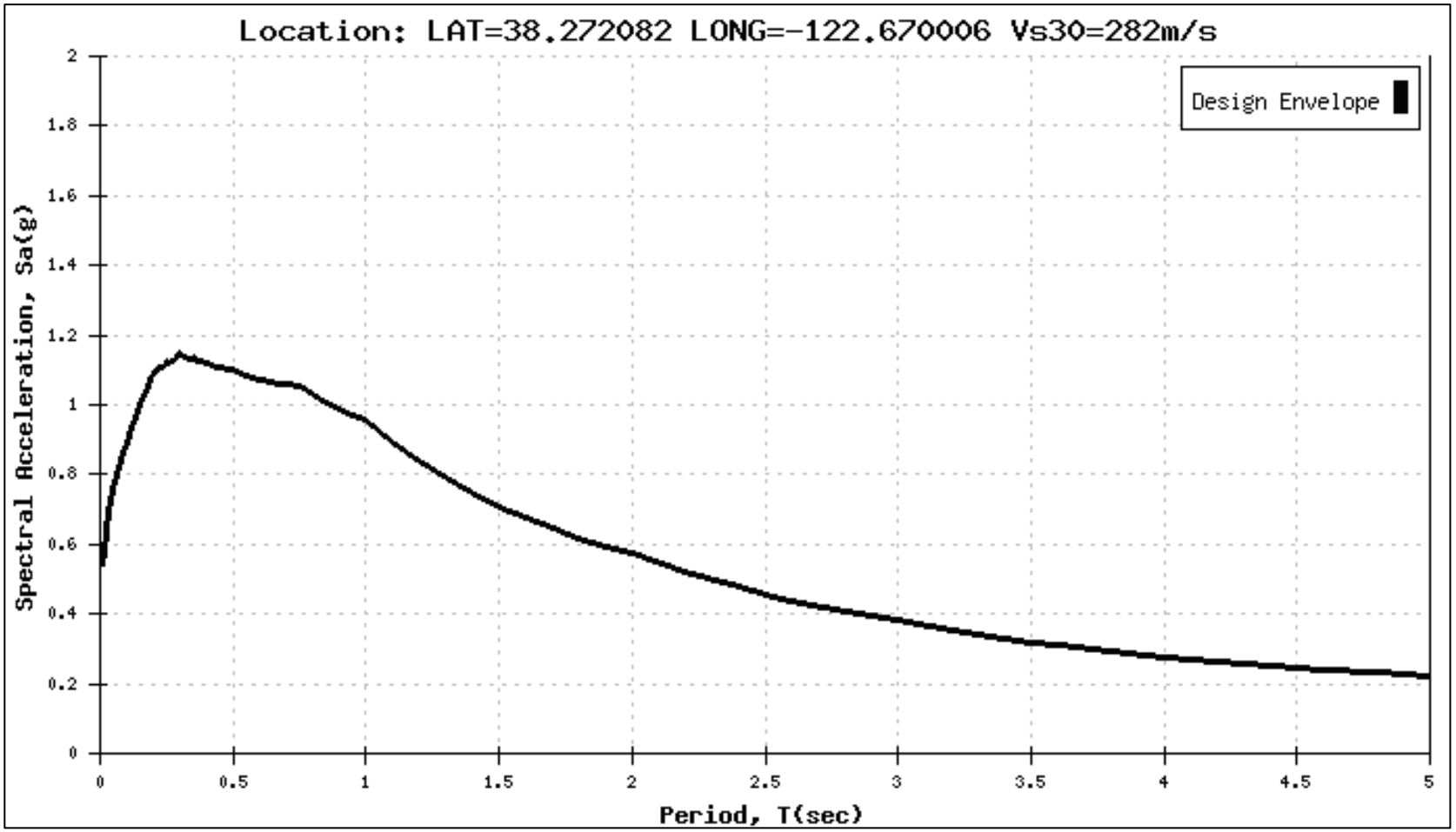
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
CONSULTANT FUNCTIONAL SUPERVISOR
CALCULATED-DESIGNED BY
CHECKED BY
REVISED BY
DATE REVISED

LAST REVISION 00-00-00
DATE PLOTTED => 9/10/2010
TIME PLOTTED => 6:40:09 AM



Reference: Caltrans ARS Online (2009)

URS 55 South Market Street, Suite 1500 San Jose, CA 95113 PHONE: (408) 297-9585 FAX: (408) 297-6962	PROJECT No 28645097	CALCULATED BY M. Thummaluru	**Calculated Spectra** **Old Redwood Highway** **Petaluma, CA**	**FIGURE 6-1**
	Date January 10, 2009	CHECKED BY S. Huang		



Reference: Caltrans ARS Online (2009)

URS 55 South Market Street, Suite 1500 San Jose, CA 95113 PHONE: (408) 297-9585 FAX: (408) 297-6962	PROJECT No 28645097	CALCULATED BY M. Thummaluru	**Calculated Spectra Design Curve** **Old Redwood Highway** **Petaluma, CA**	**FIGURE 6-2**
	Date January 10, 2009	CHECKED BY S. Huang		

Liquefaction Susceptibility Map

Susceptibility Level

- Very High
- High
- Moderate
- Low
- Very Low

Major Roads

Local Roads

Scale: 1 inch = 0.32 miles

This map is intended for planning use only and is not intended to be site-specific. Rather, it depicts the general risk within neighborhoods and the relative risk from community to community. More detailed maps are needed for site development decisions.

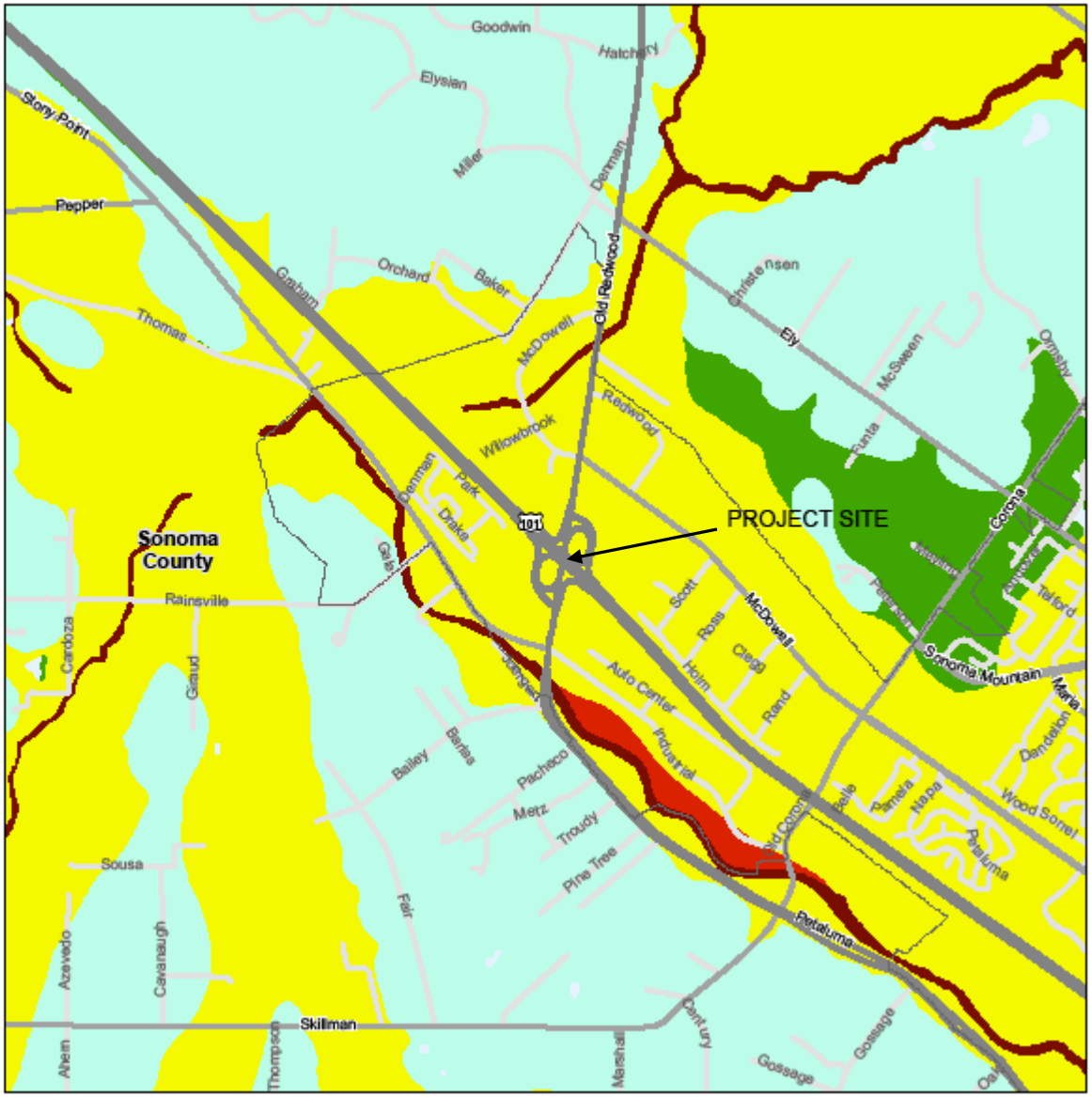
This map is available at http://quake.abag.ca.gov

Sources:
This map is based on work by William Lettis & Associates, Inc. and USGS. USGS Open-File Report 00-444, Knudsen & others, 2000 and USGS Open-File Report 2006-1037, Witter & others, 2006

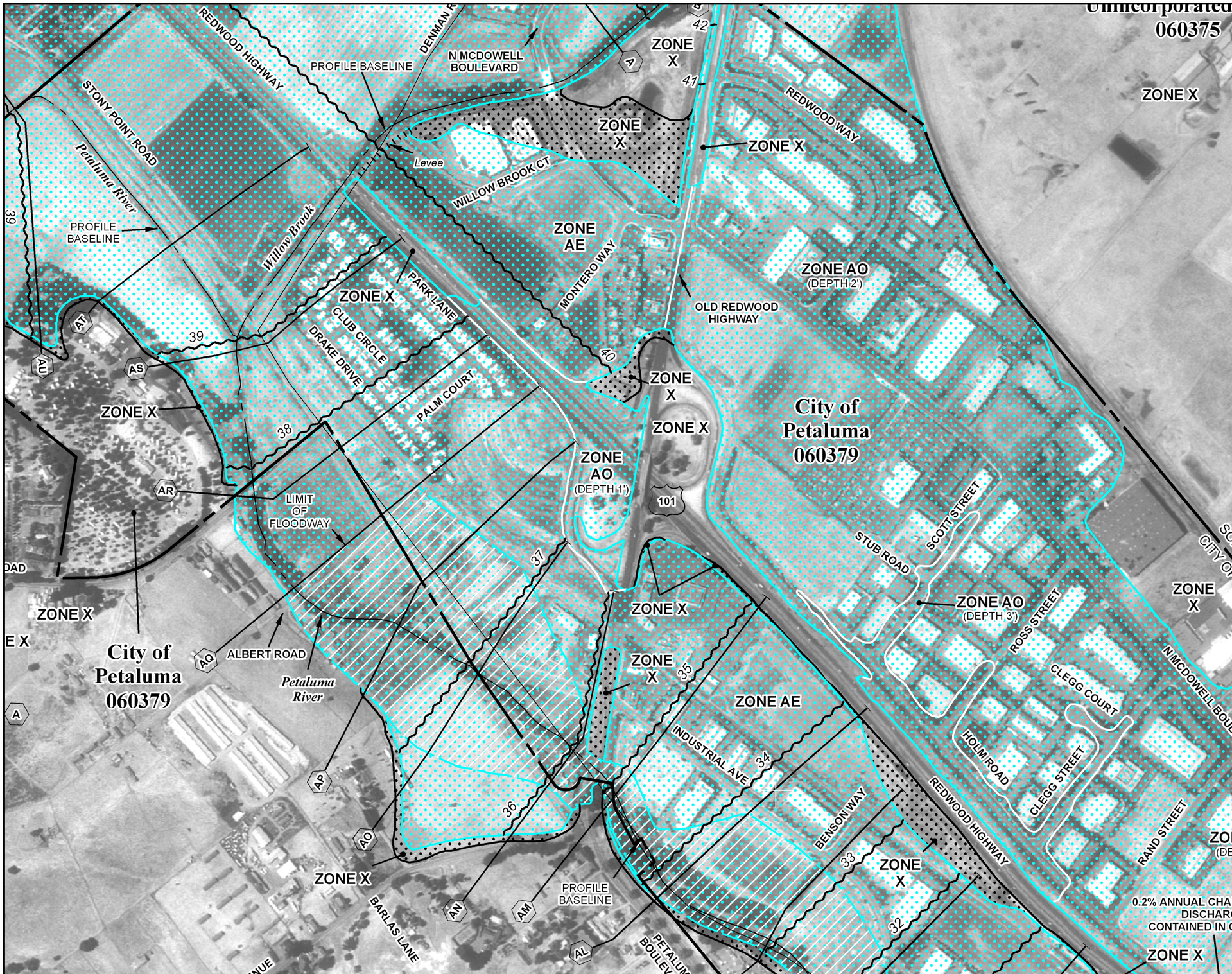
For more information visit:
http://pubs.usgs.gov/of/2000/of00-444/
http://pubs.usgs.gov/of/2006/1037/

Map Prepared by the ABAG Earthquake Program. June 2009.

ABAG Geographic Information Systems



URS 55 South Market Street, Suite 1500 San Jose, CA 95113 PHONE: (408) 297-9585 FAX: (408) 297-6962	Old Redwood Highway Petaluma, CA Project No: 28645097	**Liquefaction Susceptibility Map**	**FIGURE** **7-1** January, 2010



MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0893E

FIRM

FLOOD INSURANCE RATE MAP

SONOMA COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 893 OF 1150

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
PETALUMA, CITY OF	060379	0893	E
SONOMA COUNTY	060375	0893	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06097C0893E

EFFECTIVE DATE
DECEMBER 2, 2008

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

FIGURE 7-2

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER David A. Anderson No. 36066 Exp. 6/30/12 CIVIL STATE OF CALIFORNIA

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11 ENGLISH STREET
PETALUMA, CA 94954

URS CORPORATION
1380 LEAD HILL BLVD, SUITE 100
ROSEVILLE, CA 95661-2997

GENERAL NOTES

DESIGN: Earth retaining systems and concrete barrier railings are designed by AASHTO LFD as set forth in AASHTO Bridge Design Specifications (BDS) 2000 and modified by Caltrans BDS 2004

DESIGN LOAD: Live Pressure: 240 lb/ft2 surcharge

ALLOWABLE BEARING PRESSURE: 4,100 lb/ft2

STANDARD PLANS DATED MAY, 2006

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A10B	ACRONYMS AND ABBREVIATIONS (SHEET 2 OF 2)
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A85	CHAIN LINK FENCE TYPE CL-4
B3-9	RETAINING WALL DETAILS No. 2
B11-56	CONCRETE BARRIER TYPE 736

STANDARD PLAN SHEET No.

DETAIL No.

INDEX TO PLANS

SHEET No.	TITLE	
1	RETAINING WALLS No. 1 THRU No. 7	GENERAL NOTES
2	RETAINING WALL No. 1	GENERAL PLAN
3	RETAINING WALL No. 2	GENERAL PLAN
4	RETAINING WALL No. 3	GENERAL PLAN
5	RETAINING WALL No. 4	GENERAL PLAN
6	RETAINING WALL No. 5	GENERAL PLAN
7	RETAINING WALL No. 6	GENERAL PLAN
8	RETAINING WALL No. 7	GENERAL PLAN
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14	RETAINING WALLS No. 1 THRU No. 7	MECHANICALLY STABILIZED EMBANKMENT DETAIL No. 3
15	RETAINING WALLS No. 1 THRU No. 7	MECHANICALLY STABILIZED EMBANKMENT DETAIL No. 4
16	RETAINING WALLS No. 1 THRU No. 7	MECHANICALLY STABILIZED EMBANKMENT DETAIL No. 6
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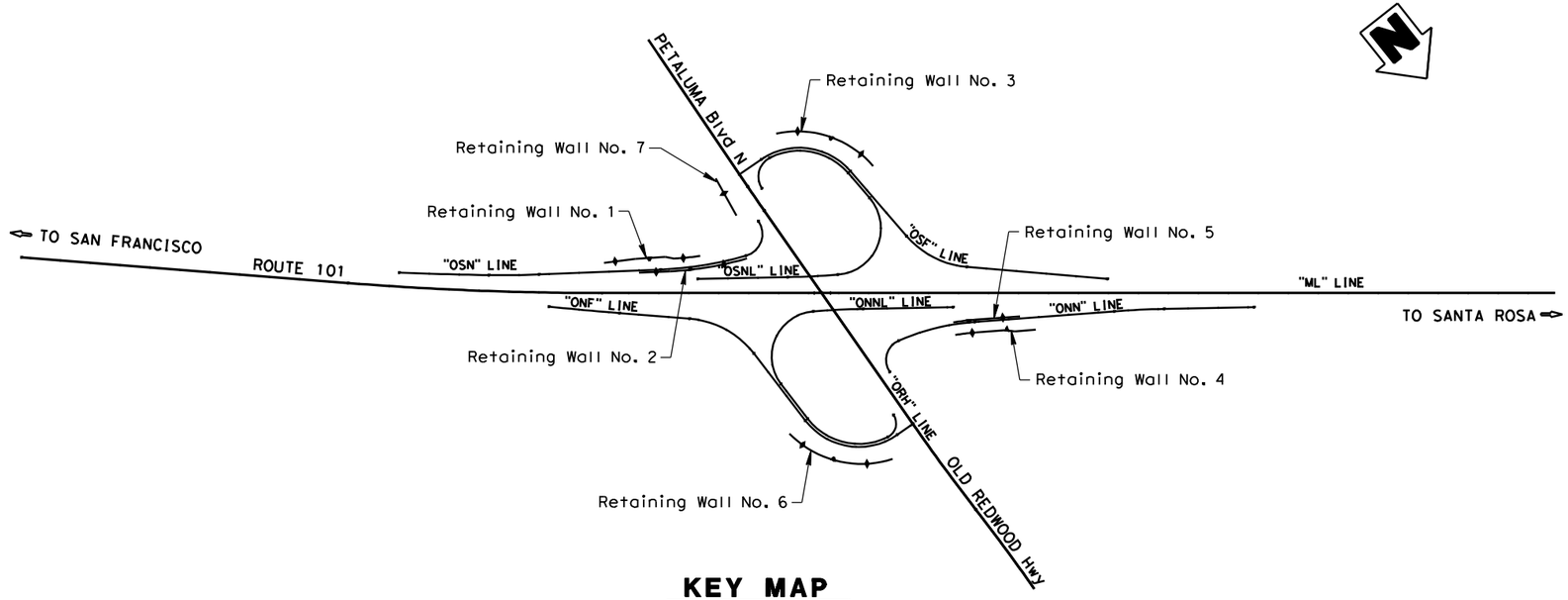

KEY MAP

DESIGN OVERSIGHT	DESIGN	BY D. Anderson	CHECKED S. Landis				
	DETAILS	BY L. Davis	CHECKED S. Landis	LAYOUT	BY D. Anderson	CHECKED	
SIGN OFF DATE	QUANTITIES	BY	CHECKED	SPECIFICATIONS	BY D. Harnagel	PLANS AND SPECS COMPARED	

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Walt LaFranchi
PROJECT ENGINEER

BRIDGE NO.
POST MILES

RETAINING WALLS No. 1 THRU No. 7
GENERAL NOTES

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV.7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE: 04000200041 CONTRACT NO.: 04-0A1854

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 02-08-10 05-21-10 09-16-10

SHEET 1 OF 27

FILE => RW-a-genotes.dgn

USERNAME => Lynette_Dobbs PLOTTED => 5/3/2011 TIME PLOTTED => 10:07:28 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER David A. Anderson No. 36066 Exp. 6/30/12 CIVIL STATE OF CALIFORNIA

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11 ENGLISH STREET
PETALUMA, CA 94954

URS CORPORATION
1380 LEAD HILL BLVD, SUITE 100
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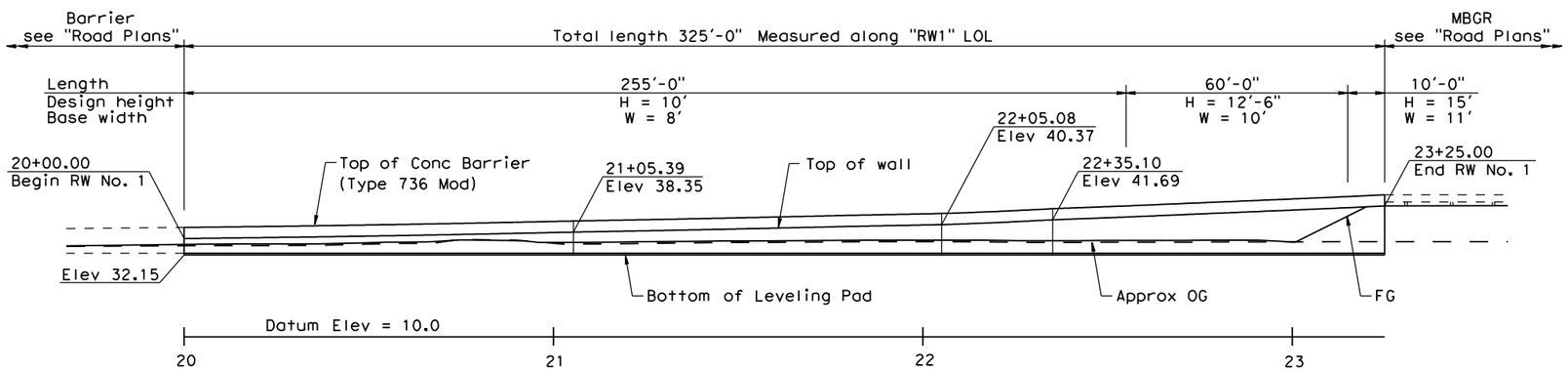
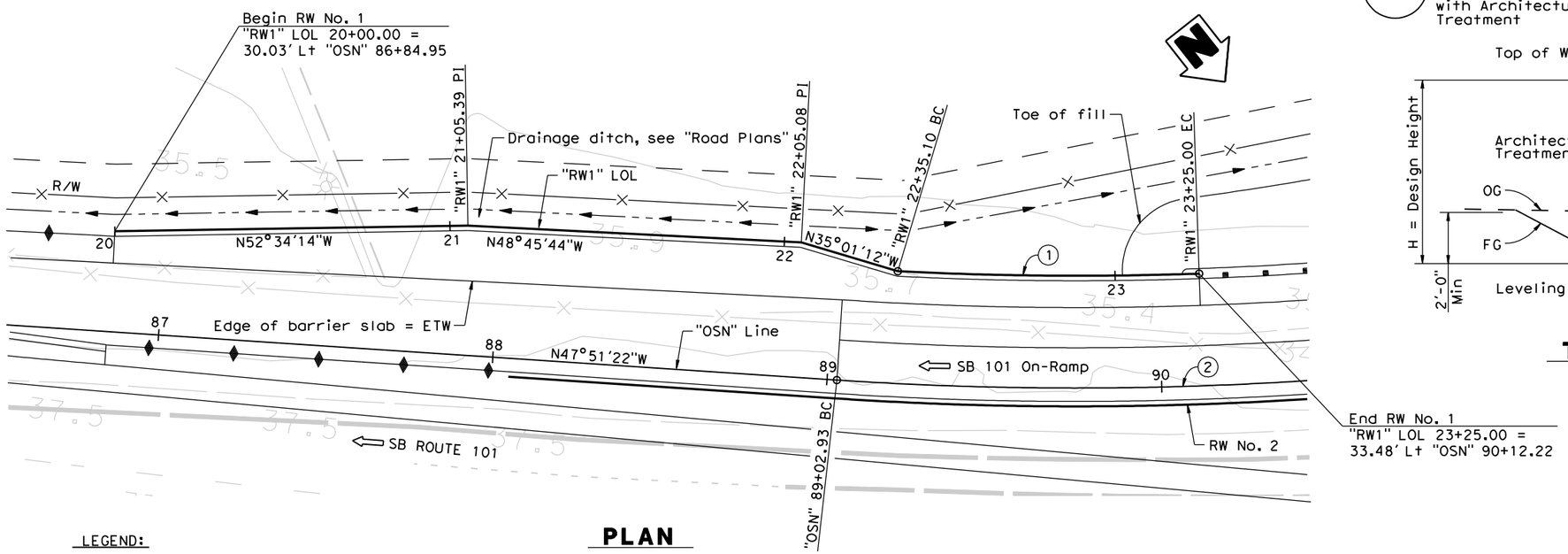


DEVELOPED & MIRRORED ELEVATION

1"=20'-0"

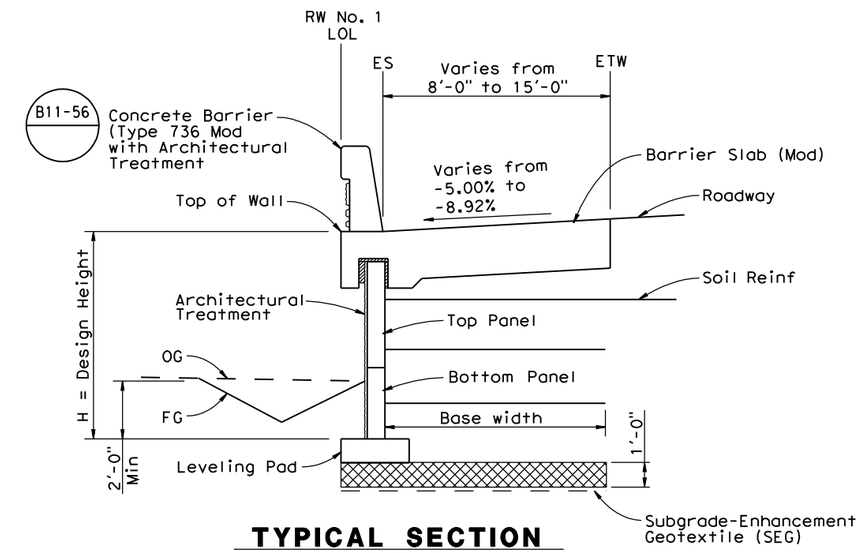
TOP OF WALL Elev

Sta	Elev
20+00	36.61
20+25	36.91
20+50	37.27
20+75	37.72
21+00	38.23
21+25	38.70
21+50	39.20
21+75	39.77
22+00	40.27
22+25	41.16
22+50	42.24
22+75	43.26
23+00	44.31
23+25	45.40



PLAN

1"=20'-0"



TYPICAL SECTION

NO SCALE

Denotes material below bottom of leveling pad to be removed and replaced with Class 2 aggregate base material

LEGEND:

⇨ Indicates direction of traffic

CURVE DATA				
No.	R	Δ	T	L
1	1072.19'	4°48'33"	45.02'	89.90'
2	1080.00'	13°44'59"	130.21'	259.18'

NOTES:

1. For MSE Wall details, see "Mechanically Stabilized Embankment Detail" and "Miscellaneous Details" sheets.
2. For layout of panels, see "Panel Layout" sheets.
3. For inspection wires, see "Miscellaneous Details" sheet.
4. The contractor shall verify controlling field dimensions before ordering or fabricating any materials.
5. For Architectural Treatment, see "Architectural Treatment Details" sheet.

DESIGN OVERSIGHT	DESIGN	BY D. Anderson	CHECKED S. Landis		
	DETAILS	BY L. Davis	CHECKED S. Landis	LAYOUT BY D. Anderson	CHECKED
SIGN OFF DATE	QUANTITIES	BY	CHECKED	SPECIFICATIONS BY D. Harnagel	PLANS AND SPECS COMPARED

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Walt LaFranchi
PROJECT ENGINEER

BRIDGE NO.

POST MILES

RETAINING WALL No. 1

GENERAL PLAN

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV.7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE: 04000200041 CONTRACT NO.: 04-0A1854

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 02-08-10 05-27-10 09-16-10

SHEET 2 OF 27

FILE => RW-a-gp01.dgn

USERNAME => Lynette_Davis PLOTTED => 5/3/2011 TIME PLOTTED => 10:07:32 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER David A. Anderson No. 36066 Exp. 6/30/12 CIVIL STATE OF CALIFORNIA

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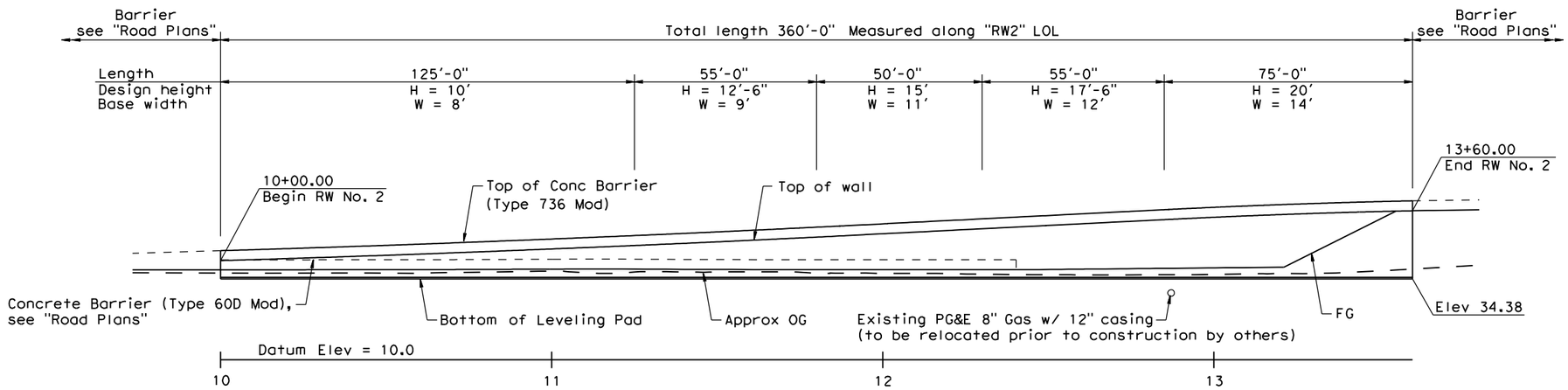
PETALUMA, CA 94954

URS CORPORATION
1380 LEAD HILL BLVD, SUITE 100
ROSEVILLE, CA 95661-2997



DEVELOPED ELEVATION

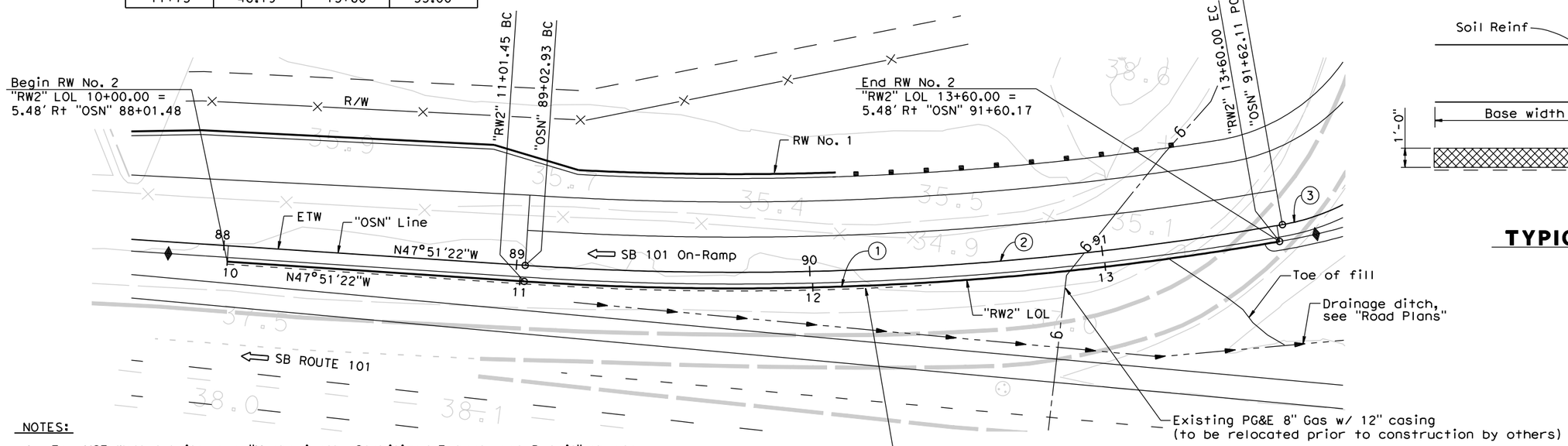
1"=20'-0"

TOP OF WALL Elev

Sta	Elev	Sta	Elev
10+00	39.95	12+00	48.04
10+25	40.72	12+25	49.30
10+50	41.56	12+50	50.56
10+75	42.47	12+75	51.81
11+00	43.46	13+00	53.03
11+25	44.50	13+25	54.01
11+50	45.61	13+50	54.76
11+75	46.79	13+60	55.00

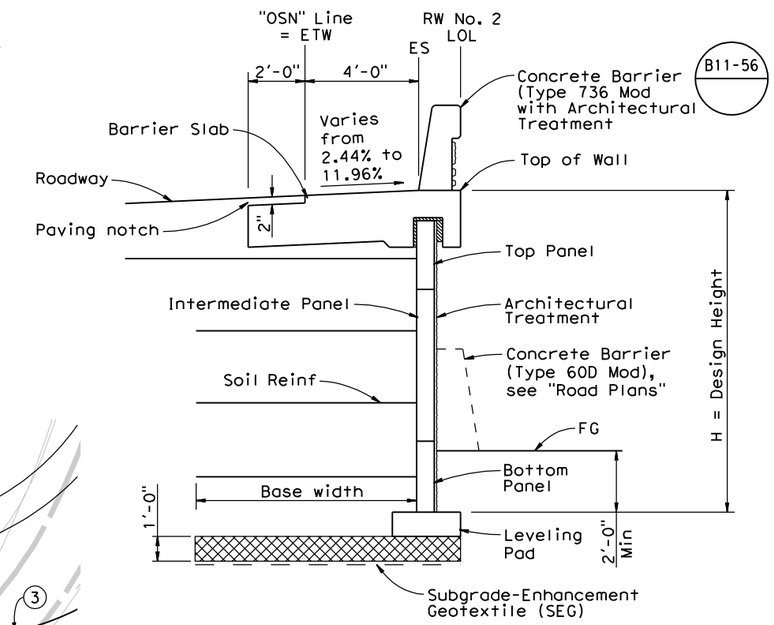
CURVE DATA

No.	R	Δ	T	L
1	1085.48'	13°38'50"	129.89'	258.55'
2	1080.00'	13°44'59"	130.21'	259.18'
3	75.00'	108°42'53"	104.59'	142.31'



PLAN

1"=20'-0"



TYPICAL SECTION

NO SCALE

Denotes material below bottom of leveling pad to be removed and replaced with Class 2 aggregate base material

NOTES:

1. For MSE Wall details, see "Mechanically Stabilized Embankment Detail" sheets.
2. For layout of panels, see "Panel Layout" sheets.
3. For inspection wires, see "Miscellaneous Details" sheet.
4. The contractor shall verify controlling field dimensions before ordering or fabricating any materials.
5. For Architectural Treatment, see "Architectural Treatment Details" sheet.

LEGEND:

Indicates direction of traffic

DESIGN OVERSIGHT	DESIGN	BY D. Anderson	CHECKED S. Landis		
	DETAILS	BY L. Davis	CHECKED S. Landis	LAYOUT BY D. Anderson	CHECKED
SIGN OFF DATE	QUANTITIES	BY	CHECKED	SPECIFICATIONS BY D. Harnagel	PLANS AND SPECS COMPARED

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Walt LaFranchi
PROJECT ENGINEER

BRIDGE NO.
POST MILES

RETAINING WALL No. 2
GENERAL PLAN

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV.7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE: 04000200041 CONTRACT NO.: 04-0A1854

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 02-08-10 05-21-10 09-16-10

SHEET 3 OF 27

FILE => RW-a-gp02.dgn

USERNAME => Lynette_Davis DATE PLOTTED => 5/3/2011 TIME PLOTTED => 10:07:35 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER David A. Anderson No. 36066 Exp. 6/30/12 CIVIL STATE OF CALIFORNIA

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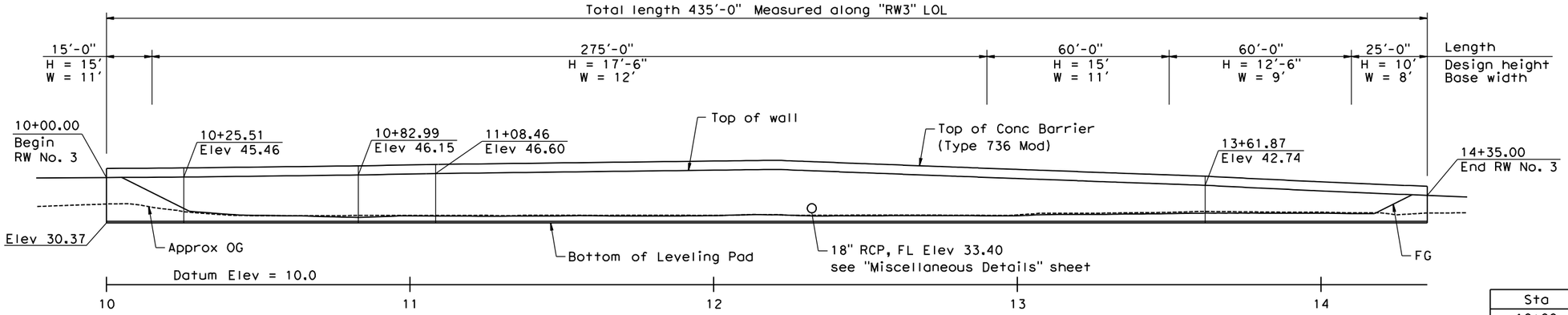
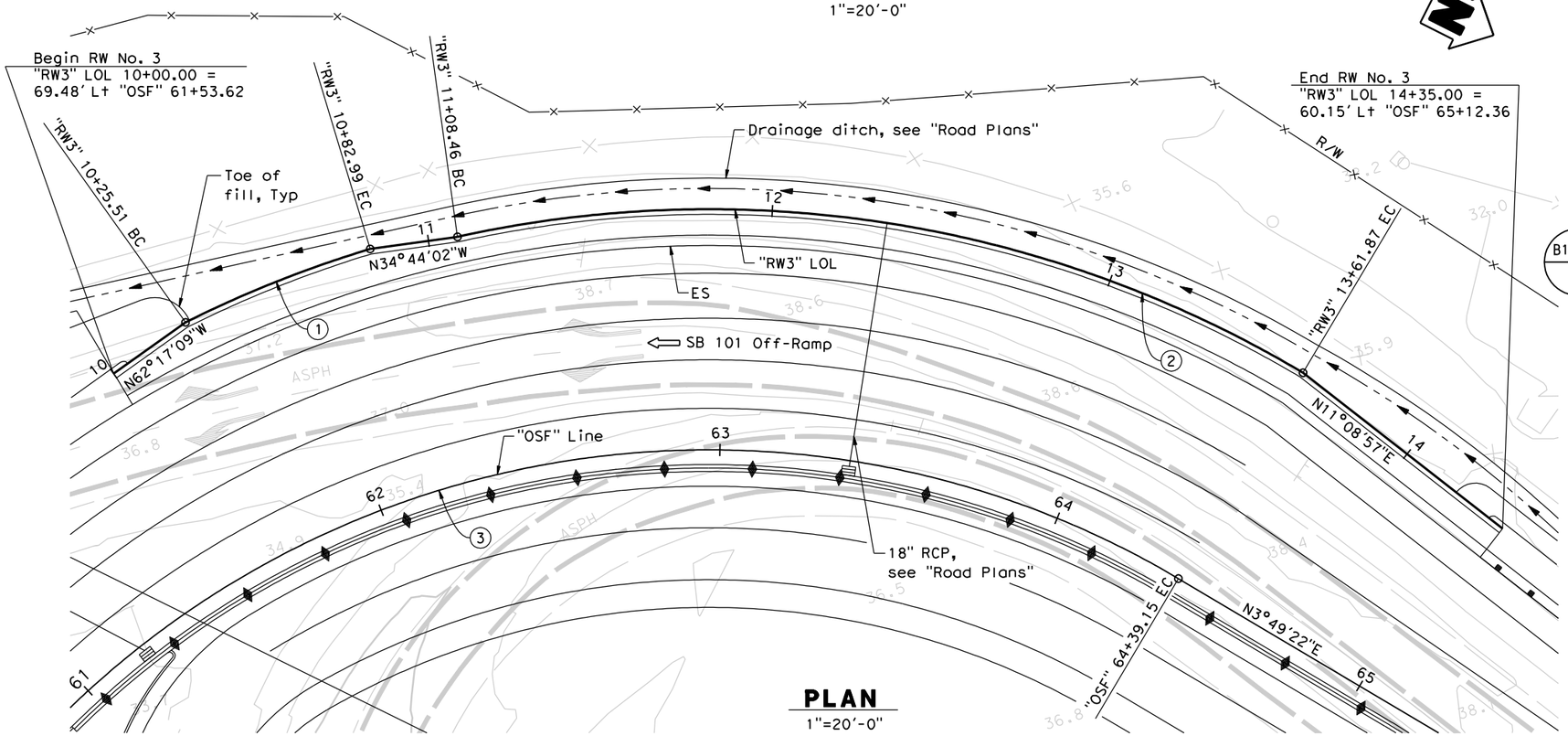


DEVELOPED & MIRRORED ELEVATION

1"=20'-0"

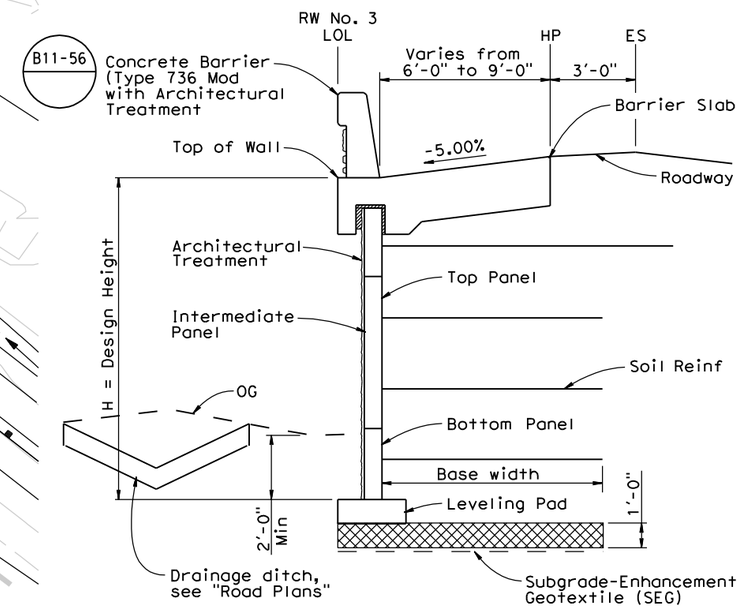
TOP OF WALL Elev

Sta	Elev	Sta	Elev
10+00	45.30	12+50	46.85
10+25	45.46	12+75	45.90
10+50	45.75	13+00	44.97
10+75	46.06	13+25	44.06
11+00	46.45	13+50	43.16
11+25	46.81	13+75	42.07
11+50	47.12	14+00	40.89
11+75	47.42	14+25	39.82
12+00	47.73	14+35	39.42
12+25	47.82		



PLAN

1"=20'-0"



TYPICAL SECTION

NO SCALE

CURVE DATA

No.	R	Δ	T	L
1	338.48'	9°43'43"	28.81'	57.47'
2	335.48'	43°16'48"	133.10'	253.41'
3	266.00'	83°12'42"	236.21'	386.32'

NOTES:

1. For MSE Wall details, see "Mechanically Stabilized Embankment Detail" sheets.
2. For layout of panels, see "Panel Layout" sheets.
3. For inspection wires, see "Miscellaneous Details" sheet.
4. The contractor shall verify controlling field dimensions before ordering or fabricating any materials.
5. For Architectural Treatment, see "Architectural Treatment Details" sheet.

LEGEND:

⟹ Indicates direction of traffic

Denotes material below bottom of leveling pad to be removed and replaced with Class 2 aggregate base material

DESIGN OVERSIGHT

SIGN OFF DATE

	BY	CHECKED
DESIGN	D. Anderson	S. Landis
DETAILS	L. Davis	S. Landis
QUANTITIES		
LAYOUT	D. Anderson	
SPECIFICATIONS	D. Harnagel	PLANS AND SPECS COMPARED

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Walt LaFranchi
PROJECT ENGINEER

BRIDGE NO.

POST MILES

RETAINING WALL No. 3

GENERAL PLAN

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV.7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE: 04000200041 CONTRACT NO.: 04-0A1854

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 02-08-10 05-21-10 09-16-10

SHEET 4 OF 27

FILE => RW-a-gp03.dgn

USERNAME => Lynette_D@ATE PLOTTED => 5/3/2011 TIME PLOTTED => 10:07:38 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER David A. Anderson No. 36066 Exp. 6/30/12 CIVIL STATE OF CALIFORNIA

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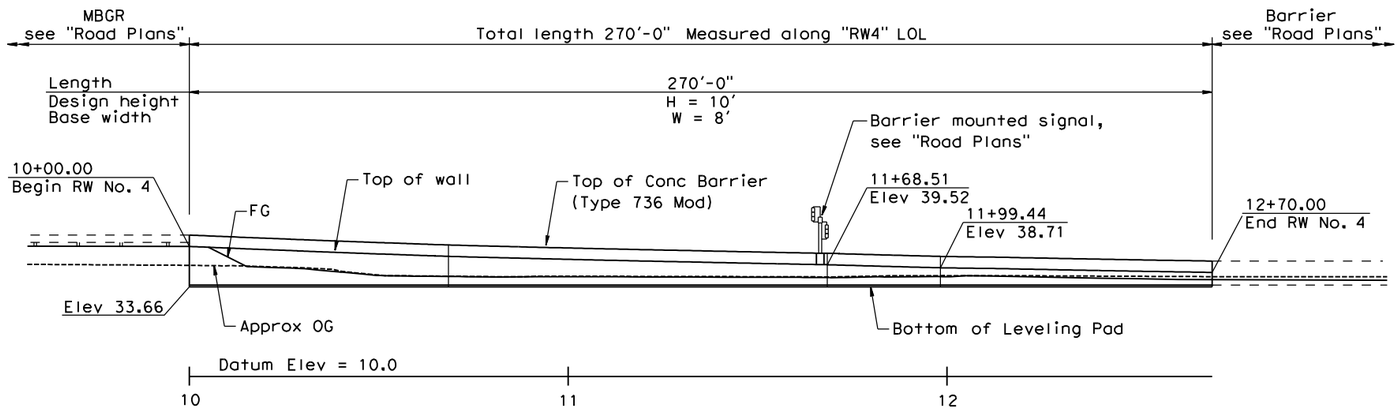
PETALUMA, CA 94954

URS CORPORATION
1380 LEAD HILL BLVD, SUITE 100
ROSEVILLE, CA 95661-2997

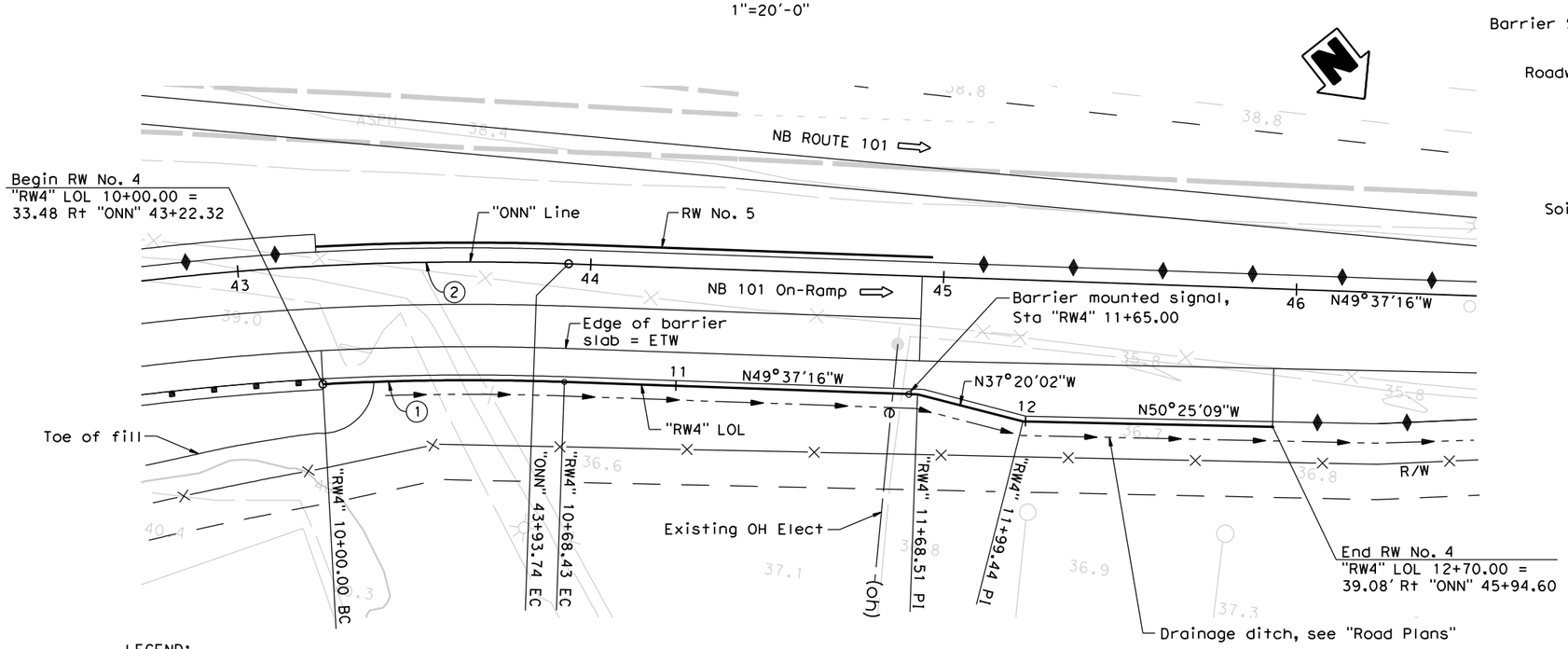


DEVELOPED ELEVATION

1"=20'-0"

TOP OF WALL Elev

Sta	Elev
10+00	44.35
10+25	43.32
10+50	42.37
10+75	41.55
11+00	40.94
11+25	41.39
11+50	39.87
11+75	39.33
12+00	38.68
12+25	38.27
12+50	37.81
12+70	37.50

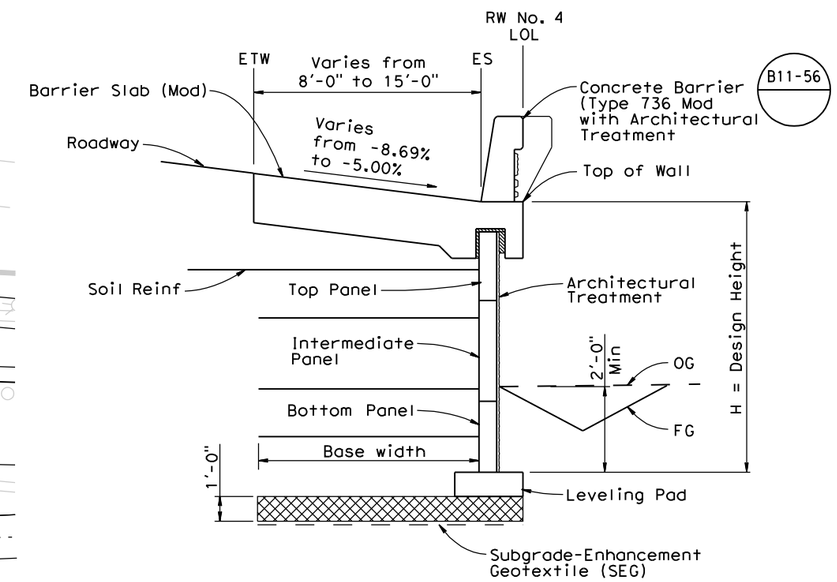


LEGEND:

⇨ Indicates direction of traffic

PLAN

1"=20'-0"



TYPICAL SECTION

NO SCALE

Denotes material below bottom of leveling pad to be removed and replaced with Class 2 aggregate base material

NOTES:

1. For MSE Wall details, see "Mechanically Stabilized Embankment Detail" and "Miscellaneous Details" sheets.
2. For layout of panels, see "Panel Layout" sheets.
3. For inspection wires, see "Miscellaneous Details" sheet.
4. The contractor shall verify controlling field dimensions before ordering or fabricating any materials.
5. For Architectural Treatment, see "Architectural Treatment Details" sheet.

CURVE DATA

No.	R	Δ	T	L
1	766.52'	05°06'53"	34.24'	68.43'
2	800.00'	17°39'06"	124.22'	246.47'

DESIGN OVERSIGHT	DESIGN	BY D. Anderson	CHECKED S. Landis		
	DETAILS	BY L. Davis	CHECKED S. Landis	LAYOUT	BY D. Anderson / CHECKED
SIGN OFF DATE	QUANTITIES	BY	CHECKED	SPECIFICATIONS	BY D. Harnagel / PLANS AND SPECS COMPARED

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Walt LaFranchi
PROJECT ENGINEER

BRIDGE NO.
POST MILES

RETAINING WALL No. 4
GENERAL PLAN

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV.7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE: 04000200041 CONTRACT NO.: 04-0A1854

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 02-08-10 05-21-10 09-16-10 SHEET 5 OF 27

FILE => RW-a-gp04.dgn

USERNAME => Lynette_Davis PLOTTED => 5/3/2011 TIME PLOTTED => 10:07:41 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER David A. Anderson No. 36066 Exp. 6/30/12 CIVIL STATE OF CALIFORNIA

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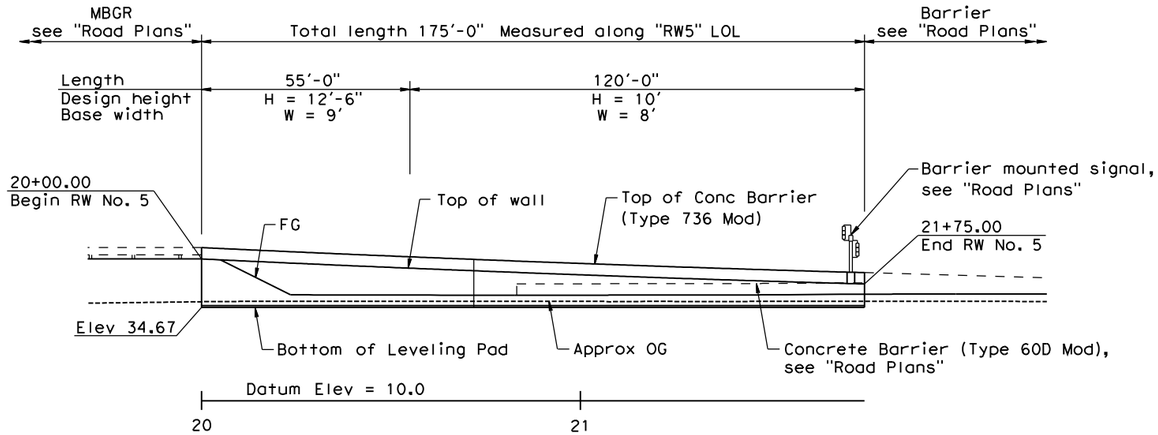
PETALUMA, CA 94954

URS CORPORATION
1380 LEAD HILL BLVD, SUITE 100
ROSEVILLE, CA 95661-2997

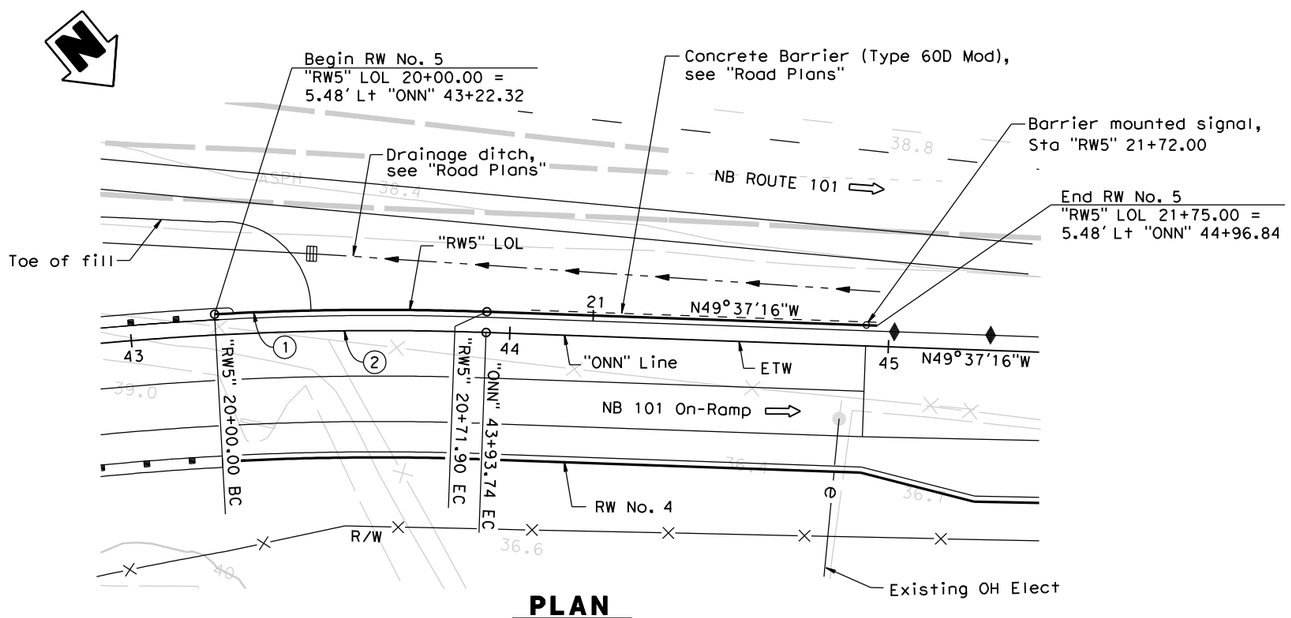


DEVELOPED & MIRRORED ELEVATION

1"=20'-0"

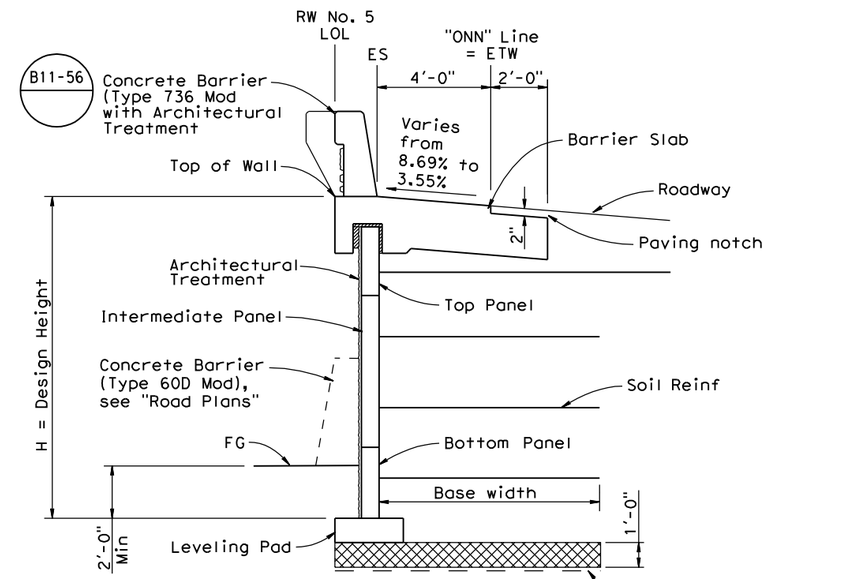
TOP OF WALL Elev

Sta	Elev
20+00	47.47
20+25	46.32
20+50	45.24
20+75	44.24
21+00	43.28
21+25	42.40
21+50	41.59
21+75	40.86



PLAN

1"=20'-0"



TYPICAL SECTION

NO SCALE

Denotes material below bottom of leveling pad to be removed and replaced with Class 2 aggregate base material

LEGEND:

⇨ Indicates direction of traffic

CURVE DATA				
No.	R	Δ	T	L
1	805.48'	5°06'53"	35.98'	71.90'
2	800.00'	17°39'06"	124.22'	246.47'

NOTES:

1. For MSE Wall details, see "Mechanically Stabilized Embankment Detail" sheets.
2. For layout of panels, see "Panel Layout" sheets.
3. For inspection wires, see "Miscellaneous Details" sheet.
4. The contractor shall verify controlling field dimensions before ordering or fabricating any materials.
5. For Architectural Treatment, see "Architectural Treatment Details" sheet.

DESIGN OVERSIGHT

SIGN OFF DATE

	BY	CHECKED
DESIGN	D. Anderson	S. Landis
DETAILS	L. Davis	S. Landis
QUANTITIES		

	BY	CHECKED
LAYOUT	D. Anderson	
SPECIFICATIONS	D. Harnagel	PLANS AND SPECS COMPARED

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Walt LaFranchi
PROJECT ENGINEER

BRIDGE NO.

POST MILES

RETAINING WALL No. 5

GENERAL PLAN

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV.7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE: 04000200041 CONTRACT NO.: 04-0A1854

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 02-08-10 05-21-10 09-16-10

SHEET 6 OF 27

FILE => RW-a-gp05.dgn

USERNAME => Lynette_Davis PLOTTED => 5/3/2011 TIME PLOTTED => 10:07:44 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER David A. Anderson No. 36066 Exp. 6/30/12 CIVIL STATE OF CALIFORNIA

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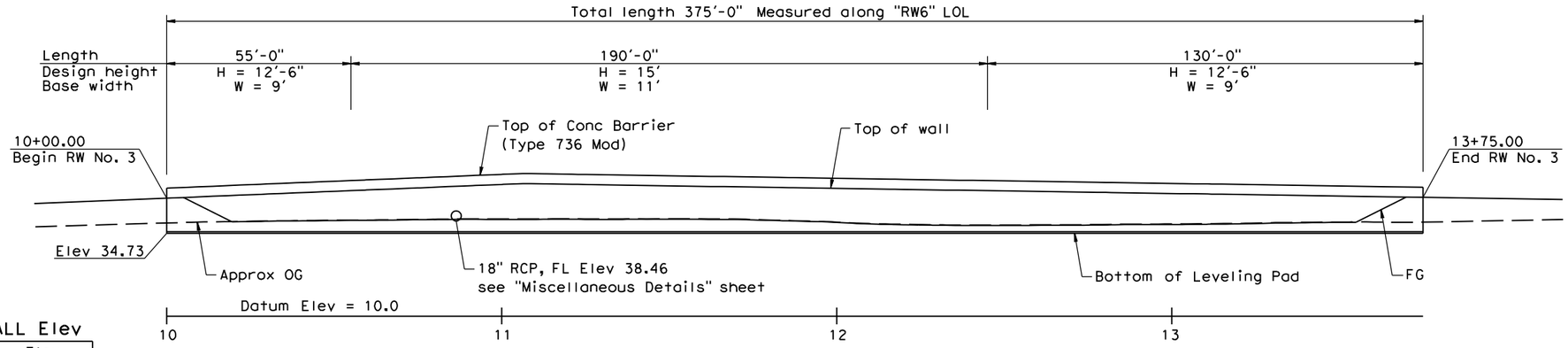
PETALUMA, CA 94954

URS CORPORATION
1380 LEAD HILL BLVD, SUITE 100
ROSEVILLE, CA 95661-2997

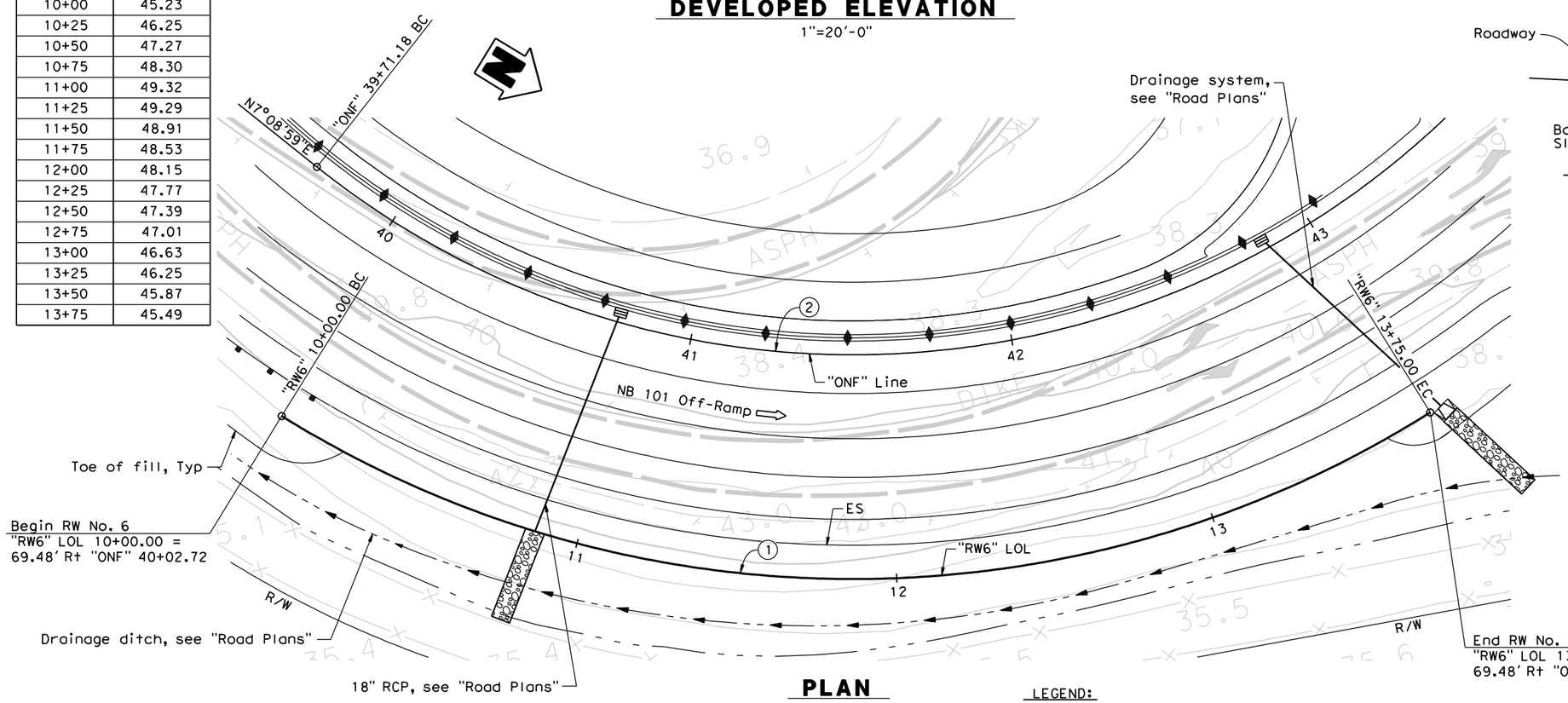


DEVELOPED ELEVATION

1"=20'-0"

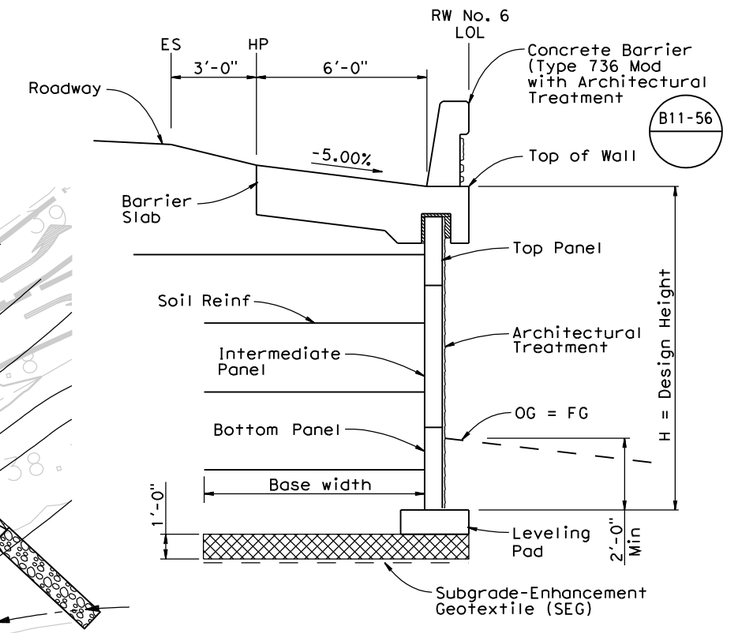
TOP OF WALL Elev

Sta	Elev
10+00	45.23
10+25	46.25
10+50	47.27
10+75	48.30
11+00	49.32
11+25	49.29
11+50	48.91
11+75	48.53
12+00	48.15
12+25	47.77
12+50	47.39
12+75	47.01
13+00	46.63
13+25	46.25
13+50	45.87
13+75	45.49



PLAN

1"=20'-0"



TYPICAL SECTION

NO SCALE

Denotes material below bottom of leveling pad to be removed and replaced with Class 2 aggregate base material

NOTES:

1. For MSE Wall details, see "Mechanically Stabilized Embankment Detail" sheets.
2. For layout of panels, see "Panel Layout" sheets.
3. For inspection wires, see "Miscellaneous Details" sheet.
4. The contractor shall verify controlling field dimensions before ordering or fabricating any materials.
5. For Architectural Treatment, see "Architectural Treatment Details" sheet.

LEGEND:

Indicates direction of traffic

CURVE DATA

No.	R	Δ	T	L
1	335.48'	64°02'43"	209.82'	375.00'
2	266.00'	87°19'37"	253.87'	405.42'

DESIGN OVERSIGHT

SIGN OFF DATE

	BY	CHECKED
DESIGN	D. Anderson	S. Landis
DETAILS	L. Davis	S. Landis
QUANTITIES		

	BY	CHECKED
LAYOUT	D. Anderson	
SPECIFICATIONS	D. Harnagel	PLANS AND SPECS COMPARED

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Walt LaFranchi
PROJECT ENGINEER

BRIDGE NO.

POST MILES

RETAINING WALL No. 6

GENERAL PLAN

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV.7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE: 04000200041 CONTRACT NO.: 04-0A1854

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 02-08-10 05-21-10 09-16-10

SHEET 7 OF 27

FILE => RW-a-gp06.dgn

USERNAME => Lynette_Davis DATE PLOTTED => 5/3/2011 TIME PLOTTED => 10:07:47 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER David A. Anderson No. 36066 Exp. 6/30/12 CIVIL STATE OF CALIFORNIA

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PETALUMA, CA 94954

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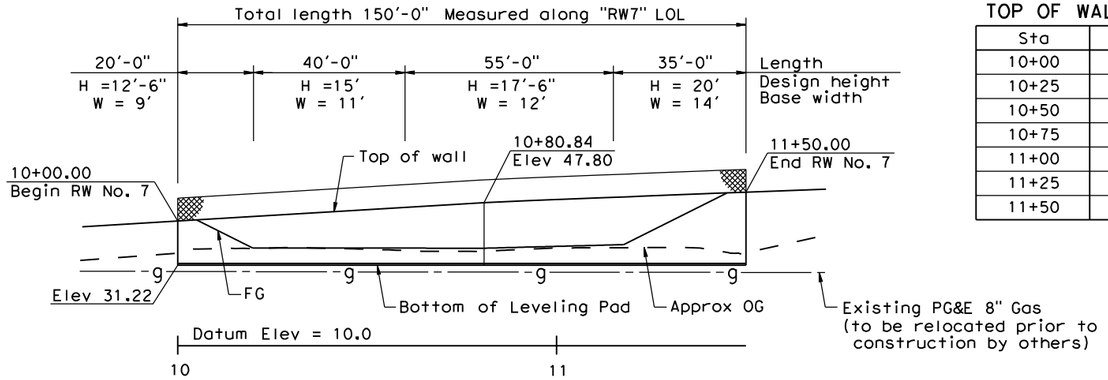
1380 LEAD HILL BLVD, SUITE 100
ROSEVILLE, CA 95661-2997

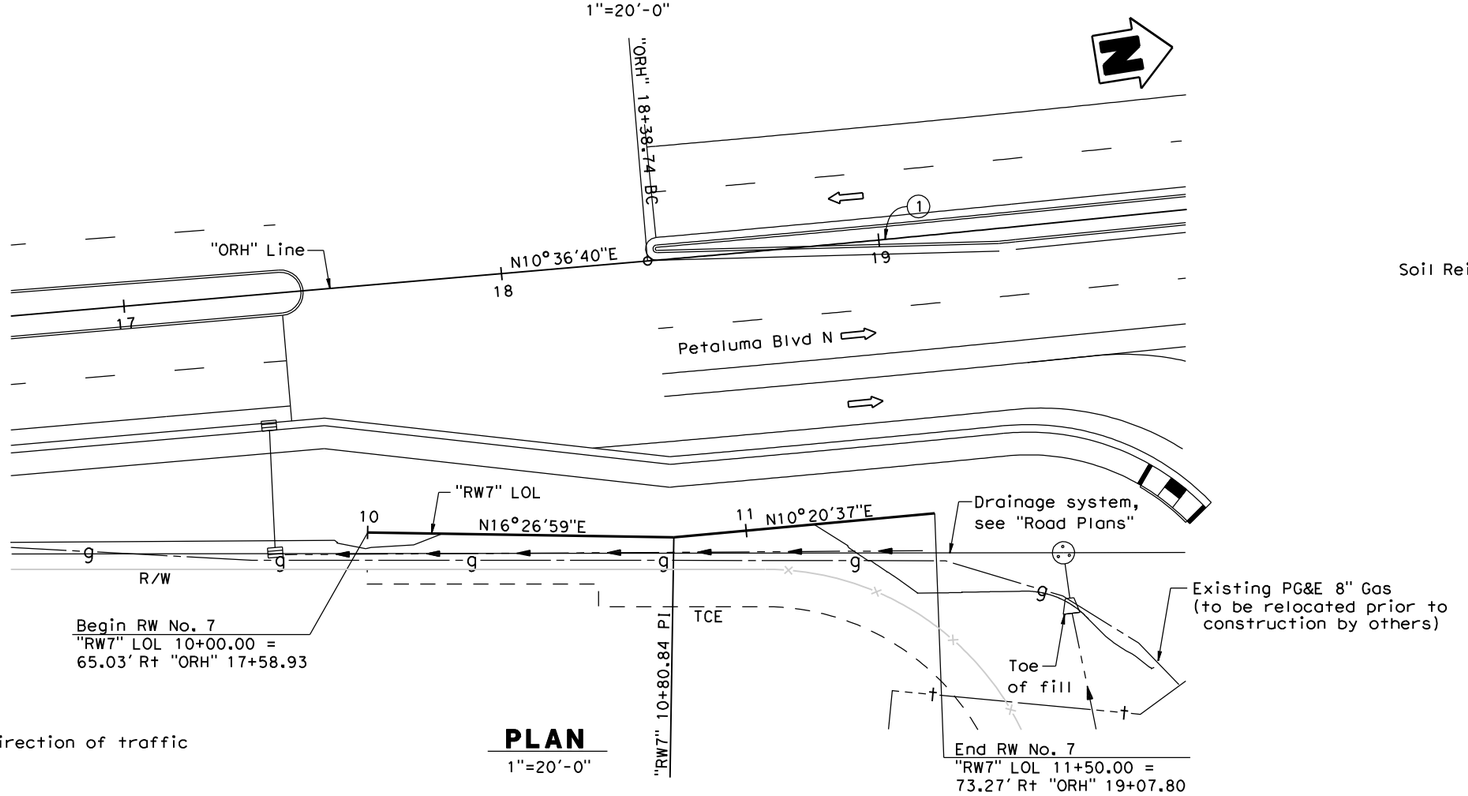


DEVELOPED ELEVATION

1"=20'-0"

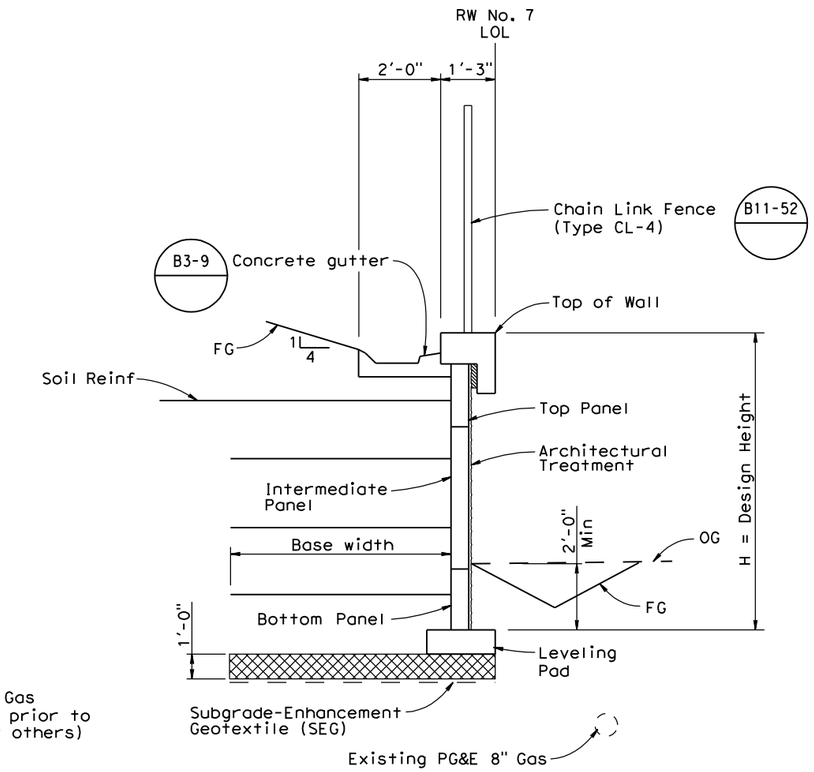
TOP OF WALL Elev

Sta	Elev
10+00	42.91
10+25	44.42
10+50	45.92
10+75	47.42
11+00	48.59
11+25	49.58
11+50	50.55



PLAN

1"=20'-0"



TYPICAL SECTION

NO SCALE

Denotes material below bottom of leveling pad to be removed and replaced with Class 2 aggregate base material

LEGEND:

Indicates direction of traffic

NOTES:

1. For MSE Wall details, see "Mechanically Stabilized Embankment Detail" sheets.
2. For layout of panels, see "Panel Layout" sheets.
3. For inspection wires, see "Miscellaneous Details" sheet.
4. The contractor shall verify controlling field dimensions before ordering or fabricating any materials.
5. For Architectural Treatment, see "Architectural Treatment Details" sheet.

CURVE DATA

No.	R	Δ	T	L
1	7,050.00'	0°47'18"	48.50'	97.00'

DESIGN OVERSIGHT	DESIGN	BY D. Anderson	CHECKED S. Landis		
	DETAILS	BY L. Davis	CHECKED S. Landis	LAYOUT BY D. Anderson	CHECKED
SIGN OFF DATE	QUANTITIES	BY	CHECKED	SPECIFICATIONS BY D. Harnagel	PLANS AND SPECS COMPARED

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Walt LaFranchi
PROJECT ENGINEER

BRIDGE NO.
POST MILES

RETAINING WALL No. 7
GENERAL PLAN

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV.7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE: 04000200041 CONTRACT NO.: 04-0A1854

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 02-08-10 05-21-10 09-16-10 SHEET 8 OF 27

FILE => RW-a-gp07.dgn

USERNAME => Lynette_D DATE PLOTTED => 5/3/2011 TIME PLOTTED => 10:07:50 AM

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO	TOTAL SHEETS
04	Son	101	7.4/8.1		

GEOTECHNICAL PROFESSIONAL DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER Stephen Huang No. C 42289 Exp. 03/31/12 GEOTECHNICAL STATE OF CALIFORNIA

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PETALUMA, CA 94954

URS CORPORATION
100 WEST SAN FERNANDO STREET, SUITE 200
SAN JOSE, CA 95113

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

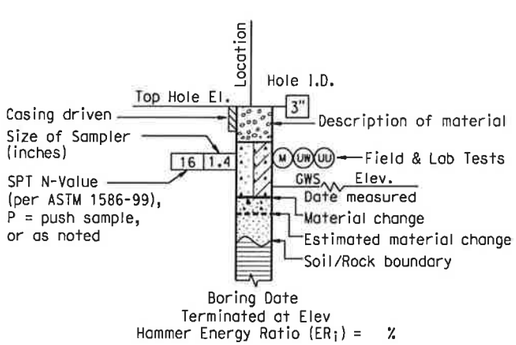
BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
⬚	O	Other

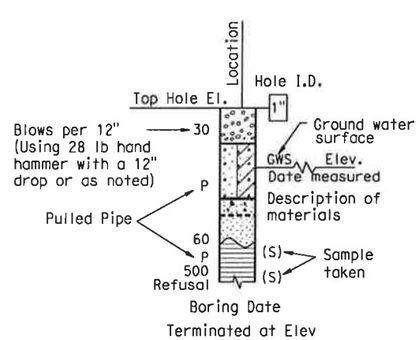
Note: Size in inches.

PLASTICITY OF FINE-GRAINED SOILS

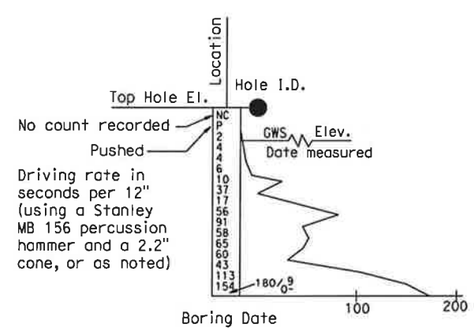
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



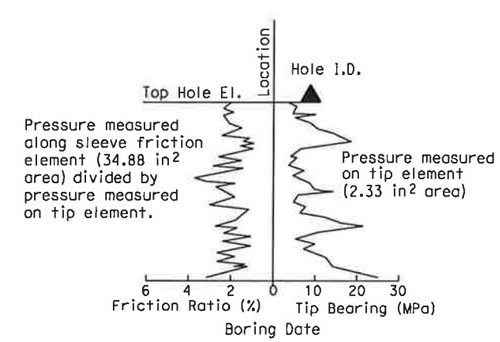
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

STEPHEN HUANG DESIGN OVERSIGHT	DRAWN BY A. CHEUNG	C. RAMBO FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	S. HUANG PROJECT ENGINEER	BRIDGE NO. N/A POST MILES N/A
SIGN OFF DATE	CHECKED BY M. THUMMALURU	DATE:			

SOIL LEGEND

RETAINING WALL No. 1 THRU No. 7

LOG OF TEST BORINGS 1 OF 9

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE:

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES

SHEET 15 OF

CONTRACT NO.: PROJECT ID:

FILE => ...\Submittal\RW-z-ltb01.dgn

USERNAME => mcdhu, THUMMALURU PLOTTED => 1/7/2011 TIME PLOTTED => 8:18:27 AM

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO	TOTAL SHEETS
04	Son	101	7.4/8.1		

GEOTECHNICAL PROFESSIONAL DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER Stephen Huang No. C 42289 Exp. 03/31/12 GEOTECHNICAL STATE OF CALIFORNIA

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APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N60 (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

SOIL LEGEND

RETAINING WALL No. 1 THRU No. 7

LOG OF TEST BORINGS 2 OF 9

STEPHEN HUANG
DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY A. CHEUNG
CHECKED BY M. THUMMALURU

C. RAMBO
FIELD INVESTIGATION BY:
DATE: N/A

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

S. HUANG
PROJECT ENGINEER

BRIDGE NO. N/A
POST MILES N/A

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE:

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES

SHEET 16 OF

FILE => ...\Submittal\RW-z-ltb02.dgn

CONTRACT NO.:

PROJECT ID:

USERNAME => mcohu, thummalu PLOTTED => 1/7/2011 TIME PLOTTED => 8:19:28 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101	7.4/8.1		

GEOTECHNICAL PROFESSIONAL DATE

REGISTERED PROFESSIONAL ENGINEER Stephen Huang No. C 42289 Exp. 03/31/12 GEOTECHNICAL STATE OF CALIFORNIA

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PETALUMA, CA 94954

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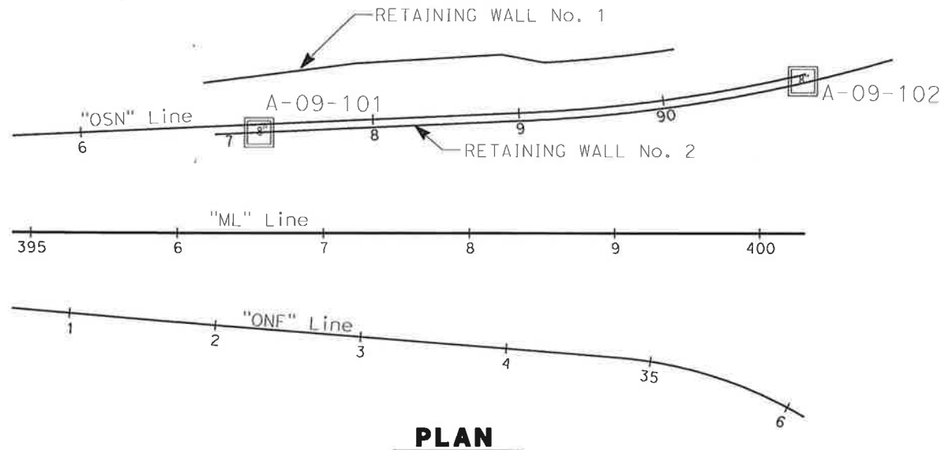
SAN JOSE, CA 95113

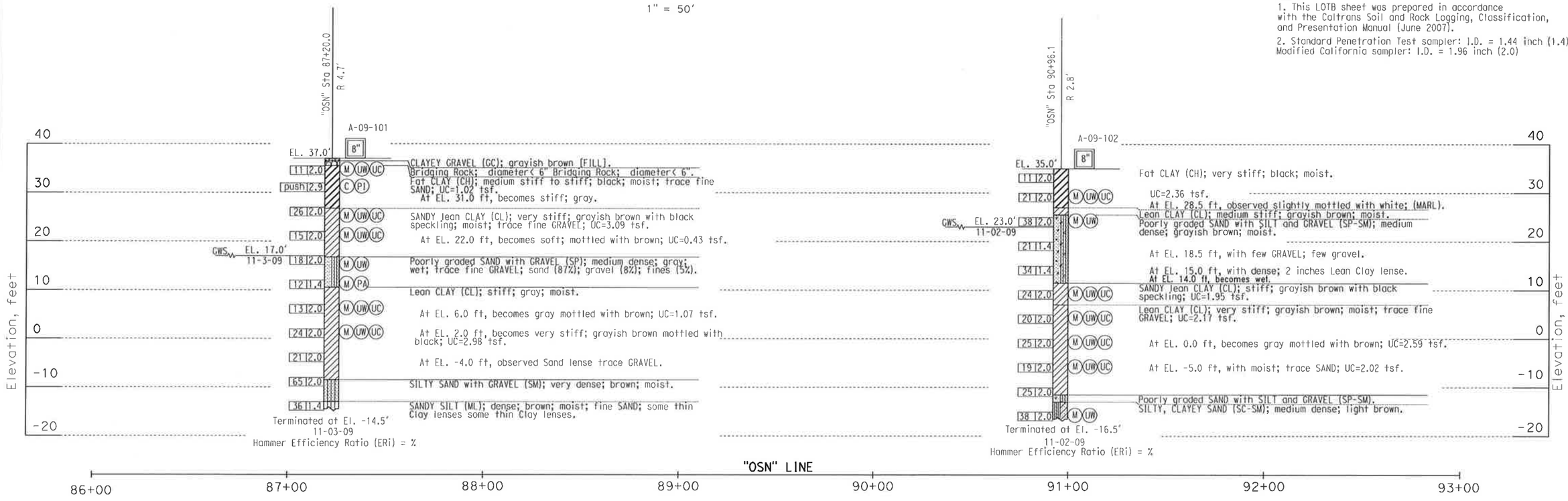


PLAN

1" = 50'

NOTE:

1. This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification, and Presentation Manual (June 2007).
2. Standard Penetration Test sampler: I.D. = 1.44 inch (1.4) Modified California sampler: I.D. = 1.96 inch (2.0)



PROFILE

Ver. 1" = 10'
Hor. 1" = 25'

STEPHEN HUANG DESIGN OVERSIGHT	DRAWN BY A. CHEUNG	C. RAMBO FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	S. HUANG PROJECT ENGINEER	BRIDGE NO. N/A	RETAINING WALL No. 1
SIGN OFF DATE	CHECKED BY M. THUMMALURU	DATE: 11/2/09 and 11/3/09			POST MILES N/A	LOG OF TEST BORINGS 3 OF 9

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE:

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES

SHEET OF

FILE => ...\Submittal\RW-2-ltb03.dgn

CONTRACT NO.:

PROJECT ID:

USERNAME => mathu_thu PLOTTED => 5/11/2011 TIME PLOTTED => 11:09:44 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101	7.4/8.1		

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PLANS APPROVAL DATE

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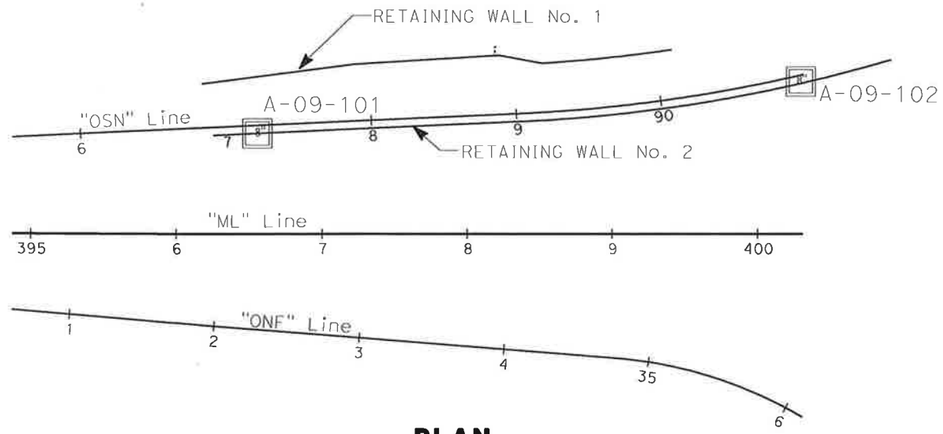
SAN JOSE, CA 95113

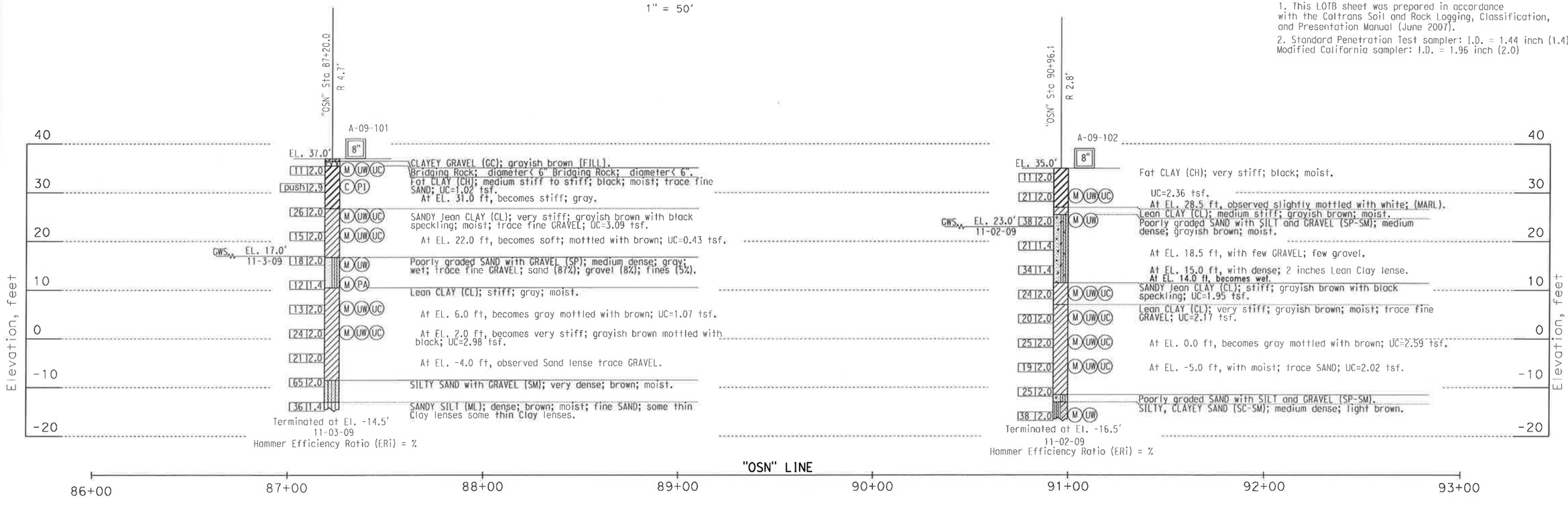


PLAN

1" = 50'

NOTE:

1. This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification, and Presentation Manual (June 2007).
2. Standard Penetration Test sampler: I.D. = 1.44 inch (1.4) Modified California sampler: I.D. = 1.96 inch (2.0)



PROFILE

Ver. 1" = 10'
Hor. 1" = 25'

STEPHEN HUANG DESIGN OVERSIGHT	DRAWN BY A. CHEUNG	C. RAMBO FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	S. HUANG PROJECT ENGINEER	BRIDGE NO. N/A
SIGN OFF DATE	CHECKED BY M. THUMMALURU	DATE: 11/2/09 and 11/3/09			POST MILES N/A

RETAINING WALL No. 2
LOG OF TEST BORINGS 4 OF 9

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE:

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES

SHEET OF

FILE => ...\Submittal\RW-2-ltb04.dgn

CONTRACT NO.:

PROJECT ID:

USERNAME => mathu_thumma@urs PLOTTED => 5/11/2011 TIME PLOTTED => 11:10:49 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101	7.4/8.1		

GEOTECHNICAL PROFESSIONAL DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER Stephen Huang No. C 42289 Exp. 03/31/12 GEOTECHNICAL STATE OF CALIFORNIA

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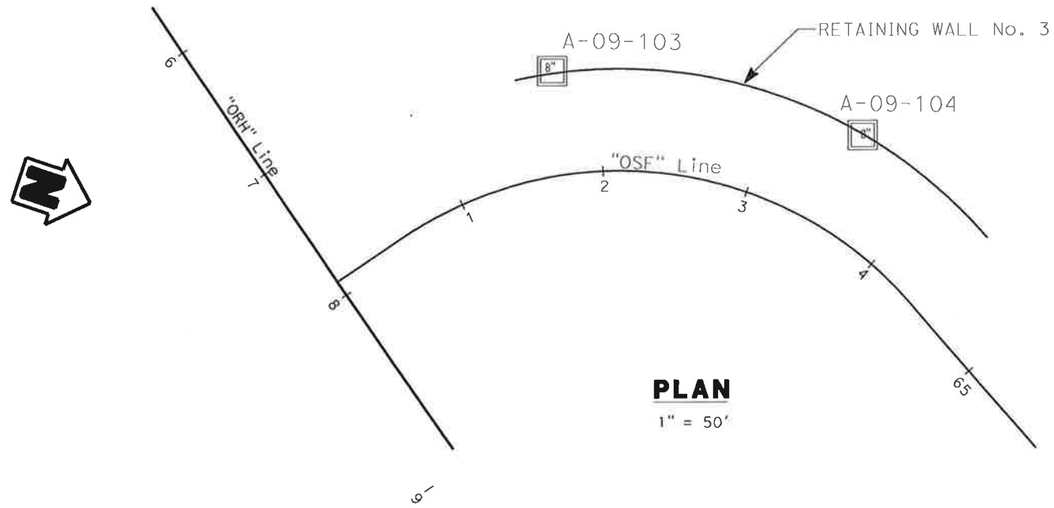
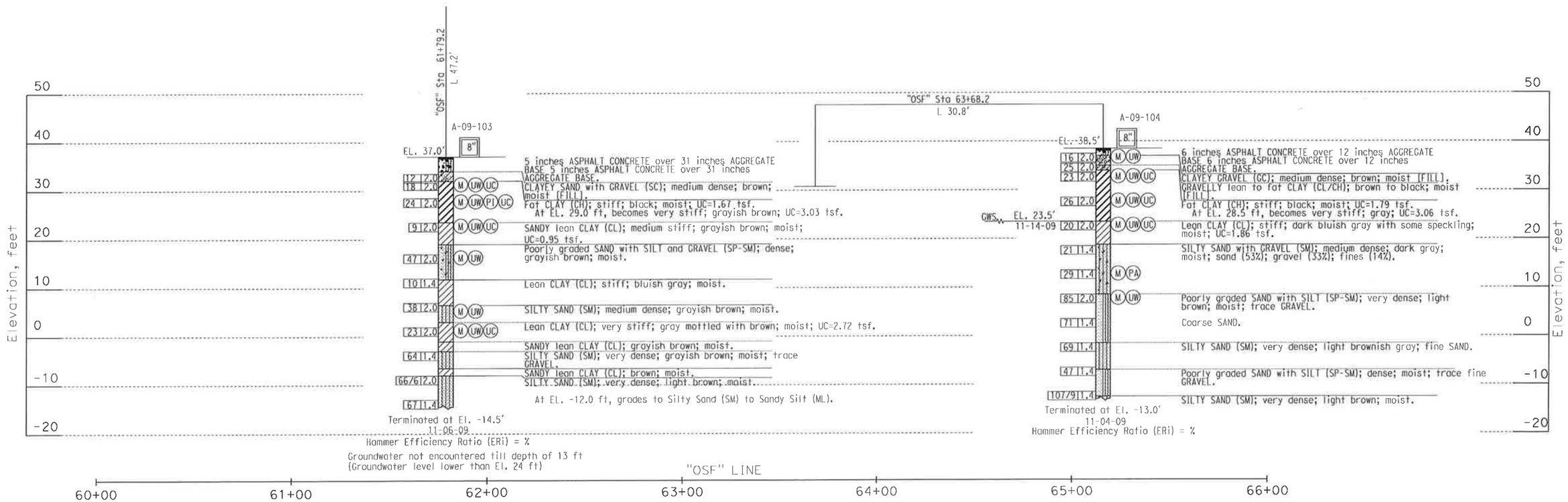
PETALUMA, CA 94954

URS CORPORATION
100 WEST SAN FERNANDO STREET, SUITE 200
SAN JOSE, CA 95113



PLAN
1" = 50'

NOTE:
1. This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification, and Presentation Manual (June 2007).
2. Groundwater was encountered in boring A-09-103, but elevation was not measured.
3. Standard Penetration Test sampler: I.D. = 1.44 inch (1.4)
Modified California sampler: I.D. = 1.96 inch (2.0)



PROFILE
Ver. 1" = 10'
Hor. 1" = 25'

STEPHEN HUANG DESIGN OVERSIGHT	DRAWN BY	A. CHEUNG	C. RAMBO FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	S. HUANG PROJECT ENGINEER
SIGN OFF DATE	CHECKED BY	M. THUMMALURU	DATE: 11/4/09 and 11/6/09		

BRIDGE NO. N/A
POST MILES N/A

RETAINING WALL No. 3
LOG OF TEST BORINGS 5 OF 9

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE:

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES | SHEET | OF

FILE => ...\Submittal\RW-z-ltb05.dgn

CONTRACT NO.: PROJECT ID:

USERNAME => mdthu, thu@dot.ca.gov PLOTTED => 5/11/2011 TIME PLOTTED => 11:12:21 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101	7.4/8.1		

GEOTECHNICAL PROFESSIONAL DATE

REGISTERED PROFESSIONAL ENGINEER Stephen Huang No. C 42289 Exp. 03/31/12 GEOTECHNICAL STATE OF CALIFORNIA

PLANS APPROVAL DATE

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PETALUMA, CA 94954

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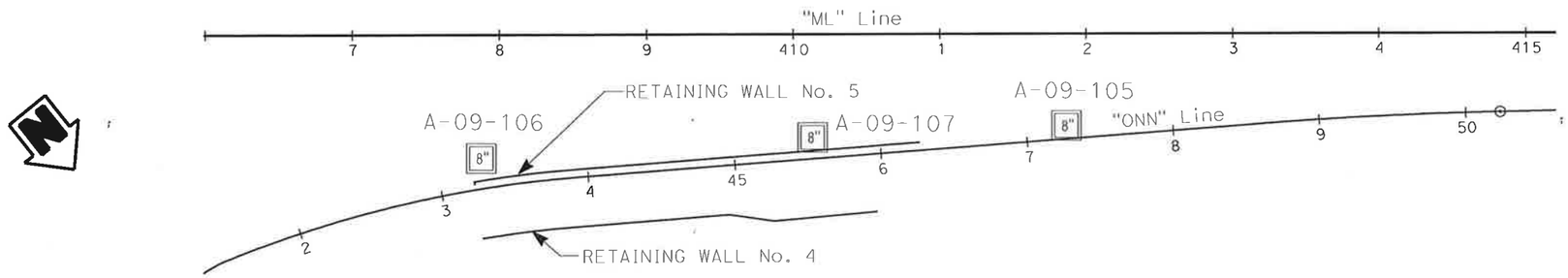
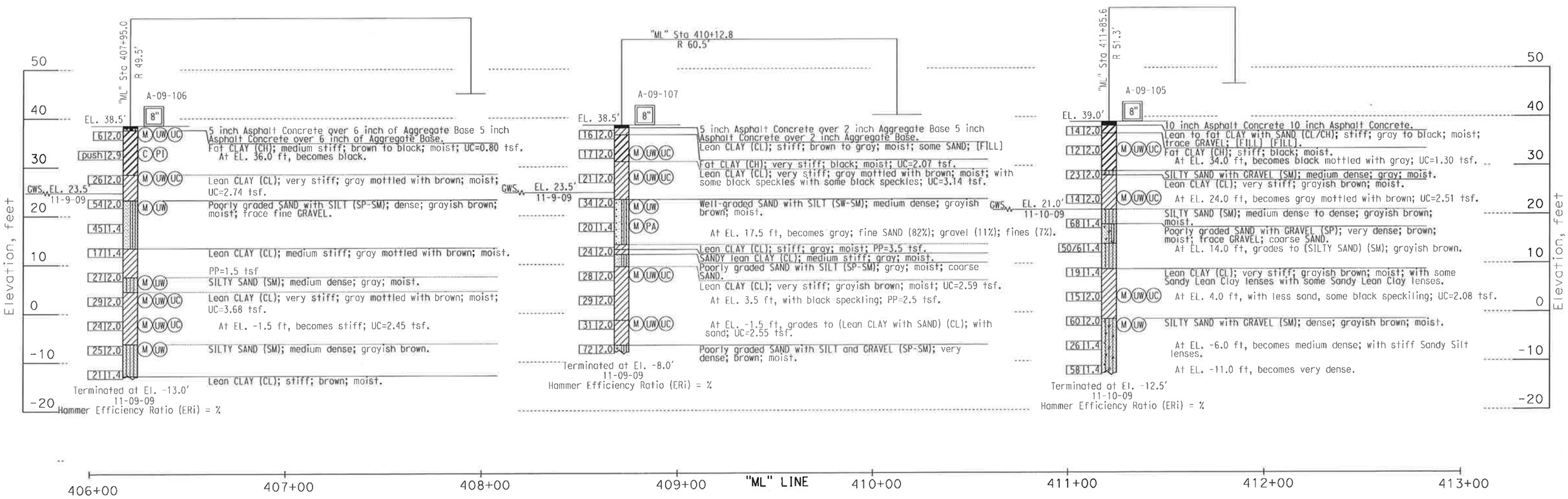
100 WEST SAN FERNANDO STREET, SUITE 200
SAN JOSE, CA 95113



PLAN

1" = 50'

NOTE:
1. This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification, and Presentation Manual (June 2007).
2. Standard Penetration Test sampler: I.D. = 1.44 inch (1.4)
Modified California sampler: I.D. = 1.96 inch (2.0)



PROFILE

Ver. 1" = 10'
Hor. 1" = 25'

STEPHEN HUANG, DESIGN OVERSIGHT	DRAWN BY: A. CHEUNG	C. RAMBO, FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	S. HUANG, PROJECT ENGINEER	BRIDGE NO. N/A
SIGN OFF DATE	CHECKED BY: M. THUMMALURU	DATE: 11/9/09 and 11/10/09			POST MILES N/A

RETAINING WALL No. 4

LOG OF TEST BORINGS 6 OF 9

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE:

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES | SHEET | OF

FILE => ...\Submittal\RW-7-Lth06.dgn

CONTRACT NO.: PROJECT ID:

USERNAME => mdthu TIME PLOTTED => 11:14:28 AM DATE PLOTTED => 5/11/2011

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101	7.4/8.1		

GEOTECHNICAL PROFESSIONAL DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER Stephen Huang No. C 42289 Exp. 03/31/12 GEOTECHNICAL STATE OF CALIFORNIA

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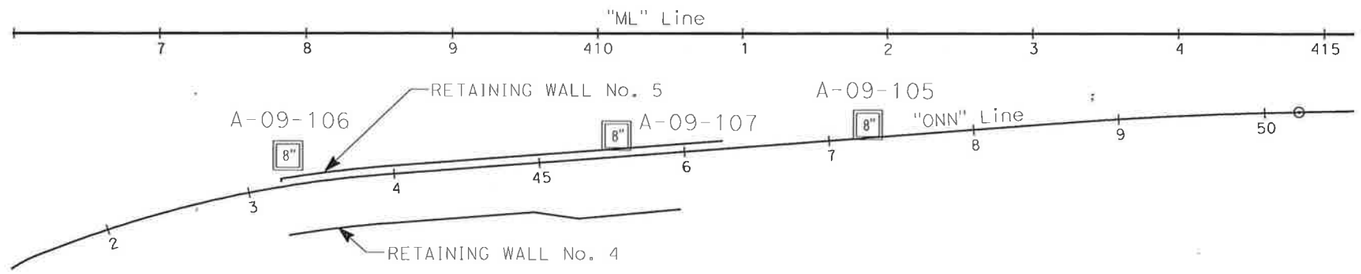
11 ENGLISH STREET
PETALUMA, CA 94954

URS CORPORATION
100 WEST SAN FERNANDO STREET, SUITE 200
SAN JOSE, CA 95113



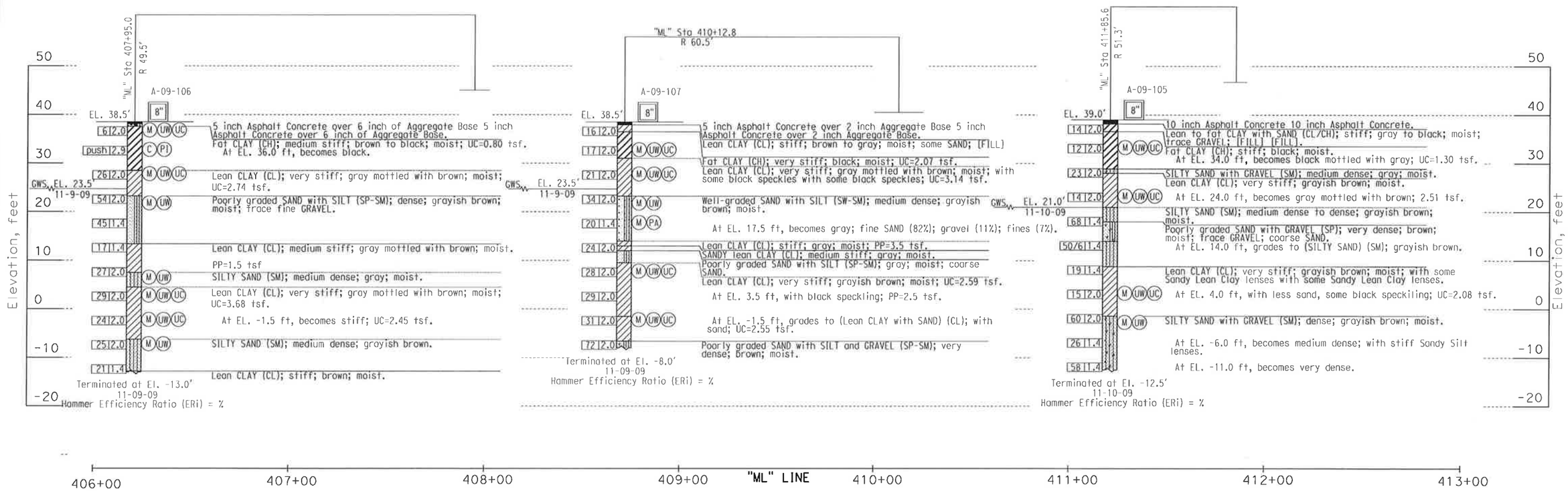
PLAN

1" = 50'

NOTE:

1. This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification, and Presentation Manual (June 2007).

2. Standard Penetration Test sampler: I.D. = 1.44 inch (1.4)
Modified California sampler: I.D. = 1.96 inch (2.0)



PROFILE

Ver. 1" = 10'
Hor. 1" = 25'

STEPHEN HUANG DESIGN OVERSIGHT	DRAWN BY A. CHEUNG	C. RAMBO FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	S. HUANG PROJECT ENGINEER	BRIDGE NO. N/A
SIGN OFF DATE	CHECKED BY M. THUMMALURU	DATE: 11/9/09 and 11/10/09			POST MILES N/A

RETAINING WALL No. 5

LOG OF TEST BORINGS 7 OF 9

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE:

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES | SHEET | OF

FILE => ...\Submittal\RW-2-ltb07.dgn

CONTRACT NO.: PROJECT ID:

USERNAME => mdhu_thummaru PLOTTED => 5/11/2011 TIME PLOTTED => 11:15:27 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101	7.4/8.1		

GEOTECHNICAL PROFESSIONAL DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER Stephen Huang No. C 42289 Exp. 03/31/12 GEOTECHNICAL STATE OF CALIFORNIA

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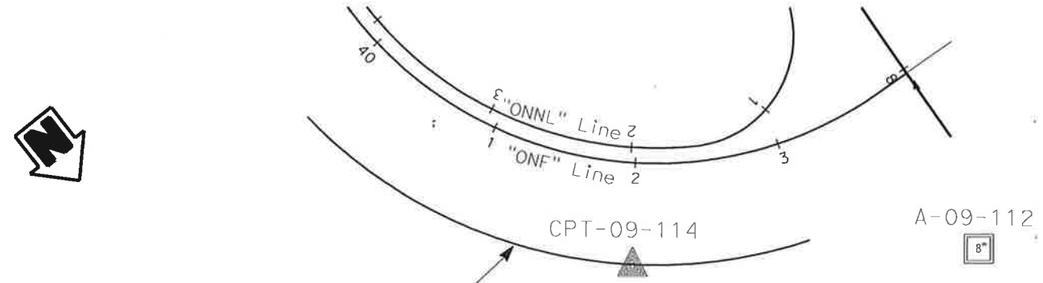
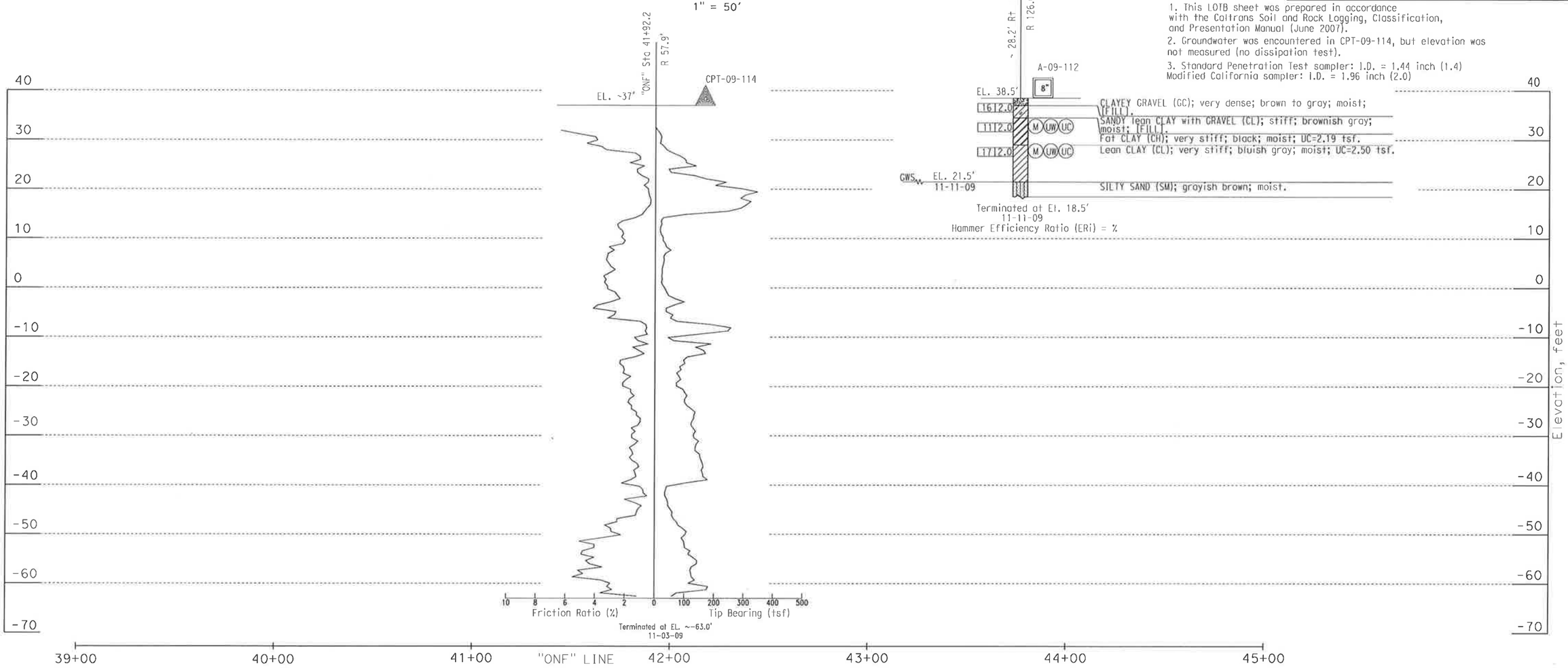
PETALUMA, CA 94954

URS CORPORATION
100 WEST SAN FERNANDO STREET, SUITE 200
SAN JOSE, CA 95113



PLAN
1" = 50'

NOTE:
1. This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification, and Presentation Manual (June 2007).
2. Groundwater was encountered in CPT-09-114, but elevation was not measured (no dissipation test).
3. Standard Penetration Test sampler: I.D. = 1.44 inch (1.4)
Modified California sampler: I.D. = 1.96 inch (2.0)



PROFILE
Ver. 1" = 10'
Hor. 1" = 25'

STEPHEN HUANG DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: A. CHEUNG CHECKED BY: M. THUMMALURU	C. RAMBO FIELD INVESTIGATION BY: DATE: 11/3/09 and 11/11/09	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	S. HUANG PROJECT ENGINEER	BRIDGE NO. N/A POST MILES N/A

RETAINING WALL No. 6
LOG OF TEST BORINGS 8 OF 9

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE:

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES

SHEET 22 OF

FILE => ...\Submittal\RW-z-11b08.dgn

CONTRACT NO.:

PROJECT ID:

USERNAME => madhu_thummaluru PLOTTED => 5/11/2011 TIME PLOTTED => 11:16:15 AM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101	7.4/8.1		

GEOTECHNICAL PROFESSIONAL DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER Stephen Huang No. C 42289 Exp. 03/31/12 GEOTECHNICAL STATE OF CALIFORNIA

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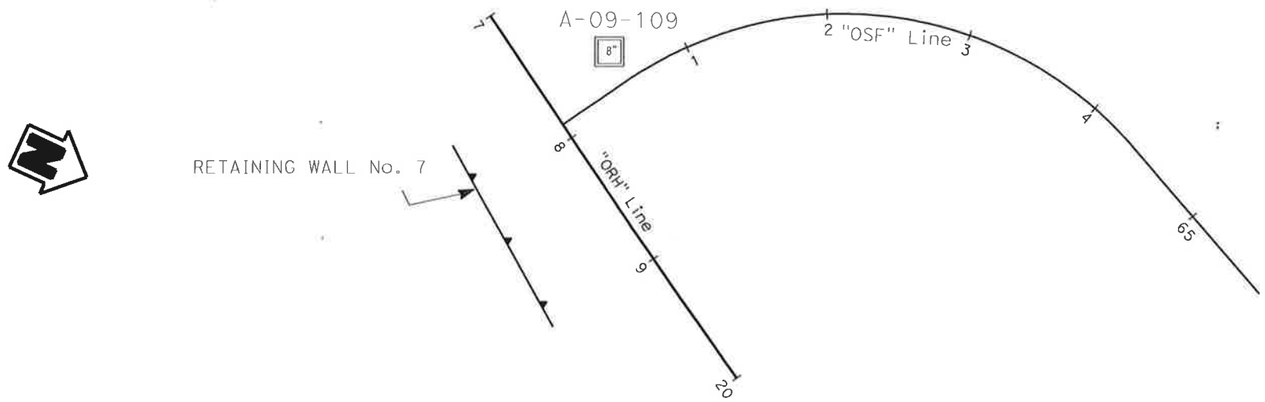
PETALUMA, CA 94954

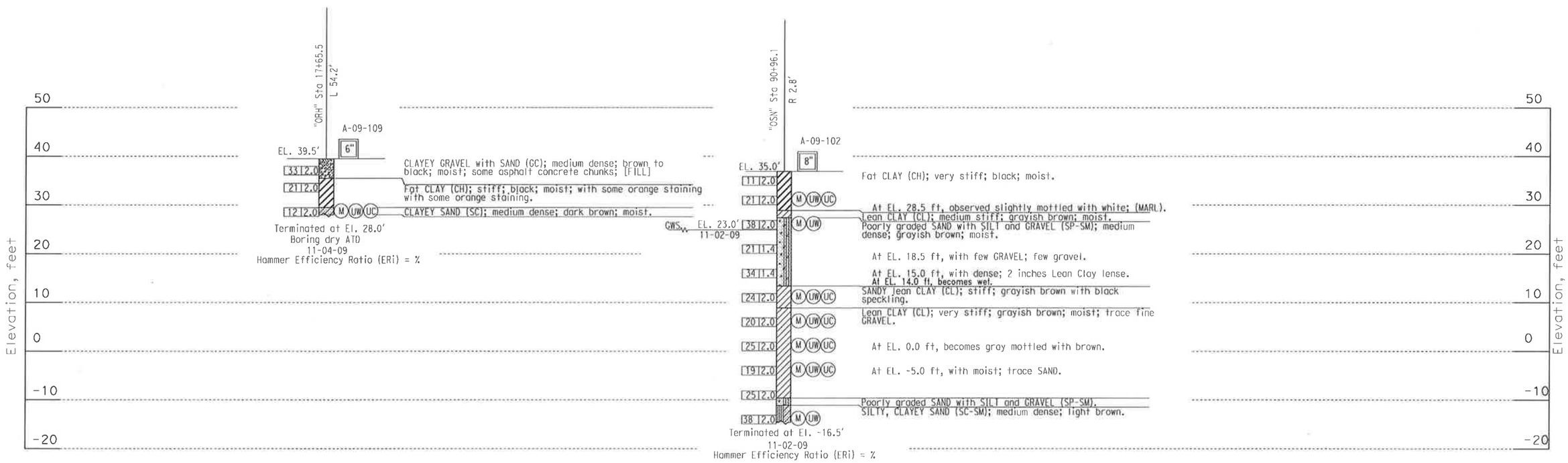
URS CORPORATION
100 WEST SAN FERNANDO STREET, SUITE 200
SAN JOSE, CA 95113

NOTE:
1. This log was prepared in accordance with the Caltrans Soil and Rock Logging, Classification, and Presentation Manual (June 2007).
2. Standard Penetration Test sampler: I.D. = 1.44 inch (1.4)
Modified California sampler: I.D. = 1.96 inch (2.0)



A-09-102
8"

PLAN
1" = 50'



PROFILE
Ver. 1" = 10'
Hor. 1" = 25'

STEPHEN HUANG DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY A. CHEUNG CHECKED BY M. THUMMALURU	C. RAMBO FIELD INVESTIGATION BY: DATE:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	S. HUANG PROJECT ENGINEER	BRIDGE NO. N/A POST MILES N/A

RETAINING WALL No. 7
LOG OF TEST BORINGS (9 OF 9)

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE:

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES | SHEET | OF

FILE => ...\Submittal\RW-z-ltb09.dgn

CONTRACT NO.: PROJECT ID:

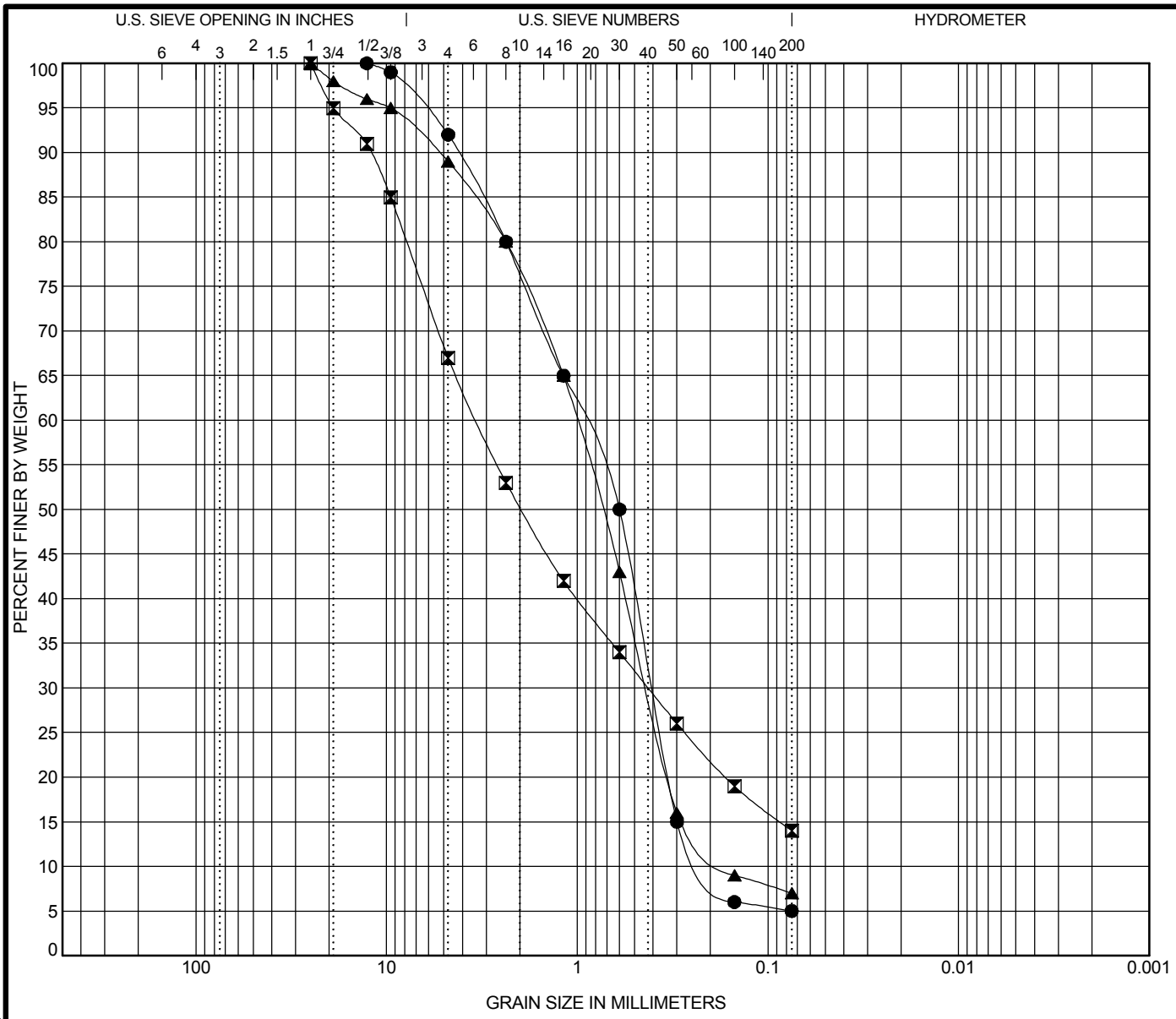
USERNAME => mochu_thummaluru PLOTTED => 5/11/2011 TIME PLOTTED => 11:23:58 AM

TABLE C-1
SUMMARY OF LABORATORY TEST RESULTS

						Sieve Analysis Results (Percent Passing)													Atterberg Limits				In-Place Conditions	
Boring or Sample No.	Date Sampled	Station	Line	Distance from Line (feet)	Depth (feet)	%<1.5-in	%<1-in	%<3/4-in	%<1/2-in	%<3/8-in	%<#4	%<#8	%<#16	%<#30	%<#50	%<#100	%<#200	R-value	Liquid Limit	Plastic Limit	Plasticity Index	Unconfined Compressive Strength (psf)	Water Content (%)	Dry Unit Weight (pcf)
A-09-101	11/3/2009	87+20.0	"OSN"	Rt. 4.7	1.5																	2030	36.4	82
A-09-101	11/3/2009	87+20.0	"OSN"	Rt. 4.7	5.0														79	37	42			
A-09-101	11/3/2009	87+20.0	"OSN"	Rt. 4.7	11.0																	6170	17.3	114
A-09-101	11/3/2009	87+20.0	"OSN"	Rt. 4.7	15.0																	860	21.3	105
A-09-101	11/3/2009	87+20.0	"OSN"	Rt. 4.7	21.0																		16	111
A-09-101	11/3/2009	87+20.0	"OSN"	Rt. 4.7	25.0				100	99	92	80	65	50	15	6	5						16.6	
A-09-101	11/3/2009	87+20.0	"OSN"	Rt. 4.7	30.0																	2140	28.3	93
A-09-101	11/3/2009	87+20.0	"OSN"	Rt. 4.7	35.0																	5960	26.6	98
A-09-102	10/2/2009	90+96.1	"OSN"	Rt. 2.8	5.0																	4710	32.6	88
A-09-102	10/2/2009	90+96.1	"OSN"	Rt. 2.8	10.0																		12.2	119
A-09-102	10/2/2009	90+96.1	"OSN"	Rt. 2.8	25.0																	3890	19.6	109
A-09-102	10/2/2009	90+96.1	"OSN"	Rt. 2.8	30.0																	4340	22.6	104
A-09-102	10/2/2009	90+96.1	"OSN"	Rt. 2.8	35.0																	5180	23	104
A-09-102	10/2/2009	90+96.1	"OSN"	Rt. 2.8	40.0																	4040	25.6	101
A-09-102	10/2/2009	90+96.1	"OSN"	Rt. 2.8	50.0																		22.6	102
A-09-103	11/6/2009	61+79.2	"OSF"	Lt. 47.2	5.0																	3330	38.7	80
A-09-103	11/6/2009	61+79.2	"OSF"	Lt. 47.2	8.5														57	19	38	6050	26.6	98
A-09-103	11/6/2009	61+79.2	"OSF"	Lt. 47.2	13.5																	1890	24.5	100
A-09-103	11/6/2009	61+79.2	"OSF"	Lt. 47.2	20.0																		12.5	118
A-09-103	11/6/2009	61+79.2	"OSF"	Lt. 47.2	31.0																		13.9	116
A-09-103	11/6/2009	61+79.2	"OSF"	Lt. 47.2	35.0																	5440	24.2	103
A-09-104	11/4/2009	63+68.2	"OSF"	Lt. 30.8	1.0																		11	97
A-09-104	11/4/2009	63+68.2	"OSF"	Lt. 30.8	5.0																	3580	38.5	79
A-09-104	11/4/2009	63+68.2	"OSF"	Lt. 30.8	10.0																	6120	27.1	96
A-09-104	11/4/2009	63+68.2	"OSF"	Lt. 30.8	15.0																	3710	22.6	104
A-09-104	11/4/2009	63+68.2	"OSF"	Lt. 30.8	25.0			95	91	85	67	53	42	34	26	19	14						15.4	
A-09-104	11/4/2009	63+68.2	"OSF"	Lt. 30.8	30.0																		15.3	108
A-09-105	11/10/2009	411+85.6	"ML"	Rt. 51.3	5.0																	2600	32.8	85
A-09-105	11/10/2009	411+85.6	"ML"	Rt. 51.3	15.0																	5020	23	104
A-09-105	11/10/2009	411+85.6	"ML"	Rt. 51.3	35.0																	4150	24.9	100
A-09-105	11/10/2009	411+85.6	"ML"	Rt. 51.3	41.0																		9.7	132
A-09-106	11/9/2009	407+95.0	"ML"	Rt. 49.5	1.0																	1600	38.2	80
A-09-106	11/9/2009	407+95.0	"ML"	Rt. 49.5	5.0														82	32	50			
A-09-106	11/9/2009	407+95.0	"ML"	Rt. 49.5	10.0																	5470	22	103

TABLE C-1
SUMMARY OF LABORATORY TEST RESULTS

						Sieve Analysis Results (Percent Passing)													Atterberg Limits				In-Place Conditions	
Boring or Sample No.	Date Sampled	Station	Line	Distance from Line (feet)	Depth (feet)	%<1.5-in	%<1-in	%<3/4-in	%<1/2-in	%<3/8-in	%<#4	%<#8	%<#16	%<#30	%<#50	%<#100	%<#200	R-value	Liquid Limit	Plastic Limit	Plasticity Index	Unconfined Compressive Strength (psf)	Water Content (%)	Dry Unit Weight (pcf)
A-09-106	11/9/2009	407+95.0	"ML"	Rt. 49.5	16.0																		19	104
A-09-106	11/9/2009	407+95.0	"ML"	Rt. 49.5	31.3																		16.5	113
A-09-106	11/9/2009	407+95.0	"ML"	Rt. 49.5	35.0																	7360	20.5	107
A-09-106	11/9/2009	407+95.0	"ML"	Rt. 49.5	40.0																	4890	25	100
A-09-106	11/9/2009	407+95.0	"ML"	Rt. 49.5	45.0																		23.2	97
A-09-107	11/9/2009	410+12.8	"ML"	Rt. 60.5	5.0																	4130	34.3	85
A-09-107	11/9/2009	410+12.8	"ML"	Rt. 60.5	10.0																	6270	22.1	102
A-09-107	11/9/2009	410+12.8	"ML"	Rt. 60.5	16.0																		22.5	96
A-09-107	11/9/2009	410+12.8	"ML"	Rt. 60.5	20.0			98	96	95	89	80	65	43	16	9	7						18.6	
A-09-107	11/9/2009	410+12.8	"ML"	Rt. 60.5	30.0																	5170	17.9	114
A-09-107	11/9/2009	410+12.8	"ML"	Rt. 60.5	40.0																	5090	21.1	107



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**A-09-101**	**25.0**	**Poorly graded SAND with SILT**				**0.85**	**4.61**
⊠	**A-09-104**	**25.0**	**CLAYEY SAND with GRAVEL**					
▲	**A-09-107**	**20.0**	**Well-graded SAND with SILT**				**1.10**	**6.11**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**A-09-101**	**25.0**	**12.7**	**0.942**	**0.404**	**0.204**	**8.0**	**87.0**	**5.0**	
⊠	**A-09-104**	**25.0**	**25**	**3.348**	**0.424**		**33.0**	**53.0**	**14.0**	
▲	**A-09-107**	**20.0**	**25**	**1.012**	**0.43**	**0.166**	**11.0**	**82.0**	**7.0**	

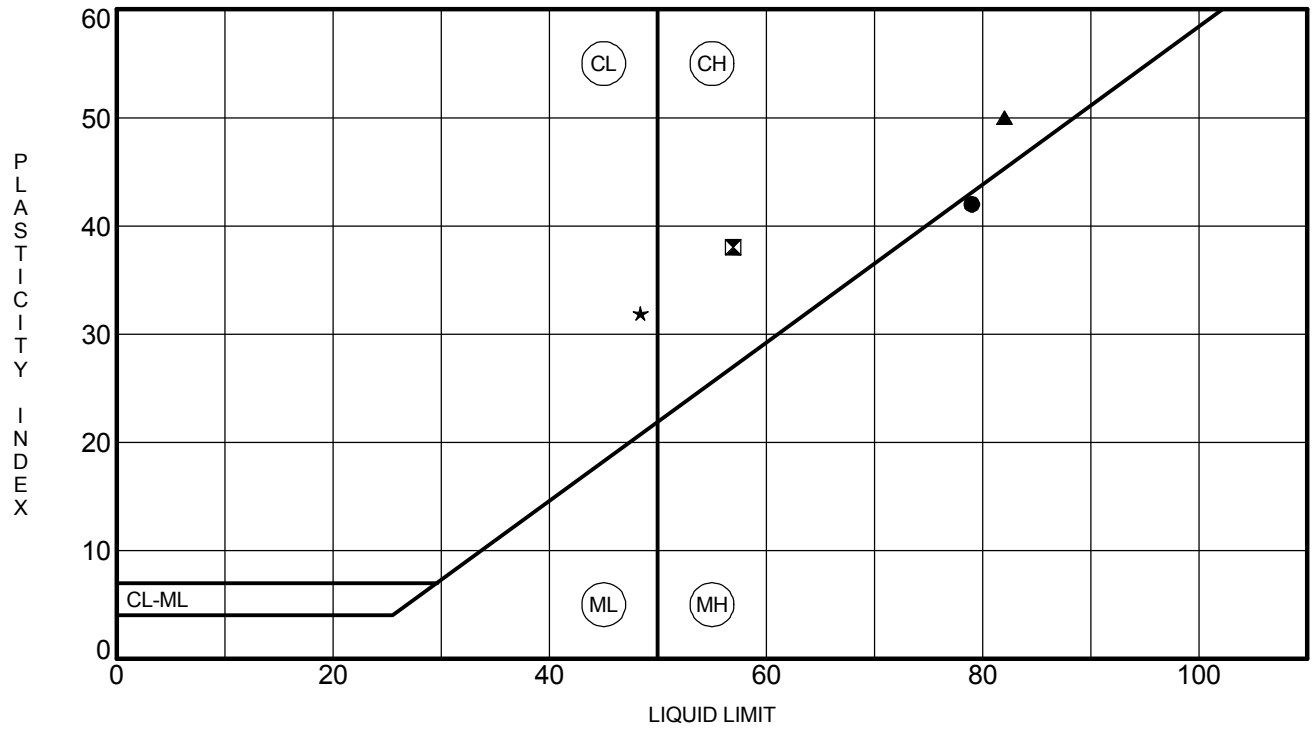
URS

55 S. Market St, Ste 1500
San Jose, CA 95113

GRAIN SIZE DISTRIBUTION

Project Name: Old Redwood Highway Intechange (28645097)
Location: Sonoma 101 7.4/8.1
Number: 12276K

URS GRAIN SIZE 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ CT.GLB 1/27/10



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**A-09-101**	**5.0**	**79**	**37**	**42**		**Fat CLAY**
⊠	**A-09-103**	**8.5**	**57**	**19**	**38**		**Fat CLAY**
▲	**A-09-106**	**5.0**	**82**	**32**	**50**		**Fat CLAY**
★	**R-09-001**	**20.0**	**48**	**16**	**32**		**Lean CLAY**

URS

55 S. Market St, Ste 1500
San Jose, CA 95113

ATTERBERG LIMITS' RESULTS

Project Name: Old Redwood Highway Intechange (28645097)
Location: Sonoma 101 7.4/8.1
Number: 12276K

URS ATTERBERG LIMITS 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

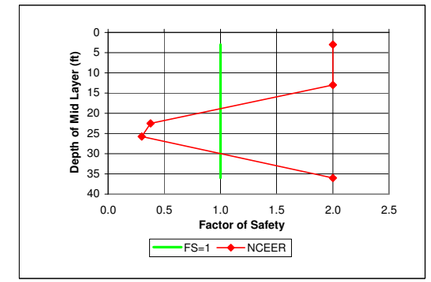
LIQUEFACTION ANALYSIS

Project	Replacement of Old Redwood Highway
Project No.	28645097
Boring No.	A-09-101

PGA =	0.54	
M_w =	7.1	
Ground Water	4.0	ft
Sampler:	Symbol	Corr. Factor
SPT	S	1
Mod.Cal	M	0.8
California	C	0.7
Mag. Weighting Factor($CSR_M/CSR_{M=7.5}$)		0.85

Note: Cells in Red must be input

Hammer type :	Type		C_E	Code	C_E
	Donut		0.75	1	2
	Safety		1	2	
	Auto		1.33	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		σ_o	EQ u	EQ σ'_o	r_d	EQ CSR	N raw	Sampler	N SPT	Fines Content	C_{fines}	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						%		EQ					during EQ	Critical						NCEER	NCEER	
1	CH	110	6.0	1.83	3	0.91	330	0	330	0.995	0.349						2.00	1.00	1.15	0.75	1.00			1.15	1.20	1.17	1.000	Y	2.00	N	1
2	CL	115	20.0	6.10	13.0	3.96	1,465	562	903	0.973	0.554						1.32	1.00	1.15	0.75	1.00			1.15	1.20	1.17	1.000	N	2.00	N	1
3	SP-SM	125	25.0	7.62	22.5	6.86	2,583	1,154	1,428	0.950	0.603	18	M	14.4	5	1.03	1.10	1.00	1.15	0.95	1.00	18	0.194	1.15	1.20	1.17	1.000	N	0.38	Liquef	1
4	SP-SM	125	26.5	8.08	25.8	7.85	2,989	1,357	1,632	0.939	0.604	12	S	12	5	1.04	1.04	1.00	1.15	0.95	1.00	14	0.154	1.15	1.20	1.17	1.000	N	0.30	Liquef	1
5	CL	115	45.5	13.87	36.0	10.97	4,175	1,997	2,178	0.883	0.594						0.92	1.00	1.15	1.00	1.00			1.15	1.20	1.17	0.994	N	2.00	N	1
6	SM	125	50.0	15.24	47.8	14.55	5,549	2,730	2,819	0.776	0.536	65	M	52	15	1.08	0.82	1.00	1.15	1.00	1.00	53	0.459	1.15	1.20	1.17	0.956	N	2.00	N	1
7	ML	125	51.5	15.70	50.8	15.47	5,924	2,917	3,007	0.745	0.515	36	S	36	55	1.19	0.80	1.00	1.15	1.00	1.00	39	0.459	1.15	1.20	1.17	0.945	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	6.0	6.0	330	0	330	0.995		N	115.2	0.349	0.30				0.00
2	20.0	14.0	1,465	562	903	0.973		N	500.2	0.554	0.47				0.00
3	25.0	5.0	2,583	1,154	1,428	0.950	17.9	Liquef	861.1	0.603	0.51		1.7		1.02
4	26.5	1.5	2,989	1,357	1,632	0.939	14.2	Liquef	985.2	0.604	0.51		1.9		0.34
5	45.5	19.0	4,175	1,997	2,178	0.883		N	1294.6	0.594	0.51				0.00
6	50.0	4.5	5,549	2,730	2,819	0.776	52.9	N	1510.8	0.536	0.46				0.00
7	51.5	1.5	5,924	2,917	3,007	0.745	39.4	N	1549.2	0.515	0.44				0.00

Total Settlement (inch) = 1.36

* 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.

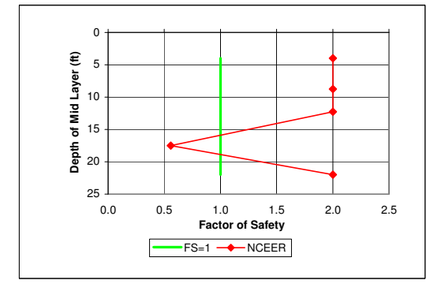
LIQUEFACTION ANALYSIS

Project	Replacement of Old Redwood Highway
Project No.	28645097
Boring No.	A-09-102

PGA =	0.54	
M_w =	7.1	
GWT during EQ	2.0	ft
Sampler:	Symbol	Corr. Factor
SPT	S	1
Mod.Cal	M	0.8
California	C	0.7
Mag. Weighting Factor($CSR_M/CSR_{M=7.5}$)		0.85

Note: Cells in Red must be input

Hammer type :	Type		C_E	Code	C_E
	Donut		0.75	1	2
	Safety		1	2	
	Auto		1.33	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		σ_o	EQ u	EQ σ'_o	r_d	EQ CSR	N raw	Sampler	N SPT	Fines Content	C_{fines}	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						%		EQ					during EQ	Critical						NCEER	NCEER	
1	CH	115	8.0	2.44	4	1.22	460	125	335	0.993	0.478						2.00	1.00	1.15	0.75	1.00			1.15	1.20	1.17	1.000	N	2.00	N	1
2	CL	115	9.5	2.90	8.8	2.67	1,006	421	585	0.982	0.593						1.54	1.00	1.15	0.75	1.00			1.15	1.20	1.17	1.000	N	2.00	N	1
3	SP-SM	130	15.0	4.57	12.3	3.73	1,450	640	810	0.974	0.612	38	M	30.4	7	1.04	1.37	1.00	1.15	0.75	1.00	37	0.459	1.15	1.20	1.17	1.000	N	2.00	N	1
4	SP-SM	125	20.0	6.10	17.5	5.33	2,120	967	1,153	0.963	0.622	21	S	21	7	1.04	1.20	1.00	1.15	0.85	1.00	26	0.295	1.15	1.20	1.17	1.000	N	0.56	Liquef	1
5	SP-SM	130	24.0	7.32	22.0	6.71	2,693	1,248	1,445	0.951	0.622	34	S	34	7	1.04	1.10	1.00	1.15	0.95	1.00	42	0.459	1.15	1.20	1.17	1.000	N	2.00	N	1
6	CL	125	46.5	14.17	35.3	10.74	4,359	2,075	2,284	0.889	0.595						0.90	1.00	1.15	1.00	1.00			1.15	1.20	1.17	0.988	N	2.00	N	1
7	SP-SM	125	51.5	15.70	49.0	14.94	6,078	2,933	3,145	0.763	0.518	38	S	38	7	1.04	0.78	1.00	1.15	1.00	1.00	35	0.459	1.15	1.20	1.17	0.938	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	8.0	8.0	460	125	335	0.993		N	160.3	0.478	0.41				0.00
2	9.5	1.5	1,006	421	585	0.982		N	346.8	0.593	0.50				0.00
3	15.0	5.5	1,450	640	810	0.974	37.4	N	495.9	0.612	0.52				0.00
4	20.0	5.0	2,120	967	1,153	0.963	25.7	Liquef	716.6	0.622	0.53		1.3		0.78
5	24.0	4.0	2,693	1,248	1,445	0.951	42.3	N	899.2	0.622	0.53				0.00
6	46.5	22.5	4,359	2,075	2,284	0.889		N	1359.9	0.595	0.51				0.00
7	51.5	5.0	6,078	2,933	3,145	0.763	35.5	N	1627.5	0.518	0.44				0.00

Total Settlement (inch) = 0.78

* 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.

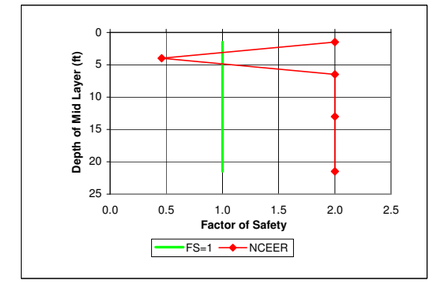
LIQUEFACTION ANALYSIS

Project	Replacement of Old Redwood Highway
Project No.	28645097
Boring No.	A-09-103

PGA =	0.54	
M_w =	7.1	
Ground Water	1.0	ft
Sampler:	Symbol	Corr. Factor
SPT	S	1
Mod.Cal	M	0.8
California	C	0.7
Mag. Weighting Factor($CSR_M/CSR_{M=7.5}$)		0.85

Note: Cells in Red must be input

Hammer type :	Type		C_E	Code	C_E
	Donut		0.75	1	2
	Safety		1	2	
	Auto		1.33	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	C_{fines}	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60-cs}$	$CRR^*_{7.5,1tsf}$	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						%		EQ					during EQ	Critical	Lower	Upper	Middle			NCEER	NCEER	
1	AC	140	3.0	0.91	1.5	0.46	210	31	179	0.998	0.412						2.00	1.00	1.15	0.75	1.00			1.15	1.20	1.17	1.000	N	2.00	N	1
2	SC	120	5.0	1.52	4.0	1.22	540	187	353	0.993	0.533	12	M	9.6	25	1.18	1.98	1.00	1.15	0.75	1.00	19	0.208	1.15	1.20	1.17	1.000	N	0.46	Liquef	1
3	CH	110	8.0	2.44	6.5	1.98	825	343	482	0.987	0.593						1.63	1.00	1.15	0.75	1.00			1.15	1.20	1.17	1.000	N	2.00	N	1
4	CL	125	18.0	5.49	13.0	3.96	1,615	749	866	0.973	0.637						1.34	1.00	1.15	0.75	1.00			1.15	1.20	1.17	1.000	N	2.00	N	1
5	SP-SM	130	25.0	7.62	21.5	6.55	2,695	1,279	1,416	0.953	0.637	47	M	37.6	7	1.04	1.11	1.00	1.15	0.95	1.00	47	0.459	1.15	1.20	1.17	1.000	N	2.00	N	1
6	CL	120	30.5	9.30	27.8	8.46	3,480	1,669	1,811	0.931	0.628						1.00	1.00	1.15	0.95	1.00			1.15	1.20	1.17	1.000	N	2.00	N	1
7	SM	130	34.0	10.36	32.3	9.83	4,038	1,950	2,088	0.908	0.617	38	M	30.4	15	1.08	0.94	1.00	1.15	0.95	1.00	34	0.459	1.15	1.20	1.17	1.000	N	2.00	N	1
8	CL	125	40.0	12.19	37.0	11.28	4,640	2,246	2,394	0.876	0.596						0.88	1.00	1.15	1.00	1.00			1.15	1.20	1.17		N			1
9	SM	125	43.5	13.26	41.8	12.73	5,234	2,543	2,691	0.835	0.570	64	M	51.2	15	1.08	0.84	1.00	1.15	1.00	1.00	53	0.459	1.15	1.20	1.17		N			1
10	CL	120	45.0	13.72	44.3	13.49	5,543	2,699	2,844	0.811	0.555						0.82	1.00	1.15	1.00	1.00			1.15	1.20	1.17	0.955	N	2.00	N	1
11	SM	130	51.5	15.70	48.3	14.71	6,055	2,948	3,107	0.771	0.527	67	S	67	20	1.10	0.79	1.00	1.15	1.00	1.00	66	0.459	1.15021394	1.20	1.17		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	3.0	3.0	210	31	179	0.998		N	73.6	0.412	0.35			0.00
2	5.0	2.0	540	187	353	0.993	19.3	Liquef	188.1	0.533	0.45		1.7	0.41
3	8.0	3.0	825	343	482	0.987		N	285.8	0.593	0.51			0.00
4	18.0	10.0	1,615	749	866	0.973		N	551.5	0.637	0.54			0.00
5	25.0	7.0	2,695	1,279	1,416	0.953	47.1	N	901.3	0.637	0.54			0.00
6	30.5	5.5	3,480	1,669	1,811	0.931		N	1137.3	0.628	0.53			0.00
7	34.0	3.5	4,038	1,950	2,088	0.908	33.8	N	1287.2	0.617	0.53			0.00
	40.0	6.0	4,640	2,246	2,394	0.876		0	1426.5	0.596	0.51			0.00
	43.5	3.5	5,234	2,543	2,691	0.835	53.1	0	1534.2	0.570	0.49			0.00
	45.0	1.5	5,543	2,699	2,844	0.811		N	1577.9	0.555	0.47			0.00

Total Settlement (inch) = 0.41

* 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.

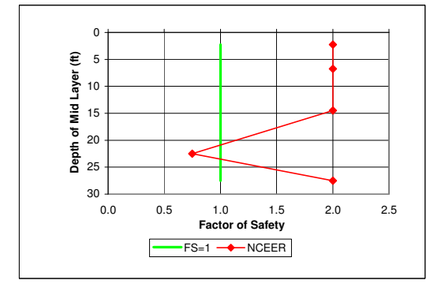
LIQUEFACTION ANALYSIS

Project	Replacement of Old Redwood Highway
Project No.	28645097
Boring No.	A-09-104

PGA =	0.54	
M_w =	7.1	
GWT during EQ	1.5	ft
Sampler:	Symbol	Corr. Factor
SPT	S	1
Mod.Cal	M	0.8
California	C	0.7
Mag. Weighting Factor($CSR_M/CSR_{M=7.5}$)		0.85

Note: Cells in Red must be input

Hammer type :	Type		C_E	Code	C_E
	Donut		0.75	1	2
	Safety		1	2	
	Auto		1.33	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		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			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	GC	130	4.5	1.37	2.25	0.69	293	47	246	0.997	0.416					0.0	2.00	1.00	1.15	0.75	1.00	0		1.15	1.20	1.17	1.000	N	2.00	N	1
2	CH	110	9.0	2.74	6.8	2.06	833	328	505	0.986	0.571					0.0	1.61	1.00	1.15	0.75	1.00	0		1.15	1.20	1.17	1.000	N	2.00	N	1
3	CL	115	20.0	6.10	14.5	4.42	1,713	811	901	0.970	0.647			0		0.0	1.32	1.00	1.15	0.85	1.00	0		1.15	1.20	1.17	1.000	N	2.00	N	1
4	SM	125	25.0	7.62	22.5	6.86	2,658	1,310	1,347	0.950	0.658	21	S	21	14	24.1	1.13	1.00	1.15	0.95	1.00	30	0.419	1.15	1.20	1.17	1.000	N	0.75	Liquef	1
5	SM	125	30.0	9.14	27.5	8.38	3,283	1,622	1,660	0.932	0.647	29	S	29	14	32.4	1.04	1.00	1.15	0.95	1.00	37	0.459	1.15	1.20	1.17	1.000	N	2.00	N	1
6	SP-SM	125	40.0	12.19	35.0	10.67	4,220	2,090	2,130	0.891	0.619	71	S	71	7	71.7	0.93	1.00	1.15	1.00	1.00	77	0.459	1.15	1.20	1.17	0.997	N	2.00	N	1
7	SM	125	45.5	13.87	42.8	13.03	5,189	2,574	2,615	0.826	0.575	69	S	69	14	74.1	0.85	1.00	1.15	1.00	1.00	72	0.459	1.15	1.20	1.17	0.968	N	2.00	N	1
8	SP-SM	125	51.5	15.70	48.5	14.78	5,908	2,933	2,975	0.768	0.535	47	S	47	14	51.2	0.80	1.00	1.15	1.00	1.00	47	0.459	1.15	1.20	1.17	0.947	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	4.5	4.5	293	47	246	0.997	0.0	N	102.3	0.416	0.35				0.00
2	9.0	4.5	833	328	505	0.986	0.0	N	288.2	0.571	0.49				0.00
3	20.0	11.0	1,713	811	901	0.970	0.0	N	582.8	0.647	0.55				0.00
4	25.0	5.0	2,658	1,310	1,347	0.950	29.7	Liquef	886.1	0.658	0.56				0.75
5	30.0	5.0	3,283	1,622	1,660	0.932	36.7	N	1074.0	0.647	0.55				0.00
6	40.0	10.0	4,220	2,090	2,130	0.891	76.8	N	1319.2	0.619	0.53				0.00
7	45.5	5.5	5,189	2,574	2,615	0.826	72.5	N	1503.8	0.575	0.49				0.00
8	51.5	6.0	5,908	2,933	2,975	0.768	47.2	N	1592.6	0.535	0.46				0.00

Total Settlement (inch) = 0.75

* 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.

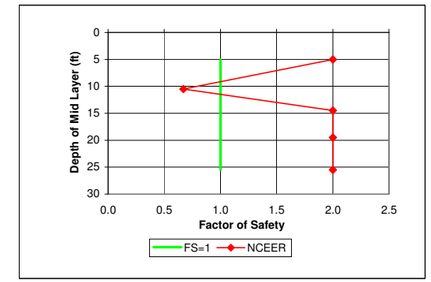
LIQUEFACTION ANALYSIS

Project	Replacement of Old Redwood Highway
Project No.	28645097
Boring No.	A-09-105

PGA =	0.54	
M_w =	7.1	
GWT during EQ	5.0	ft
Sampler:	Symbol	Corr. Factor
SPT	S	1
Mod.Cal	M	0.8
California	C	0.7
Mag. Weighting Factor($CSR_M/CSR_{M=7.5}$)		0.85

Note: Cells in Red must be input

Hammer type :	Type		C_E	Code	C_E
	Donut		0.75	1	2
	Safety		1	2	
	Auto		1.33	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		σ_o	EQ u	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	CH	110	10.0	3.05	5	1.52	550	0	550	0.990	0.348					0.0	1.96	1.00	1.15	0.75	1.00	0		1.15	1.20	1.17	1.000	Y	2.00	N	1
2	SM	125	11.0	3.35	10.5	3.20	1,163	343	819	0.978	0.487	22	M	17.6	15	20.9	1.37	1.00	1.15	0.75	1.00	25	0.278	1.15	1.20	1.17	1.000	N	0.67	Liquef	1
3	CL	115	18.0	5.49	14.5	4.42	1,628	593	1,035	0.970	0.535			0		0.0	1.25	1.00	1.15	0.85	1.00	0		1.15	1.20	1.17	1.000	N	2.00	N	1
4	SM	125	21.0	6.40	19.5	5.94	2,218	905	1,313	0.958	0.568	38	S	38	15	42.3	1.14	1.00	1.15	0.85	1.00	47	0.459	1.15	1.20	1.17	1.000	N	2.00	N	1
5	SP-SM	125	30.0	9.14	25.5	7.77	2,968	1,279	1,688	0.940	0.580	100	S	100	7	101.0	1.03	1.00	1.15	0.95	1.00	113	0.459	1.15	1.20	1.17	1.000	N	2.00	N	1
6	CL	115	40.5	12.34	35.3	10.74	4,134	1,888	2,246	0.889	0.574			0		0.0	0.91	1.00	1.15	1.00	1.00	0		1.15	1.20	1.17	0.990	N	2.00	N	1
7	SM	125	45.0	13.72	42.8	13.03	5,019	2,356	2,663	0.826	0.546	60	M	48	15	52.8	0.84	1.00	1.15	1.00	1.00	51	0.459	1.15	1.20	1.17	0.965	N	2.00	N	1
8	SM	125	50.0	15.24	47.5	14.48	5,613	2,652	2,961	0.778	0.518	26	S	26	15	29.7	0.80	1.00	1.15	1.00	1.00	28	0.331	1.15	1.20	1.17	0.948	N	0.71	Liquef	1
9	SM	125	51.5	15.70	50.8	15.47	6,019	2,855	3,164	0.745	0.498	58	S	58	15	63.3	0.78	1.00	1.15	1.00	1.00	57	0.459	1.15	1.20	1.17	0.937	N	2.00	N	1

Layer Number	Depth to Bot. Layer	Thickness ft	σ_o psf	u psf	σ'_o psf	r_d	$(N_1)_{60-cs}$	Liquefy ? NCEER	τ_{cyc} psf	$CSR_{M=7.5}$ τ_{cyc}/σ'_o	CSR_M τ_{cyc}/σ'_o	Volumetric Strain** %	Settl. in
1	10.0	10.0	550	0	550	0.990	0.0	N	191.2	0.348	0.30		
2	11.0	1.0	1,163	343	819	0.978	24.7	Liquef	399.1	0.487	0.41	1.2	0.14
3	18.0	7.0	1,628	593	1,035	0.970	0.0	N	553.9	0.535	0.46		
4	21.0	3.0	2,218	905	1,313	0.958	47.2	N	745.8	0.568	0.48		
5	30.0	9.0	2,968	1,279	1,688	0.940	113.5	N	979.1	0.580	0.49		
6	40.5	10.5	4,134	1,888	2,246	0.889	0.0	N	1289.7	0.574	0.49		
7	45.0	4.5	5,019	2,356	2,663	0.826	51.2	N	1454.5	0.546	0.47		
8	50.0	5.0	5,613	2,652	2,961	0.778	27.5	Liquef	1533.2	0.518	0.44	1.00	0.60
9	51.5	1.5	6,019	2,855	3,164	0.745	56.8	N	1574.1	0.498	0.42		

Total Settlement (inch) = 0.74

* 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.

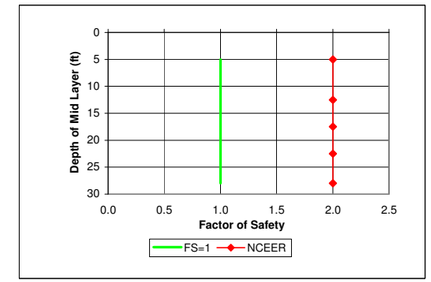
LIQUEFACTION ANALYSIS

Project	Replacement of Old Redwood Highway
Project No.	28645097
Boring No.	A-09-106

PGA =	0.54	
M_w =	7.1	
GWT during EQ	5.0	ft
Sampler:	Symbol	Corr. Factor
SPT	S	1
Mod.Cal	M	0.8
California	C	0.7
Mag. Weighting Factor($CSR_M/CSR_{M=7.5}$)		0.85

Note: Cells in Red must be input

Hammer type :	Type		C_E	Code	C_E
	Donut		0.75	1	2
	Safety		1	2	
	Auto		1.33	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		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	CH	110	10.0	3.05	5	1.52	550	0	550	0.990	0.348					0.0	1.96	1.00	1.15	0.75	1.00	0		1.15	1.20	1.17	1.000	Y	2.00	N	1
2	CL	115	15.0	4.57	12.5	3.81	1,388	468	920	0.974	0.516			0		0.0	1.31	1.00	1.15	0.75	1.00	0		1.15	1.20	1.17	1.000	N	2.00	N	1
3	SP-SM	125	20.0	6.10	17.5	5.33	1,988	780	1,208	0.963	0.556	54	M	43.2	7	43.7	1.18	1.00	1.15	0.85	1.00	50	0.459	1.15	1.20	1.17	1.000	N	2.00	N	1
4	SP-SM	125	25.0	7.62	22.5	6.86	2,613	1,092	1,521	0.950	0.573	45	S	45	7	45.5	1.07	1.00	1.15	0.95	1.00	53	0.459	1.15	1.20	1.17	1.000	N	2.00	N	1
5	CL	115	31.0	9.45	28.0	8.53	3,270	1,435	1,835	0.930	0.582			0		0.0	0.99	1.00	1.15	0.95	1.00	0		1.15	1.20	1.17	1.000	N	2.00	N	1
6	SM	125	34.0	10.36	32.5	9.91	3,803	1,716	2,087	0.907	0.580	30	M	24	15	27.7	0.94	1.00	1.15	0.95	1.00	28	0.354	1.15	1.20	1.17	1.000	N	0.72	Liquef	1
7	CL	115	45.0	13.72	39.5	12.04	4,623	2,153	2,470	0.855	0.562			0			0.87	1.00	1.15	1.00	1.00	0		1.15	1.20	1.17	0.976	N	2.00	N	1
8	SM	125	50.0	15.24	47.5	14.48	5,568	2,652	2,916	0.778	0.522	25	M	20	15	23.5	0.81	1.00	1.15	1.00	1.00	22	0.238	1.15	1.20	1.17	0.951	N	0.51	Liquef	1
9	SM	125	51.5	15.70	50.8	15.47	5,974	2,855	3,119	0.745	0.501	21	S	21	15	24.5	0.79	1.00	1.15	1.00	1.00	22	0.242	1.15	1.20	1.17	0.939	N	0.53	Liquef	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	10.0	10.0	550	0	550	0.990	0.0	N	191.2	0.348	0.30			
2	15.0	5.0	1,388	468	920	0.974	0.0	N	474.3	0.516	0.44			
3	20.0	5.0	1,988	780	1,208	0.963	50.4	N	671.8	0.556	0.47			
4	25.0	5.0	2,613	1,092	1,521	0.950	53.4	N	871.1	0.573	0.49			
5	31.0	6.0	3,270	1,435	1,835	0.930	0.0	N	1067.4	0.582	0.50			
6	34.0	3.0	3,803	1,716	2,087	0.907	28.4	Liquef	1210.3	0.580	0.49		1.0	0.36
7	45.0	11.0	4,623	2,153	2,470	0.855	0.0	N	1387.9	0.562	0.48			
8	50.0	5.0	5,568	2,652	2,916	0.778	21.8	Liquef	1520.9	0.522	0.44		1.50	0.90
9	51.5	1.5	5,974	2,855	3,119	0.745	22.1	Liquef	1562.3	0.501	0.43		1.50	0.27

Total Settlement (inch) = 1.53

* 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.

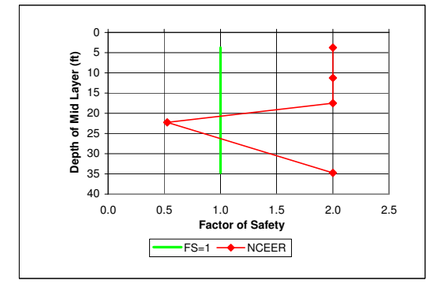
LIQUEFACTION ANALYSIS

Project	Replacement of Old Redwood Highway
Project No.	28645097
Boring No.	A-09-107

PGA =	0.56	
M_w =	7.1	
GWT during EQ	5.0	ft
Sampler:	Symbol	Corr. Factor
SPT	S	1
Mod.Cal	M	0.8
California	C	0.7
Mag. Weighting Factor($CSR_M/CSR_{M=7.5}$)		0.85

Note: Cells in Red must be input

Hammer type :	Type		C_E	Code	C_E
	Donut		0.75	1	2
	Safety		1	2	
	Auto		1.33	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		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	CH	110	7.5	2.29	3.75	1.14	413	0	413	0.993	0.362					0.0	2.00	1.00	1.15	0.75	1.00	0		1.15	1.20	1.17	1.000	Y	2.00	N	1
2	CL	115	15.0	4.57	11.3	3.43	1,256	390	866	0.976	0.515			0		0.0	1.34	1.00	1.15	0.75	1.00	0		1.15	1.20	1.17	1.000	N	2.00	N	1
3	SM	125	20.0	6.10	17.5	5.33	2,000	780	1,220	0.963	0.575	34	M	27.2	7	27.6	1.18	1.00	1.15	0.85	1.00	32	0.459	1.15	1.20	1.17	1.000	N	2.00	N	1
4	SM	125	24.5	7.47	22.3	6.78	2,594	1,076	1,517	0.951	0.592	20	S	20	7	20.3	1.08	1.00	1.15	0.95	1.00	24	0.265	1.15	1.20	1.17	1.000	N	0.53	Liquef	1
5	CL	115	45.0	13.72	34.8	10.59	4,054	1,856	2,197	0.892	0.599			0		0.0	0.92	1.00	1.15	1.00	1.00	0		1.15	1.20	1.17	0.993	N	2.00	N	1
6	SM	125	46.5	14.17	45.8	13.94	5,326	2,543	2,783	0.796	0.555	72	M	57.6	5	57.7	0.83	1.00	1.15	1.00	1.00	55	0.459	1.15	1.20	1.17	0.958	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	7.5	7.5	413	0	413	0.993	0.0	N	149.1	0.362	0.31		
2	15.0	7.5	1,256	390	866	0.976	0.0	N	446.5	0.515	0.44		
3	20.0	5.0	2,000	780	1,220	0.963	31.7	N	701.1	0.575	0.49		
4	24.5	4.5	2,594	1,076	1,517	0.951	23.8	Liquef	897.6	0.592	0.50	1.2	0.65
5	45.0	20.5	4,054	1,856	2,197	0.892	0.0	N	1316.7	0.599	0.51		
6	46.5	1.5	5,326	2,543	2,783	0.796	54.8	N	1543.4	0.555	0.47		
7													

Total Settlement (inch) = 0.65

* 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.

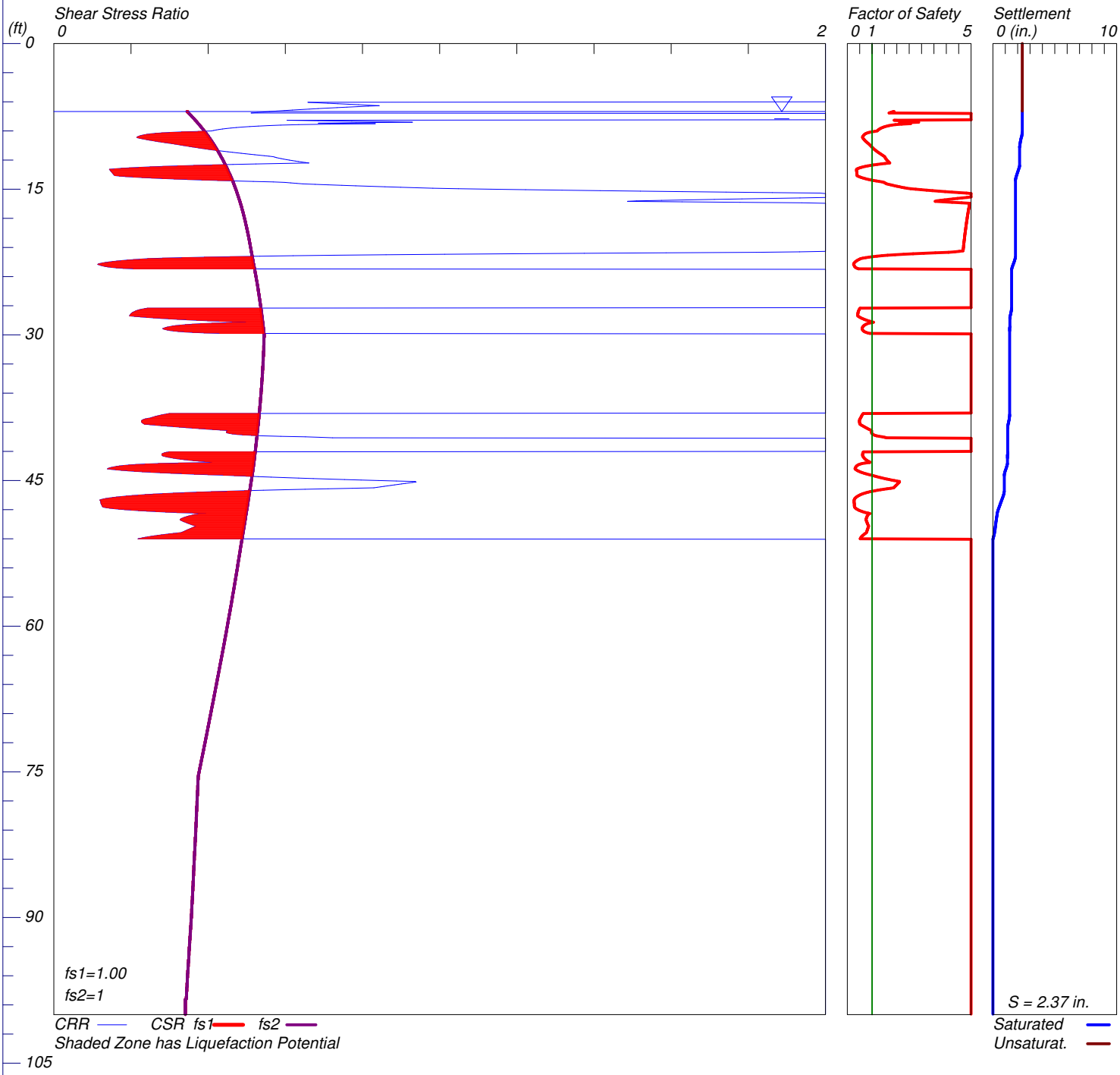
** Note: These values were obtained from a chart for estimation of volumetric strain in saturated sands based on a cyclic stress ratio and standard penetration resistance (Tokimatsu and Seed, 1987).
See figure 9.53 from "Geotechnical Earthquake Engineering" by S. Kramer.

LIQUEFACTION ANALYSIS

Replacement of Old Redwood Highway Overcrossing

Hole No.=CPT-09-114 Water Depth=7 ft

Magnitude=7.1
Acceleration=0.54g



URS

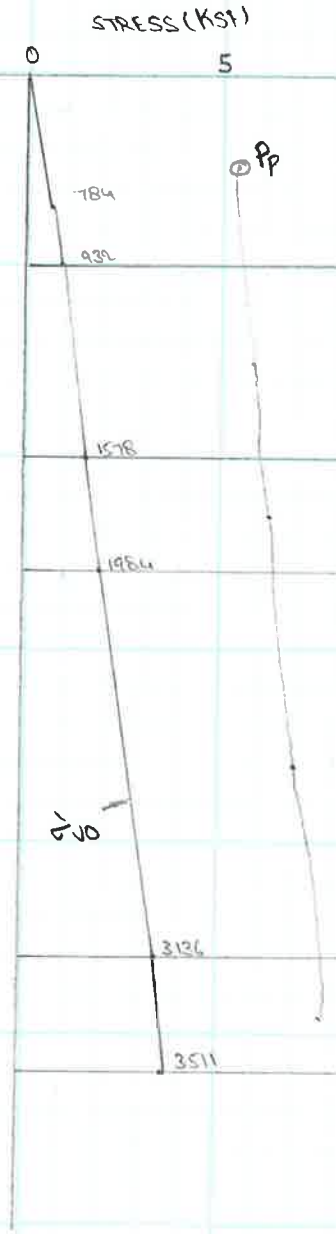
Job OLD REDWOOD HWY | Project No. 28645097 | Page 1 of 3

Description RW1 & RW2 | Computed by MT | Sheet ____ of ____

SETTLEMENT ANALYSIS | Checked by ____ | Date 12/11/09

Date ____

Reference



EL	DEPTH (ft)		γ' pcf	C_{cE}	$C_{\gamma E}$	P_p (ksf)	E 10^6 psf	μ	C_α	A	PORE PRESSURE coefficient	t 25 yr	
EL 35	0	CH (FL. ∇ 98.5)	112 / 49.6	0.16	0.026	5.2	0.1	0.5	C_c = 0.16 (1+0.012) = 0.162; C_α = 0.0648	1			S_u/P = 0 to 4.6
25	10	CL	64.6	0.05	$C_{\gamma E}$ = 1/5 C_c = 0.01	? 5.7°	0.34	0.5	C_c = 0.05 (1+0.81) = 0.09; C_α = 0.036	1			S_u/P = 0.31 to 2.9
15	20	SP-SM	67.6	-	-	? 6.2°	0.4	0.3	-	1			
5	30	CL	57.6	0.09	$C_{\gamma E}$ = 1/5 C_{cE} = 0.018	? 7.0°	0.6	0.5	0.067	1			S_u/P = 0.45 to 1.11
-5	40												
-15	50	SM	62.6			? 7.7°	0.4	0.3	-	1			

C_α based on $\frac{C_\alpha}{C_c}$ = 0.4

URS

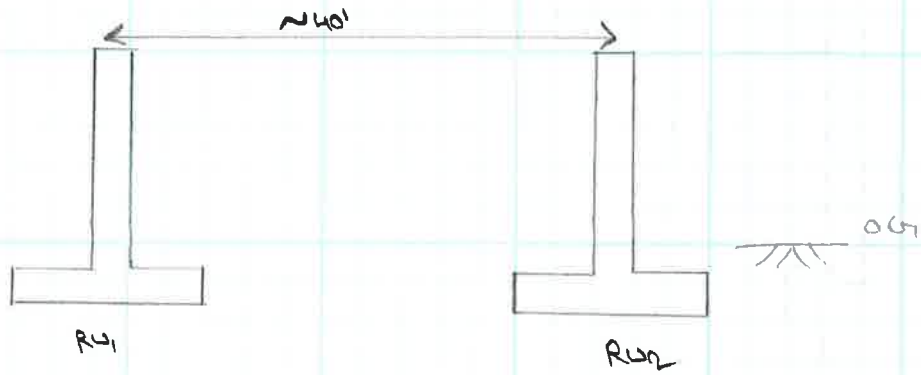
Page 2 of 3

Job _____ Project No. _____ Sheet ____ of ____

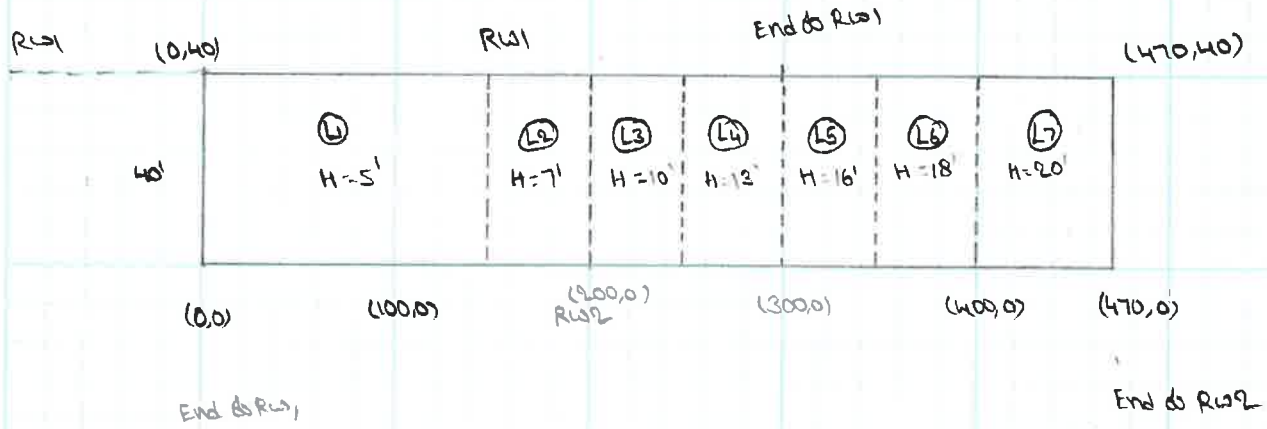
Description _____ Computed by _____ Date _____

_____ Checked by _____ Date _____

Reference



CROSS-SECTION.



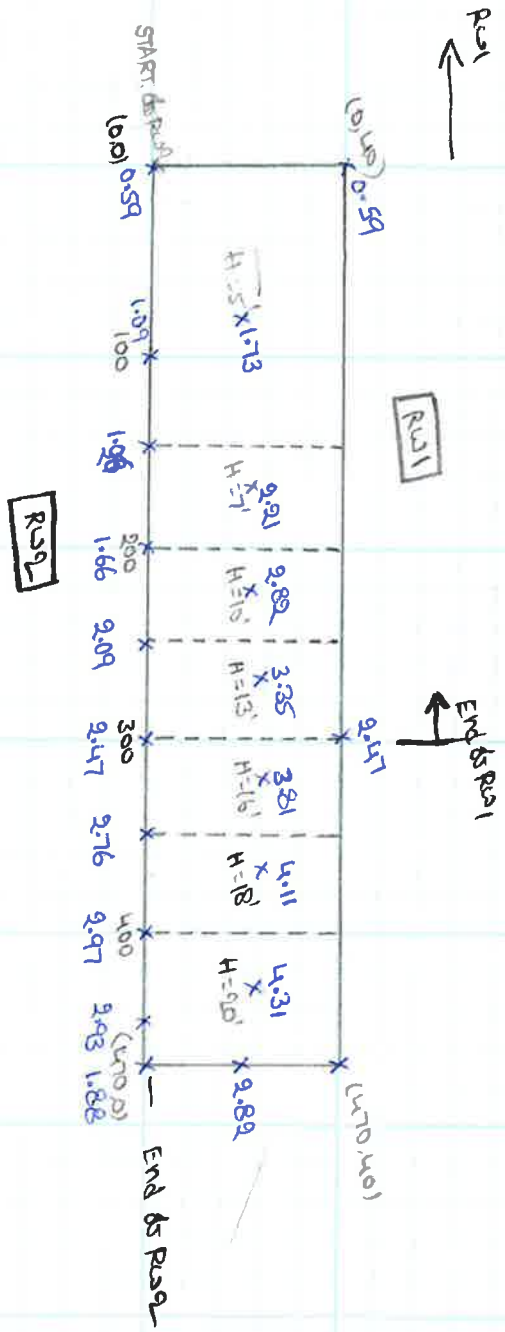
URS

Job _____ Project No. _____ Sheet ____ of ____

Description _____ Computed by _____ Date _____

_____ Checked by _____ Date _____

Reference



SETTLEMENT POINT 0,0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	392	162.5	154.2	144.5	1	0.329	0.024	0.352
2	858.4	161.9	142.7	119.8	1	0.07	0.011	0.081
3	1255.8	159.4	128.7	91.4	1	0.062	0.017	0.08
4	1781.6	153.3	113.5	63.9	1	0	0.018	0.018
5	2560.4	138.3	94.3	35.3	1	0.099	0.029	0.128
6	3324.2	121.9	80.6	20.2	1	0	0.016	0.016
						---	---	---
						0.56	0.116	0.676

SETTLEMENT POINT 0,40

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	392	162.5	154.2	144.5	1	0.329	0.024	0.352
2	858.4	161.9	142.7	119.8	1	0.07	0.011	0.081
3	1255.8	159.4	128.7	91.4	1	0.062	0.017	0.08
4	1781.6	153.3	113.5	63.9	1	0	0.018	0.018
5	2560.4	138.3	94.3	35.3	1	0.099	0.029	0.128
6	3324.2	121.9	80.6	20.2	1	0	0.016	0.016
						---	---	---
						0.56	0.116	0.676

SETTLEMENT POINT 100,0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	392	324.9	309.4	289.2	1	0.573	0.047	0.619
2	858.4	323.8	287.5	240.1	1	0.13	0.022	0.152
3	1255.8	319.2	260.4	183.6	1	0.118	0.034	0.152
4	1781.6	307.7	230.2	128.7	1	0	0.036	0.036
5	2560.4	279.8	189.2	71.7	1	0.195	0.06	0.254
6	3324.2	248.9	157.6	41.4	1	0	0.034	0.034
						---	---	---
						1.015	0.232	1.248

SETTLEMENT POINT 150,0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	392	389.9	372.9	347.1	1	0.655	0.055	0.71
2	858.4	388.6	348.8	288.4	1	0.152	0.025	0.177
3	1255.8	383.3	318.9	220.7	1	0.139	0.04	0.179
4	1781.6	370	285.1	155	1	0	0.043	0.043
5	2560.4	337.7	238.2	86.8	1	0.232	0.07	0.303
6	3324.2	302.3	200.6	50.5	1	0	0.041	0.041
						---	---	---
						1.178	0.274	1.452

SETTLEMENT POINT 200,0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	392	552.3	523.3	491.4	1	0.834	0.08	0.914
2	858.4	550.4	482.4	407.7	1	0.201	0.038	0.239
3	1255.8	542.2	432.1	311.2	1	0.187	0.06	0.247
4	1781.6	521.8	376.7	217.7	1	0	0.062	0.062
5	2560.4	472.1	303.5	120.7	1	0.318	0.104	0.422
6	3324.2	417.6	248.3	69.4	1	0	0.058	0.058
						---	---	---
						1.54	0.402	1.942

SETTLEMENT POINT 250,0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	392	747.3	704.2	664.6	1	1.012	0.11	1.122
2	858.4	744.6	643.6	551.1	1	0.254	0.053	0.307
3	1255.8	733.2	569.3	420.3	1	0.24	0.084	0.324
4	1781.6	704.8	487.8	293.5	1	0	0.085	0.085
5	2560.4	635.2	381.3	162.1	1	0.416	0.145	0.561
6	3324.2	558.5	302.5	92.6	1	0	0.079	0.079
						---	---	---
						1.921	0.557	2.478

SETTLEMENT 300,0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	392	942.2	884.8	837.9	1	1.162	0.14	1.302
2	858.4	938.8	803.9	694.5	1	0.3	0.068	0.369
3	1255.8	924.2	704.9	529.4	1	0.287	0.108	0.396
4	1781.6	887.7	596.5	369.3	1	0	0.108	0.108
5	2560.4	798.3	455.2	203.4	1	0.509	0.188	0.697
6	3324.2	699.3	351.5	115.7	1	0	0.101	0.101
						---	---	---
						2.259	0.713	2.972

SETTLEMENT 350,0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	392	1104.7	1034.3	982.3	1	1.271	0.166	1.436
2	858.4	1100.6	935.2	814.1	1	0.335	0.081	0.417
3	1255.8	1083.4	813.6	620.3	1	0.324	0.129	0.454
4	1781.6	1040.3	680.3	432.5	1	0	0.127	0.127
5	2560.4	934.3	506.4	237.8	1	0.584	0.225	0.808
6	3324.2	816	379.3	134.9	1	0	0.119	0.119
						---	---	---
						2.514	0.848	3.361

SETTLEMENT POINT 400,0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	392	1234.6	1145.5	1097.1	1	1.35	0.189	1.539
2	858.4	1229.9	1020.3	908.2	1	0.361	0.096	0.457
3	1255.8	1209.5	867.7	690.5	1	0.352	0.152	0.503
4	1781.6	1158.2	702.4	479.5	1	0	0.145	0.145
5	2560.4	1030.8	493.9	261	1	0.635	0.261	0.896
6	3324.2	887.3	350.6	145.8	1	0	0.133	0.133
						---	---	---
						2.697	0.976	3.673

SETTLEMENT POINT 450,0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	392	1298.3	1116.1	1131.5	1	1.386	0.241	1.627
2	858.4	1278.8	884.3	905.2	1	0.371	0.138	0.509
3	1255.8	1213.5	663.5	657.2	1	0.352	0.195	0.548
4	1781.6	1095.8	493	433.2	1	0	0.147	0.147
5	2560.4	895	338.6	220.6	1	0.562	0.246	0.809
6	3324.2	726.4	251.1	117.8	1	0	0.111	0.111
						---	---	---
						2.672	1.079	3.75

SETTLEMENT POINT 470,0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	392	649.8	610.7	577.9	1	0.927	0.097	1.024
2	858.4	647.5	555.6	479	1	0.228	0.047	0.275
3	1255.8	637.4	488.2	365.1	1	0.214	0.074	0.288
4	1781.6	612.3	414.3	254.7	1	0	0.074	0.074
5	2560.4	550.7	318.4	140.3	1	0.366	0.129	0.494
6	3324.2	482.3	248.6	79.8	1	0	0.069	0.069
						---	---	---
						1.735	0.49	2.225

SETTLEMENT POINT 470,0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	392	1297.1	1153.2	1016.1	1	1.385	0.27	1.655
2	858.4	1265.3	959.3	669.4	1	0.368	0.162	0.531
3	1255.8	1164.5	753.4	370.1	1	0.342	0.213	0.555
4	1781.6	1001.5	571.7	182.4	1	0	0.14	0.14
5	2560.4	769.1	390.2	68.1	1	0.493	0.216	0.709
6	3324.2	606.3	284.8	30.9	1	0	0.092	0.092
						---	---	---
						2.588	1.092	3.681

SETTLEMENT POINT 75,20

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	392	648.6	577.2	508	1	0.926	0.135	1.061
2	858.4	632.6	481.1	334.7	1	0.224	0.081	0.305
3	1255.8	582.2	379.3	185	1	0.199	0.106	0.304
4	1781.6	500.6	290.1	91.2	1	0	0.07	0.07
5	2560.4	384	202.5	34	1	0.262	0.106	0.369
6	3324.2	302.4	153.3	15.4	1	0	0.045	0.045
						---	---	---
						1.611	0.543	2.154

SETTLEMENT POINT 175, 20

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	392	908.1	817	711.7	1	1.137	0.185	1.322
2	858.4	886.4	693.7	469.6	1	0.288	0.11	0.398
3	1255.8	818.1	562	260.5	1	0.261	0.144	0.405
4	1781.6	707.9	444.2	129.2	1	0	0.096	0.096
5	2560.4	551.5	324.4	49	1	0.366	0.146	0.512
6	3324.2	442.7	252.7	22.6	1	0	0.065	0.065
						---	---	---
						2.053	0.745	2.798

SETTLEMI EMENT PC NT : 225. 0, 20.0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	392	1297.1	1156.3	1016.1	1	1.385	0.268	1.654
2	858.4	1265.3	966.7	669.5	1	0.368	0.161	0.529
3	1255.8	1164.8	766	370.2	1	0.342	0.211	0.553
4	1781.6	1002.4	589.9	182.6	1	0	0.139	0.139
5	2560.4	771.7	414.8	68.4	1	0.494	0.212	0.706
6	3324.2	611.6	312.7	31.2	1	0	0.092	0.092
						---	---	---
						2.59	1.082	3.672

SETTLEMI EMENT PC NT : 275. 0, 20.0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	392	1686.3	1500.3	1320.9	1	1.582	0.35	1.932
2	858.4	1644.9	1249.6	870.3	1	0.435	0.211	0.646
3	1255.8	1514	983.7	481.2	1	0.412	0.276	0.688
4	1781.6	1302.5	749.1	237.3	1	0	0.181	0.181
5	2560.4	1001.3	514.2	88.7	1	0.619	0.28	0.899
6	3324.2	791.2	376.7	40.4	1	0	0.12	0.12
						---	---	---
						3.049	1.417	4.466

SETTLEMENT POINT 325, 20

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	392	2075.4	1838.9	1625.3	1	1.745	0.434	2.179
2	858.4	2023.9	1520.8	1070.2	1	0.492	0.262	0.755
3	1255.8	1860.7	1184.5	590.9	1	0.474	0.343	0.817
4	1781.6	1597	889.6	290.7	1	0	0.224	0.224
5	2560.4	1221.7	596.4	108.2	1	0.732	0.348	1.08
6	3324.2	960.1	425.4	49	1	0	0.147	0.147
						---	---	---
						3.443	1.758	5.201

SETTLEMENT POINT 375,20

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	392	2334.9	2068.7	1828.9	1	1.84	0.488	2.328
2	858.4	2277.5	1709.4	1204.8	1	0.527	0.295	0.822
3	1255.8	2095.7	1326.2	665.9	1	0.512	0.388	0.9
4	1781.6	1801.5	985	328	1	0	0.253	0.253
5	2560.4	1380	639.8	122.2	1	0.809	0.4	1.208
6	3324.2	1082	438	55.2	1	0	0.168	0.168
						---	---	---
						3.687	1.993	5.679

SETTLEMENT POINT 435, 20

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	392	2594	2242	2029	1	1.926	0.564	2.49
2	858.4	2526.3	1770.5	1331.8	1	0.558	0.351	0.909
3	1255.8	2309	1278.1	729.6	1	0.544	0.461	1.004
4	1781.6	1950	864.5	352.7	1	0	0.285	0.285
5	2560.4	1425.8	498.8	125.5	1	0.831	0.445	1.276
6	3324.2	1059.8	323.4	53.8	1	0	0.17	0.17
						---	---	---
						3.858	2.277	6.135

use 0.4 for over-consolidated clay that is dry.

rw1&2.dat

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325,20,0,35,50,40,2080
375,20,0,35,50,40,2340
435,20,0,35,70,40,2600
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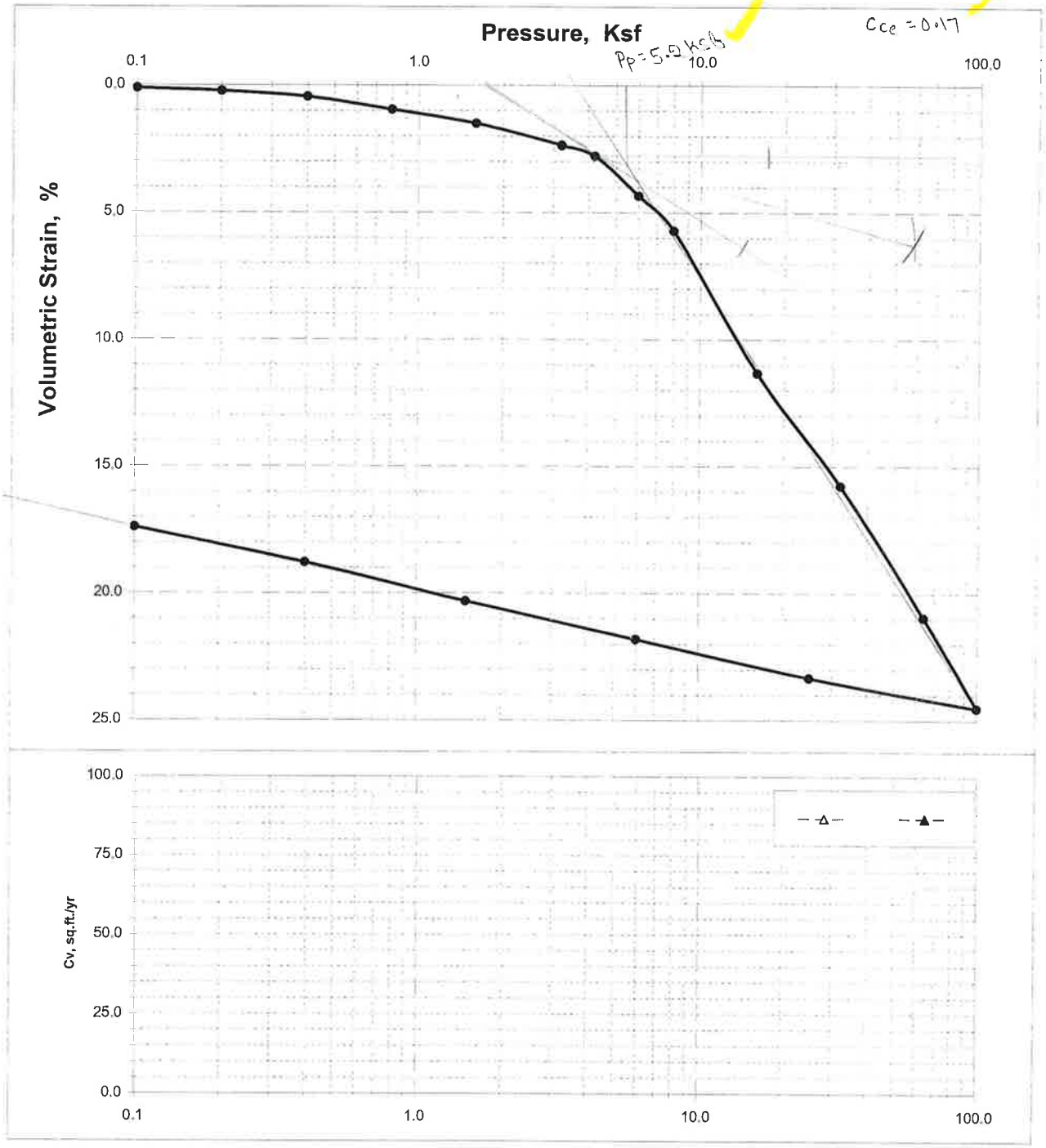
CONSOLIDATION TEST

Boring Number	A-09-106	Sample Number	10	Depth (ft)	5-7.5				
Soil Description	Dark gray clay								
	Water Content, %	Total Unit Weight, pcf	Void Ratio	Saturation %	Height in	Diameter in	Specific Gravity	Liquid Limit, %	Plasticity Index, %
Initial	35.1	113.2	1.012	93.6	1.00	2.420	(assumed) 2.70	82	50
Final	28.5	131.7	0.646	119.2	0.818				



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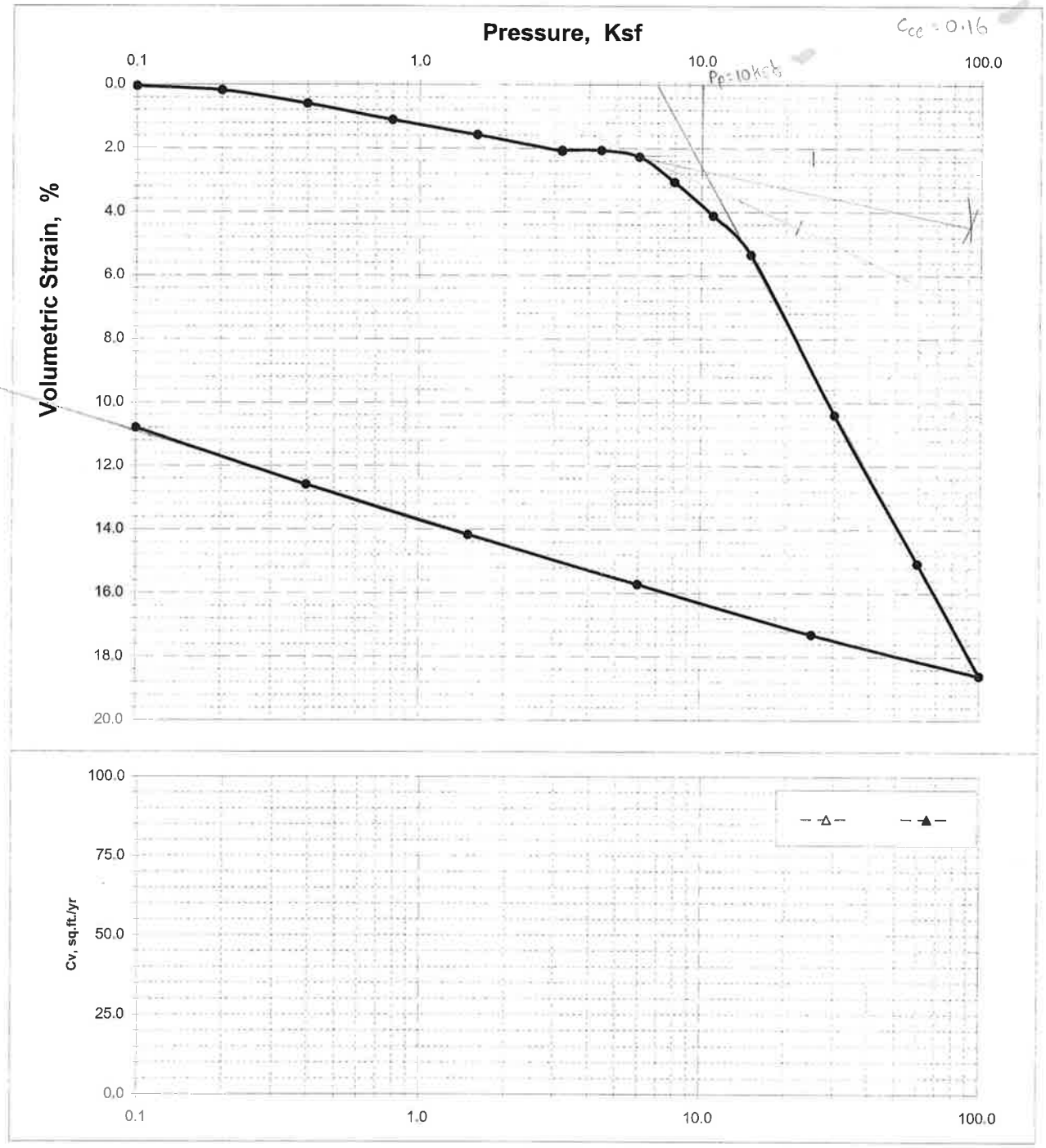
CONSOLIDATION TEST

Boring Number	A-09-101	Sample Number	2-X	Depth (ft)	5-7.5				
Soil Description	Dark brown clayey silt								
	Water Content, %	Total Unit Weight, pcf	Void Ratio	Saturation %	Height in	Diameter in	Specific Gravity	Liquid Limit, %	Plasticity Index, %
Initial	31.8	114.9	0.934	91.8	1.00	2.420	(assumed) 2.70	79	42
Final	27.3	124.4	0.725	101.7	0.892				



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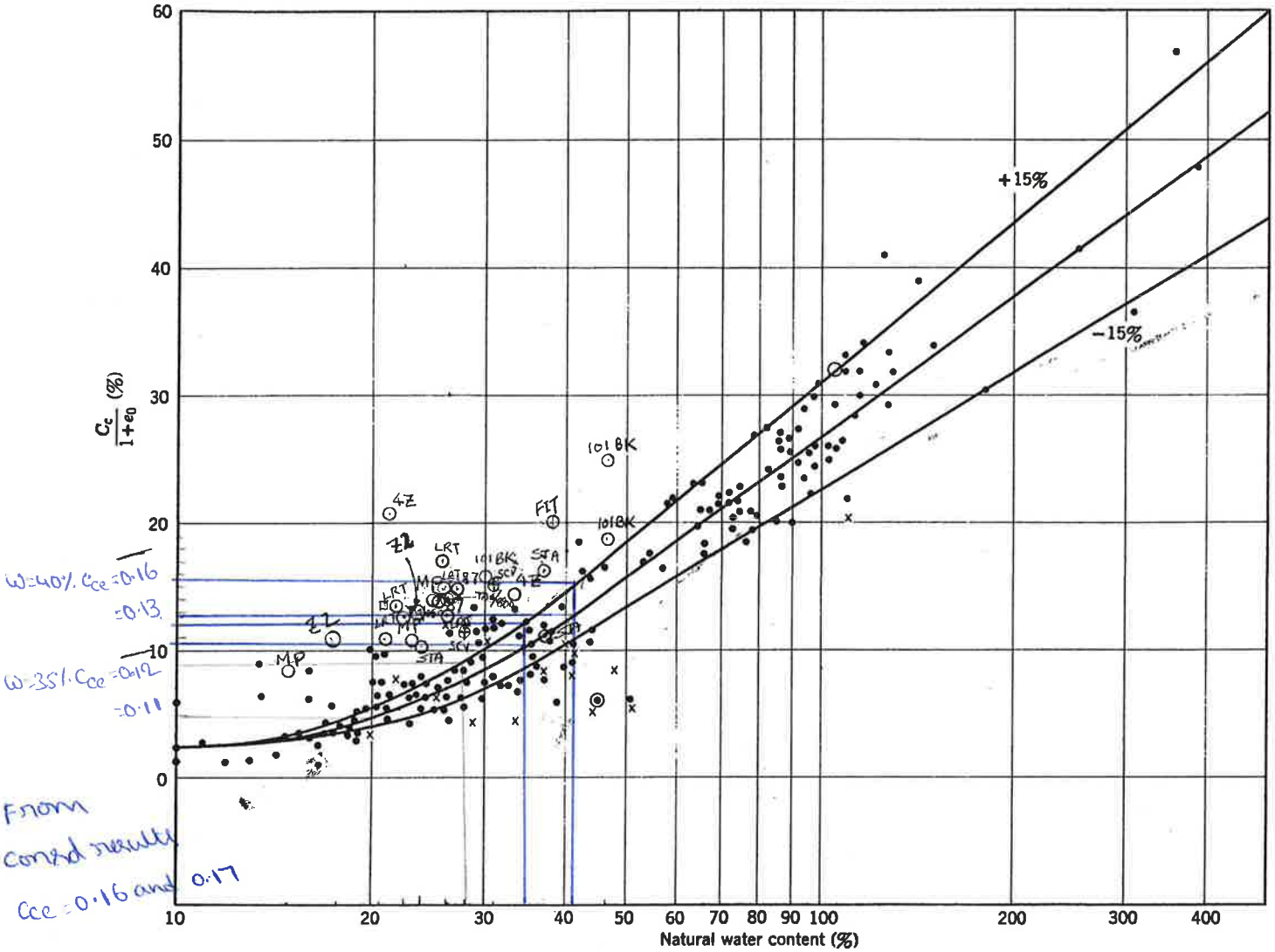
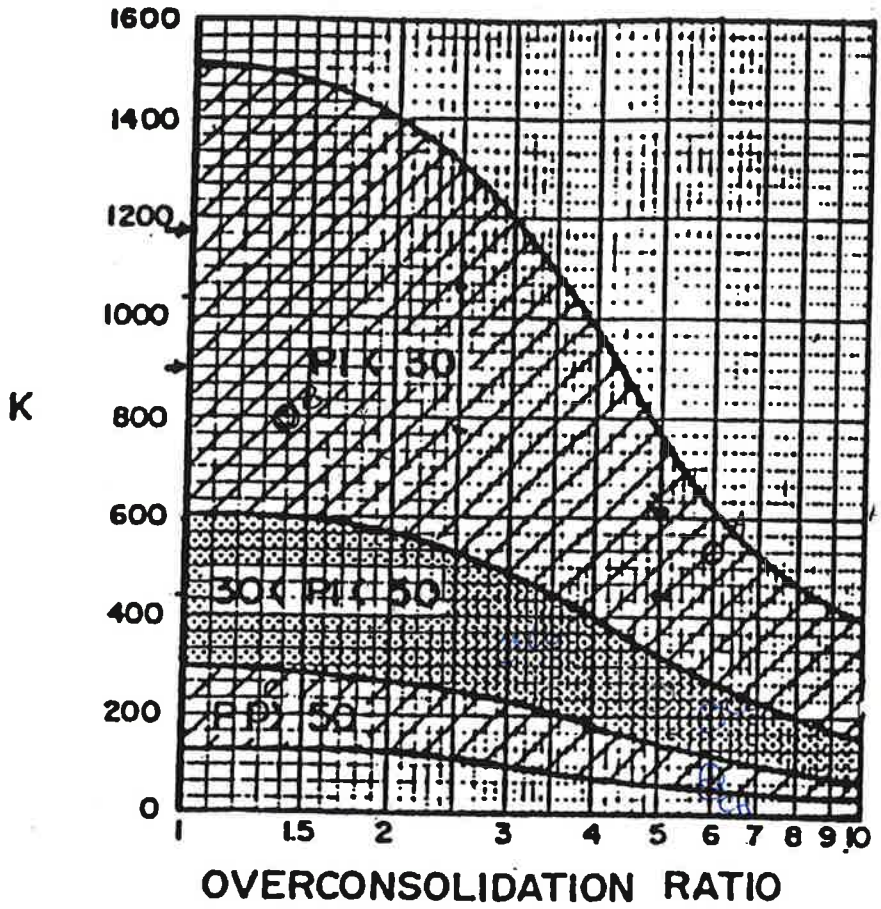


Fig. 22.1(c)

(After Lamb and Whitman, 1969)

SAN JOSE LOCAL PROJECTS

- FIT — 16755V — FIDELITY TITLE OFFICE BUILDING
- SJA — 16171V — S.J. AIRPORT
- 4Z — 8715027R — 4TH/ZANKER
- MP — 8815006R — MILPITAS PIPELINE
- LRT — 8815012R — ROUTE 85 / LRT TUNNEL
- 87 — ROUTE 87 BRIDGE (NORTH BOUND) 8810100R
- 101 BK — HWY 101 / BROKAW RD 8810188R
- TAS/880 — TASMAN DR. / I-880
- SCV — 9100204R — SANTA CLARA CONDUIT VAULT
- Z2 — 9000428R — MILPITAS ZONE 2 TANK



CH @ 10 ft
$E = KS_u = (100)(1000)$
$= 100000 = 0.1 \times 10^6$

CL @ 20 ft
$E = KS_u = (200)(1700)$
$= 340000 = 0.34 \times 10^6$

CL @ 26 ft
$E = KS_u = (300)(2000)$
$= 600000 = 0.6 \times 10^6$

$E_u = KS_u$

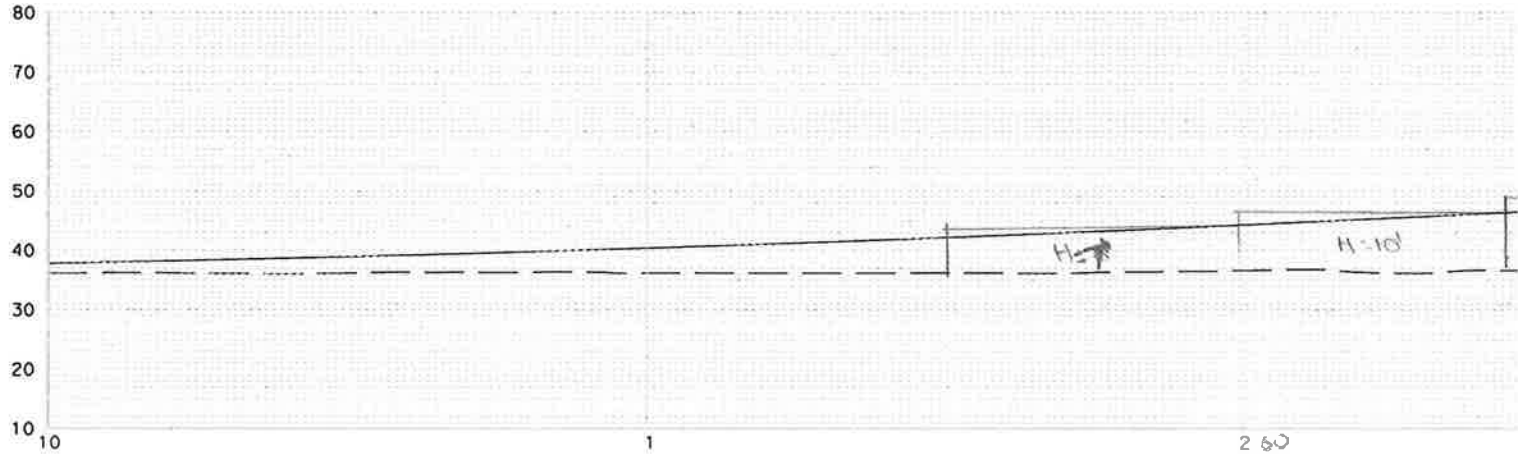
E_u = UNDRAINED MODULUS OF CLAY

K = FACTOR FROM CHART ABOVE

S_u = UNDRAINED SHEAR STRENGTH OF CLAY

Fig. 2 CHART FOR ESTIMATING UNDRAINED MODULUS OF CLAY

RW2-REV



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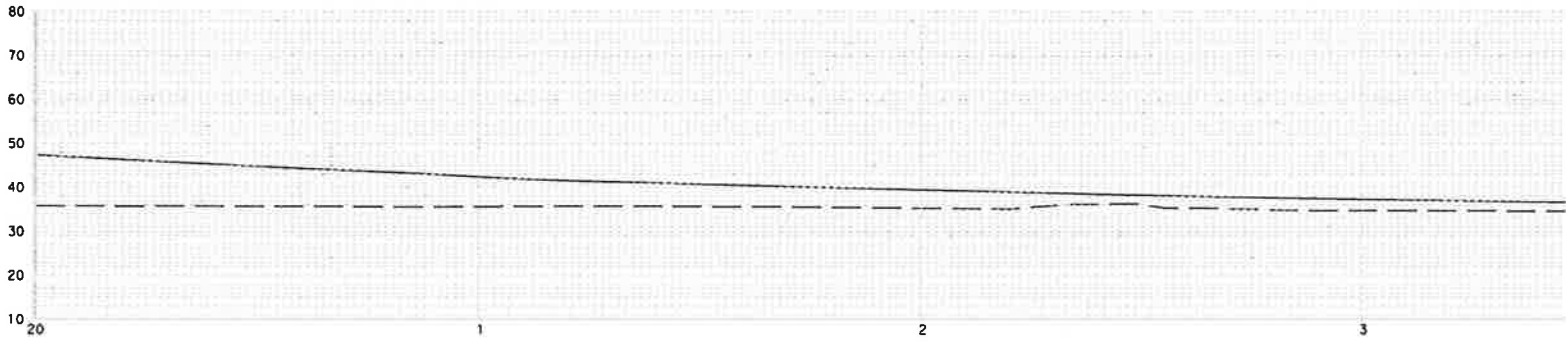

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LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-3-09	11-3-09	1861069.6 ft / 6369770.7 ft NAD83	A-09-101
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Clear Heart Drilling			' Lt Sta ~	37 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			DR 5K	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), SPT (1.44"), Shelby (2.87")			140lb/30 in - CAT Head Hammer	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			20 ft	N/A	51.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Remarks
	0	CLAYEY GRAVEL (GC); grayish brown [FILL].										
	1	Bridging Rock; diameter< 6".										
35.00	2	Fat CLAY (CH); medium stiff to stiff; black; moist; trace fine SAND.		1	4 4 7	11	55		36	82	UC = 0.51	γ = 112 c = 1020 Su/p' = 4.6
	3											
33.00	4											
	5			2			70					Shelby pushed with 1200 to 1600 psi C, PI
31.00	6	~~Lean CLAY (CL); stiff; gray; moist.~~										
	7											
29.00	8											
	9											
27.00	10	SANDY lean CLAY (CL); very stiff; grayish brown with black speckling; moist; trace fine GRAVEL.		3	8 11 15	26	75		17	114	UC = 1.54	γ = 133 c = 3080 Su/p' = 2.9
	11											
25.00	12											
	13											
23.00	14											
	15	At EL. 22.0 ft, becomes soft; mottled with brown.		4	5 7 8	15	70		21	105	UC = 0.22	γ = 127 c = 440 Su/p = 0.31
21.00	16											
	17											
19.00	18											
	19											
17.00	20											
	21	Poorly graded SAND with GRAVEL (SP); medium dense; gray; wet; trace fine GRAVEL.		5	4 7 11	18	45		16	111		γ = 129
15.00	22											
	23											
13.00	24											
	25											

(continued)

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San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				A-09-101
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Sonoma	101	7.4/8.1	04-12276K
PROJECT OR BRIDGE NAME				
Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET	
	A. Cheung	11-9-09	1 of 2	

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 12/11/09

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														
11.00	26		Poorly graded SAND with GRAVEL (SP) *(continued)*.		6	5 6 6	12	100		17					PA
	27		Lean CLAY (CL); stiff; gray; moist.												
9.00	28														
	29														
7.00	30				7	5 6 7	13	100		28	93	UC = 0.54			γ=119 C=1080 $\frac{S_u}{P}$ = 0.46
	31		At EL. 6.0 ft, becomes gray mottled with brown.												
5.00	32														
	33														
3.00	34														
	35		At EL. 2.0 ft, becomes very stiff; grayish brown mottled with black.		8	8 11 13	24	90		27	98	UC = 1.49			γ=124 C=2980 $\frac{S_u}{P}$ = 1.11
1.00	36														
	37														
-1.00	38														
	39														
-3.00	40				9	10 11 10	21	75							
	41		At EL. -4.0 ft, observed Sand lense trace GRAVEL.												
-5.00	42														
	43														
-7.00	44														
	45				10	27 31 34	65	75							
-9.00	46		SILTY SAND with GRAVEL (SM); very dense; brown; moist.												
	47														
-11.00	48														
	49														
-13.00	50		SANDY SILT (ML); dense; brown; moist; fine SAND; some thin Clay lenses.		11	11 15 21	36	100							
	51														
-15.00	52		Bottom of Borehole at 51.5 ft.												
	53														
-17.00	54														
	55														

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 12/11/09

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San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**A-09-101**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **A. Cheung**		DATE **11-9-09**	SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	10-2-09	10-2-09	1861307.4 ft / 6369479.3 ft NAD83	A-09-102
DRILLING CONTRACTOR: Clear Heart Drilling			BOREHOLE LOCATION (Offset, Station, Line): ' Lt Sta ~	SURFACE ELEVATION: 35 ft NAVD 88
DRILLING METHOD: Hollow-Stem Auger			DRILL RIG: DR 5K	BOREHOLE DIAMETER: 8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96"), SPT (1.44")			SPT HAMMER TYPE: 140lb/ CAT Head Hammer	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING 12 ft; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 51.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	Fat CLAY (CH); very stiff; black; moist.												
	1			1	3 4 7	11	55							
33.00	2													
	3													
31.00	4													
	5			2	6 9 12	21	45		33	88	UC = 1.18			γ = 117
29.00	6													c = 2360
	7	At EL. 28.5 ft, observed slightly mottled with white; (MARL).												$\frac{S_u}{P}$ = 4.0
27.00	8	Lean CLAY (CL); medium stiff; grayish brown; moist.												
	9													
25.00	10	Poorly graded SAND with SILT and GRAVEL (SP-SM); medium dense; grayish brown; moist.		3	15 17 21	38	70		12	119				γ = 133
	11													
23.00	12													
	13													
21.00	14													
	15			4	7 10 11	21	95							
19.00	16													
	17	At EL. 18.5 ft, with few GRAVEL; few gravel.												
17.00	18													
	19													
15.00	20	At EL. 15.0 ft, with dense; 2 inches Lean Clay lense.		5	15 21 13	34	95							
	21	At EL. 14.0 ft, becomes wet.												
13.00	22													
	23													
11.00	24	SANDY lean CLAY (CL); stiff; grayish brown with black speckling.												
	25													

(continued)

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55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				A-09-102
DIST. 04	COUNTY Sonoma	ROUTE 101	POSTMILE 7.4/8.1	EA 04-12276K
PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY A. Cheung	DATE 11-10-09	SHEET 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 lean CLAY (CL) *(continued)*.		6	8 11 13	24	70		20	109	UC = 0.97			γ=131 c=1940 Su/P=0.95
9.00	26														
	27														
7.00	28		Lean CLAY (CL); very stiff; grayish brown; moist; trace fine GRAVEL.												
	29														
5.00	30				7	9 9 11	20	65		23	104	UC = 1.09			γ=128 c=2180 Su/P=0.91
	31														
3.00	32														
	33														
1.00	34														
	35		At EL. 0.0 ft, becomes gray mottled with brown.		8	10 12 13	25	55		23	104	UC = 1.30			γ=128 c=2600 Su/P=0.96
-1.00	36														
	37														
-3.00	38														
	39														
-5.00	40		At EL. -5.0 ft, with moist; trace SAND.		9	7 9 10	19	85		26	101	UC = 1.01			γ=127 c=2020 Su/P=0.75
	41														
-7.00	42														
	43														
-9.00	44														
	45				10	8 10 15	25	60							
-11.00	46														
	47		Poorly graded SAND with SILT and GRAVEL (SP-SM).												
-13.00	48		SILTY, CLAYEY SAND (SC-SM); medium dense; light brown.												
	49														
-15.00	50				11	12 16 22	38	60		23	102				γ=125
	51														
-17.00	52		Bottom of Borehole at 51.5 ft.												
	53														
-19.00	54														
	55														

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 12/11/09

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55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**A-09-102**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **A. Cheung**		DATE **11-10-09**	SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-3-09	11-3-09	1860853.8 ft / 6369979.8 ft NAD83	A-09-115
DRILLING CONTRACTOR: Clear Heart Drilling			BOREHOLE LOCATION (Offset, Station, Line): ' Lt Sta ~	SURFACE ELEVATION: 37 ft NAVD 88
DRILLING METHOD: Hollow-Stem Auger			DRILL RIG: DR 5K	BOREHOLE DIAMETER: 6 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96")			SPT HAMMER TYPE: 140 lb/30 in - Rope & CAT Head	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING dry; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 11.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	CLAYEY GRAVEL (GC); brown.												
	1	BOULDERS.												
		Lean to fat CLAY (CL/CH); black and brown; moist; [FILL].		1	4 4 6	10	65							
34.50	2	Fat CLAY (CH); medium stiff; black; moist.							35	84	UC = 0.44			γ=113 c=880 $\frac{S_u}{P}$=3.9
	3													
32.50	4													
	5			2	7 12 14	26	50							
30.50	6													
	7	Lean CLAY (CL); very stiff; gray; moist.												
28.50	8													
	9													
26.50	10	At EL. 26.5 ft, becomes grayish brown mottled with brown some black speckles.		3	9 10 10	20	70		26	100	UC = 1.21			γ=126 c=2420 $\frac{S_u}{P}$=2.30
	11													
24.50	12	Bottom of Borehole at 11.5 ft.												
	13													
22.50	14													
	15													
20.50	16													
	17													
18.50	18													
	19													
16.50	20													
	21													
14.50	22													
	23													
12.50	24													
	25													

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55 S. Market St, Ste 1500
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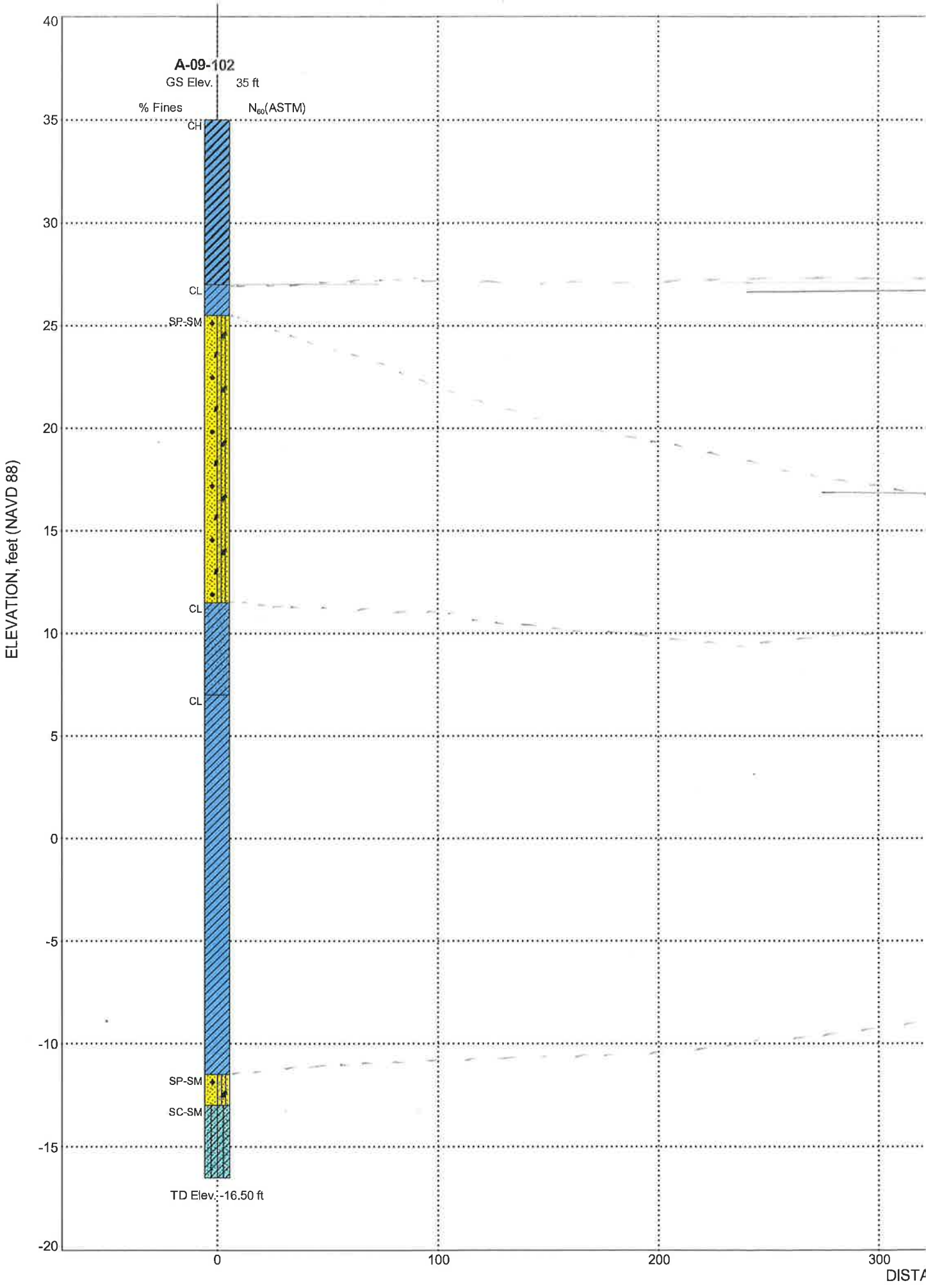
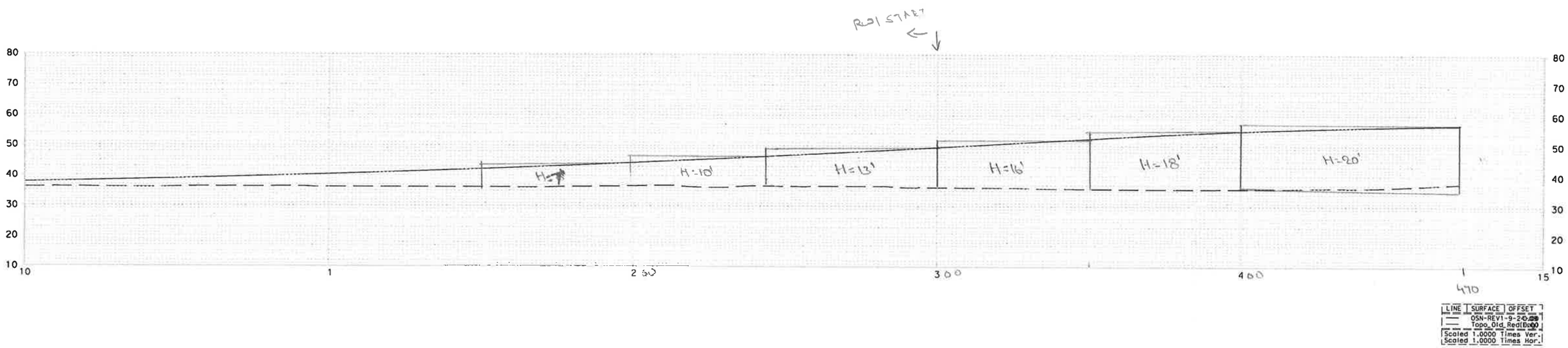
REPORT TITLE				HOLE ID
BORING RECORD				A-09-115
DIST. 04	COUNTY Sonoma	ROUTE 101	POSTMILE 7.4/8.1	EA 04-12276K
PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY A. Cheung	DATE 11-10-09	SHEET 1 of 1	

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 12/11/09


A-09-102
GS Elev. 35 ft
% Fines
N60(ASTM)
CH
CL
SP-SM
CL
CL
SP-SM
SC-SM
TD Elev. -16.50 ft
ELEVATION, feet (NAVD 88)
40
35
30
25
20
15
10
5
0
-5
-10
-15
-20
0
100
200
300
DISTA

RW2-REV1-10-1-09



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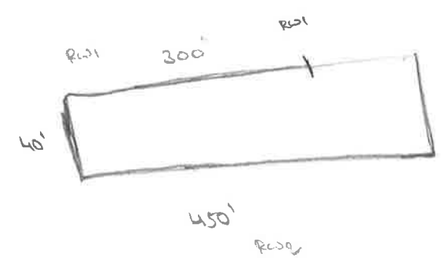
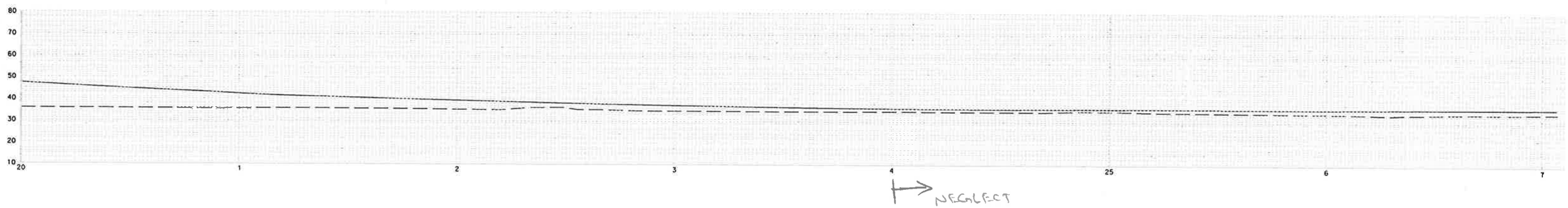


RW1-REV1-10-1-09



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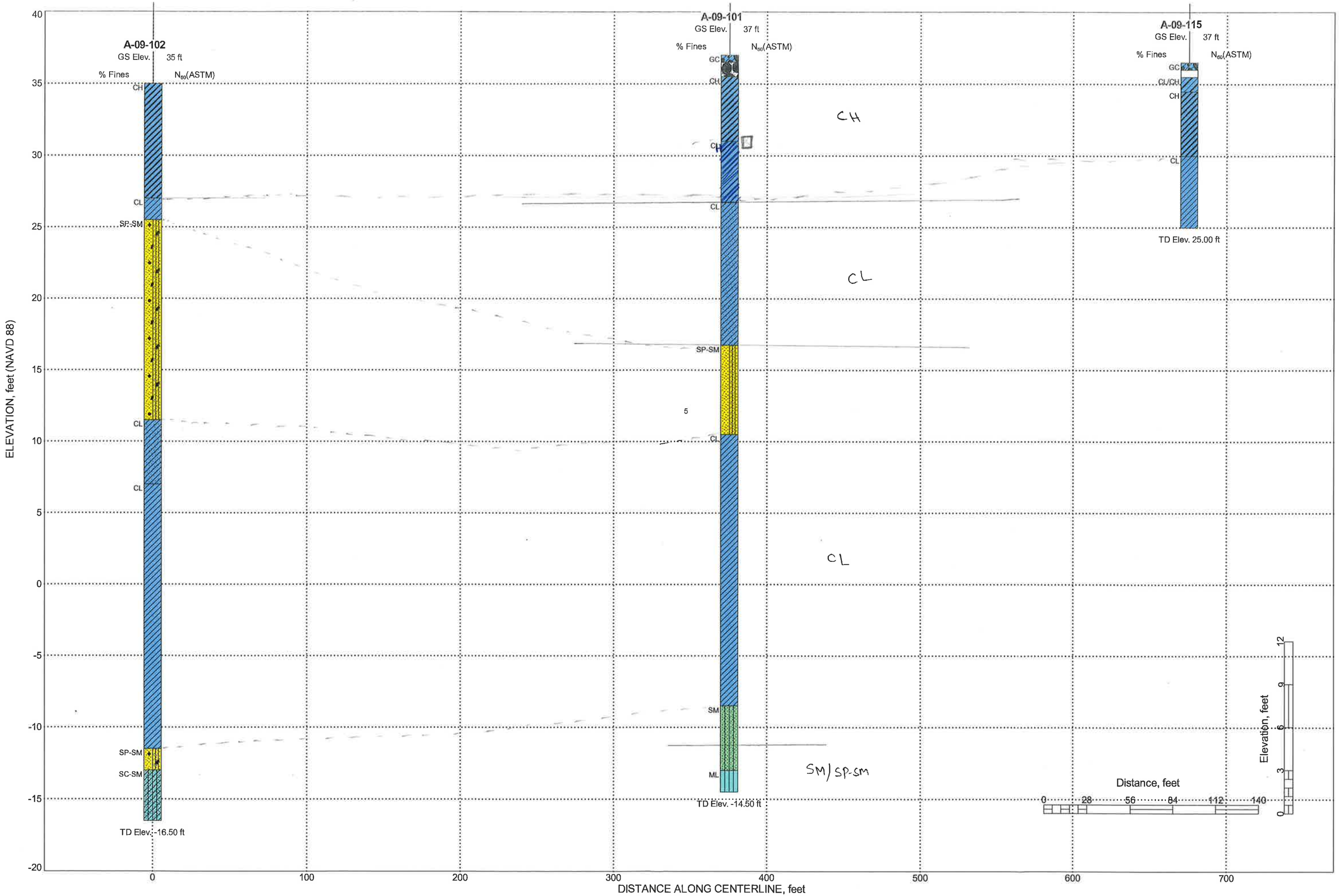


SECTION: 1-1' - Part A

URS

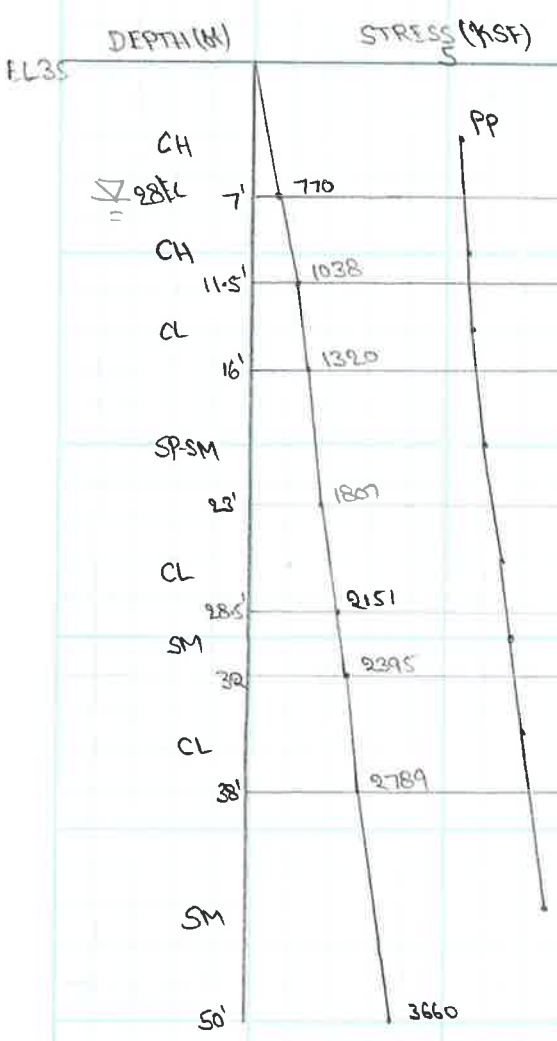
Page 1 of 3

Job OLD REDWOOD HWY OVERCROSSING — Project No. 28645097 — Sheet ___ of ___

Description RETAINING WALL 3 — Computed by MT — Date 12/18/09

SETTLEMENT CALCULATIONS. — Checked by ___ — Date ___

Reference



	γ' (PCF)	C_{CE}	$C_{\delta E}$	P_P (KSF)	E $\times 10^6$ PSF	μ	C_α	A	t_{ZERO}
CH	110	0.16	0.026	5.2	0.32	0.5	–	1	
CH	59.6	0.08	$C_{\delta E}=\frac{1}{5}C_c$ 0.016	5.3	0.6	0.5	–	1	
CL	62.6	0.05	0.01	5.6	0.4	0.5	–	1	
SP-SM	69.6	–	–	6.0	0.4	0.3	–	1	
CL	62.6	0.05	0.01	6.4	0.4	0.5	–	1	
SM	69.6	–	–	6.7	0.4	0.3	–	1	
CL	65.6	0.05	0.01	7.0	1.0	0.5	–	1	
SM	72.6	–	–	7.6	0.4	0.3	–	1	

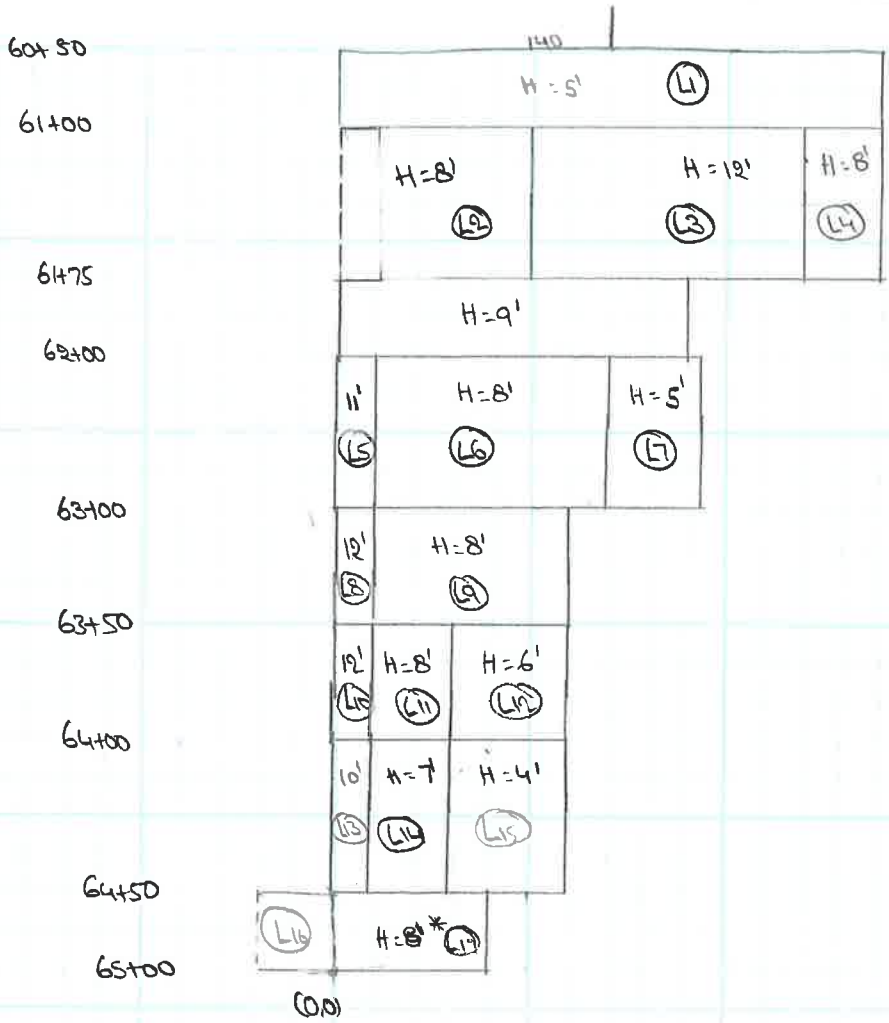
URS

Job _____ Project No. _____ Sheet ____ of ____

Description _____ Computed by _____ Date _____

_____ Checked by _____ Date _____

Reference



PLAN VIEW.

RETAINING WALL FROM 61+75 TO 64+25.

* 2 Rectangular loads.

URS

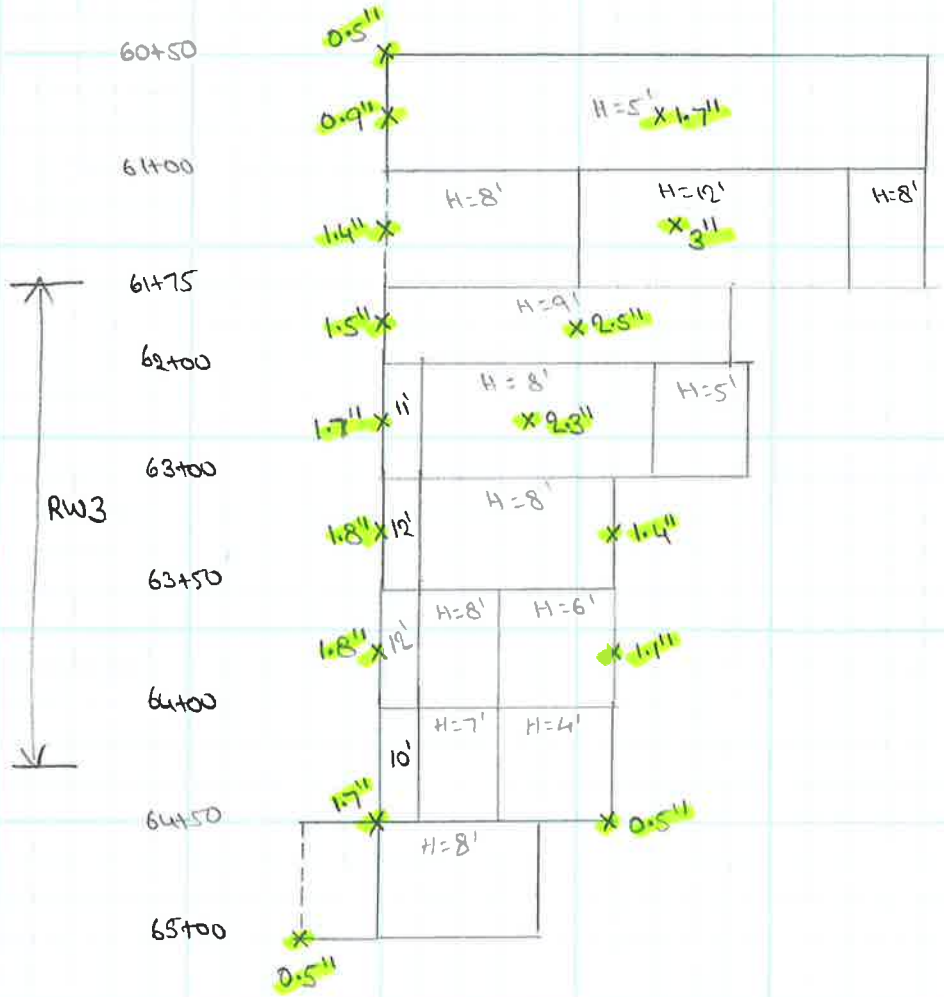
Page 3 of 3

Job _____ Project No. _____ Sheet ____ of ____

Description _____ Computed by _____ Date _____

_____ Checked by _____ Date _____

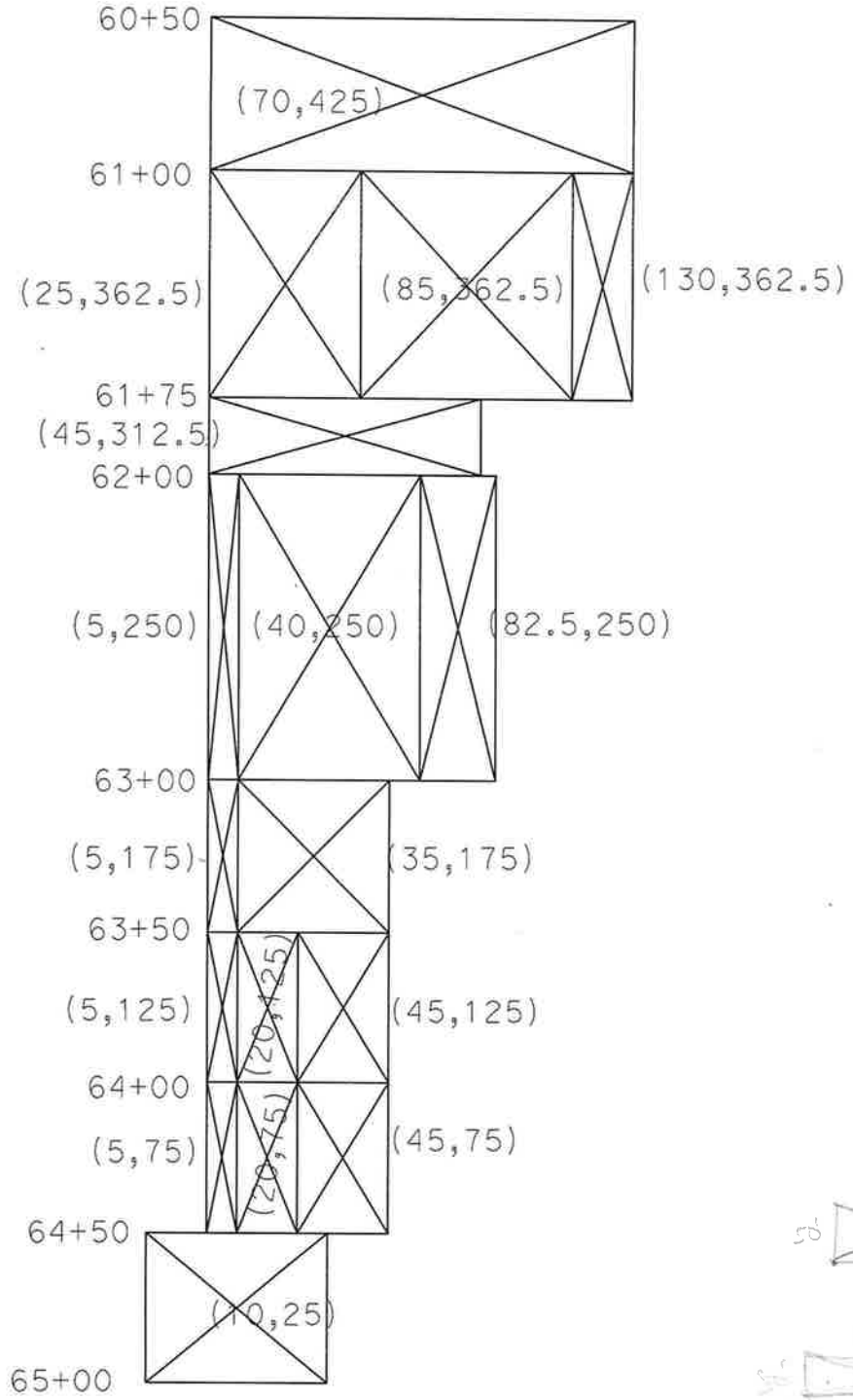
Reference

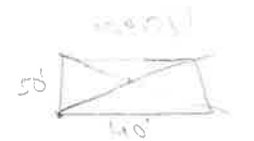


X SETTLEMENT POINT

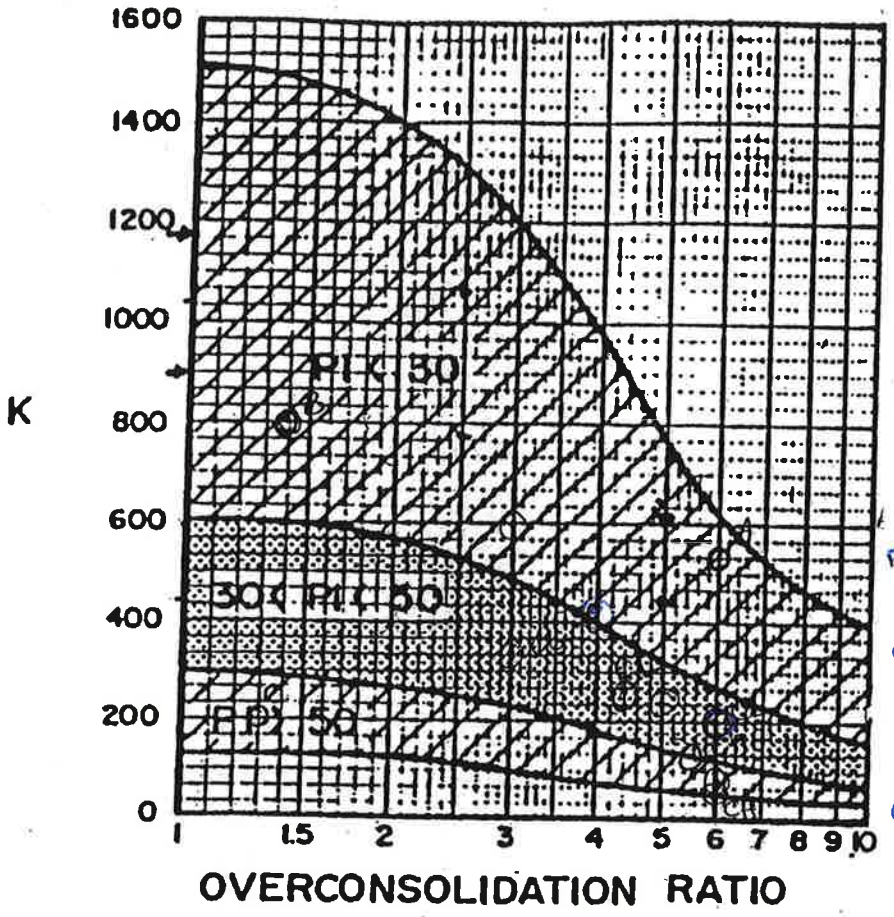
SETTLEMENT SUMMARY

RW3.


60+50
(70,425)
61+00
(25,362.5)
(85,362.5)
(130,362.5)
61+75
(45,312.5)
62+00
(5,250)
(40,250)
(82.5,250)
63+00
(5,175)
(35,175)
63+50
(5,125)
(20,125)
(45,125)
64+00
(5,75)
(20,75)
(45,75)
64+50
(10,25)
65+00


50'
40'

(10,25)
-10
30



CH @ 0'-7'
$E = KS_u = (200)(1600)$
$= 320000 = 0.32 \times 10^6$

CH @ 7'-11.5'
$E = KS_u = (200)(3000)$
$= 600000 = 0.6 \times 10^6$

CL @ 11.5'-16' and 23-28.5'
$E = KS_u = (400)(1000)$
$= 400000 = 0.4 \times 10^6$

CL @ 32-38'
$E = KS_u = (400)(2700)$
$= 1080000 = 1.08 \times 10^6 \cong 1.0 \times 10^6$

$E_u = KS_u$

E_u = UNDRAINED MODULUS OF CLAY

K = FACTOR FROM CHART ABOVE

S_u = UNDRAINED SHEAR STRENGTH OF CLAY

Fig 2 CHART FOR ESTIMATING UNDRAINED MODULUS OF CLAY

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-6-09	11-6-09	1861130.5 ft / 6369039.9 ft NAD83	A-09-103
DRILLING CONTRACTOR: Clear Heart Drilling			BOREHOLE LOCATION (Offset, Station, Line): ' Lt Sta ~	SURFACE ELEVATION: 37 ft NAVD 88
DRILLING METHOD: Hollow-Stem Auger			DRILL RIG: DR 8K	BOREHOLE DIAMETER: 8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96"), SPT (1.44")			SPT HAMMER TYPE: 140 lb/30 in - Auto Hammer	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING N/A; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 51.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	5 inches ASPHALT CONCRETE over 31 inches AGGREGATE BASE.												
35.00	2													
	3	CLAYEY SAND with GRAVEL (SC); medium dense; brown; moist [FILL].												
33.00	4			1	11 5 7	12	35							
	5	Fat CLAY (CH); stiff; black; moist.		2	5 7 11	18	55		39	80	UC = 0.83			Stabilization fabric at 5 feet; γ_m = 111; c = 1660
31.00	6													
	7													
29.00	8	At EL. 29.0 ft, becomes very stiff; grayish brown.												
	9			3	5 8 16	24	70		27	98	UC = 1.51			LL=57 PI=38 PI; γ_m = 124; c = 3020
27.00	10													
	11													
25.00	12													
	13													
23.00	14	SANDY lean CLAY (CL); medium stiff; grayish brown; moist.		4	3 4 5	9	65		25	100	UC = 0.47			Water added by driller; γ_m = 125; c = 940
	15													
21.00	16													
	17													
19.00	18	Poorly graded SAND with SILT and GRAVEL (SP-SM); dense; grayish brown; moist.												
	19													
17.00	20			5	15 23 24	47	55		12	118				γ_m = 132
	21													
15.00	22													
	23													
13.00	24													
	25													

(continued)

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San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				A-09-103
DIST. 04	COUNTY Sonoma	ROUTE 101	POSTMILE 7.4/8.1	EA 04-12276K
PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY A. Cheung	DATE 11-10-09	SHEET 1 of 2	

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
	25													
11.00	26	Lean CLAY (CL); stiff; bluish gray; moist.		6	4 5 5	10	100							
9.00	28													
7.00	30													
	31	SILTY SAND (SM); medium dense; grayish brown; moist.		7	6 15 23	38	50		14	116				γ_m=132
5.00	32													
3.00	34													
	35	Lean CLAY (CL); very stiff; gray mottled with brown; moist.		8	5 11 12	23	70		24	103	UC = 1.36			γ_m=128 c=2790
1.00	36													
-1.00	38	SANDY lean CLAY (CL); grayish brown; moist.												
-3.00	40	SILTY SAND (SM); very dense; grayish brown; moist; trace GRAVEL.		9	12 27 37	64	85							
-5.00	42													
-7.00	44	SANDY lean CLAY (CL); brown; moist.												
	45	SILTY SAND (SM); very dense; light brown; moist.		10	24 66/6"	66/ 6"	65							Sampler advanced 12 in.
-9.00	46													
-11.00	48													
	49	At EL. -12.0 ft, grades to Silty Sand (SM) to Sandy Silt (ML).												
-13.00	50			11	16 26 41	67	95							
	51													
-15.00	52	Bottom of Borehole at 51.5 ft.												
	53													
-17.00	54													
	55													

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 12/15/09

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**A-09-103**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **A. Cheung**		DATE **11-10-09**	SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-4-09	11-4-09	1861311.7 ft / 6368919.5 ft NAD83	A-09-104
DRILLING CONTRACTOR: Clear Heart Drilling			BOREHOLE LOCATION (Offset, Station, Line): ' Lt Sta ~	SURFACE ELEVATION: 39 ft NAVD 88
DRILLING METHOD: Hollow-Stem Auger			DRILL RIG: DR 5K	BOREHOLE DIAMETER: 8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96"), SPT (1.44")			SPT HAMMER TYPE: 140 lb/30 in - Rope & CAT Head	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING 20 ft; AFTER DRILLING (DATE) 15 ft on 11-14-09	TOTAL DEPTH OF BORING: 51.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Remarks
	0	6 inches ASPHALT CONCRETE over 12 inches AGGREGATE BASE.										
	1			1	11 8 8	16	25		11	97		γ_m=108
36.50	2	CLAYEY GRAVEL (GC); medium dense; brown; moist [FILL].										Bag sample 2 to 5 feet
	3			2	6 11 14	25	60					
34.50	4	GRAVELLY lean to fat CLAY (CL/CH); brown to black; moist [FILL].										
	5	Fat CLAY (CH); stiff; black; moist.		3	5 10 13	23	50		39	79	UC = 0.90	γ_m=110 c=1800
32.50	6											
	7											
30.50	8											
	9											
28.50	10	At EL. 28.5 ft, becomes very stiff; gray.		4	8 12 14	26	65		27	96	UC = 1.53	γ_m=122 c=3060
	11											
26.50	12											
	13											
24.50	14											
	15	Lean CLAY (CL); stiff; dark bluish gray with some speckling; moist.		5	5 10 10	20	50		23	104	UC = 0.93	γ_m=128 c=1860
22.50	16											
	17											
20.50	18											
	19											
18.50	20	SILTY SAND with GRAVEL (SM); medium dense; dark gray; moist.		6	15 11 10	21	75					
	21											
16.50	22											
	23											
14.50	24											
	25											

(continued)

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 12/15/09

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE	HOLE ID
BORING RECORD	A-09-104

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Sonoma	101	7.4/8.1	04-12276K

PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	A. Cheung	11-10-09	1 of 2

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
	25	SILTY SAND with GRAVEL (SM) *(continued)*.		7	8 14 15	29	70		15					+#4=33% -#200=14% PA
12.50	26													
	27													
10.50	28													
	29													
8.50	30	Poorly graded SAND with SILT (SP-SM); very dense; light brown; moist; trace GRAVEL.		8	20 40 45	85	80		15	108				γ_m=124
	31													
6.50	32													
	33													
4.50	34													
	35	Coarse SAND.		9	19 34 37	71	95							
2.50	36													
	37													
0.50	38													
	39													
-1.50	40	SILTY SAND (SM); very dense; light brownish gray; fine SAND.		10	29 33 36	69	95							
	41													
-3.50	42													
	43													
-5.50	44													
	45			11	15 27 20	47	100							
-7.50	46	Poorly graded SAND with SILT (SP-SM); dense; moist; trace fine GRAVEL.												
	47													
-9.50	48													
	49													
-11.50	50			12	20 48 59/3"	107/ 9"	90							
	51	SILTY SAND (SM); very dense; light brown; moist.												Sampler advanced 15 in.
-13.50	52	Bottom of Borehole at 51.5 ft.												
	53													
-15.50	54													
	55													

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 12/15/09

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**A-09-104**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **A. Cheung**		DATE **11-10-09**	SHEET **2 of 2**

SETTLEMENT POINT -10,0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	385	143.2	184	159.5	1	0.3	-0.007	0.293
2	904.1	164.8	168.3	164.3	1	0.063	0	0.063
3	1163.4	178	146.4	161.9	1	0.03	0.003	0.033
4	1532.2	186.4	121	155.9	1	0	0.022	0.022
5	1948	189.1	96.1	147.8	1	0.027	0.011	0.038
6	2241.9	187.9	81.4	142	1	0	0.013	0.013
7	2560.5	184.7	68.5	136.2	1	0.022	0.006	0.028
8	3192.9	175.8	50.2	126.1	1	0	0.044	0.044
						---	---	---
						0.441	0.091	0.532

SETTLEMENT POINT 0,50

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	385	710.8	547.1	615.1	1	0.992	0.034	1.026
2	904.1	673.8	373.7	498.6	1	0.209	0.021	0.23
3	1163.4	631.5	286.3	426.3	1	0.09	0.033	0.123
4	1532.2	584.1	216.8	361.8	1	0	0.086	0.086
5	1948	534.8	161.7	306	1	0.07	0.05	0.119
6	2241.9	502	132.5	274.3	1	0	0.04	0.04
7	2560.5	469.8	108.5	246.7	1	0.053	0.021	0.074
8	3192.9	415.1	76.2	206.7	1	0	0.119	0.119
						---	---	---
						1.414	0.404	1.818

SETTLEMENT POINT 60,50

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	385	132.4	173.7	147.6	1	0.28	-0.007	0.273
2	904.1	141.6	198.5	162.3	1	0.055	-0.003	0.051
3	1163.4	153.8	204.8	170.2	1	0.026	-0.004	0.022
4	1532.2	170.4	199.5	174.6	1	0	0.012	0.012
5	1948	188.8	183.2	174.8	1	0.027	0.002	0.028
6	2241.9	200	168.1	172.8	1	0	0.01	0.01
7	2560.5	209.5	151.2	169.2	1	0.025	0.004	0.028
8	3192.9	220.4	120.4	160.3	1	0	0.049	0.049
						---	---	---
						0.412	0.062	0.474

SETTLEMENT POINT 60,175

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	385	520.1	487.3	517.3	1	0.811	0.005	0.815
2	904.1	521.8	433.9	507.9	1	0.171	0.005	0.176
3	1163.4	524.6	390.6	494.1	1	0.078	0.01	0.087
4	1532.2	528.2	342.3	471.9	1	0	0.06	0.06
5	1948	530.2	291.3	442.1	1	0.069	0.027	0.096
6	2241.9	529.2	257.9	419.4	1	0	0.034	0.034
7	2560.5	525.8	225.9	395.5	1	0.058	0.015	0.074
8	3192.9	513.3	174.7	352.5	1	0	0.128	0.128
						---	---	---
						1.187	0.283	1.47

SETTLEMENT POINT 0,250

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	385	711.9	607.6	656	1	0.993	0.021	1.014
2	904.1	683.9	489.8	576.8	1	0.211	0.014	0.225
3	1163.4	654.7	432.4	528.4	1	0.093	0.021	0.114
4	1532.2	626.5	383.6	483.9	1	0	0.077	0.077
5	1948	601.8	337.8	442.1	1	0.077	0.035	0.112
6	2241.9	587.1	308.6	415.6	1	0	0.039	0.039
7	2560.5	573.4	280.5	390	1	0.063	0.017	0.08
8	3192.9	549.6	233.9	346.4	1	0	0.135	0.135
						---	---	---
						1.438	0.359	1.796

SETTLEMENT POINT 40,250

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	385	1039.8	935.2	984.4	1	1.241	0.021	1.262
2	904.1	1035.8	770.2	894.6	1	0.286	0.018	0.305
3	1163.4	1026.6	646.7	823.8	1	0.132	0.035	0.167
4	1532.2	1007.5	522.6	747.1	1	0	0.132	0.132
5	1948	975.6	407.7	668.1	1	0.116	0.072	0.189
6	2241.9	947.5	341	616.7	1	0	0.069	0.069
7	2560.5	914.8	283.2	567.2	1	0.096	0.035	0.131
8	3192.9	848.8	202	485.9	1	0	0.231	0.231
						1.871	0.614	2.485

SETTLEMENT POINT 45,312.5

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	385	1169.3	1065.2	1094.3	1	1.324	0.024	1.347
2	904.1	1161.6	899.8	982.7	1	0.31	0.02	0.33
3	1163.4	1149.2	774.6	901.7	1	0.143	0.037	0.181
4	1532.2	1128.9	646.6	815.5	1	0	0.145	0.145
5	1948	1098.3	524.6	725.9	1	0.128	0.078	0.206
6	2241.9	1071.8	451.4	666.6	1	0	0.077	0.077
7	2560.5	1040.8	385.9	608.8	1	0.107	0.039	0.146
8	3192.9	976.8	289.4	512.4	1	0	0.265	0.265
						---	---	---
						2.012	0.685	2.697

SETTLEMENT POINT 0,312.5

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	385	585	555.2	560.8	1	0.876	0.007	0.884
2	904.1	584.3	508.5	519.8	1	0.187	0.006	0.193
3	1163.4	581.9	473.1	486.9	1	0.085	0.012	0.097
4	1532.2	577.2	435.4	451.5	1	0	0.065	0.065
5	1948	570.5	395.8	414.8	1	0.074	0.027	0.101
6	2241.9	565.3	369.1	390.3	1	0	0.035	0.035
7	2560.5	559.5	342.3	365.9	1	0.062	0.015	0.077
8	3192.9	547.5	295.4	323.3	1	0	0.13	0.13
						---	---	---
						1.283	0.299	1.582

SETTLEMENT POINT 0,362.5

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	385	520	505.5	495.3	1	0.811	0.005	0.816
2	904.1	519.8	481.3	455.4	1	0.17	0.005	0.175
3	1163.4	519.4	460.5	423.9	1	0.077	0.009	0.086
4	1532.2	518.6	435.3	389.7	1	0	0.057	0.057
5	1948	516.9	405.4	353.9	1	0.067	0.023	0.09
6	2241.9	515.2	383.2	330.3	1	0	0.032	0.032
7	2560.5	512.8	359.6	307.1	1	0.057	0.013	0.07
8	3192.9	506.1	315.4	267.8	1	0	0.119	0.119
						1.183	0.262	1.445

SETTLEMENT POINT 85, 362.5

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	385	1559.5	1414.6	1416.6	1	1.536	0.038	1.574
2	904.1	1550.5	1185.8	1191.5	1	0.375	0.033	0.407
3	1163.4	1530	1014.2	1023.9	1	0.175	0.061	0.236
4	1532.2	1489	840.9	856.5	1	0	0.206	0.206
5	1948	1423.5	678.1	701.6	1	0.157	0.121	0.278
6	2241.9	1367.8	581.4	611	1	0	0.106	0.106
7	2560.5	1304.9	495.6	531.4	1	0.129	0.057	0.186
8	3192.9	1183	369.6	415.8	1	0	0.341	0.341
						---	---	---
						2.372	0.963	3.334

SETTLEMENT POINT 0,425

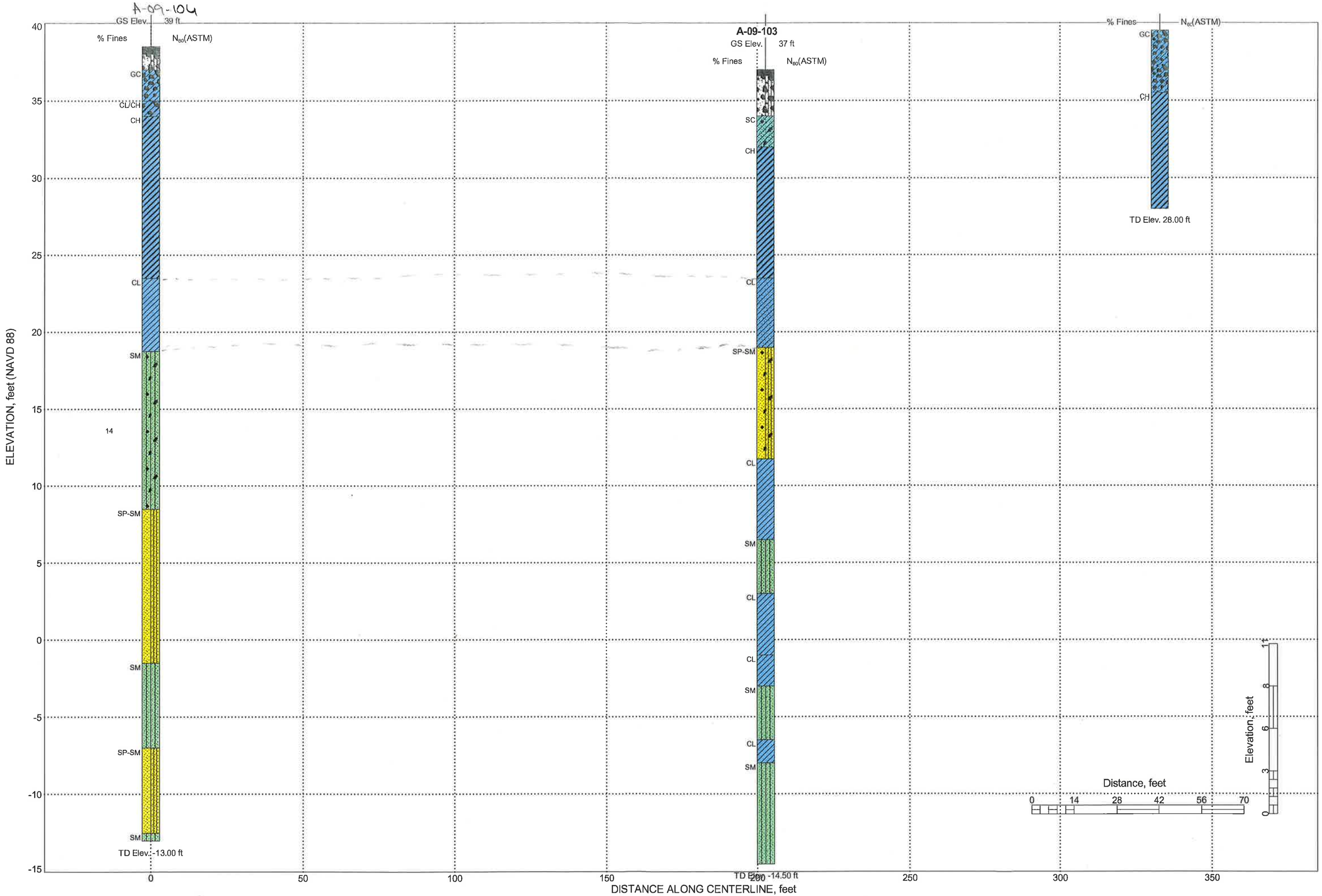
SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	385	324.9	313.1	309	1	0.58	0.004	0.584
2	904.1	323.9	294	284.7	1	0.115	0.003	0.118
3	1163.4	321.8	278.9	267.6	1	0.051	0.006	0.057
4	1532.2	318.4	262.2	251.2	1	0	0.035	0.035
5	1948	314.1	244.2	235.9	1	0.043	0.012	0.055
6	2241.9	311.1	231.8	226.2	1	0	0.018	0.018
7	2560.5	308.1	219	216.8	1	0.036	0.006	0.042
8	3192.9	303.2	195.8	200.4	1	0	0.066	0.066
						---	---	---
						0.825	0.15	0.975

SETTLEMENT POINT 70,425

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	385	650.1	607.7	632	1	0.938	0.008	0.946
2	904.1	650.8	539.2	599.6	1	0.203	0.007	0.211
3	1163.4	651.8	484.5	569.1	1	0.093	0.015	0.108
4	1532.2	652	424.4	530.5	1	0	0.077	0.077
5	1948	649.1	361.9	485	1	0.082	0.037	0.12
6	2241.9	644.2	321.2	452.7	1	0	0.043	0.043
7	2560.5	636.6	282.4	419.9	1	0.069	0.021	0.09
8	3192.9	615.9	220.1	363	1	0	0.159	0.159
						1.386	0.367	1.753

SETTLEMENT POINT 0,450

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	385	162.5	160.4	166.7	1	0.334	0	0.334
2	904.1	162.8	156.8	173.1	1	0.062	0	0.062
3	1163.4	163.4	153.5	177.6	1	0.027	0	0.027
4	1532.2	164.8	149.5	181.3	1	0	0.014	0.014
5	1948	167.1	144.3	183.5	1	0.024	0.001	0.024
6	2241.9	169.3	140.2	183.8	1	0	0.008	0.008
7	2560.5	171.9	135.5	183	1	0.02	0.001	0.021
8	3192.9	177.3	126	178.6	1	0	0.031	0.031
						---	---	---
						0.467	0.053	0.52



SECTION: 1-1' - Part A

URS

Job OLD REDWOOD HWY | Project No. 28645097 | Sheet ____ of ____

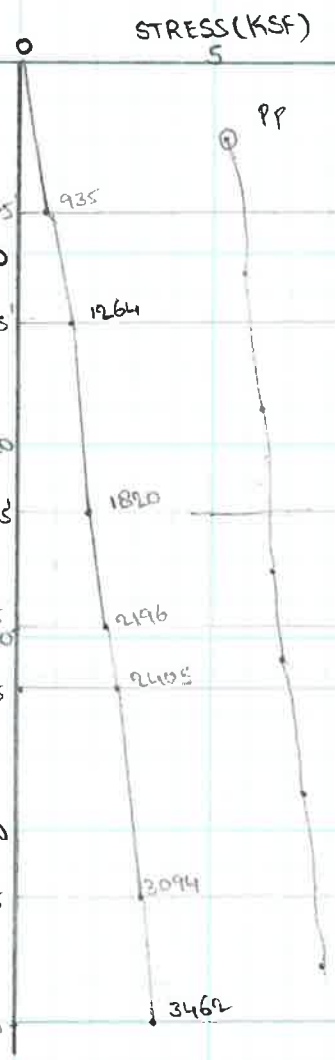
Description RW 4 & RW 5 | Computed by MT | Date 12/15/09

SETTLEMENT CALCULATIONS | Checked by ____ | Date ____

Reference

EL37

EL28 ▽



	γ' (PCF)	C_{CE}	C_{RE}	P_P (KSF)	E x10⁶ PSF	M	C_α	A	t_{ZERO}
CH	110	0.16	0.026	5.2	0.08	0.5	C_c=0.16/(1+1.012) = 0.1602; C_α=0.0648	1	
CL	59.6	0.05	C_{RE}=1/5 C_{CE} 0.01	5.8	0.6	0.5	C_c=0.05/(1+0.8) = 0.09; C_α=0.036	1	
SP-SM	55.6	-	-	6.1	0.4	0.3	-	1	
CL	62.6	0.05	0.01	6.6	1.5	0.5	0.036	1	
SM	69.6	-	-	6.9	0.4	0.3	-	1	
CL	62.6	0.05	0.01	7.3	1.5	0.5	0.036	1	
SM	56.6	-	-	7.8	0.4	0.3	-	1	

PORE PRESSURE CONSTANT

URS

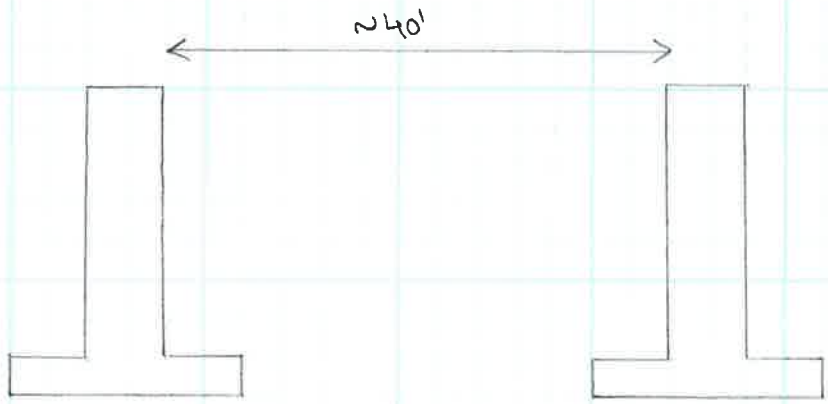
Page 2 of 3

Job _____ Project No. _____ Sheet ____ of ____

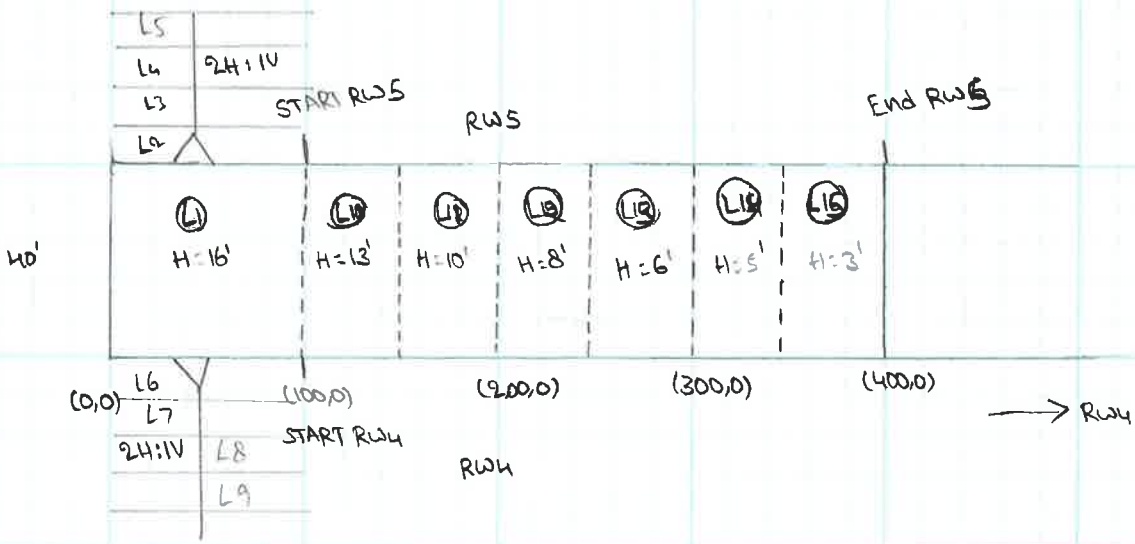
Description _____ Computed by _____ Date _____

_____ Checked by _____ Date _____

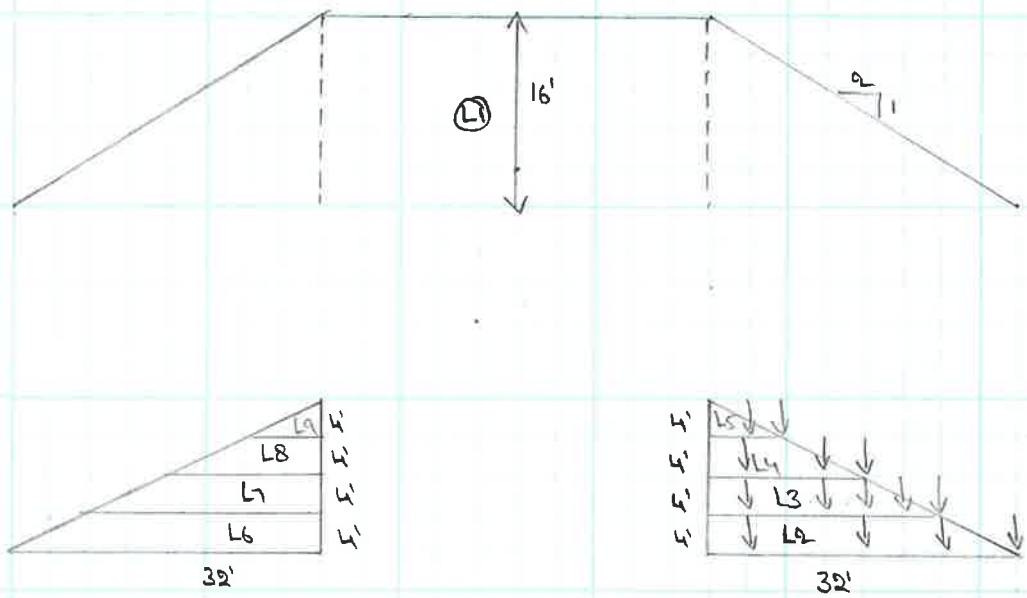
Reference



CROSS - SECTION

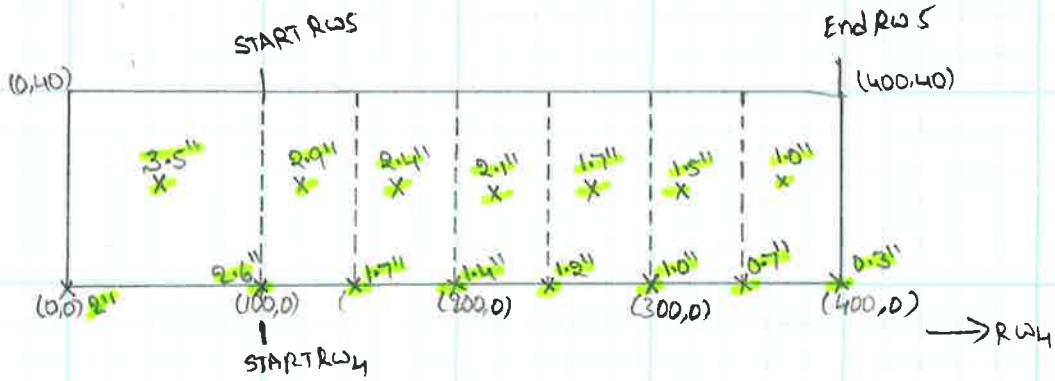


PLAN VIEW



SECTION VIEW FROM 0 TO 100

SETTLEMENTS

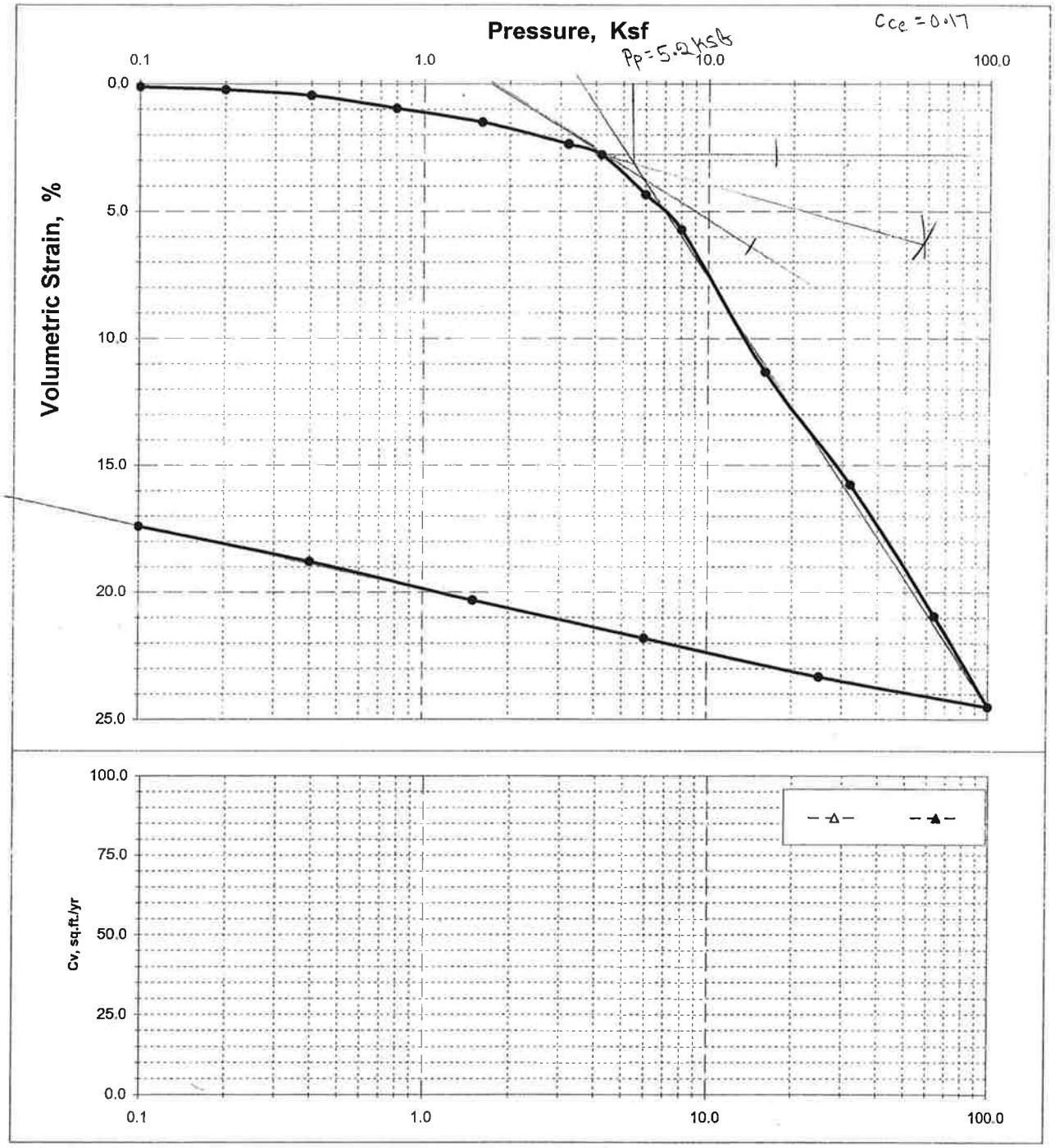


PLAN VIEW

X SETTLEMENT POINT (CONSOL + ELASTIC SETTLEMENT, FOR SANDS ONLY)

CONSOLIDATION TEST

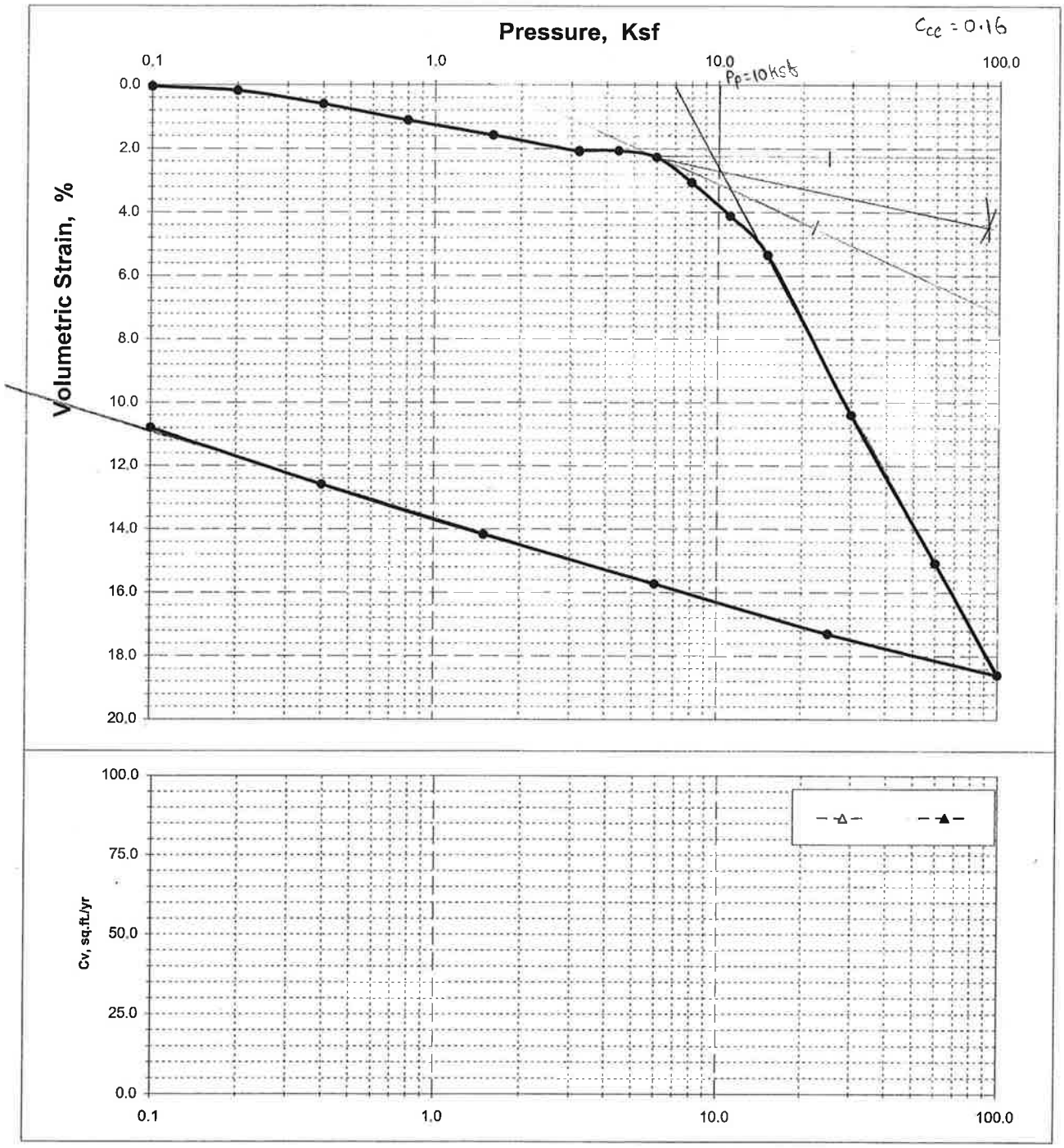
Boring Number	A-09-106	Sample Number	10	Depth (ft)	5-7.5				
Soil Description	Dark gray clay								
	Water Content, %	Total Unit Weight, pcf	Void Ratio	Saturation %	Height in	Diameter in	Specific Gravity	Liquid Limit, %	Plasticity Index, %
Initial	35.1	113.2	1.012	93.6	1.00	2.420	(assumed) 2.70	82	50
Final	28.5	131.7	0.646	119.2	0.818				



286645097

CONSOLIDATION TEST

Boring Number	A-09-101	Sample Number	2-X	Depth (ft)	5-7.5				
Soil Description	Dark brown clayey silt								
	Water Content, %	Total Unit Weight, pcf	Void Ratio	Saturation %	Height in	Diameter in	Specific Gravity	Liquid Limit, %	Plasticity Index, %
Initial	31.8	114.9	0.934	91.8	1.00	2.420	(assumed) 2.70	79	42
Final	27.3	124.4	0.725	101.7	0.892				



28645097.04

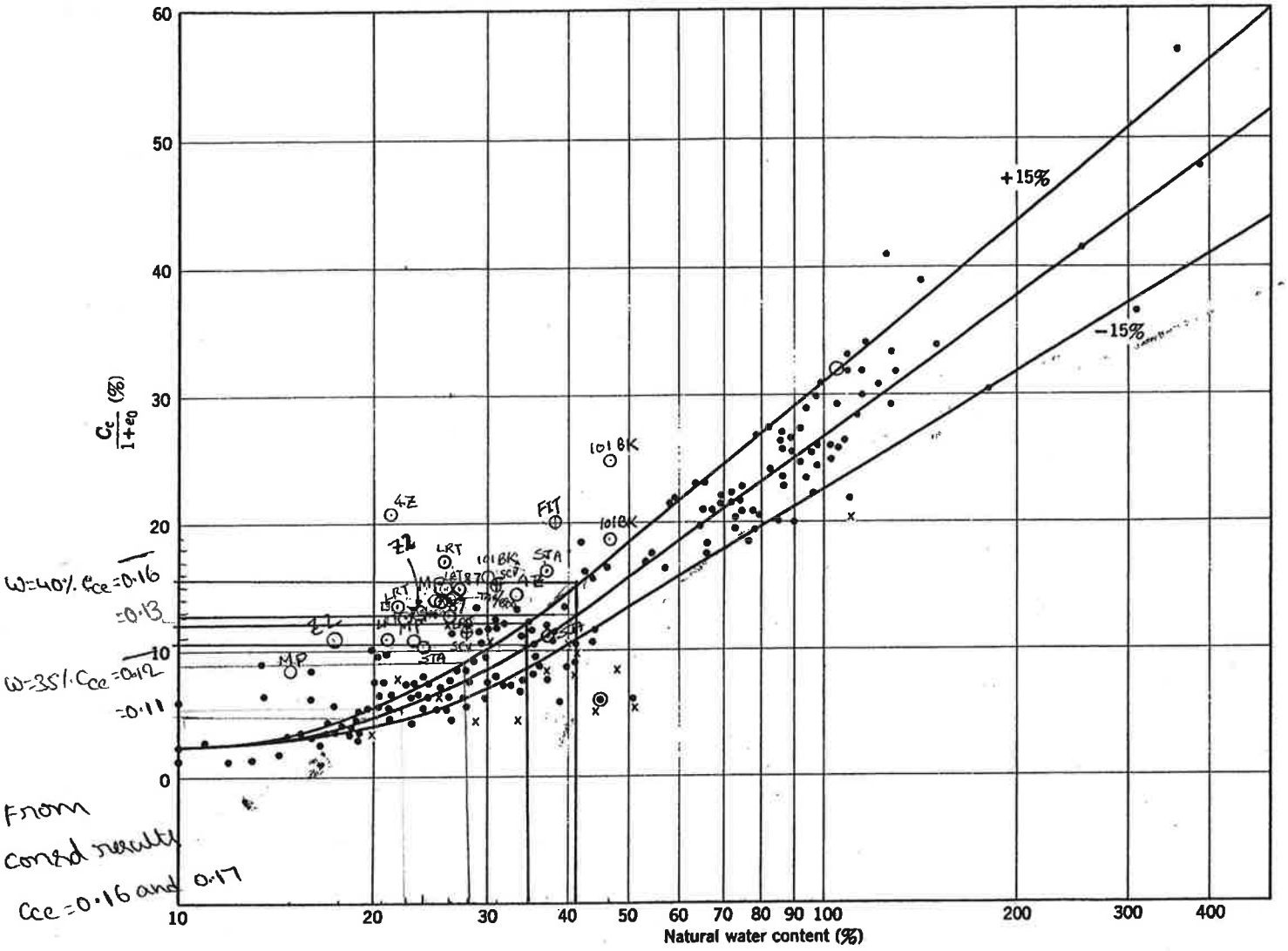
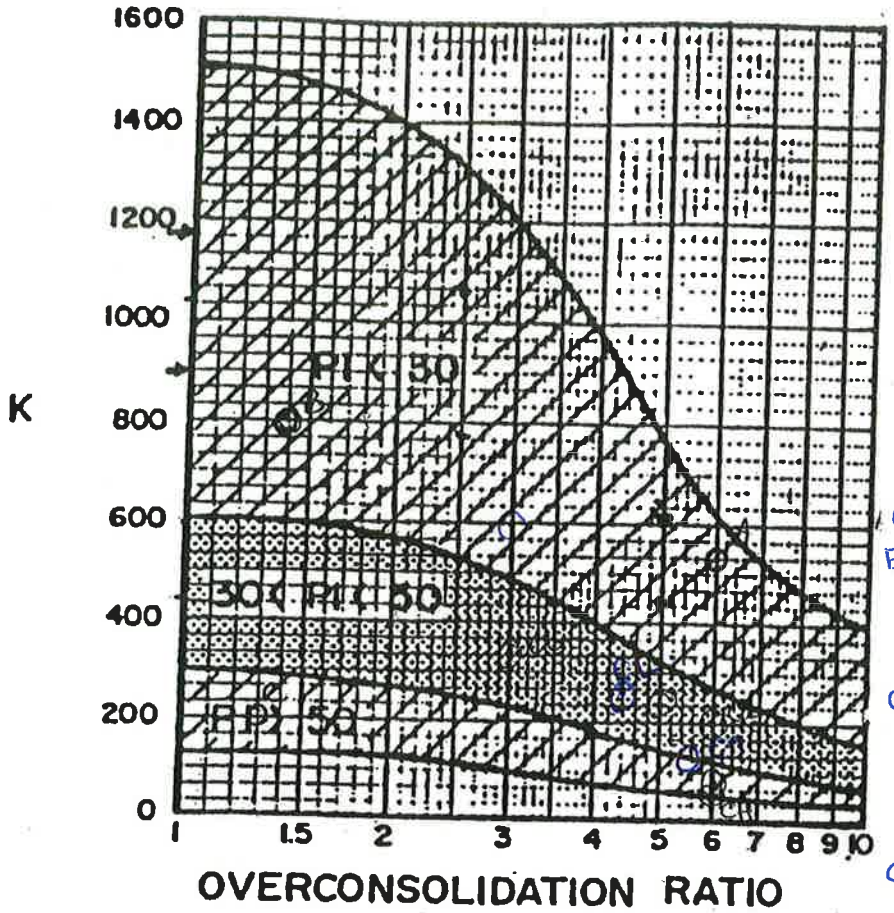


Fig. 22.1(c)

(After Lamb and Whitman, 1969)

SAN JOSE LOCAL PROJECTS

- FIT — 16755V — FIDELITY TITLE OFFICE BUILDING
- STA — 16171V — S.J. AIRPORT
- 4Z — 8715027R — 4TH/ZANKER
- MP — 8815005R — MILPITAS PIPELINE
- LRT — 8815012R — ROUTE 85 / LRT TUNNEL
- 87 — ROUTE 87 BRIDGE (NORTH BOUND) 8810100R
- 101 BK — HWY 101 / BROKAW RD 8810188R
- TAS/880 — TASMAN DR. / I-880
- SCV — 91C0204R — SANTA CLARA CONDUIT VAULT
- ZZ — 90C0428R — MILPITAS ZONE 2 TANK



CH @ 0 8.5'
E = KSu = (100)(800)
= 80000 = 0.08×10^6

CL @ 8.5-13'
E = KSu = (250)(2500)
= 625000 = 0.6×10^6

CL @ 23.5'-29.5'
= (600)(2500) = 1.5×10^6

$E_u = KS_u$

E_u = UNDRAINED MODULUS OF CLAY

K = FACTOR FROM CHART ABOVE

S_u = UNDRAINED SHEAR STRENGTH OF CLAY

Fig. 2 CHART FOR ESTIMATING UNDRAINED MODULUS OF CLAY

```
7
37,28.5,110,.16,.026,5200,.08,.5,0,1,10
28.5,23.5,59.6,.05,.01,5800,.6,.5,0,1,10
23.5,13.5,55.6,0,0,6100,.4,.3,0,1,10
13.5,7.5,62.6,0.05,0.01,6600,1.5,.5,0,1,10
7.5,4.5,69.6,0,0,6900,.4,.3,0,1,10
4.5,-6.5,62.6,0.05,0.01,7300,1.5,.5,0,1,10
-6.5,-13,56.6,0,0,7800,0.4,0.3,0,1,10
20
0
15
50,20,0,37,100,40,2080
50,56,0,37,100,32,520
50,52,0,41,100,24,520
50,48,0,45,100,16,520
50,44,0,49,100,8,520
50,-16,0,37,100,32,520
50,-12,0,41,100,24,520
50,-8,0,45,100,16,520
50,-4,0,49,100,8,520
125,20,0,37,50,40,1690
175,20,0,37,50,40,1300
225,20,0,37,50,40,1040
275,20,0,37,50,40,780
325,20,0,37,50,40,650
375,20,0,37,50,40,390
```

SETTLEMENT POINT 0,0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	467.5	966.6	825.3	717	1	1.291	0.249	1.54
2	1084	924.6	707	552.1	1	0.161	0.03	0.19
3	1511	875	597.1	412.6	1	0	0.172	0.172
4	1976.8	819.1	500.3	303.9	1	0.108	0.02	0.128
5	2269	787.1	453.7	256.9	1	0	0.052	0.052
6	2717.7	737.8	390.7	199.2	1	0.138	0.039	0.177
7	3245.9	678.4	325.6	146.8	1	0	0.105	0.105
						---	---	---
						1.698	0.666	2.363

SETTLEMENT POINT 100,0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	467.5	1388.8	1207.2	1082.2	1	1.588	0.311	1.899
2	1084	1343.3	1026.8	832.2	1	0.21	0.041	0.251
3	1511	1281.7	854.3	613.9	1	0	0.252	0.252
4	1976.8	1203.7	700.6	442.3	1	0.149	0.03	0.179
5	2269	1156.2	626.7	368.7	1	0	0.077	0.077
6	2717.7	1080.2	527.5	279.7	1	0.192	0.06	0.251
7	3245.9	986.4	426.7	201	1	0	0.156	0.156
						---	---	---
						2.139	0.928	3.067

SETTLEMENT POINT 150,0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	467.5	748	729.5	652.6	1	1.101	0.073	1.173
2	1084	744.9	670.6	507.7	1	0.136	0.016	0.152
3	1511	731.6	605.5	373.2	1	0	0.131	0.131
4	1976.8	705.7	538.7	265.6	1	0.095	0.015	0.11
5	2269	687.3	502.9	219.7	1	0	0.042	0.042
6	2717.7	655.7	450.5	165.2	1	0.124	0.031	0.155
7	3245.9	614.6	391	118.2	1	0	0.09	0.09
						---	---	---
						1.456	0.397	1.853

SETTLEMENT POINT 200,0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	467.5	584.8	555.5	507.3	1	0.934	0.068	1.003
2	1084	580.7	502.2	391.4	1	0.112	0.013	0.125
3	1511	566.8	447.5	284.1	1	0	0.104	0.104
4	1976.8	541.5	396.2	198.6	1	0.076	0.012	0.087
5	2269	524	370.5	162.4	1	0	0.033	0.033
6	2717.7	494.5	334.9	119.7	1	0.096	0.024	0.119
7	3245.9	457.4	296.5	83.5	1	0	0.067	0.067
						---	---	---
						1.218	0.321	1.538

SETTLEMENT POINT 250,0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	467.5	454.8	429.4	394.2	1	0.783	0.055	0.837
2	1084	451.5	386.8	303.8	1	0.091	0.011	0.101
3	1511	440.5	343.4	220.1	1	0	0.081	0.081
4	1976.8	420.3	302.9	153.4	1	0.06	0.009	0.07
5	2269	406.4	282.9	125.1	1	0	0.026	0.026
6	2717.7	382.8	255.4	91.7	1	0.076	0.018	0.094
7	3245.9	352.9	226.5	63.4	1	0	0.052	0.052
						---	---	---
						1.009	0.252	1.261

SETTLEMENT POINT 300,0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	467.5	357.3	335.2	309.5	1	0.654	0.045	0.699
2	1084	354.6	299.4	238.3	1	0.074	0.009	0.082
3	1511	345.7	263.1	172.3	1	0	0.065	0.065
4	1976.8	329.2	229.8	119.7	1	0.048	0.007	0.056
5	2269	317.8	213.6	97.4	1	0	0.02	0.02
6	2717.7	298.5	191.7	71.2	1	0.06	0.015	0.074
7	3245.9	273.9	169.3	48.9	1	0	0.041	0.041
						---	---	---
						0.836	0.201	1.036

SETTLEMENT POINT 350,0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	467.5	259.9	241.7	224.9	1	0.509	0.034	0.543
2	1084	257.7	212.9	172.7	1	0.056	0.006	0.062
3	1511	250.7	184.5	124.4	1	0	0.047	0.047
4	1976.8	237.7	159.3	86	1	0.036	0.006	0.041
5	2269	228.7	147.5	69.7	1	0	0.015	0.015
6	2717.7	213.5	132.2	50.6	1	0.043	0.011	0.054
7	3245.9	194.3	117.3	34.5	1	0	0.029	0.029
						---	---	---
						0.644	0.148	0.791

SETTLEMENT POINT 400,0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	467.5	97.5	96.2	84.7	1	0.218	0.009	0.227
2	1084	96.9	93.5	65.7	1	0.022	0.002	0.024
3	1511	95.1	90.4	48.1	1	0	0.016	0.016
4	1976.8	91.9	86.9	34	1	0.014	0.002	0.016
5	2269	89.7	84.9	28	1	0	0.005	0.005
6	2717.7	86	81.8	20.9	1	0.018	0.003	0.021
7	3245.9	81.4	77.9	14.8	1	0	0.01	0.01
						---	---	---
						0.272	0.047	0.319

SETTLEMENT POINT 50, 20

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	467.5	2143.6	1912.4	1917.3	1	1.981	0.292	2.273
2	1084	2151.4	1517.5	1338.9	1	0.285	0.072	0.357
3	1511	2052.6	1147.6	882.9	1	0	0.433	0.433
4	1976.8	1876.8	847.3	578.1	1	0.209	0.056	0.265
5	2269	1767.2	716	460.6	1	0	0.127	0.127
6	2717.7	1596.9	555.1	328.1	1	0.265	0.102	0.367
7	3245.9	1397.3	410.6	219.4	1	0	0.236	0.236
						---	---	---
						2.74	1.317	4.057

SETTLEMENT POINT 125, 20

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	467.5	1689.1	1531.7	1280	1	1.761	0.361	2.122
2	1084	1621	1244.1	747.8	1	0.238	0.063	0.301
3	1511	1462.3	993.5	413.3	1	0	0.312	0.312
4	1976.8	1277.9	796.1	240.9	1	0.156	0.036	0.192
5	2269	1185	708.2	186.1	1	0	0.083	0.083
6	2717.7	1060.7	595.2	131.1	1	0.189	0.061	0.25
7	3245.9	935	484.2	90.2	1	0	0.149	0.149
						---	---	---
						2.344	1.065	3.409

SETTLEMENT POINT 175, 20

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	467.5	1295.3	1149	960.7	1	1.529	0.307	1.835
2	1084	1235.5	923.2	538.6	1	0.198	0.05	0.249
3	1511	1101.3	733.6	275.4	1	0	0.24	0.24
4	1976.8	945.5	592.2	143.8	1	0.122	0.028	0.15
5	2269	867.2	532.2	104.2	1	0	0.061	0.061
6	2717.7	763.4	458	67.1	1	0.142	0.044	0.186
7	3245.9	661.6	387.3	42.5	1	0	0.104	0.104
						---	---	---
						1.991	0.833	2.824

SETTLEMI EMENT PC NT : 225. 0, 20.0

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	467.5	1036	907.8	767	1	1.345	0.253	1.599
2	1084	986.8	718.5	428	1	0.169	0.041	0.21
3	1511	876.4	562.1	216.5	1	0	0.193	0.193
4	1976.8	747.8	448.5	110.7	1	0.1	0.022	0.123
5	2269	683	401.6	78.9	1	0	0.048	0.048
6	2717.7	596.9	345.1	49.2	1	0.114	0.035	0.149
7	3245.9	512.3	293.1	29.7	1	0	0.081	0.081
						---	---	---
						1.728	0.675	2.403

SETTLEMENT POINT 275, 20

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	467.5	777.1	685.1	575.7	1	1.128	0.187	1.315
2	1084	741.3	548.8	321.9	1	0.136	0.031	0.166
3	1511	660.9	433.4	163.3	1	0	0.145	0.145
4	1976.8	567.1	346.9	83.7	1	0.079	0.017	0.096
5	2269	519.6	310.4	59.7	1	0	0.037	0.037
6	2717.7	456	266	37.1	1	0.089	0.027	0.116
7	3245.9	392.6	225.2	22.2	1	0	0.062	0.062
						---	---	---
						1.431	0.505	1.936

SETTLEMENT POINT 325, 20

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	467.5	647.4	558.1	478.7	1	1.001	0.164	1.165
2	1084	615.4	429.6	266.1	1	0.117	0.027	0.144
3	1511	543.4	326	133.6	1	0	0.122	0.122
4	1976.8	459.3	253.4	67.4	1	0.065	0.014	0.08
5	2269	416.9	224.4	47.6	1	0	0.03	0.03
6	2717.7	360.7	190.4	29.2	1	0.071	0.022	0.094
7	3245.9	305.4	160.7	17.1	1	0	0.049	0.049
						---	---	---
						1.255	0.429	1.684

SETTLEMENT POINT 375, 20

SOIL LAYER	INITIAL STRESS (PSF)	VERTICAL STRESS INCREASE (PSF)	HORIZ. X STRESS INCREASE (PSF)	HORIZ. Y STRESS INCREASE (PSF)	SKEMPTON BJERRUM FACTOR	CONSOL. COMP. (IN.)	ELASTIC COMP. (IN.)	TOTAL COMP. (IN.)
1	467.5	388.4	334.2	287	1	0.697	0.099	0.796
2	1084	368.8	256.9	159.3	1	0.076	0.016	0.092
3	1511	324.6	196.2	79.7	1	0	0.073	0.073
4	1976.8	273.2	155.4	40.1	1	0.04	0.008	0.049
5	2269	247.5	139.7	28.2	1	0	0.018	0.018
6	2717.7	213.6	121.7	17.2	1	0.043	0.013	0.056
7	3245.9	180.7	106.4	10.1	1	0	0.028	0.028
						---	---	---
						0.857	0.255	1.112

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-9-09	11-9-09	1861975.3 ft / 6369073.4 ft NAD83	A-09-106
DRILLING CONTRACTOR: Clear Heart Drilling			BOREHOLE LOCATION (Offset, Station, Line): ' Lt Sta ~ 38.5	SURFACE ELEVATION: ~~39~~ ft NAVD 88
DRILLING METHOD: Hollow-Stem Auger			DRILL RIG: DR 5K	BOREHOLE DIAMETER: 8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96"), SPT (1.44"), Shelby (2.87")			SPT HAMMER TYPE: 140 lb/30 in - Rope & CAT Head	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING 15 ft; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 51.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	5 inch Asphalt Concrete over 6 inch of Aggregate Base.												
	1	Fat CLAY (CH); medium stiff; brown to black; moist.		1	4 2 4	6	65		38	80	UC = 0.40			γm = 110 c = 800 Bag sample 2 to 5 ft
36.50	2													
	3	At EL. 36.0 ft, becomes black.												
34.50	4													
	5			2										Shelby pushed with 400 to 1000 psi C, PI
32.50	6													
	7													
30.50	8													
	9													
28.50	10	Lean CLAY (CL); very stiff; gray mottled with brown; moist.		3	6 10 16	26	75		22	103	UC = 1.37			γm = 126 c = 2740
	11													
26.50	12													
	13													
24.50	14													
	15													
22.50	16	Poorly graded SAND with SILT (SP-SM); dense; grayish brown; moist; trace fine GRAVEL.		4	18 25 29	54	70		19	104				γm = 124
	17													
20.50	18													
	19													
18.50	20			5	5 21 24	45	100							
	21													
16.50	22													
	23													
14.50	24													
	25													

(continued)

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 12/15/09

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				A-09-106
DIST. 04	COUNTY Sonoma	ROUTE 101	POSTMILE 7.4/8.1	EA 04-12276K
PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY A. Cheung	DATE 11-12-09	SHEET 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														
12.50	26		Lean CLAY (CL); medium stiff; gray mottled with brown; moist.		6	7 8 9	17	95							
	27														
10.50	28														
	29														
8.50	30				7	5 12 15	27	70				PP = 1.5			
	31		SILTY SAND (SM); medium dense; gray; moist.							17	113				γ_m = 132
6.50	32														
	33														
4.50	34		Lean CLAY (CL); very stiff; gray mottled with brown; moist.												
	35				8	10 14 15	29	65		21	107	UC = 1.84			γ_m = 129
2.50	36														c = 3680
	37														
0.50	38														
	39														
-1.50	40		At EL. -1.5 ft, becomes stiff.		9	8 12 12	24	75		25	100	UC = 1.22			γ_m = 125
	41														c = 9240
-3.50	42														
	43														
-5.50	44														
	45		SILTY SAND (SM); medium dense; grayish brown.		10	7 9 16	25	50		23	97				γ_m = 119
-7.50	46														
	47														
-9.50	48														
	49														
-11.50	50				11	15 11 10	21	70							
	51														
			Lean CLAY (CL); stiff; brown; moist.												
-13.50	52		Bottom of Borehole at 51.5 ft.												
	53														
-15.50	54														
	55														

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 12/15/09

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San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**A-09-106**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **A. Cheung**		DATE **11-12-09**	SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-9-09	11-9-09	1862124.7 ft / 6368903.8 ft NAD83	A-09-107
DRILLING CONTRACTOR: Clear Heart Drilling			BOREHOLE LOCATION (Offset, Station, Line): ' Lt Sta ~	SURFACE ELEVATION: 39 ft NAVD 88
DRILLING METHOD: Hollow-Stem Auger			DRILL RIG: DR 5K	BOREHOLE DIAMETER: 7 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96"), SPT (1.44")			SPT HAMMER TYPE: 140 lb/30 in - Rope & CAT Head	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING 15 ft; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 46.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	5 inch Asphalt Concrete over 2 inch Aggregate Base.												
	1	Lean CLAY (CL); stiff; brown to gray; moist; some SAND; [FILL].		1	6 7 9	16	70							
36.50	2	Fat CLAY (CH); very stiff; black; moist.												
	3													
34.50	4													
	5			2	2 8 9	17	65		34	85	UC = 1.03			γm = 114 c = 2060
32.50	6													
	7													
30.50	8	Lean CLAY (CL); very stiff; gray mottled with brown; moist; with some black speckles.												
	9													
28.50	10			3	6 9 12	21	70		22	102	UC = 1.57			γm = 122 c = 3140
	11													
26.50	12													
	13													
24.50	14													
	15			4	8 14 20	34	60							γm = 118
22.50	16	Well-graded SAND with SILT (SW-SM); medium dense; grayish brown; moist.							23	96				
	17													
20.50	18													
	19													
18.50	20			5	11 12 8	20	100		19					PA
	21	At EL. 17.5 ft, becomes gray; fine SAND.												
16.50	22													
	23													
14.50	24													
	25	Lean CLAY (CL); stiff; gray; moist.												

(continued)

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San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				A-09-107
DIST. 04	COUNTY Sonoma	ROUTE 101	POSTMILE 7.4/8.1	EA 04-12276K
PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY A. Cheung	DATE 11-12-09	SHEET 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														
12.50	26		SANDY lean CLAY (CL); medium stiff; gray; moist.		6	8 12 12	24	45				PP = 3.5			
	27		Poorly graded SAND with SILT (SP-SM); gray; moist; coarse SAND.												
10.50	28														
	29		Lean CLAY (CL); very stiff; grayish brown; moist.												
8.50	30				7	10 13 15	28	65		18	114	UC = 1.29			V_m = 135 c = 2580
	31														
6.50	32														
	33														
4.50	34														
	35		At EL. 3.5 ft, with black speckling.		8	10 14 15	29	80				PP = 2.5			
2.50	36														
	37														
0.50	38														
	39														
-1.50	40		At EL. -1.5 ft, grades to (Lean CLAY with SAND) (CL); with sand.		9	10 14 17	31	60		21	107	UC = 1.27			V_m = 129 c = 2540
	41														
-3.50	42														
	43														
-5.50	44														
	45		Poorly graded SAND with SILT and GRAVEL (SP-SM); very dense; brown; moist.		10	13 32 40	72	60							
-7.50	46														
	47		Bottom of Borehole at 46.5 ft.												
-9.50	48														
	49														
-11.50	50														
	51														
-13.50	52														
	53														
-15.50	54														
	55														

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San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**A-09-107**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **A. Cheung**		DATE **11-12-09**	SHEET **2 of 2**

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 12/15/09

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-10-09	11-10-09	1862240.7 ft / 6368775.1 ft NAD83	A-09-105
DRILLING CONTRACTOR: Clear Heart Drilling			BOREHOLE LOCATION (Offset, Station, Line): ' Lt Sta ~	SURFACE ELEVATION: 39 ft NAVD 88
DRILLING METHOD: Hollow-Stem Auger			DRILL RIG: CME 75	BOREHOLE DIAMETER: 8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96"), SPT (1.44")			SPT HAMMER TYPE: 140lb/30in - Auto	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING 18 ft; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 51.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	10 inch Asphalt Concrete.												
	1	Lean to fat CLAY with SAND (CL/CH); stiff; gray to black; moist; trace GRAVEL; [FILL].		1	4 7 7	14	70							
37.00	2													
	3	Fat CLAY (CH); stiff; black; moist.												
35.00	4													
	5	At EL. 34.0 ft, becomes black mottled with gray.		2	3 6 6	12	70		33	85	UC = 0.65			γ_m = 113 c = 1300
33.00	6													
	7													
31.00	8													
	9													
29.00	10	SILTY SAND with GRAVEL (SM); medium dense; gray; moist.		3	13 11 12	23	65							
	11	Lean CLAY (CL); very stiff; grayish brown; moist.												
27.00	12													
	13													
25.00	14													
	15	At EL. 24.0 ft, becomes gray mottled with brown.		4	6 6 8	14	60		23	104	UC = 1.26			γ_m = 128 c = 2520
23.00	16													
	17													
21.00	18	SILTY SAND (SM); medium dense to dense; grayish brown; moist.												
	19													
19.00	20			5	10 19 49	68	95							
	21	Poorly graded SAND with GRAVEL (SP); very dense; brown; moist; trace GRAVEL; coarse SAND.												
17.00	22													
	23													
15.00	24													
	25													

(continued)

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San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				A-09-105
DIST. 04	COUNTY Sonoma	ROUTE 101	POSTMILE 7.4/8.1	EA 04-12276K
PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY A. Cheung	DATE 11-12-09	SHEET 1 of 2	

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 12/15/09

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. 14.0 ft, grades to (SILTY SAND) (SM); grayish brown.		6	62 50/5.5"	50/ 5.5"	60							
13.00	26														Sampler advanced 11.5 in.
	27														
11.00	28														
	29														
9.00	30				7	6 8 11	19	70							
	31		Lean CLAY (CL); very stiff; grayish brown; moist; with some Sandy Lean Clay lenses.												
7.00	32														
	33														
5.00	34														
	35		At EL. 4.0 ft, with less sand, some black speckiling.		8	4 7 8	15	100		25	100	UC = 1.04			γ_m = 125 c = 2080
3.00	36														
	37														
1.00	38														
	39														
-1.00	40				9	12 30 30	60	65		10	132				γ_m = 145
	41		SILTY SAND with GRAVEL (SM); dense; grayish brown; moist.												
-3.00	42														
	43														
-5.00	44														
	45		At EL. -6.0 ft, becomes medium dense; with stiff Sandy Silt lenses.		10	13 11 15	26	95							
-7.00	46														
	47														
-9.00	48														
	49														
-11.00	50		At EL. -11.0 ft, becomes very dense.		11	16 21 37	58	100							
	51														
-13.00	52		Bottom of Borehole at 51.5 ft.												
	53														
-15.00	54														
	55														

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 12/15/09

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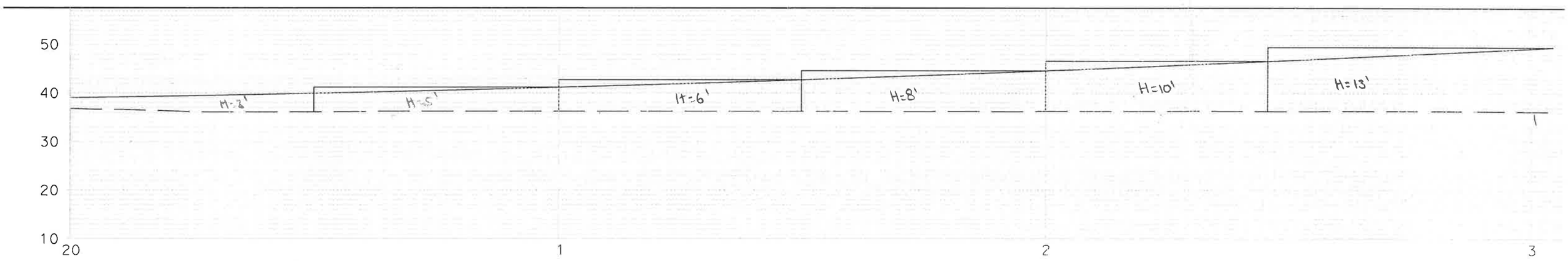
San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**A-09-105**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **A. Cheung**		DATE **11-12-09**	SHEET **2 of 2**

RW5



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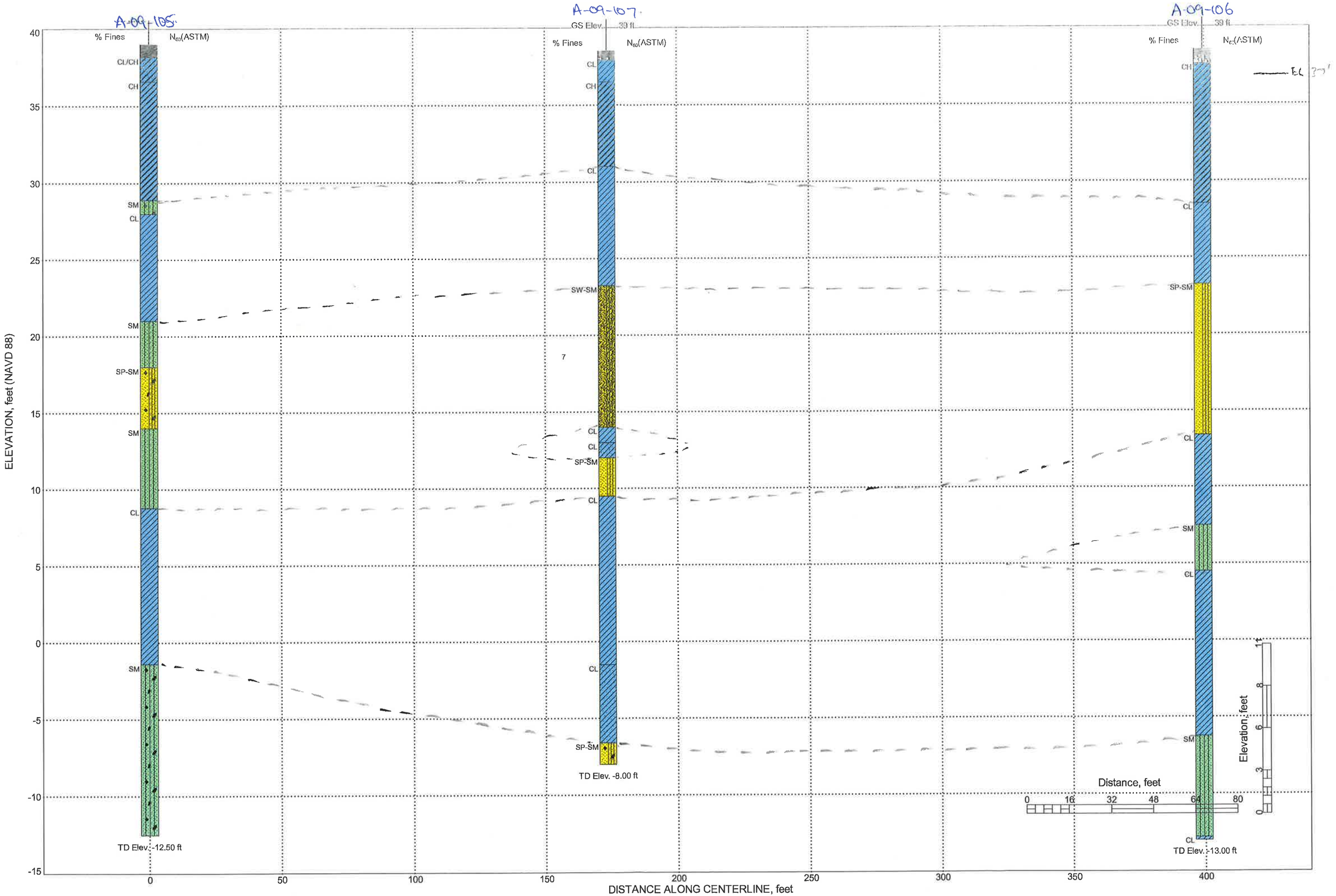


SECTION: 1-1' - Part A

URS

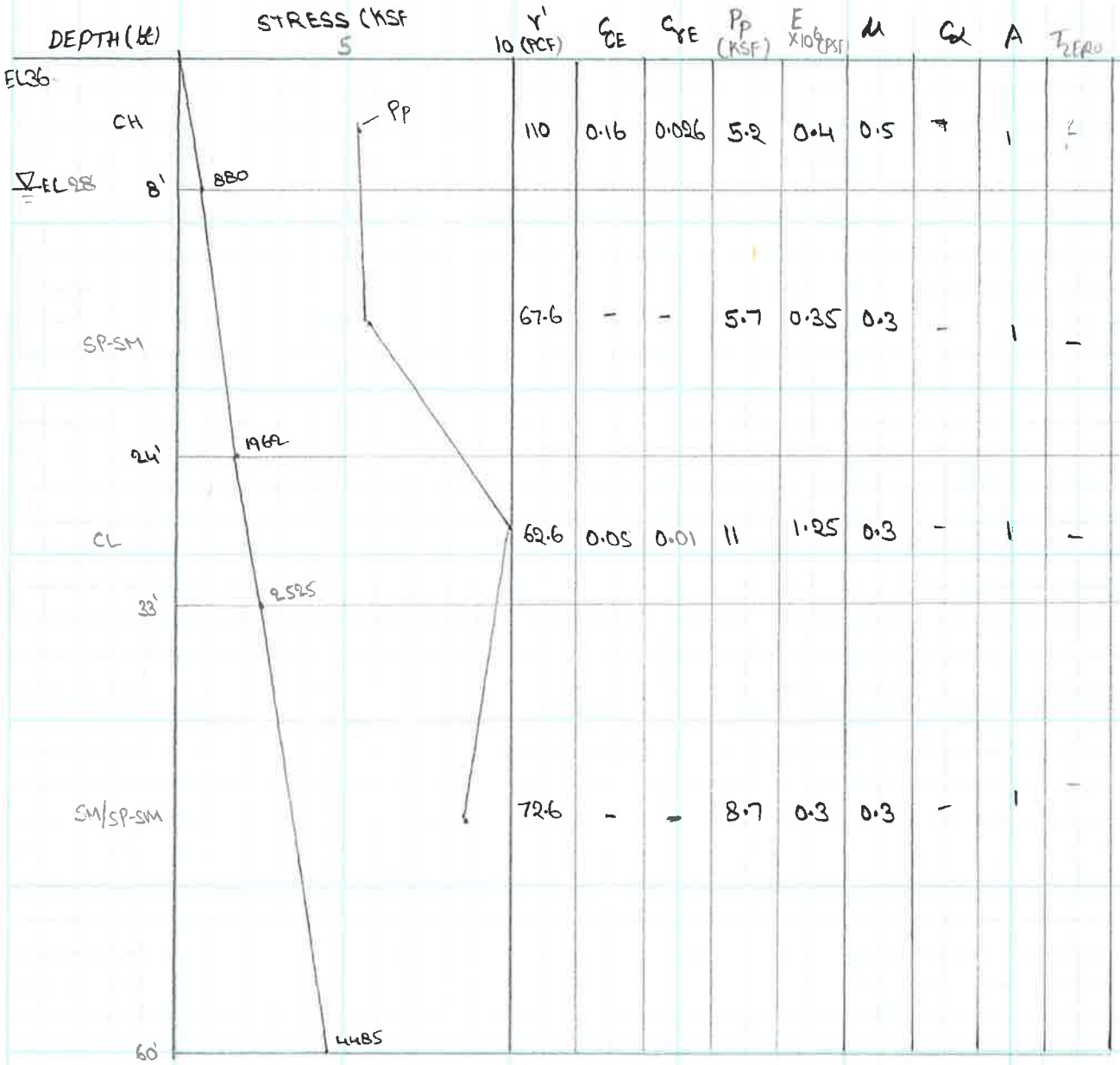
Page ____ of ____

Job OLD REDWOOD HWY OVERCROSSING | Project No. 28645097 | Sheet ____ of ____

Description RETAINING WALL 6 | Computed by MT | Date 12/23/09

SETTLEMENT CALCULATIONS | Checked by ____ | Date ____

Reference



γ' (PCF)	$C_{\varepsilon E}$	$C_{\gamma E}$	P_p (KSF)	E $\times 10^6$ PSF	μ	C_α	A	I_{ZERO}
110	0.16	0.026	5.2	0.4	0.5	–	1	–
67.6	–	–	5.7	0.35	0.3	–	1	–
62.6	0.05	0.01	11	1.25	0.3	–	1	–
72.6	–	–	8.7	0.3	0.3	–	1	–

OCR=5

$E_s = 10(N+15)$ SP-SM @ 8'-24' $N = 20$ $E_s = 10(20+15) = 350$ KSF $= 0.35 \times 10^6$ KSF

SM/SP-SM @ 33'-60' $N = 15$ $E_s = 10(15+15) = 300$ KSF $= 0.3 \times 10^6$ KSF

URS

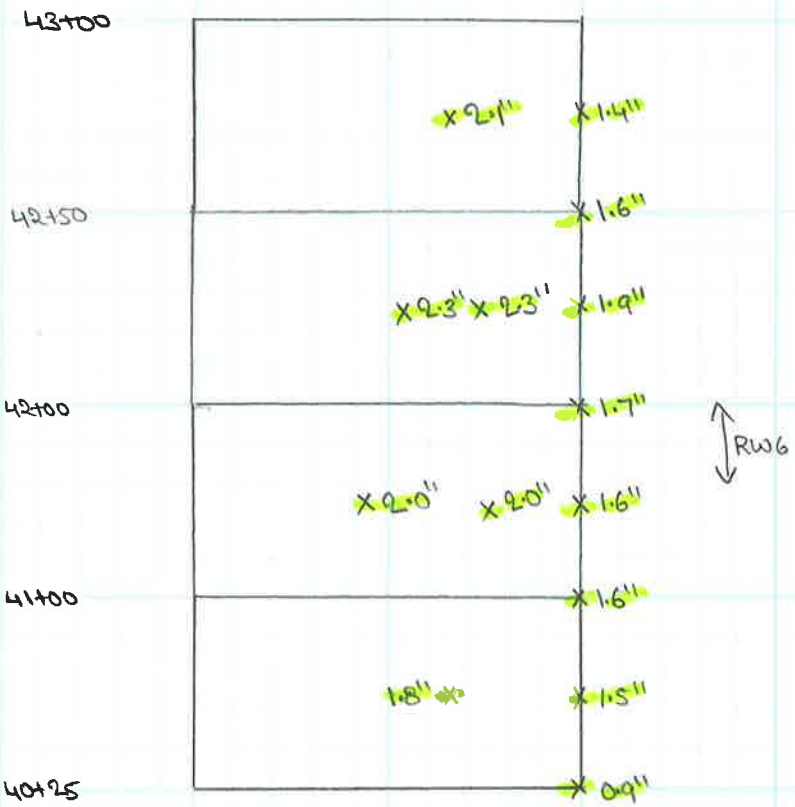
Page ____ of ____

Job _____ Project No. _____ Sheet ____ of ____

Description _____ Computed by _____ Date _____

_____ Checked by _____ Date _____

Reference



X SETTLEMENT POINT

PLAN VIEW

GREGG

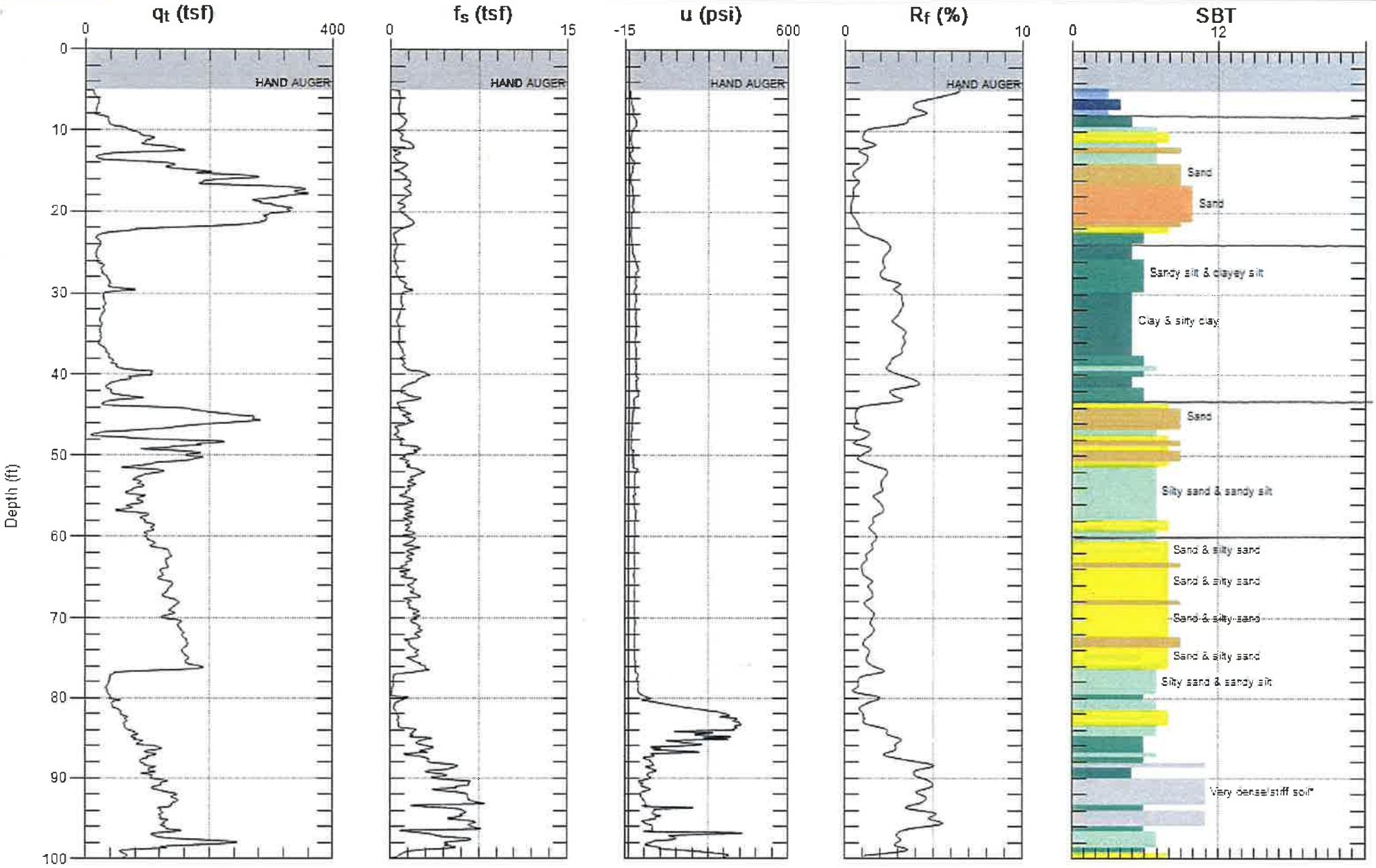
URS

Site: OLD REDWOOD HWY

Sounding: Cpt-09-114

Engineer: C.RAMBO

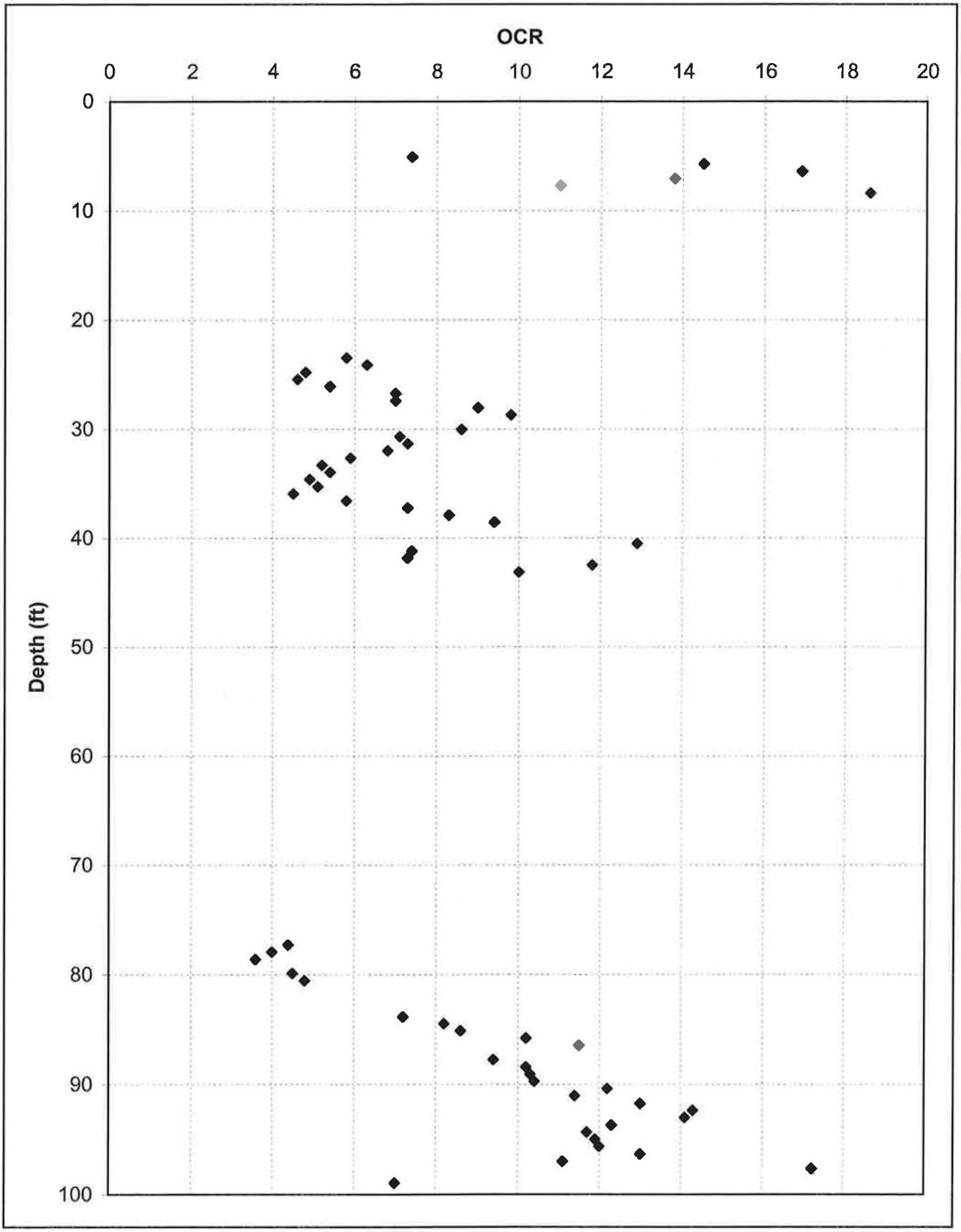
Date: 11/3/2009 05:25



Max. Depth: 100.066 (ft)
Avg. Interval: 0.656 (ft)

SBT: Soil Behavior Type (Robertson 1990)

CPT-09-114



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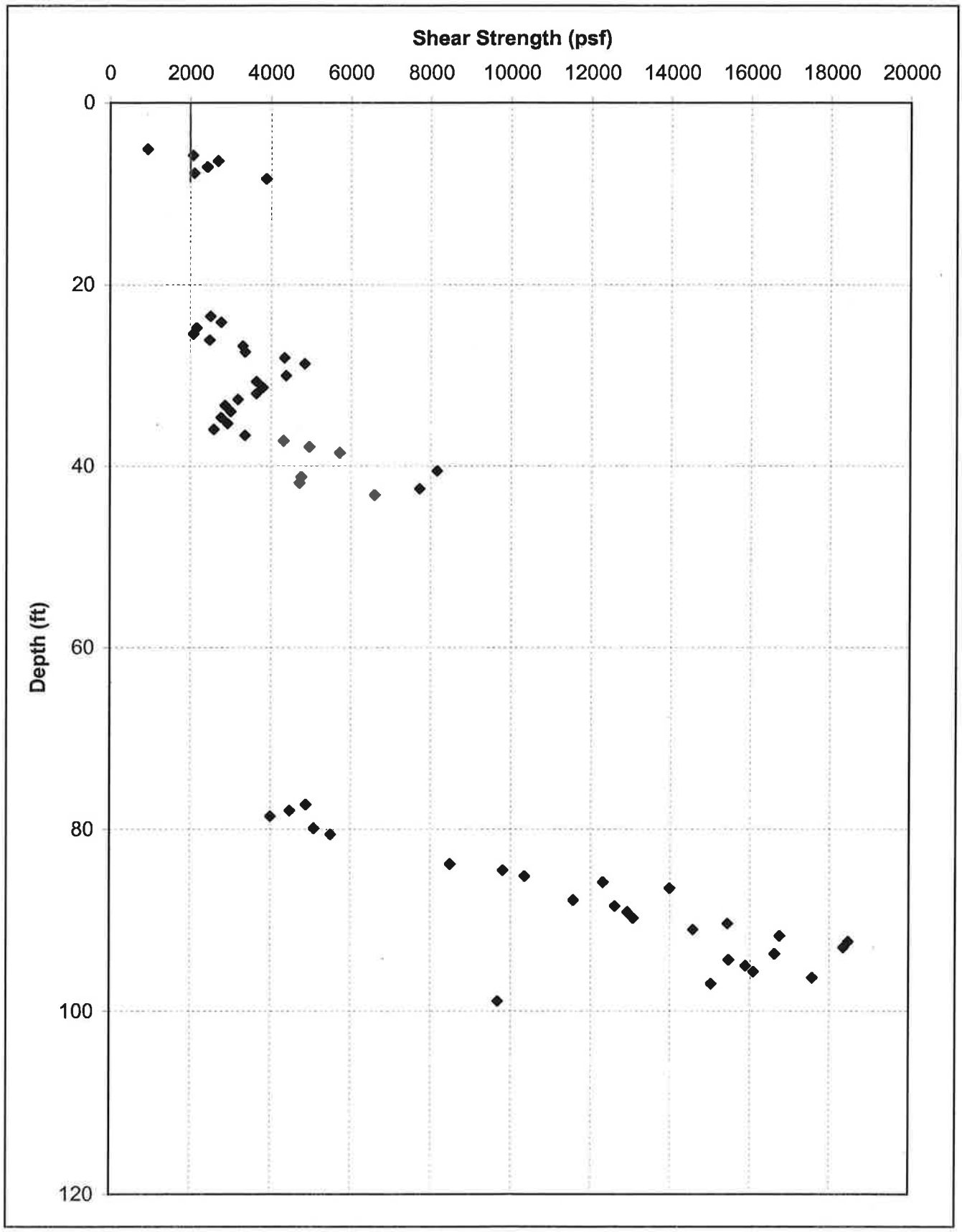
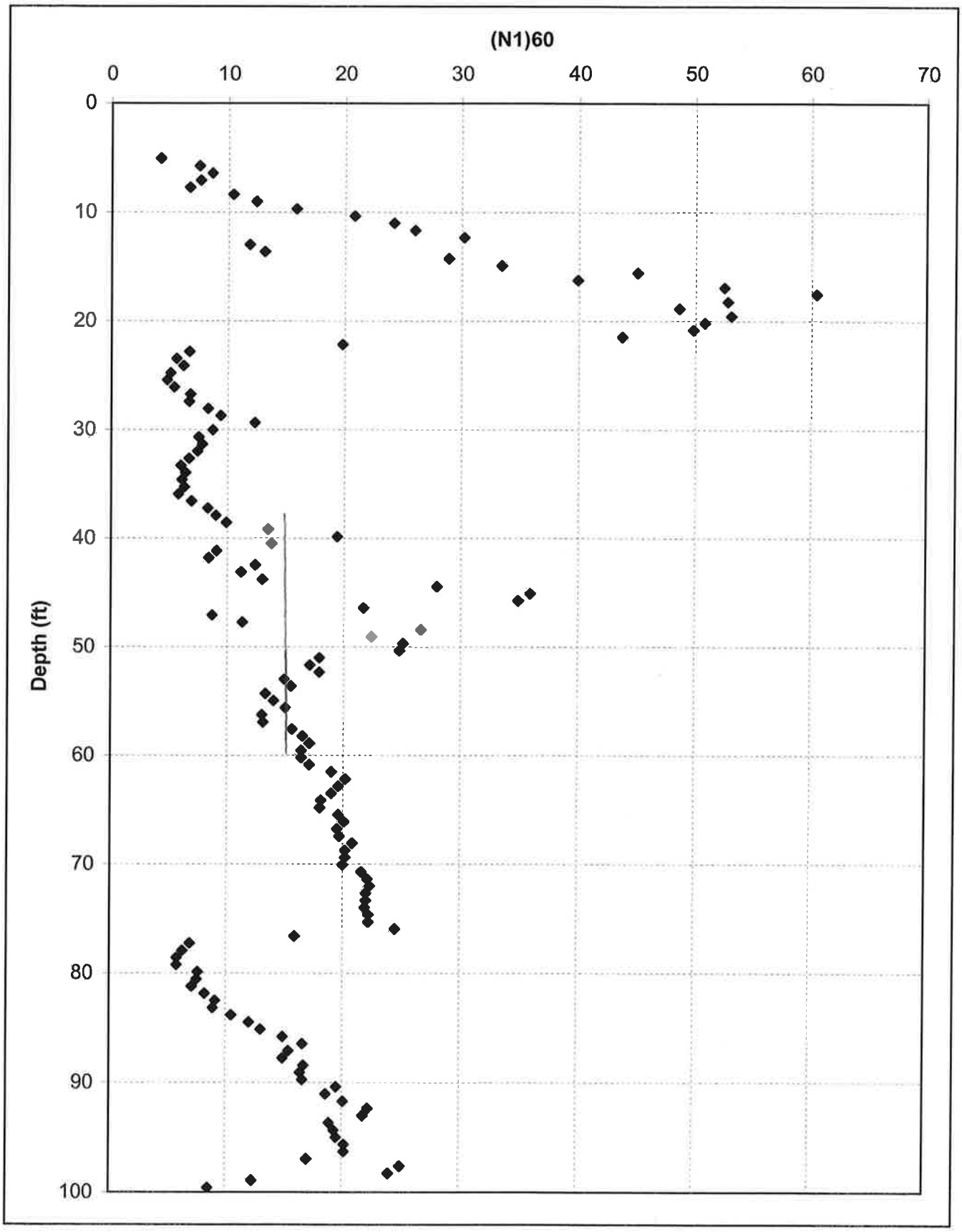

Shear Strength (psf)
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
Depth (ft)
0
20
40
60
80
100
120

CPT-09-114



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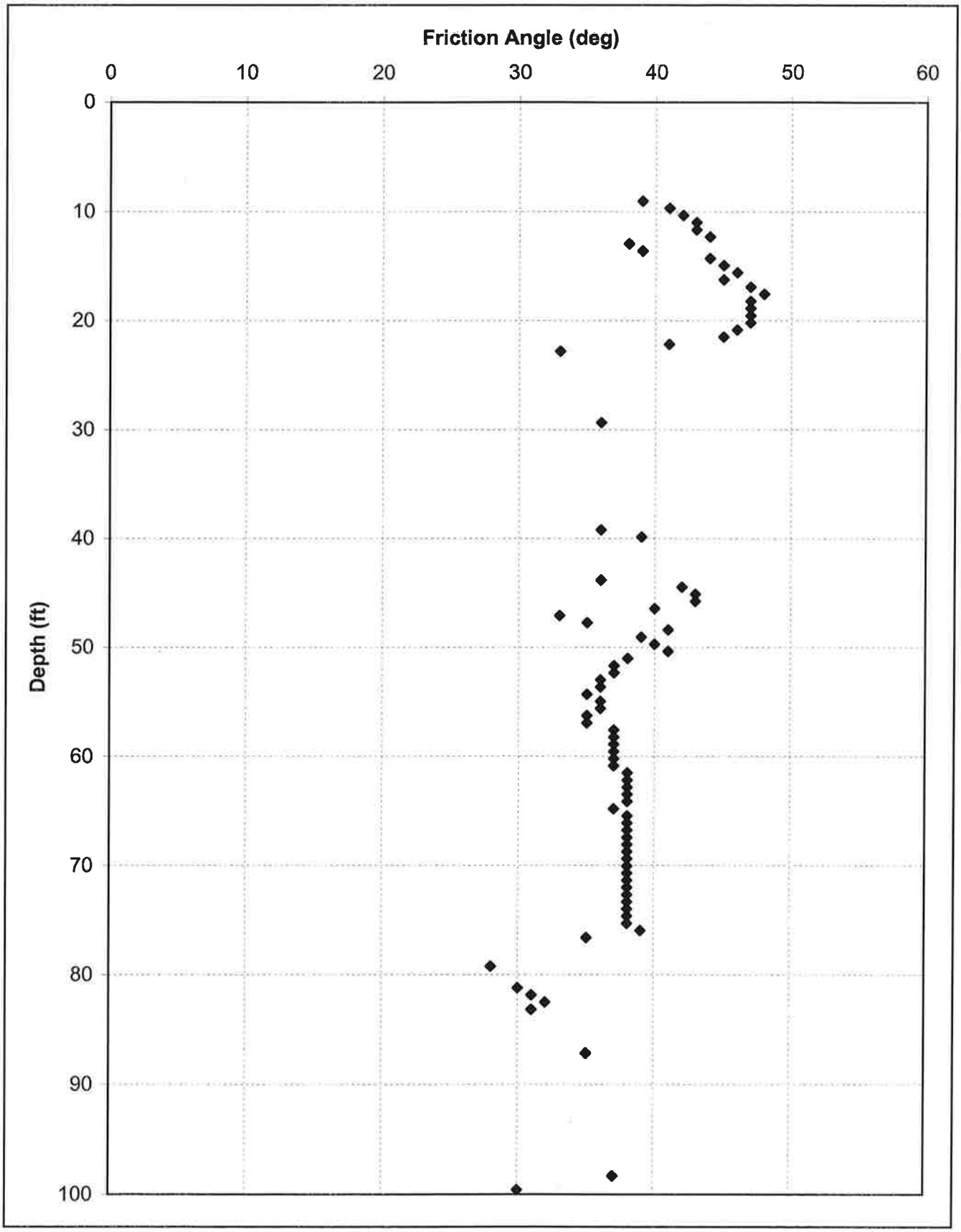
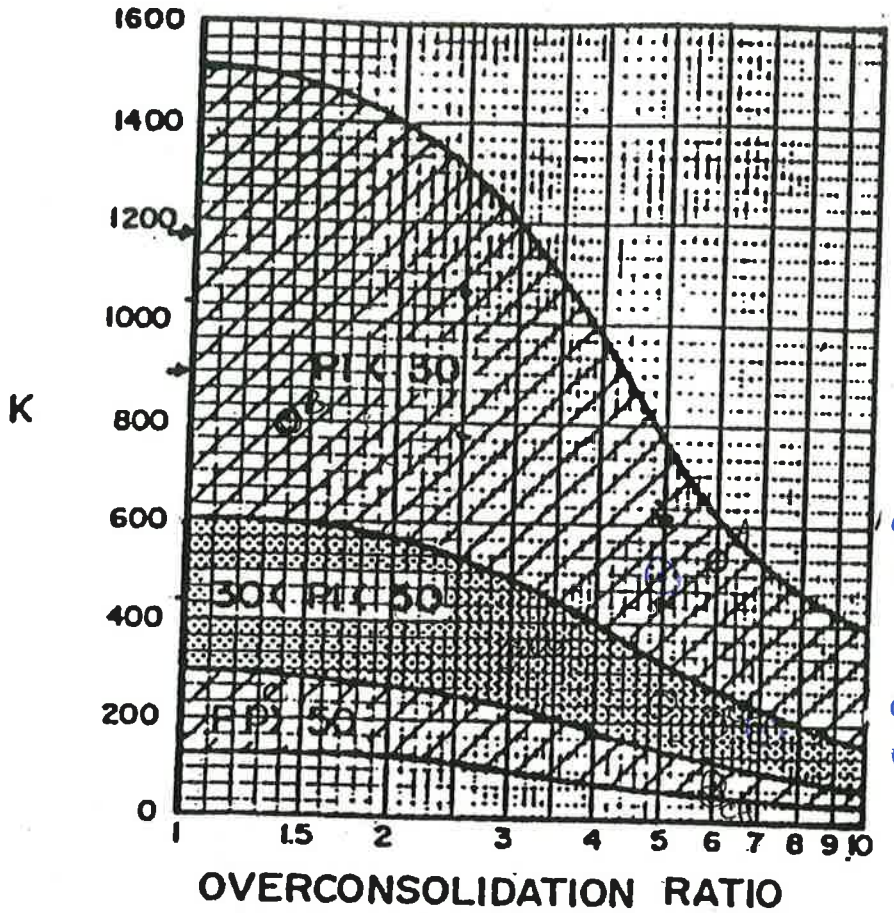

Friction Angle (deg)
0
10
20
30
40
50
60
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100



CH@ 0'-8'
$E = KS_u = (200)(2000)$
$= 400000 = 0.4 \times 10^6$

CL@ 24'-33'
$E = KS_u = (500)(2500)$
$= 1250000 = 1.25 \times 10^6$

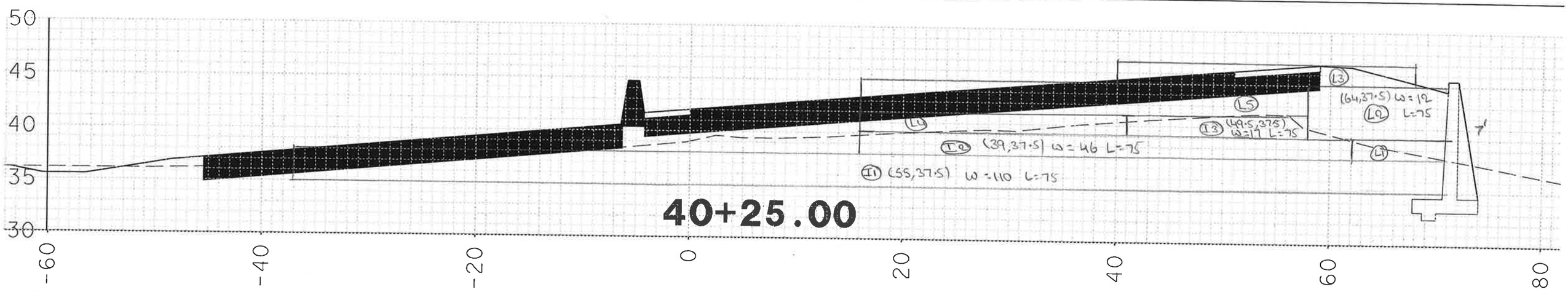
$E_u = KS_u$

E_u = UNDRAINED MODULUS OF CLAY

K = FACTOR FROM CHART ABOVE

S_u = UNDRAINED SHEAR STRENGTH OF CLAY

Fig. 2 CHART FOR ESTIMATING UNDRAINED MODULUS OF CLAY



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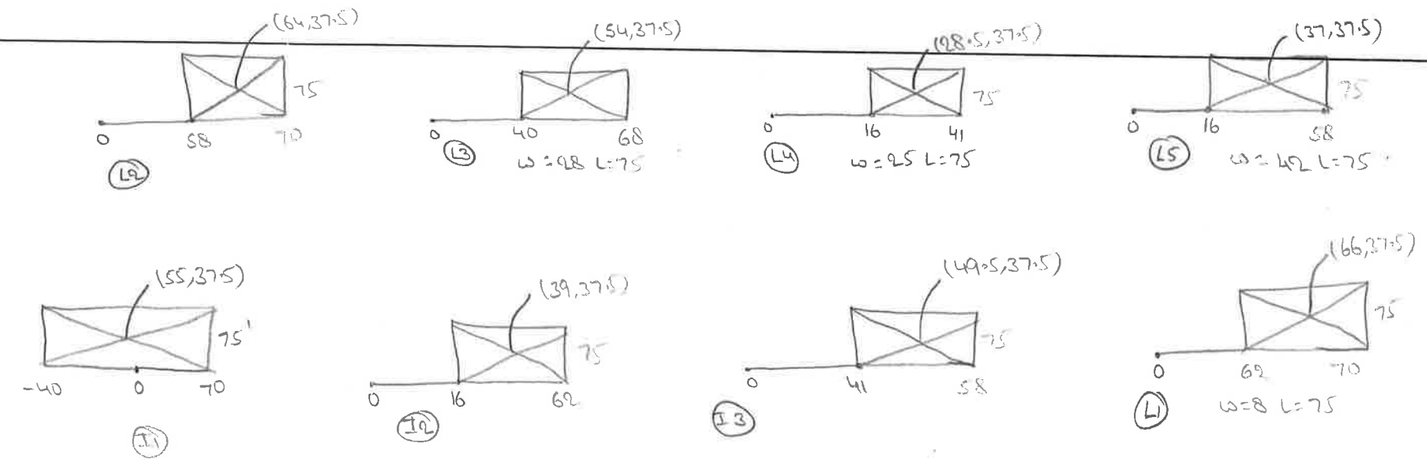

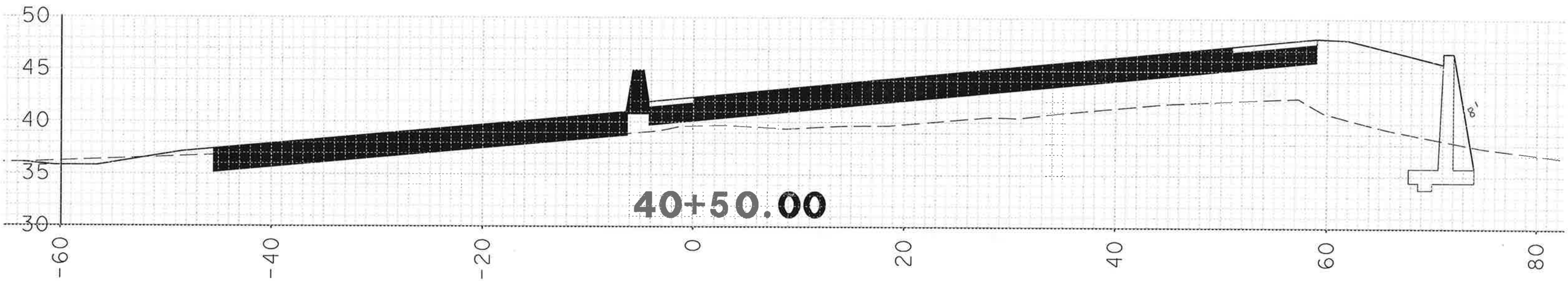

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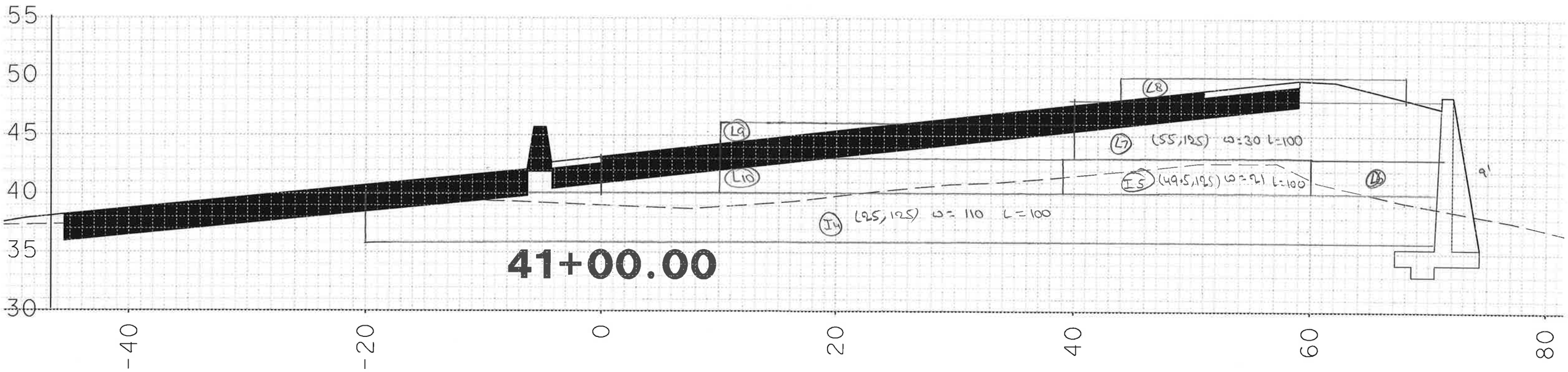

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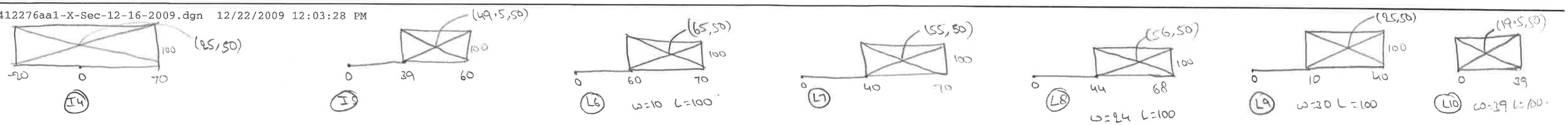

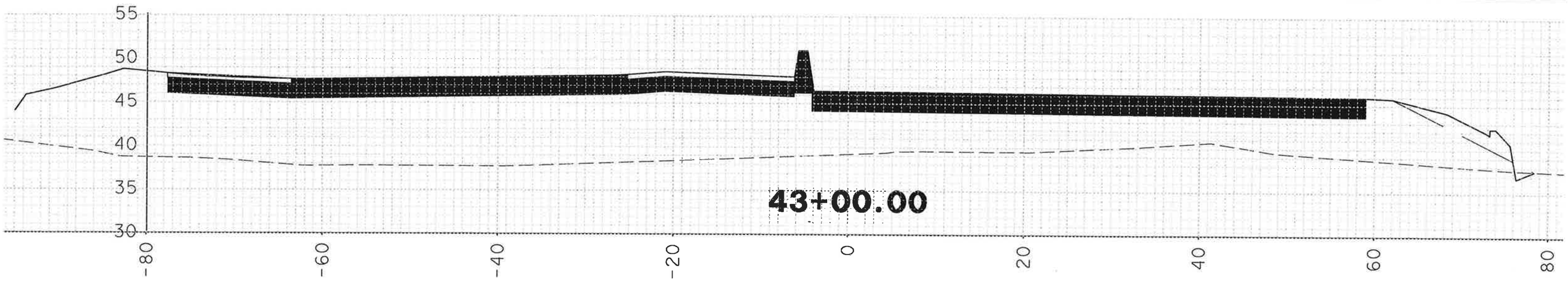

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US 101 CITY OF PETALUMA OLD REDWOOD HIGHWAY OVERCROSSING PROJECT

IN PETALUMA
FROM POST MILE 7.4 AT STATION 377+00 WEST TO POST MILE 8.1 AT STATION 439+00 ON US 101

PROPOSED RETAINING WALLS NO. 1 - 7 FOUNDATION INVESTIGATION REPORT

Prepared for

URS

Prepared by

V&A

February 2010

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INTRODUCTION 2
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Field Soil Resistivity 3
Laboratory Soil Analysis 7
TEST RESULTS 8
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RECOMMENDATIONS 12
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Prestressed Concrete Piles 12
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APPENDIX

Appendix A: Soil Sample Minimum Resistivities and Chemical Analysis

EXECUTIVE SUMMARY

The City of Petaluma located in Sonoma County, CA, is proposing to modify the overcrossing at the Old Redwood Highway at US 101 Interchange. In addition to the Interchange, this project will be constructing new retaining walls, a soundwall and extending the existing box culverts within the project limits from Post Mile 7.4 at Station 377+00 to Post Mile 8.1 at Station 439+00 on US 101 north of Petaluma River.

V&A was retained by the project designer URS Corporation to perform a soil corrosivity investigation within the project limits with regards to the proposed retaining wall foundation. V&A performed in-situ soil resistivity testing at 12 locations and interpreted the field data collected. In addition V&A interpreted the corrosivity test results from the analytical lab analysis performed on 10 bore samples by Cooper Testing Laboratory in Palo Alto, CA. The report includes the field data collected, the test methods used to perform the in-situ soil resistivity, field data analysis, laboratory analysis and test results, conclusions and recommendations.

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, and CALTRANS Memo to Designers 3-1, July 2008 (Memo). Based on the results obtained and according to the Guidelines and Memo, the soil samples tested are considered to be *non-corrosive to* reinforced concrete structures and steel piles. This conclusion is made based on the values of minimum soil resistivity, pH, sulfates and chlorides.

The result of the minimum soil resistivity of five boring samples indicates that soil resistivity is well below 1,000 ohm-cm. According to both the Guidelines and Memo, a site is considered corrosive if the soil minimum resistivity is less than 1,000 ohm-cm and either contains a chloride concentration of 500 ppm or greater, or a sulfate concentration of 2,000 ppm or greater. Therefore, the soils tested at five locations are considered *non-corrosive*, regardless of the very low soil resistivity test result.

Based on the findings and Guidelines, this report makes recommendations for the following:

- Buried Reinforced Concrete Structures
- Prestressed Concrete Piles, and
- Steel Piles

INTRODUCTION

V&A was retained by URS Corporation to perform a corrosion survey on US 101, in Petaluma, CA, from Post Mile 7.4 at Station 393+00 to Post Mile 8.1 at Station 439+00. The objective of this 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 30.5 meters (0 to 100 feet) below existing grade. This report provides recommendations for corrosion control of structural foundation materials under consideration for the proposed Retaining Walls No. 1 through 7 (Figure 1) on US 101 and Old Redwood Highway in Petaluma. 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, and CALTRANS Memo to Designers 3-1, July 2008 (Memo). These Guidelines and the Memo 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, soil samples taken during a geotechnical investigation were provided to V&A for laboratory testing (Appendix 1). 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 soil samples selected from borings ranged from 434 to 3,934 ohm-cm. The soil pH ranged from 7.3 to 8.6. Water-soluble chloride concentration ranged from less than 2 to 333 mg/kg and water-soluble sulfate concentration ranged from less than 5 to 262 mg/kg. The pH, chloride and sulfate ion concentrations indicate that the sampled soils are *non-corrosive* as defined by the Guidelines.

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 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 concrete. 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 Locations No. 1 through 12 along the US 101 City of Petaluma Old Redwood Highway Interchange Project at the proposed retaining wall locations. Figure 2 shows the soil resistivity test sites and the soil boring locations.

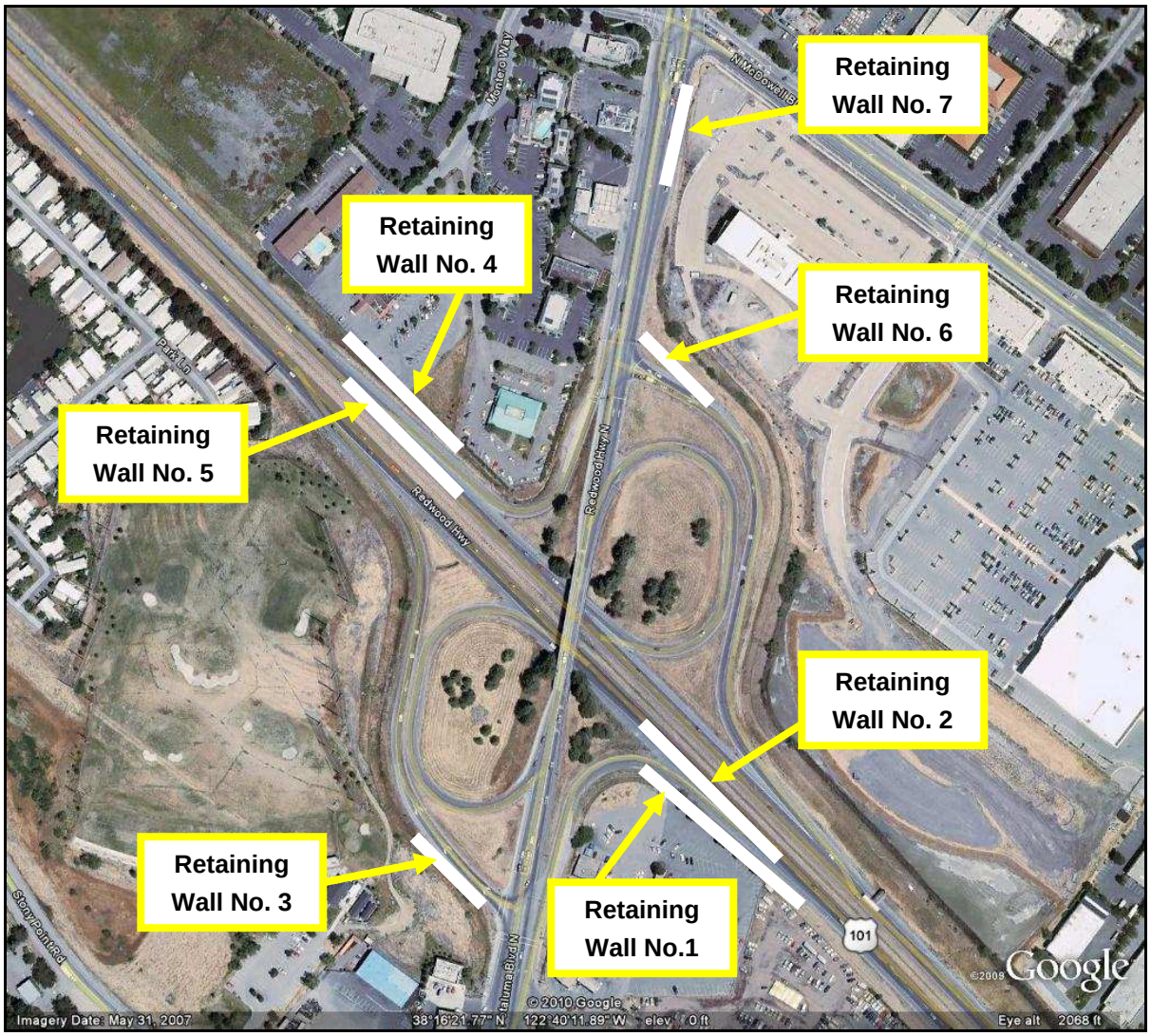

Figure 1. Project Site Map* for the Proposed Retaining Wall Foundation Investigation, Petaluma, CA**

*www.google.com
**Wall locations are approximate

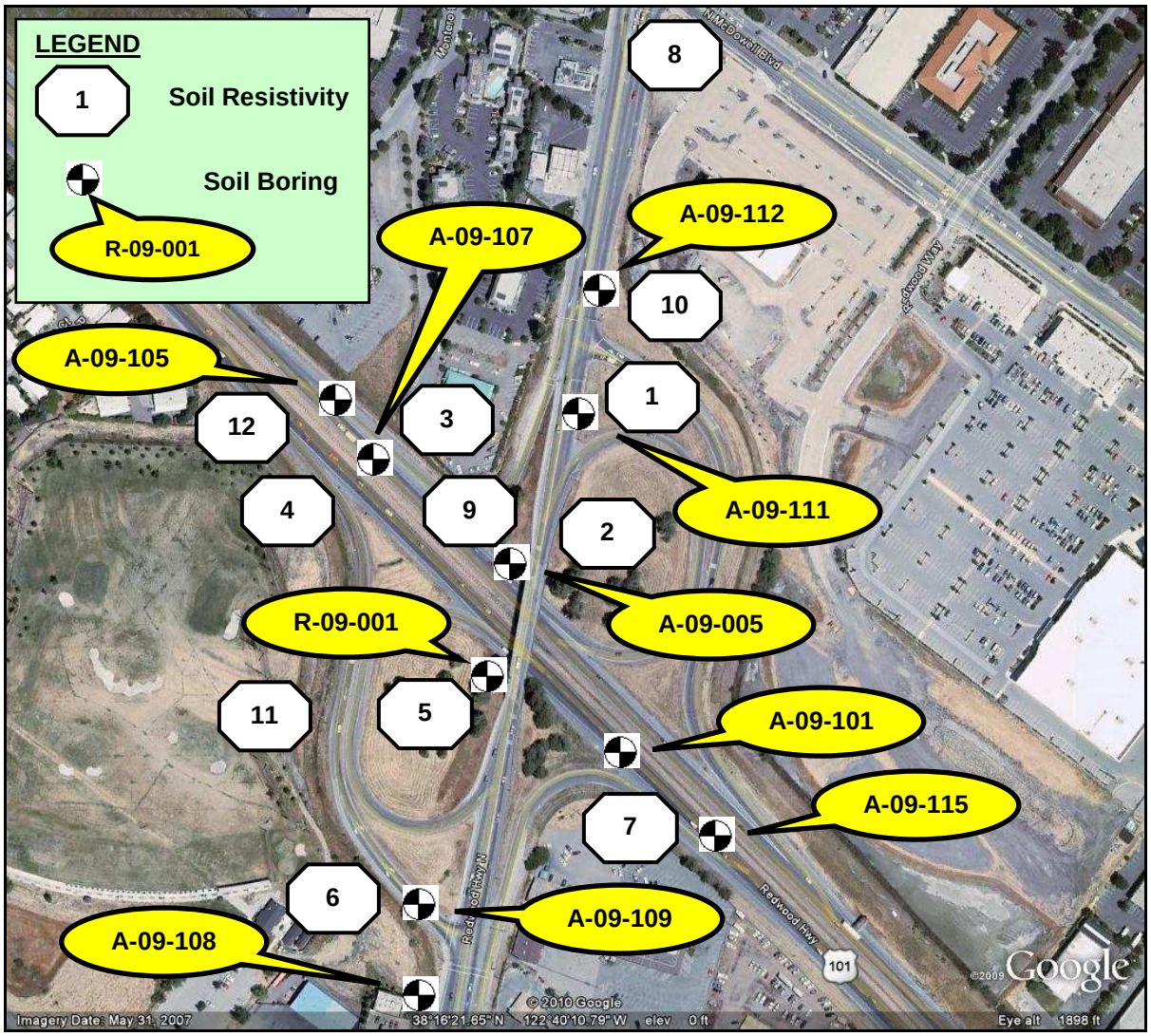

Figure 2. In-Situ Soil Resistivity Test and Boring Locations*

*Locations are approximate, map courtesy of www.google.com

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).

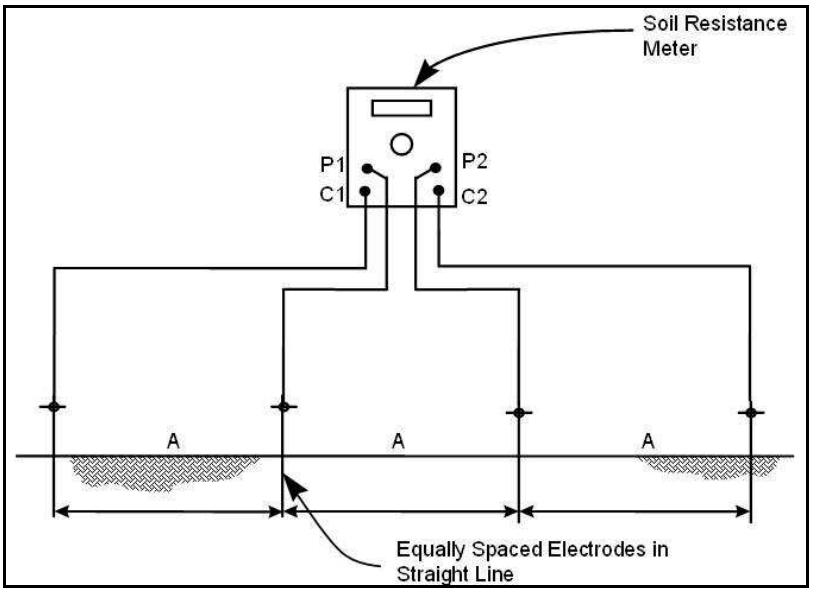

Figure 3. Wenner Four Electrode Method for Soil Resistivity Measurement

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:

$$\rho = 2 \cdot \pi \cdot A \cdot R$$

Where:

ρ	=	soil resistivity (ohm-cm)
A	=	distance between electrodes (cm)
R	=	soil resistance, instrument reading (ohms)
π	=	3.14 (approx.)

Soil resistance is measured with electrodes spaced 0.8, 1.5, 2.3, 3.1, 4.6, 7.6, 15.2, 23.0 and 30.5 meters (2.5, 5, 7.5, 10, 15, 25, 50, 75 and 100 feet) apart. Resistivity values obtained represent the average resistivity of the soil to a depth equal to the electrode spacing. An additional method of calculating the soil resistivity using the data from the Wenner Method is the Barnes-Layer resistivity calculation. The Barnes Layer calculation is used to determine the resistivity of the soil for each soil layer. While the Wenner Method at 3.1 meters will consider all 3.1 meters of soil below the surface,

the Barnes-Layer method will only consider the resistivity of only the layer of soil between 2.3 meters and 3.1 meters below the surface. This method assumes the soil layers are of a uniform thickness and parallel to the surface, which may not always be true.

The Barnes-Layer method uses the following parameters to calculate layer resistivities:

$$\rho_{b-a} = KR_{b-a} \quad \text{and} \quad \frac{1}{R_{b-a}} = \frac{1}{R_a} - \frac{1}{R_b}$$

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* (cm)
K	=	Layer constant (cm)
	=	$2\pi(b-a)$

Soil resistance measured at the proposed retaining wall location and Barnes-Layer resistivities calculated from this data are listed in Table 1.

Laboratory Soil Analysis

To supplement the field resistivity test data, ten soil samples were obtained from Soil Borings R-09-001, A-09-005, A-09-101, A-09-105, A-09-107, A-09-108, A-09-109, A-09-111, A-09-112 and A-09-115 for laboratory soil resistivity analysis (Appendix 1). A soil box was used in accordance with California Test Method 643. This apparatus is shown in Figure 4.

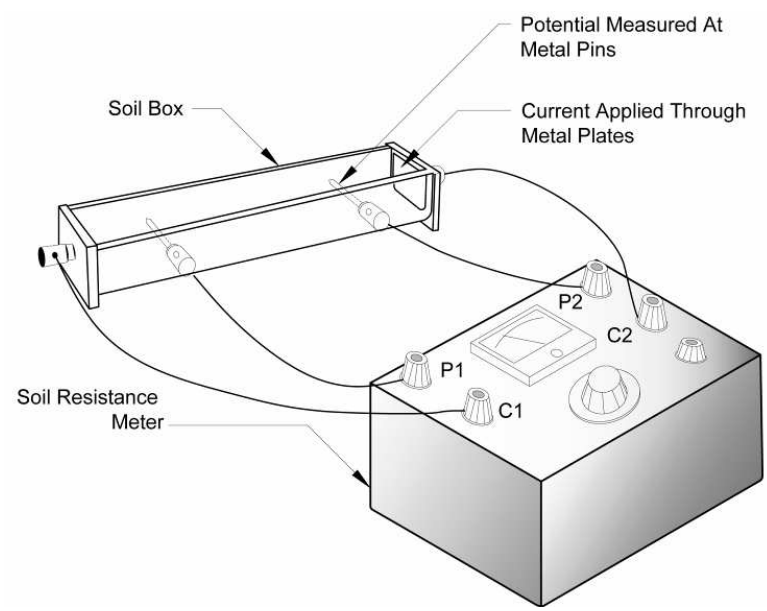

Figure 4. Soil Resistivity Measurement Using the Soil Box Method

This apparatus consists of a small plastic box with metal end plates for passing current through a tightly packed soil sample. Current is passed through the sample, causing a voltage drop across the sample. The soil resistivity is measured with a soil resistance meter, similar to the AEMC Model 4500.

Soil resistivity is first measured in the "as received" state. Distilled water is then added to the soil sample in 10-mL increments. The resistivity is measured after each addition of distilled water. 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 proposed retaining wall sites and the calculated Barnes-Layer resistivities. Table 2 lists the minimum resistivity and chemical analysis for the soil boring samples.

Table 1.
In-Situ Soil Resistivity Data

Site*	Depth (Meters)	Resistivity (ohm-cm)	Layer Resistivity (ohm-cm)	Layer (Meters)
1	0.8	2,174		0-0.8
	1.5	1,368	998	0.8-1.5
	2.3	868	501	1.5-2.3
	3.1	820	703	2.3-3.1
	4.6	1,100	3,488	3.1-4.6
2	0.8	883		0-0.8
	1.5	568	418	0.8-1.5
	2.3	463	337	1.5-2.3
	3.1	557	1,477	2.3-3.1
	4.6	853	13,793	3.1-4.6
	7.6	1,494	11,831	4.6-9.1
	15.2	2,107	3,572	9.1-13.7
	23.0	2,672	5,762	13.7-18.3
	30.5	3,217	8,312	18.3-24.4

*See Figure 2

Table 1.
In-Situ Soil Resistivity Data (Cont.)

Site*	Depth (Meters)	Resistivity (ohm-cm)	Layer Resistivity (ohm-cm)	Layer (Meters)
3	0.8	1,369		0-0.8
	1.5	600	384	0.8-1.5
	2.3	485	351	1.5-2.3
	3.1	529	720	2.3-3.1
	4.6	804	18,500	3.1-4.6
4	0.8	686		0-0.8
	1.5	632	586	0.8-1.5
	2.3	567	471	1.5-2.3
	3.1	693	2,075	2.3-3.1
	4.6	1,066	14,289	3.1-4.6
5	0.8	748		0-0.8
	1.5	548	432	0.8-1.5
	2.3	412	276	1.5-2.3
	3.1	458	684	2.3-3.1
	4.6	623	2,257	3.1-4.6
	7.6	1,235	2,615	4.6-9.1
	15.2	2,030	5,693	9.1-13.7
	23.0	2,844	14,355	13.7-18.3
	30.5	3,658	25,866	18.3-24.4
6	0.8	677		0-0.8
	1.5	574	497	0.8-1.5
	2.3	487	374	1.5-2.3
	3.1	553	938	2.3-3.1
	4.6	822	26,382	3.1-4.6
7	0.8	1,159		0-0.8
	1.5	579	386	0.8-1.5
	2.3	450	310	1.5-2.3
	3.1	471	550	2.3-3.1
	4.6	712	29,209	3.1-4.6
8	0.8	4,084		0-0.8
	1.5	2,145	1,454	0.8-1.5
	2.3	773	339	1.5-2.3
	3.1	688	517	2.3-3.1
	4.6	868	1,821	3.1-4.6

*See Figure 2

Table 1.
In-Situ Soil Resistivity Data (Cont.)

Site*	Depth (Meters)	Resistivity (ohm-cm)	Layer Resistivity (ohm-cm)	Layer (Meters)
9	0.8	1,211		0-0.8
	1.5	709	501	0.8-1.5
	2.3	589	440	1.5-2.3
	3.1	659	1.023	2.3-3.1
	4.6	750	1.036	3.1-4.6
10	0.8	952		0-0.8
	1.5	776	654	0.8-1.5
	2.3	712	613	1.5-2.3
	3.1	795	1,217	2.3-3.1
	4.6	1,023	2,398	3.1-4.6
11	0.8	673		0-0.8
	1.5	538	448	0.8-1.5
	2.3	587	719	1.5-2.3
	3.1	699	1,624	2.3-3.1
	4.6	893	2,013	3.1-4.6
12	0.8	721		0-0.8
	1.5	590	499	0.8-1.5
	2.3	641	774	1.5-2.3
	3.1	724	1,187	2.3-3.1
	4.6	911	1,881	3.1-4.6

*See Figure 2

Table 2.
Laboratory Soil Resistivity and Chemical Data

Item No.	Boring No.*	Boring Station** No.	Depth (meters)	Minimum Soil Resistivity (ohm-cm)	Chemical Data		
					pH	Sulfate (mg/kg)	Chloride (mg/kg)
1	R-09-001	403+71***	24.4 – 25	2,312	7.3	<5	69
2	A-09-005	404+53	7.6 – 8.2	3,934	7.8	<5	19
3	A-09-101	396+50	3.1 – 3.7	635	7.3	262	333
4	A-09-105	411+79	3.1 – 3.7	2,157	8.4	<5	<2
5	A-09-107	410+18	3.1 – 3.7	824	8.1	236	149
6	A-09-108	15+26****	3.1 – 3.7	1,161	7.9	<5	6
7	A-09-109	400+90	1.5 – 2.0	434	7.6	<5	119
8	A-09-111	27+08	2.4 – 3.1	508	8.0	98	59
9	A-09-112	29+21	3.1 – 3.7	787	8.6	<5	<2
10	A-09-115	393+50	3.1 – 3.7	1,104	8.3	<5	15

*See Figure 2
**Stationing numbers are approximate.
***300+00 and 400+00 series on US 101
****10+00 and 20+00 series on Old Redwood Highway Overcrossing

CONCLUSIONS

- For Retaining Walls No. 1 through 7, the soil boring chemical analysis indicate 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 and the Memo, the soil is considered *non-corrosive* to concrete structures.
- Boring samples from Locations A-09-101, A-09-107, A-09-109, A-09-111 and A-09-112 indicate resistivities well below 1,000 ohm-cm. According to the Guidelines and the Memo, the soil tested at aforementioned Locations is considered *non-corrosive* to steel piles. V&A believes that soil with minimum resistivities of 434 to 824 ohm-cm is considered *very corrosive* to steel structures and requires corrosion mitigation.
- These structures are not within 300 meters (1,000 feet) of salt or brackish water.

RECOMMENDATIONS

The following recommendations for each structural foundation material alternative are based on the test data and a review of the project requirement.

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.
- 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 2 inches should be applied over all steel reinforcement.
- The Corrosion Guidelines allow the use of mineral admixtures (such as fly ash, silica fume, metakaolin, etc.), reduced water content, and increased cementitious material content resulting in high density and durable Concrete3.
- 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.

Steel Piles

According to the Guidelines and the Memo, this soil is considered *non-corrosive* to steel piles and does not require corrosion mitigation.

APPENDIX A
SOIL SAMPLE MINIMUM RESISTIVITIES AND CHEMICAL ANALYSIS

COOPER

Corrosivity Test Summary

CTL # 632-009 Date: 2/2/2010 Tested By: PJ Checked: PJ
Client: V&A Project: URS Petaluma Proj. No: 09-0772
Remarks:

Sample Location or ID			Resistivity @ 15.5 °C (Ohm-cm)			Chloride	Sulfate		pH	ORP	Moisture	Soil Visual 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	
R-09-01	-	80-82	-	2312	-	69	<5	<0.0005	7.3	-	25.0	Brown Silty SAND
A-09-005	-	25-27	-	3934	-	19	<5	<0.0005	7.8	-	12.6	Greenish Brown Clayey SAND w/ Gravel
A-09-101	-	10-12	-	635	-	333	262	0.0262	7.3	-	16.6	Greenish Brown Clayey SAND
A-09-105	-	10-12	-	2157	-	<2	<5	<0.0005	8.4	-	16.4	Greenish Brown Clayey SAND
A-09-107	-	10-12	-	824	-	149	136	0.0136	8.1	-	5.9	Greenish Gray Sandy CLAY
A-09-108	-	10-12	-	1161	-	6	<5	<0.0005	7.9	-	29.2	Greenish Gray Sandy CLAY
A-09-109	-	-	-	434	-	119	<5	<0.0005	7.6	-	34.4	Black CLAY
A-09-111	-	8-10	-	508	-	59	98	0.0098	8.0	-	33.9	Black Sandy CLAY
A-09-112	-	10-12	-	787	-	<2	<5	<0.0005	8.6	-	23.5	Greenish Gray Sandy CLAY
A-09-115	-	10-12	-	1104	-	15	<5	<0.0005	8.3	-	19.0	Greenish Gray Sandy CLAY

COMMENTS

Client: City of Petaluma Project No: 28645097

Project Name: Old Redwood Highway Interchange Improvement Project EA 04-0A1850 (12276K)

Document Being Checked/Revision Number: 95% PS&E

Originator: Caltrans Comments Date: 5/27/2011

No	Origin	Reference	Comment	Disposition	Response	Verification
169	Dist 4 Construction / Frank Guros/ 5-27-11	"	2. Foundation Report for Retaining Walls 1-7 (MSE Walls): Clarify the conflict in subgrade preparation recommendations. The conflict regards recommending against placing construction equipment on subgrade comprising fat clay (Section 8.3.2, para. 3), but requiring compaction to 95% relative compaction prior to fill placement (Section 8.3.4). Meeting both recommendations is not possible.	A	Section 8.3.2 refers to the subgrade of MSE walls (including length of the reinforcement), whereas Section 8.3.4 refers to subgrade of embankment fill. Will clarify.	

Dispositions:
A = Will Incorporate; B = Will Evaluate; C = Disagree with Comment; D = Will Incorporate in next submittal; E = Clarify Comment; F = No Action Needed

OSFP Review Comment & Response Form

General Project Information	Review Phase		Reviewer Information
Dist: 04 EA: 0A1851 **Project Name: Old Redwood Highway** **OSFP Liaison: Tracy Bertram** **Phone: 916-227-8379** **e-mail: TracyBertram/HQ/Caltrans/CAGov**	☐ PSR/PDS (Review No. _) ☐ APS/PSR (Review No. _) ☒ APS/PR (Review No. _) ☐ Type Selection	☒ 65% PS&E Unchecked Details ☐ PS&E (Review No. _) ☐ Construction Support ☐ Other: Retaining Walls	**Reviewer Name: M.Zabolzadeh** **Functional Unit: GS-GDW** **Phone Number: ((510)2864831** **e-mail: Mohammadzabolzadeh@dot.ca.gov** **Date of Review: 10/19/2010**
	Structure Information (Use when necessary to document comments by individual structure) **Structure Name: Retaining Walls 1 Through 7** **Br No: _____**		

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	N/A	FR for the proposed retaining walls prepared by URS Corporation dated 9/10/2010.	No comment.	
2	FR	General	Our previous comments have been incorporated into the report.	No comment.	
3	FR	7-2	Under Table 7-1, it is referred to downdrag on piles. The proposed seven retaining walls are MSE walls. There are no piles involved. Remove the statement.	Will comply.	
4	FR	8-2	It is recommended to place Pervious Backfill Material (PM) behind the proposed MSE walls panels. Due to the problems associated with this material, we have eliminated this material. See updated Caltrans plans.	Will remove the reference to Pervious Backfill Material from Section 8.2.2.	
5	FR	8-3	Global stability of the proposed MSE Wall #7 should be added.	Will comply.	

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)

6	FR	8-5&6	It is referred to an example of a 10-high surcharge, which reduces the settlement period to less than a month. Does this apply to all of the proposed fills listed on this page? We recommend adding another column to Table 6-1 showing corresponding settlement periods for the proposed 5'-high and 10'-high surcharges, so that construction chooses appropriate amount of surcharge according to their time schedule.	Will revise section 8.2.5 to include the settlement periods for different surcharge heights as well as settlement mitigation methods.	
7		8-6	It is recommended the settlements of the proposed fills be monitored. Specify the number of monitoring devices and the locations (Stations and offsets) where the proposed fills should be monitored	Will comply.	
8			C3- Not Approved. Re-submittal to GS is required as submitted.	Will comply and resubmit.	

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
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✓= Comment Resolved
(for Reviewer's use)

OSFP Review Comment & Response Form

General Project Information	Review Phase		Reviewer Information
Dist: 04 EA: 0A1851 **Project Name: Old Redwood Highway** **OSFP Liaison: Tracy Bertram** **Phone: 916-227-8379** **e-mail: TracyBertram/HQ/Caltrans/CAGov**	☐ PSR/PDS (Review No. _) ☐ APS/PSR (Review No. _) ☐ APS/PR (Review No. _) ☐ Type Selection	☐ 65% PS&E Unchecked Details ☒ PS&E (Review No. _) ☐ Construction Support ☐ Other: Retaining Walls	**Reviewer Name: M.Zabolzadeh** **Functional Unit: GS-GDW** **Phone Number: ((510)2864831** **e-mail: Mohammadzabolzadeh@dot.ca.gov** **Date of Review: 6/15/2011**
	Structure Information (Use when necessary to document comments by individual structure) **Structure Name: Retaining Walls 1 Through 7** **Br No: _____**		

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	N/A	FR, Plans, SSP for the proposed retaining walls prepared by URS Corporation dated 5/16/2011.		
2	FR	General	All our previous comments have been incorporated into the report. We have no comment.		
3	FR	N/A	C1- Approved as submitted.		

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)

			account for near field effects. This spectrum has to then be compared to the spectra produced based on both the Probabilistic Seismic Hazard Analysis and Deterministic Seismic Hazard Analysis using the Caltrans On-line tool (Figure 5-1). The governing spectrum will then be the recommended Acceleration Response spectrum for the site. We recommend a separate graph titled "Recommended Acceleration Response Spectrum" be generated and added once the governing spectrum is determined. Refer to the following site to produce the aforementioned Interactive Deaggregation spectrum. http://eqint.cr.usgs.gov/deaggint/2008/index.php		
5	FR	N/A	C3- Not approved. Resubmitted to GS is required	Will comply and resubmit.	

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)

Storm Water Information Handout
Dated June, 2012

Old Redwood Highway Interchange Project
Petaluma, Sonoma County, California
0400020652 (0A1851)
June 2012

Storm Water Information Handout

Prepared for:

Prepared by:

June 2012

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Disclaimer

A "Disclaimer" is required specifying that the information provided in the Storm Water Information Handout is just a guideline and is to be used for information purposes only and should not be considered a sole source document to adhere to the requirements of the new National Pollutant Discharge Elimination System (NPDES) Construction General Permit (CGP), Number CAS000002, adopted on September 2, 2009. The contractor is required to provide water quality monitoring, sampling and implement best management practices (BMPs) based on standard industry operations, field conditions and conditions encountered based on the contractor's means and methods. The information in this handout is not to be construed in any way as a waiver of the provisions in the CGP. Bidders and contractors are cautioned to make independent investigations and examinations as they deem necessary to satisfy the conditions encountered in performance of work, with respect to the following: sampling and monitoring locations, distribution of watershed areas for sizing of BMPs, and selection of BMPs in order to conform to the requirement of the contract documents and the CGP.

1 OVERVIEW

1.1 Intent of this Document

The objectives of this Water Quality Information Handout are: to summarize general water quality information of the Project; to summarize updated requirements per the new Construction General Permit (CGP) effective on July 1, 2010; to provide general guidelines for contractors to bid on the project; to aid in developing the Storm Water Pollution Prevention Plan (SWPPP) of the project; and to highlight information necessary to file Permit Registration Documents (PRDs) to the State Water Resources Control Board (SWRCB) via the Stormwater Multi Application Reporting and Tracking System (SMARTS) and file the Notice of Intent at the start of construction.

1.2 Summary of New Requirements

The "National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities" (NPDES Number CAS000002), 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 of this document for details.

A risk assessment was done for the **Old Redwood Highway Interchange Project** (Project), and the Project was determined to be **RL 2.**

RL 2 projects will be subject to monitoring and sampling requirements, plus Numeric Action Levels (NALs) for pH and turbidity. All projects will have to upload storm water data into SMARTS, such as Notices of Intent (NOIs), SWPPPs, annual reports, and monitoring data. Detailed information is provided in "Water Pollution Control" of the Contract Special Provisions and the CGP.

2 GENERAL PROJECT INFORMATION

2.1 Location

The Project is located along United States 101 (US 101) at the Old Redwood Highway interchange in Petaluma, Sonoma County, California. Figure 1 shows the limits of the Project.

2.2 Major Engineering Features

The City of Petaluma (City), in cooperation with the California Department of Transportation (Caltrans) and the Sonoma County Transportation Authority (SCTA), has proposed the upgrade of the Old Redwood Highway Interchange along US 101 (Project) to provide congestion relief, safety enhancements, an improved pedestrian and bicycle access, and improved air quality. The Project is been coordinated with the SCTA US 101 Central HOV Lanes project that is currently in construction along the US 101 corridor. At the Old Redwood Highway interchange, mainline improvements already completed as part of the SCTA project include median paving to accommodate new HOV lanes in both directions of US 101, a median concrete barrier, localized outside mainline widening including the widening of the US 101 bridges crossing Willow Brook Creek, and a new sound wall adjacent to southbound US 101, south of Willow Brook Creek. Improvements proposed for the Project include removing the existing overcrossing (OC) and replacing it with a wider OC, reconfiguring and widening all six interchange ramps, completing the localized widening of US 101 through the interchange area to complete the SCTA project mainline improvements, and local street widening on Old Redwood Highway/Petaluma Boulevard North at the approaches to the new overcrossing.

2.3 Receiving Water Bodies

The Project is within the jurisdiction of the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). The Project site is located within Hydrologic Sub-Area 206.30, which is described as being within the San Pablo hydrologic unit and the Petaluma River hydrologic area.

The direct receiving water body for the Project is the Petaluma River. Roadway runoff is collected by culverts and ditches and discharges into the Petaluma River. The Petaluma River runs parallel to US 101 and west of the Project site, with a distance between the river and US 101 of approximately 0.25 miles.

The January 2007 Water Quality Control Plan (Basin Plan) for the SFBRWQCB provides the following existing beneficial uses for the Petaluma River:

- Cold freshwater habitat (COLD)
- Estuarine habitat (EST)
- Migration of aquatic organisms (MIGR)
- 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)
- Non-contact water recreation (REC-2)
- Navigation (NAV)

Petaluma River is listed on the Clean Water Act 303(d) List of Water Quality Limited Segments (303 [d] List) for diazinon, nutrients, pathogen, sedimentation/siltation and trash.

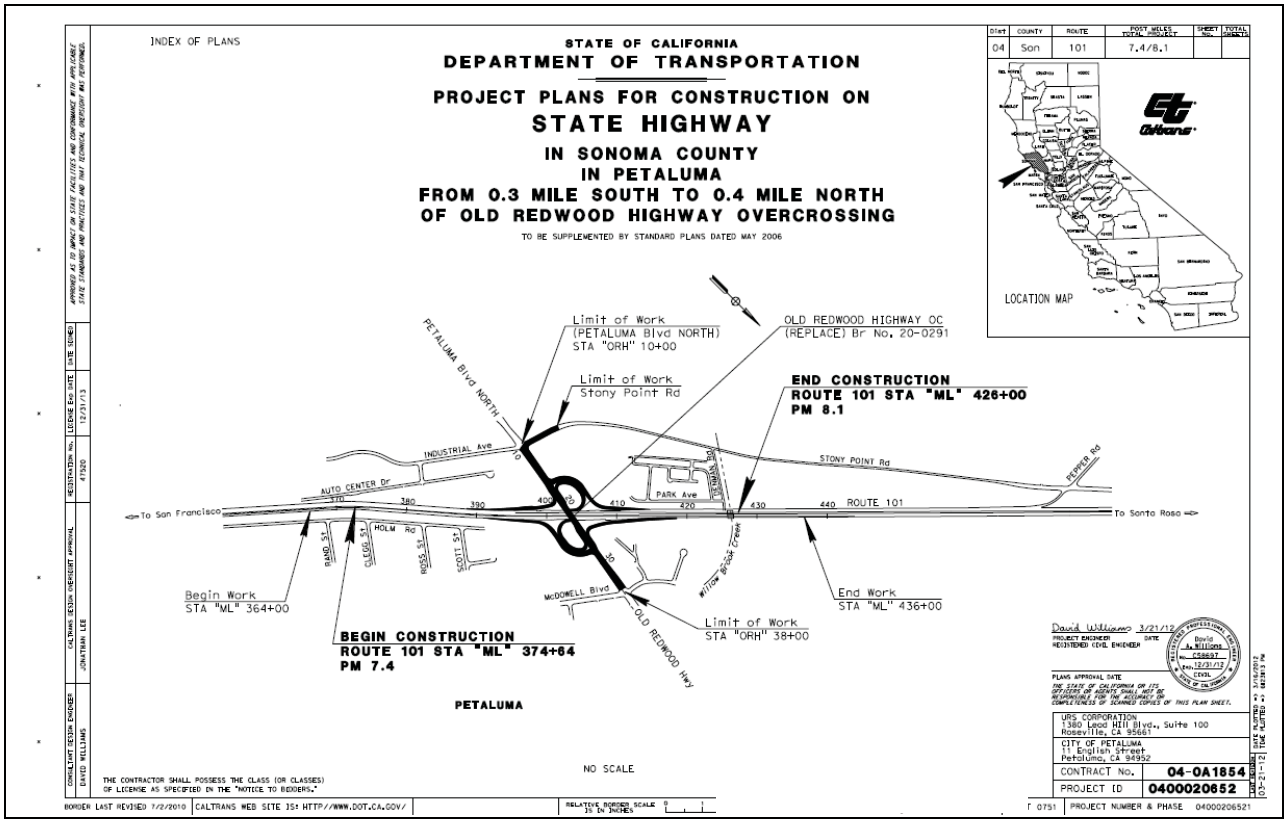


Figure 1. Project Vicinity Map

2.4 Creek Crossings

Petaluma River runs parallel to US 101 but does not cross within the Project limits. Proposed drainage facilities collect runoff from the Project and discharges to existing drainage facilities that ultimately outfall to Petaluma River.

Willow Brook Creek is the only creek that crosses within the Project limits at Post Mile 8.1. However, no runoff from the Project site discharges into Willow Brook Creek.

2.5 401 Certification

A 401 Certification is required for this Project because of impacts to existing wetlands, identified Waters of the U.S. and Waters of the State. The 401 Certification for this Project was issued on February 29, 2012. The 401 Certification and impact maps are included in Appendix D.

2.6 Climate and Rainfall

A National Oceanic and Atmospheric Administration (NOAA) weather station located in Petaluma, approximately 1.5 miles southeast of the Project site, was used to obtain the anticipated number of rainy days per year and qualifying rain events (Figure 2). The compliance storm event was determined from NOAA's online Atlas 14, Volume 6, Version 2 (http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=ca).

Rainy days per year (assumed equal to precipitation 0.10 inches or greater):	44.8 days
Qualifying rain events per year (precipitation 0.5 inches or greater):	17.5 days
Compliance Storm Event (rainfall total for the 5 year, 24 hour storm)	4.12 inches

2.7 Soils and Geology

The Geotechnical Design and Materials Report prepared by URS (2012) for the Project provides the following geology and soil information:

> "The Quaternary deposits in the project area include interfluvial marshlike basin sediments and alluvial fan deposits. These overlie Tertiary units including marine deposits of the Petaluma formation and Sonoma Volcanics."

The United States Department of Agriculture, Natural Resources Conservation Service (NRCS) web soil survey identifies the soils within the Project area as within hydrologic soil group D.

2.8 Hazardous Waste

Detailed hazardous waste studies have been completed for this Project and the findings and recommendations are discussed in the *Hazardous Materials Site Investigation Report* prepared by URS (2012) for the Project.

ADL has been identified at the on-ramp from westbound Old Redwood Highway to Northbound US 101 and within the US 101 Median. Soils within these locations can be reused within the Project with details provided in the Contract Plans and Specifications.

The groundwater within the Project limits are impacted by petroleum hydrocarbons and it has been recommended that a site-specific health and safety plan should be put in place to protect workers and the public. The Contract Specifications includes provisions for groundwater dewatering operations.

2.9 Existing (Pre-Construction) Control Practices

The SCTA Central HOV Lanes Project, Segment B, (EA 04-0A1844) which is currently in construction will place biofiltration strips along US 101 within the limits of this Project. The proposed ramp improvements from this Project result in the removal of segments of these biofiltration strips; Figure 3 identifies which biofiltration strips will be removed in order to accommodate the ramp improvements.

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: PETALUMA FIRE STA 2, CA

COOP ID: 046826

Climate Division: CA 1 **NWS Call Sign:** **Elevation: 31 Feet** **Lat: 38°16N** **Lon: 122°39W**

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	Med-ian	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	5.41	5.01	4.06	1979	10	16.31	1995	.32	1976	11.8	8.1	3.7	1.6	.47	.84	1.56	2.31	3.13	4.07	5.18	6.58	8.51	11.74	14.90
Feb	5.31	4.39	3.28	1998	3	19.59	1998	.31	1971	10.8	7.9	3.6	1.5	.42	.77	1.46	2.19	3.00	3.93	5.05	6.45	8.40	11.67	14.90
Mar	3.85	3.05	3.69	1995	9	15.04	1983	.08	1988	11.0	7.2	2.5	.9	.27	.51	1.00	1.52	2.11	2.80	3.62	4.67	6.12	8.58	11.02
Apr	1.40	1.16	1.85	1953	27	4.59	1983	.06	1977	6.0	3.6	.8	.1	.08	.17	.34	.53	.74	.99	1.30	1.69	2.24	3.16	4.09
May	.62	.26	1.78	1996	16	3.74	1998	.00+	1992	3.4	1.6	.3	@	.00	.00	.00	.04	.14	.27	.46	.71	1.08	1.74	2.42
Jun	.15	.01	1.75	1967	2	1.12	1992	.00+	1996	1.1	.4	.1	.0	.00	.00	.00	.00	.00	.02	.05	.12	.24	.47	.74
Jul	.05	.00	.91	1974	8	.95	1974	.00+	2000	.3	.1	@	.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.12	.30
Aug	.08	.00	1.00	1997	20	1.04	1997	.00+	1999	.4	.2	@	@	.00	.00	.00	.00	.00	.00	.00	.00	.02	.21	.44
Sep	.29	.10	1.85	1959	18	1.77	1989	.00+	1995	2.0	.7	.2	.0	.00	.00	.00	.00	.03	.10	.18	.31	.50	.85	1.21
Oct	1.37	.96	2.94	1962	13	4.64	1975	.00+	1995	4.4	2.3	1.2	.4	.00	.12	.35	.57	.79	1.05	1.34	1.71	2.21	3.03	3.84
Nov	3.52	2.99	3.78	1970	28	9.70	1973	.26	1986	9.6	6.3	2.6	.8	.24	.46	.91	1.39	1.93	2.56	3.31	4.27	5.60	7.85	10.08
Dec	3.80	3.13	3.80	1995	12	10.82	1996	.00	1989	9.7	6.4	2.5	.8	.28	.68	1.29	1.85	2.43	3.07	3.80	4.69	5.90	7.86	9.75
Ann	25.85	23.57	4.06	Jan 1979	10	19.59	Feb 1998	.00+	Jul 2000	70.5	44.8	17.5	6.1	11.21	13.53	16.78	19.43	21.91	24.41	27.10	30.19	34.08	40.01	45.37

+ 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: 1948-2001
(3) Derived from 1971-2000 serially complete daily data

Complete documentation available from:
www.ncdc.noaa.gov/oa/climate/normals/usnormals.html

169-B

Figure 2. Rainfall Data
Source: NOAA

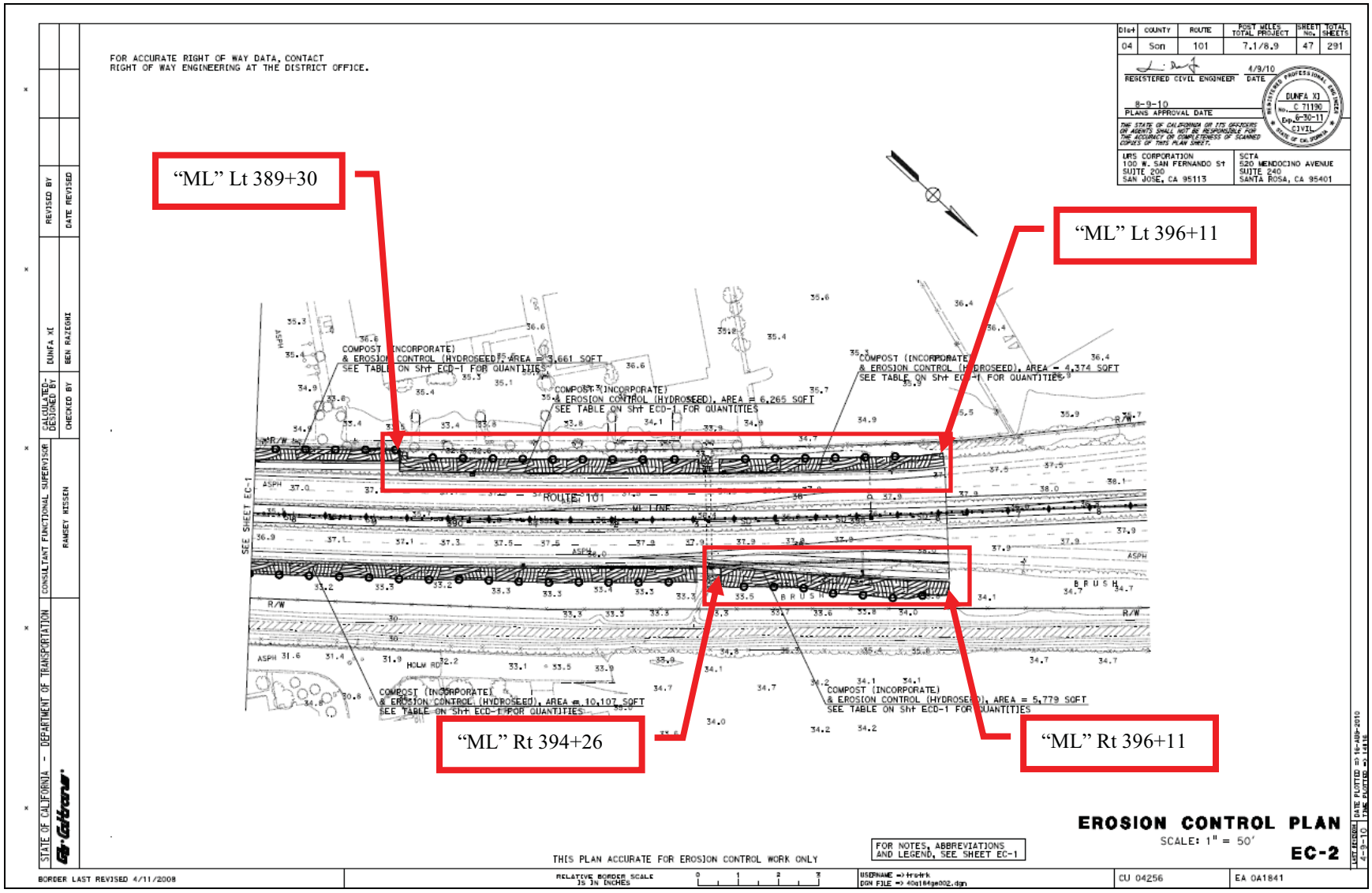


Figure 3. Removed biofiltration strips from EA 04-0a1844

3 CONSTRUCTION GENERAL PERMIT

To minimize the potential effects of construction runoff on the quality of the receiving water bodies, any construction activity affecting one acre or more must obtain coverage under the CGP. Permit applicants are required to prepare a SWPPP and implement BMPs to reduce construction effects on receiving water quality.

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 to determine the RL of the Project. This Project has a **Low Site Sediment Risk Factor** (Figure 6) and a **High Receiving Water Risk Factor** (Figure **7**); the combined risk is **Level 2** (Figure 8). The risk factors are detailed in the following sections.

3.1.1 Sediment Risk

The sediment risk is based on the following equation from the CGP "Fact Sheet" (Section J.1.a pg. 28):

Equation 1. Sediment Risk Equation
A = (R)(K)(LS)(C)(P)

Where:

R = Runoff erosivity factor
K = Soil erodibility factor
LS = Length-slope
C = Cover = 1.0 (bare ground conditions; set value per CGP)
P = Management operations and support practices = 1.0 (bare ground conditions; set value per CGP)
A = Rate of sheet and rill erosion (tons per acre)

The R value of **135.83** was determined using the SWRCB "Construction General Permit Risk Assessment R-Factor Calculation Notification" memo (see Figure 4) because the U.S. Environmental Protection Agency (EPA) "Rainfall Erosivity Factor Calculator for Small Construction Sites" is currently off-line.

The K value of **0.24** was determined from the United States Department of Agriculture NRCS "Web Soil Survey." Figure 5 is a soil map of the Project area, and Table 1 shows the soil K factor for the Project area.

The LS value of **0.40** was determined by examining the original grade delineated electronic cross sections. (See Table 2)

Based on these values, the A value is **13.04** tons per acre. Because this value is less than 15, the Project is classified as having a **low** sediment risk.

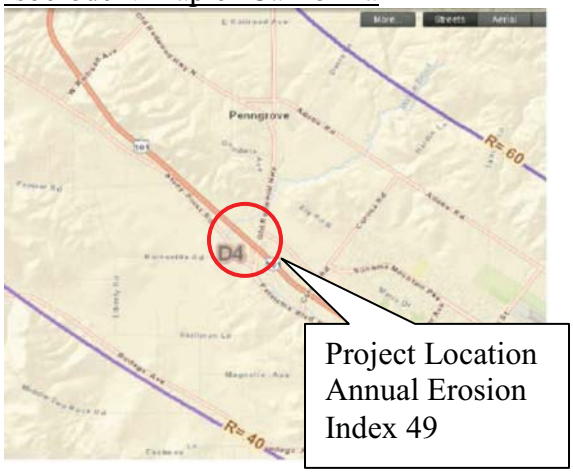
Risk Assessment R-Factor Calculation

The R value is determined from the construction Project in Petaluma with the duration from January 2013 to December 2015.

Erosivity Index (EI) Zone Map:
The Project is in EI distribution zone 20.

Erosivity Index Tables
EI percentage Jan.1 to Dec. 31
92.4% - 0.0% = 92.4%

Isoerodent Map of California



R-value for 3 years = 49 x (92.4%) x 3 years = 135.83

R-value for complete project duration = 135.83

Figure 4. R Value Calculation

Figure 5. K Factor Soil Map

Table 1. Soil erodibility factor (K) based on soil map

K Factor, Rock Free— Summary by Map Unit — Sonoma County, California				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
CeA	CLEAR LAKE CLAY, 0 TO 2 PERCENT SLOPES	.24	36.8	100.0%
Totals for Area of Interest			36.8	100.0%

Table 2. LS Factor Table

Site Specific Analysis of LS Factor
Project 04-0A1851

Number of X-Sections = 4

Alignment		Number of	Slope Segment 1				Slope Segment 2				Slope Segment 3				Weighted Average for All segments	
Station	Line	Segments	Length (ft)	Rise (ft)	Steepness (%)	LS	Length (ft)	Rise (ft)	Steepness (%)	LS	Length (ft)	Rise (ft)	Steepness (%)	LS	Total Slope Length (ft)	Weighted LS
61+00	ONNL	2	4.240	0.280	6.60	0.28	20.000	0.610	3.05	0.19	0.000	0.000	N/A	0.00	24.240	0.21
37+00	ONF	1	43.000	4.810	11.19	0.94	0.000	0.000	N/A	0.00	0.000	0.000	N/A	0.00	43.000	0.94
51+00	ONN	3	51.900	1.250	2.41	0.25	12.000	0.400	3.33	0.18	8.000	0.350	4.38	0.21	71.900	0.23
75+88.75	OSNL	2	24.580	1.530	6.22	0.37	52.420	0.760	1.45	0.17	0.000	0.000	N/A	0.00	77.000	0.23

Area Weighted LS = **0.40**
(Composite Weigthed LS / Number of X-Sections)

	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**		135.83
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**		0.24
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**		0.40
14			
15	**Watershed Erosion Estimate (=RxKxLS) in tons/acre**	13.04	
16	**Site Sediment Risk Factor**	**Low**	
17	Low Sediment Risk: < 15 tons/acre		
18	Medium Sediment Risk: >=15 and <75 tons/acre		
19	High Sediment Risk: >= 75 tons/acre		
20			

Figure 6. Sediment Risk Factor Worksheet

3.1.2 Receiving Water Body Risk

The receiving water risk is classified as **high** because Petaluma River is on the 303(d) List as impaired for sediment; additionally, Petaluma River has the beneficial uses of SPWN, COLD and MIGR.

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: 2006 Approved Sediment-impared WBs Worksheet http://www.waterboards.ca.gov/water_issues/programs/tmdl/303d_lists2006_epa.shtml **OR**	**Yes**	**High**
A.2. Does the disturbed area discharge to a waterbody with designated beneficial uses of SPAWN & COLD & MIGRATORY? http://www.ice.ucdavis.edu/geowbs/asp/wbguse.asp		

Figure 7. Receiving Water Risk Factor Worksheet

With a low sediment risk and a high receiving water body risk, the combined RL is **Level 2**, as shown in Figure 8.

Combined Risk Level Matrix

Receiving Water Risk	Sediment Risk: Low	Sediment Risk: Medium	Sediment Risk: High
Low	Level 1	Level 2	
High	Level 2		Level 3

Project Sediment Risk: Low
Project RW Risk: High
Project Combined Risk: Level 2

Figure 8. Combined Risk Level Matrix

3.2 Notice of Termination (NOT)

The CGP provides requirements for completion and approval of the NOT. The NOT requirements are presented in Section II.D of the CGP "Order." These requirements include demonstrating through photos, computational proof or other "custom methods," to be developed by Caltrans.

While these methods of demonstrating compliance are at the option of Caltrans, should the RWQCB determine that the visual photos do not adequately show compliance, further computational efforts may be required. This computational proof is obtained through the use of the Revised Universal Soil Loss Equation 2 (RUSLE2) program.

3.3 Caltrans Forms

For a list of Division of Construction Forms go to:
http://www.dot.ca.gov/hq/construc/forms.htm.

4 RUN-ON DISCHARGES

Run-on discharges are off-site storm water flows that can potentially run onto the site. Run-on discharges should be calculated based on a rainfall intensity for a 2-year, 24-hour event per the PPDG. The Rational Method is typically used to calculate run-on discharges (see Equation 1).

Equation 1. Rational Method for run-on discharge

$$Q = CiA$$

Where:

Q = Run-on discharge (cubic feet per second [cfs])
C = Runoff coefficient = **0.48** (Low Relief, High Soil Infiltration, High Vegetal Cover, High Surface Storage; see HDM Figure 819.2A)
i = 2-year, 24-hour rainfall intensity (inches/hour) = **0.136**
(Petaluma Station, http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=ca)
A = Drainage area (acre)

There are three areas of notable run-on discharge, two locations at the "OSN" Line and one location at the "ONF" Line. Table 3 summarizes the anticipated run-on discharges, and the run-on watershed maps are included in Appendix C. It is the responsibility of the contractor to determine all potential run-on based on staging and active and non-active construction work.

Table 3. Run-on discharges

Location	Area (ac)	Discharge (cfs)
1 ("OSN" Line)	1.47	0.10
2 ("OSN" Line)	1.51	0.10
3 ("ONF Line)	0.99	0.06

5 PERMIT REGISTRATION DOCUMENTS

To obtain permit coverage under the CGP, all dischargers must electronically file PRDs, NOTs, changes of information, sampling and monitoring information, annual reporting, and other compliance documents required by this CGP through the SWRCB's SMARTS. The contractor will have to coordinate these submittals with Caltrans within the timeframe allotted in the contract special provisions and as specified in the CGP. 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 which 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**
    a. The Standard Risk Assessment includes utilization of the following:
        i. Receiving water Risk Assessment interactive map
        ii. EPA Rainfall Erosivity Factor Calculator Website
        iii. Sediment Risk interactive map
        iv. Sediment sensitive water bodies list

5.1 General Information Included

The following is a list of information included in this Storm Water Information Handout that can be used for the PRDs:

- Vicinity Map
- Risk Assessment

5.2 Storm Water Pollution Prevention Plan

The contractor for the Project is required to prepare a SWPPP because the Project involves disturbing more than 1 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

The SWPPP is required to make reference to, be in compliance with and include a copy of the 401 Certification. The 401 Certification and impact maps for this Project are included in Appendix D.

The SWPPP should be submitted with the PRDs and will be forthcoming from the Contractor.

5.3 Notice of Intent (NOI)

Caltrans will be responsible for submitting the NOI to SMARTS. The contractor should provide Caltrans with the information necessary to complete the NOI. The NOI must be submitted once the contractor submits the SWPPP. A draft of the NOI is included in Appendix A.

5.4 Site Maps

Registration requirements can be met by the inclusion of the following plans, which can be found in the appendices.

- Conceptual Sampling Plan-for reference only (Appendix B)
  - Discharge Locations (Subject to changes by the Contractor and approved by the Engineer)
  - Sampling locations (Subject to changes by the Contractor and approved by the Engineer)

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	Bijan Sartipi		
Mailing Address	Title		
111 Grand Avenue	District Director		
City	State	Zip	Phone
Oakland	CA	94623	(510) 286-5900

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		
	Water Pollution Control Manager		
City	State	Zip	Phone

IV. CONSTRUCTION PROJECT INFORMATION

Site/Project Name	Site Contact Person		
Old Redwood Highway Interchange Project 0A1851	Caltrans Resident Engineer		
Physical Address/Location	Latitude	Longitude	County
Son 101 at Old Redwood Highway Interchange	38.2720 °	-122.6700 °	Sonoma
City (or nearest City)	Zip	Site Phone Number	Emergency Phone Number
Petaluma	94952		

A. Total size of construction site area: 35 Acres

B. Total area to be disturbed: 32 Acres (% of total 91)

C. Percent of site imperviousness (including rooftops):
Before Construction: 34 %
After Construction: 52 %

D. Tract Number(s): _____, _____

E. Mile Post Marker: 7.4/8.1

F. Is the construction site part of a larger common plan of development or sale?
☒ YES ☐ NO

G. Name of plan or development: Highway 101 Congestion Relief Program, Central

H. Construction commencement date: 01/ 01 / 13

I. % of site to be mass graded: _____

J. Projected construction dates:
Complete grading: ____/____/____ Complete project: 12/ 31 / 15

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: California Department of Transportation 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 from SFBRWQCB; 404 from USACOE

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:** _____
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): Petaluma River

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 Sampling Plan

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

David Williams 3/21/12
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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

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URS CORPORATION
1380 Lead Hill Blvd.
Suite 100
Roseville, CA 95661

CITY OF PETALUMA
11 ENGLISH STREET
PETALUMA, CA 94952

NOTES:

1. FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.
2. FOR UNDERDRAIN AND CLEANOUT DETAILS, SEE STANDARD PLANS D99A, D99B AND D99C.
3. STATION AND OFFSET REFERENCE LOCATIONS FOR DRAINAGE STRUCTURES ARE SHOWN ON DRAINAGE DETAIL SHEETS.
4. LOCATIONS OF EXISTING DRAINAGE FACILITIES SHOWN ON THE PLANS ARE APPROXIMATE. PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL FIELD VERIFY THE LOCATIONS AND FLOW LINES OF EXISTING DRAINAGE FACILITIES. ANY DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER.
5. FOR ALL DRAINAGE DITCH LOCATIONS AND ELEVATIONS SEE TYPICAL CROSS SECTIONS AND CONSTRUCTION DETAILS PLANS.
6. SEE DRAINAGE DETAILS DD-8 FOR BRIDGE DECK DRAINAGE SYSTEMS 53, 54, 55, 56, 57, 58, 59 AND 60.
7. EXISTING DRAINAGE FACILITY TO BE USED DURING STAGES 1 THRU 3A CONSTRUCTION. PORTION OF CULVERT CAN BE ABANDONED AS NECESSARY DURING STAGE 4 CONSTRUCTION.

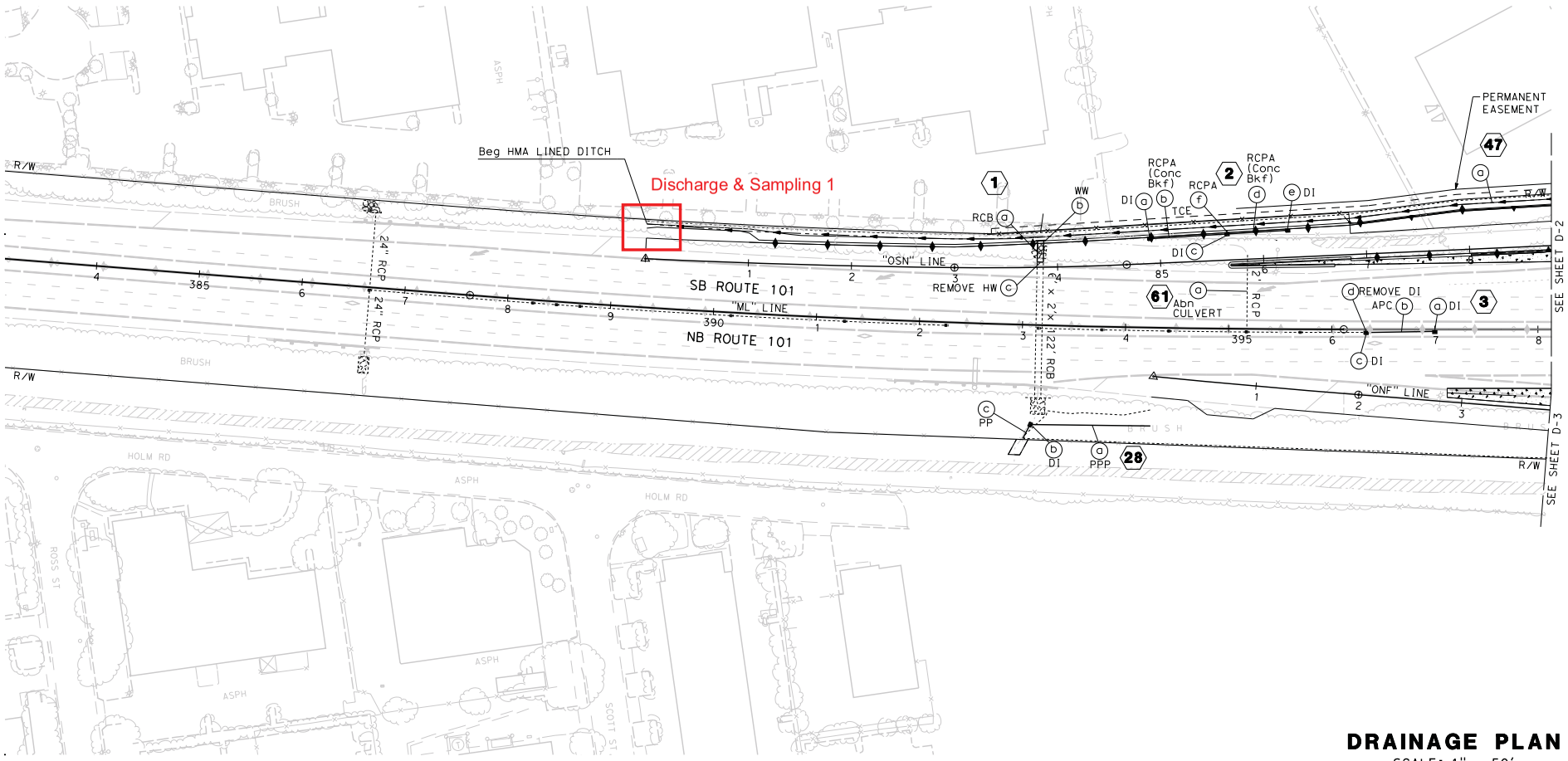
LEGEND:

(#) DRAINAGE SYSTEM No.

(a) DRAINAGE SYSTEM UNIT

Discharge & Sampling Location

Additional Sampling Location (Recommended only)



APPROVED FOR DRAINAGE WORK ONLY

DRAINAGE PLAN

SCALE: 1" = 50'

D-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM — CHECKED BY: DAVID WILLIAMS

REVISED BY — DATE REVISED

LAST REVISION 03-21-12 — DATE PLOTTED => 3/15/2012 — TIME PLOTTED => 9:29:04 AM

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

David Williams 3/21/12
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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

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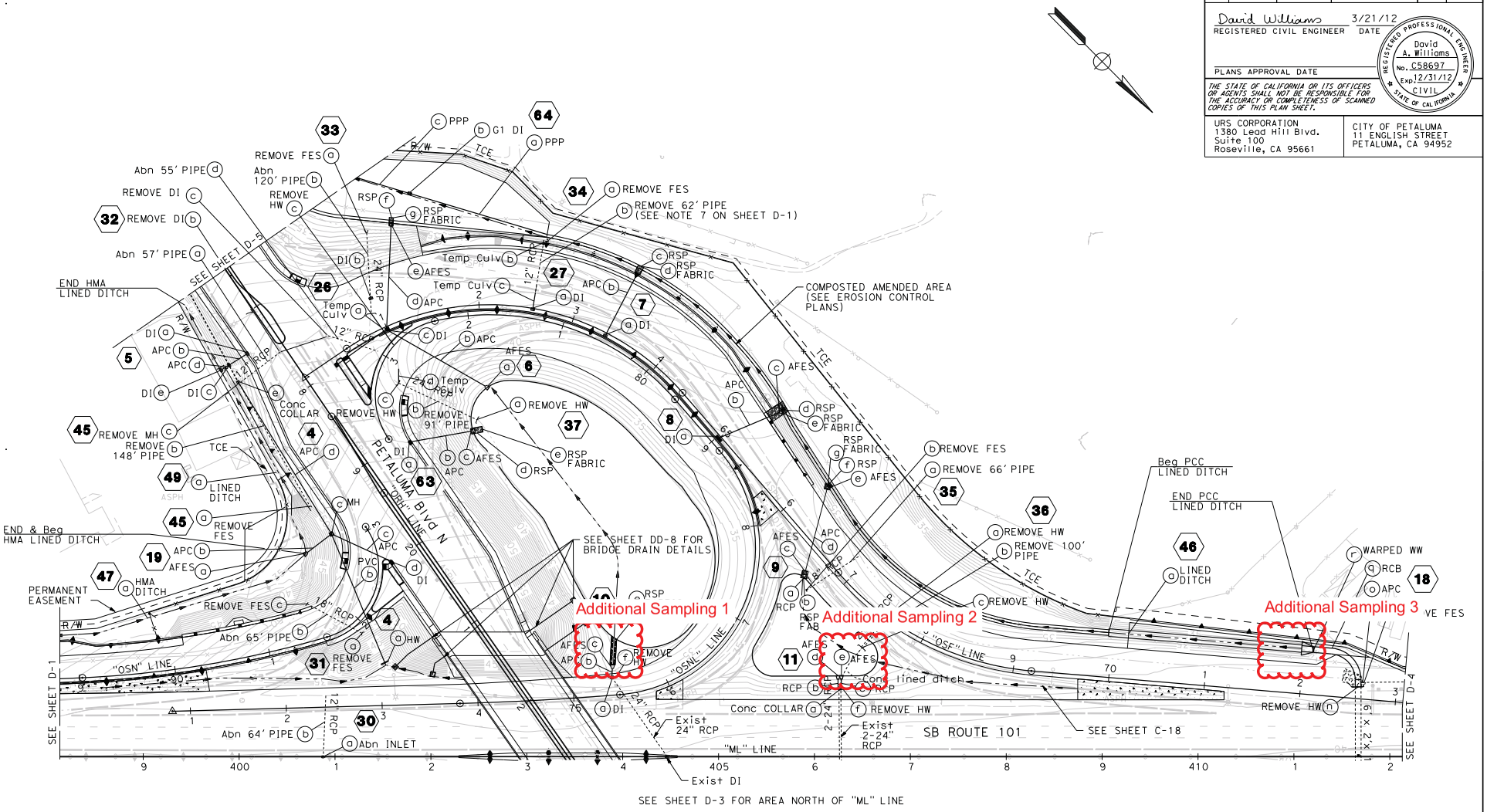

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FOR NOTES AND LEGEND, SEE SHEET D-1

DRAINAGE PLAN

SCALE: 1" = 50'

D-2

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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UNIT 0751

PROJECT NUMBER & PHASE 04000206521

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

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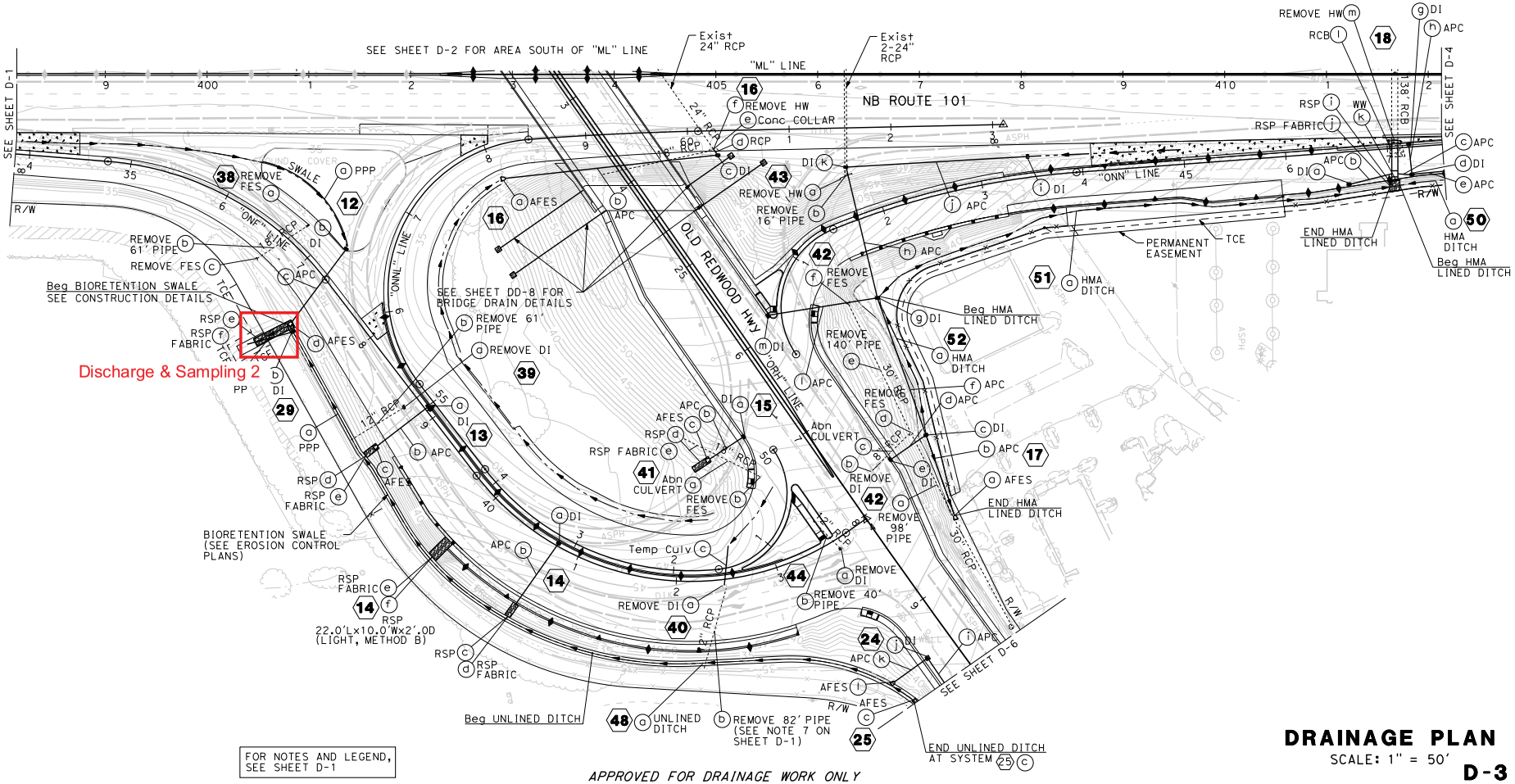

FOR NOTES AND LEGEND, SEE SHEET D-1

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DRAINAGE PLAN

SCALE: 1" = 50'

D-3

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UNIT 0751

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

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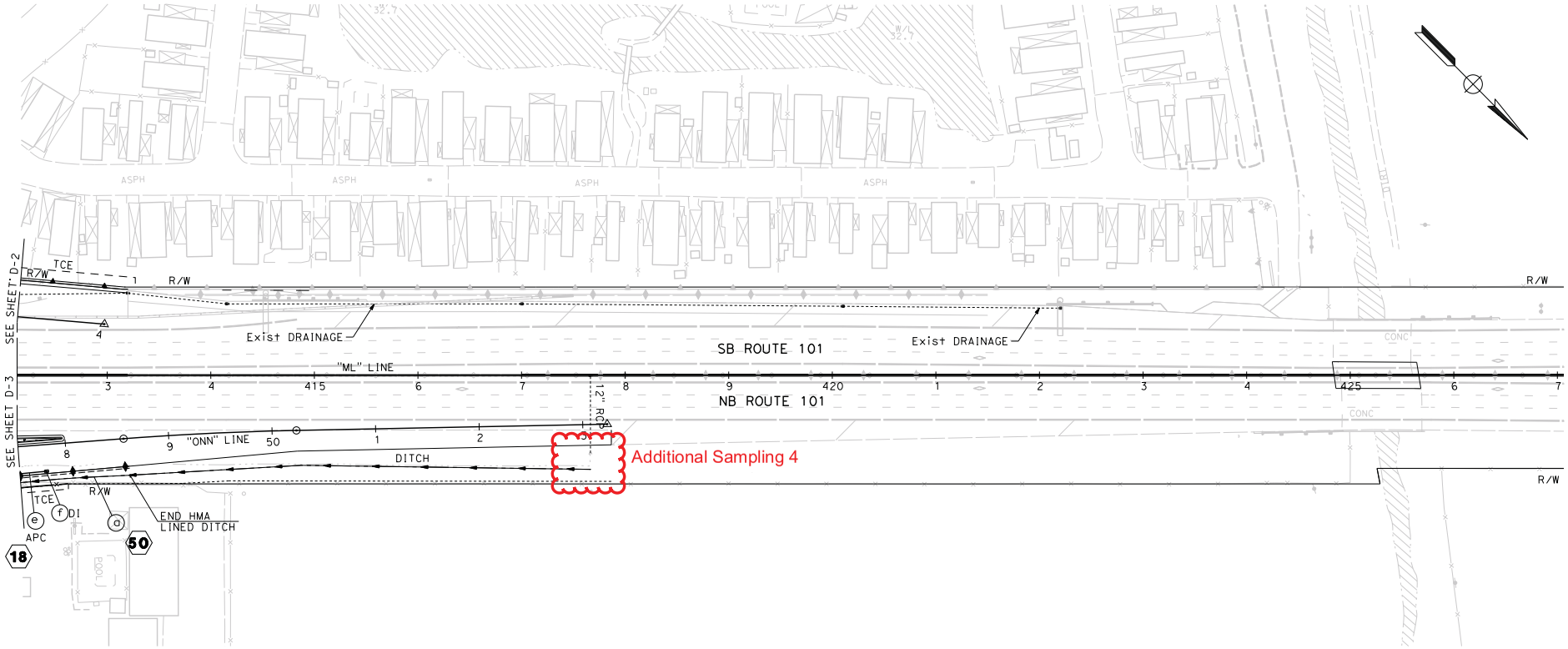

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FOR NOTES AND LEGEND, SEE SHEET D-1

DRAINAGE PLAN

SCALE: 1" = 50'

D-4

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LAST REVISION 03-21-12
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UNIT 0751

PROJECT NUMBER & PHASE 04000206521

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

David Williams 3/21/12
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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

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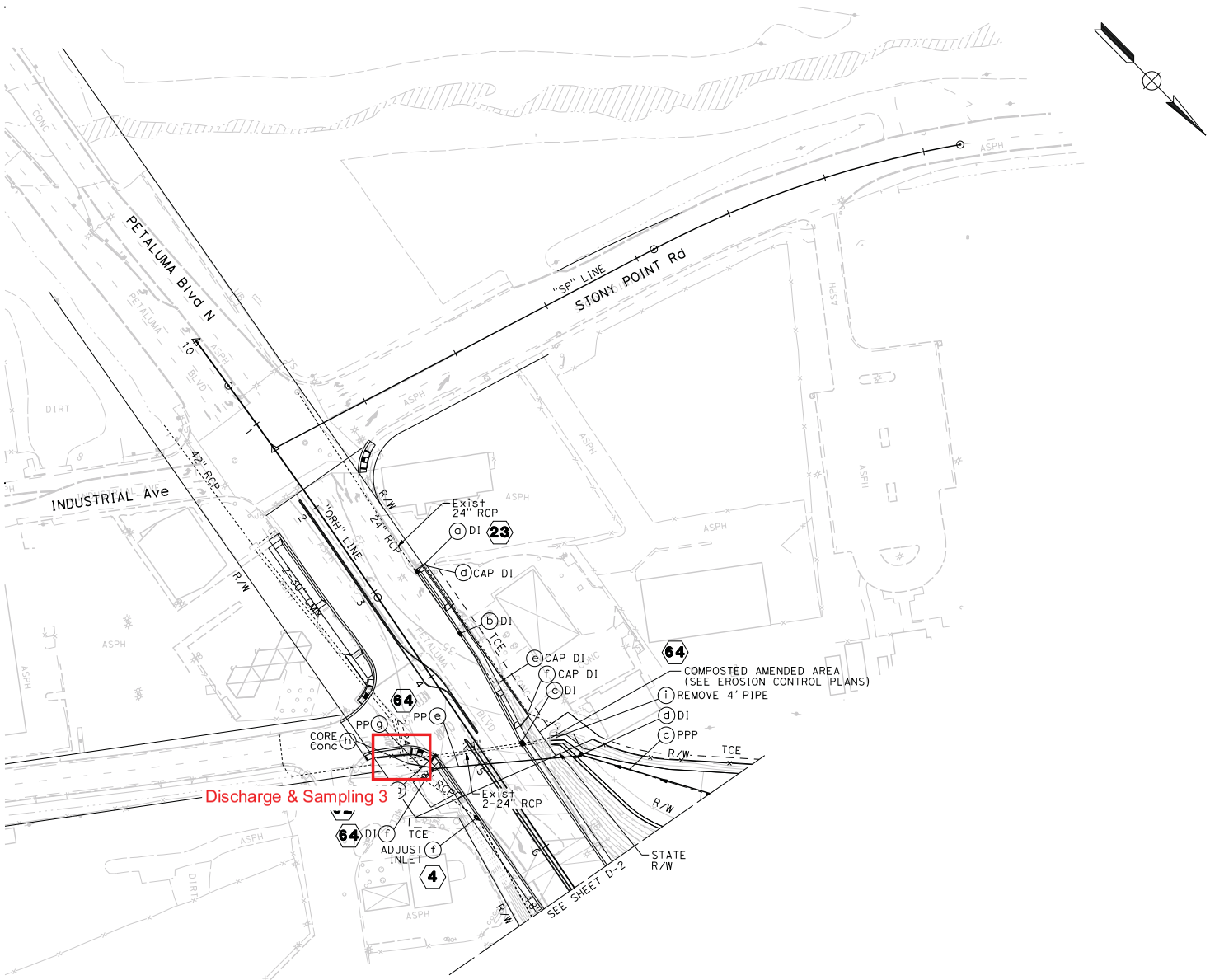

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FOR NOTES AND LEGEND, SEE SHEET D-1

DRAINAGE PLAN

SCALE: 1" = 50'

D-5

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DATE REVISED

LAST REVISION 03-21-12

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0751

PROJECT NUMBER & PHASE 04000206521

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

David Williams 3/21/12
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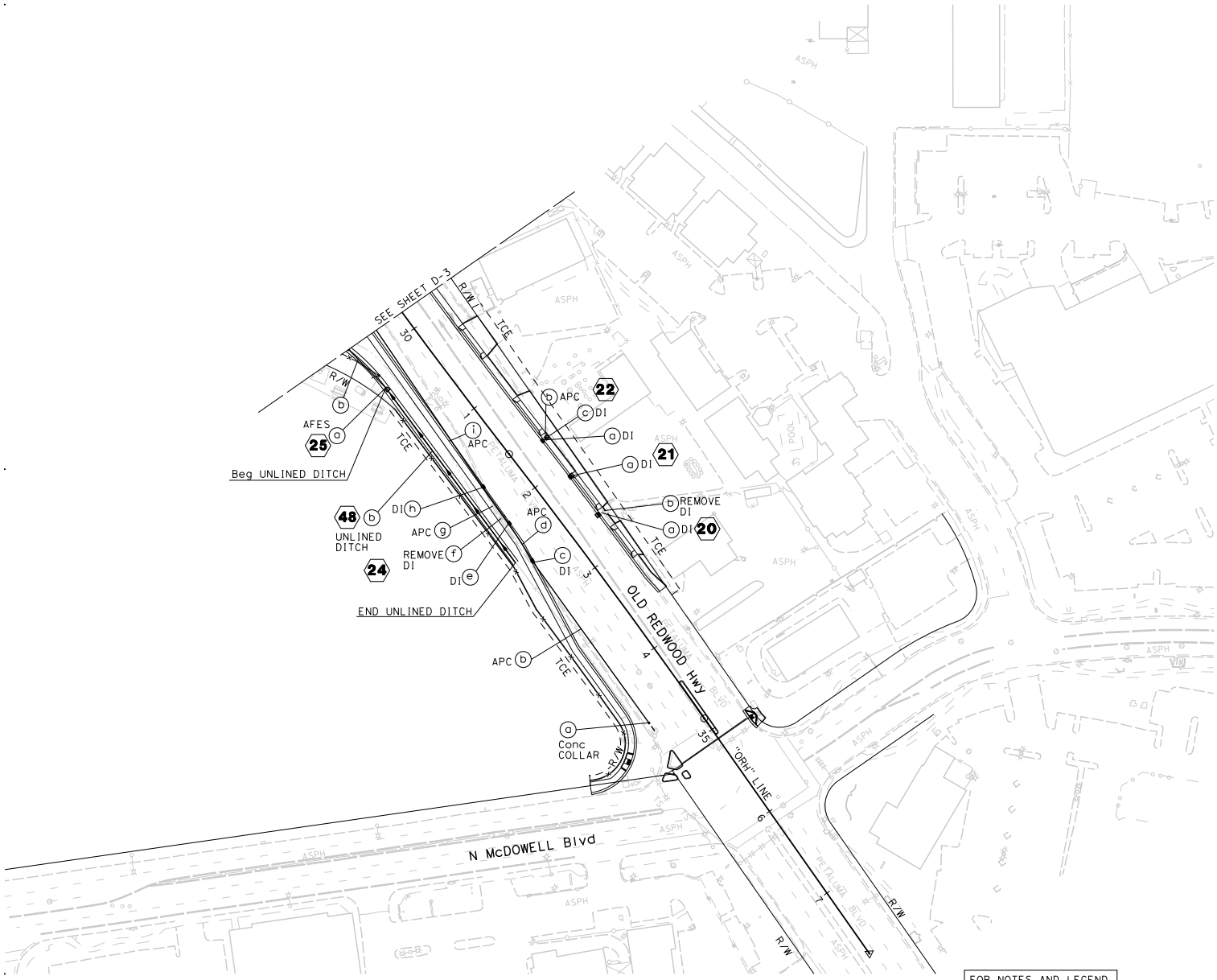

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FOR NOTES AND LEGEND, SEE SHEET D-1

DRAINAGE PLAN

SCALE: 1" = 50'

D-6

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Caltrans	RAMSEY HISSEN	CHECKED BY	DAVID WILLIAMS	DATE REVISED	

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TIME PLOTTED => 9:29:36 AM

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Appendix C Run-On Watersheds

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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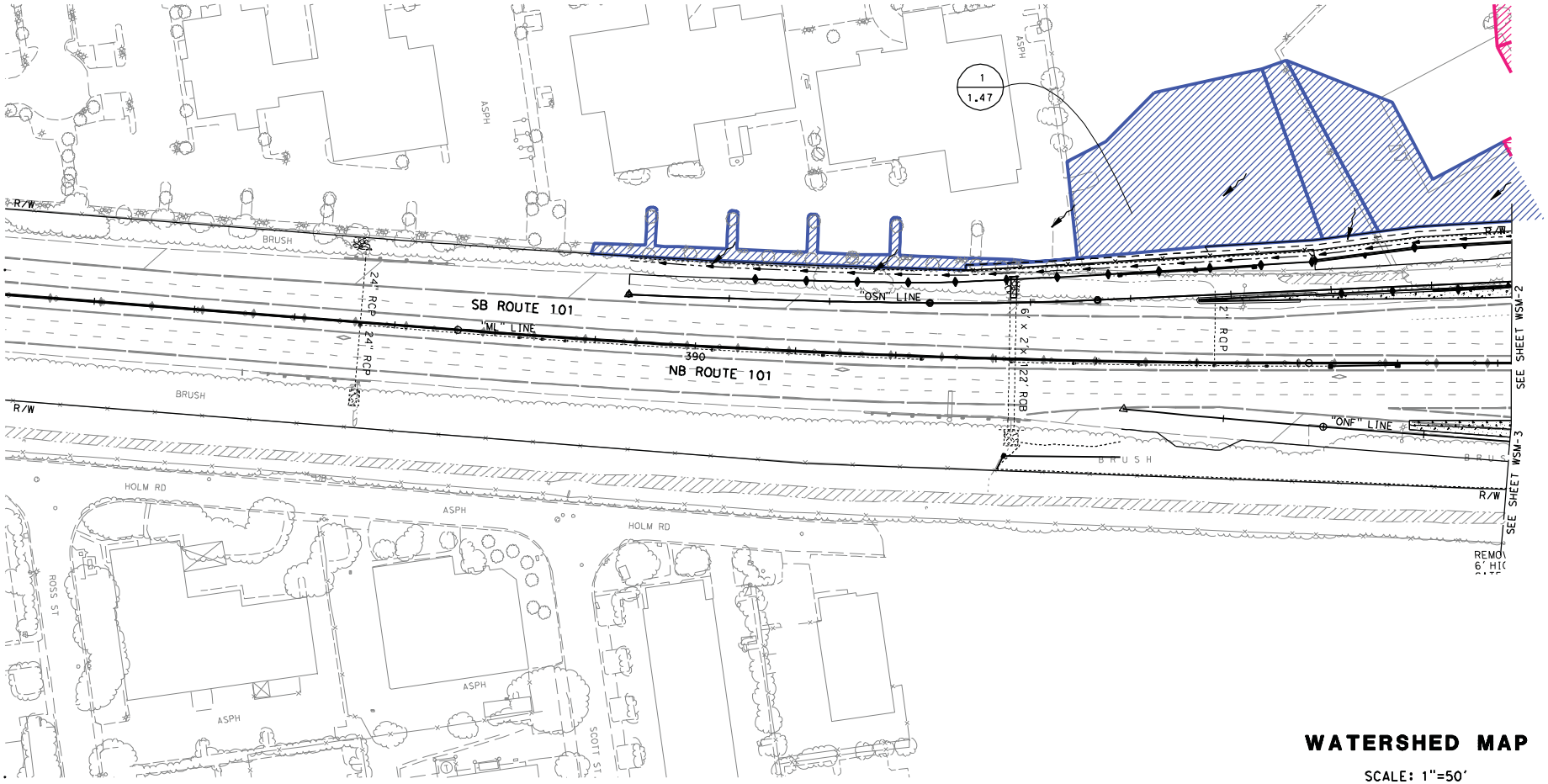
LEGEND:

RUN-ON LOCATION No. / AREA (ac)

FLOW DIRECTION

RUN-ON WATERSHED BOUNDARY



WATERSHED MAP

SCALE: 1"=50'

WSM-1

REVISED BY | DATE REVISED

CALCULATED-DESIGNED BY | CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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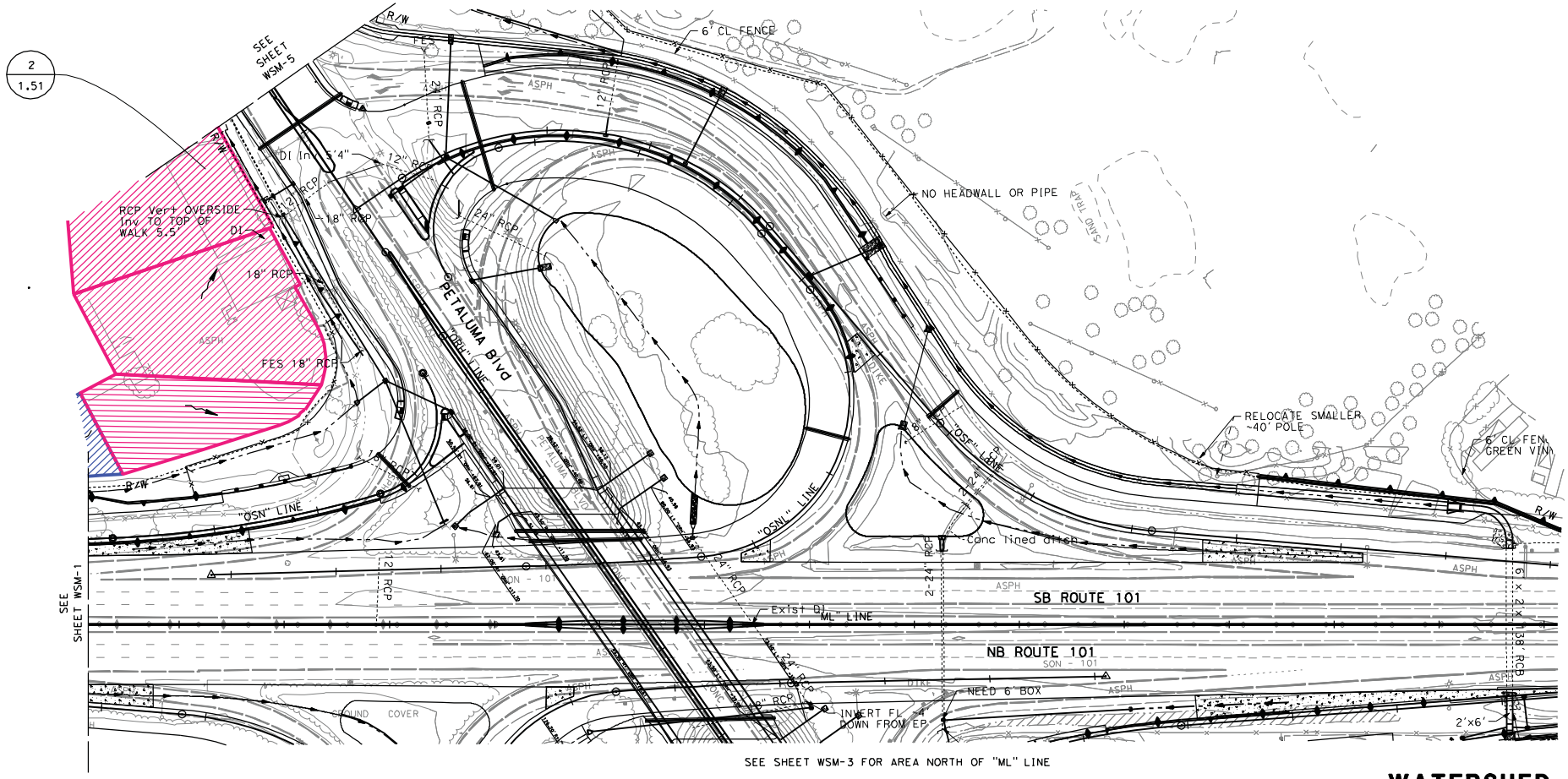
REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA



SEE SHEET WSM-3 FOR AREA NORTH OF "ML" LINE

WATERSHED MAP

SCALE: 1"=50'

WSM-2

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR

CALCULATED-DESIGNED BY

CHECKED BY

REVISED BY

DATE REVISED

LAST REVISION 00-00-00

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TIME PLOTTED => 3:52:30 PM

BORDER LAST REVISED 7/2/2010

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0751

PROJECT NUMBER & PHASE 04000206521

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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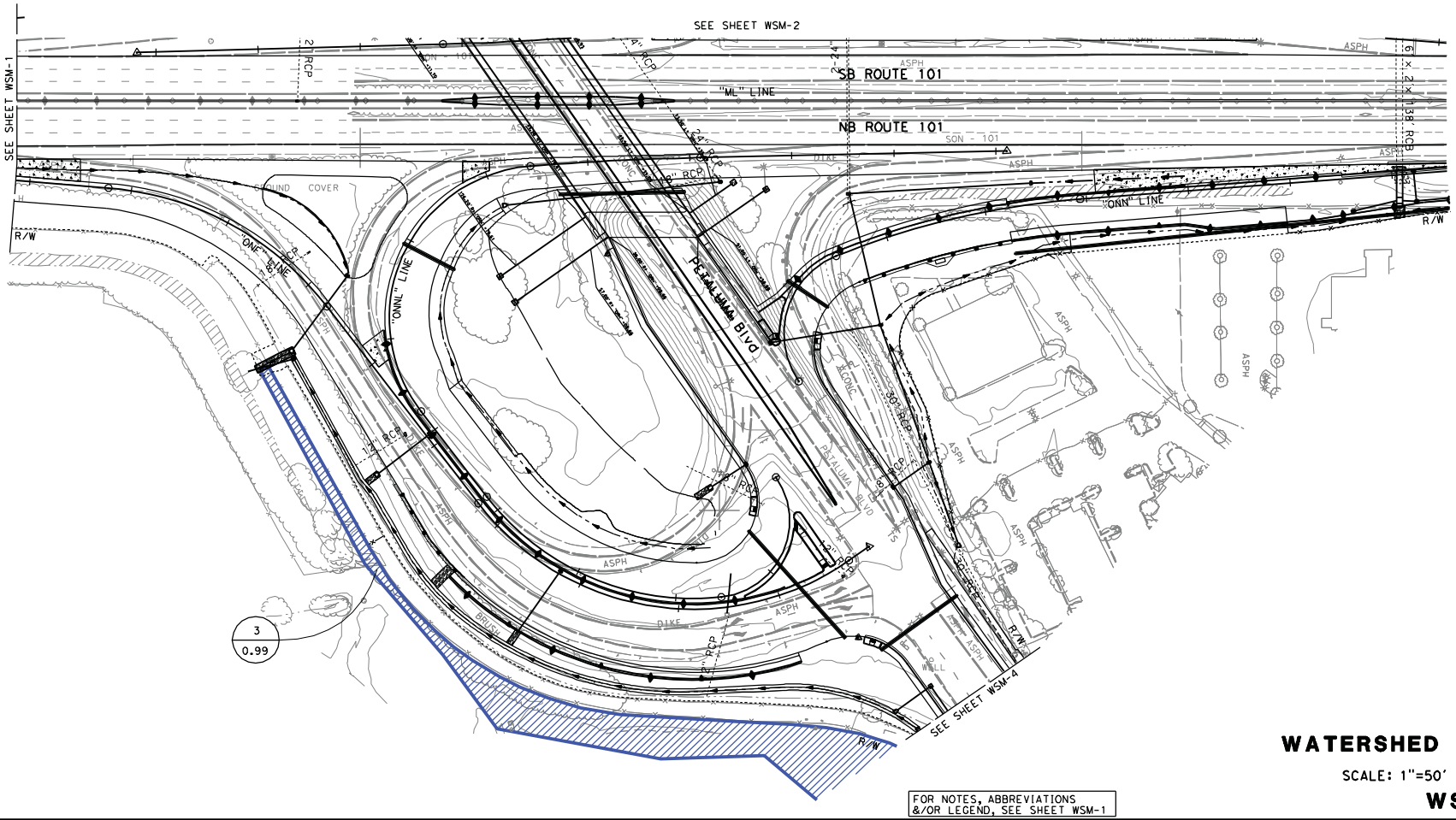

WATERSHED MAP

SCALE: 1"=50'

WSM-3

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR

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LAST REVISION 00-00-00

DATE PLOTTED => 3/19/2012

TIME PLOTTED => 6:02:44 PM

BORDER LAST REVISED 7/2/2010

USERNAME => andrew_chin

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0751

PROJECT NUMBER & PHASE 04000206521

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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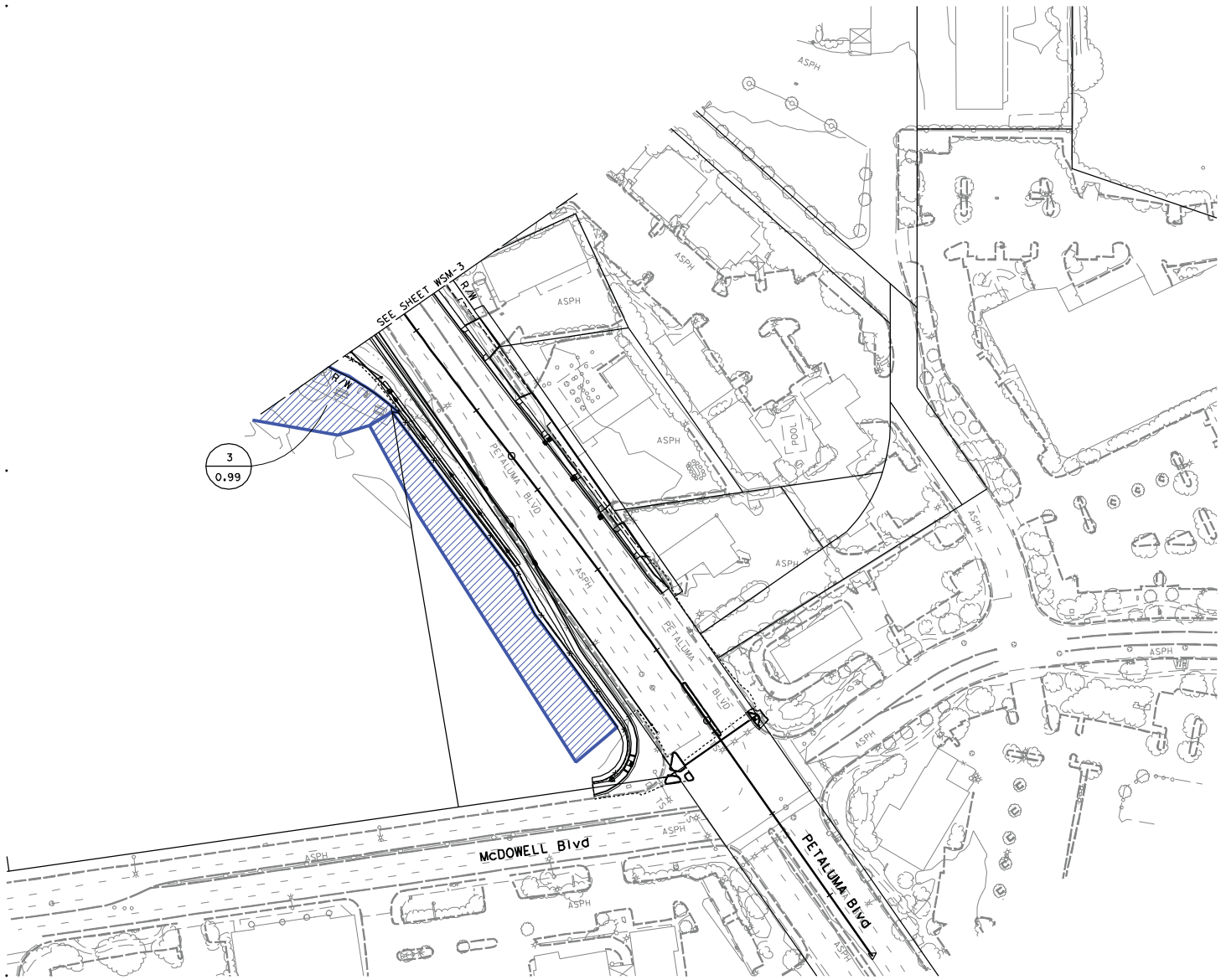

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

WATERSHED MAP

SCALE: 1"=50'

WSM-4

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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CONSULTANT FUNCTIONAL SUPERVISOR

CALCULATED-DESIGNED BY

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LAST REVISION 00-00-00

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TIME PLOTTED => 6:27:02 PM

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RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0751

PROJECT NUMBER & PHASE 04000206521

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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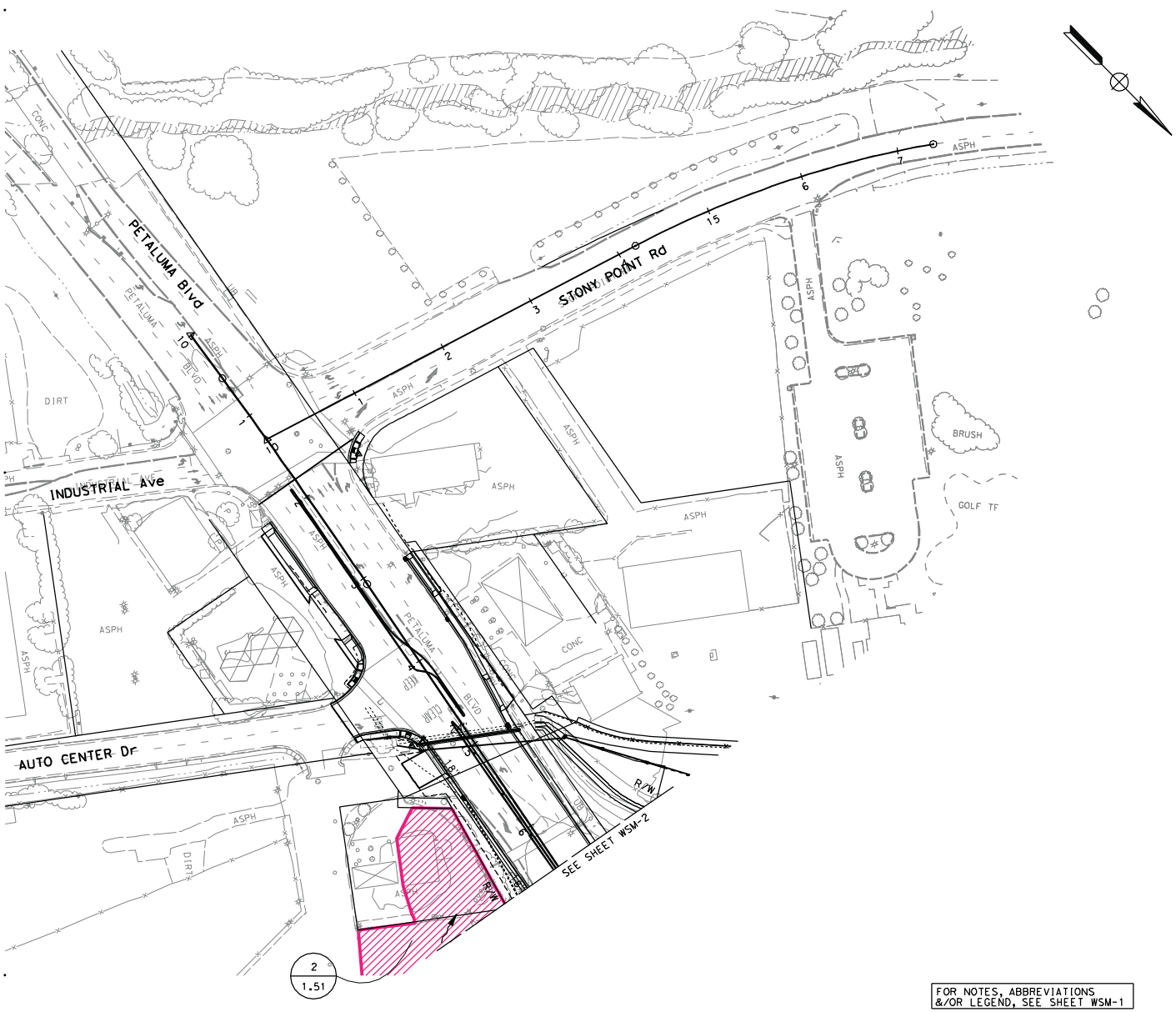

WATERSHED MAP

SCALE: 1"=50'

WSM-5

FOR NOTES, ABBREVIATIONS &/OR LEGEND, SEE SHEET WSM-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR

CALCULATED-DESIGNED BY

CHECKED BY

REVISED BY

DATE REVISED

LAST REVISION 00-00-00

DATE PLOTTED => 3/19/2012

TIME PLOTTED => 6:19:12 PM

BORDER LAST REVISED 7/2/2010

USERNAME => andrew_chin

DGN FILE => ...\Dwg\Run-on\4122761a004.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0751

PROJECT NUMBER & PHASE 04000206521

Appendix D 401 Certification

California Regional Water Quality Control Board
San Francisco Bay Region

Matthew Rodriquez
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

February 29, 2012
CIWQS Place No. 769620
401 Database No.: 02-49-C0301

Sent via electronic mail: No hard copy to follow

California Department of Transportation
Attn: Mr. Eric Schen
Eric_Schen@dot.ca.gov
111 Grand Ave.
Oakland, CA 94612-3717

Subject: Water Quality Certification for the State Route 101 Old Redwood Highway Interchange Project, City of Petaluma, Sonoma County

Department Project No.: EA 04-0A1851

Dear Mr. Schen:

We have reviewed and hereby issue water quality certification to the California Department of Transportation (Department) for the State Route 101 Old Redwood Highway Interchange Project (Project). The Department is seeking an Individual Permit for the Project from the U.S. Army Corps of Engineers (ACOE) pursuant to Section 404 of the Clean Water Act (33 U.S.C. § 1344). As such, the Department has applied to the San Francisco Bay Regional Water Quality Control Board (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 the existing State Route 101 (SR 101) freeway interchange with Old Redwood Highway in the City of Petaluma. Major elements of the upgrade include:

- Construction of a new SR 101 overcrossing along Old Redwood Highway/Petaluma Boulevard North using concrete driven piles;
- Construction of seven retaining and sound walls using cast-in-drilled-hole piles;
- Realignment and reconstruction of existing on-ramps and addition of high occupancy vehicle lanes and ramp metering;
- Realignment and reconstruction of off-ramps to increase capacity and meet current design standards;

- Realignment and reconstruction of Old Redwood Highway and Petaluma Boulevard North to align with the new overcrossing approaches;
- Widening of the SR 101 mainline to accommodate interchange reconstruction; and
- Widening the west side of Stony Point Road to accommodate a new left turn pocket on Petaluma Boulevard North.

Impacts: Project implementation would result in the permanent fill of approximately 0.82 acres of jurisdictional seasonal freshwater wetlands and the permanent fill of approximately 616 linear feet of jurisdictional waters. Permanent waters and wetlands impacts are summarized below in Table 1, *Summary of Permanent Impacts.* Project implementation would also result in permanent impacts to ten arroyo and red willows exceeding four inches diameter breast height.

Approximately 0.011 acres of jurisdictional waters would be temporarily impacted due to excavation and placement of an underground drain. Temporary Project impacts are summarized below in Table 2, *Summary of Temporary Impacts.*

Table 1: Summary of Permanent Impacts

Activity	Jurisdictional Feature Impacted (Feature ID)	Acreage and/or Linear Footage of Permanent Impact
Fill due to realignment and widening of new Petaluma Boulevard South on-ramp to southbound 101	Roadside wetland in drainage channel along southbound 101 south of Petaluma Blvd. (SW1-e)	0.0175 acres
Fill due to realignment and widening of new Petaluma Boulevard South on-ramp to southbound 101	Roadside wetland in drainage channel along southbound 101 south of Petaluma Blvd. (SW1-f)	0.0319 acres
Fill due to realignment and widening of new Petaluma Boulevard South on-ramp to southbound 101	Roadside wetland in drainage channel along southbound 101 south of Petaluma Blvd. (SW1-g)	0.0025 acres
Fill due to realignment and widening of new Petaluma Boulevard South on-ramp to southbound 101	Roadside wetland in drainage channel along southbound 101 south of Petaluma Blvd. (SW1-h)	0.0211 acres
Fill due to realignment and widening of northbound off-ramp to Old Redwood Highway and extension of gas utility line casings	Roadside wetland in drainage channel along northbound 101 off-ramp to Old Redwood Highway (SW1-m)	0.0986 acres
Fill due to realignment and widening of southbound off-ramp and southbound loop on-ramp	Roadside wetland in drainage channel along southbound 101 off-ramp to Petaluma Blvd. North (SW1-n)	0.3611 acres
Fill due to realignment and widening of the southbound 101 off-ramp and southbound loop on-ramp	Roadside wetland in drainage channel between southbound 101 off-ramp to Petaluma Blvd. North and southbound 101 mainline (SW1-o)	0.0094 acres

Table 1: Summary of Permanent Impacts (continued)

Activity	Jurisdictional Feature Impacted (Feature ID)	Acreage and/or Linear Footage of Permanent Impact
Fill due to realignment and widening of the southbound 101 off-ramp and southbound loop on-ramp	Roadside wetland in drainage channel that outfalls to a drainage channel paralleling the existing southbound 101 off-ramp (SW1-p)	0.0036 acres
Fill due to realignment and widening of the Old Redwood Highway on-ramp to northbound 101	Roadside wetland in drainage channel along Old Redwood Highway on-ramp to northbound 101 (SW1-q)	0.1804 acres
Fill due to realignment and widening of the Old Redwood Highway on-ramp to northbound 101	Roadside wetland in drainage channel along northbound 101 north of Old Redwood Highway (SW1-r)	0.0052 acres
Fill due to realignment and widening of the Old Redwood Highway on-ramp to northbound 101	Roadside wetland in drainage channel along northbound 101 north of Old Redwood Highway (SW1-s)	0.0204 acres
Fill due to realignment and widening of the Old Redwood Highway on-ramp to northbound 101	Roadside wetland in drainage channel along northbound 101 north of Old Redwood Highway (SW1-t)	0.0212 acres
Fill due to realignment and widening of Petaluma Blvd. North on-ramp to southbound 101	Roadside drainage channel along Petaluma Blvd. North on-ramp to southbound 101 (water of State 14)	0.0394 acres
Fill due to realignment and widening of the southbound 101 off-ramp and Old Redwood Highway to southbound 101 loop on-ramp	Roadside drainage channel along Petaluma Blvd. North on-ramp to southbound 101 (water of State 15)	0.0036 acres
Fill due to realignment and widening of the Old Redwood Highway to southbound 101 loop on-ramp	Drainage channel in existing Old Redwood Highway to southbound 101 loop on-ramp (water of State 16)	225 feet (0.0117 acres)
Fill due to realignment and widening of Petaluma Blvd. North on-ramp to northbound 101	Drainage channel in existing Petaluma Blvd. North to northbound 101 loop on-ramp (waters of the State 17)	399 feet (0.0092 acres)
	Total:	0.8159 acres of wetland fill due to roadway widening and realignment; 616 linear feet of roadside waters fill due to roadway widening and realignment

Table 2: Summary of Temporary Impacts

Activity	Jurisdictional Feature Impacted	Acreage and/or Linear Footage of Temporary Impact
Excavation, placement of an underdrain pipe for new biofiltration swale, and in-kind reconstruction of the drainage	Roadside wetland in drainage channel along northbound 101 south of Old Redwood Highway (SW1-l)	0.0063 acres

channel		
Excavation, placement of an underdrain pipe for new biofiltration swale, and in-kind reconstruction of the drainage channel	Roadside wetland in drainage channel along northbound 101 off-ramp to Old Redwood Highway (SW1-m)	0.0046 acres
	***Total*:**	0.0109 acres

Roadway Stormwater Runoff Pollutant Impacts: Project implementation would result in approximately 5.7 acres of new and 5.5 acres of 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. Project implementation would also result in the removal of a biofiltration strip that is currently treating stormwater runoff from 1.4 acres of impervious surface.

Hydromodification impacts: Project implementation would not result in significant hydromodification impacts due to low gradient and aggradation in the receiving waters.

Mitigation: To mitigate for permanent impacts to 0.8159 acres of jurisdictional seasonal freshwater wetlands, the Department has purchased 0.8159 acres of wetland mitigation bank credits from Burdell Ranch Wetland Conservation Bank. To mitigate for the approximately 616 linear feet of roadside waters, the Department shall re-build these ditches in-kind adjacent to their former locations. The Department shall also plant and establish twenty willow trees to mitigate for ten willow trees permanently impacted by Project implementation.

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 12.6 acres of impervious area using four bioretention swales (see Table 3, below for swale details). The four swales will treat approximately 13.1 acres of impervious area, 0.5 acres more than the required 12.6 acres. The Department may use the 0.5 acres of surplus treatment as credit towards the treatment obligations of a future, neighboring project (see certification condition no. 2).

The following bioretention swales will mitigate water quality impacts resulting from Project implementation:

Table 3: Permanent Treatment BMP Summary

Location	Length (feet)	From 101 Post Mile	To 101 Post Mile	Treated Impervious Area (acres)
Adjacent southbound lane, immediately before southbound 101 off-ramp	111	7.46	7.48	0.340
In island between southbound 101, southbound 101off-ramp and Old Redwood Hwy. loop on-ramp to southbound 101	131	7.60	7.62	0.750
Adjacent southbound 101 off-ramp to Petaluma Blvd. North	593	7.60	7.68	1.58
Adjacent the outside of northbound 101 off-ramp to Old Redwood Highway	339	7.58	7.65	10.4
			total:	*13.1*

CEQA Compliance: The Department certified an Environmental Impact Report for this Project pursuant to the provisions of the California Environmental Quality Act on August 30, 2007. On June 16, 2010, the Department revalidated the Notice of Determination, published by the State Clearinghouse on September 13, 2007, that the Project will 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 conditions imposed by the Individual Permit issued to the Department by the Corps;

2. The Department shall install four biofiltration swales to treat stormwater contaminants from no less than 13.1 acres of impervious area. The swales shall be installed and consistent with the information summarized above in "Roadway Pollutant Mitigation, and with the construction details and soil mix specifications included in Attachment A, *Bioretention Swale Details*. The Department may apply 0.5 acres of the 13.1 acres of post-construction stormwater treatment credit to a future project in the same watershed, subject to the acceptance of Water Board staff;

3. The Department shall submit, subject to the acceptance of Water Board staff, a Willow Tree Mitigation and Monitoring Plan (Plan), no later than July 31, 2012, to compensate for the ten willow trees permanently impacted by the Project. The Plan shall:

    a. Include a proposal to plant no less than twenty willows;
    b. Only deem willow plantings successful after five growing seasons, whereupon eighty percent of the planted willows shall exhibit average or improved health and vigor from the previous two growing seasons;
    c. Provide additional planting, maintenance and monitoring until the success criteria is satisfied if the above success criteria is not met;
    d. Deem willow plantings successful only after two full growing seasons have passed upon termination of supplemental watering; and
    e. At a minimum, submit years 0, 1, 3 and 5 monitoring reports to the Water Board;

4. The Project shall be constructed in conformance with the Project Description described in this certification and certification application materials. Any change in the Project that may require modification of the certification shall be approved by the Executive Officer before it is implemented;

5. The Department shall re-build earthen-lined waters of the State 16 and 17, in-kind, adjacent their current locations;

6. Regardless of date, erosion control measures shall be utilized throughout all phases of construction where sediment-laden runoff threatens to enter waters of the State. At no time shall sediment-laden runoff be allowed to enter waters of the State;

7. 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;

8. 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;

9. 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;

10. 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;

11. 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);

12. 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

13. 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 $4,893.00 on November 10, 2011.

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.

Condition 3 is a requirement for information 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

Shin-Roei Lee
2012.02.29
16:32:37 -08'00'

Bruce H. Wolfe
Executive Officer

cc (via e-mail):

Mr. Bill Orme SWRCB-DWQ
Ms. Laurie Monnrres, USACE
Ms. Jane Hicks, Regulatory Branch, USACE
Ms. Holly Costa, Regulatory Branch, USACE
Mr. David Williams, URS Corp.
Mr. Dale Bowyer, Water Board
Mr. Cyrus Vafai, Caltrans
Mr. Hardeep Takhar, Caltrans
Mr. Jason Brush, USEPA
Ms. Paula Gill, USACE

Attachment A

Bioretention Swale Details

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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

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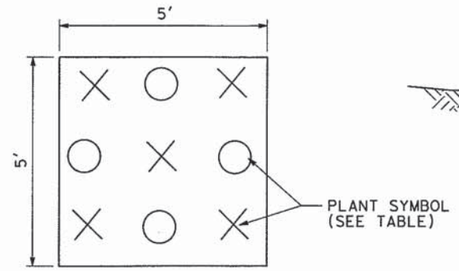
URS CORPORATION
1380 Lead Hill Blvd.
Suite 100
Roseville, CA 95661

CITY OF PETALUMA
11 ENGLISH STREET
PETALUMA, CA 94952

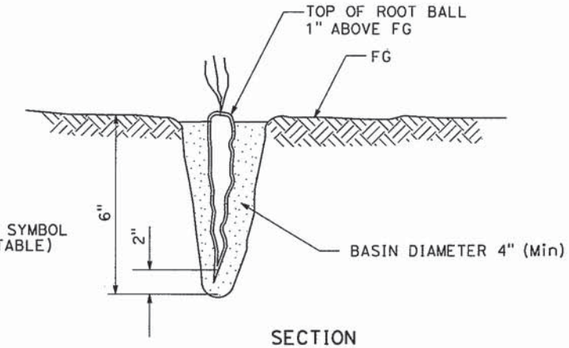
NOTE:

SEE DRAINAGE PLANS, DETAILS, AND QUANTITIES SHEETS FOR MORE INFORMATION.



PLAN

TYPICAL LINER PLANTS SPACING

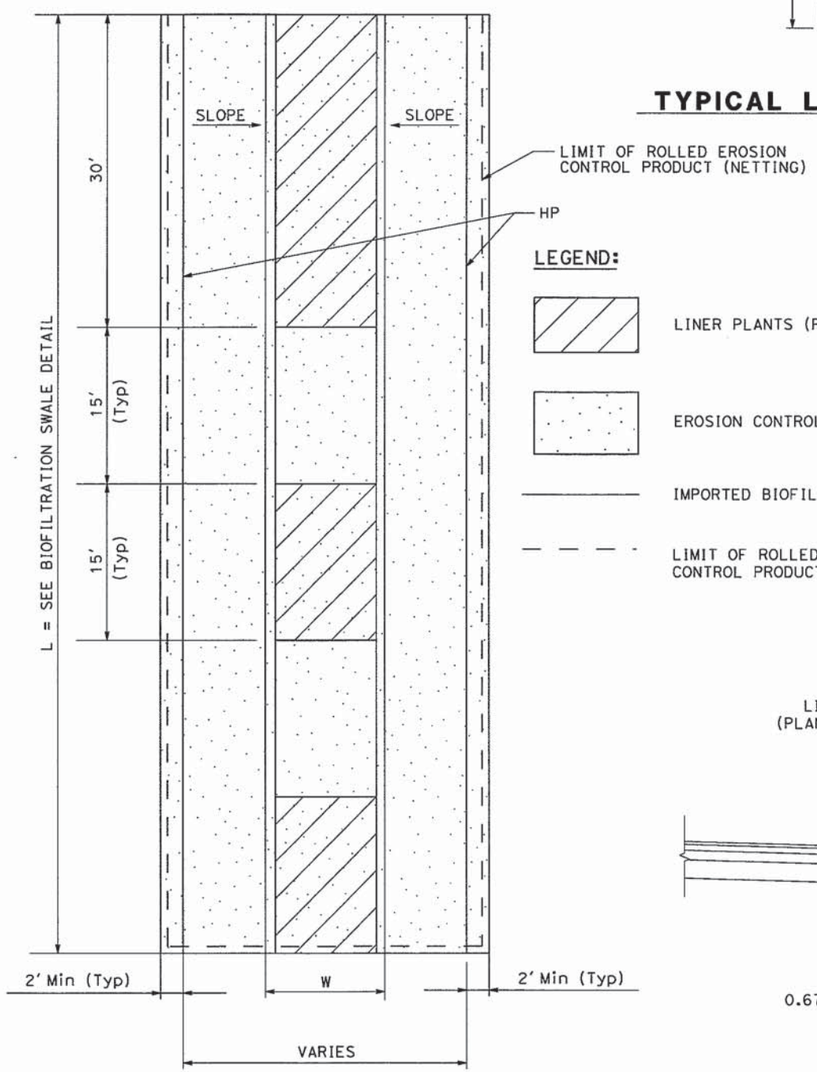


SECTION

PLANT BASIN (LINER)

PLANT LIST AND PLANTING SPECIFICATIONS

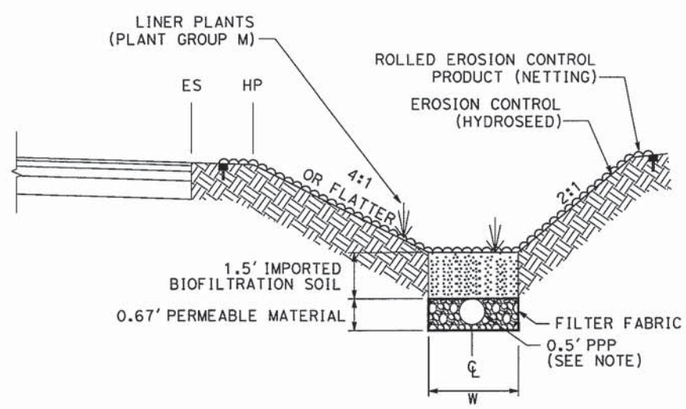
PLANT GROUP	PLANT No.	SYMBOL	BOTANICAL MAME	COMMON NAME	SIZE	QUANTITY (EA)	HOLE SIZE (INCH)	
							Dia	DEPTH
M	1	X	HORDEUM BRACHYANTHERUM	MEADOW BARLEY	LINER	4141	4	6
	2	O	FESTUCA RUBRA 'MOLATE'	MOLATE FESCUE	LINER	3313	4	6



PLAN

LEGEND:

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



SECTION

BIORETENTION SWALE DETAIL

BIORETENTION SWALE

SWALE No.	LOCATION	BOTTOM WIDTH (W)	LENGTH	POST MILE (PM)
1	"ML" 393+25 TO 394+25 R†	20' TO 25'	111'	7.46 TO 7.48
2	"ML" 400+55 TO 401+40 R†	12'	131'	7.60 TO 7.62
3	"ONF" 37+45 TO 42+50 R†	5'	593'	7.60 TO 7.68
4	"OSF" 60+70 TO 62+58 L†	15' TO 69'	339'	7.58 TO 7.65

EROSION CONTROL DETAILS

NO SCALE

ECD-1

REVISED BY	DATE REVISED
HUEY NHAM	DAVID WILLIAMS
CALCULATED-DESIGNED BY	CHECKED BY
CONSULTANT FUNCTIONAL SUPERVISOR	RAMSEY HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

LAST REVISION 09-20-10

DATE PLOTTED => 2/15/2012
TIME PLOTTED => 10:41:52 AM

10-1.__ IMPORTED BIOFILTRATION SOIL

GENERAL

Summary

This work includes furnishing, and applying biofiltration soil mix.

Submittals

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

Before mixing compost with sand and soil, submit a copy of the compost producer's compost technical data sheet and a copy of the compost producer's Seal of Testing Assurance certification. The compost technical data sheet must include:

1. Laboratory analytical test results
2. List of product ingredients

Before mixing compost with sand and soil, submit a Certificate of Compliance under 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 soil. The ratio of the components of imported biofiltration soil by volume must consist of two parts sand; one part compost; and 0.5 part soil.

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	Inches % Passing 3 100%

	% Dry Weight Basis	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).

Soil

Soil must be free of wood, waste or other deleterious material. The soil 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

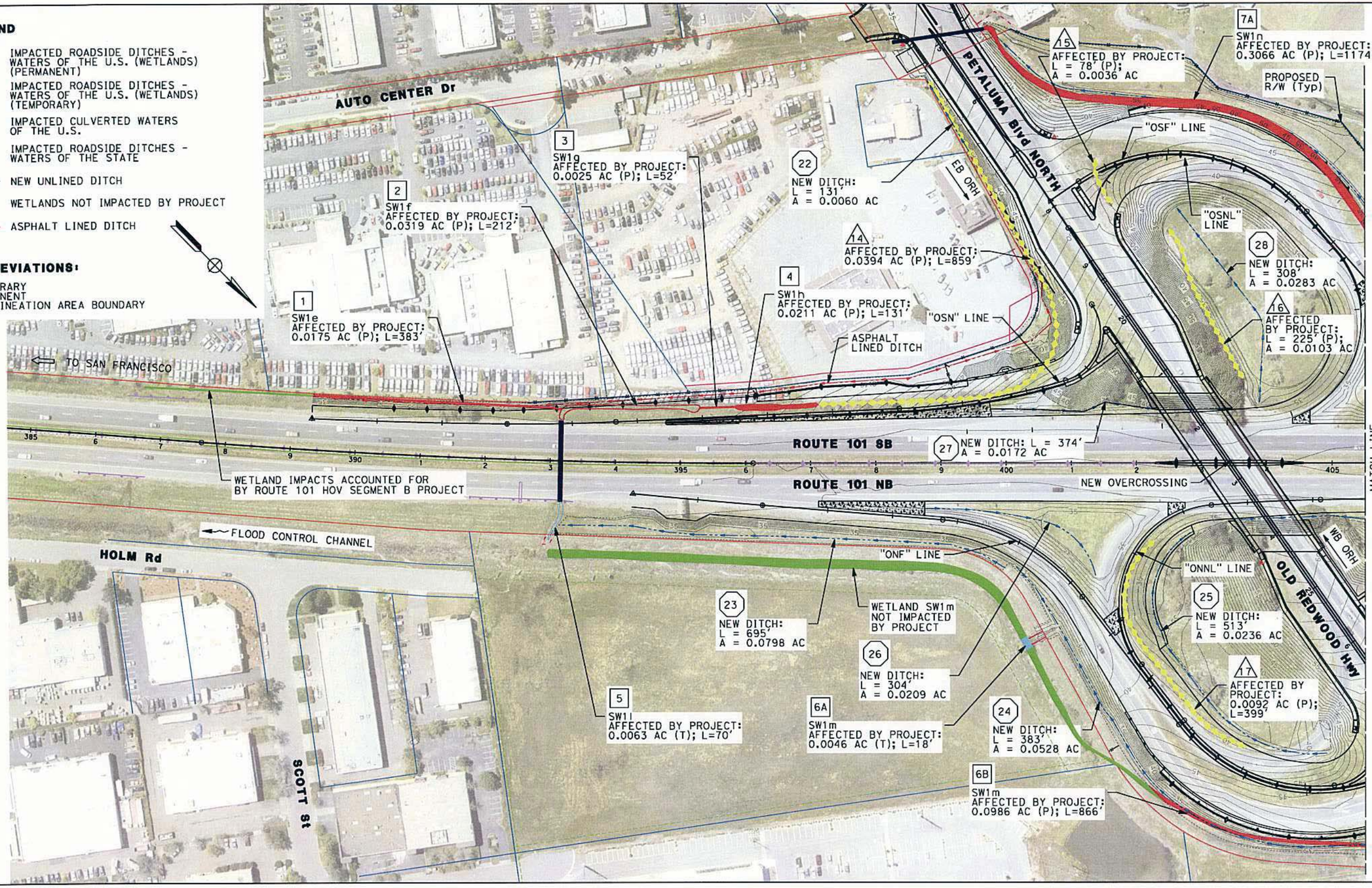
Comply with Section 20-3.02, "Preparation," of the Standard Specifications.

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

MEASUREMENT AND PAYMENT

Imported biofiltration soil is measured by the cubic yard.

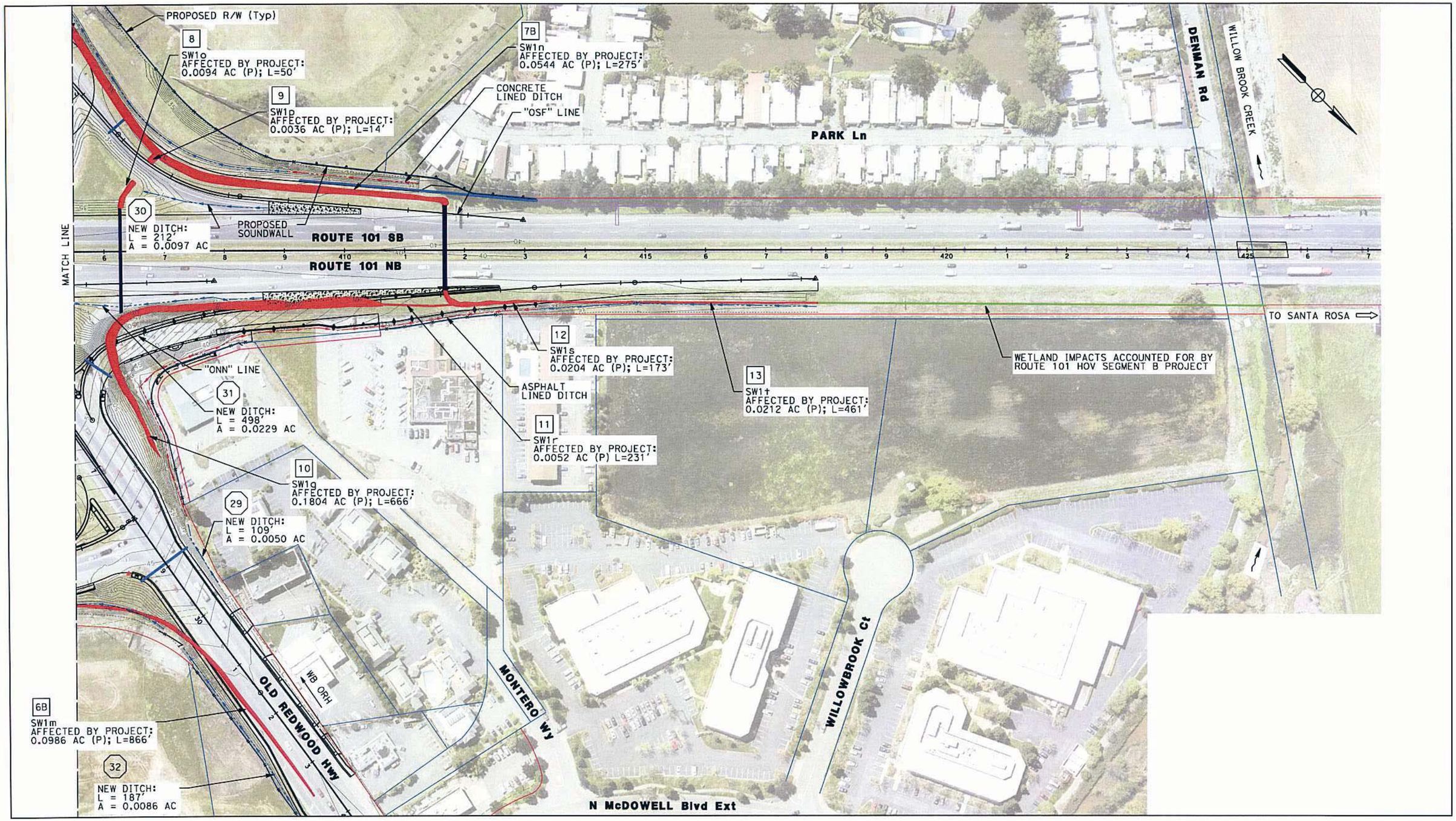
The contract price paid per cubic yard for imported biofiltration soil includes full compensation for furnishing all labor, materials, tools, equipment, incidentals, and for doing all the work involved in imported biofiltration soil, including testing, as shown on the plans, as specified in the Standard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



OLD REDWOOD HIGHWAY INTERCHANGE PROJECT
EA 04-0A1851 (12276K)
IMPACTED WATERS OF THE U.S./STATE

SHEET 1 OF 2

FEBRUARY 2012



OLD REDWOOD HIGHWAY INTERCHANGE PROJECT
EA 04-0A1851 (12276K)
IMPACTED WATERS OF THE U.S./STATE

SHEET 2 OF 2

FEBRUARY 2012

Non-Storm Water Information Package
Dated August, 2012

NON-STORMWATER INFORMATION PACKAGE

CONTRACT NO. 04-0A1854 (04 0002 0652)

Old Redwood Highway IC Project (AAOE)

California Department of Transportation
District 4
Office of Water Quality
III Grand Avenue
Oakland, California 94612
August 2012

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5. INSPECTION, MONITORING, AND REPORTING

ATTACHMENTS

A. ESTIMATED GROUNWATER SEEPAGE RATES IN THE PROJECT AREA

B. DEWATERING LOCATION PLAN

C. SAN FRANCISCO BAY REGIONAL WATER QUALITY CONTROL BOARD (RWQCB) GENERAL WASTE DISCHARGE REQUIREMENTS, ORDER NO. R2-2012-0012

D. LOCAL PUBLICLY-OWNED TREATMENT WORKS (POTW) FACILITY INFORMATION

E. HAZARDOUS MATERIALS SITE INVESTIGATION REPORT, U.S. 101/OLD REDWOOD HIGHWAY INTERCHANGE PROJECT, URS CORPORATION, APRIL 17, 2012

1. Project Description

The U.S. 101/Old Redwood Highway Interchange project in the City of Petaluma, Sonoma County, proposes reconstruction of the existing interchange and widening of the segment of U.S. 101 that passes through the interchange area.

2. Construction Activities Requiring Dewatering

Groundwater is typically present at an elevation of approximately 28 feet Mean Sea Level (MSL). The minimum elevation of the proposed project is approximately 29 feet MSL near Stony Point Road, and several bridge piles extend as deep as -14 feet below MSL. Therefore it is possible that groundwater may be encountered during excavations. Groundwater is contaminated with volatile organic compounds (VOCs) and petroleum hydrocarbons and subject to dewatering restrictions.

3. Treatment System Components

Treatment systems must be designed to remove turbidity-producing suspended solids, metals, and petroleum hydrocarbon constituents found in the groundwater.

Primary and secondary treatment may be required, or the design of the treatment system may require combined use of the various treatment components in series to achieve effective treatment. Ensure that the treatment system components are steam cleaned to remove any residual contaminants. Treatment system components may include:

1. Desilting basins
2. Weir tanks
3. Settling tanks
4. Sediment traps
5. Gravity bag filters
6. Sand media filters
7. Pressurized bag filters
8. Cartridge filters
9. In-line chemical coagulants and/or flocculants
10. Activated clay filters
11. Activated carbon filters
12. A combination of these systems to provide primary and secondary treatment

4. Disposal of Treated Groundwater

Use discharged treated water or uncontaminated ground or surface water for dust control in active work areas when possible, or discharge the water to an inactive area where the grade prevents sheet flow and the soil will allow percolation. The discharge point in the inactive area must include a velocity dissipater. The discharge volume must not exceed the area's capacity for percolation.

Do not discharge into a body of water where erosion, scour, or sedimentary deposits could occur that impact natural bedding or aquatic life. Monitor the water at the discharge point using water quality measurements and visual observation in conformance with the regulatory permit and the special provisions.

Storm water must be diverted away from excavations that would require dewatering.

5. Inspection, Monitoring, and Reporting

If treated groundwater is discharged to the storm drain system, perform compliance monitoring in conformance with the Monitoring and Reporting Program (MRP) included in Attachment E of the Order No. R2-2012-0012. If a batch discharge permit is obtained from a POTW, comply with the provisions contained in the batch discharge permit including all monitoring and reporting requirements.

During periods when the dewatering and non-storm water discharge operations occur, document the results in a Daily Inspection Report (DIR). The DIR form must include the discharge volume records and water quality monitoring records. In developing the DIR, refer to the Department's Dewatering Guide. The DIR form must be approved by the Engineer before use. The DIR must be provided weekly or as directed to the Engineer.

All information and recorded data collected or submitted as part of the DIR must be certified as true and accurate and signed by those who gather the information.

During each day of discharge, perform daily inspection of the effluent at the discharge site and include, in the DIR, observations of:

1. Date and Time.
2. Weather conditions,
3. Wind direction and velocity,
4. The presence or absence of water fowl or aquatic wildlife,
5. The color and clarity of the effluent discharge, and
6. Erosion or ponding downstream of the discharge site.

The DIR must include photographs of the discharge point and areas downstream of the discharge location. These photographs must be labeled with the time, date, and location.

A flow meter that has been approved by the Engineer for exclusive use in dewatering during construction must be used to measure all excavation discharges. All calibrations must be done in conformance with the manufacturer's instructions in the presence of the Engineer.

Record the flow-meter totalizer readings and compute average daily volumes for every day that dewatering is conducted.

ATTACHMENT A

ESTIMATED GROUNWATER SEEPAGE RATES IN THE PROJECT AREA

M E M O R A N D U M

To: Larry Zimmer, City of Petaluma

cc: David Williams, URS

From: Stephen Huang

Date: August 17, 2012

Subject: Seepage Estimates for Bridge Foundation, Retaining Wall Foundation, Sound Wall Foundation and Drainage Facility Excavations
Old Redwood Highway Interchange
Petaluma, California

This memorandum presents our estimates of groundwater flow rates and permeability at the bridge foundation, retaining wall and sound wall foundation and drainage facility excavations in the above referenced project area. It is our understanding that this information will be used in estimating construction dewatering quantities for water pollution control. Please note that the quantity of non-construction caused water, such as storm/run-off water or flow from adjacent drainage lines, is not included in this estimate.

INTRODUCTION

Based on bridge structures plans of the Old Redwood Highway Overcrossing (Replace), we have estimated foundation excavation at bent where groundwater level could rise above the bottom of excavation during construction. Similar excavation cross-sections have also been developed for each of the retaining walls and sound wall where groundwater level could rise above the bottom elevation of the foundation. Using these cross-sections, we calculated the seepage rates into the excavation. Please note that groundwater levels may fluctuate with the season and hydrology near the project site.

SOIL COEFFICIENTS OF PERMEABILLITY

The ranges of soil coefficients of permeability for various types of soils (Unified Soil Classifications) are shown in Table 1. These parameters are based on the FHWA "Highway Subdrainage Design" Manual (Report No. FHWA-TS-80-224).

Table 1: Coefficient of Permeability for Soils*

Unified Soil Classification	Relative Permeability	Coefficient of Permeability k (ft/day)
GW	Pervious	2.7 to 274
GP	Pervious to Very Pervious	13.7 to 27,400
GM	Semipervious	2.7×10^{-4} to 27
GC	Impervious	2.7×10^{-5} to 2.7×10^{-2}

Unified Soil Classification	Relative Permeability	Coefficient of Permeability k (ft/day)
SW	Pervious	1.4 to 137
SP	Semipervious to Pervious	0.14 to 1.4
SM	Impervious to Semiimpervious	$2.7x10^{-4}$ to 1.4
SC	Impervious	$2.7x10^{-5}$ to 0.14
ML	Impervious	$2.7x10^{-5}$ to 0.14
CL	Impervious	$2.7x10^{-5}$ to $2.7x10^{-3}$
OL	Impervious	$2.7x10^{-5}$ to $2.7x10^{-2}$
MH	Very Impervious	$2.7x10^{-6}$ to $2.7x10^{-4}$
CH	Very Impervious	$2.7x10^{-7}$ to $2.7x10^{-5}$

* From FHWA-TS-80-224, Table 2, page 48.

BRIDGE FOUNDATIONS

The Old Redwood Highway Overcrossing (Replace) contains 3 supports (Abut 1, Bent 2 and Abut 3). Driven piles are designed to support both the abutments, wing walls and bent. Groundwater was encountered at Elevation 27.7 feet in CPT-09-003 advanced at Bent 2. However, based on a review of available groundwater monitoring data from the State Water Resource Control Board (GEOTRACKER system), there are evidence that groundwater levels in the project vicinity vary. We estimate the groundwater level at Bent 2 ranges between Elevation 28 to 31½ feet. The bottom of pile cap at Bent 2 could be about 2 feet above the groundwater, if the pile cap is excavated during the dry summer months. However, the pile cap bottom could be about 1½ feet below groundwater, if it is excavated during the wet winter months. Table 2 shows the pile cap dimensions, groundwater information in winter, and calculated seepage rate.

Table 2: Summary of Estimated Seepage at Bridge Support Locations

Support Location	Footing/ Pile Cap Dimensions	Bottom of Pile Cap Elevation (ft)	Estimated Groundwater Table bgs(1) (ft) (Elevation in ft)	Approximate Seepage Rate (gallons/day)
Bent 2	10 x 64.5	30	6.5 (31.5)	7,300

(1) Below ground surface (bgs)

The seepage rate is based on the greater value estimated using either the FHWA method or the total volume of water filling the excavation up to the presumed groundwater level in one day. For Bent 2 pile cap excavation, the value obtained using the latter method is greater.

No groundwater is anticipated during pile cap excavations at Abut 1 and Abut 3.

RETAINING WALLS

This project consists of 7 retaining walls (RW 1 through RW 7) and are planned to be mechanically stabilized embankment (MSE) walls. Based on a review of the wall structural plans, LOTB's and available groundwater data, it is unlikely that groundwater will be encountered during the excavation of MSE wall leveling pads.

SOUND WALLS

This project contains one sound wall along a portion of the off-ramp from southbound U.S.101 to Old Redwood Highway. It is a continuation of the sound wall constructed as part of the U.S. 101 Central HOV lanes Projects. CIDH pile foundations are designed to support the sound wall. Table 3 presents the sound wall extents, groundwater information and calculated seepage rate for each CIDH pile excavation.

The seepage rate for each excavation of CIDH pile is based on the greater value estimated using either the FHWA method or the total volume of water filling the excavation up to the presumed groundwater level in one day. For all excavations, the value obtained using the latter method is greater.

Table 3: Summary of Estimated Seepage at Sound Wall Location

Station	Direction	CIDH Pile Diameter (ft)	CIDH Pile Depth (ft)	Estimated Groundwater Table bgs (ft)	Approximate Seepage Rate (gallons/day)
"SW" 40+00 to 43+97.92	SB	1.33	16	4	150(1)

(1) Seepage estimate is for a single CIDH pile.

DRAINAGE SYSTEMS

Several drainage systems (DS) are planned for this project. However, based on review of the elevations of all planned systems, one system (system 29) would have planned excavations lower than the estimated groundwater level. The stations of the DS, elevation of bottom of excavation and approximate groundwater elevation are listed in Table 4.

Table 4: Summary of Estimated Seepage at Drainage Systems

Drainage System No*	Station	Elevation of Bottom of Excavation (ft)	Estimated Groundwater Elevation (ft)
29	"ONF" 37+48.58 to 41+40.00	30.0	32.0

Based on system 29 configuration and estimated groundwater level along the trench, we estimate the seepage rate in the excavation trench to be approximately 3,000 gal/day for 100 linear feet of drainage

system excavation. The seepage rate is based on the greater value estimated using either the FHWA method or the total volume of water filling the excavation up to the presumed groundwater level in one day. For this excavation, the value obtained using the latter method is greater.

OTHER CONSIDERATIONS

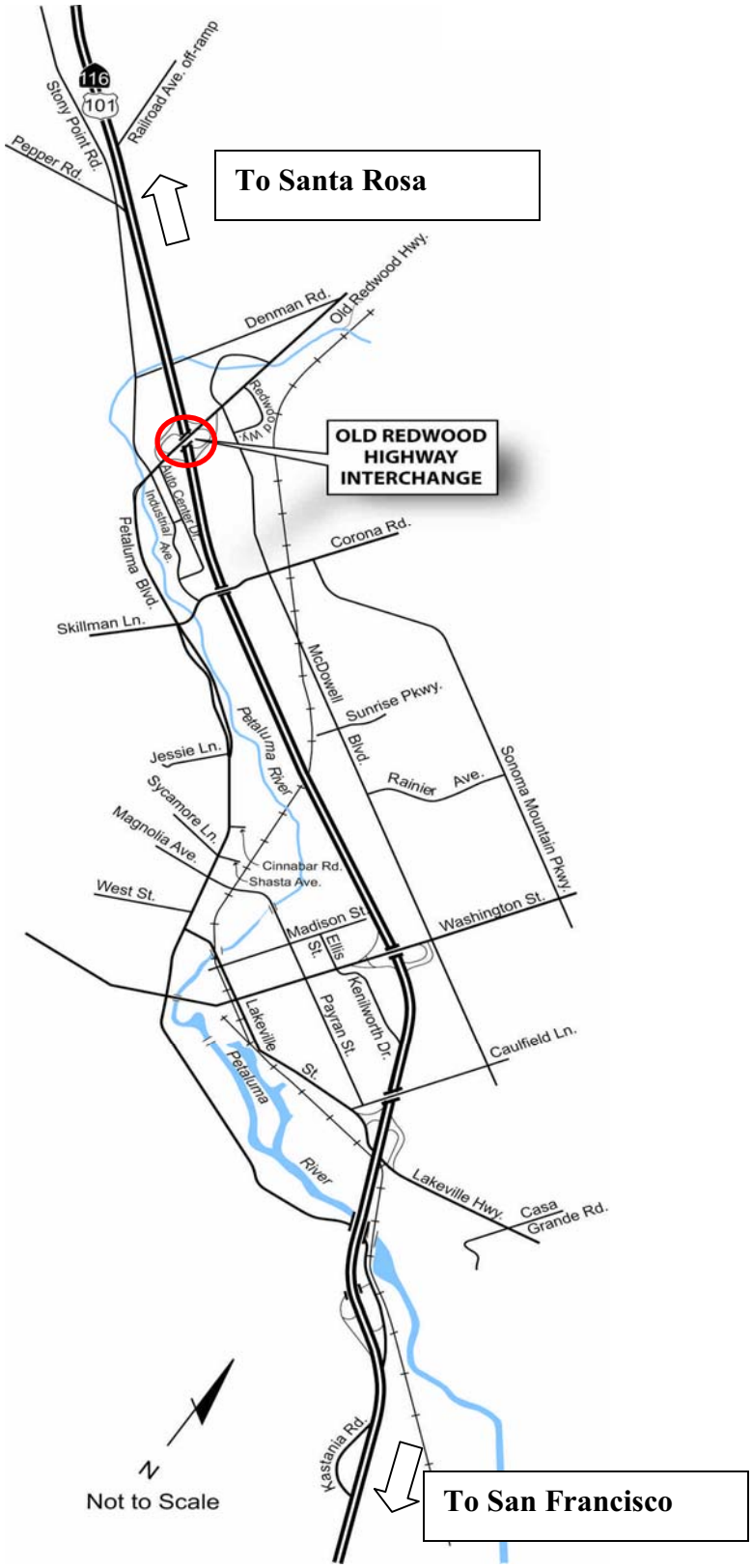
The Contractor can use the coefficients of permeability provided by the aforementioned FHWA manual to compute his/her own flow rate. It is the Contractors responsibility to determine the method of construction dewatering.

LIMITATIONS

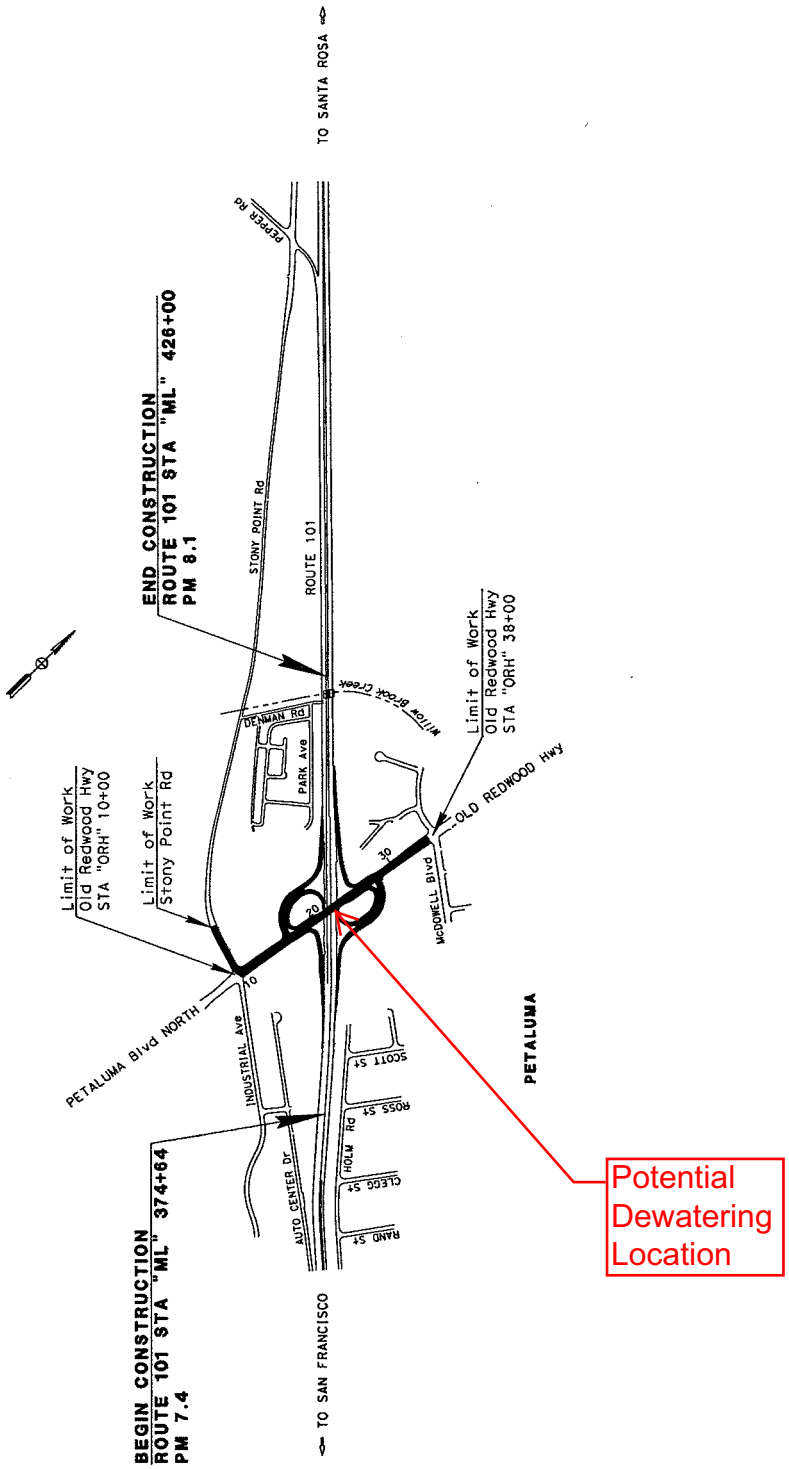
In cohesive soils, as generally encountered throughout the project alignment, a fairly long time would be required for the groundwater to seep into the bore hole and attain an equilibrium position with the long-term hydrostatic groundwater table. Thus, the immediate readings obtained may or may not be representative of the actual groundwater table level. All groundwater table (GWT) depths are approximate and based on available data from nearby borings, monitoring wells and as-built plans. Our seepage estimates have been developed in accordance with the standard of care commonly used in this profession. No other warranties are included, either express or implied, as to the professional advice presented herein.

ATTACHMENT B

DEWATERING LOCATION PLAN



PROJECT VICINITY MAP



PROJECT LOCATION MAP

ATTACHMENT C

SAN FRANCISCO BAY REGIONAL WATER QUALITY CONTROL BOARD (RWQCB) GENERAL WASTE DISCHARGE REQUIREMENTS

ORDER NO. R2-2012-0012

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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Attachments

Attachment A – Definitions
Attachment B – Notice of Intent Application Form and Instructions
Attachment C – Notice of Termination
Attachment D – Standard Provisions
Attachment E – Monitoring and Reporting Program
Attachment F – Fact Sheet

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 $\geq$ 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

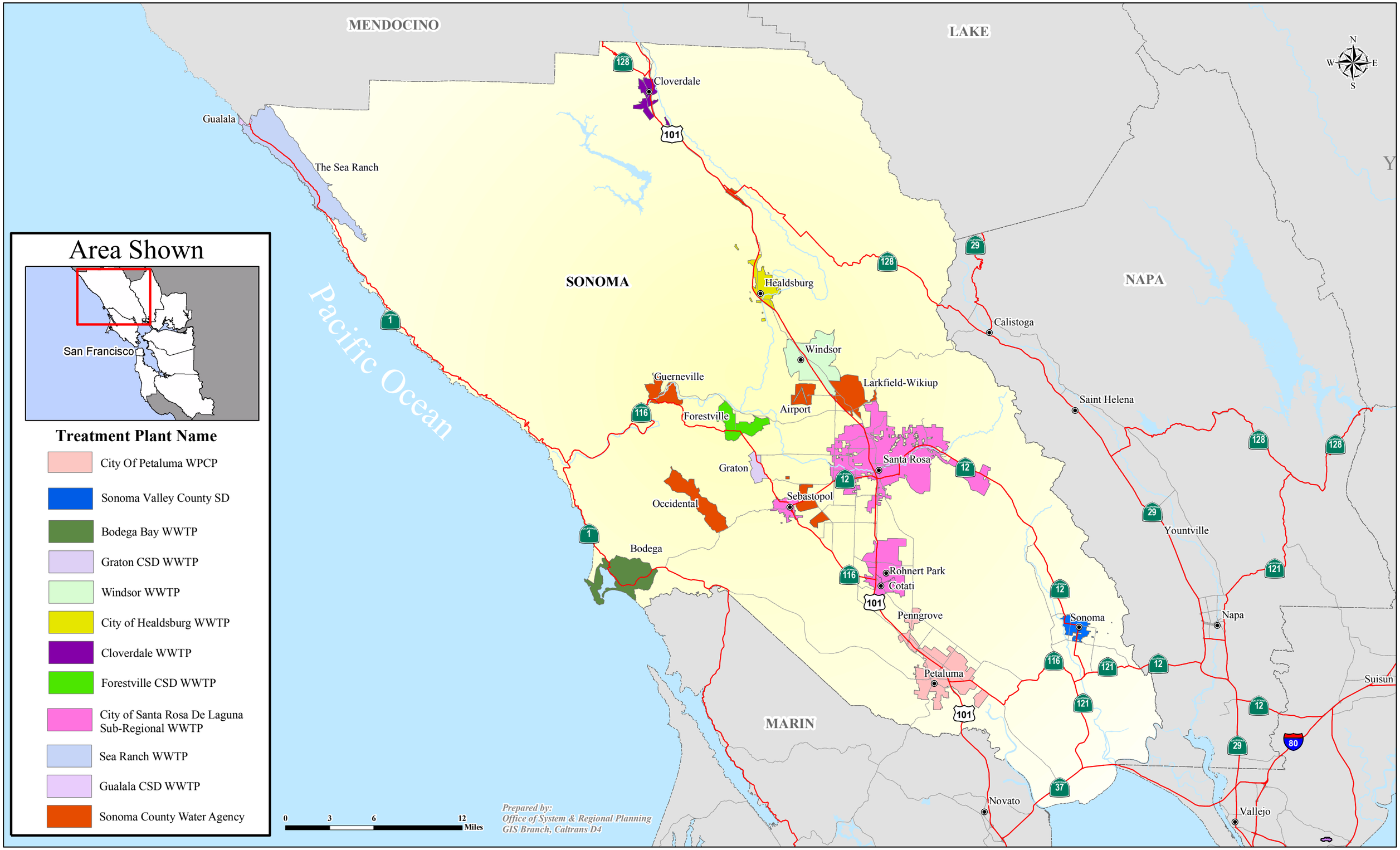
Requests for additional information or questions regarding this order should be directed to **Farhad Azimzadeh at (510) 622-2310 or by e-mail at fazimzadeh@waterboards.ca.gov.**

ATTACHMENT C

LOCAL PUBLICLY-OWNED TREATMENT WORKS (POTW) FACILITY INFORMATION

	City Discharger	Treatment Plant Name	WDR Discharger Name	Discharger Contact Name	Contact Phone No.	Contact Email	Mail Address	Ct Contact for Groundwater & De-Watering Discharges	Service Area of the POTW
101	City of Petaluma WPCP	City of Petaluma WPCP	City of Petaluma	Mike Ban	707-778-4487	mban@ci.petaluma.ca.us	Michael Ban, Director of Water Resources and Conversation, City of Petaluma, Department of Water Resources and Conservation, 11 Eglish St. Petaluma, CA 94952-2610	Margaret Orr @ 707-778-4589 says "they do accept groundwater, there is a permit process, large volume connection fee, whatever is most cost effective." Best contact for the Permit is John O'Hare @ 707-762-5892 at the Sewer Plant.	Per Mike Ban: serves just the City of Petaluma and the unincorporated area of Penngrove
102	Provide WW treatment for community of Penngrove	Provide WW treatment for community of Penngrove	Sonoma Water Agency	Jay Jasperse	707-526-5370		Sonoma County Water Agency, 2150 West College Avenue, Santa Rosa, CA 95401	Sends there WW to the City of Petaluma system - see Line # A - 102 Penngrove has no Caltrans ROW within its borders.	Part of City of Petaluma system - see Line # A - 102 Penngrove has no Caltrans ROW within its borders.
103	Sonoma Valley County SD	Sonoma Valley County SD	Sonoma Valley County SD	Jim Zambenini	707-975-5616 (cell)	jdz@scwa.ca.gov		Yes, they will accept Const water to the Sant. Sewer depending on the job, volume of flow, Contact Industrial Waste Inspector Susan Keach @ 707-521-1820	Per Susan Keach: "this is not cut-and-dried - they service the towns of Sonoma, Glen Ellen,and the "Valley of the Moon" - Mostly Hwy 12"

Sonoma County - POTW Service Areas



ATTACHMENT E

HAZARDOUS MATERIALS SITE INVESTIGATION REPORT, U.S. 101/OLD REDWOOD HIGHWAY INTERCHANGE PROJECT, URS CORPORATION, APRIL 17, 2012

Please see report in the Project Supplemental Information Package

Hazardous Materials Site Investigation Report for U.S. 101/Old Redwood Highway Interchange Project Dated April 17, 2012

EA 04-412276
04/SON/101/ PM 7.4/8.1
URS Project Number: 28645097

HAZARDOUS MATERIALS SITE INVESTIGATION REPORT U.S. 101/OLD REDWOOD HIGHWAY INTERCHANGE PROJECT

Prepared for
City of Petaluma Department of Public Works

April 17, 2012

URS Corporation
100 West San Fernando Street, Suite 200
San Jose, California 95113
408-297-9585

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EXECUTIVE SUMMARY

The U. S. 101/Old Redwood Highway Interchange project (the Project) in the City of Petaluma, Sonoma County, proposes reconstruction of the existing interchange and widening of the segment of U. S. 101 that passes through the interchange area. The Project limits include the existing California Department of Transportation (Caltrans) Right-of-Way (ROW) for U. S. 101 and the interchange area from approximately Denman Road in the north to Ross Street in the south; and the City of Petaluma (City) ROW for Old Redwood Highway/Petaluma Boulevard from approximately Industrial Avenue/Stony Point Road in the west to N. McDowell Boulevard in the east**.** The interchange within the boundary stated above will be referred hereon as "the Site" (see Figure 1). The purpose of this Hazardous Materials Site Investigation Report (Hazardous Materials SIR) is to evaluate the soil conditions for on-site use or off-site disposal of site soils, and to assess soil and groundwater to identify work safety issues for construction site workers. The following summarizes URS' conclusions and recommendations. Reuse restrictions are also shown on Figure 2.

Soil Reuse/Disposal

The majority of site soil exhibits lead at concentrations below hazardous waste criteria. Therefore, the soil reuse restrictions of the Caltrans Department of Toxic Substances Control Soil Reuse Variance do not apply to those soils. The following areas exhibited elevated concentrations of lead, and therefore reuse and/or disposal restrictions do apply. As the elevation of the new Old Redwood Highway Overcrossing (OC) will be raised by several feet as part of this project, it is likely that all reused soil can be contained below the pavement for the new Overcrossing. URS also recommends development and implementation of a site-specific health and safety plan to protect workers and the public from exposure risks due to contact with soil.

U.S. 101 Northbound On-Ramp Loop

Due to elevated concentrations of lead detected using the STLC and DI-STLC methods, soil excavated from the top one foot below existing grade for all construction for this ramp from station 57+00 until the ramp merges with U. S. 101 should be excavated and properly reused at a location below a roadway pavement structural section to be maintained by Caltrans, and five feet above the groundwater table, or that soil should be disposed as a California hazardous waste.

U. S. 101 Median

As part of the recently completed U.S. 101 Sonoma B Central HOV Lanes Project, soil contaminated with ADL was proposed to be buried within the topmost three to five feet of soil below the structural section of the central HOV lanes that are proposed within the existing U.S. 101 median. This soil may be excavated during construction of columns associated with the new Overcrossing. Soil excavated in the paved median from the top five feet below the structural section should be excavated and properly reused at a location below a roadway pavement structural section to be maintained by Caltrans, and five feet above the groundwater table, or that soil should be disposed as a California hazardous waste.

Groundwater Impacts from Off-Site Contamination

The results of this SIR indicate that site groundwater in this area has been impacted by historical releases of petroleum hydrocarbons. The project Special Provisions should require that water resulting from dewatering operations in this area should be appropriately sampled, containerized, characterized, and managed. URS recommends development and implementation of a site-specific health and safety plan to protect workers and the public from exposure risks due to contact with groundwater.

The U. S. 101/Old Redwood Highway Interchange project (the Project) in the City of Petaluma, Sonoma County, proposes reconstruction of the existing interchange and widening of the segment of U. S. 101 that passes through the interchange area. The Project limits include the existing California Department of Transportation (Caltrans) Right-of-Way (ROW) for U. S. 101 and the interchange area from approximately Denman Road in the north to Ross Street in the south; and the City of Petaluma (City) ROW for Old Redwood Highway/Petaluma Boulevard from approximately Industrial Avenue/Stony Point Road in the west to N. McDowell Boulevard in the east**.** The interchange within the boundary stated above will be referred hereon as "the Site". It is proposed to reconstruct the Old Redwood Highway Interchange to provide congestion relief, safety enhancements, improved pedestrian and bicycle access, and improved air quality. Project improvements at the Old Redwood Highway Interchange include replacing the existing two lane overcrossing (OC) with a multi lane facility with bicycle lanes and pedestrian sidewalks on both sides to align more closely with the existing improvements along Old Redwood Highway at the approaches to the bridge. The interchange ramps will be reconfigured to current design standards and enhanced with additional turning lanes, vehicle storage, and traffic operations system improvements at the ramp and local street intersections. Ramp metering is proposed on all the on-ramps at the Old Redwood Highway Interchange. As a result of these proposed improvements, soil will be excavated along the U.S. 101 mainline, interchange ramps, local streets and at the Overcrossing and retaining wall foundation locations.

The purpose of this Hazardous Materials Site Investigation Report (Hazardous Materials SIR) is to evaluate the soil conditions for on-site use or off-site disposal of site soils and to assess soil and groundwater to identify work safety issues for construction site workers. URS submitted the draft hazardous materials investigation Workplan to the City of Petaluma, Sonoma County Transportation Authority (SCTA) and Caltrans on October 21, 2009. Sampling and the resulting laboratory analysis activities were performed between November 4 and 11, 2009.

This report has been prepared in accordance with variance V09HQSCD006, which was issued by the California Environmental Protection Agency (Cal-EPA) Department of Toxic Substances Control (DTSC). This variance represents the final statewide Caltrans lead-impacted soil handling variance and is effective for construction occurring between July 1, 2009, and July 1, 2014. This variance describes reuse restrictions and disposal requirements for soils impacted by lead at various concentrations. These criteria and the corresponding regulatory restrictions are described in Section 3.1, and a copy of the variance is included as **Appendix A**. The report was prepared by URS Corporation. Mr. Patrick Walz, a registered professional engineer in the State of California (License No. 71147, expiration date June 2013) supervised field work and prepared this report.

A significant portion of the proposed Project is located entirely within the project corridor for the U. S. 101 Central HOV Lanes Project – Segment B between Post Mile (PM) 7.1 and 8.9 in Sonoma County, California (the "U. S. 101 Segment B Project", Caltrans project EA 04-0A1831). A Hazardous Materials Site Investigation Report (the U.S. 101 Segment B Hazardous Materials SIR) was prepared by URS for that project (URS, 2009a). The presence of aerially deposited lead (ADL), and associated constituents including California Assessment Metals (CAM 17 Metals), pH, asbestos, petroleum hydrocarbons and associated volatile organic compounds (VOCs) was evaluated for the project corridor in this report. Based on the results of

that investigation, and as discussed in the project Initial Site Assessment (ISA) and Workplan prepared for the proposed Project, in general, only lead and CAM 17 metals analyses were performed for this investigation, except for groundwater samples and to evaluate soil in the vicinity of potential off-site sources of petroleum hydrocarbon contamination. Where samples were collected from within the proposed project excavation area, the lead results from soil samples collected adjacent to the interchange ramps during previous investigations have been incorporated into this report. These instances are discussed specifically in Section 4.1, and these soil sample locations are shown on Figure 2. In addition, no soil sampling was performed within the U. S. 101 median. The soil reuse restrictions for the median of U. S. 101 were described in the U. S. 101 Segment B Project Hazardous Materials SIR, and those reuse restrictions have been incorporated into this document in Section 4.1.

Several locations at the project site were discussed during the ISA performed by URS in 2009 to have likely been impacted by petroleum hydrocarbons originating at several properties with LUSTs adjacent to the project area at 4990, 4998, 4999, and 5300 Old Redwood Highway. Additional samples that were collected and analyzed for petroleum hydrocarbons are described below and shown on Table 4. A discussion of the results related to these samples is included in Section 5.

- Soil samples at NB-4-1 and groundwater samples at A-09-112-GW, both of which were advanced near the former 7-Eleven at 5300 Old Redwood Highway.
- Soil samples at SB-7-2 and SB-8-2, and groundwater samples at A-09-108-GW, which are near the Chevron at 4999 Old Redwood Highway, the Shell station at 4990 Old Redwood Highway, and the former Unocal 76 station at 4998 Old Redwood Highway

2.1 DESCRIPTION OF SAMPLING AND ANALYSIS ACTIVITIES

This section describes the sampling and resulting laboratory analysis activities performed between November 4 and 11, 2009. As discussed previously, lead results from several borings advanced as part of the 2006 U. S. 101 Segment B Hazardous Materials SIR are included in the statistical evaluation of soil for this project. However, as that sampling activity was documented in the 2006 Hazardous Materials SIR, it is not discussed further in this section.

2.1.1 Sampling Locations

Figure 1 shows the location of the project Site. Figure 2 shows the sampling locations. Sampling locations were surveyed using a Trimble ProXH Global Positioning System (GPS) instrument. A total of 40 borings were advanced at 19 locations. At most sample locations, two borings were advanced; one within 1 foot of the outer pavement edge, and one at the edge of the proposed widening area. A secondary, duplicate boring was advanced at six of the boring locations. A total of 119 soil and 3 groundwater samples were collected, and all samples were analyzed for one or more constituents as indicated in Table 1.

2.1.2 Sampling Depths

Samples were generally collected at 0.5, 1.0, and 1.5 feet below ground surface (bgs), though isolated samples were collected to deeper depths where excavation was expected to be deeper than 1.5 feet, or where groundwater samples were to be collected.

2.1.3 Pre-Field Activities

2.1.3.1 Permits

URS used the existing encroachment permit for access to the Caltrans ROW. A copy of this permit is included as **Appendix C**. A permit for a Site Assessment was obtained from the Sonoma County Department of Environmental Health and is included as **Appendix D**.

2.1.3.2 Health and Safety Plan

A site-specific Health and Safety Plan was prepared for the project's field activities and was implemented by personnel working on-Site. Daily tailgate safety meetings were held before initiation of fieldwork with field personnel and subcontractors to discuss each day's activities and related safety precautions.

2.1.3.3 Utility Clearance

URS reviewed utility records to place borings away from known utility lines. Additionally, utility clearance at each sampling location was conducted through notification of Underground

Services Alert (USA) and with the assistance of a private underground utility locator. In several cases, sample locations were moved slightly in the field to avoid utilities.

2.1.3.4 Traffic Control

Cal-Safety Inc., a Caltrans-certified traffic control subcontractor was retained to divert traffic away from the field crew and sampling rig when working along roadways. All work was performed between the hours of 9 AM and 3 PM, during which time URS was permitted to close the outside shoulder of the various ramps.

2.1.4 Sample Collection Methods

At most soil sample locations a 4-inch diameter hand auger was used to collect soil cores for logging and sampling purposes. A direct push (DPT) geoprobe soil sampling system operated by ECA, Inc. of Aptos, California (State of California Drilling Contractor License No. C57-695970) was used for borings advanced deeper than 3 feet bgs. In each of the DPT borings, samples were collected by driving an approximately 4-foot long, 2-inch diameter sample barrel equipped with clean plastic liners. A sampling technician familiar with soil sampling procedures logged all borings. At boring SB-5-1, the DPT boring was advanced to the first encountered groundwater-bearing zone, and a groundwater sample was collected using a disposal bailer from the first encountered groundwater zone. Boring logs are included in **Appendix E**.

Sections of the plastic liner containing soil intervals intended for possible laboratory analysis were cut from the 4-foot long soil core, sealed with Teflon® tape, plastic end caps and masking tape, labeled with site-specific designations, and placed on ice in an ice-chest pending transport to the analytical laboratory.

At groundwater sample locations A-09-108 and A-09-112, a drill rig equipped with cone-penetrometer test (CPT) equipment was utilized. These borings were originally intended to evaluate soil conditions for geotechnical engineering considerations, but were appropriately located to evaluate site groundwater for potential contamination due to nearby LUST releases. Groundwater samples were collected using a disposal bailer from the first encountered groundwater zone. CPT logs for these borings are included in **Appendix E**. Sample SB-5-1 was collected using a direct-push hydropunch sampler advanced by a Geoprobe rig. No soil sample or core was retrieved from this sample and no boring log produced.

All soil and groundwater samples were transported on ice in an ice-chest and transported to Torrent Analytical Laboratory in Milpitas, California, a State of California certified laboratory, under URS Chain-of-Custody procedures.

Sampling equipment was cleaned after each use. Before leaving each sampling location, boring locations were filled to the surface grade with a mixture of Portland cement and bentonite grout.

2.1.5 Changes to the Field Program

Minor modifications were made to the field program during the course of the investigation. These changes fall into one of the following categories:

- Approximately 10% of sample locations were moved slightly because the original locations were at an inaccessible point or soil was not exposed in this area. The total number of sample locations was not reduced, and sample locations remained spaced approximately every 300-350 feet.
- At the request of Caltrans, two additional groundwater samples were collected to evaluate groundwater due to nearby LUST releases. These samples were collected from borings A-09-108 and A-09-112, in the project median and at the southern project extent, to evaluate groundwater for potential petroleum hydrocarbon contamination.
- At the request of Caltrans, borings NB-4-1, SB-7-2, and SB-8-2 were advanced to deeper depths than originally planned and soil samples collected were analyzed for total petroleum hydrocarbons as gasoline, diesel, and motor oil (TPH-g, TPH-d and TPH-mo respectively) near known LUST releases.

2.1.6 Soil Laboratory Analysis

Table 1 provides details of the soil analytical program, including soil sampling intervals and soil analyses conducted at each sampling location. Eight of the soil samples (from three borings) were duplicated in the field for quality control purposes.

All the soil samples included in the analytical program were analyzed for total lead by the Environmental Protection Agency's (EPA) Method 6010B. Approximately 30% of samples collected at various intervals were analyzed for additional soil analytes. A total of 137 soil samples were analyzed for one or more constituents. The number of soil samples analyzed for each analyte for the Site, including duplicate samples, follows:

- 112 soil samples were analyzed for lead (Pb) by EPA 6010B
- 25 additional soil samples were analyzed for CAM 17 metals, which includes lead, by EPA Methods 6010B and 7471
- 13 soil samples were analyzed for TPH as diesel and motor oil (TPH-d and TPH-mo) by EPA Method 8015B
- 13 soil samples were analyzed for TPH as gasoline (TPH-g) by EPA Method SW8260B.
- 2 samples were analyzed for Mercury by EPA Method 7471.

When the total concentration of any metal exceeded ten times its respective Soluble Threshold Limit Concentration (STLC), the sample was extracted with the Standard Waste Extraction Tests (WET) and, if the metal was lead, was extracted with the De-ionized Water Waste Extraction Test (DI-WET) and the extracts were analyzed for that metal. The WET test results were used for comparison with California hazardous waste criteria and the DI-WET test results were used to evaluate soils for on-Site use based on the DTSC variance governing soil. Samples in which the total concentration of any metal exceeded 20 times the STLC criteria were extracted using

the (federal) Toxicity Characteristic Leaching Procedure (TCLP) and analyzed for the metal of concern, for further comparison with federal hazardous waste criteria.

The above-referenced criteria were not exceeded for any metal except for lead. For lead, any samples exceeding 50 mg/Kg of total lead were to extracted using the WET and DI-WET methods and analyzed for lead, and any samples exceeding 100 mg/Kg of total lead were to be extracted using the TCLP method and analyzed for lead. A total of 38 samples were analyzed for lead using WET and DI-WET methods. A total of 32 samples were analyzed for lead using TCLP methods, however, the decision to analyze 17 of these samples was a result of a communication error with the lab; only 14 of the samples analyzed using TCLP methods actually exceeded 100 mg/Kg.

A complete set of the analytical results, including Chain of Custody forms, is presented in electronic format in **Appendix F**.

The following analytical quality control (QC) procedures were used to comply with Caltrans procedures. Eight samples were duplicated in the field for quality control purposes. In the laboratory QC, one sample in ten field samples was spiked with lead to ten times the detection limit or at the analyte level. (Approximately one sample in 20 was spiked and a spike duplicate was also run on each spiked sample. This is equivalent to one spike for every ten samples).

A calibration blank sample was run for every ten samples, or per batch, whichever was more frequent.

2.1.7 Groundwater Laboratory Analysis

In the course of this hazardous materials investigation, URS collected groundwater samples at sample location SB-5-1, where deeper excavation for the bridge construction is expected to take place, and at the northern and southern project extents, near where LUST releases have occurred at gas stations located on Old Redwood Highway. Three samples were each analyzed for the following constituents:

- CAM 17 metals by EPA Methods 6010B and 7471
- TPH-d and TPH-mo by EPA Method 8015B
- TPH-g, benzene/toluene/ethylbenzene/xylenes (BTEX) and methyl-tert-butyl-ether (/MTBE) by EPA Method 8260 B
- Volatile organic compounds (VOCs) by EPA Method 8260B.

Analyte concentrations in soil are presented in Tables 2 through 6. The analytical results are presented in the following sections, separated into discussions on soil and groundwater, and by analyte. Complete soil and groundwater analytical data are presented in the Analytical Laboratory Reports, attached in electronic format as **Appendix F**.

3.1 REGULATORY OVERVIEW

Based upon URS' Hazardous Materials Investigation Workplan and the DTSC Lead Variance for Caltrans, the following soil criteria have been used to evaluate the condition of soil at the Site:

- Soil considered a hazardous waste due to any criteria other than lead may not be reused.
- Soil with total lead <50 mg/Kg or extractable lead with the WET test, are not considered hazardous waste and are not subject to the reuse restrictions of the Caltrans ADL variance.
- Soil meeting hazardous waste criteria for lead only, with total lead <1411 mg/Kg, with <1.5 mg/L extractable lead with the DI-WET test can be used for fill on-Site as long as it is more than five feet above the water table and must be covered with at least 1.0 foot of non-hazardous cover.
- Soil meeting hazardous waste criteria for lead only, with <3397 mg/Kg total lead and between 1.5 mg/L and 150 mg/L of extractable lead with the DI WET can be used on the ROW on-Site as long as it is more than five feet above the water table and must be covered with a roadway pavement structural section, which will be maintained by Caltrans.
- Soil with >3397 mg/Kg total lead cannot be reused and must be disposed off-Site as a California or Federal hazardous waste.
- Soil with >5 mg/L extractable lead with TCLP cannot be reused and must be disposed off-Site as a Federal RCRA hazardous waste.

For soil that must be disposed off-Site if removed from the Caltrans ROW:

- Soil with <5.0 mg/L extractable lead with the WET test is a non-hazardous waste and can be disposed in a non-hazardous waste landfill if removed from the Caltrans ROW.
- Soil with >5.0 mg/L extractable lead with the standard WET and <5.0 mg/L extractable lead with the TCLP test is a California hazardous waste and must be disposed off-Site in a hazardous waste landfill if removed from the Caltrans ROW, or alternatively can be disposed of out of state, as non-hazardous soil.
- Soil with >5.0 mg/L extractable lead with the TCLP test is a Federal RCRA waste and must be disposed off-Site in a hazardous waste landfill.

Soil analytical results from the soil samples are discussed below.

3.2 SOIL SAMPLES

Based on the results of the U. S. 101 Segment B Hazardous Materials SIR, and as discussed in the project ISA and Workplan, only lead and CAM 17 metals analysis was performed for this

investigation, except in the vicinity of known LUST release sites on Old Redwood Highway, where analysis for petroleum hydrocarbon impacts was also performed. The results of the soils investigation are discussed below.

3.2.1 Lead

ADL was the primary focus of the soil investigation and the data in Table 2 presents the resulting lead data from the soil samples analyzed for lead as part of this investigation. All 137 soil samples analyzed, including duplicates, were analyzed for lead, either as a single metal or as part of the Cam 17 suite.

Total lead results varied from less than the detection limit of 1 mg/Kg in multiple soil samples to 800 mg/Kg in sample NB-8-1@1.0 ft.

Thirty-eight of the soil total lead results were above 50 mg/Kg. These detections were greater than ten times the STLC criteria of 5 mg/Kg (50 mg/Kg) for lead, requiring that the WET and DI-WET test be conducted on these. Another 17 of the total lead results were equal to or greater than 20 times the STLC criteria of 5.0 mg/L (100 mg/Kg) for lead. The TCLP test was also conducted on 15 of these samples; for two samples insufficient sample volume remained to perform the TCLP analysis. Due to a communication error with the laboratory, an additional 17samples were analyzed using the TCLP test, which had less than 100 mg/Kg total lead. Table 3 lists results of all soil samples concentrations using the WET, DI-WET and TCLP tests, if applicable.

3.2.2 CAM 17 Metals

A total of 25 soil samples (including duplicates) were submitted for CAM 17 metals analysis, which includes antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium and zinc. Two samples were analyzed for Mercury only. Analytical results for metals and laboratory reporting limits are presented in Table 2. No metal (other than lead, as discussed above) was detected at a concentration that requires leachability testing. The results for these metals are discussed in more detail in the following section. Therefore, no further consideration of other metals was made in this soil investigation.

It is noted that arsenic was detected at concentrations above the US EPA's residential Preliminary Remediation Goal (PRG). However, background levels of arsenic in the San Francisco Bay area may range up to the low 20s mg/Kg and typically exceeds risk-based concentrations (USEPA 2004, SFRWQCB 2008). Therefore, it is common practice to default to background concentrations for reuse decisions regarding arsenic, in which case, there are no restrictions on the on-Site reuse of soil resulting from arsenic concentrations.

Based on the background concentrations of arsenic detected, a site-specific health and safety plan may be required to protect workers and the public from exposure risks. This health and safety plan may require workers to receive HAZWOPER 24 or 40 hour training prior to beginning field work. One way to address this issue would be to control and monitor exposure to dust (which may contain constituents including lead and arsenic) via a Cal-OSHA regulatory approach.

3.2.3 Petroleum Hydrocarbons

Due to known releases of petroleum hydrocarbons related to LUST sites on Old Redwood Highway, a total of 13 soil samples collected at borings NB-4-1, SB-7-2, and SB-8-2. The results of this sampling are discussed below, and analytical results and laboratory reporting limits are presented in Table 4.

3.2.3.1 Total Petroleum Hydrocarbon as gasoline (TPH-g)

Thirteen samples were analyzed for TPH-g. TPH-g was not detected at or above the laboratory detection limit of 100 ug/Kg in any soil sample. Therefore, TPH-g is not considered further in this soils evaluation.

3.2.3.2 Total Petroleum Hydrocarbon as diesel (TPH-d)

Thirteen samples were analyzed for TPH-d. TPH-d was not detected at or above the laboratory detection limit (which ranged from 2 mg/Kg to 10 mg/Kg) in any soil sample. Therefore, the presence of TPH-d is not considered further in this soils evaluation.

3.2.3.3 Total Petroleum Hydrocarbon as motor oil (TPH-mo)

Thirteen samples were analyzed for TPH-mo. TPH-mo was detected in six samples at concentrations ranging from 6.7 mg/Kg (SB-8-2@0.5 ft) to 160 mg/Kg (NB-4-1@0.5 ft and NB-4-1@1.5 ft). While the EPA has not established a level at which TPH-d constitutes a hazardous waste, based on URS' experience these concentrations do not warrant performance of additional toxicity tests. Therefore, the presence of TPH-mo is not considered further in this soils evaluation.

3.3 GROUNDWATER

During this hazardous materials investigation, URS collected groundwater samples at sample location SB-5-1, and at geotechnical CPT boring locations A-09-108 (at the freeway median) and A-09-112, at the southern project extent near where LUST releases have occurred at gas stations located on Old Redwood Highway. Analytical results from the groundwater samples are discussed below.

3.3.1 California Assessment Metals (CAM 17 Metals)

A total of 3 groundwater samples were submitted for CAM 17 metals analysis, which includes antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium and zinc. Analytical results for metals and laboratory reporting limits are presented in Table 5. No metal was detected at a concentration exceeding the STLC criteria. Therefore, metals are not considered further in this groundwater evaluation.

3.3.2 Other Constituents of Concern

3.3.2.1 Volatile Organic Compounds (VOCs)

Three samples were analyzed for VOCs. The following VOCs were detected in one or more groundwater samples: MTBE, benzene, ethylbenzene, 1,3,5-Trimethylbenzene, 4-150 Propyltoluene, 1,2,4-Trimethylbenzene, and n-propylbenzene. No VOC detection exceeded the STLC criteria. Therefore, VOCs are not considered further in this groundwater evaluation. However, the presence of VOCs in groundwater may need to be considered for worker health and safety in the construction contract documents. Analytical results for these constituents are included in Table 6.

3.3.2.2 Total Petroleum Hydrocarbon as gasoline (TPH-g)

Three samples were analyzed for TPH-g. TPH-g was detected in sample A-09-108-GW at a concentration of 500 ug/L. While the EPA has not established a level at which TPH-g constitutes a hazardous waste, in URS' opinion this concentration does not warrant performance of additional toxicity tests. Therefore, the presence of TPH-g is not considered further in this groundwater evaluation. However, the presence of TPH-g in groundwater may need to be considered for worker health and safety in the construction contract documents. Analytical results for this constituent are included in Table 6.

3.3.2.3 Total Petroleum Hydrocarbon as diesel or motor oil (TPH-d/mo)

Three samples were analyzed for TPH-d/mo. TPH-d was detected in two samples at concentrations ranging up to 0.146 mg/L, and TPH-mo was detected in one sample at a concentration of 0.287 mg/L. While the EPA has not established a level at which TPH-d/mo constitutes a hazardous waste, in URS' opinion these concentrations do not warrant performance of additional toxicity tests. Therefore, TPH-d/mo is not considered further in this groundwater evaluation. However, the presence of TPH-d/mo in groundwater may need to be considered for worker health and safety in the construction contract documents. In addition, the presence of this groundwater contamination and the resulting requirement to appropriately store, sample, characterize, and manage and/or dispose of the water, should be addressed in the project Special Provisions. Analytical results for these constituents are included in Table 6.

3.3.3 Groundwater Elevation

Based on URS' geotechnical investigation (URS, 2010c), performed concurrently with this hazardous materials investigation, depth to groundwater was at an elevation of approximately 28 feet above Mean Sea Level (MSL) throughout the project corridor. Groundwater elevations measured during the Geotechnical investigation ranged as high as 28' MSL. Based on a review of quarterly monitoring reports associated with a Chevron at 4999 Old Redwood Highway (Conestoga-Rovers, 2011) and an Exxon at 5153 Old Redwood Highway (Cardno ERI, 2011), groundwater elevation ranges from 25' at the west end of the project to 32' at the east end of the project. It would be reasonable to assume that groundwater elevation at the median of the

project is approximately 28'. Therefore, ADL impacted soil should be placed at elevations of 33' or greater.

This section provides our evaluation of the data presented in previous sections. The evaluation includes statistical analysis and comparisons to various regulation criteria and guidelines. A summary of statistical evaluations for total and leachable quantities of lead for the Site is included as Table 7.

4.1 INCORPORATION OF RESULTS FROM U.S. 101 SEGMENT B INVESTIGATION

This proposed Project is located entirely within the project corridor for the U. S. 101 Segment B Project. The U. S. 101 Segment B Hazardous Materials SIR prepared by URS for that project documented the presence of ADL within the project corridor. Where appropriate, the lead results from soil samples collected adjacent to the interchange ramps during that previous investigation have been incorporated into this report. In addition, no soil sampling was performed within the U. S. 101 Median during this project. The soil reuse restrictions for the median of U. S. 101 were described in the U. S. 101 Segment B Hazardous Materials SIR. These situations are discussed in more detail below.

4.1.1 Samples Collected Adjacent to Ramps

Borings RWH-A-21, RWH-B-21, RWH-B-22, RWH-D-21 and RWH-D-22 were advanced adjacent to various ramps as part of the 2006 U. S. 101 Segment B Hazardous Materials SIR. However, ramp reconstruction originally planned to occur as part of that project has been deferred to the proposed Project. Therefore, the soil sample results for lead from these borings have been incorporated into the sample set for this proposed Project and statistically evaluated for reuse and/or disposal.

4.1.2 Samples Collected within the Median

Twenty-one borings were advanced within the project median as part of the U. S. 101 Segment B Hazardous Materials SIR. Based on these results, the entire median was characterized. The results of this characterization indicated that soil excavated from the top one foot of the median should only be reused at a location covered by a roadway pavement structural section and at least five feet above the groundwater table. That project has been constructed prior to the U.S. 101/Old Redwood Highway Interchange Project, and during that construction effort, soil contaminated with ADL was proposed to be buried within the three to five feet of soil below the structural section of the new central HOV lanes and within the existing U.S. 101 median. During column construction within the paved median, this soil may be encountered. Therefore, URS recommends that soil excavated from the top five feet below the structural section be excavated and properly reused at a location below a roadway pavement structural section to be maintained by Caltrans, and five feet above the groundwater table, or that soil should be disposed as a California hazardous waste.

4.2 STATISTICAL EVALUATION OF SOIL FOR THE U.S. 101/OLD REDWOOD HIGHWAY PROJECT

Based upon an initial review of the analytical results for lead, only 7 of 137 soil samples, including duplicates, exceeded hazardous waste criteria for lead (5 mg/L using the WET

method). Four of these seven samples only slightly exceeded the hazardous waste criteria, but three samples were detected at concentrations considerably above 5 mg/L. URS noted that the three soil samples that exceeded the hazardous waste criteria by the most significant amount were collected from the top 1 foot of soil from the borings NB-8-1 and NB-8-2, both of which were collected adjacent to the onramp loop to northbound 101 from Old Redwood Highway. URS removed the four samples representing the top 1 foot of soil of these two locations from the dataset and performed a statistical evaluation of total lead and WET lead concentrations for the remaining samples of the project. Based upon the DTSC Variance, if the statistical evaluation of total and WET lead concentrations indicated that the soil did not meet hazardous criteria for lead, the reuse restrictions of the variance would not apply and a statistical evaluation of DI-WET lead concentrations was not required to perform. Additionally, because no soil sample analyzed for lead using the TCLP method exceeded the federal hazardous waste criteria of 5 mg/L, no statistical evaluation of TCLP lead was performed.

Statistical Evaluation Methodology

A statistical evaluation of the analytical sample results was conducted to assess whether the soil within the project area met the hazardous waste criteria. If the soil does not meet such criteria, it is not subject to the reuse requirements of the DTSC variance. This evaluation was performed by reviewing the hazardous waste criteria for total lead and leachable lead using WET extraction techniques. To accomplish this, representative soil concentrations were compared to relevant and applicable threshold concentrations. This representative concentration term was estimated by the 95% Upper Confidence Limit of the Mean (95% UCL) of the concentration for materials to be sent off-site for disposal. The ProUCL software version 4.00.04 was used to calculate the 95% UCL (Singh et al., 2009a).

The use of 95% UCL concurs with the USEPA statistical guidance for developing a conservative estimate of the mean concentration of soil constituents or contaminants (USEPA, 2002b). The estimated 95% UCL was used to evaluate whether the soil concentrations of total lead and leachable lead exceeded the appropriate threshold criteria. If non-detects were present, the summary statistics (mean and standard deviation) and the 95% UCL were estimated based on the Kaplan-Meier (KM) method (Singh et al., 2009a) in this analysis. In addition, the results of primary and duplicate samples were averaged in order to obtain a single value. Samples collected from various depths of the same boring location were considered to be independent data points in this statistical evaluation.

In general, total lead soil samples in which the respective concentrations did not exceed ten times the STLC criteria (50 mg/kg) were not extracted/analyzed with the WET technique. As a result, this greatly reduced the number of data points that could be included in the statistical analysis for leachable lead and would also skew the 95% UCL results high for the WET evaluation, as only the samples with high total lead concentrations would be included. Therefore, to estimate WET lead concentrations in locations where the samples were not extracted and analyzed, a regression equation was developed between the existing total and WET lead results. Using the regression equation, WET lead concentrations for samples that were not analyzed for them were estimated. The 95% UCLs for leachable lead, using these estimated WET lead concentrations, in combination with those analyzed by the laboratory, were then obtained using the UCL calculation methodology discussed below.

The Site representative concentrations were evaluated by first performing an exploratory data analysis. The objective of the exploratory data analysis was to discover trends and patterns in the data so that appropriate approaches and limitations in using the datasets could be identified. Both numerical and graphical methods of exploratory data analysis were performed.

For the numerical method, a table of basic summary statistics, including mean, standard deviation, minimum and maximum detected values, for raw data (i.e., no logarithmic transformation) was prepared. For WET lead, the summary statistics were also calculated for the combined dataset including both laboratory-reported values and regression-estimated values. These statistics are presented in Table 7 of this report and can be used to make inferences concerning the population from which the sample data were drawn.

The next step involved a test of distributional assumption for the dataset, and the ProUCL software was used in this process. The purpose of this step was to check whether the data (raw or log-transformed) could be assumed to be normally distributed and/or the data (raw only) could be assumed to follow a gamma distribution. Based on the results of this evaluation, an appropriate probability distribution could be assumed for the data to be used in the calculation of the 95% UCL in the next step.

The Shapiro-Wilk W test was used to test the normality of the dataset at a 5% significance level (i.e., 95% confidence level), as described in the USEPA guidance document titled *Data Quality Assessment: Statistical Methods for Practitioners* (USEPA 2006). The test was first applied to raw data. If the raw dataset passed the normality test, the raw data were assumed to be normally distributed. If the raw data did not pass the normality test, a gamma distribution goodness-of-fit test (at a 5% significance level) was then applied to the data, and if the dataset passed the gamma distribution goodness-of-fit test, the data were assumed to follow a gamma distribution. Otherwise, the Shapiro-Wilk W test (at a 5% significance level) was applied to the log-transformed data. If the log-transformed data passed the normality test, the data were assumed to be lognormally distributed. If the data failed all three tests, the data were assumed to be non-parametric. In all cases, visual inspection of the shape of histograms and normal probability plots was performed to confirm the distributional assumption. The results of this distributional test are presented under the column heading "Goodness-of-Fit Test" "Distribution" in Table 7.

<u>For datasets without non-detect:</u>

For the total lead dataset, all samples were reported with detected results. If the data were determined to be normally distributed, the 95% UCL was calculated as follows (USEPA, 2002b):

$$UCL = \bar{x} + t_{1-\alpha,n-1}\frac{s}{\sqrt{n}}$$

where $\bar{x}$ = sample mean

t = the Student t value at α significance level, with n-1 degree of freedom

α = 0.05 (one-tailed)

n = sample size

s = sample standard deviation

Otherwise, if the data were determined to follow a gamma or lognormal distribution, or if non-parametric assumption was used, the 95% UCL was determined based on the recommendation of the ProUCL software, which took into account sample size and data skewness and ensured adequate coverage of the 95% UCL (Singh et al., 2009b). Depending on the sample statistics, the ProUCL software generally recommended one of the following methods:

- For gamma distribution, Approximate Gamma UCL or Adjusted Gamma UCL.
- For lognormal distribution, Chebyshev Theorem using the minimum variance unbiased estimator (MVUE) of the parameters for a lognormal distribution, or Land's H-statistic.
- For a non-parametric assumption, Chebyshev Theorem using the sample arithmetic mean and standard deviation, or the Hall's bootstrap method.

For datasets with non-detect(s):

For the WET lead dataset, because a combined laboratory-reported values and regression-estimated values were used, in addition to the laboratory-reporting censoring <0.1 mg/L, all regression-estimated values fell below 0.1 mg/L were also assigned to be <0.1 mg/L.

If the data were normally distributed and/or if the data were symmetric or approximately symmetric, the KM (*t*) method (i.e., Kaplan-Meier estimates using the Student's *t*-distribution cutoff value) was used to calculate the 95% UCL. The equation to compute UCL was the same as the one illustrated above, except that the sample mean and sample standard deviation were substituted by KM estimates of mean and standard deviation.

If the data were assessed to follow a gamma or lognormal distribution, or if the data were assumed to be non-parametric with moderate and high skewness, one of the following methods, in general, was recommended by the ProUCL software for the calculation of UCL:

- UCL based upon KM estimates using the Chebyshev inequality.
- UCL based upon KM estimates using the bias-corrected accelerated (BCA) bootstrap method or the percentile bootstrap method.

The detailed statistical steps of the various methods described above are documented in the ProUCL software technical guide (Singh et al., 2009b). The recommended calculation methods and UCL results, by the ProUCL software, are presented under the column heading "Method of UCL Calculation" and "Assessed 95% UCL" in Table 7.

Statistical Evaluation Limitation

Statistical evaluations described below are representing the majority of the Site. To reduce the negative impacts of isolated areas with high concentrations of lead, these locations were removed from the dataset and were planned to be treated/managed differently. If soils are not managed as described below, the statistical evaluations become invalid and additional statistical evaluation or sampling may be required.

4.2.1 Initial Soil Disposal Assumptions

Three of the four soil samples collected from the top one foot of borings NB-8-1 and NB-8-2 exceeded the California hazardous waste criteria of 5 mg/L using the WET method, with concentrations ranging from 1.5 to 40 mg/L. The DI-WET lead for these samples ranged from 0.19 to 7.6 mg/L. Therefore, all soil excavated in the vicinity of these samples should be excavated and properly reused at a location below a roadway pavement structural section to be maintained by Caltrans and 5 feet above the groundwater table, or disposed as a California hazardous waste, prior to initiating soil reuse. Because these samples will be managed separately, they were not included in the statistical evaluation. The samples removed from the statistical evaluation are NB-8-1@0.5 ft, NB-8-1@1.0 ft, NB-8-2@0.5 ft, and NB-8-2@1.0 ft.

4.2.2 Statistical Analysis for the Remainder of the Project Site

The 95% UCLM/Maximum Detection for total lead for project soil, following removal of the samples discussed in Section 4.2.1, was 51.2 mg/Kg. The 95% UCLM/Maximum Detection for WET lead for project soil, following removal of the samples discussed in Section 4.2.1, was 1.35 mg/L.

Based on the Caltrans variance, the Total and WET lead results indicate that soils at the project Site, following removal of the samples discussed in Section 4.2.1, do not meet hazardous waste criteria and are not subject to the reuse restrictions of the Caltrans variance. Therefore, a statistical analysis of DI-WET lead results was not performed.

TCLP lead was not detected in any sample at the Site at concentrations above the federal TCLP limits. The maximum detected concentration of lead using TCLP procedures was 0.90 mg/L in sample NB-8-1@1.0’. Therefore a statistical analysis of TCLP results has not been performed.

4.3 COMPARISON TO CONSTRUCTION-WORKER SCREENING LEVELS

Soil sampling results were compared to San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels - Direct Exposure Soil Screening Levels (ESLs) for Construction Workers. Lead was detected in one sample (NB-8-1@1.0’) at a concentration of 800 mg/Kg, which exceeds the Construction Worker ESL of 750 mg/Kg. No other soil sample result exceeded the ESLs.

Several locations at the project site were discussed during the ISA performed by URS in 2009 to have likely been impacted by petroleum hydrocarbons originating at several properties with LUSTs adjacent to the project area. A discussion of the results related to these samples collected near these sites is included below.

- Soil samples at NB-4-1 and groundwater samples at A-09-112-GW, both of which were advanced near the former 7-Eleven at 5300 Old Redwood Highway.
- Soil samples at SB-7-2 and SB-8-2, the Shell station at 4990 Old Redwood Highway, and the former Unocal 76 station at 4998 Old Redwood Highway

5.1 WEST OF U. S. 101

Three LUST sites are undergoing investigations due to known historical releases of underground storage tanks. These locations include the Chevron at 4999 Old Redwood Highway, the Shell station at 4990 Old Redwood Highway, and the former Unocal 76 station at 4998 Old Redwood Highway. All three LUST sites are located between Stony Point Rd/Industrial Ave. and the U. S. 101/Old Redwood Highway interchange. The western extent of surface soil disturbance for this project will take place near these sites.

To evaluate soil in the vicinity of this area, samples collected at two nearby borings were analyzed for TPH-g, TPH-d, and TPH-mo. Boring SB-7-2, located near the beginning of the on-ramp from eastbound Old Redwood Highway to southbound U. S. 101, just east of the former Unocal 76 station, was advanced to a depth of 9 feet bgs, with samples collected at 0.5, 1.0, 1.5, 3.0, 6.0, and 9.0 feet bgs. Boring SB-8-2, located on the inside of the on-loop ramp to U.S. 101 northbound from Old Redwood Highway , across the ramp from the Chevron station, was advanced to a depth of 6 feet bgs, with samples collected at 0.5, 1.0, 1.5, 3.0, and 6.0 feet bgs. TPH-g and TPH-d were not detected in any soil samples collected from these borings. TPH-mo was detected in five of the ten samples at concentrations of up to 45 mg/Kg. Based on these results the impacts to the Site soil from these three LUST sites appear minimal. Soil samples results for these constituents are shown in Table 4.

URS collected groundwater samples at sample location SB-5-1, and at geotechnical CPT boring locations A-09-108 (at the freeway median) to evaluate whether the median, where deeper excavation may take place, may be impacted by off-site LUST releases which historically occurred at gas stations located on Old Redwood Highway. In groundwater sample A-09-108-GW, TPH-g was detected in at a concentration of 500 ug/L and TPH-d was detected at a concentration of 0.142 mg/L. The VOCs 1,3,5-Trimethylbenzene, 4-150 Propyltoluene, 1,2,4-Trimethylbenzene, and n-Propylbenzene were detected in this sample. It is likely that site groundwater in this area may be impacted by the releases of petroleum hydrocarbons. Water resulting from dewatering operations in this area should be appropriately sampled, characterized, containerized and managed, and the presence of these constituents should be considered in preparing the worker health and safety plan. In addition, the presence of this groundwater contamination and the resulting requirement to appropriately store, sample, characterize, and manage and/or dispose of the water, should be discussed in the project Special Provisions.

5.2 EAST OF U. S. 101

One LUST site, the former 7-Eleven at 5300 Old Redwood Highway, is undergoing investigations due to known historical releases of underground storage tanks. This site is located near the intersection of McDowell Ave. and Old Redwood Hwy, near the beginning of the on-ramp from Old Redwood Highway to northbound U. S. 101. The eastern extent of surface soil disturbance will take place near this site.

To evaluate soil in the vicinity of this area, samples collected at one nearby boring was analyzed for TPH-g, TPH-d, and TPH-mo. Boring NB-4-1 was advanced within the nearest soil to the former 7-Eleven expected to be impacted by Project construction. This location is across Old Redwood Highway from the former 7-Eleven. The boring was advanced to a depth of 1.5 feet bgs, with samples collected at 0.5, 1.0, and 1.5 bgs. In addition, CPT boring A-09-112-GW was advanced within the sidewalk near the end of the off-ramp from northbound U.S. 101 to eastbound Old Redwood Highway.

TPH-g and TPH-d were not detected in any soil samples collected from this boring. TPH-mo was detected in all three of the samples at concentrations of up to 160 mg/Kg (at NB-4-1@0.5 ft and NB-4-1@1.5 ft). Based on these results the impacts to the Site soil from this LUST site appear minimal. Soil samples results for these constituents are shown in Table 4.

In groundwater sample A-09-112-GW, collected near the end of the off-ramp from US 101 north to Old Redwood Highway, TPH-g, TPH-d, and THP-mo were not detected. The VOCs benzene, ethylbenzene, and MTBE were detected in this sample. It is likely that site groundwater in this area may be impacted by the releases of petroleum hydrocarbons. Water resulting from dewatering operations in this area should be appropriately containerized and managed, and the presence of these constituents should be considered in preparing the worker health and safety plan.

Based upon URS' Hazardous Materials Investigation Workplan and the DTSC Lead Variance for Caltrans, the soil criteria soil criteria discussed in Section 3.1 have been used to evaluate the condition of soil at the Site.

6.1 CONCLUSIONS

6.1.1 U.S. 101 Northbound Loop On-ramp

Borings NB-8-1 and NB-8-2 were advanced adjacent to the loop on-ramp from Old Redwood Highway to northbound U. S. 101. Three of the four soil samples collected from the top one foot of borings NB-8-1 and NB-8-2 exceeded the California hazardous waste criteria of 5 mg/L using the WET method, at concentrations ranging from 1.5 to 40 mg/L. The DI-WET lead for these samples ranged from 0.19 to 7.6 mg/L. Therefore, soil in top one foot below existing grade in the vicinity of these samples should be excavated and properly reused at a location below a roadway pavement structural section to be maintained by Caltrans and five feet above the groundwater table, or disposed as a California hazardous waste, prior to initiating soil reuse. These reuse and disposal recommendations apply to all construction for this ramp from station 57+00 until the ramp merges with U. S. 101. These restrictions are also shown on Figure 2.

6.1.2 U. S. 101 Median

The entire median was characterized during the U. S. 101 Segment B Hazardous Materials SIR, and it was recommended that soil excavated from the top one foot of the median should only be reused at a location covered by a roadway pavement structural section to be maintained by Caltrans and at least five feet above the groundwater table, or that soil be disposed as a California hazardous waste. The U.S. 101 Segment B project has been constructed and therefore it is likely that soil contaminated with ADL has been placed within the topmost three to five feet of soil below the structural section of the new central HOV lanes and within the existing U.S. 101 median. This soil may be excavated during construction of columns associated with the new Overcrossing. Soil excavated from the top five feet below the roadway median structural section should be excavated and properly reused at a location below a roadway pavement structural section to be maintained by Caltrans, and five feet above the groundwater table, or that soil should be disposed as a California hazardous waste. These restrictions are also shown on Figure 2. Groundwater results collected from the vicinity of the median were discussed in Sections 5.1 and 6.1.5.

6.1.3 Remainder of Project

Based on the Caltrans variance, the Total and WET lead results indicate that soils at the project Site, following removal of the samples discussed in Section 4.2.1, do not meet hazardous waste criteria and are not subject to the reuse restrictions of the Caltrans variance.

6.1.4 Other Contaminants of Concern in Soil

As described in detail in Sections 3.2.2 and 3.2.3, various samples were analyzed for Cam 17 metals or for TPH-g, TPH-d, and TPH-mo. None of these constituents were detected at a value or concentration which exceeded applicable State or Federal hazardous waste criteria, or for those constituents for which no specific criteria has been established, none require additional testing or evaluation, in the opinion of URS. Therefore, these constituents do not restrict reuse of soil or require disposal of soil as a California or RCRA hazardous waste. Results are included as Table 4, and raw analytical reports are included on CD as **Appendix F**.

Arsenic is present at background concentrations for the region, which are greater than PRGs, therefore a site-specific health and safety plan may be required to protect workers and the public from exposure risks. This health and safety plan may require workers to receive HAZWOPER 24 or 40 hour training prior to beginning field work. One way to address this issue would be to control and monitor exposure to dust (which may contain constituents including lead and arsenic) via a Cal-OSHA regulatory approach.

6.1.5 Groundwater

During URS' environmental investigation, groundwater was typically encountered at a depth of approximately 15 feet bgs. Based on URS' geotechnical investigation, which was performed in the fall of 2009, depth to groundwater was approximately 8-17 feet bgs throughout the project corridor, at an elevation of approximately 25 feet MSL. Based on URS' geotechnical investigation (URS, 2010c), performed concurrently with this hazardous materials investigation, depth to groundwater was at an elevation of approximately 28 feet above Mean Sea Level (MSL) throughout the project corridor. Groundwater elevations measured during the Geotechnical investigation ranged as high as 28' MSL. Based on a review of quarterly monitoring reports associated with a Chevron at 4999 Old Redwood Highway (Conestoga-Rovers, 2011) and an Exxon at 5153 Old Redwood Highway (Cardno ERI, 2011), groundwater elevation ranges from 25' at the east end of the project to 32' at the east end of the project. It would be reasonable to assume that groundwater elevation at the median of the project is approximately 28'. Therefore, ADL impacted soil should be placed at elevations of 33' or greater.

Based on the current design drawings, reuse of soil should not be constrained, as there is adequate room within the proposed embankments and below the pavement of the new overcrossing for the volume of soil identified as Type Y-2.

Groundwater samples associated with the environmental investigation were collected adjacent or downgradient of properties identified as potentially impacting the Site in the ISA, and at where the deepest excavations might be expected as part of the overcrossing replacement. As discussed in Section 3.3, no constituent of concern was detected at a concentration which exceeded State or Federal hazardous waste criteria, or for constituents for which no specific criteria has been established, require additional testing or evaluation, in the opinion of URS. However, site groundwater in this area appears to have been impacted by the releases of petroleum hydrocarbons.

6.2 RECOMMENDATIONS

URS makes the following recommendations relating to soil and groundwater handling during construction:

6.2.1 Soil

If soil is to be excavated and removed from the Caltrans ROW, the disposal location should be reviewed and approved by the City of Petaluma, the SCTA, and Caltrans prior to granting approval for the contractor to move the soil. The investigation data results reported herein are considered sufficient to characterize the soil for reuse or disposal. However, if soils of unusual color or odorous soils are encountered during the project excavations or soil management activities, those soils should be stockpiled separately and subjected to additional sampling and analysis to further evaluate potential contamination.

Soil excavated from the top one foot associated with construction of the new northbound on-ramp to U. S. 101 from Old Redwood Highway, should be reused only at a location that will be covered by roadway pavement structural section and that will be at least five feet above the groundwater table. In addition, soil excavated from the top five feet below the roadway median structural section for construction of Overcrossing columns should be excavated and properly reused at a location below a roadway pavement structural section to be maintained by Caltrans, and five feet above the groundwater table, or that soil should be disposed as a California hazardous waste. As the elevation of the new Old Redwood Highway Overcrossing will be raised by several feet as part of this project, it is likely that all soil can be contained below the pavement for the new overcrossing.

Due to high concentrations of lead at points within the project site, URS recommends development and implementation of a site-specific health and safety plan to protect workers and the public from exposure risks due to lead. This health and safety plan may require workers to receive HAZWOPER 24 or 40 hour training prior to beginning field work. The health and safety plan should consider concentrations of all detected constituents, in particular lead and arsenic, which is present at background concentrations for the regions, which are greater than PRGs. In addition, the presence of these materials and the reuse requirements discussed in this SIR should be addressed in the project Special Provisions. One way to address this issue would be to control and monitor exposure to dust (which may contain constituents including lead and arsenic) via a Cal-OSHA regulatory approach.

6.2.2 Groundwater

Based upon reuse recommendations most excavated material used for backfill must be placed at least five feet above the groundwater table. ADL reuse should be restricted to elevations greater than 33’ MSL. Therefore, the locations at which soil may be reused must be carefully selected. The proposed project plans identify sufficient volume for placement of all restricted material within the embankment, and below the new roadway, of the new Overcrossing.

If groundwater observed in excavations or during dewatering exhibits odors or sheen, this groundwater should be stored separately additional sampling and analysis to further evaluate potential contamination, prior to continued worker contact or disposal.

It is likely that site groundwater in this project area may be impacted by the releases of petroleum hydrocarbons. Water resulting from dewatering operations should be appropriately sampled, containerized, characterized, and managed. URS recommends development and implementation of a site-specific health and safety plan to protect workers and the public from exposure risks due to contact with groundwater. In addition, the presence of this groundwater contamination and the resulting requirement to appropriately store, sample, characterize, and manage and/or dispose of the water, should be discussed in the project Special Provisions.

This report was prepared for the City of Petaluma Department of Public Works and Caltrans; any use by third parties is at the third parties sole risk. No investigation is sufficient enough to explore the presence of hazardous material at every location on the site. It is assumed that the samples collected and analyzed in accordance with the agreed scope of work are representative of conditions at the Site at the time of the planned construction. If soil or groundwater conditions are observed that differ from those in this report, URS Corporation should be notified so that additional recommendations can be made.

It would be extremely expensive, and perhaps impossible, to conduct a Site reconnaissance or investigation that would ensure detection of all materials at the subject property that might be considered hazardous now or in the future. URS' failure to discover hazardous materials through a reasonable and mutually agreed-upon limited scope of work does not guarantee that hazardous materials do not exist in an area. Similarly, an area that is unaffected by hazardous materials at the time of our assessment may later, due to natural phenomena or human intervention, become contaminated.

ADL	aerially deposited lead
bgs	below ground surface
Cal EPA	California Environmental Protection Agency
Caltrans	California Department of Transportation
CAM 17	California Assessment Manual Metals
City	The City of Petaluma
CPT	cone penetrating technology
DI-WET	Deionized-Water Waste Extraction Test
DPT	direct-push technology
DTSC	(California) Department of Toxic Substances Control
EPA	(Federal) Environmental Protection Agency
ft	foot/feet
GPS	Global Positioning System
HAZWOPER	Hazardous Waste Operations and Emergency Response
ISA	Initial Site Assessment
KM	Kaplan-Meier
LUST	Leaking Underground Storage Tank
MSL	feet above Mean Sea Level
ug/L	micrograms per liter
mg/Kg	milligrams per kilogram
mg/L	milligrams per liter
PM	Post Mile
QC	quality control
RCRA	Resource Conservation and Recovery Act
ROW	Right Of Way

SCTA	Sonoma County Transportation Authority
SIR	Site Investigation Report
STLC	(California) Soluble Threshold Limit Concentration
TPH	total petroleum hydrocarbons
TTLC	(California) Total Threshold Limit Concentration
TCLP	(Federal USEPA RCRA) Toxicity Characteristic Leaching Procedure
USEPA	United States Environmental Protection Agency
UCL	upper confidence limit
UCLM	upper confidence limit of the mean
URS	URS Corporation
USA	Underground Services Alert
Variance	DTSC Variance No. 00-H-VAR-01
VOC	volatile organic compounds
WET	(California) Waste Extraction Test

California EPA DTSC, *State of California Department of Transportation Variance No. V09HQSCD006*, Effective Date July 1, 2009.

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TABLES

HAZARDOUS MATERIALS SITE INVESTIGATION REPORT
U.S. 101/OLD REDWOOD HIGHWAY INTERCHANGE PROJECT
PETALUMA, CALIFORNIA

Table 1 – Sampling and Analysis Summary

Table 2 – Soil Results – Total Metals

Table 3 – Soil Results – Leachable Lead

Table 4 – Soil Results – Other COPCs

Table 5 – Groundwater Results – Total Metals

Table 6 – Groundwater Results – Other COPCs

Table 7 – Statistical Analysis, Lead in Soil

Table 1
Sampling and Analysis Summary
US 101 / Old Redwood Highway Interchange Project

Boring Sample Location ID	Sample Depth (feet)	Lab Sample ID	Sample Date	CAM 17 Metals	Lead (Total)	Lead (DI-STLC)	Lead (STLC)	Lead (TCLP)	TPH-g	VOCs	TPH-d	TPH-mo	Mercury w/o CAM 17
SOIL SAMPLES													
NB-1-1	0 - 0.5	0911056-009	11/6/2009	X	X	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911056-010	11/6/2009	X	X	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911056-011	11/6/2009	X	X	--	--	--	--	--	--	--	--
NB-1-1-d	0 - 0.5	0911056-012	11/6/2009	X	X	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911056-013	11/6/2009	X	X	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911056-014	11/6/2009	X	X	--	--	--	--	--	--	--	--
NB-1-2	0 - 0.5	0911056-015	11/6/2009	--	X	X	X	--	--	--	--	--	--
	0.5 - 1.0	0911056-016	11/6/2009	--	X	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911056-017	11/6/2009	--	X	--	--	--	--	--	--	--	--
	1.5 - 3.0	0911056-018	11/6/2009	--	X	--	--	--	--	--	--	--	--
	4.5 - 5.0	0911056-019	11/6/2009	--	X	--	--	--	--	--	--	--	--
NB-2-1	0 - 0.5	0911053-007	11/5/2009	--	X	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911053-008	11/5/2009	--	X	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911053-009	11/5/2009	--	X	--	--	--	--	--	--	--	--
NB-3-1	0 - 0.5	0911053-010	11/5/2009	--	X	X	X	--	--	--	--	--	--
	0.5 - 1.0	0911053-011	11/5/2009	--	X	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911053-012	11/5/2009	--	X	--	--	--	--	--	--	--	--
NB-3-2	0 - 0.5	0911053-013	11/5/2009	--	X	X	X	--	--	--	--	--	--
	0.5 - 1.0	0911053-014	11/5/2009	--	X	X	X	X	--	--	--	--	--
	1.0 - 1.5	0911053-015	11/5/2009	--	X	--	--	--	--	--	--	--	--
NB-4-1	0 - 0.5	0911053-001	11/5/2009	--	X	--	--	--	X	--	X	X	--
	0.5 - 1.0	0911053-002	11/5/2009	--	X	--	--	--	X	--	X	X	--
	1.0 - 1.5	0911053-003	11/5/2009	--	X	X	X	--	X	--	X	X	--
NB-4-2	0 - 0.5	0911053-004	11/5/2009	--	X	X	X	--	--	--	--	--	--
	0.5 - 1.0	0911053-005	11/5/2009	X	X	X	X	X	--	--	--	--	--
	1.0 - 1.5	0911053-006	11/5/2009	--	X	X	X	--	--	--	--	--	--
NB-5-1	0 - 0.5	0911051-013	11/5/2009	--	X	X	X	--	--	--	--	--	--
	0.5 - 1.0	0911051-014	11/5/2009	--	X	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911051-015	11/5/2009	--	X	--	--	--	--	--	--	--	--
NB-5-2	0-0.5	0911051-016	11/5/2009	--	X	X	X	--	--	--	--	--	--
	0.5-1.0	0911051-017	11/5/2009	--	X	--	--	--	--	--	--	--	--
	1.0-1.5	0911051-018	11/5/2009	--	X	--	--	--	--	--	--	--	--
NB-6-1	0 - 0.5	0911052-001	11/5/2009	--	X	X	X	X	--	--	--	--	--
	0.5 - 1.0	0911052-002	11/5/2009	X	X	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911052-003	11/5/2009	--	X	--	--	--	--	--	--	--	--

Boring Sample Location ID	Sample Depth (feet)	Lab Sample ID	Sample Date	CAM 17 Metals	Lead (Total)	Lead (DI-STLC)	Lead (STLC)	Lead (TCLP)	TPH-g	VOCs	TPH-d	TPH-mo	Mercury w/o CAM 17
NB-7-1	0 - 0.5	0911056-001	11/6/2009	--	X	X	X	--	--	--	--	--	--
	0.5 - 1.0	0911056-002	11/6/2009	--	X	X	X	X	--	--	--	--	--
	1.0 - 1.5	0911056-003	11/6/2009	--	X	X	X	X	--	--	--	--	--
NB-7-2	0 - 0.5	0911056-004	11/6/2009	--	X	X	X	--	--	--	--	--	--
	0.5 - 1.0	0911056-005	11/6/2009	X	X	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911056-006	11/6/2009	--	X	X	X	--	--	--	--	--	--
	1.5 - 3.0	0911056-007	11/6/2009	--	X	--	--	--	--	--	--	--	--
	5.5 - 6.0	0911056-008	11/6/2009	X	X	--	--	--	--	--	--	--	--
NB-8-1	0 - 0.5	0911052-013	11/5/2009	--	X	X	X	X	--	--	--	--	--
	0.5 - 1.0	0911052-014	11/5/2009	--	X	X	X	X	--	--	--	--	--
	1.0 - 1.5	0911052-015	11/5/2009	--	X	X	X	X	--	--	--	--	--
NB-8-2	0 - 0.5	0911052-016	11/5/2009	--	X	X	X	X	--	--	--	--	--
	0.5 - 1.0	0911052-017	11/5/2009	--	X	X	X	X	--	--	--	--	--
	1.0 - 1.5	0911052-018	11/5/2009	X	X	--	--	--	--	--	--	--	--
NB-9-1	0 - 0.5	0911052-004	11/5/2009	--	X	X	X	X	--	--	--	--	--
	0.5 - 1.0	0911052-005	11/5/2009	X	X	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911052-006	11/5/2009	--	X	--	--	--	--	--	--	--	--
NB-9-2	0 - 0.5	0911052-007	11/5/2009	--	X	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911052-008	11/5/2009	--	X	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911052-009	11/5/2009	--	X	--	--	--	--	--	--	--	--
NB-9-2-d	0 - 0.5	0911052-010	11/5/2009	--	X	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911052-011	11/5/2009	--	X	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911052-012	11/5/2009	--	X	--	--	--	--	--	--	--	--
NB-10-1	0-0.5	0911055-009	11/6/2009	X	X	X	X	--	--	--	--	--	--
	0.5-1.0	0911055-010	11/6/2009	--	X	--	--	--	--	--	--	--	--
	1.0-1.5	0911055-011	11/6/2009	--	X	--	--	--	--	--	--	--	--
NB-10-2	0-0.5	0911055-012	11/6/2009	--	X	X	X	X	--	--	--	--	--
	0.5-1.0	0911055-013	11/6/2009	--	X	--	--	--	--	--	--	--	--
	1.0-1.5	0911055-014	11/6/2009	--	X	--	--	--	--	--	--	--	--
RWH-D-21	0-0.5	0608026-015	8/3/2006	--	X	X	X	--	--	--	--	--	--
	0.5-1.0	0608026-016	8/3/2006	--	X	X	X	--	--	--	--	--	--
RWH-D-22	0-0.5	0612044-030	8/3/2006	--	X	--	--	--	--	--	--	--	--
	0.5-1.0	0612044-029	8/3/2006	--	X	--	--	--	--	--	--	--	--
NB-11-1	0-0.5	0911055-001	11/6/2009	--	X	X	X	X	--	--	--	--	--
	0.5-1.0	0911055-002	11/6/2009	--	X	--	--	X	--	--	--	--	--
	1.0-1.5	0911055-003	11/6/2009	--	X	--	--	--	--	--	--	--	--
	1.5-3.0	0911055-004	11/6/2009	--	X	--	--	--	--	--	--	--	--
	5.5-6.0	0911055-005	11/6/2009	--	X	--	--	--	--	--	--	--	--

Boring Sample Location ID	Sample Depth (feet)	Lab Sample ID	Sample Date	CAM 17 Metals	Lead (Total)	Lead (DI-STLC)	Lead (STLC)	Lead (TCLP)	TPH-g	VOCs	TPH-d	TPH-mo	Mercury w/o CAM 17
NB-11-2	0-0.5	0911055-006	11/6/2009	--	X	X	X	X	--	--	--	--	--
	0.5-1.0	0911055-007	11/6/2009	X	X	--	--	--	--	--	--	--	--
	1.0-1.5	0911055-008	11/6/2009	--	X	--	--	--	--	--	--	--	--
SB-1-1	0-0.5	0911050-001	11/5/2009	--	X	X	X	--	--	--	--	--	--
	0.5-1.0	0911050-002	11/5/2009	--	X	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911050-003	11/5/2009	--	X	X	X	--	--	--	--	--	--
SB-1-2	0 - 0.5	0911050-004	11/5/2009	--	X	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911050-005	11/5/2009	--	X	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911050-006	11/5/2009	--	X	--	--	--	--	--	--	--	--
RWH-B-21	0-0.5	0608026-028	8/3/2006	--	X	--	--	--	--	--	--	--	--
	0.5-1.0	0608026-029	8/3/2006	--	X	X	X	--	--	--	--	--	--
	1.0-1.5	0612044-016	8/3/2006	--	X	--	--	--	--	--	--	--	--
	1.5-2.0	0612044-015	8/3/2006	--	X	--	--	--	--	--	--	--	--
	2.5-3.0	0608026-032	8/3/2006	--	X	--	--	--	--	--	--	--	--
RWH-B-22	0-0.5	0612044-021	8/3/2006	--	X	X	X	--	--	--	--	--	--
	0.5-1.0	0612044-019	8/3/2006	--	X	--	--	--	--	--	--	--	--
	1.0-1.5	0608036-007	8/3/2006	--	X	--	--	--	--	--	--	--	--
	1.0-1.5	0612044-020	8/3/2006	--	X	--	--	--	--	--	--	--	--
	1.5-2.0	0612044-017	8/3/2006	--	X	--	--	--	--	--	--	--	--
	2.5-3.0	0612044-022	8/3/2006	--	X	--	--	--	--	--	--	--	--
	5.5-6.0	0612044-018	8/3/2006	--	X	--	--	--	--	--	--	--	--
SB-2-1	0-0.5	0911050-007	11/5/2009	--	X	--	--	--	--	--	--	--	--
	0.5-1.0	0911050-008	11/5/2009	--	X	--	--	--	--	--	--	--	--
	1.0-1.5	0911050-009	11/5/2009	X	X	--	--	--	--	--	--	--	--
SB-2-2	0-0.5	0911050-010	11/5/2009	--	X	--	--	--	--	--	--	--	--
	0.5-1.0	0911050-011	11/5/2009	--	X	--	--	--	--	--	--	--	--
SB-3-1	0-0.5	0911051-001	11/5/2009	--	X	X	X	X	--	--	--	--	--
	0.5-1.0	0911051-002	11/5/2009	--	X	--	--	X	--	--	--	--	--
	1.0-1.5	0911051-003	11/5/2009	--	X	--	--	X	--	--	--	--	--
SB-3-2	0-0.5	0911051-004	11/5/2009	--	X	X	X	X	--	--	--	--	--
	0.5-1.0	0911051-005	11/5/2009	--	X	--	--	--	--	--	--	--	--
	1.0-1.5	0911051-006	11/5/2009	--	X	--	--	--	--	--	--	--	--
SB-4-1	0-0.5	0911051-007	11/5/2009	--	X	--	--	X	--	--	--	--	--
	0.5-1.0	0911051-008	11/5/2009	--	X	--	--	--	--	--	--	--	--
	1.0-1.5	0911051-009	11/5/2009	X	X	--	--	--	--	--	--	--	--
SB-4-2	0-0.5	0911051-010	11/5/2009	--	X	--	--	X	--	--	--	--	--
	0.5-1.0	0911051-011	11/5/2009	--	X	--	--	--	--	--	--	--	--
	1.0-1.5	0911051-012	11/5/2009	--	X	--	--	--	--	--	--	--	--

Boring Sample Location ID	Sample Depth (feet)	Lab Sample ID	Sample Date	CAM 17 Metals	Lead (Total)	Lead (DI-STLC)	Lead (STLC)	Lead (TCLP)	TPH-g	VOCs	TPH-d	TPH-mo	Mercury w/o CAM 17
SB-6-1	0-0.5	0911050-012	11/5/2009	--	X	--	--	X	--	--	--	--	--
	0.5-1.0	0911050-013	11/5/2009	X	X	--	--	X	--	--	--	--	--
	1.0-1.5	0911050-014	11/5/2009	--	X	--	--	X	--	--	--	--	--
SB-6-2	0 - 0.5	0911050-015	11/5/2009	--	X	--	--	X	--	--	--	--	--
	0.5 - 1.0	0911050-016	11/5/2009	--	X	--	--	--	--	--	--	--	--
SB-6-2-d	0-0.5	0911050-017	11/5/2009	--	X	--	--	X	--	--	--	--	--
	0.5-1.0	0911050-018	11/5/2009	--	X	--	--	--	--	--	--	--	--
SB-7-1	0 - 0.5	0911054-001	11/6/2009	--	X	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911054-002	11/6/2009	--	X	--	--	X	--	--	--	--	--
	4.5 - 5.0	0911054-003	11/6/2009	--	X	--	--	X	--	--	--	--	--
SB-7-2	0-0.5	0911054-004	11/6/2009	--	X	--	--	X	--	--	--	--	--
	0.5-1.0	0911054-005	11/6/2009	X	X	X	X	X	X	--	X	X	--
	1.0-1.5	0911054-006	11/6/2009	--	X	X	X	X	X	--	X	X	X
	2.5-3.0	0911054-007	11/6/2009	--	X	--	--	--	X	--	X	X	--
	5.5-6.0	0911054-008	11/6/2009	X	X	--	--	X	X	--	X	X	--
	8.5-9.0	0911054-009	11/6/2009	X	X	--	--	--	X	--	X	X	--
RWH-A-21	0-0.5	0608026-009	8/3/2006	--	X	--	--	--	--	--	--	--	--
	0.5-1.0	0608026-011	8/3/2006	--	X	--	--	--	--	--	--	--	--
SB-8-1	0-0.5	0911054-015	11/6/2009	X	X	X	X	--	--	--	--	--	--
	0.5-1.0	0911054-016	11/6/2009	X	X	--	--	--	--	--	--	--	--
	1.0-1.5	0911054-017	11/6/2009	X	X	--	--	--	--	--	--	--	--
SB-8-2	0-0.5	0911054-010	11/6/2009	--	X	X	X	--	X	--	X	X	X
	0.5-1.0	0911054-011	11/6/2009	X	X	--	--	--	X	--	X	X	--
	1.0-1.5	0911054-012	11/6/2009	--	X	--	--	--	X	--	X	X	--
	2.5-3.0	0911054-013	11/6/2009	--	X	--	--	--	X	--	X	X	--
	5.5-6.0	0911054-014	11/6/2009	X	X	--	--	--	X	--	X	X	--
GROUNDWATER SAMPLES													
A-09-108		0911088-002	11/15/2009	X	X	--	--	--	X	X	X	X	--
SB-5-1-GW		0911019-001	11/4/2009	X	X	--	--	--	X	X	X	X	--
A-09-112		0911088-001	11/15/2009	X	X	--	--	--	X	X	X	X	--

Notes:
X = sample analyzed for specified analyte
-- = sample not analyzed for specified analyte

Boring Sample Location ID	Sample Depth (feet)	Lab Sample ID	Sample Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead (Total)	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium
		EPA Method		6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B
		Units		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
		RWQCB ESLs for Construction Workers[1]		310	15	2600	98	39	1600000 (Cr III)	94	310000	750	58	3900	260	3900	3900	62	770	230000
		10 x STLC		150	50	1,000	7.5	10	50	800	250	50	2	3,500	200	10	50	70	240	2,500
		20 x TCLP		NE	100	2,000	NE	20	100	NE	NE	100	4	NE	NE	20	100	NE	NE	NE
Northbound																			
NB-1-1	0 - 0.5	0911056-009	11/6/2009	<5.0	2.0	150	<2.0	<1.0	38	6.6	22	34	0.34	<5.0	41	<5.0	<1.0	<5.0	36	34
	0.5 - 1.0	0911056-010	11/6/2009	<5.0	2.0	150	<2.0	<1.0	41	<5.0	23	13	0.26	<5.0	39	<5.0	<1.0	<5.0	38	31
	1.0 - 1.5	0911056-011	11/6/2009	<5.0	<1.7	120	<2.0	<1.0	34	<5.0	19	15	0.20	<5.0	29	<5.0	<1.0	<5.0	32	23
NB-1-1-d	0 - 0.5	0911056-012	11/6/2009	<5.0	2.8	150	<2.0	<1.0	40	6.8	23	41	0.29	<5.0	40	<5.0	<1.0	<5.0	37	36
	0.5 - 1.0	0911056-013	11/6/2009	<5.0	2.2	130	<2.0	<1.0	41	<5.0	21	48	0.25	<5.0	35	<5.0	<1.0	<5.0	32	31
	1.0 - 1.5	0911056-014	11/6/2009	<5.0	4.4	220	<2.0	<1.0	32	25	19	22	0.21	<5.0	60	<5.0	<1.0	<5.0	39	23
NB-1-2	0 - 0.5	0911056-015	11/6/2009	--	--	--	--	--	--	--	--	**69**	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911056-016	11/6/2009	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911056-017	11/6/2009	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--	--
	1.5 - 3.0	0911056-018	11/6/2009	--	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--
	4.5 - 5.0	0911056-019	11/6/2009	--	--	--	--	--	--	--	--	6.4	--	--	--	--	--	--	--	--
NB-2-1	0 - 0.5	0911053-007	11/5/2009	--	--	--	--	--	--	--	--	39	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911053-008	11/5/2009	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911053-009	11/5/2009	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--
NB-3-1	0 - 0.5	0911053-010	11/5/2009	--	--	--	--	--	--	--	--	**64**	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911053-011	11/5/2009	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911053-012	11/5/2009	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--
NB-3-2	0 - 0.5	0911053-013	11/5/2009	--	--	--	--	--	--	--	--	**71**	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911053-014	11/5/2009	--	--	--	--	--	--	--	--	**63**	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911053-015	11/5/2009	--	--	--	--	--	--	--	--	6.8	--	--	--	--	--	--	--	--
NB-4-1	0 - 0.5	0911053-001	11/5/2009	--	--	--	--	--	--	--	--	41	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911053-002	11/5/2009	--	--	--	--	--	--	--	--	23	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911053-003	11/5/2009	--	--	--	--	--	--	--	--	**54**	--	--	--	--	--	--	--	--
NB-4-2	0 - 0.5	0911053-004	11/5/2009	--	--	--	--	--	--	--	--	**82**	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911053-005	11/5/2009	<5.0	3.0	100	<2.0	<1.0	36	16	28	**130**	0.14	<5.0	41	<5.0	<1.0	<5.0	49	81
	1.0 - 1.5	0911053-006	11/5/2009	--	--	--	--	--	--	--	--	**64**	--	--	--	--	--	--	--	--
NB-5-1	0 - 0.5	0911051-013	11/5/2009	--	--	--	--	--	--	--	--	**77**	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911051-014	11/5/2009	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911051-015	11/5/2009	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--

Boring Sample Location ID	Sample Depth (feet)	Lab Sample ID	Sample Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead (Total)	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium
		EPA Method		6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B
		Units		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
		RWQCB ESLs for Construction Workers[1]		310	15	2600	98	39	1600000 (Cr III)	94	310000	750	58	3900	260	3900	3900	62	770	230000
		10 x STLC		150	50	1,000	7.5	10	50	800	250	50	2	3,500	200	10	50	70	240	2,500
		20 x TCLP		NE	100	2,000	NE	20	100	NE	NE	100	4	NE	NE	20	100	NE	NE	NE
NB-5-2	0-0.5	0911051-016	11/5/2009	--	--	--	--	--	--	--	--	**68**	--	--	--	--	--	--	--	--
	0.5-1.0	0911051-017	11/5/2009	--	--	--	--	--	--	--	--	29	--	--	--	--	--	--	--	--
	1.0-1.5	0911051-018	11/5/2009	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--
NB-6-1	0 - 0.5	0911052-001	11/5/2009	--	--	--	--	--	--	--	--	**81**	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911052-002	11/5/2009	<5.0	2.2	100	<2.0	<1.0	49	25	32	11	<0.1	<5.0	44	<5.0	1.0	<5.0	76	41
	1.0 - 1.5	0911052-003	11/5/2009	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--
NB-7-1	0 - 0.5	0911056-001	11/6/2009	--	--	--	--	--	--	--	--	**60**	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911056-002	11/6/2009	--	--	--	--	--	--	--	--	**190**	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911056-003	11/6/2009	--	--	--	--	--	--	--	--	**200**	--	--	--	--	--	--	--	--
NB-7-2	0 - 0.5	0911056-004	11/6/2009	--	--	--	--	--	--	--	--	**52**	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911056-005	11/6/2009	<5.0	2.5	100	<2.0	<1.0	31	14	23	46	0.10	<5.0	39	<5.0	<1.0	<5.0	41	48
	1.0 - 1.5	0911056-006	11/6/2009	--	--	--	--	--	--	--	--	**51**	--	--	--	--	--	--	--	--
	1.5-3.0	0911056-007	11/6/2009	--	--	--	--	--	--	--	--	6.4	--	--	--	--	--	--	--	--
	5.5-6.0	0911056-008	11/6/2009	<5.0	3.1	340	<2.0	<1.0	35	25	19	6.4	0.21	<5.0	38	<5.0	<1.0	<5.0	41	23
NB-8-1	0 - 0.5	0911052-013	11/5/2009	--	--	--	--	--	--	--	--	**530**	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911052-014	11/5/2009	--	--	--	--	--	--	--	--	***800***	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911052-015	11/5/2009	--	--	--	--	--	--	--	--	**120**	--	--	--	--	--	--	--	--
NB-8-2	0 - 0.5	0911052-016	11/5/2009	--	--	--	--	--	--	--	--	**540**	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911052-017	11/5/2009	--	--	--	--	--	--	--	--	**110**	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911052-018	11/5/2009	<5.0	4.4	130	<2.0	<1.0	45	6.6	21	27	0.11	<5.0	37	<5.0	<1.0	<5.0	43	36
NB-9-1	0 - 0.5	0911052-004	11/5/2009	--	--	--	--	--	--	--	--	**59**	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911052-005	11/5/2009	<5.0	<1.7	41	<2.0	<1.0	23	23	42	19	<0.1	<5.0	67	<5.0	<1.0	<5.0	52	47
	1.0 - 1.5	0911052-006	11/5/2009	--	--	--	--	--	--	--	--	10	--	--	--	--	--	--	--	--
NB-9-2	0 - 0.5	0911052-007	11/5/2009	--	--	--	--	--	--	--	--	43	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911052-008	11/5/2009	--	--	--	--	--	--	--	--	27	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911052-009	11/5/2009	--	--	--	--	--	--	--	--	7.6	--	--	--	--	--	--	--	--
NB-9-2-d	0 - 0.5	0911052-010	11/5/2009	--	--	--	--	--	--	--	--	26	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911052-011	11/5/2009	--	--	--	--	--	--	--	--	6.9	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911052-012	11/5/2009	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--	--	--
NB-10-1	0-0.5	0911055-009	11/6/2009	<5.0	13	59	<2.0	<1.0	42	21	26	**91**	0.10	<5.0	70	<5.0	<1.0	<5.0	48	65
	0.5-1.0	0911055-010	11/6/2009	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--
	1.0-1.5	0911055-011	11/6/2009	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--

Boring Sample Location ID	Sample Depth (feet)	Lab Sample ID	Sample Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead (Total)	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium
		EPA Method		6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B
		Units		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
		RWQCB ESLs for Construction Workers[1]		310	15	2600	98	39	1600000 (Cr III)	94	310000	750	58	3900	260	3900	3900	62	770	230000
		10 x STLC		150	50	1,000	7.5	10	50	800	250	50	2	3,500	200	10	50	70	240	2,500
		20 x TCLP		NE	100	2,000	NE	20	100	NE	NE	100	4	NE	NE	20	100	NE	NE	NE
NB-10-2	0-0.5	0911055-012	11/6/2009	--	--	--	--	--	--	--	--	**100**	--	--	--	--	--	--	--	--
	0.5-1.0	0911055-013	11/6/2009	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--
	1.0-1.5	0911055-014	11/6/2009	--	--	--	--	--	--	--	--	9.7	--	--	--	--	--	--	--	--
RWH-D-21	0-0.5	0608026-015	8/3/2006	--	--	--	--	--	--	--	--	73	--	--	--	--	--	--	--	--
	0.5-1.0	0608026-016	8/3/2006	--	--	--	--	--	--	--	--	59	--	--	--	--	--	--	--	--
RWH-D-22	0-0.5	0612044-030	8/3/2006	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--
	0.5-1.0	0612044-029	8/3/2006	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--
NB-11-1	0-0.5	0911055-001	11/6/2009	--	--	--	--	--	--	--	--	87	--	--	--	--	--	--	--	--
	0.5-1.0	0911055-002	11/6/2009	--	--	--	--	--	--	--	--	2.8	--	--	--	--	--	--	--	--
	1.0-1.5	0911055-003	11/6/2009	--	--	--	--	--	--	--	--	2.8	--	--	--	--	--	--	--	--
	1.5-3.0	0911055-004	11/6/2009	--	--	--	--	--	--	--	--	4.4	--	--	--	--	--	--	--	--
	5.5-6.0	0911055-005	11/6/2009	--	--	--	--	--	--	--	--	7.7	--	--	--	--	--	--	--	--
NB-11-2	0-0.5	0911055-006	11/6/2009	--	--	--	--	--	--	--	--	**140**	--	--	--	--	--	--	--	--
	0.5-1.0	0911055-007	11/6/2009	<5.0	3.0	160	<2.0	<1.0	42	13	25	8.2	0.22	<5.0	42	<5.0	<1.0	<5.0	42	32
	1.0-1.5	0911055-008	11/6/2009	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--
Southbound																				
SB-1-1	0-0.5	0911050-001	11/5/2009	--	--	--	--	--	--	--	--	**70**	--	--	--	--	--	--	--	--
	0.5-1.0	0911050-002	11/5/2009	--	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911050-003	11/5/2009	--	--	--	--	--	--	--	--	**54**	--	--	--	--	--	--	--	--
SB-1-2	0 - 0.5	0911050-004	11/5/2009	--	--	--	--	--	--	--	--	48	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911050-005	11/5/2009	--	--	--	--	--	--	--	--	28	--	--	--	--	--	--	--	--
	1.0 - 1.5	0911050-006	11/5/2009	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--
RWH-B-21	0-0.5	0608026-028	8/3/2006	--	--	--	--	--	--	--	--	45	--	--	--	--	--	--	--	--
	0.5-1.0	0608026-029	8/3/2006	--	--	--	--	--	--	--	--	110	--	--	--	--	--	--	--	--
	1.0-1.5	0612044-016	8/3/2006	--	--	--	--	--	--	--	--	28	--	--	--	--	--	--	--	--
	1.5-2.0	0612044-015	8/3/2006	--	--	--	--	--	--	--	--	7.4	--	--	--	--	--	--	--	--
	2.5-3.0	0608026-032	8/3/2006	--	--	--	--	--	--	--	--	7.7	--	--	--	--	--	--	--	--
RWH-B-22	0-0.5	0612044-021	8/3/2006	--	--	--	--	--	--	--	--	51	--	--	--	--	--	--	--	--
	0.5-1.0	0612044-019	8/3/2006	--	--	--	--	--	--	--	--	9.6	--	--	--	--	--	--	--	--
	1.0-1.5	0608036-007 & 0612044-020	8/3/2006	--	--	--	--	--	--	--	--	9.6 & 13	--	--	--	--	--	--	--	--
	1.5-2.0	0612044-017	8/3/2006	--	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--
	2.5-3.0	0612044-022	8/3/2006	--	--	--	--	--	--	--	--	9.1	--	--	--	--	--	--	--	--
	5.5-6.0	0612044-018	8/3/2006	--	--	--	--	--	--	--	--	31	--	--	--	--	--	--	--	--

Boring Sample Location ID	Sample Depth (feet)	Lab Sample ID	Sample Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead (Total)	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium
		EPA Method		6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B
		Units		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
		RWQCB ESLs for Construction Workers[1]		310	15	2600	98	39	1600000 (Cr III)	94	310000	750	58	3900	260	3900	3900	62	770	230000
		10 x STLC		150	50	1,000	7.5	10	50	800	250	50	2	3,500	200	10	50	70	240	2,500
		20 x TCLP		NE	100	2,000	NE	20	100	NE	NE	100	4	NE	NE	20	100	NE	NE	NE
SB-2-1	0-0.5	0911050-007	11/5/2009	--	--	--	--	--	--	--	--	33	--	--	--	--	--	--	--	--
	0.5-1.0	0911050-008	11/5/2009	--	--	--	--	--	--	--	--	30	--	--	--	--	--	--	--	--
	1.0-1.5	0911050-009	11/5/2009	<5.0	2.3	84	<2.0	<1.0	48	24	33	23	<.10	<5.0	46	<5.0	<1.0	<5.0	70	42
SB-2-2	0-0.5	0911050-010	11/5/2009	--	--	--	--	--	--	--	--	26	--	--	--	--	--	--	--	--
	0.5-1.0	0911050-011	11/5/2009	--	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--
SB-3-1	0-0.5	0911051-001	11/5/2009	--	--	--	--	--	--	--	--	**120**	--	--	--	--	--	--	--	--
	0.5-1.0	0911051-002	11/5/2009	--	--	--	--	--	--	--	--	5	--	--	--	--	--	--	--	--
	1.0-1.5	0911051-003	11/5/2009	--	--	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--
SB-3-2	0-0.5	0911051-004	11/5/2009	--	--	--	--	--	--	--	--	**150**	--	--	--	--	--	--	--	--
	0.5-1.0	0911051-005	11/5/2009	--	--	--	--	--	--	--	--	23	--	--	--	--	--	--	--	--
	1.0-1.5	0911051-006	11/5/2009	--	--	--	--	--	--	--	--	37	--	--	--	--	--	--	--	--
SB-4-1	0-0.5	0911051-007	11/5/2009	--	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--
	0.5-1.0	0911051-008	11/5/2009	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--
	1.0-1.5	0911051-009	11/5/2009	<5.0	<1.7	92	<2.0	<1.0	34	16	27	6.8	<.10	<5.0	26	<5.0	1.8	<5.0	85	30
SB-4-2	0-0.5	0911051-010	11/5/2009	--	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--
	0.5-1.0	0911051-011	11/5/2009	--	--	--	--	--	--	--	--	8.9	--	--	--	--	--	--	--	--
	1.0-1.5	0911051-012	11/5/2009	--	--	--	--	--	--	--	--	9.1	--	--	--	--	--	--	--	--
SB-6-1	0-0.5	0911050-012	11/5/2009	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--
	0.5-1.0	0911050-013	11/5/2009	<5.0	2.2	90	<2.0	<1.0	35	27	33	7	--	<5.0	42	<5.0	<1.0	<5.0	78	34
	1.0-1.5	0911050-014	11/5/2009	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--
SB-6-2	0 - 0.5	0911050-015	11/5/2009	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911050-016	11/5/2009	--	--	--	--	--	--	--	--	8.5	--	--	--	--	--	--	--	--
SB-6-2-d	0-0.5	0911050-017	11/5/2009	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--
	0.5-1.0	0911050-018	11/5/2009	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--	--	--
SB-7-1	0 - 0.5	0911054-001	11/6/2009	--	--	--	--	--	--	--	--	34	--	--	--	--	--	--	--	--
	0.5 - 1.0	0911054-002	11/6/2009	--	--	--	--	--	--	--	--	26	--	--	--	--	--	--	--	--
	4.5 - 5.0	0911054-003	11/6/2009	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--	--	--
SB-7-2	0-0.5	0911054-004	11/6/2009	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--
	0.5-1.0	0911054-005	11/6/2009	<5.0	4.8	110	<2.0	<1.0	37	15	24	**140**	0.13	<5.0	51	<5.0	<1.0	<5.0	38	60
	1.0-1.5	0911054-006	11/6/2009	--	--	--	--	--	--	--	--	**130**	0.10	--	--	--	--	--	--	--
	2.5-3.0	0911054-007	11/6/2009	--	--	--	--	--	--	--	--	7.1	--	--	--	--	--	--	--	--
	5.5-6.0	0911054-008	11/6/2009	<5.0	1.8	140	<2.0	<1.0	34	6.3	18	5.2	0.17	<5.0	36	<5.0	<1.0	<5.0	33	22
	8.5-9.0	0911054-009	11/6/2009	<5.0	4.6	540	<2.0	<1.0	34	9.6	15	5	0.19	<5.0	41	<5.0	<1.0	<5.0	38	24

Boring Sample Location ID	Sample Depth (feet)	Lab Sample ID	Sample Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead (Total)	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zi
		EPA Method		6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B
		Units		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
		RWQCB ESLs for Construction Workers[1]		310	15	2600	98	39	1600000 (Cr III)	94	310000	750	58	3900	260	3900	3900	62	770	230000
		10 x STLC		150	50	1,000	7.5	10	50	800	250	50	2	3,500	200	10	50	70	240	2,500
		20 x TCLP		NE	100	2,000	NE	20	100	NE	NE	100	4	NE	NE	20	100	NE	NE	NE
RWH-A-21	0-0.5	0608026-009	8/3/2006	--	--	--	--	--	--	--	--	9.4	--	--	--	--	--	--	--	--
	0.5-1.0	0608026-011	8/3/2006	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--
SB-8-1	0-0.5	0911054-015	11/6/2009	<5.0	5.3	94	<2.0	<1.0	29	16	39	**400**	0.14	<5.0	45	<5.0	<1.0	<5.0	52	150
	0.5-1.0	0911054-016	11/6/2009	<5.0	5	74	<2.0	<1.0	31	12	18	4.6	<0.10	<5.0	43	<5.0	<1.0	<5.0	35	26
	1.0-1.5	0911054-017	11/6/2009	<5.0	8.9	37	<2.0	<1.0	36	14	34	6.2	<0.10	<5.0	40	<5.0	<1.0	<5.0	51	24
SB-8-2	0-0.5	0911054-010	11/6/2009	--	--	--	--	--	--	--	--	**120**	<0.10	--	--	--	--	--	--	--
	0.5-1.0	0911054-011	11/6/2009	<5.0	6	50	<2.0	<1.0	44	15	24	42	<0.10	<5.0	66	<5.0	<1.0	<5.0	40	38
	1.0-1.5	0911054-012	11/6/2009	--	--	--	--	--	--	--	--	6.9	--	--	--	--	--	--	--	--
	2.5-3.0	0911054-013	11/6/2009	--	--	--	--	--	--	--	--	5.8	--	--	--	--	--	--	--	--
	5.5-6.0	0911054-014	11/6/2009	<5.0	2.9	220	<2.0	<1.0	39	7.6	20	5.8	0.2	<5.0	39	<5.0	<1.0	<5.0	42	28

Notes:
EPA = US Environmental Protection Agency
mg/Kg = milligrams per kilogram
STLC = Soluble Threshold Limits Concentrations
TCLP = Toxicity Characteristic Leaching Procedure
NE = Not Established
-- = sample not analyzed for specified analyte
Bold indicates value exceeds 10 x STLC; See Table 3 for Leachate results
italics = result exceeds Construction Worker ESL
1 = RWQCB Direct Exposure Soil Screening Levels (ESLs) for Construction/Trench Workers, May 2008
The symbol "<" (less than) indicates that the analyte was not detected at a concentration above the laboratory detection limit specified.

Table 3
Soil Results - Leachable Lead
US 101 / Old Redwood Highway Interchange Project

Boring Sample Location ID	Sample Depth (feet)	Lab Sample ID	Sample Date	Lead (Total)	Lead (DI-STLC)	Lead (STLC)	Lead (TCLP)
		EPA Method		6010B	6010B	6010B	6010B
		Units		mg/Kg	mg/L	mg/L	mg/L
		10 X STLC/20 X TCLP Limit[1]		50/100	--	--	--
		Hazardous Waste Limit[2]		--	--	5.0	5.0
		Reuse Restrictions[3]		1411/3397	1.5/150	--	--
NB-1-1	0 - 0.5	0911056-009	11/6/2009	34	--	--	--
	0.5 - 1.0	0911056-010	11/6/2009	13	--	--	--
	1.0 - 1.5	0911056-011	11/6/2009	15	--	--	--
NB-1-1-d	0 - 0.5	0911056-012	11/6/2009	41	--	--	--
	0.5 - 1.0	0911056-013	11/6/2009	48	--	--	--
	1.0 - 1.5	0911056-014	11/6/2009	22	--	--	--
NB-1-2	0 - 0.5	0911056-015	11/6/2009	69	<0.10	0.73	--
	0.5 - 1.0	0911056-016	11/6/2009	22	--	--	--
	1.0 - 1.5	0911056-017	11/6/2009	24	--	--	--
	1.5 - 3.0	0911056-018	11/6/2009	7.0	--	--	--
	4.5 - 5.0	0911056-019	11/6/2009	6.4	--	--	--
NB-2-1	0 - 0.5	0911053-007	11/5/2009	39	--	--	--
	0.5 - 1.0	0911053-008	11/5/2009	18	--	--	--
	1.0 - 1.5	0911053-009	11/5/2009	12	--	--	--
NB-3-1	0 - 0.5	0911053-010	11/5/2009	64	<0.10	2.0	--
	0.5 - 1.0	0911053-011	11/5/2009	16	--	--	--
	1.0 - 1.5	0911053-012	11/5/2009	14	--	--	--
NB-3-2	0 - 0.5	0911053-013	11/5/2009	71	<0.10	2.9	--
	0.5 - 1.0	0911053-014	11/5/2009	63	<0.10	2.2	<0.10
	1.0 - 1.5	0911053-015	11/5/2009	6.8	--	--	--
NB-4-1	0 - 0.5	0911053-001	11/5/2009	41	--	--	--
	0.5 - 1.0	0911053-002	11/5/2009	23	--	--	--
	1.0 - 1.5	0911053-003	11/5/2009	54	<0.10	1.4	--
NB-4-2	0 - 0.5	0911053-004	11/5/2009	82	<0.10	3.0	--
	0.5 - 1.0	0911053-005	11/5/2009	130	0.13	3.6	<0.10
	1.0 - 1.5	0911053-006	11/5/2009	64	<0.10	2.5	--
NB-5-1	0 - 0.5	0911051-013	11/5/2009	77	0.14	4.2	--
	0.5 - 1.0	0911051-014	11/5/2009	24	--	--	--
	1.0 - 1.5	0911051-015	11/5/2009	11	--	--	--
NB-5-2	0-0.5	0911051-016	11/5/2009	68	<0.10	1.2	--
	0.5-1.0	0911051-017	11/5/2009	29	--	--	--
	1.0-1.5	0911051-018	11/5/2009	13	--	--	--
NB-6-1	0 - 0.5	0911052-001	11/5/2009	81	<0.10	1.9	<0.10
	0.5 - 1.0	0911052-002	11/5/2009	11	--	--	--
	1.0 - 1.5	0911052-003	11/5/2009	19	--	--	--
NB-7-1	0 - 0.5	0911056-001	11/6/2009	60	<0.10	1.9	--
	0.5 - 1.0	0911056-002	11/6/2009	190	0.38	**7.3**	<0.10
	1.0 - 1.5	0911056-003	11/6/2009	200	0.26	**5.3**	<0.10

Table 3
Soil Results - Leachable Lead
US 101 / Old Redwood Highway Interchange Project

Boring Sample Location ID	Sample Depth (feet)	Lab Sample ID	Sample Date	Lead (Total)	Lead (DI-STLC)	Lead (STLC)	Lead (TCLP)
		EPA Method		6010B	6010B	6010B	6010B
		Units		mg/Kg	mg/L	mg/L	mg/L
		10 X STLC/20 X TCLP Limit[1]		50/100	--	--	--
		Hazardous Waste Limit[2]		--	--	5.0	5.0
		Reuse Restrictions[3]		1411/3397	1.5/150	--	--
NB-7-2	0 - 0.5	0911056-004	11/6/2009	52	<0.10	2.0	--
	0.5 - 1.0	0911056-005	11/6/2009	46	--	--	--
	1.0 - 1.5	0911056-006	11/6/2009	51	<0.10	1.7	--
	1.5-3.0	0911056-007	11/6/2009	6.4	--	--	--
	5.5-6.0	0911056-008	11/6/2009	6.4	--	--	--
NB-8-1	0 - 0.5	0911052-013	11/5/2009	530	**2.6**	**23**	0.45
	0.5 - 1.0	0911052-014	11/5/2009	800	**7.6**	**40**	0.90
NB-8-1	1.0 - 1.5	0911052-015	11/5/2009	120	0.53	3.8	<0.10
NB-8-2	0 - 0.5	0911052-016	11/5/2009	540	**2.8**	**21**	0.18
	0.5 - 1.0	0911052-017	11/5/2009	110	0.19	1.5	<0.10
NB-8-2	1.0 - 1.5	0911052-018	11/5/2009	27	--	--	--
NB-9-1	0 - 0.5	0911052-004	11/5/2009	59	<0.10	1.9	<0.10
	0.5 - 1.0	0911052-005	11/5/2009	19	--	--	--
	1.0 - 1.5	0911052-006	11/5/2009	10	--	--	--
NB-9-2	0 - 0.5	0911052-007	11/5/2009	43	--	--	--
	0.5 - 1.0	0911052-008	11/5/2009	27	--	--	--
	1.0 - 1.5	0911052-009	11/5/2009	7.6	--	--	--
NB-9-2-d	0 - 0.5	0911052-010	11/5/2009	26	--	--	--
	0.5 - 1.0	0911052-011	11/5/2009	6.9	--	--	--
	1.0 - 1.5	0911052-012	11/5/2009	20	--	--	--
NB-10-1	0-0.5	0911055-009	11/6/2009	91	<0.10	0.86	--
	0.5-1.0	0911055-010	11/6/2009	18	--	--	--
	1.0-1.5	0911055-011	11/6/2009	16	--	--	--
NB-10-2	0-0.5	0911055-012	11/6/2009	100	<0.10	3.0	<0.10
	0.5-1.0	0911055-013	11/6/2009	22	--	--	--
	1.0-1.5	0911055-014	11/6/2009	9.7	--	--	--
RWH-D-21	0-0.5	0608026-015	8/3/2006	73	<0.050	3.63	--
	0.5-1.0	0608026-016	8/3/2006	59	<0.050	1.43	--
RWH-D-22	0-0.5	0612044-030	8/3/2006	13	--	--	--
	0.5-1.0	0612044-029	8/3/2006	16	--	--	--
NB-11-1	0-0.5	0911055-001	11/6/2009	87	<0.10	**5.1**	<0.10
	0.5-1.0	0911055-002	11/6/2009	2.8	--	--	<0.10
	1.0-1.5	0911055-003	11/6/2009	2.8	--	--	--
	1.5-3.0	0911055-004	11/6/2009	4.4	--	--	--
	5.5-6.0	0911055-005	11/6/2009	7.7	--	--	--
NB-11-2	0-0.5	0911055-006	11/6/2009	140	<0.10	4.6	<0.10
	0.5-1.0	0911055-007	11/6/2009	8.2	--	--	--
	1.0-1.5	0911055-008	11/6/2009	14	--	--	--
SB-1-1	0-0.5	0911050-001	11/5/2009	70	<0.10	3.3	--
	0.5-1.0	0911050-002	11/5/2009	15	--	--	--
	1.0 - 1.5	0911050-003	11/5/2009	54	<0.10	1.2	--

Table 3
Soil Results - Leachable Lead
US 101 / Old Redwood Highway Interchange Project

Boring Sample Location ID	Sample Depth (feet)	Lab Sample ID	Sample Date	Lead (Total)	Lead (DI-STLC)	Lead (STLC)	Lead (TCLP)
		EPA Method		6010B	6010B	6010B	6010B
		Units		mg/Kg	mg/L	mg/L	mg/L
		10 X STLC/20 X TCLP Limit[1]		50/100	--	--	--
		Hazardous Waste Limit[2]		--	--	5.0	5.0
		Reuse Restrictions[3]		1411/3397	1.5/150	--	--
SB-1-2	0 - 0.5	0911050-004	11/5/2009	48	--	--	--
	0.5 - 1.0	0911050-005	11/5/2009	28	--	--	--
	1.0 - 1.5	0911050-006	11/5/2009	19	--	--	--
RWH-B-21	0-0.5	0608026-028	8/3/2006	45	--	--	--
	0.5-1.0	0608026-029	8/3/2006	110	0.12	2.6	*
	1.0-1.5	0612044-016	8/3/2006	28	--	--	--
	1.5-2.0	0612044-015	8/3/2006	7.4	--	--	--
	2.5-3.0	0608026-032	8/3/2006	7.7	--	--	--
RWH-B-22	0-0.5	0612044-021	8/3/2006	51	<0.1	1.08	--
	0.5-1.0	0612044-019	8/3/2006	9.6	--	--	--
	1.0-1.5	0608036-007 & 0612044-020	8/3/2006	9.6 & 13	--	--	--
	1.5-2.0	0612044-017	8/3/2006	15	--	--	--
	2.5-3.0	0612044-022	8/3/2006	9.1	--	--	--
	5.5-6.0	0612044-018	8/3/2006	31	--	--	--
SB-2-1	0-0.5	0911050-007	11/5/2009	33	--	--	--
	0.5-1.0	0911050-008	11/5/2009	30	--	--	--
	1.0-1.5	0911050-009	11/5/2009	23	--	--	--
SB-2-2	0-0.5	0911050-010	11/5/2009	26	--	--	--
	0.5-1.0	0911050-011	11/5/2009	15	--	--	--
SB-3-1	0-0.5	0911051-001	11/5/2009	120	<0.10	<0.10	<0.10
	0.5-1.0	0911051-002	11/5/2009	5.0	--	--	<0.10
	1.0-1.5	0911051-003	11/5/2009	6.0	--	--	<0.10
SB-3-2	0-0.5	0911051-004	11/5/2009	150	<0.10	1.7	<0.10
	0.5-1.0	0911051-005	11/5/2009	23	--	--	--
	1.0-1.5	0911051-006	11/5/2009	37	--	--	--
SB-4-1	0-0.5	0911051-007	11/5/2009	15	--	--	<0.10
	0.5-1.0	0911051-008	11/5/2009	11	--	--	--
	1.0-1.5	0911051-009	11/5/2009	6.8	--	--	--
SB-4-2	0-0.5	0911051-010	11/5/2009	15	--	--	<0.10
	0.5-1.0	0911051-011	11/5/2009	8.9	--	--	--
	1.0-1.5	0911051-012	11/5/2009	9.1	--	--	--
SB-6-1	0-0.5	0911050-012	11/5/2009	13	--	--	<0.10
	0.5-1.0	0911050-013	11/5/2009	7.0	--	--	<0.10
	1.0-1.5	0911050-014	11/5/2009	3.0	--	--	<0.10
SB-6-2	0 - 0.5	0911050-015	11/5/2009	19	--	--	<0.10
	0.5 - 1.0	0911050-016	11/5/2009	8.5	--	--	--
SB-6-2-d	0-0.5	0911050-017	11/5/2009	17	--	--	<0.10
	0.5-1.0	0911050-018	11/5/2009	20	--	--	--

Boring Sample Location ID	Sample Depth (feet)	Lab Sample ID	Sample Date	Lead (Total)	Lead (DI-STLC)	Lead (STLC)	Lead (TCLP)
		EPA Method		6010B	6010B	6010B	6010B
		Units		mg/Kg	mg/L	mg/L	mg/L
		10 X STLC/20 X TCLP Limit[1]		50/100	--	--	--
		Hazardous Waste Limit[2]		--	--	5.0	5.0
		Reuse Restrictions[3]		1411/3397	1.5/150	--	--
SB-7-1	0 - 0.5	0911054-001	11/6/2009	34	--	--	--
	0.5 - 1.0	0911054-002	11/6/2009	26	--	--	<0.10
	4.5 - 5.0	0911054-003	11/6/2009	20	--	--	<0.10
SB-7-2	0-0.5	0911054-004	11/5/2009	13			<0.10
	0.5-1.0	0911054-005	11/6/2009	140	0.39	**6.0**	<0.10
	1.0-1.5	0911054-006	11/6/2009	130	<0.10	4.8	<0.10
	2.5-3.0	0911054-007	11/6/2009	7.1	--	--	--
	5.5-6.0	0911054-008	11/6/2009	5.2	--	--	<0.10
	8.5-9.0	0911054-009	11/6/2009	5.0	--	--	--
RWH-A-21	0-0.5	0608026-009	8/3/2006	9.4	--	--	--
	0.5-1.0	0608026-011	8/3/2006	13	--	--	--
SB-8-1	0-0.5	0911054-015	11/6/2009	400	1.3	0.84	*
	0.5-1.0	0911054-016	11/6/2009	4.6	--	--	--
	1.0-1.5	0911054-017	11/6/2009	6.2	--	--	--
SB-8-2	0-0.5	0911054-010	11/6/2009	120	<0.10	1.8	*
	0.5-1.0	0911054-011	11/6/2009	42	--	--	--
	1.0-1.5	0911054-012	11/6/2009	6.9	--	--	--
	2.5-3.0	0911054-013	11/6/2009	5.8	--	--	--
	5.5-6.0	0911054-014	11/6/2009	5.8	--	--	--

Notes:

1: Samples with total lead concentrations exceeding these limits were tested using DI-STLC and STLC, and TCLP, methods, respectively.

2: Samples exceeding these concentrations would exceed California (STLC) or Federal (TCLP) Hazardous Waste Criteria

3: Samples exceeding these concentrations would fall into one of several reuse restrictions described in the Caltrans DTSC Variance V09HQSCD006. Note that these criteria only apply where soil represents a California Hazardous Waste (i.e. if soil has STLC Lead > 5.0)

YELLOW represents soil samples at which the soil group meets hazardous waste criteria, and therefore, where reuse restrictions appply.

Bold indicates value exceeds Criteria

EPA = US Environmental Protection Agency

mg/L = milligrams per liter

mg/Kg = milligrams per kilogram

STLC = Soluble Threshold Limits Concentrations

TCLP = Toxicity Characteristic Leaching Procedure

* = insuffecient sample volume to perform analysis

-- = sample not analyzed for specified analyte

The symbol "<" (less than) indicates that the analyte was not detected at a concentration above the laboratory detection limit specified.

EPA = US Environmental Protection Agency

NE* Due to insufficient sample mass available, no extraction was performed on requested sample.

Table 4
Soil Results - Other COPCs
US 101 / Old Redwood Highway Interchange Project

Boring Sample Location ID	Sample Depth (feet)	Lab Sample ID	Sample Date	TPH-g	TPH-d	TPH-mo
		EPA Method		8260B	8015B	8015B
		RWQCB ESLs for Construction Workers1		4200	4200	12000
		Units		ug/Kg	mg/Kg	mg/Kg
NB-4-1	0 - 0.5	0911053-001	11/5/2009	<100	<10	160
	0.5 - 1.0	0911053-002	11/5/2009	<100	<10	84
	1.0 - 1.5	0911053-003	11/5/2009	<100	<10	160
SB-7-2	0.5 - 1.0	0911054-006	11/6/2009	<100	<2.0	45
	1.0 - 1.5	0911054-007	11/6/2009	<100	<2.0	<4.0
	2.5 - 3.0	0911054-008	11/6/2009	<100	<2.0	<4.0
	5.5 - 6.0	0911054-009	11/6/2009	<100	<2.0	<4.0
SB-8-2	0 - 0.5	0911054-010	11/6/2009	<100	<2.0	6.7
	0.5 - 1.0	0911054-011	11/6/2009	<100	<2.0	35
	1.0 - 1.5	0911054-012	11/6/2009	<100	<2.0	7.5
	2.5 - 3.0	0911054-013	11/6/2009	<100	<2.0	<4.0
	5.5 - 6.0	0911054-014	11/6/2009	<100	<2.0	<4.0

Notes:

EPA = US Environmental Protection Agency

mg/Kg = milligrams per kilogram

ug/Kg = micrograms per kilogram

The symbol "<" (less than) indicates that the analyte was not detected at a concentration above the laboratory detection limit specified.

-- = Not sample

1 = RWQCB Direct Exposure Soil Screening Levels (ESLs) for Construction/Trench Workers, May 2008

Boring Sample Location ID	Lab Sample ID	Sample Date	Sample Depth	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
	EPA Method			6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	6010B	7471A	6010B	6010B	6010B	6010B	6010B	6010B	6010B
	Units		Ft BGS	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	STLC			15	5	100	0.75	1	5	80	25	5	0.2	350	20	1	5	7	24	250
	TCLP			NE	5	100	NE	1	5	NE	NE	5	0.2	NE	NE	1	5	NE	NE	NE
	ESL			0.006	0.036	1	0.00053	0.00025	0.05	0.003	0.0031	0.0025	0.000025	0.035	0.0082	0.05	0.00019	0.002	0.015	0.081
SB-5-1-GW	0911019-001	11/4/2009	15	<0.010	<0.010	0.061	<0.0050	<0.0050	<0.0050	0.010	<0.010	<0.015	<0.00020	0.021	0.035	<0.010	0.00150	0.010	0.028	0.0080
A-09-108	0911088-002	11/11/2009	10	<0.010	0.037	2.1	0.0050	<0.0050	<0.0050	0.099	0.096	<0.015	<0.00020	<0.0050	0.31	<0.010	<0.0050	<0.010	0.20	0.11
A-09-112	0911088-001	11/11/2009	17	<0.010	<0.037	1.1	0.0080	<0.0050	0.0080	0.28	0.11	<0.015	0.0013	<0.0050	0.37	<0.010	<0.0050	<0.010	0.21	0.19

Notes:
EPA = US Environmental Protection Agency
mg/L = milligrams per Liter
STLC = Soluble Threshold Limits Concentrations - for comparison to State hazardous waste thresholds.
TCLP = Toxicity Characteristic Leaching Procedure - for comparison to Federal hazardous waste thresholds.
ESL = SF Bay RWQCB, Table A-1: Environmental Screening Limits (ESLs) May 2008 for Groundwater where water is a potential drinking water source - for contractor use in determining Health & Safety requirements.
NE = Not Established
The symbol "<" (less than) indicates that the analyte was not detected at a concentration above the laboratory detection limit specified.

Boring Sample Location ID	Lab Sample ID	Sample Date	Sample Depth	TPH-g	TPH-d	TPH-mo	Benzene	Ethylbenzene	MTBE	Other VOCs	1,3,5 Trimethylbenzene	4-150 Propyltoluene	1,2,4-Trimethylbenzene	n-Propylbenzene
	EPA Method		8260B (TPH	8015B	8015B	8260B	8260B	8260B	8260B	8260B	8260B	8260B	8260B	8260B
	Units		Ft BGS	ug/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
SB-5-1-GW	0911019-001	11/4/2009	15	<61	0.146[1]	0.287[1]	<0.61	<0.61	14	ND[2]	<0.61	<0.61	<0.61	<0.61
A-09-108-GW	0911088-002	11/11/2009	10	500[1]	0.142[1]	<0.28	<0.58	<0.58	<0.58	ND[2]	4.3	0.92	28	2.3
A-09-112-GW	0911088-001	11/11/2009	17	<60	<0.17	<0.33	0.68	2.2	34	ND[2]	<0.60	<0.60	<0.60	<0.60

Notes:
EPA = US Environmental Protection Agency
mg/L = milligrams per liter
ug/L = micrograms per liter
NE = Not Established
-- = sample not analyzed for specified analyte
Bold indicates value exceeds 10 x STLC

[1] Sample chromatogram does not resemble typical diesel or motor oil pattern (discrete peaks present). Hydrocarbons and hydrocarbon peaks within the diesel range quantitated as diesel; hydrocarbon peaks within the motor oil range quantitated as motor oil.

[2] See analytical report for reporting limits.
The symbol "<" (less than) indicates that the analyte was not detected at a concentration above the laboratory detection limit specified.

Table 7
Summary Statistics and 95% UCL Results (Revised: 1/26/2010)
US101 / Old Redwood Highway Interchange Project

		Summary Statistics - Raw Data				Detected and Nondetect Values			Summary Statistics - Data Included Predicted Values from Regression			Goodness-of-Fit Test	Upper Confidence Limit (UCL)	
Parameter	Unit	No. of Samples	Detection Rate	Mean	Std Dev	Min Detected	Max Detected	Reporting Limit of NDs	No. of Samples	Mean	Std Dev	Distribution	Method of UCL Calculation	Assessed 95% UCL
Lead (STLC)	mg/L	34	97%	2.71	1.62	0.73	7.3	0.1	120	1.13	1.34	Lognormal	95% KM (BCA) UCL	**1.35**
Lead (Total)	mg/Kg	120	100%	41.0	52.5	2.8	400	-	120	41.0	52.5	Lognormal	95% H-UCL	**51.2**

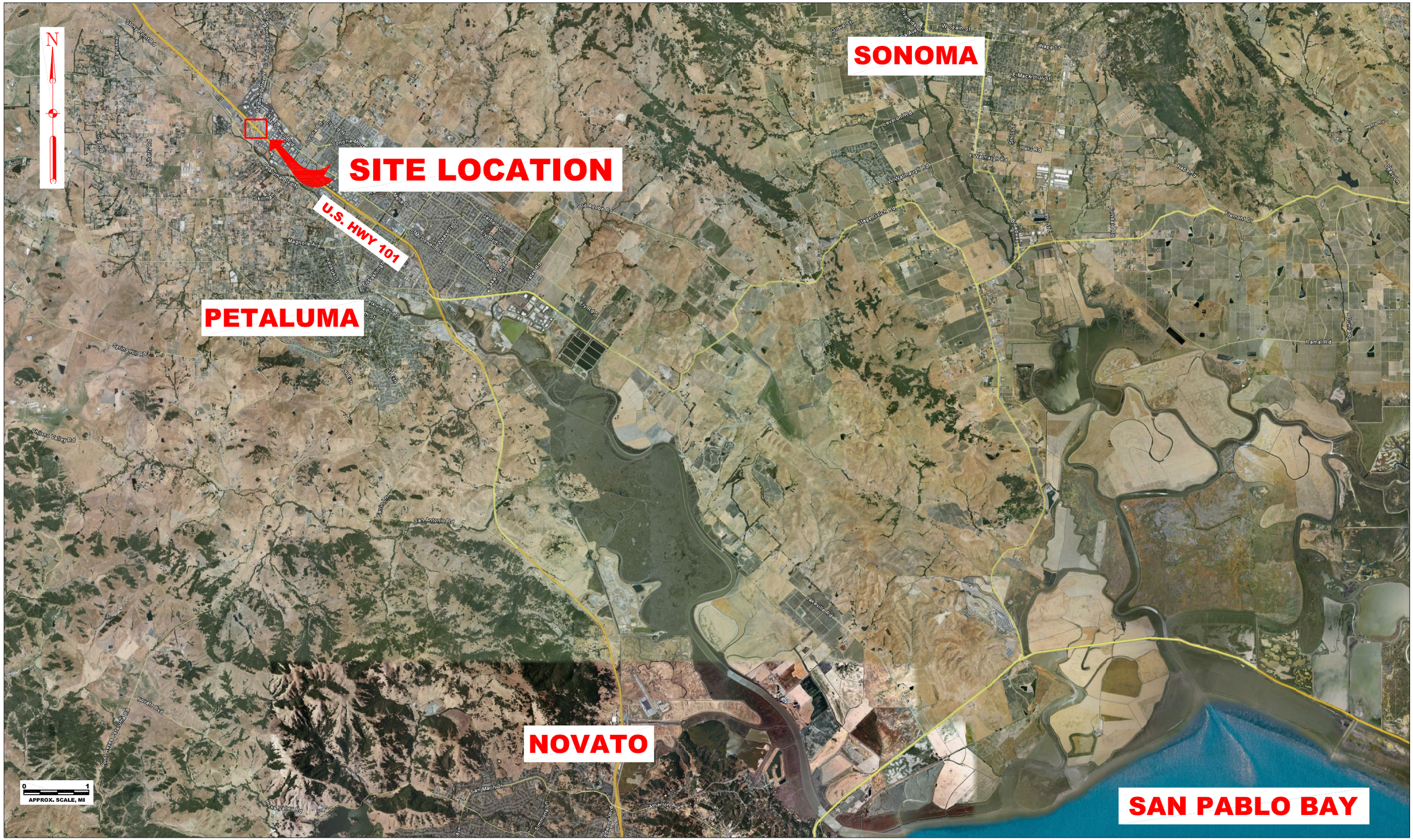
Notes:
(1) If duplicates exist, the average of the duplicate results is used as a single data point.
(2) All samples collected at various depths at the same location are considered independent data points.
(3) If the dataset contains nondetects, summary statistics and UCLs are estimated by the Kaplan-Meier (KM) method when possible.
(4) Goodness-of-Fit Test at 5% significance level is used to test for distributional assumption.
(5) The distributional assumption from (4) is used to select the appropriate UCL calculation method. For normal distribution, the UCL is based on the t-statistics. For lognormal distribution, gamma distribution, and non-parametric assumption, the UCL is based on the recommendations from USEPA (2002) and Singh (2007).
(6) References:
USEPA (2002) *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites.* Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Report No. OSWER 9285.6-10.
Singh, A., R. Maichle, A.K. Singh, and S.E. Lee. (2007) *ProUCL Version 4.0 User Guide.* Office of Research and Development, U.S. Environmental Protection Agency, Report No. EPA/600/R-07/038.
(7) The following locations are excluded:
NB-8-1 and NB-8-2, at depths 0-0.5 ft and 0.5-1.0 ft

FIGURES

HAZARDOUS MATERIALS SITE INVESTIGATION REPORT
U.S. 101/OLD REDWOOD HIGHWAY INTERCHANGE PROJECT
PETALUMA, CALIFORNIA

Figure 1 Location Map

Figure 2 Environmental Borings and Soil Reuse Summary



URS

U.S.101/OLD REDWOOD HIGHWAY INTERCHANGE PROJECT
HAZARDOUS MATERIALS SITE INVESTIGATION REPORT
PETALUMA, CALIFORNIA

LOCATION MAP

~3/4" = 1 Mile

Figure
1

02/04/10

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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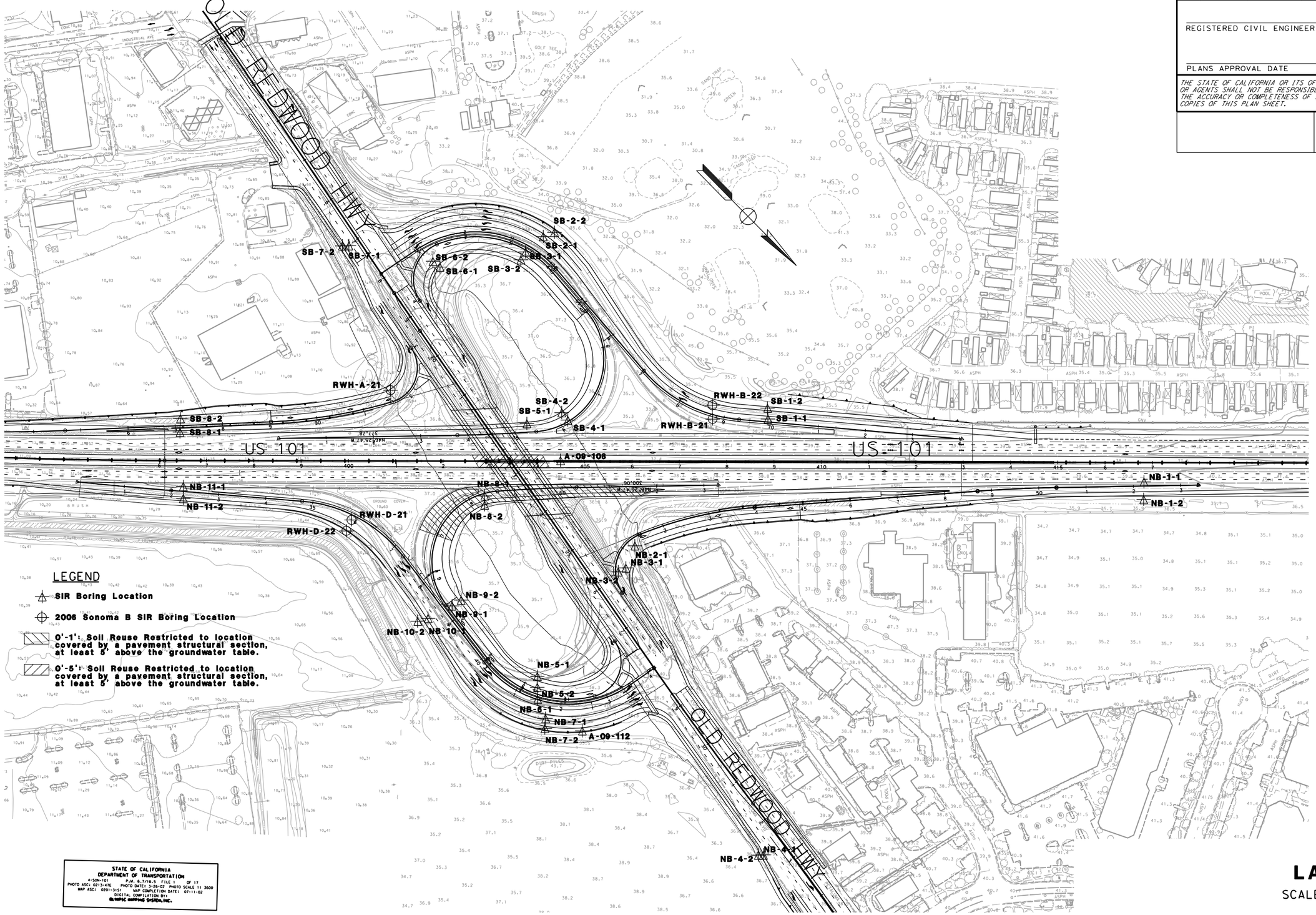
URS CORPORATION
55 South Market Street
Suite 1500
San Jose, CA 95113



LAYOUT

SCALE: 1" = 200'

FIGURE 2

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR

CALCULATED-DESIGNED BY .

CHECKED BY .

REVISED BY

DATE REVISED

LAST REVISION 00-00-00

DATE PLOTTED => $DATE
TIME PLOTTED => $TIME

APPENDIX A

HAZARDOUS MATERIALS SITE INVESTIGATION REPORT
U.S. 101/OLD REDWOOD HIGHWAY INTERCHANGE PROJECT
PETALUMA, CALIFORNIA

DTSC Statewide Variance V09HQSCD006

California Environmental Protection Agency
Department of Toxic Substances Control

VARIANCE

Applicant Names:

State of California
Department of Transportation
(Caltrans)
1120 N Street
Sacramento, California 95814

Variance No. V09HQSCD006

Effective Date: July 1, 2009

Expiration Date: July 1, 2014

Modification History:

Pursuant to California Health and Safety Code, Section 25143, the Department of Toxic Substances Control hereby issues the attached Variance consisting of 9 pages to the Department of Transportation.

Beverly Rikala
Team Leader, Operating Facilities Team
Department of Toxic Substances Control

Date:

1. INTRODUCTION.

a) Pursuant to Health and Safety Code, section 25143, the California Department of Toxic Substances Control (DTSC) grants this variance to the applicant below for waste considered to be hazardous solely because of its lead concentrations and as further specified herein.

b) DTSC hereby grants this variance only from the requirements specified herein and only in accordance with all terms and conditions specified herein.

2. IDENTIFYING INFORMATION.

APPLICANT/OWNER/OPERATOR

State of California
Department of Transportation, (Caltrans)
All Districts

3. TYPE OF VARIANCE.

Generation, Manifest, Transportation, Storage and Disposal.

4. ISSUANCE AND EXPIRATION DATES.

DATE ISSUED: July 1, 2009 EXPIRATION DATE: July 1, 2014

5. APPLICABLE STATUTES AND REGULATIONS. The hazardous waste that is the subject of this variance is fully regulated under Health and Safety Code, section 25100, et seq. and California Code of Regulations, title 22, division 4.5 except as specifically identified in Section 8 of this variance.

6. DEFINITION. For purposes of this variance, “lead-contaminated soil(s)” shall mean soil that meets the criteria for hazardous waste but contains less than 3397 mg/kg total lead and is hazardous primarily because of aerially-deposited lead contamination associated with exhaust emissions from the operation of motor vehicles.

7. FINDINGS/DETERMINATIONS. DTSC has determined that the variance applicant meets the requirements set forth in Health and Safety Code, section 25143 for a variance from specific regulatory requirements as outlined in Section 8 of this variance. The specific determinations and findings made by DTSC are as follows:

a) Caltrans intends to excavate, stockpile, transport, bury and cover large volumes of soil associated with highway construction projects. In the more urbanized highway corridors around the State this soil is contaminated with lead, primarily due to historic emissions from automobile exhausts. In situ sampling and laboratory testing has shown that some of the soil contains concentrations of lead in excess of State

regulatory thresholds, and thus any generated waste from disturbance of the soil would be regulated as hazardous waste. Such soil contains a Total Threshold Limit Concentration (TTLC) of 1000 milligrams per kilogram (mg/kg) or more lead and/or it meets or exceeds the Soluble Threshold Limit Concentration (STLC) for lead of 5 milligrams per liter (mg/l). A Human Health Risk Assessment prepared for this variance concludes that soil contaminated with elevated concentrations of lead can be managed in a way that presents no significant risk to human health.

b) The lead-contaminated soil will be placed only in Caltrans' right-of-way. Depending on concentration levels, the wastes will be covered with a minimum thickness of one (1) foot of non-hazardous soil or asphalt/concrete cover and will always be at least five (5) feet above the highest groundwater elevation. Caltrans will assure that proper health and safety procedures will be followed for workers, including any persons engaged in maintenance work in areas where the waste has been buried and covered.

c) DTSC finds and requires that the lead-contaminated soil excavated, stockpiled, transported, buried and covered pursuant to this variance is a non-RCRA hazardous waste, and that the waste management activity is insignificant as a potential hazard to human health and safety and the environment, when managed in accordance with the conditions, limitations and other requirements specified in this variance.

8. PROVISIONS WAIVED.

Provided Caltrans meets the terms and conditions of this variance, DTSC waives the hazardous waste management requirements of Health and Safety Code, Chapter 6.5 and California Code of Regulations, title 22 for the lead-contaminated soil that Caltrans reuses in projects that would require Caltrans to obtain a permit for a disposal facility and any other generator requirements that concern the transportation, manifesting, storage and land disposal of hazardous waste.

9. SPECIFIC CONDITIONS, LIMITATIONS AND OTHER REQUIREMENTS.

In order for the provisions discussed in section 8 to be waived, lead-contaminated soil must not exceed the contaminant concentrations discussed below and Caltrans management practices must meet all the following conditions:

a) Caltrans implementation of this variance shall comply with all applicable state laws and regulations for water quality control, water quality control plans, waste discharge requirements (including storm water permits), and others issued by the State Water Resources Control Board (SWRCB) and/or a California Regional Water Quality Control Board (RWQCB). Caltrans shall provide written notification to the appropriate RWQCB at least 30 days prior to advertisement for bids of projects that involve invocation of this variance, or as otherwise negotiated with the SWRCB or appropriate RWQCB.

b) The waivers in this variance shall only be applied to lead-contaminated soil that is

not a RCRA hazardous waste and is hazardous primarily because of aerially-deposited lead contamination associated with exhaust emissions from the operation of motor vehicles. The variance is not applicable to any other hazardous waste.

c) Soil containing 1.5 mg/l extractable lead or less (based on a modified waste extraction test using deionized water as the extractant) and 1411 mg/kg or less total lead may be used as fill provided that the lead-contaminated soil is placed a minimum of five (5) feet above the maximum historic water table elevation and covered with at least one (1) foot of nonhazardous soil that will be maintained by Caltrans to prevent future erosion.

d) Soil containing 150 mg/L extractable lead or less (based on a modified waste extraction test using deionized water as the extractant) and 3397 mg/kg or less total lead may be used as fill provided that the lead-contaminated soils are placed a minimum of five (5) feet above the maximum historic water table elevation and protected from infiltration by a pavement structure which will be maintained by Caltrans.

e) Lead-contaminated soil with a pH less than 5.5 but greater than 5.0 shall only be used as fill material under the paved portion of the roadway. Lead-contaminated soil with a pH at or less than 5.0 shall be managed as a hazardous waste.

f) For each project that has the potential to generate waste by disturbing lead-contaminated soil (as defined in 6), Caltrans shall conduct sampling and analysis to adequately characterize the soils containing aerially deposited lead in the areas of planned excavation along the project route. Such sampling and analysis shall include the Toxicity Characteristic Leaching Procedure (TCLP) as prescribed by the United States Environmental Protection Agency to determine whether concentrations of contaminants in soil exceed federal criteria for classification as a hazardous waste.

g) Lead-contaminated soil managed pursuant to this variance shall not be moved outside the designated corridor boundaries (see paragraph t) below. All lead-contaminated soil not buried and covered within the same Caltrans corridor where it originated is not eligible for management under this variance and shall be managed as a hazardous waste.

h) Lead-contaminated soil managed pursuant to this variance shall not be placed in areas where it would become in contact with groundwater or surface water (such as streams and rivers).

i) Lead-contaminated soil managed pursuant to this variance shall be buried and covered only in locations that are protected from erosion that may result from storm water run-on and run-off.

j) The lead-contaminated soil shall be buried and covered in a manner that will prevent accidental or deliberate breach of the asphalt, concrete, and/or cover soil.

k) The presence of lead-contaminated soil shall be incorporated into the projects' as-built drawings. The as-built drawings shall be annotated with the location, representative analytical data, and volume of lead-contaminated soil. The as-built drawings shall also state the depth of the cover. These as-built drawings shall be retained by Caltrans.

l) Caltrans shall ensure that no other hazardous wastes, other than the lead-contaminated hazardous waste soil, are placed in the burial areas.

m) Lead-contaminated soil shall not be buried within ten (10) feet of culverts or locations subject to frequent worker exposure.

n) Excavated lead-contaminated soil not placed into the designated area (fill area, roadbed area) by the end of the working day shall be stockpiled and covered with sheets of polyethylene or at least one foot of non-hazardous soil. The lead-contaminated soil, while stockpiled or under transport, shall be protected from contacting surface water and from being dislodged or transported by wind or storm water. The stockpile covers shall be inspected at least once a week and within 24 hours after rainstorms. If the lead-contaminated soil is stockpiled for more than 4 days from the time of excavation, Caltrans shall restrict public access to the stockpile by using barriers that meet the safety requirements of the construction zone. The lead-contaminated soil shall be stockpiled for no more than 90 days from the time the soil is first excavated. If the contaminated soil is stockpiled beyond the 90 day limit Caltrans shall:

1. notify DTSC in writing of the 90 day exceedance and expected date of removal;
2. perform weekly inspections of the stockpiled material to ensure that there is adequate protection from run-on, runoff, public access, and wind dispersion; and
3. notify DTSC on weekly basis of the stockpile status until the stockpile is removed.

The lead-contaminated soil shall be stockpiled for no more than 180 days from the time the soil is first excavated.

o) Caltrans shall ensure that all stockpiling of lead-contaminated soil remains within the project area of the specified corridor. Stockpiling of lead-contaminated soil within the specified corridor, but outside the project area, is prohibited.

p) Caltrans shall conduct confirmatory sampling of any stockpile area in areas not known or expected to contain lead-contaminated soil after removal of the lead-contaminated soil to ensure that contamination has not been left behind or has not migrated from the stockpiled material to the surrounding soils.

q) Caltrans shall stockpile lead-contaminated soil only on high ground (i.e. no sump

areas or low points) so that stockpiled soil will not come in contact with surface water run-on or run-off.

r) Caltrans shall not stockpile lead-contaminated soil in environmentally and ecologically sensitive areas.

s) Caltrans shall ensure that storm/rain run-off that has come into contact with stockpiled lead-contaminated soil will not flow to storm drains, inlets, or waters of the State.

t) Caltrans may dispose of the lead-contaminated soil only within the operating right-of-way of an existing highway, as defined in Streets and Highways Code, section 23. Caltrans may move lead-contaminated soil from one Caltrans project to another Caltrans project only if the lead-contaminated soil remains within the same designated corridor.

Caltrans shall record any movement of lead-contaminated soil by using a bill of lading. The bill of lading must contain: 1) the US DOT description including shipping name, hazard class and ID number; 2) handling codes; 3) quantity of material; 4) volume of material; 5) date of shipment; 6) origin and destination of shipment; and 7) any specific handling instructions. The bill of lading shall be referenced in and kept on file with the project's as-built drawings. The lead-contaminated soil must be kept covered during transportation.

u) For each specific corridor where this variance is to be implemented, all of the following information shall be submitted in writing to DTSC at least five (5) days before construction of any project begins:

1. plan drawing designating the boundaries of the corridor where lead-contaminated soils will be excavated, stockpiled, buried and covered;

2. a list of the Caltrans projects that the corridor encompasses;

3. a list of Caltrans contractors that will be conducting any phase of work on any project affected by this variance;

4. duration of corridor construction;

5. location where sampling and analytical data used to make lead concentration level determinations are kept (e.g. a particular Caltrans project file);

6. name and phone number (including area code) of project resident engineer and project manager;

7. location where Caltrans and contractor health and safety plan and records are kept;

8. location of project special provisions (including page or section number) for soil excavation, transportation, stockpile, burial and placement of cover material;

9. location of project drawings (including drawing page number) for soil excavation, burial and placement of cover in plan and cross section (for example, "The project plans are located at the resident engineer's office located at 5th and Main Streets, City of Fresno, See pages xxxxx of contract xxxx");

10. updated information if a Caltrans project within the corridor is added, changed or deleted; and

11. type of environmental document prepared for each project, date of adoption, document title, Clearing House number and where the document is available for review. A copy of the Caltrans Categorical Exemption, Categorical Exclusion Form, or if filed, the Notice of Exemption for any project shall be submitted to the DTSC Headquarters Project Manager.

v) Changes in location of lead-contaminated soil placement, quantities or protection measures (field changes) shall be noted in the resident engineer's project log within five (5) days of the field change.

w) Caltrans shall ensure that field changes are in compliance with the requirements of this variance.

x) Operational procedures described in the California Environmental Quality Act (CEQA) Special Initial Study shall be followed by Caltrans for activities conducted under this variance.

y) Caltrans shall implement appropriate health and safety procedures to protect its employees and the public, and to prevent or minimize exposure to potentially hazardous wastes. A project-specific health and safety plan must be prepared and implemented. The monitoring and exposure standards shall be based on construction standards for exposure to lead in California Code of Regulations, title 8, section 1532.1.

z) Caltrans shall provide a district Coordinator for this variance. This Coordinator will be the primary point of contact for information flowing to, or received from, DTSC regarding any matter or submission under this variance. Caltrans shall promptly notify DTSC of the name of Coordinator and any change in the Coordinator.

aa) Caltrans shall conduct regular inspections, consistent with Caltrans' Maintenance Division's current Pavement Inspection and Slope Inspection programs, of the locations where lead-contaminated soil has been buried and/or covered pursuant to this variance. If site inspection reveals deterioration of cover so

that conditions in the variance are not met, Caltrans shall repair or replace the cover.

bb) Caltrans shall develop and implement a record keeping mechanisms to record and retain permanent records of all locations where lead-contaminated soil has been buried per this variance. The records shall be made available to DTSC.

cc) If areas subject to the terms of this variance are sold, relinquished or abandoned (including roadways), all future property owners shall be notified in writing in advance by Caltrans of the requirements of this variance, and Caltrans shall provide the owner with a copy of the variance. A copy of such a notice shall be sent to DTSC and contain the corridor location and project. Caltrans shall also disclose to DTSC and the new owner the location of areas where lead-contaminated soil has been buried. Future property owners shall be subject to the same requirements as Caltrans.

dd) For the purposes of informing the public about instances where the variance is implemented, Caltrans shall:

1. maintain current fact sheets at all Caltrans resident engineer offices and the Caltrans District office. Caltrans shall make the fact sheets available to anyone expressing an interest in variance-related work.

2. maintain a binder(s) containing copies of all reports submitted to DTSC at the District office. Caltrans shall ensure that the binders are readily accessible to the public.

3. carry out the following actions when it identifies additional projects:

(A) notify the public via a display advertisement in a newspaper of general circulation in that area.

(B) update and distribute the fact sheet to the mailing list and repository locations.

ee) Lead-contaminated soil may be buried only in areas where access is limited or where lead-contaminated soil is covered and contained by a pavement structure.

ff) Dust containing lead-contaminated soil must be controlled. Water or dust palliative may be applied to control dust. If visible dust migration occurs, all excavation, stockpiling and truck loading and burying must be stopped. The granting of this variance confers no relief on Caltrans from compliance with the laws, regulations and requirements enforced by any local air district or the California Air Resources Board.

gg) Sampling and analysis is required to show the lead-contaminated soil meets the variance criteria. All sampling and analysis must be conducted in

accordance with the appropriate methods specified in U.S. EPA SW-846.

hh) DTSC retains the right to require Caltrans or any future owner to remove, and properly dispose of, lead-contaminated soil in the event DTSC determines it is necessary for protection of public health, safety or the environment.

ii) DTSC finds that some projects involving lead-contaminated soil are joint projects between Caltrans and other government entities. In these joint projects, Caltrans may not be the lead agency implementing the project although Caltrans is still involved if the project occurs on its right-of-way.

Caltrans may invoke this variance for joint projects where Caltrans and local government entity are involved provided that 1) the project is within the Caltrans Right-of-Way; 2) Caltrans reviews/ oversees all phases of the project including design, contracting, environmental assessment, construction, operation, and maintenance; and 3) Caltrans oversees the project to verify all variance conditions are complied with. Caltrans will be fully responsible for the variance notification and implementation in these joint projects.

jj) All correspondence shall be directed to the following office:

Hazardous Waste Permitting
Department of Toxic Substances Control
8800 Cal Center Drive
Sacramento, CA 95826

Attn: Caltrans Lead Variance Notification Unit

10. DISCLAIMER.

a) The issuance of this variance does not relieve Caltrans of the responsibility for compliance with Health and Safety Code, chapter 6.5, or the regulations adopted thereunder, and any other laws and regulations other than those specifically identified in Section 8 of this variance. Caltrans is subject to all terms and conditions herein. The granting of this variance confers no relief from compliance with any federal, State or local requirements other than those specifically provided herein.

b) The issuance of this variance does not release Caltrans from any liability associated with the handling of hazardous waste, except as specifically provided herein and subject to all terms and conditions of this variance.

11. VARIANCE MODIFICATION OR REVOCATION. This variance is subject to review at the discretion of DTSC and may be modified or revoked by DTSC upon change of ownership and at any other time pursuant to Health and Safety Code, section 25143.

12. CEQA DETERMINATION. DTSC adopted a Negative Declaration on June 30, 2009.

Approved:

_____	_____
Date	Beverly Rikala Operating Facilities Team Department of Toxic Substances Control

APPENDIX B

HAZARDOUS MATERIALS SITE INVESTIGATION REPORT
U.S. 101/OLD REDWOOD HIGHWAY INTERCHANGE PROJECT
PETALUMA, CALIFORNIA

Sampling Table and Figure, Hazardous Materials Investigation Workplan (January 8, 2010)

Table 1
Draft Sampling Plan
Hazardous Material Site Investigation
US 101/Old Redwood Highway Project
Petaluma, California

Boring Location	Sample Collection System*	Sample Depth (ft)	Analysis	Groundwater	Comments
NB-1-1	Hand or Geoprobe	0.5 1 1.5	CAM17 Metals CAM17 Metals CAM17 Metals	No	
NB-1-1-d	Hand or Geoprobe	0.5 1 1.5	CAM17 Metals CAM17 Metals CAM17 Metals	No	Duplicate Boring
NB-1-2	Geoprobe	0.5 1 1.5 3 6	Lead Lead Lead Lead Lead	No	Associated with Retaining Wall
NB-2-1	Hand or Geoprobe	0.5 1 1.5	Lead Lead Lead	No	
NB-3-1	Hand or Geoprobe	0.5 1 1.5	Lead Lead Lead	No	
NB-3-2	Hand or Geoprobe	0.5 1 1.5	Lead Lead Lead	No	
NB-4-1	Hand or Geoprobe	0.5 1 1.5	Lead, TPH-d/mo, and TPH-g Lead, TPH-d/mo, and TPH-g Lead, TPH-d/mo, and TPH-g	No	Located in the vicinity of Valero and 7-Eleven gas stations.
NB-4-2	Geoprobe	0.5 1 1.5	Lead CAM 17 Metals Lead	No	Associated with Retaining Wall
NB-5-1	Hand or Geoprobe	0.5 1 1.5	Lead Lead Lead	No	
NB-5-2	Hand or Geoprobe	0.5 1 1.5	Lead Lead Lead	No	
NB-6-1	Hand or Geoprobe	0.5 1 1.5	Lead CAM 17 Metals Lead	No	
NB-7-1	Hand or Geoprobe	0.5 1 1.5	Lead Lead Lead	No	
NB-7-2	Geoprobe	0.5 1 1.5 3 6	Lead CAM 17 Metals Lead Lead Lead	No	Associated with Retaining Wall
NB-8-1	Hand or Geoprobe	0.5 1 1.5	Lead Lead Lead	No	
NB-8-2	Hand or Geoprobe	0.5 1 1.5	Lead Lead CAM 17 Metals	No	

Table 1
Draft Sampling Plan
Hazardous Material Site Investigation
US 101/Old Redwood Highway Project
Petaluma, California

Boring Location	Sample Collection System*	Sample Depth (ft)	Analysis	Groundwater	Comments
NB-9-1	Hand or Geoprobe	0.5 1 1.5	Lead CAM 17 Metals Lead	No	
NB-9-2	Hand or Geoprobe	0.5 1 1.5	Lead Lead Lead	No	
NB-9-2-d	Hand or Geoprobe	0.5 1 1.5	Lead Lead Lead	No	Duplicate Boring
NB-10-1	Hand or Geoprobe	0.5 1 1.5	CAM 17 Metals Lead Lead	No	
NB-10-2	Hand or Geoprobe	0.5 1 1.5	Lead Lead Lead	No	
NB-11-1	Hand or Geoprobe	0.5 1 1.5	Lead Lead Lead	No	
NB-11-2	Geoprobe	0.5 1 1.5 3 6	Lead CAM 17 Metals Lead Lead Lead	No	Associated with Retaining Wall
A-09-112	Hollow-Stem Auger	First water bearing zone	None	Yes: TPH-d/mo, TPH-g, BTEX, VOCs, and Cam 17 Metals	Associated with nearby gas station.
SB-1-1	Hand or Geoprobe	0.5 1 1.5	CAM 17 Metals Lead Lead	No	
SB-1-2	Hand or Geoprobe	0.5 1 1.5	Lead Lead Lead	No	
SB-2-1	Hand or Geoprobe	0.5 1 1.5	Lead Lead CAM 17 Metals	No	
SB-2-2	Hand or Geoprobe	0.5 1	Lead Lead	No	Located at the bottom of a slope. Shallower sampling recommended.
SB-3-1	Hand or Geoprobe	0.5 1 1.5	Lead Lead Lead	No	
SB-3-2	Hand or Geoprobe	0.5 1 1.5	Lead Lead Lead	No	
SB-4-1	Hand or Geoprobe	0.5 1 1.5	Lead Lead CAM 17 Metals	No	
SB-4-2	Hand or Geoprobe	0.5 1 1.5	Lead Lead Lead	No	
SB-5-1	CPT	First water bearing zone	None	Yes: TPH-d/mo, TPH-g, BTEX, VOCs, and Cam 17 Metals	Associated with Bridge Construction
SB-6-1	Geoprobe	0.5 1 1.5	Lead CAM 17 Metals Lead	No	

Table 1
Draft Sampling Plan
Hazardous Material Site Investigation
US 101/Old Redwood Highway Project
Petaluma, California

Boring Location	Sample Collection System*	Sample Depth (ft)	Analysis	Groundwater	Comments
SB-6-2	Hand or Geoprobe	0.5 1	Lead Lead	No	Located at the bottom of a slope. Shallower sampling recommended.
SB-6-2-d	Hand or Geoprobe	0.5 1	Lead Lead	No	Duplicate Boring
SB-7-1	Hand or Geoprobe	0.5 1 1.5	Lead Lead Lead	No	
SB-7-2	Geoprobe	0.5 1 1.5 3 6 9	Lead, TPH-d/mo, and TPH-g Cam 17 Metals, VOCs, TPH-d/mo, and TPH-g Lead, TPH-d/mo, and TPH-g Lead, TPH-d/mo, and TPH-g TPH-g, and CAM 17 Metals TPH-g, and CAM 17 Metals	No	Associated with Retaining Wall, and near Gas Stations
SB-8-1	Hand or Geoprobe	0.5 1 1.5	CAM 17 Metals CAM 17 Metals CAM 17 Metals	No	
SB-8-2	Geoprobe	0.5 1 1.5 3 6	Lead, TPH-d/mo, and TPH-g TPH-d/mo, TPH-g, and CAM 17 Metals Lead, TPH-d/mo, and TPH-g Lead, TPH-d/mo, and TPH-g TPH-d/mo, TPH-g, and CAM 17 Metals	No	Located in the vicinity of unpaved parking lot. Associated with Retaining Wall
A-09-108	Hollow-Stem Auger	First water bearing zone	None	Yes: TPH-d/mo, TPH-g, BTEX, VOCs, and Cam 17 Metals	Associated with nearby gas station.

Note:
* Drilling system may vary base on field condition.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

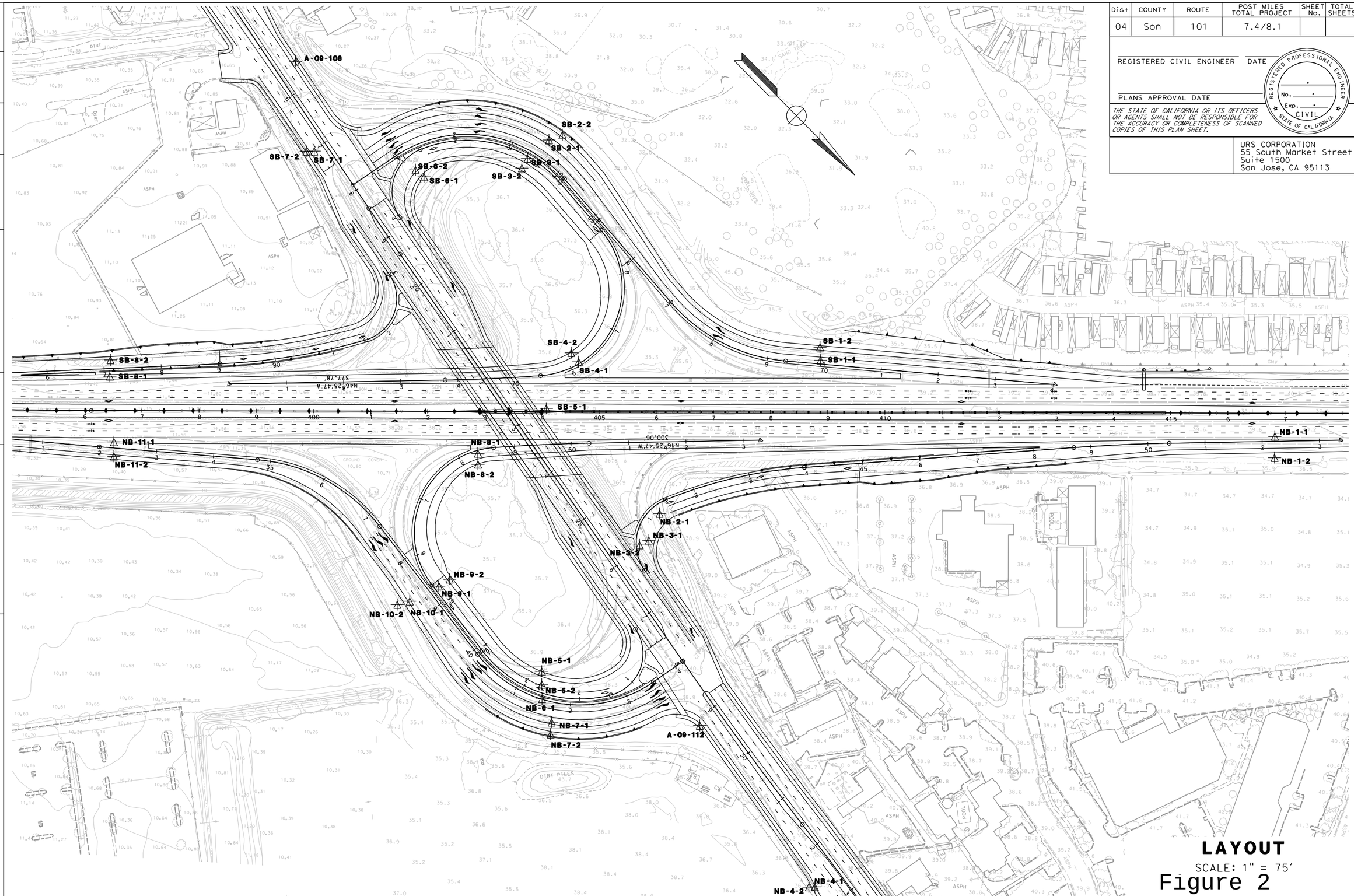
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. 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
55 South Market Street
Suite 1500
San Jose, CA 95113



LAYOUT

SCALE: 1" = 75'

Figure 2

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR

CALCULATED-DESIGNED BY

CHECKED BY

REVISED BY

DATE REVISED

LAST REVISION 00-00-00

DATE PLOTTED => 12/1/2009
TIME PLOTTED => 11:29:48 AM

BORDER LAST REVISED 4/11/2008

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

USERNAME => andrew_cheung
DGN FILE => ...\bor_location\ENV_BORING.dgn

CU 00000

EA 264081

APPENDIX C

HAZARDOUS MATERIALS SITE INVESTIGATION REPORT
U.S. 101/OLD REDWOOD HIGHWAY INTERCHANGE PROJECT
PETALUMA, CALIFORNIA

Encroachment Permit

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION

ENCROACHMENT PERMIT

TR-0120

Permit No.	0409-NSV0854
Dist/Co/Rte/PM	04-Son-101 7.3/8.1
Date	June 23, 2009
Fee Paid	$
Deposit	$
Performance Bond Amount (1)	
Payment Bond Amount (2)	
Bond Company	
Bond Number (1)	
Bond Number (2)	

In compliance with (*Check one*):

☒ Your application of May 27, 2009

☐ Utility Notice No. _____ of _____

☐ Agreement No. _____ of _____

☐ R/W Contract No. _____ of _____

TO: City of Petaluma Public Works
11 English Street
Petaluma, CA 94952

Attn: Mr. Vincent Marengo
Phone: (707) 778-4478

, **PERMITTEE**

and subject to the following, **PERMISSION IS HEREBY GRANTED** to:

Perform field investigations for PA&ED and PS&E phases of project including site review, environmental studies, field surveys, geotechnical investigation and exploration, hazardous material investigation and exploration, utility potholing and traffic studies on State Highway 04-Son-101, Post Miles 7.3/8.1, in the City of Petaluma, in Sonoma County.

A minimum of one week prior to start of work under this permit, notice shall be given and advance approval of construction detail, operations, public safety and traffic control shall be obtained from State Representative Bahram Iranpour, (707) 762-5540, 611 Payran Street, Petaluma, CA, 94952, weekdays between the hours of 7:30 AM and 4:15 PM, holidays excluded.

All permitted work requires the permittee to apply for and obtain a work authorization number prior to start of work. See the attached "Encroachment Permit Work Scheduling Procedures" and the attached "Encroachment Permit Work Scheduling Request Form". Additional time beyond the minimum seven-day advance notice required in the above paragraph may be required for obtaining the traffic control approval.

Immediately following completion of the work permitted herein, the permittee shall fill out and mail the Notice of Completion attached to this permit.

The following attachments are also included as part of this permit (*Check applicable*):

☒ Yes	☐ No	General Provisions
☐ Yes	☒ No	Utility Maintenance Provisions
☐ Yes	☒ No	Special Provisions
☐ Yes	☒ No	A Cal-OSHA permit required prior to beginning work: # _____

In addition to fee, the permittee will be billed actual costs for:

☐ Yes	☒ No	Review
☒ Yes	☐ No	Inspection
☒ Yes	☐ No	Field Work

(If any Caltrans effort expended)

☐ Yes ☒ No The information in the environmental documentation has been reviewed and considered prior to approval of this permit.

This permit is void unless the work is completed before December 31, 2010.

This permit is to be strictly construed and no other work other than specifically mentioned is hereby authorized.
No project work shall be commenced until all other necessary permits and environmental clearances have been obtained.

DAC
cc: DRivers(2), BIranpour
DTM-PChan
TMC-JRichardson
County of Sonoma

APPROVED:

BIJAN SARTIPI, District Director

BY:

MICHAEL D. CONDIE, District Permit Engineer

When approved, traffic control performed under this permit shall be in accordance with the appropriate State Standard Plan Sheets T-10 through T-14. Where required by the plan, the use of a flashing arrow-board is MANDATORY.

For shoulder closure, see attached State Standard Plan Sheet T-10. For lane and ramp closures, see attached State Standard Plan Sheets T-11 and T-14. Parking may be restricted, as needed. Work is permitted from 9:00 AM to 3:00 PM, Monday through Friday, holidays excepted.

When operations are conducted, permittee shall furnish, place and maintain signs and safety equipment in accordance with "Part 6 of the MUTCD and of the MUTCD California Supplement", which can be located at **http://www.dot.ca.gov/hq/traffops/signtech/mutcdsupp/pdf/MUTCD2003CASupp.pdf**

If an accident or other incident (related to or not related to the permitted activity) occurs within, or close to the permitted activity, the permittee shall immediately stop work and remove traffic controls from the highway unless public health, welfare and safety is endangered by unfinished work. Only traffic control to protect open excavations may remain in place. After free traffic flow is restored, work in accordance with the conditions of the permit may be returned.

Permittee shall provide suitable measures, as approved by State's representative, to warn, protect and assure safe passage of pedestrians while work is in progress. The site of the work shall be enclosed by suitable barricades, signs and lights, as approved by State's representative, to warn and protect traffic effectively.

The permittee shall ensure that all drilling fluids and earthly material are disposed of in a manner acceptable to the appropriate local, state, or federal regulatory agencies. Excess drilling material shall be tested for contamination and disposed of in accordance with local, state, and federal requirements.

Excavations made within the limits of the highway shall be backfilled before leaving the work for the night unless otherwise authorized by State's representative. After backfilling the trench, temporary surfacing shall be placed if required by State's representative. Excavating holes in paved surfacing is prohibited. No excavation shall be left open overnight without written permission from the Caltrans representative or unless otherwise specified herein.

Cement slurry backfill complying with Section 19-3.062 of the current Caltrans Standard Specifications may be used under all paved surfaces.

Any excavation within 3.1 meters (10 ft.) of the traveled way shall be protected by Type K barrier railing placed at a 10:1 taper or as otherwise directed by the State Representative. Any Type K barrier railing placed within 3.1 meters (10 ft.) of the traveled way shall have one appropriate reflective marker affixed to the top of each section. A Type "P" object marker shall be installed in front of the approach end section.

No tree roots two inches or more in diameter shall be cut. Material shall be removed from around root system so as to avoid damage thereto. Roots shall be protected with burlap wrapping while exposed.

SURVEY WORK IS PROHIBITED ON FREEWAYS. All survey operations shall be conducted off the traveled way except where necessary to cross pavements and medians. Survey vehicles may be parked in State highway right of way off paved shoulders. Auxiliary support and employee vehicles shall remain outside the State right of way.

All permittee's personnel shall wear appropriate personal protective equipment, including hard hats and bright-colored vests, shirts or jackets with retro-reflective material while on State highway right of way.

Any change or damage to any existing facilities, landscaping, irrigation or drainage pattern, whether occasioned by increase or diversion, and the cost of any damage, repairs or restoration within the State's right of way shall be the responsibility of the permittee.

The contractor for the permittee shall apply for a duplicate Encroachment Permit for the work authorized therein, and the application shall be accompanied by a $574.00 check to cover the permit processing fee.

Changes to the Plans, Specifications, and Permit Provisions are not allowed without prior approval from the State Representative.

APPENDIX D

HAZARDOUS MATERIALS SITE INVESTIGATION REPORT
U.S. 101/OLD REDWOOD HIGHWAY INTERCHANGE PROJECT
PETALUMA, CALIFORNIA

Sonoma County Department of Environmental Health Permit

COUNTY OF SONOMA — DEPARTMENT OF HEALTH SERVICES
ENVIRONMENTAL HEALTH DIVISION
475 Aviation Blvd., Suite 220, Santa Rosa, CA 95403
Phone (707) 565-6565 Fax (707) 565-6525 www.sonoma-county.org

APPLICATION FOR DRILLING PERMIT
for Regional Board Lead/Environmental Assessment / LOP Lead

For Office Use Only
Amount paid $525
Receipt number 0448
Payment date 11-3-09 Rev. code 1348
Site ID# —
Permit # 09RC0051SS

Well type: [ ] Monitoring well [ ] Recovery extraction well [ ] Boring [ ] Injection well [ ] Destruct [x] Environmental assessment
[ ] Soil gas survey [ ] Direct push [ ] Air sparging/venting [ ] Remediation well [ ] Other

Well depth ____ Boring depth ____

On-site well/boring 38 Borings ID# See Work Plan # Off-site well/boring ____ ID # ____

Submit legal right-of-entry/off-site well address/encroachment permit

On-site Address U.S. Highway 101/Old Redwood Highway AP# ____

Facility Name U.S. Highway 101/Old Redwood Highway

On-site Owner Caltrans Phone 510 - 286 - 4923
Street 111 Grand Ave City Oakland State CA Zip 94623

Responsible Party Ramsey Hissen, URS Phone 408 - 297 - 9585
Street 55 South Market St., #1500 City San Jose State CA Zip 95113

Consultant URS Patrick Walz & Susie Vedantham Phone 408-297-9585
Street 55 South Market St., #1500 City San Jose State CA Zip 95113
License #/Type Environmental Consultants

Drilling Contractor Environmental Control Associates (ECA) Phone 831-662-8178
Street 3011 Twin Palms Drive City Aptos State CA Zip 95003
C-57 License # 695970

Type of work: [ ] Initial investigation ____ # Wells [ ] Subsequent investigation ____ # Wells [ ] Destruct ____ # Wells

Groundwater investigation due to: [ ] Underground tank [ ] Surface impoundment [ ] Environmental assessment
[ ] Surface disposal practice—specify involved industry
[ ] Other

Perforated intervals N/A Chemical constituents ____

Disposal method for soil cuttings Store in drums on-site Disposal method for development water None

Drilling method 2" Direct push Method of drill equip. rinsate containment ____

If destroying a well, abandonment method ~~N/A~~ Borings will be backfilled by tremie grouting with a cement bentonite grout.

Submit plot plan of wells in relation to all sewer or septic lines.

Is well to be constructed within: 100 feet of a septic tank or leachfield? [ ] Yes [ ] No N/A
50 feet of any sanitary sewer line? [ ] Yes [ ] No
25 feet of any private sanitary sewer line? [ ] Yes [ ] No

In addition, all monitoring wells must include ***identification system*** affixed to interior surface:
1) Well identification 2) Well type 3) Well depth 4) Well casing diameter 5) Perforated intervals

Well identification number and well type shall be ***affixed*** to the ***exterior surface*** security structure.

COPY

For Office Use Only

Address 7 Highway 121

Site ID# —

Permit # SR0005785

I hereby agree to comply with all laws and regulations of the County of Sonoma and State of California pertaining to water well construction. I will telephone (707) 565-6565, 48 hours in advance, to notify the Environmental Health Specialist when completing or destroying a well. I will furnish the Director of Health Services and the owner a legible copy of the State Water Well Driller's Report within 15 days; and a copy of the Summary Report, including sample results, should be received by this Department within 90 days in order to obtain final approval on this well permit. I acknowledge that the application will become a permit ***only*** after site approval and payment of fee. I understand that this permit is not transferable and expires one year from date of issuance.

For ECA

Signature of Well Driller—***no proxies*** Date 10/27/09

Insurance Carrier The Hartford # W4RC4570158A Expiration Date 8/1/2010

Once all wells/borings are installed, submit a Well Driller's Log and/or Summary Report to complete permit process.

Indicate on attached plot plan the exact location of well(s) with respect to the following items: property lines, water bodies or water courses drainage pattern, roads, existing wells, sewer main and laterals and private sewage disposal systems or other sources of contamination or pollution. INCLUDE DIMENSIONS. The validity of this permit depends upon the accuracy of the information provided by the applicant.

Conditions of permit:

Borings shall be back filled by tremie grout with a cement-bentonite grout.

FOR OFFICE USE ONLY – ENVIRONMENTAL HEALTH DIVISION

Permit approved by Lesley Kwartz ENTERED MSM Date 11/3/09

Constr. approved by _____ Observed? [ ] Yes [ ] No Well # _____ Date ___/___/___

RWQCB / LOP approval _____ Date ___/___/___

drilling permit.doc (Revised August 2006)

Copies: White—File Yellow—Driller Pink—Consultant Gold—Owner/Resp. Party

APPENDIX E

HAZARDOUS MATERIALS SITE INVESTIGATION REPORT
U.S. 101/OLD REDWOOD HIGHWAY INTERCHANGE PROJECT
PETALUMA, CALIFORNIA

Boring Logs and CPT Logs (Not Included in this Draft Submittal)

GREGG

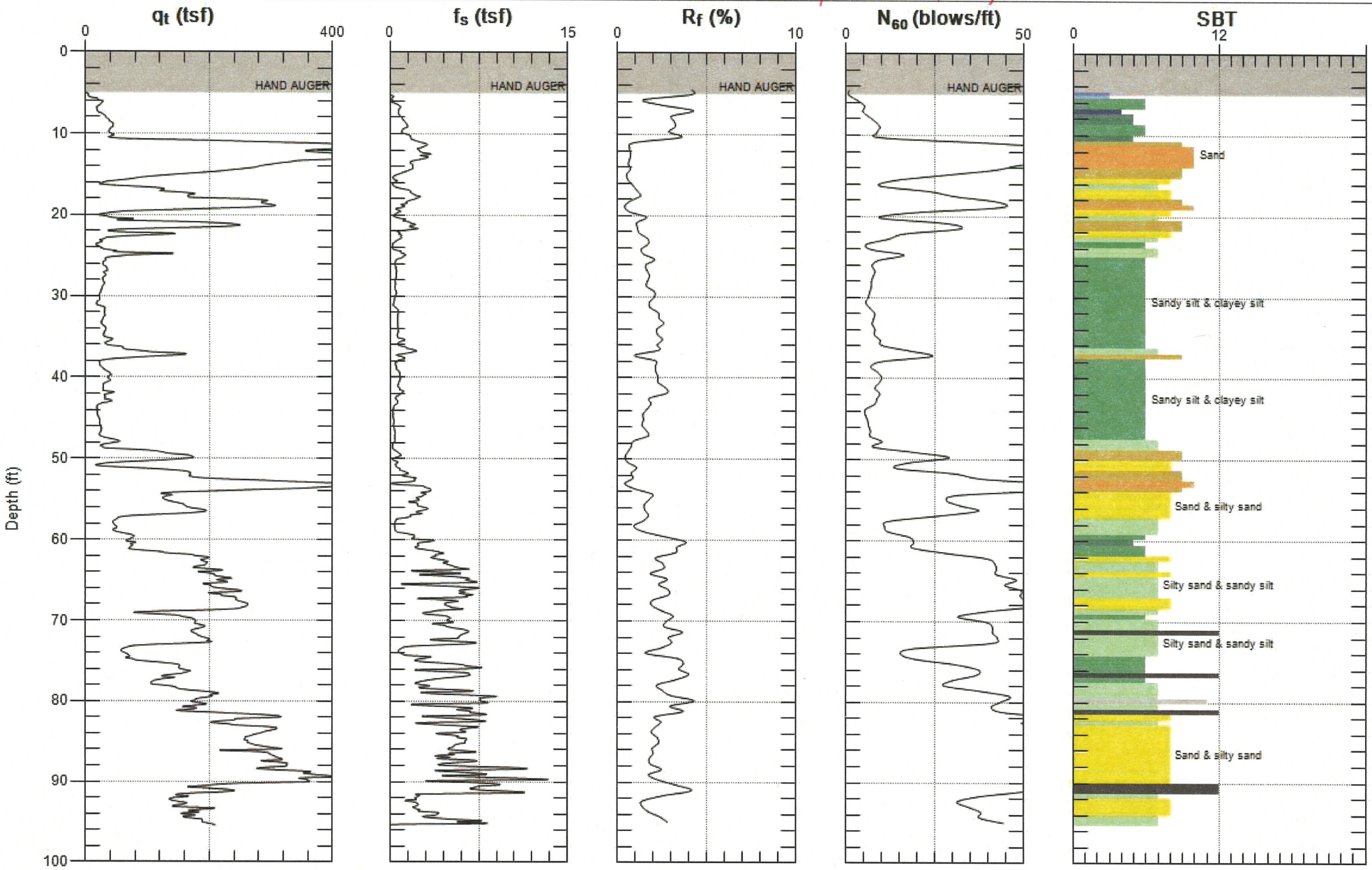
URS

Site: OLD REDWOOD HWY

Engineer: C.RAMBO

Sounding: Cpt-09-003 (Sample ID A-09-108)

Date: 11/3/2009 10:59



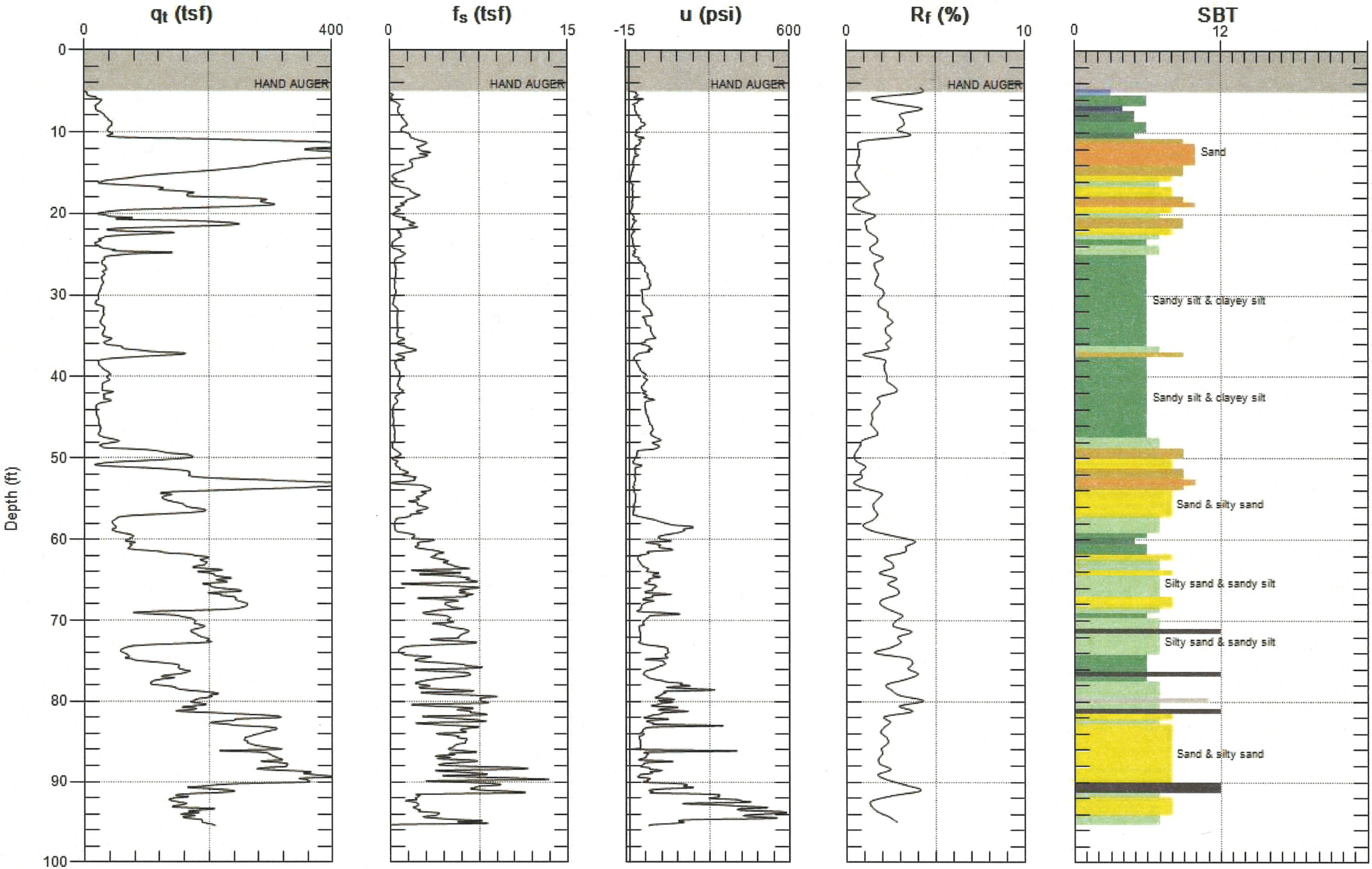
Max. Depth: 95.472 (ft)
Avg. Interval: 0.656 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG URS

Site: OLD REDWOOD HWY
Sounding: Cpt-09-003

Engineer: C.RAMBO
Date: 11/3/2009 10:59



Max. Depth: 95.472 (ft)
Avg. Interval: 0.656 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG

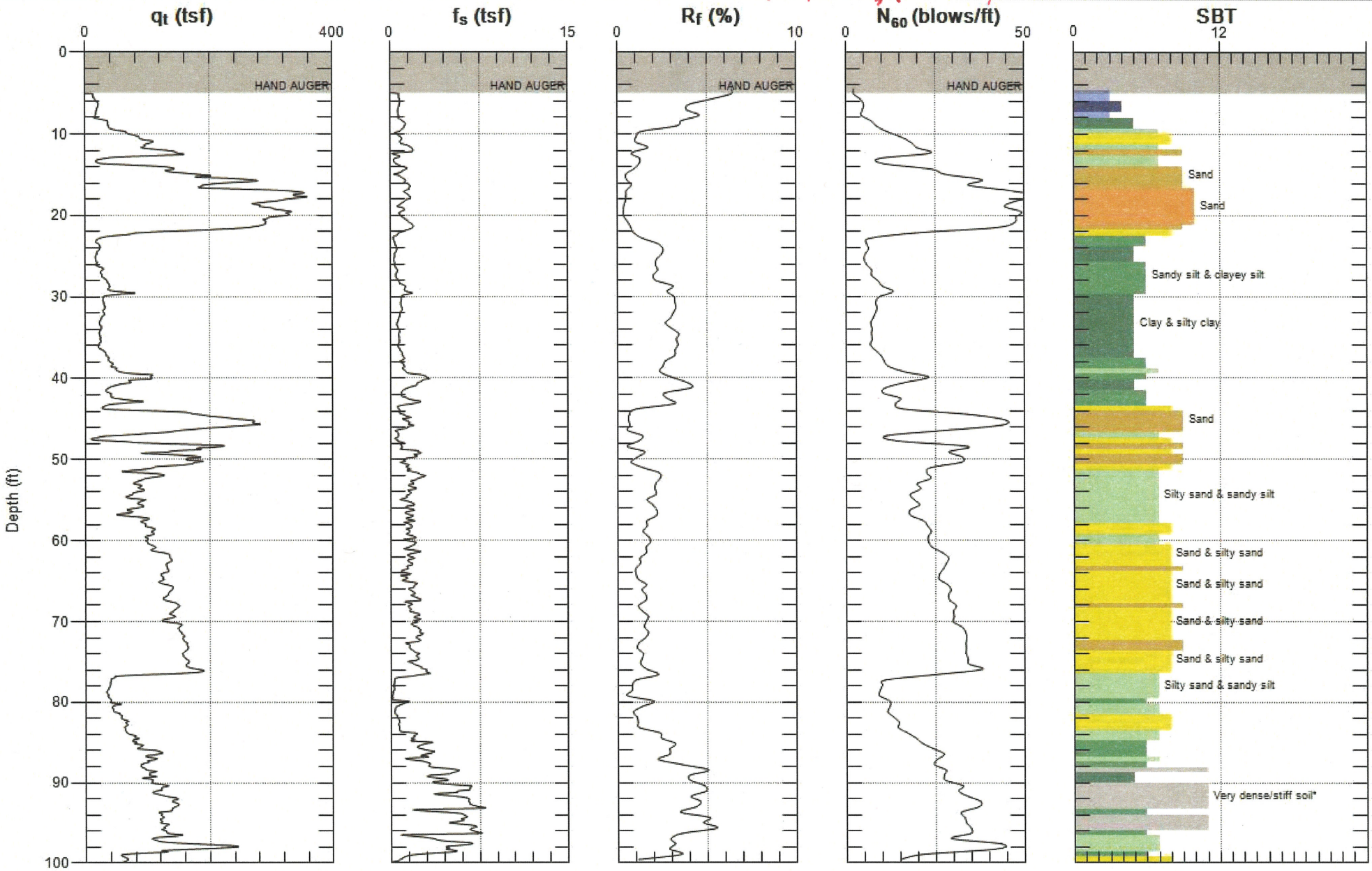
URS

Site: OLD REDWOOD HWY

Sounding: Cpt-09-114 (Sample ID CPT-09-112)

Engineer: C.RAMBO

Date: 11/3/2009 05:25



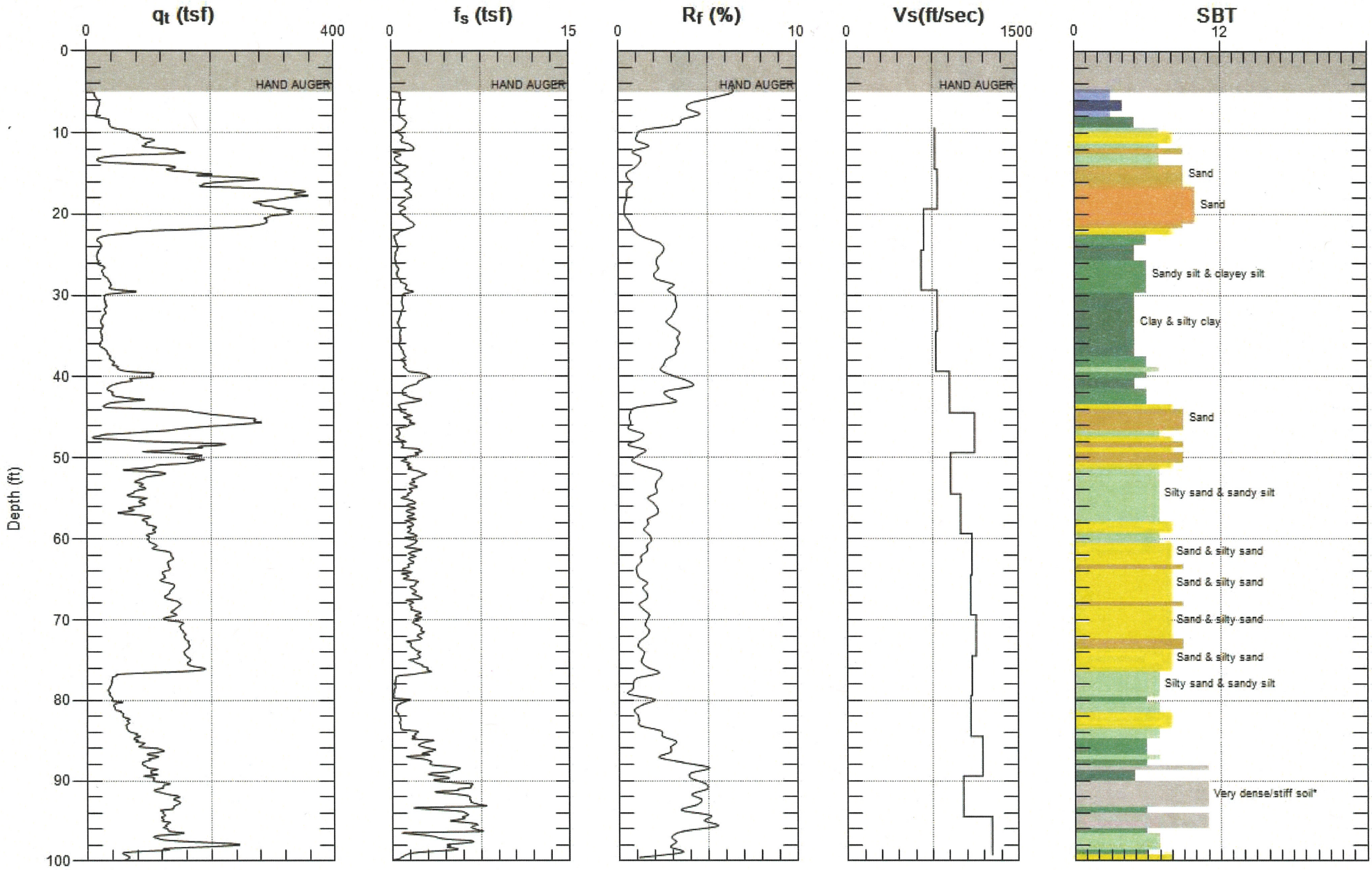
Max. Depth: 100.066 (ft)
Avg. Interval: 0.656 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG URS

Site: OLD REDWOOD HWY
Sounding: Cpt-09-114

Engineer: C.RAMBO
Date: 11/3/2009 05:25



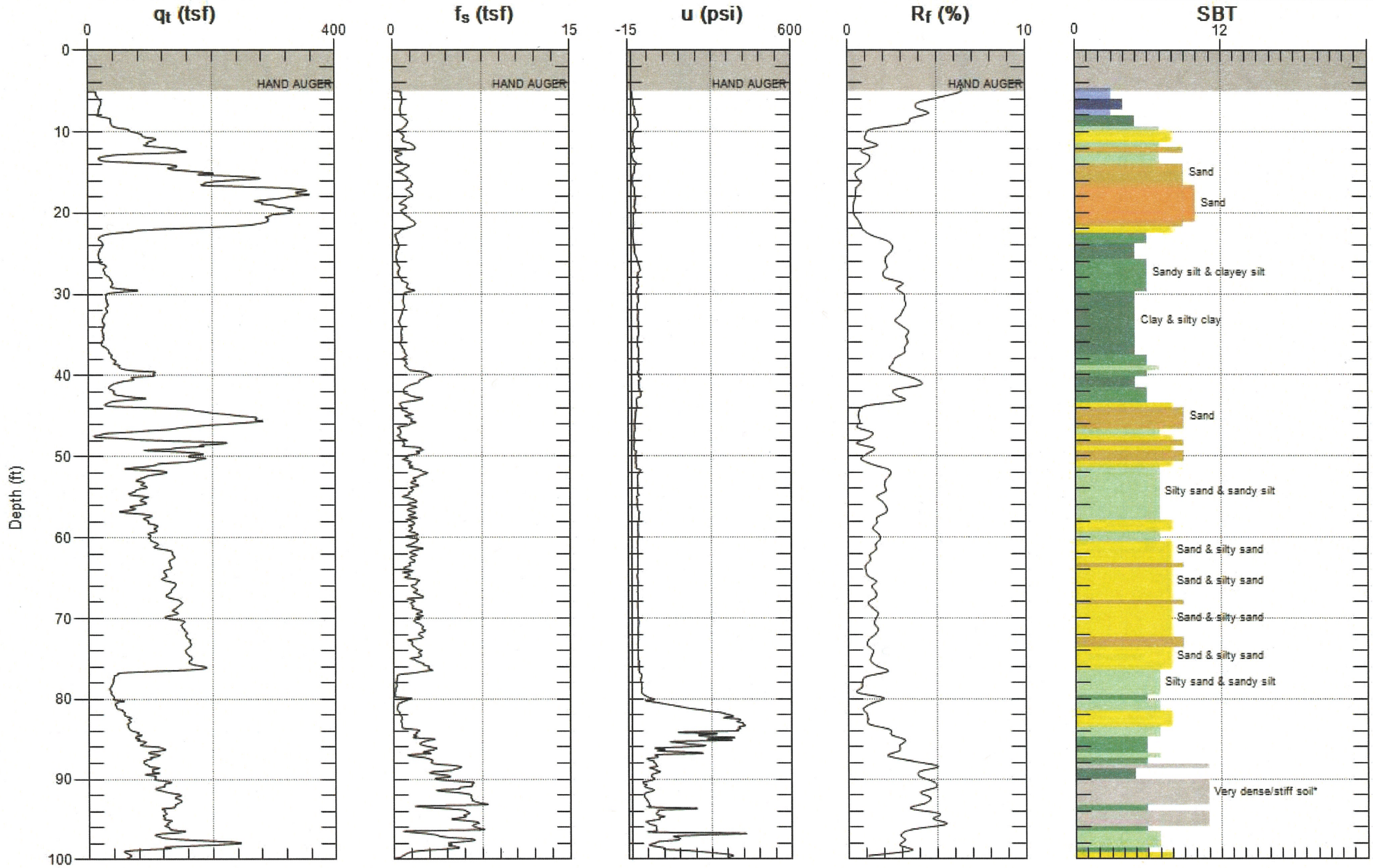
Max. Depth: 100.066 (ft)
Avg. Interval: 0.656 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG URS

Site: OLD REDWOOD HWY
Sounding: Cpt-09-114

Engineer: C.RAMBO
Date: 11/3/2009 05:25



Max. Depth: 100.066 (ft)
Avg. Interval: 0.656 (ft)

SBT: Soil Behavior Type (Robertson 1990)

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-6-09	11-6-09		NB-1-1
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
ECA, Inc.			Offset L	
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Continuous Push			Geoprobe 5410	2"
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
sleeve			N/A	N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING N/A; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING
Cement Grout				1.5 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		Fat CLAY (CH); soft; black; wet; trace GRAVEL; trace SAND.		1										NB-1-1@0.5
					2										NB-1-1@1.0
	1				3										NB-1-1@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

URS

URS Corporation

100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB-1-1
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-7-10	SHEET 1 of 1	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-6-09	11-6-09		NB-1-2
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
ECA, Inc.			Offset L	
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hand Auger			Hand Auger	4"
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Jars			N/A	N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
N/A			N/A	N/A	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		Fat CLAY with SAND (CH); very soft; dark gray; moist to wet.		1										NB-1-2@0.5
					2										NB-1-2@1.0
	1				3										NB-1-2@1.5
	2														
					4										NB-1-2@3.0
	3														
	4														
					5										NB-1-2@5.0
	5		Bottom of Borehole at 5.0 ft.												
	6														
	7														
	8														
	9														
	10														

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100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB-1-2
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-7-10	SHEET 1 of 1	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		NB-2-1
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
ECA, Inc.			Offset L	
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hand Auger			Hand Auger	4"
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Jars			N/A	N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
N/A			N/A	N/A	1.5 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 lean CLAY with GRAVEL (CL); medium stiff; brown; moist.		1										NB-2-1@0.5
					2										NB-2-1@1.0
	1				3										NB-2-1@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

URS

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100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB-2-1
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-7-10	SHEET 1 of 1	

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		NB-3-1
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
ECA, Inc.			Offset L	
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hand Auger			Hand Auger	4"
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Jars			N/A	N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
N/A			N/A	N/A	1.5 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 lean CLAY with GRAVEL (CL); medium stiff; brown; moist.		1										NB-3-1@0.5
					2										NB-3-1@1.0
	1				3										NB-3-1@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

URS

URS Corporation

100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB-3-1
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Sonoma			04-28645097
PROJECT OR BRIDGE NAME				
Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET	
	M.Thummaluru	10-7-10	1 of 1	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		NB3-2
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
ECA, Inc.			Offset L	
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hand Auger			Hand Auger	4"
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Jars			N/A	N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
N/A			N/A	N/A	1.5 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 lean CLAY with GRAVEL medium stiff; brown; moist.		1										NB-3-2@0.5
					2										NB-3-2@1.0
	1		At 1 ft, contains some light brown sand pockets.		3										NB-3-2@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

URS

URS Corporation

100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB3-2
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-7-10	SHEET 1 of 1	

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		NB-4-1
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
ECA, Inc.			Offset L	
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hand Auger			Hand Auger	4"
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Jars			N/A	N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
N/A			N/A	N/A	1.5 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		GRAVELLY lean CLAY with SAND (CL); soft to medium stiff; dark brown; moist.		1										NB-4-1@0.5
					2										NB-4-1@1.0
	1				3										NB-4-1@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

URS

URS Corporation

100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB-4-1
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Sonoma			04-28645097
PROJECT OR BRIDGE NAME				
Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET	
	M.Thummaluru	10-7-10	1 of 1	

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		NB-4-2
DRILLING CONTRACTOR: ECA, Inc.			BOREHOLE LOCATION (Station, Offset, Line): Offset L	SURFACE ELEVATION
DRILLING METHOD: Hand Auger			DRILL RIG: Hand Auger	BOREHOLE DIAMETER: 4"
SAMPLER TYPE(S) AND SIZE(S) (ID): Jars			SPT HAMMER TYPE: N/A	HAMMER EFFICIENCY, ERi: N/A
BOREHOLE BACKFILL AND COMPLETION: N/A			GROUNDWATER READINGS: DURING DRILLING N/A; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 1.5 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		GRAVELLY lean CLAY with SAND (CL); medium stiff; dark brown mottled with light brown; moist.		1										NB-4-2@0.5
					2										NB-4-2@1.0
	1				3										NB-4-2@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

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100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB-4-2
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-7-10	SHEET 1 of 1	

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		NB-5-1
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
ECA, Inc.			Offset L	
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hand Auger			Hand Auger	4"
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Jars			N/A	N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
N/A			N/A	N/A	1.5 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 lean CLAY with GRAVEL (CL); soft to medium stiff; brown; moist.		1										NB-5-1@0.5
			Fat CLAY (CH); medium stiff; dark gray; moist; few fine GRAVEL; with light brown sand pockets.		2										NB-5-1@1.0
	1				3										NB-5-1@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

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100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB-5-1
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-7-10	SHEET 1 of 1	

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		NB-5-2
DRILLING CONTRACTOR: ECA, Inc.			BOREHOLE LOCATION (Station, Offset, Line): Offset L	SURFACE ELEVATION
DRILLING METHOD: Hand Auger			DRILL RIG: Hand Auger	BOREHOLE DIAMETER: 4"
SAMPLER TYPE(S) AND SIZE(S) (ID): Jars			SPT HAMMER TYPE: N/A	HAMMER EFFICIENCY, ERi: N/A
BOREHOLE BACKFILL AND COMPLETION: N/A			GROUNDWATER READINGS: DURING DRILLING N/A; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 1.5 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 with GRAVEL (ML); medium stiff; brown; moist; with light brown sand pockets.		1										NB-5-2@0.5
					2										NB-5-2@1.0
	1				3										NB-5-2@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

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San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB-5-2
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-7-10	SHEET 1 of 1	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		NB-6-1
DRILLING CONTRACTOR: ECA, Inc.			BOREHOLE LOCATION (Station, Offset, Line): Offset L	SURFACE ELEVATION
DRILLING METHOD: Hand Auger			DRILL RIG: Hand Auger	BOREHOLE DIAMETER: 4"
SAMPLER TYPE(S) AND SIZE(S) (ID): Jars			SPT HAMMER TYPE: N/A	HAMMER EFFICIENCY, ERi: N/A
BOREHOLE BACKFILL AND COMPLETION: N/A			GROUNDWATER READINGS: DURING DRILLING N/A; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 1.5 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 lean CLAY (CL/SC); stiff to very stiff; brown; dry to moist; with pockets of gravel upto 3 inches..		1										NB-6-1@0.5
					2										NB-6-1@1.0
	1				3										NB-6-1@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

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100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB-6-1
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-7-10	SHEET 1 of 1	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-6-09	11-6-09		NB-7-1
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
ECA, Inc.			Offset L	
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Continuous Push			Geoprobe 5410	2"
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
sleeve			N/A	N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
N/A			N/A / N/A	1.5 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 lean CLAY with GRAVEL (CL); medium stiff; brown; moist.		1										NB-7-1@0.5
					2										NB-7-1@1.0
	1				3										NB-7-1@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

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San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB-7-1
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Sonoma			04-28645097
PROJECT OR BRIDGE NAME				
Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET	
	M.Thummaluru	10-8-10	1 of 1	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-6-09	11-6-09		NB-7-2
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
ECA, Inc.			Offset L	
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Continuous Push			Geoprobe 5410	2"
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
sleeve			N/A	N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING N/A; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING
Cement Grout				6.0 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); medium stiff; brown; moist.		1										NB-7-2@.5
					2										NB-7-2@1
	1				3										NB-7-2@1.5
	2		Fat CLAY (CH); medium stiff; black; moist.												
					4										NB-7-2@3.0
	3														
	4														
	5				5										NB-7-2@6.0
	6		Bottom of Borehole at 6.0 ft.												
	7														
	8														
	9														
	10														

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San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB-7-2
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-8-10	SHEET 1 of 1	

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		NB-8-1
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
ECA, Inc.			Offset L	
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hand Auger			Hand Auger	4"
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Jars			N/A	N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
N/A			N/A	N/A	1.5 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 lean CLAY with GRAVEL (CL); medium stiff; brown; moist.		1										NB-8-1@0.5
					2										NB-8-1@1.0
	1				3										NB-8-1@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

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San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB-8-1
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Sonoma			04-28645097
PROJECT OR BRIDGE NAME				
Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET	
	M.Thummaluru	10-7-10	1 of 1	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		NB-8-2
DRILLING CONTRACTOR: ECA, Inc.			BOREHOLE LOCATION (Station, Offset, Line): Offset L	SURFACE ELEVATION
DRILLING METHOD: Hand Auger			DRILL RIG: Hand Auger	BOREHOLE DIAMETER: 4"
SAMPLER TYPE(S) AND SIZE(S) (ID): Jars			SPT HAMMER TYPE: N/A	HAMMER EFFICIENCY, ERi: N/A
BOREHOLE BACKFILL AND COMPLETION: N/A			GROUNDWATER READINGS: DURING DRILLING N/A; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 1.5 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		Lean to fat CLAY with SAND (CL/CH); soft; brown; moist.		1										NB-8-2@0.5
			Fat CLAY with SAND (CH); medium stiff; dark gray to black; moist.		2										NB-8-2@1.0
	1				3										NB-8-2@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

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100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB-8-2
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-7-10	SHEET 1 of 1	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		NB-9-1
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
ECA, Inc.			Offset L	
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hand Auger			Hand Auger	4"
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Jars			N/A	N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
N/A			N/A	N/A	1.5 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 lean CLAY with GRAVEL (CL); medium stiff; brown; moist.		1										NB-9-1@0.5
					2										NB-9-1@1.0
	1				3										NB-9-1@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

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100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB-9-1
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-7-10	SHEET 1 of 1	

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		NB-9-2
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
ECA, Inc.			Offset L	
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hand Auger			Hand Auger	4"
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Jars			N/A	N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
N/A			N/A	N/A	1.5 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		Lean to fat CLAY with SAND (CL/CH); soft to medium stiff; brown; moist; with sand pockets and gravel.		1										NB-9-2@0.5
					2										NB-9-2@1.0
	1				3										NB-9-2@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

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100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB-9-2
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-7-10	SHEET 1 of 1	

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-6-09	11-6-09		NB-10-1
DRILLING CONTRACTOR: ECA, Inc.			BOREHOLE LOCATION (Station, Offset, Line): Offset L	SURFACE ELEVATION
DRILLING METHOD: Continuous Push			DRILL RIG: Geoprobe 5410	BOREHOLE DIAMETER: 2"
SAMPLER TYPE(S) AND SIZE(S) (ID): sleeve			SPT HAMMER TYPE: N/A	HAMMER EFFICIENCY, ERi: N/A
BOREHOLE BACKFILL AND COMPLETION: N/A			GROUNDWATER READINGS: DURING DRILLING N/A; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 1.5 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 Lean CLAY to Sandy SILT (CL/ML) with Gravel Light brown, moist, medium stiff.		1										NB-10-1@0.5
					2										NB-10-1@1.0
	1				3										NB-10-1@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

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REPORT TITLE				HOLE ID
BORING RECORD				NB-10-1
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-8-10	SHEET 1 of 1	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-6-09	11-6-09		NB-10-2
DRILLING CONTRACTOR: ECA, Inc.			BOREHOLE LOCATION (Station, Offset, Line): Offset L	SURFACE ELEVATION
DRILLING METHOD: Continuous Push			DRILL RIG: Geoprobe 5410	BOREHOLE DIAMETER: 2"
SAMPLER TYPE(S) AND SIZE(S) (ID): sleeve			SPT HAMMER TYPE: N/A	HAMMER EFFICIENCY, ERi: N/A
BOREHOLE BACKFILL AND COMPLETION: N/A			GROUNDWATER READINGS: DURING DRILLING N/A; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 1.5 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 lean CLAY with GRAVEL (CL); medium stiff; brown; moist.		1										NB-10-2@0.5
					2										NB-10-2@1.0
	1		Lean to fat CLAY (CL/CH); medium stiff; dark brown; moist; trace GRAVEL.		3										NB-10-2@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

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REPORT TITLE				HOLE ID
BORING RECORD				NB-10-2
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-8-10	SHEET 1 of 1	

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-6-09	11-6-09		NB-11-1
DRILLING CONTRACTOR: ECA, Inc.			BOREHOLE LOCATION (Station, Offset, Line): Offset L	SURFACE ELEVATION
DRILLING METHOD: Continuous Push			DRILL RIG: Geoprobe 5410	BOREHOLE DIAMETER: 2"
SAMPLER TYPE(S) AND SIZE(S) (ID): sleeve			SPT HAMMER TYPE: N/A	HAMMER EFFICIENCY, ERi: N/A
BOREHOLE BACKFILL AND COMPLETION: Cement Grout			GROUNDWATER READINGS: DURING DRILLING N/A; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 6.0 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		CLAYEY GRAVEL with SAND (GC); medium dense; light brown; moist; Baserock.		1										NB-11-1@.5
					2										NB-11-1@1.0
	1		SANDY lean CLAY with GRAVEL (CL); medium stiff; brown; moist.		3										NB-11-1@1.5
	2				4										NB-11-1@3.0
	3		Fat CLAY with SAND (CH); medium stiff; black; moist.												
	4														
	5				5										NB-11-1@6.0
	6		Bottom of Borehole at 6.0 ft.												
	7														
	8														
	9														
	10														

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100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB-11-1
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-8-10	SHEET 1 of 1	

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-6-09	11-6-09		NB-11-2
DRILLING CONTRACTOR: ECA, Inc.			BOREHOLE LOCATION (Station, Offset, Line): Offset L	SURFACE ELEVATION
DRILLING METHOD: Hand Auger			DRILL RIG: Hand Auger	BOREHOLE DIAMETER: 4"
SAMPLER TYPE(S) AND SIZE(S) (ID): Jars			SPT HAMMER TYPE: N/A	HAMMER EFFICIENCY, ERi: N/A
BOREHOLE BACKFILL AND COMPLETION: N/A			GROUNDWATER READINGS: DURING DRILLING N/A; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 1.5 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 lean CLAY with GRAVEL (CL); medium stiff; brown; moist.		1										NB-11-2@0.5
					2										NB-11-2@1.0
	1				3										NB-11-2@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

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100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				NB-11-2
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-7-10	SHEET 1 of 1	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		SB-1-1
DRILLING CONTRACTOR: ECA, Inc.			BOREHOLE LOCATION (Station, Offset, Line): Offset L	SURFACE ELEVATION
DRILLING METHOD: Hand Auger			DRILL RIG: Hand Auger	BOREHOLE DIAMETER: 4"
SAMPLER TYPE(S) AND SIZE(S) (ID): Jars			SPT HAMMER TYPE: N/A	HAMMER EFFICIENCY, ERi: N/A
BOREHOLE BACKFILL AND COMPLETION: N/A			GROUNDWATER READINGS: DURING DRILLING N/A; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 1.5 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 with GRAVEL (ML); medium stiff; brown; moist.		1										SB-1-1@0.5
					2										SB-1-1@1.0
	1		At 1 ft, contains Cobbles upto 5 inches sizes.		3										SB-1-1@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

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San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				SB-1-1
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-7-10	SHEET 1 of 1	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		SB-1-2
DRILLING CONTRACTOR: ECA, Inc.			BOREHOLE LOCATION (Station, Offset, Line): Offset L	SURFACE ELEVATION
DRILLING METHOD: Hand Auger			DRILL RIG: Hand Auger	BOREHOLE DIAMETER: 4"
SAMPLER TYPE(S) AND SIZE(S) (ID): Jars			SPT HAMMER TYPE: N/A	HAMMER EFFICIENCY, ERi: N/A
BOREHOLE BACKFILL AND COMPLETION: N/A			GROUNDWATER READINGS: DURING DRILLING N/A; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 1.5 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 with GRAVEL (ML); medium stiff; brown; moist.		1										SB-1-2@0.5
					2										SB-1-2@1.0
	1				3										SB-1-2@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

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100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				SB-1-2
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-7-10	SHEET 1 of 1	

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		SB-2-1
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
ECA, Inc.			Offset L	
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hand Auger			Hand Auger	4"
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Jars			N/A	N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
N/A			N/A	N/A	1.5 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 to Silty SAND (ML/SM) with Gravel Medium stiff, reddish brown, moist, gravel up to 2 inches.		1										SB-2-1@0.5
					2										SB-2-1@1.0
	1				3										SB-2-1@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

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San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				SB-2-1
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-7-10	SHEET 1 of 1	

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		SB-2-2
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
ECA, Inc.			Offset L	
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hand Auger			Hand Auger	4"
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Jars			N/A	N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
N/A			N/A	N/A	1.0 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); soft to medium stiff; dark brown; moist.		1										SB-2-2@0.5
					2										SB-2-2@1.0
	1		Bottom of Borehole at 1.0 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

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100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				SB-2-2
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Sonoma			04-28645097
PROJECT OR BRIDGE NAME				
Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET	
	M.Thummaluru	10-7-10	1 of 1	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		SB-3-1
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
ECA, Inc.			Offset L	
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Continuous Push			Geoprobe 5410	2"
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
sleeve			N/A	N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
N/A			N/A / N/A	1.5 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		SILTY SAND with GRAVEL (SM); dense; light brown; dry.		1										SB-3-1@0.5
			SANDY lean CLAY with GRAVEL (CL); medium stiff; brown; moist.		2										SB-3-1@1.0
	1				3										SB-3-1@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

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100 W San Fernando St, Ste 200
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REPORT TITLE				HOLE ID
BORING RECORD				SB-3-1
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-7-10	SHEET 1 of 1	

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		SB-3-2
DRILLING CONTRACTOR: ECA, Inc.			BOREHOLE LOCATION (Station, Offset, Line): Offset L	SURFACE ELEVATION
DRILLING METHOD: Hand Auger			DRILL RIG: Hand Auger	BOREHOLE DIAMETER: 4"
SAMPLER TYPE(S) AND SIZE(S) (ID): Jars			SPT HAMMER TYPE: N/A	HAMMER EFFICIENCY, ERi: N/A
BOREHOLE BACKFILL AND COMPLETION: N/A			GROUNDWATER READINGS: DURING DRILLING N/A; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 1.5 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 lean CLAY with GRAVEL (CL); medium stiff; dark brown; moist.		1										SB-3-2@0.5
					2										SB-3-2@1.0
	1				3										SB-3-2@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

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100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				SB-3-2
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-7-10	SHEET 1 of 1	

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		SB-4-1
DRILLING CONTRACTOR: ECA, Inc.			BOREHOLE LOCATION (Station, Offset, Line): Offset L	SURFACE ELEVATION
DRILLING METHOD: Continuous Push			DRILL RIG: Geoprobe 5410	BOREHOLE DIAMETER: 2"
SAMPLER TYPE(S) AND SIZE(S) (ID): sleeve			SPT HAMMER TYPE: N/A	HAMMER EFFICIENCY, ERi: N/A
BOREHOLE BACKFILL AND COMPLETION: N/A			GROUNDWATER READINGS: DURING DRILLING N/A; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 1.5 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; brown; moist.		1										SB-4-1@0.5
					2										SB-4-1@1.0
	1		SANDY lean CLAY with GRAVEL (CL); medium stiff; brown; moist; red gravel.		3										SB-4-1@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

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100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				SB-4-1
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-7-10	SHEET 1 of 1	

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		SB-4-2
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
ECA, Inc.			Offset L	
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Continuous Push			Geoprobe 5410	2"
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
sleeve			N/A	N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
N/A			N/A / N/A	1.5 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		Lean to fat CLAY (CL/CH); soft to medium stiff; dark brown; moist.		1										SB-4-2@0.5
			Fat CLAY (CH); soft to medium stiff; dark gray; moist.		2										SB-4-2@1.0
	1				3										SB-4-2@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

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100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				SB-4-2
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-7-10	SHEET 1 of 1	

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		SB-6-1
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
ECA, Inc.			Offset L	
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Continuous Push			Geoprobe 5410	2"
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
sleeve			N/A	N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
N/A			N/A / N/A	1.5 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 with GRAVEL (ML); medium stiff; brown; moist.		1										SB-6-1@0.5
					2										SB-6-1@1.0
	1				3										SB-6-1@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

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100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				SB-6-1
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-7-10	SHEET 1 of 1	

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-5-09	11-5-09		SB-6-2
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
ECA, Inc.			Offset L	
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hand Auger			Hand Auger	4"
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Jars			N/A	N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
N/A			N/A	N/A	1.0 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); soft to medium stiff; brown; moist.		1										SB-6-2@0.5
					2										SB-6-2@1.0
	1		Bottom of Borehole at 1.0 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

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100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				SB-6-2
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Sonoma			04-28645097
PROJECT OR BRIDGE NAME				
Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET	
	M.Thummaluru	10-7-10	1 of 1	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-6-09	11-6-09		SB-7-1
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
ECA, Inc.			Offset L	
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Continuous Push			Geoprobe 5410	2"
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
sleeve			N/A	N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING N/A; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING
N/A				1.5 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 lean CLAY with GRAVEL (CL); medium stiff; brown; moist.		1										SB-7-1@0.5
					2										SB-7-1@1.0
	1				3										SB-7-1@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

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100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				SB-7-1
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-8-10	SHEET 1 of 1	

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-6-09	11-6-09		SB-7-2
DRILLING CONTRACTOR: ECA, Inc.			BOREHOLE LOCATION (Station, Offset, Line): Offset L	SURFACE ELEVATION
DRILLING METHOD: Continuous Push			DRILL RIG: Geoprobe 5410	BOREHOLE DIAMETER: 2"
SAMPLER TYPE(S) AND SIZE(S) (ID): sleeve			SPT HAMMER TYPE: N/A	HAMMER EFFICIENCY, ERi: N/A
BOREHOLE BACKFILL AND COMPLETION: Cement Grout			GROUNDWATER READINGS: DURING DRILLING N/A; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 9.0 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); medium stiff; brown; moist.		1										SB-7-2@.5
					2										SB-7-2@1.0
	1		CLAYEY GRAVEL with SAND (GC); dense; gray; moist.		3										SB-7-2@1.5
			Fat CLAY with SAND (CH); medium stiff; black; moist.												
	2														
					4										SB-7-2@3.0
	3														
	4														
	5														
					5										SB-7-2@6.0
	6		At 6 ft, becomes stiff.												
	7														
			Lean to fat CLAY (CL/CH); stiff; light gray; moist.												
	8														
					6										SB-7-2@9.0
	9		Bottom of Borehole at 9.0 ft.												
	10														

URS Corporation

100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				SB-7-2
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-8-10	SHEET 1 of 1	

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-6-09	11-6-09		SB-8-1
DRILLING CONTRACTOR: ECA, Inc.			BOREHOLE LOCATION (Station, Offset, Line): Offset L	SURFACE ELEVATION
DRILLING METHOD: Continuous Push			DRILL RIG: Geoprobe 5410	BOREHOLE DIAMETER: 2"
SAMPLER TYPE(S) AND SIZE(S) (ID): sleeve			SPT HAMMER TYPE: N/A	HAMMER EFFICIENCY, ERi: N/A
BOREHOLE BACKFILL AND COMPLETION: N/A			GROUNDWATER READINGS: DURING DRILLING N/A; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 1.5 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 lean CLAY with GRAVEL (CL); medium stiff; brown; moist.		1										SB-8-1@0.5
					2										SB-8-1@1.0
	1				3										SB-8-1@1.5
			Bottom of Borehole at 1.5 ft.												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														

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100 W San Fernando St, Ste 200
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REPORT TITLE				HOLE ID
BORING RECORD				SB-8-1
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-8-10	SHEET 1 of 1	

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Ball	11-6-09	11-6-09		SB-8-2
DRILLING CONTRACTOR			BOREHOLE LOCATION (Station, Offset, Line)	SURFACE ELEVATION
ECA, Inc.			Offset L	
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Continuous Push			Geoprobe 5410	2"
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
sleeve			N/A	N/A
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
N/A			N/A / N/A	6.0 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); medium stiff; brown; moist.		1										SB-8-2@.5
					2										SB-8-2@1.0
	1				3										SB-8-2@1.5
	2		Fat CLAY with SAND (CH); medium stiff; black; moist.		4										SB-8-2@3.0
	3														
	4														
	5				5										SB-8-2@6.0
	6		Bottom of Borehole at 6.0 ft.												
	7														
	8														
	9														
	10														

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100 W San Fernando St, Ste 200
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				SB-8-2
DIST. 04	COUNTY Sonoma	ROUTE	POSTMILE	EA 04-28645097
PROJECT OR BRIDGE NAME: Old Redwood Highway Interchange				
BRIDGE NUMBER	PREPARED BY M.Thummaluru	DATE 10-8-10	SHEET 1 of 1	

URS BORING RECORD 022008 28645097-OLD REDWOOD HIGHWAY (ENV).GPJ 9/8/10

APPENDIX F

HAZARDOUS MATERIALS SITE INVESTIGATION REPORT
U.S. 101/OLD REDWOOD HIGHWAY INTERCHANGE PROJECT
PETALUMA, CALIFORNIA

Analytical Results (on CD)

Torrent
LABORATORY, INC.

November 12, 2009

Patrick Walz
URS Corporation, San Jose
55 South Market St., Suite 1500
San Jose, CA 95113

TEL: (408) 297-9585
FAX (408) 297-6962

RE: US 101/Petaluma Highway

Order No.: 0911019

Dear Patrick Walz:

Torrent Laboratory, Inc. received 1 sample on 11/5/2009 for the analyses presented in the following report.

All data for associated QC met EPA or laboratory specification(s) except where noted in the case narrative.
Reported data is applicable for only the samples received as part of the order number referenced above.

Torrent Laboratory, Inc, is certified by the State of California, ELAP #1991. If you have any questions regarding these tests results, please feel free to contact the Project Management Team at (408)263-5258;ext: 204.

Sincerely,

Laboratory Director

11/12/09
Date

Patti Sandrock
QA Officer

483 Sinclair Frontage Rd., Milpitas, CA 95035 | tel: 408.263.5258 | main fax: 408.263.8293 | project manager fax: 408.263.2708
www.torrentlab.com

TORRENT LABORATORY, INC.

483 Sinclair Frontage Road • Milpitas, CA • Phone: (408) 263-5258 • Fax: (408) 263-8293

Visit us at www.torrentlab.com email: analysis@torrentlab.com

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/5/2009
Date Reported: 11/12/2009

Client Sample ID: SB-5-1-GW
Sample Location: US 101/Petaluma Highway
Sample Matrix: GROUNDWATER
Date/Time Sampled 11/4/2009 12:40:00 PM

Lab Sample ID: 0911019-001
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	11/10/2009	0.01	1	0.010	ND	mg/L	5780
Arsenic	SW6010B	11/10/2009	0.01	1	0.010	ND	mg/L	5780
Barium	SW6010B	11/10/2009	0.01	1	0.010	0.061	mg/L	5780
Beryllium	SW6010B	11/10/2009	0.005	1	0.0050	ND	mg/L	5780
Cadmium	SW6010B	11/10/2009	0.005	1	0.0050	ND	mg/L	5780
Chromium	SW6010B	11/10/2009	0.005	1	0.0050	ND	mg/L	5780
Cobalt	SW6010B	11/10/2009	0.005	1	0.0050	0.010	mg/L	5780
Copper	SW6010B	11/10/2009	0.01	1	0.010	ND	mg/L	5780
Lead	SW6010B	11/10/2009	0.015	1	0.015	ND	mg/L	5780
Molybdenum	SW6010B	11/10/2009	0.005	1	0.0050	0.021	mg/L	5780
Nickel	SW6010B	11/10/2009	0.01	1	0.010	0.035	mg/L	5780
Selenium	SW6010B	11/10/2009	0.01	1	0.010	ND	mg/L	5780
Silver	SW6010B	11/10/2009	0.005	1	0.0050	0.0050	mg/L	5780
Thallium	SW6010B	11/10/2009	0.01	1	0.010	ND	mg/L	5780
Vanadium	SW6010B	11/10/2009	0.01	1	0.010	0.028	mg/L	5780
Zinc	SW6010B	11/10/2009	0.005	1	0.0050	0.0080	mg/L	5780
Mercury	SW7470A	11/11/2009	0.0002	1	0.00020	ND	mg/L	5782
TPH (Diesel)	SW8015B	11/6/2009	0.1	1	0.12	0.146x	mg/L	R21686
TPH (Motor Oil)	SW8015B	11/6/2009	0.2	1	0.24	0.287x	mg/L	R21686
Surr: Pentacosane	SW8015B	11/6/2009	0	1	57.9-125	101	%REC	R21686

Note:x-Sample chromatogram does not resemble typical diesel or motor oil pattern (discrete peaks present). Hydrocarbons and hydrocarbon peaks within the diesel range quantitated as diesel; hydrocarbons and hydrocarbon peaks within the motor oil range quantitated as motor oil.

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/5/2009
Date Reported: 11/12/2009

Client Sample ID: SB-5-1-GW
Sample Location: US 101/Petaluma Highway
Sample Matrix: GROUNDWATER
Date/Time Sampled 11/4/2009 12:40:00 PM

Lab Sample ID: 0911019-001
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
1,1,1,2-Tetrachloroethane	SW8260B	11/9/2009	1	1.22	1.2	ND	µg/L	R21674
1,1,1-Trichloroethane	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
1,1,2,2-Tetrachloroethane	SW8260B	11/9/2009	1	1.22	1.2	ND	µg/L	R21674
1,1,2-Trichloroethane	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
1,1-Dichloroethane	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
1,1-Dichloroethene	SW8260B	11/9/2009	1	1.22	1.2	ND	µg/L	R21674
1,1-Dichloropropene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
1,2,3-Trichlorobenzene	SW8260B	11/9/2009	1	1.22	1.2	ND	µg/L	R21674
1,2,3-Trichloropropane	SW8260B	11/9/2009	1	1.22	1.2	ND	µg/L	R21674
1,2,4-Trichlorobenzene	SW8260B	11/9/2009	1	1.22	1.2	ND	µg/L	R21674
1,2,4-Trimethylbenzene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
1,2-Dibromo-3-chloropropane	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
1,2-Dibromoethane (EDB)	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
1,2-Dichlorobenzene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
1,2-Dichloroethane (EDC)	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
1,2-Dichloropropane	SW8260B	11/9/2009	1	1.22	1.2	ND	µg/L	R21674
1,3,5-Trimethylbenzene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
1,3-Dichlorobenzene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
1,3-Dichloropropene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
1,4-Dichlorobenzene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
2,2-Dichloropropane	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
2-Chloroethyl vinyl ether	SW8260B	11/9/2009	6	1.22	7.3	ND	µg/L	R21674
2-Chlorotoluene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
4-Chlorotoluene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
4-Isopropyltoluene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
Acetone	SW8260B	11/9/2009	10	1.22	12	ND	µg/L	R21674
Benzene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
Bromobenzene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
Bromochloromethane	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
Bromodichloromethane	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
Bromoform	SW8260B	11/9/2009	1	1.22	1.2	ND	µg/L	R21674
Bromomethane	SW8260B	11/9/2009	1	1.22	1.2	ND	µg/L	R21674
Carbon tetrachloride	SW8260B	11/9/2009	1	1.22	1.2	ND	µg/L	R21674
Chlorobenzene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
Chloroform	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
Chloromethane	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
cis-1,2-Dichloroethene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
cis-1,3-Dichloropropene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
Dibromochloromethane	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
Dibromomethane	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
Dichlorodifluoromethane	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
Diisopropyl ether (DIPE)	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
Ethyl tert-butyl ether (ETBE)	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/5/2009
Date Reported: 11/12/2009

Client Sample ID: SB-5-1-GW
Sample Location: US 101/Petaluma Highway
Sample Matrix: GROUNDWATER
Date/Time Sampled 11/4/2009 12:40:00 PM

Lab Sample ID: 0911019-001
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Ethylbenzene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
Freon-113	SW8260B	11/9/2009	1	1.22	1.2	ND	µg/L	R21674
Hexachlorobutadiene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
Isopropylbenzene	SW8260B	11/9/2009	1	1.22	1.2	ND	µg/L	R21674
Methyl tert-butyl ether (MTBE)	SW8260B	11/9/2009	0.5	1.22	0.61	14	µg/L	R21674
Methylene chloride	SW8260B	11/9/2009	5	1.22	6.1	ND	µg/L	R21674
Naphthalene	SW8260B	11/9/2009	1	1.22	1.2	ND	µg/L	R21674
n-Butylbenzene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
n-Propylbenzene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
sec-Butylbenzene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
Styrene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
t-Butyl alcohol (t-Butanol)	SW8260B	11/9/2009	5	1.22	6.1	ND	µg/L	R21674
tert-Amyl methyl ether (TAME)	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
tert-Butylbenzene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
Tetrachloroethene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
Toluene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
trans-1,2-Dichloroethene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
trans-1,3-Dichloropropene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
Trichloroethene	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
Trichlorofluoromethane	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
Vinyl chloride	SW8260B	11/9/2009	0.5	1.22	0.61	ND	µg/L	R21674
Xylenes, Total	SW8260B	11/9/2009	1.5	1.22	1.8	ND	µg/L	R21674
Surr: Dibromofluoromethane	SW8260B	11/9/2009	0	1.22	61.2-131	112	%REC	R21674
Surr: 4-Bromofluorobenzene	SW8260B	11/9/2009	0	1.22	64.1-120	104	%REC	R21674
Surr: Toluene-d8	SW8260B	11/9/2009	0	1.22	75.1-127	111	%REC	R21674

Note: Reporting limits were raised due to sediment in all VOAs.

TPH (Gasoline)	SW8260B(TPH)	11/9/2009	50	1.22	61	ND	µg/L	G21674
Surr: 4-Bromofllurobenzene	SW8260B(TPH)	11/9/2009	0	1.22	53-118	107	%REC	G21674

Note: Raised reporting limit - see comment for 8260B analysis.

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Definitions, legends and Notes

Note	Description
ug/kg	Microgram per kilogram (ppb, part per billion).
ug/L	Microgram per liter (ppb, part per billion).
mg/kg	Milligram per kilogram (ppm, part per million).
mg/L	Milligram per liter (ppm, part per million).
LCS/LCSD	Laboratory control sample/laboratory control sample duplicate.
MDL	Method detection limit.
MRL	Modified reporting limit. When sample is subject to dilution, reporting limit times dilution factor yields MRL.
MS/MSD	Matrix spike/matrix spike duplicate.
N/A	Not applicable.
ND	Not detected at or above detection limit.
NR	Not reported.
QC	Quality Control.
RL	Reporting limit.
% RPD	Percent relative difference.
a	pH was measured immediately upon the receipt of the sample, but it was still done outside the holding time.
sub	Analyzed by subcontracting laboratory, Lab Certificate #

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Torrent Laboratory, Inc.

Date: *12-Nov-09*

CLIENT: URS Corporation, San Jose
Work Order: 0911019
Project: US 101/Petaluma Highway

ANALYTICAL QC SUMMARY REPORT

BatchID: 5780

Sample ID: **MB-5780** SampType: **MBLK** TestCode: **6010B_W** Units: **mg/L** Prep Date: **11/10/2009** RunNo: **21709**
Client ID: **ZZZZZ** Batch ID: **5780** TestNo: **SW6010B** **(E200.7/SW3** Analysis Date: **11/10/2009** SeqNo: **311615**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	ND	0.010									
Arsenic	ND	0.010									
Barium	ND	0.010									
Beryllium	ND	0.0050									
Cadmium	ND	0.0050									
Chromium	ND	0.0050									
Cobalt	ND	0.0050									
Copper	ND	0.010									
Lead	ND	0.015									
Molybdenum	ND	0.0050									
Nickel	ND	0.010									
Selenium	ND	0.020									
Silver	ND	0.0050									
Thallium	ND	0.010									
Vanadium	ND	0.010									
Zinc	ND	0.010									

Sample ID: **LCS-5780** SampType: **LCS** TestCode: **6010B_W** Units: **mg/L** Prep Date: **11/10/2009** RunNo: **21709**
Client ID: **ZZZZZ** Batch ID: **5780** TestNo: **SW6010B** **(E200.7/SW3** Analysis Date: **11/10/2009** SeqNo: **311613**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	1.067	0.010	1	0	107	80	120				
Arsenic	1.014	0.010	1	0	101	80	120				
Barium	0.9690	0.010	1	0	96.9	80	120				
Beryllium	1.054	0.0050	1	0	105	80	120				
Cadmium	0.9790	0.0050	1	0	97.9	80	120				
Chromium	0.9620	0.0050	1	0	96.2	80	120				
Cobalt	0.9620	0.0050	1	0	96.2	80	120				
Copper	0.9860	0.010	1	0	98.6	80	120				

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911019
Project: US 101/Petaluma Highway

ANALYTICAL QC SUMMARY REPORT

BatchID: 5780

Sample ID: **LCS-5780** SampType: **LCS** TestCode: **6010B_W** Units: **mg/L** Prep Date: **11/10/2009** RunNo: **21709**
Client ID: **ZZZZZ** Batch ID: **5780** TestNo: **SW6010B** **(E200.7/SW3** Analysis Date: **11/10/2009** SeqNo: **311613**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	1.020	0.015	1	0	102	80	120				
Molybdenum	1.019	0.0050	1	0	102	80	120				
Nickel	0.9710	0.010	1	0	97.1	80	120				
Selenium	1.029	0.020	1	0	103	80	120				
Silver	0.9850	0.0050	1	0	98.5	80	120				
Thallium	1.011	0.010	1	0	101	80	120				
Vanadium	0.9710	0.010	1	0	97.1	80	120				
Zinc	0.9540	0.010	1	0	95.4	80	120				

Sample ID: **LCSD-5780** SampType: **LCSD** TestCode: **6010B_W** Units: **mg/L** Prep Date: **11/10/2009** RunNo: **21709**
Client ID: **ZZZZZ** Batch ID: **5780** TestNo: **SW6010B** **(E200.7/SW3** Analysis Date: **11/10/2009** SeqNo: **311614**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	1.058	0.010	1	0	106	80	120	1.067	0.847	20	
Arsenic	1.004	0.010	1	0	100	80	120	1.014	0.991	20	
Barium	0.9540	0.010	1	0	95.4	80	120	0.969	1.56	20	
Beryllium	1.045	0.0050	1	0	104	80	120	1.054	0.858	20	
Cadmium	0.9640	0.0050	1	0	96.4	80	120	0.979	1.54	20	
Chromium	0.9470	0.0050	1	0	94.7	80	120	0.962	1.57	20	
Cobalt	0.9480	0.0050	1	0	94.8	80	120	0.962	1.47	20	
Copper	0.9670	0.010	1	0	96.7	80	120	0.986	1.95	20	
Lead	1.012	0.015	1	0	101	80	120	1.02	0.787	20	
Molybdenum	1.011	0.0050	1	0	101	80	120	1.019	0.788	20	
Nickel	0.9500	0.010	1	0	95.0	80	120	0.971	2.19	20	
Selenium	1.017	0.020	1	0	102	80	120	1.029	1.17	20	
Silver	0.9640	0.0050	1	0	96.4	80	120	0.985	2.15	20	
Thallium	1.005	0.010	1	0	101	80	120	1.011	0.595	20	
Vanadium	0.9510	0.010	1	0	95.1	80	120	0.971	2.08	20	
Zinc	0.9510	0.010	1	0	95.1	80	120	0.954	0.315	20	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911019
Project: US 101/Petaluma Highway

ANALYTICAL QC SUMMARY REPORT

BatchID: 5780

Sample ID: **0911019-001AMS** SampType: **MS** TestCode: **6010B_W** Units: **mg/L** Prep Date: **11/10/2009** RunNo: **21709**
Client ID: **SB-5-1-GW** Batch ID: **5780** TestNo: **SW6010B** **(E200.7/SW3** Analysis Date: **11/10/2009** SeqNo: **311610**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	1.039	0.010	1	0	104	75	125				
Arsenic	1.020	0.010	1	0	102	75	125				
Barium	0.9730	0.010	1	0.061	91.2	75	125				
Beryllium	0.9560	0.0050	1	0	95.6	75	125				
Cadmium	0.9370	0.0050	1	0	93.7	75	125				
Chromium	0.9130	0.0050	1	0	91.3	75	125				
Cobalt	0.8800	0.0050	1	0.01	87.0	75	125				
Copper	0.9590	0.010	1	0.003	95.6	75	125				
Lead	0.9270	0.015	1	0	92.7	75	125				
Molybdenum	1.002	0.0050	1	0.021	98.1	75	125				
Nickel	0.9000	0.010	1	0.035	86.5	75	125				
Selenium	1.010	0.020	1	0	101	75	125				
Silver	0.9700	0.0050	1	0.005	96.5	75	125				
Thallium	0.8840	0.010	1	0	88.4	75	125				
Vanadium	0.9590	0.010	1	0.028	93.1	75	125				
Zinc	0.8770	0.010	1	0.008	86.9	75	125				

Sample ID: **0911019-001AMSD** SampType: **MSD** TestCode: **6010B_W** Units: **mg/L** Prep Date: **11/10/2009** RunNo: **21709**
Client ID: **SB-5-1-GW** Batch ID: **5780** TestNo: **SW6010B** **(E200.7/SW3** Analysis Date: **11/10/2009** SeqNo: **311611**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	1.020	0.010	1	0	102	75	125	1.039	1.85	30	
Arsenic	1.001	0.010	1	0	100	75	125	1.02	1.88	30	
Barium	0.9840	0.010	1	0.061	92.3	75	125	0.973	1.12	30	
Beryllium	0.9800	0.0050	1	0	98.0	75	125	0.956	2.48	30	
Cadmium	0.9290	0.0050	1	0	92.9	75	125	0.937	0.857	30	
Chromium	0.9050	0.0050	1	0	90.5	75	125	0.913	0.880	30	
Cobalt	0.8710	0.0050	1	0.01	86.1	75	125	0.88	1.03	30	
Copper	0.9550	0.010	1	0.003	95.2	75	125	0.959	0.418	30	
Lead	0.9100	0.015	1	0	91.0	75	125	0.927	1.85	30	
Molybdenum	0.9820	0.0050	1	0.021	96.1	75	125	1.002	2.02	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911019
Project: US 101/Petaluma Highway

ANALYTICAL QC SUMMARY REPORT

BatchID: 5780

Sample ID: **0911019-001AMSD**	SampType: **MSD**	TestCode: **6010B_W**	Units: **mg/L**	Prep Date: **11/10/2009**	RunNo: **21709**
Client ID: **SB-5-1-GW**	Batch ID: **5780**	TestNo: **SW6010B**	**(E200.7/SW3**	Analysis Date: **11/10/2009**	SeqNo: **311611**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nickel	0.8960	0.010	1	0.035	86.1	75	125	0.9	0.445	30	
Selenium	0.9810	0.020	1	0	98.1	75	125	1.01	2.91	30	
Silver	0.9640	0.0050	1	0.005	95.9	75	125	0.97	0.620	30	
Thallium	0.8730	0.010	1	0	87.3	75	125	0.884	1.25	30	
Vanadium	0.9550	0.010	1	0.028	92.7	75	125	0.959	0.418	30	
Zinc	0.8790	0.010	1	0.008	87.1	75	125	0.877	0.228	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911019
Project: US 101/Petaluma Highway

ANALYTICAL QC SUMMARY REPORT

BatchID: 5782

Sample ID: **MB-5782**	SampType: **MBLK**	TestCode: **HG_W_7470A**	Units: **mg/L**	Prep Date: **11/10/2009**	RunNo: **21700**
Client ID: **ZZZZZ**	Batch ID: **5782**	TestNo: **SW7470A**	**(SW7470A)**	Analysis Date: **11/11/2009**	SeqNo: **311552**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	ND	0.00020									

Sample ID: **LCS-5782**	SampType: **LCS**	TestCode: **HG_W_7470A**	Units: **mg/L**	Prep Date: **11/10/2009**	RunNo: **21700**
Client ID: **ZZZZZ**	Batch ID: **5782**	TestNo: **SW7470A**	**(SW7470A)**	Analysis Date: **11/11/2009**	SeqNo: **311550**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	0.01760	0.00020	0.015	0	117	80	120				

Sample ID: **LCSD-5782**	SampType: **LCSD**	TestCode: **HG_W_7470A**	Units: **mg/L**	Prep Date: **11/10/2009**	RunNo: **21700**
Client ID: **ZZZZZ**	Batch ID: **5782**	TestNo: **SW7470A**	**(SW7470A)**	Analysis Date: **11/11/2009**	SeqNo: **311551**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	0.01772	0.00020	0.015	0	118	80	120	0.0176	0.680	20	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911019
Project: US 101/Petaluma Highway

ANALYTICAL QC SUMMARY REPORT

BatchID: G21674

Sample ID: **MB-G21674** SampType: **MBLK** TestCode: **TPH_GAS_W** Units: **µg/L** Prep Date: **11/9/2009** RunNo: **21674**
Client ID: **ZZZZZ** Batch ID: **G21674** TestNo: **SW8260B(TP** Analysis Date: **11/9/2009** SeqNo: **311209**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Gasoline)	ND	50									
Surr: 4-Bromofllurobenzene	8.900	0	11.36	0	78.3	53	118				

Sample ID: **LCS-G21674** SampType: **LCS** TestCode: **TPH_GAS_W** Units: **µg/L** Prep Date: **11/9/2009** RunNo: **21674**
Client ID: **ZZZZZ** Batch ID: **G21674** TestNo: **SW8260B(TP** Analysis Date: **11/9/2009** SeqNo: **311210**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Gasoline)	195.7	50	227	40	68.6	52.4	127				
Surr: 4-Bromofllurobenzene	8.700	0	11.36	0	76.6	53	118				

Sample ID: **LCSD-G21674** SampType: **LCSD** TestCode: **TPH_GAS_W** Units: **µg/L** Prep Date: **11/9/2009** RunNo: **21674**
Client ID: **ZZZZZ** Batch ID: **G21674** TestNo: **SW8260B(TP** Analysis Date: **11/9/2009** SeqNo: **311211**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Gasoline)	211.6	50	227	40	75.6	52.4	127	195.7	7.81	20	
Surr: 4-Bromofllurobenzene	13.10	0	11.36	0	115	53	118	0	0	0	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911019
Project: US 101/Petaluma Highway

ANALYTICAL QC SUMMARY REPORT

BatchID: R21674

Sample ID: **BLK-R21674**	SampType: **MBLK**	TestCode: **8260B_W**	Units: **µg/L**	Prep Date: **11/9/2009**	RunNo: **21674**
Client ID: **ZZZZZ**	Batch ID: **R21674**	TestNo: **SW8260B**		Analysis Date: **11/9/2009**	SeqNo: **311368**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1,1,2-Tetrachloroethane	ND	1.0									
1,1,1-Trichloroethane	ND	0.50									
1,1,2,2-Tetrachloroethane	ND	1.0									
1,1,2-Trichloroethane	ND	0.50									
1,1-Dichloroethane	ND	0.50									
1,1-Dichloroethene	ND	1.0									
1,1-Dichloropropene	ND	0.50									
1,2,3-Trichlorobenzene	ND	1.0									
1,2,3-Trichloropropane	ND	1.0									
1,2,4-Trichlorobenzene	ND	1.0									
1,2,4-Trimethylbenzene	ND	0.50									
1,2-Dibromo-3-chloropropane	ND	0.50									
1,2-Dibromoethane (EDB)	ND	0.50									
1,2-Dichlorobenzene	ND	0.50									
1,2-Dichloroethane (EDC)	ND	0.50									
1,2-Dichloropropane	ND	1.0									
1,3,5-Trimethylbenzene	ND	0.50									
1,3-Dichlorobenzene	ND	0.50									
1,4-Dichlorobenzene	ND	0.50									
2,2-Dichloropropane	ND	0.50									
2-Chloroethyl vinyl ether	ND	6.0									
2-Chlorotoluene	ND	0.50									
4-Chlorotoluene	ND	0.50									
4-Isopropyltoluene	ND	0.50									
Acetone	ND	10									
Benzene	ND	0.50									
Bromobenzene	ND	0.50									
Bromochloromethane	ND	0.50									
Bromodichloromethane	ND	0.50									
Bromoform	ND	1.0									
Bromomethane	ND	1.0									

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911019
Project: US 101/Petaluma Highway

ANALYTICAL QC SUMMARY REPORT

BatchID: R21674

Sample ID: **BLK-R21674**	SampType: **MBLK**	TestCode: **8260B_W**	Units: **µg/L**	Prep Date: **11/9/2009**	RunNo: **21674**
Client ID: **ZZZZZ**	Batch ID: **R21674**	TestNo: **SW8260B**		Analysis Date: **11/9/2009**	SeqNo: **311368**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Carbon tetrachloride	ND	1.0									
Chlorobenzene	ND	0.50									
Chloroform	ND	0.50									
Chloromethane	ND	0.50									
cis-1,2-Dichloroethene	ND	0.50									
cis-1,3-Dichloropropene	ND	0.50									
Dibromochloromethane	ND	0.50									
Dibromomethane	ND	0.50									
Dichlorodifluoromethane	ND	0.50									
Diisopropyl ether (DIPE)	ND	0.50									
Ethyl tert-butyl ether (ETBE)	ND	0.50									
Ethylbenzene	ND	0.50									
Freon-113	ND	1.0									
Hexachlorobutadiene	ND	0.50									
Isopropylbenzene	ND	1.0									
Methyl tert-butyl ether (MTBE)	ND	0.50									
Methylene chloride	ND	5.0									
Naphthalene	ND	1.0									
n-Butylbenzene	ND	0.50									
n-Propylbenzene	ND	0.50									
sec-Butylbenzene	ND	0.50									
Styrene	ND	0.50									
t-Butyl alcohol (t-Butanol)	ND	5.0									
tert-Amyl methyl ether (TAME)	ND	0.50									
tert-Butylbenzene	ND	0.50									
Tetrachloroethene	ND	0.50									
Toluene	ND	0.50									
trans-1,2-Dichloroethene	ND	0.50									
trans-1,3-Dichloropropene	ND	0.50									
Trichloroethene	ND	0.50									
Trichlorofluoromethane	ND	0.50									

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911019
Project: US 101/Petaluma Highway

ANALYTICAL QC SUMMARY REPORT

BatchID: R21674

Sample ID: **BLK-R21674** SampType: **MBLK** TestCode: **8260B_W** Units: **µg/L** Prep Date: **11/9/2009** RunNo: **21674**
Client ID: **ZZZZZ** Batch ID: **R21674** TestNo: **SW8260B** Analysis Date: **11/9/2009** SeqNo: **311368**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vinyl chloride	ND	0.50									
Xylenes, Total	ND	1.5									
Surr: Dibromofluoromethane	11.90	0	11.36	0	105	61.2	131				
Surr: 4-Bromofluorobenzene	12.55	0	11.36	0	110	64.1	120				
Surr: Toluene-d8	11.93	0	11.36	0	105	75.1	127				

Sample ID: **LCS-R21674** SampType: **LCS** TestCode: **8260B_W** Units: **µg/L** Prep Date: **11/9/2009** RunNo: **21674**
Client ID: **ZZZZZ** Batch ID: **R21674** TestNo: **SW8260B** Analysis Date: **11/9/2009** SeqNo: **311369**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	19.98	1.0	17.04	0	117	61.4	129				
Benzene	18.09	0.50	17.04	0	106	66.9	140				
Chlorobenzene	19.19	0.50	17.04	0	113	73.9	137				
Toluene	18.38	0.50	17.04	0	108	76.6	123				
Trichloroethene	18.31	0.50	17.04	0	107	69.3	144				
Surr: Dibromofluoromethane	10.67	0	11.36	0	93.9	61.2	131				
Surr: 4-Bromofluorobenzene	12.29	0	11.36	0	108	64.1	120				
Surr: Toluene-d8	11.66	0	11.36	0	103	75.1	127				

Sample ID: **LCSD-R21674** SampType: **LCSD** TestCode: **8260B_W** Units: **µg/L** Prep Date: **11/9/2009** RunNo: **21674**
Client ID: **ZZZZZ** Batch ID: **R21674** TestNo: **SW8260B** Analysis Date: **11/9/2009** SeqNo: **311370**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	19.16	1.0	17.04	0	112	61.4	129	19.98	4.19	20	
Benzene	18.71	0.50	17.04	0	110	66.9	140	18.09	3.37	20	
Chlorobenzene	19.16	0.50	17.04	0	112	73.9	137	19.19	0.156	20	
Toluene	17.06	0.50	17.04	0	100	76.6	123	18.38	7.45	20	
Trichloroethene	15.35	0.50	17.04	0	90.1	69.3	144	18.31	17.6	20	
Surr: Dibromofluoromethane	13.01	0	11.36	0	115	61.2	131	0	0	0	
Surr: 4-Bromofluorobenzene	11.66	0	11.36	0	103	64.1	120	0	0	0	
Surr: Toluene-d8	11.07	0	11.36	0	97.4	75.1	127	0	0	0	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911019
Project: US 101/Petaluma Highway

ANALYTICAL QC SUMMARY REPORT

BatchID: R21686

Sample ID: **WD091105A-MB** SampType: **MBLK** TestCode: **TPHDO_W** Units: **mg/L** Prep Date: **11/5/2009** RunNo: **21686**
Client ID: **ZZZZZ** Batch ID: **R21686** TestNo: **SW8015B** Analysis Date: **11/6/2009** SeqNo: **311293**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Diesel)	ND	0.10									
TPH (Motor Oil)	ND	0.20									
Surr: Pentacosane	0.09600	0	0.1	0	96.0	57.9	125				

Sample ID: **WD091105A-LCS** SampType: **LCS** TestCode: **TPHDO_W** Units: **mg/L** Prep Date: **11/5/2009** RunNo: **21686**
Client ID: **ZZZZZ** Batch ID: **R21686** TestNo: **SW8015B** Analysis Date: **11/6/2009** SeqNo: **311294**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Diesel)	0.7440	0.10	1	0	74.4	50.3	125				
Surr: Pentacosane	0.1020	0	0.1	0	102	57.9	125				

Sample ID: **WD091105A-LCSD** SampType: **LCSD** TestCode: **TPHDO_W** Units: **mg/L** Prep Date: **11/5/2009** RunNo: **21686**
Client ID: **ZZZZZ** Batch ID: **R21686** TestNo: **SW8015B** Analysis Date: **11/6/2009** SeqNo: **311295**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Diesel)	0.6040	0.10	1	0	60.4	50.3	125	0.744	20.8	30	
Surr: Pentacosane	0.1010	0	0.1	0	101	57.9	125	0	0	0	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

Torrent LABORATORY, INC.
483 Sinclair Frontage Road
Milpitas, CA 95035
Phone: 408.263.5258
FAX: 408.263.8293
www.torrentlab.com

RESET

CHAIN OF CUSTODY

• NOTE: SHADED AREAS ARE FOR TORRENT LAB USE ONLY •

LAB WORK ORDER NO 0911019

Company Name: URS Corp.	Location of Sampling: US 101/Petaluma Highway
Address: 55 S. Market St., #1500	Purpose: Groundwater Sampling
City: San Jose; State: Ca; Zip Code: 95113	Special Instructions / Comments:
Telephone: (408) 297-9585; FAX:	
REPORT TO: Patrick Walz; SAMPLER: Chuck Rambo	P.O. #: ; EMAIL:

TURNAROUND TIME:
- ☐ 10 Work Days
- ☐ 3 Work Days
- ☐ Noon - Nxt Day
- ☐ 7 Work Days
- ☐ 2 Work Days
- ☐ 2 - 8 Hours
- ☑ 5 Work Days
- ☐ 1 Work Day
- ☐ Other

SAMPLE TYPE:
- ☐ Storm Water
- ☐ Air
- ☐ Waste Water
- ☐ Other
- ☑ Ground Water
- ☐ Soil

REPORT FORMAT:
- ☐ QC Level IV
- ☐ EDF
- ☐ Excel / EDD

ANALYSIS REQUESTED

LAB ID	CLIENT'S SAMPLE I.D.	DATE / TIME SAMPLED	MATRIX	# OF CONT	CONT TYPE	VOCs	BTEX / TPH-g	TPH-d/mo	CAM 17 Metals						REMARKS
001A	SB-5-1-GW	11-4-09 12:40-12:55 AM	GW	3, 1, 1	Voas, 250	✓	✓	✓	✓						
														Temp. 5°C	

	Relinquished By:	Print:	Date:	Time:	Received By:	Print:	Date:	Time:
1	Charles Rambo	Charles Rambo	11-4-09	16:13	Stacy P. Hood	Stacy P. Hood	11/4/09	16:14
2	Stacy P. Hood	Stacy P. Hood	11/4/09	16:50	ONTRAC			

Were Samples Received in Good Condition? ☑ Yes ☐ NO Samples on Ice? ☑ Yes ☐ NO Method of Shipment On Trac Sample seals intact? ☐ Yes ☐ NO ☑ N/A

NOTE: Samples are discarded by the laboratory 30 days from date of receipt unless other arrange -ments are made.

Page 1 of 1

Log In By: Date: Log In Reviewed By: Date:

OnTrac 11-5-09 9:35 Am. P. L. Ghodasara 11-5-09 9:35 Am

Torrent
LABORATORY, INC.

January 05, 2010 (Revised)

Patrick Walz
URS Corporation, San Jose
55 South Market St., Suite 1500
San Jose, CA 95113

TEL: (408) 297-9585
FAX (408) 297-6962

RE: 28645097.04002

Order No.: 0911050

Dear Patrick Walz:

Torrent Laboratory, Inc. received 18 samples on 11/6/2009 for the analyses presented in the following report.

All data for associated QC met EPA or laboratory specification(s) except where noted in the case narrative.
Reported data is applicable for only the samples received as part of the order number referenced above.

Torrent Laboratory, Inc, is certified by the State of California, ELAP #1991. If you have any questions regarding these tests results, please feel free to contact the Project Management Team at (408)263-5258;ext: 204.

Sincerely,

Laboratory Director

1/5/10
Date

Patti Sandrock
QA Officer

483 Sinclair Frontage Rd., Milpitas, CA 95035 | tel: 408.263.5258 | main fax: 408.263.8293 | project manager fax: 408.263.2708
www.torrentlab.com

Torrent Laboratory, Inc. **Date:** *05-Jan-10*

CLIENT: URS Corporation, San Jose
Project: 28645097.04002
Lab Order: 0911050

CASE NARRATIVE

Note: Extraction of 50 g sample / 500g 0.2M Sodium Citrate Solution was performed according to wet extraction procedure (WET) which was rotated in a rotary shaker for 48 hours.

Date Prepared: started on 12/26/09 @ 12:30pm and ended on 12/28/09 2 12:30pm

Note: Extraction of 50 g sample /DI water was performed according to wet extraction procedure (DI STLC) which was rotated in a rotary shaker for 48 hours.

Date Prepared: started on 12/28/09 @ 8:30pm and ended on 12/30/09 @ 8:30pm.

Note: Extraction of 25 g sample / 500g TCLP Fluid # 1 was performed according to Toxicity Characteristic Leaching Procedure (TCLP) which was rotated in a rotary shaker for 18 hours.

Date Prepared: started on 12/30/09 @ 5:0pm and ended on 12/31/09 @ 11:0am.

Per Client request STLC, DI STLC and TCLP added to some samples and sample 013 reanalyzed for CAM17.

Rev1 1/5/10.

Certified Analytical Report of
Total Metals

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-6-1 @1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 10:18:00 AM

Lab Sample ID: 0911050-013B
Date Prepared: 12/28/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	12/28/2009	5	1	5.0	ND	mg/Kg	5945
Arsenic	SW6010B	12/28/2009	1.7	1	1.7	2.2	mg/Kg	5945
Barium	SW6010B	12/28/2009	5	1	5.0	90	mg/Kg	5945
Beryllium	SW6010B	12/28/2009	2	1	2.0	ND	mg/Kg	5945
Cadmium	SW6010B	12/28/2009	1	1	1.0	ND	mg/Kg	5945
Chromium	SW6010B	12/28/2009	5	1	5.0	35	mg/Kg	5945
Cobalt	SW6010B	12/28/2009	5	1	5.0	27	mg/Kg	5945
Copper	SW6010B	12/28/2009	5	1	5.0	33	mg/Kg	5945
Lead	SW6010B	12/28/2009	1	1	1.0	7.1	mg/Kg	5945
Molybdenum	SW6010B	12/28/2009	5	1	5.0	ND	mg/Kg	5945
Nickel	SW6010B	12/28/2009	5	1	5.0	42	mg/Kg	5945
Selenium	SW6010B	12/28/2009	5	1	5.0	ND	mg/Kg	5945
Silver	SW6010B	12/28/2009	1	1	1.0	ND	mg/Kg	5945
Thallium	SW6010B	12/28/2009	5	1	5.0	ND	mg/Kg	5945
Vanadium	SW6010B	12/28/2009	5	1	5.0	78	mg/Kg	5945
Zinc	SW6010B	12/28/2009	5	1	5.0	34	mg/Kg	5945

sample has expired at the time analysis is requested.

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Definitions, legends and Notes

Note	Description
ug/kg	Microgram per kilogram (ppb, part per billion).
ug/L	Microgram per liter (ppb, part per billion).
mg/kg	Milligram per kilogram (ppm, part per million).
mg/L	Milligram per liter (ppm, part per million).
LCS/LCSD	Laboratory control sample/laboratory control sample duplicate.
MDL	Method detection limit.
MRL	Modified reporting limit. When sample is subject to dilution, reporting limit times dilution factor yields MRL.
MS/MSD	Matrix spike/matrix spike duplicate.
N/A	Not applicable.
ND	Not detected at or above detection limit.
NR	Not reported.
QC	Quality Control.
RL	Reporting limit.
% RPD	Percent relative difference.
a	pH was measured immediately upon the receipt of the sample, but it was still done outside the holding time.
sub	Analyzed by subcontracting laboratory, Lab Certificate #

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

TORRENT LABORATORY, INC.

483 Sinclair Frontage Road • Milpitas, CA • Phone: (408) 263-5258 • Fax: (408) 263-8293

Visit us at www.torrentlab.com email: analysis@torrentlab.com

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-1-1 @0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 9:05:00 AM

Lab Sample ID: 0911050-001
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	ND	mg/L	5951
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	3.3	mg/L	5948
Lead	SW6010B	11/10/2009	1	1	1.0	70	mg/Kg	5779

Client Sample ID: SB-1-1 @1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 9:08:00 AM

Lab Sample ID: 0911050-002
Date Prepared: 11/9/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/10/2009	1	1	1.0	15	mg/Kg	5779

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-1-1 @1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 9:10:00 AM

Lab Sample ID: 0911050-003
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	ND	mg/L	5951
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	1.2	mg/L	5948
Lead	SW6010B	11/10/2009	1	1	1.0	54	mg/Kg	5779

Client Sample ID: SB-1-2 @0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 9:15:00 AM

Lab Sample ID: 0911050-004
Date Prepared: 11/9/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/10/2009	1	1	1.0	48	mg/Kg	5779

Client Sample ID: SB-1-2 @1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 9:20:00 AM

Lab Sample ID: 0911050-005
Date Prepared: 11/9/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/10/2009	1	1	1.0	28	mg/Kg	5779

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-1-2 @1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 9:25:00 AM

Lab Sample ID: 0911050-006
Date Prepared: 11/9/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/10/2009	1	1	1.0	19	mg/Kg	5779

Client Sample ID: SB-2-1 @0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 9:45:00 AM

Lab Sample ID: 0911050-007
Date Prepared: 11/9/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/10/2009	1	1	1.0	33	mg/Kg	5779

Client Sample ID: SB-2-1 @1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 9:50:00 AM

Lab Sample ID: 0911050-008
Date Prepared: 11/9/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/10/2009	1	1	1.0	30	mg/Kg	5779

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-2-1 @1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 9:55:00 AM

Lab Sample ID: 0911050-009
Date Prepared: 11/9/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	11/10/2009	5	1	5.0	ND	mg/Kg	5779
Arsenic	SW6010B	11/10/2009	1.7	1	1.7	2.3	mg/Kg	5779
Barium	SW6010B	11/10/2009	5	1	5.0	84	mg/Kg	5779
Beryllium	SW6010B	11/10/2009	2	1	2.0	ND	mg/Kg	5779
Cadmium	SW6010B	11/10/2009	1	1	1.0	ND	mg/Kg	5779
Chromium	SW6010B	11/10/2009	5	1	5.0	48	mg/Kg	5779
Cobalt	SW6010B	11/10/2009	5	1	5.0	24	mg/Kg	5779
Copper	SW6010B	11/10/2009	5	1	5.0	33	mg/Kg	5779
Lead	SW6010B	11/10/2009	1	1	1.0	23	mg/Kg	5779
Molybdenum	SW6010B	11/10/2009	5	1	5.0	ND	mg/Kg	5779
Nickel	SW6010B	11/10/2009	5	1	5.0	46	mg/Kg	5779
Selenium	SW6010B	11/10/2009	5	1	5.0	ND	mg/Kg	5779
Silver	SW6010B	11/10/2009	1	1	1.0	ND	mg/Kg	5779
Thallium	SW6010B	11/10/2009	5	1	5.0	ND	mg/Kg	5779
Vanadium	SW6010B	11/10/2009	5	1	5.0	70	mg/Kg	5779
Zinc	SW6010B	11/10/2009	5	1	5.0	42	mg/Kg	5779
Mercury	SW7471A	11/10/2009	0.1	1	0.10	ND	mg/Kg	5777

Client Sample ID: SB-2-2 @0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 10:00:00 AM

Lab Sample ID: 0911050-010
Date Prepared: 11/9/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/10/2009	1	1	1.0	26	mg/Kg	5779

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-2-2 @1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 10:05:00 AM

Lab Sample ID: 0911050-011
Date Prepared: 11/9/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/10/2009	1	1	1.0	15	mg/Kg	5779

Client Sample ID: SB-6-1 @0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 10:15:00 AM

Lab Sample ID: 0911050-012
Date Prepared: 12/31/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5956
Lead	SW6010B	11/10/2009	1	1	1.0	13	mg/Kg	5779

Client Sample ID: SB-6-1 @1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 10:18:00 AM

Lab Sample ID: 0911050-013
Date Prepared: 12/31/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5956
Lead	SW6010B	11/10/2009	1	1	1.0	7.0	mg/Kg	5779

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-6-1 @1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 10:20:00 AM

Lab Sample ID: 0911050-014
Date Prepared: 12/31/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5956
Lead	SW6010B	11/10/2009	1	1	1.0	3.0	mg/Kg	5779

Client Sample ID: SB-6-2 @0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 10:22:00 AM

Lab Sample ID: 0911050-015
Date Prepared: 12/31/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5956
Lead	SW6010B	11/10/2009	1	1	1.0	19	mg/Kg	5779

Client Sample ID: SB-6-2 @1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 10:25:00 AM

Lab Sample ID: 0911050-016
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	8.5	mg/Kg	5784

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-6-2-d @0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 10:22:00 AM

Lab Sample ID: 0911050-017
Date Prepared: 12/31/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5956
Lead	SW6010B	11/11/2009	1	1	1.0	17	mg/Kg	5784

Client Sample ID: SB-6-2-D@1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 10:25:00 AM

Lab Sample ID: 0911050-018
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	20	mg/Kg	5784

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Definitions, legends and Notes

Note	Description
ug/kg	Microgram per kilogram (ppb, part per billion).
ug/L	Microgram per liter (ppb, part per billion).
mg/kg	Milligram per kilogram (ppm, part per million).
mg/L	Milligram per liter (ppm, part per million).
LCS/LCSD	Laboratory control sample/laboratory control sample duplicate.
MDL	Method detection limit.
MRL	Modified reporting limit. When sample is subject to dilution, reporting limit times dilution factor yields MRL.
MS/MSD	Matrix spike/matrix spike duplicate.
N/A	Not applicable.
ND	Not detected at or above detection limit.
NR	Not reported.
QC	Quality Control.
RL	Reporting limit.
% RPD	Percent relative difference.
a	pH was measured immediately upon the receipt of the sample, but it was still done outside the holding time.
sub	Analyzed by subcontracting laboratory, Lab Certificate #

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Torrent Laboratory, Inc.

Date: *05-Jan-10*

CLIENT: URS Corporation, San Jose
Work Order: 0911050
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5777

Sample ID: **MB-5777** SampType: **MBLK** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **11/9/2009** RunNo: **21691**
Client ID: **ZZZZZ** Batch ID: **5777** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **11/10/2009** SeqNo: **311357**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	ND	0.10									

Sample ID: **LCS-5777** SampType: **LCS** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **11/9/2009** RunNo: **21691**
Client ID: **ZZZZZ** Batch ID: **5777** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **11/10/2009** SeqNo: **311355**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1.302	0.10	1.25	0	104	78.5	125				

Sample ID: **LCSD-5777** SampType: **LCSD** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **11/9/2009** RunNo: **21691**
Client ID: **ZZZZZ** Batch ID: **5777** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **11/10/2009** SeqNo: **311356**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1.310	0.10	1.25	0	105	78.5	125	1.302	0.574	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911050
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5779

Sample ID: **MB-5779** SampType: **MBLK** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/9/2009** RunNo: **21696**
Client ID: **ZZZZZ** Batch ID: **5779** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/10/2009** SeqNo: **311496**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	ND	5.0									
Arsenic	ND	1.7									
Barium	ND	5.0									
Beryllium	ND	2.0									
Cadmium	ND	1.0									
Chromium	ND	5.0									
Cobalt	ND	5.0									
Copper	ND	5.0									
Lead	ND	1.0									
Molybdenum	ND	5.0									
Nickel	ND	5.0									
Selenium	ND	5.0									
Silver	ND	1.0									
Thallium	ND	5.0									
Vanadium	ND	5.0									
Zinc	ND	5.0									

Sample ID: **LCS-5779** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/9/2009** RunNo: **21696**
Client ID: **ZZZZZ** Batch ID: **5779** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/10/2009** SeqNo: **311494**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	50.65	5.0	50	0	101	30.7	130				
Arsenic	48.20	1.7	50	0	96.4	71	121				
Barium	53.70	5.0	50	0.15	107	70.2	130				
Beryllium	51.15	2.0	50	0	102	73.3	115				
Cadmium	51.55	1.0	50	0	103	68.7	110				
Chromium	53.15	5.0	50	0.15	106	76	116				
Cobalt	52.80	5.0	50	0	106	57.4	122				
Copper	54.65	5.0	50	0.5	108	74.8	119				
Lead	49.05	1.0	50	0.25	97.6	67.9	118				
Molybdenum	50.45	5.0	50	0	101	62.9	123				

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911050
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5779

Sample ID: **LCS-5779** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/9/2009** RunNo: **21696**
Client ID: **ZZZZZ** Batch ID: **5779** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/10/2009** SeqNo: **311494**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nickel	52.20	5.0	50	0.1	104	61.5	122				
Selenium	46.45	5.0	50	0	92.9	62	111				
Silver	53.25	1.0	50	0	106	81.1	109				
Thallium	47.65	5.0	50	0	95.3	39.2	125				
Vanadium	54.00	5.0	50	0	108	65.8	122				
Zinc	51.70	5.0	50	0	103	59.9	122				

Sample ID: **LCSD-5779** SampType: **LCSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/9/2009** RunNo: **21696**
Client ID: **ZZZZZ** Batch ID: **5779** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/10/2009** SeqNo: **311495**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	50.40	5.0	50	0	101	30.7	130	50.65	0.495	30	
Arsenic	47.85	1.7	50	0	95.7	71	121	48.2	0.729	30	
Barium	50.30	5.0	50	0.15	100	70.2	130	53.7	6.54	30	
Beryllium	48.65	2.0	50	0	97.3	73.3	115	51.15	5.01	30	
Cadmium	48.20	1.0	50	0	96.4	68.7	110	51.55	6.72	30	
Chromium	49.90	5.0	50	0.15	99.5	76	116	53.15	6.31	30	
Cobalt	49.30	5.0	50	0	98.6	57.4	122	52.8	6.86	30	
Copper	51.25	5.0	50	0.5	102	74.8	119	54.65	6.42	30	
Lead	48.75	1.0	50	0.25	97.0	67.9	118	49.05	0.613	30	
Molybdenum	50.25	5.0	50	0	101	62.9	123	50.45	0.397	30	
Nickel	48.75	5.0	50	0.1	97.3	61.5	122	52.2	6.84	30	
Selenium	46.40	5.0	50	0	92.8	62	111	46.45	0.108	30	
Silver	49.35	1.0	50	0	98.7	81.1	109	53.25	7.60	30	
Thallium	47.55	5.0	50	0	95.1	39.2	125	47.65	0.210	30	
Vanadium	50.50	5.0	50	0	101	65.8	122	54	6.70	30	
Zinc	48.20	5.0	50	0	96.4	59.9	122	51.7	7.01	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911050
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5784

Sample ID: **MB-5784** SampType: **MBLK** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21710**
Client ID: **ZZZZZ** Batch ID: **5784** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311641**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	ND	1.0									

Sample ID: **LCS-5784** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21710**
Client ID: **ZZZZZ** Batch ID: **5784** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311639**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	49.45	1.0	50	0.45	98.0	67.9	118				

Sample ID: **LCSD-5784** SampType: **LCSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21710**
Client ID: **ZZZZZ** Batch ID: **5784** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311640**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	50.95	1.0	50	0.45	101	67.9	118	49.45	2.99	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911050
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5945

Sample ID: **MB-5945** SampType: **MBLK** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **12/28/2009** RunNo: **22259**
Client ID: **ZZZZZ** Batch ID: **5945** TestNo: **SW6010B (SW3050B)** Analysis Date: **12/28/2009** SeqNo: **318303**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	ND	5.0									
Arsenic	ND	1.7									
Barium	ND	5.0									
Beryllium	ND	2.0									
Cadmium	ND	1.0									
Chromium	ND	5.0									
Cobalt	ND	5.0									
Copper	ND	5.0									
Lead	ND	1.0									
Molybdenum	ND	5.0									
Nickel	ND	5.0									
Selenium	ND	5.0									
Silver	ND	1.0									
Thallium	ND	5.0									
Vanadium	ND	5.0									
Zinc	ND	5.0									

Sample ID: **LCS-5945** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **12/28/2009** RunNo: **22259**
Client ID: **ZZZZZ** Batch ID: **5945** TestNo: **SW6010B (SW3050B)** Analysis Date: **12/28/2009** SeqNo: **318301**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	47.80	5.0	50	0	95.6	30.7	130				
Arsenic	48.30	1.7	50	0	96.6	71	121				
Barium	50.30	5.0	50	0.9	98.8	70.2	130				
Beryllium	48.90	2.0	50	0.1	97.6	73.3	115				
Cadmium	47.40	1.0	50	0.1	94.6	68.7	110				
Chromium	50.75	5.0	50	0.2	101	76	116				
Cobalt	49.85	5.0	50	0.15	99.4	57.4	122				
Copper	50.50	5.0	50	0.45	100	74.8	119				
Lead	48.70	1.0	50	0.2	97.0	67.9	118				
Molybdenum	50.40	5.0	50	0.1	101	62.9	123				

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911050
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5945

Sample ID: **LCS-5945** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **12/28/2009** RunNo: **22259**
Client ID: **ZZZZZ** Batch ID: **5945** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **12/28/2009** SeqNo: **318301**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nickel	50.00	5.0	50	0.25	99.5	61.5	122				
Selenium	46.30	5.0	50	0	92.6	62	111				
Silver	48.25	1.0	50	0	96.5	81.1	109				
Thallium	46.80	5.0	50	0	93.6	39.2	125				
Vanadium	50.45	5.0	50	0.15	101	65.8	122				
Zinc	48.75	5.0	50	0.75	96.0	59.9	122				

Sample ID: **LCSD-5945** SampType: **LCSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **12/28/2009** RunNo: **22259**
Client ID: **ZZZZZ** Batch ID: **5945** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **12/28/2009** SeqNo: **318302**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	46.95	5.0	50	0	93.9	30.7	130	47.8	1.79	30	
Arsenic	47.75	1.7	50	0	95.5	71	121	48.3	1.15	30	
Barium	51.20	5.0	50	0.9	101	70.2	130	50.3	1.77	30	
Beryllium	50.90	2.0	50	0.1	102	73.3	115	48.9	4.01	30	
Cadmium	48.05	1.0	50	0.1	95.9	68.7	110	47.4	1.36	30	
Chromium	51.55	5.0	50	0.2	103	76	116	50.75	1.56	30	
Cobalt	51.00	5.0	50	0.15	102	57.4	122	49.85	2.28	30	
Copper	51.90	5.0	50	0.45	103	74.8	119	50.5	2.73	30	
Lead	48.10	1.0	50	0.2	95.8	67.9	118	48.7	1.24	30	
Molybdenum	49.65	5.0	50	0.1	99.1	62.9	123	50.4	1.50	30	
Nickel	51.20	5.0	50	0.25	102	61.5	122	50	2.37	30	
Selenium	45.80	5.0	50	0	91.6	62	111	46.3	1.09	30	
Silver	49.25	1.0	50	0	98.5	81.1	109	48.25	2.05	30	
Thallium	46.25	5.0	50	0	92.5	39.2	125	46.8	1.18	30	
Vanadium	51.50	5.0	50	0.15	103	65.8	122	50.45	2.06	30	
Zinc	49.55	5.0	50	0.75	97.6	59.9	122	48.75	1.63	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911050
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5947

Sample ID: **MB-5947** SampType: **MBLK** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **12/28/2009** RunNo: **22256**
Client ID: **ZZZZZ** Batch ID: **5947** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **12/29/2009** SeqNo: **318219**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	ND	0.10									

Sample ID: **LCS-5947** SampType: **LCS** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **12/28/2009** RunNo: **22256**
Client ID: **ZZZZZ** Batch ID: **5947** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **12/29/2009** SeqNo: **318217**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1.110	0.10	1.25	0	88.8	78.5	125				

Sample ID: **LCSD-5947** SampType: **LCSD** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **12/28/2009** RunNo: **22256**
Client ID: **ZZZZZ** Batch ID: **5947** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **12/29/2009** SeqNo: **318218**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1.308	0.10	1.25	0	105	78.5	125	1.11	16.4	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911050
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5948

Sample ID: **MB-5948** SampType: **MBLK** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22262**
Client ID: **ZZZZZ** Batch ID: **5948** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318398**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	ND	0.10									

Sample ID: **LCS-5948** SampType: **LCS** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22262**
Client ID: **ZZZZZ** Batch ID: **5948** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318396**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	9.010	0.10	10	0	90.1	75	125				

Sample ID: **LCSD-5948** SampType: **LCSD** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22262**
Client ID: **ZZZZZ** Batch ID: **5948** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318397**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	8.590	0.10	10	0	85.9	75	125	9.01	4.77	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911050
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5951

Sample ID: **MB-5951** SampType: **MBLK** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **12/30/2009** RunNo: **22287**
Client ID: **ZZZZZ** Batch ID: **5951** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318878**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	ND	0.10									

Sample ID: **LCS-5951** SampType: **LCS** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **12/30/2009** RunNo: **22287**
Client ID: **ZZZZZ** Batch ID: **5951** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318876**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	0.9720	0.10	1	0	97.2	75	125				

Sample ID: **LCSD-5951** SampType: **LCSD** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **12/30/2009** RunNo: **22287**
Client ID: **ZZZZZ** Batch ID: **5951** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318877**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	0.9710	0.10	1	0	97.1	75	125	0.972	0.103	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911050
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5956

Sample ID: **MB-5956** SampType: **MBLK** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **12/31/2009** RunNo: **22292**
Client ID: **ZZZZZ** Batch ID: **5956** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318960**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	ND	0.10									

Sample ID: **LCS-5956** SampType: **LCS** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **12/31/2009** RunNo: **22292**
Client ID: **ZZZZZ** Batch ID: **5956** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318958**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	9.490	0.10	10	0	94.9	75	125				

Sample ID: **LCSD-5956** SampType: **LCSD** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **12/31/2009** RunNo: **22292**
Client ID: **ZZZZZ** Batch ID: **5956** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318959**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	9.600	0.10	10	0	96.0	75	125	9.49	1.15	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

Torrent LABORATORY, INC.
483 Sinclair Frontage Road
Milpitas, CA 95035
Phone: 408.263.5258
FAX: 408.263.8293
www.torrentlab.com

RESET

CHAIN OF CUSTODY

• NOTE: SHADED AREAS ARE FOR TORRENT LAB USE ONLY •

LAB WORK ORDER NO: 0911050

Company Name: URS San Jose	Location of Sampling: Petaluma, CA
Address: 55 South Market St., Suite 1500	Purpose: Soil Investigation
City: San Jose / State: CA / Zip Code: 95113	Special Instructions / Comments: No more than 20 samples per work order
Telephone: 4082979585 / FAX: 4082976962	
REPORT TO: P Walz / SAMPLER: P Walz	P.O. #: 28645097.04002 / EMAIL:

TURNAROUND TIME: [x] 10 Work Days [ ] 3 Work Days [ ] Noon - Nxt Day [ ] 7 Work Days [ ] 2 Work Days [ ] 2 - 8 Hours [ ] 5 Work Days [ ] 1 Work Day [ ] Other

SAMPLE TYPE: [ ] Storm Water [ ] Air [ ] Waste Water [ ] Other [ ] Ground Water [x] Soil

REPORT FORMAT: [ ] QC Level IV [ ] EDF [ ] Excel / EDD

ANALYSIS REQUESTED

LAB ID	CLIENT'S SAMPLE I.D.	DATE / TIME SAMPLED	MATRIX	# OF CONT	CONT TYPE	Cam 17 Metals	Lead	TPH-d/mo	TPH-g						REMARKS
001A	SB-1-1 @ 0.5	11-5-09 0905	Soil	1	Jar		X								
002A	SB-1-1 @ 1.0	0908					X								
003A	SB-1-1 @ 1.5	0910					X								
004A	SB-1-2 @ 0.5	0915					X								
005A	SB-1-2 @ 1.0	0920					X								
006A	SB-1-2 @ 1.5	0925					X								
007A	SB-2-1 @ 0.5	0945					X								
008A	SB-2-1 @ 1.0	0950					X								
009A	SB-2-1 @ 1.5	0955				X									
010A	SB-2-2 @ 0.5	1000					X								

Temp: 4°C

	Relinquished By:	Print:	Date:	Time:	Received By:	Print:	Date:	Time:
1	[signature]	P Walz	11-6-09	1630	[signature]		11/6	5:00
2	[signature]		11-6	5:58	[signature]	Print: NAVIN G.	11-6-09	5:58

Were Samples Received in Good Condition? [x] Yes [ ] NO Samples on Ice? [x] Yes [ ] NO Method of Shipment Hispeed Sample seals intact? [ ] Yes [ ] NO [x] N/A

NOTE: Samples are discarded by the laboratory 30 days from date of receipt unless other arrange -ments are made.

Log In By: Date: Log In Reviewed By: Date:

Page 1 of 2

Work order 1 of 7

Torrent LABORATORY, INC.
483 Sinclair Frontage Road
Milpitas, CA 95035
Phone: 408.263.5258
FAX: 408.263.8293
www.torrentlab.com

RESET

CHAIN OF CUSTODY

• NOTE: SHADED AREAS ARE FOR TORRENT LAB USE ONLY •

LAB WORK ORDER NO 0911050

Company Name: URS San Jose	Location of Sampling: Petaluma, CA
Address: 55 South Market St., Suite 1500	Purpose: Soil Investigation
City: San Jose State: CA Zip Code: 95113	Special Instructions / Comments:
Telephone: 4082979585 FAX: 4082976962	
REPORT TO: P Walz SAMPLER: P Walz	P.O. #: 28645097.04002 EMAIL:

TURNAROUND TIME: [x] 10 Work Days [ ] 3 Work Days [ ] Noon - Nxt Day [ ] 7 Work Days [ ] 2 Work Days [ ] 2 - 8 Hours [ ] 5 Work Days [ ] 1 Work Day [ ] Other

SAMPLE TYPE: [ ] Storm Water [ ] Air [ ] Waste Water [ ] Other [ ] Ground Water [x] Soil

REPORT FORMAT: [ ] QC Level IV [ ] EDF [ ] Excel / EDD

ANALYSIS REQUESTED

LAB ID	CLIENT'S SAMPLE I.D.	DATE / TIME SAMPLED	MATRIX	# OF CONT	CONT TYPE	Cam 17 Metals	Lead	TPH-d/mo	TPH-g						REMARKS
011A	SB-2-2 @ 1.0	11-5-09 1005	Soil	1	Jar		X								
012A	SB-6-1 @ 0.5	1015					X								
013A	SB-6-1 @ 1.0	1018					X								
014A	SB-6-1 @ 1.5	1020					X								
015A	SB-6-2 @ 0.5	1022					X								
016A	SB-6-2 @ 1.0	1025					X								
017A	SB-6-2-d @ 0.5	1022 ~~1020~~					X								
018A	SB-6-2-d @ 1.0	1025 ~~1030~~					X								

Temp 4°C

	Relinquished By:	Print:	Date:	Time:	Received By:	Print:	Date:	Time:
1	[signature]	P Walz	11-6-09	1830	[signature]		11/6	2200
2	[signature]		11-6	5:58	[signature]		11-6-09	5:58

Were Samples Received in Good Condition? [x] Yes [ ] NO Samples on Ice? [x] Yes [ ] NO Method of Shipment Hispeed Sample seals intact? [ ] Yes [ ] NO [x] N/A

NOTE: Samples are discarded by the laboratory 30 days from date of receipt unless other arrange -ments are made.

Page 2 of 2

Log In By: Date: Log In Reviewed By: Date:

WO 1 of 7

Torrent
LABORATORY, INC.

January 05, 2010 (Revised)

Patrick Walz
URS Corporation, San Jose
55 South Market St., Suite 1500
San Jose, CA 95113

TEL: (408) 297-9585
FAX (408) 297-6962

RE: 28645097.04002

Order No.: 0911051

Dear Patrick Walz:

Torrent Laboratory, Inc. received 18 samples on 11/6/2009 for the analyses presented in the following report.

All data for associated QC met EPA or laboratory specification(s) except where noted in the case narrative.
Reported data is applicable for only the samples received as part of the order number referenced above.

Torrent Laboratory, Inc, is certified by the State of California, ELAP #1991. If you have any questions regarding these tests results, please feel free to contact the Project Management Team at (408)263-5258;ext: 204.

Sincerely,

Laboratory Director

1/5/10
Date

Patti Sandrock
QA Officer

483 Sinclair Frontage Rd., Milpitas, CA 95035 | tel: 408.263.5258 | main fax: 408.263.8293 | project manager fax: 408.263.2708
www.torrentlab.com

Torrent Laboratory, Inc. **Date:** *05-Jan-10*

CLIENT: URS Corporation, San Jose
Project: 28645097.04002
Lab Order: 0911051

CASE NARRATIVE

Analytical Comment for 6010B, 0910051-009A MSD, Note:The % recovery in the MSD for Vanadium is outside of laboratory control limits but within % RPD limits and % recovery limits for the LCS/LCSD. No corrective action is required.

Note: Extraction of 50 g sample / 500g 0.2M Sodium Citrate Solution was performed according to wet extraction procedure (WET) which was rotated in a rotary shaker for 48 hours.

Date Prepared: started on 12/26/09 @ 12:30pm and ended on 12/28/09 2 12:30pm

Note: Extraction of 50 g sample / DI water was performed according to wet extraction procedure (DI STLC) which was rotated in a rotary shaker for 48 hours.

Date Prepared: started on 12/28/09 @ 8:30pm and ended on 12/30/09 @ 8:30pm.

Note: Extraction of 25 g sample / 500g TCLP Fluid # 1 was performed according to Toxicity Characteristic Leaching Procedure (TCLP) which was rotated in a rotary shaker for 18 hours.

Date Prepared: started on 12/30/09 @ 5:0pm and ended on 12/31/09 @ 11:0am.

Per Client request STLC, DI DTLC, TCLP added to some samples and reported.

Rev1 1/5/10

TORRENT LABORATORY, INC.

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Visit us at www.torrentlab.com email: analysis@torrentlab.com

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-3-1 @0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 10:40:00 AM

Lab Sample ID: 0911051-001
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	ND	mg/L	5951
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	ND	mg/L	5948
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5956
Lead	SW6010B	11/11/2009	1	1	1.0	120	mg/Kg	5784

Client Sample ID: SB-3-1 @1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 10:42:00 AM

Lab Sample ID: 0911051-002
Date Prepared: 12/31/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5956
Lead	SW6010B	11/11/2009	1	1	1.0	5.0	mg/Kg	5784

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-3-1 @ 1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 10:45:00 AM

Lab Sample ID: 0911051-003
Date Prepared: 12/31/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5956
Lead	SW6010B	11/11/2009	1	1	1.0	6.0	mg/Kg	5784

Client Sample ID: SB-3-2 @0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 10:50:00 AM

Lab Sample ID: 0911051-004
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	ND	mg/L	5951
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	1.7	mg/L	5948
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5956
Lead	SW6010B	11/11/2009	1	1	1.0	150	mg/Kg	5784

Client Sample ID: SB-3-2 @1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 10:52:00 AM

Lab Sample ID: 0911051-005
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	23	mg/Kg	5784

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-3-2 @1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 10:55:00 AM

Lab Sample ID: 0911051-006
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	37	mg/Kg	5784

Client Sample ID: SB-4-1 @0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 11:10:00 AM

Lab Sample ID: 0911051-007
Date Prepared: 12/31/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5956
Lead	SW6010B	11/11/2009	1	1	1.0	15	mg/Kg	5784

Client Sample ID: SB-4-1 @1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 11:12:00 AM

Lab Sample ID: 0911051-008
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	11	mg/Kg	5784

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-4-1 @1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 11:15:00 AM

Lab Sample ID: 0911051-009
Date Prepared: 11/9/2009-11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	11/11/2009	5	1	5.0	ND	mg/Kg	5784
Arsenic	SW6010B	11/11/2009	1.7	1	1.7	ND	mg/Kg	5784
Barium	SW6010B	11/11/2009	5	1	5.0	92	mg/Kg	5784
Beryllium	SW6010B	11/11/2009	2	1	2.0	ND	mg/Kg	5784
Cadmium	SW6010B	11/11/2009	1	1	1.0	ND	mg/Kg	5784
Chromium	SW6010B	11/11/2009	5	1	5.0	34	mg/Kg	5784
Cobalt	SW6010B	11/11/2009	5	1	5.0	16	mg/Kg	5784
Copper	SW6010B	11/11/2009	5	1	5.0	27	mg/Kg	5784
Lead	SW6010B	11/11/2009	1	1	1.0	6.8	mg/Kg	5784
Molybdenum	SW6010B	11/11/2009	5	1	5.0	ND	mg/Kg	5784
Nickel	SW6010B	11/11/2009	5	1	5.0	26	mg/Kg	5784
Selenium	SW6010B	11/11/2009	5	1	5.0	ND	mg/Kg	5784
Silver	SW6010B	11/11/2009	1	1	1.0	1.8	mg/Kg	5784
Thallium	SW6010B	11/11/2009	5	1	5.0	ND	mg/Kg	5784
Vanadium	SW6010B	11/11/2009	5	1	5.0	85	mg/Kg	5784
Zinc	SW6010B	11/11/2009	5	1	5.0	30	mg/Kg	5784
Mercury	SW7471A	11/10/2009	0.1	1	0.10	ND	mg/Kg	5777

Client Sample ID: SB-4-2 @0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 11:20:00 AM

Lab Sample ID: 0911051-010
Date Prepared: 12/31/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5956
Lead	SW6010B	11/11/2009	1	1	1.0	15	mg/Kg	5784

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-4-2 @1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 11:22:00 AM

Lab Sample ID: 0911051-011
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	8.9	mg/Kg	5784

Client Sample ID: SB-4-2 @1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 11:25:00 AM

Lab Sample ID: 0911051-012
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	9.1	mg/Kg	5784

Client Sample ID: NB-5-1 @0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 12:15:00 PM

Lab Sample ID: 0911051-013
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	0.14	mg/L	5951
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	4.2	mg/L	5948
Lead	SW6010B	11/11/2009	1	1	1.0	77	mg/Kg	5784

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: NB-5-1 @1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 12:17:00 PM

Lab Sample ID: 0911051-014
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	24	mg/Kg	5784

Client Sample ID: NB-5-1 @1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 12:20:00 PM

Lab Sample ID: 0911051-015
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	11	mg/Kg	5784

Client Sample ID: NB-5-2 @0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 12:25:00 PM

Lab Sample ID: 0911051-016
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	ND	mg/L	5951
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	1.2	mg/L	5948
Lead	SW6010B	11/11/2009	1	1	1.0	68	mg/Kg	5784

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: NB-5-2 @1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 12:27:00 PM

Lab Sample ID: 0911051-017
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	29	mg/Kg	5785

Client Sample ID: NB-5-2 @1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 12:30:00 PM

Lab Sample ID: 0911051-018
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	13	mg/Kg	5785

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Definitions, legends and Notes

Note	Description
ug/kg	Microgram per kilogram (ppb, part per billion).
ug/L	Microgram per liter (ppb, part per billion).
mg/kg	Milligram per kilogram (ppm, part per million).
mg/L	Milligram per liter (ppm, part per million).
LCS/LCSD	Laboratory control sample/laboratory control sample duplicate.
MDL	Method detection limit.
MRL	Modified reporting limit. When sample is subject to dilution, reporting limit times dilution factor yields MRL.
MS/MSD	Matrix spike/matrix spike duplicate.
N/A	Not applicable.
ND	Not detected at or above detection limit.
NR	Not reported.
QC	Quality Control.
RL	Reporting limit.
% RPD	Percent relative difference.
a	pH was measured immediately upon the receipt of the sample, but it was still done outside the holding time.
sub	Analyzed by subcontracting laboratory, Lab Certificate #

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Torrent Laboratory, Inc.

Date: *05-Jan-10*

CLIENT: URS Corporation, San Jose
Work Order: 0911051
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5777

Sample ID: **MB-5777** SampType: **MBLK** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **11/9/2009** RunNo: **21691**
Client ID: **ZZZZZ** Batch ID: **5777** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **11/10/2009** SeqNo: **311357**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	ND	0.10									

Sample ID: **LCS-5777** SampType: **LCS** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **11/9/2009** RunNo: **21691**
Client ID: **ZZZZZ** Batch ID: **5777** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **11/10/2009** SeqNo: **311355**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1.302	0.10	1.25	0	104	78.5	125				

Sample ID: **LCSD-5777** SampType: **LCSD** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **11/9/2009** RunNo: **21691**
Client ID: **ZZZZZ** Batch ID: **5777** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **11/10/2009** SeqNo: **311356**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1.310	0.10	1.25	0	105	78.5	125	1.302	0.574	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911051
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5784

Sample ID: **MB-5784** SampType: **MBLK** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21710**
Client ID: **ZZZZZ** Batch ID: **5784** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311641**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	ND	5.0									
Arsenic	ND	1.7									
Barium	ND	5.0									
Beryllium	ND	2.0									
Cadmium	ND	1.0									
Chromium	ND	5.0									
Cobalt	ND	5.0									
Copper	ND	5.0									
Lead	ND	1.0									
Molybdenum	ND	5.0									
Nickel	ND	5.0									
Selenium	ND	5.0									
Silver	ND	1.0									
Thallium	ND	5.0									
Vanadium	ND	5.0									
Zinc	ND	5.0									

Sample ID: **LCS-5784** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21710**
Client ID: **ZZZZZ** Batch ID: **5784** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311639**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	48.50	5.0	50	0	97.0	30.7	130				
Arsenic	48.10	1.7	50	0	96.2	71	121				
Barium	51.70	5.0	50	0.2	103	70.2	130				
Beryllium	49.35	2.0	50	0.1	98.5	73.3	115				
Cadmium	48.95	1.0	50	0.1	97.7	68.7	110				
Chromium	51.40	5.0	50	0.15	103	76	116				
Cobalt	50.85	5.0	50	0	102	57.4	122				
Copper	53.80	5.0	50	0.65	106	74.8	119				
Lead	49.45	1.0	50	0.45	98.0	67.9	118				
Molybdenum	50.00	5.0	50	0.1	99.8	62.9	123				

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911051
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5784

Sample ID: **LCS-5784** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21710**
Client ID: **ZZZZZ** Batch ID: **5784** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311639**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nickel	50.80	5.0	50	0.15	101	61.5	122				
Selenium	45.15	5.0	50	0	90.3	62	111				
Silver	50.80	1.0	50	0	102	81.1	109				
Thallium	46.70	5.0	50	0.15	93.1	39.2	125				
Vanadium	51.90	5.0	50	0	104	65.8	122				
Zinc	52.85	5.0	50	1.4	103	59.9	122				

Sample ID: **LCSD-5784** SampType: **LCSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21710**
Client ID: **ZZZZZ** Batch ID: **5784** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311640**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	49.85	5.0	50	0	99.7	30.7	130	48.5	2.75	30	
Arsenic	49.60	1.7	50	0	99.2	71	121	48.1	3.07	30	
Barium	53.75	5.0	50	0.2	107	70.2	130	51.7	3.89	30	
Beryllium	51.35	2.0	50	0.1	103	73.3	115	49.35	3.97	30	
Cadmium	50.90	1.0	50	0.1	102	68.7	110	48.95	3.91	30	
Chromium	54.55	5.0	50	0.15	109	76	116	51.4	5.95	30	
Cobalt	53.20	5.0	50	0	106	57.4	122	50.85	4.52	30	
Copper	54.65	5.0	50	0.65	108	74.8	119	53.8	1.57	30	
Lead	50.95	1.0	50	0.45	101	67.9	118	49.45	2.99	30	
Molybdenum	51.60	5.0	50	0.1	103	62.9	123	50	3.15	30	
Nickel	53.20	5.0	50	0.15	106	61.5	122	50.8	4.62	30	
Selenium	46.55	5.0	50	0	93.1	62	111	45.15	3.05	30	
Silver	52.30	1.0	50	0	105	81.1	109	50.8	2.91	30	
Thallium	48.40	5.0	50	0.15	96.5	39.2	125	46.7	3.58	30	
Vanadium	54.20	5.0	50	0	108	65.8	122	51.9	4.34	30	
Zinc	54.40	5.0	50	1.4	106	59.9	122	52.85	2.89	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911051
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5784

Sample ID: **0911051-009AMS** SampType: **MS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21710**
Client ID: **SB-4-1 @1.5** Batch ID: **5784** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311629**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	34.70	5.0	50	2	65.4	30.7	130				
Arsenic	44.25	1.7	50	1.55	85.4	71	121				
Barium	129.4	5.0	50	92.3	74.2	56.2	127				
Beryllium	44.20	2.0	50	0	88.4	73.3	115				
Cadmium	47.65	1.0	50	0	95.3	68.7	110				
Chromium	83.85	5.0	50	34.5	98.7	76	116				
Cobalt	62.70	5.0	50	16.3	92.8	57.4	122				
Copper	78.45	5.0	50	27.25	102	74.8	119				
Lead	53.50	1.0	50	6.85	93.3	60.5	113				
Molybdenum	43.00	5.0	50	0	86.0	62.9	123				
Nickel	67.80	5.0	50	26.45	82.7	61.5	122				
Selenium	39.15	5.0	50	0	78.3	62	111				
Silver	50.35	1.0	50	1.85	97.0	81.1	109				
Thallium	33.90	5.0	50	0	67.8	39.2	125				
Vanadium	131.6	5.0	50	84.9	93.4	65.8	122				
Zinc	66.00	5.0	50	30.1	71.8	59.9	122				

Sample ID: **0911051-009AMSD** SampType: **MSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21710**
Client ID: **SB-4-1 @1.5** Batch ID: **5784** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311630**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	35.70	5.0	50	2	67.4	30.7	130	34.7	2.84	30	
Arsenic	43.65	1.7	50	1.55	84.2	71	121	44.25	1.37	30	
Barium	121.2	5.0	50	92.3	57.7	56.2	127	129.4	6.59	30	
Beryllium	45.15	2.0	50	0	90.3	73.3	115	44.2	2.13	30	
Cadmium	47.00	1.0	50	0	94.0	68.7	110	47.65	1.37	30	
Chromium	85.35	5.0	50	34.5	102	76	116	83.85	1.77	30	
Cobalt	62.00	5.0	50	16.3	91.4	57.4	122	62.7	1.12	30	
Copper	81.10	5.0	50	27.25	108	74.8	119	78.45	3.32	30	
Lead	52.45	1.0	50	6.85	91.2	60.5	113	53.5	1.98	30	
Molybdenum	43.10	5.0	50	0	86.2	62.9	123	43	0.232	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911051
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5784

Sample ID: **0911051-009AMSD** SampType: **MSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21710**
Client ID: **SB-4-1 @1.5** Batch ID: **5784** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311630**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nickel	77.05	5.0	50	26.45	101	61.5	122	67.8	12.8	30	
Selenium	38.30	5.0	50	0	76.6	62	111	39.15	2.19	30	
Silver	50.10	1.0	50	1.85	96.5	81.1	109	50.35	0.498	30	
Thallium	33.45	5.0	50	0	66.9	39.2	125	33.9	1.34	30	
Vanadium	117.0	5.0	50	84.9	64.3	65.8	122	131.6	11.7	30	S
Zinc	71.95	5.0	50	30.1	83.7	59.9	122	66	8.63	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911051
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5785

Sample ID: **MB-5785** SampType: **MBLK** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21722**
Client ID: **ZZZZZ** Batch ID: **5785** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311828**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	ND	1.0									

Sample ID: **LCS-5785** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21722**
Client ID: **ZZZZZ** Batch ID: **5785** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311826**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	49.70	1.0	50	0.15	99.1	67.9	118				

Sample ID: **LCSD-5785** SampType: **LCSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21722**
Client ID: **ZZZZZ** Batch ID: **5785** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311827**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	49.45	1.0	50	0.15	98.6	67.9	118	49.7	0.504	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911051
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5948

Sample ID: **MB-5948** SampType: **MBLK** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22262**
Client ID: **ZZZZZ** Batch ID: **5948** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318398**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	ND	0.10									

Sample ID: **LCS-5948** SampType: **LCS** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22262**
Client ID: **ZZZZZ** Batch ID: **5948** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318396**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	9.010	0.10	10	0	90.1	75	125				

Sample ID: **LCSD-5948** SampType: **LCSD** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22262**
Client ID: **ZZZZZ** Batch ID: **5948** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318397**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	8.590	0.10	10	0	85.9	75	125	9.01	4.77	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911051
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5951

Sample ID: **MB-5951** SampType: **MBLK** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **12/30/2009** RunNo: **22287**
Client ID: **ZZZZZ** Batch ID: **5951** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318878**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	ND	0.10									

Sample ID: **LCS-5951** SampType: **LCS** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **12/30/2009** RunNo: **22287**
Client ID: **ZZZZZ** Batch ID: **5951** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318876**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	0.9720	0.10	1	0	97.2	75	125				

Sample ID: **LCSD-5951** SampType: **LCSD** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **12/30/2009** RunNo: **22287**
Client ID: **ZZZZZ** Batch ID: **5951** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318877**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	0.9710	0.10	1	0	97.1	75	125	0.972	0.103	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911051
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5956

Sample ID: **MB-5956** SampType: **MBLK** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **12/31/2009** RunNo: **22292**
Client ID: **ZZZZZ** Batch ID: **5956** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318960**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	ND	0.10									

Sample ID: **LCS-5956** SampType: **LCS** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **12/31/2009** RunNo: **22292**
Client ID: **ZZZZZ** Batch ID: **5956** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318958**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	9.490	0.10	10	0	94.9	75	125				

Sample ID: **LCSD-5956** SampType: **LCSD** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **12/31/2009** RunNo: **22292**
Client ID: **ZZZZZ** Batch ID: **5956** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318959**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	9.600	0.10	10	0	96.0	75	125	9.49	1.15	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

Torrent LABORATORY, INC.
483 Sinclair Frontage Road
Milpitas, CA 95035
Phone: 408.263.5258
FAX: 408.263.8293
www.torrentlab.com

RESET

CHAIN OF CUSTODY

• NOTE: SHADED AREAS ARE FOR TORRENT LAB USE ONLY •

LAB WORK ORDER NO: 0911051

Company Name: URS San Jose	Location of Sampling: Petaluma, CA
Address: 55 South Market St., Suite 1500	Purpose: Soil Investigation
City: San Jose / State: CA / Zip Code: 95113	Special Instructions / Comments: Max 20 sample / WO
Telephone: 4082979585 / FAX: 4082976962	
REPORT TO: P Walz / SAMPLER: P Walz	P.O. #: 28645097.04002 / EMAIL:

TURNAROUND TIME: [x] 10 Work Days [ ] 3 Work Days [ ] Noon - Nxt Day [ ] 7 Work Days [ ] 2 Work Days [ ] 2 - 8 Hours [ ] 5 Work Days [ ] 1 Work Day [ ] Other

SAMPLE TYPE: [ ] Storm Water [ ] Air [ ] Waste Water [ ] Other [ ] Ground Water [x] Soil

REPORT FORMAT: [ ] QC Level IV [ ] EDF [ ] Excel / EDD

ANALYSIS REQUESTED

LAB ID	CLIENT'S SAMPLE I.D.	DATE / TIME SAMPLED	MATRIX	# OF CONT	CONT TYPE	Cam 17 Metals	Lead	TPH-d/mo	TPH-g						REMARKS
001A	SB-3-1 @ 0.5	11-5-09 1040	Soil	1	Jar		X								
002A	SB-3-1 @ 1.0	1042					X								
003A	SB-3-1 @ 1.5	1045					X								
004A	SB-3-2 @ 0.5	1050					X								
005A	SB-3-2 @ 1.0	1052					X								
006A	SB-3-2 @ 1.5	1055					X								
007A	SB-4-1 @ 0.5	1110					X								
008A	SB-4-1 @ 1.0	1112					X								
009A	SB-4-1 @ 1.5	1115				X	X								
010A	SB-4-2 @ 0.5	1120					X								

Temp 4°C

	Relinquished By:	Print:	Date:	Time:	Received By:	Print:	Date:	Time:
1	[signature]	P Walz	11-6-09	1630	[signature]		11/6	5:00
2	[signature]		11-6	5:58	[signature]		11-6-09	5:58

Were Samples Received in Good Condition? [x] Yes [ ] NO Samples on Ice? [x] Yes [ ] NO Method of Shipment flispeed Sample seals intact? [ ] Yes [ ] NO [x] N/A

NOTE: Samples are discarded by the laboratory 30 days from date of receipt unless other arrange -ments are made.

Log In By: Date: Log In Reviewed By: Date:

Page 1 of 7

Work order 2 of 7

Torrent LABORATORY, INC.
483 Sinclair Frontage Road
Milpitas, CA 95035
Phone: 408.263.5258
FAX: 408.263.8293
www.torrentlab.com

RESET

CHAIN OF CUSTODY

•NOTE: SHADED AREAS ARE FOR TORRENT LAB USE ONLY•

LAB WORK ORDER NO 0911051

Company Name: URS San Jose	Location of Sampling: Petaluma, CA
Address: 55 South Market St., Suite 1500	Purpose: Soil Investigation
City: San Jose / State: CA / Zip Code: 95113	Special Instructions / Comments:
Telephone: 4082979585 / FAX: 4082976962	
REPORT TO: P Walz / SAMPLER: P Walz	P.O. #: 28645097.04002 / EMAIL:

TURNAROUND TIME: ☑ 10 Work Days ☐ 3 Work Days ☐ Noon - Nxt Day ☐ 7 Work Days ☐ 2 Work Days ☐ 2 - 8 Hours ☐ 5 Work Days ☐ 1 Work Day ☐ Other

SAMPLE TYPE: ☐ Storm Water ☐ Air ☐ Waste Water ☐ Other ☐ Ground Water ☑ Soil

REPORT FORMAT: ☐ QC Level IV ☐ EDF ☐ Excel / EDD

ANALYSIS REQUESTED

LAB ID	CLIENT'S SAMPLE I.D.	DATE / TIME SAMPLED	MATRIX	# OF CONT	CONT TYPE	Cam 17 Metals	Lead	TPH-d/mo	TPH-g						REMARKS
011A	SB-Y-2 @ 1.0	11-5-09 1122	Soil	1	Jar		X								
012A	SB-Y-2 @ 1.5	1125					X								
013A	NB-S-1 @ 0.5	1215					X								
014A	NB-S-1 @ 1.0	1217					X								
015A	NB-S-1 @ 1.5	1220					X								
016A	NB-S-2 @ 0.5	1225					X								
017A	NB-S-2 @ 1.0	1227					X								
018A	NB-S-2 @ 1.5	1230					X								
							X								

Temp 4°C

	Relinquished By:	Print:	Date:	Time:	Received By:	Print:	Date:	Time:
1	[signature]	P Walz	11-6-09	1630	[signature]		11/6	5:00
2	[signature]		11-6	5:58	[signature]		11-6-09	5:58

Were Samples Received in Good Condition? ☑ Yes ☐ NO Samples on Ice? ☑ Yes ☐ NO Method of Shipment Hispeed Sample seals intact? ☐ Yes ☐ NO ☑ N/A

NOTE: Samples are discarded by the laboratory 30 days from date of receipt unless other arrange -ments are made.

Log In By: Date: Log In Reviewed By: Date:

Torrent
LABORATORY, INC.

January 08, 2010

Patrick Walz
URS Corporation, San Jose
55 South Market St., Suite 1500
San Jose, CA 95113

TEL: (408) 297-9585
FAX (408) 297-6962

RE: 28645097.04002

Order No.: 0911052

Dear Patrick Walz:

Torrent Laboratory, Inc. received 18 samples on 11/6/2009 for the analyses presented in the following report.

All data for associated QC met EPA or laboratory specification(s) except where noted in the case narrative.
Reported data is applicable for only the samples received as part of the order number referenced above.

Torrent Laboratory, Inc, is certified by the State of California, ELAP #1991. If you have any questions regarding these tests results, please feel free to contact the Project Management Team at (408)263-5258;ext: 204.

Sincerely,

Laboratory Director

1/8/10
Date

Patti Sandrock
QA Officer

483 Sinclair Frontage Rd., Milpitas, CA 95035 | tel: 408.263.5258 | main fax: 408.263.8293 | project manager fax: 408.263.2708
www.torrentlab.com

Torrent Laboratory, Inc. **Date:** *08-Jan-10*

CLIENT: URS Corporation, San Jose
Project: 28645097.04002
Lab Order: 0911052

CASE NARRATIVE

Analytical Comment for SW7471A. Note:The % recoveries in the MSD for mercury are outside of laboratory control limits but within % RPD limits and % recovery limits for the LCS/LCSD. No corrective action is required.

Analytical Comment for 6010B. Note:The % recoveries in the MS (RunNo: 21722) for barium and nickel are outside of laboratory control limits but within % RPD limits and % recovery limits for the LCS/LCSD. No corrective action is required.

Analytical Comment for 6010B. Note:The % recoveries in the MS (RunNo: 21723) for chromium are outside of laboratory control limits but within % RPD limits and % recovery limits for the LCS/LCSD. No corrective action is required.

Note: Extraction of 50 g sample / 500g 0.2M Sodium Citrate Solution was performed according to wet extraction procedure (WET) which was rotated in a rotary shaker for 48 hours.

Date Prepared: started on 12/26/09 @ 12:30pm and ended on 12/28/09 2 12:30pm

Note: Extraction of 50 g sample / DI water was performed according to wet extraction procedure (DI STLC) which was rotated in a rotary shaker for 48 hours.

Date Prepared: started on 01/04/10 @ 8:30pm and ended on 01/06/10 @ 8:30pm.

Note: Extraction of 25 g sample / 500g TCLP Fluid # 1 was performed according to Toxicity Characteristic Leaching Procedure (TCLP) which was rotated in a rotary shaker for 18 hours.

Date Prepared: started on 12/30/09 @ 5:0pm and ended on 12/31/09 @ 11:0am.

CLIENT:	URS Corporation, San Jose
Project:	28645097.04002
Lab Order:	0911052

CASE NARRATIVE

Per Client request STLC, DI DTLC, TCLP added to some samples and reported.

Rev1 1/8/10

TORRENT LABORATORY, INC.

483 Sinclair Frontage Road • Milpitas, CA • Phone: (408) 263-5258 • Fax: (408) 263-8293

Visit us at www.torrentlab.com email: analysis@torrentlab.com

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/8/2010

Client Sample ID: NB-6-1@0.5
Sample Location: Petaluma CA
Sample Matrix:
Date/Time Sampled 11/5/2009 12:35:00 PM

Lab Sample ID: 0911052-001
Date Prepared: 1/6/2010

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	1/7/2010	0.1	1	0.10	ND	mg/L	5972
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	1.9	mg/L	5948
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5956
Lead	SW6010B	11/11/2009	1	1	1.0	81	mg/Kg	5785

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/8/2010

Client Sample ID: NB-6-1 @1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 12:37:00 PM

Lab Sample ID: 0911052-002
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	11/11/2009	5	1	5.0	ND	mg/Kg	5785
Arsenic	SW6010B	11/11/2009	1.7	1	1.7	2.2	mg/Kg	5785
Barium	SW6010B	11/11/2009	5	1	5.0	100	mg/Kg	5785
Beryllium	SW6010B	11/11/2009	2	1	2.0	ND	mg/Kg	5785
Cadmium	SW6010B	11/11/2009	1	1	1.0	ND	mg/Kg	5785
Chromium	SW6010B	11/11/2009	5	1	5.0	49	mg/Kg	5785
Cobalt	SW6010B	11/11/2009	5	1	5.0	25	mg/Kg	5785
Copper	SW6010B	11/11/2009	5	1	5.0	32	mg/Kg	5785
Lead	SW6010B	11/11/2009	1	1	1.0	11	mg/Kg	5785
Molybdenum	SW6010B	11/11/2009	5	1	5.0	ND	mg/Kg	5785
Nickel	SW6010B	11/11/2009	5	1	5.0	44	mg/Kg	5785
Selenium	SW6010B	11/11/2009	5	1	5.0	ND	mg/Kg	5785
Silver	SW6010B	11/11/2009	1	1	1.0	1.0	mg/Kg	5785
Thallium	SW6010B	11/11/2009	5	1	5.0	ND	mg/Kg	5785
Vanadium	SW6010B	11/11/2009	5	1	5.0	76	mg/Kg	5785
Zinc	SW6010B	11/11/2009	5	1	5.0	41	mg/Kg	5785
Mercury	SW7471A	11/11/2009	0.1	1	0.10	ND	mg/Kg	5783

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/8/2010

Client Sample ID: NB-6-1 @1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 12:40:00 PM

Lab Sample ID: 0911052-003
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	19	mg/Kg	5785

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/8/2010

Client Sample ID: NB-9-1 @0.5
Sample Location: Petaluma CA
Sample Matrix:
Date/Time Sampled 11/5/2009 1:05:00 PM

Lab Sample ID: 0911052-004
Date Prepared: 1/6/2010

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	1/7/2010	0.1	1	0.10	ND	mg/L	5972
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	1.9	mg/L	5948
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5956
Lead	SW6010B	11/11/2009	1	1	1.0	59	mg/Kg	5785

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/8/2010

Client Sample ID: NB-9-1 @1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 1:07:00 PM

Lab Sample ID: 0911052-005
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	11/11/2009	5	1	5.0	ND	mg/Kg	5785
Arsenic	SW6010B	11/11/2009	1.7	1	1.7	ND	mg/Kg	5785
Barium	SW6010B	11/11/2009	5	1	5.0	41	mg/Kg	5785
Beryllium	SW6010B	11/11/2009	2	1	2.0	ND	mg/Kg	5785
Cadmium	SW6010B	11/11/2009	1	1	1.0	ND	mg/Kg	5785
Chromium	SW6010B	11/11/2009	5	1	5.0	23	mg/Kg	5785
Cobalt	SW6010B	11/11/2009	5	1	5.0	23	mg/Kg	5785
Copper	SW6010B	11/11/2009	5	1	5.0	42	mg/Kg	5785
Lead	SW6010B	11/11/2009	1	1	1.0	19	mg/Kg	5785
Molybdenum	SW6010B	11/11/2009	5	1	5.0	ND	mg/Kg	5785
Nickel	SW6010B	11/11/2009	5	1	5.0	67	mg/Kg	5785
Selenium	SW6010B	11/11/2009	5	1	5.0	ND	mg/Kg	5785
Silver	SW6010B	11/11/2009	1	1	1.0	ND	mg/Kg	5785
Thallium	SW6010B	11/11/2009	5	1	5.0	ND	mg/Kg	5785
Vanadium	SW6010B	11/11/2009	5	1	5.0	52	mg/Kg	5785
Zinc	SW6010B	11/11/2009	5	1	5.0	47	mg/Kg	5785
Mercury	SW7471A	11/11/2009	0.1	1	0.10	ND	mg/Kg	5783

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/8/2010

Client Sample ID: NB-9-1 @1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 1:10:00 PM

Lab Sample ID: 0911052-006
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	10	mg/Kg	5785

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/8/2010

Client Sample ID: NB-9-2 @0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 1:12:00 PM

Lab Sample ID: 0911052-007
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	43	mg/Kg	5785

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/8/2010

Client Sample ID: NB-9-2 @1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 1:15:00 PM

Lab Sample ID: 0911052-008
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	27	mg/Kg	5785

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/8/2010

Client Sample ID: NB-9-2@1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 1:18:00 PM

Lab Sample ID: 0911052-009
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	7.6	mg/Kg	5785

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/8/2010

Client Sample ID: NB-9-2-d@0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 1:12:00 PM

Lab Sample ID: 0911052-010
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	26	mg/Kg	5785

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/8/2010

Client Sample ID: NB-9-2-d@1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 1:15:00 PM

Lab Sample ID: 0911052-011
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	6.9	mg/Kg	5785

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/8/2010

Client Sample ID: NB-9-2d@1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 1:18:00 PM

Lab Sample ID: 0911052-012
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	20	mg/Kg	5785

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/8/2010

Client Sample ID: NB-8-1 @0.5
Sample Location: Petaluma CA
Sample Matrix:
Date/Time Sampled 11/5/2009 1:30:00 PM

Lab Sample ID: 0911052-013
Date Prepared: 1/6/2010

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	1/7/2010	0.1	1	0.10	2.6	mg/L	5972
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	23	mg/L	5948
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	0.45	mg/L	5956
Lead	SW6010B	11/11/2009	1	1	1.0	530	mg/Kg	5785

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/8/2010

Client Sample ID: NB-8-1 @1.0
Sample Location: Petaluma CA
Sample Matrix:
Date/Time Sampled 11/5/2009 1:32:00 PM

Lab Sample ID: 0911052-014
Date Prepared: 1/6/2010

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	1/7/2010	0.1	1	0.10	7.6	mg/L	5972
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	40	mg/L	5948
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	0.90	mg/L	5956
Lead	SW6010B	11/11/2009	1	1	1.0	800	mg/Kg	5785

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/8/2010

Client Sample ID: NB-8-1 @1.5
Sample Location: Petaluma CA
Sample Matrix:
Date/Time Sampled 11/5/2009 1:35:00 PM

Lab Sample ID: 0911052-015
Date Prepared: 1/6/2010

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	1/7/2010	0.1	1	0.10	0.53	mg/L	5972
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	3.8	mg/L	5948
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5956
Lead	SW6010B	11/11/2009	1	1	1.0	120	mg/Kg	5785

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/8/2010

Client Sample ID: NB-8-2 @0.5
Sample Location: Petaluma CA
Sample Matrix:
Date/Time Sampled 11/5/2009 1:40:00 PM

Lab Sample ID: 0911052-016
Date Prepared: 1/6/2010

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	1/7/2010	0.1	1	0.10	2.8	mg/L	5972
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	21	mg/L	5948
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	0.18	mg/L	5956
Lead	SW6010B	11/11/2009	1	1	1.0	540	mg/Kg	5785

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/8/2010

Client Sample ID: NB-8-2 21.0
Sample Location: Petaluma CA
Sample Matrix:
Date/Time Sampled 11/5/2009 1:42:00 PM

Lab Sample ID: 0911052-017
Date Prepared: 1/6/2010

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	1/7/2010	0.1	1	0.10	0.19	mg/L	5972
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	1.5	mg/L	5948
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5956
Lead	SW6010B	11/11/2009	1	1	1.0	110	mg/Kg	5785

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/8/2010

Client Sample ID: NB-8-2 21.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 1:45:00 PM

Lab Sample ID: 0911052-018
Date Prepared: 11/10/2009-11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	11/11/2009	5	1	5.0	ND	mg/Kg	5786
Arsenic	SW6010B	11/11/2009	1.7	1	1.7	4.4	mg/Kg	5786
Barium	SW6010B	11/11/2009	5	1	5.0	130	mg/Kg	5786
Beryllium	SW6010B	11/11/2009	2	1	2.0	ND	mg/Kg	5786
Cadmium	SW6010B	11/11/2009	1	1	1.0	ND	mg/Kg	5786
Chromium	SW6010B	11/11/2009	5	1	5.0	45	mg/Kg	5786
Cobalt	SW6010B	11/11/2009	5	1	5.0	6.6	mg/Kg	5786
Copper	SW6010B	11/11/2009	5	1	5.0	21	mg/Kg	5786
Lead	SW6010B	11/11/2009	1	1	1.0	27	mg/Kg	5786
Molybdenum	SW6010B	11/11/2009	5	1	5.0	ND	mg/Kg	5786
Nickel	SW6010B	11/11/2009	5	1	5.0	37	mg/Kg	5786
Selenium	SW6010B	11/11/2009	5	1	5.0	ND	mg/Kg	5786
Silver	SW6010B	11/11/2009	1	1	1.0	ND	mg/Kg	5786
Thallium	SW6010B	11/11/2009	5	1	5.0	ND	mg/Kg	5786
Vanadium	SW6010B	11/11/2009	5	1	5.0	43	mg/Kg	5786
Zinc	SW6010B	11/11/2009	5	1	5.0	36	mg/Kg	5786
Mercury	SW7471A	11/13/2009	0.1	1	0.10	0.11	mg/Kg	5789

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Definitions, legends and Notes

Note	Description
ug/kg	Microgram per kilogram (ppb, part per billion).
ug/L	Microgram per liter (ppb, part per billion).
mg/kg	Milligram per kilogram (ppm, part per million).
mg/L	Milligram per liter (ppm, part per million).
LCS/LCSD	Laboratory control sample/laboratory control sample duplicate.
MDL	Method detection limit.
MRL	Modified reporting limit. When sample is subject to dilution, reporting limit times dilution factor yields MRL.
MS/MSD	Matrix spike/matrix spike duplicate.
N/A	Not applicable.
ND	Not detected at or above detection limit.
NR	Not reported.
QC	Quality Control.
RL	Reporting limit.
% RPD	Percent relative difference.
a	pH was measured immediately upon the receipt of the sample, but it was still done outside the holding time.
sub	Analyzed by subcontracting laboratory, Lab Certificate #

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Torrent Laboratory, Inc.

Date: *08-Jan-10*

CLIENT: URS Corporation, San Jose
Work Order: 0911052
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5783

Sample ID: **MB-5783** SampType: **MBLK** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21774**
Client ID: **ZZZZZ** Batch ID: **5783** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **11/11/2009** SeqNo: **312456**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	ND	0.10									

Sample ID: **LCS-5783** SampType: **LCS** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21774**
Client ID: **ZZZZZ** Batch ID: **5783** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **11/11/2009** SeqNo: **312454**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1.373	0.10	1.25	0	110	78.5	125				

Sample ID: **LCSD-5783** SampType: **LCSD** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21774**
Client ID: **ZZZZZ** Batch ID: **5783** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **11/11/2009** SeqNo: **312455**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1.382	0.10	1.25	0	111	78.5	125	1.373	0.605	30	

Sample ID: **0911052-002AMS** SampType: **MS** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21774**
Client ID: **NB-6-1 @1.0** Batch ID: **5783** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **11/11/2009** SeqNo: **312434**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1.683	0.10	1.25	0	135	55.3	137				

Sample ID: **0911052-002AMSD** SampType: **MSD** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21774**
Client ID: **NB-6-1 @1.0** Batch ID: **5783** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **11/11/2009** SeqNo: **312435**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1.863	0.10	1.25	0	149	55.3	137	1.683	10.1	30	S

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911052
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5785

Sample ID: **MB-5785** SampType: **MBLK** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21722**
Client ID: **ZZZZZ** Batch ID: **5785** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311828**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	ND	5.0									
Arsenic	ND	1.7									
Barium	ND	5.0									
Beryllium	ND	2.0									
Cadmium	ND	1.0									
Chromium	ND	5.0									
Cobalt	ND	5.0									
Copper	ND	5.0									
Lead	ND	1.0									
Molybdenum	ND	5.0									
Nickel	ND	5.0									
Selenium	ND	5.0									
Silver	ND	1.0									
Thallium	ND	5.0									
Vanadium	ND	5.0									
Zinc	ND	5.0									

Sample ID: **LCS-5785** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21722**
Client ID: **ZZZZZ** Batch ID: **5785** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311826**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	51.40	5.0	50	0	103	30.7	130				
Arsenic	48.95	1.7	50	0	97.9	71	121				
Barium	49.40	5.0	50	0.3	98.2	70.2	130				
Beryllium	49.25	2.0	50	0	98.5	73.3	115				
Cadmium	47.25	1.0	50	0	94.5	68.7	110				
Chromium	49.25	5.0	50	0.15	98.2	76	116				
Cobalt	48.35	5.0	50	0	96.7	57.4	122				
Copper	50.15	5.0	50	0.5	99.3	74.8	119				
Lead	49.70	1.0	50	0.15	99.1	67.9	118				
Molybdenum	51.35	5.0	50	0	103	62.9	123				

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911052
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5785

Sample ID: **LCS-5785** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21722**
Client ID: **ZZZZZ** Batch ID: **5785** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311826**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nickel	48.15	5.0	50	0.1	96.1	61.5	122				
Selenium	46.95	5.0	50	0	93.9	62	111				
Silver	48.75	1.0	50	0	97.5	81.1	109				
Thallium	48.15	5.0	50	0	96.3	39.2	125				
Vanadium	49.90	5.0	50	0	99.8	65.8	122				
Zinc	46.30	5.0	50	0	92.6	59.9	122				

Sample ID: **LCSD-5785** SampType: **LCSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21722**
Client ID: **ZZZZZ** Batch ID: **5785** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311827**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	51.20	5.0	50	0	102	30.7	130	51.4	0.390	30	
Arsenic	48.75	1.7	50	0	97.5	71	121	48.95	0.409	30	
Barium	49.70	5.0	50	0.3	98.8	70.2	130	49.4	0.605	30	
Beryllium	47.95	2.0	50	0	95.9	73.3	115	49.25	2.67	30	
Cadmium	47.55	1.0	50	0	95.1	68.7	110	47.25	0.633	30	
Chromium	49.45	5.0	50	0.15	98.6	76	116	49.25	0.405	30	
Cobalt	48.55	5.0	50	0	97.1	57.4	122	48.35	0.413	30	
Copper	50.40	5.0	50	0.5	99.8	74.8	119	50.15	0.497	30	
Lead	49.45	1.0	50	0.15	98.6	67.9	118	49.7	0.504	30	
Molybdenum	51.15	5.0	50	0	102	62.9	123	51.35	0.390	30	
Nickel	48.15	5.0	50	0.1	96.1	61.5	122	48.15	0	30	
Selenium	46.95	5.0	50	0	93.9	62	111	46.95	0	30	
Silver	48.75	1.0	50	0	97.5	81.1	109	48.75	0	30	
Thallium	48.30	5.0	50	0	96.6	39.2	125	48.15	0.311	30	
Vanadium	50.05	5.0	50	0	100	65.8	122	49.9	0.300	30	
Zinc	46.50	5.0	50	0	93.0	59.9	122	46.3	0.431	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911052
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5785

Sample ID: **0911052-002AMS** SampType: **MS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21722**
Client ID: **NB-6-1 @1.0** Batch ID: **5785** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311808**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	39.80	5.0	50	2.85	73.9	30.7	130				
Arsenic	45.35	1.7	50	2.2	86.3	71	121				
Barium	119.3	5.0	50	101.2	36.1	56.2	127				S
Beryllium	43.05	2.0	50	0	86.1	73.3	115				
Cadmium	45.10	1.0	50	0	90.2	68.7	110				
Chromium	99.80	5.0	50	48.75	102	76	116				
Cobalt	62.80	5.0	50	25.15	75.3	57.4	122				
Copper	78.50	5.0	50	32.5	92.0	74.8	119				
Lead	51.20	1.0	50	10.95	80.5	60.5	113				
Molybdenum	43.10	5.0	50	0	86.2	62.9	123				
Nickel	73.95	5.0	50	43.5	60.9	61.5	122				S
Selenium	42.20	5.0	50	0	84.4	62	111				
Silver	49.75	1.0	50	1	97.5	81.1	109				
Thallium	35.10	5.0	50	0	70.2	39.2	125				
Vanadium	122.6	5.0	50	76.4	92.5	65.8	122				
Zinc	81.40	5.0	50	41.35	80.1	59.9	122				

Sample ID: **0911052-002AMSD** SampType: **MSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21722**
Client ID: **NB-6-1 @1.0** Batch ID: **5785** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311809**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	35.05	5.0	50	2.85	64.4	30.7	130	39.8	12.7	30	
Arsenic	46.40	1.7	50	2.2	88.4	71	121	45.35	2.29	30	
Barium	146.0	5.0	50	101.2	89.6	56.2	127	119.3	20.2	30	
Beryllium	43.60	2.0	50	0	87.2	73.3	115	43.05	1.27	30	
Cadmium	45.20	1.0	50	0	90.4	68.7	110	45.1	0.221	30	
Chromium	101.1	5.0	50	48.75	105	76	116	99.8	1.29	30	
Cobalt	65.80	5.0	50	25.15	81.3	57.4	122	62.8	4.67	30	
Copper	82.55	5.0	50	32.5	100	74.8	119	78.5	5.03	30	
Lead	51.05	1.0	50	10.95	80.2	60.5	113	51.2	0.293	30	
Molybdenum	42.35	5.0	50	0	84.7	62.9	123	43.1	1.76	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911052
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5785

Sample ID: **0911052-002AMSD** SampType: **MSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21722**
Client ID: **NB-6-1 @1.0** Batch ID: **5785** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311809**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nickel	77.25	5.0	50	43.5	67.5	61.5	122	73.95	4.37	30	
Selenium	40.00	5.0	50	0	80.0	62	111	42.2	5.35	30	
Silver	51.00	1.0	50	1	100	81.1	109	49.75	2.48	30	
Thallium	35.40	5.0	50	0	70.8	39.2	125	35.1	0.851	30	
Vanadium	125.9	5.0	50	76.4	99.0	65.8	122	122.6	2.62	30	
Zinc	80.75	5.0	50	41.35	78.8	59.9	122	81.4	0.802	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911052
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5786

Sample ID: **MB-5786** SampType: **MBLK** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21723**
Client ID: **ZZZZZ** Batch ID: **5786** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311854**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	ND	5.0									
Arsenic	ND	1.7									
Barium	ND	5.0									
Beryllium	ND	2.0									
Cadmium	ND	1.0									
Chromium	ND	5.0									
Cobalt	ND	5.0									
Copper	ND	5.0									
Lead	ND	1.0									
Molybdenum	ND	5.0									
Nickel	ND	5.0									
Selenium	ND	5.0									
Silver	ND	1.0									
Thallium	ND	5.0									
Vanadium	ND	5.0									
Zinc	ND	5.0									

Sample ID: **LCS-5786** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21723**
Client ID: **ZZZZZ** Batch ID: **5786** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311852**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	50.55	5.0	50	0	101	30.7	130				
Arsenic	49.55	1.7	50	0	99.1	71	121				
Barium	50.70	5.0	50	0.25	101	70.2	130				
Beryllium	48.05	2.0	50	0	96.1	73.3	115				
Cadmium	48.20	1.0	50	0	96.4	68.7	110				
Chromium	50.70	5.0	50	0.15	101	76	116				
Cobalt	49.55	5.0	50	0	99.1	57.4	122				
Copper	51.20	5.0	50	0.45	102	74.8	119				
Lead	50.50	1.0	50	0.2	101	67.9	118				
Molybdenum	51.65	5.0	50	0	103	62.9	123				

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911052
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5786

Sample ID: **LCS-5786** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21723**
Client ID: **ZZZZZ** Batch ID: **5786** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311852**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nickel	49.40	5.0	50	0.1	98.6	61.5	122				
Selenium	47.10	5.0	50	0	94.2	62	111				
Silver	49.50	1.0	50	0	99.0	81.1	109				
Thallium	48.30	5.0	50	0	96.6	39.2	125				
Vanadium	50.90	5.0	50	0	102	65.8	122				
Zinc	50.20	5.0	50	0.7	99.0	59.9	122				

Sample ID: **LCSD-5786** SampType: **LCSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21723**
Client ID: **ZZZZZ** Batch ID: **5786** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311853**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	50.85	5.0	50	0	102	30.7	130	50.55	0.592	30	
Arsenic	49.70	1.7	50	0	99.4	71	121	49.55	0.302	30	
Barium	51.00	5.0	50	0.25	102	70.2	130	50.7	0.590	30	
Beryllium	48.15	2.0	50	0	96.3	73.3	115	48.05	0.208	30	
Cadmium	48.75	1.0	50	0	97.5	68.7	110	48.2	1.13	30	
Chromium	51.60	5.0	50	0.15	103	76	116	50.7	1.76	30	
Cobalt	49.95	5.0	50	0	99.9	57.4	122	49.55	0.804	30	
Copper	52.40	5.0	50	0.45	104	74.8	119	51.2	2.32	30	
Lead	50.70	1.0	50	0.2	101	67.9	118	50.5	0.395	30	
Molybdenum	52.00	5.0	50	0	104	62.9	123	51.65	0.675	30	
Nickel	50.25	5.0	50	0.1	100	61.5	122	49.4	1.71	30	
Selenium	47.20	5.0	50	0	94.4	62	111	47.1	0.212	30	
Silver	50.20	1.0	50	0	100	81.1	109	49.5	1.40	30	
Thallium	48.70	5.0	50	0	97.4	39.2	125	48.3	0.825	30	
Vanadium	51.60	5.0	50	0	103	65.8	122	50.9	1.37	30	
Zinc	50.50	5.0	50	0.7	99.6	59.9	122	50.2	0.596	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911052
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5786

Sample ID: **0911052-018AMS** SampType: **MS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21723**
Client ID: **NB-8-2 21.5** Batch ID: **5786** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311831**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	33.00	5.0	50	0	66.0	30.7	130				
Arsenic	51.30	1.7	50	4.35	93.9	71	121				
Barium	186.6	5.0	50	126.7	120	56.2	127				
Beryllium	46.10	2.0	50	0	92.2	73.3	115				
Cadmium	47.30	1.0	50	0	94.6	68.7	110				
Chromium	103.8	5.0	50	44.9	118	76	116				S
Cobalt	51.75	5.0	50	6.55	90.4	57.4	122				
Copper	73.45	5.0	50	21.2	104	74.8	119				
Lead	71.85	1.0	50	26.8	90.1	60.5	113				
Molybdenum	44.10	5.0	50	0	88.2	62.9	123				
Nickel	89.55	5.0	50	37.05	105	61.5	122				
Selenium	43.85	5.0	50	0	87.7	62	111				
Silver	50.05	1.0	50	0	100	81.1	109				
Thallium	41.25	5.0	50	0	82.5	39.2	125				
Vanadium	99.40	5.0	50	42.65	114	65.8	122				
Zinc	87.40	5.0	50	35.8	103	59.9	122				

Sample ID: **0911052-018AMSD** SampType: **MSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21723**
Client ID: **NB-8-2 21.5** Batch ID: **5786** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311832**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	35.25	5.0	50	0	70.5	30.7	130	33	6.59	30	
Arsenic	48.90	1.7	50	4.35	89.1	71	121	51.3	4.79	30	
Barium	177.2	5.0	50	126.7	101	56.2	127	186.6	5.17	30	
Beryllium	45.50	2.0	50	0	91.0	73.3	115	46.1	1.31	30	
Cadmium	44.65	1.0	50	0	89.3	68.7	110	47.3	5.76	30	
Chromium	98.00	5.0	50	44.9	106	76	116	103.8	5.75	30	
Cobalt	50.10	5.0	50	6.55	87.1	57.4	122	51.75	3.24	30	
Copper	71.10	5.0	50	21.2	99.8	74.8	119	73.45	3.25	30	
Lead	68.40	1.0	50	26.8	83.2	60.5	113	71.85	4.92	30	
Molybdenum	43.85	5.0	50	0	87.7	62.9	123	44.1	0.569	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911052
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5786

Sample ID: **0911052-018AMSD** SampType: **MSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21723**
Client ID: **NB-8-2 21.5** Batch ID: **5786** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311832**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nickel	84.00	5.0	50	37.05	93.9	61.5	122	89.55	6.40	30	
Selenium	43.10	5.0	50	0	86.2	62	111	43.85	1.73	30	
Silver	47.30	1.0	50	0	94.6	81.1	109	50.05	5.65	30	
Thallium	41.05	5.0	50	0	82.1	39.2	125	41.25	0.486	30	
Vanadium	94.55	5.0	50	42.65	104	65.8	122	99.4	5.00	30	
Zinc	80.40	5.0	50	35.8	89.2	59.9	122	87.4	8.34	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911052
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5789

Sample ID: **MB-5789**	SampType: **MBLK**	TestCode: **HG_CTS**	Units: **mg/Kg**	Prep Date: **11/11/2009**	RunNo: **21735**
Client ID: **ZZZZZ**	Batch ID: **5789**	TestNo: **SW7471A**	**(SW7471APR**	Analysis Date: **11/13/2009**	SeqNo: **311972**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	ND	0.10									

Sample ID: **LCS-5789**	SampType: **LCS**	TestCode: **HG_CTS**	Units: **mg/Kg**	Prep Date: **11/11/2009**	RunNo: **21735**
Client ID: **ZZZZZ**	Batch ID: **5789**	TestNo: **SW7471A**	**(SW7471APR**	Analysis Date: **11/13/2009**	SeqNo: **311969**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1.018	0.10	1.25	0	81.5	78.5	125				

Sample ID: **LCSD-5789**	SampType: **LCSD**	TestCode: **HG_CTS**	Units: **mg/Kg**	Prep Date: **11/11/2009**	RunNo: **21735**
Client ID: **ZZZZZ**	Batch ID: **5789**	TestNo: **SW7471A**	**(SW7471APR**	Analysis Date: **11/13/2009**	SeqNo: **311970**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	0.9958	0.10	1.25	0	79.7	78.5	125	1.018	2.23	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911052
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5948

Sample ID: **MB-5948** SampType: **MBLK** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22262**
Client ID: **ZZZZZ** Batch ID: **5948** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318398**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	ND	0.10									

Sample ID: **LCS-5948** SampType: **LCS** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22262**
Client ID: **ZZZZZ** Batch ID: **5948** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318396**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	9.010	0.10	10	0	90.1	75	125				

Sample ID: **LCSD-5948** SampType: **LCSD** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22262**
Client ID: **ZZZZZ** Batch ID: **5948** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318397**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	8.590	0.10	10	0	85.9	75	125	9.01	4.77	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911052
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5956

Sample ID: **MB-5956** SampType: **MBLK** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **12/31/2009** RunNo: **22292**
Client ID: **ZZZZZ** Batch ID: **5956** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318960**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	ND	0.10									

Sample ID: **LCS-5956** SampType: **LCS** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **12/31/2009** RunNo: **22292**
Client ID: **ZZZZZ** Batch ID: **5956** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318958**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	9.490	0.10	10	0	94.9	75	125				

Sample ID: **LCSD-5956** SampType: **LCSD** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **12/31/2009** RunNo: **22292**
Client ID: **ZZZZZ** Batch ID: **5956** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318959**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	9.600	0.10	10	0	96.0	75	125	9.49	1.15	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911052
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5972

Sample ID: **MB-5972** SampType: **MBLK** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **1/6/2010** RunNo: **22328**
Client ID: **ZZZZZ** Batch ID: **5972** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **1/7/2010** SeqNo: **319301**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	ND	0.10									

Sample ID: **LCS-5972** SampType: **LCS** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **1/6/2010** RunNo: **22328**
Client ID: **ZZZZZ** Batch ID: **5972** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **1/7/2010** SeqNo: **319299**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	1.066	0.10	1	0	107	75	125				

Sample ID: **LCSD-5972** SampType: **LCSD** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **1/6/2010** RunNo: **22328**
Client ID: **ZZZZZ** Batch ID: **5972** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **1/7/2010** SeqNo: **319300**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	1.015	0.10	1	0	102	75	125	1.066	4.90	30	

Sample ID: **0911052-001AMS** SampType: **MS** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **1/6/2010** RunNo: **22328**
Client ID: **NB-6-1@0.5** Batch ID: **5972** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **1/7/2010** SeqNo: **319291**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	9.970	0.10	10	0.09	98.8	75	125				

Sample ID: **0911052-001AMSD** SampType: **MSD** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **1/6/2010** RunNo: **22328**
Client ID: **NB-6-1@0.5** Batch ID: **5972** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **1/7/2010** SeqNo: **319292**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	9.990	0.10	10	0.09	99.0	75	125	9.97	0.200	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

Torrent Laboratory, Inc.

WORK ORDER Summary

09-Nov-09

Work Order 0911052

Client ID: URS CORPORATION

Project: 28645097.04002 **QC Level:**

Comments: 10 day TAT!!! 18 soils @4'C. 15 for lead only, 2 for CAM 17, -018A (NB-8-2@1.5) not marked for any anlaysis - polaced on hold until client contacted

Sample ID	Client Sample ID	Collection Date	Date Received	Date Due	Matrix	Test Code	Hld	MS	SEL	Sub	Storage
0911052-001A	NB-6-1@0.5	11/5/2009 12:35:00 PM	11/6/2009	11/17/2009		3050B_S	☐	☐	☐	☐	SR
				11/17/2009		6010B_S	☐	☐	☑	☐	SR
0911052-002A	NB-6-1 @1.0	11/5/2009 12:37:00 PM		11/17/2009	Soil	3050B_S	☐	☐	☐	☐	SR
				11/17/2009		6010B_S	☐	☐	☑	☐	SR
				11/17/2009		7471_PREP	☐	☐	☐	☐	SR
				11/17/2009		HG_CTS	☐	☐	☐	☐	SR
0911052-003A	NB-6-1 @1.5	11/5/2009 12:40:00 PM		11/17/2009		3050B_S	☐	☐	☐	☐	SR
				11/17/2009		6010B_S	☐	☐	☑	☐	SR
0911052-004A	NB-9-1 @0.5	11/5/2009 1:05:00 PM		11/17/2009		3050B_S	☐	☐	☐	☐	SR
				11/17/2009		6010B_S	☐	☐	☑	☐	SR
0911052-005A	NB-9-1 @1.0	11/5/2009 1:07:00 PM		11/17/2009		3050B_S	☐	☐	☐	☐	SR
				11/17/2009		6010B_S	☐	☐	☑	☐	SR
				11/17/2009		7471_PREP	☐	☐	☐	☐	SR
				11/17/2009		HG_CTS	☐	☐	☐	☐	SR
0911052-006A	NB-9-1 @1.5	11/5/2009 1:10:00 PM		11/17/2009		3050B_S	☐	☐	☐	☐	SR
				11/17/2009		6010B_S	☐	☐	☑	☐	SR
0911052-007A	NB-9-2 @0.5	11/5/2009 1:12:00 PM		11/17/2009		3050B_S	☐	☐	☐	☐	SR
				11/17/2009		6010B_S	☐	☐	☑	☐	SR
0911052-008A	NB-9-2 @1.0	11/5/2009 1:15:00 PM		11/17/2009		3050B_S	☐	☐	☐	☐	SR
				11/17/2009		6010B_S	☐	☐	☑	☐	SR
0911052-009A	NB-9-2@1.5	11/5/2009 1:18:00 PM		11/17/2009		3050B_S	☐	☐	☐	☐	SR
				11/17/2009		6010B_S	☐	☐	☑	☐	SR
0911052-010A	NB-9-2-d@0.5	11/5/2009 1:12:00 PM		11/17/2009		3050B_S	☐	☐	☐	☐	SR
				11/17/2009		6010B_S	☐	☐	☑	☐	SR
0911052-011A	NB-9-2-d@1.0	11/5/2009 1:15:00 PM		11/17/2009		3050B_S	☐	☐	☐	☐	SR
				11/17/2009		6010B_S	☐	☐	☑	☐	SR
0911052-012A	NB-9-2d@1.5	11/5/2009 1:18:00 PM		11/17/2009		3050B_S	☐	☐	☐	☐	SR

WORK ORDER Summary

09-Nov-09

Work Order 0911052

Client ID: URS CORPORATION

Project: 28645097.04002 **QC Level:**

Comments: 10 day TAT!!! 18 soils @4'C. 15 for lead only, 2 for CAM 17, -018A (NB-8-2@1.5) not marked for any anlaysis - polaced on hold until client contacted

Sample ID	Client Sample ID	Collection Date	Date Received	Date Due	Matrix	Test Code	Hld	MS	SEL	Sub	Storage
0911052-012A	NB-9-2d@1.5	11/5/2009 1:18:00 PM	11/6/2009	11/17/2009	Soil	6010B_S	☐	☐	☑	☐	SR
0911052-013A	NB-8-1 @0.5	11/5/2009 1:30:00 PM		11/17/2009		3050B_S	☐	☐	☐	☐	SR
				11/17/2009		6010B_S	☐	☐	☑	☐	SR
0911052-014A	NB-8-1 @1.0	11/5/2009 1:32:00 PM		11/17/2009		3050B_S	☐	☐	☐	☐	SR
				11/17/2009		6010B_S	☐	☐	☑	☐	SR
0911052-015A	NB-8-1 @1.5	11/5/2009 1:35:00 PM		11/17/2009		3050B_S	☐	☐	☐	☐	SR
				11/17/2009		6010B_S	☐	☐	☑	☐	SR
0911052-016A	NB-8-2 @0.5	11/5/2009 1:40:00 PM		11/17/2009		3050B_S	☐	☐	☐	☐	SR
				11/17/2009		6010B_S	☐	☐	☑	☐	SR
0911052-017A	NB-8-2 21.0	11/5/2009 1:42:00 PM		11/17/2009		3050B_S	☐	☐	☐	☐	SR
				11/17/2009		6010B_S	☐	☐	☑	☐	SR
0911052-018A	NB-8-2 21.5	11/5/2009 1:45:00 PM		11/17/2009		3050B_S	☑	☐	☐	☐	SR
				11/17/2009		6010B_S	☑	☐	☑	☐	SR

Torrent LABORATORY, INC.
483 Sinclair Frontage Road
Milpitas, CA 95035
Phone: 408.263.5258
FAX: 408.263.8293
www.torrentlab.com

RESET

CHAIN OF CUSTODY

• NOTE: SHADED AREAS ARE FOR TORRENT LAB USE ONLY •

LAB WORK ORDER NO: 0911052

Company Name: URS San Jose	Location of Sampling: Petaluma, CA
Address: 55 South Market St., Suite 1500	Purpose: Soil Investigation
City: San Jose; State: CA; Zip Code: 95113	Special Instructions / Comments: ≤ 20 Samples / work order
Telephone: 4082979585; FAX: 4082976962	
REPORT TO: P Walz; SAMPLER: P Walz	P.O. #: 28645097.04002; EMAIL:

TURNAROUND TIME: [x] 10 Work Days [ ] 3 Work Days [ ] Noon - Nxt Day [ ] 7 Work Days [ ] 2 Work Days [ ] 2 - 8 Hours [ ] 5 Work Days [ ] 1 Work Day [ ] Other

SAMPLE TYPE: [ ] Storm Water [ ] Air [ ] Waste Water [ ] Other [ ] Ground Water [x] Soil

REPORT FORMAT: [ ] QC Level IV [ ] EDF [ ] Excel / EDD

ANALYSIS REQUESTED

LAB ID	CLIENT'S SAMPLE I.D.	DATE / TIME SAMPLED	MATRIX	# OF CONT	CONT TYPE	Cam 17 Metals	Lead	TPH-d/mo	TPH-g						REMARKS
001A	NB-6-1 @ 0.5	11-5-09 1235	Soil	1	Jar		X								
002A	NB-6-1 @ 1.0	1237				X									
003A	NB-6-1 @ 1.5	1240					X								
004A	NB-9-1 @ .5	1305					X								
005A	NB-9-1 @ 1	1307				X									
006A	NB-9-1 @ 1.5	1310					X								
007A	NB-9-2 @ .5	1312					X								
008A	NB-9-2 @ 1	1315					X								
009A	NB-9-2 @ 1.5	1318					X								
010A	NB-9-2-d @ .5	1312					X								

Temp 4°C

	Relinquished By:	Print:	Date:	Time:	Received By:	Print:	Date:	Time:
1	P. Walz	P Walz	11-6-09	1630	[illegible]	[illegible]	11/6	5 -
2	[illegible]		11-6	5:58	R. F. Ghadesara		11-6-09	5:58

Were Samples Received in Good Condition? [x] Yes [ ] NO Samples on Ice? [x] Yes [ ] NO Method of Shipment Hispeed Sample seals intact? [ ] Yes [ ] NO [x] N/A

NOTE: Samples are discarded by the laboratory 30 days from date of receipt unless other arrange -ments are made.

Log In By: Date: Log In Reviewed By: Date:

Page 1 of 2

Work order 3 of 7

Torrent LABORATORY, INC.
483 Sinclair Frontage Road
Milpitas, CA 95035
Phone: 408.263.5258
FAX: 408.263.8293
www.torrentlab.com

RESET

CHAIN OF CUSTODY

• NOTE: SHADED AREAS ARE FOR TORRENT LAB USE ONLY •

LAB WORK ORDER NO: 0911052

Company Name: URS San Jose	Location of Sampling: Petaluma, CA
Address: 55 South Market St., Suite 1500	Purpose: Soil Investigation
City: San Jose / State: CA / Zip Code: 95113	Special Instructions / Comments:
Telephone: 4082979585 / FAX: 4082976962	
REPORT TO: P Walz / SAMPLER: P Walz	P.O. #: 28645097.04002 / EMAIL:

TURNAROUND TIME: ☑ 10 Work Days ☐ 3 Work Days ☐ Noon - Nxt Day ☐ 7 Work Days ☐ 2 Work Days ☐ 2 - 8 Hours ☐ 5 Work Days ☐ 1 Work Day ☐ Other

SAMPLE TYPE: ☐ Storm Water ☐ Air ☐ Waste Water ☐ Other ☐ Ground Water ☑ Soil

REPORT FORMAT: ☐ QC Level IV ☐ EDF ☐ Excel / EDD

ANALYSIS REQUESTED

LAB ID	CLIENT'S SAMPLE I.D.	DATE / TIME SAMPLED	MATRIX	# OF CONT	CONT TYPE	Cam 17 Metals	Lead	TPH-d/mo	TPH-g						REMARKS
011A	NB-9-2-d @ 1	11-5-09 1315	Soil	1	Jar		X								
012A	NB-9-2d @1.5	1318					X								
013A	NB-8-1 @.5	1330					X								
014A	NB-8-1 @ 1	1332					X								
015A	NB-8-1 @1.5	1335					X								
~~016A~~	~~NB-9-1 @ 0.5~~						X								
~~017A~~ 016A	NB-9-NB-8-2@0.5	1340					X								4°C
~~018A~~ 017A	NB-8-2 @ 1.0	1342					X						Temp		
~~019A~~ 018A	NB-8-2@1.5	1345													

	Relinquished By:	Print:	Date:	Time:	Received By:	Print:	Date:	Time:
1	[signature]	P Walz	11-6-09	1630	[signature]		11/10	5
2	[signature]		11-6	5:58	[signature]		11-6-09	5:58

Were Samples Received in Good Condition? ☑ Yes ☐ NO Samples on Ice? ☑ Yes ☐ NO Method of Shipment Hispeed Sample seals intact? ☐ Yes ☐ NO ☑ N/A

NOTE: Samples are discarded by the laboratory 30 days from date of receipt unless other arrange -ments are made.

Log In By: Date: Log In Reviewed By: Date:

Torrent
LABORATORY, INC.

January 28, 2010 (Revision 3)

Patrick Walz
URS Corporation, San Jose
55 South Market St., Suite 1500
San Jose, CA 95113

TEL: (408) 297-9585
FAX (408) 297-6962

RE: 28645097.04002

Order No.: 0911053

Dear Patrick Walz:

Torrent Laboratory, Inc. received 15 samples on 11/6/2009 for the analyses presented in the following report.

All data for associated QC met EPA or laboratory specification(s) except where noted in the case narrative.
Reported data is applicable for only the samples received as part of the order number referenced above.

Torrent Laboratory, Inc, is certified by the State of California, ELAP #1991. If you have any questions regarding these tests results, please feel free to contact the Project Management Team at (408)263-5258;ext: 204.

Sincerely,

Laboratory Director

1/28/10
Date

Patti Sandrock
QA Officer

Torrent Laboratory, Inc. **Date:** *28-Jan-10*

CLIENT: URS Corporation, San Jose
Project: 28645097.04002
Lab Order: 0911053

CASE NARRATIVE

Note: Extraction of 50 g sample / 500g 0.2M Sodium Citrate Solution was performed according to wet extraction procedure (WET) which was rotated in a rotary shaker for 48 hours.

Date Prepared: started on 12/26/09 @ 12:30pm and ended on 12/28/09 2 12:30pm

Note: Extraction of 50 g sample /DI water was performed according to wet extraction procedure (DI STLC) which was rotated in a rotary shaker for 48 hours.

Date Prepared: started on 12/28/09 @ 8:30pm and ended on 12/30/09 @ 8:30pm.

Note: Extraction of 25 g sample / 500g TCLP Fluid # 1 was performed according to Toxicity Characteristic Leaching Procedure (TCLP) which was rotated in a rotary shaker for 18 hours.

Date Prepared: started on 12/30/09 @ 5:0pm and ended on 12/31/09 @ 11:0am.

Per Client request STLC, DI STLC and TCLP added to some samples and reported.

Rev1 1/5/10

Note: Extraction of 25 g sample / 500g TCLP Fluid # 1 was performed according to Toxicity Characteristic Leaching Procedure (TCLP) which was rotated in a rotary shaker for 18 hours.

Date Prepared: started on 1/11/10 @ 5:30pm and ended on 1/12/10 @ 11:30am.

CLIENT:	URS Corporation, San Jose
Project:	28645097.04002
Lab Order:	0911053

CASE NARRATIVE

Per Client request TCLP Pb analyzed and reported for sample 005A.

Rev2 1/18/10

Per client request samples 002A and 003A analyzed and reported for TPHg and TPHD/Mo outside recommended holding time.
This analysis was requested originallly on the coc, but lab missed it.

Rev3 1/28/10

TORRENT LABORATORY, INC.

483 Sinclair Frontage Road • Milpitas, CA • Phone: (408) 263-5258 • Fax: (408) 263-8293

Visit us at www.torrentlab.com email: analysis@torrentlab.com

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/28/2010

Client Sample ID: NB-4-1 @0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 2:10:00 PM

Lab Sample ID: 0911053-001
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	41	mg/Kg	5786
TPH (Diesel)	SW8015B	11/12/2009	2	5	10	ND	mg/Kg	R21718
TPH (Motor Oil)	SW8015B	11/12/2009	4	5	20	160	mg/Kg	R21718
Surr: Pentacosane	SW8015B	11/12/2009	0	5	59.7-129	97.7	%REC	R21718
TPH (Gasoline)	SW8260B(TPH)	11/11/2009	100	1	100	ND	µg/Kg	G21717
Surr: 4-Bromofllurobenzene	SW8260B(TPH)	11/11/2009	0	1	56.9-133	58.0	%REC	G21717

Client Sample ID: NB-4-1 @1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 2:12:00 PM

Lab Sample ID: 0911053-002
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	23	mg/Kg	5786
TPH (Diesel)	SW8015B	1/27/2010	2	2	4.0	ND	mg/Kg	R22492
TPH (Motor Oil)	SW8015B	1/27/2010	4	2	8.0	84	mg/Kg	R22492
Surr: Pentacosane	SW8015B	1/27/2010	0	2	59.7-129	96.0	%REC	R22492
TPH (Gasoline)	SW8260B(TPH)	1/27/2010	100	1	100	ND	µg/Kg	G22491
Surr: 4-Bromofllurobenzene	SW8260B(TPH)	1/27/2010	0	1	56.9-133	74.0	%REC	G22491

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/28/2010

Client Sample ID: NB-4-1 @1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 2:15:00 PM

Lab Sample ID: 0911053-003
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	ND	mg/L	5951
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	1.4	mg/L	5948
Lead	SW6010B	11/11/2009	1	1	1.0	54	mg/Kg	5786
TPH (Diesel)	SW8015B	1/27/2010	2	2	4.0	ND	mg/Kg	R22492
TPH (Motor Oil)	SW8015B	1/27/2010	4	2	8.0	160	mg/Kg	R22492
Surr: Pentacosane	SW8015B	1/27/2010	0	2	59.7-129	102	%REC	R22492
TPH (Gasoline)	SW8260B(TPH)	1/27/2010	100	1	100	ND	µg/Kg	G22491
Surr: 4-Bromofllurobenzene	SW8260B(TPH)	1/27/2010	0	1	56.9-133	76.0	%REC	G22491

Client Sample ID: NB-4-2 @0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 2:18:00 PM

Lab Sample ID: 0911053-004
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	ND	mg/L	5951
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	3.0	mg/L	5948
Lead	SW6010B	11/11/2009	1	1	1.0	82	mg/Kg	5786

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/28/2010

Client Sample ID: NB-4-2 @1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 2:20:00 PM

Lab Sample ID: 0911053-005
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	0.13	mg/L	5951
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	3.6	mg/L	5948
Lead (TCLP)	6010B (TCLP)	1/12/2010	0.1	1	0.10	ND	mg/L	5983
Antimony	SW6010B	11/11/2009	5	1	5.0	ND	mg/Kg	5786
Arsenic	SW6010B	11/11/2009	1.7	1	1.7	3.0	mg/Kg	5786
Barium	SW6010B	11/11/2009	5	1	5.0	100	mg/Kg	5786
Beryllium	SW6010B	11/11/2009	2	1	2.0	ND	mg/Kg	5786
Cadmium	SW6010B	11/11/2009	1	1	1.0	ND	mg/Kg	5786
Chromium	SW6010B	11/11/2009	5	1	5.0	36	mg/Kg	5786
Cobalt	SW6010B	11/11/2009	5	1	5.0	16	mg/Kg	5786
Copper	SW6010B	11/11/2009	5	1	5.0	28	mg/Kg	5786
Lead	SW6010B	11/11/2009	1	1	1.0	130	mg/Kg	5786
Molybdenum	SW6010B	11/11/2009	5	1	5.0	ND	mg/Kg	5786
Nickel	SW6010B	11/11/2009	5	1	5.0	41	mg/Kg	5786
Selenium	SW6010B	11/11/2009	5	1	5.0	ND	mg/Kg	5786
Silver	SW6010B	11/11/2009	1	1	1.0	ND	mg/Kg	5786
Thallium	SW6010B	11/11/2009	5	1	5.0	ND	mg/Kg	5786
Vanadium	SW6010B	11/11/2009	5	1	5.0	49	mg/Kg	5786
Zinc	SW6010B	11/11/2009	5	1	5.0	81	mg/Kg	5786
Mercury	SW7471A	11/11/2009	0.1	1	0.10	0.14	mg/Kg	5783

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/28/2010

Client Sample ID: NB-4-2 @1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 2:22:00 PM

Lab Sample ID: 0911053-006
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	ND	mg/L	5951
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	2.5	mg/L	5948
Lead	SW6010B	11/11/2009	1	1	1.0	64	mg/Kg	5786

Client Sample ID: NB-2-1 @0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 2:28:00 PM

Lab Sample ID: 0911053-007
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	39	mg/Kg	5786

Client Sample ID: NB-2-1 @1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 2:30:00 PM

Lab Sample ID: 0911053-008
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	18	mg/Kg	5786

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/28/2010

Client Sample ID: NB-2-1 @1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 2:32:00 PM

Lab Sample ID: 0911053-009
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	12	mg/Kg	5786

Client Sample ID: NB-3-1 @0./5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 2:40:00 PM

Lab Sample ID: 0911053-010
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	ND	mg/L	5951
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	2.0	mg/L	5948
Lead	SW6010B	11/11/2009	1	1	1.0	64	mg/Kg	5786

Client Sample ID: NB-3-1 @1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 2:42:00 PM

Lab Sample ID: 0911053-011
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	16	mg/Kg	5786

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/28/2010

Client Sample ID: NB-3-1 @1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 2:45:00 PM

Lab Sample ID: 0911053-012
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	14	mg/Kg	5786

Client Sample ID: NB-3-2 @0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 2:50:00 PM

Lab Sample ID: 0911053-013
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	ND	mg/L	5951
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	2.9	mg/L	5949
Lead	SW6010B	11/11/2009	1	1	1.0	71	mg/Kg	5786

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/28/2010

Client Sample ID: NB-3-2 @1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 2:52:00 PM

Lab Sample ID: 0911053-014
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	ND	mg/L	5951
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	2.2	mg/L	5949
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5956
Lead	SW6010B	12/28/2009	1	1	1.0	63	mg/Kg	5945

Client Sample ID: NB-3-2 @1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/5/2009 2:55:00 PM

Lab Sample ID: 0911053-015
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	6.8	mg/Kg	5786

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Definitions, legends and Notes

Note	Description
ug/kg	Microgram per kilogram (ppb, part per billion).
ug/L	Microgram per liter (ppb, part per billion).
mg/kg	Milligram per kilogram (ppm, part per million).
mg/L	Milligram per liter (ppm, part per million).
LCS/LCSD	Laboratory control sample/laboratory control sample duplicate.
MDL	Method detection limit.
MRL	Modified reporting limit. When sample is subject to dilution, reporting limit times dilution factor yields MRL.
MS/MSD	Matrix spike/matrix spike duplicate.
N/A	Not applicable.
ND	Not detected at or above detection limit.
NR	Not reported.
QC	Quality Control.
RL	Reporting limit.
% RPD	Percent relative difference.
a	pH was measured immediately upon the receipt of the sample, but it was still done outside the holding time.
sub	Analyzed by subcontracting laboratory, Lab Certificate #

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Torrent Laboratory, Inc.

Date: *28-Jan-10*

CLIENT: URS Corporation, San Jose
Work Order: 0911053
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5783

Sample ID: **MB-5783** SampType: **MBLK** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21774**
Client ID: **ZZZZZ** Batch ID: **5783** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **11/11/2009** SeqNo: **312456**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	ND	0.10									

Sample ID: **LCS-5783** SampType: **LCS** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21774**
Client ID: **ZZZZZ** Batch ID: **5783** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **11/11/2009** SeqNo: **312454**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1.373	0.10	1.25	0	110	78.5	125				

Sample ID: **LCSD-5783** SampType: **LCSD** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21774**
Client ID: **ZZZZZ** Batch ID: **5783** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **11/11/2009** SeqNo: **312455**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1.382	0.10	1.25	0	111	78.5	125	1.373	0.605	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911053
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5786

Sample ID: **MB-5786** SampType: **MBLK** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21723**
Client ID: **ZZZZZ** Batch ID: **5786** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311854**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	ND	5.0									
Arsenic	ND	1.7									
Barium	ND	5.0									
Beryllium	ND	2.0									
Cadmium	ND	1.0									
Chromium	ND	5.0									
Cobalt	ND	5.0									
Copper	ND	5.0									
Lead	ND	1.0									
Molybdenum	ND	5.0									
Nickel	ND	5.0									
Selenium	ND	5.0									
Silver	ND	1.0									
Thallium	ND	5.0									
Vanadium	ND	5.0									
Zinc	ND	5.0									

Sample ID: **LCS-5786** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21723**
Client ID: **ZZZZZ** Batch ID: **5786** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311852**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	50.55	5.0	50	0	101	30.7	130				
Arsenic	49.55	1.7	50	0	99.1	71	121				
Barium	50.70	5.0	50	0.25	101	70.2	130				
Beryllium	48.05	2.0	50	0	96.1	73.3	115				
Cadmium	48.20	1.0	50	0	96.4	68.7	110				
Chromium	50.70	5.0	50	0.15	101	76	116				
Cobalt	49.55	5.0	50	0	99.1	57.4	122				
Copper	51.20	5.0	50	0.45	102	74.8	119				
Lead	50.50	1.0	50	0.2	101	67.9	118				
Molybdenum	51.65	5.0	50	0	103	62.9	123				

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911053
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5786

Sample ID: **LCS-5786** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21723**
Client ID: **ZZZZZ** Batch ID: **5786** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311852**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nickel	49.40	5.0	50	0.1	98.6	61.5	122				
Selenium	47.10	5.0	50	0	94.2	62	111				
Silver	49.50	1.0	50	0	99.0	81.1	109				
Thallium	48.30	5.0	50	0	96.6	39.2	125				
Vanadium	50.90	5.0	50	0	102	65.8	122				
Zinc	50.20	5.0	50	0.7	99.0	59.9	122				

Sample ID: **LCSD-5786** SampType: **LCSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21723**
Client ID: **ZZZZZ** Batch ID: **5786** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311853**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	50.85	5.0	50	0	102	30.7	130	50.55	0.592	30	
Arsenic	49.70	1.7	50	0	99.4	71	121	49.55	0.302	30	
Barium	51.00	5.0	50	0.25	102	70.2	130	50.7	0.590	30	
Beryllium	48.15	2.0	50	0	96.3	73.3	115	48.05	0.208	30	
Cadmium	48.75	1.0	50	0	97.5	68.7	110	48.2	1.13	30	
Chromium	51.60	5.0	50	0.15	103	76	116	50.7	1.76	30	
Cobalt	49.95	5.0	50	0	99.9	57.4	122	49.55	0.804	30	
Copper	52.40	5.0	50	0.45	104	74.8	119	51.2	2.32	30	
Lead	50.70	1.0	50	0.2	101	67.9	118	50.5	0.395	30	
Molybdenum	52.00	5.0	50	0	104	62.9	123	51.65	0.675	30	
Nickel	50.25	5.0	50	0.1	100	61.5	122	49.4	1.71	30	
Selenium	47.20	5.0	50	0	94.4	62	111	47.1	0.212	30	
Silver	50.20	1.0	50	0	100	81.1	109	49.5	1.40	30	
Thallium	48.70	5.0	50	0	97.4	39.2	125	48.3	0.825	30	
Vanadium	51.60	5.0	50	0	103	65.8	122	50.9	1.37	30	
Zinc	50.50	5.0	50	0.7	99.6	59.9	122	50.2	0.596	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911053
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5945

Sample ID: **MB-5945** SampType: **MBLK** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **12/28/2009** RunNo: **22259**
Client ID: **ZZZZZ** Batch ID: **5945** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **12/28/2009** SeqNo: **318303**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	ND	1.0									

Sample ID: **LCS-5945** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **12/28/2009** RunNo: **22259**
Client ID: **ZZZZZ** Batch ID: **5945** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **12/28/2009** SeqNo: **318301**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	48.70	1.0	50	0.2	97.0	67.9	118				

Sample ID: **LCSD-5945** SampType: **LCSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **12/28/2009** RunNo: **22259**
Client ID: **ZZZZZ** Batch ID: **5945** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **12/28/2009** SeqNo: **318302**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	48.10	1.0	50	0.2	95.8	67.9	118	48.7	1.24	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911053
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5948

Sample ID: **MB-5948** SampType: **MBLK** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22262**
Client ID: **ZZZZZ** Batch ID: **5948** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318398**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	ND	0.10									

Sample ID: **LCS-5948** SampType: **LCS** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22262**
Client ID: **ZZZZZ** Batch ID: **5948** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318396**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	9.010	0.10	10	0	90.1	75	125				

Sample ID: **LCSD-5948** SampType: **LCSD** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22262**
Client ID: **ZZZZZ** Batch ID: **5948** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318397**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	8.590	0.10	10	0	85.9	75	125	9.01	4.77	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911053
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5949

Sample ID: **MB-5949** SampType: **MBLK** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22266**
Client ID: **ZZZZZ** Batch ID: **5949** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318462**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	ND	0.10									

Sample ID: **LCS-5949** SampType: **LCS** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22266**
Client ID: **ZZZZZ** Batch ID: **5949** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318460**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	8.410	0.10	10	0	84.1	75	125				

Sample ID: **LCSD-5949** SampType: **LCSD** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22266**
Client ID: **ZZZZZ** Batch ID: **5949** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318461**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	8.670	0.10	10	0	86.7	75	125	8.41	3.04	30	

Sample ID: **0911053-013AMS** SampType: **MS** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22266**
Client ID: **NB-3-2 @0.5** Batch ID: **5949** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318444**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	11.44	0.10	10	2.93	85.1	75	125				

Sample ID: **0911053-013AMSD** SampType: **MSD** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22266**
Client ID: **NB-3-2 @0.5** Batch ID: **5949** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318445**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	11.31	0.10	10	2.93	83.8	75	125	11.44	1.14	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911053
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5951

Sample ID: **MB-5951** SampType: **MBLK** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **12/30/2009** RunNo: **22287**
Client ID: **ZZZZZ** Batch ID: **5951** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318878**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	ND	0.10									

Sample ID: **LCS-5951** SampType: **LCS** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **12/30/2009** RunNo: **22287**
Client ID: **ZZZZZ** Batch ID: **5951** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318876**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	0.9720	0.10	1	0	97.2	75	125				

Sample ID: **LCSD-5951** SampType: **LCSD** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **12/30/2009** RunNo: **22287**
Client ID: **ZZZZZ** Batch ID: **5951** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318877**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	0.9710	0.10	1	0	97.1	75	125	0.972	0.103	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911053
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5956

Sample ID: **MB-5956** SampType: **MBLK** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **12/31/2009** RunNo: **22292**
Client ID: **ZZZZZ** Batch ID: **5956** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318960**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	ND	0.10									

Sample ID: **LCS-5956** SampType: **LCS** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **12/31/2009** RunNo: **22292**
Client ID: **ZZZZZ** Batch ID: **5956** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318958**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	9.490	0.10	10	0	94.9	75	125				

Sample ID: **LCSD-5956** SampType: **LCSD** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **12/31/2009** RunNo: **22292**
Client ID: **ZZZZZ** Batch ID: **5956** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318959**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	9.600	0.10	10	0	96.0	75	125	9.49	1.15	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911053
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5983

Sample ID: **MB-5983** SampType: **MBLK** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **1/12/2010** RunNo: **22362**
Client ID: **ZZZZZ** Batch ID: **5983** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **1/12/2010** SeqNo: **319589**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	ND	0.10									

Sample ID: **LCS-5983** SampType: **LCS** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **1/12/2010** RunNo: **22362**
Client ID: **ZZZZZ** Batch ID: **5983** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **1/12/2010** SeqNo: **319587**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	9.390	0.10	10	0	93.9	75	125				

Sample ID: **LCSD-5983** SampType: **LCSD** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **1/12/2010** RunNo: **22362**
Client ID: **ZZZZZ** Batch ID: **5983** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **1/12/2010** SeqNo: **319588**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	9.510	0.10	10	0	95.1	75	125	9.39	1.27	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911053
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: G21717

Sample ID: **MB_G21717** SampType: **MBLK** TestCode: **TPH_GAS_S_** Units: **µg/Kg** Prep Date: **11/11/2009** RunNo: **21717**
Client ID: **ZZZZZ** Batch ID: **G21717** TestNo: **SW8260B(TP** Analysis Date: **11/11/2009** SeqNo: **311717**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Gasoline)	ND	100									
Surr: 4-Bromofllurobenzene	38.00	0	50	0	76.0	56.9	133				

Sample ID: **LCS_G21717** SampType: **LCS** TestCode: **TPH_GAS_S_** Units: **µg/Kg** Prep Date: **11/11/2009** RunNo: **21717**
Client ID: **ZZZZZ** Batch ID: **G21717** TestNo: **SW8260B(TP** Analysis Date: **11/11/2009** SeqNo: **311718**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Gasoline)	871.0	100	1000	0	87.1	48.2	132				
Surr: 4-Bromofllurobenzene	33.00	0	50	0	66.0	56.9	133				

Sample ID: **LCSD_G21717** SampType: **LCSD** TestCode: **TPH_GAS_S_** Units: **µg/Kg** Prep Date: **11/11/2009** RunNo: **21717**
Client ID: **ZZZZZ** Batch ID: **G21717** TestNo: **SW8260B(TP** Analysis Date: **11/11/2009** SeqNo: **311719**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Gasoline)	858.0	100	1000	0	85.8	48.2	132	871	1.50	30	
Surr: 4-Bromofllurobenzene	36.00	0	50	0	72.0	56.9	133	0	0	0	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911053
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: G22491

Sample ID: **MB_G22491** SampType: **MBLK** TestCode: **TPH_GAS_S_** Units: **µg/Kg** Prep Date: **1/27/2010** RunNo: **22491**
Client ID: **ZZZZZ** Batch ID: **G22491** TestNo: **SW8260B(TP** Analysis Date: **1/27/2010** SeqNo: **321224**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Gasoline)	ND	100									
Surr: 4-Bromofllurobenzene	50.00	0	50	0	100	56.9	133				

Sample ID: **LCS_G22491** SampType: **LCS** TestCode: **TPH_GAS_S_** Units: **µg/Kg** Prep Date: **1/27/2010** RunNo: **22491**
Client ID: **ZZZZZ** Batch ID: **G22491** TestNo: **SW8260B(TP** Analysis Date: **1/27/2010** SeqNo: **321226**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Gasoline)	972.0	100	1000	20	95.2	48.2	132				
Surr: 4-Bromofllurobenzene	53.00	0	50	0	106	56.9	133				

Sample ID: **LCSD_G22491** SampType: **LCSD** TestCode: **TPH_GAS_S_** Units: **µg/Kg** Prep Date: **1/27/2010** RunNo: **22491**
Client ID: **ZZZZZ** Batch ID: **G22491** TestNo: **SW8260B(TP** Analysis Date: **1/27/2010** SeqNo: **321227**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Gasoline)	861.0	100	1000	20	84.1	48.2	132	972	12.1	30	
Surr: 4-Bromofllurobenzene	48.00	0	50	0	96.0	56.9	133	0	0	0	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911053
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: R21718

Sample ID: **SD091110A-MB** SampType: **MBLK** TestCode: **TPHDO_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21718**
Client ID: **ZZZZZ** Batch ID: **R21718** TestNo: **SW8015B** Analysis Date: **11/11/2009** SeqNo: **311773**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Diesel)	ND	2.0									
TPH (Motor Oil)	ND	4.0									
Surr: Pentacosane	3.481	0	3.3	0	105	59.7	129				

Sample ID: **SD091110A-LCS** SampType: **LCS** TestCode: **TPHDO_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21718**
Client ID: **ZZZZZ** Batch ID: **R21718** TestNo: **SW8015B** Analysis Date: **11/11/2009** SeqNo: **311774**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Diesel)	27.29	2.0	33.33	0	81.9	52.7	115				
Surr: Pentacosane	2.753	0	3.3	0	83.4	59.7	129				

Sample ID: **SD091110A-LCSD** SampType: **LCSD** TestCode: **TPHDO_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21718**
Client ID: **ZZZZZ** Batch ID: **R21718** TestNo: **SW8015B** Analysis Date: **11/11/2009** SeqNo: **311775**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Diesel)	33.05	2.0	33.33	0	99.2	52.7	115	27.29	19.1	30	
Surr: Pentacosane	3.601	0	3.3	0	109	59.7	129	0	0	0	

Sample ID: **0911053-001A MS** SampType: **MS** TestCode: **TPHDO_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21718**
Client ID: **NB-4-1 @0.5** Batch ID: **R21718** TestNo: **SW8015B** Analysis Date: **11/12/2009** SeqNo: **312460**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Diesel)	21.52	10	33.33	0	64.6	52.7	115				
Surr: Pentacosane	3.170	0	3.3	0	96.1	59.7	129				

Sample ID: **0911053-001A MSD** SampType: **MSD** TestCode: **TPHDO_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21718**
Client ID: **NB-4-1 @0.5** Batch ID: **R21718** TestNo: **SW8015B** Analysis Date: **11/12/2009** SeqNo: **312461**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Diesel)	19.86	10	33.33	0	59.6	52.7	115	21.52	8.03	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911053
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: R21718

Sample ID: **0911053-001A MSD** SampType: **MSD** TestCode: **TPHDO_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21718**
Client ID: **NB-4-1 @0.5** Batch ID: **R21718** TestNo: **SW8015B** Analysis Date: **11/12/2009** SeqNo: **312461**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Surr: Pentacosane	3.230	0	3.3	0	97.9	59.7	129	0	0	0	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911053
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: R22492

Sample ID: **SD100126A-MB** SampType: **MBLK** TestCode: **TPHDO_S** Units: **mg/Kg** Prep Date: **1/26/2010** RunNo: **22492**
Client ID: **ZZZZZ** Batch ID: **R22492** TestNo: **SW8015B** Analysis Date: **1/27/2010** SeqNo: **321217**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Diesel)	ND	2.0									
TPH (Motor Oil)	ND	4.0									
Surr: Pentacosane	2.709	0	3.3	0	82.1	59.7	129				

Sample ID: **SD100126A-LCS** SampType: **LCS** TestCode: **TPHDO_S** Units: **mg/Kg** Prep Date: **1/26/2010** RunNo: **22492**
Client ID: **ZZZZZ** Batch ID: **R22492** TestNo: **SW8015B** Analysis Date: **1/27/2010** SeqNo: **321218**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Diesel)	24.47	2.0	33.33	0	73.4	52.7	115				
Surr: Pentacosane	3.050	0	3.3	0	92.4	59.7	129				

Sample ID: **SD100126A-LCSD** SampType: **LCSD** TestCode: **TPHDO_S** Units: **mg/Kg** Prep Date: **1/26/2010** RunNo: **22492**
Client ID: **ZZZZZ** Batch ID: **R22492** TestNo: **SW8015B** Analysis Date: **1/27/2010** SeqNo: **321219**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Diesel)	23.07	2.0	33.33	0	69.2	52.7	115	24.47	5.89	30	
Surr: Pentacosane	2.616	0	3.3	0	79.3	59.7	129	0	0	0	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

Torrent LABORATORY, INC.
483 Sinclair Frontage Road
Milpitas, CA 95035
Phone: 408.263.5258
FAX: 408.263.8293
www.torrentlab.com

RESET

CHAIN OF CUSTODY

• NOTE: SHADED AREAS ARE FOR TORRENT LAB USE ONLY •

LAB WORK ORDER NO 0911053

Company Name: URS San Jose	Location of Sampling: Petaluma, CA
Address: 55 South Market St., Suite 1500	Purpose: Soil Investigation
City: San Jose; State: CA; Zip Code: 95113	Special Instructions / Comments:
Telephone: 4082979585; FAX: 4082976962	
REPORT TO: P Walz; SAMPLER: P Walz	P.O. #: 28645097.04002; EMAIL:

TURNAROUND TIME: [x] 10 Work Days [ ] 3 Work Days [ ] Noon - Nxt Day [ ] 7 Work Days [ ] 2 Work Days [ ] 2 - 8 Hours [ ] 5 Work Days [ ] 1 Work Day [ ] Other

SAMPLE TYPE: [ ] Storm Water [ ] Air [ ] Waste Water [ ] Other [ ] Ground Water [x] Soil

REPORT FORMAT: [ ] QC Level IV [ ] EDF [ ] Excel / EDD

ANALYSIS REQUESTED

LAB ID	CLIENT'S SAMPLE I.D.	DATE / TIME SAMPLED	MATRIX	# OF CONT	CONT TYPE	Cam 17 Metals	Lead	TPH-d/mo	TPH-g						REMARKS
001A	NB-4-1 @ 0.5	11-5-09 1410	Soil	1	Jar		X	X	X						
002A	NB-4-1 @ 1.0	1412					X	X	X						
003A	NB-4-1 @ 1.5	1415					X	X	X						
004A	NB-4-2 @ 0.5	1418					X								
005A	NB-4-2 @ 1.0	1420				X									
006A	NB-4-2 @ 1.5	1422					X								
007A	NB-2-1 @ 0.5	1428					X								
008A	NB-2-1 @ 1.0	1430					X								
009A	NB-2-1 @ 1.5	1432					X								
010A	NB-3-1 @ 0.5	1440					X								

Temp 4°C

	Relinquished By:	Print:	Date:	Time:	Received By:	Print:	Date:	Time:
1	[signature]	Walz	11-6-09	1630	[signature]		11/6	5
2	[signature]		11-6	5-58	[signature]		11-6-09	5:58

Were Samples Received in Good Condition? [x] Yes [ ] NO Samples on Ice? [x] Yes [ ] NO Method of Shipment Hispeed Sample seals intact? [ ] Yes [ ] NO [x] N/A

NOTE: Samples are discarded by the laboratory 30 days from date of receipt unless other arrange -ments are made.

Page 1 of 2

Log In By: Date: Log In Reviewed By: Date:

Work order 4 of 7

Torrent LABORATORY, INC.
483 Sinclair Frontage Road
Milpitas, CA 95035
Phone: 408.263.5258
FAX: 408.263.8293
www.torrentlab.com

RESET

CHAIN OF CUSTODY

• NOTE: SHADED AREAS ARE FOR TORRENT LAB USE ONLY •

LAB WORK ORDER NO: 0911053

Company Name: URS San Jose	Location of Sampling: Petaluma, CA
Address: 55 South Market St., Suite 1500	Purpose: Soil Investigation
City: San Jose; State: CA; Zip Code: 95113	Special Instructions / Comments:
Telephone: 4082979585; FAX: 4082976962	
REPORT TO: P Walz; SAMPLER: P Walz	P.O. #: 28645097.04002; EMAIL:

TURNAROUND TIME: [x] 10 Work Days [ ] 3 Work Days [ ] Noon - Nxt Day [ ] 7 Work Days [ ] 2 Work Days [ ] 2 - 8 Hours [ ] 5 Work Days [ ] 1 Work Day [ ] Other

SAMPLE TYPE: [ ] Storm Water [ ] Air [ ] Waste Water [ ] Other [ ] Ground Water [x] Soil

REPORT FORMAT: [ ] QC Level IV [ ] EDF [ ] Excel / EDD

ANALYSIS REQUESTED

LAB ID	CLIENT'S SAMPLE I.D.	DATE / TIME SAMPLED	MATRIX	# OF CONT	CONT TYPE	Cam 17 Metals	Lead	TPH-d/mo	TPH-g						REMARKS
011A	NB-3-1 @ 1.0	11-5-09 1442	Soil	1	Jar		X								
012A	NB-3-1 @ 1.5	1445					X								
013A	NB-3-2 @ 0.5	1450					X								
014A	NB-3-2 @ 1.0	1452					X								
015A	NB-3-2 @ 1.5	1455					X								

Temp 4°C

	Relinquished By:	Print:	Date:	Time:	Received By:	Print:	Date:	Time:
1	[signature]	P Walz	11-6-09	1630	[signature]		11/6	5
2	[signature]		11-6	5:58	[signature]		11-6-09	5:58

Were Samples Received in Good Condition? [x] Yes [ ] NO Samples on Ice? [x] Yes [ ] NO Method of Shipment Hispeed Sample seals intact? [ ] Yes [ ] NO [x] N/A

NOTE: Samples are discarded by the laboratory 30 days from date of receipt unless other arrange -ments are made.

Log In By: Date: Log In Reviewed By: Date:

Torrent
LABORATORY, INC.

January 05, 2010 (Revised)

Patrick Walz
URS Corporation, San Jose
55 South Market St., Suite 1500
San Jose, CA 95113

TEL: (408) 297-9585
FAX (408) 297-6962

RE: 28645097.04002

Order No.: 0911054

Dear Patrick Walz:

Torrent Laboratory, Inc. received 17 samples on 11/6/2009 for the analyses presented in the following report.

All data for associated QC met EPA or laboratory specification(s) except where noted in the case narrative.
Reported data is applicable for only the samples received as part of the order number referenced above.

Torrent Laboratory, Inc, is certified by the State of California, ELAP #1991. If you have any questions regarding these tests results, please feel free to contact the Project Management Team at (408)263-5258;ext: 204.

Sincerely,

Laboratory Director

1/5/10
Date

Patti Sandrock
QA Officer

483 Sinclair Frontage Rd., Milpitas, CA 95035 | tel: 408.263.5258 | main fax: 408.263.8293 | project manager fax: 408.263.2708
www.torrentlab.com

Torrent Laboratory, Inc. **Date:** *05-Jan-10*

CLIENT: URS Corporation, San Jose
Project: 28645097.04002
Lab Order: 0911054

CASE NARRATIVE

Analytical Comment for 6010B, 0910054-005 MS, MSD, Note:The % recoveries in the MS for Lead and in the MSD for Chromium, Lead and Zinc are outside of laboratory control limits but within % RPD limits and % recovery limits for the LCS/LCSD. No corrective action is required.

Analytical Comment for HG_S, 0911054-002A, MSD, Note:The % recoverys in the MSD for is outside of laboratory control limits but within % RPD limits and % recovery limits for the LCS/LCSD. No corrective action is required.

Prep Comments for 7471_PREP, Sample 0911054-015A, 016A, 017A: The prep HoldTime was exceeded by 4.57 days.

REVISIONS:

Report revised to include CAM 17 data for samples 015 - 017.

Note: Extraction of 50 g sample / 500g 0.2M Sodium Citrate Solution was performed according to wet extraction procedure (WET) which was rotated in a rotary shaker for 48 hours.

Date Prepared: started on 12/26/09 @ 12:30pm and ended on 12/28/09 2 12:30pm

Note: Extraction of 50 g sample /DI water was performed according to wet extraction procedure (DI STLC) which was rotated in a rotary shaker for 48 hours.

Date Prepared: started on 12/28/09 @ 8:30pm and ended on 12/30/09 @ 8:30pm.

Note: Extraction of 25 g sample / 500g TCLP Fluid # 1 was performed according to Toxicity Characteristic Leaching Procedure (TCLP) which was rotated in a rotary shaker for 18 hours.

Date Prepared: started on 12/30/09 @ 5:0pm and ended on 12/31/09 @ 11:0am.

CLIENT:	URS Corporation, San Jose
Project:	28645097.04002
Lab Order:	0911054

CASE NARRATIVE

Per Client request STLC, DI STLC and TCLP added to some samples and reported.

Rev1 1/5/10

TORRENT LABORATORY, INC.

483 Sinclair Frontage Road • Milpitas, CA • Phone: (408) 263-5258 • Fax: (408) 263-8293

Visit us at www.torrentlab.com email: analysis@torrentlab.com

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-7-1 @ 0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 9:15:00 AM

Lab Sample ID: 0911054-001
Date Prepared: 11/10/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/11/2009	1	1	1.0	34	mg/Kg	5786

Client Sample ID: SB-7-1 @ 1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 9:19:00 AM

Lab Sample ID: 0911054-002
Date Prepared: 12/31/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5957
Lead	SW6010B	11/11/2009	1	1	1.0	26	mg/Kg	5786

Client Sample ID: SB-7-1 @ 5.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 9:20:00 AM

Lab Sample ID: 0911054-003
Date Prepared: 12/31/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5957
Lead	SW6010B	11/11/2009	1	1	1.0	20	mg/Kg	5786

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-7-2 @ 0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 9:22:00 AM

Lab Sample ID: 0911054-004
Date Prepared: 12/31/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5957
Lead	SW6010B	11/12/2009	1	1	1.0	13	mg/Kg	5790

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-7-2 @ 1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 9:25:00 AM

Lab Sample ID: 0911054-005
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	0.39	mg/L	5951
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	6.0	mg/L	5949
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5957
Antimony	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Arsenic	SW6010B	11/12/2009	1.7	1	1.7	4.8	mg/Kg	5790
Barium	SW6010B	11/12/2009	5	1	5.0	110	mg/Kg	5790
Beryllium	SW6010B	11/12/2009	2	1	2.0	ND	mg/Kg	5790
Cadmium	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5790
Chromium	SW6010B	11/12/2009	5	1	5.0	37	mg/Kg	5790
Cobalt	SW6010B	11/12/2009	5	1	5.0	15	mg/Kg	5790
Copper	SW6010B	11/12/2009	5	1	5.0	24	mg/Kg	5790
Lead	SW6010B	11/12/2009	1	1	1.0	140	mg/Kg	5790
Molybdenum	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Nickel	SW6010B	11/12/2009	5	1	5.0	51	mg/Kg	5790
Selenium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Silver	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5790
Thallium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Vanadium	SW6010B	11/12/2009	5	1	5.0	38	mg/Kg	5790
Zinc	SW6010B	11/12/2009	5	1	5.0	60	mg/Kg	5790
Mercury	SW7471A	11/11/2009	0.1	1	0.10	0.13	mg/Kg	5783
TPH (Diesel)	SW8015B	11/12/2009	2	1	2.0	ND	mg/Kg	R21718
TPH (Motor Oil)	SW8015B	11/12/2009	4	1	4.0	31	mg/Kg	R21718
Surr: Pentacosane	SW8015B	11/12/2009	0	1	59.7-129	96.1	%REC	R21718
TPH (Gasoline)	SW8260B(TPH)	11/13/2009	100	1	100	ND	µg/Kg	G21721
Surr: 4-Bromofllurobenzene	SW8260B(TPH)	11/13/2009	0	1	56.9-133	74.0	%REC	G21721

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-7-2 @ 1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 9:27:00 AM

Lab Sample ID: 0911054-006
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	ND	mg/L	5951
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	4.8	mg/L	5949
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5957
Lead	SW6010B	11/12/2009	1	1	1.0	130	mg/Kg	5790
Mercury	SW7471A	12/29/2009	0.1	1	0.10	0.10	mg/Kg	5947
sample has expired at the time analysis is requested.								
TPH (Diesel)	SW8015B	11/12/2009	2	1	2.0	ND	mg/Kg	R21718
TPH (Motor Oil)	SW8015B	11/12/2009	4	1	4.0	45	mg/Kg	R21718
Surr: Pentacosane	SW8015B	11/12/2009	0	1	59.7-129	100	%REC	R21718
TPH (Gasoline)	SW8260B(TPH)	11/11/2009	100	1	100	ND	µg/Kg	G21701
Surr: 4-Bromofllurobenzene	SW8260B(TPH)	11/11/2009	0	1	56.9-133	58.0	%REC	G21701

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-7-2 @ 3.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 9:30:00 AM

Lab Sample ID: 0911054-007
Date Prepared: 11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/12/2009	1	1	1.0	7.1	mg/Kg	5790
TPH (Diesel)	SW8015B	11/11/2009	2	1	2.0	ND	mg/Kg	R21718
TPH (Motor Oil)	SW8015B	11/11/2009	4	1	4.0	ND	mg/Kg	R21718
Surr: Pentacosane	SW8015B	11/11/2009	0	1	59.7-129	97.5	%REC	R21718
TPH (Gasoline)	SW8260B(TPH)	11/13/2009	100	1	100	ND	µg/Kg	G21721
Surr: 4-Bromofllurobenzene	SW8260B(TPH)	11/13/2009	0	1	56.9-133	66.0	%REC	G21721

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-7-2 @ 6.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 9:35:00 AM

Lab Sample ID: 0911054-008
Date Prepared: 12/31/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5957
Antimony	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Arsenic	SW6010B	11/12/2009	1.7	1	1.7	1.8	mg/Kg	5790
Barium	SW6010B	11/12/2009	5	1	5.0	140	mg/Kg	5790
Beryllium	SW6010B	11/12/2009	2	1	2.0	ND	mg/Kg	5790
Cadmium	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5790
Chromium	SW6010B	11/12/2009	5	1	5.0	34	mg/Kg	5790
Cobalt	SW6010B	11/12/2009	5	1	5.0	6.3	mg/Kg	5790
Copper	SW6010B	11/12/2009	5	1	5.0	18	mg/Kg	5790
Lead	SW6010B	11/12/2009	1	1	1.0	5.2	mg/Kg	5790
Molybdenum	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Nickel	SW6010B	11/12/2009	5	1	5.0	36	mg/Kg	5790
Selenium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Silver	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5790
Thallium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Vanadium	SW6010B	11/12/2009	5	1	5.0	33	mg/Kg	5790
Zinc	SW6010B	11/12/2009	5	1	5.0	22	mg/Kg	5790
Mercury	SW7471A	11/11/2009	0.1	1	0.10	0.17	mg/Kg	5783
TPH (Diesel)	SW8015B	11/12/2009	2	1	2.0	ND	mg/Kg	R21718
TPH (Motor Oil)	SW8015B	11/12/2009	4	1	4.0	ND	mg/Kg	R21718
Surr: Pentacosane	SW8015B	11/12/2009	0	1	59.7-129	94.5	%REC	R21718
TPH (Gasoline)	SW8260B(TPH)	11/11/2009	100	1	100	ND	µg/Kg	G21717
Surr: 4-Bromofllurobenzene	SW8260B(TPH)	11/11/2009	0	1	56.9-133	60.0	%REC	G21717

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-7-2 @ 9.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 9:45:00 AM

Lab Sample ID: 0911054-009
Date Prepared: 11/10/2009-11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Arsenic	SW6010B	11/12/2009	1.7	1	1.7	4.6	mg/Kg	5790
Barium	SW6010B	11/12/2009	5	1	5.0	540	mg/Kg	5790
Beryllium	SW6010B	11/12/2009	2	1	2.0	ND	mg/Kg	5790
Cadmium	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5790
Chromium	SW6010B	11/12/2009	5	1	5.0	34	mg/Kg	5790
Cobalt	SW6010B	11/12/2009	5	1	5.0	9.6	mg/Kg	5790
Copper	SW6010B	11/12/2009	5	1	5.0	15	mg/Kg	5790
Lead	SW6010B	11/12/2009	1	1	1.0	5.0	mg/Kg	5790
Molybdenum	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Nickel	SW6010B	11/12/2009	5	1	5.0	41	mg/Kg	5790
Selenium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Silver	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5790
Thallium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Vanadium	SW6010B	11/12/2009	5	1	5.0	38	mg/Kg	5790
Zinc	SW6010B	11/12/2009	5	1	5.0	24	mg/Kg	5790
Mercury	SW7471A	11/11/2009	0.1	1	0.10	0.19	mg/Kg	5783
TPH (Diesel)	SW8015B	11/12/2009	2	1	2.0	ND	mg/Kg	R21718
TPH (Motor Oil)	SW8015B	11/12/2009	4	1	4.0	ND	mg/Kg	R21718
Surr: Pentacosane	SW8015B	11/12/2009	0	1	59.7-129	99.1	%REC	R21718
TPH (Gasoline)	SW8260B(TPH)	11/13/2009	100	1	100	ND	µg/Kg	G21721
Surr: 4-Bromofllurobenzene	SW8260B(TPH)	11/13/2009	0	1	56.9-133	88.0	%REC	G21721

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-8-2 @ 0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 10:00:00 AM

Lab Sample ID: 0911054-010
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	ND	mg/L	5951
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	1.8	mg/L	5949
Lead	SW6010B	11/12/2009	1	1	1.0	120	mg/Kg	5790
Mercury	SW7471A	12/29/2009	0.1	1	0.10	ND	mg/Kg	5947
sample has expired at the time analysis is requested.								
TPH (Diesel)	SW8015B	11/12/2009	2	1	2.0	ND	mg/Kg	R21718
TPH (Motor Oil)	SW8015B	11/12/2009	4	1	4.0	6.7	mg/Kg	R21718
Surr: Pentacosane	SW8015B	11/12/2009	0	1	59.7-129	93.9	%REC	R21718
Note: Discrete peaks present within the motor oil quatitation range.								
TPH (Gasoline)	SW8260B(TPH)	11/13/2009	100	1	100	ND	µg/Kg	G21721
Surr: 4-Bromofllurobenzene	SW8260B(TPH)	11/13/2009	0	1	56.9-133	76.0	%REC	G21721

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-8-2 @ 1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 10:02:00 AM

Lab Sample ID: 0911054-011
Date Prepared: 11/10/2009-11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Arsenic	SW6010B	11/12/2009	1.7	1	1.7	6.0	mg/Kg	5790
Barium	SW6010B	11/12/2009	5	1	5.0	50	mg/Kg	5790
Beryllium	SW6010B	11/12/2009	2	1	2.0	ND	mg/Kg	5790
Cadmium	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5790
Chromium	SW6010B	11/12/2009	5	1	5.0	44	mg/Kg	5790
Cobalt	SW6010B	11/12/2009	5	1	5.0	15	mg/Kg	5790
Copper	SW6010B	11/12/2009	5	1	5.0	24	mg/Kg	5790
Lead	SW6010B	11/12/2009	1	1	1.0	42	mg/Kg	5790
Molybdenum	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Nickel	SW6010B	11/12/2009	5	1	5.0	66	mg/Kg	5790
Selenium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Silver	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5790
Thallium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Vanadium	SW6010B	11/12/2009	5	1	5.0	40	mg/Kg	5790
Zinc	SW6010B	11/12/2009	5	1	5.0	38	mg/Kg	5790
Mercury	SW7471A	11/11/2009	0.1	1	0.10	ND	mg/Kg	5783
TPH (Diesel)	SW8015B	11/12/2009	2	1	2.0	ND	mg/Kg	R21718
TPH (Motor Oil)	SW8015B	11/12/2009	4	1	4.0	35	mg/Kg	R21718
Surr: Pentacosane	SW8015B	11/12/2009	0	1	59.7-129	92.9	%REC	R21718
Note: Discrete peaks present within the motor oil quatitation range.								
TPH (Gasoline)	SW8260B(TPH)	11/13/2009	100	1	100	ND	µg/Kg	G21721
Surr: 4-Bromofllurobenzene	SW8260B(TPH)	11/13/2009	0	1	56.9-133	62.0	%REC	G21721

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-8-2 @ 1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 10:04:00 AM

Lab Sample ID: 0911054-012
Date Prepared: 11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/12/2009	1	1	1.0	6.9	mg/Kg	5790
TPH (Diesel)	SW8015B	11/12/2009	2	1	2.0	ND	mg/Kg	R21718
TPH (Motor Oil)	SW8015B	11/12/2009	4	1	4.0	7.5	mg/Kg	R21718
Surr: Pentacosane	SW8015B	11/12/2009	0	1	59.7-129	96.9	%REC	R21718
TPH (Gasoline)	SW8260B(TPH)	11/11/2009	100	1	100	ND	µg/Kg	G21701
Surr: 4-Bromofllurobenzene	SW8260B(TPH)	11/11/2009	0	1	56.9-133	58.0	%REC	G21701

Client Sample ID: SB-8-2 @ 3.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 10:06:00 AM

Lab Sample ID: 0911054-013
Date Prepared: 11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/12/2009	1	1	1.0	5.8	mg/Kg	5790
TPH (Diesel)	SW8015B	11/12/2009	2	1	2.0	ND	mg/Kg	R21718
TPH (Motor Oil)	SW8015B	11/12/2009	4	1	4.0	ND	mg/Kg	R21718
Surr: Pentacosane	SW8015B	11/12/2009	0	1	59.7-129	105	%REC	R21718
TPH (Gasoline)	SW8260B(TPH)	11/13/2009	100	1	100	ND	µg/Kg	G21721
Surr: 4-Bromofllurobenzene	SW8260B(TPH)	11/13/2009	0	1	56.9-133	78.0	%REC	G21721

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-8-2 @ 6.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 10:08:00 AM

Lab Sample ID: 0911054-014
Date Prepared: 11/10/2009-11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Arsenic	SW6010B	11/12/2009	1.7	1	1.7	2.9	mg/Kg	5790
Barium	SW6010B	11/12/2009	5	1	5.0	220	mg/Kg	5790
Beryllium	SW6010B	11/12/2009	2	1	2.0	ND	mg/Kg	5790
Cadmium	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5790
Chromium	SW6010B	11/12/2009	5	1	5.0	39	mg/Kg	5790
Cobalt	SW6010B	11/12/2009	5	1	5.0	7.6	mg/Kg	5790
Copper	SW6010B	11/12/2009	5	1	5.0	20	mg/Kg	5790
Lead	SW6010B	11/12/2009	1	1	1.0	5.8	mg/Kg	5790
Molybdenum	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Nickel	SW6010B	11/12/2009	5	1	5.0	39	mg/Kg	5790
Selenium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Silver	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5790
Thallium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Vanadium	SW6010B	11/12/2009	5	1	5.0	42	mg/Kg	5790
Zinc	SW6010B	11/12/2009	5	1	5.0	28	mg/Kg	5790
Mercury	SW7471A	11/11/2009	0.1	1	0.10	0.20	mg/Kg	5783
TPH (Diesel)	SW8015B	11/12/2009	2	1	2.0	ND	mg/Kg	R21718
TPH (Motor Oil)	SW8015B	11/12/2009	4	1	4.0	ND	mg/Kg	R21718
Surr: Pentacosane	SW8015B	11/12/2009	0	1	59.7-129	97.3	%REC	R21718
TPH (Gasoline)	SW8260B(TPH)	11/11/2009	100	1	100	ND	µg/Kg	G21701
Surr: 4-Bromofllurobenzene	SW8260B(TPH)	11/11/2009	0	1	56.9-133	50.0	%REC	G21701

Note: S - Low recovery due to matrix effect. Result confirmed by another runs (MS/MSD).

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-8-1 @ 0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 10:15:00 AM

Lab Sample ID: 0911054-015
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	1.3	mg/L	5951
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	0.84	mg/L	5949
Antimony	SW6010B	12/9/2009	5	1	5.0	ND	mg/Kg	5891
Arsenic	SW6010B	12/9/2009	1.7	1	1.7	5.3	mg/Kg	5891
Barium	SW6010B	12/9/2009	5	1	5.0	94	mg/Kg	5891
Beryllium	SW6010B	12/9/2009	2	1	2.0	ND	mg/Kg	5891
Cadmium	SW6010B	12/9/2009	1	1	1.0	ND	mg/Kg	5891
Chromium	SW6010B	12/9/2009	5	1	5.0	29	mg/Kg	5891
Cobalt	SW6010B	12/9/2009	5	1	5.0	16	mg/Kg	5891
Copper	SW6010B	12/9/2009	5	1	5.0	39	mg/Kg	5891
Lead	SW6010B	12/9/2009	1	1	1.0	400	mg/Kg	5891
Molybdenum	SW6010B	12/9/2009	5	1	5.0	ND	mg/Kg	5891
Nickel	SW6010B	12/9/2009	5	1	5.0	45	mg/Kg	5891
Selenium	SW6010B	12/9/2009	5	1	5.0	ND	mg/Kg	5891
Silver	SW6010B	12/9/2009	1	1	1.0	ND	mg/Kg	5891
Thallium	SW6010B	12/9/2009	5	1	5.0	ND	mg/Kg	5891
Vanadium	SW6010B	12/9/2009	5	1	5.0	52	mg/Kg	5891
Zinc	SW6010B	12/9/2009	5	1	5.0	150	mg/Kg	5891
Mercury	SW7471A	12/10/2009	0.1	1	0.10	0.14	mg/Kg	5892

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-8-1 @ 1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 10:17:00 AM

Lab Sample ID: 0911054-016
Date Prepared: 12/9/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	12/9/2009	5	1	5.0	ND	mg/Kg	5891
Arsenic	SW6010B	12/9/2009	1.7	1	1.7	5.0	mg/Kg	5891
Barium	SW6010B	12/9/2009	5	1	5.0	74	mg/Kg	5891
Beryllium	SW6010B	12/9/2009	2	1	2.0	ND	mg/Kg	5891
Cadmium	SW6010B	12/9/2009	1	1	1.0	ND	mg/Kg	5891
Chromium	SW6010B	12/9/2009	5	1	5.0	31	mg/Kg	5891
Cobalt	SW6010B	12/9/2009	5	1	5.0	12	mg/Kg	5891
Copper	SW6010B	12/9/2009	5	1	5.0	18	mg/Kg	5891
Lead	SW6010B	12/9/2009	1	1	1.0	4.6	mg/Kg	5891
Molybdenum	SW6010B	12/9/2009	5	1	5.0	ND	mg/Kg	5891
Nickel	SW6010B	12/9/2009	5	1	5.0	43	mg/Kg	5891
Selenium	SW6010B	12/9/2009	5	1	5.0	ND	mg/Kg	5891
Silver	SW6010B	12/9/2009	1	1	1.0	ND	mg/Kg	5891
Thallium	SW6010B	12/9/2009	5	1	5.0	ND	mg/Kg	5891
Vanadium	SW6010B	12/9/2009	5	1	5.0	35	mg/Kg	5891
Zinc	SW6010B	12/9/2009	5	1	5.0	26	mg/Kg	5891
Mercury	SW7471A	12/10/2009	0.1	1	0.10	ND	mg/Kg	5892

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/5/2010

Client Sample ID: SB-8-1 @ 1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 10:19:00 AM

Lab Sample ID: 0911054-017
Date Prepared: 12/9/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	12/9/2009	5	1	5.0	ND	mg/Kg	5891
Arsenic	SW6010B	12/9/2009	1.7	1	1.7	8.9	mg/Kg	5891
Barium	SW6010B	12/9/2009	5	1	5.0	37	mg/Kg	5891
Beryllium	SW6010B	12/9/2009	2	1	2.0	ND	mg/Kg	5891
Cadmium	SW6010B	12/9/2009	1	1	1.0	ND	mg/Kg	5891
Chromium	SW6010B	12/9/2009	5	1	5.0	36	mg/Kg	5891
Cobalt	SW6010B	12/9/2009	5	1	5.0	14	mg/Kg	5891
Copper	SW6010B	12/9/2009	5	1	5.0	34	mg/Kg	5891
Lead	SW6010B	12/9/2009	1	1	1.0	6.2	mg/Kg	5891
Molybdenum	SW6010B	12/9/2009	5	1	5.0	ND	mg/Kg	5891
Nickel	SW6010B	12/9/2009	5	1	5.0	40	mg/Kg	5891
Selenium	SW6010B	12/9/2009	5	1	5.0	ND	mg/Kg	5891
Silver	SW6010B	12/9/2009	1	1	1.0	ND	mg/Kg	5891
Thallium	SW6010B	12/9/2009	5	1	5.0	ND	mg/Kg	5891
Vanadium	SW6010B	12/9/2009	5	1	5.0	51	mg/Kg	5891
Zinc	SW6010B	12/9/2009	5	1	5.0	24	mg/Kg	5891
Mercury	SW7471A	12/10/2009	0.1	1	0.10	ND	mg/Kg	5892

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Definitions, legends and Notes

Note	Description
ug/kg	Microgram per kilogram (ppb, part per billion).
ug/L	Microgram per liter (ppb, part per billion).
mg/kg	Milligram per kilogram (ppm, part per million).
mg/L	Milligram per liter (ppm, part per million).
LCS/LCSD	Laboratory control sample/laboratory control sample duplicate.
MDL	Method detection limit.
MRL	Modified reporting limit. When sample is subject to dilution, reporting limit times dilution factor yields MRL.
MS/MSD	Matrix spike/matrix spike duplicate.
N/A	Not applicable.
ND	Not detected at or above detection limit.
NR	Not reported.
QC	Quality Control.
RL	Reporting limit.
% RPD	Percent relative difference.
a	pH was measured immediately upon the receipt of the sample, but it was still done outside the holding time.
sub	Analyzed by subcontracting laboratory, Lab Certificate #

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Torrent Laboratory, Inc.

Date: *05-Jan-10*

CLIENT: URS Corporation, San Jose
Work Order: 0911054
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5783

Sample ID: **MB-5783** SampType: **MBLK** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21774**
Client ID: **ZZZZZ** Batch ID: **5783** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **11/11/2009** SeqNo: **312456**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	ND	0.10									

Sample ID: **LCS-5783** SampType: **LCS** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21774**
Client ID: **ZZZZZ** Batch ID: **5783** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **11/11/2009** SeqNo: **312454**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1.373	0.10	1.25	0	110	78.5	125				

Sample ID: **LCSD-5783** SampType: **LCSD** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21774**
Client ID: **ZZZZZ** Batch ID: **5783** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **11/11/2009** SeqNo: **312455**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1.382	0.10	1.25	0	111	78.5	125	1.373	0.605	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911054
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5786

Sample ID: **MB-5786** SampType: **MBLK** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21723**
Client ID: **ZZZZZ** Batch ID: **5786** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311854**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	ND	1.0									

Sample ID: **LCS-5786** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21723**
Client ID: **ZZZZZ** Batch ID: **5786** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311852**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	50.50	1.0	50	0.2	101	67.9	118				

Sample ID: **LCSD-5786** SampType: **LCSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21723**
Client ID: **ZZZZZ** Batch ID: **5786** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/11/2009** SeqNo: **311853**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	50.70	1.0	50	0.2	101	67.9	118	50.5	0.395	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911054
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5790

Sample ID: **MB-5790** SampType: **MBLK** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/11/2009** RunNo: **21725**
Client ID: **ZZZZZ** Batch ID: **5790** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/12/2009** SeqNo: **311898**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	ND	5.0									
Arsenic	ND	1.7									
Barium	ND	5.0									
Beryllium	ND	2.0									
Cadmium	ND	1.0									
Chromium	ND	5.0									
Cobalt	ND	5.0									
Copper	ND	5.0									
Lead	ND	1.0									
Molybdenum	ND	5.0									
Nickel	ND	5.0									
Selenium	ND	5.0									
Silver	ND	1.0									
Thallium	ND	5.0									
Vanadium	ND	5.0									
Zinc	ND	5.0									

Sample ID: **LCS-5790** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/11/2009** RunNo: **21725**
Client ID: **ZZZZZ** Batch ID: **5790** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/12/2009** SeqNo: **311896**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	49.20	5.0	50	0	98.4	30.7	130				
Arsenic	47.35	1.7	50	0	94.7	71	121				
Barium	49.50	5.0	50	0.45	98.1	70.2	130				
Beryllium	49.80	2.0	50	0	99.6	73.3	115				
Cadmium	46.80	1.0	50	0	93.6	68.7	110				
Chromium	49.65	5.0	50	0.15	99.0	76	116				
Cobalt	48.25	5.0	50	0	96.5	57.4	122				
Copper	49.30	5.0	50	0.65	97.3	74.8	119				
Lead	48.30	1.0	50	0.3	96.0	67.9	118				
Molybdenum	49.75	5.0	50	0.1	99.3	62.9	123				

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911054
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5790

Sample ID: **LCS-5790** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/11/2009** RunNo: **21725**
Client ID: **ZZZZZ** Batch ID: **5790** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/12/2009** SeqNo: **311896**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nickel	47.65	5.0	50	0.15	95.0	61.5	122				
Selenium	45.20	5.0	50	0	90.4	62	111				
Silver	47.95	1.0	50	0	95.9	81.1	109				
Thallium	46.85	5.0	50	0	93.7	39.2	125				
Vanadium	49.45	5.0	50	0	98.9	65.8	122				
Zinc	48.10	5.0	50	1.55	93.1	59.9	122				

Sample ID: **LCSD-5790** SampType: **LCSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/11/2009** RunNo: **21725**
Client ID: **ZZZZZ** Batch ID: **5790** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/12/2009** SeqNo: **311897**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	49.60	5.0	50	0	99.2	30.7	130	49.2	0.810	30	
Arsenic	48.20	1.7	50	0	96.4	71	121	47.35	1.78	30	
Barium	49.60	5.0	50	0.45	98.3	70.2	130	49.5	0.202	30	
Beryllium	52.20	2.0	50	0	104	73.3	115	49.8	4.71	30	
Cadmium	46.80	1.0	50	0	93.6	68.7	110	46.8	0	30	
Chromium	49.75	5.0	50	0.15	99.2	76	116	49.65	0.201	30	
Cobalt	48.45	5.0	50	0	96.9	57.4	122	48.25	0.414	30	
Copper	49.90	5.0	50	0.65	98.5	74.8	119	49.3	1.21	30	
Lead	48.90	1.0	50	0.3	97.2	67.9	118	48.3	1.23	30	
Molybdenum	50.30	5.0	50	0.1	100	62.9	123	49.75	1.10	30	
Nickel	48.10	5.0	50	0.15	95.9	61.5	122	47.65	0.940	30	
Selenium	45.40	5.0	50	0	90.8	62	111	45.2	0.442	30	
Silver	48.10	1.0	50	0	96.2	81.1	109	47.95	0.312	30	
Thallium	47.55	5.0	50	0	95.1	39.2	125	46.85	1.48	30	
Vanadium	49.95	5.0	50	0	99.9	65.8	122	49.45	1.01	30	
Zinc	47.95	5.0	50	1.55	92.8	59.9	122	48.1	0.312	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911054
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5790

Sample ID: **0911054-005AMS** SampType: **MS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/11/2009** RunNo: **21725**
Client ID: **SB-7-2 @ 1.0** Batch ID: **5790** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/12/2009** SeqNo: **311876**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	37.30	5.0	50	0	74.6	30.7	130	0	0		
Arsenic	49.95	1.7	50	4.85	90.2	71	121	4.85	0		
Barium	158.6	5.0	50	109.8	97.8	56.2	127	109.8	0		
Beryllium	47.65	2.0	50	0	95.3	73.3	115	0	0		
Cadmium	45.95	1.0	50	0.45	91.0	68.7	110	0.45	0		
Chromium	92.90	5.0	50	36.95	112	76	116	36.95	0		
Cobalt	55.35	5.0	50	14.75	81.2	57.4	122	14.75	0		
Copper	74.55	5.0	50	23.75	102	74.8	119	23.75	0		
Lead	203.8	1.0	50	137	134	60.5	113	137	0		S
Molybdenum	43.90	5.0	50	0.4	87.0	62.9	123	0.4	0		
Nickel	87.20	5.0	50	51.3	71.8	61.5	122	51.3	0		
Selenium	42.95	5.0	50	0	85.9	62	111	0	0		
Silver	48.50	1.0	50	0	97.0	81.1	109	0	0		
Thallium	38.40	5.0	50	0	76.8	39.2	125	0	0		
Vanadium	89.85	5.0	50	38.3	103	65.8	122	38.3	0		
Zinc	107.2	5.0	50	59.65	95.1	59.9	122	59.65	0		

Sample ID: **0911054-005AMSD** SampType: **MSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/11/2009** RunNo: **21725**
Client ID: **SB-7-2 @ 1.0** Batch ID: **5790** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/12/2009** SeqNo: **311877**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	35.80	5.0	50	0	71.6	30.7	130	37.3	4.10	30	
Arsenic	47.85	1.7	50	4.85	86.0	71	121	49.95	4.29	30	
Barium	164.8	5.0	50	109.8	110	56.2	127	158.6	3.83	30	
Beryllium	48.25	2.0	50	0	96.5	73.3	115	47.65	1.25	30	
Cadmium	46.55	1.0	50	0.45	92.2	68.7	110	45.95	1.30	30	
Chromium	99.20	5.0	50	36.95	124	76	116	92.9	6.56	30	S
Cobalt	59.40	5.0	50	14.75	89.3	57.4	122	55.35	7.06	30	
Copper	81.95	5.0	50	23.75	116	74.8	119	74.55	9.46	30	
Lead	264.4	1.0	50	137	255	60.5	113	203.8	25.9	30	S
Molybdenum	43.15	5.0	50	0.4	85.5	62.9	123	43.9	1.72	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911054
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5790

Sample ID: **0911054-005AMSD** SampType: **MSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/11/2009** RunNo: **21725**
Client ID: **SB-7-2 @ 1.0** Batch ID: **5790** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/12/2009** SeqNo: **311877**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nickel	94.00	5.0	50	51.3	85.4	61.5	122	87.2	7.51	30	
Selenium	39.70	5.0	50	0	79.4	62	111	42.95	7.86	30	
Silver	49.60	1.0	50	0	99.2	81.1	109	48.5	2.24	30	
Thallium	37.80	5.0	50	0	75.6	39.2	125	38.4	1.57	30	
Vanadium	93.55	5.0	50	38.3	110	65.8	122	89.85	4.03	30	
Zinc	127.0	5.0	50	59.65	135	59.9	122	107.2	16.9	30	S

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911054
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5891

Sample ID: **MB-5891** SampType: **MBLK** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **12/9/2009** RunNo: **22053**
Client ID: **ZZZZZ** Batch ID: **5891** TestNo: **SW6010B (SW3050B)** Analysis Date: **12/9/2009** SeqNo: **315732**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	ND	5.0									
Arsenic	ND	1.7									
Barium	ND	5.0									
Beryllium	ND	2.0									
Cadmium	ND	1.0									
Chromium	ND	5.0									
Cobalt	ND	5.0									
Copper	ND	5.0									
Lead	ND	1.0									
Molybdenum	ND	5.0									
Nickel	ND	5.0									
Selenium	ND	5.0									
Silver	ND	1.0									
Thallium	ND	5.0									
Vanadium	ND	5.0									
Zinc	ND	5.0									

Sample ID: **LCS-5891** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **12/9/2009** RunNo: **22053**
Client ID: **ZZZZZ** Batch ID: **5891** TestNo: **SW6010B (SW3050B)** Analysis Date: **12/9/2009** SeqNo: **315730**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	48.15	5.0	50	0	96.3	30.7	130				
Arsenic	48.10	1.7	50	0.35	95.5	71	121				
Barium	51.80	5.0	50	0	104	70.2	130				
Beryllium	46.65	2.0	50	0	93.3	73.3	115				
Cadmium	49.00	1.0	50	0.1	97.8	68.7	110				
Chromium	52.30	5.0	50	0.1	104	76	116				
Cobalt	51.50	5.0	50	0.15	103	57.4	122				
Copper	52.80	5.0	50	1.45	103	74.8	119				
Lead	49.75	1.0	50	0.75	98.0	67.9	118				
Molybdenum	49.90	5.0	50	0	99.8	62.9	123				

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911054
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5891

Sample ID: **LCS-5891** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **12/9/2009** RunNo: **22053**
Client ID: **ZZZZZ** Batch ID: **5891** TestNo: **SW6010B (SW3050B)** Analysis Date: **12/9/2009** SeqNo: **315730**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nickel	51.75	5.0	50	0.4	103	61.5	122				
Selenium	45.70	5.0	50	0	91.4	62	111				
Silver	49.45	1.0	50	0	98.9	81.1	109				
Thallium	46.15	5.0	50	0	92.3	39.2	125				
Vanadium	52.40	5.0	50	0	105	65.8	122				
Zinc	52.00	5.0	50	2.3	99.4	59.9	122				

Sample ID: **LCSD-5891** SampType: **LCSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **12/9/2009** RunNo: **22053**
Client ID: **ZZZZZ** Batch ID: **5891** TestNo: **SW6010B (SW3050B)** Analysis Date: **12/9/2009** SeqNo: **315731**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	48.30	5.0	50	0	96.6	30.7	130	48.15	0.311	30	
Arsenic	48.50	1.7	50	0.35	96.3	71	121	48.1	0.828	30	
Barium	48.50	5.0	50	0	97.0	70.2	130	51.8	6.58	30	
Beryllium	48.00	2.0	50	0	96.0	73.3	115	46.65	2.85	30	
Cadmium	46.35	1.0	50	0.1	92.5	68.7	110	49	5.56	30	
Chromium	49.35	5.0	50	0.1	98.5	76	116	52.3	5.80	30	
Cobalt	48.15	5.0	50	0.15	96.0	57.4	122	51.5	6.72	30	
Copper	54.00	5.0	50	1.45	105	74.8	119	52.8	2.25	30	
Lead	50.50	1.0	50	0.75	99.5	67.9	118	49.75	1.50	30	
Molybdenum	48.05	5.0	50	0	96.1	62.9	123	49.9	3.78	30	
Nickel	48.90	5.0	50	0.4	97.0	61.5	122	51.75	5.66	30	
Selenium	46.30	5.0	50	0	92.6	62	111	45.7	1.30	30	
Silver	47.40	1.0	50	0	94.8	81.1	109	49.45	4.23	30	
Thallium	46.60	5.0	50	0	93.2	39.2	125	46.15	0.970	30	
Vanadium	49.20	5.0	50	0	98.4	65.8	122	52.4	6.30	30	
Zinc	58.70	5.0	50	2.3	113	59.9	122	52	12.1	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911054
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5892

Sample ID: **MB-5892** SampType: **MBLK** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **12/9/2009** RunNo: **22048**
Client ID: **ZZZZZ** Batch ID: **5892** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **12/10/2009** SeqNo: **315693**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	ND	0.10									

Sample ID: **LCS-5892** SampType: **LCS** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **12/9/2009** RunNo: **22048**
Client ID: **ZZZZZ** Batch ID: **5892** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **12/10/2009** SeqNo: **315691**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1.432	0.10	1.25	0	115	78.5	125				

Sample ID: **LCSD-5892** SampType: **LCSD** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **12/9/2009** RunNo: **22048**
Client ID: **ZZZZZ** Batch ID: **5892** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **12/10/2009** SeqNo: **315692**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1.416	0.10	1.25	0	113	78.5	125	1.432	1.17	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911054
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5947

Sample ID: **MB-5947** SampType: **MBLK** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **12/28/2009** RunNo: **22256**
Client ID: **ZZZZZ** Batch ID: **5947** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **12/29/2009** SeqNo: **318219**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	ND	0.10									

Sample ID: **LCS-5947** SampType: **LCS** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **12/28/2009** RunNo: **22256**
Client ID: **ZZZZZ** Batch ID: **5947** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **12/29/2009** SeqNo: **318217**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1.110	0.10	1.25	0	88.8	78.5	125				

Sample ID: **LCSD-5947** SampType: **LCSD** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **12/28/2009** RunNo: **22256**
Client ID: **ZZZZZ** Batch ID: **5947** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **12/29/2009** SeqNo: **318218**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1.308	0.10	1.25	0	105	78.5	125	1.11	16.4	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911054
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5949

Sample ID: **MB-5949** SampType: **MBLK** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22266**
Client ID: **ZZZZZ** Batch ID: **5949** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318462**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	ND	0.10									

Sample ID: **LCS-5949** SampType: **LCS** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22266**
Client ID: **ZZZZZ** Batch ID: **5949** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318460**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	8.410	0.10	10	0	84.1	75	125				

Sample ID: **LCSD-5949** SampType: **LCSD** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22266**
Client ID: **ZZZZZ** Batch ID: **5949** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318461**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	8.670	0.10	10	0	86.7	75	125	8.41	3.04	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911054
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5951

Sample ID: **MB-5951** SampType: **MBLK** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **12/30/2009** RunNo: **22287**
Client ID: **ZZZZZ** Batch ID: **5951** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318878**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	ND	0.10									

Sample ID: **LCS-5951** SampType: **LCS** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **12/30/2009** RunNo: **22287**
Client ID: **ZZZZZ** Batch ID: **5951** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318876**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	0.9720	0.10	1	0	97.2	75	125				

Sample ID: **LCSD-5951** SampType: **LCSD** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **12/30/2009** RunNo: **22287**
Client ID: **ZZZZZ** Batch ID: **5951** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318877**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	0.9710	0.10	1	0	97.1	75	125	0.972	0.103	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911054
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5957

Sample ID: **MB-5957** SampType: **MBLK** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **12/31/2009** RunNo: **22293**
Client ID: **ZZZZZ** Batch ID: **5957** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318977**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	ND	0.10									

Sample ID: **LCS-5957** SampType: **LCS** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **12/31/2009** RunNo: **22293**
Client ID: **ZZZZZ** Batch ID: **5957** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318975**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	9.580	0.10	10	0	95.8	75	125				

Sample ID: **LCSD-5957** SampType: **LCSD** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **12/31/2009** RunNo: **22293**
Client ID: **ZZZZZ** Batch ID: **5957** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318976**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	9.580	0.10	10	0	95.8	75	125	9.58	0	30	

Sample ID: **0911054-002AMS** SampType: **MS** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **12/31/2009** RunNo: **22293**
Client ID: **SB-7-1 @ 1.0** Batch ID: **5957** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318963**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	9.390	0.10	10	0	93.9	75	125				

Sample ID: **0911054-002AMSD** SampType: **MSD** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **12/31/2009** RunNo: **22293**
Client ID: **SB-7-1 @ 1.0** Batch ID: **5957** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318964**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	9.280	0.10	10	0	92.8	75	125	9.39	1.18	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911054
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: G21701

Sample ID: **MB_G21701** SampType: **MBLK** TestCode: **TPH_GAS_S_** Units: **µg/Kg** Prep Date: **11/10/2009** RunNo: **21701**
Client ID: **ZZZZZ** Batch ID: **G21701** TestNo: **SW8260B(TP** Analysis Date: **11/10/2009** SeqNo: **311565**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Gasoline)	ND	100									
Surr: 4-Bromofllurobenzene	35.00	0	50	0	70.0	56.9	133				

Sample ID: **LCS_G21701** SampType: **LCS** TestCode: **TPH_GAS_S_** Units: **µg/Kg** Prep Date: **11/10/2009** RunNo: **21701**
Client ID: **ZZZZZ** Batch ID: **G21701** TestNo: **SW8260B(TP** Analysis Date: **11/10/2009** SeqNo: **311566**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Gasoline)	1147	100	1000	0	115	48.2	132				
Surr: 4-Bromofllurobenzene	41.00	0	50	0	82.0	56.9	133				

Sample ID: **LCSD_G21701** SampType: **LCSD** TestCode: **TPH_GAS_S_** Units: **µg/Kg** Prep Date: **11/10/2009** RunNo: **21701**
Client ID: **ZZZZZ** Batch ID: **G21701** TestNo: **SW8260B(TP** Analysis Date: **11/10/2009** SeqNo: **311567**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Gasoline)	881.0	100	1000	0	88.1	48.2	132	1147	26.2	30	
Surr: 4-Bromofllurobenzene	38.00	0	50	0	76.0	56.9	133	0	0	0	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911054
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: G21717

Sample ID: **MB_G21717** SampType: **MBLK** TestCode: **TPH_GAS_S_** Units: **µg/Kg** Prep Date: **11/11/2009** RunNo: **21717**
Client ID: **ZZZZZ** Batch ID: **G21717** TestNo: **SW8260B(TP** Analysis Date: **11/11/2009** SeqNo: **311717**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Gasoline)	ND	100									
Surr: 4-Bromofllurobenzene	38.00	0	50	0	76.0	56.9	133				

Sample ID: **LCS_G21717** SampType: **LCS** TestCode: **TPH_GAS_S_** Units: **µg/Kg** Prep Date: **11/11/2009** RunNo: **21717**
Client ID: **ZZZZZ** Batch ID: **G21717** TestNo: **SW8260B(TP** Analysis Date: **11/11/2009** SeqNo: **311718**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Gasoline)	871.0	100	1000	0	87.1	48.2	132				
Surr: 4-Bromofllurobenzene	33.00	0	50	0	66.0	56.9	133				

Sample ID: **LCSD_G21717** SampType: **LCSD** TestCode: **TPH_GAS_S_** Units: **µg/Kg** Prep Date: **11/11/2009** RunNo: **21717**
Client ID: **ZZZZZ** Batch ID: **G21717** TestNo: **SW8260B(TP** Analysis Date: **11/11/2009** SeqNo: **311719**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Gasoline)	858.0	100	1000	0	85.8	48.2	132	871	1.50	30	
Surr: 4-Bromofllurobenzene	36.00	0	50	0	72.0	56.9	133	0	0	0	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911054
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: G21721

Sample ID: **MB_G21721** SampType: **MBLK** TestCode: **TPH_GAS_S_** Units: **µg/Kg** Prep Date: **11/12/2009** RunNo: **21721**
Client ID: **ZZZZZ** Batch ID: **G21721** TestNo: **SW8260B(TP** Analysis Date: **11/12/2009** SeqNo: **311799**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Gasoline)	ND	100									
Surr: 4-Bromofllurobenzene	52.00	0	50	0	104	56.9	133				

Sample ID: **LCS_G21721** SampType: **LCS** TestCode: **TPH_GAS_S_** Units: **µg/Kg** Prep Date: **11/12/2009** RunNo: **21721**
Client ID: **ZZZZZ** Batch ID: **G21721** TestNo: **SW8260B(TP** Analysis Date: **11/12/2009** SeqNo: **311800**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Gasoline)	975.0	100	1000	0	97.5	48.2	132				
Surr: 4-Bromofllurobenzene	50.00	0	50	0	100	56.9	133				

Sample ID: **LCSD_G21721** SampType: **LCSD** TestCode: **TPH_GAS_S_** Units: **µg/Kg** Prep Date: **11/12/2009** RunNo: **21721**
Client ID: **ZZZZZ** Batch ID: **G21721** TestNo: **SW8260B(TP** Analysis Date: **11/12/2009** SeqNo: **311801**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Gasoline)	1162	100	1000	0	116	48.2	132	975	17.5	30	
Surr: 4-Bromofllurobenzene	54.00	0	50	0	108	56.9	133	0	0	0	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911054
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: R21718

Sample ID: **SD091110A-MB** SampType: **MBLK** TestCode: **TPHDO_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21718**
Client ID: **ZZZZZ** Batch ID: **R21718** TestNo: **SW8015B** Analysis Date: **11/11/2009** SeqNo: **311773**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Diesel)	ND	2.0									
TPH (Motor Oil)	ND	4.0									
Surr: Pentacosane	3.481	0	3.3	0	105	59.7	129				

Sample ID: **SD091110A-LCS** SampType: **LCS** TestCode: **TPHDO_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21718**
Client ID: **ZZZZZ** Batch ID: **R21718** TestNo: **SW8015B** Analysis Date: **11/11/2009** SeqNo: **311774**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Diesel)	27.29	2.0	33.33	0	81.9	52.7	115				
Surr: Pentacosane	2.753	0	3.3	0	83.4	59.7	129				

Sample ID: **SD091110A-LCSD** SampType: **LCSD** TestCode: **TPHDO_S** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21718**
Client ID: **ZZZZZ** Batch ID: **R21718** TestNo: **SW8015B** Analysis Date: **11/11/2009** SeqNo: **311775**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Diesel)	33.05	2.0	33.33	0	99.2	52.7	115	27.29	19.1	30	
Surr: Pentacosane	3.601	0	3.3	0	109	59.7	129	0	0	0	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

Torrent LABORATORY, INC.
483 Sinclair Frontage Road
Milpitas, CA 95035
Phone: 408.263.5258
FAX: 408.263.8293
www.torrentlab.com

RESET

CHAIN OF CUSTODY

NOTE: SHADED AREAS ARE FOR TORRENT LAB USE ONLY

LAB WORK ORDER NO 0911054

Company Name: URS San Jose	Location of Sampling: Petaluma, CA
Address: 55 South Market St., Suite 1500	Purpose: Soil Investigation
City: San Jose State: CA Zip Code: 95113	Special Instructions / Comments:
Telephone: 4082979585 FAX: 4082976962	
REPORT TO: P Walz SAMPLER: P Walz	P.O. #: 28645097.04002 EMAIL:

TURNAROUND TIME: [x] 10 Work Days [ ] 3 Work Days [ ] Noon - Nxt Day [ ] 7 Work Days [ ] 2 Work Days [ ] 2 - 8 Hours [ ] 5 Work Days [ ] 1 Work Day [ ] Other

SAMPLE TYPE: [ ] Storm Water [ ] Air [ ] Waste Water [ ] Other [ ] Ground Water [x] Soil

REPORT FORMAT: [ ] QC Level IV [ ] EDF [ ] Excel / EDD

ANALYSIS REQUESTED

LAB ID	CLIENT'S SAMPLE I.D.	DATE / TIME SAMPLED	MATRIX	# OF CONT	CONT TYPE	Cam 17 Metals	Lead	TPH-d/mo	TPH-g						REMARKS
001A	SB-7-1 @ 0.5	11-6-09 0915	Soil	1	Jar		X								
002A	SB-7-1 @ 1.0	0917					X								
003A	SB-7-1 @ 1.5	0920					X								
004A	SB-7-2 @ 0.5	0922			Sleeve		X	X	X						
005A	SB-7-2 @ 1.0	0925				X		X	X						
006A	SB-7-2 @ 1.5	0927					X	X	X						
007A	SB-7-2 @ 3.0	0930					X	X	X						
008A	SB-7-2 @ 6.0	0935				X		X	X					Temp 4°C	
009A	SB-7-2 @ 9.0	0945				X		X	X						
010A	SB-8-2 @ 0.5	1000					X	X	X						

	Relinquished By:	Print:	Date:	Time:	Received By:	Print:	Date:	Time:
1	PW	PWalz	11-6-09	1630			11/6	5
2			11-6	5:58			11-6-09	5:58

Were Samples Received in Good Condition? [x] Yes [ ] NO Samples on Ice? [x] Yes [ ] NO Method of Shipment Hispeed Sample seals intact? [ ] Yes [ ] NO [x] N/A

NOTE: Samples are discarded by the laboratory 30 days from date of receipt unless other arrange -ments are made.

Log In By: Date: Log In Reviewed By: Date:

Page 1 of 2

Work order 5 of 7

Torrent LABORATORY, INC.
483 Sinclair Frontage Road
Milpitas, CA 95035
Phone: 408.263.5258
FAX: 408.263.8293
www.torrentlab.com

RESET

CHAIN OF CUSTODY

•NOTE: SHADED AREAS ARE FOR TORRENT LAB USE ONLY•

LAB WORK ORDER NO: 0911054

Company Name: URS San Jose	Location of Sampling: Petaluma, CA
Address: 55 South Market St., Suite 1500	Purpose: Soil Investigation
City: San Jose / State: CA / Zip Code: 95113	Special Instructions / Comments:
Telephone: 4082979585 / FAX: 4082976962	
REPORT TO: P Walz / SAMPLER: P Walz	P.O. #: 28645097.04002 / EMAIL:

TURNAROUND TIME: ☑ 10 Work Days ☐ 3 Work Days ☐ Noon - Nxt Day ☐ 7 Work Days ☐ 2 Work Days ☐ 2 - 8 Hours ☐ 5 Work Days ☐ 1 Work Day ☐ Other

SAMPLE TYPE: ☐ Storm Water ☐ Air ☐ Waste Water ☐ Other ☐ Ground Water ☑ Soil

REPORT FORMAT: ☐ QC Level IV ☐ EDF ☐ Excel / EDD

ANALYSIS REQUESTED

LAB ID	CLIENT'S SAMPLE I.D.	DATE / TIME SAMPLED	MATRIX	# OF CONT	CONT TYPE	Cam 17 Metals	Lead	TPH-d/mo	TPH-g						REMARKS
011A	SB-8-2@1.0	11-6-09 1002	Soil	1	Stea	X		X	X						
012A	SB-8-2@1.5	1004					X	X	X						
013A	SB-8-2@3.0	1006					X	X	X						
014A	SB-8-2@6.0	1008				X		X	X						
015A	SB-8-1@0.5	1015	Soil												
016A	SB-8-1@1.0	1017													
017A	SB-8-1@1.5	1019													
	~~SB-8-1~~														

Temp 4°C

	Relinquished By:	Print:	Date:	Time:	Received By:	Print:	Date:	Time:
1	[illegible]	PWalz	11-6-09	1630	[illegible]		11/6	5
2	[illegible]		11-6	5:58	M. G. Ghodasara		11-6-09	5:58

Were Samples Received in Good Condition? ☑ Yes ☐ NO Samples on Ice? ☑ Yes ☐ NO Method of Shipment Hispeed Sample seals intact? ☐ Yes ☐ NO ☑ N/A

NOTE: Samples are discarded by the laboratory 30 days from date of receipt unless other arrange-ments are made.

Page 2 of 2

Log In By: Date: Log In Reviewed By: Date:

WO 5 of 7

Torrent
LABORATORY, INC.

January 18, 2010 (Revision 2)

Patrick Walz
URS Corporation, San Jose
55 South Market St., Suite 1500
San Jose, CA 95113

TEL: (408) 297-9585
FAX (408) 297-6962

RE: 28645097.04002

Order No.: 0911055

Dear Patrick Walz:

Torrent Laboratory, Inc. received 14 samples on 11/6/2009 for the analyses presented in the following report.

All data for associated QC met EPA or laboratory specification(s) except where noted in the case narrative.
Reported data is applicable for only the samples received as part of the order number referenced above.

Torrent Laboratory, Inc, is certified by the State of California, ELAP #1991. If you have any questions regarding these tests results, please feel free to contact the Project Management Team at (408)263-5258;ext: 204.

Sincerely,

Laboratory Director

11/18/10
Date

Patti Sandrock
QA Officer

483 Sinclair Frontage Rd., Milpitas, CA 95035 | tel: 408.263.5258 | main fax: 408.263.8293 | project manager fax: 408.263.2708
www.torrentlab.com

Torrent Laboratory, Inc. **Date:** *18-Jan-10*

CLIENT: URS Corporation, San Jose
Project: 28645097.04002
Lab Order: 0911055

CASE NARRATIVE

Analytical Comment for Method SW6010B. Note:The % recoveries in the MS/MSD for lead and in the MSD for zinc are outside of laboratory control limits but within % RPD limits and % recovery limits for the LCS/LCSD. No corrective action is required.

Note: Extraction of 50 g sample / 500g 0.2M Sodium Citrate Solution was performed according to wet extraction procedure (WET) which was rotated in a rotary shaker for 48 hours.

Date Prepared: started on 12/26/09 @ 12:30pm and ended on 12/28/09 2 12:30pm

Note: Extraction of 50 g sample /DI water was performed according to wet extraction procedure (DI STLC) which was rotated in a rotary shaker for 48 hours.

Date Prepared: started on 12/28/09 @ 8:30pm and ended on 12/30/09 @ 8:30pm.

Note: Extraction of 25 g sample / 500g TCLP Fluid # 1 was performed according to Toxicity Characteristic Leaching Procedure (TCLP) which was rotated in a rotary shaker for 18 hours.

Date Prepared: started on 12/30/09 @ 5:0pm and ended on 12/31/09 @ 11:0am.

Per Client request STLC, DI STLC and TCLP added to some samples and reported.

Rev1 1/5/10

Note: Extraction of 50 g sample / 500g 0.2M Sodium Citrate Solution was performed according to wet extraction procedure (WET) which was rotated in a rotary shaker for 48 hours.

CLIENT:	URS Corporation, San Jose
Project:	28645097.04002
Lab Order:	0911055

CASE NARRATIVE

Date Prepared: started on 1/11/2010 @ 5:30pm and ended on 1/13/2010 @ 5:30pm.

Per client request STLC, DI-STLC analyzed and reported for sample 001A.

Rev2 1/18/10.

TORRENT LABORATORY, INC.

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Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/18/2010

Client Sample ID: NB-11-1 @ 0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 10:45:00 AM

Lab Sample ID: 0911055-001
Date Prepared: 1/13/2010

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	1/13/2010	0.1	1	1.0	ND	mg/L	5989
Lead (STLC)	6010B (STLC)	1/13/2010	0.1	1	0.10	5.1	mg/L	5988
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5957
Lead	SW6010B	11/12/2009	1	1	1.0	87	mg/Kg	5790

Client Sample ID: NB-11-1 @ 1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 10:47:00 AM

Lab Sample ID: 0911055-002
Date Prepared: 12/31/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5957
Lead	SW6010B	11/12/2009	1	1	1.0	2.8	mg/Kg	5790

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/18/2010

Client Sample ID: NB-11-1 @ 1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 10:50:00 AM

Lab Sample ID: 0911055-003
Date Prepared: 11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/12/2009	1	1	1.0	2.8	mg/Kg	5790

Client Sample ID: NB-11-1 @ 3.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 10:52:00 AM

Lab Sample ID: 0911055-004
Date Prepared: 11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/12/2009	1	1	1.0	4.4	mg/Kg	5790

Client Sample ID: NB-11-1 @ 6.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 10:55:00 AM

Lab Sample ID: 0911055-005
Date Prepared: 11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/12/2009	1	1	1.0	7.7	mg/Kg	5790

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/18/2010

Client Sample ID: NB-11-2 @ 0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 11:00:00 AM

Lab Sample ID: 0911055-006
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	ND	mg/L	5951
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	4.6	mg/L	5949
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5957
Lead	SW6010B	11/12/2009	1	1	1.0	140	mg/Kg	5790

Client Sample ID: NB-11-2 @ 1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 11:05:00 AM

Lab Sample ID: 0911055-007
Date Prepared: 11/10/2009-11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Arsenic	SW6010B	11/12/2009	1.7	1	1.7	3.0	mg/Kg	5790
Barium	SW6010B	11/12/2009	5	1	5.0	160	mg/Kg	5790
Beryllium	SW6010B	11/12/2009	2	1	2.0	ND	mg/Kg	5790
Cadmium	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5790
Chromium	SW6010B	11/12/2009	5	1	5.0	42	mg/Kg	5790
Cobalt	SW6010B	11/12/2009	5	1	5.0	13	mg/Kg	5790
Copper	SW6010B	11/12/2009	5	1	5.0	25	mg/Kg	5790
Lead	SW6010B	11/12/2009	1	1	1.0	8.2	mg/Kg	5790
Molybdenum	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Nickel	SW6010B	11/12/2009	5	1	5.0	42	mg/Kg	5790
Selenium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Silver	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5790
Thallium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5790
Vanadium	SW6010B	11/12/2009	5	1	5.0	42	mg/Kg	5790
Zinc	SW6010B	11/12/2009	5	1	5.0	32	mg/Kg	5790
Mercury	SW7471A	11/11/2009	0.1	1	0.10	0.22	mg/Kg	5783

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/18/2010

Client Sample ID: NB-11-2 @ 1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 11:10:00 AM

Lab Sample ID: 0911055-008
Date Prepared: 11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/12/2009	1	1	1.0	14	mg/Kg	5790

Client Sample ID: NB-10-1 @ 0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 11:20:00 AM

Lab Sample ID: 0911055-009
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	ND	mg/L	5951
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	0.86	mg/L	5949
Antimony	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Arsenic	SW6010B	11/12/2009	1.7	1	1.7	13	mg/Kg	5791
Barium	SW6010B	11/12/2009	5	1	5.0	59	mg/Kg	5791
Beryllium	SW6010B	11/12/2009	2	1	2.0	ND	mg/Kg	5791
Cadmium	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5791
Chromium	SW6010B	11/12/2009	5	1	5.0	42	mg/Kg	5791
Cobalt	SW6010B	11/12/2009	5	1	5.0	21	mg/Kg	5791
Copper	SW6010B	11/12/2009	5	1	5.0	26	mg/Kg	5791
Lead	SW6010B	11/12/2009	1	1	1.0	91	mg/Kg	5791
Molybdenum	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Nickel	SW6010B	11/12/2009	5	1	5.0	70	mg/Kg	5791
Selenium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Silver	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5791
Thallium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Vanadium	SW6010B	11/12/2009	5	1	5.0	48	mg/Kg	5791
Zinc	SW6010B	11/12/2009	5	1	5.0	65	mg/Kg	5791
Mercury	SW7471A	11/11/2009	0.1	1	0.10	0.10	mg/Kg	5783

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/18/2010

Client Sample ID: NB-10-1 @ 1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 11:22:00 AM

Lab Sample ID: 0911055-010
Date Prepared: 11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/12/2009	1	1	1.0	18	mg/Kg	5791

Client Sample ID: NB-10-1 @ 1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 11:25:00 AM

Lab Sample ID: 0911055-011
Date Prepared: 11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/12/2009	1	1	1.0	16	mg/Kg	5791

Client Sample ID: NB-10-2 @ 0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 11:30:00 AM

Lab Sample ID: 0911055-012
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	ND	mg/L	5952
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	3.0	mg/L	5949
Lead (TCLP)	6010B (TCLP)	12/31/2009	0.1	1	0.10	ND	mg/L	5957
Lead	SW6010B	11/12/2009	1	1	1.0	100	mg/Kg	5791

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/18/2010

Client Sample ID: NB-10-2 @ 1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 11:32:00 AM

Lab Sample ID: 0911055-013
Date Prepared: 11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/12/2009	1	1	1.0	22	mg/Kg	5791

Client Sample ID: NB-10-2 @ 1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 11:35:00 AM

Lab Sample ID: 0911055-014
Date Prepared: 11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/12/2009	1	1	1.0	9.7	mg/Kg	5791

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Definitions, legends and Notes

Note	Description
ug/kg	Microgram per kilogram (ppb, part per billion).
ug/L	Microgram per liter (ppb, part per billion).
mg/kg	Milligram per kilogram (ppm, part per million).
mg/L	Milligram per liter (ppm, part per million).
LCS/LCSD	Laboratory control sample/laboratory control sample duplicate.
MDL	Method detection limit.
MRL	Modified reporting limit. When sample is subject to dilution, reporting limit times dilution factor yields MRL.
MS/MSD	Matrix spike/matrix spike duplicate.
N/A	Not applicable.
ND	Not detected at or above detection limit.
NR	Not reported.
QC	Quality Control.
RL	Reporting limit.
% RPD	Percent relative difference.
a	pH was measured immediately upon the receipt of the sample, but it was still done outside the holding time.
sub	Analyzed by subcontracting laboratory, Lab Certificate #

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Torrent Laboratory, Inc.

Date: *18-Jan-10*

CLIENT: URS Corporation, San Jose
Work Order: 0911055
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5783

Sample ID: **MB-5783** SampType: **MBLK** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21774**
Client ID: **ZZZZZ** Batch ID: **5783** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **11/11/2009** SeqNo: **312456**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	ND	0.10									

Sample ID: **LCS-5783** SampType: **LCS** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21774**
Client ID: **ZZZZZ** Batch ID: **5783** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **11/11/2009** SeqNo: **312454**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1.373	0.10	1.25	0	110	78.5	125				

Sample ID: **LCSD-5783** SampType: **LCSD** TestCode: **HG_CTS** Units: **mg/Kg** Prep Date: **11/10/2009** RunNo: **21774**
Client ID: **ZZZZZ** Batch ID: **5783** TestNo: **SW7471A** **(SW7471APR** Analysis Date: **11/11/2009** SeqNo: **312455**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1.382	0.10	1.25	0	111	78.5	125	1.373	0.605	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911055
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5790

Sample ID: **MB-5790** SampType: **MBLK** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/11/2009** RunNo: **21725**
Client ID: **ZZZZZ** Batch ID: **5790** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/12/2009** SeqNo: **311898**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	ND	5.0									
Arsenic	ND	1.7									
Barium	ND	5.0									
Beryllium	ND	2.0									
Cadmium	ND	1.0									
Chromium	ND	5.0									
Cobalt	ND	5.0									
Copper	ND	5.0									
Lead	ND	1.0									
Molybdenum	ND	5.0									
Nickel	ND	5.0									
Selenium	ND	5.0									
Silver	ND	1.0									
Thallium	ND	5.0									
Vanadium	ND	5.0									
Zinc	ND	5.0									

Sample ID: **LCS-5790** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/11/2009** RunNo: **21725**
Client ID: **ZZZZZ** Batch ID: **5790** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/12/2009** SeqNo: **311896**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	49.20	5.0	50	0	98.4	30.7	130				
Arsenic	47.35	1.7	50	0	94.7	71	121				
Barium	49.50	5.0	50	0.45	98.1	70.2	130				
Beryllium	49.80	2.0	50	0	99.6	73.3	115				
Cadmium	46.80	1.0	50	0	93.6	68.7	110				
Chromium	49.65	5.0	50	0.15	99.0	76	116				
Cobalt	48.25	5.0	50	0	96.5	57.4	122				
Copper	49.30	5.0	50	0.65	97.3	74.8	119				
Lead	48.30	1.0	50	0.3	96.0	67.9	118				
Molybdenum	49.75	5.0	50	0.1	99.3	62.9	123				

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911055
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5790

Sample ID: **LCS-5790** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/11/2009** RunNo: **21725**
Client ID: **ZZZZZ** Batch ID: **5790** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/12/2009** SeqNo: **311896**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nickel	47.65	5.0	50	0.15	95.0	61.5	122				
Selenium	45.20	5.0	50	0	90.4	62	111				
Silver	47.95	1.0	50	0	95.9	81.1	109				
Thallium	46.85	5.0	50	0	93.7	39.2	125				
Vanadium	49.45	5.0	50	0	98.9	65.8	122				
Zinc	48.10	5.0	50	1.55	93.1	59.9	122				

Sample ID: **LCSD-5790** SampType: **LCSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/11/2009** RunNo: **21725**
Client ID: **ZZZZZ** Batch ID: **5790** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/12/2009** SeqNo: **311897**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	49.60	5.0	50	0	99.2	30.7	130	49.2	0.810	30	
Arsenic	48.20	1.7	50	0	96.4	71	121	47.35	1.78	30	
Barium	49.60	5.0	50	0.45	98.3	70.2	130	49.5	0.202	30	
Beryllium	52.20	2.0	50	0	104	73.3	115	49.8	4.71	30	
Cadmium	46.80	1.0	50	0	93.6	68.7	110	46.8	0	30	
Chromium	49.75	5.0	50	0.15	99.2	76	116	49.65	0.201	30	
Cobalt	48.45	5.0	50	0	96.9	57.4	122	48.25	0.414	30	
Copper	49.90	5.0	50	0.65	98.5	74.8	119	49.3	1.21	30	
Lead	48.90	1.0	50	0.3	97.2	67.9	118	48.3	1.23	30	
Molybdenum	50.30	5.0	50	0.1	100	62.9	123	49.75	1.10	30	
Nickel	48.10	5.0	50	0.15	95.9	61.5	122	47.65	0.940	30	
Selenium	45.40	5.0	50	0	90.8	62	111	45.2	0.442	30	
Silver	48.10	1.0	50	0	96.2	81.1	109	47.95	0.312	30	
Thallium	47.55	5.0	50	0	95.1	39.2	125	46.85	1.48	30	
Vanadium	49.95	5.0	50	0	99.9	65.8	122	49.45	1.01	30	
Zinc	47.95	5.0	50	1.55	92.8	59.9	122	48.1	0.312	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911055
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5791

Sample ID: **MB-5791** SampType: **MBLK** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/11/2009** RunNo: **21758**
Client ID: **ZZZZZ** Batch ID: **5791** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/12/2009** SeqNo: **312261**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	ND	5.0									
Arsenic	ND	1.7									
Barium	ND	5.0									
Beryllium	ND	2.0									
Cadmium	ND	1.0									
Chromium	ND	5.0									
Cobalt	ND	5.0									
Copper	ND	5.0									
Lead	ND	1.0									
Molybdenum	ND	5.0									
Nickel	ND	5.0									
Selenium	ND	5.0									
Silver	ND	1.0									
Thallium	ND	5.0									
Vanadium	ND	5.0									
Zinc	ND	5.0									

Sample ID: **LCS-5791** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/11/2009** RunNo: **21758**
Client ID: **ZZZZZ** Batch ID: **5791** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/12/2009** SeqNo: **312259**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	50.40	5.0	50	0	101	30.7	130				
Arsenic	48.35	1.7	50	0	96.7	71	121				
Barium	48.95	5.0	50	0.2	97.5	70.2	130				
Beryllium	49.80	2.0	50	0	99.6	73.3	115				
Cadmium	46.45	1.0	50	0	92.9	68.7	110				
Chromium	49.00	5.0	50	0.15	97.7	76	116				
Cobalt	48.00	5.0	50	0	96.0	57.4	122				
Copper	49.15	5.0	50	0.5	97.3	74.8	119				
Lead	49.00	1.0	50	0.2	97.6	67.9	118				
Molybdenum	50.80	5.0	50	0	102	62.9	123				

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911055
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5791

Sample ID: **LCS-5791** SampType: **LCS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/11/2009** RunNo: **21758**
Client ID: **ZZZZZ** Batch ID: **5791** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/12/2009** SeqNo: **312259**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nickel	47.50	5.0	50	0.15	94.7	61.5	122				
Selenium	46.05	5.0	50	0	92.1	62	111				
Silver	48.25	1.0	50	0	96.5	81.1	109				
Thallium	47.50	5.0	50	0	95.0	39.2	125				
Vanadium	49.40	5.0	50	0	98.8	65.8	122				
Zinc	46.90	5.0	50	0	93.8	59.9	122				

Sample ID: **LCSD-5791** SampType: **LCSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/11/2009** RunNo: **21758**
Client ID: **ZZZZZ** Batch ID: **5791** TestNo: **SW6010B** **(SW3050B)** Analysis Date: **11/12/2009** SeqNo: **312260**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	49.90	5.0	50	0	99.8	30.7	130	50.4	0.997	30	
Arsenic	48.00	1.7	50	0	96.0	71	121	48.35	0.727	30	
Barium	51.70	5.0	50	0.2	103	70.2	130	48.95	5.46	30	
Beryllium	48.15	2.0	50	0	96.3	73.3	115	49.8	3.37	30	
Cadmium	49.20	1.0	50	0	98.4	68.7	110	46.45	5.75	30	
Chromium	51.85	5.0	50	0.15	103	76	116	49	5.65	30	
Cobalt	51.20	5.0	50	0	102	57.4	122	48	6.45	30	
Copper	52.20	5.0	50	0.5	103	74.8	119	49.15	6.02	30	
Lead	48.70	1.0	50	0.2	97.0	67.9	118	49	0.614	30	
Molybdenum	50.45	5.0	50	0	101	62.9	123	50.8	0.691	30	
Nickel	50.60	5.0	50	0.15	101	61.5	122	47.5	6.32	30	
Selenium	45.95	5.0	50	0	91.9	62	111	46.05	0.217	30	
Silver	50.95	1.0	50	0	102	81.1	109	48.25	5.44	30	
Thallium	47.55	5.0	50	0	95.1	39.2	125	47.5	0.105	30	
Vanadium	52.25	5.0	50	0	104	65.8	122	49.4	5.61	30	
Zinc	50.20	5.0	50	0	100	59.9	122	46.9	6.80	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911055
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5791

Sample ID: **0911055-009AMS** SampType: **MS** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/11/2009** RunNo: **21758**
Client ID: **NB-10-1 @ 0.5** Batch ID: **5791** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/12/2009** SeqNo: **312238**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	33.50	5.0	50	1.5	64.0	30.7	130				
Arsenic	55.35	1.7	50	13.3	84.1	71	121				
Barium	105.9	5.0	50	58.95	93.9	56.2	127				
Beryllium	43.90	2.0	50	0	87.8	73.3	115				
Cadmium	45.85	1.0	50	0.45	90.8	68.7	110				
Chromium	90.85	5.0	50	41.6	98.5	76	116				
Cobalt	66.30	5.0	50	21.2	90.2	57.4	122				
Copper	75.65	5.0	50	25.8	99.7	74.8	119				
Lead	98.60	1.0	50	90.95	15.3	60.5	113				S
Molybdenum	44.05	5.0	50	2.65	82.8	62.9	123				
Nickel	109.0	5.0	50	70.25	77.5	61.5	122				
Selenium	40.50	5.0	50	3.1	74.8	62	111				
Silver	48.20	1.0	50	0	96.4	81.1	109				
Thallium	38.55	5.0	50	0	77.1	39.2	125				
Vanadium	96.50	5.0	50	47.5	98.0	65.8	122				
Zinc	101.7	5.0	50	65.1	73.2	59.9	122				

Sample ID: **0911055-009AMSD** SampType: **MSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/11/2009** RunNo: **21758**
Client ID: **NB-10-1 @ 0.5** Batch ID: **5791** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/12/2009** SeqNo: **312239**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	33.25	5.0	50	1.5	63.5	30.7	130	33.5	0.749	30	
Arsenic	54.25	1.7	50	13.3	81.9	71	121	55.35	2.01	30	
Barium	94.75	5.0	50	58.95	71.6	56.2	127	105.9	11.1	30	
Beryllium	45.70	2.0	50	0	91.4	73.3	115	43.9	4.02	30	
Cadmium	45.80	1.0	50	0.45	90.7	68.7	110	45.85	0.109	30	
Chromium	94.60	5.0	50	41.6	106	76	116	90.85	4.04	30	
Cobalt	57.00	5.0	50	21.2	71.6	57.4	122	66.3	15.1	30	
Copper	73.60	5.0	50	25.8	95.6	74.8	119	75.65	2.75	30	
Lead	83.90	1.0	50	90.95	-14.1	60.5	113	98.6	16.1	30	S
Molybdenum	43.30	5.0	50	2.65	81.3	62.9	123	44.05	1.72	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911055
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5791

Sample ID: **0911055-009AMSD** SampType: **MSD** TestCode: **6010B_S** Units: **mg/Kg** Prep Date: **11/11/2009** RunNo: **21758**
Client ID: **NB-10-1 @ 0.5** Batch ID: **5791** TestNo: **SW6010B (SW3050B)** Analysis Date: **11/12/2009** SeqNo: **312239**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nickel	106.8	5.0	50	70.25	73.2	61.5	122	109	1.99	30	
Selenium	41.70	5.0	50	3.1	77.2	62	111	40.5	2.92	30	
Silver	48.00	1.0	50	0	96.0	81.1	109	48.2	0.416	30	
Thallium	37.30	5.0	50	0	74.6	39.2	125	38.55	3.30	30	
Vanadium	93.15	5.0	50	47.5	91.3	65.8	122	96.5	3.53	30	
Zinc	90.65	5.0	50	65.1	51.1	59.9	122	101.7	11.5	30	S

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911055
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5949

Sample ID: **MB-5949** SampType: **MBLK** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22266**
Client ID: **ZZZZZ** Batch ID: **5949** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318462**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	ND	0.10									

Sample ID: **LCS-5949** SampType: **LCS** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22266**
Client ID: **ZZZZZ** Batch ID: **5949** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318460**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	8.410	0.10	10	0	84.1	75	125				

Sample ID: **LCSD-5949** SampType: **LCSD** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **12/28/2009** RunNo: **22266**
Client ID: **ZZZZZ** Batch ID: **5949** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **12/29/2009** SeqNo: **318461**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	8.670	0.10	10	0	86.7	75	125	8.41	3.04	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911055
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5951

Sample ID: **MB-5951** SampType: **MBLK** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **12/30/2009** RunNo: **22287**
Client ID: **ZZZZZ** Batch ID: **5951** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318878**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	ND	0.10									

Sample ID: **LCS-5951** SampType: **LCS** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **12/30/2009** RunNo: **22287**
Client ID: **ZZZZZ** Batch ID: **5951** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318876**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	0.9720	0.10	1	0	97.2	75	125				

Sample ID: **LCSD-5951** SampType: **LCSD** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **12/30/2009** RunNo: **22287**
Client ID: **ZZZZZ** Batch ID: **5951** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318877**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	0.9710	0.10	1	0	97.1	75	125	0.972	0.103	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911055
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5952

Sample ID: **MB-5952** SampType: **MBLK** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **12/30/2009** RunNo: **22288**
Client ID: **ZZZZZ** Batch ID: **5952** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318891**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	ND	0.10									

Sample ID: **LCS-5952** SampType: **LCS** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **12/30/2009** RunNo: **22288**
Client ID: **ZZZZZ** Batch ID: **5952** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318889**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	1.001	0.10	1	0	100	75	125				

Sample ID: **LCSD-5952** SampType: **LCSD** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **12/30/2009** RunNo: **22288**
Client ID: **ZZZZZ** Batch ID: **5952** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318890**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	0.9610	0.10	1	0	96.1	75	125	1.001	4.08	30	

Sample ID: **0911055-012AMS** SampType: **MS** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **12/30/2009** RunNo: **22288**
Client ID: **NB-10-2 @ 0.5** Batch ID: **5952** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318881**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	9.850	0.10	10	0.04	98.1	75	125				

Sample ID: **0911055-012AMSD** SampType: **MSD** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **12/30/2009** RunNo: **22288**
Client ID: **NB-10-2 @ 0.5** Batch ID: **5952** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318882**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	9.870	0.10	10	0.04	98.3	75	125	9.85	0.203	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911055
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5957

Sample ID: **MB-5957** SampType: **MBLK** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **12/31/2009** RunNo: **22293**
Client ID: **ZZZZZ** Batch ID: **5957** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318977**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	ND	0.10									

Sample ID: **LCS-5957** SampType: **LCS** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **12/31/2009** RunNo: **22293**
Client ID: **ZZZZZ** Batch ID: **5957** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318975**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	9.580	0.10	10	0	95.8	75	125				

Sample ID: **LCSD-5957** SampType: **LCSD** TestCode: **6010B (TCLP)** Units: **mg/L** Prep Date: **12/31/2009** RunNo: **22293**
Client ID: **ZZZZZ** Batch ID: **5957** TestNo: **6010B (TCLP) (SW3010A)** Analysis Date: **12/31/2009** SeqNo: **318976**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (TCLP)	9.580	0.10	10	0	95.8	75	125	9.58	0	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911055
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5988

Sample ID: **MB-5988** SampType: **MBLK** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **1/13/2010** RunNo: **22376**
Client ID: **ZZZZZ** Batch ID: **5988** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **1/13/2010** SeqNo: **319770**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	ND	0.10									

Sample ID: **LCS-5988** SampType: **LCS** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **1/13/2010** RunNo: **22376**
Client ID: **ZZZZZ** Batch ID: **5988** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **1/13/2010** SeqNo: **319768**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	8.560	0.10	10	0.01	85.5	75	125				

Sample ID: **LCSD-5988** SampType: **LCSD** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **1/13/2010** RunNo: **22376**
Client ID: **ZZZZZ** Batch ID: **5988** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **1/13/2010** SeqNo: **319769**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	8.430	0.10	10	0.01	84.2	75	125	8.56	1.53	30	

Sample ID: **0911055-001AMS** SampType: **MS** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **1/13/2010** RunNo: **22376**
Client ID: **NB-11-1 @ 0.5** Batch ID: **5988** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **1/13/2010** SeqNo: **319766**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	13.55	0.10	10	5.1	84.5	75	125				

Sample ID: **0911055-001AMSD** SampType: **MSD** TestCode: **6010B (STLC)** Units: **mg/L** Prep Date: **1/13/2010** RunNo: **22376**
Client ID: **NB-11-1 @ 0.5** Batch ID: **5988** TestNo: **6010B (STLC) (SW3010A)** Analysis Date: **1/13/2010** SeqNo: **319767**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (STLC)	13.23	0.10	10	5.1	81.3	75	125	13.55	2.39	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911055
Project: 28645097.04002

ANALYTICAL QC SUMMARY REPORT

BatchID: 5989

Sample ID: **MB-5989** SampType: **MBLK** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **1/13/2010** RunNo: **22377**
Client ID: **ZZZZZ** Batch ID: **5989** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **1/13/2010** SeqNo: **319779**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	ND	1.0									

Sample ID: **LCS-5989** SampType: **LCS** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **1/13/2010** RunNo: **22377**
Client ID: **ZZZZZ** Batch ID: **5989** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **1/13/2010** SeqNo: **319777**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	10.36	1.0	10	0	104	75	125				

Sample ID: **LCSD-5989** SampType: **LCSD** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **1/13/2010** RunNo: **22377**
Client ID: **ZZZZZ** Batch ID: **5989** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **1/13/2010** SeqNo: **319778**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	10.08	1.0	10	0	101	75	125	10.36	2.74	30	

Sample ID: **0911055-001AMS** SampType: **MS** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **1/13/2010** RunNo: **22377**
Client ID: **NB-11-1 @ 0.5** Batch ID: **5989** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **1/13/2010** SeqNo: **319775**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	10.53	1.0	10	0.57	99.6	75	125				

Sample ID: **0911055-001AMSD** SampType: **MSD** TestCode: **6010B (DI-ST** Units: **mg/L** Prep Date: **1/13/2010** RunNo: **22377**
Client ID: **NB-11-1 @ 0.5** Batch ID: **5989** TestNo: **6010B (DI-ST (SW3010A)** Analysis Date: **1/13/2010** SeqNo: **319776**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead (DI-STLC)	10.72	1.0	10	0.57	102	75	125	10.53	1.79	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

Torrent Laboratory, Inc

Change Order Form

Date: 1/11/10 Time: _____

Client: URS Order ID: _____

Project Number: 0911055, 053, 56 Project Name: Petaluma

Order Taken By: Hutan Ordered By: P. Walz

TAT Requested: 5 days. Date Report Re-Issued _____

Laboratory ID	Client ID	Change Requested
0911055-001A	NB-11-1@0.5	STLC, DI STLC Pb
0911053-005A	NB-4-2@1.0	TCLP Pb
0911056-002A	NB-7-1@1.0	TCLP Pb
0911056-003A	NB-7-1@1.5	TCLP Pb

Remarks: Pls analyze above sample on a 5 day TAT due on 1/19/10.

Date Test(s) Added: 1/11/10 Test(s) Added By: NM

Note: Original to be placed in client file (electronic and/or hardcopy)

From: Patrick_Walz@URSCorp.com
Subject: Additional Requests for Old Redwood Highway
Date: Mon, January 11, 2010 10:10
To: psandrock@torrentlab.com

Hi Patti.

For the work orders you sent over the past couple of days, we had previously requested TTLC Cam 17 be run on sample 0911050-013, however you sent us TCLP lead instead. Can you please run TTLC Cam 17? ✓

Also, the following sample IDs need correction.
Sample ID 0911052-017 and -018 should be NB 8-2@1.0 and
0911054-003 should be SB-7-1@1.5.

Finally, 0911054-004 was run for TCLP but we had not requested that; can we be credited for that - we are gonna request more samples that can go against.

Finally we'd like to have the following extra samples run:

STLC and DISTLC on 0911055-001
TCLP for 0911053-005, 0911056-002, and 0911056-003.

A 5 day turnaround on these would be appreciated if possible. Thanks!

Thank you,
Patrick Walz
Environmental Engineer
URS San Jose Great Place to Work Representative
URS Corporation
patrick_walz@URSCorp.com
408-297-9585 ext 265
Cell: 408-722-7941

This e-mail and any attachments contain URS Corporation confidential information that may be proprietary or privileged. If you receive this message in error or are not the intended recipient, you should not retain, distribute, disclose or use any of this information and you should destroy the e-mail and any attachments or copies.

Attachments:

untitled-[1]	
Size:	1.3 k
Type:	text/plain
untitled-[3]	
Size:	0 k
Type:	text/plain

Torrent
LABORATORY, INC.

January 18, 2010 (Revsion 2)

Patrick Walz
URS Corporation, San Jose
55 South Market St., Suite 1500
San Jose, CA 95113

TEL: (408) 297-9585
FAX (408) 297-6962

RE: 28645097.04002

Order No.: 0911056

Dear Patrick Walz:

Torrent Laboratory, Inc. received 19 samples on 11/6/2009 for the analyses presented in the following report.

All data for associated QC met EPA or laboratory specification(s) except where noted in the case narrative.
Reported data is applicable for only the samples received as part of the order number referenced above.

Torrent Laboratory, Inc, is certified by the State of California, ELAP #1991. If you have any questions regarding these tests results, please feel free to contact the Project Management Team at (408)263-5258;ext: 204.

Sincerely,

Laboratory Director

1/18/10
Date

Patti Sandrock
QA Officer

Torrent Laboratory, Inc. **Date:** *18-Jan-10*

CLIENT: URS Corporation, San Jose
Project: 28645097.04002
Lab Order: 0911056

CASE NARRATIVE

Analytical Comment for 6010B. Note:The % recoveries in the MS for Barium, Cobalt, and Nickel, and MSD for Barium and Nickel are outside of laboratory control limits but within % RPD limits and % recovery limits for the LCS/LCSD. No corrective action is required.

Note: Extraction of 50 g sample / 500g 0.2M Sodium Citrate Solution was performed according to wet extraction procedure (WET) which was rotated in a rotary shaker for 48 hours.

Date Prepared: started on 12/26/09 @ 12:30pm and ended on 12/28/09 2 12:30pm

Note: Extraction of 50 g sample /DI water was performed according to wet extraction procedure (DI STLC) which was rotated in a rotary shaker for 48 hours.

Date Prepared: started on 12/28/09 @ 8:30pm and ended on 12/30/09 @ 8:30pm.

Note: Extraction of 25 g sample / 500g TCLP Fluid # 1 was performed according to Toxicity Characteristic Leaching Procedure (TCLP) which was rotated in a rotary shaker for 18 hours.

Date Prepared: started on 12/30/09 @ 5:0pm and ended on 12/31/09 @ 11:0am.

Per Client request STLC, DI STLC and TCLP added to some samples and reported.

Rev1 1/5/10

Note: Extraction of 25 g sample / 500g TCLP Fluid # 1 was performed according to Toxicity Characteristic Leaching Procedure (TCLP) which was rotated in a rotary shaker for 18 hours.

CLIENT:	URS Corporation, San Jose
Project:	28645097.04002
Lab Order:	0911056

CASE NARRATIVE

Date Prepared: started on 1/11/10 @ 5:30pm and ended on 1/12/10 @ 11:30am

Per Client request TCLP Lead analyzed and reported for sample 002A, 003A.

Rev2 1/18/10

TORRENT LABORATORY, INC.

483 Sinclair Frontage Road • Milpitas, CA • Phone: (408) 263-5258 • Fax: (408) 263-8293

Visit us at www.torrentlab.com email: analysis@torrentlab.com

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/18/2010

Client Sample ID: NB-7-1 @ 0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 11:45:00 AM

Lab Sample ID: 0911056-001
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	ND	mg/L	5952
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	1.9	mg/L	5949
Lead	SW6010B	11/12/2009	1	1	1.0	60	mg/Kg	5791

Client Sample ID: NB-7-1 @ 1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 11:47:00 AM

Lab Sample ID: 0911056-002
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	0.38	mg/L	5952
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	7.3	mg/L	5949
Lead (TCLP)	6010B (TCLP)	1/12/2010	0.1	1	0.10	ND	mg/L	5983
Lead	SW6010B	11/12/2009	1	1	1.0	190	mg/Kg	5791

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/18/2010

Client Sample ID: NB-7-1 @ 1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 11:50:00 AM

Lab Sample ID: 0911056-003
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	0.26	mg/L	5952
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	5.3	mg/L	5949
Lead (TCLP)	6010B (TCLP)	1/12/2010	0.1	1	0.10	ND	mg/L	5983
Lead	SW6010B	11/12/2009	1	1	1.0	200	mg/Kg	5791

Client Sample ID: NB-7-2 @ 0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 11:55:00 AM

Lab Sample ID: 0911056-004
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	ND	mg/L	5952
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	2.0	mg/L	5949
Lead	SW6010B	11/12/2009	1	1	1.0	52	mg/Kg	5791

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/18/2010

Client Sample ID: NB-7-2 @ 1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 11:57:00 AM

Lab Sample ID: 0911056-005
Date Prepared: 11/10/2009-11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Arsenic	SW6010B	11/12/2009	1.7	1	1.7	2.5	mg/Kg	5791
Barium	SW6010B	11/12/2009	5	1	5.0	100	mg/Kg	5791
Beryllium	SW6010B	11/12/2009	2	1	2.0	ND	mg/Kg	5791
Cadmium	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5791
Chromium	SW6010B	11/12/2009	5	1	5.0	31	mg/Kg	5791
Cobalt	SW6010B	11/12/2009	5	1	5.0	14	mg/Kg	5791
Copper	SW6010B	11/12/2009	5	1	5.0	23	mg/Kg	5791
Lead	SW6010B	11/12/2009	1	1	1.0	46	mg/Kg	5791
Molybdenum	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Nickel	SW6010B	11/12/2009	5	1	5.0	39	mg/Kg	5791
Selenium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Silver	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5791
Thallium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Vanadium	SW6010B	11/12/2009	5	1	5.0	41	mg/Kg	5791
Zinc	SW6010B	11/12/2009	5	1	5.0	48	mg/Kg	5791
Mercury	SW7471A	11/11/2009	0.1	1	0.10	0.10	mg/Kg	5783

Client Sample ID: NB-7-2 @ 1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 12:00:00 PM

Lab Sample ID: 0911056-006
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	ND	mg/L	5952
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	1.7	mg/L	5949
Lead	SW6010B	11/12/2009	1	1	1.0	51	mg/Kg	5791

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/18/2010

Client Sample ID: NB-7-2 @ 3.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 12:05:00 PM

Lab Sample ID: 0911056-007
Date Prepared: 11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/12/2009	1	1	1.0	6.4	mg/Kg	5791

Client Sample ID: NB-7-2 @ 6.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 12:10:00 PM

Lab Sample ID: 0911056-008
Date Prepared: 11/10/2009-11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Arsenic	SW6010B	11/12/2009	1.7	1	1.7	3.1	mg/Kg	5791
Barium	SW6010B	11/12/2009	5	1	5.0	340	mg/Kg	5791
Beryllium	SW6010B	11/12/2009	2	1	2.0	ND	mg/Kg	5791
Cadmium	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5791
Chromium	SW6010B	11/12/2009	5	1	5.0	35	mg/Kg	5791
Cobalt	SW6010B	11/12/2009	5	1	5.0	25	mg/Kg	5791
Copper	SW6010B	11/12/2009	5	1	5.0	19	mg/Kg	5791
Lead	SW6010B	11/12/2009	1	1	1.0	6.4	mg/Kg	5791
Molybdenum	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Nickel	SW6010B	11/12/2009	5	1	5.0	38	mg/Kg	5791
Selenium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Silver	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5791
Thallium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Vanadium	SW6010B	11/12/2009	5	1	5.0	41	mg/Kg	5791
Zinc	SW6010B	11/12/2009	5	1	5.0	23	mg/Kg	5791
Mercury	SW7471A	11/11/2009	0.1	1	0.10	0.21	mg/Kg	5783

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/18/2010

Client Sample ID: NB-1-1 @ 0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 12:30:00 PM

Lab Sample ID: 0911056-009
Date Prepared: 11/10/2009-11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Arsenic	SW6010B	11/12/2009	1.7	1	1.7	2.0	mg/Kg	5791
Barium	SW6010B	11/12/2009	5	1	5.0	150	mg/Kg	5791
Beryllium	SW6010B	11/12/2009	2	1	2.0	ND	mg/Kg	5791
Cadmium	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5791
Chromium	SW6010B	11/12/2009	5	1	5.0	38	mg/Kg	5791
Cobalt	SW6010B	11/12/2009	5	1	5.0	6.6	mg/Kg	5791
Copper	SW6010B	11/12/2009	5	1	5.0	22	mg/Kg	5791
Lead	SW6010B	11/12/2009	1	1	1.0	34	mg/Kg	5791
Molybdenum	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Nickel	SW6010B	11/12/2009	5	1	5.0	41	mg/Kg	5791
Selenium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Silver	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5791
Thallium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Vanadium	SW6010B	11/12/2009	5	1	5.0	36	mg/Kg	5791
Zinc	SW6010B	11/12/2009	5	1	5.0	34	mg/Kg	5791
Mercury	SW7471A	11/11/2009	0.1	1	0.10	0.34	mg/Kg	5783

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/18/2010

Client Sample ID: NB-1-1 @ 1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 12:32:00 PM

Lab Sample ID: 0911056-010
Date Prepared: 11/10/2009-11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Arsenic	SW6010B	11/12/2009	1.7	1	1.7	2.0	mg/Kg	5791
Barium	SW6010B	11/12/2009	5	1	5.0	150	mg/Kg	5791
Beryllium	SW6010B	11/12/2009	2	1	2.0	ND	mg/Kg	5791
Cadmium	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5791
Chromium	SW6010B	11/12/2009	5	1	5.0	41	mg/Kg	5791
Cobalt	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Copper	SW6010B	11/12/2009	5	1	5.0	23	mg/Kg	5791
Lead	SW6010B	11/12/2009	1	1	1.0	13	mg/Kg	5791
Molybdenum	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Nickel	SW6010B	11/12/2009	5	1	5.0	39	mg/Kg	5791
Selenium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Silver	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5791
Thallium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Vanadium	SW6010B	11/12/2009	5	1	5.0	38	mg/Kg	5791
Zinc	SW6010B	11/12/2009	5	1	5.0	31	mg/Kg	5791
Mercury	SW7471A	11/11/2009	0.1	1	0.10	0.26	mg/Kg	5783

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/18/2010

Client Sample ID: NB-1-1 @ 1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 12:35:00 PM

Lab Sample ID: 0911056-011
Date Prepared: 11/10/2009-11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Arsenic	SW6010B	11/12/2009	1.7	1	1.7	ND	mg/Kg	5791
Barium	SW6010B	11/12/2009	5	1	5.0	120	mg/Kg	5791
Beryllium	SW6010B	11/12/2009	2	1	2.0	ND	mg/Kg	5791
Cadmium	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5791
Chromium	SW6010B	11/12/2009	5	1	5.0	34	mg/Kg	5791
Cobalt	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Copper	SW6010B	11/12/2009	5	1	5.0	19	mg/Kg	5791
Lead	SW6010B	11/12/2009	1	1	1.0	15	mg/Kg	5791
Molybdenum	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Nickel	SW6010B	11/12/2009	5	1	5.0	29	mg/Kg	5791
Selenium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Silver	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5791
Thallium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Vanadium	SW6010B	11/12/2009	5	1	5.0	32	mg/Kg	5791
Zinc	SW6010B	11/12/2009	5	1	5.0	23	mg/Kg	5791
Mercury	SW7471A	11/11/2009	0.1	1	0.10	0.20	mg/Kg	5783

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/18/2010

Client Sample ID: NB-1-1-d @ 0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 12:30:00 PM

Lab Sample ID: 0911056-012
Date Prepared: 11/10/2009-11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Arsenic	SW6010B	11/12/2009	1.7	1	1.7	2.8	mg/Kg	5791
Barium	SW6010B	11/12/2009	5	1	5.0	150	mg/Kg	5791
Beryllium	SW6010B	11/12/2009	2	1	2.0	ND	mg/Kg	5791
Cadmium	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5791
Chromium	SW6010B	11/12/2009	5	1	5.0	40	mg/Kg	5791
Cobalt	SW6010B	11/12/2009	5	1	5.0	6.8	mg/Kg	5791
Copper	SW6010B	11/12/2009	5	1	5.0	23	mg/Kg	5791
Lead	SW6010B	11/12/2009	1	1	1.0	41	mg/Kg	5791
Molybdenum	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Nickel	SW6010B	11/12/2009	5	1	5.0	40	mg/Kg	5791
Selenium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Silver	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5791
Thallium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Vanadium	SW6010B	11/12/2009	5	1	5.0	37	mg/Kg	5791
Zinc	SW6010B	11/12/2009	5	1	5.0	36	mg/Kg	5791
Mercury	SW7471A	11/11/2009	0.1	1	0.10	0.29	mg/Kg	5783

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/18/2010

Client Sample ID: NB-1-1-d @ 1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 12:32:00 PM

Lab Sample ID: 0911056-013
Date Prepared: 11/10/2009-11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Arsenic	SW6010B	11/12/2009	1.7	1	1.7	2.2	mg/Kg	5791
Barium	SW6010B	11/12/2009	5	1	5.0	130	mg/Kg	5791
Beryllium	SW6010B	11/12/2009	2	1	2.0	ND	mg/Kg	5791
Cadmium	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5791
Chromium	SW6010B	11/12/2009	5	1	5.0	41	mg/Kg	5791
Cobalt	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Copper	SW6010B	11/12/2009	5	1	5.0	21	mg/Kg	5791
Lead	SW6010B	11/12/2009	1	1	1.0	48	mg/Kg	5791
Molybdenum	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Nickel	SW6010B	11/12/2009	5	1	5.0	35	mg/Kg	5791
Selenium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Silver	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5791
Thallium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5791
Vanadium	SW6010B	11/12/2009	5	1	5.0	32	mg/Kg	5791
Zinc	SW6010B	11/12/2009	5	1	5.0	31	mg/Kg	5791
Mercury	SW7471A	11/11/2009	0.1	1	0.10	0.25	mg/Kg	5783

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/18/2010

Client Sample ID: NB-1-1-d @ 1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 12:35:00 PM

Lab Sample ID: 0911056-014
Date Prepared: 11/10/2009-11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5792
Arsenic	SW6010B	11/12/2009	1.7	1	1.7	4.4	mg/Kg	5792
Barium	SW6010B	11/12/2009	5	1	5.0	220	mg/Kg	5792
Beryllium	SW6010B	11/12/2009	2	1	2.0	ND	mg/Kg	5792
Cadmium	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5792
Chromium	SW6010B	11/12/2009	5	1	5.0	32	mg/Kg	5792
Cobalt	SW6010B	11/12/2009	5	1	5.0	25	mg/Kg	5792
Copper	SW6010B	11/12/2009	5	1	5.0	19	mg/Kg	5792
Lead	SW6010B	11/12/2009	1	1	1.0	22	mg/Kg	5792
Molybdenum	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5792
Nickel	SW6010B	11/12/2009	5	1	5.0	60	mg/Kg	5792
Selenium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5792
Silver	SW6010B	11/12/2009	1	1	1.0	ND	mg/Kg	5792
Thallium	SW6010B	11/12/2009	5	1	5.0	ND	mg/Kg	5792
Vanadium	SW6010B	11/12/2009	5	1	5.0	39	mg/Kg	5792
Zinc	SW6010B	11/12/2009	5	1	5.0	23	mg/Kg	5792
Mercury	SW7471A	11/11/2009	0.1	1	0.10	0.21	mg/Kg	5783

Client Sample ID: NB-1-2 @ 0.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 12:45:00 PM

Lab Sample ID: 0911056-015
Date Prepared: 12/30/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead (DI-STLC)	6010B (DI-STLC)	12/31/2009	0.1	1	0.10	ND	mg/L	5952
Lead (STLC)	6010B (STLC)	12/29/2009	0.1	1	0.10	0.73	mg/L	5949
Lead	SW6010B	11/12/2009	1	1	1.0	69	mg/Kg	5792

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/6/2009
Date Reported: 1/18/2010

Client Sample ID: NB-1-2 @ 1.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 12:47:00 PM

Lab Sample ID: 0911056-016
Date Prepared: 11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/12/2009	1	1	1.0	22	mg/Kg	5792

Client Sample ID: NB-1-2 @ 1.5
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 12:50:00 PM

Lab Sample ID: 0911056-017
Date Prepared: 11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/12/2009	1	1	1.0	24	mg/Kg	5792

Client Sample ID: NB-1-2 @ 3.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 12:52:00 PM

Lab Sample ID: 0911056-018
Date Prepared: 11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/12/2009	1	1	1.0	7.0	mg/Kg	5792

Client Sample ID: NB-1-2 @ 5.0
Sample Location: Petaluma CA
Sample Matrix: SOIL
Date/Time Sampled 11/6/2009 12:55:00 PM

Lab Sample ID: 0911056-019
Date Prepared: 11/11/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Lead	SW6010B	11/12/2009	1	1	1.0	6.4	mg/Kg	5792

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Definitions, legends and Notes

Note	Description
ug/kg	Microgram per kilogram (ppb, part per billion).
ug/L	Microgram per liter (ppb, part per billion).
mg/kg	Milligram per kilogram (ppm, part per million).
mg/L	Milligram per liter (ppm, part per million).
LCS/LCSD	Laboratory control sample/laboratory control sample duplicate.
MDL	Method detection limit.
MRL	Modified reporting limit. When sample is subject to dilution, reporting limit times dilution factor yields MRL.
MS/MSD	Matrix spike/matrix spike duplicate.
N/A	Not applicable.
ND	Not detected at or above detection limit.
NR	Not reported.
QC	Quality Control.
RL	Reporting limit.
% RPD	Percent relative difference.
a	pH was measured immediately upon the receipt of the sample, but it was still done outside the holding time.
sub	Analyzed by subcontracting laboratory, Lab Certificate #

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Torrent Laboratory, Inc

Change Order Form

Date: 1/11/10 Time: _____

Client: URS Order ID: _____

Project Number: 0911055, 053, 56 Project Name: Petaluma

Order Taken By: Hutan Ordered By: P. Walz

TAT Requested: 5 days. Date Report Re-Issued _____

Laboratory ID	Client ID	Change Requested
0911055-001A	NB-11-1@0.5	STLC, DI STLC Pb
0911053-005A	NB-4-2@1.0	TCLP Pb
0911056-002A	NB-7-1@1.0	TCLP Pb
0911056-003A	NB-7-1@1.5	TCLP Pb

Remarks: Pls analyze above sample on a 5 day TAT due on 1/19/10.

Date Test(s) Added: 1/11/10 Test(s) Added By: NM

Note: Original to be placed in client file (electronic and/or hardcopy)

From: Patrick_Walz@URSCorp.com
Subject: Additional Requests for Old Redwood Highway
Date: Mon, January 11, 2010 10:10
To: psandrock@torrentlab.com

Hi Patti.

For the work orders you sent over the past couple of days, we had previously requested TTLC Cam 17 be run on sample 0911050-013, however you sent us TCLP lead instead. Can you please run TTLC Cam 17? ✓

Also, the following sample IDs need correction.
Sample ID 0911052-017 and -018 should be NB 8-2@1.0 and
0911054-003 should be SB-7-1@1.5.

Finally, 0911054-004 was run for TCLP but we had not requested that; can we be credited for that - we are gonna request more samples that can go against.

Finally we'd like to have the following extra samples run:

STLC and DISTLC on 0911055-001
TCLP for 0911053-005, 0911056-002, and 0911056-003.

A 5 day turnaround on these would be appreciated if possible. Thanks!

Thank you,
Patrick Walz
Environmental Engineer
URS San Jose Great Place to Work Representative
URS Corporation
patrick_walz@URSCorp.com
408-297-9585 ext 265
Cell: 408-722-7941

This e-mail and any attachments contain URS Corporation confidential information that may be proprietary or privileged. If you receive this message in error or are not the intended recipient, you should not retain, distribute, disclose or use any of this information and you should destroy the e-mail and any attachments or copies.

Attachments:

untitled-[1]	
Size:	1.3 k
Type:	text/plain
untitled-[3]	
Size:	0 k
Type:	text/plain

Torrent
LABORATORY, INC.

November 19, 2009

Patrick Walz
URS Corporation, San Jose
55 South Market St., Suite 1500
San Jose, CA 95113

TEL: (408) 297-9585
FAX (408) 297-6962

RE: Petaluma

Order No.: 0911088

Dear Patrick Walz:

Torrent Laboratory, Inc. received 2 samples on 11/12/2009 for the analyses presented in the following report.

All data for associated QC met EPA or laboratory specification(s) except where noted in the case narrative.
Reported data is applicable for only the samples received as part of the order number referenced above.

Torrent Laboratory, Inc, is certified by the State of California, ELAP #1991. If you have any questions regarding these tests results, please feel free to contact the Project Management Team at (408)263-5258;ext: 204.

Sincerely,

Laboratory Director

11/19/09
Date

Patti Sandrock
QA Officer

483 Sinclair Frontage Rd., Milpitas, CA 95035 | tel: 408.263.5258 | main fax: 408.263.8293 | project manager fax: 408.263.2708
www.torrentlab.com

Torrent Laboratory, Inc. **Date:** *19-Nov-09*

CLIENT: URS Corporation, San Jose
Project: Petaluma
Lab Order: 0911088

CASE NARRATIVE

Analytical Comment for 6010B_W. Note:The % recoveries in the MSD for Barium and Nickel are outside of laboratory control limits but within % RPD limits and % recovery limits for the LCS/LCSD. No corrective action is required.

TORRENT LABORATORY, INC.

483 Sinclair Frontage Road • Milpitas, CA • Phone: (408) 263-5258 • Fax: (408) 263-8293

Visit us at www.torrentlab.com email: analysis@torrentlab.com

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/12/2009
Date Reported: 11/19/2009

Client Sample ID: A-09-112
Sample Location: Petaluma
Sample Matrix: GROUNDWATER
Date/Time Sampled 11/11/2009 12:20:00 PM

Lab Sample ID: 0911088-001
Date Prepared: 11/15/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	11/16/2009	0.01	1	0.010	ND	mg/L	5805
Arsenic	SW6010B	11/16/2009	0.01	1	0.010	0.037	mg/L	5805
Barium	SW6010B	11/16/2009	0.01	1	0.010	1.1	mg/L	5805
Beryllium	SW6010B	11/16/2009	0.005	1	0.0050	0.0080	mg/L	5805
Cadmium	SW6010B	11/16/2009	0.005	1	0.0050	ND	mg/L	5805
Chromium	SW6010B	11/16/2009	0.005	1	0.0050	0.0080	mg/L	5805
Cobalt	SW6010B	11/16/2009	0.005	1	0.0050	0.28	mg/L	5805
Copper	SW6010B	11/16/2009	0.01	1	0.010	0.11	mg/L	5805
Lead	SW6010B	11/16/2009	0.015	1	0.015	ND	mg/L	5805
Molybdenum	SW6010B	11/16/2009	0.005	1	0.0050	ND	mg/L	5805
Nickel	SW6010B	11/16/2009	0.01	1	0.010	0.37	mg/L	5805
Selenium	SW6010B	11/16/2009	0.01	1	0.010	ND	mg/L	5805
Silver	SW6010B	11/16/2009	0.005	1	0.0050	ND	mg/L	5805
Thallium	SW6010B	11/16/2009	0.01	1	0.010	ND	mg/L	5805
Vanadium	SW6010B	11/16/2009	0.01	1	0.010	0.21	mg/L	5805
Zinc	SW6010B	11/16/2009	0.005	1	0.0050	0.19	mg/L	5805
Mercury	SW7470A	11/16/2009	0.0002	1	0.00020	0.0013	mg/L	5806
TPH (Diesel)	SW8015B	11/17/2009	0.1	1	0.17	ND	mg/L	R21738
TPH (Motor Oil)	SW8015B	11/17/2009	0.2	1	0.33	ND	mg/L	R21738
Surr: Pentacosane	SW8015B	11/17/2009	0	1	57.9-125	108	%REC	R21738

Note: Reporting limits increased due to limited sample available (sediment present).

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

1,1,1,2-Tetrachloroethane	SW8260B	11/17/2009	1	1.19	1.2	ND	µg/L	R21792
1,1,1-Trichloroethane	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
1,1,2,2-Tetrachloroethane	SW8260B	11/17/2009	1	1.19	1.2	ND	µg/L	R21792
1,1,2-Trichloroethane	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
1,1-Dichloroethane	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
1,1-Dichloroethene	SW8260B	11/17/2009	1	1.19	1.2	ND	µg/L	R21792
1,1-Dichloropropene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
1,2,3-Trichlorobenzene	SW8260B	11/17/2009	1	1.19	1.2	ND	µg/L	R21792
1,2,3-Trichloropropane	SW8260B	11/17/2009	1	1.19	1.2	ND	µg/L	R21792
1,2,4-Trichlorobenzene	SW8260B	11/17/2009	1	1.19	1.2	ND	µg/L	R21792
1,2,4-Trimethylbenzene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
1,2-Dibromo-3-chloropropane	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
1,2-Dibromoethane (EDB)	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
1,2-Dichlorobenzene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
1,2-Dichloroethane (EDC)	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
1,2-Dichloropropane	SW8260B	11/17/2009	1	1.19	1.2	ND	µg/L	R21792
1,3,5-Trimethylbenzene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
1,3-Dichlorobenzene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
1,3-Dichloropropene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
1,4-Dichlorobenzene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
2,2-Dichloropropane	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
2-Chloroethyl vinyl ether	SW8260B	11/17/2009	6	1.19	7.1	ND	µg/L	R21792
2-Chlorotoluene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
4-Chlorotoluene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
4-Isopropyltoluene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
Acetone	SW8260B	11/17/2009	10	1.19	12	ND	µg/L	R21792
Benzene	SW8260B	11/17/2009	0.5	1.19	0.60	0.68	µg/L	R21792
Bromobenzene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
Bromochloromethane	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
Bromodichloromethane	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
Bromoform	SW8260B	11/17/2009	1	1.19	1.2	ND	µg/L	R21792
Bromomethane	SW8260B	11/17/2009	1	1.19	1.2	ND	µg/L	R21792
Carbon tetrachloride	SW8260B	11/17/2009	1	1.19	1.2	ND	µg/L	R21792
Chlorobenzene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
Chloroform	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
Chloromethane	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
cis-1,2-Dichloroethene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
cis-1,3-Dichloropropene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
Dibromochloromethane	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
Dibromomethane	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
Dichlorodifluoromethane	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
Diisopropyl ether (DIPE)	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
Ethyl tert-butyl ether (ETBE)	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
Ethylbenzene	SW8260B	11/17/2009	0.5	1.19	0.60	2.2	µg/L	R21792
Freon-113	SW8260B	11/17/2009	1	1.19	1.2	ND	µg/L	R21792
Hexachlorobutadiene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
Isopropylbenzene	SW8260B	11/17/2009	1	1.19	1.2	ND	µg/L	R21792
Methyl tert-butyl ether (MTBE)	SW8260B	11/17/2009	0.5	1.19	0.60	34	µg/L	R21792
Methylene chloride	SW8260B	11/17/2009	5	1.19	6.0	ND	µg/L	R21792
Naphthalene	SW8260B	11/17/2009	1	1.19	1.2	ND	µg/L	R21792
n-Butylbenzene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
n-Propylbenzene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
sec-Butylbenzene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Styrene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
t-Butyl alcohol (t-Butanol)	SW8260B	11/17/2009	5	1.19	6.0	ND	µg/L	R21792
tert-Amyl methyl ether (TAME)	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
tert-Butylbenzene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
Tetrachloroethene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
Toluene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
trans-1,2-Dichloroethene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
trans-1,3-Dichloropropene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
Trichloroethene	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
Trichlorofluoromethane	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
Vinyl chloride	SW8260B	11/17/2009	0.5	1.19	0.60	ND	µg/L	R21792
Xylenes, Total	SW8260B	11/17/2009	1.5	1.19	1.8	ND	µg/L	R21792
Surr: Dibromofluoromethane	SW8260B	11/17/2009	0	1.19	61.2-131	98.1	%REC	R21792
Surr: 4-Bromofluorobenzene	SW8260B	11/17/2009	0	1.19	64.1-120	89.3	%REC	R21792
Surr: Toluene-d8	SW8260B	11/17/2009	0	1.19	75.1-127	96.6	%REC	R21792

Note: Reporting limits increased due to sediment in all VOA.

TPH (Gasoline)	SW8260B(TPH)	11/17/2009	50	1.19	60	ND	µg/L	G21792
Surr: 4-Bromofllurobenzene	SW8260B(TPH)	11/17/2009	0	1.19	53-118	72.4	%REC	G21792

Note: Raised reporting limit - see comment for 8260B analysis.

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Report prepared for: Patrick Walz
URS Corporation, San Jose

Date Received: 11/12/2009
Date Reported: 11/19/2009

Client Sample ID: A-09-108
Sample Location: Petaluma
Sample Matrix: GROUNDWATER
Date/Time Sampled 11/11/2009 9:52:00 AM

Lab Sample ID: 0911088-002
Date Prepared: 11/15/2009

Parameters	Analysis Method	Date Analyzed	RL	Dilution Factor	MRL	Result	Units	Analytical Batch
Antimony	SW6010B	11/16/2009	0.01	1	0.010	ND	mg/L	5805
Arsenic	SW6010B	11/16/2009	0.01	1	0.010	0.037	mg/L	5805
Barium	SW6010B	11/16/2009	0.01	1	0.010	2.1	mg/L	5805
Beryllium	SW6010B	11/16/2009	0.005	1	0.0050	0.0050	mg/L	5805
Cadmium	SW6010B	11/16/2009	0.005	1	0.0050	ND	mg/L	5805
Chromium	SW6010B	11/16/2009	0.005	1	0.0050	ND	mg/L	5805
Cobalt	SW6010B	11/16/2009	0.005	1	0.0050	0.099	mg/L	5805
Copper	SW6010B	11/16/2009	0.01	1	0.010	0.096	mg/L	5805
Lead	SW6010B	11/16/2009	0.015	1	0.015	ND	mg/L	5805
Molybdenum	SW6010B	11/16/2009	0.005	1	0.0050	ND	mg/L	5805
Nickel	SW6010B	11/16/2009	0.01	1	0.010	0.31	mg/L	5805
Selenium	SW6010B	11/16/2009	0.01	1	0.010	ND	mg/L	5805
Silver	SW6010B	11/16/2009	0.005	1	0.0050	ND	mg/L	5805
Thallium	SW6010B	11/16/2009	0.01	1	0.010	ND	mg/L	5805
Vanadium	SW6010B	11/16/2009	0.01	1	0.010	0.20	mg/L	5805
Zinc	SW6010B	11/16/2009	0.005	1	0.0050	0.11	mg/L	5805
Mercury	SW7470A	11/16/2009	0.0002	1	0.00020	ND	mg/L	5806
TPH (Diesel)	SW8015B	11/17/2009	0.1	1	0.14	0.142x	mg/L	R21738
TPH (Motor Oil)	SW8015B	11/17/2009	0.2	1	0.28	ND	mg/L	R21738
Surr: Pentacosane	SW8015B	11/17/2009	0	1	57.9-125	111	%REC	R21738

Note:x-Sample chromatogram does not resemble typical diesel pattern (possibly fuel lighter than diesel). Hydrocarbons within the diesel range quantitated as diesel.

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

1,1,1,2-Tetrachloroethane	SW8260B	11/17/2009	1	1.16	1.2	ND	µg/L	R21792
1,1,1-Trichloroethane	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
1,1,2,2-Tetrachloroethane	SW8260B	11/17/2009	1	1.16	1.2	ND	µg/L	R21792
1,1,2-Trichloroethane	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
1,1-Dichloroethane	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
1,1-Dichloroethene	SW8260B	11/17/2009	1	1.16	1.2	ND	µg/L	R21792
1,1-Dichloropropene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
1,2,3-Trichlorobenzene	SW8260B	11/17/2009	1	1.16	1.2	ND	µg/L	R21792
1,2,3-Trichloropropane	SW8260B	11/17/2009	1	1.16	1.2	ND	µg/L	R21792
1,2,4-Trichlorobenzene	SW8260B	11/17/2009	1	1.16	1.2	ND	µg/L	R21792
1,2,4-Trimethylbenzene	SW8260B	11/17/2009	0.5	1.16	0.58	28	µg/L	R21792
1,2-Dibromo-3-chloropropane	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
1,2-Dibromoethane (EDB)	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
1,2-Dichlorobenzene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
1,2-Dichloroethane (EDC)	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
1,2-Dichloropropane	SW8260B	11/17/2009	1	1.16	1.2	ND	µg/L	R21792
1,3,5-Trimethylbenzene	SW8260B	11/17/2009	0.5	1.16	0.58	4.3	µg/L	R21792
1,3-Dichlorobenzene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
1,3-Dichloropropene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
1,4-Dichlorobenzene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
2,2-Dichloropropane	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
2-Chloroethyl vinyl ether	SW8260B	11/17/2009	6	1.16	7.0	ND	µg/L	R21792
2-Chlorotoluene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
4-Chlorotoluene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
4-Isopropyltoluene	SW8260B	11/17/2009	0.5	1.16	0.58	0.92	µg/L	R21792
Acetone	SW8260B	11/17/2009	10	1.16	12	ND	µg/L	R21792
Benzene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
Bromobenzene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
Bromochloromethane	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
Bromodichloromethane	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
Bromoform	SW8260B	11/17/2009	1	1.16	1.2	ND	µg/L	R21792
Bromomethane	SW8260B	11/17/2009	1	1.16	1.2	ND	µg/L	R21792
Carbon tetrachloride	SW8260B	11/17/2009	1	1.16	1.2	ND	µg/L	R21792
Chlorobenzene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
Chloroform	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
Chloromethane	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
cis-1,2-Dichloroethene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
cis-1,3-Dichloropropene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
Dibromochloromethane	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
Dibromomethane	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
Dichlorodifluoromethane	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
Diisopropyl ether (DIPE)	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
Ethyl tert-butyl ether (ETBE)	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
Ethylbenzene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
Freon-113	SW8260B	11/17/2009	1	1.16	1.2	ND	µg/L	R21792
Hexachlorobutadiene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
Isopropylbenzene	SW8260B	11/17/2009	1	1.16	1.2	ND	µg/L	R21792
Methyl tert-butyl ether (MTBE)	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
Methylene chloride	SW8260B	11/17/2009	5	1.16	5.8	ND	µg/L	R21792
Naphthalene	SW8260B	11/17/2009	1	1.16	1.2	ND	µg/L	R21792
n-Butylbenzene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
n-Propylbenzene	SW8260B	11/17/2009	0.5	1.16	0.58	2.3	µg/L	R21792
sec-Butylbenzene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792

Styrene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
t-Butyl alcohol (t-Butanol)	SW8260B	11/17/2009	5	1.16	5.8	ND	µg/L	R21792
tert-Amyl methyl ether (TAME)	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
tert-Butylbenzene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
Tetrachloroethene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
Toluene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
trans-1,2-Dichloroethene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
trans-1,3-Dichloropropene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
Trichloroethene	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
Trichlorofluoromethane	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
Vinyl chloride	SW8260B	11/17/2009	0.5	1.16	0.58	ND	µg/L	R21792
Xylenes, Total	SW8260B	11/17/2009	1.5	1.16	1.7	ND	µg/L	R21792
Surr: Dibromofluoromethane	SW8260B	11/17/2009	0	1.16	61.2-131	78.4	%REC	R21792
Surr: 4-Bromofluorobenzene	SW8260B	11/17/2009	0	1.16	64.1-120	102	%REC	R21792
Surr: Toluene-d8	SW8260B	11/17/2009	0	1.16	75.1-127	93.5	%REC	R21792

Note: Reporting limits increased due to sediment in all VOA.

TPH (Gasoline)	SW8260B(TPH)	11/17/2009	50	1.16	58	500x	µg/L	G21792
Surr: 4-Bromofllurobenzene	SW8260B(TPH)	11/17/2009	0	1.16	53-118	81.9	%REC	G21792

Note: x- Sample chromatogram does not resemble gasoline standard pattern. Reported value due to presence of heavy end non-gasoline compounds within range of C5-C12 quantified as Gasoline.

Definitions, legends and Notes

Note	Description
ug/kg	Microgram per kilogram (ppb, part per billion).
ug/L	Microgram per liter (ppb, part per billion).
mg/kg	Milligram per kilogram (ppm, part per million).
mg/L	Milligram per liter (ppm, part per million).
LCS/LCSD	Laboratory control sample/laboratory control sample duplicate.
MDL	Method detection limit.
MRL	Modified reporting limit. When sample is subject to dilution, reporting limit times dilution factor yields MRL.
MS/MSD	Matrix spike/matrix spike duplicate.
N/A	Not applicable.
ND	Not detected at or above detection limit.
NR	Not reported.
QC	Quality Control.
RL	Reporting limit.
% RPD	Percent relative difference.
a	pH was measured immediately upon the receipt of the sample, but it was still done outside the holding time.
sub	Analyzed by subcontracting laboratory, Lab Certificate #

These analyses were performed according to State of California Environmental Laboratory Accreditation program, Certificate # 1991

Torrent Laboratory, Inc.

Date: *19-Nov-09*

CLIENT: URS Corporation, San Jose
Work Order: 0911088
Project: Petaluma

ANALYTICAL QC SUMMARY REPORT

BatchID: 5805

Sample ID: **MB-5805** SampType: **MBLK** TestCode: **6010B_W** Units: **mg/L** Prep Date: **11/15/2009** RunNo: **21778**
Client ID: **ZZZZZ** Batch ID: **5805** TestNo: **SW6010B** **(E200.7/SW30** Analysis Date: **11/16/2009** SeqNo: **312514**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	ND	0.010									
Arsenic	ND	0.010									
Barium	ND	0.010									
Beryllium	ND	0.0050									
Cadmium	ND	0.0050									
Chromium	ND	0.0050									
Cobalt	ND	0.0050									
Copper	ND	0.010									
Lead	ND	0.015									
Molybdenum	ND	0.0050									
Nickel	ND	0.010									
Selenium	ND	0.020									
Silver	ND	0.0050									
Thallium	ND	0.010									
Vanadium	ND	0.010									
Zinc	ND	0.010									

Sample ID: **LCS-5805** SampType: **LCS** TestCode: **6010B_W** Units: **mg/L** Prep Date: **11/15/2009** RunNo: **21778**
Client ID: **ZZZZZ** Batch ID: **5805** TestNo: **SW6010B** **(E200.7/SW30** Analysis Date: **11/16/2009** SeqNo: **312512**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	1.052	0.010	1	0	105	80	120				
Arsenic	1.025	0.010	1	0	103	80	120				
Barium	1.036	0.010	1	0	104	80	120				
Beryllium	0.9850	0.0050	1	0	98.5	80	120				
Cadmium	1.025	0.0050	1	0	103	80	120				
Chromium	1.031	0.0050	1	0	103	80	120				
Cobalt	1.040	0.0050	1	0	104	80	120				
Copper	1.034	0.010	1	0	103	80	120				

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911088
Project: Petaluma

ANALYTICAL QC SUMMARY REPORT

BatchID: 5805

Sample ID: **LCS-5805** SampType: **LCS** TestCode: **6010B_W** Units: **mg/L** Prep Date: **11/15/2009** RunNo: **21778**
Client ID: **ZZZZZ** Batch ID: **5805** TestNo: **SW6010B** **(E200.7/SW30** Analysis Date: **11/16/2009** SeqNo: **312512**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	1.026	0.015	1	0	103	80	120				
Molybdenum	1.025	0.0050	1	0	103	80	120				
Nickel	1.038	0.010	1	0	104	80	120				
Selenium	1.023	0.020	1	0.004	102	80	120				
Silver	1.032	0.0050	1	0	103	80	120				
Thallium	1.008	0.010	1	0	101	80	120				
Vanadium	1.035	0.010	1	0	104	80	120				
Zinc	1.074	0.010	1	0.00362	107	80	120				

Sample ID: **LCSD-5805** SampType: **LCSD** TestCode: **6010B_W** Units: **mg/L** Prep Date: **11/15/2009** RunNo: **21778**
Client ID: **ZZZZZ** Batch ID: **5805** TestNo: **SW6010B** **(E200.7/SW30** Analysis Date: **11/16/2009** SeqNo: **312513**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	1.040	0.010	1	0	104	80	120	1.052	1.15	20	
Arsenic	1.016	0.010	1	0	102	80	120	1.025	0.882	20	
Barium	1.031	0.010	1	0	103	80	120	1.036	0.484	20	
Beryllium	1.011	0.0050	1	0	101	80	120	0.985	2.61	20	
Cadmium	1.023	0.0050	1	0	102	80	120	1.025	0.195	20	
Chromium	1.028	0.0050	1	0	103	80	120	1.031	0.291	20	
Cobalt	1.033	0.0050	1	0	103	80	120	1.04	0.675	20	
Copper	1.033	0.010	1	0	103	80	120	1.034	0.0968	20	
Lead	1.016	0.015	1	0	102	80	120	1.026	0.979	20	
Molybdenum	1.016	0.0050	1	0	102	80	120	1.025	0.882	20	
Nickel	1.035	0.010	1	0	104	80	120	1.038	0.289	20	
Selenium	1.013	0.020	1	0.004	101	80	120	1.023	0.982	20	
Silver	1.030	0.0050	1	0	103	80	120	1.032	0.194	20	
Thallium	0.9990	0.010	1	0	99.9	80	120	1.008	0.897	20	
Vanadium	1.029	0.010	1	0	103	80	120	1.035	0.581	20	
Zinc	1.094	0.010	1	0.00362	109	80	120	1.074	1.85	20	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911088
Project: Petaluma

ANALYTICAL QC SUMMARY REPORT

BatchID: 5805

Sample ID: **0911088-002AMS** SampType: **MS** TestCode: **6010B_W** Units: **mg/L** Prep Date: **11/15/2009** RunNo: **21778**
Client ID: **A-09-108** Batch ID: **5805** TestNo: **SW6010B** **(E200.7/SW30** Analysis Date: **11/16/2009** SeqNo: **312510**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	1.014	0.010	1	0	101	75	125				
Arsenic	1.039	0.010	1	0.037	100	75	125				
Barium	3.253	0.010	1	2.106	115	75	125				
Beryllium	1.043	0.0050	1	0.005	104	75	125				
Cadmium	0.9700	0.0050	1	0.003	96.7	75	125				
Chromium	0.9700	0.0050	1	0.004	96.6	75	125				
Cobalt	1.043	0.0050	1	0.099	94.4	75	125				
Copper	1.097	0.010	1	0.096	100	75	125				
Lead	0.9410	0.015	1	0	94.1	75	125				
Molybdenum	0.9820	0.0050	1	0.002	98.0	75	125				
Nickel	1.336	0.010	1	0.307	103	75	125				
Selenium	0.9780	0.020	1	0.007	97.1	75	125				
Silver	1.005	0.0050	1	0	101	75	125				
Thallium	0.9130	0.010	1	0	91.3	75	125				
Vanadium	1.186	0.010	1	0.202	98.4	75	125				
Zinc	1.062	0.010	1	0.11	95.2	75	125				

Sample ID: **0911088-002AMSD** SampType: **MSD** TestCode: **6010B_W** Units: **mg/L** Prep Date: **11/15/2009** RunNo: **21778**
Client ID: **A-09-108** Batch ID: **5805** TestNo: **SW6010B** **(E200.7/SW30** Analysis Date: **11/16/2009** SeqNo: **312511**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	0.9840	0.010	1	0	98.4	75	125	1.014	3.00	30	
Arsenic	1.008	0.010	1	0.037	97.1	75	125	1.039	3.03	30	
Barium	3.736	0.010	1	2.106	163	75	125	3.253	13.8	30	S
Beryllium	0.9240	0.0050	1	0.005	91.9	75	125	1.043	12.1	30	
Cadmium	0.9600	0.0050	1	0.003	95.7	75	125	0.97	1.04	30	
Chromium	0.9740	0.0050	1	0.004	97.0	75	125	0.97	0.412	30	
Cobalt	1.085	0.0050	1	0.099	98.6	75	125	1.043	3.95	30	
Copper	1.146	0.010	1	0.096	105	75	125	1.097	4.37	30	
Lead	0.9120	0.015	1	0	91.2	75	125	0.941	3.13	30	
Molybdenum	0.9500	0.0050	1	0.002	94.8	75	125	0.982	3.31	30	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911088
Project: Petaluma

ANALYTICAL QC SUMMARY REPORT

BatchID: 5805

Sample ID: **0911088-002AMSD** SampType: **MSD** TestCode: **6010B_W** Units: **mg/L** Prep Date: **11/15/2009** RunNo: **21778**
Client ID: **A-09-108** Batch ID: **5805** TestNo: **SW6010B** **(E200.7/SW30** Analysis Date: **11/16/2009** SeqNo: **312511**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nickel	1.597	0.010	1	0.307	129	75	125	1.336	17.8	30	S
Selenium	0.9500	0.020	1	0.007	94.3	75	125	0.978	2.90	30	
Silver	1.001	0.0050	1	0	100	75	125	1.005	0.399	30	
Thallium	0.8820	0.010	1	0	88.2	75	125	0.913	3.45	30	
Vanadium	1.188	0.010	1	0.202	98.6	75	125	1.186	0.168	30	
Zinc	1.231	0.010	1	0.11	112	75	125	1.062	14.7	30	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911088
Project: Petaluma

ANALYTICAL QC SUMMARY REPORT

BatchID: 5806

Sample ID: **MB-5806** SampType: **MBLK** TestCode: **HG_W_7470A** Units: **mg/L** Prep Date: **11/15/2009** RunNo: **21772**
Client ID: **ZZZZZ** Batch ID: **5806** TestNo: **SW7470A** **(SW7470A)** Analysis Date: **11/16/2009** SeqNo: **312421**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	ND	0.00020									

Sample ID: **LCS-5806** SampType: **LCS** TestCode: **HG_W_7470A** Units: **mg/L** Prep Date: **11/15/2009** RunNo: **21772**
Client ID: **ZZZZZ** Batch ID: **5806** TestNo: **SW7470A** **(SW7470A)** Analysis Date: **11/16/2009** SeqNo: **312419**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	0.01469	0.00020	0.015	0	97.9	80	120				

Sample ID: **LCSD-5806** SampType: **LCSD** TestCode: **HG_W_7470A** Units: **mg/L** Prep Date: **11/15/2009** RunNo: **21772**
Client ID: **ZZZZZ** Batch ID: **5806** TestNo: **SW7470A** **(SW7470A)** Analysis Date: **11/16/2009** SeqNo: **312420**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	0.01458	0.00020	0.015	0	97.2	80	120	0.01469	0.752	20	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911088
Project: Petaluma

ANALYTICAL QC SUMMARY REPORT

BatchID: G21792

Sample ID: **MBG-G21792** SampType: **MBLK** TestCode: **TPH_GAS_W** Units: **µg/L** Prep Date: **11/17/2009** RunNo: **21792**
Client ID: **ZZZZZ** Batch ID: **G21792** TestNo: **SW8260B(TP** Analysis Date: **11/17/2009** SeqNo: **312853**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Gasoline)	ND	50									
Surr: 4-Bromofllurobenzene	8.600	0	11.36	0	75.7	53	118				

Sample ID: **LCSG-G21792** SampType: **LCS** TestCode: **TPH_GAS_W** Units: **µg/L** Prep Date: **11/17/2009** RunNo: **21792**
Client ID: **ZZZZZ** Batch ID: **G21792** TestNo: **SW8260B(TP** Analysis Date: **11/17/2009** SeqNo: **312854**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Gasoline)	221.8	50	227	0	97.7	52.4	127				
Surr: 4-Bromofllurobenzene	9.100	0	11.36	0	80.1	53	118				

Sample ID: **LCSDG-G21792** SampType: **LCSD** TestCode: **TPH_GAS_W** Units: **µg/L** Prep Date: **11/17/2009** RunNo: **21792**
Client ID: **ZZZZZ** Batch ID: **G21792** TestNo: **SW8260B(TP** Analysis Date: **11/17/2009** SeqNo: **312856**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Gasoline)	183.2	50	227	0	80.7	52.4	127	221.8	19.1	20	
Surr: 4-Bromofllurobenzene	9.300	0	11.36	0	81.9	53	118	0	0	0	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911088
Project: Petaluma

ANALYTICAL QC SUMMARY REPORT

BatchID: R21738

Sample ID: **WD091112A-MB** SampType: **MBLK** TestCode: **TPHDO_W** Units: **mg/L** Prep Date: **11/12/2009** RunNo: **21738**
Client ID: **ZZZZZ** Batch ID: **R21738** TestNo: **SW8015B** Analysis Date: **11/12/2009** SeqNo: **312026**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Diesel)	ND	0.10									
TPH (Motor Oil)	ND	0.20									
Surr: Pentacosane	0.1050	0	0.1	0	105	57.9	125				

Sample ID: **WD091113A-MB** SampType: **MBLK** TestCode: **TPHDO_W** Units: **mg/L** Prep Date: **11/13/2009** RunNo: **21738**
Client ID: **ZZZZZ** Batch ID: **R21738** TestNo: **SW8015B** Analysis Date: **11/13/2009** SeqNo: **312370**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Diesel)	ND	0.10									
TPH (Motor Oil)	ND	0.20									
Surr: Pentacosane	0.1090	0	0.1	0	109	57.9	125				

Sample ID: **WD091112A-LCS** SampType: **LCS** TestCode: **TPHDO_W** Units: **mg/L** Prep Date: **11/12/2009** RunNo: **21738**
Client ID: **ZZZZZ** Batch ID: **R21738** TestNo: **SW8015B** Analysis Date: **11/12/2009** SeqNo: **312027**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Diesel)	0.7510	0.10	1	0	75.1	50.3	125				
Surr: Pentacosane	0.1030	0	0.1	0	103	57.9	125				

Sample ID: **WD091112A-LCSD** SampType: **LCSD** TestCode: **TPHDO_W** Units: **mg/L** Prep Date: **11/12/2009** RunNo: **21738**
Client ID: **ZZZZZ** Batch ID: **R21738** TestNo: **SW8015B** Analysis Date: **11/12/2009** SeqNo: **312028**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPH (Diesel)	0.7400	0.10	1	0	74.0	50.3	125	0.751	1.48	30	
Surr: Pentacosane	0.1100	0	0.1	0	110	57.9	125	0	0	0	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911088
Project: Petaluma

ANALYTICAL QC SUMMARY REPORT

BatchID: R21792

Sample ID: **MB-R21792** SampType: **MBLK** TestCode: **8260B_W** Units: **µg/L** Prep Date: **11/17/2009** RunNo: **21792**
Client ID: **ZZZZZ** Batch ID: **R21792** TestNo: **SW8260B** Analysis Date: **11/17/2009** SeqNo: **312849**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1,1,2-Tetrachloroethane	ND	1.0									
1,1,1-Trichloroethane	ND	0.50									
1,1,2,2-Tetrachloroethane	ND	1.0									
1,1,2-Trichloroethane	ND	0.50									
1,1-Dichloroethane	ND	0.50									
1,1-Dichloroethene	ND	1.0									
1,1-Dichloropropene	ND	0.50									
1,2,3-Trichlorobenzene	ND	1.0									
1,2,3-Trichloropropane	ND	1.0									
1,2,4-Trichlorobenzene	ND	1.0									
1,2,4-Trimethylbenzene	ND	0.50									
1,2-Dibromo-3-chloropropane	ND	0.50									
1,2-Dibromoethane (EDB)	ND	0.50									
1,2-Dichlorobenzene	ND	0.50									
1,2-Dichloroethane (EDC)	ND	0.50									
1,2-Dichloropropane	ND	1.0									
1,3,5-Trimethylbenzene	ND	0.50									
1,3-Dichlorobenzene	ND	0.50									
1,4-Dichlorobenzene	ND	0.50									
2,2-Dichloropropane	ND	0.50									
2-Chloroethyl vinyl ether	ND	6.0									
2-Chlorotoluene	ND	0.50									
4-Chlorotoluene	ND	0.50									
4-Isopropyltoluene	ND	0.50									
Acetone	ND	10									
Benzene	ND	0.50									
Bromobenzene	ND	0.50									
Bromochloromethane	ND	0.50									
Bromodichloromethane	ND	0.50									
Bromoform	ND	1.0									
Bromomethane	ND	1.0									

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911088
Project: Petaluma

ANALYTICAL QC SUMMARY REPORT

BatchID: R21792

Sample ID: **MB-R21792**	SampType: **MBLK**	TestCode: **8260B_W**	Units: **µg/L**	Prep Date: **11/17/2009**	RunNo: **21792**
Client ID: **ZZZZZ**	Batch ID: **R21792**	TestNo: **SW8260B**		Analysis Date: **11/17/2009**	SeqNo: **312849**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Carbon tetrachloride	ND	1.0									
Chlorobenzene	ND	0.50									
Chloroform	ND	0.50									
Chloromethane	ND	0.50									
cis-1,2-Dichloroethene	ND	0.50									
cis-1,3-Dichloropropene	ND	0.50									
Dibromochloromethane	ND	0.50									
Dibromomethane	ND	0.50									
Dichlorodifluoromethane	ND	0.50									
Diisopropyl ether (DIPE)	ND	0.50									
Ethyl tert-butyl ether (ETBE)	ND	0.50									
Ethylbenzene	ND	0.50									
Freon-113	ND	1.0									
Hexachlorobutadiene	ND	0.50									
Isopropylbenzene	ND	1.0									
Methyl tert-butyl ether (MTBE)	ND	0.50									
Methylene chloride	ND	5.0									
Naphthalene	ND	1.0									
n-Butylbenzene	ND	0.50									
n-Propylbenzene	ND	0.50									
sec-Butylbenzene	ND	0.50									
Styrene	ND	0.50									
t-Butyl alcohol (t-Butanol)	ND	5.0									
tert-Amyl methyl ether (TAME)	ND	0.50									
tert-Butylbenzene	ND	0.50									
Tetrachloroethene	ND	0.50									
Toluene	ND	0.50									
trans-1,2-Dichloroethene	ND	0.50									
trans-1,3-Dichloropropene	ND	0.50									
Trichloroethene	ND	0.50									
Trichlorofluoromethane	ND	0.50									

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: URS Corporation, San Jose
Work Order: 0911088
Project: Petaluma

ANALYTICAL QC SUMMARY REPORT

BatchID: R21792

Sample ID: **MB-R21792** SampType: **MBLK** TestCode: **8260B_W** Units: **µg/L** Prep Date: **11/17/2009** RunNo: **21792**
Client ID: **ZZZZZ** Batch ID: **R21792** TestNo: **SW8260B** Analysis Date: **11/17/2009** SeqNo: **312849**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Vinyl chloride	ND	0.50									
Xylenes, Total	ND	1.5									
Surr: Dibromofluoromethane	12.11	0	11.36	0	107	61.2	131				
Surr: 4-Bromofluorobenzene	11.79	0	11.36	0	104	64.1	120				
Surr: Toluene-d8	10.36	0	11.36	0	91.2	75.1	127				

Sample ID: **LCS-R21792** SampType: **LCS** TestCode: **8260B_W** Units: **µg/L** Prep Date: **11/17/2009** RunNo: **21792**
Client ID: **ZZZZZ** Batch ID: **R21792** TestNo: **SW8260B** Analysis Date: **11/17/2009** SeqNo: **312850**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	15.76	1.0	17.04	0	92.5	61.4	129				
Benzene	17.78	0.50	17.04	0	104	66.9	140				
Chlorobenzene	16.45	0.50	17.04	0	96.5	73.9	137				
Toluene	17.49	0.50	17.04	0	103	76.6	123				
Trichloroethene	16.68	0.50	17.04	0	97.9	69.3	144				
Surr: Dibromofluoromethane	11.47	0	11.36	0	101	61.2	131				
Surr: 4-Bromofluorobenzene	10.23	0	11.36	0	90.1	64.1	120				
Surr: Toluene-d8	12.07	0	11.36	0	106	75.1	127				

Sample ID: **LCSD-R21792** SampType: **LCSD** TestCode: **8260B_W** Units: **µg/L** Prep Date: **11/17/2009** RunNo: **21792**
Client ID: **ZZZZZ** Batch ID: **R21792** TestNo: **SW8260B** Analysis Date: **11/17/2009** SeqNo: **312851**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	14.06	1.0	17.04	0	82.5	61.4	129	15.76	11.4	20	
Benzene	16.96	0.50	17.04	0	99.5	66.9	140	17.78	4.72	20	
Chlorobenzene	16.90	0.50	17.04	0	99.2	73.9	137	16.45	2.70	20	
Toluene	15.53	0.50	17.04	0	91.1	76.6	123	17.49	11.9	20	
Trichloroethene	13.93	0.50	17.04	0	81.7	69.3	144	16.68	18.0	20	
Surr: Dibromofluoromethane	12.29	0	11.36	0	108	61.2	131	0	0	0	
Surr: 4-Bromofluorobenzene	9.770	0	11.36	0	86.0	64.1	120	0	0	0	
Surr: Toluene-d8	10.57	0	11.36	0	93.0	75.1	127	0	0	0	

Qualifiers:
E Value above quantitation range
ND Not Detected at the Reporting Limit
H Holding times for preparation or analysis exceeded
R RPD outside accepted recovery limits
J Analyte detected below quantitation limits
S Spike Recovery outside accepted recovery limits

Torrent LABORATORY, INC.
483 Sinclair Frontage Road
Milpitas, CA 95035
Phone: 408.263.5258
FAX: 408.263.8293
www.torrentlab.com

CHAIN OF CUSTODY

• NOTE: SHADED AREAS ARE FOR TORRENT LAB USE ONLY •

LAB WORK ORDER NO: 0911088

Company Name: URS Corp.
Address: 55 S. Market St Suite 1500
City: San Jos State: CA Zip Code: 95113
Telephone: (408) 297 9585 FAX:
REPORT TO: Patrick Walz SAMPLER: Chuck Rambo

Location of Sampling: Petaluma
Purpose:
Special Instructions / Comments:
P.O. #: EMAIL:

TURNAROUND TIME: ☐ 10 Work Days ☐ 3 Work Days ☐ Noon - Nxt Day ☐ 7 Work Days ☐ 2 Work Days ☐ 2 - 8 Hours ☐ 5 Work Days ☐ 1 Work Day ☐ Other

SAMPLE TYPE: ☐ Storm Water ☐ Air ☐ Waste Water ☐ Other ☒ Ground Water ☐ Soil

REPORT FORMAT: ☐ QC Level IV ☐ EDF ☐ Excel / EDD

ANALYSIS REQUESTED

LAB ID	CLIENT'S SAMPLE I.D.	DATE / TIME SAMPLED	MATRIX	# OF CONT	CONT TYPE	EPA 8260B - Full List ☒ / EPA 8260B - 8010 List ☐	THP gas ☒ / BTEX ☐ / Oxygenates ☐ / MTBE	THP Diesel ☒ / Si-Gel ☐ / Motor Oil ☒	Pesticide - 8081 ☐	PCB - 8082 ☐	Metals ☒ / CAM - 17 ☐ / LUFT 5 ☐ / 7 Metals	8270 Full List ☐ / PAHs Only ☐			REMARKS
001A	A-09-112	10/11/09 12:20	GW	1 1 3	1L Amber 250mL Poly VOAs	X	X	X			X				
002A	A-09-108	11 952	GW	↓	↓	X	X	X			X				

Temp 5°C

TORRENT LAB

	Relinquished By:	Print:	Date:	Time:	Received By:	Print:	Date:	Time:
1	[signature]	[illegible]	11-12-09	11:12	C Moore	C Moore	11/12	11:24
2	C Moore	C Moore	11/12	11:55	[signature]		11/12/09	11:55am

Were Samples Received in Good Condition? ☒ Yes ☐ NO Samples on Ice? ☒ Yes ☐ NO Method of Shipment Hi Speed Sample seals intact? ☐ Yes ☐ NO ☒ N/A

NOTE: Samples are discarded by the laboratory 30 days from date of receipt unless other arrangements are made.

Page 1 of 1

Log In By: _____ Date: _____ Log In Reviewed By: _____ Date: _____

“Ornamental Logo Concrete and Paint Coloring Required” Document

PETALUMA
1858

Hazardous Materials Report for
U.S. 101/Old Redwood Highway Bridge
Dated April 17, 2012

U.S. 101 / OLD REDWOOD HIGHWAY INTERCHANGE PROJECT

Hazardous Materials Report for U.S. 101/Old Redwood Highway Bridge

PETALUMA, CALIFORNIA

Prepared for:

The City of Petaluma Department of Public Works

Prepared by:

URS

100 West San Fernando Street, Suite 200

San Jose, CA 95113

www.URScorp.com

April 17, 2012

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Appendix A: List of Abbreviations and Acronyms

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Appendix D: MACS Laboratory Analysis Reports

Asbestos Laboratory Analysis

Lead-Based Paint Laboratory Analysis

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1. INTRODUCTION

1.1 PROJECT OBJECTIVE

The City of Petaluma Department of Public Works contracted with URS Corporation to conduct an inspection for asbestos-containing materials (ACMs) and metal-based paint (commonly referred to as lead-based paint, LBP) prior to demolition of U.S. 101/Old Redwood Highway Bridge located in Petaluma, California (the Site). The structure is scheduled to be replaced with multi-lane facility with bicycle lanes and pedestrian sidewalks on both sides. The Site was inspected and sampled on February 25, 2010.

URS contracted Kellco Services, a certified asbestos and lead consultant, to conduct sampling of potential ACM or LBP materials at the Site. Mr. Derrick Quatch oversaw field sampling, and Mr. Tim Cannard oversaw preparation of Kellco's report. Mr. Cannard is a licensed Certified Asbestos Consultant (CAC) , licensed by the State of California Division of Occupational Safety and Health, license number 94-1395, and a Certified Lead Inspector (CLI), licensed by the State of California Department of Public Health, license number 764. Mr. Quatch is also licensed by these agencies (license numbers 02-3214 and 2280, respectively).

The results of this inspection can be used to help with Occupational Safety & Health Administration (OSHA) compliance, disposal requirements, and other regulatory requirements. A list of acronyms used in this report is included in Appendix A.

The scope of services included the following tasks:

1.1.1 Task 1: Asbestos-Containing Materials (ACM) Inspection

- Conduct visual asbestos inspections using Certified Asbestos Consultants (CAC)
- Inspectors provided by Kellco Services collected samples of materials suspected of containing asbestos for analysis
- Photographic record of samples and sample locations
- Sample analysis by Macs Laboratory, Inc.
- Conduct visual inspection for potential PCB- and Mercury- containing materials

1.1.2 Task 2: Lead/Metal-Based Paint (LBP) Inspection

- Conduct visual metal-based paint inspections by Certified Lead Inspectors (CLI)
- Collect samples of paint materials suspected of containing the 17 California Assessment Manual heavy metals (CAM 17 Metals) for analysis
- Photographic record of samples and sample locations
- Sample analysis by Macs Laboratory, Inc.

1.2 INSPECTED FACILITY

The subject bridge is scheduled for demolition and replacement. The existing two lane overcrossing/bridge is to be replaced with multi-lane facility with bicycle lanes and pedestrian sidewalks on both sides.

The inspection performed was both visual and tactile. Samples were taken of suspect materials from the exterior of structures within the survey area. During the inspection, a reasonable attempt was made to find suspect materials in the concrete used for the rail, footing, overpass, bases, and expansion joint and in other paints used for bridges. If any non-sampled materials are uncovered during construction or demolition, these should be submitted for asbestos and/or metal-based paint analysis.

2. ASBESTOS INSPECTION

The Environmental Protection Agency defines ACM as any material that contains greater than 1% asbestos. Materials containing less than 10% asbestos can be submitted for further analysis by the Point Count method as described in Appendix B. If the Point Count method (and only the point count method) determines that the material contains less than 1% asbestos, it can be disposed of as non-hazardous asbestos-containing construction waste. If materials containing less than 10% asbestos by Polarized Light Microscopy are not submitted for point counting, they must be presumed to be asbestos-containing material and disposed of as hazardous asbestos waste.

2.1 ASBESTOS INSPECTION DETAILS

URS provided consulting oversight services for the inspection and analysis of Potential Asbestos-Containing Materials (P-ACM) at the Site. Samples of P-ACM were collected from the exterior of the structures. During the inspection, a reasonable attempt was made to find P-ACM in the concrete used for the rail, footing, overpass, bases, and expansion joint and in other paints used for bridges. Each collected sample was stored in a Zip-Loc® bag, with its original location marked and photographed. The number of samples collected was judged sufficient to provide adequate characterization of these materials. The locations of the samples collected and photographs are illustrated in Appendix C. Field sample identifications shown on the figure are cross-referenced in Table 1; and photographs of the samples are included in Appendix C.

Samples of P-ACM were analyzed by a certified laboratory using Polarized Light Microscopy (PLM), the recommended method of the U.S. Environmental Protection Agency (EPA). A brief description of the analytical procedures is included in Appendix B. A summary of the laboratory analyses of sampled P-ACMs is included in Table 1. All tested materials were found to be non-detect for asbestos. Detailed analytical results for sampled materials are included in Appendix D. KELLCO's qualifications are included in Appendix E.

In the event that non-sampled P-ACM is uncovered during future renovation activities, these materials should be sampled and submitted for asbestos analysis.

2.2 ASBESTOS ANALYTICAL QUALITY CONTROL

For every 10 field samples, the laboratory performs a Quality Control (QC) duplicate sample. These samples were analyzed and compared to the original results. The QC analytical results are available upon request.

2.3 ASBESTOS ANALYTICAL RESULTS

A total of 18 separate samples of P-ACM were collected from the Site. Laboratory analysis indicated that all of these bulk samples were non-detect for asbestos content. A detailed listing of materials that were "non-detect" for asbestos is provided in Table 1.

3. LEAD/METAL-BASED PAINT INSPECTION

The US Environmental Protection Agency (EPA), OSHA, and the U.S. Department of Urban Development (HUD) define lead-based paint (LBP) as paint or other surface coatings that contain lead greater than 1 milligram per square centimeter (mg/cm^2) on an area basis, or 5,000 milligram per kilogram (mg/kg) or parts per million (PPM) on a weight basis (i.e., a lead content at least 0.5% by weight)[1]. Cal-OSHA regulations for lead exposure define any paint surface with a lead content of 600 PPM, or 0.06% by weight, as a lead health hazard and require that a Negative Initial Determination for lead exposure be made for paint that contains greater than 0.06% (600 ppm) of lead, and that a worker protection program be developed for such paint that incorporates elements such as work practices, training, personal protection equipment and respiratory protection be implemented pursuant to OSHA regulatory requirements[2]. Removal or disturbance of material with any detectable amount of lead paint must be handled in accordance with OSHA regulations. Facility components with intact lead paint and no other hazardous materials can be disposed of as non-hazardous construction waste. Paint chips and debris must be disposed of as lead-containing hazardous waste. Paint samples were analyzed for CAM 17 Metals to investigate the paint for the presence of all 17 heavy metals on the CAM 17 Metals list; lead being one of these metals.

3.1 LEAD/METAL-BASED PAINT INSPECTION DETAILS

URS provided consulting oversight services for the inspection and analysis of paint for CAM-17 Metals at the Site. Samples of paint were collected from the exterior of structures. Each collected sample was stored in a sealed plastic container, its original location marked and photographed.

Samples of paint were analyzed by a certified laboratory using Atomic Absorption (AA), the recommended method by the U.S. Environmental Protection Agency (EPA). A brief description of the analytical procedures is included in Appendix B. A summary of the laboratory analyses of sampled paint is included in Table 2. Paint samples were analyzed on a weight basis and are therefore reported as mg/kg, which is equivalent to PPM. Detailed analytical results for sampled materials are included in Appendix D. KELLCO's qualifications are included in Appendix E.

In the event that non-sampled paint is uncovered during future renovation activities, these materials should be sampled and submitted for lead analysis.

3.2 PAINT ANALYTICAL QUALITY CONTROL

For every 10 field samples, the laboratory performs a Quality Control (QC) duplicate sample. These samples were submitted and analyzed and compared to the original results. The QC analytical results are available upon request.

---

[1] Current Lead-Based Paint Definitions can be found at: http://www.epa.gov/lead/pubs/leadtest.pdf

[2] Current Cal-OSHA regulations for lead-based paint abatement can be found at: http://www.dir.ca.gov/Title8/1532_1.html

3.3 PAINT ANALYTICAL RESULTS

A total of four bulk samples of paint were collected from the Site. Laboratory analysis indicated that none of the samples were LBP, having at least 5,000 PPM of lead. However, two of the four samples were detected at concentrations exceeding 600 PPM, which requires that Cal-OSHA regulations be followed if paint removal is required. The highest detected concentration of lead was 1,582 PPM at sample URS-01. The locations of the samples collected and photographs are illustrated in Appendix C. Field sample identifications shown on the figure are cross-referenced in Table 2; and photographs of the samples are included in Appendix C.

4.1 RECOMMENDATIONS

Since the inspected structures are expected to undergo future demolition and identified hazards may be disturbed during potential construction activities, all federal, state and local regulations are to be complied with from an environmental protection, worker protection, and waste disposal perspective during such activities. Notifications to the regulatory agencies may be required. Regulatory agencies may include, but are not limited to, the U.S. and California Occupational Safety and Health Administrations (OSHA and Cal-OSHA), federal and state environmental protection agencies, the California Department of Health Services (Cal-DHS), the Bay Area Air Quality District, and appropriate local agencies. In the event that non-sampled P-ACM and/or P-LBP are uncovered during future activities, these materials should be sampled and submitted for analysis.

4.1.1 Asbestos Recommendations

According to these analytical results the materials tested are not ACM, therefore Cal-OSHA regulations do not apply. The materials can therefore be disposed of as construction waste, and no registered abatement contractor is required for demolition.

However, if non-sampled P-ACM materials are uncovered during demolition, these materials should be sampled and submitted for analysis before further proceeding.

4.1.2 Lead/Metal Based Paint Recommendations

While none of the samples qualify as LBP based on EPA or HUD definitions, two of the four samples collected and analyzed are considered to be lead based paint by OSHA and Cal-OSHA, and therefore, URS recommends that all paint on the bridge be considered positive for LBP. URS recommends that all appropriate OSHA requirements be observed. Anyone coming in contact with LBP should be advised not to disturb it without taking precautionary measures appropriate to avoid exposure. Lead based paint in good condition (intact without chipping or peeling) may be disposed of as non-hazardous waste. However, paint in poor condition must be abated per Cal-OSHA and CDPH requirements prior to demolition and the paint chips profiled separately. At the time of the inspection all observed paint was in good condition.

The Contractor should be provided with all metal-based paint sampling results for preparation of their Health and Safety Plan.

TABLES

HAZARDOUS MATERIALS REPORT
U.S. 101/OLD REDWOOD HIGHWAY BRIDGE
PETALUMA, CALIFORNIA

Table 1 Summary of Sampled Materials with No Detected Asbestos
Table 2 Summary of Metals Results in Paint

Table 1
Summary of Materials with No Detected Asbestos
U.S. 101/Old Redwood Highway Bridge

LAB LOGIN #	FIELD SAMPLE #	LOCATION	MATERIAL	COLOR
L200591-1	URS-R-01	Rail - NE	Concrete	Grey
L200591-2	URS-B-02	Base - NE	Concrete	Grey
L200591-3	URS-F-03	Footing - NE	Patch	Grey
L200591-4	URS-F-04	Footing - NE	Concrete / Paint	Grey
L200591-5	URS-F-05	Footing - SE	Concrete	Grey
L200591-6	URS-R-06	Rail - SE	-	Grey
L200591-7	URS-B-07	Overpass - S	Sealant	Black
L200591-8	URS-R-08	Rail - S	Concrete	Grey
L200591-9	URS-F-09	Footing - S	Concrete	Grey
L200591-10	URS-F-10	Footing - NW	Patch	Grey
L200591-11	URS-F-11	Footing - NW	Concrete	-
L200591-12	URS-B-12	Overpass / Bridge Expansion Joint - W	Concrete - Expansion Joint West	Grey
L200591-13	URS-B-13	Overpass / Bridge Expansion Joint - W	Reflexter Mastic - Expansion Joint West	Grey
L200591-14	URS-B-14	Overpass / Bridge - E	Concrete - Expansion Joint East	Grey
L200591-15	URS-B-15	Overpass / Bridge - E	Asphalt - Expansion Joint East	Black
L200591-16	URS-B-16	Overpass / Bridge - NW	Paint	Yellow
L200591-17	URS-B-17	Overpass / Bridge - SE	Compact Board	-
L200591-18	URS-B-18	Overpass / Bridge - SW	Paint	White

Table 2
Summary of Metals Results in Paint

Lab Sample Number:	200590 - 1	200590 - 2	200590 - 3	200590 - 4
Client Sample Number:	URS-01	URS-02	URS-03	URS-04
Field Description:	White paint on footing	White paint on footing	White paint – road striping	Yellow paint – road striping
Matrix:	BULK	BULK	BULK	BULK
Extraction Type:	Acid	Acid	Acid	Acid
Units:	mg/kg (PPM)	mg/kg (PPM)	mg/kg (PPM)	mg/kg (PPM)
Sb Antimony	13.29	24.84	2.63	3.13
As Arsenic	13.87	20.43	7.95	4.29
Ba Barium	327.64	572.89	9.22	54.09
Be Beryllium	0.53	0.84	0.20	0.22
Cd Cadmium	6.11	5.48	0.50	2.12
Cr Chromium	92.73	29.43	2.27	13.41
Co Cobalt	8.04	10.96	7.78	3.79
Cu Copper	76.17	114.53	3.55	13.46
Pb Lead	1,190.42	1,582.17	268.67	190.17
Hg Mercury	27.15	33.52	3.93	6.70
Mo Molybdenum	7.92	12.95	1.70	3.02
Ni Nickel	43.26	20.38	3.38	20.55
Se Selenium	791.53	1,396.94	205.17	258.82
Ag Silver	1.95	2.83	2.32	0.93
Tl Thallium	11.72	19.55	12.68	4.09
V Vanadium	68.87	42.43	4.47	14.59
Zn Zinc	398.17	248.93	63.90	102.58

APPENDIX A

HAZARDOUS MATERIALS REPORT
U.S. 101/OLD REDWOOD HIGHWAY BRIDGE
PETALUMA, CALIFORNIA

List of Acronyms and Abbreviations

AA	Atomic Absorption
ACM	Asbestos Containing Material
AIHA	American Industrial Hygiene Association
ASTM	American Society for Testing and Materials
CAC	Certified Asbestos Consultant
Cal-DHS	California Department of Health Services
Cal-OSHA	California Occupational Safety and Health Administration
CLI	Certified Lead Inspector
CLPDC	Certified Lead Project Designer Consultant
ELAP	California Environmental Laboratory Accreditation Program
ELLAP	California Environmental Lead Laboratory Accreditation Program
EPA	U.S. Environmental Protection Agency
HUD	U.S. Department of Housing and Urban Development
HVAC	Heating, ventilation, and air conditioning
LBP	Lead-Based Paint
NIOSH	National Institute of Occupational Safety
NIST	National Institute of Standards and Technology
NVLAP	National Voluntary Laboratory Accreditation Program
OSHA	U.S. Occupational Safety and Health Administration
P-ACM	Potential Asbestos Containing Material
PAT	Proficiency Analytical Test
Pb	Plumbus: Latin word origin for lead
PCM	Point Count Method
PEL	Permissible Exposure Limit
P-LBP	Potential Lead-Based Paint
PLM	Polarized Light Microscopy
ppm	Parts per million
QC	Quality Control

APPENDIX B

HAZARDOUS MATERIALS REPORT
U.S. 101/OLD REDWOOD HIGHWAY BRIDGE
PETALUMA, CALIFORNIA

Analytical Procedures

Analytical Procedures

POLARIZED LIGHT MICROSCOPY (PLM)

- Bulk samples were analyzed in accordance with U.S. EPA "Test Method for Determination of Asbestos in Bulk Building Materials, 1993," with inclusion of area percent estimates of the sample components. The use of the McCrone Color Dispersion Staining Technique supplements the analysis when considered useful by the analyst. The samples are prepared with refractive immersion oil and are examined under Polarized Light Microscopy (PLM). The accuracy of the visual estimate method is 1%. As per the standard "...The accuracy in the determination of the presence or absence of asbestos of greater than 1 area percent asbestos is greater than 99%." ASTM Committee D22.05, 1/18/88, Standard *Method of Testing for Asbestos Containing Materials by Polarized Light Microscopy*. If the sample matrix is reduced to minimize non-asbestos components, the detection limit can be mathematically enhanced, based on the amount of material remaining after matrix reduction. This method is called gravimetric reduction. This method involves ashing and chemical dissolution of the sample.

POINT COUNTING

- The Point Counting method is a much more accurate analytical method for determining the percent of asbestos in a particular material. KELLCO-MACS uses a muffle furnace to ash the sample and remove organic compounds. Hydrochloric acid is used to dissolve some of the nonasbestos minerals. Under this method a minimum of 125 points are counted from each of 8 different slide preparations of the same sample (total of 1000 points min.) If the **Point Count Method** determines that the material contains less than 1% asbestos, the material being analyzed can be treated as non-hazardous asbestos containing construction waste**. Note: ONLY the Point Count Method can be used for this determination.**

ATOMIC ABSORPTION FOR LEAD

- Paint samples were collected for atomic absorption (AA) analysis. The detection limit for each sample depends upon many factors including the sensitivity of the instrument and the sample size. In the KELLCO-MACS laboratory utilizing flame AA, the detection limit is normally .01% or 100 parts per million (ppm).

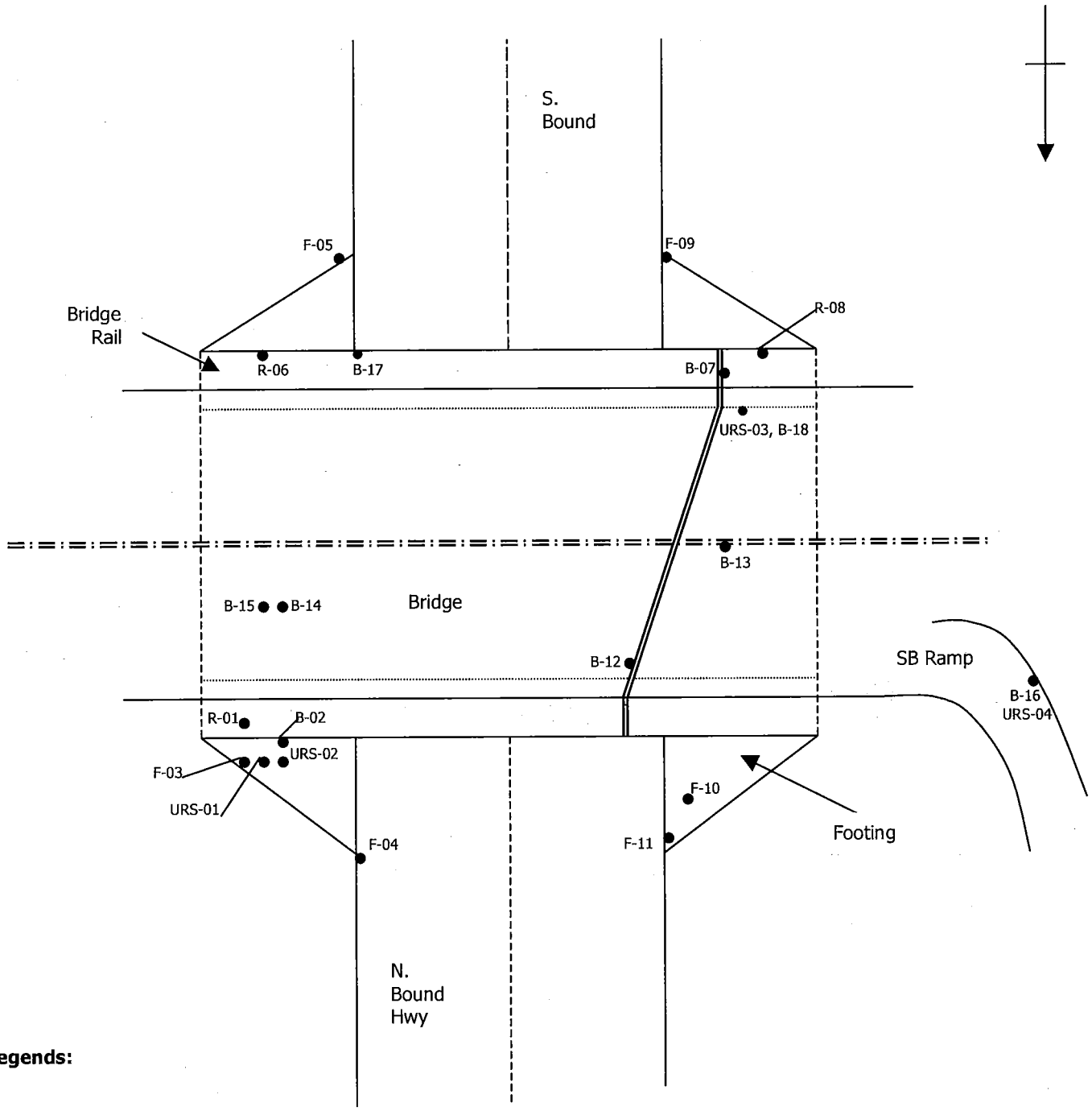
CAM 17 Testing

- CAM 17 Metals were tested by Macs Lab, Inc. using ICP-MS, Extraction Method SW3050B and Analytical Method 6010B/3050.

APPENDIX C

HAZARDOUS MATERIALS REPORT
U.S. 101/OLD REDWOOD HIGHWAY BRIDGE
PETALUMA, CALIFORNIA

Sample Location Map
Photographs of Sample Locations



Legends:

● Sample Location

Note: Plan not drawn to actual scale

KELLCO-MACS	Building Drawing/Sample Location Map	Date: February 25, 2010
	3137 Diablo Ave., Hayward, CA (510)786-9751 Fax (510) 786-9625	Job #: 1002-44
Client: URS Corporation 55 S. Market Street, 1500 San Jose, CA 95113	Job Site: Denman BR 20-159 1959	Drawn By: Siew Yee Lee

EXIT 47A
Old Redwood Hwy
1 MILE
Penngrove

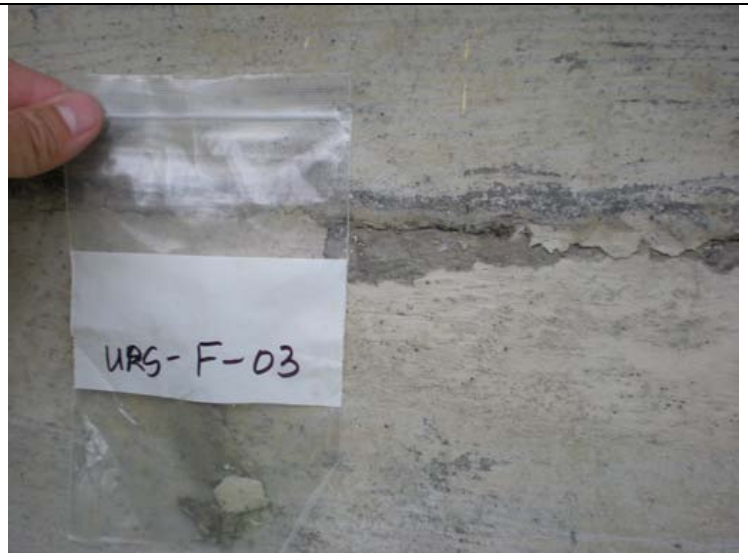
Old Redwood Hwy
Penngrove

Santa Rosa
101
San Francisco
FREEWAY
ENTRANCE
101
South

URS-R-01

URS-B-02

URS-01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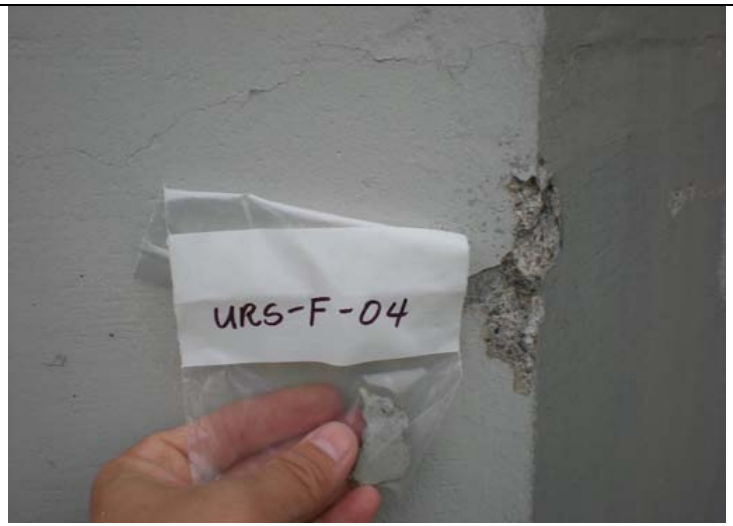
URS-02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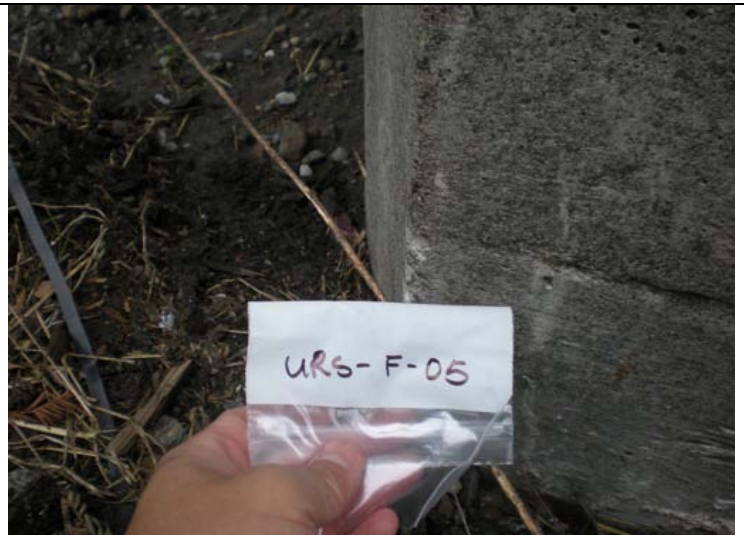
DENMAN
IER 20-159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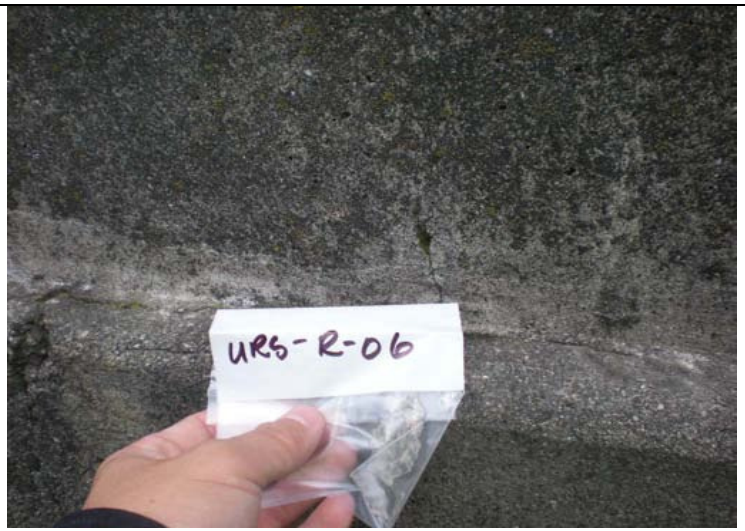
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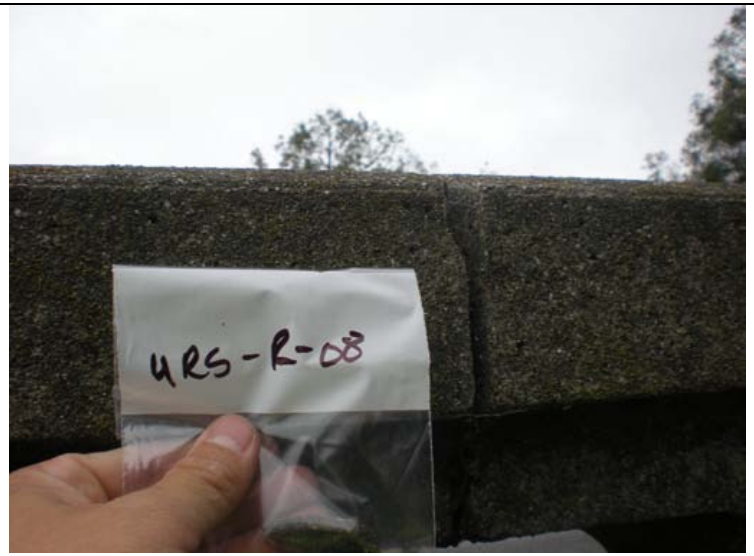
URS-B-07

URS-03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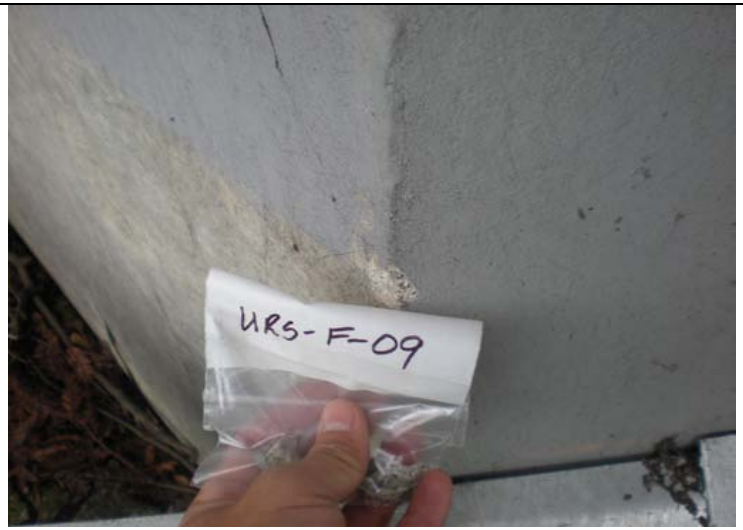
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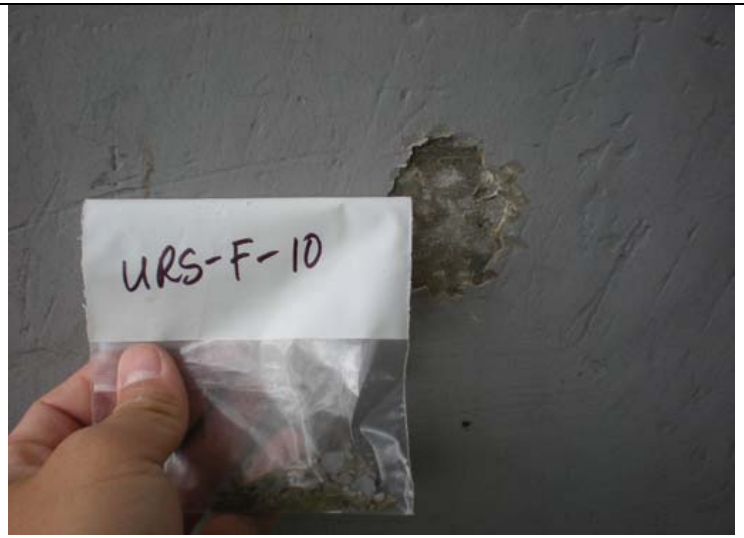
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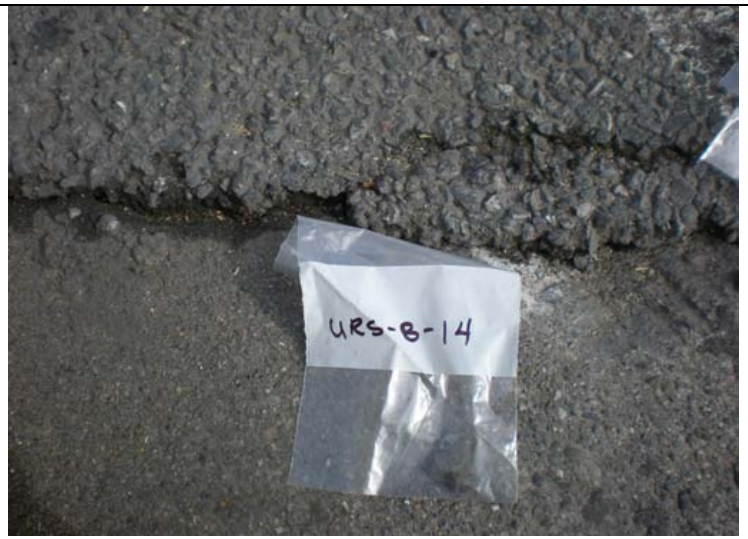
URS-F-11

DENMAN
BR 20-159
1955

URS-04

URS-B-12

URS-B-15


URS-B-14

=166

Santa Rosa
101
San Francisco

Santa Rosa
101
San Francisco
101

APPENDIX D

HAZARDOUS MATERIALS REPORT
U.S. 101/OLD REDWOOD HIGHWAY BRIDGE
PETALUMA, CALIFORNIA

MACS Laboratory Analysis Report
Asbestos Laboratory Analysis
Lead-Based Paint Laboratory Analysis

A Creative Joint Venture For Better Environmental Solutions

US 101 & Old Redwood Highway Bridge
Petaluma, CA

KELLCO-MACS Job #1002-44

Pre-Demolition
Asbestos and CAM 17 Heavy Metals Inspection Report

for

URS Corporation
55 South Market Street
Suite #1500
San Jose, CA 95113

March 15, 2010

3137 Diablo Avenue • Hayward, CA 94545-2701• (510) 786-9751 • fax (510) 786-9625
http://www.kellcomacs.com email: mailbox3137@kellcomacs.com

MACS Lab, Inc.
3137 Diablo Ave
Hayward, CA 94545-2701

510-786-9751

Bulk Asbestos Analysis

Report

Method: EPA-600/M4-82-020

KELLCO Services
3137 Diablo Ave

Hayward CA 94545

Person to contact: Tim Cannard
Contact phone: 510-786-9751
FAX phone: 510-786-9625
Sampled by: Derrik /Siew Yee Lee
Sampled on: February 25, 2010
Analyzed on: March 1, 2010 at: 07:29
Corresponding invoice number: 200591

Analyst: DD (signature)

Laboratory manager: (signature)

Job Number: 1002-44

Job Description: US 101 & Old Redwood Highway Overpass, Petaluma, CA

Lab Sample Number	Client Sample Number and Description	Asbestos detected?	Fibers present	Remarks
L200591-1	URS-R-01 Rail - NE - Grey - Concrete	**N.D.**	< 1% Cellulose	Gray concrete. Balance of sample is unspecified non-fibrous material.
L200591-2	URS-B-02 Base - NE - Grey - Concrete	**N.D.**	< 1% Cellulose	Gray concrete. Balance of sample is unspecified non-fibrous material.
L200591-3	URS-F-03 Footing - NE - Grey - Patch	**N.D.**	< 1% Cellulose	Gray patch. Balance of sample is unspecified non-fibrous material.
L200591-4	URS-F-04 Footing - NE - Grey - Concrete / Paint	**N.D.**	< 1% Cellulose	Gray concrete/paint. Balance of sample is unspecified non-fibrous material.
L200591-5	URS-F-05 Footing - SE - Grey - Concrete	**N.D.**	< 1% Cellulose	Gray concrete. Balance of sample is unspecified non-fibrous material.

* Chrysotile, Amosite, Crocidolite, Tremolite, Actinolite, and Anthophyllite are asbestos fibers. N.D.=None Detected PC =Point Counted

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NVLAP®
NVLAP Lab Code 101948-0

MACS Lab, Inc.
3137 Diablo Ave
Hayward, CA 94545-2701

510-786-9751

Bulk Asbestos Analysis

Report

Lab Sample Number	Client Sample Number and Description	Asbestos detected?	Fibers present	Remarks
L200591-6	URS-R-06 Rail - SE - Grey	**N.D.**	< 1% Cellulose	Gray concrete/ rail. Balance of sample is unspecified non-fibrous material.
L200591-7	URS-B-07 Overpass - S - Blk - Sealant	**N.D.**	No Fibers	Black sealant. Balance of sample is organic binders and unspecified non-fibrous material.
L200591-8	URS-R-08 Rail - S - Grey - Concrete	**N.D.**	< 1% Cellulose	Gray concrete/rail. Balance of sample is unspecified non-fibrous material.
L200591-9	URS-F-09 Footing - S - Grey - Concrete	**N.D.**	No Fibers	Gray concrete. Balance of sample is unspecified non-fibrous material.
L200591-10	URS-F-10 Footing - NW - Grey - Patch	**N.D.**	3% Cellulose	Gray patch. Balance of sample is unspecified non-fibrous material.
L200591-11	URS-F-11 Footing - NW - Concrete	**N.D.**	No Fibers	Gray concrete. Balance of sample is unspecified non-fibrous material.
L200591-12	URS-B-12 Overpass / Bridge Expension Joint - W. - Grey - Concrete - Expension Joint W.	**N.D.**	< 1% Cellulose	Gray concrete. Balance of sample is unspecified non-fibrous material.
L200591-13	URS-B-13 Overpass / Bridge Expension Joint - W. - Grey - Reflexter Mastic - Expension Joint W.	**N.D.**	2% Cellulose	Overpass / Bridge Expension Joint - W. - Grey - Reflexter Mastic & gray concrete. Balance of sample is unspecified non-fibrous material.
L200591-14	URS-B-14 Overpass / Bridge - E. - Grey - Concrete - Expension Joint E.	**N.D.**	< 1% Cellulose	Gray concrete. Balance of sample is unspecified non-fibrous material.

* Chrysotile, Amosite, Crocidolite, Tremolite, Actinolite, and Anthophyllite are asbestos fibers. N.D.=None Detected PC =Point Counted

NVLAP Lab Code 101948-0

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MACS Lab, Inc.
3137 Diablo Ave
Hayward, CA 94545-2701

510-786-9751

Bulk Asbestos Analysis

Report

Lab Sample Number	Client Sample Number and Description	Asbestos detected?	Fibers present	Remarks
L200591-15	URS-B-15 Overpass / Bridge - E. - Blk - Asphalt - Expension Joint E.	**N.D.**	< 1% Cellulose	Black asphalt. Balance of sample is organic binders and unspecified non-fibrous material.
L200591-16	URS-B-16 Overpass / Bridge - NW - Yell - Paint	**N.D.**	< 1% Cellulose	Yellow paint. Balance of sample is unspecified non-fibrous material.
L200591-17	URS-B-17 Overpass / Bridge - SE - Compact Board	**N.D.**	85% Cellulose	Black/gray compact board. Balance of sample is unspecified non-fibrous material.
L200591-18	URS-B-18 Overpass / Bridge - SW - Wht - Paint	**N.D.**	No Fibers	White paint. Balance of sample is unspecified non-fibrous material.

* Chrysotile, Amosite, Crocidolite, Tremolite, Actinolite, and Anthophyllite are asbestos fibers. N.D.=None Detected PC =Point Counted

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NVLAP Lab Code 101948-0

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MACS Lab, Inc.
3137 Diablo Ave
Hayward, CA 94545-2701

510-786-9751

Bulk Asbestos Analysis

QA Report

Method: EPA-600/M

KELLCO Services
3137 Diablo Ave

Hayward CA 94545

Laboratory manager: _____
(signature)

Lab Sample Number	Client Sample Number and Description	Asbestos detected?	Fibers present	Remarks
Blank sample		**N.D.**	No fibers	
		PC*		

End of report.

* Chrysotile, Amosite, Crocidolite, Tremolite, Actinolite, and Anthophyllite are asbestos fibers. N.D.=None Detected PC =Point Counted

NVLAP Lab Code 101948-0

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CLIENT	JOBSITE
URS Corporation 55 South Market Street 1500 San Jose CA 95113	US 101 & Old Redwood Highway Overpas Highway 101 & Old Redwood Highway Petaluma CA.

KELLCO-MACS JOB#: **1002-44** LAB LOGIN # L 200591

COLLECTED BY: Derrik / Siew Yee Lee

COLLECTED DATE 2/25/10

TURN AROUND TIME: Normal 4 8 24 48 5-DAY

RESULTS NEEDED BY

CIRCLE TYPE OF BULK ANALYSIS

PLM LEAD PAINT LEAD WIPE NON VIABLE MOLD VIABLE MOLD eCOLI OTHER

SAMPLES REC'D _____ ANALYZE TO FIRST POSITIVE YES NO

REPORT RESULTS TO PROJECT MANAGER: Tim Cannard

NOTES & COMMENTS:

CHAIN OF CUSTODY & SAMPLE SUBMITAL FORM PAGE____ OF ____

KELLCO-MACS JOB#: **1002-44**
US 101 & Old Redwood Highway Overpass

FIELD NUMBER	LOCATION (bldg, rm#, area)		COLOR	MATERIAL or SUBSTRATE (ft w/ size, mastic, tjc, etc.)	NOTES: Like condition, damage, quantity, inside what, beneath what? direction in building (N,S,E,W) etc.)
URS-R-01	Rail	NE	grey	concrete	
B-02	Base	NE	"	"	
F-03	Footing	NE	"	patch / ~~sealant~~	
F-04	Footing	NE	grey	concrete / paint	
F-05	Footing	SE	"	concrete	
R-06	Rail	SE	"		
B-07	Overpass	S	blk	sealant	
R-08	Rail	S	grey	concrete	
F-09	Footing	S	grey	concrete	

RELEASED BY	DATE	TIME	RECEIVED BY	DATE	TIME
[illegible]	2/25/10		Danielle Griffin	2/25/10	3:18

L 200591

CHAIN OF CUSTODY & SAMPLE SUBMITAL FORM PAGE 2 OF 2

KELLCO-MACS JOB#: **1002-44**
US 101 & Old Redwood Highway Overpass

FIELD NUMBER	LOCATION (bldg, rm#, area)	COLOR	MATERIAL or SUBSTRATE (ft.w/ size, mastic, tjc, etc.)	NOTES: Like condition, damage, quantity, inside what, beneath what? direction in building (N,S,E,W) etc.)
URS - F - 10	fa Footing ~~S~~/W.	grey	patch	
F - 11	Footing NW.	.	concrete	
B - 12	overpass / bridge W Expansion joint		"	Expenson joint W.
B - 13	overpass / bridge W. Expansion joint		reflexter mastic	" " W.
B - 14	overpass / bridge E.		concrete	" " E.
B - 15	overpass / bridge E	blk	asphalt	" " E.
B - 16	" " NW	yell ~~wht~~	paint	
B - 17	" " SE		compact board	
B - 18	" " SW	wht	paint	

RELEASED BY	DATE	TIME	RECEIVED BY	DATE	TIME
[illegible]	2/25/10		Danielle Griffin	2/25/10	3:18

MACS Lab Incorporated
Analytical and Environmental Services
3137 Diablo Avenue, Hayward, Ca 94545-2701 (510) 786-9751 * (510) 786-9625 Fax * www.macslab.com

CAM-17 Bulk Materials Analysis Report - Method: EPA 6010B/3050

KELLCO Services
3137 Diablo Avenue
Hayward, CA 94545

Contact: Tim Cannard
Phone: (510) 786-9751
Email: mailbox3137@kellcomacs.com
Job #: 1002-44

Laboratory Number: 200590
Sampled By: Derrik/Siew Yee Lee
Sampled On: February 25, 2010
Submitted On: February 25, 2010
Analyzed On: February 26, 2010
Reported On: February 26, 2010
SOP: CAM17
Sample Type: Bulk

Job Description: US 101 & Old Redwood Highway Overpass-Petaluma, CA

	Lab Sample Number:	200590 -1	200590 -2	200590 -3	200590 -4	
	Client Sample Number:	URS-01	URS-02	URS-03	URS-04	
	Matrix:	Bulk	Bulk	Bulk	Bulk	
	Extraction Type:	Acid	Acid	Acid	Acid	
	Units:	mg/kg (PPM)	mg/kg (PPM)	mg/kg (PPM)	mg/kg (PPM)	
Sb	Antimony	13.29	24.84	2.63	3.13	
As	Arsenic	13.87	20.43	7.95	4.29	
Ba	Barium	327.64	572.89	9.22	54.09	
Be	Beryllium	0.53	0.84	0.20	0.22	
Cd	Cadmium	6.11	5.48	0.50	2.12	
Cr	Chromium	92.73	29.43	2.27	13.41	
Co	Cobalt	8.04	10.96	7.78	3.79	
Cu	Copper	76.17	114.53	3.55	13.46	
Pb	Lead	1,190.42	1,582.17	268.67	190.77	
Hg	Mercury	27.15	33.52	3.93	6.70	
Mo	Molybdenum	7.92	12.95	1.70	3.02	
Ni	Nickel	43.26	20.38	3.38	20.55	
Se	Selenium	791.53	1,396.94	205.17	258.82	
Ag	Silver	1.95	2.83	2.32	0.93	
Tl	Thallium	11.72	19.55	12.68	4.09	
V	Vanadium	68.87	42.43	4.47	14.59	
Zn	Zinc	398.17	248.93	63.90	102.58	

Analyst: _____ (Signature)

Laboratory Manager: _____ (Signature)

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CLIENT	JOBSITE
URS Corporation 55 South Market Street 1500 San Jose CA 95113	US 101 & Old Redwood Highway Overpas Highway 101 & Old Redwood Highway Petaluma CA.

KELLCO-MACS JOB#: **1002-44** LAB LOGIN # I200590

COLLECTED BY: Derrik / Siew Yee Lee

COLLECTED DATE 2.25.10

TURN AROUND TIME: Normal 4 8 24 48 5-DAY

RESULTS NEEDED BY

CIRCLE TYPE OF BULK ANALYSIS

PLM LEAD PAINT LEAD WIPE NON VIABLE MOLD VIABLE MOLD eCOLI OTHER CAM-17

SAMPLES REC'D _____ ANALYZE TO FIRST POSITIVE YES NO

REPORT RESULTS TO PROJECT MANAGER: Tim Cannard

NOTES & COMMENTS:

CHAIN OF CUSTODY & SAMPLE SUBMITAL FORM PAGE____ OF ____

KELLCO-MACS JOB#: **1002-44**
US 101 & Old Redwood Highway Overpass

FIELD NUMBER	LOCATION (bldg, rm#, area)	COLOR	MATERIAL or SUBSTRATE (ft w/ size, mastic, tjc, etc.)	NOTES: Like condition, damage, quantity, inside what, beneath what? direction in building (N,S,E,W) etc.)
URS-01	Bridge Footing N.	Grey	paint on ~~#~~ patch	
URS-02	Bridge Footing N.	grey	paint on concrete	
URS-03	Road stricker S.	yelt	paint on concrete	
URS-04	Road stricker ~~SW~~ NW	yell	" on asphalt	

RELEASED BY	DATE	TIME	RECEIVED BY	DATE	TIME
[illegible]	2.25.10		Danielle Griffin	2/25/10	3:00

APPENDIX E

HAZARDOUS MATERIALS REPORT
U.S. 101/OLD REDWOOD HIGHWAY BRIDGE
PETALUMA, CALIFORNIA

KELLCO Qualifications

KELLCO QUALIFICATIONS

KELLCO Services, Inc. is an independent asbestos and lead consulting and laboratory group with the following credentials:

- The KELLCO asbestos inspector is licensed with the State of California Department of Occupational Safety and Health (CAL-OSHA).

- The KELLCO lead inspector is licensed by the Department of Health Services (DHS).

- The laboratory holds the following credentials:

    - NVLAP PLM for Asbestos: NIST National Voluntary Laboratory Accreditation Program certificate of accreditation for bulk asbestos analysis by polarized light microscopy (Accreditation #101331).

    - AIHA Accreditation for Industrial Hygiene Analytical Laboratory for PLM, PCM, and AA for lead (Accreditation #526).

    - ELAP PLM for Asbestos: California Department of Health Services, Environmental Laboratory Accreditation Program, certificate for bulk asbestos analysis (Certificate #1315).

    - PAT Program: AIHA/NIOSH Proficiency Analytical Test Program for fiber analysis of airborne asbestos samples by PCM and for heavy metal analysis of paint, soil, dust, and air samples by AA (Lab ID #11109).

    - AIHA ELLAP Accreditation for Lead: Accreditation for the Environmental Lead Laboratory recognized by the EPA as meeting the requirements of the National Lead Laboratory Accreditation Program established under Title X (Lab ID #11109).

    - ELAP AA for Lead and other Metals California Department of Health Services, Environmental Laboratory Accreditation Program, Certificate for Metal Analysis by Atomic Absorption (Certificate #1315).

The following supporting documents are attached to this report:

- Laboratory analytical reports
- Photographs of sample locations
- Floor plan or sketch showing sample locations
- Summary of Asbestos with estimated quantities

Geotechnical Design Report and Materials Report
Dated March 19, 2012

04-SON-101-PM7.4/8.1

EA04-OA1851 (12276K)
MARCH 19, 2012

GEOTECHNICAL DESIGN REPORT AND MATERIALS REPORT

OLD REDWOOD HIGHWAY INTERCHANGE PETALUMA, CALIFORNIA

Prepared for
City of Petaluma
Public Works
11 English Street
Petaluma, CA 94952

URS

100 West San Fernando, Suite 200
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`

URS

March 19, 2012
URS Project 28645097

File No.04-Son-101-PM 7.4/8.1
EA04-0A1851(12276K)

Mr. Larry Zimmer
Project Director
City of Petaluma
Public Works
11 English Street
Petaluma, CA 94952

Subject: **Geotechnical Design Report and Materials Report (GDMR)**
Old Redwood Highway Interchange
Petaluma, California

Dear Mr. Zimmer:

URS has completed a geotechnical investigation and the Geotechnical Design Report/Materials Report (GDMR) for the proposed modifications to Old Redwood Highway Interchange on U.S. 101 in Petaluma, California. The accompanying report has been prepared in accordance with Caltrans GDR Guidelines, dated December 2006 and Corrosion Guidelines, dated September 2003.

The report presents our engineering opinions and recommendations regarding the geotechnical factors influencing the design and construction of the proposed roadways and road signs. The opinions and recommendations have been based upon the results of our field investigation (November 2009), laboratory testing, engineering judgment and local experience. Mr. Madhu Thummaluru, P.E., performed engineering calculations and assisted in preparation of this report. Mr. Mark Schmoll, Certified Engineering Geologist, contributed to the seismic source characterization and the evaluation of geologic conditions along the project alignment. Mr. Michael Larson, G.E. provided technical review and guidance to the URS project team over the course of the investigation.

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

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1.1 DESCRIPTION OF PROJECT

1.1.1 Location and Route Description

The City of Petaluma (City), located in Sonoma County within District 04 of the State of California Department of Transportation (Caltrans), proposes to reconstruct the Old Redwood Highway Interchange at U.S. 101 Post Mile (PM) 7.65, approximately 4 miles north of the Petaluma River. The key component of the improvement is to replace the existing overcrossing (OC) structure to meet current design standards and current and future traffic requirements.

The proposed OC structure will accommodate four lanes of traffic with a 12-foot median, and will include bicycle lanes and pedestrian sidewalks on both sides. The U.S. 101/Old Redwood Highway interchange ramps will be reconfigured and widened accordingly. Other improvements include traffic operations system improvements and enhanced signalization improvements at the adjacent intersections. This project will accommodate the proposed Sonoma County Transportation Authority (SCTA) U.S. 101 Central HOV Lanes Project, which widens U.S. 101 within the limits of the Old Redwood Highway Interchange Project. Figures 1-1 and 1-2 present the Project Location Map and Vicinity Map, respectively.

The interchange will be reconstructed with a modified par-clo configuration similar in nature to the existing configuration.

Below is a summary of features for the proposed design option:

- New OC where Old Redwood Highway crosses U.S. 101.
- Traffic signals will be installed at ramp termini.
- Off-ramps will provide two left-turn lanes and two right-turn lanes.
- Ramp metering facilities including HOV bypass lanes and CHP enforcement areas will be provided on all on-ramps.
- Old Redwood Highway will be widened to accommodate two 12-foot wide through lanes in each direction, raised median, 6-foot wide bike lanes, and 6-foot wide sidewalks in each direction between Stony Point Road and North McDowell Boulevard. Additional widening will be provided locally to accommodate turn lanes.
- A new right-turn lane from eastbound Old Redwood Highway to southbound North McDowell Boulevard will be added.
- Retaining walls will be constructed to maintain interchange improvements within existing right of way, where feasible.
- Adjoining driveways will be reconstructed to match proposed grades.

The control line reference station locations are shown in Key Map K-1 in Appendix A.

1.1.2 Retaining Walls

A total of seven (7) retaining walls are planned as shown on Figure 1-3 (Retaining Wall No. 1 through No. 7, General Notes) and as summarized in the following table.

Table 1-1: Summary of Retaining Walls

Wall No.	Alignment	Begin Station (Approximately)	End Station (Approximately)	Length (ft)	Height (ft)
1	"OSN" Lt.	86+84.95	90+12.33	325.10	10 – 12.5
2	"OSN" Rt.	88+01.48	91+60.17	360	10 – 20
3	"OSF" Lt.	61+53.62	65+12.36	435	15 – 17.5
4	"ONN" Rt.	43+20.77	45+94.05	270.94	10
5	"ONN" Lt.	43+22.32	44+96.84	175	10 – 12.5
6	"ONF" Rt.	40+02.72	43+00.06	375	12.5 – 15
7	"ORH"	17+58.93	19+07.80	150	12.5 - 20

Lt. = Offset to the left direction
Rt. = Offset to the right direction

Standard Type 1 walls on spread footings are considered unfeasible for Walls RW 1 through 7 because of excessive settlement and/or bearing capacity issues. Therefore, non-standard type walls are required at Walls RW 1 through 7; the geotechnical design parameters and aspects of these walls are presented in the Retaining Wall Foundation Report, under a separate cover.

1.1.3 Soundwall

One soundwall is planned along a portion of the off-ramp from southbound U.S.101 to Old Redwood Highway. It is a continuation of the soundwall constructed as part of the U.S. 101 Central HOV Lanes Project (Segment B). This wall is required to mitigate traffic noise impact. The length of this soundwall is about 398 feet. The soundwall plan and elevation views are shown on Figure 1-4.

1.2 EXISTING STRUCTURE

Based on as-built data from Caltrans (Contract Number 54-4TC63) dated January 13, 1956, the Old Redwood Highway Overcrossing (formerly Denman Overcrossing) is a 2-span bridge supported at abutments on the north and south ends (Abut 1 and Abut 3, respectively) and a bent (Bent 2) in between. The plans indicate that the abutments and bent are supported on circular, reinforced concrete piles. As shown on the Standard Pile Details sheet, Cast-in-Place Concrete Piles, Alternative "Z," was used for the foundation piles. The concrete piles were installed by first driving a steel shell extending from the bottom of the pile cap to the pile tip elevation. Then, the steel shell was filled with concrete to form the pile. The steel shell tapered from a diameter of 15½ inches at the butt to a minimum diameter of 8 inches at the tip. The table below presents a summary of the design capacities and as-built pile tip elevations.

Table 1-2: As-Built Pile Capacity

Location	Pile Type	Nominal Resistance (tons)		Pile Tip Elevation (ft)
		Compression	Tension	
Abutment 1	Concrete (cast-in-place)	32	0	-5 to -15
Bent 2	Concrete (cast-in-place)	32	0	-2 to -18
Abutment 3	Concrete (cast-in-place)	32	0	-6 to -21

1.3 PHYSICAL SETTING

1.3.1 Climate

Climatologically, the area is classified as Mediterranean with dry summers and mild winters. There are two nearby weather stations (Western Regional Climate Center, 2006), including one at Petaluma (P) and one at Santa Rosa (SR); the following discussion includes records at both weather stations. The mean annual temperature is 58° F (P and SR). Extremes of temperatures expected range from an average daily maximum of 82.5° F (P) and 83.2° F (SR) in August to average daily lows of 38.1° F (P) and 37.1° F (SR) in January. The highest and lowest temperatures on record in Petaluma are 110° F and 18° F and in Santa Rosa are 110° F and 15° F. Freezing temperatures should only be expected to occur for an average of 23.6 days (P) and 30.2 days (SR) per year, so freeze-thaw conditions should not be a factor.

Precipitation in Petaluma averages about 25 inches per year and in Santa Rosa about 30 inches per year, primarily confined to the months of October through April. December and January usually have the most precipitation accumulation, averaging about 4-¾ to 5-½ inches per month in Petaluma and 5-¾ to 6-¼ inches per month in Santa Rosa. Thunderstorms are rare.

1.3.2 Terrain

The topography along the existing roadways connecting to the Old Redwood Highway OC structure ranges in elevation from approximately 35 to 38 feet.

Development within the project limits is primarily commercial and industrial.

1.3.3 Surface Drainage

Watershed

Watersheds for the Project area are composed of relatively flat lands. The Project discharges to ditches and cross culverts and ultimately to the Petaluma River off-site. Willow Brook Creek is the only creek within the Project limits; however, there is no direct discharge from the Project

limits into Willow Brook Creek due to the profile of U.S. 101 and the Project site drainage patterns (Wreco, 2012).

Flood Sources

According to the City of Petaluma Flood Insurance Study, the greatest flood event that occurred was from January 3 to 5, 1982. This event caused an estimated $28 million in damage. The flood event occurred over a 50-plus block area on both sides of the Petaluma River; the parts of the City having the highest impact from that flood were the areas near Jess Avenue and Payran Street, located approximately 2.2 miles southeast of the Willow Brook Creek crossing. The flood caused 4 to 5 feet of inundation of homes, commercial, and industrial buildings in the area.

Another flood event lasted from February 14 to 17, 1986, and it caused approximately $1 million in damage. The area inundated by this flood event was in the Petaluma River reach that traverses the part of the City that is urbanized, located approximately 4.3 miles southeast of Willow Brook Creek, between the Lynch Creek confluence and the Lakeville Avenue Bridge.

1.3.4 Regional Geology

The Old Redwood Highway Interchange project area is located in the Coast Range physiographic province, near the southern end of the Coast Range Thrust. The Coast Range province is characterized by north to northwest trending elongated mountain ranges and intervening valleys. This physiography reflects the influence of the San Andreas fault system, a domain of north-northwest oriented right-lateral strike-slip faulting that accommodates the majority of the plate motion between the Pacific and North American plates. In addition to the right-lateral strike-slip deformation, a component of convergence oriented normal to the plate boundary is accommodated by a series of folds and thrust faults, including the faults of the Coast Range-Sierran Block Boundary zone, oriented sub-parallel to the faults of the San Andreas system.

Late Cenozoic (last 30 million years) deformation associated with the transpressional plate boundary is reflected in the Coast Range geology, which typically consists of intensely folded and faulted Upper Jurassic (150 million years old) and younger rocks of the Franciscan Complex, a complex assemblage of metamorphosed oceanic crustal rocks and marine sediments. In the Neogene, compressional basins of deposition, *en echelon* folds, northwest-trending strike-slip faults, and lesser east-west-trending thrust faults that dip both east and west were formed. The region is now characterized by elongate topographic regions comprising fault-bounded slivers of different rock types. The majority of the reverse faults now appear to be either inactive or significantly less active than the northwest-striking, strike-slip faults of the San Andreas system, which offset them.

Information regarding the actual depth of the bedrock at the site is not available. Based on published information on geology of the site, the bedrock consists of rocks of the Pliocene age (1 to 13 million years old) Sonoma Volcanics and older marine siltstones, sandstones, and conglomerates of the Petaluma formation.

1.4 PREVIOUS INVESTIGATIONS NEAR SITE

Available foundation investigation data obtained from Caltrans archive includes the as-built Log of Test Borings sheet and foundation plan referenced in Caltrans File Number 54-4TC63F, 40002280, entitled "Denman Overcrossing, Bridge Number 20-0159," and dated December 24, 1956.

1.5 REVIEW COMMENTS

URS initially submitted a Geotechnical Design and Materials Report dated February 8, 2010 for the proposed ORH Interchange project. Subsequently, Caltrans reviewed our report and later reports and provided their comments in correspondence dated April 21, 2010 and December 15, 2010. URS has incorporated these review comments in this report. No further comments were received from Caltrans on the reports submitted with the 95% PS&E submittal on January 24, 2011 and the Final PS&E submittal on September 26, 2011. Copies of review comments and URS responses are attached in Appendix I.

2.1 ORIGINAL CONSTRUCTION

Existing roadway structural pavement sections are shown on as-built plans titled "Plan and Profile of State Highway in Sonoma County, between Railroad Avenue and 1.4 miles south of Petaluma Creek, dated March 12, 1954(Contract Number 54-4TC-63F). Copies of Typical Cross Section drawings are presented in Appendix B as reference.

Consistent with Caltrans terminology, for the remainder of this report, the following definitions, abbreviations, and acronyms are used:

- Asphalt concrete, Type A is AC(A)
- Asphalt treated permeable material is ATPB
- Asphalt concrete base, Type A is ACB(A)
- Cement treated base, Class A is Cl. A CTB
- Cement treated base, Class B is C1. B CTB
- Cement treated subbase is CTS
- Cement treated subgrade is CTSR
- Class 3 aggregate base is Cl. 3 AB
- Class 4 aggregate subbase is Cl. 4 AS
- Hot mix asphalt is HMA
- Lean concrete base is LCB
- Open graded asphalt concrete is OGAC
- Open graded friction course is OGFC
- Pervious subbase material is PSM
- Permeable material is Perm.
- Perforated metal pipe is PMP
- Plant-Mixed Surfacing is PMS; 1954 terminology for asphalt concrete
- Portland cement concrete is PCC
- Rubberized asphalt concrete, gap graded is RAC-G
- Rubberized Hot Mix Asphalt – Type G is RHMA-G
- Selected material is SM

2.2 STRUCTURAL PAVEMENT SECTION

According to Typical Cross Sections presented in the record drawings discussed in Section 2.1, the existing pavement sections for Old Redwood Highway, U.S. 101 mainline and interchange ramps consist of the following structural elements.

Table 2-1: Existing Typical Structural Sections

Component	Control Line	Traveled Way Section (feet)		Record Drawings
Old Redwood Highway	"H"	PMS CTB SM	0.25 0.50 0.33	54-4TC-63F
On-Ramps and Off-Ramps	"H1" to "H6"	PMS CTB SM	0.25 0.50 0.33	54-4TC-63F

Table 2-1: Existing Typical Structural Sections

Component	Control Line	Traveled Way Section (feet)		Record Drawings
U.S. 101/ORH Mainline Southbound	"ML"	RAC (G) AC PCC CTS SM	0.20 0.40 0.67 0.33 0.50	54-4TC2-F 04-0C0004
U.S. 101/ORH Mainline Northbound	"ML"	RAC (G) AC PCC CTS SM	0.20 0.50 0.67 0.33 0.50	54-4TC2-F 04-0C0004

2.2.1 Measured Structural Pavement Section

The existing pavement structural sections were measured where our boring locations coincided with the existing pavement. Approximate measurements of the existing section were made in exploratory boreholes at the time of drilling and are summarized in the following table.

Table 2-2: Borings in Shoulders/Median

Boring Number	Approximate Station	Offset (feet)	AC Thickness		AB Thickness	
			(inches)	(feet)	(inches)	(feet)
A-09-103	"OSF" 61+79.2	Lt. 47.2	5	0.42	31	2.58
A-09-104	"OSF" 63+68.2	Lt. 30.8	6	0.5	12	1
A-09-105	"ML" 411+85.6	Rt. 51.3	10	0.83		
A-09-106	"ML" 407+95.0	Rt. 49.6	5	0.42	6	0.5
A-09-107	"ML" 410+12.8	Rt. 60.5	5	0.42	2	0.17
A-09-108	"ORH" 15+31.5	Lt. 44.1	13	1.1		
A-09-111	"ORH" 26+98.2	Rt. 26.7	12	1		
A-09-116	"ML" 393+41.2	Rt. 48.5	3.5	0.3	15	1.2

2.2.2 Pavement Condition Survey

A cursory pavement condition survey based on visual observations was conducted on December 13, 2011. The visual condition survey of the existing roadways consisted of noting locations and types of observable distress. The approximate limits of pavement distress/damage were mapped on Google aerial photographs.

The severity for each type of pavement distress (damage) is based on descriptions in the manual, Pavement Condition Index Distress Identification Manual for Asphalt and Surface Treated Pavements, 2nd Edition, dated February 1986, prepared by the Metropolitan Transportation Commission & Eres Consultants, Inc. The severity of damage was classified under three categories: low severity, medium severity, and high severity. All nine types of pavement damage from the manual were included in the visual condition survey (see Figure L-1).

A sketch of the pavement damage showing the approximate locations and sizes of damaged areas and degrees of severity of damage are shown on drawings presented in Appendix L. All areas were noted with an L (low severity), an M (medium severity) or an S (high severity). Figure L-1 presents the criteria for determining the severity of each type of pavement damage and the color associated with each type of pavement damage. The drawings are presented in Figures L-2 and L-3. The types of pavement damage are defined below.

- Alligator Cracking – consists of a series of interconnecting cracks caused by fatigue failure of the asphalt concrete under repeated traffic loading.
- Block Cracking – consists of interconnected cracks over a large proportion of the pavement and occurs when the asphalt has hardened significantly.
- Distortions – consist of a series of closely spaced ridges, or longitudinal displacements of the pavement and are caused by corrugations, bumps, sags and shoving of the pavement.
- Longitudinal / Transverse Cracking – consist of cracks parallel to the laydown direction and are caused by either poor paving joint construction, asphalt concrete shrinkage, reflective cracking or decreased support or decreased thickness near the edge of the pavement.
- Patches – consist of areas that have been replaced with new material, including utility trenches, and are always considered a pavement defect regardless of patch performance.
- Rutting / Depressions – consist of surface depressions within the wheel path and are caused by consolidation or lateral movement of subgrade material due to traffic loads.
- Weathering / Raveling – consists of the wearing of pavement surface and are caused by a loss of asphalt or tar binder and dislodged aggregate particles due to asphalt binder hardening or a poor quality mix.
- Grinding – consists of areas where the asphalt concrete has been ground down either for striping removal or to even out the existing pavement.
- Gouges – consist of areas where the pavement surface has been scraped, dented, or damaged in any way due to heavy machinery or equipment.

Based on Figures L-2 and L-3, two types of pavement damage were observed and mapped: (1) alligator cracking and (2) block cracking. Proposed mitigation for alligator cracking includes removal of asphalt concrete, cement treated base and aggregate subbase and then patching full depth HMA to replace existing AC and CTB up to a thickness about 1.1 feet. Since a majority of the block cracking is less than ¼ inch wide and relatively shallow, the standard pavement preparation of cold plane should remove the cracks prior to the specified HMA overlays. If cracks exceed ¼ inch wide, the cracks should be routed before applying crack sealant as outlined in HDM 645, "Engineering Procedures for Pavement and Roadway Rehabilition."

3.1 FIELD EXPLORATION

To supplement available data, URS drilled fifteen hollow stem auger borings (A-09-004, A-09-005, A-09-101 to A-09-109, A-09-111, A-09-112, A-09-115, and A-09-116), one rotary wash boring (R-09-001), and advanced two CPTs (CPT-09-003 and CPT-09-114). Borings A-09-004 and A-09-005 were drilled on the embankment to termination depths of 30 and 26½ feet, respectively. Boring R-09-001 was drilled to a depth of 95 feet, whereas CPT-09-003 and CPT-09-114 were advanced to depths of approximately 96½ feet and 99½ feet, respectively. The field exploration was performed on October 26, November 3 and 5, 2009. The locations of the explorations are shown on Figures 3-1 through 3-4.

A representative of URS observed 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 and labeled immediately to preserve their natural moisture content. At completion of the exploration, samples were delivered to the laboratory for further examination and testing. The CPT and borings were then backfilled with a mixture of cement and bentonite in accordance with the requirements of the Sonoma County Health Department.

The Unified Soil Classification System, as well as guidelines summarizing soil consistency and relative density, are presented on the LOTB legend. The logging method is consistent with guidelines presented in Caltrans Soil & Rock Logging, Classification, and Presentation Manual, dated June 2007.

Comprehensive descriptions of the soils encountered at each boring, together with field and laboratory test data are presented on the Boring Records (Appendix C).

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 new bridge abutments footprint, or near future retaining walls. The pavement sections encountered in our explorations are presented previously in Section 2 “Existing Structural Pavement Sections”.

3.2.2 Subsurface Conditions

Based on as-built information retrieved from Caltrans archive dated June 1952, exploratory Borings B-1, B-2, B-3 and B-4 were drilled on June 15 and 17, 1952, to investigate the site of the existing Old Redwood Highway OC. Depths of these borings ranged from 44 to 59 feet. Based on LOTB, Drawing No. 2921-8, Boring B-3 revealed stiff clay in the upper 9 feet underlain by a 5-foot thick layer of very dense sand and gravel. Below the sand and gravel deposits, soft sandy clay (about 5 feet thick) was found overlying stiff to very stiff, blue silt and silty clay that extended to approximately 45 feet in depth. Very dense sand and gravel deposits extended to terminal depth of the boring. Copies of these LOTBs are included in Appendix E.

Based on 2009 field explorations, Boring A-09-101 encountered fill soils extending to depths of 1.5 feet. Borings A-09-103 through A-09-107 were drilled on the ramp shoulder and encountered asphalt concrete pavement 5 to 10 inches thick underlain by up to 31 inches of aggregate base. Fill soils underlying the existing pavement section were encountered to depths ranging from 2 to 5 feet, and can generally be classified as stiff to very stiff lean clay to sandy lean clay with gravel and medium dense clayey gravel.

Native soils below fill and structural pavement materials consist of a maximum thickness of 9 feet of medium stiff to very stiff fat clay underlain by medium stiff to very stiff lean clay and sandy lean clay to a depth of 18 feet below ground surface (bgs). Beneath these cohesive deposits, the borings encountered medium dense to very dense sand and silty sand to a depth of 26 feet, except in Boring A-09-104 where alternating layers of sand and silty sand extended to boring termination depth of 51.5 feet. These granular deposits were underlain by medium stiff to very stiff lean clay to a depth of 45 feet. Medium dense to very dense silty sand was encountered in all borings below depths of 45 feet and extended to termination depth of borings.

3.2.3 Groundwater

Groundwater was encountered at Elevation 24.5 feet, 25.1 feet and 25.5 feet in 1952 Borings B-2, B-3 and B-4, respectively. Depth to groundwater ranged from 7 to 8.5 feet bgs. However, there was no indication of groundwater encountered or measured in B-1. Considering the year (1952) of the original plans of Denman OC, it is likely that the project datum were based on NGVD29 datum. Therefore, to make comparison in the groundwater levels measured during the 2009 investigation, it would be reasonable to convert the elevations to NAVD88 datum presented in Table 3-2 as reference.

All of the 2009 borings were drilled using a hollow stem auger, except R-09-001. Groundwater was measured in all 2009 explorations at depths ranging from 12 to 20 feet bgs, except in A-09-103 and CPT-09-114. Water was introduced as stabilization fluid during drilling of A-09-103 at a depth of 13 feet, thereby precluding a reliable groundwater measurement at this location. Pore pressure dissipation test conducted at CPT-09-003, advanced for the investigation of Bent 2 of the OC structure, indicated groundwater depth at 9.3 feet bgs. No dissipation test was conducted while advancing CPT-09-114. The groundwater depths and corresponding elevations at each location are summarized in the following table.

Table 3-2: Summary of Groundwater Level Measurements (NAVD88 Datum)

Boring	Groundwater Depth (feet)	Approximate Groundwater Elevation (feet)
A-09-004	28.5	25.5
A-09-005	Dry	--
A-09-101	20	17
A-09-102	12	23
A-09-104	15	23.5
A-09-105	18	21
A-09-106	15	23.5
A-09-107	15	23.5

Table 3-2: Summary of Groundwater Level Measurements (NAVD88 Datum)

Boring	Groundwater Depth (feet)	Approximate Groundwater Elevation (feet)
A-09-108	10	25
A-09-109	11.5	28
A-09-111	Dry	--
A-09-112	17	21.5
A-09-115	Dry	--
A-09-116	11.5	26.5
CPT-09-003	9.7	27.7
B-2 (1952)	8.4	24.5
B-3 (1952)	8.5	25.1
B-4 (1952)	7	25.5

Based on review of available groundwater monitoring data from the State Water Resource Control Board (GEOTRACKER system), the groundwater generally flows from a northeast to a southwest direction through the interchange towards the Petaluma River. Groundwater levels were measured as high as Elevation 33.6 feet at 5153 Old Redwood Highway (located about 600 feet in the northwestern direction from the interchange) during the winter months of 2006. During the same period, groundwater levels were about as high as Elevation 30 feet at 4998 Petaluma Boulevard and Elevation 26.3 feet at 4999 Petaluma Boulevard. Based on available groundwater levels measured in the period from 1987 to 2011, we estimate the following high groundwater levels could occur:

Location	Estimated Groundwater Elevation (feet)
U.S. 101 Northbound Off-ramp and Loop On-ramp	32
U.S. 101 Northbound On-ramp	31 to 26
Old Redwood Highway OC East Approach (Abut 3) to West Approach (Abut 1)	31½ to 28
U.S. 101 Southbound Off-ramp and Loop On-ramp	28 to 26
U.S. 101 Southbound On-ramp	29

4.1 PROJECT SITE SEISMICITY

The project site lies between known active and potentially active geologic faults. The closest active fault to this section of U.S. 101 is a portion of the Rodgers Creek fault (RCF). This fault is designated with a Maximum Moment Magnitude (MMax) of 7.1 in the Caltrans 2007 fault database. The location of this fault is obtained from the 2007 Caltrans Deterministic PGA Map. The horizontal distance from the site to the Rodgers Creek fault is about 5 miles, with a corresponding PGA [V_s=2,500 feet per second (fps)] contour of 0.4g based on the 2007 California Deterministic PGA Map and 0.45g based on work by others (Sadigh, et al, 1997).

Table 4-1: Seismic Source Parameters

Fault	Type	MMax	Distance* (miles)	Near Field Effects?	Design PGA for V_s=2,500 feet/sec (g)
Rodgers Creek	strike-slip	7.1	4.9	Y	0.4
San Andreas	strike-slip	7.9	13.9	N	0.4

*The distances are based on Caltrans ARS Online (2009).

For design, a site PGA of 0.54 g was estimated using Caltrans ARS Online tool; this value of PGA corresponds to a site specific average shear wave velocity of 925 fps.

4.2 POTENTIAL GEOLOGIC HAZARDS

4.2.1 Surface Fault Displacement and Ground Shaking

Surface fault rupture tends to recur along existing fault traces. The highest potential for surface faulting is along existing fault traces that have had Holocene fault displacement. The California Geological Survey (formerly Division of Mines and Geology) has produced maps showing Alquist-Priolo Earthquake Fault Zones along faults with known Holocene activity that pose a potential surface faulting hazard. There are no Alquist-Priolo zones mapped in the vicinity of the project limits. The closest active fault to the site is the Rodgers Creek fault, approximately 4½ to 5 miles to the east. The San Andreas fault is located 13½ to 14½ miles to the west. The potential for surface fault ruptures along the alignment is considered remote.

4.2.2 Landslides

Based on the relatively flat topography at the site, landsliding is not considered a hazard at the project site.

4.2.3 Settlement and Seismic Compaction

Settlement 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.

Compaction settlement, or seismic densification, occurs when loose granular soils above the groundwater table increase in density as a result of earthquake shaking. This soil densification can result in differential settlement because of variations in soil composition, thickness, and initial density. For design, we estimated the potential post-earthquake settlement at A-09-004 and A-09-005, using the computer program LIQUEFY PRO[1]. In our analyses we used a peak ground acceleration (PGA) of 0.54g and design earthquake moment magnitude (Mw) of 7.1. At Boring A-09-004, the soils above groundwater table are primarily lean clay and fat clay. At Boring A-09-005, the soils above groundwater table are primarily lean clay, fat clay and clayey gravel. The results of these studies indicate that the magnitude of seismic compaction settlement at abutments is almost nil. Therefore, we believe that the risk of compaction settlement causing differential settlement during earthquake shaking at the site is low.

4.2.4 Liquefaction

Soil liquefaction is a phenomenon in which saturated cohesionless soils are subject to a temporary but essentially total loss of shear strength under the reversing, cyclic shear stresses associated with earthquake shaking. In extreme cases, the soil particles can be suspended in groundwater, resulting in the deposit becoming mobile and fluid-like. Three conditions are generally required for liquefaction to occur: 1) a cohesionless soil of loose to medium dense relative density; 2) a saturated condition; and 3) rapid, large strain cyclic loading normally induced by earthquake ground shaking. Liquefaction can result in loss of foundation bearing capacity, differential settlements, and lateral spreading. Traditionally, a depth of 50 feet has been used as the depth of analysis for the evaluation of liquefaction.

Based on a liquefaction susceptibility map generated from the Association of Bay Area Governments (ABAG) geographic information systems (GIS) and reproduced in this report as Figure 4-1 (primarily based on Knudsen, et al, 2000 data, and Witter & others, 2006), the project alignment at Old Redwood Highway OC is mapped as an area of "moderate" liquefaction susceptibility.

Based on evaluation of subsurface soils susceptible to liquefaction, it is considered that the likely consequence of a strong earthquake will be post-liquefaction settlement. Because of the depths of these liquefiable layers and the distance of the site to the nearest creek (more than 2,000 feet), lateral spreading and other types of slope instability are unlikely. For site specific analysis based on boring data and CPT soundings, we estimated post-liquefaction settlement based on peak ground acceleration (PGA) of 0.54g and design earthquake moment magnitude, Mw, of 7.1. Table 4-2 presents a summary of the estimated post-liquefaction ground surface settlement.

[1] LIQUEFY PRO is a software program that evaluates liquefaction potential and calculates settlement of a soil deposit due to seismic loads. The program is based on methods recommended in the 2001 NCEER Workshop and 2008 Edition of SP117 Implementation. The seismic load is estimated with Seed's simplified method (Seed, 1971), which gives a Cyclic Stress Ratio (CSR) that is compared with the Cyclic Resistance Ratio (CRR) of the soil. The CRR calculation is based upon input data from common in-situ tests such as SPT and CPT. Because the BPT-test is more appropriate for gravel type soils the user can also use BPT data as input for the liquefaction analysis. The program finally makes an estimate of the earthquake-induced settlements using the results from the liquefaction evaluation. The software was developed by CivilTech Software, located in the Seattle-Bellevue area.

Table 4-2: Estimated Post Liquefaction Ground Surface Settlement

Boring / CPT Number	Depth Ranges of Liquefiable Layers (feet)	Estimated Ground Surface Settlement (inch)
A-09-101	20–26.5	1¼
A-09-102	15–20	¾
A-09-103	3-5	½
A-09-104	20–25	¾
A-09-105	10–11, 45–50	¾
A-09-106	31-34, 45–51.5	1½
A-09-107	20–24.5	¾
CPT-09-114	9–15, 21–22, 27–30, 40-50	2¼
R-09-001	9-11, 16-20, 45-46.5	< 1
CPT-09-003	15-17, 19.5-20.5, 22-29, 35.5-38, 47-50	3½

4.2.5 Flooding

Based on WRECO's Floodplain Location Hydraulic Study Report, dated March 2012, the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs) dated December 2, 2008, reveal that the Project area is within the 100-year flood (1% floodplain) associated with the nearby Willow Brook Creek and Petaluma River. The City of Petaluma has recently restudied the floodplains throughout the City limits including those in the Project area. The City submitted the restudy to FEMA who accepted the science behind the floodplain restudy in November, 2011. FEMA is currently preparing revised FEMA FIRMs that the City anticipates beginning public circulation with in April, 2012. On average, the floodplain restudy indicates that the updated Base Flood Elevations (BFEs) are 2-ft below the existing BFEs based on the published December 2, 2008, FEMA FIRMs within the Project area and that the 24-hour, 100-yr storm event would not overtop U.S. 101.

The entire Project area drains to the Petaluma River. During flood events, the high water surface elevation in the Petaluma River causes backwater that extends to the drainage facilities upstream, including Willow Brook Creek, and inundates the flatland area on both sides of U.S. 101 in the Project area.

4.3 SCOUR

The closest channel is Willow Brook Creek which is more than 2,000 feet north of the interchange. Therefore, channel scour is unlikely to pose any risk to the interchange improvements.

5.1 STRUCTURAL SECTION DESIGN PARAMETERS

Structural pavement section designs described in the following paragraphs follow in general the Caltrans Highway Design Manual, Chapters 600-670 "Pavement Engineering", dated September 1, 2006 to July 24, 2009, and in particular Chapter 630 "Flexible Pavement".

Acronyms used in this section are defined in Section 2.1 "Original Construction".

5.1.1 Traffic Data

The projected traffic loading for the ORH Interchange 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 as discussed in the approved pavement selection review committee checklist, dated October 11, 2007, for the U.S. 101 HOV project from Old Redwood Highway to Rohnert Park Expressway in Rohnert Park. In addition, the TIs for ORH on-ramps and off-ramps and Old Redwood Highway are based on Highway Design Manual Section 613.5, Specific Traffic Loading Considerations. The Old Redwood Highway interchange is considered to be ramps serving residential areas with light truck traffic with some anticipated commercial development within the pavement design life. Accordingly, the following TI values for the various segments of the project were established:

Table 5-1: Summary of Design TIs

Interchange Segment	Design TI
U.S. 101 mainline	13
ORH On-Ramps and Off-Ramps	8
Old Redwood Highway	10

5.2 SUBGRADE CONDITIONS

The native subgrade conditions beneath the areas of the proposed roadway and ramp modifications were revealed by the exploratory borings listed previously in Section 3. Two bulk samples were retrieved from the borings along Old Redwood Highway, and were submitted to R-value testing; the test results are summarized in the table below and in Appendix F.

Table 5-2: R-Value Test Results

Boring	R-Value	Soil Description	Depth Interval (feet)	Control Line Designation	Stationing (feet)	Offset (feet) (1)
A-09-108	2	CH	3-6	ORH	15+31	44 Lt
A-09-111	33	CL	2-6	ORH	26+98	26 Rt

1. Lt = Left, Rt = Right

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 sample from A-09-108 falls in this category. The sample from A-09-111 reveals properties similar to engineered fill materials. Based on review of subsurface data in the upper 5 feet of exploratory borings, we developed the following subgrade design R-values for the various roadway alignments:

Table 5-3: Subgrade Design R-values

Alignment	Design R-value	Anticipated Subgrade Condition
Line H1 to H6 On-Ramps and Off-Ramps	15	Selected Materials with R-value ≥15
Old Redwood Highway (Line H) on Fill	15	Selected Materials with R-value ≥15
Old Redwood Highway (Line H) on Native Soils	5	A-09-108
U.S. 101 Mainline	15	Selected Materials with R-value ≥15

5.3 NEW STRUCTURAL PAVEMENT SECTIONS

5.3.1 General

We have analyzed structural pavement design, numbered Structural Pavement Cross Sections (SPCS) 1 through 4 that are consistent with the SCTA Central HOV Lanes Project (Segment B). The following report sections present the minimum structural pavement sections.

5.3.2 Recommended Mainline Sections for U.S. 101 at ORH

Design Factors for SPCS 1, TI_{20} = 13.0, R-value = 15, GE (required) = 3.54 feet.

Recommended Structural Section		
Structural Section (feet)		**Gravel Equivalent (feet)**
OGFC	0.10	N.A.
RHMA-G	0.20	
HMA	0.45	1.09
LCB	0.65	1.24
Class 4 AS	1.30	1.30
	Total	**3.63**

5.3.3 Recommended Sections for On-Ramps and Off-Ramps

Design Factors for SPCS 2, TI_{20} = 8.0, R-value = 15, GE (required) = 2.18 feet.

Recommended Structural Section		
Structural Section (feet)		**Gravel Equivalent (feet)**
HMA	0.40	0.80
Class 2 AB	0.65	0.72
Class 4 AS	0.70	0.70
	Total	**2.22**

5.3.4 Recommended Section for Old Redwood Highway on Native Soils

Design Factors for SPCS 3, TI_{20} = 10.0, R-value = 5, GE (required) = 3.04 feet.

Recommended Structural Section		
Structural Section (feet)		**Gravel Equivalent (feet)**
HMA	0.50	0.90
Class 2 AB	0.85	0.94
Class 4 AS	1.20	1.20
	Total	**3.04**

5.3.5 Recommended Section for Old Redwood Highway on Fill

Design Factors for SPCS 4, TI_{20} = 10.0, R-value = 15, GE (required) = 2.72 feet.

Recommended Structural Section		
Structural Section (feet)		**Gravel Equivalent (feet)**
HMA	0.50	0.90
Class 2 AB	0.85	0.94
Class 4 AS	0.90	0.90
	Total	**2.74**

6.1 FOUNDATION TREATMENT

6.1.1 Clearing and Grubbing

Before any grading begins, all locations to be filled should be cleared of existing improvements (rails, posts, curbs, pavements, etc.), all debris, vegetation, and any soils containing roots or other vegetative matter in accordance with Section 16 of Caltrans Standard Specifications. A stripping depth of 4 to 6 inches is estimated. The entire root ball of large shrubs should be removed, including all roots greater than 1 inch in diameter.

6.1.2 Subgrade Preparation

Immediately after existing guardrail posts have been removed, the resulting voids should be backfilled with slurry cement up to present ground surface in accordance with Caltrans Standard Specifications Section 19-3.062 "Slurry Cement Backfill".

All subgrades should be prepared in accordance with Caltrans Standard Specifications Section 25-1.03 "Subgrade". After the areas to receive fill have been cleared and stripped, the exposed subgrade soil should be scarified, moisture conditioned to near the optimum moisture content, and compacted to the requirements of fill to a minimum depth of 6 inches. When the subgrade has been compacted and approved by the Engineer, fill can be placed to provide the desired finished grades.

6.1.3 Fill Material

In general, materials intended for use as fill materials should be a soil or soil/rock mixture that is free of organic matter and other deleterious substances in accordance with Section 19 of Caltrans Standard Specifications. In addition, these materials should have an R-value greater than 15 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. In our opinion, the fat clays excavated from the project site should not be reused as engineered fill due to their expansive nature, i.e. potential to shrink and swell with moisture changes. A detailed discussion about the reuse of onsite soils is provided in Section 6.5 "Cuts and Excavations".

6.1.4 Fill Placement

All fill should be constructed in accordance with Caltrans Standard Specifications Section 19, entitled "Earthwork." Relative compaction of not less than 90 percent should be achieved in all fill materials, except where 95 percent is required.

6.2 ESTIMATED SETTLEMENT

6.2.1 General

Based on the profile sheets developed for the Old Redwood Highway OC and those along the on-ramps and off-ramps, new fills ranging from 5 to 22 feet in height are planned. As discussed previously in "Section 3.22 Subsurface Conditions," native soils below fill and structural pavement materials consist of a maximum thickness of 9 feet of medium stiff to very stiff fat clay underlain by medium stiff to very stiff lean clay and sandy lean clay to a depth of 18 feet below ground surface (bgs). Beneath these cohesive deposits, the borings encountered primarily granular soils. Groundwater depths ranged from about 7 feet to more than 25 feet bgs. Consequently, a majority of the long term ground surface settlement at the site is attributed to consolidation of the native fat clay in the upper 10 feet, and to a lesser degree, consolidation of interbeds of deeper lean clays.

We evaluated settlement of the approach embankment and the ramps due to placement of new fill. A summary of the settlement analysis results is presented in Table 6-1.

Table 6-1: Retaining Wall/Embankment Settlement Analysis

Control Line	New Fill Height (feet)	Ultimate Settlement (Consolidation +Immediate) (inches)	Structures
"ORH"	5 to 22(Average 38 ft wide)	½ to 3¾	Old Redwood Highway OC, including RW#7
"OSN"	5 to 19	1¾ to 4	RW #1 & RW #2
"ONN"	3 to 18	1 to 3¾	RW #4 & RW #5
"ONF"	7 to 10	1 to 1¾	RW #6
"OSF"	5 to 12	1 to 3	RW #3

The consolidation settlement at "ORH" embankment is estimated to take about 9 months to reach approximately 90 percent of consolidation. Based on our discussion with Caltrans District 4 Geotechnical Engineer, it is Caltrans' experience that ramp embankments and MSE walls should be able to tolerate total settlements on the order of 1 to 2 inches and differential settlements on the order of ½ inch in 50 lineal feet of wall. However, bridge approach embankments should have 90% consolidation settlement taken place prior to the installation of abutment piles. Therefore, the basis for settlement period for control line "ORH" should be 90 percent consolidation (Criterion 1), whereas that for lines "OSN," "ONN," "ONF," and "OSF" should be 1 inch total consolidation settlement and ½ inch differential settlement (Criterion 2). Embankment fill induced settlement can be mitigated by using light weight aggregate (LWF) as fill material or Expanded Polystyrene Foam (EPS) blocks in lieu of general fill materials. For

more details regarding this subject, please refer to Section 6.3 "Other Ground Improvement Methods." Each embankment will be built in 2 or more stages in order to maintain traffic flow and minimize the need for interchange closure during construction. Embankments built in each stage are shown on the construction and traffic handling plans (SC-1 through SC-49) provided in Appendix G.

Estimated ultimate settlement of the approach embankments and ramps along the control lines have been plotted and presented on Figures 6-1 through 6-5 for Control Lines ONN, OSN, ORH, ONF, and OSF, respectively. Estimated settlement profiles along Control Lines OSF and ONF are applicable to those for Control Lines OSNL and ONNL, respectively, because the settlement estimates are based on loads of combined on and off ramps and loop ramps. The ultimate settlement is shown in the lower half of these figures, whereas the fill height at the corresponding station is shown in the upper half of these figures. On the lower half of Figures 6-1 through 6-5, the ultimate settlement plots are based on:

- Soil fill in embankment and retaining wall backfill, all fill placed in single stage (no surcharge); and
- Soil fill in embankment and retaining wall backfill, fill placed in two or more stages at different times (no surcharge).

It is estimated that the maximum ultimate settlement for the interchange approach embankment and ramps fill (single stage) is about 4 inches.

These plots can be used to estimate differential settlement at the interface (conformance line) between two stages. As an example, refer to Figure 6-1 along Control Line "ONN" at about Station 41+50. For Stage 1, soil fill is placed between Stations 41+50 to 46+50 (for 500 feet). For Stage 2, soil fill is placed between Stations 41+50 to 40+50. As shown in Figure 6-1, differential settlement on the order of 1½ inches could occur in the vicinity of Station 41+50 (conformance between Stages 1 and 2). Post construction settlement of less than 1 inch is expected (see Table 6-2) for the ONN embankment. When settlement is complete in Stage 2, final grading can then be achieved.

6.2.2 Surcharge

Depending on the construction sequence or staging of the interchange improvements, surcharging the fills may be required to reduce the settlement period so that post construction settlement would meet either Criterion 1 or Criterion 2 (Section 6.2.1). For the surcharge method, a temporary soil fill is placed on top of the design finished grade for a limited period of time. Both Caltrans and URS have had good success in implementing the surcharge method to accelerate settlement. The actual settlement is typically measured and confirmed in the field by installing and monitoring settlement monitoring devices. Based on our experience, surcharge height is typically 10 feet, but may occasionally be 5 or 15 feet. In our evaluation we estimated settlements for surcharge heights of 5 feet and 10 feet, and compared the settlements periods for the case of no surcharge.

In Table 6-2 for soil fill we estimate settlement period for (1) no soil surcharge, (2) 5 feet of soil surcharge and (3) 10 feet of soil surcharge along control lines ORH, OSN, ONN, ONF, ONNL, OSNL and OSF. As discussed in the previous section each embankment will be constructed in 2

or more stages. Stages that require surcharge and/or settlement period are shown in the parentheses.

Table 6-2: Estimated Ground Surface Settlement (Soil Embankment Fill)

Control Line	Max. Ultimate Settlement (inches)	Settlement Period (months)			Post Construction Settlement (inches)
		No Surcharge	5 ft Surcharge	10 ft Surcharge	
"ORH"	3¾	9 (stage 1A)	3 (stage1A)	2 (stage 1A)	⅜
"OSN"	4	1 (stage 1& 2)	<1 (stage 1& 2)	-	~1
"ONN"	3¾	1 (stage 1 & 2)	<1 (stage 1 & 2)	-	~1
"ONF" and "ONNL"	1¾	1 (stage 2A)	<1 (stage 2A)	-	<1
"OSF" and "OSNL"	3	1 (stage 3 & 3A)	<1 (stage 3 & 3A)	-	~1

We recommend surcharge to be implemented at the stages shown in parentheses for the corresponding settlement period. For example, to achieve 90 percent consolidation in 2 months or less for "ORH" approach embankment, the minimum surcharge height should be 10 feet.

6.3 OTHER GROUND IMPROVEMENT METHODS

In order to shorten settlement periods where new embankment fill will be placed, we have considered several ground improvement techniques as discussed below. The goal is to expedite construction and to open the interchange for traffic as soon as possible.

6.3.1 Light Weight Fill

For this technique, most of the proposed embankment soil fill is replaced by substituting either light weight aggregate or Expanded Polystyrene Foam (EPS) blocks. For example, the moist unit weight of soil fill is on the order of 125 pounds per cubic foot (pcf), whereas lightweight aggregate is about 70 pcf and EPS is about 2 pcf. In our estimate of embankment settlement using light weight fill (LWF), we assumed a 2-foot thick HMA/AB/AS pavement section with an average moist unit weight of 145 pcf. (For this method a lower moist unit weight is used in the

fill, so the ultimate consolidation of the underlying fat clay and lean clay layers results in a lower ground surface settlement.)

Our estimates indicate maximum ultimate settlement for LWF aggregate (single stage) is about 2¾ inches. These estimates are based on the fact that LWF aggregate is used for embankment construction and soil fill is used for retaining wall backfill.

For example, along control line "ORH" near Station 21+00 (fill height of about 19 feet) use of LWF reduces maximum ultimate ground surface settlement from order of 3¾ to 2½ inches (see Figure 6-3). Furthermore, differential settlement on the order of ½ inch or greater could occur at the interface of retaining wall soil backfill and embankment LWF (see note 1 on Figure 6-3).

Table 6-3 presents estimated settlement period, with LWF.

Table 6-3: Estimated Ground Surface Settlement (Light Weight Fill)

Control Line	Max. Ultimate Settlement (inches)	Settlement Period (months)			Post Construction Settlement (inches)
		No Surcharge	5 ft Surcharge	10 ft Surcharge	
"ORH"	2½	6 (Stage 1A)	3 (Stage (1A)	2 (Stage 1A)	¼
"OSN"	2¾	<1 (stage 1 & 2)	-	-	<1
"ONN"	2½	<1 (stage 1 & 2)	-	-	<1
"ONF" and "ONNL"	1¼	-	-	-	<1
"OSF" and "OSNL"	2¼	<1 (stage 3 & 3A)	-	-	<1

Although it is technically feasible to use LWF as MSE wall backfill, Caltrans do not recommend such an application of LWF. Furthermore, it is relatively expensive compared to the traditional method of using soil fill and surcharge. Hence, no further consideration was given to LWF as backfill for retaining walls.

6.3.2 Removal of Compressible Soils

For this method, the compressible (native) clay soil is excavated and replaced with compacted engineered fill. Although, it is possible to reuse this clay material , a designated staging area where the soil could be aerated (dried out) and processed will be required; then, the processed fill will have to be hauled back into the excavation and be recompacted. The extra processing and handling of the excavated soils would deem the reuse of the clays not feasible. Therefore, the excavated clay soils should be hauled offsite for this option. Considering (1) the close proximity of existing roadways, embankments and structures and (2) the need for temporary shoring for deeper excavations, we estimate a practical excavation depth to be about 4 to 5 feet. In addition, most of the compressible fat clays occur in the upper 10 feet. Therefore, replacing the upper 4 to 5 feet of compressible clays with engineered fill should reduce about half the ultimate surface

settlement, for example from 4 inches to less than 2 inches for embankment heights of 22 feet. If the construction schedule does not permit a settlement period (no surcharge) of 1 month or less, replacing the upper 4 to 5 feet of fat clays with engineered fill should achieve Criterion 2 mentioned in Section 6.2.1 for lines OSN, ONN, ONF,, ONNL, OSNL and OSF. However, this removal option is not viable for the "ORH" embankment because of the close proximity of the cut to the existing embankment; temporary shoring is likely needed.

6.3.3 Nearby Experience

The Washington Creek On-Ramp project is located from East Washington Street to State Route 101 Northbound in Petaluma; it is positioned about 3 miles southeast of the Old Redwood Highway Interchange. Caltrans performed a geotechnical investigation and prepared a Memorandum dated August 11, 2006 (Final Geotechnical Design Recommendations) addressing ground improvements for (1) the embankment and (2) Washington Creek On-Ramp (WCOR).

Caltrans states in the 2006 report, "Based on the recent borings, the site is underlain by interbeded very soft to firm silty clay and clay, and loose to medium dense silty sand to sand to depth ranging from the surface to a depth of 13.7 m (45.0 ft), or to elevation of -4.3 m (-14.1 ft). Underneath to the maximum depth of the exploration, interbeded layers of dense and very dense sand, sandy gravel, and gravel, and stiff to very stiff sandy to silty clay were encountered. A layer of medium dense silty to gravelly sand was encountered in boring B-1 at depth of about 12.5 m (41.0 ft) to 13.7 m (45.0 ft) and in boring B-2 at depth of about 6.1 m (20.0 ft) to 6.6 m (25.0 ft), or at consistent elevations ranging from 1.1 m (3.6 ft) to 2.7 m (8.9 ft)."

Caltrans further states that the proposed widening of Route 101, in both southbound and northbound directions will require fill of up to 10 feet (3.0 m) in height. Field exploration indicates the foundation soil at the proposed fill locations consists of compressible, soft clay and silty clay. Their analysis indicates these soils will settle in the range of 7 to 8 inches (175 to 200 mm) at some locations. "Since the settlement will occur immediately behind the retaining wall footing, it will adversely affect the roadway grade and drainage and hence it is imperative that the settlement is mitigated." Caltrans recommended using Light Weight Fill (LWF) in lieu of regular fill at excessive settlement areas. The use of LWF will reduce the anticipated settlement to less than 2 inches (<50mm). Caltrans also stated, "It is important that the LWF has proper drainage and it is separated from the regular fill and other materials by a filter fabric."

At the WCOR, two MSE retaining walls are proposed : RW2 and RW4; maximum wall and fill height is 7.0 m (23.0 feet). Caltrans states "The foundation soils…. consists of 2.0 m (6.6 feet) to 7.0 m (23.0 feet) of very soft and soft silty clay interbedded with loose to medium dense sand/silty sand and underlain by relatively firm to stiff clay. The top soil layer does not have adequate bearing capacity and it will settle excessively under the proposed MSE wall loading. Our analysis indicates that the wall will settle in excess of 390 mm (15 inches) at some locations. Since the subsurface soil profile and soil consistency are highly irregular, majority of the anticipated settlement is likely to be differential settlement. Furthermore, our calculations show that 90 percent of the primary consolidation settlement will take over 5.5 years to complete. Some of the loose to medium dense silty sand/sand layers are susceptible to liquefaction during a major seismic event."

"To improve the bearing capacity, reduce/accelerate settlement, and mitigate against possible liquefaction, ground improvement is needed at this site." Caltrans considered the following three (3) ground improvement/mitigation options for this project.

"***Stage construction (with controlled rate of loading) and wick drains*** – This option involves installation of prefabricated wick drains to accelerate the settlement and controlled rate of loading (staging) during construction of the MSE walls. The controlled rate of loading allows the foundation soils to gain strength as the consolidation settlement of the soft soil occurs. Our analysis shows that the anticipated strength gain of the foundation soil due to consolidation is not sufficient to meet the bearing capacity requirement. Therefore, this option is not suitable for this site."

"***Extension of the Washington Creek on-ramp bridge to eliminate the MSE walls*** – This option was rejected because it was deemed too expensive."

"***Insitu Cement Deep Soil Mixing (Soil-Cement)*** – In deep soil mixing, soil and grout are mixed together in place by the pugmilltype action of the specially designed overlapping augers and blades on the mixing shafts. As the mixing shafts are advanced into the soil, grout/cement is pumped through the hollow stem of the shafts and injected into the soil at the shaft tips. Auger flights and mixing blades on the shafts blend the soil with cement grout in a pugmill fashion. When the design depth is reached, the mixing shafts are withdrawn while the mixing process is continued. The process is then repeated to form continuous columns."

"Soil mixing can improve the foundation soil bearing capacity, reduces the settlement significantly, and prevents liquefaction. Therefore we (Caltrans) recommended insitu deep soil mixing as the ground improvement option for this site."

Caltrans further states their calculations show that wet soil mixing with 0.9 m (2.95 feet) diameter soil-cement columns installed in a design pattern to the depth of relatively firm soils will improve the foundation soil bearing capacity to greater than 4,550 psf. Since the thickness of the soft soil layer varies, the depth of the proposed ground improvement (soil mixing) also varies, ranging from 5.0 m (16.4 feet) to 8.0 m (26.2 feet).

6.3.3.1 Comparison of Route 101 Embankment / WCOR Site to Old Redwood Highway Interchange Site

We have compared a list of geotechnical parameters and issues at the three locations as summarized in the following Table 6-4.

Table 6-4: Comparison of Geotechnical Parameters / Issues at Three Sites

Consideration	Site		
	Route 101 Embankment	**WCOR**	**Old Redwood Hwy IC**
Maximum Depth of Fat Clay (feet)	40	23	10
Maximum Fill Height (feet)	10	23	22

Consideration	Site		
	Route 101 Embankment	WCOR	Old Redwood Hwy IC
Maximum Settlement (inches)	8	15	4
Ground Improvement Recommended	LWF	Deep Soil Mixing (DSM) to Depths of 16 to 26 feet	Considering Surcharging 3 Months or LWF or Removal of Compressible Soils
Comments		Inadequate Bearing Capacity. Some Loose to Medium Dense Sand Layers Susceptible to Liquefaction	
Maximum Estimated Settlement with Proposed Mitigation (inches)	<2	Not Available. Reduces the Settlement Significantly	<½

As shown in the above Table 6-4, the present ORHIC site has the thinnest fat clay layer and has the least maximum settlement (4 inches), even though the Route 101 Embankment has the least maximum fill height (10 feet). Therefore, subsurface conditions at Old Redwood Highway IC are more favorable than the other two sites.

6.4 MONITORING SETTLEMENT

To facilitate the Resident Engineer in determining whether to increase or decrease the duration of settlement periods, we recommend the embankment construction at the interchange be monitored in accordance with California Test 112, "Method for Installation and Use of Embankment Settlement Devices." As a minimum, two settlement monitoring devices should be installed at each abutment along "ORH" Stations 20+75 and 24+50. One device should be installed near the toe of existing embankment slope, and the second one about half way between existing and proposed embankment toe. Similarly, settlement monitoring should be conducted along control lines "OSN (RW#1 and RW #2) and "ONN" (RW #4 and RW #5). As a minimum, we recommend 2 settlement monitoring devices be installed along the wall alignment where fill height exceeds 10 feet. The approximate locations of these devices should be as follows:

Table 6-5: Proposed Locations of Embankment Settlement Devices

Control Line	Station	Offset (feet)
”ORH”	20+75	44 Rt
	20+75	64 Rt
”ORH”	24+50	48 Rt
	24+50	96 Rt
“OSN”	91+00	0
	92+25	0
“ONN”	41+25	20 Rt
	43+25	0

6.4.1 Drainage Pipe Crossings

Based on evaluation of drainage systems and fill heights (refer to Appendix J for drainage system plans and profiles), four drainage systems with 18 to 24 inch diameter pipes, that are planned under on and off ramps, have the potential of differential settlement along the pipe profile exceeding one-half percent due to the load induced by the on and off ramps. These four systems are as follows:

Table 6-6: Summary of Drainage Pipe Crossings

Drainage System Number	Stations Across Ramps	Embankment Fill Height (feet)
4	“OSN” 91+20.01 to 91+23.41	15 to 18
6	“OSF 60+91.75 to “OSNL” 81+67.21	8 to 12
7	“OSF” 63+37.79	12
17	“ORH” 28+50.74 to “ML” 408+06.32	13 to 18

We understand that reinforced concrete (RCP) or PVC pipes are planned for these systems. To minimize potential of pipe cracking due to subgrade settlement (resulting from new fill), we have considered the following 4 alternatives for pipe design and installation:

1. Design the pipeline by varying the segment length such that the rotation due to subgrade settlement is within the pipe joint tolerance. For this alternative, we have estimated the settlement profiles along the pipelines to facilitate the selection of pipe segment lengths; the settlement profiles are presented on Figure 6-6. Based on these profiles, the differential settlement along the pipelines can be estimated in terms of rotations.
2. Camber the profile to match anticipated settlements shown on Figure 6-6.
3. Pipe jacking under the new ramps after the specified settlement periods.

4. Install pipes in trenches excavated in the new embankment after the specified settlement periods.

Alternative 1 is estimated to have permanent resulting pipeline profiles similar to the settlement profiles presented on Figure 6-6. The pipe designer should determine if these settlement profiles will affect the hydraulics (operations) of the pipelines. Furthermore, if the differential settlement or profile rotations for practical pipe segment lengths exceed pipeline manufacturer's tolerable limits, then, Alternatives 3 or 4 should be further evaluated. However, Alternatives 2 and 3 are likely more costly than Alternative 1. Alternative 2 has been coordinated with Caltrans Hydraulics department and deemed the preferred alternative.

6.5 CUTS AND EXCAVATIONS

In all on-ramp and off-ramp areas, fill height more than 7 feet are currently planned for placement of new pavement sections and retaining wall foundations. However, at a few locations, a fill height of up to 25 feet is expected.

Based on the Floodplain Location Hydraulic Study Report by WRECO, dated March, 2012, the planned interchange improvements will result in loss of floodplain storage. To recover the loss of floodplain storage, it is proposed to excavate additional cut (in the form of basins and ditches) to at least the same volume as the fill added to the floodplain zone to ensure compliance with the City of Petaluma "net zero fill into the floodplain" ordinance within the Project area. Lean to fat clays were encountered at all boring locations at depths ranging from the original ground surface to depths of 4 to 9 feet bgs, as discussed previously in Section 3.2.2 "Subsurface Conditions".

In our opinion, the fat clays excavated from the proposed mitigation basins and all other excavations should not be reused as engineered fill due to their expansive nature, i.e. potential to shrink and swell with moisture changes. This requirement is included in Section 9, Specifications, 9.2.1 Earthwork. If used in embankments, CH soils will slough where exposed. The insitu moisture content of these soils is about 30 percent and is more than 10 percent higher than optimum moisture content. Due to the high moisture content, these fat clays will require considerable effort during aeration (drying out) by the Contractor; for this reason also we recommend that the fat clay be hauled offsite and not be reused in new embankments or wall backfill. It should be noted where 2009 borings encountered fill, the fill materials generally consisted of clayey sand (with gravel), sandy lean clay (with gravel), clayey gravel, lean clay (with gravel); therefore onsite fat clays were not reused in the existing embankments. The approximate earthwork quantities are as follows:

- Excavation ≈ 38,500 cubic yards (cy)
- Fill ≈ 106,500 cy
- Borrow ≈ 109,000 cy

For reasons discussed above (for fat clay) most of the fill (106,500 cy) should be imported.

As discussed in Section 3.2.2, "Groundwater," groundwater levels rise in the winter and spring months. Therefore, it is conceivable that some free water could potentially be encountered in the bottom of the proposed basins if construction occurs in the winter and spring months.

6.6 EMBANKMENTS

The planned fills should be constructed in accordance with Caltrans Standard Specifications Section 19, entitled "Earthwork". The undesirable materials should be removed in accordance with Caltrans Standard Specifications Section 16, "Clearing and Grubbing".

Consistent with Caltrans standards, the proposed slope inclinations of new embankments throughout the project are 4H:1V and 1½H:1V (with slope paving) under bridge abutments. However, in constrained locations, embankment slopes as step as 2H:1V are proposed. In our opinion, the existing embankment soils and supporting soils are capable of being inclined at these proposed slopes provided that the new embankment fills are constructed in accordance with the recommendations of this report and Caltrans Standard Specifications. For most engineered fill embankments constructed with the above slope inclinations, stability analyses generally are not required.

New embankment fill should be benched and keyed into existing slopes as specified in Caltrans Standard Specifications Section 19-6 "Embankment Construction".

6.7 EARTHWORK FACTORS

Relatively shallow excavations (less than 6 feet) and fill heights up to 25 feet are anticipated. A majority of the cut materials will be generated by excavating the ditches and basins throughout the Project area as well as removal of existing U.S. 101 outside shoulder to allow for placement of the new traveled way pavement structural section.

In general, no apparent distress was observed in median shoulder pavements during field investigation in 2009. 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, and earthwork factor of 1.0 should be used for existing asphalt concrete and aggregate base materials used for fill material compacted to a relative compaction of 95 percent.

6.8 RETAINING WALLS

As discussed previously in Section 1.1.2 "Retaining Walls", seven (7) retaining walls are planned. Foundation design concepts and geotechnical recommendations for these special walls (non-standard) RW #1 through #7 are presented in a separate Foundation Report.

6.9 SOUNDWALLS

1.1.1 Sound Wall Description

One sound wall is planned along a portion of the off-ramp from southbound U.S.101 to Old Redwood Highway. It is a continuation of the sound wall constructed as part of the U.S. 101 Central HOV Lanes Project (Segment B). The length of this sound wall is about 398 feet with a

design height of 14 feet. This wall will be placed on a Type736SV concrete barrier. The sound wall plan and elevation views are shown on Figure 1-4.

6.9.1 Subsurface Conditions

Two (2) exploratory borings (NB01A and NB02) were performed in year 2008 near the proposed alignment of the sound wall. The borings were drilled on August 10 and 23, 2006 to terminal depths of 30 to 31½ feet below existing ground surface (bgs).

Fill was encountered in Borings NB01A and NB02 to depths of 2 and 2½ feet, respectively below ground surface (bgs). The fill consists of very stiff sandy lean clay with gravel and lean clay with sand.

Underlying the fill are alluvial soils which generally consist of stiff to very stiff fat clay and stiff to very stiff lean clay and sandy lean clay to terminal boring depths of 30 to 31½ feet bgs (NB01A and NB02).

Granular interbeds 3 to 6 feet thick were observed in both borings beginning at depths ranging from 15 to 21 feet bgs. These granular deposits were classified as medium dense poorly graded sand with silt to silty sand.

Groundwater was encountered at depths of 8 feet and 24 feet bgs in Borings NB01A and NB02, respectively.

6.9.2 Design Considerations

Recommended Design Parameters

Segments of the sound wall will be placed in level ground. We recommend that cast-in-drilled hole (CIDH) piles be used as foundations to resist both vertical and horizontal wall design loads. The sound walls will consist of reinforced concrete masonry blocks.

Based on our analysis of the boring logs and laboratory test results, we have estimated the friction angle Φ' for this sound wall. We then compared this value to the Φ' value used in the Caltrans Standard Plans. The comparison is summarized in the following table for sound wall on Type 736SV concrete barrier.

Estimated Φ' (degrees)	Caltrans Standard Sheet Name	Recommended Φ' on Caltrans Standard Sheet (degrees)
30	Sound Wall-Masonry Block on Type 736 SV Barrier, Details No. 3	30

We also recommend the following:

* Isolation Factor
  - 3.0 for ground surface level on both sides of wall
  - 2.0 for ground surface sloped on either side of wall

* Minimum Pier Length = 5 feet
* Minimum Pile Diameter = 16 inches

Post Liquefaction Settlement

Table 6-3 presents a summary of the estimated post-liquefaction ground surface settlement at soundwall.

Table 6-3: Estimated Post Liquefaction Ground Surface Settlement at Soundwall

Boring/CPT Number	Depth to Top of Layer (feet)	Layer Thickness (feet)	Estimated Ground Surface Settlement (inch)
NB01A	15	6	<1
NB02	21	3	<¼

As shown in the above table, GSS is ½ inch or less at NB02 and three other explorations performed close to the sound wall as part of the SCTA U.S. 101 Central Lanes HOV Project (segment B). Based on our liquefaction calculations and engineering judgement, differential settlements are estimated to be less than ½ inch along the sound wall.

6.9.3 Construction Considerations for Sound Wall

Fill was encountered in Borings NB01A and NB02 to depths ranging from 2 to 2½ feet bgs. Underlying the fill, the conditions encountered in these borings consist of layers of lean clay and fat clay with granular interbeds. Groundwater was encountered at depths of 8 to 24 feet bgs at the time of drilling. In addition, planned depth of CIDH-piles is 16 feet.

The conditions encountered in borings consist primarily of layers of fat clay and lean clay with granular interbeds. Groundwater was encountered in borings at variable depths of about 8 to 24 feet bgs at the time of drilling. In cohesive soils as generally encountered, a fairly long time would be required for the groundwater to seep into the borehole and attain an equilibrium position with the long-term hydrostatic groundwater table. Thus, the immediate readings obtained may or may not be representative of the actual groundwater table level. Furthermore, seasonal fluctuations in groundwater levels should be anticipated throughout the year. While the cohesive deposits will help to keep the holes open during construction, some sloughing and caving can be expected in the cohesionless deposits. Therefore, it is recommended that the Contractor have casing on site, should it be needed to minimize the risk of caving in either clay or sand soils. Casing should be withdrawn from the hole slowly as the concrete is being placed; a minimum head of concrete of 3 feet should be maintained in the casing at all times. All CIDH piles should be installed under the direct observation of the Geotechnical Engineer.

6.10 GEOTECHNICAL CALCULATIONS

A copy of our geotechnical engineering calculations are presented in Appendix H. These calculations include estimated settlement.

7.1 CORROSION INVESTIGATION

V&A was retained by URS to perform a soil corrosivity evaluation within the project limits with regards to the construction materials to be selected. V&A performed in-situ soil resistivity testing and interpreted the field data collected. In addition, V&A interpreted the corrosivity test results on selected boring samples from the analytical lab analysis performed by Cooper Testing Laboratory in Palo Alto, CA. The report includes the field data collected, the test methods used to perform the in-situ soil resistivity testing, laboratory analysis and lab test results, and the analysis of the tests performed.

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, and CALTRANS Memo to Designers 3-1, July 2008 (Memo). Based on the results obtained, and according to the Guidelines and Memo, the soil samples tested are considered to be *non-corrosive to* reinforced concrete structures and steel piles. This conclusion is based on the values of minimum soil resistivity, pH, sulfates and chlorides.

The results of the minimum soil resistivity of the five boring samples indicate that soil resistivity is well below 1,000 ohm-cm. According to both the Guidelines and Memo, a site is considered corrosive if the soil's minimum resistivity is less than 1,000 ohm-cm and either contains a chloride concentration of 500 ppm or greater, or a sulfate concentration of 2,000 ppm or greater. Therefore, the soils tested at the five locations are considered *non-corrosive*, regardless of the very low soil resistivity test result.

Alternative pipe materials were selected using the Department of Transportation Altpipe Software Version 6.09. The software calculates Maintenance-Free Service Design Estimates using California Department of Transportation (Caltrans) criteria (see Appendices B and C of the Corrosion Study Report in Appendix K). The program Altpipe does not recommend usage of aluminum pipes and/or aluminized steel pipes due to low minimum soil resistivities.

7.1.1 Conclusions

1. The chloride ion concentration of the soil borings analyzed is less than 500 mg/kg.
2. The sulfate ion concentration of the soil borings is less than 2,000 mg/kg.
3. The soil pH of the soil borings analyzed is greater than 5.5.
4. The site is considered *non-corrosive* in accordance with Guidelines and the Memo.
5. The project site is not located within 300 meters (1,000 feet) of a salt or brackish water source.

7.1.2 Recommendations

Based on the test data and review of the project requirements, specific recommendations for each material alternative are listed below:

7.1.2.1 Buried Reinforced Concrete Structures And Cast-In-Place Piles

Buried concrete structures should be constructed of durable concrete as described in ACI Standards 201.2R and 222R. These recommendations include, but are not limited to, the following:

- The water/cement ratio should not exceed 0.50.
- A concrete cover of a minimum of 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 watersoluble 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 are the minimums required by Caltrans Standard Specifications 90-1.01.
- Standard reinforced concrete pipe design should be suitable for this user defined level of chlorides.

7.1.2.2 Alternative Pipe Material Selection

Alternative pipe materials were selected using the Department of Transportation Altpipe Software Version 6.09 that calculates Maintenance-Free Service Design Estimates using California Department of Transportation (Caltrans) criteria (see Appendices B and C), based on the harshest soil conditions from the sampled soil borings (R-09-101 with a pH of 7.3 and a minimum resistivity of 635 ohm-cm, chloride 333 mg/kg and sulfate 262 mg/kg).

V&A's report (Appendix K) includes the Culvert Service Design Estimates for pipes ranging from 12 inches to 48 inches in diameter. The estimated service life in years for the following:

- Plain Galvanized
- Bituminous Coating (Hot-Dipped)
- Bituminous Coating and Paved Invert
- Polymerized Asphalt Invert
- Polymeric Sheet Coating

V&A's report also includes the Alternative Pipe Materials for pipes ranging from 12 inch to 48 inches in diameter. The required minimum thickness in inches for the following steel pipes:

Steel Pipes:

- Corrugated Steel Pipe – Hellical Corrugations – 2 2/3" x 1/2" Corrugations
- Corrugated Steel Pipe – Annular Corrugations – 2 2/3" x 1/2" Corrugations
- Corrugated Steel Pipe – Hellical Corrugations – 3" x 1" Corrugations
- Corrugated Steel Pipe – Hellical Corrugations – 5" x 1" Corrugations
- Steel Spiral Rib Pipe – 3/4" x 1" Ribs at 11 ½" Pitch
- Steel Spiral Rib Pipe – 3/4" x 1" Ribs at 8 ½" Pitch
- Steel Spiral Rib Pipe – 3/4" x 3/4" Ribs at 7 ½" Pitch

Also included are the following:

Plastic Pipes - (Availability) – Indicates which type is allowed per diameter of pipe:

- PVC Corrugated
- PVC Ribbed
- HDPE Corrugated -Type S
- HDPE Ribbed
- HDPE Corrugated -Type C

Reinforced Concrete Pipes - Materials needed:

- Steel Cover (in)
- Sack of Cement
- Percentage Water

Due to low minimum soil resistivities encountered, Aluminum (CAP and ASRP) or Aluminized Steel (ASSRP and CASP) pipes are not recommended.

Materials available for the project construction are summarized in Table 8-1.

9.1 RECOMMENDATIONS

The specifications for this project shall be Caltrans Standard Specifications dated 2003 or later, as applicable.

9.2 SPECIFICATIONS

9.2.1 Earthwork

Earthwork shall conform to the applicable portions of Section 19 of the Standard Specifications and to current Special Provisions.

Expansive fat clay (CH) was encountered in all 2009 borings. Where these CH soils are excavated, these soils are classified as unsuitable material as per Section 19-2.02 of Standard Specifications.

Structure Backfill

Structure backfill shall conform to the provisions in Section 19-3 of the Standard Specifications.

Embankment Construction

Embankment material for at least 4 feet below the grading plane shall conform to the requirements noted in the Special Provisions. All imported borrow shall conform to the provisions of Section 19-7.02 of the Standard Specifications and to current Special Provisions.

9.2.2 Structural Pavement Sections

Hot Mix Asphalt (HMA)

Hot mix asphalt shall be Type A, ¾-inch maximum coarse graded and shall conform to the provisions in Section 39 of the Standard Specifications and to the requirements noted in the Standard Special Provisions.

Open Graded Friction Course (OGFC)

Open graded friction course shall be ½-inch maximum and shall conform to the provisions in Section 39 of the Standard Specifications and to the requirements noted in Section 39-100 of Standard Special Provisions.

Rubberized Hot Mix Asphalt, Gap-Graded (RHMA-G)

Rubberized hot mix asphalt shall conform to the provisions in Section 39 of the Standard Specifications and to the requirements noted in Section 39-100 of the Standard Special Provisions.

Aggregate Base (AB)

Aggregate base shall be Class 3, 1½-inch or ¾-inch maximum grading and shall conform to the provisions in Section 26 of the Standard Specifications and to the requirements noted in the Standard Special Provisions.

Aggregate Subbase (AS)

Aggregate subbase shall be Class 4 and shall conform to the provisions in Section 25 of the Specifications and to the requirements noted in the Standard Special Provisions.

9.2.3 Culverts And Drains

Filter Fabric

Filter fabric shall conform to the provisions in Section 88-1.03 of the Standard Specifications.

9.2.4 Standard Special Provisions

Aggregate Base (AB)

Aggregate base shall be Class 3, 1½-inch or ¾-inch maximum grading and shall conform to the provisions in Section 26 of the Standard Specifications and to the following Special Provisions.

The aggregate grading for Class 3 aggregate base is revised from the Class 2 aggregate base by changing "Percentage Passing" the No. 200 screen to:

	1½-inch Maximum		¾-inch Maximum	
	Operating Range	Contract Compliance	Operating Range	Contract Compliance
No. 200	2-11	0-14	2-11	0-14

The quality requirements shall conform to the quality requirements shown on the following table.

Tests	California Test Method Number	Requirements	
		Operating Range	Contract Compliance
Sand Equivalent	217	25 Min.	22 Min.
Resistance (R-value)	301	-	78 Min.
Durability Index	229	-	35 Min.

Aggregate Subbase (AS)

Aggregate subbase shall be Class 4 and shall conform to the provisions in Section 25 of the Caltrans Standard Specifications and to the following Special Provisions.

Class 4 aggregate subbase shall be clean and free from vegetable matter and other deleterious substances.

The percentage composition by weight of Class 4 aggregate subbase shall conform to the following grading as determined by California Test Method No. 202.

Sieve Size	Percentage Passing Moving Range	Individual Test Results
2½-inches	100	100
No. 4	30-65	25-70
No. 200	0-15	0-18

Class 4 aggregate subbase shall also conform to the quality requirements shown on the following table.

Tests	California Test Method Number	Requirements Operating Range	Contract Compliance
Sand Equivalent	217	21 Min.	18 Min.
Resistance (R-value)	301	--	50 Min.

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 that 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 URS 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 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-09-004	11/5/2009	21+11.1	"ORH"	Rt. 26.1	1.5																		12.8	113
A-09-004	11/5/2009	21+11.1	"ORH"	Rt. 26.1	15																		16.2	118
A-09-004	11/5/2009	21+11.1	"ORH"	Rt. 26.1	26																	5280	22.9	103
A-09-004	11/5/2009	21+11.1	"ORH"	Rt. 26.1	28.5																		18.1	107
A-09-005	11/5/2009	24+39.4	"ORH"	Lt. 32.6	3.5																		10.5	119
A-09-005	11/5/2009	24+39.4	"ORH"	Lt. 32.6	8.5																	4800	20.4	109
A-09-005	11/5/2009	24+39.4	"ORH"	Lt. 32.6	13.5																		17.1	113
A-09-101	11/3/2009	87+20.0	"OSN"	Rt. 4.7	1.5																	2030	36.4	82
A-09-101	11/3/2009	87+20.0	"OSN"	Rt. 4.7	5														79	37	42			
A-09-101	11/3/2009	87+20.0	"OSN"	Rt. 4.7	11																	6170	17.3	114
A-09-101	11/3/2009	87+20.0	"OSN"	Rt. 4.7	15																	860	21.3	105
A-09-101	11/3/2009	87+20.0	"OSN"	Rt. 4.7	21																		16	111
A-09-101	11/3/2009	87+20.0	"OSN"	Rt. 4.7	25				100	99	92	80	65	50	15	6	5						16.6	
A-09-101	11/3/2009	87+20.0	"OSN"	Rt. 4.7	30																	2140	28.3	93
A-09-101	11/3/2009	87+20.0	"OSN"	Rt. 4.7	35																	5960	26.6	98
A-09-102	10/2/2009	90+96.1	"OSN"	Rt. 2.8	5																	4710	32.6	88
A-09-102	10/2/2009	90+96.1	"OSN"	Rt. 2.8	10																		12.2	119
A-09-102	10/2/2009	90+96.1	"OSN"	Rt. 2.8	25																	3890	19.6	109
A-09-102	10/2/2009	90+96.1	"OSN"	Rt. 2.8	30																	4340	22.6	104
A-09-102	10/2/2009	90+96.1	"OSN"	Rt. 2.8	35																	5180	23	104
A-09-102	10/2/2009	90+96.1	"OSN"	Rt. 2.8	40																	4040	25.6	101
A-09-102	10/2/2009	90+96.1	"OSN"	Rt. 2.8	50																		22.6	102
A-09-103	11/6/2009	61+79.2	"OSF"	Lt. 47.2	5																	3330	38.7	80
A-09-103	11/6/2009	61+79.2	"OSF"	Lt. 47.2	8.5														57	19	38	6050	26.6	98
A-09-103	11/6/2009	61+79.2	"OSF"	Lt. 47.2	13.5																	1890	24.5	100
A-09-103	11/6/2009	61+79.2	"OSF"	Lt. 47.2	20																		12.5	118
A-09-103	11/6/2009	61+79.2	"OSF"	Lt. 47.2	31																		13.9	116
A-09-103	11/6/2009	61+79.2	"OSF"	Lt. 47.2	35																	5440	24.2	103
A-09-104	11/4/2009	63+68.2	"OSF"	Lt. 30.8	1																		11	97
A-09-104	11/4/2009	63+68.2	"OSF"	Lt. 30.8	5																	3580	38.5	79
A-09-104	11/4/2009	63+68.2	"OSF"	Lt. 30.8	10																	6120	27.1	96
A-09-104	11/4/2009	63+68.2	"OSF"	Lt. 30.8	15																	3710	22.6	104
A-09-104	11/4/2009	63+68.2	"OSF"	Lt. 30.8	25			95	91	85	67	53	42	34	26	19	14						15.4	
A-09-104	11/4/2009	63+68.2	"OSF"	Lt. 30.8	30																		15.3	108
A-09-105	11/10/2009	411+85.6	"ML"	Rt 51.3	5																	2600	32.8	85
A-09-105	11/10/2009	411+85.6	"ML"	Rt 51.3	15																	5020	23	104
A-09-105	11/10/2009	411+85.6	"ML"	Rt 51.3	35																	4150	24.9	100
A-09-105	11/10/2009	411+85.6	"ML"	Rt 51.3	41																		9.7	132
A-09-106	11/9/2009	407+95.0	"ML"	Rt. 49.5	1																	1600	38.2	80
A-09-106	11/9/2009	407+95.0	"ML"	Rt. 49.5	5														82	32	50			
A-09-106	11/9/2009	407+95.0	"ML"	Rt. 49.5	10																	5470	22	103
A-09-106	11/9/2009	407+95.0	"ML"	Rt. 49.5	16																		19	104
A-09-106	11/9/2009	407+95.0	"ML"	Rt. 49.5	31.3																		16.5	113

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-09-106	11/9/2009	407+95.0	"ML"	Rt. 49.5	35																	7360	20.5	107
A-09-106	11/9/2009	407+95.0	"ML"	Rt. 49.5	40																	4890	25	100
A-09-106	11/9/2009	407+95.0	"ML"	Rt. 49.5	45																		23.2	97
A-09-107	11/9/2009	410+12.8	"ML"	Rt 60.5	5																	4130	34.3	85
A-09-107	11/9/2009	410+12.8	"ML"	Rt 60.5	10																	6270	22.1	102
A-09-107	11/9/2009	410+12.8	"ML"	Rt 60.5	16																		22.5	96
A-09-107	11/9/2009	410+12.8	"ML"	Rt 60.5	20			98	96	95	89	80	65	43	16	9	7						18.6	
A-09-107	11/9/2009	410+12.8	"ML"	Rt 60.5	30																	5170	17.9	114
A-09-107	11/9/2009	410+12.8	"ML"	Rt 60.5	40																	5090	21.1	107
A-09-108	11/11/2009	15+31.5	"ORH"	Lt. 44.1	3-6													2						
A-09-108	11/11/2009	15+31.5	"ORH"	Lt. 44.1	5																	1180	41.3	74
A-09-109	11/4/2009	17+65.5	"ORH"	Lt. 54.2	10																	950	16.4	115
A-09-111	11/11/2009	26+98.2	"ORH"	Rt. 26.7	2-6													33						
A-09-111	11/11/2009	26+98.2	"ORH"	Rt. 26.7	8.5																	3480	31.8	88
A-09-112	11/11/2009	29+29.5	"ORH"	Rt. 28.2	5																	4380	28.3	92
A-09-112	11/11/2009	29+29.5	"ORH"	Rt. 28.2	10																	5000	20.8	106
A-09-115	11/3/2009	393+51.9	"ML"	Lt. 72.5	2.2																	1770	34.7	84
A-09-115	11/3/2009	393+51.9	"ML"	Lt. 72.5	10																	4820	25.9	100
A-09-116	11/3/2009	393+41.2	"ML"	Rt. 48.5	5																	3690	32.9	87
A-09-116	11/3/2009	393+41.2	"ML"	Rt. 48.5	11																	3660	24.5	100
R-09-001	10/26/2009	22+06.6	"ORH"	Lt. 56.1	1																	1650	41.4	78
R-09-001	10/26/2009	22+06.6	"ORH"	Lt. 56.1	5																	5000	35.2	86
R-09-001	10/26/2009	22+06.6	"ORH"	Lt. 56.1	20														48	16	32		24	
R-09-001	10/26/2009	22+06.6	"ORH"	Lt. 56.1	30																	5090	16.1	116
R-09-001	10/26/2009	22+06.6	"ORH"	Lt. 56.1	35																	5120	24.9	99
R-09-001	10/26/2009	22+06.6	"ORH"	Lt. 56.1	40																	3530	32.4	88
R-09-001	10/26/2009	22+06.6	"ORH"	Lt. 56.1	45																		21.2	100

TABLE 8-1
MATERIALS AVAILABLE

Source:		Stony Point Rock Quarry Cotati	Soils Plus Sonoma	Mark West Quarry Santa Rosa	Blue Rock Forestville	Canyon Rock, Inc Forestville	Sebastopol Ready Mix Santa Rosa	Superior Supplies, Inc Santa Rosa	Northern California Ready Mix Santa Rosa	Asphalt & Asphalt Products (BoDean Co. Inc) Santa Rosa
		707-795-1775	707-996-3400	707-576-8205	707-576-8205	707-887-2207	707-823-1067	707-546-7864	707-546-9422	707-576-8205 (707-576-8209x115)
Haul Distance (one way) Miles:		7	14	28	22	22	14	14	18	15
Quarry:		Stony Point		Mark West	Blue Rock					
Product:	Units:									
Portland Cement Concrete: Class A, 6 Sack 7 Sack, no CaC1 7 Sack, 2% CaC1	Cubic Yard						- 	$130.00 $136.00 $138.00	-	
Asphalt Concrete: Type A Open Graded Rubberized (RAC-G)	Ton	- -	- -	- -	- -	- -	- -	- -	- -	$74.70 -
Cement Treated Base: Plant Mix	Ton									
Cement Treated Base Aggregate (Class A)	Ton									
Asphalt Treated Permeable Base	Ton									
Aggregate Base Rock, Class 2	Ton	Recycle $12.60 Virgin $17.40	Recycle $11.25 Virgin $17.85	$13.45	$11.95	Recycle $9.00 Virgin$8.00				
Aggregate Sub-Base rock Class 4	Ton		$9.75							
Structural Backfill	Ton									
Permeable Material Class 1, Type A	Ton									
Permeable Material Class 2	Ton		$25.00	$28.00	$28.00					
Import Borrow	Ton									
Gabion Rock	Ton				$30.00					

URS	Old Redwood Highway Overcrossing Project	PROJECT LOCATION MAP	Not to Scale Figure 1-1 January 2010

INDEX OF PLANS

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

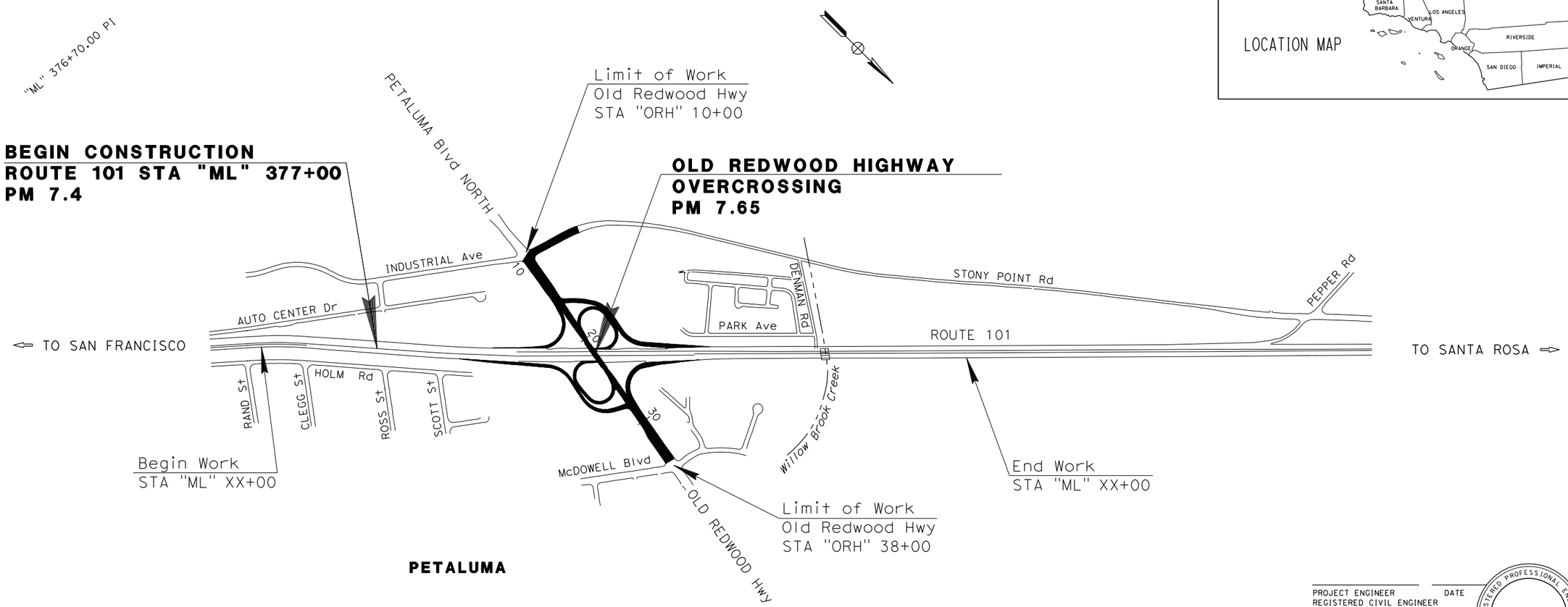
PROJECT PLANS FOR CONSTRUCTION ON
STATE HIGHWAY

IN SONOMA COUNTY
IN PETALUMA
ON ROUTE 101 AT OLD REDWOOD HIGHWAY OVERCROSSING

TO BE SUPPLEMENTED BY STANDARD PLANS DATED MAY 2006

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1	1	

LOCATION MAP



VICINITY MAP
FIGURE 1-2

PROJECT ENGINEER DATE
REGISTERED CIVIL ENGINEER

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

URS CORPORATION
55 South Market Street, Suite 1500
San Jose, CA 95113

CONTRACT No.

LAST REVISION 00-00-00

DATE PLOTTED => 1/27/2010
TIME PLOTTED => 9:07:18 AM

APPROVED AS TO IMPACT ON STATE FACILITIES AND CONFORMANCE WITH APPLICABLE STATE STANDARDS AND PRACTICES AND THAT TECHNICAL OVERSIGHT WAS PERFORMED.

CONSULTANT DESIGN ENGINEER | CALTRANS DESIGN OVERSIGHT APPROVAL | REGISTRATION No. | LICENSE Exp DATE | DATE SIGNED

THE CONTRACTOR SHALL POSSESS THE CLASS (OR CLASSES) OF LICENSE AS SPECIFIED IN THE "NOTICE TO BIDDERS."

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. 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.

CITY OF PETALUMA PUBLIC WORKS
11 ENGLISH STREET
PETALUMA, CA 94954

URS CORPORATION
1380 LEAD HILL BLVD, SUITE 100
ROSEVILLE, CA 95661-2997

GENERAL NOTES

DESIGN: Earth retaining systems and concrete barrier railings are designed by AASHTO LFD as set forth in AASHTO Bridge Design Specifications (BDS) 2000 and modified by Caltrans BDS 2004

DESIGN LOAD: Live Pressure: 240 lb/ft2 surcharge

ALLOWABLE BEARING PRESSURE: 6.150 lb/ft2

STANDARD PLANS DATED MAY, 2006

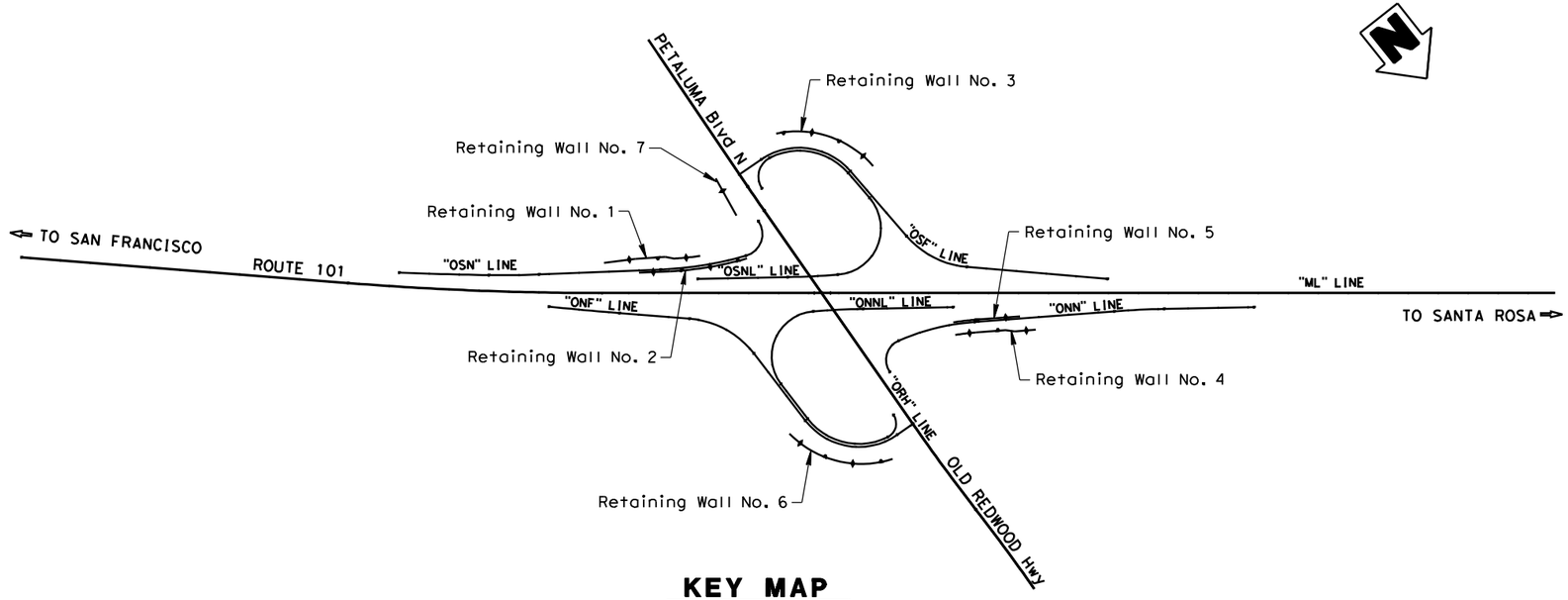
A10A	ACRONYMS AND ABBREVIATIONS (SHEET 1 OF 2)
A10B	ACRONYMS AND ABBREVIATIONS (SHEET 2 OF 2)
A10C	SYMBOLS (SHEET 1 OF 2)
A10D	SYMBOLS (SHEET 2 OF 2)
A62B	LIMIT OF PAYMENT FOR EXCAVATION AND BACKFILL BRIDGE SURCHARGE AND WALL
B3-9	RETAINING WALL DETAILS No. 2
B11-52	CHAIN LINK RAILING TYPE 7
B11-56	CONCRETE BARRIER TYPE 736

STANDARD PLAN SHEET No.

DETAIL No.

INDEX TO PLANS

SHEET No.	TITLE	
1	RETAINING WALLS No. 1 THRU No. 7	GENERAL NOTES
2	RETAINING WALL No. 1	GENERAL PLAN
3	RETAINING WALL No. 2	GENERAL PLAN
4	RETAINING WALL No. 3	GENERAL PLAN
5	RETAINING WALL No. 4	GENERAL PLAN
6	RETAINING WALL No. 5	GENERAL PLAN
7	RETAINING WALL No. 6	GENERAL PLAN
8	RETAINING WALL No. 7	GENERAL PLAN
9	RETAINING WALLS No. 1 AND No. 2	PANEL LAYOUT
10	RETAINING WALLS No. 3 THRU No. 5	PANEL LAYOUT
11	RETAINING WALLS No. 6 AND No. 7	PANEL LAYOUT
12	RETAINING WALLS No. 1 THRU No. 7	MECHANICALLY STABILIZED EMBANKMENT DETAIL No. 1
13	RETAINING WALLS No. 1 THRU No. 7	MECHANICALLY STABILIZED EMBANKMENT DETAIL No. 2
14	RETAINING WALLS No. 1 THRU No. 7	MECHANICALLY STABILIZED EMBANKMENT DETAIL No. 3
15	RETAINING WALLS No. 1 THRU No. 7	MECHANICALLY STABILIZED EMBANKMENT DETAIL No. 4
16	RETAINING WALLS No. 1 THRU No. 7	MECHANICALLY STABILIZED EMBANKMENT DETAIL No. 6
17	RETAINING WALLS No. 1 THRU No. 7	MISCELLANEOUS DETAILS
18	RETAINING WALLS No. 1 THRU No. 7	LOG OF TEST BORINGS 1 OF 9
19	RETAINING WALLS No. 1 THRU No. 7	LOG OF TEST BORINGS 2 OF 9
20	RETAINING WALL No. 1	LOG OF TEST BORINGS 3 OF 9
21	RETAINING WALL No. 2	LOG OF TEST BORINGS 4 OF 9
22	RETAINING WALL No. 3	LOG OF TEST BORINGS 5 OF 9
23	RETAINING WALL No. 4	LOG OF TEST BORINGS 6 OF 9
24	RETAINING WALL No. 5	LOG OF TEST BORINGS 7 OF 9
25	RETAINING WALL No. 6	LOG OF TEST BORINGS 8 OF 9
26	RETAINING WALL No. 7	LOG OF TEST BORINGS 9 OF 9



KEY MAP

FIGURE 1-3

DESIGN OVERSIGHT	DESIGN	BY D. Anderson	CHECKED	LOAD & RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 W/"LOW-BOY"; PERMIT DESIGN VEHICLE
SIGN OFF DATE	DETAILS	BY L. Davis	CHECKED	LAYOUT	BY D. Anderson — CHECKED
	QUANTITIES	BY	CHECKED	SPECIFICATIONS	BY D. Harnagel — PLANS AND SPECS COMPARED

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Walt LaFranchi
PROJECT ENGINEER

BRIDGE NO.
POST MILES

RETAINING WALLS No. 1 THRU No. 7
GENERAL NOTES

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV.7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT:
PROJECT NUMBER & PHASE: 04000200041

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 01-26-10 02-08-10 05-24-10 09-16-10

SHEET 1 OF 26

FILE => $REQUEST

CONTRACT NO.: 04-0A1851 PROJECT ID: 0400020004

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1	134	153

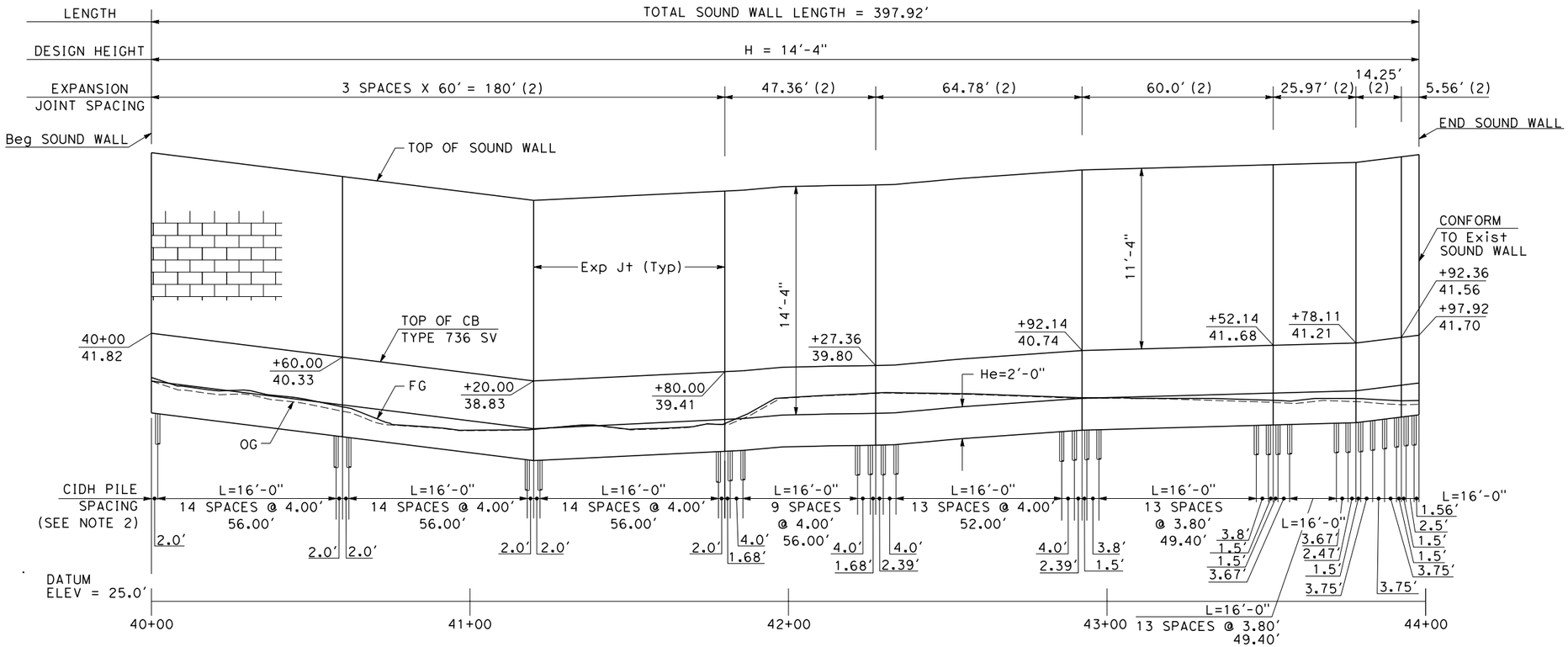
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

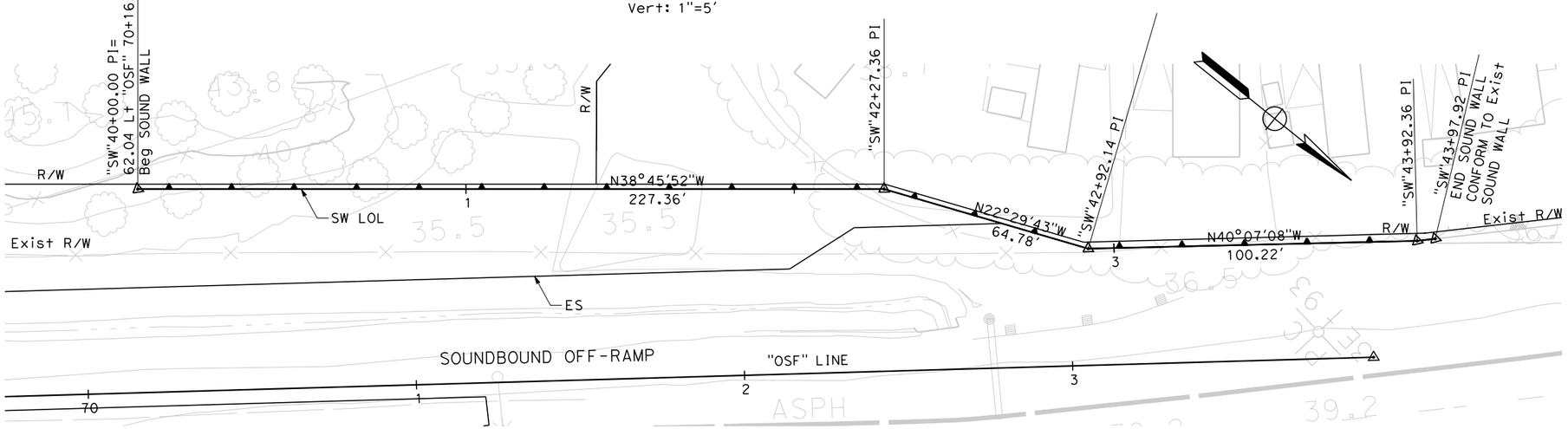
THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

URS CORPORATION
55 South Market Street
Suite 1500
San Jose, CA 95113



ELEVATION

Horiz: 1"=20'
Vert: 1"=5'



PLAN

SCALE: 1"=20'

NOTES:

1. SOUND WALL HEIGHT ON CONCRETE BARRIER IS MEASURED PERPENDICULAR TO ES.
2. SPACING IS MEASURED ALONG "SW" LOL.
3. THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

FIGURE 1-4

SOUND WALL PLAN

SCALE AS SHOWN

SW-2

REVISED BY | DATE REVISED | CALCULATED-DESIGNED BY | CHECKED BY | SUPERVISOR

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | CONSULTANT FUNCTIONAL SUPERVISOR

Caltrans

LAST REVISION 00-00-00 | DATE PLOTTED => 1/29/2010 | TIME PLOTTED => 4:31:15 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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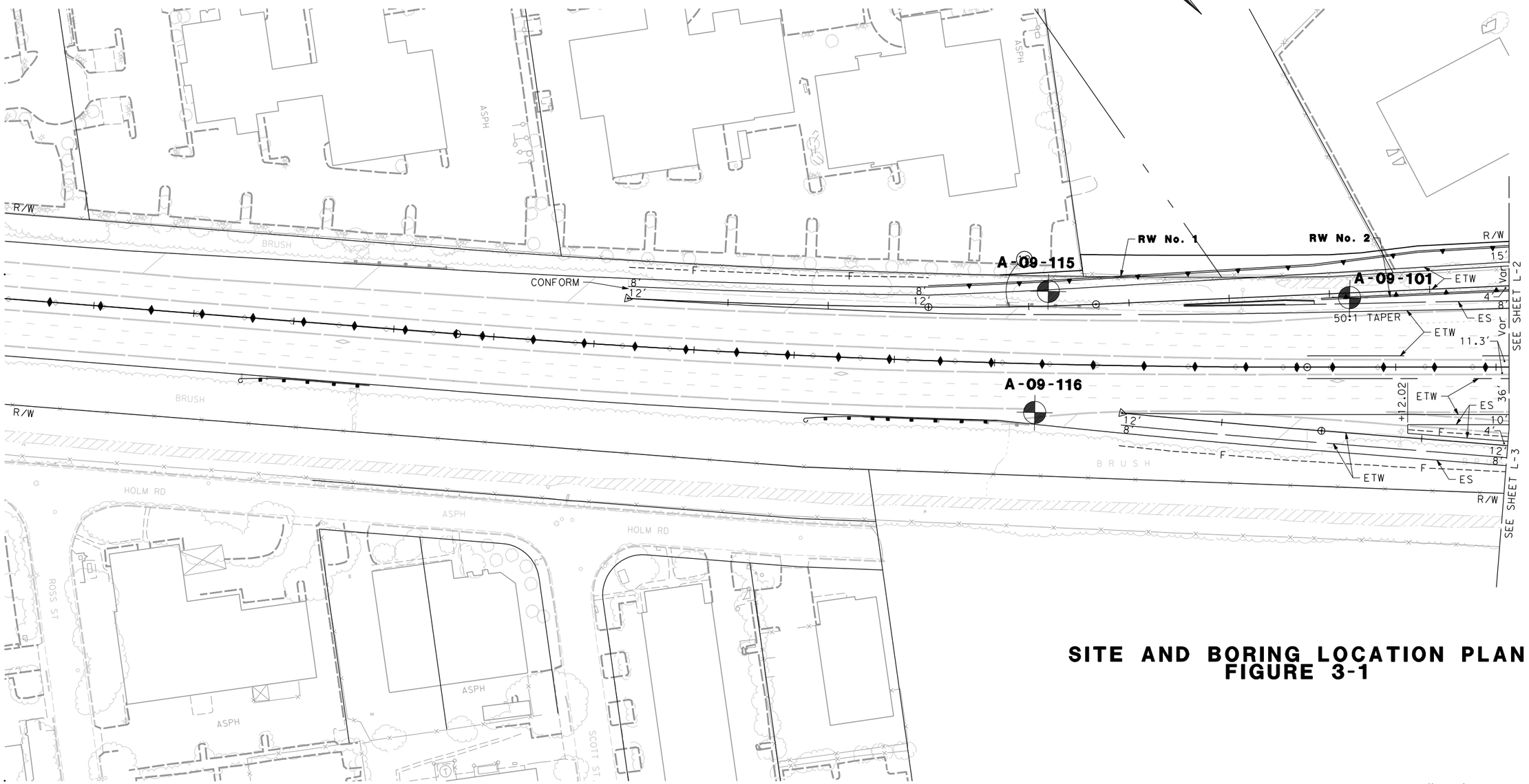
URS CORPORATION
55 South Market Street
Suite 1500
San Jose, CA 95113

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

LEGEND:
- 1952 Explorations
- 2009 Exploratory Borings
- 2009 Cone Penetration Test

CURVE DATA

No.	R	Δ	T	L	CURVE CENTER N	CURVE CENTER E
1	10,847.85′	04°28′53"	424.45′	848.47′	1853380.6395	6362217.0628
11	8,302.60′	02°04′12"	150.00′	299.97′	1854944.5282	6364170.6340
12	3,000.00′	03°11′29"	83.57′	167.10′	1858672.0213	6367942.0261
21	10,895.15′	01°02′58"	99.79′	199.58′	1854036.1366	6361626.9895



SITE AND BORING LOCATION PLAN
FIGURE 3-1

SCALE: 1"=50′

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

LAST REVISION 00-00-00
DATE PLOTTED => 1/27/2010
TIME PLOTTED => 9:16:39 AM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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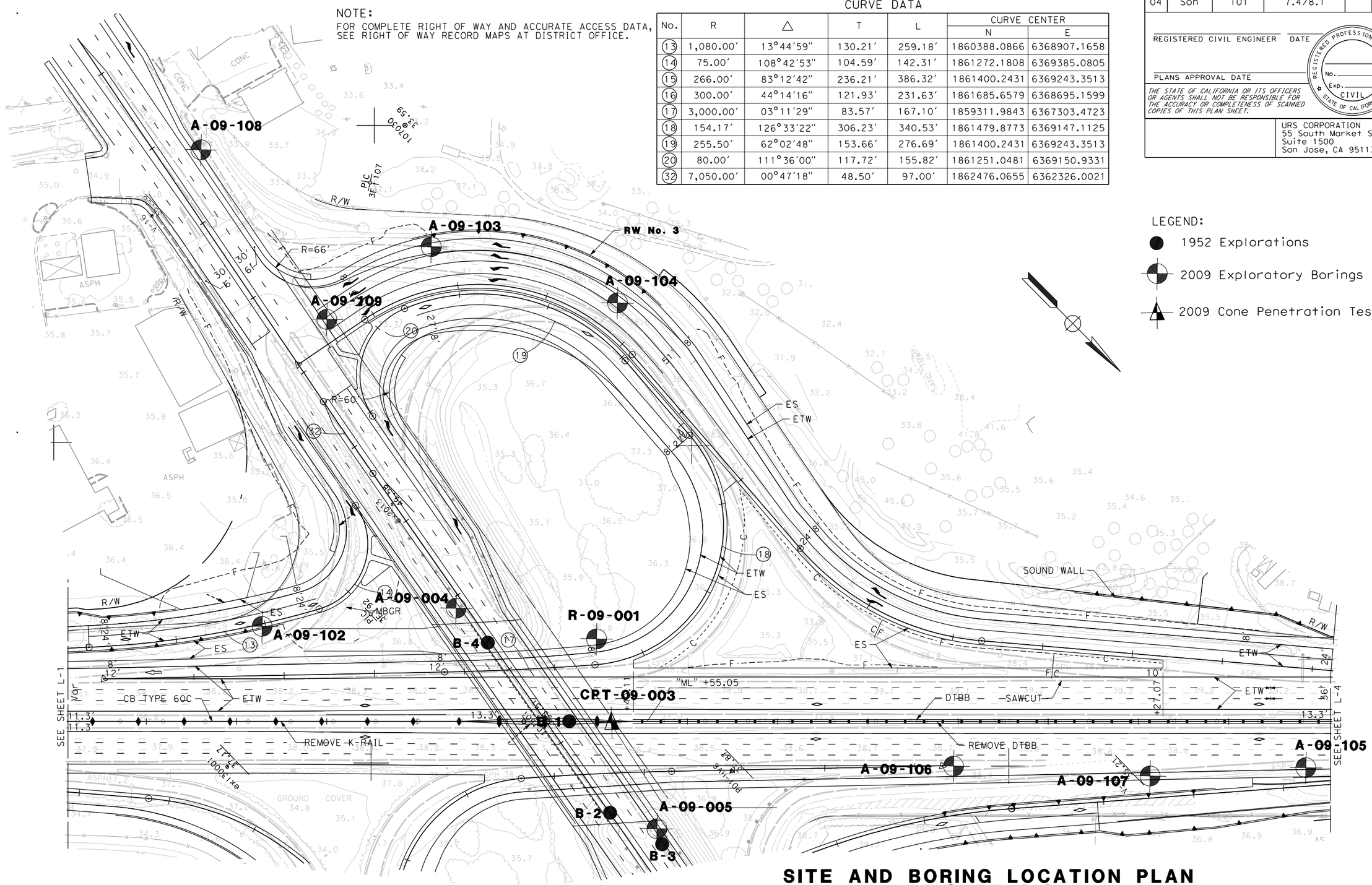
URS CORPORATION
55 South Market Street
Suite 1500
San Jose, CA 95113

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

CURVE DATA

No.	R	△	T	L	CURVE CENTER N	CURVE CENTER E
13	1,080.00′	13°44′59"	130.21′	259.18′	1860388.0866	6368907.1658
14	75.00′	108°42′53"	104.59′	142.31′	1861272.1808	6369385.0805
15	266.00′	83°12′42"	236.21′	386.32′	1861400.2431	6369243.3513
16	300.00′	44°14′16"	121.93′	231.63′	1861685.6579	6368695.1599
17	3,000.00′	03°11′29"	83.57′	167.10′	1859311.9843	6367303.4723
18	154.17′	126°33′22"	306.23′	340.53′	1861479.8773	6369147.1125
19	255.50′	62°02′48"	153.66′	276.69′	1861400.2431	6369243.3513
20	80.00′	111°36′00"	117.72′	155.82′	1861251.0481	6369150.9331
32	7,050.00′	00°47′18"	48.50′	97.00′	1862476.0655	6362326.0021

LEGEND:
- 1952 Explorations
- 2009 Exploratory Borings
- 2009 Cone Penetration Test



SEE SHEET L-3 FOR AREA NORTH OF "ML" LINE

SITE AND BORING LOCATION PLAN
FIGURE 3-2

SCALE: 1"=50′

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans®

CONSULTANT FUNCTIONAL SUPERVISOR
CALCULATED-DESIGNED BY
CHECKED BY
REVISED BY
DATE REVISED

LAST REVISION 00-00-00
DATE PLOTTED => 1/27/2010
TIME PLOTTED => 9:44:50 AM

BORDER LAST REVISED 4/11/2008
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
USERNAME => madhu_thummaluru
DGN FILE => ...\Site and Boring Location Plan Fig 3-2 .dgn
CU 00000
EA 04-0A1851

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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55 South Market Street
Suite 1500
San Jose, CA 95113

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

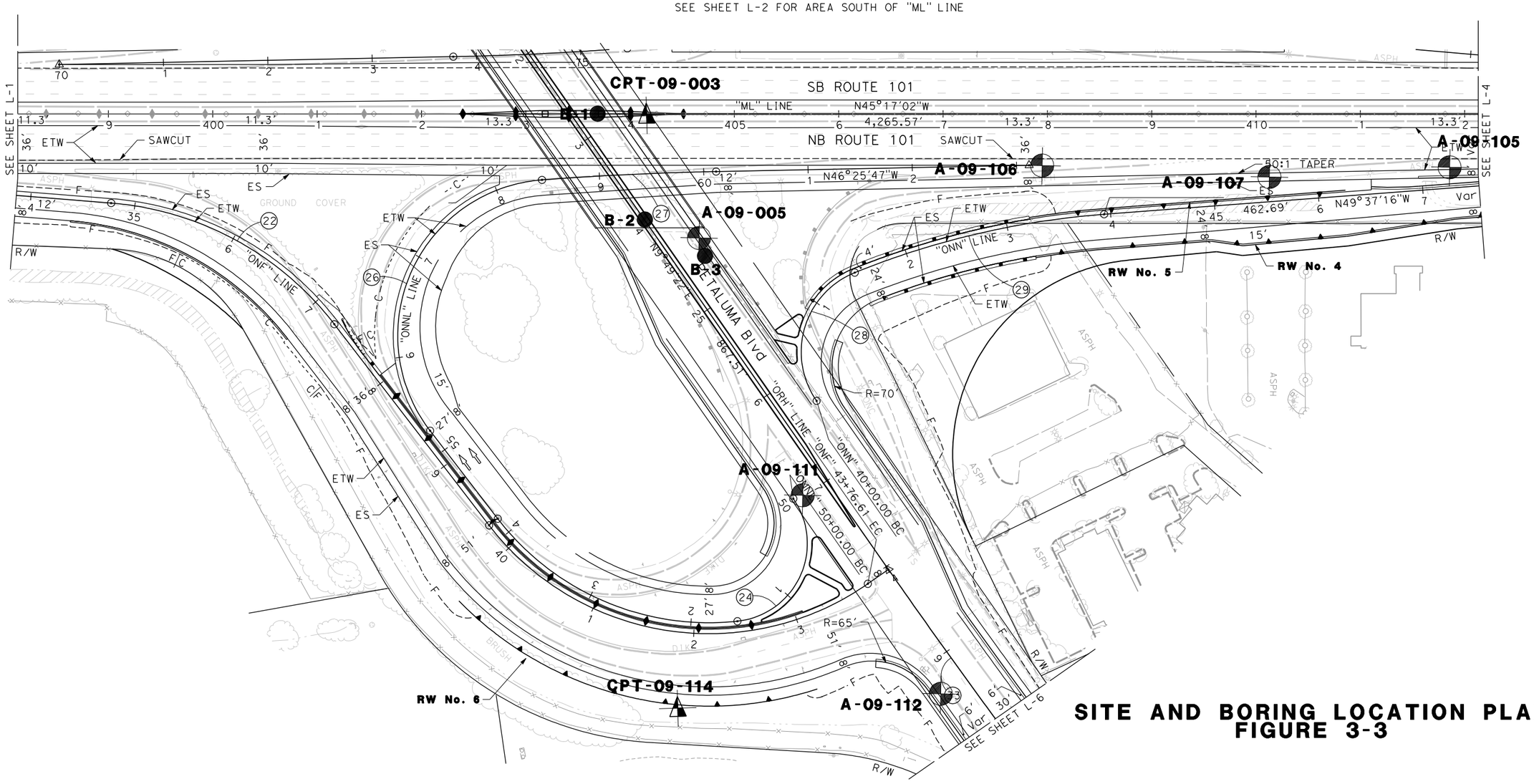
LEGEND:

- 1952 Explorations
- 2009 Exploratory Borings
- 2009 Cone Penetration Test

CURVE DATA

No.	R	Δ	T	L	CURVE CENTER N	CURVE CENTER E
22	300.00′	47°52′22"	133.17′	250.66′	1861550.3041	6369930.3472
23	266.00′	87°19′37"	253.87′	405.42′	1861862.1716	6369399.0311
24	75.00′	118°47′23"	126.79′	155.50′	1862003.2115	6369511.6721
25	255.50′	58°32′14"	143.20′	261.04′	1861862.1716	6369399.0311
26	149.64′	123°13′45"	276.92′	321.83′	1861743.3717	6369490.8210
27	3,000.00′	03°11′29"	83.57′	167.10′	1863914.7138	6371337.3954
28	82.00′	102°54′16"	102.91′	147.27′	1861979.0978	6369275.0901
29	800.00′	17°39′06"	124.22′	246.47′	1862641.3493	6369552.4832
33	7,050.00′	2°52′45"	177.17′	354.26′	1863330.8585	6362473.9989

SEE SHEET L-2 FOR AREA SOUTH OF "ML" LINE



SITE AND BORING LOCATION PLAN
FIGURE 3-3

SCALE: 1"=50′

REVISED BY | DATE REVISED
CALCULATED-DESIGNED BY | CHECKED BY
CONSULTANT FUNCTIONAL SUPERVISOR
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Caltrans

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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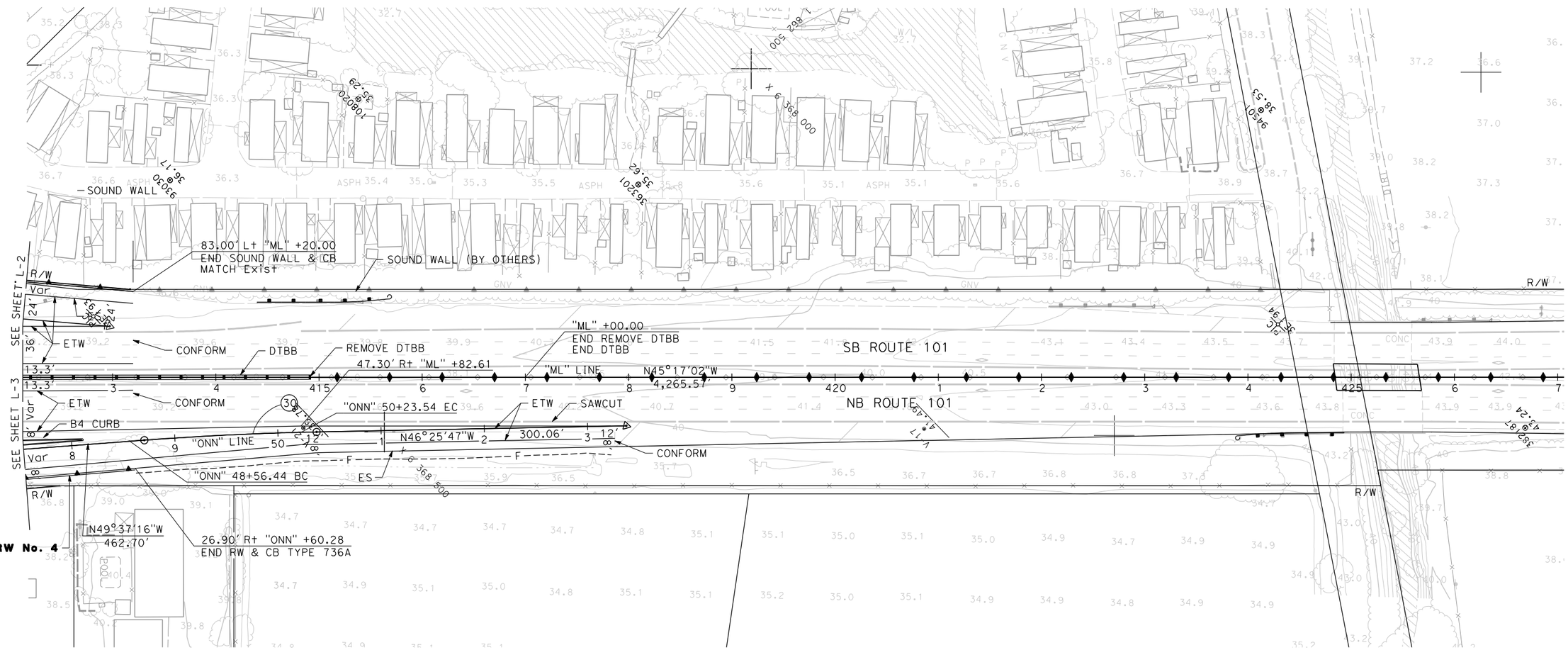
Suite 1500
San Jose, CA 95113

NOTE:
FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY RECORD MAPS AT DISTRICT OFFICE.

CURVE DATA

No.	R	△	T	L	CURVE CENTER N	CURVE CENTER E
30	3,000.00′	3°11′29"	83.57′	167.10′	1864617.0120	6370625.2571



SITE AND BORING LOCATION PLAN
FIGURE 3-4

SCALE: 1"=50′

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR | CALCULATED-DESIGNED BY | CHECKED BY | REVISED BY | DATE REVISED

LAST REVISION 00-00-00 | DATE PLOTTED => 1/27/2010 | TIME PLOTTED => 10:01:38 AM

BORDER LAST REVISED 4/11/2008 | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | USERNAME => madhu_thummaluru | DGN FILE => ...\Figures\Site Plan Fig 3-4.dgn | CU 00000 | EA 04-0A1851

Liquefaction Susceptibility Map

Susceptibility Level

- Very High
- High
- Moderate
- Low
- Very Low

Major Roads

Local Roads

Scale: 1 inch = 0.32 miles

This map is intended for planning use only and is not intended to be site-specific. Rather, it depicts the general risk within neighborhoods and the relative risk from community to community. More detailed maps are needed for site development decisions.

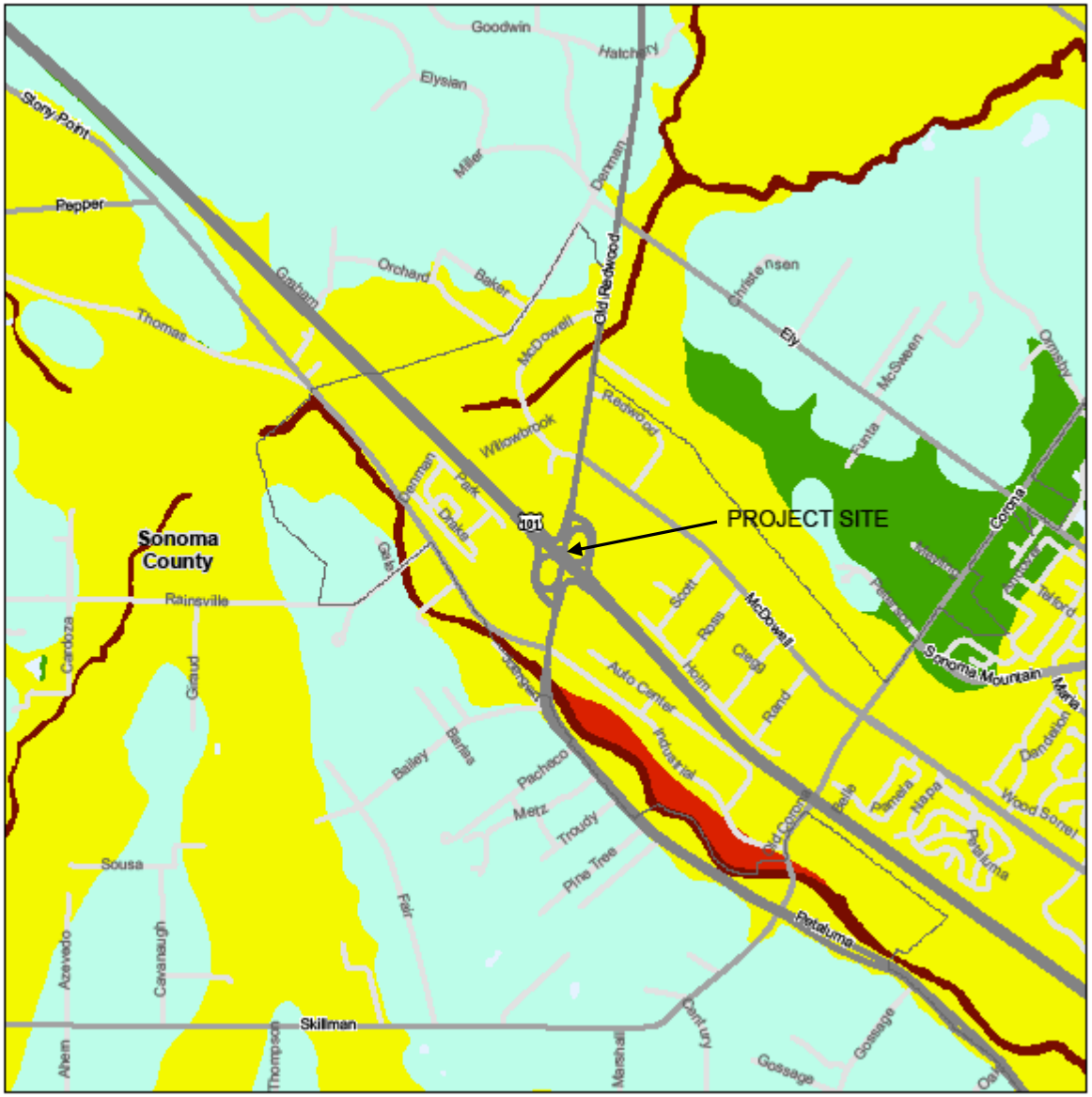
This map is available at http://quake.abag.ca.gov

Sources:
This map is based on work by William Lettis & Associates, Inc. and USGS. USGS Open-File Report 00-444, Knudsen & others, 2000 and USGS Open-File Report 2006-1037, Witter & others, 2006

For more information visit:
http://pubs.usgs.gov/of/2000/of00-444/
http://pubs.usgs.gov/of/2006/1037/

Map Prepared by the ABAG Earthquake Program. June 2009.

ABAG Geographic Information Systems



URS 55 South Market Street, Suite 1500 San Jose, CA 95113 PHONE: (408) 297-9585 FAX: (408) 297-6962	Old Redwood Highway Petaluma, CA Project No: 28645097	**Liquefaction Susceptibility Map**	**FIGURE** **4-1** January, 2010

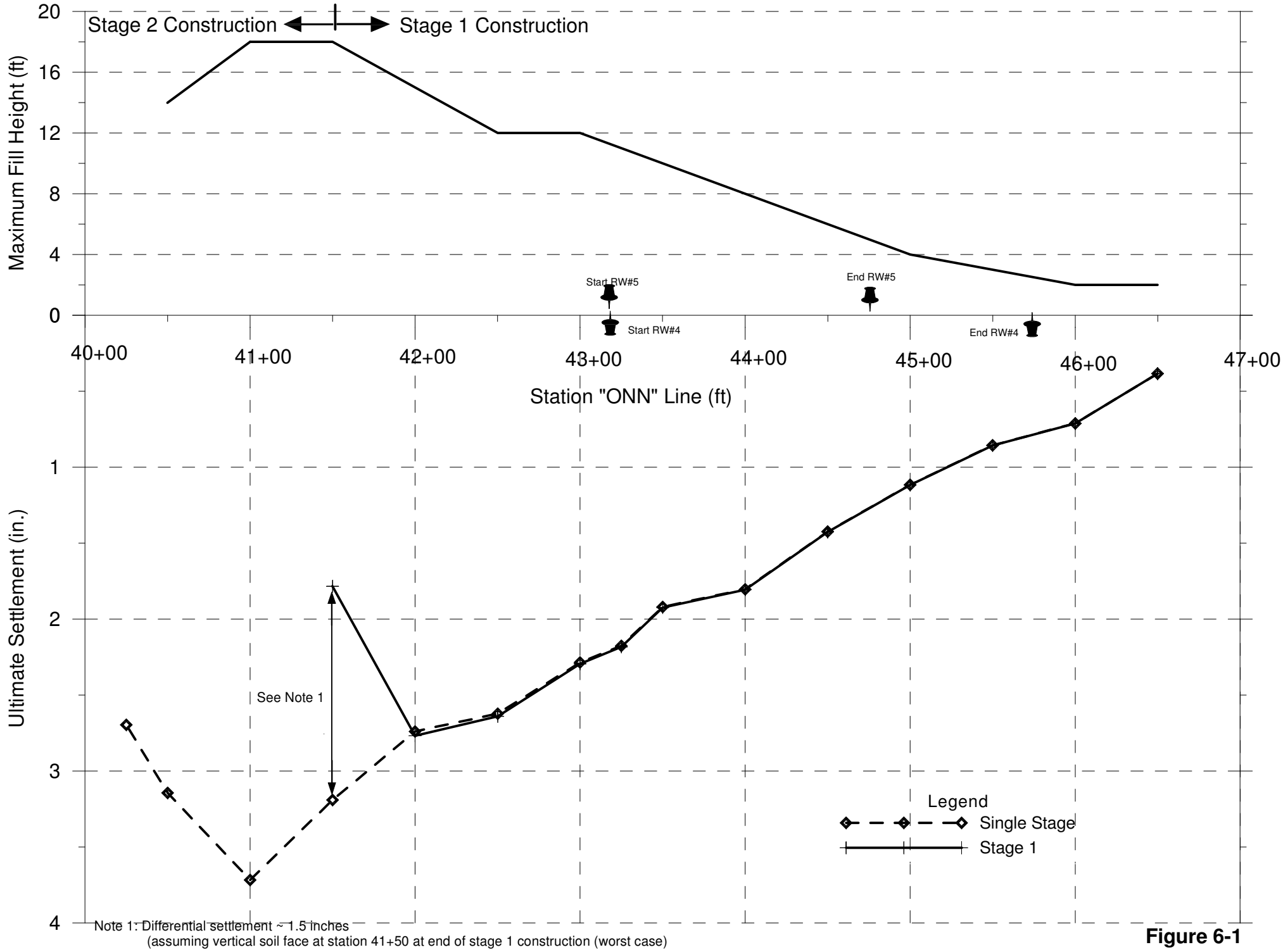

Stage 2 Construction
Stage 1 Construction
Maximum Fill Height (ft)
20
16
12
8
4
0
Start RW#5
Start RW#4
End RW#5
End RW#4
40+00
41+00
42+00
43+00
44+00
45+00
46+00
47+00
Station "ONN" Line (ft)
Ultimate Settlement (in.)
1
2
3
4
See Note 1
Legend
Single Stage
Stage 1
Note 1: Differential settlement ~ 1.5 inches
(assuming vertical soil face at station 41+50 at end of stage 1 construction (worst case)

Figure 6-1

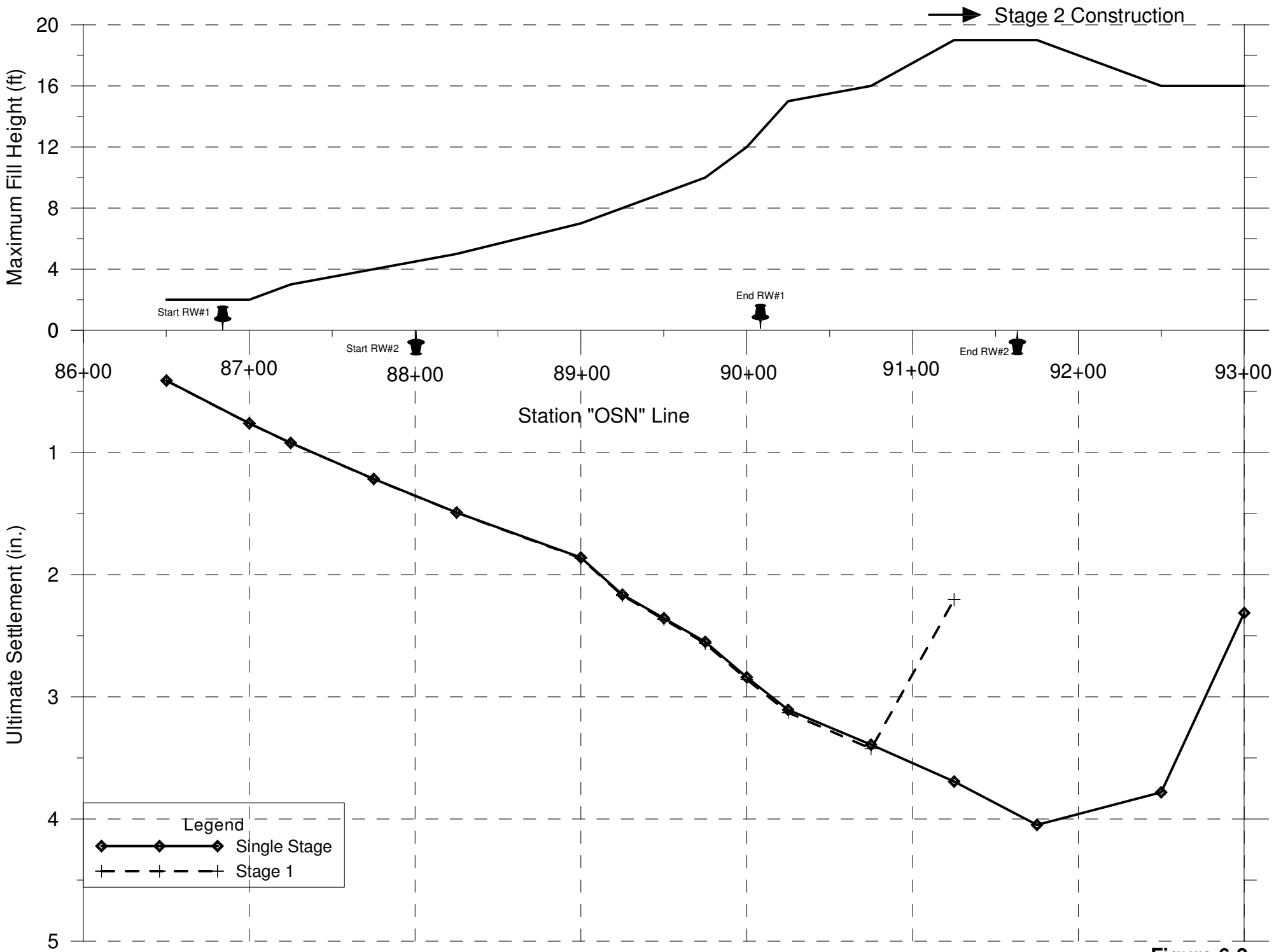
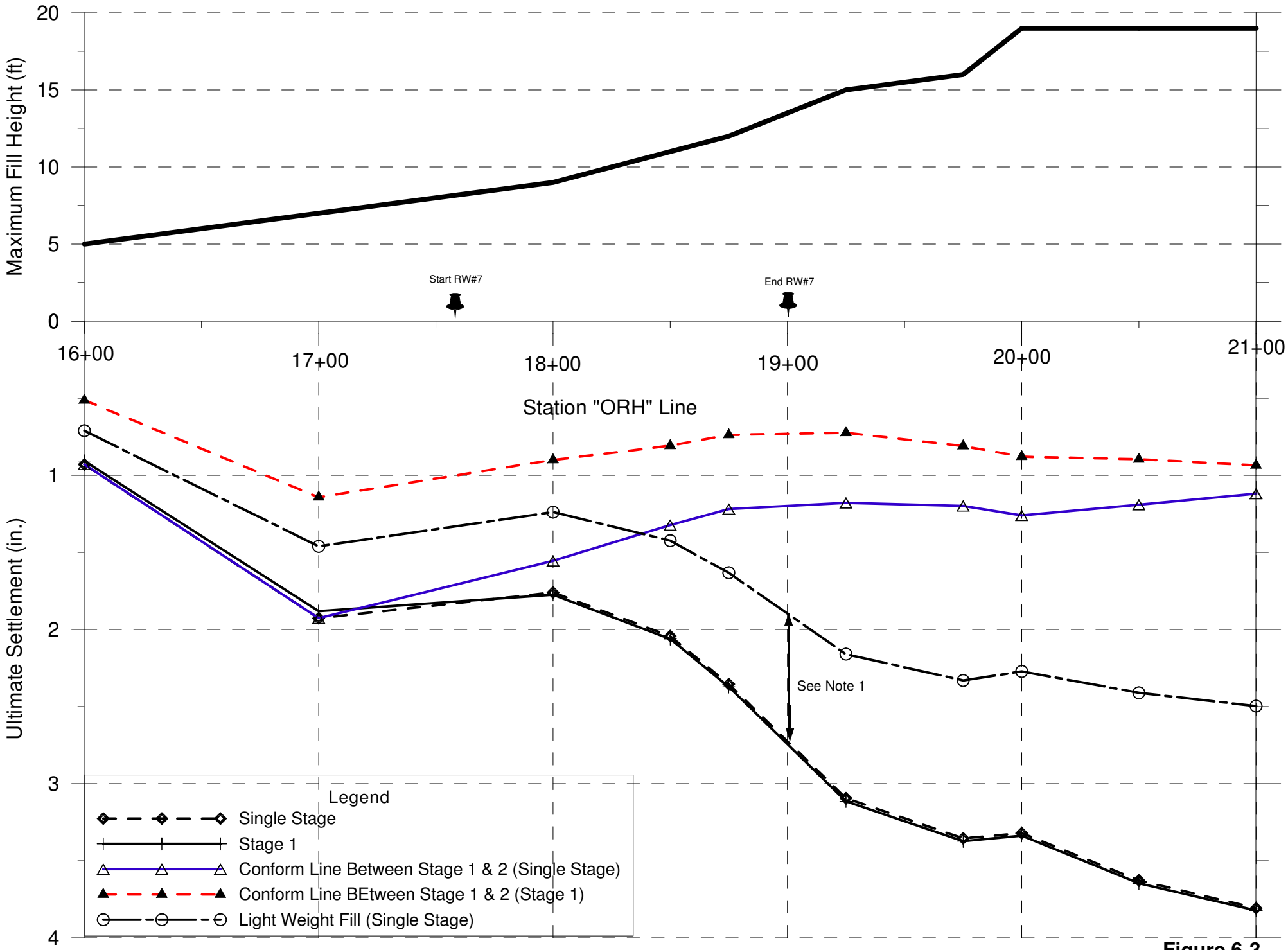

Stage 2 Construction
Maximum Fill Height (ft)
20
16
12
8
4
0
Start RW#1
Start RW#2
End RW#1
End RW#2
86+00
87+00
88+00
89+00
90+00
91+00
92+00
93+00
Station "OSN" Line
Ultimate Settlement (in.)
1
2
3
4
5
Legend
Single Stage
Stage 1

Figure 6-2



Note 1: Differential settlement ~ 0.5 inch

Figure 6-3

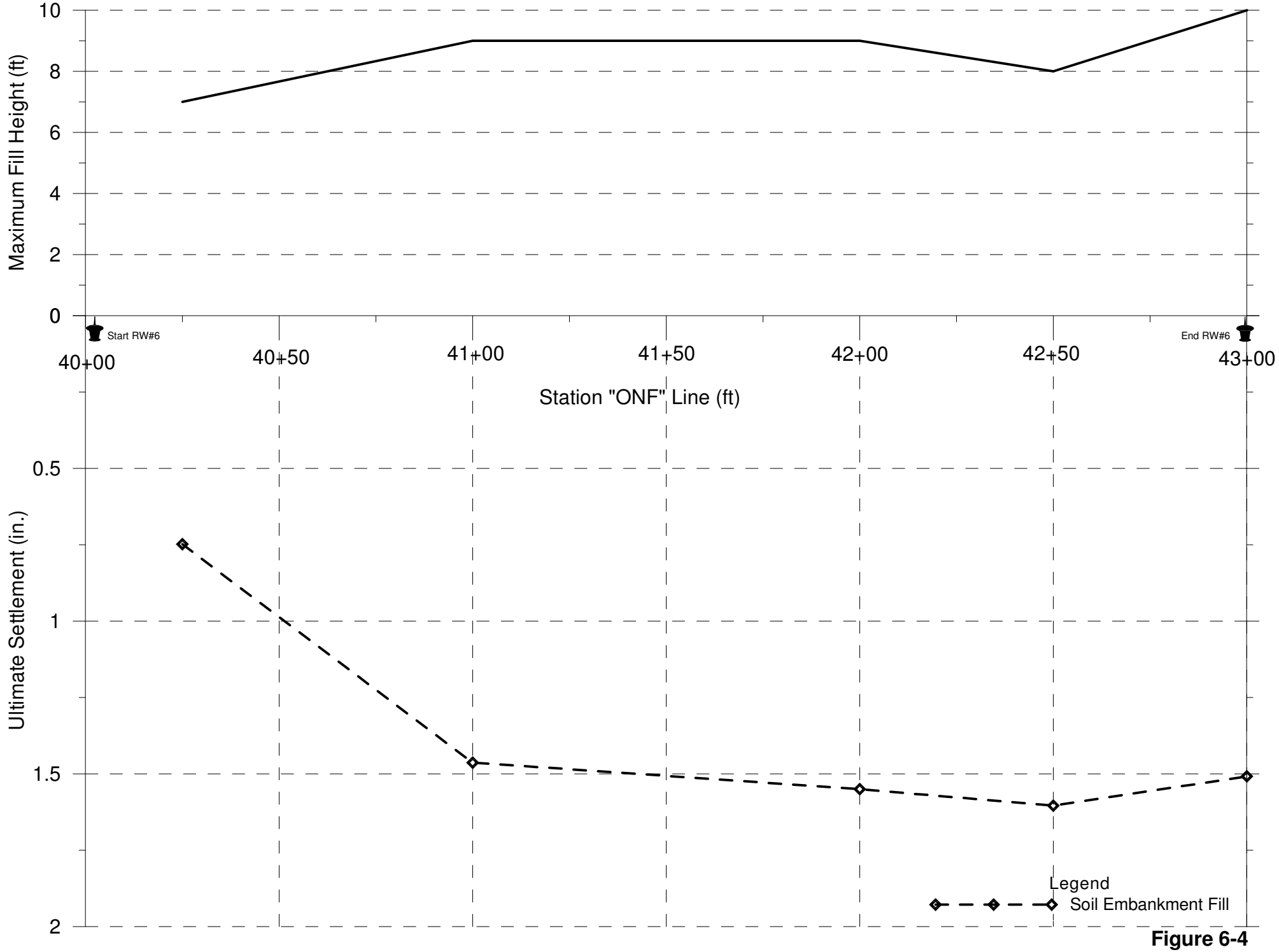

Maximum Fill Height (ft)
10
8
6
4
2
0
Start RW#6
End RW#6
40+00
40+50
41+00
41+50
42+00
42+50
43+00
Station "ONF" Line (ft)
Ultimate Settlement (in.)
0.5
1
1.5
2
Legend
Soil Embankment Fill

Figure 6-4

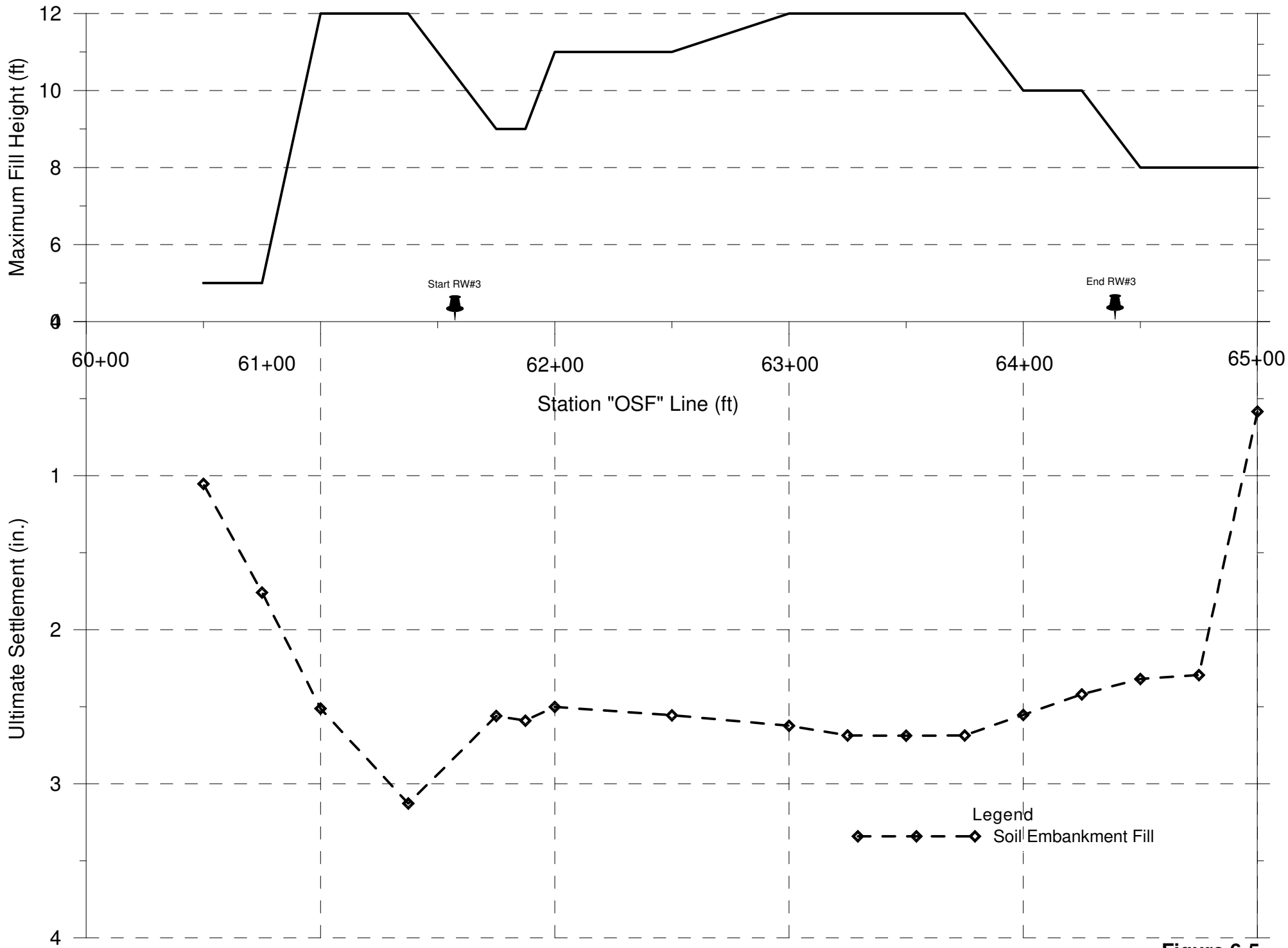
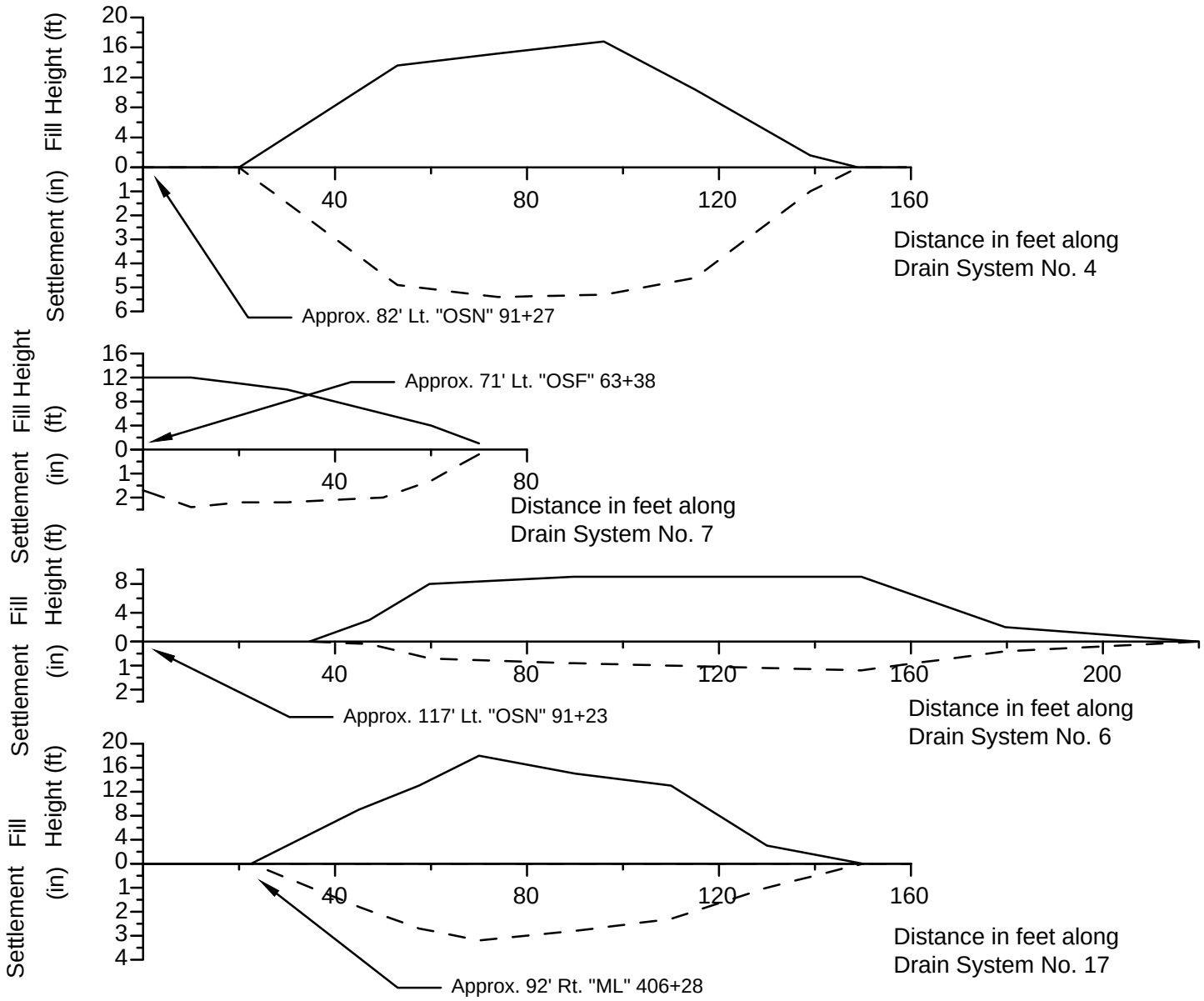

Maximum Fill Height (ft)
12
10
8
6
4
Start RW#3
End RW#3
60+00
61+00
62+00
63+00
64+00
65+00
Station "OSF" Line (ft)
Ultimate Settlement (in.)
1
2
3
4
Legend
Soil Embankment Fill

Figure 6-5

X:\Old Redwood Interchange PSE\440_Materials\Analysis\Settlement\Pipes



URS	Old Redwood Highway **Interchange** Petaluma, California	Drainage System Deflection Profile	Not of Scale Figure 6-6 March 2012

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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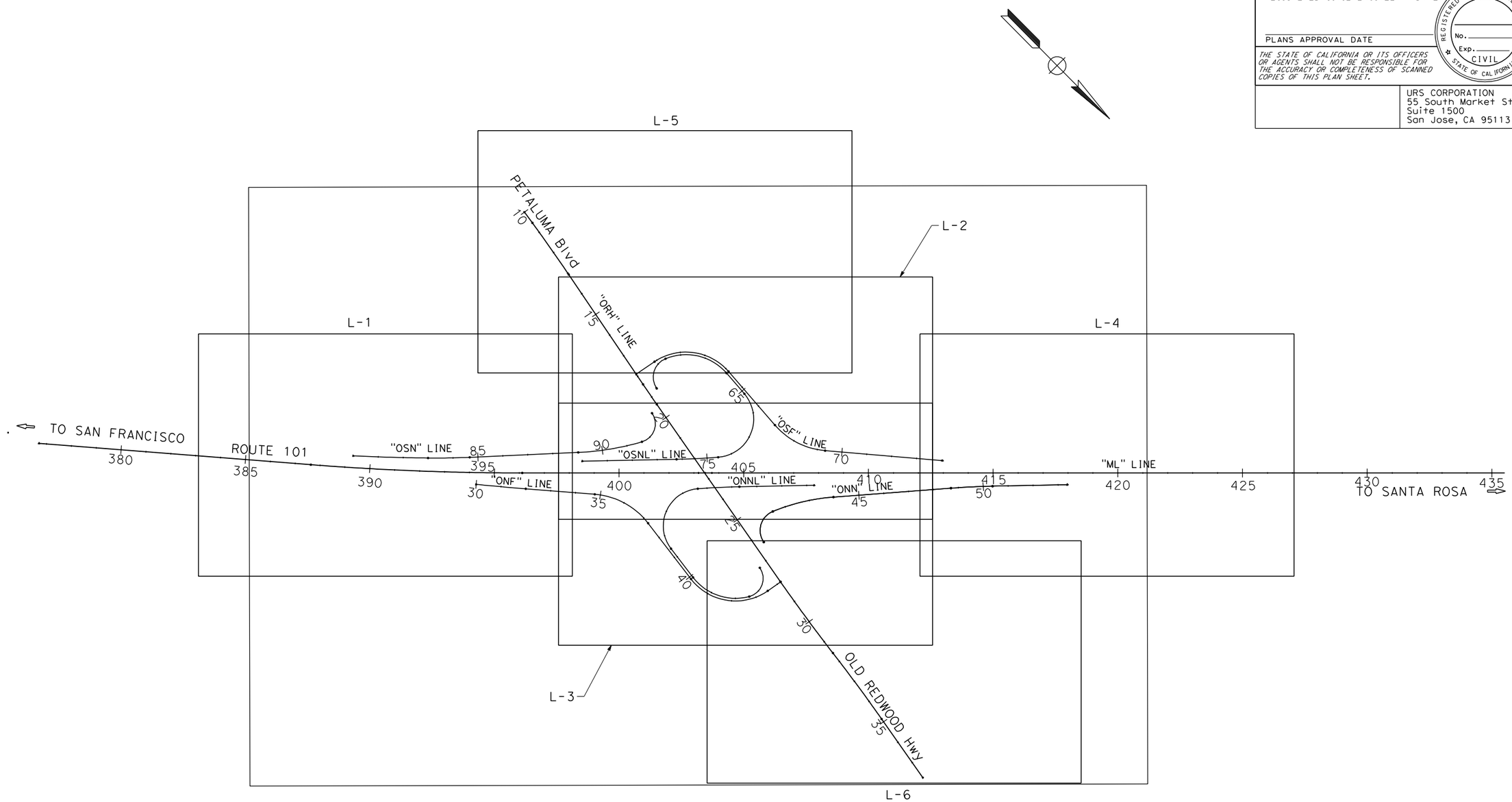


KEYMAP & LINE INDEX

SCALE 1"=200'

K-1

REVISED BY | DATE REVISED

CALCULATED- DESIGNED BY | CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 00-00-00 | DATE PLOTTED => 1/27/2010 | TIME PLOTTED => 2:45:51 PM

" " 4 Paving Details
" " 5-26 Plan and Profile
" " 27-36 Construction Details
" " 37-46 Pavement Elevations
" " 47-54 Miscellaneous Drainage Structures
55A " " 55-59 Quantity Summaries
56A " " 60 Miscellaneous Details
" " 61-67 Standard Structures
" " 68-81 Highway Lighting
" " 1-238 Cross Sections
" " 1-3 Mass Diagram
Sheet No. 1-73 Bridge Plans
Bridge across Willow Brook
Denman Overcrossing
Corona Road Overcrossing
North Petaluma Overhead
Bridge across Lynch Creek
Bridge across Washington St. Creek
Washington St. Overcrossing
Off-Ramp Bridge across Washington St. Creek
Route 1/104 Separation and Overhead
South Petaluma Undercrossing

DIVISION OF HIGHWAYS

PLAN AND PROFILE OF STATE HIGHWAY

In Sonoma County, between Railroad Avenue and 1.4 miles south of Petaluma Creek

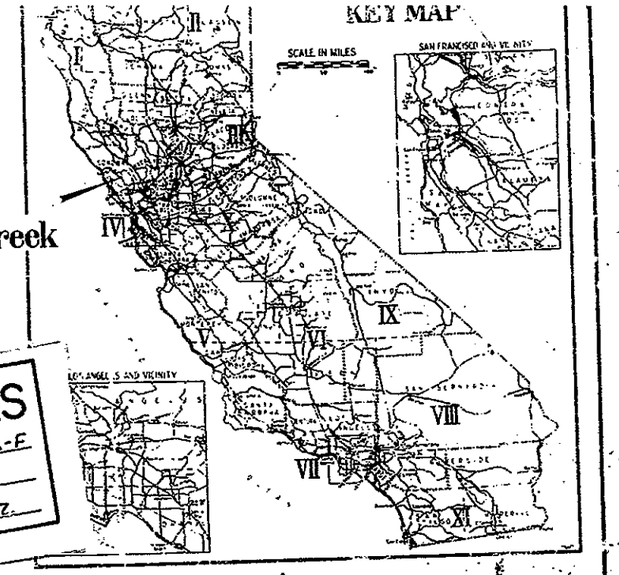
Scales { Plan: 1 In.=100 Ft. / Profile: Hor. 1 In.=100 Ft. Vert. 1 In.=10 Ft.

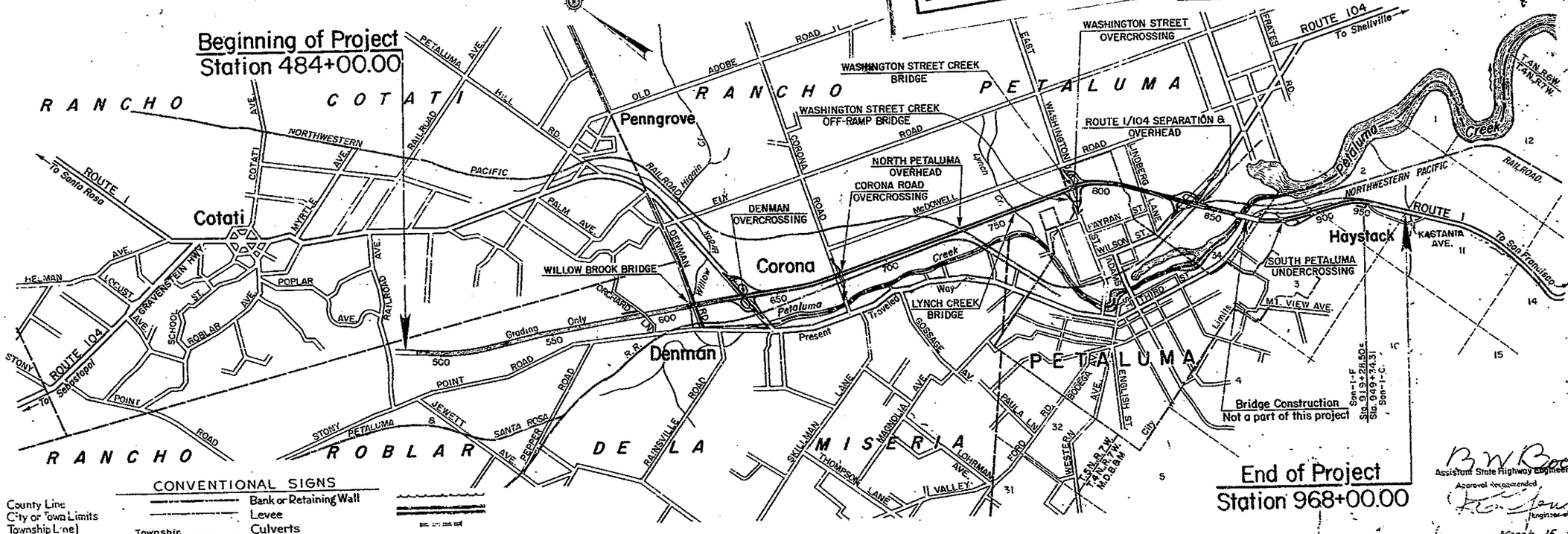
(being the detail plans of a portion of the route for the State highway adopted by the California Highway Commission March 23, 1950 and declared a

FREEWAY

by resolution of the California Highway Commission March 23, 1950)

AS BUILT PLANS
Contract No. 54-4TC63-F
Date Completed
Document No. 4000 1442





CONVENTIONAL SIGNS

County Line
City or Town Limits
Township Line
Section Line
Grant Line
Township (N.E. or other Township, Section or Grant)
Fence
Guard Rail
Unfenced Property
Right of Way Line
Base or Survey Line
Traveled Way
Railway Tracks
Bank or Retaining Wall
Levee
Culverts
Drop Inlet
Trolley Pole
Power Poles
Power Trees
Telegraph or Telephone Pole
Marsh

SCALE IN FEET
0 2000 4000 6000

Length of Project-45,395.59 feet=8.598 miles

B. W. Booser
Assistant State Highway Engineer Dist. IV
Approval recommended
Approved March 15, 1954
State Highway Engineer
Civil Engineer in Charge
Director of Public Works

54-4TC-63F

IV-907

DIST.	COUNTY	ROUTE	SECTION	SHEET No.	TOTAL SHEETS
IV	SON.	1	F.Pet.C	2	81.

APPROVED March 15, 1954
E. T. McCoy
CIVIL ENGINEER LICENSE No. 20881

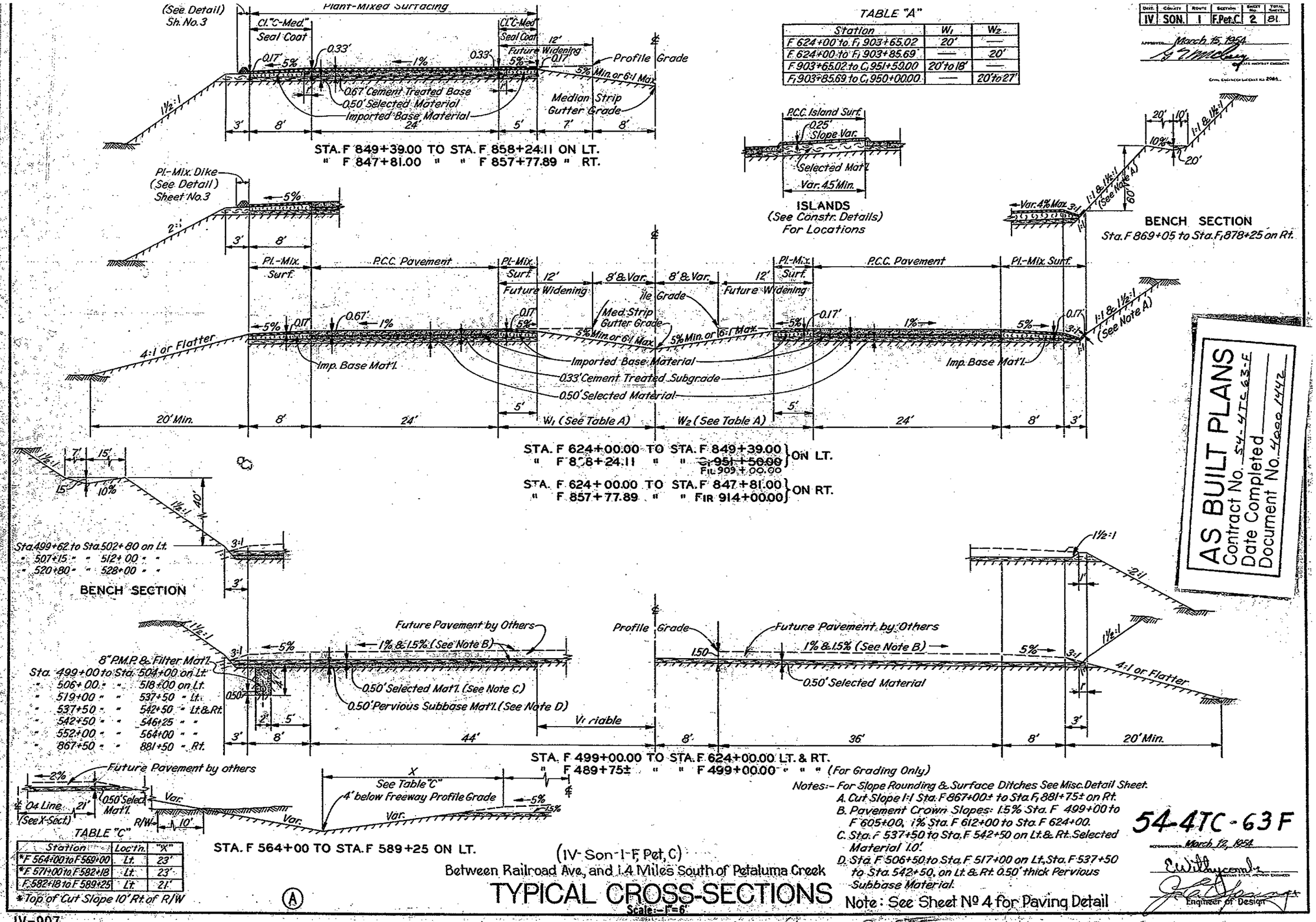


TABLE "A"

Station	W1	W2
F 624+00 to F1 903+65.02	20'	—
F 624+00 to F1 903+85.69	—	20'
F 903+65.02 to C1 951+50.00	20' to 18'	—
F1 903+85.69 to C1 950+00.00	—	20' to 27'

TABLE "C"

Station	Loc'tn.	"X"
*F 564+00 to F 569+00	Lt.	23'
*F 571+00 to F 582+18	Lt.	23'
F 582+18 to F 589+25	Lt.	21'

* Top of Cut Slope 10' Rt. of R/W

Notes:- For Slope Rounding & Surface Ditches See Misc. Detail Sheet.

A. Cut Slope 1:1 Sta. F 867+00± to Sta. F1 881+75± on Rt.

B. Pavement Crown Slopes: 1.5% Sta. F 499+00 to F 605+00, 1% Sta. F 612+00 to Sta. F 624+00.

C. Sta. F 537+50 to Sta. F 542+50 on Lt. & Rt. Selected Material 1.0'.

D. Sta. F 506+50 to Sta. F 517+00 on Lt., Sta. F 537+50 to Sta. 542+50, on Lt. & Rt. 0.50' thick Pervious Subbase Material.

Note: See Sheet № 4 for Paving Detail

AS BUILT PLANS
Contract No. 54-4TC63-F
Date Completed
Document No. 4000 1442

54-4TC-63F

March 12, 1954

E. Willyoung
Engineer of Design

(IV-Son-1-F, Pet, C)
Between Railroad Ave., and 1.4 Miles South of Petaluma Creek

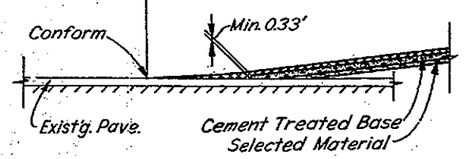
TYPICAL CROSS-SECTIONS

Scale:- 1" = 6'

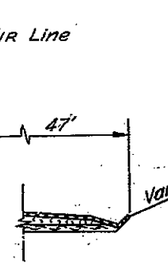
(A)

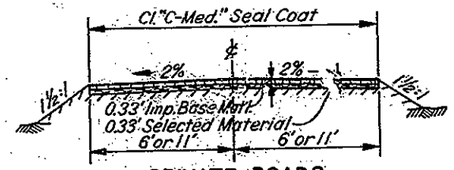
IV-907

Rev. 2488

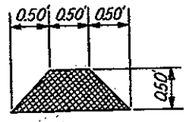


LONGITUDINAL SECTION

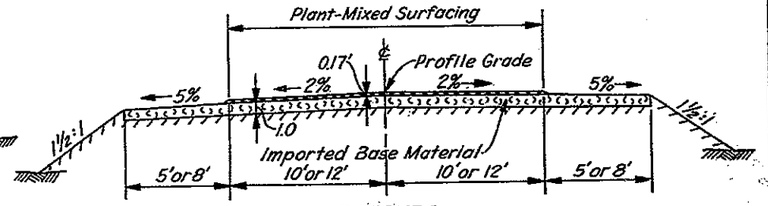




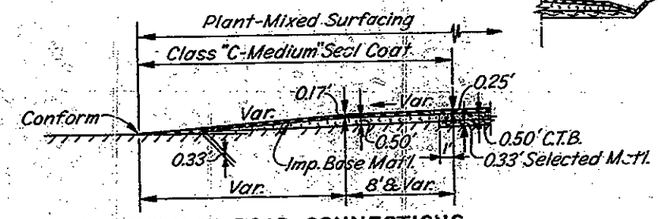
PRIVATE ROADS
STA. O3 31+55 TO STA. O3 37+27
STA. Co 111+60 " " Co 113+45 ON LT.



PLANT-MIXED DIKE
Scale:- 1" = 1'



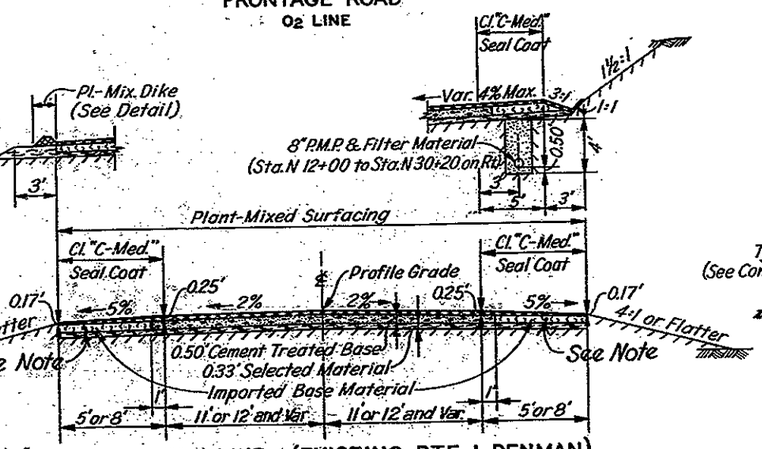
DETOURS
HD LINE (EXISTING RTE. I, DENMAN)
WD " (WASHINGTON ST.)



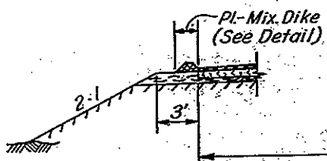
PRIVATE ROAD CONNECTIONS

STA. H 647+77 ON LT. (O1 LINE)
" W 20+55 " RT.
" W 21+70 " LT. (W7 LINE)
STA. D 26+33 ON LT.
" D 28+81.07 ON RT.
" N 28+62 ON RT.

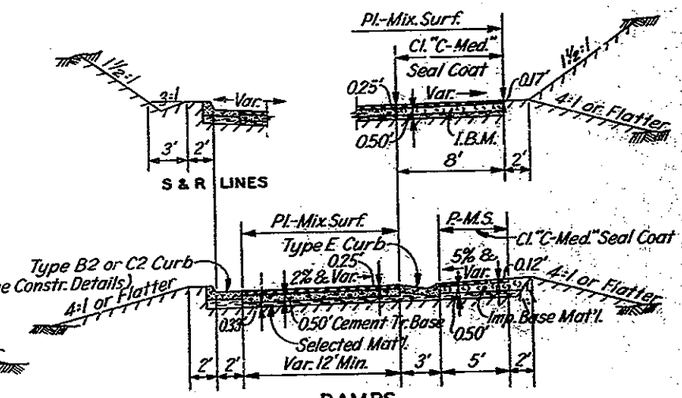
LONGITUDINAL SECTION



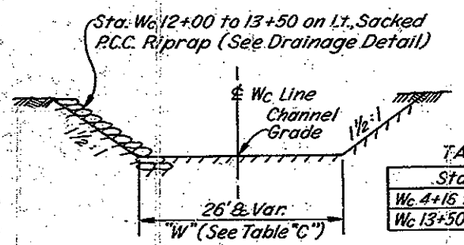
FRONTAGE ROAD
O2 LINE



S & R LINES



RAMPS
H1, H2, H3, H5 & H6 LINES (DENMAN INTERCHANGE)
W1, W2, W3, W4, W5 & W5A LINES (WASHINGTON ST. INTERCHANGE)
D1, D2, D3 & D4 LINES (ROUTE 104 INTERCHANGE)



CHANNEL CHANGE
(WASHINGTON ST.)

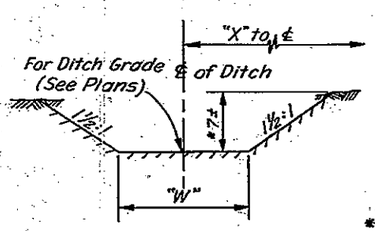
Sta. Wc 12+00 to 13+50 on Lt. Sacked P.C.C. Riprap (See Drainage Detail)

TABLE "C"

Station	"W"
Wc 4+16 to 13+50	26'
Wc 13+50 " 13+80	Var. 26-14'

Note:- Sta. H 647+00 to Sta. H 649+50 Left and Right Cement Treated Base Shoulders in lieu of Imported Base Material.

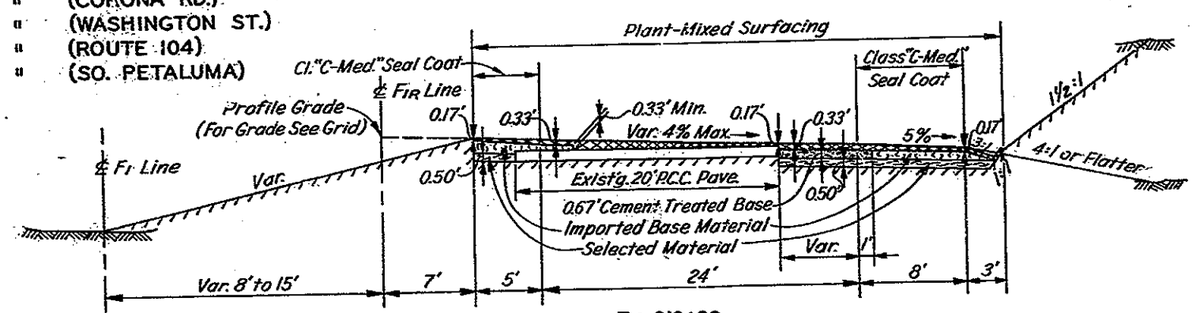
H LINE (EXISTING RTE. I, DENMAN)
Co " (CORONA RD.)
W " (WASHINGTON ST.)
D " (ROUTE 104)
N " (SO. PETALUMA)



DITCH SECTION
(See Table "B")

TABLE "B"

Station	Loc'tn.	"W"	"X"
F 589+65 to F 601+00	Lt.	4'	77' Min. to F Line
F 597+70	Rt.	8'	Rt. Angle to F Line
* F 611+41	Along Cr.	30'	Bet. R/W Line
F 612+00 to F 625+00	Lt.	3'	85' Min. to F Line
F 625+00 - H 648+00	Rt.	3'	33' " " H Line
F 660+21 - F 675+54	Lt.	10'	1205' Min. to F Line
F 816+50 - D 42+09	"	Var. 3 to 6	35' " " D2 "



STA. FIR 914+00 TO STA. FIR 919+88 / C1 950+00 ON RT.

Note:-
For Slope Rounding & Surface Ditches
See Misc. Detail Sheet.

(IV-Son-1-F, Pet, C)
Between Railroad Ave. and 1.4 Miles South of Petaluma Creek

TYPICAL CROSS-SECTIONS

Scale:- 1" = 5'

(B)

54-4TC-63F

Paul 2488

March 12 1954

Engineer of Design

IV-907

7	CALIF.	F-0145(3)	1	84

P.M. 0.0/7.4

New 04-Son-101

DIST	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
IV	Son	1	E,C	1	58

INDEX OF SHEETS

Sheet No. 1 Title Sheet
" " 2-3 Typical Cross Sections
" " 4 Paving Details
" " 5-14 Plan and Profile Added Sheet #12A
" " 15 Miscellaneous Profiles
" " 16 Wilfred Overhead Embankments
" " 17-22 Construction Details
" " 23-27 Pavement Elevations
" " 28 School Street Pedestrian Undercrossing
" " 29 Cattlepasses
" " 30-35 Miscellaneous Drainage Structures
" " 36 Miscellaneous Quantities
" " 37-38 Structure List
" " 39-46 Miscellaneous Details
" " 47 Standard Curb Sections
" " 48-58 Lighting Plans Added Sheet #52A
" " 1-133 Cross Sections
" " 1-2 Mass Diagram

BRIDGE PLANS

Sheet No. 1-5 Copeland Creek Bridge
" 6 to 66 Rte. 1/104 Separation
" 81 to 86 Roblar Avenue Undercrossing
" 41 to 46 Railroad Avenue Undercrossing
" 51 to 53 Standard Details

STATE OF CALIFORNIA

DEPARTMENT OF PUBLIC WORKS

DIVISION OF HIGHWAYS

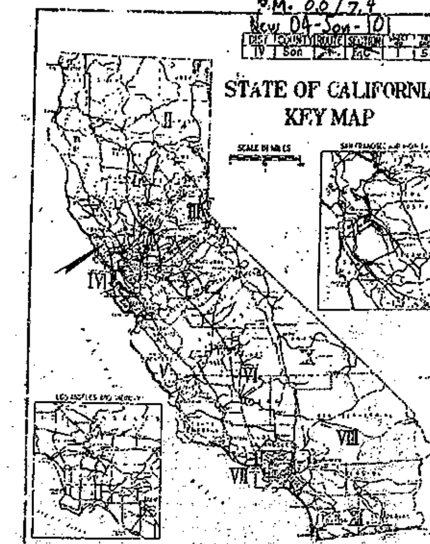
PLAN AND PROFILE OF

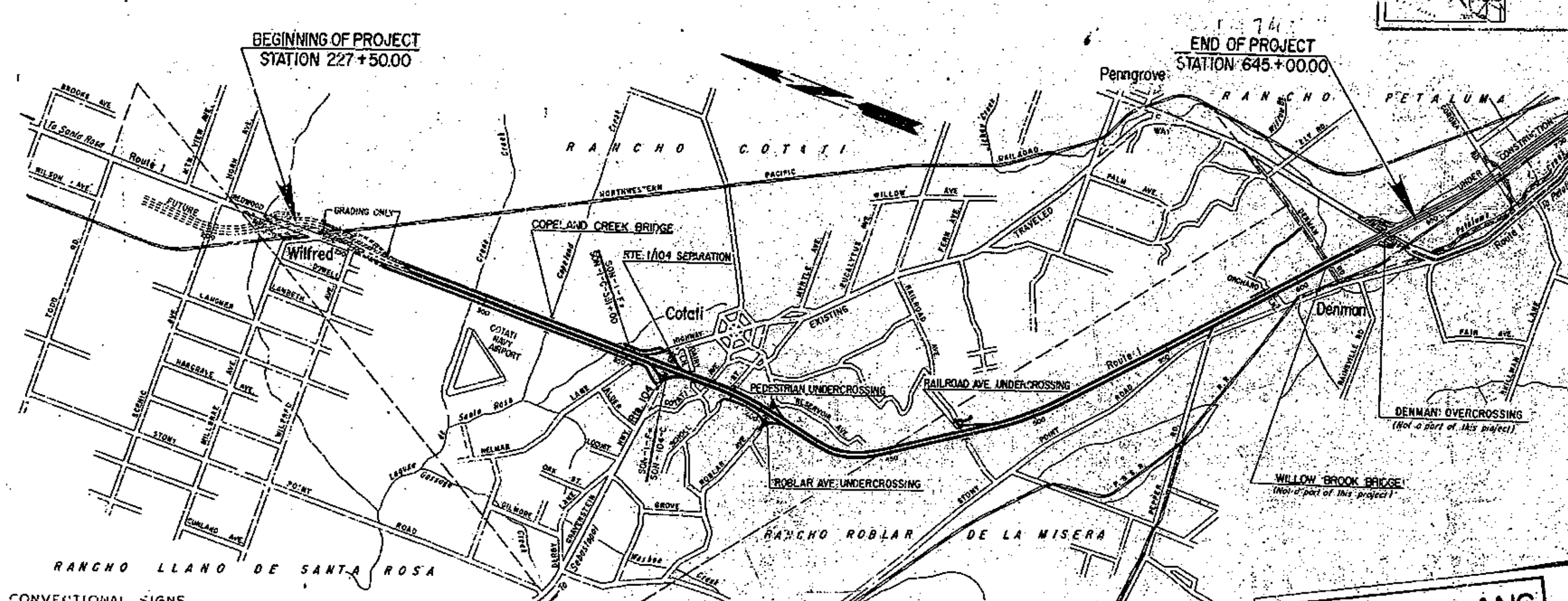
STATE HIGHWAY

In Sonoma County, between 3 miles north of Cotati at Wilfred and existing Route 1 at Denman

Scales {Plan: 1 in. = 100 Ft.
{Profile: Hor. 1 in. = 100 Ft. Vert. 1 In. = 10 Ft.

(being the detail plans of a portion of the route for the State highway adopted by the California Highway Commission September 17, 1953 and March 23, 1950. FREEWAY established September 17, 1953 and March 23, 1950)





CONVENTIONAL SIGNS

County Line		Bank or Retaining Wall	
City or Town Limits		Levee	
Township Line, Section Line, Grant Line		Culverts	
Fence		Drop Inlet	
Guard Rail		Trolley Pole	
Unfenced Property		Power Pole	
Right of Way Line		Power Tower	
Base or Survey Line		Telegraph or Telephone Pole	
Traveled Way			
Railway Tracks		Marsh	

SCALE

0 1000 2000 3000 4000 5000 FEET

Length of Project 41,750.00 Feet = 7.907 Miles

AS BUILT PLANS
Contract No. 56-4TC2-F
Date Completed
Document No. 4000141I

E. A. Weymouth
District Engineer Dist. IV
Approval Recommended
J. C. Young
Engineer of Design
Approved February 8, 1955
G. T. McCoy
State Highway Engineer
Civil Engineer License 2084
Frank B. Durkee
Director of Public Works

56-4TC2-F

IV-908

F-0145 (2)

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
IV	SON.	1	F.Pet.C.	2	81

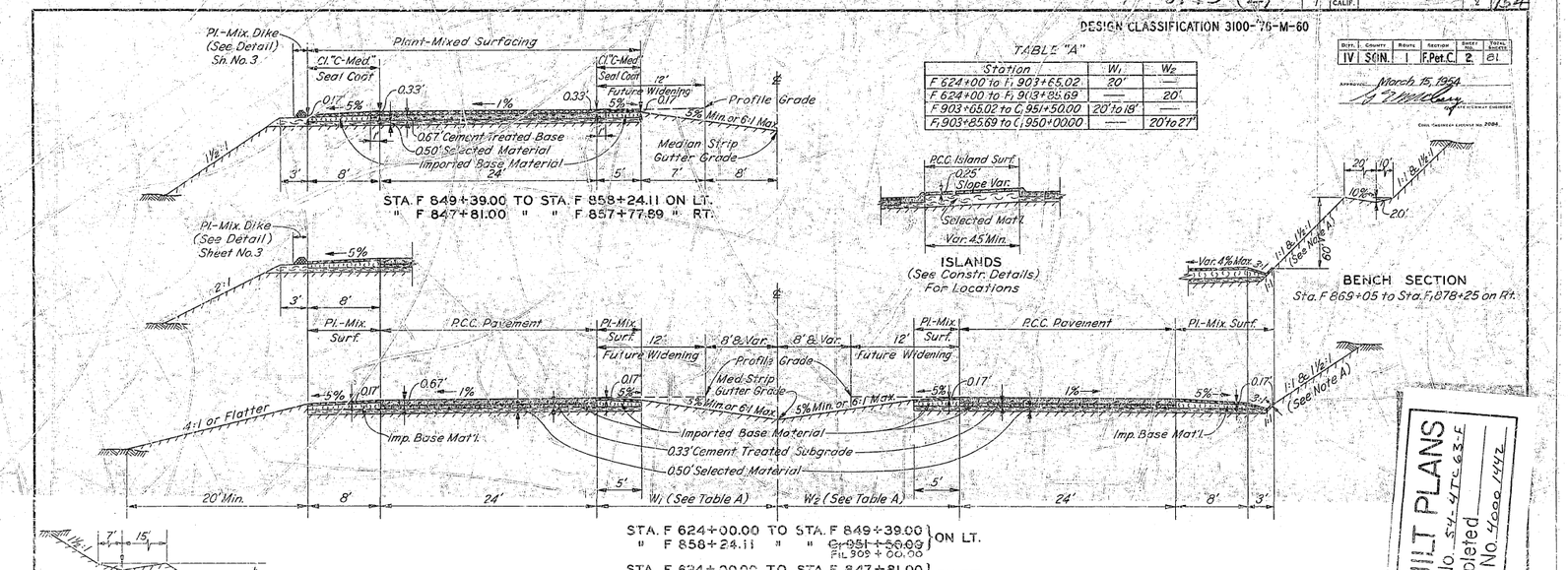
DIST. DIV. NO.	STATE	FEDERAL PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.		2	154

DESIGN CLASSIFICATION 3100-'76-M-60

TABLE "A"

Station	W_1	W_2
F 624+00 to F 903+65.02	20'	—
F 624+00 to F 903+85.69	—	20'
F 903+65.02 to C 951+50.00	20' to 18'	—
F 903+85.69 to C 950+00.00	—	20' to 27'

March 15, 1954



Station	Locth.	"X"
*F 564+00 to F 569+00	Lt.	23'
*F 571+00 to F 582+18	Lt.	23'
F 582+18 to F 589+25	Lt.	21'

*Top of Cut Slope 10' Rt. of R/W

Notes:- For Slope Rounding & Surface Ditches See Misc. Detail Sheet.

A. Cut Slope 1:1 Sta. F 867+00± to Sta. F 881+75± on Rt.

B. Pavement Crown Slopes: 1.5% Sta. F 499+00 to F 605+00, 1% Sta. F 612+00 to Sta. F 624+00.

C. Sta. F 537+50 to Sta. F 542+50 on Lt & Rt. Selected Material 1.0'.

D. Sta. F 506+50 to Sta. F 517+00 on Lt., Sta. F 537+50 to Sta. 542+50, on Lt. & Rt. 0.50' thick Pervious Subbase Material.

Note: See Sheet No 4 for Paving Detail

(IV-Son-1-F.Pet.C)

Between Railroad Ave., and 1.4 Miles South of Petaluma Creek

TYPICAL CROSS-SECTIONS

Scale:-1"=6'

54-4TC-63F

March 15, 1954

Engineer of Design

AS BUILT PLANS
Contract No. 54-4TC-63-F
Date Completed
Document No. 4000 1442

IV-907

AS BUILT PLANS
Contract No. 54-4TC63-F
Date Completed
Document No. 4000 1442

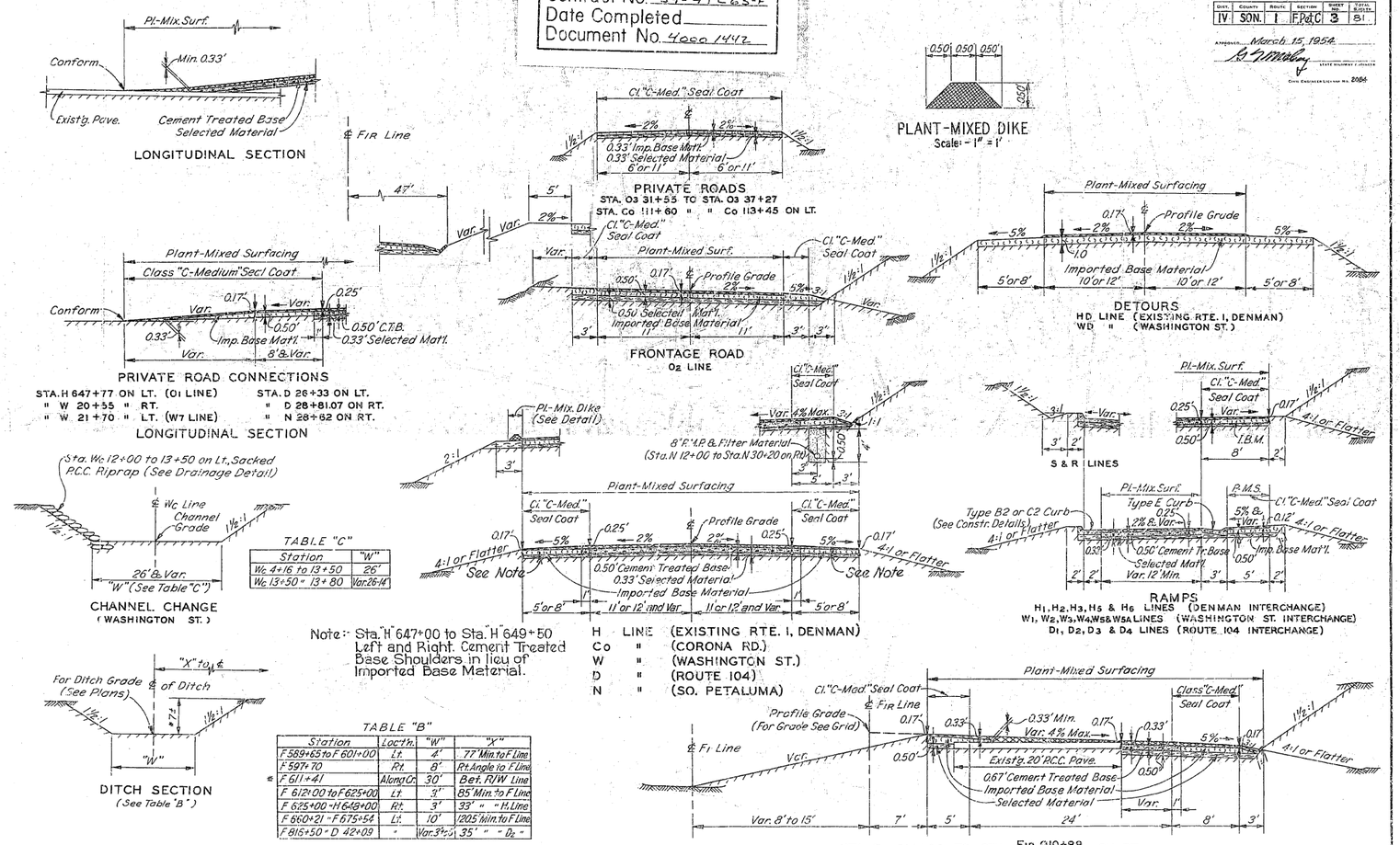
F-0145 (2)

D.P.W. DIV. NO.	STATE	FEDERAL PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.		3	154

DESIGN CLASSIFICATION 3100-76-M-60

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
IV	SON.	I	F,Pet,C	3	81

APPROVED March 15, 1954
R. S. Mallory
STATE HIGHWAY ENGINEER
CIVIL ENGINEER LICENSE NO. 2086



Station	Loc'tn.	"W"	"X"
F 589+65 to F 601+00	Lt.	4'	77' Min. to F Line
F 597+70	Rt.	8'	Pt. Angle to F Line
F 611+41	Along Cr.	30'	Bet. R/W Line
F 612+00 to F 625+00	Lt.	3'	85' Min. to F Line
F 625+00 - H 648+00	Rt.	3'	33' " " H Line
F 660+21 - F 675+54	Lt.	10'	1205' Min. to F Line
F 815+50 " D 42+09	"	Var. 3' to 5'	35' " " D2 "

Note:-
For Slope Rounding & Surface Ditches See Misc. Detail Sheet.

(IV-Son-1-F, Pet, C)
Between Railroad Ave. and 1.4 Miles South of Petaluma Creek

TYPICAL CROSS-SECTIONS

Scale:- 1" = 6'

(B)

54-4TC-63F

March 12, 1954
E. Witthuhn
Engineer of Design

IV-907

2488

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-5-09	11-5-09	1861435.4 ft / 6369327.2 ft NAD83	A-09-004
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Clear Heart Drilling			~ 26.1' Rt Sta ~ 21+11.1 ORH	54 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			Portable Rig	8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140 lb/30 in - Rope & CAT Head	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			28.5 ft	N/A	30.0 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	CLAYEY GRAVEL (GC); brown [FILL].												Hand Drilling from 0 to 1.5 feet
	1													
52.00	2	SANDY lean CLAY with GRAVEL (CL/SC); brown; moist [FILL].		1	6 11 15	26	85		13	113				
	3													
50.00	4													
	5			2	20 20 39	59	85							
48.00	6	Coarse gray GRAVEL.												
	7													
46.00	8													
	9													
44.00	10			3	14 22 22	44	90							
	11	At EL. 43.0 ft, becomes brown mottled with grayish brown; few GRAVEL.												
42.00	12													
	13													
40.00	14													
	15	At EL. 39.0 ft, becomes reddish brown mottled with gray.		4	12 14 20	34	75		16	118				
38.00	16													
	17													
36.00	18													
	19	Gravelly.												
34.00	20	Lean CLAY with SAND (CL); stiff; gray and black.		5	7 10 11	21	65							
	21	Fat CLAY (CH); stiff; black; trace GRAVEL.												
32.00	22													
	23													
30.00	24													
	25													

(continued)

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				A-09-004
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Sonoma	101	7.4/8.1	04-12276K
PROJECT OR BRIDGE NAME				
Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET	
	A. Cheung	11-9-09	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		Fat CLAY (CH) *(continued)*.		6	7 9 11	20	85							
28.00	26		Lean CLAY (CL); very stiff; gray; moist.							23	103	UC = 1.32			
	27														
26.00	28		Poorly graded SAND with SILT (SP-SM); medium dense; grayish brown; wet.												
	29				7	7 8 9	17	75		18	107				
24.00	30		Bottom of Borehole at 30.0 ft.												
	31														
22.00	32														
	33														
20.00	34														
	35														
18.00	36														
	37														
16.00	38														
	39														
14.00	40														
	41														
12.00	42														
	43														
10.00	44														
	45														
8.00	46														
	47														
6.00	48														
	49														
4.00	50														
	51														
2.00	52														
	53														
0.00	54														
	55														

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**A-09-004**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **A. Cheung**	DATE **11-9-09**	SHEET **2 of 2**	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-5-09	11-5-09	1861774.9 ft / 6369326.1 ft NAD83	A-09-005
DRILLING CONTRACTOR: Clear Heart Drilling			BOREHOLE LOCATION (Offset, Station, Line): ~ 32.6' Lt Sta ~ 24+39.4 ORH	SURFACE ELEVATION: 54 ft NAVD 88
DRILLING METHOD: Hollow-Stem Auger			DRILL RIG: Portable Rig	BOREHOLE DIAMETER: 8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96")			SPT HAMMER TYPE: 140 lb/30 in - Rope & CAT Head	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING dry; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 26.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	CLAYEY GRAVEL (GC); medium dense; brown; with concrete chuncks and large roots to 3.5 feet [FILL].												
52.00	2													
50.00	4		X	1	9 9 11	20	65		10	119				
48.00	6													
46.00	8	Lean CLAY (CL); very stiff; brown to black; moist; some GRAVEL [FILL].												
	9		X	2	9 13 16	29	75		20	109	UC = 1.2			
44.00	10													
42.00	12													
40.00	14	At EL. 40.5 ft, with increase in gravel content.	X	3	10 14 16	30	65		17	113				
38.00	16													
36.00	18													
	19	Lean CLAY with GRAVEL (CL); stiff; bluish gray; moist [FILL].	X	4	9 9 10	19	75							
34.00	20													
	21	Fat CLAY (CH); stiff; black; moist.												
32.00	22													
30.00	24													
	25	SANDY lean CLAY (CL); very stiff; gray.												

(continued)

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				A-09-005
DIST. 04	COUNTY Sonoma	ROUTE 101	POSTMILE 7.4/8.1	EA 04-12276K
PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY A. Cheung	DATE 11-9-09	SHEET 1 of 2	

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25				5	15									
28.00	26		Poorly graded SAND with GRAVEL (SP); very dense; grayish brown; trace GRAVEL.			32 35	67								
	27		Bottom of Borehole at 26.5 ft.												
26.00	28														
	29														
24.00	30														
	31														
22.00	32														
	33														
20.00	34														
	35														
18.00	36														
	37														
16.00	38														
	39														
14.00	40														
	41														
12.00	42														
	43														
10.00	44														
	45														
8.00	46														
	47														
6.00	48														
	49														
4.00	50														
	51														
2.00	52														
	53														
0.00	54														
	55														

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**A-09-005**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **A. Cheung**	DATE **11-9-09**	SHEET **2 of 2**	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-3-09	11-3-09	1861069.6 ft / 6369770.7 ft NAD83	A-09-101
DRILLING CONTRACTOR: Clear Heart Drilling			BOREHOLE LOCATION (Offset, Station, Line): ~ 4.7' Rt Sta ~ 87+20.0 OSN	SURFACE ELEVATION: 37 ft NAVD 88
DRILLING METHOD: Hollow-Stem Auger			DRILL RIG: DR 5K	BOREHOLE DIAMETER: 8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96"), SPT (1.44"), Shelby (2.87")			SPT HAMMER TYPE: 140lb/30 in - CAT Head Hammer	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING 20 ft; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 51.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	CLAYEY GRAVEL (GC); grayish brown [FILL].												
	1	Bridging Rock; diameter< 6".												
35.00	2	Fat CLAY (CH); medium stiff to stiff; black; moist; trace fine SAND.		1	4 4 7	11	55		36	82	UC = 0.51			
	3													
33.00	4													
	5			2			70							Shelby pushed with 1200 to 1600 psi C, PI
31.00	6	At EL. 31.0 ft, becomes stiff; gray.												
	7													
29.00	8													
	9													
27.00	10	SANDY lean CLAY (CL); very stiff; grayish brown with black speckling; moist; trace fine GRAVEL.		3	8 11 15	26	75		17	114	UC = 1.54			
	11													
25.00	12													
	13													
23.00	14													
	15	At EL. 22.0 ft, becomes soft; mottled with brown.		4	5 7 8	15	70		21	105	UC = 0.22			
21.00	16													
	17													
19.00	18													
	19													
17.00	20	Poorly graded SAND with GRAVEL (SP); medium dense; gray; wet; trace fine GRAVEL.		5	4 7 11	18	45		16	111				
	21													
15.00	22													
	23													
13.00	24													
	25													

(continued)

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				A-09-101
DIST. 04	COUNTY Sonoma	ROUTE 101	POSTMILE 7.4/8.1	EA 04-12276K
PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY A. Cheung	DATE 11-9-09	SHEET 1 of 2	

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
	25	Poorly graded SAND with GRAVEL (SP) *(continued)*.		6	5 6 6	12	100		17					PA
11.00	26													
	27	Lean CLAY (CL); stiff; gray; moist.												
9.00	28													
	29													
7.00	30			7	5 6 7	13	100		28	93	UC = 0.54			
	31	At EL. 6.0 ft, becomes gray mottled with brown.												
5.00	32													
	33													
3.00	34													
	35	At EL. 2.0 ft, becomes very stiff; grayish brown mottled with black.		8	8 11 13	24	90		27	98	UC = 1.49			
1.00	36													
	37													
-1.00	38													
	39													
-3.00	40			9	10 11 10	21	75							
	41	At EL. -4.0 ft, observed Sand lense trace GRAVEL.												
-5.00	42													
	43													
-7.00	44													
	45			10	27 31 34	65	75							
-9.00	46	SILTY SAND with GRAVEL (SM); very dense; brown; moist.												
	47													
-11.00	48													
	49													
-13.00	50	SANDY SILT (ML); dense; brown; moist; fine SAND; some thin Clay lenses.		11	11 15 21	36	100							
	51													
-15.00	52	Bottom of Borehole at 51.5 ft.												
	53													
-17.00	54													
	55													

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

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55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**A-09-101**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **A. Cheung**		DATE **11-9-09**	SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	10-2-09	10-2-09	1861307.4 ft / 6369479.3 ft NAD83	A-09-102
DRILLING CONTRACTOR: Clear Heart Drilling			BOREHOLE LOCATION (Offset, Station, Line): ~ 2.8' Rt Sta ~ 90+96.1 OSN	SURFACE ELEVATION: 35 ft NAVD 88
DRILLING METHOD: Hollow-Stem Auger			DRILL RIG: DR 5K	BOREHOLE DIAMETER: 8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96"), SPT (1.44")			SPT HAMMER TYPE: 140lb/ CAT Head Hammer	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING 12 ft; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 51.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	Fat CLAY (CH); very stiff; black; moist.												
	1													
33.00	2			1	3 4 7	11	55							
	3													
31.00	4													
	5			2	6 9 12	21	45		33	88	UC = 1.18			
29.00	6													
	7	At EL. 28.5 ft, observed slightly mottled with white; (MARL).												
27.00	8	Lean CLAY (CL); medium stiff; grayish brown; moist.												
	9													
25.00	10	Poorly graded SAND with SILT and GRAVEL (SP-SM); medium dense; grayish brown; moist.		3	15 17 21	38	70		12	119				
	11													
23.00	12													
	13													
21.00	14													
	15			4	7 10 11	21	95							
19.00	16													
	17	At EL. 18.5 ft, with few GRAVEL; few gravel.												
17.00	18													
	19													
15.00	20	At EL. 15.0 ft, with dense; 2 inches Lean Clay lense.		5	15 21 13	34	95							
	21	At EL. 14.0 ft, becomes wet.												
13.00	22													
	23													
11.00	24	SANDY lean CLAY (CL); stiff; grayish brown with black speckling.												
	25													

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REPORT TITLE				HOLE ID
BORING RECORD				A-09-102
DIST. 04	COUNTY Sonoma	ROUTE 101	POSTMILE 7.4/8.1	EA 04-12276K
PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY A. Cheung	DATE 11-10-09	SHEET 1 of 2	

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

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
	25	SANDY lean CLAY (CL) *(continued)*.		6	8 11 13	24	70		20	109	UC = 0.97			
9.00	26													
	27													
7.00	28	Lean CLAY (CL); very stiff; grayish brown; moist; trace fine GRAVEL.												
	29													
5.00	30			7	9 9 11	20	65		23	104	UC = 1.09			
	31													
3.00	32													
	33													
1.00	34													
	35	At EL. 0.0 ft, becomes gray mottled with brown.		8	10 12 13	25	55		23	104	UC = 1.30			
-1.00	36													
	37													
-3.00	38													
	39													
-5.00	40	At EL. -5.0 ft, with moist; trace SAND.		9	7 9 10	19	85		26	101	UC = 1.01			
	41													
-7.00	42													
	43													
-9.00	44													
	45			10	8 10 15	25	60							
-11.00	46													
	47	Poorly graded SAND with SILT and GRAVEL (SP-SM).												
-13.00	48	SILTY, CLAYEY SAND (SC-SM); medium dense; light brown.												
	49													
-15.00	50			11	12 16 22	38	60		23	102				
	51													
-17.00	52	Bottom of Borehole at 51.5 ft.												
	53													
-19.00	54													
	55													

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

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REPORT TITLE				HOLE ID
BORING RECORD				**A-09-102**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **A. Cheung**	DATE **11-10-09**	SHEET **2 of 2**	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-6-09	11-6-09	1861130.5 ft / 6369039.9 ft NAD83	A-09-103
DRILLING CONTRACTOR: Clear Heart Drilling			BOREHOLE LOCATION (Offset, Station, Line): ~ 47.2' Lt Sta ~ 61+79.2 OSF	SURFACE ELEVATION: 37 ft NAVD 88
DRILLING METHOD: Hollow-Stem Auger			DRILL RIG: DR 8K	BOREHOLE DIAMETER: 8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96"), SPT (1.44")			SPT HAMMER TYPE: 140 lb/30 in - Auto Hammer	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING N/A; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 51.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	5 inches ASPHALT CONCRETE over 31 inches AGGREGATE BASE.												
35.00	2													
	3	CLAYEY SAND with GRAVEL (SC); medium dense; brown; moist [FILL].												
33.00	4		X	1	11 5 7	12	35							
	5	Fat CLAY (CH); stiff; black; moist.	X	2	5 7 11	18	55		39	80	UC = 0.83			Stabilization fabric at 5 feet
31.00	6													
	7													
29.00	8	At EL. 29.0 ft, becomes very stiff; grayish brown.												
	9		X	3	5 8 16	24	70		27	98	UC = 1.51			LL=57 PI=38 PI
27.00	10													
	11													
25.00	12													
	13													
23.00	14	SANDY lean CLAY (CL); medium stiff; grayish brown; moist.	X	4	3 4 5	9	65		25	100	UC = 0.47			Water added by driller
	15													
21.00	16													
	17													
19.00	18	Poorly graded SAND with SILT and GRAVEL (SP-SM); dense; grayish brown; moist.												
	19													
17.00	20		X	5	15 23 24	47	55		12	118				
	21													
15.00	22													
	23													
13.00	24													
	25													

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REPORT TITLE				HOLE ID
BORING RECORD				A-09-103
DIST. 04	COUNTY Sonoma	ROUTE 101	POSTMILE 7.4/8.1	EA 04-12276K
PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY A. Cheung	DATE 11-10-09	SHEET 1 of 2	

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

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
	25													
11.00	26	Lean CLAY (CL); stiff; bluish gray; moist.		6	4 5 5	10	100							
	27													
9.00	28													
	29													
7.00	30			7	6 15 23	38	50							
	31	SILTY SAND (SM); medium dense; grayish brown; moist.							14	116				
5.00	32													
	33													
3.00	34	Lean CLAY (CL); very stiff; gray mottled with brown; moist.												
	35			8	5 11 12	23	70		24	103	UC = 1.36			
1.00	36													
	37													
-1.00	38	SANDY lean CLAY (CL); grayish brown; moist.												
	39													
-3.00	40	SILTY SAND (SM); very dense; grayish brown; moist; trace GRAVEL.		9	12 27 37	64	85							
	41													
-5.00	42													
	43													
-7.00	44	SANDY lean CLAY (CL); brown; moist.												
	45	SILTY SAND (SM); very dense; light brown; moist.		10	24 66/6"	66/ 6"	65							
-9.00	46													Sampler advanced 12 in.
	47													
-11.00	48													
	49	At EL. -12.0 ft, grades to Silty Sand (SM) to Sandy Silt (ML).												
-13.00	50			11	16 26 41	67	95							
	51													
-15.00	52	Bottom of Borehole at 51.5 ft.												
	53													
-17.00	54													
	55													

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

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REPORT TITLE				HOLE ID
BORING RECORD				**A-09-103**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **A. Cheung**	DATE **11-10-09**	SHEET **2 of 2**	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-4-09	11-4-09	1861311.7 ft / 6368919.5 ft NAD83	A-09-104
DRILLING CONTRACTOR: Clear Heart Drilling			BOREHOLE LOCATION (Offset, Station, Line): ~ 30.8' Lt Sta ~ 63+68.2 OSF	SURFACE ELEVATION: 39 ft NAVD 88
DRILLING METHOD: Hollow-Stem Auger			DRILL RIG: DR 5K	BOREHOLE DIAMETER: 8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96"), SPT (1.44")			SPT HAMMER TYPE: 140 lb/30 in - Rope & CAT Head	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING 20 ft; AFTER DRILLING (DATE) 15 ft on 11-14-09	TOTAL DEPTH OF BORING: 51.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	6 inches ASPHALT CONCRETE over 12 inches AGGREGATE BASE.												
36.50	2	CLAYEY GRAVEL (GC); medium dense; brown; moist [FILL].		1	11 8 8	16	25		11	97				Bag sample 2 to 5 feet
34.50	4	GRAVELLY lean to fat CLAY (CL/CH); brown to black; moist [FILL].		2	6 11 14	25	60							
	5	Fat CLAY (CH); stiff; black; moist.												
32.50	6			3	5 10 13	23	50		39	79	UC = 0.90			
30.50	8													
28.50	10	At EL. 28.5 ft, becomes very stiff; gray.		4	8 12 14	26	65		27	96	UC = 1.53			
26.50	12													
24.50	14													
	15	Lean CLAY (CL); stiff; dark bluish gray with some speckling; moist.		5	5 10 10	20	50		23	104	UC = 0.93			
22.50	16													
20.50	18													
18.50	20	SILTY SAND with GRAVEL (SM); medium dense; dark gray; moist.		6	15 11 10	21	75							
16.50	22													
14.50	24													
	25													

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REPORT TITLE				HOLE ID
BORING RECORD				A-09-104
DIST. 04	COUNTY Sonoma	ROUTE 101	POSTMILE 7.4/8.1	EA 04-12276K
PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY A. Cheung	DATE 11-10-09	SHEET 1 of 2	

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		SILTY SAND with GRAVEL (SM) *(continued)*.		7	8 14 15	29	70		15					+#4=33% -#200=14% PA
12.50	26														
	27														
10.50	28														
	29														
8.50	30		Poorly graded SAND with SILT (SP-SM); very dense; light brown; moist; trace GRAVEL.		8	20 40 45	85	80		15	108				
	31														
6.50	32														
	33														
4.50	34														
	35		Coarse SAND.		9	19 34 37	71	95							
2.50	36														
	37														
0.50	38														
	39														
-1.50	40		SILTY SAND (SM); very dense; light brownish gray; fine SAND.		10	29 33 36	69	95							
	41														
-3.50	42														
	43														
-5.50	44														
	45				11	15 27 20	47	100							
-7.50	46		Poorly graded SAND with SILT (SP-SM); dense; moist; trace fine GRAVEL.												
	47														
-9.50	48														
	49														
-11.50	50				12	20 48 59/3"	107/ 9"	90							
	51		SILTY SAND (SM); very dense; light brown; moist.												Sampler advanced 15 in.
-13.50	52		Bottom of Borehole at 51.5 ft.												
	53														
-15.50	54														
	55														

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

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REPORT TITLE				HOLE ID
BORING RECORD				**A-09-104**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **A. Cheung**		DATE **11-10-09**	SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-10-09	11-10-09	1862240.7 ft / 6368775.1 ft NAD83	A-09-105
DRILLING CONTRACTOR: Clear Heart Drilling			BOREHOLE LOCATION (Offset, Station, Line): ~ 51.3' Rt Sta ~ 411+85.6 ML	SURFACE ELEVATION: 39 ft NAVD 88
DRILLING METHOD: Hollow-Stem Auger			DRILL RIG: CME 75	BOREHOLE DIAMETER: 8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96"), SPT (1.44")			SPT HAMMER TYPE: 140lb/30in - Auto	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING 18 ft; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 51.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	10 inch Asphalt Concrete.												
	1	Lean to fat CLAY with SAND (CL/CH); stiff; gray to black; moist; trace GRAVEL; [FILL].		1	4 7 7	14	70							
37.00	2													
	3	Fat CLAY (CH); stiff; black; moist.												
35.00	4													
	5	At EL. 34.0 ft, becomes black mottled with gray.		2	3 6 6	12	70		33	85	UC = 0.65			
33.00	6													
	7													
31.00	8													
	9													
29.00	10	SILTY SAND with GRAVEL (SM); medium dense; gray; moist.		3	13 11 12	23	65							
	11	Lean CLAY (CL); very stiff; grayish brown; moist.												
27.00	12													
	13													
25.00	14													
	15	At EL. 24.0 ft, becomes gray mottled with brown.		4	6 6 8	14	60		23	104	UC = 1.26			
23.00	16													
	17													
21.00	18	SILTY SAND (SM); medium dense to dense; grayish brown; moist.												
	19													
19.00	20			5	10 19 49	68	95							
	21	Poorly graded SAND with GRAVEL (SP); very dense; brown; moist; trace GRAVEL; coarse SAND.												
17.00	22													
	23													
15.00	24													
	25													

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REPORT TITLE				HOLE ID
BORING RECORD				A-09-105
DIST. 04	COUNTY Sonoma	ROUTE 101	POSTMILE 7.4/8.1	EA 04-12276K
PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY A. Cheung	DATE 11-12-09	SHEET 1 of 2	

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

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
	25	At EL. 14.0 ft, grades to (SILTY SAND) (SM); grayish brown.		6	62 50/5.5"	50/5.5"	60							
13.00	26													Sampler advanced 11.5 in.
	27													
11.00	28													
	29													
9.00	30	Lean CLAY (CL); very stiff; grayish brown; moist; with some Sandy Lean Clay lenses.		7	6 8 11	19	70							
	31													
7.00	32													
	33													
5.00	34													
	35	At EL. 4.0 ft, with less sand, some black speckiling.		8	4 7 8	15	100		25	100	UC = 1.04			
3.00	36													
	37													
1.00	38													
	39													
-1.00	40			9	12 30 30	60	65							
	41	SILTY SAND with GRAVEL (SM); dense; grayish brown; moist.							10	132				
-3.00	42													
	43													
-5.00	44													
	45	At EL. -6.0 ft, becomes medium dense; with stiff Sandy Silt lenses.		10	13 11 15	26	95							
-7.00	46													
	47													
-9.00	48													
	49													
-11.00	50	At EL. -11.0 ft, becomes very dense.		11	16 21 37	58	100							
	51													
-13.00	52	Bottom of Borehole at 51.5 ft.												
	53													
-15.00	54													
	55													

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REPORT TITLE				HOLE ID
BORING RECORD				**A-09-105**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **A. Cheung**	DATE **11-12-09**	SHEET **2 of 2**	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-9-09	11-9-09	1861975.3 ft / 6369073.4 ft NAD83	A-09-106
DRILLING CONTRACTOR: Clear Heart Drilling			BOREHOLE LOCATION (Offset, Station, Line): ~ 49.5' Rt Sta ~ 407+95.0 ML	SURFACE ELEVATION: 39 ft NAVD 88
DRILLING METHOD: Hollow-Stem Auger			DRILL RIG: DR 5K	BOREHOLE DIAMETER: 8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96"), SPT (1.44"), Shelby (2.87")			SPT HAMMER TYPE: 140 lb/30 in - Rope & CAT Head	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING 15 ft; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 51.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	5 inch Asphalt Concrete over 6 inch of Aggregate Base.												
	1	Fat CLAY (CH); medium stiff; brown to black; moist.		1	4 2 4	6	65		38	80	UC = 0.40			
36.50	2													Bag sample 2 to 5 ft
	3	At EL. 36.0 ft, becomes black.												
34.50	4													
	5			2										Shelby pushed with 400 to 1000 psi C, PI
32.50	6													
	7													
30.50	8													
	9													
28.50	10	Lean CLAY (CL); very stiff; gray mottled with brown; moist.		3	6 10 16	26	75		22	103	UC = 1.37			
	11													
26.50	12													
	13													
24.50	14													
	15													
22.50	16	Poorly graded SAND with SILT (SP-SM); dense; grayish brown; moist; trace fine GRAVEL.		4	18 25 29	54	70		19	104				
	17													
20.50	18													
	19													
18.50	20			5	5 21 24	45	100							
	21													
16.50	22													
	23													
14.50	24													
	25													

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REPORT TITLE				HOLE ID
BORING RECORD				A-09-106
DIST. 04	COUNTY Sonoma	ROUTE 101	POSTMILE 7.4/8.1	EA 04-12276K
PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY A. Cheung		DATE 11-12-09	SHEET 1 of 2

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

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
	25													
12.50	26	Lean CLAY (CL); medium stiff; gray mottled with brown; moist.		6	7 8 9	17	95							
	27													
10.50	28													
	29													
8.50	30			7	5 12 15	27	70				PP = 1.5			
	31	SILTY SAND (SM); medium dense; gray; moist.							17	113				
6.50	32													
	33													
4.50	34	Lean CLAY (CL); very stiff; gray mottled with brown; moist.												
	35			8	10 14 15	29	65		21	107	UC = 1.84			
2.50	36													
	37													
0.50	38													
	39													
-1.50	40	At EL. -1.5 ft, becomes stiff.		9	8 12 12	24	75		25	100	UC = 1.22			
	41													
-3.50	42													
	43													
-5.50	44													
	45	SILTY SAND (SM); medium dense; grayish brown.		10	7 9 16	25	50		23	97				
-7.50	46													
	47													
-9.50	48													
	49													
-11.50	50			11	15 11 10	21	70							
	51													
		Lean CLAY (CL); stiff; brown; moist.												
-13.50	52	Bottom of Borehole at 51.5 ft.												
	53													
-15.50	54													
	55													

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55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**A-09-106**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **A. Cheung**	DATE **11-12-09**	SHEET **2 of 2**	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-9-09	11-9-09	1862124.7 ft / 6368903.8 ft NAD83	A-09-107
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Clear Heart Drilling			~ 60.5' Rt Sta ~ 410+12.8 ML	39 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			DR 5K	7 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), SPT (1.44")			140 lb/30 in - Rope & CAT Head	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS: DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			15 ft	N/A	46.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	5 inch Asphalt Concrete over 2 inch Aggregate Base.												
	1	Lean CLAY (CL); stiff; brown to gray; moist; some SAND; [FILL].		1	6 7 9	16	70							
36.50	2	Fat CLAY (CH); very stiff; black; moist.												
	3													
34.50	4													
	5			2	2 8 9	17	65		34	85	UC = 1.03			
32.50	6													
	7													
30.50	8	Lean CLAY (CL); very stiff; gray mottled with brown; moist; with some black speckles.												
	9													
28.50	10			3	6 9 12	21	70		22	102	UC = 1.57			
	11													
26.50	12													
	13													
24.50	14													
	15			4	8 14 20	34	60		23	96				
22.50	16	Well-graded SAND with SILT (SW-SM); medium dense; grayish brown; moist.												
	17													
20.50	18													
	19													
18.50	20			5	11 12 8	20	100		19					PA
	21	At EL. 17.5 ft, becomes gray; fine SAND.												
16.50	22													
	23													
14.50	24													
	25	Lean CLAY (CL); stiff; gray; moist.												

(continued)

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

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REPORT TITLE				HOLE ID
BORING RECORD				A-09-107
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Sonoma	101	7.4/8.1	04-12276K
PROJECT OR BRIDGE NAME				
Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET	
	A. Cheung	11-12-09	1 of 2	

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
	25			6	8 12 12	24	45				PP = 3.5			
12.50	26	SANDY lean CLAY (CL); medium stiff; gray; moist.												
	27	Poorly graded SAND with SILT (SP-SM); gray; moist; coarse SAND.												
10.50	28													
	29	Lean CLAY (CL); very stiff; grayish brown; moist.												
8.50	30			7	10 13 15	28	65		18	114	UC = 1.29			
	31													
6.50	32													
	33													
4.50	34													
	35	At EL. 3.5 ft, with black speckling.		8	10 14 15	29	80				PP = 2.5			
2.50	36													
	37													
0.50	38													
	39													
-1.50	40	At EL. -1.5 ft, grades to (Lean CLAY with SAND) (CL); with sand.		9	10 14 17	31	60		21	107	UC = 1.27			
	41													
-3.50	42													
	43													
-5.50	44													
	45	Poorly graded SAND with SILT and GRAVEL (SP-SM); very dense; brown; moist.		10	13 32 40	72	60							
-7.50	46													
	47	Bottom of Borehole at 46.5 ft.												
-9.50	48													
	49													
-11.50	50													
	51													
-13.50	52													
	53													
-15.50	54													
	55													

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

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55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**A-09-107**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **A. Cheung**	DATE **11-12-09**	SHEET **2 of 2**	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-11-09	11-11-09	1860884.1 ft / 6369155.5 ft NAD83	A-09-108
DRILLING CONTRACTOR: Clear Heart Drilling			BOREHOLE LOCATION (Offset, Station, Line): ~ 44.1' Lt Sta ~ 15+31.5 ORH	SURFACE ELEVATION: 35 ft NAVD 88
DRILLING METHOD: Solid-Stem Auger			DRILL RIG: CME 75	BOREHOLE DIAMETER: 6 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96")			SPT HAMMER TYPE: 140lb/30in - Auto	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING 10 ft; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 12.0 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	13 inches Asphalt Concrete.												
	1	Lean to fat CLAY (CL/CH); black to gray; moist; some GRAVEL; trace SAND; [FILL].												
33.00	2			1	4 3 4	7	20							
	3	Fat CLAY (CH); medium stiff; black; moist.												Bag sample 3 to 6 ft
31.00	4													
	5			2	4 5 6	11	45		41	74	UC = 0.30			R
29.00	6													
	7	Lean CLAY (CL); stiff; dark gray; moist.												
27.00	8													
	9													
25.00	10	SILTY SAND (SM); loose; gray; moist.		3	8 3 6	9	65							
	11	Lean CLAY (CL); stiff; brown mottled with gray; moist.												
23.00	12	Bottom of Borehole at 12.0 ft.												
	13													
21.00	14													
	15													
19.00	16													
	17													
17.00	18													
	19													
15.00	20													
	21													
13.00	22													
	23													
11.00	24													
	25													

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

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REPORT TITLE				HOLE ID
BORING RECORD				A-09-108
DIST. 04	COUNTY Sonoma	ROUTE 101	POSTMILE 7.4/8.1	EA 04-12276K
PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY A. Cheung	DATE 11-12-09	SHEET 1 of 1	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-4-09	11-4-09	1861115.9 ft / 6369188.6 ft NAD83	A-09-109
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Clear Heart Drilling			~ 54.2' Lt Sta ~ 17+65.5 ORH	40 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Solid-Stem Auger			DR 5K	6 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140 lb/30 in - Rope & CAT Head	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			11.5 ft	N/A	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		CLAYEY GRAVEL with SAND (GC); medium dense; brown to black; moist; some asphalt concrete chunks; [FILL].												
	1														
37.50	2				1	11 16 17	33	45							Bag sampe 2 to 5 ft
	3														
35.50	4		Fat CLAY (CH); stiff; black; moist; with some orange staining.												
	5				2	7 10 11	21	55							
33.50	6														
	7														
31.50	8														
	9														
29.50	10		CLAYEY SAND (SC); medium dense; dark brown; moist.		3	4 5 7	12	55		16	115	UC = 0.24			
	11														
27.50	12		Bottom of Borehole at 11.5 ft.												
	13														
25.50	14														
	15														
23.50	16														
	17														
21.50	18														
	19														
19.50	20														
	21														
17.50	22														
	23														
15.50	24														
	25														

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REPORT TITLE				HOLE ID
BORING RECORD				A-09-109
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Sonoma	101	7.4/8.1	04-12276K
PROJECT OR BRIDGE NAME				
Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	A. Cheung		11-10-09	1 of 1

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-11-09	11-11-09	1862020.1 ft / 6369429.1 ft NAD83	A-09-111
DRILLING CONTRACTOR: Clear Heart Drilling			BOREHOLE LOCATION (Offset, Station, Line): ~ 26.7' Rt Sta ~ 26+98.2 ORH	SURFACE ELEVATION: 42 ft NAVD 88
DRILLING METHOD: Solid-Stem Auger			DRILL RIG: CME 75	BOREHOLE DIAMETER: 6 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96")			SPT HAMMER TYPE: 140lb/30in - Auto	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING dry; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 10.0 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	12 inches Asphalt Concrete.												
	1	CLAYEY GRAVEL with SAND (GC); very dense; brown; moist; [FILL].		1	20 REF									Hit obstruction
40.00	2													Sampler advanced in.
	3	CLAYEY SAND (SC); medium dense; gray to brown; moist; [FILL].												R
38.00	4			2	9 10 13	23	35							
	5	Lean CLAY with SAND (CL); brown; moist; [FILL].												
36.00	6	Fat CLAY (CH); stiff; black to gray; moist.												
	7													
34.00	8													
	9			3	5 5 8	13	65		32	88	UC = 0.87			
32.00	10	Bottom of Borehole at 10.0 ft.												
	11													
30.00	12													
	13													
28.00	14													
	15													
26.00	16													
	17													
24.00	18													
	19													
22.00	20													
	21													
20.00	22													
	23													
18.00	24													
	25													

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REPORT TITLE				HOLE ID
BORING RECORD				A-09-111
DIST. 04	COUNTY Sonoma	ROUTE 101	POSTMILE 7.4/8.1	EA 04-12276K
PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY A. Cheung	DATE 11-12-09	SHEET 1 of 1	

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-11-09	11-11-09	1862248.4 ft / 6369468.9 ft NAD83	A-09-112
DRILLING CONTRACTOR: Clear Heart Drilling			BOREHOLE LOCATION (Offset, Station, Line): ~ 28.2' Rt Sta ~ 29+29.5 ORH	SURFACE ELEVATION: 39 ft NAVD 88
DRILLING METHOD: Solid-Stem Auger			DRILL RIG: CME 75	BOREHOLE DIAMETER: 6 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96")			SPT HAMMER TYPE: 140lb/30in - Auto	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING 17 ft; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 20.0 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	CLAYEY GRAVEL (GC); very dense; brown to gray; moist; [FILL].												
	1			1	35 8 8	16	45							
36.50	2	SANDY lean CLAY with GRAVEL (CL); stiff; brownish gray; moist; [FILL].												
	3													
34.50	4	Fat CLAY (CH); very stiff; black; moist.												
	5			2	4 5 6	11	65		28	92	UC = 1.10			
32.50	6													
	7													
30.50	8													
	9													
28.50	10	Lean CLAY (CL); very stiff; bluish gray; moist.		3	5 8 9	17	50		21	106	UC = 1.25			
	11													
26.50	12													
	13													
24.50	14													
	15													
22.50	16													
	17	SILTY SAND (SM); grayish brown; moist.												
20.50	18													
	19													
18.50	20	Bottom of Borehole at 20.0 ft.												
	21													
16.50	22													
	23													
14.50	24													
	25													

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

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REPORT TITLE				HOLE ID
BORING RECORD				A-09-112
DIST. 04	COUNTY Sonoma	ROUTE 101	POSTMILE 7.4/8.1	EA 04-12276K
PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY A. Cheung	DATE 11-12-09	SHEET 1 of 1	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-3-09	11-3-09	1860853.8 ft / 6369979.8 ft NAD83	A-09-115
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
Clear Heart Drilling			~ 72.5' Lt Sta ~ 393+51.9 ML	37 ft NAVD 88
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Hollow-Stem Auger			DR 5K	6 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96")			140 lb/30 in - Rope & CAT Head	
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			dry	N/A	11.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	CLAYEY GRAVEL (GC); brown.												
		BOULDERS.												
	1	Lean to fat CLAY (CL/CH); black and brown; moist; [FILL].		1	4 4 6	10	65							
34.50	2	Fat CLAY (CH); medium stiff; black; moist.							35	84	UC = 0.44			
	3													
32.50	4													
	5			2	7 12 14	26	50							
30.50	6													
	7	Lean CLAY (CL); very stiff; gray; moist.												
28.50	8													
	9													
26.50	10	At EL. 26.5 ft, becomes grayish brown mottled with brown some black speckles.		3	9 10 10	20	70		26	100	UC = 1.21			
	11													
24.50	12	Bottom of Borehole at 11.5 ft.												
	13													
22.50	14													
	15													
20.50	16													
	17													
18.50	18													
	19													
16.50	20													
	21													
14.50	22													
	23													
12.50	24													
	25													

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REPORT TITLE				HOLE ID
BORING RECORD				A-09-115
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Sonoma	101	7.4/8.1	04-12276K
PROJECT OR BRIDGE NAME				
Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY	DATE	SHEET	
	A. Cheung	11-10-09	1 of 1	

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-3-09	11-3-09	1860906.1 ft / 6370099.1 ft NAD83	A-09-116
DRILLING CONTRACTOR: Clear Heart Drilling			BOREHOLE LOCATION (Offset, Station, Line): ~ 48.5' Rt Sta ~ 393+41.2 ML	SURFACE ELEVATION: 38 ft NAVD 88
DRILLING METHOD: Solid-Stem Auger			DRILL RIG: DR 5K	BOREHOLE DIAMETER: 6 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96")			SPT HAMMER TYPE: 140 lb/30 in - Rope & CAT Head	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING 11.5 ft; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 11.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	3.5 inch of Asphalt Concrete over 15 inch Aggregate Base.												
35.50	2	GRAVELLY lean CLAY (CL); stiff; brown; moist; [FILL].		1	8 9 11	20	55							
33.50	4	Fat CLAY (CH); stiff; black; moist.												
31.50	6			2	5 8 10	18	40		33	87	UC = 0.92			
27.50	10			3	7 8 12	20	35		25	100	UC = 0.92			
	11	Lean CLAY (CL); stiff; grayish brown; moist.												
25.50	12	Bottom of Borehole at 11.5 ft.												

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

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REPORT TITLE				HOLE ID
BORING RECORD				A-09-116
DIST. 04	COUNTY Sonoma	ROUTE 101	POSTMILE 7.4/8.1	EA 04-12276K
PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY A. Cheung	DATE 11-10-09	SHEET 1 of 1	

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	10-26-09	10-27-09	1861549.5 ft / 6369263.3 ft NAD83	R-09-001
DRILLING CONTRACTOR: Exploration Geoservices, Inc			BOREHOLE LOCATION (Offset, Station, Line): ~ 56.1' Lt Sta ~ 22+06.6 ORH	SURFACE ELEVATION: 36 ft NAVD 88
DRILLING METHOD: Rotary Wash			DRILL RIG: CME 75	BOREHOLE DIAMETER: 4-7/8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96"), SPT (1.44")			SPT HAMMER TYPE: 140lb/30in - Auto	HAMMER EFFICIENCY, ERi: 107%
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING N/A; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 96.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	Fat CLAY (CH); medium stiff; black to dark gray; moist.												
	1			1	3 4 6	10	70		41	78	UC = 0.41			
34.00	2													
	3													
32.00	4													
	5	At EL. 31.0 ft, grades to (Fat CLAY with SAND) (CH); very stiff; dark gray; trace coarse SAND.		2	4 4 9	13			35	86	UC = 1.25			
30.00	6													
	7													
28.00	8													
	9	Poorly graded SAND with GRAVEL (SP); medium dense; grayish brown; wet; trace fine GRAVEL.												
26.00	10			3	8 7 2	9	70							
	11	Lean CLAY (CL); medium stiff; light grayish brown; moist.												
24.00	12													
	13													
22.00	14	GRAVELLY lean CLAY (CL); gray mottled with brown; moist.												End of drilling 10/26/09 Resume drilling 10/27/09
	15			4	7 7 10	17	70							
20.00	16	CLAYEY GRAVEL (GC); medium dense; gray; wet. Poorly graded SAND with SILT (SP-SM); medium dense; gray; moist.												
	17													
18.00	18													
	19													
16.00	20	Lean CLAY (CL); stiff; brown; moist.		5	5 4 5	9	80		24					PI
	21													
14.00	22													
	23													
12.00	24													
	25													

(continued)

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				R-09-001
DIST. 04	COUNTY Sonoma	ROUTE 101	POSTMILE 7.4/8.1	EA 04-12276K
PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY M. Thummaluru		DATE 11-2-09	SHEET 1 of 4

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
	25	Lean CLAY (CL) *(continued)*.		6	5 12 12	24	0							
10.00	26	SILTY SAND (SM); medium dense; dark gray; moist.												
	27	Lean CLAY (CL); medium stiff; brown to gray; moist.		7	6 5 6	11	50							
8.00	28													
	29													
6.00	30	SANDY lean CLAY (CL); very stiff; gray; moist.		8	7 8 9	17	75		16	116	UC = 1.27			
	31													
4.00	32													
	33	Fat CLAY (CH); very stiff; gray mottled with brown with black speckling; moist.												
2.00	34													
	35			9	7 8 9	17	60		25	99	UC = 1.28			
0.00	36													
	37													
-2.00	38													
	39													
-4.00	40	At EL. -4.0 ft, becomes dark bluish gray.		10	5 7 10	17	75		32	88	UC = 0.88			
	41													
-6.00	42													
	43													
-8.00	44													
	45	CLAYEY SAND (SC/CL); medium dense; grayish brown; moist.		11	6 9 13	22	85		21	100				
-10.00	46	SILTY SAND (SM); medium dense; gray; moist.												
	47	Lean CLAY (CL); stiff; gray; moist.												
-12.00	48													
	49	Poorly graded SAND with SILT (SP-SM); dense; orange brown; moist; some GRAVEL.												
-14.00	50			12	23 20 25	45	75							
	51													
-16.00	52													
	53													
-18.00	54	Lean CLAY (CL); gray; moist.												
	55													

(continued)

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**R-09-001**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **M. Thummaluru**	DATE **11-2-09**	SHEET **2 of 4**	

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	55		Lean CLAY (CL) *(continued)*.		13	8 12 18	30	0							
-20.00	56		SILTY SAND (SM); medium dense; light brown; moist.												
	57		At EL. -21.0 ft, becomes dense.		14	15 18 28	46	100							
-22.00	58														
	59		SANDY lean CLAY (CL); medium stiff; light brown; moist.												
-24.00	60				15	8 14 23	37	80							
	61		CLAYEY SAND (SC); dense; light brown; moist.												
-26.00	62														
	63														
-28.00	64														
	65				16	10 15 21	36	85							
-30.00	66														
	67														
-32.00	68														
	69														
-34.00	70		SILTY, CLAYEY SAND (SC-SM); dense; light brown; moist.		17	13 21 26	47	90							
	71														
-36.00	72														
	73														
-38.00	74														
	75				18	8 16 23	39	100							
-40.00	76														
	77														
-42.00	78														
	79														
-44.00	80				19	10 17 19	36	80							
	81														
-46.00	82														
	83														
-48.00	84														
	85														

(continued)

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**R-09-001**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **M. Thummaluru**	DATE **11-2-09**	SHEET **3 of 4**	

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	85		At EL. -49.0 ft, becomes very dense.												
-50.00	86		SILTY, CLAYEY SAND (SC-SM) *(continued)*.		20	19 26 35	61	80							
	87														
-52.00	88		Gravel lense.												
	89		CLAYEY SAND (SC); very dense; light brown; moist.												
-54.00	90				21	23 35 50/4"	85/ 10"	80							
	91														Sampler advanced 16 in.
-56.00	92														
	93														
-58.00	94														
	95		At EL. -59.0 ft, becomes dense.		22	12 18 31	49	90							
-60.00	96														
	97		Bottom of Borehole at 96.5 ft.												
-62.00	98														
	99														
-64.00	100														
	101														
-66.00	102														
	103														
-68.00	104														
	105														
-70.00	106														
	107														
-72.00	108														
	109														
-74.00	110														
	111														
-76.00	112														
	113														
-78.00	114														
	115														

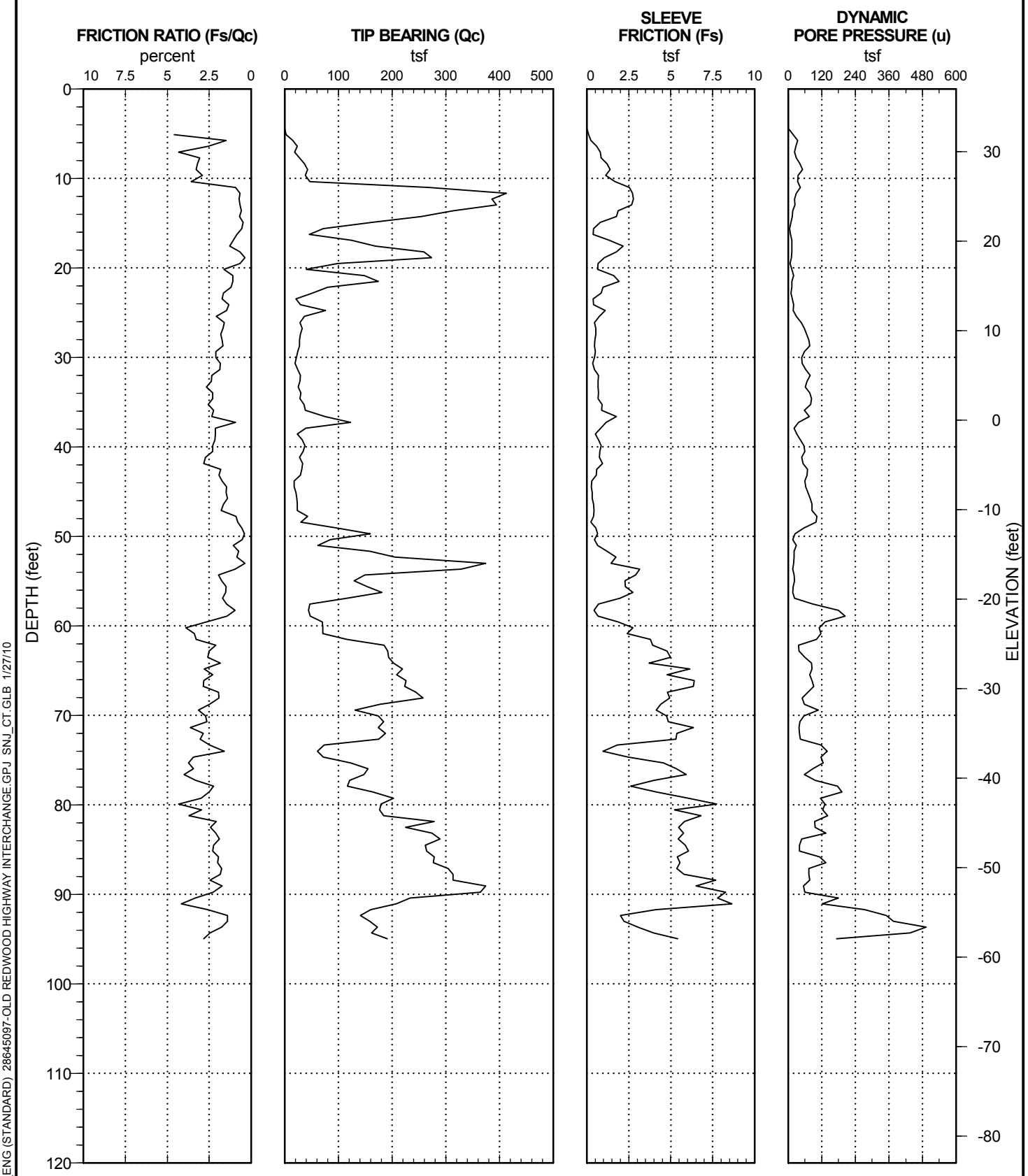
URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**R-09-001**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **M. Thummaluru**	DATE **11-2-09**	SHEET **4 of 4**	



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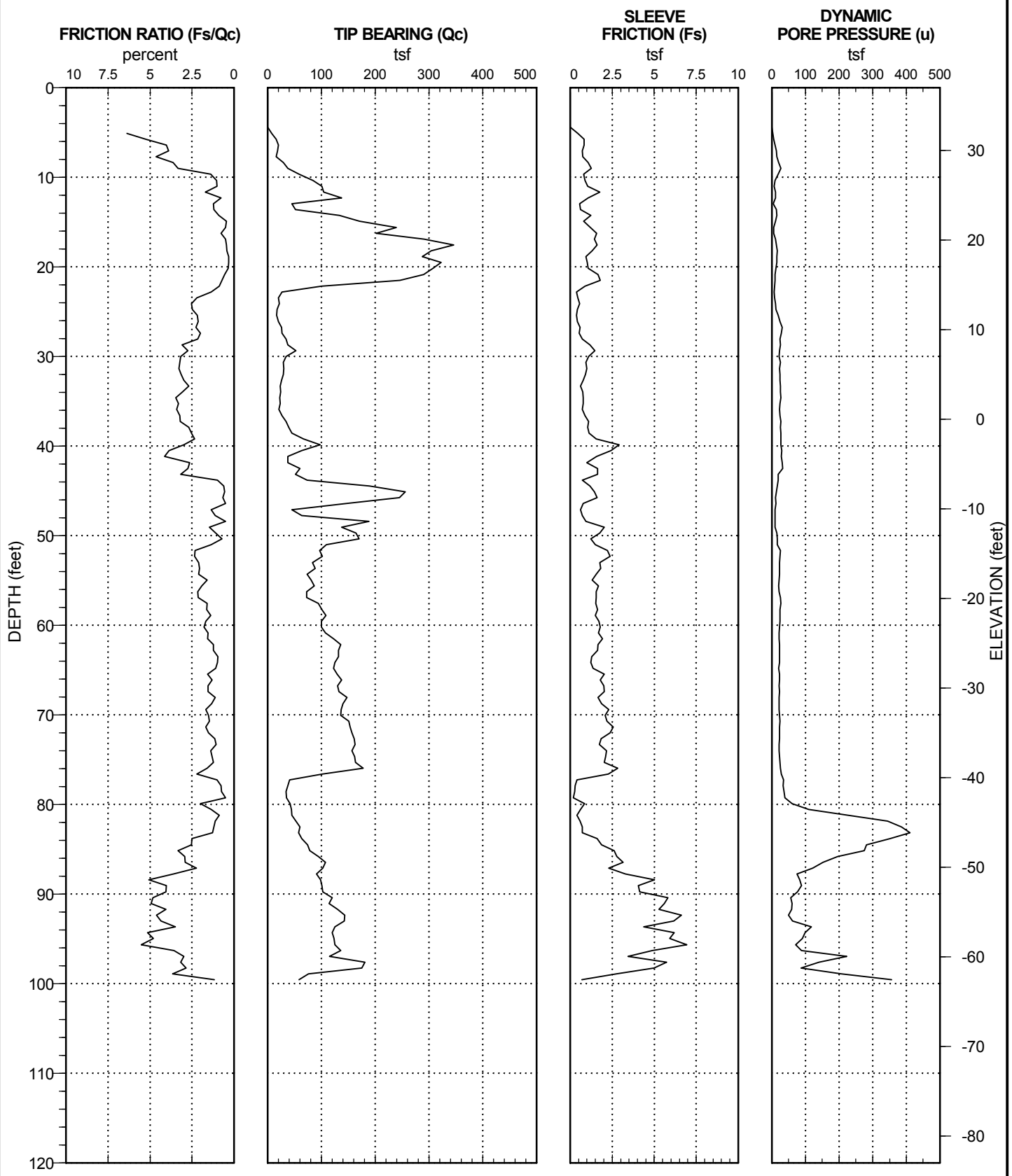
55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**CPT-09-003**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **M.Thummaluru**	DATE **11-16-09**	SHEET **1 of 1**	

URS CPT RECORD MET_ENG (STANDARD) 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10



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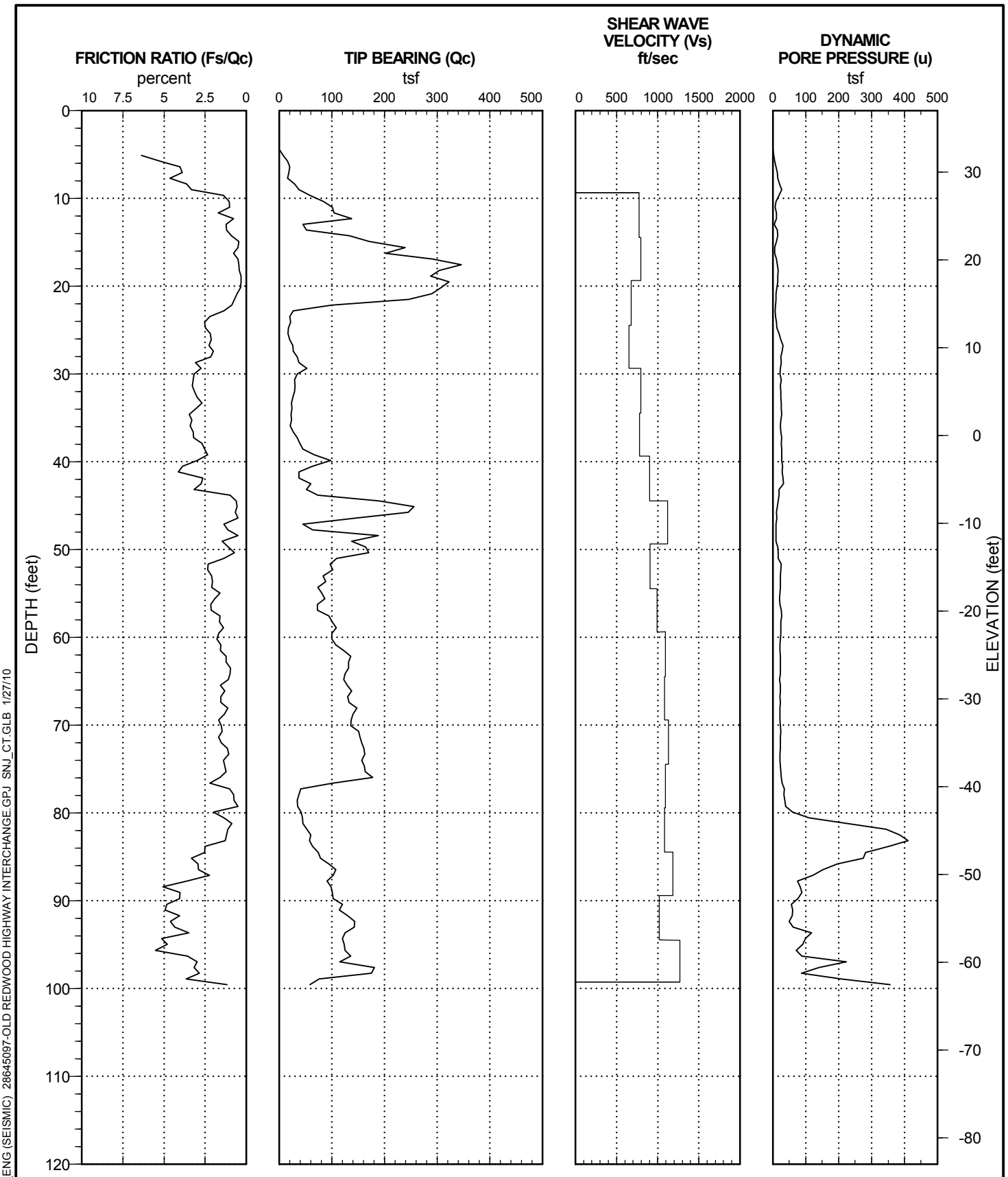
San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**CPT-09-114**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY		DATE **11-16-09**	SHEET **1 of 2**

URS CPT RECORD MET_ENG (STANDARD) 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10



URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

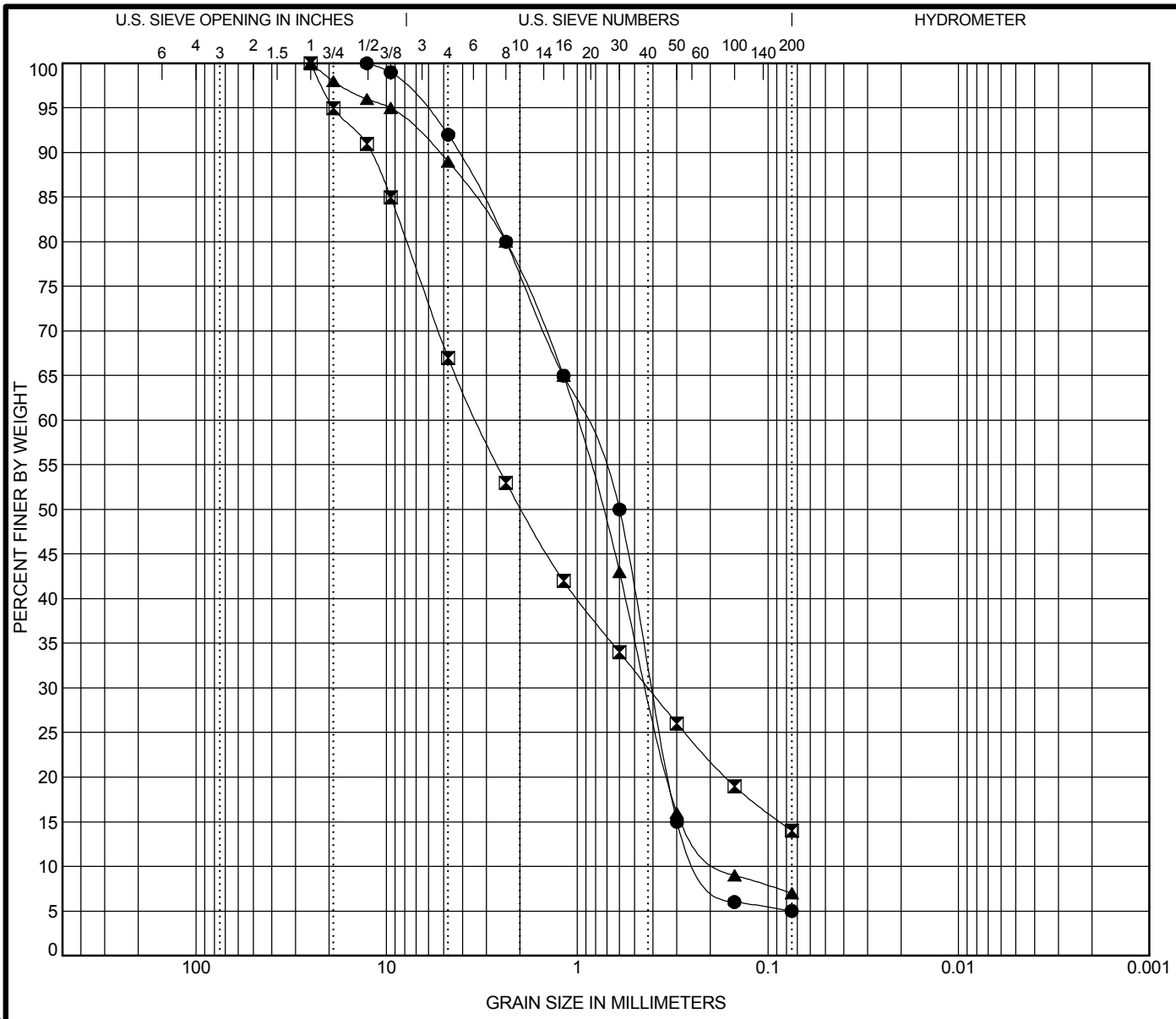
REPORT TITLE				HOLE ID
BORING RECORD				**CPT-09-114**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY		DATE **11-16-09**	SHEET **2 of 2**

URS CPT RECORD MET_ENG (SEISMIC) 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

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.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**A-09-101**	**25.0**	**Poorly graded SAND with SILT**				**0.85**	**4.61**
⊠	**A-09-104**	**25.0**	**CLAYEY SAND with GRAVEL**					
▲	**A-09-107**	**20.0**	**Well-graded SAND with SILT**				**1.10**	**6.11**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**A-09-101**	**25.0**	**12.7**	**0.942**	**0.404**	**0.204**	**8.0**	**87.0**	**5.0**	
⊠	**A-09-104**	**25.0**	**25**	**3.348**	**0.424**		**33.0**	**53.0**	**14.0**	
▲	**A-09-107**	**20.0**	**25**	**1.012**	**0.43**	**0.166**	**11.0**	**82.0**	**7.0**	

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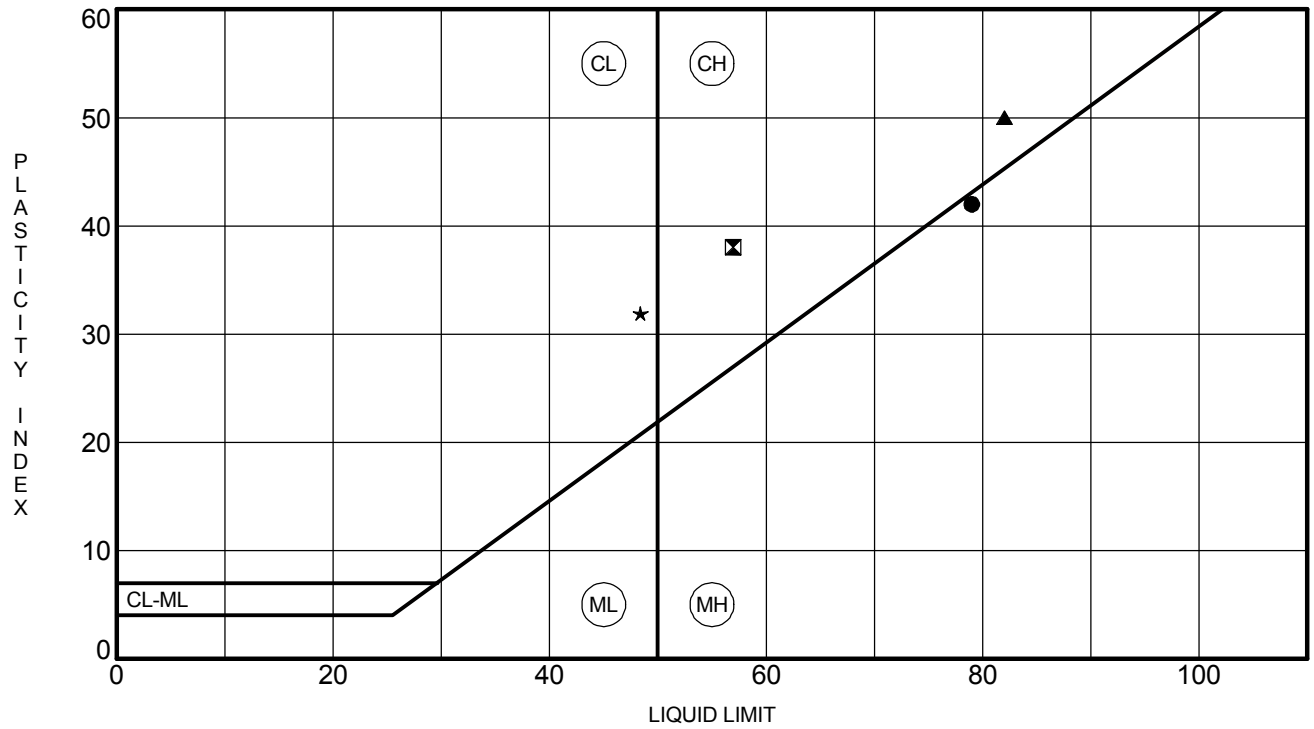
55 S. Market St, Ste 1500
San Jose, CA 95113

GRAIN SIZE DISTRIBUTION

Project Name: Old Redwood Highway Intechange (28645097)
Location: Sonoma 101 7.4/8.1
Number: 12276K

URS GRAIN SIZE 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ CT.GLB 1/27/10



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**A-09-101**	**5.0**	**79**	**37**	**42**		**Fat CLAY**
⊠	**A-09-103**	**8.5**	**57**	**19**	**38**		**Fat CLAY**
▲	**A-09-106**	**5.0**	**82**	**32**	**50**		**Fat CLAY**
★	**R-09-001**	**20.0**	**48**	**16**	**32**		**Lean CLAY**

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55 S. Market St, Ste 1500
San Jose, CA 95113

ATTERBERG LIMITS' RESULTS

Project Name: Old Redwood Highway Intechange (28645097)
Location: Sonoma 101 7.4/8.1
Number: 12276K

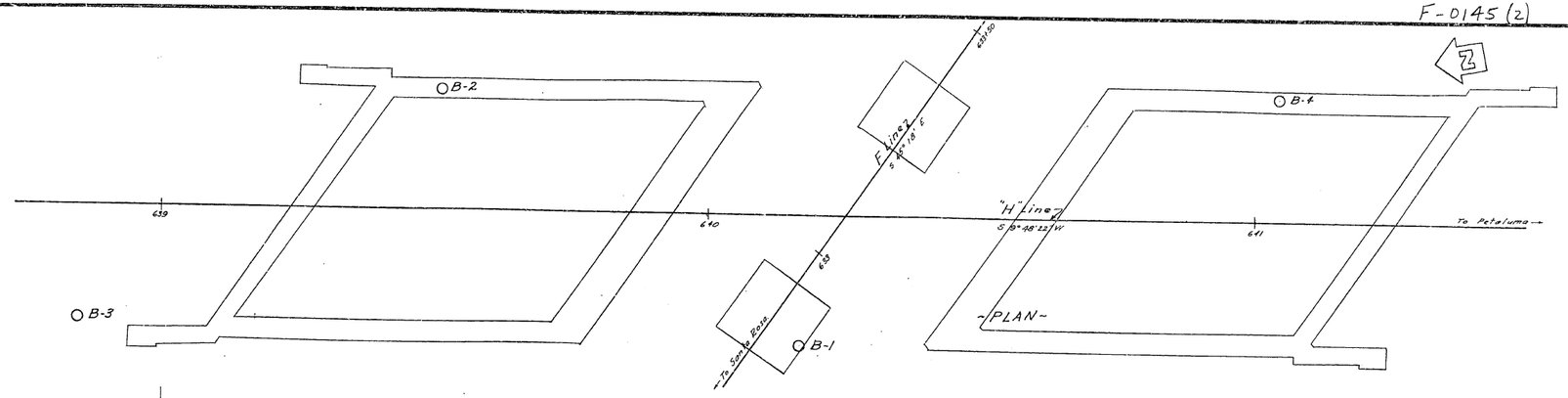
URS ATTERBERG LIMITS 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 1/27/10

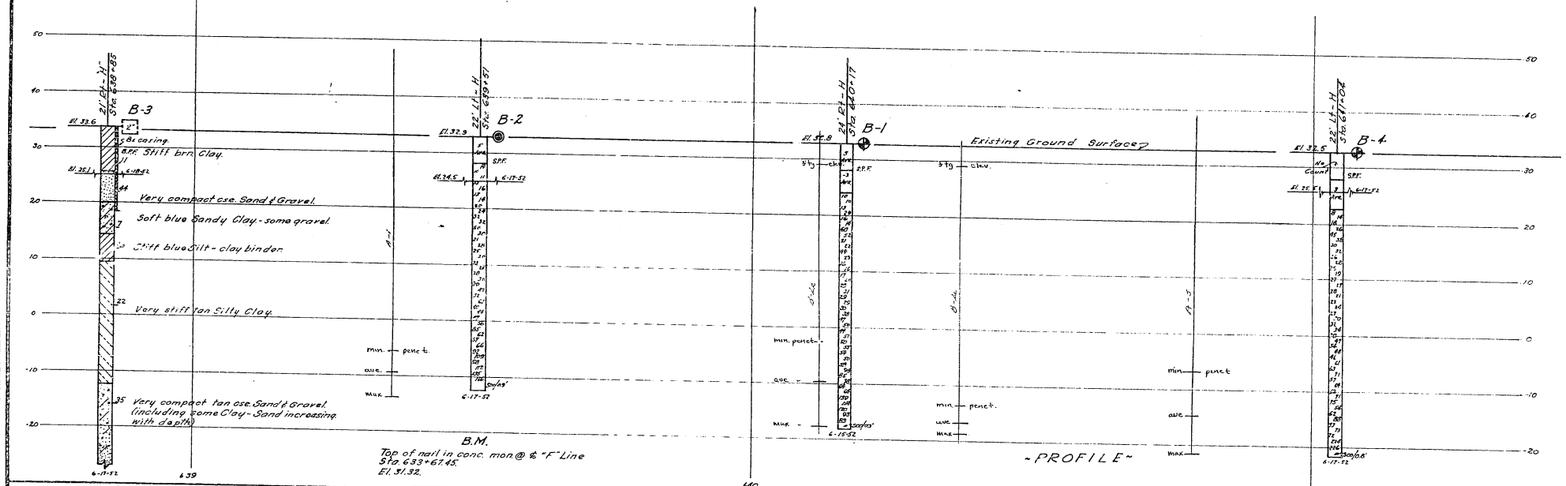
F-0145 (2)

93 154

W Son. 1-1 F -BB-73

March 15, 1962





AS BUILT PLANS

Contract No. 54-4TC63

Date Completed

Document No. 40007280

~Notes~

Relative rates of penetration were obtained as follows:
B-1, 2 & 4 (secs per foot) driving 1⅝" A-Rod or 2½" Core Penetrometer with 40.2" Mohr man-Terry air hammer at 115 p.s.i. gage pressure.
B-3 (blows per foot) driving 1⅞" Sampler with 140 lb. hammer and a 30" free fall.

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

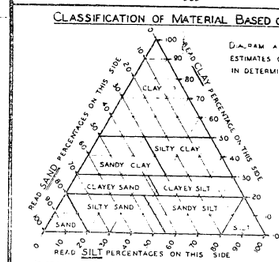


DIAGRAM AND TABLE SHOWING THE BASIS FOR ESTIMATES OF GRADE SIZE DISTRIBUTION USED IN DETERMINATION OF CLASS NAMES

GROUPING USED IN TRIANGULAR CLASSIFICATION			
CLASS NAME	PERCENTAGE OF SIZES PRESENT		
	SAND	SILT	CLAY
SAND	80-100	0-20	0-20
SILTY SAND	45-80	0-55	0-20
SANDY SILT	0-45	55-80	0-20
SILT	0-20	80-100	0-20
CLAYEY SAND	30-80	0-42	20-30
CLAYEY SILT	0-30	42-80	20-30
SANDY CLAY	50-70	0-40	30-50
SILTY CLAY	0-30	20-70	30-50
CLAY	0-50	0-50	50-100

IF GRAVEL IS PRESENT IN APPRECIABLE AMOUNTS THE TERM "GRAVELLY" MAY BE ADDED TO THE CLASS NAME, VIS "GRAVELLY SAND". THE TERMS "COARSE", "MEDIUM" AND "FINE" WHEN USED TO DESCRIBE GRAVEL, SAND AND SILT REFER TO STANDARD GRADE SIZE LIMITS.

LEGEND OF BORING OPERATIONS

- PLAN OF AUGER BORING
- 1" SAMPLER BORING
- ROTARY WASH BORING
- 1" CLOSED SAMPLER DRIVEN
- CORE BORING
- 2½" PENETROMETER DRIVEN
- 1⅜" SAMPLER BORING
- 2" TO 5" AUGER BORING
- 6" TO 20" AUGER BORING
- CASING DRIVEN
- JET BORING
- SAMPLE TAKEN
- 1⅝" A-ROD DRIVEN

THE APPROPRIATE BORING SYMBOLS DESIGNATING THE METHOD OF OPERATION ARE SHOWN AT THE UPPER RIGHT-HAND CORNER OF THE RESPECTIVE BORING. WHERE TOOL CHANGES WERE MADE DURING THE BORING OPERATION SYMBOLS ARE SHOWN AT THE POINT OF CHANGE.

LEGEND OF EARTH MATERIALS

- GRAVEL — G
- SAND — S
- SILT — SI
- CLAY — C
- SILTY SAND — SI S
- CLAYEY SAND — C S
- SANDY SILT — S SI
- CLAYEY SILT — C SI
- SANDY CLAY — SC
- SILTY CLAY — SI C
- PEAT AND/OR ORGANIC CLAY — O
- SANDSTONE — SS
- SHALE — SH
- BROKEN ROCK (FRAGMENTS) — BR
- ROCK — R
- FILL MATERIAL

ABBREVIATIONS

EL 69.4	ELEVATION OF GROUND AT TEST HOLE
bpf	BLOWS PER FOOT — (SEE NOTE ABOVE)
P	PILLED PIPE
M	MOISTURE AS % DRY WEIGHT
EL 64.3 8-12-49	ELEVATION OF GROUND WATER AND DATE

NOTES

THE CONTRACTOR'S ATTENTION IS DIRECTED TO SECTION 2, ARTICLE (C) OF THE STANDARD SPECIFICATIONS AND TO THE SPECIAL PROVISIONS ACCOMPANYING THIS SET OF PLANS.

CLASSIFICATION OF EARTH MATERIAL AS SHOWN ON THIS SHEET IS BASED UPON FIELD INSPECTION AND IS NOT TO BE CONSTRUED TO IMPLY MECHANICAL ANALYSIS.

CONTRACT No. 54-4TC63 P
DATE ACCEPTED DEC 24 1968
AS BUILT
RESIDENT ENGINEER
REVISIONS BY K.L.B. DATE 1/3/69

DENMAN OVERCROSSING

LOG OF TEST BORINGS

SCALE 1" = 10'

BRIDGE NO. 20-159

FILE NO.

DRAWING NO. 2921-8

PREL. DRAWING NO. P-2921

XS-16-

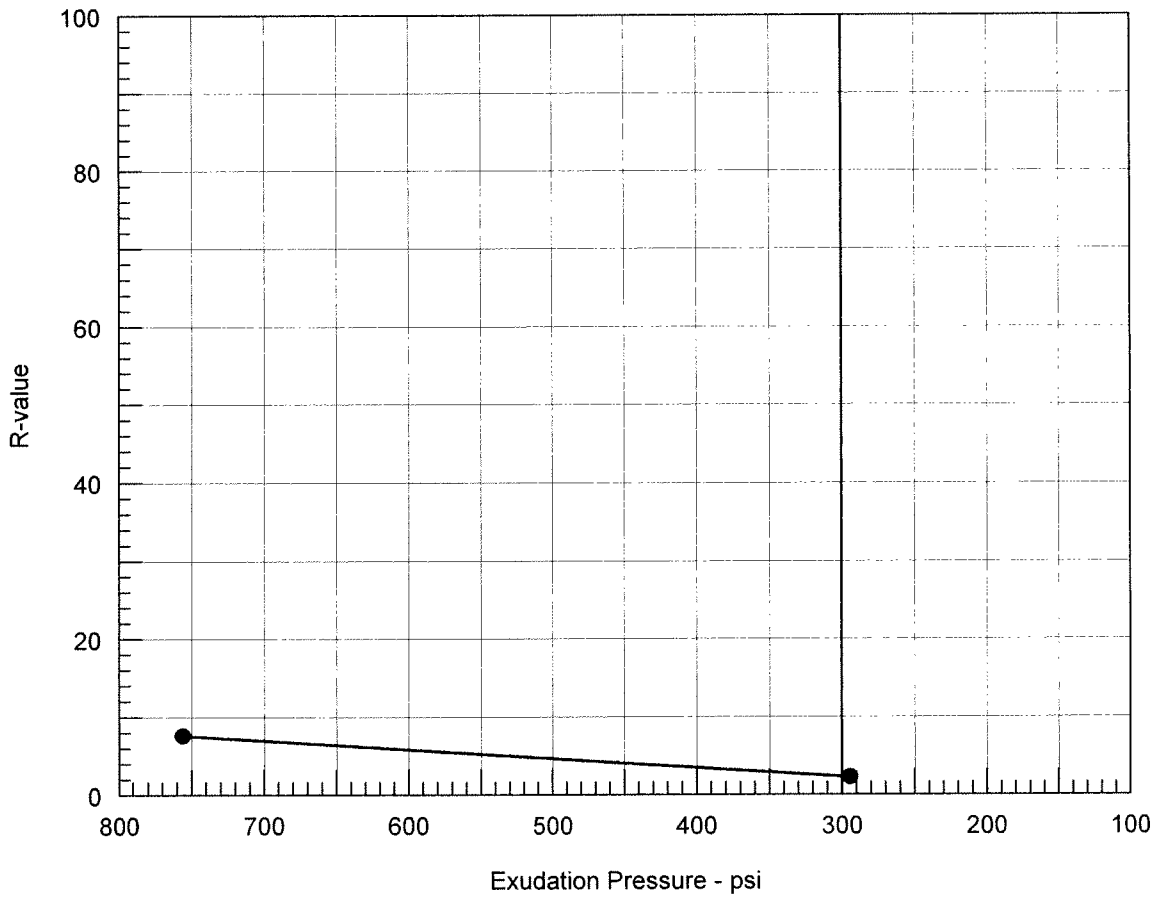
I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE _____ SIGNATURE _____ TITLE _____

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

Resistance value (R-value) tests were performed on two (2) bulk samples of near surface soils at borings. The results of these tests are presented herein.

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psf	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	35	90.2	29.0	153	142	2.53	756	8	8
2	20	88.2	36.3	13	154	2.39	294	2	2

Test Results	Material Description
R-value at 300 psi exudation pressure = 2	Dark gray clay

Project No.: 28645097.04

Project: Replacement of Old Redwood Highway

Source of Sample: A-09-108 **Depth:** 3-6

Date: 12/4/2009

Tested by:

Checked by:

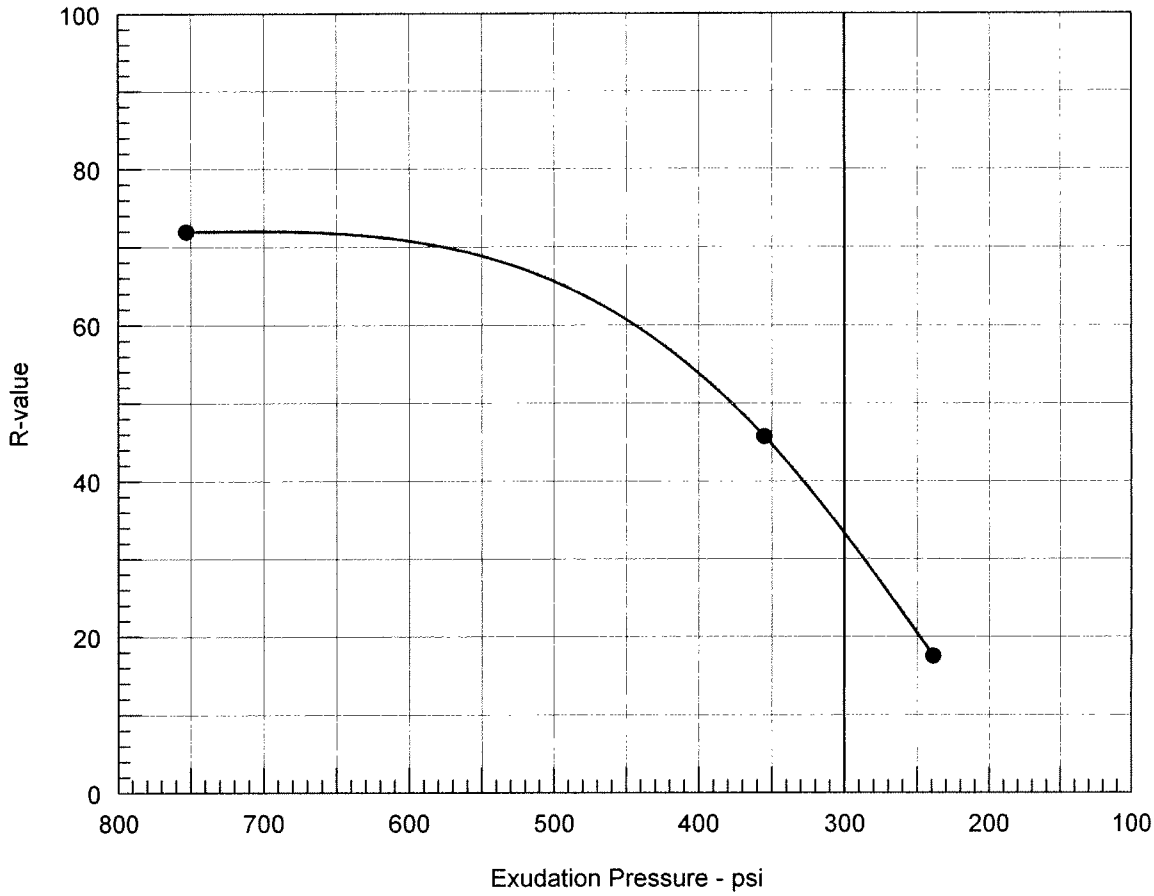
Remarks:
R-Value less than 5. During exudation, sample extruded from bottom of the mold. Causing completion of the testing.

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 psf	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	45	116.6	15.1	0	123	2.57	239	17	17
2	100	120.9	13.3	0	77	2.58	355	44	46
3	350	124.6	11.5	170	36	2.40	753	74	72

Test Results	Material Description
R-value at 300 psi exudation pressure = 33	Brown sandy clay with gravel

Project No.: 28645097.04

Project: Replacement of Old Redwood Highway

Source of Sample: A-09-111 **Depth:** 2-6

Date: 12/4/2009

Tested by:

Checked by:

Remarks:

R-VALUE TEST REPORT

SIGNET TESTING LABS, INC.

Figure _____

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. 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
55 South Market Street
Suite 1500
San Jose, CA 95113

STAGE 1 CONSTRUCTION

1. CONSTRUCT NB ROUTE 101 ON-RAMP IMPROVEMENTS, RETAINING WALLS No. 4 AND No. 5, CONCRETE BARRIERS AND BOX CULVERT EXTENSION.
2. CONSTRUCT SB ROUTE 101 OFF-RAMP IMPROVEMENTS, SOUND WALL, AND BOX CULVERT EXTENSION. THIS WORK SHALL NOT BE CONSTRUCTED CONCURRENTLY WITH TEMP PAVEMENT ON OTHER SIDE.
3. CONSTRUCT TEMPORARY PAVEMENT FOR SB ROUTE 101 OFF-RAMP. THIS WORK SHALL NOT BE CONSTRUCTED CONCURRENTLY WITH WORK ON THE SIDE.
4. CONSTRUCT SB ROUTE 101 ON-RAMP IMPROVEMENTS, RETAINING WALL No. 1 AND MAJORITY OF WALL No. 2, CONCRETE BARRIERS AND BOX CULVERT EXTENSION.
5. CONSTRUCT NB ROUTE 101 OFF-RAMP IMPROVEMENTS. WORK SHALL NOT BE CONSTRUCTED CONCURRENTLY WITH THE OTHER SIDE.
6. CONSTRUCT TEMPORARY PAVEMENT FOR NB ROUTE 101 OFF-RAMP AND PETALUMA Blvd N. WORK SHALL NOT BE CONSTRUCTED CONCURRENTLY WITH THE OTHER SIDE.
7. CONSTRUCT WIDENING AND IMPROVEMENTS ON PETALUMA Blvd N.

STAGE 1 TRAFFIC

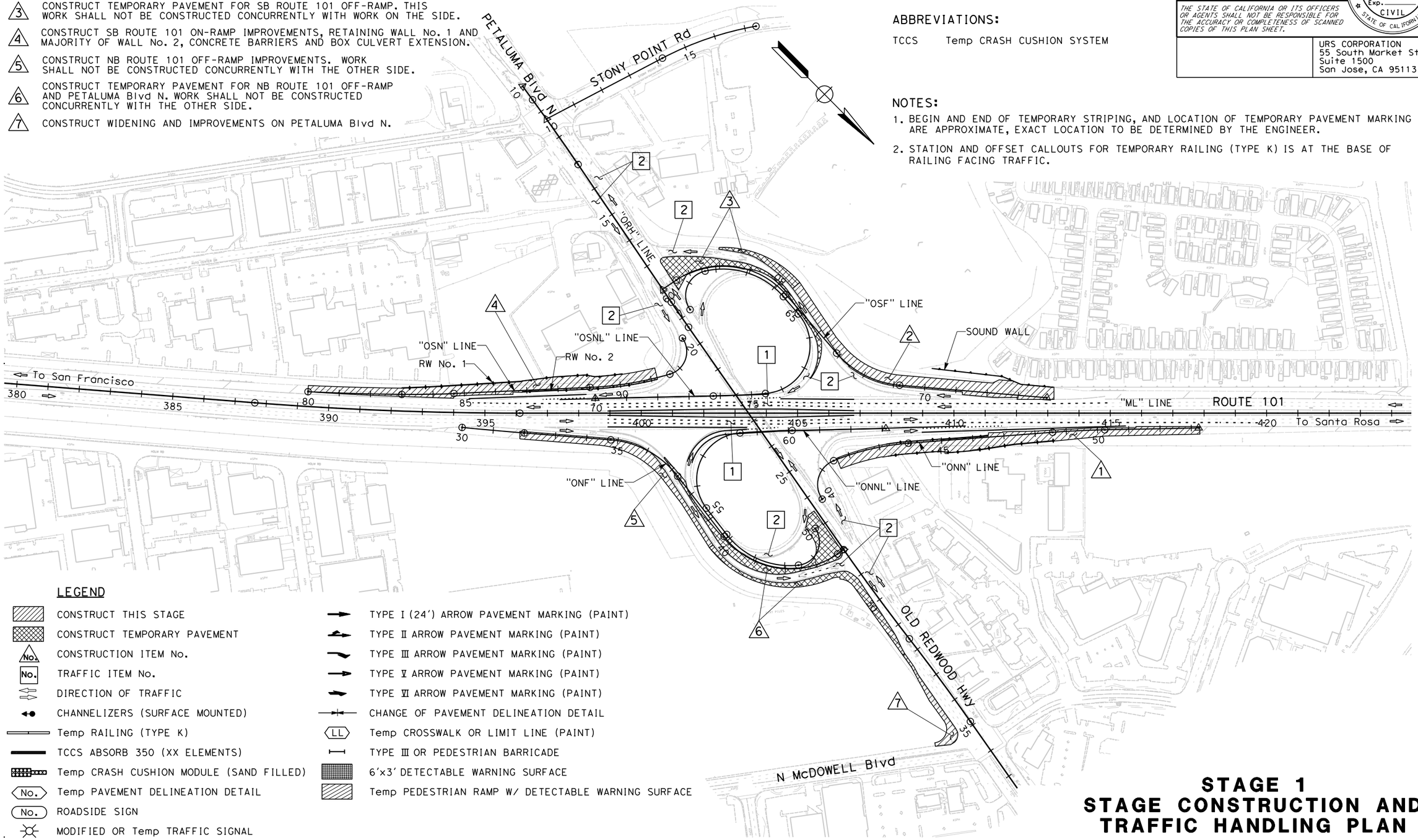
1. SHIFT TRAFFIC LANES ON ROUTE 101 TOWARDS THE OUTSIDE USING 11' LANES.
2. THE REMAINING TRAFFIC ON MAINLINE, RAMPS, AND PETALUMA Blvd N/OLD REDWOOD Hwy REMAIN UNCHANGED.

ABBREVIATIONS:

TCCS Temp CRASH CUSHION SYSTEM

NOTES:

1. BEGIN AND END OF TEMPORARY STRIPING, AND LOCATION OF TEMPORARY PAVEMENT MARKING ARE APPROXIMATE, EXACT LOCATION TO BE DETERMINED BY THE ENGINEER.
2. STATION AND OFFSET CALLOUTS FOR TEMPORARY RAILING (TYPE K) IS AT THE BASE OF RAILING FACING TRAFFIC.



LEGEND

- CONSTRUCT THIS STAGE
- CONSTRUCT TEMPORARY PAVEMENT
- No. CONSTRUCTION ITEM No.
- No. TRAFFIC ITEM No.
- DIRECTION OF TRAFFIC
- CHANNELIZERS (SURFACE MOUNTED)
- Temp RAILING (TYPE K)
- TCCS ABSORB 350 (XX ELEMENTS)
- Temp CRASH CUSHION MODULE (SAND FILLED)
- No. Temp PAVEMENT DELINEATION DETAIL
- No. ROADSIDE SIGN
- MODIFIED OR Temp TRAFFIC SIGNAL
- TYPE I (24') ARROW PAVEMENT MARKING (PAINT)
- TYPE II ARROW PAVEMENT MARKING (PAINT)
- TYPE III ARROW PAVEMENT MARKING (PAINT)
- TYPE V ARROW PAVEMENT MARKING (PAINT)
- TYPE VI ARROW PAVEMENT MARKING (PAINT)
- CHANGE OF PAVEMENT DELINEATION DETAIL
- LL Temp CROSSWALK OR LIMIT LINE (PAINT)
- TYPE III OR PEDESTRIAN BARRICADE
- 6'x3' DETECTABLE WARNING SURFACE
- Temp PEDESTRIAN RAMP W/ DETECTABLE WARNING SURFACE

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

STAGE 1
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

NO SCALE

SC-1

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CALCULATED-DESIGNED BY	CHECKED BY
HUEY NHAM	DAVID WILLIAMS

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04	Son	101	7.4/8.1		

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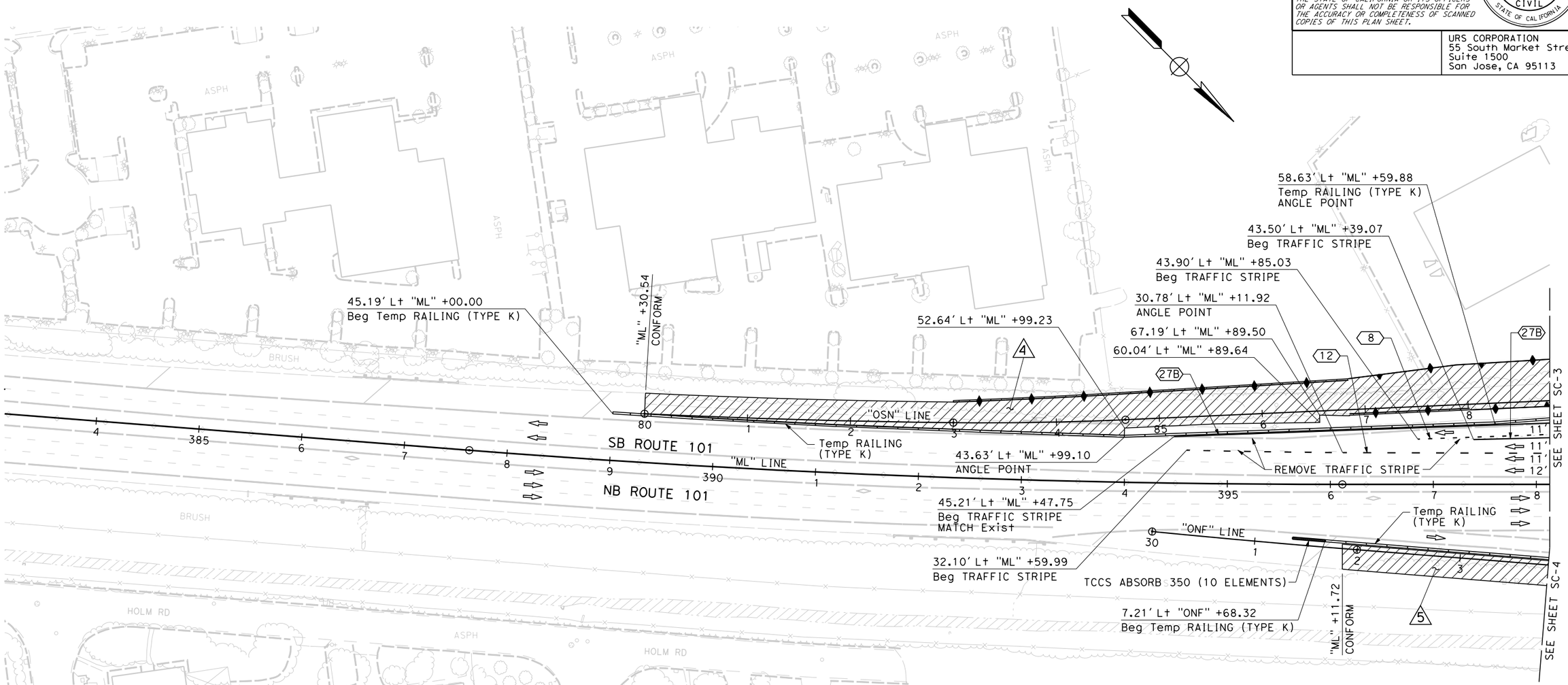

STAGE 1
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-2

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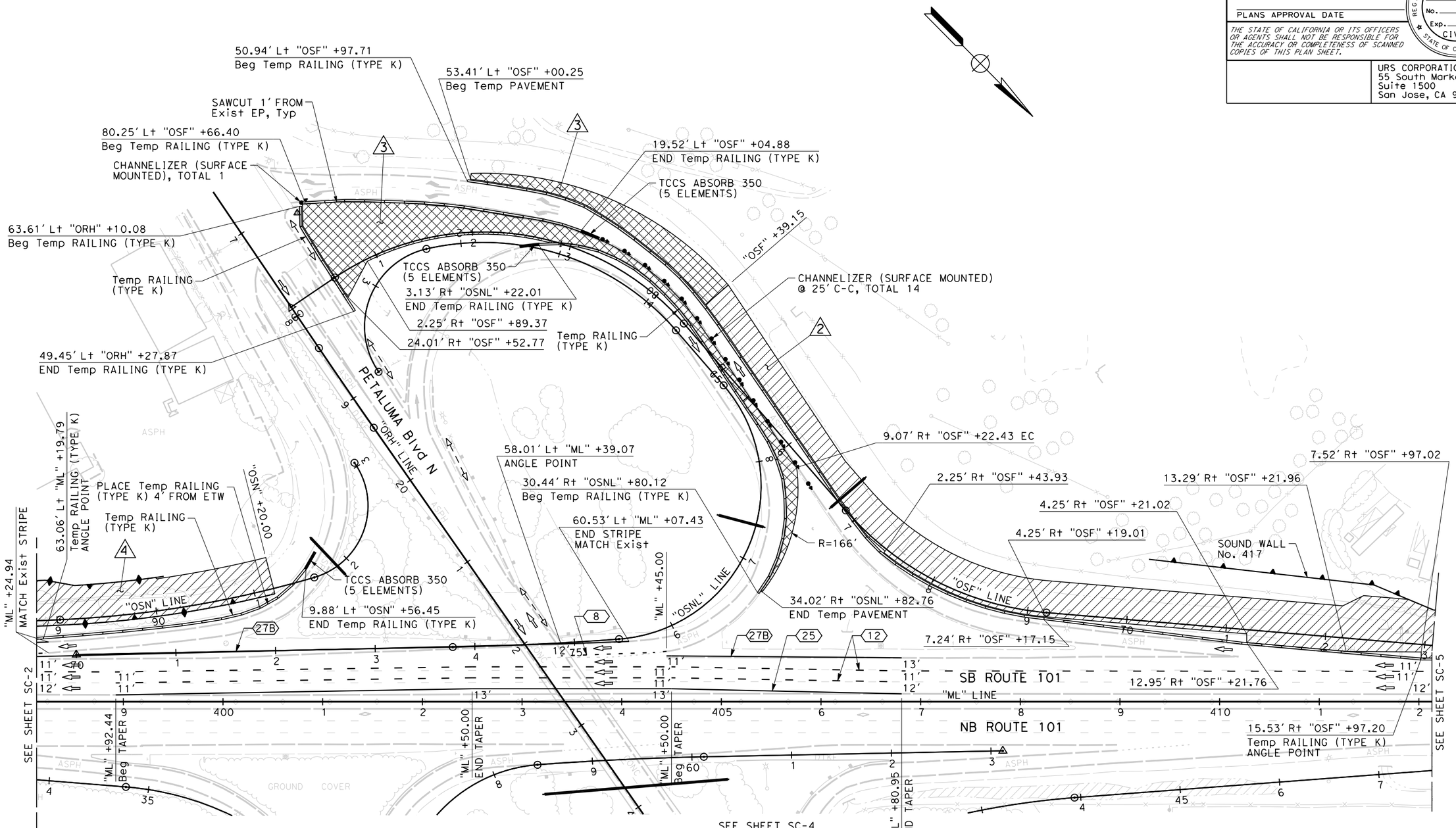

STAGE 1
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

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SC-3

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BORDER LAST REVISED 7/2/2010 | USERNAME => huey_nham | DGN FILE => 412276ma003.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0000 | PROJECT NUMBER & PHASE 04000200041

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

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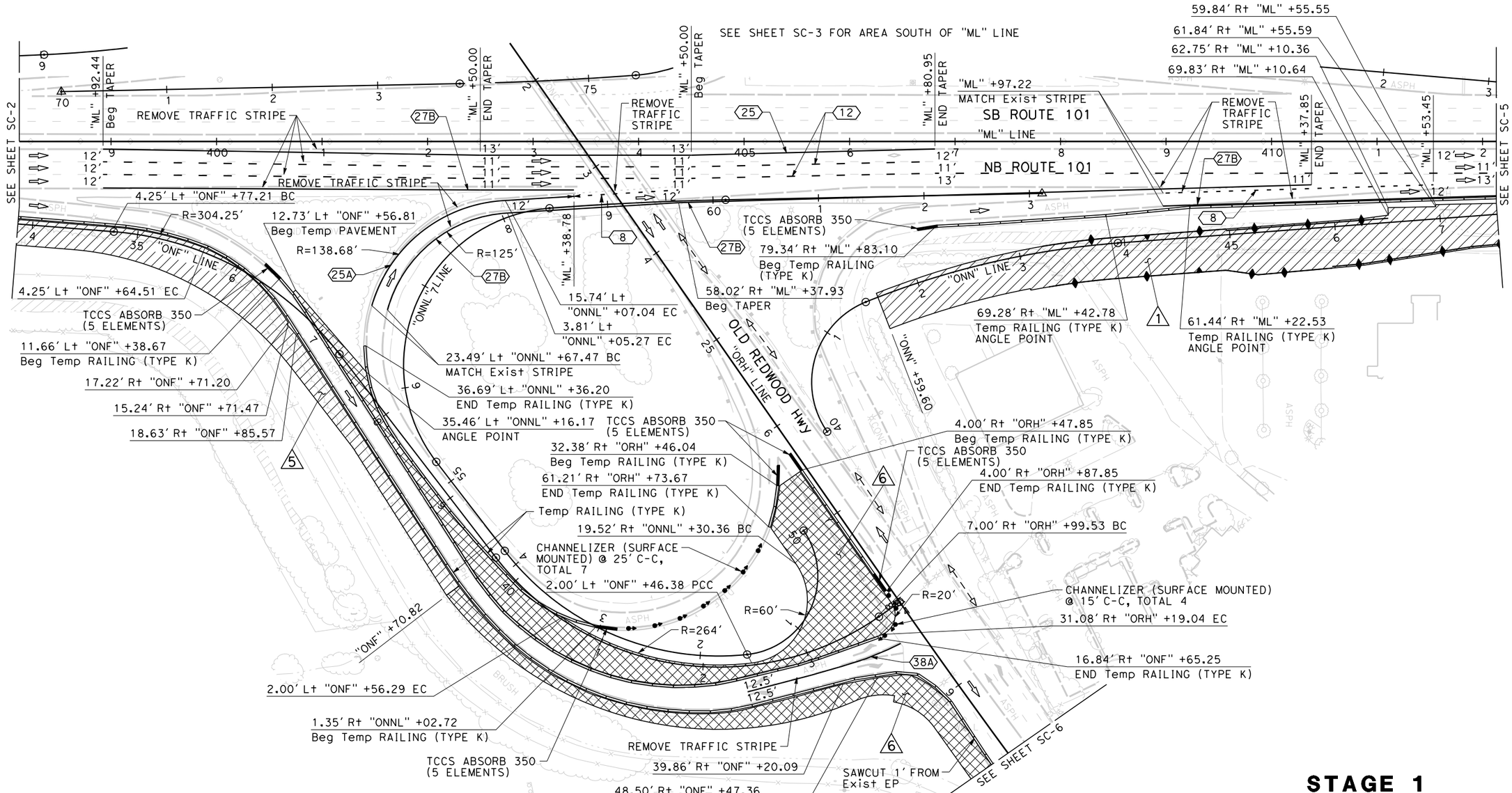

STAGE 1
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

SC-4

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

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04	Son	101	7.4/8.1		

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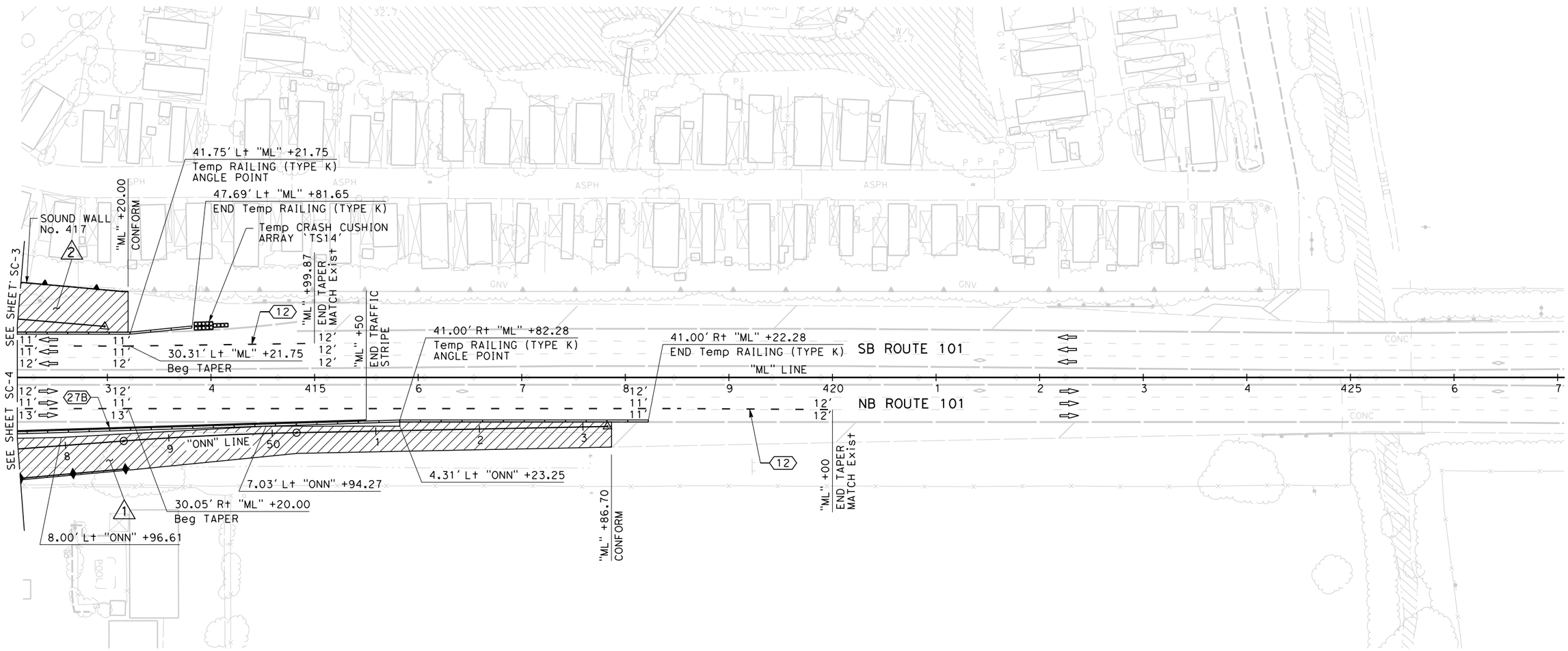

STAGE 1
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-5

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04	Son	101	7.4/8.1		

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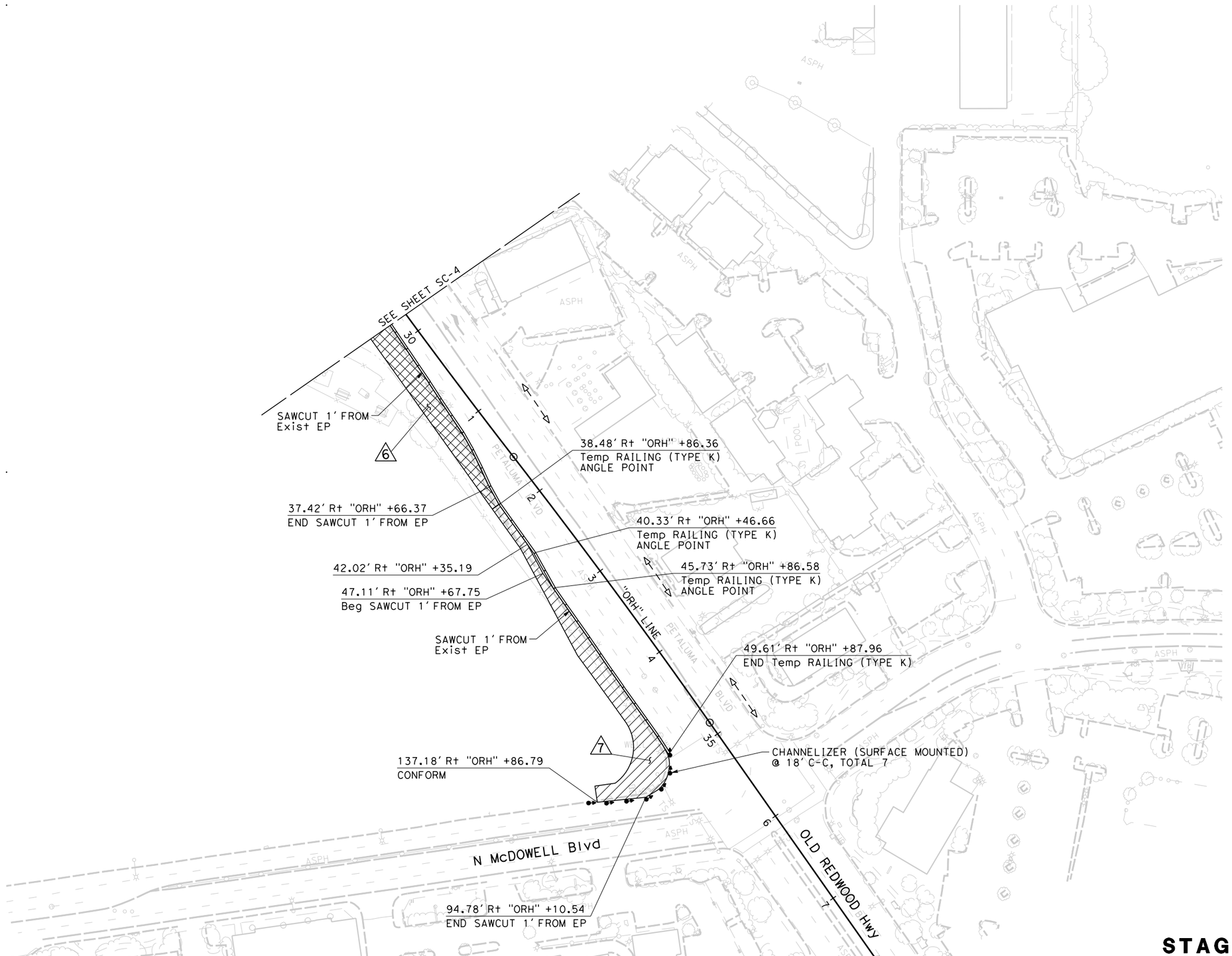

STAGE 1
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

SC-6

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

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04	Son	101	7.4/8.1		

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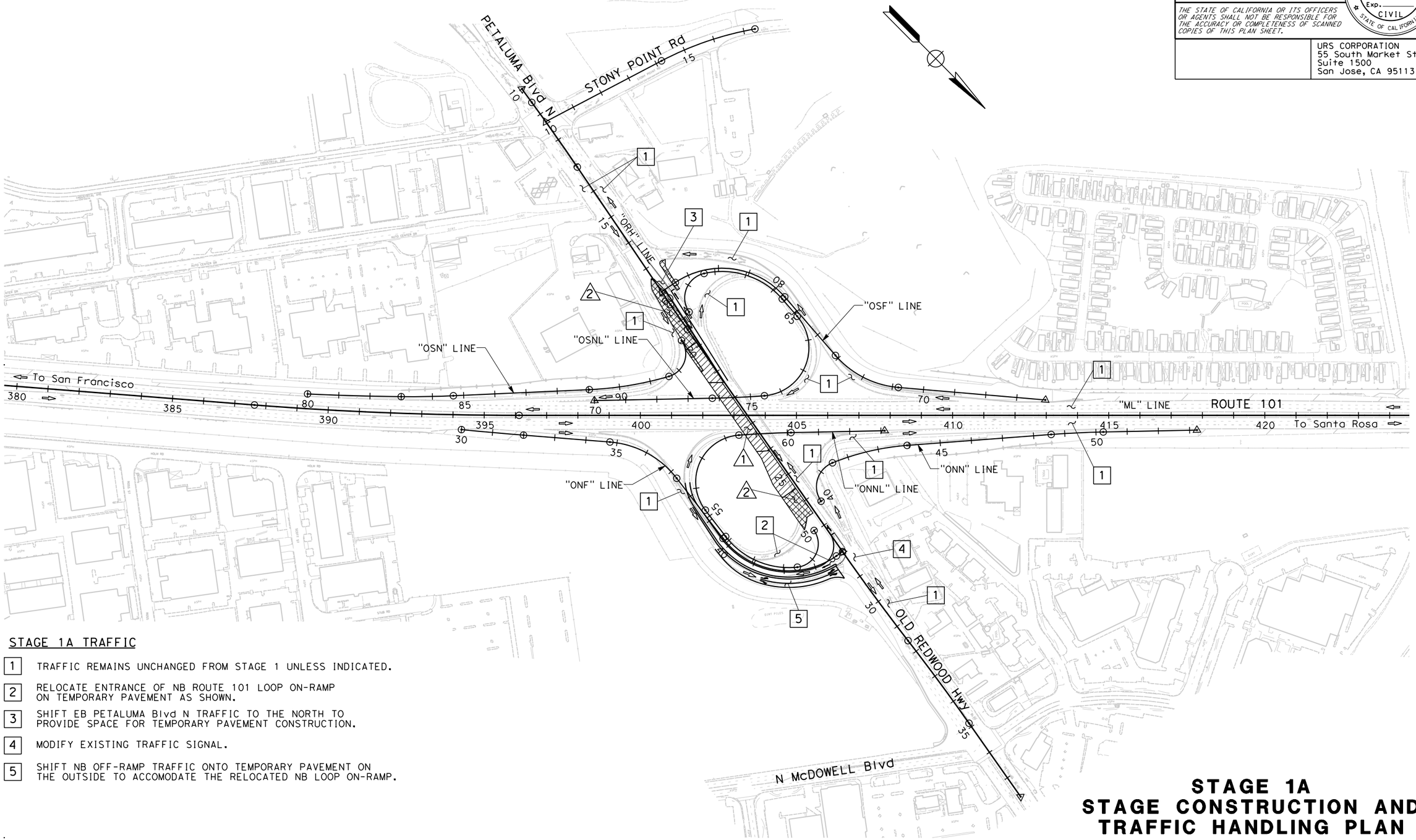
STAGE 1A CONSTRUCTION

1. CONSTRUCT THE SOUTH PORTION OF OLD REDWOOD Hwy OVERCROSSING STRUCTURE.
2. CONSTRUCT TEMPORARY PAVEMENT TRANSITION FROM BRIDGE STRUCTURE TO EXISTING PAVEMENT.



STAGE 1A TRAFFIC

1. TRAFFIC REMAINS UNCHANGED FROM STAGE 1 UNLESS INDICATED.
2. RELOCATE ENTRANCE OF NB ROUTE 101 LOOP ON-RAMP ON TEMPORARY PAVEMENT AS SHOWN.
3. SHIFT EB PETALUMA Blvd N TRAFFIC TO THE NORTH TO PROVIDE SPACE FOR TEMPORARY PAVEMENT CONSTRUCTION.
4. MODIFY EXISTING TRAFFIC SIGNAL.
5. SHIFT NB OFF-RAMP TRAFFIC ONTO TEMPORARY PAVEMENT ON THE OUTSIDE TO ACCOMODATE THE RELOCATED NB LOOP ON-RAMP.

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

STAGE 1A
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

NO SCALE

SC-7

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04	Son	101	7.4/8.1		

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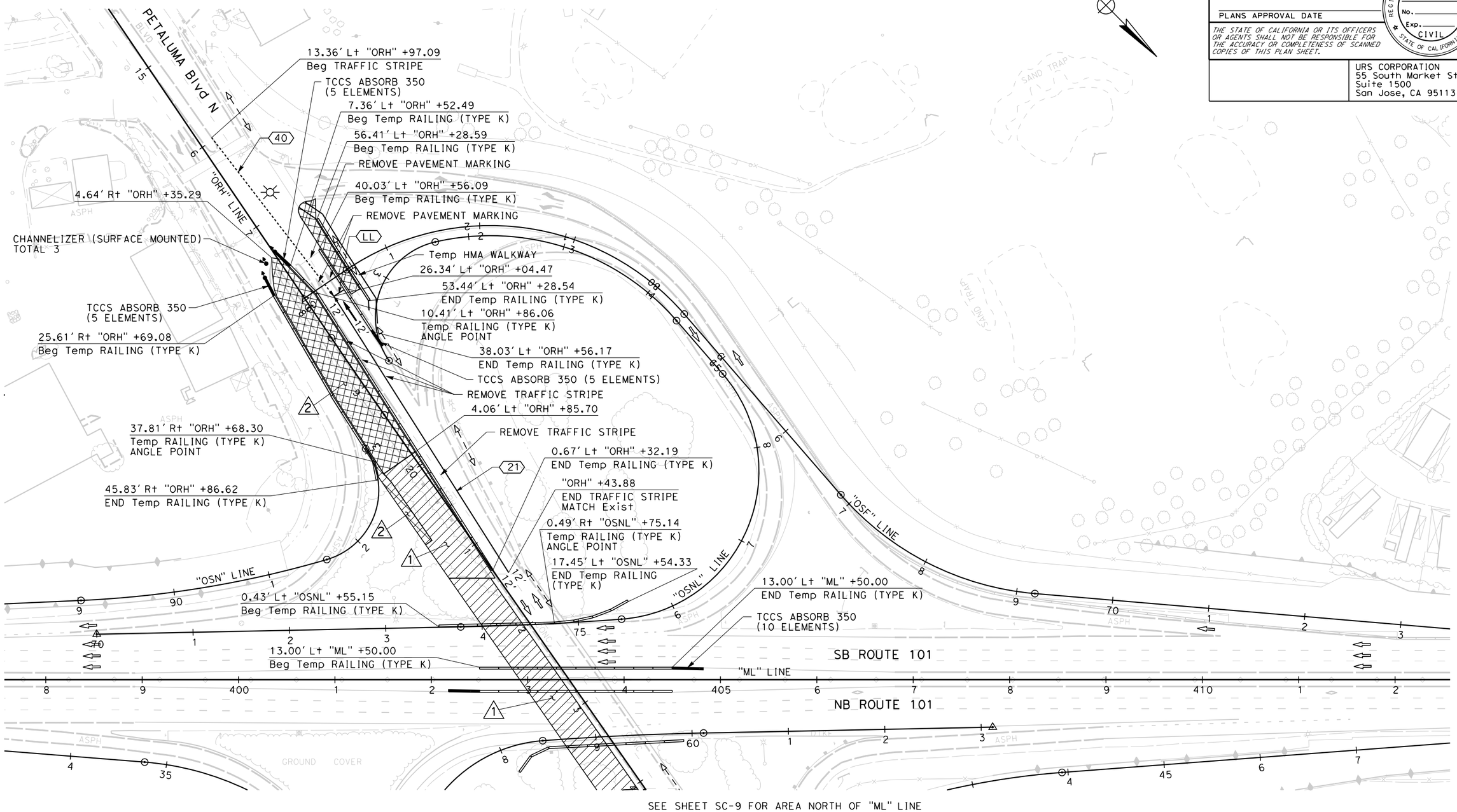

SEE SHEET SC-9 FOR AREA NORTH OF "ML" LINE

STAGE 1A
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

SC-8

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

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04	Son	101	7.4/8.1		

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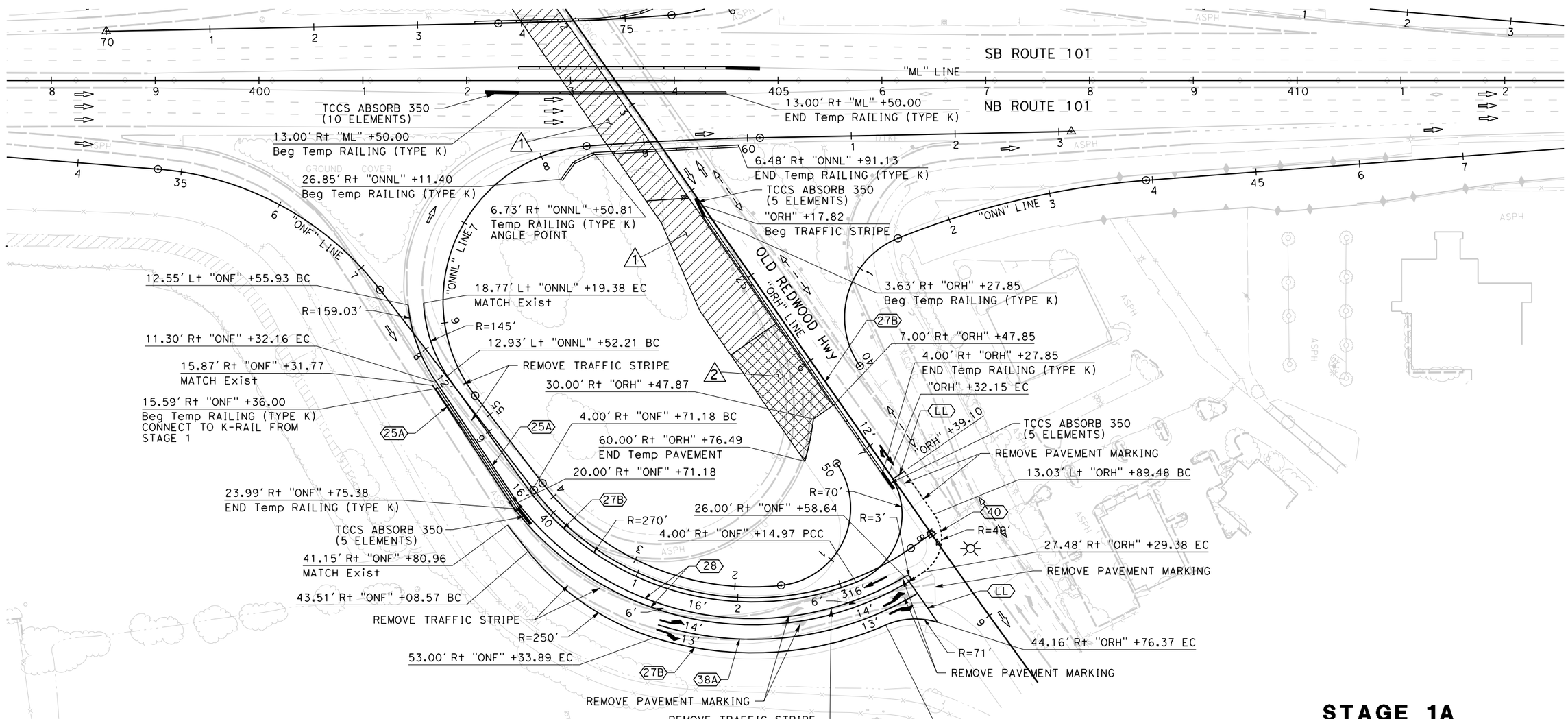
SEE SHEET SC-8 FOR AREA SOUTH OF "ML" LINE



STAGE 1A
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-9

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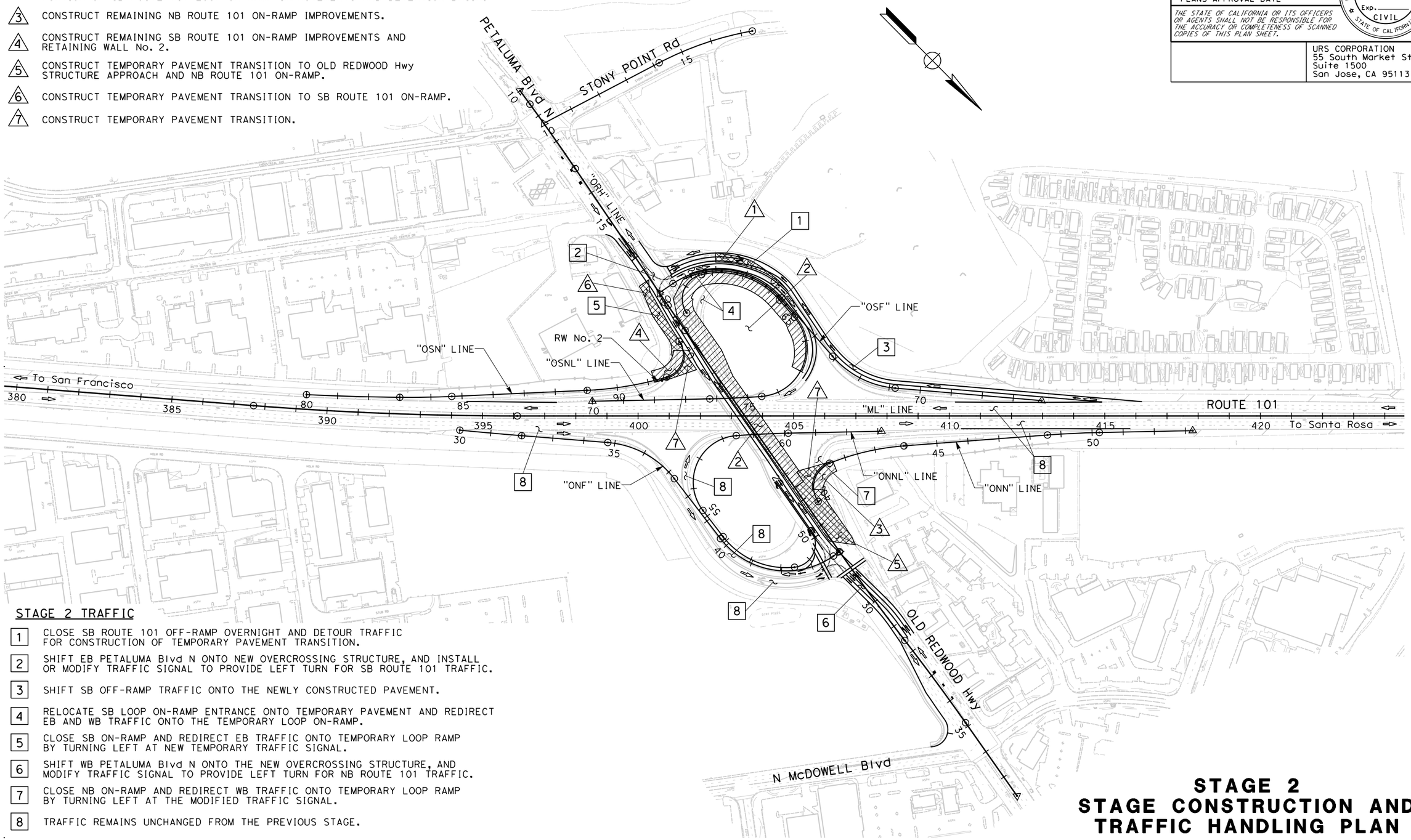
STAGE 2 CONSTRUCTION

1. CONSTRUCT TEMPORARY PAVEMENT TRANSITION ON SB ROUTE 101 OFF-RAMP.
2. CONSTRUCT REMAINING NORTH SIDE OF OLD REDWOOD Hwy OVERCROSSING STRUCTURE, PORTION OF SB ROUTE 101 LOOP ON-RAMP IMPROVEMENTS AND DETENTION BASIN.
3. CONSTRUCT REMAINING NB ROUTE 101 ON-RAMP IMPROVEMENTS.
4. CONSTRUCT REMAINING SB ROUTE 101 ON-RAMP IMPROVEMENTS AND RETAINING WALL No. 2.
5. CONSTRUCT TEMPORARY PAVEMENT TRANSITION TO OLD REDWOOD Hwy STRUCTURE APPROACH AND NB ROUTE 101 ON-RAMP.
6. CONSTRUCT TEMPORARY PAVEMENT TRANSITION TO SB ROUTE 101 ON-RAMP.
7. CONSTRUCT TEMPORARY PAVEMENT TRANSITION.



STAGE 2 TRAFFIC

1. CLOSE SB ROUTE 101 OFF-RAMP OVERNIGHT AND DETOUR TRAFFIC FOR CONSTRUCTION OF TEMPORARY PAVEMENT TRANSITION.
2. SHIFT EB PETALUMA Blvd N ONTO NEW OVERCROSSING STRUCTURE, AND INSTALL OR MODIFY TRAFFIC SIGNAL TO PROVIDE LEFT TURN FOR SB ROUTE 101 TRAFFIC.
3. SHIFT SB OFF-RAMP TRAFFIC ONTO THE NEWLY CONSTRUCTED PAVEMENT.
4. RELOCATE SB LOOP ON-RAMP ENTRANCE ONTO TEMPORARY PAVEMENT AND REDIRECT EB AND WB TRAFFIC ONTO THE TEMPORARY LOOP ON-RAMP.
5. CLOSE SB ON-RAMP AND REDIRECT EB TRAFFIC ONTO TEMPORARY LOOP RAMP BY TURNING LEFT AT NEW TEMPORARY TRAFFIC SIGNAL.
6. SHIFT WB PETALUMA Blvd N ONTO THE NEW OVERCROSSING STRUCTURE, AND MODIFY TRAFFIC SIGNAL TO PROVIDE LEFT TURN FOR NB ROUTE 101 TRAFFIC.
7. CLOSE NB ON-RAMP AND REDIRECT WB TRAFFIC ONTO TEMPORARY LOOP RAMP BY TURNING LEFT AT THE MODIFIED TRAFFIC SIGNAL.
8. TRAFFIC REMAINS UNCHANGED FROM THE PREVIOUS STAGE.

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

STAGE 2
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

NO SCALE

SC-10

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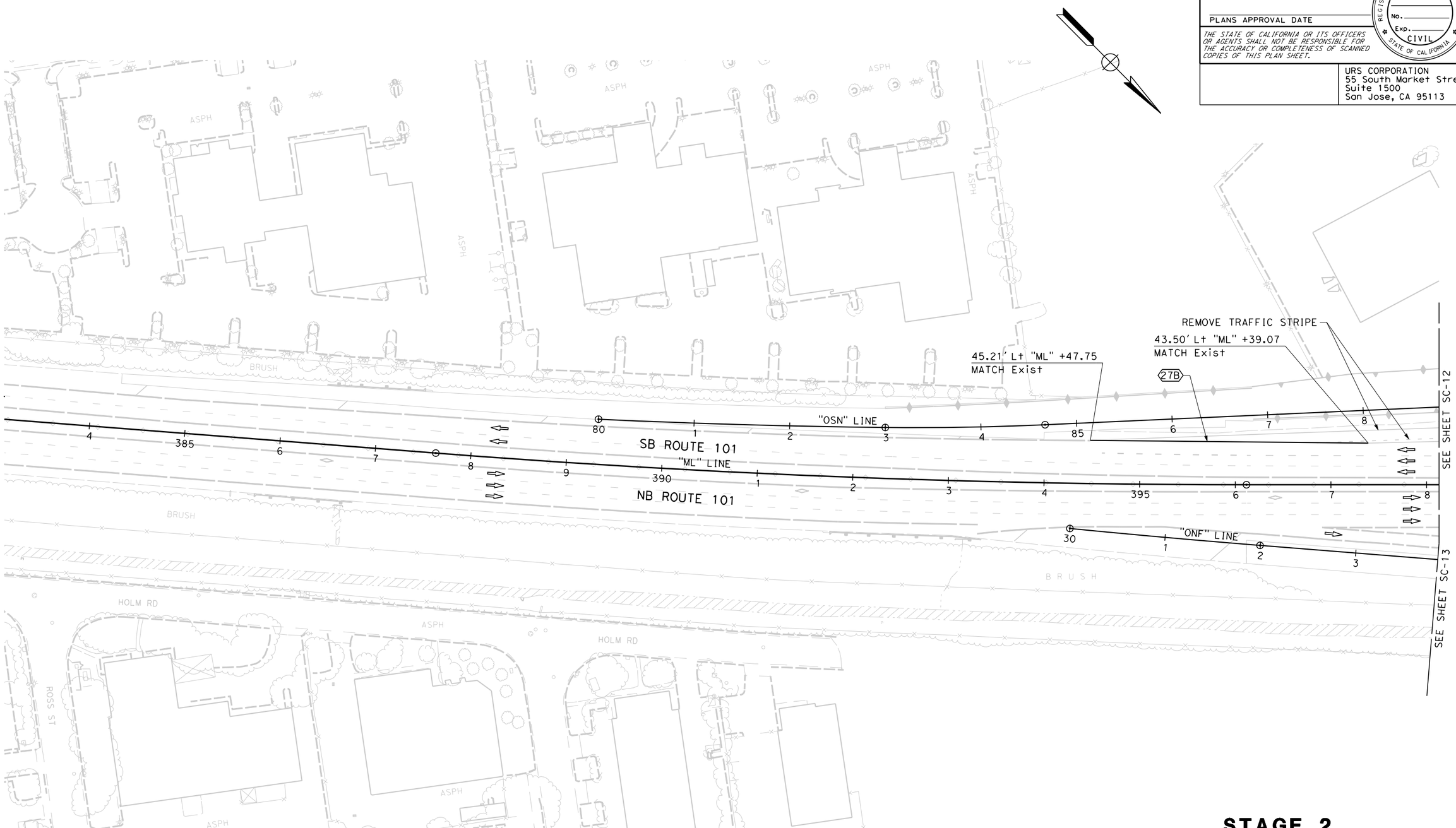

STAGE 2
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

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SC-11

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BORDER LAST REVISED 7/2/2010

USERNAME => huey_nham
DGN FILE => 412276ma011.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0000

PROJECT NUMBER & PHASE 04000200041

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

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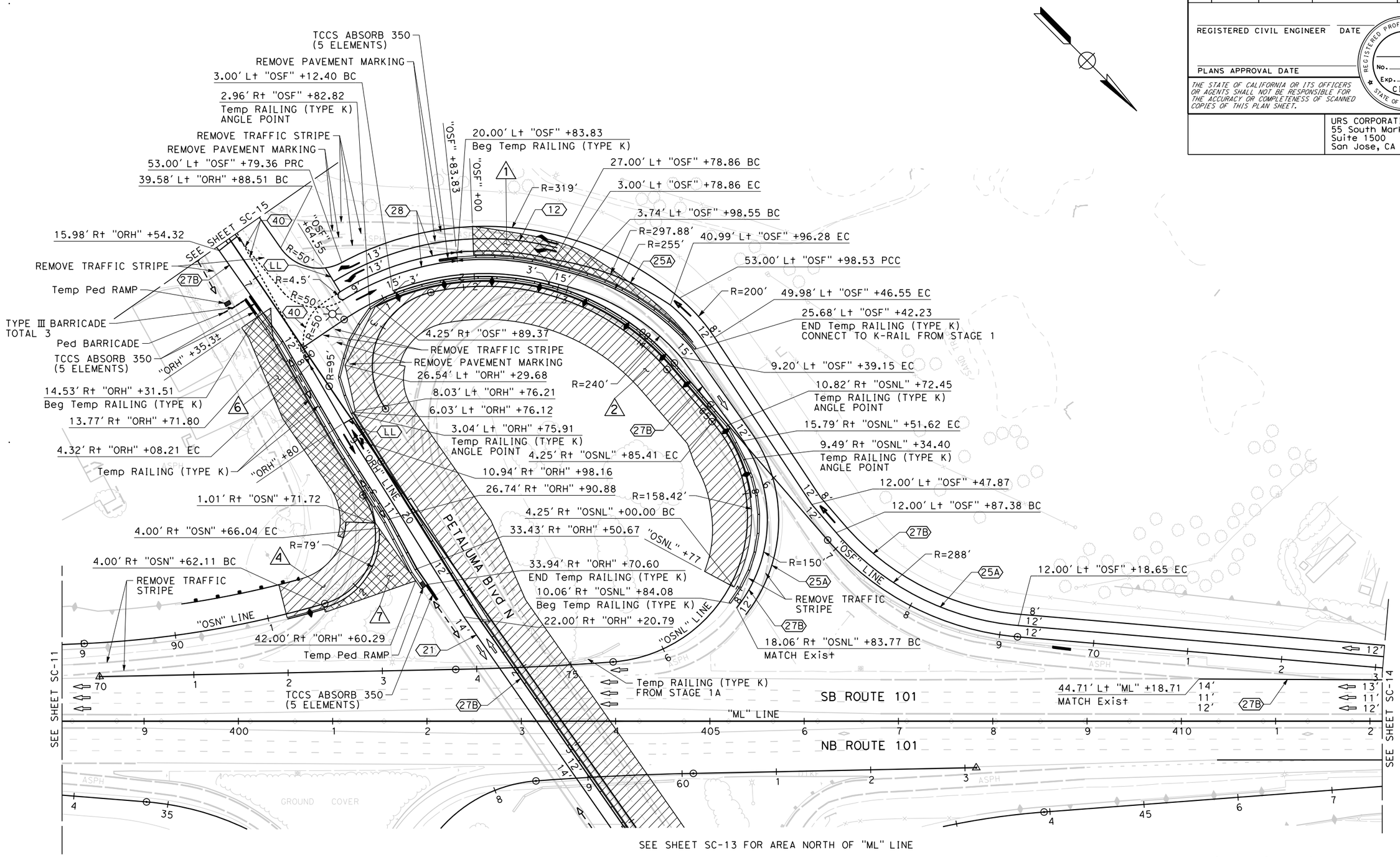

STAGE 2
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-12

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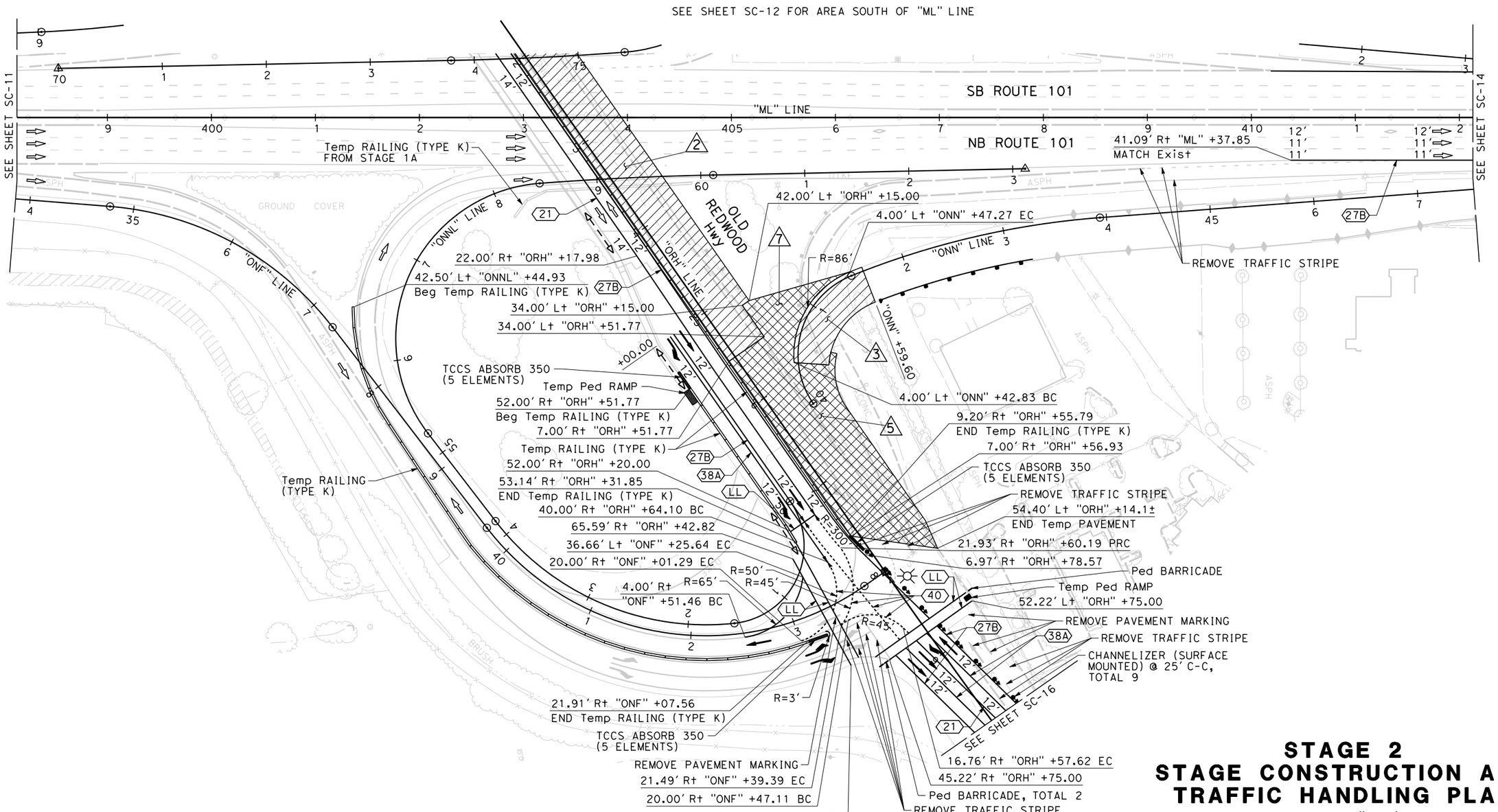

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

STAGE 2
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

SC-13

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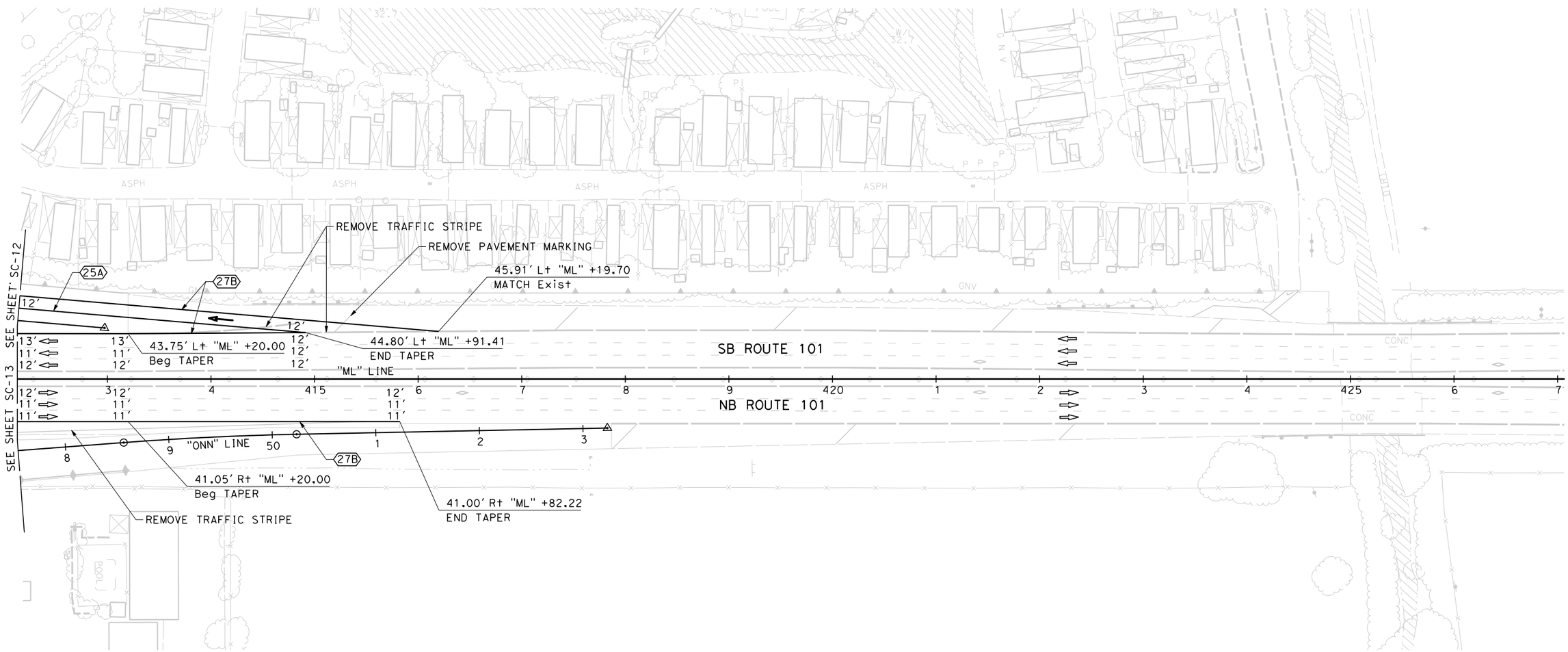

STAGE 2
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

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SC-14

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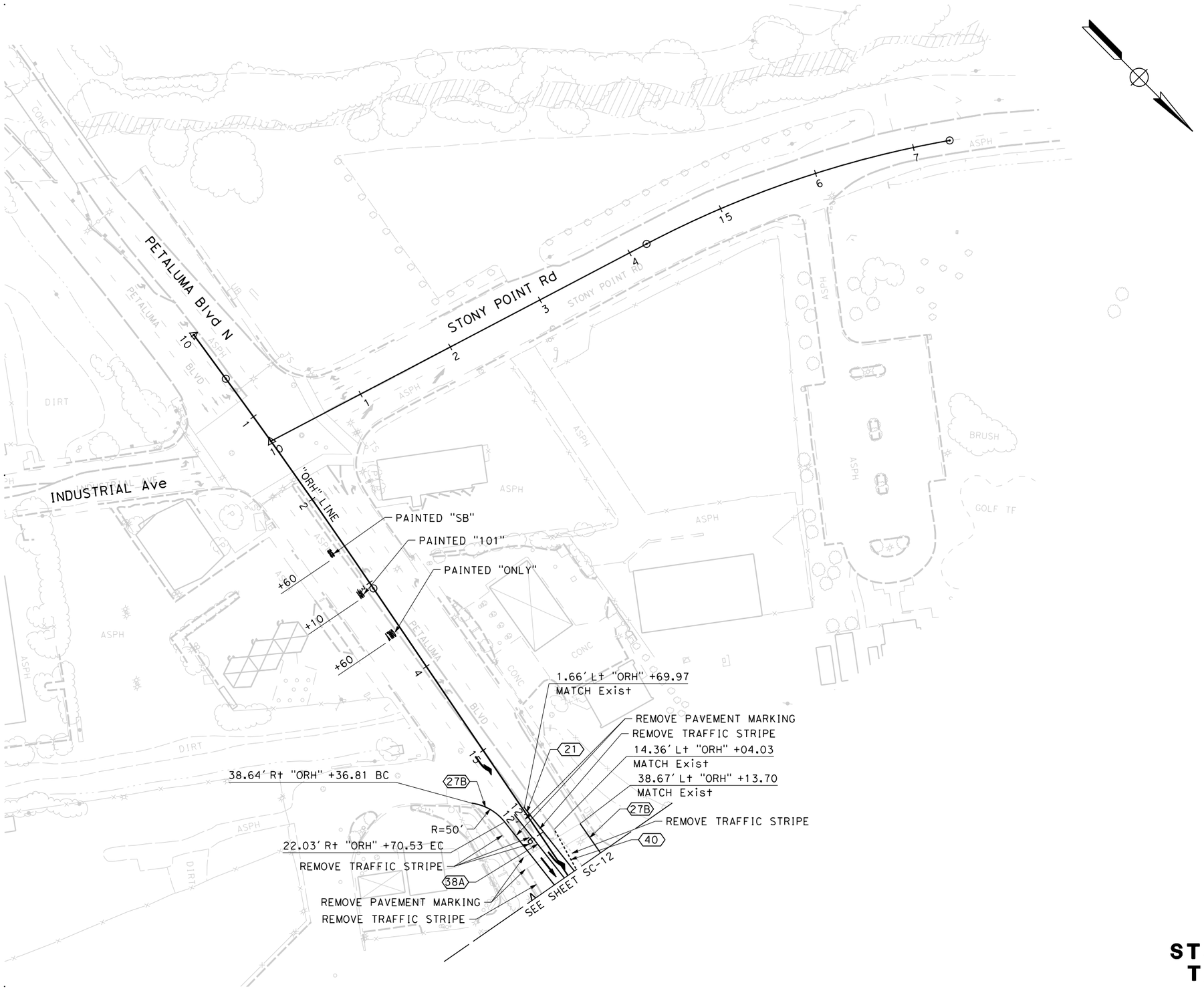

STAGE 2
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-15

REVISED BY	DATE REVISED

CALCULATED-DESIGNED BY	CHECKED BY
HUEY NHAM	DAVID WILLIAMS

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

LAST REVISION 09-20-10 | DATE PLOTTED => 9/16/2010 | TIME PLOTTED => 12:41:42 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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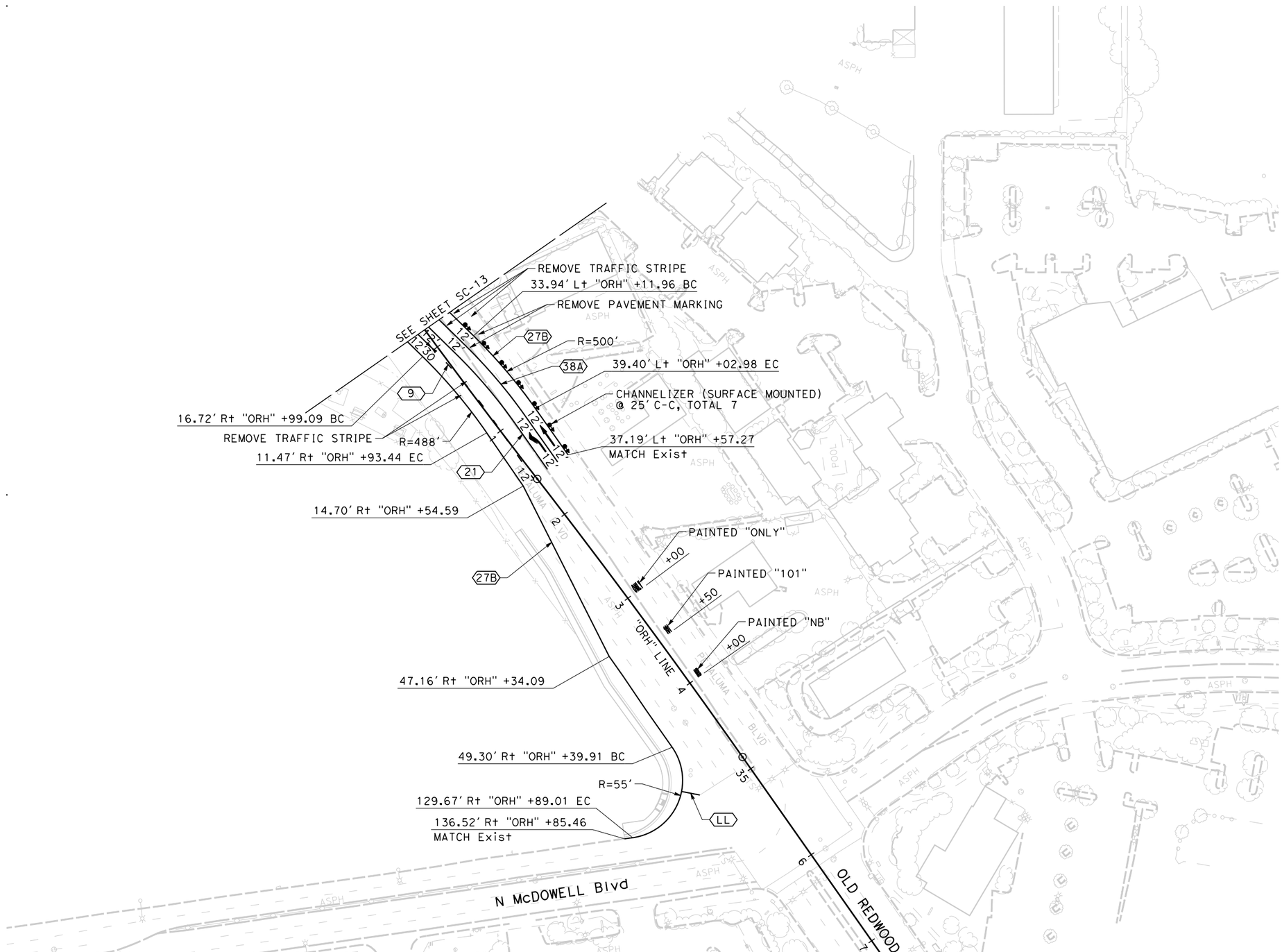

STAGE 2
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-16

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: DAVID WILLIAMS

CHECKED BY: HUEY NHAM

REVISED BY

DATE REVISED

LAST REVISION 09-20-10

DATE PLOTTED => 9/16/2010
TIME PLOTTED => 12:41:45 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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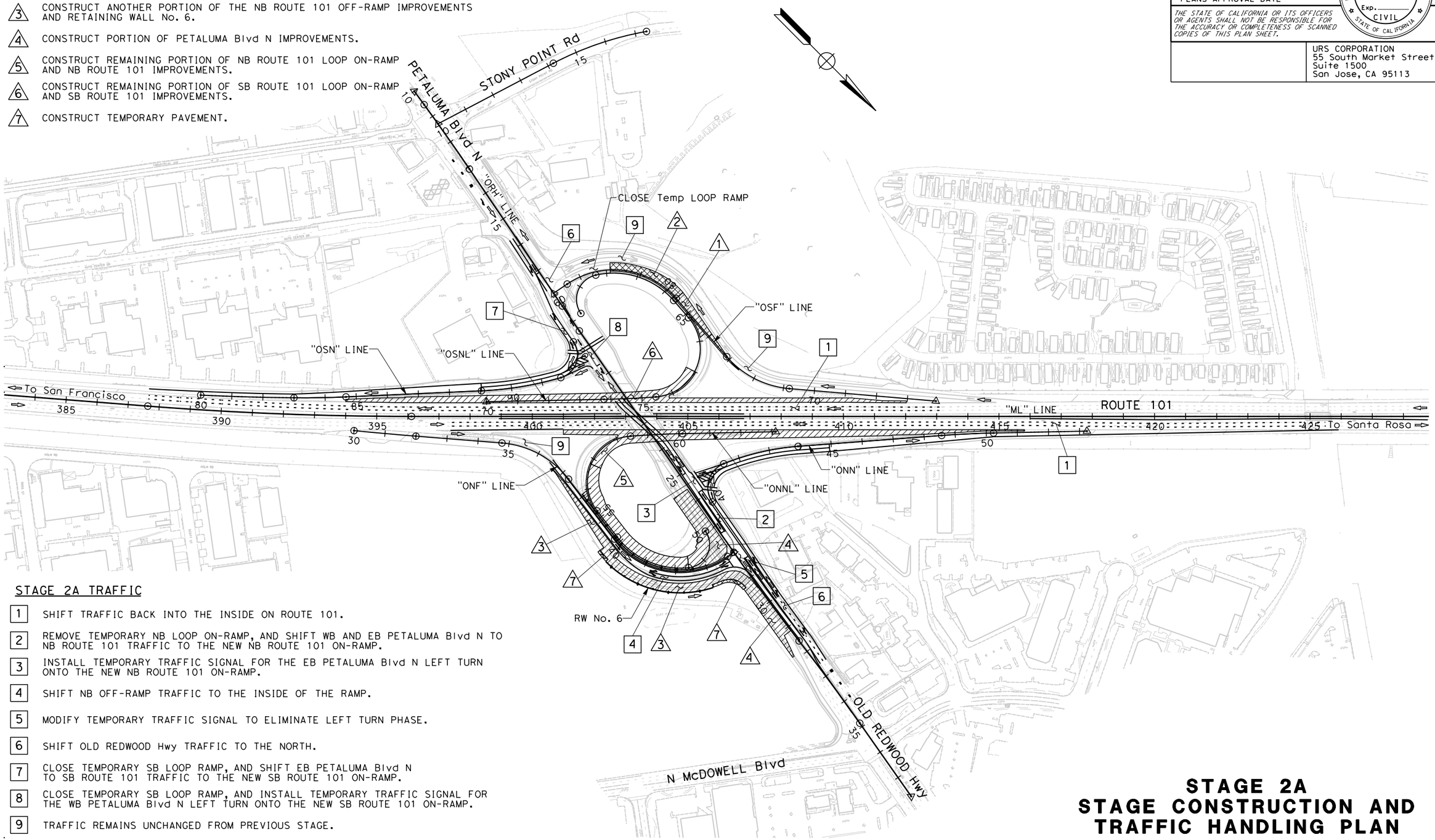
STAGE 2A CONSTRUCTION

1. CONSTRUCT ANOTHER PORTION OF THE SB ROUTE 101 OFF-RAMP IMPROVEMENTS.
2. CONSTRUCT TEMPORARY PAVEMENT TRANSITION ON SB ROUTE 101 OFF-RAMP.
3. CONSTRUCT ANOTHER PORTION OF THE NB ROUTE 101 OFF-RAMP IMPROVEMENTS AND RETAINING WALL No. 6.
4. CONSTRUCT PORTION OF PETALUMA Blvd N IMPROVEMENTS.
5. CONSTRUCT REMAINING PORTION OF NB ROUTE 101 LOOP ON-RAMP AND NB ROUTE 101 IMPROVEMENTS.
6. CONSTRUCT REMAINING PORTION OF SB ROUTE 101 LOOP ON-RAMP AND SB ROUTE 101 IMPROVEMENTS.
7. CONSTRUCT TEMPORARY PAVEMENT.

NOTE:

1. PLACE PERMANENT STRIPING AND PAVEMENT MARKING AS SHOWN AND RELEVANT ROADWAY SIGNS. FOR DETAILS NOT SHOWN, SEE "PD" AND "S" SHEETS FOR LOCATION AND DETAILS.



STAGE 2A TRAFFIC

1. SHIFT TRAFFIC BACK INTO THE INSIDE ON ROUTE 101.
2. REMOVE TEMPORARY NB LOOP ON-RAMP, AND SHIFT WB AND EB PETALUMA Blvd N TO NB ROUTE 101 TRAFFIC TO THE NEW NB ROUTE 101 ON-RAMP.
3. INSTALL TEMPORARY TRAFFIC SIGNAL FOR THE EB PETALUMA Blvd N LEFT TURN ONTO THE NEW NB ROUTE 101 ON-RAMP.
4. SHIFT NB OFF-RAMP TRAFFIC TO THE INSIDE OF THE RAMP.
5. MODIFY TEMPORARY TRAFFIC SIGNAL TO ELIMINATE LEFT TURN PHASE.
6. SHIFT OLD REDWOOD Hwy TRAFFIC TO THE NORTH.
7. CLOSE TEMPORARY SB LOOP RAMP, AND SHIFT EB PETALUMA Blvd N TO SB ROUTE 101 TRAFFIC TO THE NEW SB ROUTE 101 ON-RAMP.
8. CLOSE TEMPORARY SB LOOP RAMP, AND INSTALL TEMPORARY TRAFFIC SIGNAL FOR THE WB PETALUMA Blvd N LEFT TURN ONTO THE NEW SB ROUTE 101 ON-RAMP.
9. TRAFFIC REMAINS UNCHANGED FROM PREVIOUS STAGE.

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

STAGE 2A
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

NO SCALE

SC-17

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM

CHECKED BY: DAVID WILLIAMS

REVISED BY / DATE REVISED

LAST REVISION 09-20-10

DATE PLOTTED => 9/16/2010
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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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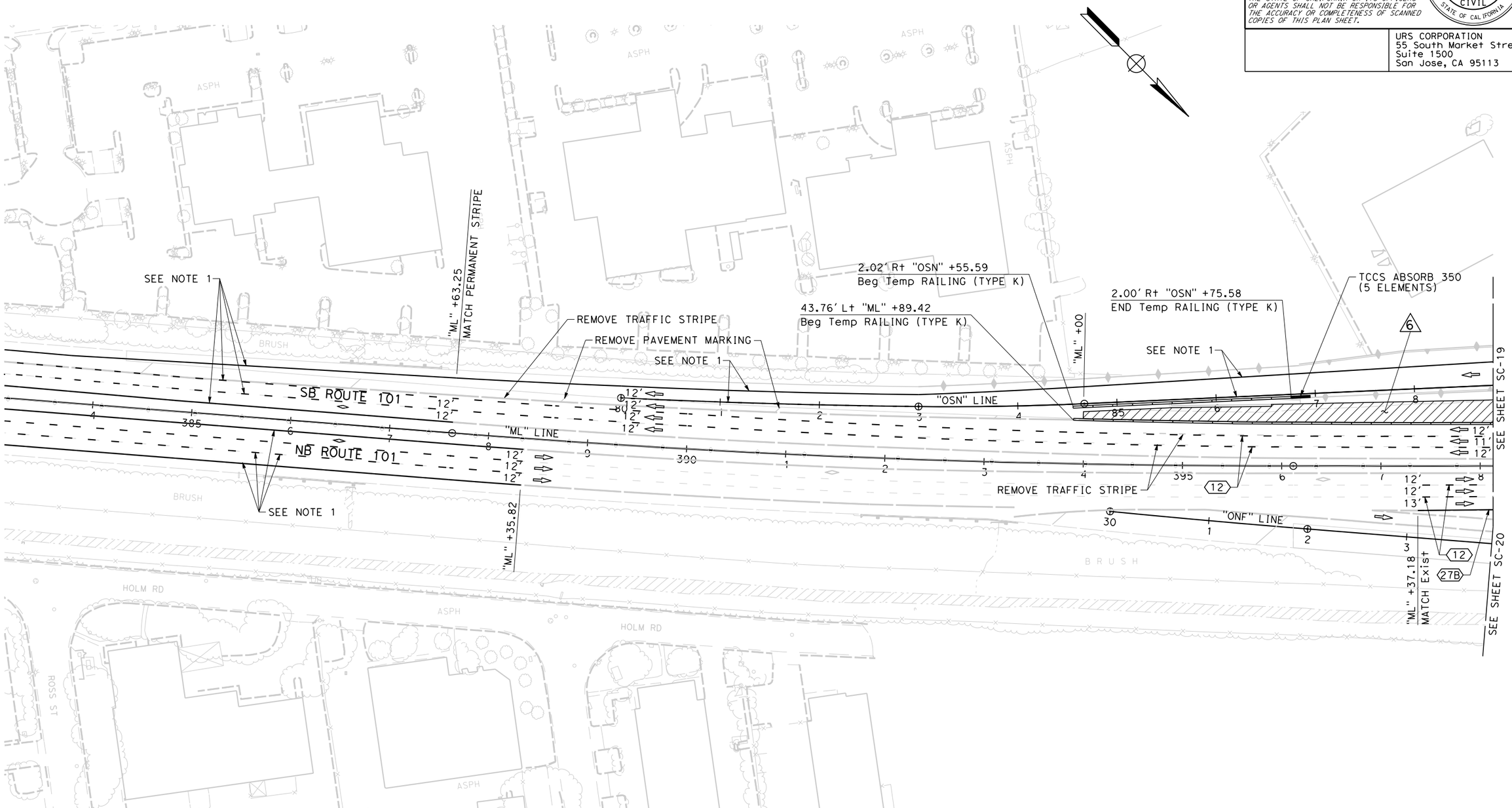

STAGE 2A
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-18

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: DAVID WILLIAMS

CHECKED BY:

REVISED BY: HUEY NHAM

DATE REVISED:

LAST REVISION 09-20-10

DATE PLOTTED => 9/16/2010
TIME PLOTTED => 12:41:55 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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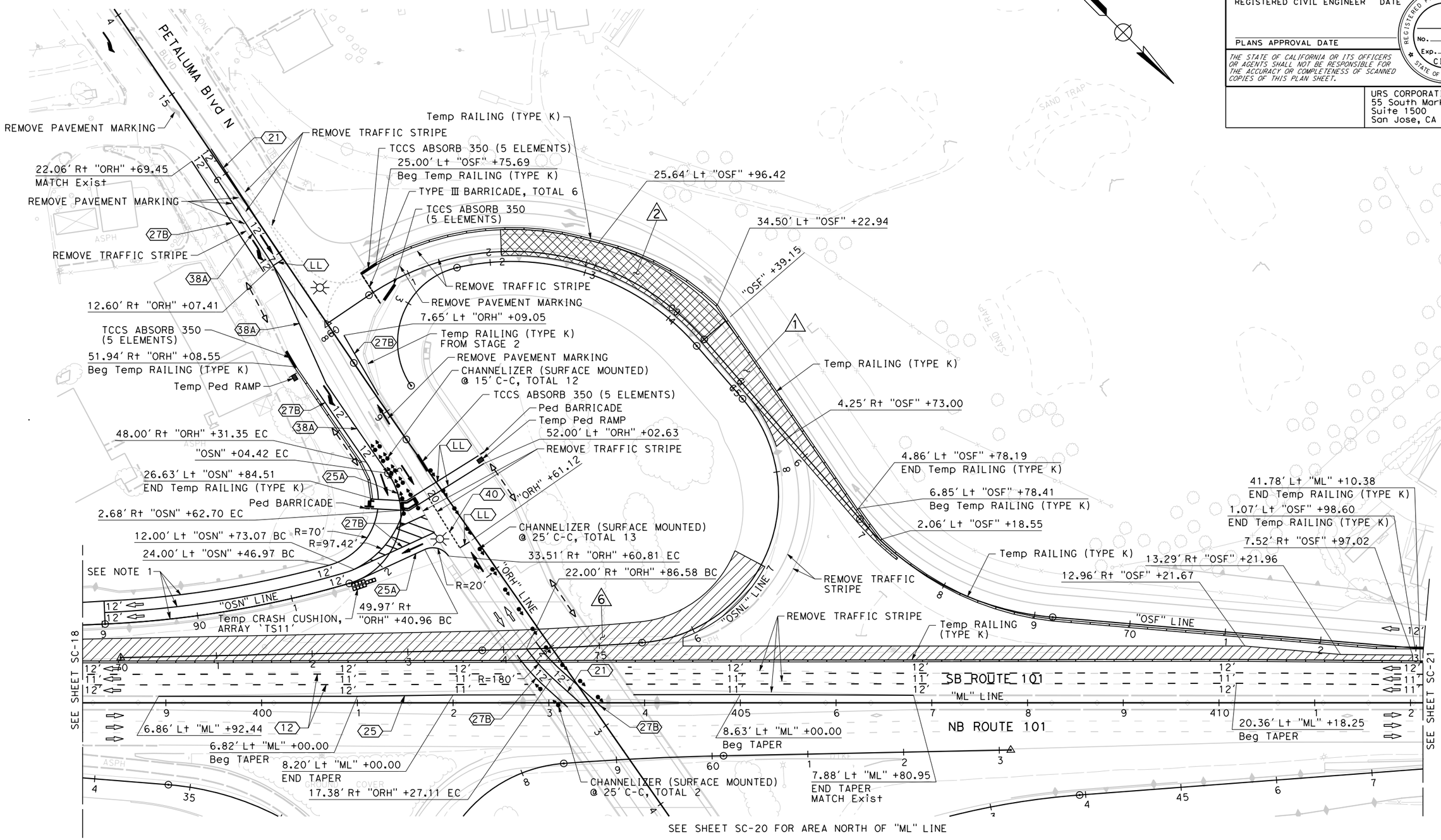

STAGE 2A
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-19

REVISED BY	DATE REVISED
HUEY NHAM	DAVID WILLIAMS

CALCULATED-DESIGNED BY | CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

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Caltrans

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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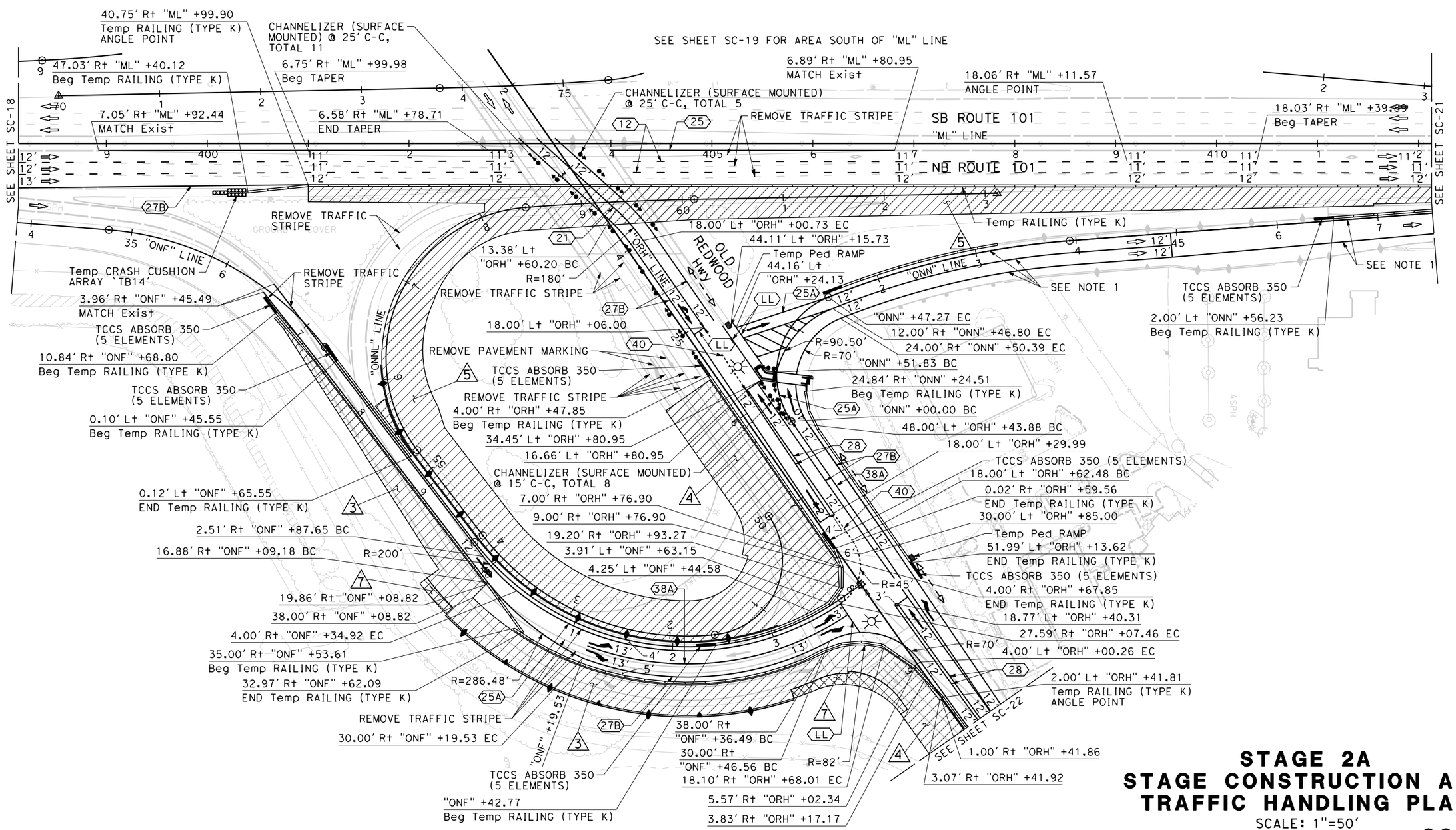

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

STAGE 2A
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

SC-20

REVISED BY	DATE REVISED
HUEY NHAM	DAVID WILLIAMS
CALCULATED-DESIGNED BY	CHECKED BY
CONSULTANT FUNCTIONAL SUPERVISOR	RAMSEY HISSEN

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Caltrans

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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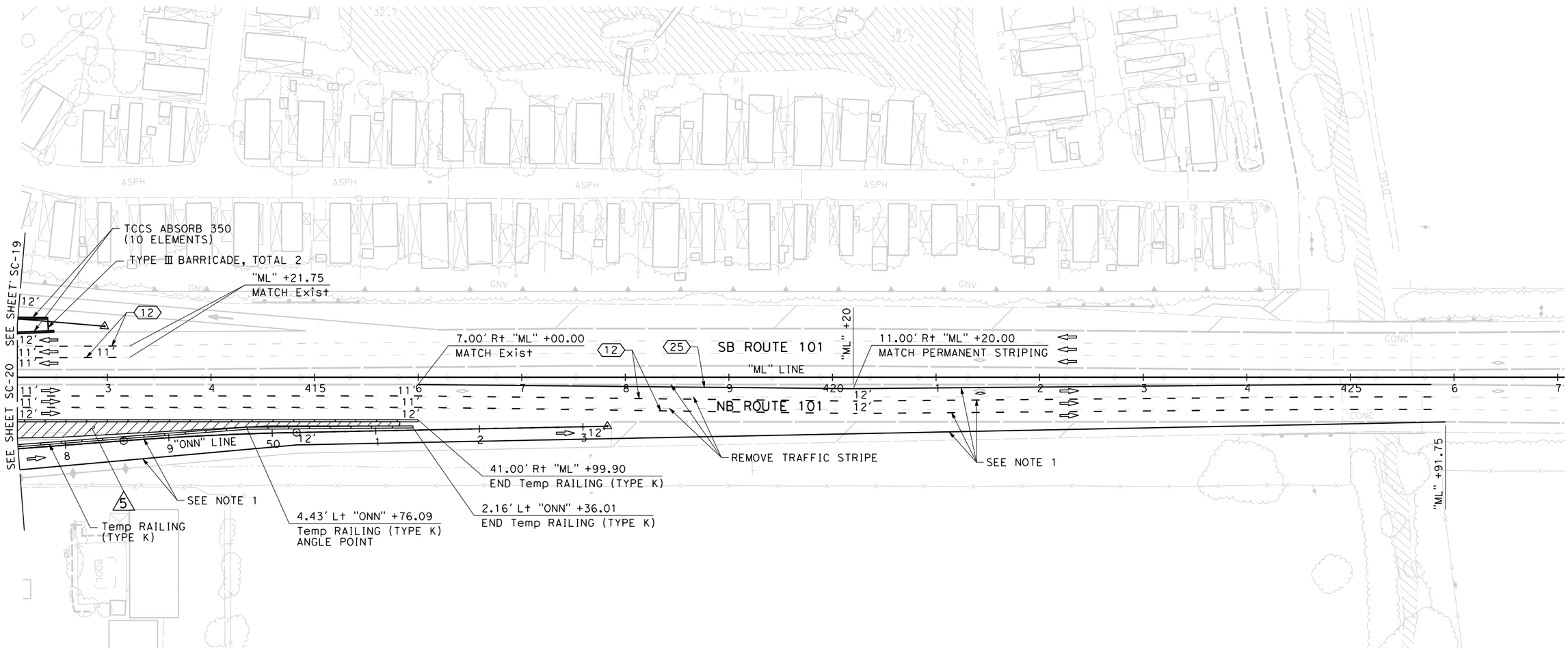

STAGE 2A
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-21

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM

CHECKED BY: DAVID WILLIAMS

REVISED BY

DATE REVISED

LAST REVISION 09-20-10

DATE PLOTTED => 9/16/2010
TIME PLOTTED => 12:42:07 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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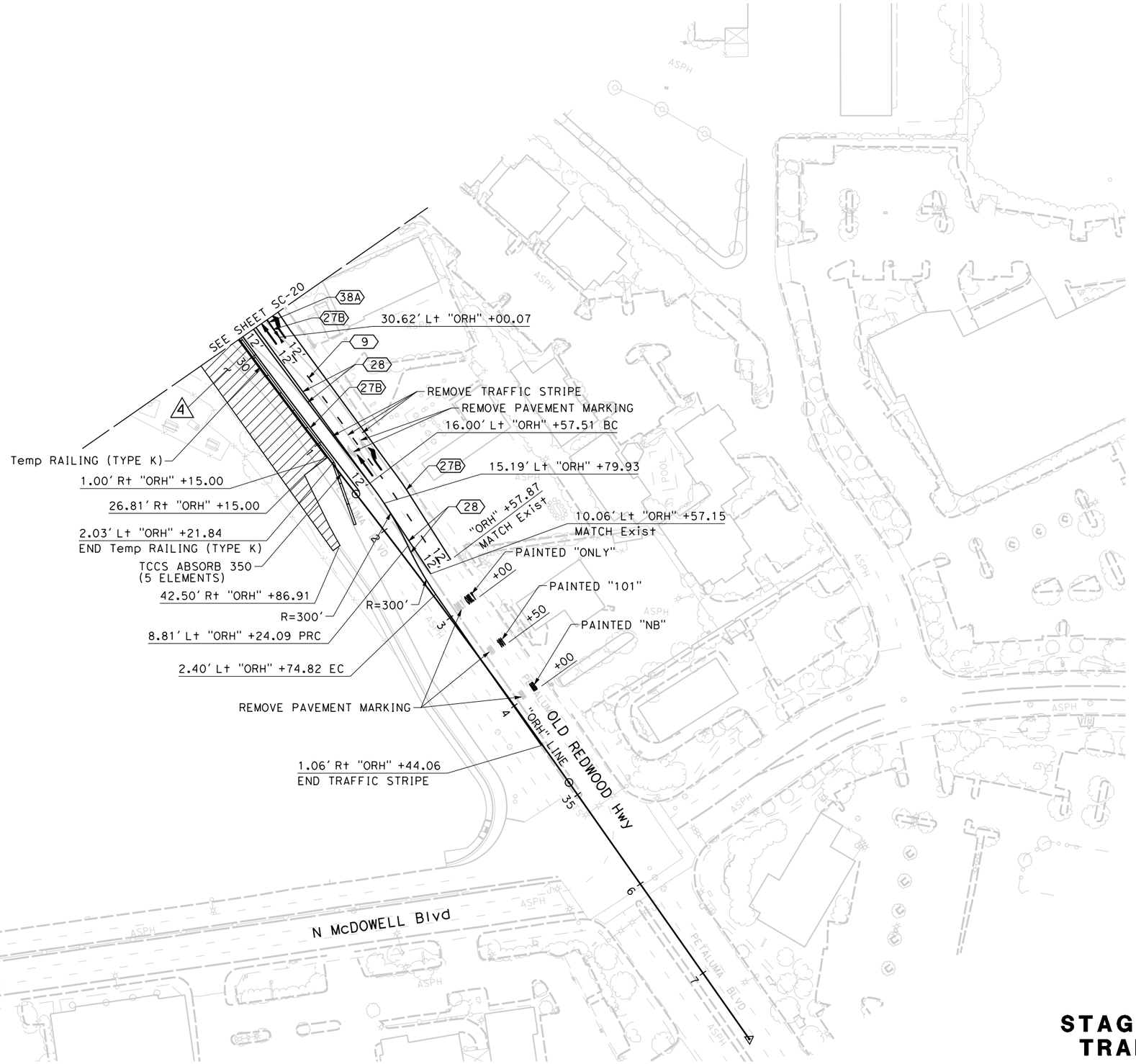

STAGE 2A
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-22

REVISED BY	DATE REVISED

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HUEY NHAM	DAVID WILLIAMS

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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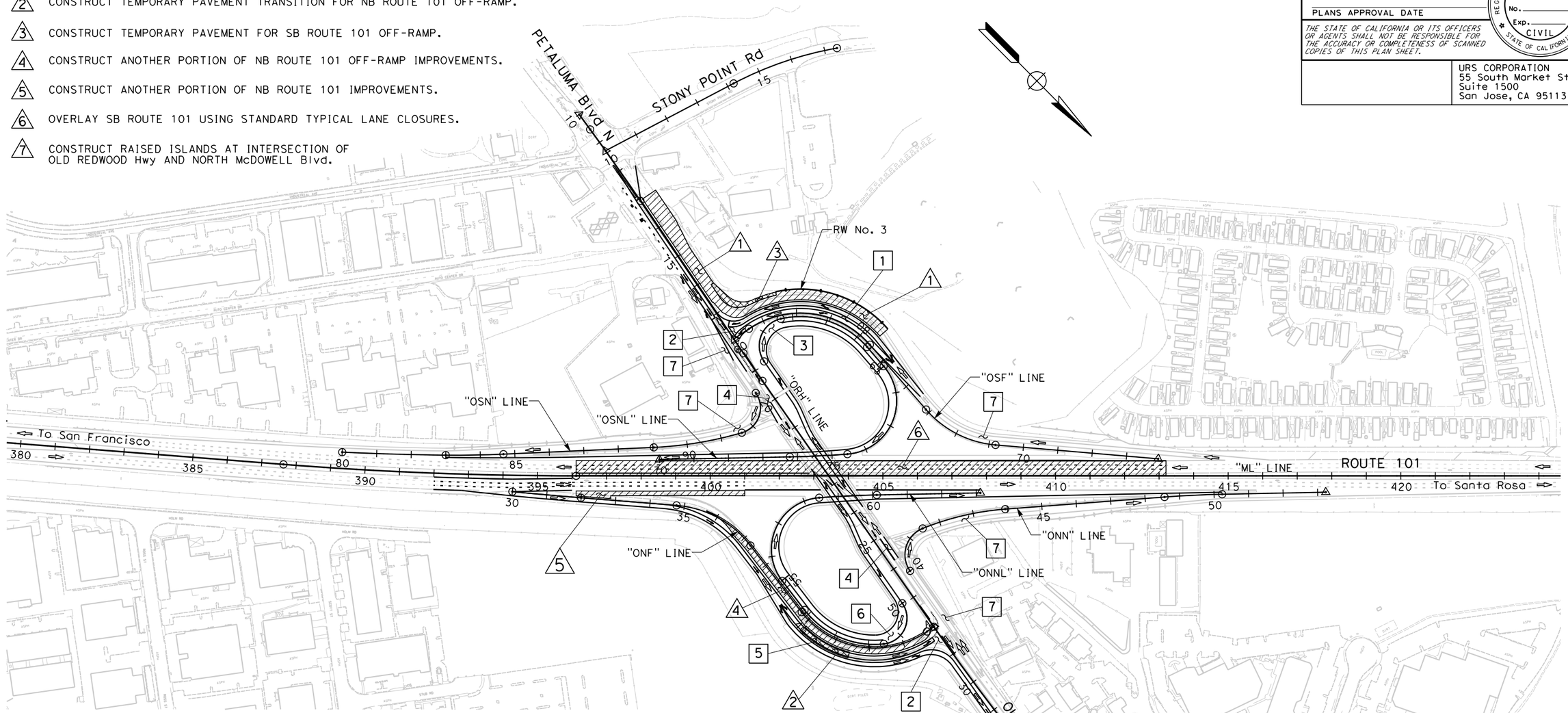
STAGE 3 CONSTRUCTION

1. CONSTRUCT ANOTHER PORTION OF SB ROUTE 101 OFF-RAMP AND PETALUMA Blvd N IMPROVEMENTS, AND RETAINING WALL No. 3.
2. CONSTRUCT TEMPORARY PAVEMENT TRANSITION FOR NB ROUTE 101 OFF-RAMP.
3. CONSTRUCT TEMPORARY PAVEMENT FOR SB ROUTE 101 OFF-RAMP.
4. CONSTRUCT ANOTHER PORTION OF NB ROUTE 101 OFF-RAMP IMPROVEMENTS.
5. CONSTRUCT ANOTHER PORTION OF NB ROUTE 101 IMPROVEMENTS.
6. OVERLAY SB ROUTE 101 USING STANDARD TYPICAL LANE CLOSURES.
7. CONSTRUCT RAISED ISLANDS AT INTERSECTION OF OLD REDWOOD Hwy AND NORTH McDOWELL Blvd.

NOTE:

1. PLACE PERMANENT STRIPING AND PAVEMENT MARKING AS SHOWN AND RELEVANT ROADWAY SIGNS. FOR DETAILS NOT SHOWN, SEE "PD" AND "S" SHEETS FOR LOCATION AND DETAILS.



STAGE 3 TRAFFIC

1. SHIFT TRAFFIC TO THE INSIDE FOR CONSTRUCTION OF THE OUTSIDE.
2. MODIFY TEMPORARY TRAFFIC SIGNAL TO PROVIDE LEFT TURN FROM THE OFF-RAMP.
3. SHIFT WB TO SB ROUTE 101 FROM SB ON-RAMP TO THE NEW SB LOOP ON-RAMP AND REMOVE TEMPORARY SIGNAL FOR LEFT TURN ONTO THE SB ON-RAMP.
4. MODIFY TEMPORARY TRAFFIC SIGNAL.
5. SHIFT NB OFF-RAMP TRAFFIC TO THE OUTSIDE, WITH RIGHT TURN TRAFFIC ON THE PERMANENT PAVEMENT, AND CLOSE NB ROUTE 101 OFF-RAMP OVERNIGHT AND DETOUR TRAFFIC FOR CONSTRUCTION OF TEMPORARY PAVEMENT TRANSITION.
6. SHIFT EB TO NB ROUTE 101 FROM NB ON-RAMP TO THE NEW NB LOOP ON-RAMP, AND REMOVE TEMPORARY SIGNAL FOR LEFT TURN ONTO THE NB ON-RAMP.
7. TRAFFIC REMAINS UNCHANGED FROM PREVIOUS STAGE.

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

STAGE 3
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

NO SCALE

SC-23

REVISED BY	DATE REVISED

CALCULATED-DESIGNED BY: HUEY NHAM
CHECKED BY: DAVID WILLIAMS
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

LAST REVISION 09-20-10
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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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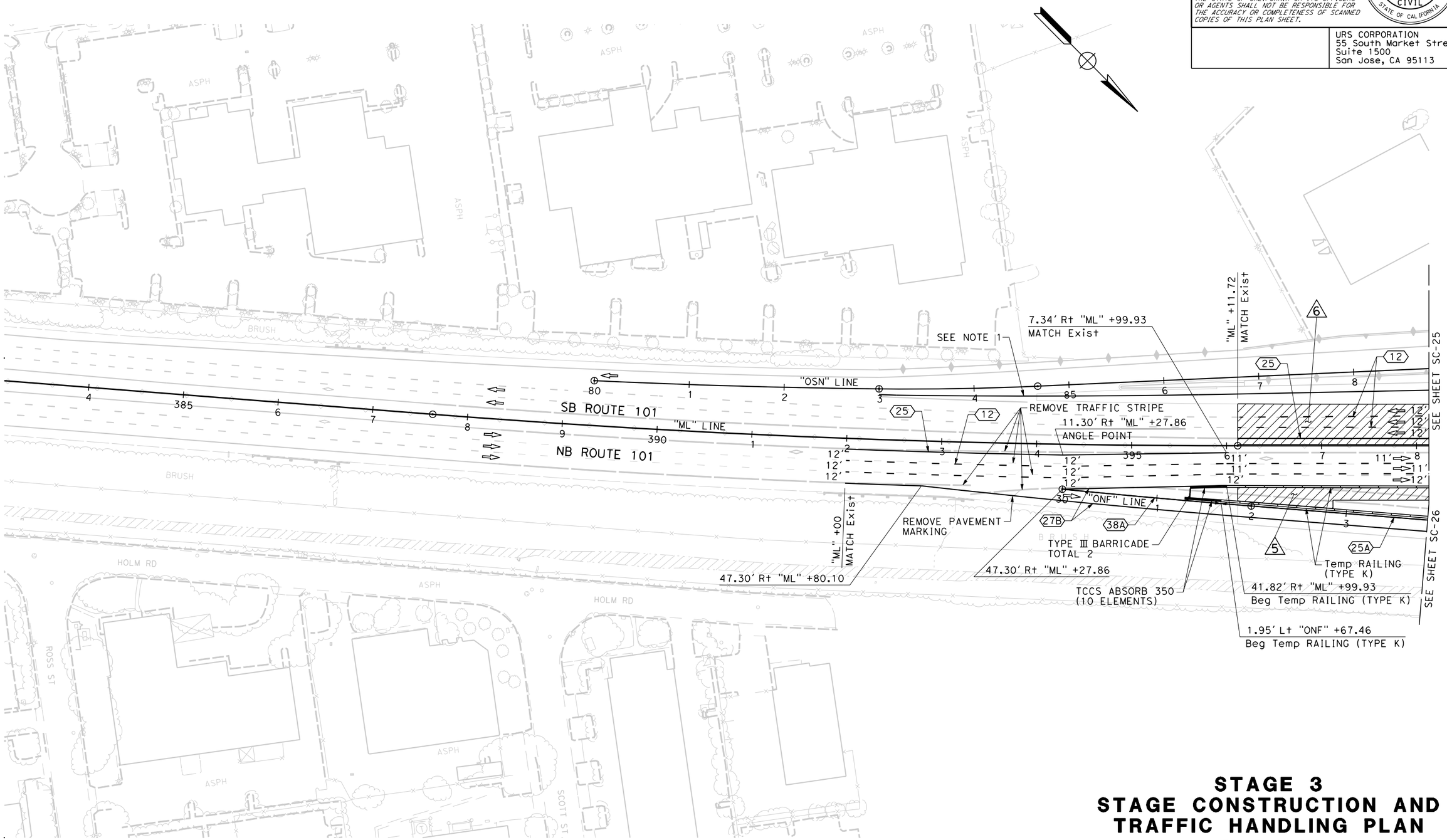

STAGE 3
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-24

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM

CHECKED BY: DAVID WILLIAMS

REVISED BY

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LAST REVISION 09-20-10

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TIME PLOTTED => 12:42:19 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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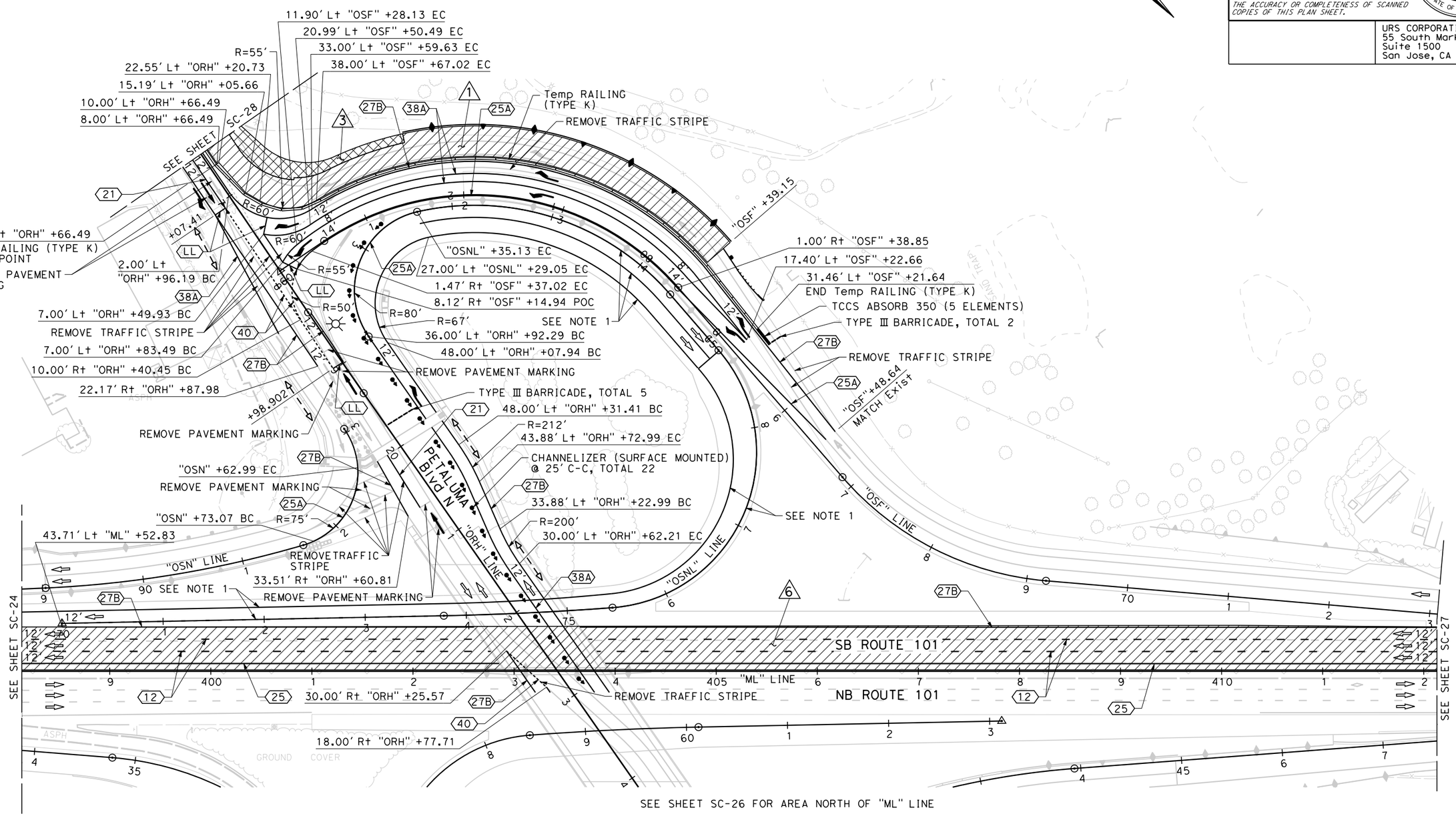

STAGE 3
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-25

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: DAVID WILLIAMS

CHECKED BY

REVISED BY: HUEY NHAM

DATE REVISED

LAST REVISION 09-20-10

DATE PLOTTED => 9/16/2010
TIME PLOTTED => 12:42:22 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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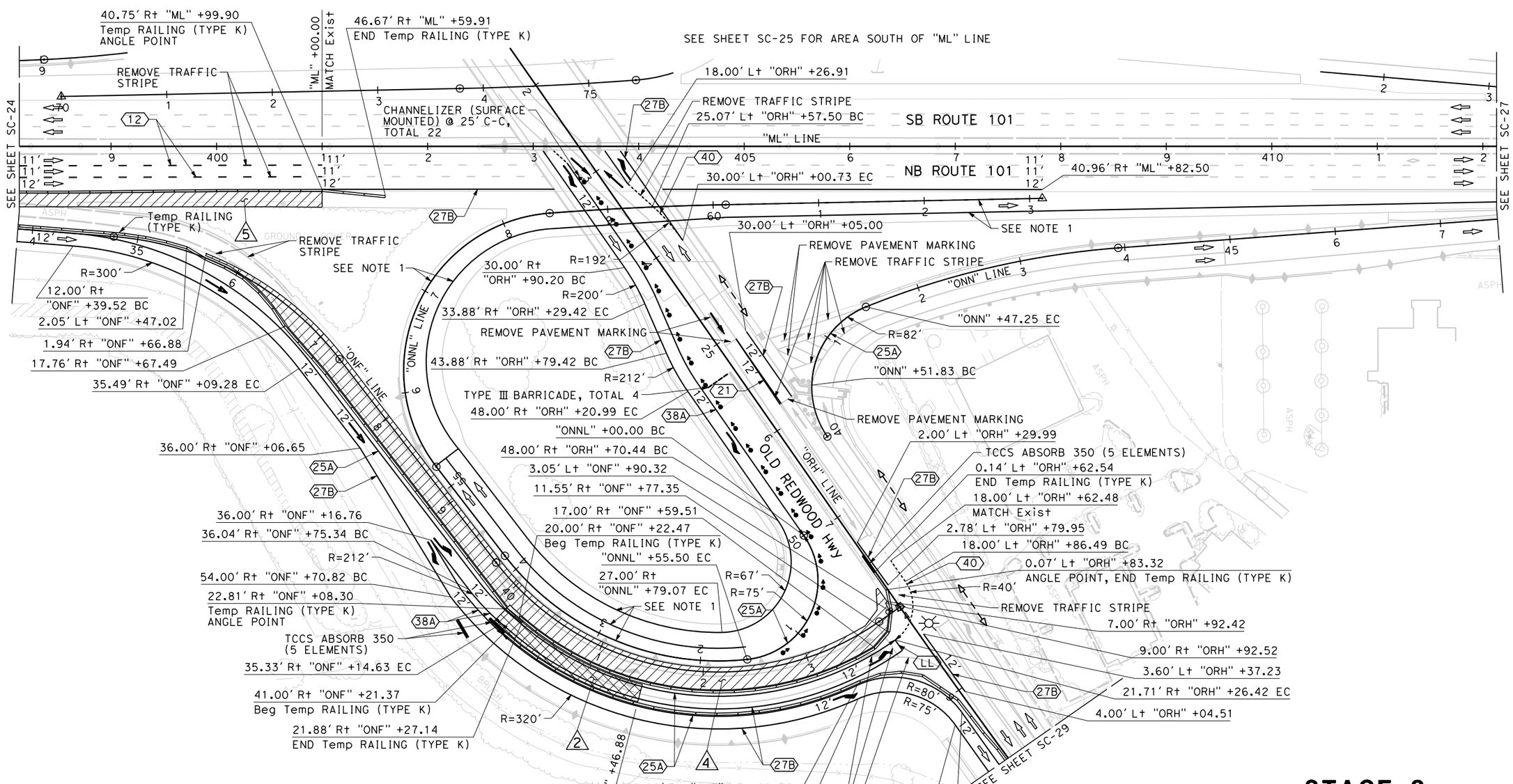

STAGE 3
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-26

REVISED BY | DATE REVISED
HUEY NHAM | DAVID WILLIAMS
CALCULATED-DESIGNED BY | CHECKED BY
CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 09-20-10 | DATE PLOTTED => 9/16/2010 | TIME PLOTTED => 12:42:26 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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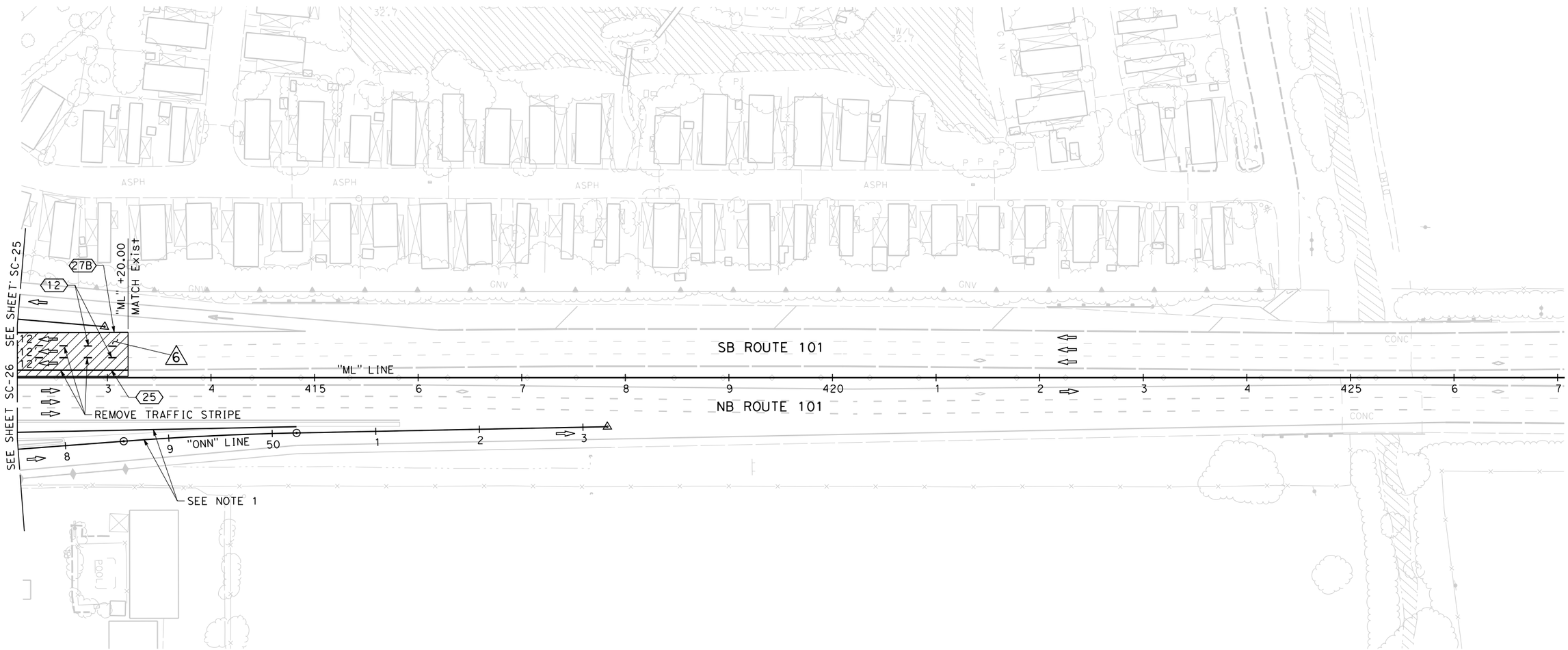

STAGE 3
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

SC-27

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM

CHECKED BY: DAVID WILLIAMS

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DATE REVISED

LAST REVISION 09-20-10

DATE PLOTTED => 9/16/2010
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BORDER LAST REVISED 7/2/2010

USERNAME => huey_nham
DGN FILE => 412276ma027.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0000

PROJECT NUMBER & PHASE 04000200041

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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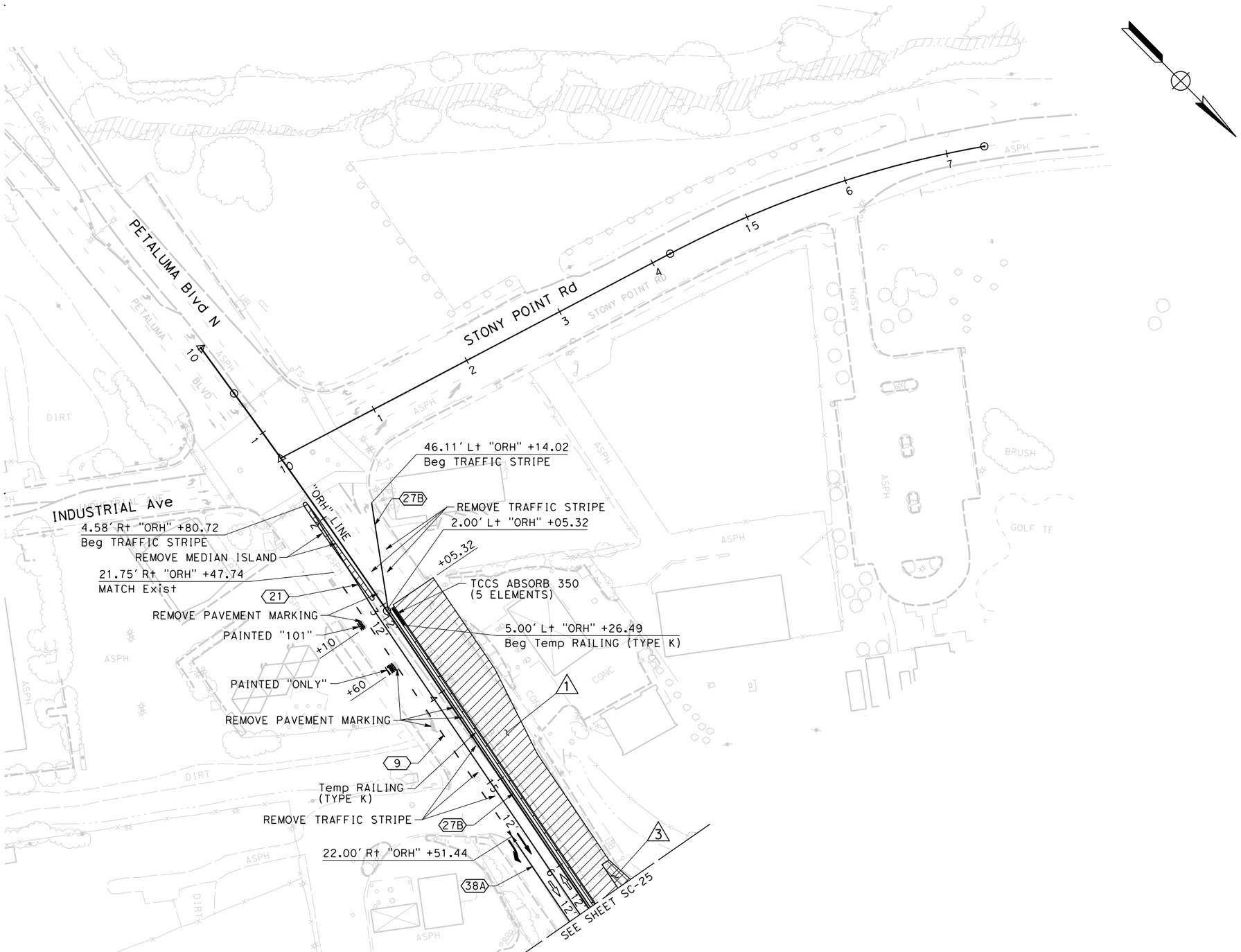

STAGE 3
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-28

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM

CHECKED BY: DAVID WILLIAMS

REVISED BY

DATE REVISED

LAST REVISION 09-20-10 DATE PLOTTED => 9/16/2010 TIME PLOTTED => 12:42:32 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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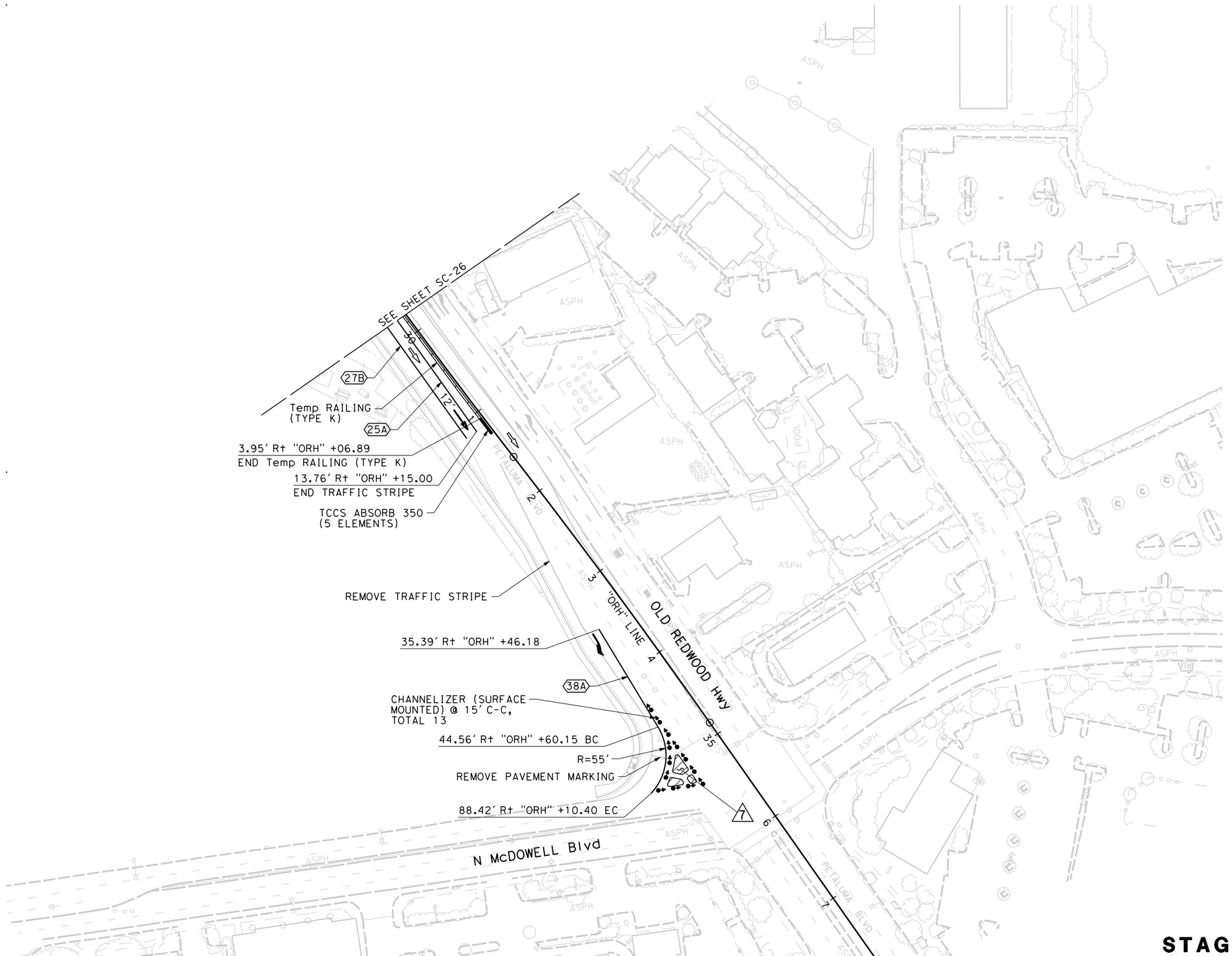

STAGE 3
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-29

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM

CHECKED BY: DAVID WILLIAMS

REVISED BY

DATE REVISED

LAST REVISION 09-20-10

DATE PLOTTED => 9/16/2010
TIME PLOTTED => 12:42:35 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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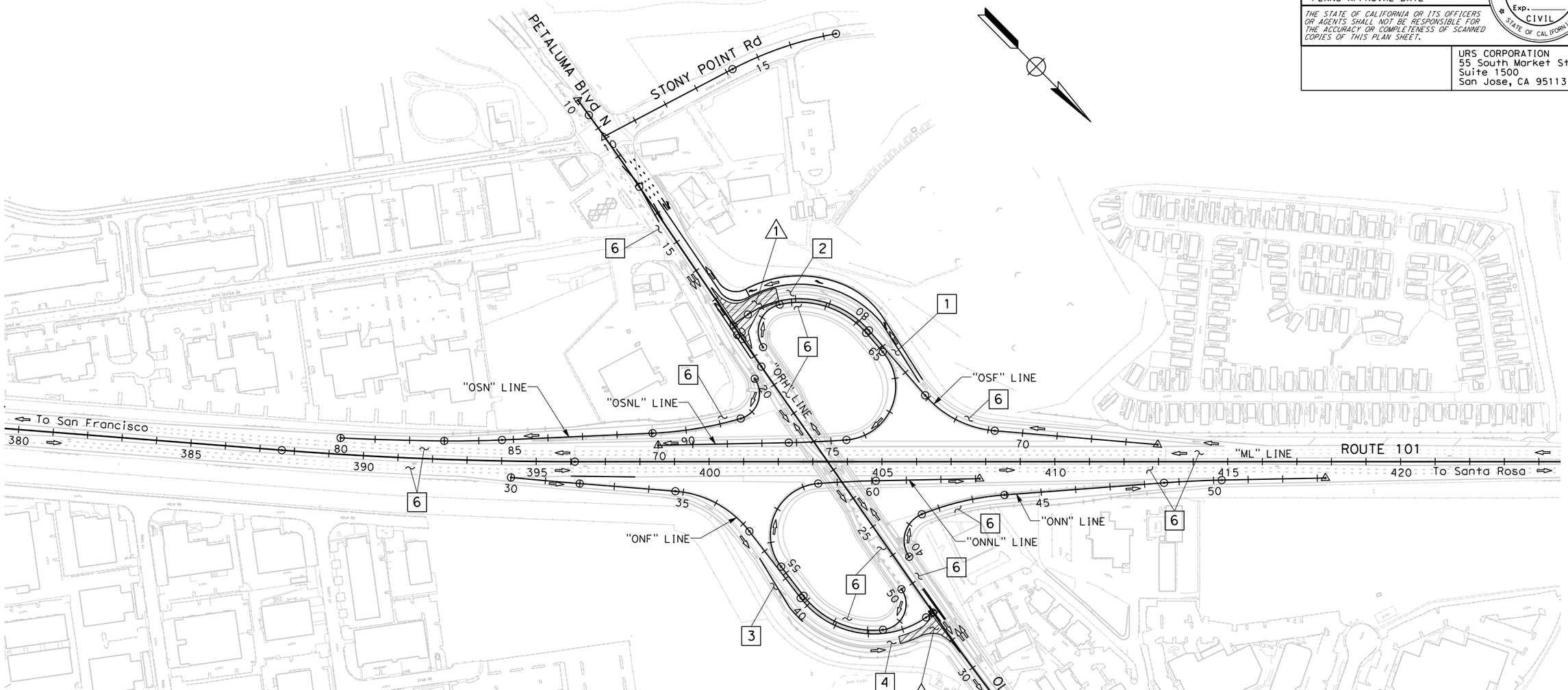
URS CORPORATION
55 South Market Street
Suite 1500
San Jose, CA 95113

STAGE 3A CONSTRUCTION

1. CONSTRUCT ANOTHER PORTION OF SB ROUTE 101 OFF-RAMP IMPROVEMENTS.
2. CONSTRUCT ANOTHER PORTION OF NB ROUTE 101 OFF-RAMP IMPROVEMENTS.



STAGE 3A TRAFFIC

1. SHIFT SB OFF-RAMP TRAFFIC TO THE OUTSIDE ONTO THE PERMANENT PAVEMENT.
2. CLOSE SB ROUTE 101 OFF-RAMP LEFT TURN ONTO PETALUMA Blvd N AND DETOUR TRAFFIC TO PETALUMA Blvd N, THEN EAST ON CORONA ROAD, THEN NORTH ON N McDOWELL Blvd. SEE DETOUR PLAN FOR DETAILS.
3. SHIFT NB OFF-RAMP TRAFFIC TO THE OUTSIDE ONTO THE PERMANENT PAVEMENT.
4. CLOSE NB ROUTE 101 OFF-RAMP LEFT TURN ONTO OLD REDWOOD Hwy AND DETOUR TRAFFIC TO THE SOUTH ON N McDOWELL Blvd, THEN WEST ON CORONA ROAD, THEN NORTH ON PETALUMA Blvd N. SEE DETOUR PLAN FOR DETAILS.
5. MODIFY TEMPORARY TRAFFIC SIGNAL TO ELIMINATE LEFT TURN.
6. TRAFFIC REMAINS UNCHANGED FROM PREVIOUS STAGE.

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

STAGE 3A
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

NO SCALE

SC-30

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM

CHECKED BY: DAVID WILLIAMS

REVISED BY

DATE REVISED

LAST REVISION 09-20-10

DATE PLOTTED => 9/16/2010
TIME PLOTTED => 12:42:38 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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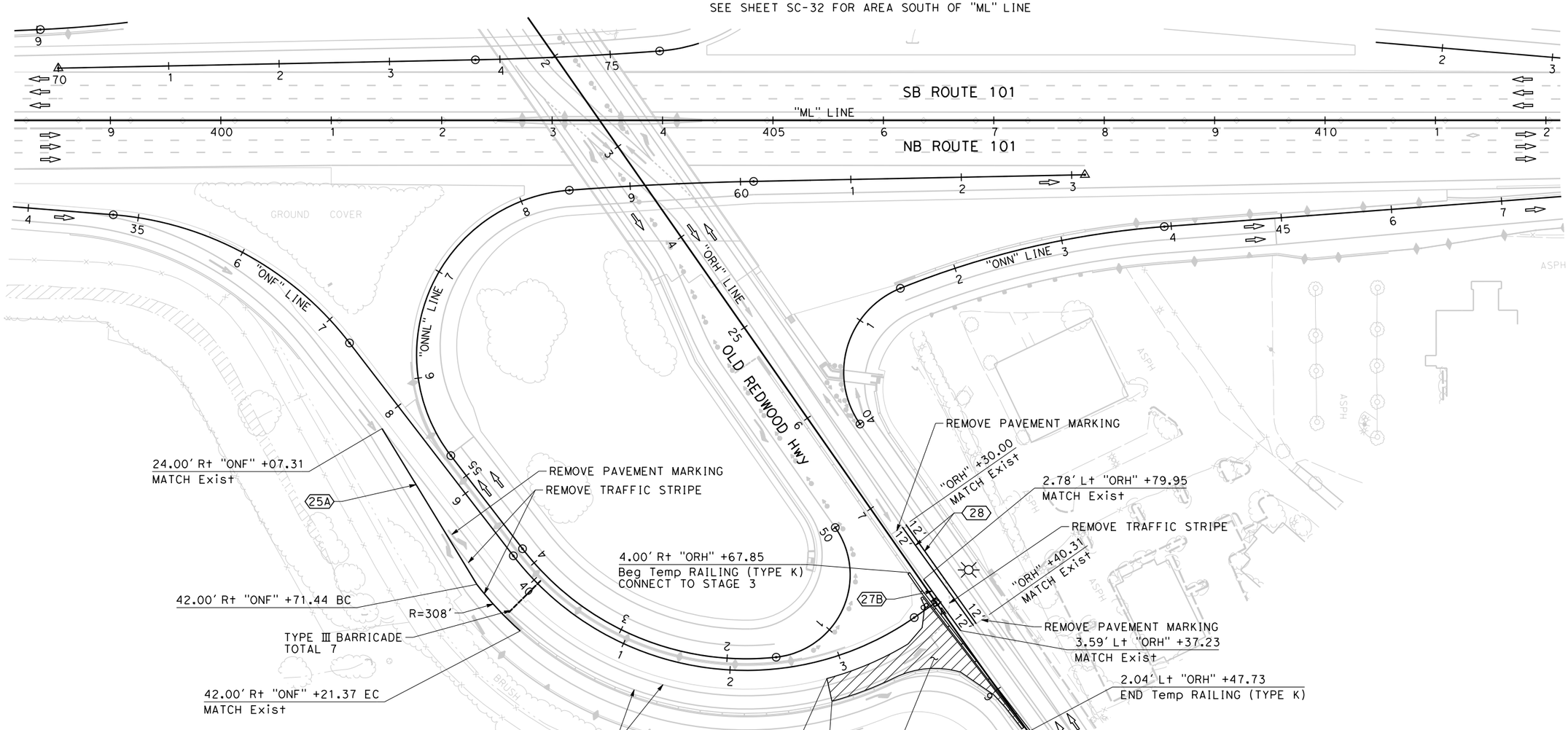
SEE SHEET SC-32 FOR AREA SOUTH OF "ML" LINE



STAGE 3A
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-31

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM

CHECKED BY: DAVID WILLIAMS

REVISED BY

DATE REVISED

LAST REVISION 09-20-10

DATE PLOTTED => 9/16/2010

TIME PLOTTED => 12:42:43 PM

BORDER LAST REVISED 7/2/2010

USERNAME => huey_nham

DGN FILE => 412276ma031.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0000

PROJECT NUMBER & PHASE 04000200041

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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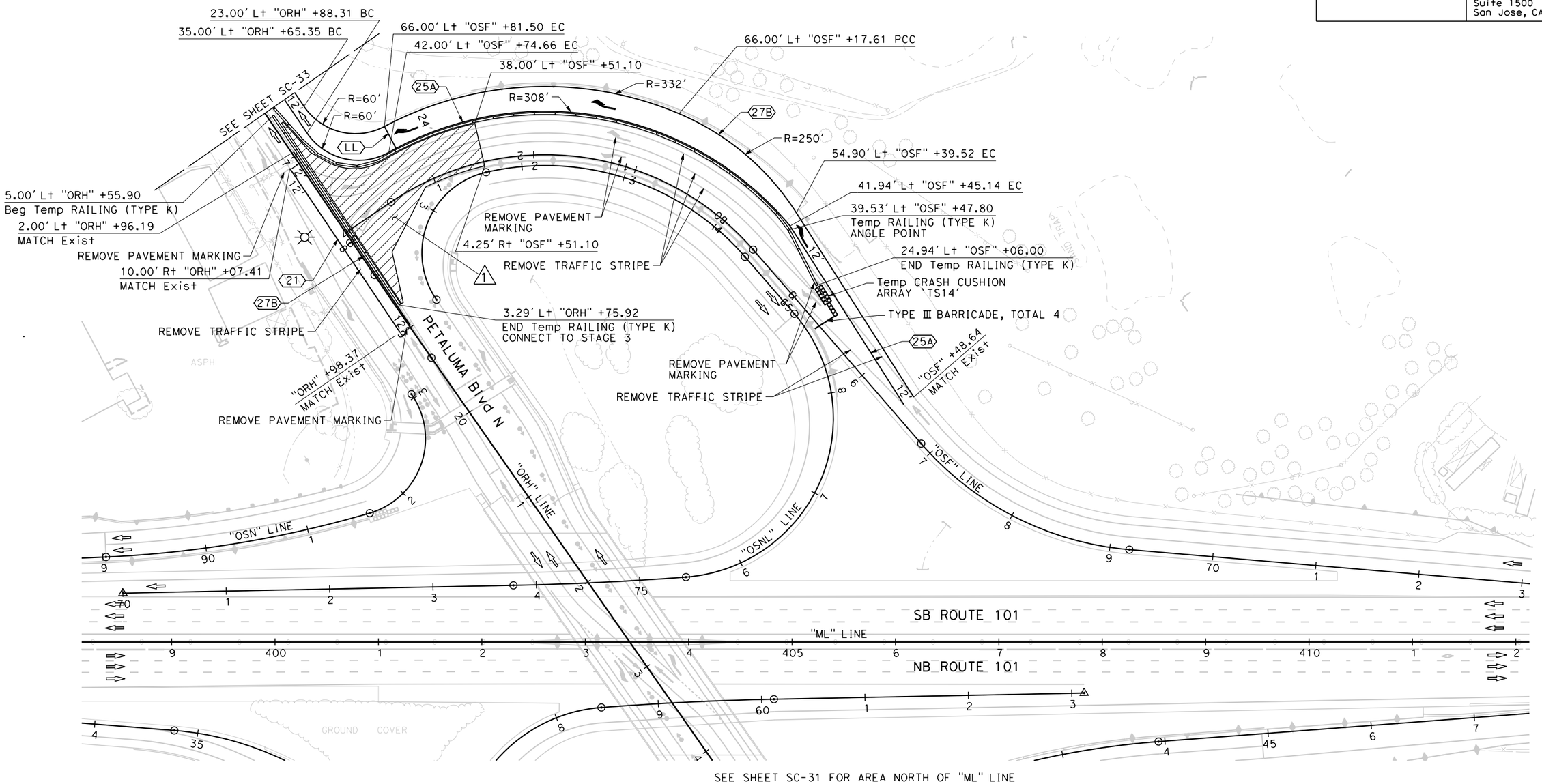

SEE SHEET SC-31 FOR AREA NORTH OF "ML" LINE

STAGE 3A
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-32

REVISED BY	DATE REVISED
HUEY NHAM	DAVID WILLIAMS

CALCULATED-DESIGNED BY | CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

LAST REVISION 09-20-10 | DATE PLOTTED => 9/16/2010 TIME PLOTTED => 12:42:46 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => huey_nham DGN FILE => 412276ma032.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0000 | PROJECT NUMBER & PHASE 04000200041

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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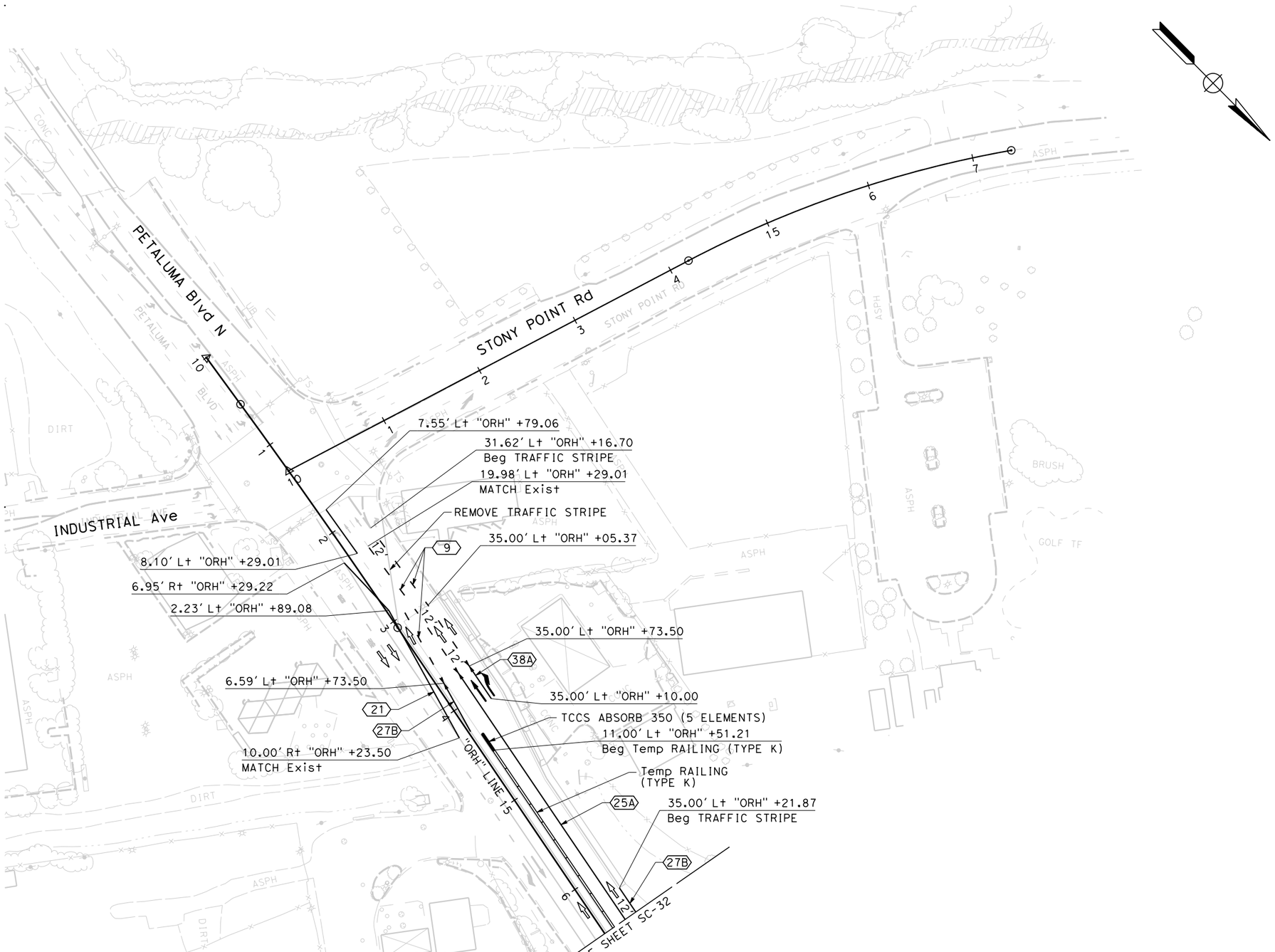

STAGE 3A
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-33

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM

CHECKED BY: DAVID WILLIAMS

REVISED BY

DATE REVISED

LAST REVISION 09-20-10

DATE PLOTTED => 9/16/2010

TIME PLOTTED => 12:42:49 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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URS CORPORATION
55 South Market Street
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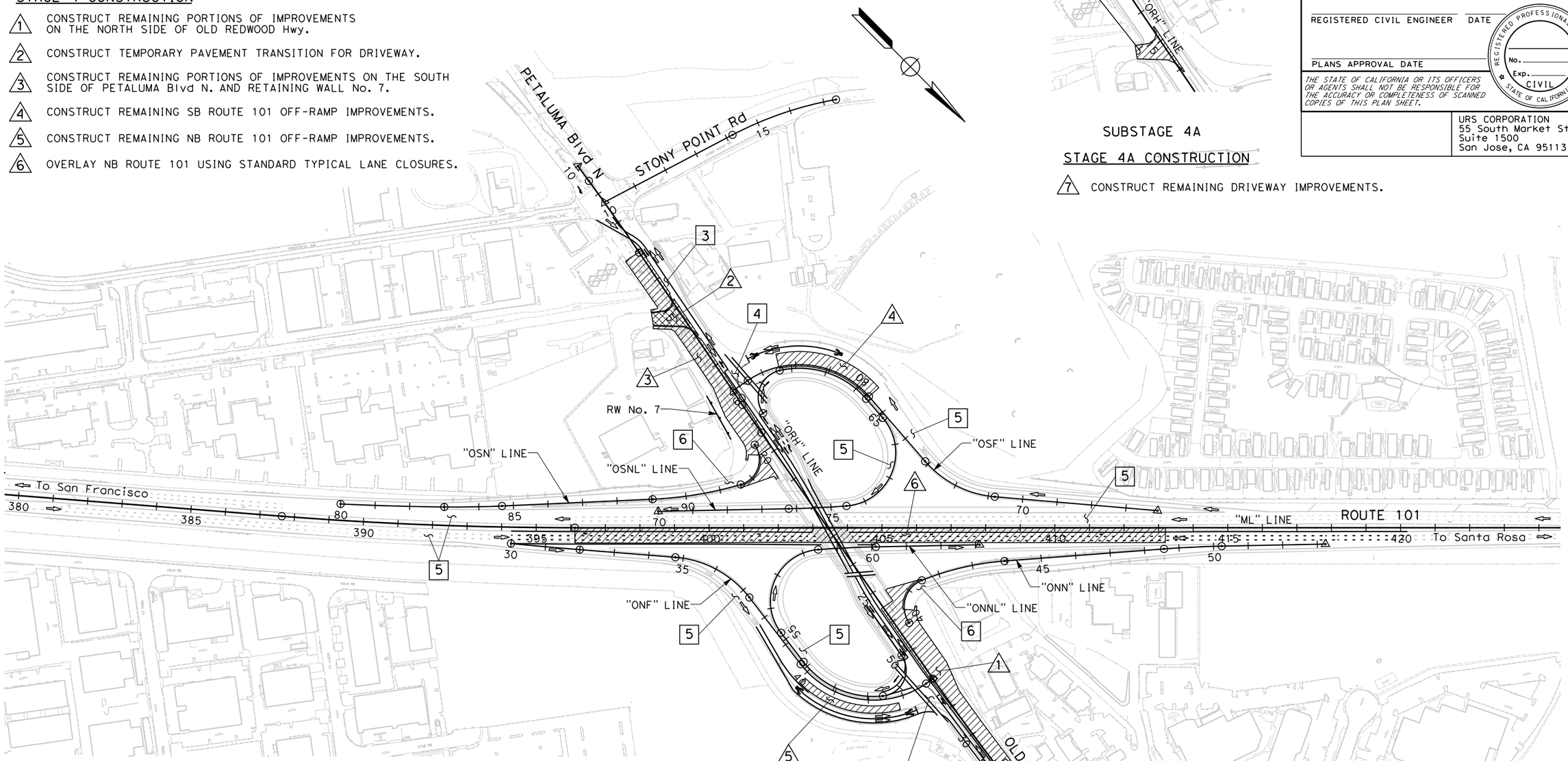
San Jose, CA 95113

STAGE 4 CONSTRUCTION

1. CONSTRUCT REMAINING PORTIONS OF IMPROVEMENTS ON THE NORTH SIDE OF OLD REDWOOD Hwy.
2. CONSTRUCT TEMPORARY PAVEMENT TRANSITION FOR DRIVEWAY.
3. CONSTRUCT REMAINING PORTIONS OF IMPROVEMENTS ON THE SOUTH SIDE OF PETALUMA Blvd N. AND RETAINING WALL No. 7.
4. CONSTRUCT REMAINING SB ROUTE 101 OFF-RAMP IMPROVEMENTS.
5. CONSTRUCT REMAINING NB ROUTE 101 OFF-RAMP IMPROVEMENTS.
6. OVERLAY NB ROUTE 101 USING STANDARD TYPICAL LANE CLOSURES.



SUBSTAGE 4A

STAGE 4A CONSTRUCTION

7. CONSTRUCT REMAINING DRIVEWAY IMPROVEMENTS.

STAGE 4 TRAFFIC

1. SHIFT OLD REDWOOD Hwy TRAFFIC TO THE SOUTH ONTO THE NEW PAVEMENT.
2. MODIFY TEMPORARY TRAFFIC SIGNAL TO PROVIDE LEFT TURN ONTO OLD REDWOOD Hwy AND LEFT TURN ONTO NB LOOP ON-RAMP.
3. SHIFT PETALUMA Blvd N TRAFFIC TO THE NORTH ONTO THE NEW PAVEMENT.
4. MODIFY TEMPORARY TRAFFIC SIGNAL TO PROVIDE LEFT TURN ONTO PETALUMA Blvd N AND LEFT TURN ONTO SB LOOP ON-RAMP.
5. TRAFFIC REMAINS UNCHANGED FROM PREVIOUS STAGE.
6. CLOSE NB AND SB ON-RAMPS.
7. MODIFY EXISTING TRAFFIC SIGNAL TO PROVIDE FOR PEDESTRIAN CROSSING.

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

STAGE 4
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

NO SCALE

SC-34

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM

CHECKED BY: DAVID WILLIAMS

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LAST REVISION 09-20-10 | DATE PLOTTED => 9/16/2010 | TIME PLOTTED => 12:42:54 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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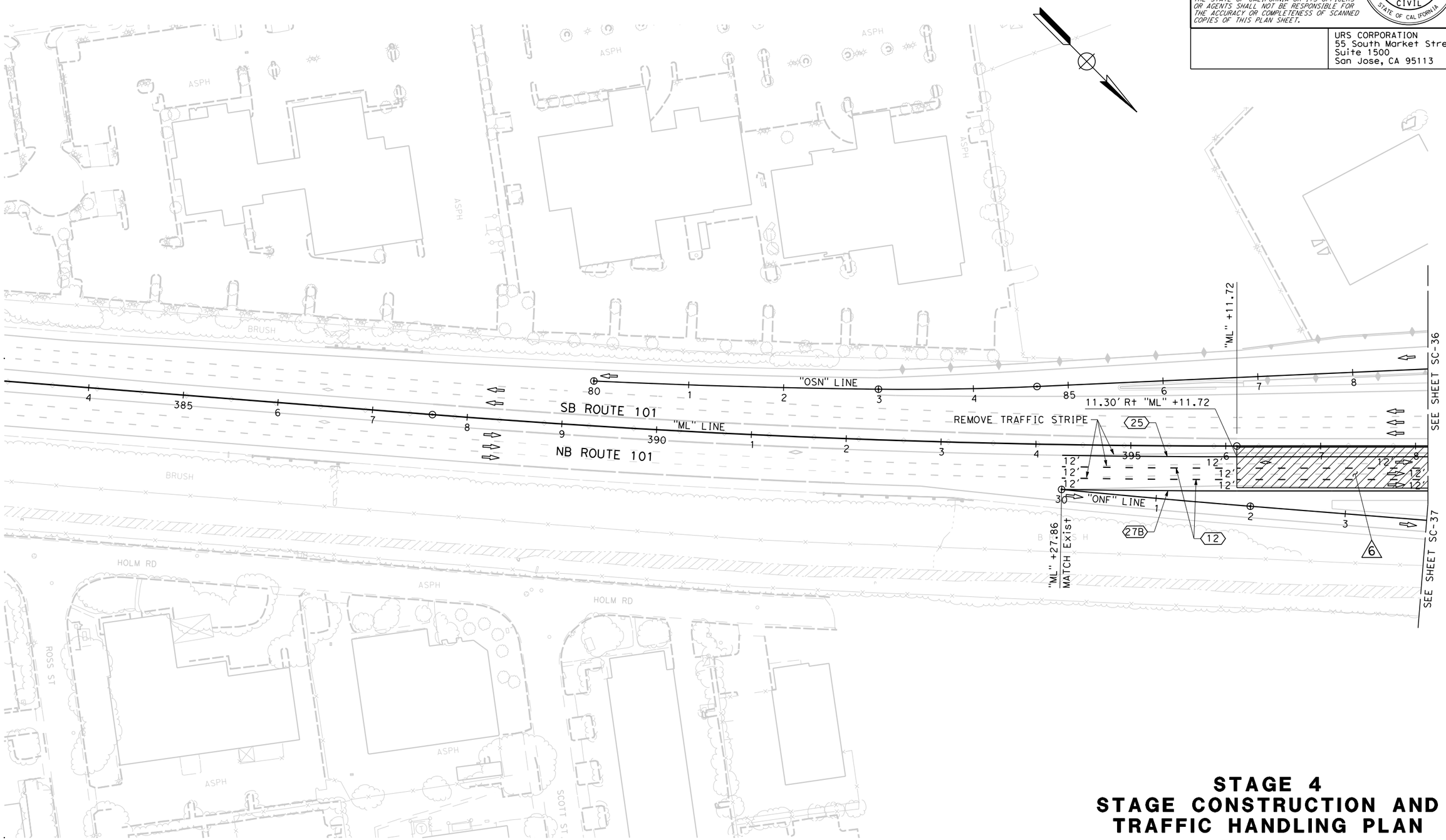

STAGE 4
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-35

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM

CHECKED BY: DAVID WILLIAMS

REVISED BY

DATE REVISED

LAST REVISION 09-20-10

DATE PLOTTED => 9/16/2010
TIME PLOTTED => 12:42:59 PM

BORDER LAST REVISED 7/2/2010

USERNAME => huey_nham
DGN FILE => 412276ma035.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0000

PROJECT NUMBER & PHASE 04000200041

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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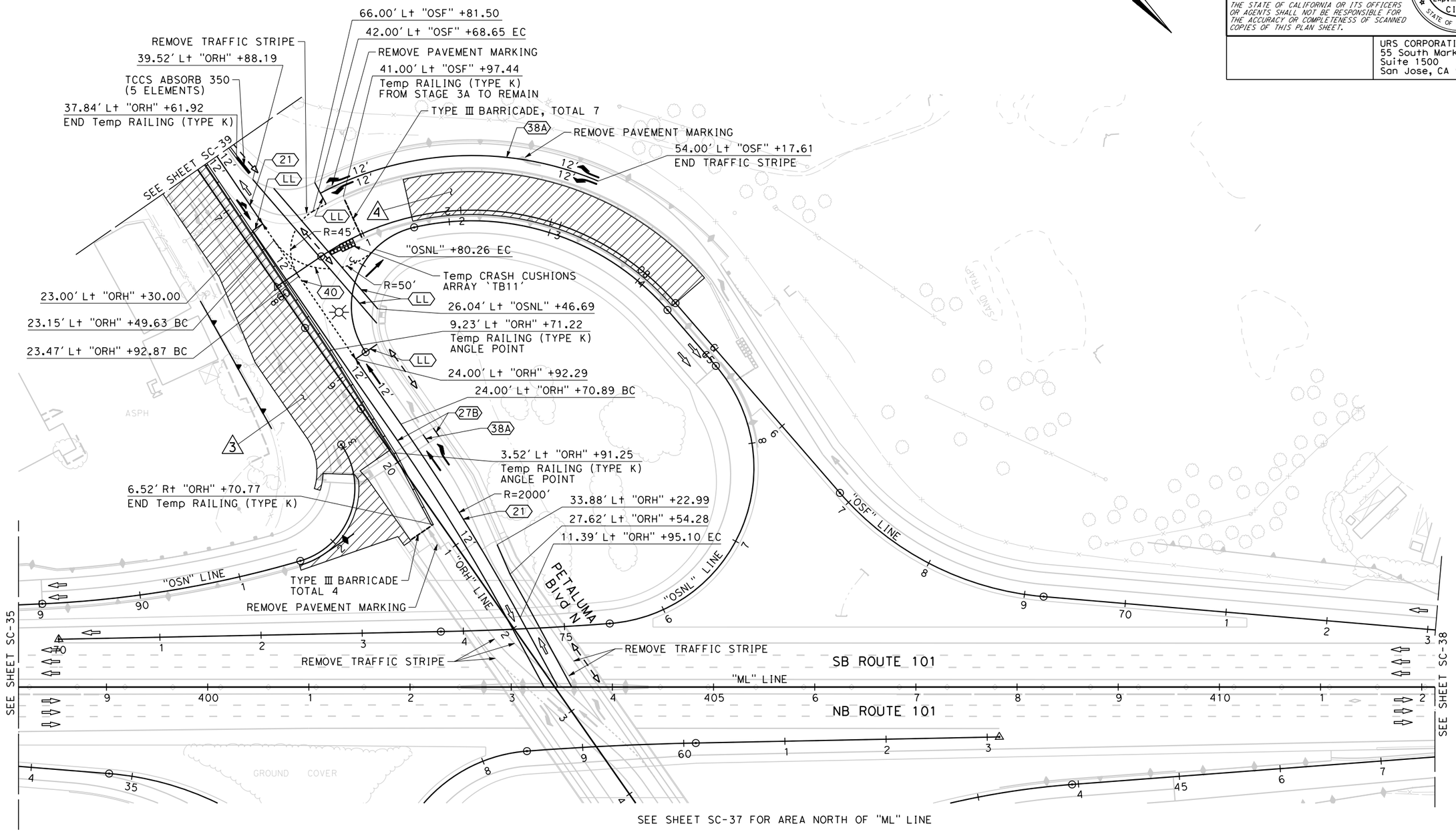

STAGE 4
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-36

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: DAVID WILLIAMS

CHECKED BY: HUEY NHAM

REVISED BY

DATE REVISED

LAST REVISION 09-20-10

DATE PLOTTED => 9/16/2010
TIME PLOTTED => 12:43:02 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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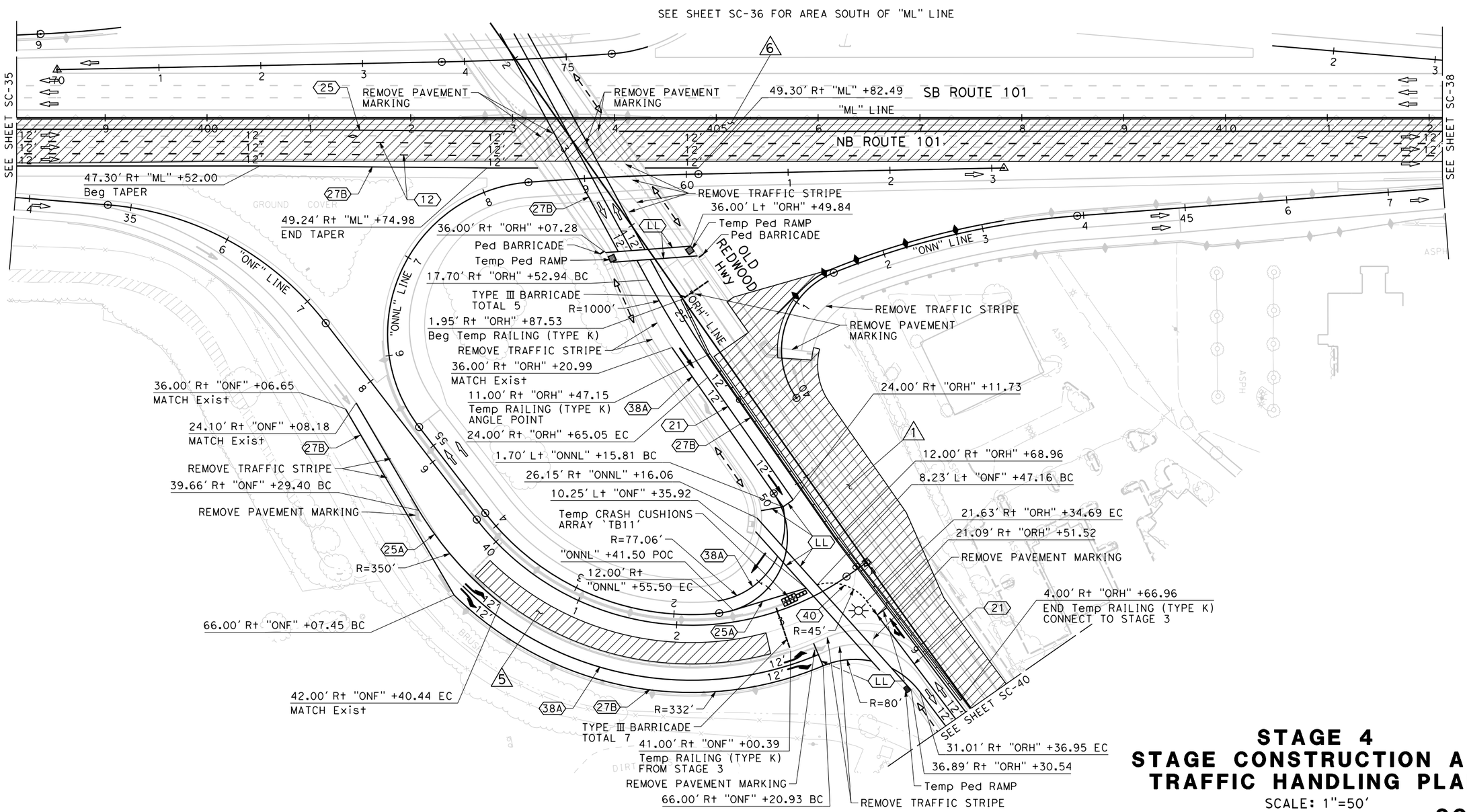

STAGE 4
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-37

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM

CHECKED BY: DAVID WILLIAMS

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DATE REVISED

LAST REVISION 09-20-10 | DATE PLOTTED => 9/16/2010 | TIME PLOTTED => 12:43:06 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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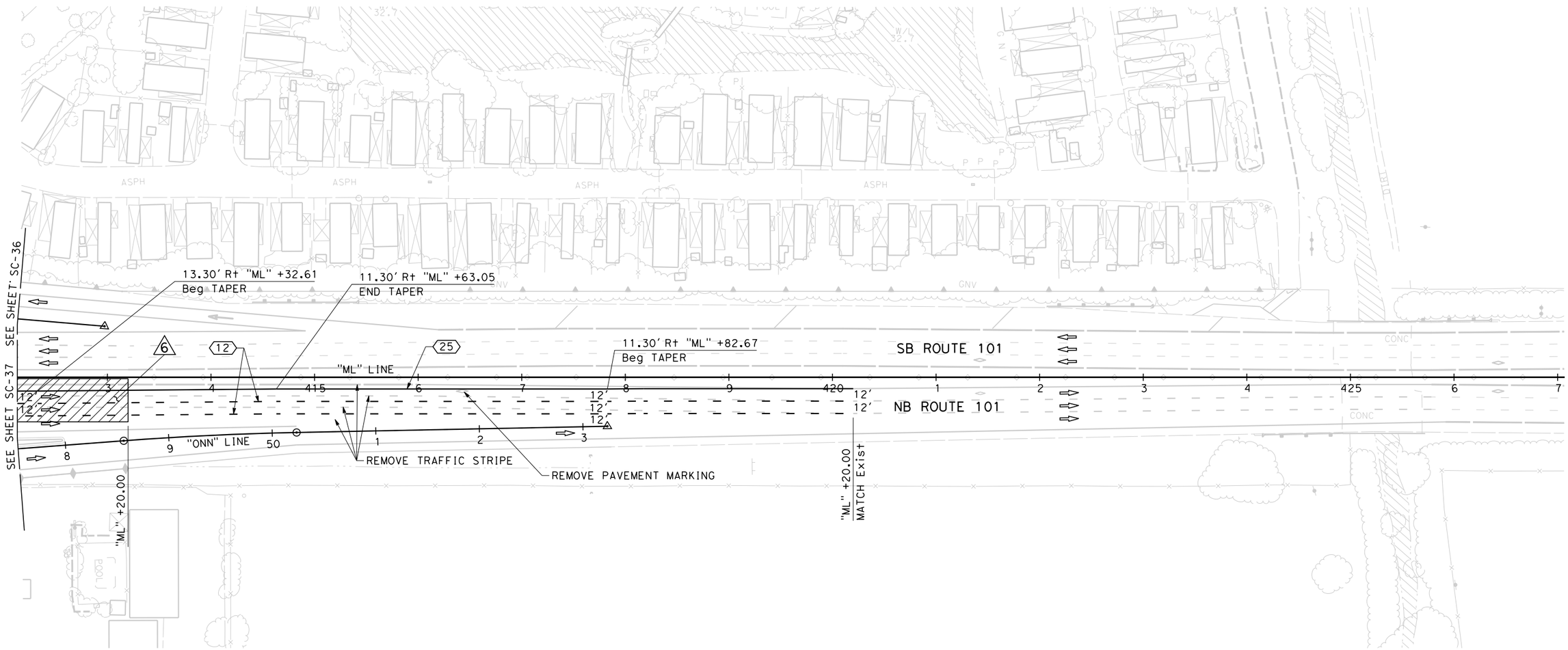

STAGE 4
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-38

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM

CHECKED BY: DAVID WILLIAMS

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LAST REVISION 09-20-10

DATE PLOTTED => 9/16/2010
TIME PLOTTED => 12:43:09 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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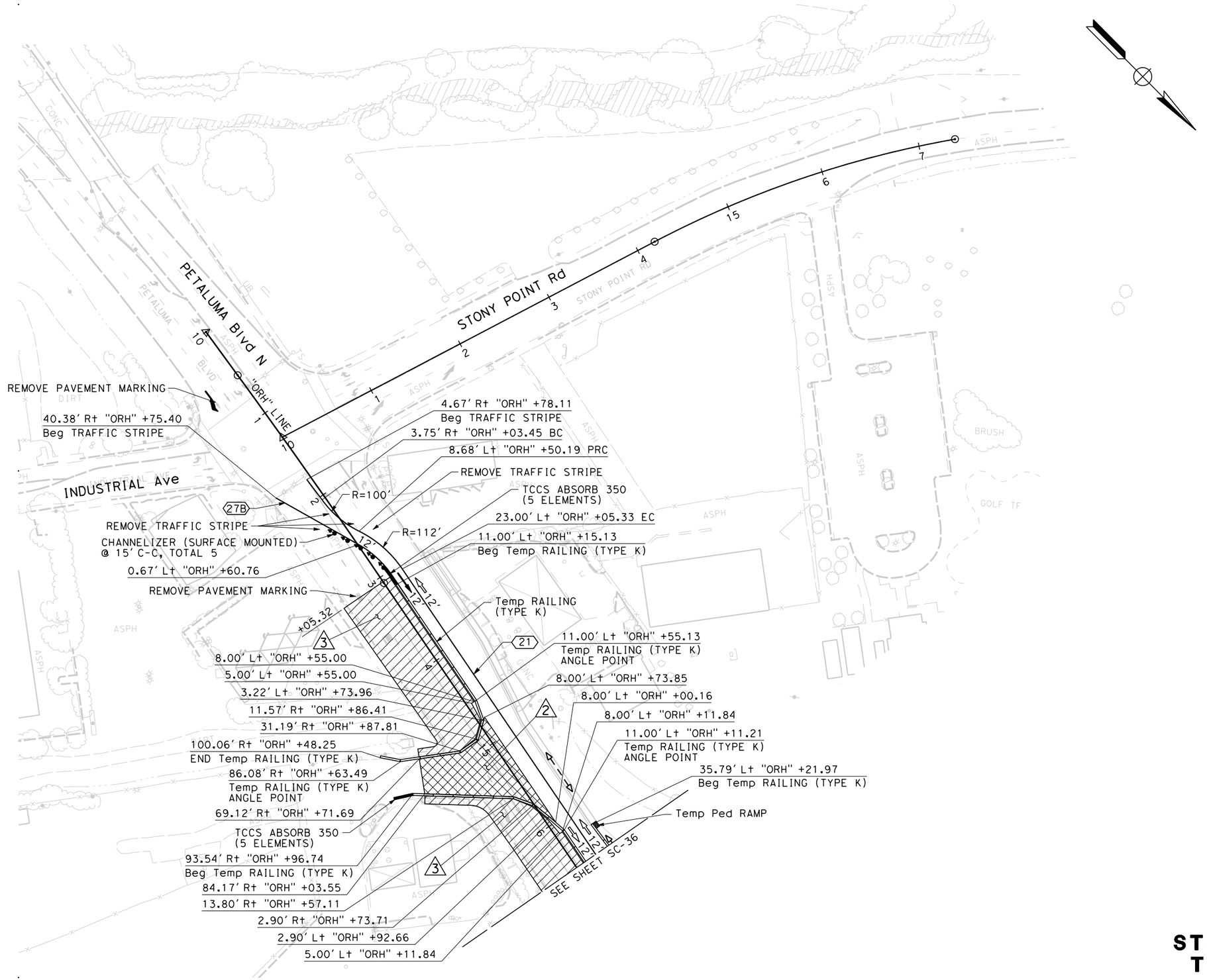

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

STAGE 4
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

SC-39

REVISED BY	DATE REVISED

CALCULATED-DESIGNED BY	CHECKED BY
HUEY NHAM	DAVID WILLIAMS

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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LAST REVISION 09-20-10 | DATE PLOTTED => 9/16/2010 | TIME PLOTTED => 12:43:12 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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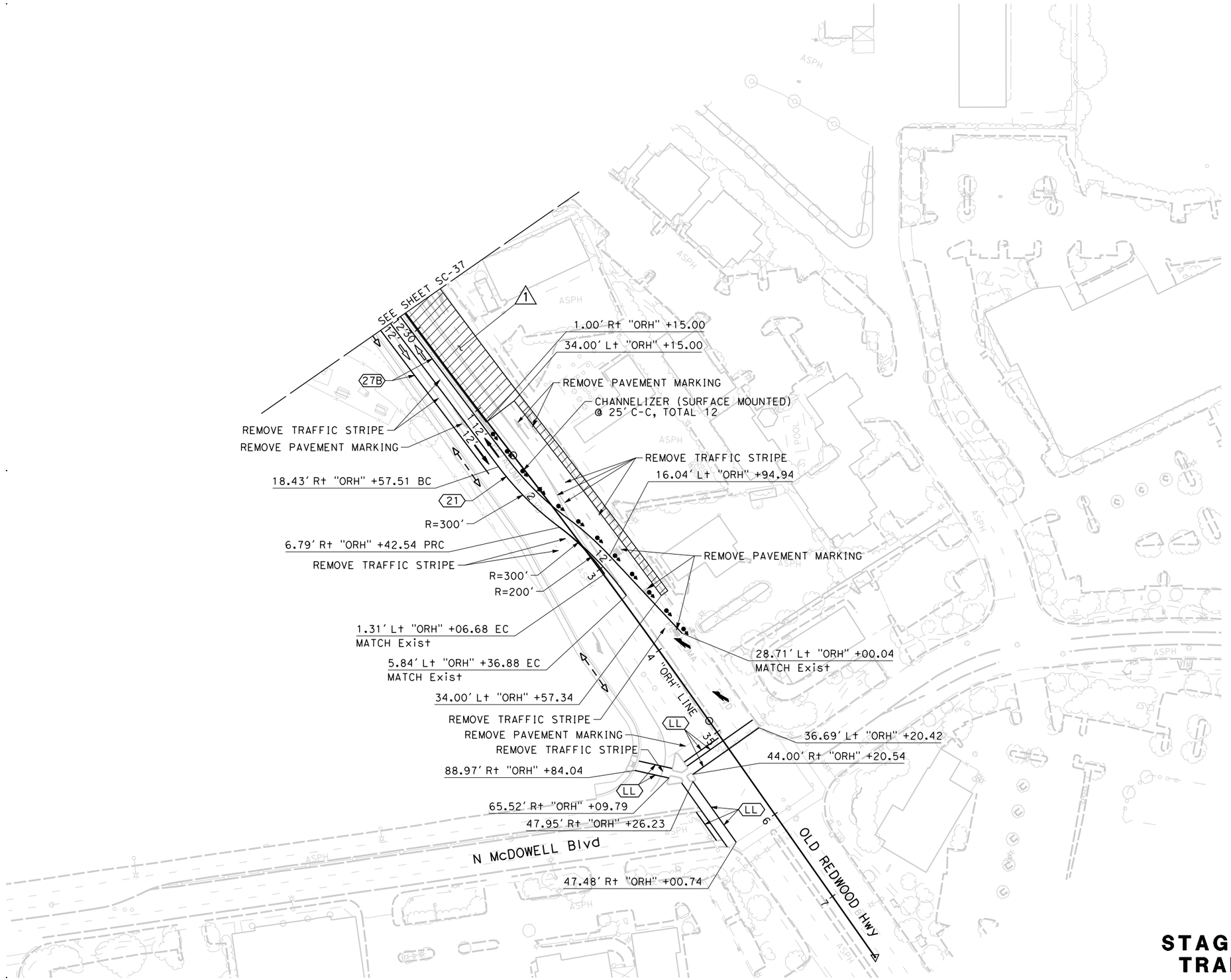

STAGE 4
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-40

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM

CHECKED BY: DAVID WILLIAMS

REVISED BY

DATE REVISED

LAST REVISION 09-20-10

DATE PLOTTED => 9/16/2010
TIME PLOTTED => 12:43:15 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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URS CORPORATION
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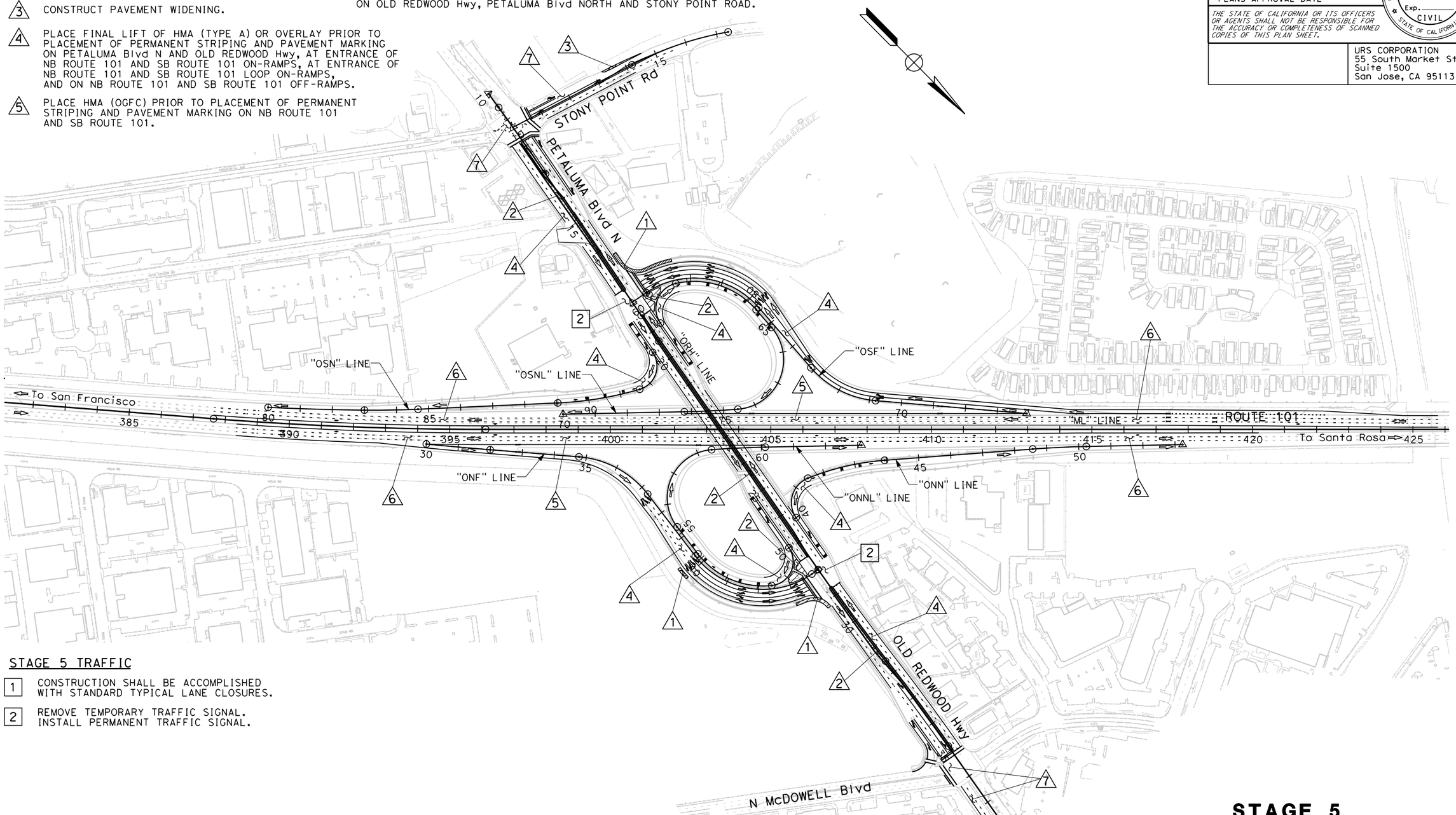
San Jose, CA 95113

STAGE 5 CONSTRUCTION

1. REMOVE TEMPORARY PAVING AND CONSTRUCT REMAINING CURB, GUTTER, AND SIDEWALK.
2. CONSTRUCT RAISED MEDIAN ISLANDS.
3. CONSTRUCT PAVEMENT WIDENING.
4. PLACE FINAL LIFT OF HMA (TYPE A) OR OVERLAY PRIOR TO PLACEMENT OF PERMANENT STRIPING AND PAVEMENT MARKING ON PETALUMA Blvd N AND OLD REDWOOD Hwy, AT ENTRANCE OF NB ROUTE 101 AND SB ROUTE 101 ON-RAMPS, AT ENTRANCE OF NB ROUTE 101 AND SB ROUTE 101 LOOP ON-RAMPS, AND ON NB ROUTE 101 AND SB ROUTE 101 OFF-RAMPS.
5. PLACE HMA (OGFC) PRIOR TO PLACEMENT OF PERMANENT STRIPING AND PAVEMENT MARKING ON NB ROUTE 101 AND SB ROUTE 101.
6. REMOVE TEMPORARY STRIPING AND PAVEMENT MARKING AS SHOWN PRIOR TO PLACEMENT OF PERMANENT STRIPING AND PAVEMENT MARKING ON NB ROUTE 101 AND SB ROUTE 101.
7. REMOVE EXISTING AND TEMPORARY STRIPING AND PAVEMENT MARKING AS SHOWN PRIOR TO PLACEMENT OF PERMANENT STRIPING AND PAVEMENT MARKING ON OLD REDWOOD Hwy, PETALUMA Blvd NORTH AND STONY POINT ROAD.

NOTE:

1. ALL STRIPING AND PAVEMENT MARKING SHOWN ARE PERMANENT. FOR DETAILS NOT SHOWN, SEE "PD" SHEETS FOR LOCATION AND DETAILS.



STAGE 5 TRAFFIC

1. CONSTRUCTION SHALL BE ACCOMPLISHED WITH STANDARD TYPICAL LANE CLOSURES.
2. REMOVE TEMPORARY TRAFFIC SIGNAL. INSTALL PERMANENT TRAFFIC SIGNAL.

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

STAGE 5
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

NO SCALE

SC-41

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM

CHECKED BY: DAVID WILLIAMS

REVISED BY

DATE REVISED

LAST REVISION 09-20-10

DATE PLOTTED => 9/16/2010
TIME PLOTTED => 12:43:19 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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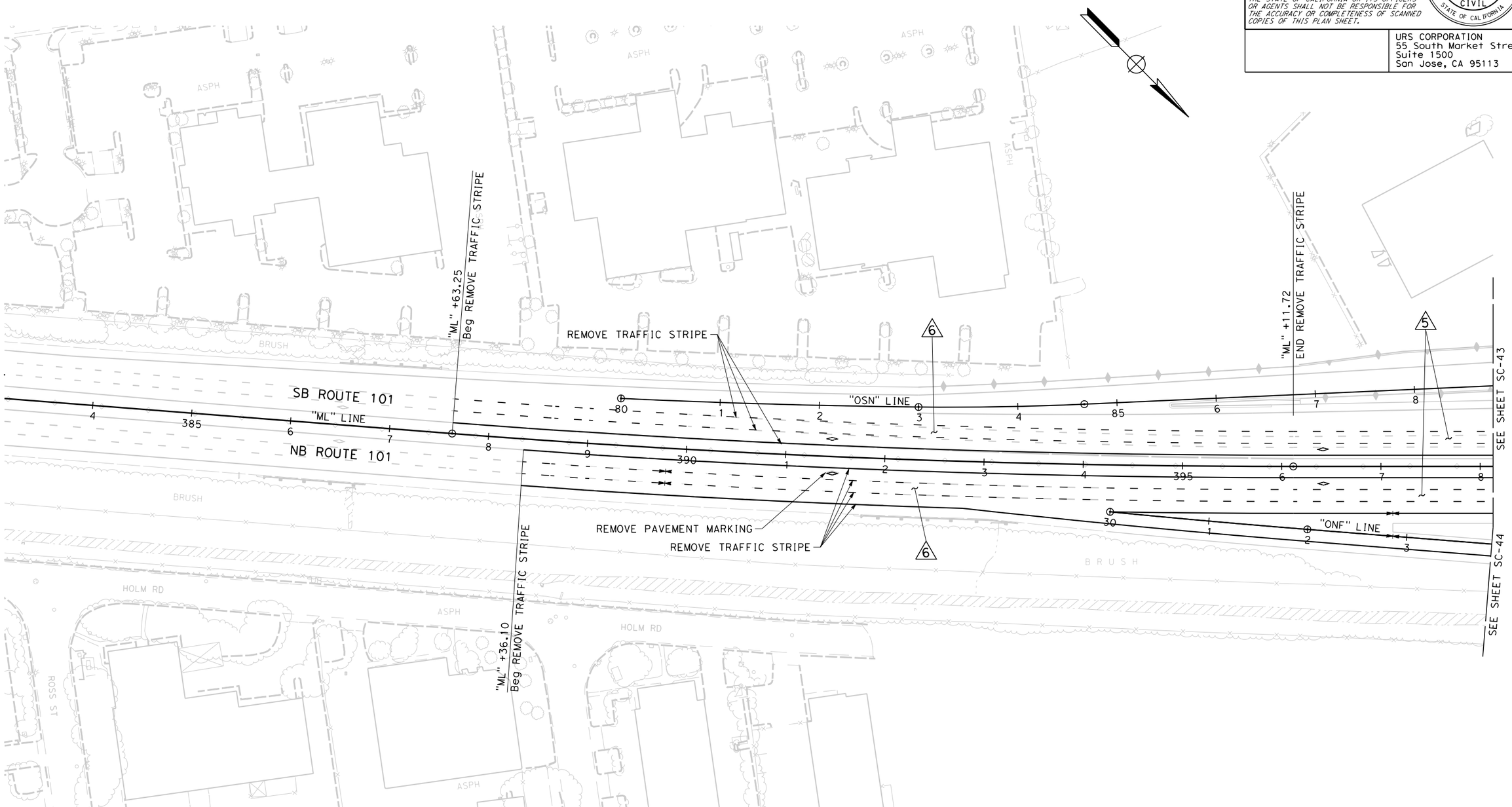

STAGE 5
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-42

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM

CHECKED BY: DAVID WILLIAMS

REVISED BY

DATE REVISED

LAST REVISION 09-20-10

DATE PLOTTED => 9/16/2010
TIME PLOTTED => 12:43:24 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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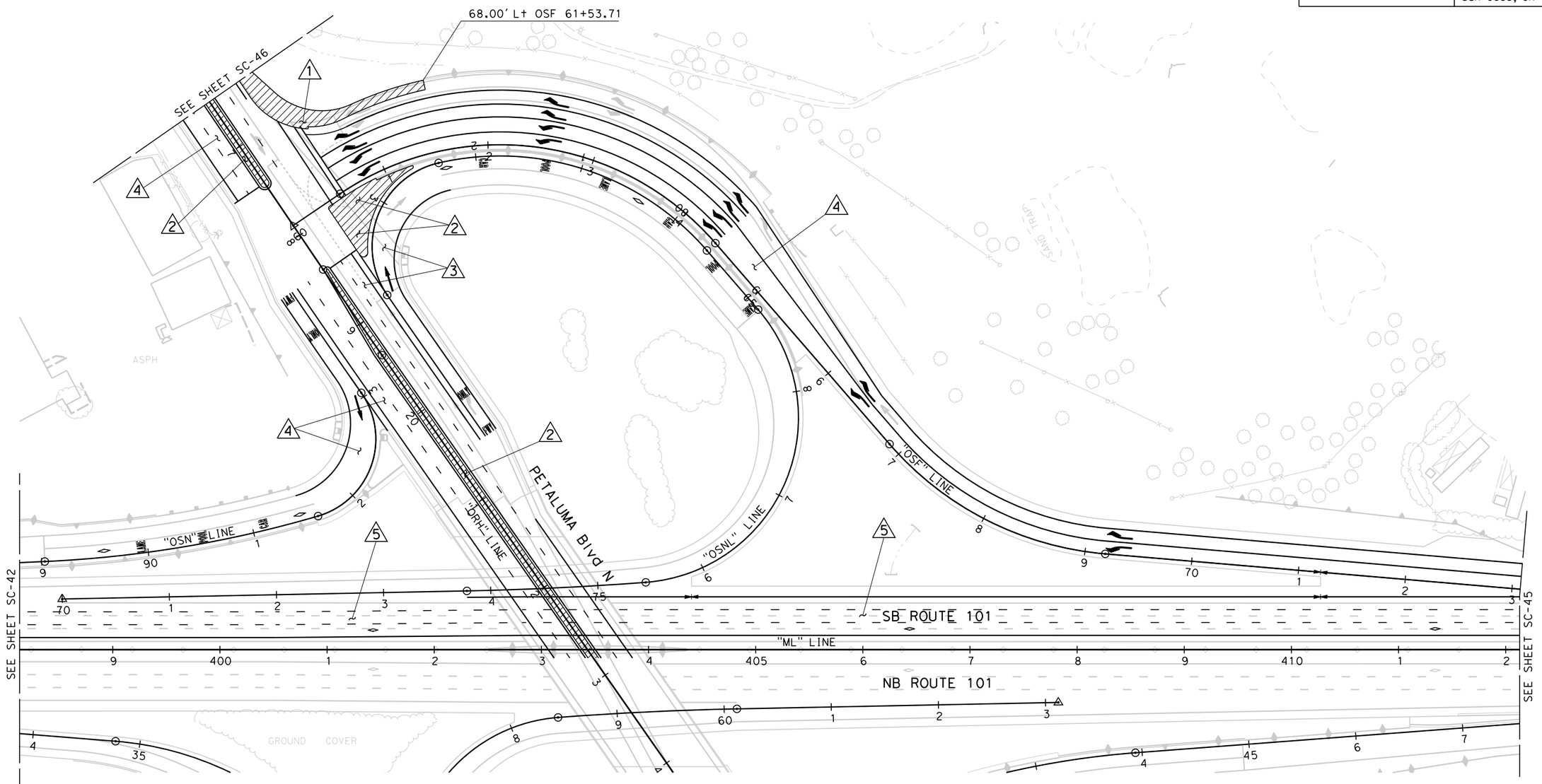

STAGE 5
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-43

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM

CHECKED BY: DAVID WILLIAMS

REVISED BY

DATE REVISED

LAST REVISION 09-20-10

DATE PLOTTED => 9/16/2010

TIME PLOTTED => 12:43:27 PM

BORDER LAST REVISED 7/2/2010

USERNAME => huey_nham

DGN FILE => 412276ma043.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0000

PROJECT NUMBER & PHASE 04000200041

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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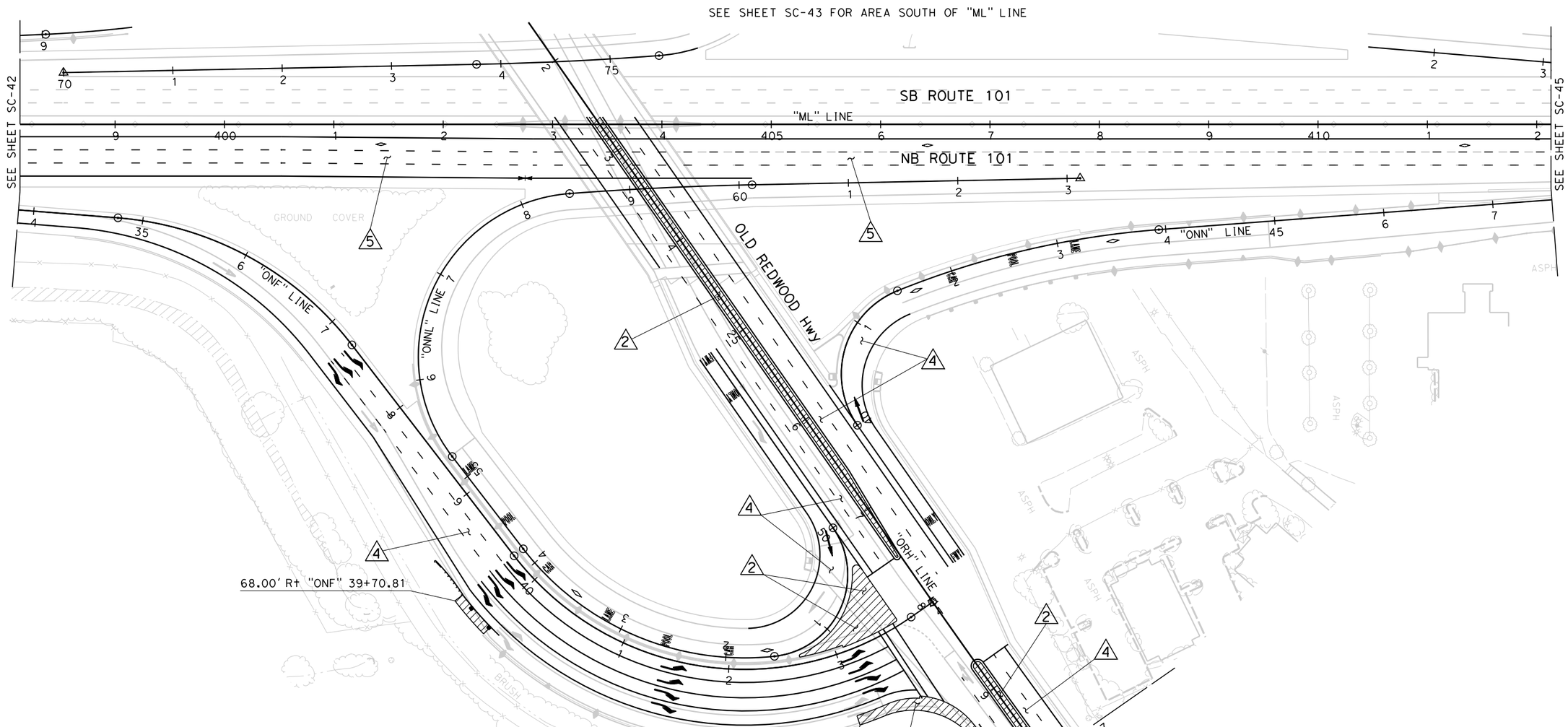

STAGE 5
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

SC-44

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM

CHECKED BY: DAVID WILLIAMS

REVISED BY

DATE REVISED

LAST REVISION DATE PLOTTED => 9/16/2010
TIME PLOTTED => 12:43:30 PM

BORDER LAST REVISED 7/2/2010

USERNAME => huey_nham
DGN FILE => 412276ma044.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0000

PROJECT NUMBER & PHASE 04000200041

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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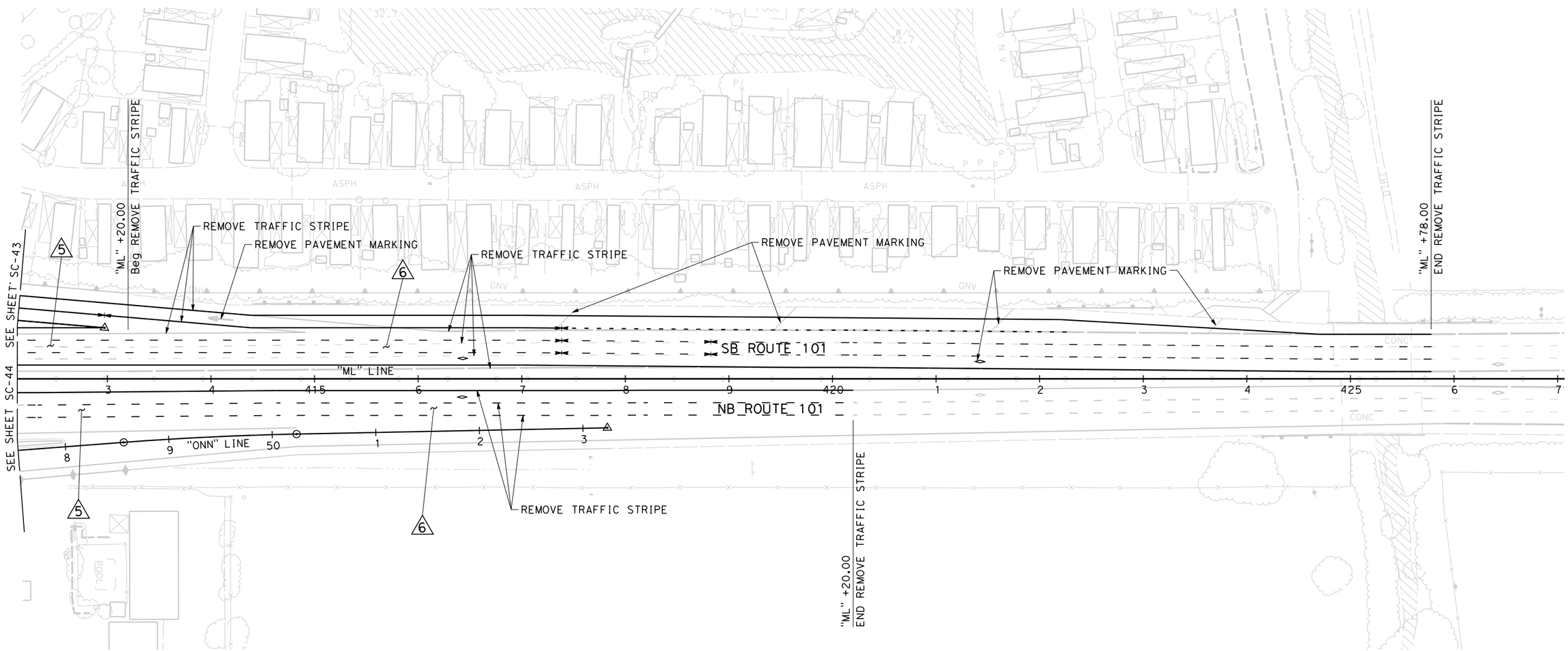

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STAGE 5
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

SC-45

REVISED BY	DATE REVISED
HUEY NHAM	DAVID WILLIAMS

CALCULATED-DESIGNED BY | CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

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BORDER LAST REVISED 7/2/2010 | USERNAME => huey_nham | DGN FILE => 412276ma045.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0000 | PROJECT NUMBER & PHASE 04000200041

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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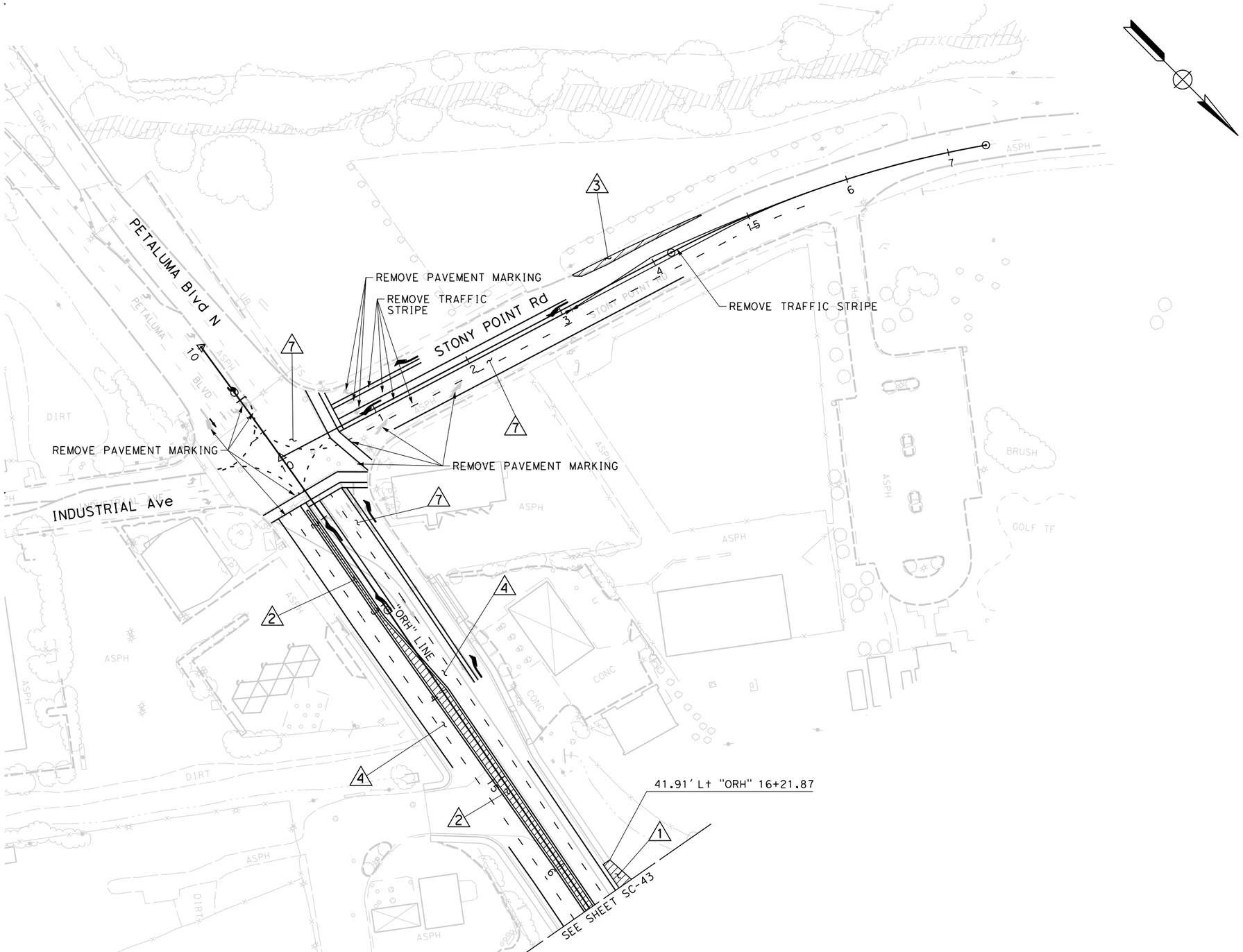

STAGE 5
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

SC-46

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM

CHECKED BY: DAVID WILLIAMS

REVISED BY

DATE REVISED

LAST REVISION 09-20-10

DATE PLOTTED => 9/16/2010
TIME PLOTTED => 12:43:35 PM

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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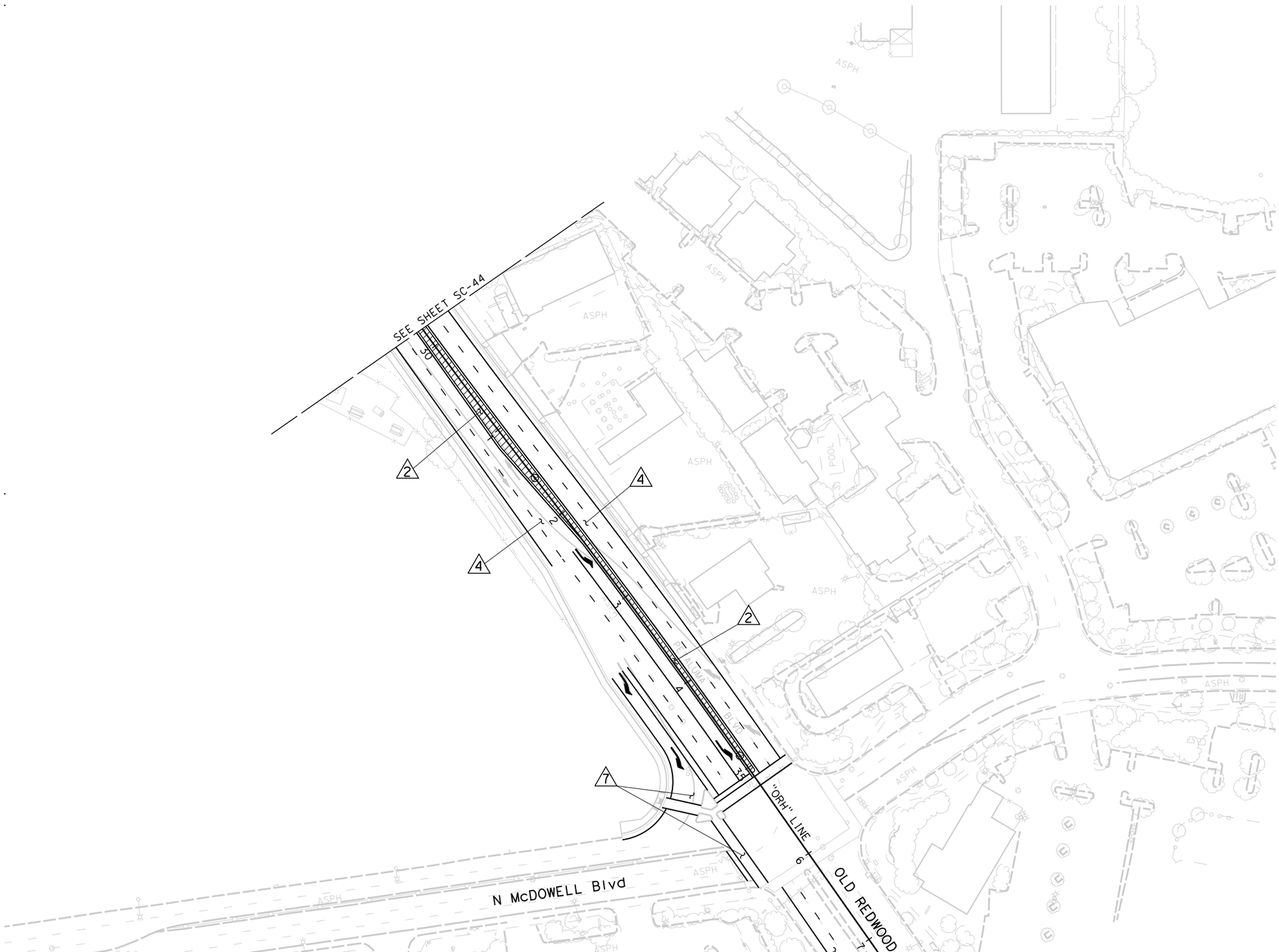

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION AND TRAFFIC HANDLING WORK ONLY

STAGE 5
STAGE CONSTRUCTION AND TRAFFIC HANDLING PLAN

SCALE: 1"=50'

SC-47

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM

CHECKED BY: DAVID WILLIAMS

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

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STAGE CONSTRUCTION QUANTITIES

STAGE	TEMPORARY RAILING (TYPE K)	TEMPORARY CRASH CUSHION (ABSORB 350) (5 ELEMENTS)	TEMPORARY CRASH CUSHION (ABSORB 350) (10 ELEMENTS)	TEMPORARY CRASH CUSHION MODULE	CHANNELIZER (SURFACE MOUNTED)	TYPE III BARRICADE	PEDESTRIAN BARRICADE	TEMPORARY PEDESTRIAN RAMP	TEMPORARY PAVEMENT MARKER	TEMPORARY RETAINING WALL
	LF	EA	EA	EA	EA	EA	EA	EA	EA	EA
1	7720	8	1	14	33				155	370
1A	2020	6	2		3				9	2563
2	3800	7			16	3	4	4	93	1685
2A	7320	12	2	25	43	8	2	4	299	7172
3	3480	6	2		57	13			275	6896
3A	1380	1		14		11			62	2280
4	1380	2		22	17	23			122	
DE PLAN						2				
TOTAL	27100	42	7	75	169	60	6	8	1015	20966

TEMPORARY TRAFFIC STRIPE (PAINT)

STAGE	DETAIL No.	TEMPORARY TRAFFIC STRIPE	DESCRIPTION	LENGTH
		LF		
1	27B	3,300	4" WHITE EDGE OF TRAVEL WAY	3,299
	8	602	4" WHITE LANE STRIPE	602
	12	5,723	4" WHITE LANE STRIPE	5,722
	21	339	4" YELLOW CENTER STRIPE	339
	25	1,578	4" YELLOW EDGE STRIPE	1,577
	38A	153	8" WHITE CHANNELIZING LINE	153
1A	28	1,566	4" YELLOW MEDIAN STRIPE	783
	25	360	4" YELLOW EDGE STRIPE	360
	27B	1,770	4" WHITE EDGE OF TRAVEL WAY	1,769
	40	316	4" WHITE LANE EXTENSION STRIPE	316
	38A	260	8" WHITE CHANNELIZING LINE	259
2	27B	6,700	4" WHITE EDGE OF TRAVEL WAY	6,700
	12	247	4" WHITE LANE STRIPE	247
	21	1,258	4" YELLOW NO PASSING STRIPE	1,258
	25A	2,019	4" YELLOW EDGE STRIPE	2,018
	28	273	4" YELLOW MEDIAN STRIPE	137
	40	735	4" WHITE LANE EXTENSION STRIPE	735
	38A	681	8" WHITE CHANNELIZING LINE	680
2A	27B	5,357	4" WHITE EDGE OF TRAVEL WAY	5,357
	28	1,370	4" YELLOW MEDIAN STRIPE	685
	9	259	4" WHITE LANE STRIPE	258
	12	9,679	4" WHITE LANE STRIPE	9,678
	21	416	4" YELLOW NO PASSING STRIPE	416
	25	1,998	4" YELLOW EDGE STRIPE	1,997
	25A	1,074	4" YELLOW EDGE STRIPE	1,074
	38A	986	8" WHITE CHANNELIZING LINE	985
	40	352	4" WHITE LANE EXTENSION STRIPE	352
3	9	304	4" WHITE LANE STRIPE	304
	12	5,217	4" WHITE LANE STRIPE	5,217
	21	634	4" YELLOW NO PASSING STRIPE	633
	25	1,709	4" YELLOW EDGE STRIPE	1,709
	25A	2,841	4" YELLOW EDGE STRIPE	2,840
	27B	7,304	4" WHITE EDGE OF TRAVEL WAY	7,304
	40	456	4" WHITE LANE EXTENSION STRIPE	456
	38A	2,296	8" WHITE CHANNELIZING LINE	2,296
3A	9	166	4" WHITE LANE STRIPE	166
	21	173	4" YELLOW NO PASSING STRIPE	172
	25A	1,329	4" YELLOW EDGE STRIPE	1,328
	27B	1,021	4" WHITE EDGE OF TRAVEL WAY	1,020
	28	190	4" YELLOW MEDIAN STRIPE	95
	38A	105	8" WHITE CHANNELIZING LINE	105
4	27B	4,398	4" WHITE EDGE OF TRAVEL WAY	4,397
	12	5,186	4" WHITE LANE STRIPE	5,186
	21	1,940	4" YELLOW NO PASSING STRIPE	1,939
	25A	245	4" YELLOW EDGE STRIPE	244
TOTAL		84,885		

TEMPORARY PAVEMENT MARKING (PAINT)

STAGE	DESCRIPTION	EA	SQFT	TOTAL SQFT
1A	LIMIT LINE	75	1	76
	TYPE I ARROW	2	31	62
	TYPE II ARROW	1	45	45
	TYPE III ARROW	4	42	168
2	LIMIT LINE	168	1	168
	TYPE I ARROW	7	31	217
	TYPE II ARROW	1	45	45
	TYPE III ARROW	12	42	504
	TYPE V ARROW	3	33	99
	SB	2	14	28
	101	2	17	34
	ONLY	2	22	44
2A	LIMIT LINE	144	1	144
	TYPE I ARROW	8	31	248
	TYPE II ARROW	2	45	90
	TYPE III ARROW	10	42	420
	NB	2	14	28
	101	2	17	34
	ONLY	2	22	44
3	LIMIT LINE	130	1	131
	TYPE I ARROW	7	31	217
	TYPE II ARROW	2	45	90
	TYPE III ARROW	17	42	714
	101	1	17	17
	ONLY	1	22	22
3A	TYPE I ARROW	1	31	31
	TYPE III ARROW	4	42	168
4	LIMIT LINE	85	1	85
	TYPE I ARROW	7	31	217
	TYPE II ARROW	2	45	90
	TYPE III ARROW	9	42	378
	TYPE VI ARROW	2	42	84
	DIAMOND SYMBOL	4	11	44
TOTAL				4786

PAVEMENT DELINEATION QUANTITIES (REMOVAL)

LOCATION	REMOVE THERMOPLASTIC TRAFFIC STRIPE	REMOVE THERMOPLASTIC TRAFFIC STRIPE	
	SQFT	WHITE (LF)	YELLOW (LF)
"ML" LINE		13578	
RAMPS		7242	
OLD REDWOOD HWY		5997	
WITHIN PROJECT LIMIT	2048		21026
TOTAL	2048	26817	21026

STAGE CONSTRUCTION QUANTITIES

SCQ-1

REVISED BY | DATE REVISED
HUEY NHAM | DAVID WILLIAMS
CALCULATED-DESIGNED BY | CHECKED BY
CONSULTANT FUNCTIONAL SUPERVISOR
RAMSEY HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

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DATE PLOTTED => 9/16/2010
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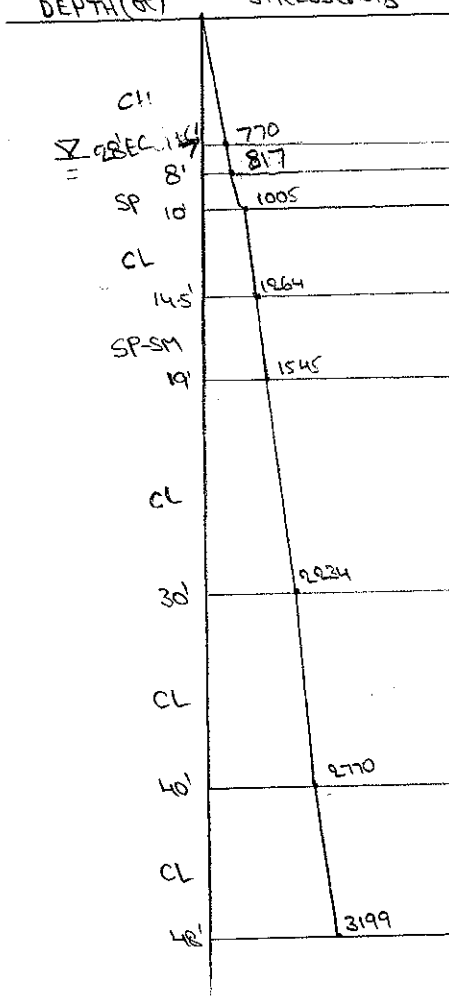
URS

Job OLD REDWOOD HWY OVERCROSSING — Project No. 28645097 — Sheet ___ of ___

Description EMBANKMENT SETTLEMENT — Computed by MJ — Date 12/21/09

Checked by ___ — Date ___

Reference



	γ' (PCF)	C_{CE}	C_{RE}	P_p (KSF)	E x10^6 (PSF)	μ	C_α	A	t_{ZERO}	
CH	110	0.16	0.026	5.2	0.3	0.5	–	1	–	$\frac{S_u}{P}$ = 4.5 to 5
SEC. 1	47.6	0.16	0.026	6.2	0.3	0.5	–	1	–	
SP	62.6	–	–	5.3	0.3	0.3	–	1	–	
CL	57.6	0.05	0.01	5.4	0.3	0.5	–	1	–	
SP-SM	62.6	–	–	5.5	0.35	0.5	–	1	–	
CL	62.6	0.05	0.01	13.0	1.0	0.5	–	1	–	$\frac{S_u}{P}$ = 1.1
CL	53.6	0.05	0.01	7.5	1.0	0.5	–	1	–	$\frac{S_u}{P}$ = 0.6
CL	53.6	0.05	0.01	8.2	1.0	0.5	–	1	–	

IN COMPRESSIBLE VERY DENSE SAND LAYERS.

CL @ 19'-30' $\frac{S_u}{\sigma'_{vo}} = 1.1$ $\quad \frac{S_u}{P'} = m \cdot OCR^{\alpha}$ $\quad \alpha = 0.8$ $\quad m = 0.23 \left(\frac{S_u}{\sigma'_v}\ NC = 0.23\right)$

$1.1 = 0.23\,(OCR)^{0.8}$ $\quad (OCR)^{0.8} = 4.78 \Rightarrow OCR \cong 7$ $\quad P_p = (7)(1890) = 13226\ PSF \cong 13\ KSF$

CL @ 30'-40' $\frac{S_u}{\sigma'_{vo}} = 0.6$ $\quad 0.6 = 0.23\,(OCR)^{0.8}$ $\quad (OCR)^{0.8} = 2.61 \Rightarrow OCR = 3.3 \cong 3.$

$P_p = (3)(2502) = 7506\ PSF \cong 7.5\ KSF$

$E_s = 10(N+15)$ $\quad$ SP @ 8'-10' $\quad E_s = 10(14+15) = 290\ KSF$

SP-SM @ 14.5'-19' $\quad E_s = 10(20+15) = 350\ KSF$

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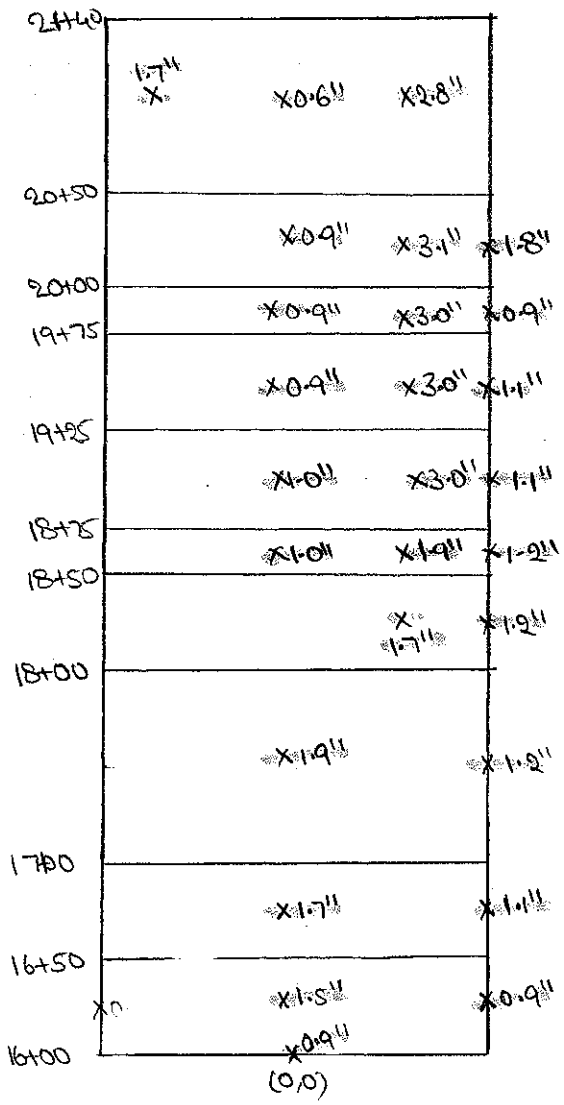
Page ____ of ____

Job ____ Project No. ____ Sheet ____ of ____

Description ____ Computed by ____ Date ____

____ Checked by ____ Date ____

Reference



PLAN VIEW.

X SETTLEMENT POINT

URS

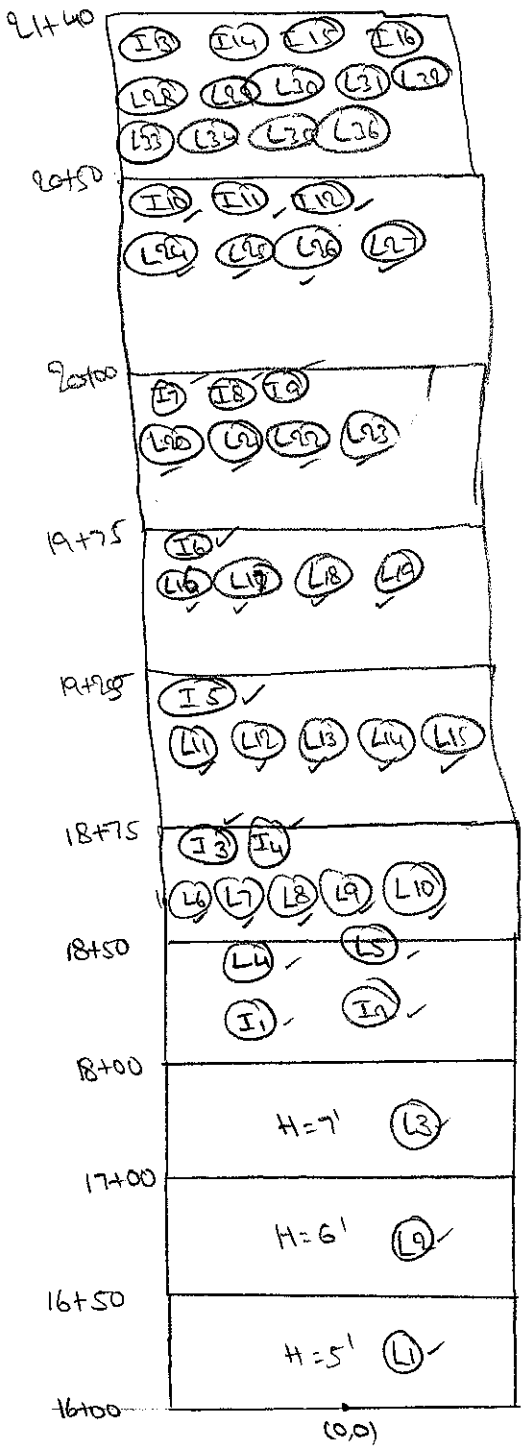
Page ____ of ____

Job _____ Project No. _____ Sheet ____ of ____

Description _____ Computed by _____ Date _____

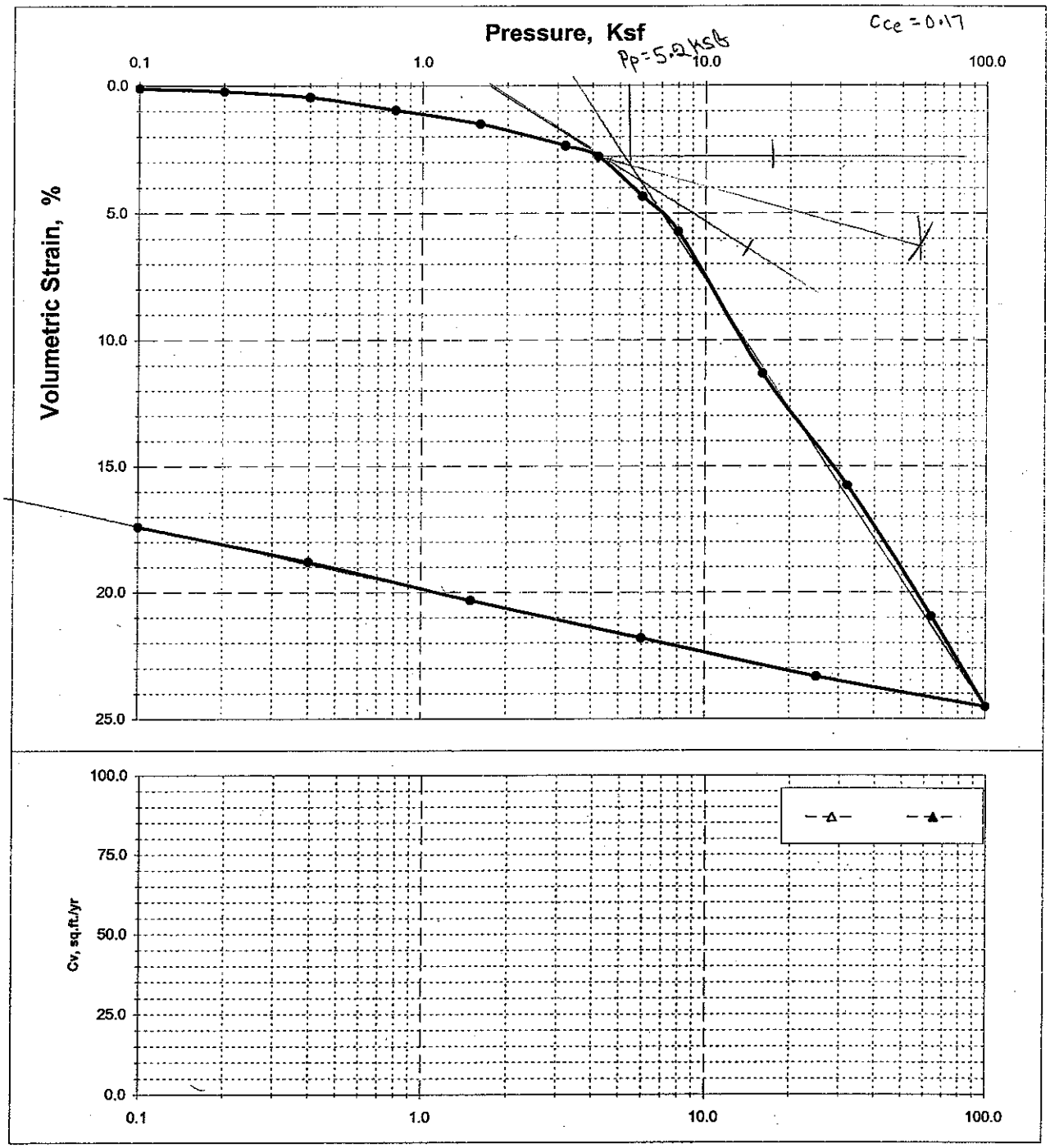
_____ Checked by _____ Date _____

Reference



CONSOLIDATION TEST

Boring Number	A-09-106	Sample Number	10	Depth (ft)	5-7.5			
Soil Description	Dark gray clay							
	Water Content, %	Total Unit Weight, pcf	Void Ratio	Saturation %	Height in	Diameter in	Specific Gravity	Liquid Limit, %	Plasticity Index, %
Initial	35.1	113.2	1.012	93.6	1.00		(assumed)		
Final	28.5	131.7	0.646	119.2	0.818	2.420	2.70	82	50

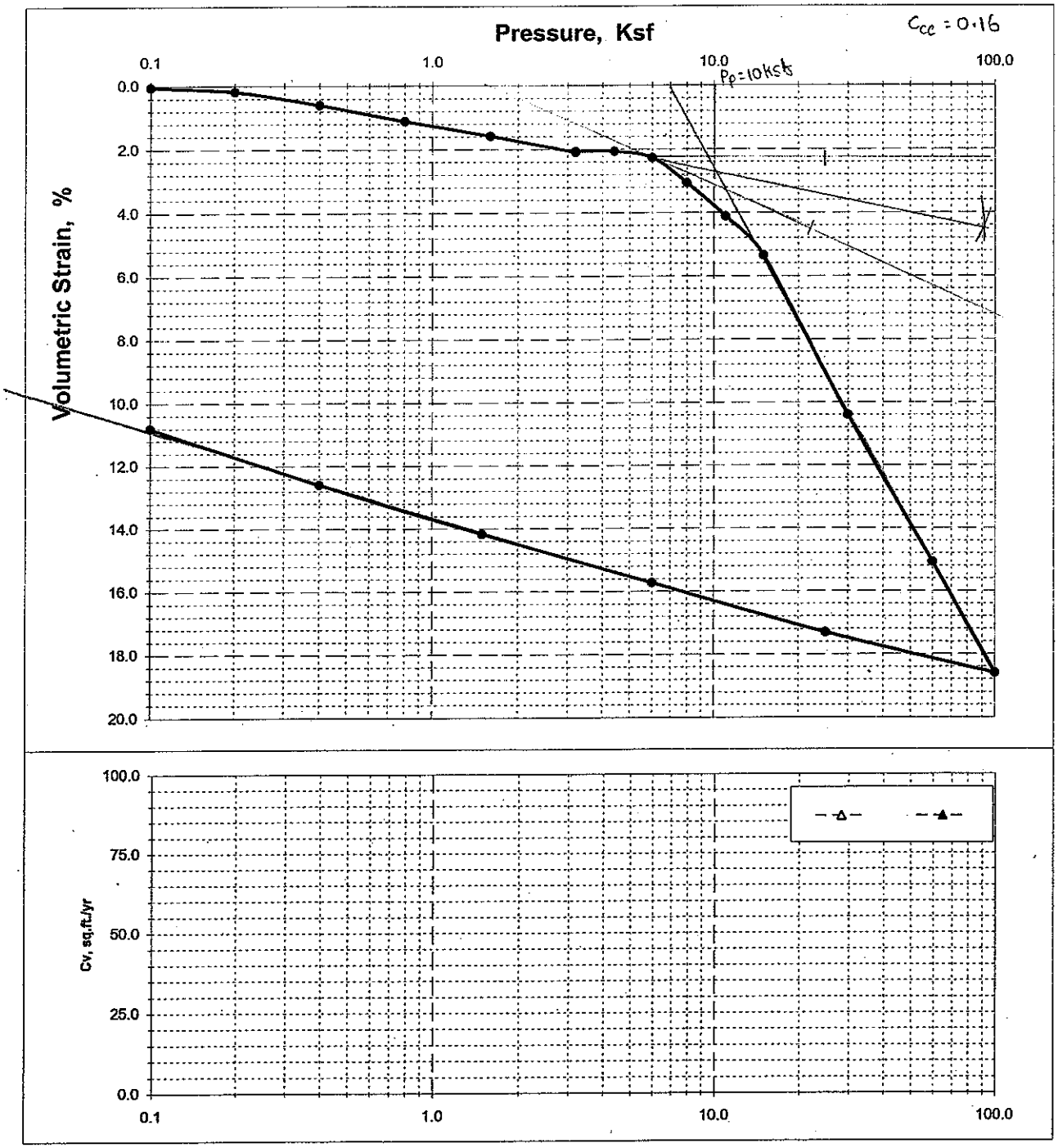


286645097

CONSOLIDATION TEST

Boring Number	A-09-101	Sample Number	2-X	Depth (ft)	5-7.5	
Soil Description	Dark brown clayey silt					

	Water Content, %	Total Unit Weight, pcf	Void Ratio	Saturation %	Height in	Diameter in	Specific Gravity	Liquid Limit, %	Plasticity Index, %
Initial	31.8	114.9	0.934	91.8	1.00	2.420	(assumed) 2.70	79	42
Final	27.3	124.4	0.725	101.7	0.892				



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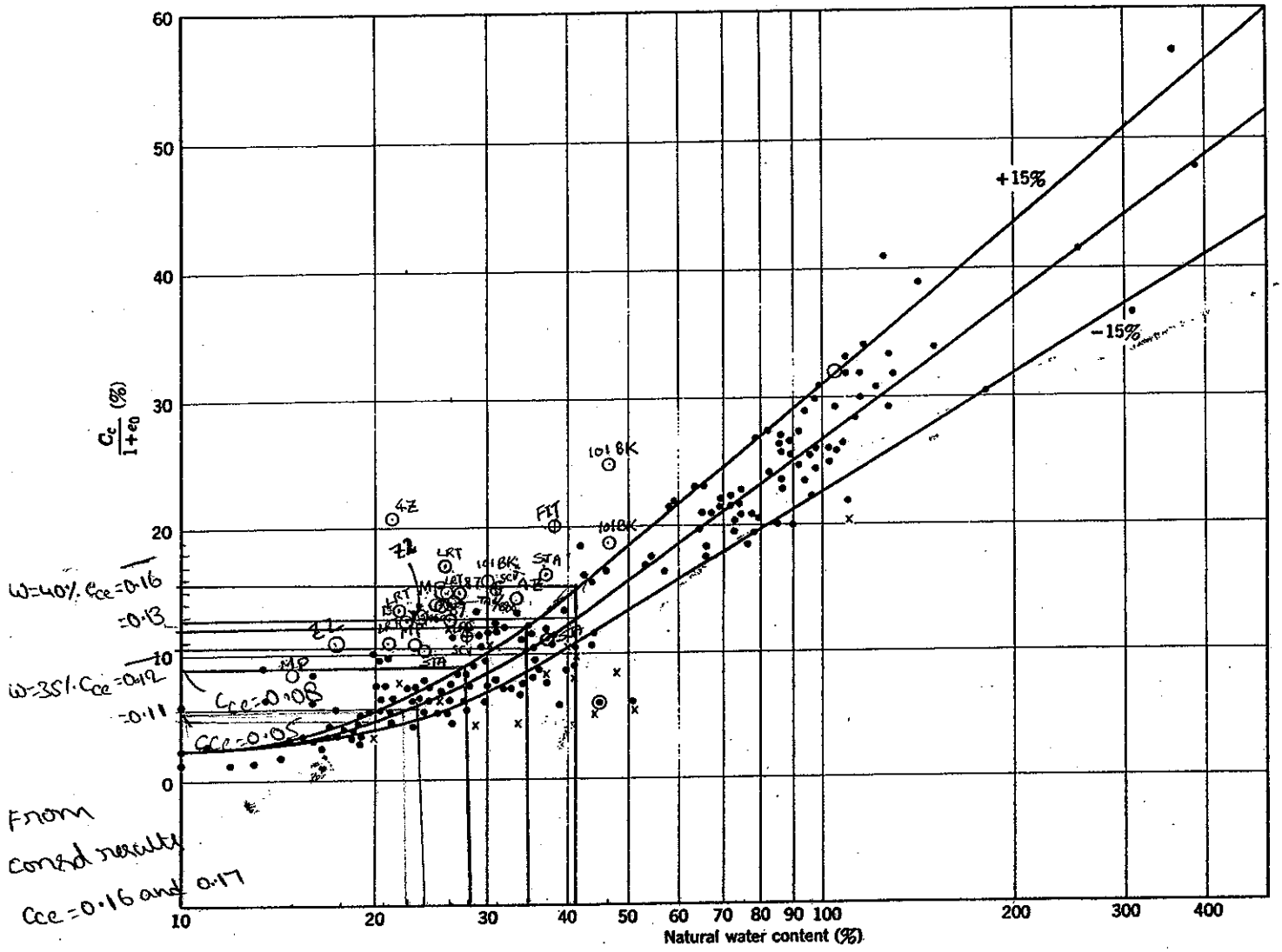
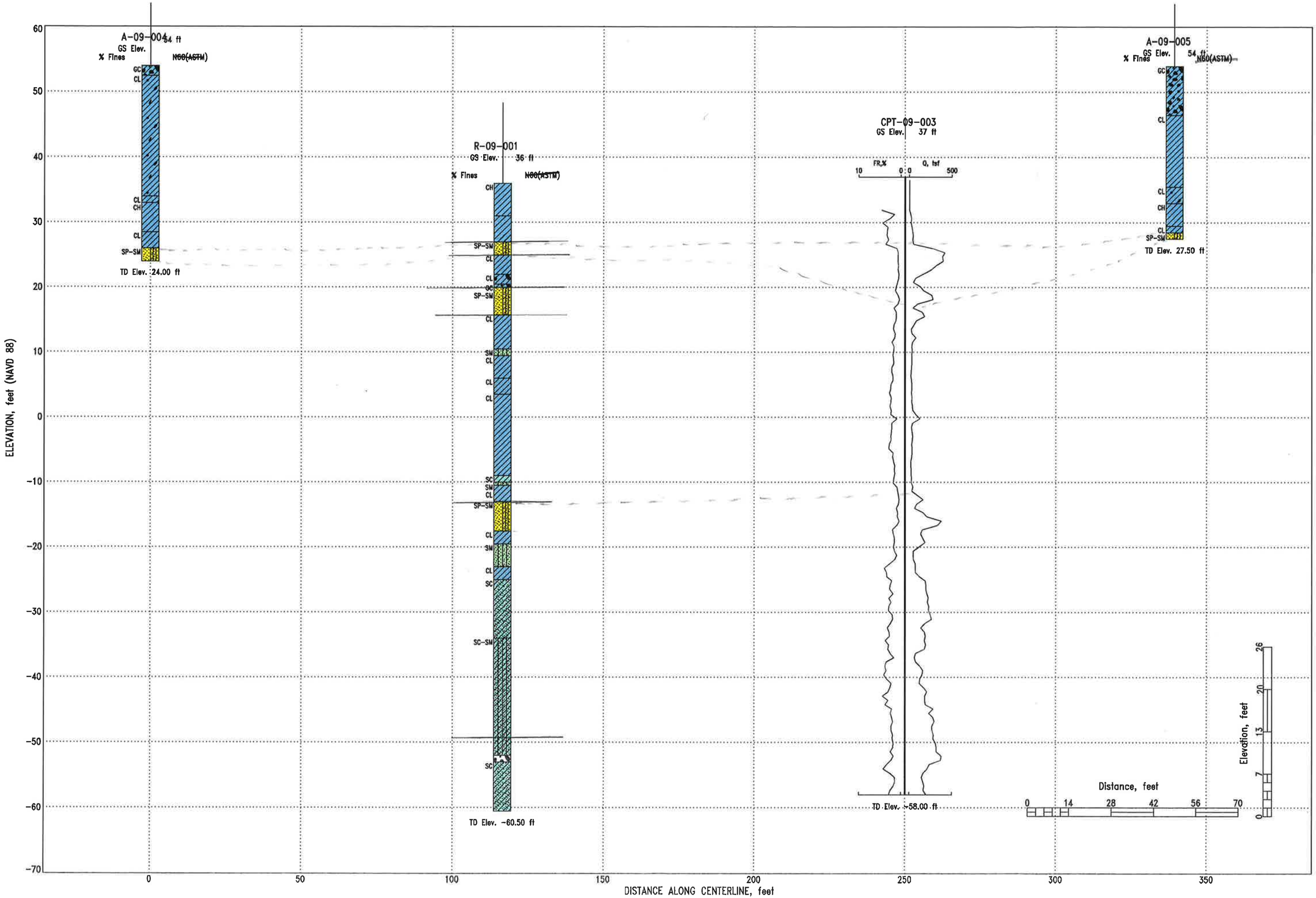


Fig. 22.1(c)

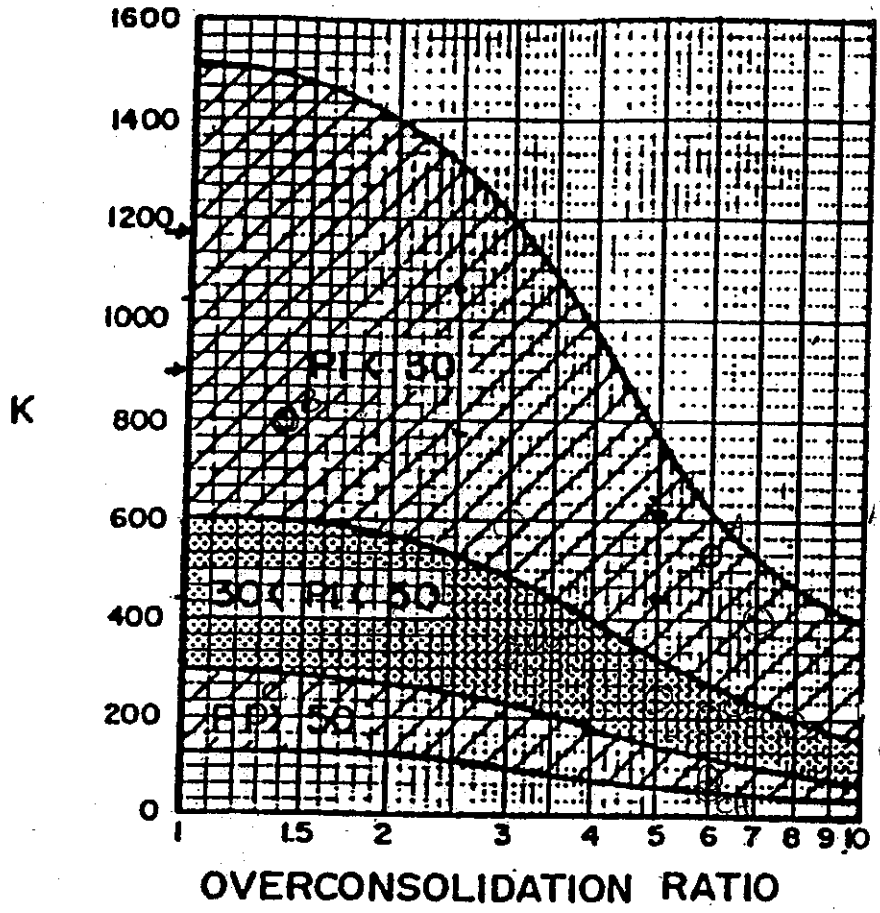
(After Lamb and Whitman, 1969)

SAN JOSE LOCAL PROJECTS

- FIT — 16755V — FIDELITY TITLE OFFICE BUILDING
- SJA — 16171V — S.J. AIRPORT
- 4Z — 8715027R — 4TH/ZANKER
- MP — 8815006R — MILPITAS PIPELINE
- LRT — 8815012R — ROUTE 85 / LRT TUNNEL
- 87 — ROUTE 87 BRIDGE (NORTH BOUND) 8810100R
- 101BK — HWY 101 / BROKAW RD 8810188R
- TAS/880 — TASMAN DR. / I-880
- SCV — 9100204R — SANTA CLARA CONDUIT VAULT
- ZZ — 9000428R — MILPITAS ZONE 2 TANK



SECTION: 1-1' - Part A



CH @ 0'-8'
E=KSu = (200)(1500) = 300000
= 0.3x10^6 PSF

CL @ 19'-30'
E=KSu = (400)(2500) = 1000000
= 1.0x10^6 PSF

CL @ 30'-40' & 40'-48'
E=KSu = (600)(1750) = 1050000
= 1.05x10^6 ≅ 1.0x10^6

$E_u = KS_u$

E_u = UNDRAINED MODULUS OF CLAY

K = FACTOR FROM CHART ABOVE

S_u = UNDRAINED SHEAR STRENGTH OF CLAY

Fig 2 CHART FOR ESTIMATING UNDRAINED MODULUS OF CLAY

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-5-09	11-5-09	1861435.4 ft / 6369327.2 ft NAD83	A-09-004
DRILLING CONTRACTOR: Clear Heart Drilling			BOREHOLE LOCATION (Offset, Station, Line): ' Lt Sta ~	SURFACE ELEVATION: 54 ft NAVD 88
DRILLING METHOD: Hollow-Stem Auger			DRILL RIG: Portable Rig	BOREHOLE DIAMETER: 8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96")			SPT HAMMER TYPE: 140 lb/30 in - Rope & CAT Head	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING 28.5 ft; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 30.0 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	CLAYEY GRAVEL (GC); brown [FILL].												Hand Drilling from 0 to 1.5 feet
52.00	2	SANDY lean CLAY with GRAVEL (CL/SC); brown; moist [FILL].		1	6 11 15	26	85		13	113				γm = 128
48.00	6	Coarse gray GRAVEL.		2	20 20 39	59	85							
44.00	10			3	14 22 22	44	90							
	11	At EL. 43.0 ft, becomes brown mottled with grayish brown; few GRAVEL.												
38.00	16	At EL. 39.0 ft, becomes reddish brown mottled with gray.		4	12 14 20	34	75		16	118				γm = 137
36.00	18	Gravelly.												
34.00	20	Lean CLAY with SAND (CL); stiff; gray and black.		5	7 10 11	21	65							
	21	Fat CLAY (CH); stiff; black; trace GRAVEL.												
32.00	22													
30.00	24													
	25													

(continued)

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 12/21/09

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				A-09-004
DIST. 04	COUNTY Sonoma	ROUTE 101	POSTMILE 7.4/8.1	EA 04-12276K
PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY A. Cheung		DATE 11-9-09	SHEET 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		Fat CLAY (CH) *(continued)*.		6	7 9 11	20	85							
28.00	26		Lean CLAY (CL); very stiff; gray; moist.							23	103	UC = 1.32			YM-127 C= 2640
	27														
26.00	28		Poorly graded SAND with SILT (SP-SM); medium dense; grayish brown; wet.		7	7 8 9	17	75		18	107				
	29														
24.00	30		Bottom of Borehole at 30.0 ft.												
	31														
22.00	32														
	33														
20.00	34														
	35														
18.00	36														
	37														
16.00	38														
	39														
14.00	40														
	41														
12.00	42														
	43														
10.00	44														
	45														
8.00	46														
	47														
6.00	48														
	49														
4.00	50														
	51														
2.00	52														
	53														
0.00	54														
	55														

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 12/21/09

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**A-09-004**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **A. Cheung**		DATE **11-9-09**	SHEET **2 of 2**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	11-5-09	11-5-09	1861774.9 ft / 6369326.1 ft NAD83	A-09-005
DRILLING CONTRACTOR: Clear Heart Drilling			BOREHOLE LOCATION (Offset, Station, Line): ' Lt Sta ~	SURFACE ELEVATION: 54 ft NAVD 88
DRILLING METHOD: Hollow-Stem Auger			DRILL RIG: Portable Rig	BOREHOLE DIAMETER: 8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96")			SPT HAMMER TYPE: 140 lb/30 in - Rope & CAT Head	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING: dry; AFTER DRILLING (DATE): N/A	TOTAL DEPTH OF BORING: 26.5 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 GRAVEL (GC); medium dense; brown; with concrete chuncks and large roots to 3.5 feet [FILL].												
	1														
52.00	2														
	3														
50.00	4				1	9 9 11	20	65		10	119				Vm=131
	5														
48.00	6														
	7														
46.00	8		Lean CLAY (CL); very stiff; brown to black; moist; some GRAVEL [FILL].												
	9				2	9 13 16	29	75		20	109	UC = 1.2			Vm = 131 C= 2600
44.00	10														
	11														
42.00	12														
	13														
40.00	14		At EL. 40.5 ft, with increase in gravel content.		3	10 14 16	30	65		17	113				Vm = 132
	15														
38.00	16														
	17														
36.00	18														
	19		Lean CLAY with GRAVEL (CL); stiff; bluish gray; moist [FILL].		4	9 9 10	19	75							
34.00	20														
	21		Fat CLAY (CH); stiff; black; moist.												
32.00	22														
	23														
30.00	24														
	25		SANDY lean CLAY (CL); very stiff; gray.												

(continued)

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REPORT TITLE				HOLE ID
BORING RECORD				A-09-005
DIST. 04	COUNTY Sonoma	ROUTE 101	POSTMILE 7.4/8.1	EA 04-12276K
PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY A. Cheung		DATE 11-9-09	SHEET 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				5	15									
28.00	26		Poorly graded SAND with GRAVEL (SP); very dense; grayish brown; trace GRAVEL.			32 35	67								
	27		Bottom of Borehole at 26.5 ft.												
26.00	28														
	29														
24.00	30														
	31														
22.00	32														
	33														
20.00	34														
	35														
18.00	36														
	37														
16.00	38														
	39														
14.00	40														
	41														
12.00	42														
	43														
10.00	44														
	45														
8.00	46														
	47														
6.00	48														
	49														
4.00	50														
	51														
2.00	52														
	53														
0.00	54														
	55														

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San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**A-09-005**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **A. Cheung**		DATE **11-9-09**	SHEET **2 of 2**

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 12/21/09

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
C. Rambo	10-26-09	10-27-09	1861549.5 ft / 6369263.3 ft NAD83	R-09-001
DRILLING CONTRACTOR: Exploration Geoservices, Inc			BOREHOLE LOCATION (Offset, Station, Line): ' Lt Sta ~	SURFACE ELEVATION: 36 ft NAVD 88
DRILLING METHOD: Rotary Wash			DRILL RIG: CME 75	BOREHOLE DIAMETER: 4-7/8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID): Modified CA (1.96"), SPT (1.44")			SPT HAMMER TYPE: 140lb/30in - Auto	HAMMER EFFICIENCY, ERi: 107%
BOREHOLE BACKFILL AND COMPLETION: Cement			GROUNDWATER READINGS: DURING DRILLING N/A; AFTER DRILLING (DATE) N/A	TOTAL DEPTH OF BORING: 96.5 ft

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0	Fat CLAY (CH); medium stiff; black to dark gray; moist.												
	1			1	3 4 6	10	70		41	78	UC = 0.41			γm = 110 c = 820
34.00	2													
	3													
32.00	4													
	5	At EL. 31.0 ft, grades to (Fat CLAY with SAND) (CH); very stiff; dark gray; trace coarse SAND.		2	4 4 9	13			35	86	UC = 1.25			γm = 116 c = 2500.
30.00	6													
	7													
28.00	8													
	9	Poorly graded SAND with GRAVEL (SP); medium dense; grayish brown; wet; trace fine GRAVEL.												
26.00	10			3	8 7 2	9	70							
	11	Lean CLAY (CL); medium stiff; light grayish brown; moist.												
24.00	12													
	13													
22.00	14	GRAVELLY lean CLAY (CL); gray mottled with brown; moist.												End of drilling 10/26/09 Resume drilling 10/27/09
	15			4	7 7 10	17	70							
20.00	16	CLAYEY GRAVEL (GC); medium dense; gray; wet. Poorly graded SAND with SILT (SP-SM); medium dense; gray; moist.												
	17													
18.00	18													
	19													
16.00	20	Lean CLAY (CL); stiff; brown; moist.		5	5 4 5	9	80		24					PI LL=48 PI=32
	21													
14.00	22													
	23													
12.00	24													
	25													

(continued)

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 12/21/09

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San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				R-09-001
DIST. 04	COUNTY Sonoma	ROUTE 101	POSTMILE 7.4/8.1	EA 04-12276K
PROJECT OR BRIDGE NAME: Old Redwood Highway Intechange (28645097)				
BRIDGE NUMBER	PREPARED BY M. Thummaluru	DATE 11-2-09	SHEET 1 of 4	

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
	25	Lean CLAY (CL) *(continued)*.		6	5 12 12	24	0						
10.00	26	SILTY SAND (SM); dense; dark gray; moist.											
	27	Lean CLAY (CL); medium stiff; brown to gray; moist.		7	6 5 6	11	50						
8.00	28												
	29												
6.00	30	SANDY lean CLAY (CL); very stiff; gray; moist.		8	7 8 9	17	75		16	116	UC = 1.27		γ_m = 135 c = 2540
	31												
4.00	32												
	33	Lean CLAY (CL); very stiff; gray mottled with brown with black speckling; moist.											
2.00	34												
	35			9	7 8 9	17	60		25	99	UC = 1.28		γ_m = 124 c = 2560
0.00	36												
	37												
-2.00	38												
	39												
-4.00	40	At EL. -4.0 ft, becomes dark bluish gray.		10	5 7 10	17	75		32	88	UC = 0.88		γ_m = 116 c = 1760
	41												
-6.00	42												
	43												
-8.00	44												
	45	CLAYEY SAND (SC/CL); medium dense; grayish brown; moist.		11	6 9 13	22	85		21	100			γ_m = 121
-10.00	46	SILTY SAND (SM); dense; gray; moist.											
	47	Lean CLAY (CL); stiff; gray; moist.											
-12.00	48												
	49	Poorly graded SAND with SILT (SP-SM); very dense; orange brown; moist; some GRAVEL.											
-14.00	50			12	23 20 25	45	75						
	51												
-16.00	52												
	53												
-18.00	54	Lean CLAY (CL); gray; moist.											
	55												

(continued)

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San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**R-09-001**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **M. Thummaluru**	DATE **11-2-09**	SHEET **2 of 4**	

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	Lean CLAY (CL) *(continued)*.		13	8 12 18	30	0							
-20.00	56	SILTY SAND (SM); dense; light brown; moist.												
	57	At EL. -21.0 ft, becomes very dense.		14	15 18 28	46	100							
-22.00	58													
	59	SANDY lean CLAY (CL); medium stiff; light brown; moist.												
-24.00	60			15	8 14 23	37	80							
	61	CLAYEY SAND (SC); very dense; light brown; moist.												
-26.00	62													
	63													
-28.00	64													
	65			16	10 15 21	36	85							
-30.00	66													
	67													
-32.00	68													
	69													
-34.00	70	SILTY, CLAYEY SAND (SC-SM); very dense; light brown; moist.		17	13 21 26	47	90							
	71													
-36.00	72													
	73													
-38.00	74													
	75			18	8 16 23	39	100							
-40.00	76													
	77													
-42.00	78													
	79													
-44.00	80			19	10 17 19	36	80							
	81													
-46.00	82													
	83													
-48.00	84													
	85													

(continued)

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 12/21/09

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San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**R-09-001**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **M. Thummaluru**	DATE **11-2-09**	SHEET **3 of 4**	

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	85		SILTY, CLAYEY SAND (SC-SM) *(continued)*.		20	19 26 35	61	80							
-50.00	86														
	87														
-52.00	88		Gravel lense.												
	89		CLAYEY SAND (SC); very dense; light brown; moist.												
-54.00	90				21	23 35 50/4"	85/ 10"	80							Sampler advanced 16 in.
	91														
-56.00	92														
	93														
-58.00	94														
	95		At EL. -59.0 ft, becomes dense.		22	12 18 31	49	90							
-60.00	96														
	97		Bottom of Borehole at 96.5 ft.												
-62.00	98														
	99														
-64.00	100														
	101														
-66.00	102														
	103														
-68.00	104														
	105														
-70.00	106														
	107														
-72.00	108														
	109														
-74.00	110														
	111														
-76.00	112														
	113														
-78.00	114														
	115														

URS BORING RECORD 200802 28645097-OLD REDWOOD HIGHWAY INTERCHANGE.GPJ SNJ_CT.GLB 12/21/09

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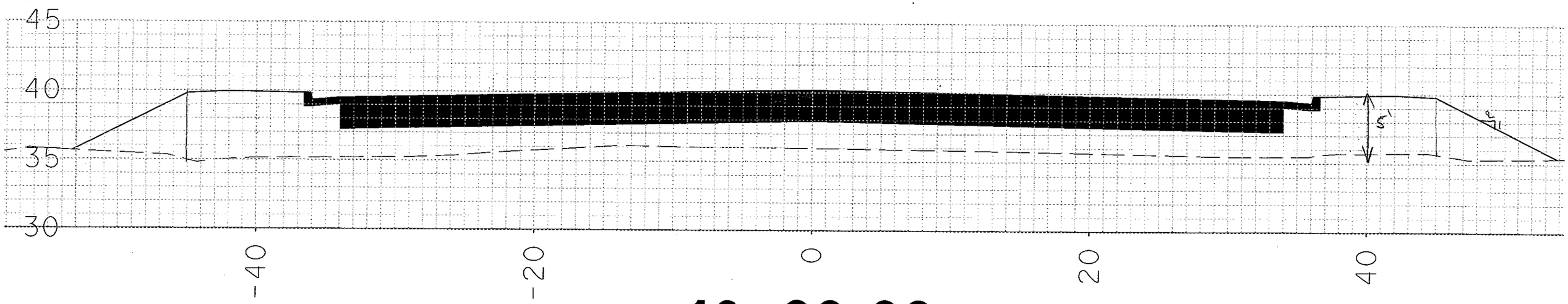
San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**R-09-001**
DIST. **04**	COUNTY **Sonoma**	ROUTE **101**	POSTMILE **7.4/8.1**	EA **04-12276K**
PROJECT OR BRIDGE NAME **Old Redwood Highway Intechange (28645097)**				
BRIDGE NUMBER	PREPARED BY **M. Thummaluru**	DATE **11-2-09**	SHEET **4 of 4**	



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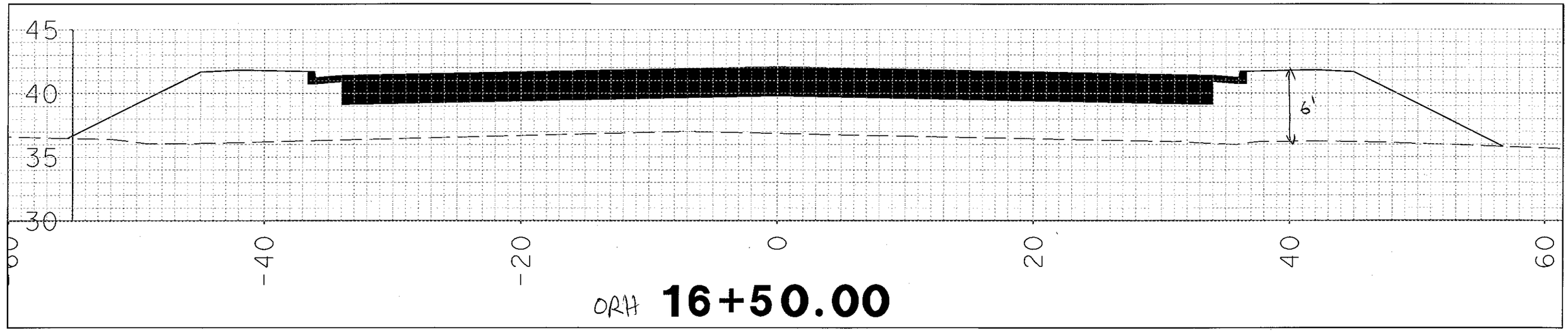

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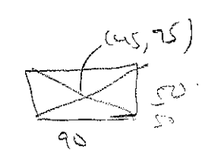

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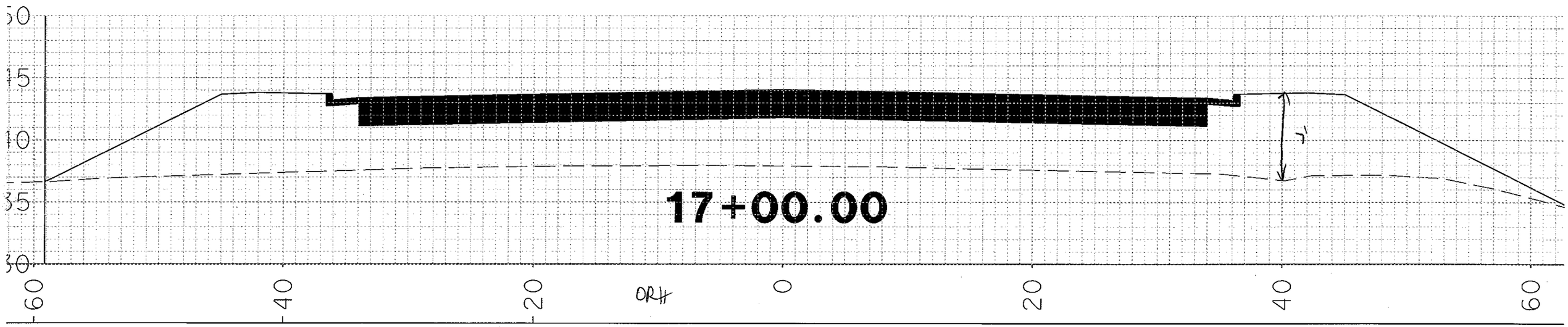

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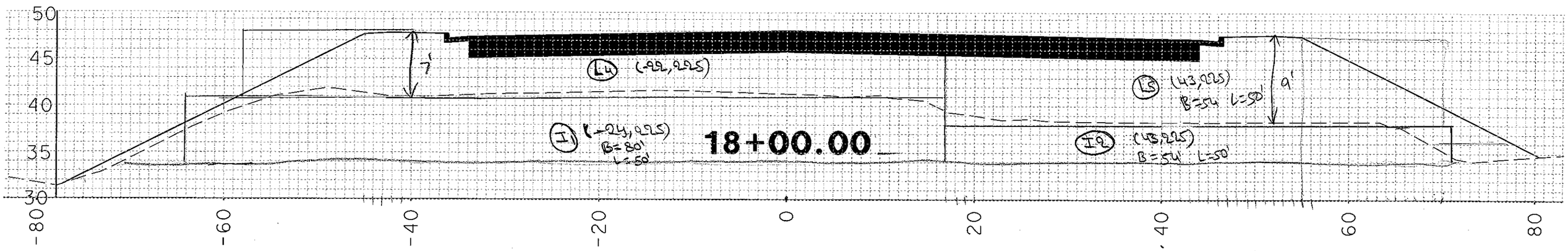

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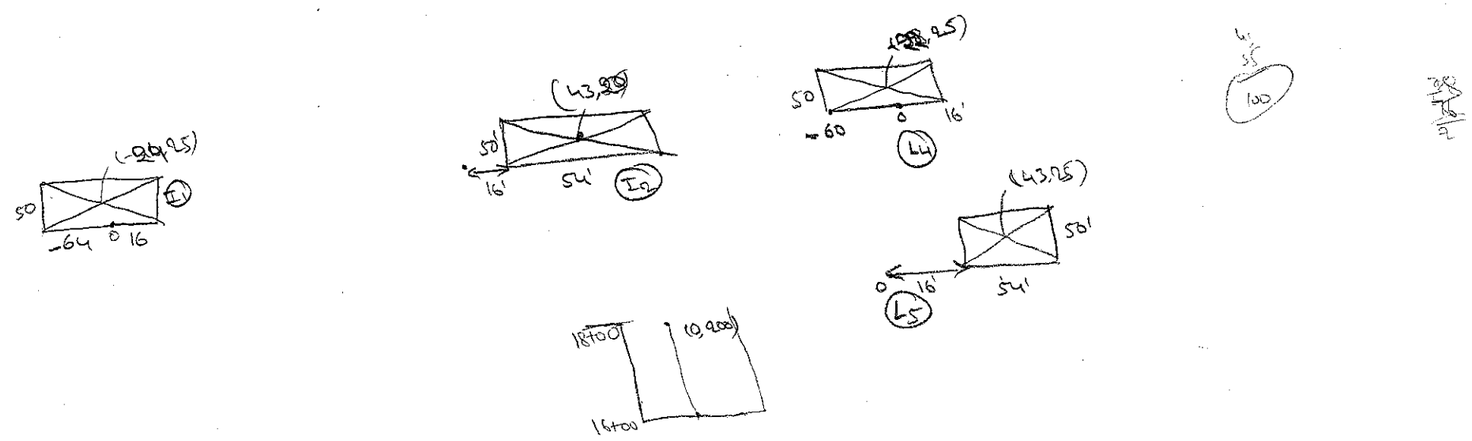

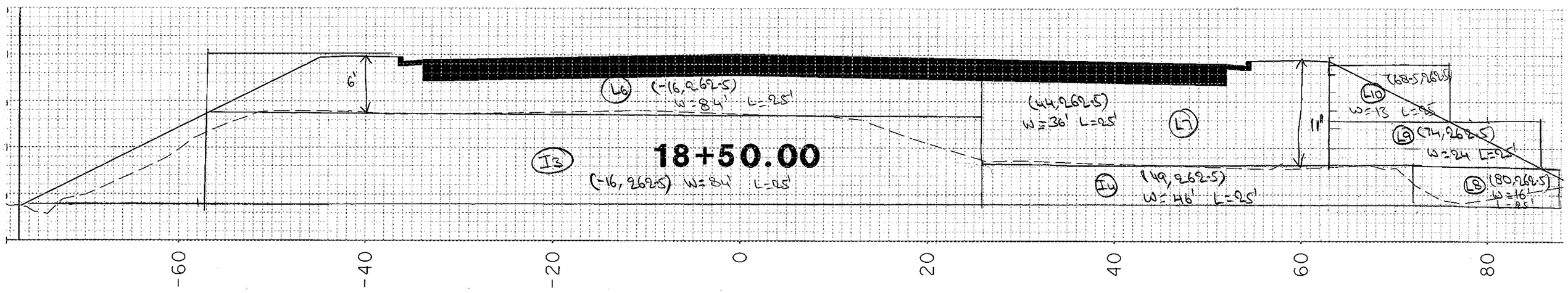

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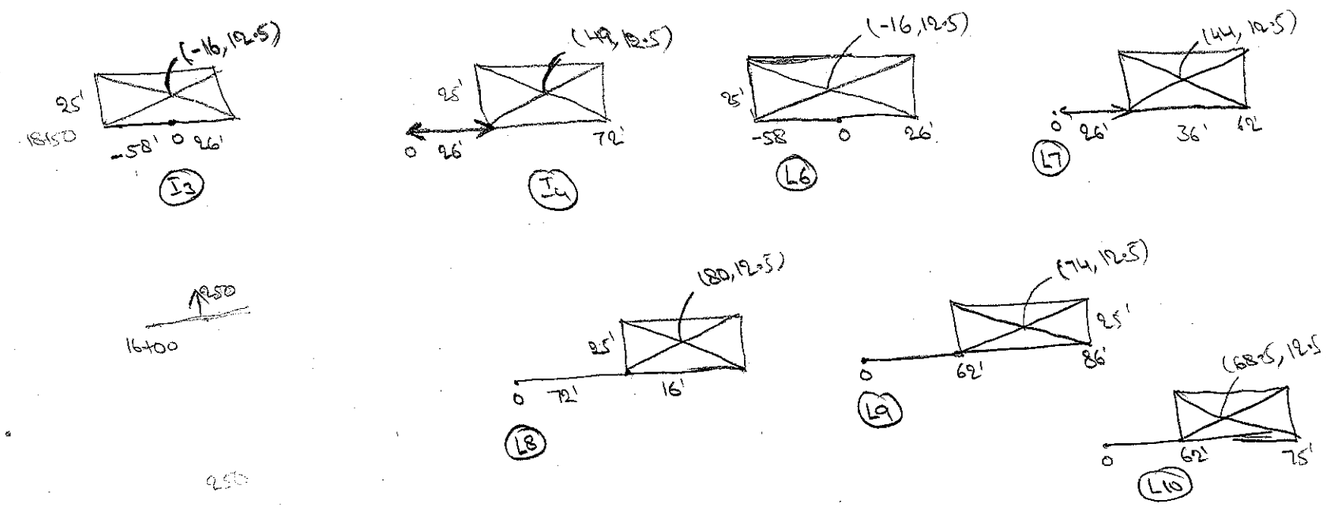

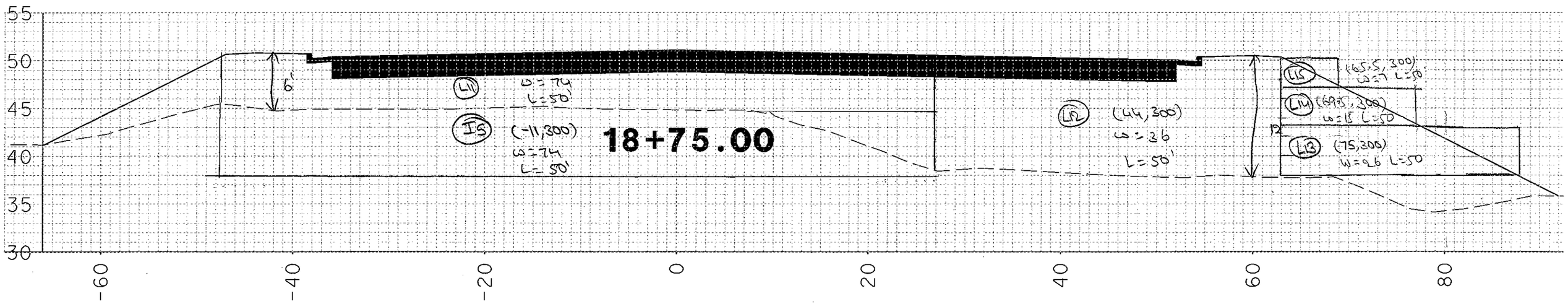

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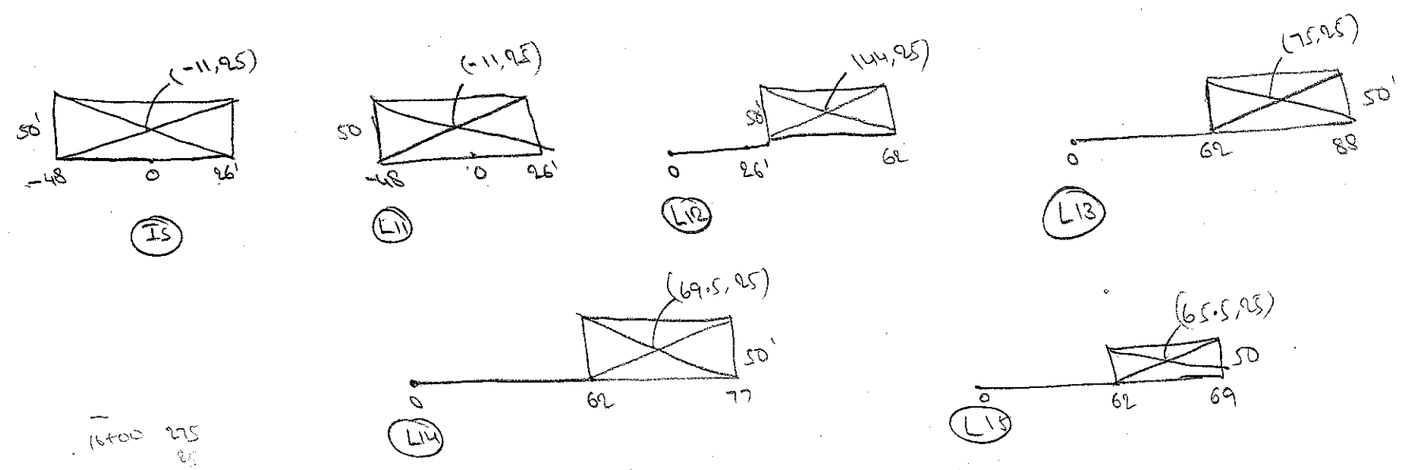

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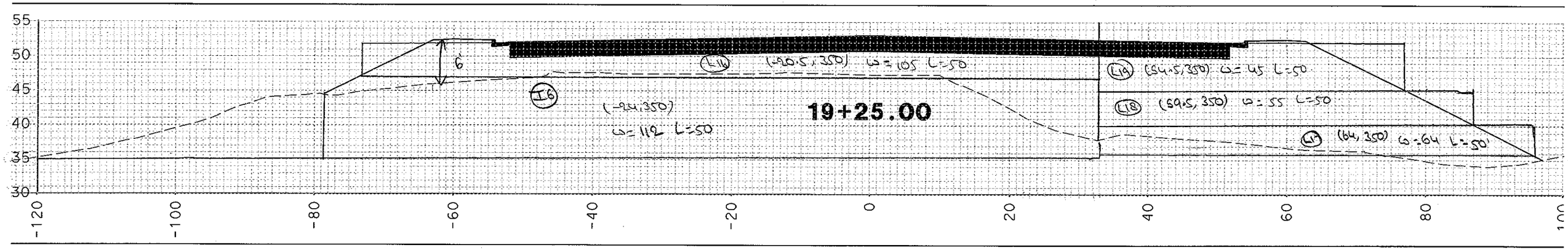

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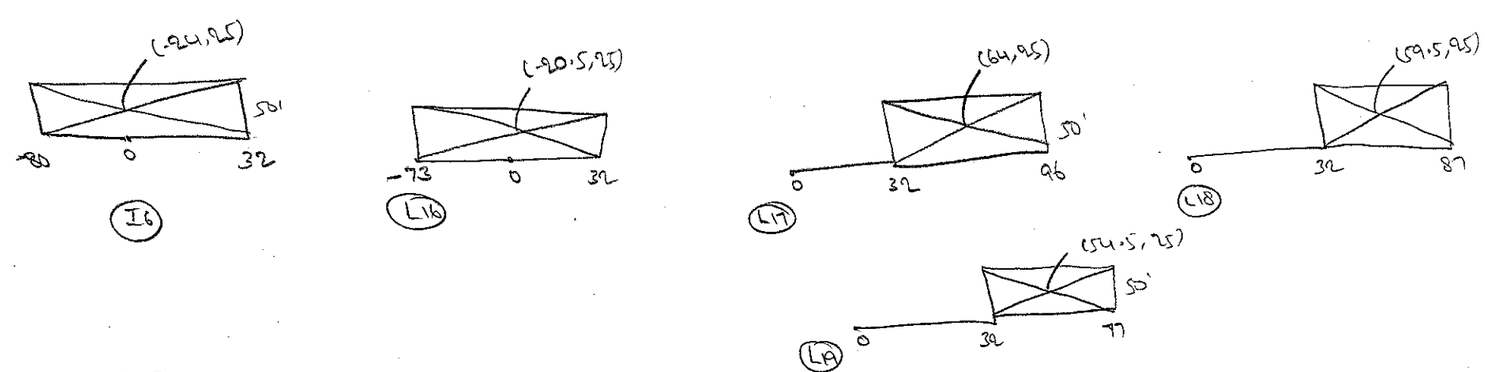

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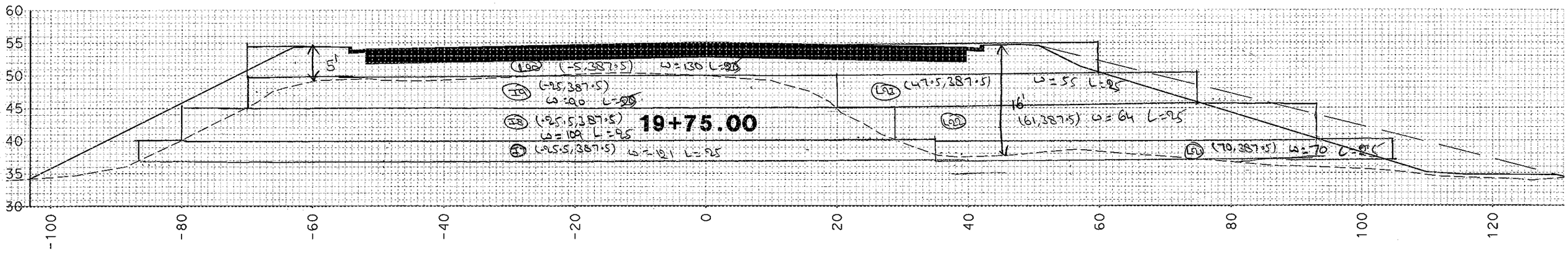

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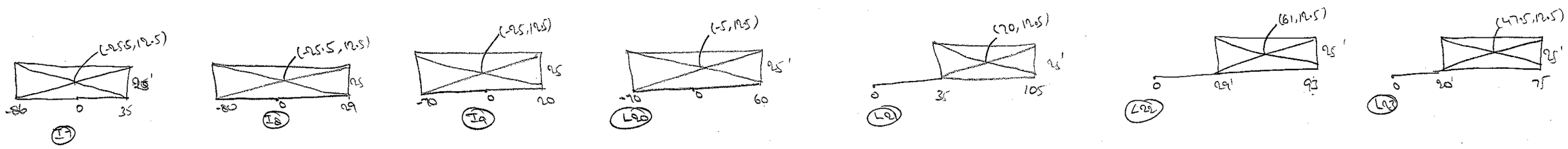

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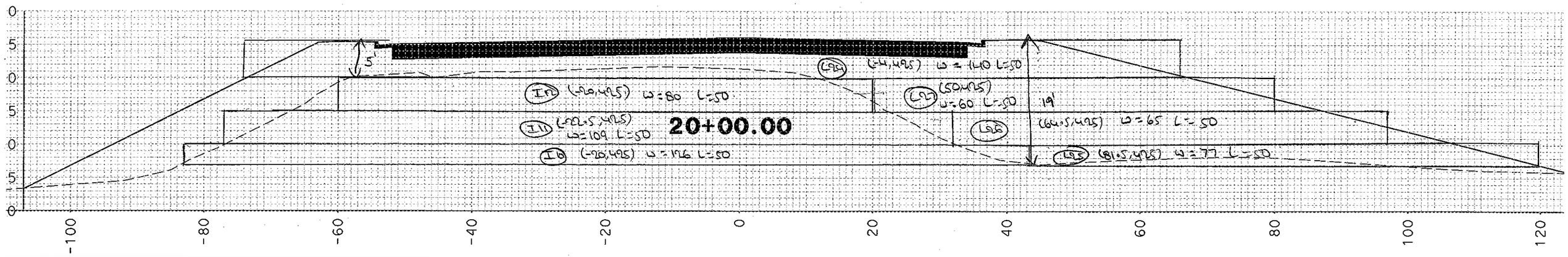

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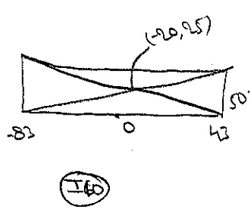

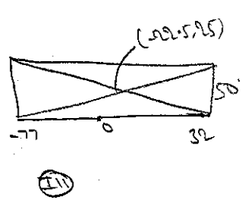

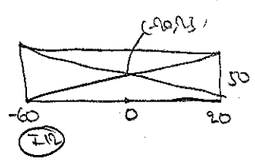

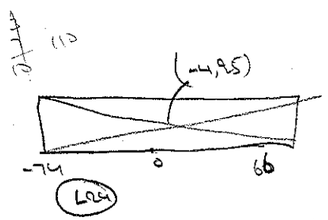

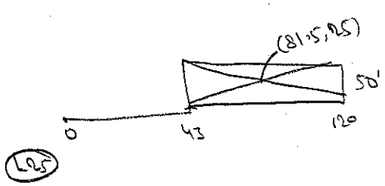

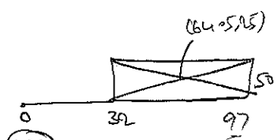

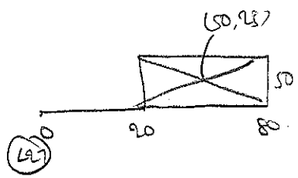

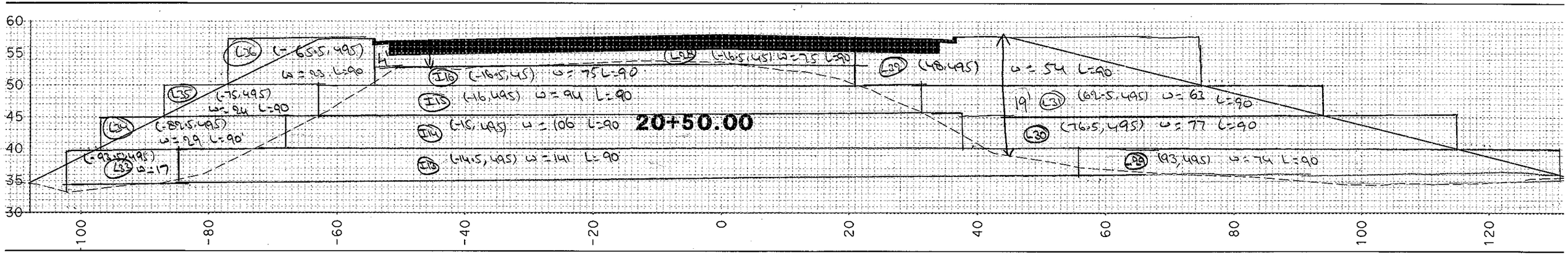

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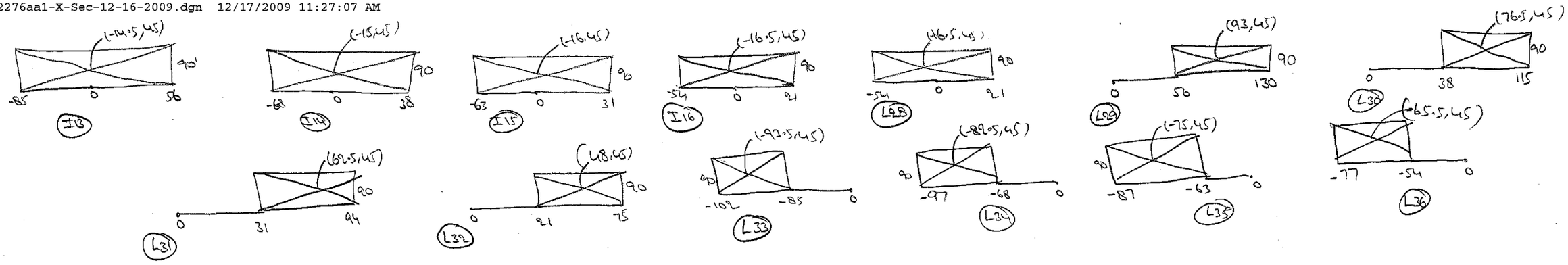

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			By:	Name	

Geotech & Materials Report Review Comments

TECHNICAL REVIEW COMMENTS AND RESPONSES
Independent Technical Review Comments, 4/21/10

Title: **Son 101 Central HOV Lanes Project - Phase C** | Submittal: **Geotech and Materials Review Comments**

CODE: A-Will Comply; B-Consultant to Evaluate; C-Will Not Incorporate; D-Agency to Evaluate; E-No Action Required

		Geotech & Material Report comments	Design		
No.	**Functional Unit**	**Review Comments**	**Design Responses**	**Proposed Action:**	**Final Action :**
	Materials Branch				
		1. In Section 2.1 "Original Construction": Include Caltrans terminology abbreviation definitions for OGFC (Open Graded Friction Course) and RHMA-G (Rubberized Hot Mix Asphalt-Type G).	Will comply.	**A**	
		2. In Section 3.1 "Field Exploration": In the 4th sentence "...depths of 30 to 26 1/2…" insert "feet" to define the measurement increment. Though mentioned in Section 3.1 there does not appear to be a "Table 3-1" showing Summary Of Laboratory Test Results.	Will add depth measurement increment to clarify. Because of the size of Table 3-1, two separate 11x17 inch sheets have been included in the “Table Section” (after the Table tab).	**A** **E**	
		3. In Section 5.1.1 "Traffic Data": Are the Traffic Index's (T.I.'s) given for the ORH On-Off Ramps and Old Redwood Highway valid per traffic counts at the site specific locations, and if so have they been evaluated as currently up-to-date?	The TI for on-off ramps are based on July 1, 2008 Highway Design Manual for medium traffic classification with a 20-year design life.	**E**	

		4. Section 5.3.2 "Recommended Mainline Sections for U.S 101 at ORH": Should LCB be the base to use for the proposed new 101 Mainline sections at the ORH? The pavement structural section shows using Aggregate Base (AB). The use of LCB base for the 101 mainline should be consistent with the upcoming 101 Mainline HOV lane widening project (EA 1A1841), which is within the same project limits. Also in Section 5.3.2 the proposed new pavement structural section for the 101 Mainline at the ORH appears to be under designed showing an AB thickness of 0.65'. The Gravel Equivalent (0.24') for AB is also shown incorrect; should it be 1.24'.	Concur that U.S. 101 mainline section should match. Will revise report.	**A**	
		5. In Section 9.2.4 "Standard Special Provisions-Aggregate Subbase (AS)": In the last paragraph the Sand Equivalent and Resistance (R-value) requirements should be "Operating Range" and "Contract Compliance" not, respectively, "Moving Average" and "Individual Test Results" as now shown.	Will update corresponding Standard Special Provisions.	**A**	
	Geotech Branch	Table 6-1 shows the estimated amount of 90% consolidation settlement as high as 4.5 inches due to the proposed fills up to 25 ft high. Based on the Plan Sheets DP-2 and DP-3, there are proposed 18 inches and 24 inches diameter APC under these fills as part of drainage systems 4, 7, and 8. If the original ground settles as a result of the proposed fill, the differential settlements will crack the proposed culverts leading to over-saturation of the foundation soil and future pavement settlement. This issue should be discussed in the GDR	Concur that post-construction settlement should be minimized in order to reduce potential for damages to pipelines. Alternatives including settlement period with monitoring followed with pipe jacking installation method; it should be further evaluated with the design team. Will include discussion of potential impact and mitigation alternatives.	**A**	

			By:	Evalyn Seidman
65% PS&E Submittal Review Comments2nd				
TECHNICAL REVIEW COMMENTS AND RESPONSES **Independent Technical Review Comments,**				
Title: **Son 101 Central HOV Lanes Project - Phase C**		Submittal: **65% PSE Comments 12-15-2010**		
CODE: A-Will Comply; B-Consultant to Evaluate; C-Will Not Incorporate; D-Agency to Evaluate; E-No Action Required				
		PS&E COMMENTS	Design		
No.	**Functional Unit**	**Review Comments**	**Design Responses**	**Proposed Action:**	**Final Action:**
1	GDR/MR	Page 6-2 refers to an example of a 10-high surcharge, which reduces the settlement period to less than a month. Does this apply to all of the proposed fills listed on this page? We recommend adding another column to Table 6-1 showing corresponding settlement periods for the proposed 5'-high and 10'-high surcharges, so that construction chooses appropriate amount of surcharge according to their time schedule.	Will revise Section 6 to include the settlement periods for 5 and 10 feet high surcharges.	**A**	**A**
2	GDR/MR	Page 6-2 recommends the settlements of the proposed fills be monitored. Specify the number of monitoring devices and the locations (Stations and offsets) where the proposed fills should be monitored.	Will revise Section 6 to include the station and offset of recommended settlement monitoring devices.	**A**	**A**

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1	41	153

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PLANS APPROVAL DATE

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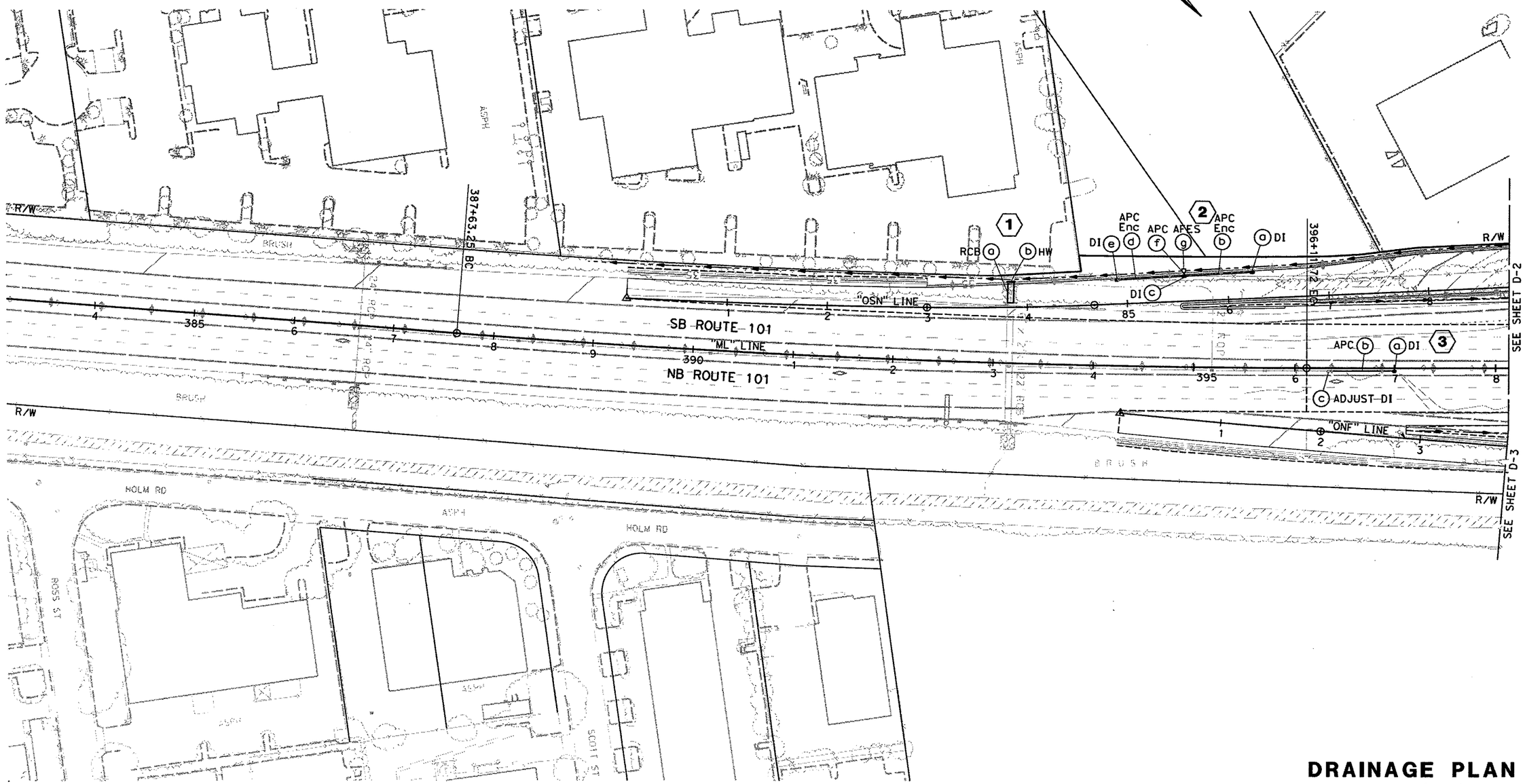

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DRAINAGE PLAN

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D-1

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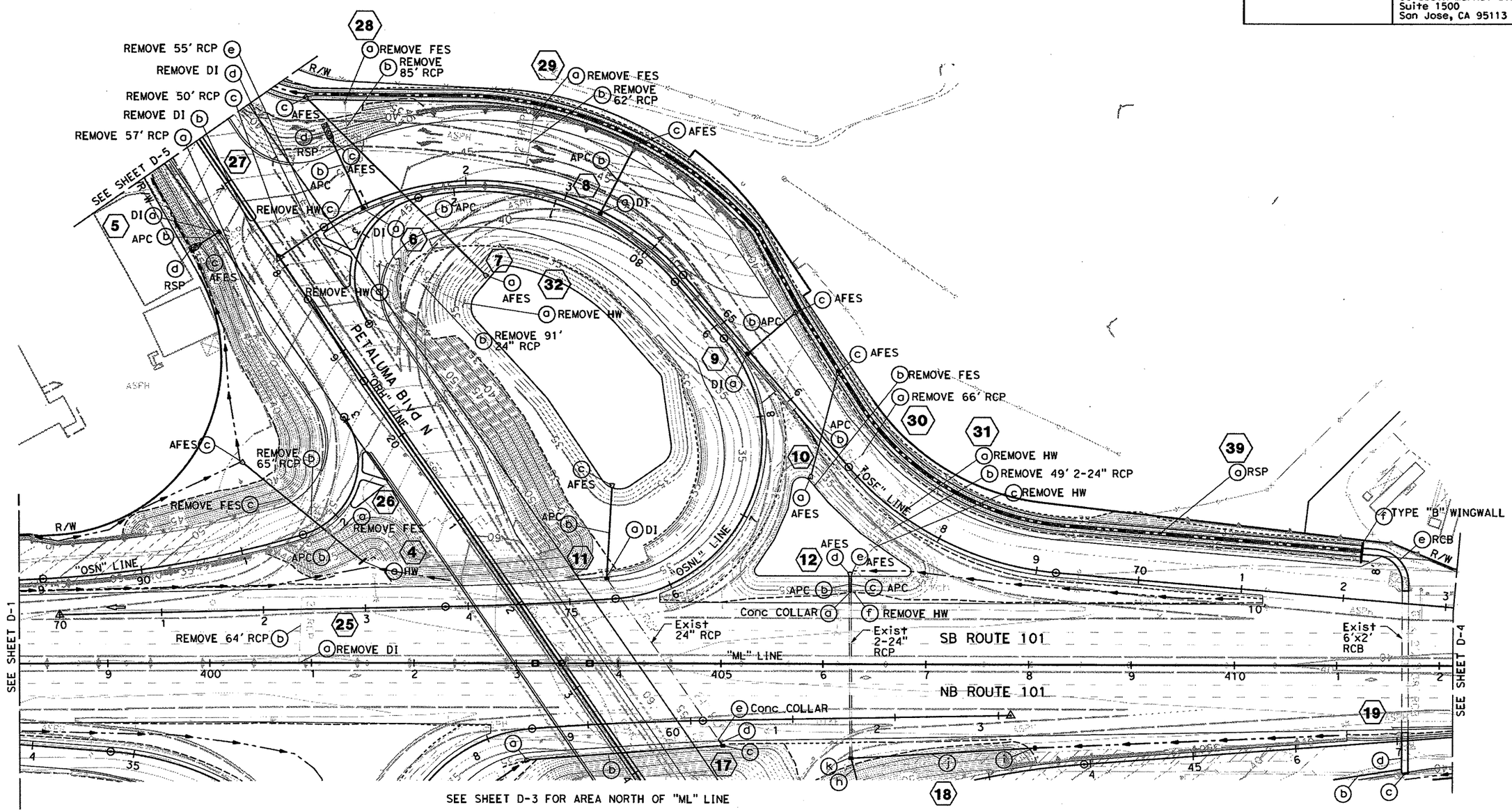

DRAINAGE PLAN

SCALE: 1"=50'

D-2

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EA 04-0A1851

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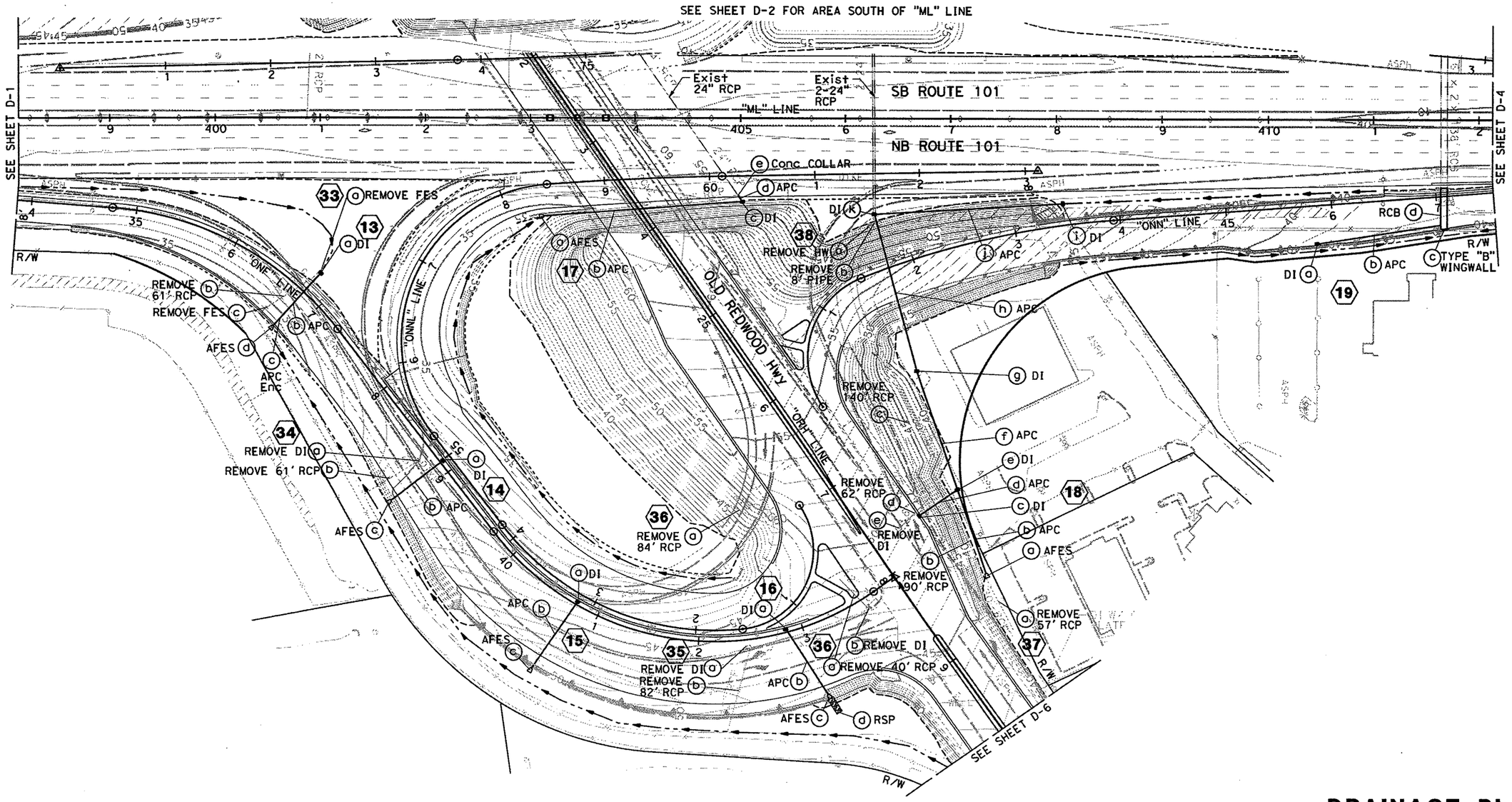

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D-3

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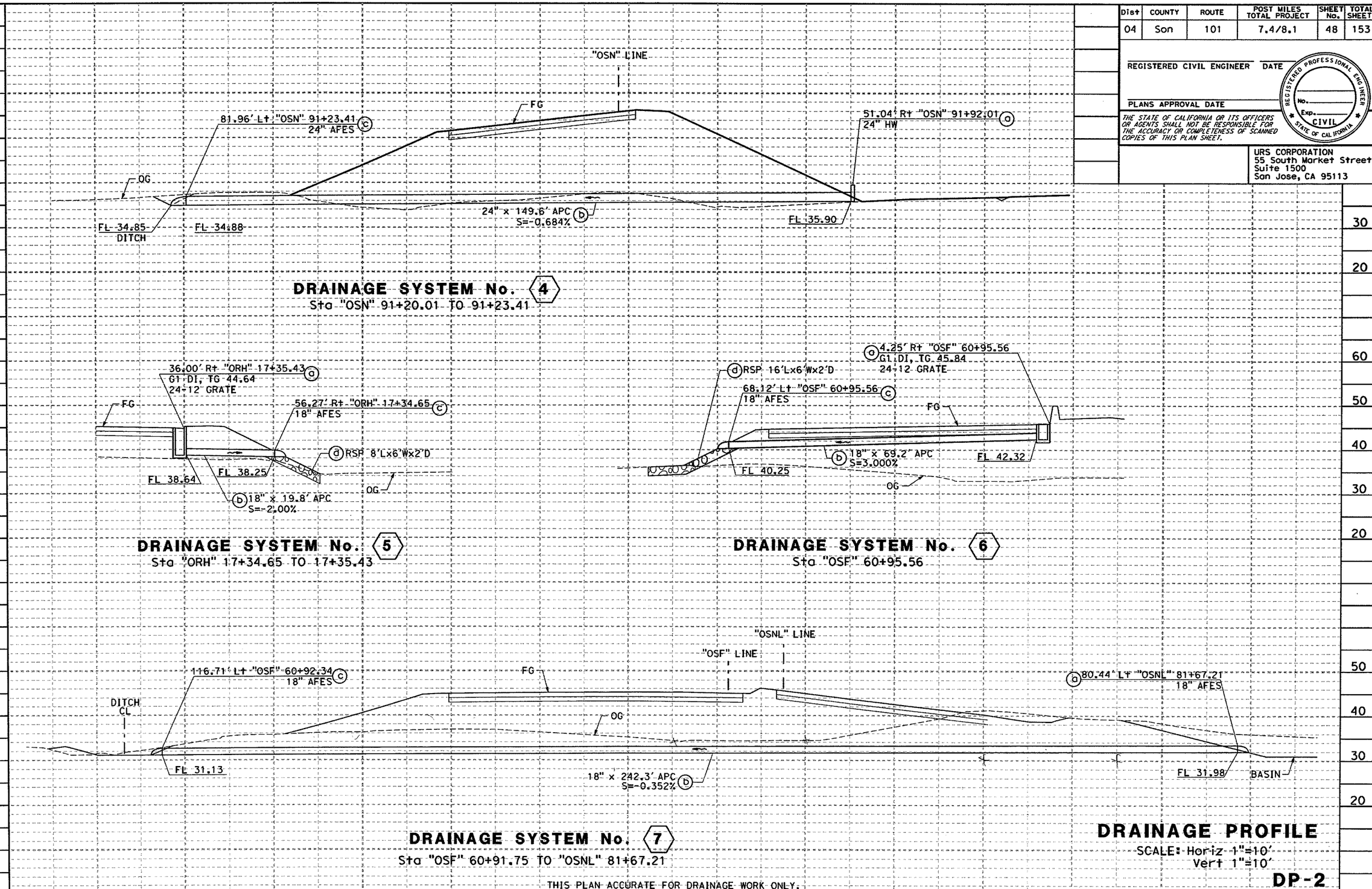

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DRAINAGE PROFILE

SCALE: Horiz 1"=10'
Vert 1"=10'

DP-2

STATION		TOTAL
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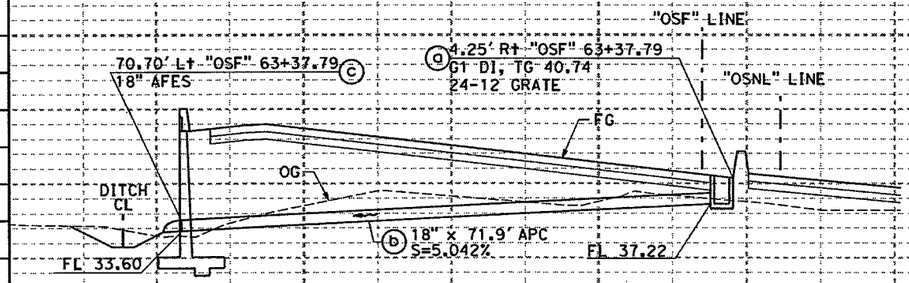

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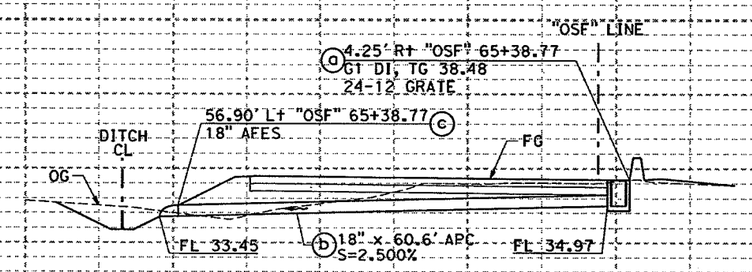

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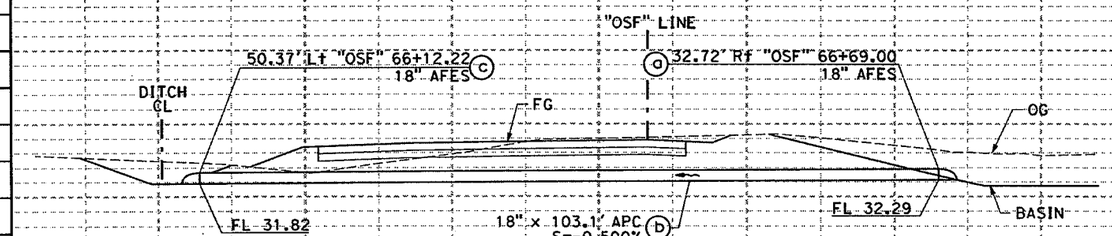

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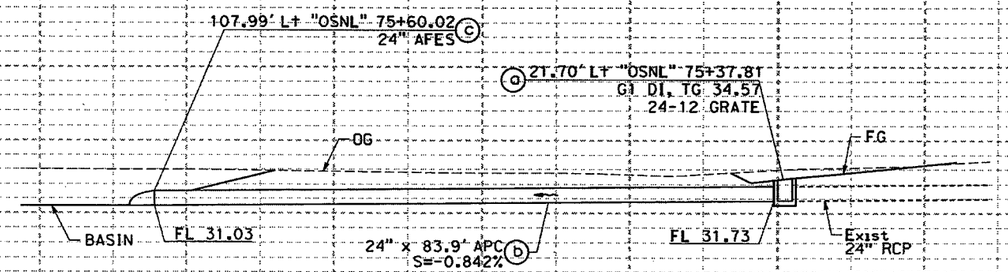

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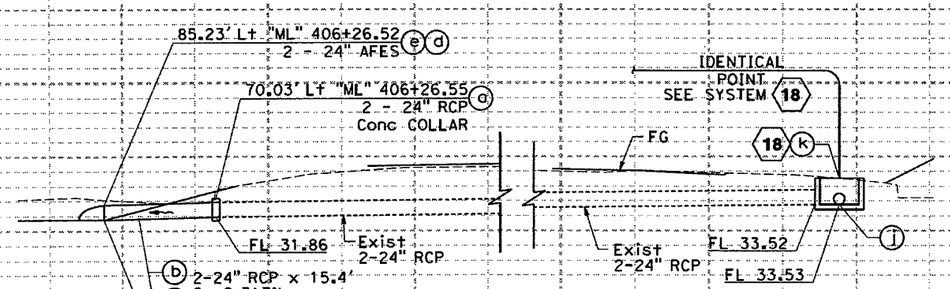

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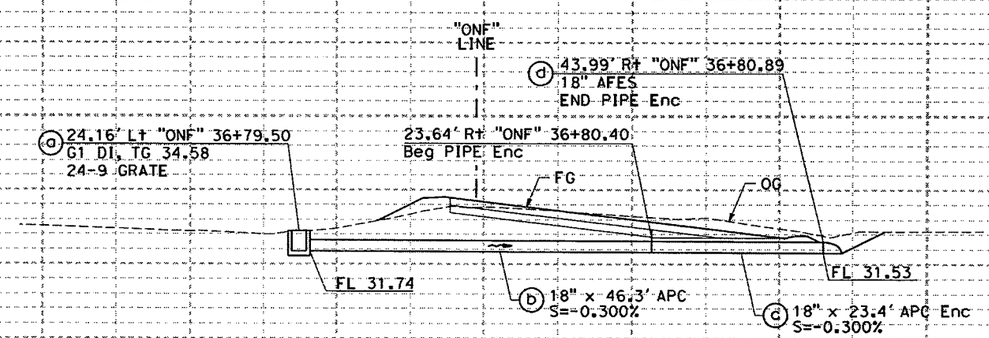

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DP-3

STATION		TOTAL
CY	Exc	
	Emb	

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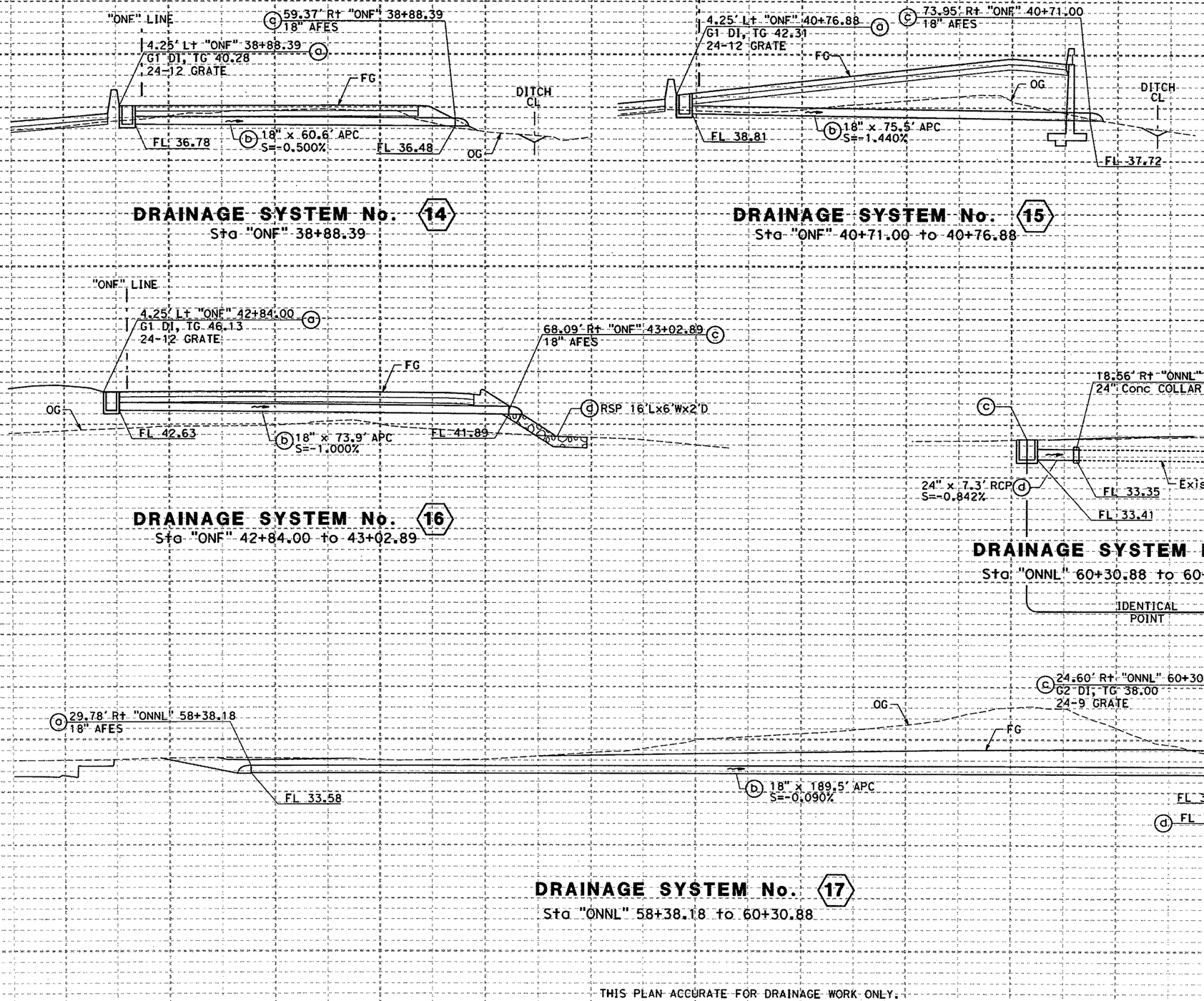

DRAINAGE PROFILE

SCALE: Horiz 1"=10'
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DP-4

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STATION	
CY	Exc
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TOTAL

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04	Son	101	7.4/8.1	51	153

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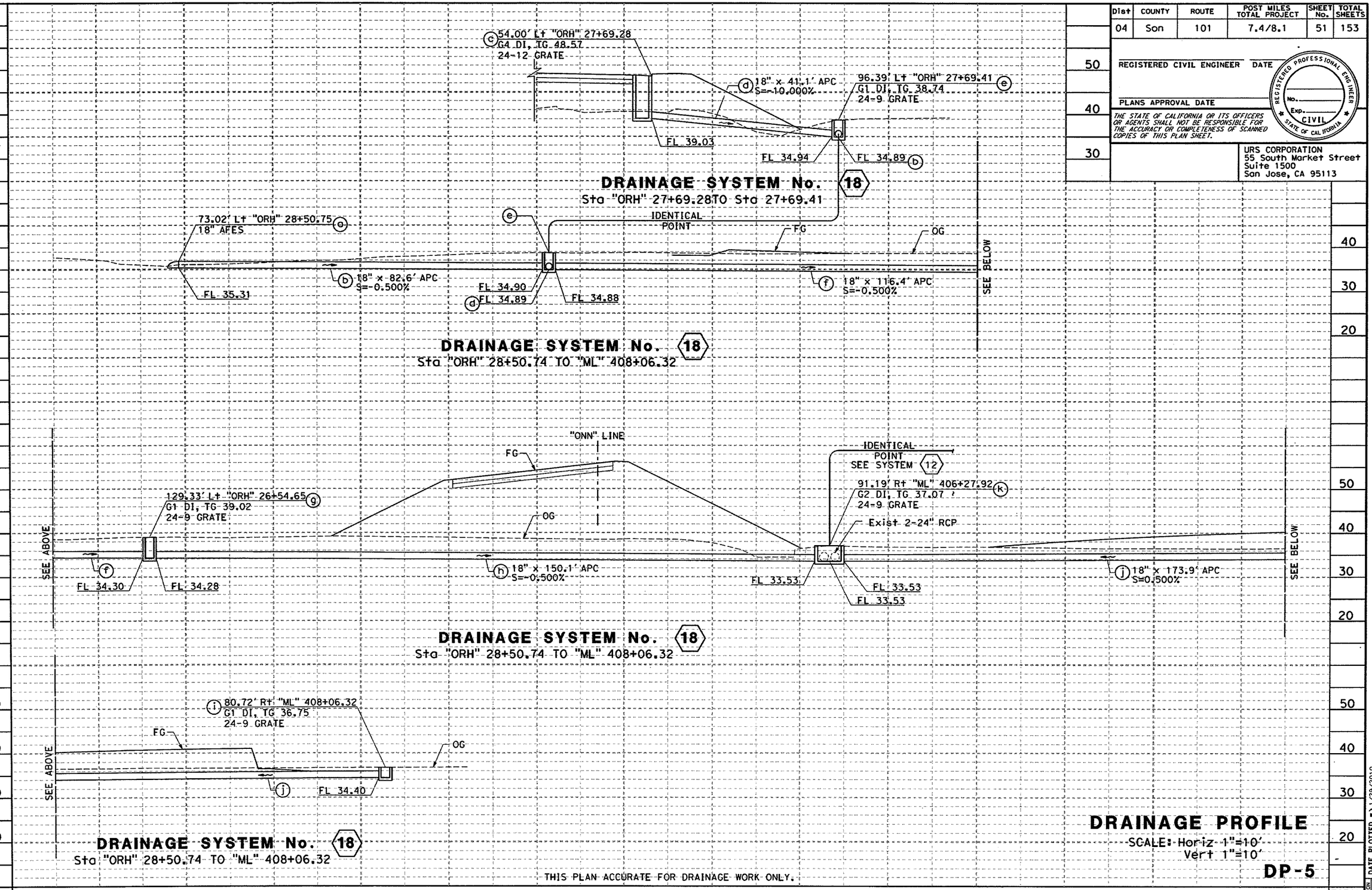

DRAINAGE PROFILE

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DP-5

STATION		TOTAL
CY	Exc	
	Emb	

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04	Son	101	7.4/8.1	52	153

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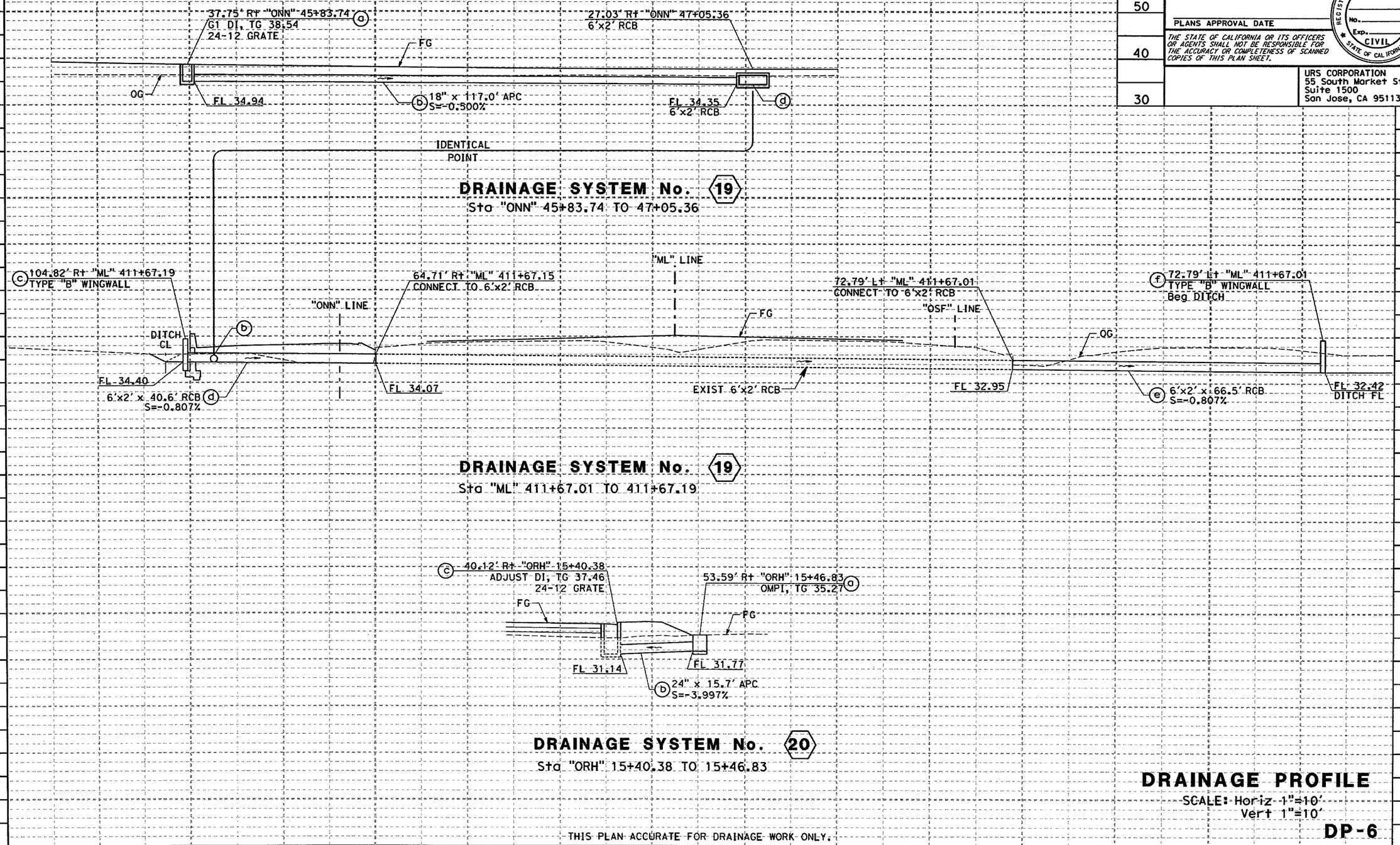

DRAINAGE PROFILE

SCALE: Horiz 1"=10'
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DP-6

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STATION		
CY	Exc	
	Emb	

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US 101 CITY OF PETALUMA OLD REDWOOD HIGHWAY OVERCROSSING PROJECT

IN PETALUMA FROM POST MILE 7.4 AT STATION 377+00 TO POST MILE 8.1 AT POST MILE 439+00 ON US 101

MATERIALS REPORT

Prepared for

URS

Prepared by

V&A

March 2010

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APPENDICES

Appendix A: Soil Laboratory Chemical Analysis Results
Appendix B: Culvert Service Design Estimates
Appendix C: Alternative Pipe Material Selection

EXECUTIVE SUMMARY

The City of Petaluma, located in Sonoma County, CA, is proposing to modify the overcrossing at the Old Redwood Highway at US 101 Interchange. In addition to the Interchange, this project will construct new retaining walls, a soundwall and will extend the existing box culverts within the project limits from Post Mile 7.4 to Post Mile 8.1 on US 101 north of Petaluma River.

V&A was retained by the project designer, URS, to perform a soil corrosivity evaluation within the project limits with regards to the construction materials to be selected. V&A performed in-situ soil resistivity testing and interpreted the field data collected. In addition, V&A interpreted the corrosivity test results on selected boring samples from the analytical lab analysis performed by Cooper Testing Laboratory in Palo Alto, CA. The report includes the field data collected, the test methods used to perform the in-situ soil resistivity testing, laboratory analysis and lab test results, and the analysis of the tests performed.

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, and CALTRANS Memo to Designers 3-1, July 2008 (Memo). Based on the results obtained, and according to the Guidelines and Memo, the soil samples tested are considered to be *non-corrosive to* reinforced concrete structures and steel piles. This conclusion is made based on the values of minimum soil resistivity, pH, sulfates and chlorides.

The results of the minimum soil resistivity of the five boring samples indicate that soil resistivity is well below 1,000 ohm-cm. According to both the Guidelines and Memo, a site is considered corrosive if the soil's minimum resistivity is less than 1,000 ohm-cm and either contains a chloride concentration of 500 ppm or greater, or a sulfate concentration of 2,000 ppm or greater. Therefore, the soils tested at the five locations are considered *non-corrosive*, regardless of the very low soil resistivity test result.

Alternative pipe materials were selected using the Department of Transportation Altpipe Software Version 6.09. The software calculates Maintenance-Free Service Design Estimates using California Department of Transportation (Caltrans) criteria (see Appendices B and C). The program Altpipe does not recommend usage of aluminum pipes and/or aluminized steel pipes due to low minimum soil resistivities.

Based on the findings, the Guidelines and the Memo, this report makes recommendations for the following:

- Buried Reinforced Concrete Structures and Cast-in-Place Piles
- Prestressed Concrete Piles
- Cast-In-Drilled Hole (CIDH) Piles
- Culvert, Mechanically stabilized embankment and metallic soil reinforcement backfill
- Alternative pipe material selection

INTRODUCTION

V&A was retained by URS Corporation to perform a soil corrosivity Investigation for the proposed US 101 City of Petaluma, Old Redwood Highway Overcrossing Project. This project runs from Post Mile 7.4 at Station 377+00 to Post Mile 8.1 at Station 8.1 on US 101 in Petaluma, CA (Figure 1, Page 3). The objective of this investigation was to measure various soil parameters and evaluate the results in order to determine the corrosivity of the soil to the proposed structures associated with the US 101 City of Petaluma, Old Redwood Highway Interchange Project.

This report provides recommendations for corrosion control for the following:

- Buried Reinforced Concrete Structures and Cast-in-Place Piles
- Prestressed Concrete Piles
- Cast-In-Drilled Hole (CIDH) Piles
- Culvert, Mechanically stabilized embankment and metallic soil reinforcement backfill
- Alternative pipe material selection

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:

- ***Chloride concentration is 500 ppm (mg/kg) or greater***
- ***Sulfate concentration is 2,000 mg/kg or greater***
- ***pH is 5.5 or less***

In addition to the Guidelines, Caltrans Memo to Designers (Memo) 3-1, July 2008, considers a site to be corrosive if:

- ***pH is 5.5 or less, or***
- ***Soil minimum resistivity is less than 1,000 ohm-cm, and***
- ***Chloride concentration is 500 ppm (mg/kg) or greater, or***
- ***Sulfate concentration is 2,000 mg/kg or greater***

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 the eventual disruption of the concrete matrix. High concentrations of bicarbonates tend to decrease soil resistivities. Although bicarbonates are not aggressive to concrete, lower resistivity environments can promote corrosion activity.

Acidity, as indicated by the pH value, is another important factor of soil. The lower the pH (the more acidic the environment), the higher the corrosivity will be 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 due to corrosion. Soil resistivity measurements were conducted in the field during the initial stages of the project. In addition, soil samples, collected by URS during the geotechnical investigation were forwarded to Cooper Testing Laboratory in Palo Alto, CA, for chemical analysis (Appendix A). The soil borings were analyzed for minimum resistivity, pH, water soluble chloride ion concentration and water soluble sulfate ion concentration, in accordance with the Guidelines.

The pH of the soil samples analyzed ranged from 7.3 to 8.6. The water soluble chloride ion concentration of the soil borings analyzed ranged from below the minimum detection level of 2 milligrams per kilogram (mg/kg) to 333 mg/kg. The water soluble sulfate ion concentration of the soil borings analyzed ranged from below the minimum detection level of 5 mg/kg to 262 mg/kg.

Based on the results of the corrosion analysis, the site is considered *non-corrosiv*e to concrete structures.

TEST METHODS

In attempting to predict 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 when evaluating corrosivity. 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 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 concrete. 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. Acidic (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.

In-Situ Soil Resistivity

Resistivity of the soil was measured at 12 locations on the project alignment (Table 1). Figure 2 shows the field soil resistivity testing locations and soil boring locations.

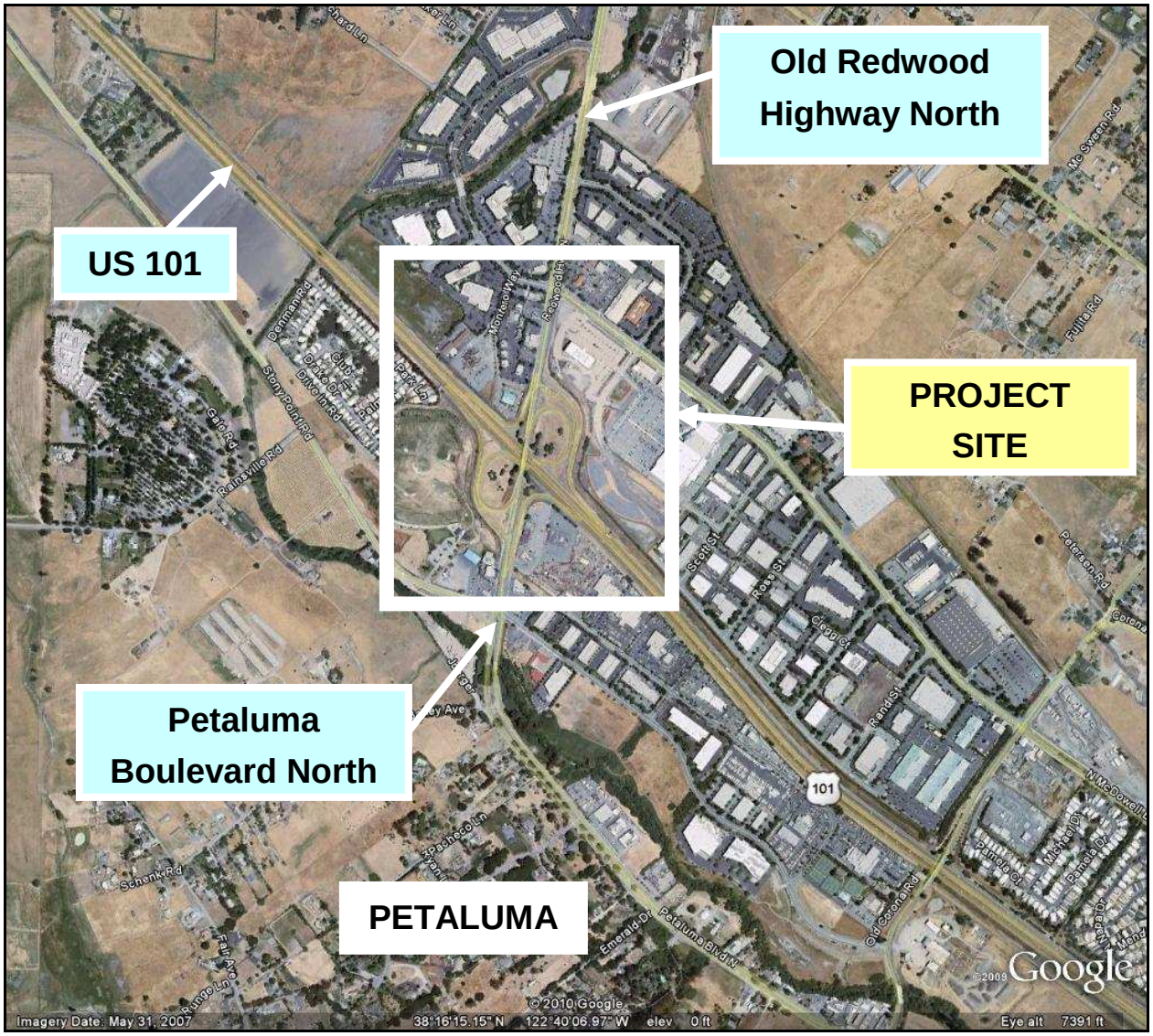


Figure 1. Vicinity and Project Site Map[1]

[1] Maps courtesy of the Google

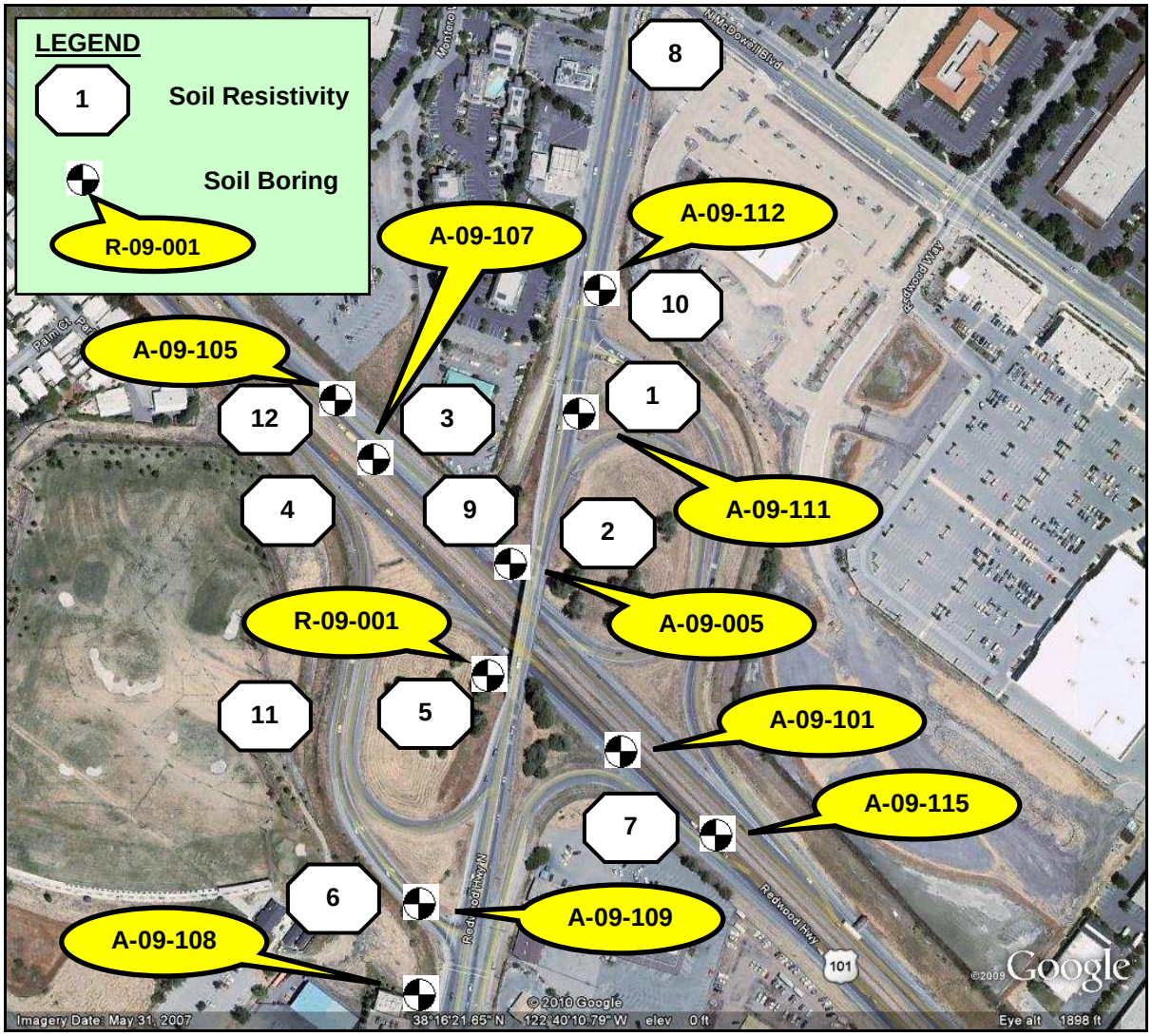


Figure 2. In-Situ Resistivity Testing and Soil Boring Locations

In-situ soil resistivity was measured using the Wenner 4-Electrode (Wenner) Method, with a DIGITAL GROUND RESISTANCE TESTER, Model 4500, manufactured by AEMC. The Wenner Method involves the use of four metal probes or electrodes, driven into the ground along a straight line, equidistant from each other, as shown in Figure 3.

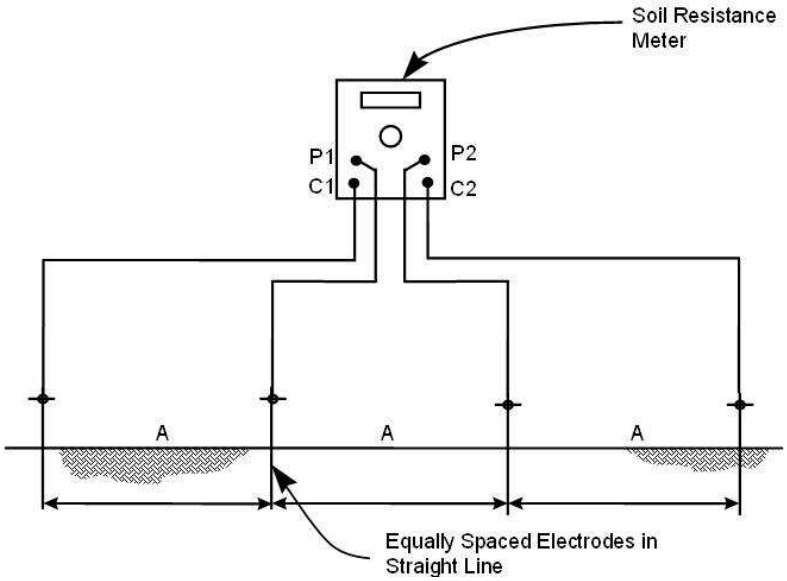


Figure 3. In-Situ Soil Resistivity Measurement

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 probes. The voltage drop is then measured across electrodes P1 and P2. Resistivity of the soil is computed from the instrument reading according to the following formula:

$$\rho = 2 \cdot \pi \cdot A \cdot R$$

Where:

ρ	=	soil resistivity (ohm-cm)
A	=	distance between electrodes (cm)
R	=	soil resistance, instrument reading (ohms)
π	=	3.14 (approx.)

Soil resistance is measured with electrodes spaced 0.8, 1.5, 2.3, 3.1, 4.6, 7.6, 15.2, 23.0 and 30.5 meters (2.5, 5, 7.5, 10, 15, 25, 50, 75 and 100 feet) apart. Resistivity values obtained represent the average resistivity of the soil to a depth equal to the electrode spacing. An additional method of calculating the soil resistivity using the data from the Wenner Method is the Barnes-Layer resistivity calculation. The Barnes Layer calculation is used to determine the resistivity of the soil for each soil layer. While the Wenner Method at 3.1 meters will consider all 3.1 meters of soil below the surface, the Barnes-Layer method will only consider the resistivity of the layer of soil between 2.3 meters and 3.1 meters below the surface. This method assumes the soil layers are of a uniform thickness and are parallel to the surface, which may not always be true.

$\rho_{b-a} = KR_{b-a}$ 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 (cm)
K	=	2 π (b-a)

Barnes Layer resistivity is calculated for layers 0 to 0.8, 0.8 to 1.5, 1.5 to 2.3, 2.3 to 3, 3 to 4.6, 4.6 to 9.1, 9.1 to 13.7, 13.7 to 18.3, and 18.3 to 24.4 meters (0 to 2.5, 2.5 to 5, 5 to 10, 10 to 15, 15 to 30, 30 to 45, 45 to 60, and 60 to 80 feet) below grade.

Laboratory Analysis of Soil and Water

To supplement the resistivity data obtained during field testing, soil samples from the project site were obtained from URS. The soil samples, along with water samples collected by V&A, were forwarded to Cooper Testing Laboratory in Palo Alto, CA, for testing. The samples were tested for pH, minimum (saturated) resistivity and water soluble chloride and sulfate ion concentrations.

TEST RESULTS AND DISCUSSION

Data obtained during this investigation has been summarized in tabular form for analysis and presentation. Table 1 lists the results of the field soil resistivity measurements conducted at the site. Table 2 lists the minimum soil resistivity for each sample collected as well as the chemical analysis of the samples.

In-Situ Soil Resistivity

Since corrosion is a natural electrochemical process accompanied by the flow of electrical current, it is important to understand how easily current will travel through the soil surrounding steel or steel reinforced concrete structure. Resistivity is a measure of the ability of a soil to conduct an electric current. Soil resistivity is primarily dependent on the chemical and moisture content of the soil. As the concentrations of chemical constituents increase, the soil resistivity will decrease. Additional moisture generally decreases the soil resistivity up to the point where the maximum solubility for the dissolved ionic chemicals is achieved. Beyond the maximum solubility, an increase in moisture generally increases the resistivity as the chemicals become more and more diluted. Since corrosion rate depends on current flow through the soil to and from the metal, soil corrosivity normally increases as soil resistivity decreases.

Table 1.
In-Situ Soil Resistivity Data

Site*	Depth (Meters)	Resistivity (ohm-cm)	Layer Resistivity (ohm-cm)	Layer (Meters)
1	0.8	2,174		0-0.8
	1.5	1,368	998	0.8-1.5
	2.3	868	501	1.5-2.3
	3.1	820	703	2.3-3.1
	4.6	1,100	3,488	3.1-4.6
2	0.8	883		0-0.8
	1.5	568	418	0.8-1.5
	2.3	463	337	1.5-2.3
	3.1	557	1,477	2.3-3.1
	4.6	853	13,793	3.1-4.6
	7.6	1,494	11,831	4.6-7.6
	15.2	2,107	3,572	7.6-15.2
	23.0	2,672	5,762	15.2-23.0
	30.5	3,217	8,312	23.0-30.5
3	0.8	1,369		0-0.8
	1.5	600	384	0.8-1.5
	2.3	485	351	1.5-2.3
	3.1	529	720	2.3-3.1
	4.6	804	18,500	3.1-4.6
4	0.8	686		0-0.8
	1.5	632	586	0.8-1.5
	2.3	567	471	1.5-2.3
	3.1	693	2,075	2.3-3.1
	4.6	1,066	14,289	3.1-4.6
5	0.8	748		0-0.8
	1.5	548	432	0.8-1.5
	2.3	412	276	1.5-2.3
	3.1	458	684	2.3-3.1
	4.6	623	2,257	3.1-4.6
	7.6	1,235	2,615	4.6-7.6
	15.2	2,030	5,693	7.6-15.2
	23.0	2,844	14,355	15.2-23.0
	30.5	3,658	25,866	23.0-30.5

*See Figure 2

Table 1.
In-Situ Soil Resistivity Data (Cont.)

Site*	Depth (Meters)	Resistivity (ohm-cm)	Layer Resistivity (ohm-cm)	Layer (Meters)
6	0.8	677		0-0.8
	1.5	574	497	0.8-1.5
	2.3	487	374	1.5-2.3
	3.1	553	938	2.3-3.1
	4.6	822	26,382	3.1-4.6
7	0.8	1,159		0-0.8
	1.5	579	386	0.8-1.5
	2.3	450	310	1.5-2.3
	3.1	471	550	2.3-3.1
	4.6	712	29,209	3.1-4.6
8	0.8	4,084		0-0.8
	1.5	2,145	1,454	0.8-1.5
	2.3	773	339	1.5-2.3
	3.1	688	517	2.3-3.1
	4.6	868	1,821	3.1-4.6
9	0.8	1,211		0-0.8
	1.5	709	501	0.8-1.5
	2.3	589	440	1.5-2.3
	3.1	659	1.023	2.3-3.1
	4.6	750	1.036	3.1-4.6
10	0.8	952		0-0.8
	1.5	776	654	0.8-1.5
	2.3	712	613	1.5-2.3
	3.1	795	1,217	2.3-3.1
	4.6	1,023	2,398	3.1-4.6
11	0.8	673		0-0.8
	1.5	538	448	0.8-1.5
	2.3	587	719	1.5-2.3
	3.1	699	1,624	2.3-3.1
	4.6	893	2,013	3.1-4.6
12	0.8	721		0-0.8
	1.5	590	499	0.8-1.5
	2.3	641	774	1.5-2.3
	3.1	724	1,187	2.3-3.1
	4.6	911	1,881	3.1-4.6

*See Figure 2

Laboratory Analysis of Soil Samples

Table 2 lists the minimum (saturated) soil resistivity for each sample collected, as well as the chemical analysis of the samples.

Based on the corrosion analysis, the soil is classified as *non-corrosive* in accordance with the Guidelines and the Memo.

Table 2.
Minimum (Saturated) Resistivity and Chemical Data

Item No.	Boring No.	Station*	Depth (meters)	Minimum (Saturated) Resistivity (ohm-cm)	Chemical Data		
					pH	Sulfate (mg/kg)**	Chloride (mg/kg)
1	R-09-001	403+71***	24.4 – 25	2,321	7.3	<5	69
2	A-09-005	404+53	7.6 – 8.2	3,934	7.8	<5	19
3	A-09-101	396+50	3.1 – 3.7	635	7.3	262	333
4	A-09-105	411+79	3.1 – 3.7	2,157	8.4	<5	<2
5	A-09-107	410+18	3.1 – 3.7	824	8.1	236	149
6	A-09-108	15+26****	3.1 – 3.7	1,161	7.9	<5	6
7	A-09-109	400+90	1.5 – 2.0	434	7.6	<5	119
8	A-09-111	27+08	2.4 – 3.1	508	8.0	98	59
9	A-09-112	29+21	3.1 – 3.7	787	8.6	<5	<2
10	A-09-115	393+50	3.1 – 3.7	1,104	8.3	<5	15

*Stationing numbers are approximate.
**mg/kg – milligrams per kilogram
***300+00 and 400+00 series on US 101
****10+00 and 20+00 series on Old Redwood Highway Overcrossing

Based on the corrosion analysis, the soil is classified as *non-corrosive* in accordance with the Guidelines and the Memo.

CONCLUSIONS

- The chloride ion concentration of the soil borings analyzed is less than 500 mg/kg.
- The sulfate ion concentration of the soil borings is less than 2,000 mg/kg.
- The soil pH of the soil borings analyzed is greater than 5.5.
- The site is considered *non-corrosive* in accordance with Guidelines and the Memo.
- The project site is not located within 300 meters (1,000 feet) of a salt or brackish water source.

RECOMMENDATIONS

Based on the test data and review of the project requirements, specific recommendations for each material alternative are 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 concrete cover of a minimum 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 are the minimums required by Caltrans Standard Specifications 90-1.01.
- Standard reinforced concrete pipe design should be suitable for this user defined level of chlorides.

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.

Cast-in-Drilled-Hole (CIDH) Piles

Cast-in-drilled-hole (CIDH) concrete piling shall conform to the provisions in Section 49-4, "Cast-In-Place Concrete Piles," of the Standard Specifications and the special provisions.

The concrete used in CIDH piles should be dense and homogeneous throughout the length and cross section of the pile per California Test 233.

Concrete deposited under slurry shall have a nominal slump equal to or greater than 7 inches, shall contain not less than 675 pounds of cementitious material per cubic yard, and shall be proportioned to prevent excessive bleed water and segregation. The nominal and maximum slump and penetration requirements in Section 90-6.06, "Amount of Water and Penetration," of the Standard Specifications shall not apply.

Concrete for portions of CIDH concrete piling to be formed shall contain not less than 675 pounds of cementitious material per cubic yard and shall contain 6.0±1.5 percent air entrainment in the freshly mixed concrete.

Concrete shall conform to the requirements in "Mass Concrete for Cast-in-Place Concrete Piles" of the special provisions.

Culvert, Mechanically Stabilized Embankment and Metallic Soil Reinforcement Backfill

Fast setting concrete backfill may need to be used when placing culverts in existing roadways. When using an admixture to decrease concrete curing times, only non-chloride admixtures should be considered.

Culvert materials were selected using the Department of Transportation AltPipe Software Version 6.09 that calculates Maintenance-Free Service Design Estimates using California Department of Transportation (Caltrans) criteria (See Appendices B and C).

Non-corrosive backfill for metallic soil reinforcement, such as tie-back anchors or soil nails and reinforced concrete structures, shall meet the following requirements, in accordance with the Guidelines:

- 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.

Alternative Pipe Material Selection

Alternative pipe materials were selected using the Department of Transportation Altpipe Software Version 6.09 that calculates Maintenance-Free Service Design Estimates using California Department of Transportation (Caltrans) criteria (see Appendices B and C), based on the harshest soil conditions from the sampled soil borings (R-09-101 with a pH of 7.3 and a minimum resistivity of 635 ohm-cm, chloride 333 mg/kg and sulfate 262 mg/kg).

Appendix B includes the Culvert Service Design Estimates for pipes ranging from 12 inch to 48 inches in diameter. The estimated service life in years for the following:

- Plain Galvanized
- Bituminous Coating (Hot-Dipped)
- Bituminous Coating and Paved Invert
- Polymerized Asphalt Invert
- Polymeric Sheet Coating

Appendix C includes the Alternative Pipe Materials for pipes ranging from 12 inch to 48 inches in diameter. The required minimum thickness in inches for the following steel pipes:

Steel Pipes:

- Corrugated Steel Pipe – Hellical Corrugations – 2 2/3” x 1/2” Corrugations
- Corrugated Steel Pipe – Annular Corrugations – 2 2/3” x 1/2” Corrugations
- Corrugated Steel Pipe – Hellical Corrugations – 3” x 1” Corrugations
- Corrugated Steel Pipe – Hellical Corrugations – 5” x 1” Corrugations
- Steel Spiral Rib Pipe – 3/4” x 1” Ribs at 11 ½” Pitch
- Steel Spiral Rib Pipe – 3/4” x 1” Ribs at 8 ½” Pitch
- Steel Spiral Rib Pipe – 3/4” x 3/4” Ribs at 7 ½” Pitch

Appendix C also includes the following:

Plastic Pipes - (Availability) – Indicates which type is allowed per diameter of pipe:

- PVC Corrugated
- PVC Ribbed
- HDPE Corrugated -Type S
- HDPE Ribbed
- HDPE Corrugated -Type C

Reinforced Concrete Pipes - Materials needed:

- Steel Cover (in)
- Sack of Cement
- Percentage Water

Due to low minimum soil resistivities encountered, Aluminum (CAP and ASRP) or Aluminized Steel (ASSRP and CASP) pipes are not recommended.

APPENDIX A
SOIL LABORATORY CHEMICAL ANALYSIS RESULTS

COOPER

Corrosivity Test Summary

CTL # 632-009 Date: 2/2/2010 Tested By: PJ Checked: PJ
Client: V&A Project: URS Petaluma Proj. No: 09-0772
Remarks:

Sample Location or ID			Resistivity @ 15.5 °C (Ohm-cm)			Chloride	Sulfate		pH	ORP	Moisture	Soil Visual 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	
R-09-01	-	80-82	-	2312	-	69	<5	<0.0005	7.3	-	25.0	Brown Silty SAND
A-09-005	-	25-27	-	3934	-	19	<5	<0.0005	7.8	-	12.6	Greenish Brown Clayey SAND w/ Gravel
A-09-101	-	10-12	-	635	-	333	262	0.0262	7.3	-	16.6	Greenish Brown Clayey SAND
A-09-105	-	10-12	-	2157	-	<2	<5	<0.0005	8.4	-	16.4	Greenish Brown Clayey SAND
A-09-107	-	10-12	-	824	-	149	136	0.0136	8.1	-	5.9	Greenish Gray Sandy CLAY
A-09-108	-	10-12	-	1161	-	6	<5	<0.0005	7.9	-	29.2	Greenish Gray Sandy CLAY
A-09-109	-	-	-	434	-	119	<5	<0.0005	7.6	-	34.4	Black CLAY
A-09-111	-	8-10	-	508	-	59	98	0.0098	8.0	-	33.9	Black Sandy CLAY
A-09-112	-	10-12	-	787	-	<2	<5	<0.0005	8.6	-	23.5	Greenish Gray Sandy CLAY
A-09-115	-	10-12	-	1104	-	15	<5	<0.0005	8.3	-	19.0	Greenish Gray Sandy CLAY

APPENDIX B
CULVERT SERVICE DESIGN ESTIMATES

50-Year Maintenance-Free Service Design Estimates for Drainage Facilities Using Caltrans Highway Design Manual Criteria and AltPipe Version 6.09

Caltrans AltPipe

Project EA: 04-12276K
Project Engineer: Stephen Huang, URS
Location: Petaluma
Description: Old Redwood Highway Crossing

Pipe Diameter (in)	Steel Thickness (in)	Estimated Service Life (Years)				
		Plain Galvanized	Bituminous Coating (Hot-Dipped)	Bituminous Coating and Paved Invert	Polymerized Asphalt Invert	Polymeric Sheet Coating
12	0.052	25.9	33.9	40.9	*	*
	0.064	31.9	46.9	46.9	*	*
15	0.052	25.9	33.9	40.9	*	*
	0.064	31.9	46.9	46.9	*	*
18	0.052	25.9	33.9	40.9	*	*
	0.064	31.9	46.9	46.9	*	*
21	0.052	25.9	33.9	40.9	*	*
	0.064	31.9	46.9	46.9	*	*
	0.079	39.4	47.4	*	*	*
24	0.052	25.9	33.9	40.9	*	*
	0.064	31.9	46.9	46.9	*	*
	0.079	39.4	47.4	*	*	*
	0.109	*	*	*	*	*
27	N/A	N/A	N/A	N/A	N/A	N/A

*Provides adequate abrasion resistance or exceeds a 50-year design service life.
N/A = Not Available

Caltrans AltPipe

Project EA: 04-12276K
Project Engineer: Stephen Huang, URS
Location: Petaluma
Description: Old Redwood Highway Crossing

Pipe Diameter (in)	Steel Thickness (in)	Estimated Service Life (Years)				
		Plain Galvanized	Bituminous Coating (Hot-Dipped)	Bituminous Coating and Paved Invert	Polymerized Asphalt Invert	Polymeric Sheet Coating
30	0.052	25.9	33.9	40.9	*	*
	0.064	31.9	46.9	46.9	*	*
	0.079	39.4	47.4	*	*	*
	0.109	*	*	*	*	*
36	0.052	25.9	33.9	40.9	*	*
	0.064	31.9	46.9	46.9	*	*
	0.079	39.4	47.4	*	*	*
	0.109	*	*	*	*	*
	0.138	*	*	*	*	*
42	0.052	25.9	33.9	40.9	*	*
	0.064	31.9	46.9	46.9	*	*
	0.079	39.4	47.4	*	*	*
	0.109	*	*	*	*	*
	0.138	*	*	*	*	*

*Provides adequate abrasion resistance or exceeds a 50-year design service life.

Caltrans AltPipe

Project EA: 04-12276K
Project Engineer: Stephen Huang, URS
Location: Petaluma
Description: Old Redwood Highway Crossing

Pipe Diameter (in)	Steel Thickness (in)	Estimated Service Life (Years)				
		Plain Galvanized	Bituminous Coating (Hot-Dipped)	Bituminous Coating and Paved Invert	Polymerized Asphalt Invert	Polymeric Sheet Coating
45	0.064	31.9	46.9	46.9	*	*
	0.079	39.4	47.4	*	*	*
	0.109	*	*	*	*	*
	0.138	*	*	*	*	N/A
	0.168	*	*	*	N/A	N/A
48	0.064	31.9	46.9	46.9	*	*
	0.079	39.4	47.4	*	*	*
	0.109	*	*	*	*	*
	0.138	*	*	*	*	N/A
	0.168	*	*	*	N/A	N/A

*Provides adequate abrasion resistance or exceeds a 50-year design service life.
N/A = Not Available

APPENDIX C
ALTERNATIVE PIPE MATERIAL SELECTION

50-Year Maintenance-Free Service Design Estimates for Drainage Facilities Using Caltrans Highway Design Manual Criteria and AltPipe Version 6.09

Caltrans AltPipe

Project EA: 04-12276K
Project Engineer: Stephen Huang, URS
Location: Petaluma
Description: Old Redwood Highway Crossing

Steel Pipes

	Drainage System	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Pipe Diameter (in)	12	15	18	21	24	27	30	36	42	45	48
Pipe Type	Coating	Minimum Thickness (in)										
Corrugated Steel Pipe - Helical Corrugations - 2⅔" X ½" Corrugations	GAL (Galvanized)							0.109	0.109	0.109		0.109
	AL2 (Aluminum Type 2)											
	BC (Bituminous Coating)							0.109	0.109	0.109		0.109
	BCI (BC+paved invert)							0.109	0.109	0.109		0.109
	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
Corrugated Steel Pipe - Annular Corrugations - 2⅔" X ½" Corrugations	GAL (Galvanized)								0.109	0.109		0.109
	AL2 (Aluminum Type 2)											
	BC (Bituminous Coating)								0.109	0.109		0.109
	BCI (BC+paved invert)								0.109	0.109		0.109
	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
Corrugated Steel Pipe - Helical Corrugations - 3" X 1" Corrugations	GAL (Galvanized)										0.109	0.109
	AL2 (Aluminum Type 2)											
	BC (Bituminous Coating)										0.109	0.109
	BCI (BC+paved invert)										0.109	0.109
	PA (Polymerized Asphalt)										0.064	0.064
	PS (Polymeric Sheet)										0.064	0.064
Corrugated Steel Pipe - Helical Corrugations - 5" X 1" Corrugations	GAL (Galvanized)											0.109
	AL2 (Aluminum Type 2)											
	BC (Bituminous Coating)											0.109
	BCI (BC+paved invert)											0.109
	PA (Polymerized Asphalt)											0.064
	PS (Polymeric Sheet)											0.064
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch	GAL (Galvanized)					0.109		0.109	0.109	0.109		0.109
	AL2 (Aluminum Type 2)											
	BC (Bituminous Coating)					0.109		0.109	0.109	0.109		0.109
	BCI (BC+paved invert)					0.109		0.109	0.109	0.109		0.109
	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)					0.109		0.109	0.109	0.109		0.109
	AL2 (Aluminum Type 2)											
	BC (Bituminous Coating)					0.109		0.109	0.109	0.109		0.109
	BCI (BC+paved invert)					0.109		0.109	0.109	0.109		0.109
	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

Caltrans AltPipe

Project EA: 04-12276K
Project Engineer: Stephen Huang, URS
Location: Petaluma
Description: Old Redwood Highway Crossing

Steel Pipes

	Drainage System	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Pipe Diameter (in)	12	15	18	21	24	27	30	36	42	45	48
Pipe Type	Coating	Minimum Thickness (in)										
Steel Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch	GAL (Galvanized)					0.109		0.109	0.109	0.109		
	AL2 (Aluminum Type 2)											
	BC (Bituminous Coating)					0.109		0.109	0.109	0.109		0.109
	BCI (BC+paved invert)					0.109		0.109	0.109	0.109		0.109
	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		0.064

Caltrans AltPipe

Project EA: 04-12276K
Project Engineer: Stephen Huang, URS
Location: Petaluma
Description: Old Redwood Highway Crossing

Aluminum (CAP and ASRP) or Aluminized Steel (ASSRP and CASP) Pipes - Not Recommended - Minimum Soil Resistivity is too Low.

Plastic Pipes

	Drainage System	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Pipe Diameter (in)	12	15	18	21	24	27	30	36	42	45	48
Pipe Type		Availability										
PVC Corrugated		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
HDPE Ribbed				Allowable	Allowable	Allowable						
HDPE Corrugated - Type C				Allowable		Allowable						

Reinforced Concrete Pipes

	Drainage System	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Pipe Diameter (in)	12	15	18	21	24	27	30	36	42	45	48
Steel Cover (in)		0.75	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sacks of Cement		5	5	5	5	5	5	5	5	5	5	5
Percentage Water		11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1

Other Information

	Drainage System	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Soil pH		7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3
Minimum Soil Resistivity (ohm-cm)		635	635	635	635	635	635	635	635	635	635	635
Sulfate Concentration (ppm)		262	262	262	262	262	262	262	262	262	262	262
Chloride Concentration (ppm)		333	333	333	333	333	333	333	333	333	333	333
Abrasion Level		2	2	2	2	2	2	2	2	2	2	2
2–5 Year Flow Velocity (ft/sec)		5	5	5	5	5	5	5	5	5	5	5
Design Service Life (years)		50	50	50	50	50	50	50	50	50	50	50
Height of Cover (ft)		2	2	2	2	2	2	2	2	2	2	2

Pavement Evaluation Criteria

1 - Alligator Cracking

L - Low severity: few hairline cracks, no apalling
M - Medium severity: multiple hailrline cracks, light spalling
S - High severity: progressive cracking, spalling, potholes

2 - Block Cracking

L - Low severity:
M - Medium severity:
S - High severity:

3 - Distortions (bumps/sags)

L - Low severity: no speed reduction is necessary, bounce slightly, little discomfort
M - Medium severity: some reduction of speed is necessary
S - High severity: speed significantly reduced for safety/comfort

4 - Longitudinal/Transverse Cracking

L - Low severity: non-filled, less than 3/8 inch or filled any width
M - Medium severity: filled or non-filled, 3/8 inch to 3 inch crack, crack surrounded by light and random cracking
S - High severity: filled or non-filled, over 3 inch crack, surrounded by medium to severe random cracking, including broken pavement

5 - Patching

L - Low severity: good condition patch
M - Medium severity: moderately deteriorated patch/ride quality
S - High severity: badly deteriorated patch/ride quality, patch needs replacement

6 - Rutting/Depressions

L - Low severity: 1/2 to 1 inch
M - Medium severity: 1 to 2 inches
S - High severity: greater than 2 inches

7 - Weathering/Raveling

L - Low severity: surface starting to wear away, nopenetration with a coin
M - Medium severity: aggregate binder worn away, surface moderately rough, pitted, soft surface where oil has spilled can be penetrated with a coin
S - High severity: very rough, pitted, edge missing pieces, aggregate binder loose in areas where oil has spilled

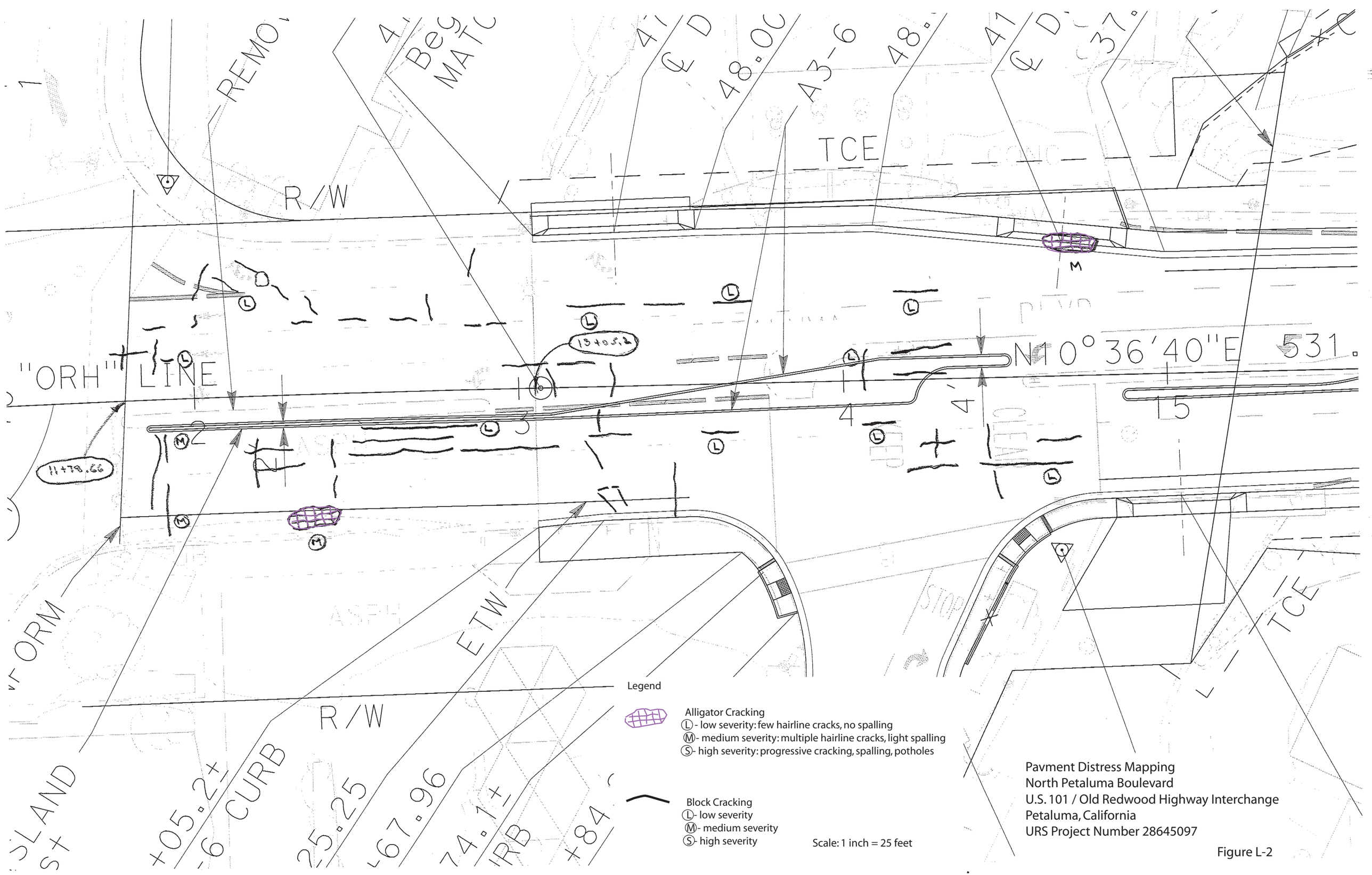
8 - Grinding

L - Low severity: less than 1/4 inch deep
M - Medium severity: 1/4 to 1/2 inch deep
S - High severity: greater than 1/2 inch deep

9 - Gouges

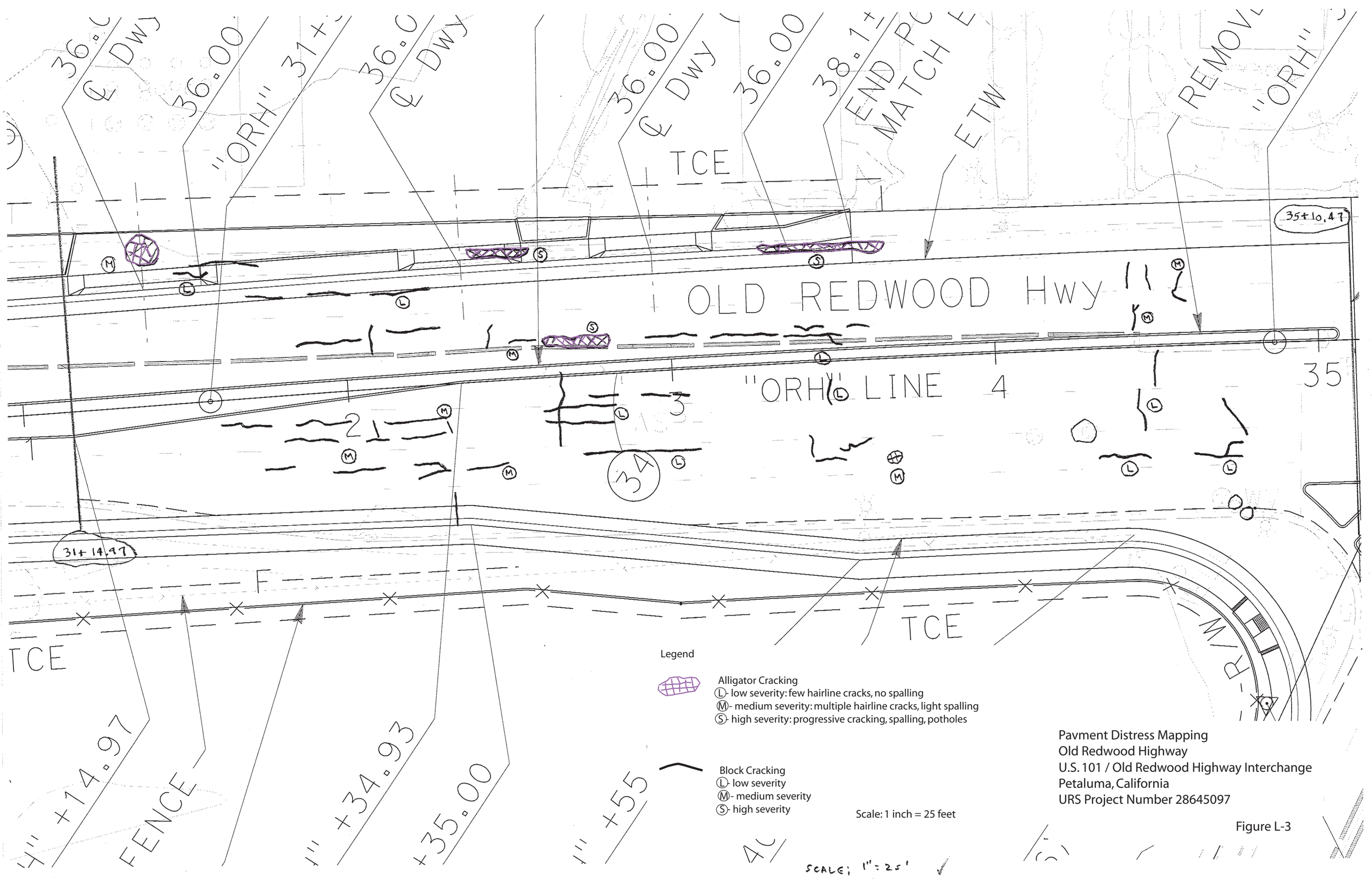
L - Low severity: 1/2 to 1 inch
M - Medium severity: 1 to 2 inches
S - High severity: greater than 2 inches

Figure L-1



Pavment Distress Mapping
North Petaluma Boulevard
U.S. 101 / Old Redwood Highway Interchange
Petaluma, California
URS Project Number 28645097

Figure L-2



Pavment Distress Mapping
Old Redwood Highway
U.S. 101 / Old Redwood Highway Interchange
Petaluma, California
URS Project Number 28645097

Figure L-3

Regional Water Quality Control Board
Clean Water Act Section 401 Water Quality Certification
Dated February 29, 2012

California Regional Water Quality Control Board
San Francisco Bay Region

Matthew Rodriquez
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

February 29, 2012
CIWQS Place No. 769620
401 Database No.: 02-49-C0301

Sent via electronic mail: No hard copy to follow

California Department of Transportation
Attn: Mr. Eric Schen
Eric_Schen@dot.ca.gov
111 Grand Ave.
Oakland, CA 94612-3717

Subject: Water Quality Certification for the State Route 101 Old Redwood Highway Interchange Project, City of Petaluma, Sonoma County

Department Project No.: EA 04-0A1851

Dear Mr. Schen:

We have reviewed and hereby issue water quality certification to the California Department of Transportation (Department) for the State Route 101 Old Redwood Highway Interchange Project (Project). The Department is seeking an Individual Permit for the Project from the U.S. Army Corps of Engineers (ACOE) pursuant to Section 404 of the Clean Water Act (33 U.S.C. § 1344). As such, the Department has applied to the San Francisco Bay Regional Water Quality Control Board (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 the existing State Route 101 (SR 101) freeway interchange with Old Redwood Highway in the City of Petaluma. Major elements of the upgrade include:

- Construction of a new SR 101 overcrossing along Old Redwood Highway/Petaluma Boulevard North using concrete driven piles;
- Construction of seven retaining and sound walls using cast-in-drilled-hole piles;
- Realignment and reconstruction of existing on-ramps and addition of high occupancy vehicle lanes and ramp metering;
- Realignment and reconstruction of off-ramps to increase capacity and meet current design standards;

- Realignment and reconstruction of Old Redwood Highway and Petaluma Boulevard North to align with the new overcrossing approaches;
- Widening of the SR 101 mainline to accommodate interchange reconstruction; and
- Widening the west side of Stony Point Road to accommodate a new left turn pocket on Petaluma Boulevard North.

Impacts: Project implementation would result in the permanent fill of approximately 0.82 acres of jurisdictional seasonal freshwater wetlands and the permanent fill of approximately 616 linear feet of jurisdictional waters. Permanent waters and wetlands impacts are summarized below in Table 1, *Summary of Permanent Impacts.* Project implementation would also result in permanent impacts to ten arroyo and red willows exceeding four inches diameter breast height.

Approximately 0.011 acres of jurisdictional waters would be temporarily impacted due to excavation and placement of an underground drain. Temporary Project impacts are summarized below in Table 2, *Summary of Temporary Impacts.*

Table 1: Summary of Permanent Impacts

Activity	Jurisdictional Feature Impacted (Feature ID)	Acreage and/or Linear Footage of Permanent Impact
Fill due to realignment and widening of new Petaluma Boulevard South on-ramp to southbound 101	Roadside wetland in drainage channel along southbound 101 south of Petaluma Blvd. (SW1-e)	0.0175 acres
Fill due to realignment and widening of new Petaluma Boulevard South on-ramp to southbound 101	Roadside wetland in drainage channel along southbound 101 south of Petaluma Blvd. (SW1-f)	0.0319 acres
Fill due to realignment and widening of new Petaluma Boulevard South on-ramp to southbound 101	Roadside wetland in drainage channel along southbound 101 south of Petaluma Blvd. (SW1-g)	0.0025 acres
Fill due to realignment and widening of new Petaluma Boulevard South on-ramp to southbound 101	Roadside wetland in drainage channel along southbound 101 south of Petaluma Blvd. (SW1-h)	0.0211 acres
Fill due to realignment and widening of northbound off-ramp to Old Redwood Highway and extension of gas utility line casings	Roadside wetland in drainage channel along northbound 101 off-ramp to Old Redwood Highway (SW1-m)	0.0986 acres
Fill due to realignment and widening of southbound off-ramp and southbound loop on-ramp	Roadside wetland in drainage channel along southbound 101 off-ramp to Petaluma Blvd. North (SW1-n)	0.3611 acres
Fill due to realignment and widening of the southbound 101 off-ramp and southbound loop on-ramp	Roadside wetland in drainage channel between southbound 101 off-ramp to Petaluma Blvd. North and southbound 101 mainline (SW1-o)	0.0094 acres

Table 1: Summary of Permanent Impacts (continued)

Activity	Jurisdictional Feature Impacted (Feature ID)	Acreage and/or Linear Footage of Permanent Impact
Fill due to realignment and widening of the southbound 101 off-ramp and southbound loop on-ramp	Roadside wetland in drainage channel that outfalls to a drainage channel paralleling the existing southbound 101 off-ramp (SW1-p)	0.0036 acres
Fill due to realignment and widening of the Old Redwood Highway on-ramp to northbound 101	Roadside wetland in drainage channel along Old Redwood Highway on-ramp to northbound 101 (SW1-q)	0.1804 acres
Fill due to realignment and widening of the Old Redwood Highway on-ramp to northbound 101	Roadside wetland in drainage channel along northbound 101 north of Old Redwood Highway (SW1-r)	0.0052 acres
Fill due to realignment and widening of the Old Redwood Highway on-ramp to northbound 101	Roadside wetland in drainage channel along northbound 101 north of Old Redwood Highway (SW1-s)	0.0204 acres
Fill due to realignment and widening of the Old Redwood Highway on-ramp to northbound 101	Roadside wetland in drainage channel along northbound 101 north of Old Redwood Highway (SW1-t)	0.0212 acres
Fill due to realignment and widening of Petaluma Blvd. North on-ramp to southbound 101	Roadside drainage channel along Petaluma Blvd. North on-ramp to southbound 101 (water of State 14)	0.0394 acres
Fill due to realignment and widening of the southbound 101 off-ramp and Old Redwood Highway to southbound 101 loop on-ramp	Roadside drainage channel along Petaluma Blvd. North on-ramp to southbound 101 (water of State 15)	0.0036 acres
Fill due to realignment and widening of the Old Redwood Highway to southbound 101 loop on-ramp	Drainage channel in existing Old Redwood Highway to southbound 101 loop on-ramp (water of State 16)	225 feet (0.0117 acres)
Fill due to realignment and widening of Petaluma Blvd. North on-ramp to northbound 101	Drainage channel in existing Petaluma Blvd. North to northbound 101 loop on-ramp (waters of the State 17)	399 feet (0.0092 acres)
	Total:	0.8159 acres of wetland fill due to roadway widening and realignment; 616 linear feet of roadside waters fill due to roadway widening and realignment

Table 2: Summary of Temporary Impacts

Activity	Jurisdictional Feature Impacted	Acreage and/or Linear Footage of Temporary Impact
Excavation, placement of an underdrain pipe for new biofiltration swale, and in-kind reconstruction of the drainage	Roadside wetland in drainage channel along northbound 101 south of Old Redwood Highway (SW1-l)	0.0063 acres

channel		
Excavation, placement of an underdrain pipe for new biofiltration swale, and in-kind reconstruction of the drainage channel	Roadside wetland in drainage channel along northbound 101 off-ramp to Old Redwood Highway (SW1-m)	0.0046 acres
	***Total*:**	0.0109 acres

Roadway Stormwater Runoff Pollutant Impacts: Project implementation would result in approximately 5.7 acres of new and 5.5 acres of 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. Project implementation would also result in the removal of a biofiltration strip that is currently treating stormwater runoff from 1.4 acres of impervious surface.

Hydromodification impacts: Project implementation would not result in significant hydromodification impacts due to low gradient and aggradation in the receiving waters.

Mitigation: To mitigate for permanent impacts to 0.8159 acres of jurisdictional seasonal freshwater wetlands, the Department has purchased 0.8159 acres of wetland mitigation bank credits from Burdell Ranch Wetland Conservation Bank. To mitigate for the approximately 616 linear feet of roadside waters, the Department shall re-build these ditches in-kind adjacent to their former locations. The Department shall also plant and establish twenty willow trees to mitigate for ten willow trees permanently impacted by Project implementation.

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 12.6 acres of impervious area using four bioretention swales (see Table 3, below for swale details). The four swales will treat approximately 13.1 acres of impervious area, 0.5 acres more than the required 12.6 acres. The Department may use the 0.5 acres of surplus treatment as credit towards the treatment obligations of a future, neighboring project (see certification condition no. 2).

The following bioretention swales will mitigate water quality impacts resulting from Project implementation:

Table 3: Permanent Treatment BMP Summary

Location	Length (feet)	From 101 Post Mile	To 101 Post Mile	Treated Impervious Area (acres)
Adjacent southbound lane, immediately before southbound 101 off-ramp	111	7.46	7.48	0.340
In island between southbound 101, southbound 101off-ramp and Old Redwood Hwy. loop on-ramp to southbound 101	131	7.60	7.62	0.750
Adjacent southbound 101 off-ramp to Petaluma Blvd. North	593	7.60	7.68	1.58
Adjacent the outside of northbound 101 off-ramp to Old Redwood Highway	339	7.58	7.65	10.4
			total:	*13.1*

CEQA Compliance: The Department certified an Environmental Impact Report for this Project pursuant to the provisions of the California Environmental Quality Act on August 30, 2007. On June 16, 2010, the Department revalidated the Notice of Determination, published by the State Clearinghouse on September 13, 2007, that the Project will 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 conditions imposed by the Individual Permit issued to the Department by the Corps;

2. The Department shall install four biofiltration swales to treat stormwater contaminants from no less than 13.1 acres of impervious area. The swales shall be installed and consistent with the information summarized above in "Roadway Pollutant Mitigation, and with the construction details and soil mix specifications included in Attachment A, *Bioretention Swale Details*. The Department may apply 0.5 acres of the 13.1 acres of post-construction stormwater treatment credit to a future project in the same watershed, subject to the acceptance of Water Board staff;

3. The Department shall submit, subject to the acceptance of Water Board staff, a Willow Tree Mitigation and Monitoring Plan (Plan), no later than July 31, 2012, to compensate for the ten willow trees permanently impacted by the Project. The Plan shall:

    a. Include a proposal to plant no less than twenty willows;
    b. Only deem willow plantings successful after five growing seasons, whereupon eighty percent of the planted willows shall exhibit average or improved health and vigor from the previous two growing seasons;
    c. Provide additional planting, maintenance and monitoring until the success criteria is satisfied if the above success criteria is not met;
    d. Deem willow plantings successful only after two full growing seasons have passed upon termination of supplemental watering; and
    e. At a minimum, submit years 0, 1, 3 and 5 monitoring reports to the Water Board;

4. The Project shall be constructed in conformance with the Project Description described in this certification and certification application materials. Any change in the Project that may require modification of the certification shall be approved by the Executive Officer before it is implemented;

5. The Department shall re-build earthen-lined waters of the State 16 and 17, in-kind, adjacent their current locations;

6. Regardless of date, erosion control measures shall be utilized throughout all phases of construction where sediment-laden runoff threatens to enter waters of the State. At no time shall sediment-laden runoff be allowed to enter waters of the State;

7. 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;

8. 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;

9. 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;

10. 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;

11. 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);

12. 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

13. 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 $4,893.00 on November 10, 2011.

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.

Condition 3 is a requirement for information 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
Ms. Laurie Monnrres, USACE
Ms. Jane Hicks, Regulatory Branch, USACE
Ms. Holly Costa, Regulatory Branch, USACE
Mr. David Williams, URS Corp.
Mr. Dale Bowyer, Water Board
Mr. Cyrus Vafai, Caltrans
Mr. Hardeep Takhar, Caltrans
Mr. Jason Brush, USEPA
Ms. Paula Gill, USACE

Attachment A

Bioretention Swale Details

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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

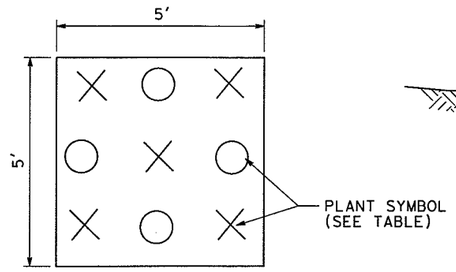
THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

URS CORPORATION
1380 Lead Hill Blvd.
Suite 100
Roseville, CA 95661

CITY OF PETALUMA
11 ENGLISH STREET
PETALUMA, CA 94952

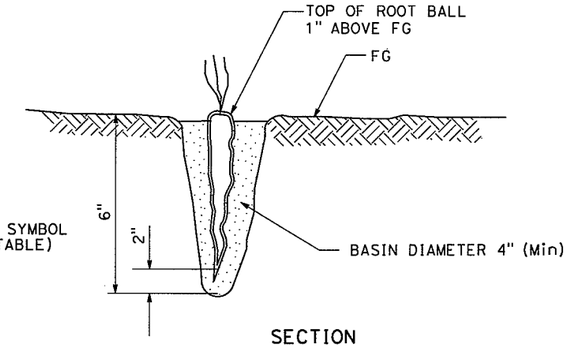
NOTE:

SEE DRAINAGE PLANS, DETAILS, AND QUANTITIES SHEETS FOR MORE INFORMATION.



PLAN

TYPICAL LINER PLANTS SPACING

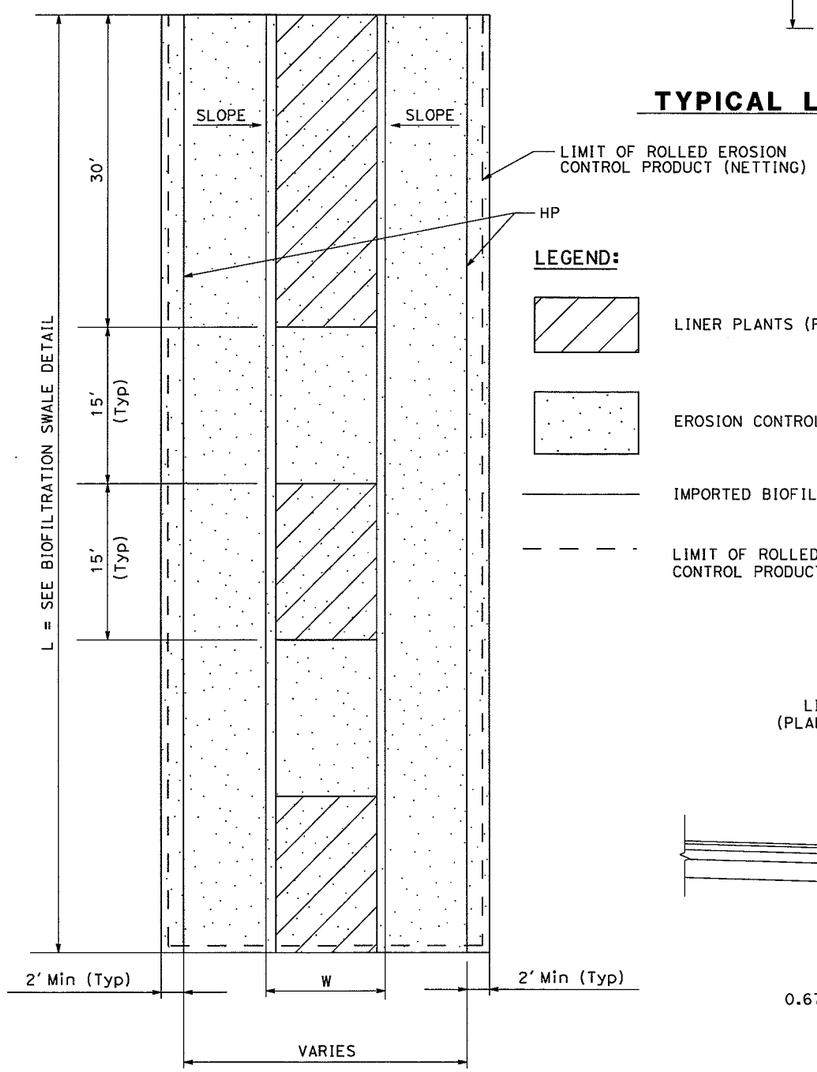


SECTION

PLANT BASIN (LINER)

PLANT LIST AND PLANTING SPECIFICATIONS

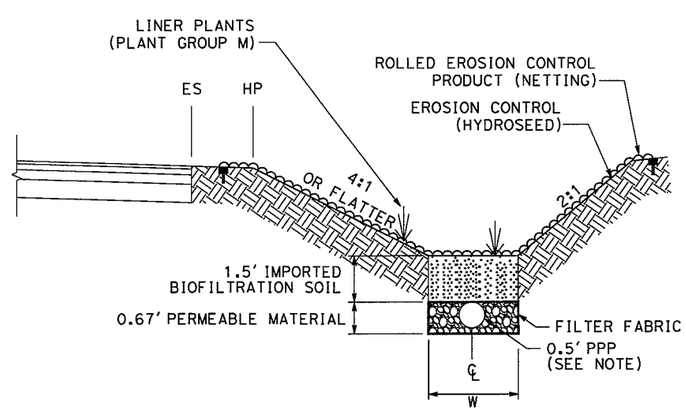
PLANT GROUP	PLANT No.	SYMBOL	BOTANICAL MAME	COMMON NAME	SIZE	QUANTITY (EA)	HOLE SIZE (INCH)	
							Dia	DEPTH
M	1	X	HORDEUM BRACHYANTHERUM	MEADOW BARLEY	LINER	4141	4	6
	2	O	FESTUCA RUBRA 'MOLATE'	MOLATE FESCUE	LINER	3313	4	6



PLAN

LEGEND:

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



SECTION

BIORETENTION SWALE DETAIL

BIORETENTION SWALE

SWALE No.	LOCATION	BOTTOM WIDTH (W)	LENGTH	POST MILE (PM)
1	"ML" 393+25 TO 394+25 R†	20' TO 25'	111'	7.46 TO 7.48
2	"ML" 400+55 TO 401+40 R†	12'	131'	7.60 TO 7.62
3	"ONF" 37+45 TO 42+50 R†	5'	593'	7.60 TO 7.68
4	"OSF" 60+70 TO 62+58 L†	15' TO 69'	339'	7.58 TO 7.65

EROSION CONTROL DETAILS

NO SCALE

ECD-1

REVISED BY	DATE REVISED
HUEY NHAM	DAVID WILLIAMS

CALCULATED-DESIGNED BY / CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

LAST REVISION 09-20-10 DATE PLOTTED => 2/15/2012 TIME PLOTTED => 10:41:52 AM

10-1.__ IMPORTED BIOFILTRATION SOIL

GENERAL

Summary

This work includes furnishing, and applying biofiltration soil mix.

Submittals

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

Before mixing compost with sand and soil, submit a copy of the compost producer's compost technical data sheet and a copy of the compost producer's Seal of Testing Assurance certification. The compost technical data sheet must include:

1. Laboratory analytical test results
2. List of product ingredients

Before mixing compost with sand and soil, submit a Certificate of Compliance under 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 soil. The ratio of the components of imported biofiltration soil by volume must consist of two parts sand; one part compost; and 0.5 part soil.

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	Inches % Passing 3 100%

	% Dry Weight Basis	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).

Soil

Soil must be free of wood, waste or other deleterious material. The soil 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

Imported biofiltration soil is measured by the cubic yard.

The contract 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.

U.S. Army Corps of Engineers
Clean Water Act Section 404 Permit
Dated July 9, 2012

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

REPLY TO
ATTENTION OF:

JUL - 9 2012

Regulatory Division

SUBJECT: File Number 2008-00045N

Mr. Jeffery Jensen
Office of Biological Sciences and Permits
California Department of Transportation (Caltrans)
111 Grand Avenue
P.O. Box 23660
Oakland, California 94623-0660

Dear Mr. Jensen:

Enclosed are two copies of a Department of the Army (DA) permit to reconstruct the Old Redwood Highway interchange located at the intersection of Petaluma Boulevard and Route 101 in the town of Petaluma, Sonoma County, California. This proffered permit supersedes the initial proffered permit sent to you for signature on March 19, 2012.

You are advised that the Corps has established an Administrative Appeal Process, as described in our regulations at 33 C.F.R. Part 331 (65 Fed. Reg. 16486; March 28, 2000) and outlined in the enclosed flowchart and Notification of Administrative Appeal Options, Process, and Request for Appeal (NAO-RFA) form. The following two options are available to you in your evaluation of the enclosed permit:

1. You may sign and date both copies of the permit on the line designated for "Permittee". Your signature on the permit indicates that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions. We will then forward one copy of the fully executed permit for your records, at which time you will be authorized to commence work.

2. You may decline to sign the permit because you object to certain terms and conditions, and you may request that the permit be modified. If you decline the permit, you must return the permit to the District Engineer and may not proceed with your project until notified by the District Engineer. You must outline your objections to the terms and conditions of the permit by completing Section II of the NAO-RFA form. Your objections must be received by the District Engineer within sixty (60) days of the date of this letter, or you will forfeit your right to request changes to the terms and conditions of the permit.

Upon receipt of the completed NAO-RFA form, the District Engineer will evaluate your objections, and may: (a) modify the permit to address all of your objections, (b) modify the permit to address some of your objections, or (c) not modify the permit, having determined that the permit should be issued as previously written. In any of these three cases, the District Engineer will send you a final permit for your reconsideration, as well as a second NAO-RFA form. Should you decline the final proffered permit, you can appeal the declined permit by submitting the completed NAO-RFA form to the Division Engineer. The NAO-RFA form must be received by the Division Engineer within sixty (60) days of the date of the second transmittal letter, or you will forfeit your right to pursue an appeal.

If you fail to sign and return both copies of this permit or fail to request a modification of the permit within sixty (60) days from the date of this letter, your permit application may be withdrawn pursuant to our regulations at 33 C.F.R. Section 325.2(d)(5). Should you have any questions regarding this matter, please call Paula Gill of our Regulatory Division at (415) 503-6776 or by email at Paula.C.Gill@usace.army.mil. Please address all correspondence to the Regulatory Division and refer to the File Number at the head of this letter.

Sincerely,

John K. Baker, P.E.
Lieutenant Colonel, U.S. Army
Commander and District Engineer

Enclosures

DEPARTMENT OF THE ARMY PERMIT

PERMITTEE: Mr. Jeffery Jensen
Office of Biological Sciences and Permits
California Department of Transportation (Caltrans)
111 Grand Avenue
P.O. Box 23660
Oakland, California 94623-0660

PERMIT NO.: 2008-00045N

ISSUING OFFICE: San Francisco District

NOTE: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate District or Division office of the Corps of Engineers having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below:

PROJECT DESCRIPTION: The authorized activity involves reconstruction of the Old Redwood Highway interchange. Work will include installation of seven new retaining walls and a new segment of sound wall. Realignment and reconstruction of the four interchange on-ramps (Old Redwood Highway interchange) will include realignment and reconstruction of the north and southbound off-ramps, slightly widening the Route 101 mainline, realignment and reconstruction of the approaches to the new Route 101 overcrossing, installation of appropriate new traffic signals, and widening of Stony Point Road. Project implementation will result in a total of 0.77 acre of permanent wetlands impact, 0.01 acre of temporary wetlands impact, and 0.06 acre of temporary culverted waters impact. Temporary impacts to wetlands within existing ditches would be mitigated with the construction of new ditches/swales along the new ramps within the vicinity of the roadway. Permanently impacted wetlands have been mitigated off site by the purchase of wetland mitigation credits (August 2, 1010) from the Burdell Ranch Wetland Conservation Bank. All work shall be completed in accordance with the plans and drawings titled "*USACE File #2008-00045N, Central 101 HOV Lanes Segment C, March 6, 2012, Figure 1 to 7*" provided as enclosure 1.

PROJECT LOCATION: The project is located at the intersection of Petaluma Boulevard and Route 101 in the town of Petaluma, Sonoma County, California.

PERMIT CONDITIONS:

GENERAL CONDITIONS:

1. The time limit for completing the work authorized ends on July 30, 2017. If you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least one month before the above date is reached.

2. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.

3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and State coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

4. If you sell the property associated with this permit, you must obtain the signature of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this authorization.

5. A conditioned water quality certification has been issued for your project. You must comply with the conditions specified in the certification as special conditions to this permit. For your convenience, a copy of the certification is attached if it contains such conditions (enclosure 2).

6. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of your permit.

7. You understand and agree that, if future operations by the United States require the removal, relocation or other alteration of the structure or work authorized herein, 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, you 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.

SPECIAL CONDITIONS:

1. This Corps permit does not authorize you to take federally listed 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 Biological Opinion (BO) under ESA Section 7 with "incidental take" provisions with which you must comply). The enclosed U.S. Fish and Wildlife Service (FWS) BO issued April 28, 2010 (No. 81420-2008-F-0733-R001), contain mandatory terms and conditions to implement the reasonable and prudent measures that are associated with "incidental take" (enclosure 3). You must also comply 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 would constitute unauthorized take and it would also constitute non-compliance with your Corps permit. The FWS is the appropriate authority to determine compliance with the terms and conditions of their BOs and with ESA.

2. You shall employ sediment and erosion control best management practices as needed throughout the project area. 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. After construction, any materials used to dewater areas within the creeks shall be removed in their entirety.

3. Within 1-year of initiation of temporary impact to a jurisdictional feature, you shall recontour temporarily impacted areas and replant those areas with appropriate soil-stabilizing species. You shall monitor revegetated areas for 5 years. At the end of the fifth year, revegetated areas shall provide 75% absolute vegetative cover. In revegetated wetlands, over half of the cover must be occupied by hydrophytic plants (having a facultative (FAC) or wetter indicator status). You shall submit a monitoring report for the revegetated areas at the end of year 1, 3, and 5. The reports shall include representative photos of the revegetated areas. If the cover requirements for the revegetated areas are not met, the Corps may require further monitoring, revegetation, and/or off-site mitigation.

FURTHER INFORMATION:

1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to:

( ) Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. Section 403).
(X) Section 404 of the Clean Water Act (33 U.S.C. Section 1344).

( ) Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. Section 1413).

2. Limits of this authorization:

   a. This permit does not obviate the need to obtain other Federal, State, or local authorizations required by law.

   b. This permit does not grant any property rights or exclusive privileges.

   c. This permit does not authorize any injury to the property or rights of others.

   d. This permit does not authorize interference with any existing or proposed Federal project.

3. Limits of Federal Liability: In issuing this permit, the Federal Government does not assume any liability for the following:

   a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.

   b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.

   c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.

   d. Design or construction deficiencies associated with the permitted work.

   e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision: This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

   a. You fail to comply with the terms and conditions of this permit.

   b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate. (See Item 4 above.)

   c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 C.F.R. Section 325.7 or enforcement procedures such as those contained in 33 C.F.R. Sections 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 C.F.R. Section 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. Extensions: General Condition 1 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give favorable consideration to a request for

an extension of this time limit.

Your signature below, as permittee, indicates that you accept and agree to comply with the terms and conditions of this permit.

(PERMITTEE) (DATE) July 10, 2012

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

Torrey A. DiCiro, P.E., PMP
Lieutenant Colonel, U.S. Army
District Commander

(DATE)

When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

(TRANSFEREE)

(DATE)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

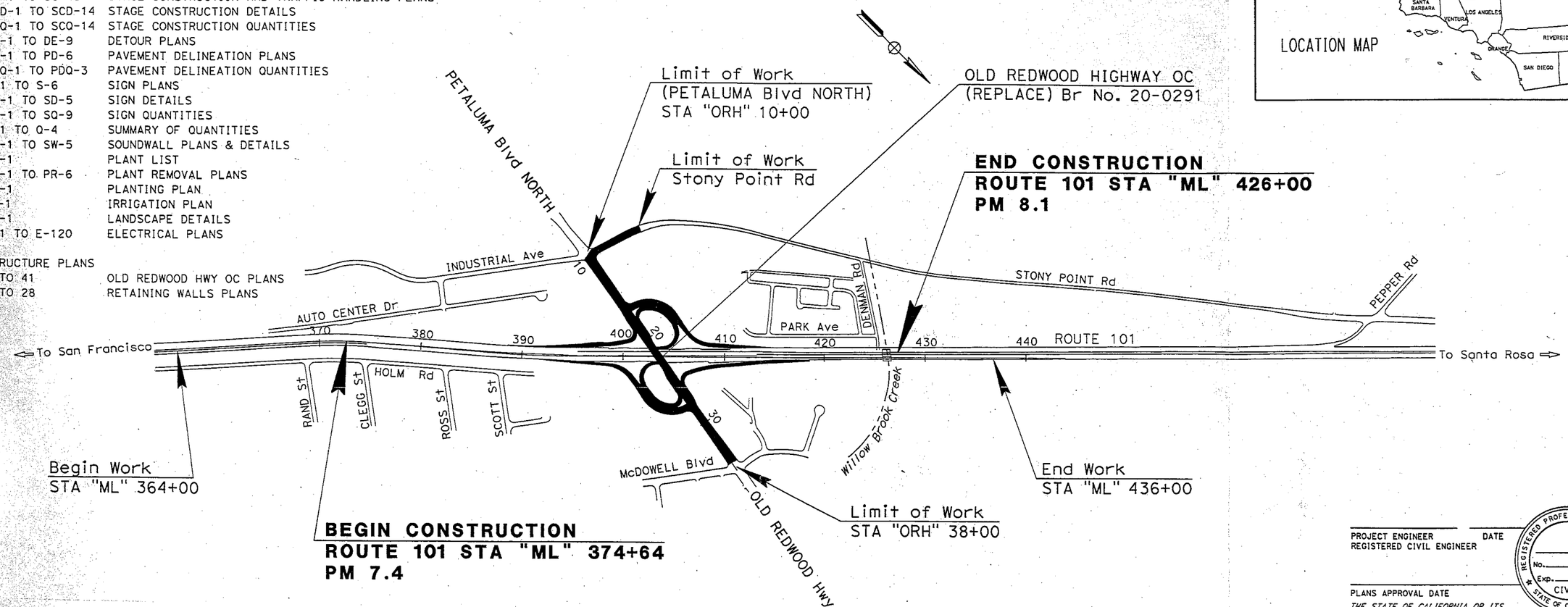
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

PROJECT PLANS FOR CONSTRUCTION ON
STATE HIGHWAY
IN SONOMA COUNTY
IN PETALUMA
FROM 0.3 MILE SOUTH TO 0.4 MILE NORTH OF OLD REDWOOD HIGHWAY OVERCROSSING

TO BE SUPPLEMENTED BY STANDARD PLANS DATED MAY 2006

INDEX OF PLANS

SHEET No.	DESCRIPTION
X-1 TO X-11	TYPICAL CROSS SECTIONS
K-1	KEY MAP AND LINE INDEX
L-1 TO L-6	LAYOUTS
P-1 TO P-2	PROFILES
PS-1 TO PS-6	PROFILES AND SUPERELEVATION DIAGRAMS
C-1 TO C-26	CONSTRUCTION DETAILS
WPC-1 TO WPC-6	TEMPORARY WATER POLLUTION CONTROL PLANS
WPCQ-1	TEMPORARY WATER POLLUTION CONTROL QUANTITIES
EC-1 TO EC-6	EROSION CONTROL PLANS
ECD-1 TO ECD-2	EROSION CONTROL DETAILS
ECQ-1	EROSION CONTROL QUANTITIES
G-1 TO G-6	CONTOUR GRADING
D-1 TO D-6	DRAINAGE PLANS
DP-1 TO DP-10	DRAINAGE PROFILES
DD-1 TO DD-8	DRAINAGE DETAILS
DQ-1 TO DQ-16	DRAINAGE QUANTITIES
U-1 TO U-7	UTILITY PLANS
UD-1 TO UD-4	UTILITY DETAILS
SC-1 TO SC-49	STAGE CONSTRUCTION AND TRAFFIC HANDLING PLANS
SCD-1 TO SCD-14	STAGE CONSTRUCTION DETAILS
SCQ-1 TO SCQ-14	STAGE CONSTRUCTION QUANTITIES
DE-1 TO DE-9	DETOUR PLANS
PD-1 TO PD-6	PAVEMENT DELINEATION PLANS
PDQ-1 TO PDQ-3	PAVEMENT DELINEATION QUANTITIES
S-1 TO S-6	SIGN PLANS
SD-1 TO SD-5	SIGN DETAILS
SQ-1 TO SQ-9	SIGN QUANTITIES
Q-1 TO Q-4	SUMMARY OF QUANTITIES
SW-1 TO SW-5	SOUNDWALL PLANS & DETAILS
PL-1	PLANT LIST
PR-1 TO PR-6	PLANT REMOVAL PLANS
PP-1	PLANTING PLAN
IP-1	IRRIGATION PLAN
LD-1	LANDSCAPE DETAILS
E-1 TO E-120	ELECTRICAL PLANS
STRUCTURE PLANS	
1 TO 41	OLD REDWOOD HWY OC PLANS
1 TO 28	RETAINING WALLS PLANS



USACE File #2008-00045N
Central 101 HOV Lanes Segment C
March 6, 2012
Page 1 of 7

U.S. Army Corps of Engineers
San Francisco District
Regulatory Division

NO SCALE

THE CONTRACTOR SHALL POSSESS THE CLASS (OR CLASSES) OF LICENSE AS SPECIFIED IN THE "NOTICE TO BIDDERS."

APPROVED AS TO IMPACT ON STATE FACILITIES AND CONFORMANCE WITH APPLICABLE STATE STANDARDS AND PRACTICES AND THAT TECHNICAL OVERSIGHT WAS PERFORMED.

CONSULTANT DESIGN ENGINEER: DAVID WILLIAMS
CALTRANS DESIGN OVERSIGHT APPROVAL: JONATHAN LEE
REGISTRATION No. 47520
LICENSE Exp DATE 12/31/13
DATE SIGNED

PROJECT ENGINEER REGISTERED CIVIL ENGINEER — DATE
REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA
PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

URS CORPORATION
1380 Lead Hill Blvd., Suite 100
Roseville, CA 95661

CITY OF PETALUMA
11 English Street
Petaluma, CA 94952

CONTRACT No.	04-0A1851
PROJECT ID	0400020652

DATE PLOTTED => 9/21/2011
TIME PLOTTED => 2:41:47 PM
LAST REVISION 09-20-10

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER David A. Williams No. C58697 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.

URS CORPORATION
1380 Lead Hill Blvd.
Suite 100
Roseville, CA 95661

CITY OF PETALUMA
11 ENGLISH STREET
PETALUMA, CA 94952

NOTES:

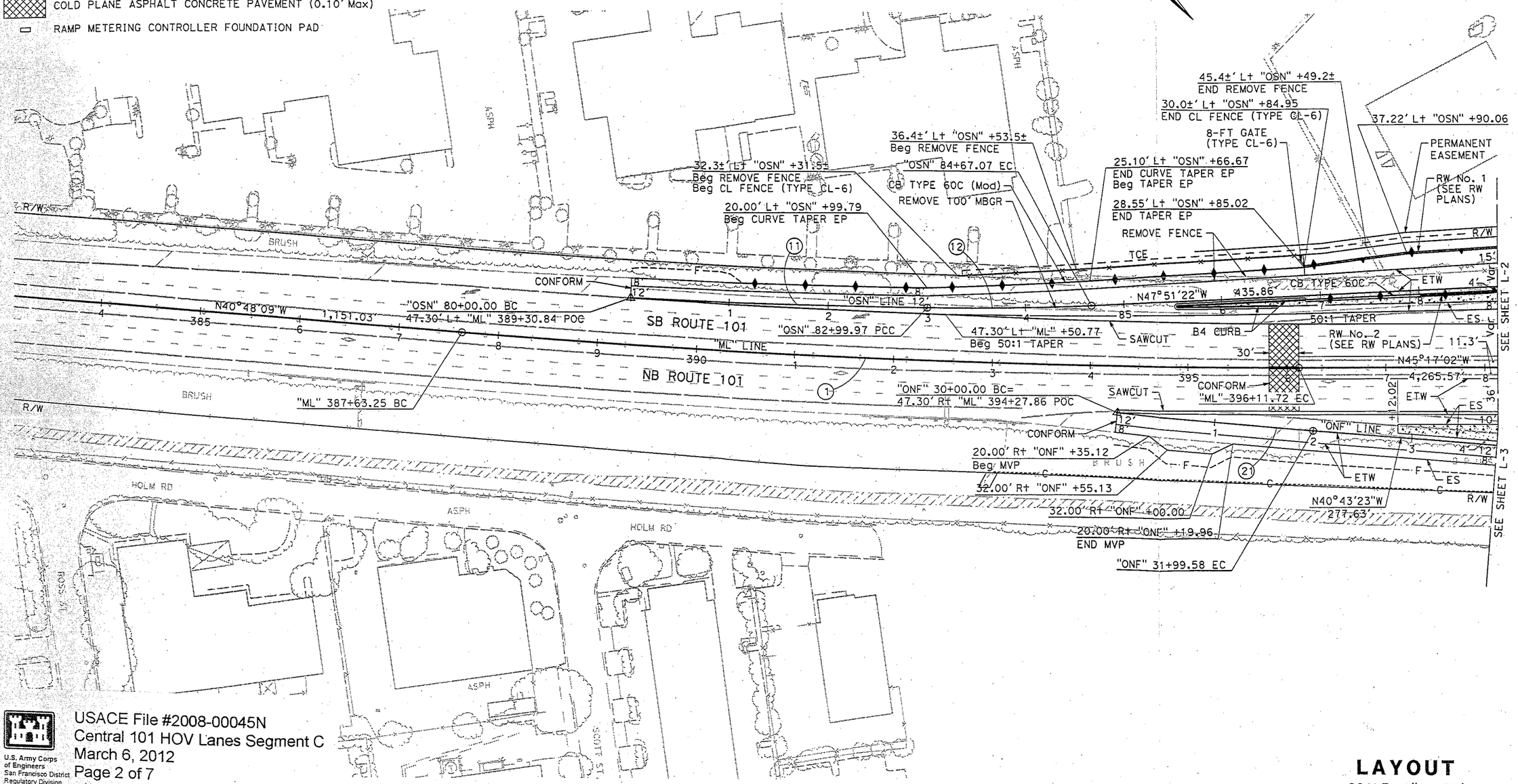
1. FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.
2. FOR MORE DETAILS OR DETAILS NOT SHOWN, SEE "CONSTRUCTION DETAILS" SHEETS.
3. FOR RETAINING WALL AND SOUND WALL DETAILS, SEE "RETAINING WALL" AND "SOUND WALL" SHEETS.

LEGEND:

- 4" THICK MINOR CONCRETE (MEDIUM BROOM FINISH)
- SURVEY MONUMENT (TYPE A)
- IRRIGATION CROSSOVER (SEE Std PLAN H9)
- COLD PLANE ASPHALT CONCRETE PAVEMENT (0.10' Max)
- RAMP METERING CONTROLLER FOUNDATION PAD

CURVE DATA

No.	R	Δ	T	L	CURVE CENTER N	CURVE CENTER E
1	10,847.85'	4°28'53"	424.45'	848.47'	1853380.6395	6362217.0628
11	8,302.60'	2°04'12"	150.00'	299.97'	1854944.5282	6364170.6340
12	3,000.00'	3°11'29"	83.57'	167.10'	1858672.0213	6367942.0261
21	10,895.15'	1°02'58"	99.79'	199.58'	1854036.1366	6361626.9895



USACE File #2008-00045N
Central 101 HOV Lanes Segment C
March 6, 2012
Page 2 of 7

U.S. Army Corps of Engineers
San Francisco District
Regulatory Division

LAYOUT

SCALE: 1" = 50'

L-1

REVISED BY	DATE REVISED
HUEY NHAM	DAVID WILLIAMS

CALCULATED-DESIGNED BY | CHECKED BY

RAMSEY HISSEN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | CONSULTANT FUNCTIONAL SUPERVISOR

LAST REVISION 09-20-10 | DATE PLOTTED => 9/20/2011 | TIME PLOTTED => 5:43:27 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => huey_nham | DGN FILE => 0400020004ec001.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0751 | PROJECT NUMBER & PHASE 04000206521

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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

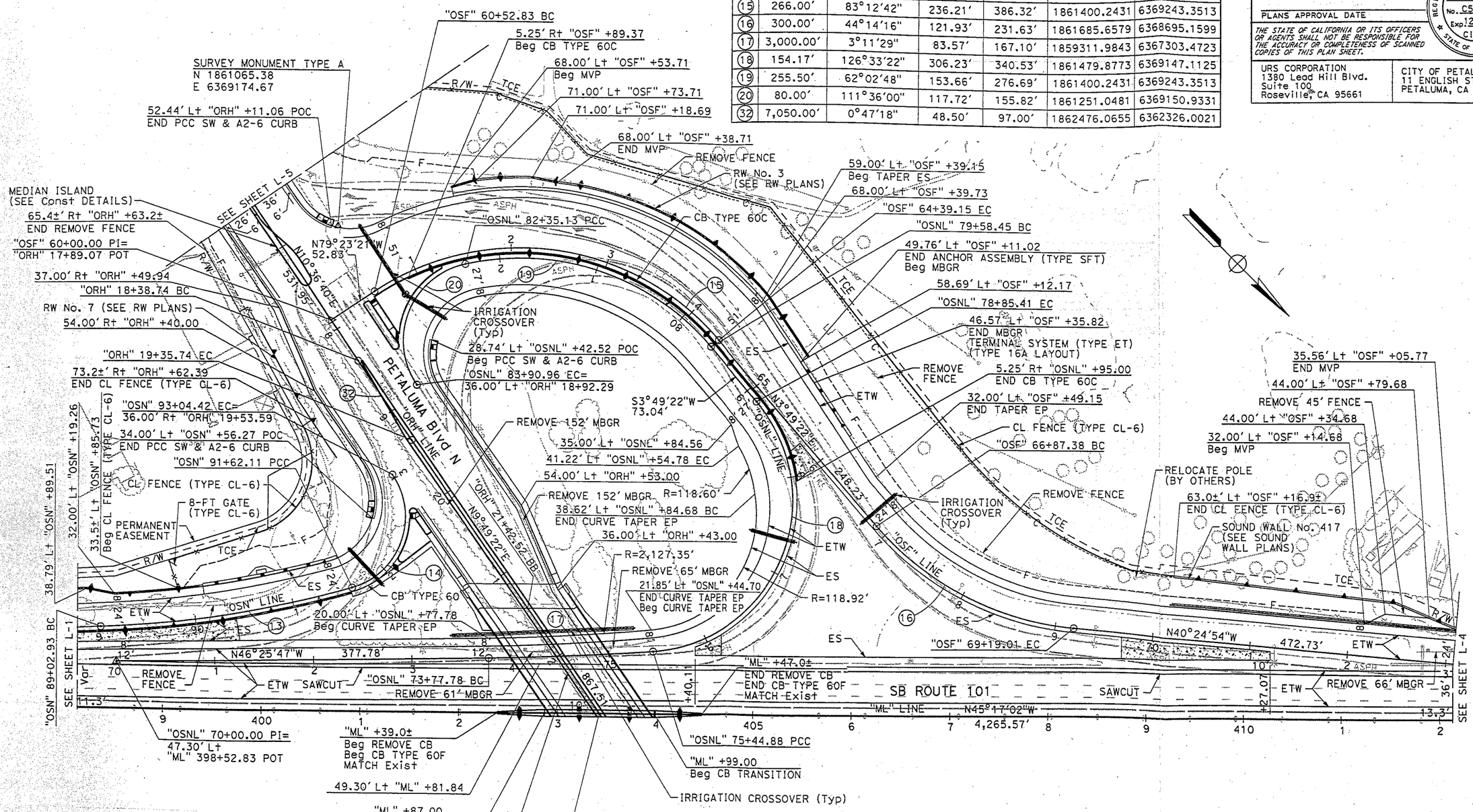
THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

URS CORPORATION
1380 Lead Hill Blvd.
Suite 100
Roseville, CA 95661

CITY OF PETALUMA
11 ENGLISH STREET
PETALUMA, CA 94952

CURVE DATA

No.	R	Δ	T	L	CURVE CENTER N	CURVE CENTER E
13	1,080.00′	13°44′59"	130.21′	259.18′	1860388.0866	6368907.1658
14	75.00′	108°42′53"	104.59′	142.31′	1861272.1808	6369385.0805
15	266.00′	83°12′42"	236.21′	386.32′	1861400.2431	6369243.3513
16	300.00′	44°14′16"	121.93′	231.63′	1861685.6579	6368695.1599
17	3,000.00′	3°11′29"	83.57′	167.10′	1859311.9843	6367303.4723
18	154.17′	126°33′22"	306.23′	340.53′	1861479.8773	6369147.1125
19	255.50′	62°02′48"	153.66′	276.69′	1861400.2431	6369243.3513
20	80.00′	111°36′00"	117.72′	155.82′	1861251.0481	6369150.9331
32	7,050.00′	0°47′18"	48.50′	97.00′	1862476.0655	6362326.0021



USACE File #2008-00045N
Central 101 HOV Lanes Segment C
March 6, 2012
Page 3 of 7

U.S. Army Corps of Engineers
San Francisco District
Regulatory Division

LAYOUT
SCALE: 1" = 50′

L-2

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN
CALCULATED-DESIGNED BY: HUEY NHAM
CHECKED BY: DAVID WILLIAMS
REVISED BY / DATE REVISED

LAST REVISION 09-20-10
DATE PLOTTED => 9/20/2011
TIME PLOTTED => 5:43:32 PM

BORDER LAST REVISED 7/2/2010
USERNAME => huey_nham
DGN FILE => 0400020004ea002.dgn
RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3
UNIT 0751
PROJECT NUMBER & PHASE 04000206521

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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

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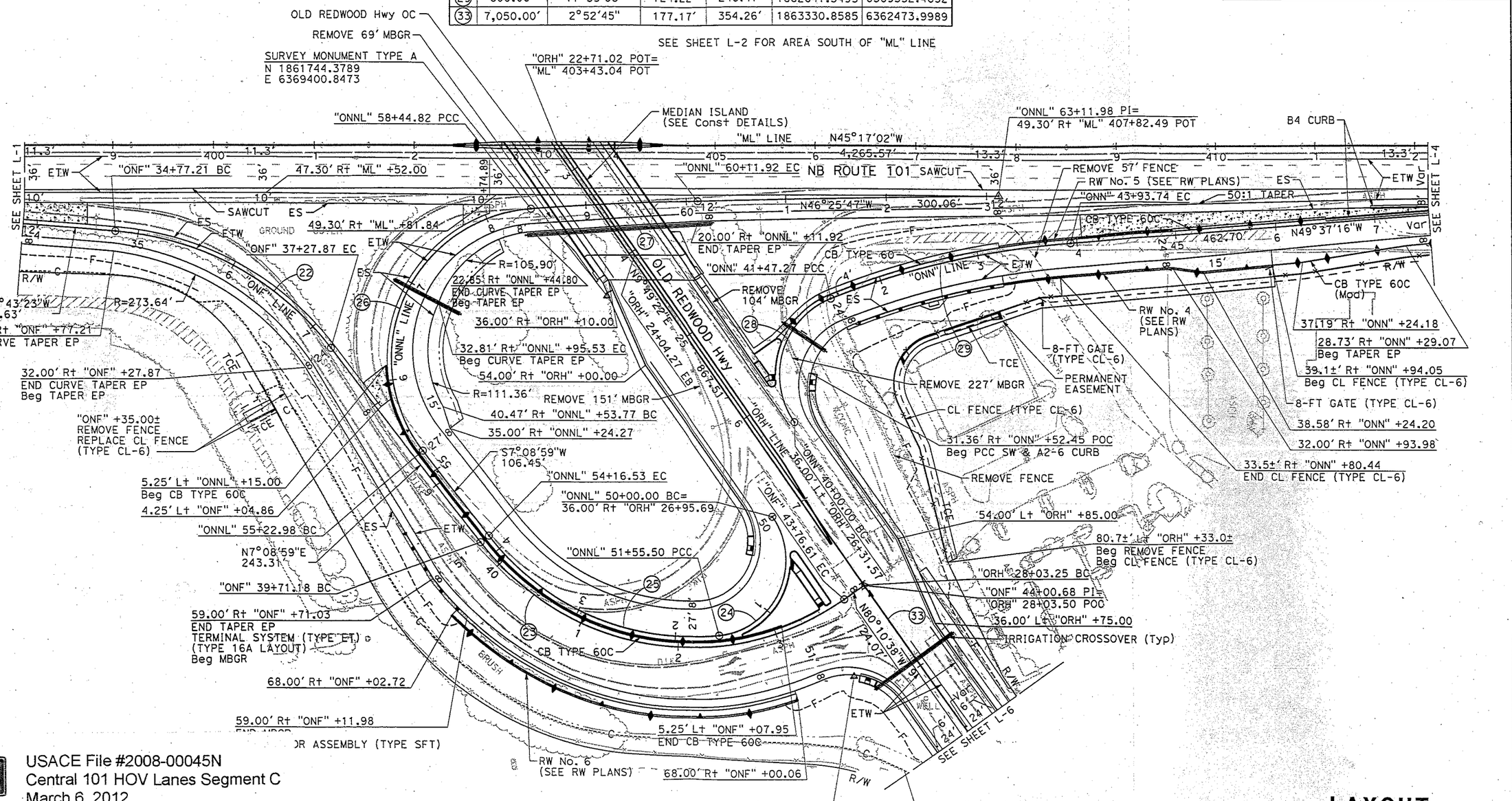
URS CORPORATION
1380 Lead Hill Blvd.
Suite 100
Roseville, CA 95661

CITY OF PETALUMA
11 ENGLISH STREET
PETALUMA, CA 94952

CURVE DATA

No.	R	Δ	T	L	CURVE CENTER N	CURVE CENTER E
22	300.00′	47°52′22"	133.17′	250.66′	1861550.3041	6369930.3472
23	266.00′	87°19′37"	253.87′	405.42′	1861862.1716	6369399.0311
24	75.00′	118°47′23"	126.79′	155.50′	1862003.2115	6369511.6721
25	255.50′	58°32′14"	143.20′	261.04′	1861862.1716	6369399.0311
26	149.64′	123°13′45"	276.92′	321.83′	1861743.3717	6369490.8210
27	3,000.00′	3°11′29"	83.57′	167.10′	1863914.7138	6371337.3954
28	82.00′	102°54′16"	102.91′	147.27′	1861979.0978	6369275.0901
29	800.00′	17°39′06"	124.22′	246.47′	1862641.3493	6369552.4832
33	7,050.00′	2°52′45"	177.17′	354.26′	1863330.8585	6362473.9989

SEE SHEET L-2 FOR AREA SOUTH OF "ML" LINE



FOR NOTES AND LEGEND, SEE SHEET L-1

USACE File #2008-00045N
Central 101 HOV Lanes Segment C
March 6, 2012
Page 4 of 7

U.S. Army Corps of Engineers
San Francisco District
Regulatory Division

LAYOUT

SCALE: 1" = 50′

L-3

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN | CALCULATED-DESIGNED BY: HUEY NHAM | CHECKED BY: DAVID WILLIAMS | REVISED BY | DATE REVISED

Caltrans

LAST REVISION 09-20-10 | DATE PLOTTED => 9/20/2011 | TIME PLOTTED => 5:43:35 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => huey_nham | DGN FILE => 0400020004ea003.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0751 | PROJECT NUMBER & PHASE 04000206521

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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

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CITY OF PETALUMA
11 ENGLISH STREET
PETALUMA, CA 94952

CURVE DATA

No.	R	Δ	T	L	CURVE CENTER N	CURVE CENTER E
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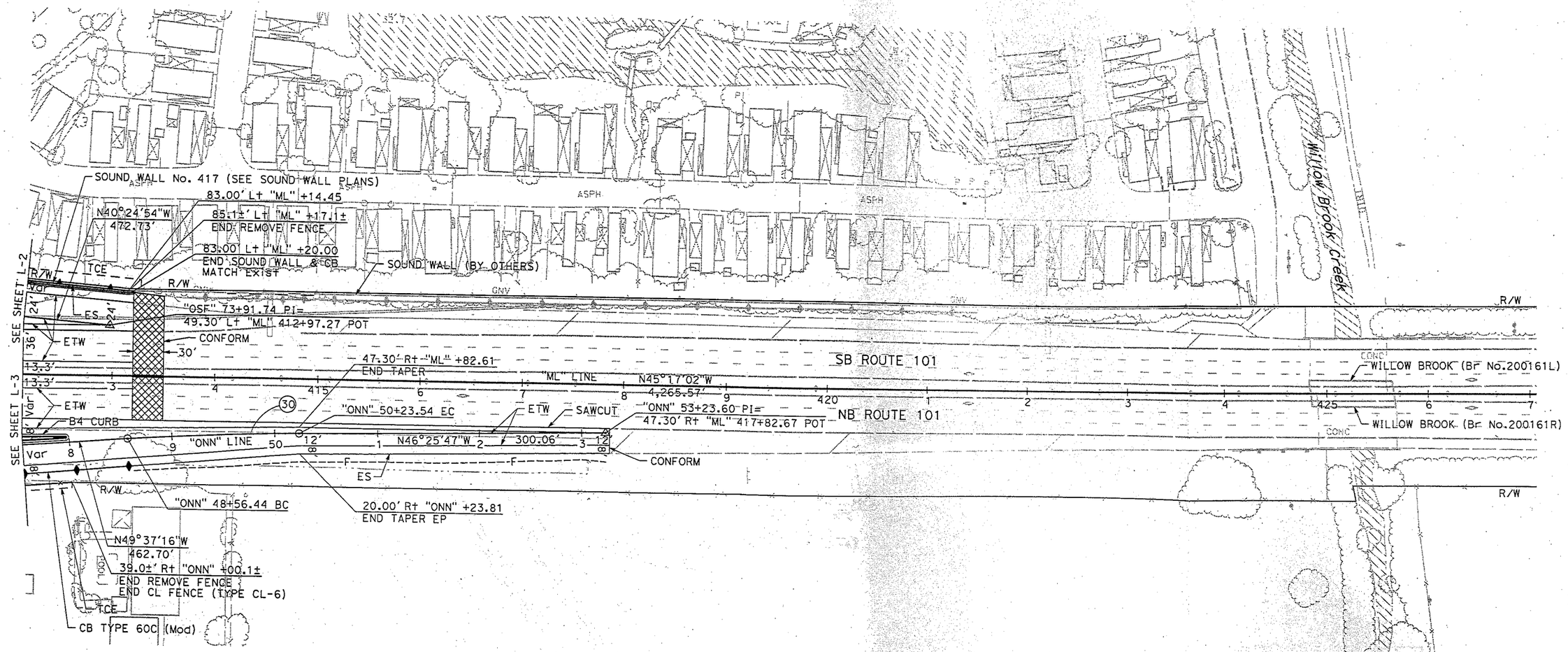

U.S. Army Corps of Engineers
San Francisco District
Regulatory Division

USACE File #2008-00045N
Central 101 HOV Lanes Segment C
March 6, 2012
Page 5 of 7

FOR NOTES AND LEGEND, SEE SHEET L-1

LAYOUT

SCALE: 1" = 50′

L-4

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM | CHECKED BY: DAVID WILLIAMS

REVISED BY | DATE REVISED

LAST REVISION 09-20-10 | DATE PLOTTED => 9/20/2011 | TIME PLOTTED => 5:43:39 PM

BORDER LAST REVISED 7/2/2010 | USERNAME => huey_nham | DGN FILE => 0400020004ea004.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0751 | PROJECT NUMBER & PHASE 04000206521

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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

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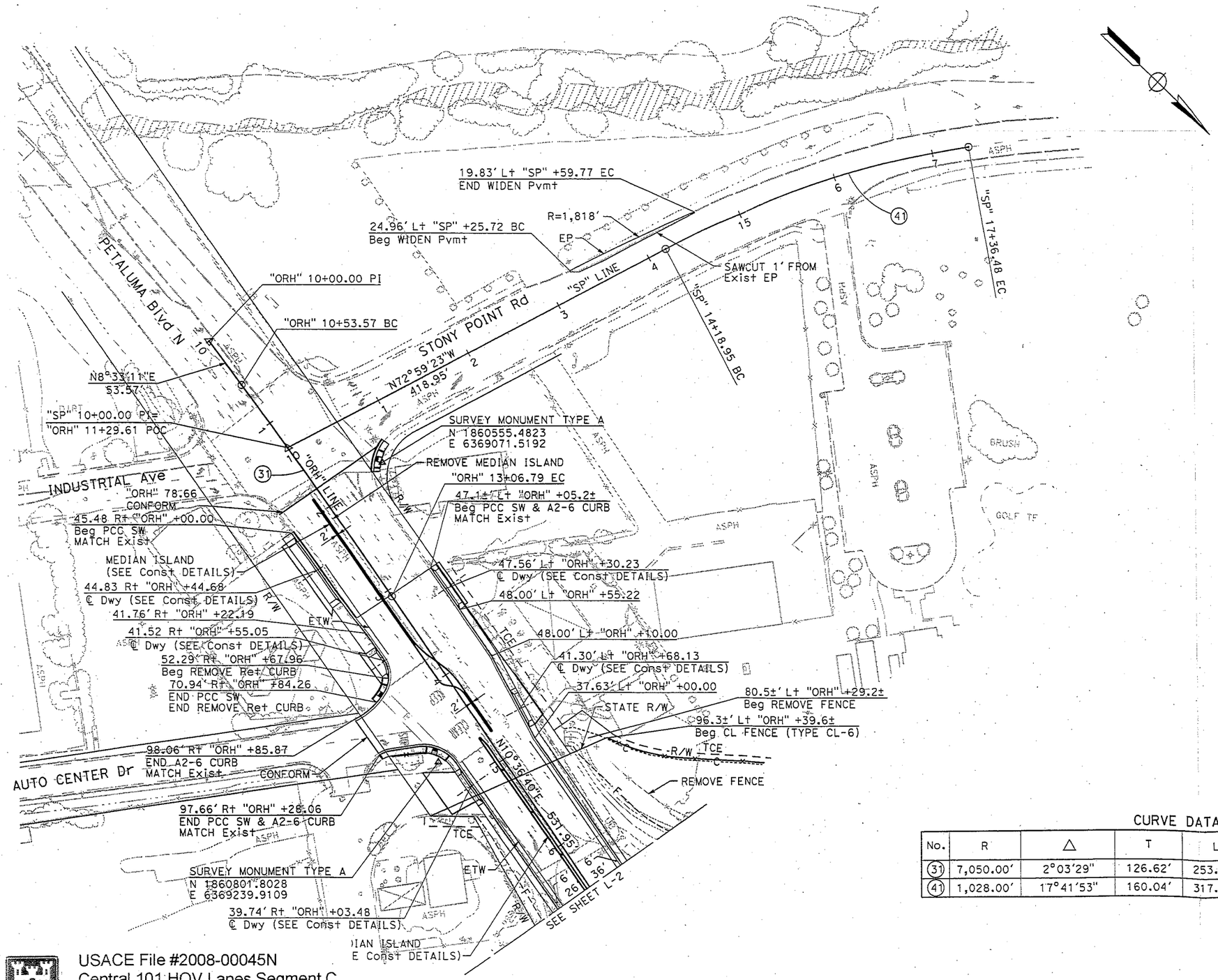
11 ENGLISH STREET
PETALUMA, CA 94952



CURVE DATA

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41	1,028.00'	17°41'53"	160.04'	317.54'	1861586.0745	6369027.1767

U.S. Army Corps of Engineers
San Francisco District
Regulatory Division

USACE File #2008-00045N
Central 101 HOV Lanes Segment C
March 6, 2012
Page 6 of 7

FOR NOTES AND LEGEND, SEE SHEET L-1

LAYOUT

SCALE: 1" = 50'

L-5

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM
CHECKED BY: DAVID WILLIAMS
REVISED BY
DATE REVISED

LAST REVISION 09-20-10
DATE PLOTTED => 9/21/2011
TIME PLOTTED => 3:24:26 PM

U.S. Army Corps of Engineers
San Francisco District
Regulatory Division

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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

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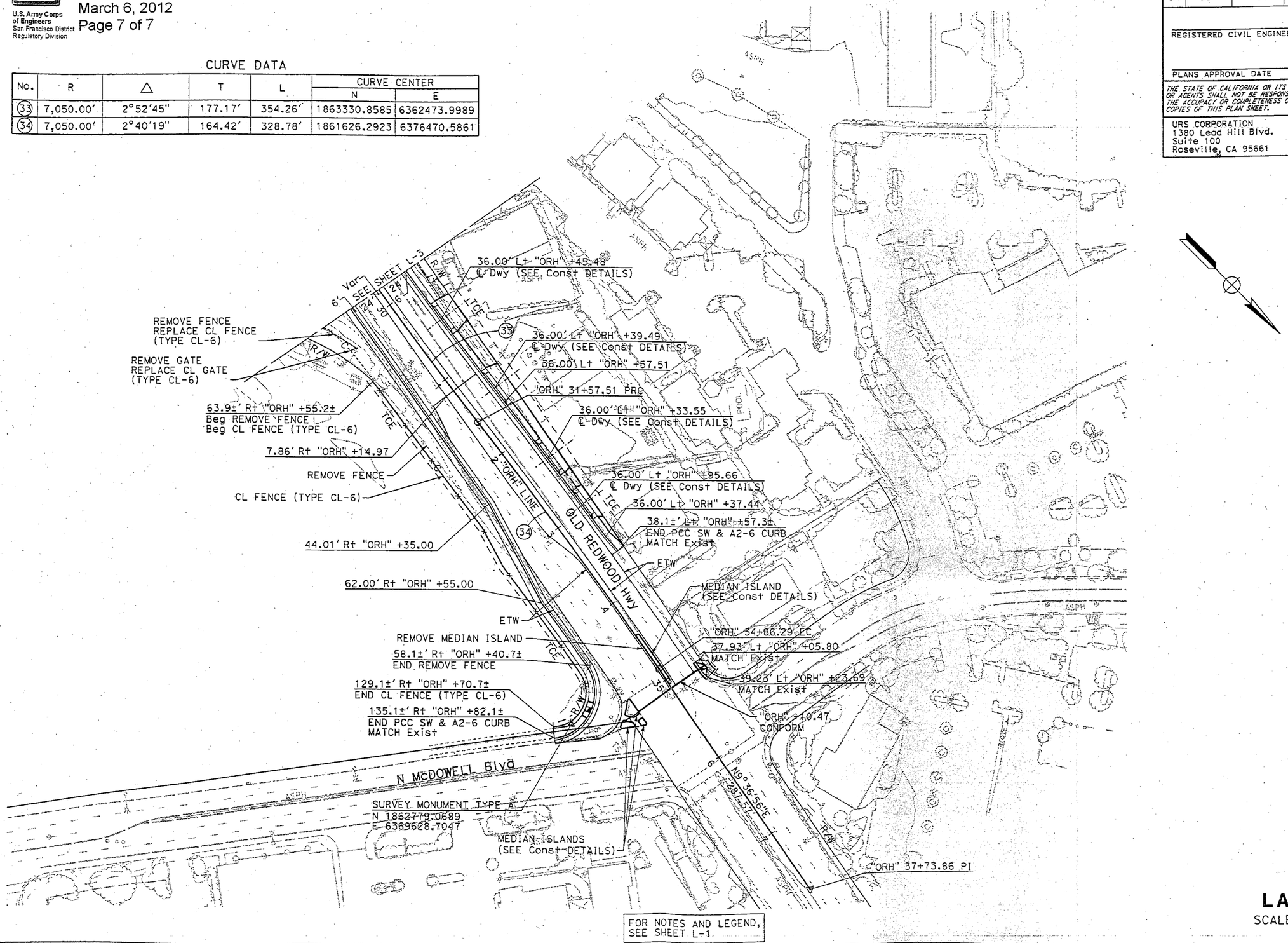
URS CORPORATION
1380 Lead Hill Blvd.
Suite 100
Roseville, CA 95661

CITY OF PETALUMA
11 ENGLISH STREET
PETALUMA, CA 94952

CURVE DATA

No.	R	△	T	L	CURVE CENTER N	CURVE CENTER E
33	7,050.00′	2°52′45″	177.17′	354.26′	1863330.8585	6362473.9989
34	7,050.00′	2°40′19″	164.42′	328.78′	1861626.2923	6376470.5861



LAYOUT
SCALE: 1" = 50′

L-6

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	CONSULTANT FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	DATE REVISED
Caltrans	RAMSEY HISSEN	CHECKED BY	DAVID WILLIAMS	HUEY NHAM

LAST REVISION 09-20-10 | DATE PLOTTED => 9/20/2011 | TIME PLOTTED => 5:43:47 PM

California Regional Water Quality Control Board
San Francisco Bay Region

Matthew Rodriquez
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

February 29, 2012
CIWQS Place No. 769620
401 Database No.: 02-49-C0301

Sent via electronic mail: No hard copy to follow

California Department of Transportation
Attn: Mr. Eric Schen
Eric_Schen@dot.ca.gov
111 Grand Ave.
Oakland, CA 94612-3717

Subject: Water Quality Certification for the State Route 101 Old Redwood Highway Interchange Project, City of Petaluma, Sonoma County

Department Project No.: EA 04-0A1851

Dear Mr. Schen:

We have reviewed and hereby issue water quality certification to the California Department of Transportation (Department) for the State Route 101 Old Redwood Highway Interchange Project (Project). The Department is seeking an Individual Permit for the Project from the U.S. Army Corps of Engineers (ACOE) pursuant to Section 404 of the Clean Water Act (33 U.S.C. § 1344). As such, the Department has applied to the San Francisco Bay Regional Water Quality Control Board (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 the existing State Route 101 (SR 101) freeway interchange with Old Redwood Highway in the City of Petaluma. Major elements of the upgrade include:

- Construction of a new SR 101 overcrossing along Old Redwood Highway/Petaluma Boulevard North using concrete driven piles;
- Construction of seven retaining and sound walls using cast-in-drilled-hole piles;
- Realignment and reconstruction of existing on-ramps and addition of high occupancy vehicle lanes and ramp metering;
- Realignment and reconstruction of off-ramps to increase capacity and meet current design standards;

- Realignment and reconstruction of Old Redwood Highway and Petaluma Boulevard North to align with the new overcrossing approaches;
- Widening of the SR 101 mainline to accommodate interchange reconstruction; and
- Widening the west side of Stony Point Road to accommodate a new left turn pocket on Petaluma Boulevard North.

Impacts: Project implementation would result in the permanent fill of approximately 0.82 acres of jurisdictional seasonal freshwater wetlands and the permanent fill of approximately 616 linear feet of jurisdictional waters. Permanent waters and wetlands impacts are summarized below in Table 1, *Summary of Permanent Impacts.* Project implementation would also result in permanent impacts to ten arroyo and red willows exceeding four inches diameter breast height.

Approximately 0.011 acres of jurisdictional waters would be temporarily impacted due to excavation and placement of an underground drain. Temporary Project impacts are summarized below in Table 2, *Summary of Temporary Impacts.*

Table 1: Summary of Permanent Impacts

Activity	Jurisdictional Feature Impacted (Feature ID)	Acreage and or Linear Footage of Permanent Impact
Fill due to realignment and widening of new Petaluma Boulevard South on-ramp to southbound 101	Roadside wetland in drainage channel along southbound 101 south of Petaluma Blvd. (SW1-e)	0.0175 acres
Fill due to realignment and widening of new Petaluma Boulevard South on-ramp to southbound 101	Roadside wetland in drainage channel along southbound 101 south of Petaluma Blvd. (SW1-f)	0.0319 acres
Fill due to realignment and widening of new Petaluma Boulevard South on-ramp to southbound 101	Roadside wetland in drainage channel along southbound 101 south of Petaluma Blvd. (SW1-g)	0.0025 acres
Fill due to realignment and widening of new Petaluma Boulevard South on-ramp to southbound 101	Roadside wetland in drainage channel along southbound 101 south of Petaluma Blvd. (SW1-h)	0.0211 acres
Fill due to realignment and widening of northbound off-ramp to Old Redwood Highway and extension of gas utility line casings	Roadside wetland in drainage channel along northbound 101 off-ramp to Old Redwood Highway (SW1-m)	0.0986 acres
Fill due to realignment and widening of southbound off-ramp and southbound loop on-ramp	Roadside wetland in drainage channel along southbound 101 off-ramp to Petaluma Blvd. North (SW1-n)	0.3611 acres
Fill due to realignment and widening of the southbound 101 off-ramp and southbound loop on-ramp	Roadside wetland in drainage channel between southbound 101 off-ramp to Petaluma Blvd. North and southbound 101 mainline (SW1-o)	0.0094 acres

Table 1: Summary of Permanent Impacts (continued)

Activity	Jurisdictional Feature Impacted (Feature ID)	Acreage and/or Linear Footage of Permanent Impact
Fill due to realignment and widening of the southbound 101 off-ramp and southbound loop on-ramp	Roadside wetland in drainage channel that outfalls to a drainage channel paralleling the existing southbound 101 off-ramp (SW1-p)	0.0036 acres
Fill due to realignment and widening of the Old Redwood Highway on-ramp to northbound 101	Roadside wetland in drainage channel along Old Redwood Highway on-ramp to northbound 101 (SW1-q)	0.1804 acres
Fill due to realignment and widening of the Old Redwood Highway on-ramp to northbound 101	Roadside wetland in drainage channel along northbound 101 north of Old Redwood Highway (SW1-r)	0.0052 acres
Fill due to realignment and widening of the Old Redwood Highway on-ramp to northbound 101	Roadside wetland in drainage channel along northbound 101 north of Old Redwood Highway (SW1-s)	0.0204 acres
Fill due to realignment and widening of the Old Redwood Highway on-ramp to northbound 101	Roadside wetland in drainage channel along northbound 101 north of Old Redwood Highway (SW1-t)	0.0212 acres
Fill due to realignment and widening of Petaluma Blvd. North on-ramp to southbound 101	Roadside drainage channel along Petaluma Blvd. North on-ramp to southbound 101 (water of State 14)	0.0394 acres
Fill due to realignment and widening of the southbound 101 off-ramp and Old Redwood Highway to southbound 101 loop on-ramp	Roadside drainage channel along Petaluma Blvd. North on-ramp to southbound 101 (water of State 15)	0.0036 acres
Fill due to realignment and widening of the Old Redwood Highway to southbound 101 loop on-ramp	Drainage channel in existing Old Redwood Highway to southbound 101 loop on-ramp (water of State 16)	225 feet (0.0117 acres)
Fill due to realignment and widening of Petaluma Blvd. North on-ramp to northbound 101	Drainage channel in existing Petaluma Blvd. North to northbound 101 loop on-ramp (waters of the State 17)	399 feet (0.0092 acres)
	Total:	0.8159 acres of wetland fill due to roadway widening and realignment; 616 linear feet of roadside waters fill due to roadway widening and realignment

Table 2: Summary of Temporary Impacts

Activity	Jurisdictional Feature Impacted	Acreage and/or Linear Footage of Temporary Impact
Excavation, placement of an underdrain pipe for new biofiltration swale, and in-kind reconstruction of the drainage	Roadside wetland in drainage channel along northbound 101 south of Old Redwood Highway (SW1-l)	0.0063 acres

channel		
Excavation, placement of an underdrain pipe for new biofiltration swale, and in-kind reconstruction of the drainage channel	Roadside wetland in drainage channel along northbound 101 off-ramp to Old Redwood Highway (SW1-m)	0.0046 acres
	Total:	0.0109 acres

Roadway Stormwater Runoff Pollutant Impacts: Project implementation would result in approximately 5.7 acres of new and 5.5 acres of 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. Project implementation would also result in the removal of a biofiltration strip that is currently treating stormwater runoff from 1.4 acres of impervious surface.

Hydromodification impacts: Project implementation would not result in significant hydromodification impacts due to low gradient and aggradation in the receiving waters.

Mitigation: To mitigate for permanent impacts to 0.8159 acres of jurisdictional seasonal freshwater wetlands, the Department has purchased 0.8159 acres of wetland mitigation bank credits from Burdell Ranch Wetland Conservation Bank. To mitigate for the approximately 616 linear feet of roadside waters, the Department shall re-build these ditches in-kind adjacent to their former locations. The Department shall also plant and establish twenty willow trees to mitigate for ten willow trees permanently impacted by Project implementation.

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 12.6 acres of impervious area using four bioretention swales (see Table 3, below for swale details). The four swales will treat approximately 13.1 acres of impervious area, 0.5 acres more than the required 12.6 acres. The Department may use the 0.5 acres of surplus treatment as credit towards the treatment obligations of a future, neighboring project (see certification condition no. 2).

The following bioretention swales will mitigate water quality impacts resulting from Project implementation:

Table 3: Permanent Treatment BMP Summary

Location	Length (feet)	From 101 Post Mile	To 101 Post Mile	Treated Impervious Area (acres)
Adjacent southbound lane, immediately before southbound 101 off-ramp	111	7.46	7.48	0.340
In island between southbound 101, southbound 101off-ramp and Old Redwood Hwy. loop on-ramp to southbound 101	131	7.60	7.62	0.750
Adjacent southbound 101 off-ramp to Petaluma Blvd. North	593	7.60	7.68	1.58
Adjacent the outside of northbound 101 off-ramp to Old Redwood Highway	339	7.58	7.65	10.4
			total:	*13.1*

CEQA Compliance: The Department certified an Environmental Impact Report for this Project pursuant to the provisions of the California Environmental Quality Act on August 30, 2007. On June 16, 2010, the Department revalidated the Notice of Determination, published by the State Clearinghouse on September 13, 2007, that the Project will 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 conditions imposed by the Individual Permit issued to the Department by the Corps;

2. The Department shall install four biofiltration swales to treat stormwater contaminants from no less than 13.1 acres of impervious area. The swales shall be installed and consistent with the information summarized above in "Roadway Pollutant Mitigation, and with the construction details and soil mix specifications included in Attachment A, *Bioretention Swale Details*. The Department may apply 0.5 acres of the 13.1 acres of post-construction stormwater treatment credit to a future project in the same watershed, subject to the acceptance of Water Board staff;

3. The Department shall submit, subject to the acceptance of Water Board staff, a Willow Tree Mitigation and Monitoring Plan (Plan), no later than July 31, 2012, to compensate for the ten willow trees permanently impacted by the Project. The Plan shall:

    a. Include a proposal to plant no less than twenty willows;
    b. Only deem willow plantings successful after five growing seasons, whereupon eighty percent of the planted willows shall exhibit average or improved health and vigor from the previous two growing seasons;
    c. Provide additional planting, maintenance and monitoring until the success criteria is satisfied if the above success criteria is not met;
    d. Deem willow plantings successful only after two full growing seasons have passed upon termination of supplemental watering; and
    e. At a minimum, submit years 0, 1, 3 and 5 monitoring reports to the Water Board;

4. The Project shall be constructed in conformance with the Project Description described in this certification and certification application materials. Any change in the Project that may require modification of the certification shall be approved by the Executive Officer before it is implemented;

5. The Department shall re-build earthen-lined waters of the State 16 and 17, in-kind, adjacent their current locations;

6. Regardless of date, erosion control measures shall be utilized throughout all phases of construction where sediment-laden runoff threatens to enter waters of the State. At no time shall sediment-laden runoff be allowed to enter waters of the State;

7. 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;

8. 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;

9. 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;

10. 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;

11. 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);

12. 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

13. 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 $4,893.00 on November 10, 2011.

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.

Condition 3 is a requirement for information 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

Shin-Roei Lee
2012.02.29
16:32:37 -08'00'

Bruce H. Wolfe
Executive Officer

cc (via e-mail):

Mr. Bill Orme SWRCB-DWQ
Ms. Laurie Monnrres, USACE
Ms. Jane Hicks, Regulatory Branch, USACE
Ms. Holly Costa, Regulatory Branch, USACE
Mr. David Williams, URS Corp.
Mr. Dale Bowyer, Water Board
Mr. Cyrus Vafai, Caltrans
Mr. Hardeep Takhar, Caltrans
Mr. Jason Brush, USEPA
Ms. Paula Gill, USACE

Attachment A

Bioretention Swale Details

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Son	101	7.4/8.1		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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

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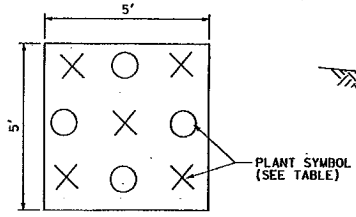
URS CORPORATION
1380 Lead Hill Blvd.
Suite 100
Roseville, CA 95661

CITY OF PETALUMA
11 ENGLISH STREET
PETALUMA, CA 94952

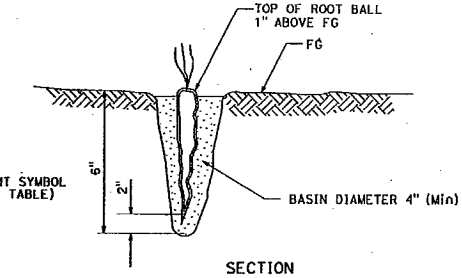
NOTE:

SEE DRAINAGE PLANS, DETAILS, AND QUANTITIES SHEETS FOR MORE INFORMATION.



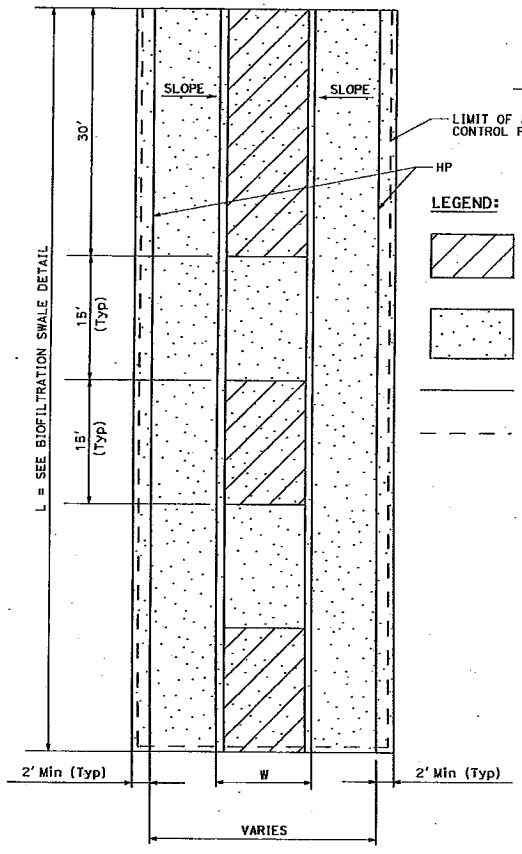
PLAN

TYPICAL LINER PLANTS SPACING



SECTION

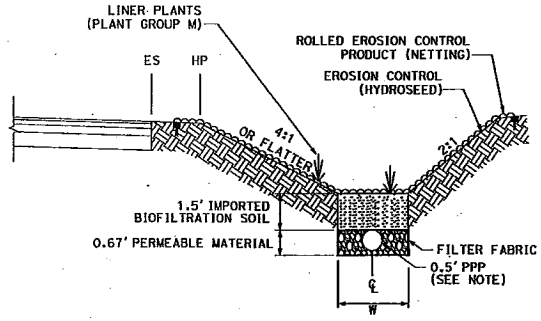
PLANT BASIN (LINER)



PLAN

LEGEND:

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



SECTION

BIORETENTION SWALE DETAIL

PLANT LIST AND PLANTING SPECIFICATIONS

PLANT GROUP	PLANT No.	SYMBOL	BOTANICAL NAME	COMMON NAME	SIZE	QUANTITY (EA)	HOLE SIZE (INCH)	
							Dia	DEPTH
M	1	X	HORDEUM BRACHYANTHERUM	MEADOW BARLEY	LINER	4141	4	6
	2	O	FESTUCA RUBRA 'MOLATE'	MOLATE FESCUE	LINER	3313	4	6

BIORETENTION SWALE

SWALE No.	LOCATION	BOTTOM WIDTH (W)	LENGTH	POST MILE (PM)
1	"ML" 393+25 TO 394+25 Rt	20' TO 25'	111'	7.46 TO 7.48
2	"ML" 400+55 TO 401+40 Rt	12'	131'	7.60 TO 7.62
3	"ONF" 37+45 TO 42+50 Rt	5'	593'	7.60 TO 7.68
4	"OSF" 60+70 TO 62+58 Lt	15' TO 69'	339'	7.58 TO 7.65

EROSION CONTROL DETAILS

NO SCALE

ECD-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: RAMSEY HISSEN

CALCULATED-DESIGNED BY: HUEY NHAM

CHECKED BY: DAVID WILLIAMS

REVISED BY

DATE REVISED

LAST REVISION 09-20-10

DATE PLOTTED => 2/15/2012
TIME PLOTTED => 10:41:52 AM

BORDER LAST REVISED 7/2/2010

USERNAME => huey_nham
DGN FILE => 04000206004gf001.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 0751

PROJECT NUMBER & PHASE 04000206521

10-1.__ IMPORTED BIOFILTRATION SOIL

GENERAL

Summary

This work includes furnishing, and applying biofiltration soil mix.

Submittals

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

Before mixing compost with sand and soil, submit a copy of the compost producer's compost technical data sheet and a copy of the compost producer's Seal of Testing Assurance certification. The compost technical data sheet must include:

1. Laboratory analytical test results
2. List of product ingredients

Before mixing compost with sand and soil, submit a Certificate of Compliance under 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 soil. The ratio of the components of imported biofiltration soil by volume must consist of two parts sand; one part compost; and 0.5 part soil.

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	Inches % Passing 3 100%

	% Dry Weight Basis	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).

Soil

Soil must be free of wood, waste or other deleterious material. The soil 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

Imported biofiltration soil is measured by the cubic yard.

The contract 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.

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-0733-R001

APR 28 2010

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

Subject: Reinitiation of the Biological Opinion on the Effects of the Proposed Three Highway 101 Lane Widening and Improvement Projects in Sonoma County, California: the Old Redwood Highway in Petaluma to Rohnert Park Expressway in Rohnert Park Project, the Wilfred Avenue Interchange Project, and the Steele Lane in Santa Rosa to Windsor River Road Project on the endangered Sebastopol meadowfoam, the endangered Sonoma sunshine, the endangered Burke's goldfield; and the endangered Sonoma County Distinct Population Segment of the California tiger salamander (Caltrans EA 12965, OA100, and OA180 and Service File No. 1-1-05-F-0300 and 81420-2008-F-0733-2)

Dear Mr. Richards:

This is in response to your February 17, 2010, request for reinitiation with the U. S. Fish and Wildlife Service (Service) on the California Department of Transportation's (Caltrans) three Highway 101 Lane Widening and Improvement Projects in Sonoma County, California (Service File Number: 1-1-05-F-0300). The reinitiation is for the northern project segment which encompassed the State Route 101 corridor from Steele Lane in Santa Rosa to Windsor River Road. At issue are the potential effects on the endangered Sebastopol meadowfoam (*Limnanthes vinculans*), the endangered Sonoma sunshine (*Blennosperma bakeri*), the endangered Burke's goldfield (*Lasthenia burkei*), and the endangered Sonoma County Distinct Population Segment of the California tiger salamander (*Ambystoma californiense*). This document is issued pursuant to section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act).

This document represents the second reinitiation of consultation for the three combined projects. The first reinitiation for the original October 18, 2006, biological opinion was completed on April 15, 2008 (Service File: 81420-2008-F-0733-2).

TAKE PRIDE IN AMERICA

January 6, 2010: The Service met Caltrans at the project site to review the Airport Boulevard project description changes.

February 17, 2010: The Service received a request to reinitiate consultation on the Sonoma Highway 101 Widening and Improvement Project from Caltrans. The letter of request was dated February 17, 2010. Reinitiation was based on design changes associated with the Airport Boulevard/State Route 101 interchange modification.

April 12, 2010: The Service received an email from Caltrans clarifying that the design changes to the Phase B activities associated with the Airport Boulevard/State Route 101 interchange project resulted in the addition of 5.07 acres to the overall construction footprint. Therefore the construction footprint for the Northern Project is now 68.45 acres (63.38 + 5.07).

3. Change the project description for the Northern Project from item 3 of the April 15, 2008, reinitiation (which also applies to the first paragraph under the *Description of Proposed Action* on page 8 of the October 18, 2006, biological opinion) from:

The proposed project "corridor" consists of three interrelated, yet independent projects located on Highway 101 between the cities of Windsor and Petaluma in Sonoma County, California. The projects are identified as the approximately 63.38 acre (25.65 hectare) and 7.6-mile (12.23 kilometer) long Northern Project from Steele Lane in Santa Rosa to Windsor River Road in Windsor; the approximately 26.43 acre (10.70 hectare) and 1.6-mile (2.60 kilometer) long Wilfred Project from Rohnert Park Expressway to Santa Rosa Avenue in Rohnert Park; and the approximately 83.06 acre (33.61 hectare) and 6.4-mile (10.30 kilometer) long Central Project from Old Redwood Highway in Petaluma to Rohnert Park Expressway in Rohnert Park. (The Central Project was initially referred to as the Southern Project during the first stages of consultation. All project lengths and areas are based on GIS (Geographic Information System) information provided by Caltrans on June 27, 2005; June 30, 2005; May 2, 2006; May 18, 2006; July 28, 2006, and revised information provided by Caltrans on November 5, 2007.) The combined area for the three highway 101 projects is approximately 172.83 acres (69.94 hectares). The three projects are combined in this biological opinion because of their interrelated and interdependent nature as defined at 50 CFR 402 and as a result of an agreement reached during the February 10, 2004, meeting between the Service, Caltrans, FHWA (Federal Highway Administration), and SCTA (Sonoma County Transportation Authority) to combine formal consultation for these three projects. It was also established at the February meeting that these three projects would be constructed by at least three separate construction contracts. These three projects have been further divided into phases, defined as separate construction contracts and this biological opinion applies to each project or project phase independently.

The Northern Project will be divided into three construction phases. Phase A will consist of all proposed improvements to Highway 101, except soundwalls and ramp improvements at Airport Boulevard and Fulton Road. Phase B includes the ramp improvements to Airport Boulevard and Fulton Road, as well as the new Airport Boulevard overcrossing, collector distribution roads and bridges between Airport Boulevard and Fulton Road, and all project soundwalls.

Phase C consists of final landscaping.

To:

The Northern Project
The Northern Project will be divided into three construction phases.

Phase A comprises widening State Route 101 from four to six lanes; widening State Route 101 shoulders; modifying and adding new drainage structures; widening, extending and adding auxiliary lanes; modifying interchanges; modifying the bridges at Mark West Creek, Poole Creek, and Pruitt Creek; realigning and reconstructing ramps, which include California Highway Patrol enforcement areas and High Occupancy Vehicle bypass lanes; installing ramp metering, closed circuit cameras, changeable message signs, overhead signs, new traffic signals, traffic monitoring stations, and a highway advisory radio system; and constructing retaining walls.

Phase B is scheduled to remove the existing Fulton Road on- and off-ramps and construct a new northbound off-ramp over Mark West Creek to Airport Boulevard. This will require a new bridge over Mark West Creek. It is proposed that this bridge will be a cast-in-place reinforced concrete slab, which will be approximately 133 feet long and 40 feet wide. It will be wide enough to carry two traffic lanes plus shoulders. It is proposed to be a two-span bridge supported by a series of nine 16-inch driven concrete piles, which will be placed in a line paralleling the flow line of the creek.

Caltrans also proposes to widen the existing Mark West Creek Bridge on the west side to accommodate a new on-ramp to southbound State Route 101. The existing bridge will be widened with a cast-in-place reinforced concrete slab type bridge to match the existing one. The widened section will be approximately 150 feet long and vary between 30 and 15 feet in width. It will be wide enough to carry one on-ramp traffic lane plus any area needed for the taper of the ramp metering lane, two shoulders and a portion of the gore area of the on-ramp. The bridge is proposed to be five spans, supported by four bents in the creek. Each bent in the widening section will simply extend the bents of the existing bridge with a series of two to three 16-inch driven concrete piles connected with curtain walls in between. The bents roughly parallel the direction of flow in the creek. There will be a total number of ten new piles.

Table 1. Compensation for loss of California tiger salamander habitat by project.

Affected Area	**Northern Project** (acres)		**Wilfred Project** (acres)	**Central Project** (acres)		**Total** (acres)
Phase	Phase A	Phase B	Phase A	Phase A	Phase B	
Within 500 feet of an individual California tiger salamander at 2:1	0	0	1.86	4.92	0	6.78
Within 500 and 2200 feet of a known California tiger salamander breeding site at 2:1	0	0	0	10.14	0	10.14
Within 2200 feet and 1.3 miles of a known California tiger salamander breeding site at 1:1	0	0	3.41	11.05	0	14.46
Within California tiger salamander dispersal habitat at 0.2:1	6.46	3.53	0	0	0.52	10.52
Total for California Tiger Salamander	**6.46**	**3.53**	**5.27**	**26.11**	**0.52**	**41.90**

To:

Caltrans/SCTA will compensate for the loss of 80.45 acres of California tiger salamander habitat with the acquisition and preservation of 42.88 acres of habitat for the California tiger salamander. Compensation will be achieved by one or more of the following methods: establishment of a conservation easement, development of a management plan, and provision of a perpetual endowment sufficient to cover management and maintenance of protected lands for the benefit and recovery of California tiger salamander; or purchase of credits in a conservation bank approved by the Service to sell California tiger salamander credits in Sonoma County. Funds may be donated to the Santa Rosa Plain Conservation Strategy administered by the California Wildlife Foundation to compensate for the effects of the action on the 57.53 acres of California tiger salamander dispersal habitat as shown in the following Table 1 at 0.2:1 (i.e., 11.50 acres) in lieu of acquiring and preserving 11.50 acres of the 42.88 acres.

As this action covers three (3) independent projects, with multiple construction phases along an approximately 15.6-mile (25.1 kilometer) corridor, compensation may be achieved for each project and project phase independently as shown in the following tables 1 and 2. The calculations used to determine the values in the following Table 1 are as defined by the interim guidance for the Conservation Strategy (Conservation Strategy Team 2005b). Adjustments to areas of effects and corresponding compensations will be

Table 1. Compensation for loss of California tiger salamander habitat by project.

Affected Area	**Northern Project** (acres)		**Wilfred Project** (acres)	**Central Project** (acres)		**Total** (acres)
Phase	Phase A	Phase B	Phase A	Phase A	Phase B	
Within 500 feet of an individual California tiger salamander at 2:1	0	0	1.86	4.92	0	6.78
Within 500 and 2200 feet of a known California tiger salamander breeding site at 2:1	0	0	0	10.14	0	10.14
Within 2200 feet and 1.3 miles of a known California tiger salamander breeding site at 1:1	0	0	3.41	11.05	0	14.46
Within California tiger salamander dispersal habitat at 0.2:1	6.46	4.52	0	0	0.52	11.50
Total for California Tiger Salamander	**6.46**	**4.52**	**5.27**	**26.11**	**0.52**	**42.88**

6. Change the *Action Area* definition from item 9 of the April 15, 2008, reinitiation (which also applies to the *Action Area* definition on page 18 of the October 18, 2006, 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." Based on GIS information provided by Caltrans on June 27, 2005; June 30, 2005; May 2, 2006; May 18, 2006; July 28, 2006; and January 11, 2008, the action area for the proposed action includes all lands associated with the approximately 63.38 acre (25.65 hectare) Northern Project; the approximately 26.43 acre (10.70 hectare) Wilfred Project; and the approximately 83.06 acre (33.61 hectare) Central Project footprints 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." Based on GIS and acreage information provided by Caltrans on June 27, 2005; June 30, 2005; May 2, 2006; May 18, 2006; July 28, 2006; January 11, 2008, and April 12, 2010, the action area for the proposed action includes all lands associated with

known California tiger salamander breeding site. The habitat loss is summarized for each of the three projects in Table 3.

8. Change Table 3 from item 15 of the April 15, 2008, reinitiation (which also applies to the Table 3 on page 38 of the October 18, 2006, biological opinion) from:

Table 3. Effects of proposed action to California tiger salamander habitat by project.

Affected Area	**Northern Project** (acres)		**Wilfred Project** (acres)	**Central Project** (acres)		**Total Area** (acres)
Phase	Phase A	Phase B	Phase A	Phase A	Phase B	
Within 500 feet of an individual California tiger salamander	0	0	0.93	2.46	**0**	**3.39**
Within 500 and 2200 feet of a known California tiger salamander breeding site	0	0	0	5.07	**0**	**5.07**
Within 2200 feet and 1.3 miles of a known California tiger salamander breeding site	0	0	3.41	11.05	**0**	**14.16**
Within California tiger salamander dispersal habitat	32.3	17.67	0	0	**2.61**	**52.58**
Total	**32.3**	**17.67**	**4.34**	**18.58**	**2.61**	**75.5**

To:

mitigation banks and preserves likely would ensure that the conservation values of the bank or preserve would be maintained to provide optimal conditions for breeding, foraging, refugia, and dispersal of tiger salamanders.

10. Change item 18 of the April 15, 2008, reinitiation (which also applies to the *Conclusion* section on page 43 of the October 18, 2006, biological opinion) from:

After reviewing the current status of the California tiger salamander and the three listed plants, the environmental baseline for the action areas, and the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the three Highway 101 projects are not likely to jeopardize the continued existence of these four listed species. We based these determinations on the following: (1) the effects analysis and compensation abide by the guidelines of the Conservation Strategy, (2) the action area primarily provides upland habitat for the California tiger salamander, (3) no California tiger salamander breeding ponds will be lost within the action area, and/or (4) numerous conservation measures would be implemented to minimize the effect of take on individual California tiger salamanders and the three listed plants. The loss of upland foraging, dispersal, and seasonal wetland habitat within the action area will be minimized by the preservation and management of 41.90 acres of tiger salamander habitat and the acquisition of 0.7 acres of occupied or established and 0.35 established habitat for any of the three listed plants. Critical habitat has not been proposed or designated for the three listed plants; therefore none will be adversely modified. Critical habitat has not been designated for the California tiger salamander; therefore none will be adversely modified.

To:

After reviewing the current status of the California tiger salamander and the three listed plants, the environmental baseline for the action areas, and the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the three Highway 101 projects are not likely to jeopardize the continued existence of these four listed species. We based these determinations on the following: (1) the effects analysis and compensation abide by the guidelines of the Conservation Strategy, (2) the action area primarily provides upland habitat for the California tiger salamander, (3) no California tiger salamander breeding ponds will be lost within the action area, and/or (4) numerous conservation measures would be implemented to minimize the effect of take on individual California tiger salamanders and the three listed plants. The loss of upland foraging, dispersal, and seasonal wetland habitat within the action area will be minimized by the preservation and management of 42.88 acres of tiger salamander habitat and the acquisition of 0.7 acres of occupied or established and 0.35 established habitat for any of the three listed plants.

To:

Dan Crum, Resident Agent-in-Charge of the Service's Law Enforcement Division at (916) 414-6660. The California Department of Fish and Game contact is Melissa Escaron at (707) 339-0334.

This concludes the reinitiation of the formal consultation on the three Highway 101 Lane Widening and Improvement Projects in Sonoma County. As provided in 50 CFR 402.16, 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 re-initiation.

If you have any questions regarding this reinitiation of the biological opinion for the three Highway 101 Lane Widening and Improvement Projects in Sonoma County, please contact John Cleckler or Ryan Olah at the letterhead address or at (916) 414-6600.

Sincerely,

Susan K. Moore
Field Supervisor

cc:
Liam Davis, California Department of Fish and Game, Yountville, California
Melissa Escaron, California Department of Fish and Game, Yountville, California
Patrick Moeszinger, California Department of Fish and Game, Yountville, California
Scott Wilson, California Department of Fish and Game, Yountville, California
Steven Bargsten, Regional Water Quality Control Board, Santa Rosa, California
Michael Monroe, Environmental Protection Agency, San Francisco, California
Guy Preston, Preston Engineering Management Consulting, Ashland, Oregon