INFORMATION HANDOUT

MATERIALS INFORMATION

GEOTECHNICAL DESIGN AND MATERIAL REPORT, ROUTE 680 AUXILIARY LANE PROJECT – SEGMENT 2, MARCH 29, 2012

FINAL FOUNDATION REPORT, RETAINING WALLS, ROUTE 680 AUXLIARY LANES - SEGMENT, JANURARY 2012

ASBESTOS AND LEAD-CONTAINING PAINT SURVEY REPORT, I-680 SEGMENT 2 AUXILIARY LAENS PROJECT CONTRA COSTA COUNTY, CALIFORNIA, JANUARY 2012

CAL-OSHA TUNNEL CLASSIFICATION

STORM WATER INFORMATION HANDOUT

ROUTE: 04-CC-680-4.3/6.7

GEOTECHNICAL DESIGN & MATERIALS REPORT
ROUTE 680 AUXILIARY LANE PROJECT - SEGMENT 2
CONTRA COSTA COUNTY, CALIFORNIA
04-CC-680 PM 4.3/6.7

For

MARK THOMAS & COMPANY, INC.
3000 Oak Road, Suite 650
Walnut Creek, CA 94597

PARIKH CONSULTANTS, INC.
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March 29, 2012 Job No. 2011-124-GDR

PARIKH
Practicing in the Geosciences

Geotechnical ■
Environmental ■
Materials Testing ■
Construction Inspection ■

MARK THOMAS & COMPANY, INC
3000 Oak Road, Suite 650
Walnut Creek, CA 94597

Job No.: 2011-124-GDR
March 29, 2012

Attn: Mr. Sasha Dansky

Sub: GEOTECHNICAL DESIGN & MATERIALS REPORT
ROUTE 680 AUXILIARY LANE PROJECT - SEGMENT 2
CONTRA COSTA COUNTY, CALIFORNIA

Dear Mr. Dansky:

Transmitted herewith is the Geotechnical Design & Materials Report for the subject project. The report was prepared in accordance with the scope of work outlined in our proposal. The report is for submittal to Caltrans for their review and approval.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning our findings or conclusions, please feel free to contact this office.

Very truly yours,
PARIKH CONSULTANTS, INC.

Gary Parikh, P.E., G.E., 666
Project Manager

Attachment: Geotechnical Design & Materials Report

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"Approved as to impact on State facilities and conformance with applicable State standards and practices, and the technical oversight were performed as described in the California Department of Transportation A&E Consultant Services Manual."

Caltrans MOHAMMAD DEHGHANFARD

Title Transportation Engineer

Date 7/11/12 (CIVIL 51432)

Caltrans for TINU MISHRA

Title TRANSPORTATION ENGINEER (CIVIL C 56176)

Date 7/11/2012

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GEOTECHNICAL DESIGN & MATERIALS REPORT
ROUTE 680 AUXILIARY LANE PROJECT - SEGMENT 2
CONTRA COSTA COUNTY, CALIFORNIA
04-CC-680 PM 4.3/6.7

1. INTRODUCTION

This report presents the results of our geotechnical engineering investigation for the proposed "Route 680 Auxiliary Lane Project - Segment 2" in Contra Costa County, California, hereinafter referred to as "PROJECT". The work was performed in general accordance with the scope of work outlined in our proposal to Mark Thomas & Company, Inc. (Designer). The general location of the project site and its vicinity are shown in the Project Location Map, Plate 1.

This report addresses geotechnical design recommendations for sound walls (SW), corrosion recommendations for the culvert design, overhead sign structures (OHS), and structural pavement sections. The investigation included review of readily available soils and geologic literature pertaining to the site including as-built information and "Log of Test Borings" (LOTBs), site reconnaissance, drilling exploratory soil borings, obtaining representative soil samples and logging soil materials encountered in exploratory borings, laboratory testing of the representative soil samples, performing engineering analyses, and preparation of this report.

The purpose of this report is to document subsurface geotechnical conditions, provide analyses of anticipated site conditions as they pertain to the project described herein, and to recommend design and construction criteria for the roadway portions of the project. This report also establishes a geotechnical baseline to be used in assessing the existence and scope of changed site conditions, if any.

The report is intended for use by the project design engineer, construction personnel, bidders and contractors for information and reference purposes only and should not be construed as project specifications.

2. EXISTING FACILITIES AND PROPOSED IMPROVEMENTS

The project information is contained in the Project Report prepared by Contra Costa Transportation Authority (CCTA), dated December 2002 and approved by Caltrans in February 2003. The Segment 2 project runs from the Sycamore Valley Road Interchange to the Crow

Canyon Road Interchange (PM R4.3 – PM R6.7). Within the project limits, the existing freeway I-680 is a north/south facility with three lanes of mixed flow traffic and one HOV lane in each direction. This portion of I-680 was first constructed in 1964 as a 4-lane freeway and improved to a six-lane freeway in 1967. In 1995, HOV lanes were opened. Sound walls currently exist at the outside shoulder edges throughout the majority of the project area. Sound walls within this portion of I-680 are a mixture of permanent and relocatable walls. The existing right of way width within the project area and outside interchange areas is generally restricted to approximately 197 to 230 feet. The bridge structures existing within the project limit include Fostoria Way Overcrossing and Greenbrook Drive Overcrossing.

Proposed Improvements

The Segment 2 project will provide 2.4 miles of auxiliary lanes in each direction of I-680 between Sycamore Valley Road in the Town of Danville and Crow Canyon Road in the City of San Ramon. The project will improve weave and merge maneuvers in this segment of I-680. Proposed improvements include adding 12-foot wide lane and 12-foot wide shoulder in both directions of the I-680, relocation of existing sound walls and/or construction of new ones, construction of retaining walls, and installation of overhead sign structures. All proposed improvements would be within the Caltrans right-of-way. It is our understanding that the design and constructions for the subject project will be following the 2006 Caltrans Standard Plans and Specifications.

Project plans indicate the finish grade for the widened auxiliary lanes will be matched with the adjacent travel lanes. Cuts and fills will be required for widening as appropriate. Significant portions of the cuts and fills will be supported by retaining walls. Discussions on retaining walls will be presented in a separate Foundation Report.

Sound Walls

Project plans show that three (3) sound walls are planned at the following locations.

TABLE 1: SOUND WALL LOCATIONS

Sound Wall	Location	Approximate Stations
SW No. 1	East side of I-680 in northbound direction	244+00 to 262+16
SW No. 2*	East side of I-680 in northbound direction	285+00 to 340+49
SW No. 3	West side of I-680 in southbound direction	286+63 to 301+23

Note: Parts of Sound Wall No. 2 will be constructed on top of the proposed Retaining Walls No. 4, 6A and 6B

Overhead Sign Structures

Five (5) single post overhead sign structures are proposed for this project.

TABLE 2: OVERHEAD SIGN STRUCTURE LOCATIONS

Sign Structure	Location	Approximate Station
B	West side of I-680 in southbound direction	272+50
D	East side of I-680 in northbound direction	265+25
F	West side of I-680 in southbound direction	316+90
H	East side of I-680 in northbound direction	317+10
K	East side of I-680 in northbound direction	338+50

Structural Pavement Sections

New pavement sections will be constructed between approximate Station 247+42 and 344+74 in southbound direction and from approximate Station 237+73 to 339+67 in northbound direction.

The recommendations presented in this report are based on the above information. Any major deviation should be reported to this office for consideration.

3. PERTINENT REPORTS AND INVESTIGATION

The following pertinent as-built information was made available to us by Mark Tomas & Company, Inc.:

- Caltrans As-built Log of Test Borings – Greenbrook Drive Overcrossing (1964) (Br. No 28-223).
- Caltrans As-built Plans – Greenbrook Drive Overcrossing (1967) (Br. No 28-223).
- As-built Pavement Typical Cross Sections for I-680 associated with roadway widening within the project limits.

In addition to the as-built information obtained from the Designer, the following investigation reports were also reviewed to supplement the subsurface information for the project during this study.

- PARIKH Consultants, Inc., November 2001, "Preliminary Geotechnical Report, I-680 Auxiliary Lanes, 04-CC-680-KP R4.7/R12.2 (PM R2.9/R7.6), Contra Costa County, California, CU 04219, EA 22853K", prepared for Washington Infrastructure Services, Inc.
- PARIKH Consultants, Inc., October 2003, "Geotechnical Design & Materials Report, I-680 Auxiliary Lanes Improvement (Seg. 3), 04-680-CC-KP 4.7/7.0, Contra Costa County, CA, EA 228551, CU 04219", prepared for DMJM + HARRIS.
- PARIKH Consultants, Inc., January 2004, "Geotechnical Design & Materials Report, I-680 Auxiliary Lanes Improvement (Seg. 1), 04-680-CC-KP 4.7/12.2, Contra Costa County, CA, EA 228531, CU 04219", prepared for DMJM + HARRIS.

4. PHYSICAL SETTING

4.1 Climate

The project area is characterized with moderate climatic conditions. This consists of mild winters, warmer summers, small daily and seasonal temperature ranges and mild humidity. Based on the information obtained from the website of Western Regional Climate Center – Walnut Creek 2 ESE Station, the annual average temperature ranges in the project vicinity are from 44° F to 74° F. The annual average total precipitation is 19.2 inches. It is estimated that about 97% of the total precipitation falls between October and April.

4.2 Topography and Drainage

Based on the plans provided by the Designer, the topography within the project limits along the I-680 corridor is relatively flat with roadway elevations gradually decreasing approximately from 480 feet in the south end to 388 feet in the north end. Grade differences may vary within the project limits due to roadway crossing and bridge embankments. The topography also suggests that originally, the site was a rolling terrain generally sloping down easterly. The highway in this section was mostly constructed by cutting into the native slope or built at grade. San Ramon Creek runs mostly parallel to the project alignment to the east side of I-680. The surface drainage will be collected in the local storm drain systems. In general, along the project corridor, hills or valleys do not directly influence the site.

4.3 Man-Made and Natural Features of Engineering and Construction Significance

Two bridge crossings are along the proposed project corridor. Fostoria Way Overcrossing is basically outside the major improvement area, at the south of Station 232+00. Portion of proposed Retaining Wall No. 2 and Retaining Wall No. 3 will run under the Greenbrook Drive Overcrossing at the west and east side of the bridge, respectively. Special design is needed for non-standard retaining walls at Greenbrook Drive Overcrossing location.

4.4 Regional Geology and Seismicity

The project alignment is in the eastern portion of the San Francisco Bay Area in the Coast Range geomorphic province of California. The Coast Ranges are mountain ranges (~ 2000-4000, occasionally 6000 ft elevation above sea level) and valleys. The ranges and valleys trend northwest, subparallel to the San Andreas Fault. The province extends to the east where strata dip beneath alluvium of the Great Valley; to the west meeting the Pacific ocean with mountains rising sharply from uplifted and terraced, wave-cut coast; to the north into Oregon, and to the south where the Transverse Ranges begin. The Coast Ranges are composed of thick late Mesozoic and Cenozoic sedimentary strata. The northern and southern ranges are separated by a depression containing the San Francisco Bay. Offshore, the continental shelf is transected by submarine canyons. The Monterey submarine canyon, ~10,000 feet deep, is apparently a

submerged river canyon. The northern coast ranges are dominated by irregular, knobby, landslide topography of the Franciscan Formation. The eastern border is characterized by strike-ridges and valleys in Upper Mesozoic strata. In several areas, Franciscan rocks are overlain by volcanic cones and flows of the Quien Sabe, Sonoma, and Clear Lake volcanic fields. The Coast Ranges are subparallel to the rift valley of the active San Andreas Fault. The San Andreas is more than 965 km long, extending from Pt. Arena to the Gulf of California. The Salinian block to the west of the San Andreas has a granitic core, extending from the southern extremity of the Coast Ranges to north of the Farallon Islands.

The region consists of marine and non-marine sedimentary strata with ages range from Late Cretaceous to Pliocene. The dominant strata are the Contra Costa and San Pablo Groups. These groups have been complexly folded into a series of synclines and anticlines that trend northwest. The area has also been cut by a complex series of high angle thrust and strike slip faults. This folding and the faulting have produced the northwest trending ridge and valley systems. These valleys have been filled with alluvium, derived from the surrounding ridges.

Significant earthquakes, which have occurred in this area, are generally associated with crustal movements along well-defined active fault zones. Faults in the vicinity of the site with a moderate to high potential for surface rupture include the Calaveras fault, the Hayward fault, the Pleasanton fault, the Mountain Diablo Thrust fault, and the Greenville fault. The State Alquist-Priolo Earthquake Fault Zones Map of the Diablo Quadrangle (1982) shows that the project site is not within the extent of the fault zone established by the State. Plate 4, the Fault Map provides a general fault system within the vicinity of the project site.

5. EXPLORATION

5.1 Drilling and Sampling

A total of sixty-nine (69) borings were drilled for the PROJECT between June 16 and July 15, and on November 21, 2011. The boring locations generally followed the current Caltrans practice, approximate 300-foot spacing between borings along retaining walls, 1000-foot spacing

along new proposed paved areas and 500-foot spacing along sound walls. Due to the on-going (slab replacement) construction in the north and south bound lanes, limited access was available for drilling at some locations. The boring program was therefore adjusted to conform to the construction safety requirements. The approximate locations of these borings are shown on the Site Plan, Plate 2.

- Twenty-one (21) borings (R-1 through R-21) were drilled to the depth of approximately 5 feet to collect bulk samples for the pavement design. The locations, stations and other pertinent information for these borings are summarized in Table 3A.

- Forty-six (48) borings (A-11-101 through A-11-145 plus A-11-110P, A-11-146P and A-11-147P) were drilled for the design of sound walls, retaining walls, and overhead sign structures. The boring depths ranged approximately from 16.5 to 55.5 feet below the existing grade. Most of the borings were drilled at the roadway shoulder. Some were drilled on the western slope. The locations, stations and other pertinent information for these borings are summarized in Table 3B.

The borings were drilled under the technical supervision of our engineer, who classified and continuously logged the soils encountered during drilling and supervised the collection of soil samples at various depths for visual examination and laboratory testing. Selected samples were obtained from 2.5-inch I.D. (Modified California, MC) and 1.4-inch I.D. (Standard Penetration Test, SPT) samplers at various depths. The samplers were driven into subsurface soils under the impact of a 140-pound hammer having a free fall of 30 inches. The blow counts required to drive the sampler for the last 12 inches are presented on the Log of Test Boring in Appendix A. After visual examination, the samples were sealed and transported to our laboratory for further evaluation and testing.

The descriptions of the soil materials encountered in the exploratory borings and relevant boring information are presented on the LOTBs, in Appendix A. The laboratory test methods and results are presented in Appendix B. The logs presented in Appendix A were prepared from the field logs which were edited after visual re-examination of the soil samples in the laboratory and results of classification tests on selected soil samples as indicated on the LOTBs.

TABLE 3A: SUMMARY OF BORINGS (PAVEMENT DESIGN)

Boring No.	Approx. Station (ft)	Approx. Offset "A4" Line (ft)	Approx. Boring Depth (ft)	Approx. Ground Elev. (ft)	Date Drilled	Soil Description
R-1	242+00	80 Rt.	5	476.0	06/16/11	Lean Clay
R-2	247+25	80 Rt.	5	476.0	06/16/11	Lean Clay
R-3	253+00	80 Lt.	5	474.0	06/27/11	Lean Clay
R-4	257+25	80 Rt.	5	472.0	06/16/11	Lean Clay
R-5	263+00	80 Lt.	5	473.0	06/27/11	Lean Clay with Sand
R-6	266+00	80 Rt.	5	469.0	06/20/11	Silt
R-7	273+00	80 Lt.	5	463.0	06/27/11	Lean Clay
R-8	276+00	80 Rt.	5	458.0	06/20/11	Lean Clay with Gravel
R-9	283+00	80 Lt.	5	453.0	06/27/11	Lean Clay
R-10	286+00	90 Rt.	5	453.0	06/20/11	Lean Clay
R-11	293+00	80 Lt.	5	449.0	06/27/11	Lean Clay
R-12	296+00	80 Rt.	5	447.0	06/20/11	Lean Clay with Sand and Gravel
R-13	303+75	80 Lt.	5	443.0	06/30/11	Fat Clay with Sand and Gravel
R-14	306+00	80 Rt.	5	440.0	06/20/11	Lean Clay with Sand
R-15	312+75	90 Lt.	5	439.0	06/27/11	Lean Clay
R-16	316+00	80 Rt.	5	435.0	06/20/11	Lean Clay with Gravel
R-17	322+50	80 Lt.	5	433.0	06/27/11	Lean Clay with Sand and Gravel
R-18	326+00	80 Rt.	5	426.0	06/20/11	Lean Clay
R-19	332+50	85 Lt.	5	417.0	06/23/11	Lean Clay
R-20	335+75	80 Rt.	5	412.0	06/22/11	Lean Clay
R-21	342+75	85 Lt.	5	400.0	06/23/11	Lean Clay with Gravel

TABLE 3B: SUMMARY OF BORINGS (WALLS AND SIGN STRUCTURES)

Boring No.	Approx. Station (ft)	Approx. Offset "A4" Line (ft)	Approx. Boring Depth (ft)	Approx. Ground Elev. (ft)	Date Drilled
A-11-101	245+00	67 Rt.	26.5	475.0	06/16/11
A-11-102	250+00	64.5 Rt.	31.5	475.0	06/16/11
A-11-103	255+00	61.5 Rt.	26.5	473.0	06/16/11

Boring No.	Approx. Station (ft)	Approx. Offset "A4" Line (ft)	Approx. Boring Depth (ft)	Approx. Ground Elev. (ft)	Date Drilled
A-11-104	260+00	65 Rt.	25.5	472.0	06/16/11
A-11-105	262+00	63 Rt.	31.0	471.0	06/17/11
A-11-106	265+00	63.5 Rt.	30.5	469.0	06/17/11
A-11-107	268+00	80 Rt.	31.5	467.0	06/20/11
A-11-108	271+00	80 Rt.	31.5	462.0	06/20/11
A-11-109	281+75	62 Rt.	31.5	454.0	06/21/11
A-11-110	275+00	69.5 Lt.	28.0	460.0	07/05/11
A-11-110P*	275+00	100 Lt.	16.5	471.0	07/13/11
A-11-111	278+00	80 Lt.	46.5	457.0	07/15/11
A-11-112	281+30	65 Lt.	34.5	455.0	07/01/11
A-11-113	284+00	65 Lt.	26.5	453.0	07/01/11
A-11-114	287+00	65 Lt.	45.0	452.0	07/01/11
A-11-115	290+00	66 Lt.	36.5	449.0	07/11/11
A-11-116P*	288+00	130 Lt.	31.5	473.0	07/13/11
A-11-117	293+00	110 Lt.	31.5	452.0	06/27/11
A-11-118	298+00	70 Lt.	25.5	446.0	07/05/11
A-11-119	286+00	62 Rt.	26.5	454.0	06/21/11
A-11-120	289+00	62 Rt.	26.5	452.0	06/21/11
A-11-121	292+00	65 Rt.	31.5	451.0	06/23/11
A-11-122	295+00	64 Rt.	49.0	449.0	06/21/11
A-11-123	298+00	65 Rt.	31.5	445.0	06/22/11
A-11-124	301+00	65 Rt.	49.5	444.0	06/21/11
A-11-125	301+00	65 Lt.	26.0	444.0	07/05/11
A-11-126	304+00	65 Lt.	27.0	442.0	06/30/11
A-11-127	307+00	65 Lt.	17.0	443.0	06/30/11
A-11-128	310+00	70 Lt.	16.5	441.0	06/30/11
A-11-129	313+00	80 Lt.	36.0	440.0	06/24/11
A-11-130	315+00	80 Lt.	30.0	440.0	06/24/11
A-11-131	304+00	65 Rt.	26.5	442.0	06/22/11
A-11-132	307+00	65 Rt.	26.0	441.0	06/22/11
A-11-133	310+00	65 Rt.	26.5	439.0	06/22/11
A-11-134	313+00	65 Rt.	25.5	437.0	06/22/11

Boring No.	Approx. Station (ft)	Approx. Offset "A4" Line (ft)	Approx. Boring Depth (ft)	Approx. Ground Elev. (ft)	Date Drilled
A-11-135	317+00	65 Rt.	30.5	435.0	06/23/11
A-11-136	319+00	65 Rt.	50.5	435.0	06/22/11
A-11-137	322+00	65 Rt.	31.5	432.0	06/23/11
A-11-138	325+00	65 Rt.	55.5	428.0	06/23/11
A-11-139	328+00	65 Rt.	31.5	425.0	06/24/11
A-11-140	331+00	65 Rt.	36.5	420.0	06/23/11
A-11-141	334+00	65 Rt.	36.5	415.0	06/23/11
A-11-142	337+00	65 Rt.	26.5	409.0	06/24/11
A-11-143	317+00	70 Lt.	30.5	437.0	07/14/11
A-11-144	266+00	80 Lt.	31.0	469.0	07/14/11
A-11-145	248+00	80 Lt.	31.5	475.0	07/14/11
A-11-146P*	278+30	135 Lt.	21.5	489.0	11/21/11
A-11-147P*	285+45	130 Lt.	26.5	484.0	11/21/11

*: "P" stands for 4" diameter solid stem auger portable drill rig.

Due to limitations inherent in geotechnical investigations, it is neither uncommon to encounter unforeseen variations in the subsurface soil conditions during construction nor is it practical to determine all such variations during an acceptable program of drilling and sampling for a project of this scope. Such variations, when encountered, generally require additional engineering services to attain a properly constructed project. We, therefore, recommend that a contingency fund be provided to accommodate any additional charges resulting from technical services that may be required during construction.

5.2 Geologic Mapping

The project site consists of mostly older basin deposits, alluvial fans, fluvial deposits and embankment. The central segment of the site was previously cut through hillside terrace and has been in place for about 50 years. Most of the site is relatively flat. Site specific geologic mapping was not performed for the road widening project.

5.3 Geophysical Studies

The subject was considered and was determined to be not applicable to the project.

5.4 Instrumentation

The subject was considered and was determined to be not applicable to the project.

5.5 Exploration Notes

The exploratory borings mainly encountered undivided surficial deposits. Most of the borings were drilled with a truck-mounted drill rig using 8-inch-diameter hollow stem auger. A few borings, where the boring locations presented access difficulties, were drilled using a portable drill rig with a 4-inch-diameter solid stem auger.

6. GEOTECHNICAL TESTING

6.1 In-Situ Testing

In-situ testing consisted of recording blow counts during sampling in the field. The soil samples were obtained during drilling by driving a 2.5-inch I.D. Modified California sampler or a 1.4-inch I.D. Standard Penetration Test Sampler into the subsurface soils under the impact of a 140-lb hammer falling through 30 inches. The drilling subcontractor was Exploration Geoservices, Inc. (EGS). Based on the energy efficiency of the hammer used by EGS, which is approximate 55%, when correlating standard penetration data, the blow counts for the Standard Penetration Test Sampler (SPT-N) can be taken as roughly 0.6 times that for the Modified California Sampler in similar soils. From the average SPT-N values for various soil materials encountered in the field exploration, the subsoils are generally stiff to hard for clay/silt and medium dense to very dense for the sandy soils.

6.2 Laboratory Testing

Laboratory tests performed for this study included the following: Laboratory determination of Moisture-Density (California Test Method 226), Atterberg Limits (California Test Method 204), Grain Size Analysis (California Test Method 203), Unconfined Compression Test (California Test Method 221), R-value Test (California Test Method 301), Corrosion Test (California Test Method 643), pH of lime treated soils (ASTM C977), and Unconfined Compression Test for lime treated soils (California Test Method 373). The laboratory test results are contained in Appendix B. Test results of Atterberg Limits, unconfined compression, and grain size analysis are also presented on LOTBs, Appendix A.

7. GEOTECHNICAL CONDITIONS

7.1 Site Geology

Relatively young geologic features pertaining to the site were evaluated by reference to the map of Quaternary Geology of Contra Costa County, California and Surrounding Areas, Derived from the Digital Database Open-file 97-98, by E.J. Helley and R.W. Graymer, 1997. Based on the map, different Quaternary age units are present beneath much of the alignment. According to the geologic map, majority of the surficial material are in Basin Deposits (Holocene, Qhb), Alluvial Fans and Fluvial Deposits (Holocene, Qhaf), and Alluvial Fans and Fluvial Deposits (Pleistocene, Qpaf). The Quaternary geologic map of the general project area is shown on Plate 3. Descriptions of the main geologic units are as follows:

Qhb - Basin Deposits (Holocene). Very fine silty clay to clay deposits occupying flat-floored basins at the distal edge of alluvial fans adjacent to the bay mud.

Qhaf - Alluvial Fans and Fluvial Deposits (Holocene). Alluvial fan deposits are brown or tan, medium dense to dense, gravely sand or sandy gravel that generally grades upward, to sandy or silty clay.

Qpaf - Alluvial Fans and Fluvial Deposits (Pleistocene). Brown dense gravely and clayey sand or clayey gravel that fines upward to sandy clay. Deposits display various sorting and are located along most stream channels in the county.

The portion of the published USGS geologic map that includes the project location is shown on Plate 3.

7.1.1 Lithology

Several published maps (Nilsen, 1976, Herd; 1979; and CDMG; 1982) have identified most of the hillside (through which the central portion of the project alignment has been cut) as a large (presumably deep-seated) landslide complex. However, site-specific investigations were conducted in the 1980s (by Terrasearch, Berloger-Long, and Engeo) prior to development of the large subdivision west of Highway 680; they determined that the toes of the landslides do not extend as far east as the highway itself. Consequently, the rock encountered in our borings is identified as "bedrock" consistent with the Briones Formation indicated on published geologic maps (Dibblee, 1980; and Graymer, 1998).

In general, the bedrock consists of sandstone, siltstone, and claystone. It is yellowish brown where oxidized and gray to grayish brown where not oxidized (apparently below the persistent water level). The grain size of the sandstone varies from fine to medium coarse. Bedding planes and fracture surfaces were not apparent in the samples obtained from the borings. However, previous mapping of exposures on the hillsides located west of the highway revealed bedding planes that dip steeply toward the northeast. Bedrock was encountered at various depths in 15 of the borings. (Table 4 indicates the elevation of the ground surface, the depth to bedrock, the elevation, the type of bedrock, and its color.) The character of bedrock encountered in each boring is described in the boring logs on the LOTB sheets.

TABLE 4: BEDROCK INFORMATION

Boring No.	Approx. Ground Elev. (ft)	Approx. Bedrock Depth (ft)	Approx. Bedrock Elev. (ft)	Type of Bedrock	Color
A-11-106	469.0	0.0	469.0	Claystone	yellowish brown
A-11-107	467.0	0.0	467.0	Claystone / Siltstone	yellowish brown
A-11-110	460.0	13.0	447.0	Claystone	dark brwon
A-11-110P	471.0	4.5	466.5	Claystone	yellowish brown
A-11-111	457.0	15.0	442.0	Siltstone	brown

Boring No.	Approx. Ground Elev. (ft)	Approx. Bedrock Depth (ft)	Approx. Bedrock Elev. (ft)	Type of Bedrock	Color
A-11-112	455.0	31.5	423.5	Claystone	gray
A-11-113	453.0	27.5	425.5	Claystone	gray
A-11-125	444.0	14.5	429.5	Sandstone	brown
A-11-126	442.0	20.0	422.0	Sandstone	gray
A-11-127	443.0	0.0	443.0	Sandstone	yellowish brown
A-11-128	441.0	0.0	441.0	Sandstone	yellowish brown
A-11-129	440.0	9.5	430.5	Sandstone	yellowish brown
A-11-130	440.0	14.0	426.0	Sandstone	grayish brown
A-11-143	437.0	24.0	413.0	Sandstone	brown
A-11-144	469.0	25.0	444.0	Siltstone	gray

7.1.2 Structure

As stated in section above, bedrock was encountered at various depths in 15 of the borings and bedding planes and fracture surfaces were not apparent in the samples obtained from the borings. The subject was considered and was determined to be not applicable for the project.

7.1.3 Existing Slope Stability

The majority of the project alignment appears to be constructed by cutting into natural slopes except in the vicinity of the overcrossings. The existing slopes along the corridor are landscaped and generally appear to be in good conditions.

7.2 Subsurface Soil Conditions

Based on the boring data and as-built LOTBs, the subsurface soil conditions at the project site indicate predominantly stiff to hard clayey materials. Fat clay was found in upper portion in some borings. Highly expansive soils need to be considered during foundation and pavement design. Medium dense to very dense sandy layers were encountered at various locations. Sedimentary rocks (claystone, siltstone and sandstone) were encountered mostly in the central part of the site. Groundwater was encountered in 20 borings at depths ranging from 11.5 to 45

feet below grade during drilling. The subsurface soil information corresponding with the design and construction segments is discussed as follows:

Sound Walls

Sound Wall No. 1 (Approx. Sta. 244+00 to 262+16)

SW No. 1 is located in the southern end portion of the project alignment in the northbound direction. Borings A-11-101 through A-11-104 were drilled on the eastern freeway shoulder for SW No. 1. The subsurface soils predominately consisted of stiff to hard clayey materials to the maximum depths drilled, approximately from 25.5 to 31.5 feet. Very stiff fat clay from 6 to 9 feet thick was encountered in Borings A-11-101, A-11-102 and A-11-104 in the upper portion. About 1.5 feet thick of medium dense clayey gravel was encountered in Boring A-11-102 at about 25 feet. Groundwater was encountered in Borings A-11-101 and A-11-102 at depth of about 11.5 (Elev. 463.5 ft) and 14 (Elev. 461 ft) feet, respectively.

Sound Wall No. 2 (Approx. Sta. 285+00 to 340+49)

SW No. 2 extends from the middle to the north end portion of the project alignment in the northbound direction. At locations of Retaining Walls No. 4, 6A and 6B, parts of Sound Wall No. 2 will be on top of the retaining walls. The subsurface conditions at those locations will be discussed in the Foundation Report for retaining walls.

- Sta. 285+00 to 292+02 - Borings A-11-119, A-11-120 and A-11-121 were drilled to depths ranging from 26.5 to 31.5 feet on the eastern roadway shoulder for this segment. Boring A-11-119 encountered about 2 feet of hard lean clay overlying very dense silty sand to the maximum depth drilled, approximately 26.5 feet. Boring A-11-120 encountered about 3 feet of stiff fat clay followed by interbedded lean clay, silt and sandy lean clay, stiff to hard, to the maximum depth drilled, approximately 26.5 feet. About 2 feet of dense silty sand was found at depth of 20 feet of A-11-120. Boring A-11-121 found stiff to hard lean clay to the bottom of the drilled hole, approximately 31.5 feet

deep. Groundwater was encountered in Borings A-11-120 and A-11-121 at 20 (Elev. 432 ft) and 28 (Elev. 423 ft) feet, respectively.

- Sta. 298+80 to 315+62 – Borings A-11-124, and A-11-131 through A-11-134 were drilled on the eastern freeway shoulder for this segment. The borings mostly encountered stiff to hard lean clay from 6 to 35 feet thick underlain by very dense silty or clayey sand to the maximum depths drilled, approximately from 25.5 to 49.5 feet below grade. The upper about 6 feet of Boring A-11-134 was found to be very stiff fat clay. Groundwater was found at about 45 feet (Elev. 399 ft) in Boring A-11-124.

- Sta. 320+32 to 340+49 – Borings A-11-137 through A-11-142 were placed on the eastern freeway shoulder for this segment. In general, the subsurface soil profile consisted of stiff and very stiff lean clay, with exception of Boring A-11-138, to the maximum depths drilled, approximately ranging from 26.5 to 55.5 feet below grade. Fat clay about 8 feet in thickness, very stiff, was encountered under the pavement sections of Boring A-11-138. Medium dense silty sand about 4 feet thick was also encountered at 25 feet in Boring A-11-138. Groundwater was encountered at 32 (Elev. 396 ft), 30 (Elev. 390 ft) and 25 (Elev. 390 ft) feet in Borings A-11-138, A-11-140 and A-11-141, respectively.

Sound Wall No. 3 (Approx. Sta. 286+63 to 301+23)

SW No. 3 is located in the central part of the project alignment in the southbound direction, which is on the eastern side of San Ramon Valley Boulevard and on top of the slope. Borings A-11-116P, A-11-117, A-11-118 and A-11-125 were advanced along the SW No. 3 alignment. Borings A-11-116P and A-11-117 were placed on top of the slope, which encountered mostly stiff to hard lean clay to the maximum depth drilled, approximately 31.5 feet. About 3 feet of medium dense sand layers were encountered at 5 feet in A-11-116P and at top of A-11-117. Boring A-11-118 and A-11-125 were drilled on the western freeway shoulder. Boring A-11-118 found 12 feet of stiff to very stiff lean clay underlain by dense to very dense silty sand to the bottom of the hole, about 25.5 feet deep. Boring A-11-125 found 8 feet of very stiff lean clay on top of 4 feet of very dense silty sand underlain by sedimentary rock (sandstone) to the maximum

depth drilled, about 26 feet. Groundwater was encountered in Borings A-11-118 at depth of about 24 feet (Elev. 422 ft).

Overhead Sign Structures

Boring was drilled for each single overhead sign structure with exception. Overhead Sign Structure B has been relocated from prior Station 265+99 to present location, Station 272+50, about 650 feet to the north of previous position on the same side of freeway. No boring was drilled at the new sign location (Boring A-11-144 was originally drilled at approximate Sta. 266+00 for OHS B). The subsurface profile at the new OHS B location is estimated based on the borings in its vicinity. It is judged that subsurface conditions at the present OHS B location generally consist of very stiff to hard clayey materials underlain by sedimentary rock. OHS D has been relocated from Sta. 268+10 to Sta. 265+25 too. Boring A-11-106 instead of prior A-11-107 is referred for OHS D. Subsurface soils encountered in borings for overhead sign structures are summarized below.

TABLE 5: SUBSURFACE CONDITONS FOR SIGN STRUCTURES

Sign Structure	Approx. Station	Reference Boring	Subsurface Conditions
B	SB 272+50	A-11-110, A-11-110P and A-11-144	Subsoils consisted of very stiff to hard lean clay overlying sedimentary rock (siltstone and claystone) to the bottom of the boring drilled, approximately 16.5 to 31 feet below grade. No free groundwater was encountered.
D	NB 265+25	A-11-106	The boring indicated sedimentary rock of claystone to the maximum depth explored, approximately 30.5 feet. No free groundwater was encountered.
F	SB 316+90	A-11-143	Very stiff fat clay, about 5 feet thick, was found on top of the hard lean clay overlying sandstone sedimentary rock. The rock extended from 24 feet to the bottom of the hole drilled, approximately 30.5 feet. No free groundwater was encountered.
H	NB 317+10	A-11-135	Stiff to very stiff lean clay was found extending to the bottom of the boring, approximately 30.5 feet. Groundwater was found at 25 feet (Elev. 410 ft).
K	NB 338+50	A-11-142	Stiff to very stiff lean clay was found extending to the bottom of the hole, approximately 26.5 feet. No free groundwater was encountered.

Structural Pavement Sections

Twenty-one (21) shallow boring were drilled on the eastern and western sides of the freeway to collect bulk samples for pavement design. The borings were drilled to 5 feet deep. In combination with the information from the borings for other structures, the surficial soils appeared mostly to be lean clay with fat clay mostly scattered in the south and middle north locations. The surficial soils generally show moderate to highly expansive potential with Liquid Limits (LL) ranging from 28 to 61 and Plasticity Indices (PI) ranging from 8 to 40. Subgrade soils to the south of approximate Station 320+00 generally indicated relatively low R-values (R<10). Soil descriptions of bulk soil samples are presented in Table 3A in Section 5.1 and their laboratory test results are presented in Table 12 in Section 9.1.

Detailed descriptions of the materials encountered in the exploratory borings are presented in the LOTBs in Appendix A. It should be noted that these descriptions and related information depict subsurface conditions only at the locations indicated and on the particular date noted on the LOTBs. Because of the variability from place to place within soil/rock in general, subsurface conditions at other locations may differ from conditions occurring at the locations explored. The abrupt stratum changes shown on the logs may be gradational, and relatively minor changes in soil types within a stratum may not be noted due to inherent limitations in the field investigations. Also, the passage of time may result in a change in the soil conditions at the locations due to environmental changes.

7.3 Water

7.3.1 Water Drainage

The grade at the project site gently slopes toward the north. The surface water/drainage generally follows the ground topography and is collected in local storm drainage system. In addition, the area includes the San Ramon Creek.

7.3.1.1 Scour

San Ramon Creek is to the east side of and parallel to I-680, outside of the project limit. No structure is planned to be constructed over the existing creek. The subject was considered and was determined to be not applicable for the roadway project.

7.3.1.2 Erosion

The existing slopes have established landscaping to help control erosion. It is recommended that construction of the proposed project be undertaken during the dry season or winterization measures be undertaken. Newly graded slopes, which are expected to be along the segments of Retaining Walls No. 4, 6A and 6B, should be covered with erosion control measures.

7.3.2 Groundwater

Groundwater was encountered in twenty (20) borings during the field exploration. Table 6 below summarizes the boring and groundwater information.

TABLE 6: SUMMARY OF GROUNDWATER INFORMATION

Boring No.	Approx. Station (ft)	Approx. Offset "A4" Line (ft)	Approx. Boring Depth (ft)	Approx. Ground Elev. (ft)	Approx. Groundwater Elev. (ft)	Groundwater Depth (ft)	Approx. Finished Grade Elev. (ft.)	Measuring Date
A-11-101	245+00	67 Rt.	26.5	475.0	463.5	11.5	475	6/16/11
A-11-102	250+00	64.5 Rt.	31.5	475.0	461.0	14.0	474	6/16/11
A-11-108	271+00	80 Rt.	31.5	462.0	442.0	20.0	462	6/20/11
A-11-114	287+00	65 Lt.	45.0	452.0	437.5	14.5	449	7/1/11
A-11-115	290+00	66 Lt.	36.5	449.0	437.0	12.0	449	7/11/11
A-11-118	298+00	70 Lt.	25.5	446.0	422.0	24.0	445	7/5/11
A-11-120	289+00	62 Rt.	26.5	452.0	432.0	20.0	453	6/21/11
A-11-121	292+00	65 Rt.	31.5	451.0	423.0	28.0	451.5	6/23/11
A-11-122	295+00	64 Rt.	49.0	449.0	410.0	39.0	449	6/21/11
A-11-123	298+00	65 Rt.	31.5	445.0	417.0	28.0	445	6/22/11
A-11-124	301+00	65 Rt.	49.5	444.0	399.0	45.0	443.5	6/21/11

Boring No.	Approx. Station (ft)	Approx. Offset "A4" Line (ft)	Approx. Boring Depth (ft)	Approx. Ground Elev. (ft)	Approx. Groundwater Elev. (ft)	Groundwater Depth (ft)	Approx. Finished Grade Elev. (ft.)	Measuring Date
A-11-126	304+00	65 Lt.	27.0	442.0	425.0	17.0	442	6/30/11
A-11-127	307+00	65 Lt.	17.0	443.0	428.0	15.0	443	6/30/11
A-11-128	310+00	70 Lt.	16.5	441.0	426.0	15.0	441	6/30/11
A-11-135	317+00	65 Rt.	30.5	435.0	410.0	25.0	434.5	6/23/11
A-11-136	319+00	65 Rt.	50.5	435.0	403.0	32.0	434	6/22/11
A-11-138	325+00	65 Rt.	55.5	428.0	396.0	32.0	428	6/23/11
A-11-140	331+00	65 Rt.	36.5	420.0	390.0	30.0	419	6/23/11
A-11-141	334+00	65 Rt.	36.5	415.0	390.0	25.0	414.5	6/23/11
A-11-145	248+00	80 Lt.	31.5	475.0	461.0	14.0	475	7/14/11

In general, groundwater was encountered at depths of 11.5 to 45.0 feet below ground surface during our field exploration (Elev. 390.0 and 463.5 feet). It is anticipated that groundwater level will vary with the passage of time due to seasonal groundwater fluctuations, surface and subsurface flow, ground surface run-off and other environmental factors.

7.4 Project Site Seismicity

7.4.1 Ground Motions

The project is located in a seismically active part of northern California. Many faults in the San Francisco Bay Area are capable of producing earthquakes, which may cause strong ground shaking at the site. The attached Fault Map, Plate 4, presents the locations of the fault systems relative to the project site.

Maximum moment earthquake magnitudes for some of the major faults in the area are determined by Caltrans' recently developed online ARS tool (V1.0.4). The reference was also made to the Caltrans Deterministic PGA Map of September 2007. These maximum moment earthquake magnitudes represent the largest earthquakes that could occur on the given fault based on the current understanding of the regional tectonic structure. Table 7 below provides the estimated distances and magnitudes of the nearest faults to the project alignment.

TABLE 7: EARTHQUAKE INFORMATION

Fault	Fault ID	Fault Type	Maximum Moment Magnitude	Approx. Nearest Distance (miles)	Deterministic PGA (g)
Greenville Fault Zone (Clayton section)	351	RLSS(1)	6.6	8.8	_(3)
Greenville Fault Zone (Marsh Creek – Greenville section)	352	RLSS(1)	6.6	9.8	_(3)
Mountain Diablo Thrust Fault	150	R(2)	6.6	1.8	_(3)
Pleasanton Fault	216	RLSS(1)	6.7	0.4	0.51
Calaveras Fault Zone (Northern Calaveras section)	321	RLSS(1)	7.4	0.5	0.52
Hayward Fault Zone (Southern Hayward section)	354	RLSS(1)	7.3	9.1	_(3)

(1) RLSS = Right-lateral strike-slip fault
(2) R = Reverse fault
(3) The PGA is not provided in the ARS on-line program

7.4.2 Ground Rupture

Based on available geological and seismic data, the possibility of the site to experience strong ground shaking may be considered moderate to high.

The project alignment is not within the Alquist Priolo Earthquake Fault Zones (EFZ, formerly Special Studies Zone), adopted by the California State Geologist. The potential for fault rupture within the project alignment is considered low. The impact of the earthquake is considered to be minimal with regard to the roadway widening project. Roadway maintenance should be expected if pavement distress or damage occurred after seismic events.

8. GEOTECHNICAL ANALYSES AND DESIGN

8.1 Seismic Analysis

8.1.1 Parameter Selection

Caltrans updated the 1996 Seismic Hazard map with the new Caltrans Deterministic PGA Map

(September 2007) and the Caltrans ARS Online (V1.0.4) design spectrum for development of response spectra for design. The structural designer should conform to the Caltrans current Seismic Design Criteria. The current design methods incorporate both deterministic and probabilistic seismic hazards to produce the Design Response Spectrum, which is the envelope of the output spectra. The probabilistic response spectrum to be used for design of structures is based on the data from the 2008 USGS Interactive Deaggregations (Beta) program for a 5% in 50 years probability of exceedance (975-year return period) or the Caltrans ARS Online program.

The information gathered indicates competent subsurface soils at the project site. According to the procedures contained in the Caltrans Geotechnical Services Design Manual, V1.0, August 2009, an average shear wave velocity of 305 m/s was adopted. For sites with shear wave velocities greater than 300 m/s, it is acceptable to use ARS Online for generating probabilistic spectrum. With use of the Caltrans ARS Online (V1.0.4), an average peak ground acceleration (PGA) of 0.72g was adopted for design and analyses. The ARS output for the site is attached as Plate 5. A probabilistic earthquake magnitude of 6.76, produced by the 2008 USGS Interactive Deaggregations (Beta) program, was used for liquefaction analyses.

8.1.2 Analysis

Majority of the proposed cuts and fills in the project are supported by retaining walls. Concrete barrier Type 60SC Mod will be utilized at locations where the minor slopes are less than 3 feet in height and the gradients are not steeper than 2H:1V. With the competent subsurface soils and the relatively low groundwater table, the slopes should be stable under seismic loads. Therefore, analyses to assess the stability of the slopes in the project site were not deemed necessary and were not performed.

8.1.3 Liquefaction Potential

Liquefaction is a phenomenon in which saturated soils are subject to a temporary but essentially total loss of shear strength under the reversing, cyclic shear stresses associated with earthquake shaking. Submerged, cohesionless sands and silts of low relative density are the type of soils

which usually are susceptible to liquefaction - the susceptibility increases with decreasing relative density (reflected by the number of blows to drive a sampler), and decreasing fines content. Accepted procedures for the assessment for liquefaction potential for cohesionless soils have evolved over the years through research and field observations (Youd et al, 2001). Recent research and field observations have shown that clays of low plasticity are also potentially liquefiable, based on the moisture content and plasticity characteristics of the clay. Procedures for the assessment of liquefaction potential for clay soils have also been established and have received general acceptance. (Bray et. al., 2004).

The site predominately consisted of stiff to hard clayey materials and sedimentary rocks. The risk of liquefaction at the site is considered to be low. However, due to existence of relatively thin layers of sandy soils, local liquefaction and minor post-liquefaction settlement is anticipated. The liquefaction potential and post-liquefaction settlement was analyzed based on the procedures outlined in the Youd et al, 2001summary report from NCEER workshops. The analysis results indicate that the post-liquefaction settlement at the site is generally on the order of ½ inch. Based on the analyses, potentially liquefiable layers of sands and gravels were identified at the following locations and depths:

TABLE 8: SUMMARY OF LIQUEFACTION ANALYSES

Boring No.	Depth (ft)	Soil Description	Settlement (in)
A-11-102	24 - 27	Medium dense clayey gravel	0.3
A-11-108*	20 - 23	Medium stiff sandy silt	0.8
A-11-114	43 - 45	Dense silty sand	0.5
A-11-115	25 - 29	Medium dense clayey sand	0.6
A-11-120	20 - 22	Dense silty sand	0.4
A-11-122	38 - 42	Medium dense silty sand	0.5
A-11-123	28 - 31	Dense silty sand	0.4

*: No sound walls or retaining walls are planned at the location of Boring A-11-108.

As may be noted from the above table, liquefaction zones and locations are isolated and deep and are thus of minimal significance for the roadway, wall and sign structures. The calculations for liquefaction potential are attached in Appendix C.

8.2 Cuts and Excavations

Based on the plans, the finish grades for Route 680 widening will, in general be matched with the adjacent grades for the existing road surface. The following are significant cuts and excavations for the project:

- A vertical cut up to 10 feet height will be required into the toe of a 2H:1V slope on the eastern side of the freeway for spread footings for Retaining Walls No. 1C and 1D.

- A vertical cut up to about 14 feet height will be required into the toe of a 2H:1V slope on the western side of the freeway. The cut will be retained by soil nail and/or ground anchor walls (Retaining Wall No. 2).

- A vertical cut up to about 10 feet height will be required into the toe of a 2H:1V slope on the eastern side of the freeway, under Greenbrook Drive Overcrossing. The cut will be retained by a ground anchor wall (Retaining Wall No. 3).

- A vertical cut up to 10 feet height will be required into the toe of a 2H:1V slope on the western side of the freeway for spread footings for Retaining Wall No. 5.

8.2.1 Stability

Where not contained by retaining walls, Type 60SC Mod concrete barrier will be used for retaining minor slopes with height less than 3 feet and slope gradient of 2H:1V or flatter. The subsurface soil conditions generally consist of stiff to hard clay, sedimentary rocks and medium dense to dense sand. Groundwater was not encountered within the cut depths. Based on the subsurface soil conditions, it appears that the stability of the cut slopes should be acceptable.

8.2.2 Rippability

The proposed excavations are anticipated to be in native soils or soft rock. Based on the investigation, rippability does not appear to be a concern for construction.

8.2.3 Grading Factor

Source of the fill may include the fill generated from the cuts planned for the project. Fill may also be imported from outside borrow sources. The source of borrow is unknown at the time of report preparation. Based on previous experience, for preliminary estimate, a grading factor of 0.9 may be assumed for import materials.

8.3 Embankments

8.3.1 Evaluation of Embankment Settlements

The finish grades for the new auxiliary lanes will be matched with the existing I-680 traveled way. Embankment fill therefore will be required in several locations to level the ground surface for the roadway widening, especially, at locations of Retaining Walls No. 4, 6A and 6B on the eastern side of freeway. Based on the plans, the embankment fills will have thicknesses of less than 10 feet.

Subsurface Soil Conditions

The boring data indicates that the subsurface soil conditions underneath the proposed fill embankments generally consist of stiff to hard clays, medium dense to very dense sand, gravel and sandstone (Borings A-11-121, -122 and -123 for Retaining Wall No. 4 and Borings A-11-135, -136 and -137 for Retaining Walls No. 6A and 6B). Groundwater was encountered at depths more than 25 feet below the finished grade in the planned embankment fill locations.

Evaluations

As indicated above, soft or loose soils layers were generally not found during our subsurface investigation. The competent subsurface conditions coupled with deep groundwater level preclude the potential occurrence of significant consolidation settlements for the embankment. Our calculations show that most settlement will occur within the over-consolidated range and

should happen during fill placement. A potential consolidation settlement of less than ½ inch is estimated for a less than 10-ft embankment fill.

Differential Settlement

Since total settlements are not significant, differential settlements should also not be significant.

8.3.2 Evaluation of Embankment Stability

New embankment fill about 5 to 7 feet thick will be required at the locations as described in Section 8.3.1 above and will be restrained by retaining walls. Based on the layout sheets with topography provided by the Designer, the existing eastern freeway embankment at those planned fill locations is about 10 feet high and has about 2H:1V or flatter slope gradients. Camino Ramon Boulevard runs along the toe of the existing embankment. Based on the plans, the footing for retaining walls will be set at close to the level of the Camino Ramon Boulevard. The underlying soils are competent materials per data from the borings. Groundwater was deeper than 15 feet below the toe of the existing embankment. It was judged that under the above conditions, potential for slope instability was minimal. Therefore, analyses to assess the stability of the slopes in the project site were not deemed necessary.

8.4 Earth Retaining System

It is our understanding that due to right-of-way and other geometric constraints, the Route 680 modification and widening project will require construction of six (6) retaining walls along the northbound and southbound directions. The existing slopes will be cut or filled to provide level ground for the roadway widening. The retaining walls will be separated into ten (10) design and construction segments. The proposed walls include Caltrans standard reinforced concrete walls (Type 1A, Type 1SWB and Type 7) on spread footings. Non-standard soil nail and ground anchor walls need to be specially designed. Discussions on the proposed retaining walls are presented in a separate Foundation Report.

8.5 Culverts

The drainage plans provided by the Designer indicates several new Alternative Pipe Culverts (APC) with diameters ranging from 15 to 24 inches. It is our understanding that small diameter culverts (24 inches and under) can be designed and constructed using Standard Plans and Specifications, and no specific geotechnical investigation is required per Caltrans guidelines.

8.5.1 Corrosion Investigation

The corrosion investigation for this project was performed in general accordance with the provisions of California Test Method 643. Representative native soil samples at the anticipated pipe subgrade were obtained for corrosion tests. A summary of the corrosion test results is presented in Table 9.

TABLE 9: SUMMARY OF CORROSION TEST RESULTS

Boring No.	Station (Approx.)	Offset From "A4 Line" (ft) (Approx.)	Corrosion Tests					
			Sample No.	Depth (ft)	pH	Resistivity (ohm-cm)	Chloride (ppm)	Sulfate (ppm)
A-11-101	245+00	67 Rt.	2	6	7.63	540	48.2	198.5
A-11-106	265+00	63.5 Rt.	2	6	6.97	1660	26.8	46.9
A-11-108	271+00	80 Rt.	2	6	7.57	830	21.0	71.4
A-11-109	281+75	62 Rt.	2	6	7.27	1050	39.5	77.0
A-11-110	275+00	69.5 Lt.	2	6	7.56	280	71.4	1137.9
A-11-114	287+00	65 Lt.	3	10	7.20	1420	11.8	15.5
A-11-118	298+00	70 Lt.	2	6	7.56	1980	8.0	17.1
A-11-120	289+00	62 Rt.	4	16	6.91	1770	27.2	43.4
A-11-122	295+00	64 Rt.	2	4.5	7.34	1150	57.2	111.9
A-11-127	307+00	65 Lt.	1	2.5	7.45	960	11.9	12.3
A-11-133	310+00	65 Rt.	2	6	6.39	1470	27.1	79.4
A-11-137	322+00	65 Rt.	2	6	7.62	880	19.2	36.8
A-11-140	331+00	65 Rt.	2	6	7.50	670	18.3	90.9
A-11-142	337+00	65 Rt.	1	3	6.90	1340	15.5	1.6
A-11-143	317+00	70 Lt.	2	6	7.47	1930	14.5	66.9
A-11-144	266+00	80 Lt.	2	6	7.64	830	38.2	680.7
A-11-145	248+00	80 Lt.	1	3	6.99	670	15.2	143.1

Based on the test results, the on-site soils are classified as non-corrosive per Caltrans corrosion design guidelines. Standard Type II modified or Type I-P (MS) modified cement may be used for the concrete substructures. For selection of pipe material for culvert and storm drain applications, it is our understanding that AltPipe computer program is used by Caltrans to assist the designers. AltPipe program is a web-based tool (http://dapl.ca.gov//design/altpipe). The computations performed by AltPipe are based on the procedures and Caltrans Test Methods described in Chapter 850 of the Caltrans Highway Design Manual (HDM). AltPipe incorporates current requirements from the HDM supplemented by Caltrans Design Information Bulletin No. 83 (DIB. No. 83, June 30, 2003 and updated on August 20, 2011) for abrasion potential for material selection. The AltPipe program is intended for final design by the civil or hydraulic engineer.

AltPipe analysis was performed using the online Caltrans Alternative Pipe Version 6.09. In addition to the soil corrosivity data, the input require data such as Abrasion Level, 2-5 year flow velocity, design service life and height of cover were provided by the Designer. The summary table of AltPipe analysis results and the computer analysis printouts are attached in Appendix C.

8.5.2 Bore-and-Jack Culvert

Based on the information provided by the Designer, there is no bore-and-jack culvert planned for this project. The plans show that the project will bore electrical conduits of 3 inches diameter beneath the roadway at locations close to Stations 244, 267, 285, 285, 291, 318 and 335. The subsoils in those locations were generally stiff to hard clayey soils.

8.6 Minor Structure Foundations

8.6.1 Sound Wall

Three sound walls are proposed, with Sound Walls No. 1 and 2 on the east side and No. 3 on the west side of the freeway. Caltrans Standard Plans and Specifications will be followed for sound wall design and construction. According to the plans supplied by the Designer, the sound walls will be on either Type 736S / SV concrete barrier or pile cap supported by standard 16 inch

diameter CIDH concrete piles. The piles are of lengths ranging from 9.5 to 16 feet for wall heights ranging from 12 to 13.67 feet. The soil investigation and geotechnical recommendations for sound wall design are generally in conformance with the guidelines provided in Caltrans Geotechnical Manual of July 2010 for sound walls (Standard Plan). Since the maximum length of design CIDH piles will be 16 feet, only the soil conditions within the upper about 15 to 20 feet below the bottom of concrete barrier or pile cap were considered for determination of the design parameters (with no less competent materials at depths deeper than 20 feet). According to the manual, the soil friction angle was determined by correlations with the adjusted SPT blow counts $(N_1)_{60}$, and for cohesive soils, unconfined compressive strength (q_u) or undrained shear strength (C_u) was used to approximate an equivalent granular "N" value. The soil friction angle was then used for selecting CIDH pile foundation lengths for the sound walls.

Subsurface soil conditions underneath the sound wall alignments were described in Section 7.2. Per the subsoil data, it is our opinion that, standard CIDH concrete pile foundation is generally suitable for the proposed sound walls with following exception:

Due to shallow groundwater encountered in Borings A-11-101 and A-11-102 in the south end of Sound Wall No. 1 alignment, which could be shallower than 10 feet below the finished grade, the standard 16 inch diameter CIDH concrete piles cannot be used in these locations per Caltrans Geotechnical Manual and can be replaced with spread footing foundations. The affected wall segment is approximately from Station 244+00 to Station 253+12.

Spread footing can be used instead of CIDH piles for the affected segment, Station 244+00 to 253+12. The minimum footing width of 6.5 feet is required for a sound wall of 14 feet high according to the 2006 Caltrans standard plan B15-1. The required ultimate soil bearing capacity is 0.6 tsf. Borings A-11-101 and A-11-102 show that the subsurface soils are generally composed of stiff to very stiff clayey materials with an average $(N_1)_{60}$ value of 13 in the upper about 20 feet. The estimated ultimate bearing capacity of soils below the spread footing is 4 tsf, which exceeds the loading demand of 0.6 tsf.

The following table lists the CIDH concrete pile foundation recommendations for sound walls. The stations, wall height and ground line are provided by the Designer. The lengths of CIDH concrete piles are from the 2006 Caltrans Standard Plans B15-5 and B15-8.

TABLE 10: SOUND WALL FOUNDATION RECOMMENDATIONS

Wall No.	Direction	Starting Station	End Station	Wall Height (ft)	Ground Line	CIDH Pile Length (ft)	Friction Angle (ϕ)
1	NB	244+00	253+12	13.67	Case 2	Footing*	-
		253+12	262+16	13.67	Case 2	16.0	30
2	NB	285+00	292+02	12.33	Case 2	16.0	30
		298+80	307+56	12.33	Case 2	16.0	30
		307+56	309+48	12.33	Case 2	16.0	30
		309+48	315+62	12.33	Case 2	16.0	30
		320+32	322+16	12.33	Case 2	16.0	30
		323+81	340+49	12.33	Case 2	16.0	30
3	SB	286+63	301+23	12.0	Case 2	16.0	30

*: Spread footing of 6.5 feet in width can be used instead of CIDH piles at this location. Refer to the 2006 Caltrans standard plan B15-1.

Along the sound wall alignment, groundwater was found generally deeper than 20 feet during drilling except at location mentioned above. Groundwater conditions may vary from location to location and by season.

8.6.2 Overhead Sign Structures

It is proposed to install five (5) new single post type overhead sign structures (Truss), supported by standard CIDH concrete piles, along I-680 as shown below.

TABLE 11: SIGN STRUCTURE FOUNDATION RECOMMENDATIONS

Sign Structure	Approximate Station	Post Type	CIDH Pile Diameter (ft)	CIDH Pile Length (ft)
B	SB 272+50	VIII	5	25
D	NB 265+25	VIII	5	25
F	SB 316+90	VII	5	23
H	NB 317+10	VIII	5	25
K	NB 338+50	VII	5	23

Per 2006 Caltrans Standard Plan S8, the recommended pile diameter is 5 feet and the recommended foundation depths are 23 and 25 feet with round pedestal for post Type VII and VIII, respectively. Design of the pile depth for the foundation is based on an assumed soil friction angle of 30 degrees.

The piles for the overhead sign structures are subject to vertical loads, lateral loads, bending moments and torsion moments. Analyses were performed for behavior of the piles based on the loads provided by the Designer and subsurface conditions specific to the structure locations. The calculations show that the pile capacities developed from the friction resistance are adequate for vertical and torsion load demands. The LPILE V6.0 computer program was used for lateral analyses. The deflections at the top of the piles were less than 0.11 inch. These deflections are considered acceptable. The subsurface conditions were thus adequate for the use of standard foundation for all the sign structures. Calculations and computer printouts are included in Appendix C.

8.6.3 CIDH Piles

It should be pointed out, localized hard drilling and raveling or caving may be expected which may require additional drilling and cleaning effort and may increase the concrete volume for the piles. It is prudent to make the contractor aware of these conditions so that he takes appropriate steps to comply with the standards and maintain the integrity of the CIDH piles.

Occasional thin sandy soil layers may be encountered. Contractor should be prepared for possible caving conditions. Pile excavations may require temporary steel casing or similar measures to maintain the holes open. All pile excavations should be observed by the geotechnical engineer or regulatory agency prior to the placement of the reinforcement and concrete so that if conditions differ from those anticipated, appropriate recommendations can be made.

Entering into CIDH holes for excavation or inspection is not anticipated for this project. The five (5) overhead sign structure locations can be classified as “potentially gassy” according to Tunnel Safety Orders specified in Section 110.12 of Caltrans HDM. It is advisable that proper

Cal-OSHA or other regulating procedures be followed for notice of the classification and any special orders, rules, special conditions, or regulation to be used at the job site.

8.6.4 Other Minor Structures

According to the plan, other minor structures for this project include the traffic signal systems and minor drainage structures. The foundation design of these minor structures should be according to the Caltrans Standard Plans. Based on the borings, the existing soils on site should provide adequate design capacity for these structures.

9. STRUCTURAL PAVEMENT

9.1 Laboratory Tests on Subgrade Material

Laboratory tests were conducted on representative bulk samples collected at subgrade level. The R-values of the subsurface soils at the project site were typically less than 15 and some of the tests indicate expansive conditions. We have grouped the areas that are lower than R=10 and above R=10. Per Caltrans Highway Design Manual (HDM), subgrade soils with R-value less than 10 and PI greater than 12 should be properly treated to bring the R-value to greater than 10 if rigid pavement sections are planned.

Lime treatment for subgrade is considered for a portion of the project that generally has R<10. The percentage of lime used for subgrade soil treatment (6 percent) was determined according to the pH test results of the treated materials on selected samples in accordance with the test method ASTM C977. The samples were treated with 6% SS-lime by dry weight of the soil for subsequent tests. Unconfined compression tests following California Test Method 373 were performed on four samples of the lime treated soils. The test results are summarized in Table 12. Additional data on the tests are presented in Appendix B.

TABLE 12: SUMMARY OF TEST RESULTS ON SUBGRADE SOILS

Boring No.	Approx. Station (ft.)	Approx. Offset From "A4" line (ft)	Atterberg Limits	R-Value	Compressive Strength (Lime Treated) (psi)
R-1	242+00	80 Rt.	LL=47, PI=8	7	-
R-2	247+25	80 Rt.	-	-	548
R-3	253+00	80 Lt.	LL=44, PI=22	11	-
R-4	257+25	80 Rt.	LL=48, PI=29	-	-
R-8	276+00	80 Rt.	-	-	541
R-11	293+00	80 Lt.	LL=44, PI=25	-	393
R-12	296+00	80 Rt.	LL=33, PI=16	15	-
R-14	306+00	80 Rt.	LL=47, PI=30	-	276
R-15	312+75	90 Lt.	LL=33, PI=14	-	-
R-16	316+00	80 Rt.	-	6	-
R-17	322+50	80 Lt.	-	10	-
R-18	326+00	80 Rt.	-	10	-
R-20	335+75	80 Rt.	-	12	-
R-21	342+75	85 Lt.	-	11	-

The unconfined compressive strength (UCS) test results for lime stabilized materials ranged from 276 to 548 psi. Based on the laboratory test results, it is our opinion that the subgrade should be treated with minimum 6% SS-lime mixture to achieve the required minimum UCS of 300 psi as set in Caltrans HDM. However, it is recommended that the specifications require the determinations of the percent lime content for the required minimum UCS for the lime treated subbase (LTS) during construction. All treatment operations should be performed in accordance with the project specifications and Caltrans standards.

9.2 As-Built Pavement Sections

The as-built pavement sections based on the "Typical Cross Sections", Sheets X-1 through X-6 of the plans, provided by the Designer are presented in Appendix D. Total thicknesses of the existing pavement sections generally range from 2 to 2.5 feet. It should be noted that the sections may not include any overlays that may have been placed during the maintenance program. In general, the existing traveled ways have concrete pavement for main lanes and hot mix asphalt pavement for shoulders approximately from Station 247+42 to 344+74 southbound and from Station 237+73 to 339+67 northbound. Typical Cross Sections on Sheet X-6 show 0.4 to 1.48

feet of aggregate subbase (AS) and permeable material (PM) at the bottom of the existing pavement sections from approximate Station 335+00 to 343+59 southbound and Station 335+00 to 339+17 northbound. For new pavement sections within above stations, permeable material and edge drain should be considered for new structural pavement to continue the existing subbase drainage path.

9.3 Recommended Structural Pavement Sections

Pavement design are based on Caltrans Highway Design Manual (updated July 24, 2009) and the "Rigid Pavement Base Design - Pavement Policy Manual PPB09-01" dated August 27, 2009. It is our understanding that rigid concrete pavement sections are planned for the roadway widening. Traffic Index (TI) value of 13.5 for 20 years of design life as recommended by the Designer is used for the design. In addition, recommendations for 40 years design life for concrete pavement are provided using TI of 14.5, which is for use by the Designer for a Life Cycle Cost Analysis (LCCA).

9.3.1 Rigid Pavement Sections

Design for rigid (concrete) pavements was based on Inland Valley, Type II soil conditions (includes portions of treated Type III soil) presented in the Caltrans Highway Design Manual. The new pavement sections were designed for one segment with R-value generally greater than 10, and the other with R-value generally less than 10, and therefore, subgrade lime treatment is needed to increase the soil strength. The required minimum depth of subgrade lime treatment to raise the subgrade R-value above 10 is 0.65 foot per Caltrans HDM. A Caltrans standard bond breaker is required between JPCP and LCB to avoid bonding between the two layers.

TABLE 13A: RIGID PAVEMENT SECTIONS (20 YEARS OF DESIGN LIFE)

Location	**TI**	**R-Value**	**Structural Pavement Section (ft)**					
			With Lateral Support (ft)			**Without Lateral Support (ft)**		
			Opt. 1	**Opt. 2**	**Opt. 3**	**Opt. 1**	**Opt. 2**	**Opt. 3**
SB Approx. Sta. 320 to 344+74 NB Approx. Sta. 320 to 339+67 **(subgrade lime treatment is <u>not</u> needed within above stations)**	13.5	10	0.95 JPCP	0.95 JPCP	0.85 CRCP	1.05 JPCP	1.05 JPCP	0.95 CRCP
			0.35 LCB	0.25 HMA-A	0.25 HMA-A	0.35 LCB	0.25 HMA-A	0.25 HMA-A
			0.70 AS	0.70 AS	0.70 AS	0.70 AS	0.70 AS	0.70 AS
SB Approx. Sta. 247+42 to 320 NB Approx. Sta. 237+73 to 320 **(subgrade lime treatment is needed for above stations)**	13.5	>=10*	The structural pavements sections are the same as above. In addition, the existing subgrade should be treated with minimum 6% SS Quick Lime to a minimum depth of 0.65 foot below the design pavement sections.					

JPCP = Jointed Plain Concrete Pavement;
CRCP = Continuously Reinforced Concrete Pavement;
LCB = Lean Concrete Base;
HMA-A: Hot Mix Asphalt (Type A);
AS: Aggregate Sub-base (Class 4) with R-value equal to 50.

*LTS is required to raise the subgrade R value above 10. This is after treatment design value.

TABLE 13B: RIGID PAVEMENT SECTIONS (40 YEARS OF DESIGN LIFE)

Location	**TI**	**R-Value**	**Structural Pavement Section (ft)**					
			With Lateral Support (ft)			**Without Lateral Support (ft)**		
			Opt. 1	**Opt. 2**	**Opt. 3**	**Opt. 1**	**Opt. 2**	**Opt. 3**
SB Approx. Sta. 320 to 344+74 NB Approx. Sta. 320 to 339+67 **(subgrade lime treatment is <u>not</u> needed within above stations)**	14.5	10	1.00 JPCP	1.00 JPCP	0.90 CRCP	1.15 JPCP	1.15 JPCP	1.00 CRCP
			0.35 LCB	0.25 HMA-A	0.25 HMA-A	0.35 LCB	0.25 HMA-A	0.25 HMA-A
			0.70 AS	0.70 AS	0.70 AS	0.70 AS	0.70 AS	0.70 AS
SB Approx. Sta. 247+42 to 320 NB Approx. Sta. 237+73 to 320 **(subgrade lime treatment is needed for above stations)**	14.5	>=10*	The structural pavements sections are the same as above. In addition, the existing subgrade should be treated with minimum 6% SS Quick Lime to a minimum depth of 0.65 foot below the design pavement sections.					

JPCP = Jointed Plain Concrete Pavement;
CRCP = Continuously Reinforced Concrete Pavement;
LCB = Lean Concrete Base;
HMA-A: Hot Mix Asphalt (Type A);
AS: Aggregate Sub-base (Class 4) with R-value equal to 50.

*LTS is required to raise the subgrade R value above 10. This is after treatment design value.

According to the Caltrans Highway Design Manual, treating the subgrade does not eliminate or reduce the required aggregate subbase for rigid or composite pavements in the rigid pavement catalog. Therefore, for segments where subgrade lime treatment is recommended, the required 0.70 foot of AS cannot be omitted. Where new concrete pavement is required in narrow (< 12 feet wide) sections, LTS cannot be constructed by conventional equipment. In such locations, it is proposed that LTS be replaced by equal thickness of AS. As such, the total thickness of aggregate subbase will be a minimum of 1.35 (0.65 + 0.70) feet beneath the LCB or HMA-A layers. Subgrade pumping and yield conditions should be expected under heavy compactors due to low strength subgrade situation. Subgrade Enhancement Geotextiles (SEG) should be applied on the subgrade. According to Caltrans Guide for Designing Subgrade Enhancement Geotextiles, April 28, 2009, at a minimum, SEG Class B2 as set in Section 88-1.02 of Caltrans Standard Specifications, should be used for subgrade stabilization purpose.

9.3.2 Rapid Strength Concrete

It is our understanding that to shorten traffic closing time, Rapid Strength Concrete (RSC) may be needed at few locations for stage construction purpose. Wherever the RSC pavement is planned, the design pavement sections Option 1 as recommended in Section 9.3.1 above, should be followed and the RSC instead of conventional concrete should be used. A bond breaker is required between LCB (RSC) and JPCP (RSC) to avoid bonding between the two layers, which can cause cracks and joints in the LCB to reflect through the rigid pavement. The recommended RSC pavement sections are as follows (TI=13.5 for 20 years of design life):

<u>Subgrade R-value >= 10 (subgrade lime treatment is not needed)</u>

- 0.95 feet of JPCP (RSC) with lateral support or 1.05 feet of JPCP (RSC) without lateral support
- Bond Breaker (Caltrans standard)
- 0.35 feet of LCB (RSC)
- 0.70 feet of Aggregate subbase (AS) Class 4 with R value equal to 50

Subgrade R-value < 10 (subgrade lime treatment is needed)

According to the Caltrans HDM, the required 0.70 foot of AS cannot be omitted with lime treated subbase. At locations where the subgrade lime treatment is recommended, the required lime treatment subbase (LTS) can be replaced with equal thickness of aggregate subbase. In such case, the total thickness of aggregate subbase will be a minimum of 1.35 feet beneath the RSC layers. Subgrade pumping and yield conditions should be expected under heavy compactors due to low strength subdrade situation. Subgrade Enhancement Geotextiles (SEG) should be applied on the subgrade. At a minimum, SEG Class B2 as set in Section 88-1.02 of Caltrans Standard Specifications, can be used for subgrade stabilization purpose.

- 0.95 feet of JPCP (RSC) with lateral support or 1.05 feet of JPCP (RSC) without lateral support
- Bond Breaker (Caltrans standard)
- 0.35 feet of LCB (RSC)
- 1.35 feet minimum of Aggregate Subbase Class 4 with R value equal to 50
- Subgrade Enhancement Geotextile, Class B2

It is recommended that proper special specification and provision be established for design and construction of RSC pavement sections.

9.3.3 Asphalt Concrete Pavement Sections

Maintenance Vehicle Pullout (MVP) areas need asphalt concrete pavement sections. The MVP areas are within the subgrade lime treatment limits. The required minimum 0.65 feet of LTS can be replaced with the same thickness of aggregate subbase. Subgrade Enhancement Geotextile should be used on the subgrade for weak subgrade conditions. Recommendations for pavement sections in MVP areas are as follows:

- 0.50 feet HMA-A
- 1.60 feet Class 2 AB
- 0.65 feet AS

- Subgrade Enhancement Geotextile, Class B2

Asphalt concrete pavement sections will also be needed for short and narrow strips at the south and north ends of the widening alignment in both directions. Recommendations for pavement sections in these areas are as follows:

- 0.70 feet HMA-A
- 1.10 feet Class 2 AB
- 1.50 AS
- SEG Class B2 (if within the lime treatment limits)

10. MATERIAL SOURCES

There are several commercial sources of asphalt, concrete, and aggregate products in the area. Table 14 lists available commercial suppliers in the area.

TABLE 14: SOURCES OF IMPORTED BORROW

Source	Location	Approx. Haul Dist. (one way, mile)
Morgan Masonry Supply	2233 San Ramon Valley Blvd., San Ramon	<1
Pleasanton Ready Mix	3400 Boulder St., Pleasanton	13.2
RMC Cemex	1544 Stanley Blvd., Pleasanton	15.5

11. MATERIAL DISPOSAL

Majority embankment fill sections will require imported borrow material for the project. Surplus of cutting materials can generally be hauled away and disposed to regular disposal sites. Disposal of ADL contaminated material (if any) is beyond the scope of this report.

12. CONSTRUCTION CONSIDERATIONS

12.1 Construction Advisories

The site is the existing I-680. Therefore traffic control and construction staging is required to

maintain traffic flow during construction. There are numerous utility lines at the site. The contractor should verify the utility lines, be aware of the existing conditions and plan the construction activities accordingly.

The borings encountered clayey/sandy materials near the existing ground surface. Localized subgrade pumping may be encountered during earthwork construction depending on the weather, subsurface moisture, and surface drainage conditions. Equipment mobility may also be difficult if the subgrade is wet. In such a case, the subgrade soils may require reworking, aeration, or over-excavation and replacing with dry granular fill to facilitate earthwork construction.

12.2 Construction Consideration that Influence Specifications

The contractor should verify the existing utility line conditions, and these locations should not be used for stockpiling of borrow materials. Any utility conflicts with proposed construction should also be reviewed prior to construction. There may be excavations that are proposed near existing utility lines. Contractor should take precautions to protect the utilities from damage caused by such excavations.

12.3 Construction Monitoring and Instrumentation

In general, the construction subject of monitoring and instrumentation was considered and was determined to be not significant for the project. However, Contractor may need to monitor his excavations that are in near proximity to existing utilities or other improvements.

12.4 Hazardous Waste Considerations

The project environmental study report should be referred to for further details at the sites within the project.

12.5 Differing Site Conditions

The soil conditions described in this report are based on available boring data. It should be noted

that these borings depict subsurface conditions only at the locations drilled. Because of the variability from place to place within soils in general, and the nature of geologic depositions, subsurface soil conditions could change between the explored locations.

Early communication should be made between the Resident Engineer, the Contractor and the Geotechnical Engineer as soon as conditions that differ from those established in this report are recognized by any of the parties. Additional recommendations could be provided if such conditions arise.

13. RECOMMENDATIONS AND SPECIFICATIONS

13.1 Summary of Recommendations

If the designer has questions or concerns regarding any of these recommendations, or, if conditions are found to be different during construction, the Geotechnical Engineer who prepared this report should be contacted. Additional fieldwork, analysis or changes in recommendations may be required. These services may be provided under a separate authorization, as necessary. A concise summary of the geotechnical recommendations is presented below:

- Design peak ground acceleration (PGA) = 0.72 g.
- The boring data indicates that the subsoils consist predominantly of stiff to hard clay with layers of medium dense to very dense sand. Sedimentary rock was found in the central portion of the site.
- Groundwater was encountered between Elev. 390.0 feet and 463.5 feet during drilling (about 11.5 to 45 feet below finished grade).
- The impact of liquefaction potential to this project is considered low. (Ref.: Section 8.1.3).
- The embankments and cut slopes are considered stable given the subsoil conditions, maximum height of the embankments and slopes, and the retaining walls to be constructed.

- The settlement due to the placing of the embankment fill is expected to be insignificant.
- Standard CIDH concrete piles can be used as planned for foundations for supporting sound walls and overhead sign structures (Ref.: Section 8.6).
- The structural pavement sections for the project include rigid pavement sections for the mainline widening (Ref: Section 9).

13.2 Recommended Materials Specifications

13.2.1 Standard Specifications

Unless otherwise stated in the special provisions, all materials specifications should conform to Caltrans Standard Specifications, including but not limited to the following: Earthwork, Structure Backfill, Pervious Backfill Material, Reinforcing Geofabric, Thermoplastic Pipes, Concrete, bond breaker, Hot Mix Asphalt, Aggregate Base, Aggregate Subbase and Lean Concrete Base, etc.

13.2.2 Special Provisions

<u>Imported Borrow:</u>
Imported material should be in accordance with the Caltrans specifications set forth in Section 19. In particular, for new embankment/roadway construction, the material placed within 4 feet of the finish pavement subgrade should meet the following requirements:

- Free of organic or other deleterious materials.
- An R-value of no less than 15.

<u>Aggregate Base:</u>
Class 2 aggregate base shall conform to the provisions in Section 26 of Caltrans Standard Specifications. It shall also be clean and free from organic matter and other deleterious substances.

Aggregate Subbase:

Aggregate Subbase shall be Class 4 and shall conform to the provisions in Section 25 of the Caltrans Standard Specifications and to these Special Provisions. Class 4 aggregate subbase shall be clean and free from organic matter and other deleterious substances. The percentage composition by weight of Class 4 aggregate subbase shall conform to the following grading as determined by California Test Method No. 202.

Gradation Requirement (Percent Passing)

Sieve Sizes	Operating Range	Contract Compliance
2-1/2”	100	100
No. 4	30 – 65	25 – 70
No. 200	0 – 15	0 – 18

Class 4 aggregate subbase shall also conform to the quality requirements given in the following table:

Quality requirements

California Test Method	Operating Range	Contract Compliance
Sand Equivalent (217)	21 Min.	18 Min.
Resistance (R-value) (301)	50	50 Min.

14. INVESTIGATION LIMITATIONS

Our services consist of professional opinions and recommendations made in accordance with generally accepted geotechnical engineering principles and practices and are based on our field exploration and the assumption that the soil conditions do not deviate from observed conditions. No warranty, expressed or implied, of merchantability or fitness, is made or intended in connection with our work or by the furnishing of oral or written reports or findings. The scope of our services did not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in structures, soil, surface water, groundwater or air, below or around this site. Unanticipated soil conditions are commonly encountered and cannot be fully determined by taking soil samples and excavating test borings; differing soil conditions may require that additional expenditures be made during construction to attain a properly

constructed project. Some contingency fund is thus recommended to accommodate these possible extra costs.

This report has been prepared for the proposed "Route 680 Auxiliary Lane Project – Segment 2" project as described earlier, to assist the engineer in the design of this project. In the event any changes in the design or location of the facilities are planned, or if any variations or undesirable conditions are encountered during construction, our findings and recommendations shall not be considered valid unless the changes or variations are reviewed and our recommendations modified or approved by us in writing.

This report is issued with the understanding that it is the designer's responsibility to ensure that the information and recommendations contained herein are incorporated into the project and that necessary steps are also taken to see that the recommendations are carried out in the field.

The findings in this report are valid as of the present date. However, changes in the soil conditions can occur with the passage of time, whether they are due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation or from the broadening of knowledge. Accordingly, the findings in this report might be invalidated, wholly or partially, by changes outside of our control.

Respectfully submitted,
PARIKH CONSULTANTS, INC.

Peter Haoli Wei, GE 2922
Project Engineer

Gary Parikh, G.E. 666
Project Manager

REGISTERED PROFESSIONAL ENGINEER
GAURANG R. PARIKH
No. 666
EXP. 12-31-13
GEOTECHNICAL
STATE OF CALIFORNIA

T:\Ongoing Projects\2011\2011_124 Mark Thomas & CompanyRte 680 Aux lanes Seg 2

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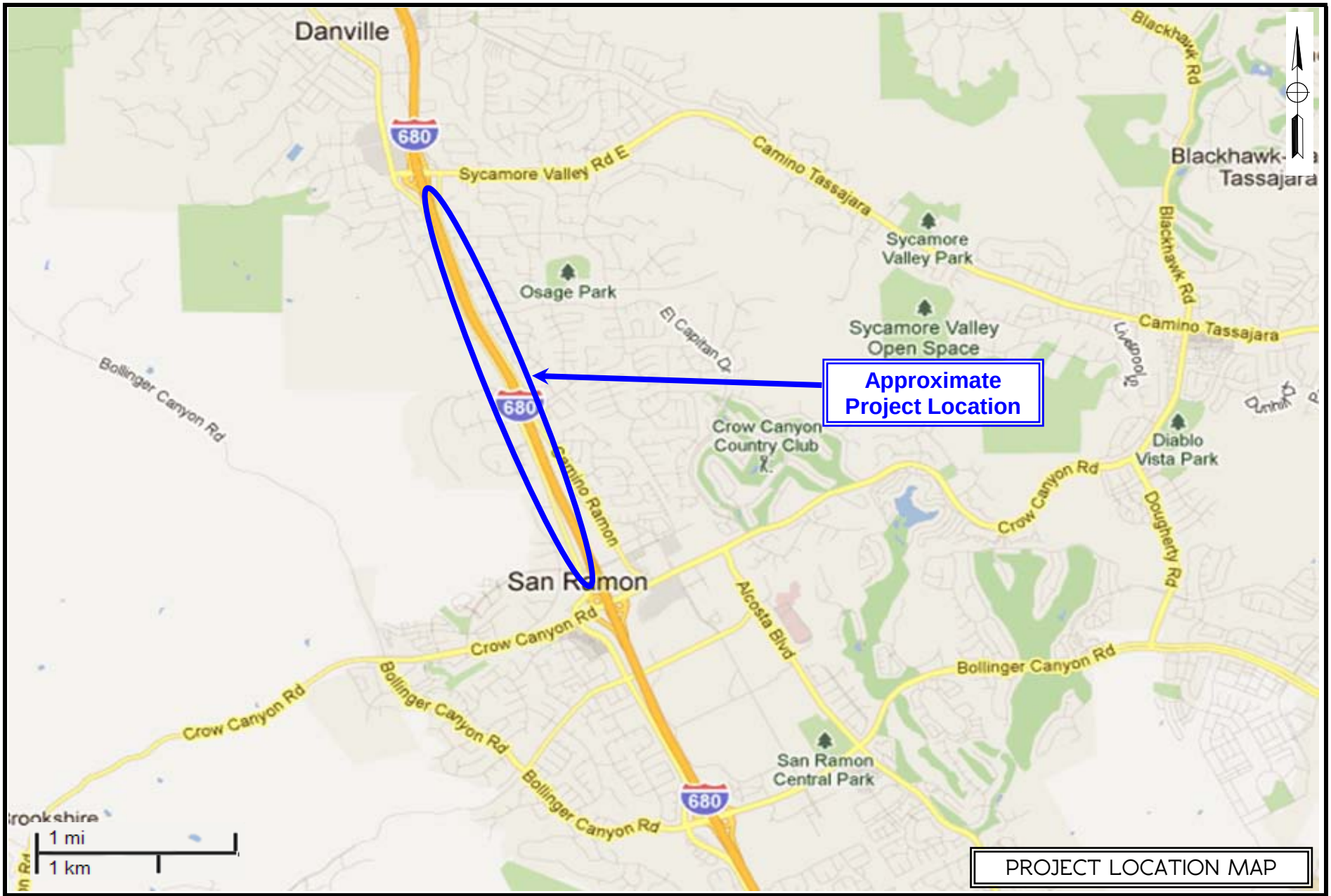
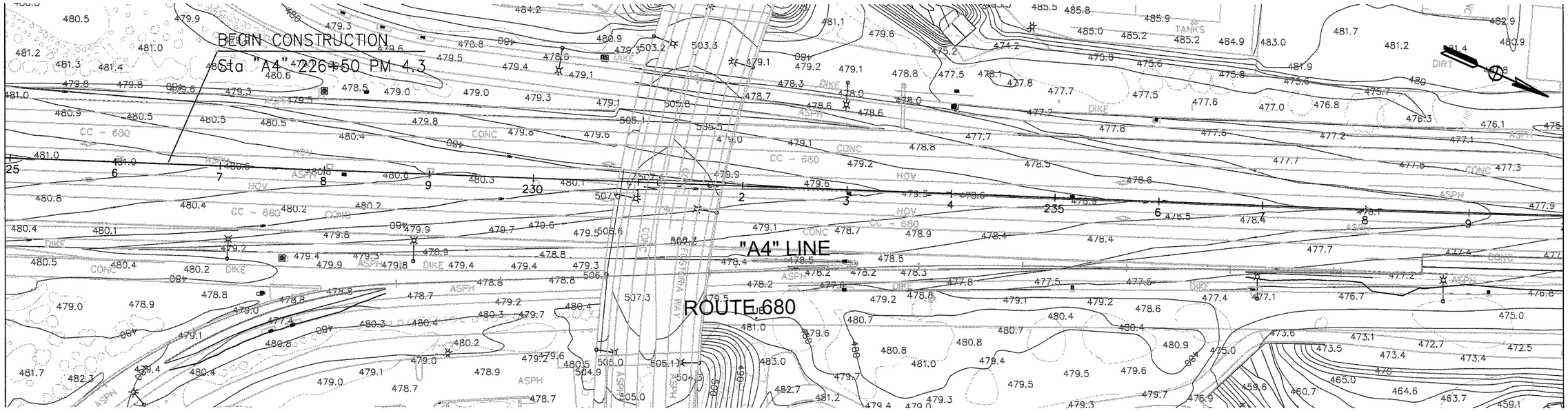


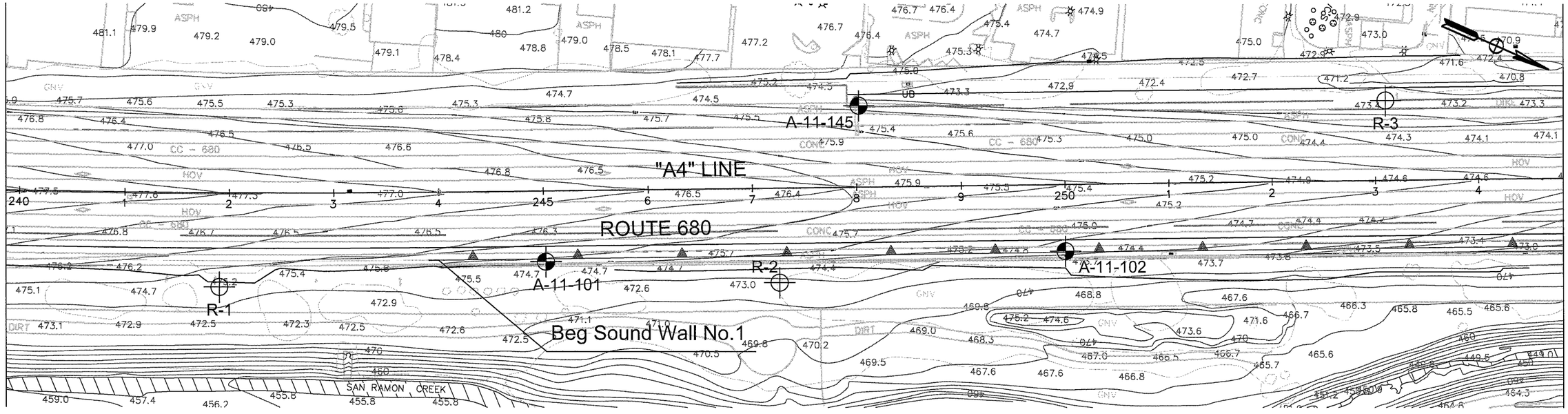
PROJECT LOCATION MAP

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

ROUTE 680 AUXILIARY LANE PROJECT - SEGMENT 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO.: 2011-124-GDR	**PLATE NO.: 1**





SITE PLAN

LEGEND

A-11-101
Approx. Boring Location

R-1
Approx. R-Value Boring Location

SCALE 1 inch = 100 feet

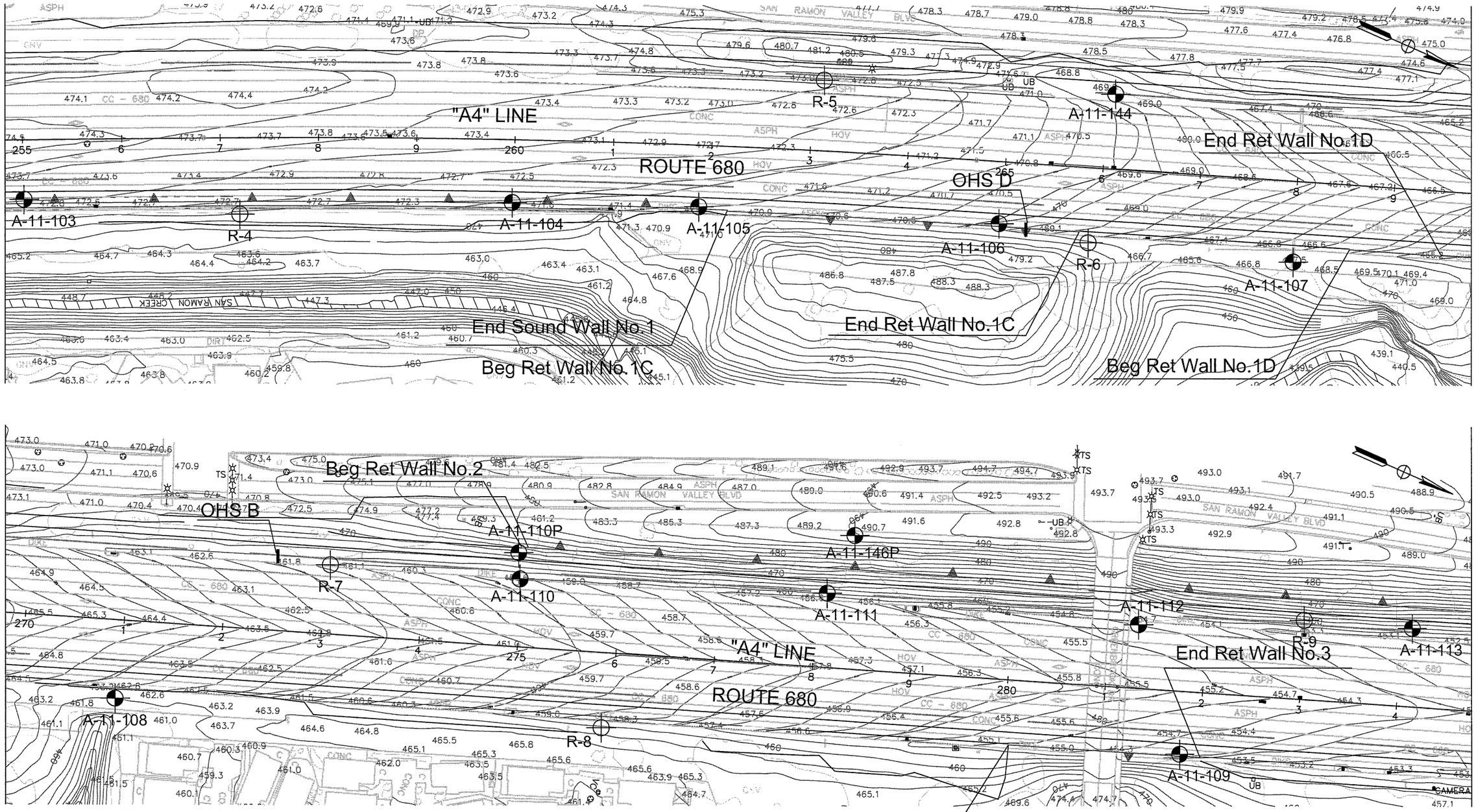
Note: All units are in feet unless otherwise specified
Reference Map was provided by Mark Thomas & Co, Inc.

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

ROUTE 680 AUXILIARY LANE PROJECT SEGMENT 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO.:2011-124-GDR

PLATE NO: 2A



SITE PLAN

LEGEND

A-11-101 — Approx. Boring Location

R-1 — Approx. R-Value Boring Location

SCALE 1 inch = 100 feet

Note: All units are in feet unless otherwise specified
Reference Map was provided by Mark Thomas & Co, Inc.

PARIKH CONSULTANTS, INC.
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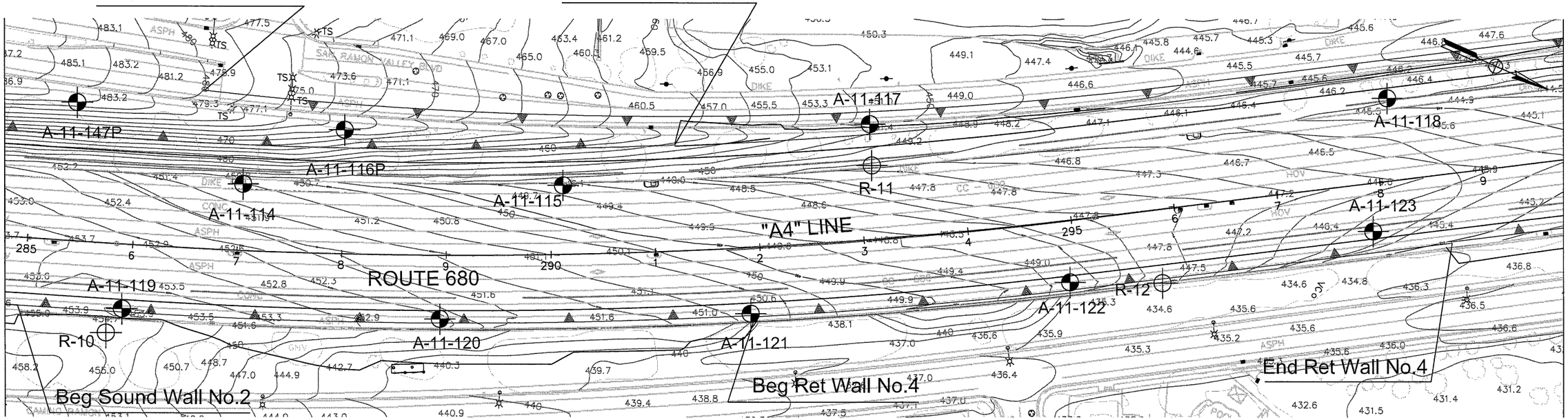
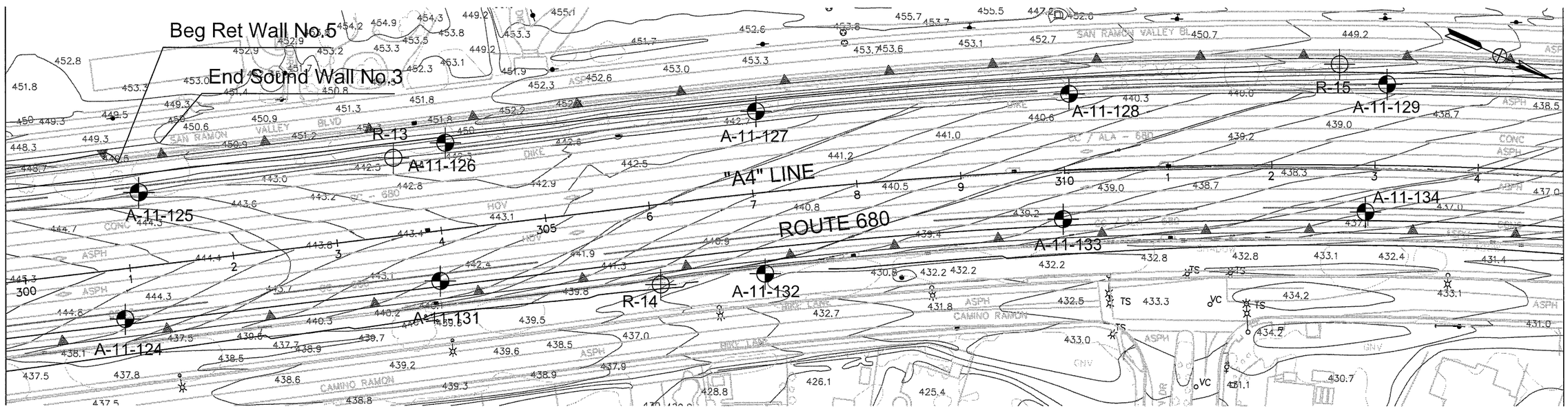
MATERIALS ENGINEERING

ROUTE 680 AUXILIARY LANE PROJECT SEGMENT 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO.:2011-124-GDR | PLATE NO: 2B





LEGEND

A-11-101 — Approx. Boring Location

R-1 — Approx. R-Value Boring Location

SCALE 1 inch = 100 feet

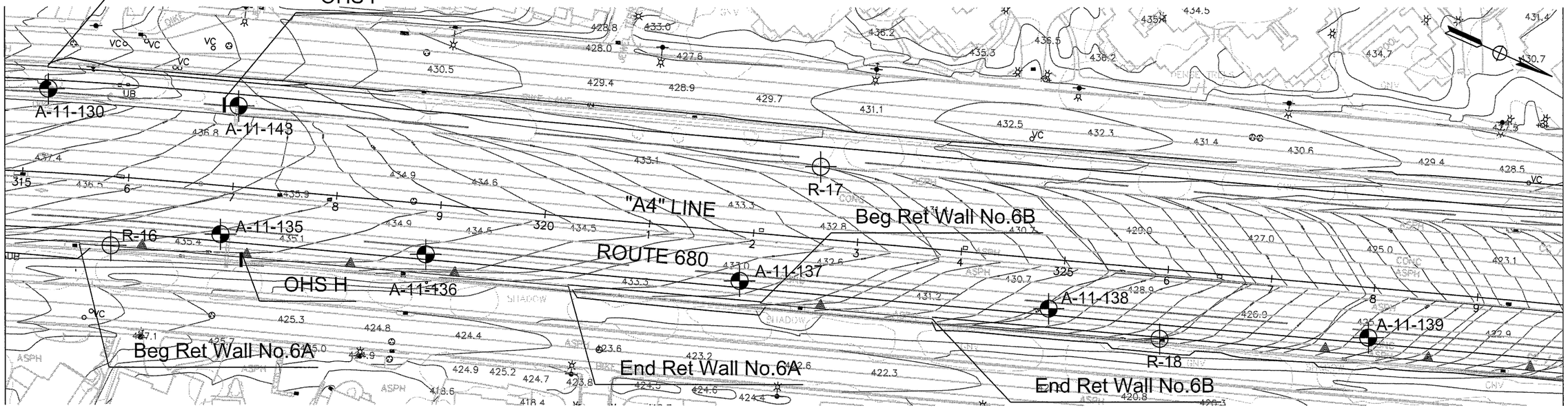
Note: All units are in feet unless otherwise specified
Reference Map was provided by Mark Thomas & Co, Inc.

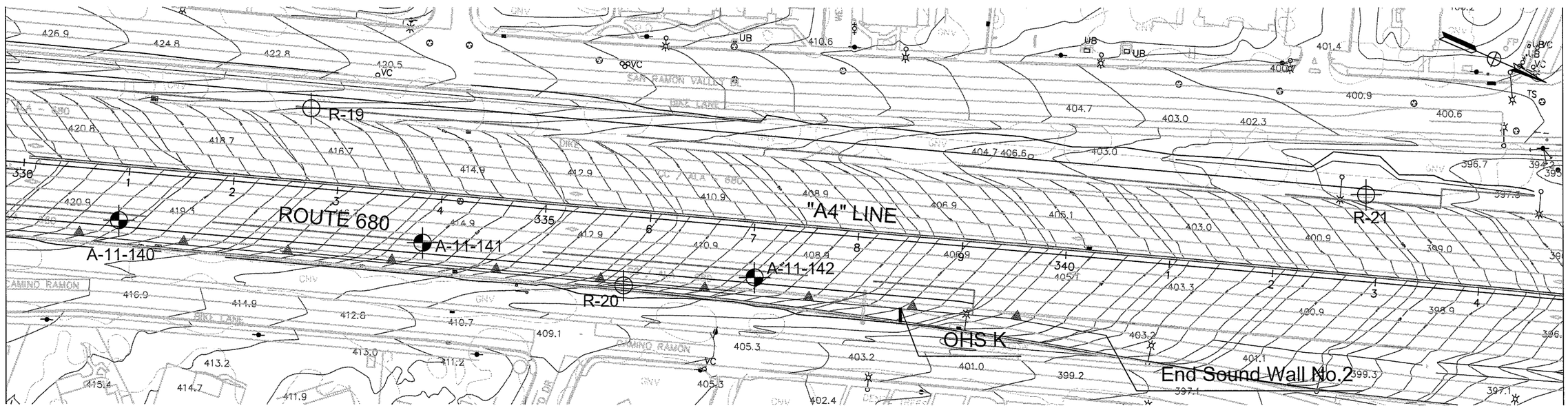
SITE PLAN

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

ROUTE 680 AUXILIARY LANE PROJECT SEGMENT 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO.:2011-124-GDR | PLATE NO: 2C





SITE PLAN

LEGEND

A-11-101
Approx. Boring Location

R-1
Approx. R-Value Boring Location

SCALE 1 inch = 100 feet

Note: All units are in feet unless otherwise specified
Reference Map was provided by Mark Thomas & Co, Inc.

PARIKH CONSULTANTS, INC.
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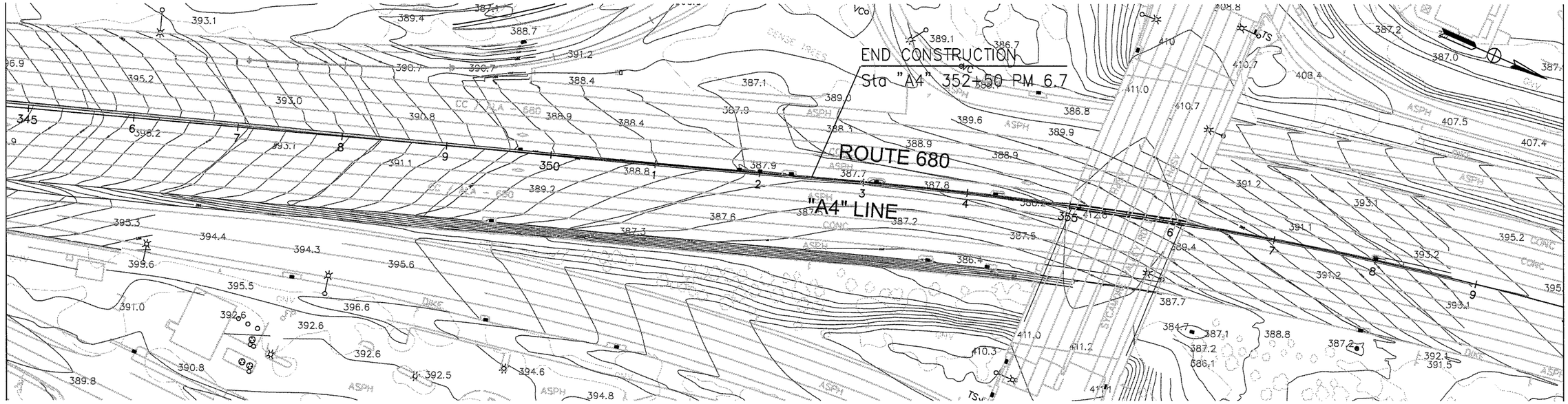
ROUTE 680 AUXILIARY LANE PROJECT SEGMENT 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO.:2011-124-GDR | PLATE NO: 2D

SEE PLATE 2D



SITE PLAN

LEGEND

A-11-101
Approx. Boring Location

R-1
Approx. R-Value Boring Location

SCALE 1 inch = 100 feet

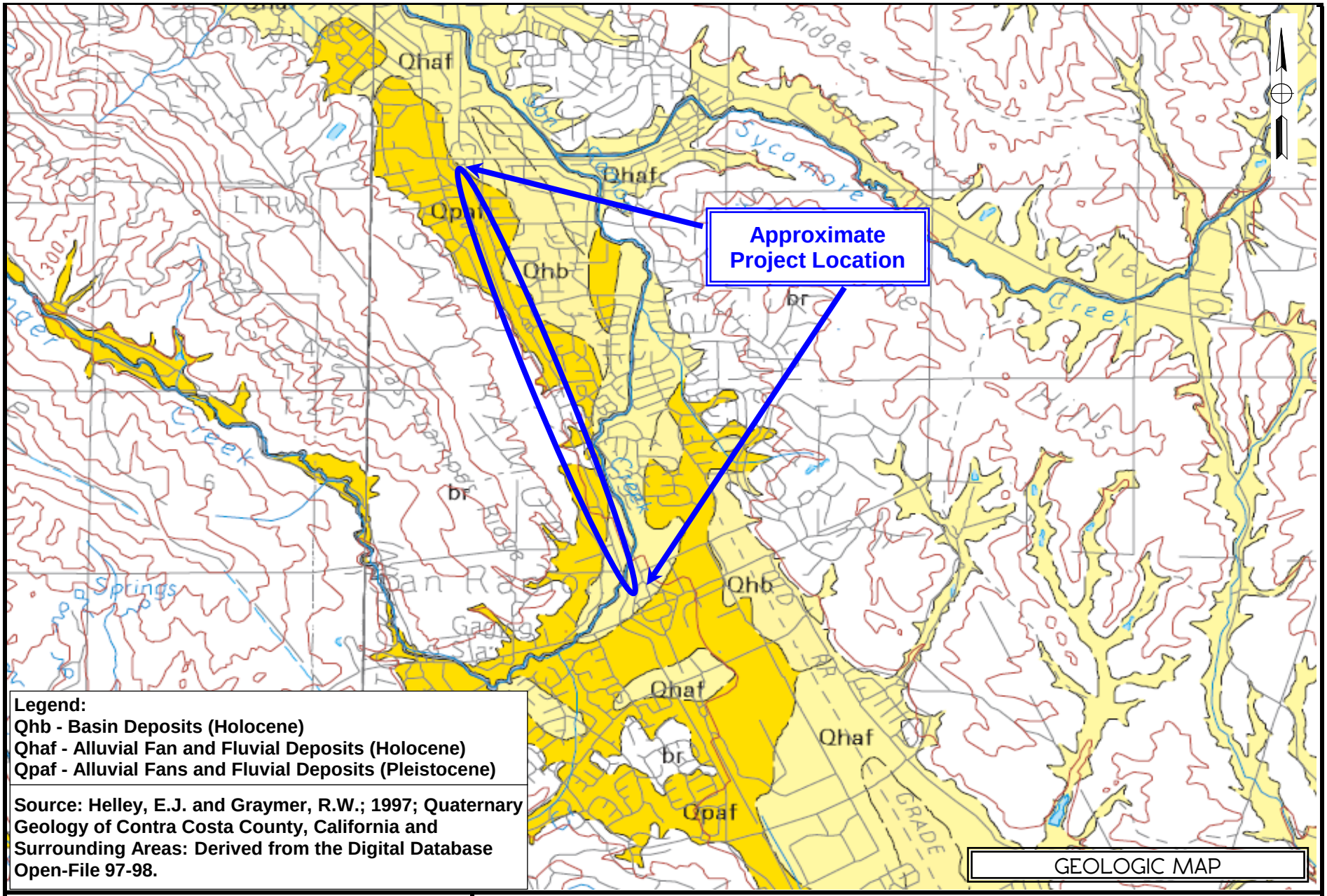
Note: All units are in feet unless otherwise specified
Reference Map was provided by Mark Thomas & Co, Inc.

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

ROUTE 680 AUXILIARY LANE PROJECT SEGMENT 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO.:2011-124-GDR

PLATE NO: 2E



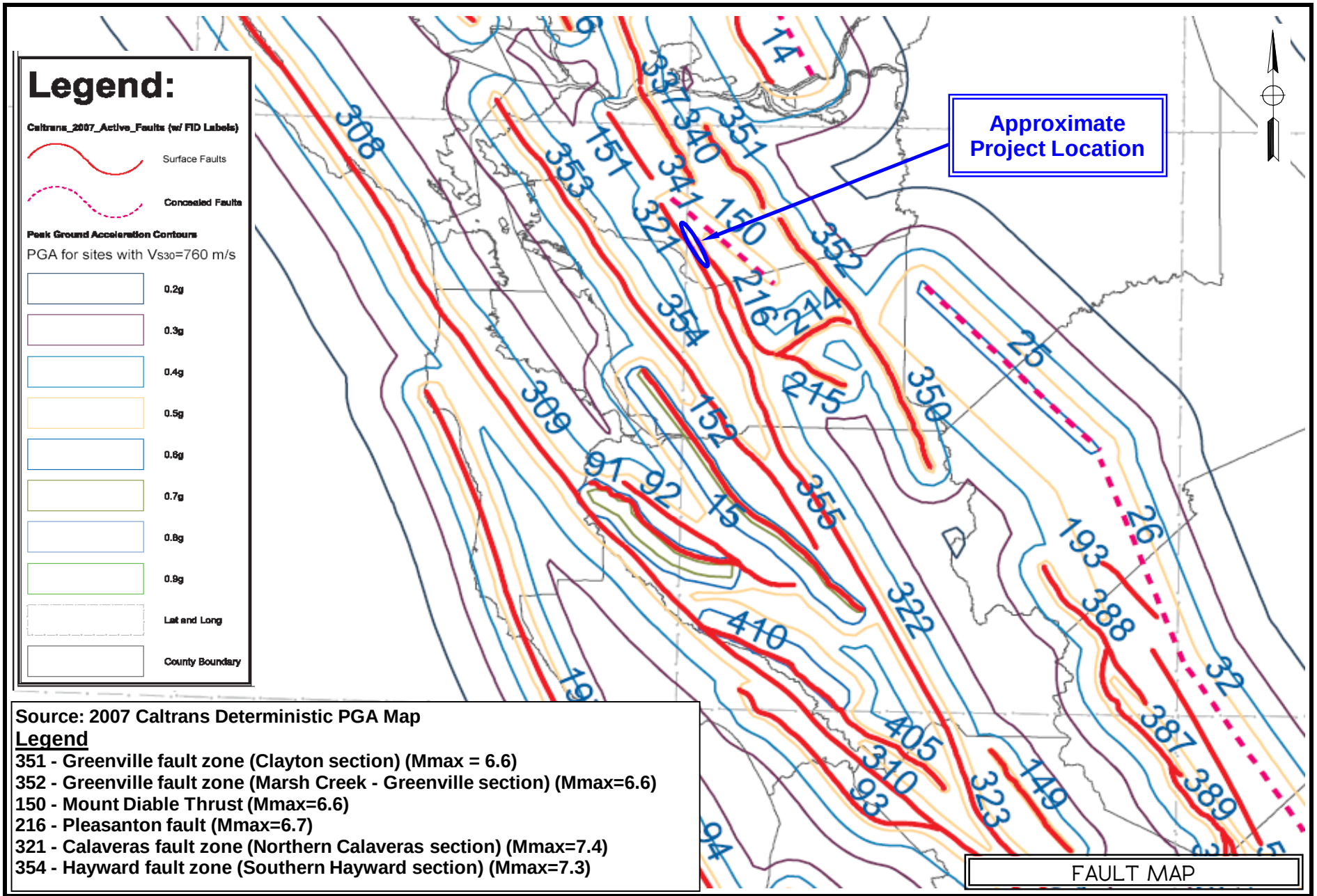
Legend:
Qhb - Basin Deposits (Holocene)
Qhaf - Alluvial Fan and Fluvial Deposits (Holocene)
Qpaf - Alluvial Fans and Fluvial Deposits (Pleistocene)

Source: Helley, E.J. and Graymer, R.W.; 1997; Quaternary Geology of Contra Costa County, California and Surrounding Areas: Derived from the Digital Database Open-File 97-98.

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

ROUTE 680 AUXILIARY LANE PROJECT - SEGMENT 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO.: 2011-124-GDR | **PLATE NO.: 3**



Source: 2007 Caltrans Deterministic PGA Map

Legend

351 - Greenville fault zone (Clayton section) (Mmax = 6.6)
352 - Greenville fault zone (Marsh Creek - Greenville section) (Mmax=6.6)
150 - Mount Diable Thrust (Mmax=6.6)
216 - Pleasanton fault (Mmax=6.7)
321 - Calaveras fault zone (Northern Calaveras section) (Mmax=7.4)
354 - Hayward fault zone (Southern Hayward section) (Mmax=7.3)

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MATERIALS TESTING

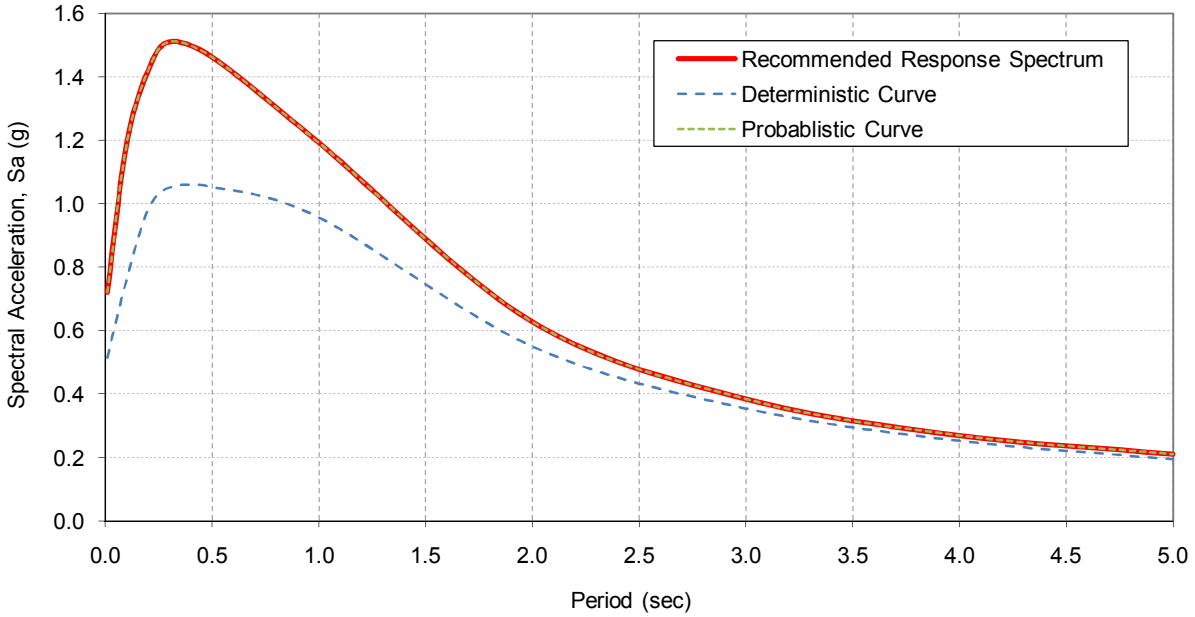
ROUTE 680 AUXILIARY LANE PROJECT - SEGMENT 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO.: 2011-124-GDR

PLATE NO.: 4

RECOMMENDED ARS CURVE

(Envelope of Deterministic & Probablistic Curves)



Site Information

Latitude:	37.7925
Longitude	-121.9829
V_{S30} (m/s) =	305
$Z_{1.0}$ (m) =	N/A
$Z_{2.5}$ (km) =	N/A
Near Fault Factor, Derived from USGS Deagg. Dist (km) =	2.8

Recommended Response Spectrum

Period (sec)	SA Base Spectrum (g)	Adjusted for Near Fault Effect	Adjusted For Basin Effect	Final Adjusted Spectral Acceleration (g)
0.0	0.721	1.000	1.000	0.721
0.1	1.187	1.000	1.000	1.187
0.2	1.419	1.000	1.000	1.419
0.3	1.511	1.000	1.000	1.511
0.5	1.463	1.000	1.000	1.463
1.0	0.994	1.200	1.000	1.193
2.0	0.523	1.200	1.000	0.628
3.0	0.320	1.200	1.000	0.384
4.0	0.224	1.200	1.000	0.269
5.0	0.175	1.200	1.000	0.210

Governing Curve:

Envelope of:

(1) Calaveras fault zone (Northern Calaveras section) (Fault ID: 321, Fault Type: RLSS)

(2) Caltrans ARS Online Probablistic Curve

Source:

1. Caltrans ARS Online tool (V.1.0.4, http://dap3.dot.ca.gov/shake_stable/)
2. USGS Deaggregation 2008 beta (http://eqint.cr.usgs.gov/deaggint/2008/index.php)
3. Caltrans Geotechnical Services Design Manual (Version 1.0)

Note:

Refer to "Probablistic Response Spectum Spreadsheet" (attached) for development of the recommended ARS curve.

PARIKH CONSULTANTS, INC.
GEOTECHNICAL ENGINEERING
MATERIALS TESTING

Rte. 680 Auxiliary Lane Project - Seg. 2

Project No.: 2011-124-GDR | **Plate No.: 5**

APPENDIX A

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 3/28/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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

CONTRA COSTA TRANSPORTATION AUTHORITY
2999 OAK ROAD, SUITE 100
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596

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.

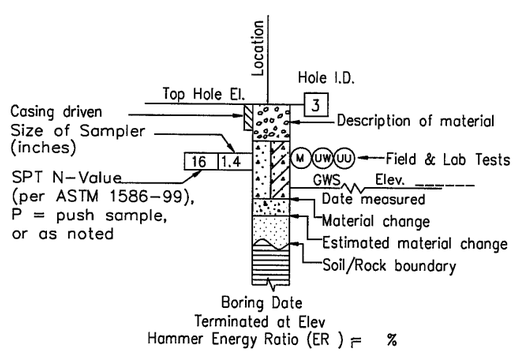
BOREHOLE IDENTIFICATION

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)

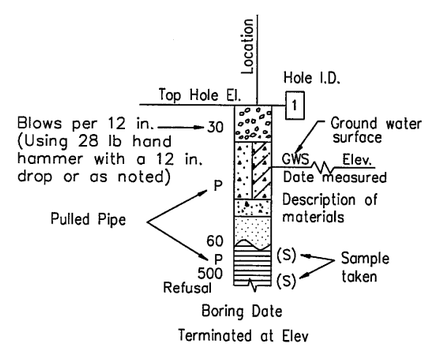
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

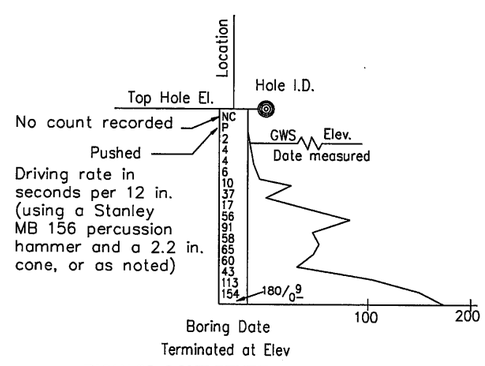
Description	Shear Strength (tsf)	Pocket Penetrometer Measurement, PP, (tsf)	Torvane Measurement, TV, (tsf)	Vane Shear Measurement, VS, (tsf)
Very Soft	Less than 0.12	Less than 0.25	Less than 0.12	Less than 0.12
Soft	0.12 – 0.25	0.25 – 0.5	0.12 – 0.25	0.12 – 0.25
Medium Stiff	0.25 – 0.5	0.5 – 1	0.25 –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



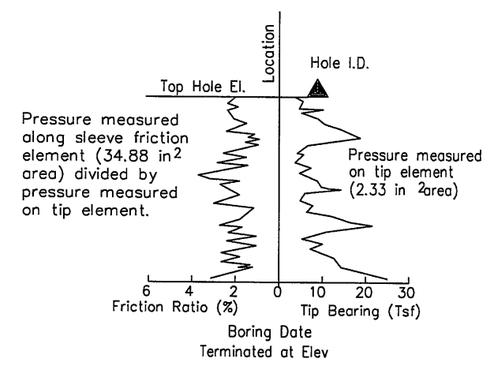
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) BORING

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI/AZJ	E. ORTAKCI, A. BAKANE, V. SANTOS FIELD INVESTIGATION BY:
SIGN OFF DATE	CHECKED BY	P. WEI	DATE: JUNE 2011 to NOVEMBER 2011

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

PETER WEI — PROJECT ENGINEER

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

BRIDGE NO.

POST MILES 4.3/6.7

ROUTE 680 AUXILIARY LANE PROJECT SEGMENT 2

SOIL LEGEND NO. 1

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 11/23/11 2/28/12 — SHEET — OF

CONTRACT NO.: PROJECT ID:

FILE => $REQUEST

Ajackson Mar 28, 2012 - 2:11pm S:\ACAD\2011-124-GDR\LOTB_GDR.dwg

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

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

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 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
- (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)
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 3/28/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 in.)
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	Visible 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 (in.)
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	1/300 - 1/64
Silt and Clay		Less than 1/300

DESIGN OVERSIGHT — SIGN OFF DATE

DRAWN BY: E. ORTAKCI/AZJ — CHECKED BY: P. WEI

E. ORTAKCI, A. BAKANE, V. SANTOS — FIELD INVESTIGATION BY: — DATE: JUNE 2011 to NOVEMBER 2011

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

PETER WEI — PROJECT ENGINEER

BRIDGE NO. — POST MILES 4.3/6.7

ROUTE 680 AUXILIARY LANE PROJECT SEGMENT 2

SOIL LEGEND NO. 2

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 11/23/11 2/28/12 — SHEET — OF

FILE => $REQUEST — CONTRACT NO.: — PROJECT ID:

Mar 28, 2012 - 2:11pm S:\MCAD\2011-124-GDR\LOTB_GDR.dwg — Apickson

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

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 3/28/12

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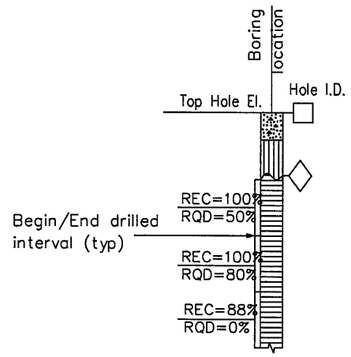
WALNUT CREKE, CA 94596

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

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

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

RQD* Indicates soundness criteria not met.



BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 10 ft
Very Thickly Bedded	3 ft – 10 ft
Thickly Bedded	1 ft – 3 ft
Moderately Bedded	4 in. – 1 ft
Thinly Bedded	1 in. – 4 in.
Very Thinly Bedded	1/4 in. – 1 in.
Laminated	Less than 1/4 in.

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 pocketknife or sharp pick with light or moderate pressure. Breaks with moderate hammer blows.
Moderately Soft	Can be grooved 1/16 in. deep with a pocketknife or 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 manual 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 in. to 1 ft.
Intensely Fractured	Core lengths mostly from 1 to 4 in.
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 discoloration 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."

DESIGN OVERSIGHT — DRAWN BY E. ORTAKCI/AZJ — E. ORTAKCI, A. BAKANE, V. SANTOS — FIELD INVESTIGATION BY:

SIGN OFF DATE — CHECKED BY P. WEI — DATE: JUNE 2011 to NOVEMBER 2011

CS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

PETER WEI — PROJECT ENGINEER

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

BRIDGE NO.

POST MILES 4.3/6.7

ROUTE 680 AUXILIARY LANE PROJECT SEGMENT 2

SOIL LEGEND NO. 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 11/23/11 2/28/12 — SHEET — OF

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FILE => $REQUEST

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 3/28/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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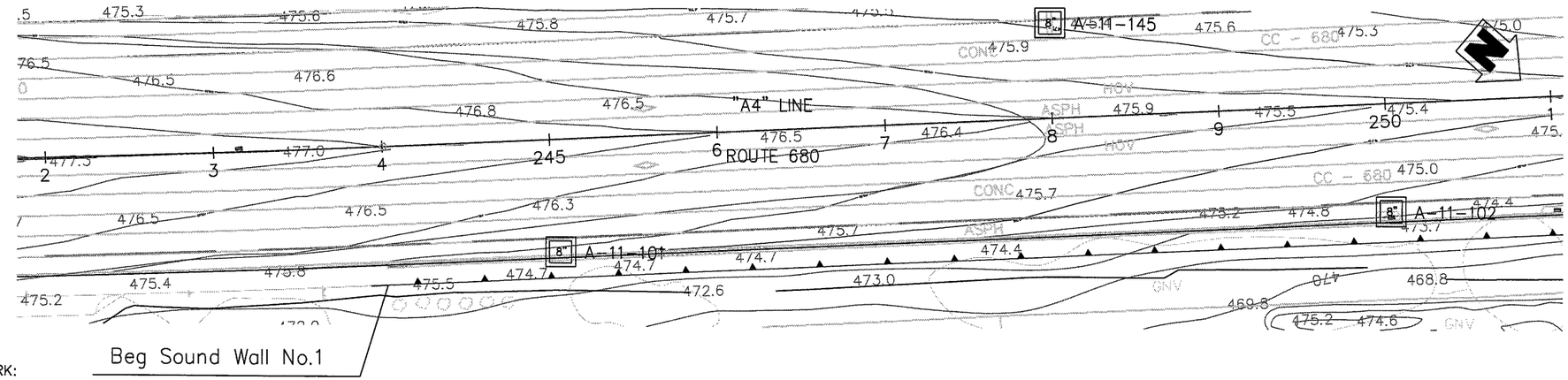
PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREEK, CA 94596



BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

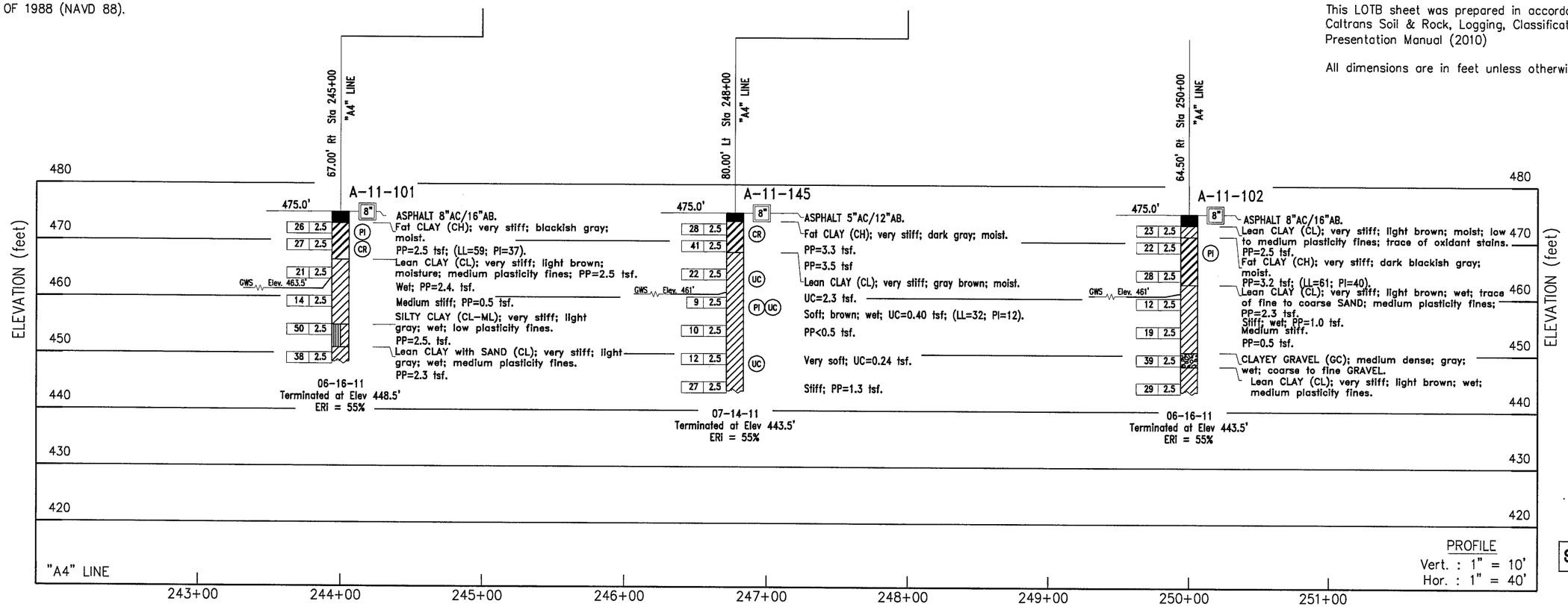
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

PLAN
1"=40'

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown



PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

SW NO. 1 (1)

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI/AZJ	E. ORTAKCI, A. BAKANE, V. SANTOS	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI PROJECT ENGINEER	BRIDGE NO. / SOUND WALL NO. 1
SIGN OFF DATE	CHECKED BY	P. WEI	FIELD INVESTIGATION BY: DATE: JUNE 2011 to NOVEMBER 2011			POST MILES / LOG OF TEST BORING NO. 1
GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)				ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3	UNIT: 0736 PROJECT NUMBER & PHASE: 04000210664	DISREGARD PRINTS BEARING EARLIER REVISION DATES 11/23/11 2/28/12 — REVISION DATES — SHEET — OF

FILE => $REQUEST — CONTRACT NO.: — PROJECT ID:

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

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DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 3/28/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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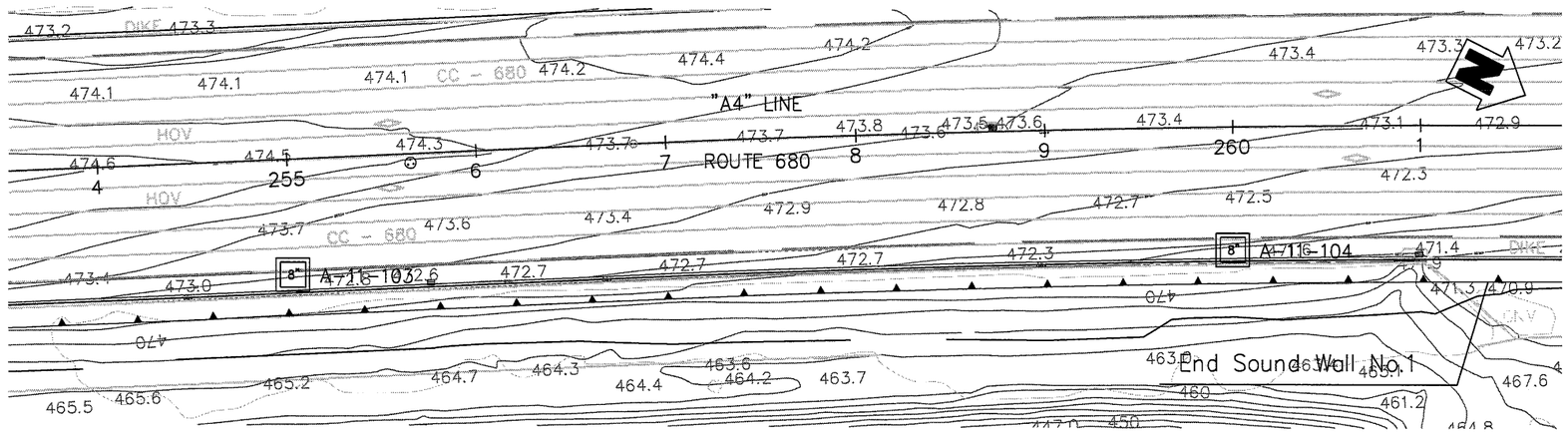


PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

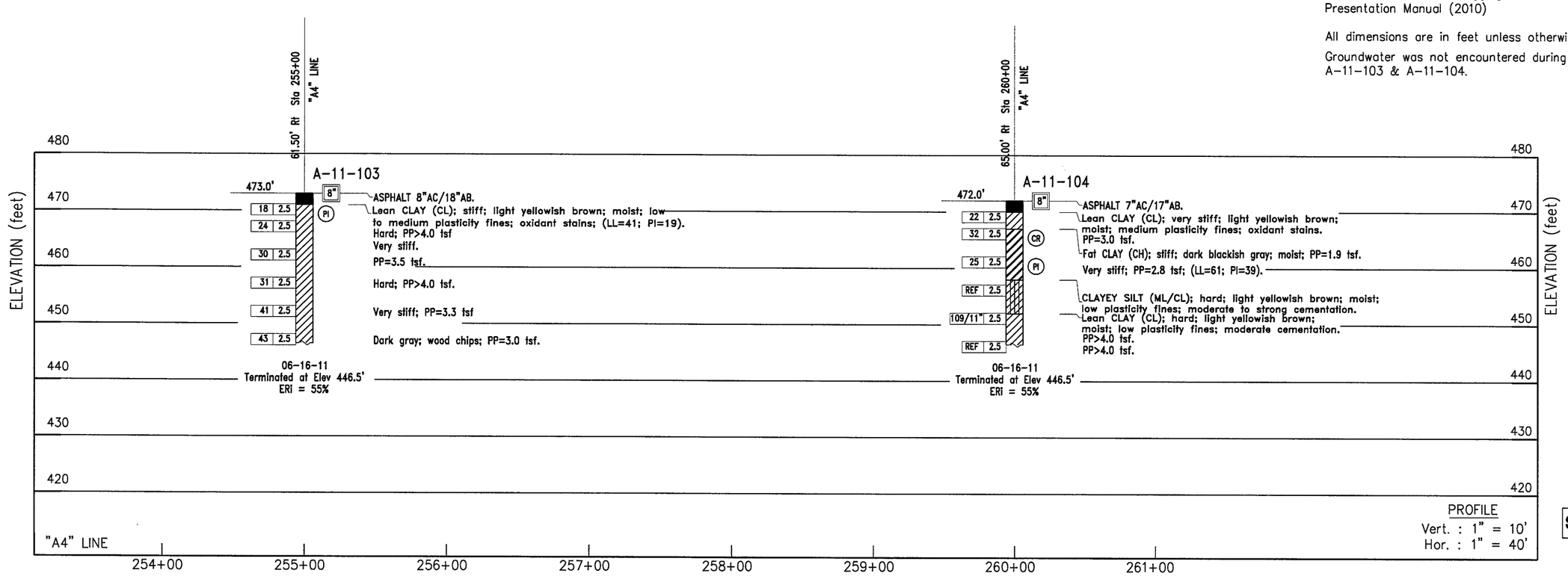
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Borings A-11-103 & A-11-104.



PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

SW NO. 1 (2)

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI/AZJ	E. ORTAKCI, A. BAKANE, V. SANTOS	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI PROJECT ENGINEER
SIGN OFF DATE	CHECKED BY	P. WEI	FIELD INVESTIGATION BY: DATE: JUNE 2011 to NOVEMBER 2011		

BRIDGE NO. — POST MILES

SOUND WALL NO. 1

LOG OF TEST BORINGS NO. 2

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES 11/23/11 2/28/12

REVISION DATES — SHEET — OF

CONTRACT NO.: — PROJECT ID:

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DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 3/28/12

PLANS APPROVAL DATE

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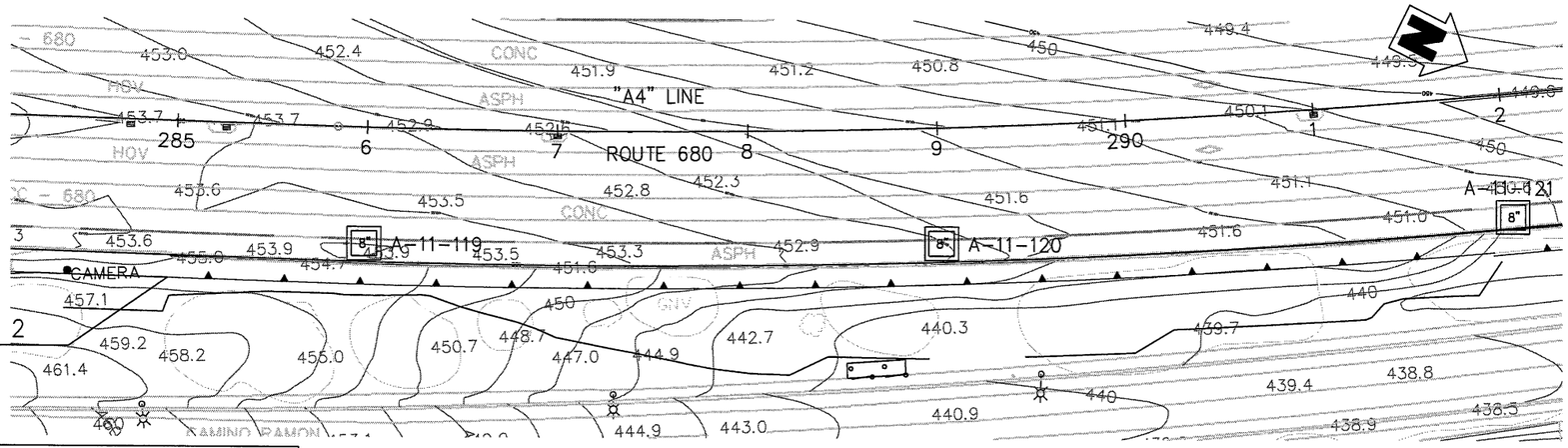

PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
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THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
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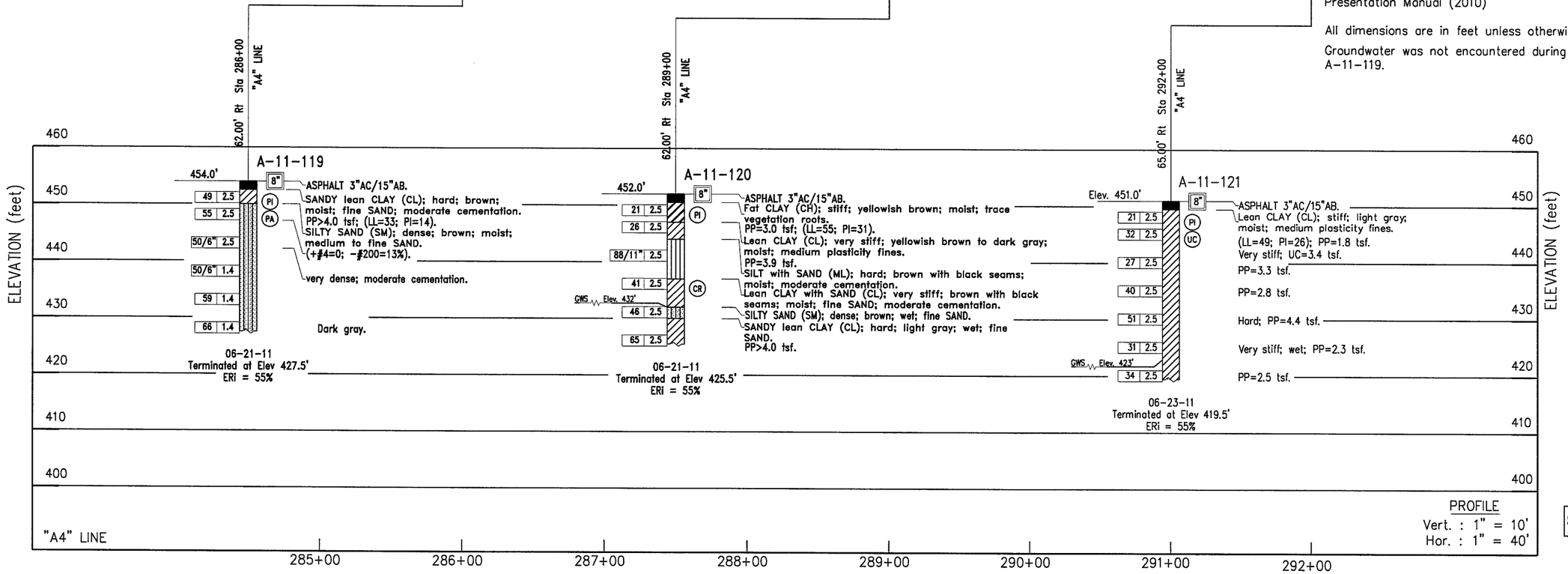
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Boring A-11-119.



PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

SW NO. 2 (1)

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI/AZJ	E. ORTAKCI, A. BAKANE, V. SANTOS	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI — PROJECT ENGINEER
SIGN OFF DATE	CHECKED BY	P. WEI	FIELD INVESTIGATION BY: DATE: JUNE 2011 to NOVEMBER 2011		BRIDGE NO. / POST MILES

SOUND WALL NO. 2

LOG OF TEST BORINGS NO. 1

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 11/23/11 2/28/12 — SHEET — OF

CONTRACT NO.: PROJECT ID:

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 3/28/12

PLANS APPROVAL DATE

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1243 ALPINE ROAD, SUITE 110
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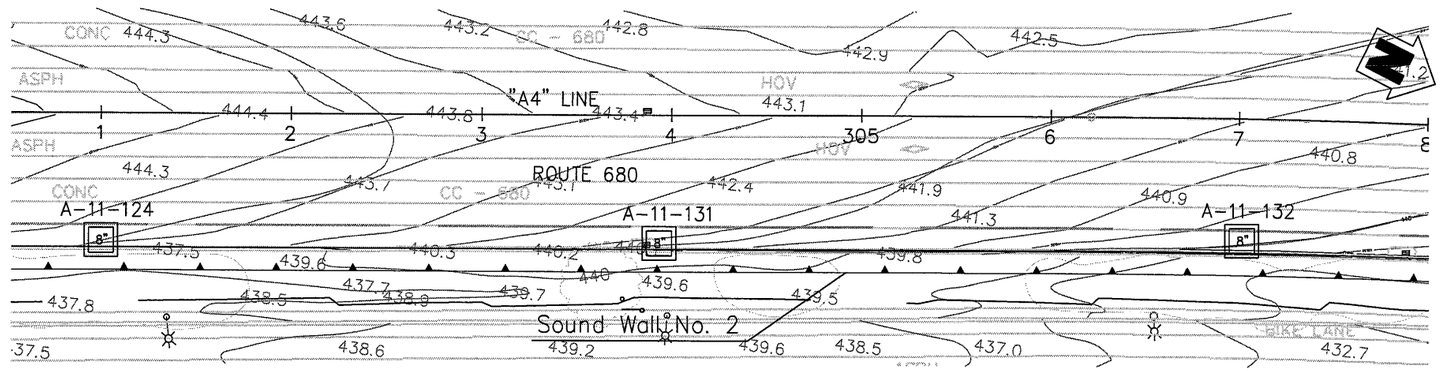

PLAN
1"=40'

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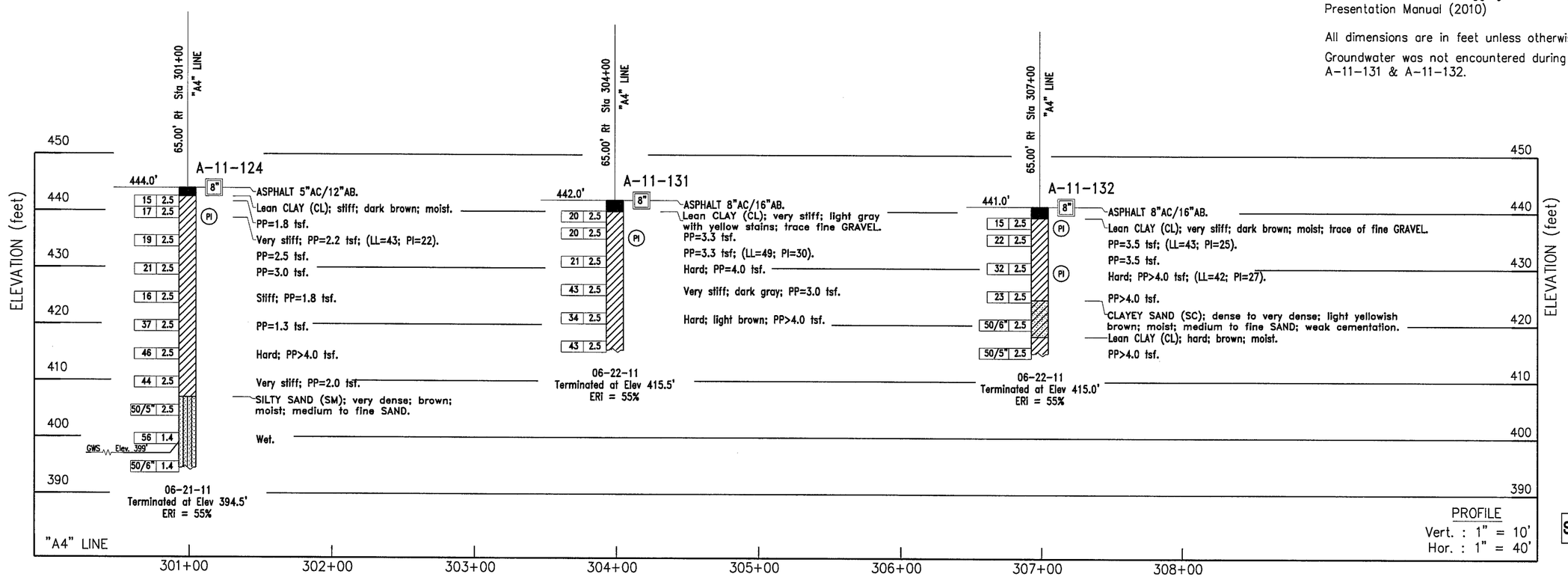
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Borings A-11-131 & A-11-132.



PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

SW NO. 2 (2)

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI/AZJ	E. ORTAKCI, A. BAKANE, V. SANTOS — FIELD INVESTIGATION BY:
SIGN OFF DATE	CHECKED BY	P. WEI	DATE: JUNE 2011 to NOVEMBER 2011

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

PETER WEI — PROJECT ENGINEER

BRIDGE NO. — POST MILES

SOUND WALL NO. 2

LOG OF TEST BORINGS NO. 2

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 11/23/11 12/28/12 — SHEET — OF

CONTRACT NO.: — PROJECT ID:

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 3/28/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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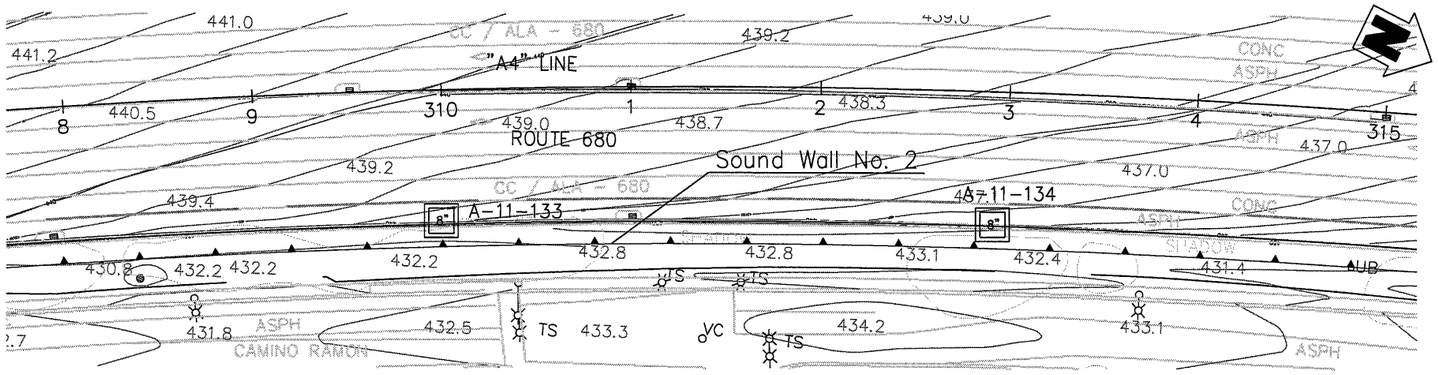
CONTRA COSTA TRANSPORTATION AUTHORITY
2999 OAK ROAD, SUITE 100
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596



BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

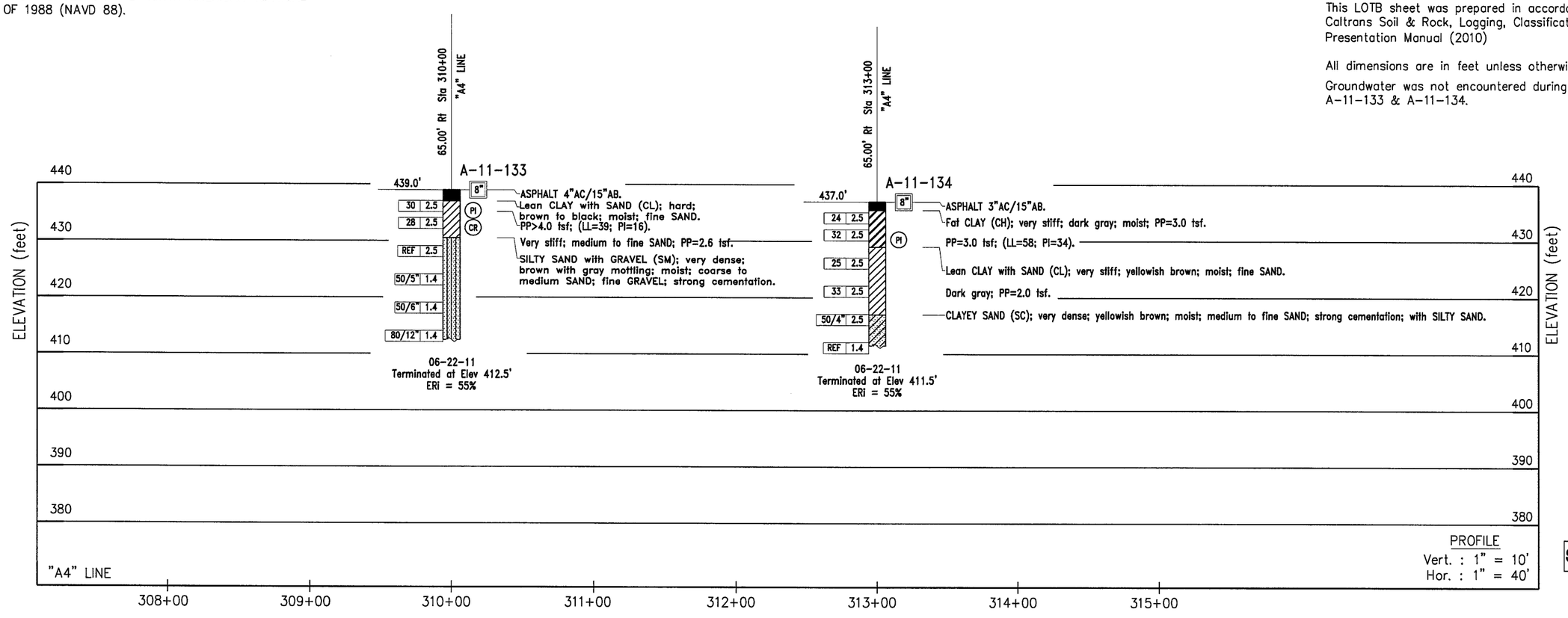
PLAN
1"=40'

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Borings A-11-133 & A-11-134.



PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

SW NO. 2 (3)

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI/AZJ	E. ORTAKCI, A. BAKANE, V. SANTOS	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI	BRIDGE NO.	SOUND WALL NO. 2
SIGN OFF DATE	CHECKED BY	P. WEI	FIELD INVESTIGATION BY: DATE: JUNE 2011 to NOVEMBER 2011		PROJECT ENGINEER	POST MILES	LOG OF TEST BORINGS NO. 3

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 11/25/11 2/28/12

REVISION DATES — SHEET — OF

FILE => $REQUEST

CONTRACT NO.: PROJECT ID:

Ajackson Mar 28, 2012 - 2:19pm S:\CAD\2011-124-GDR\LOTB_GDR.dwg

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 3/28/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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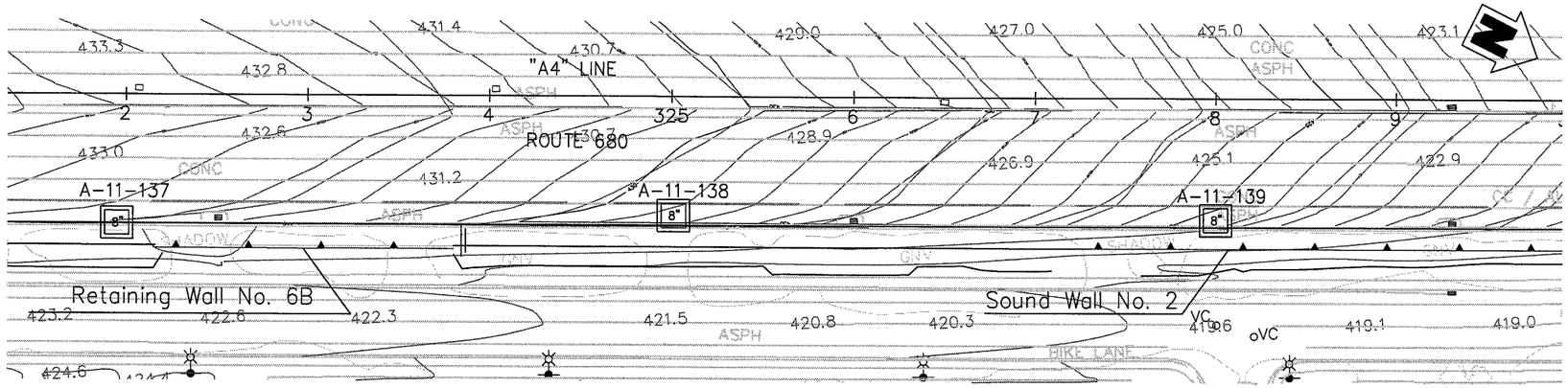
CONTRA COSTA TRANSPORTATION AUTHORITY
2999 OAK ROAD, SUITE 100
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596



PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

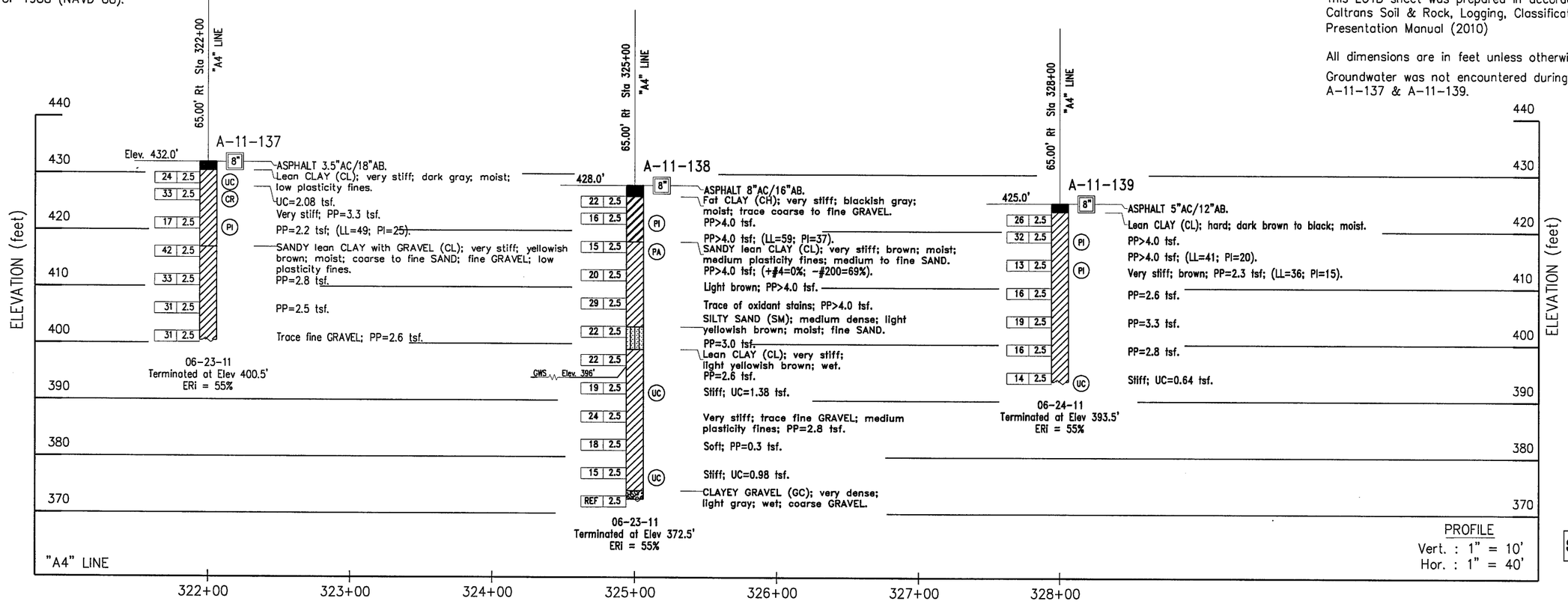
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Borings A-11-137 & A-11-139.



PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

SW NO. 2 (4)

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI/AZJ	E. ORTAKCI, A. BAKANE, V. SANTOS	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI	BRIDGE NO.	SOUND WALL NO. 2
SIGN OFF DATE	CHECKED BY	P. WEI	FIELD INVESTIGATION BY: DATE: JUNE 2011 to NOVEMBER 2011		PROJECT ENGINEER	POST MILES	LOG OF TEST BORINGS NO. 4

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 11/23/11 2/28/12

REVISION DATES | SHEET | OF

FILE => $REQUEST

CONTRACT NO.: PROJECT ID:

Mar 28, 2012 - 2:20pm S:\ACAD\2011-124-GDR\LOTB_GDR.dwg Ajackson

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 3/28/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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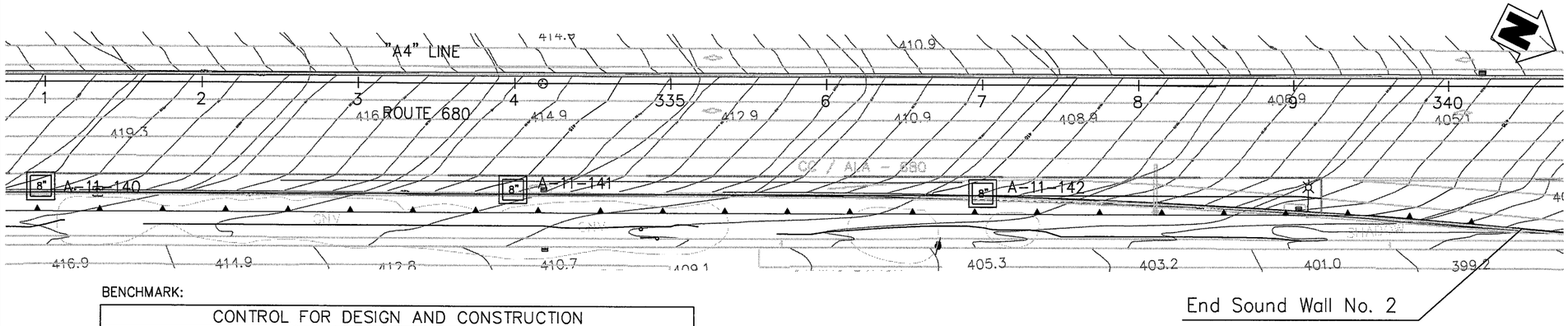
CONTRA COSTA TRANSPORTATION AUTHORITY
2999 OAK ROAD, SUITE 100
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREEK, CA 94596



BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

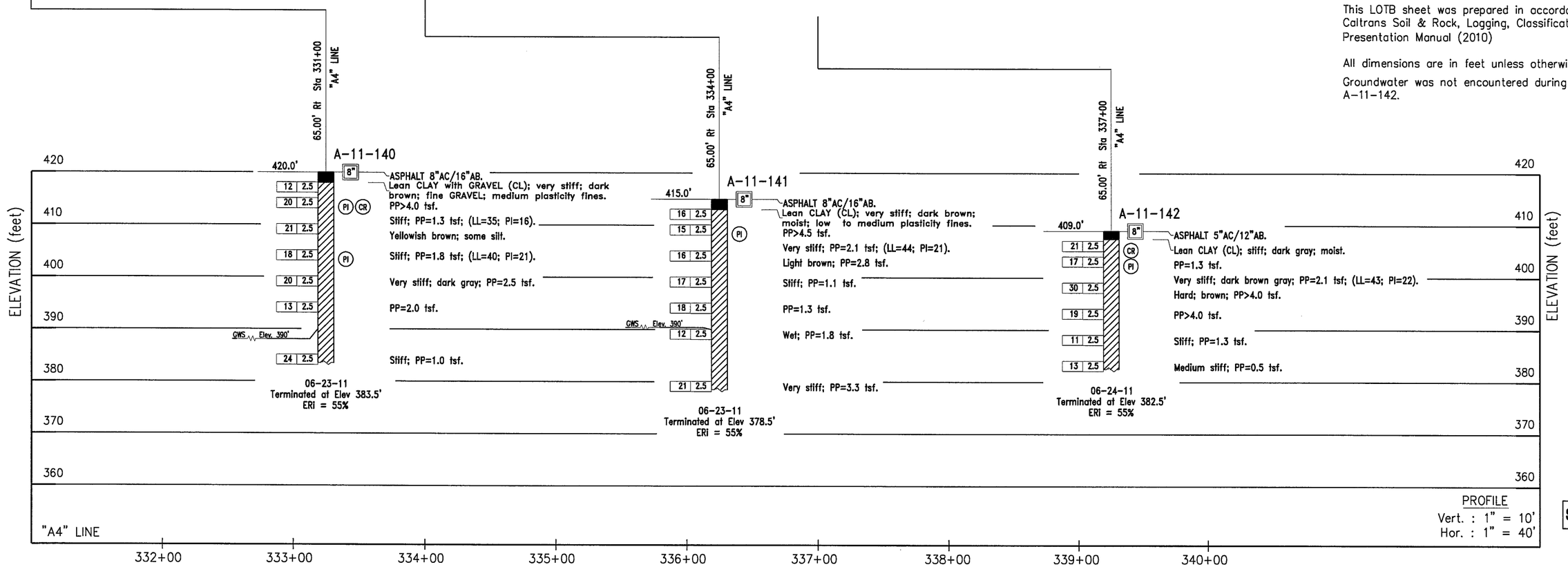
PLAN
1"=40'

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Boring A-11-142.



PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

SW NO. 2 (5)

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI/AZJ	E. ORTAKCI, A. BAKANE, V. SANTOS — FIELD INVESTIGATION BY:
SIGN OFF DATE	CHECKED BY	P. WEI	DATE: JUNE 2011 to NOVEMBER 2011

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

PETER WEI — PROJECT ENGINEER

BRIDGE NO. — POST MILES

SOUND WALL NO. 2

LOG OF TEST BORINGS NO. 5

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 11/23/11 2/28/12 — SHEET — OF

FILE => $REQUEST

CONTRACT NO.: PROJECT ID:

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 3/28/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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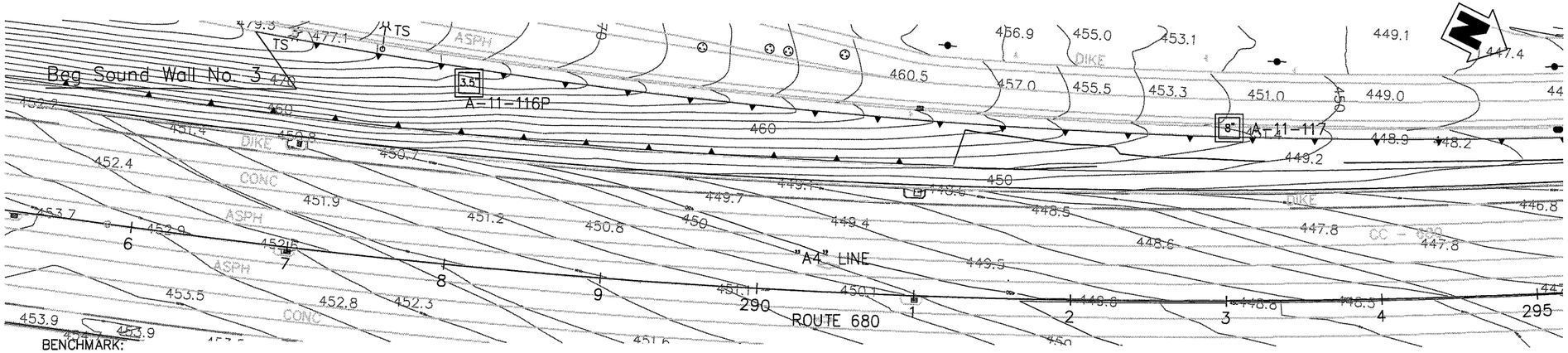
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596



BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

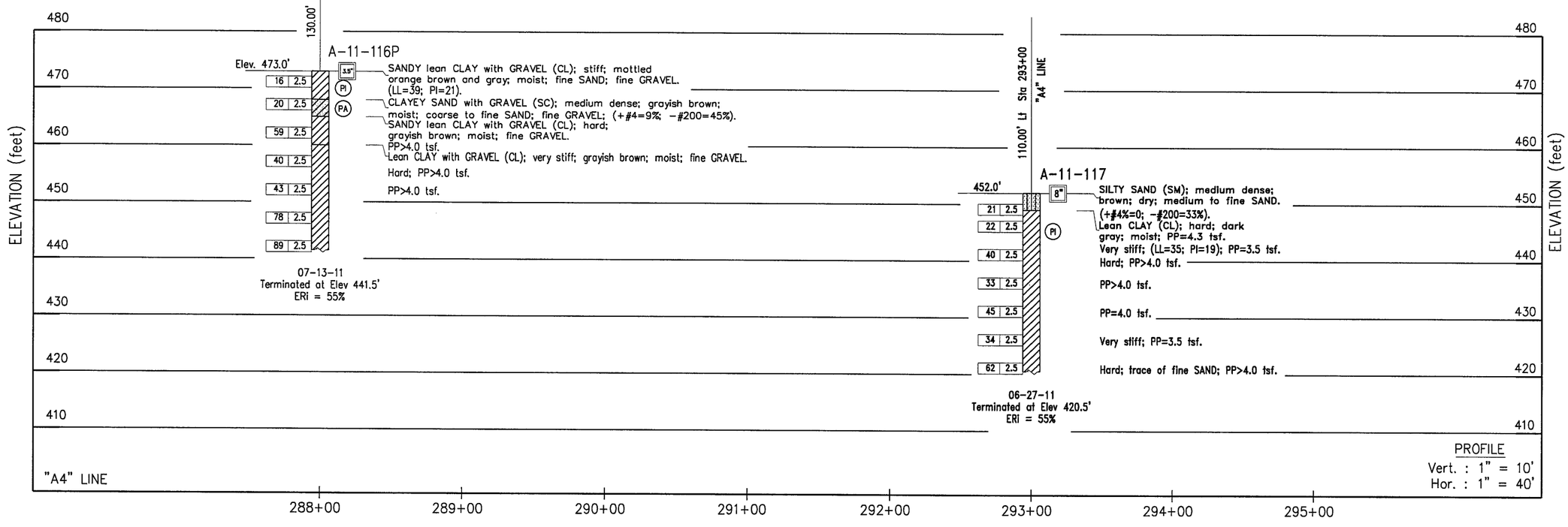
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

PLAN
1"=40'

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)
All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Borings A-11-116P & A-11-117.



PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

SW NO. 3 (1)

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI/AZJ	E. ORTAKCI, A. BAKANE, V. SANTOS	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI PROJECT ENGINEER
SIGN OFF DATE	CHECKED BY	P. WEI	FIELD INVESTIGATION BY: DATE: JUNE 2011 to NOVEMBER 2011		

BRIDGE NO. — POST MILES

SOUND WALL NO. 3

LOG OF TEST BORINGS NO. 1

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 11/23/11 2/28/12

REVISION DATES — SHEET — OF

CONTRACT NO.: — PROJECT ID:

FILE => $REQUEST

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

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DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 3/28/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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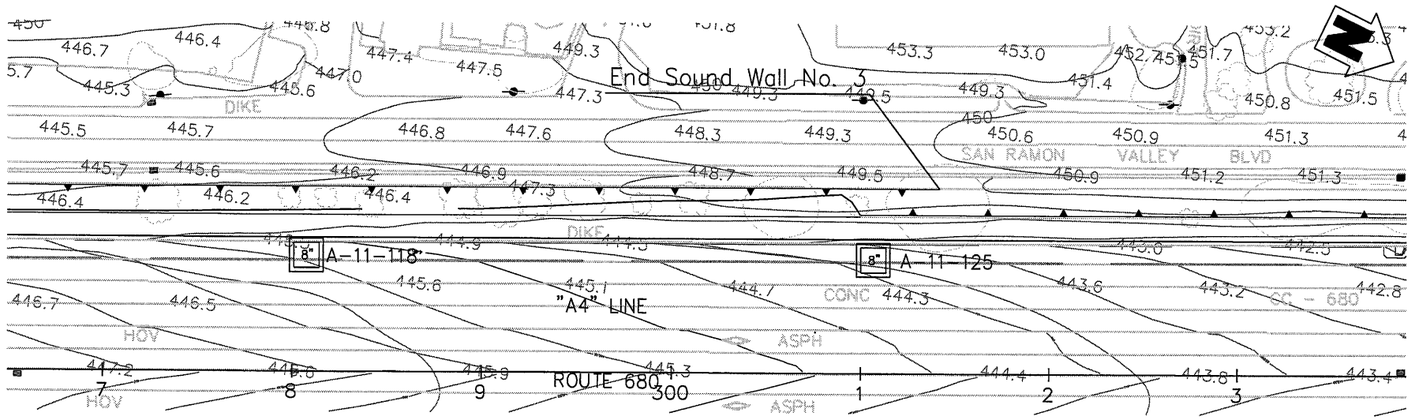
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREEK, CA 94596



PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

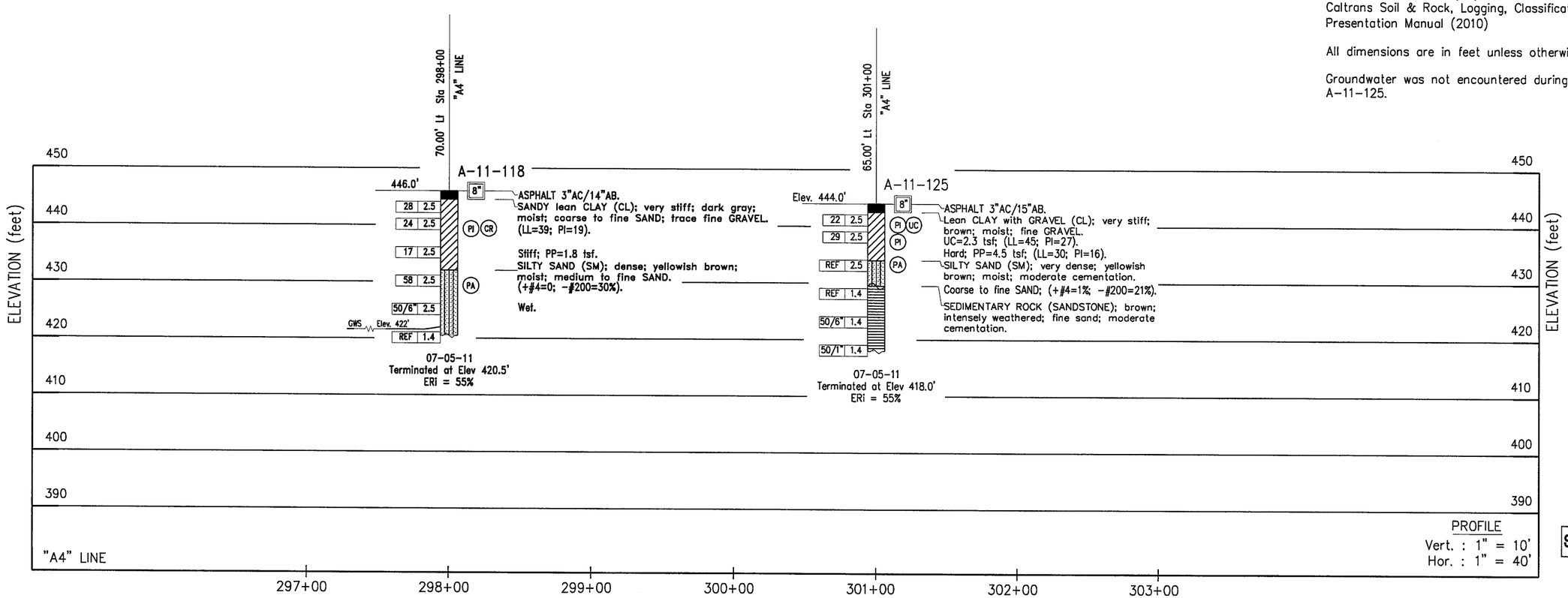
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Boring A-11-125.



PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

SW NO. 3 (2)

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI/AZJ	E. ORTAKCI, A. BAKANE, V. SANTOS	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI	BRIDGE NO.	SOUND WALL NO. 3
SIGN OFF DATE	CHECKED BY	P. WEI	FIELD INVESTIGATION BY: DATE: JUNE 2011 to NOVEMBER 2011		PROJECT ENGINEER	POST MILES	LOG OF TEST BORINGS NO. 2

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 11/23/11 2/28/12 — SHEET — OF

FILE => $REQUEST

CONTRACT NO.: PROJECT ID:

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 3/28/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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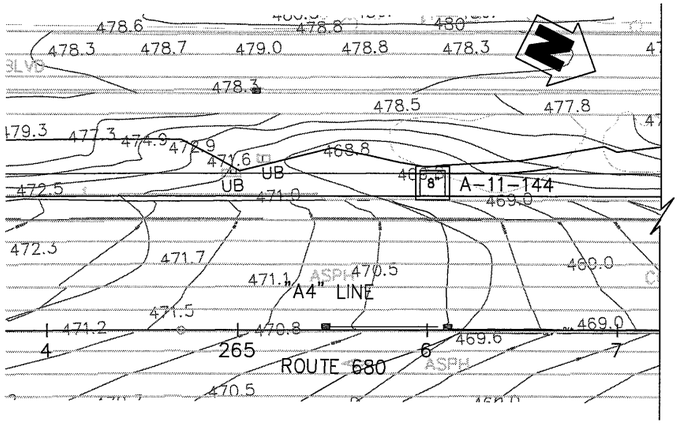
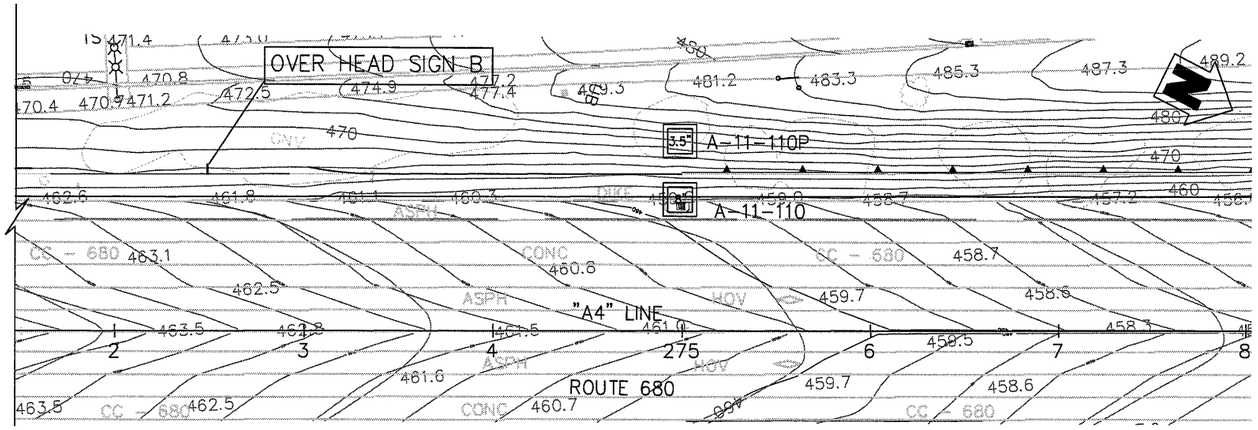
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREEK, CA 94596





PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

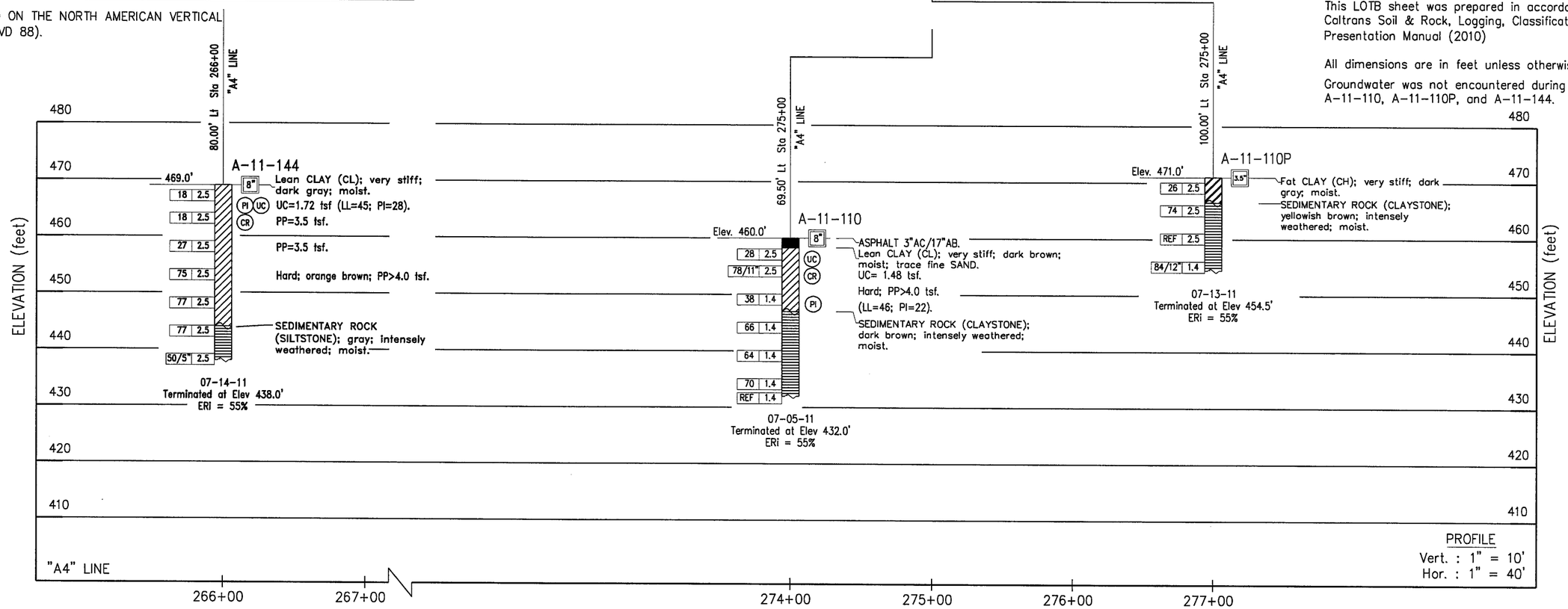
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Borings A-11-110, A-11-110P, and A-11-144.



PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

OHS B

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI/AZJ	E. ORTAKCI, A. BAKANE, V. SANTOS	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI	BRIDGE NO.	OVERHEAD SIGN B
SIGN OFF DATE	CHECKED BY	P. WEI	FIELD INVESTIGATION BY: DATE: JUNE 2011 to NOVEMBER 2011		PROJECT ENGINEER	POST MILES	LOG OF TEST BORINGS

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 11/25/11 2/28/12

REVISION DATES | SHEET | OF

FILE => $REQUEST

CONTRACT NO.: PROJECT ID:

Mar 28, 2012 - 2:23pm S:\ACAD\2011-124-GDR\LOTB_GDR.dwg Ajackson

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 3/28/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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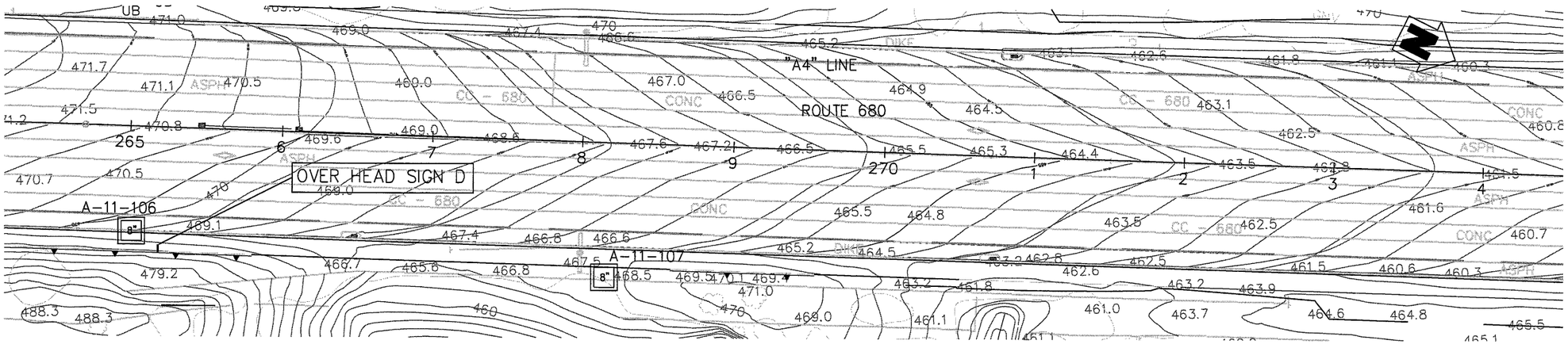
CONTRA COSTA TRANSPORTATION AUTHORITY
2999 OAK ROAD, SUITE 100
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREEK, CA 94596



PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

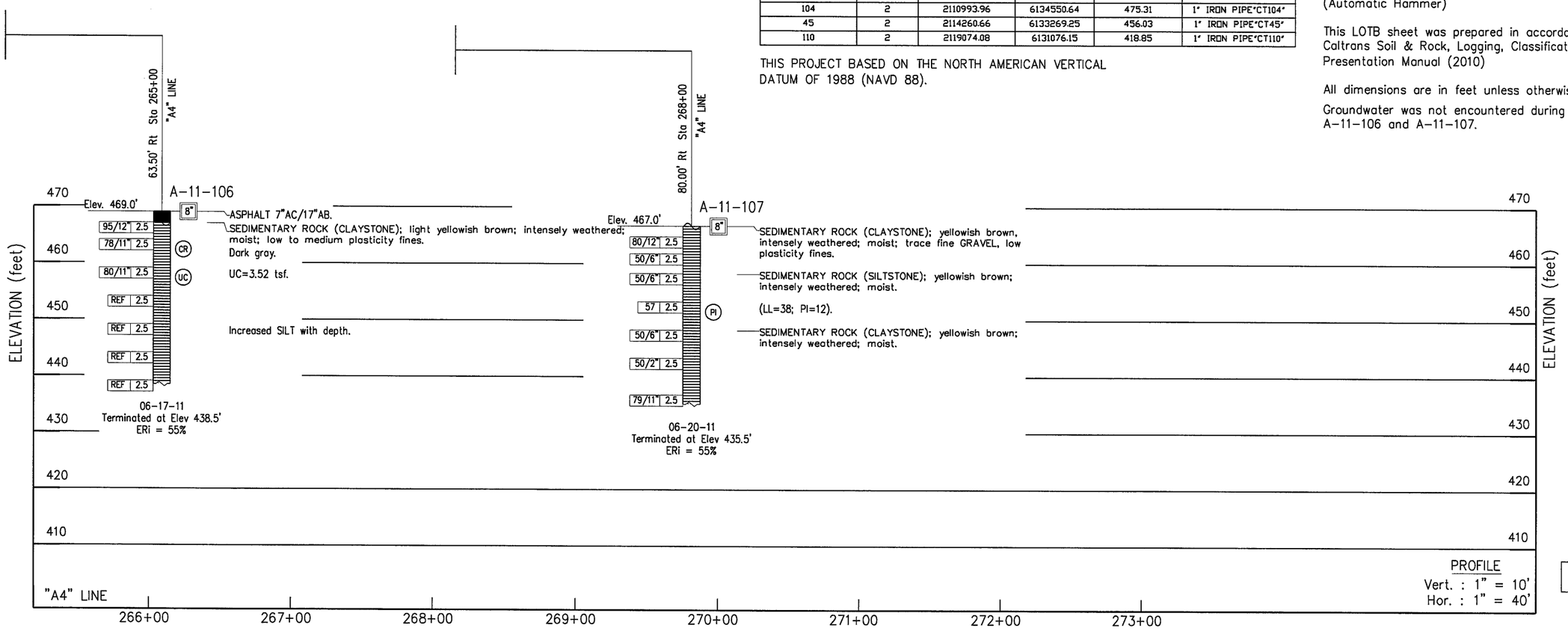
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Boring A-11-106 and A-11-107.



PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

OHS D

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI/AZJ	E. ORTAKCI, A. BAKANE, V. SANTOS FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI PROJECT ENGINEER	BRIDGE NO.	OVERHEAD SIGN D
SIGN OFF DATE	CHECKED BY	P. WEI	DATE: JUNE 2011 to NOVEMBER 2011			POST MILES	LOG OF TEST BORINGS
GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)				ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3	UNIT: 0736 PROJECT NUMBER & PHASE: 04000210664	DISREGARD PRINTS BEARING EARLIER REVISION DATES	REVISION DATES 11/23/11 2/28/12 — SHEET — OF

FILE => $REQUEST — CONTRACT NO.: — PROJECT ID:

Mar 28, 2012 - 2:18pm S:\ACAD\2011-124-GDR\LOTB_GDR.dwg — Ajackson — USERNAME => $USER — DATE PLOTTED => $DATE — TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 3/28/12

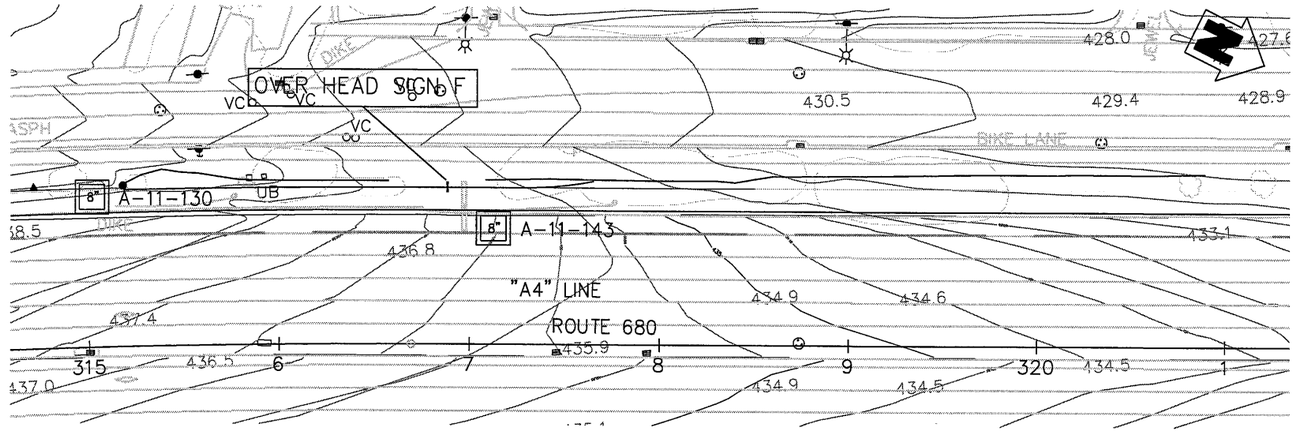
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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

CONTRA COSTA TRANSPORTATION AUTHORITY
2999 OAK ROAD, SUITE 100
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596



PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

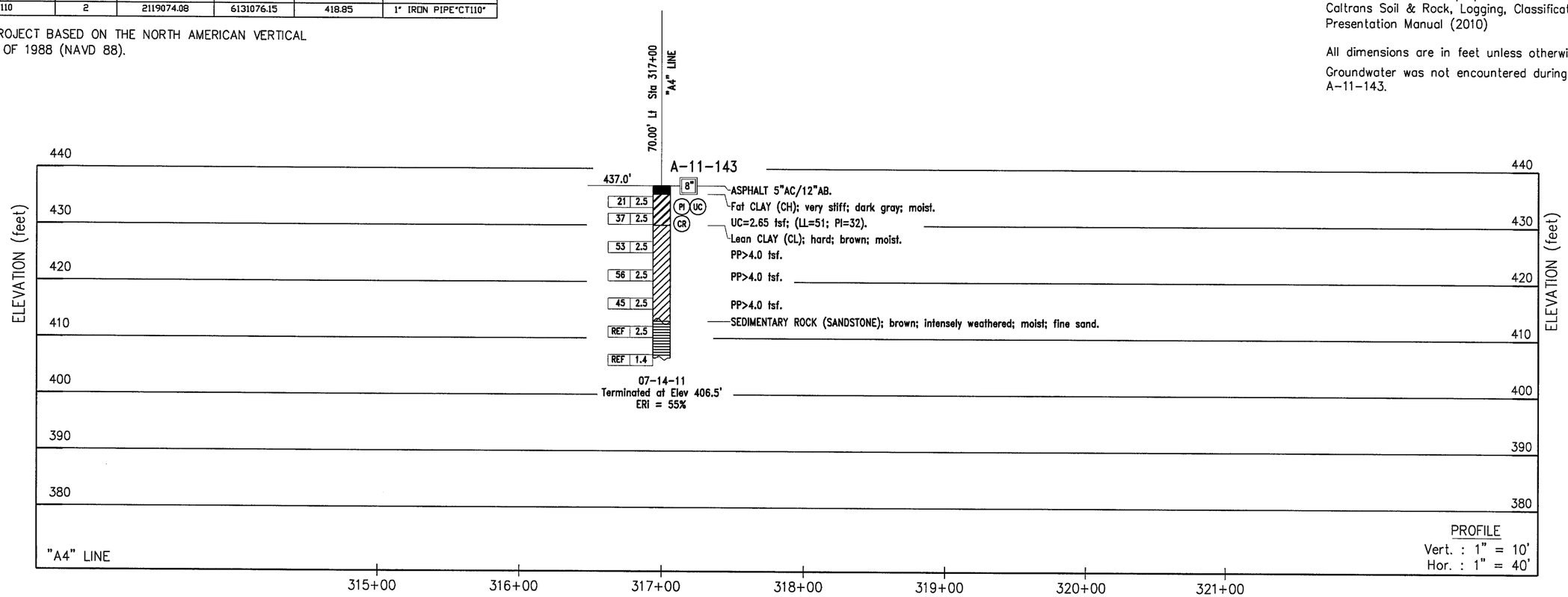
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Boring A-11-143.



PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

OHS F

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI/AZJ	E. ORTAKCI, A. BAKANE, V. SANTOS FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI PROJECT ENGINEER	BRIDGE NO.	OVERHEAD SIGN F
SIGN OFF DATE	CHECKED BY	P. WEI	DATE: JUNE 2011 to NOVEMBER 2011			POST MILES	LOG OF TEST BORINGS
GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)			ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3		UNIT: 0736 PROJECT NUMBER & PHASE: 04000210664	DISREGARD PRINTS BEARING EARLIER REVISION DATES	REVISION DATES 11/23/11 2/28/12 — SHEET — OF
					FILE => $REQUEST	CONTRACT NO.:	PROJECT ID:

Mar 28, 2012 - 2:24pm S:\MCAD\2011-124-GDR\LOTB_GDR.dwg Ajackson

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 3/28/12

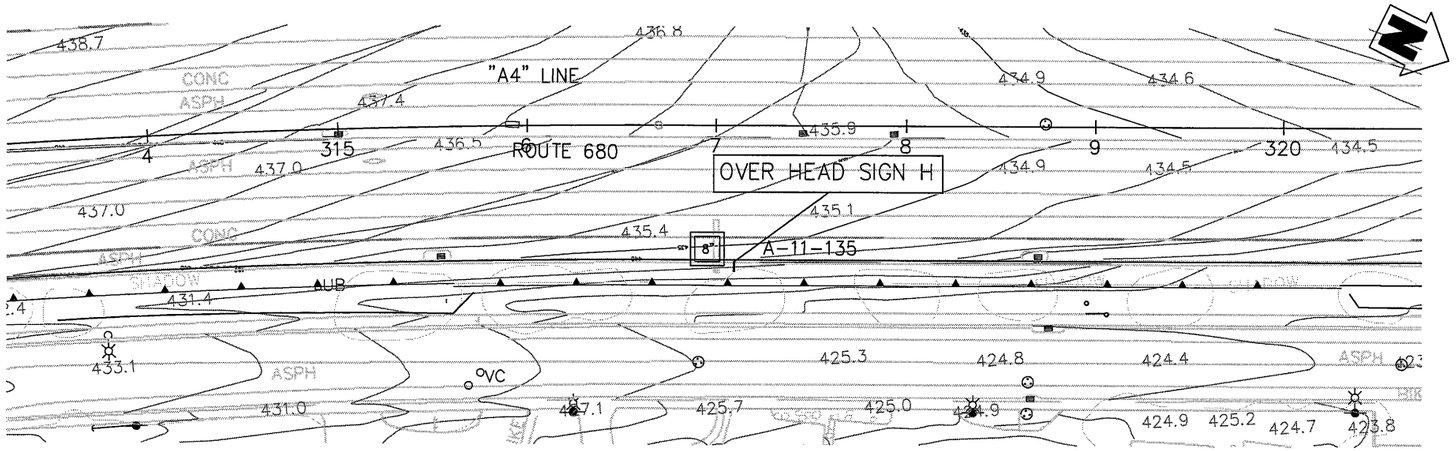
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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

CONTRA COSTA TRANSPORTATION AUTHORITY
2999 OAK ROAD, SUITE 100
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596



PLAN
1"=40'

BENCHMARK:

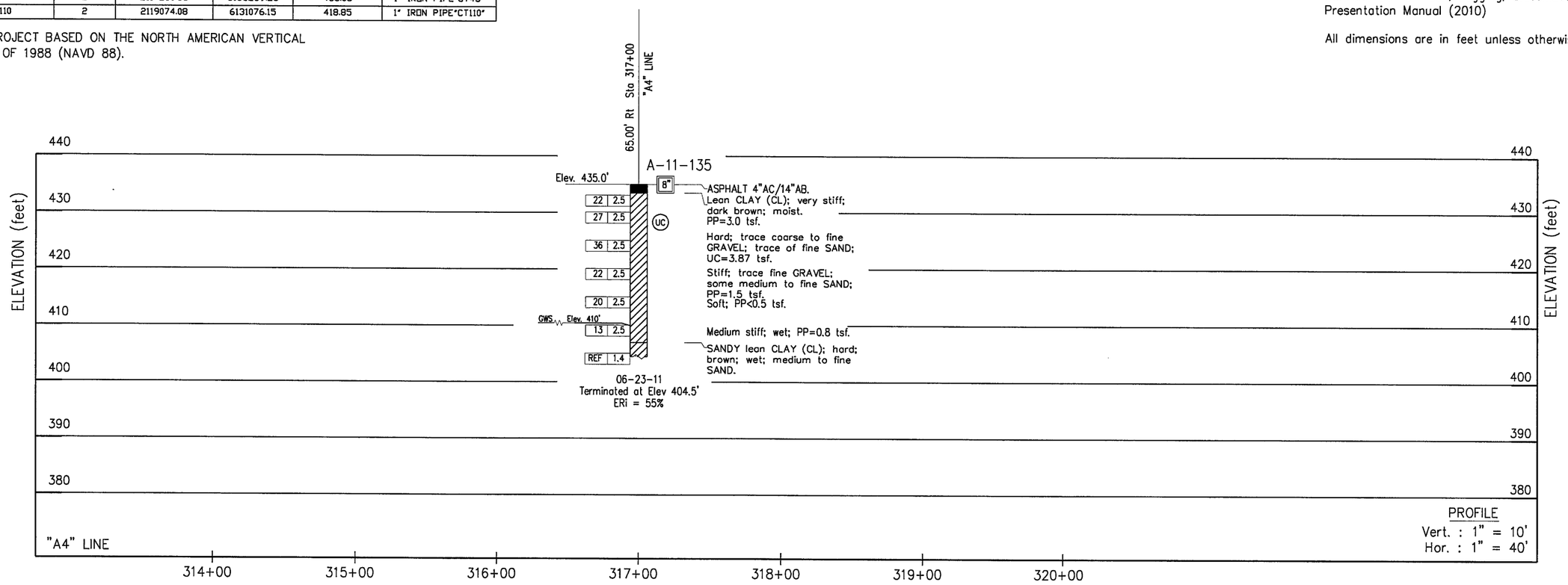
CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown



OHS H

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI/AZJ	E. ORTAKCI, A. BAKANE, V. SANTOS FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI PROJECT ENGINEER
SIGN OFF DATE	CHECKED BY	P. WEI	DATE: JUNE 2011 to NOVEMBER 2011		

BRIDGE NO. — POST MILES

OVERHEAD SIGN H

LOG OF TEST BORINGS

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 11/23/11 2/28/12

REVISION DATES — SHEET — OF

CONTRACT NO.: — PROJECT ID:

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Ajackson Mar 28, 2012 - 2:20pm S:\ACAD\2011-124-GDR\LOTB_GDR.dwg

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 3/28/12

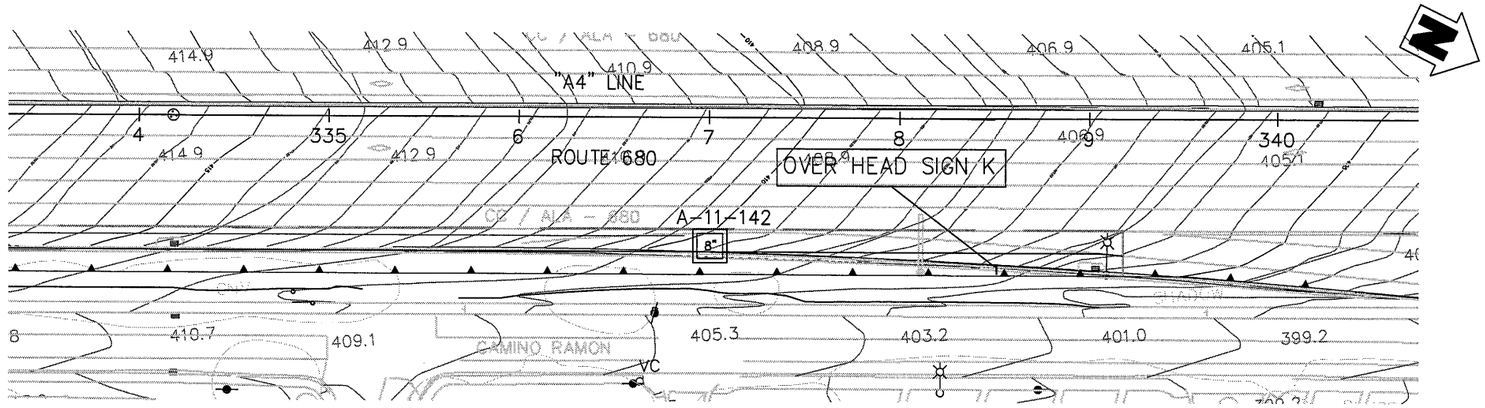
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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

CONTRA COSTA TRANSPORTATION AUTHORITY
2999 OAK ROAD, SUITE 100
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREEK, CA 94596



PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

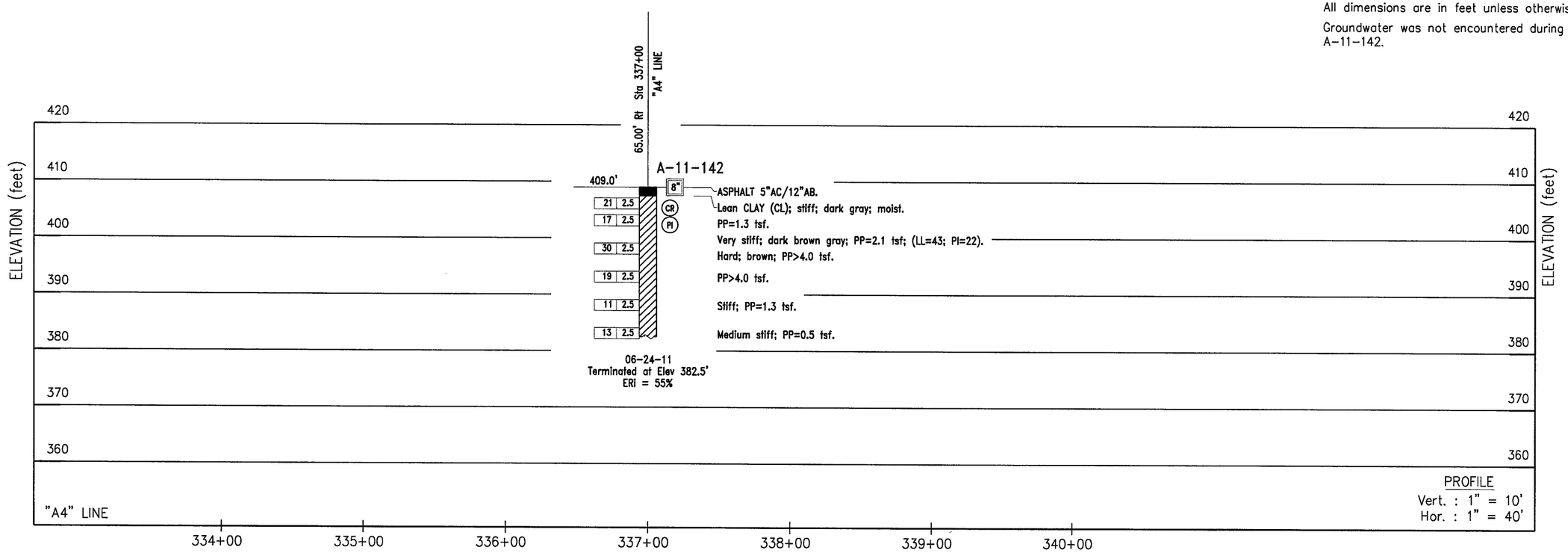
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Boring A-11-142.



PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

OHS K

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI/AZJ	E. ORTAKCI, A. BAKANE, V. SANTOS FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI PROJECT ENGINEER	BRIDGE NO.	OVERHEAD SIGN K
SIGN OFF DATE	CHECKED BY	P. WEI	DATE: JUNE 2011 to NOVEMBER 2011			POST MILES	LOG OF TEST BORINGS
GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/16/10)				ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3	UNIT: 0736 PROJECT NUMBER & PHASE: 04000210664	DISREGARD PRINTS BEARING EARLIER REVISION DATES	REVISION DATES 11/25/11 2/28/12 — SHEET — OF

FILE => $REQUEST — CONTRACT NO.: — PROJECT ID:

Ajackson Mar 28, 2012 - 2:22pm S:\ACAD\2011-124-GDR\LOTB_GDR.dwg

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/21/12

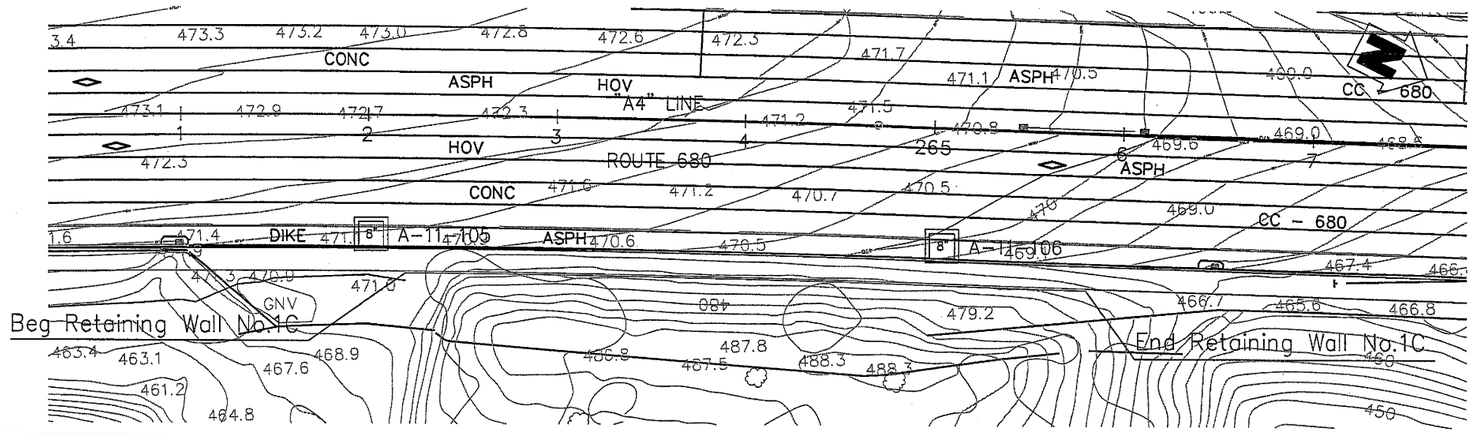
PLANS APPROVAL DATE

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

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

CONTRA COSTA TRANSPORTATION AUTHORITY
2999 OAK ROAD, SUITE 100
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596



PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

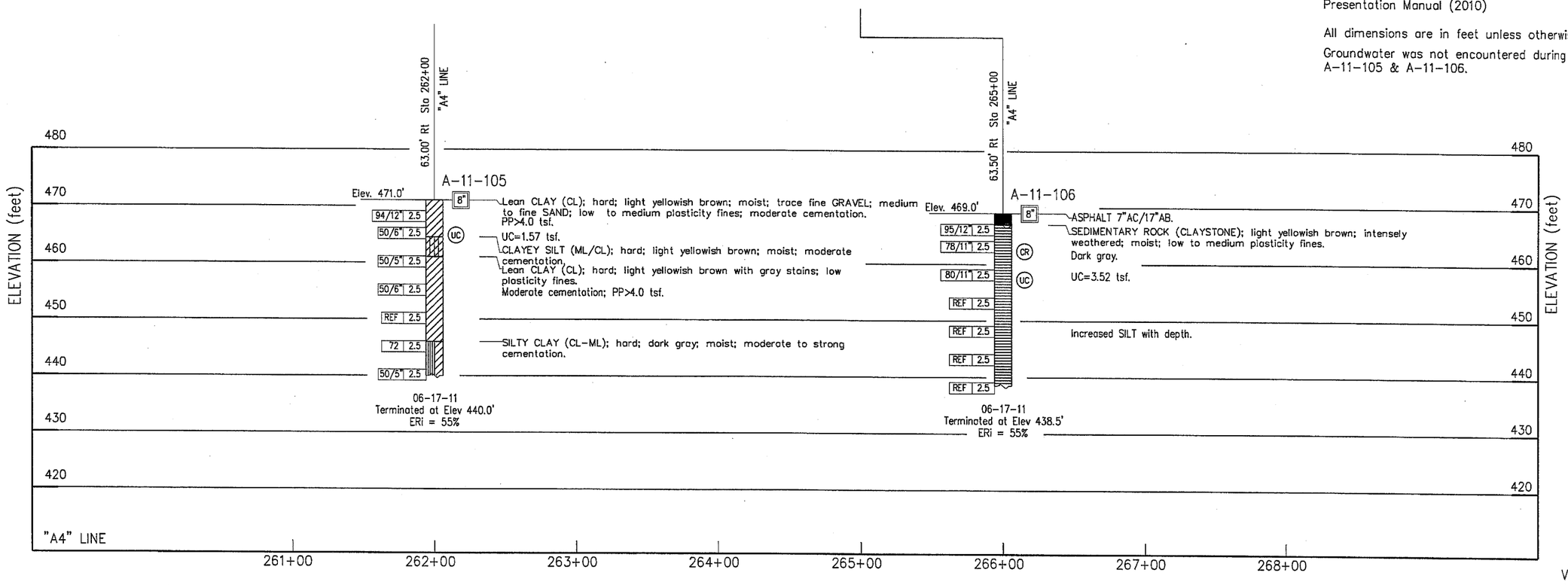
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Borings A-11-105 & A-11-106.



RW No. 1C

PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI	E. ORTAKCI, A. BAKANE, V. SANTOS	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI	BRIDGE NO.
SIGN OFF DATE	CHECKED BY	P. WEI	FIELD INVESTIGATION BY: DATE: JUNE 2011 TO NOVEMBER 2011		PROJECT ENGINEER	POST MILES

RETAINING WALL NO. 1C
LOG OF TEST BORINGS

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES 12/08/11 02/21/12

REVISION DATES — SHEET — OF

CONTRACT NO.

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/21/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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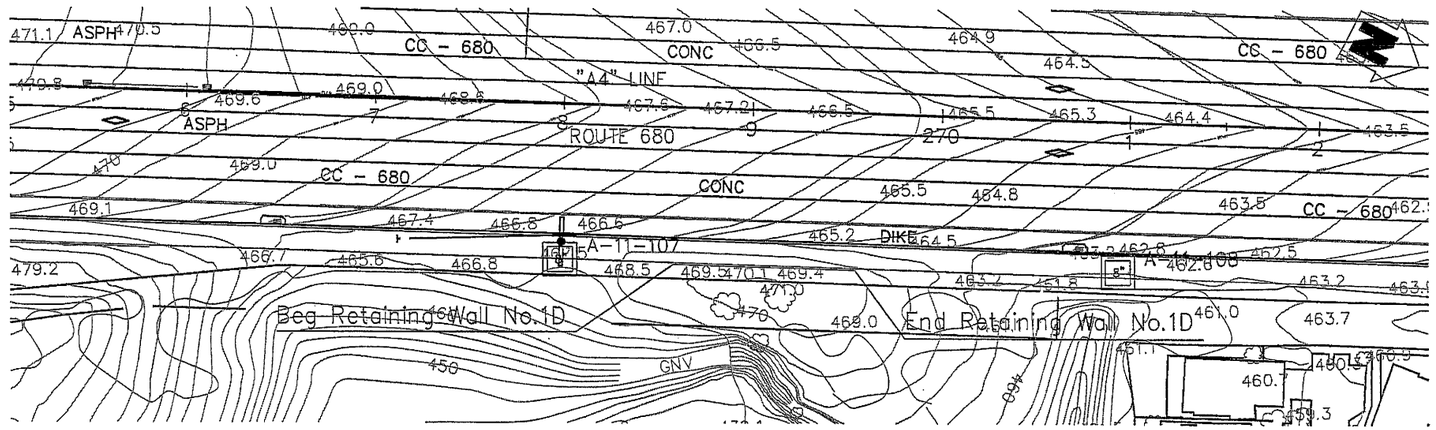
CONTRA COSTA TRANSPORTATION AUTHORITY
2999 OAK ROAD, SUITE 100
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREEK, CA 94596



PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

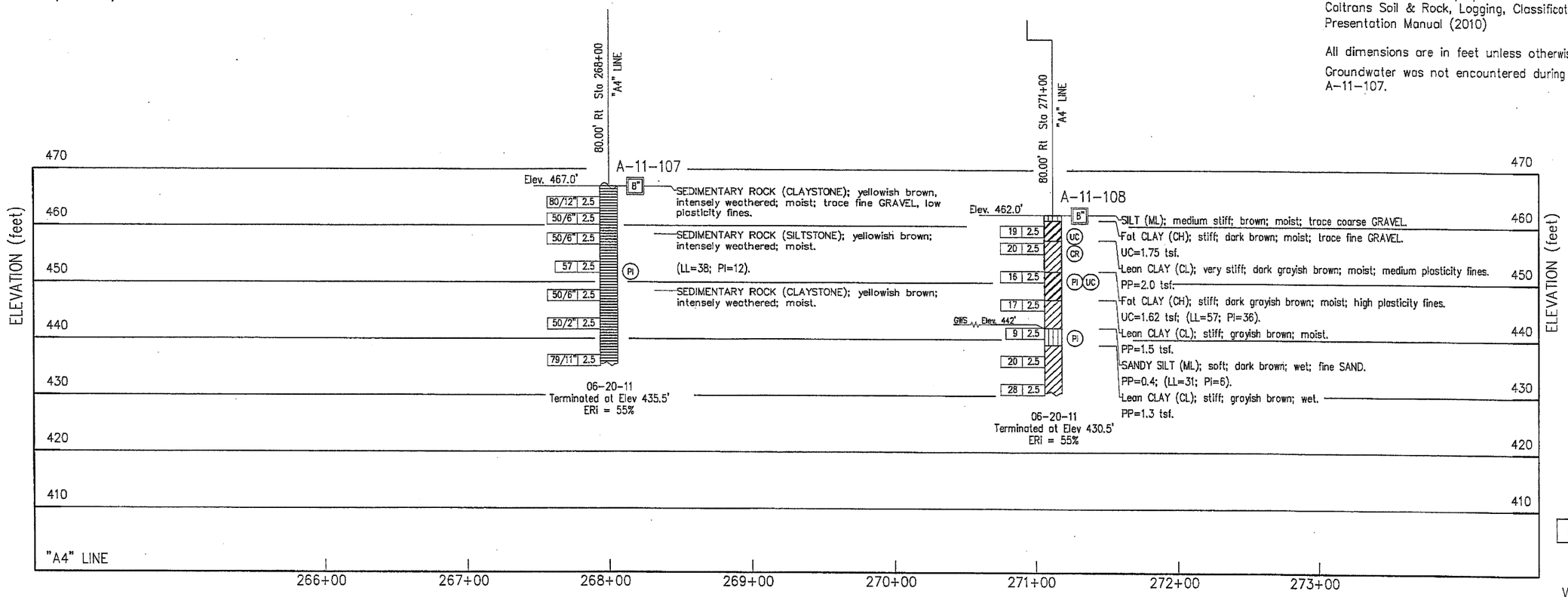
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Boring A-11-107.



RW No. 1D

PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI	E. ORTAKCI, A. BAKANE, V. SANTOS FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI PROJECT ENGINEER
SIGN OFF DATE	CHECKED BY	P. WEI	DATE: JUNE 2011 TO NOVEMBER 2011		

BRIDGE NO.
POST MILES

RETAINING WALL NO. 1D
LOG OF TEST BORINGS

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 12/28/11 02/21/12

REVISION DATES — SHEET — OF

JSERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/21/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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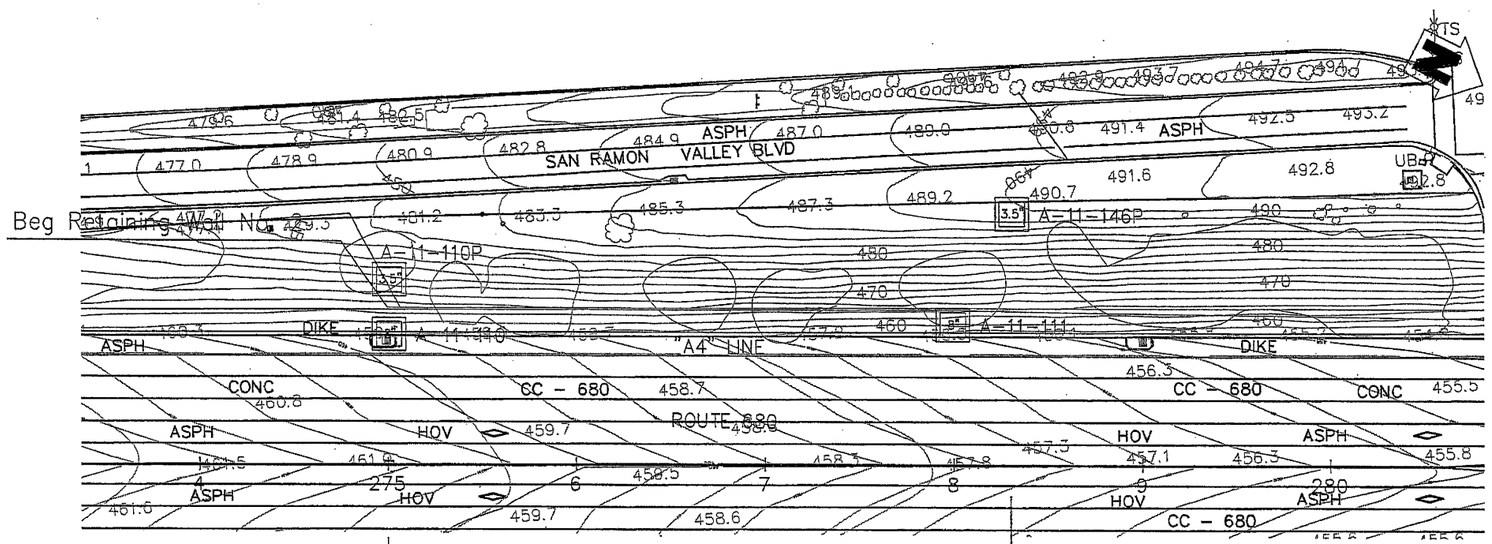
CONTRA COSTA TRANSPORTATION AUTHORITY
2999 OAK ROAD, SUITE 100
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREEK, CA 94596



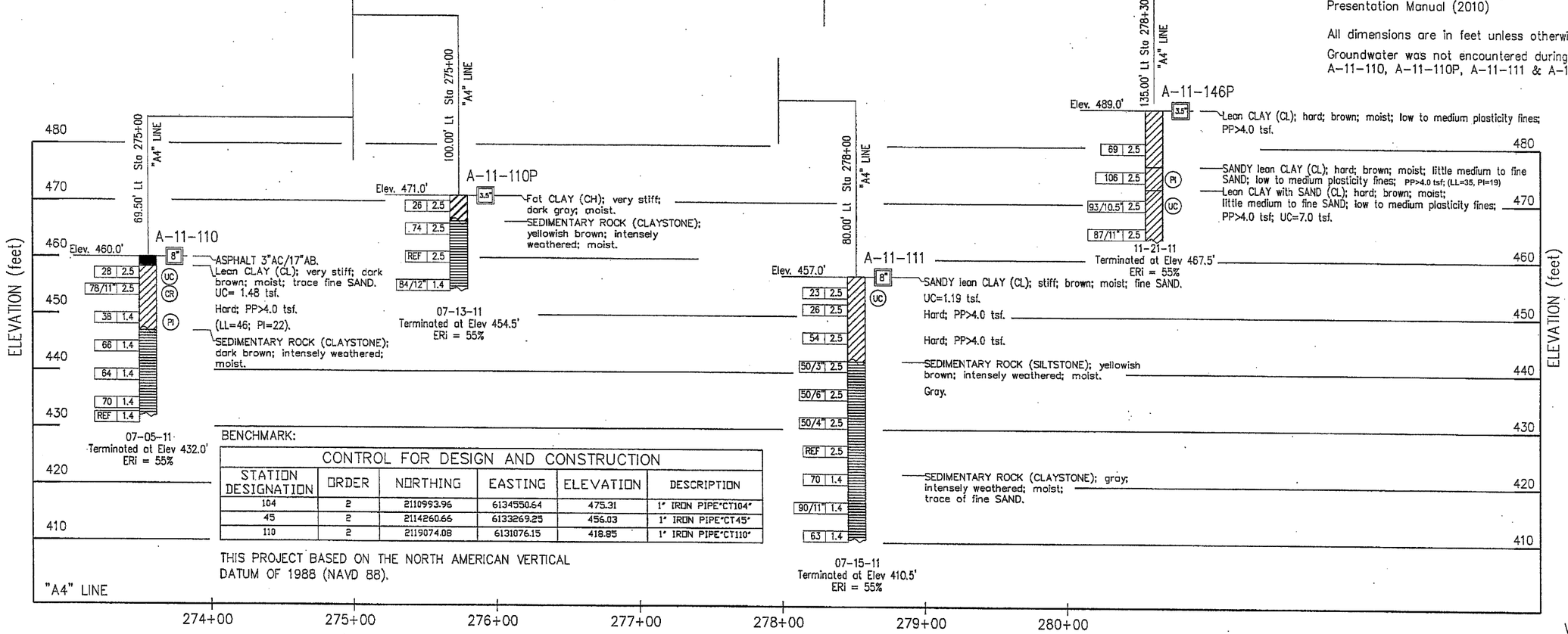
PLAN
1"=40'

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Borings A-11-110, A-11-110P, A-11-111 & A-11-146P.



BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION

STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

RW No. 2 (1)

PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

DESIGN OVERSIGHT
SIGN OFF DATE
DRAWN BY E. ORTAKCI
CHECKED BY P. WEI
E. ORTAKCI, A. BAKANE, V. SANTOS
FIELD INVESTIGATION BY:
DATE: JUNE 2011 TO NOVEMBER 2011

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

PETER WEI
PROJECT ENGINEER

BRIDGE NO. 28E0121
POST MILES

RETAINING WALL NO. 2
LOG OF TEST BORINGS NO. 1

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/18/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES 12/18/11 02/21/12

REVISION DATES — SHEET — OF

CONTRACT NO.: — PROJECT ID:

FILE => $REQUEST

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/21/12

PLANS APPROVAL DATE

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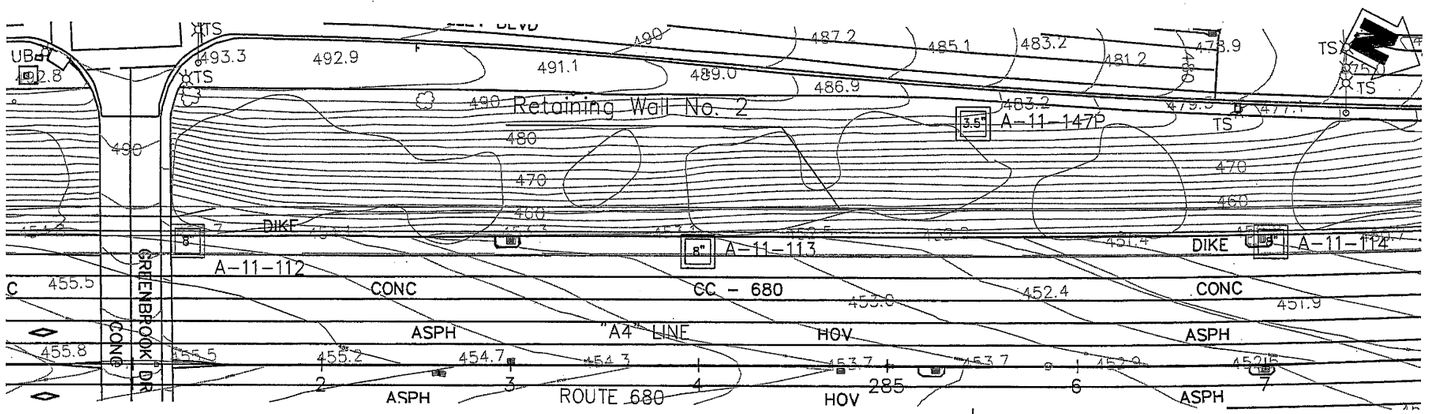
REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

CONTRA COSTA TRANSPORTATION AUTHORITY
2999 OAK ROAD, SUITE 100
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREEK, CA 94596



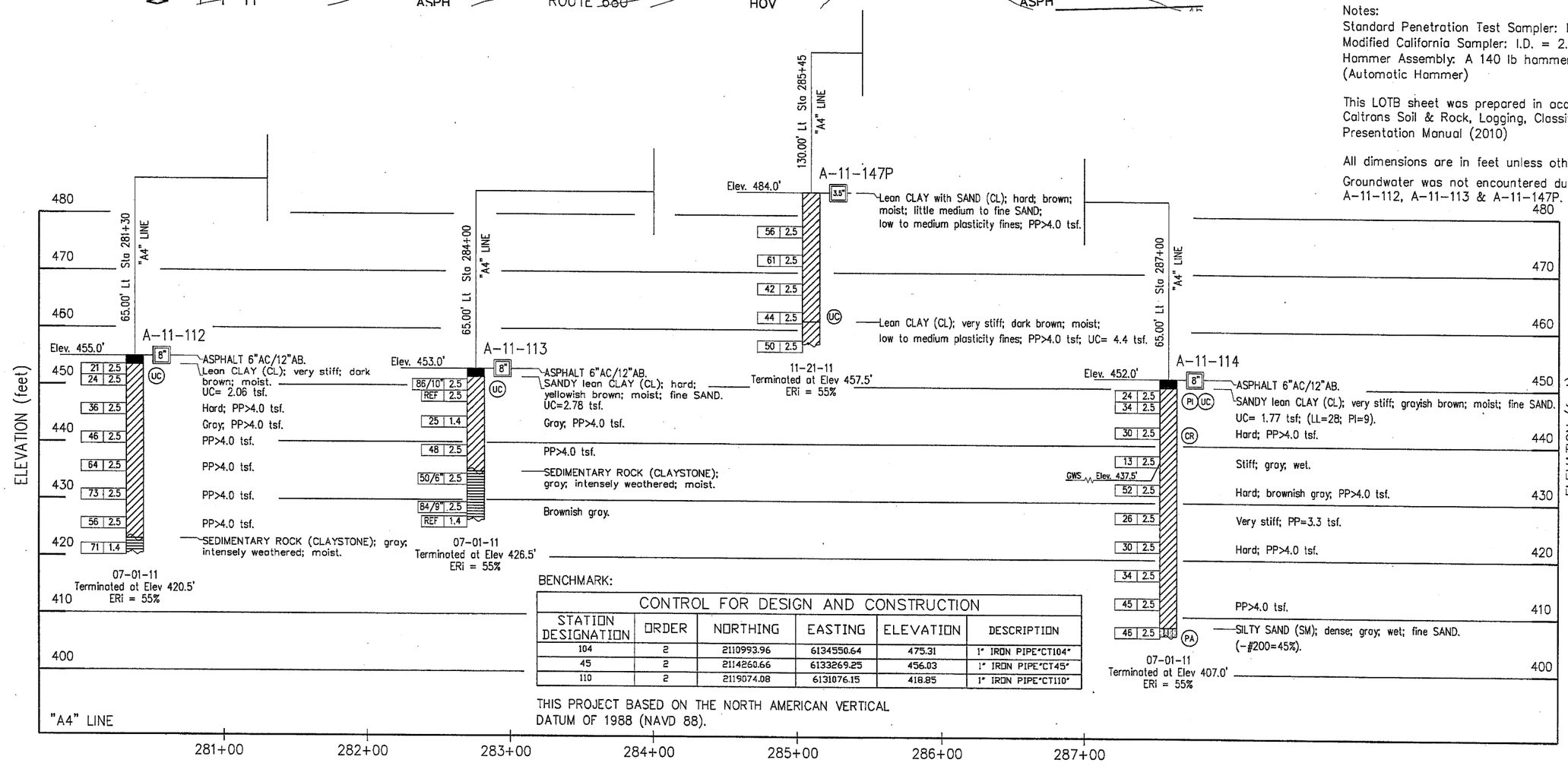
PLAN
1"=40'

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Borings A-11-112, A-11-113 & A-11-147P.



BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION

STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

RW No. 2 (2)

PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI	E. ORTAKCI, A. BAKANE, V. SANTOS — FIELD INVESTIGATION BY:
SIGN OFF DATE	CHECKED BY	P. WEI	DATE: JUNE 2011 TO NOVEMBER 2011

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

PETER WEI — PROJECT ENGINEER

BRIDGE NO. 28E0121 — POST MILES

RETAINING WALL NO. 2
LOG OF TEST BORINGS NO. 2

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 12/08/11 02/21/12 — SHEET — OF

FILE => $REQUEST — CONTRACT NO: — PROJECT ID:

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/21/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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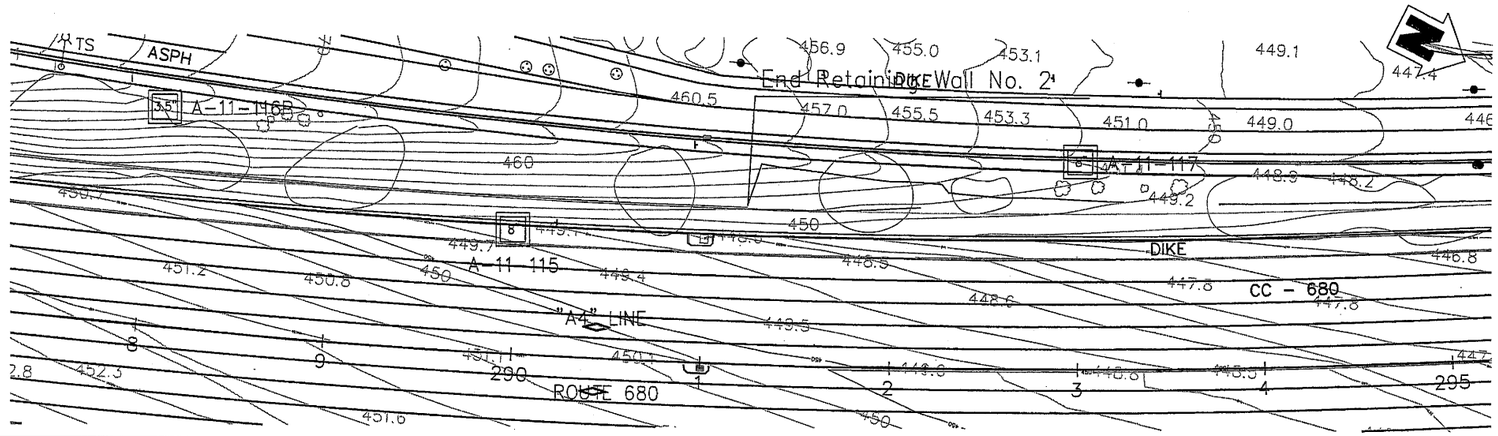
CONTRA COSTA TRANSPORTATION AUTHORITY
2999 OAK ROAD, SUITE 100
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREEK, CA 94596



PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

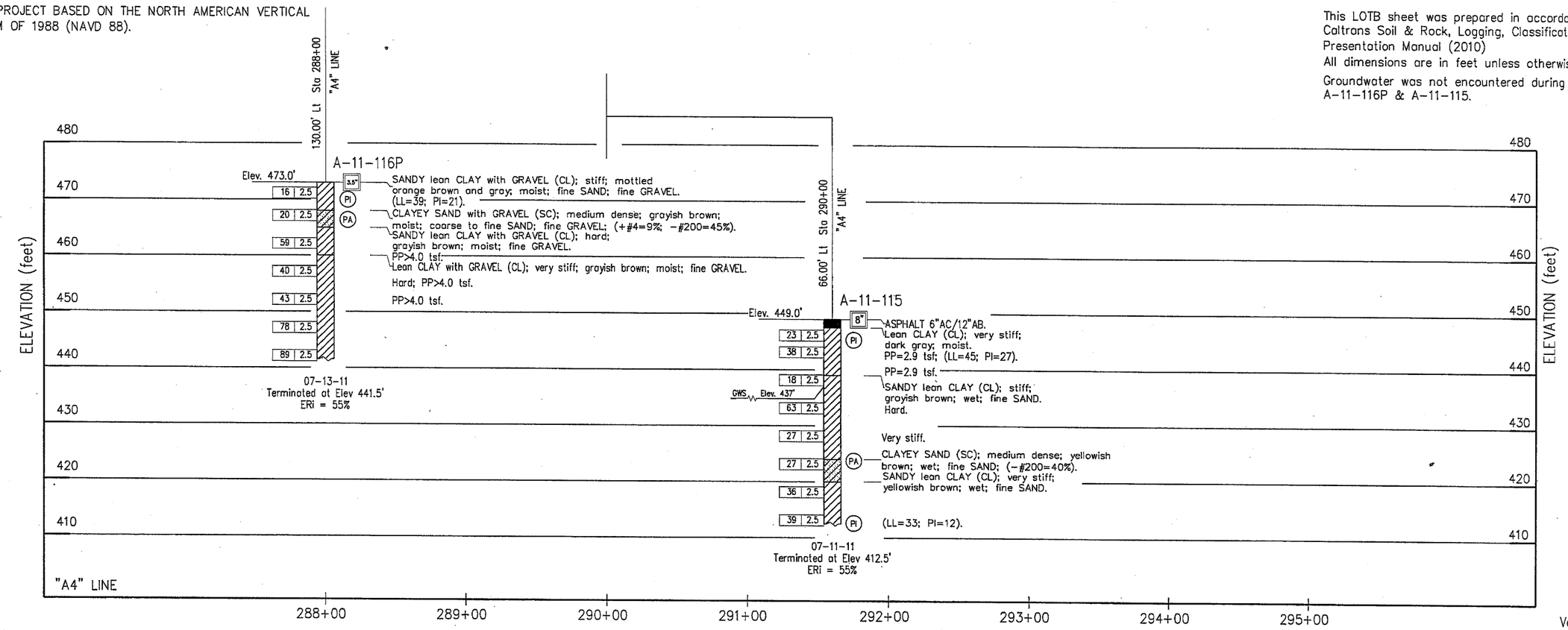
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Borings A-11-116P & A-11-115.



RW No. 2 (3)

PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI	E. ORTAKCI, A. BAKANE, V. SANTOS FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI PROJECT ENGINEER	BRIDGE NO. 28E0121	RETAINING WALL NO. 2
SIGN OFF DATE	CHECKED BY	P. WEI	DATE: JUNE 2011 TO NOVEMBER 2011			POST MILES	LOG OF TEST BORINGS NO. 3

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES 12/28/11 02/21/12

REVISION DATES — SHEET — OF

CONTRACT NO: — PROJECT ID:

FILE => $REQUEST

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/21/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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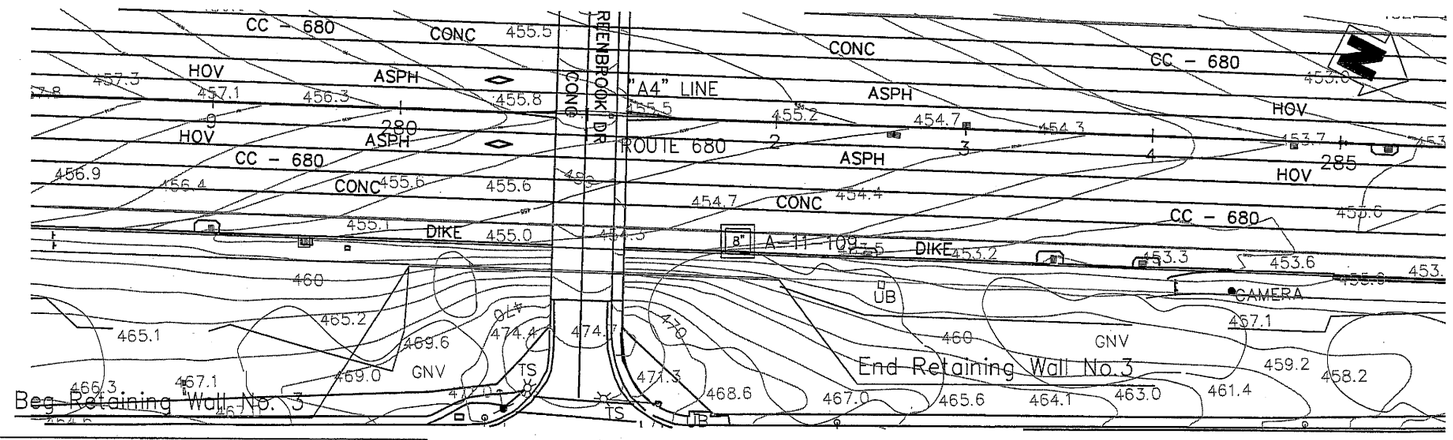
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596



PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

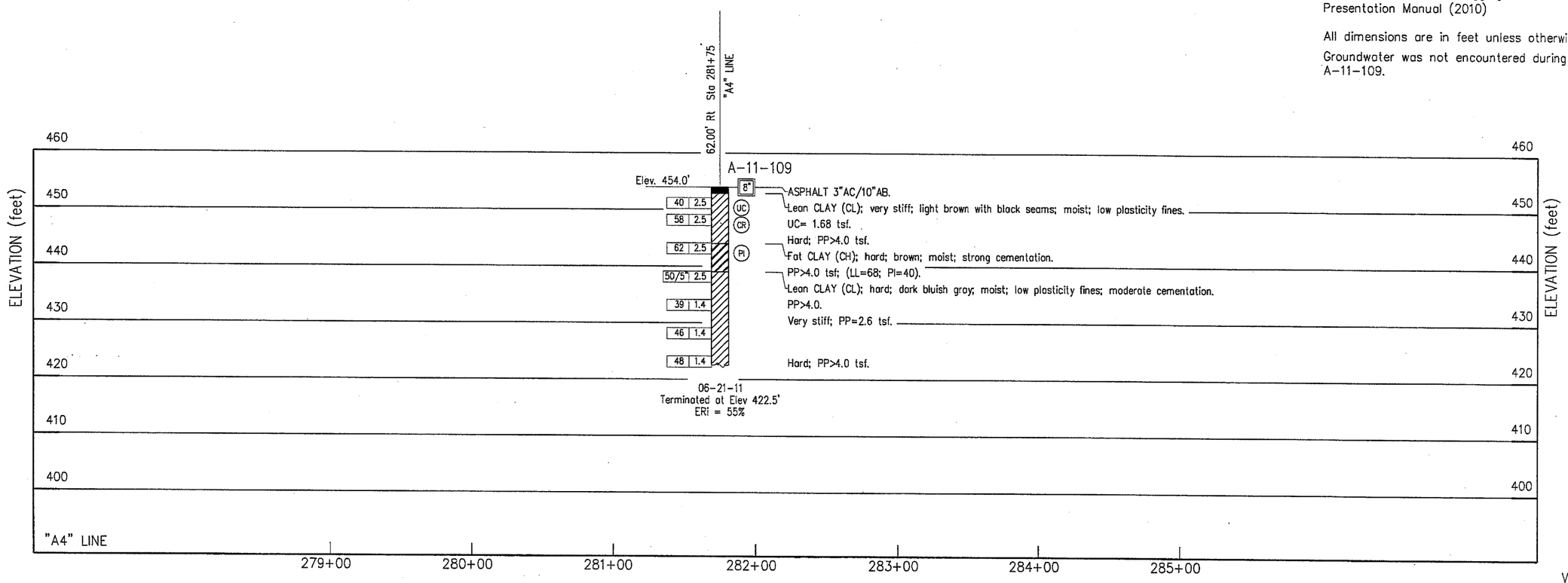
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Boring A-11-109.



RW No. 3

PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI	E. ORTAKCI, A. BAKANE, V. SANTOS	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI	BRIDGE NO. 28E0122	RETAINING WALL NO. 3
SIGN OFF DATE	CHECKED BY	P. WEI	FIELD INVESTIGATION BY: DATE: JUNE 2011 TO NOVEMBER 2011		PROJECT ENGINEER	POST MILES	LOG OF TEST BORINGS

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/15/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES 12/28/11 02/21/12

REVISION DATES — SHEET — OF

CONTRACT NO: — PROJECT ID:

FILE => $REQUEST

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/21/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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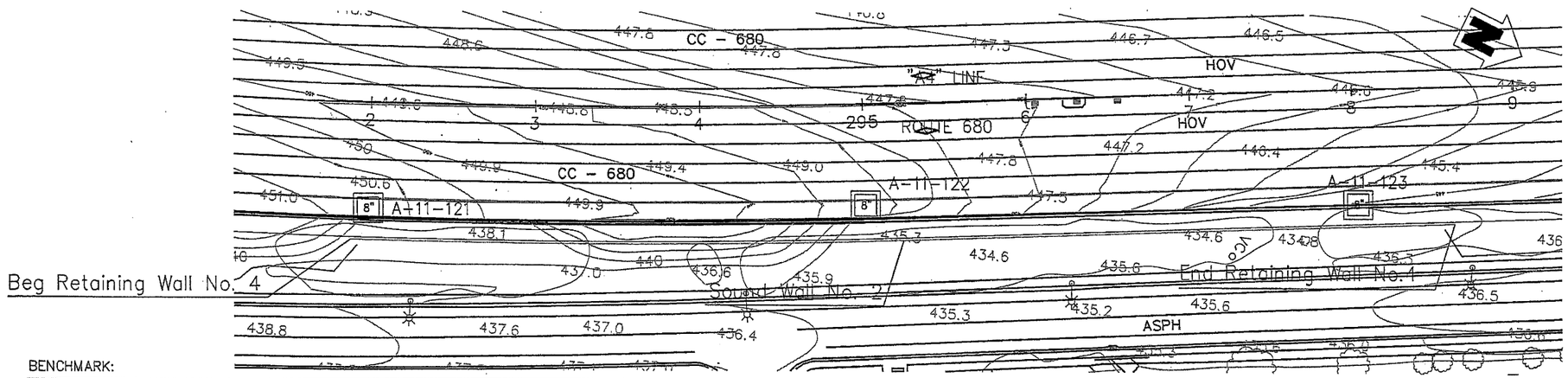
PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596



PLAN
1"=40'

BENCHMARK:

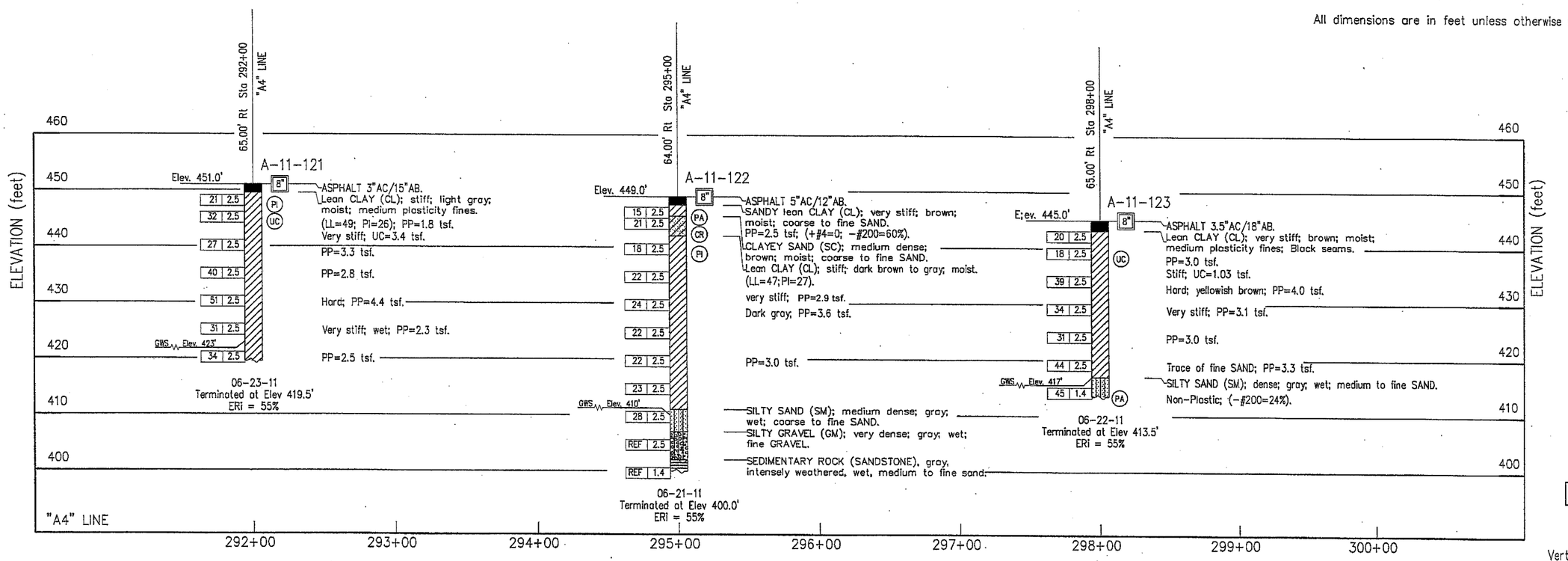
CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown



RW No. 4

PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI	E. ORTAKCI, A. BAKANE, V. SANTOS	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI PROJECT ENGINEER	BRIDGE NO.
SIGN OFF DATE	CHECKED BY	P. WEI	FIELD INVESTIGATION BY: DATE: JUNE 2011 TO NOVEMBER 2011			POST MILES

RETAINING WALL NO. 4
LOG OF TEST BORINGS

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES 12/06/11 02/21/12

REVISION DATES — SHEET — OF

CONTRACT NO: — PROJECT ID:

FILE => $REQUEST

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/21/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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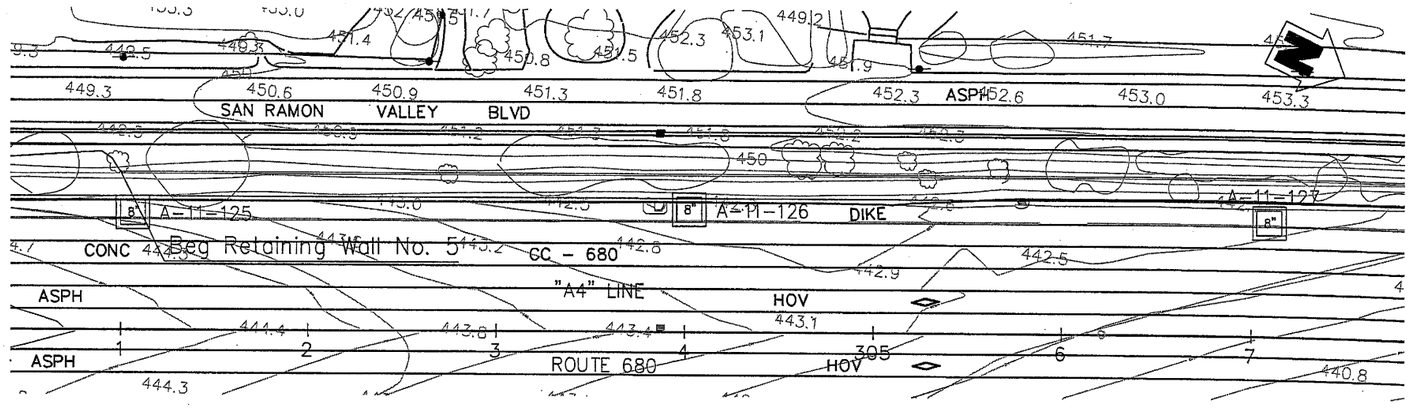
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596



PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

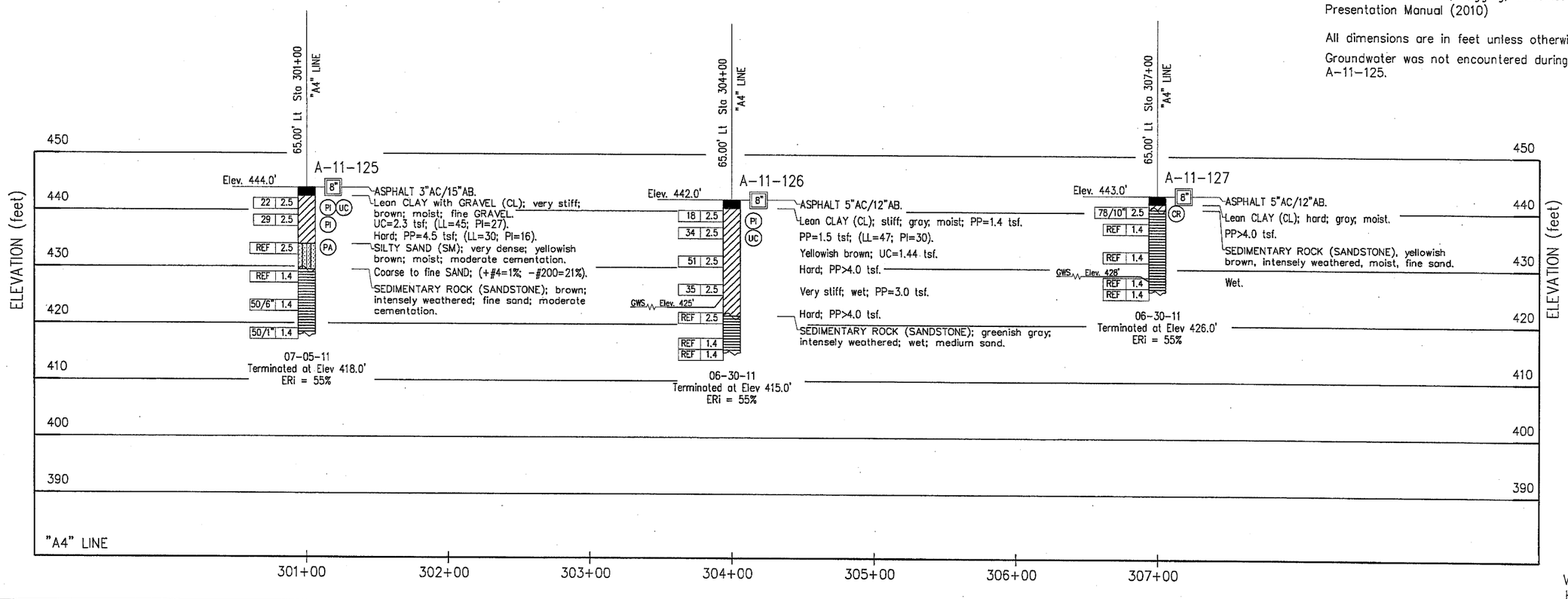
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Boring A-11-125.



RW No. 5 (1)

PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI	E. ORTAKCI, A. BAKANE, V. SANTOS	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI	BRIDGE NO.
SIGN OFF DATE	CHECKED BY	P. WEI	FIELD INVESTIGATION BY: DATE: JUNE 2011 TO NOVEMBER 2011		PROJECT ENGINEER	POST MILES

RETAINING WALL NO. 5
LOG OF TEST BORINGS NO. 1

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 12/28/11 02/21/12

REVISION DATES — SHEET — OF

FILE => $REQUEST — CONTRACT NO: — PROJECT ID:

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/21/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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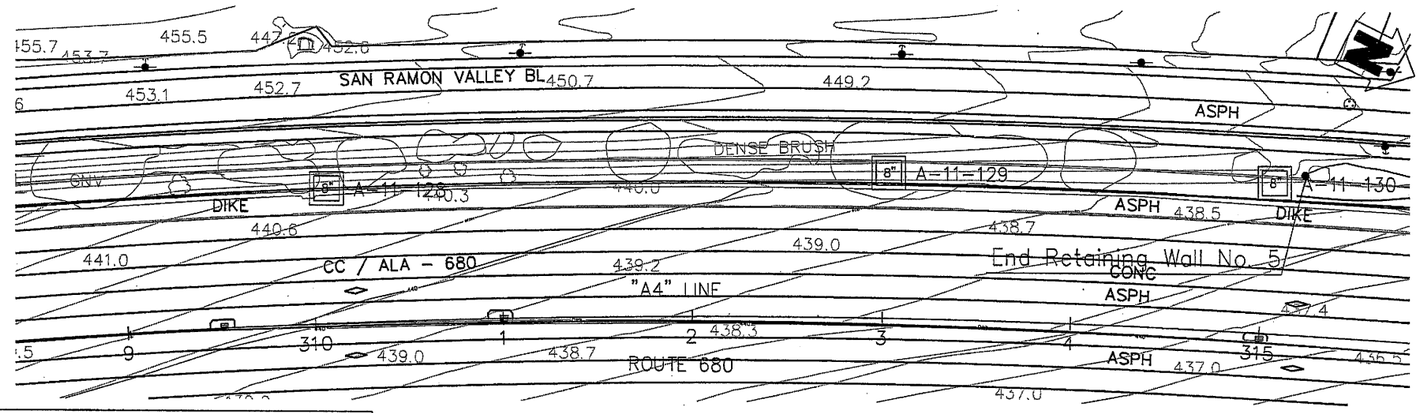
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596



PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

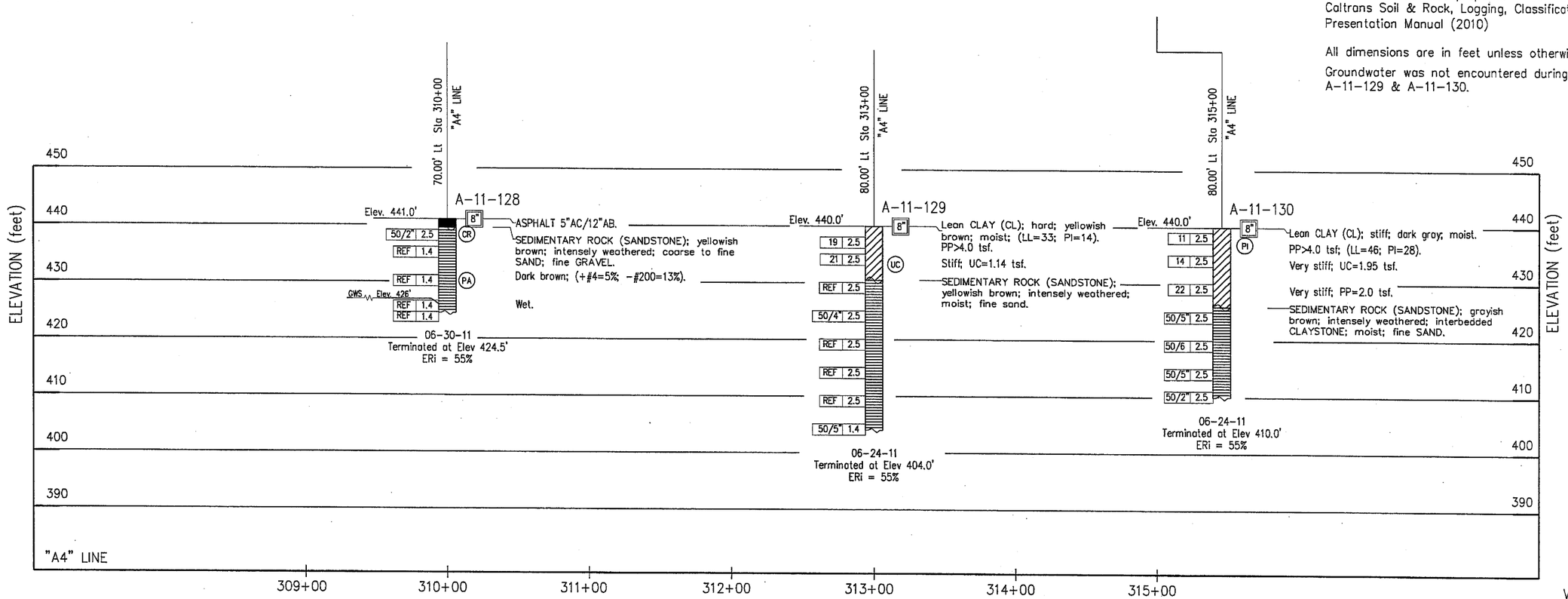
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Borings A-11-129 & A-11-130.



RW No. 5 (2)

PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI	E. ORTAKCI, A. BAKANE, V. SANTOS	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI	BRIDGE NO.
SIGN OFF DATE	CHECKED BY	P. WEI	FIELD INVESTIGATION BY: DATE: JUNE 2011 TO NOVEMBER 2011		PROJECT ENGINEER	POST MILES

RETAINING WALL NO. 5
LOG OF TEST BORINGS NO. 2

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES 12/08/11 02/21/12

REVISION DATES — SHEET — OF

CONTRACT NO: — PROJECT ID:

FILE => $REQUEST

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/21/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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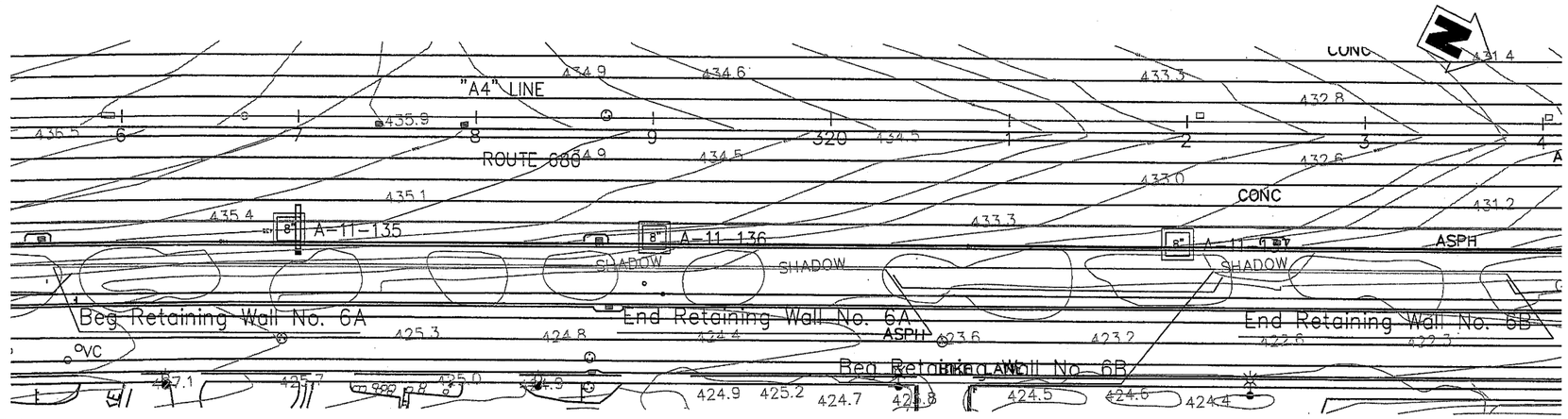
PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596



PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

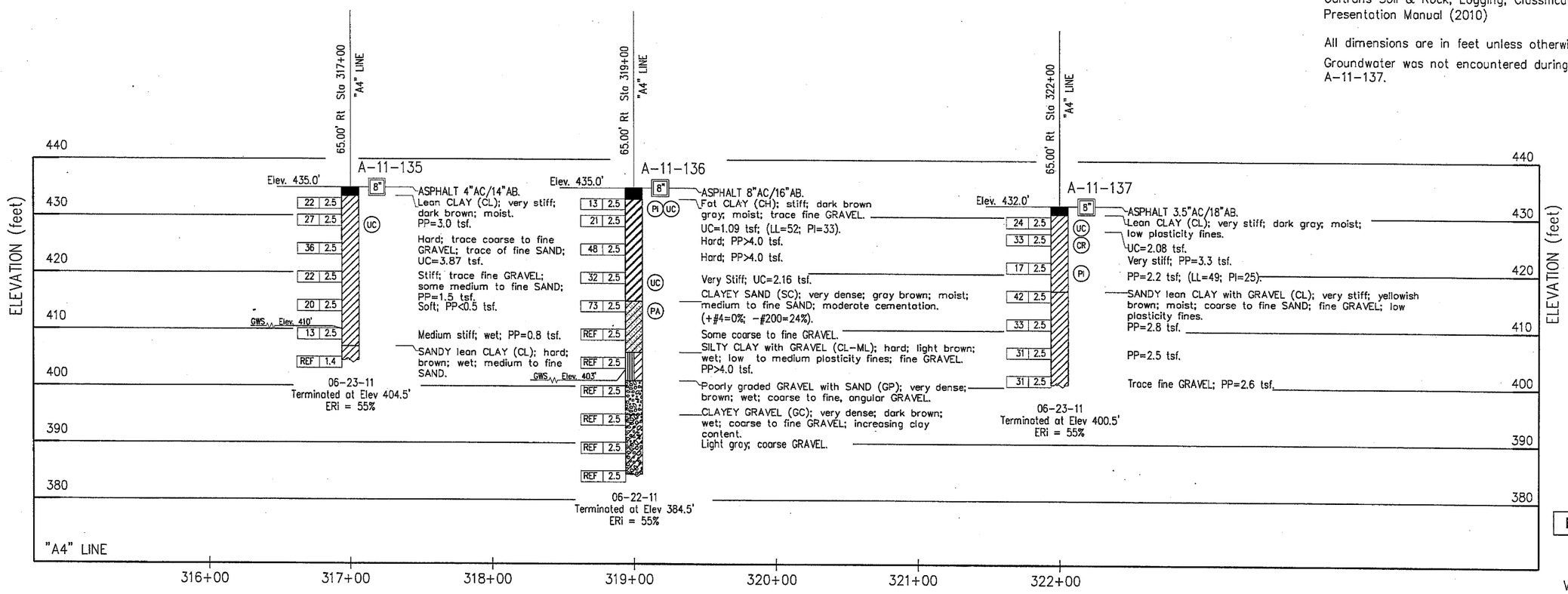
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Boring A-11-137.



RW No. 6A & 6B

PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI	E. ORTAKCI, A. BAKANE, V. SANTOS	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI	BRIDGE NO.
SIGN OFF DATE	CHECKED BY	P. WEI	FIELD INVESTIGATION BY: DATE: JUNE 2011 TO NOVEMBER 2011		PROJECT ENGINEER	POST MILES

RETAINING WALL NO. 6A & 6B
LOG OF TEST BORINGS

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES 12/08/11 02/21/12

REVISION DATES — SHEET — OF

CONTRACT NO.: — PROJECT ID:

FILE => $REQUEST

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

(OLD IV-00-107-A)

FED. AID STATE REGION	STATE	F. A. PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	PREFIX	SHEET NO.	TOTAL SHEETS
IV	CC	680	OBG	202	202

R. C. Brandt
Senior Engineer Civil - Structures - Bridges

DATE October 19, 1964

OFFICE OF STRUCTURE FOUNDATIONS – ENGINEERING SERVICE CENTER

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILE–TOTAL PROJECT	Sheet No.	Total Sheets
04	CC	680	4.3/6.7		

CERTIFIED ENGINEER Gary Parikh — DATE 2/28/12

REGISTERED PROFESSIONAL ENGINEER GARY PARIKH No. G.E. 666 Exp. 12/31/13 GEOTECHNICAL STATE OF CALIFORNIA

RTE 680 AUXILIARY LANE SEGMENT 2

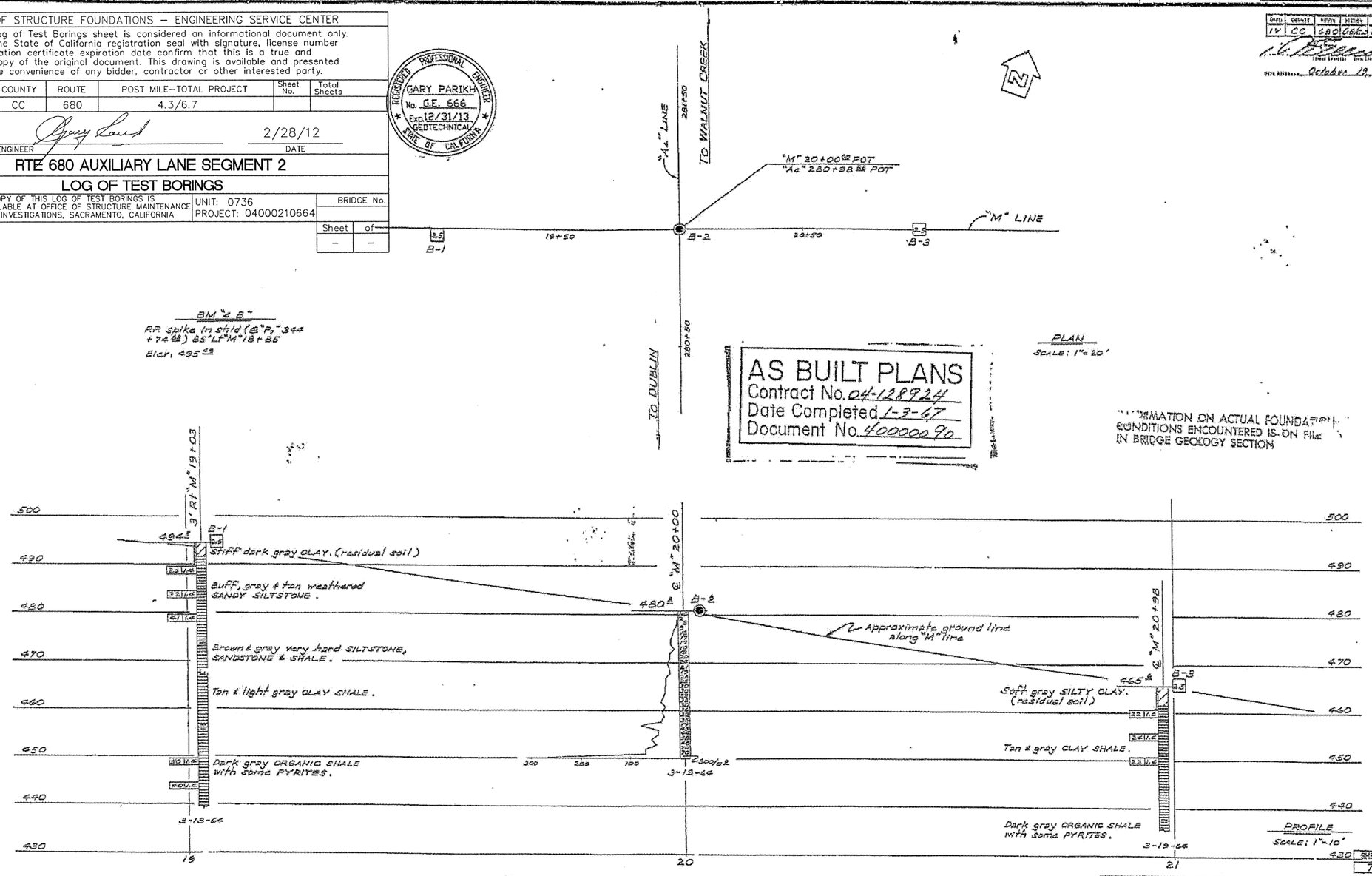
LOG OF TEST BORINGS

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

UNIT: 0736
PROJECT: 04000210664

BRIDGE No.

Sheet – of –



AS BUILT PLANS
Contract No. 04-128924
Date Completed 1-3-67
Document No. 40000090

INFORMATION ON ACTUAL FOUNDATION CONDITIONS ENCOUNTERED IS ON FILE IN BRIDGE GEOLOGY SECTION

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE March, 1964

LEGEND OF BORING OPERATIONS

LEGEND OF EARTH MATERIALS

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRAIN SIZE LIMITS

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.

FIELD STUDY Jr. T. Nelson 3-24
DRAWN Jr. K. Erdow 4-17-64
CHECKED Jr. T. Nelson 5-20-56
Approved Recommended for Approval: Engineering Geologist

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

202

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

NORTH SAN RAMON OC

LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 28-223 | FILE | DRAWING

Storeyard prints bearing earlier numbers → PREL. DRAWING No. PR-28223-2

APPENDIX B

LABORATORY TESTS

Classification Tests
The field classification of the samples was visually verified in the laboratory according to the Unified Soil Classification System. The results are presented in “Log of Test Borings”, Appendix A.

Moisture-Density
The natural moisture contents and dry unit weights were determined for selected undisturbed samples of the soils in general accordance with ASTM D 2216. This information was used to classify and correlate the soils. The results are presented at the appropriate depths on the "Lab Summary", Plates B-2A through B-2H.

Unconfined Compression Tests
Strength tests were performed on selected undisturbed samples. Unconfined compression tests were performed in general accordance with ASTM D 2166. The results are presented at the appropriate depths on the "Lab Summary", Plate B-2A through B-2H.

Atterberg Limits
The Atterberg Limits (ASTM D 4318) were determined on selected samples of the fine-grained materials. These results were used to classify the soils, as well as to obtain an indication of the effective strength characteristics and expansion potential. The tests results are presented on Plates B-3A through B-3C.

Grain Size Classification
Grain size classification tests (ASTM D422) were performed on selected samples of granular soil to aid in the classification. The results are presented on Plates B-4A and B-4B, “Grain Size Distribution Curves”.

Corrosion Tests
Corrosion tests were performed on selected samples to determine the corrosion potential of the soils. The pH and minimum resistively tests were performed according to California Test Method 643. The tests were performed by Sunland Analytical. The test results are presented on Plates B-5A and B-5Q.

R-value Tests
R-value tests were performed on representative bulk samples for pavement design. The tests were performed according to California Test Method 301. The test results are presented on Plates B-6A through B-6H.

Unconfined Compression Tests
Unconfined compression strength tests were performed on lime treated soil samples in accordance with California Test Method 373. The results are presented on Plates B-7A through B-7D.

Borehole	Sample Number	Depth	Classi-fication	Water Content	Dry Density	Liquid Limit	Plastic Limit	Plasticity Index	% > Sieve 4	% < Sieve 200	Unconfined Compressive Strength (tsf)
A-11-101	1	3.0	CH	26.1	98.6	59	22	37			
A-11-101	2	6.0	CH	26.5	96.3						
A-11-101	3	11.0	CH	26.9	98.1						
A-11-101	4	16.0	CH	30.3	94.5						
A-11-101	5	21.0	CL-ML	20.6	107.1						
A-11-101	6	26.0	CL	23.2	103.2						
A-11-102	1	3.0	CL	23.5	99.4						
A-11-102	2	6.0	CH	26.7	91.9	61	21	40			
A-11-102	3	11.0	CH	24.8	100.8						
A-11-102	4	16.0	CH	24.7	105.5						
A-11-102	5	21.0	CL	32.2	89.2						
A-11-102	6	26.0	GC	29.1	97.6						
A-11-103	1	3.0	CL	23.6	92.1	41	22	19			
A-11-103	2	6.0	CL	21.0	102.6						
A-11-103	3	11.0	CL	19.8	107.9						
A-11-103	4	16.0	CL	22.1	105.1						
A-11-103	5	21.0	CL	25.3	96.4						
A-11-103	6	26.0	CL	21.4	101.7						
A-11-104	1	3.0	CL	23.2	102.4						
A-11-104	2	6.0	CH	22.5	101.7						
A-11-104	3	11.0	CH	26.9	96.1	61	22	39			
A-11-104	4	15.0	ML/CL	15.5	-						
A-11-104	5	21.0	CL	21.2	104.0						
A-11-104	6	25.0	CL	18.6	103.5						
A-11-105	1	3.0	CL	19.2	106.9						
A-11-105	2	5.5	CL	17.5	104.9						1.57
A-11-105	3	10.5	CL	17.5	108.7						
A-11-105	4	15.5	CL	17.9	108.4						
A-11-105	5	20.0	CL	14.4	-						
A-11-105	6	26.0	CL-ML	14.0	-						
A-11-105	7	30.5	CL-ML	4.3	-						
A-11-106	1	3.0	-	22.6	102.7						
A-11-106	2	6.0	-	23.1	100.2						
A-11-106	3	11.0	-	18.5	107.3						3.52
A-11-106	4	15.0	-	11.7	126.3						
A-11-106	5	20.0	-	16.1	112.8						
A-11-106	6	25.0	-	18.6	102.7						
A-11-106	7	30.0	-	9.5	110.7						
A-11-107	1	3.0	-	12.7	104.7						
A-11-107	2	5.5	-	10.8	122.0						
A-11-107	3	9.0	-	21.1	101.4						
A-11-107	4	14.5	-	24.4	95.9	38	26	12			
A-11-107	5	19.0	-	17.7	106.2						

Borehole	Sample Number	Depth	Classi-fication	Water Content	Dry Density	Liquid Limit	Plastic Limit	Plasticity Index	% > Sieve 4	% < Sieve 200	Unconfined Compressive Strength (tsf)
A-11-107	6	24.0	-	17.3	112.1						
A-11-107	7	31.0	-	17.8	107.9						
A-11-108	1	3.0	CH	19.0	100.9						1.75
A-11-108	2	6.0	CL	24.5	99.8						
A-11-108	3	11.0	CH	28.9	92.7	57	21	36			1.62
A-11-108	4	16.0	CL	27.2	93.6						
A-11-108	5	21.0	ML	26.4	97.6	31	25	6			
A-11-108	6	26.0	CL	27.0	98.2						
A-11-108	7	31.0	CL	29.9	94.9						
A-11-109	1	3.0	CL	21.3	102.2						1.68
A-11-109	2	6.0	CL	19.7	106.3						
A-11-109	3	11.0	CH	25.7	91.2	68	28	40			
A-11-109	4	15.5	CL	16.5	112.6						
A-11-109	5	21.0	CL	18.3	-						
A-11-109	6	26.0	CL	-	-						
A-11-109	7	31.0	CL	18.1	-						
A-11-110	1	3.0	CL	17.4	104.4						1.48
A-11-110	2	6.0	CL	17.4	101.4						
A-11-110	3	11.0	CL	20.4	-	46	24	22			
A-11-110	4	16.0	-	17.0	-						
A-11-110	5	21.0	-	18.9	-						
A-11-110	6	26.0	-	17.2	-						
A-11-110	7	27.5	-	17.0	-						
A-11-110P	1	2.0	CH	17.6	104.5						
A-11-110P	2	6.0	-	22.8	93.6						
A-11-110P	3	10.0	-	27.3	95.4						
A-11-110P	4	16.0	-	23.6	-						
A-11-111	1	3.0	CL	25.5	96.7						1.19
A-11-111	2	6.0	CL	25.4	96.0						
A-11-111	3	11.0	CL	26.7	97.0						
A-11-111	4	15.5	-	16.1	114.4						
A-11-111	5	20.5	-	15.3	118.3						
A-11-111	6	25.5	-	19.3	107.9						
A-11-111	7	30.0	-	11.5	120.1						
A-11-111	8	36.0	-	13.2	-						
A-11-111	9	41.0	-	11.9	-						
A-11-111	10	46.0	-	15.8	-						
A-11-112	1	3.0	CL	38.0	88.4						2.06
A-11-112	2	4.5	CL	24.9	97.5						
A-11-112	3	9.5	CL	21.4	102.4						
A-11-112	4	14.5	CL	21.6	104.8						
A-11-112	5	19.5	CL	17.4	111.1						
A-11-112	6	24.5	CL	19.1	-						

Borehole	Sample Number	Depth	Classi-fication	Water Content	Dry Density	Liquid Limit	Plastic Limit	Plasticity Index	% > Sieve 4	% < Sieve 200	Unconfined Compressive Strength (tsf)
A-11-112	7	29.5	CL	22.5	98.1						
A-11-112	8	34.0	-	18.6	-						
A-11-113	1	3.0	CL	16.4	111.7						2.78
A-11-113	2	3.5	CL	12.0	-						
A-11-113	3	9.5	CL	18.8	-						
A-11-113	4	14.5	CL	14.7	-						
A-11-113	5	19.0	-	14.3	-						
A-11-113	6	24.5	-	21.7	103.2						
A-11-113	7	26.0	-	3.2	-						
A-11-114	1	3.0	CL	18.5	108.4	28	19	9			1.77
A-11-114	2	4.5	CL	18.9	104.6						
A-11-114	3	9.5	CL	23.8	97.5						
A-11-114	4	14.5	CL	23.7	102.3						
A-11-114	5	19.5	CL	21.3	105.9						
A-11-114	6	24.5	CL	23.6	101.7						
A-11-114	7	29.5	CL	18.8	110.2						
A-11-114	8	34.5	CL	18.4	111.0						
A-11-114	9	39.5	CL	18.9	111.3						
A-11-114	10	44.5	SM	20.6	107.5					44.5	
A-11-115	1	3.0	CL	19.8	108.9	45	18	27			
A-11-115	2	6.0	CL	19.1	108.0						
A-11-115	3	11.0	CL	19.4	107.8						
A-11-115	4	16.0	CL	19.1	110.1						
A-11-115	5	21.0	CL	21.9	106.0						
A-11-115	6	26.0	SC	25.2	100.6					39.7	
A-11-115	7	31.0	CL	23.3	102.5						
A-11-115	8	36.0	CL	23.9	101.0	33	21	12			
A-11-116P	1	2.0	CL	14.9	-	39	18	21			
A-11-116P	2	6.0	SC	15.1	-				8.9	44.6	
A-11-116P	3	11.0	CL	14.1	106.2						
A-11-116P	4	16.0	CL	17.8	109.1						
A-11-116P	5	21.0	CL	17.7	111.1						
A-11-116P	6	26.0	CL	15.8	115.3						
A-11-116P	7	31.0	CL	19.8	-						
A-11-117	1	3.0	SM	17.8	88.0						
A-11-117	2	6.0	CL	19.6	100.5	35	16	19			
A-11-117	3	11.0	CL	17.3	109.3						
A-11-117	4	16.0	CL	20.0	105.8						
A-11-117	5	21.0	CL	20.6	110.2						
A-11-117	6	26.0	CL	31.2	89.7						
A-11-117	7	31.0	CL	23.8	100.4						
A-11-118	1	3.0	CL	15.9	107.4						
A-11-118	2	6.0	CL	20.2	98.0	39	20	19			

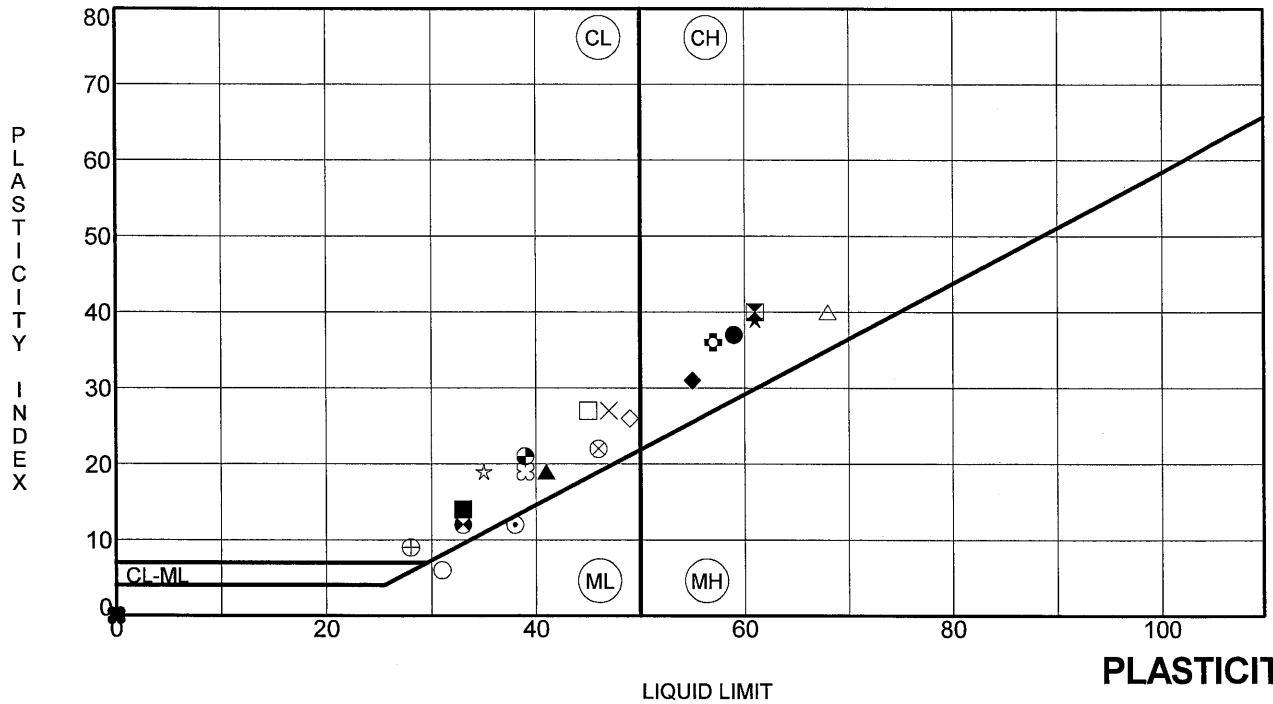
Borehole	Sample Number	Depth	Classi-fication	Water Content	Dry Density	Liquid Limit	Plastic Limit	Plasticity Index	% > Sieve 4	% < Sieve 200	Unconfined Compressive Strength (tsf)
A-11-118	3	11.0	CL	20.7	106.5						
A-11-118	4	16.0	SM	20.3	105.1					30.0	
A-11-118	5	20.5	SM	16.8	106.4						
A-11-118	6	25.0	SM	12.6	-						
A-11-119	1	3.0	CL	15.2	113.8	33	19	14			
A-11-119	2	6.0	SM	14.5	112.6					13.0	
A-11-119	3	10.5	SM	15.4	114.8						
A-11-119	4	15.5	SM	14.1	-						
A-11-119	5	21.0	SM	13.3	-						
A-11-119	6	26.0	SM	16.0	-						
A-11-120	1	3.0	CH	26.0	98.0	55	24	31			
A-11-120	2	6.0	CL	20.9	105.3						
A-11-120	3	11.0	ML	24.7	103.8						
A-11-120	4	16.0	CL	21.5	104.0						
A-11-120	5	21.0	SM	23.0	101.7						
A-11-120	6	26.0	CL	19.7	104.9						
A-11-121	1	3.0	CL	30.5	77.2	49	23	26			
A-11-121	2	6.0	CL	23.1	100.3						3.4
A-11-121	3	11.0	CL	20.0	98.7						
A-11-121	4	16.0	CL	20.7	103.8						
A-11-121	5	21.0	CL	20.0	97.8						
A-11-121	6	26.0	CL	24.2	98.9						
A-11-121	7	31.0	CL	22.8	101.5						
A-11-122	1	3.0	CL	21.0	98.0				0.3	59.8	
A-11-122	2	4.5	SC	18.4	100.8						
A-11-122	3	9.5	CL	21.4	96.1	47	20	27			
A-11-122	4	14.5	CL	21.0	102.4						
A-11-122	5	19.5	CL	19.3	105.3						
A-11-122	6	24.5	CL	19.0	103.5						
A-11-122	7	29.5	CL	19.4	-						
A-11-122	8	34.5	CL	25.6	-						
A-11-122	9	39.5	SM	24.7	101.8						
A-11-122	10	43.5	GM	16.8	111.3						
A-11-122	11	48.5	GM	16.2	-						
A-11-123	1	3.0	CL	21.1	94.0						
A-11-123	2	6.0	CL	23.1	94.8						1.03
A-11-123	3	11.0	CL	20.8	103.4						
A-11-123	4	16.0	CL	24.8	96.7						
A-11-123	5	21.0	CL	17.6	109.2						
A-11-123	6	26.0	CL	21.4	103.5						
A-11-123	7	31.0	SM	-	-	NP	NP	NP		23.6	
A-11-124	1	2.5	CL	22.9	100.3						
A-11-124	2	4.5	CL	24.5	95.9	43	21	22			

Borehole	Sample Number	Depth	Classi-fication	Water Content	Dry Density	Liquid Limit	Plastic Limit	Plasticity Index	% > Sieve 4	% < Sieve 200	Unconfined Compressive Strength (tsf)
A-11-124	3	9.5	CL	25.8	95.6						
A-11-124	4	14.5	CL	17.8	111.4						
A-11-124	5	19.5	CL	29.9	89.1						
A-11-124	6	24.5	CL	59.7	62.1						
A-11-124	7	29.5	CL	46.2	70.6						
A-11-124	8	34.5	CL	42.1	64.8						
A-11-124	9	39.0	SM	22.8	-						
A-11-124	10	44.5	SM	24.1	-						
A-11-124	11	49.0	SM	29.8	-						
A-11-125	1	3.0	CL	24.2	99.6	45	18	27			2.3
A-11-125	2	6.0	CL	14.9	109.3	30	14	16			
A-11-125	3	10.0	SM	24.1	77.1				0.8	20.5	
A-11-125	4	15.0	-	31.5	-						
A-11-125	5	20.5	-	36.0	-						
A-11-125	6	25.5	-	33.7	-						
A-11-126	1	3.0	CL	22.9	102.8	47	17	30			
A-11-126	2	6.0	CL	20.6	104.9						1.44
A-11-126	3	11.0	CL	24.5	-						
A-11-126	4	16.0	CL	29.0	95.0						
A-11-126	5	20.0	CL	38.0	82.8						
A-11-126	6	25.0	-	49.5	-						
A-11-127	1	2.5	CL	19.5	104.2						
A-11-127	2	5.0	-	18.8	-						
A-11-127	3	10.0	-	20.5	-						
A-11-127	4	15.0	-	25.6	-						
A-11-127	5	16.5	-	-	-						
A-11-128	1	2.5	-	26.9	85.8						
A-11-128	2	5.0	-	21.5	-						
A-11-128	3	10.0	-	16.5	-						
A-11-128	4	15.0	-	20.4	-						
A-11-128	5	16.0	-	22.1	-						
A-11-129	1	3.0	CL	24.5	92.4						
A-11-129	2	6.0	CL	26.0	94.9						1.14
A-11-129	3	10.0	-	22.4	-						
A-11-129	4	15.5	-	21.1	-						
A-11-129	5	20.0	-	24.3	-						
A-11-129	6	25.0	-	17.6	-						
A-11-129	7	30.0	-	9.9	-						
A-11-130	1	2.0	CL	15.4	-	46	19	27			
A-11-130	2	6.0	CL	27.4	92.9						
A-11-130	3	11.0	CL	23.4	102.6						
A-11-130	4	15.5	-	24.3	-						
A-11-130	5	20.5	-	26.5	83.6						

Borehole	Sample Number	Depth	Classi-fication	Water Content	Dry Density	Liquid Limit	Plastic Limit	Plasticity Index	% > Sieve 4	% < Sieve 200	Unconfined Compressive Strength (tsf)
A-11-130	6	25.5	-	27.1	-						
A-11-130	7	29.5	-	31.8	-						
A-11-131	1	3.0	CL	23.1	100.3						
A-11-131	2	6.0	CL	22.1	99.1	49	19	30			
A-11-131	3	11.0	CL	19.6	109.1						
A-11-131	4	16.0	CL	41.9	70.8						
A-11-131	5	21.0	CL	24.9	96.4						
A-11-131	6	26.0	CL	-	-						
A-11-132	1	3.0	CL	23.8	102.9	43	18	25			
A-11-132	2	6.0	CL	22.1	103.1						
A-11-132	3	11.0	CL	17.5	112.2	42	15	27			
A-11-132	4	16.0	CL	22.1	102.1						
A-11-132	5	20.5	SC	20.1	108.0						
A-11-132	6	25.5	CL	24.8	91.5						
A-11-133	1	3.0	CL	17.2	106.1	39	23	16			
A-11-133	2	6.0	CL	24.5	98.9						
A-11-133	3	10.0	SM	39.5	-						
A-11-133	4	15.5	SM	27.9	-						
A-11-133	5	20.5	SM	27.5	-						
A-11-133	6	26.0	SM	20.5	-						
A-11-134	1	3.0	CH	26.8	96.1						
A-11-134	2	6.0	CH	25.0	96.8	58	24	34			
A-11-134	3	11.0	CL	21.8	101.3						
A-11-134	4	16.0	CL	20.2	106.4						
A-11-134	5	20.5	SC	23.1	-						
A-11-134	6	25.0	SC	26.8	-						
A-11-135	1	3.0	CL	25.1	99.8						
A-11-135	2	6.0	CL	22.3	99.4						3.87
A-11-135	3	11.0	CL	24.1	-						
A-11-135	4	16.0	CL	25.1	-						
A-11-135	5	21.0	CL	27.6	-						
A-11-135	6	26.0	CL	24.6	-						
A-11-135	7	30.0	CL	23.2	-						
A-11-136	1	3.0	CH	20.8	100.3	52	19	33			1.09
A-11-136	2	6.0	CH	18.8	107.0						
A-11-136	3	11.0	CH	20.9	104.5						
A-11-136	4	16.0	CH	20.8	98.9						2.16
A-11-136	5	21.0	SC	17.8	107.2				0.0	24.3	
A-11-136	6	25.0	SC	18.8	-						
A-11-136	7	30.0	CL-ML	24.2	-						
A-11-136	8	35.0	GP	17.5	-						
A-11-136	9	40.0	GC	22.1	-						
A-11-136	10	45.0	GC	16.7	-						

Borehole	Sample Number	Depth	Classi-fication	Water Content	Dry Density	Liquid Limit	Plastic Limit	Plasticity Index	% > Sieve 4	% < Sieve 200	Unconfined Compressive Strength (tsf)
A-11-136	11	50.0	GC	16.8	-						
A-11-137	1	3.0	CL	20.7	102.1						2.08
A-11-137	2	6.0	CL	19.8	106.8						
A-11-137	3	11.0	CL	25.5	97.1	49	24	25			
A-11-137	4	16.0	CL	18.6	103.9						
A-11-137	5	21.0	CL	23.9	100.3						
A-11-137	6	26.0	CL	26.8	95.8						
A-11-137	7	31.0	CL	24.5	99.2						
A-11-138	1	3.0	CH	20.2	107.0						
A-11-138	2	6.0	CH	23.9	98.7	59	22	37			
A-11-138	3	11.0	CL	16.7	98.5				0.4	69.0	
A-11-138	4	16.0	CL	15.9	86.2						
A-11-138	5	21.0	CL	17.6	93.2						
A-11-138	6	26.0	SM	18.8	94.2						
A-11-138	7	31.0	CL	24.3	98.6						
A-11-138	8	36.0	CL	28.2	93.8						1.38
A-11-138	9	41.0	CL	23.5	99.1						
A-11-138	10	46.0	CL	31.0	91.8						
A-11-138	11	51.0	CL	26.5	96.8						0.98
A-11-138	12	55.0	GC	25.5	-						
A-11-139	1	3.0	CL	22.2	-						
A-11-139	2	6.0	CL	18.8	102.1	41	21	20			
A-11-139	3	11.0	CL	20.0	95.8	36	21	15			
A-11-139	4	16.0	CL	20.9	102.1						
A-11-139	5	21.0	CL	22.2	91.5						
A-11-139	6	26.0	CL	24.9	97.3						
A-11-139	7	31.0	CL	27.4	93.4						0.64
A-11-140	1	3.0	CL	26.4	-						
A-11-140	2	6.0	CL	29.6	94.7	35	19	16			
A-11-140	3	11.0	CL	13.9	-						
A-11-140	4	16.0	CL	27.4	96.6	40	19	21			
A-11-140	5	21.0	CL	23.8	92.7						
A-11-140	6	26.0	CL	12.0	-						
A-11-140	7	36.0	CL	25.2	100.2						
A-11-141	1	3.0	CL	21.3	82.9						
A-11-141	2	6.0	CL	23.6	96.4	44	23	21			
A-11-141	3	11.0	CL	23.4	95.1						
A-11-141	4	16.0	CL	27.0	92.6						
A-11-141	5	21.0	CL	16.7	96.8						
A-11-141	6	26.0	CL	21.5	69.9						
A-11-141	7	31.0	CL	-	-						
A-11-141	8	36.0	CL	22.3	89.9						
A-11-142	1	3.0	CL	23.8	90.5						

Borehole	Sample Number	Depth	Classi-fication	Water Content	Dry Density	Liquid Limit	Plastic Limit	Plasticity Index	% > Sieve 4	% < Sieve 200	Unconfined Compressive Strength (tsf)
A-11-142	2	6.0	CL	23.5	90.4	43	21	22			
A-11-142	3	11.0	CL	16.2	91.6						
A-11-142	4	16.0	CL	17.5	94.3						
A-11-142	5	21.0	CL	27.4	94.3						
A-11-142	6	26.0	CL	29.7	93.9						
A-11-143	1	3.0	CH	19.6	105.1	51	19	32			2.65
A-11-143	2	6.0	CH	16.6	-						
A-11-143	3	11.0	CL	16.4	107.8						
A-11-143	4	16.0	CL	18.0	-						
A-11-143	5	21.0	CL	17.3	111.0						
A-11-143	6	25.0	CL	22.8	-						
A-11-143	7	30.0	CL	20.6	-						
A-11-144	1	3.0	CL	23.3	100.1	45	17	28			1.72
A-11-144	2	6.0	CL	19.1	108.6						
A-11-144	3	11.0	CL	27.7	95.2						
A-11-144	4	16.0	CL	24.3	97.5						
A-11-144	5	21.0	CL	16.8	-						
A-11-144	6	26.0	CL	16.6	-						
A-11-144	7	30.5	CL	12.1	-						
A-11-145	1	3.0	CH	23.7	102.6						
A-11-145	2	6.0	CH	19.3	107.9						
A-11-145	3	11.0	CL	24.9	100.1						2.3
A-11-145	4	16.0	CL	28.2	95.4	32	20	12			0.4
A-11-145	5	21.0	CL	31.9	92.0						
A-11-145	6	26.0	CL	30.4	90.8						0.24
A-11-145	7	31.0	CL	23.5	105.2						
A-11-146P	1	6.0	CL	18.0	111.1						
A-11-146P	2	11.0	CL	13.9	111.5	35	16	19			
A-11-146P	3	16.0	CL	18.5	107.6						7
A-11-146P	4	21.0	CL	20.5	106.6						
A-11-147P	1	6.0	CL	28.6	81.9						
A-11-147P	2	11.0	CL	14.1	112.0						
A-11-147P	3	16.0	CL	26.8	94.7						
A-11-147P	4	21.0	CL	27.1	103.7						4.47
A-11-147P	5	26.0	CL	25.9	94.8						



PLASTICITY

	BOREHOLE	SAMPLE #	DEPTH	LL	PL	PI	Fines	Classification
●	A-11-101	1	3.0	59	22	37		Fat CLAY
⧗	A-11-102	2	6.0	61	21	40		Fat CLAY
▲	A-11-103	1	3.0	41	22	19		Lean CLAY
★	A-11-104	3	11.0	61	22	39		Fat CLAY
⊙	A-11-107	4	14.5	38	26	12		SILTSTONE
✿	A-11-108	3	11.0	57	21	36		Fat CLAY
○	A-11-108	5	21.0	31	25	6		SANDY SILT
△	A-11-109	3	11.0	68	28	40		Fat CLAY
⊗	A-11-110	3	11.0	46	24	22		Lean CLAY
⊕	A-11-114	1	3.0	28	19	9		SANDY lean CLAY
□	A-11-115	1	3.0	45	18	27		Lean CLAY
⊗	A-11-115	8	36.0	33	21	12		SANDY lean CLAY
◕	A-11-116P	1	2.0	39	18	21		SANDY lean CLAY with GRAVEL
☆	A-11-117	2	6.0	35	16	19		Lean CLAY
✿	A-11-118	2	6.0	39	20	19		SANDY lean CLAY
■	A-11-119	1	3.0	33	19	14		SANDY lean CLAY
◆	A-11-120	1	3.0	55	24	31		Fat CLAY
◇	A-11-121	1	3.0	49	23	26		Lean CLAY
×	A-11-122	3	9.5	47	20	27		Lean CLAY
✖	A-11-123	7	31.0	NP	NP	NP	24	SILTY SAND

PARIKH CONSULTANTS, INC.
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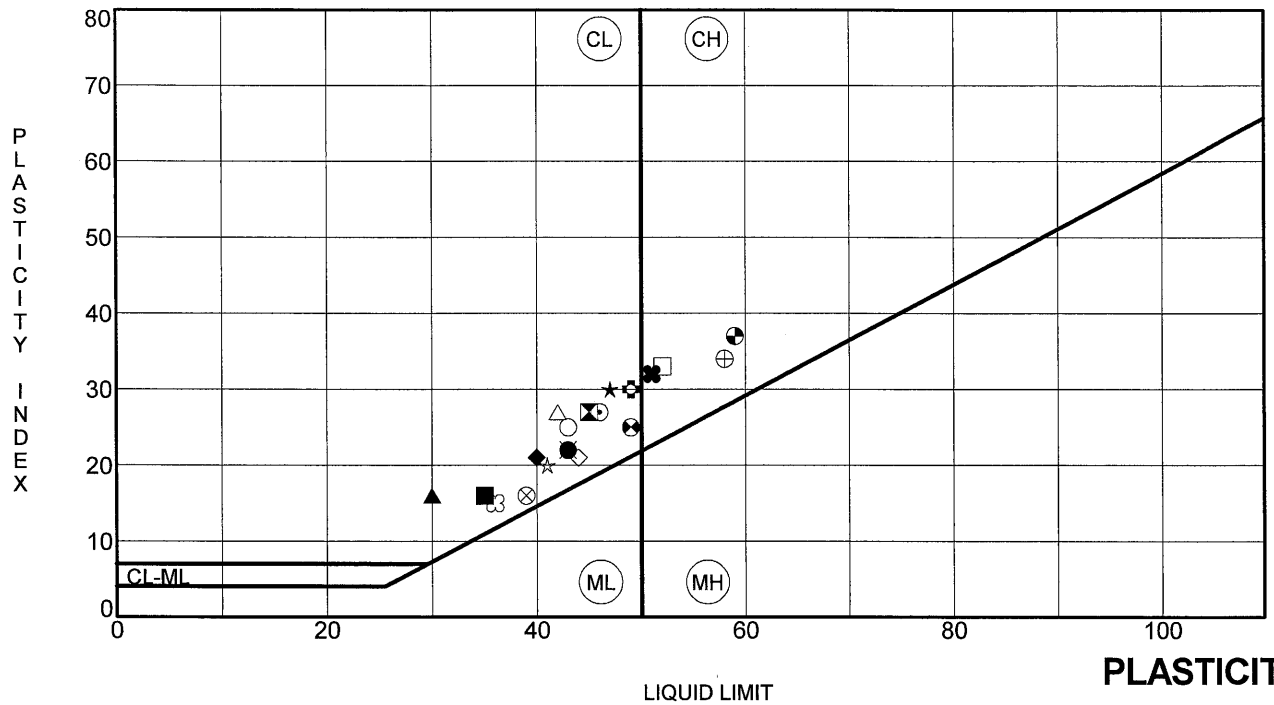
MATERIALS ENGINEERING

RTE 680 AUXILIARY LANE PROJECT SEG. 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO: 2011-124-GDR | PLATE NO: B-3A



PLASTICITY

	BOREHOLE	SAMPLE #	DEPTH	LL	PL	PI	Fines	Classification
●	A-11-124	2	4.5	43	21	22		Lean CLAY
⧗	A-11-125	1	3.0	45	18	27		Lean CLAY with GRAVEL
▲	A-11-125	2	6.0	30	14	16		Lean CLAY with GRAVEL
★	A-11-126	1	3.0	47	17	30		Lean CLAY
⊙	A-11-130	1	2.0	46	19	27		Lean CLAY
✿	A-11-131	2	6.0	49	19	30		Lean CLAY
○	A-11-132	1	3.0	43	18	25		Lean CLAY
△	A-11-132	3	11.0	42	15	27		Lean CLAY
⊗	A-11-133	1	3.0	39	23	16		Lean CLAY with SAND
⊕	A-11-134	2	6.0	58	24	34		Fat CLAY
□	A-11-136	1	3.0	52	19	33		Fat CLAY
⚉	A-11-137	3	11.0	49	24	25		Lean CLAY
◕	A-11-138	2	6.0	59	22	37		Fat CLAY
☆	A-11-139	2	6.0	41	21	20		Lean CLAY
✿	A-11-139	3	11.0	36	21	15		Lean CLAY
■	A-11-140	2	6.0	35	19	16		Lean CLAY with GRAVEL
◆	A-11-140	4	16.0	40	19	21		Lean CLAY with GRAVEL
◇	A-11-141	2	6.0	44	23	21		Lean CLAY
×	A-11-142	2	6.0	43	21	22		Lean CLAY
✖	A-11-143	1	3.0	51	19	32		Fat CLAY

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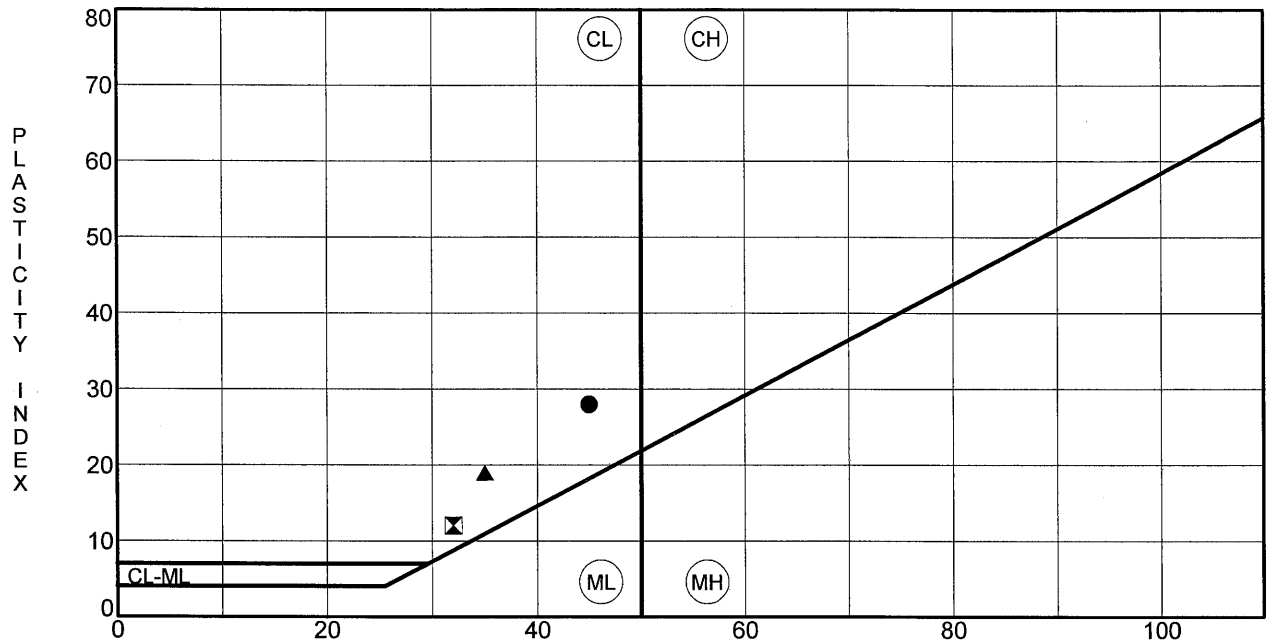
MATERIALS ENGINEERING

RTE 680 AUXILIARY LANE PROJECT SEG. 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO: 2011-124-GDR | PLATE NO: B-3B



PLASTICITY

	BOREHOLE	SAMPLE #	DEPTH	LL	PL	PI	Fines	Classification
●	**A-11-144**	**1**	**3.0**	**45**	**17**	**28**		**Lean CLAY**
⧗	**A-11-145**	**4**	**16.0**	**32**	**20**	**12**		**Lean CLAY**
▲	**A-11-146P**	**2**	**11.0**	**35**	**16**	**19**		**Lean CLAY**

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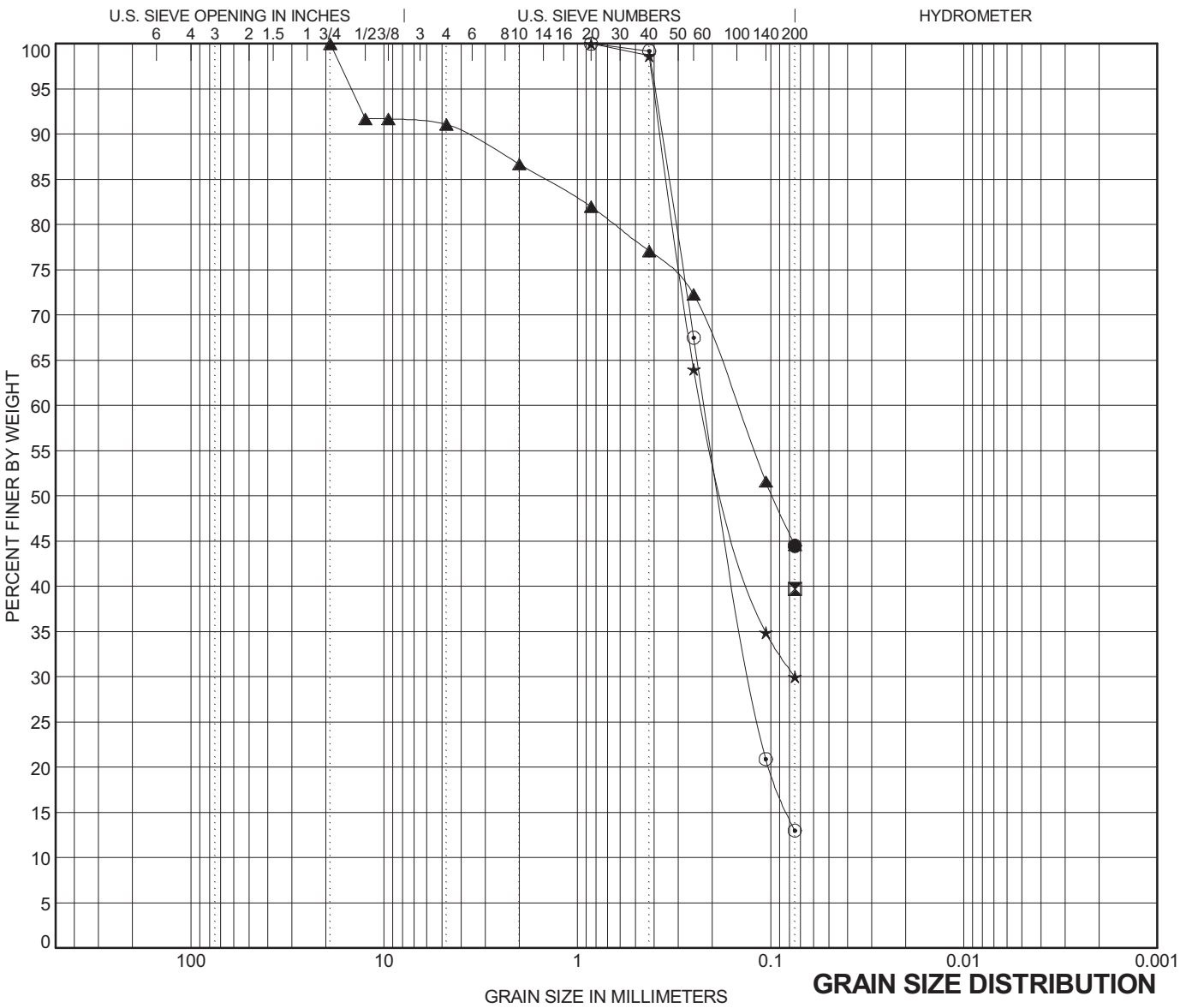
RTE 680 AUXILIARY LANE PROJECT SEG. 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO: 2011-124-GDR | PLATE NO: B-3C



GRAIN SIZE DISTRIBUTION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING	SAMPLE #	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	A-11-114	10	44.5	SILTY SAND					
⊠	A-11-115	6	26.0	CLAYEY SAND					
▲	A-11-116	2	6.0	CLAYEY SAND with GRAVEL					
★	A-11-118	4	16.0	SILTY SAND					
⊙	A-11-119	2	6.0	SILTY SAND					

	BORING	SAMPLE #	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	A-11-114	10	44.5	0.075						44.5	
⊠	A-11-115	6	26.0	0.075						39.7	
▲	A-11-116	2	6.0	19	0.15			8.9	46.5	44.6	
★	A-11-118	4	16.0	0.85	0.222	0.075		0.0	70.0	30.0	
⊙	A-11-119	2	6.0	0.85	0.218	0.125		0.0	87.0	13.0	

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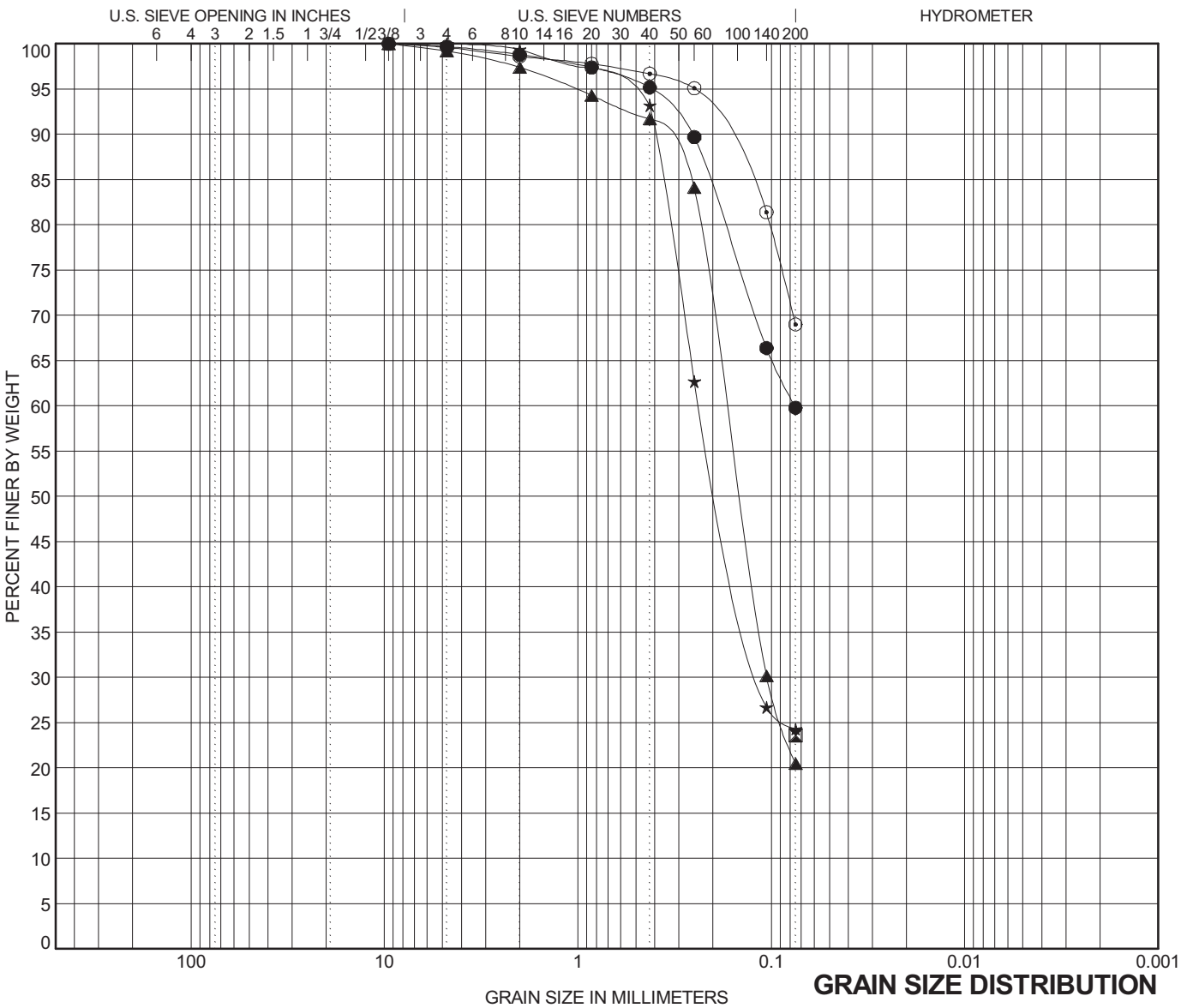
JOB NO: 2011-124-GDR

PLATE NO: B-4A



GRAIN SIZE DISTRIBUTION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING	SAMPLE #	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	A-11-122	1	3.0	SANDY lean CLAY					
⧗	A-11-123	7	31.0	SILTY SAND	NP	NP	NP		
▲	A-11-125	3	10.0	SILTY SAND					
★	A-11-136	5	21.0	CLAYEY SAND					
⊙	A-11-138	3	11.0	SANDY lean CLAY					

	BORING	SAMPLE #	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	A-11-122	1	3.0	9.5	0.076			0.3	39.9	59.8	
⧗	A-11-123	7	31.0	0.075						23.6	
▲	A-11-125	3	10.0	9.5	0.17	0.105		0.8	78.7	20.5	
★	A-11-136	5	21.0	4.75	0.234	0.115		0.0	75.7	24.3	
⊙	A-11-138	3	11.0	9.5				0.4	30.6	69.0	

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MATERIALS ENGINEERING

RTE 680 AUXILIARY LANE PROJECT SEG. 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO: 2011-124-GDR

PLATE NO: B-4B

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 09/21/2011
Date Submitted 09/15/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-WAL/I680 Site ID : A11-101#2 @ 6'.
Thank you for your business.

* For future reference to this analysis please use SUN # 61004-125210.

EVALUATION FOR SOIL CORROSION

Soil pH	7.63	
Minimum Resistivity	0.54 ohm-cm (x1000)	
Chloride	48.2 ppm	00.00482 %
Sulfate	198.5 ppm	00.01985 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

SEP 22 2011

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 07/29/2011
Date Submitted 07/25/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-WAL/I680 Site ID : A-11-106#2@ 6'.
Thank you for your business.

* For future reference to this analysis please use SUN # 60645-124210.

EVALUATION FOR SOIL CORROSION

Soil pH	6.97	
Minimum Resistivity	1.66 ohm-cm (x1000)	
Chloride	26.8 ppm	00.00268 %
Sulfate	46.9 ppm	00.00469 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

AUG 3 2011

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 07/29/2011
Date Submitted 07/25/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-WAL/I680 Site ID : A-11-108#2@ 6'.
Thank you for your business.

* For future reference to this analysis please use SUN # 60645-124208.

EVALUATION FOR SOIL CORROSION

Soil pH	7.57		
Minimum Resistivity	0.83 ohm-cm (x1000)		
Chloride	21.0 ppm	00.00210	%
Sulfate	71.4 ppm	00.00714	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

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AUG 9 2011

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 07/29/2011
Date Submitted 07/25/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-WAL/I680 Site ID : A-11-109#2@ 6'.
Thank you for your business.

* For future reference to this analysis please use SUN # 60645-124207.

EVALUATION FOR SOIL CORROSION

Soil pH	7.27	
Minimum Resistivity	1.05 ohm-cm (x1000)	
Chloride	39.5 ppm	00.00395 %
Sulfate	77.0 ppm	00.00770 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

AUG - 9 2011

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 08/12/2011
Date Submitted 08/08/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-WAL/I680 Site ID : A11-110-WAL#2@6.
Thank you for your business.

* For future reference to this analysis please use SUN # 60766-124507.

EVALUATION FOR SOIL CORROSION

Soil pH	7.56	
Minimum Resistivity	0.28 ohm-cm (x1000)	
Chloride	71.4 ppm	00.00714 %
Sulfate	1137.9 ppm	00.11379 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

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Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 08/05/2011
Date Submitted 08/01/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-WAL/I680 Site ID : A11-114#3 @ 10'.
Thank you for your business.

* For future reference to this analysis please use SUN # 60727-124429.

EVALUATION FOR SOIL CORROSION

Soil pH	7.20	
Minimum Resistivity	1.42 ohm-cm (x1000)	
Chloride	11.8 ppm	00.00118 %
Sulfate	15.5 ppm	00.00155 %

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 08/05/2011
Date Submitted 08/01/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-WAL/I680 Site ID : A11-118#2 @ 6'.
Thank you for your business.

* For future reference to this analysis please use SUN # 60727-124428.

EVALUATION FOR SOIL CORROSION

Soil pH	7.56		
Minimum Resistivity	1.98 ohm-cm (x1000)		
Chloride	8.0 ppm	00.00080	%
Sulfate	17.1 ppm	00.00171	%

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 07/29/2011
Date Submitted 07/25/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-WAL/I680 Site ID : A-11-120#4@ 16'.
Thank you for your business.

* For future reference to this analysis please use SUN # 60645-124209.

EVALUATION FOR SOIL CORROSION

Soil pH	6.91	
Minimum Resistivity	1.77 ohm-cm (x1000)	
Chloride	27.2 ppm	00.00272 %
Sulfate	43.4 ppm	00.00434 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

AUG 9 2011

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 07/29/2011
Date Submitted 07/25/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-WAL/I680 Site ID : A-11-122#2@4.5'.
Thank you for your business.

* For future reference to this analysis please use SUN # 60645-124213.

EVALUATION FOR SOIL CORROSION

Soil pH	7.34		
Minimum Resistivity	1.15 ohm-cm (x1000)		
Chloride	57.2 ppm	00.00572	%
Sulfate	111.9 ppm	00.01119	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

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Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 08/05/2011
Date Submitted 08/01/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-WAL/I680 Site ID : A11-127#1 @ 2.5.
Thank you for your business.

* For future reference to this analysis please use SUN # 60727-124431.

EVALUATION FOR SOIL CORROSION

Soil pH	7.45	
Minimum Resistivity	0.96 ohm-cm (x1000)	
Chloride	11.9 ppm	00.00119 %
Sulfate	12.3 ppm	00.00123 %

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 07/29/2011
Date Submitted 07/25/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-WAL/I680 Site ID : A-11-133#2@ 6'.
Thank you for your business.

* For future reference to this analysis please use SUN # 60645-124212.

EVALUATION FOR SOIL CORROSION

Soil pH	6.39	
Minimum Resistivity	1.47 ohm-cm (x1000)	
Chloride	27.1 ppm	00.00271 %
Sulfate	79.4 ppm	00.00794 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

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Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 07/29/2011
Date Submitted 07/25/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-WAL/I680 Site ID : A-11-137#2 @ 6'.
Thank you for your business.

* For future reference to this analysis please use SUN # 60645-124211.

EVALUATION FOR SOIL CORROSION

Soil pH	7.62		
Minimum Resistivity	0.88 ohm-cm (x1000)		
Chloride	19.2 ppm	00.00192	%
Sulfate	36.8 ppm	00.00368	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

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Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 08/26/2011
Date Submitted 08/23/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-WAL/I-680 Site ID : A11-140#2 @ 6'.
Thank you for your business.

* For future reference to this analysis please use SUN # 60860-124831.

EVALUATION FOR SOIL CORROSION

Soil pH	7.50	
Minimum Resistivity	0.67 ohm-cm (x1000)	
Chloride	18.3 ppm	00.00183 %
Sulfate	90.9 ppm	00.00909 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 08/05/2011
Date Submitted 08/01/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-WAL/I680 Site ID : A11-142#1 @ 3'.
Thank you for your business.

* For future reference to this analysis please use SUN # 60727-124430.

EVALUATION FOR SOIL CORROSION

Soil pH	6.90	
Minimum Resistivity	1.34 ohm-cm (x1000)	
Chloride	15.5 ppm	00.00155 %
Sulfate	1.6 ppm	00.00016 %

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 09/02/2011
Date Submitted 08/30/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-GDR/680 Site ID : A11-143#2 @ 6'.
Thank you for your business.

* For future reference to this analysis please use SUN # 60911-124962.

EVALUATION FOR SOIL CORROSION

Soil pH	7.47	
Minimum Resistivity	1.93 ohm-cm (x1000)	
Chloride	14.5 ppm	00.00145 %
Sulfate	66.9 ppm	00.00669 %

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 09/02/2011
Date Submitted 08/30/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-GDR/680 Site ID : A11-144#2 @ 6'.
Thank you for your business.

* For future reference to this analysis please use SUN # 60911-124963.

EVALUATION FOR SOIL CORROSION

Soil pH	7.64		
Minimum Resistivity	0.83 ohm-cm (x1000)		
Chloride	38.2 ppm	00.00382	%
Sulfate	680.7 ppm	00.06807	%

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 09/02/2011
Date Submitted 08/30/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-GDR/680 Site ID : A11-145#1 @ 3'.
Thank you for your business.

* For future reference to this analysis please use SUN # 60911-124961.

EVALUATION FOR SOIL CORROSION

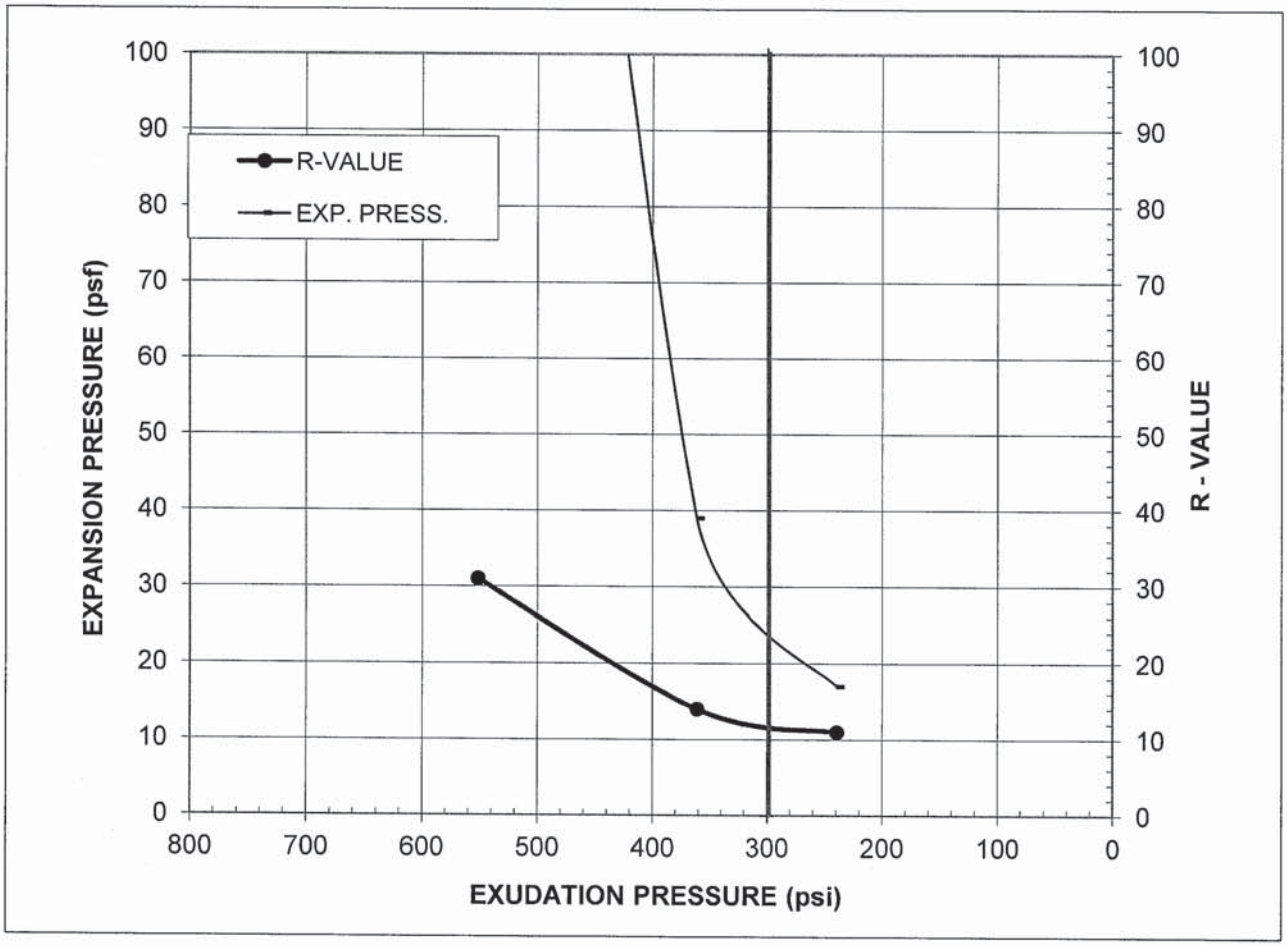
Soil pH	6.99		
Minimum Resistivity	0.67 ohm-cm (x1000)		
Chloride	15.2 ppm	00.00152	%
Sulfate	143.1 ppm	00.01431	%

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

R-VALUE REPORT

Parikh Consultants, Inc. | ASTM D2844 or CTM 301 | (408) 452-9000

Project Name:	I - 680 Aux. Lane - Seg. 2	Date:	2/9/12
Client:	Mark Thomas & Associates	Project #:	2011-124-GDR
Sample #: R-3	Depth: 0'-5'	Lab #:	M844
Location / Source:	Onsite / native	Sample Date:	
Material :	Lean Clay, olive	Sampled By:	



Specimen No.	A	B	C
Exudation Pressure, psi	239.31	361.45	551.74
Expansion Pressure, psf	17	39	259
R-Value	11	14	31
Moisture Content at Test, %	20.5	19.1	17.7
Dry Density at Test, pcf	104.4	106.4	111.7

R-Value @ 300 psi Exudation Pressure = 11

Expansion Pressure @300 psi Exudation, psf = **24**

Minimum R-Value Requirement:

Comments:

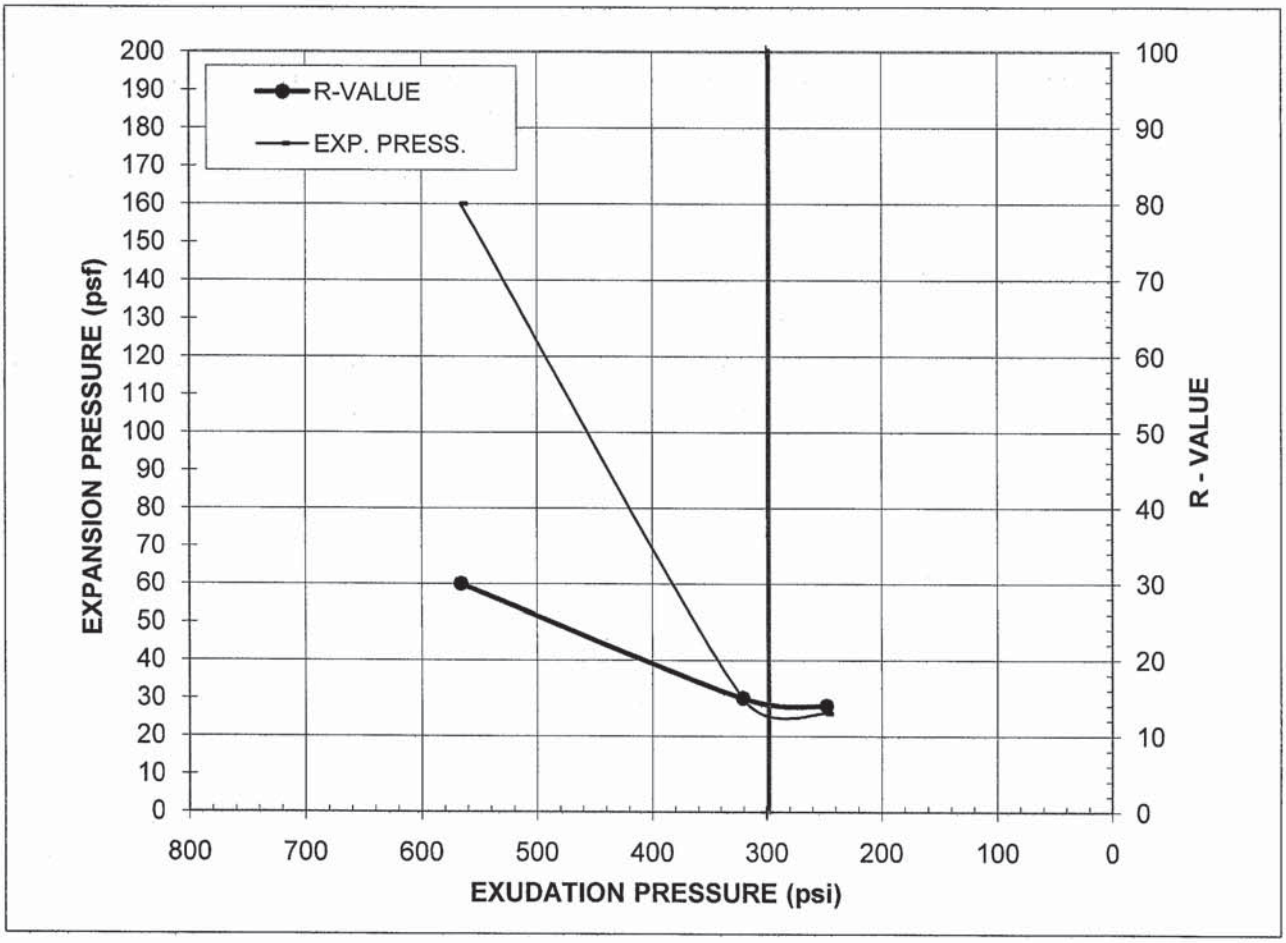
Report By: Prav Dayah

RVALUE with calcs pdp

R-VALUE REPORT

Parikh Consultants, Inc. **ASTM D2844 or CTM 301** (408) 452-9000

Project Name:	Interstate 680 Aux. Lanes Seg. 2	Date:	8/19/11
Client:	Mark Thomas & Company Inc.	Project #:	2011-124-GDR
Sample #: R-12	Depth: 0'-5'	Lab #:	M824
Location / Source:	Onsite / Native		
Material :	Lean Clay with Sand and Gravel, brown		



Specimen No.	A	B	C
Exudation Pressure, psi	248	321	566
Expansion Pressure, psf	26	30	160
R-Value	14	15	30
Moisture Content at Test, %	18.3	16.4	14.6
Dry Density at Test, pcf	112.6	112.9	117.5

R-Value @ 300 psi Exudation Pressure = 15

Expansion Pressure @300 psi Exudation, psf = **28**

Minimum R-Value Requirement:

Comments:

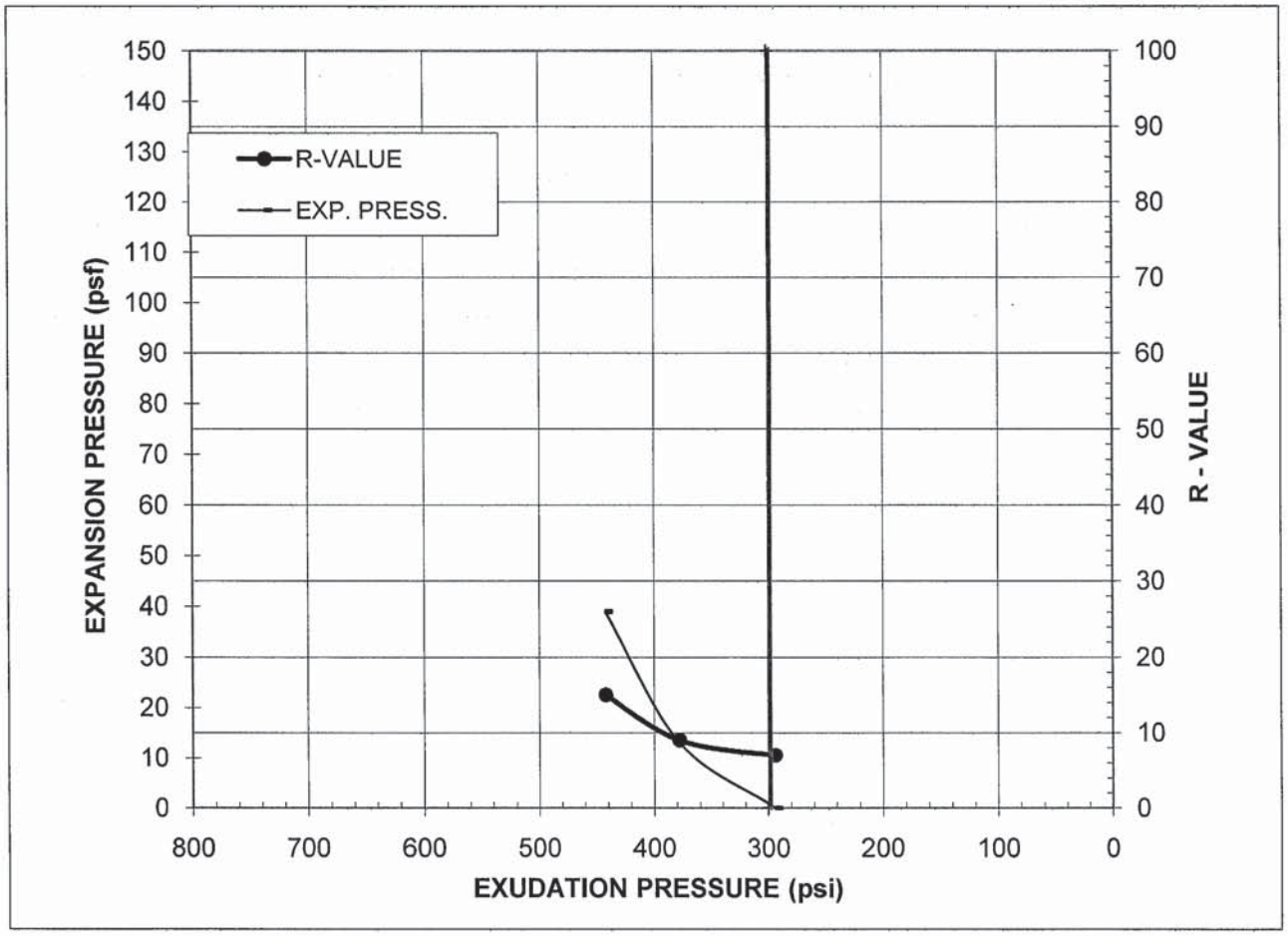
Report By: Prav Dayah

RVALUE with calcs pdp

R-VALUE REPORT

Parikh Consultants, Inc. | ASTM D2844 or CTM 301 | (408) 452-9000

Project Name:	Interstate 680 Aux. Lanes Seg. 2	Date:	8/18/11
Client:	Mark Thomas & Company Inc.	Project #:	2011-124-GDR
Sample #: R-13	Depth: 0'-5'	Lab #:	M824
Location / Source:	Onsite / Native		
Material :	Fat Clay with sand and some gravel, dark brown		



Specimen No.	A	B	C
Exudation Pressure, psi	294	378	442
Expansion Pressure, psf	0	13	39
R-Value	7	9	15
Moisture Content at Test, %	20.6	18.7	16.8
Dry Density at Test, pcf	107.0	111.3	115.6

R-Value @ 300 psi Exudation Pressure = 7

Expansion Pressure @300 psi Exudation, psf = **0**

Minimum R-Value Requirement:

Comments:

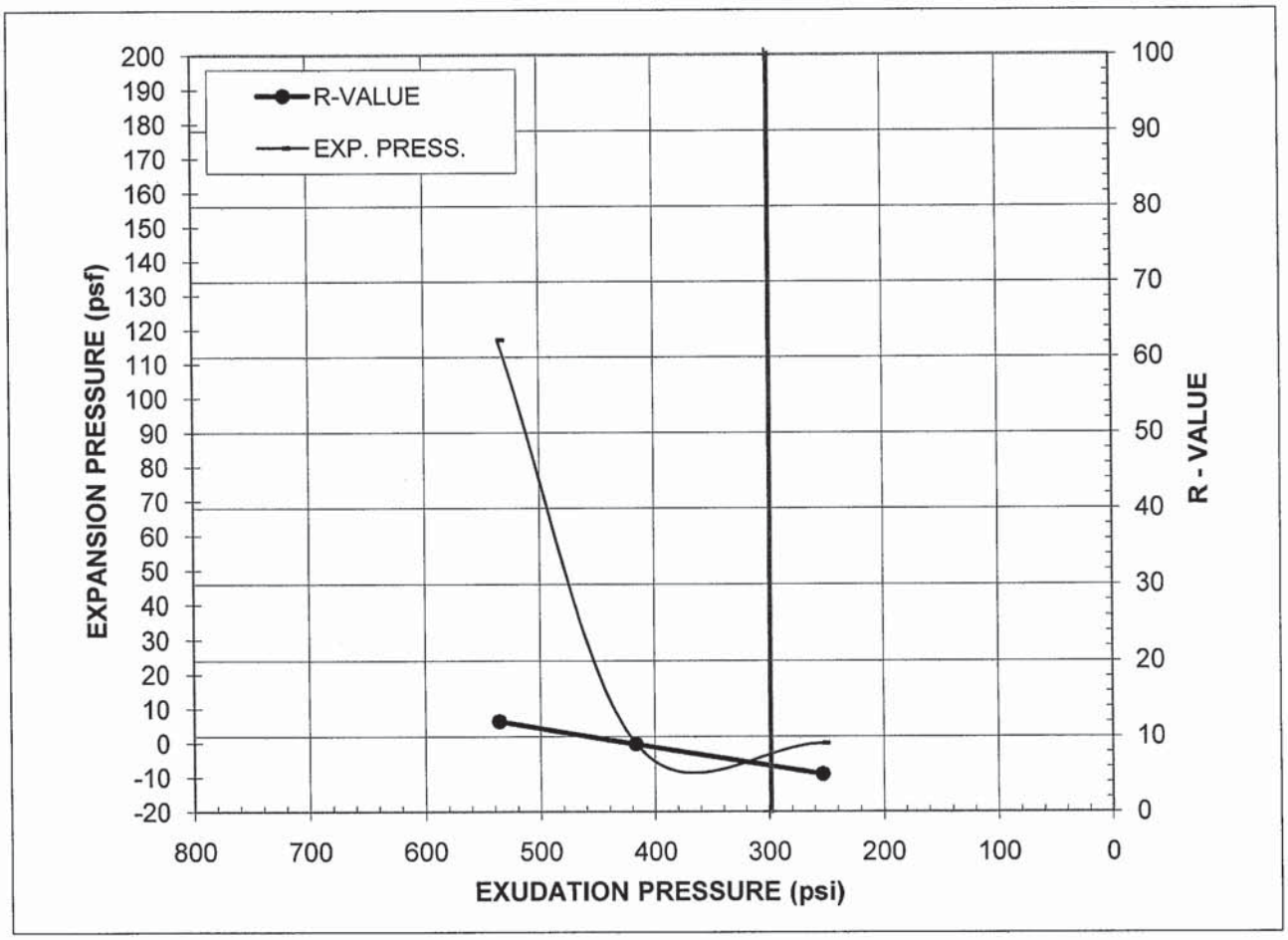
Report By: Prav Dayah

RVALUE with calcs pdp

R-VALUE REPORT

Parikh Consultants, Inc. | ASTM D2844 or CTM 301 | (408) 452-9000

Project Name:	Interstate 680 Aux. Lanes Seg. 2	Date:	8/19/11
Client:	Mark Thomas & Company Inc.	Project #:	2011-124-GDR
Sample #: R-16	Depth: 0'-5'	Lab #:	M824
Location / Source:	Onsite / Native		
Material :	Lean Clay with Gravel, dark brown		



Specimen No.	A	B	C
Exudation Pressure, psi	253	417	536
Expansion Pressure, psf	0	0	117
R-Value	5	9	12
Moisture Content at Test, %	27.1	23.2	21.3
Dry Density at Test, pcf	94.4	100.6	103.7

R-Value @ 300 psi Exudation Pressure = 6

Expansion Pressure @300 psi Exudation, psf = **0**

Minimum R-Value Requirement:

Comments:

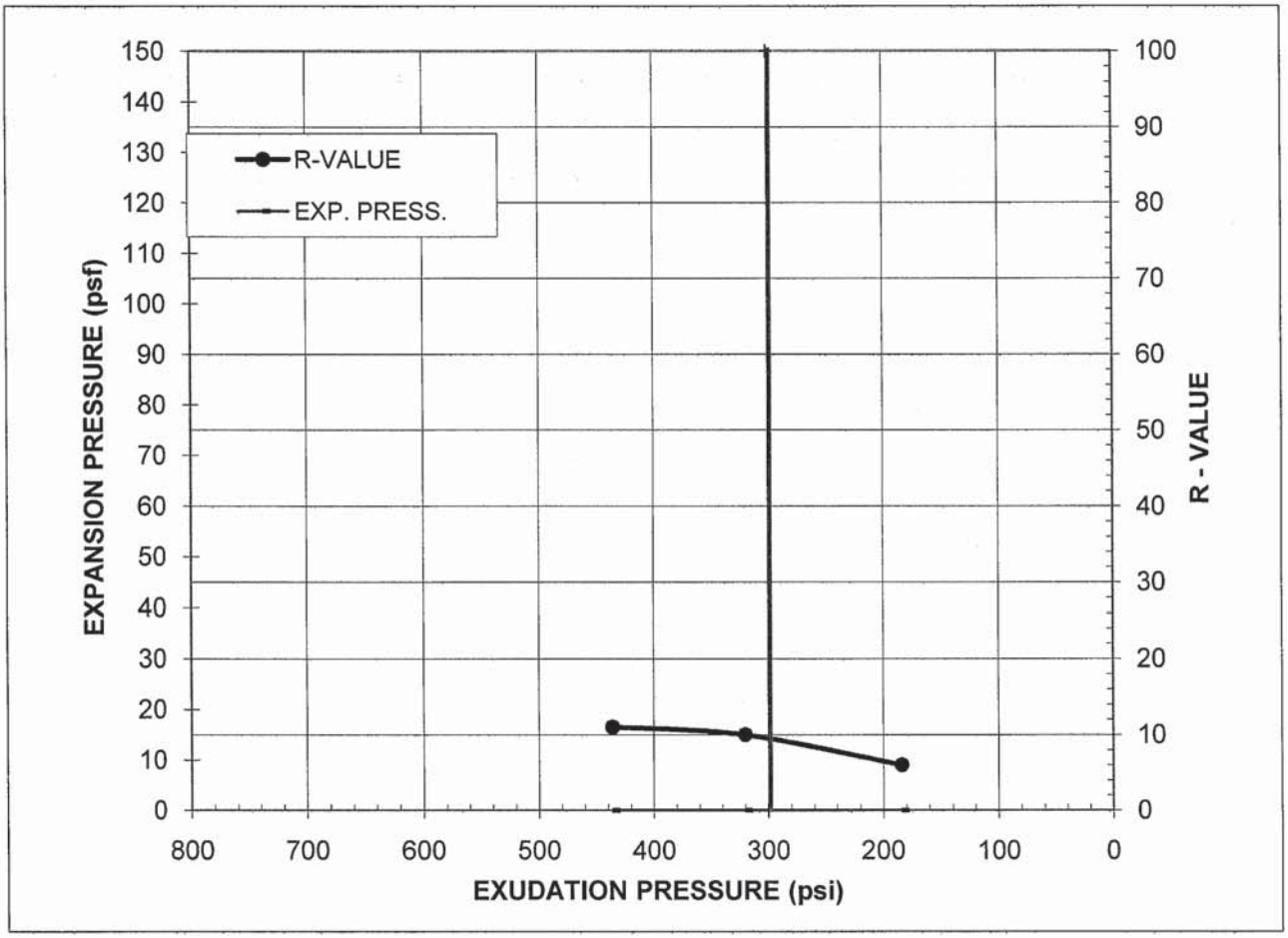
Report By: Prav Dayah

RVALUE with calcs pdp

R-VALUE REPORT

Parikh Consultants, Inc. | ASTM D2844 or CTM 301 | (408) 452-9000

Project Name:	Interstate 680 Aux. Lanes Seg. 2	Date:	8/18/11
Client:	Mark Thomas & Company Inc.	Project #:	2011-124-GDR
Sample #: R-17	Depth: 0'-5'	Lab #:	M824
Location / Source:	Onsite / Native		
Material :	Lean Clay with some Sand and Gravel, dark brown		



Specimen No.	A	B	C
Exudation Pressure, psi	184	320	436
Expansion Pressure, psf	0	0	0
R-Value	6	10	11
Moisture Content at Test, %	23.9	22.9	21.0
Dry Density at Test, pcf	95.5	98.2	102.5

R-Value @ 300 psi Exudation Pressure = 10

Expansion Pressure @300 psi Exudation, psf = **0**

Minimum R-Value Requirement:

Comments:

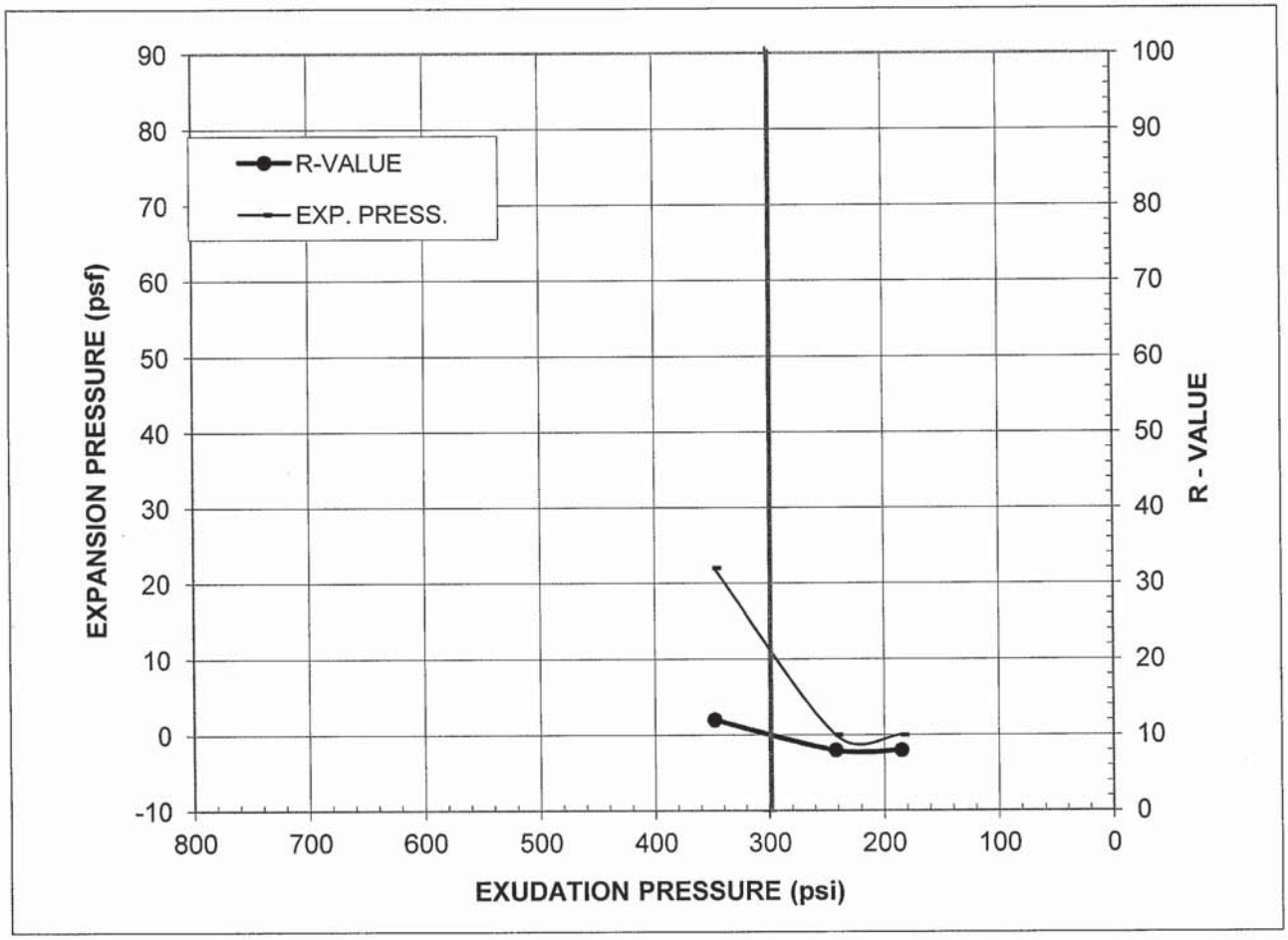
Report By: Prav Dayah

RVALUE with calcs pdp

R-VALUE REPORT

Parikh Consultants, Inc. — ASTM D2844 or CTM 301 — (408) 452-9000

Project Name:	I - 680 Aux. Lane - Seg. 2	Date:	2/8/12
Client:	Mark Thomas & Associates	Project #:	2011-124-GDR
Sample #: R-18	Depth: 0'-5'	Lab #:	M844
Location / Source:	Onsite / native	Sample Date:	
Material :	Fat Clay, brown	Sampled By:	



Specimen No.	A	B	C
Exudation Pressure, psi	185	242	348
Expansion Pressure, psf	0	0	22
R-Value	8	8	12
Moisture Content at Test, %	22.5	20.6	18.3
Dry Density at Test, pcf	101.9	105.2	109.4

R-Value @ 300 psi Exudation Pressure = 10

Expansion Pressure @300 psi Exudation, psf = **10**

Minimum R-Value Requirement:

Comments:

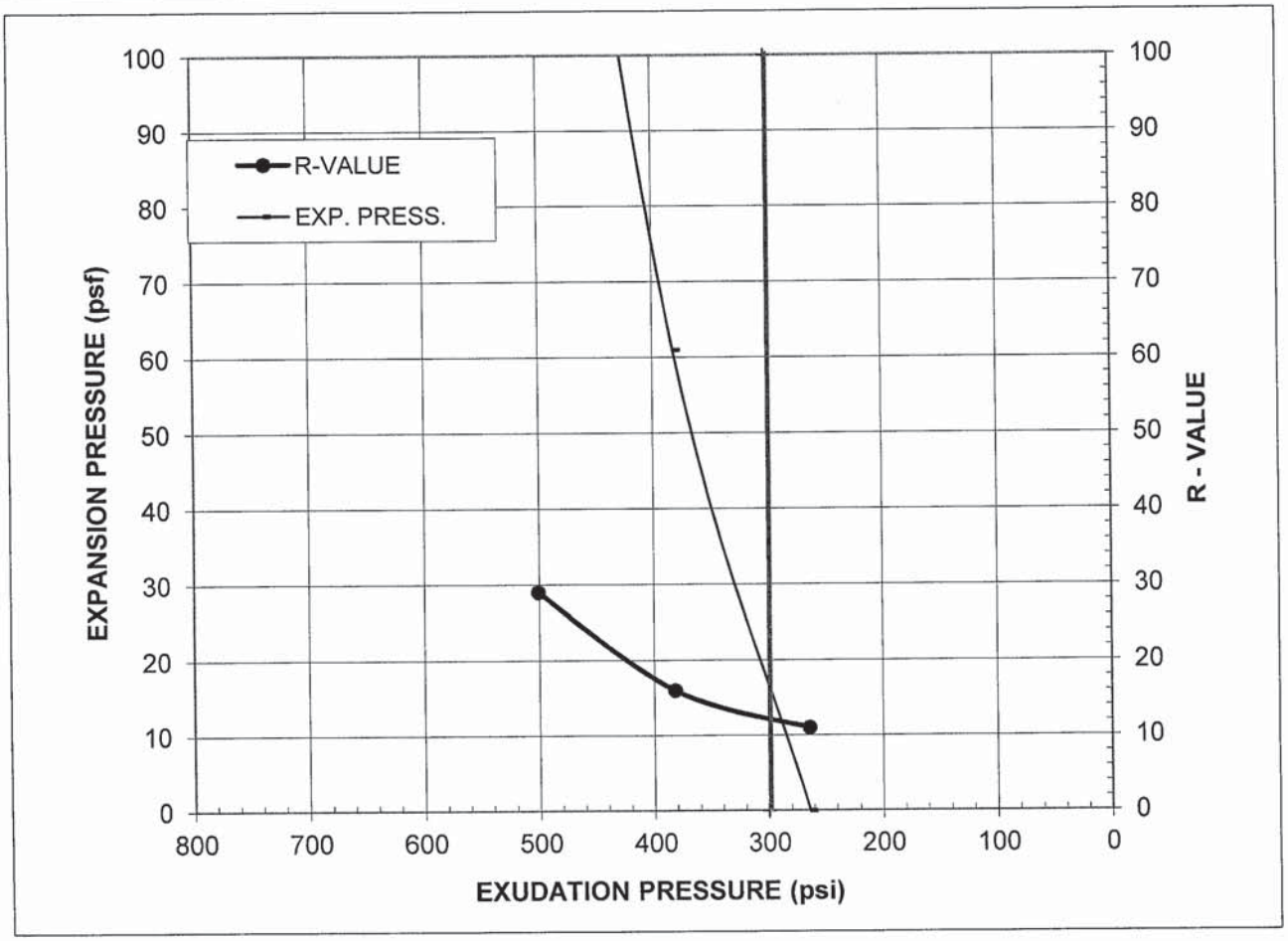
Report By: Prav Dayah

RVALUE with calcs pdp

R-VALUE REPORT

Parikh Consultants, Inc. ASTM D2844 or CTM 301 (408) 452-9000

Project Name:	I - 680 Aux. Lane - Seg. 2	Date:	2/9/12
Client:	Mark Thomas & Associates	Project #:	2011-124-GDR
Sample #: R-20	Depth: 0'-5'	Lab #:	M844
Location / Source:	Onsite / native	Sample Date:	
Material :	Lean Clay, brown	Sampled By:	



Specimen No.	A	B	C
Exudation Pressure, psi	264	382	501
Expansion Pressure, psf	0	61	176
R-Value	11	16	29
Moisture Content at Test, %	21.0	19.3	17.5
Dry Density at Test, pcf	102.6	105.6	110.6

R-Value @ 300 psi Exudation Pressure = 12

Expansion Pressure @300 psi Exudation, psf = **16**

Minimum R-Value Requirement:

Comments:

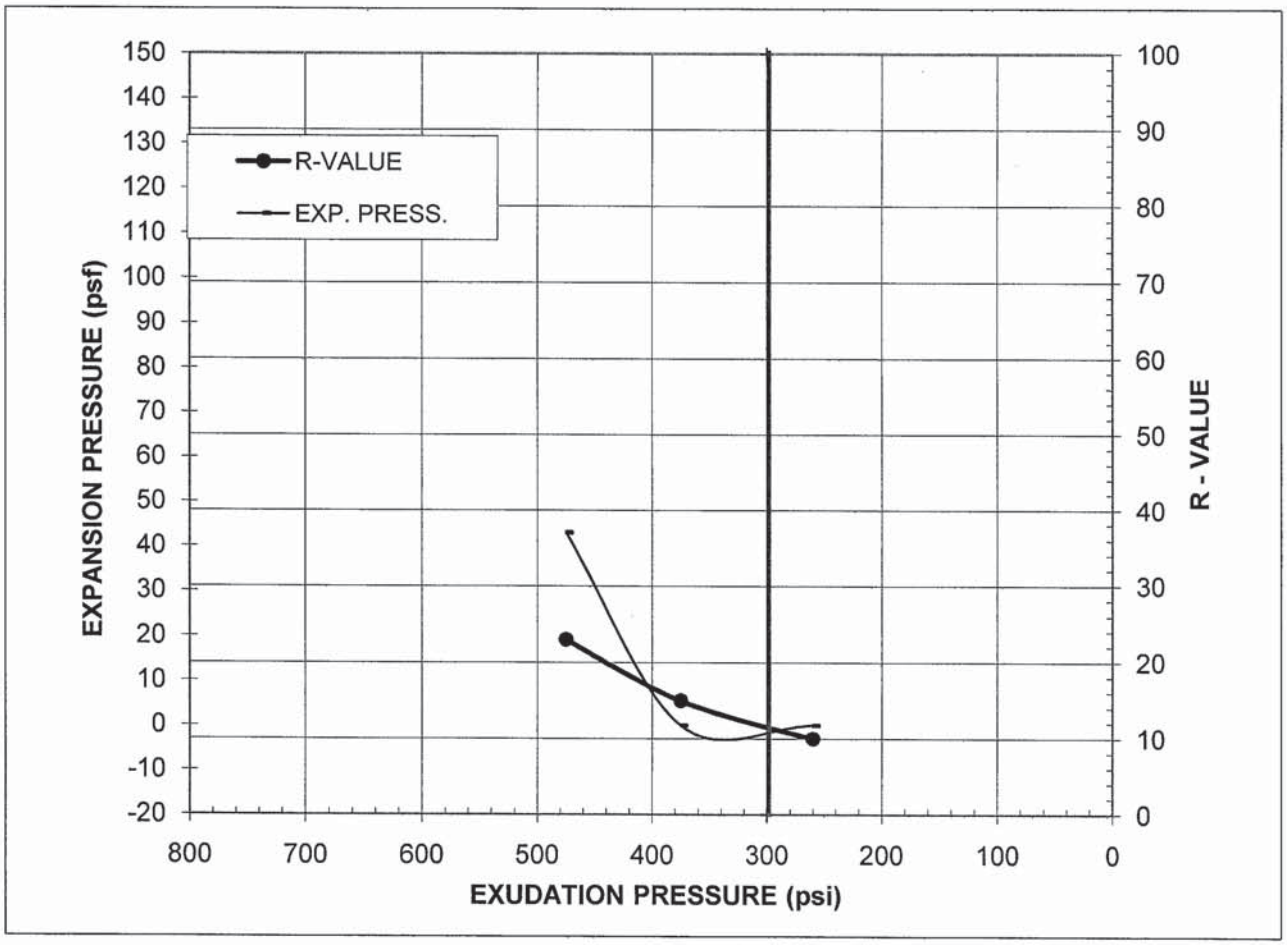
Report By: Prav Dayah

RVALUE with calcs pdp

R-VALUE REPORT

Parikh Consultants, Inc. **ASTM D2844 or CTM 301** (408) 452-9000

Project Name:	Interstate 680 Aux. Lanes Seg. 2	Date:	8/18/11
Client:	Mark Thomas & Company Inc.	Project #:	2011-124-GDR
Sample #: R-21	Depth: 0'-5'	Lab #:	M824
Location / Source:	Onsite / Native		
Material :	Lean Clay with some Gravel, dark brown		



Specimen No.	A	B	C
Exudation Pressure, psi	260	375	475
Expansion Pressure, psf	0	0	43
R-Value	10	15	23
Moisture Content at Test, %	24.9	22.9	21.4
Dry Density at Test, pcf	95.8	99.6	103.0

R-Value @ 300 psi Exudation Pressure = 11

Expansion Pressure @300 psi Exudation, psf = **0**

Minimum R-Value Requirement:

Comments:

Report By: Prav Dayah

RVALUE with calcs pdp

Unconfined Compressive Strength of Lime-Treated Soils & Aggregates (Caltrans 373)

CTL Job No:	157-292A	**Boring:**	R-2	Avg Peak Load, lbs	6891
Client:	Parikh Consultants	**Sample:**			
Project Name:	Rte 680 Aux. Lane Segment 2	**Depth, ft:**	0-5	**Avg. Unconfined Compressive Strength, psi**	**548**
Project No.:	2011-124-GDR	**Date:** 10/6/2011	**By:** PJ		
Soil Description:	Brown Sandy CLAY				
Lime Source:	Chemical Lime Company	**Lime Type:**	SS Lime	**Avg. Unconfined Compressive Strength, Mpa**	**3.78**
Percent Lime Added:	6.0				

	Compaction					Compression	
Specimen Number	A	B	C	D	E	F	G
Total Water (%):	13.7	11.7	15.7	17.7	19.9	17.7	17.7
Dry Density, D_d (kg/m^3):	1702	1653	1726	1743	1731	1681	1680
Dry Density, D_d (pcf):	106.3	103.2	107.8	108.8	108.1	104.9	104.9
Peak Load (lbs):						6628	7153
Unconfined Compressive Strength (psi):						527.5	569.2
Unconfined Compressive Strength (MPa):						3.637	3.925

The Zero Air-Voids curves represent the dry density at 100% saturation for each value of specific gravity

Unconfined Compressive Strength of Lime-Treated Soils & Aggregates (Caltrans 373)

CTL Job No:	157-292B	**Boring:**	R-8	Avg Peak Load, lbs	6798
Client:	Parikh Consultants	**Sample:**			
Project Name:	Rte 680 Aux. Lane Segment 2	**Depth, ft:**	0-5	**Avg. Unconfined Compressive Strength, psi**	**541**
Project No.:	2011-124-GDR	**Date:** 10/6/2011	**By:** PJ		
Soil Description:	Brown Sandy CLAY				
Lime Source:	Chemical Lime Company	**Lime Type:**	SS Lime	**Avg. Unconfined Compressive Strength, Mpa**	**3.73**
Percent Lime Added:	6.0				

	Compaction					Compression	
Specimen Number	A	B	C	D	E	F	G
Total Water (%):	15.6	17.6	19.5	21.5		17.6	17.6
Dry Density, D_d (kg/m^3):	1728	1746	1734	1688		1690	1678
Dry Density, D_d (pcf):	107.8	109.0	108.2	105.3		105.5	104.8
Peak Load (lbs):						6778	6818
Unconfined Compressive Strength (psi):						539.4	542.6
Unconfined Compressive Strength (MPa):						3.719	3.741

The Zero Air-Voids curves represent the dry density at 100% saturation for each value of specific gravity

COOPER TESTING LABORATORY

Unconfined Compressive Strength of Lime-Treated Soils & Aggregates (Caltrans 373)

CTL Job No:	157-292C	**Boring:**	R-11	Avg Peak Load, lbs	4943
Client:	Parikh Consultants	**Sample:**			
Project Name:	Rte 680 Aux. Lane Segment 2	**Depth, ft:**	0-5	**Avg. Unconfined Compressive Strength, psi**	**393**
Project No.:	2011-124-GDR	**Date:** 10/6/2011	**By:** PJ		
Soil Description:	Brown Clayey SAND				
Lime Source:	Chemical Lime Company	**Lime Type:**	SS Lime	**Avg. Unconfined Compressive Strength, Mpa**	**2.71**
Percent Lime Added:	6.0				

	Compaction					Compression	
Specimen Number	A	B	C	D	E	F	G
Total Water (%):	16.8	14.9	18.9			16.8	16.8
Dry Density, D_d (kg/m^3):	1778	1743	1763			1681	1690
Dry Density, D_d (pcf):	111.0	108.8	110.0			104.9	105.5
Peak Load (lbs):						4326	5559
Unconfined Compressive Strength (psi):						344.3	442.4
Unconfined Compressive Strength (MPa):						2.374	3.050

The Zero Air-Voids curves represent the dry density at 100% saturation for each value of specific gravity

Unconfined Compressive Strength of Lime-Treated Soils & Aggregates (Caltrans 373)

CTL Job No:	157-292D	**Boring:**	R-14	Avg Peak Load, lbs	3464
Client:	Parikh Consultants	**Sample:**			
Project Name:	Rte 680 Aux. Lane Segment 2	**Depth, ft:**	0-5	**Avg. Unconfined Compressive Strength, psi**	**276**
Project No.:	2011-124-GDR	**Date:** 10/6/2011	**By:** PJ		
Soil Description:	Brown Clayey SAND				
Lime Source:	Chemical Lime Company	**Lime Type:**	SS Lime	**Avg. Unconfined Compressive Strength, Mpa**	**1.90**
Percent Lime Added:	6.0				

	Compaction					Compression	
Specimen Number	A	B	C	D	E	F	G
Total Water (%):	15.4	13.4	17.4			15.4	15.4
Dry Density, D_d (kg/m^3):	1846	1810	1809			1749	1771
Dry Density, D_d (pcf):	115.2	113.0	112.9			109.2	110.6
Peak Load (lbs):						3778	3150
Unconfined Compressive Strength (psi):						300.7	250.7
Unconfined Compressive Strength (MPa):						2.073	1.728

The Zero Air-Voids curves represent the dry density at 100% saturation for each value of specific gravity

APPENDIX C

LIQUEFACTION POTENTIAL ANALYSIS

PROJECT NAME ***Rte I-680 Auxiliary Lane Project - Seg. 2***
PROJECT NO. ***2011-124-GDR***
BORING NO. ***A-11-102***

BOREHOLE DIA (in)= 5
GW DEPTH (ft)= 14

SOIL GROUPS
1. GRAVELS, SANDS AND NONPLASTIC SILTS
2. CLAYS AND PLASTIC SILTS

HAMMER ENERGY = *55%*

FAULT INFO
Great Valley Fault
a_{max} (g)= 0.72
FAULT M_w = 6.76

MSF = 1.30

Sample No	Depth (ft)	Soil Type	Blow Count	Sampler Type	CYCLIC STRESS RATIO (CSR) σ_v (psf)	σ_v' (psf)	γ_d	CSR	LIQUEFACTION RESISTANCE ($CRR_{7.5}$) SPT-$N_{eq.}$	C_E	C_R	C_S	C_B	N_{60}	C_N	$(N_1)_{60}$	F.C.	$(N_1)_{60,CS}$	$CRR_{7.5}$	F.S.=($CRR_{7.5}$/CSR)*MSF*Kσ*Kα Kσ	Kα	F.S.	Volumetric Strain (%)
1	2	2	23	mc	250	250	1.00		15.0	0.9	0.75	1.0	1.0	10.3	1.66	17.1				1.00	1		
2	5	2	22	mc	625	625	0.99		14.3	0.9	0.75	1.0	1.0	9.8	1.45	14.3				1.00	1		
3	10	2	28	mc	1250	1250	0.98		18.2	0.9	0.80	1.0	1.0	13.3	1.21	16.1				1.00	1		
4	15	2	14	mc	1875	1813	0.97		9.1	0.9	0.85	1.0	1.0	7.1	1.04	7.4				1.00	1		
5	20	2	19	mc	2500	2125	0.96		12.4	0.9	0.95	1.0	1.0	10.8	0.97	10.5				0.98	1		
6	25	1	39	mc	3125	2438	0.94	0.57	25.4	0.9	0.95	1.0	1.0	22.1	0.91	20.1	35%	29.1	0.41	0.92	1	0.88	0.7
7	30	2	29	mc	3750	2750	0.92		18.9	0.9	1.00	1.0	1.0	17.3	0.85	14.8				0.88	1		
8		2	31	mc	0	0	1.00		20.2	0.9	0.75	1.0	1.0	13.9	1.70					1.00	1		
9		2	100	mc	0	0	1.00		65.0	0.9	0.75	1.0	1.0	44.7	1.70					1.00	2		

Total Liquefaction Settlement (in.)= 0.3

1. The correction factors C_E (Energy Ratio), C_B (Borehole Diameter), C_R (Rod Length) and C_S (Sampling Method-liner) are per Youd et al. (2001).
2. For correction of overburden, $C_N = 2.2/(1.2 + \sigma_v'/P_a)$ with a maximum value of 1.7 per Kayen et al. (1992) as cited in Youd et al. (2001).
3. The influence of Fines Contents are expressed by the following correction: $(N_1)_{60cs} = \alpha + \beta\ (N_1)_{60}$

where α and β = coefficients determined from the following relationships

for FC $\leq$ 5% $\alpha = 0$, $\beta = 1.0$

for 5% < FC < 35% $\alpha = \exp(1.76-(190/FC^2))$, $\beta = (0.99+(FC^{1.5}/1000))$

for FC $\geq$ 35% $\alpha = 5.0$, $\beta = 1.2$

Reference: Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER Workshops on Evaluation of Liquefaction Resistance of Soils, Youd, et al., ASCE Journal of Geotechnical and Geoenvironmental Engineering, October 2001, Vol. 127 No. 10

LIQUEFACTION POTENTIAL ANALYSIS

PROJECT NAME ***Rte I-680 Auxiliary Lane Project - Seg. 2***
PROJECT NO. ***2011-124-GDR***
BORING NO. ***A-11-108***

BOREHOLE DIA (in)= 5
GW DEPTH (ft)= 20

SOIL GROUPS
1. GRAVELS, SANDS AND NONPLASTIC SILTS
2. CLAYS AND PLASTIC SILTS

HAMMER ENERGY = *55%*

FAULT INFO
Great Valley Fault
a_{max} (g)= 0.72
FAULT M_w = 6.76

MSF = 1.30

Sample No	Depth (ft)	Soil Type	Blow Count	Sampler Type	CYCLIC STRESS RATIO (CSR) σ_v (psf)	σ_v' (psf)	γ_d	CSR	LIQUEFACTION RESISTANCE ($CRR_{7.5}$) SPT-$N_{eq.}$	C_E	C_R	C_S	C_B	N_{60}	C_N	$(N_1)_{60}$	F.C.	$(N_1)_{60,CS}$	$CRR_{7.5}$	$K\sigma$	$K\alpha$	F.S.	Volumetric Strain (%)
1	2	2	19	mc	250	250	1.00		12.4	0.9	0.75	1.0	1.0	8.5	1.66	14.1				1.00	1		
2	5	2	20	mc	625	625	0.99		13.0	0.9	0.75	1.0	1.0	8.9	1.45	13.0				1.00	1		
3	10	2	16	mc	1250	1250	0.98		10.4	0.9	0.80	1.0	1.0	7.6	1.21	9.2				1.00	1		
4	15	2	17	mc	1875	1875	0.97		11.1	0.9	0.85	1.0	1.0	8.6	1.03	8.9				1.00	1		
5	20	1	9	mc	2500	2494	0.96	0.45	5.9	0.9	0.95	1.0	1.0	5.1	0.90	4.6	35%	10.5	0.12	0.95	1	0.32	2.5
6	25	2	20	mc	3125	2806	0.94		13.0	0.9	0.95	1.0	1.0	11.3	0.85	9.6				0.90	1		
7	30	2	28	mc	3750	3119	0.92		18.2	0.9	1.00	1.0	1.0	16.7	0.80	13.3				0.84	1		
8		2	31	mc	0	0	1.00		20.2	0.9	0.75	1.0	1.0	13.9	1.70					1.00	1		
9		2	100	mc	0	0	1.00		65.0	0.9	0.75	1.0	1.0	44.7	1.70					1.00	2		

*F.S.=($CRR_{7.5}$/CSR)*MSF*K σ*K α*

Total Liquefaction Settlement (in.)= 0.8
No structure at this location

1. The correction factors C_E (Energy Ratio), C_B (Borehole Diameter), C_R (Rod Length) and C_S (Sampling Method-liner) are per Youd et al. (2001).
2. For correction of overburden, $C_N = 2.2/(1.2 + \sigma_v'/P_a)$ with a maximum value of 1.7 per Kayen et al. (1992) as cited in Youd et al. (2001).
3. The influence of Fines Contents are expressed by the following correction: $(N_1)_{60cs} = \alpha + \beta\ (N_1)_{60}$
   where α and β = coefficients determined from the following relationships
   for FC $\leq$ 5% $\alpha = 0$, $\beta = 1.0$
   for 5% < FC < 35% $\alpha = \exp(1.76-(190/FC^2))$, $\beta = (0.99+(FC^{1.5}/1000))$
   for FC $\geq$ 35% $\alpha = 5.0$, $\beta = 1.2$

Reference: Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER Workshops on Evaluation of Liquefaction Resistance of Soils, Youd, et al., ASCE Journal of Geotechnical and Geoenvironmental Engineering, October 2001, Vol. 127 No. 10

LIQUEFACTION POTENTIAL ANALYSIS

PROJECT NAME ***Rte I-680 Auxiliary Lane Project - Seg. 2***
PROJECT NO. ***2011-124-GDR***
BORING NO. ***A-11-114***

BOREHOLE DIA (in)= 5
GW DEPTH (ft)= 15

SOIL GROUPS
1. GRAVELS, SANDS AND NONPLASTIC SILTS
2. CLAYS AND PLASTIC SILTS

HAMMER ENERGY = *55%*

FAULT INFO
Great Valley Fault
a_{max} (g)= 0.72
FAULT M_w = 6.76

MSF = 1.30

					CYCLIC STRESS RATIO (CSR)				*LIQUEFACTION RESISTANCE ($CRR_{7.5}$)*											*F.S.=($CRR_{7.5}$/CSR)*MSF*Kσ*Kα*			
Sample No	Depth (ft)	Soil Type	Blow Count	Sampler Type	σ_v (psf)	σ_v' (psf)	γ_d	CSR	SPT-$N_{eq.}$	C_E	C_R	C_S	C_B	N_{60}	C_N	$(N_1)_{60}$	F.C.	$(N_1)_{60,CS}$	$CRR_{7.5}$	Kσ	Kα	F.S.	Volumetric Strain (%)
1	2	2	24	mc	250	250	1.00		15.6	0.9	0.75	1.0	1.0	10.7	1.66	17.8				1.00	1		
2	5	2	34	mc	625	625	0.99		22.1	0.9	0.75	1.0	1.0	15.2	1.45	22.1				1.00	1		
3	10	2	30	mc	1250	1250	0.98		19.5	0.9	0.80	1.0	1.0	14.3	1.21	17.2				1.00	1		
4	15	2	13	mc	1875	1844	0.97		8.5	0.9	0.85	1.0	1.0	6.6	1.04	6.8				1.00	1		
5	20	2	52	mc	2500	2156	0.96		33.8	0.9	0.95	1.0	1.0	29.4	0.97	28.4				0.97	1		
6	25	2	26	mc	3125	2469	0.94		16.9	0.9	0.95	1.0	1.0	14.7	0.90	13.3				0.93	1		
7	30	2	30	mc	3750	2781	0.92		19.5	0.9	1.00	1.0	1.0	17.9	0.85	15.2				0.88	1		
8	35	2	34	mc	4375	3094	0.89		22.1	0.9	1.00	1.0	1.0	20.3	0.80	16.2				0.84	1		
9	40	2	45	mc	5000	3406	0.85		29.3	0.9	1.00	1.0	1.0	26.8	0.76	20.3				0.81	1		
10	45	1	46	mc	5625	3719	0.80	0.57	29.9	0.9	1.00	1.0	1.0	27.4	0.72	19.7	45%	28.7	0.39	0.78	1	0.71	0.8

Total Liquefaction Settlement (in.)= 0.48

1. The correction factors C_E (Energy Ratio), C_B (Borehole Diameter), C_R (Rod Length) and C_S (Sampling Method-liner) are per Youd et al. (2001).
2. For correction of overburden, $C_N = 2.2/(1.2 + \sigma_v'/P_a)$ with a maximum value of 1.7 per Kayen et al. (1992) as cited in Youd et al. (2001).
3. The influence of Fines Contents are expressed by the following correction: $(N_1)_{60cs} = \alpha + \beta\ (N_1)_{60}$

where α and β = coefficients determined from the following relationships

for FC $\leq$ 5% $\alpha = 0$, $\beta = 1.0$

for 5% < FC < 35% $\alpha = \exp(1.76-(190/FC^2))$, $\beta = (0.99+(FC^{1.5}/1000))$

for FC $\geq$ 35% $\alpha = 5.0$, $\beta = 1.2$

Reference: Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER Workshops on Evaluation of Liquefaction Resistance of Soils, Youd, et al., ASCE Journal of Geotechnical and Geoenvironmental Engineering, October 2001, Vol. 127 No. 10

LIQUEFACTION POTENTIAL ANALYSIS

PROJECT NAME ***Rte I-680 Auxiliary Lane Project - Seg. 2***
PROJECT NO. ***2011-124-GDR***
BORING NO. ***A-11-115***

BOREHOLE DIA (in)= 5
GW DEPTH (ft)= 12

SOIL GROUPS
1. GRAVELS, SANDS AND NONPLASTIC SILTS
2. CLAYS AND PLASTIC SILTS

HAMMER ENERGY = *55%*

FAULT INFO
Great Valley Fault
a_{max} (g)= 0.72
FAULT M_w = 6.76

MSF = 1.30

					CYCLIC STRESS RATIO (CSR)				*LIQUEFACTION RESISTANCE ($CRR_{7.5}$)*											*F.S.=($CRR_{7.5}$/CSR)*MSF*Kσ*Kα*			
Sample No	Depth (ft)	Soil Type	Blow Count	Sampler Type	σ_v (psf)	σ_v' (psf)	γ_d	CSR	SPT-$N_{eq.}$	C_E	C_R	C_S	C_B	N_{60}	C_N	$(N_1)_{60}$	F.C.	$(N_1)_{60,CS}$	$CRR_{7.5}$	Kσ	Kα	F.S.	Volumetric Strain (%)
1	2	2	23	mc	250	250	1.00		15.0	0.9	0.75	1.0	1.0	10.3	1.66	17.1				1.00	1		
2	5	2	38	mc	625	625	0.99		24.7	0.9	0.75	1.0	1.0	17.0	1.45	24.7				1.00	1		
3	10	2	18	mc	1250	1250	0.98		11.7	0.9	0.80	1.0	1.0	8.6	1.21	10.3				1.00	1		
4	15	2	63	mc	1875	1688	0.97		41.0	0.9	0.85	1.0	1.0	31.9	1.08	34.3				1.00	1		
5	20	2	27	mc	2500	2000	0.96		17.6	0.9	0.95	1.0	1.0	15.3	1.00	15.3				1.00	1		
6	25	1	27	mc	3125	2313	0.94	0.60	17.6	0.9	0.95	1.0	1.0	15.3	0.93	14.3	40%	22.1	0.24	0.95	1	0.51	1.3
7	30	2	36	mc	3750	2625	0.92		23.4	0.9	1.00	1.0	1.0	21.5	0.88	18.8				0.90	1		
8	35	2	39	mc	4375	2938	0.89		25.4	0.9	1.00	1.0	1.0	23.2	0.82	19.2				0.86	1		
9		2		mc	0	0	1.00		0.0	0.9	0.75	1.0	1.0	0.0	1.70	0.0				1.00	1		
10		2		mc	0	0	1.00		0.0	0.9	0.75	1.0	1.0	0.0	1.70	0.0				1.00	1		

Total Liquefaction Settlement (in.)= 0.62

1. The correction factors C_E (Energy Ratio), C_B (Borehole Diameter), C_R (Rod Length) and C_S (Sampling Method-liner) are per Youd et al. (2001).
2. For correction of overburden, $C_N = 2.2/(1.2 + \sigma_v'/P_a)$ with a maximum value of 1.7 per Kayen et al. (1992) as cited in Youd et al. (2001).
3. The influence of Fines Contents are expressed by the following correction: $(N_1)_{60cs} = \alpha + \beta\ (N_1)_{60}$

where α and β = coefficients determined from the following relationships

for FC $\leq$ 5% $\alpha = 0$, $\beta = 1.0$

for 5% < FC < 35% $\alpha = \exp(1.76-(190/FC^2))$, $\beta = (0.99+(FC^{1.5}/1000))$

for FC $\geq$ 35% $\alpha = 5.0$, $\beta = 1.2$

Reference: Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER Workshops on Evaluation of Liquefaction Resistance of Soils, Youd, et al., ASCE Journal of Geotechnical and Geoenvironmental Engineering, October 2001, Vol. 127 No. 10

LIQUEFACTION POTENTIAL ANALYSIS

PROJECT NAME ***Rte I-680 Auxiliary Lane Project - Seg. 2***
PROJECT NO. ***2011-124-GDR***
BORING NO. ***A-11-120***

BOREHOLE DIA (in)= 5
GW DEPTH (ft)= 19

SOIL GROUPS
1. GRAVELS, SANDS AND NONPLASTIC SILTS
2. CLAYS AND PLASTIC SILTS

HAMMER ENERGY = *55%*

FAULT INFO
Great Valley Fault
a_{max} (g)= 0.72
FAULT M_w = 6.76

MSF = 1.30

					CYCLIC STRESS RATIO (CSR)				*LIQUEFACTION RESISTANCE ($CRR_{7.5}$)*											*F.S.=($CRR_{7.5}$/CSR)*MSF*Kσ*Kα*			
Sample No	Depth (ft)	Soil Type	Blow Count	Sampler Type	σ_v (psf)	σ_v' (psf)	γ_d	CSR	SPT-$N_{eq.}$	C_E	C_R	C_S	C_B	N_{60}	C_N	$(N_1)_{60}$	F.C.	$(N_1)_{60,CS}$	$CRR_{7.5}$	Kσ	Kα	F.S.	Volumetric Strain (%)
1	2	2	21	mc	250	250	1.00		13.7	0.9	0.75	1.0	1.0	9.4	1.66	15.6				1.00	1		
2	5	2	26	mc	625	625	0.99		16.9	0.9	0.75	1.0	1.0	11.6	1.45	16.9				1.00	1		
3	10	2	90	mc	1250	1250	0.98		58.5	0.9	0.80	1.0	1.0	42.9	1.21	51.7				1.00	1		
4	15	2	41	mc	1875	1875	0.97		26.7	0.9	0.85	1.0	1.0	20.8	1.03	21.4				1.00	1		
5	19	1	46	mc	2375	2369	0.96	0.45	29.9	0.9	0.85	1.0	1.0	23.3	0.92	21.5	15%	25.0	0.29	0.93	1	0.79	1.2
6	22	2	46	mc	2750	2556	0.95		29.9	0.9	0.95	1.0	1.0	26.0	0.89	23.1				0.91	1		
7	25	2	65	mc	3125	2744	0.94		42.3	0.9	0.95	1.0	1.0	36.8	0.86					0.88	1		
8		2		mc	0	0	1.00		0.0	0.9	0.75	1.0	1.0	0.0	1.70					1.00	1		
8		2		mc	0	0	1.00		0.0	0.9	0.75	1.0	1.0	0.0	1.70					1.00	2		

Total Liquefaction Settlement (in.)= 0.43

1. The correction factors C_E (Energy Ratio), C_B (Borehole Diameter), C_R (Rod Length) and C_S (Sampling Method-liner) are per Youd et al. (2001).
2. For correction of overburden, $C_N = 2.2/(1.2 + \sigma_v'/P_a)$ with a maximum value of 1.7 per Kayen et al. (1992) as cited in Youd et al. (2001).
3. The influence of Fines Contents are expressed by the following correction: $(N_1)_{60cs} = \alpha + \beta\ (N_1)_{60}$

where α and β = coefficients determined from the following relationships

for FC $\leq$ 5% $\alpha = 0$, $\beta = 1.0$

for 5% < FC < 35% $\alpha = \exp(1.76-(190/FC^2))$, $\beta = (0.99+(FC^{1.5}/1000))$

for FC $\geq$ 35% $\alpha = 5.0$, $\beta = 1.2$

Reference: Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER Workshops on Evaluation of Liquefaction Resistance of Soils, Youd, et al., ASCE Journal of Geotechnical and Geoenvironmental Engineering, October 2001, Vol. 127 No. 10

LIQUEFACTION POTENTIAL ANALYSIS

PROJECT NAME ***Rte I-680 Auxiliary Lane Project - Seg. 2***
PROJECT NO. ***2011-124-GDR***
BORING NO. ***A-11-122***

BOREHOLE DIA (in)= 5
GW DEPTH (ft)= 39

SOIL GROUPS
1. GRAVELS, SANDS AND NONPLASTIC SILTS
2. CLAYS AND PLASTIC SILTS

HAMMER ENERGY = *55%*

FAULT INFO
Great Valley Fault
a_{max} (g)= 0.72
FAULT M_w = 6.76

MSF = 1.30

					CYCLIC STRESS RATIO (CSR)				*LIQUEFACTION RESISTANCE ($CRR_{7.5}$)*											*F.S.=($CRR_{7.5}$/CSR)*MSF*Kσ*Kα*			
Sample No	Depth (ft)	Soil Type	Blow Count	Sampler Type	σ_v (psf)	σ_v' (psf)	γ_d	CSR	SPT-$N_{eq.}$	C_E	C_R	C_S	C_B	N_{60}	C_N	$(N_1)_{60}$	F.C.	$(N_1)_{60,CS}$	$CRR_{7.5}$	Kσ	Kα	F.S.	Volumetric Strain (%)
1	2	2	15	mc	250	250	1.00		9.8	0.9	0.75	1.0	1.0	6.7	1.66	11.1				1.00	1		
2	5	1	21	mc	625	625	0.99	0.46	13.7	0.9	0.75	1.0	1.0	9.4	1.45	13.7		13.7	0.15	1.00	1		
3	10	2	18	mc	1250	1250	0.98		11.7	0.9	0.80	1.0	1.0	8.6	1.21	10.3				1.00	1		
4	15	2	22	mc	1875	1875	0.97		14.3	0.9	0.85	1.0	1.0	11.1	1.03	11.5				1.00	1		
5	20	2	24	mc	2500	2500	0.96		15.6	0.9	0.95	1.0	1.0	13.6	0.90	12.2				0.93	1		
6	25	2	22	mc	3125	3125	0.94		14.3	0.9	0.95	1.0	1.0	12.5	0.80	9.9				0.87	1		
7	30	2	22	mc	3750	3750	0.92		14.3	0.9	1.00	1.0	1.0	13.1	0.72	9.4				0.78	1		
8	35	2	23	mc	4375	4375	0.89		15.0	0.9	1.00	1.0	1.0	13.7	0.65	8.9				0.73	1		
9	40	1	28	mc	5000	4938	0.85	0.40	18.2	0.9	1.00	1.0	1.0	16.7	0.60	10.0	15%	13.0	0.14	0.70	1	0.32	2.1
10	45	1	100	mc	5625	5250	0.80	0.40	65.0	0.9	1.00	1.0	1.0	59.6	0.58	34.3		34.3		0.68	1		
11	50	1	100	spt	6250	5563	0.75	0.40	100.0	0.9	1.00	1.2	1.0	110.0	0.55	60.8		60.8		0.66	1		

Total Liquefaction Settlement (in.)= 0.50

1. The correction factors C_E (Energy Ratio), C_B (Borehole Diameter), C_R (Rod Length) and C_S (Sampling Method-liner) are per Youd et al. (2001).
2. For correction of overburden, $C_N = 2.2/(1.2 + \sigma_v'/P_a)$ with a maximum value of 1.7 per Kayen et al. (1992) as cited in Youd et al. (2001).
3. The influence of Fines Contents are expressed by the following correction: $(N_1)_{60cs} = \alpha + \beta\ (N_1)_{60}$

where α and β = coefficients determined from the following relationships

for FC $\leq$ 5% $\alpha = 0$, $\beta = 1.0$

for 5% < FC < 35% $\alpha = \exp(1.76-(190/FC^2))$, $\beta = (0.99+(FC^{1.5}/1000))$

for FC $\geq$ 35% $\alpha = 5.0$, $\beta = 1.2$

Reference: Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER Workshops on Evaluation of Liquefaction Resistance of Soils, Youd, et al., ASCE Journal of Geotechnical and Geoenvironmental Engineering, October 2001, Vol. 127 No. 10

LIQUEFACTION POTENTIAL ANALYSIS

PROJECT NAME ***Rte I-680 Auxiliary Lane Project - Seg. 2***
PROJECT NO. ***2011-124-GDR***
BORING NO. ***A-11-123***

BOREHOLE DIA (in)= 5
GW DEPTH (ft)= 28

SOIL GROUPS
1. GRAVELS, SANDS AND NONPLASTIC SILTS
2. CLAYS AND PLASTIC SILTS

HAMMER ENERGY = *55%*

FAULT INFO
Great Valley Fault
a_{max} (g)= 0.72
FAULT M_w = 6.76

MSF = 1.30

					CYCLIC STRESS RATIO (CSR)				*LIQUEFACTION RESISTANCE ($CRR_{7.5}$)*												*F.S.=($CRR_{7.5}$/CSR)*MSF*Kσ*Kα*			
Sample No	Depth (ft)	Soil Type	Blow Count	Sampler Type	σ_v (psf)	σ_v' (psf)	γ_d	CSR	SPT-$N_{eq.}$	C_E	C_R	C_S	C_B	N_{60}	C_N	$(N_1)_{60}$	F.C.	$(N_1)_{60,CS}$	$CRR_{7.5}$	Kσ	Kα	F.S.	Volumetric Strain (%)
1	2	2	20	mc	250	250	1.00		13.0	0.9	0.75	1.0	1.0	8.9	1.66	14.8				1.00	1		
2	5	2	18	mc	625	625	0.99		11.7	0.9	0.75	1.0	1.0	8.0	1.45	11.7				1.00	1		
3	10	2	39	mc	1250	1250	0.98		25.4	0.9	0.80	1.0	1.0	18.6	1.21	22.4				1.00	1		
4	15	2	34	mc	1875	1875	0.97		22.1	0.9	0.85	1.0	1.0	17.2	1.03	17.7				1.00	1		
5	20	2	31	mc	2500	2500	0.96		20.2	0.9	0.95	1.0	1.0	17.5	0.90	15.8				0.92	1		
6	25	2	44	mc	3125	3125	0.94		28.6	0.9	0.95	1.0	1.0	24.9	0.80	19.8				0.84	1		
7	30	1	45	mc	3750	3625	0.92	0.45	29.3	0.9	1.00	1.0	1.0	26.8	0.73	19.6	24%	25.8	0.31	0.79	1	0.71	1.2
8		2		mc	0	0	1.00		0.0	0.9	0.75	1.0	1.0	0.0	1.70					1.00	1		
9		2		mc	0	0	1.00		0.0	0.9	0.75	1.0	1.0	0.0	1.70					1.00	2		

Total Liquefaction Settlement (in.)= 0.43

1. The correction factors C_E (Energy Ratio), C_B (Borehole Diameter), C_R (Rod Length) and C_S (Sampling Method-liner) are per Youd et al. (2001).
2. For correction of overburden, $C_N = 2.2/(1.2 + \sigma_v'/P_a)$ with a maximum value of 1.7 per Kayen et al. (1992) as cited in Youd et al. (2001).
3. The influence of Fines Contents are expressed by the following correction: $(N_1)_{60cs} = \alpha + \beta\ (N_1)_{60}$

where α and β = coefficients determined from the following relationships

for FC $\leq$ 5% $\alpha = 0$, $\beta = 1.0$

for 5% < FC < 35% $\alpha = \exp(1.76-(190/FC^2))$, $\beta = (0.99+(FC^{1.5}/1000))$

for FC $\geq$ 35% $\alpha = 5.0$, $\beta = 1.2$

Reference: Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER Workshops on Evaluation of Liquefaction Resistance of Soils, Youd, et al., ASCE Journal of Geotechnical and Geoenvironmental Engineering, October 2001, Vol. 127 No. 10

SETTLEMENT ANALYSIS

PROJECT NAME **Rte. 680 Auxiliary Lane Project - Segment 2**
PROJECT NO. **2011-124-GDR**
BORING NO. **A-11-121** RW 4

Embankment H (ft)=	7	*Contact Pressure (psf)=*	875	*Contact Area, B (ft)=*	6.5	*Cr/Cc=*	20.0%	***GROUPS***	
Unit Weight (pcf)=	125	*GW Level (ft)=*	28	*Contact Area, L (ft)=*	600	*Ei*	55%	1. GRAVELS AND SANDS	
				Plain Strain? (Y/N)=	y			2. CLAYS AND SILTS	

Soil Type	Depth From	Depth To	BLOW COUNT	SAMPLER TYPE	AVG SPT-N	γ_T (pcf)	γ' (pcf)	ω	σ_v' (psf)	$\Delta\sigma_v'$ (psf)	Pp (psf)	$Cr/1+e_0$	$Cc/1+e_0$	Settlements (in) OC	NC	SAND	Sum
2	0	5	21	MC	13	101.0	101.0	30.5%	253	631.9	6256	0.0303	0.1513	0.544			0.544
2	5	10	32	MC	19	123.0	123.0	23.1%	813	406.3	9533	0.0266	0.1329	0.176			0.176
2	10	15	27	MC	16	118.0	118.0	20.0%	1415	299.3	8044	0.0250	0.1252	0.083			0.083
2	15	20	40	MC	24	125.0	125.0	20.7%	2023	237.0	11917	0.0254	0.1269	0.048			0.048
2	20	25	51	MC	30	117.0	117.0	20.0%	2628	196.1	15194	0.0250	0.1252	0.047			0.047
2	25	30	31	MC	18	123.0	60.6	24.2%	3072	167.3	9235	0.0271	0.1356	0.037			0.037
2	30	35	34	MC	20	125.0	62.6	22.8%	3380	145.8	10129	0.0264	0.1322	0.029			0.029
													Estimated Settlement (in)=	*1.0*	*0.0*	*0.0*	***0.97***

SETTLEMENT ANALYSIS

PROJECT NAME **Rte. 680 Auxiliary Lane Project - Segment 2**
PROJECT NO. **2011-124-GDR**
BORING NO. **A-11-122** RW 4

Embankment H (ft)= 7 *Contact Pressure (psf)=* 875 *Contact Area, B (ft)=* 6.5 *Cr/Cc=* 20.0%
Unit Weight (pcf)= 125 *GW Level (ft)=* 39 *Contact Area, L (ft)=* 600 *Ei* 55%
Plain Strain? (Y/N)= y

GROUPS
1. GRAVELS AND SANDS
2. CLAYS AND SILTS

Soil Type	Depth From	Depth To	BLOW COUNT	SAMPLER TYPE	AVG SPT-N	γ_T (pcf)	γ' (pcf)	ω	σ_v' (psf)	$\Delta\sigma_v'$ (psf)	Pp (psf)	$Cr/1+e_0$	$Cc/1+e_0$	Settlements (in) OC	NC	SAND	Sum
2	0	2	15	MC	9	119.0	119.0	21.0%	119	758.3	4469	0.0255	0.1277	0.868			0.868
1	2	5	21	MC	13	119.0	119.0	18.4%	417	568.8							
2	5	10	18	MC	11	117.0	117.0	21.4%	888	406.3	5363	0.0257	0.1287	0.164			0.164
2	10	15	22	MC	13	124.0	124.0	21.0%	1490	299.3	6554	0.0255	0.1277	0.080			0.080
2	15	20	24	MC	14	126.0	126.0	19.3%	2115	237.0	7150	0.0247	0.1234	0.068			0.068
2	20	25	22	MC	13	123.0	123.0	19.0%	2738	196.1	6554	0.0245	0.1227	0.044			0.044
2	25	30	22	MC	13	125.0	125.0	19.4%	3358	167.3	6554	0.0247	0.1237	0.031			0.031
2	30	35	23	MC	14	125.0	125.0	25.6%	3983	145.8	6852	0.0278	0.1391	0.026			0.026
2	35	40	28	MC	17	127.0	64.6	24.7%	4457	129.3	8342	0.0274	0.1369	0.020			0.020
													Estimated Settlement (in)=	*1.3*	*0.0*	*0.0*	***1.30***

SETTLEMENT ANALYSIS

PROJECT NAME **Rte. 680 Auxiliary Lane Project - Segment 2**
PROJECT NO. **2011-124-GDR**
BORING NO. **A-11-123** RW 4

Embankment H (ft)= 7 *Contact Pressure (psf)=* 875 *Contact Area, B (ft)=* 6.5 *Cr/Cc=* 15.0%
Unit Weight (pcf)= 125 *GW Level (ft)=* 29 *Contact Area, L (ft)=* 600 *Ei* 55%
Plain Strain? (Y/N)= y

GROUPS
1. GRAVELS AND SANDS
2. CLAYS AND SILTS

Soil Type	Depth From	Depth To	BLOW COUNT	SAMPLER TYPE	AVG SPT-N	γ_T (pcf)	γ' (pcf)	ω	σ_v' (psf)	$\Delta\sigma_v'$ (psf)	Pp (psf)	$Cr/1+e_0$	$Cc/1+e_0$	Settlements (in) OC	NC	SAND	Sum
2	0	2	20	MC	12	114.0	114.0	21.1%	114	758.3	5958	0.0192	0.1279	0.884			0.884
2	2	5	18	MC	11	117.0	117.0	23.1%	404	568.8	5363	0.0199	0.1329	0.382			0.382
2	5	10	39	MC	23	125.0	125.0	20.8%	892	406.3	11619	0.0191	0.1272	0.163			0.163
2	10	15	34	MC	20	121.0	121.0	24.8%	1507	299.3	10129	0.0206	0.1371	0.079			0.079
2	15	20	31	MC	18	128.0	128.0	17.6%	2129	237.0	9235	0.0179	0.1192	0.049			0.049
2	20	25	44	MC	26	126.0	126.0	21.4%	2764	196.1	13108	0.0193	0.1287	0.034			0.034
2	25	30	45	MC	27	125.0	62.6	15.0%	3236	167.3	13406	0.0169	0.1126	0.022			0.022
													Estimated Settlement (in)=	*1.6*	*0.0*	*0.0*	***1.61***

SETTLEMENT ANALYSIS

PROJECT NAME **Rte. 680 Auxiliary Lane Project - Segment 2**
PROJECT NO. **2011-124-GDR**
BORING NO. **A-11-135** RW 6

Embankment H (ft)= 7 *Contact Pressure (psf)=* 875 *Contact Area, B (ft)=* 6 *Cr/Cc=* 15.0%
Unit Weight (pcf)= 125 *GW Level (ft)=* 25 *Contact Area, L (ft)=* 450 *Ei* 55%
Plain Strain? (Y/N)= y

GROUPS
1. GRAVELS AND SANDS
2. CLAYS AND SILTS

Soil Type	Depth From	Depth To	BLOW COUNT	SAMPLER TYPE	AVG SPT-N	γ_T (pcf)	γ' (pcf)	ω	σ_v' (psf)	$\Delta\sigma_v'$ (psf)	Pp (psf)	$Cr/1+e_0$	$Cc/1+e_0$	Settlements (in) OC	NC	SAND	Sum
2	0	2	22	MC	13	125.0	125.0	25.1%	125	750.0	6554	0.0207	0.1379	0.845			0.845
2	2	5	27	MC	16	122.0	122.0	22.3%	433	552.6	8044	0.0196	0.1309	0.357			0.357
2	5	10	36	MC	21	120.0	120.0	24.1%	916	388.9	10725	0.0203	0.1354	0.154			0.154
2	10	15	22	MC	13	120.0	120.0	25.1%	1516	283.8	6554	0.0207	0.1379	0.075			0.075
2	15	20	20	MC	12	120.0	120.0	27.6%	2116	223.4	5958	0.0216	0.1441	0.057			0.057
2	20	25	13	MC	8	120.0	120.0	24.6%	2716	184.2	3873	0.0205	0.1366	0.035			0.035
2	25	30	100	MC	60	120.0	57.6	23.2%	3160	156.7	29792	0.0200	0.1332	0.025			0.025
2	30	35	45	MC	27	125.0	62.6	15.0%	3461	136.4	13406	0.0169	0.1126	0.017			0.017
													Estimated Settlement (in)=	*1.6*	*0.0*	*0.0*	***1.56***

SETTLEMENT ANALYSIS

PROJECT NAME **Rte. 680 Auxiliary Lane Project - Segment 2**
PROJECT NO. **2011-124-GDR**
BORING NO. **A-11-136** RW 6

Embankment H (ft)= 7 *Contact Pressure (psf)=* 875 *Contact Area, B (ft)=* 6 *Cr/Cc=* 15.0%
Unit Weight (pcf)= 125 *GW Level (ft)=* 32 *Contact Area, L (ft)=* 450 *Ei* 55%
Plain Strain? (Y/N)= y

GROUPS
1. GRAVELS AND SANDS
2. CLAYS AND SILTS

Soil Type	Depth From	Depth To	BLOW COUNT	SAMPLER TYPE	AVG SPT-N	γ_T (pcf)	γ' (pcf)	ω	σ_v' (psf)	$\Delta\sigma_v'$ (psf)	Pp (psf)	$Cr/1+e_0$	$Cc/1+e_0$	Settlements (in) OC	NC	SAND	Sum
2	0	2	13	MC	8	121.0	121.0	20.8%	121	750.0	3873	0.0191	0.1272	0.857			0.857
2	2	5	21	MC	13	127.0	127.0	18.8%	433	552.6	6256	0.0183	0.1222	0.358			0.358
2	5	10	48	MC	29	126.0	126.0	20.9%	938	388.9	14300	0.0191	0.1274	0.151			0.151
2	10	15	32	MC	19	119.0	119.0	20.8%	1551	283.8	9533	0.0191	0.1272	0.073			0.073
2	15	20	73	MC	43	126.0	126.0	17.8%	2163	223.4	21748	0.0179	0.1197	0.046			0.046
2	20	25	100	MC	60	120.0	120.0	18.8%	2778	184.2	29792	0.0183	0.1222	0.031			0.031
2	25	30	100	MC	60	120.0	120.0	24.2%	3378	156.7	29792	0.0203	0.1356	0.024			0.024
													Estimated Settlement (in)=	*1.5*	*0.0*	*0.0*	***1.54***

SETTLEMENT ANALYSIS

PROJECT NAME **Rte. 680 Auxiliary Lane Project - Segment 2**
PROJECT NO. **2011-124-GDR**
BORING NO. **A-11-137** RW 6

Embankment H (ft)= 7 *Contact Pressure (psf)=* 875 *Contact Area, B (ft)=* 6 *Cr/Cc=* 15.0%
Unit Weight (pcf)= 125 *GW Level (ft)=* 50 *Contact Area, L (ft)=* 113 *Ei* 55%
Plain Strain? (Y/N)= y

GROUPS
1. GRAVELS AND SANDS
2. CLAYS AND SILTS

Soil Type	Depth From	Depth To	BLOW COUNT	SAMPLER TYPE	AVG SPT-N	γ_T (pcf)	γ' (pcf)	ω	σ_v' (psf)	$\Delta\sigma_v'$ (psf)	Pp (psf)	$Cr/1+e_0$	$Cc/1+e_0$	Settlements (in) OC	NC	SAND	Sum
2	0	2	24	MC	14	123.0	123.0	20.7%	123	750.0	7150	0.0190	0.1269	0.851			0.851
2	2	5	33	MC	20	128.0	128.0	19.8%	438	552.6	9831	0.0187	0.1247	0.354			0.354
2	5	10	17	MC	10	122.0	122.0	25.5%	935	388.9	5065	0.0208	0.1389	0.151			0.151
2	10	15	42	MC	25	123.0	123.0	18.6%	1548	283.8	12513	0.0182	0.1217	0.073			0.073
2	15	20	33	MC	20	124.0	124.0	23.9%	2165	223.4	9831	0.0202	0.1349	0.052			0.052
2	20	25	25	MC	15	121.0	121.0	26.8%	2778	184.2	7448	0.0213	0.1421	0.036			0.036
2	25	30	31	MC	18	124.0	124.0	24.5%	3390	156.7	9235	0.0205	0.1364	0.024			0.024
2	30	35	31	MC	18	125.0	125.0	24.5%	4013	136.4	9235	0.0205	0.1364	0.018			0.018
													Estimated Settlement (in)=	*1.6*	*0.0*	*0.0*	***1.56***

Drainage System	Drainage System Unit	APC Diameter (in)	Approx. Beginning Station	Approx. End Station	Ref. Boring (A-11-___)	Steel Pipes															
						Corrugated Steel Pipe - Helical Corrugations					Corrugated Steel Pipe - Annual Corrugations					Steel Spiral Rib Pipe					
						2 2/3" x 1/2" Corrugations					2 2/3" x 1/2" Corrugations					3/4" x 1" Ribs at 11 1/2" Pitch					
						Coat					Coat					Coat					
						AL2	BC	BCI	PA	PS	AL2	BC	BCI	PA	PS	GAL	AL2	BC	BCI	PA	PS
						Minimum Thickness (in)					Minimum Thickness (in)					Minimum Thickness (in)					
1	f	18	230+93	230+94	101				0.052	0.052				0.064	0.064						
	d	18	230+70	230+93	101				0.052	0.052				0.064	0.064						
	b	18	230+70	230+70	101				0.052	0.052				0.064	0.064						
3	j	18	249+97	251+01	145				0.052	0.052				0.064	0.064						
	b	18	248+41	251+01	145				0.052	0.052				0.064	0.064						
	f	18	251+00	251+01	145				0.052	0.052				0.064	0.064						
	m	18	246+61	248+41	145				0.052	0.052				0.064	0.064						
4	e	18	253+33	255+65	145				0.052	0.052				0.064	0.064						
6	c	18	266+58	266+92	144				0.052	0.052				0.064	0.064						
7	k	24	270+84	274+24	110				0.052	0.052				0.064	0.064					0.064	0.064
	i	18	274+24	274+24	110				0.052	0.052				0.064	0.064						
	g	24	274+24	274+97	110				0.052	0.052				0.064	0.064					0.064	0.064
	e	18	274+97	274+97	110				0.052	0.052				0.064	0.064						
	b	18	274+98	274+98	110				0.052	0.052				0.064	0.064						
8	aj	24	293+53	296+33	Ave. 120 + 122				0.052	0.052				0.064	0.064			0.109	0.109	0.064	0.064
	ag	24	291+23	293+53	Ave. 120 + 122				0.052	0.052				0.064	0.064			0.109	0.109	0.064	0.064
	ae	24	291+00	291+23	Ave. 120 + 122				0.052	0.052				0.064	0.064			0.109	0.109	0.064	0.064
	ao	15	291+00	291+00	Ave. 120 + 114	0.052			0.052	0.052				0.064	0.064						
	ac	18	291+00	291+00	Ave. 120 + 114	0.052			0.052	0.052	0.064			0.064	0.064						
	z	24	288+99	291+00	Ave. 120 + 114	0.052			0.052	0.052	0.064			0.064	0.064		0.064	0.109	0.109	0.064	0.064
	w	24	286+98	288+99	Ave. 120 + 114	0.052			0.052	0.052	0.064			0.064	0.064		0.064	0.109	0.109	0.064	0.064
	t	18	286+98	286+98	Ave. 120 + 114	0.052			0.052	0.052	0.064			0.064	0.064						
	r	24	282+98	286+98	Ave. 120 + 114	0.052			0.052	0.052	0.064			0.064	0.064		0.064	0.109	0.109	0.064	0.064
	p	18	282+98	282+98	109				0.052	0.052				0.064	0.064						
	m	24	281+11	282+98	109			0.079	0.052	0.052			0.079	0.064	0.064	0.109		0.109	0.079	0.064	0.064
	k	24	280+90	281+11	109			0.079	0.052	0.052			0.079	0.064	0.064	0.109		0.109	0.079	0.064	0.064
	i	24	280+70	280+90	109			0.079	0.052	0.052			0.079	0.064	0.064	0.109		0.109	0.079	0.064	0.064
	g	24	278+98	280+80	109			0.079	0.052	0.052			0.079	0.064	0.064	0.109		0.109	0.079	0.064	0.064
	e	24	278+98	278+98	109			0.079	0.052	0.052			0.079	0.064	0.064	0.109		0.109	0.079	0.064	0.064
	b	24	278+98	278+98	109			0.079	0.052	0.052			0.079	0.064	0.064	0.109		0.109	0.079	0.064	0.064
9	n	18	283+47	283+47	109				0.052	0.052				0.064	0.064						
	h	18	282+50	283+47	109				0.052	0.052				0.064	0.064						
	l	18	283+47	283+96	109				0.052	0.052				0.064	0.064						
	j	18	283+96	284+44	109				0.052	0.052				0.064	0.064						
	f	18	282+04	282+50	109				0.052	0.052				0.064	0.064						
	d	18	281+17	282+04	109				0.052	0.052				0.064	0.064						
	b	18	280+07	281+17	109				0.052	0.052				0.064	0.064						
10	d	18	299+53	299+53	118	0.052	0.064	0.064	0.052	0.052	0.064	0.064	0.064	0.064	0.064						
11	k	18	303+86	303+86	127				0.052	0.052				0.064	0.064						
	d	18	303+87	303+87	127				0.052	0.052				0.064	0.064						
	a	18	303+87	303+87	127				0.052	0.052				0.064	0.064						
	o	18	300+87	303+87	127				0.052	0.052				0.064	0.064						
	i	18	303+00	303+86	127				0.052	0.052				0.064	0.064						
14	c	18	311+00	311+00	133				0.052	0.052				0.064	0.064						
15	d	18	315+53	315+67	143	0.052	0.064	0.064	0.052	0.052	0.064	0.064	0.064	0.064	0.064						
17	b	18	315+20	318+74	143	0.052	0.064	0.064	0.052	0.052	0.064	0.064	0.064	0.064	0.064						
19	b	18	329+31	329+31	Ave. 137 + 140				0.052	0.052				0.064	0.064						
	f	18	325+99	329+30	Ave. 137 + 140				0.052	0.052				0.064	0.064						
	j	18	322+50	325+99	Ave. 137 + 140				0.052	0.052				0.064	0.064						
21	b	18	49+74	49+73	142				0.052	0.052				0.064	0.064						
23	c	18	242+23	243+16	101				0.052	0.052				0.064	0.064						
	b	18	243+16	244+17	101				0.052	0.052				0.064	0.064						
	f	18	243+13	244+80	101				0.052	0.052				0.064	0.064						
24	c	18	258+72	259+64	106	0.052			0.052	0.052	0.064			0.064	0.064						

Drainage System	Drainage System Unit	APC Diameter (in)	Steel Pipes												Aluminum Pipes			
			Steel Spiral Rib Pipe						Steel Spiral Rib Pipe						Corrugated Aluminum Pipe - Annular Corrugations	Corrugated Aluminum Pipe - Helical Corrugations	Aluminum Spiral Rib Pipe	Aluminum Spiral Rib Pipe
			3/4" x 1" Ribs at 8 1/2" Pitch						3/4" x 3/4" Ribs at 7 1/2" Pitch						2 2/3" x 1/2" Corrugations	2 2/3" x 1/2" Corrugations	3/4" x 1" Ribs at 11 1/2" Pitch	3/4" x 3/4" Ribs at 7 1/2" Pitch
			Coat						Coat									
			GAL	AL2	BC	BCI	PA	PS	GAL	AL2	BC	BCI	PA	PS				
			Minimum Thickness (in)						Minimum Thickness (in)						Minimum Thickness (in)			
1	f	18																
	d	18																
	b	18																
3	j	18																
	b	18																
	f	18																
	m	18																
4	e	18																
6	c	18																
7	k	24					0.064	0.064					0.064	0.064				
	i	18																
	g	24					0.064	0.064					0.064	0.064				
	e	18																
	b	18																
8	aj	24			0.109	0.109	0.064	0.064			0.109	0.109	0.064	0.064				
	ag	24			0.109	0.109	0.064	0.064			0.109	0.109	0.064	0.064				
	ae	24			0.109	0.109	0.064	0.064			0.109	0.109	0.064	0.064				
	ao	15													0.06	0.06		
	ac	18													0.06	0.06		
	z	24		0.064	0.109	0.109	0.064	0.064		0.064	0.109	0.109	0.064	0.064	0.06	0.06	0.06	0.06
	w	24		0.064	0.109	0.109	0.064	0.064		0.064	0.109	0.109	0.064	0.064	0.06	0.06	0.06	0.06
	t	18													0.06	0.06		
	r	24		0.064	0.109	0.109	0.064	0.064		0.064	0.109	0.109	0.064	0.064	0.06	0.06	0.06	0.06
	p	18																
	m	24	0.109		0.109	0.079	0.064	0.064	0.109		0.109	0.079	0.064	0.064				
	k	24	0.109		0.109	0.079	0.064	0.064	0.109		0.109	0.079	0.064	0.064				
	i	24	0.109		0.109	0.079	0.064	0.064	0.109		0.109	0.079	0.064	0.064				
	g	24	0.109		0.109	0.079	0.064	0.064	0.109		0.109	0.079	0.064	0.064				
	e	24	0.109		0.109	0.079	0.064	0.064	0.109		0.109	0.079	0.064	0.064				
	b	24	0.109		0.109	0.079	0.064	0.064	0.109		0.109	0.079	0.064	0.064				
9	n	18																
	h	18																
	l	18																
	j	18																
	f	18																
	d	18																
	b	18																
10	d	18													0.06	0.06		
11	k	18																
	d	18																
	a	18																
	o	18																
	i	18																
14	c	18																
15	d	18													0.06	0.06		
17	b	18													0.06	0.06		
19	b	18																
	f	18																
	j	18																
21	b	18																
23	c	18																
	b	18																
	f	18																
24	c	18													0.06	0.06		

Drainage System	Drainage System Unit	APC Diameter (in)	Plastic Pipes					Reinforced Concrete Pipes			Other Information							
			PVC Corrugated	PVC Ribbed	HDPE Corrugated - Type S	HDPE Ribbed	HDPE Corrugated - Type C	Steel Cover (in)	Sacks of Cement	Percent of Water	Soil pH	Minimum Soil Resistivity (ohm-cm)	Sulfate Concentration (ppm)	Chloride Concentration (ppm)	Abrasion Level	2-5 Year Flow Velocity (ft/sec)	Design Service Life (yrs)	Hight of Cover (ft)
1	f	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.63	540	198.5	48.2	1	2.27	50	3
	d	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.63	540	198.5	48.2	1	2.06	50	4.5
	b	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.63	540	198.5	48.2	1	1.2	50	4.5
3	j	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	6.99	670	143.1	15.2	1	0.77	50	2
	b	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	6.99	670	143.1	15.2	1	1.93	50	4
	f	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	6.99	670	143.1	15.2	1	0.99	50	4
	m	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	6.99	670	143.1	15.2	1	1.78	50	3.5
4	e	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	6.99	670	143.1	15.2	1	1.86	50	3
6	c	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.64	830	680.7	38.2	1	1.62	50	4
7	k	24	Allowable	Allowable	Allowable	Allowable	Allowable	1	5	11.1	7.56	280	1137.9	71.4	1	2.14	50	9
	i	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.56	280	1137.9	71.4	1	0.36	50	4
	g	24	Allowable	Allowable	Allowable	Allowable	Allowable	1	5	11.1	7.56	280	1137.9	71.4	1	1.77	50	3.5
	e	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.56	280	1137.9	71.4	1	1.84	50	3
	b	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.56	280	1137.9	71.4	1	2.96	50	2
8	aj	24	Allowable	Allowable	Allowable	Allowable	Allowable	1	5	11.1	7.1	1460	77.6	42.2	1	4.49	50	10.5
	ag	24	Allowable	Allowable	Allowable	Allowable	Allowable	1	5	11.1	7.1	1460	77.6	42.2	1	5.83	50	8
	ae	24	Allowable	Allowable	Allowable	Allowable	Allowable	1	5	11.1	7.1	1460	77.6	42.2	1	5.81	50	7.5
	ao	15	Allowable					0.75	5	11.1	7.05	1595	29.5	19.5	1	2.42	50	10.5
	ac	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.05	1595	29.5	19.5	1	0.89	50	9
	z	24	Allowable	Allowable	Allowable	Allowable	Allowable	1	5	11.1	7.05	1595	29.5	19.5	1	3.7	50	10
	w	24	Allowable	Allowable	Allowable	Allowable	Allowable	1	5	11.1	7.05	1595	29.5	19.5	1	4.84	50	9.5
	t	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.05	1595	29.5	19.5	1	0.61	50	6
	r	24	Allowable	Allowable	Allowable	Allowable	Allowable	1	5	11.1	7.05	1595	29.5	19.5	1	4.45	50	6
	p	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.27	1050	77	39.5	1	2.25	50	4.5
	m	24	Allowable	Allowable	Allowable	Allowable	Allowable	1	5	11.1	7.27	1050	77	39.5	1	3.36	50	4
	k	24	Allowable	Allowable	Allowable	Allowable	Allowable	1	5	11.1	7.27	1050	77	39.5	1	3.34	50	3.5
	i	24	Allowable	Allowable	Allowable	Allowable	Allowable	1	5	11.1	7.27	1050	77	39.5	1	3.08	50	3
	g	24	Allowable	Allowable	Allowable	Allowable	Allowable	1	5	11.1	7.27	1050	77	39.5	1	2.92	50	3
	e	24	Allowable	Allowable	Allowable	Allowable	Allowable	1	5	11.1	7.27	1050	77	39.5	1	1.73	50	3
	b	24	Allowable	Allowable	Allowable	Allowable	Allowable	1	5	11.1	7.27	1050	77	39.5	1	2.41	50	2
9	n	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.27	1050	77	39.5	1	2.28	50	1
	h	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.27	1050	77	39.5	1	1.86	50	1
	l	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.27	1050	77	39.5	1	0.39	50	1
	j	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.27	1050	77	39.5	1	0.65	50	1
	f	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.27	1050	77	39.5	1	1.72	50	1
	d	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.27	1050	77	39.5	1	1.91	50	1
	b	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.27	1050	77	39.5	1	1.66	50	1
10	d	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.56	1980	17.1	8	1	1.9	50	3.5
11	k	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.45	960	12.3	11.9	1	3.71	50	2
	d	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.45	960	12.3	11.9	1	1.81	50	1
	a	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.45	960	12.3	11.9	1	1.28	50	5
	o	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.45	960	12.3	11.9	1	1.77	50	1
	i	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.45	960	12.3	11.9	1	1.29	50	1
14	c	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	6.39	1470	79.4	27.1	1	2.63	50	2
15	d	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.47	1930	66.9	14.5	1	1.05	50	3
17	b	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.47	1930	66.9	14.5	1	1.69	50	3.5
19	b	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.56	775	63.9	18.9	1	3.96	50	2.5
	f	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.56	775	63.9	18.9	1	3.27	50	5
	j	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.56	775	63.9	18.9	1	3.03	50	4
21	b	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	6.9	1340	1.6	15.5	1	2.22	50	3
23	c	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.63	540	198.5	48.2	1	2.1	50	3
	b	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.63	540	198.5	48.2	1	0.87	50	4
	f	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	7.63	540	198.5	48.2	1	1.53	50	5.5
24	c	18	Allowable	Allowable	Allowable	Allowable	Allowable	0.75	5	11.1	6.97	1660	46.9	26.8	1	0.77	50	5.5

AltPipe

Project EA: **04-CC-680 4.3/6.7**
Project Engineer: **PW**
Location: **Contra Costa County**
Description: **I-680 Aux Lane Seg. 2**

Steel Pipes

DSN/U		1b	1d	1f	3b	3f	3j	3m	4e	6c
Pipe Diameter (in)		**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**
Pipe Type	**Coat**	**Minimum Thickness (in)**								
Corrugated Steel Pipe - Helical Corrugations - 2⅔" X ½" Corrugations	PA	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	PS	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
Corrugated Steel Pipe - Annular Corrugations - 2⅔" X ½" Corrugations	PA	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
	PS	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064

Plastic Pipes

DSN/U	1b	1d	1f	3b	3f	3j	3m	4e	6c
Pipe Diameter (in)	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**
Pipe Type	**Availability**								
PVC Corrugated	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
PVC Ribbed	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Corrugated - Type S	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Ribbed	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Corrugated - Type C	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable

Reinforced Concrete Pipes

DSN/U	1b	1d	1f	3b	3f	3j	3m	4e	6c
Pipe Diameter (in)	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**
Steel Cover (in)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75

DSN/U	1b	1d	1f	3b	3f	3j	3m	4e	6c
Pipe Diameter (in)	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**
Sacks of Cement	5	5	5	5	5	5	5	5	5
Percentage Water	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1

Other Information

DSN/U	1b	1d	1f	3b	3f	3j	3m	4e	6c
Soil pH	7.63	7.63	7.63	6.99	6.99	6.99	6.99	6.99	7.64
Minimum Soil Resistivity (ohm-cm)	540	540	540	670	670	670	670	670	830
Sulfate Concentration (ppm)	198.5	198.5	198.5	143.1	143.1	143.1	143.1	143.1	680.7
Chloride Concentration (ppm)	48.2	48.2	48.2	15.2	15.2	15.2	15.2	15.2	38.2
Abrasion Level	1	1	1	1	1	1	1	1	1
2–5 Year Flow Velocity (ft/sec)	1.2	2.06	2.27	1.93	0.99	0.77	1.78	1.86	1.62
Design Service Life (years)	50	50	50	50	50	50	50	50	50
Height of Cover (ft)	4.5	4.5	3	4	4	2	3.5	3	4

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AltPipe

Project EA: **04-CC-680 4.3/6.7**
Project Engineer: **PW**
Location: **Contra Costa County**
Description: **I-680 Aux Lane Seg. 2**

Steel Pipes

DSN/U		7b	7e	7g	7i	7k	8b	8e	8g	8i
Pipe Diameter (in)		**18**	**18**	**24**	**18**	**24**	**24**	**24**	**24**	**24**
Pipe Type	**Coat**	**Minimum Thickness (in)**								
Corrugated Steel Pipe - Helical Corrugations - 2⅔" X ½" Corrugations	BCI						0.079	0.079	0.079	0.079
	PA	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	PS	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
Corrugated Steel Pipe - Annular Corrugations - 2⅔" X ½" Corrugations	BCI						0.079	0.079	0.079	0.079
	PA	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
	PS	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch	GAL						0.109	0.109	0.109	0.109
	BC						0.109	0.109	0.109	0.109
	BCI						0.079	0.079	0.079	0.079
	PA			0.064		0.064	0.064	0.064	0.064	0.064
	PS			0.064		0.064	0.064	0.064	0.064	0.064
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 8½" Pitch	GAL						0.109	0.109	0.109	0.109
	BC						0.109	0.109	0.109	0.109
	BCI						0.079	0.079	0.079	0.079
	PA			0.064		0.064	0.064	0.064	0.064	0.064
	PS			0.064		0.064	0.064	0.064	0.064	0.064
Steel Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch	GAL						0.109	0.109	0.109	0.109
	BC						0.109	0.109	0.109	0.109
	BCI						0.079	0.079	0.079	0.079
	PA			0.064		0.064	0.064	0.064	0.064	0.064
	PS			0.064		0.064	0.064	0.064	0.064	0.064

Plastic Pipes

DSN/U	7b	7e	7g	7i	7k	8b	8e	8g	8i
Pipe Diameter (in)	**18**	**18**	**24**	**18**	**24**	**24**	**24**	**24**	**24**
Pipe Type	**Availability**								
PVC Corrugated	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable

DSN/U	7b	7e	7g	7i	7k	8b	8e	8g	8i
Pipe Diameter (in)	**18**	**18**	**24**	**18**	**24**	**24**	**24**	**24**	**24**
Pipe Type	**Availability**								
PVC Ribbed	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Corrugated - Type S	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Ribbed	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Corrugated - Type C	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable

Reinforced Concrete Pipes

DSN/U	7b	7e	7g	7i	7k	8b	8e	8g	8i
Pipe Diameter (in)	**18**	**18**	**24**	**18**	**24**	**24**	**24**	**24**	**24**
Steel Cover (in)	0.75	0.75	1	0.75	1	1	1	1	1
Sacks of Cement	5	5	5	5	5	5	5	5	5
Percentage Water	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1

Other Information

DSN/U	7b	7e	7g	7i	7k	8b	8e	8g	8i
Soil pH	7.56	7.56	7.56	7.56	7.56	7.27	7.27	7.27	7.27
Minimum Soil Resistivity (ohm-cm)	280	280	280	280	280	1050	1050	1050	1050
Sulfate Concentration (ppm)	1137.9	1137.9	1137.9	1137.9	1137.9	77	77	77	77
Chloride Concentration (ppm)	71.4	71.4	71.4	71.4	71.4	39.5	39.5	39.5	39.5
Abrasion Level	1	1	1	1	1	1	1	1	1
2–5 Year Flow Velocity (ft/sec)	2.96	1.84	1.77	0.36	2.14	2.41	1.73	2.92	3.08
Design Service Life (years)	50	50	50	50	50	50	50	50	50
Height of Cover (ft)	2	3	3.5	4	9	2	3	3	3

AltPipe

Project EA: **04-CC-680 4.3/6.7**
Project Engineer: **PW**
Location: **Contra Costa County**
Description: **I-680 Aux Lane Seg. 2**

Steel Pipes

DSN/U		8k	8m	8p	8r	8t	8w	8z	8ac	8ao
Pipe Diameter (in)		**24**	**24**	**18**	**24**	**18**	**24**	**24**	**18**	**15**
Pipe Type	**Coat**	**Minimum Thickness (in)**								
Corrugated Steel Pipe - Helical Corrugations - 2⅔" X ½" Corrugations	AL2				0.052	0.052	0.052	0.052	0.052	0.052
	BCI	0.079	0.079							
	PA	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	PS	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
Corrugated Steel Pipe - Annular Corrugations - 2⅔" X ½" Corrugations	AL2				0.064	0.064	0.064	0.064	0.064	
	BCI	0.079	0.079							
	PA	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	
	PS	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch	GAL	0.109	0.109							
	AL2				0.064		0.064	0.064		
	BC	0.109	0.109		0.109		0.109	0.109		
	BCI	0.079	0.079		0.109		0.109	0.109		
	PA	0.064	0.064		0.064		0.064	0.064		
	PS	0.064	0.064		0.064		0.064	0.064		
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 8½" Pitch	GAL	0.109	0.109							
	AL2				0.064		0.064	0.064		
	BC	0.109	0.109		0.109		0.109	0.109		
	BCI	0.079	0.079		0.109		0.109	0.109		
	PA	0.064	0.064		0.064		0.064	0.064		
	PS	0.064	0.064		0.064		0.064	0.064		
Steel Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch	GAL	0.109	0.109							
	AL2				0.064		0.064	0.064		
	BC	0.109	0.109		0.109		0.109	0.109		
	BCI	0.079	0.079		0.109		0.109	0.109		
	PA	0.064	0.064		0.064		0.064	0.064		
	PS	0.064	0.064		0.064		0.064	0.064		

Aluminum Pipes

DSN/U	8k	8m	8p	8r	8t	8w	8z	8ac	8ao
Pipe Diameter (in)	**24**	**24**	**18**	**24**	**18**	**24**	**24**	**18**	**15**
Pipe Type	**Minimum Thickness (in)**								
Corrugated Aluminum Pipe - Annular Corrugations - 2⅔" X ½" Corrugations				0.060	0.060	0.060	0.060	0.060	0.060
Corrugated Aluminum Pipe - Helical Corrugations - 2⅔" X ½" Corrugations				0.060	0.060	0.060	0.060	0.060	0.060
Aluminum Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch				0.060		0.060	0.060		
Aluminum Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch				0.060		0.060	0.060		

Plastic Pipes

DSN/U	8k	8m	8p	8r	8t	8w	8z	8ac	8ao
Pipe Diameter (in)	**24**	**24**	**18**	**24**	**18**	**24**	**24**	**18**	**15**
Pipe Type	**Availability**								
PVC Corrugated	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
PVC Ribbed	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	
HDPE Corrugated - Type S	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	
HDPE Ribbed	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	
HDPE Corrugated - Type C	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	

Reinforced Concrete Pipes

DSN/U	8k	8m	8p	8r	8t	8w	8z	8ac	8ao
Pipe Diameter (in)	**24**	**24**	**18**	**24**	**18**	**24**	**24**	**18**	**15**
Steel Cover (in)	1	1	0.75	1	0.75	1	1	0.75	0.75
Sacks of Cement	5	5	5	5	5	5	5	5	5
Percentage Water	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1

Other Information

DSN/U	8k	8m	8p	8r	8t	8w	8z	8ac	8ao
Soil pH	7.27	7.27	7.27	7.05	7.05	7.05	7.05	7.05	7.05
Minimum Soil Resistivity (ohm-cm)	1050	1050	1050	1595	1595	1595	1595	1595	1595
Sulfate Concentration (ppm)	77	77	77	29.5	29.5	29.5	29.5	29.5	29.5
Chloride Concentration (ppm)	39.5	39.5	39.5	19.5	19.5	19.5	19.5	19.5	19.5
Abrasion Level	1	1	1	1	1	1	1	1	1
2–5 Year Flow Velocity (ft/sec)	3.34	3.36	2.25	4.45	0.61	4.84	3.7	0.89	2.42
Design Service Life (years)	50	50	50	50	50	50	50	50	50
Height of Cover (ft)	3.5	4	4.5	6	6	9.5	10	9	10.5

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AltPipe

Project EA: **04-CC-680 4.3/6.7**
Project Engineer: **PW**
Location: **Contra Costa County**
Description: **I-680 Aux Lane Seg. 2**

Steel Pipes

DSN/U		8ae	8ag	8aj	9b	9d	9f	9j	9l
Pipe Diameter (in)		**24**	**24**	**24**	**18**	**18**	**18**	**18**	**18**
Pipe Type	**Coat**	**Minimum Thickness (in)**							
Corrugated Steel Pipe - Helical Corrugations - 2⅔" X ½" Corrugations	PA	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	PS	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
Corrugated Steel Pipe - Annular Corrugations - 2⅔" X ½" Corrugations	PA	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
	PS	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 11½" Pitch	BC	0.109	0.109	0.109					
	BCI	0.109	0.109	0.109					
	PA	0.064	0.064	0.064					
	PS	0.064	0.064	0.064					
Steel Spiral Rib Pipe - ¾" X 1" Ribs At 8½" Pitch	BC	0.109	0.109	0.109					
	BCI	0.109	0.109	0.109					
	PA	0.064	0.064	0.064					
	PS	0.064	0.064	0.064					
Steel Spiral Rib Pipe - ¾" X ¾" Ribs At 7½" Pitch	BC	0.109	0.109	0.109					
	BCI	0.109	0.109	0.109					
	PA	0.064	0.064	0.064					
	PS	0.064	0.064	0.064					

Plastic Pipes

DSN/U	8ae	8ag	8aj	9b	9d	9f	9j	9l
Pipe Diameter (in)	**24**	**24**	**24**	**18**	**18**	**18**	**18**	**18**
Pipe Type	**Availability**							
PVC Corrugated	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
PVC Ribbed	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable

DSN/U	8ae	8ag	8aj	9b	9d	9f	9j	9l
Pipe Diameter (in)	**24**	**24**	**24**	**18**	**18**	**18**	**18**	**18**
Pipe Type	**Availability**							
HDPE Corrugated - Type S	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Ribbed	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Corrugated - Type C	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable

Reinforced Concrete Pipes

DSN/U	8ae	8ag	8aj	9b	9d	9f	9j	9l
Pipe Diameter (in)	**24**	**24**	**24**	**18**	**18**	**18**	**18**	**18**
Steel Cover (in)	1	1	1	0.75	0.75	0.75	0.75	0.75
Sacks of Cement	5	5	5	5	5	5	5	5
Percentage Water	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1

Other Information

DSN/U	8ae	8ag	8aj	9b	9d	9f	9j	9l
Soil pH	7.1	7.1	7.1	7.27	7.27	7.27	7.27	7.27
Minimum Soil Resistivity (ohm-cm)	1460	1460	1460	1050	1050	1050	1050	1050
Sulfate Concentration (ppm)	77.6	77.6	77.6	77	77	77	77	77
Chloride Concentration (ppm)	42.2	42.2	42.2	39.5	39.5	39.5	39.5	39.5
Abrasion Level	1	1	1	1	1	1	1	1
2–5 Year Flow Velocity (ft/sec)	5.81	5.83	4.49	1.66	1.91	1.72	0.65	0.39
Design Service Life (years)	50	50	50	50	50	50	50	50
Height of Cover (ft)	7.5	8	10.5	2	2	2	2	2

AltPipe

Project EA: **04-CC-680 4.3/6.7**
Project Engineer: **PW**
Location: **Contra Costa County**
Description: **I-680 Aux Lane Seg. 2**

Steel Pipes

DSN/U		9h	9n	10d	11a	11d	11i	11k	11o
Pipe Diameter (in)		18	18	18	18	18	18	18	18
Pipe Type	Coat	Minimum Thickness (in)							
Corrugated Steel Pipe - Helical Corrugations - 2⅔" X ½" Corrugations	AL2			0.052					
	BC			0.064					
	BCI			0.064					
	PA	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	PS	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
Corrugated Steel Pipe - Annular Corrugations - 2⅔" X ½" Corrugations	AL2			0.064					
	BC			0.064					
	BCI			0.064					
	PA	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
	PS	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064

Aluminum Pipes

DSN/U	9h	9n	10d	11a	11d	11i	11k	11o
Pipe Diameter (in)	18	18	18	18	18	18	18	18
Pipe Type	Minimum Thickness (in)							
Corrugated Aluminum Pipe - Annular Corrugations - 2⅔" X ½" Corrugations			0.060					
Corrugated Aluminum Pipe - Helical Corrugations - 2⅔" X ½" Corrugations			0.060					

Plastic Pipes

DSN/U	9h	9n	10d	11a	11d	11i	11k	11o
Pipe Diameter (in)	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**
Pipe Type	**Availability**							
PVC Corrugated	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
PVC Ribbed	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Corrugated - Type S	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Ribbed	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Corrugated - Type C	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable

Reinforced Concrete Pipes

DSN/U	9h	9n	10d	11a	11d	11i	11k	11o
Pipe Diameter (in)	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**
Steel Cover (in)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Sacks of Cement	5	5	5	5	5	5	5	5
Percentage Water	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1

Other Information

DSN/U	9h	9n	10d	11a	11d	11i	11k	11o
Soil pH	7.27	7.27	7.56	7.45	7.45	7.45	7.45	7.45
Minimum Soil Resistivity (ohm-cm)	1050	1050	1980	960	960	960	960	960
Sulfate Concentration (ppm)	77	77	17.1	12.3	12.3	12.3	12.3	12.3
Chloride Concentration (ppm)	39.5	39.5	8	11.9	11.9	11.9	11.9	11.9
Abrasion Level	1	1	1	1	1	1	1	1
2–5 Year Flow Velocity (ft/sec)	1.86	2.28	1.90	1.28	1.81	1.29	3.71	1.77
Design Service Life (years)	50	50	50	50	50	50	50	50
Height of Cover (ft)	2	2	3.5	5	2	2	2	2

AltPipe

Project EA: **04-CC-680 4.3/6.7**
Project Engineer: **PW**
Location: **Contra Costa County**
Description: **I-680 Aux Lane Seg. 2**

Steel Pipes

DSN/U		14c	15d	17b	19b	19f	19j	21b
Pipe Diameter (in)		**18**	**18**	**18**	**18**	**18**	**18**	**18**
Pipe Type	**Coat**	**Minimum Thickness (in)**						
Corrugated Steel Pipe - Helical Corrugations - 2⅔" X ½" Corrugations	AL2		0.052	0.052				
	BC		0.064	0.064				
	BCI		0.064	0.064				
	PA	0.052	0.052	0.052	0.052	0.052	0.052	0.052
	PS	0.052	0.052	0.052	0.052	0.052	0.052	0.052
Corrugated Steel Pipe - Annular Corrugations - 2⅔" X ½" Corrugations	AL2		0.064	0.064				
	BC		0.064	0.064				
	BCI		0.064	0.064				
	PA	0.064	0.064	0.064	0.064	0.064	0.064	0.064
	PS	0.064	0.064	0.064	0.064	0.064	0.064	0.064

Aluminum Pipes

DSN/U	14c	15d	17b	19b	19f	19j	21b
Pipe Diameter (in)	**18**	**18**	**18**	**18**	**18**	**18**	**18**
Pipe Type	**Minimum Thickness (in)**						
Corrugated Aluminum Pipe - Annular Corrugations - 2⅔" X ½" Corrugations		0.060	0.060				
Corrugated Aluminum Pipe - Helical Corrugations - 2⅔" X ½" Corrugations		0.060	0.060				

Plastic Pipes

DSN/U	14c	15d	17b	19b	19f	19j	21b
Pipe Diameter (in)	**18**	**18**	**18**	**18**	**18**	**18**	**18**
Pipe Type	**Availability**						
PVC Corrugated	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
PVC Ribbed	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Corrugated - Type S	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Ribbed	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable
HDPE Corrugated - Type C	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable	Allowable

Reinforced Concrete Pipes

DSN/U	14c	15d	17b	19b	19f	19j	21b
Pipe Diameter (in)	**18**	**18**	**18**	**18**	**18**	**18**	**18**
Steel Cover (in)	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Sacks of Cement	5	5	5	5	5	5	5
Percentage Water	11.1	11.1	11.1	11.1	11.1	11.1	11.1

Other Information

DSN/U	14c	15d	17b	19b	19f	19j	21b
Soil pH	6.39	7.47	7.47	7.56	7.56	7.56	6.9
Minimum Soil Resistivity (ohm-cm)	1470	1930	1930	775	775	775	1340
Sulfate Concentration (ppm)	79.4	66.9	66.9	63.9	63.9	63.9	1.6
Chloride Concentration (ppm)	27.1	14.5	14.5	18.9	18.9	18.9	15.5
Abrasion Level	1	1	1	1	1	1	1
2–5 Year Flow Velocity (ft/sec)	2.63	1.05	1.69	3.96	3.27	3.03	2.22
Design Service Life (years)	50	50	50	50	50	50	50
Height of Cover (ft)	2	3	3.5	2.5	5	4	3

AltPipe

Project EA: **04-CC-680 4.3/6.7**
Project Engineer: **PW**
Location: **Contra Costa County**
Description: **I-680 Aux Lane Seg. 2**

Steel Pipes

	DSN/U	23b	23c	23f	24c
	Pipe Diameter (in)	**18**	**18**	**18**	**18**
Pipe Type	**Coat**	**Minimum Thickness (in)**			
Corrugated Steel Pipe - Helical Corrugations - 2⅔" X ½" Corrugations	AL2				0.052
	PA	0.052	0.052	0.052	0.052
	PS	0.052	0.052	0.052	0.052
Corrugated Steel Pipe - Annular Corrugations - 2⅔" X ½" Corrugations	AL2				0.064
	PA	0.064	0.064	0.064	0.064
	PS	0.064	0.064	0.064	0.064

Aluminum Pipes

DSN/U	23b	23c	23f	24c
Pipe Diameter (in)	**18**	**18**	**18**	**18**
Pipe Type	**Minimum Thickness (in)**			
Corrugated Aluminum Pipe - Annular Corrugations - 2⅔" X ½" Corrugations				0.060
Corrugated Aluminum Pipe - Helical Corrugations - 2⅔" X ½" Corrugations				0.060

Plastic Pipes

DSN/U	23b	23c	23f	24c
Pipe Diameter (in)	**18**	**18**	**18**	**18**
Pipe Type	**Availability**			
PVC Corrugated	Allowable	Allowable	Allowable	Allowable
PVC Ribbed	Allowable	Allowable	Allowable	Allowable
HDPE Corrugated - Type S	Allowable	Allowable	Allowable	Allowable
HDPE Ribbed	Allowable	Allowable	Allowable	Allowable
HDPE Corrugated - Type C	Allowable	Allowable	Allowable	Allowable

Reinforced Concrete Pipes

DSN/U	23b	23c	23f	24c
Pipe Diameter (in)	**18**	**18**	**18**	**18**
Steel Cover (in)	0.75	0.75	0.75	0.75
Sacks of Cement	5	5	5	5
Percentage Water	11.1	11.1	11.1	11.1

Other Information

DSN/U	23b	23c	23f	24c
Soil pH	7.63	7.63	7.63	6.97
Minimum Soil Resistivity (ohm-cm)	540	540	540	1660
Sulfate Concentration (ppm)	198.5	198.5	198.5	46.9
Chloride Concentration (ppm)	48.2	48.2	48.2	26.8
Abrasion Level	1	1	1	1
2–5 Year Flow Velocity (ft/sec)	0.87	2.10	1.53	0.77
Design Service Life (years)	50	50	50	50
Height of Cover (ft)	4	3	5.5	5.5

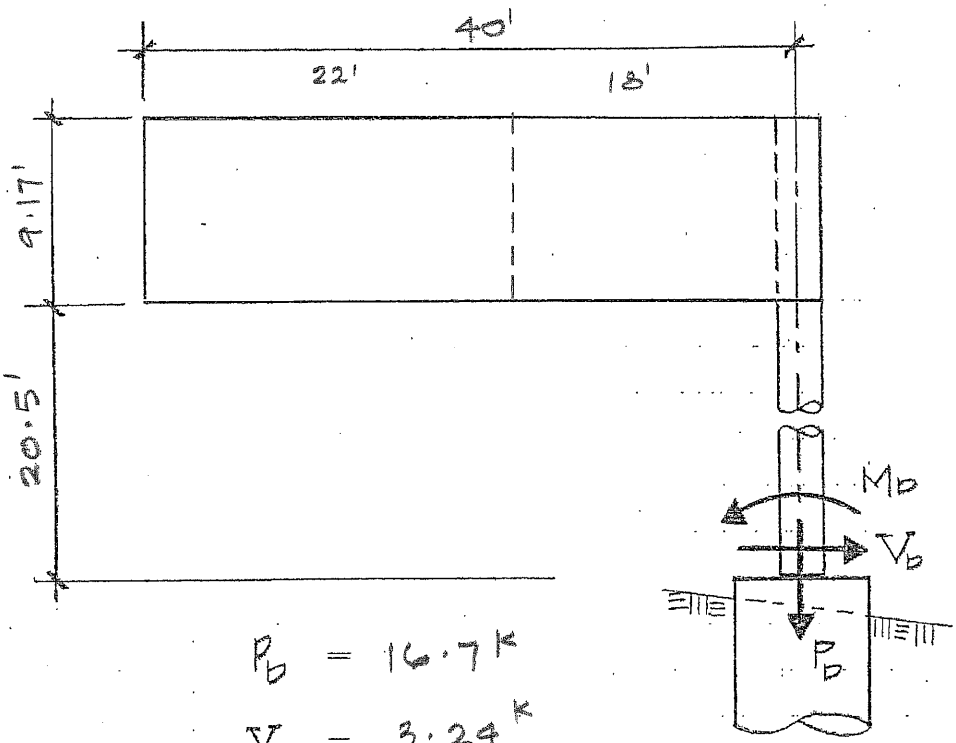
AltPipe Version 6.09 © State of California

MARK THOMAS & COMPANY, INC.
Providing Engineering, Surveying and Planning Services

FILE NO. _____
JOB TITLE 680-AUX LN - OH SIGNS
SUBJECT _____
PREPARED BY HM DATE 3-22-12
CHECKED BY _____ DATE _____

OH SIGN: B

STA: "A4" 272+50.0 FSBT



$P_D = 16.7^K$

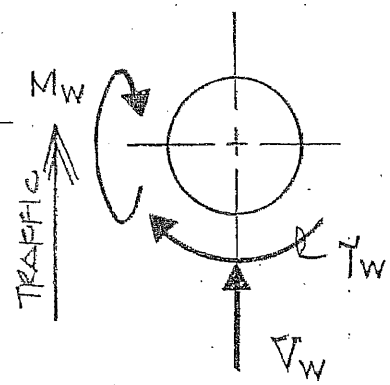
$V_D = 3.24^K$

$M_D = 273^{1K}$

$V_W = 16.2^K$

$M_W = 867^{1K}$

$T_W = 312^{1K}$



$$M_T = \sqrt{273^2 + 867^2} = 909 \text{ kf}$$

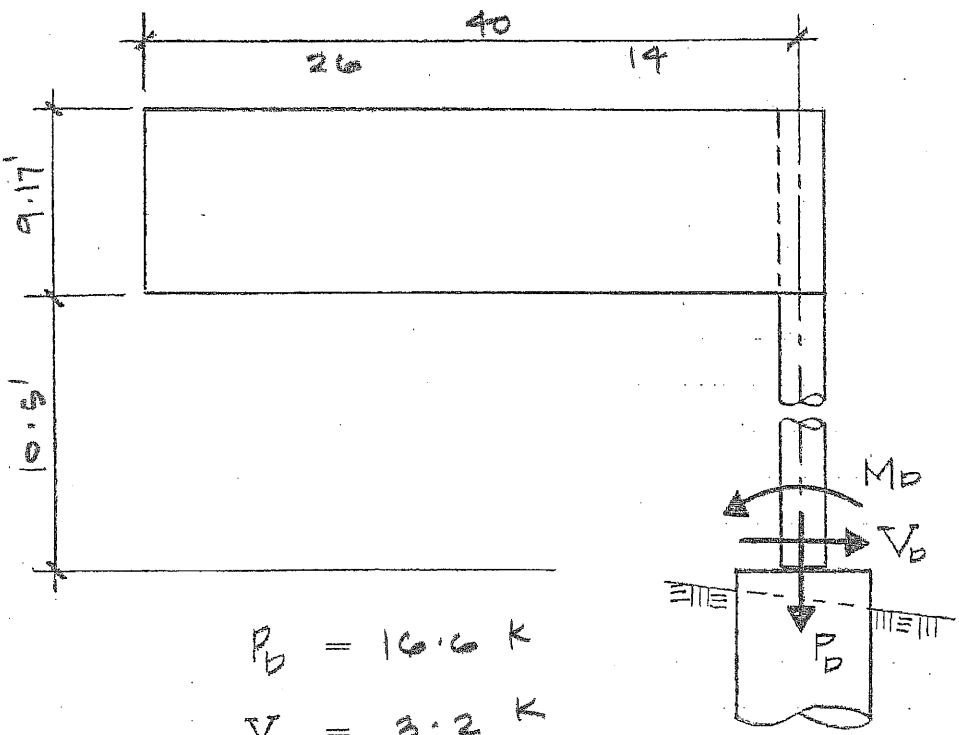
$$V_T = \sqrt{3.24^2 + 16.2^2} = 16.5 \text{ K}$$

MARK THOMAS & COMPANY, INC.
Providing Engineering, Surveying and Planning Services

FILE NO. _____
JOB TITLE 680 - AUX LN, OH SIGNS
SUBJECT _____
PREPARED BY HM DATE 3.22.12
CHECKED BY _____ DATE _____

OH SIGN: D

STA: "A4" 265 + 25.0 FNBT



$P_D = 16.6$ K

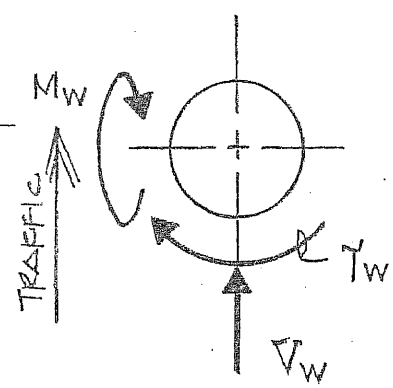
$V_D = 3.2$ K

$M_D = 282$ 'K

$V_W = 16.0$ K

$M_W = 704$ 'K

$T_W = 312$ 'K



$$M_T = \sqrt{282^2 + 704^2} = 758.4 \text{ kf}$$

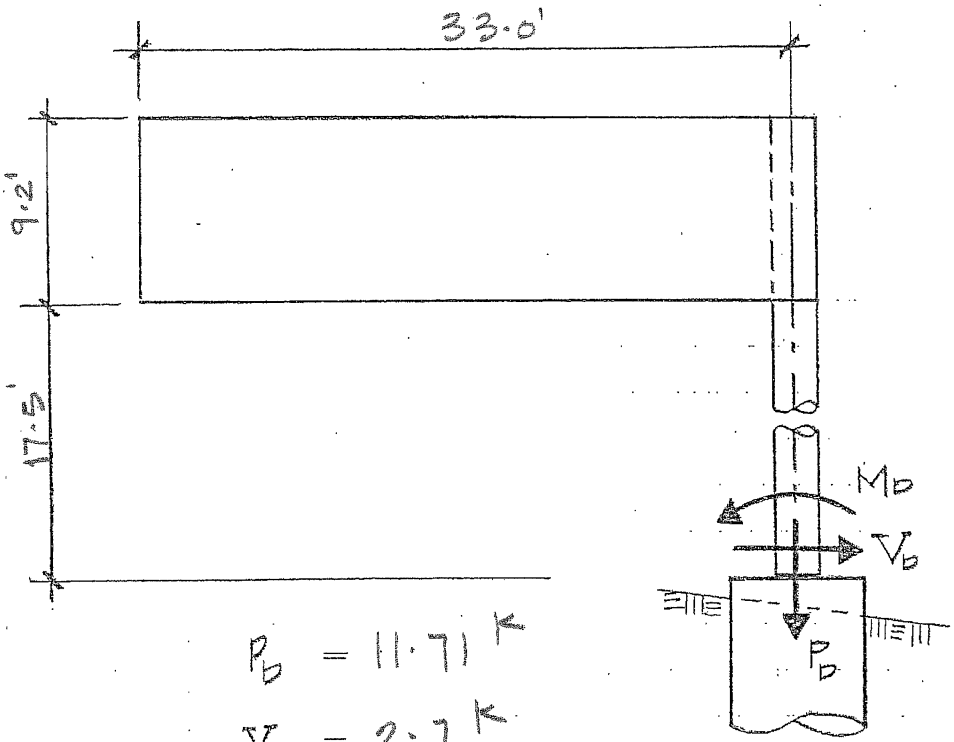
$$V_T = \sqrt{3.2^2 + 16.0^2} = 16.3 \text{ k}$$

MARK THOMAS & COMPANY, INC.
Providing Engineering, Surveying and Planning Services

FILE NO. _____
JOB TITLE 680 AUX LN
SUBJECT OH SIGN FTG LOADS
PREPARED BY HM DATE 11-10-11
CHECKED BY _____ DATE _____

OH SIGN: F

STA: "A4" 317+00 FSBT



$P_D = 11.71^{k}$

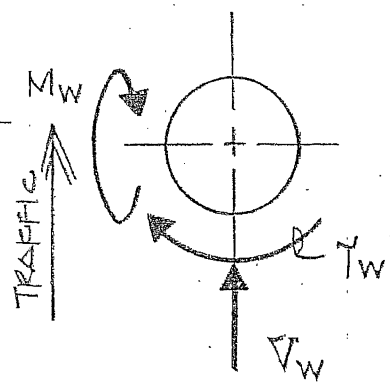
$V_D = 2.7^{k}$

$M_D = 162.6^{1k}$

$V_W = 13.4^{k}$

$M_W = 609.2^{1k}$

$T_W = 212.2^{1k}$



$$M_T = \sqrt{162.6^2 + 609.2^2} = 630.5 \text{ kf}$$

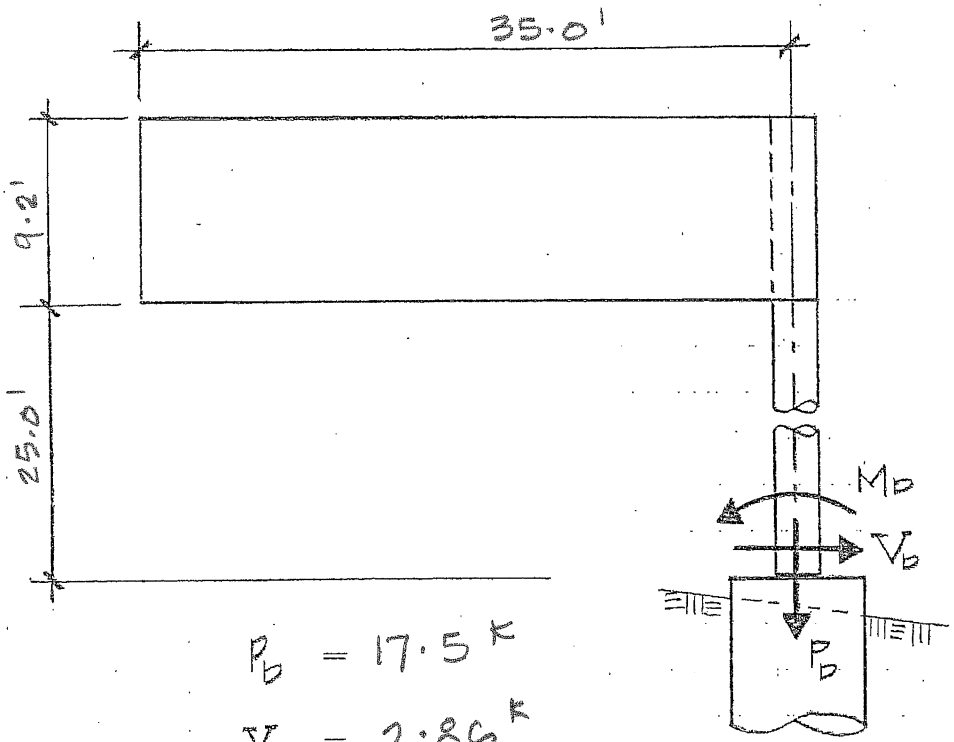
$$V_T = \sqrt{2.7^2 + 13.4^2} = 13.67 \text{ K}$$

MARK THOMAS & COMPANY, INC.
Providing Engineering, Surveying and Planning Services

FILE NO. _____
JOB TITLE 680 AUX LN
SUBJECT OH SIGN FTG LOADS
PREPARED BY HM DATE 11-10-11
CHECKED BY _____ DATE _____

OH SIGN: H

STA: "A4" 317+00 FNBT



$P_D = 17.5^{K}$

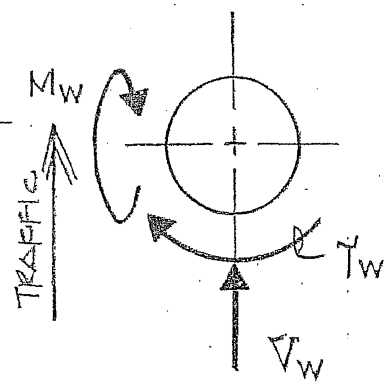
$V_D = 2.86^{K}$

$M_D = 233.2^{1K}$

$V_W = 14.3^{K}$

$M_W = 777.7^{1K}$

$T_W = 238.7^{1K}$



$$M_T = \sqrt{233.2^2 + 777.7^2} = 811.9 \text{ kf}$$

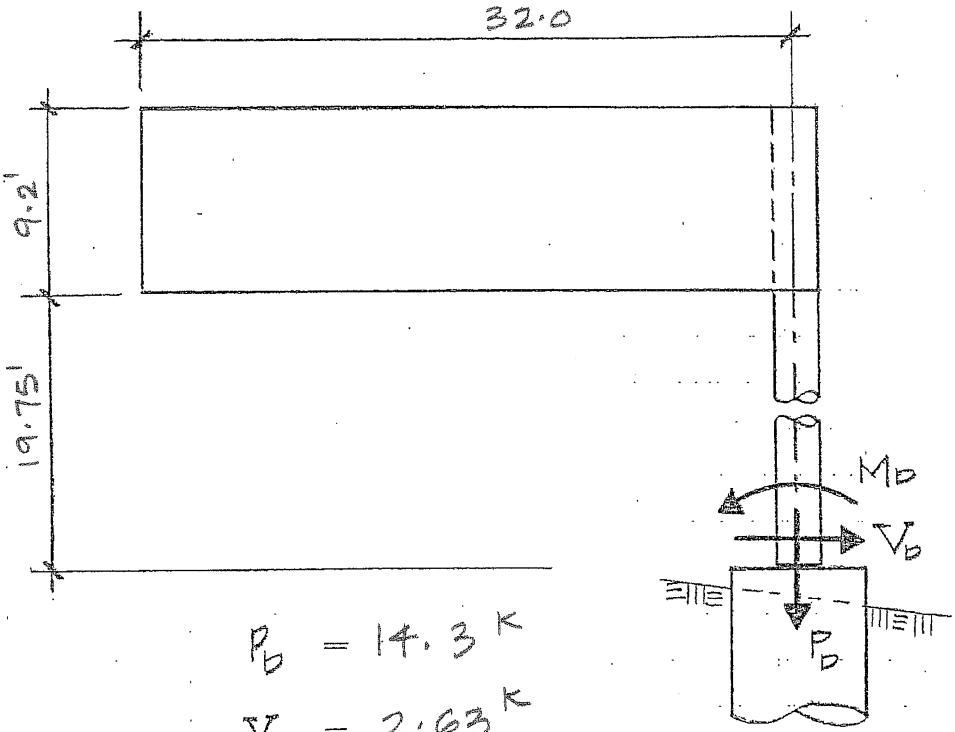
$$V_T = \sqrt{2.86^2 + 14.3^2} = 14.58 \text{ K}$$

MARK THOMAS & COMPANY, INC.
Providing Engineering, Surveying and Planning Services

FILE NO. _____
JOB TITLE 680 AUX LN
SUBJECT OH SIGN FTG LOADS
PREPARED BY HM DATE 11-10-11
CHECKED BY _____ DATE _____

OH SIGN: K

STA : "A4" 338+50 FNBT



$P_D = 14.3^{K}$

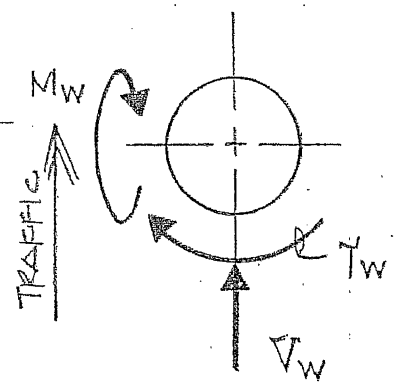
$V_D = 2.63^{K}$

$M_D = 197.4^{'K}$

$V_W = 13.2^{K}$

$M_W = 617.3^{'K}$

$T_W = 203.0^{'K}$



$$M_T = \sqrt{197.4^2 + 617.3^2} = 648.1 \text{ Kf}$$

$$V_T = \sqrt{2.63^2 + 13.2^2} = 13.46 \text{ K}$$

OH sign B Sta: 272+50 A4 SB (Previously 265+99)

Design 5' ϕ and 25' CIDH

Boring A-11-144 (conservative)

0 CL $\bar{N} = 8$, $c = 960$ psf

6' CL $\bar{N} = 13$, $c = 1560$ psf

13' CL $\bar{N} = 40$, $c = 4800$ psf, use 3000 psf

24' MST $\bar{N} = 50$, use 3000 psf

31'

$\alpha = 0.55$ for clay

(FHWA-NHI-10-016, May 2010)

Vertical capacity:

$P_{all} = 0.55 \times 5 \times 3.14 \times (960 \times 6 + 1560 \times 7 + 3000 \times 12)/(2 \times 1000)$

$= 227$ K $> P_D = 16.7$ K ✓

Torsion capacity:

$T_{all} = 227 \times 2.5 = 567.5$ kf

$> T_w = 312$ kf ✓

Passive capacity $P_p = \frac{1}{2}\gamma H^2 + 2cH$

$P_p = \frac{1}{2} \times 125 \times (6 + 7 + 12)^2 + 2 \times (960 \times 6 + 1560 \times 7 + 3000 \times 12)$

$= 144{,}422.5 \doteq 144.4$ K

Design $\phi = 30°$ $K_p = \tan^2(45 + 30/2) = 3$

$P_{ps} = \frac{1}{2} K_p \gamma H^2 = \frac{1}{2} \times 3 \times 125 \times 25^2/1000 = 117.2$ K $< P_p$ ✓

OH sign D sta. 265+25 A4 NB (previously 268+00)

Design 5' φ and 25' CIDH

Boring A-11-106

$\alpha = 0.55$ for clay
(FHWA-NHI-10-016, May 2010)

Vertical capacity:

$P_{all} = 0.55 \times 5 \times 3.14 \times 3000 \times 25 / (2 \times 1000)$
$= 323.8\ K > P_D = 16.6\ K$ ✓

Torsion capacity:

$T_{all} = 323.8 \times 2.5 = 809.5\ K > T_w = 312\ Kf$ ✓

Passive capacity:

$P_p = \frac{1}{2}\gamma H^2 + 2cH$
$= (\frac{1}{2} \times 125 \times 25^2 + 2 \times 3000 \times 25)/1000$
$= 189\ K$

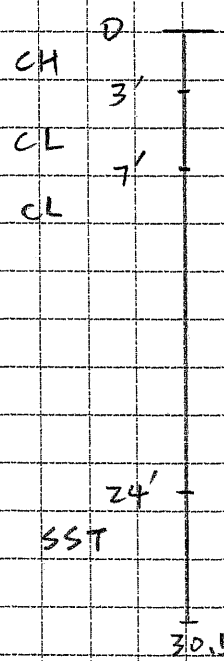
Design $\phi = 30°$ $K_p = 3$

$P_{ps} = \frac{1}{2} K_p \gamma H^2 = \frac{1}{2} \times 3 \times 125 \times 25^2 / 1000 = 117.2\ K < P_p = 189\ K$ ✓

OH sign F Sta: 316+90 A4 SB (previously 317+00)

Design 5' φ and 23' CIDH

Boring A-11-143



$\bar{N} = 10$, $c = 1200$ psf

$\bar{N} = 17$, $c = 2040$ psf

$\bar{N} = 26$, $c = 3120$ psf

$\alpha = 0.55$ for clay

(FHWA-NHI-10-016, May 2010)

Vertical capacity:

$P_{all} = 0.55 \times 5 \times 3.14 \times (1200 \times 3 + 2040 \times 4 + 3120 \times 16)/(2 \times 1000)$

$= 266.3\ k > P_D = 11.7\ k$ ✓

Torsion capacity:

$T_{all} = 266.3 \times 2.5 = 665.8\ kf$

$> T_w = 212.2\ kf$ ✓

Passive capacity: $P_p = \frac{1}{2}\gamma H^2 + 2cH$

$P_p = \frac{1}{2} \times 125 \times (3 + 4 + 16)^2 + 2 \times (1200 \times 3 + 2040 \times 4 + 3120 \times 16)$

$= 156{,}422.5 \doteq 156.4\ k$

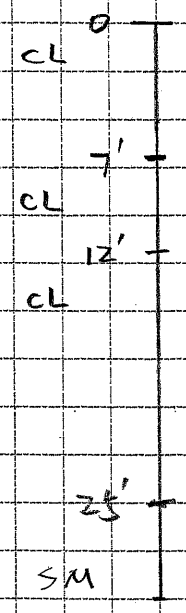
Design $\phi = 30°$ $K_p = 3$

$P_{ps} = \frac{1}{2} K_p \gamma H^2 = \frac{1}{2} \times 3 \times 125 \times 23^2/1000 = 99.2\ k < P_p$ ✓

OH sign H Sta: 317+10 A4 NB
(previously 317+00)

Design 5' ϕ and 25' CIDH

Boring A-11-135



$\alpha = 0.55$ for clay

(FHWA-NHI-10-016, May 2010)

Vertical capacity:

$P_{all} = 0.55 \times 5 \times 3.14 \times (1320 \times 7 + 2040 \times 5 + 1200 \times 13) / (2 \times 1000)$
$= 151.3$ K $> P_D = 17.5$ K ✓

Torsion capacity:

$T_{all} = 151.3 \times 2.5 = 378.3 > T_w = 238.7$ ✓

Passive capacity:

$P_P = \frac{1}{2}\gamma H^2 + 2cH = \frac{1}{2} \times 125 \times (7 + 5 + 13)^2 + 2 \times (1320 \times 7 + 2040 \times 5 + 1200 \times 13)$
$= 109{,}142.5 \doteq 109.1$ K

Design $\varphi = 30°$ $K_p = 3$

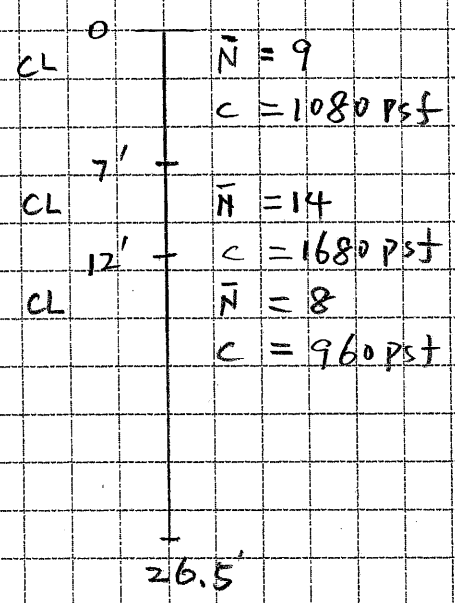
$P_{PS} = \frac{1}{2} K_p \gamma H^2 = \frac{1}{2} \times 125 \times 3 \times 25^2 / 1000 = 117.2$ K $> P_P$

check deflection

OH sign K Sta: 338+50 A4 NB

Design 5' ϕ and 23' CIDH

Boring A-11-142



$\alpha = 0.55$ for clay

(FHWA-NHI-10-016, May 2010)

Vertical capacity:

$P_{all} = 0.55 \times 5 \times 3.14 \times (1080 \times 7 + 1680 \times 5 + 960 \times 11)/(2 \times 1000) = 114.5K$

$P_{all} > P_D = 14.3$ K ✓

Torsion capacity:

$T_{all} = 114.5 \times 2.5 = 286.3 > T_w = 203.0$ kf ✓

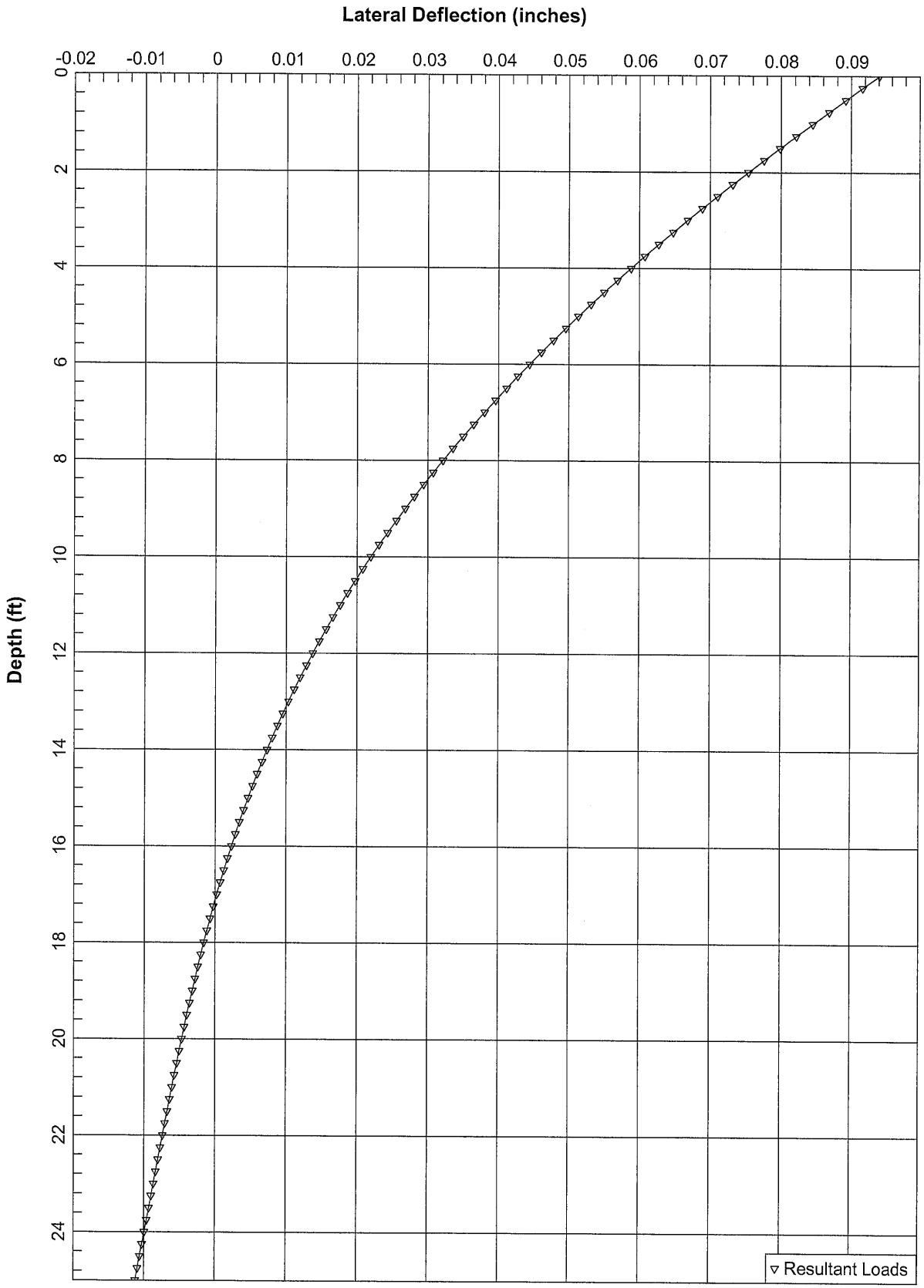
Passive capacity:

$P_p = \frac{1}{2}\gamma H^2 + 2cH = \frac{1}{2} \times 125 \times (7 + 5 + 11)^2 + 2 \times (1080 \times 7 + 1680 \times 5 + 960 \times 11) = 86,102.5 \doteq 86.1$ k

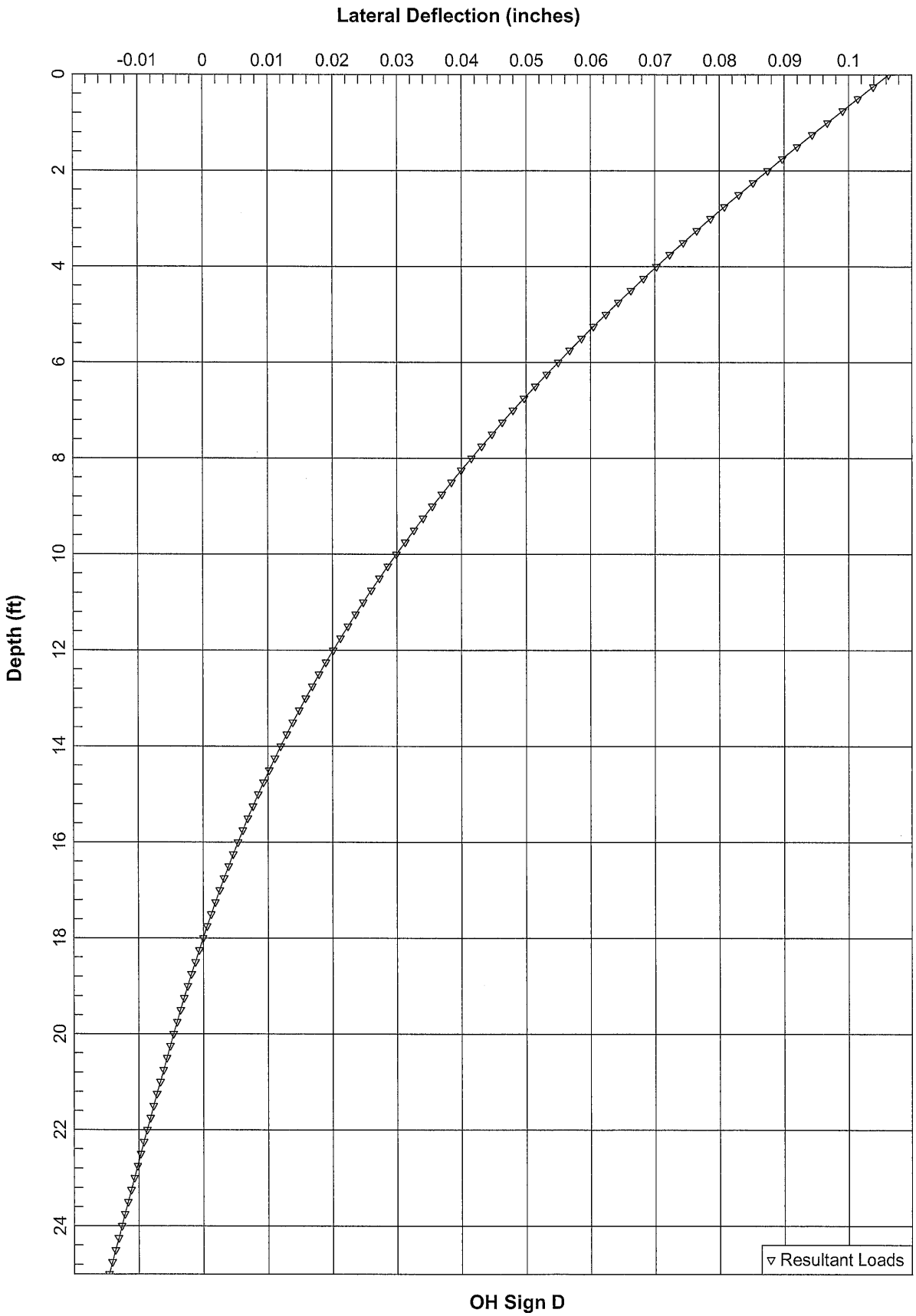
Design $\phi = 30°$ $K_p = 3$

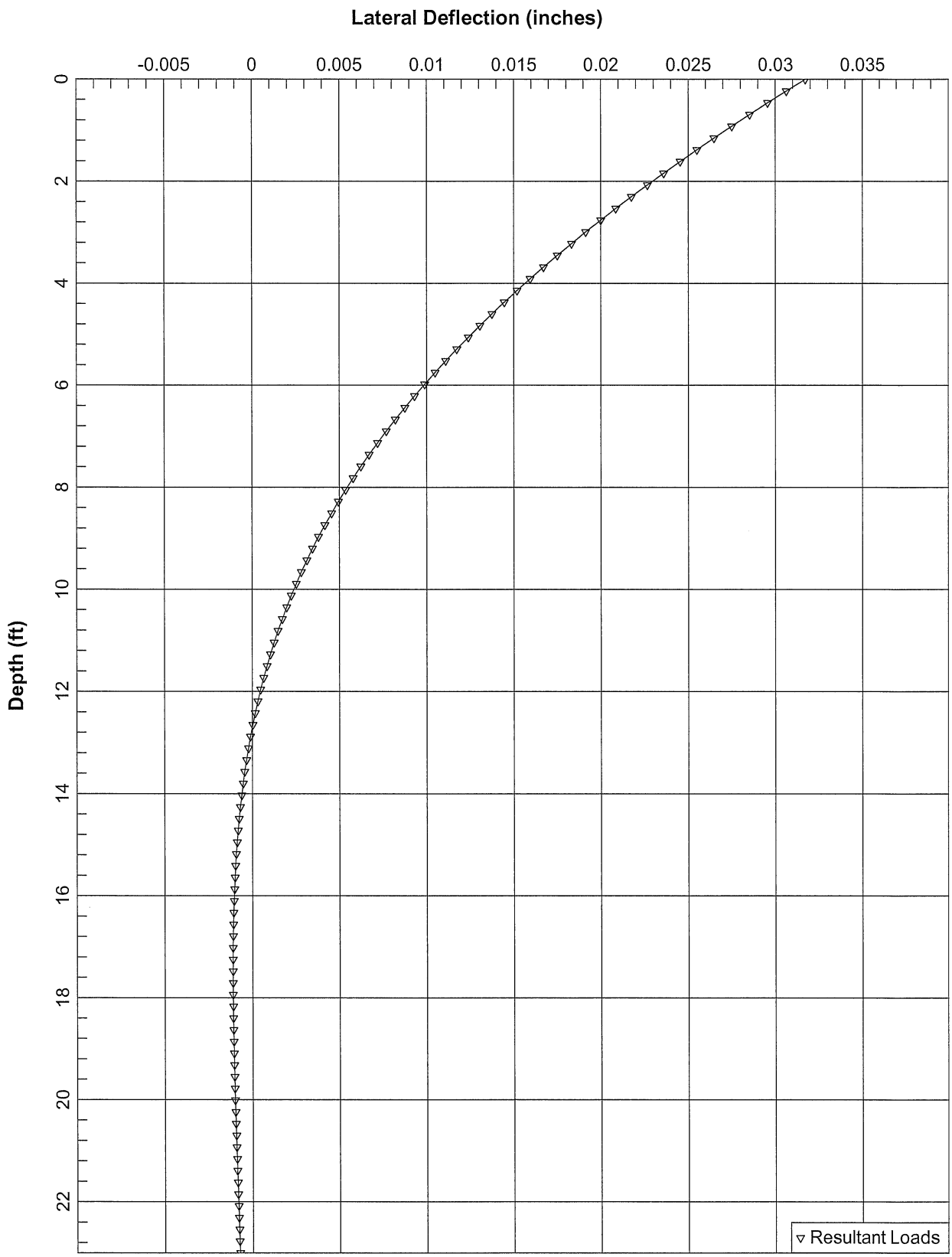
$P_{ps} = \frac{1}{2} K_p \gamma H^2 = \frac{1}{2} \times 125 \times 3 \times 23^2/1000 = 99.2$ K $> P_p$

check deflection


Lateral Deflection (inches)
-0.02
-0.01
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
Resultant Loads

OH Sign B


Lateral Deflection (inches)
-0.01
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
Resultant Loads
OH Sign D


Lateral Deflection (inches)
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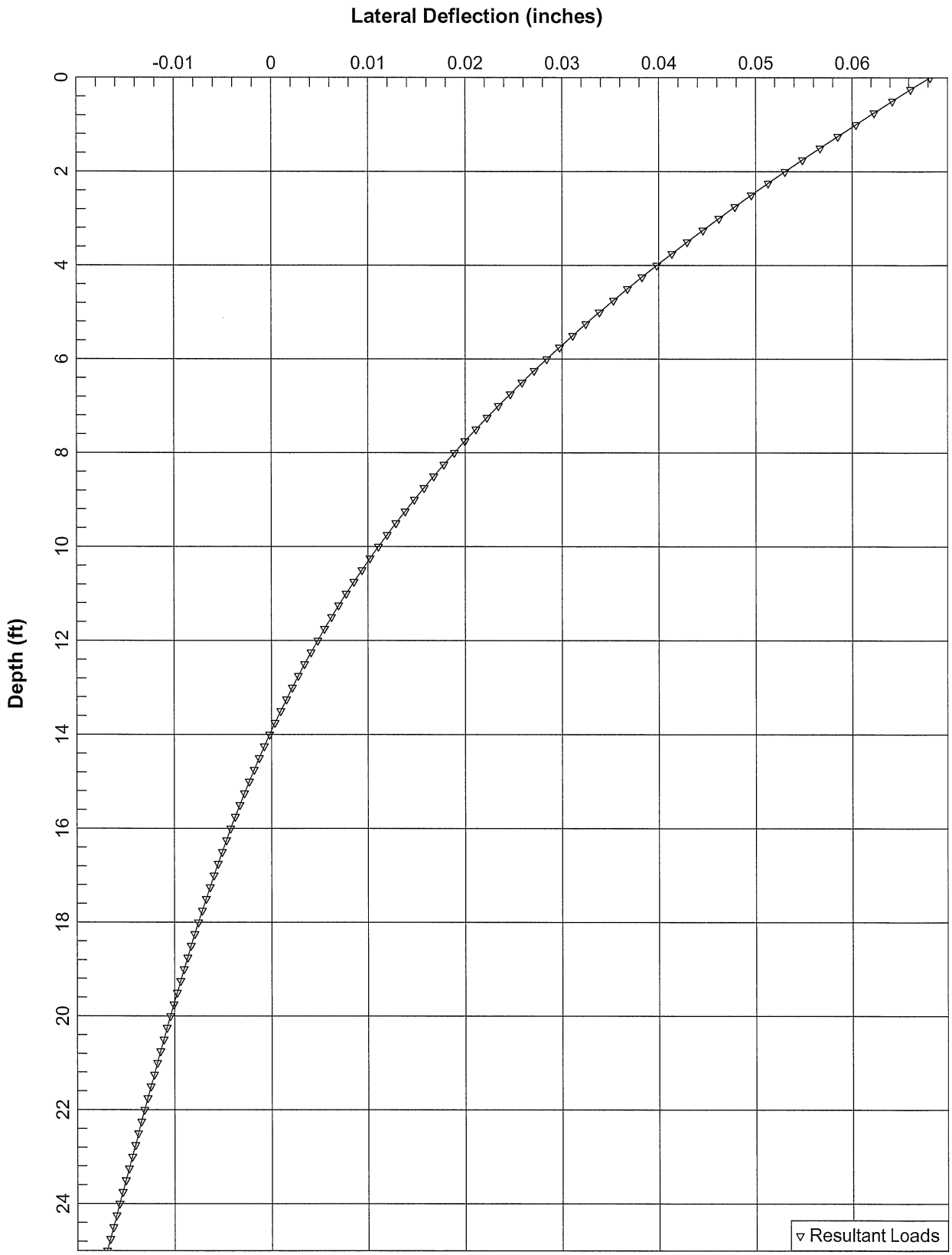
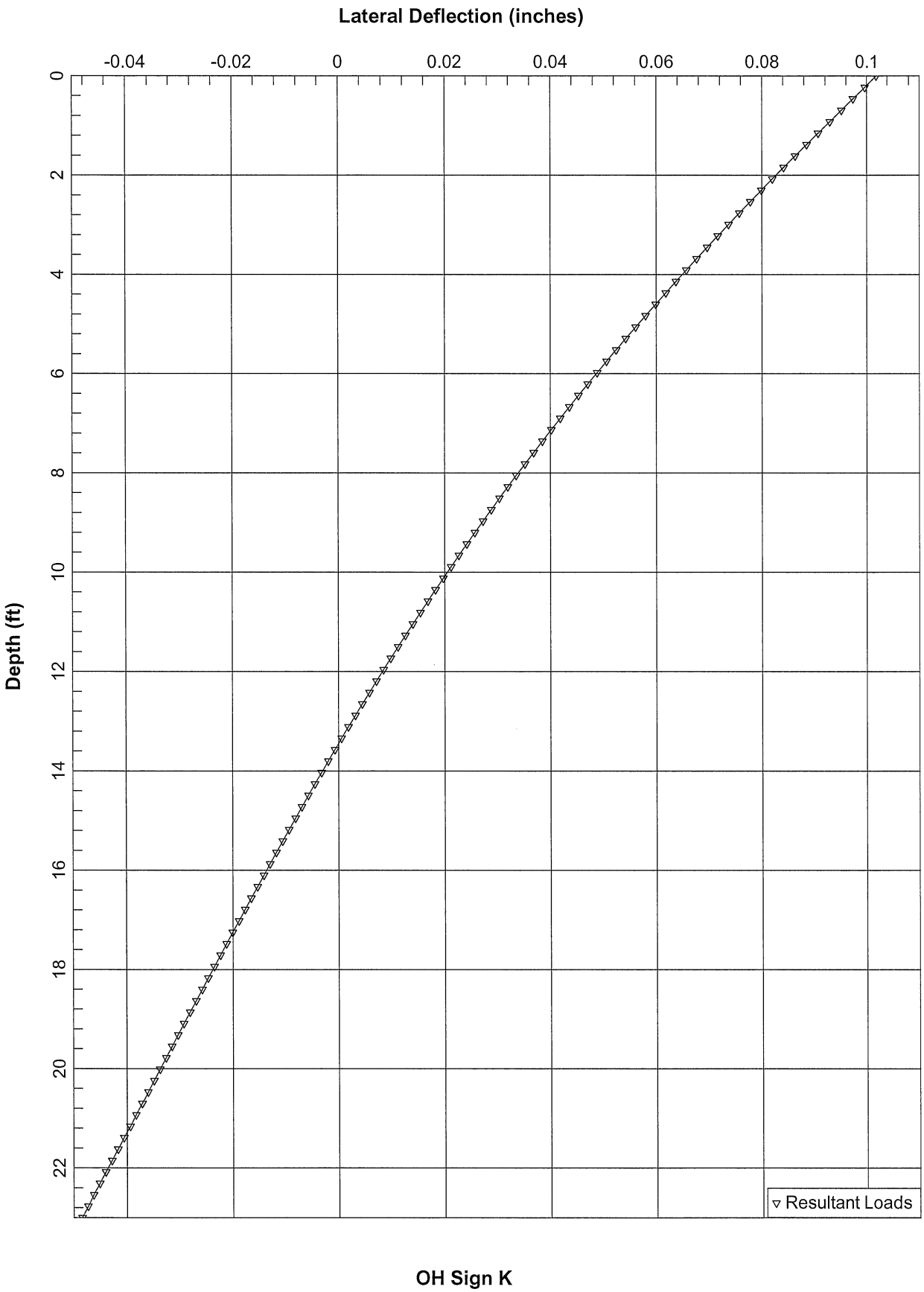
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
Resultant Loads

OH Sign F


Lateral Deflection (inches)
-0.01
0
0.01
0.02
0.03
0.04
0.05
0.06
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
Resultant Loads

OH Sign H


Lateral Deflection (inches)
-0.04
-0.02
0
0.02
0.04
0.06
0.08
0.1
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
Resultant Loads
OH Sign K

APPENDIX D

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	CC	680	R4.3/R6.7	2	361

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER S.D.DANSKY No. 60220 Exp. 6-30-12 CIVIL STATE OF CALIFORNIA

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2999 OAK ROAD, SUITE 100
WALNUT CREEK, CA 94597

NOTES:

1. DIMENSIONS OF THE PAVEMENT STRUCTURES (STRUCTURAL SECTIONS) ARE SUBJECT TO TOLERANCES SPECIFIED IN THE STANDARD SPECIFICATIONS.
2. SUPERELEVATIONS AS SHOWN OR AS DIRECTED BY THE ENGINEER.
3. FOR LIMITS AND TYPES OF DIKE AND MBGR, SEE LAYOUT SHEETS.
4. FOR LIMITS AND DETAILS OF BIORETENTION AREAS, SEE DRAINAGE SHEETS.
5. FOR DETAILS OF VEGETATION CONTROL, SEE STANDARD PLANS.

ABBREVIATIONS:

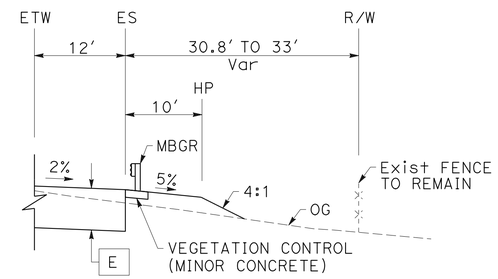
CTB (TYPE)	CEMENT TREATED BASE (TYPE A)
DGAC	DENSE GRADED ASPHALT CONCRETE
FOB	FACE OF BARRIER
GPI	GEOSYNTHETIC PAVEMENT INTERLAYER
HMA (OG)	HOT MIX ASPHALT (OPEN GRADED)
HMA-A	HOT MIX ASPHALT (TYPE A)
LCBRS	LEAN CONCRETE BASE-RAPID SETTING
LSS	LIME STABILIZED SOIL
PPCP	PRECAST POST-TENSIONED CONCRETE PAVEMENT
RHMA-G	RUBBERIZED HOT MIX ASPHALT - GAP GRADED
RSC	RAPID STRENGTH CONCRETE
SAMI-R	STRESS ABSORBING MEMBRANE INTERLAYER (RUBBERIZED)

TYPICAL STRUCTURAL SECTIONS:

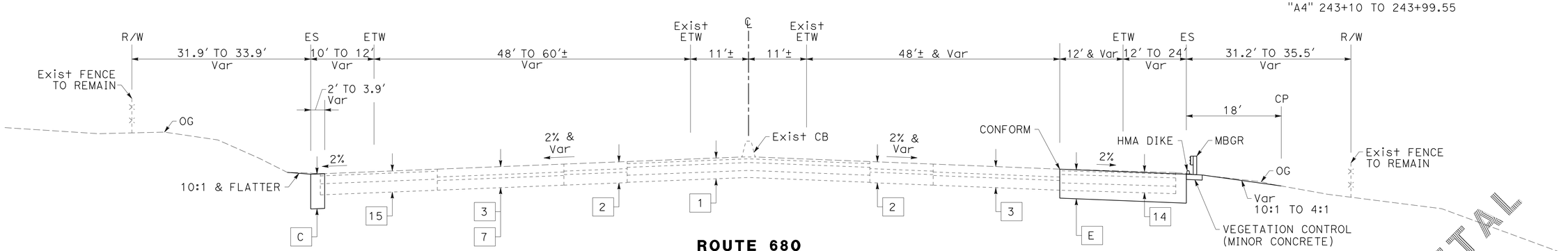
1: Exist 0.20' RHMA-G, 0.35' AC (TYPE A), 0.75' CI A CTB, 0.70' LSS
2: Exist 0.70' OR 1.00' PCC, 0.35' CTB, 1.00' AS
3: Exist 0.75' PCC, 0.35' CTB (TYPE A), 0.90' CI 1 AS
4: Exist 0.75' PCP, 0.50' LCBRS, 0.75' AS
5: Exist 0.70' PPCP, 0.60' LCBRS, 0.75' AS
6: Exist 0.75' JPCP, 0.35' LCB, 0.90' CI 1 AS
7: Exist 1.05' JPCP, 0.35' LCB, 0.70' CI 4 AS
8: Exist 0.20' RHMA-G, 0.45' HMA-A, 0.35' AB, 0.90' CI 4 AS
9: Exist 0.75' PCC, 0.45' CTB, 1.30' AS & PM
10: Exist 0.75' PCP, 0.50' LCBRS, 1.25' AS & PM
11: Exist 0.75' JPCP, 0.45' LCB, 1.30' AS & PM
12: Exist 1.20' PCC, 1.30' CTB
13: Exist 0.70' PPCP, 0.60' LCBRS, 1.25' AS & PM
14: Exist 0.15' RHMA-G, 0.35' HMA-A, 0.80' DGAC, 0.70' AS
15: Exist 0.20' RHMA-G, 0.75' DGAC, 1.05' AS
16: Exist 0.15' RHMA-G, 0.15' HMA-A, 0.65' CTB, 1.05' AS
17: Exist 0.20' RHMA-G, 0.35' HMA-A, 0.20' FBARIC, 1.30' AS
A: 1.05' JPCP, 0.35' LCB, 0.70' CI 4 AS, 0.65' LSS
B: 1.05' JPCP, 0.35' LCB, 0.70' CI 4 AS
C: 0.70' HMA-A, 1.05' CI 2 AB, 1.50' CI 4 AS
D: 0.50' HMA-A, 1.50' CI 2 AB
E: 0.95' JPCP (RSC), BOND BREAKER, 0.35' LCB (RSC), 1.35' CI 4 AS, GEOTEXTILE CI B2
F: 0.95' JPCP (RSC), BOND BREAKER, 0.35' LCB (RSC), 0.70' CI 4 AS

INTERSTATE 680 DESIGN DESIGNATION

ADT (2000)	163,000	D	59%
ADT (2025)	206,000	T	4.2%
DHV	10,025	V	65 mph
ESAL	28,220,000	TI_{25}	13.5



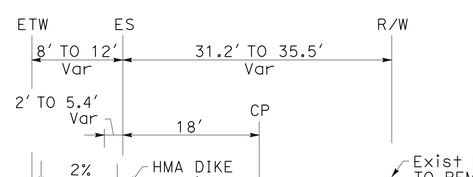
NORTHBOUND
"A4" 243+10 TO 243+99.55



ROUTE 680

SOUTHBOUND
"A4" 247+42.40 TO 247+92.40

NORTHBOUND
"A4" 238+57.83 TO 243+99.55



NORTHBOUND
"A4" 237+73.20 TO 238+57.83

100% SUBMITTAL 03/30/12

TYPICAL CROSS SECTIONS

NO SCALE

X-1

REVISED BY	DATE REVISED
AC	3/30/12
AC	1/4/12
AC	9/13/11

ALEX CROSKEY — QUYNH NGUYEN — CALCULATED-DESIGNED BY — CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: MICHAEL LOHMAN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

LAST REVISION 03-30-12 | DATE PLOTTED => 28-MAR-2012 | TIME PLOTTED => 17:17

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	CC	680	R4.3/R6.7	3	361

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER S.D.DANSKY No. 60220 Exp. 6-30-12 CIVIL STATE OF CALIFORNIA

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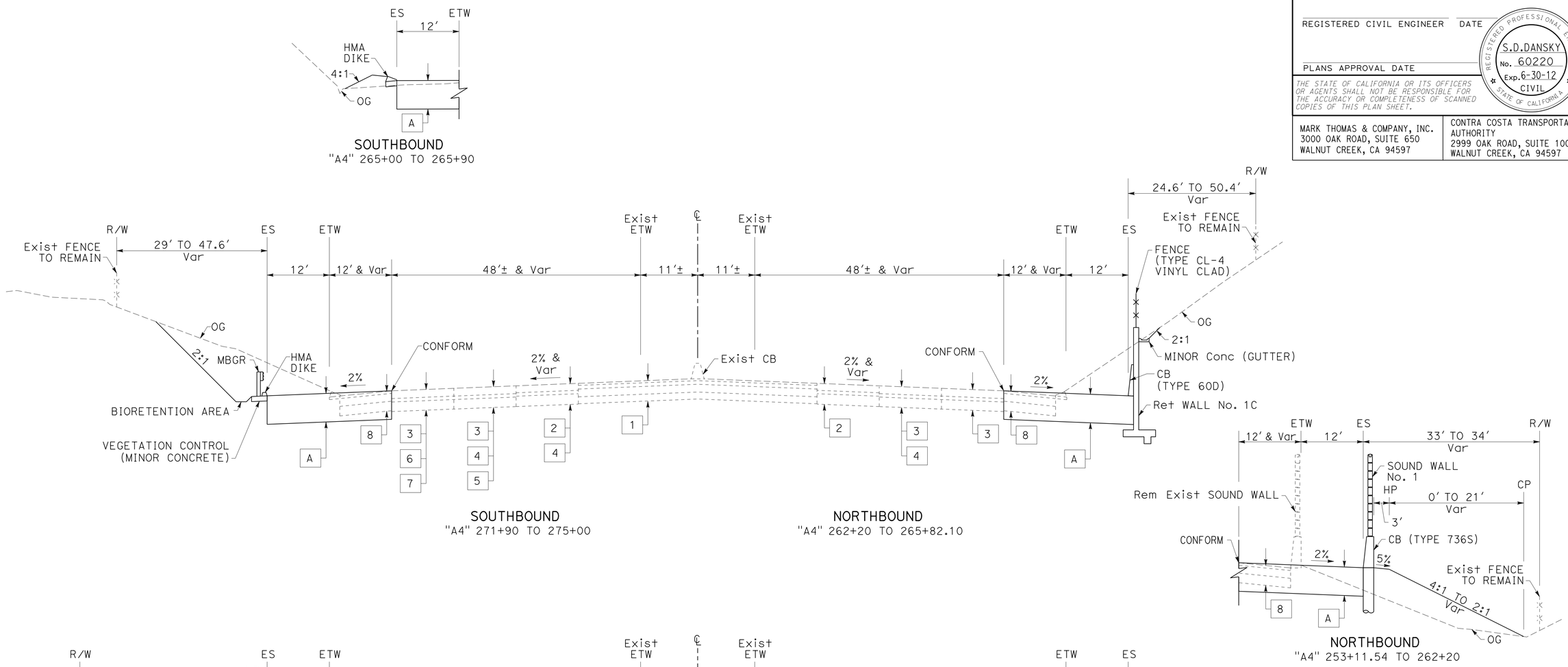

100% SUBMITTAL 03/30/12

TYPICAL CROSS SECTIONS

NO SCALE

X-2

REVISED BY	DATE REVISED
AC	3/30/12
AC	1/4/12
AC	9/13/11

CALCULATED-DESIGNED BY: ALEX CROSKEY
CHECKED BY: QUYNH NGUYEN
CONSULTANT FUNCTIONAL SUPERVISOR: MICHAEL LOHMAN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	CC	680	R4.3/R6.7	4	361

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER S.D.DANSKY No. 60220 Exp. 6-30-12 CIVIL STATE OF CALIFORNIA

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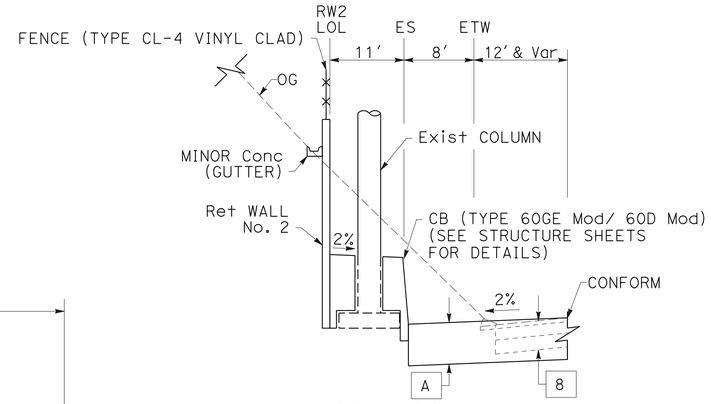
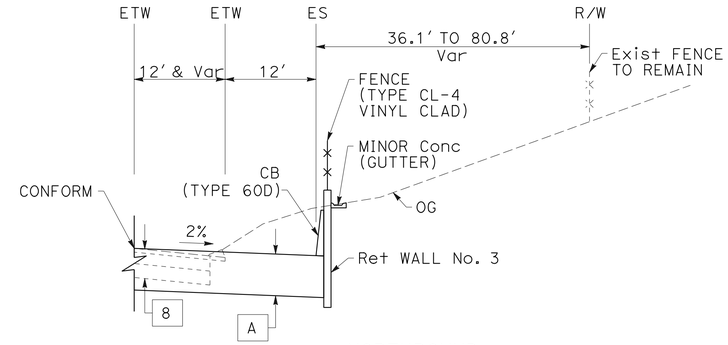
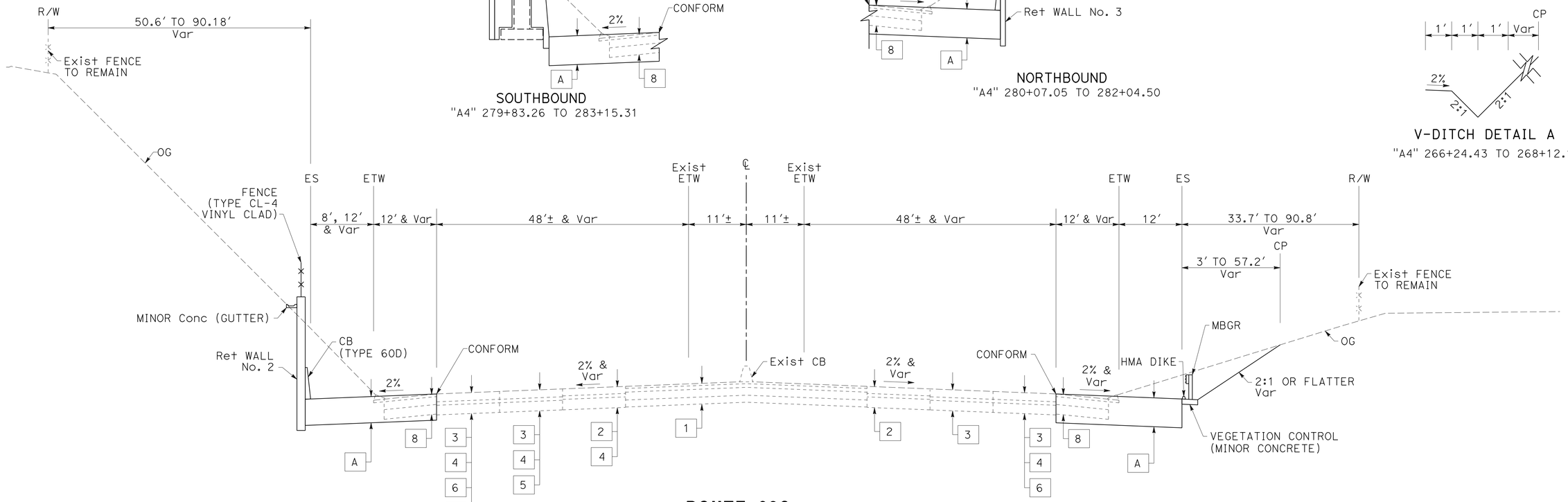


SOUTHBOUND
"A4" 279+83.26 TO 283+15.31



NORTHBOUND
"A4" 280+07.05 TO 282+04.50

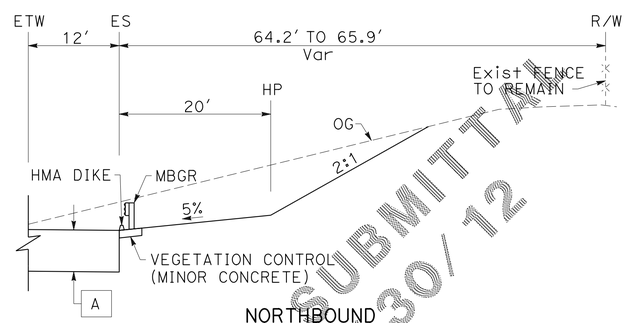
V-DITCH DETAIL A
"A4" 266+24.43 TO 268+12.10



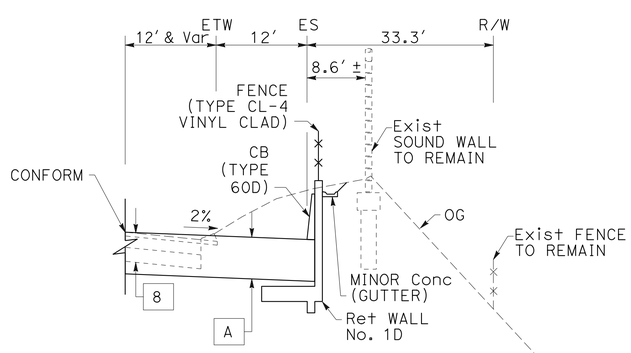
ROUTE 680

SOUTHBOUND
"A4" 275+00 TO 286+63

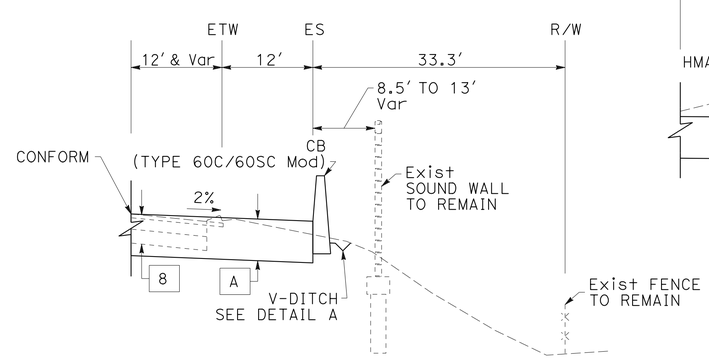
NORTHBOUND
"A4" 270+52.10 TO 284+96.87



NORTHBOUND
"A4" 284+30 TO 284+82



NORTHBOUND
"A4" 268+60.10 TO 269+56.10



NORTHBOUND
"A4" 265+82.10 TO 268+60.10
"A4" 269+56.10 TO 270+52.10

100% SUBMITTAL 03/30/12

TYPICAL CROSS SECTIONS

NO SCALE

X-3

REVISED BY	DATE REVISED
AC	3/30/12
AC	1/4/12
AC	9/13/11

ALEX CROSKEY — QUYNH NGUYEN — CALCULATED-DESIGNED BY — CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: MICHAEL LOHMAN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans

LAST REVISION 03-30-12 — DATE PLOTTED => 28-MAR-2012 — TIME PLOTTED => 17:17

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	CC	680	R4.3/R6.7	5	361

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER S.D.DANSKY No. 60220 Exp. 6-30-12 CIVIL STATE OF CALIFORNIA

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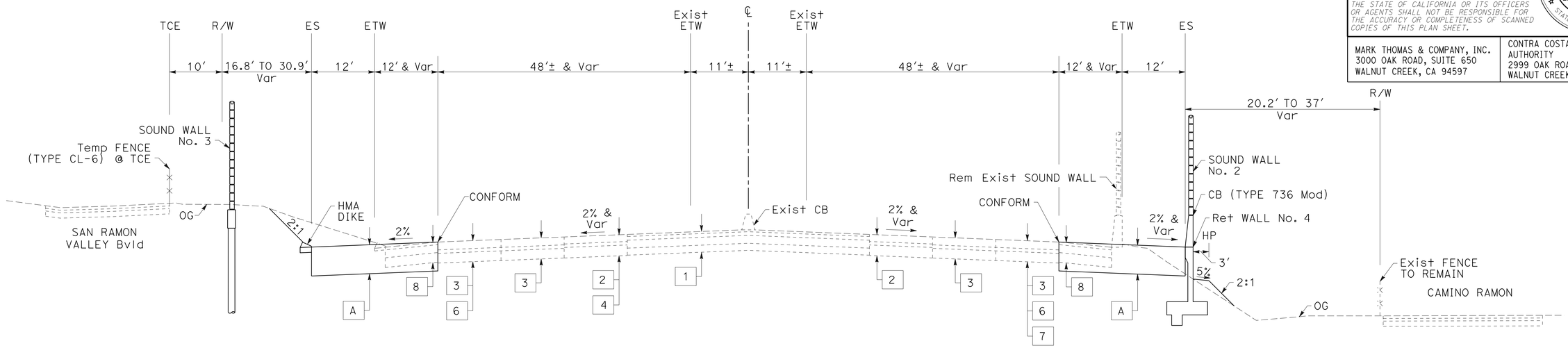
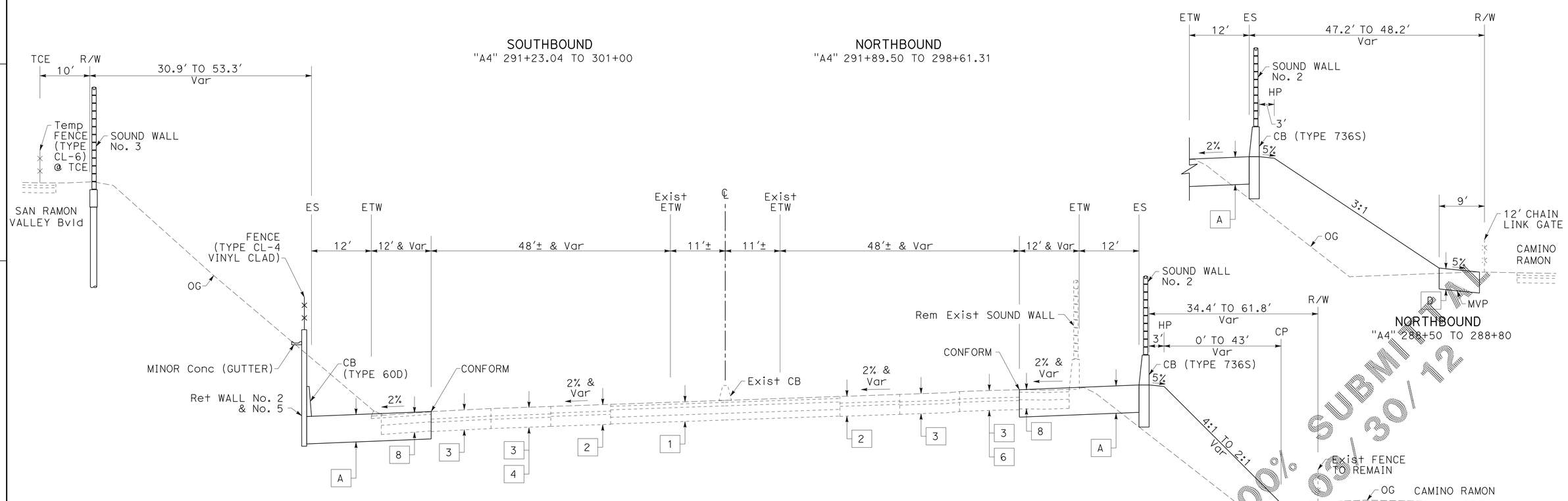


SOUTHBOUND
"A4" 291+23.04 TO 301+00

NORTHBOUND
"A4" 291+89.50 TO 298+61.31



SOUTHBOUND
"A4" 286+63 TO 291+23.04
"A4" 301+00 TO 301+41.78

NORTHBOUND
"A4" 284+96.87 TO 291+89.50

NORTHBOUND
"A4" 288+50 TO 288+80

100% SUBMITTAL 03/30/12

ROUTE 680

TYPICAL CROSS SECTIONS

NO SCALE

X-4

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Caltrans

CONSULTANT FUNCTIONAL SUPERVISOR: MICHAEL LOHMAN

CALCULATED-DESIGNED BY: ALEX CROSKEY

CHECKED BY: QUYNH NGUYEN

REVISED BY: AC, AC, AC

DATE REVISED: 9/13/11, 1/4/12, 3/30/12

LAST REVISION 03-30-12

DATE PLOTTED => 28-MAR-2012
TIME PLOTTED => 17:18

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	CC	680	R4.3/R6.7	6	361

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER S.D.DANSKY No. 60220 Exp. 6-30-12 CIVIL STATE OF CALIFORNIA

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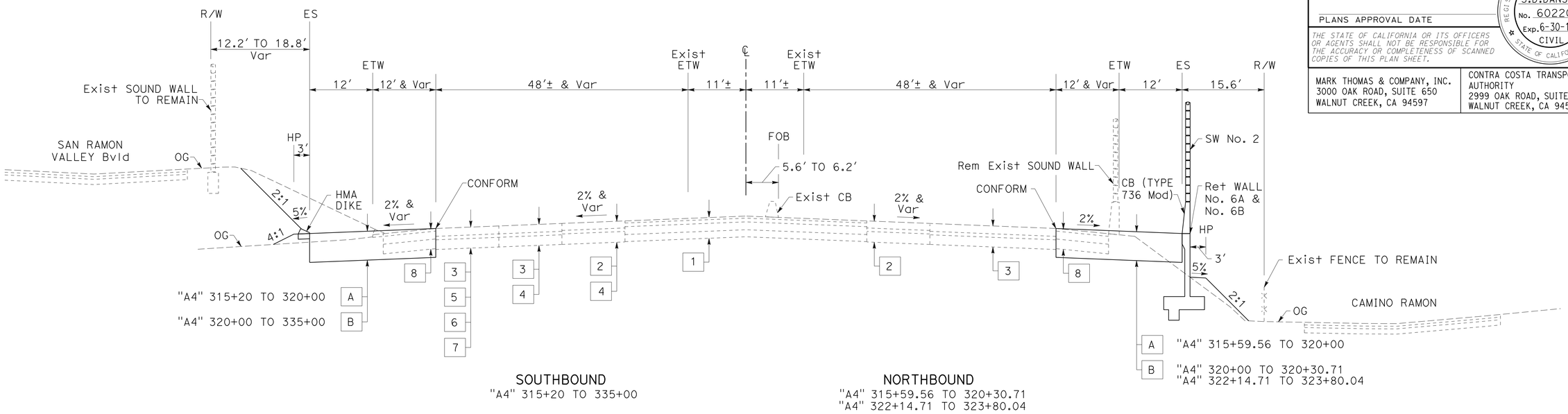

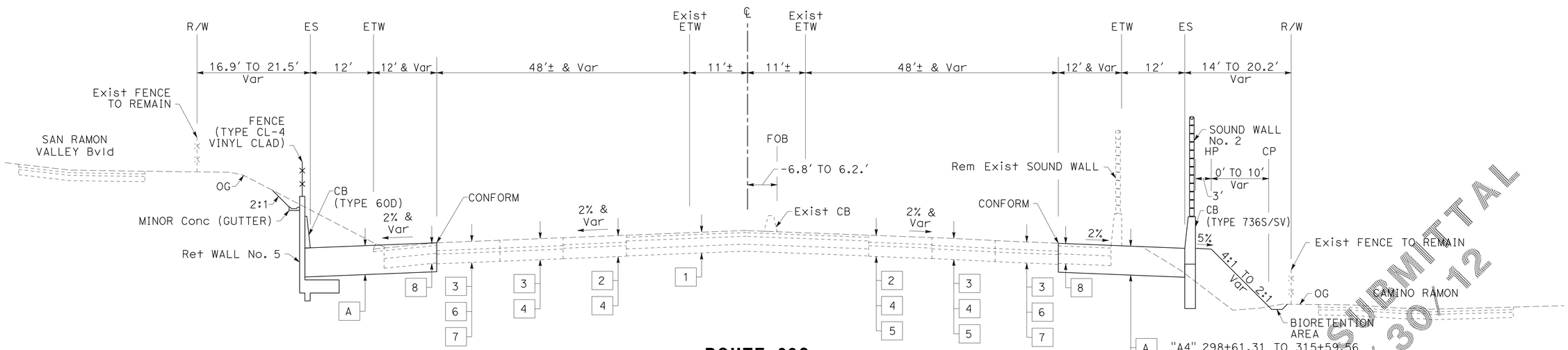

100% SUBMITTAL 03/30/12

TYPICAL CROSS SECTIONS

NO SCALE

X-5

AC	AC	AC	REVISED BY	ALEX CROSKEY	CALCULATED-DESIGNED BY
3/30/12	1/4/12	9/13/11	DATE REVISED	QUYNH NGUYEN	CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR: MICHAEL LOHMAN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	CC	680	R4.3/R6.7	7	361

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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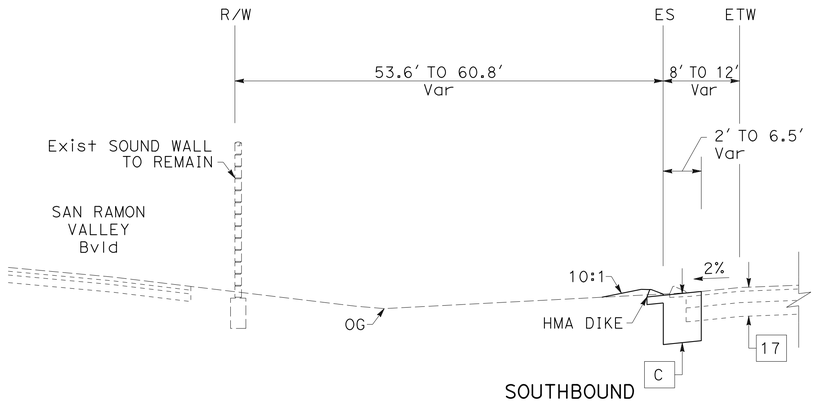
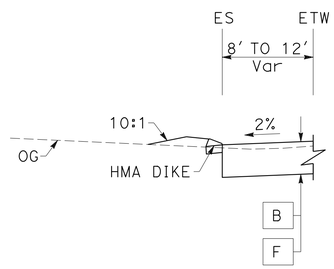
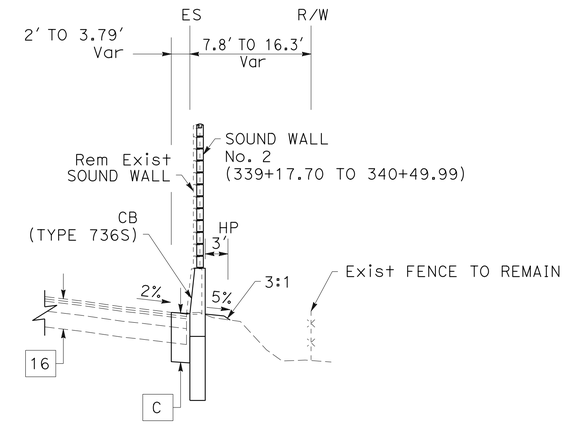


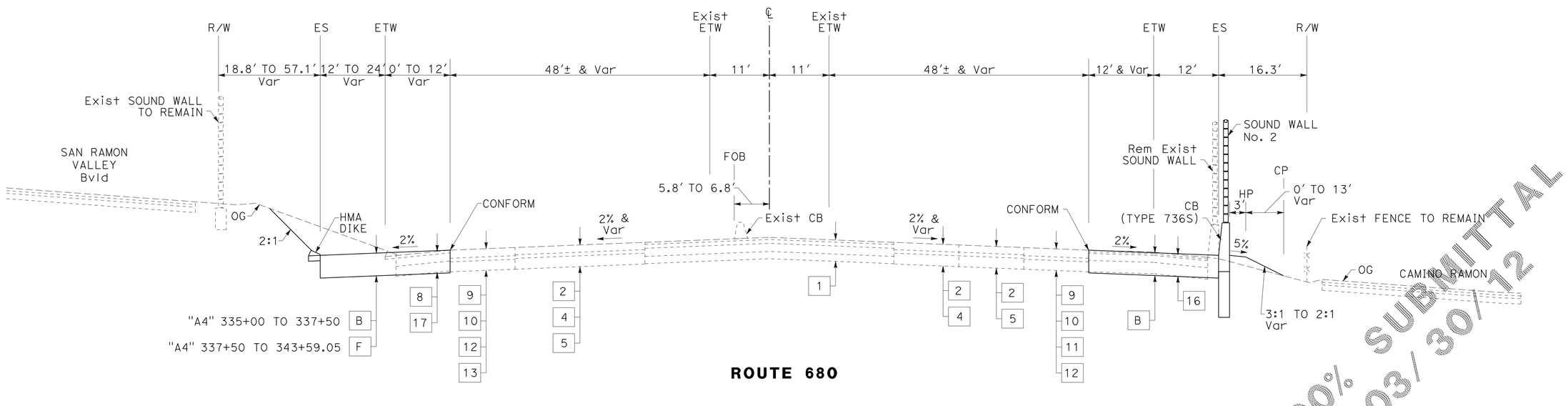
SOUTHBOUND
"A4" 343+59.05 TO 344+74.05



SOUTHBOUND
"A4" 337+05 TO 343+59.05



NORTHBOUND
"A4" 339+17.70 TO 339+67.70



ROUTE 680

SOUTHBOUND
"A4" 335+00 TO 343+59.05

NORTHBOUND
"A4" 335+00 TO 339+17.17

100% SUBMITTAL 03/30/12

TYPICAL CROSS SECTIONS

NO SCALE

X-6

AC	AC	AC
3/30/12	1/4/12	9/13/11

REVISED BY — DATE REVISED

ALEX CROSKEY — QUYNH NGUYEN

CALCULATED-DESIGNED BY — CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR — MICHAEL LOHMAN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

LAST REVISION 03-30-12 | DATE PLOTTED => 28-MAR-2012 | TIME PLOTTED => 17:18

APPENDIX E

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: KEN KITAMURA
District Branch Chief
Design Contra Costa

Attention: David Chan

Date: December 19, 2011

File: 04-CC 680 PM 4.3/6.7
04-0736-2285H1
CC I-680 Aux Lane Segment 2

From: LEONARDO DELEON
Materials Design Engineer
Engineering Services I – Materials A

Concurred by: TINU MISHRA, P.E.
District Materials Engineer
District Branch Chief – Materials A

Subject: Review of Draft Geotechnical Design and Materials Report (GDMR)

This memorandum is in response to your transmittal letter dated November 30, 2011 requesting our review and comment on the draft GDMR submitted by Parikh Consultants, Inc. The project proposes to add auxiliary lanes and shoulders on both Northbound and Southbound I-680 from Crow Canyon Road to Sycamore Valley Road within the above referenced project limits.

Our review comments are the following:

Section 8.5.1 Corrosion Investigation

- The results and summary of Alt Pipe program should be included in the report. They should include the thickness of the pipe/culvert and the type of material.

Section 9 Table 14: Summary of Test Results on Subgrade Soil

- The table does not show all the test results for 1) Attenberg Limits, 2) R-Value, 3) Compressive Strength (Lime Treated). All the boring locations should provide these tests results to get the "balanced design" in selecting the appropriate R-Value and to set the correct limits of subgrade lime treatment.

Section 9.3 Recommended Structural Pavement Section

- A Traffic Index (TI) of 13.5 was provided by the Designer. You should specify how many years is the TI. More importantly, Caltrans Advance Planning and Traffic Forecasting should verify if the TI=13.5 is appropriate for these auxiliary lanes.

If you have any questions, please call Leonardo Deleon at (510) 622-5444.

c: Daily File, Route File

L. Deleon/ld/CC 680 Aux Lane Segment 2, Draft GDMR Review

Peter Wei

From: Quynh Nguyen [qnguyen@markthomas.com]
Sent: Friday, January 20, 2012 8:34 AM
To: Peter Wei
Cc: Sasha Dansky
Subject: FW: GDMR Review Comments to CC-680 (EA#2285H1) from Geology

Peter,

Below are the last comments for the GDMR. Please let us know the pavement section for 40 year for the LCCA when you have it figured.

Thank you,

Quynh

-----Original Message-----
From: David Chan [mailto:david_chan@dot.ca.gov]
Sent: Tuesday, January 17, 2012 1:45 PM
To: Quynh Nguyen; Sasha Dansky
Cc: Leonardo Deleon; Ken Kitamura; Hamid Fathollahi; Carlos M Mora; Mohammad Dehghan; Matthew Gaffney; Shohreh Jamarani
Subject: RE: GDMR Review Comments to CC-680 (EA#2285H1) from Geology

Hi Sasha and Quynh,

Please find the following comments on the GDMR from Materials:

1) The GDMR should provide pavement design options for both the 20 year (TI=13.5) and 40 year (TI=14.5) PCCP design.

2) Then the designer should run a Life Cycle Cost Analysis (LCCA) between the 20-year and 40-year PCCP design that will be provided in the GDMR. The design period for this project should depend on the lowest LCCA (costs) between the two PCCP design.

These are the last comments for the GDMR in the first review.

Thanks.

David Chan
Department of Transportation, District 4 Office of Design Contra Costa Mail Station: 9-D
111 Grand Avenue/Mail: P.O. Box 23660
Oakland, CA 94623-0660
(O) (510) 622-5763
(F) (510) 286-5122

David
Chan/D04/Caltrans
/CAGov To

01/12/2012 02:28 PM

Quynh Nguyen <qnguyen@markthomas.com>

cc

Sasha Dansky <SDansky@markthomas.com>, Leonardo Deleon/D04/Caltrans/CAGov@DOT

Subject

RE: GDMR Review Comments to CC-680 (EA#2285H1) from Geology(Document link: David Chan)

Hi Quynh,

The TI and pavement sections are being checked by Materials. I expect comments by Jan. 18 Wednesday.

Thanks.

David Chan
Department of Transportation, District 4 Office of Design Contra Costa Mail Station: 9-D
111 Grand Avenue/Mail: P.O. Box 23660
Oakland, CA 94623-0660
(O) (510) 622-5763
(F) (510) 286-5122

Quynh Nguyen <qnguyen@markthomas.com>

01/12/2012 01:39 PM

To

David Chan <david_chan@dot.ca.gov>

cc

Sasha Dansky <SDansky@markthomas.com>

Subject

RE: GDMR Review Comments to CC-680 (EA#2285H1) from Geology

Thanks David. Should we expect more comments on the GDMR?

Quynh

-----Original Message-----
From: David Chan [mailto:david_chan@dot.ca.gov]
Sent: Wednesday, January 11, 2012 12:38 PM
To: Sasha Dansky
Cc: Carlos M Mora; Ken Kitamura; Leonardo Deleon; Mohammad Dehghan; Quynh Nguyen; Matthew Gaffney
Subject: Re: GDMR Review Comments to CC-680 (EA#2285H1) from Geology

Hi Sasha,

Please find attached comments on the GDMR from CT Geology:

We have reviewed the November 23, 2011, I-680 Auxiliary Lane Project – Segment 2 Geotechnical Design and Materials Report, by Parikh Consultants, Inc., we have the following comments:

· Site Plans do not label the locations of the retaining walls, soundwalls and overhead signs. Please correct.
· Page 6 – Section 4.4 Regional Geology and Seismicity reads: "…Coast Range geomorphic province…terminates…on the north by South Fork Mountain." The coast range province extends into Oregon and South Fork Mountain is north of the Great Valley Province. Please correct.
· Page 13 – Section 7.1.1 Lithology states "…The subject was considered and was determined to be not applicable for the project." Rock was encountered in numerous borings, so it is applicable, please describe.
· Page 13 – Section 7.2 Subsurface - Soundwalls presents approximate depths at 25.5 to 31.5 feet, actual depths 26.5 to 31.5 feet.
· Page 17 – Section 7.2 Subsurface – Retaining wall No. 2 presents approximate shallow depth at 26.5, but boring A-11-110 is 16.5 feet deep.
· Page 19-20 – Section 7.2 Structural Pavement Sections – the Lab data for 21, 5 feet borings is not included.
· Page 21 – Section 7.3.2 Groundwater – Boring A-11-145 is mentioned in Table 6: Summary of Groundwater Information, this boring log is not attached.
· Page 22 – Section 7.4.1 Groundwater – Table 7 – Greenville Fault Zone (March Creek – Greenville section) is stated at 8.8 miles from the project site, it is 9.8 miles from the project site. Greenville Fault Zone (Clayton section) is 8.8 miles from the project site.

Thanks.

David Chan
Department of Transportation, District 4 Office of Design Contra Costa Mail Station: 9-D
111 Grand Avenue/Mail: P.O. Box 23660
Oakland, CA 94623-0660

(O) (510) 622-5763
(F) (510) 286-5122

David Chan/D04/Caltrans/CAGov
01/05/2012 03:39 PM

To: Sasha Dansky <SDansky@markthomas.com>, Quynh Nguyen <qnguyen@markthomas.com>

cc: Ken Kitamura/D04/Caltrans/CAGov@DOT, Mohammad Dehghan/D04/Caltrans/CAGov@DOT, Leonardo Deleon/D04/Caltrans/CAGov@DOT, Carlos M Mora/D04/Caltrans/CAGov@DOT

Subject: GDMR Review Comments to CC-680 (EA#2285H1) from Hydraulics

Hi Sasha,

I am forwarding comments on the GDMR as I receive them.... I expect Geotech to still have comments.

Hydraulics has the following comment on the GDMR:
Please include an APC recommendation along with the ALTPIPE calculations.

Thanks.

David Chan
Department of Transportation, District 4 Office of Design Contra Costa Mail Station: 9-D
111 Grand Avenue/Mail: P.O. Box 23660
Oakland, CA 94623-0660
(O) (510) 622-5763
(F) (510) 286-5122

PARIKH
Practicing in the Geosciences

Geotechnical ■
Environmental ■
Materials Testing ■
Construction Inspection ■

To: **Mark Thomas and Company, Inc.**
3000 Oak Road, Suite 650
Walnut Creek, CA 94597

Date: March 23, 2012
Job No.: 2011-124-GDR

Attn.: Mr. Sasha Dansky

From: Peter Haoli Wei, P.E., G.E.; Gary Parikh, P.E., G.E. 666

Sub: Responses to Caltrans Review Comments
Route 680 Auxiliary Lane Project - Segment 2
Contra Costa County, California

Mr. Dansky:

This memorandum presents our responses to the review comments by Caltrans on the draft Geotechnical Design and Materials Report (GDMR) dated November 23, 2011 for the subject project in Contra Costa County, California.

The following references are comments as received from Caltrans:

Reference Item 1: Memorandum dated December 19, 2011 from Engineering Services I – Materials A,
Reference Item 2: E-mail dated January 5, 2012 from Hydraulics,
Reference Item 3: E-mail dated January 11, 2012 from Geology, and
Reference Item 4: E-mail dated January 17, 2012 from Materials.

Reference Item 1

Comment 1:

Section 8.5.1 Corrosion Investigation

- The results and summary of Alt Pipe program should be included in the report. They should include the thickness of the pipe/culvert and the type of material.

PCI Response 1:

AltPipe analysis was performed using the Caltrans online program Alternative Pipe Version 6.09. A summary table has been forwarded to the Designer. The computer AltPipe analysis results and summary table will be included in the revised report.

Comment 2:

Section 9 Table 14: Summary of Test Results on Subgrade Soil

- The table does not show all the test results for 1) Atterberg Limits, 2) R-Value, 3) Compressive Strength (Lime Treated). All the boring locations should provide these tests results to get the "balanced design" in selecting the appropriate R-Value and to set the correct limits of subgrade lime treatment.

PCI Response 2:

Prior to laboratory testing, all bulk soil samples collected were visually reexamined and classified in the lab and those samples showing alike characteristics in the same area were grouped together (screening). This is our normal process for all samples before assigning specific laboratory tests. The R-value and Atterberg Limits tests were assigned to representative samples. Based on the test results, the pavement alignment was grouped into lime treatment (R-value < 10) and no lime treatment (R-value >= 10) sections. Additional R-value tests were conducted on three soil samples (R-3, R-18 and R-20) and the test results will be added into Table 12 (Table 14 in the draft report): Summary of Test Results on Subgrade Soil. The additional tests produced R-values ranging from 10 to 12, which supports the previously established limits for lime treatment and no lime treatment sections. Based on this additional refinement, we are of the opinion that we have reasonable data to group the two areas as recommended.

Comment 3:

Section 9.3 Recommended Structural Pavement Section

- A Traffic Index (TI) of 13.5 was provided by the Designer. You should specify how many years is the TI. More importantly, Caltrans Advance Planning and Traffic Forecasting should verify if the TI=13.5 is appropriate for these auxiliary lanes.

PCI Response 3:

Refer to response to Comment 1 of Reference Item 4, TI of 13.5 is for 20 years of design life and TI of 14.5 is for 40 years of design life.

Reference Item 2

Comment 1:

Please include an APC recommendation along with the AltPipe calculations.

PCI Response 1:

The Designer, Mark Thomas & Company, Inc. is to address this comment. We performed AltPipe analyses and the results have been forwarded to the Designer and will be included in the revised report.

Reference Item 3

Comment 1:

Site Plans do not label the locations of the retaining walls, sound walls and overhead sign. Please correct.

PCI Response 1:

The locations of above-mentioned structures will be indicated on the Site Plans in the revised report.

Comment 2:

Page 6 – Section 4.4 Regional Geology and Seismicity reads: "…Coast Range geomorphic province…terminates…on the north by South Fork Mountain." The coast range province extends into Oregon and South Fork Mountain is north of the Great Valley Province. Please correct.

PCI Response 2:

The phrase will be corrected in the revised report.

Comment 3:

Page 13 – Section 7.1.1 Lithology states "…The subject was considered and was determined to be not applicable for the project." Rock was encountered in numerous borings, so it is applicable, please describe.

PCI Response 3:

Discussions on Lithology will be included in the revised report.

Comment 4:

Page 13 – Section 7.2 Subsurface – Sound walls presents approximate depths at 25.5 to 31.5 feet, actual depths 26.5 to 31.5 feet.

PCI Response 4:

Borings A-11-101 through A-11-104 were drilled to depths ranging from 25.5 to 31.5 feet for Sound Wall No. 1. The report will be amended to reflect correct depths.

Comment 5:

Page 17 – Section 7.2 Subsurface – Retaining wall No. 2 presents approximate shallow depth at 26.5, but boring A-11-110 is 16.5 feet deep.

PCI Response 5:

Discussions on subsurface conditions beneath the retaining walls will be included in a separate Foundation Report for retaining walls.

Comment 6:

Page 19-20 – Section 7.2 Structural Pavement Sections – the lab data for 21, 5 feet borings is not included.

PCI Response 6:

The laboratory test data is presented in Table 14 in draft GDMR: Summary of Test Results on Subgrade Soil in the revised report. Table 14 will be changed to Table 12 with additional data in the revised report.

Comment 7:

Page 21 – Section 7.3.2 Groundwater – Boring A-11-145 is mentioned in Table 6: Summary of Groundwater Information, this boring log is not attached.

PCI Response 7:

Boring A-11-145 was originally drilled for overhead sign structure at approximate Sta. 248+00 southbound. Since the associated structure has been removed from the modified plan, the boring log was removed from the LOTBs too. The boring log of A-11-145 will be presented in the LOTBs in the revised report.

Comment 8:

Page 22 – Section 7.4.1 Ground Motions – Table 7 – Greenville Fault Zone (March Creek – Greenville section) is stated at 8.8 miles from the project site, it is 9.8 miles from the project site. Greenville Fault Zone (Clayton section) is 8.8 miles from the project site.

PCI Response 8:

Table 7 will be revised to show Greenville Fault Zone, Clayton section, Fault ID 351 (8.8 mi) and Marsh Creek – Greenville section, Fault ID 352 (9.8 mi).

Reference Item 4

Comment 1:

The GDMR should provide pavement design options for both the 20 year (TI=13.5) and 40 year (TI=14.5) PCCP design.

PCI Response 1:

The PCCP pavement design option for 20 years (TI=13.5) is presented in the draft GDMR. We have provided a memorandum including recommendations for both PCCP pavement design options for 20-year (TI=13.5) and 40-year (TI = 14.5) design life. The recommendations will be included in the revised report.

Comment 2:

Then the designer should run a Life Cycle Cost Analysis (LCCA) between the 20-year and 40-year PCCP design that will be provided in the GDMR. The design period for this project should depend on the lowest LCCA (costs) between the two PCCP designs.

PCI Response 2:

The Designer, Mark Thomas & Company, Inc. is to address this comment.

FOUNDATION REPORT
(FINAL)
RETAINING WALLS
ROUTE 680 AUXILIARY LANE PROJECT - SEGMENT 2
CONTRA COSTA COUNTY, CALIFORNIA
04-CC-680 PM 4.3/6.7

For

MARK THOMAS & COMPANY, INC.
1960 Zanker Road
San Jose, CA 95112

PARIKH CONSULTANTS, INC.

2360 Qume Drive, Suite A
San Jose, CA 95131

June 25, 2012

Job No. 2011-124-WAL

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FOUNDATION REPORT
(FINAL)
RETAINING WALLS
ROUTE 680 AUXILIARY LANE PROJECT – SEGMENT 2
CONTRA COSTA COUNTY, CALIFORNIA
04-CC-680 PM 4.3/6.7

1.0 SCOPE OF WORK

This report presents the results of our geotechnical engineering investigation for the retaining walls that are part of the proposed "Route 680 Auxiliary Lane Project - Segment 2" in Contra Costa County, California. The purpose of this investigation was to evaluate the general soil and groundwater conditions at the site, evaluate their engineering properties, and provide foundation design recommendations for the proposed retaining walls. The general location of the project site and its vicinity are shown on the Project Location Map, Plate 1.

This report addresses geotechnical design recommendations for retaining walls as needed for the project (including standard retaining walls, soil nail walls and ground anchor walls). The scope of this investigation included review of readily available soils and geologic literature pertaining to the site including as-built information and "Log of Test Borings" (LOTB), site reconnaissance, drilling exploratory soil borings, obtaining representative soil samples and logging soil materials encountered in exploratory borings, laboratory testing of the representative soil samples, performing engineering analyses, and preparation of this report.

The geotechnical recommendations presented in this report are intended for design input and are not intended to be used as specifications. These recommendations should not be used directly for bidding purposes or for construction cost estimates.

2.0 PROJECT DESCRIPTION

The Segment 2 project will provide 2.4 miles of auxiliary lanes in each direction of I-680 between Sycamore Valley Road in the Town of Danville and Crow Canyon Road in the City of San Ramon. The project will improve weave and merge maneuvers in this segment of I-680. Proposed improvements include adding 12-foot wide lane and 12-foot wide shoulder in both directions of I-680. The project plans indicate that the finished grade for the widened auxiliary lanes will be matched with the adjacent travel lanes. Cut and fills will be required for widening as appropriate. Significant portions of the cuts and fills will be supported by retaining walls. A total of six (6) retaining walls, separated into 10 segments, are proposed. Information of approximate wall locations, type of walls, and maximum wall heights was provided by the Designer and is

summarized in Table 1.

TABLE 1: SUMMARY OF PROPOSED RETAINING WALLS

Wall No.	Wall Type	Direction	Location		Wall Height (ft)	Wall Length (ft)
			Starting Station	End Station		
1C	Type 1A	NB	262+20	265+80	6 - 10	360
1D	Type 7	NB	268+58	269+54	6	96
2	Type 1A	SB	275+00	275+16	10	16
	Soil Nail	SB	275+16	280+36	8 - 12	520
	Ground Anchor	SB	280+36	281+64	10-14	128
	Soil Nail	SB	281+64	290+99	8 - 12	935
	Type 1A	SB	290+99	291+16	6	17
3	Ground Anchor	NB	280+07	282+04	8 - 11	197
4	Type 1SWB	NB	291+89	298+67	8 - 10	678
5	Type 7	SB	301+00	315+35	6 - 10	1435
6A	Type 1SWB	NB	315+60	320+29	6 - 10	469
6B	Type 1SWB	NB	322+15	323+80	8 - 10	165

Per the table above, the proposed walls include Caltrans standard reinforced concrete walls (Type 1A, Type 1SWB and Type 7) on spread footings, which should conform to the Caltrans design requirements and guidelines. Non-standard soil nail and ground anchor walls need to be specially designed.

3.0 EXCEPTIONS TO POLICY

Design and construction of the retaining walls should follow the Caltrans standard plans and specifications, which represent one of the bases of recommendations presented herein. The investigation for the proposed foundations has generally followed Caltrans current practices.

4.0 FIELD INVESTIGATION AND TESTING PROGRAM

Based on the subsurface investigation work plan, exploratory borings were drilled at the site between June 16 and July 15, and on November 21, 2011. The borings placed along the retaining wall alignments are summarized in Tables 2A and 2B below. The boring locations generally followed the current Caltrans practice, approximate 300-foot spacing between borings along retaining walls. Due to the on-going (slab replacement) construction in the north and south bound

lanes, limited access was available for drilling at some locations. The boring program was therefore adjusted to conform to the construction safety requirements. The approximate boring locations are presented on the Site Plan, Plate 2.

TABLE 2A: SUMMARY OF PERTINENT BORINGS

Retaining Wall No.	Direction	Approx. Stations	Reference Borings
1C	NB	262+20 to 265+80	A-11-105 and A-11-106
1D	NB	268+58 to 269+54	A-11-107
2	SB	275+00 to 275+16	A-11-110
	SB	275+16 to 280+36	A-11-110, A-11-110P*, A-11-111 and A-11-146P*
	SB	280+36 to 281+64	A-11-112 and As-built B-1 (1964)
	SB	281+64 to 290+99	A-11-113, A-11-114, A-11-115, A-11-116P* and A-11-147P*
	SB	290+99 to 291+16	A-11-115
3	NB	280+07 to 282+04	A-11-109 and As-built B-3 (1964)
4	NB	291+89 to 298+67	A-11-121, A-11-122 and A-11-123
5	SB	301+00 to 315+35	A-11-125 through A-11-130
6A	NB	315+60 to 320+29	A-11-135 and A-11-136
6B	NB	322+15 to 323+80	A-11-137

*: "P" stands for 4" diameter solid stem auger portable drill rig.

TABLE 2B: SUMMARY OF BORING INFORMATION

Boring No.	Approx. Station (ft)	Approx. Offset "A4" Line (ft)	Approx. Boring Depth (ft)	Approx. Ground Elev. (ft)	Date Drilled
A-11-105	262+00	63 Rt.	31.0	471.0	06/17/11
A-11-106	265+00	63.5 Rt.	30.5	469.0	06/17/11
A-11-107	268+00	80 Rt.	31.5	467.0	06/20/11
A-11-109	281+75	62 Rt.	31.5	454.0	06/21/11
A-11-110	275+00	69.5 Lt.	28.0	460.0	07/05/11
A-11-110P*	275+00	100 Lt.	16.5	471.0	07/13/11
A-11-111	278+00	80 Lt.	46.5	457.0	07/15/11

Boring No.	Approx. Station (ft)	Approx. Offset "A4" Line (ft)	Approx. Boring Depth (ft)	Approx. Ground Elev. (ft)	Date Drilled
A-11-112	281+30	65 Lt.	34.5	455.0	07/01/11
A-11-113	284+00	65 Lt.	26.5	453.0	07/01/11
A-11-114	287+00	65 Lt.	45.0	452.0	07/01/11
A-11-115	290+00	66 Lt.	36.5	449.0	07/11/11
A-11-116P*	288+00	130 Lt.	31.5	473.0	07/13/11
A-11-121	292+00	65 Rt.	31.5	451.0	06/23/11
A-11-122	295+00	64 Rt.	49.0	449.0	06/21/11
A-11-123	298+00	65 Rt.	31.5	445.0	06/22/11
A-11-125	301+00	65 Lt.	26.0	444.0	07/05/11
A-11-126	304+00	65 Lt.	27.0	442.0	06/30/11
A-11-127	307+00	65 Lt.	17.0	443.0	06/30/11
A-11-128	310+00	70 Lt.	16.5	441.0	06/30/11
A-11-129	313+00	80 Lt.	36.0	440.0	06/24/11
A-11-130	315+00	80 Lt.	30.0	440.0	06/24/11
A-11-135	317+00	65 Rt.	30.5	435.0	06/23/11
A-11-136	319+00	65 Rt.	50.5	435.0	06/22/11
A-11-137	322+00	65 Rt.	31.5	432.0	06/23/11
A-11-146P*	278+30	135 Lt.	21.5	489.0	11/21/11
A-11-147P*	285+45	130 Lt.	26.5	484.0	11/21/11

*: "P" stands for 4" diameter solid stem auger portable drill rig.

Most of the borings were drilled with a truck-mounted drill rig using 8-inch-diameter hollow stem auger. A few borings, where the boring locations presented access difficulties, were drilled using a portable drill rig with a 4-inch-diameter solid stem auger. The borings were drilled under the technical supervision of our engineer, who classified and continuously logged the soils encountered during drilling and supervised the collection of soil samples at various depths for visual examination and laboratory testing. Selected samples were obtained from 2.5-inch I.D. (Modified California, MC) and 1.4-inch I.D. (Standard Penetration Test, SPT) samplers at various depths. The samplers were driven into subsurface soils under the impact of a 140-pound hammer having a free fall of 30 inches. The blow counts required to drive the sampler for the last 12 inches are presented on the "Log of Test Boring" in Appendix A. The drilling subcontractor was Exploration Geoservices, Inc. (EGS). Based on the energy efficiency of the hammer used by EGS,

which is approximately 55%, when correlating standard penetration data, the blow counts for the Standard Penetration Test Sampler (SPT-N) can be taken as roughly 0.6 times that for the Modified California Sampler in similar soils. After visual examination, the samples were sealed and transported to our laboratory for further evaluation and testing.

The boring logs presented in Appendix A were prepared from the field logs which were edited after visual re-examination of the soil samples in the laboratory and results of classification tests on selected soil samples as indicated on the logs. The abrupt stratum changes shown on these logs may be gradual and relatively minor changes in soil types within a stratum may not be noted on the logs due to field limitations.

Due to limitations inherent in geotechnical investigations, it is neither uncommon to encounter unforeseen variations in the soil conditions during construction nor is it practical to determine all such variations during an acceptable program of drilling and sampling for a project of this scope. Such variations, when encountered, generally require additional engineering services to attain a properly constructed project. We, therefore, recommend that a contingency fund be provided to accommodate any additional charges resulting from technical services that may be required during construction.

5.0 LABORATORY TESTING PROGRAM

Laboratory tests were performed on selected soil samples in the laboratory to evaluate the physical and engineering properties of the subsoils. The tests performed for the study include the following: Laboratory determination of Moisture-Density (California Test Method 226), Atterberg Limits (California Test Method 204), Grain Size Analysis (California Test Method 203), Unconfined Compression Test (California Test Method 221), and Corrosion Test (California Test Method 643). The laboratory test results are attached in Appendix B.

6.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

6.1 Site Geology

Quaternary Geology

Relatively young geologic conditions in the vicinity of the site were evaluated by reference to the map of Quaternary Geology of Contra Costa County, California and Surrounding Areas: Derived from the Digital Database Open-file 97-98, by E.J. Helley and R.W. Graymer, 1997. Based on the map, different Quaternary age units are present beneath much of the alignment. According to the Quaternary geologic map, a majority of the surficial material are in Basin Deposits (Holocene, Qhb), Alluvial Fans and Fluvial Deposits (Holocene, Qhaf), and Alluvial Fans and Fluvial Deposits (Pleistocene, Qpaf). The Quaternary geologic map of the general project area is shown on Plate 3A. Descriptions of the main geologic units are as follows:

Qhb - Basin Deposits (Holocene). Very fine silty clay to clay deposits occupying flat-floored basins at the distal edge of alluvial fans adjacent to the bay mud.

Qhaf - Alluvial Fans and Fluvial Deposits (Holocene). Alluvial fan deposits are brown or tan, medium dense to dense, gravely sand or sandy gravel that generally grades upward, to sandy or silty clay.

Qpaf - Alluvial Fans and Fluvial Deposits (Pleistocene). Brown dense gravely and clayey sand or clayey gravel that fines upward to sandy clay. Deposits display various sorting and are located along most stream channels in the county.

The portion of the published USGS Quaternary deposits map that includes the project location is shown on Plate 3A.

Bedrock Geology

Bedrock beneath the project location consists of Tertiary age (late Miocene, approximately 10 to 13 million years old) Briones Sandstone, which contains a lower reef member and upper Cierbo Sandstone members forming the limbs of an anticline (upward fold), the axis of which trends northwest/southeast several hundred feet west of the Highway 680. Dibblee mapped the bedrock

geology of the Diablo Quadrangle (published in black and white in 1980 and in color in 2005) (See Plates 3B -1 and 3B-2). These and subsequent geologic plates are rotated with north to the lower right to correspond with the orientation of the Site Plan shown in Plates 2A through 2E. The bedrock exposed in the higher slopes was mapped by Dibblee as Briones Formation ("Tss" on 1980 map and "Tbr" on 2005 map) with bedding planes that dip steeply toward the southwest. Dibblee's maps shows the project alignment crossing "Old Alluvium" ("Qoa") on the lower slopes of Las Trampas Ridge. Dibblee mapped several eroded "windows" through the old alluvium that expose overturned beds of Briones Formation beneath.

Mapped Faults

Dibblee mapped several traces of the Calaveras Fault as "inferred" (dashed lines) across the old alluvium on the slopes several hundred feet west of Highway 680 and as "concealed" (dotted lines) beneath the younger alluvium (Qa) on the floor of San Ramon Valley; one of Dibblee's "concealed" fault traces was mapped directly beneath the highway.

On the original 1974 Special Studies Zones Map* of the Diablo Quadrangle, the California Division of Mines and Geoogy (CDMG)* mapped several fault traces as "inferred" on the hillside west of Highway 680. On the revised 1982 Special Studies Zones Map*, CDMG mapped two traces of the Calaveras Fault as "inferred" on the slope 800 and 2800 feet west of Highway 680; the official zones do not extend as far east as the highway and the currently proposed retaining walls (See Plate 3C).

*(In 1994, the State legislature changed the name of the A-P zones to Earthquake Fault Zones and the California Division of Mines and Geology (CDMG) to the California Geological Survey.)

The 2010 State Active Fault Map shows several fault traces with "Holocene displacement during past 11,000 years" (shaded orange) on the slopes several hundred feet west of Highway 680 where the retaining walls are currently planned (See Plates 4B and 4C).

Mapped Landslides

Landslides were mapped by Nilsen (1971 and 1975) via reconnaissance photo-interpretation throughout the Bay Area, including most of the east-facing slopes of Las Trampas Ridge and portions of Highway 680 (See Plate 3D). Herd (1978) mapped evidence of faulting in the Diablo Quadrangle and included a large landslide covering the entire east-facing slope of Las Trasmpas Ridge, extending beneath several intervals of Highway 680 (See Plate 3E). The 1982 Special Studies Zones Map includes the note "Area of Massive Landslides" with seven arrows pointing to the slopes located west of Highway 680 (See Plate 3C).

Geologic Investigation of Nearby

In 1978, Berloger, Long and Associates (BLA) mapped several faults west of and parallel with Highway 680 based upon their interpretation of high-altitiude black and white stereo-paired aerial photographs, a pair of Skylab 4 color stereo photographs, and two sets of low-altitude stereo photographs taken in early June of 1978 when seepage areas were clearly visible following the previous wet winter (See Plate 3F). Field evidence collected by BLA suggested that their Lineament "E" is the main trace of the Calaveras Fault which reportedly produced surface rupture in 1861 and that Lineament "G" is fault-related. Other lineaments (A through D) were determined by BLA to be the result of landsliding, differential erosion, or bedrock structure, not surface fault rupture. BLA logged a number of trenches cut across Lineament "G" in which their geologist found evidence of fault displacements, one lineament projects toward the currently proposed Retaining Wall #4 (See Plate 3G). However, our investigation did not reveal any evidence that such a fault exists beneath the highway at that location. It seems likely that the fault curves northward and follows the toe of the slope and the directional trend of the main fault trace.

BLA's 1978 investigation of the property located west of the central portion of the project area indicated that the geology is more complex than previously understood. The morphology of that slope suggested that may be a large bedrock landslide overlain by subsequent, smaller landslides; however, that morphology might be the result of differential erosion of less resistant units within the bedrock. BLA's field data did not substantiate their earlier landslide interpretation for the lower portion of the slope upon which Highway 680 was built.

Summary of Geologic Hazards

Based upon the findings of previous investigations conducted by others in the area and the results of our investigation at the sites of the proposed retaining walls, we conclude that the likelihood of surface fault rupture or landslide movement to affect the proposed walls is low. However, the close proximity of the active Calaveras poses a high potential for strong to violent earthquake ground shaking to occur when a future major earthquake originates on that segment of the fault.

6.2 Subsurface Conditions

The topography of the project site indicates that originally, the site was a rolling terrain generally sloping down easterly. The highway in this section was constructed by cutting into the native slopes. Based on the boring data and as-built LOTB, the subsurface soil conditions at the project site indicate predominantly native stiff to hard clayey materials. Fat clay was found in upper portion in some borings. On-site soils show moderate to highly expansive potential with Liquid Limits (LL) up to 68 and Plasticity Index up to 40 on tested soil samples. Medium dense to very dense sandy layers were encountered at various locations. Sedimentary rocks (claystone, siltstone and sandstone) were encountered mostly in the central part of the site at varying depths.

Based on the Project Report prepared by Contra Costa Transportation Authority (CCTA), dated December 2002 and Caltrans as-built LOTB for Greenbrook Drive Overcrossing (1964, Br. No. 28-223), the freeway was first constructed in 1964 as a 4-lane freeway and improved to a six-lane freeway in 1967 followed by adding HOV lanes in 1995. The as-built LOTB shows that Borings B-1, B-2 and B-3 were drilled at the west, central and east of "A4" line, respectively. It shows that the ground elevations were at about 494.5, 480.5 and 465.5 feet for B-1, B-2 and B-3, respectively. Comparing to the current freeway pavement elevation of about 455.5 feet at the overcrossing location, it suggests that more than 30 feet high cut slope was made during previous freeway and overcrossing construction. The slopes are mostly at about 2H:1V slope gradient and not retained by manmade structures. San Ramon Valley Boulevard is on the top of the western slope, parallel to the freeway. The slopes have been built for about 50 years and being well maintained and

generally in stable condition.

Fat clay and moderately – highly expansive soils are common in the San Francisco Bay Area. Almost 70 percent of the soils that underlie Contra Costa County possess a significant shrink-swell potential (Chapter 2.4 of 2009 CPT DEIR by Contra Costa Transportation Authority). Seasonal changes of moisture and temperature can produce swelling and shrinking in fat clay and may cause horizontal or downhill ground movement, generally within the zone of seasonal variation. Slope failures or landslides due to creep of fat clay have not been observed at the project site. Given the fact that the existing slopes have been in place for almost 50 years and generally in stable condition, the potential of landslides due to expansive soils is considered to be low for this project. However, high plasticity of expansive soils has been considered in the retaining wall design.

7.0 GROUND WATER

Table 3 summarizes the information of groundwater encountered during our field investigation.

TABLE 3: SUMMARY OF GROUNDWATER INFORMATION

Boring No.	Approx. Station (ft)	Approx. Offset "A4" Line (ft)	Approx. Boring Depth (ft)	Approx. Ground Elev. (ft)	Approx. Groundwater Elev. (ft)	Groundwater Depth (ft)	Measuring Date
A-11-114	287+00	65 Lt.	45.0	452.0	437.5	14.5	7/1/11
A-11-115	290+00	66 Lt.	36.5	449.0	437.0	12.0	7/11/11
A-11-121	292+00	65 Rt.	31.5	451.0	423.0	28.0	6/23/11
A-11-122	295+00	64 Rt.	49.0	449.0	410.0	39.0	6/21/11
A-11-123	298+00	65 Rt.	31.5	445.0	417.0	28.0	6/22/11
A-11-126	304+00	65 Lt.	27.0	442.0	425.0	17.0	6/30/11
A-11-127	307+00	65 Lt.	17.0	443.0	428.0	15.0	6/30/11
A-11-128	310+00	70 Lt.	16.5	441.0	426.0	15.0	6/30/11
A-11-135	317+00	65 Rt.	30.5	435.0	410.0	25.0	6/23/11
A-11-136	319+00	65 Rt.	50.5	435.0	403.0	32.0	6/22/11

In general, groundwater under the proposed retaining walls was encountered at depths of 12.0 to 39.0 feet below ground surface during our field exploration. It is anticipated that groundwater

level will vary with the passage of time due to seasonal groundwater fluctuations, surface and subsurface flow, ground surface run-off and other environmental factors.

8.0 SCOUR EVALUATION

San Ramon Creek is to the east side of and parallel to I-680, outside of the project limit. No structure is planned to be constructed over the existing creek. The subject was determined to be not applicable for the project.

9.0 CORROSION EVALUATION

The corrosion investigation for retaining wall structures was performed on selected samples in general accordance with the provisions of California Test Method 643. A summary of the corrosion test results is presented in the following table. For structural elements, Caltrans Corrosion Guidelines (September 2003) consider a site to be corrosive if one or more of the following conditions exist for the representative soil/water samples at the site: Chloride concentration is 500 ppm or greater; Sulfate concentration is 2000 ppm or greater; or the pH value is 5.5 or less.

TABLE 4: SUMMARY OF CORROSION TEST RESULTS

Boring No.	Station (Approx.)	Offset From "A4 Line" (ft) (Approx.)	Corrosion Tests					
			Sample No.	Depth (ft)	pH	Resistivity (ohm-cm)	Chloride (ppm)	Sulfate (ppm)
A-11-109	281+75	62 Rt.	2	6	7.27	1050	39.5	77.0
A-11-110	275+00	69.5 Lt.	2	6	7.56	280	71.4	1137.9
A-11-114	287+00	65 Lt.	3	10	7.20	1420	11.8	15.5
A-11-122	295+00	65 Rt.	2	4.5	7.34	1150	57.2	111.9
A-11-127	307+00	65 Lt.	1	2.5	7.45	960	11.9	12.3
A-11-137	322+00	65 Rt.	2	6	7.62	880	19.2	36.8

Based on the test results, the on-site soils are classified as non-corrosive per Caltrans corrosion design guidelines. Standard Type II modified or Type I-P (MS) modified cement may be used for the concrete substructures. The test results are presented in Appendix B.

10.0 SEISMIC RECOMMENDATIONS

10.1 Seismic Sources

The project is located in a seismically active part of northern California. Many faults in the San Francisco Bay Area are capable of producing earthquakes, which may cause strong ground shaking at the site. Maximum moment magnitudes, distances and deterministic PGA of the closest faults in the area based on the 2007 Caltrans Deterministic PGA Map and ARS Online Report (V1.0.4) are summarized below. The maximum moment magnitudes represent the largest earthquake that a fault is capable of generating and is related to the seismic moment. The attached Fault Map, Plate 4A, presents the locations of the fault systems relative to the project site.

TABLE 5: EARTHQUAKE INFORMATION

Fault	Fault ID	Fault Type	Maximum Moment Magnitude	Approx. Nearest Distance (miles)	Deterministic PGA (g)
Greenville Fault Zone (Clayton section)	351	RLSS(1)	6.6	8.8	–(3)
Greenville Fault Zone (Marsh Creek – Greenville section)	352	RLSS(1)	6.6	9.8	–(3)
Mountain Diablo Thrust Fault	150	R(2)	6.6	1.8	–(3)
Pleasanton Fault	216	RLSS(1)	6.7	0.4	0.51
Calaveras Fault Zone (Northern Calaveras section)	321	RLSS(1)	7.4	0.5	0.52
Hayward Fault Zone (Southern Hayward section)	354	RLSS(1)	7.3	9.1	–(3)

(1) RLSS = Right-lateral strike-slip fault
(2) R = Reverse fault
(3) The PGA is not provided in the Caltrans ARS On-line program

10.2 Seismic Design Criteria

Caltrans updated the 1996 Seismic Hazard map with the 2007 Caltrans Deterministic PGA Map and the ARS Online (V1.0.4) design spectrum for development of response spectra for design. Development of the design ARS curve is based on several input parameters, including site location (longitude/ latitude), average shear wave velocity, Vs 30, for the top 30 m (100 feet), and other site parameters, such as fault characteristics, site-to-fault distances. The design methods incorporate both deterministic and probabilistic seismic hazards to produce the Design Response Spectrum.

The probabilistic response spectrum to be used for design of structures is based on the data from the 2008 USGS Interactive Deaggregations (Beta) program for a 5% in 50 years probability of exceedance (975-year return period) or the Caltrans ARS Online program.

The average shear wave velocity for the top 30 m (100 feet) at the site was estimated by using established correlations and guidelines in the Caltrans Design Manual (V1.0, August 2009). An average shear wave velocity value of 305 m/sec was adopted. According to the Manual, for site with Vs30 > 300 m/sec, it is acceptable to use Caltrans ARS Online to generate probabilistic response spectrum. According to the Caltrans ARS Online, peak ground acceleration (PGA) of 0.72g was adopted for design and analyses. A probabilistic earthquake magnitude of 6.76, produced by the 2008 USGS Interactive Deaggregations (Beta) program, was used for liquefaction analyses. The ARS Design Curve is presented on Plate 5.

10.3 Liquefaction Potential

Liquefaction is a phenomenon in which saturated cohesionless soils are subject to a temporary but essentially total loss of shear strength under the reversing, cyclic shear stresses associated with earthquake shaking. Submerged cohesionless sands and low-plastic silts of low relative density are the type of soils that usually are susceptible to liquefaction. The liquefaction potential was evaluated according to the procedure proposed in "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils", by Youd, et al., 2001.

The site predominately consisted of stiff to hard clayey materials and sedimentary rocks. The risk of liquefaction at the site is believed to be low. However, due to existence of relatively thin layers of sandy soils, local liquefaction and minor post-liquefaction settlement is anticipated. The liquefaction potential and post-liquefaction settlement was analyzed based on the procedures outlined in the Youd et al, 2001summary report from NCEER workshops. The analysis results indicate that the post-liquefaction settlement at the site is generally on the order of about ½ inch. Based on the analyses, potentially liquefiable layers of sands and gravels were identified at the following locations and depths:

TABLE 6: SUMMARY OF LIQUEFACTION ANALYSES

Boring No.	Depth (ft)	Soil Description	Settlement (in)
A-11-114	43 - 45	Dense silty sand	0.5
A-11-115	25 - 29	Medium dense clayey sand	0.6
A-11-122	38 - 42	Medium dense silty sand	0.5
A-11-123	28 - 31	Dense silty sand	0.4

As may be noted from the above table, liquefaction zones and locations are isolated and deep and are thus of minimal significance for the wall structures. The calculations for liquefaction potential are attached in Appendix C.

11.0 AS-BUILT FOUNDATION DATA

The following pertinent as-built information was made available to us by Mark Tomas & Company, Inc.:

- Caltrans As-built Log of Test Boring – Greenbrook Drive Overcrossing (1964) (Br. No 28-223)
- Caltrans As-built Plans – Greenbrook Drive Overcrossing (1967) (Br. No 28-223)

According to the Caltrans as-built information for the existing overcrossing, the Abutments 1 and 4 as well as Bents 2 and 3 are supported by spread footing foundations. Portion of the proposed Retaining Wall No. 2 will be located below the overcrossing at the western side of freeway. The wall runs directly adjacent to and behind the existing Bent 2 footing. Special consideration is needed to minimize the impact on the existing bent foundation. Proposed Retaining Wall No. 3 will also be placed below the overcrossing at the eastern side of freeway, which is about 12 ft from the existing Abutment 4. The bottom elevation of the existing Abutment 4 footing foundation is at about 460 ft. The footing will impose additional lateral pressures on the wall due to surcharge. The as-built LOTB and plans are included in Appendices A and E, respectively.

12.0 FOUNDATION RECOMMENDATIONS

12.1 General

It is our understanding that due to right-of-way and other geometric constraints, the Route 680 modification and widening project will require construction of six (6) retaining walls along the northbound and southbound directions. The existing slopes will be cut or filled to provide level ground for the roadway widening. The retaining walls will be separated into ten (10) design and construction segments. The general information of the proposed retaining walls was previously summarized in Table 1 in Section 2.0, "Project Description".

Based on the findings of the investigation, it is our opinion that the site is feasible for the proposed retaining walls provided the recommendations presented in this report are incorporated into the design and construction.

This report was prepared specifically for the proposed retaining walls according to the plans provided to us. Normal construction procedures were assumed throughout our analysis and represent one of the bases of recommendations presented herein. Our design criteria have been based upon the materials encountered at the site. Therefore, we should be notified in the event that these conditions are changed, so as to modify or amend our recommendations.

12.2 Foundations

Discussions for the proposed retaining walls are presented below. Supporting calculations are attached in Appendix C.

Retaining Wall No. 1C (Approx. Sta. 262+20 to 265+80) – *Standard Type 1A*
Retaining Wall No. 1D (Approx. Sta. 268+58 to 269+54) – *Standard Type 7*

Retaining Walls No. 1C and 1D are walls proposed in cut along the eastern side of the roadway in northbound direction. Retaining Wall No. 1C is about 360 feet long and 6 to 10 feet high. Retaining Wall No. 1D is of 96 feet long and 6 feet high. The top footing elevations of wall No. 1C are approximately from 466 to 468 feet. For wall No. 1D, the top footing elevation is 462.5 feet. Ground surface elevations vary approximately from 464.5 to 471 feet.

Borings A-11-105 and A-11-106 were drilled for Retaining Wall No. 1C. Boring A-11-107 was drilled for Retaining Wall No. 1D. The borings were advanced to depths between 30.5 and 31.5 feet on the eastern freeway shoulder. Boring A-11-105 was mostly composed of hard lean clay, clayey silt and silty clay. The subsoils in Borings A-11-106 and A-11-107 primarily consisted of sedimentary rock (claystone and siltstone). No free groundwater was encountered in these three borings. Undrained shear strength of 3 ksf was adopted for soils in these wall locations.

A standard wall Type 1A with load case II is proposed for Retaining Wall No. 1C. It is our understanding that 2006 Caltrans standard plan (B3-3) will be used for design at this wall location. The plan shows that the toe pressure demand is 2.3 ksf for a wall of 10 feet high. Based on our boring data, allowable bearing capacity was calculated as 5.3 ksf, which exceeds the required bearing capacity. Therefore, it is our opinion that standard wall Type 1A is feasible for proposed Retaining Wall No. 1C.

A Type 7 wall as shown on Caltrans 1993 standard drawing xs14-010 will be used for Retaining Wall No. 1D. The standard Type 7 wall is based on structure backfill with friction angle of 34 degrees and unit weight of 120 pcf. The minimum allowable bearing pressure requirement is 2.0 ksf. The back slope is roughly level. Based on the on-site soil condition, calculated lateral earth pressure on the wall is less than design lateral earth pressure (equivalent fluid pressure of 36 pcf based on soil friction angle of 34 degrees). Calculated allowable bearing capacity is about 5 ksf, which exceeds the bearing pressure demand of 2.0 ksf. Therefore the proposed Type 7 can be used for Retaining Wall No. 1D.

At minimum, RW No. 1D wall design should be based on the soil condition as shown on the standard drawing. It is also assumed that the retained soils are in drained condition. Proper drainage system should be installed behind the retaining wall. The designer should include appropriate surcharge loads to the retaining wall.

Retaining Wall No. 2 (Approx. Sta. 275+16 to 280+36 and 281+64 to 290+99) – *Soil Nail*
Retaining Wall No. 2 (Approx. Sta. 275+00 to 275+16 and 290+99 to 291+16) – *Type 1A*

Retaining Wall No. 2 is a wall proposed in cut along the western side of the roadway in southbound direction. From Station 275+16 to 280+36, the wall is about 520 feet long and 8 to 12 feet high. From Station 281+64 to 290+99, the wall is about 935 feet long and 8 to 12 feet high. The bottom elevations of the proposed walls vary approximately from 446 to 456.5 feet. Ground surface elevations vary approximately from 448 to 460 feet. Portion of Retaining Wall No. 2 (Sta. 280+36 to 281+64) with ground anchor will be discussed in the next section. In addition, instead of soil nail wall, standard wall Type 1A will be used at the beginning and end of Retaining Wall No. 2 for very short distances, about 16 (Sta. 275+00 to 275+16) and 17 (290+99 to 291+16) feet in length, respectively.

Borings A-11-110 through A-11-115 were placed on the western freeway shoulder along the retaining wall alignment to depths ranging from 26.5 to 46.5 feet. Borings A-11-110P, A-11-116P, A-11-146P and A-11-147P were placed on the slope behind the planned wall alignment, which were drilled to depths ranging from 16.5 to 31.5 feet below grade. In addition, as-built LOTB shows that Boring B-1 was previously drilled at location behind Bent 2 of Greenbrook Drive Overcrossing. The boring extended approximately from elevation 494.5 to 440 feet (54.5 feet deep) with the bottom of the boring at about 15 feet below the shoulder of the freeway. Cross sections showing approximate slope profiles, boring and soil nail wall locations are attached in Appendix D.

Generally, the subsurface soils under these wall segments consisted of lean clay and sandy lean clay, very stiff to hard, from 11 to 41 feet thick, underlain by sedimentary rock (claystone and siltstone) in Borings A-11-110 through A-11-113 and A-11-110P, and by dense silty and clayey sand in Borings A-11-114 and A-11-115 to the maximum depths advanced. Boring A-11-116P had about 3 feet of medium dense sand layer at 5 feet followed by very stiff to hard clay to the bottom of the drilled hole, roughly 31.5 feet deep. Borings A-11-146P and A-11-147P encountered very stiff to hard lean clay to the bottom drilled, approximately 21.5 and 26.5 feet, respectively. Prior as-built LOTB Boring B-1 revealed predominately siltstone, clay shale and

organic shale in the boring. Groundwater was encountered at 14.5 (Elev. 437.5 ft) and 12 (Elev. 437 ft) feet in Borings A-11-114 and A-11-115, respectively.

A soil nail wall is proposed for these wall segments except the portion under Greenbrook Drive Overcrossing. It is anticipated that the soil nails will extend into hard clay or bedrock in southern portion of the wall (Station 275+16 to 280+36) and stiff to very stiff clay in the northern portion of the wall (Station 281+64 to 290+99). Hard drilling should be encountered for drilling into the bedrock. No caving condition is expected based on the data from our borings and as-built LOTB. Groundwater is estimated to be deeper than 10 feet below the roadway shoulder at the wall location. Groundwater should generally not impose adverse impact on the soil nail wall construction. We recommend that the following geotechnical parameters be incorporated into soil nail wall design using the Caltrans SNAILZ computer program:

Soil type = Sandy Lean Clay
Unit weight = 125 pcf
Internal friction angle, phi' = 26°
Cohesion, c' = 350 psf
Ultimate pullout resistance = 2.2 k/ft (Sta. 275+16 to 280+36)
Ultimate pullout resistance = 1.9 k/ft (Sta. 281+64 to 290+99)
Groundwater elevation = 437 ft
Seismic coefficient, k = 0.2 g

The proposed wall design under seismic loading condition should be analyzed per Caltrans guidelines (Guidelines for Structures Foundation Reports manual, Ver. 2.0, 2006, updated 2009), which recommend that the seismic factor equal to one third of the horizontal peak acceleration and not exceeding 0.2 g. Based on the anticipated PGA of 0.72 g, a seismic coefficient of 0.2 g is recommended. Sites with a pseudo-static factor of safety equal to or greater than 1.1 shall be considered to have adequate stability.

For the SNAILZ analysis, it is recommended that 75% of the ultimate bond strength be used for input if "Ultimate" option was chosen for a target global design factor of safety of 1.5 under static condition. Please note that the recommended ultimate pullout resistance is estimated based on the

soil type according to the typical values shown in Table 3.10 of the Geotechnical Engineering Circular No. 7, FHWA 0-IF-03-017, March 2003. The ultimate pullout resistance should be verified by field test. The estimated pullout resistances are provided for analysis and preliminary cost estimation purpose only. Appropriate surcharges should be considered by the wall designer.

The preliminary analyses were performed by the structural engineer using Caltrans SnailWin 3.10 program in cooperation with this office for inputting soil data and other parameters. The computer analysis outputs were reviewed by this office to ascertain that above recommendations have been incorporated into the soil nail wall analyses and the results satisfy the minimum factor of safety requirement. The analysis results are presented in Appendix C.

Caltrans specifications for soil nail construction are recommended. Appropriate drainage shall be provided behind the soil nail walls. The facing should be reinforced and shotcreted expeditiously. The contractor should make his own interpretation regarding constructability of the soil nails. Proper quality control by the contractor and appropriate inspections and testing should be implemented. Typically, five percent (5%) of the total production nails should be proof tested. Creep test should be performed as part of a verification or proof test.

Stability Testing should be performed before construction to verify the integrity of the excavated wall face. The exposed excavated face should be free of raveling, sloughing, or measurable lateral movement at the completion of the test. The table below provides wall zones for testing. At least one Stability Testing should be conducted in each wall zone limits.

TABLE 7: STABILITY TEST WALL ZONES FOR RW NO. 2

Wall Zone	Approx. Starting Station	Approx. End Station	Approx. Upper Elev. (ft)	Approx. Lower Elev. (ft)
1	275+16	277+50	466	456
2	277+50	280+36	463	452
3	281+64	283+50	461	450
4	283+50	286+00	460	449
5	286+00	288+00	458	448
6	288+00	289+50	455	446
7	289+50	290+99	453	446

The allowable soil bearing capacities were examined for Type 1A wall. The walls will be 10 and 6 feet in height with bearing pressure of 2.3 and 1.5 ksf at the beginning and end of Retaining Wall No. 2, respectively. Per data from Borings A-11-110 and A-11-115, allowable bearing capacities were estimated to be 3.4 and 2.8 ksf at the beginning and end of RW No. 2, respectively, which exceed the soil bearing demands. Therefore, Type 1A wall can be installed as planned.

Retaining Wall No. 2 (Approx. Sta. 280+36 to 281+64) – *Ground Anchor*

Portion of Retaining Wall No. 2 will be located below Greenbrook Drive Overcrossing. The wall runs adjacent and behind the existing Bent 2 footing. A ground anchor wall instead of soil nail wall is proposed for this portion, about 128 feet in length. Design height of the wall is 10 to 14 feet. Design recommendations for ground anchor wall are based on Caltrans 2000 Bridge Design Specifications (BDS), Section 5. Based on the data from Boring A-11-112 and as-built Boring B-1, the subsoils consisted of very stiff to hard clays and clay shale with undrained shear strength estimated to be 3.5 ksf in the bond zone. The onsite soil shows moderate to high plasticity. Per Table 6.2 in 1996 Post Tensioning Institute (PTI) manual "Recommendations For Prestressed Rock And Soil Anchors", presumptive ultimate unit bond stress was determined for high plasticity clay, assuming pressure grouted. According to Caltrans BDS, the apparent lateral earth pressures for use in the ground anchor wall design are trapezoidal. The earth pressure diagram behind the wall as shown on Figure 5.5.5.7.1-1 of Caltrans BDS is attached as Plate 6. The pressure shape varies depending on the number of levels of anchors. When calculating the maximum ordinate of pressure diagram, the total lateral load (P_{Total}) should not be less than 1.44 times the active lateral earth pressure resultant (P_{active}). P_{active} can be estimated using equivalent fluid pressure (EFP) of 95 pcf. A horizontal seismic coefficient of 0.36 g was adopted, which equals ½ PGA at the site. Using the equation by Seed and Whiteman (1970), the imposed seismic lateral earth pressure behind the wall was calculated. Geotechnical recommendations for ground anchor wall are as follows:

Soil type = Very Stiff to Hard Clay and Clay Shale
Active equivalent fluid pressure = 95 pcf
Total lateral load P_{Total} = 68.4 * H * H / 1000 kip
Minimum unbonded length = 15 ft

Ultimate bond strength (presumptive) = 20 psi
Incremental seismic lateral earth pressure = 17H
Friction coefficient between soil and wall = 0.35
Allowable bearing pressure = 2.5 ksf

Note: 1. A factor of 1.44 has already been included in the equation for P_{Total}.
2. H is the design height of the wall in feet.
3. Seismic pressure is uniformly distributed along the wall height.

The as-built foundation plan shows that the existing Abutment 1 spread footing foundation of Greenbrook Drive Overcrossing is about 45 feet away from the proposed retaining wall under the overcrossing. The Abutment 1 spread footing is 3.5 feet wide with bottom elevation at 477 feet on the top of a 2H:1V slope. The design footing pressure is 3 ksf. The as-built layout suggests that the lateral pressure from the existing abutment footing foundation on the retaining wall is minimal and can be neglected.

It is anticipated that the ground anchor will extend into the clayey native soils. No caving condition is expected based on the data from our boring and as-built LOTB. No groundwater was encountered during our field exploration at this location and in the previous as-built boring. Groundwater is generally not expected to impose adverse impact on the ground anchor wall construction.

The contractor should make his own interpretation regarding constructability of the wall. Special measures should be taken to avoid conflict with the existing overcrossing bent. Caltrans specifications for ground anchor wall construction are recommended. The strength of the anchors should be verified during construction using proof tests on ground anchors as required in the specifications. All ground anchors should be proof tested, unless a performance test has been run on it. Extended creep testing should be conducted due to high plasticity of the onsite soils. Appropriate drainage should be provided behind the wall. The facing should be reinforced and shotcreted expeditiously. Proper quality control by the contractor and appropriate inspections and testing should be implemented.

Retaining Wall No. 3 (Approx. Sta. 280+07 to 282+04) – *Ground Anchor*

Retaining Wall No. 3 is a wall proposed in cut under Greenbrook Drive Overcrossing in northbound direction. The wall is about 197 feet long with design height up to 11 feet. The bottom elevation of the wall is planned to be at about 451 feet. Ground surface elevation is at about 455 feet.

Boring A-11-109 was drilled on the roadway shoulder at location close to the northern end of the wall to a depth of approximately 31.5 feet, which generally encountered very stiff to hard lean clay with hard fat clay layer located between 10 and 15 feet. As-built LOTB at the overcrossing site was also reviewed. It appears that the existing slope of the Abutment 4 at this location was created by excavating into the native soils during previous construction. The subsurface soils generally consisted of hard clay on top of the clay shale. Groundwater was not encountered in the borings. The laboratory test results show that the subsoils have very high expansion potential with a Liquid Limit (LL) of 68 and Plasticity Index (PI) of 40.

A ground anchor wall is proposed at this location. Design recommendations for ground anchor wall are based on Caltrans 2000 Bridge Design Specifications (BDS), Section 5. Based on Boring A-11-109 and as-built Boring B-3, hard clays and clay shale with undrained shear strength estimated to be 3.5 ksf in the bond zone, representative of the onsite soils were used in the calculations. Per Table 6.2 in 1996 Post Tensioning Institute (PTI) manual "Recommendations For Prestressed Rock And Soil Anchors", presumptive ultimate unit bond stress was determined for high plasticity clay, assuming pressure grouted. According to Caltrans BDS, the apparent lateral earth pressures for use in the ground anchor wall design are trapezoidal. The earth pressure diagram behind the wall as shown on Figure 5.5.5.7.1-1 of Caltrans BDS is attached as Plate 6. The pressure shape varies depending on the number of levels of anchors. When calculating the maximum ordinate of pressure diagram, the total lateral load (P_{Total}) should not be less than 1.44 times the active lateral earth pressure resultant (P_{active}). P_{active} can be estimated using equivalent fluid pressure (EFP) of 95 pcf. A horizontal seismic coefficient of 0.36 g was adopted, which equals ½ PGA at the site. Using the equation by Seed and Whiteman (1970), the imposed seismic lateral earth pressure behind the wall was calculated. Our geotechnical recommendations for ground anchor wall are as follows:

Soil type = Hard Fat Clay and Clay Shale
Active equivalent fluid pressure = 95 pcf
Total lateral load P_{Total} = 68.4 * H * H / 1000 kip
Minimum unbonded length = 15 ft
Ultimate bond strength (presumptive) = 20 psi
Incremental seismic lateral earth pressure = 17H
Friction coefficient between soil and wall = 0.35
Allowable bearing pressure = 3 ksf

Note:
1. The unbonded length should also extend to at least 5 feet beyond the back side of the as-built Abutment 4 footing.
2. A factor of 1.44 has already been included in equation for P_{Total}.
3. H is the design height of the wall in feet.
4. Seismic pressure is uniformly distributed along the wall height.

Abutment 4 on spread footing foundation is on the top of a 2H:1V slope. Based on the as-built plans, the spread footing is 3.5 feet wide with the bottom elevation at 460 ft and the design load of 5 ksf. The horizontal distance between the Abutment 4 spread footing foundation and the proposed retaining wall is about 12 ft. Additional imposed lateral pressures due to the surcharge from the existing Abutment 4 should be included in the ground anchor wall design. The existing footing was treated as a uniformly loaded strip parallel to the wall and the lateral pressures were calculated using elastic solution. A spread sheet printout for the footing surcharge calculation is attached as Plate 7.

We anticipate that the ground anchor will extend into hard native clay or bedrock. No caving condition is expected based on the data from our boring and as-built LOTB. No groundwater was encountered during our field exploration and in previous as-built boring. Groundwater is generally not expected to impose adverse impact on the ground anchor wall construction.

The contractor should make his own interpretation regarding constructability of the wall. Caltrans specifications for ground anchor wall construction are recommended. The strength of the ground anchor should be verified during construction using proof tests on anchors as required in the

specifications. All anchors should be proof tested, unless a performance test has been run on it. Extended creep testing should be conducted due to high plasticity of the onsite soils. Appropriate drainage should be provided behind the wall. The facing should be reinforced and shotcreted expeditiously. Proper quality control by the contractor and appropriate inspections and testing should be implemented.

Retaining Wall No. 4 (Approx. Sta. 291+89 to 298+67) – *Standard Type 1SWB*

Retaining Wall No. 4 is a wall proposed in fill along the eastern side of the northbound roadway. The length of wall in this section is approximately 678 feet. The heights of the retaining wall vary from 8 to 10 feet. The top of footing elevations of the retaining wall will be approximately from 437 to 444 feet. Ground surface elevations at highway shoulder vary from approximately 445 to 451 feet. Sound wall of 12.33 feet height will be on a concrete barrier on top of the retaining wall in this segment. About 5 to 7 feet of fill will be needed to create level grade for roadway widening.

Borings A-11-121, A-11-122 and A-11-123 were drilled on the roadway shoulder along the retaining wall alignment to depths ranging from 31.5 to 49 feet. The subsurface soil profile showed that predominately stiff to hard lean clay extended to the bottom of Boring A-11-121 (31.5 feet) and to 38 and 28 feet in Borings A-11-122 and A-11-123, respectively. Medium dense to very dense silty sand, silty gravel and sandstone was found below the clay layers in Borings A-11-122 and A-11-123 to the bottom of the holes, about 49 and 31.5 feet, respectively. Groundwater was encountered in three borings at 28 to 39 feet (Elev. 410 to 423 ft). Undrained soil shear strength of 1.3 ksf was adopted for clayey material beneath the footing foundation.

A standard wall Type 1SWB is proposed. According to Caltrans 2005 standard drawing (xs14-220e), for wall height up to 10 feet, the ultimate bearing capacity needs to be on the order of 6.5 ksf. The calculated soil bearing capacity is 6.86 ksf, which exceeds the loading demand. Therefore, standard wall Type 1SWB is feasible for the proposed Retaining Wall No. 4. However, the result appears to be marginal. To provide uniform foundation support and to account for local irregularities, it is recommended that the footing subgrade be over-excavated a minimum of 2 feet and replaced with Class 3 aggregate base rock compacted to a minimum 95 percent relative compaction per Caltrans standards. Soil overexcavation and replacement should be extended to a

minimum of 2 feet beyond the spread footing footprint.

The retaining wall will be located on fill slope. Caltrans standard specifications should be followed for construction of fill embankment. When calculating passive resistance of the wall on slope, the portion above the bottom of the footing should be ignored unless there is a minimum 8 feet horizontal distance between the outer corner of the footing and the slope face.

Retaining Wall No. 5 (Approx. Sta. 301+00 to 315+35) – *Standard Type 7*

Retaining Wall No. 5 is a wall proposed in cut along the western side of the roadway in southbound direction. The wall is about 1435 feet long, approximately from Sta. 301+00 to 315+35. The design height is from 6 to 10 feet. The top of footing elevations vary approximately from 436.5 to 439 feet. Ground surface elevations vary from approximately 438.5 to 444 feet.

Borings A-11-125 through A-11-130 were drilled on the shoulder of the roadway along the retaining wall alignment to depths ranging from 16.5 to 36 feet. Subsurface soils in Borings A-11-125 through A-11-128 were generally found to be very stiff to hard lean clay, with thickness up to about 20 feet, overlying sandstone sedimentary rock. Borings A-11-129 and A-11-130 found about 10 to 14 feet of stiff lean clay overlying sandstone bedrock. Groundwater was encountered at about 15 to 17 feet in Borings A-11-126, -127 and -128 (Elev. 425 to 428 ft).

A standard wall Type 7 is proposed for Retaining Wall No. 5. It is our understanding that the 1993 Caltrans standard drawing xs14-010 will be used for design of the wall. The standard wall Type 7 is based on structure backfill with friction angle of 34 degrees and unit weight of 120 pcf. The minimum allowable bearing pressure requirement is 2.0 ksf. Based on the on-site soil condition, the proposed standard wall Type 7 is feasible for Retaining Wall No. 5 provided the following subgrade treatment recommendations are incorporated into design and construction.

Due to varying subsoil conditions under the wall alignment, different soil shear strengths were adopted for clayey soils below the footing at specified sections.

- Approx. Sta. 301+00 to 312+00: Undrained soil strength of 1.5 ksf was adopted. Calculated allowable soil bearing capacity is about 2.7 ksf, which exceeds indicated loading demand of 2.0 ksf. Subgrade soil treatment is not required.

- Approx. Sta. 312+00 to 315+35: Undrained soil strength of 1.0 ksf was adopted. Calculated allowable soil bearing capacity is 1.8 ksf, which is less than required minimum allowable pressure of 2.0 ksf. Subgrade soils beneath the footing should be over-excavated a minimum of 2 feet and replaced with Aggregate Base (Class 3) compacted to a minimum 95 percent relative compaction per Caltrans standards. Soil treatment should be extended to a minimum of 2 feet beyond the spread footing footprint. Such soil treatment will lower the bearing pressure under the aggregate base to less than the allowable soil bearing capacity of 1.8 ksf.

At a minimum, RW No. 5 design should be based on the soil condition as shown on the standard drawing assuming that the structure backfill will be placed behind the wall. It is also assumed the retained soils are in drained condition. Proper drainage system should be installed behind the retaining wall. The designer should include appropriate surcharge loads to the retaining wall.

Retaining Wall No. 6A (Approx. Sta. 315+60 to 320+29) – *Standard Type 1SWB*
Retaining Wall No. 6B (Approx. Sta. 322+15 to 323+80) – *Standard Type 1SWB*

Retaining Walls No. 6A and 6B are walls proposed in fill along the eastern side of the northbound roadway. The total length of walls in these sections is approximately 634 feet. The heights of the retaining wall vary from 8 to 10 feet. Sound wall of 12.33 feet in height will be on a concrete barrier on top of the retaining wall in this segment. The top of footing elevations of the walls vary approximately from 424.5 to 429 feet for RW No. 6A and is at 623 feet for RW No. 6B. Ground surface elevations at highway shoulder vary from approximately 431 to 436 feet. About 5 to 7 feet of fill will be needed to create level grade for roadway widening.

Borings A-11-135 and A-11-136 for RW No. 6A and A-11-137 for RW No. 6B were drilled on the shoulder of the roadway along the retaining wall alignment to depths ranging from 30.5 to 50.5 feet. Borings A-11-135 and A-11-137 consisted of mostly stiff to very stiff lean clay to

approximate 30.5 and 31.5 feet, the maximum depth drilled, respectively. A-11-136 encountered 18 feet of stiff to hard fat clay followed by interbedded very dense silty sand, gravel and hard silty clay to the maximum depth explored, about 50.5 feet. Groundwater was encountered in borings A11-135 and A-11-136 at about 25 and 32 feet, respectively (Elevations vary from 403 to 410 ft). Undrained soil shear strength of 1.3 ksf was adopted for calculation.

A standard wall Type 1SWB is proposed. According to the Caltrans 2005 standard drawing (xs14-220e), for wall height up to 10 feet, the ultimate bearing capacity needs to be on the order of 6.5 ksf. The calculated soil bearing capacity is 6.86 ksf, which exceeds the loading demand. Therefore, the standard wall Type 1SWB is feasible for the proposed Retaining Walls No. 6A and 6B. However, the result appears to be marginal. To provide uniform foundation support and to account for local irregularities, it is recommended that the footing subgrade be over-excavated a minimum of 2 feet and replaced with Class 3 aggregate base rock compacted to a minimum 95 percent relative compaction per Caltrans standards. Soil over-excavation and replacement should be extended to a minimum of 2 feet beyond the spread footing footprint.

The retaining wall will be located on fill slope. Caltrans standard specifications should be followed for construction of fill embankment. When calculating passive resistance of the wall on slope, the portion above the bottom of the footing should be ignored unless there is a minimum 8 feet horizontal distance between the outer corner of the footing and the slope face.

13.0 GRADING

All grading operations should be performed in accordance with the project specifications and Caltrans Standard Specifications for Earthwork (Section 19). A representative from this office or regulatory agency should observe all excavated areas during grading and perform moisture and density tests on prepared subgrade and compacted fill material.

Unless otherwise stated in the special provisions, all materials specifications should conform to Caltrans Standard Specifications, including Structure Backfill. Any fill material imported to the site should be non-expansive with PI<12 and free of organic or other deleterious stuff. In particular, for new embankment/roadway construction, the material placed within 4 feet of the finish pavement subgrade should have an R-value of no less than 15.

Should there be any alterations of the proposed construction that will affect the stated bases of our recommendations, we should be informed so that we can review such changes and amend or submit additional recommendations. This office should review the final grading plans prior to grading to see that the intent of our recommendations is included in the plans.

14.0 NOTES TO DESIGNER

According to Designer's instruction, the 2006 Caltrans standard plan, B3-3, was used for analyzing the feasibility of standard wall Type 1A for Retaining Walls No. 1C and 5. A factor of safety of 3 was incorporated into the allowable soil bearing capacity calculation. The 2005 Caltrans standard drawing xs14-220e was followed for feasibility determination of standard wall Type 1SWB for Retaining Walls No. 4, 6A and 6B. Caltrans 1993 standard drawing xs14-010 for Type 7 wall was used for Retaining Wall No. 1D. Ground anchor wall design was based on 2000 Caltrans Bridge Design Specifications. The design used LFD approach instead of LRFD method. Soil capacity requirement is different between LFD and LRFD design methods. Subsoil conditions under the wall foundation satisfying one design method requirement may not satisfy the other. If there is any change on using the standard plan or drawing, this office should be notified to review the design approach and provide any supplemental recommendations.

15.0 CONSTRUCTION CONSIDERATIONS

15.1 General

To a degree, the performance of any structure is dependent upon construction procedures and quality. Hence, observation of grading, foundation excavation and backfill operations should be carried out by the geotechnical engineer. If the encountered subsurface conditions differ from those forming the basis of our recommendations, this office should be informed in order to assess the need for design changes. Therefore, the recommendations presented in this report are contingent upon good quality control and these geotechnical observations during construction.

15.2 Construction Advisories

The site is the existing I-680. Therefore, traffic control and construction staging is required to maintain traffic flow during construction. It is apparent that there are numerous utility lines at the site. The contractor should verify the utility lines, be aware of the existing conditions and plan the construction activities accordingly.

The borings encountered clayey/sandy materials near the existing ground surface. Localized subgrade pumping may be encountered during earthwork construction depending on the weather, subsurface moisture, and surface drainage conditions. Equipment mobility may also be difficult if the subgrade is wet. In such a case, the subgrade soils may require reworking, aeration, or over-excavation and replacing with dry granular fill to facilitate earthwork construction.

Prospective contractors for the project must be directed to evaluate construction-related issues on the basis of their own knowledge and experience in the local area, on the basis of similar projects in other areas, or on the basis of field investigation on the site performed by them, taking into account their proposed construction methods and procedures. In addition, construction activities related to excavation and lateral earth support must conform to safety requirements of OSHA and other applicable regulatory agencies.

15.3 Plan Review

We recommend that final plans for foundation be reviewed by this office prior to construction so that the intent of our recommendations is included in the project plans and specifications and to further see that no misunderstandings or misinterpretations have occurred.

15.4 Differing Site Conditions

The soil conditions described in this report are based on available boring data. It should be noted that these borings depict subsurface conditions only at the locations drilled. Because of the variability from place to place within soils in general, and the nature of geologic depositions, subsurface soil conditions could change between the explored locations.

Early communication should be made between the Resident Engineer, the Contractor and the Geotechnical Engineer as soon as conditions that differ from those discussed in this report are recognized by any of the parties. Additional recommendations could be provided if such conditions arise.

16.0 INVESTIGATION LIMITATIONS

Our services consist of professional opinions and recommendations made in accordance with generally accepted geotechnical engineering principles and practices and are based on our site reconnaissance and the assumption that the subsurface conditions do not deviate from observed conditions. All work done is in accordance with generally accepted geotechnical engineering principles and practices. No warranty, expressed or implied, of merchantability or fitness, is made or intended in connection with our work or by the furnishing of oral or written reports or findings. The scope of our services did not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in structures, soil, surface water, groundwater or air, below or around this site. Unanticipated soil conditions are commonly encountered and cannot be fully determined by taking soil samples and excavating test borings; different soil conditions may require that additional expenditures be made during construction to attain a properly constructed project. Some contingency fund is thus recommended to accommodate these possible extra costs.

This report has been prepared for the proposed project as described earlier, to assist the engineer in the design of this project. In the event any changes in the design or location of the facilities are planned, or if any variations or undesirable conditions are encountered during construction, our conclusions and recommendations shall not be considered valid unless the changes or variations are reviewed and our recommendations modified or approved by us in writing.

This report is issued with the understanding that it is the designer's responsibility to ensure that the information and recommendations contained herein are incorporated into the project and that necessary steps are also taken to see that the recommendations are carried out in the field.

The findings in this report are valid as of the present date. However, changes in the subsurface conditions can occur with the passage of time, whether they are due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation or from the broadening of knowledge. Accordingly, the findings in this report might be invalidated, wholly or partially, by changes outside of our control.

Respectfully submitted,
PARIKH CONSULTANTS, INC.

Peter Haoli Wei, GE 2922
Project Engineer

Gary Parikh, P.E., G.E. 666
Project Manager

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GAURANG R. PARIKH
No. 666
EXP 12-31-13
GEOTECHNICAL
STATE OF CALIFORNIA

James B. Baker, CEG 1021
Project Engineering Geologist

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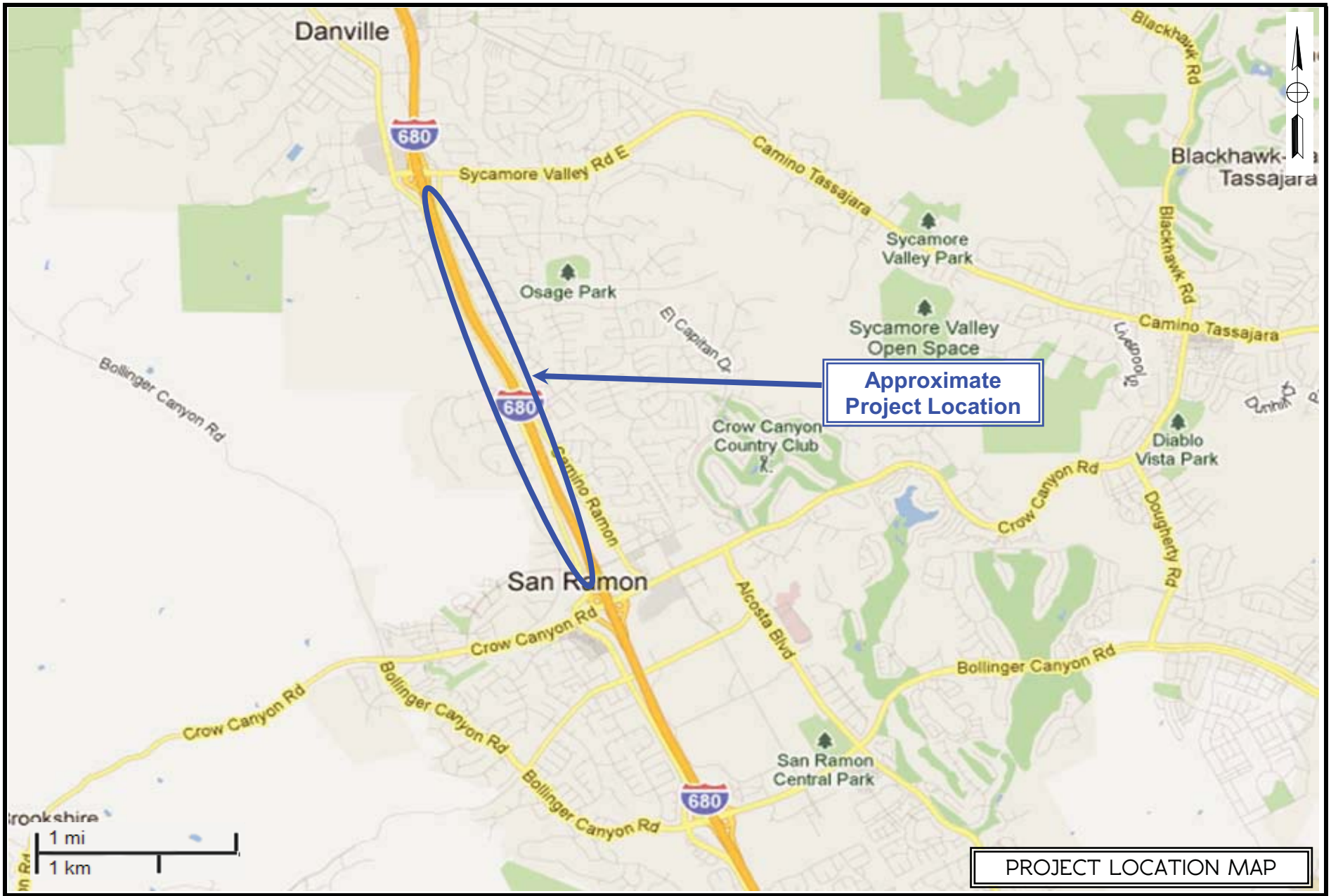
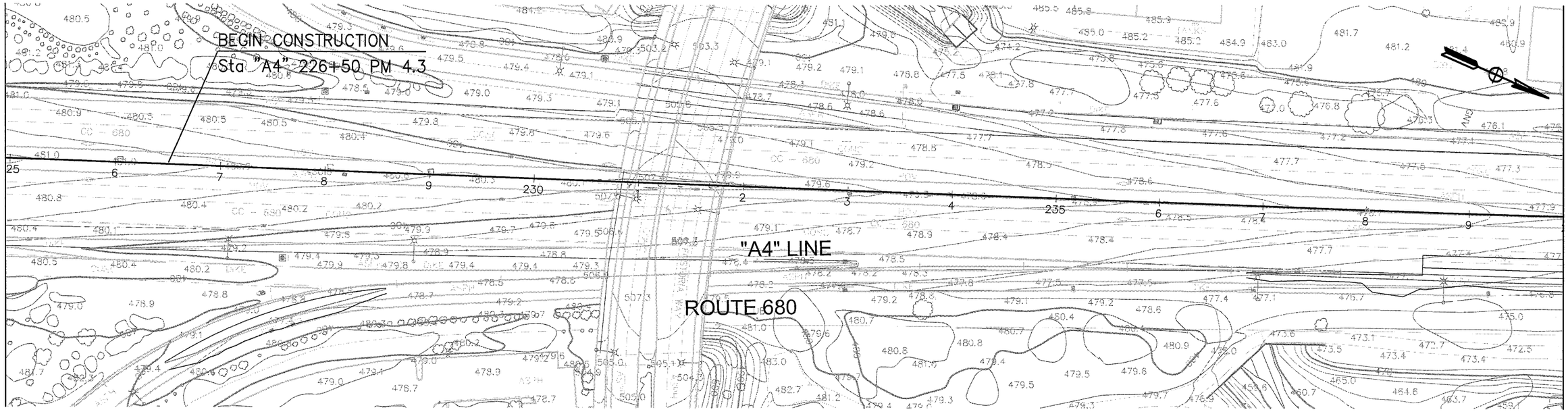


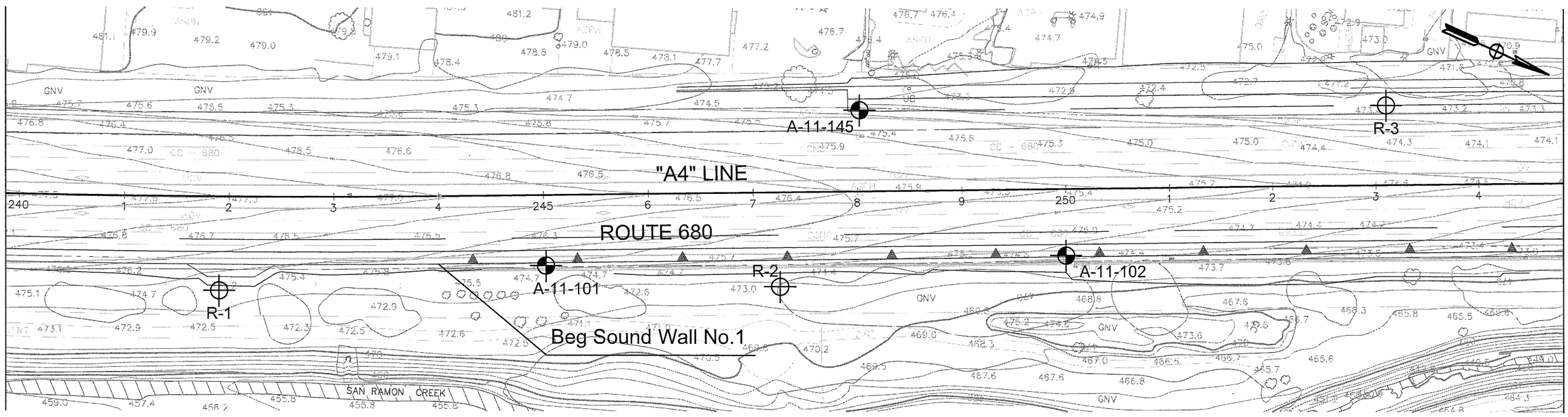
PROJECT LOCATION MAP

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

ROUTE 680 AUXILIARY LANE PROJECT - SEGMENT 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO.: 2011-124-WAL	PLATE NO.: 1





LEGEND

A-11-101 — Approx. Boring Location

R-1 — Approx. R-Value Boring Location

SCALE 1 inch = 100 feet

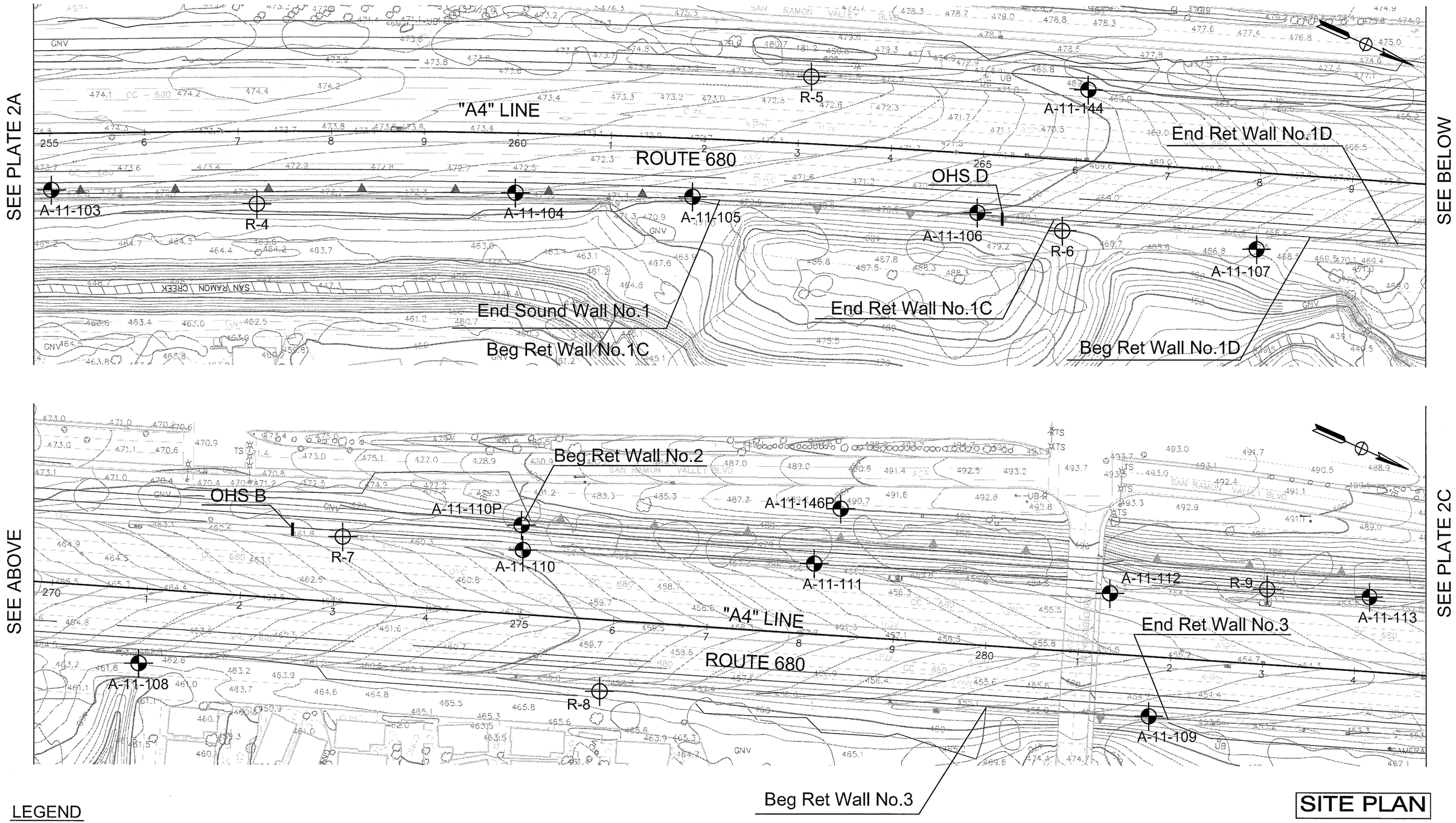
Note: All units are in feet unless otherwise specified
Reference Map was provided by Mark Thomas & Co, Inc.

SITE PLAN

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

ROUTE 680 AUXILIARY LANE PROJECT SEGMENT 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO.:2011-124-WAL | PLATE NO: 2A



SITE PLAN

LEGEND

A-11-101 — Approx. Boring Location

R-1 — Approx. R-Value Boring Location

SCALE 1 inch = 100 feet

Note: All units are in feet unless otherwise specified
Reference Map was provided by Mark Thomas & Co, Inc.

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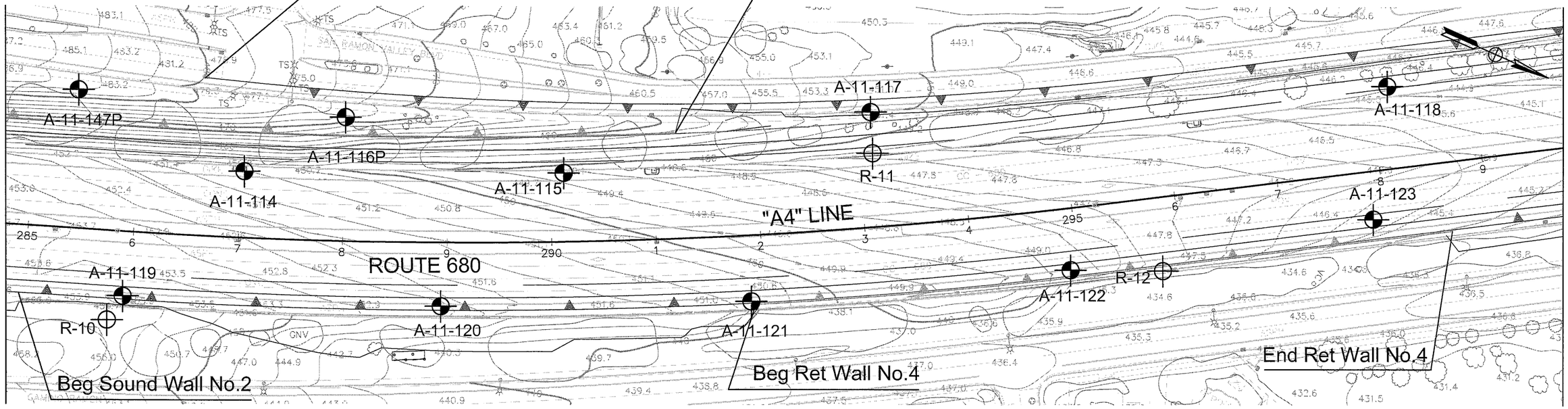
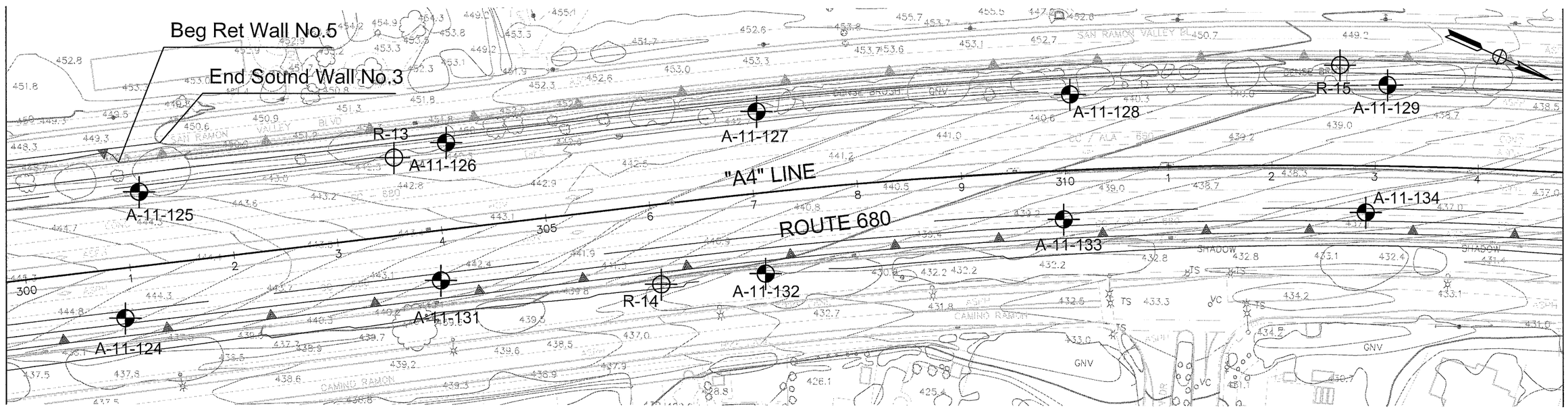
ROUTE 680 AUXILIARY LANE PROJECT SEGMENT 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO.:2011-124-WAL | PLATE NO: 2B





SITE PLAN

LEGEND

A-11-101 — Approx. Boring Location

R-1 — Approx. R-Value Boring Location

SCALE 1 inch = 100 feet

Note: All units are in feet unless otherwise specified
Reference Map was provided by Mark Thomas & Co, Inc.

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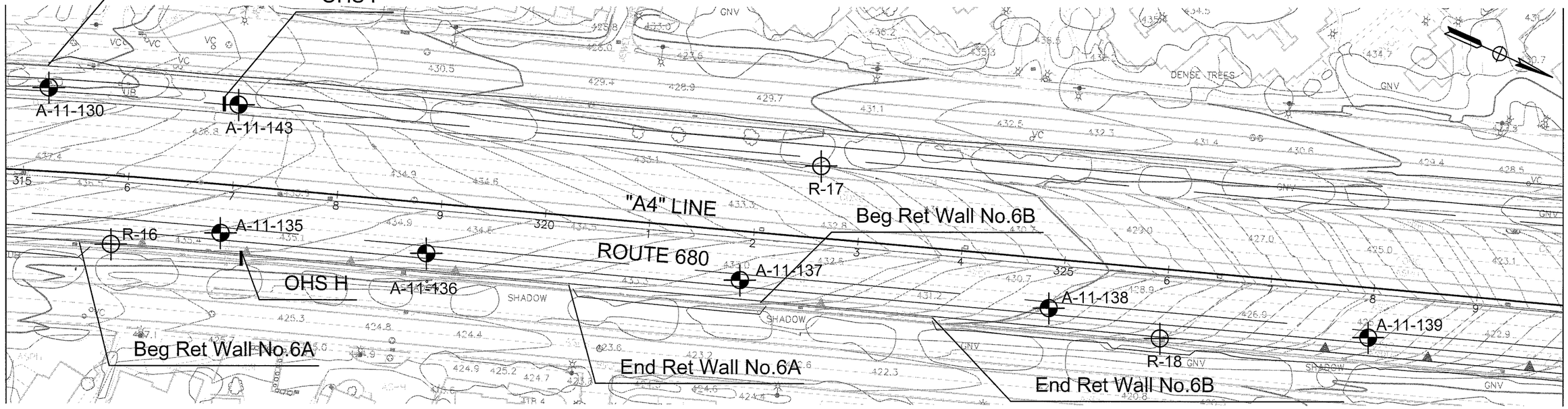
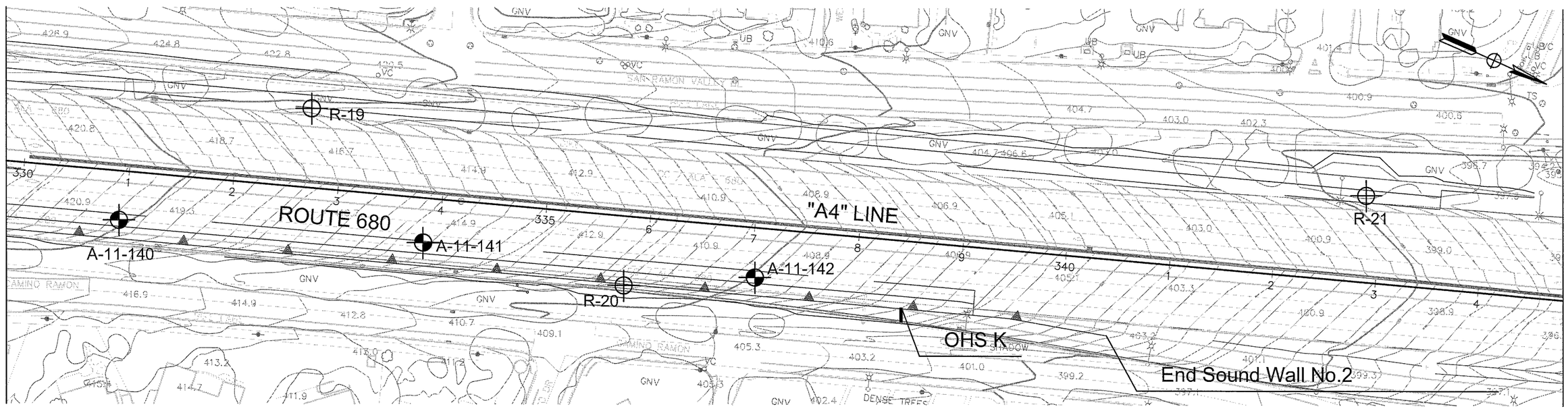
ROUTE 680 AUXILIARY LANE PROJECT SEGMENT 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO.:2011-124-WAL | PLATE NO: 2C





LEGEND

A-11-101
Approx. Boring Location

R-1
Approx. R-Value Boring Location

SCALE 1 inch = 100 feet

Note: All units are in feet unless otherwise specified
Reference Map was provided by Mark Thomas & Co, Inc.

SITE PLAN

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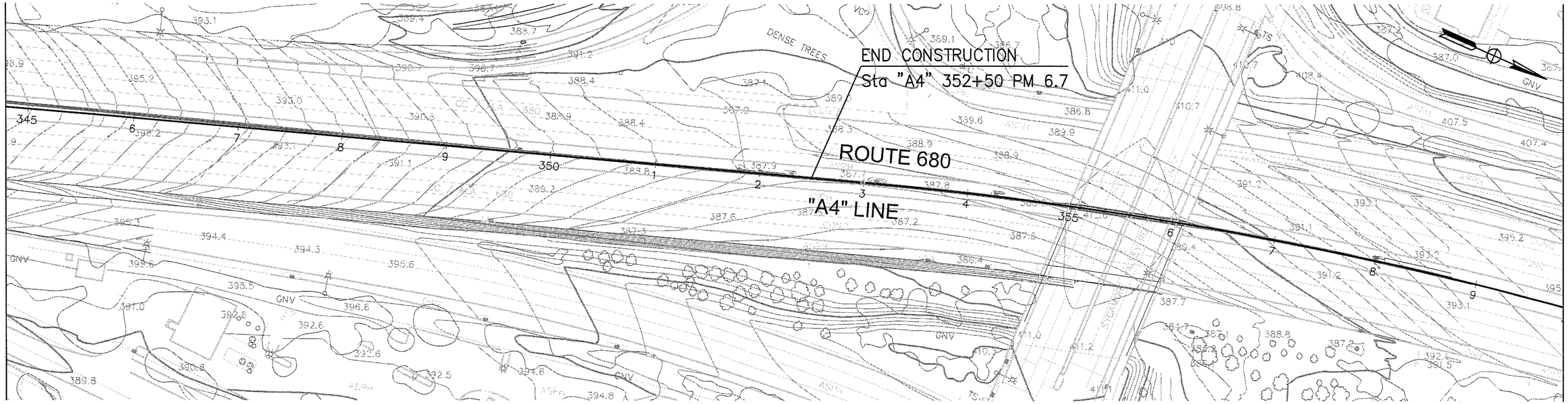
ROUTE 680 AUXILIARY LANE PROJECT SEGMENT 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO.:2011-124-WAL | PLATE NO: 2D

SEE PLATE 2D



SITE PLAN

LEGEND

A-11-101 Approx. Boring Location

R-1 Approx. R-Value Boring Location

SCALE 1 inch = 100 feet

Note: All units are in feet unless otherwise specified
Reference Map was provided by Mark Thomas & Co, Inc.

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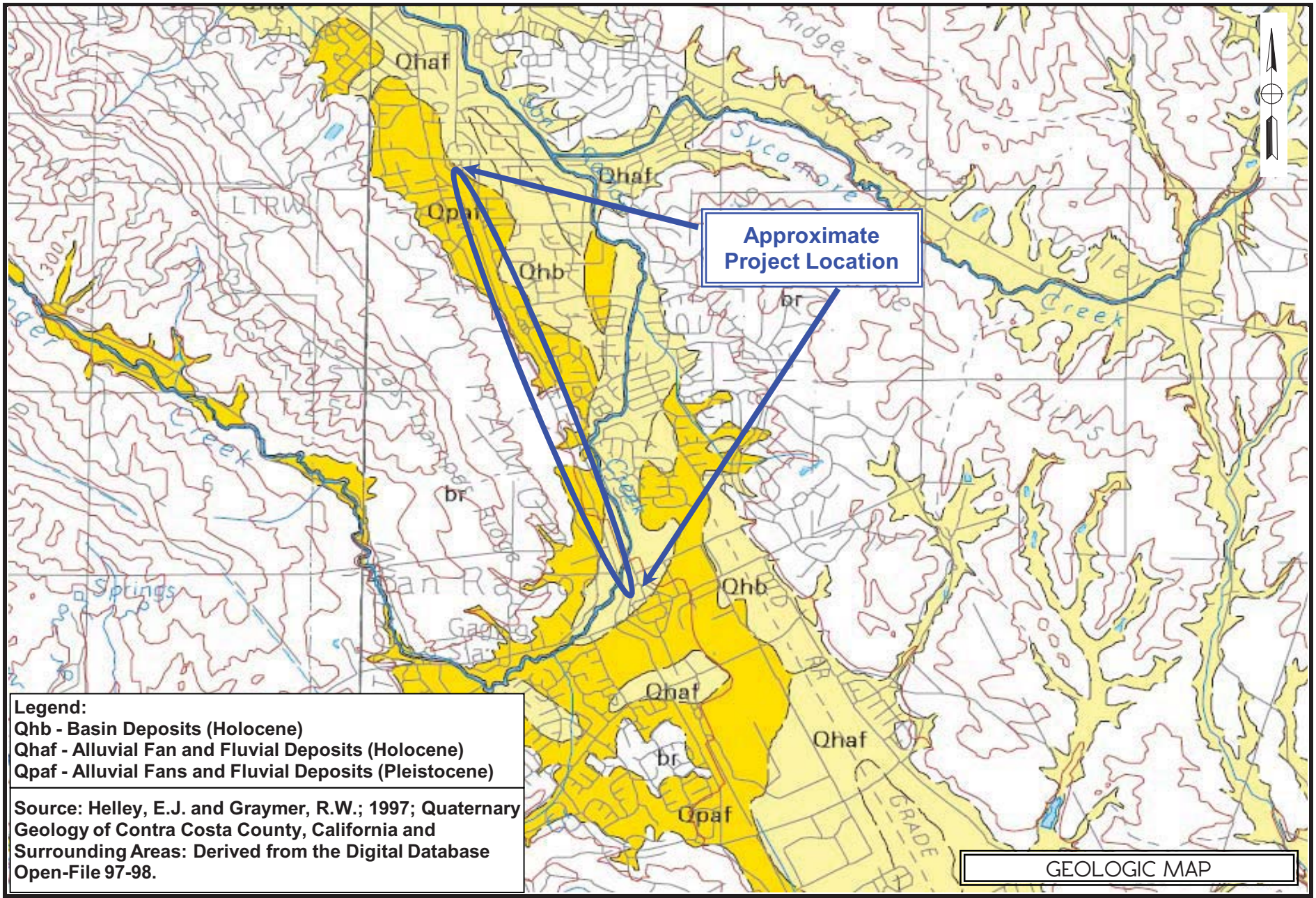
MATERIALS ENGINEERING

ROUTE 680 AUXILIARY LANE PROJECT SEGMENT 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO.:2011-124-WAL | PLATE NO: 2E



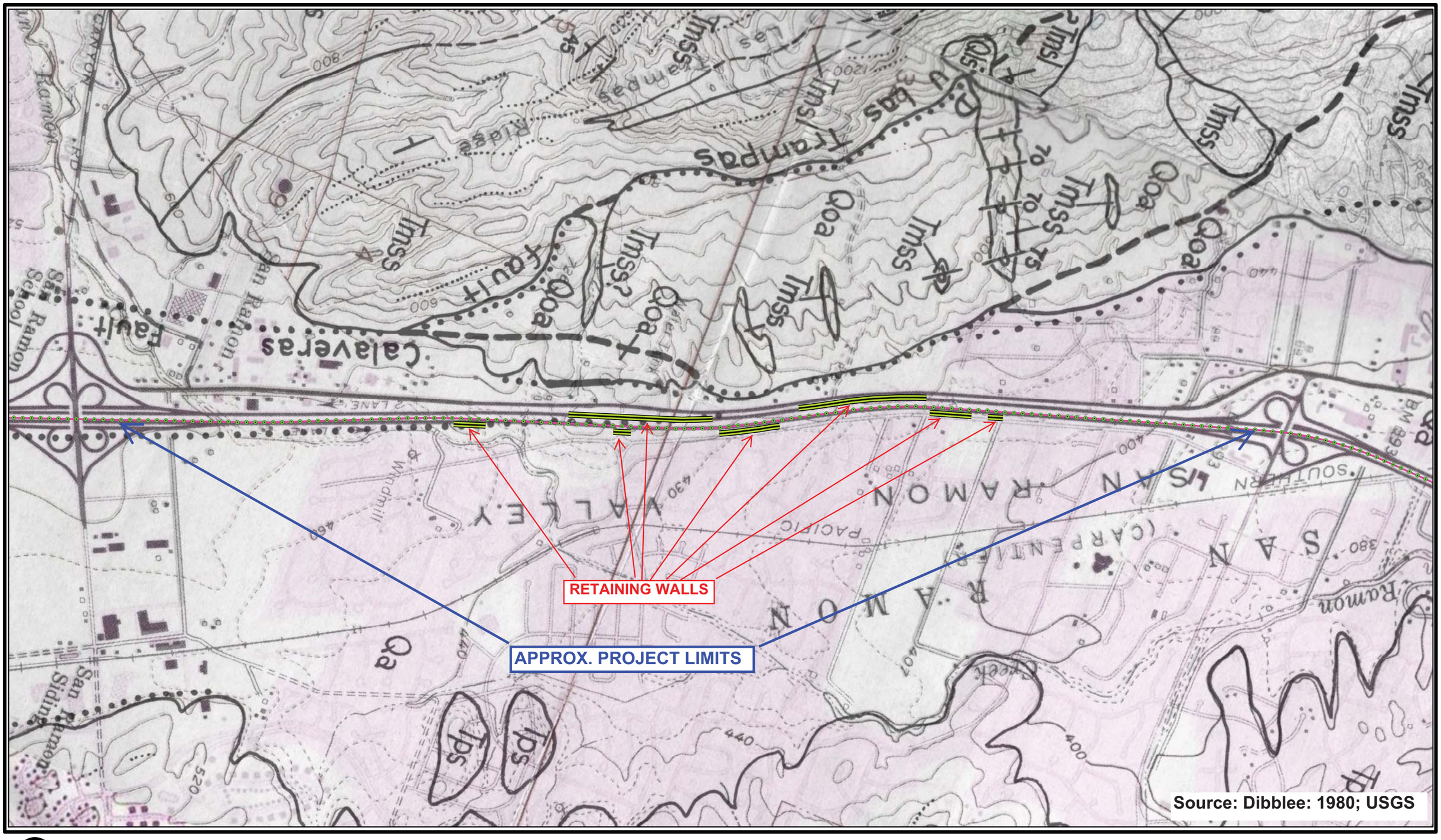
Legend:
Qhb - Basin Deposits (Holocene)
Qhaf - Alluvial Fan and Fluvial Deposits (Holocene)
Qpaf - Alluvial Fans and Fluvial Deposits (Pleistocene)

Source: Helley, E.J. and Graymer, R.W.; 1997; Quaternary Geology of Contra Costa County, California and Surrounding Areas: Derived from the Digital Database Open-File 97-98.

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS TESTING

ROUTE 680 AUXILIARY LANE PROJECT - SEGMENT 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO.: 2011-124-WAL | **PLATE NO.: 3A**



0 500 1,000 2,000 3,000 4,000 5,000 Feet

PLATE NO. 3B-1

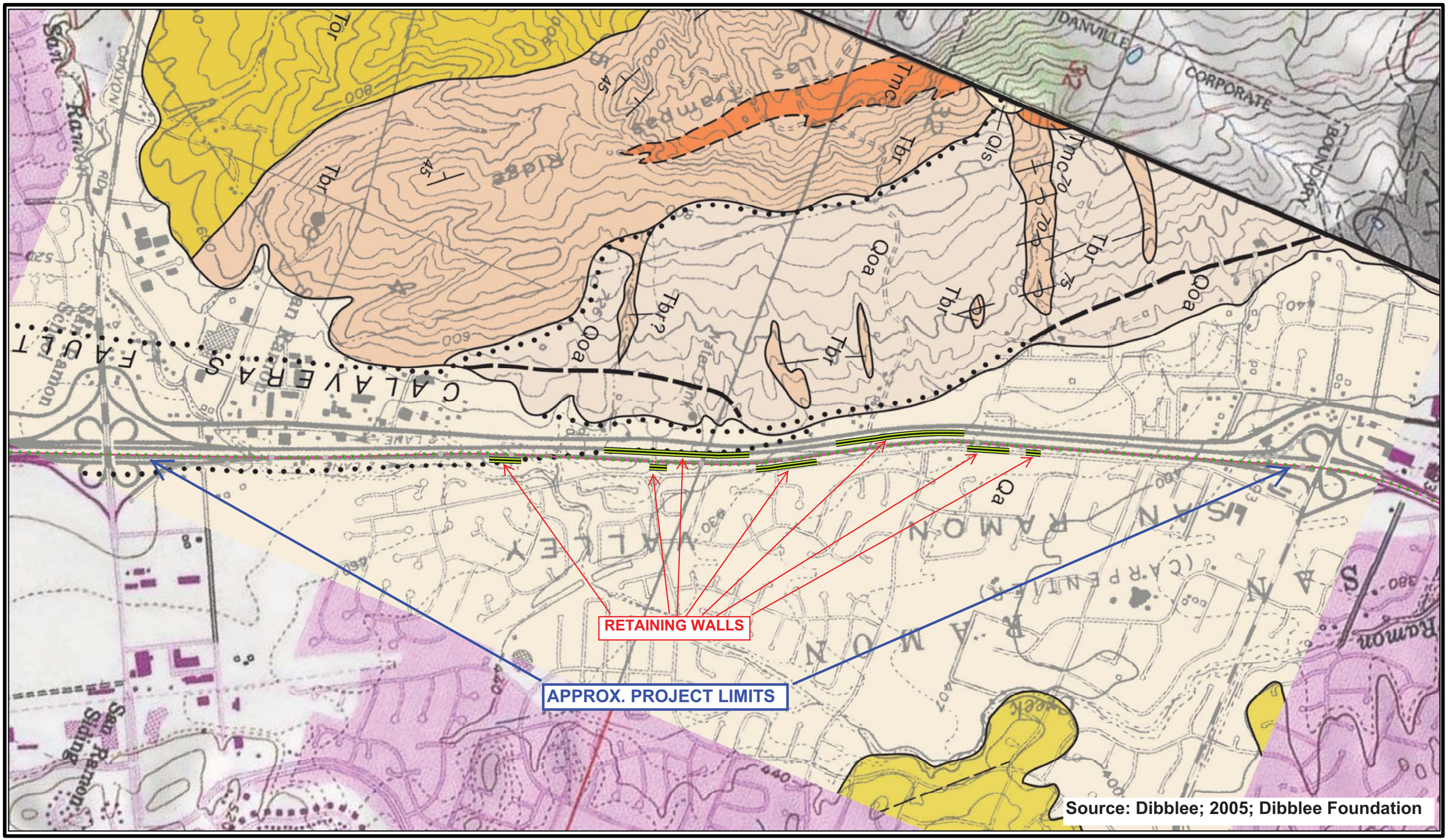
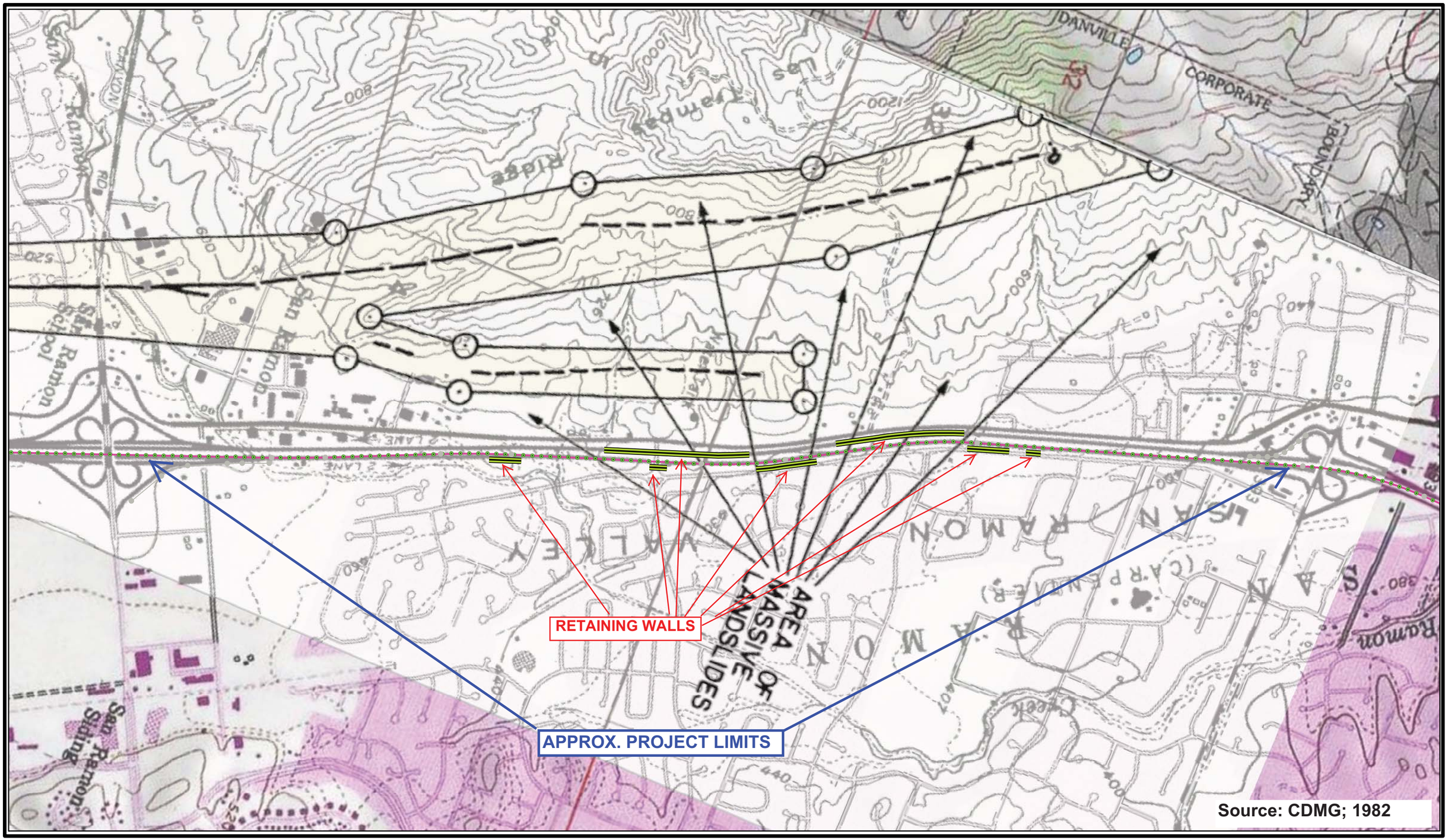
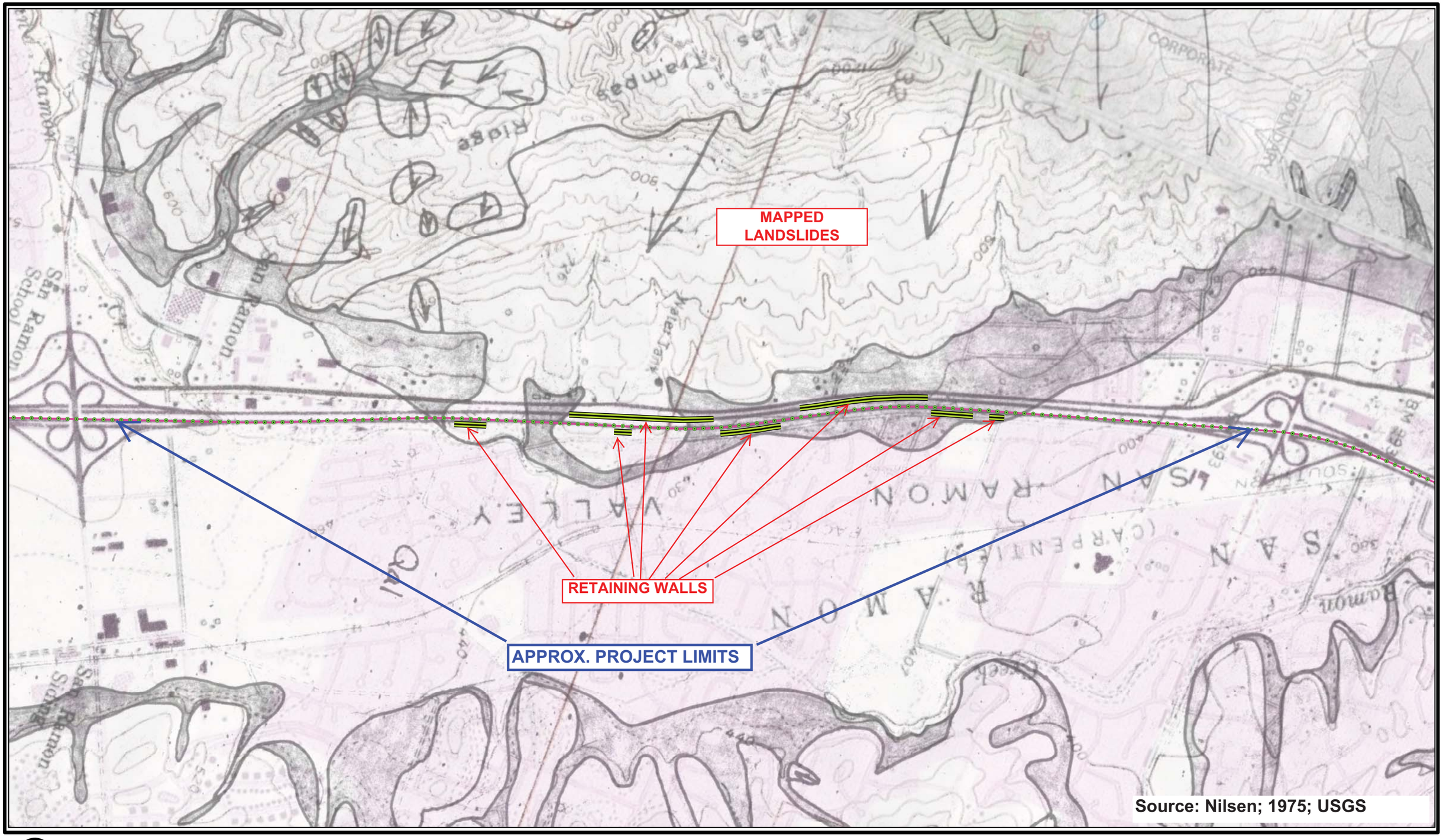

RETAINING WALLS
APPROX. PROJECT LIMITS
Source: Dibblee; 2005; Dibblee Foundation
CALAVERAS
FAULT
SAN RAMON
VALLEY
DANVILLE
CORPORATE
BOUNDARY
Qoa
Tbr
Tmc
Qls
Tbr?
0 500 1,000 2,000 3,000 4,000 5,000 Feet

PLATE NO. 3B-2



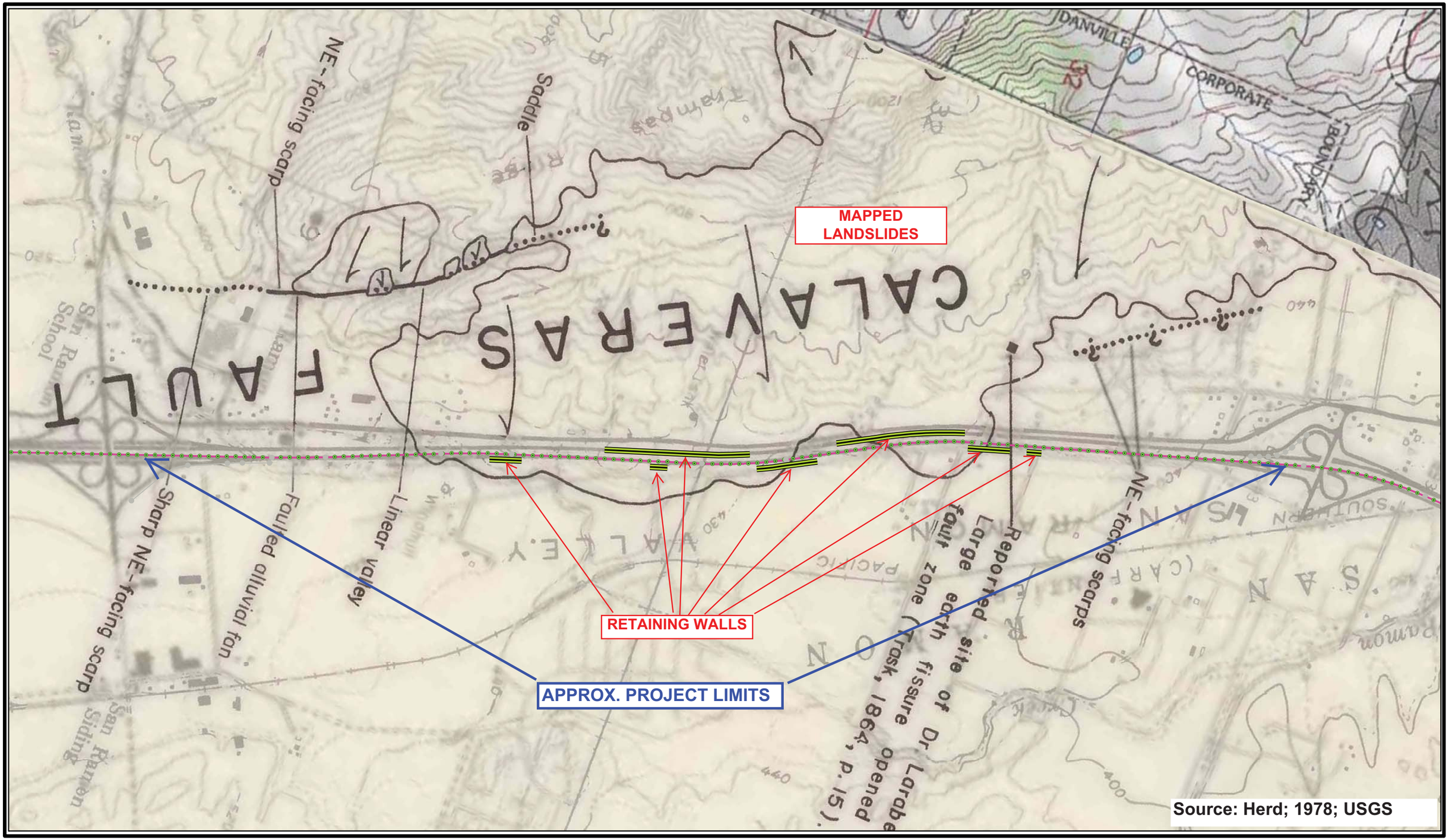
0 500 1,000 2,000 3,000 4,000 5,000 Feet

PLATE NO. 3C



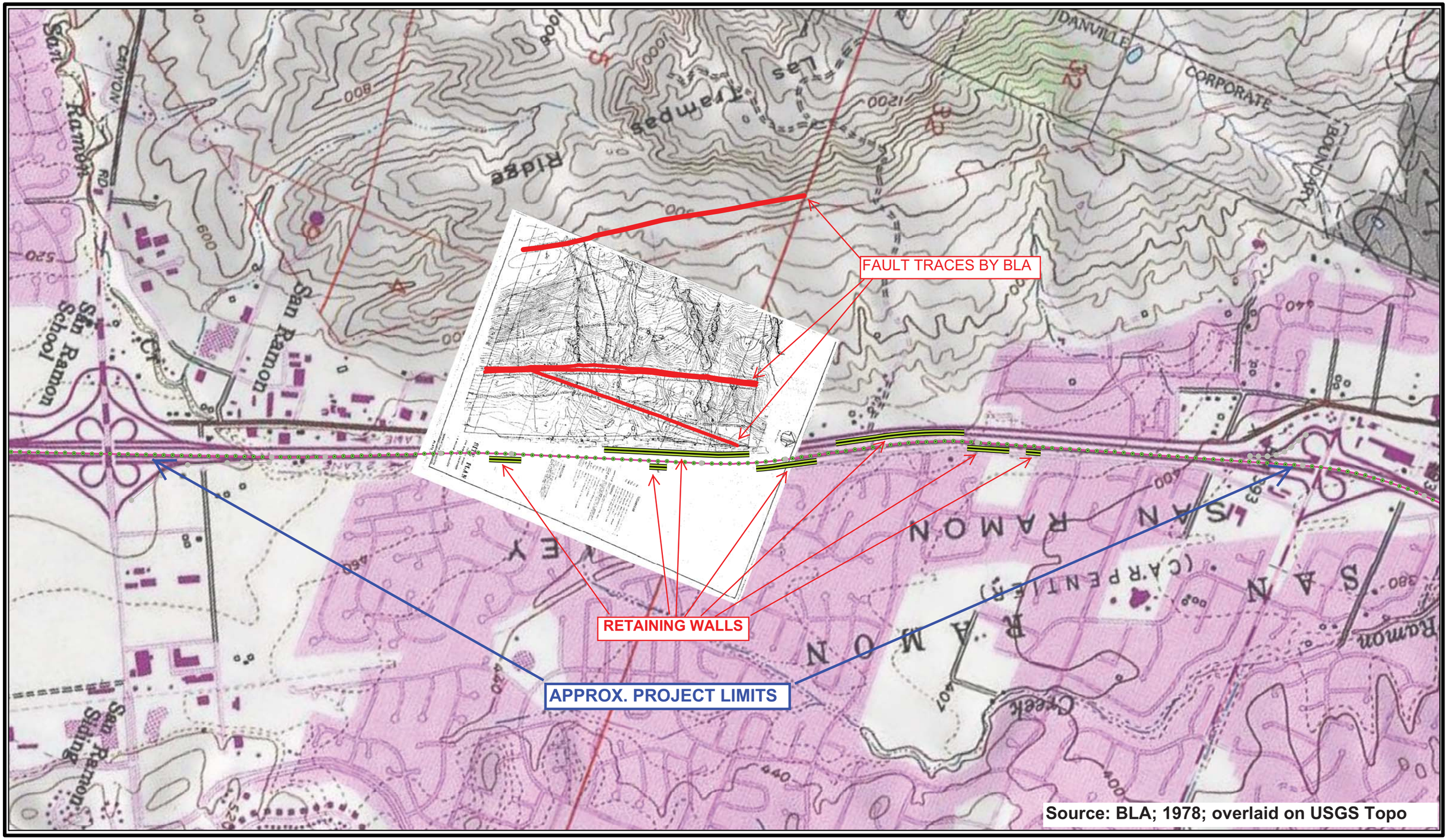
0 500 1,000 2,000 3,000 4,000 5,000 Feet

PLATE NO. 3D



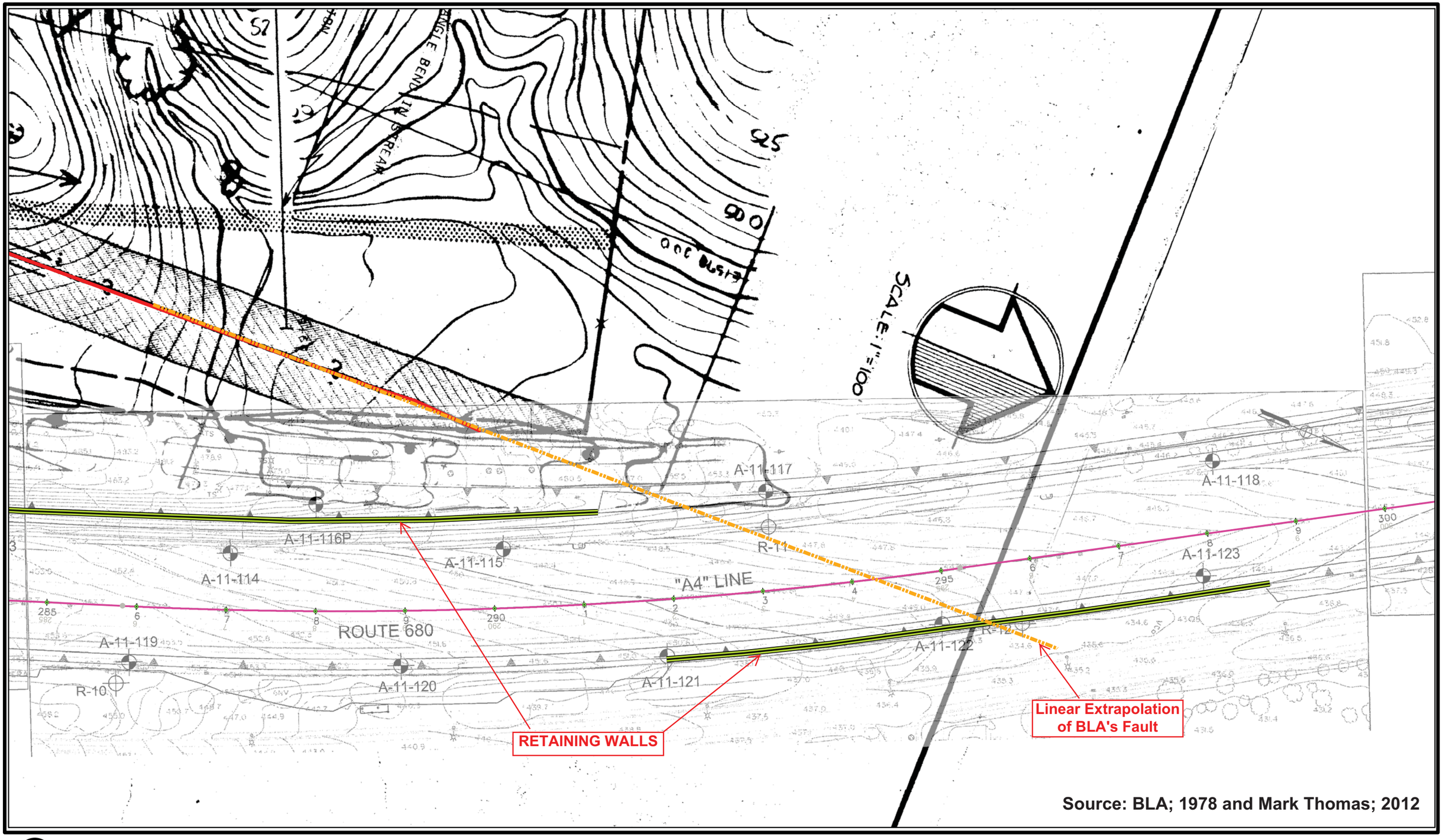
0 500 1,000 2,000 3,000 4,000 5,000 Feet

PLATE NO. 3E



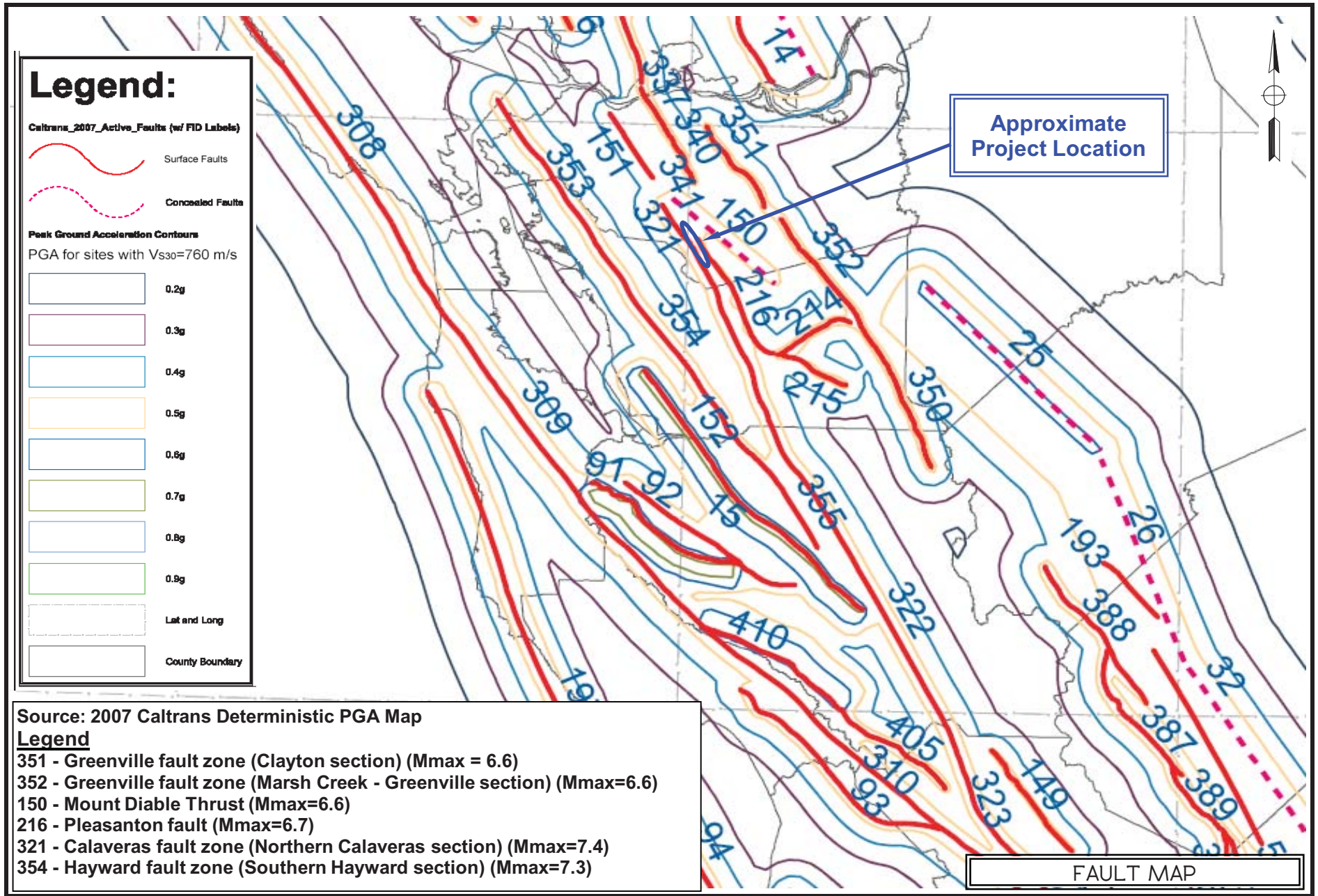
0 500 1,000 2,000 3,000 4,000 5,000 Feet

PLATE NO. 3F



0 50 100 200 300 400 500 Feet

PLATE NO. 3G



Source: 2007 Caltrans Deterministic PGA Map

Legend

351 - Greenville fault zone (Clayton section) (Mmax = 6.6)
352 - Greenville fault zone (Marsh Creek - Greenville section) (Mmax=6.6)
150 - Mount Diable Thrust (Mmax=6.6)
216 - Pleasanton fault (Mmax=6.7)
321 - Calaveras fault zone (Northern Calaveras section) (Mmax=7.4)
354 - Hayward fault zone (Southern Hayward section) (Mmax=7.3)

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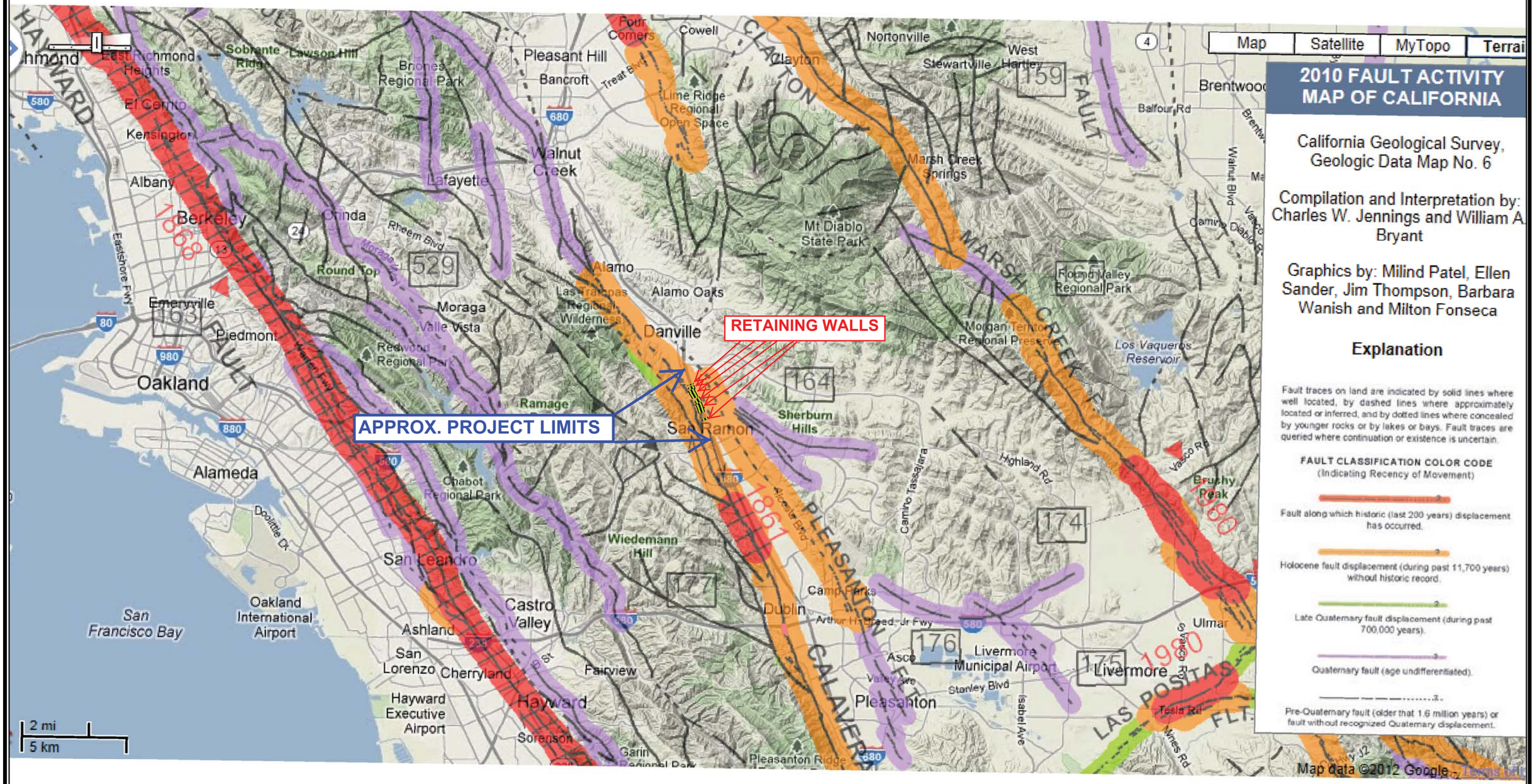
ROUTE 680 AUXILIARY LANE PROJECT - SEGMENT 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO.: 2011-124-WAL | PLATE NO.: 4A



Source: CGS; 2010

0 1.5 3 6 9 12 15 Miles

PLATE NO. 4B

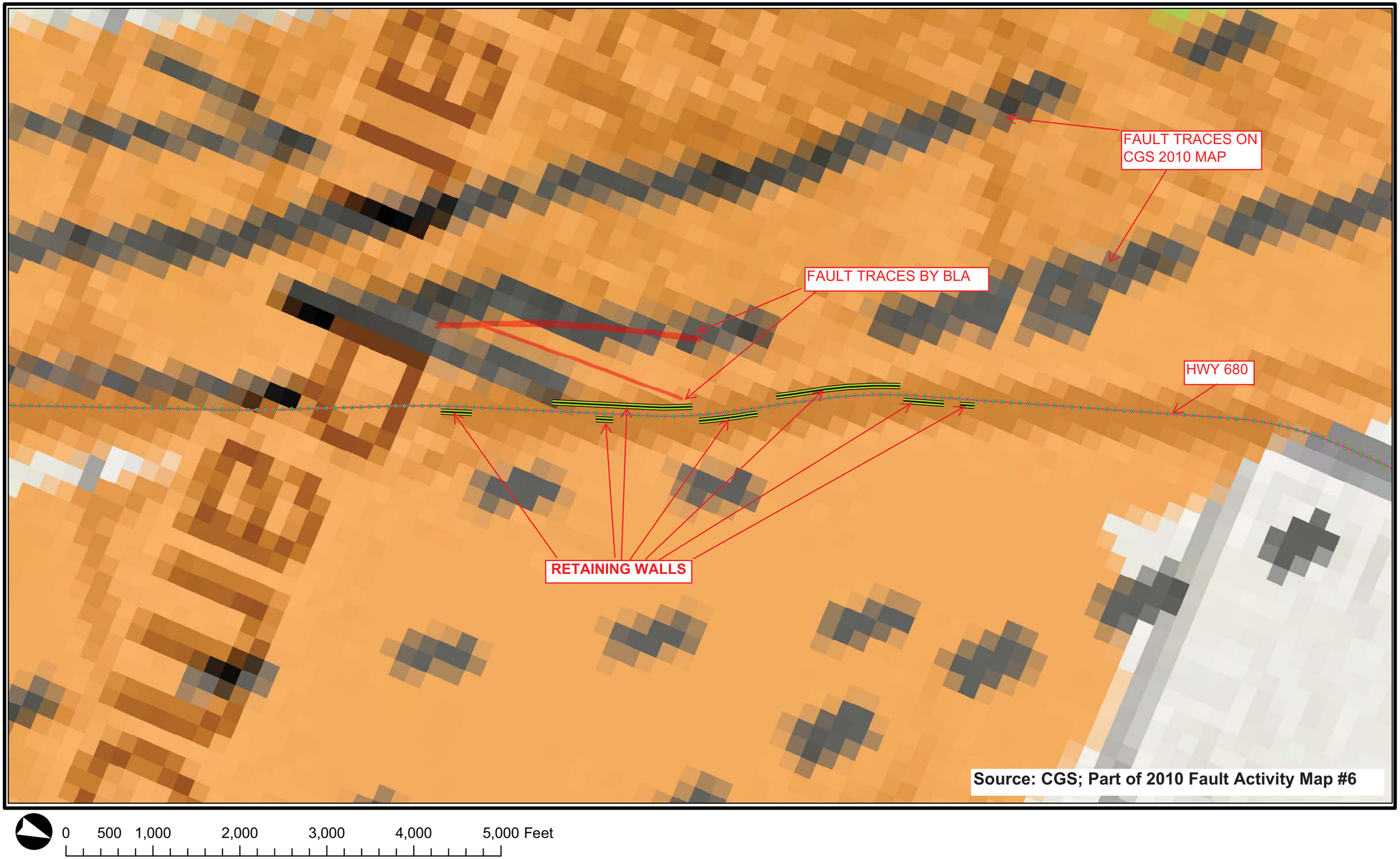
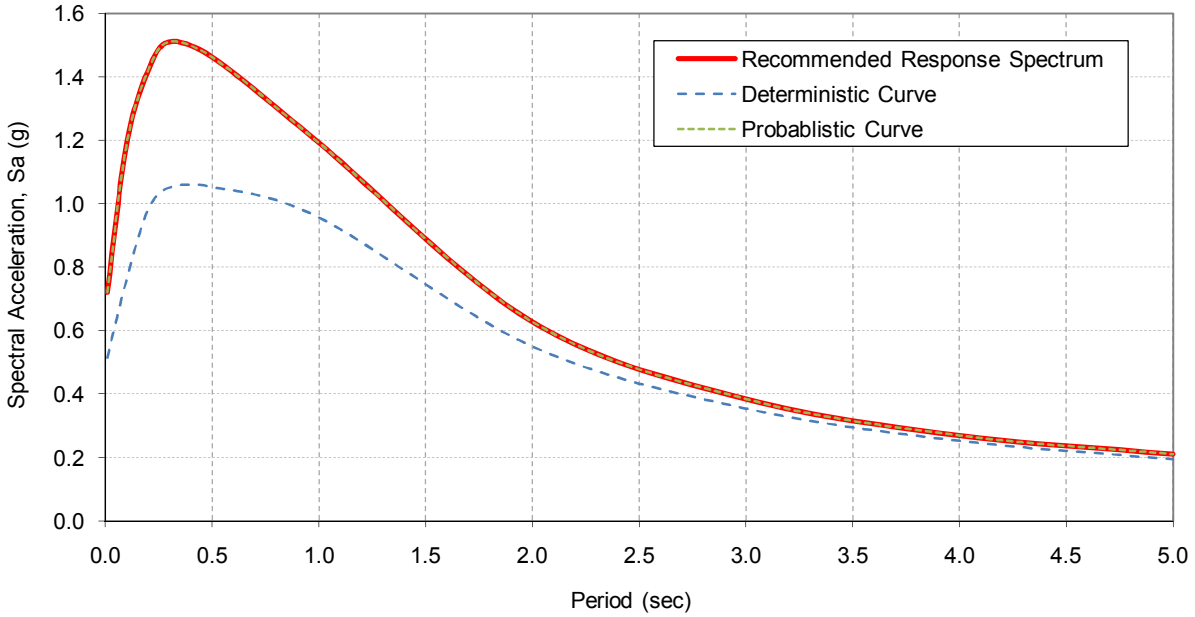

FAULT TRACES ON
CGS 2010 MAP
FAULT TRACES BY BLA
HWY 680
RETAINING WALLS
Source: CGS; Part of 2010 Fault Activity Map #6
0
500
1,000
2,000
3,000
4,000
5,000 Feet

PLATE NO. 4C

RECOMMENDED ARS CURVE

(Envelope of Deterministic & Probablistic Curves)



Site Information

Latitude:	37.7925
Longitude	-121.9829
V_{S30} (m/s) =	305
$Z_{1.0}$ (m) =	N/A
$Z_{2.5}$ (km) =	N/A
Near Fault Factor, Derived from USGS Deagg. Dist (km) =	2.8

Recommended Response Spectrum

Period (sec)	SA Base Spectrum (g)	Adjusted for Near Fault Effect	Adjusted For Basin Effect	Final Adjusted Spectral Acceleration (g)
0.0	0.721	1.000	1.000	0.721
0.1	1.187	1.000	1.000	1.187
0.2	1.419	1.000	1.000	1.419
0.3	1.511	1.000	1.000	1.511
0.5	1.463	1.000	1.000	1.463
1.0	0.994	1.200	1.000	1.193
2.0	0.523	1.200	1.000	0.628
3.0	0.320	1.200	1.000	0.384
4.0	0.224	1.200	1.000	0.269
5.0	0.175	1.200	1.000	0.210

Governing Curve:

Envelope of:

(1) Calaveras fault zone (Northern Calaveras section) (Fault ID: 321, Fault Type: RLSS)

(2) Caltrans ARS Online Probablistic Curve

Source:

1. Caltrans ARS Online tool (V.1.0.4, http://dap3.dot.ca.gov/shake_stable/)
2. USGS Deaggregation 2008 beta (http://eqint.cr.usgs.gov/deaggint/2008/index.php)
3. Caltrans Geotechnical Services Design Manual (Version 1.0)

Note:

Refer to "Probablistic Response Spectum Spreadsheet" (attached) for development of the recommended ARS curve.

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GEOTECHNICAL ENGINEERING
MATERIALS TESTING

Rte. 680 Auxiliary Lane Project - Seg. 2

Project No.: 2011-124-WAL | **Plate No.: 5**

5.5.5.7 Lateral Earth Pressures for Anchored Walls

For anchored walls restrained by tie rods and structural anchors, the lateral earth pressure acting on the wall may be determined in accordance with Article 5.5.5.6.

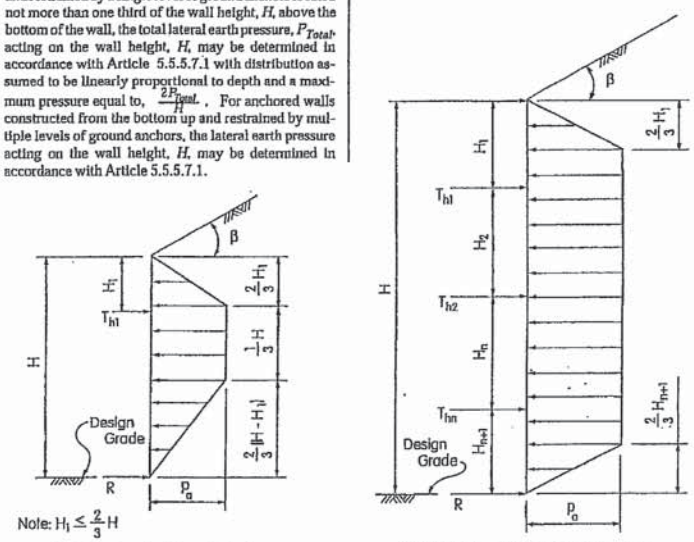
For anchored walls constructed from the top down and restrained by ground anchors (tieback anchors), the lateral earth pressure acting on the wall height, H, may be determined in accordance with Articles 5.5.5.7.1 and 5.5.5.7.2.

For anchored walls constructed from the bottom up and restrained by a single level of ground anchors located not more than one third of the wall height, H, above the bottom of the wall, the total lateral earth pressure, P_{Total}, acting on the wall height, H, may be determined in accordance with Article 5.5.5.7.1 with distribution assumed to be linearly proportional to depth and a maximum pressure equal to, $\frac{2P_{Total}}{H}$. For anchored walls constructed from the bottom up and restrained by multiple levels of ground anchors, the lateral earth pressure acting on the wall height, H, may be determined in accordance with Article 5.5.5.7.1.

In developing the lateral earth pressure for design of an anchored wall, consideration shall be given to wall displacements that may affect adjacent structures and/or underground utilities.

C5.5.5.7

In the development of lateral earth pressures, the method and sequence of wall construction, the rigidity of the wall/anchor system, the physical characteristics and stability of the ground mass to be supported/retained, allowable wall deflections, anchor spacing and prestress and the potential for anchor yield should be considered.



a) Wall with a single level of anchors

b) Wall with multiple levels of anchors

Figure 5.5.5.7.1-1 Lateral Earth Pressure Distributions for Anchored Walls Constructed from the Top Down in Cohesionless Soils

5.5.5.7.1 Cohesionless Soils

The lateral earth pressure distribution for the design of temporary or permanent anchored walls constructed in cohesionless soils may be determined using Figure 5.5.5.7.1-1, for which the maximum ordinate, p_a, of the pressure diagram is determined as follows:

For walls with a single level of anchors:

$$p_a = \frac{P_{Total}}{\frac{2}{3}H} \qquad (5.5.5.7.1\text{-}1)$$

For walls with multiple levels of anchors:

$$p_a = \frac{P_{Total}}{\left(H - \frac{1}{3}H_1 - \frac{1}{3}H_{n+1}\right)} \qquad (5.5.5.7.1\text{-}2)$$

where:

p_a = maximum ordinate of pressure diagram (KSF)

P_{Total} = total lateral load required to be applied to the wall face to provide a factor of safety equal to 1.3 for the retained soil mass when stability is analyzed using an appropriate limiting equilibrium method of analysis. Except that P_{Total} shall not be less than $1.44P_a$. (KIP)

P_a = active lateral earth pressure resultant acting on the wall height, H, and determined using Coulomb's theory with a wall friction angle, δ, equal to zero. (KIP)

H = wall design height (FT)

H_1 = distance from ground surface at top of wall to uppermost level of anchors. (FT)

H_{n+1} = distance from design grade at bottom of a wall to lowermost level of anchors (FT)

T_{hi} = horizontal component of design force in anchor at level i (KIP/FT)

R = design reaction force at design grade at bottom of wall to be resisted by embedded portion of wall (KIP/FT)

5.5.5.7.2 Cohesive Soils

The lateral earth pressure distribution for cohesive soils is related to the stability number, N_S, which is defined as:

$$N_s = \frac{\gamma_s H}{S_u}$$

where:

γ_s = total unit weight of soil (KCF)

H = wall design height (FT)

S_u = average undrained shear strength of soil (KSF)

5.5.5.7.2a Stiff to Hard

For temporary anchored walls in stiff to hard cohesive soils ($N_s \le 4$), and β = zero, the lateral earth pressure may be determined using Figure 5.5.5.7.1-1, with the maximum ordinate, p_a, of the pressure diagram determined as:

$$p_a = 0.2\gamma_s H \text{ to } 0.4\gamma_s H \qquad (5.5.5.7.2a\text{-}1)$$

where:

p_a = maximum ordinate of pressure diagram (KSF)

γ_s = total unit weight of soil (KCF)

H = wall design height (FT)

For permanent anchored walls in stiff to hard cohesive soils, the lateral earth pressure distributions described in Article 5.5.5.7.1 may be used with, P_{Total}, based on the drained friction angle of the cohesive soil. For permanent walls, the distribution (permanent or temporary) resulting in the maximum total force shall be used for design.

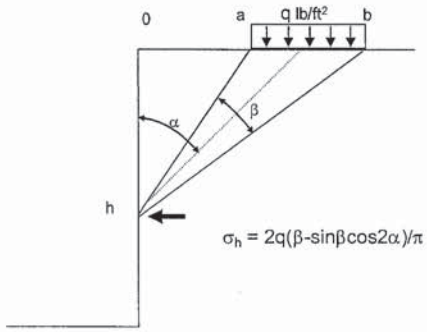
PLATE 6

Lateral Surahcrge due to Strip Load (Elastic Solution)

For RW No. 3

Date 12/15/2011

Job No. 2011-124-WAL



$\sigma_h = 2q(\beta - \sin\beta\cos 2\alpha)/\pi$

Input

q = 5000 psf

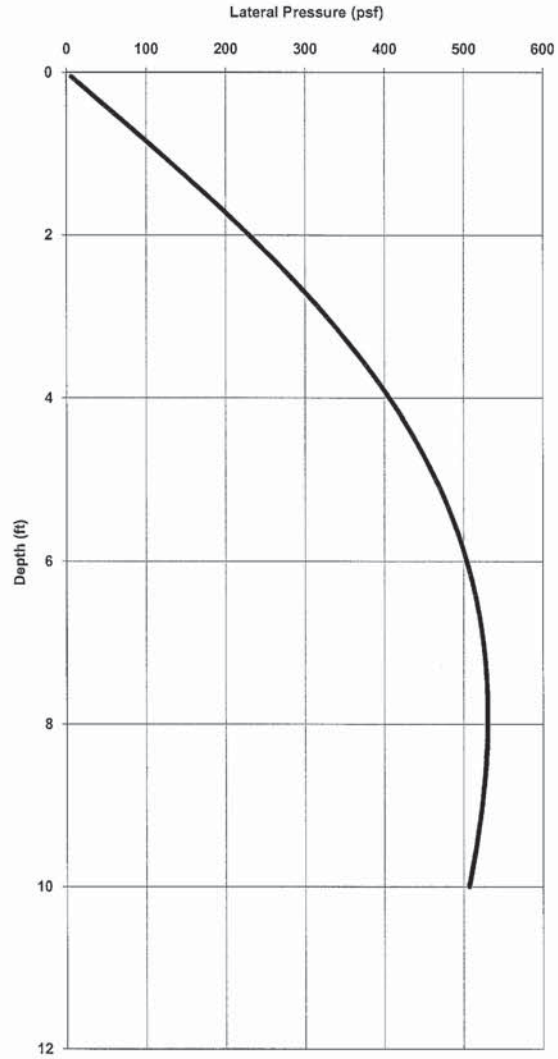
a = 12.00 ft

b = 15.5 ft

$\alpha = \text{atan}((a+b)/2h)$

$\beta = \text{atan}(b/h) - \text{atan}(a/h)$

h (ft)	α	β	σ_h (psf)	Segmental Load (kips)
0.05	1.567	0.001	5.99	
0.10	1.564	0.002	11.98	0.000
0.20	1.556	0.004	23.95	0.002
0.30	1.549	0.006	35.90	0.003
0.40	1.542	0.008	47.83	0.004
0.50	1.534	0.009	59.74	0.005
0.60	1.527	0.011	71.60	0.007
0.70	1.520	0.013	83.41	0.008
0.80	1.513	0.015	95.18	0.009
0.90	1.505	0.017	106.88	0.010
1.00	1.498	0.019	118.51	0.011
1.10	1.491	0.021	130.07	0.012
1.20	1.484	0.022	141.54	0.014
1.30	1.477	0.024	152.93	0.015
1.40	1.469	0.026	164.21	0.016
1.50	1.462	0.028	175.40	0.017
1.60	1.455	0.030	186.47	0.018
1.70	1.448	0.031	197.43	0.019
1.80	1.441	0.033	208.27	0.020
1.90	1.433	0.035	218.98	0.021
2.00	1.426	0.037	229.56	0.022
2.20	1.412	0.040	250.28	0.048
2.40	1.398	0.044	270.41	0.052
2.60	1.384	0.047	289.90	0.056
2.80	1.370	0.051	308.72	0.060
3.00	1.356	0.054	326.83	0.064
3.50	1.322	0.062	368.86	0.174
4.00	1.288	0.069	406.00	0.194
4.50	1.255	0.076	438.07	0.211
5.00	1.222	0.083	465.04	0.226
5.50	1.190	0.089	486.98	0.238
6.00	1.159	0.094	504.08	0.248
6.50	1.129	0.099	516.59	0.255
7.00	1.100	0.104	524.85	0.260
7.50	1.071	0.108	529.23	0.264
8.00	1.044	0.112	530.12	0.265
8.50	1.017	0.115	527.92	0.265
9.00	0.991	0.117	523.04	0.263
9.50	0.966	0.120	515.86	0.260
10.00	0.942	0.122	506.74	0.256



p= 3.89 kips/ft of wall

Point of Action = 2.952 ft below top

APPENDIX A

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/28/12

PLANS APPROVAL DATE

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

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

CONTRA COSTA TRANSPORTATION AUTHORITY
2999 OAK ROAD, SUITE 100
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596

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.

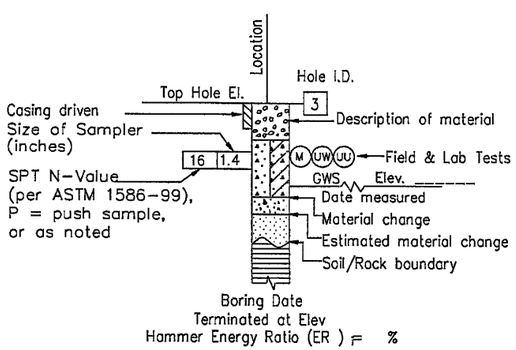
BOREHOLE IDENTIFICATION

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)

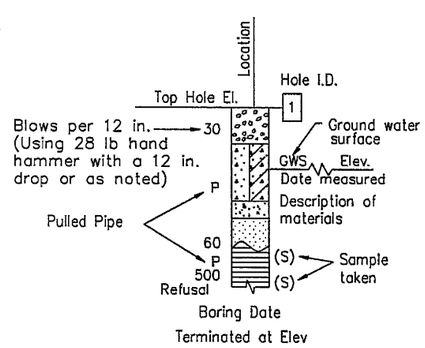
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

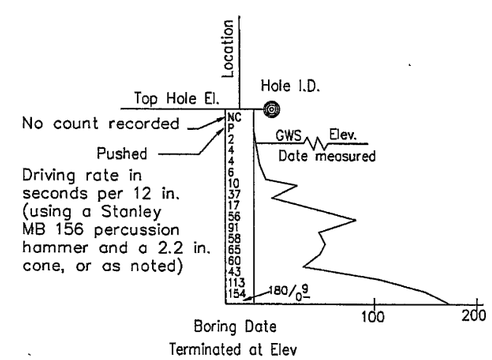
Description	Shear Strength (tsf)	Pocket Penetrometer Measurement, PP, (tsf)	Torvane Measurement, TV, (tsf)	Vane Shear Measurement, VS, (tsf)
Very Soft	Less than 0.12	Less than 0.25	Less than 0.12	Less than 0.12
Soft	0.12 – 0.25	0.25 – 0.5	0.12 – 0.25	0.12 – 0.25
Medium Stiff	0.25 – 0.5	0.5 – 1	0.25 –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



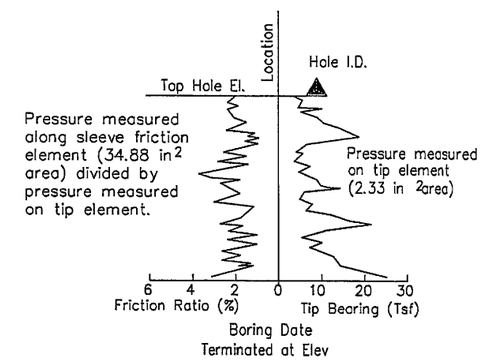
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) BORING

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI/AZJ	E. ORTAKCI, A. BAKANE, V. SANTOS FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI PROJECT ENGINEER	BRIDGE NO.	ROUTE 680 AUXILIARY LANE PROJECT SEGMENT 2
SIGN OFF DATE	CHECKED BY	P. WEI	DATE: JUNE 2011 TO NOVEMBER, 2011			POST MILES 4.3/6.7	SOIL LEGEND NO. 1

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 11/25/11 2/28/12

REVISION DATES — SHEET — OF

CONTRACT NO. — PROJECT ID

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/28/12

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REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596

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 with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (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)
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 in.)
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	Visible 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 (in.)
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	1/300 – 1/64
Silt and Clay		Less than 1/300

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY E. ORTAKCI/AZJ

CHECKED BY P. WEI

E. ORTAKCI, A. BAKANE, V. SANTOS
FIELD INVESTIGATION BY:
DATE: JUNE 2011 TO NOVEMBER, 2011

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

PETER WEI
PROJECT ENGINEER

BRIDGE NO.

POST MILES 4.3/6.7

ROUTE 680 AUXILIARY LANE PROJECT SEGMENT 2

SOIL LEGEND NO. 2

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 11/25/11 2/28/12

SHEET OF

CONTRACT NO.:

PROJECT ID:

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/28/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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CONTRA COSTA TRANSPORTATION AUTHORITY
2999 OAK ROAD, SUITE 100
WALNUT CREEK, CA 94597

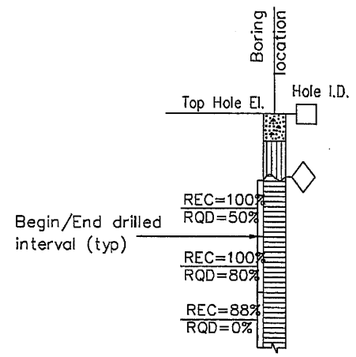
PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596

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

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

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

RQD* Indicates soundness criteria not met.



BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 10 ft
Very Thickly Bedded	3 ft – 10 ft
Thickly Bedded	1 ft – 3 ft
Moderately Bedded	4 in. – 1 ft
Thinly Bedded	1 in. – 4 in.
Very Thinly Bedded	1/4 in. – 1 in.
Laminated	Less than 1/4 in.

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 pocketknife or sharp pick with light or moderate pressure. Breaks with moderate hammer blows.
Moderately Soft	Can be grooved 1/16 in. deep with a pocketknife or 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 manual 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 in. to 1 ft.
Intensely Fractured	Core lengths mostly from 1 to 4 in.
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 discoloration 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."

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI/AZJ	E. ORTAKCI, A. BAKANE, V. SANTOS — FIELD INVESTIGATION BY:
SIGN OFF DATE	CHECKED BY	P. WEI	DATE: JUNE 2011 TO NOVEMBER, 2011

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

PETER WEI — PROJECT ENGINEER

BRIDGE NO. — POST MILES 4.3/6.7

ROUTE 680 AUXILIARY LANE PROJECT SEGMENT 2

SOIL LEGEND NO. 3

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 11/25/11 2/28/12

REVISION DATES — SHEET — OF

CONTRACT NO.: — PROJECT ID:

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/21/12

PLANS APPROVAL DATE

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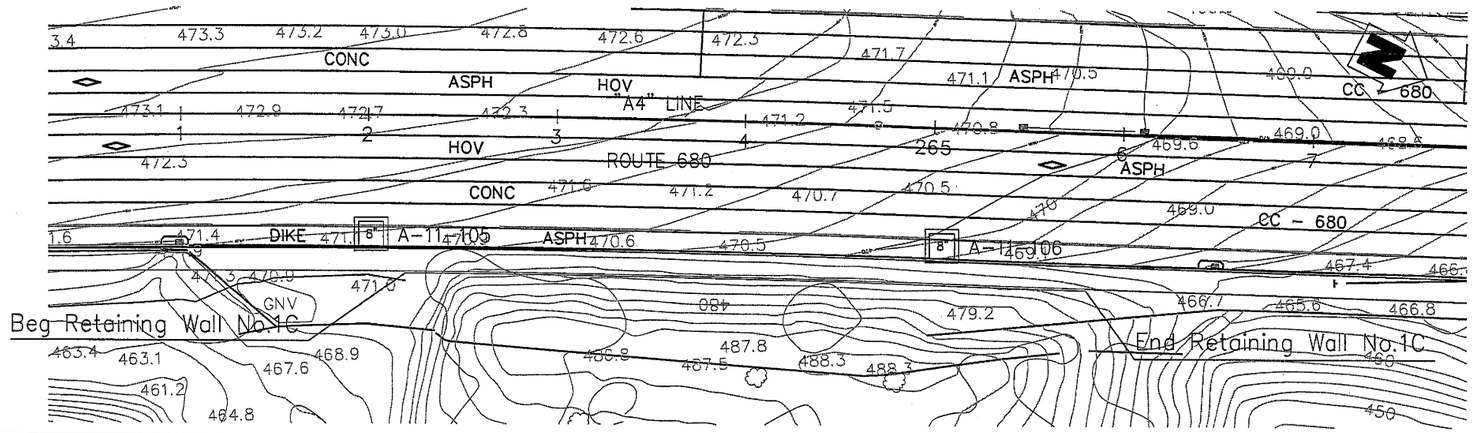
REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

CONTRA COSTA TRANSPORTATION AUTHORITY
2999 OAK ROAD, SUITE 100
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596



PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

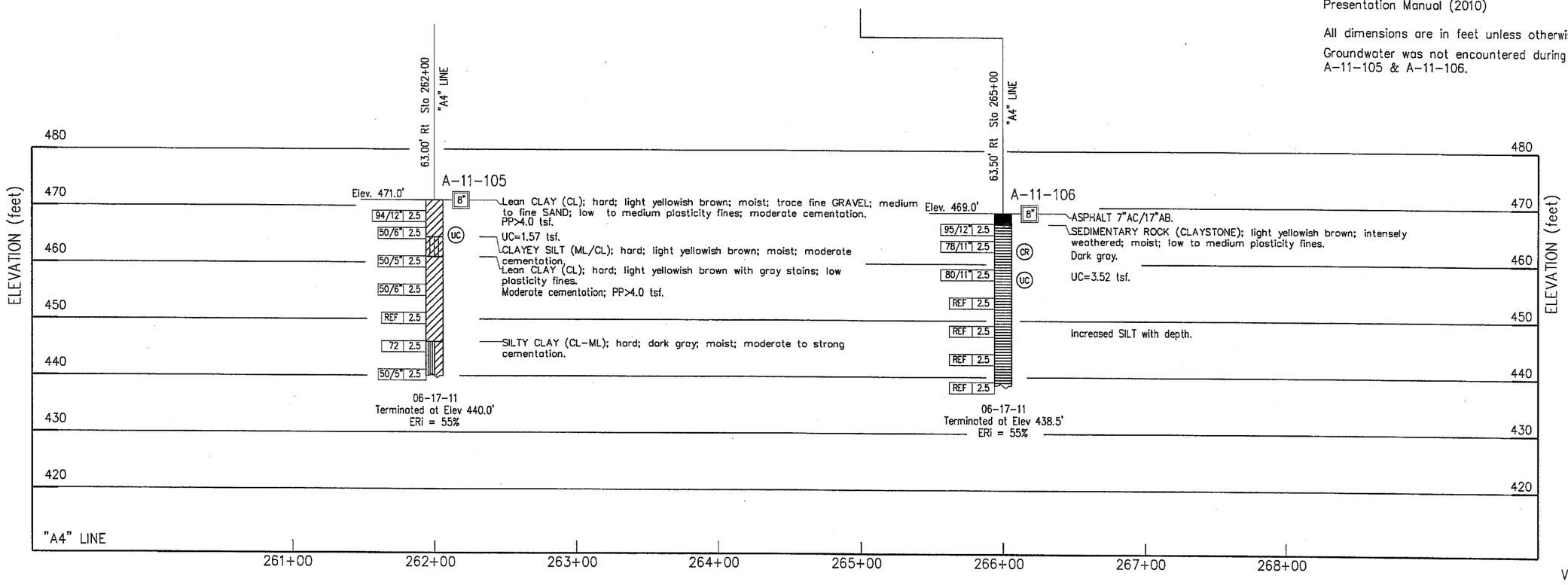
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Borings A-11-105 & A-11-106.



RW No. 1C

PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI	E. ORTAKCI, A. BAKANE, V. SANTOS	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI	BRIDGE NO.
SIGN OFF DATE	CHECKED BY	P. WEI	FIELD INVESTIGATION BY: DATE: JUNE 2011 TO NOVEMBER 2011		PROJECT ENGINEER	POST MILES

RETAINING WALL NO. 1C
LOG OF TEST BORINGS

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES 12/08/11 02/21/12

REVISION DATES — SHEET — OF

CONTRACT NO.

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/21/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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CONTRA COSTA TRANSPORTATION AUTHORITY
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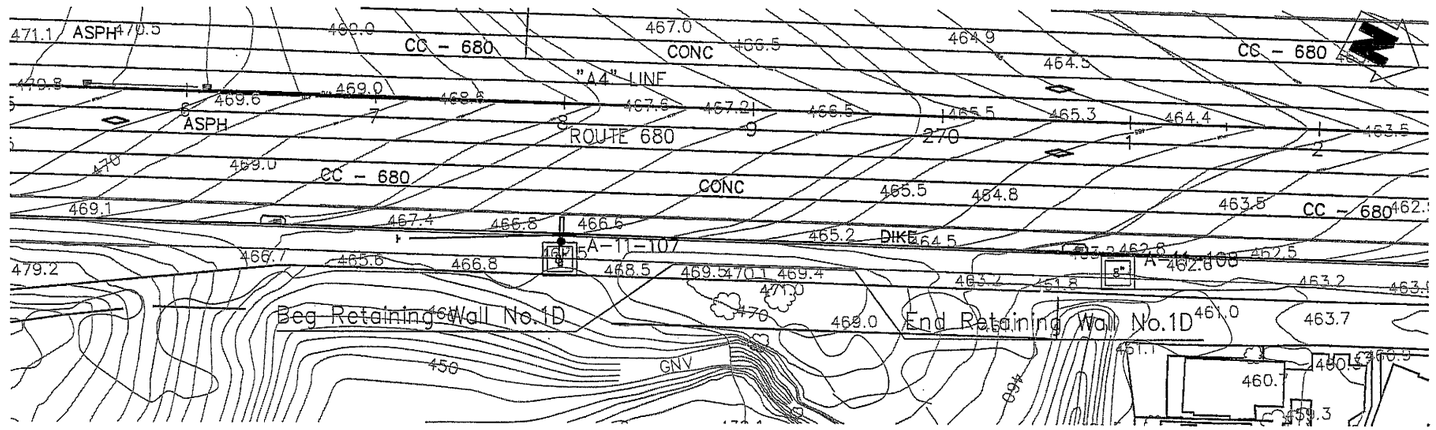
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREEK, CA 94596



PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

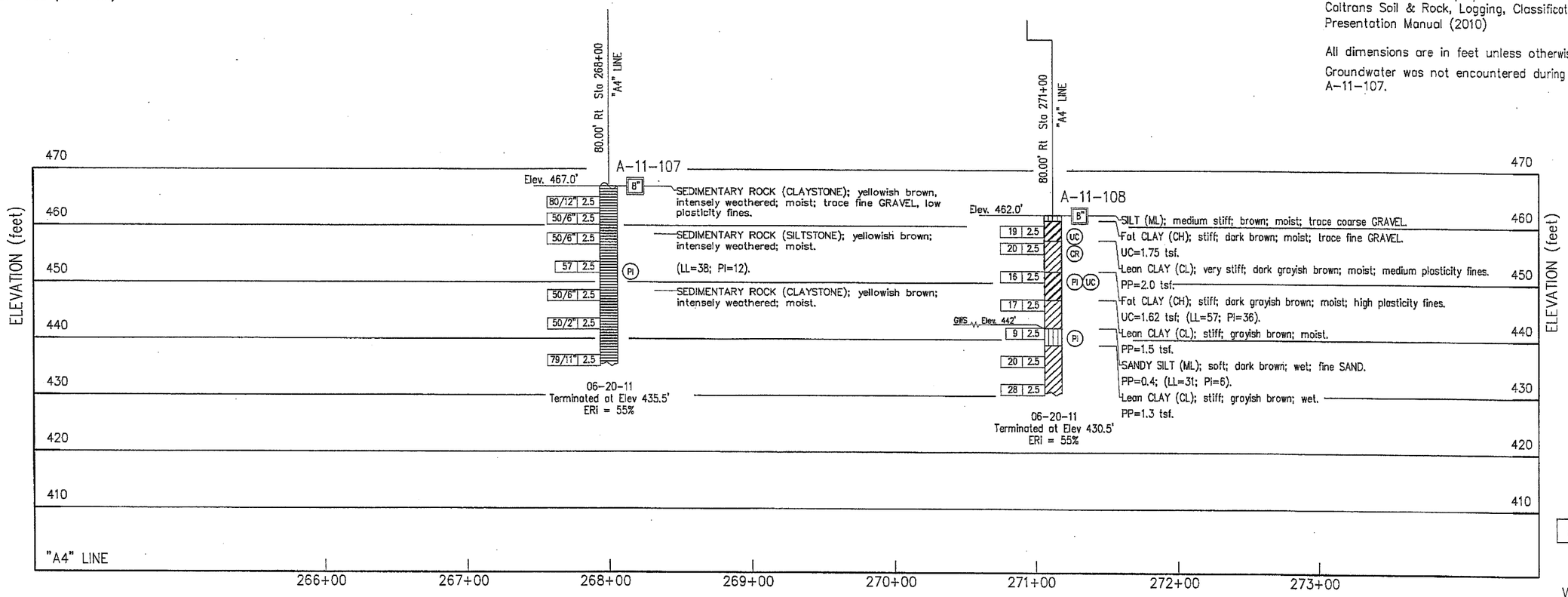
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Boring A-11-107.



RW No. 1D

PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI	E. ORTAKCI, A. BAKANE, V. SANTOS FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI PROJECT ENGINEER
SIGN OFF DATE	CHECKED BY	P. WEI	DATE: JUNE 2011 TO NOVEMBER 2011		

BRIDGE NO.
POST MILES

RETAINING WALL NO. 1D
LOG OF TEST BORINGS

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 12/28/11 02/21/12

REVISION DATES — SHEET — OF

JSERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/21/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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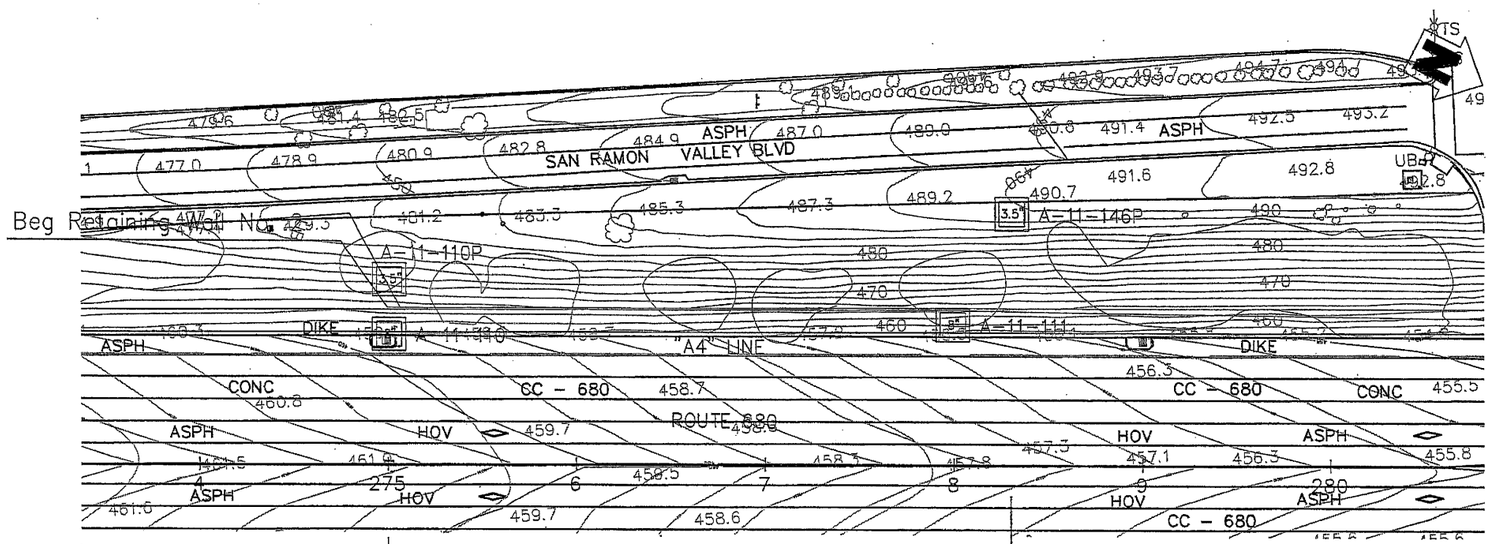
PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREEK, CA 94596



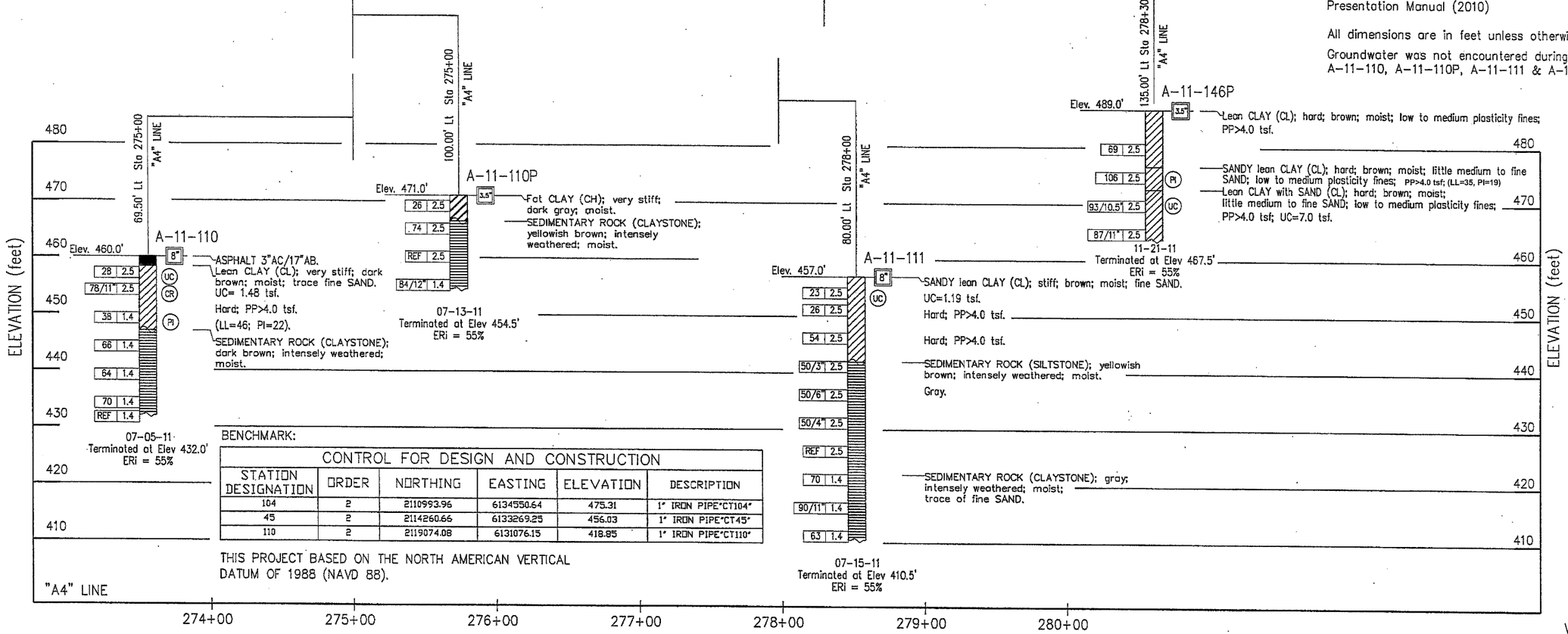
PLAN
1"=40'

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Borings A-11-110, A-11-110P, A-11-111 & A-11-146P.



BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION

STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

RW No. 2 (1)

PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

DESIGN OVERSIGHT
SIGN OFF DATE
DRAWN BY E. ORTAKCI
CHECKED BY P. WEI
E. ORTAKCI, A. BAKANE, V. SANTOS
FIELD INVESTIGATION BY:
DATE: JUNE 2011 TO NOVEMBER 2011

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

PETER WEI
PROJECT ENGINEER

BRIDGE NO. 28E0121
POST MILES

RETAINING WALL NO. 2
LOG OF TEST BORINGS NO. 1

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/18/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES 12/18/11 02/21/12

REVISION DATES — SHEET — OF

CONTRACT NO.: — PROJECT ID:

FILE => $REQUEST

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/21/12

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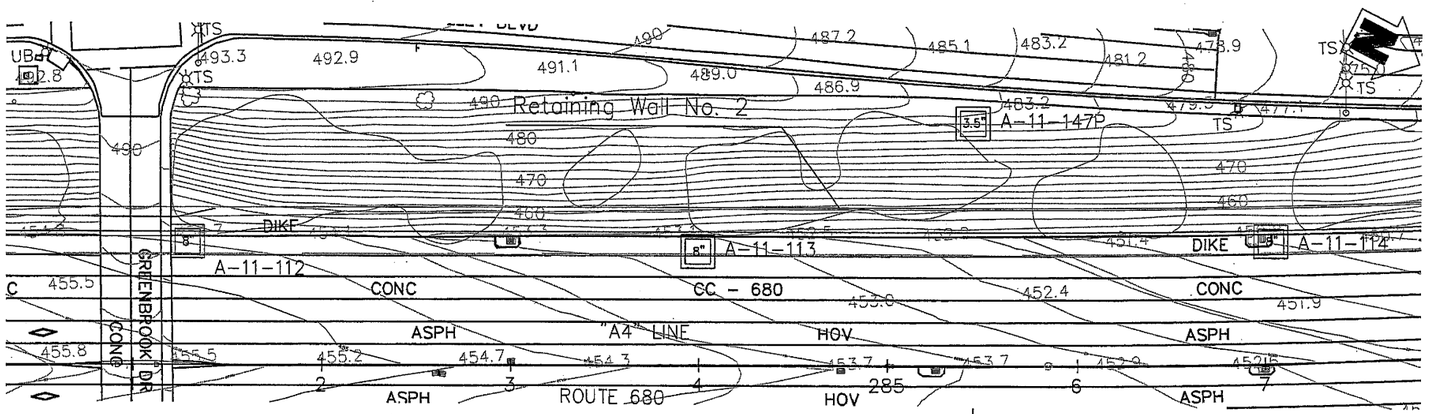


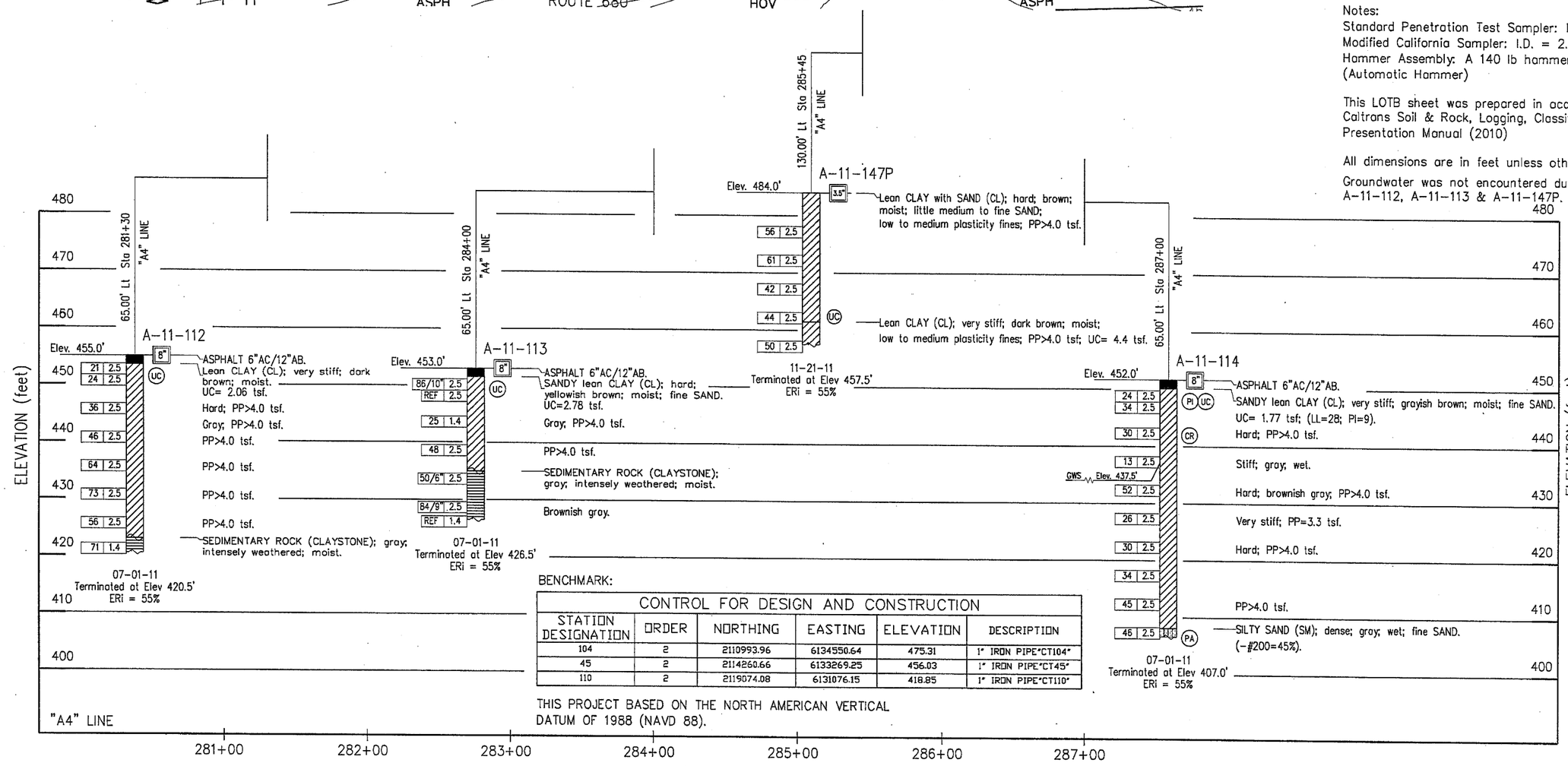
PLAN
1"=40'

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Borings A-11-112, A-11-113 & A-11-147P.



BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION

STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
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110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

RW No. 2 (2)

PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI	E. ORTAKCI, A. BAKANE, V. SANTOS — FIELD INVESTIGATION BY:
SIGN OFF DATE	CHECKED BY	P. WEI	DATE: JUNE 2011 TO NOVEMBER 2011

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

PETER WEI — PROJECT ENGINEER

BRIDGE NO. 28E0121 — POST MILES

RETAINING WALL NO. 2
LOG OF TEST BORINGS NO. 2

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES 12/08/11 02/21/12 — SHEET — OF

FILE => $REQUEST — CONTRACT NO: — PROJECT ID:

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/21/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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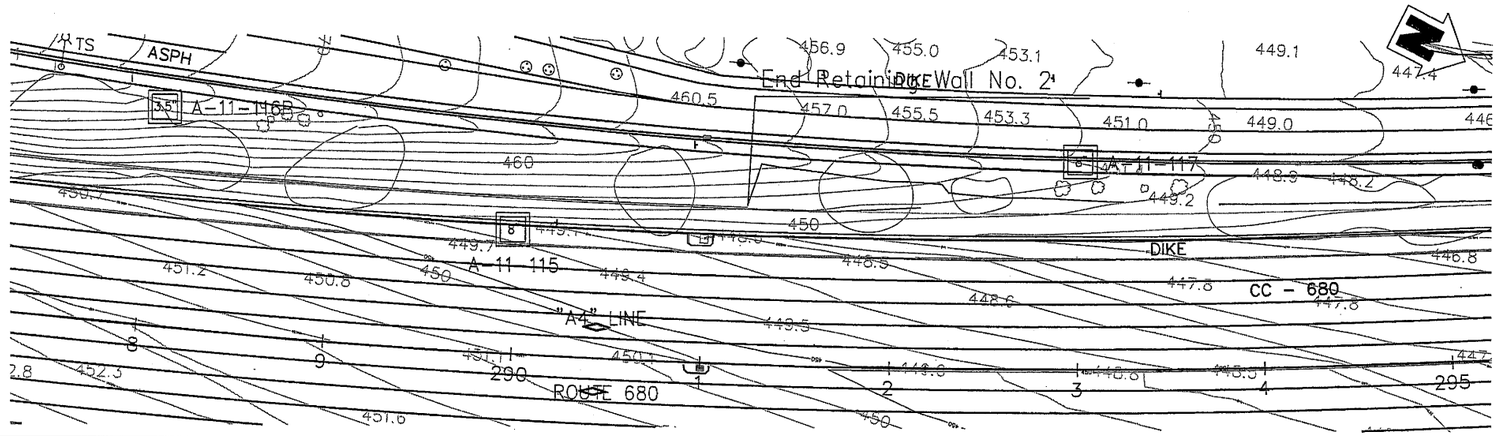
1243 ALPINE ROAD, SUITE 110
WALNUT CREEK, CA 94596



PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

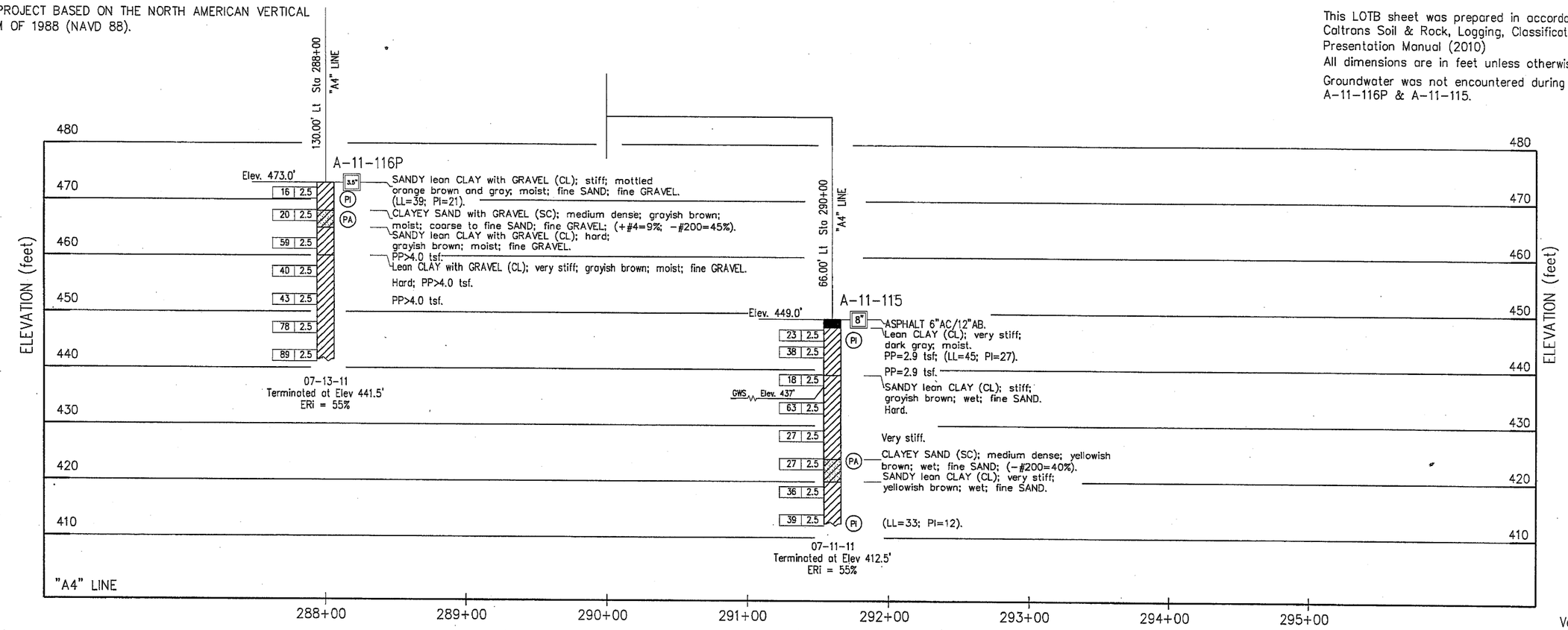
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Borings A-11-116P & A-11-115.



RW No. 2 (3)

PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI	E. ORTAKCI, A. BAKANE, V. SANTOS FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI PROJECT ENGINEER	BRIDGE NO. 28E0121	RETAINING WALL NO. 2
SIGN OFF DATE	CHECKED BY	P. WEI	DATE: JUNE 2011 TO NOVEMBER 2011			POST MILES	LOG OF TEST BORINGS NO. 3

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES 12/28/11 02/21/12

REVISION DATES — SHEET — OF

CONTRACT NO: — PROJECT ID:

FILE => $REQUEST

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/21/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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CONTRA COSTA TRANSPORTATION AUTHORITY
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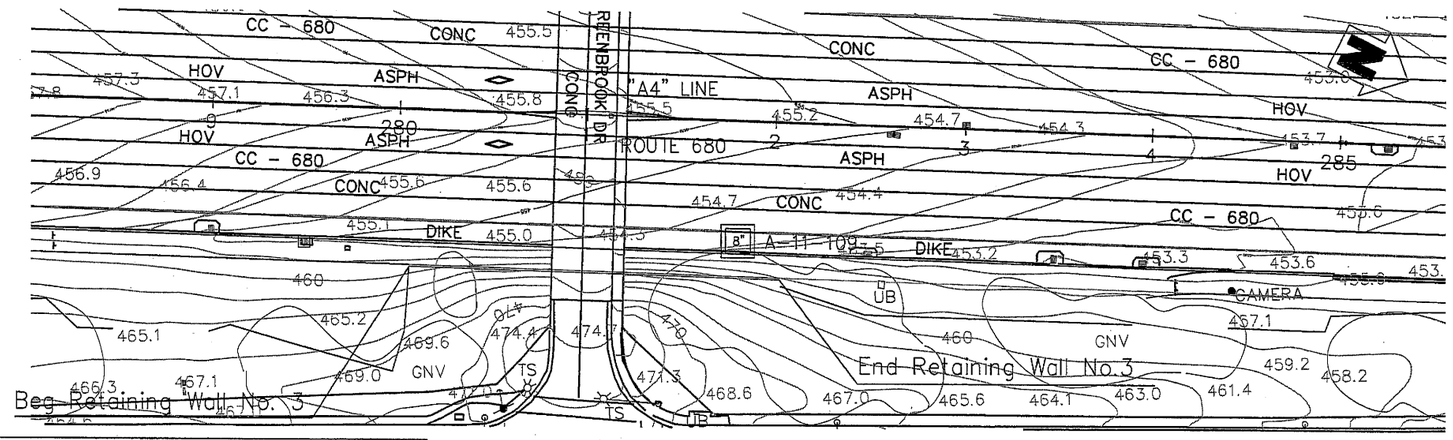
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596



PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

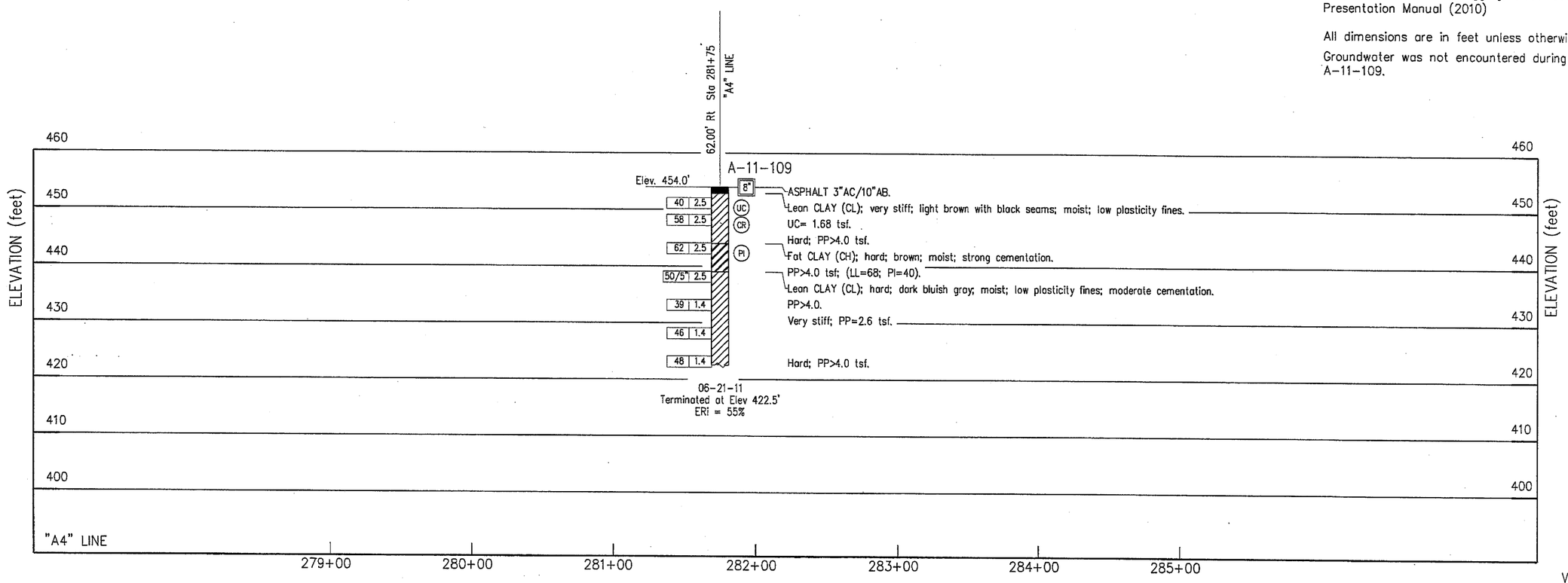
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Boring A-11-109.



RW No. 3

PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI	E. ORTAKCI, A. BAKANE, V. SANTOS	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI	BRIDGE NO. 28E0122	RETAINING WALL NO. 3
SIGN OFF DATE	CHECKED BY	P. WEI	FIELD INVESTIGATION BY: DATE: JUNE 2011 TO NOVEMBER 2011		PROJECT ENGINEER	POST MILES	LOG OF TEST BORINGS

GS GEOTECHNICAL LOG OF TEST BORINGS SHEET (ENGLISH) (REV. 7/15/10)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES 12/28/11 02/21/12

REVISION DATES — SHEET — OF

CONTRACT NO: — PROJECT ID:

FILE => $REQUEST

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/21/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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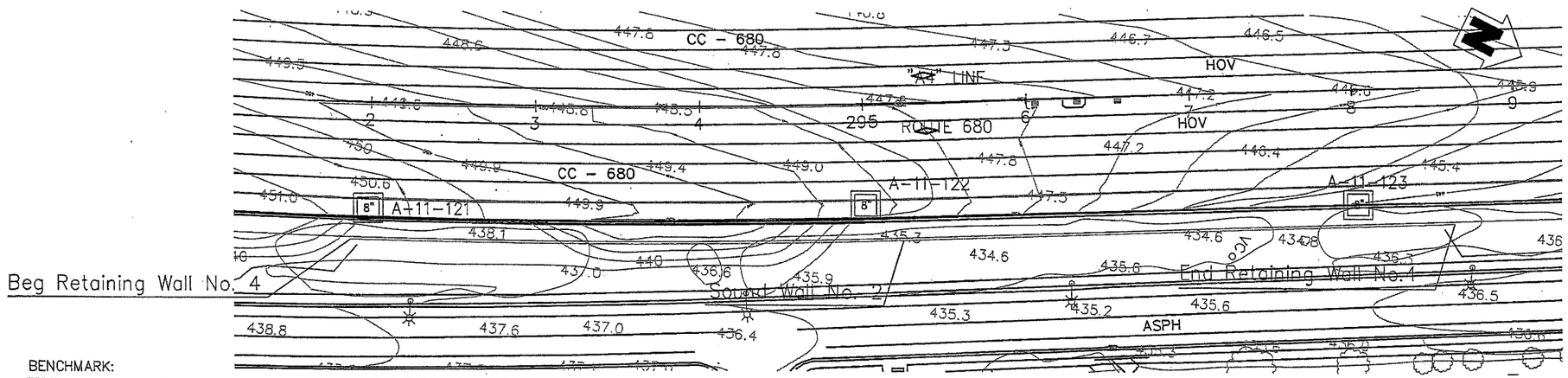
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596



PLAN
1"=40'

BENCHMARK:

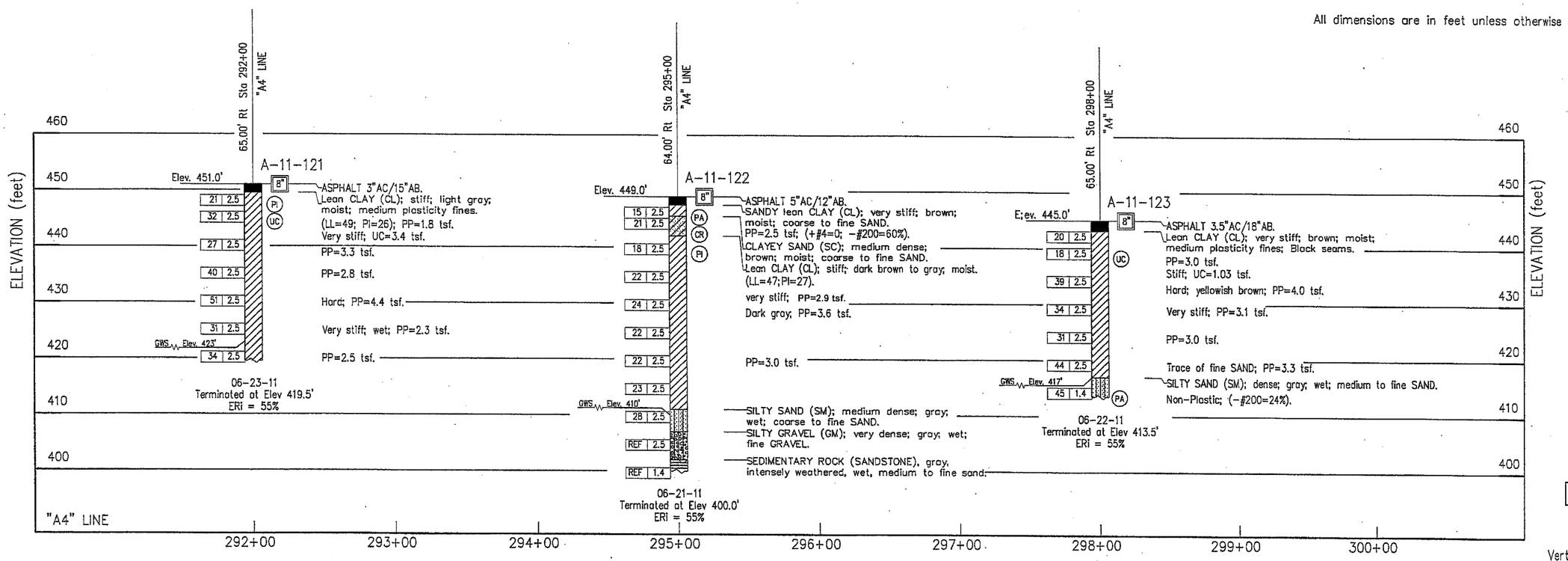
CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown



RW No. 4

PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI	E. ORTAKCI, A. BAKANE, V. SANTOS	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI PROJECT ENGINEER	BRIDGE NO.
SIGN OFF DATE	CHECKED BY	P. WEI	FIELD INVESTIGATION BY: DATE: JUNE 2011 TO NOVEMBER 2011			POST MILES

RETAINING WALL NO. 4
LOG OF TEST BORINGS

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES 12/06/11 02/21/12

REVISION DATES — SHEET — OF

CONTRACT NO: — PROJECT ID:

FILE => $REQUEST

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/21/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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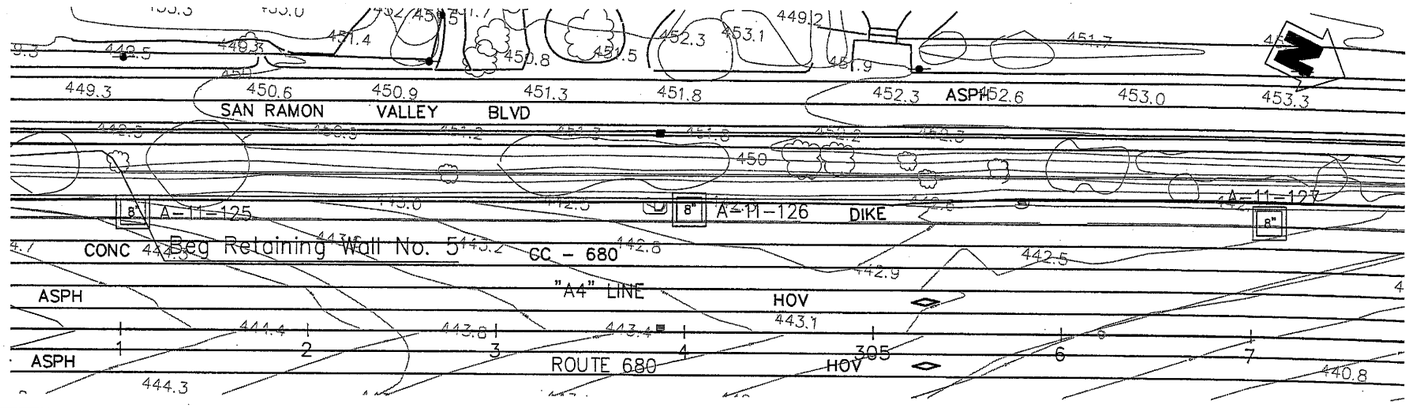
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596



PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

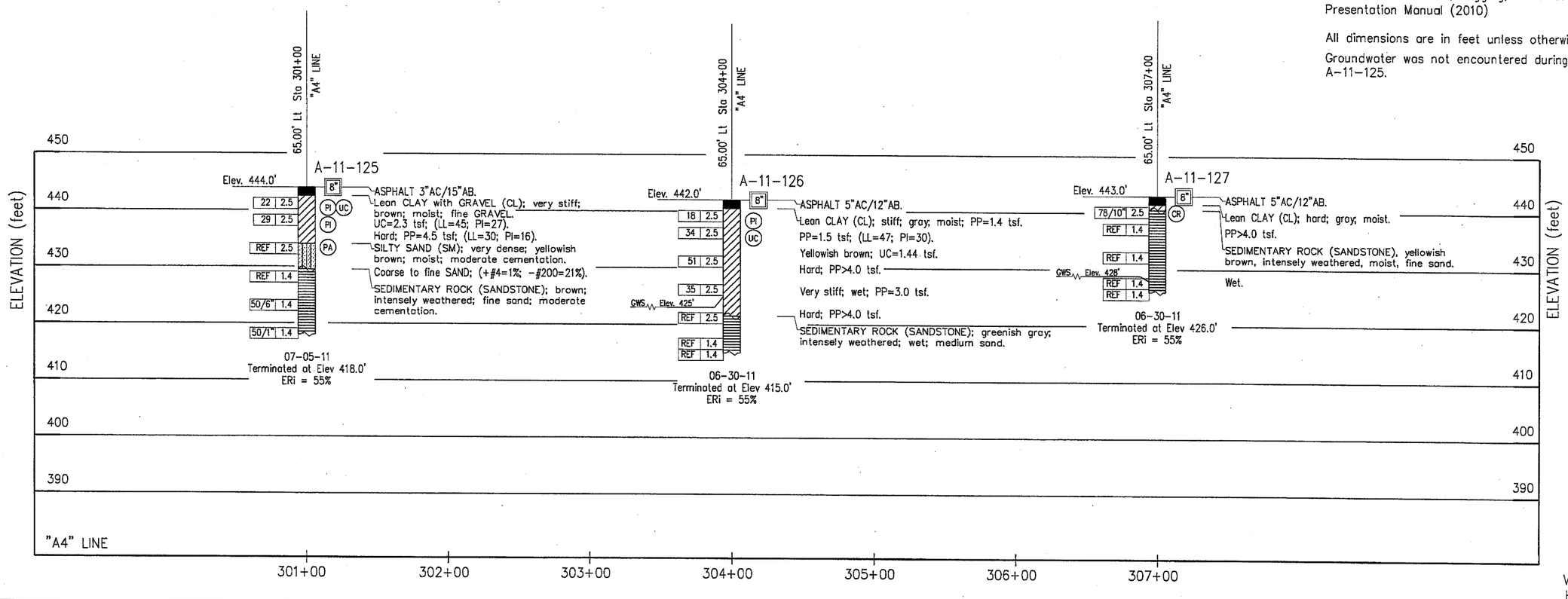
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Boring A-11-125.



RW No. 5 (1)

PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI	E. ORTAKCI, A. BAKANE, V. SANTOS	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI	BRIDGE NO.
SIGN OFF DATE	CHECKED BY	P. WEI	FIELD INVESTIGATION BY: DATE: JUNE 2011 TO NOVEMBER 2011		PROJECT ENGINEER	POST MILES

RETAINING WALL NO. 5
LOG OF TEST BORINGS NO. 1

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 12/28/11 02/21/12

REVISION DATES — SHEET — OF

FILE => $REQUEST — CONTRACT NO: — PROJECT ID:

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/21/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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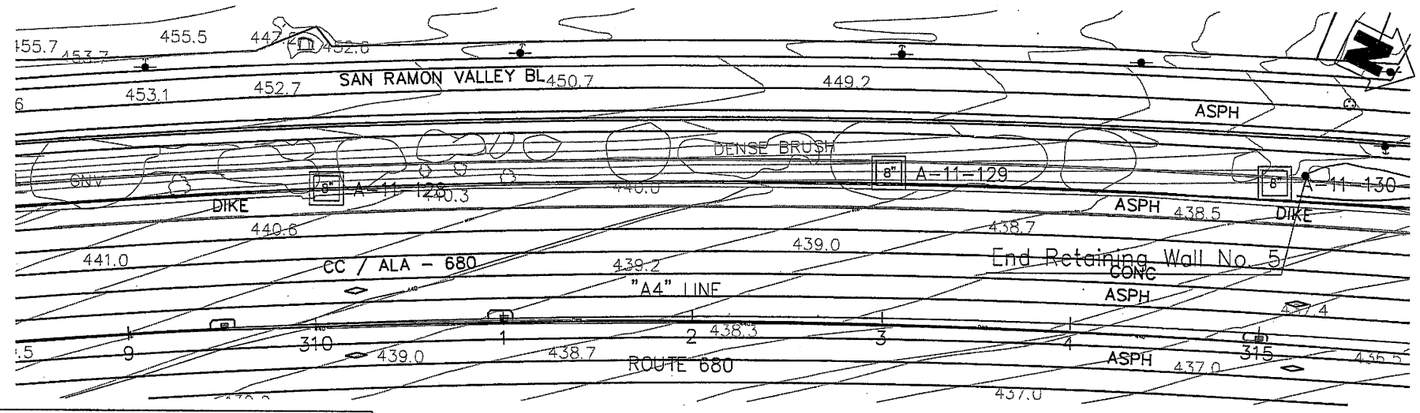
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596



PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

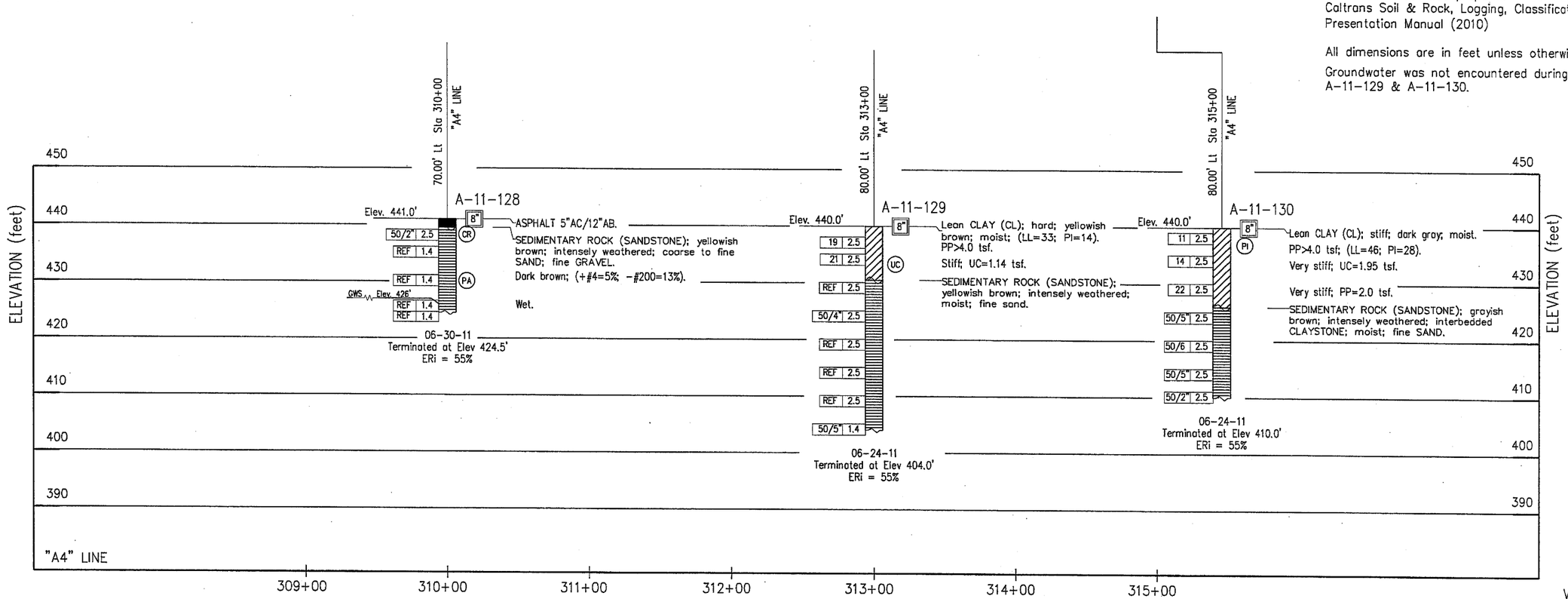
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Borings A-11-129 & A-11-130.



RW No. 5 (2)

PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI	E. ORTAKCI, A. BAKANE, V. SANTOS	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI	BRIDGE NO.
SIGN OFF DATE	CHECKED BY	P. WEI	FIELD INVESTIGATION BY: DATE: JUNE 2011 TO NOVEMBER 2011		PROJECT ENGINEER	POST MILES

RETAINING WALL NO. 5
LOG OF TEST BORINGS NO. 2

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES 12/08/11 02/21/12

REVISION DATES — SHEET — OF

CONTRACT NO: — PROJECT ID:

FILE => $REQUEST

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

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	CC	680	4.3/6.7		

GEOTECHNICAL PROFESSIONAL — DATE 2/21/12

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

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CONTRA COSTA TRANSPORTATION AUTHORITY
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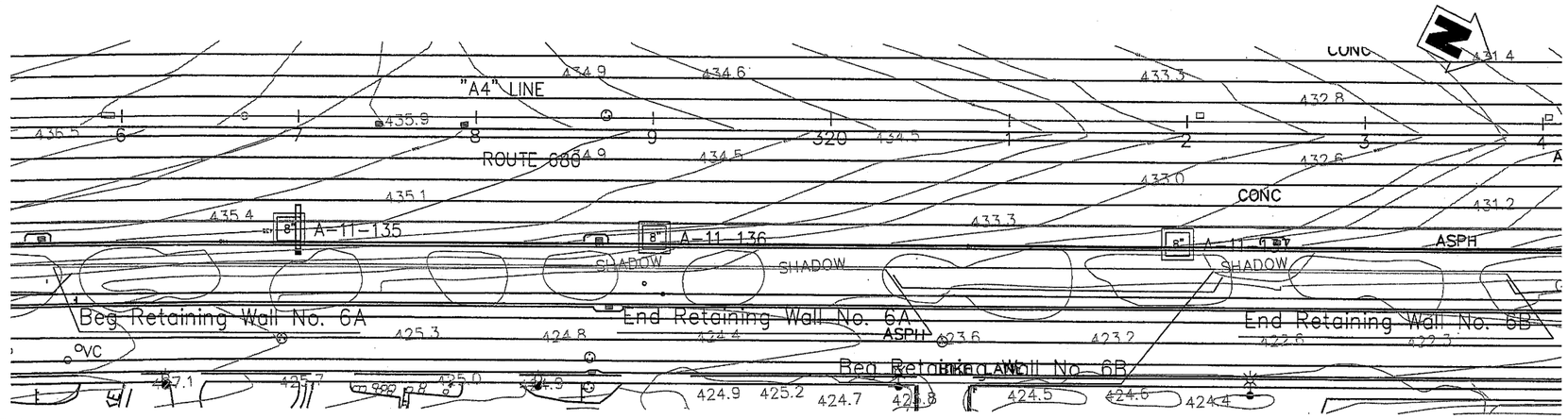
WALNUT CREEK, CA 94597

PARIKH CONSULTANTS, INC.
1243 ALPINE ROAD, SUITE 110
WALNUT CREKE, CA 94596



PLAN
1"=40'

BENCHMARK:

CONTROL FOR DESIGN AND CONSTRUCTION					
STATION DESIGNATION	ORDER	NORTHING	EASTING	ELEVATION	DESCRIPTION
104	2	2110993.96	6134550.64	475.31	1" IRON PIPE"CT104"
45	2	2114260.66	6133269.25	456.03	1" IRON PIPE"CT45"
110	2	2119074.08	6131076.15	418.85	1" IRON PIPE"CT110"

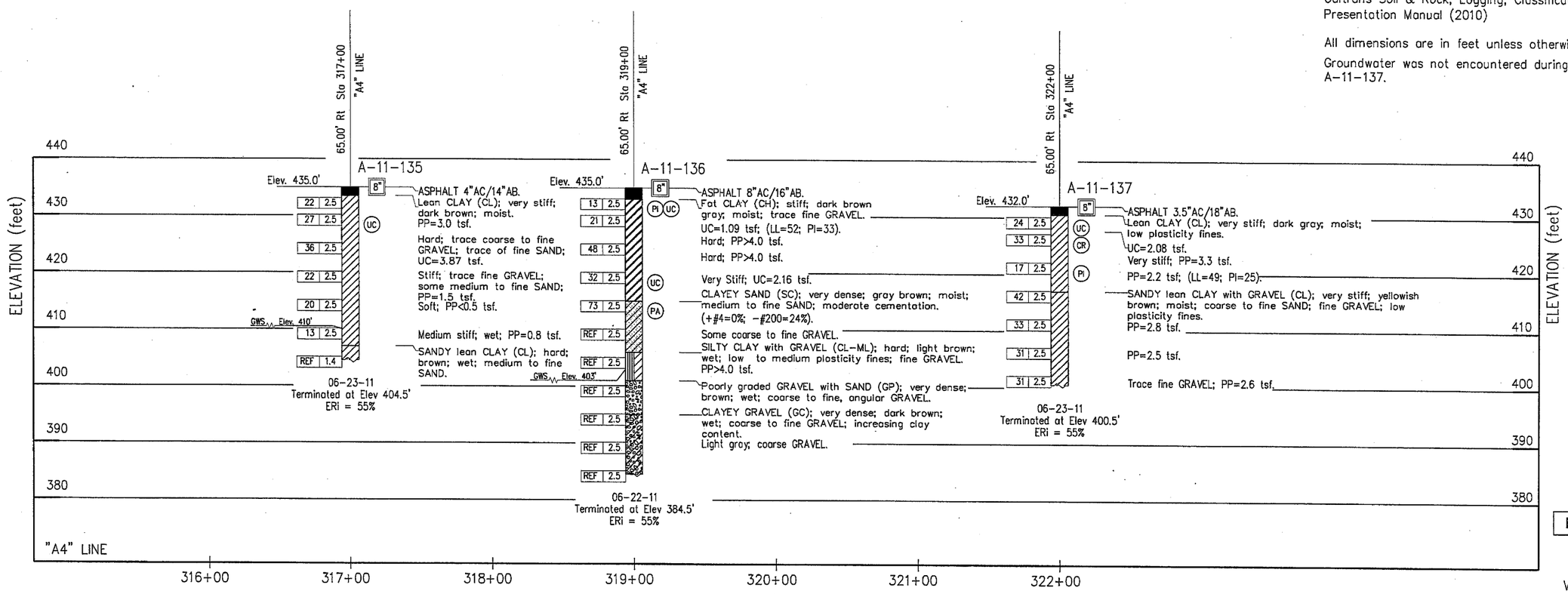
THIS PROJECT BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

Notes:
Standard Penetration Test Sampler: I.D. = 1.4"; O.D. = 2"
Modified California Sampler: I.D. = 2.5"; O.D. = 3"
Hammer Assembly: A 140 lb hammer with a 30" drop (Automatic Hammer)

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock, Logging, Classification, and Presentation Manual (2010)

All dimensions are in feet unless otherwise shown

Groundwater was not encountered during drilling for Boring A-11-137.



RW No. 6A & 6B

PROFILE
Vert. : 1" = 10'
Hor. : 1" = 40'

DESIGN OVERSIGHT	DRAWN BY	E. ORTAKCI	E. ORTAKCI, A. BAKANE, V. SANTOS	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	PETER WEI	BRIDGE NO.
SIGN OFF DATE	CHECKED BY	P. WEI	FIELD INVESTIGATION BY: DATE: JUNE 2011 TO NOVEMBER 2011		PROJECT ENGINEER	POST MILES

RETAINING WALL NO. 6A & 6B
LOG OF TEST BORINGS

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

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 0736
PROJECT NUMBER & PHASE: 04000210664

DISREGARD PRINTS BEARING EARLIER REVISION DATES 12/08/11 02/21/12

REVISION DATES — SHEET — OF

CONTRACT NO.: — PROJECT ID:

FILE => $REQUEST

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

(OLD IV-CC-107-A)

FED. ROAD DIST. NO.	STATE	F.A. PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	POST MILES	PREF. PROJ. NO.	SHEET NO.	TOTAL SHEETS
IV	CC	680	0.0/6.7	202	202	

October 19, 1966

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES-TOTAL PROJECT	Sheet No.	Total Sheets
04	CC	680	4.3/6.7		

REGISTERED CIVIL ENGINEER — DATE 2/21/12

RETAINING WALLS NO. 2 & 3

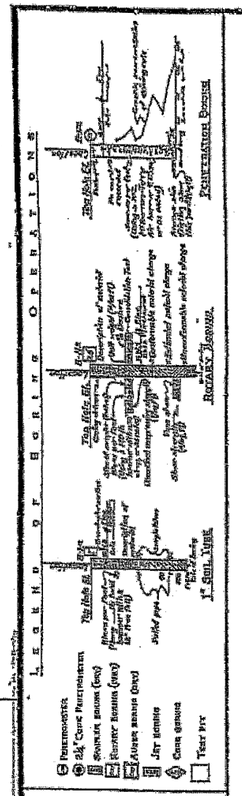
LOG OF TEST BORINGS

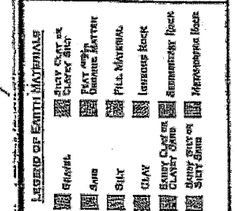
NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

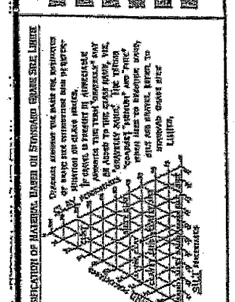
UNIT: 0736
PROJECT NUMBER & PHASE: 0400021064

BRIDGE No. | Sheet | of

REGISTERED PROFESSIONAL ENGINEER
GARY PARIKH
No. G.E. 666
Exp. 12/31/13
GEOTECHNICAL
STATE OF CALIFORNIA





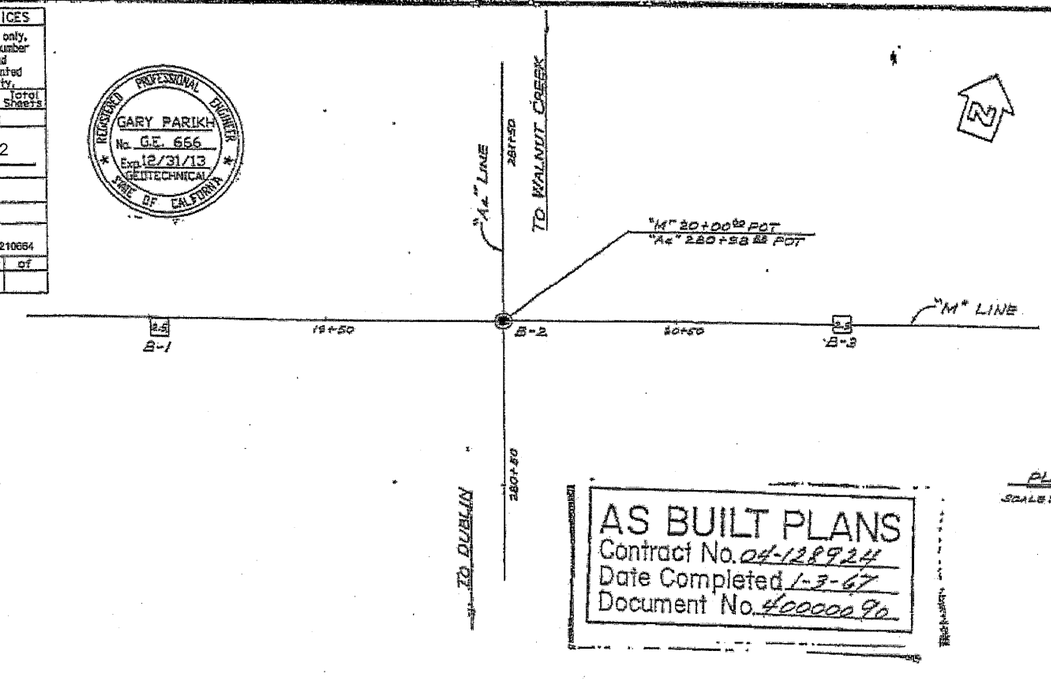


NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

FIELD ENTRY	
DRAWN	
CHECKED	

Area of Exploration

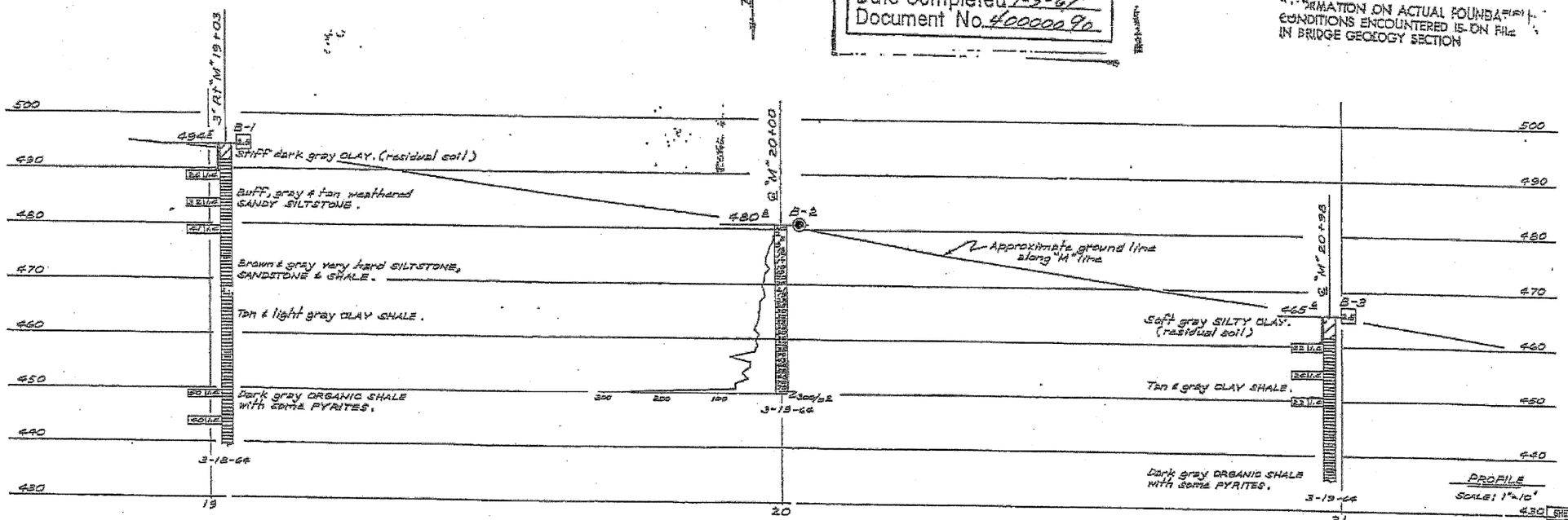
BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION



AS BUILT PLANS
Contract No. 04-128924
Date Completed 1-3-67
Document No. 400000.90

PLAN
SCALE: 1" = 20'

INFORMATION ON ACTUAL FOUNDATION CONDITIONS ENCOUNTERED IS ON file IN BRIDGE GEOLOGY SECTION



PROFILE
SCALE: 1" = 10'

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE MARCH, 1966

SHEET 7 OF 7

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

NORTH SAN RAMON OC

LOG OF TEST BORINGS

SCALE AS Noted | BRIDGE 28-223 | FILE | DRAWING

Disregard prefix bearing earlier numbers → PREL. DRAWING No. PR-28223-2

202

APPENDIX B

LABORATORY TESTS

Classification Tests
The field classification of the samples was visually verified in the laboratory according to the Unified Soil Classification System. The results are presented in “Log of Test Borings”, Appendix A.

Moisture-Density
The natural moisture contents and dry unit weights were determined for selected undisturbed samples of the soils in general accordance with California Test Method 226. This information was used to classify and correlate the soils. The results are presented at the appropriate depths on the "Lab Summary", Plates B-2A through B-2E.

Unconfined Compression Tests
Strength tests were performed on selected undisturbed samples. Unconfined compression tests were performed in general accordance with California Test Method 221. The results are presented at the appropriate depths on the "Lab Summary", Plate B-2A through B-2E.

Atterberg Limits
The Atterberg Limits (California Test Method 204) were determined on selected samples of the fine-grained materials. These results were used to classify the soils, as well as to obtain an indication of the effective strength characteristics and expansion potential. The tests results are presented on Plate B-3.

Grain Size Classification
Grain size classification tests (California Test Method 203) were performed on selected samples of granular soil to aid in the classification. The results are presented on Plates B-4A and B-4B, “Grain Size Distribution Curves”.

Corrosion Tests
Corrosion tests were performed on selected samples to determine the corrosion potential of the soils. The pH and minimum resistively tests were performed according to California Test Method 643. The tests were performed by Sunland Analytical. The test results are presented on Plates B-5A and B-5F.

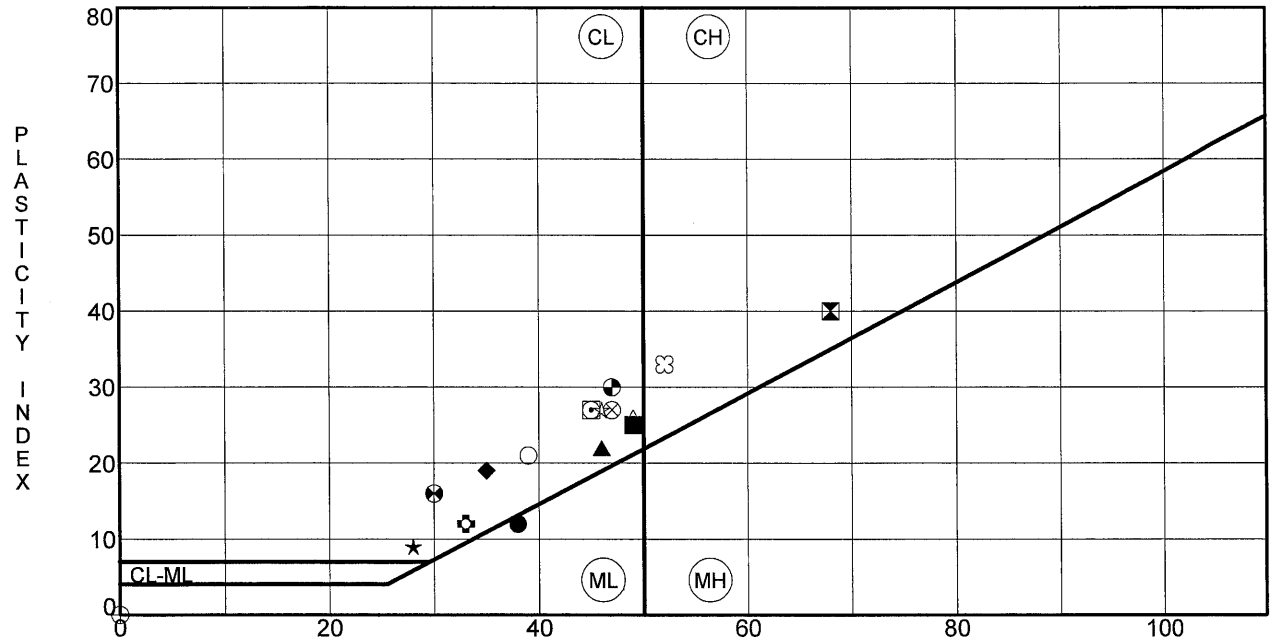
Borehole	Sample Number	Depth	Classi-fication	Water Content	Dry Density	Liquid Limit	Plastic Limit	Plasticity Index	% > Sieve 4	% < Sieve 200	Unconfined Compressive Strength (tsf)
A-11-105	1	3.0	CL	19.2	106.9						
A-11-105	2	5.5	CL	17.5	104.9						1.57
A-11-105	3	10.5	CL	17.5	108.7						
A-11-105	4	15.5	CL	17.9	108.4						
A-11-105	5	20.0	CL	14.4	-						
A-11-105	6	26.0	CL-ML	14.0	-						
A-11-105	7	30.5	CL-ML	4.3	-						
A-11-106	1	3.0	-	22.6	102.7						
A-11-106	2	6.0	-	23.1	100.2						
A-11-106	3	11.0	-	18.5	107.3						3.52
A-11-106	4	15.0	-	11.7	126.3						
A-11-106	5	20.0	-	16.1	112.8						
A-11-106	6	25.0	-	18.6	102.7						
A-11-106	7	30.0	-	9.5	110.7						
A-11-107	1	3.0	-	12.7	104.7						
A-11-107	2	5.5	-	10.8	122.0						
A-11-107	3	9.0	-	21.1	101.4						
A-11-107	4	14.5	-	24.4	95.9	38	26	12			
A-11-107	5	19.0	-	17.7	106.2						
A-11-107	6	24.0	-	17.3	112.1						
A-11-107	7	31.0	-	17.8	107.9						
A-11-109	1	3.0	CL	21.3	102.2						1.68
A-11-109	2	6.0	CL	19.7	106.3						
A-11-109	3	11.0	CH	25.7	91.2	68	28	40			
A-11-109	4	15.5	CL	16.5	112.6						
A-11-109	5	21.0	CL	18.3	-						
A-11-109	6	26.0	CL	-	-						
A-11-109	7	31.0	CL	18.1	-						
A-11-110	1	3.0	CL	17.4	104.4						1.48
A-11-110	2	6.0	CL	17.4	101.4						
A-11-110	3	11.0	CL	20.4	-	46	24	22			
A-11-110	4	16.0	-	17.0	-						
A-11-110	5	21.0	-	18.9	-						
A-11-110	6	26.0	-	17.2	-						
A-11-110	7	27.5	-	17.0	-						
A-11-110P	1	2.0	CH	17.6	104.5						
A-11-110P	2	6.0	-	22.8	93.6						
A-11-110P	3	10.0	-	27.3	95.4						
A-11-110P	4	16.0	-	23.6	-						
A-11-111	1	3.0	CL	25.5	96.7						1.19
A-11-111	2	6.0	CL	25.4	96.0						
A-11-111	3	11.0	CL	26.7	97.0						
A-11-111	4	15.5	-	16.1	114.4						

Borehole	Sample Number	Depth	Classi-fication	Water Content	Dry Density	Liquid Limit	Plastic Limit	Plasticity Index	% > Sieve 4	% < Sieve 200	Unconfined Compressive Strength (tsf)
A-11-111	5	20.5	-	15.3	118.3						
A-11-111	6	25.5	-	19.3	107.9						
A-11-111	7	30.0	-	11.5	120.1						
A-11-111	8	36.0	-	13.2	-						
A-11-111	9	41.0	-	11.9	-						
A-11-111	10	46.0	-	15.8	-						
A-11-112	1	3.0	CL	38.0	88.4						2.06
A-11-112	2	4.5	CL	24.9	97.5						
A-11-112	3	9.5	CL	21.4	102.4						
A-11-112	4	14.5	CL	21.6	104.8						
A-11-112	5	19.5	CL	17.4	111.1						
A-11-112	6	24.5	CL	19.1	-						
A-11-112	7	29.5	CL	22.5	98.1						
A-11-112	8	34.0	-	18.6	-						
A-11-113	1	3.0	CL	16.4	111.7						2.78
A-11-113	2	3.5	CL	12.0	-						
A-11-113	3	9.5	CL	18.8	-						
A-11-113	4	14.5	CL	14.7	-						
A-11-113	5	19.0	-	14.3	-						
A-11-113	6	24.5	-	21.7	103.2						
A-11-113	7	26.0	-	3.2	-						
A-11-114	1	3.0	CL	18.5	108.4	28	19	9			1.77
A-11-114	2	4.5	CL	18.9	104.6						
A-11-114	3	9.5	CL	23.8	97.5						
A-11-114	4	14.5	CL	23.7	102.3						
A-11-114	5	19.5	CL	21.3	105.9						
A-11-114	6	24.5	CL	23.6	101.7						
A-11-114	7	29.5	CL	18.8	110.2						
A-11-114	8	34.5	CL	18.4	111.0						
A-11-114	9	39.5	CL	18.9	111.3						
A-11-114	10	44.5	SM	20.6	107.5					44.5	
A-11-115	1	3.0	CL	19.8	108.9	45	18	27			
A-11-115	2	6.0	CL	19.1	108.0						
A-11-115	3	11.0	CL	19.4	107.8						
A-11-115	4	16.0	CL	19.1	110.1						
A-11-115	5	21.0	CL	21.9	106.0						
A-11-115	6	26.0	SC	25.2	100.6					39.7	
A-11-115	7	31.0	CL	23.3	102.5						
A-11-115	8	36.0	CL	23.9	101.0	33	21	12			
A-11-116P	1	2.0	CL	14.9	-	39	18	21			
A-11-116P	2	6.0	SC	15.1	-				8.9	44.6	
A-11-116P	3	11.0	CL	14.1	106.2						
A-11-116P	4	16.0	CL	17.8	109.1						

Borehole	Sample Number	Depth	Classi-fication	Water Content	Dry Density	Liquid Limit	Plastic Limit	Plasticity Index	% > Sieve 4	% < Sieve 200	Unconfined Compressive Strength (tsf)
A-11-116P	5	21.0	CL	17.7	111.1						
A-11-116P	6	26.0	CL	15.8	115.3						
A-11-116P	7	31.0	CL	19.8	-						
A-11-121	1	3.0	CL	30.5	77.2	49	23	26			
A-11-121	2	6.0	CL	23.1	100.3						3.4
A-11-121	3	11.0	CL	20.0	98.7						
A-11-121	4	16.0	CL	20.7	103.8						
A-11-121	5	21.0	CL	20.0	97.8						
A-11-121	6	26.0	CL	24.2	98.9						
A-11-121	7	31.0	CL	22.8	101.5						
A-11-122	1	3.0	CL	21.0	98.0				0.3	59.8	
A-11-122	2	4.5	SC	18.4	100.8						
A-11-122	3	9.5	CL	21.4	96.1	47	20	27			
A-11-122	4	14.5	CL	21.0	102.4						
A-11-122	5	19.5	CL	19.3	105.3						
A-11-122	6	24.5	CL	19.0	103.5						
A-11-122	7	29.5	CL	19.4	-						
A-11-122	8	34.5	CL	25.6	-						
A-11-122	9	39.5	SM	24.7	101.8						
A-11-122	10	43.5	GM	16.8	111.3						
A-11-122	11	48.5	GM	16.2	-						
A-11-123	1	3.0	CL	21.1	94.0						
A-11-123	2	6.0	CL	23.1	94.8						1.03
A-11-123	3	11.0	CL	20.8	103.4						
A-11-123	4	16.0	CL	24.8	96.7						
A-11-123	5	21.0	CL	17.6	109.2						
A-11-123	6	26.0	CL	21.4	103.5						
A-11-123	7	31.0	SM	-	-	NP	NP	NP		23.6	
A-11-125	1	3.0	CL	24.2	99.6	45	18	27			2.3
A-11-125	2	6.0	CL	14.9	109.3	30	14	16			
A-11-125	3	10.0	SM	24.1	77.1				0.8	20.5	
A-11-125	4	15.0	-	31.5	-						
A-11-125	5	20.5	-	36.0	-						
A-11-125	6	25.5	-	33.7	-						
A-11-126	1	3.0	CL	22.9	102.8	47	17	30			
A-11-126	2	6.0	CL	20.6	104.9						1.44
A-11-126	3	11.0	CL	24.5	-						
A-11-126	4	16.0	CL	29.0	95.0						
A-11-126	5	20.0	CL	38.0	82.8						
A-11-126	6	25.0	-	49.5	-						
A-11-127	1	2.5	CL	19.5	104.2						
A-11-127	2	5.0	-	18.8	-						
A-11-127	3	10.0	-	20.5	-						

Borehole	Sample Number	Depth	Classi-fication	Water Content	Dry Density	Liquid Limit	Plastic Limit	Plasticity Index	% > Sieve 4	% < Sieve 200	Unconfined Compressive Strength (tsf)
A-11-127	4	15.0	-	25.6	-						
A-11-127	5	16.5	-	-	-						
A-11-128	1	2.5	-	26.9	85.8						
A-11-128	2	5.0	-	21.5	-						
A-11-128	3	10.0	-	16.5	-						
A-11-128	4	15.0	-	20.4	-						
A-11-128	5	16.0	-	22.1	-						
A-11-129	1	3.0	CL	24.5	92.4						
A-11-129	2	6.0	CL	26.0	94.9						1.14
A-11-129	3	10.0	-	22.4	-						
A-11-129	4	15.5	-	21.1	-						
A-11-129	5	20.0	-	24.3	-						
A-11-129	6	25.0	-	17.6	-						
A-11-129	7	30.0	-	9.9	-						
A-11-130	1	2.0	CL	15.4	-	46	19	27			
A-11-130	2	6.0	CL	27.4	92.9						
A-11-130	3	11.0	CL	23.4	102.6						
A-11-130	4	15.5	-	24.3	-						
A-11-130	5	20.5	-	26.5	83.6						
A-11-130	6	25.5	-	27.1	-						
A-11-130	7	29.5	-	31.8	-						
A-11-135	1	3.0	CL	25.1	99.8						
A-11-135	2	6.0	CL	22.3	99.4						3.87
A-11-135	3	11.0	CL	24.1	-						
A-11-135	4	16.0	CL	25.1	-						
A-11-135	5	21.0	CL	27.6	-						
A-11-135	6	26.0	CL	24.6	-						
A-11-135	7	30.0	CL	23.2	-						
A-11-136	1	3.0	CH	20.8	100.3	52	19	33			1.09
A-11-136	2	6.0	CH	18.8	107.0						
A-11-136	3	11.0	CH	20.9	104.5						
A-11-136	4	16.0	CH	20.8	98.9						2.16
A-11-136	5	21.0	SC	17.8	107.2				0.0	24.3	
A-11-136	6	25.0	SC	18.8	-						
A-11-136	7	30.0	CL-ML	24.2	-						
A-11-136	8	35.0	GP	17.5	-						
A-11-136	9	40.0	GC	22.1	-						
A-11-136	10	45.0	GC	16.7	-						
A-11-136	11	50.0	GC	16.8	-						
A-11-137	1	3.0	CL	20.7	102.1						2.08
A-11-137	2	6.0	CL	19.8	106.8						
A-11-137	3	11.0	CL	25.5	97.1	49	24	25			
A-11-137	4	16.0	CL	18.6	103.9						

Borehole	Sample Number	Depth	Classi-fication	Water Content	Dry Density	Liquid Limit	Plastic Limit	Plasticity Index	% > Sieve 4	% < Sieve 200	Unconfined Compressive Strength (tsf)
A-11-137	5	21.0	CL	23.9	100.3						
A-11-137	6	26.0	CL	26.8	95.8						
A-11-137	7	31.0	CL	24.5	99.2						
A-11-146P	1	6.0	CL	18.0	111.1						
A-11-146P	2	11.0	CL	13.9	111.5	35	16	19			
A-11-146P	3	16.0	CL	18.5	107.6						7
A-11-146P	4	21.0	CL	20.5	106.6						
A-11-147P	1	6.0	CL	28.6	81.9						
A-11-147P	2	11.0	CL	14.1	112.0						
A-11-147P	3	16.0	CL	26.8	94.7						
A-11-147P	4	21.0	CL	27.1	103.7						4.47
A-11-147P	5	26.0	CL	25.9	94.8						



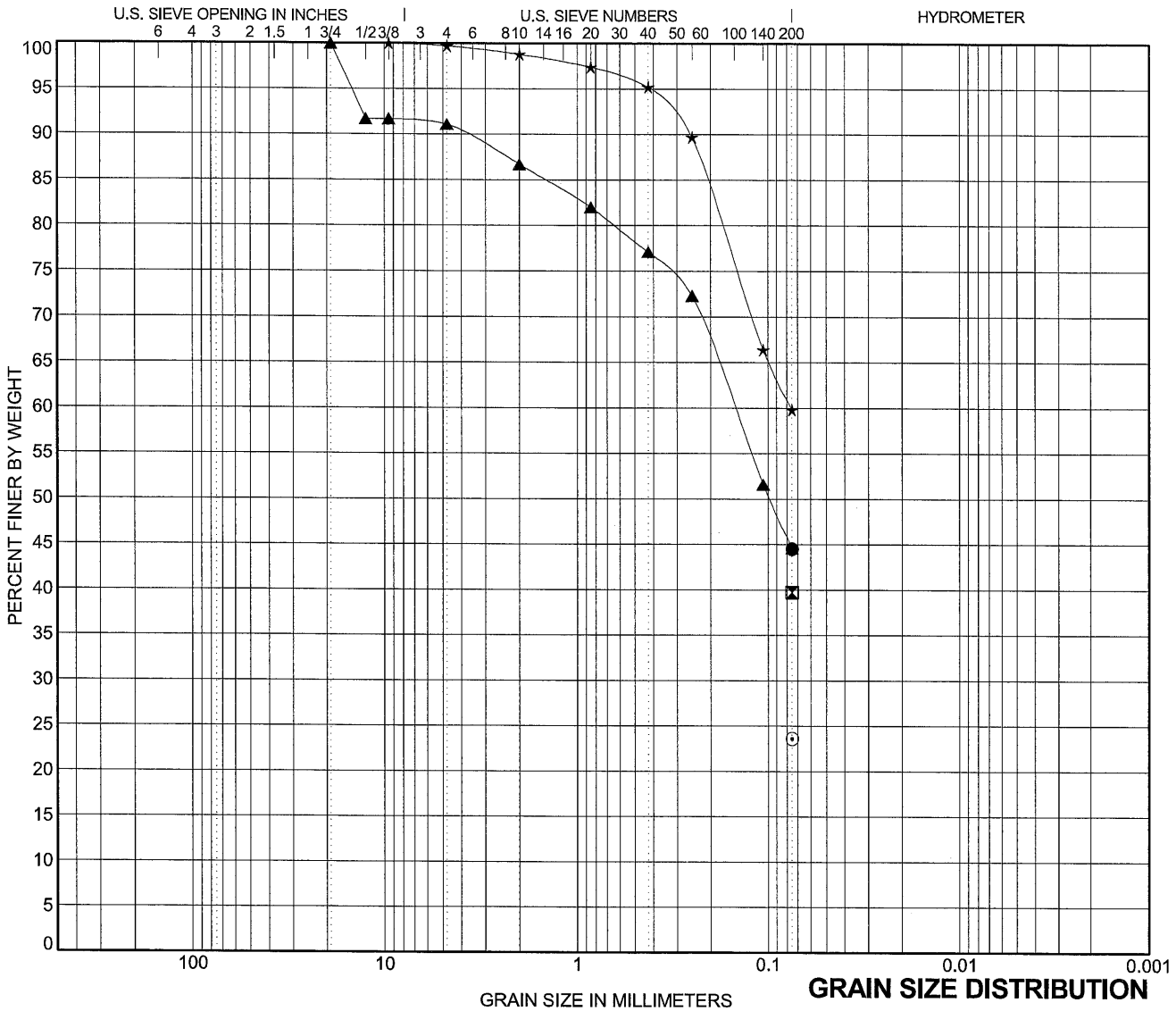
PLASTICITY

	BOREHOLE	SAMPLE #	DEPTH	LL	PL	PI	Fines	Classification
●	A-11-107	4	14.5	38	26	12		SILTSTONE
⊠	A-11-109	3	11.0	68	28	40		Fat CLAY
▲	A-11-110	3	11.0	46	24	22		Lean CLAY
★	A-11-114	1	3.0	28	19	9		SANDY lean CLAY
⊙	A-11-115	1	3.0	45	18	27		Lean CLAY
✿	A-11-115	8	36.0	33	21	12		SANDY lean CLAY
○	A-11-116P	1	2.0	39	18	21		SANDY lean CLAY with GRAVEL
△	A-11-121	1	3.0	49	23	26		Lean CLAY
⊗	A-11-122	3	9.5	47	20	27		Lean CLAY
⊕	A-11-123	7	31.0	NP	NP	NP	24	SILTY SAND
□	A-11-125	1	3.0	45	18	27		Lean CLAY with GRAVEL
⊖	A-11-125	2	6.0	30	14	16		Lean CLAY with GRAVEL
◕	A-11-126	1	3.0	47	17	30		Lean CLAY
☆	A-11-130	1	2.0	46	19	27		Lean CLAY
✿	A-11-136	1	3.0	52	19	33		Fat CLAY
■	A-11-137	3	11.0	49	24	25		Lean CLAY
◆	A-11-146P	2	11.0	35	16	19		Lean CLAY

PARIKH CONSULTANTS, INC.
GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

RTE 680 AUXILIARY LANE PROJECT SEG. 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO:2011-124-WAL | PLATE NO: B-3



GRAIN SIZE DISTRIBUTION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING	SAMPLE #	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	A-11-114	10	44.5	SILTY SAND					
⧗	A-11-115	6	26.0	CLAYEY SAND					
▲	A-11-116P	2	6.0	CLAYEY SAND with GRAVEL					
★	A-11-122	1	3.0	SANDY lean CLAY					
⊙	A-11-123	7	31.0	SILTY SAND	NP	NP	NP		

	BORING	SAMPLE #	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	A-11-114	10	44.5	0.075						44.5	
⧗	A-11-115	6	26.0	0.075						39.7	
▲	A-11-116P	2	6.0	19	0.15			8.9	46.5	44.6	
★	A-11-122	1	3.0	9.5	0.076			0.3	39.9	59.8	
⊙	A-11-123	7	31.0	0.075						23.6	

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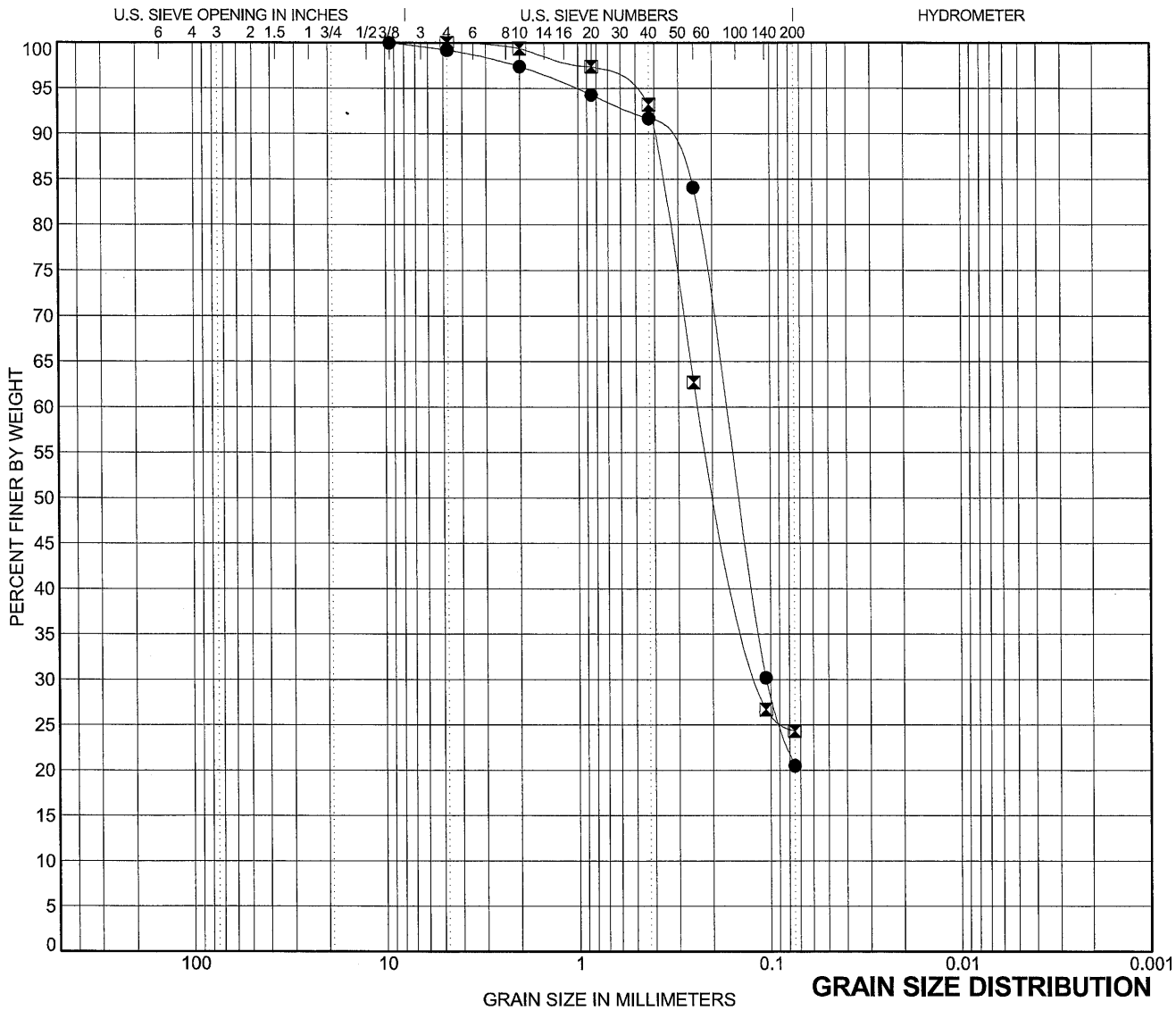
MATERIALS ENGINEERING

RTE 680 AUXILIARY LANE PROJECT SEG. 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO:2011-124-WAL

PLATE NO: B-4A



GRAIN SIZE DISTRIBUTION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING	SAMPLE #	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**A-11-125**	**3**	**10.0**	**SILTY SAND**					
⧗	**A-11-136**	**5**	**21.0**	**CLAYEY SAND**					

	BORING	SAMPLE #	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**A-11-125**	**3**	**10.0**	**9.5**	**0.17**	**0.105**		**0.8**	**78.7**	**20.5**	
⧗	**A-11-136**	**5**	**21.0**	**4.75**	**0.234**	**0.115**		**0.0**	**75.7**	**24.3**	

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GEOTECHNICAL CONSULTANTS
MATERIALS ENGINEERING

RTE 680 AUXILIARY LANE PROJECT SEG. 2
CONTRA COSTA COUNTY, CALIFORNIA

JOB NO:2011-124-WAL

PLATE NO: B-4B

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 07/29/2011
Date Submitted 07/25/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-WAL/I680 Site ID : A-11-109#2@ 6'.
Thank you for your business.

* For future reference to this analysis please use SUN # 60645-124207.

EVALUATION FOR SOIL CORROSION

Soil pH	7.27	
Minimum Resistivity	1.05 ohm-cm (x1000)	
Chloride	39.5 ppm	00.00395 %
Sulfate	77.0 ppm	00.00770 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

AUG - 9 2011

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 08/12/2011
Date Submitted 08/08/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-WAL/I680 Site ID : A11-110-WAL#2@6.
Thank you for your business.

* For future reference to this analysis please use SUN # 60766-124507.

EVALUATION FOR SOIL CORROSION

Soil pH	7.56	
Minimum Resistivity	0.28 ohm-cm (x1000)	
Chloride	71.4 ppm	00.00714 %
Sulfate	1137.9 ppm	00.11379 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

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AUG 15 2011

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 08/05/2011
Date Submitted 08/01/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-WAL/I680 Site ID : A11-114#3 @ 10'.
Thank you for your business.

* For future reference to this analysis please use SUN # 60727-124429.

EVALUATION FOR SOIL CORROSION

Soil pH	7.20	
Minimum Resistivity	1.42 ohm-cm (x1000)	
Chloride	11.8 ppm	00.00118 %
Sulfate	15.5 ppm	00.00155 %

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 07/29/2011
Date Submitted 07/25/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-WAL/I680 Site ID : A-11-122#2@4.5'.
Thank you for your business.

* For future reference to this analysis please use SUN # 60645-124213.

EVALUATION FOR SOIL CORROSION

Soil pH	7.34	
Minimum Resistivity	1.15 ohm-cm (x1000)	
Chloride	57.2 ppm	00.00572 %
Sulfate	111.9 ppm	00.01119 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

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Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 08/05/2011
Date Submitted 08/01/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-WAL/I680 Site ID : A11-127#1 @ 2.5.
Thank you for your business.

* For future reference to this analysis please use SUN # 60727-124431.

EVALUATION FOR SOIL CORROSION

Soil pH	7.45		
Minimum Resistivity	0.96 ohm-cm (x1000)		
Chloride	11.9 ppm	00.00119	%
Sulfate	12.3 ppm	00.00123	%

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 07/29/2011
Date Submitted 07/25/2011

To: Prav Dayah
Parikh Consultants, Inc.
2360 Qume Dr, Ste.A
San Jose, CA 95131

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2011-124-WAL/I680 Site ID : A-11-137#2 @ 6'.
Thank you for your business.

* For future reference to this analysis please use SUN # 60645-124211.

EVALUATION FOR SOIL CORROSION

Soil pH	7.62		
Minimum Resistivity	0.88 ohm-cm (x1000)		
Chloride	19.2 ppm	00.00192	%
Sulfate	36.8 ppm	00.00368	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

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APPENDIX C

LIQUEFACTION POTENTIAL ANALYSIS

PROJECT NAME **Rte I-680 Auxiliary Lane Project - Seg. 2**
PROJECT NO. **2011-124-WAL**
BORING NO. **A-11-114**

BOREHOLE DIA (in)= 5
GW DEPTH (ft)= 15

SOIL GROUPS
1. GRAVELS, SANDS AND NONPLASTIC SILTS
2. CLAYS AND PLASTIC SILTS

HAMMER ENERGY = *55%*

FAULT INFO
Great Valley Fault
a_{max} *(g)=* 0.72
FAULT M_w = 6.76

MSF = 1.30

					CYCLIC STRESS RATIO (CSR)				*LIQUEFACTION RESISTANCE ($CRR_{7.5}$)*											*F.S.=($CRR_{7.5}$/CSR)*MSF*Kσ*Kα*			
Sample No	Depth (ft)	Soil Type	Blow Count	Sampler Type	σ_v (psf)	σ_v' (psf)	γ_d	CSR	SPT-$N_{eq.}$	C_E	C_R	C_S	C_B	N_{60}	C_N	$(N_1)_{60}$	F.C.	$(N_1)_{60,cs}$	$CRR_{7.5}$	Kσ	Kα	F.S.	Volumetric Strain (%)
1	2	2	24	mc	250	250	1.00		15.6	0.9	0.75	1.0	1.0	10.7	1.66	17.8				1.00	1		
2	5	2	34	mc	625	625	0.99		22.1	0.9	0.75	1.0	1.0	15.2	1.45	22.1				1.00	1		
3	10	2	30	mc	1250	1250	0.98		19.5	0.9	0.80	1.0	1.0	14.3	1.21	17.2				1.00	1		
4	15	2	13	mc	1875	1844	0.97		8.5	0.9	0.85	1.0	1.0	6.6	1.04	6.8				1.00	1		
5	20	2	52	mc	2500	2156	0.96		33.8	0.9	0.95	1.0	1.0	29.4	0.97	28.4				0.97	1		
6	25	2	26	mc	3125	2469	0.94		16.9	0.9	0.95	1.0	1.0	14.7	0.90	13.3				0.93	1		
7	30	2	30	mc	3750	2781	0.92		19.5	0.9	1.00	1.0	1.0	17.9	0.85	15.2				0.88	1		
8	35	2	34	mc	4375	3094	0.89		22.1	0.9	1.00	1.0	1.0	20.3	0.80	16.2				0.84	1		
9	40	2	45	mc	5000	3406	0.85		29.3	0.9	1.00	1.0	1.0	26.8	0.76	20.3				0.81	1		
10	45	1	46	mc	5625	3719	0.80	0.57	29.9	0.9	1.00	1.0	1.0	27.4	0.72	19.7	45%	28.7	0.39	0.78	1	0.71	0.8

Total Liquefaction Settlement (in.)= 0.48

1. The correction factors C_E (Energy Ratio), C_B (Borehole Diameter), C_R (Rod Length) and C_S (Sampling Method-liner) are per Youd et al. (2001).
2. For correction of overburden, $C_N = 2.2/(1.2 + \sigma_v'/P_a)$ with a maximum value of 1.7 per Kayen et al. (1992) as cited in Youd et al. (2001).
3. The influence of Fines Contents are expressed by the following correction: $(N_1)_{60cs} = \alpha + \beta\,(N_1)_{60}$
   where α and β = coefficients determined from the following relationships
   for FC $\leq$ 5% $\alpha = 0$, $\beta = 1.0$
   for 5% < FC < 35% $\alpha = \exp(1.76-(190/FC^2))$, $\beta = (0.99+(FC^{1.5}/1000))$
   for FC $\geq$ 35% $\alpha = 5.0$, $\beta = 1.2$

Reference: Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER Workshops on Evaluation of Liquefaction Resistance of Soils, Youd, et al., ASCE Journal of Geotechnical and Geoenvironmental Engineering, October 2001, Vol. 127 No. 10

LIQUEFACTION POTENTIAL ANALYSIS

PROJECT NAME **Rte I-680 Auxiliary Lane Project - Seg. 2**
PROJECT NO. **2011-124-WAL**
BORING NO. **A-11-115**

BOREHOLE DIA (in)= 5
GW DEPTH (ft)= 12

SOIL GROUPS
1. GRAVELS, SANDS AND NONPLASTIC SILTS
2. CLAYS AND PLASTIC SILTS

HAMMER ENERGY = *55%*

FAULT INFO
Great Valley Fault
a_{max} *(g)=* 0.72
FAULT M_w *=* 6.76

MSF = 1.30

					CYCLIC STRESS RATIO (CSR)				*LIQUEFACTION RESISTANCE ($CRR_{7.5}$)*											*F.S.=($CRR_{7.5}$/CSR)*MSF*Kσ*Kα*			
Sample No	Depth (ft)	Soil Type	Blow Count	Sampler Type	σ_v (psf)	σ_v' (psf)	γ_d	CSR	SPT-$N_{eq.}$	C_E	C_R	C_S	C_B	N_{60}	C_N	$(N_1)_{60}$	F.C.	$(N_1)_{60,cs}$	$CRR_{7.5}$	Kσ	Kα	F.S.	Volumetric Strain (%)
1	2	2	23	mc	250	250	1.00		15.0	0.9	0.75	1.0	1.0	10.3	1.66	17.1				1.00	1		
2	5	2	38	mc	625	625	0.99		24.7	0.9	0.75	1.0	1.0	17.0	1.45	24.7				1.00	1		
3	10	2	18	mc	1250	1250	0.98		11.7	0.9	0.80	1.0	1.0	8.6	1.21	10.3				1.00	1		
4	15	2	63	mc	1875	1688	0.97		41.0	0.9	0.85	1.0	1.0	31.9	1.08	34.3				1.00	1		
5	20	2	27	mc	2500	2000	0.96		17.6	0.9	0.95	1.0	1.0	15.3	1.00	15.3				1.00	1		
6	25	1	27	mc	3125	2313	0.94	0.60	17.6	0.9	0.95	1.0	1.0	15.3	0.93	14.3	40%	22.1	0.24	0.95	1	0.51	1.3
7	30	2	36	mc	3750	2625	0.92		23.4	0.9	1.00	1.0	1.0	21.5	0.88	18.8				0.90	1		
8	35	2	39	mc	4375	2938	0.89		25.4	0.9	1.00	1.0	1.0	23.2	0.82	19.2				0.86	1		
9		2		mc	0	0	1.00		0.0	0.9	0.75	1.0	1.0	0.0	1.70	0.0				1.00	1		
10		2		mc	0	0	1.00		0.0	0.9	0.75	1.0	1.0	0.0	1.70	0.0				1.00	1		

Total Liquefaction Settlement (in.)= 0.62

1. The correction factors C_E (Energy Ratio), C_B (Borehole Diameter), C_R (Rod Length) and C_S (Sampling Method-liner) are per Youd et al. (2001).
2. For correction of overburden, $C_N = 2.2/(1.2 + \sigma_v'/P_a)$ with a maximum value of 1.7 per Kayen et al. (1992) as cited in Youd et al. (2001).
3. The influence of Fines Contents are expressed by the following correction: $(N_1)_{60cs} = \alpha + \beta\,(N_1)_{60}$
   where α and β = coefficients determined from the following relationships
   for FC $\leq$ 5% $\alpha = 0$, $\beta = 1.0$
   for 5% < FC < 35% $\alpha = \exp(1.76-(190/FC^2))$, $\beta = (0.99+(FC^{1.5}/1000))$
   for FC $\geq$ 35% $\alpha = 5.0$, $\beta = 1.2$

Reference: Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER Workshops on Evaluation of Liquefaction Resistance of Soils, Youd, et al., ASCE Journal of Geotechnical and Geoenvironmental Engineering, October 2001, Vol. 127 No. 10

LIQUEFACTION POTENTIAL ANALYSIS

PROJECT NAME ***Rte I-680 Auxiliary Lane Project - Seg. 2***
PROJECT NO. ***2011-124-WAL***
BORING NO. ***A-11-122***

BOREHOLE DIA (in)= 5
GW DEPTH (ft)= 39

SOIL GROUPS
1. GRAVELS, SANDS AND NONPLASTIC SILTS
2. CLAYS AND PLASTIC SILTS

HAMMER ENERGY = *55%*

FAULT INFO
Great Valley Fault
a_{max} *(g)=* 0.72
FAULT M_w = 6.76

MSF = 1.30

					CYCLIC STRESS RATIO (CSR)				*LIQUEFACTION RESISTANCE ($CRR_{7.5}$)*											*F.S.=($CRR_{7.5}$/CSR)*MSF*Kσ*Kα*			
Sample No	Depth (ft)	Soil Type	Blow Count	Sampler Type	σ_v (psf)	σ_v' (psf)	γ_d	CSR	SPT-$N_{eq.}$	C_E	C_R	C_S	C_B	N_{60}	C_N	$(N_1)_{60}$	F.C.	$(N_1)_{60,cs}$	$CRR_{7.5}$	Kσ	Kα	F.S.	Volumetric Strain (%)
1	2	2	15	mc	250	250	1.00		9.8	0.9	0.75	1.0	1.0	6.7	1.66	11.1				1.00	1		
2	5	1	21	mc	625	625	0.99	0.46	13.7	0.9	0.75	1.0	1.0	9.4	1.45	13.7		13.7	0.15	1.00	1		
3	10	2	18	mc	1250	1250	0.98		11.7	0.9	0.80	1.0	1.0	8.6	1.21	10.3				1.00	1		
4	15	2	22	mc	1875	1875	0.97		14.3	0.9	0.85	1.0	1.0	11.1	1.03	11.5				1.00	1		
5	20	2	24	mc	2500	2500	0.96		15.6	0.9	0.95	1.0	1.0	13.6	0.90	12.2				0.93	1		
6	25	2	22	mc	3125	3125	0.94		14.3	0.9	0.95	1.0	1.0	12.5	0.80	9.9				0.87	1		
7	30	2	22	mc	3750	3750	0.92		14.3	0.9	1.00	1.0	1.0	13.1	0.72	9.4				0.78	1		
8	35	2	23	mc	4375	4375	0.89		15.0	0.9	1.00	1.0	1.0	13.7	0.65	8.9				0.73	1		
9	40	1	28	mc	5000	4938	0.85	0.40	18.2	0.9	1.00	1.0	1.0	16.7	0.60	10.0	15%	13.0	0.14	0.70	1	0.32	2.1
10	45	1	100	mc	5625	5250	0.80	0.40	65.0	0.9	1.00	1.0	1.0	59.6	0.58	34.3		34.3		0.68	1		
11	50	1	100	spt	6250	5563	0.75	0.40	100.0	0.9	1.00	1.2	1.0	110.0	0.55	60.8		60.8		0.66	1		
																				Total Liquefaction Settlement (in.)=			0.50

1. The correction factors C_E (Energy Ratio), C_B (Borehole Diameter), C_R (Rod Length) and C_S (Sampling Method-liner) are per Youd et al. (2001).
2. For correction of overburden, $C_N = 2.2/(1.2 + \sigma_v'/P_a)$ with a maximum value of 1.7 per Kayen et al. (1992) as cited in Youd et al. (2001).
3. The influence of Fines Contents are expressed by the following correction: $(N_1)_{60cs} = \alpha + \beta\,(N_1)_{60}$

   where α and β = coefficients determined from the following relationships

   for FC ≤ 5% $\alpha = 0$, $\beta = 1.0$

   for 5% < FC < 35% $\alpha = \exp(1.76-(190/FC^2))$, $\beta = (0.99+(FC^{1.5}/1000))$

   for FC ≥ 35% $\alpha = 5.0$, $\beta = 1.2$

Reference: Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER Workshops on Evaluation of Liquefaction Resistance of Soils, Youd, et al., ASCE Journal of Geotechnical and Geoenvironmental Engineering, October 2001, Vol. 127 No. 10

LIQUEFACTION POTENTIAL ANALYSIS

PROJECT NAME **Rte I-680 Auxiliary Lane Project - Seg. 2**
PROJECT NO. **2011-124-WAL**
BORING NO. **A-11-123**

BOREHOLE DIA (in)= 5
GW DEPTH (ft)= 28

SOIL GROUPS
1. GRAVELS, SANDS AND NONPLASTIC SILTS
2. CLAYS AND PLASTIC SILTS

HAMMER ENERGY = *55%*

FAULT INFO
Great Valley Fault
a_{max} *(g)=* 0.72
FAULT M_w = 6.76

MSF = 1.30

					CYCLIC STRESS RATIO (CSR)				*LIQUEFACTION RESISTANCE ($CRR_{7.5}$)*											*F.S.=($CRR_{7.5}$/CSR)*MSF*Kσ*Kα*			
Sample No	Depth (ft)	Soil Type	Blow Count	Sampler Type	σ_v (psf)	σ_v' (psf)	γ_d	CSR	SPT-$N_{eq.}$	C_E	C_R	C_S	C_B	N_{60}	C_N	$(N_1)_{60}$	F.C.	$(N_1)_{60,cs}$	$CRR_{7.5}$	Kσ	Kα	F.S.	Volumetric Strain (%)
1	2	2	20	mc	250	250	1.00		13.0	0.9	0.75	1.0	1.0	8.9	1.66	14.8				1.00	1		
2	5	2	18	mc	625	625	0.99		11.7	0.9	0.75	1.0	1.0	8.0	1.45	11.7				1.00	1		
3	10	2	39	mc	1250	1250	0.98		25.4	0.9	0.80	1.0	1.0	18.6	1.21	22.4				1.00	1		
4	15	2	34	mc	1875	1875	0.97		22.1	0.9	0.85	1.0	1.0	17.2	1.03	17.7				1.00	1		
5	20	2	31	mc	2500	2500	0.96		20.2	0.9	0.95	1.0	1.0	17.5	0.90	15.8				0.92	1		
6	25	2	44	mc	3125	3125	0.94		28.6	0.9	0.95	1.0	1.0	24.9	0.80	19.8				0.84	1		
7	30	1	45	mc	3750	3625	0.92	0.45	29.3	0.9	1.00	1.0	1.0	26.8	0.73	19.6	24%	25.8	0.31	0.79	1	0.71	1.2
8		2		mc	0	0	1.00		0.0	0.9	0.75	1.0	1.0	0.0	1.70					1.00	1		
9		2		mc	0	0	1.00		0.0	0.9	0.75	1.0	1.0	0.0	1.70					1.00	2		

Total Liquefaction Settlement (in.)= 0.43

1. The correction factors C_E (Energy Ratio), C_B (Borehole Diameter), C_R (Rod Length) and C_S (Sampling Method-liner) are per Youd et al. (2001).
2. For correction of overburden, $C_N = 2.2/(1.2 + \sigma_v'/P_a)$ with a maximum value of 1.7 per Kayen et al. (1992) as cited in Youd et al. (2001).
3. The influence of Fines Contents are expressed by the following correction: $(N_1)_{60cs} = \alpha + \beta\,(N_1)_{60}$
   where α and β = coefficients determined from the following relationships
   for FC $\leq$ 5% $\alpha = 0$, $\beta = 1.0$
   for 5% < FC < 35% $\alpha = \exp(1.76-(190/FC^2))$, $\beta = (0.99+(FC^{1.5}/1000))$
   for FC $\geq$ 35% $\alpha = 5.0$, $\beta = 1.2$

Reference: Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER Workshops on Evaluation of Liquefaction Resistance of Soils, Youd, et al., ASCE Journal of Geotechnical and Geoenvironmental Engineering, October 2001, Vol. 127 No. 10

RW No. 1C

Standard Type 1A, Loading Case II (2006 Standard plan B3-3)

Max Wall H = 10 ft. Sta. 262+20 to 265+80

Elev. of top of footing 466 to 468 ft.

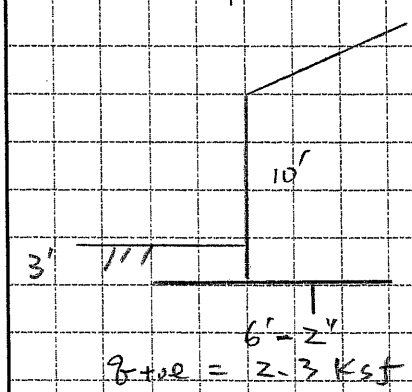
Footing width: 6'-2"

Footing depth: 3' bgs

Reference borings: A-11-105, A-11-106

Subsoils are hard clay to claystone with $\bar{N} > 50$. No free ground water encountered

Adopt $c = 3$ ksf, $\phi = 0$



$$q_{ult} = cN_c + \gamma D N_q + \frac{1}{2}\gamma B N_\gamma$$

$N_c = 5.14$, $N_q = 1$ $N_\gamma = 0$

$\therefore q_{ult} = 3 \times 5.14 + 0.12 \times 3 = 15.78$ ksf

$q_{all} = 15.78/3 = 5.26$ ksf

q_{all} > required toe press of 2.3 ksf for Type 1A for RW 1C.

Table 10.6.3.1.2a-1 Bearing Capacity Factors N_c (*Prandtl, 1921*), N_q (*Reissner, 1924*), and N_γ (*Vesic, 1975*).

ϕ_f	N_c	N_q	N_γ	ϕ_f	N_c	N_q	N_γ
0	5.14	1.0	0.0	23	18.1	8.7	8.2
1	5.4	1.1	0.1	24	19.3	9.6	9.4
2	5.6	1.2	0.2	25	20.7	10.7	10.9
3	5.9	1.3	0.2	26	22.3	11.9	12.5
4	6.2	1.4	0.3	27	23.9	13.2	14.5
5	6.5	1.6	0.5	28	25.8	14.7	16.7
6	6.8	1.7	0.6	29	27.9	16.4	19.3
7	7.2	1.9	0.7	30	30.1	18.4	22.4
8	7.5	2.1	0.9	31	32.7	20.6	26.0
9	7.9	2.3	1.0	32	35.5	23.2	30.2
10	8.4	2.5	1.2	33	38.6	26.1	35.2
11	8.8	2.7	1.4	34	42.2	29.4	41.1
12	9.3	3.0	1.7	35	46.1	33.3	48.0
13	9.8	3.3	2.0	36	50.6	37.8	56.3
14	10.4	3.6	2.3	37	55.6	42.9	66.2
15	11.0	3.9	2.7	38	61.4	48.9	78.0
16	11.6	4.3	3.1	39	67.9	56.0	92.3
17	12.3	4.8	3.5	40	75.3	64.2	109.4
18	13.1	5.3	4.1	41	83.9	73.9	130.2
19	13.9	5.8	4.7	42	93.7	85.4	155.6
20	14.8	6.4	5.4	43	105.1	99.0	186.5
21	15.8	7.1	6.2	44	118.4	115.3	224.6
22	16.9	7.8	7.1	45	133.9	134.9	271.8

Table 10.6.3.1.2a-2 Coefficients C_{wq} and $C_{w\gamma}$ for Various Groundwater Depths.

D_w	C_{wq}	$C_{w\gamma}$
0.0	0.5	0.5
D_f	1.0	0.5
$>1.5B + D_f$	1.0	1.0

Where the position of groundwater is at a depth less than 1.5 times the footing width below the footing base, the bearing resistance is affected. The highest anticipated groundwater level should be used in design.

Table 10.6.3.1.2a-3 Shape Correction Factors s_c, s_γ, s_q.

Factor	Friction Angle	Cohesion Term (s_c)	Unit Weight Term (s_γ)	Surcharge Term (s_q)
Shape Factors s_c, s_γ, s_q	$\phi_f = 0$	$1+\left(\frac{B}{5L}\right)$	1.0	1.0
	$\phi_f > 0$	$1+\left(\frac{B}{L}\right)\left(\frac{N_q}{N_c}\right)$	$1-0.4\left(\frac{B}{L}\right)$	$1+\left(\frac{B}{L}\tan\phi_f\right)$

RW 1D

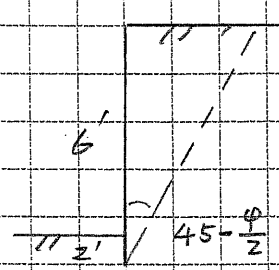
Standard Type 7 (Standard drawing XS14-010, 1993)

Max H = 6 ft Sta: 268+58 to 269+54
Top of footing elevations: 462.5 to 463.5 ft

Backslope is about level

Ref. boring: A-11-107
subsoil is claystone $\bar{N}_{60} = 50$ PI = 19
Groundwater was not encounted
$s_u = 50 \times 120 = 6000$ psf = 6 ksf
Adopt c = 100 pcf $\varphi = 27°$ $\gamma = 125$ pcf

For level backslope with soil-wall friction $\delta = 0$, Coulomb's equation produces the same result as Rankine's equation.

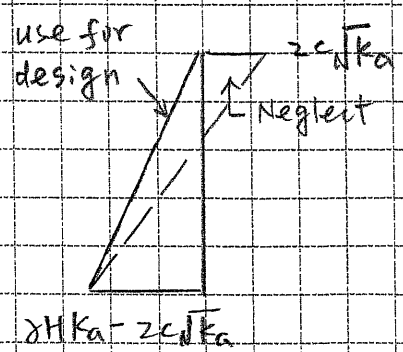


$K_a = \tan^2(45 - \varphi/2) = 0.37$

$\gamma H K_a - 2c\sqrt{K_a} = 125 \times 8 \times 0.37 - 2 \times 100\sqrt{0.37} = 248$ psf

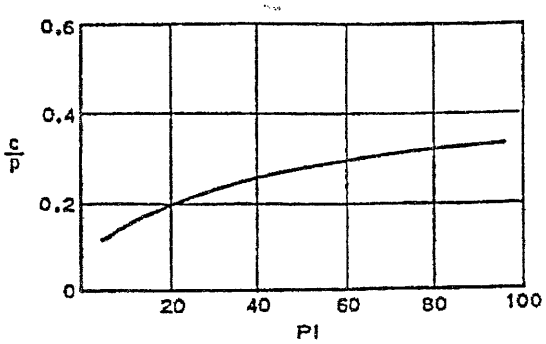
$125 \times 8 \times K_a^* = 248$ psf $K_a^* = 0.25$
(equivalent K_a)

∴ Equivalent fluid pressure EFP = 0.25 × 125
= 31 pcf

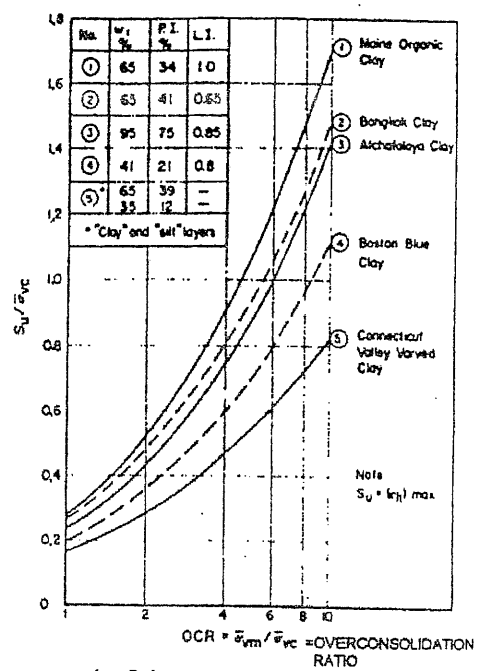


which is less than the EFP of 36 pcf based on structure backfill with friction angle of 34°.

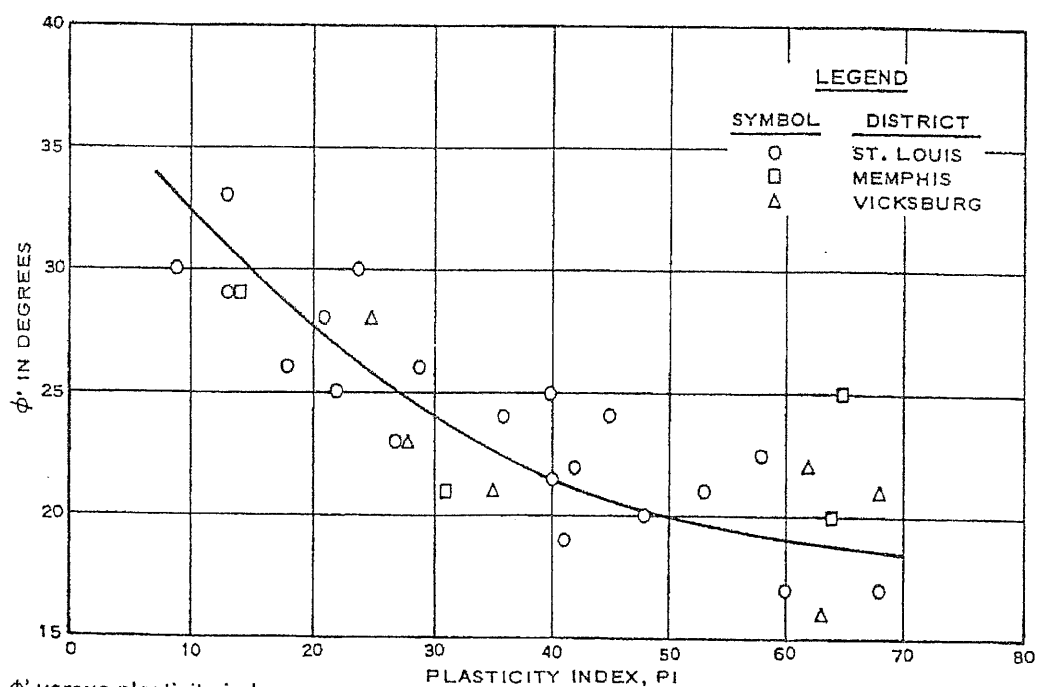
Bearing capacity
$q_{ult} = 3 \times 5.14 = 15.4$ k
$q_{all} = 5$ k > 2.0 ksf on the drawing



a. c/p versus plasticity index for normally consolidated soils (after Bjerrum, ref. A-2)



b. S_u/σ_{vc} versus overconsolidation ratio (after Ladd and Foott, 1974, Ref. A-2)



c. φ' versus plasticity index

Figure 3-2. Example correlations of strength characteristics for fine-grained soils

PARIKH
Practicing in the Geosciences

JOB 2011-124-WAL
SHEET NO 1 OF 1
CALCULATED BY P. Wei DATE 12-15-11
CHECKED BY YDW DATE 12/4
SCALE N.T.S.

RW 2 (soil nail wall)

soil nail wall is proposed

Max H = 12 ft Station: 275+16 to 280+36
281+64 to 290+99

Ref Borings: A-11-110 through A-11-115, A-11-116P
A-11-146P, A-11-147P
subsoils are very stiff to hard clay underlain by claystone and siltstone or dense sand.

Groundwater was encountered at 14.5' (Ele. 437.5') and 12' (Ele. 437') in A-11-114 and A-11-115, respectively.

UC from 1.2 to 2.8 t, and PP from 1.8 to 4 t
PI from 9 to 22
use s_u = 2500 psf for hard clay
use s_u = 2000 psf for very stiff clay

Assign c' = 350 psf
ϕ' = 26°
γ = 125 pcf
Ultimate Bond Strength = 8.5 psi (may increase by test)
PGA = 0.72 g
use 0.2 g per Caltrans Guidelines for Structures Foundation Reports, V. 2.0, updated Dec. 2009 for seismic coefficient

per table 3.10 FHWA-IF-03-017
ultimate bond strength 10 psi Sta. 275+00 to 280+60
8.5 psi Sta. 281+40 to 291+16

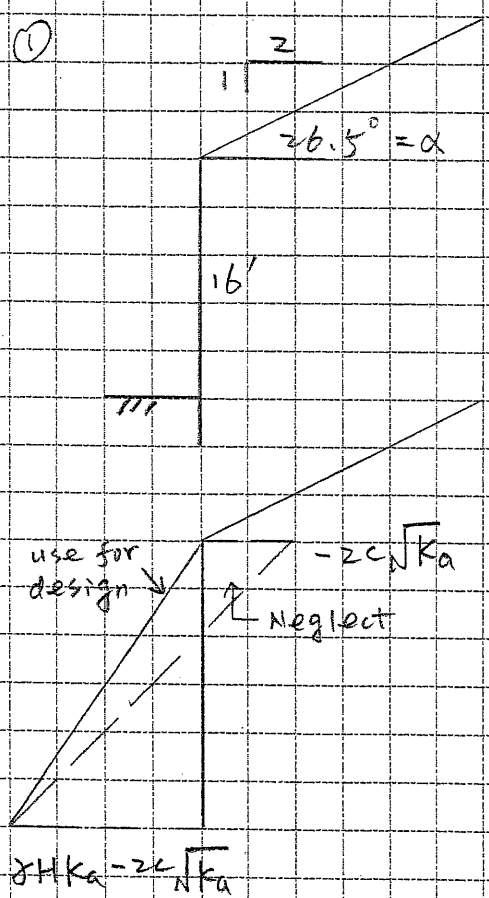
RW 2 (Ground Anchor Wall)

Ground anchor wall is proposed under Greenbrook Dr. overcrossing at southbound abutment

Max H = 14 ft, Sta: 286+36 to 281+64

Ref. boring: A-11-112 and as-built LOTB B-1
very stiff to hard clay u_c = 2 tsf, PP > 3.25 tsf
No groundwater encountered
moderately to highly expansive soil
$\bar{N}_{60}$ = 29 in bound zone

(1)



Adopt c = 100 psf φ = 26.5° γ = 125 pcf
(For expansive soil, conservative)
check K_a using Rankine's theory to account for cohesion

$$K_a = \cos\alpha \frac{\cos\alpha - (\cos^2\alpha - \cos^2\varphi)^{1/2}}{\cos\alpha + (\cos^2\alpha - \cos^2\varphi)^{1/2}} = 0.89$$

$$\gamma H K_a - 2c K_a^{1/2} = 125 \times 14 \times 0.89 - 2 \times 100 \times 0.89^{1/2}$$
$$= 1368 \text{ psf}$$

$$125 \times 14 \times K_a^* = 1368 \text{ psf}$$

K_a^* = 0.78 (equivalent K_a)

use K_a = 0.78 γ = 125 pcf for design
Equivalent fluid pressure (EFP)
= 0.78 × 125 = 97.5 psf use 95 pcf

$P_a = \frac{1}{2} \cdot EFP \cdot H^2 = 0.5 \times 95 H^2 = 47.5 H^2$
$P_{total} = 1.44 P_a = 68.4 H^2$
Per Caltrans Bridge Design specification 2004 (sec. 5.5.5.7), a factor of 1.44 should be applied to P_a for P_{total}.

RW 2 (Ground Anchor Wall)

② per Caltrans ARS on-line, PGA = 0.72 g at the site

use $k_h = 0.5$ PGA $= 0.36$ g

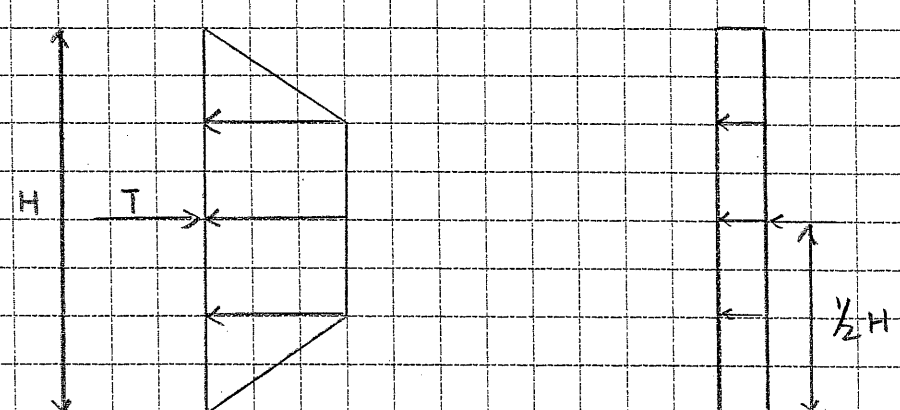
The existing abutment slope is 2H:1V. The M-O equation is not applicable for such k_h and slope

use simplified equation by Seed and Whiteman (1970) for level ground backslope

$$\Delta P_{AE} = \frac{3}{8} k_h \gamma H^2 = 0.375 \times 0.36 \times 125 \times H^2 = 16.87\, H^2 \quad \text{use } 17\, H^2$$

The apparent earth pressure distribution is trapezodial per Caltrans BDS (Sec 5.5.5.7). Shape varies depending on levels of anchors. The pressure distribution diagram is attached as plate 6.

The seismic incremental earth pressure is uniformly distributed along the wall height.



EFP = 95 pcf $\qquad \Delta P_{AE} = 17 H^2$

RW 2 (Ground Anchor wall)

Based on $\bar{N}_{60} = 29$ in bond zone $S_u = 29 \times 120 = 3480$ psf

Per Table 6.2 in PTI manual "Recommendations For Prestressed Rock And Soil Anchors", 1996, the ultimate bond stress is estimated to be 20 psi. for very stiff clay and medium to high plasticity

No surcharge from the existing Abutment 1 spread footing since the footing is about 45 ft away from the wall

RW 3 (Ground Anchor wall)

Ground anchor wall is proposed under Green brook Dr. overcrossing at north bound abutment

Max H = 11 ft Sta: 280+07 to 282+04

Ref. boring: A-11-109 and as-built LOTB B-3
Hard clay uc = 1.7 tsf pp > 3.5 tsf
LL = 68 PI = 40 very expansive
No groundwater encountered
Highly expansive soil
$\bar{N}_{60}$ = 29 in bond zone

Adopt c = 100 psf ϕ = 26.5° γ = 125 pcf
Back slope is about 2H:1V

soil condition is similar to that for RW 2 ground anchor wall
Calculation is the same as that for RW 2 ground anchor wall

use EFP = 95 pcf and ultimate bond stress = 20 psi

In addition, since the existing spread footing for Abutment 4 is only about 12 ft away from the wall, and the bottom of footing is at Elev. 460 ft, about the same level as the top of the wall, surcharge from the footing should be included. Calculation of surcharge using elastic solution is attached as plate 7.

RW No. 4

Standard Type 1 SWB (2005 Standard drawing XS14-220e)

Max wall H = 10 ft. Sta. 291+89 to 298+67

Elev. of top of footing: 437 to 444 ft

Footing width: 8'-6"

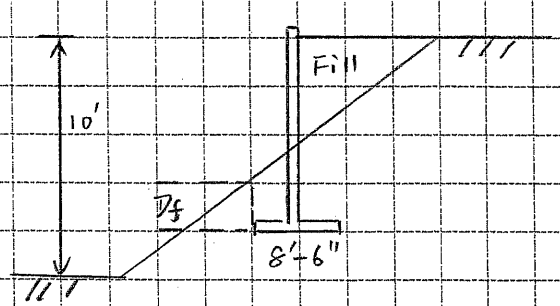
Footing depth: 3' bgs

Reference borings: A-11-121, A-11-122 and A-11-123

Subsoils are mostly stiff to very stiff clay with uc from 1.0 tsf to 3.4 tsf and pp from 1.5 to 3.5 tsf for the upper 40 ft bgs. Groundwater was at 28 to 39 ft bgs.

About 5 to 7' fill is needed to level the grade for traffic lane widening.

Adopt $c = 1.3$ ksf, $\phi = 0$ ($\bar{N} = 11$)



Required $q_{ult} = 6.5$ ksf

The wall will be on the slope

$H_s = 10'$ $B = 8.5'$ $D_f = 3'$

2H:1V slope $i = 26.5°$

$B < H_s$, $D_f/B = 3/8.5 = 0.35$

$\therefore N_q = 0$

$\therefore N_{cq} = 5$, $N_{rq} = 1$

$q_{ult} = cN_{cq} + \gamma D_f N_{rq} = 1.3 \times 5 + 0.12 \times 3 \times 1$

$= 6.86$ ksf > required 6.5 ksf

Bearing capacity is marginal. Recommend 2' overexcavation and replacement with Class 3 AB below footing.

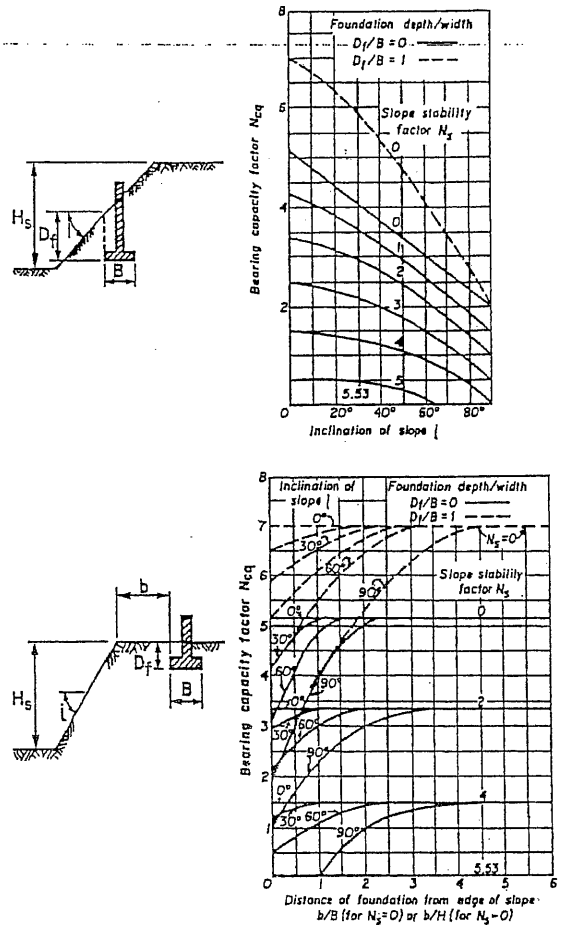


Figure 10.6.3.1.2c-1 Modified Bearing Capacity Factors for Footing in Cohesive Soils and on or Adjacent to Sloping Ground after Meyerhof (*1957*).

RW No. 5

Standard Type 7, loading case 2 (1993 Standard drawing XS14-010)

Max H = 10 ft, station 301+00 to 315+35

Elev. of top of footing 436.5 to 439 ft

Footing width: 9.18 ft

Footing depth: 3 ft bgs

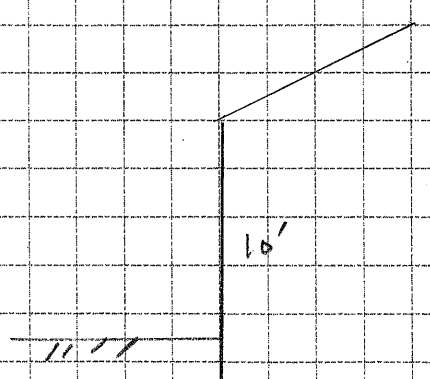
Reference borings: A-11-125 through A-11-130

Bearing Pressure: 2.0 ksf (minimum)

(1) Sta. 301+00 to 312+00

Borings A-11-125 through A-11-128, very stiff to hard clay overlying sandstone bedrock. Groundwater was at 15 ~ 17 ft bgs. PI < 30

use $c = 1.5$ ksf, $\varphi = 0$, $\gamma = 0.12$ kcf ($\bar{N} = 15$)



$q_{ult} = cN_c + \gamma D N_q + \frac{1}{2}\gamma B N_\gamma$

$N_c = 5.14$ $N_q = 1$ $N_\gamma = 0$

$\therefore q_{ult} = 1.5 \times 5.14 + 0.12 \times 3 = 8.07$ ksf

$q_{all} = 8.07/3 = 2.69$ ksf > minimum service bearing pressure demand

RW No. 5 (continued)

Boring A-11-129 and A-11-130 encountered 10 to 14 ft of stiff clay overlying sandstone bedrock. No free groundwater
PI = 14 to 28

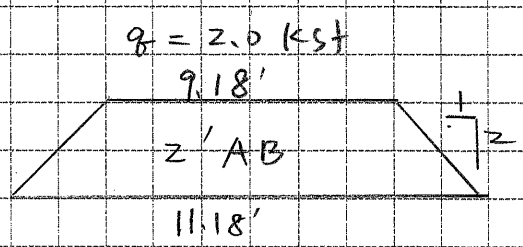
use $c = 1.0$ ksf, $\phi = 0$, $\gamma = 0.12$ ksf ($\bar{N} = 9$)

$q_{all} = q_{ult}/3 = (1 \times 5.14 + 0.12 \times 3)/3 = 1.83$ ksf < required 2.0 ksf

Overexcavate 2 ft of subsoil beneath the footing and replace with Class 3 AB

At the bottom of AB $q = 2.0 \times 9.18/(9.18 + 2) = 1.64$ ksf

q is less than soil bearing capacity of 1.83 ksf



RW No. 6A and 6B

Standard Type 1SWB (2005 standard drawing XS14-2208)

Max wall H = 10 ft. Sta. 315+60 to 320+29 6A
322+15 to 323+80 6B

Elev. of top of footing: 424.5 to 429 ft 6A
423 ft 6B

Footing width: 8'-6"

Footing depth: 3' bgs

Reference borings: A-11-135, A-11-136 6A
A-11-137 6B

Subsoils are stiff to very stiff clay, uc from 2 to 3.8 tsf and PP from 0.5 to 3 tsf for upper 30 ft. Groundwater was at 25 to 32 ft bgs.

The walls will be on the slope. About 5 to 7 ft fill will be needed for leveling grade for traffic lane widening.

Adopt c = 1.3 ksf, $\phi = 0$ ($\bar{N} = 11$)

Calculations are the same as for Retaing wall No. 4.

Recommend 2' overexcavation and replacement with Class 3 AB. below the footing.

PROJECT TITLE: RW No.2 - Sta 275 to 280.6

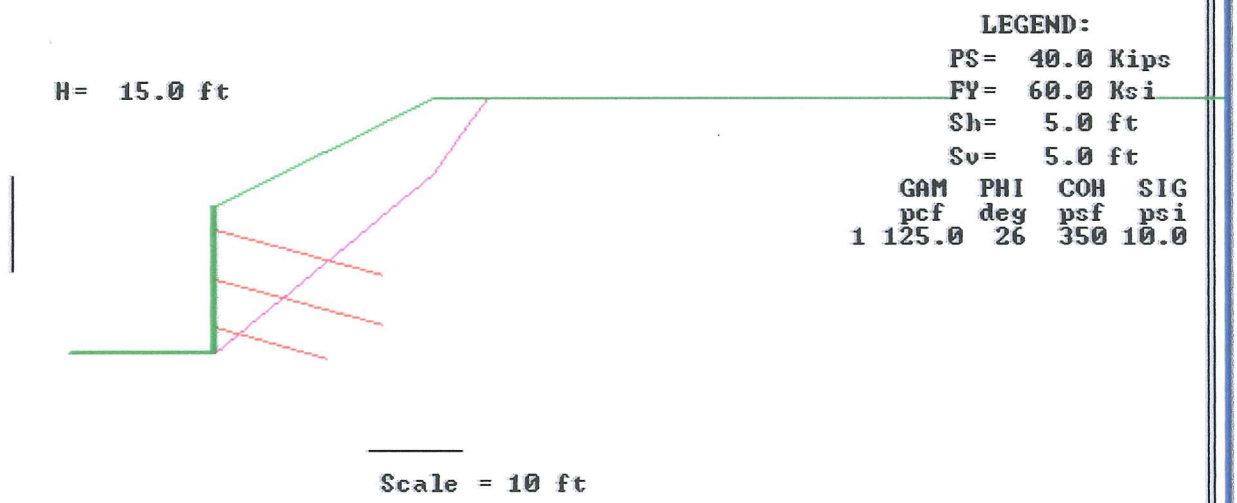
Date: 12-15-2011

SnailWin 5.10

File: RW No. 2- Sta 275 to 280.6

Minimum Factor of Safety = 1.55

28.0 ft Behind Wall Crest
At Wall Toe



LEGEND:

PS= 40.0 Kips
FY= 60.0 Ksi
Sh= 5.0 ft
Sv= 5.0 ft

	GAM pcf	PHI deg	COH psf	SIG psi
1	125.0	26	350	10.0

```
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*     DIVISION OF MATERIALS AND FOUNDATIONS      *
*   Office of Roadway Geotechnical Engineering   *
*    Date: 12-15-2011          Time: 14:42:39    *
**************************************************
```

Project Identification - RW No.2 - Sta 275 to 280.6

--------- WALL GEOMETRY ---------

Vertical Wall Height	=	15.0 ft	
Wall Batter	=	0.0 degree	
		Angle (Deg)	Length (Feet)
First Slope from Wallcrest.	=	26.0	25.0
Second Slope from 1st slope.	=	0.0	0.0
Third Slope from 2nd slope.	=	0.0	0.0
Fourth Slope from 3rd slope.	=	0.0	0.0
Fifth Slope from 3rd slope.	=	0.0	0.0
Sixth Slope from 3rd slope.	=	0.0	0.0
Seventh Slope Angle.	=	0.0	

--------- SLOPE BELOW THE WALL ---------

There is NO SLOPE BELOW THE TOE of the wall

--------- SURCHARGE ---------

There is NO SURCHARGE imposed on the system.

--------- OPTION #1 ---------

Ultimate Punching shear, Bond & Yield Stress are used.

--------- SOIL PARAMETERS ---------

Soil Layer	Unit Weight (Pcf)	Friction Angle (Degree)	Cohesion Intercept (Psf)	Bond* Stress (Psi)	Coordinates of Boundary XS1 (ft)	YS1 (ft)	XS2 (ft)	YS2 (ft)
1	125.0	26.0	350.0	10.0	0.0	0.0	0.0	0.0

* Ultimate bond Stress values also depend on BSF (Bond Stress Factor.)

--------- WATER SURFACE ---------

NO Water Table defined for this problem.

--------- SEARCH LIMIT ---------

The Search Limit is from 0.0 to 40.0 ft

You have chosen NOT TO LIMIT the search of failure planes to specific nodes.

--------- REINFORCEMENT PARAMETERS ---------

Number of Reinforcement Levels	=	3
Horizontal Spacing	=	5.0 ft
Yield Stress of Reinforcement	=	60.0 ksi
Diameter of Grouted Hole	=	6.0 in
Punching Shear	=	40.0 kips

---------- (Varying Reinforcement Parameters) ---------

Level	Length (ft)	Inclination (degrees)	Vertical Spacing (ft)	Bar Diameter (in)	Bond Stress Factor
1	18.0	15.0	2.5	1.00	0.75
2	18.0	15.0	5.0	1.00	0.75
3	12.0	15.0	5.0	1.00	0.75

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
Toe	2.618	4.0	51.8	6.5	89.9	11.9

Reinf. Stress at Level 1 = 11.431 Ksi (Pullout controls...)
2 = 11.435 Ksi (Pullout controls...)
3 = 8.514 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 2	1.978	8.0	67.1	20.5	89.9	0.0

Reinf. Stress at Level 1 = 14.283 Ksi (Pullout controls...)
2 = 16.432 Ksi (Pullout controls...)
3 = 12.029 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 3	1.800	12.0	60.1	24.1	89.9	0.0

Reinf. Stress at Level 1 = 13.856 Ksi (Pullout controls...)
2 = 16.953 Ksi (Pullout controls...)
3 = 12.851 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 4	1.665	16.0	43.5	13.2	64.9	15.1

Reinf. Stress at Level 1 = 10.007 Ksi (Pullout controls...)
2 = 15.080 Ksi (Pullout controls...)
3 = 12.810 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 5	1.666	20.0	51.1	31.8	89.9	0.0

Reinf. Stress at Level 1 = 12.191 Ksi (Pullout controls...)
2 = 16.647 Ksi (Pullout controls...)
3 = 13.326 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 6	1.609	24.0	47.2	35.4	89.9	0.0

Reinf. Stress at Level 1 = 11.293 Ksi (Pullout controls...)
2 = 16.443 Ksi (Pullout controls...)
3 = 13.537 Ksi (Pullout controls...)

```
          MINIMUM    DISTANCE    LOWER FAILURE   UPPER FAILURE
          SAFETY      BEHIND         PLANE           PLANE
          FACTOR     WALL TOE    ANGLE  LENGTH   ANGLE  LENGTH
                       (ft)      (deg)   (ft)    (deg)   (ft)

NODE 7
    1.546        28.0       39.0   28.8     54.3    9.6

  Reinf. Stress at Level  1 =   8.394 Ksi (Pullout controls...)
                          2 =  15.096 Ksi (Pullout controls...)
                          3 =  13.414 Ksi (Pullout controls...)

          MINIMUM    DISTANCE    LOWER FAILURE   UPPER FAILURE
          SAFETY      BEHIND         PLANE           PLANE
          FACTOR     WALL TOE    ANGLE  LENGTH   ANGLE  LENGTH
                       (ft)      (deg)   (ft)    (deg)   (ft)

NODE 8
    1.555        32.0       39.0   41.2     89.9    0.0

  Reinf. Stress at Level  1 =   8.346 Ksi (Pullout controls...)
                          2 =  15.009 Ksi (Pullout controls...)
                          3 =  13.337 Ksi (Pullout controls...)

          MINIMUM    DISTANCE    LOWER FAILURE   UPPER FAILURE
          SAFETY      BEHIND         PLANE           PLANE
          FACTOR     WALL TOE    ANGLE  LENGTH   ANGLE  LENGTH
                       (ft)      (deg)   (ft)    (deg)   (ft)

NODE 9
    1.580        36.0       35.8   44.4     89.9    0.0

  Reinf. Stress at Level  1 =   6.718 Ksi (Pullout controls...)
                          2 =  13.871 Ksi (Pullout controls...)
                          3 =  12.824 Ksi (Pullout controls...)

          MINIMUM    DISTANCE    LOWER FAILURE   UPPER FAILURE
          SAFETY      BEHIND         PLANE           PLANE
          FACTOR     WALL TOE    ANGLE  LENGTH   ANGLE  LENGTH
                       (ft)      (deg)   (ft)    (deg)   (ft)

NODE10
    1.620        40.0       26.0   17.8     37.1   30.1

  Reinf. Stress at Level  1 =   1.341 Ksi (Pullout controls...)
                          2 =  10.280 Ksi (Pullout controls...)
                          3 =  11.425 Ksi (Pullout controls...)


     ******************************************************************
     *                 For Factor of Safety = 1.0                     *
     *          Maximum Average Reinforcement Working Force:          *
     *                      0.000 Kips/level                          *
     ******************************************************************
```

PROJECT TITLE: RW No.2 - Sta 275 to 280.6

Date: 12-15-2011

SnailWin 3.10

File: RW No. 2- Sta 275 to 280.6 EQ

Minimum Factor of Safety = 1.15

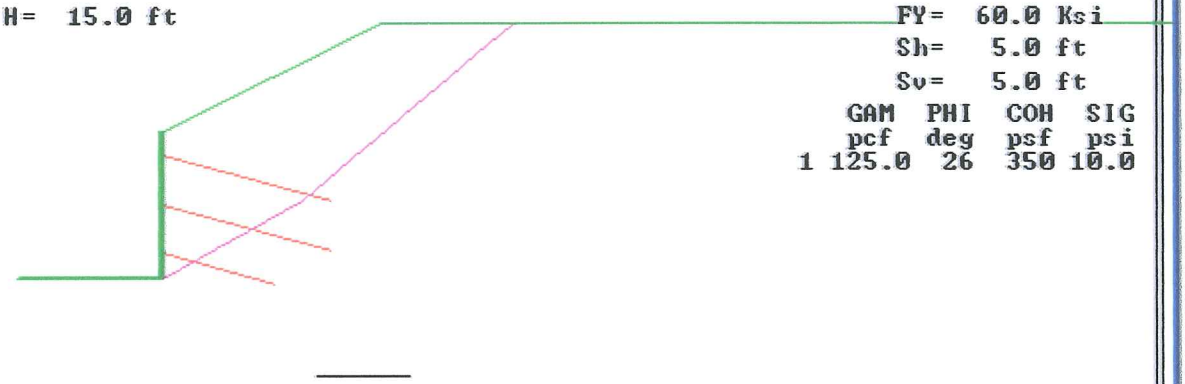
36.0 ft Behind Wall Crest
At Wall Toe

LEGEND:
Crit.Ac= 0.28g
Hoz. KH= 0.20g
Vrt.PKH= 0.00g

PS= 40.0 Kips
FY= 60.0 Ksi
Sh= 5.0 ft
Sv= 5.0 ft

	GAM pcf	PHI deg	COH psf	SIG psi
1	125.0	26	350	10.0

H= 15.0 ft



Scale = 10 ft

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*   Office of Roadway Geotechnical Engineering  *
*    Date: 12-15-2011          Time: 14:49:08   *
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Project Identification - RW No.2 - Sta 275 to 280.6

--------- WALL GEOMETRY ---------

Vertical Wall Height	=	15.0 ft	
Wall Batter	=	0.0 degree	
		Angle (Deg)	Length (Feet)
First Slope from Wallcrest.	=	26.0	25.0
Second Slope from 1st slope.	=	0.0	0.0
Third Slope from 2nd slope.	=	0.0	0.0
Fourth Slope from 3rd slope.	=	0.0	0.0
Fifth Slope from 3rd slope.	=	0.0	0.0
Sixth Slope from 3rd slope.	=	0.0	0.0
Seventh Slope Angle.	=	0.0	

--------- SLOPE BELOW THE WALL ---------

There is NO SLOPE BELOW THE TOE of the wall

--------- SURCHARGE ---------

There is NO SURCHARGE imposed on the system.

--------- OPTION #1 ---------

Ultimate Punching shear, Bond & Yield Stress are used.

--------- SOIL PARAMETERS ---------

Soil Layer	Unit Weight (Pcf)	Friction Angle (Degree)	Cohesion Intercept (Psf)	Bond* Stress (Psi)	Coordinates of Boundary XS1 (ft)	YS1 (ft)	XS2 (ft)	YS2 (ft)
1	125.0	26.0	350.0	10.0	0.0	0.0	0.0	0.0

* Ultimate bond Stress values also depend on BSF (Bond Stress Factor.)

--------- EARTHQUAKE ACCELERATION ---------

Horizontal Earthquake Coefficient = 0.20 (a/g)
Vertical Earthquake Coefficient = 0.00

--------- WATER SURFACE ---------

NO Water Table defined for this problem.

--------- SEARCH LIMIT ---------

The Search Limit is from 0.0 to 40.0 ft

You have chosen NOT TO LIMIT the search of failure planes to specific nodes.

--------- REINFORCEMENT PARAMETERS ---------

Number of Reinforcement Levels = 3
Horizontal Spacing = 5.0 ft
Yield Stress of Reinforcement = 60.0 ksi
Diameter of Grouted Hole = 6.0 in
Punching Shear = 40.0 kips

---------- (Varying Reinforcement Parameters) ---------

Level	Length (ft)	Inclination (degrees)	Vertical Spacing (ft)	Bar Diameter (in)	Bond Stress Factor
1	18.0	15.0	2.5	1.00	0.75
2	18.0	15.0	5.0	1.00	0.75
3	12.0	15.0	5.0	1.00	0.75

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
Toe	2.089	4.0	51.8	6.5	89.9	11.9

Reinf. Stress at Level 1 = 14.324 Ksi (Pullout controls...)
2 = 14.329 Ksi (Pullout controls...)
3 = 10.669 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 2	1.783	8.0	67.1	20.5	89.9	0.0

Reinf. Stress at Level 1 = 15.845 Ksi (Pullout controls...)
2 = 18.228 Ksi (Pullout controls...)
3 = 13.344 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 3	1.571	12.0	60.1	24.1	89.9	0.0

Reinf. Stress at Level 1 = 15.875 Ksi (Pullout controls...)
2 = 19.422 Ksi (Pullout controls...)
3 = 14.722 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 4	1.372	16.0	43.5	13.2	64.9	15.1

Reinf. Stress at Level 1 = 12.144 Ksi (Pullout controls...)
2 = 18.302 Ksi (Pullout controls...)
3 = 15.546 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 5	1.349	20.0	31.8	9.4	58.8	23.2

Reinf. Stress at Level 1 = 10.892 Ksi (Pullout controls...)
2 = 15.214 Ksi (Pullout controls...)
3 = 14.545 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 6	1.257	24.0	33.0	14.3	56.6	21.8

Reinf. Stress at Level 1 = 8.086 Ksi (Pullout controls...)
2 = 16.374 Ksi (Pullout controls...)
3 = 15.765 Ksi (Pullout controls...)

```
          MINIMUM    DISTANCE    LOWER FAILURE   UPPER FAILURE
          SAFETY      BEHIND         PLANE           PLANE
          FACTOR     WALL TOE    ANGLE  LENGTH   ANGLE  LENGTH
                       (ft)      (deg)   (ft)    (deg)   (ft)

NODE 7
    1.193        28.0       29.1   16.0     52.4   22.9

  Reinf. Stress at Level  1 =   5.196 Ksi (Pullout controls...)
                          2 =  15.530 Ksi (Pullout controls...)
                          3 =  16.037 Ksi (Pullout controls...)

          MINIMUM    DISTANCE    LOWER FAILURE   UPPER FAILURE
          SAFETY      BEHIND         PLANE           PLANE
          FACTOR     WALL TOE    ANGLE  LENGTH   ANGLE  LENGTH
                       (ft)      (deg)   (ft)    (deg)   (ft)

NODE 8
    1.161        32.0       31.3   15.0     43.4   26.4

  Reinf. Stress at Level  1 =   6.803 Ksi (Pullout controls...)
                          2 =  17.011 Ksi (Pullout controls...)
                          3 =  16.837 Ksi (Pullout controls...)

          MINIMUM    DISTANCE    LOWER FAILURE   UPPER FAILURE
          SAFETY      BEHIND         PLANE           PLANE
          FACTOR     WALL TOE    ANGLE  LENGTH   ANGLE  LENGTH
                       (ft)      (deg)   (ft)    (deg)   (ft)

NODE 9
    1.153        36.0       28.4   16.4     40.1   28.2

  Reinf. Stress at Level  1 =   4.301 Ksi (Pullout controls...)
                          2 =  15.741 Ksi (Pullout controls...)
                          3 =  16.492 Ksi (Pullout controls...)

          MINIMUM    DISTANCE    LOWER FAILURE   UPPER FAILURE
          SAFETY      BEHIND         PLANE           PLANE
          FACTOR     WALL TOE    ANGLE  LENGTH   ANGLE  LENGTH
                       (ft)      (deg)   (ft)    (deg)   (ft)

NODE10
    1.158        40.0       26.0   17.8     37.1   30.1

  Reinf. Stress at Level  1 =   1.876 Ksi (Pullout controls...)
                          2 =  14.379 Ksi (Pullout controls...)
                          3 =  15.981 Ksi (Pullout controls...)


     ******************************************************************
     *                 For Factor of Safety = 1.0                     *
     *          Maximum Average Reinforcement Working Force:          *
     *                      4.783 Kips/level                          *
     ******************************************************************
```

PROJECT TITLE: RW No.2 - Sta 281.4 to 291.2

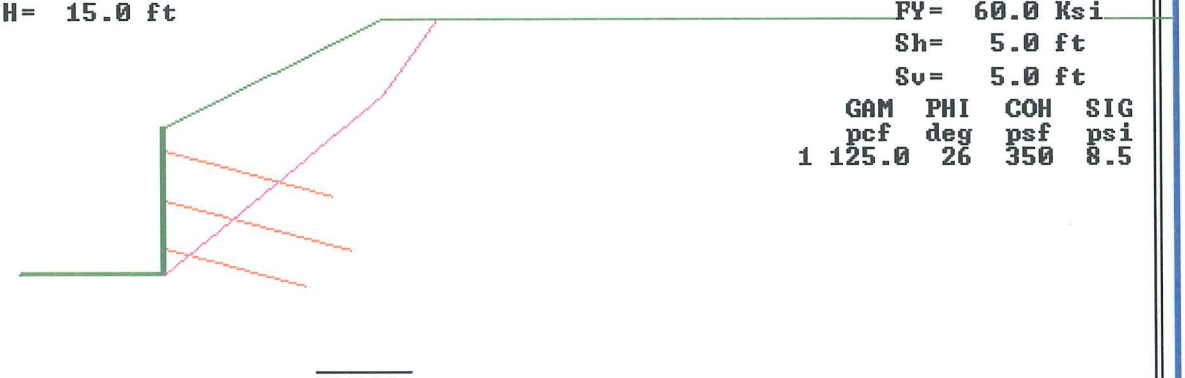
Date: 12-23-2011

SnailWin 5.10 File: RW No. 2- Sta 281.4 to 291.2

Minimum Factor of Safety = 1.55

28.0 ft Behind Wall Crest
At Wall Toe

H= 15.0 ft



LEGEND:

PS= 40.0 Kips
PY= 60.0 Ksi
Sh= 5.0 ft
Sv= 5.0 ft

	GAM pcf	PHI deg	COH psf	SIG psi
1	125.0	26	350	8.5

Scale = 10 ft

```
*************************************************
*    CALIFORNIA DEPARTMENT OF TRANSPORTATION    *
*          ENGINEERING SERVICE CENTER           *
*     DIVISION OF MATERIALS AND FOUNDATIONS     *
*   Office of Roadway Geotechnical Engineering  *
*    Date: 12-15-2011          Time: 14:54:03   *
*************************************************
```

Project Identification - RW No.2 - Sta 275 to 280.6

--------- WALL GEOMETRY ---------

Vertical Wall Height	=	15.0 ft	
Wall Batter	=	0.0 degree	
		Angle (Deg)	Length (Feet)
First Slope from Wallcrest.	=	26.0	25.0
Second Slope from 1st slope.	=	0.0	0.0
Third Slope from 2nd slope.	=	0.0	0.0
Fourth Slope from 3rd slope.	=	0.0	0.0
Fifth Slope from 3rd slope.	=	0.0	0.0
Sixth Slope from 3rd slope.	=	0.0	0.0
Seventh Slope Angle.	=	0.0	

--------- SLOPE BELOW THE WALL ---------

There is NO SLOPE BELOW THE TOE of the wall

--------- SURCHARGE ---------

There is NO SURCHARGE imposed on the system.

--------- OPTION #1 ---------

Ultimate Punching shear, Bond & Yield Stress are used.

--------- SOIL PARAMETERS ---------

Soil Layer	Unit Weight (Pcf)	Friction Angle (Degree)	Cohesion Intercept (Psf)	Bond* Stress (Psi)	Coordinates of Boundary XS1 (ft)	YS1 (ft)	XS2 (ft)	YS2 (ft)
1	125.0	26.0	350.0	8.5	0.0	0.0	0.0	0.0

* Ultimate bond Stress values also depend on BSF (Bond Stress Factor.)

--------- WATER SURFACE ---------

NO Water Table defined for this problem.

--------- SEARCH LIMIT ---------

The Search Limit is from 0.0 to 40.0 ft

You have chosen NOT TO LIMIT the search of failure planes to specific nodes.

--------- REINFORCEMENT PARAMETERS ---------

Number of Reinforcement Levels	=	3
Horizontal Spacing	=	5.0 ft
Yield Stress of Reinforcement	=	60.0 ksi
Diameter of Grouted Hole	=	6.0 in
Punching Shear	=	40.0 kips

---------- (Varying Reinforcement Parameters) ---------

Level	Length (ft)	Inclination (degrees)	Vertical Spacing (ft)	Bar Diameter (in)	Bond Stress Factor
1	18.0	15.0	2.5	1.00	0.75
2	20.0	15.0	5.0	1.00	0.75
3	15.0	15.0	5.0	1.00	0.75

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
Toe	2.706	4.0	51.8	6.5	89.9	11.9

Reinf. Stress at Level 1 = 9.399 Ksi (Pullout controls...)
2 = 10.759 Ksi (Pullout controls...)
3 = 9.036 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 2	1.954	8.0	67.1	20.5	89.9	0.0

Reinf. Stress at Level 1 = 12.292 Ksi (Pullout controls...)
2 = 16.021 Ksi (Pullout controls...)
3 = 13.171 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 3	1.782	12.0	60.1	24.1	89.9	0.0

Reinf. Stress at Level 1 = 11.899 Ksi (Pullout controls...)
2 = 16.619 Ksi (Pullout controls...)
3 = 14.127 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 4	1.669	16.0	43.5	13.2	64.9	15.1

Reinf. Stress at Level 1 = 8.489 Ksi (Pullout controls...)
2 = 14.993 Ksi (Pullout controls...)
3 = 14.168 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 5	1.658	20.0	51.1	31.8	89.9	0.0

Reinf. Stress at Level 1 = 10.417 Ksi (Pullout controls...)
2 = 16.439 Ksi (Pullout controls...)
3 = 14.709 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 6	1.604	24.0	47.2	35.4	89.9	0.0

Reinf. Stress at Level 1 = 9.627 Ksi (Pullout controls...)
2 = 16.307 Ksi (Pullout controls...)
3 = 14.974 Ksi (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 7					
1.549	28.0	39.0	28.8	54.3	9.6

Reinf. Stress at Level 1 = 7.120 Ksi (Pullout controls...)
2 = 15.173 Ksi (Pullout controls...)
3 = 14.932 Ksi (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 8					
1.558	32.0	39.0	41.2	89.9	0.0

Reinf. Stress at Level 1 = 7.079 Ksi (Pullout controls...)
2 = 15.086 Ksi (Pullout controls...)
3 = 14.847 Ksi (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 9					
1.587	36.0	35.8	44.4	89.9	0.0

Reinf. Stress at Level 1 = 5.687 Ksi (Pullout controls...)
2 = 14.057 Ksi (Pullout controls...)
3 = 14.327 Ksi (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE10					
1.633	40.0	33.0	47.7	89.9	0.0

Reinf. Stress at Level 1 = 4.370 Ksi (Pullout controls...)
2 = 12.966 Ksi (Pullout controls...)
3 = 13.692 Ksi (Pullout controls...)

```
*****************************************************************
*                For Factor of Safety = 1.0                     *
*         Maximum Average Reinforcement Working Force:          *
*                     0.000 Kips/level                          *
*****************************************************************
```

PROJECT TITLE: RW No.2 - Sta 281.4 to 291.2

Date: 12-23-2011

SnailWin 5.10 - RW No. 2- Sta 281.4 to 291.2 EQ

Minimum Factor of Safety = 1.17

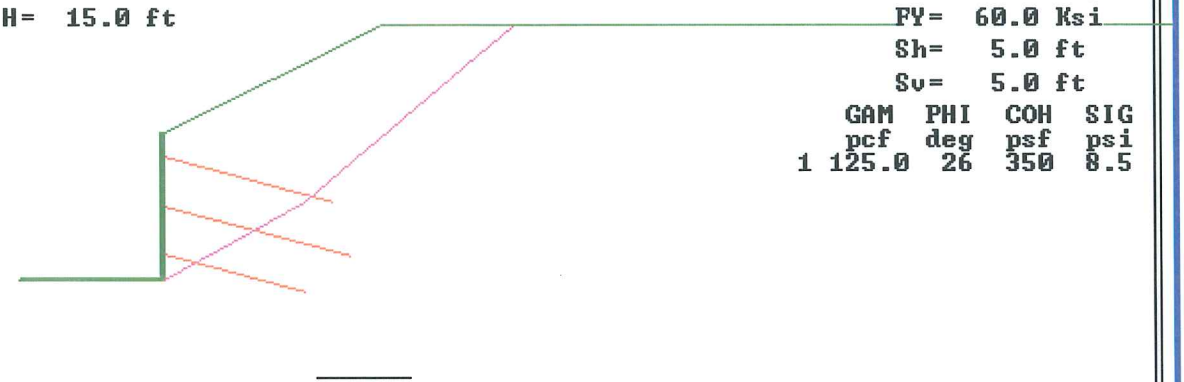
36.0 ft Behind Wall Crest
At Wall Toe

LEGEND:
Crit.Ac= 0.29g
Hoz. KH= 0.20g
Vrt.PKH= 0.00g

PS= 40.0 Kips
FY= 60.0 Ksi
Sh= 5.0 ft
Sv= 5.0 ft

	GAM pcf	PHI deg	COH psf	SIG psi
1	125.0	26	350	8.5

H= 15.0 ft



Scale = 10 ft

File: RW No. 2- Sta 281.4 to 291.2 EQ

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**************************************************
*    CALIFORNIA DEPARTMENT OF TRANSPORTATION     *
*          ENGINEERING SERVICE CENTER            *
*     DIVISION OF MATERIALS AND FOUNDATIONS      *
*   Office of Roadway Geotechnical Engineering   *
*    Date: 12-15-2011          Time: 14:56:22    *
**************************************************
```

Project Identification - RW No.2 - Sta 275 to 280.6

--------- WALL GEOMETRY ---------

Vertical Wall Height	=	15.0 ft	
Wall Batter	=	0.0 degree	
		Angle (Deg)	Length (Feet)
First Slope from Wallcrest.	=	26.0	25.0
Second Slope from 1st slope.	=	0.0	0.0
Third Slope from 2nd slope.	=	0.0	0.0
Fourth Slope from 3rd slope.	=	0.0	0.0
Fifth Slope from 3rd slope.	=	0.0	0.0
Sixth Slope from 3rd slope.	=	0.0	0.0
Seventh Slope Angle.	=	0.0	

--------- SLOPE BELOW THE WALL ---------

There is NO SLOPE BELOW THE TOE of the wall

--------- SURCHARGE ---------

There is NO SURCHARGE imposed on the system.

--------- OPTION #1 ---------

Ultimate Punching shear, Bond & Yield Stress are used.

--------- SOIL PARAMETERS ---------

Soil Layer	Unit Weight (Pcf)	Friction Angle (Degree)	Cohesion Intercept (Psf)	Bond* Stress (Psi)	Coordinates of Boundary XS1 (ft)	YS1 (ft)	XS2 (ft)	YS2 (ft)
1	125.0	26.0	350.0	8.5	0.0	0.0	0.0	0.0

* Ultimate bond Stress values also depend on BSF (Bond Stress Factor.)

File: RW No. 2- Sta 281.4 to 291.2 EQ

--------- EARTHQUAKE ACCELERATION ---------

Horizontal Earthquake Coefficient = 0.20 (a/g)
Vertical Earthquake Coefficient = 0.00

--------- WATER SURFACE ---------

NO Water Table defined for this problem.

--------- SEARCH LIMIT ---------

The Search Limit is from 0.0 to 40.0 ft

You have chosen NOT TO LIMIT the search of failure planes to specific nodes.

--------- REINFORCEMENT PARAMETERS ---------

Number of Reinforcement Levels = 3
Horizontal Spacing = 5.0 ft
Yield Stress of Reinforcement = 60.0 ksi
Diameter of Grouted Hole = 6.0 in
Punching Shear = 40.0 kips

---------- (Varying Reinforcement Parameters) ---------

Level	Length (ft)	Inclination (degrees)	Vertical Spacing (ft)	Bar Diameter (in)	Bond Stress Factor
1	18.0	15.0	2.5	1.00	0.75
2	20.0	15.0	5.0	1.00	0.75
3	15.0	15.0	5.0	1.00	0.75

File: RW No. 2- Sta 281.4 to 291.2 EQ

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
Toe	2.149	4.0	51.8	6.5	89.9	11.9

Reinf. Stress at Level 1 = 11.834 Ksi (Pullout controls...)
2 = 13.546 Ksi (Pullout controls...)
3 = 11.377 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 2	1.760	8.0	67.1	20.5	89.9	0.0

Reinf. Stress at Level 1 = 13.649 Ksi (Pullout controls...)
2 = 17.789 Ksi (Pullout controls...)
3 = 14.625 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 3	1.554	12.0	60.1	24.1	89.9	0.0

Reinf. Stress at Level 1 = 13.644 Ksi (Pullout controls...)
2 = 19.056 Ksi (Pullout controls...)
3 = 16.198 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 4	1.375	16.0	43.5	13.2	64.9	15.1

Reinf. Stress at Level 1 = 10.301 Ksi (Pullout controls...)
2 = 18.194 Ksi (Pullout controls...)
3 = 17.192 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 5	1.362	20.0	31.8	9.4	58.8	23.2

Reinf. Stress at Level 1 = 9.165 Ksi (Pullout controls...)
2 = 15.498 Ksi (Pullout controls...)
3 = 16.283 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 6	1.277	24.0	33.0	14.3	56.6	21.8

Reinf. Stress at Level 1 = 6.769 Ksi (Pullout controls...)
2 = 16.582 Ksi (Pullout controls...)
3 = 17.510 Ksi (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 7					
1.199	28.0	34.8	13.6	47.2	24.7

Reinf. Stress at Level 1 = 7.797 Ksi (Pullout controls...)
2 = 18.281 Ksi (Pullout controls...)
3 = 18.854 Ksi (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 8					
1.171	32.0	31.3	15.0	43.4	26.4

Reinf. Stress at Level 1 = 5.730 Ksi (Pullout controls...)
2 = 17.464 Ksi (Pullout controls...)
3 = 18.885 Ksi (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 9					
1.165	36.0	28.4	16.4	40.1	28.2

Reinf. Stress at Level 1 = 3.616 Ksi (Pullout controls...)
2 = 16.383 Ksi (Pullout controls...)
3 = 18.589 Ksi (Pullout controls...)

MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE10					
1.173	40.0	26.0	17.8	37.1	30.1

Reinf. Stress at Level 1 = 1.575 Ksi (Pullout controls...)
2 = 15.198 Ksi (Pullout controls...)
3 = 18.107 Ksi (Pullout controls...)

```
*****************************************************************
*                 For Factor of Safety = 1.0                    *
*         Maximum Average Reinforcement Working Force:          *
*                     4.783 Kips/level                          *
*****************************************************************
```

PROJECT TITLE: RW No.2 - Sta 275 to 280.6 Two Tier Wall

Date: 12-20-2011 File: RW No.2 Sta 275 to 280.6 Two Tier Wall

SnailWrn 3.10

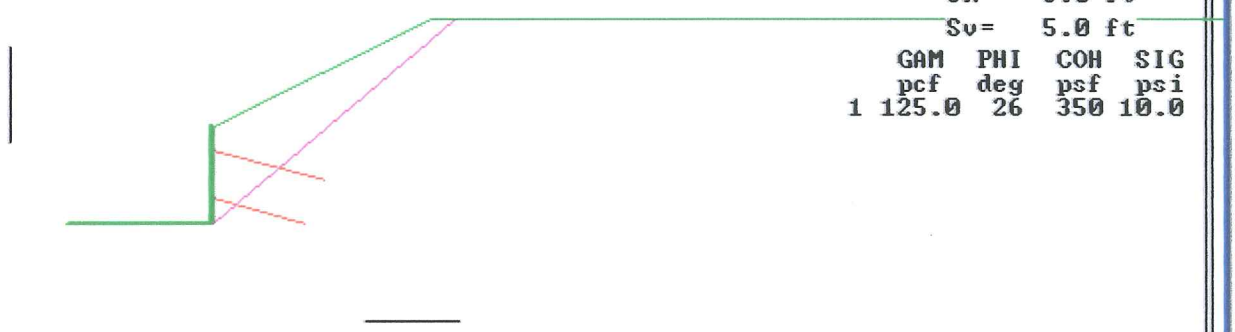
Minimum Factor of Safety = 1.91

25.0 ft Behind Wall Crest
At Wall Toe

LEGEND:
PS= 40.0 Kips
FY= 60.0 Ksi
Sh= 5.0 ft
Sv= 5.0 ft

	GAM pcf	PHI deg	COH psf	SIG psi
1	125.0	26	350	10.0

H= 10.0 ft



Scale = 10 ft

File: RW No. 2- Sta 275 to 280.6 Two Tier Wall

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**************************************************
*    CALIFORNIA DEPARTMENT OF TRANSPORTATION     *
*          ENGINEERING SERVICE CENTER            *
*     DIVISION OF MATERIALS AND FOUNDATIONS      *
*   Office of Roadway Geotechnical Engineering   *
*    Date: 12-20-2011          Time: 17:22:41    *
**************************************************
```

Project Identification - RW No.2 - Sta 275 to 280.6 Two Tier Wall

--------- WALL GEOMETRY ---------

Vertical Wall Height	=	10.0 ft	
Wall Batter	=	0.0 degree	
		Angle (Deg)	Length (Feet)
First Slope from Wallcrest.	=	26.0	25.0
Second Slope from 1st slope.	=	0.0	0.0
Third Slope from 2nd slope.	=	0.0	0.0
Fourth Slope from 3rd slope.	=	0.0	0.0
Fifth Slope from 3rd slope.	=	0.0	0.0
Sixth Slope from 3rd slope.	=	0.0	0.0
Seventh Slope Angle.	=	0.0	

--------- SLOPE BELOW THE WALL ---------

There is NO SLOPE BELOW THE TOE of the wall

--------- SURCHARGE ---------

There is NO SURCHARGE imposed on the system.

--------- OPTION #1 ---------

Ultimate Punching shear, Bond & Yield Stress are used.

--------- SOIL PARAMETERS ---------

Soil Layer	Unit Weight (Pcf)	Friction Angle (Degree)	Cohesion Intercept (Psf)	Bond* Stress (Psi)	Coordinates of Boundary XS1 (ft)	YS1 (ft)	XS2 (ft)	YS2 (ft)
1	125.0	26.0	350.0	10.0	0.0	0.0	0.0	0.0

* Ultimate bond Stress values also depend on BSF (Bond Stress Factor.)

File: RW No. 2- Sta 275 to 280.6 Two Tier Wall

--------- WATER SURFACE ---------

NO Water Table defined for this problem.

--------- SEARCH LIMIT ---------

The Search Limit is from 0.0 to 25.0 ft

You have chosen NOT TO LIMIT the search of failure planes to specific nodes.

--------- REINFORCEMENT PARAMETERS ---------

Number of Reinforcement Levels	=	2
Horizontal Spacing	=	5.0 ft
Yield Stress of Reinforcement	=	60.0 ksi
Diameter of Grouted Hole	=	6.0 in
Punching Shear	=	40.0 kips

---------- (Varying Reinforcement Parameters) ---------

Level	Length (ft)	Inclination (degrees)	Vertical Spacing (ft)	Bar Diameter (in)	Bond Stress Factor
1	12.0	15.0	2.5	1.00	0.75
2	10.0	15.0	5.0	1.00	0.75

File: RW No. 2- Sta 275 to 280.6 Two Tier Wall

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
Toe	2.928	2.5	69.6	7.2	89.9	4.5

Reinf. Stress at Level 1 = 6.943 Ksi (Pullout controls...)
2 = 6.733 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 2	2.791	5.0	57.3	7.4	80.9	6.3

Reinf. Stress at Level 1 = 6.057 Ksi (Pullout controls...)
2 = 6.641 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 3	2.668	7.5	24.5	3.3	69.9	13.1

Reinf. Stress at Level 1 = 5.712 Ksi (Pullout controls...)
2 = 5.490 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 4	2.464	10.0	26.4	3.3	62.4	15.1

Reinf. Stress at Level 1 = 5.630 Ksi (Pullout controls...)
2 = 5.958 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 5	2.042	12.5	52.2	20.4	89.9	0.0

Reinf. Stress at Level 1 = 7.414 Ksi (Pullout controls...)
2 = 8.818 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 6	2.010	15.0	49.1	22.9	89.9	0.0

Reinf. Stress at Level 1 = 7.028 Ksi (Pullout controls...)
2 = 8.789 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)

```
NODE 7
     2.000        17.5       46.6   25.5     89.9    0.0

  Reinf. Stress at Level  1 =   6.641 Ksi (Pullout controls...)
                          2 =   8.694 Ksi (Pullout controls...)

          MINIMUM    DISTANCE    LOWER FAILURE   UPPER FAILURE
          SAFETY      BEHIND         PLANE           PLANE
          FACTOR     WALL TOE    ANGLE  LENGTH   ANGLE  LENGTH
                       (ft)      (deg)   (ft)    (deg)   (ft)

NODE 8
     1.994        20.0       44.6   28.1     89.9    0.0

  Reinf. Stress at Level  1 =   6.300 Ksi (Pullout controls...)
                          2 =   8.598 Ksi (Pullout controls...)

          MINIMUM    DISTANCE    LOWER FAILURE   UPPER FAILURE
          SAFETY      BEHIND         PLANE           PLANE
          FACTOR     WALL TOE    ANGLE  LENGTH   ANGLE  LENGTH
                       (ft)      (deg)   (ft)    (deg)   (ft)

NODE 9
     1.993        22.5       43.0   30.7     89.9    0.0

  Reinf. Stress at Level  1 =   5.989 Ksi (Pullout controls...)
                          2 =   8.498 Ksi (Pullout controls...)

          MINIMUM    DISTANCE    LOWER FAILURE   UPPER FAILURE
          SAFETY      BEHIND         PLANE           PLANE
          FACTOR     WALL TOE    ANGLE  LENGTH   ANGLE  LENGTH
                       (ft)      (deg)   (ft)    (deg)   (ft)

NODE10
     1.907        25.0       40.0   32.6     89.9    0.0

  Reinf. Stress at Level  1 =   5.643 Ksi (Pullout controls...)
                          2 =   8.677 Ksi (Pullout controls...)


     ******************************************************************
     *                 For Factor of Safety = 1.0                     *
     *          Maximum Average Reinforcement Working Force:          *
     *                      0.000 Kips/level                          *
     ******************************************************************
```

PROJECT TITLE: RW No.2 - Sta 275 to 280.6 Two Tier Wall EQ

Date: 12-20-2011 File: RW No.2- Sta 275 to 280.6 Two Tier Wall E

Sndlwin 9.10

Minimum Factor of Safety = 1.39

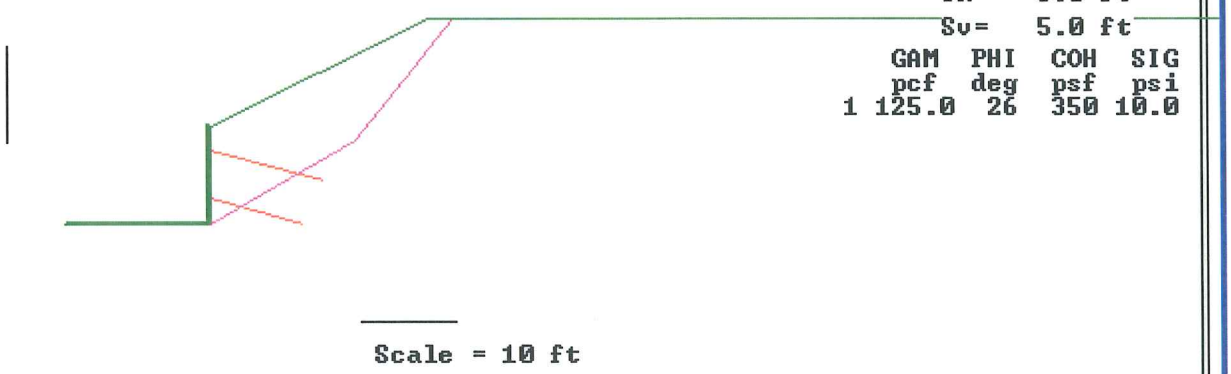
25.0 ft Behind Wall Crest
At Wall Toe

LEGEND:
Crit.Ac= 0.42g
Hoz. KH= 0.20g
Vrt.PKH= 0.00g

PS= 40.0 Kips
FY= 60.0 Ksi
Sh= 5.0 ft
Sv= 5.0 ft

H= 10.0 ft

	GAM pcf	PHI deg	COH psf	SIG psi
1	125.0	26	350	10.0



Scale = 10 ft

File: RW No. 2- Sta 275 to 280.6 Two Tier Wall EQ

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**************************************************
*    CALIFORNIA DEPARTMENT OF TRANSPORTATION     *
*          ENGINEERING SERVICE CENTER            *
*     DIVISION OF MATERIALS AND FOUNDATIONS      *
*   Office of Roadway Geotechnical Engineering   *
*    Date: 12-20-2011          Time: 18:41:17    *
**************************************************
```

Project Identification - RW No.2 - Sta 275 to 280.6 Two Tier Wall EQ

--------- WALL GEOMETRY ---------

Vertical Wall Height	=	10.0 ft	
Wall Batter	=	0.0 degree	
		Angle (Deg)	Length (Feet)
First Slope from Wallcrest.	=	26.0	25.0
Second Slope from 1st slope.	=	0.0	0.0
Third Slope from 2nd slope.	=	0.0	0.0
Fourth Slope from 3rd slope.	=	0.0	0.0
Fifth Slope from 3rd slope.	=	0.0	0.0
Sixth Slope from 3rd slope.	=	0.0	0.0
Seventh Slope Angle.	=	0.0	

--------- SLOPE BELOW THE WALL ---------

There is NO SLOPE BELOW THE TOE of the wall

--------- SURCHARGE ---------

There is NO SURCHARGE imposed on the system.

--------- OPTION #1 ---------

Ultimate Punching shear, Bond & Yield Stress are used.

--------- SOIL PARAMETERS ---------

Soil Layer	Unit Weight (Pcf)	Friction Angle (Degree)	Cohesion Intercept (Psf)	Bond* Stress (Psi)	Coordinates of Boundary XS1 (ft)	YS1 (ft)	XS2 (ft)	YS2 (ft)
1	125.0	26.0	350.0	10.0	0.0	0.0	0.0	0.0

* Ultimate bond Stress values also depend on BSF (Bond Stress Factor.)

File: RW No. 2- Sta 275 to 280.6 Two Tier Wall EQ

--------- EARTHQUAKE ACCELERATION ---------

Horizontal Earthquake Coefficient = 0.20 (a/g)
Vertical Earthquake Coefficient = 0.00

--------- WATER SURFACE ---------

NO Water Table defined for this problem.

--------- SEARCH LIMIT ---------

The Search Limit is from 0.0 to 25.0 ft

You have chosen NOT TO LIMIT the search of failure planes to specific nodes.

--------- REINFORCEMENT PARAMETERS ---------

Number of Reinforcement Levels	=	2
Horizontal Spacing	=	5.0 ft
Yield Stress of Reinforcement	=	60.0 ksi
Diameter of Grouted Hole	=	6.0 in
Punching Shear	=	40.0 kips

---------- (Varying Reinforcement Parameters) ---------

Level	Length (ft)	Inclination (degrees)	Vertical Spacing (ft)	Bar Diameter (in)	Bond Stress Factor
1	12.0	15.0	2.5	1.00	0.75
2	10.0	15.0	5.0	1.00	0.75

File: RW No. 2- Sta 275 to 280.6 Two Tier Wall EQ

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
Toe	2.604	2.5	69.6	7.2	89.9	4.5

Reinf. Stress at Level 1 = 7.807 Ksi (Pullout controls...)
2 = 7.570 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 2	2.244	5.0	54.1	7.7	85.4	6.2

Reinf. Stress at Level 1 = 7.060 Ksi (Pullout controls...)
2 = 8.115 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 3	2.016	7.5	42.3	8.1	79.6	8.3

Reinf. Stress at Level 1 = 6.119 Ksi (Pullout controls...)
2 = 8.362 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 4	1.897	10.0	26.4	3.3	62.4	15.1

Reinf. Stress at Level 1 = 7.312 Ksi (Pullout controls...)
2 = 7.737 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 5	1.718	12.5	52.2	20.4	89.9	0.0

Reinf. Stress at Level 1 = 8.814 Ksi (Pullout controls...)
2 = 10.484 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 6	1.649	15.0	34.7	9.1	58.3	14.3

Reinf. Stress at Level 1 = 5.334 Ksi (Pullout controls...)
2 = 9.567 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)

```
NODE 7
     1.571        17.5       27.9   11.9     61.7   14.7

  Reinf. Stress at Level  1 =   3.113 Ksi (Pullout controls...)
                          2 =   9.286 Ksi (Pullout controls...)

           MINIMUM    DISTANCE    LOWER FAILURE   UPPER FAILURE
           SAFETY      BEHIND         PLANE           PLANE
           FACTOR     WALL TOE    ANGLE  LENGTH   ANGLE  LENGTH
                        (ft)      (deg)   (ft)    (deg)   (ft)

NODE 8
     1.506        20.0       29.4   16.1     63.2   13.3

  Reinf. Stress at Level  1 =   3.831 Ksi (Pullout controls...)
                          2 =   9.881 Ksi (Pullout controls...)

           MINIMUM    DISTANCE    LOWER FAILURE   UPPER FAILURE
           SAFETY      BEHIND         PLANE           PLANE
           FACTOR     WALL TOE    ANGLE  LENGTH   ANGLE  LENGTH
                        (ft)      (deg)   (ft)    (deg)   (ft)

NODE 9
     1.480        22.5       29.2   12.9     52.5   18.5

  Reinf. Stress at Level  1 =   3.808 Ksi (Pullout controls...)
                          2 =  10.025 Ksi (Pullout controls...)

           MINIMUM    DISTANCE    LOWER FAILURE   UPPER FAILURE
           SAFETY      BEHIND         PLANE           PLANE
           FACTOR     WALL TOE    ANGLE  LENGTH   ANGLE  LENGTH
                        (ft)      (deg)   (ft)    (deg)   (ft)

NODE10
     1.387        25.0       29.2   17.2     51.5   16.1

  Reinf. Stress at Level  1 =   4.065 Ksi (Pullout controls...)
                          2 =  10.702 Ksi (Pullout controls...)

      ******************************************************************
      *                 For Factor of Safety = 1.0                     *
      *          Maximum Average Reinforcement Working Force:          *
      *                      0.000 Kips/level                          *
      ******************************************************************
```

PROJECT TITLE: RW No.2 - Sta 281.4 to 291.2 Two Tier Wall

Date: 12-22-2011 File: RW No.2- Sta 281.4 to 291.2 Two Tier Wall

Shallwin 9.10

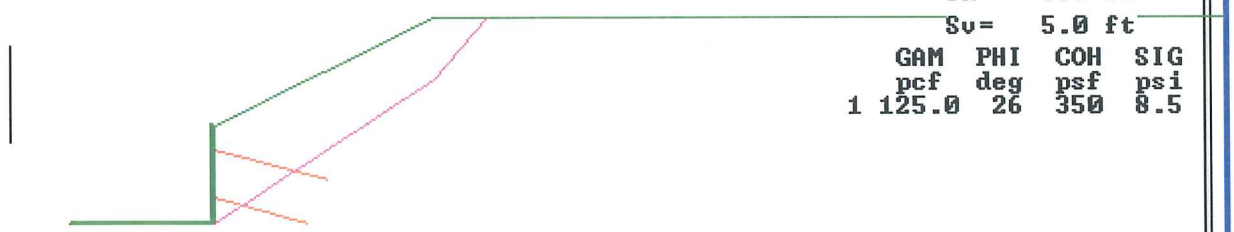
Minimum Factor of Safety = 1.81

28.0 ft Behind Wall Crest
At Wall Toe

LEGEND:
PS= 40.0 Kips
PY= 60.0 Ksi
Sh= 5.0 ft
Sv= 5.0 ft

	GAM pcf	PHI deg	COH psf	SIG psi
1	125.0	26	350	8.5

H= 10.0 ft



Scale = 10 ft

File: RW No. 2- Sta 281.4 to 291.2 Two Tier Wall

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*    CALIFORNIA DEPARTMENT OF TRANSPORTATION    *
*          ENGINEERING SERVICE CENTER           *
*     DIVISION OF MATERIALS AND FOUNDATIONS     *
*   Office of Roadway Geotechnical Engineering  *
*    Date: 12-20-2011          Time: 18:55:22   *
*************************************************
```

Project Identification - RW No.2 - Sta 275 to 280.6 Two Tier Wall

--------- WALL GEOMETRY ---------

Vertical Wall Height	=	10.0 ft	
Wall Batter	=	0.0 degree	
		Angle (Deg)	Length (Feet)
First Slope from Wallcrest.	=	26.0	25.0
Second Slope from 1st slope.	=	0.0	0.0
Third Slope from 2nd slope.	=	0.0	0.0
Fourth Slope from 3rd slope.	=	0.0	0.0
Fifth Slope from 3rd slope.	=	0.0	0.0
Sixth Slope from 3rd slope.	=	0.0	0.0
Seventh Slope Angle.	=	0.0	

--------- SLOPE BELOW THE WALL ---------

There is NO SLOPE BELOW THE TOE of the wall

--------- SURCHARGE ---------

There is NO SURCHARGE imposed on the system.

--------- OPTION #1 ---------

Ultimate Punching shear, Bond & Yield Stress are used.

--------- SOIL PARAMETERS ---------

Soil Layer	Unit Weight (Pcf)	Friction Angle (Degree)	Cohesion Intercept (Psf)	Bond* Stress (Psi)	Coordinates of Boundary XS1 (ft)	YS1 (ft)	XS2 (ft)	YS2 (ft)
1	125.0	26.0	350.0	8.5	0.0	0.0	0.0	0.0

* Ultimate bond Stress values also depend on BSF (Bond Stress Factor.)

File: RW No. 2- Sta 281.4 to 291.2 Two Tier Wall

--------- WATER SURFACE ---------

NO Water Table defined for this problem.

--------- SEARCH LIMIT ---------

The Search Limit is from 0.0 to 40.0 ft

You have chosen NOT TO LIMIT the search of failure planes to specific nodes.

--------- REINFORCEMENT PARAMETERS ---------

Number of Reinforcement Levels	=	2
Horizontal Spacing	=	5.0 ft
Yield Stress of Reinforcement	=	60.0 ksi
Diameter of Grouted Hole	=	6.0 in
Punching Shear	=	40.0 kips

---------- (Varying Reinforcement Parameters) ---------

Level	Length (ft)	Inclination (degrees)	Vertical Spacing (ft)	Bar Diameter (in)	Bond Stress Factor
1	12.0	15.0	2.5	1.00	0.75
2	10.0	15.0	5.0	1.00	0.75

File: RW No. 2- Sta 281.4 to 291.2 Two Tier Wall

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
Toe	2.676	4.0	56.2	7.2	89.9	6.0

Reinf. Stress at Level 1 = 5.391 Ksi (Pullout controls...)
2 = 5.853 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 2	2.412	8.0	44.8	7.9	73.9	8.7

Reinf. Stress at Level 1 = 4.630 Ksi (Pullout controls...)
2 = 6.051 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 3	1.981	12.0	52.9	19.9	89.9	0.0

Reinf. Stress at Level 1 = 6.594 Ksi (Pullout controls...)
2 = 7.760 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 4	1.942	16.0	48.1	23.9	89.9	0.0

Reinf. Stress at Level 1 = 6.029 Ksi (Pullout controls...)
2 = 7.683 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 5	1.936	20.0	44.6	28.1	89.9	0.0

Reinf. Stress at Level 1 = 5.515 Ksi (Pullout controls...)
2 = 7.528 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 6	1.884	24.0	41.1	31.9	89.9	0.0

Reinf. Stress at Level 1 = 5.063 Ksi (Pullout controls...)
2 = 7.534 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)

```
NODE 7
     1.807        28.0        33.2   26.8     48.3    8.4

  Reinf. Stress at Level  1 =   3.645 Ksi (Pullout controls...)
                          2 =   7.311 Ksi (Pullout controls...)

          MINIMUM    DISTANCE    LOWER FAILURE   UPPER FAILURE
          SAFETY      BEHIND         PLANE           PLANE
          FACTOR     WALL TOE    ANGLE  LENGTH   ANGLE  LENGTH
                       (ft)      (deg)   (ft)    (deg)   (ft)

NODE 8
     1.850        32.0        33.2   38.3     89.9    0.0

  Reinf. Stress at Level  1 =   3.559 Ksi (Pullout controls...)
                          2 =   7.140 Ksi (Pullout controls...)

          MINIMUM    DISTANCE    LOWER FAILURE   UPPER FAILURE
          SAFETY      BEHIND         PLANE           PLANE
          FACTOR     WALL TOE    ANGLE  LENGTH   ANGLE  LENGTH
                       (ft)      (deg)   (ft)    (deg)   (ft)

NODE 9
     1.907        36.0        30.2   41.7     89.9    0.0

  Reinf. Stress at Level  1 =   2.760 Ksi (Pullout controls...)
                          2 =   6.697 Ksi (Pullout controls...)

          MINIMUM    DISTANCE    LOWER FAILURE   UPPER FAILURE
          SAFETY      BEHIND         PLANE           PLANE
          FACTOR     WALL TOE    ANGLE  LENGTH   ANGLE  LENGTH
                       (ft)      (deg)   (ft)    (deg)   (ft)

NODE10
     1.986        40.0        27.7   45.2     89.9    0.0

  Reinf. Stress at Level  1 =   2.030 Ksi (Pullout controls...)
                          2 =   6.224 Ksi (Pullout controls...)

      ******************************************************************
      *                 For Factor of Safety = 1.0                     *
      *          Maximum Average Reinforcement Working Force:          *
      *                      0.000 Kips/level                          *
      ******************************************************************
```

PROJECT TITLE: RW No.2 - Sta 281.4 to 291.2 Two Tier Wall EQ

Date: 12-23-2011 File: RWSNo.2 - Sta 281.4 to 291.2 Two Tier Wall E

Shari Pwin 3.10

Minimum Factor of Safety = 1.31

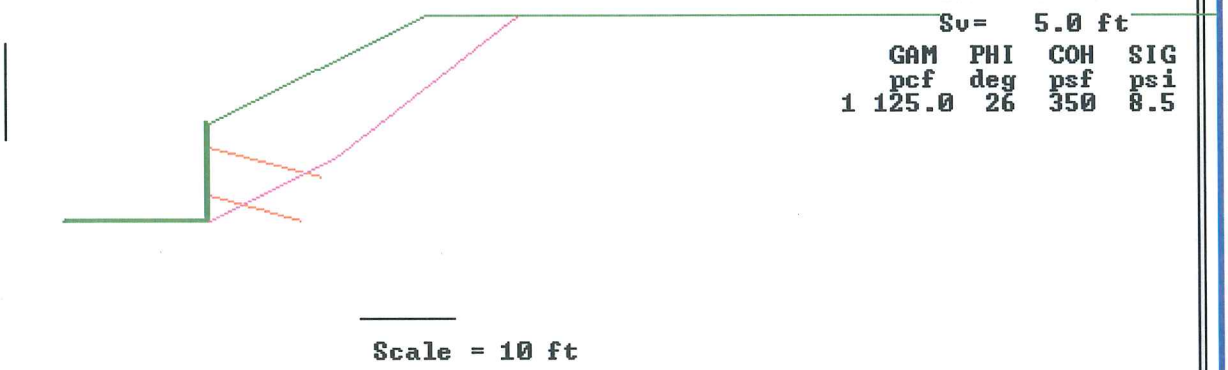
32.0 ft Behind Wall Crest
At Wall Toe

LEGEND:
Crit.Ac= 0.38g
Hoz. KH= 0.20g
Vrt.PKH= 0.00g

PS= 40.0 Kips
FY= 60.0 Ksi
Sh= 5.0 ft
Sv= 5.0 ft

H= 10.0 ft

	GAM pcf	PHI deg	COH psf	SIG psi
1	125.0	26	350	8.5



Scale = 10 ft

File: RW No. 2- Sta 281.4 to 291.2 Two Tier Wall EQ

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*************************************************
*    CALIFORNIA DEPARTMENT OF TRANSPORTATION    *
*          ENGINEERING SERVICE CENTER           *
*     DIVISION OF MATERIALS AND FOUNDATIONS     *
*   Office of Roadway Geotechnical Engineering  *
*    Date: 12-20-2011          Time: 18:58:29   *
*************************************************
```

Project Identification - RW No.2 - Sta 275 to 280.6 Two Tier Wall EQ

--------- WALL GEOMETRY ---------

Vertical Wall Height	=	10.0 ft	
Wall Batter	=	0.0 degree	
		Angle (Deg)	Length (Feet)
First Slope from Wallcrest.	=	26.0	25.0
Second Slope from 1st slope.	=	0.0	0.0
Third Slope from 2nd slope.	=	0.0	0.0
Fourth Slope from 3rd slope.	=	0.0	0.0
Fifth Slope from 3rd slope.	=	0.0	0.0
Sixth Slope from 3rd slope.	=	0.0	0.0
Seventh Slope Angle.	=	0.0	

--------- SLOPE BELOW THE WALL ---------

There is NO SLOPE BELOW THE TOE of the wall

--------- SURCHARGE ---------

There is NO SURCHARGE imposed on the system.

--------- OPTION #1 ---------

Ultimate Punching shear, Bond & Yield Stress are used.

--------- SOIL PARAMETERS ---------

Soil Layer	Unit Weight (Pcf)	Friction Angle (Degree)	Cohesion Intercept (Psf)	Bond* Stress (Psi)	Coordinates of Boundary XS1 (ft)	YS1 (ft)	XS2 (ft)	YS2 (ft)
1	125.0	26.0	350.0	8.5	0.0	0.0	0.0	0.0

* Ultimate bond Stress values also depend on BSF (Bond Stress Factor.)

File: RW No. 2- Sta 281.4 to 291.2 Two Tier Wall EQ

--------- EARTHQUAKE ACCELERATION ---------

Horizontal Earthquake Coefficient = 0.20 (a/g)
Vertical Earthquake Coefficient = 0.00

--------- WATER SURFACE ---------

NO Water Table defined for this problem.

--------- SEARCH LIMIT ---------

The Search Limit is from 0.0 to 40.0 ft

You have chosen NOT TO LIMIT the search of failure planes to specific nodes.

--------- REINFORCEMENT PARAMETERS ---------

Number of Reinforcement Levels = 2
Horizontal Spacing = 5.0 ft
Yield Stress of Reinforcement = 60.0 ksi
Diameter of Grouted Hole = 6.0 in
Punching Shear = 40.0 kips

---------- (Varying Reinforcement Parameters) ---------

Level	Length (ft)	Inclination (degrees)	Vertical Spacing (ft)	Bar Diameter (in)	Bond Stress Factor
1	12.0	15.0	2.5	1.00	0.75
2	10.0	15.0	5.0	1.00	0.75

File: RW No. 2- Sta 281.4 to 291.2 Two Tier Wall EQ

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
Toe	2.183	4.0	56.2	7.2	89.9	6.0

Reinf. Stress at Level 1 = 6.608 Ksi (Pullout controls...)
2 = 7.174 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 2	1.867	8.0	41.0	8.5	79.1	8.5

Reinf. Stress at Level 1 = 5.243 Ksi (Pullout controls...)
2 = 7.594 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 3	1.664	12.0	33.4	8.6	66.6	12.1

Reinf. Stress at Level 1 = 4.655 Ksi (Pullout controls...)
2 = 7.957 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 4	1.529	16.0	33.7	9.6	57.3	14.8

Reinf. Stress at Level 1 = 4.455 Ksi (Pullout controls...)
2 = 8.688 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 5	1.474	20.0	30.7	11.6	54.1	17.1

Reinf. Stress at Level 1 = 3.709 Ksi (Pullout controls...)
2 = 8.710 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)
NODE 6	1.382	24.0	32.0	19.8	55.5	12.7

Reinf. Stress at Level 1 = 4.375 Ksi (Pullout controls...)
2 = 9.430 Ksi (Pullout controls...)

	MINIMUM SAFETY FACTOR	DISTANCE BEHIND WALL TOE (ft)	LOWER FAILURE PLANE ANGLE (deg)	LOWER FAILURE PLANE LENGTH (ft)	UPPER FAILURE PLANE ANGLE (deg)	UPPER FAILURE PLANE LENGTH (ft)

```
NODE 7
     1.325        28.0       26.5   18.8     48.3   16.8

  Reinf. Stress at Level  1 =   2.601 Ksi (Pullout controls...)
                          2 =   9.183 Ksi (Pullout controls...)

          MINIMUM    DISTANCE    LOWER FAILURE   UPPER FAILURE
          SAFETY      BEHIND         PLANE           PLANE
          FACTOR     WALL TOE    ANGLE  LENGTH   ANGLE  LENGTH
                       (ft)      (deg)   (ft)    (deg)   (ft)

NODE 8
     1.307        32.0       26.2   14.3     37.4   24.2

  Reinf. Stress at Level  1 =   2.489 Ksi (Pullout controls...)
                          2 =   9.255 Ksi (Pullout controls...)

          MINIMUM    DISTANCE    LOWER FAILURE   UPPER FAILURE
          SAFETY      BEHIND         PLANE           PLANE
          FACTOR     WALL TOE    ANGLE  LENGTH   ANGLE  LENGTH
                       (ft)      (deg)   (ft)    (deg)   (ft)

NODE 9
     1.313        36.0       21.2   11.6     33.6   30.3

  Reinf. Stress at Level  1 =   0.502 Ksi (Pullout controls...)
                          2 =   8.464 Ksi (Pullout controls...)

          MINIMUM    DISTANCE    LOWER FAILURE   UPPER FAILURE
          SAFETY      BEHIND         PLANE           PLANE
          FACTOR     WALL TOE    ANGLE  LENGTH   ANGLE  LENGTH
                       (ft)      (deg)   (ft)    (deg)   (ft)

NODE10
     1.338        40.0       21.5   17.2     31.4   28.1

  Reinf. Stress at Level  1 =   0.346 Ksi (Pullout controls...)
                          2 =   8.351 Ksi (Pullout controls...)

      ******************************************************************
      *                 For Factor of Safety = 1.0                     *
      *          Maximum Average Reinforcement Working Force:          *
      *                      0.000 Kips/level                          *
      ******************************************************************
```

APPENDIX D

PARIKH

Practicing in the Geosciences

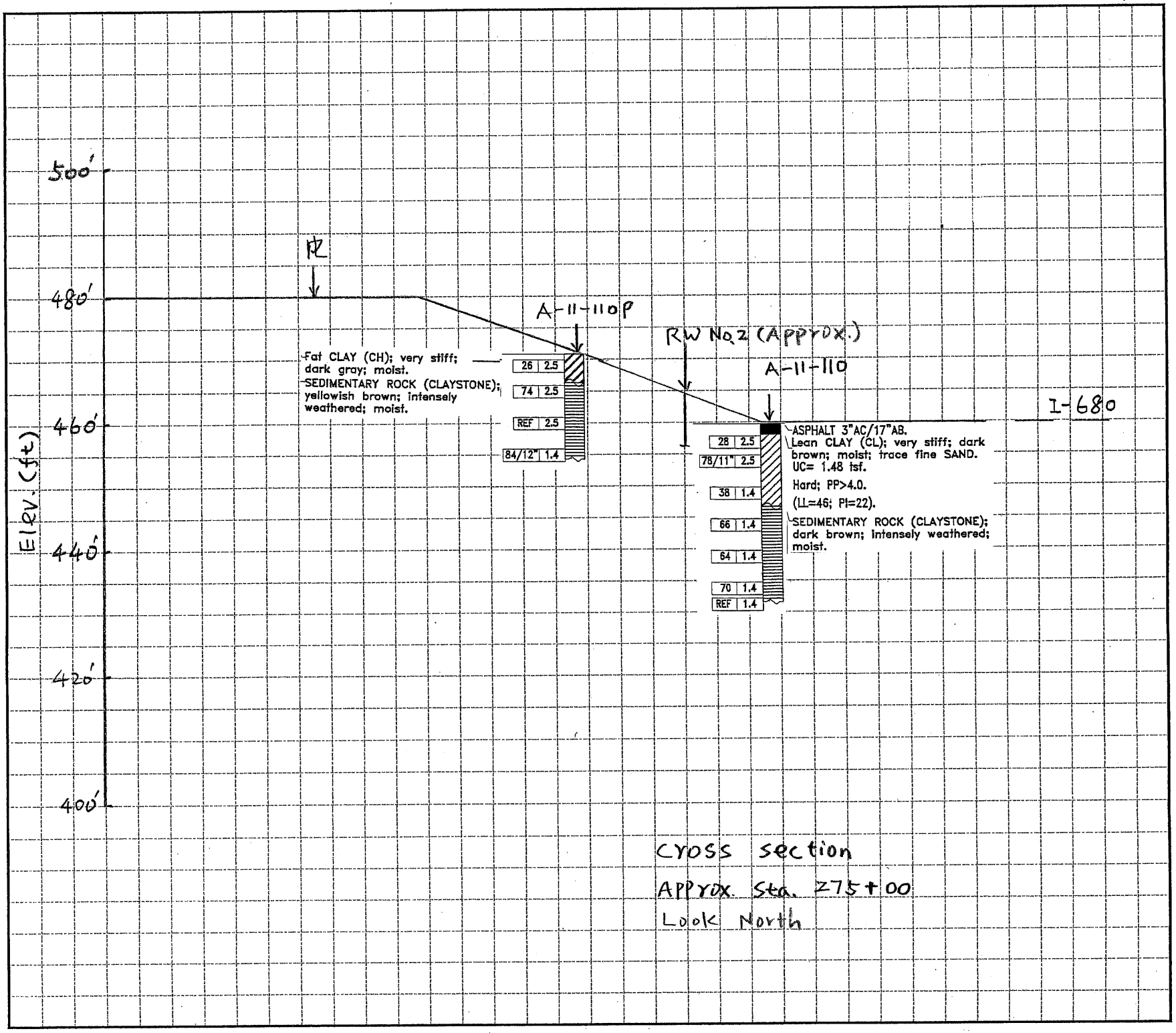
JOB 2011-124-WAL

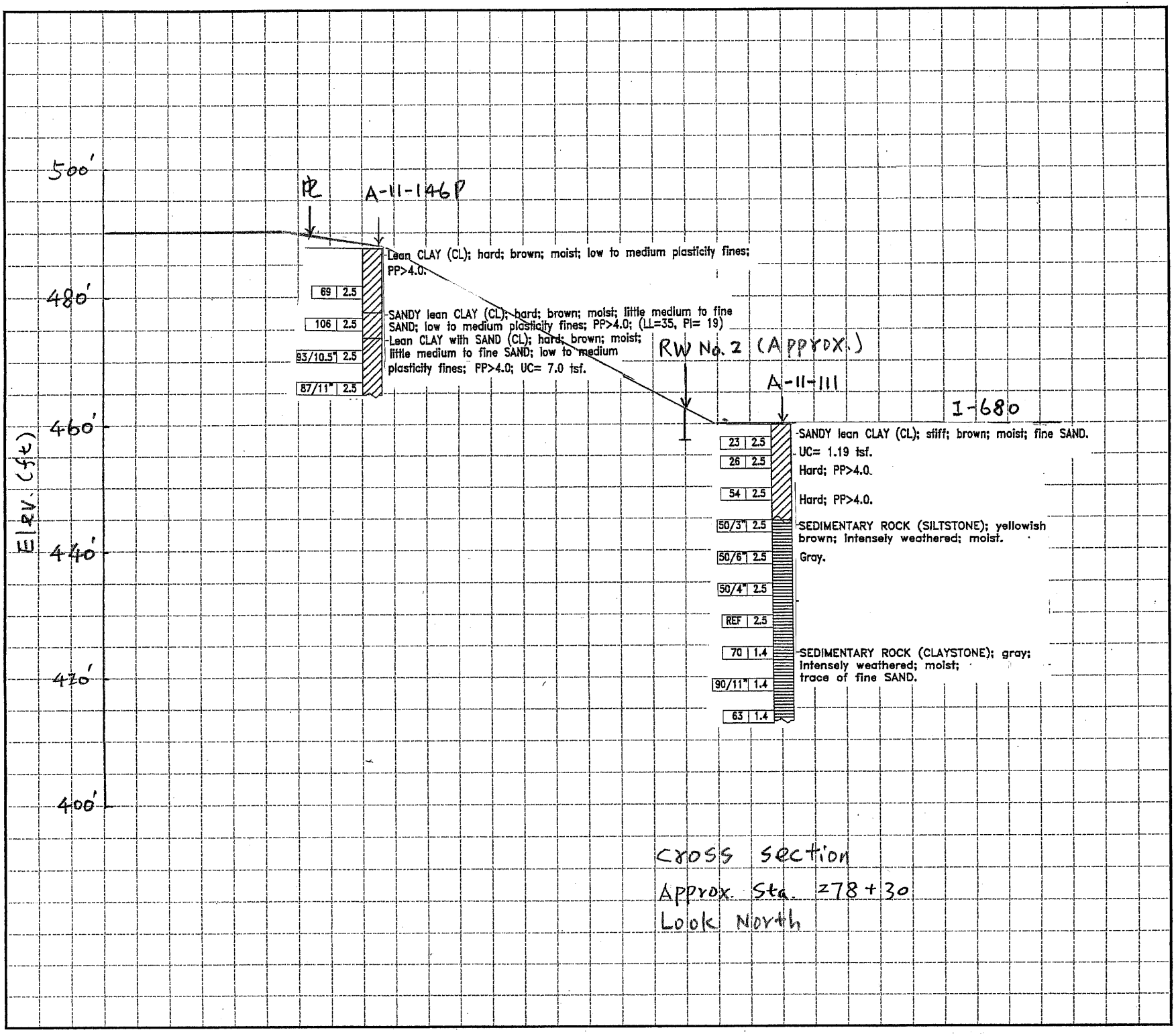
SHEET NO 1 OF 5

CALCULATED BY P. Wei DATE 2/15/12

CHECKED BY DATE

SCALE 1" = 20'



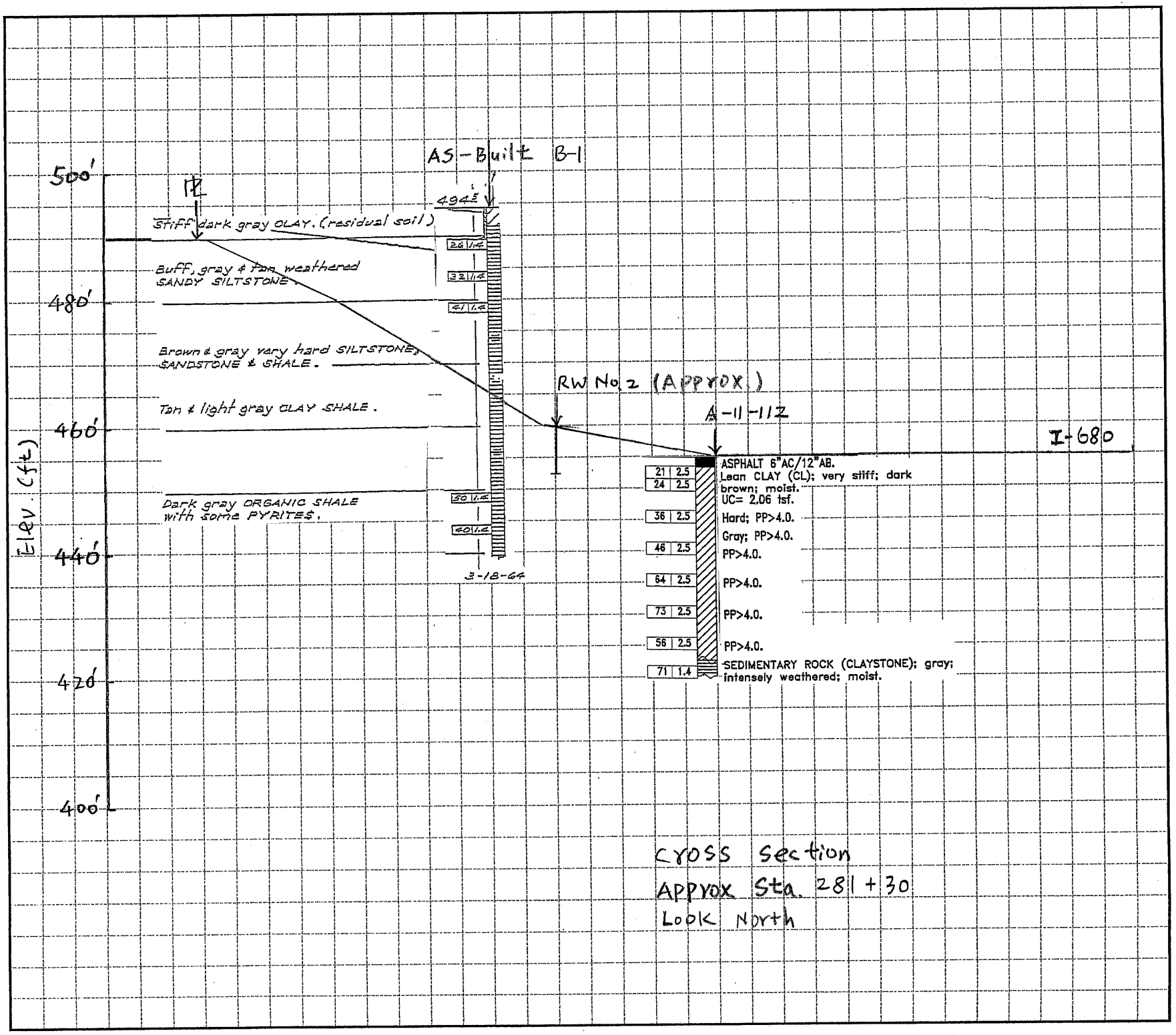


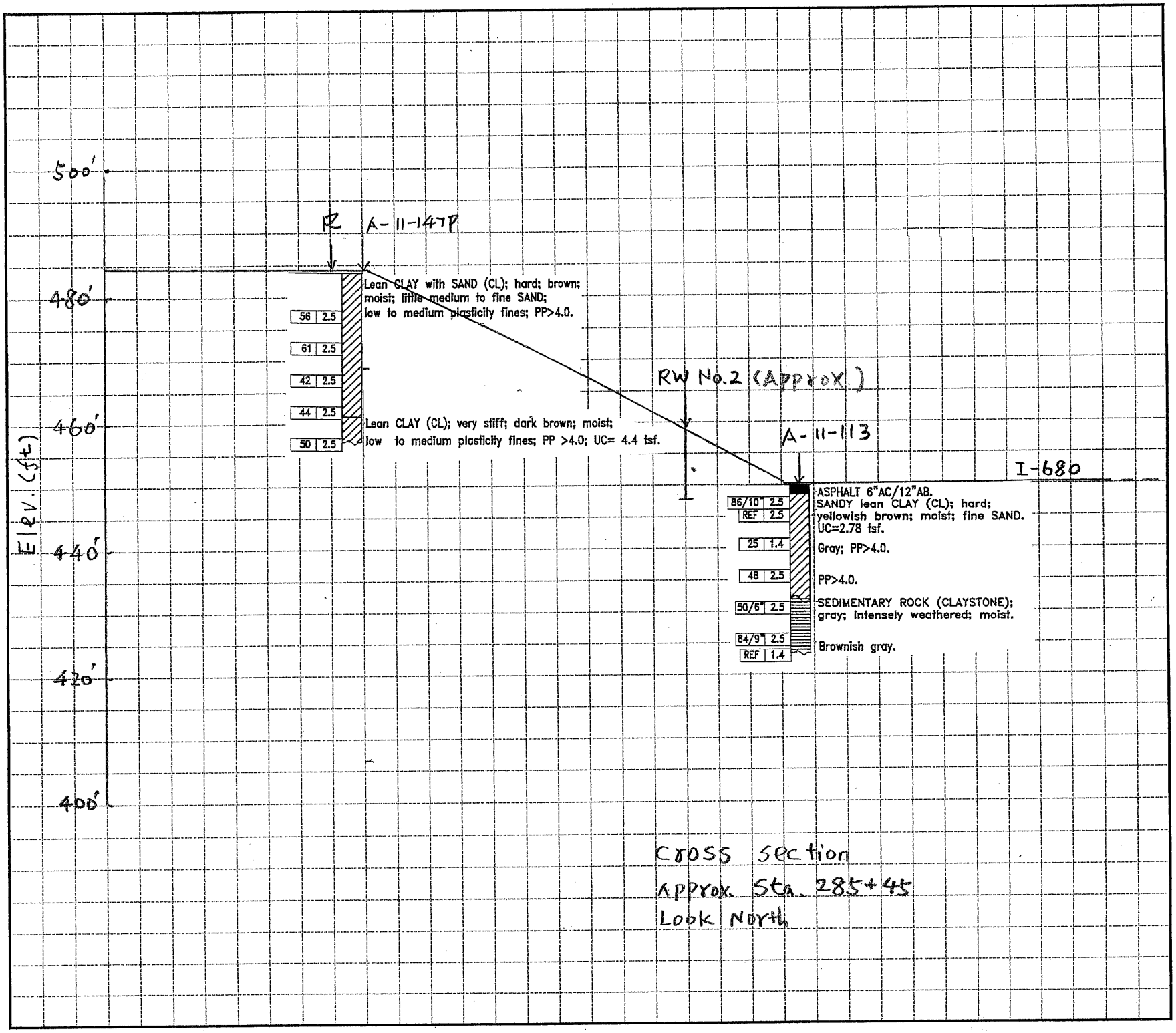
PARIKH
Practicing in the Geosciences

JOB 2011-124-WAL
SHEET NO 2 OF 5
CALCULATED BY P. Wei DATE 2/15/12
CHECKED BY DATE
SCALE 1" = 20'

PARIKH
Practicing in the Geosciences

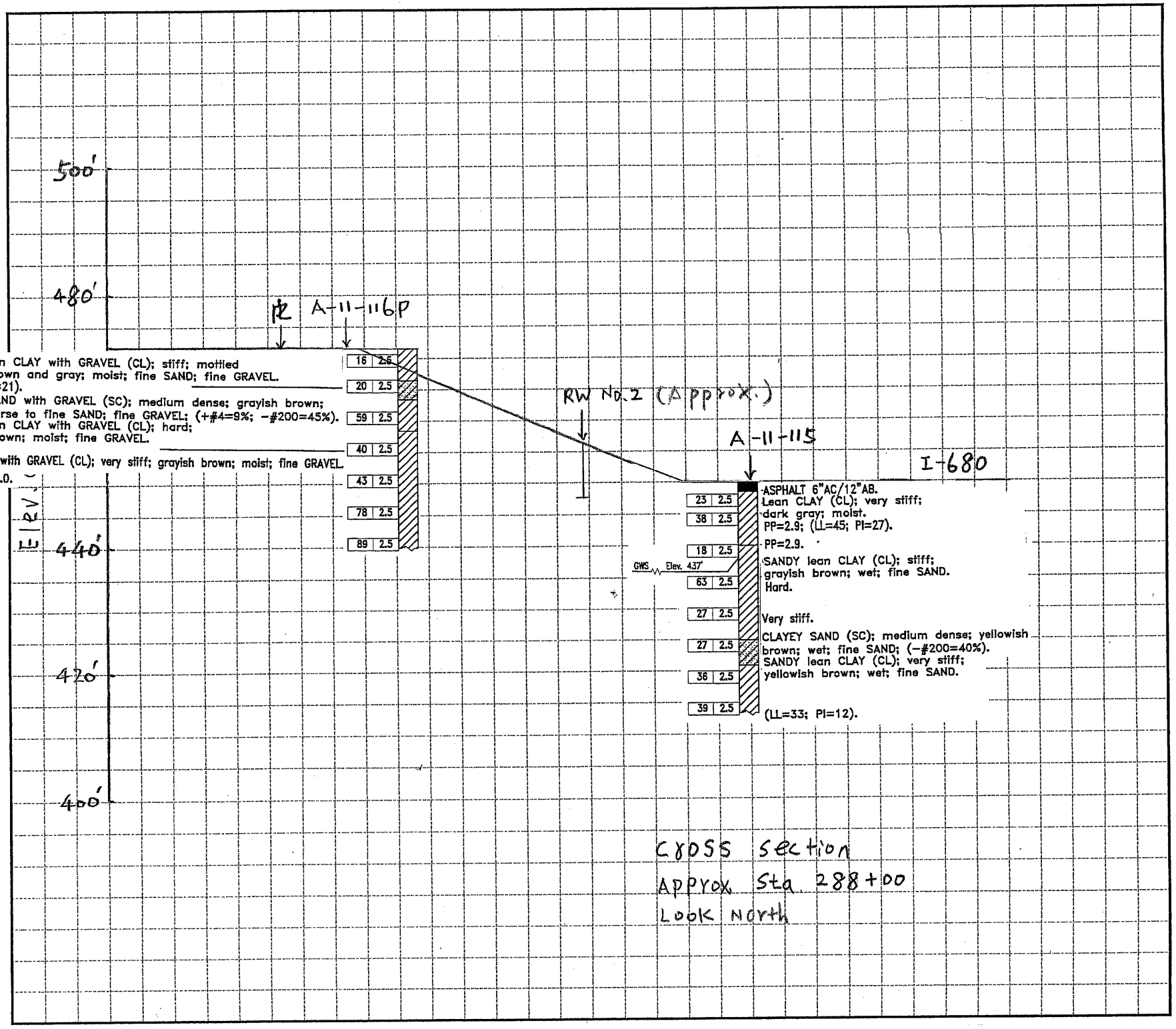
JOB 2011-124-WAL
SHEET NO 3 OF 5
CALCULATED BY R.W.L. DATE 2/13/12
CHECKED BY DATE
SCALE 1" = 20'





PARIKH
Practicing in the Geosciences

JOB 2011-124-WAL
SHEET NO 4 OF 5
CALCULATED BY P. Wei DATE 2/15/12
CHECKED BY DATE
SCALE 1" = 20'



PARIKH
Practicing in the Geosciences

JOB 2011-124-WAL
SHEET NO 5 OF 5
CALCULATED BY P. Wei DATE 2/15/12
CHECKED BY DATE
SCALE 1" = 20'

APPENDIX E

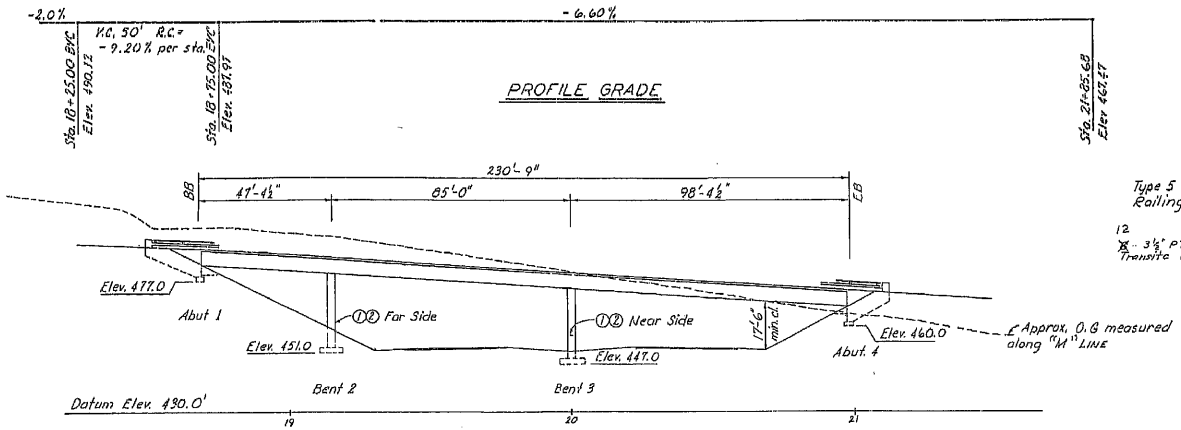
I-680-1(109)29

(Old-IV-CC-107-A)

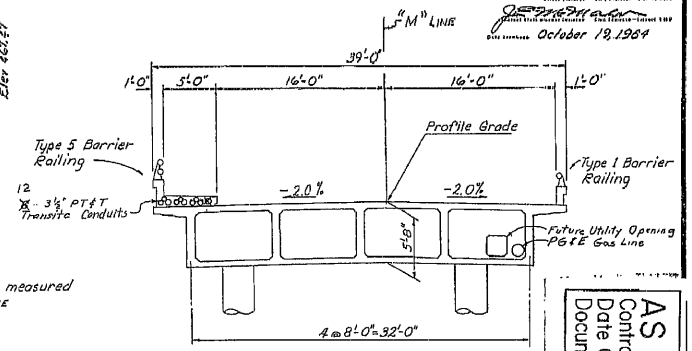
FED. ROAD DIST. NO.	STATE	F.A. PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	BRIDGE NO.	POST MILE	SHEET NO.	TOTAL SHEETS
IV	CC	680	28-223	19.8	202	

October 19, 1964

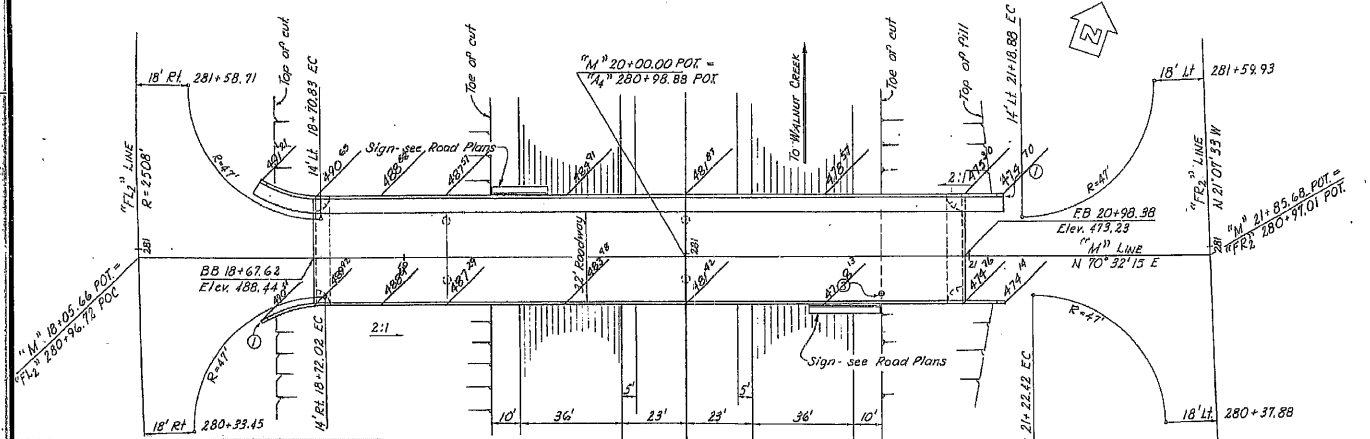


ELEVATION



TYPICAL SECTION
5/16" = 1'-0"

AS BUILT PLANS
Contract No. 04-128224
Date Completed 1-3-67
Document No. 4000020 P2



PLAN

INDEX TO PLANS

Sheet No	Title
1.	General Plan
2.	Foundation Plan
3.	Abutment Details
4.	Bent Details
5.	Typical Section & Girder Layout
6.	Girder Reinforcement
7.	Log of Test Borings

See "Crow Canyon Road O.C." Bridge No. 28-206 for:

Standard Details No. 1 (Box Girder)
Barrier Railing Sheet 1
Barrier Railing Sheet 2

APPROXIMATE QUANTITIES

*STRUCTURE EXCAVATION (BRIDGE)	260 C.Y.
*STRUCTURE BACKFILL (BRIDGE)	185 C.Y.
*CLASS "A" CONCRETE (BRIDGE)	640 C.Y.
*BAR REINFORCING (BRIDGE)	181,000 LBS.
BARRIER RAILING (TYPE 1)	266 L.F.
BARRIER RAILING (TYPE 5)(5')	266 L.F.

*FINAL QUANTITIES

SHEET 1 OF 7

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES-TOTAL PROJECT	Sheet No.	Total Sheets
04	CC	680	4.3/6.7		

REGISTERED CIVIL ENGINEER — DATE 2/17/12

ROUTE 680 AUXILIARY LANE PROJECT - SEGMENT 2

LOG OF TEST BORINGS

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

UNIT: 0738
PROJECT NUMBER & PHASE: 0400021664

BRIDGE No. | Sheet | of

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA

ELEVATIONS TAKEN ON OUTSIDE BARRIER RAILING BOLTS (WITH CHISELED + MARK)

AS BUILT
CORRECTIONS BY L.S. Miyashiro TMR
CONTRACT NO. 04-128224
DATE Sept. 1966 Oct '66

FOR GENERAL NOTES SEE "FOUNDATION PLAN"

LIVE LOADING H20-S16-44 AND ALTERNATIVE

BRIDGE DEPARTMENT — DESIGN SECTION — 15

Section Supervisor R.C. Pilarski
Project Designer C. Hsieh, C. Hart

DESIGN	by T. Hsieh, C. Hart 1-64	Checked Paul J. Jurasch 5-64
DETAILS	by M. Miyatani 2-64	Checked Paul J. Jurasch 5-64
LAYOUT	by C. Hsieh, C. Hart	Checked Paul J. Jurasch 5-64
QUANTITIES	by R.H. 5-64	Checked M. Miyatani 5-64
SPECIFICATIONS	by T. Barlest 7-64	Checked

Approved Recommended by — Bridge Engineer — Date Approved — FHWA Div. Admin. No. — Date

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

NORTH SAN RAMON OVERCROSSING

LOCATED APPROX. 1.0 MILE NORTH OF THE COMMUNITY OF SAN RAMON ON ROAD IV-CC-680 IN CONTRA COSTA COUNTY

GENERAL PLAN

Except as noted SCALE 1" = 20' | BRIDGE 28-223 | FILE | DRAWING 28223-1

PRELIMINARY DRAWING NO. — REVISION DATES

62-04T10H1289.2 — Discard prints bearing earlier revision dates

196

163

OLD-IV-CC-107-A

FED. ROAD DIST. NO.	STATE	F. A. PROJECT No.	SHEET No.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	SECTION	SHEET No.	TOTAL SHEETS
IV	CC	680	0.6-6.8	197	502

October 19, 1964

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

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DIST.	COUNTY	ROUTE	POST MILES-TOTAL PROJECT	Sheet No.	total Sheets
04	CC	680	4.3/5.7		

REGISTERED CIVIL ENGINEER — DATE 2/17/12

ROUTE 680 AUXILIARY LANE PROJECT - SEGMENT 2

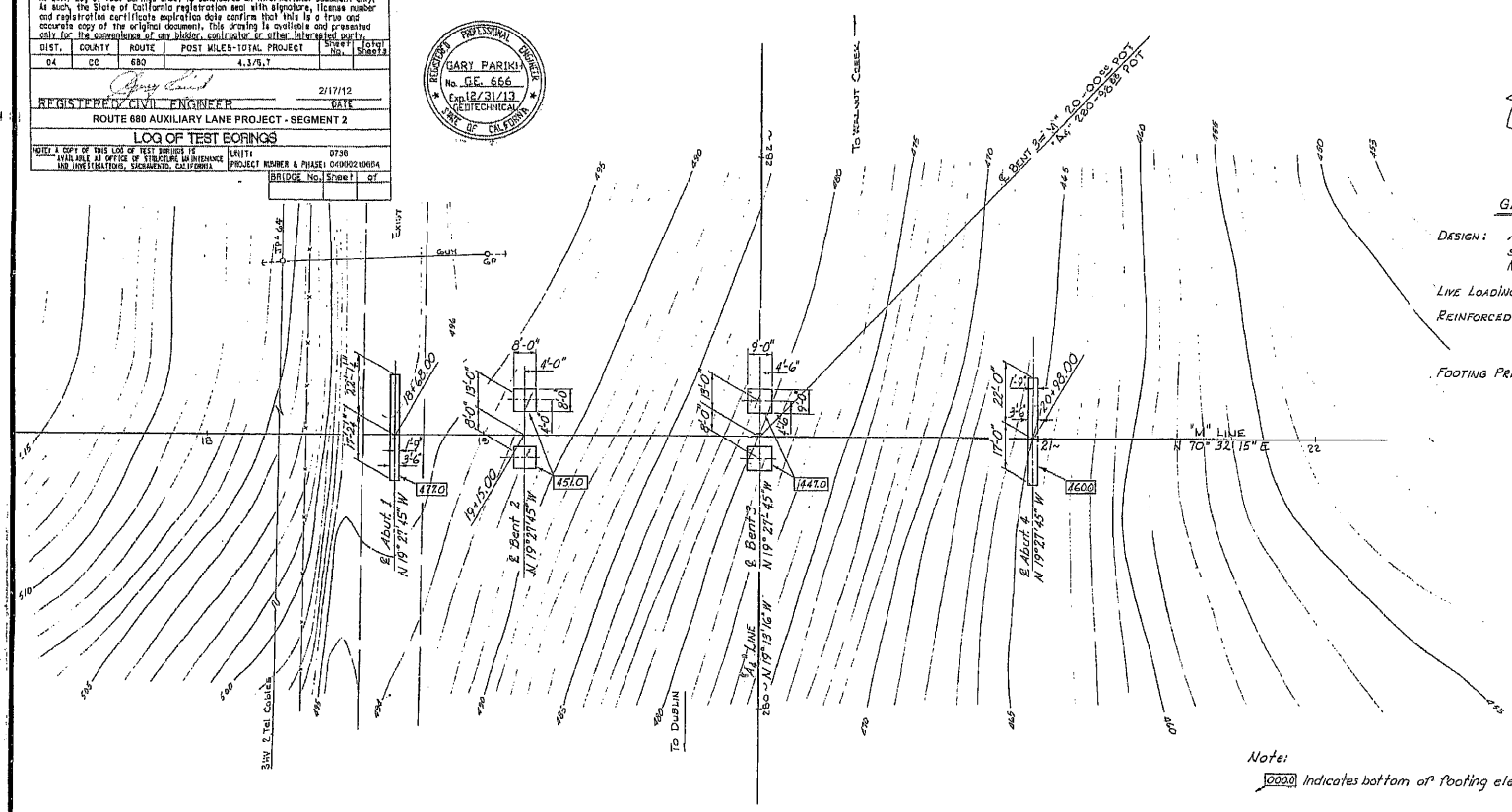
LOG OF TEST BORINGS

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

UNIT: 0738
PROJECT NUMBER & PHASE: 0400021068A

BRIDGE No.	Sheet	of

REGISTERED PROFESSIONAL ENGINEER — GARY PARIKH — No. G.E. 666 — Exp. 12/31/13 — GEOTECHNICAL — STATE OF CALIFORNIA



GENERAL NOTES (Highway Structure)

DESIGN: A.A.S.H.O. Dated 1961 with revisions and as supplemented by Bridge Planning and Design Manual.

LIVE LOADING: H20-S16-44 and alternative

REINFORCED CONCRETE: f_s = 20,000 P.S.I., N=10
F_c = 1,200 P.S.I.

FOOTING PRESSURE:

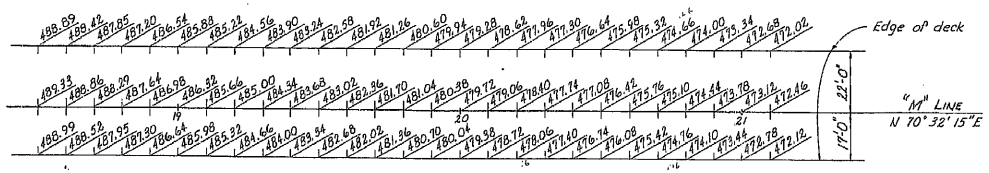
	Allowable	Design
Abut 1	4 Tons P.S.F.	1½ Tons P.S.F.
Bent 2	4 Tons P.S.F.	4 Tons PSF
Bent 3	4 Tons P.S.F.	4 Tons P.S.F.
Abut 4	2½ Tons P.S.F.	2½ Tons P.S.F.

AS BUILT PLANS
Contract No. 04-128924
Date Completed 1-3-67
Document No. 4000090

Note:
0000 Indicates bottom of footing elevation.

BM "4 B"
Fd-R.R. spike in shld
(@ P.T. 344+74.85) 85' Lt
"M" 15+66
EL. 496.42

BM "4 B-6"
Fd-R.R. spike in shld @
"M" 332+90.88 55'N JP70
EL. 469.85



10' GRID OF DECK ELEVATIONS

Note:
These elevations are calculated from profile line at 10' stations along "M" Line.
These elevations do not include camber.

AS BUILT
CORRECTIONS BY L.S. Miyashiro TMR
CONTRACT NO. 04-128924
DATE April 9, 1966 Dec. 1966
No "As Built" Changes

SHEET	OF
2	7

LEVEL DATUM ...U.S.C.&G.S.
FOR ALINEMENT SEE ...F.C. 28223 =1...
CONTOURS AS OF ... 1-64
SITE PLAN TO SUPPLEMENT CONTRACT DATA.
SURVEY BY E.G.W. ...DATE 1-64
DRAWN BY L.B.T. ...DATE 1-64
TRACED BY J.S. ...DATE 1-8-64

BRIDGE DEPARTMENT
DESIGN SECTION 15
Section Supervisor R.C. Blecke

DESIGN	R.C. Blecke / Checked Paul J Jurnich	3-64 / 5-64
DETAILS	H. Hizutani / Checked Paul J Jurnich	3-64 / 5-64
QUANTITIES	R.H. Sieu / Checked H. Hizutani	3-64

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

NORTH SAN RAMON OC

FOUNDATION PLAN

SCALE 1" = 20' | BRIDGE 28-223 | FILE E-28 | DRAWING 28223-2

PRELIM. DRAWING NO. P 3 5 6

PR 28223-1

22-04T10H1289.2

197

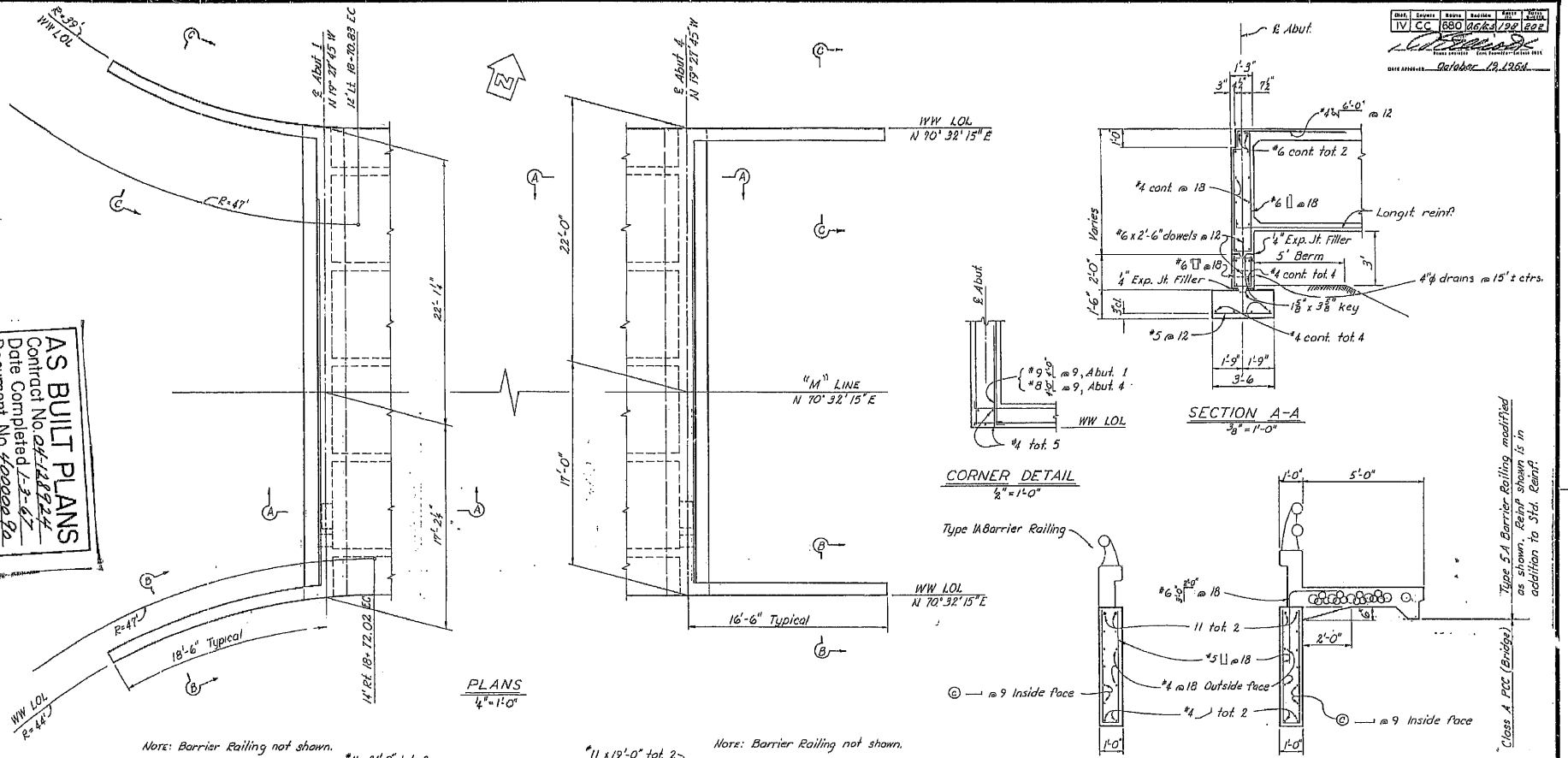
OLD-IV-CC-107-A

FED. AID DIV. NO.	STATE	F.A. PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

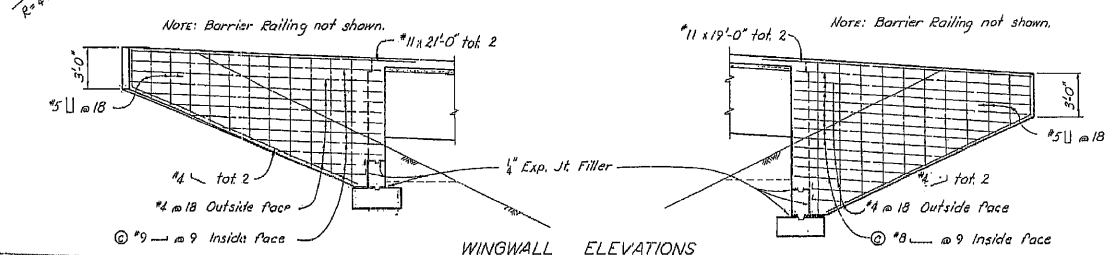
DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
IV	CC	680	26K.8	198	202

ROBERT SHUSETT — CHIEF ENGINEER-DIRECTOR

DATE APPROVED October 19, 1966



PLANS
¼" = 1'-0"



WINGWALL ELEVATIONS
¼" = 1'-0"

AS BUILT PLANS
Contract No. 04-128924
Date Completed 1-3-67
Document No. 4000009a

AS BUILT
CORRECTIONS BY L.S. Myashiro TMR
CONTRACT NO. 04-128924
DATE Sept. 1966 Dec. 1966
SHEET 3 OF 7

BRIDGE DEPARTMENT
DESIGN SECTION 15
Section Supervisor R.C. Blake
DESIGN by C.S. Myashiro 2-64
CHECKED Paul J. Jumich 5-64
DETAILS by M. Butani 2-64
CHECKED Paul J. Jumich 5-64
QUANTITIES by R.H. Frey
CHECKED M. Newton 5-64

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

NORTH SAN RAMON OVERCROSSING

ABUTMENT DETAILS

SCALE AS NOTED | BRIDGE 28-223 | FILE | DRAWING 28223-3

FED. HIGHWAY DRAWING NO. | REVISION DATES

Disregard prints bearing earlier revision dates

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

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DIST.	COUNTY	ROUTE	POST MILES-TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	CC	680	4.3/8.7		

REGISTERED CIVIL ENGINEER — DATE 2/17/12

ROUTE 680 AUXILIARY LANE PROJECT - SEGMENT 2

LOG OF TEST BORINGS

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

UNIT: 0730
PROJECT NUMBER & PHASE: 0400021006A

BRIDGE No. | Sheet | of

REGISTERED PROFESSIONAL ENGINEER
GARY PARIKH
No. GE 666
Exp. 12/31/13
GEOTECHNICAL
STATE OF CALIFORNIA

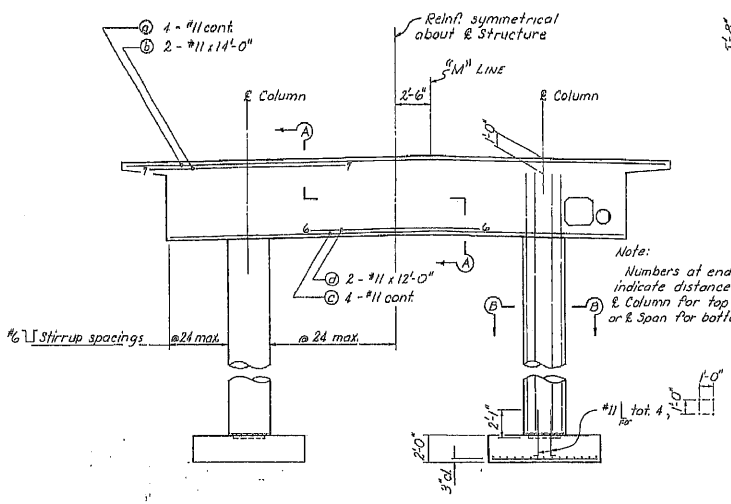
1968

OLD-IV-CC-107-A

FED. ROAD DIV.	STATE	F.A. PROJECT No.	POST'D SPD	TOTAL SHEETS
7	CALIF.			

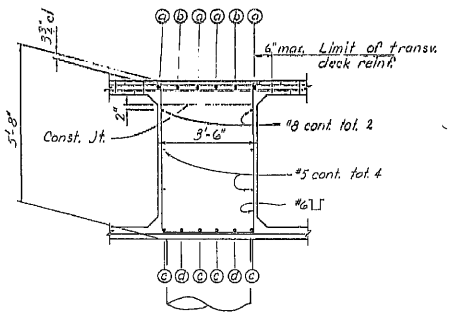
DIST.	COUNTY	ROUTE	SECTION	POST MILE	TOTAL SHEETS
IV	CC	680	4.3/6.7	199	202

Date Approved October 12, 1961

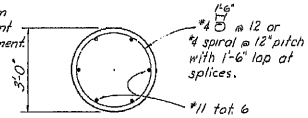


BENT 2 ELEVATION

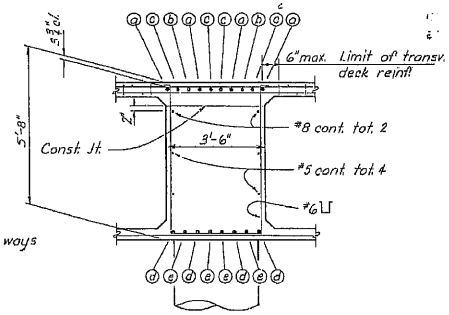
Note:
Numbers at ends of bars indicate distance in feet from ℄ Column for top reinforcement or ℄ Span for bottom reinforcement.



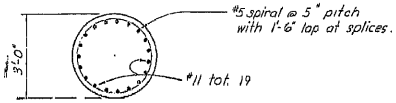
SECTION A-A
½" = 1'-0"



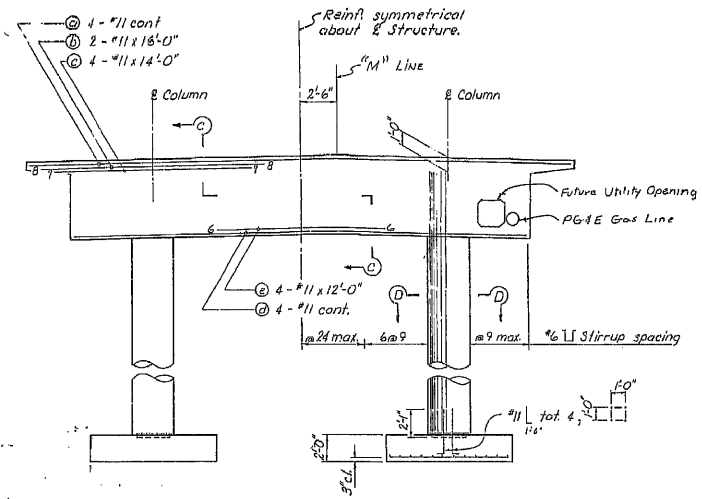
SECTION B-B
½" = 1'-0"



SECTION C-C
½" = 1'-0"

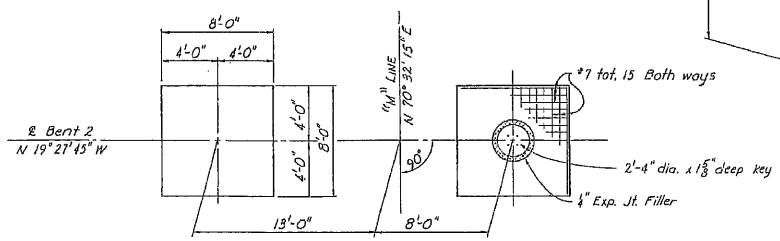


SECTION D-D
½" = 1'-0"

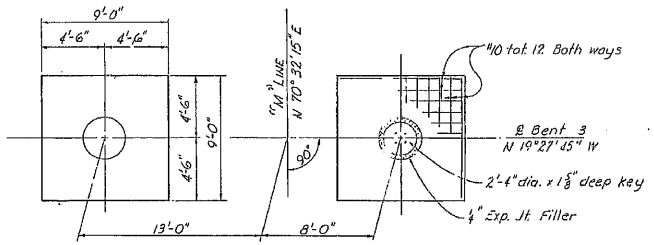


BENT 3 ELEVATION

AS BUILT
CORRECTIONS BY L.S. Myashiro TMR
CONTRACT NO. 04-128924
DATE April 4, 1966 Dec. 1966



BENT 2 FOOTING PLAN



BENT 3 FOOTING PLAN

AS BUILT PLANS
Contract No. 04-128924
Date Completed 1-3-67
Document No. 400000.90

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES				
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DIST.	COUNTY	ROUTE	POST MILES-TOTAL PROJECT	Sheet No. / Total Sheets
04	CC	680	4.3/6.7	
REGISTERED CIVIL ENGINEER			DATE 2/17/12	
ROUTE 680 AUXILIARY LANE PROJECT - SEGMENT 2				
LOG OF TEST BORINGS				
NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA			UNIT: 0730 PROJECT NUMBER & PHASE: 0400021006A	
BRIDGE No.	Sheet	of		

REGISTERED PROFESSIONAL ENGINEER
GARY PARIKH
No. GE. 666
Exp. 12/31/13
GEOTECHNICAL
STATE OF CALIFORNIA

BRIDGE DEPARTMENT
DESIGN SECTION 15
Section Supervisor R.C. Blake
DESIGN By C. Ramalho 2-64
Checked Paul J. Jurich 5-64
DETAILS By A. Bautani 2-64
Checked Paul J. Jurich 5-64
QUANTITIES By R.H. 5/64
Checked M. Tsai 5-64

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

NORTH SAN RAMON OVERCROSSING

BENT DETAILS

EXCEPT AS NOTED SCALE ¼" = 1'-0" | BRIDGE 28-223 | FILE | DRAWING 28223-4

PRELIMINARY DRAWING No. P-28-223-4-5-1-1 | REVISION DATES

Disregard prints bearing earlier revision dates

SHEET 4 OF 7

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APPENDIX F

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. OVERCOMER HOR
Senior Transportation Engineer
Office of Special Funded Projects

Date: February 15, 2012

File: 04-CC-680 PM 4.3/6.7
04-2285H1
PS&E Review

From: M. DEHGHAN/A. SOJOURNER
M & R Engineer/Engineering Geologist
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

H. Nikoui
HOOSHMAND NIKOUI
Chief, Branch A
Office of Geotechnical Design West
Geotechnical Services
Division of Engineering Services

Subject: Review of Foundation Report, I-680 Auxiliary Lane Project – Segment 2

We have reviewed the draft Foundation Report for the I-680 Auxiliary Lane Project – Segment 2 by Parikh Consultants. We have the following comments.

Page 2, Section 3.0 "Assuming normal construction procedures are followed." This is meaningless.

Page 3, Section 4.0 Table 2 – Can you give station and offsets of the borings in this table?

Page 4, Section 6.0.

Why is the Alquist-Priolo map not referenced in this section? It is not mentioned until Section 10.3. The Calaveras Fault and a mapped "area of massive landslides" lie within a few hundred feet of the project, yet no mention at all is made of this in the Foundation Report. This is an egregious omission and must be corrected.

Discuss the location of the fault, the mapped landslides, and potential impacts to the project in detail. Do the slides extend into the project area? Could the toe of a slide cross in to the project boundaries?

See comments on Section 6.2 and address the issue of fat clay and expansive soils with respect to possible slide planes in the project area.

The bedrock geologic map and/or the Alquist Priolo map should be presented and discussed here, not just the Quaternary geologic map.

Page 5 - There is no fault on the map on Plate 3. Add another geologic map that includes the fault.

Page 5 - Section 6.2 "the Highway was constructed by cutting into native slopes..." Describe in detail any potential unstable slopes. Where cuts are exposed, describe their condition, stability and age. When were they cut, and how have they held up?

Fat clay and moderately – highly expansive soils were found in the borings. Discuss this as an indicator of unstable slopes or landslide planes. How can this be understood with respect to potential landslides in the project area?

Page 6 - Section 7.0

In Table 3, provide the date when the groundwater levels were measured.

Page 7 - Section 10.1

In Table 5, Give the deterministic PGA.

There are no horizontal borings for the RW#2 soil nail wall. Please address the assumed soil parameters.

If you have any questions or need additional information, please call me at (510) 286-4717 or Hooshmand Nikoui, Branch Chief at (510) 286-4811.

c: M Dehghan, HNikoui,GWilcox, ASojourner, Daily File, Route File

M/Dehghan/mm

PARIKH
Practicing in the Geosciences

Geotechnical ■
Environmental ■
Materials Testing ■
Construction Inspection ■

To: **Mark Thomas and Company, Inc.**
1960 Zanker Road
San Jose, CA 95112

Date: February 21, 2012
Job No.: 2011-124-WAL

Attn.: Mr. Po Chen

From: Peter Haoli Wei, P.E., G.E.; James B. Baker, CEG; Gary Parikh, P.E., G.E. 666

Sub: Response to Caltrans Review Comments
Route 680 Auxiliary Lane Project - Segment 2
Contra Costa County, California

Mr. Chen:

This memorandum presents our responses to the review comments by Caltrans on the draft Foundation Report (FR) for the subject project in Contra Costa County, California. Parikh Consultants, Inc. (PCI) previously prepared a draft foundation report on January 4, 2012. The responses to the comments have been incorporated, as applicable, in the revised report that is being prepared at this time.

The following reference is comments as received from Caltrans:

Memorandum dated February 15, 2012 from Office of Geotechnical Design – West, Geotechnical Services, Division of Engineering Services

Comment 1:

- Page 2, Section 3.0 "Assuming normal construction procedures are followed." This is meaningless.

PCI Response 1:

Comment will be incorporated. The section has been revised in the revised report.

Comment 2:

- Page 3, Section 4.0 Table 2 – Can you give station and offsets of the borings in this table?

PCI Response 2:

Comment will be incorporated. The station and offsets of the reference borings for each retaining wall are included in Table 2 in the revised report.

Comment 3:

- Page 4, Section 6.0. Why is the Alquist-Priolo map not referenced in this section? It is not mentioned until Section 10.3. The Calaveras Fault and a mapped "area of massive landslides" lie within a few hundred feet of the project, yet no mention at all is mad of this in the Foundation Report. This is an egregious omission and must be corrected.
- Discuss the location of the fault, the mapped landslides, and potential impacts to the project in detail. Do the slides extend into the project area? Could the toe of a slide cross in to the project boundaries?
- See comments on Section 6.2 and address the issue of fat clay and expansive soils with respect to possible slide planes in the project area.
- The bedrock geologic map and/or the Alquist Priolo map should be presented and discussed here, not just the Quaternary geologic map.

PCI Response 3:

Comment will be incorporated. Discussions on quaternary geology, bedrock geology, mapped faults, mapped landslides, geologic investigations of nearby and summary of geologic hazards are included in Section 6.1 of the revised report.

Comment 4:

- Page 5 – There is no fault on the map on Plate 3. Add another geologic map that includes the fault.

PCI Response 4:

Comment will be incorporated. Refer to PCI Response 3, additional geologic maps and fault maps and discussions are included in the revised report.

Comment 5:

- Page 5 – Section 6.2 "the Highway was constructed by cutting into native slopes…" Describe in detail any potential unstable slopes. Where cuts are exposed, describe their condition, stability and age. When were they cut, and how have they held up?
- Fat clay and moderately – highly expansive soils were found in the borings. Discuss this as an indicator of unstable slopes or landslides. How can this be understood with respect to potential landslides in the project area?

PCI Response 5:

Comment will be incorporated. Discussions on slope cutting and fat clay are included in Sec. 6.2 of the revised report.

Comment 6:

- Page 6 – Section 7.0 In Table 3, provide the date when the groundwater levels were measured.

PCI Response 6:

Comment will be incorporated. Groundwater levels were measured during drilling. The dates of measuring are included in Table 3 in the revised report.

Comment 7:

- Page 7 – Section 10.1 In Table 5, Give the deterministic PGA.

PCI Response 7:

Comment will be incorporated. Deterministic PGAs are included in Table 5 in the revised report.

Comment 8:

- There are no horizontal borings for the RW#2 soil nail wall. Please address the assumed soil parameters.

PCI Response 8:

We have forwarded the cross sections and LOTBs of RW #2 to Mr. Hooshmand Nikoui, Chief, Office of Geotechnical Design West, Geotechnical Services, Division of Engineering Services for review. Mr. Nikoui reviewed the borings and their locations and concluded that they are adequate for the purpose intended and there is no need for horizontal borings. (E-mail of February 21, 2012 is attached).

Peter Wei

From: Hooshmand Nikoui [hooshmand_nikoui@dot.ca.gov]
Sent: Tuesday, February 21, 2012 2:03 PM
To: Gary Parikh
Cc: Gary Parikh; Peter Wei
Subject: Re: FW: 04-2285H1/ 04-CC-680-Aux Lane Seg 2
Attachments: AR-M455N_20120214_160639.pdf; Cross sections and LOTBs for RW No 2.pdf

I have reviewed the borings and their locations and concluded that they are adequate for the purpose intended and there is no need for horizontal borings.

Hooshmand Nikoui, Chief
Branch A- GDW
510-286-4811
925-864-0282

PREPARED FOR:

MARK THOMAS & COMPANY
3000 OAK ROAD, SUITE 650
WALNUT CREEK, CALIFORNIA

PREPARED BY:

GEOCON CONSULTANTS, INC.
6671 BRISA STREET
LIVERMORE, CALIFORNIA 94550

GEOCON

GEOCON PROJECT NO. E8595-06-02

JANUARY 2012

GEOCON
CONSULTANTS, INC.
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

Project No. E8595-06-02
January , 2012

Mr. Sasha Dansky
Mark Thomas & Company, Inc.
3000 Oak Road, Suite 650
Walnut Creek, California 94597

Subject: ASBESTOS AND LEAD-CONTAINING PAINT SURVEY REPORT
I-680 SEGMENT 2 AUXILIARY LANES PROJECT
CONTRA COSTA COUNTY, CALIFORNIA

Dear Mr. Dansky:

We have performed an asbestos and lead-containing paint survey at the subject site (Site). The scope of services provided by Geocon included surveying soundwalls along northbound and southbound Interstate 680 within the project limits for suspect asbestos-containing materials and lead-containing paint, collecting bulk samples, and submitting the samples to a laboratory for analysis.

The accompanying report summarizes the services performed and the results of laboratory testing.

The contents of this report reflect the views of Geocon, who are responsible for the facts and accuracy of the data presented herein. This report does not constitute a standard, specification, or regulation.

If there are questions concerning the contents of this report, or if we may be of further service, please contact us at your convenience.

Sincerely,

GEOCON CONSULTANTS, INC.

Chris Giuntoli, CAC
Senior Project Scientist

Richard Day, CEG, CHG
Vice President

(1) Addressee
(1) Caltrans District 4, Chris Wilson

DRAFT

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DRAFT

ASBESTOS AND LEAD-CONTAINING PAINT SURVEY REPORT

1.0 INTRODUCTION

1.1 Site Description

The subject site (Site) consists of soundwalls along northbound and southbound Interstate 680 (I-680) between Sycamore Valley Road and Crow Canyon Road in Danville and San Ramon, California. The approximate project location is depicted on the Vicinity Map, Figure 1, and Site Plan, Figure 2.

1.2 Objectives

Our objectives were to assess the potential presence and quantity of asbestos and lead-containing paint (LCP) at the Site prior to activities associated with highway widening and soundwall demolition. The information obtained from this investigation will be used by Mark Thomas & Company, Inc. for waste profiling, determining California Occupational Safety and Health Administration (Cal/OSHA) applicability, and coordinating asbestos and LCP disturbance activities.

> *It was <u>not</u> Geocon's intent during this inspection to conduct an evaluation of lead-based paint hazards in accordance with United States Department of Housing and Urban Development (HUD) guidelines.*

2.0 BACKGROUND

2.1 Asbestos

The *Code of Federal Regulations (CFR)*, 40 CFR 61, Subpart M, National Emissions Standards for Hazardous Air Pollutants (NESHAP) and Federal Occupational Safety and Health Administration (FED OSHA) classify asbestos-containing material (ACM) as any material or product that contains *greater than* 1% asbestos. Nonfriable ACM is classified by NESHAP as either Category I or Category II material defined as follows:

- **Category I** – asbestos-containing packings, gaskets, resilient floor coverings, and asphalt roofing products.
- **Category II** – all remaining types of nonfriable asbestos-containing material not included in Category I that when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.

Regulated asbestos-containing material (RACM), a hazardous waste when friable, is classified as any manufactured material that contains *greater than* 1% asbestos by dry weight *and* is:

- Friable (can be crumbled, pulverized, or reduced to powder by hand pressure); or
- Category I material that has become friable; or

- Category I material that has been subjected to sanding, grinding, cutting, or abrading; or
- Category II nonfriable material that has a high probability of becoming crumbled, pulverized, or reduced to a powder during demolition or renovation activities.

Activities that disturb materials containing *any* amount of asbestos are subject to certain requirements of the Cal/OSHA asbestos standard contained in Title 8, CCR Section 1529. Typically, removal or disturbance of more than 100 square feet of material containing more than 0.1% asbestos must be performed by a registered asbestos abatement contractor, but associated waste labeling is not required if the material contains 1% or less asbestos. When the asbestos content of a material exceeds 1%, virtually all requirements of the standard become effective.

Materials containing more than 1% asbestos are also subject to NESHAP regulations (40 CFR Part 61, Subpart M). RACM (friable ACM and nonfriable ACM that will become friable during demolition operations) must be removed from structures prior to demolition. Certain nonfriable ACM and materials containing 1% or less asbestos may remain in structures during demolition; however, there are waste handling/disposal issues and Cal/OSHA work requirements that must be addressed. Contractors are responsible for segregating and characterizing waste streams prior to disposal.

With respect to potential worker exposure, notification, and registration requirements, Cal/OSHA defines asbestos-containing construction material (ACCM) as construction material that contains more than 0.1% asbestos (Title 8, CCR 341.6).

2.2 Lead Paint

Construction activities (including demolition) that disturb materials or paints containing *any* amount of lead are subject to certain requirements of the Cal/OSHA lead standard contained in Title 8, CCR, Section 1532.1. Deteriorated paint is defined by Title 17, CCR, Division 1, Chapter 8, §35022 as a surface coating that is cracking, chalking, flaking, chipping, peeling, non-intact, failed, or otherwise separating from a substrate. Demolition of a deteriorated LCP component would require waste characterization and appropriate disposal. Intact LCP on a component is currently accepted by most landfills and recycling facilities; however, contractors are responsible for segregating and characterizing waste streams prior to disposal.

For a solid waste containing lead, the waste is classified as California hazardous when: 1) the total lead content equals or exceeds the respective Total Threshold Limit Concentration (TTLC) of 1,000 milligrams per kilogram (mg/kg); or 2) the soluble lead content equals or exceeds the respective Soluble Threshold Limit Concentration (STLC) of 5 milligrams per liter (mg/l) based on the standard Waste Extraction Test (WET). A waste has the potential for exceeding the lead STLC when the waste's total lead content is greater than or equal to ten times the respective STLC value since the WET uses a 1:10 dilution ratio. Hence, when total lead is detected at a concentration greater than or equal to

50 mg/kg, and assuming that 100 percent of the total lead is soluble, soluble lead analysis is required. Lead-containing waste is classified as "Resource, Conservation, and Recovery Act" (RCRA) hazardous, or Federal hazardous, when the soluble lead content equals or exceeds the Federal regulatory level of 5 mg/l based on the Toxicity Characteristic Leaching Procedure (TCLP).

The above regulatory criteria are based on chemical concentrations. Wastes may also be classified as hazardous based on other criteria such as ignitability; however, for the purposes of this investigation, toxicity (i.e., lead concentration) is the primary factor considered for waste classification since waste generated during the construction activities would not likely warrant testing for ignitability or other criteria. Waste that is classified as either California-hazardous or RCRA-hazardous requires management as a hazardous waste.

Potential hazards exist to workers who remove or cut through LCP coatings during demolition. Dust containing hazardous concentrations of lead may be generated during scraping or cutting materials coated with lead-containing paint. Torching of these materials may produce lead oxide fumes. Therefore, air monitoring and/or respiratory protection may be required during the demolition of materials coated with LCP. Guidelines regarding regulatory provisions for construction work where workers may be exposed to lead are presented in Title 8, CCR, Section 1532.1.

3.0 SCOPE OF SERVICES

Mr. Chris Giuntoli, a California-Certified Asbestos Consultant (CAC), certification No. 02-3164 (expiration June 19, 2012), and Certified Lead Paint Inspector/Assessor with the California Department of Public Health (DPH), certification number I-5502 (expiration June 14, 2012), performed the asbestos and LCP survey at the Site on October 20, 2011.

3.1 Asbestos

Suspect ACM were grouped into homogeneous areas with representative samples randomly collected from each. In addition, each potential ACM was evaluated for quantity and friability. A total of 22 bulk asbestos samples were collected during our survey.

Geocon's procedures for inspection and sampling are discussed below:

- Collected bulk asbestos samples after first wetting friable material with a light mist of water. The samples were then cut from the substrate and transferred to a labeled container. Note that when multiple samples were collected, the sampling locations were distributed throughout the homogeneous area (spaces where the material was observed).
- Relinquished bulk asbestos samples to EMSL Analytical, Inc., a California-licensed laboratory, for asbestos analysis in accordance with EPA Test Method 600/R-93/116 using polarized light microscopy (PLM) under standard chain-of-custody procedures. EMSL Analytical, Inc. is a laboratory accredited by the National Institute of Standards and Technology National

Voluntary Laboratory Accreditation Program (NIST-NVLAP) for bulk asbestos fiber analysis. The laboratory analyses were requested on a five-day turnaround time.

Sample identification numbers, material descriptions, approximate quantities, friability assessments, and photo references are summarized in Table 1. Sample locations are presented on the Site Plan, Figure 2. Materials represented by the samples collected are shown in the attached photographs.

3.2 Lead Paint

We observed no painted surfaces at the Site during our survey. Consequently, we collected no paint samples.

4.0 INVESTIGATIVE RESULTS

No asbestos was detected in samples of suspect materials collected during our survey. Laboratory results for the asbestos samples are summarized on Table 1. Reproductions of the laboratory report and chain-of-custody documentation are presented in Appendix A.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Asbestos

Since no asbestos was detected, the Cal/OSHA asbestos standard does not apply for activities disturbing suspect materials represented by samples collected during our survey. In addition, suspect materials represented by samples collected during our survey would not be considered a California hazardous waste based on asbestos content.

In accordance with Bay Area Air Quality Management District (BAAQMD) Regulation 11, Rule 2, written notification is required ten working days prior to commencement of *any* demolition activity (whether asbestos is present or not).

5.2 Lead Paint

We recommend that all paints at the Site (graffiti, graffiti abatement, signage, traffic striping, etc.) be treated as lead-containing for purposes of complying with the Cal/OSHA lead standard (Title 8, CCR, Section 1532.1) during future maintenance, renovation, and demolition activities. This recommendation is based on the fact that lead is still an ingredient of some paints.

6.0 REPORT LIMITATIONS

This report has been prepared exclusively for Mark Thomas & Company, Inc. The information contained herein is only valid as of the date of the report and will require an update to reflect additional information obtained.

The asbestos and deteriorated LCP survey was conducted in conformance with generally accepted standards of practice for identifying and evaluating asbestos and LCP in structures. The survey addressed only the structures identified in Section 1.1. Due to the nature of structure surveys, asbestos and LCP use, and laboratory analytical limitations, some asbestos or deteriorated LCP in the structures may not have been identified. Spaces, such as cavities, crawlspaces, voids, and pipe chases, may have been concealed to our investigator. Previous renovation work may have concealed or covered spaces or materials, or may have partially demolished materials and left debris in inaccessible areas. Additionally, renovation activities may have partially replaced asbestos with indistinguishable non-asbestos. Asbestos and/or LCP may exist in areas not accessible or sampled in conjunction with our scope of services.

During renovation or demolition operations, suspect materials may be uncovered which are different from those accessible for sampling during this assessment. Personnel in charge of renovation/demolition should be alerted to note materials uncovered during such activities that differ substantially from those included in this or previous assessment reports. If additional suspect materials are found, they should be treated as ACM and/or LCP until/unless sampling and analysis indicate otherwise.

This report is not a comprehensive site characterization and should not be construed as such. The findings as presented in this report are predicated on the results of the limited sampling and laboratory testing performed. In addition, the information obtained is not intended to address potential impacts related to sources other than those specified herein. Therefore, the report should be deemed conclusive with respect to only the information obtained. We make no warranty, express or implied, with respect to the content of this report or any subsequent reports, correspondence, or consultation. Geocon strived to perform the services summarized herein in accordance with the local standard of care in the geographic region at the time the services were rendered.

The contents of this report reflect the views of the author who is responsible for the facts and accuracy of the data presented herein. This report does not constitute a standard, specification, or regulation.

Project No. E8595-06-02
January , 2012

Mr. Sasha Dansky
Mark Thomas & Company, Inc.
3000 Oak Road, Suite 650
Walnut Creek, California 94597

Subject: ASBESTOS AND LEAD-CONTAINING PAINT SURVEY REPORT
I-680 SEGMENT 2 AUXILIARY LANES PROJECT
CONTRA COSTA COUNTY, CALIFORNIA

Dear Mr. Dansky:

We have performed an asbestos and lead-containing paint survey at the subject site (Site). The scope of services provided by Geocon included surveying soundwalls along northbound and southbound Interstate 680 within the project limits for suspect asbestos-containing materials and lead-containing paint, collecting bulk samples, and submitting the samples to a laboratory for analysis.

The accompanying report summarizes the services performed and the results of laboratory testing.

The contents of this report reflect the views of Geocon, who are responsible for the facts and accuracy of the data presented herein. This report does not constitute a standard, specification, or regulation.

If there are questions concerning the contents of this report, or if we may be of further service, please contact us at your convenience.

Sincerely,

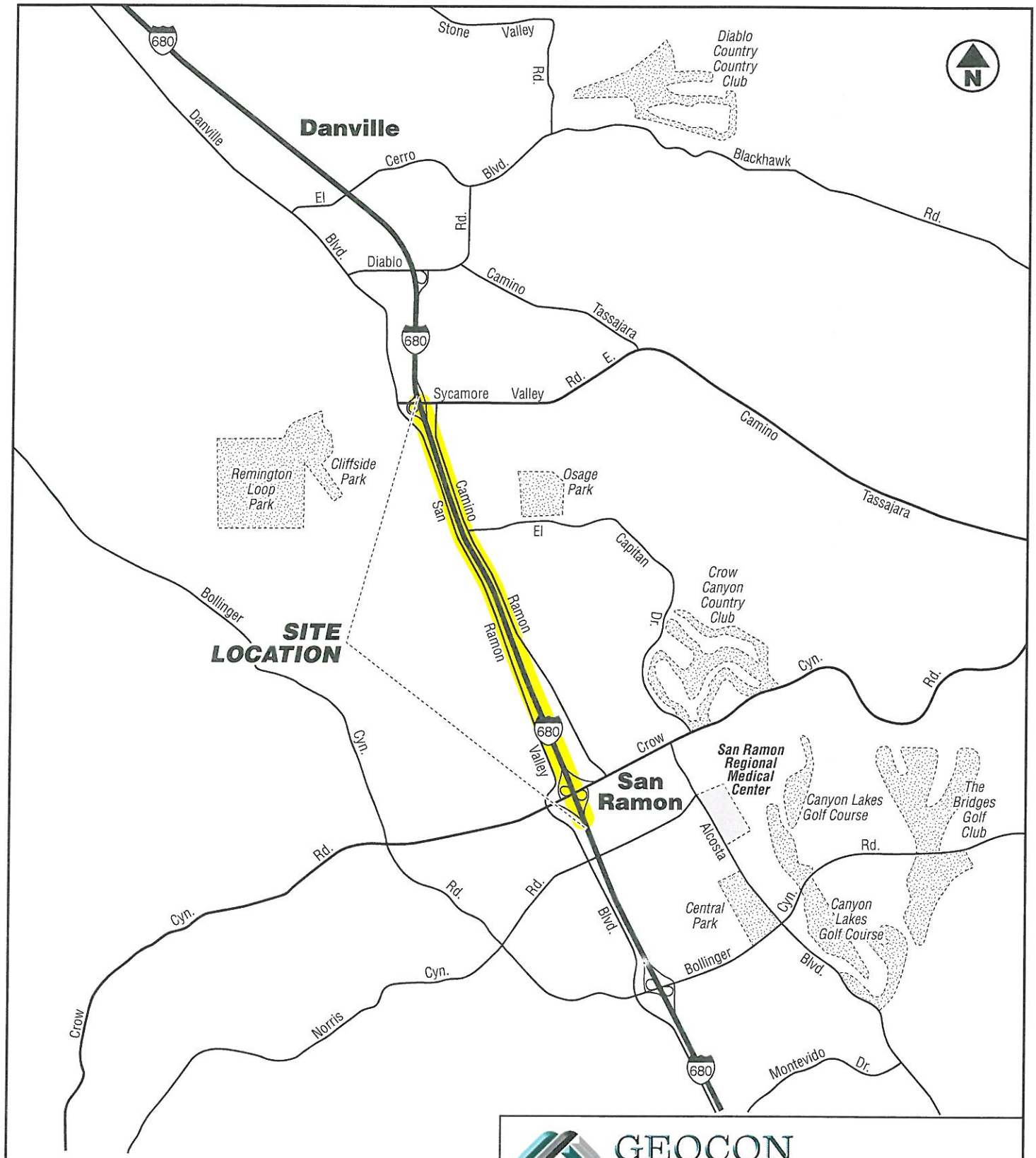
GEOCON CONSULTANTS, INC.

Chris Giuntoli, CAC
Senior Project Scientist

Richard Day, CEG, CHG
Vice President

(1) Addressee
(1) Caltrans District 4, Chris Wilson

DRAFT



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Scale in Miles

GEOCON
CONSULTANTS, INC.
6671 BRISA STREET – LIVERMORE, CA 94550
PHONE 925.371.5900 – FAX 925.371.5915

I-680 Segment 2 Auxiliary Lanes Project

Contra Costa County, California

VICINITY MAP

E8595-06-02	January 2012	Figure 1

N

NOT TO SCALE

LEGEND:

- Approximate Asbestos Sample Location
- Soundwall

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6671 BRISA STREET – LIVERMORE, CA 94550
PHONE 925.371.5900 – FAX 925.371.5915

I-680 Segment 2 Auxiliary Lanes Project

Contra Costa County,
California

SITE PLAN

E8595-06-02	January 2012	Figure 2

Photo 1 – I-680 northbound soundwall at the southern portion of the project area, north of the Crow Canyon Road Overcrossing

Photo 2 – Soundwall concrete, I-680 northbound

Photo 3 – Soundwall joint fill material, I-680 northbound

GEOCON
CONSULTANTS, INC.
6671 BRISA STREET – LIVERMORE, CA 94550
PHONE 925.371.5900 – FAX 925.371.5915

PHOTOGRAPHS 1, 2, & 3		
I-680 Segment 2 Auxiliary Lanes Project Danville and San Ramon, California		
E8595-06-02		January 2012

Photo 4 – Soundwall cinder block and mortar, I-680 northbound

Photo 5 – Soundwall cinder block and mortar, I-680 northbound

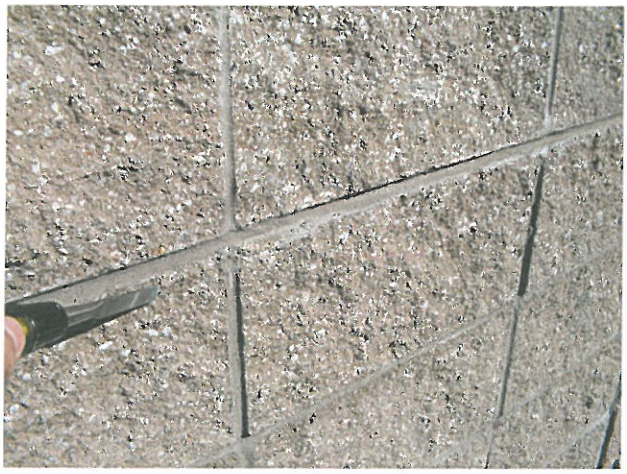

Photo 6 – Soundwall cinder block and mortar, I-680 southbound

TABLE 1
SUMMARY OF ANALYTICAL LABORATORY TEST RESULTS - ASBESTOS
I-680 SEGMENT 2 AUXILIARY LANES PROJECT
CONTRA COSTA COUNTY, CALIFORNIA

Polarized Light Microscopy (PLM) - EPA Test Method 600/R-93/116

Sample Group ID	Description of Suspect Material	Approximate Quantity	Friable	Site Photo	Asbestos Content
1	Soundwall concrete, Northbound I-680	NA	NA	2	ND
2	Soundwall joint fill material, Northbound I-680	NA	NA	3	ND
3	Mortar, Northbound I-680	NA	NA	4	ND
4	Cinder block, Northbound I-680	NA	NA	4	ND
5	Mortar, Northbound I-680	NA	NA	5	ND
6	Cinder block, Northbound I-680	NA	NA	5	ND
7	Mortar, Southbound I-680	NA	NA	6	ND
8	Cinder block, Southbound I-680	NA	NA	6	ND

Notes:

NA = Not applicable

ND = No asbestos fibers detected

DRAFT

APPENDIX A

EMSL Analytical, Inc
2235 Polvorosa Ave , Suite 230, San Leandro, CA 94577
Phone: (510) 895-3675 Fax: (510) 895-3680 Email: sanleandrolab@emsl.com

Attn: **Chris Giuntoli**
Geocon Consultants, Inc.
4010 Technology Way Ste D
Carson City, NV 89706

Fax: (775) 888-9904 Phone: (775) 888-9900
Project: **E8595-06-02**

Customer ID: GCNV25
Customer PO: E8595-06-02
Received: 10/21/11 9:00 AM
EMSL Order: 091112030

EMSL Proj:
Analysis Date: 10/28/2011

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos % Fibrous	Non-Asbestos % Non-Fibrous	Asbestos % Type
680-1A *091112030-0001*	Soundwall cement (NB)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**
680-1B *091112030-0002*	Soundwall cement (NB)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**
680-1C *091112030-0003*	Soundwall cement (NB)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**
680-2A *091112030-0004*	Joint fill material (NB)	Brown Fibrous Homogeneous	90% Cellulose	10% Non-fibrous (other)	**None Detected**
680-2B *091112030-0005*	Joint fill material (NB)	Brown Fibrous Homogeneous	90% Cellulose	10% Non-fibrous (other)	**None Detected**
680-2C *091112030-0006*	Joint fill material (NB)	Brown Fibrous Homogeneous	90% Cellulose	10% Non-fibrous (other)	**None Detected**
680-3A *091112030-0007*	Mortar (NB)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**

Initial report from 10/28/2011 08:49:19

Analyst(s)

Cheryl Alvarado (14)
Mike J. Williams (8)

Baojia Ke, Laboratory Manager
or other approved signatory

Due to magnification limitations inherent in PLM, asbestos fibers in dimensions below the resolution capability of PLM may not be detected. Samples reported as <1% or none detected may require additional testing by TEM to confirm asbestos quantities. The above test report relates only to the items tested and may not be reproduced in any form without the express written approval of EMSL Analytical, Inc. EMSL's liability is limited to the cost of analysis. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client.Samples received in good condition unless otherwise noted.
Samples analyzed by EMSL Analytical, Inc San Leandro, CA NVLAP Lab Code 101048-3, MA AA000201, WA C2007

EMSL Analytical, Inc
2235 Polvorosa Ave , Suite 230, San Leandro, CA 94577
Phone: (510) 895-3675 Fax: (510) 895-3680 Email: sanleandrolab@emsl.com

Attn: **Chris Giuntoli**
Geocon Consultants, Inc.
4010 Technology Way Ste D
Carson City, NV 89706

Fax: (775) 888-9904 Phone: (775) 888-9900
Project: **E8595-06-02**

Customer ID: GCNV25
Customer PO: E8595-06-02
Received: 10/21/11 9:00 AM
EMSL Order: 091112030

EMSL Proj:
Analysis Date: 10/28/2011

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
680-3B *091112030-0008*	Mortar (NB)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**
680-4A *091112030-0009*	Cinder block (NB)	Red Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**
680-4B *091112030-0010*	Cinder block (NB)	Red Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**
680-5A *091112030-0011*	Mortar (NB)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**
680-5B *091112030-0012*	Mortar (NB)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**
680-5C *091112030-0013*	Mortar (NB)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**
680-6A *091112030-0014*	Cinder block (NB)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**

Initial report from 10/28/2011 08:49:19

Analyst(s)

Cheryl Alvarado (14)
Mike J. Williams (8)

Baojia Ke, Laboratory Manager
or other approved signatory

Due to magnification limitations inherent in PLM, asbestos fibers in dimensions below the resolution capability of PLM may not be detected. Samples reported as <1% or none detected may require additional testing by TEM to confirm asbestos quantities. The above test report relates only to the items tested and may not be reproduced in any form without the express written approval of EMSL Analytical, Inc. EMSL's liability is limited to the cost of analysis. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client.Samples received in good condition unless otherwise noted.
Samples analyzed by EMSL Analytical, Inc San Leandro, CA NVLAP Lab Code 101048-3, MA AA000201, WA C2007

EMSL Analytical, Inc
2235 Polvorosa Ave , Suite 230, San Leandro, CA 94577
Phone: (510) 895-3675 Fax: (510) 895-3680 Email: sanleandrolab@emsl.com

Attn: **Chris Giuntoli**
Geocon Consultants, Inc.
4010 Technology Way Ste D
Carson City, NV 89706

Fax: (775) 888-9904 Phone: (775) 888-9900
Project: **E8595-06-02**

Customer ID: GCNV25
Customer PO: E8595-06-02
Received: 10/21/11 9:00 AM
EMSL Order: 091112030

EMSL Proj:
Analysis Date: 10/28/2011

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
680-6B *091112030-0015*	Cinder block (NB)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**
680-6C *091112030-0016*	Cinder block (NB)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**
680-7A *091112030-0017*	Mortar (SB)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**
680-7B *091112030-0018*	Mortar (SB)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**
680-7C *091112030-0019*	Mortar (SB)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**
680-8A *091112030-0020*	Cinder block (SB)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**
680-8B *091112030-0021*	Cinder block (SB)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**

Initial report from 10/28/2011 08:49:19

Analyst(s)

Cheryl Alvarado (14)
Mike J. Williams (8)

Baojia Ke, Laboratory Manager
or other approved signatory

Due to magnification limitations inherent in PLM, asbestos fibers in dimensions below the resolution capability of PLM may not be detected. Samples reported as <1% or none detected may require additional testing by TEM to confirm asbestos quantities. The above test report relates only to the items tested and may not be reproduced in any form without the express written approval of EMSL Analytical, Inc. EMSL's liability is limited to the cost of analysis. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client.Samples received in good condition unless otherwise noted.
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Attn: **Chris Giuntoli**
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4010 Technology Way Ste D
Carson City, NV 89706

Fax: (775) 888-9904 Phone: (775) 888-9900
Project: **E8595-06-02**

Customer ID: GCNV25
Customer PO: E8595-06-02
Received: 10/21/11 9:00 AM
EMSL Order: 091112030

EMSL Proj:
Analysis Date: 10/28/2011

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
680-8C *091112030-0022*	Cinder block (SB)	Gray Non-Fibrous Homogeneous		100% Non-fibrous (other)	**None Detected**

Initial report from 10/28/2011 08:49:19

Analyst(s)

Cheryl Alvarado (14)
Mike J. Williams (8)

Baojia Ke, Laboratory Manager
or other approved signatory

Due to magnification limitations inherent in PLM, asbestos fibers in dimensions below the resolution capability of PLM may not be detected. Samples reported as <1% or none detected may require additional testing by TEM to confirm asbestos quantities. The above test report relates only to the items tested and may not be reproduced in any form without the express written approval of EMSL Analytical, Inc. EMSL's liability is limited to the cost of analysis. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client.Samples received in good condition unless otherwise noted.
Samples analyzed by EMSL Analytical, Inc San Leandro, CA NVLAP Lab Code 101048-3, MA AA000201, WA C2007

THIS IS THE LAST PAGE OF THE REPORT.

091112030

EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

Asbestos Chain of Custody

EMSL Order Number (*Lab Use Only*): 091112030

EMSL ANALYTICAL, INC.
2235 POLVOROSA DR., STE. 230
SAN LEANDRO, CA 94577
PHONE: (510) 895-3675
FAX: (510) 895-3680

EMSL-Bill to: ☒ Same ☐ Different
If Bill to is Different note instructions in Comments**
Third Party Billing requires written authorization from third party

Company: GEOCON
Street: 4010 TECHNOLOGY WAY, SUITE D
City: CARSON CITY State/Province: NV Zip/Postal Code: 89706 Country: US
Report To (Name): CHRIS GIUNTOLI Fax #:
Telephone #: 775-888-9900 Email Address: GIUNTOLI@GEOCONINC.COM
Project Name/Number: E8595-06-02
Please Provide Results: ☐ Fax ☒ Email Purchase Order: U.S. State Samples Taken:

Turnaround Time (TAT) Options* – Please Check
☐ 3 Hour ☐ 6 Hour ☐ 24 Hour ☐ 48 Hour ☐ 72 Hour ☐ 96 Hour ☒ 1 Week ☐ 2 Week

**For TEM Air 3 hours/6 hours, please call ahead to schedule.*There is a premium charge for 3 Hour TEM AHERA or EPA Level II TAT. You will be asked to sign an authorization form for this service. Analysis completed in accordance with EMSL's Terms and Conditions located in the Analytical Price Guide.*

PCM - Air
☐ NIOSH 7400
☐ w/ OSHA 8hr. TWA

PLM - Bulk (reporting limit)
☒ PLM EPA 600/R-93/116 (<1%)
☐ PLM EPA NOB (<1%)
Point Count
☐ 400 (<0.25%) ☐ 1000 (<0.1%)
Point Count w/Gravimetric
☐ 400 (<0.25%) ☐ 1000 (<0.1%)
☐ NYS 198.1 (friable in NY)
☐ NYS 198.6 NOB (non-friable-NY)
☐ NIOSH 9002 (<1%)

TEM – Air ☐ **4-4.5hr TAT** (AHERA only)
☐ AHERA 40 CFR, Part 763
☐ NIOSH 7402
☐ EPA Level II
☐ ISO 10312

TEM - Bulk
☐ TEM EPA NOB
☐ NYS NOB 198.4 (non-friable-NY)
☐ Chatfield SOP
☐ TEM Mass Analysis-EPA 600 sec. 2.5

TEM – Water: EPA 100.2
Fibers >10µm ☐ Waste ☐ Drinking
All Fiber Sizes ☐ Waste ☐ Drinking

TEM- Dust
☐ Microvac - ASTM D 5755
☐ Wipe - ASTM D6480
☐ Carpet Sonication (EPA 600/J-93/167)

Soil/Rock/Vermiculite
☐ PLM CARB 435 - A (0.25% sensitivity)
☐ PLM CARB 435 - B (0.1% sensitivity)
☐ TEM CARB 435 - B (0.1% sensitivity)
☐ TEM CARB 435 - C (0.01% sensitivity)
☐ EPA Protocol (Semi-Quantitative)
☐ EPA Protocol (Quantitative)

Other:
☐

☐ **Check For Positive Stop – Clearly Identify Homogenous Group**

Samplers Name: CHRIS GIUNTOLI Samplers Signature: [signature]

Sample #	Sample Description	Volume/Area (Air) HA # (Bulk)	Date/Time Sampled
680-1A	SANDWALL CEMENT (NB)		10/20/11
680-1B	↓		↓
680-1C	↓		↓
680-2A	JOINT FILL MATERIAL (NB)		↓
680-2B	↓		↓
680-2C	↓		↓
680-3A	MORTAR (NB)		↓
680-3B	↓		↓

Total # of Samples: 22

Client Sample # (s):
Relinquished (Client): [signature] Date: 10/20/11 Time: 1800
Received (Lab): [signature] Date: RECEIVED OCT 21 2011 Time: 0900
Comments/Special Instructions:

091112030

EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

Asbestos Chain of Custody

EMSL Order Number *(Lab Use Only)*: 091112030

EMSL ANALYTICAL, INC
2235 POLVOROSA DR., STE 230
SAN LEANDRO, CA 94577
PHONE: (510) 895-3675
FAX: (510) 895-3680

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information

Sample #	Sample Description	Volume/Area (Air) HA # (Bulk)	Date/Time Sampled
680-4A	CINDER BLOCK (NB)		10/20/11
680-4B	↓		↓
680-5A	MORTAR (NB)		
680-5B	↓		
680-5C	↓		
680-6A	CINDER BLOCK (NB)		
680-6B	↓		
680-6C	↓		
680-7A	MORTAR (SB)		
680-7B	↓		
680-7C	↓		
680-8A	CINDER BLOCK (SB)		
680-8B	↓		
680-8C	↓		↓

*Comments/Special Instructions:

RECEIVED OCT 21 2011
0900

Controlled Document – Asbestos COC – R2 – 1/12/2010

STATE OF CALIFORNIA EDMUND G. BROWN, JR., Governor

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

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

April 12, 2012

Mark Thomas & Company
3000 Oak Road, Suite 650
Walnut Creek, CA 94597

Attention: Sasha Dansky, P.E. (via e-mail: sdansky@markthomas.com)

Subject: Underground Classification #: C123-013-12T Thru C127-013-12T

Interstate 680 Auxiliary Lane Segment 2 Project

Mr. Dansky:

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

When the contractor who will be performing the work is selected, please advise them to notify this office to determine if a mandated Prejob Conference with the Division is required prior to commencing any activity associated with drilling of the shaft(s).

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

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

Sincerely,

Douglas Patterson
Senior Engineer

cc: R. Brockman

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C123-013-12T

DEPARTMENT OF TRANSPORTATION
NAME OF TUNNEL OR MINE AND COMPANY NAME

of 111 GRAND AVENUE, OAKLAND, CA 94612
MAILING ADDRESS

at INTERSTATE 680 AUXILIARY LANE SEGMENT 2 PROJECT
LOCATION

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

as required by the California Labor Code § 7955.

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

SPECIAL CONDITIONS

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

The one 60-inch diameter 25-foot deep drilled shaft along the west shoulder of Southbound I-680, located approximately 5,200 feet north of Crow Canyon Road, Danville, Contra Costa County

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

Date April 12, 2012

Douglas Patterson, Senior Engineer

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C124-013-12T

DEPARTMENT OF TRANSPORTATION
NAME OF TUNNEL OR MINE AND COMPANY NAME

of 111 GRAND AVENUE, OAKLAND, CA 94612
MAILING ADDRESS

at INTERSTATE 680 AUXILIARY LANE SEGMENT 2 PROJECT
LOCATION

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

as required by the California Labor Code § 7955.

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

SPECIAL CONDITIONS

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

One 60-inch diameter 25-foot deep drilled shaft along the east shoulder Northbound I-680 located approximately 4,470 feet north of Crow Canyon Road, Danville, Contra Costa County

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

Date April 12, 2012

Douglas Patterson, Senior Engineer

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C125-013-12T

DEPARTMENT OF TRANSPORTATION
NAME OF TUNNEL OR MINE AND COMPANY NAME

of 111 GRAND AVENUE, OAKLAND, CA 94612
MAILING ADDRESS

at INTERSTATE 680 AUXILIARY LANE SEGMENT 2 PROJECT
LOCATION

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

as required by the California Labor Code § 7955.

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

SPECIAL CONDITIONS

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

One 60-inch diameter 23-foot deep drilled shaft along the west shoulder of Southbound I-680 located approximately 3,870 feet south of Sycamore Valley Road, Danville, Contra Costa County

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

Date April 12, 2012

Douglas Patterson, Senior Engineer

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

Underground Classification

C126-013-12T

DEPARTMENT OF TRANSPORTATION
NAME OF TUNNEL OR MINE AND COMPANY NAME

of 111 GRAND AVENUE, OAKLAND, CA 94612
MAILING ADDRESS

at INTERSTATE 680 AUXILIARY LANE SEGMENT 2 PROJECT
LOCATION

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

as required by the California Labor Code § 7955.

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

SPECIAL CONDITIONS

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

One 60-inch diameter 25-foot deep drilled shaft along the east shoulder Northbound I-680 located approximately 3,850 feet south of Sycamore Valley Road, Danville, Contra Costa County

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

Date April 12, 2012

Douglas Patterson, Senior Engineer

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

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C127-013-12T

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

One 60-inch diameter 23-foot deep drilled shaft along the east shoulder of Northbound I-680 located approximately 1,708 feet south fo Sycamore Valley Road, Danville, Contra Costa County

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

Date April 12, 2012

Douglas Patterson, Senior Engineer

I680 Segment 2 Auxiliary Lanes Project
Contra Costa County, California
EA 2285H4
May 2012

Storm Water Information Handout

Prepared For

Prepared By

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Attachments

Attachment A Project Vicinity Map
Attachment B NOAA Precipitation Data
Attachment C Risk Level Determination
Attachment D Run-on Discharge Calculations
Attachment E Temporary Water Pollution Control Drawings

Disclaimer

A "Disclaimer" is required specifying that the information provided in the Storm Water Information Handout is just a guideline and is to be used for information purposes only and should not be considered a sole source document to adhere to the requirements of the new National Pollutant Discharge Elimination System (NPDES) Construction General Permit (CGP), Number CAS000002, adopted on September 2, 2009. The contractor is required to provide water quality monitoring, sampling and implement best management practices (BMPs) based on standard industry operations, field conditions and conditions encountered based on the contractor's means and methods. The information in this handout is not to be construed in any way as a waiver of the provisions in the CGP. Bidders and contractors are cautioned to make independent investigations and examinations as they deem necessary to satisfy the conditions encountered in performance of work, with respect to the following: sampling and monitoring locations, distribution of watershed areas for sizing of BMPs, and selection of BMPs in order to conform to the requirement of the contract documents and the CGP.

1 OVERVIEW

1.1 Intent of this Document

The objectives of this Water Quality Information Handout are: to summarize general water quality information of the Project; to summarize updated requirements per the new Construction General Permit (CGP), which became effective as of July 1, 2010; to provide general guidelines for contractors to bid on the project; to aid in developing the Storm Water Pollution Prevention Plan (SWPPP) of the project; and to highlight information necessary to file Project Registration Documents (PRDs) to the State Water Resources Control Board via the Stormwater Multi Application Reporting and Tracking System (SMARTS) and file the Notice of Intent at the start of construction.

1.2 Summary of New Requirements

The "National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities" (NPDES Number CAS000002), or CGP, regulates discharges from construction activities within the Project area.

The CGP is based on a risk level (RL) permitting approach. The RL is calculated by 1) project sediment risk and 2) receiving water risk. See the risk assessment calculations in Attachment C of this document for details.

A risk assessment was done for the **I680 Segment 2 Auxiliary Lanes Project (EA 04-2285H1)**, and the Project was determined to be **RL 2.**

RL 2 projects will be subject to monitoring and sampling requirements, plus Numeric Action Levels (NALs) for pH and turbidity. All projects will have to upload storm water data into SMARTS, such as Notices of Intent (NOIs), SWPPPs, annual reports, and monitoring data.

2 GENERAL PROJECT INFORMATION

2.1 Location

The project is located in central Contra Costa County along Interstate 680 (I680) between the Crow Canyon Road and Sycamore Valley Road interchanges. The project lies within the City of San Ramon and the Town of Danville. See Vicinity Map, Attachment A.

2.2 Major Engineering Features

The project consists of adding new auxiliary lanes and shoulders to the northbound and southbound directions of I680. This project is Segment 2 of I680 Auxiliary Lane Project. Segments 1 and 3 of the project have already been constructed.

The project proposes the following improvements:

- I680 widening
- 2:1 to 4:1 (H:V) embankment and 2:1 (H:V) cut slopes
- Drainage improvements
- Signing and pavement delineation
- Construction of retaining walls
- Construction of sound walls

2.3 Receiving Water Bodies

The Project Site is located within the San Ramon Creek watershed, a subwatershed of the Walnut Creek Watershed, which encompasses 93,556 acres in central Contra Costa County.

The direct receiving water body for this project is San Ramon Creek. This creek generally parallels the project and flows from south to north.

Other drainage features that are adjacent to the I680 Auxiliary Lanes Project and in the project vicinity include: San Ramon Creek, Sycamore Creek, and Green Valley Creek. San Ramon Creek travels roughly 8 miles north of the project site before its confluence with Walnut Creek. From the terminus of San Ramon Creek, Walnut Creek travels approximately 12 miles north where it discharges into Suisun Bay.

There are no Drinking Water Reservoirs and/or recharge facilities within the project limits.

The Clean Water Act (CWA) Section 303(d) List of Water Quality Limited Segments (hereto known as “303(d) List”) is a list of water bodies that do not meet water quality standards. The State Water Resources Control Board (SWRCB, San Francisco Bay Region) developed this list and it is also approved by the United States Environmental Protection Agency (US EPA). These regulations require that the responsible jurisdictions establish a ranking system, by priority, for water bodies on the list; also, action plans need to be developed, such as Total Maximum Daily

Loads (TMDLs), in order to improve water quality. The 303(d) List is typically revised every two years.

San Ramon Creek is not listed on the 303(d) List of Water Quality Limited Segments. Walnut Creek is listed on the 303(d) list with Diazinon as the Pollutant of Concern.

2.4 Climate and Rainfall

A National Oceanic and Atmospheric Administration (NOAA) weather station located in Livermore, approximately 13 miles southeast of the Project site, was used to obtain precipitation data (Attachment B).

Rainy days per year (assumed equal to precipitation 0.10 inches or greater): 35.4 days

Qualifying rain events per year (precipitation 0.5 inches or greater): 9.0 days

2.5 Soils and Geology

The soil on the proposed site, as mapped by the Natural Resources Conservation Service, consists mainly of Cropley Clay, Conejo Clay Loam, Diablo Clay, Clear Lake Clay, and Garretson Loam. The Preliminary Geologic Evaluation for the project states that the I680 Auxiliary Lanes Project will not result in adverse geologic impacts. Design of the roadways and structures is in accordance with regulatory standards and design guidelines to address seismic risk. These include Caltrans Seismic Design Criteria and Caltrans Highway Design Manual. A Geotechnical Design and Materials Report (GDMR) has been prepared by Parikh Consultants, Inc. in November, 2011. Soil data collection together with site specific borings and penetrometer data has been conducted to determine foundation requirements. Soil laboratory test data has been conducted to determine site specific geotechnical design parameters.

2.6 Hazardous Waste

Recent studies have identified total lead in shallow soils near roadways attributed to the use of lead in gasoline, which was phased out beginning in the mid-1970s. Lead concentrations in shallow soils near roadways are affected by two factors: traffic volumes and wind patterns. No ADL sampling was conducted as part of the ISA, but there may be a potential for exposed soils near roadways in the study area to have elevated concentrations of total and/or soluble lead due to the age and frequency of use of the project corridor by diesel trucks and vehicles using leaded gasoline prior to the mid1970s. Soils exceeding hazardous waste thresholds will be classified as a hazardous waste, once excavated, and could require special handling and disposal procedures. Soil with elevated lead concentrations could also be a health hazard to construction workers, who may have direct contact with soils during project construction activities.

In addition, there are two adjoining leaking underground storage tanks, PCF Gas Station at 1990 San Ramon Valley Boulevard and San Ramon Gasoline at 2108 San Ramon Valley Boulevard. These properties have been identified to have petroleum hydrocarbon impacts to soil and groundwater that may have impacted adjacent Caltrans ROW and represent a moderate risk to the design and construction of the planned I-680 improvements. Based on the project limits and proposed construction activities, environmental impacts at other identified and potentially contaminated private properties within the project ESA represent a low risk to the design and construction of the planned I-680 improvements.

Other potential sources of hazardous waste include asbestos containing soundwall material, lead containing paint and yellow thermoplastic and paint striping. Asbestos containing pipe and treated wood may also be encountered during construction of the auxiliary lanes.

2.7 Existing (Pre-Construction) Control Practices

There are no existing treatment BMPs within the project limits.

3 CONSTRUCTION GENERAL PERMIT

To minimize the potential effects of construction runoff on the quality of the receiving water bodies, any construction activity affecting one acre or more must obtain coverage under the CGP. Permit applicants are required to prepare a SWPPP and implement BMPs to reduce construction effects on receiving water quality.

3.1 Risk Assessment

The CGP requirements include a risk assessment to determine the Project's impact risk to receiving water bodies. The risk assessment uses measurements of the Project's potential sediment risk and the sensitivity of the receiving water bodies to sediment to determine the RL of the Project. This Project has a **Medium Site Sediment Risk Factor** and a **High Receiving Water Risk Factor**; the combined risk is **Level 2** (See Attachment C). The risk factors are detailed in the following sections.

3.1.1 Sediment Risk

The sediment risk is based on the following equation from the adopted NPDES permit "Fact Sheet" (Section J.1.a pg. 28):

Equation 1 - Sediment Risk Equation
$A = (R)(K)(LS)(C)(P)$

Where:

R = Runoff erosivity factor
K = Soil erodibility factor
LS = Length-slope factor
C = Cover
P = Management operations and support practices
A = Rate of sheet and rill erosion (tons/acre)

The rainfall runoff erosivity factor (R) was determined from the United States Environmental Protection Agency (EPA) "Rainfall Erosivity Factor Calculator for Small Construction Sites." The erosivity index value for the Project was determined to be **43.6**.

The soil erodibility factor (K) was determined from the United States Department of Agriculture Natural Resources Conservation Services "Web Soil Survey." A weighted average of the soil erodibility factor by area was used; this value is **0.22**.

The length-slope factor (LS) was determined by examining the original grade delineated on the Typical Cross Sections included in the Contract Project Plans. Based on these cross sections, the weighted average LS factor was determined to be **3.37**.

The cover factor (C) and management operations and support practices (P) are given values of 1.0 by the adopted NPDES permit to simulate bare ground conditions.

Based on these factors, the rate of sheet and rill erosion (A) is **32.33** tons per acre. Because this value is greater than 15 tons per acre and less than 75 tons per acre, the project is classified as having a **medium** sediment risk.

3.1.2 Receiving Water Body Risk

The receiving water body risk is classified as **high** because Walnut Creek has the beneficial uses of SPWN, COLD and MIGR.

3.1.3 Combined Risk

With a medium sediment risk and a high receiving water body risk, the combined Risk Level is Level **2**.

3.2 Notice of Termination (NOT)

The CGP provides both revised and new requirements for completion and approval of the NOT. The NOT requirements are presented in Section II.D of the new CGP permit "Order." These requirements include demonstrating through photos, computational proof or other "custom methods," such as results of testing and analysis, that the terms of the NOT have been satisfied.

While these methods of demonstrating compliance are at the option of the contractor, should the RWQCB determine that the visual photos do not adequately show compliance, further computational efforts may be required. This computational proof is obtained through the use of the Revised Universal Soil Loss Equation 2 (RUSLE2) program.

3.3 Caltrans Forms

The following forms have been developed by the Division of Construction as of 09/2010:

- CEM-2030 "Stormwater Site Inspection Report"
  Visual inspection monitoring form

- CEM-2034 "Stormwater Best Management Status Report"
  Identifies BMP types and quantities to be installed on a weekly basis

- CEM-2035 "Stormwater Site Inspection Report Corrective Actions Summary"
  Describes actions taken for existing BMP failures

- CEM-2045 "Rain Event Action Plan-Highway Construction Phase"

REAP to be used during active work phase

- CEM-2046 “Rain Event Action Plan-Plant Establishment Phase”
  REAP to be used during plant establishment phase

- CEM-2047 “Rain Event Action Plan-Innactive Project”
  REAP to be used for inactive work phase

- CEM-2090 “Notice of Completion of Construction”
  Describes efforts to show compliance with NOT requirements

4 RUN-ON DISCHARGES

Run-on discharges are off-site storm water flows that can potentially run onto the site. The calculations are based on a rainfall intensity for a 2-year, 1-hour event per the Caltrans Computational Sheet for Determining Run-on Discharges. The runoff coefficient is calculated using an impervious/pervious surface map found in the Storm Water Data Report (SWDR). The area calculations use the watershed delineations provided in the Drainage Report for this project. See Attachment D for calculations.

The runoff coefficient is 0.68.

The rainfall intensity for a 2-year, 1-hour event is 0.50 in/hour.

The total drainage area for the project is 76 acres.

The Site Area Run-on Discharge is 25.84 ft^(3)/s

5 PROJECT REGISTRATION DOCUMENTS

To obtain permit coverage under the CGP, all dischargers must electronically file PRDs, NOTs, changes of information, sampling and monitoring information, annual reporting, and other compliance documents required by this CGP through the SWRCB's SMARTS. The contractor will have to coordinate these submittals with Caltrans within the timeframe allotted in the contract special provisions and as specified in the permit. SMARTS is found under the following website:

https://smarts.waterboards.ca.gov/smarts/faces/SwSmartsLogin.jsp

PRDs include the following information:

1. Notice of Intent (NOI)
2. Site Map(s) Includes:
    a. The project's surrounding area (vicinity)
    b. Site layout
    c. Construction site boundaries
    d. Drainage areas
    e. Discharge locations
    f. Sampling locations
    g. Areas of soil disturbance (temporary or permanent)
    h. Active areas of soil disturbance (cut or fill)
    i. Locations of all runoff BMPs
    j. Locations of all erosion control BMPs
    k. Locations of all sediment control BMPs
    l. ATS location (if applicable)
    m. Locations of sensitive habitats, watercourses, or other features which are not to be disturbed
    n. Locations of all post-construction BMPs
    o. Locations of storage areas for waste, vehicles, service, loading/unloading of materials, access (entrance/exits) points to construction site, fueling and water storage, water transfer for dust control and compaction practices

3. SWPPP

4. Risk Assessment

1. The Standard Risk Assessment includes utilization of the following:
    a. Receiving water Risk Assessment interactive map
    b. EPA Rainfall Erosivity Factor Calculator Website
    c. Sediment Risk interactive map
    d. Sediment sensitive water bodies list

2. The Site-Specific Risk Assessment includes the completion of the hand calculated R value Risk Calculator

5.1 General Information Included

The following is a list of information included in this Storm Water Information Handout that can be used for the PRDs:

- Vicinity Map
- Risk Assessment
- Temporary Water Pollution Control Plans (Site Map)

5.2 Storm Water Pollution Prevention Plan

The contractor for the Project is required to prepare a Storm Water Pollution Prevention Plan (SWPPP) because the Project involves disturbing more than 1 ac of soil. The SWPPP must include the following information:

- Active areas of cut and fill
- Areas of soil disturbance (temporary and permanent)
- Locations of storage areas for waste, vehicles, access, etc.
- Locations of all runoff BMPs
- Locations of all erosion control BMPs
- Locations of all sediment control BMPs

The SWPPP should be submitted with the PRDs and will be forthcoming from the Contractor.

5.3 Notice of Intent (NOI)

The NOI must be submitted once the contractor submits the SWPPP.

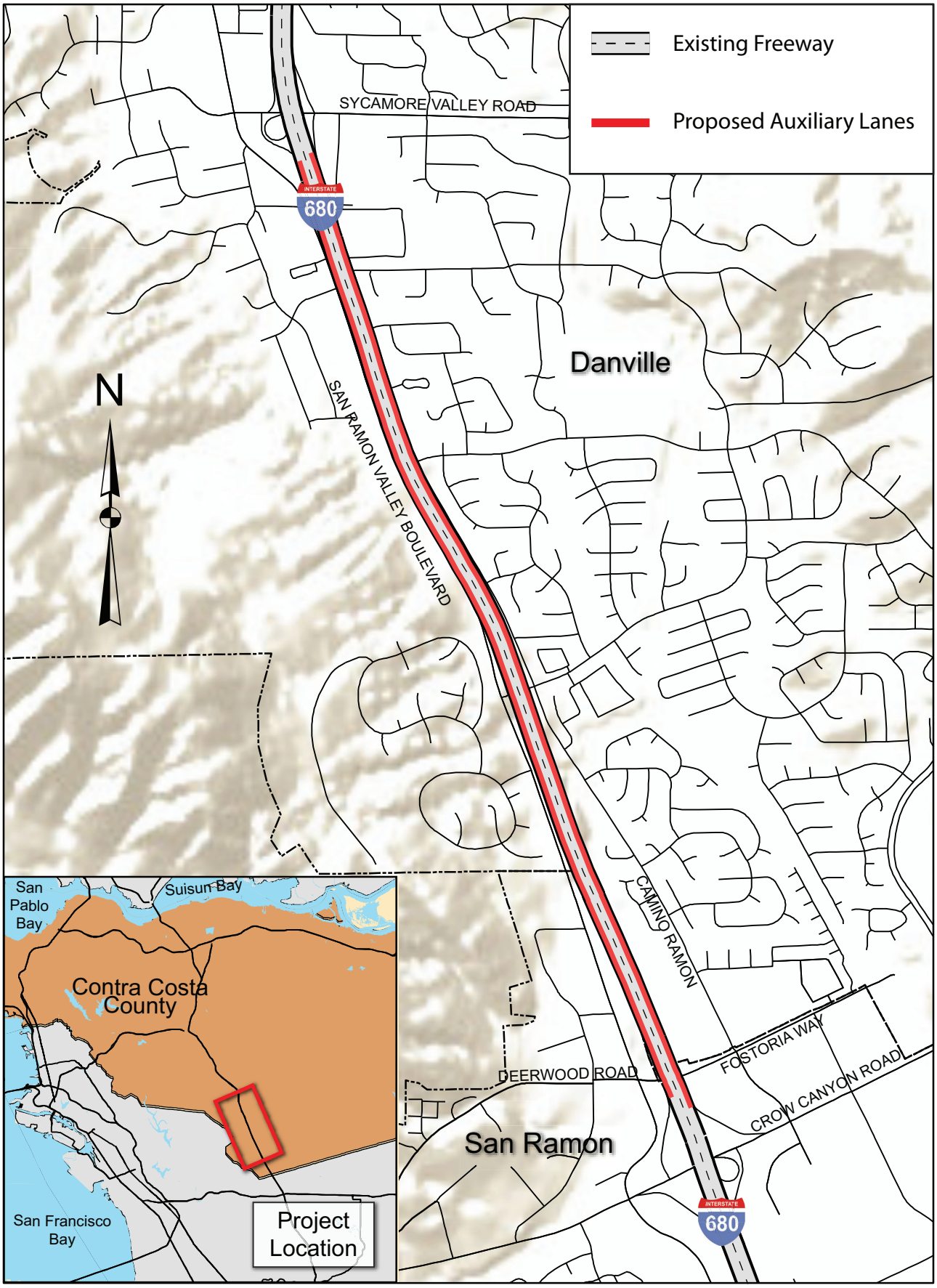
5.4 Site Maps

Registration requirements can be met by the inclusion of the Temporary Water Pollution Control Plans (Attachment E). Please note that the attached plans are not fully inclusive site maps and will need additional information to be considered complete:

- Discharge locations
- Sampling locations
- Storage locations

Attachment A

Project Vicinity Map



I-680 Auxiliary Lanes Project
Segment 2

CONTRA COSTA transportation authority

Attachment B

NOAA Precipitation Data

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data,
and Information Service

Climatography of the United States No. 20 1971-2000

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville, North Carolina 28801
www.ncdc.noaa.gov

Station: LIVERMORE, CA **COOP ID: 044997**

Climate Division: CA 4 **NWS Call Sign:** **Elevation: 480 Feet** **Lat: 37°42N** **Lon: 121°47W**

Precipitation (inches)

	Precipitation Totals									Mean Number of Days (3)				Precipitation Probabilities (1) Probability that the monthly/annual precipitation will be equal to or less than the indicated amount										
	Means/ Medians(1)		Extremes							Daily Precipitation				Monthly/Annual Precipitation vs Probability Levels These values were determined from the incomplete gamma distribution										
Month	Mean	Med-ian	Highest Daily(2)	Year	Day	Highest Monthly(1)	Year	Lowest Monthly(1)	Year	>= 0.01	>= 0.10	>= 0.50	>= 1.00	.05	.10	.20	.30	.40	.50	.60	.70	.80	.90	.95
Jan	2.99	1.94	3.45	1952	12	6.64	1995	.30	1976	10.1	6.2	1.9	.7	.28	.49	.90	1.31	1.77	2.28	2.89	3.65	4.70	6.44	8.14
Feb	2.77	2.71	2.93	1963	1	7.30	1998	.15	1997	9.2	6.2	2.1	.5	.28	.48	.86	1.25	1.67	2.14	2.69	3.38	4.32	5.89	7.42
Mar	2.47	2.32	2.00	1937	21	6.66	1995	.06	1997	9.9	6.4	1.4	.3	.18	.34	.66	.99	1.37	1.81	2.33	3.00	3.92	5.47	7.00
Apr	.96	.76	1.80	1958	3	3.51	1983	.15	1997	5.7	3.0	.3	@	.13	.21	.35	.48	.62	.77	.95	1.17	1.46	1.93	2.39
May	.43	.18	.82	1990	28	2.00	1998	.00+	1992	3.1	1.3	.1	.0	.00	.00	.00	.03	.10	.19	.31	.49	.74	1.21	1.70
Jun	.09	.04	.60	1995	16	.70	1995	.00+	1996	.9	.3	@	.0	.00	.00	.00	.00	.00	.02	.06	.11	.17	.27	.38
Jul	.03	.00	.67	1980	2	.70	1980	.00+	2000	.2	.1	@	.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.07	.21
Aug	.08	.00	.50	1983	19	.91	1976	.00+	1998	.5	.2	@	.0	.00	.00	.00	.00	.00	.00	.00	.00	.04	.25	.50
Sep	.24	.04	1.53	1959	19	1.48	1982	.00+	1997	1.4	.6	.1	@	.00	.00	.00	.00	.00	.04	.11	.22	.40	.74	1.09
Oct	.84	.58	2.17	1962	13	2.98	1972	.00+	1995	3.3	1.8	.6	.1	.00	.03	.12	.24	.37	.54	.74	1.01	1.39	2.05	2.71
Nov	1.88	1.37	3.05	1950	19	5.44	1983	.01	1995	7.7	4.4	1.2	.2	.06	.14	.33	.57	.85	1.20	1.64	2.23	3.06	4.52	6.00
Dec	2.04	1.96	3.26	1955	23	5.37	1995	.10	1989	8.4	4.9	1.3	.2	.25	.41	.70	.98	1.28	1.62	2.01	2.49	3.14	4.21	5.25
Ann	14.82	13.37	3.45	Jan 1952	12	7.30	Feb 1998	.00+	Jul 2000	60.4	35.4	9.0	2.0	6.77	8.08	9.88	11.35	12.71	14.08	15.54	17.21	19.32	22.50	25.38

+ Also occurred on an earlier date(s)
# Denotes amounts of a trace
@ Denotes mean number of days greater than 0 but less than .05
** Statistics not computed because less than six years out of thirty had measurable precipitation

(1) From the 1971-2000 Monthly Normals
(2) Derived from station's available digital record: 1930-2001
(3) Derived from 1971-2000 serially complete daily data

Complete documentation available from:
www.ncdc.noaa.gov/oa/climate/normals/usnormals.html

Attachment C

Risk Level Determination

Sediment Risk Factor Worksheet	Entry

A) R Factor

Analyses of data indicated that when factors other than rainfall are held constant, soil loss is directly proportional to a rainfall factor composed of total storm kinetic energy (E) times the maximum 30-min intensity (I30) (Wischmeier and Smith, 1958). The numerical value of R is the average annual sum of EI30 for storm events during a rainfall record of at least 22 years. "Isoerodent" maps were developed based on R values calculated for more than 1000 locations in the Western U.S. Refer to the link below to determine the R factor for the project site.

http://cfpub.epa.gov/npdes/stormwater/LEW/lewCalculator.cfm

R Factor Value	43.6

B) K Factor (weighted average, by area, for all site soils)

The soil-erodibility factor K represents: (1) susceptibility of soil or surface material to erosion, (2) transportability of the sediment, and (3) the amount and rate of runoff given a particular rainfall input, as measured under a standard condition. Fine-textured soils that are high in clay have low K values (about 0.05 to 0.15) because the particles are resistant to detachment. Coarse-textured soils, such as sandy soils, also have low K values (about 0.05 to 0.2) because of high infiltration resulting in low runoff even though these particles are easily detached. Medium-textured soils, such as a silt loam, have moderate K values (about 0.25 to 0.45) because they are moderately susceptible to particle detachment and they produce runoff at moderate rates. Soils having a high silt content are especially susceptible to erosion and have high K values, which can exceed 0.45 and can be as large as 0.65. Silt-size particles are easily detached and tend to crust, producing high rates and large volumes of runoff. Use Site-specific data must be submitted.

Site-specific K factor guidance

K Factor Value	0.22

C) LS Factor (weighted average, by area, for all slopes)

The effect of topography on erosion is accounted for by the LS factor, which combines the effects of a hillslope-length factor, L, and a hillslope-gradient factor, S. Generally speaking, as hillslope length and/or hillslope gradient increase, soil loss increases. As hillslope length increases, total soil loss and soil loss per unit area increase due to the progressive accumulation of runoff in the downslope direction. As the hillslope gradient increases, the velocity and erosivity of runoff increases. Use the LS table located in separate tab of this spreadsheet to determine LS factors. Estimate the weighted LS for the site prior to construction.

LS Table

LS Factor Value	3.37
Watershed Erosion Estimate (=RxKxLS) in tons/acre	32.32504
Site Sediment Risk Factor Low Sediment Risk: < 15 tons/acre Medium Sediment Risk: >=15 and <75 tons/acre High Sediment Risk: >= 75 tons/acre	**Medium**

Receiving Water (RW) Risk Factor Worksheet	Entry	Score
A. Watershed Characteristics	**yes/no**	
A.1. Does the disturbed area discharge (either directly or indirectly) to a **303(d)-listed waterbody impaired by sediment** (For help with impaired waterbodies please visit the link below) or has a **USEPA approved TMDL implementation plan for sediment**?: http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml **OR** A.2. Does the disturbed area discharge to a waterbody with designated beneficial uses of SPAWN & COLD & MIGRATORY? (For help please review the appropriate Regional Board Basin Plan) http://www.waterboards.ca.gov/waterboards_map.shtml	**Yes**	**High**

Region 1 Basin Plan

Region 2 Basin Plan

Region 3 Basin Plan

Region 4 Basin Plan

Region 5 Basin Plan

Region 6 Basin Plan

Region 7 Basin Plan

Region 8 Basin Plan

Region 9 Basin Plan

Combined Risk Level Matrix

Receiving Water Risk	Sediment Risk: Low	Sediment Risk: Medium	Sediment Risk: High
Low	Level 1	Level 2	
High	Level 2		Level 3

Project Sediment Risk: Medium

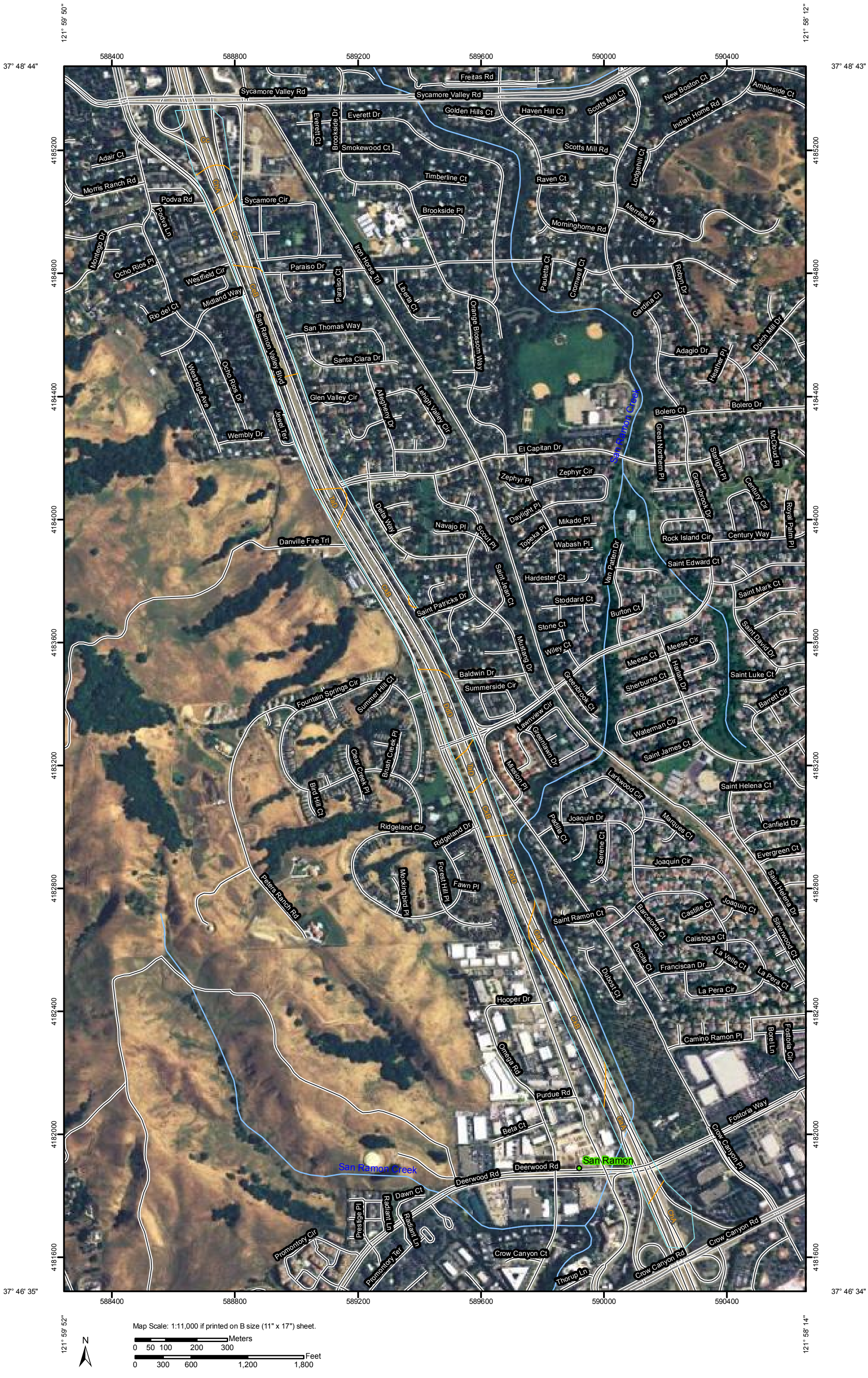
Project RW Risk: High

Project Combined Risk: Level 2

Weighted LS Factor Calculation

		Left Side			Right Side				Weighted ave by Length	Table Value
	P Line	**L_S (ft)**	**S_S**	**$L_S x S_S$**	**L_N (ft)**	**S_N**	**$L_N x S_N$**	**ΣL**	**S**	**LS**
"A4" Line	240+00			0	72.41	0	0	72	0%	0.05
	245+00			0	86.32	4.61%	3.98	86	5%	0.68
	250+00	32.83	6.94%	2.28	29.13	14.35%	4.18	62	10%	1.2
	255+00	16.18	19.59%	3.17	33.52	12.83%	4.3	50	15%	1.64
	260+00	20.42	9.75%	1.99	31.05	21.45%	6.66	51	17%	2.1
	265+00	9.33	0.43%	0.04	60.75	11.59%	7.04	70	10%	1.2
	270+00	43.4	18.18%	7.89	9.47	187.65%	17.77	53	49%	7.2
	275+00	51.59	38.05%	19.63	27.49	5.09%	1.4	79	27%	5.58
	280+00	73.59	49.61%	36.51	56.06	10.56%	5.92	130	33%	10.35
	285+00	68.55	48.85%	33.49	60.56	20.51%	12.42	129	36%	10.35
	290+00	43.74	34.80%	15.22	30.48	17.91%	5.46	74	28%	4.44
	295+00	9.85	4.47%	0.44	32.08	37.50%	12.03	42	30%	3.22
	300+00	24.06	17.04%	4.1	21.19	63.28%	13.41	45	39%	4.24
	305+00	27.47	34.33%	9.43	20.04	34.38%	6.89	48	34%	4.24
	310+00	26.63	43.86%	11.68	17.26	23.17%	4	44	36%	4.24
	315+00	23.88	21.86%	5.22	17.55	34.36%	6.03	41	27%	3.22
	320+00	85.42	5.27%	4.5	18.33	29.79%	5.46	104	10%	1.92
	325+00	9.63	5.61%	0.54	61.46	13.90%	8.54	71	13%	1.87
	330+00	9.3	3.01%	0.28	43.44	18.83%	8.18	53	16%	2.21
	335+00	9.68	2.27%	0.22	46.98	5.11%	2.4	57	5%	0.58
	340+00	18.97	3.43%	0.65			0	19	3%	0.21

Weighted Average LS = 3.37



Map Scale: 1:11,000 if printed on B size (11" x 17") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 300 600 1,200 1,800

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Gully

Short Steep Slope

Other

Political Features

Cities

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

MAP INFORMATION

Map Scale: 1:11,000 if printed on B size (11" × 17") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Contra Costa County, California
Survey Area Data: Version 8, Jul 22, 2008

Date(s) aerial images were photographed: 6/13/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Contra Costa County, California (CA013)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
Cc	CLEAR LAKE CLAY	11.5	13.4%
CeB	CONEJO CLAY LOAM, 2 TO 5 PERCENT SLOPES	8.0	9.3%
ChA	CONEJO CLAY LOAM, CLAY SUBSTRATUM, 0 TO 2 PERCENT SLOPES	8.6	10.0%
CkB	CROPLEY CLAY, 2 TO 5 PERCENT SLOPES	33.0	38.4%
DdD	DIABLO CLAY, 9 TO 15 PERCENT SLOPES	11.6	13.5%
GaA	GARRETSON LOAM, 0 TO 2 PERCENT SLOPES	9.1	10.5%
TaD	TIERRA LOAM, 9 TO 15 PERCENT SLOPES	4.3	5.0%
Totals for Area of Interest		**86.1**	**100.0%**

K Factor - Rock Free

Summary by Map Unit — Western Riverside Area, California					
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI	
Cc	Clear Lake Clay	0.2	11.5	13.4%	2.30
CeB	Conejo Clay Loam, 2 to 5 percent slopes	0.2	8.0	9.3%	1.60
ChA	Conejo Clay Loam, Clay Substratum, 0 to 2 percent slopes	0.2	8.6	10.0%	1.72
CkB	Cropley Clay, 2 to 5 percent slopes	0.2	33.0	38.3%	6.60
DdD	Diablo Clay, 9 to 15 percent slopes	0.2	11.6	13.5%	2.32
GaA	Garretson Loam, 0 to 2 percent slopes	0.32	9.1	10.6%	2.91
TaD	Tierra Loam, 9 to 15 percent slopes	0.32	4.3	5.0%	1.38
Totals for Area of Interest			86.1	100.0%	18.83

Weighted K Factor **0.22**

Rainfall Erosivity Factor Calculator for Small Construction Sites

Facility Information

Facility Name: 680 Auxiliary Lanes
Start Date: 10/01/2012
End Date: 11/30/2013
Latitude: 37.7933
Longitutde: -121.9813

Erosivity Index Calculator Results

AN EROSIVITY INDEX VALUE OF **43.6** HAS BEEN DETERMINED FOR THE CONSTF PERIOD OF **10/01/2012** - **11/30/2013**.

A rainfall erosivity factor of 5.0 or greater has been calculated for your site and period of construction. **You do not qualify for a waiver from NPDES permitting requirements**.

Sta

SUISUN BASIN

COUNTY Waterbody	AGR	MUN	FRSH	GWR	IND	PROC	COMM	SHELL	COLD	EST	MAR	MIGR	RARE	SPWN	WARM	WILD	REC-1	REC-2	NAV
SOLANO COUNTY, continued																			
Volanti Slough							E			E			E			E	E	E	
Montezuma Slough							E			E		E	E	E	E	E	E	E	E
Nurse Slough							E			E		E	E			E	E	E	
Denverton Slough							E			E		E	E			E	E	E	
Denverton Creek													E	E	E	E	E	E	
CONTRA COSTA COUNTY																			
Alhambra Creek									E			E	E		E	E	E	E	
Franklin Creek									E			E	E	E	E	E	E	E	
Arroyo del Hambre									E						E	E	E	E	
Peyton Slough					E		E			E		E	E			E	E	E	
Pacheco Creek															E	E	E	E	
Walnut Creek									E			E	E	E	E	E	E	E	
Grayson Creek									E			E	E		E	E	E	E	
Pine Creek									E			E	E	E	E	E	E	E	
Galindo Creek									E						E	E	E	E	
San Ramon Creek															E	E	E	E	
Bollinger Canyon Creek									E					E	E	E	E	E	
Las Trampas Creek									E				E		E	E	E	E	
Tice Creek													E		E	E	E	E	
Lafayette Creek									E						E	E	E	E	
Lafayette Reservoir		E					E		E					E	E	E	E*	E	
Hastings Slough										E			E			E	E	E	
Mt. Diablo Creek									E			E	E	E	E	E	E	E	
Mitchell Creek									E			E	E	E	E	E	E	E	
Donner Creek									E					E	E	E	E	E	
Mallard Slough (Contra Costa)							E			E		E	E			E	E	E	
Kirker Creek													E		E	E	E	E	
New York Slough							E			E		E	E			E	E	E	E

E: Existing beneficial use E*: Water quality objectives apply; water contact recreation is prohibited or limited to protect public health P: Potential beneficial use

Attachment D

Run-on Discharge Calculations

Computational Sheet for Determining Run-on Discharges

Existing Site Conditions

Area Runoff Coefficient		=	.68	(A)
Area Rainfall Intensity		=	0.50 in/hr	(B)
Drainage Area		=	76 Acres	(C)
Site Area Run-on Discharge	(A) x (B) x (C)	=	25.84 ft^3/sec	(D)

Computation Sheet for Determining Runoff Coefficients

Total Site Area	=	17.92 Acres	(A)

Existing Site Conditions

Impervious Site Area [1]	=	5.06 Acres	(B)
Impervious Site Area Runoff Coefficient [2, 4]	=	.95	(C)
Pervious Site Area [3]	=	12.86 Acres	(D)
Pervious Site Area Runoff Coefficient [4]	=	.25	(E)
Existing Site Area Runoff Coefficient $\frac{(B \times C) + (D \times E)}{(A)}$	=	.45	(F)

Proposed Site Conditions (after construction)

Impervious Site Area [1]	=	10.94 Acres	(G)
Impervious Site Area Runoff Coefficient [2, 4]	=	.95	(H)
Pervious Site Area [3]	=	6.98 Acres	(I)
Pervious Site Area Runoff Coefficient [4]	=	.25	(J)
Proposed Site Area Runoff Coefficient $\frac{(G \times H) + (I \times J)}{(A)}$	=	.68	(K)

1. Includes paved areas, areas covered by buildings, and other impervious surfaces.
2. Use 0.95 unless lower or higher runoff coefficient can be verified.
3. Includes areas of vegetation, most unpaved or uncovered soil surfaces, and other pervious areas.
4. Refer to local Hydrology Manual for typical C values.

Attachment E

Temporary Water Pollution Control Drawings

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	CC	680	R4.3/R6.7		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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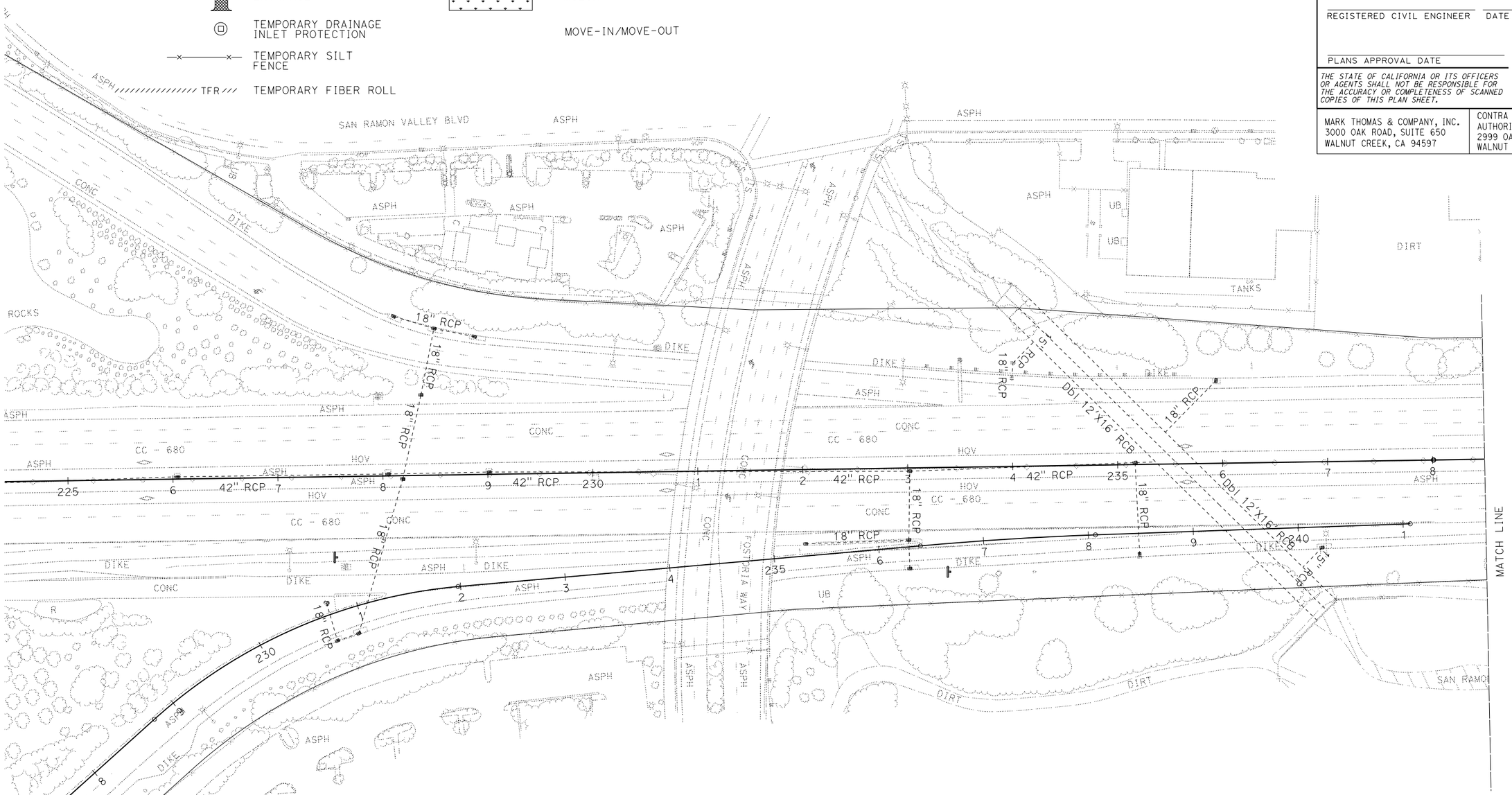
WALNUT CREEK, CA 94597

CONTRA COSTA TRANSPORTATION AUTHORITY
2999 OAK ROAD, SUITE 100
WALNUT CREEK, CA 94597

LEGEND:

- TEMPORARY CONSTRUCTION ENTRANCE
- TEMPORARY DRAINAGE INLET PROTECTION
- TEMPORARY SILT FENCE
- TFR — TEMPORARY FIBER ROLL
- TEMPORARY HYDRAULIC MULCH
- MOVE-IN/MOVE-OUT



WATER POLLUTION CONTROL PLAN
STAGE 1

SCALE: 1" = 50'

WPC-1

REVISED BY	DATE REVISED
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	1/4/12
	9/13/11

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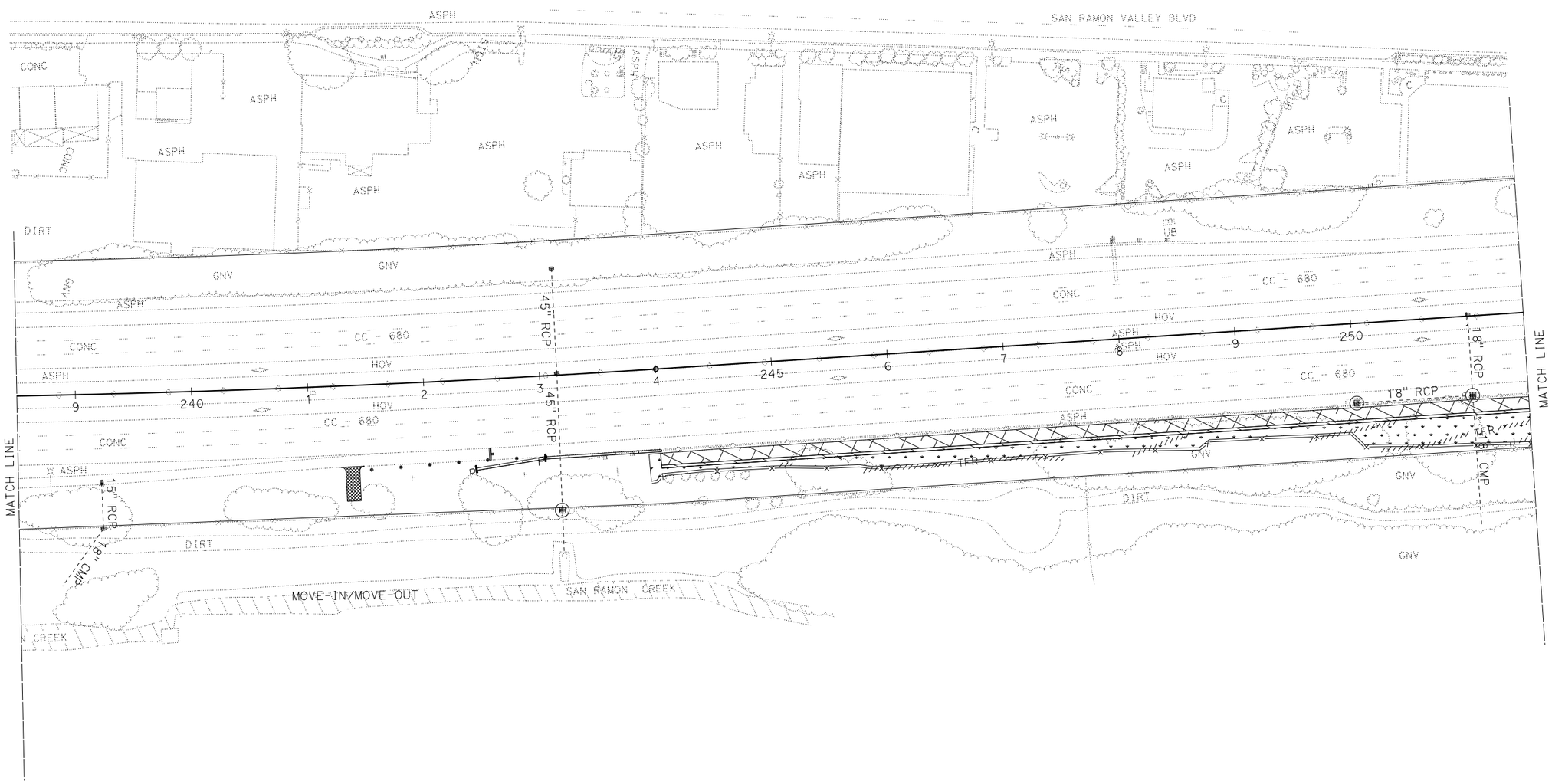

WATER POLLUTION CONTROL PLAN
STAGE 1

SCALE: 1" = 50'

WPC-2

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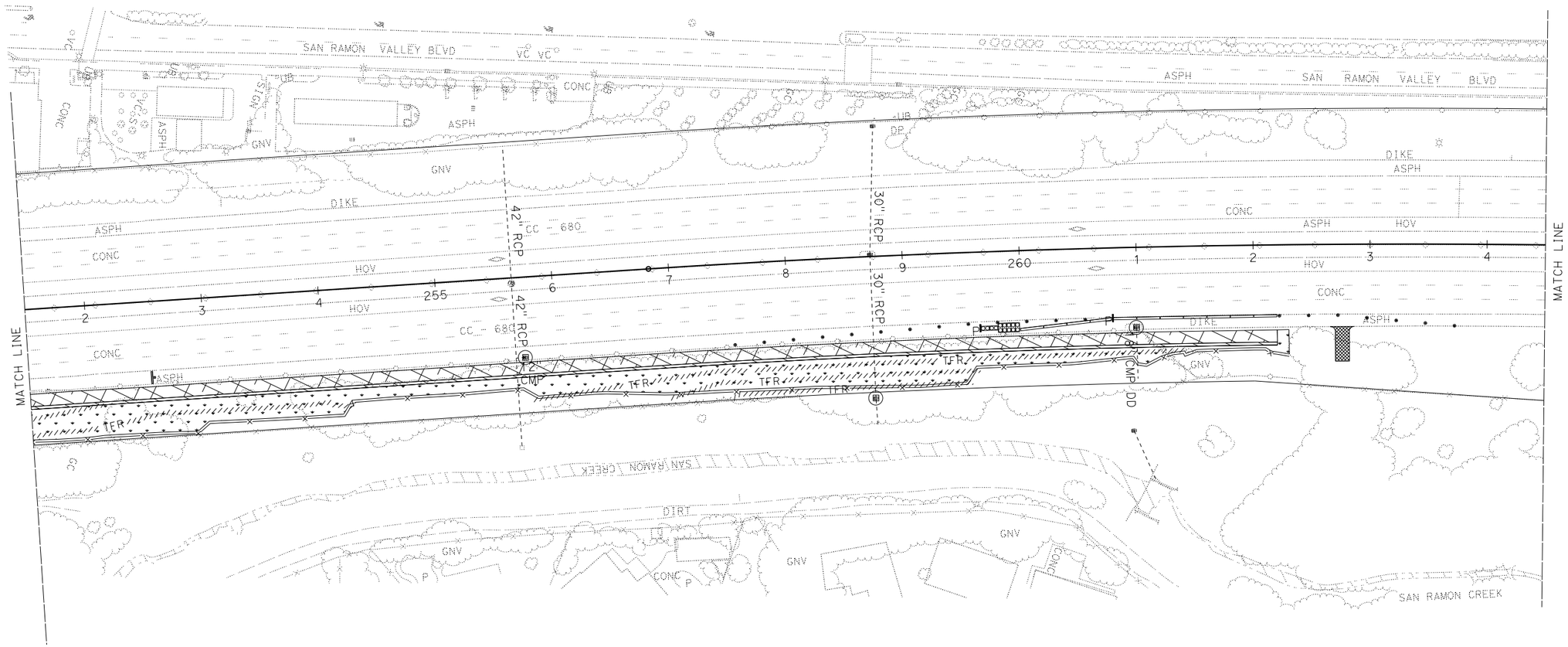

WATER POLLUTION CONTROL PLAN
STAGE 1

SCALE: 1" = 50'

WPC-3

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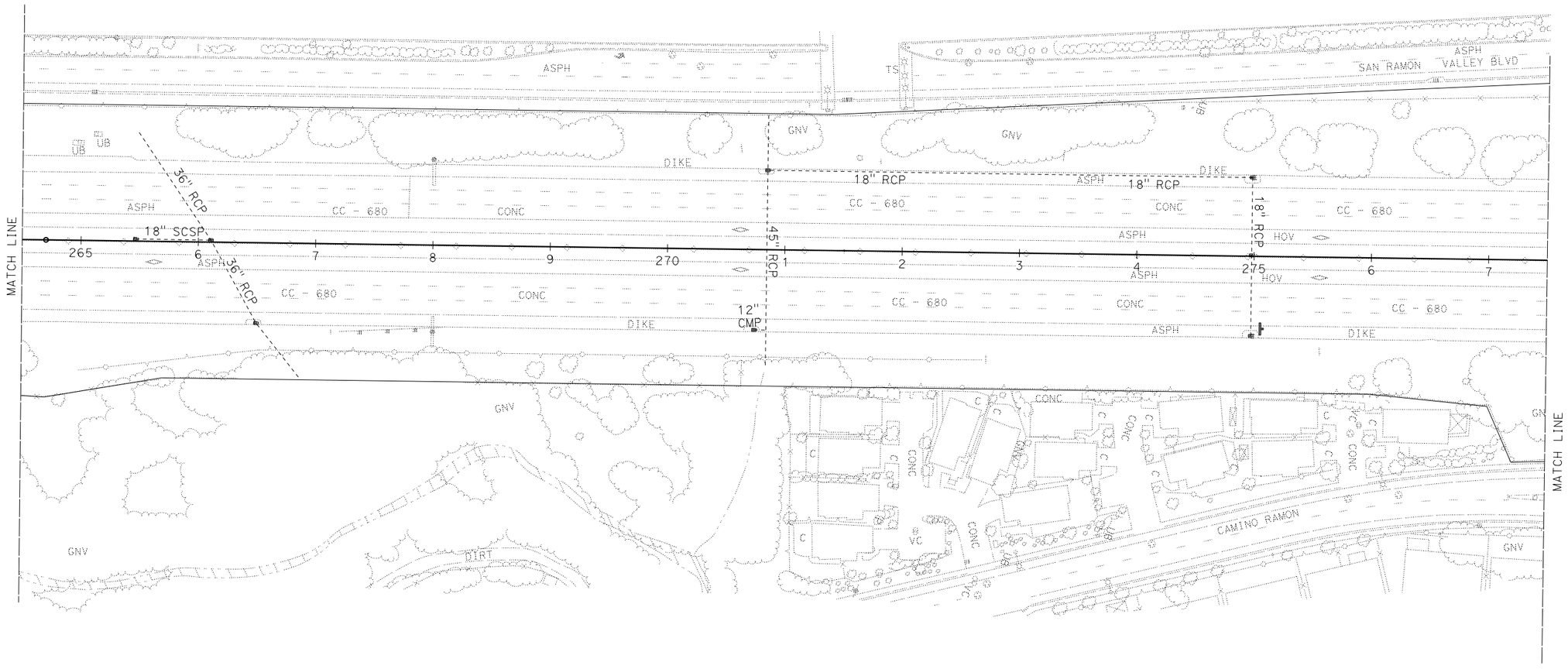

WATER POLLUTION CONTROL PLAN
STAGE 1
SCALE: 1" = 50'

WPC-4

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	1/4/12		
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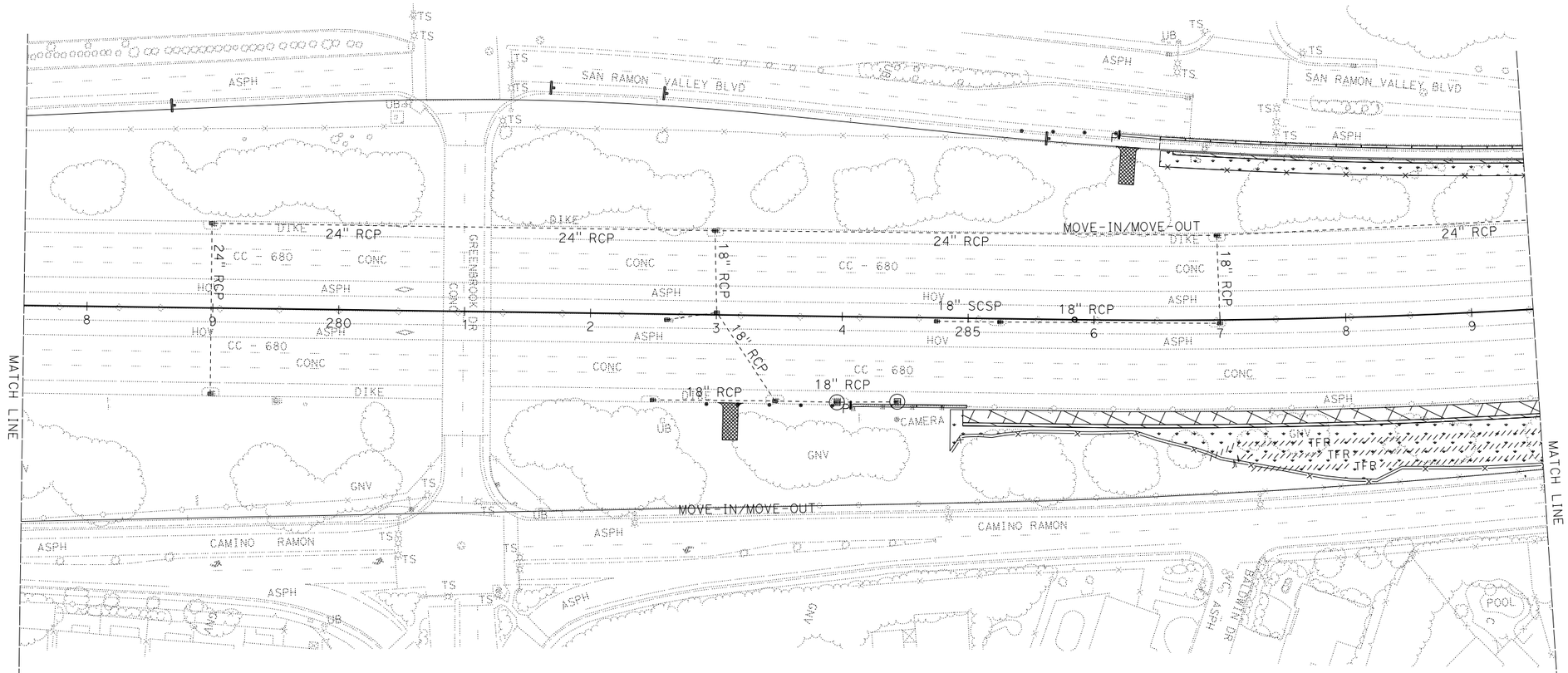

WATER POLLUTION CONTROL PLAN
STAGE 1

SCALE: 1" = 50'

WPC-5

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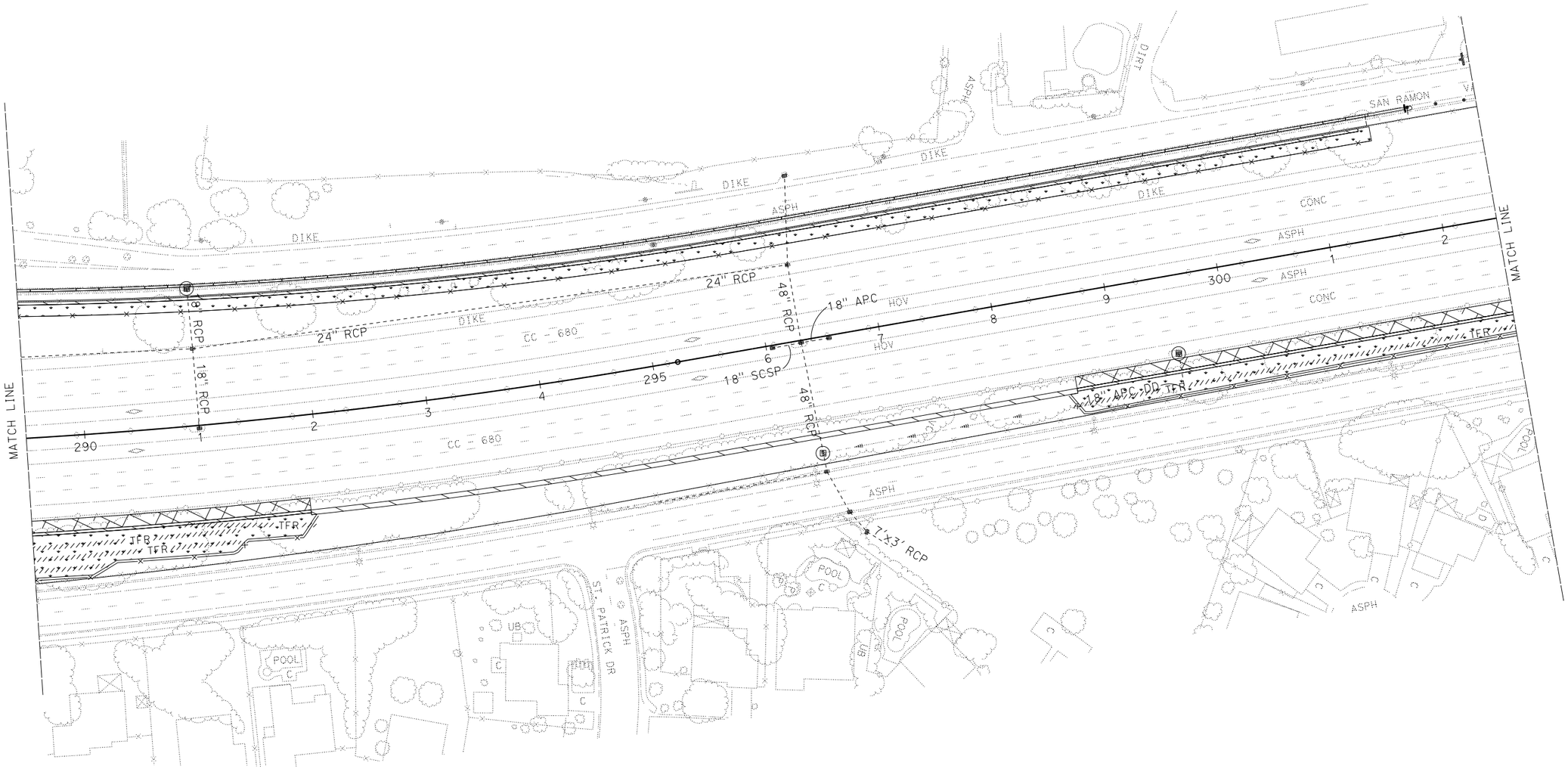

WATER POLLUTION CONTROL PLAN
STAGE 1

SCALE: 1" = 50'

WPC-6

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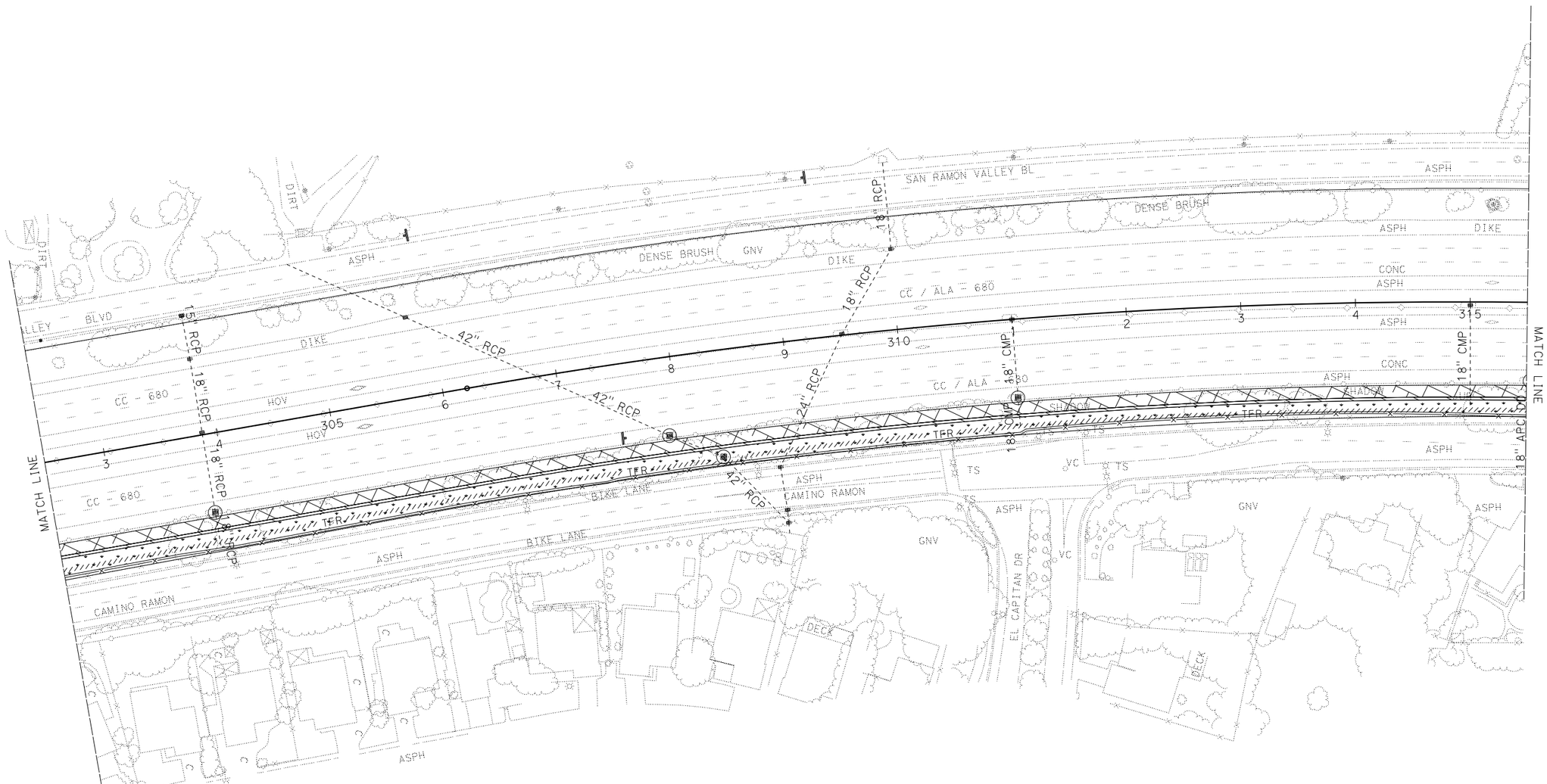

WATER POLLUTION CONTROL PLAN
STAGE 1
SCALE: 1" = 50'

WPC-7

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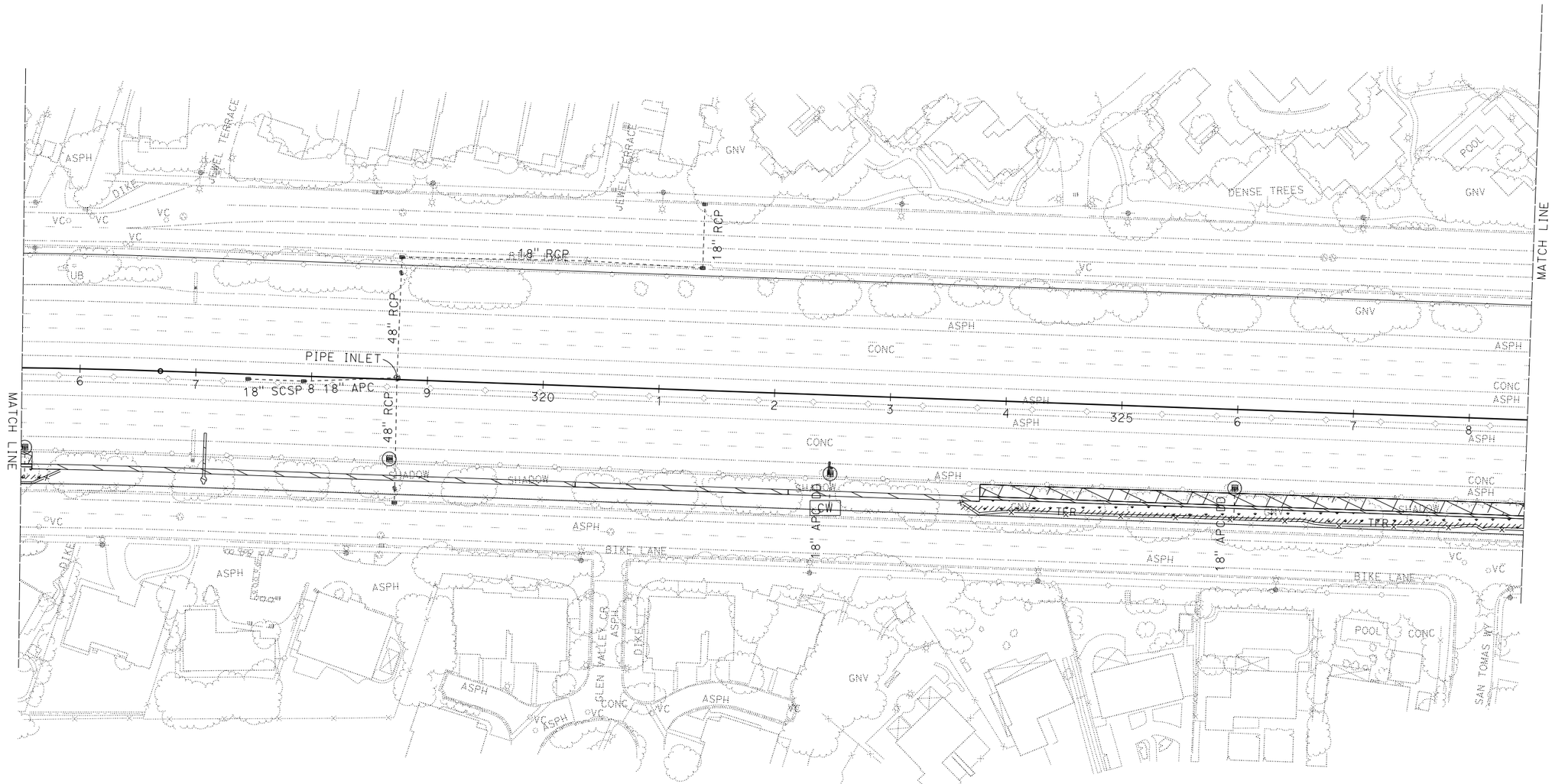

WATER POLLUTION CONTROL PLAN
STAGE 1

SCALE: 1" = 50'

WPC-8

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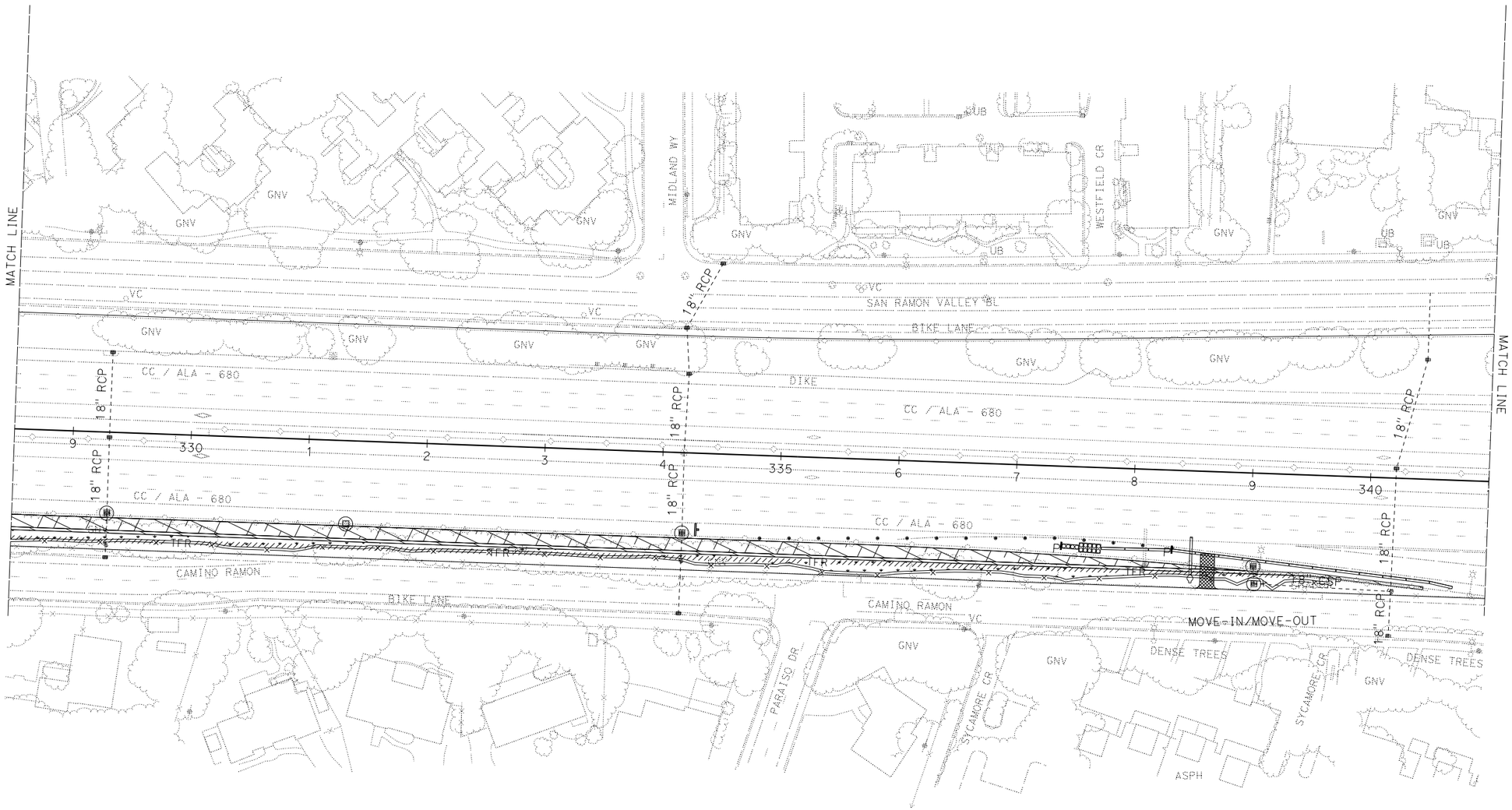

WATER POLLUTION CONTROL PLAN
STAGE 1
SCALE: 1" = 50'

WPC-9

			3/30/12
			1/4/12
			9/13/11
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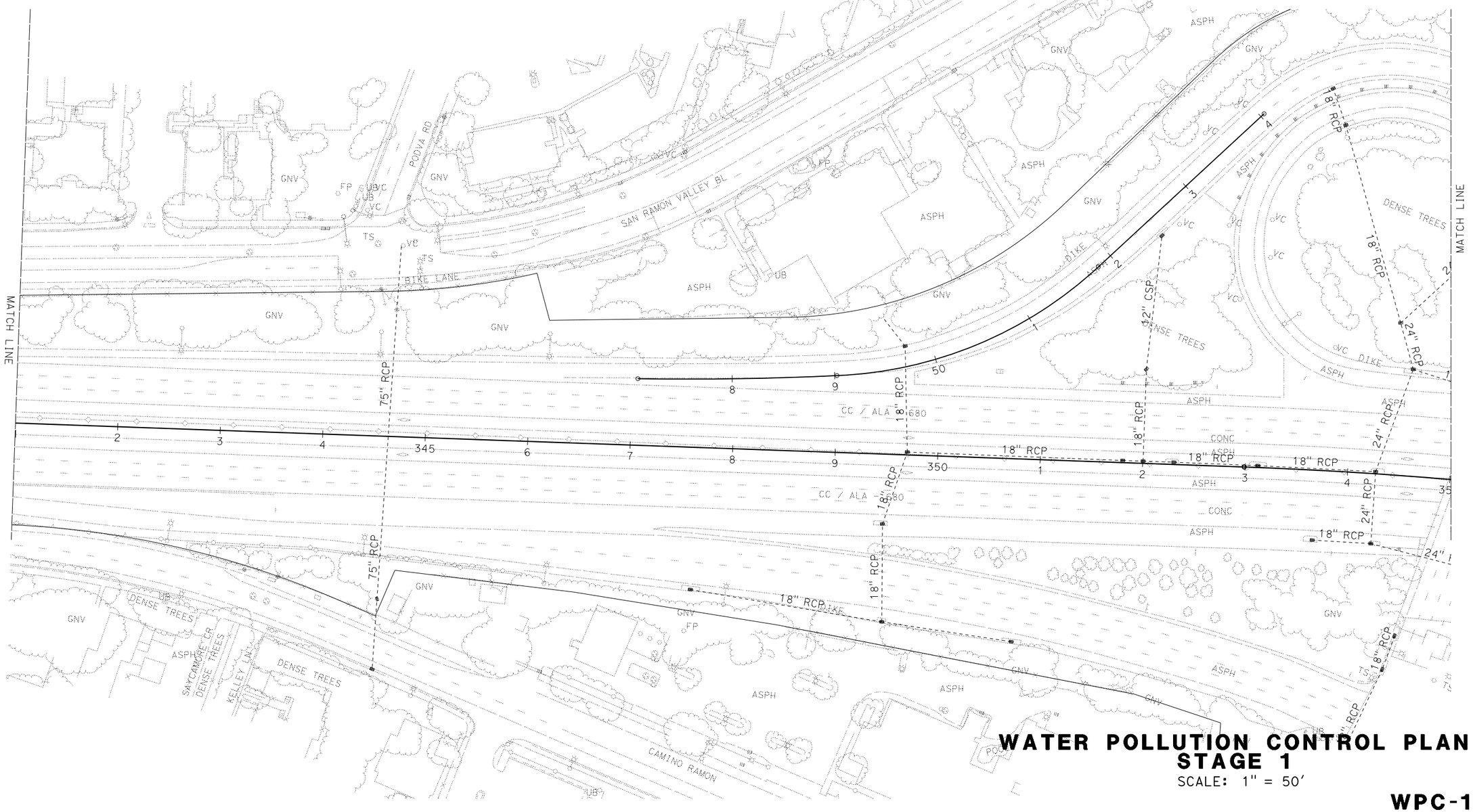

WATER POLLUTION CONTROL PLAN
STAGE 1
SCALE: 1" = 50'

WPC-10

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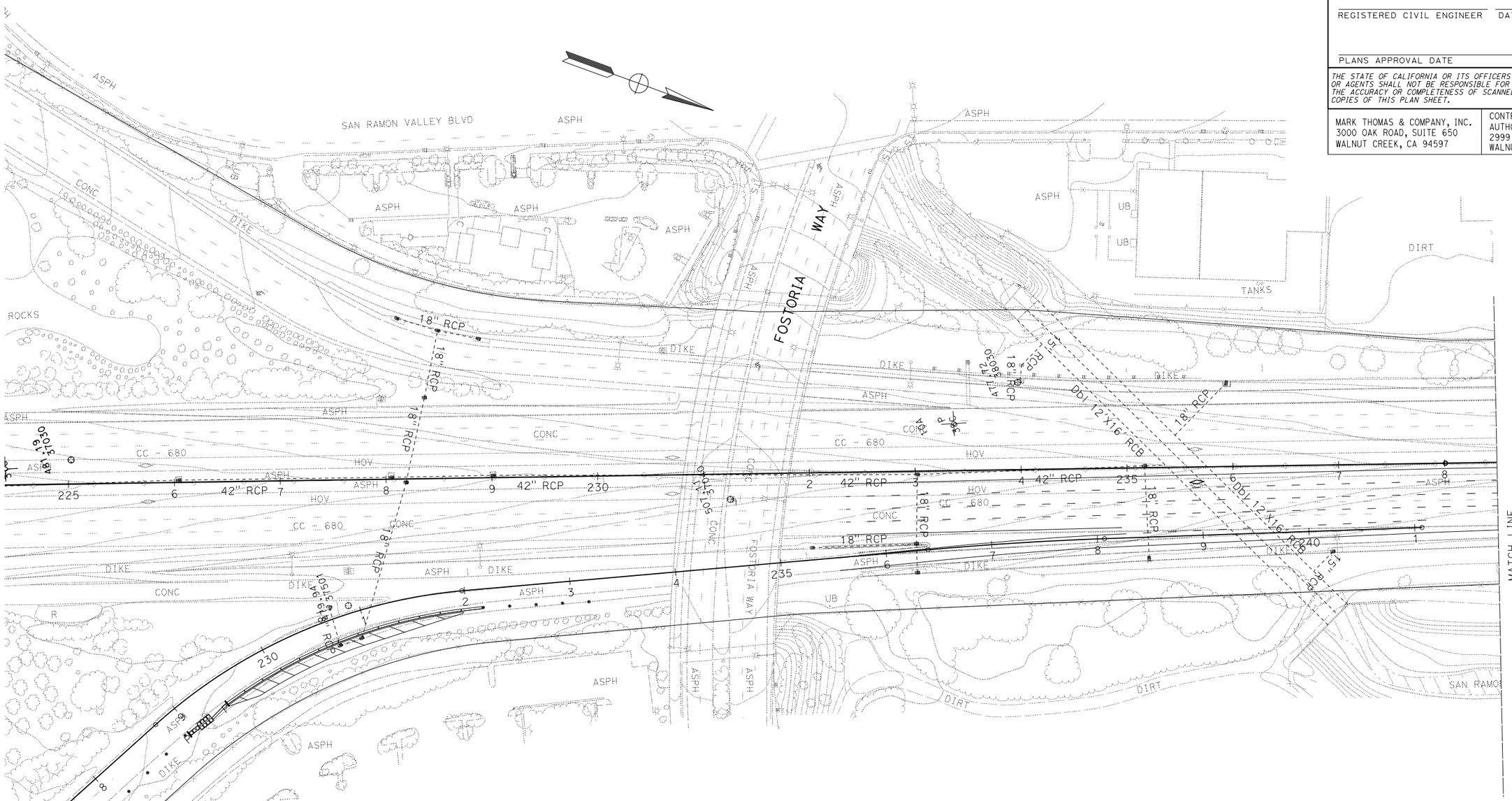

WATER POLLUTION CONTROL PLAN
STAGE 2A

SCALE: 1" = 50'

WPC-1

			3/30/12
			1/4/12
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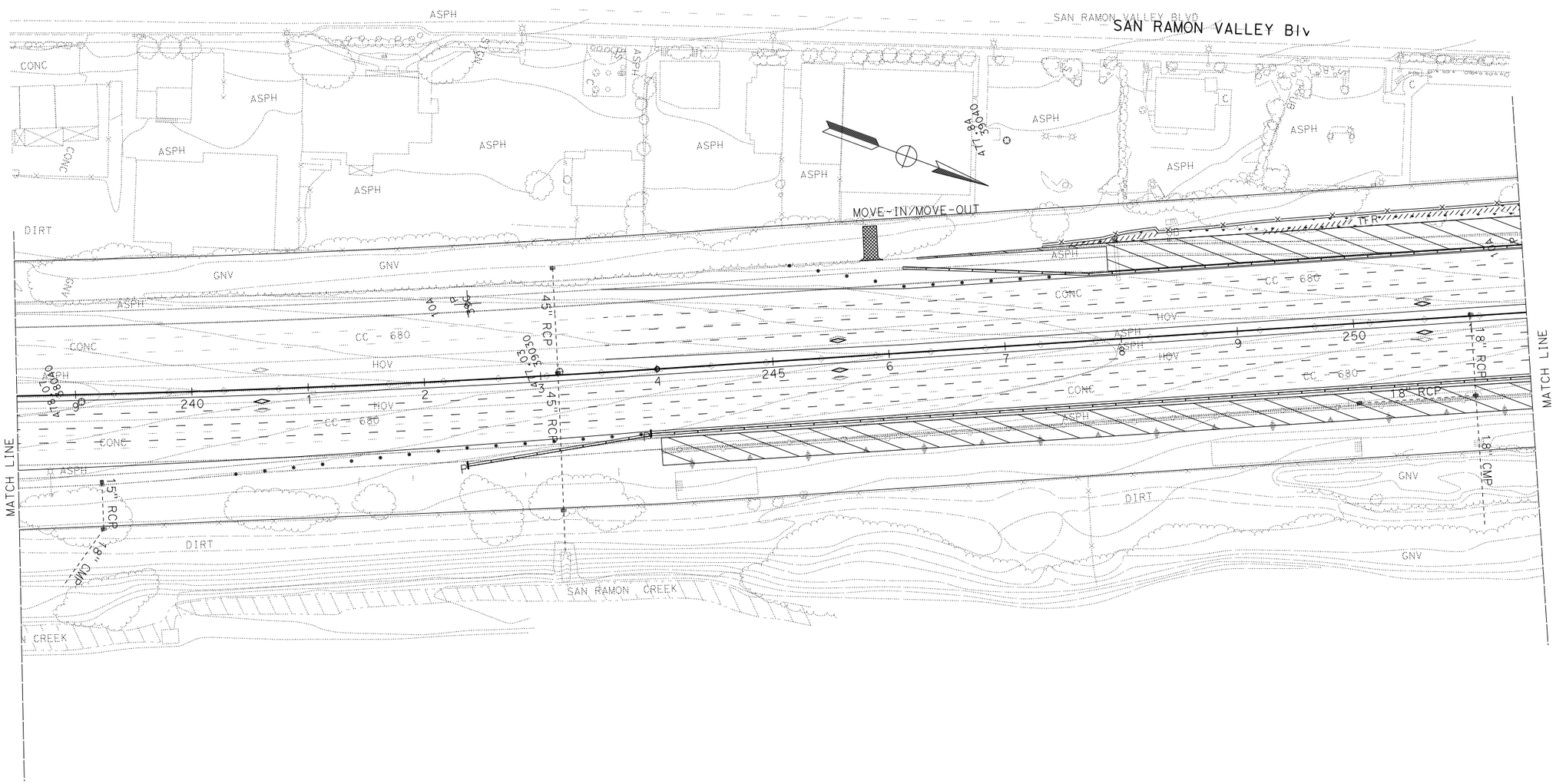

WATER POLLUTION CONTROL PLAN
STAGE 2A

SCALE: 1" = 50'

WPC-2

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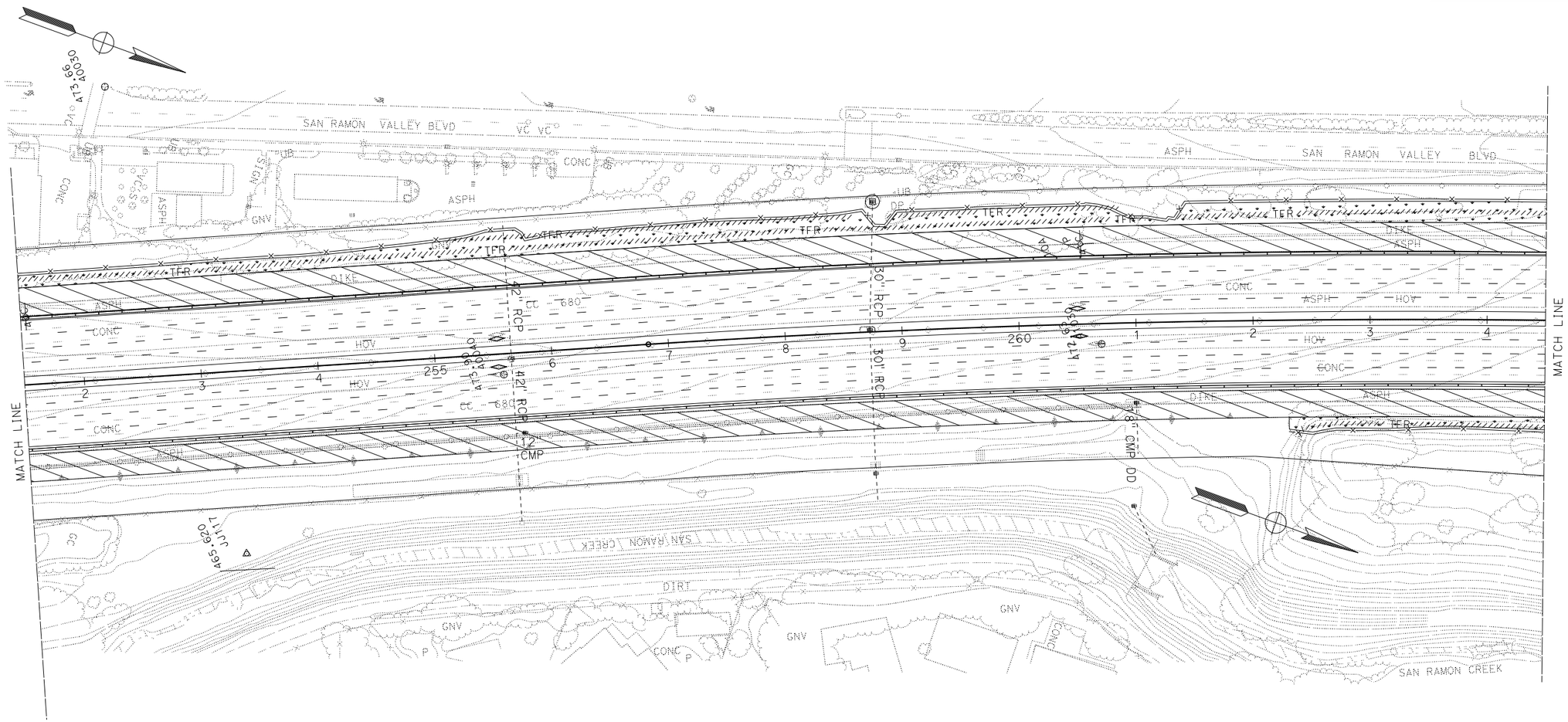
DESIGN PLANE: 29R GO= 5830251.6352 1894251.6352 -214748.3647



WATER POLLUTION CONTROL PLAN
STAGE 2A

SCALE: 1" = 50'

WPC-3

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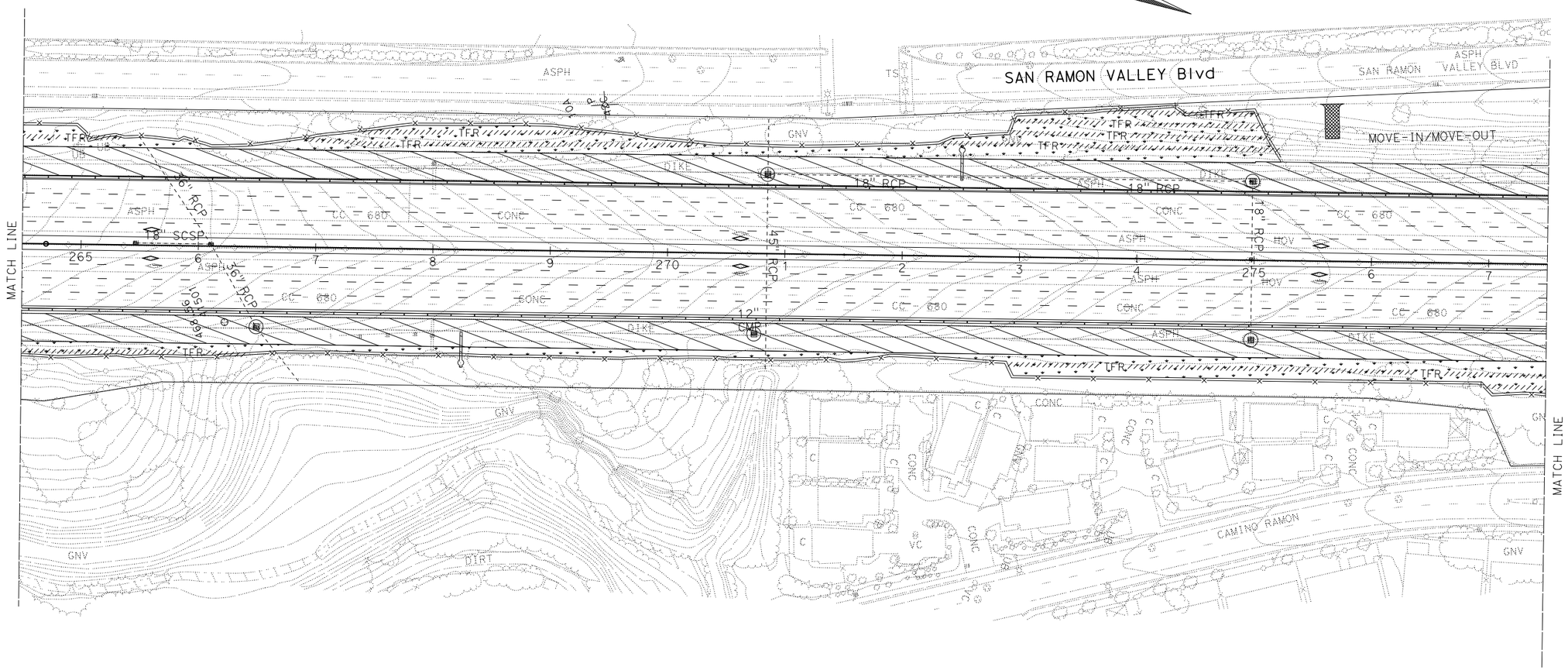

WATER POLLUTION CONTROL PLAN
STAGE 2A

SCALE: 1" = 50'

WPC-4

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	9/13/11

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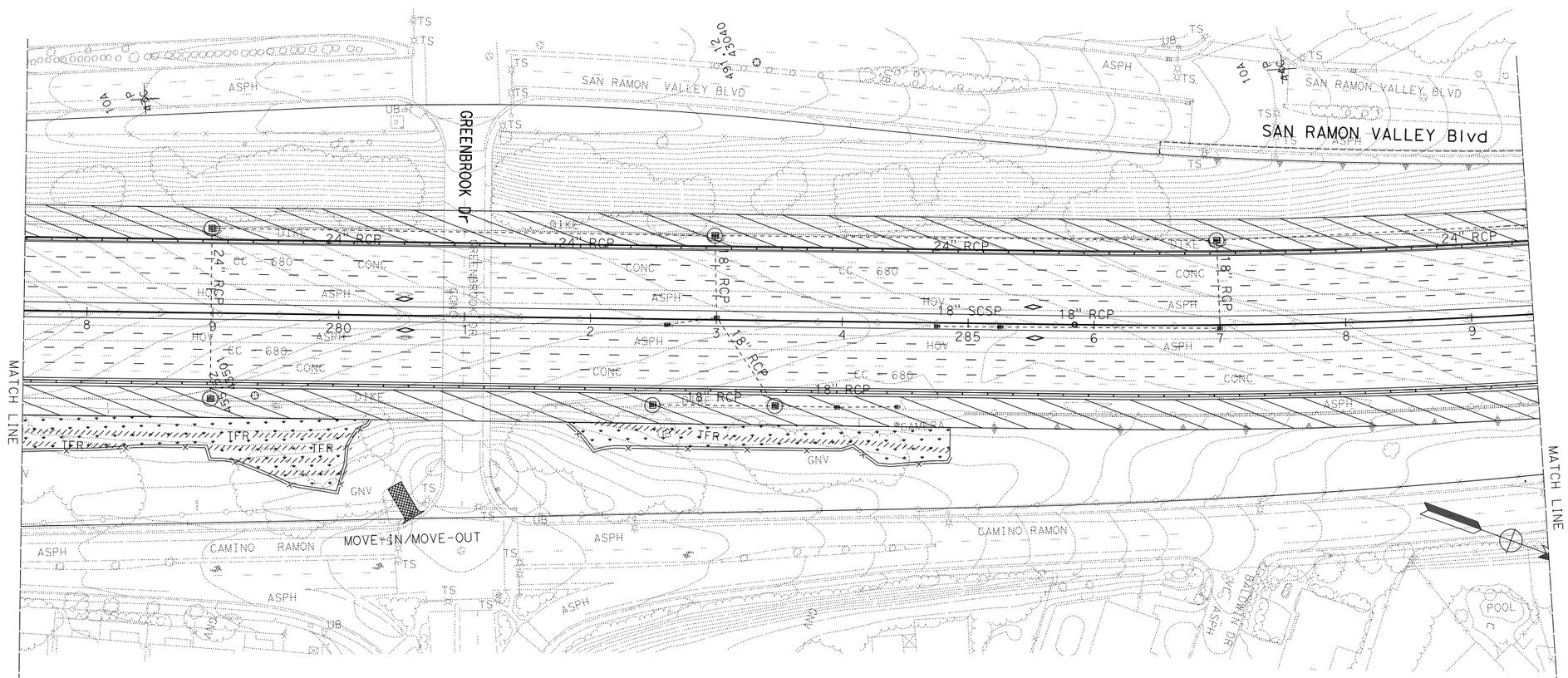

WATER POLLUTION CONTROL PLAN
STAGE 2A

SCALE: 1" = 50'

WPC-5

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	9/13/11

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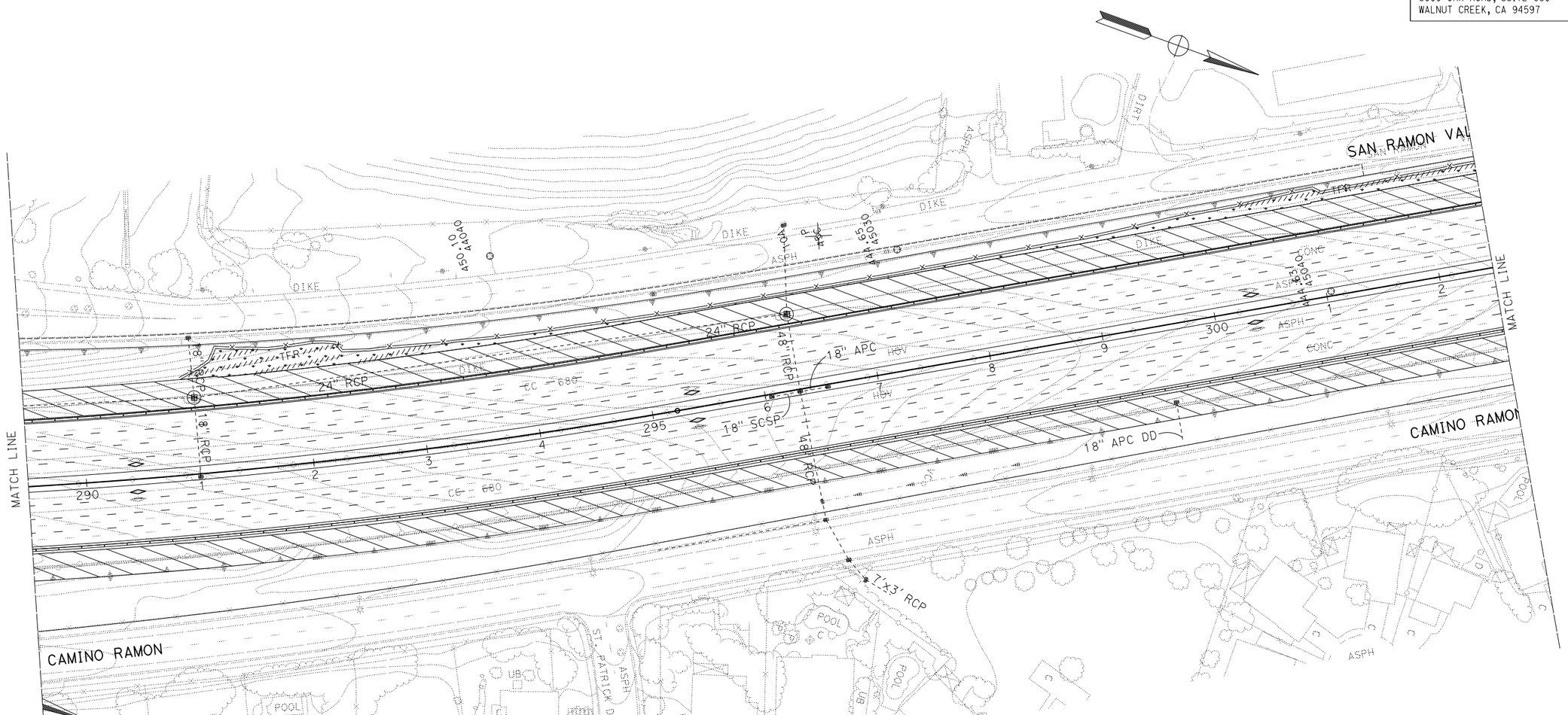

WATER POLLUTION CONTROL PLAN
STAGE 2A

SCALE: 1" = 50'

WPC-6

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BORDER LAST REVISED 7/2/2010 | USERNAME => vabraham | DGN FILE => Stage2A_006.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0736 | PROJECT NUMBER & PHASE 04000210661

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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WALNUT CREEK, CA 94597

CONTRA COSTA TRANSPORTATION AUTHORITY
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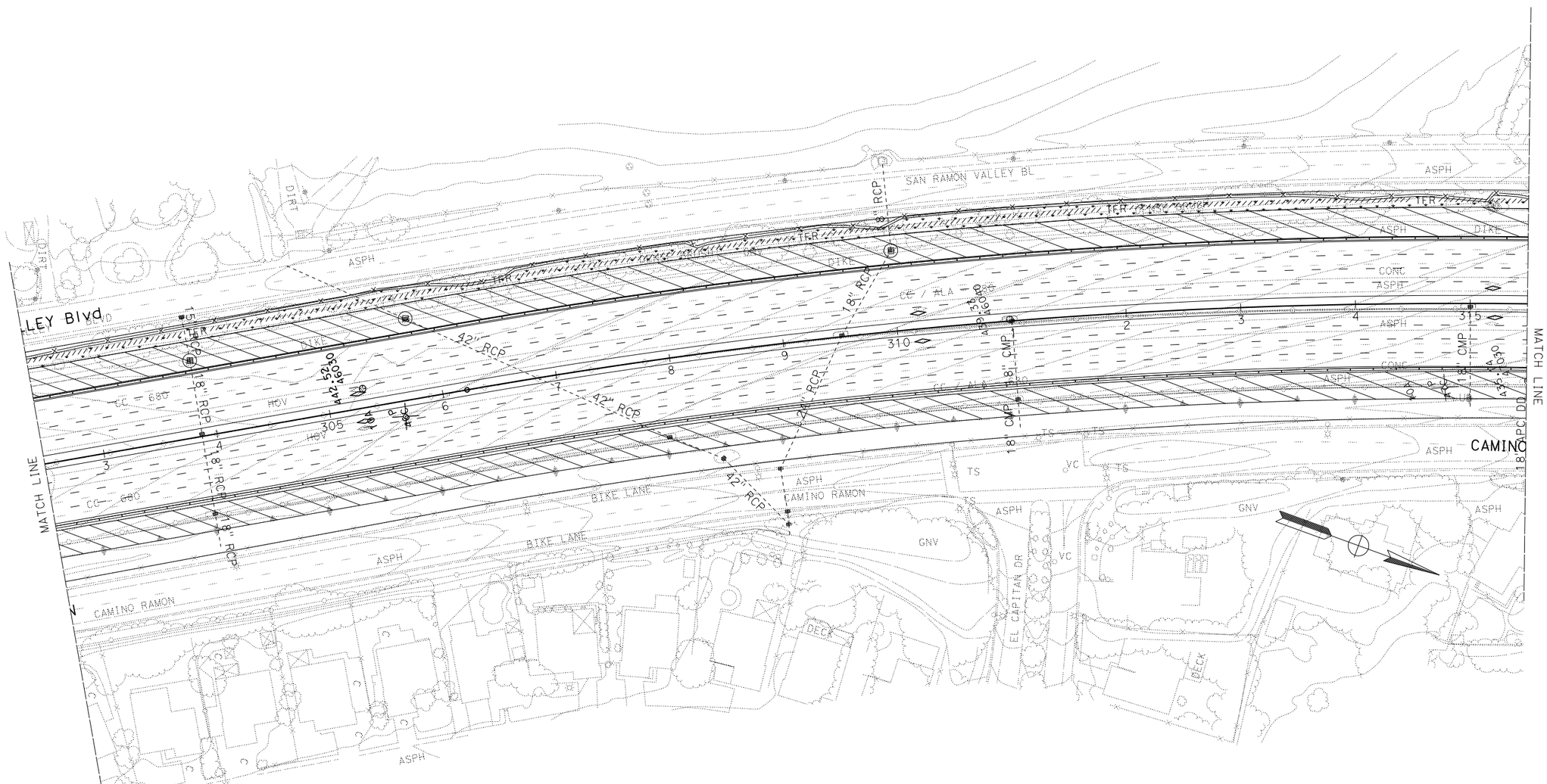
WALNUT CREEK, CA 94597



WATER POLLUTION CONTROL PLAN
STAGE 2A

SCALE: 1" = 50'

WPC-7

			3/30/12
			1/4/12
		REVISED BY	9/13/11
		DATE REVISED	
CALCULATED-DESIGNED BY			
CHECKED BY			

CONSULTANT FUNCTIONAL SUPERVISOR
MICHAEL LOHMAN

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

LAST REVISION 04-11-12
DATE PLOTTED => 28-JUN-2012
TIME PLOTTED => 09:39

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	CC	680	R4.3/R6.7		

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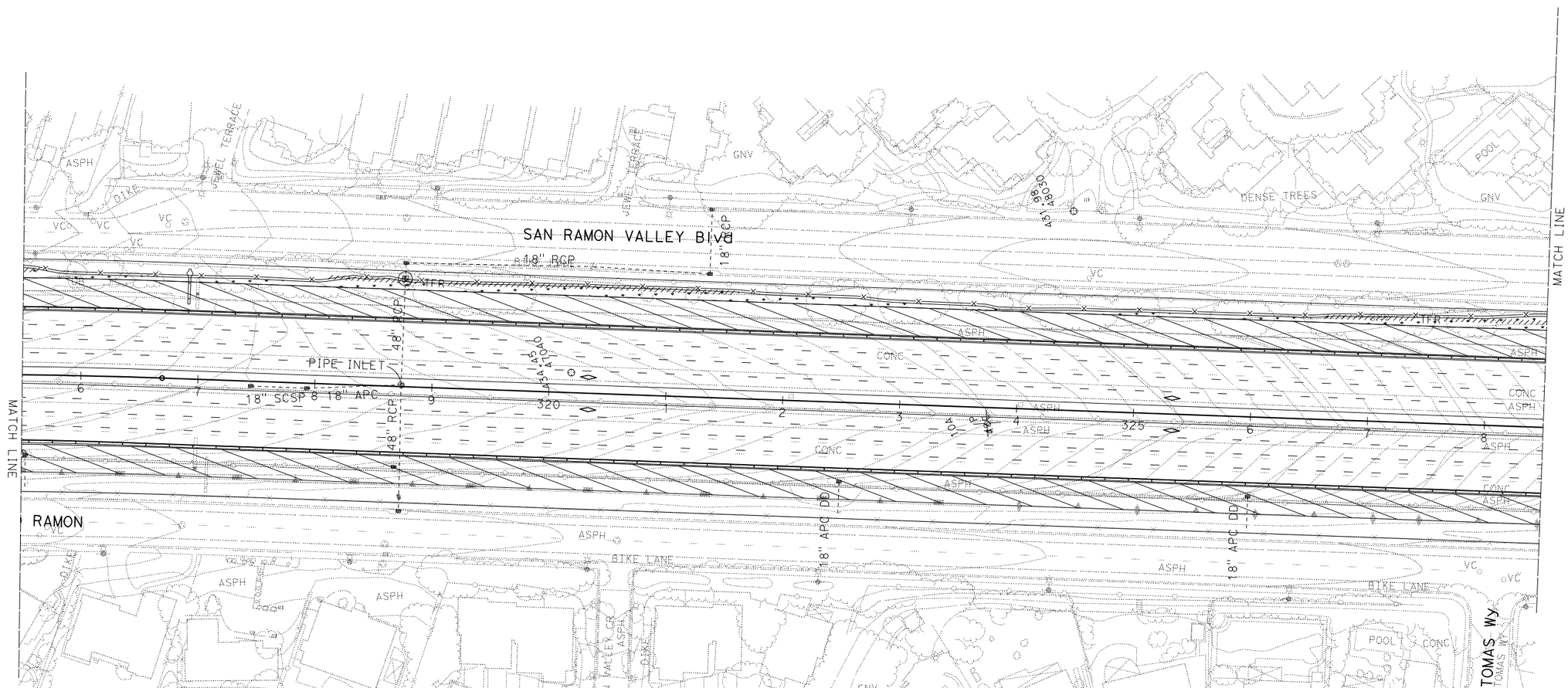

WATER POLLUTION CONTROL PLAN
STAGE 2A

SCALE: 1" = 50'

WPC-8

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			1/4/12
			9/13/11
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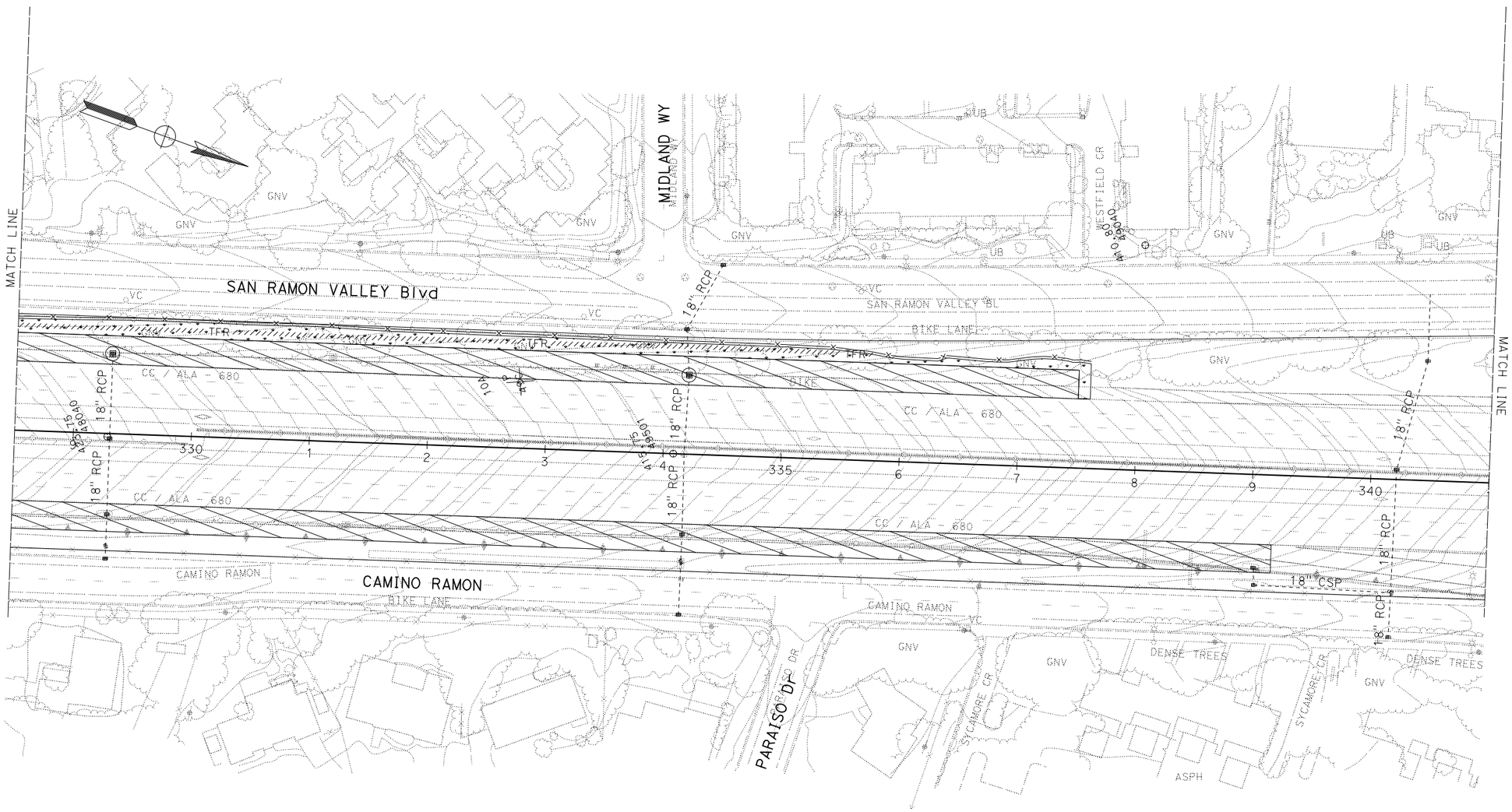

WATER POLLUTION CONTROL PLAN
STAGE 2A

SCALE: 1" = 50'

WPC-9

			3/30/12
			1/4/12
			9/13/11
		REVISED BY	DATE REVISED
CALCULATED-DESIGNED BY			
CHECKED BY			

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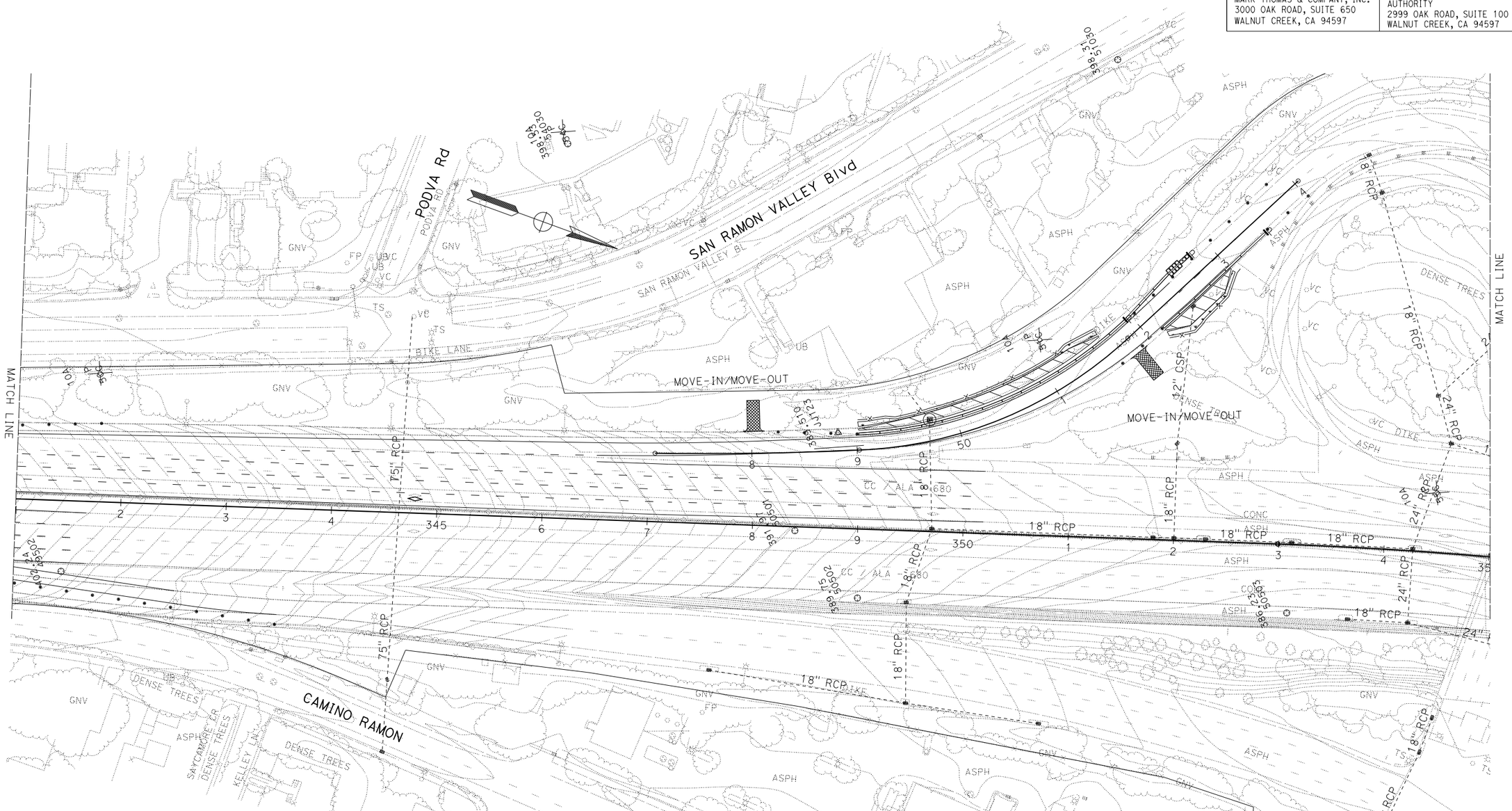

WATER POLLUTION CONTROL PLAN
STAGE 2A
SCALE: 1" = 50'

WPC-10

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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CONSULTANT FUNCTIONAL SUPERVISOR: MICHAEL LOHMAN

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DATE REVISED: 9/13/11 | 1/4/12 | 3/30/12

LAST REVISION 04-11-12 | DATE PLOTTED => 28-JUN-2012 | TIME PLOTTED => 09:39

BORDER LAST REVISED 7/2/2010 | USERNAME => vabraham | DGN FILE => Stage2A_010.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0736 | PROJECT NUMBER & PHASE 04000210661

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	CC	680	R4.3/R6.7		

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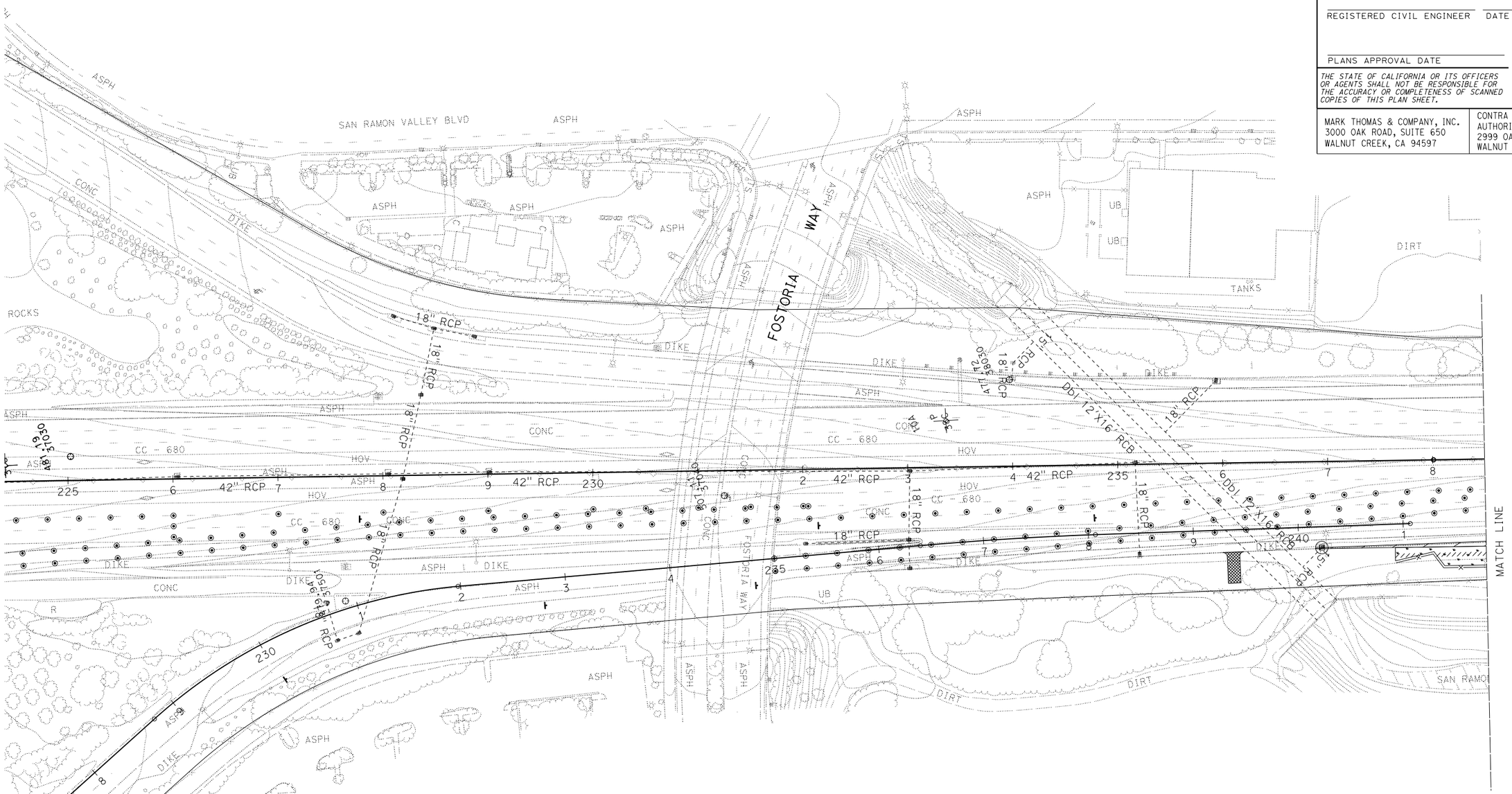

WATER POLLUTION CONTROL PLAN
STAGE 2B

SCALE: 1" = 50'

WPC-1

REVISED BY	DATE REVISED
	3/30/12
	1/4/12
	9/13/11

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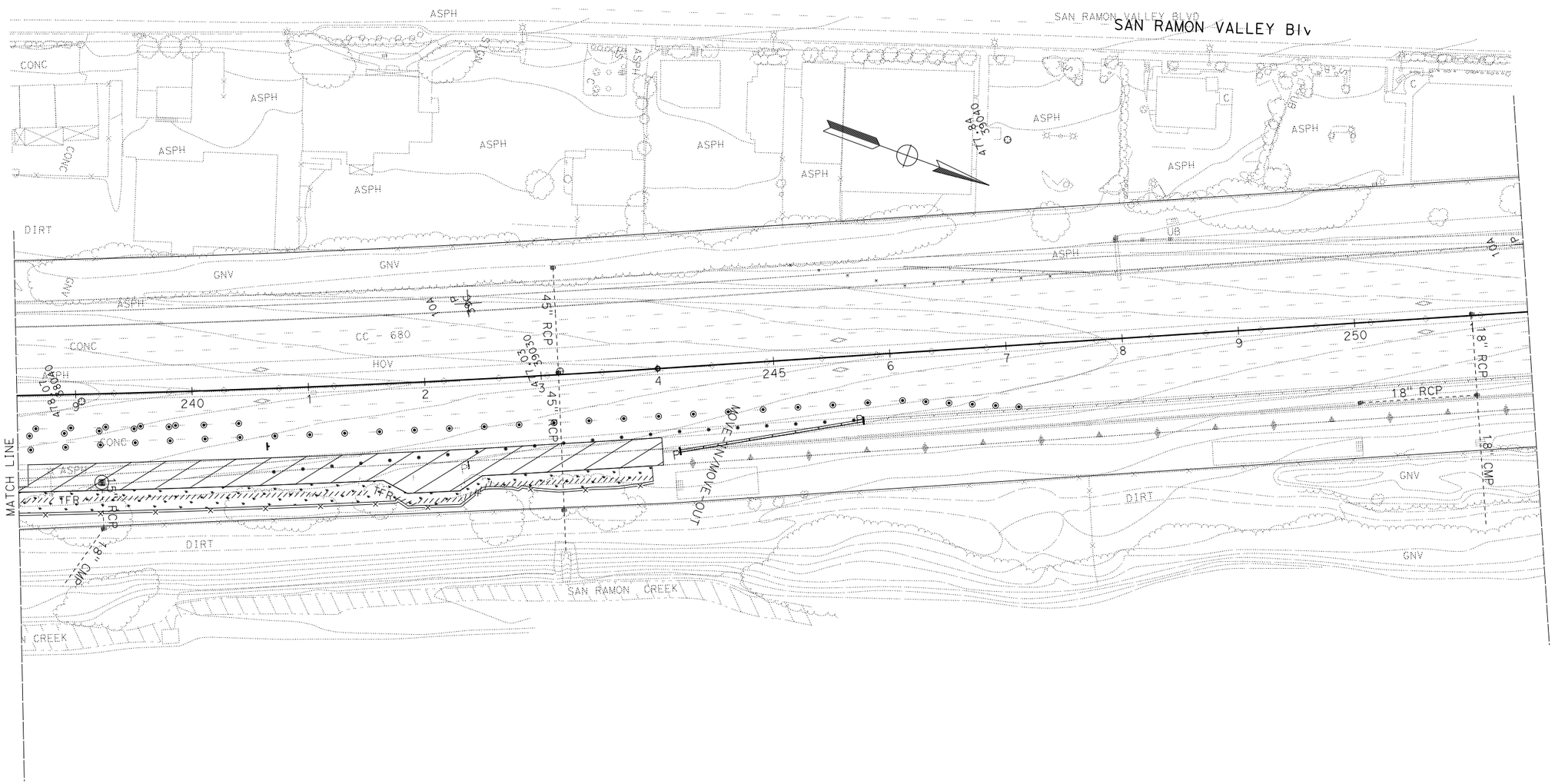

WATER POLLUTION CONTROL PLAN
STAGE 2B

SCALE: 1" = 50'

WPC-2

REVISED BY	DATE REVISED
	3/30/12
	1/4/12
	9/13/11

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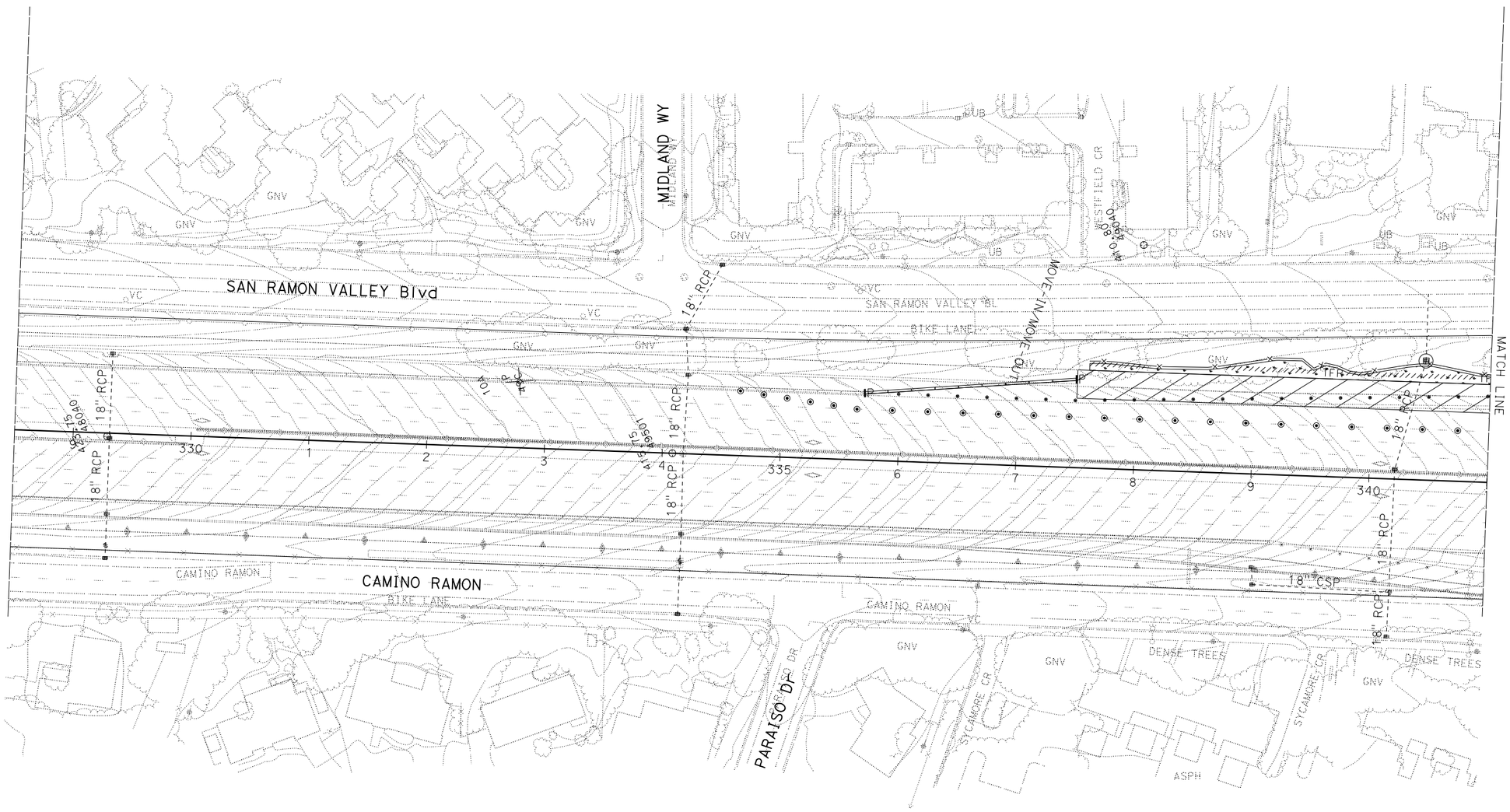

WATER POLLUTION CONTROL PLAN
STAGE 2B
SCALE: 1" = 50'

WPC-9

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

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CONSULTANT FUNCTIONAL SUPERVISOR: MICHAEL LOHMAN

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DATE REVISED: 9/13/11 1/4/12 3/30/12

LAST REVISION 04-11-12

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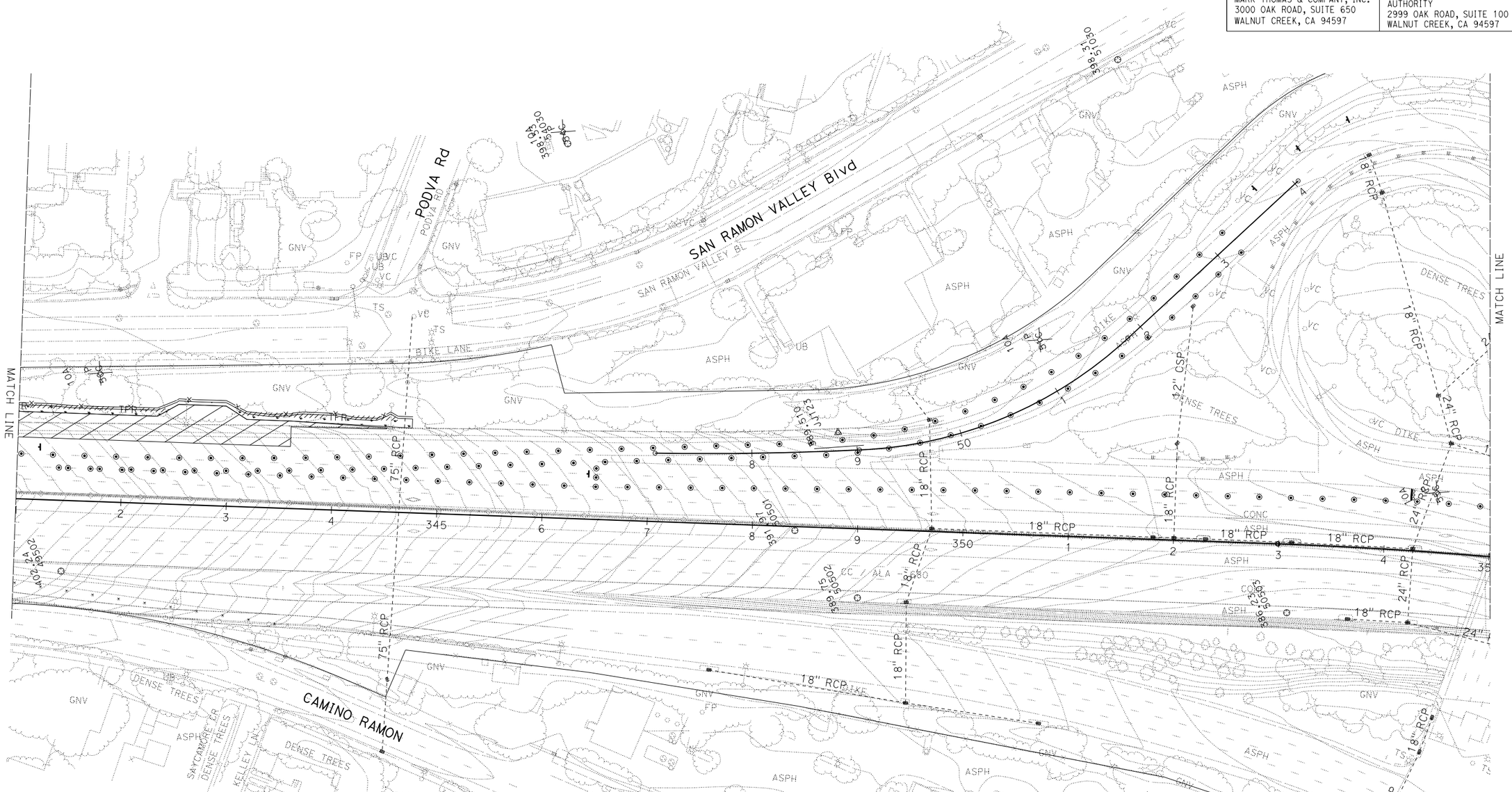

WATER POLLUTION CONTROL PLAN
STAGE 2B

SCALE: 1" = 50'

WPC-10

	3/30/12		
	1/4/12		
	9/13/11	REVISED BY	
	DATE REVISED		
		CALCULATED-DESIGNED BY	
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		CONSULTANT FUNCTIONAL SUPERVISOR	
		MICHAEL LOHMAN	
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REGISTERED CIVIL ENGINEER 04/11/12 DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER S.D.DANSKY No. 60220 Exp. 6-30-12 CIVIL STATE OF CALIFORNIA

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TEMPORARY WATER POLLUTION CONTROL SUMMARY

STAGE No.	Temp DRAINAGE INLET PROTECTION	Temp Const ENTRANCE	Temp CONCRETE WASHOUT (PORTABLE)	Temp HYDRAULIC MULCH (BONDED FIBER MATRIX)	Temp FIBER ROLL	Temp SILT FENCE	MOVE IN/MOVE OUT (Temp EROSION CONTROL)
	EA		LS	SQYD	LF		EA
1	24	5		10217	6438	7447	4
2A	21	5		12736	8629	10119	5
2B	3	1		1623	1180	1377	2
TOTAL	48	11	1	24576	16247	18943	11

TEMPORARY WATER POLLUTION CONTROL QUANTITIES

WPCQ-1

VA	VA	VA	VA
3/30/12	1/4/12	9/13/11	DATE REVISED

REVISED BY

VINEET ABRAHAM

QUYNH NGUYEN

CALCULATED-DESIGNED BY

CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR

MICHAEL LOHMAN

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TIME PLOTTED => 08:53