FOUNDATION REPORT
US 50/LATROBE ROAD
WEST BOUND OFF-RAMP UC
(BRIDGE NO. 25-0122K)
03-ED-50, EA 03-2E5101

EL DORADO COUNTY, CALIFORNIA

Prepared by:

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March 2012

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File No. 1072.8
March 30, 2012

Mr. Brent Lemon, P.E.
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3247 Ramos Circle
Sacramento, CA 95827

Subject: **FOUNDATION REPORT**
US 50/Latrobe Road West Bound Off-Ramp UC
Bridge No. 25-0122K, 03-ED-50, EA 03-2E5101
El Dorado County, California

Dear Mr. Lemon:

Blackburn Consulting (BCI) is pleased to submit this Foundation Report for the Latrobe Road West Bound Off-Ramp UC, New Bridge No. 25-0122K, in El Dorado County, California. BCI prepared this report in accordance with our Agreement dated February 3, 2012 between BCI and Quincy Engineering, Inc. We submitted a Draft Foundation Report on March 5, 2012 and incorporate review comments in this report. Review comment and response is included in Appendix C.

Thank you for the opportunity to be part of your design team. Please call if you have questions or require additional information.

Sincerely;

BLACKBURN CONSULTING

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FOUNDATION REPORT
US 50 / Latrobe Road West Bound Off-Ramp UC
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El Dorado County, California

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1 INTRODUCTION

1.1 Purpose

Blackburn Consulting (BCI) prepared this Foundation Report for the proposed Latrobe Road West Bound Off-Ramp Undercrossing (UC, Bridge No. 25-0122K) in El Dorado County, California. BCI prepared this report in accordance with our Agreement dated February 3, 2012 between BCI and Quincy Engineering, Inc. (QEI).

BCI prepared this report for QEI and the design team to use for project design. Do not use or rely upon this report for different locations or improvements without the written consent of BCI.

1.2 Scope of Services

To prepare this report, BCI:

- Discussed the project with the QEI design team
- Reviewed available project documentation provided by QEI and obtained by BCI
- Reviewed published maps and literature related to site soil, rock, and geologic conditions
- Drilled/excavated, logged, and sampled one boring and one trench to supplement existing subsurface data at the UC location
- Performed engineering analysis

1.3 Site Description

The project is located on US 50 about 4,500 feet east of the Sacramento County line in El Dorado County, California where US 50 crosses over Latrobe Road. Latrobe Road changes to El Dorado Hills Boulevard immediately north of US 50. The project is part of the US 50 Phase-1 HOV Lane Project that extends from the Sacramento/El Dorado County line (PM 0.0) to west of Bass Lake Road (PM 2.9) along US 50. Figure 1 shows the bridge site location.

1.4 Project Description

The proposed project is approximately the 4th construction phase (and final bridge construction phase) of the ultimate improvement project for this interchange. Funding for the project is State and Local. The overall project consists of reconstruction of the westbound on- and off-ramps of the El Dorado Hills Boulevard/Latrobe Road interchange on US 50 from Post Mile (PM) 0.20 to 1.40. Proposed improvements include:

- West bound diagonal on-ramp
- West bound loop off-ramp
- Latrobe Road West Bound Off-Ramp UC (Bridge No. 25-0122K)
- Installation of new signals at the westbound ramp intersection
- Modifications to the existing intersection at El Dorado Hills Boulevard and Saratoga Way
- Overhead sign structure at the off-ramp exit
- Drainage system improvements
- Removal of the existing west bound ramps and signalized intersection

The UC bridge will consist of a two-span precast, prestressed, concrete box girder structure and will be 200 feet long and approximately 39 feet wide. The new deck grade will pass through elevation 630.14 at Abutment-1 (west end) and 626.95 at Abutment-3 (east end).

The substructure will consist of high wall abutments and a two-column bent, all supported on spread footings in rock. Based on discussions with QEI, uniform base of spread footing foundations are planned at elevation 598.0 feet for all supports.

New retaining walls will include Standard Type 1 walls on the north side of the bridge with infill walls on the south side (between the new bridge and the existing). The infill wall will have a height similar to the abutment walls (approximately 24 to 30 feet). The retaining walls on the north side will vary in height from 16 to 24 feet with foundations stepping up from elevation 602 feet to 610 feet. See the General Plan and Foundation Plan attached in Appendix A for bridge details.

Benchmark datum used for this project is National Geodetic Vertical Datum of 1929 and North American Datum of 1983.

2 DOCUMENT REVIEW

To determine subsurface conditions and develop foundation design and construction recommendations, BCI reviewed the following structure/site information published by the State of California Bridge Department (Caltrans) and private consultant reports.

2.1 Caltrans

- Foundation Study, Latrobe Road UC, III-EC-11-A, Bridge No. 25-71 R/L, OR, March 15, 1963.

- As-Built Plans, Latrobe Road Undercrossing, Sheets 1/11 – 11/11, As-Built stamp undated, plans dated January 6, 1964.

- Memorandum, Foundation Report for Latrobe Road UC (Br-25-71 R/L & OR), August 3, 1965.

- Memorandum, Preliminary Geologic Recommendations and Resource Estimate for Advance Planning Study, Latrobe Road Undercrossing, Bridge No. 25-0071 LR, April 5, 2000.

- Memorandum, Seismic Design Recommendations, Latrobe Road Undercrossing, Bridge No. 25-0071 LR, March 31, 2000.

2.2 Consultant Reports

- Blackburn Consulting, Foundation Report, Latrobe Road UC, Bridge No. 25-0122, EA 03-3A7111, El Dorado County, March 11, 2008

- Taber Consultants, Foundation Investigation, Latrobe Road Retaining Wall, Bridge No. 25E0002, 03-ED-50-1.1/1.7, El Dorado County, December 6, 2004.

- Taber Consultants, Foundation Investigation, Latrobe Rd WB OR UC Bridge May 14, 2002.

- España Geotechnical Consulting, Final Materials Report for the El Dorado Hills Boulevard-SR 50 Interchange, 03-EL-50-KP 0.28/2.52, El Dorado County, for CH2M Hill, January 2002.

3 SUBSURFACE INVESTIGATION

Considering the significant amount of existing subsurface data at the bridge location and adjacent bridge locations, we performed only minor additional subsurface investigation. For the ramp work, BCI completed a trench near Abutment 1 and one boring near Abutment 3. Taber (2002) completed 3 borings (one at each abutment and 1 at the center bent) at the bridge site during a previous study; this is the primary subsurface information source for this project. In addition, other subsurface investigations have been completed for the original mainline UC and the recent bridge replacement project. We discuss the findings of these investigations further in Section 5.3, Subsurface Soil and Rock Conditions.

4 LABORATORY TESTS

For this study, the following laboratory tests were performed on soil/rock samples obtained from our test boring/trench:

- Moisture Content-Dry Density (ASTM D2937 & D2216)
- pH/Minimum Resistivity (CTM 643)
- Chloride (CTM 422) and Sulfate (CTM 417)

We attach laboratory test results in Appendix A.

5 SITE GEOLOGY AND SUBSURFACE CONDITIONS

5.1 Regional Geology

The project is located within the foothills of the Sierra Nevada geomorphic province of California. The Sierra Nevada has a general northwest topographic trend and is on the order of 430 miles long and 40 to 80 miles wide. Rock of the Sierra Nevada was created roughly 120 to 130 million years ago when sediments as thick as 30,000 feet along with volcanic rocks were buckled and warped resulting in a series of low mountain ranges. The roots of these mountain ranges were then intruded by granitic rock.

The Sierra Nevada was tilted upward as a result of faulting along the east edge of the mountain ranges. In the higher elevations of the Sierra Nevada, much of the older sedimentary rock has been eroded to expose granitic rock. Older rocks that remain have been metamorphosed and are exposed in the foothills of the Sierra Nevada.

Most of El Dorado County is underlain by Mesozoic-age metavolcanic and metasedimentary rocks. The metamorphic rock structure is dominated by a series of northwest-trending faults and fault zones that mark the boundaries of various rock types.

5.2 Local Geology and Faulting

Published geologic mapping by Wagner[1] and Busch[2] shows Jurassic-age metavolcanic and metasedimentary rock throughout the project area. The mapping also shows the north-south trending West Bear Mountains Fault (a.k.a., Prairie Creek-Spenceville-Deadman Fault per Caltrans) about 1,000 feet east of the Latrobe Road UC. We show local site geology and faulting on Figure 2 (based on Busch, 2001).

West of the West Bear Mountains Fault, the referenced mapping shows metavolcanic rock associated with the Copper Hill Volcanics ("mostly mafic to andesitic pyroclastic rocks, lava and pillow lava; subordinate felsic porphyritic and pyroclastic rocks") and metasedimentary rock associated with the Salt Springs Slate ("mostly dark gray slate with subordinate tuff, greywacke and rare conglomerate"). East of the West Bear Mountain Fault, mapped geology is shown as ophiolitic terrain comprised of metavolcanic rocks ("mafic to felsic; minor sedimentary rock") and metasedimentary rocks ("slate, quartzite, chert, carbonate rock").

The referenced mapping does not show the project site within an ultramafic rock area. However, ultramafic rocks are mapped nearby. This is a common host rock for naturally occurring asbestos minerals (NOA). Geologic mapping of asbestos containing rocks by Churchill[3] shows

[1] Wagner, D.L. et al, "Geologic Map of the Sacramento Quadrangle, California", California Geological Survey, Map No. 1A, 1981, revised 1987.
[2] Busch, "Generalized Geologic Map of El Dorado County, California", June, 2001, California Geological Survey, OFR 2000-03.
[3] Churchill, et al., 2000, "Areas More Likely to Contain Natural Occurrences of Asbestos in Western El Dorado County, California", California Geological Survey, OFR 2000-02

an "area more likely to contain naturally occurring asbestos" about one mile north of the Latrobe Road UC and also east of Bass Lake Road (2 miles east of the project). The mapping shows the entire project interval to be within an area "that probably does not contain asbestos."

Mapping by Bruyn, 2005[4], shows the project within a "Quarter Mile Buffer for More Likely to Contain Asbestos or Fault Line". Churchill discusses the possibility of serpentine occurring in faults or within fault zones, which may contain chrysotile or tremolite/actinolite asbestos.

During our surface reconnaissance of the project area and in our subsurface exploration, we did not observe outcrops containing serpentinite, a host rock for NOA, or significant bands of fibrous (asbestiform) minerals within the visible bedrock. As discussed above, NOA mapping does not show the project interval within an ultramafic rock area, although the project is near mapped faults and other areas known to contain naturally occurring asbestos.

5.3 Subsurface Soil and Rock Conditions

5.3.1 Caltrans

Subsurface exploration performed by the State in December 1962 consisted of five, 1-inch soil tube borings, supplemented by three 2.5-inch diameter cone penetration borings. The cone penetration borings were driven to effective refusal at depths varying from 5 feet to 30 feet using a No. 2 M^c^Kiernan-Terry air hammer at 115 psi.

The foundation study and LOTB drawing indicate that subsurface materials at the site consist of clay and fill underlain by slate [rock]. Appendix A includes the LOTB drawing (January 6, 1964) for those borings.

5.3.2 Previous Consultant Explorations

The referenced Taber Consultants (Taber) reports are the most pertinent to the project. Taber drilled three exploratory borings to a maximum depth of 46 feet below the ground surface (bgs) in February 1999 at the UC location (Taber 2002 report). Taber used solid-stem flight auger and rotary drilling methods to drill through soil and weathered bedrock, and diamond-coring equipment to drill the borings through the less weathered rock.

In general, Taber identified metamorphic rock at elevations ranging from approximately 613 ft near Abutment 1 (west end) to 616 ft near Abutment 3 (east end). In the boring completed in El Dorado Hills Boulevard/Latrobe Road near Bent 2, rock was encountered at a depth of about 1.5 ft below the ground surface (approx. elevation of 603 ft). In the boring at El Dorado Hills Blvd/Latrobe Road and the boring at Abutment 3, the upper 17 to 20 feet of rock is described as "very intensely weathered and fractured". Below these depths and in the boring completed near

[4] Bruyn, 2005, "Asbestos Review Areas, Western Slope, County of El Dorado, State of California", El Dorado County

Abutment 1, the rock is generally described as "moderately to slightly weathered." Fill and native soil overlay the rock. In Appendix A, we include the Taber LOTB information (redrafted) on our LOTB for the project.

5.3.3 BCI Exploration

For this project, BCI primarily used the data from the 1999 Taber LOTB. For the ramp work, we completed an additional trench near Abutment 1 and one boring near Abutment 3. These exploration points confirm the presence of shallow rock near the abutments. We include a soil / rock unit profile with engineering properties in Appendix B.

At Abutment 1, rock at and below foundation level (elev. 598) is moderately to slightly weathered, intensely to moderately fractured, and hard to very hard. The Rock Quality Designation (RQD) for cores near foundation level range from 10 to 26%. We classify this rock as having "very poor" to "poor" rock mass quality based on Table 4.4.8.1.2A, Caltrans Bridge Design Specifications, November 2003.

At Bent 2, rock at and below foundation level is decomposed to moderately weathered, very intensely to intensely fractured, and very soft to soft. Coring was not necessary at foundation level and SPT blowcounts ranged from 66 to 54 for a 6-inch drive.

At Abutment 3, rock at and below foundation level is moderately to slightly weathered, intensely fractured and very hard. RQD for core near foundation level ranges from 0 to 100%. We classify rock as having "very poor to fair" rock mass quality.

Appendix A contains the LOTB drawings for this study which provides more specific soil and rock descriptions and an explanation of descriptive terms used to log soil and rock core. Appendix A also contains the description of the exploration and sampling methods, and laboratory tests conducted on samples obtained during the exploration.

5.4 Groundwater

5.4.1 Caltrans

The 1963 Caltrans foundation study states "Groundwater was not encountered during the field study; however, surface water was present." The April 5, 2000 Memorandum states "Groundwater was encountered during the field investigation in December 1962. The highest groundwater elevation (per 1963 datum) measured at the site is at elevation 187.3 m (614.5 ft)." The as-built LOTB shows groundwater levels as follows in Table 1:

Table 1 – Groundwater Summary from 1963 Foundation Study

Boring No.	Boring Elevation (Ground Surface, ft)	Measured Groundwater Elevation (ft)
B5	607.8	607.3
B6	614.5	613.5
B7	612.0	609.0
B8	612.6	612.6

Note: Elevations shown are referenced to datum used in 1963

5.4.2 Previous Consultant Explorations

Taber encountered groundwater at depths ranging between about 7 feet and 14 feet bgs (elevation of 614.7 feet to 592.2 feet) in borings completed in February 1999.

5.4.3 BCI Observations

During our subsurface exploration for the Latrobe Road UC (June 2007), we encountered groundwater at a depth of about 36 feet (elevation 591.6 feet msl) in Boring 07-B2. We did not encounter groundwater within the augered intervals in Borings 07-B1 or 07-B3 to depths of 16 feet (elevation 605.5 feet) and 5 feet (elevation 600.2 feet), respectively. We did not obtain groundwater measurements in those borings below the augered intervals due to the presence of drill fluid.

During construction of the recent mainline UC improvements (May 2010), we observed groundwater in foundation excavations for the abutments and bent (base of excavation at elevation 598 feet). This water required pumping for removal prior to placement of concrete. Foundation excavation was completed during a very wet spring season.

In general, we expect:

- overburden soils and upper portions of decomposed rock to be seasonally saturated
- shallow groundwater and seepage along the soil/rock interface and within shallow, fractured rock during the winter months or extended periods of rainfall
- groundwater within the underlying less-weathered rock to be discontinuous, likely transmitted as seepage through rock discontinuities (e.g., fractures, joints, etc.).

6 CORROSION EVALUATION

6.1 Previous Studies

Taber Consultants evaluated soil corrosivity for previous studies made within the project area in the vicinity of the Latrobe Road UC. Laboratory test results indicate a "non-corrosive" soils environment as defined by the September 2003 Caltrans "Corrosion Guidelines" publication.[5]

BCI evaluated soil and weathered rock samples obtained during our site exploration for the adjacent mainline UC project. Test results for that project also indicate a "non-corrosive" soils environment. Table 2 presents those corrosivity test results.

Table 2 - Soil Corrosion Test Summary

Boring and Sample	Depth (ft)	Approx. Elevation (ft)	Minimum Resistivity (Ohm-cm)	pH	Chloride Content (ppm)	Sulfate Content (ppm)
B1-1	5.5	616	1,930	7.01	16.4	52.2
B1, Run 1	15.5	606	1,050	7.55	31.7	154.4
B2-4	21	607	3,220	7.25	6.1	18.6

The laboratory test results indicate a "non-corrosive" soils environment as defined by the Caltrans "Corrosion Guidelines" publication (2003).

6.2 Current Study

BCI completed an additional corrosion test on a sample of weathered rock from Boring A-12-104 near Abutment 3. Test results indicate the following:

- Chloride content of 4 ppm
- Sulfate content was non-detectable
- Minimum resistivity of 2,931 Ohm-cm
- pH of 8.67

The additional test supports a "non-corrosive" soils/weathered rock environment. Appendix A contains the test result.

[5] Caltrans considers a site to be corrosive to foundation elements if one or more of the following conditions exist: 1) Chloride concentration is greater than or equal to 500 ppm, 2) sulfate concentration is greater than or equal to 2000 ppm, or 3) pH is 5.5 or less (Corrosion Guidelines, Version 1.0, 2003).

7 NATURALLY OCCURRING ASBESTOS

Previous studies referenced above include laboratory tests on rock to evaluate the presence of naturally occurring asbestos. None of the samples tested detected the presence of naturally occurring asbestos minerals at or near the bridge site.

BCI evaluated soil/rock samples obtained during the subsurface exploration for the mainline UC for the presence of naturally occurring asbestos (NOA). Asbestos TEM Laboratories, Inc. tested the samples in accordance with the California Air Resources Board (CARB) Method 435 for determination of asbestos.

For the adjacent Latrobe Road UC project, laboratory test results on two samples, Sample ID: LB-2-1 II and LB-2-5 III, show <0.25% Actinolite and “None Detected”, respectively.

8 SEISMIC DATA AND EVALUATION

8.1 Geologic Hazards

Published mapping does not show landslide features within the project interval. Based on our review, existing fill and cut slopes in the project area have performed well and appear stable. The high, north facing, rock cut on the eastbound off-ramp (south side of US 50) has experienced some slab, and wedge failures due to the steepness of the slope and exposure of discontinuities with unfavorable orientation; these conditions are not present near the west bound off-ramp UC. We did not observe significant geologic hazards (such as landsliding, settlement, soft soils, severe erosion, springs, etc) during our review of the subject site.

8.2 Seismic Study

8.2.1 Ground Motion Study

Based on Caltrans ARS Online (V1.0.4) and other mapping, the closest recognized Late Quaternary or younger fault is the Bear Mountains Fault Zone (Rescue Fault section, Caltrans Fault ID No. 83, Maximum Magnitude, MMax = 6.5) located approximately 8.75 miles (14 km) east of the site. Figure 3, Seismic Hazard Map in Appendix A, shows the approximate fault locations.

We used the Caltrans ARS Online (web-based tool) to calculate both deterministic and probabilistic acceleration response spectra for the site based on criteria provided in Appendix B of the Caltrans Seismic Design Criteria (Revision Date:11/2010). Caltrans design spectrum is based on the larger of the deterministic and probabilistic spectral values.

The deterministic spectrum is determined as the average of median response spectra calculated using ground motion prediction equations developed under the “Next Generation Attenuation”

(NGA) project. 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. Probabilistic analysis includes deaggregation for applicable fault distance when near-fault effects apply (as for the UC site).

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 of the soil profile. For the project site, we assume a Site Class B/C with Vs30 equal to 760 meters per second (approximately 2,500 feet per second) based on the mapped ground conditions (underlain by shallow metamorphic rock).

In general, the minimum deterministic spectra controls at shorter site periods and the probabilistic spectra controls at longer periods (above about 0.9 seconds). The peak ground acceleration (PGA) at the site is approximately 0.2g based on Caltrans ARS Online and minimum deterministic levels of ground acceleration. We present data points for site spectra in the Table 3 below and graphed site spectra in Figure 4.

Table 3 - Caltrans ARS Online Envelope* Spectrum Data

Period	SA	Period	SA	Period	SA	Period	SA
0	0.197	**0.085**	0.376	**0.35**	0.333	**1.4**	0.092
0.01	0.197	**0.09**	0.389	**0.36**	0.327	**1.5**	0.086
0.02	0.201	**0.095**	0.401	**0.38**	0.315	**1.6**	0.082
0.022	0.204	**0.1**	0.414	**0.4**	0.303	**1.7**	0.078
0.025	0.208	**0.11**	0.43	**0.42**	0.291	**1.8**	0.074
0.029	0.214	**0.12**	0.445	**0.44**	0.279	**1.9**	0.071
0.03	0.216	**0.13**	0.458	**0.45**	0.273	**2**	0.068
0.032	0.221	**0.133**	0.461	**0.46**	0.267	**2.2**	0.061
0.035	0.228	**0.14**	0.468	**0.48**	0.257	**2.4**	0.055
0.036	0.231	**0.15**	0.476	**0.5**	0.248	**2.5**	0.052
0.04	0.241	**0.16**	0.476	**0.55**	0.223	**2.6**	0.05
0.042	0.246	**0.17**	0.474	**0.6**	0.203	**2.8**	0.046
0.044	0.251	**0.18**	0.472	**0.65**	0.185	**3**	0.042
0.045	0.254	**0.19**	0.469	**0.667**	0.18	**3.2**	0.039
0.046	0.256	**0.2**	0.466	**0.7**	0.171	**3.4**	0.036
0.048	0.262	**0.22**	0.444	**0.75**	0.158	**3.5**	0.034
0.05	0.267	**0.24**	0.423	**0.8**	0.148	**3.6**	0.033
0.055	0.284	**0.25**	0.413	**0.85**	0.138	**3.8**	0.031
0.06	0.3	**0.26**	0.403	**0.9**	0.131	**4**	0.029
0.065	0.317	**0.28**	0.386	**0.95**	0.126	**4.2**	0.027
0.067	0.323	**0.29**	0.377	**1**	0.121	**4.4**	0.026
0.07	0.333	**0.3**	0.369	**1.1**	0.112	**4.6**	0.025
0.075	0.348	**0.32**	0.354	**1.2**	0.104	**4.8**	0.024
0.08	0.362	**0.34**	0.34	**1.3**	0.097	**5**	0.023

* Envelope data for this site is a combination of the Minimum Deterministic Spectra and Probabilistic Spectra

8.2.2 Liquefaction Evaluation

Liquefaction can occur when saturated, loose to medium dense, granular soils (generally within 50 feet of the surface), or specifically defined cohesive soils, are subjected to ground shaking. Rock is present at shallow depths throughout the project site. We consider the potential for detrimental soils liquefaction to be very low to nonexistent.

8.2.3 Fault Rupture

The site does not lie within or adjacent to an Alquist–Priolo Earthquake Fault Zone for fault rupture hazard (Bryant and Hart, 2007)[6], and no known active faults cross the project location. The referenced mapping by Busch shows the main trace of the West Bear Mountains Fault (Prairie Creek-Spenceville-Deadman Fault) crossing US 50 about 1,000 feet east of Latrobe Road and a north-south trending splay associated with this fault crossing US 50 about 3,000 feet east of the Latrobe Road. Jennings (1994)[7] shows the West Bear Mountains Fault as Pre-Quaternary in age (>1.6 million years), considered inactive. The Caltrans Deterministic PGA Map (September 2007) does not show this fault as an active seismic source and shows no active faults in the project area. The closest fault considered in ground motion analysis is the East Bear Mountains Fault (or Rescue section, Caltrans Fault Identification No. 83) located approximately 8 miles east of the site (see Figure 3). We consider the potential for fault rupture at the site to be low.

8.2.4 Seismic Settlement

During a seismic event, ground shaking can cause densification of granular soil above the water table that can result in settlement of the ground surface. As discussed above, rock is present at shallow depth throughout the site. We consider the possibility of detrimental seismic settlement at this site to be low when embankment fills are constructed in accordance with Caltrans specifications.

8.2.5 Seismic Slope Instability

We consider the potential for seismic slope instability in the form of landslides and mudslides at this site to be very low to nonexistent. Similarly, we consider the potential for seismically induced rockslides or rockfall on engineered cut/fill slopes constructed no steeper than 1.5H:1V to be very low.

9 AS-BUILT FOUNDATION DATA

The Caltrans April 5, 2000 Memorandum presents a summary of the existing Latrobe Road UC, Bridge No. 25-0071 LR foundations. Table 4 below summarizes the foundation data obtained from the as-built plans, foundation report and the memorandum.

[6] Fault Rupture Hazard Zones in California, Special Publication 42, Interim Revision; California Geological Survey
[7] Fault Activity Map of California and Adjacent Areas, Geologic Map No. 6, California Division of Mines and Geology

Table 4 - As-Built Foundation Data for Latrobe Road UC, Bridge No. 25-0071 LR

Location	Foundation Type	Design Bearing Capacity (tsf)	Pile Design Loading (ton)	R/L Elevation* (ft)
Abutment 1R/1L	10 BP 42 H-Pile	--	45	597.3/600
Bent 2R	Spread Footing, 8 ft square by 2 ft thick	4	--	600/600
Bent 2L				600/600
Bent 3R				599.2/601
Bent 3L				601/601
Bent 4R				600.5/601
Bent 4L				601/601
Abutment 5R/5L	10 BP 42 H-Pile	--	45	601.6/605.2

* Bottom of footing elevation and average tip elevations. The average tip elevations shown on the as-built plans vary slightly from the average taken from the pile driving records. The values presented are the averages obtained from the pile driving records. Elevations shown in the table are referenced to datum used in 1963 for original study, and are approximately 2.6 feet lower than current NAVD 88 project datum.

All piles were driven using a Delmag D12 Diesel hammer. For the right bridge abutments, embankment fill was predrilled prior to driving piles. Predrilling was not required for the left bridge abutments. The spread footing at Bent 3 (right bridge, right column) was overexcavated 1.8 feet below the planned elevation. The spread footing at Bent 4 (right bridge, right column) was overexcavated 0.5 feet below the planned elevation.

As-built information has not yet been released for the mainline bridge replacement project in 2010 but the design foundation information is as follows in Table 5:

Table 5 – Foundation Design Information for Latrobe Mainline Bridge Replacement

Support Location	Spread Footing Size (ft)		Bottom of Footing Elevation (ft)	Minimum Footing Embedment Depth (ft)	WSD (LRFD Service-I Limit State Load Combination)	LRFD		
						Service	Strength $\varphi_b = 0.45$	Extreme Event $\varphi_b = 1.0$
	B	L			Allowable Gross Bearing Capacity (ksf)	Permissible Net Contact Stress (ksf)	Factored Gross Nominal Bearing Resistance (ksf)	Factored Gross Nominal Bearing Resistance (ksf)
Abut 1	18.0	142.0	598.0	5.0	7.5	N/A	N/A	N/A
Bent 2	12.0	14.0	598.0	7.0	N/A	23.0	15.0	34.0
Abut 3	18.0	142.0	598.0	5.0	7.5	N/A	N/A	N/A

It is our understanding, based on limited observation during construction and discussion with others, that the fractured and weathered nature of the rock allowed for foundation excavation with conventional equipment (significant chiseling was not necessary).

10 FOUNDATION RECOMMENDATIONS

We consider the most appropriate foundation type at this site to be spread footings established within the underlying rock unit. Below, we provide specific recommendations for spread footing foundations established within weathered rock. Site foundation characteristics/ constraints affecting details of support level and bearing include:

- depth to rock and variation of rock surface along individual support lines
- hard rock excavation to bearing levels
- mechanical defects of the rock (fractures/joints)
- potential presence of semi-detached blocks of rock or overbreak within footing excavations

Alternatively, Cast-In-Drilled-Hole (CIDH) piles or large diameter drilled-shafts (at the bent) can be considered at this site, particularly if resistance to high uplift and lateral load demands is required. Such piles would need to be 24-inch (minimum) diameter in consideration for potential ground water and likely require difficult excavation within variably hard rock. CIDH pile tip elevations would depend on pile/shaft diameter and defined compressive, tensile and lateral loading requirements.

We do not expect that driven (displacement) piles will achieve adequate penetration for stability and do not recommend their use. Steel H-piles could be considered at the abutments but they would be short (some likely ≤ 12 feet), achieve only very limited rock penetration (i.e., point bearing only), and provide little lateral or tensile resistance.

10.1 Spread Footing Data Table

Based on footing foundation design data provided by QEI and our geotechnical analysis, we provide spread footing foundation design recommendations in Table 6. A discussion of our analyses follows.

Table 6 – Spread Footing Data Table
Foundation Design Recommendations for Spread Footings [1, 2]

Support Location	Footing Size (ft)		Bottom of Footing Elevation (ft)[3]	Minimum Footing Embedment Depth (ft)	WSD (LRFD Service-I Limit State Load Combination)		LRFD		
							Service	Strength $\varphi_b = 0.45$	Extreme Event $\varphi_b = 1.0$
	B	L			Permissible Gross Contact Stress (ksf)	Allowable Gross Bearing Capacity (ksf)	Permissible Net Contact Stress (ksf)	Factored Gross Nominal Bearing Resistance (ksf)	Factored Gross Nominal Bearing Resistance (ksf)
Abut 1	18.0	40.0[4]	598.0	7.0	12	13	N/A	N/A	N/A
Bent 2	12.0	14.0	598.0	10.0	N/A	N/A	23	23	52
Abut 3	18.0	40.0[4]	598.0	7.0	12	13	N/A	N/A	N/A

Notes: 1) Recommendations are based on the foundation geometry and loads provided by the Design Engineer. The footing contact area is taken as equal to the effective footing area, where applicable.
2) See Memo to Designers (MTD) 4-1 for definitions and applications of the recommended design parameters.
3) Footing elevation conforms to QEI Foundation Plan
4) Footing length will be extended 27.5 ft for wall footing (between existing and new structure)

BCI determined the values shown above based on Working Stress Design (WSD) at the abutments and Load and Resistance Factor Design (LRFD) at the bent. Our recommendations are based on specific loads provided by the design engineer for the foundation geometry shown in the Spread Footing Data Table. We conservatively modeled the rock at foundation level as a dense, gravelly soil with groundwater near the surface (elevation of approximately 603 feet). We include footing foundation design data provided by QEI and our spread footing design calculations in Appendix B.

10.2 Settlement

We determined the total settlement of spread footing foundations at all supports based on elastic settlement theory and conservatively modeled the rock as a dense, gravel soil. For spread footings established as above, we estimate that settlement will be nominal (less than 1-inch) and will occur substantially during construction. We expect differential settlement to be less than one-half of the total settlement. We include our settlement calculations in Appendix B.

Due to the presence of rock at foundation level, induced settlement at existing, adjacent structure locations (mainline bridge abutments) will be insignificant.

10.3 Lateral Load Resistance

Calculate lateral load resistance of spread footings for seismic or other transient loads as follows:

- A soil friction factor (tan δ) of 0.45 for cast in-place concrete foundations bearing on intact rock materials.
- An allowable passive pressure of 250 pcf equivalent fluid pressure against the face of the footing (based on formed footings with compacted structure backfill or footings poured neat against intact rock), with a resistance factor (φ_τ) of 0.5.
- Passive and friction resistance may be combined.

10.4 Retaining Walls

New retaining walls (Type 1) are planned along the north side of each abutment. The planned length, height, and bottom of footing elevation for the walls are as follows in Table 7:

Table 7 – Abutment Retaining Wall Summary

Support Location	Total Length (feet)	Height (feet)	Base of Footing Elevation for Type 1 Retaining Wall (feet)
Abut - 1	44	18, 22, and 24	Steps up from 602 to 610
Abut - 3	36	16, 20, and 24	Steps up from 602 to 610

For Type-1 retaining walls with level backfill (Case 1) condition, Caltrans "Standard Plans" indicate maximum toe pressures of 3.5 ksf to 4.9 ksf for retaining wall heights between 16 feet and 24 feet high.

We expect the planned retaining walls established at or below elevation 610 feet at Abutment 1 and Abutment 3 to engage intact, weathered rock. Minor engineered fill (Structure Backfill) prism may occur below the wall foundations due to excavation and backfill for adjacent abutment foundations (at elevation 598 ft).

Adequate bearing capacity is available for maximum toe pressures indicated for the Caltrans Type-1 retaining wall foundations established within intact weathered rock (or engineered fill prism) at or below elevation 610 feet at Abutment 1 and 3. Maximum and differential settlements across and along the walls will be less than 1-inch. We expect that settlement will occur substantially during construction.

10.5 Approach Fill Earthwork

10.5.1 Fill Material

We assume locally excavated soil/weathered rock will be used for construction of approach fills at this location. The source of borrow material for construction of approach fills has not been identified. Proposed borrow must be tested and approved for use by the project engineer prior to transporting to the site.

10.5.2 Expansive Material

Expansive materials shall not be placed as part of the embankment within the limits of the bridge abutment for the full width of the embankment. Place only material with a low expansion potential. Low expansion material is defined as having an Expansion Index (EI) less than 50 (per ASTM D4829), and a Sand Equivalent (SE) greater than 20 (per California Test 217).

10.5.3 Geometry and Stability

Where approach fill is placed, side slopes will have a gradient of 2H:1V or flatter. The proposed geometry is a common slope gradient considered stable for typical approach fill construction. We assume abutment backfill will consist of materials conforming to Structure Backfill requirements. The mostly moderate slope of the existing ground surface and high strength of the underlying rock will provide a stable base on which to construct the fills. Foundations supported on or near a fill slope are not proposed.

10.5.4 Site Preparation

In the area of approach fills, clear and grub existing slopes in accordance with the Caltrans “Standard Specifications”, Section 16. Construct structure backfill at the abutments in accordance with the “Standard Specifications”, Section 19-3.06. Construct the embankment approach fills in accordance with the “Standard Specifications”, Section 19-6.01, including at least 95% relative compaction on all fill within 150 ft of bridge abutments.

10.5.5 Settlement

Due to the presence of shallow rock, we do not anticipate significant settlement at approach fills. We expect post-construction settlement between the abutment backwall and adjacent approach fills/backfill to be less than ½-inch, provided structure backfill is compacted in accordance with the “Standard Specifications.” A waiting period is not necessary.

11 LATERAL EARTH PRESSURES

We assume that the approach fill material meets the requirements of Caltrans standard for Structure Backfill. To determine equivalent fluid weights (EFWs), we use Caltrans specified materials with a soil unit weight of approximately 120 pcf, a minimum angle of internal friction equal to 33 degrees, and an assumed drainage material behind the walls. Use the following EFWs to design the abutments walls and wing walls at Abutments 1 and 3:

Condition	EFW Static	EFW Seismic
Active	36 lb/ft^3	40 lb/ft^3
At-Rest	55 lb/ft^3	62 lb/ft^3
Passive	270 lb/ft^3	250 lb/ft^3

The values shown above assume level backfill conditions and that drainage is placed behind walls in accordance with Caltrans "Standard Plans and Specifications." To limit wall deflection to acceptable levels, BCI applied a factor of safety of 1.5 to the ultimate passive pressure to generate the allowable passive pressures provided above.

We estimate the EFWs for seismic loading using the Mononobe-Okabe equation for active and passive lateral coefficients K_a and K_p. We estimated the at-rest coefficient, K_o, for the seismic condition using an increase ratio similar to the active condition. In the Mononobe-Okabe equation, BCI used a horizontal seismic acceleration coefficient (k_h) of 0.10 calculated using the equation in Chapter 11, Section 11.6.5 of the AASHTO LRFD Bridge Design Specifications-4th Edition. This k_h value assumes that the walls displace at least 1-inch during the design seismic event. We calculated the above static EFWs using methods presented in the 1982 Naval Facilities (NAVFAC) Design Manual 7.2.

Apply the resultant of the seismic active and at-rest pressures at a depth 0.5H from the base of the wall, where H equals the wall height. For surcharge loads, apply an additional uniform lateral load behind the wall equivalent to 0.30 times the surcharge pressure. Use a soil friction factor (tan δ) of 0.45 for cast in-place concrete foundations bearing on weathered rock. The passive pressures are applicable for concrete placed directly against undisturbed soil/weathered rock or compacted fill.

For seismic loading into abutments, use a maximum passive pressure of 5.0 ksf for longitudinal abutment response, with the proportionality factor presented in Section 7.8.1 of Caltrans Seismic Design Criteria v.1.6.

12 CONSTRUCTION CONSIDERATIONS

12.1 Excavation and Shoring

We expect that excavation of soils can be achieved using typical heavy-duty construction equipment and that excavation of weathered rock within footing limits to depths indicated above will be locally difficult, but generally achievable without blasting. Use of air tools/chiseling may be necessary.

Rock blasting may disrupt/degrade integrity of the surrounding rock and the adjacent bridge structures (particularly at the abutments). Therefore, rock blasting should not be permitted.

The contractor is responsible for design and construction of excavation sloping and shoring in accordance with Cal OSHA requirements and the Caltrans “Trenching and Shoring Manual.” Native soils and weathered rock can be classified as Type B soils in accordance with Cal OSHA.

Particular consideration for shoring will be required for local areas of weak rock, existing embankment fill, areas exhibiting potential for failure along daylighting fracture planes, and to protect existing bridge supports. Particular consideration will be required to protect the existing bridge abutments during construction.

12.2 Foundation Construction

Place footing concrete “neat” (without forming), against trimmed, intact bearing material within clean and dry excavations. If forming is necessary, backfill excavations outside footing limits with lean concrete or suitable granular backfill (i.e. “Structure Backfill” per Caltrans “Standard Specifications”) compacted to at least 95% relative compaction (per CTM 216).

If it is necessary to deepen footing excavations to engage suitable bearing materials, it is acceptable to backfill with structural concrete to plan footing grade, up to a depth of 3 feet below the footing, with BCI approval. Any exposed open joint/fractures should be evaluated by a BCI Engineering Geologist with respect to bearing/stability considerations and cleaned/surfaced-grouted, if necessary.

12.3 Foundation Monitoring

During construction, we recommend placement of monitoring points on the existing footings adjacent to new construction, and frequent surveying for movement. In the event significant (>¼-inch horizontal or vertical) movement of the existing foundations is detected, contact BCI immediately for consultation to evaluate movement and consider mitigations, if necessary.

12.4 Dewatering

We do not anticipate the presence of groundwater within footing excavations during dry season construction (July through October). If/where seepage is encountered, we expect it can be controlled with sump pumps.

12.5 Naturally Occurring Asbestos

Based on the previous test results at the mainline bridge location, testing in adjacent areas completed by BCI for the other ramp work, and observed rock conditions, BCI considers the risk of encountering rock with significant quantities of NOA minerals to be low. However, considering the occurrence of NOA in the vicinity of the project, we recommend preparation of an Asbestos Hazard Mitigation Plan in compliance with provisions of El Dorado County Air Quality Management District (EDAQMD) Rule 223-2.and California Air Resources Board requirements.

Visually monitor rock types exposed during construction for the potential presence of naturally occurring asbestos (NOA) minerals. If construction activities expose NOA, comply with the applicable provisions of EDAQMD Rule 223-2 and the State of California Asbestos Airborne Toxic Control Measure (ACTM), CCR Title 17, Section 93105. In addition, prepare a worker health and safety program for excavations in areas with NOA in accordance with all regulatory requirements, including CAL OSHA.

12.6 Storm Water Quality

We expect that construction term erosion control will be available by means of typical good construction practices (e.g., use of erosion barriers, synthetic slope covers, hydro-seeding, etc.). This project will involve earthwork and we expect that the contractor will develop a Storm Water Pollution Prevention Plan, specific for this project.

13 RISK MANAGEMENT

Our experience and that of our profession clearly indicates that the risks of costly design, construction, and maintenance problems can be significantly lowered by retaining the geotechnical engineer of record to provide additional services. For this project, BCI should be retained to:

- Review and provide written comments on the (civil, structural) plans and specifications prior to construction.

- Monitor construction to check and document our report assumptions. At a minimum, review bridge and wall foundation excavations to observe foundation conditions for the presence of open joints / fractures (or other defects), and confirm bearing materials and treatment of rock defects (if/as necessary).

- Update this report if design changes occur, two years or more lapse between this report and construction, and/or site conditions change

If BCI is not retained to perform the above applicable services, we are not responsible for any other parties' interpretation of our report, and subsequent addenda, letters, and discussions.

14 LIMITATIONS

BCI performed services in accordance with the generally accepted geotechnical standard of practice currently used in this area. Where referenced, we used CTM and ASTM standards as a general (not strict) *guideline* only. We do not warranty our services.

BCI also based this report on the current site and project conditions. We assumed the soil/rock and groundwater conditions encountered at our exploration points and those by others are representative of the subsurface conditions across the site. Actual conditions between borings could be different. Groundwater may be higher in other locations and times than measured in the borings.

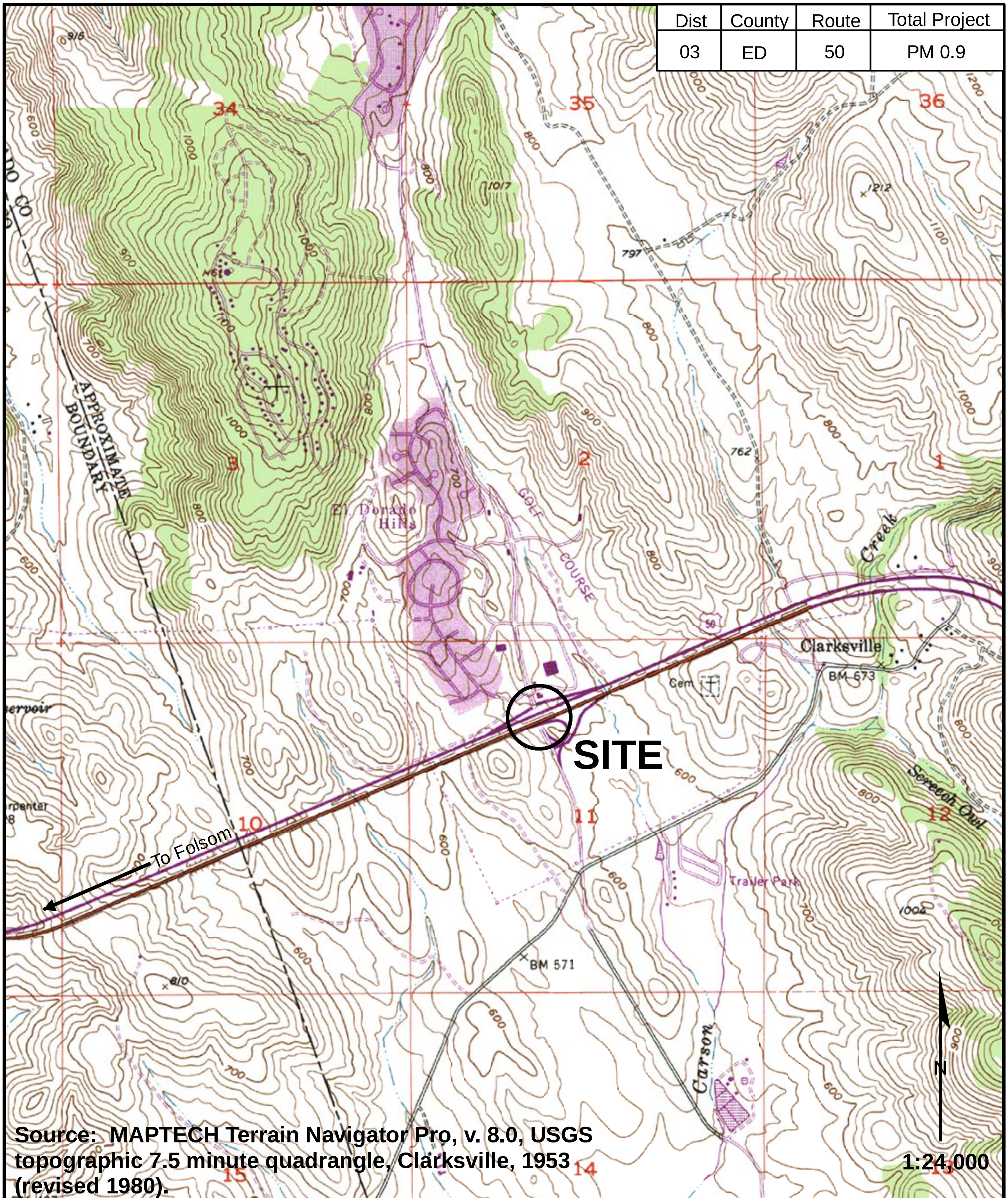
The interface between soil and rock types on the logs is approximate. The transition between soil and rock types may be abrupt or gradual. We base our recommendations on the final logs, which represent an interpretation of the field logs and general knowledge of the site and geological conditions.

Our scope did not include evaluation of flooding or hazardous materials on site. This Report should only be used for design and construction of the Latrobe Road West Bound Off-Ramp Undercrossing, as described herein. We provide a separate Geotechnical Design/Materials Report for the overall project and a Limited Phase II Assessment for hazardous materials.

Modern design and construction are complex, with many regulatory sources, restrictions, involved parties, construction alternatives, etc. It is common to experience changes and delays. The owner should set aside a reasonable contingency fund based on complexities and cost estimates to cover changes and delays.

Figures

Dist	County	Route	Total Project
03	ED	50	PM 0.9



Source: MAPTECH Terrain Navigator Pro, v. 8.0, USGS topographic 7.5 minute quadrangle, Clarksville, 1953 (revised 1980).

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VICINITY MAP

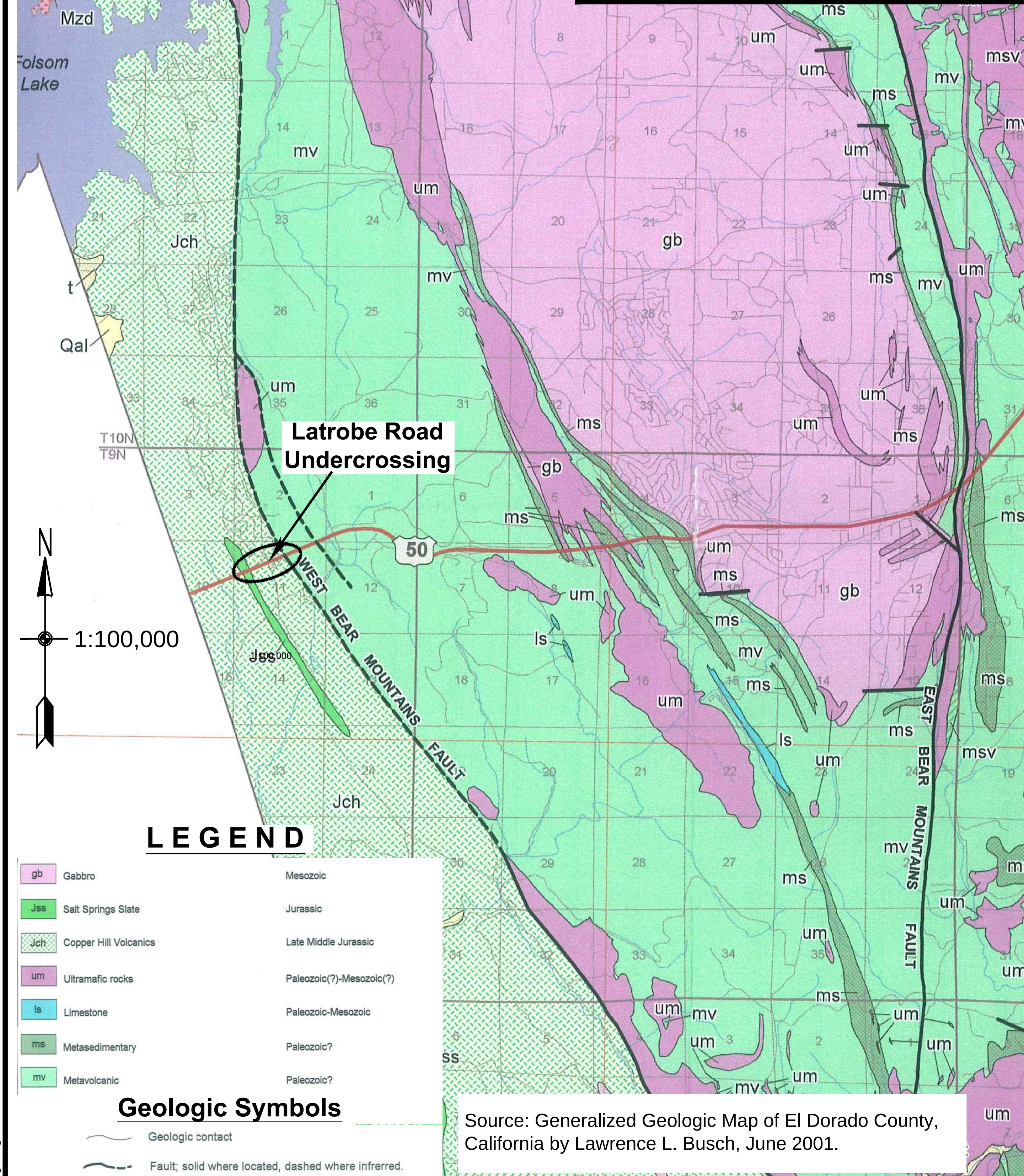
State Route 50 Latrobe Rd Undercrossing
Bridge No. 25-0122K, EA 03-2E5101
El Dorado County, California

File No. 1072.8

March 2012

Figure 1

DIST	COUNTY	ROUTE	TOTAL PROJECT
03	ED	50	PM 0.9



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GEOLOGIC MAP

State Route 50 Latrobe Rd Undercrossing
Bridge No. 25-0122K, EA 03-2E5101
El Dorado County, California

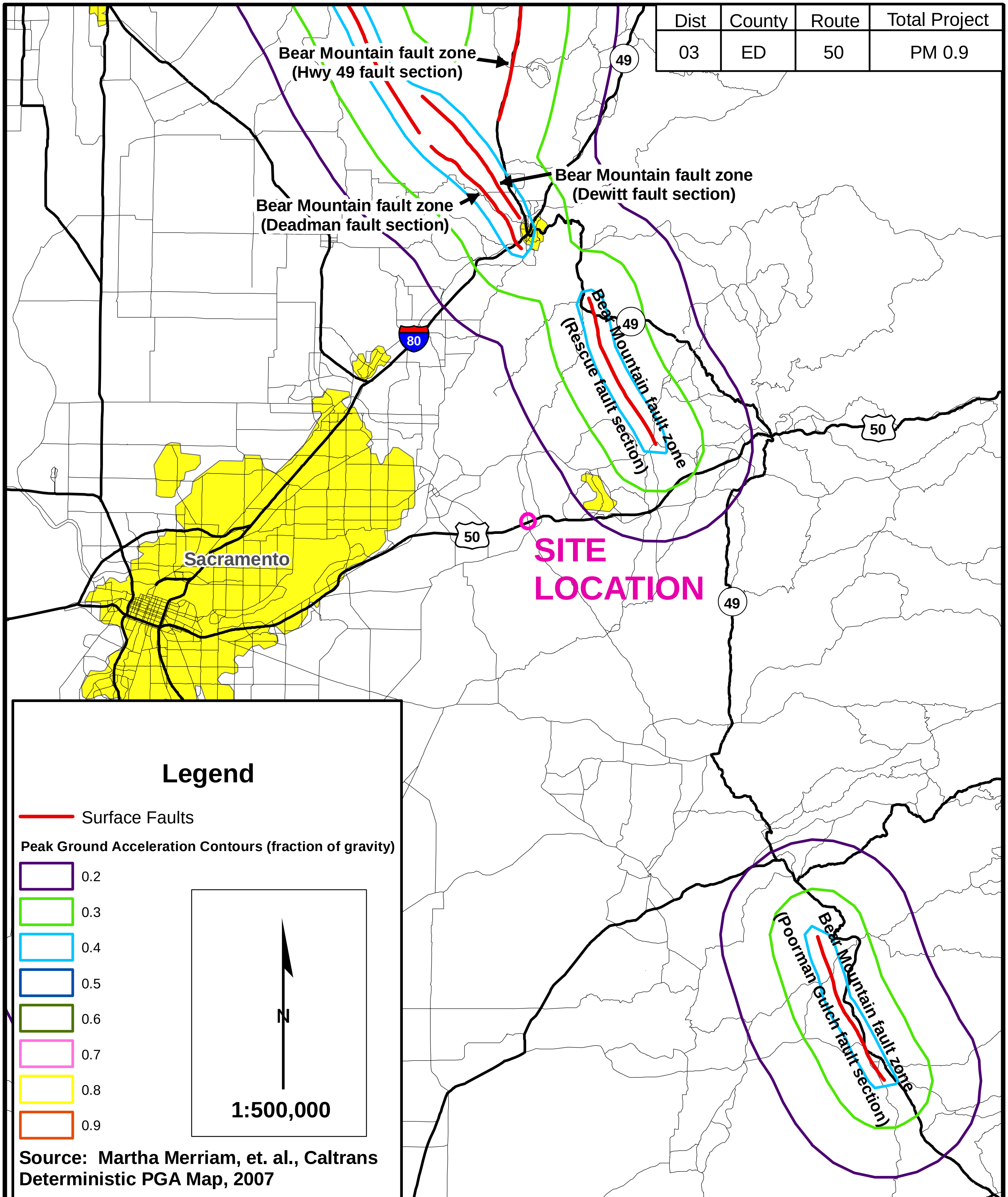
File No. 1072.8

March 2012

Figure 2

2/23/2012 1072.8 Geologic Map Fig 2.dwg

Dist	County	Route	Total Project
03	ED	50	PM 0.9



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SEISMIC HAZARD MAP

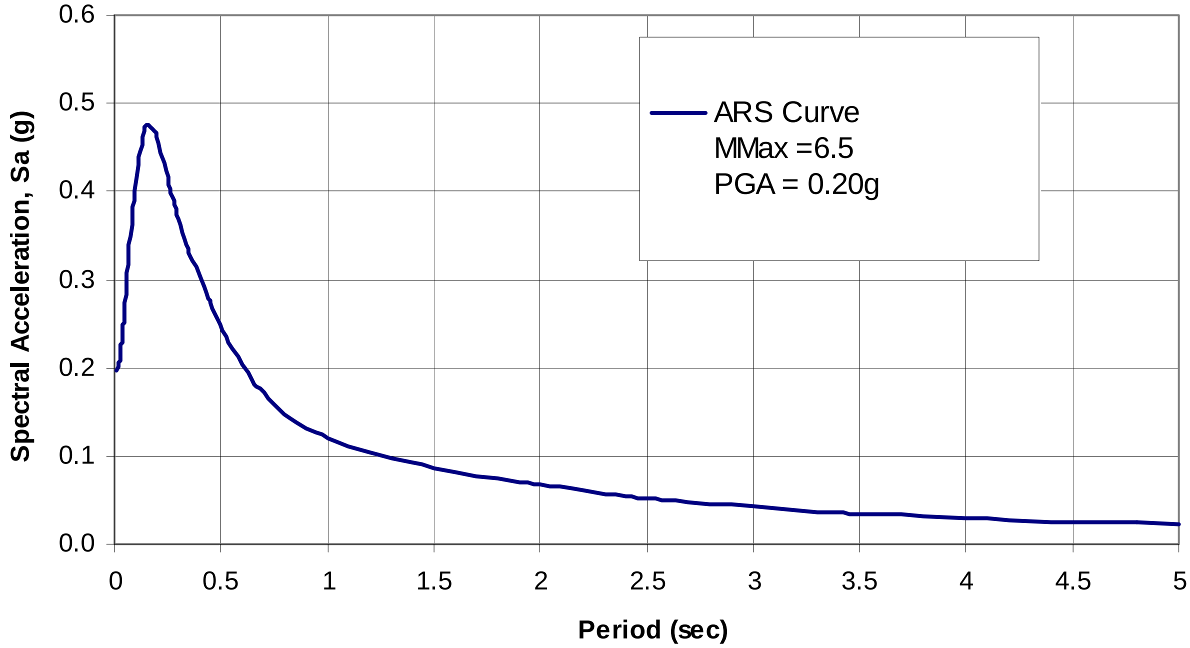
State Route 50 Latrobe Rd Undercrossing
Bridge No. 25-0122K, EA 03-2E5101
El Dorado County, California

File No. 1072.8

March 2012

Figure 3

ARS Curve
(5% Damping)



Reference: Geotechnical Services Design Manual (Version 1.0, August 2009) and Caltrans Seismic Design Criteria, Appendix B, Revised 11/2010

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ARS CURVE

State Route Latrobe Rd Undercrossing
Bridge No. 25-0122K, EA 03-2E5101
El Dorado County, California

File No. 1072.8

March 2012

Figure 4

APPENDIX A

- Subsurface Exploration Summary
- Laboratory Test Results
- Log of Test Borings
  - Latrobe Road WB Off-Ramp UC (Sheets 1 through 4)
  - Latrobe Road Undercrossing (BCI, August 2007)
- General Plan
- Foundation Plan

SUBSURFACE EXPLORATION SUMMARY

To provide additional subsurface data and confirmation of shallow rock conditions, BCI retained Taber Consultants to drill and sample 1 exploratory borings near the west bound off-ramp UC location. Taber used a CME 75 truck-mounted rig, equipped with 4-inch O.D. solid flight augers, to drill the boring on February 6, 2012 to refusal (in rock) at a depth of 8.5 feet below the ground surface (bgs).

Taber obtained relatively undisturbed samples using a Modified California Sampler (equipped with 2.5-inch I.D. brass liners). Samplers were driven into the ground with a 140 pound, automatic hammer falling 30 inches.

The test trench was excavated by Monte Ricky Excavation using a CAT 430-D backhoe equipped with an 18-inch wide bucket. BCI obtained bulk samples from the excavation.

BCI's geologist logged the boring and trench consistent with the Unified Soil Classification System (USCS) and Caltrans' 2010 logging manual, and noted the degree of weathering, fracture density, and hardness. BCI also made groundwater water observations during exploration operations. At the completion of field work, the explorations were backfilled with cuttings.

BCI's boring and trench locations and elevations were determined by field estimation (they were not surveyed).

Taber completed 3 borings at the bridge site in 1999. For the drilling and sampling methods used to advance these borings, refer to the LOTB.

LABORATORY TEST RESULTS

BCI performed laboratory tests on selected samples obtained from the exploratory borings. Tests included:

- pH/Minimum Resistivity (CTM 643)
- Chloride (CTM 422)
- Sulfate (CTM 417)

BCI performed laboratory tests in substantial conformance with the designated test procedure. The test results are attached.

The following table summarizes the NOA test results from the mainline bridge replacement project (BCI, 2008).

Naturally Occurring Asbestos (NOA) Test Summary
US 50 HOV Lane Project Mainline Bridge Replacement

Location	Line	Station	Sample ID	Depth (ft)	Elevation (ft, msl)	% Asbestos	Type
Latrobe Road UC	A2	55+12.5	LB-2-1 II	5-6	622	ND	N/A
	A2	55+12.5	LB-2-5 III	26-27	601	<0.25%	Actinolite

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Minimum Resistivity and pH Test Results

File No.: 1072.8
Date: 2/14/2012
Project Name: SR 50 HOV Westbound Ramps

Sample ID	Minimum Resistivity, Ohm-cm @ 15.5^{o} C	pH
A12-104-B03	2,931	8.67

Minimum Resistivity and pH performed based on Caltrans Test Method 643

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
03	ED	50	0.4/1.2		

CERTIFIED ENGINEERING GEOLOGIST 03/30/12 DATE

PROFESSIONAL GEOLOGIST PATRICK F. FISCHER No. 1739 Exp. 1/31/13 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

PLANS APPROVAL DATE

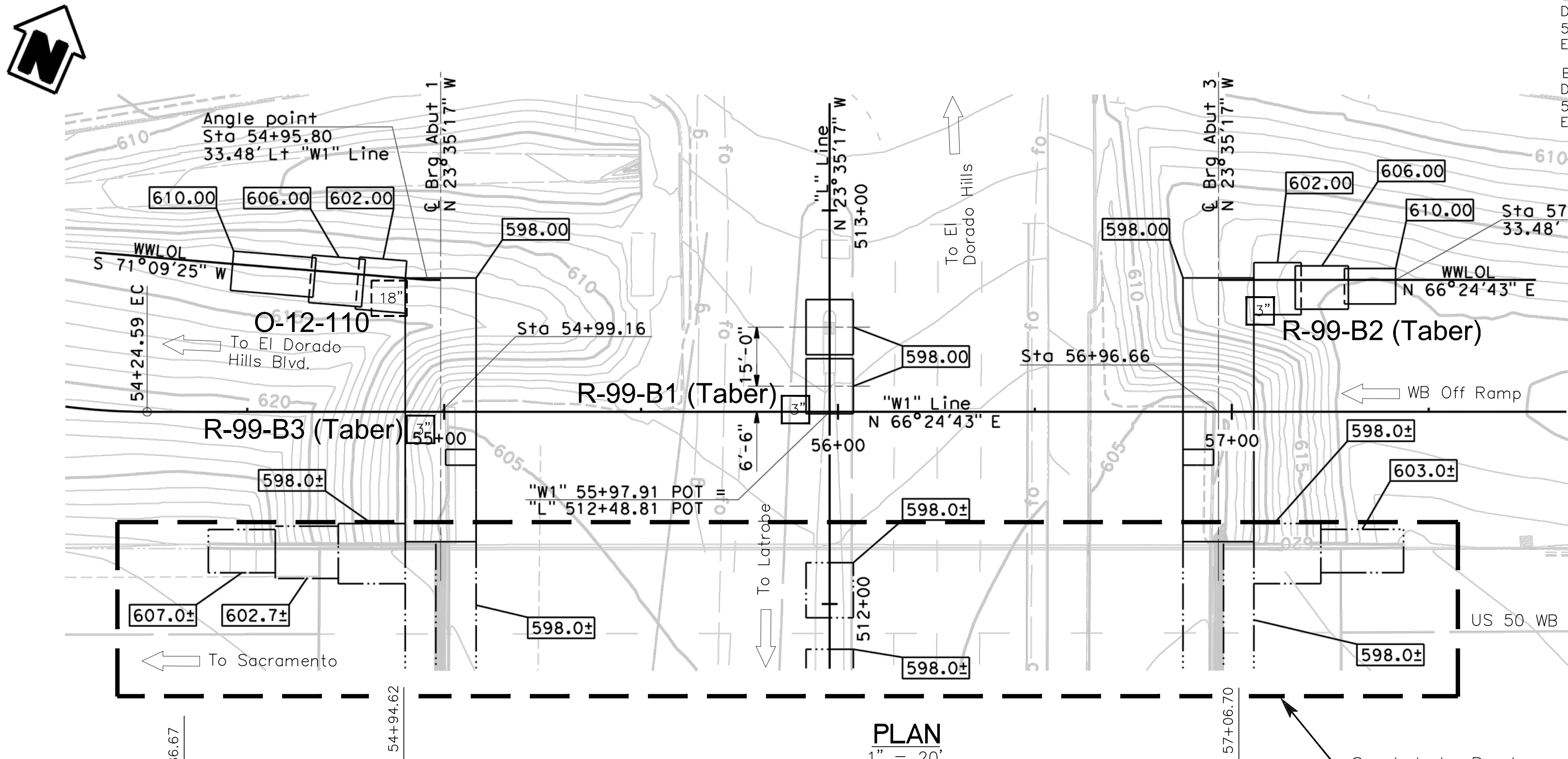
BLACKBURN CONSULTING
2491 BOATMAN AVENUE
WEST SACRAMENTO, CA 95691 FILE No. 1072.8

QUINCY ENGINEERING, INC.
3247 RAMOS CIRCLE
SACRAMENTO, CA 95827-2501

BENCHMARKS

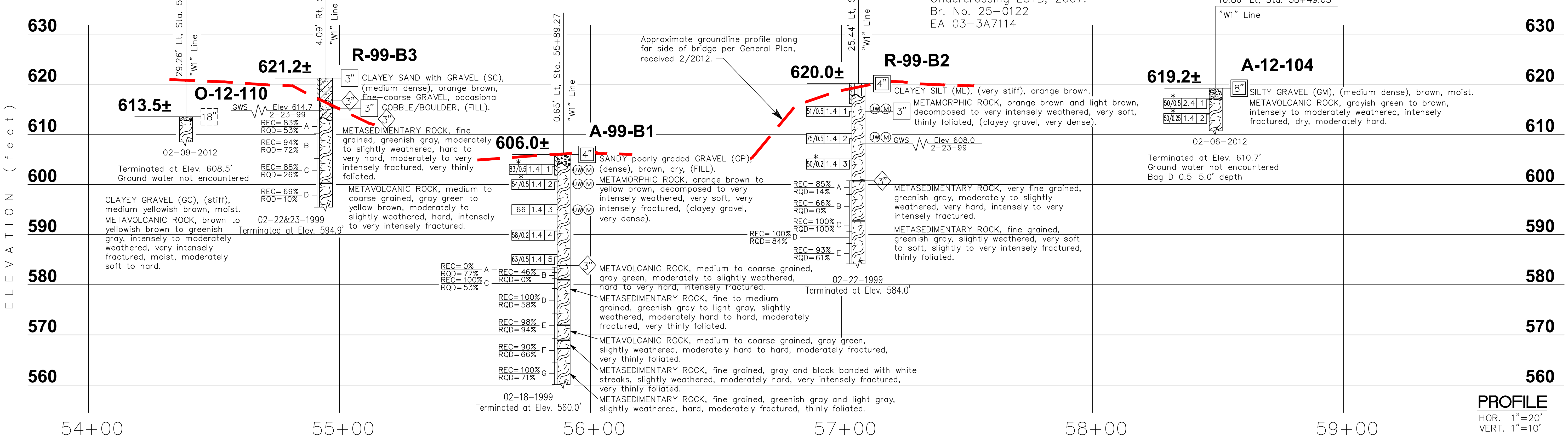
BENCHMARK# 25113 ELEV. 624.68 NAVD 1929
DESCRIPTION: BRASS DISK, 78.24' LT, STATION 54+98.37, "A2" LINE, NORTHING 2000992.20, EASTING 682695.14.

BENCHMARK# 64 ELEV. 618.23 NAVD 1929
DESCRIPTION: MONUMENT, 67.26' RT, STATION 58+96.89, "A2" LINE, NORTHING 2001018.23, EASTING 6827374.58.



NOTES:

1. 1999 Field classification of soils was in accordance with ASTM D 2488-00 "Description and Identification of Soils (Visual-Manual Procedure)" and 2012 Field classification of soils was in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual 2010. See Log of Test Borings No. 2 and 3, "Soil Legend". 1999 boring logs converted from metric to english.
2. 1999 Rock classification according to Caltrans "Soil & Rock Logging Classification Manual (Field Guide)", August 1996, and Bureau of Reclamation, U.S. Department of the Interior, USBR-5000, "Procedure for Determining Unified Soil Classification", Earth Manual, Part II, Third Edition, 1990.
3. Standard Penetration tests were performed in accordance with ASTM D 1586-99 (1999) and 1586-08 (2012) using a hammer operated with cat-head, rope and pulley with a 30-inch drop (1999) and automated drop system (2012). Drill rods were 1 5/8-inch diameter "A"-rods; sampler was driven with brass liners.
4. "2.4 inch sampler": ID=2.4 inch, OD=2.9 inch. Driven in same manner as SPT ("1.4 inch") sampler.
5. Where indicated by an asterisk (*) the number of blows shown is for only that fraction of the initial 0.5 ft. "seating drive" interval penetrated.
6. If laboratory tests are not shown as being performed, the soil descriptions presented in the LOTB are based solely on the visual practices described in the before mentioned Manuals.
7. The length of each sampled interval is shown graphically on the boring log.
8. Consistency of soils shown in ( ) where estimated.
9. Groundwater surface (GWS) reflect the fluid level in the borings on the specified date. Groundwater surface is subject to seasonal fluctuations and may occur at higher or lower elevations depending on the conditions at any particular time.
10. Electronic media for plan view provided by Quincy Engineering, "Foundation Plan" dated March 2012.
11. Boring elevations are approximate and based on "Topography" received December 2004.
12. The "Log of Test Borings" drawing is included with plans in accordance with Section 2-1.06B of Caltrans "Standard Specifications", 2010.



R. SOWERS
DESIGN OVERSIGHT
3/30/12
SIGN OFF DATE

DRAWN BY M. ROBERTSON
CHECKED BY R. PICKARD

W. NICHOLS 1999, R. PICKARD 2012
FIELD INVESTIGATION BY:
DATE: FEBRUARY 1999 and FEBRUARY 2012

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

Tim Osterkamp
PROJECT ENGINEER

BRIDGE NO. 25-0122K
POST MILE 0.9

LATROBE ROAD WB OFF RAMP UC

LOG OF TEST BORINGS 1 OF 4

GS CIVIL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: X
PROJECT NUMBER & PHASE: 0312000163
CONTRACT NO.: 03-2E5101

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 03/30/12
REVISION DATES SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

3/28/2012 1072.8 US 50 Latrobe Road WB Off Ramp LOTB.dwg

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
03	ED	50	0.4/1.2		

CERTIFIED ENGINEERING GEOLOGIST 03/30/12 DATE

PROFESSIONAL GEOLOGIST PATRICK F. FISCHER No. 1739 Exp. 1/31/13 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

PLANS APPROVAL DATE

BLACKBURN CONSULTING
2491 BOATMAN AVENUE
WEST SACRAMENTO, CA 95691 FILE No. 1072.8

QUINCY ENGINEERING, INC.
3247 RAMOS CIRCLE
SACRAMENTO, CA 95827-2501

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (2010)

CEMENTATION

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

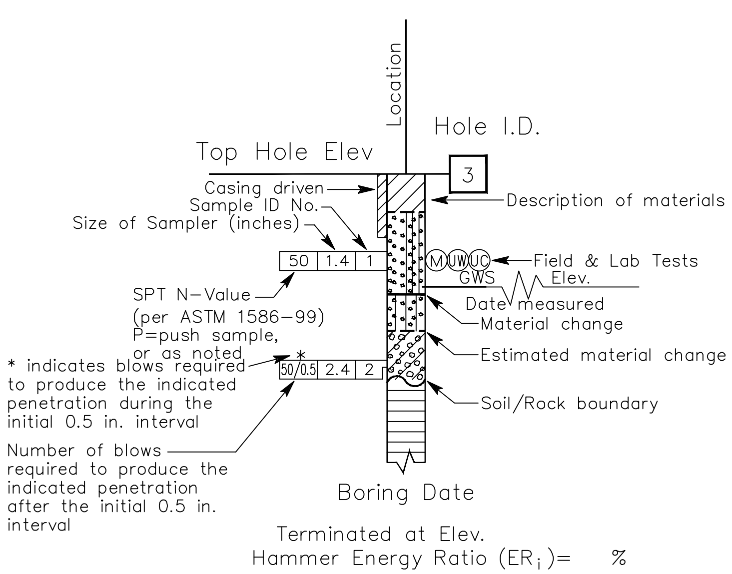
BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring (hollow or solid stem bucket)
Size	R RW RC P	Rotary drilled boring (conventional) Rotary drilled with self-casing wire-line Rotary core with continuously-sampled, self-casing wire-line 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)
	O	Other (note on LOTB)

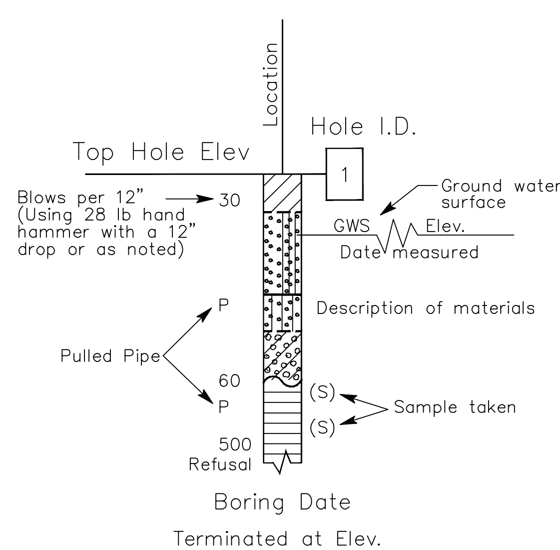
NOTE: Size in inches.

CONSISTENCY OF COHESIVE SOILS

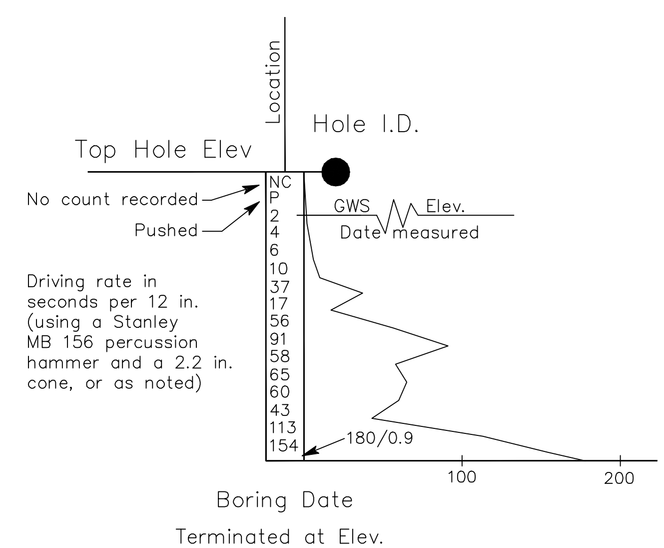
Description	Shear Strength (tsf)	Pocket Penetrometer Measurement, PP, (tsf)	Torvane Measurement, TV, (tsf)
Very Soft	Less than 0.12	Less than 0.25	Less than 0.12
Soft	0.12 - 0.25	0.25 - 0.50	0.12 - 0.25
Medium Stiff	0.25 - 0.5	0.50 - 1	0.25 - 0.5
Stiff	0.5 - 1	1 - 2	0.5 - 1
Very Stiff	1 - 2	2 - 4	1 - 2
Hard	Greater than 2	Greater than 4	Greater than 4



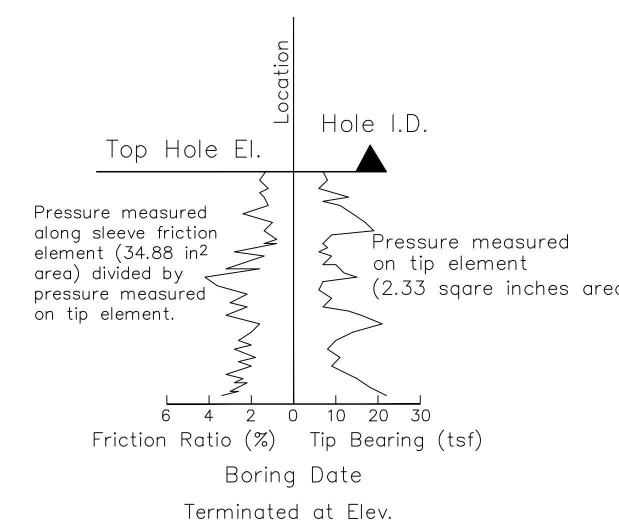
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

SOIL LEGEND

LATROBE ROAD WB OFF RAMP UC

LOG OF TEST BORINGS 2 OF 4

R. SOWERS DESIGN OVERSIGHT	DRAWN BY	M. ROBERTSON	W. NICHOLS 1999, R. PICKARD 2012 FIELD INVESTIGATION BY:
3/30/12 SIGN OFF DATE	CHECKED BY	R. PICKARD	DATE: FEBRUARY 1999 and FEBRUARY 2012

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Tim Osterkamp PROJECT ENGINEER

BRIDGE NO. 25-0122K POST MILE 0.9

GS CIVIL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: X
PROJECT NUMBER & PHASE: 0312000163 CONTRACT NO.: 03-2E5101

DISREGARD PRINTS BEARING EARLIER REVISION DATES 03/30/12 REVISION DATES SHEET OF

FILE => $REQUEST

3/28/2012 1072.8 US 50 Latrobe Road WB Off Ramp LOTB.dwg

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
03	ED	50	0.4/1.2		

CERTIFIED ENGINEERING GEOLOGIST 03/30/12 DATE

PLANS APPROVAL DATE

PROFESSIONAL GEOLOGIST PATRICK F. FISCHER No. 1739 Exp. 1/31/13 CERTIFIED ENGINEERING GEOLOGIST 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.

BLACKBURN CONSULTING
2491 BOATMAN AVENUE
WEST SACRAMENTO, CA 95691 FILE No. 1072.8

QUINCY ENGINEERING, INC.
3247 RAMOS CIRCLE
SACRAMENTO, CA 95827-2501

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

GROUP SYMBOLS AND NAMES

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

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 2937)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60}-Value (Blows / 12 inches)
Very Loose	0 - 5
Loose	5 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Greater than 50

MOISTURE

Description	Criteria
Dry	No discernable moisture
Moist	Moisture present, but no free water
Wet	Visable free water

PERCENT OR PROPORTION OF SOILS

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

PARTICLE SIZE

Description		Size
Boulder		Greater than 12"
Cobble		3" - 12"
Gravel	Coarse	3/4" - 3"
	Fine	1/5" - 3/4"
Sand	Coarse	1/16" - 1/5"
	Medium	1/64" - 1/16"
	Fine	Less than 1/300"

SOIL LEGEND

LATROBE ROAD WB OFF RAMP UC

LOG OF TEST BORINGS 3 OF 4

R. SOWERS
DESIGN OVERSIGHT
3/30/12
SIGN OFF DATE

DRAWN BY M. ROBERTSON
CHECKED BY R. PICKARD

W. NICHOLS 1999, R. PICKARD 2012
FIELD INVESTIGATION BY:
DATE: FEBRUARY 1999 and FEBRUARY 2012

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

Tim Osterkamp
PROJECT ENGINEER

BRIDGE NO. 25-0122K
POST MILE 0.9

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (2010)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
03	ED	50	0.4/1.2		

CERTIFIED ENGINEERING GEOLOGIST 03/30/12 DATE

PROFESSIONAL GEOLOGIST PATRICK F. FISCHER No. 1739 Exp. 1/31/13 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

PLANS APPROVAL DATE

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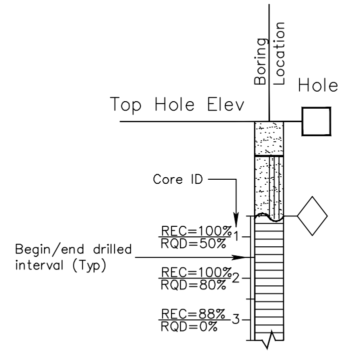
BLACKBURN CONSULTING
2491 BOATMAN AVENUE
WEST SACRAMENTO, CA 95691 FILE No. 1072.8

QUINCY ENGINEERING, INC.
3247 RAMOS CIRCLE
SACRAMENTO, CA 95827-2501

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (inches)}}{\text{Total length of core run (inches)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of the intact core pieces} \geq 4 \text{ inches}}{\text{Total length of core run (inches)}} \times 100\%$$



RQD* Indicates soundness criteria not met.

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 10'
Very thickly bedded	3 – 10'
Thickly bedded	1 – 3'
Moderately bedded	4" – 1'
Thinly bedded	1" – 4"
Very thinly bedded	1/4" – 1"
Laminated	Less than 1/4"

LEGEND OF ROCK MATERIALS

IGNEOUS ROCK

SEDIMENTARY ROCK

METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Cannot be scratched with a pocketknife or sharp pick, can only be chipped with repeated heavy hammer blows.
Very Hard	Cannot be scratched with a pocketknife or sharp pick, breaks with repeated heavy hammer blows.
Hard	Can be scratched with a pocketknife or sharp pick with difficulty (heavy pressure). Breaks with heavy hammer blows.
Moderately Hard	Can be scratched with a pocket knife or sharp pick with light or moderate pressure, breaks with moderate hammer blows.
Moderately Soft	Can be grooved 1/16 inch deep with a pocketnife of sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Can be grooved or gouged easily by a pocketknife or sharp pick with light pressure, can be scratched with fingernail, breaks with light to moderate pressure.
Very Soft	Can be readily indented, grooved or gouged with fingernail, or carved with a pocketknife, breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Core lengths greater than 3 ft.
Slightly fractured	Core lengths mostly from 1 to 3 ft.
Moderately fractured	Core lengths mostly from 4 inches to 1 ft.
Intensely fractured	Core lengths mostly from 1 inches to 4 inches.
Very intensely fractured	Mostly chips and fragments.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features					General Characteristics
	Chemical weathering–Discoloration and/or oxidation		Mechanical Weathering–Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and leaching		
	Body of rock	Fracture Surfaces		Texture	Leaching	
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No leaching.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discolorization or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy".	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes".

3/28/2012 1072.8 US 50 Latrobe Road WB Off Ramp LOTB.dwg

ROCK LEGEND

LATROBE ROAD WB OFF RAMP UC

LOG OF TEST BORINGS 4 OF 4

R. SOWERS
DESIGN OVERSIGHT
3/30/12
SIGN OFF DATE

DRAWN BY M. ROBERTSON
CHECKED BY R. PICKARD

W. NICHOLS 1999, R. PICKARD 2012
FIELD INVESTIGATION BY:
DATE: FEBRUARY 1999 and FEBRUARY 2012

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Tim Osterkamp
PROJECT ENGINEER

BRIDGE NO. 25-0122K
POST MILE 0.9

GS CIVIL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: X
PROJECT NUMBER & PHASE: 0312000163
CONTRACT NO.: 03-2E5101

DISREGARD PRINTS BEARING EARLIER REVISION DATES 03/30/12

REVISION DATES SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	TOTAL PROJECT	SHEET No	TOTAL SHEETS
03	ED	50	0.00/2.90		

W. Eric Nichols 3/11/08
CERTIFIED ENGINEERING GEOLOGIST DATE

PLANS APPROVAL DATE

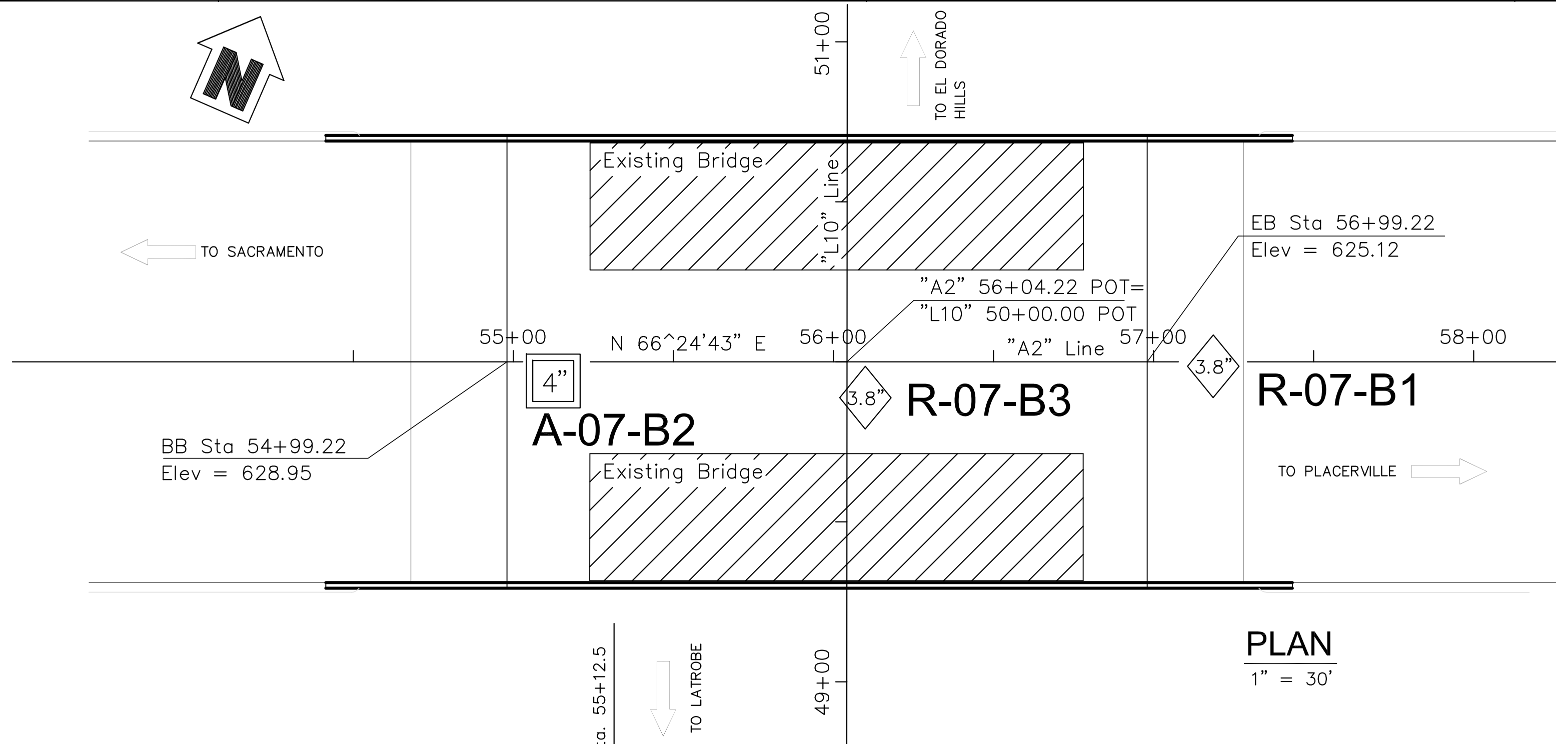
The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

PROFESSIONAL GEOLOGIST William E. Nichols No. 2229 Exp. 1-31-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

BLACKBURN CONSULTING
2437 FRONT STREET
WEST SACRAMENTO, CA 95691
File No. 1072.2

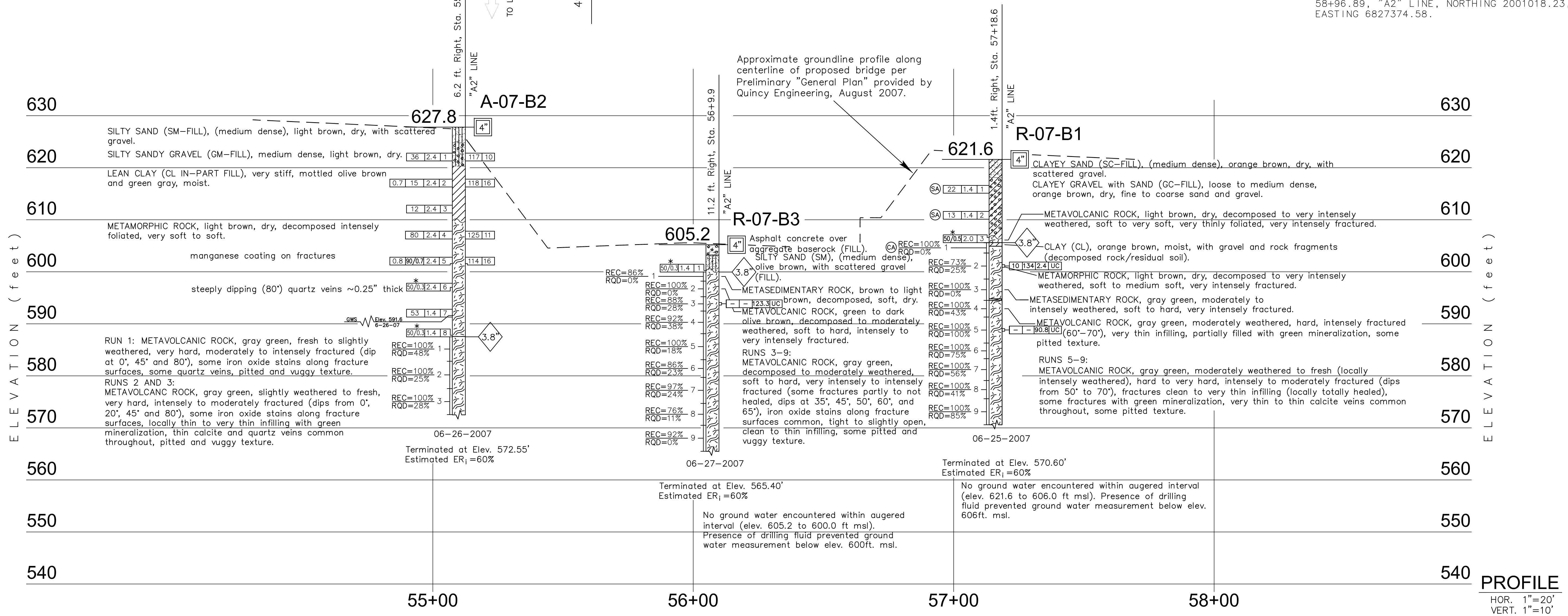
QUINCY ENGINEERING
3247 RAMOS CIRCLE
SACRAMENTO, CA 95827-2501

NOTES:
1. Field classification of soils was in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (June 2007). See Log of Test Borings 4 of 5 "Soil Legend" and Log of Test Borings 5 of 5 "Rock Legend".
2. Standard Penetration tests were performed in accordance with ASTM D 1586-99 using a 140 lb. safety hammer operated with cat-head, rope and pully with a 30-inch drop. Drill rods were 1 5/8-inch diameter "A"-rods; sampler was driven with brass liners.
3. "2.4 inch sampler": ID=2.4 inch, OD=2.9 inch. Driven in same manner as SPT ("1.4 inch") sampler but with brass liners.
4. Where indicated by an asterisk (*) the number of blows shown is for only that fraction of the initial 0.5 ft. "seating drive" interval penetrated.
5. If laboratory tests are not shown as being performed, the soil descriptions presented in the LOTB are based solely on the visual practices described in this Manual.
6. The length of each sampled interval is shown graphically on the boring log. Whole number blow counts ("N") represent the "standard penetration resistance" interval in accordance with the Caltrans Soil & Logging, Classification, and Presentation Manual (June 2007).
7. Where less than 0.5 feet of penetration is achieved, the blow count shown is for that fraction of the "standard penetration resistance" interval actually penetrated.
8. Consistency of soils shown in ( ) where estimated.
8. Ground water surface (GWS) elevations in the borings indicated on the Log of Test Boring Sheets reflect the fluid level in the borings on the specified date.
9. Ground water surface elevations are subject to seasonal fluctuations and may occur at higher or lower elevations depending on the conditions at any particular time.
10. Electronic media for preliminary plan view provided by Quincy Engineering, Inc., dated August 21, 2007.
11. The "Log of Test Borings" drawing is included with plans in accordance with Section 2-1.03 of Caltrans "Standard Specifications".



PLAN
1" = 30'

BENCH MARKS ELEV. 624.68
BENCHMARK# 25113
DESCRIPTION: BRASS DISK, 78.24' LT, STATION 54+98.37, "A2" LINE, NORTHING 2000992.20, EASTING 682695.14.
ELEV. 618.23
BENCHMARK# 64
DESCRIPTION: MONUMENT, 67.26' RT, STATION 58+96.89, "A2" LINE, NORTHING 2001018.23, EASTING 6827374.58.



PROFILE
HOR. 1"=20'
VERT. 1"=10'

ENGINEERING SERVICES		GEOTECHNICAL SERVICES	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DESIGN OVERSIGHT	BRIDGE NO. 25-0122	LATROBE ROAD UNDERCROSSING
FUNCTIONAL SUPERVISOR	DRAWN BY: M. D. Robertson	FIELD INVESTIGATION BY: Rob Pickard, June 2007		NAME: Tim Osterkamp	POST MILE 0.9	LOG OF TEST BORINGS 1 of 5
NAME:	CHECKED BY: W. E. Nichols					

03/11/08 1072.2 Latrobe Road UC.dwg

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 03252
EA 3A7111

DISREGARD PRINTS BEARING EARLIER REVISION DATES 04/18/08

REVISION DATES

SHEET 20 OF 24

111-ED-50

FED. ROAD DIV No	STATE	PROJ. No.	FISCAL YEAR	SHEET No.	TOTAL SHEETS
7	CAL.				

DIST	COUNTY	ROUTE	SECTION	SHEET No.	TOTAL SHEETS
III	ED	4	A	159	171

DATE APPROVED January 6, 1964

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. It does not attest to the accuracy or validity of the information contained in the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES–TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
03	ED	50	0.00/2.90		

W. Eric Nichols 3/11/08
REGISTERED ENGINEERING GEOLOGIST DATE

LATROBE ROAD UNDERCROSSING
LOG OF TEST BORINGS 2 of 5

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA. CU: 03252 EA: 3A7111 BRIDGE NO. 25–0122

SHEET 21 OF 24

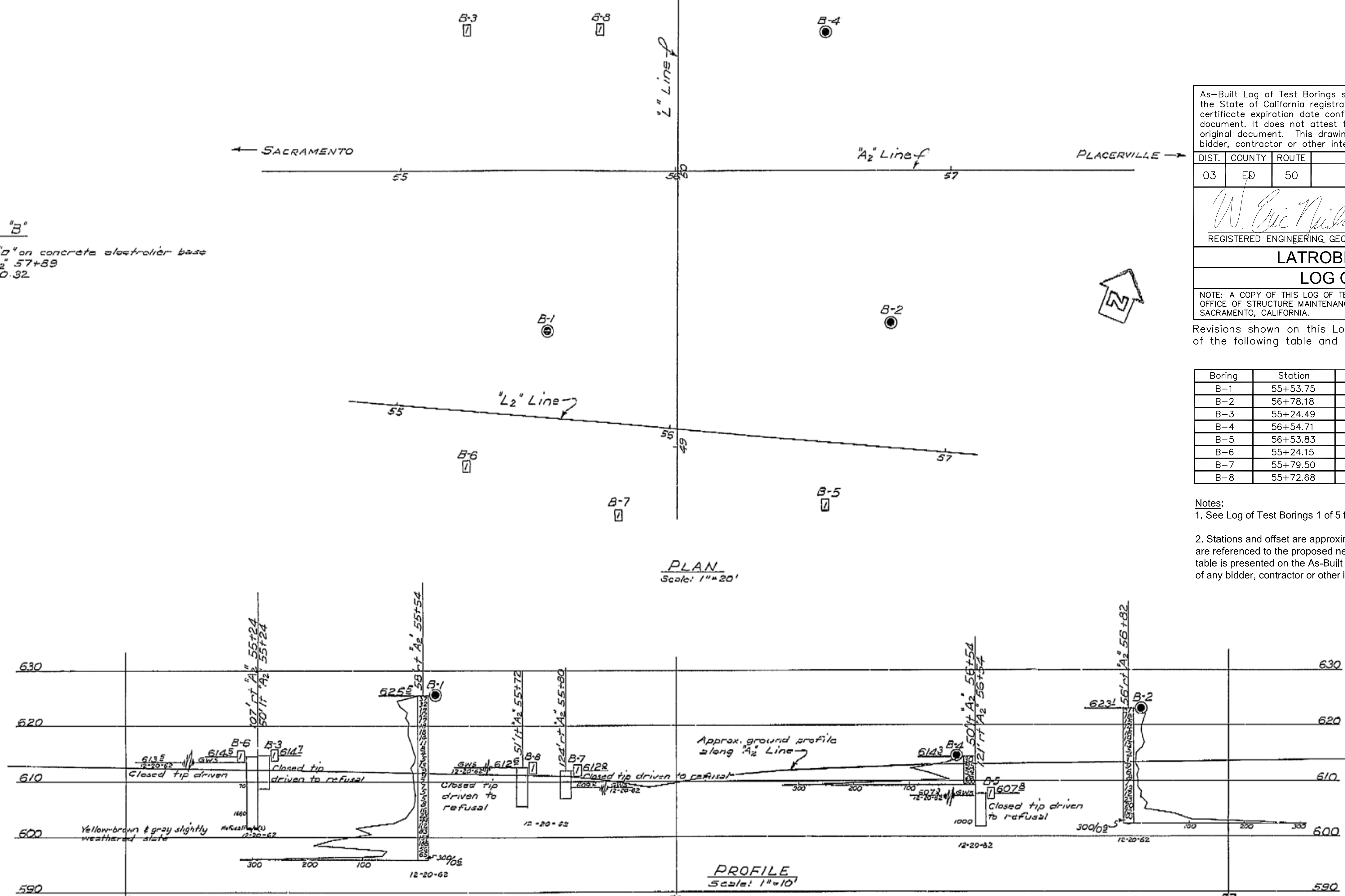
Revisions shown on this Log of Test Borings are the addition of the following table and notes.

Boring	Station	Offset from "A2" Line
B–1	55+53.75	58.10 ft Rt
B–2	56+78.18	54.73 ft Rt
B–3	55+24.49	51.08 ft Lt
B–4	56+54.71	50.29 ft Lt
B–5	56+53.83	121.09 ft Rt
B–6	55+24.15	107.32 ft Rt
B–7	55+79.50	124.82 ft Rt
B–8	55+72.68	51.17 ft Lt

PROFESSIONAL GEOLOGIST William E. Nichols No. 2229 Exp. 1–31–10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

Notes:
1. See Log of Test Borings 1 of 5 for stationing.

2. Stations and offset are approximate. The data presented in the table above are referenced to the proposed new structure location and stationing. This table is presented on the As-Built log of test boring sheet for the convenience of any bidder, contractor or other interested party.



THIS SET OF PLANS HAS BEEN CORRECTED TO CORRESPOND TO THE "AS BUILT" PRINTS DATED ______, AS SUBMITTED BY RESIDENT ENGINEER ______
TRACINGS CORRECTED BY: ______ DATE: ______

BRIDGE DEPARTMENT

FIELD STUDY By Nelson 12-62
DRAWN By Darr 1-63
CHECKED By Schroeder 3-63

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

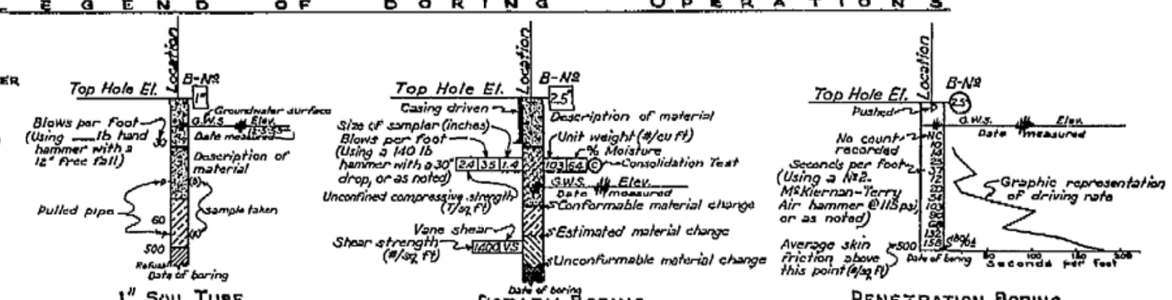
DIAGRAM SHOWING THE BASIS FOR ESTIMATES OF GRADE SIZE DISTRIBUTION USED IN DETERMINATION OF CLASS NAMES. IF GRAVEL IS PRESENT IN APPRECIABLE AMOUNTS THE TERM "GRAVELLY" MAY BE ADDED TO THE CLASS NAME, VIZ, "GRAVELLY SAND". THE TERMS "COARSE", "MEDIUM" AND "FINE" WHEN USED TO DESCRIBE SAND, SILT AND GRAVEL REFER TO STANDARD GRADE SIZE LIMITS.

LEGEND OF EARTH MATERIALS

GRAVEL, SAND, SILT, CLAY, SANDY CLAY OR CLAYEY SAND, SANDY SILT OR SILTY SAND, SILTY CLAY OR CLAYEY SILT, PEAT AND/OR ORGANIC MATTER, FILL MATERIAL, IGNEOUS ROCK, SEDIMENTARY ROCK, METAMORPHIC ROCK

LEGEND OF BORING OPERATIONS

PENETROMETER
2¼" CONE PENETROMETER
SAMPLER BORING (DRY)
ROTARY BORING (WET)
AUGER BORING (DRY)
JET BORING
CORE BORING
TEST PIT



NOTE

Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

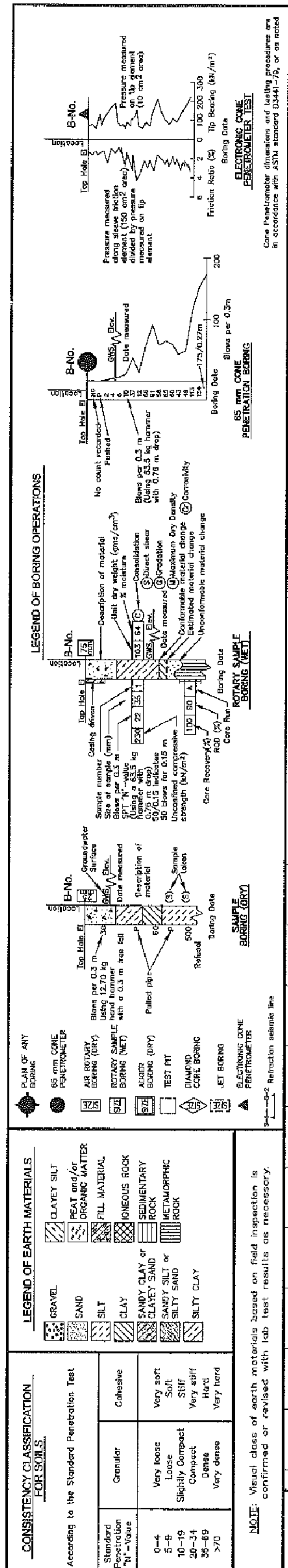
STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

LATROBE ROAD UNDERCROSSING
LOG OF TEST BORINGS

SCALE As shown | BRIDGE 25-71 R/L | FILE | DRAWING 2571-11

PREL. DRAWING NO. P-

159



DIST.	COUNTY	ROUTE	KP TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
03	ED	50	1.1/1.7	60	71

12/6/2004
REGISTERED ENGINEERING GEOLOGIST

PLANS APPROVAL DATE

TABER CONSULTANTS
3911 West Capitol Ave.
West Sacramento, CA 95691

JOB No. 1P2/398/189-1.1 LOCATION: 38121-F1:103N:198W

REGISTERED GEOLOGIST William E. Nichols No. 2229 Exp. 1-31-06 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

CH2M Hill
2485 Natomas Park Drive, Suite 600
Sacramento, CA 95833

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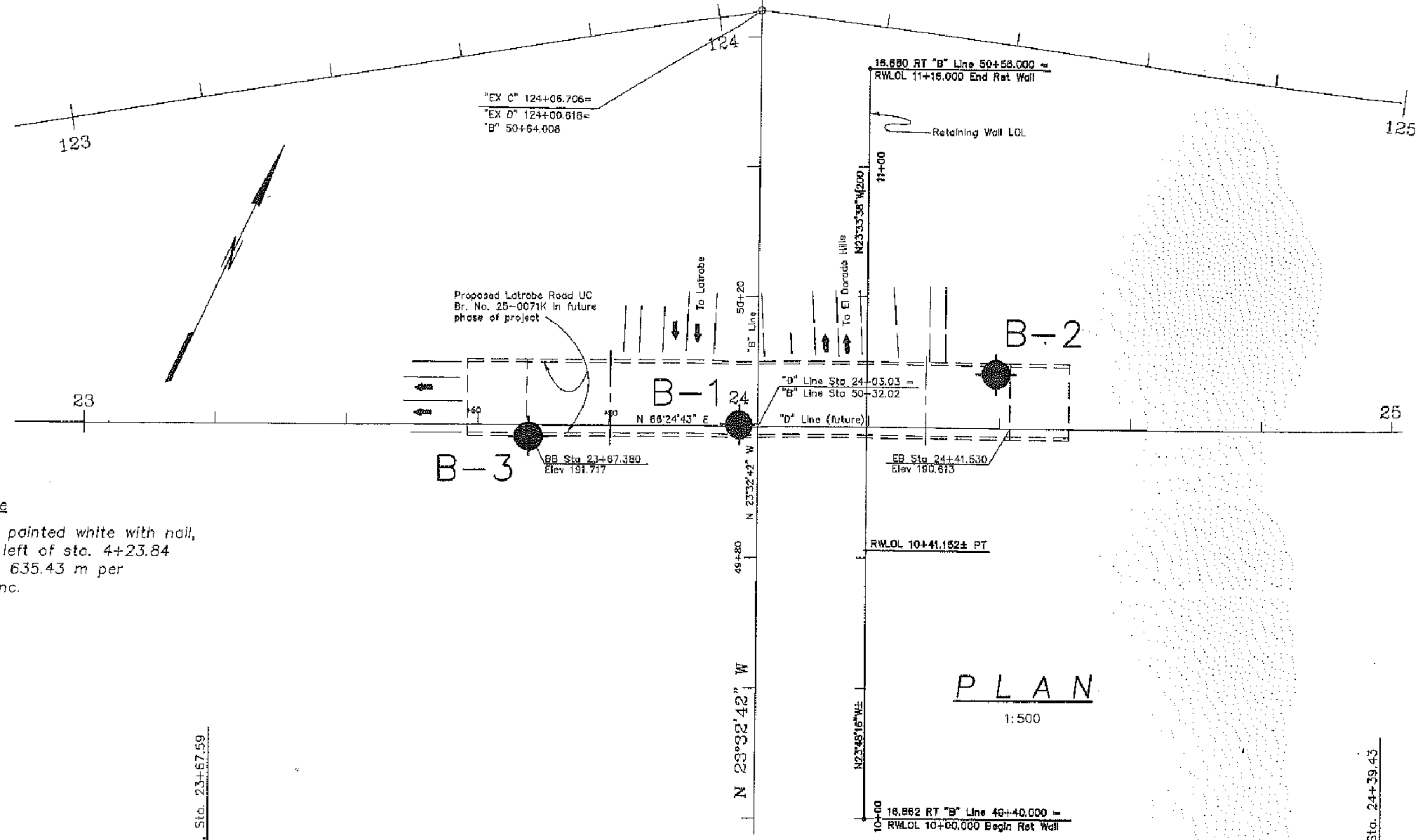
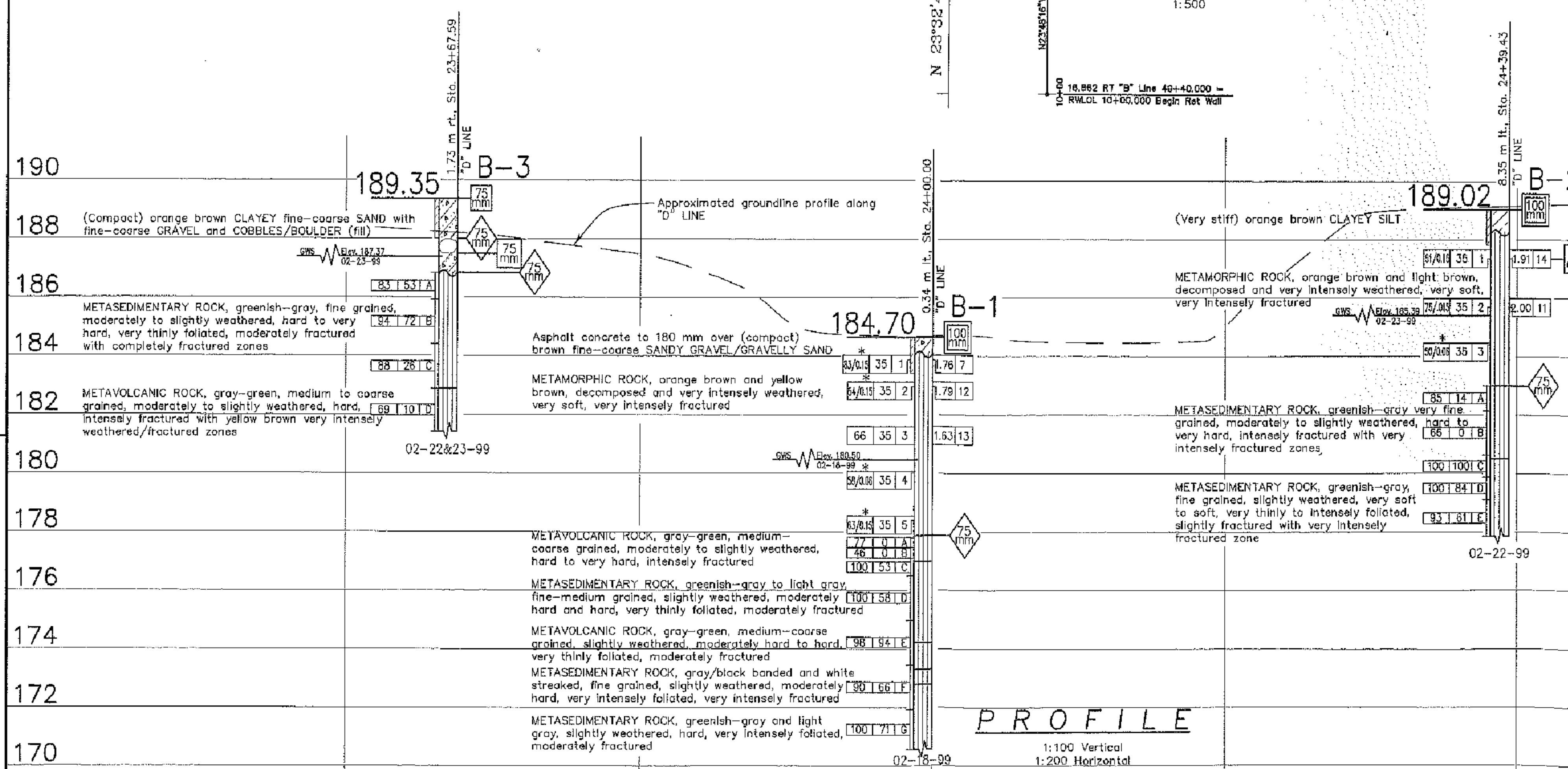


Elevation Reference

Aerial Flight Cross painted white with nail, located 154.85 m left of sta. 4+23.84 "D" Line, -- Elev. 635.43 m per HDR Engineering, Inc.

NOTES:
1. Field classification of soils was in accordance with ASTM D 2488-00 "Description and Identification of Soils (Visual-Manual Procedure)."
2. Rock classification according to Caltrans "Soil & Rock Logging Classification Manual (Field Guide)", August 1996, and Bureau of Reclamation, U.S. Department of the Interior, USBR-5000, "Procedure for Determining Unified Soil Classification", Earth Manual, Part II, Third Edition, 1990.
3. Standard Penetration tests were performed in accordance with ASTM D 1586-99 using a safety hammer operated with cat-head, rope and pully. Drill rods were 41 mm diameter "A"-rods; sampler was driven with brass liners.
4. Where indicated by an asterisk (*) the number of blows shown is for only that fraction of the initial .15 m "seating drive" interval penetrated.
5. The length of each sampled interval is shown graphically on the boring log. Whole number blow counts ("N") represent the "standard penetration resistance" interval in accordance with ASTM D1586-99. Where less than 0.45 m of penetration is achieved, the blow count shown is for that fraction of the "standard penetration resistance" interval actually penetrated.
6. Consistency of soils shown in ( ) where estimated.
7. Rock Quality Designation (RQD), Weathering, Rock Hardness/Strength, Bedding, and Fracture Density, as shown on this sheet, were used to describe all rock core from borings drilled in 2003. Descriptors were determined in the field.
8. All borings for this project were logged in English units, and were subsequently converted to metric units.
9. Groundwater surface (GWS) elevations in the borings indicated on the Log of Test Boring Sheets reflect the fluid level in the borings on the specified date.
10. Groundwater surface elevations are subject to seasonal fluctuations and may occur at higher or lower elevations depending on the conditions at any particular time.
11. Electronic media for plan view provided by CH2M Hill, December 2004.
12. The "Log of Test Borings" drawing is included with plans in accordance with Section 2-1.03 of Caltrans "Standard Specifications".



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. It does not attest to the accuracy or validity of the information contained in the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES-TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
03	ED	50	0.0-2.9		

REGISTERED ENGINEERING GEOLOGIST — DATE 3/11/08

LATROBE ROAD UNDERCROSSING
LOG OF TEST BORINGS 3 of 5

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA.
CU: 03252 EA: 3A7111
BRIDGE NO. 25-0122
SHEET 22 OF 24

Revisions shown on this Log of Test Borings are the addition of the following table and notes.

Boring	Station	Offset from "A2" Line
B-1	55+99.56	105.45 ft Lt
B-2	56+64.05	118.69 ft Lt
B-3	55+46.58	102.13 ft Lt

Notes:
1. See Log of Test Borings 1 of 5 for stationing.

2. Stations and offset are approximate. The data presented in the table above are referenced to the proposed new structure location and stationing. This table is presented on the As-Built log of test boring sheet for the convenience of any bidder, contractor or other interested party.

PROFESSIONAL GEOLOGIST William E. Nichols No. 2229 Exp. 1-31-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

172

PHASE 1.2B

DESIGN OVERSIGHT	DRAWN BY: T. M. Arkus	W. E. Nichols, FIELD INVESTIGATOR	METRIC "ALL DIMENSIONS AND ELEVATIONS ARE IN METRIC (m)"
SIGN OFF DATE	CHECKED BY: W. E. Nichols	DATE February 1999	

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Paul Gervacio, PROJECT ENGINEER

BRIDGE NO. 25E0002
KP 1.28

LATROBE ROAD RETAINING WALL
LOG OF TEST BORINGS

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 20 40 60 80
CU 03198
EA 434101
DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES (PRELIMINARY STAGE ONLY) SHEET OF

12/06/04 1P2398189-1arevised.dwg 1=1

DIST	COUNTY	ROUTE	TOTAL PROJECT	SHEET No	TOTAL SHEETS
03	ED	50	0.0-2.9		

CERTIFIED ENGINEERING GEOLOGIST 3/11/08 DATE

PROFESSIONAL GEOLOGIST William E. Nichols No. 2229 Exp. 1-31-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

PLANS APPROVAL DATE

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BLACKBURN CONSULTING
2437 FRONT STREET
WEST SACRAMENTO, CA 95691
File No. 1072.2

QUINCY ENGINEERING
3247 RAMOS CIRCLE
SACRAMENTO, CA 95827-2501

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
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 2435-04)
- (CL) Collapse Potential (ASTM D 5333-03)
- (CP) Compaction Curve (CTM 216-06)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767-04)
- (DS) Direct Shear (ASTM D 3080-04)
- (EI) Expansion Index (ASTM D 4829-03)
- (M) Moisture Content (ASTM D 2216-05)
- (OC) Organic Content-% (ASTM D 2974-07)
- (P) Permeability (CTM 220-05)
- (PA) Particle Size Analysis (ASTM D 422-63) (2002)
- (PI) Platicity Index (AASHTO T 90-00) Liquid Limit (AASHTO T 89-02)
- (PL) Point Load Index (ASTM D 5731-05)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301-00)
- (SE) Sand Equivalent (CTM 217-99)
- (SG) Specific Gravity (AASHTO T 100-06)
- (SL) Shrinkage Limit (ASTM D 427-04)
- (SW) Swell Potential (ASTM D 4546-03)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166-06) Unconfined Compression-Rock (ASTM D 2938-95) (2002)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850-03)
- (UW) Unit Weight (ASTM D 2937-04)
- (VS) Vane Shear (AASHTO T 223-96) (2004)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} -Value (Blows / 12 in.)
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 in.
Cobble		3 to 12 in.
Gravel	Coarse	3/4 to 3 in.
	Fine	No. 4 to 3/4 in.
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

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

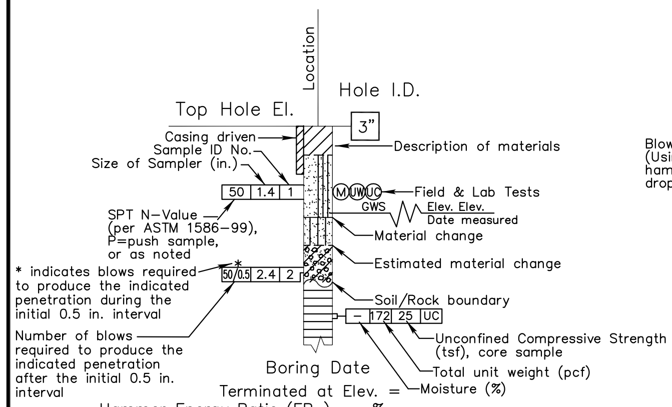
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	<0.25	<0.25	<0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	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

PLASTICITY OF FINE-GRAINED SOILS

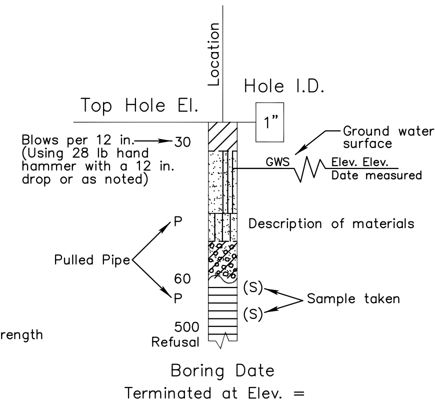
Description	Criteria
Nonplatic	A 1/8-in. thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be 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.

BOREHOLE IDENTIFICATION

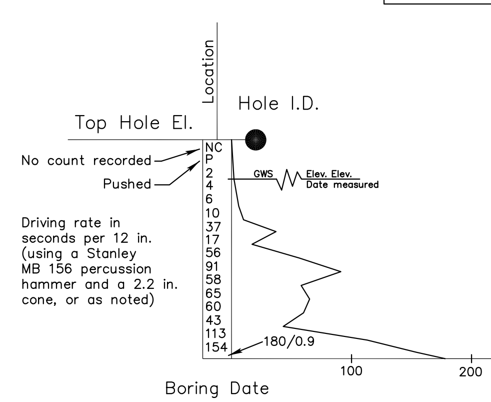
Symbol	Hole Type	Description
	A	Auger Boring
	R P	Rotary drilled boring Rotary percussion boring (air)
	R	Rotary drilled diamond core
	HD HA	Hand driven (1-inch soil tube) Hand Auger
	D	Dynamic Cone Penetration Boring
	CPT	Cone Penetration Test (ASTM D 5778-95)
	O	Other



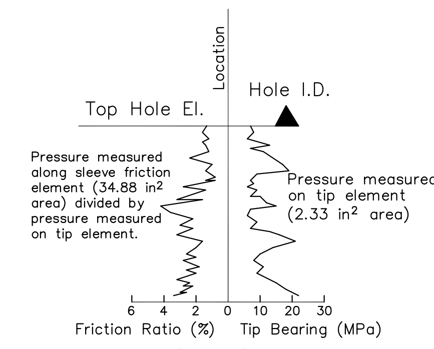
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATON BORING



CONE PENETRATON TEST (CPT) SOUNDING

SOIL LEGEND

LATROBE ROAD UNDERCROSSING

LOG OF TEST BORINGS 4 of 5

ENGINEERING SERVICES	GEOTECHNICAL SERVICES	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DESIGN OVERSIGHT	BRIDGE NO.
PREPARED BY	M. D. Robertson		NAME: Tim Osterkamp	25-0122
CHECKED BY	W. E. Nichols			POST MILE 0.9

04/22/08 LATROBE ROAD UC LEGENDS.DWG

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 03252
EA 3A7111

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 04/18/08

REVISION DATES

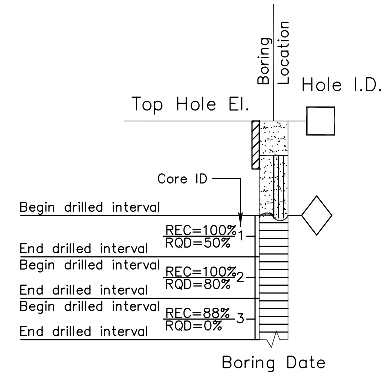
SHEET 23 OF 24

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

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (in.)}}{\text{Total length of core run (in.)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of the intact core pieces} \geq 4 \text{ in.}}{\text{Total length of core run (in.)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (PSI)
Extremely Strong	> 30,000
Very Strong	14,500 – 30,000
Strong	7,000 – 14,500
Medium Strong	3,500 – 7,000
Weak	700 – 3,500
Very Weak	150 – 700
Extremely Weak	< 150

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 10 ft
Very thickly bedded	3 to 10 ft
Thickly bedded	1 to 3 ft
Moderately bedded	4 in. to 1 ft
Thinly bedded	1 in. to 4 in.
Very thinly bedded	3/8 in. to 1 in.
Laminated	Less than 3/8 in.

LEGEND OF ROCK MATERIALS

IGNEOUS ROCK

SEDIMENTARY ROCK

METAMORPHIC ROCK

IGNEOUS AND METAMORPHIC ROCK GRAIN SIZE DESCRIPTORS

Description	Average crystal diameter
Very coarse–grained or pegmatic	>3/8 inch
Coarse–grained	3/16–3/8 inch
Medium–grained	1/32–3/16 inch
Fine–grained	0.04–1/32 inch
Aphanitic (cannot be seen with the unaided eye)	<0.04 inch

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife; no steel marks left on surface.
Very Hard	Specimen cannot be scratched with a pocket knife; steel marks left on surface.
Hard	Specimen can be scratched with a pocket knife with difficulty (heavy pressure).
Moderately Hard	Specimen can be scratched with a pocket knife with light to moderate pressure.
Moderately Soft	Specimen can be grooved 1/6 in. deep with a pocket knife with moderate or heavy pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife with light pressure, can be scratched with fingernail.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 3 feet.
Slightly fractured	Lengths from 1 to 3 feet with few lengths less than 1 foot or greater than 3 feet.
Moderately fractured	Lengths mostly in 4 in. to 1 foot range with most lengths about 8 in.
Intensely fractured	Lenghts average from 1 to 4 in. with scattered fragmented intervals with lengths less than 4 in.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features					General Characteristics
	Chemical weathering–Discoloration and/or oxidation		Mechanical Weathering–Grain boundary conditions (disaggregation) primarily for granitics and some coarse–grained sediments	Texture and solutioning		
	Body of rock	Fracture Surfaces		Texture	Solutioning	
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discolorization or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe–Mg minerals are "rusty", feldspar crystals are "cloudy".	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe–Mg minerals are altered to clay to some extent; or chemical alteration produces in–situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe–Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes".

Combination descriptors (such as "slightly weathered to fresh") are used where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic features. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed".

DIST	COUNTY	ROUTE	TOTAL PROJECT	SHEET No	TOTAL SHEETS
03	ED	50	0.0–2.9		

W. Eric Nichols 3/11/08
CERTIFIED ENGINEERING GEOLOGIST DATE

PROFESSIONAL GEOLOGIST William E. Nichols No. 2229 Exp. 1–31–10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

PLANS APPROVAL DATE

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BLACKBURN CONSULTING
2437 FRONT STREET
WEST SACRAMENTO, CA 95691
File No. 1072.2

QUINCY ENGINEERING
3247 RAMOS CIRCLE
SACRAMENTO, CA 95827–2501

ROCK LEGEND

LATROBE ROAD UNDERCROSSING

LOG OF TEST BORINGS 5 of 5

ENGINEERING SERVICES	GEOTECHNICAL SERVICES
PREPARED BY	M. D. Robertson
CHECKED BY	W. E. Nichols

PREPARED FOR THE **STATE OF CALIFORNIA** DEPARTMENT OF TRANSPORTATION

DESIGN OVERSIGHT
NAME: Tim Osterkamp

BRIDGE NO. 25–0122
POST MILE 0.9

04/22/08 LATROBE ROAD UC LEGENDS.DWG

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 03252
EA 3A7111

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 04/18/08

REVISION DATES | SHEET 24 | OF 24

REGISTERED CIVIL ENGINEER X DATE

95% SUBMITTAL

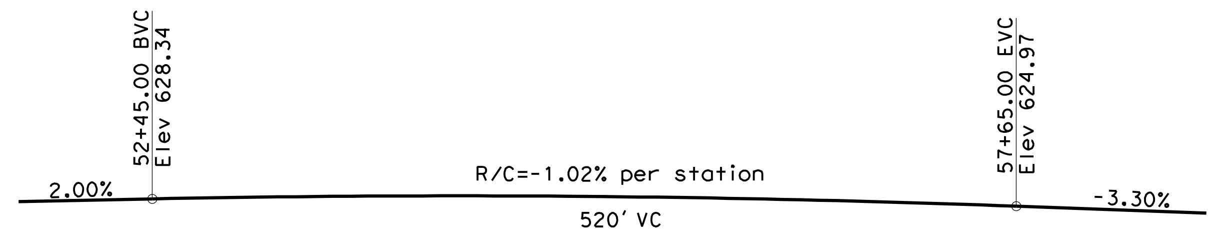
PLANS APPROVAL DATE

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

REGISTERED PROFESSIONAL ENGINEER Danny J. Mossman No. 70850 Exp. 06-30-13 CIVIL STATE OF CALIFORNIA

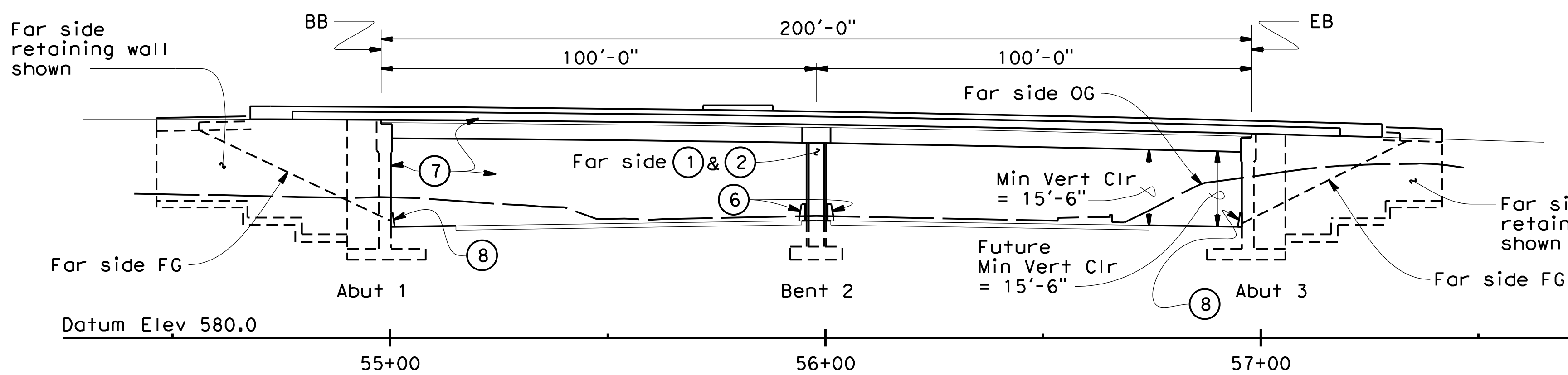
QUINCY ENGINEERING, INC
3247 Ramos Circle
Sacramento, CA 95827 - 2501

El Dorado County
2850 Fairlane Court
Placerville, CA 95667



PROFILE GRADE "W1" LINE

No Scale



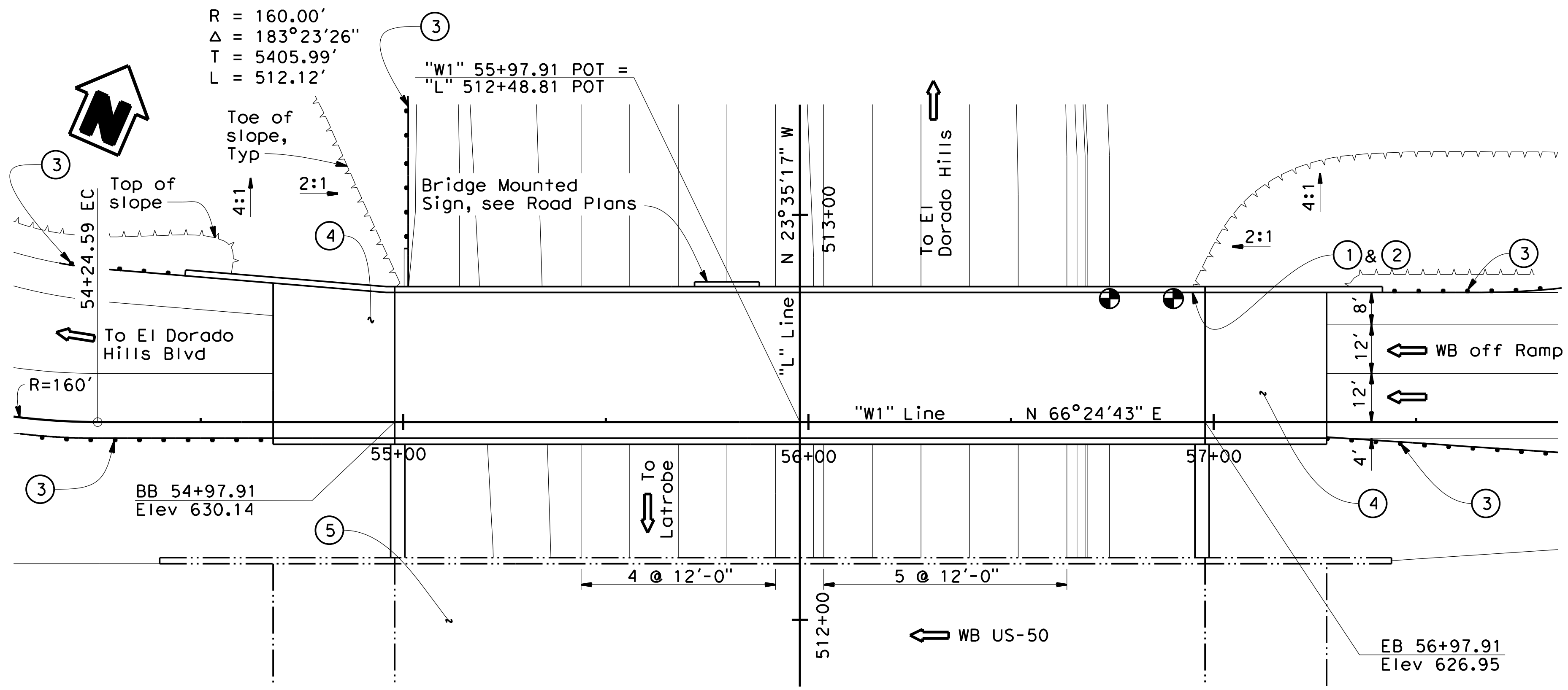
ELEVATION

1"=20'

INDEX TO PLANS

CURVE DATA

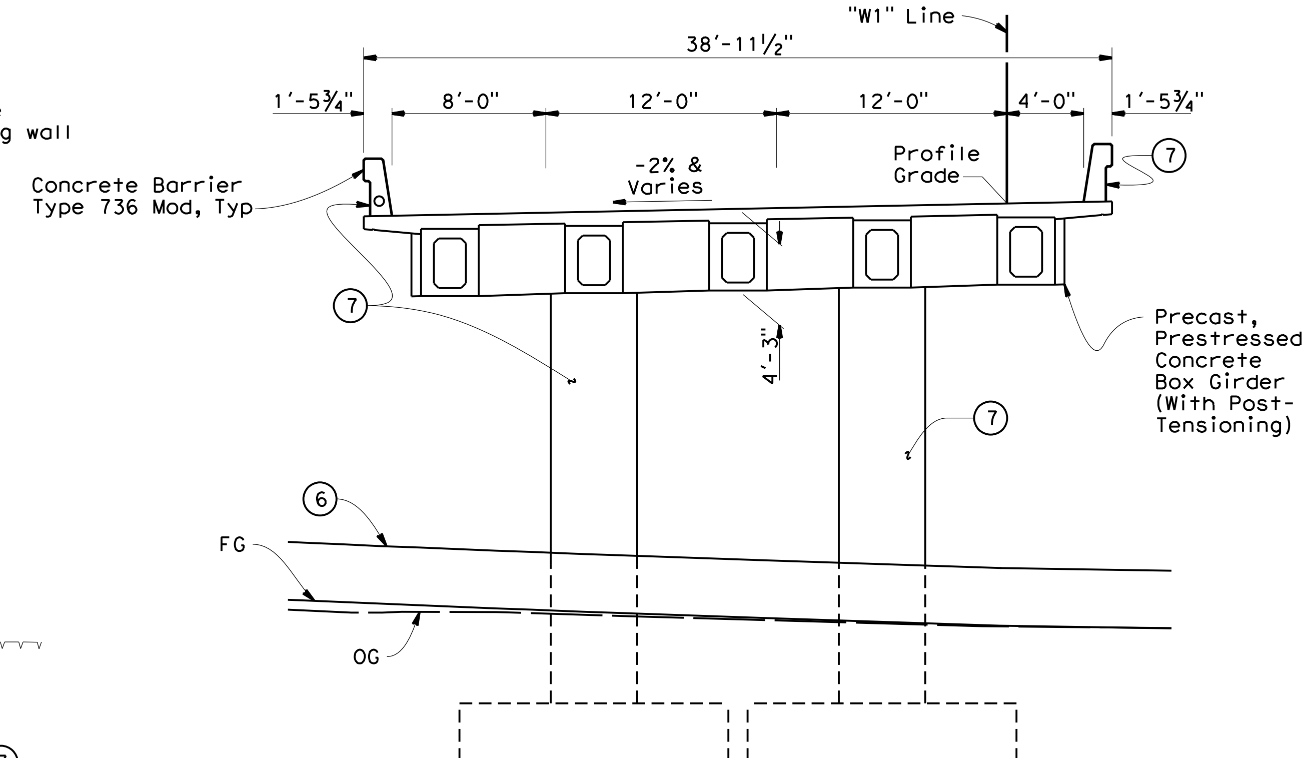
R = 160.00'
Δ = 183°23'26"
T = 5405.99'
L = 512.12'



PLAN

1"=20'

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



TYPICAL SECTION

1"=5'

Notes:

1. Paint Bridge "Br No. 25-0122K"
2. Paint "Latrobe Rd. WB Off Ramp UC"
3. MBGR see Road Plans
4. Structure Approach Type N(30S)
5. Existing Latrobe Road Undercrossing "Br No. 25-0122"
6. Concrete Barrier Type 60F, see Road Plans
7. Architectural Treatment, not shown
8. Concrete Barrier Type 60D, see Road Plans

● Indicates point of minimum vertical clearance

-·-·- Existing structure

For General Notes and Quantities, see "General Notes" sheet.

For Spread Footing Data Table, see "Foundation Plan" sheet.

APPENDIX B

- Footing Data (provided by QEI)
- Calculations for WSD Design and LRFD Design

Transmitted by:

From:	Patrick Fischer
Date:	03/01/2012
Project:	Latrobe Road UC WB Off Ramp UC

Completed by:

Client:	Quincy Engineering, Inc.
Bridge Designer:	Danny Mossman
Date Completed:	03/01/2012

Note: Please insert N/A where applicable

Footing Foundation Design Data						
Support No.	Design Method (WSD or LRFD)	Finish Grade Elev. (ft)	BOF Elevation (ft)	Footing Size (ft)		Permissible Settlement under Service Load (in) *
				B	L	
Abutment 1	WSD	605.00	598.00	18.00	40.00	1.00
Bent 2	LRFD	608.00	598.00	12.00	14.00	1.00
Abutment 3	WSD	605.00	598.00	18.00	40.00	1.00

*Based on CALTRANS' current practice, the total permissible settlement for a shallow footing is one inch for structures with continuous spans or multi-column bents, and two inches for simple span structures.

Scour Data				
Support No.	Degradation Scour (ft)	Base Flood Scour (ft)		Total Scour (ft)
		Contraction	Local	
Abutment 1	N/A	N/A	N/A	N/A
Bent 2	N/A	N/A	N/A	N/A
Abutment 3	N/A	N/A	N/A	N/A

LRFD Service Limit State I

Support No.	Total Load					Permanent Load *		
	Vertical Load (kip)	Effective Dimensions (ft)		Horizontal Load (kip)		Vertical Load (kip)	Effective Dimensions (ft)	
		B'	L'	Longitudinal Direction	Transverse Direction		B'	L'
Abutment 1	2,412	N/A	N/A	N/A	N/A	1,112	N/A	N/A
Bent 2	1,230	12.00	14.00	34	8	626	12.00	14.00
Abutment 3	2,174	N/A	N/A	N/A	N/A	1,026	N/A	N/A

* See table 3.4.1-2 in the AASHTO LRFD Bridge Design Specifications for components of permanent load.

LRFD Strength and Extreme Event Limit States

Support No.	Strength Limit State (Controlling Group)			Extreme Event Limit State (Controlling Group)		
	Vertical Load (kip)	Effective Dimensions (ft)		Vertical Load (kip)	Effective Dimensions (ft)	
		B'	L'		B'	L'
Abutment 1	N/A	N/A	N/A	1,112	N/A	N/A
Bent 2	1,957	12.00	14.00	626	12.00	14.00
Abutment 3	N/A	N/A	N/A	1,026	N/A	N/A

NOMINAL BEARING RESISTANCE -- STRENGTH LIMIT STATE (AASHTO Bridge Design Specifications)

Date:	2/28/2012	*Support:*	**Abutment 1 and 3, B = 18 ft, L = 40 ft**
Project:	Latrobe Rd WB Off Ramp UC	*Boring:*	R-99-B3 and R-99-B2 (Taber 1999)
BCI No:	1072.8	*Base of Footing:*	598.0 ft

Equation: $q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\,\gamma B N_{\gamma m} C_{w\gamma}$

in which:

$N_{cm} = N_c s_c i_c$

$N_{qm} = N_q s_q d_q i_q$

$N_{\gamma m} = N_\gamma s_\gamma i_\gamma$

D_w	C_{wq}	$C_{w\gamma}$
0	0.5	0.5
D_f	1.0	0.5
>1.5B+D_f	1.0	1.0

where:

q_n = nominal bearing resistance

c = cohesion (psf)

B = footing width (feet)

γ = total (moist) unit weight of soil (pcf)

D_f = footing embedment depth (feet)

N_c, N_q, and N_γ = bearing capacity factors

C_{wq} & $C_{w\gamma}$ = correction factors for location of ground water

s_c, s_γ, and s_q = footing shape correction factors

d_q = correction factor to account for shearing resistance in material above bearing level

i_c, i_γ, and i_q = load inclination factors

D_w = depth to ground water taken from the ground surface (feet)

Input Parameters

γ =	120 (pcf)	d_q =	1.0	Bottom Footing Elevation (feet): 598.0
ϕ =	35 (degrees)	i_c =	1.0	Finished Grade (feet): 605.0
c =	0 (psf)	i_γ =	1.0	Ground Water Elevation (feet): 605.0
D_f =	7 (feet)	i_q =	1.0	
D_w =	0 (feet)			

Solve for Nominal Bearing Resistance

	Effective Footing Dimensions B'	L'	C_{wq}	$C_{w\gamma}$	s_c	s_γ	s_q	Nominal Bearing Resistance (Resistance Factor = 1.0)			WSD Allowable Bearing (Factor of Safety = 3)		
Case 1	(feet)							(psf)	(ksf)	(tsf)	(psf)	(ksf)	(tsf)
1	10.0	40.0	0.50	0.50	1.18	0.90	1.18	29402	29.40	14.7	9801	9.80	4.9
2	12.0	40.0	0.50	0.50	1.22	0.88	1.21	32140	32.14	16.1	10713	10.71	5.4
3	14.0	40.0	0.50	0.50	1.25	0.86	1.25	34762	34.76	17.4	11587	11.59	5.8
4	18.0	40.0	0.50	0.50	1.32	0.82	1.32	39661	39.66	19.8	13220	13.22	6.6
5	20.0	40.0	0.50	0.50	1.36	0.80	1.35	41937	41.94	21.0	13979	13.98	7.0
6	22.0	40.0	0.50	0.50	1.40	0.78	1.39	44098	44.10	22.0	14699	14.70	7.3
7	24.0	40.0	0.50	0.50	1.43	0.76	1.42	46144	46.14	23.1	15381	15.38	7.7
8	26.0	40.0	0.50	0.50	1.47	0.74	1.46	48074	48.07	24.0	16025	16.02	8.0
Case 2													
1													
2													
3													
4													
5													
6													
7													
8													

Bearing Capacity Factors

N_c = 46.12

N_q = 33.30

N_γ = 48.03

Shape Correction Factors

ϕ	s_c	s_γ	s_q
$\phi = 0$	1 + (B/5L)	1.0	1.0
$\phi > 0$	1 + (B/L)(N_q/N_c)	1 - 0.4(B/L)	1 + (B/L)tanϕ

Note: If L > 5B, then s_c, s_γ, and s_q = 1.0 (Geotechnical Engineering Circular No. 6, FHWA-SA-02-054, pgs 55-56)

Estimate unfactored vertical pressure at prescribed settlement

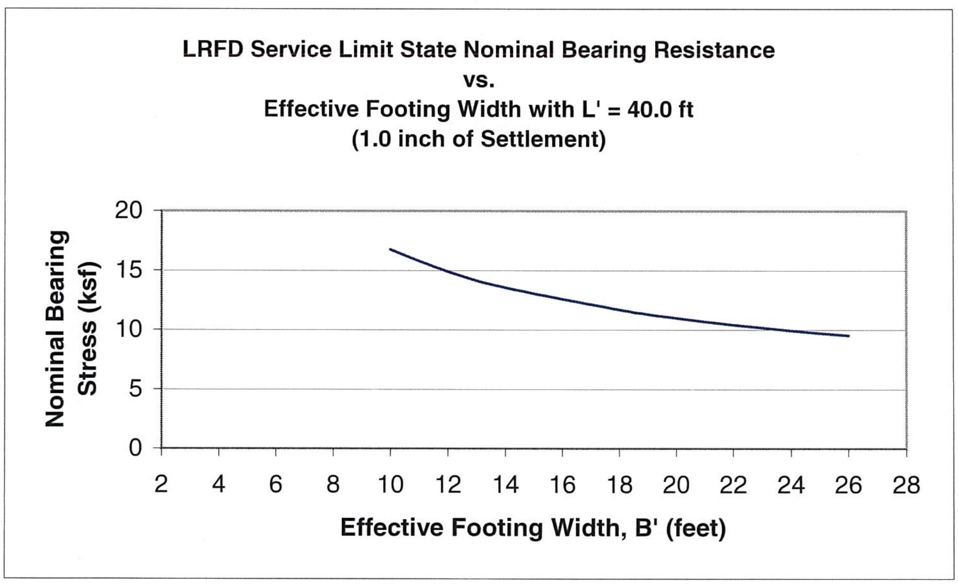
Date:	2/28/2012	*Support:*	**Abutment 1 and 3, B = 18 ft, L = 40 ft**
Project:	Latrobe Rd WB Off Ramp UC	*Boring:*	R-99-B3 and R-99-B2 (Taber 1999)
BCI No:	1072.8	*Base of Footing:*	598.0 ft

Equation:

$qo = (Se \times Es \times \beta z) / (1-v^2) \times A^{1/2}$

Se, Settlement (in.)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
B', Effective Footing Width (ft.)	10.0	12.0	14.0	18.0	20.0	22.0	24.0	26.0
L', Effective Footing Length (ft.)	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
L/B Ratio	4.00	3.33	2.86	2.22	2.00	1.82	1.67	1.54
βz (shape and rigidity factor)	1.18	1.15	1.12	1.10	1.09	1.08	1.08	1.08
A, Footing Area (sq. ft)	400	480	560	720	800	880	960	1040
Square Root A	20.00	21.91	23.66	26.83	28.28	29.66	30.98	32.25
Es, Soil Modulus (ksf)	3000	3000	3000	3000	3000	3000	3000	3000
v, Poisson's Ratio	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
qo (unfactored vertical pressure-ksf)	16.74	14.89	13.54	11.67	10.98	10.42	9.93	9.51
qo (kPa)	801	713	648	559	526	499	475	455

Note: Unfactored vertical pressure determined by equation 4.4.7.2.2-1 (Caltrans Bridge Design Specifications, November 2003, pg 4-20).



B' (feet)	**qo** (ksf)
10.0	16.7
12.0	14.9
14.0	13.5
18.0	11.7
20.0	11.0
22.0	10.4
24.0	9.9
26.0	9.5

For B' = 18', Permissable = 11.7 ksf.
Gross = Permissable plus initial overburden, = 11.7 ksf + (7' x 60 pcf)/1000 lbs/k, = 12.12 ksf

NOMINAL BEARING RESISTANCE -- STRENGTH LIMIT STATE (AASHTO Bridge Design Specifications)

Date:	2/28/2012	*Support:*	**Bent 2, B = 12 ft, L = 14 ft**
Project:	Latrobe Rd WB Off Ramp UC	*Boring:*	A-99-B1 (Taber 1999)
BCI No:	1072.8	*Base of Footing:*	598.0 ft

Equation: $q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\,\gamma B N_{\gamma m} C_{w\gamma}$

in which:

$N_{cm} = N_c s_c i_c$

$N_{qm} = N_q s_q d_q i_q$

$N_{\gamma m} = N_\gamma s_\gamma i_\gamma$

D_w	C_{wq}	$C_{w\gamma}$
0	0.5	0.5
D_f	1.0	0.5
>1.5B+D_f	1.0	1.0

where:

q_n = nominal bearing resistance

c = cohesion (psf)

B = footing width (feet)

γ = total (moist) unit weight of soil (pcf)

D_f = footing embedment depth (feet)

N_c, N_q, and N_γ = bearing capacity factors

C_{wq} & $C_{w\gamma}$ = correction factors for location of ground water

s_c, s_γ, and s_q = footing shape correction factors

d_q = correction factor to account for shearing resistance in material above bearing level

i_c, i_γ, and i_q = load inclination factors

D_w = depth to ground water taken from the ground surface (feet)

Input Parameters

γ =	120	(pcf)
ϕ =	35	(degrees)
c =	0	(psf)
D_f =	10	(feet)
D_w =	3	(feet)

d_q =	1.0
i_c =	1.0
i_γ =	1.0
i_q =	1.0

Bottom Footing Elevation (feet):	598.0
Finished Grade (feet):	608.0
Ground Water Elevation (feet):	605.0

Resistance Factor (φ_b)= 0.45

Solve for Nominal Bearing Resistance

	Effective Footing Dimensions B'	L'	C_{wq}	$C_{w\gamma}$	s_c	s_γ	s_q	Nominal Bearing Resistance (Resistance Factor = 1.0)			Strength Limit State: Factored Nominal Bearing Resistance (Resistance Factor = 0.45)		
Case 1	(feet)							(psf)	(ksf)	(tsf)	(psf)	(ksf)	(tsf)
1	4.0	4.0	0.65	0.50	1.72	0.60	1.70	47619	47.62	23.8	21429	21.43	10.7
2	6.0	6.0	0.65	0.50	1.72	0.60	1.70	49348	49.35	24.7	22207	22.21	11.1
3	8.0	8.0	0.65	0.50	1.72	0.60	1.70	51078	51.08	25.5	22985	22.98	11.5
4	10.0	10.0	0.65	0.50	1.72	0.60	1.70	52807	52.81	26.4	23763	23.76	11.9
5	12.0	12.0	0.65	0.50	1.72	0.60	1.70	54536	54.54	27.3	24541	24.54	12.3
6	14.0	14.0	0.65	0.50	1.72	0.60	1.70	56265	56.26	28.1	25319	25.32	12.7
7	18.0	18.0	0.65	0.50	1.72	0.60	1.70	59723	59.72	29.9	26875	26.88	13.4
8	20.0	20.0	0.65	0.50	1.72	0.60	1.70	61452	61.45	30.7	27653	27.65	13.8
Case 2													
1	7.0	14.0	0.65	0.50	1.36	0.80	1.35	43137	43.14	21.6	19411	19.41	9.7
2	8.0	14.0	0.65	0.50	1.41	0.77	1.40	45259	45.26	22.6	20367	20.37	10.2
3	9.0	14.0	0.65	0.50	1.46	0.74	1.45	47299	47.30	23.6	21285	21.28	10.6
4	10.0	14.0	0.65	0.50	1.52	0.71	1.50	49257	49.26	24.6	22166	22.17	11.1
5	11.0	14.0	0.65	0.50	1.57	0.69	1.55	51132	51.13	25.6	23010	23.01	11.5
6	12.0	14.0	0.65	0.50	1.62	0.66	1.60	52926	52.93	26.5	23816	23.82	11.9
7	13.0	14.0	0.65	0.50	1.67	0.63	1.65	54636	54.64	27.3	24586	24.59	12.3
8	14.0	14.0	0.65	0.50	1.72	0.60	1.70	56265	56.26	28.1	25319	25.32	12.7

Bearing Capacity Factors

N_c = 46.12

N_q = 33.30

N_γ = 48.03

Shape Correction Factors

ϕ	s_c	s_γ	s_q
$\phi = 0$	1 + (B/5L)	1.0	1.0
$\phi > 0$	1 + (B/L)(N_q/N_c)	1 - 0.4(B/L)	1 + (B/L)tanϕ

Note: If L > 5B, then s_c, s_γ, and s_q = 1.0 (Geotechnical Engineering Circular No. 6, FHWA-SA-02-054, pgs 55-56)

Estimate unfactored vertical pressure at prescribed settlement

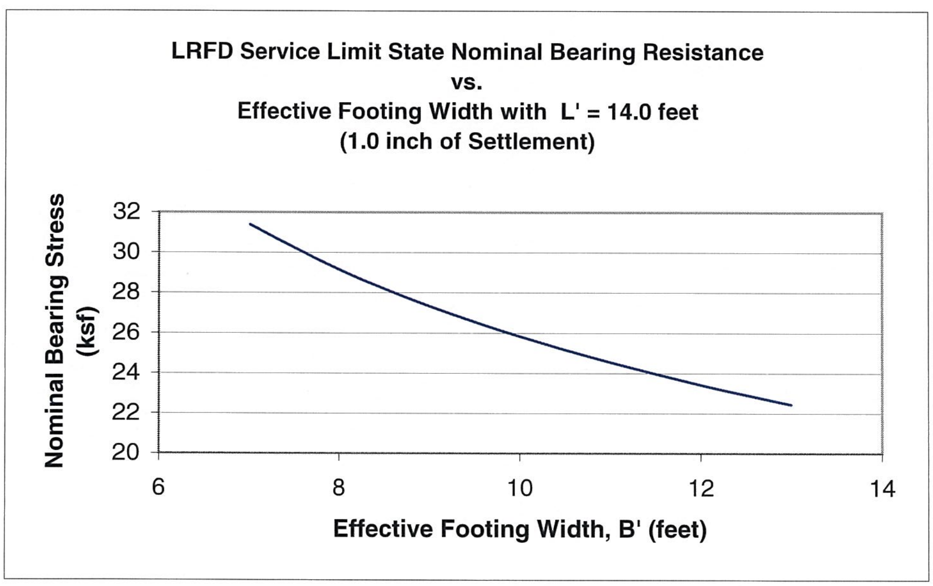
Date:	2/28/2012	*Support:*	**Bent 2, B = 12 ft, L = 14 ft**
Project:	Latrobe Rd WB Off Ramp UC	*Boring:*	A-99-B1 (Taber 1999)
BCI No:	1072.8	*Base of Footing:*	598.0 ft

Equation:

$qo = (Se \times Es \times \beta z) / (1-v^2) \times A^{1/2}$

Se, Settlement (in.)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
B, Footing Width (ft.)	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0
L, Footing Length (ft.)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
L/B Ratio	2.00	1.75	1.56	1.40	1.27	1.17	1.08	1.00
βz (shape and rigidity factor)	1.09	1.08	1.08	1.07	1.07	1.07	1.06	1.06
A, Footing Area (sq. ft)	98	112	126	140	154	168	182	196
Square Root A	9.90	10.58	11.22	11.83	12.41	12.96	13.49	14.00
Es, Soil Modulus (ksf)	3000	3000	3000	3000	3000	3000	3000	3000
v, Poisson's Ratio	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
qo (unfactored vertical pressure-ksf)	31.37	29.14	27.33	25.81	24.52	23.41	22.43	21.57
qo (kPa)	1502	1395	1308	1236	1174	1121	1074	1033

Note: Unfactored vertical pressure determined by equation 4.4.7.2.2-1 (Caltrans Bridge Design Specifications, November 2003, pg 4-20).



B'	qo
(feet)	(ksf)
7.0	31.4
8.0	29.1
9.0	27.3
10.0	25.8
11.0	24.5
12.0	23.4
13.0	22.4
14.0	21.6

NOMINAL BEARING RESISTANCE -- STRENGTH LIMIT STATE (AASHTO Bridge Design Specifications)

Date:	2/28/2012	*Support:*	**Abutment 1& 3 Ret Walls, B = 12-24 ft, L = 12-20 ft**
Project:	Latrobe Rd WB Off Ramp UC	*Boring:*	R-99-B2&B3 (Taber) and A-12-104&O-12-110 (BCI)
BCI No:	1072.8	*Base of Footing:*	Varies (check with worst case condition)

Equation: $q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\,\gamma B N_{\gamma m} C_{w\gamma}$

in which:

$N_{cm} = N_c s_c i_c$

$N_{qm} = N_q s_q d_q i_q$

$N_{\gamma m} = N_\gamma s_\gamma i_\gamma$

D_w	C_{wq}	$C_{w\gamma}$
0	0.5	0.5
D_f	1.0	0.5
>1.5B+D_f	1.0	1.0

where:

q_n = nominal bearing resistance

c = cohesion (psf)

B = footing width (feet)

γ = total (moist) unit weight of soil (pcf)

D_f = footing embedment depth (feet)

N_c, N_q, and N_γ = bearing capacity factors

C_{wq} & $C_{w\gamma}$ = correction factors for location of ground water

s_c, s_γ, and s_q = footing shape correction factors

d_q = correction factor to account for shearing resistance in material above bearing level

i_c, i_γ, and i_q = load inclination factors

D_w = depth to ground water taken from the ground surface (feet)

Input Parameters

γ =	120 (pcf)	d_q =	1.0	Bottom Footing Elevation (feet):	602.0	lowest
ϕ =	35 (degrees)	i_c =	1.0	Finished Grade (feet):	varies	
c =	0 (psf)	i_γ =	1.0	Ground Water Elevation (feet):	603.0	worst case
D_f =	4 (feet)	i_q =	1.0			
D_w =	-1 (feet)					

Solve for Nominal Bearing Resistance

	Effective Footing Dimensions							Nominal Bearing Resistance			WSD Allowable Bearing		
	B'	L'	C_{wq}	$C_{w\gamma}$	s_c	s_γ	s_q	Resistance Factor = 1.0			Factor of Safety = 3		
Case 1	(feet)							(psf)	(ksf)	(tsf)	(psf)	(ksf)	(tsf)
1	7.3	12.0	0.38	0.50	1.44	0.76	1.42	16452	16.45	8.2	5484	5.48	2.7
2	9.0	12.0	0.38	0.50	1.54	0.70	1.53	18219	18.22	9.1	6073	6.07	3.0
3	11.0	12.0	0.38	0.50	1.66	0.63	1.64	19880	19.88	9.9	6627	6.63	3.3
4	13.3	12.0	0.38	0.50	1.80	0.56	1.77	21288	21.29	10.6	7096	7.10	3.5
5	9.0	20.0	0.38	0.50	1.32	0.82	1.32	18517	18.52	9.3	6172	6.17	3.1
6													
7													
8													
Case 2													
1													
2													
3													
4													
5													
6													
7													
8													

Bearing Capacity Factors

N_c = 46.12

N_q = 33.30

N_γ = 48.03

Shape Correction Factors

ϕ	s_c	s_γ	s_q
$\phi = 0$	1 + (B/5L)	1.0	1.0
$\phi > 0$	1 + (B/L)(N_q/N_c)	1 - 0.4(B/L)	1 + (B/L)tanϕ

Note: If L > 5B, then s_c, s_γ, and s_q = 1.0 (Geotechnical Engineering Circular No. 6, FHWA-SA-02-054, pgs 55-56)

ELASTIC CONSTANTS OF VARIOUS SOILS
MODIFIED AFTER US DEPARTMENT OF THE NAVY (1982) AND BOWLES (1982)

Typical Range of Values

Soil Type	Young's Modulus, Es (ksf)	Poisson's Ratio, ν (dim)
Clay:		
Soft sensitive	50-300	
Medium stiff to stiff	300-1,000	0.4-0.5 (undrained)
Very stiff	1,000-2,000	
Loess	300-1,200	0.1-0.3
Silt	40-400	0.3-0.35
Fine sand:		
Loose	160-240	
Medium dense	240-400	0.25
Dense	400-600	
Sand:		
Loose	200-600	0.2-0.35
Medium dense	600-1,000	
Dense	1,000-1,600	0.3-0.4
Gravel:		
Loose	600-1,600	0.2-0.35
Medium dense	1,600-2,000	
Dense	2,000-4,000	0.3-0.4

For weathered rock:
use $E_s = 3000$
$\nu = 0.35$

Estimating Es from N(1)

Soil Type	Young's Modulus, Es (ksf)
Silts, sandy silts, slightly cohesive mixtures	$8N_1$(2)
Clean fine to medium sands and slightly silty sands	$14N_1$
Coarse sands and sands with little gravel	$20N_1$
Sandy gravel and gravels	$24N_1$

Estimating Es from S_u(3)

Soil Type	Young's Modulus, Es (ksf)
Soft sensitive clay	$400S_u$-$1,000S_u$
Medium stiff to stiff clay	$1,500S_u$-$2,400S_u$
Very stiff clay	$3,000S_u$-$4,000S_u$

(1) N = Standard Penetration Test (SPT) resistance.
(2) N_1 = SPT corrected for depth.
(3) S_u = Undrained shear strength (ksf).

Source: Caltrans Bridge Design Specifications, November 2003, page 4-19.

EQUIVALENT FLUID WEIGHTS (EFWs)

Project: Latrobe Road West Bound Off Ramp UC
BCI No.: 1072.8
Date: 2/28/2012
By: PFF

EFWs for static condition determined using equations in; Naval Facilities (NAVFAC) Design Manual 7.2 for active (K_A) and passive (K_P) lateral coefficients; and USACE Retaining and Floodwalls Manual (EM 1110-2-2502) for at-rest (K_O) lateral coefficient.
EFWs for seismic loading conditions determined using the Mononobe-Okabe equation for active and passive lateral coefficients K_{AE} and K_{PE}.

Unit wieght of soil (pcf),	γ =	120.0	
Internal friction angle of soil (degrees),	ϕ =	33.0	(<45°)
Inclination of wall with respect to vertical (degrees),	β =	0.0	
Wall friction angle (degrees),	δ =	22.0	($\delta = 2\phi/3$)
Inclination of soil surface above wall (degrees),	i =	0.0	
Peak Ground Acceleration (g),	PGA =	0.20	
Horizontal seismic acceleration coefficient,	k_h =	0.10	
Vertical seismic acceleration coefficient,	k_v =	0.00	
Lateral wall displacement (inches),	d =	1.00	($1 \le d \ge 8$)

EFW = Kγ

	EFW	**Factor of Safety** 1.0	1.5	2.0	
	Active	36	--	--	psf/f
*	**Passive**	407	271	203	psf/f
	At rest	55	--	--	psf/f
	Active$_{EQ}$	40	--	--	psf/f
*	**Passive$_{EQ}$**	384	256	192	psf/f
	At rest$_{EQ}$	62	--	--	psf/f

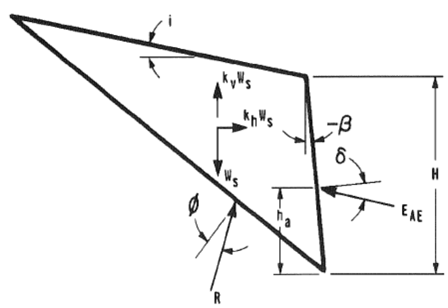
Coefficient of Friciton (sliding) = tan(0.75ϕ) = 0.46

K_A =	0.29
K_P =	3.39
K_O =	0.46
K_{AE} =	0.33
K_{PE} =	3.20

Static Loading

Active Pressure Coefficient (K_A):

$$K_A = [\cos\phi/\{1 + [\sin\phi(\sin\phi - \cos\phi\tan i)]^{0.5}\}]^2$$



Passive Pressure Coefficient (K_P):

$$K_P = [\cos\phi/\{1 - [\sin\phi(\sin\phi + \cos\phi\tan i)]^{0.5}\}]^2$$

At-rest Pressure Coefficient (K_O):

$$K_O = (1 - \sin\phi) \cdot (1 + \sin i)$$

Seismic Loading

Seismic Active Pressure Coefficient (K_{AE}):

$$K_{AE} = \frac{\cos^2(\phi - \theta - \beta)}{\cos\theta\cos^2\beta\cos(\delta + \beta + \theta)} \times \left[1 + \sqrt{\frac{\sin(\phi + \delta)\sin(\phi - \theta - i)}{\cos(\delta + \beta + \theta)\cos(i - \beta)}}\right]^{-2}$$

Seismic Passive Pressure Coefficient (K_{PE}):

$$K_{PE} = \frac{\cos^2(\phi - \theta + \beta)}{\cos\theta\cos^2\beta\cos(\delta - \beta + \theta)} \times \left[1 - \sqrt{\frac{\sin(\phi + \delta)\sin(\phi - \theta + i)}{\cos(\delta - \beta + \theta)\cos(i - \beta)}}\right]^{-2}$$

1) For Seismic Active Case: $\phi \ge \theta + i$
2) For Seismic Passive Case: $\phi \ge \theta - i$
3) $k_h \approx 0.74A(A/d)^{0.25}$; A = PGA (Section 11.6.5, AASHTO LRFD Bridge Design Specifications, 4th Edition, 2007)
4) For $k_h \le 0.2$, neglect k_v
5) For $k_h \ge 0.2$, $k_v \approx k_h/2$
6) Seismic Passive case neglects wall friction

* Level Backfill Condition Only.

US 50 / Latrobe Rd. WB Off-Ramp UC

Comparison of ARS Curves
(unlock sheet with "shmi")

Model Inputs

Fault

Magnitude	6.5	(5 to 8.5)
F_{RV}	0	(input 1 = Rev)
F_{NM}	1	(input 1 = Normal)
Dip (degree)	90	(0 to 90)
Z_{TOR} (km)	0	

Distance

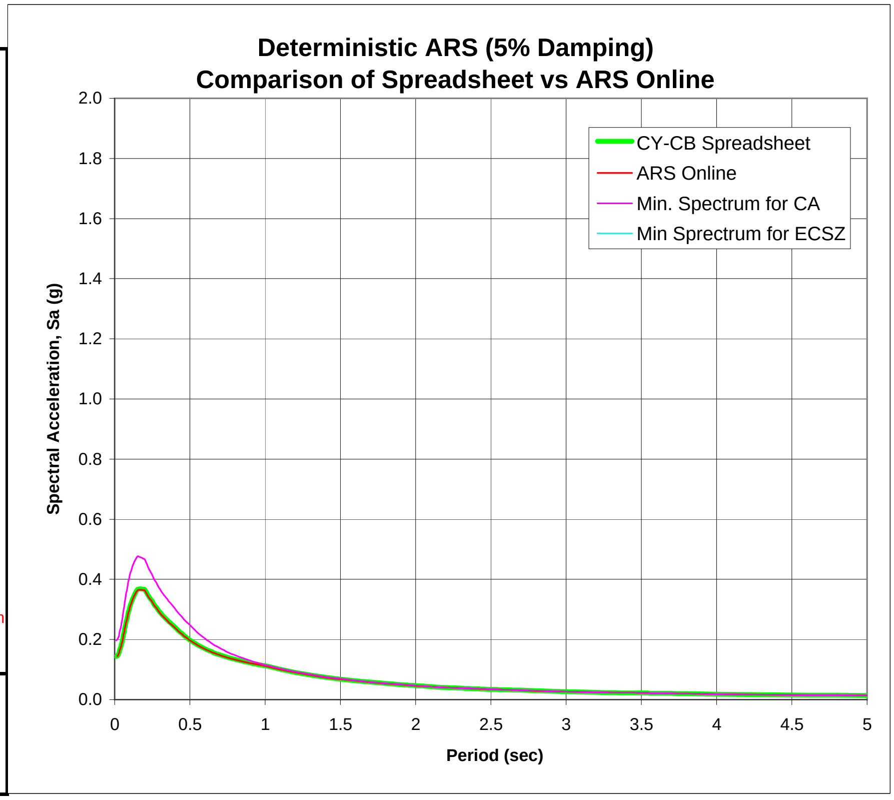
R_{RUP} (km)	14.0	
R_{JB} (km)	14.0	
R_x (km)	14.0	
Hanging Wall?	☐ Yes?	
Near-Field Factor?	☑ Yes?	

Site

V_{S30} (m/sec)	760	(270 to 1500 m/s)
$Z_{1.0}$ (m)	0	(0 - No Basin)
$Z_{2.5}$ (km)	0	(0 - No Basin)
No. Cal. Basin?	☐ Yes ?	(Check only for sites located within a Basin)
So. Cal. Basin?	☐ Yes ?	

Analysis

ARS Online vs CY-CB Spreadsheet Results
MAX. % Diff. = 3%



CY-CB Spreadsheet Results	
T (sec)	CB-CY S(a)
0.010	0.14382
0.020	0.14643
0.022	0.14868
0.025	0.15199
0.029	0.15631
0.030	0.15749
0.032	0.16112
0.035	0.16658
0.036	0.16846
0.040	0.17578
0.042	0.17956
0.044	0.18331
0.045	0.18522
0.046	0.18712
0.048	0.19088
0.050	0.19466
0.055	0.20714
0.060	0.21956
0.065	0.23168
0.067	0.23654
0.070	0.24355
0.075	0.25504
0.080	0.26625
0.085	0.27720
0.090	0.28767
0.095	0.29796
0.100	0.30773
0.110	0.32259
0.120	0.33597
0.130	0.34768
0.133	0.35071
0.140	0.35754
0.150	0.36618
0.160	0.36758
0.170	0.36800
0.180	0.36793
0.190	0.36730
0.200	0.36637
0.220	0.34931
0.240	0.33375
0.250	0.32643
0.260	0.31878
0.280	0.30485
0.290	0.29818
0.300	0.29182
0.320	0.28035
0.340	0.26957
0.350	0.26451
0.360	0.25960
0.380	0.25030
0.400	0.24166
0.420	0.23164
0.440	0.22228
0.450	0.21792
0.460	0.21368
0.480	0.20562
0.500	0.19823
0.550	0.18245
0.600	0.16939
0.650	0.15840
0.660	0.15580
0.700	0.14905
0.750	0.14096
0.800	0.13404
0.850	0.12792
0.900	0.12239
0.950	0.11743
1.000	0.11289
1.100	0.10082
1.200	0.09082
1.300	0.08229
1.400	0.07496

Place ARS Online Deterministic Data Here "Paste"					
T (sec)	Base S(a)	Basin Factor	Near Fault Factor	Final Adj. S(a)	Diff. (%)
0.01	0.143	1	1	0.143	1%
0.02	0.145	1	1	0.145	1%
0.022	0.147	1	1	0.147	1%
0.025	0.151	1	1	0.151	1%
0.029	0.155	1	1	0.155	1%
0.03	0.156	1	1	0.156	1%
0.032	0.16	1	1	0.16	1%
0.035	0.165	1	1	0.165	1%
0.036	0.167	1	1	0.167	1%
0.04	0.174	1	1	0.174	1%
0.042	0.178	1	1	0.178	1%
0.044	0.182	1	1	0.182	1%
0.045	0.184	1	1	0.184	1%
0.046	0.186	1	1	0.186	1%
0.048	0.189	1	1	0.189	1%
0.05	0.193	1	1	0.193	1%
0.055	0.205	1	1	0.205	1%
0.06	0.218	1	1	0.218	1%
0.065	0.23	1	1	0.23	1%
0.067	0.235	1	1	0.235	1%
0.07	0.241	1	1	0.241	1%
0.075	0.253	1	1	0.253	1%
0.08	0.264	1	1	0.264	1%
0.085	0.275	1	1	0.275	1%
0.09	0.285	1	1	0.285	1%
0.095	0.295	1	1	0.295	1%
0.1	0.305	1	1	0.305	1%
0.11	0.32	1	1	0.32	1%
0.12	0.333	1	1	0.333	1%
0.13	0.345	1	1	0.345	1%
0.133	0.348	1	1	0.348	1%
0.14	0.355	1	1	0.355	1%
0.15	0.363	1	1	0.363	1%
0.16	0.365	1	1	0.365	1%
0.17	0.365	1	1	0.365	1%
0.18	0.365	1	1	0.365	1%
0.19	0.364	1	1	0.364	1%
0.2	0.363	1	1	0.363	1%
0.22	0.346	1	1	0.346	1%
0.24	0.331	1	1	0.331	1%
0.25	0.324	1	1	0.324	1%
0.26	0.316	1	1	0.316	1%
0.28	0.302	1	1	0.302	1%
0.29	0.296	1	1	0.296	1%
0.3	0.289	1	1	0.289	1%
0.32	0.278	1	1	0.278	1%
0.34	0.267	1	1	0.267	1%
0.35	0.262	1	1	0.262	1%
0.36	0.257	1	1	0.257	1%
0.38	0.248	1	1	0.248	1%
0.4	0.24	1	1	0.24	1%
0.42	0.23	1	1	0.23	1%
0.44	0.22	1	1	0.22	1%
0.45	0.216	1	1	0.216	1%
0.46	0.212	1	1	0.212	1%
0.48	0.204	1	1	0.204	1%
0.5	0.197	1	1	0.197	1%
0.55	0.177	1	1.02	0.181	1%
0.6	0.161	1	1.04	0.168	1%
0.65	0.148	1	1.06	0.157	1%
0.667	0.144	1	1.067	0.154	1%
0.7	0.137	1	1.08	0.148	1%
0.75	0.127	1	1.1	0.14	1%
0.8	0.119	1	1.12	0.133	1%
0.85	0.111	1	1.14	0.127	1%
0.9	0.105	1	1.16	0.121	1%
0.95	0.099	1	1.18	0.117	0%
1	0.093	1	1.2	0.112	1%
1.1	0.083	1	1.2	0.1	1%
1.2	0.075	1	1.2	0.09	1%
1.3	0.068	1	1.2	0.082	0%
1.4	0.062	1	1.2	0.074	1%

For Comparsion Plots of Min. Sprectra, Paste Special into Cells			
Min. Spectrum for CA		Min Sprectrum for ECSZ	
T (sec)	S (a)	T (sec)	S (a)
0.01	0.197		
0.02	0.201		
0.022	0.204		
0.025	0.208		
0.029	0.214		
0.03	0.216		
0.032	0.221		
0.035	0.228		
0.036	0.231		
0.04	0.241		
0.042	0.246		
0.044	0.251		
0.045	0.254		
0.046	0.256		
0.048	0.262		
0.05	0.267		
0.055	0.284		
0.06	0.3		
0.065	0.317		
0.067	0.323		
0.07	0.333		
0.075	0.348		
0.08	0.362		
0.085	0.376		
0.09	0.389		
0.095	0.401		
0.1	0.414		
0.11	0.43		
0.12	0.445		
0.13	0.458		
0.133	0.461		
0.14	0.468		
0.15	0.476		
0.16	0.476		
0.17	0.474		
0.18	0.472		
0.19	0.469		
0.2	0.466		
0.22	0.444		
0.24	0.423		
0.25	0.413		
0.26	0.403		
0.28	0.386		
0.29	0.377		
0.3	0.369		
0.32	0.354		
0.34	0.34		
0.35	0.333		
0.36	0.327		
0.38	0.315		
0.4	0.303		
0.42	0.291		
0.44	0.279		
0.45	0.273		
0.46	0.267		
0.48	0.257		
0.5	0.248		
0.55	0.223		
0.6	0.203		
0.65	0.185		
0.667	0.18		
0.7	0.171		
0.75	0.158		
0.8	0.148		
0.85	0.138		
0.9	0.13		
0.95	0.122		
1	0.115		
1.1	0.103		
1.2	0.093		
1.3	0.084		
1.4	0.076		

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CY-CB Spreadsheet Results	
T (sec)	CB-CY S(a)
1.500	0.06859
1.600	0.06302
1.700	0.05815
1.800	0.05383
1.900	0.04999
2.000	0.04662
2.200	0.04097
2.400	0.03641
2.500	0.03446
2.600	0.03267
2.800	0.02955
3.000	0.02690
3.200	0.02472
3.400	0.02284
3.500	0.02198
3.600	0.02118
3.800	0.01972
4.000	0.01841
4.200	0.01731
4.400	0.01633
4.600	0.01543
4.800	0.01462
5.000	0.01387

95

Place ARS Online Deterministic Data Here "Paste"					
T (sec)	Base S(a)	Basin Factor	Near Fault Factor	Final Adj. S(a)	Diff. (%)
1.5	0.057	1	1.2	0.068	1%
1.6	0.052	1	1.2	0.063	0%
1.7	0.048	1	1.2	0.058	0%
1.8	0.045	1	1.2	0.053	2%
1.9	0.041	1	1.2	0.05	0%
2	0.039	1	1.2	0.046	1%
2.2	0.034	1	1.2	0.041	0%
2.4	0.03	1	1.2	0.036	1%
2.5	0.029	1	1.2	0.034	1%
2.6	0.027	1	1.2	0.033	1%
2.8	0.025	1	1.2	0.029	2%
3	0.022	1	1.2	0.027	0%
3.2	0.021	1	1.2	0.025	1%
3.4	0.019	1	1.2	0.023	1%
3.5	0.018	1	1.2	0.022	0%
3.6	0.018	1	1.2	0.021	1%
3.8	0.016	1	1.2	0.02	1%
4	0.015	1	1.2	0.018	2%
4.2	0.014	1	1.2	0.017	2%
4.4	0.014	1	1.2	0.016	2%
4.6	0.013	1	1.2	0.015	3%
4.8	0.012	1	1.2	0.015	3%
5	0.012	1	1.2	0.014	1%

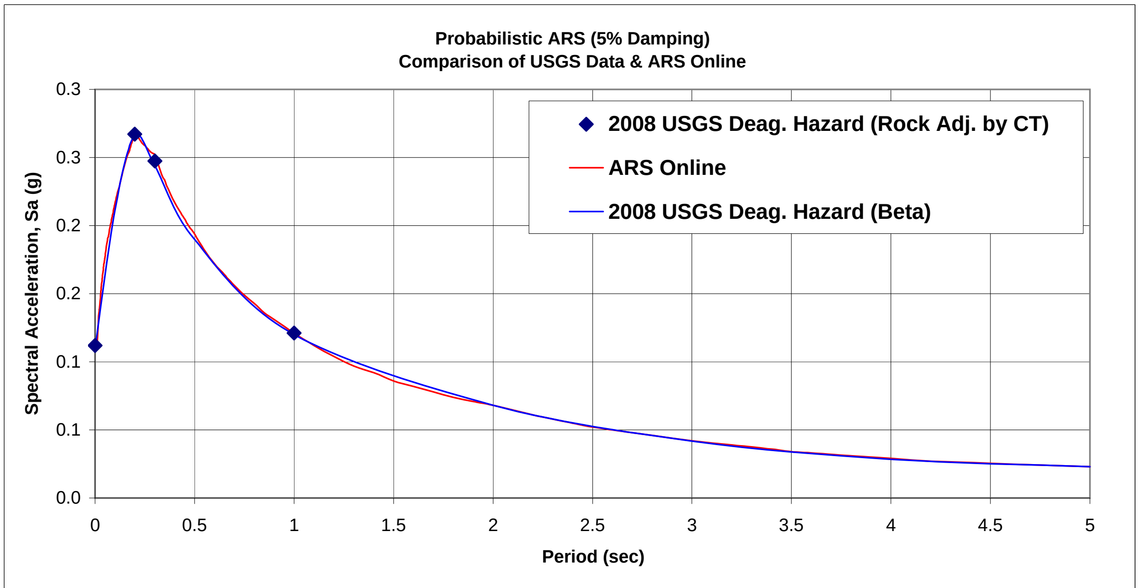
For Comparsion Plots of Min. Sprectra, Paste Special into Cells			
Min. Spectrum for CA		Min Sprectrum for ECSZ	
T (sec)	S (a)	T (sec)	S (a)
1.5	0.07		
1.6	0.064		
1.7	0.059		
1.8	0.054		
1.9	0.051		
2	0.047		
2.2	0.041		
2.4	0.037		
2.5	0.035		
2.6	0.033		
2.8	0.03		
3	0.027		
3.2	0.025		
3.4	0.023		
3.5	0.022		
3.6	0.021		
3.8	0.02		
4	0.018		
4.2	0.017		
4.4	0.016		
4.6	0.015		
4.8	0.015		
5	0.014		

US 50/Latrobe Rd WB Off-ramp UC

Comparison spreadsheet of the 2008 USGS Probabilistic Seismic Hazard Data and ARS Online Probabilistic Data (unlock spreadsheet "shmi")
Spectral Accelerations Points from USGS Website at http://earthquake.usgs.gov/research/hazmaps/products_data/2008/data/

*** Note: This spreadsheet uses the given latitude and longitude data provided by the user to estimate spectral acceleration values with a probability of exceedence 5% in 50 yrs (or 975 yr return period). The four spectral acceleration data points plotted on the graph are from the USGS website and are based on a 0.05 degree grid. Basic interpolation is used to estimate intermediate values inside each grid. Raw Data points are provided in the tabs of this spreadsheet. Corner grid spectral acceleration data are shown in the "calculation" tab.**

Input Site Information	
Latitude	Longitude
38.6532	-121.0707
V_{S30} (m/s) =	760
Near Fault Factor, Derived from USGS Deagg. Dist (km) =	83
$Z_{1.0}$ (m) =	0
$Z_{2.5}$ (km) =	0



Place ARS Online Probabilistic Data Here "Paste"

T (sec)	Base Spectrum S(a)	Basin Factor	Near Fault Factor	Final Adj. Spectrum S(a)
0.01	0.112	1	1	0.112
0.02	0.136	1	1	0.136
0.022	0.14	1	1	0.14
0.025	0.145	1	1	0.145
0.029	0.152	1	1	0.152
0.03	0.153	1	1	0.153
0.032	0.156	1	1	0.156
0.035	0.16	1	1	0.16
0.036	0.161	1	1	0.161
0.04	0.166	1	1	0.166
0.042	0.168	1	1	0.168
0.044	0.171	1	1	0.171
0.045	0.172	1	1	0.172
0.046	0.173	1	1	0.173
0.048	0.175	1	1	0.175
0.05	0.177	1	1	0.177
0.055	0.182	1	1	0.182
0.06	0.187	1	1	0.187
0.065	0.191	1	1	0.191
0.067	0.192	1	1	0.192
0.07	0.195	1	1	0.195
0.075	0.199	1	1	0.199
0.08	0.202	1	1	0.202
0.085	0.206	1	1	0.206
0.09	0.209	1	1	0.209
0.095	0.213	1	1	0.213
0.1	0.216	1	1	0.216
0.11	0.222	1	1	0.222
0.12	0.228	1	1	0.228
0.13	0.234	1	1	0.234
0.133	0.236	1	1	0.236
0.14	0.24	1	1	0.24
0.15	0.245	1	1	0.245
0.16	0.25	1	1	0.25
0.17	0.254	1	1	0.254
0.18	0.259	1	1	0.259
0.19	0.263	1	1	0.263
0.2	0.268	1	1	0.268
0.22	0.264	1	1	0.264
0.24	0.26	1	1	0.26
0.25	0.259	1	1	0.259

Analysis of ARS Online Results vs USGS Deaggregation Hazard (Adj. By CT)

Period (sec)	USGS Interpolated Spectral Accel.	Adj. for Near Fault Effect	Adj. for Soil Amplification	Adj. For Basin Effect	Final Adj. USGS Spec Accel	ARS Online Final Adj. Spect. Accel.	% Difference (bet. USGS & ARS Online)
0	0.111	1.000	1.007	1.000	0.112	0.112	-0.1%
0.2	0.266	1.000	1.003	1.000	0.267	0.268	-0.3%
0.3	0.246	1.000	1.006	1.000	0.247	0.252	-1.9%
1	0.121	1.000	1.000	1.000	0.121	0.121	0.1%

Max % Difference = 1.9%

USGS Deaggregation Hazard (Beta) with Near Field and Basin Factors

Period (sec)	INPUT USGS Deagg. Spec Accel	Adj. for Near Fault Effect	Adj. For Basin Effect	Final Adj. USGS Deagg Spec Accel	ARS Online Final Adj. Spect. Accel.	% Difference (bet. USGS & ARS Online)
0	0.11	1.000	1.000	0.110	0.112	*1.8%*
0.1	0.211	1.000	1.000	0.211	0.216	*2.4%*
0.2	0.2663	1.000	1.000	0.266	0.268	*0.6%*
0.3	0.244	1.000	1.000	0.244	0.252	*3.3%*
0.5	0.19	1.000	1.000	0.190	0.194	2.1%
1	0.12	1.000	1.000	0.120	0.121	0.8%
2	0.068	1.000	1.000	0.068	0.068	0.0%
3	0.04172	1.000	1.000	0.042	0.042	0.7%
4	0.02843	1.000	1.000	0.028	0.029	2.0%
5	0.02311	1.000	1.000	0.023	0.023	0.5%

Max % Difference = 2.1%

0.26	0.257	1	1	0.257
0.28	0.254	1	1	0.254
0.29	0.253	1	1	0.253
0.3	0.252	1	1	0.252
0.32	0.244	1	1	0.244
0.34	0.236	1	1	0.236
0.35	0.233	1	1	0.233
0.36	0.229	1	1	0.229
0.38	0.223	1	1	0.223
0.4	0.217	1	1	0.217
0.42	0.212	1	1	0.212
0.44	0.207	1	1	0.207
0.45	0.205	1	1	0.205
0.46	0.202	1	1	0.202
0.48	0.198	1	1	0.198
0.5	0.194	1	1	0.194
0.55	0.182	1	1	0.182
0.6	0.172	1	1	0.172
0.65	0.164	1	1	0.164
0.667	0.161	1	1	0.161
0.7	0.156	1	1	0.156
0.75	0.149	1	1	0.149
0.8	0.143	1	1	0.143
0.85	0.136	1	1	0.136
0.9	0.131	1	1	0.131
0.95	0.126	1	1	0.126
1	0.121	1	1	0.121
1.1	0.112	1	1	0.112
1.2	0.104	1	1	0.104
1.3	0.097	1	1	0.097
1.4	0.092	1	1	0.092
1.5	0.086	1	1	0.086
1.6	0.082	1	1	0.082
1.7	0.078	1	1	0.078
1.8	0.074	1	1	0.074
1.9	0.071	1	1	0.071
2	0.068	1	1	0.068
2.2	0.061	1	1	0.061
2.4	0.055	1	1	0.055
2.5	0.052	1	1	0.052
2.6	0.05	1	1	0.05
2.8	0.046	1	1	0.046
3	0.042	1	1	0.042
3.2	0.039	1	1	0.039
3.4	0.036	1	1	0.036
3.5	0.034	1	1	0.034
3.6	0.033	1	1	0.033
3.8	0.031	1	1	0.031
4	0.029	1	1	0.029
4.2	0.027	1	1	0.027
4.4	0.026	1	1	0.026
4.6	0.025	1	1	0.025
4.8	0.024	1	1	0.024
5	0.023	1	1	0.023

APPENDIX C

Caltrans Review Comment and BCI Response

95% Comment Resolution Table

Plans (P) or Specials (S)	Page	Comments	Name	Response	Resolved (Y)/(N)	Resolution /Initial
CALTRANS COMMENTS			**OSFP/ OGS**			
Draft Foundation Report	Title Pg	Include “03-ED-50”	Eric Fredrickson & Mark Hagy	“03-ED-50” is included on the Title page		
Draft Foundation Report	Header info	Include “Hwy 50”. We need to know what route PM 0.9 pertains to.	Eric Fredrickson & Mark Hagy	Reference to Hwy 50 is included in the header information		
Draft Foundation Report	Pg 15	Table 6- Verify information show on the plans match report.	Eric Fredrickson & Mark Hagy	Table 6 is updated/verified to be consistent with the latest plans		