MPEG
MILLER PACIFIC
ENGINEERING GROUP

November 6, 2020
File: 2548.001bltr.doc

Hines Interests Limited Partnership
101 California Street, Suite 1000
San Francisco, California 94111

Attn: Mr. Charlie Tilleman

Re: Response to Review Comments
Petaluma Junction
Petaluma, California

This letter summarizes our response to geotechnical-related review comments for the proposed Petaluma Junction development. The review comments were prepared by the City of Petaluma and are summarized in their letter dated October 6, 2020. The City's review included one comment pertaining to our Preliminary Geotechnical Report dated December 18, 2017, as summarized below:

> *Based on review of other development applications in the immediate vicinity, Bay Mud soils may be located on the project site since they have been identified on nearby sites. Bay Mud soils are susceptible to subsidence under heavy loads. The geotechnical report prepared in 2017 does not indicate the presence of Bay Mud. Staff is looking for clarification on the presence or absence of this soil type and how that may impact the geotechnical recommendations contained in the report*.

Regional geologic mapping indicates the site is underlain by Holocene-age terrace deposits and is north of the mapped area underlain by Bay Mud (also referred to in the mapping as "Estuarine Deposits"). Our Preliminary Geotechnical Report includes reference subsurface data consisting of five cone penetration tests (CPTs) which were completed at the site by Engeo. One of the CPTs (CPT 3) completed near the northwest side of the site encountered approximately 10 feet of relatively soft and potentially compressible soils. While the CPT method does not allow for soil sampling, the data suggests the material is likely Bay Mud. The soils encountered in the other four CPTs were characterized as overconsolidated silty clay and clayey silt which suggests the materials are alluvial terrace deposits which are stiffer and less compressible and are not Bay Mud.

Based on the available data, it does appear that the northwest portion of the site may be underlain by Bay Mud. It should be noted that our Preliminary Geotechnical Report is intended to address geologic hazards and other anticipated geotechnical challenges to aid the project team during planning and in evaluating feasibility. Additional borings and laboratory testing will be completed as part of a future geotechnical investigation which will provide design-level geotechnical recommendations and criteria. This will include obtaining samples of subsurface soils and evaluating the potential for soft soil and settlement under new buildings, site grading and other improvements. A detailed evaluation of settlement was not performed as part of the

MILLER PACIFIC
ENGINEERING GROUP

preliminary report since borings and laboratory testing are not yet complete, and building layouts, structural loads, site grading/new fill loads and other project details are not yet defined. As noted in our preliminary report, settlement analyses and various alternatives for mitigating potential building settlements will be addressed as part of a future design-level geotechnical investigation.

We trust that this letter contains the information you require at this time. If we can be of further assistance or should there be any questions or concerns regarding this report, please call.

Very truly yours,
MILLER PACIFIC ENGINEERING GROUP

REVIEWED BY:

Rusty Arend
Geotechnical Engineer No. 3031
(Expires 6/30/21)

Scott Stephens
Geotechnical Engineer No. 2398
(Expires 6/30/21)

December 18, 2017
File: 2548.001altr.doc

Hines Interests Limited Partnership
101 California Street, Suite 1000
San Francisco, California 94111

Attn: Mr. Brendan Cronshaw

Re: Update to Preliminary Geotechnical Report
Petaluma Junction
Petaluma, California

Introduction and Project Description

This letter presents our supplemental, preliminary geotechnical recommendations for the Petaluma Junction development in Petaluma, California. The proposed mixed-use development encompasses an approximately 4.5-acre, vacant parcel (APN 007-131-003) located southwest of the Sonoma-Marin Area Rail Transit's (SMART) Petaluma Downtown Station. The project area is shown on the Site Location Map, Figure 1.

Based on our review of preliminary plans[1] and discussions with the project team, we understand the project is expected to include developing the site with two four-story buildings with about 300 units for multi-family residential and retail use. A separate six-story parking structure is also planned as part of the development. Preliminary plans indicate the buildings will be constructed at or near existing grades and no significant below-grade structures are anticipated. While detailed structural information is not available at this time, the new buildings are expected to induce moderate to heavy foundation loads. Ancillary improvements may include exterior hardscape and asphalt paving, new underground utilities, site drainage, landscaping, and other improvements "typical" of such developments.

Our work was performed in accordance with our Agreement for Professional Services dated November 20, 2017. Engeo previously prepared a Preliminary Geotechnical Report[2] for the site dated October 5, 2016 which provided preliminary conclusions and recommendations for use in project planning. This previous report is attached for reference in Appendix A. Several project features have changed since issuance of Engeo's report, including the use of taller, heavier structures. The purpose of our services is to review the Engeo report along with other available, published geologic and geotechnical information, and to provide any supplemental preliminary recommendations that should be incorporated into the project planning and design.

[1] Architects Orange, "Site & 1st Floor Plan, Petaluma Station, Petaluma, California", November 8, 2017.

[2] Engeo, "Preliminary Geotechnical Report, 315 D Street, Petaluma, California", October 5, 2016.

Site Reconnaissance and Surface Conditions

We conducted a site reconnaissance on November 27, 2017 to observe surface conditions within the project area. As shown on the Site Plan, Figure 2, the site is bordered to the southeast by D Street, to the northeast by the SMART Petaluma Downtown Station, to the northwest by East Washington Street and to the southwest by Copeland Street. The ground surface is relatively level throughout the site with surface elevations ranging from about 10 to 14 feet (based on Google Earth imagery). The property is enclosed by a fence and site access is provided through gates located off of East Washington Street and D Street.

Two abandoned railroad spur lines parallel the northeastern property boundary adjacent to the SMART parking lot. It appears the property is currently being used as storage for SMART as there are railroad ties, crossing signs and other materials staged throughout the project area. Several stockpiles of soil, asphalt, old storm drain pipes and other construction debris are present at various locations. The ground surface is covered with grass and sparse shrubbery and up to several feet of ballast has been placed in some areas.

Previous Subsurface Exploration

Several investigations have been conducted within the vicinity of the site by Miller Pacific and other Consultants as part of the proposed project or other nearby projects. As part of our update to the Preliminary Geotechnical Report, we reviewed the following documents:

Engeo, *Preliminary Geotechnical Report, 315 D Street, Petaluma, California,* October 5, 2016.

Miller Pacific Engineering Group, *Geotechnical Investigation, Adobe Road Winery, 1 C Street, Petaluma, California,* December 2, 2016.

Miller Pacific Engineering Group, *Geotechnical Investigation, Petaluma Trestle Rehabilitation, Petaluma, California,* November 30, 2011.

Miller Pacific Engineering Group, *Slope Stability Analysis, McNear Peninsula, Petaluma, California,* May 18, 2004.

Miller Pacific Engineering Group, *Geotechnical Investigation, Petaluma Flood Control Project, Petaluma, California*, June 20, 1996.

Pinnacle Environmental Inc., *Phase 1 Environmental Site Assessment of a Commercial Property, 315 D Street, Petaluma, California, 91952*, April 21, 2016.

Pinnacle Environmental Inc., *Subsurface Phase II Environmental Site Assessment Report of a Commercial Property, 315 D Street, Petaluma, California 94952*, July 26, 2016.

U.S. Army Corp of Engineers, *Petaluma River, City of Petaluma, California, Section 205, Detailed Project Report for Flood Control, Appendix A, Basis of Design*", November, 1994.

The approximate locations of the nearby borings and cone penetration tests (CPTs) from these previous investigations are shown on the Existing Exploration Plan, Figure 3. The CPT, boring logs, and laboratory testing from the previous investigations are included under Appendix B.

Conclusions

Based on the results of previous subsurface exploration within the site vicinity, we judge that construction of the proposed improvements is feasible from a geotechnical standpoint. The preliminary conclusions and recommendations contained in the Engeo report are generally appropriate for the project site conditions and should be relied upon by the project team as project planning and design advance. The following paragraph includes current seismic design criteria and updated, preliminary foundation design recommendations that should supersede the recommendations in the Engeo Report.

CBC Seismic Criteria

Minimum mitigation of ground shaking includes seismic design of new structures in conformance with the provisions of the most recent edition (2016) of the California Building Code. The magnitude and character of these ground motions will depend on the particular earthquake and the site response characteristics. Based on the interpreted subsurface conditions and close proximity of several nearby faults, we recommend the CBC coefficients and site values shown in Table 1 be used to calculate the design base shear of the new construction.

Table 1 – 2016 California Building Code Seismic Design Criteria

Parameter	Design Value
Site Class	B
Site Latitude	38.237°N
Site Longitude	-122.636°W
Spectral Response (short), S_S	1.560 g
Spectral Response (1-sec), S_1	0.612 g
Site Coefficient, F_a	1.0
Site Coefficient, F_V	1.5

Reference: USGS US Seismic Design Maps (http://earthquake.usgs.gov/designmaps/us/application), accessed on December 18, 2017.

Preliminary Foundation Design Criteria

Engeo's report indicates the proposed commercial, residential, and parking structures can likely be founded on post-tensioned or stiffened mat foundations bearing on geogrid-reinforced engineered fill. These preliminary recommendations were based upon the use of relatively lightly-loaded, wood framed buildings of two stories or less. The proposed project has since been modified to include new structures up to six stories in height which will likely induce moderate to heavy foundation loads. A post-tensioned or stiffened mat foundation may remain a feasible alternative for the proposed structures provided that estimated building settlements are within acceptable limits. An evaluation of building settlements should be performed as part of final design once additional subsurface exploration and detailed structural information is available. If estimated building settlements are not within acceptable limits, load-balancing or a deep foundation system may be required.

Load balancing may be considered as a means of reducing the potential settlements for the new buildings. This approach would include overexcavating beneath the structure and replacing a portion of the soil that is removed with lightweight material consisting of lava rock, cellular concrete or geofoam. To minimize settlement, the buildings would be designed so that the foundation bearing pressures do not exceed the weight of the soil removed from the excavation. For estimating the required depth of overexcavation, a unit weight of 125 pounds per cubic foot should be used for the existing fill and near-surface soils. The unit weight of the lightweight materials typically varies from about 50 to 65 pounds per cubic foot for lava rock, 25 to 35 pounds per cubic foot for cellular concrete, and 2 to 3 pounds per cubic foot for geofoam.

A deep foundation system may also be utilized to support the new structures and to reduce building settlements. Various deep foundation alternatives are judged to be appropriate, including torque-down piles, auger-cast piles, drilled piers or driven piles. The deep foundations would need to extend through the existing fill and near-surface soils and into the underlying dense/stiff soils. For planning purposes, we anticipate deep foundations would be installed to depths of about 50 feet with estimated capacities of about 70 kips per foundation element. The actual depth and capacity of deep foundations would be determined after a design-level geotechnical investigation is completed.

We trust that this letter contains the information you require at this time. If we can be of further assistance or should there be any questions or concerns regarding this report, please call.

Very truly yours,
MILLER PACIFIC ENGINEERING GROUP REVIEWED BY:

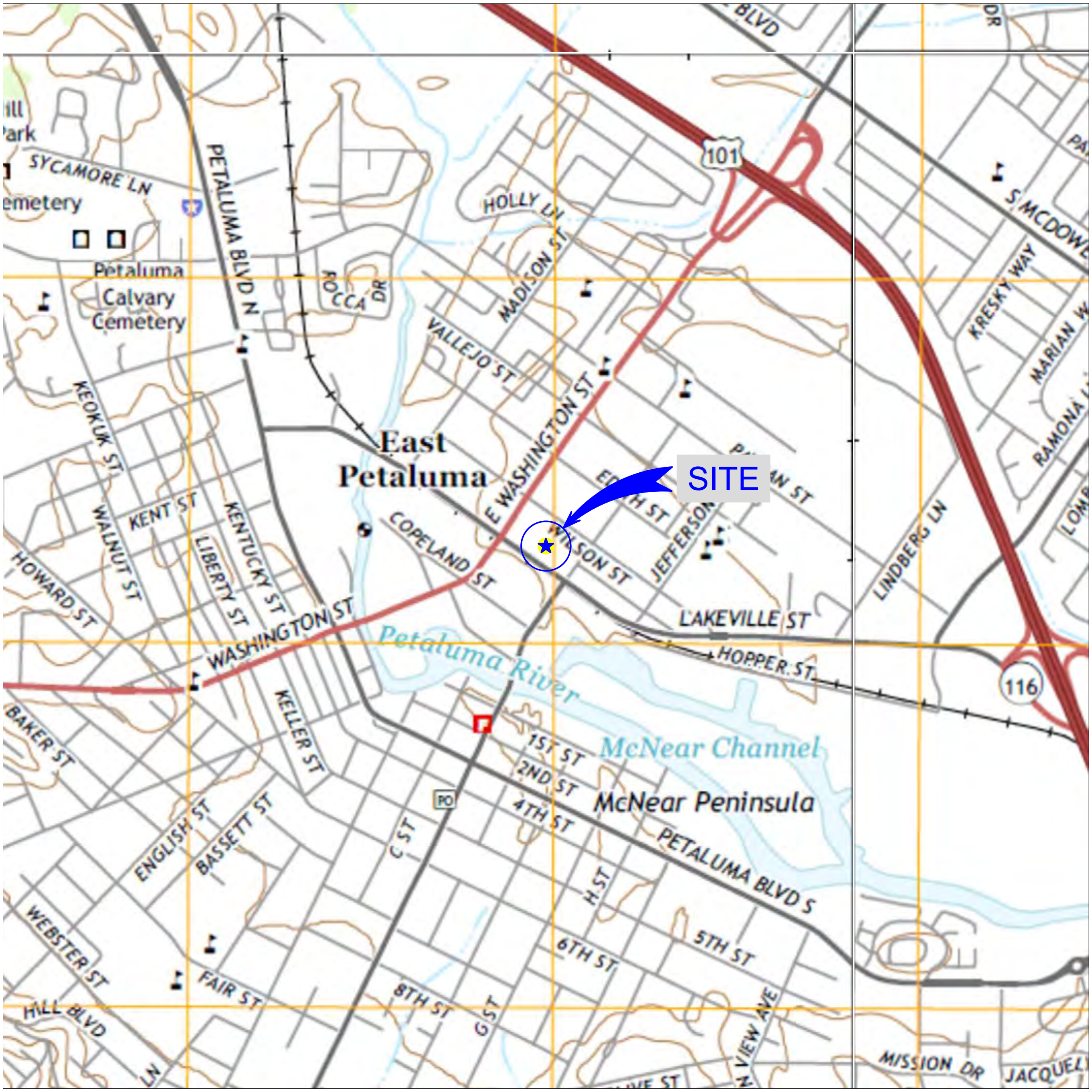
REGISTERED PROFESSIONAL ENGINEER
RUSSELL C. AREND
No. 3031
Exp. 6/30 19
GEOTECHNICAL
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
SCOTT A. STEPHENS
2398
Exp. 6/30/ 19
GEOTECHNICAL
STATE OF CALIFORNIA

Rusty Arend
Geotechnical Engineer No. 3031
(Expires 6/30/19)

Scott Stephens
Geotechnical Engineer No. 2398
(Expires 6/30/19)

Attachments: Figures 1 to 3, Appendices A and B



SITE COORDINATES
LAT. 38.2370°
LON. -122.6360°

SITE LOCATION

(NO SCALE)

NORTH

REFERENCE: Google Earth, 2017

MILLER PACIFIC ENGINEERING GROUP	504 Redwood Blvd. Suite 220 Novato, CA 94947 T 415 / 382-3444 F 415 / 382-3450 www.millerpac.com	SITE LOCATION MAP Petaluma Junction Petaluma, California Project No. 2458.001 Date: 2/1/2017	Drawn RCA Checked	1 FIGURE

FILENAME: 2548.001 Figures.dwg

NORTH

SCALE

0 50 100 200 FEET

MPEG MILLER PACIFIC ENGINEERING GROUP

FILE: 2548.001 Figures.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

SITE PLAN

Petaluma Junction
Petaluma, California

Project No. 2548.001 Date: 8/3/2016

Designed
Drawn RCA
Checked SAS

2
FIGURE

LEGEND:

- APPROXIMATE CPT LOCATION BY ENGEO, 2016
- APPROXIMATE BORING LOCATION BY MILLER PACIFIC, 2016
- APPROXIMATE CPT LOCATION BY MILLER PACIFIC, 2011
- APPROXIMATE BORING LOCATION BY MILLER PACIFIC, 2004
- APPROXIMATE BORING LOCATION BY MILLER PACIFIC, 1999
- APPROXIMATE BORING LOCATION BY MILLER PACIFIC, 1996
- APPROXIMATE CPT LOCATION BY MILLER PACIFIC, 1996
- APPROXIMATE BORING LOCATION BY ARMY CORP OF ENGINEERS, 1994

NORTH

SCALE

0 100 200 400 FEET

MPEG MILLER PACIFIC ENGINEERING GROUP

FILE: 2548.001 Existing Exploration

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

EXISTING EXPLORATION PLAN

Petaluma Junction
Petaluma, California

Project No. 2458.001 Date: 11/27/2017

Designed
Drawn RCA
Checked SAS

3
FIGURE

APPENDIX A

PRELIMINARY GEOTECHNICAL REPORT BY ENGEO

Preliminary Geotechnical Report

315 D Street
Petaluma, California

Submitted to:
Mr. Todd Kurtin
Lomas Partners LLC
13848 Weddington Street
Sherman Oaks, CA 91401

Prepared by:
ENGEO Incorporated

October 5, 2016

Project No:
13253.000.000

Project No.
13253.000.000

October 5, 2016

Mr. Todd Kurtin
Lomas Partners LLC
13848 Weddington Street
Sherman Oaks, CA 91401

Subject: 315 D Street
Petaluma, California

PRELIMINARY GEOTECHNICAL REPORT

Dear Mr. Kurtin:

With your authorization, we completed this preliminary geotechnical report for the 315 D Street project located in Petaluma, California. In preparation of this report, we reviewed our previous field exploration at the neighboring Haystack project to the south of the site, performed a site reconnaissance, conducted a field exploration involving the advancement of cone penetration tests, and obtained near surface samples for laboratory testing. Following review of the field explorations and laboratory test data, we present our conclusions and preliminary recommendations regarding the proposed mixed-use development.

Our findings indicate that the study area is suitable for the proposed development provided the preliminary conclusions and recommendations, and guidelines provided in this report are implemented during project planning. Potential geologic hazards in the study area include potentially liquefiable soil, potentially compressible soil, existing fill, expansive soil, and shallow groundwater. Additional geotechnical exploration services will be required for design-level recommendations. We are pleased to have been of service to you on this project and are prepared to consult further with you and your design team as the project progresses.

Sincerely,

ENGEO Incorporated

Caroline Haatveit

Caroline Haatveit, EIT

REGISTERED PROFESSIONAL ENGINEER
LEROY CHAN
No. 3001
GEOTECHNICAL
STATE OF CALIFORNIA

Leroy Chan, GE

ch/tpb/lc/jf

Theodore P. Bayham, GE, CEG

REGISTERED PROFESSIONAL ENGINEER
THEODORE P. BAYHAM
No. 2480
GEOTECHNICAL
STATE OF CALIFORNIA

TABLE OF CONTENTS

Letter of Transmittal

1.0 INTRODUCTION 1
1.1 PURPOSE AND SCOPE 1
1.2 SITE LOCATION AND DESCRIPTION 1
1.3 PROPOSED DEVELOPMENT 1
2.0 GEOLOGY AND SEISMICITY 2
2.1 REGIONAL GEOLOGY AND SITE SOILS....................2
2.2 SITE SEISMICITY 2
3.0 FIELD EXPLORATION....................3
3.1 CONE PENETRATION TESTING....................3
3.2 LABORATORY TESTING 3
4.0 SUBSURFACE CONDITIONS 4
4.1 GROUNDWATER....................4
5.0 SEISMIC HAZARDS....................4
5.1.1 Ground Rupture 5
5.1.2 Ground Shaking 5
5.1.3 Liquefaction 5
5.1.4 Lateral Spreading....................6
5.1.5 Lurching....................6
6.0 DISCUSSION AND CONCLUSIONS....................6
6.1 LIQUEFACTION-INDUCED GROUND SETTLEMENT....................7
6.2 COMPRESSIBLE SOILS....................7
6.3 EXISTING FILLS 8
6.4 EXPANSIVE SOIL....................8
6.5 SHALLOW GROUNDWATER....................8
7.0 2013 CBC SEISMIC DESIGN PARAMETERS....................9
8.0 PRELIMINARY FOUNDATION RECOMMENDATIONS 9
8.1 SECONDARY SLAB-ON-GRADE CONSTRUCTION....................10
9.0 PRELIMINARY EARTHWORK RECOMMENDATIONS 10
9.1 LIQUEFACTION HAZARD MITIGATION MEASURES....................10
9.2 EXISTING FILL....................11
9.3 SELECTION OF MATERIALS 11
9.4 FILL PLACEMENT....................11

TABLE OF CONTENTS (Continued)

9.5 TEMPORARY DEWATERING FOR UTITLITY CONSTRUCTION 12
10.0 PRELIMINARY PAVEMENT DESIGN 12
11.0 DESIGN-LEVEL GEOTECHNICAL EXPLORATION 13
12.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS 13

SELECTED REFERENCES
FIGURES
APPENDIX A – Cone Penetration Test (CPT) Logs (Middle Earth Geo Testing)
APPENDIX B – CLiq Preliminary Liquefaction Analysis
APPENDIX C – Laboratory Test Results

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

The purpose of this preliminary geotechnical report is to provide preliminary conclusions and recommendations for the proposed mixed-use development in Petaluma, California. The information presented in this report may be used for general land planning purposes.

The scope of our services included:

- Reviewing available literature and geologic maps for the immediate area;
- Reviewing previous field explorations and laboratory test results of the neighboring Haystack project immediately south of the project site;
- Performing a field exploration, which included retaining a subcontractor to advance five cone penetration tests to a depth of approximately 50 feet below ground surface, and collecting near-surface soil samples for laboratory testing;
- Engineering analyses to evaluate site conditions; and,
- Preparing a report summarizing our initial recommendations for proposed site development and recommendations for additional studies.

We prepared this report exclusively for Lomas Partners LLC and their design team consultants. We should review any changes made in the character, design or layout of the development to modify the conclusions and recommendations contained in this report, as necessary. This document may not be reproduced in whole or in part by any means whatsoever, nor may it be quoted or excerpted without our express written consent.

1.2 SITE LOCATION AND DESCRIPTION

The 315 D Street property is approximately 4½ acres in size and is located in Petaluma, California (Figure 1). The site is rectangular and bounded by East Washington Street to the west, Copeland Street to the south, East D Street to the east, and the Petaluma Downtown rail station to the north. The site is relatively level and is currently being used for equipment and stockpile storage for the Sonoma-Marin Area Rail Transit (SMART).

1.3 PROPOSED DEVELOPMENT

Based on the conceptual plans provided by Brian Daigle Architect, the proposed project will include mixed-used two to three story buildings fronting the perimeter streets, and an interior one- to two-level parking garage. Subterranean levels are not anticipated, and the proposed development will primarily be situated close to existing grades. A new street will bisect the project perpendicular to Copeland Street.

Details regarding planned structural loads and site grading are not available at this time. For this report, we assume grading will be minor and structural loads for the proposed structures will be lightly loading wood-frame type construction. .

2.0 GEOLOGY AND SEISMICITY

2.1 REGIONAL GEOLOGY AND SITE SOILS

The site is located within the Coast Ranges geomorphic province of California. The Coast Ranges are characterized by a series of northwest-trending ridges and valleys that have experienced extensive uplift, folding, and faulting continuing through recent geologic time. Regional geologic mapping of the vicinity (Bezore, 2002) shows the site to be located just outside of the fringe of the Wilson Grove Formation underlain by Holocene terrace and estuarine deposits.

2.2 SITE SEISMICITY

The project is located in a region that contains active earthquake faults; however, no active faults are known to cross the property and the site is not located within an Alquist-Priolo Earthquake Fault Zone. Fault rupture through the site, therefore, is not anticipated. An active fault is defined by the State Mining and Geology Board as one that has had surface displacement within Holocene time (about the last 11,000 years) (Hart, 1997). Numerous small earthquakes occur every year in the San Francisco Bay Region, and larger earthquakes have been recorded and can be expected to occur in the future. The site has been mapped as highly susceptible to liquefaction by USGS. This indicates that site soil may be liquefiable based on mapped geology and depth to groundwater and a site-specific study of liquefaction hazard is required prior to site development.

Based on the United States Geological Survey's (USGS) 2008 National Seismic Hazard Maps, the closest active fault in the area is the Rodgers Creek fault, which is approximately 5.3 miles northeast of the site. Figure 6 shows the approximate locations of mapped active faults and significant historic earthquakes recorded within the San Francisco Bay Region. The following table lists the closest mapped active faults and their proximity to the site.

TABLE 2.2-1
Summarized Nearest Active Faults

Fault Name	Approximate Distance from Project Site (miles)	Maximum Moment Magnitude (Ellsworth)
Rodgers Creek	5.3	7.1
San Andreas	14.6	7.9
West Napa	17.6	6.5
Hayward	17.8	7.1

The Uniform California Earthquake Rupture Forecast (UCERF3, 2013) evaluated the 30-year probability of a Moment Magnitude 6.7 or greater earthquake occurring on the known active fault systems in the San Francisco Bay Area. The UCERF3 generated an overall probability of 72 percent for a Moment Magnitude 6.7 or greater earthquake in the San Francisco Region as a whole.

3.0 FIELD EXPLORATION

3.1 CONE PENETRATION TESTING

To characterize the subsurface condition, we conducted a field exploration on August 25, 2016, that consisted of advancing five cone penetration tests (CPTs) extending to depths of approximately 50 feet below ground surface (bgs). The approximate locations of the CPTs are shown on Figure 2. Our CPTs were advanced until they encountered practical refusal. The CPT data can be found in Appendix A of this report.

We retained a CPT subcontractor who performed the CPTs in general accordance with ASTM D-5778. Measurements collected during testing include the tip resistance to penetration of the cone (Qc), the resistance of the surface sleeve (Fs), and dynamic pore pressure (U). The CPT logs and supporting empirical data are located in Appendix A. During our field exploration, we also obtained near-surface soil samples for lab testing of near-surface soils.

Pore pressure dissipation tests were conducted in order to determine approximate depths to groundwater. Pore pressure dissipation data is summarized in Section 4.1, below. The CPT holes were backfilled with cement-bentonite grout.

3.2 LABORATORY TESTING

We performed laboratory testing, including Atterberg Limits and sieve testing, on select samples recovered during our field exploration. The laboratory test results are presented in Appendix C.

4.0 SUBSURFACE CONDITIONS

The subsurface conditions encountered in our CPTs consist of approximately 3 feet of existing fills underlain by alluvial soil deposits. The alluvial soil deposits are comprised of alternating layers of clay and silty clay with interbedded layers of silty sand and sandy silt to depths of between 36 and 48 feet below ground surface. Below these depths, the CPTs generally encountered very stiff or dense soil deposits.

4.1 GROUNDWATER

Based on the pore pressure test data, groundwater is estimated at a depth of between approximately 6½ and 9½ feet below the ground surface. Summary of pore pressure dissipation test data are provided in Table 4.1-1:

TABLE 4.1-1
Pore Pressure Dissipation Test Summary

Exploration Location	Estimated Depth to Groundwater (feet)
1-CPT1	9½
1-CPT2	6½
1-CPT3	*
1-CPT4	7
1-CPT5	*

*Test not completed

Fluctuations in groundwater levels should be expected during seasonal changes or over a period of years because of precipitation changes, perched zones, changes in drainage patterns, or irrigation. For preliminary design purposes, we consider a groundwater level on the order of 5 feet bgs.

5.0 SEISMIC HAZARDS

Potential seismic hazards resulting from a nearby moderate to major earthquake can generally be classified as primary and secondary. The primary effect is ground rupture, also called surface faulting. The common secondary seismic hazards include ground shaking, liquefaction, densification and lateral spreading. Based on topographic and lithologic data, the risk of regional subsidence/uplift, landslides, tsunamis, or seiches is considered low to negligible at the site.

The following sections present a discussion of these hazards as they apply to the site.

5.1.1 Ground Rupture

As described above, the site is not located within an Earthquake Fault Special Study Zone. Therefore, it is our opinion that ground rupture is unlikely at the subject property.

5.1.2 Ground Shaking

An earthquake of moderate to high magnitude generated within the San Francisco Bay Region could cause considerable ground shaking at the site, similar to that which has occurred in the past. To mitigate the shaking effects, all structures should be designed using sound engineering judgment and the current California Building Code (CBC) requirements, as a minimum. Seismic design provisions of current building codes generally prescribe minimum lateral forces, applied statically to the structure, combined with the gravity forces of dead-and-live loads. The code-prescribed lateral forces are generally considered to be substantially smaller than the comparable forces that would be associated with a major earthquake. Therefore, structures should be able to: (1) resist minor earthquakes without damage, (2) resist moderate earthquakes without structural damage but with some nonstructural damage, and (3) resist major earthquakes without collapse but with some structural as well as nonstructural damage. Conformance to the current building code recommendations does not constitute any kind of guarantee that significant structural damage would not occur in the event of a maximum magnitude earthquake; however, it is reasonable to expect that a well-designed and well-constructed structure will not collapse or cause loss of life in a major earthquake (SEAOC, 1996).

5.1.3 Liquefaction

Liquefaction is the loss of strength to soil layers due to cyclic loading or seismic shaking. Generally, loose coarse-grained material will undergo liquefaction under a seismic event. Based on observations of soil behavior under seismic shaking and laboratory testing, some fine-grained material, such as silt and clay, can also undergo liquefaction, or cyclic softening dependent on the plasticity index (PI). In order for a soil to be potentially liquefiable, it must be saturated; therefore, for this site, we conservatively considered soil at a depth of 5 feet below the ground surface to be susceptible to liquefaction based on our exploration data from CPT pore pressure dissipation tests.

We analyzed the potential for liquefaction and resulting settlement using the CPT data with the software program CLiq (version 1.7.6.34) applying the methodologies published by Robertson (2009) and Zhang et al. (2002). We used a design groundwater depth of 5 feet, the Maximum Considered Earthquake Geometric Mean Peak Ground Acceleration (PGA_M) mapped for the site based on the 2013 California Building Code of 0.60g, and a moment magnitude of 7.94 based on a theoretical rupture of the San Andreas fault. In our analyses, we assumed an I_c (soil behavior index) cutoff of 2.6 to represent the boundary of sand and fine-grained soil; we also considered the potential of fine-grained soil to liquefy (or cyclically soften).

We present the results of our preliminary liquefaction analysis in Appendix B, and discuss the results in Section 6.0.

It should be noted that our preliminary analysis suggests that majority of the soil layers that are potentially susceptible to seismic deformation has a relatively fines-content based on CPT interpretations. Representative samples of these material were not collected due to the method of exploration conducted within this scope, therefore, we recommend additional laboratory testing to update the liquefaction analyses be performed during a design-level study.

5.1.4 Lateral Spreading

Lateral spreading is a failure within a continuous soil layer (typically due to liquefaction) that causes the overlying soil mass to move toward a free face or down a slope. Generally, effects of lateral spreading are most significant at the free face or the crest of a slope and diminish with distance from the slope.

Because the site is relatively level and over 500 feet away from free face of the Petaluma River, existing exploration in the area have suggested that the layers of potentially-liquefiable material appears discontinuous, we believe the potential for lateral spreading is low. We recommend that this is further assessed during a design-level exploration, once the susceptibility for liquefaction is further explored.

5.1.5 Lurching

Ground lurching is a result of the rolling motion imparted to the ground surface during energy released by an earthquake. Such rolling motion can cause ground cracks to form. The potential for the formation of these cracks is considered greater at contacts between deep alluvium and bedrock. Such an occurrence is possible at the site as in other locations in the Bay Area, but based on the site location, it is our opinion that the offset is expected to be minor.

6.0 DISCUSSION AND CONCLUSIONS

From a geologic and geotechnical standpoint, the study area appears to be suitable for the proposed development. The preliminary recommendations in this report should be considered in the initial planning for the study area. Additional explorations will be required to develop design-level recommendations for site grading and foundations.

Potential geologic hazards in the study area include the following:

- potentially liquefiable soil
- potentially compressible soil
- existing fill
- expansive soil
- shallow groundwater

We discuss each of these potential hazards and other geotechnical issues relevant to the study below.

6.1 LIQUEFACTION-INDUCED GROUND SETTLEMENT

Results of the preliminary liquefaction-induced settlement are shown in Table 6.1-1. Analysis output from analytical software Cliq is provided in Appendix B.

TABLE 6.1-1
Total Liquefaction-Induced Settlement Estimates (I_c = 2.60)

Exploration Location	Estimated Total Vertical Settlement
1-CPT1	3½
1-CPT2	2
1-CPT3	2
1-CPT4	1
1-CPT5	3

We calculated liquefaction-induced settlements that are between 1 and 3½ inches of total vertical settlement. For planning purposes, we recommend the site be designed for 3½ inches total liquefaction-induced settlement and with differential liquefaction-induced settlements of 1¾ inches over a distance of 30 feet. Once further characterized is completed for the site following a design-level study, this settlement estimate may be able to be modified.

Based on our experience with neighboring projects, this material that has been determined here to be potentially liquefiable may contain a significant amount of fine-grained material and may be less susceptible to liquefaction-induced settlement than has been presented above. We recommend a design-level exploration that involves borings and laboratory testing for further characterization and analyses of the potentially liquefiable material.

As discussed by Youd and Garris (1995), liquefiable soil that is not overlain by a sufficiently thick layer of soil that is not liquefiable is more prone to ground surface disruptions such as fissures and sand boils. Building foundations bearing on shallow liquefiable soil could be subject to localized bearing capacity failures or excessive settlement due to ground loss. The thickness of non-liquefiable soil necessary to reduce this risk is a function of the thickness of the liquefiable soil layer below. Based on the study by Youd and Garris, there may be an insufficient thickness of non-liquefiable soil to prevent sand boils. Without mitigation there is a risk of sand boils forming in isolated areas within the proposed building footprint. There effects could also result in limited areas of pavement buckling, utility breaks or settlement greater than the amounts discussed in Table 6.1-1 above.

6.2 COMPRESSIBLE SOILS

Compressible soils may settle in response to new loads introduced by new fill, structures or equipment; this settlement, if it occurs may occur as elastic or consolidation settlement. Elastic settlement is a function of soil stiffness while consolidation settlement is highly dependent on the amount of water-filled voids within the soil. The rate of settlement is highly dependent on the permeability of the soil and the presence of water. Consequently, sandy soil will settle almost immediately, whereas clayey soil below the water table will settle much more slowly.

In most of our CPTs, the clay that was encountered was overconsolidated, with the exception of 1-CPT3 located at the southwestern corner of the site, where a layer of potentially compressible clay at approximate 8 to 15 feet below ground surface was encountered. This localized layer was interpreted to be normally consolidated and, therefore, would potentially be compressible subjected to magnitude of new loading from the proposed structures.

We recommend that additional borings and laboratory testing be concentrated in this area of the site during a design-level exploration for further characterization and analysis of this potentially compressible material and its potential effect on the proposed development. The amount of consolidation settlement is subject to the loading conditions and should be assessed further once loading conditions are known during a design-level exploration.

6.3 EXISTING FILLS

Evidence of existing fill, approximately 3 feet in thickness, was apparent in our CPT soundings and hand-auger samples. The existing fill appears to be highly variable, which could result in variable performance for structures on shallow foundations bearing on this material. Existing fill without documentation that it was placed in an engineered manner with appropriate levels of compaction for the proposed development should be considered non-engineered. In general, non-engineered fill should be excavated and replaced as engineered fill. The extent and quality of existing fill should be evaluated at the time of design-level study and mitigated during grading activities.

6.4 EXPANSIVE SOIL

Based upon our sampling and testing of near-surface soil, the surficial soil at the site is expected to be moderately expansive. Expansive soil shrinks and swells as a result of moisture changes. This can cause heaving and cracking of slabs-on-grade, pavements, and structures founded on shallow foundations.

Successful construction on expansive soil requires special attention during grading. It is imperative to keep exposed soils moist by occasional sprinkling. If the soil dries, it is extremely difficult to remoisturize the soil (because of their clayey nature) without excavation, moisture conditioning, and recompaction.

6.5 SHALLOW GROUNDWATER

Based on the encountered groundwater depth encountered in our exploration at a depth of between 6½ and 9½ feet below the ground surface, the static groundwater level beneath the site could affect the proposed development.

Shallow groundwater can:

1. Impede grading activities.
2. Require temporary construction dewatering.
3. Cause moisture damage to sensitive floor coverings.
4. Transmit moisture vapor through slabs causing excessive mold/mildew build-up, fogging of windows, and damage to computers and other sensitive equipment.

7.0 2013 CBC SEISMIC DESIGN PARAMETERS

Based on the subsurface conditions and the types of structures planned, we characterized the site as Site Class D. We provide the ASCE 7-10 seismic design parameters for Site Class D in the table below:

TABLE 7.0-1
ASCE 7-10 Seismic Design Parameters
Site Location Lat: 38.2368°N Long: 122.6356°W

Parameter	Design Value
Site Class	D
Mapped MCE_R Spectral Response Acceleration at Short Periods, S_S (g)	1.56
Mapped MCE_R Spectral Response Acceleration at 1-second Period, S_1 (g)	0.61
Site Coefficient, F_A	1.0
Site Coefficient, F_V	1.5
MCE_R Spectral Response Acceleration at Short Periods, S_{MS} (g)	1.56
MCE_R Spectral Response Acceleration at 1-second Period, S_{M1} (g)	0.92
Design Spectral Response Acceleration at Short Period, S_{DS} (g)	1.04
Design Spectral Response Acceleration at 1-second Period, S_{D1} (g)	0.61
MCE_G Peak Ground Acceleration adjusted for Site Class effects, PGA_M (g)	0.60

8.0 PRELIMINARY FOUNDATION RECOMMENDATIONS

The proposed structures will need to be able to address the shrink-swell of the surface soil and potential differential settlement due to static loading and liquefaction. While these soil movements should be combined to evaluate the seismic load case, our experience indicates that larger amounts of architectural distress are commonly tolerated for load checks including seismic loading.

Based on our experience and the anticipated building types, it is our opinion that the proposed commercial, residential, and parking structures can be founded on post-tensioned (PT) or stiffened mat foundations bearing on geogrid-reinforced engineered fill.

Further discussion about proposed building loads and layouts, additional exploration, laboratory testing, and detailed assessment of estimated liquefaction- and load-induced settlements should occur prior to preparation of site-specific foundation designs for the development. The amount of estimated settlement will impact the selection of foundation type for the structures.

Additional PT mat foundation and reinforced mat foundation recommendations will be provided upon conclusion of a design-level study.

8.1 SECONDARY SLAB-ON-GRADE CONSTRUCTION

This section provides guidelines for secondary slabs such as exterior walkways, driveways, steps, approach ramps, and sidewalks.

Secondary slabs-on-grade should be constructed structurally independent of the foundation system. This allows slab movement to occur with a minimum of foundation distress. Secondary slabs-on-grade should be designed by the Structural Engineer specifically for their intended use and loading requirements. Cracking of conventional slabs should be expected as a result of concrete shrinkage. Slabs-on-grade should be reinforced and include frequent control joints to control the cracking. Such reinforcement should be designed by the Structural Engineer. In our experience, welded wire mesh may not be sufficient to control slab cracking.

Ideally, secondary slabs-on-grade should have a minimum thickness of 4 inches. A 4-inch-thick layer of clean crushed rock or gravel should be placed under slabs. Slabs should slope away from the buildings at a slope of at least 2 percent to prevent water from flowing toward the building. Turned down free edges extending at least beneath the crushed rock or gravel into compacted soil should be constructed to reduce water infiltration into subgrade soils. Waterproof barriers may also be considered.

Alternatively, and with some additional risk of cracking and/or heaving of secondary slabs, the layer of clean crushed rock or gravel beneath slabs and the turned down edges can be eliminated. If these recommendations are eliminated, it is critical that uniformity in soil moisture conditioning be achieved in subgrade soils and that subgrade soils are not allowed to dry out prior to slab construction.

9.0 PRELIMINARY EARTHWORK RECOMMENDATIONS

The following recommendations are for initial land planning and preliminary estimating purposes. Final recommendations regarding site grading and foundation construction will be provided after additional site-specific exploration has been undertaken.

9.1 LIQUEFACTION HAZARD MITIGATION MEASURES

Due to the variable subsurface conditions at the site and the associated varying degrees of liquefaction-induced settlement predicted around the site, we recommend that within the building envelope and the area extending 10 feet beyond the edge of the building that the existing fill be removed and replaced with engineered fill reinforced with geotextile fabric (geogrid) layer(s). In order to help bridge any differential settlements caused by liquefaction, we recommend that the upper 5 feet of subsurface material be completely over-excavated and recompacted as engineered fill or imported granular fill. The layers of geogrids should consist of triaxial geogrids placed between layers of backfill. Further recommendations regarding liquefaction hazard mitigation measures will be provided upon conclusion of a design-level study.

9.2 EXISTING FILL

The history of the fill placement on the site is unknown. Consequently, it is assumed that the existing fill and utility trench backfill are considered non-engineered and should be subexcavated to expose underlying competent native soil that is approved in the field by a representative of our firm. Additionally, as discussed above in Section 9.1, on a preliminary level we recommend that a layer of triaxial geogrid should be installed over the exposed overexcavated subgrade and again in the middle of the engineered fill layer in order to help bridge differential settlements caused by liquefaction-induced or load-induced settlements.

9.3 SELECTION OF MATERIALS

The site soils are suitable for use as engineered fill provided they do not contain deleterious material, debris and high organic content (soil that contains more than 3 percent organics). We should be informed when import materials are planned for the site. Import materials should have a PI less than 12 and with no particle greater than 6 inches in diameter. Import materials should be submitted and approved by our representatives prior to delivery at the site.

9.4 FILL PLACEMENT

After removal of any loose soil, the exposed non-yielding surface of areas to receive fill should be scarified to a depth of 12 inches, moisture conditioned, and recompacted to provide adequate bonding with the initial lift of fill. The lift thickness should not exceed 12 inches or the depth of penetration of the compaction equipment used, whichever is less. For land planning and cost estimating purposes, the following compaction control requirements should be applied to all fill including backfill, except for landscape areas:

- For materials with an observed Plasticity Index (PI) less than 12 we recommend:

Test Procedures:	ASTM D-1557, latest edition.
Required Moisture Content:	Not less than 2 percentage points above optimum moisture content.
Minimum Relative Compaction:	Not less than 90 percent.

- For materials with an observed PI greater than 12 we recommend:

Test Procedures:	ASTM D-1557, latest edition.
Required Moisture Content:	Not less than 4 percentage points above optimum moisture content.
Relative Compaction:	Between 87 and 92 percent.

We recommend that all site preparation, including demolition and stripping be performed under the observation of the Geotechnical Engineer's qualified field representative.

9.5 TEMPORARY DEWATERING FOR UTITLITY CONSTRUCTION

As previously mentioned, groundwater was encountered between 6½ and 9½ feet below ground surface during our site exploration. Utility trench excavation may require temporary dewatering during construction to keep the excavation and working areas reasonably dry. We anticipate that dewatering for utility construction can be accomplished by pumping from sumps. Extended dewatering of utility trench excavations may cause settlement of newly installed pipelines and adjacent improvements. In addition, post-construction long-term dewatering may occur due to the movement of water along utility trenches. We recommend that utility trenches include low permeability cutoffs to reduce the risk of inadvertent groundwater flow along permeable backfill. In addition, seepage into utility joints may effectively cause dewatering and lead to settlement. We recommend that trench depth be limited as much as practical for the development and that utilities be watertight.

10.0 PRELIMINARY PAVEMENT DESIGN

Preliminary pavement design is provided based on assumed Traffic Indices and subgrade resistance values (R-value). The Traffic Index should be determined by the Civil Engineer or appropriate public agency. Based on an assumed R-value of 5, the method contained in Chapters 600 through 630 of the Highway Design Manual by Caltrans (including the asphalt factor of safety), and assumed Traffic Indices ranging from 5.0 to 6.0, we recommend the minimum pavement design sections shown in Table 10.0-1

TABLE 10.0-1
Preliminary Asphalt Concrete Pavement Sections for an R-Value of 5

Traffic Index (TI)	Pavement Design	
	HMA (inches)	AB (inches)
5.0	3.0	10.0
5.5	3.0	12.0
6.0	3.5	13.0

The Civil Engineer should determine the appropriate traffic indices based on the estimated traffic loads and frequencies. The subgrade and aggregate base should be compacted in accordance with Section 7.4. Aggregate Base should meet the requirements for ¾ inch maximum Class 2 AB per Section 26-1.02a of the latest Caltrans Standard Specifications.

11.0 DESIGN-LEVEL GEOTECHNICAL EXPLORATION

A design-level geotechnical exploration should be performed as part of the design process, which would include borings, and laboratory soil testing as needed, to provide data for preparation of specific recommendations regarding site grading, remedial grading measures, foundations, and drainage for the proposed development. The exploration will also allow for more detailed evaluations of the above-described geotechnical issues and afford the opportunity to provide techniques and procedures to be implemented during construction to mitigate potential geotechnical/geological hazards.

12.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

This report is issued with the understanding that it is the responsibility of the owner to transmit the information and recommendations of this report to developers, owners, buyers, architects, engineers, and designers for the project so that the necessary steps can be taken by the contractors and subcontractors to carry out such recommendations in the field. The conclusions and recommendations contained in this report are solely professional opinions.

The professional staff of ENGEO strives to perform its services in a proper and professional manner with reasonable care and competence but is not infallible. There are risks of earth movement and property damages inherent in land development. We are unable to eliminate all risks or provide insurance; therefore, we are unable to guarantee or warrant the results of our services.

This report is based upon field and other conditions discovered at the time of preparation of ENGEO's report. This document must not be subject to unauthorized reuse that is, reusing without written authorization of ENGEO. Such authorization is essential because it requires ENGEO to evaluate the document's applicability given new circumstances, not the least of which is passage of time. Actual field or other conditions will necessitate clarifications, adjustments, modifications or other changes to ENGEO's documents. Therefore, ENGEO must be engaged to prepare the necessary clarifications, adjustments, modifications or other changes before construction activities commence or further activity proceeds. If ENGEO's scope of services does not include on-study area construction observation, or if other persons or entities are retained to provide such services, ENGEO cannot be held responsible for any or all claims arising from or resulting from the performance of such services by other persons or entities, and from any or all claims arising from or resulting from clarifications, adjustments, modifications, discrepancies or other changes necessary to reflect changed field or other conditions.

SELECTED REFERENCES

Bray, J.D. and Sancio, R.B., September 2006, Assessment of the Liquefaction Susceptibility of Fine-Grained Soils, Journal of Geotechnical and Geoenvironmental Engineering. California Building Code, 2010.

Bezore, S., Randolph-Load, C.E., Witter, R.C., 2002, Geological Map of Petaluma, California, U.S. California Geological Survey.

California Building Standards Commission, 2013 California Building Code, Volumes 1 and 2, Sacramento, Calfornia.

ENGEO, Geotechnical Exploration, Haystack Property, Petaluma, California; March 8, 2006; Project No. 6809.2.001.01.

Hart, E.W., and Bryant, W.A., 1997, Fault rupture hazard in California: Alquist-Priolo earthquake fault zoning act with index to earthquake fault zone maps: California Division of Mines and Geology Special Publication 42.

Idriss, I.M. and Boulanger, R.W., 2008, Soil Liquefaction During Earthquakes, Earthquake Engineering Research Institute, Monograph MNO-12.

Robertson, P.K., 2009, Interpretation of Cone Penetration Tests – A Unified Approach, Canadian Geotechnical Journal 2009, Vol 46, pp. 1337-1355

Seed, R.B., Cetin K.O., Moss R.E.S., Kammerer A.M., Wu J., Pestana J.M., Riemer M.F., Sancio R.B., Bray J.D., Kayen R.E., Faris A., 2003, Recent Advances in Soil Liquefaction Engineering A unified and Consistent Framework, 26th Annual ASCE Los Angeles Geotechnical Spring Seminar.

SEAOC, 1996, Recommended Lateral Force Requirements and Commentary.

United States Geologic Survey (USGS); 2008, National Seismic Hazard Maps Fault Parameters.

Working Group on California Earthquake Probabilities, 2013, The Uniform California Earthquake Rupture Forecast, Version 3 UCERF 3, USGS Open File Report 2013.

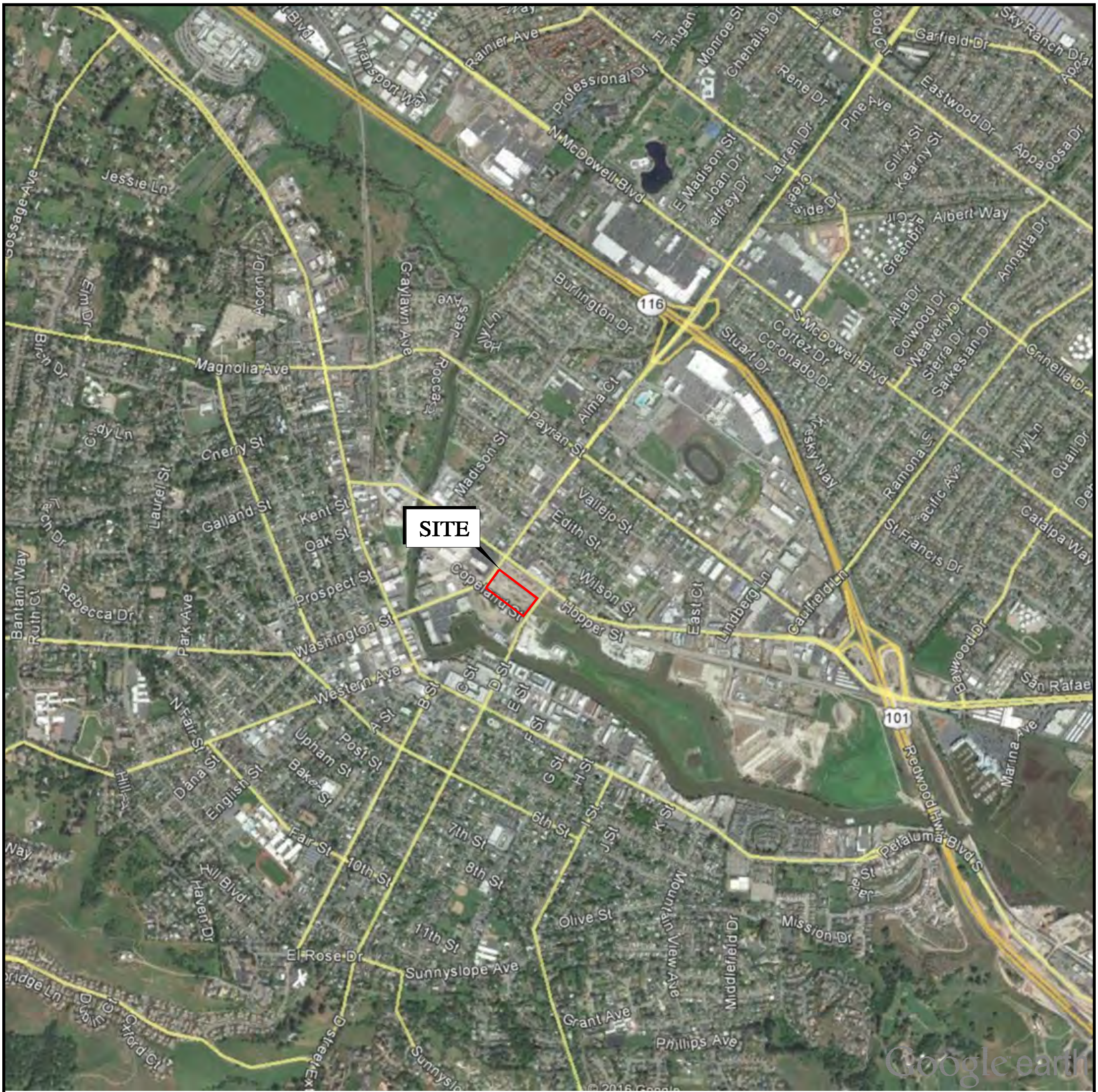
Youd, T.L. and Garris, C.T., 1995, Liquefaction-Induced Ground-Surface Disruption, Journal of Geotechnical Engineering, American Society of Civil Engineers, Vol. 121, No. 11, November, pp. 805-809.

Zhang, G., Robertson, P.K., and Brachman, R.W.I., 2002, Estimating Liquefaction-Induced Ground Settlements from CPT for Level Ground, Can. Geotech. J. 39, 1168-1180.

FIGURES

Figure 1 - Vicinity Map
Figure 2 - Site Plan
Figure 3 - Regional Geologic Map
Figure 4 – Liquefaction Susceptibility Map
Figure 5 – Regional Faulting and Seismicity

FIGURES



0 FEET 2000

0 METERS 1000

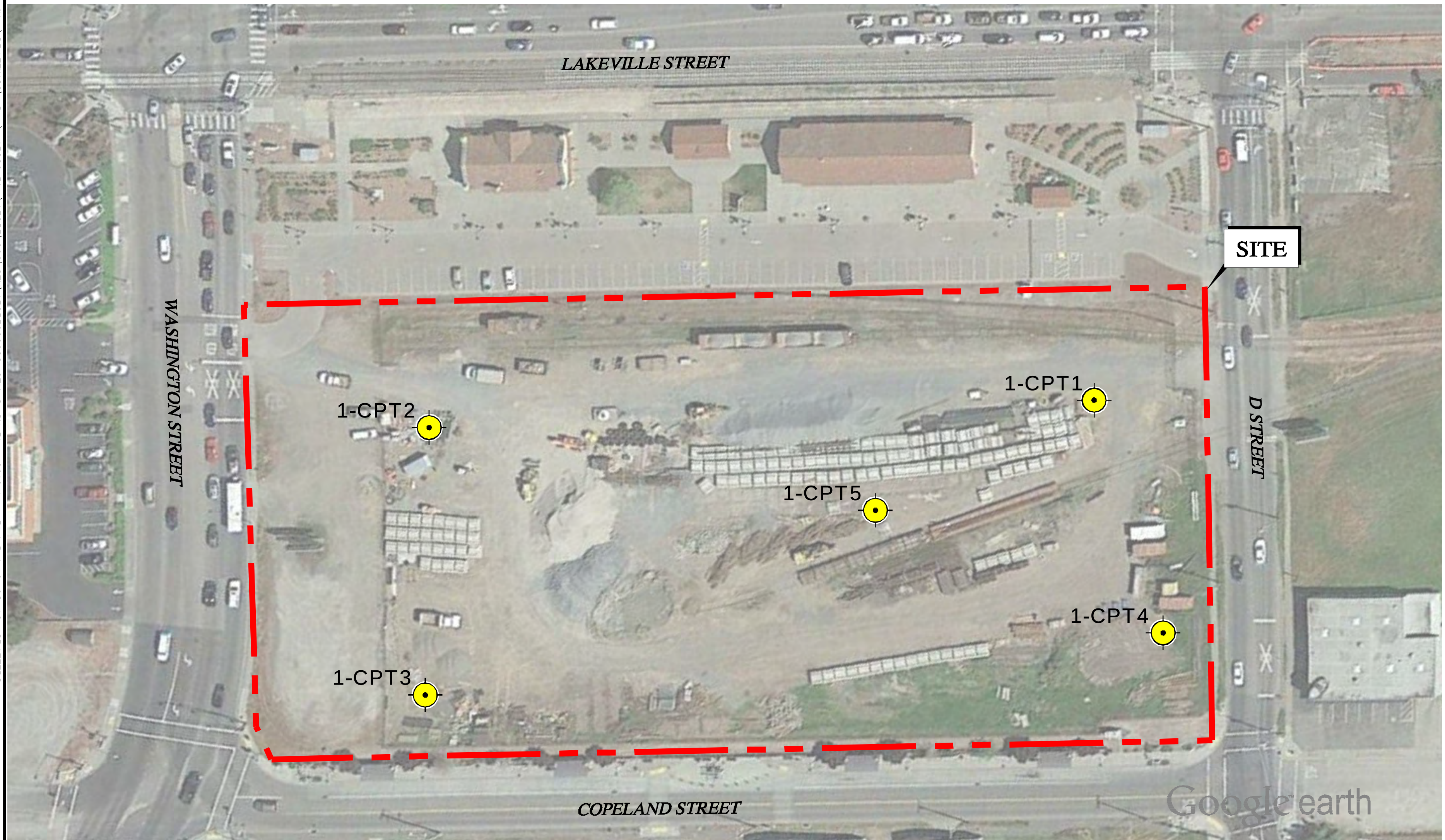
BASE MAP SOURCE: GOOGLE EARTH MAPPING SERVICE

ENGEO Expect Excellence	VICINITY MAP 315 D STREET PETALUMA, CALIFORNIA	PROJECT NO.: 13253.000.000		FIGURE NO. 1
		SCALE: AS SHOWN		
		DRAWN BY: SRP	CHECKED BY: LC	

G:\Drafting\DRAFTING2_Dwg_13000 Plus\13253\000\GEX\13253000000-GEX-1-VicinityMap-0916.dwg Plot Date: 9-08-16 SPATTERS

ORIGINAL FIGURE PRINTED IN COLOR

G:\Drafting\DRAFTING2_Dwg_13000 Plus\13253\000\GEX\13253000000-GEX-2-SitePlan-0916.dwg Plot Date:9-08-16 SPATTERS



EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

1-CPT5 — CONE PENETRATION TEST (ENGEO, 2016)

N

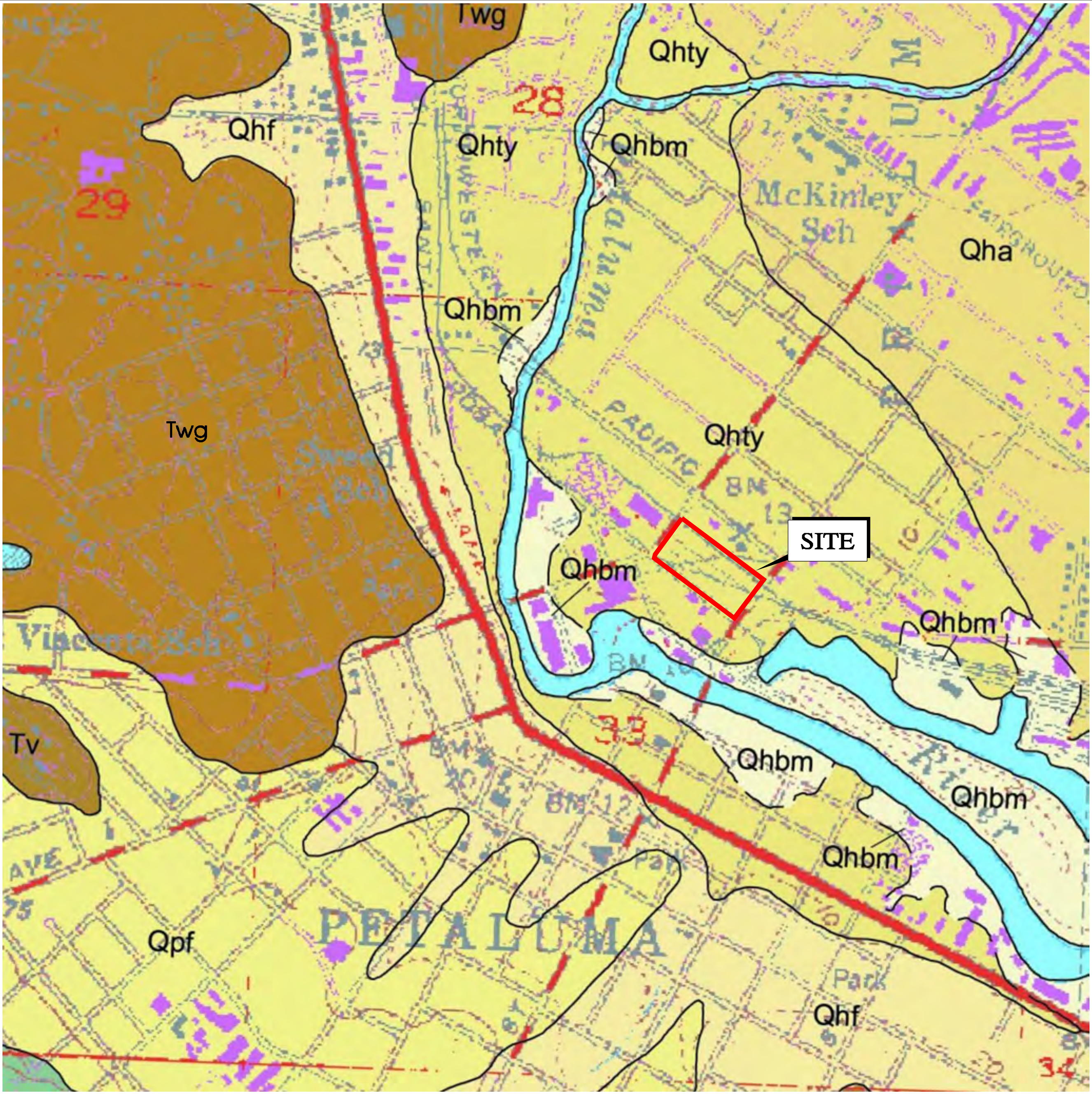
0 FEET 100

0 METERS 50

BASE MAP SOURCE: GOOGLE EARTH MAPPING SERVICE

ENGEO Expect Excellence	SITE PLAN 315 D STREET PETALUMA, CALIFORNIA	PROJECT NO.: 13253.000.000 SCALE: AS SHOWN DRAWN BY: SRP CHECKED BY: LC	FIGURE NO. 2

ORIGINAL FIGURE PRINTED IN COLOR



EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

Qhbm	HOLOCENE ESTUARINE DEPOSITS (COMPRESSIBLE CLAY DEPOSIT)
Qhf	HOLOCENE FAN DEPOSITS
Qhty	HOLOCENE TERRACE DEPOSITS
Qpf	LATE PLEISTOCENE FAN DEPOSITS
Twg	WILSON GROVE FORMATION

N

0 FEET 1000

0 METERS 500

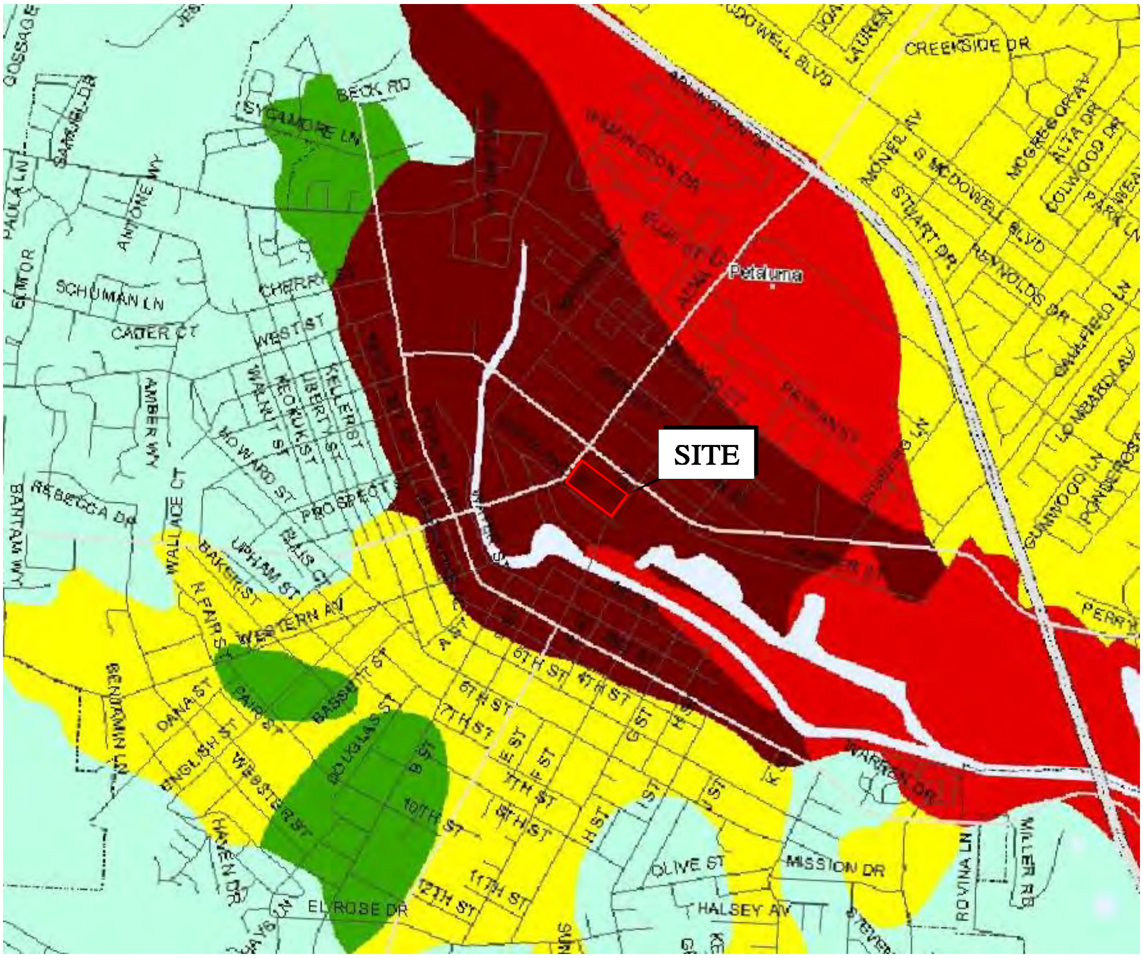
BASE MAP SOURCE: BEZORE, 2002

ENGEO Expect Excellence

REGIONAL GEOLOGIC MAP	PROJECT NO.: 13253.000.000		FIGURE NO.
315 D STREET	SCALE: AS SHOWN		3
PETALUMA, CALIFORNIA	DRAWN BY: SRP	CHECKED BY: LC	

G:\Drafting\DRAFTING2_Dwg_13000 Plus\13253\000\GEX\13253000000-GEX-3-GeoligicMap-0916.dwg Plot Date: 9-08-16 SPATTERS

ORIGINAL FIGURE PRINTED IN COLOR



EXPLANATION

Liquefaction Susceptibility

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

N

0 FEET 2000

0 METERS 1000

BASE MAP SOURCE: ABAG, 2000

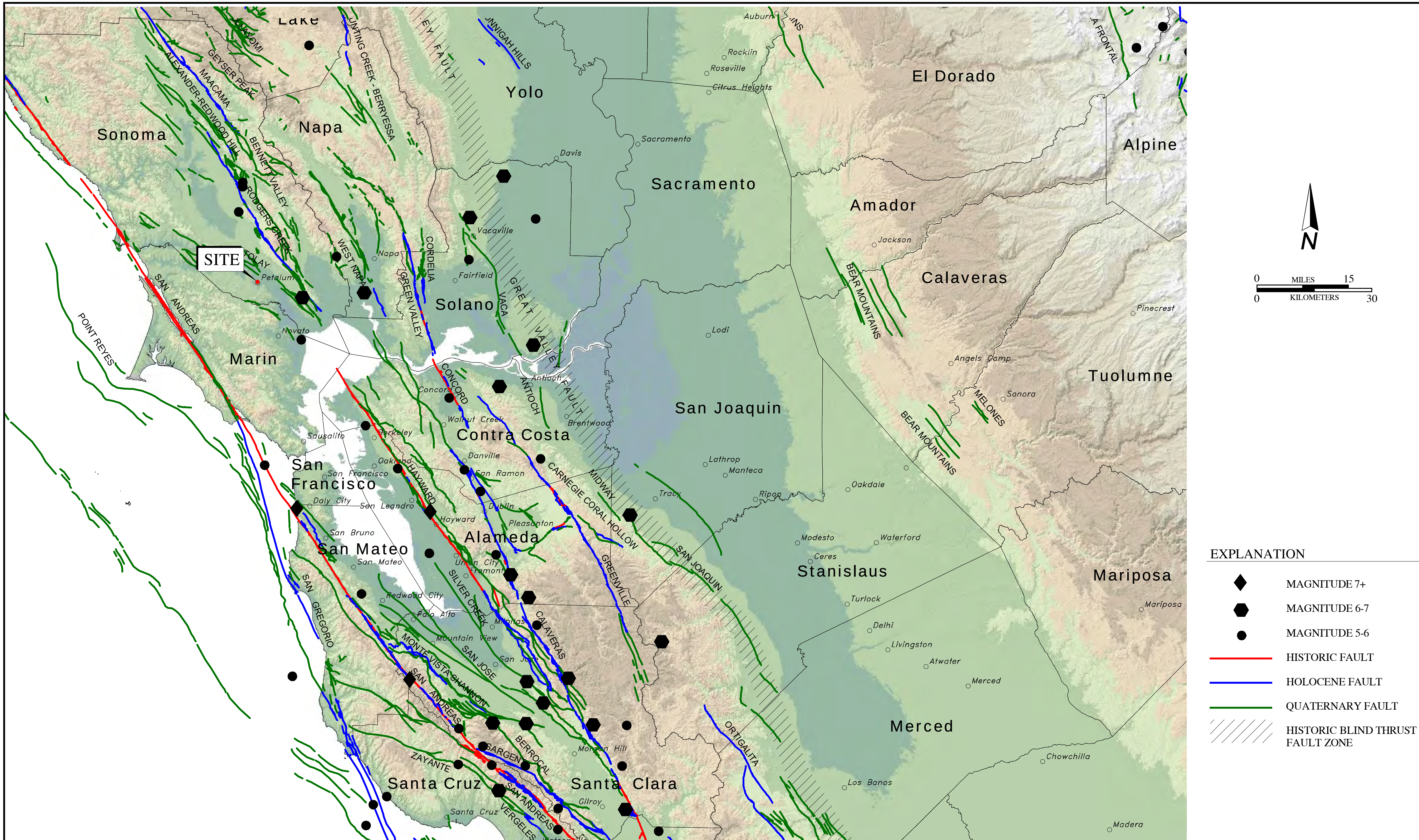
ENGEO
Expect Excellence

LIQUEFACTION SUSCEPTIBILITY MAP
315 D STREET
PETALUMA, CALIFORNIA

PROJECT NO.: 13253.000.000		FIGURE NO.
SCALE: AS SHOWN		4
DRAWN BY: SRP	CHECKED BY: LC	

G:\Drafting\DRAFTING2_Dwg_13000 Plus\13253\000\GEX\13253000000-GEX-4-SeismicHazardZonesMap-0916.dwg Plot Date: 9-08-16 SPATTERS

ORIGINAL FIGURE PRINTED IN COLOR



BASE MAP SOURCE:
COLOR HILLSHADE IMAGE BASED ON THE NATIONAL ELEVATION DATASET (NED) AT 30 METER RESOLUTION
U.S.G.S. QUATERNARY FAULT DATABASE, NOVEMBER, 2010
U.S.G.S. HISTORIC EARTHQUAKE DATABASE (1800–2000)

ENGEO
Expect Excellence

REGIONAL FAULTING AND SEISMICITY
315 D STREET
PETALUMA, CALIFORNIA

PROJECT NO.: 13253.000.000		FIGURE NO
SCALE: AS SHOWN		5
DRAWN BY: SRP	CHECKED BY: LC	

G:\Drafting\DRAFTING2_Dwg_13000 Plus\13253\000\GEX\13253000000-GEX-5-FaultMap-0916.dwg Plot Date: 9-07-16 SPATTERS

ORIGINAL FIGURE PRINTED IN COLOR

APPENDIX A

Middle Earth Geo Testing
Cone Penetration Test (CPT) Logs

APPENDIX A

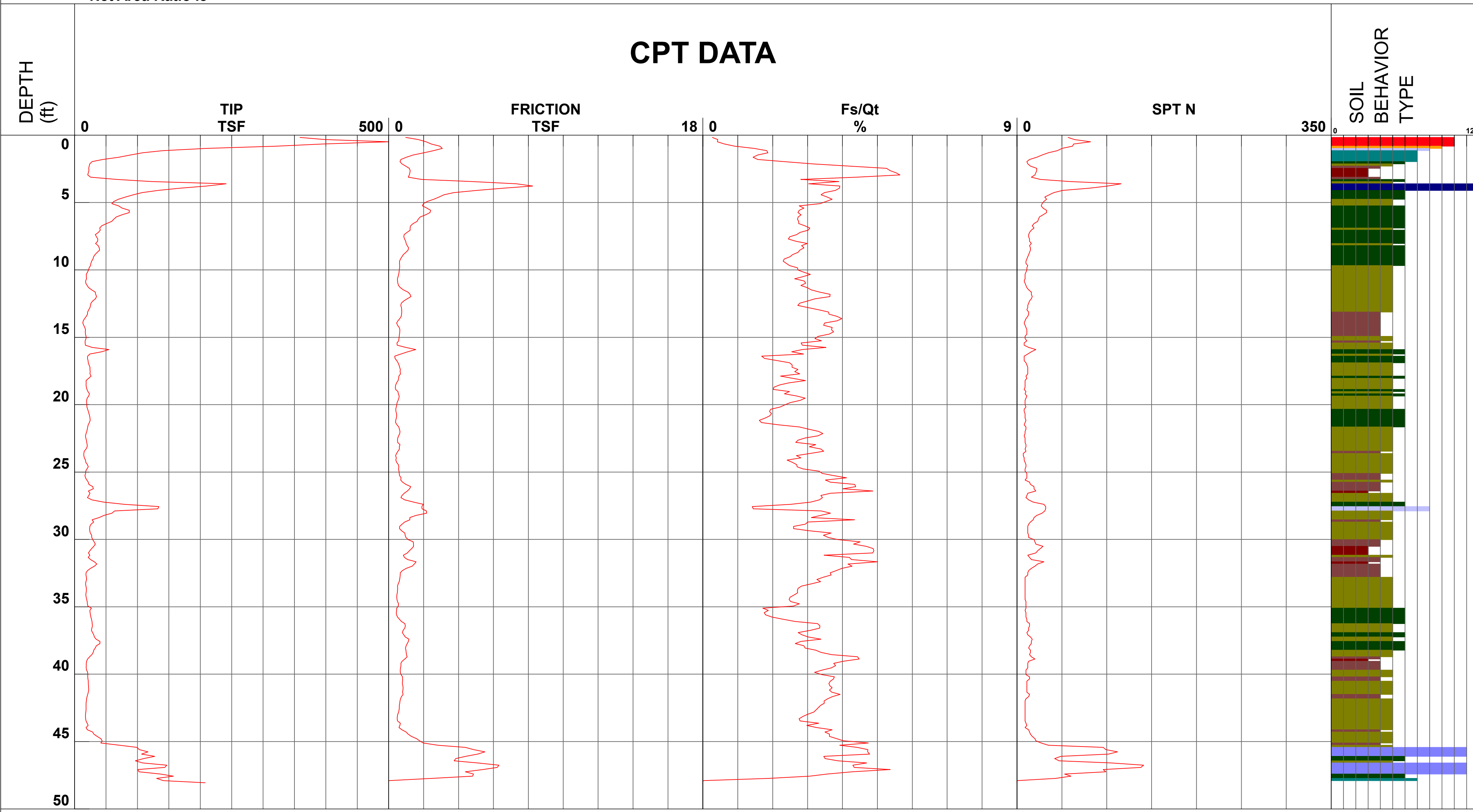
Engeo Inc

Middle Earth Geo Testing Inc.

Project	Petaluma Station Mix Use Development	Operator	JH-KK	Filename	SDF(030).cpt
Job Number	13253.000.000	Cone Number	DDG1333	GPS	
Hole Number	1CPT-1	Date and Time	8/25/2016 9:19:36 AM	Maximum Depth	48.06 ft
EST GW Depth During Test		9.40 ft			

Net Area Ratio .8

CPT DATA



1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

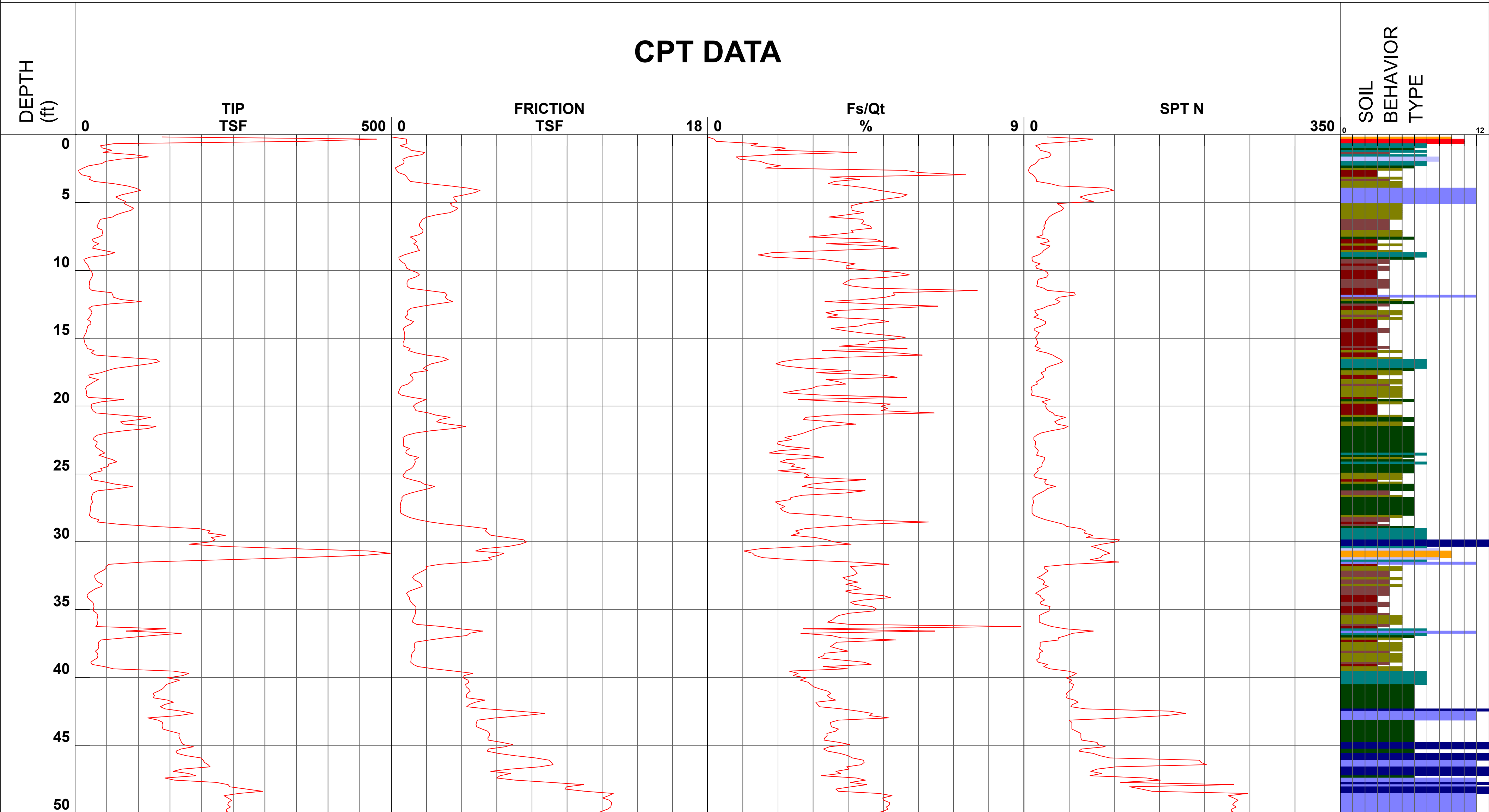
Cone Size 10cm squared

S*Soil behavior type and SPT based on data from UBC-1983

Engeo Inc

Project	Petaluma Station Mix Use Development	Operator	JH-KK	Filename	SDF(004).cpt
Job Number	13253.000.000	Cone Number	DDG1333	GPS	
Hole Number	1CPT-2	Date and Time	8/25/2016 1:27:57 PM	Maximum Depth	50.52 ft
EST GW Depth During Test		6.70 ft			

Net Area Ratio .8



1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Cone Size 10cm squared

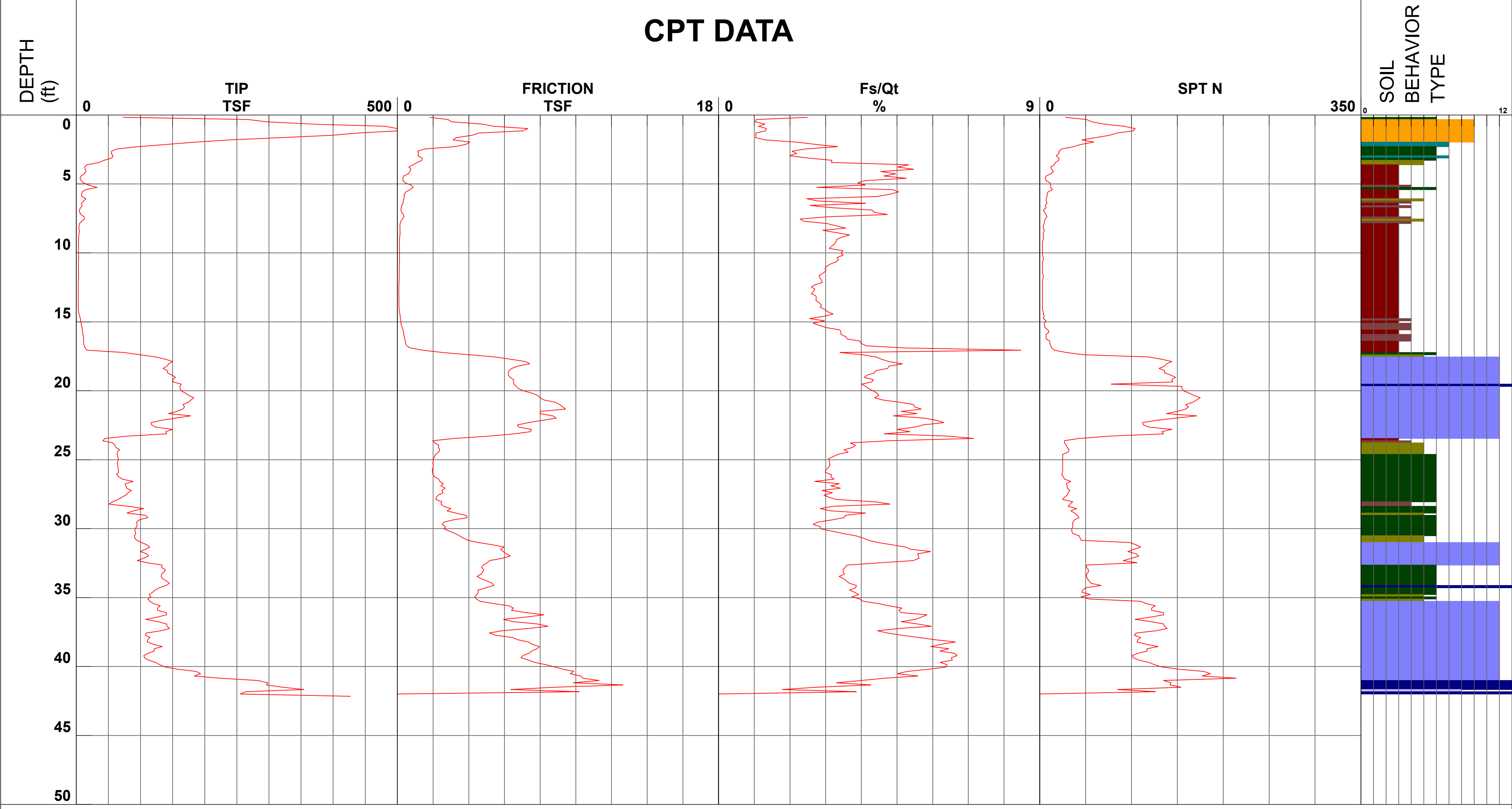
S*Soil behavior type and SPT based on data from UBC-1983

Engeo Inc

Project	Petaluma Station Mix Use Development	Operator	JH-KK	Filename	SDF(034).cpt
Job Number	13253.000.000	Cone Number	DDG1333	GPS	
Hole Number	1CPT-3	Date and Time	8/25/2016 12:31:16 PM	Maximum Depth	42.16 ft
EST GW Depth During Test			7.00 ft		

Net Area Ratio .8

CPT DATA



1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

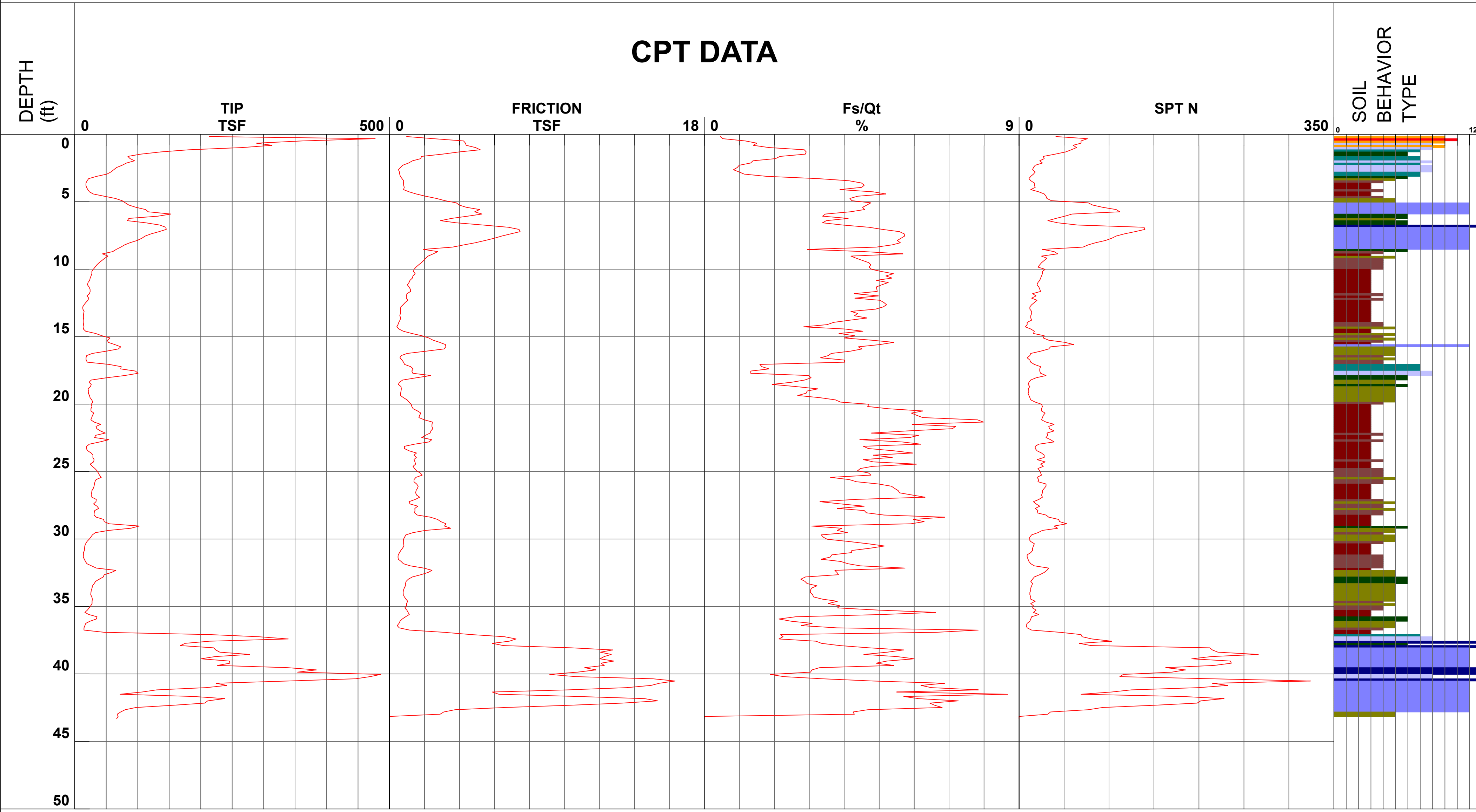
Cone Size 10cm squared

S*Soil behavior type and SPT based on data from UBC-1983

Engeo Inc

Project	Petaluma Station Mix Use Development	Operator	JH-KK	Filename	SDF(033).cpt
Job Number	13253.000.000	Cone Number	DDG1333	GPS	
Hole Number	1CPT-4	Date and Time	8/25/2016 11:32:20 AM	Maximum Depth	43.31 ft
EST GW Depth During Test		6.90 ft			

Net Area Ratio .8



- 1 - sensitive fine grained
- 2 - organic material
- 3 - clay
- 4 - silty clay to clay
- 5 - clayey silt to silty clay
- 6 - sandy silt to clayey silt
- 7 - silty sand to sandy silt
- 8 - sand to silty sand
- 9 - sand
- 10 - gravelly sand to sand
- 11 - very stiff fine grained (*)
- 12 - sand to clayey sand (*)

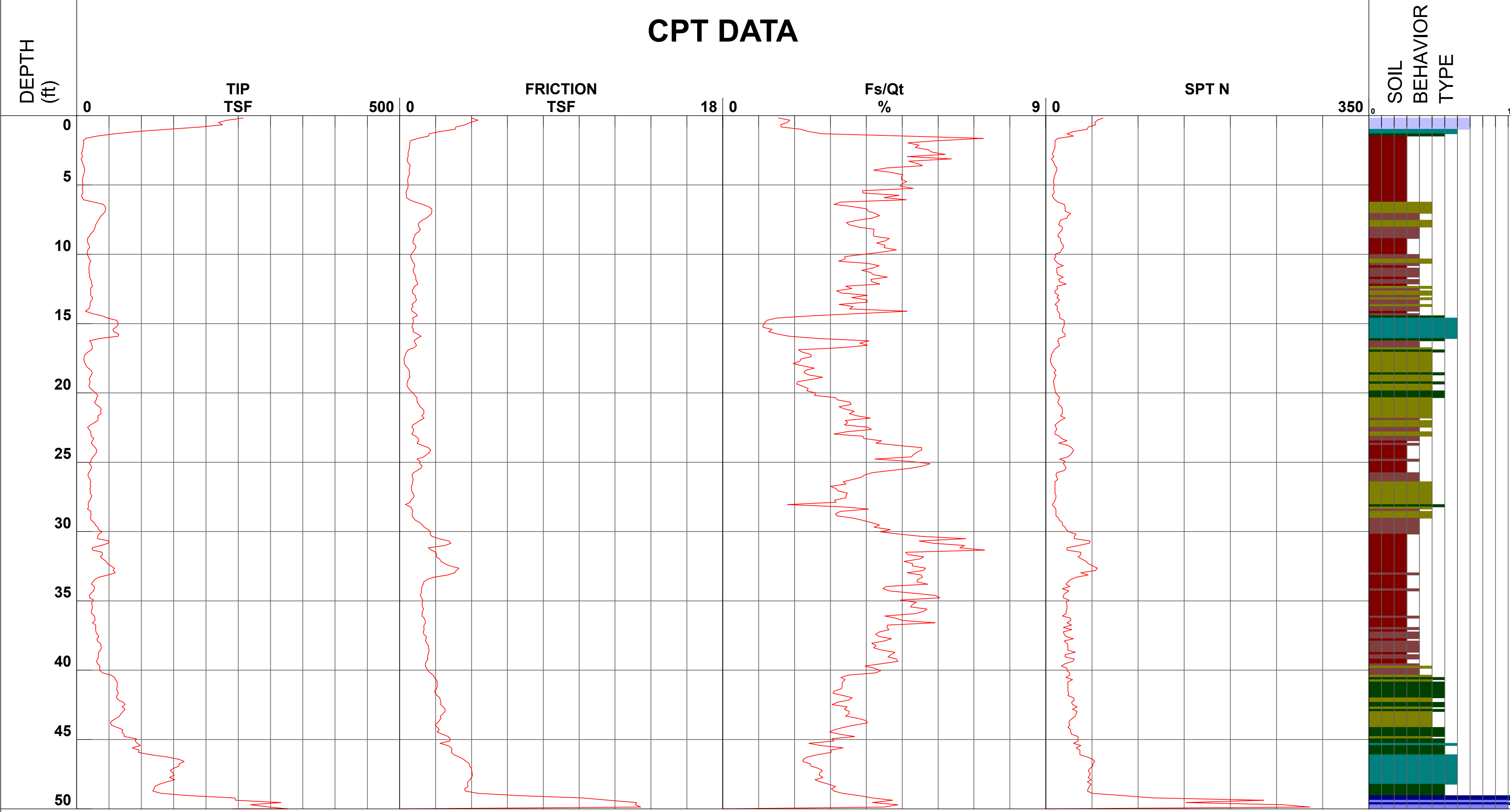
Cone Size 10cm squared

S*Soil behavior type and SPT based on data from UBC-1983

Engeo Inc

Project	Petaluma Station Mix Use Development	Operator	JH-KK	Filename	SDF(005).cpt
Job Number	13253.000.000	Cone Number	DDG1333	GPS	
Hole Number	1CPT-5	Date and Time	8/25/2016 2:14:26 PM	Maximum Depth	50.20 ft
EST GW Depth During Test			7.00 ft		

Net Area Ratio .8



1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Cone Size 10cm squared

S*Soil behavior type and SPT based on data from UBC-1983

APPENDIX B

CLiq Preliminary Liquefaction Analysis

APPENDIX B

ENGEO
Expect Excellence

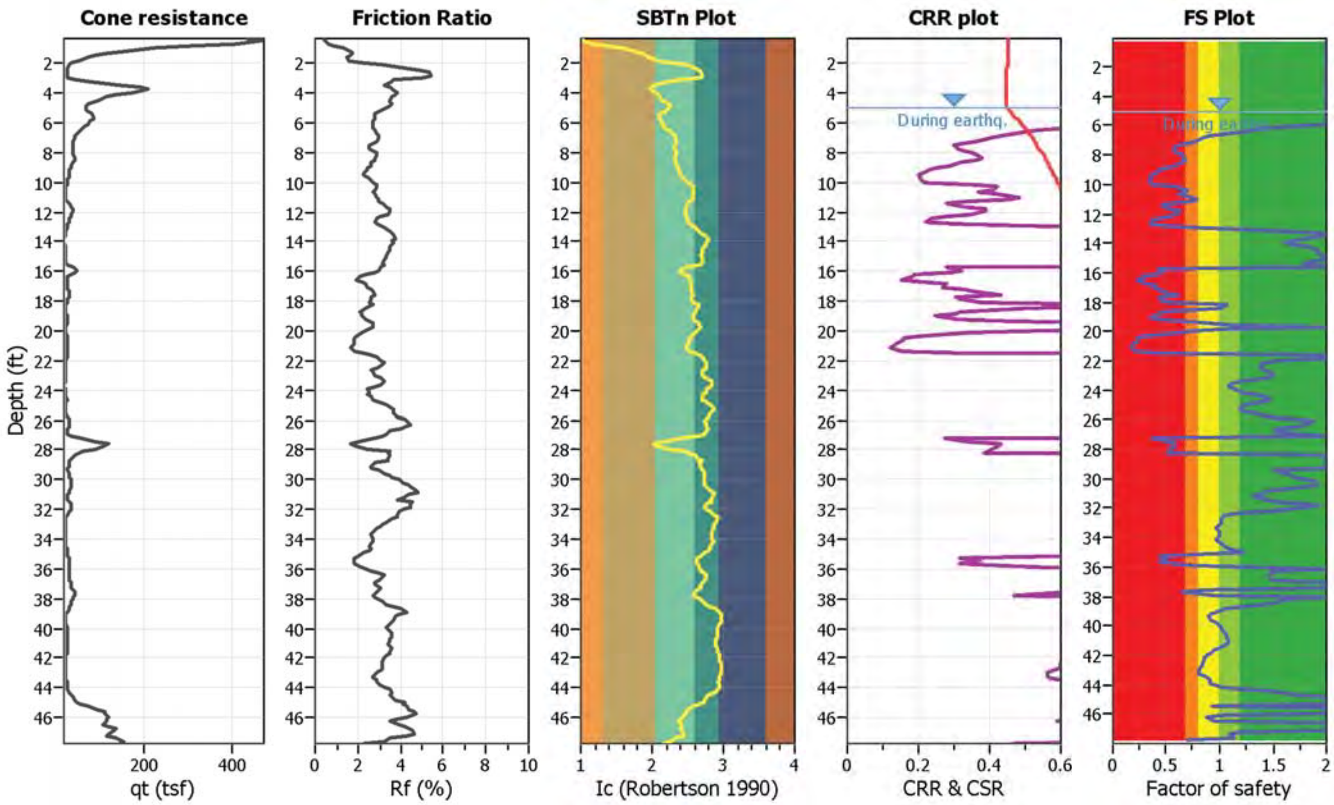
LIQUEFACTION ANALYSIS REPORT

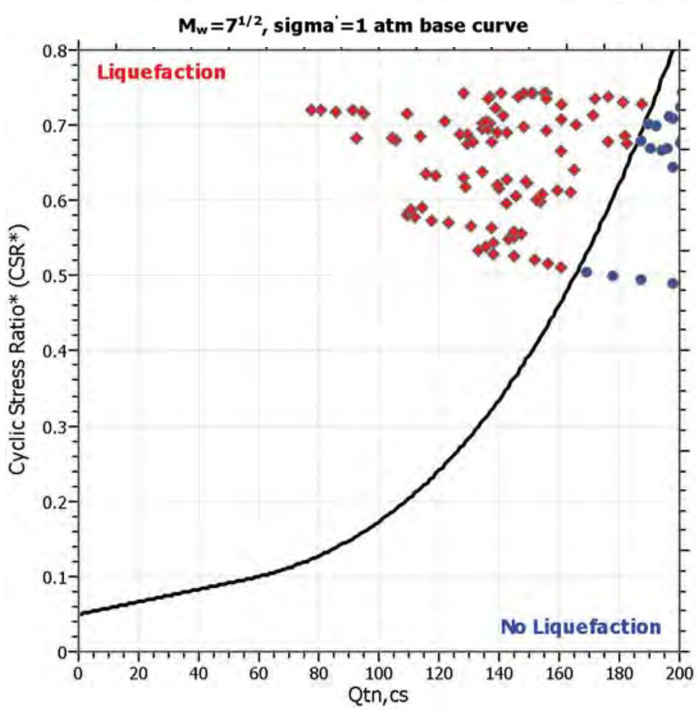
Project title : 315 D Street **Location : Petaluma, California**

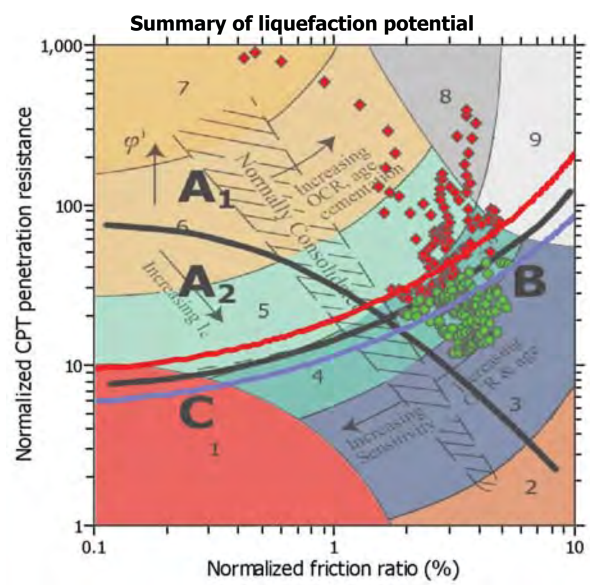
CPT file : 1-CPT1

Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	5.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	5.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.94	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.60	Unit weight calculation:	Based on SBT	K_σ applied:	No		

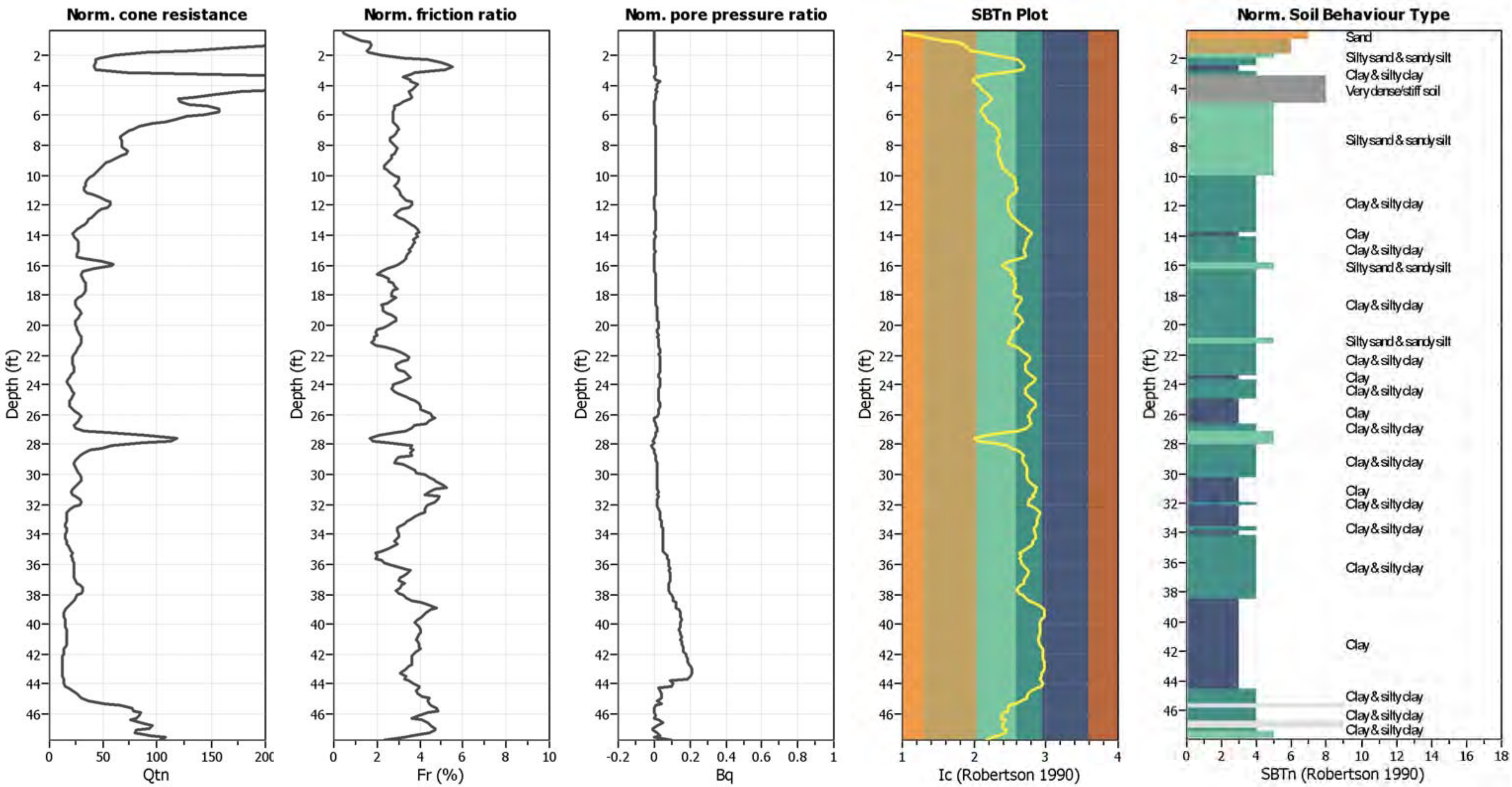






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots (normalized)



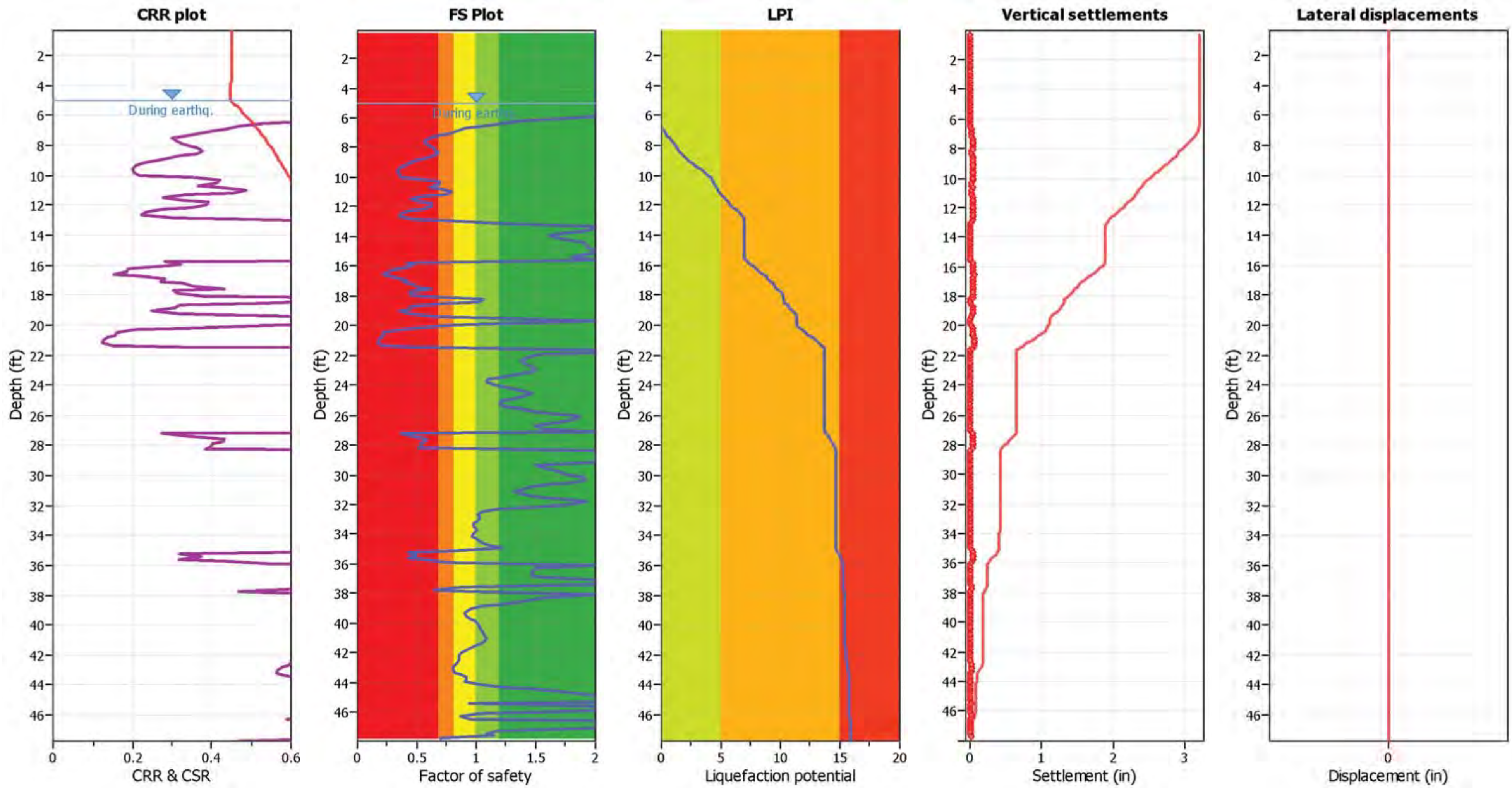
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_{σ} applied:	No
Earthquake magnitude M_w:	7.94	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.60	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.94	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.60	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

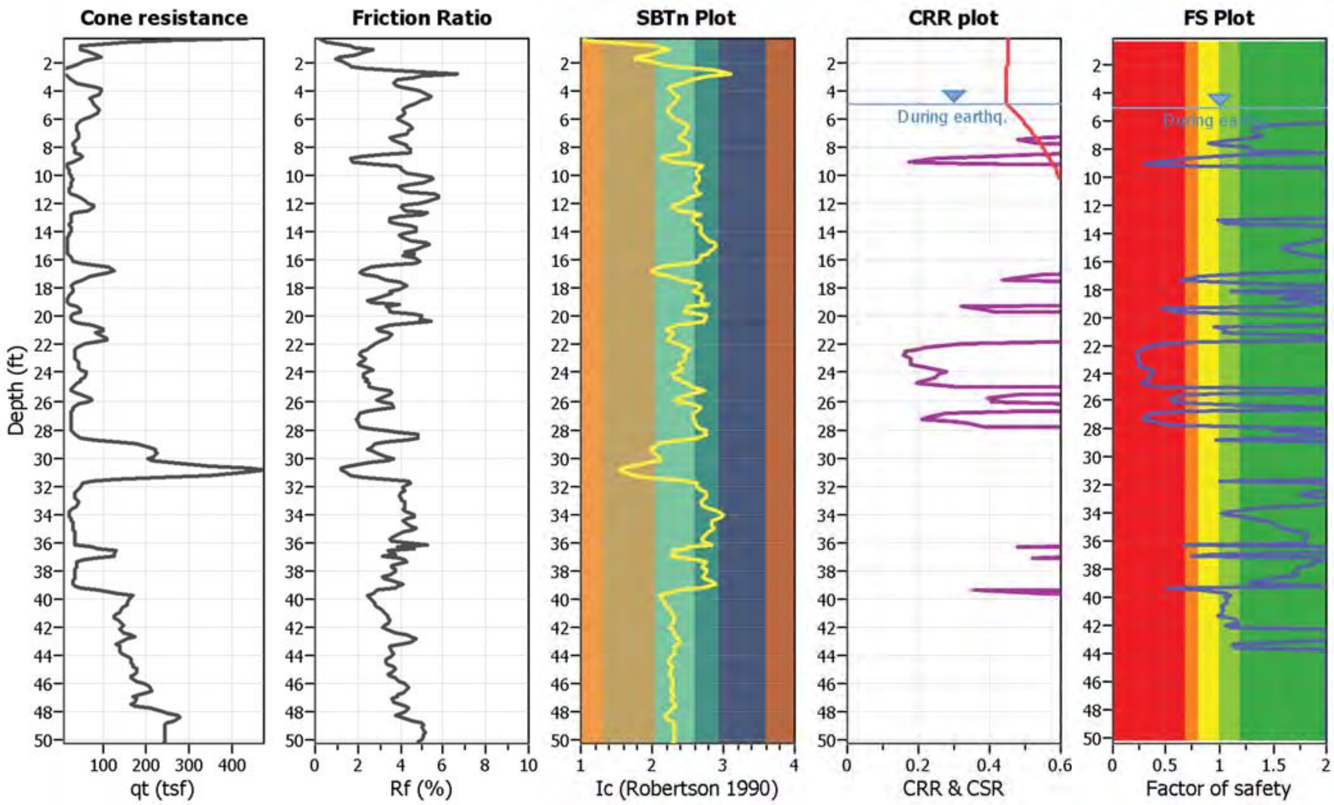
LIQUEFACTION ANALYSIS REPORT

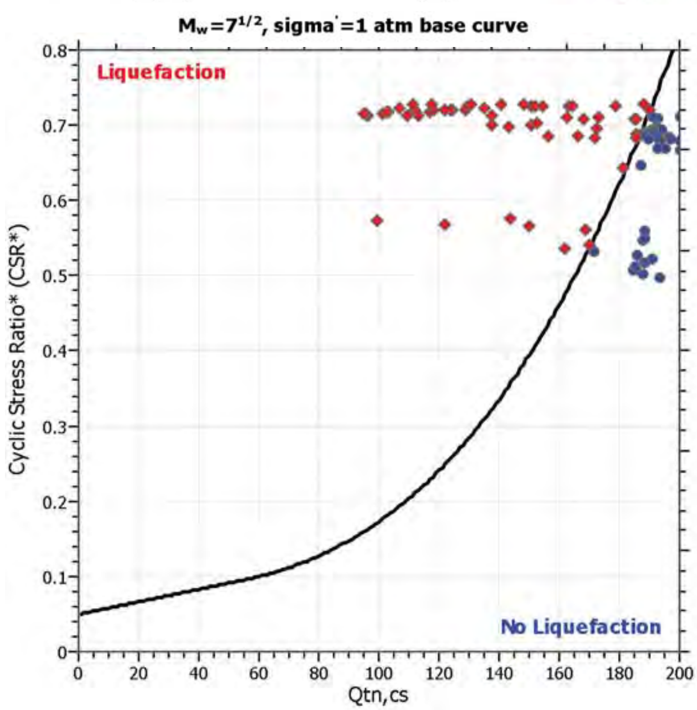
Project title : 315 D Street **Location : Petaluma, California**

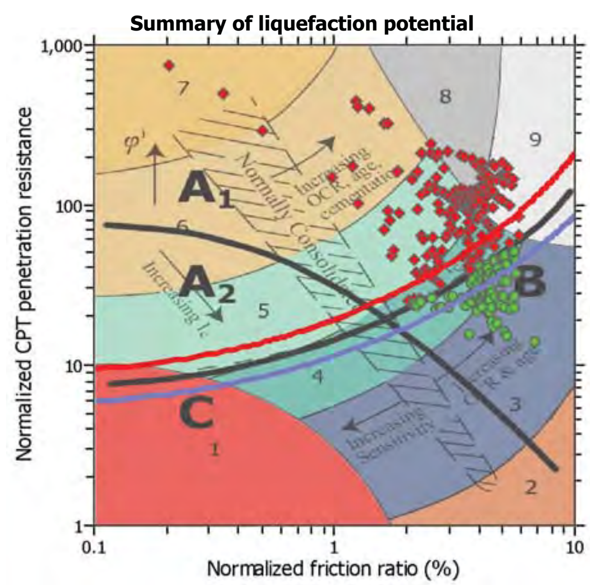
CPT file : 1-CPT2

Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	5.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	5.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.94	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.60	Unit weight calculation:	Based on SBT	K_σ applied:	No		

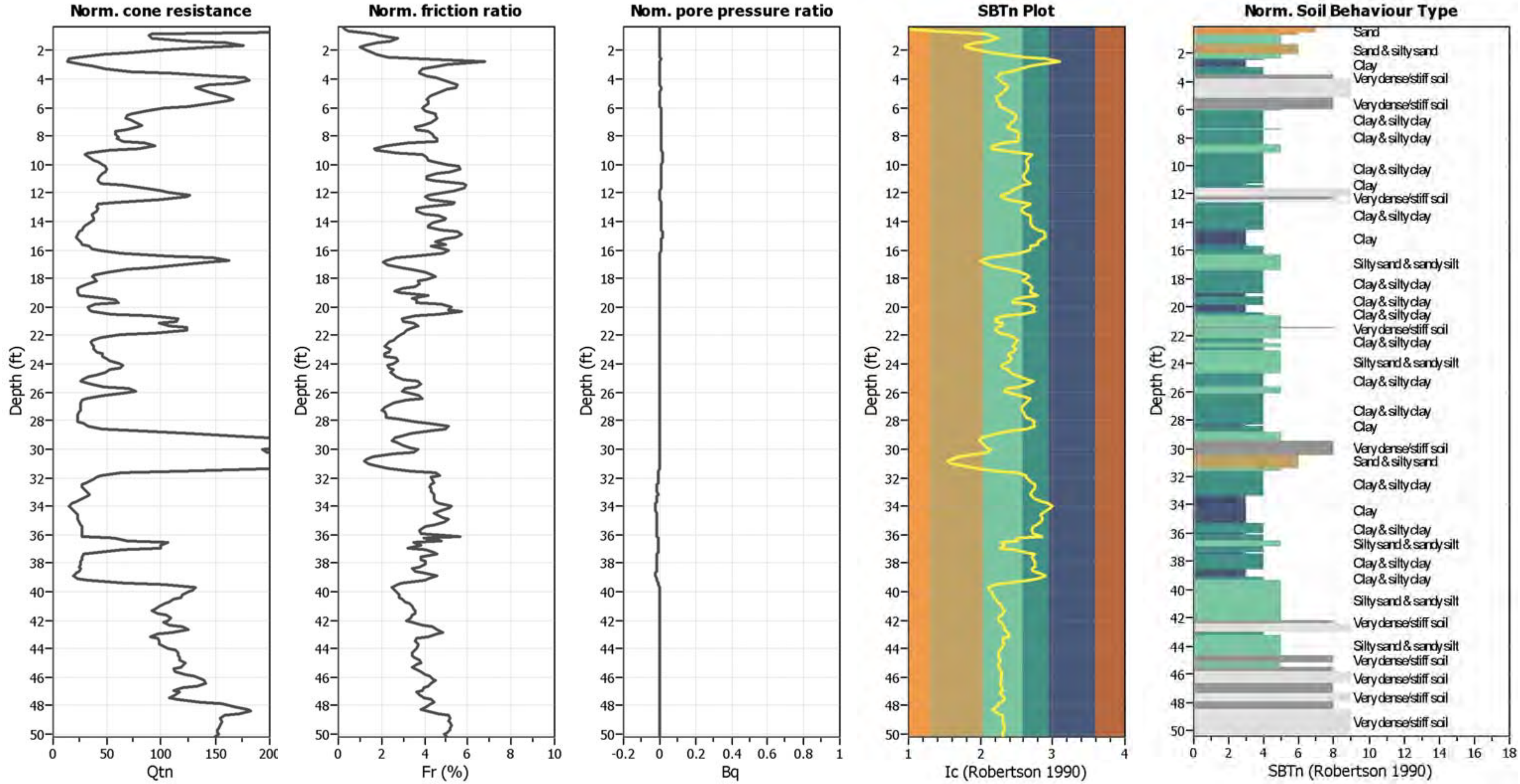






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots (normalized)



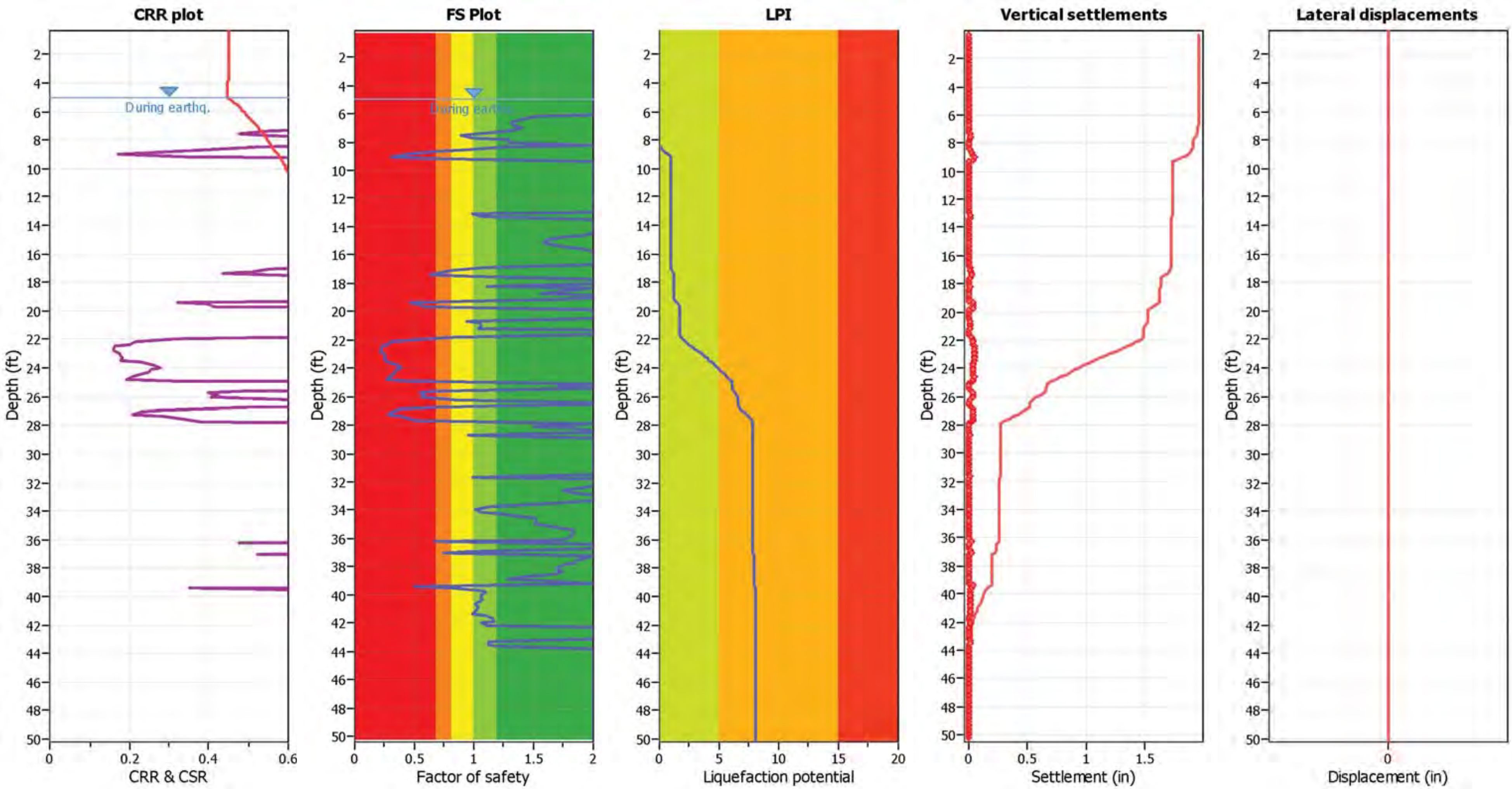
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.94	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.60	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.94	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.60	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

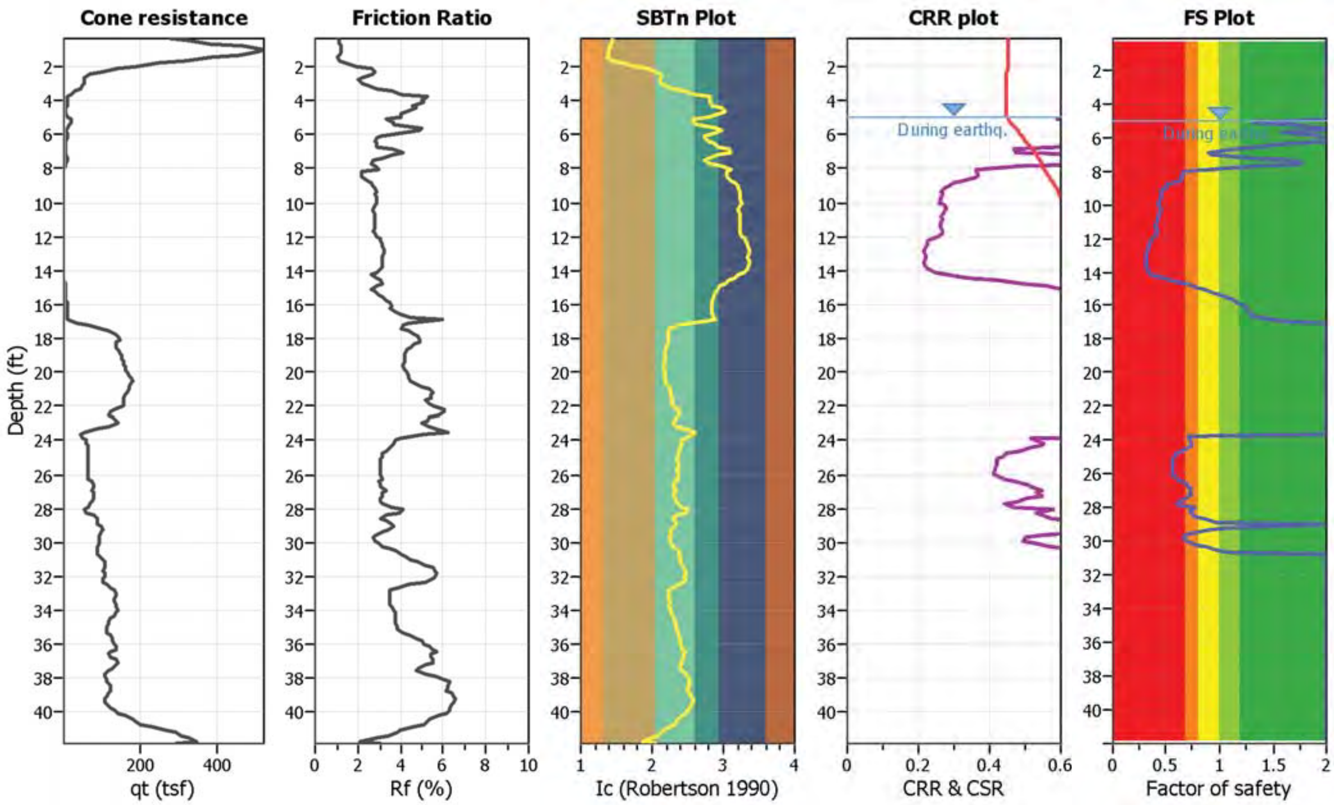
LIQUEFACTION ANALYSIS REPORT

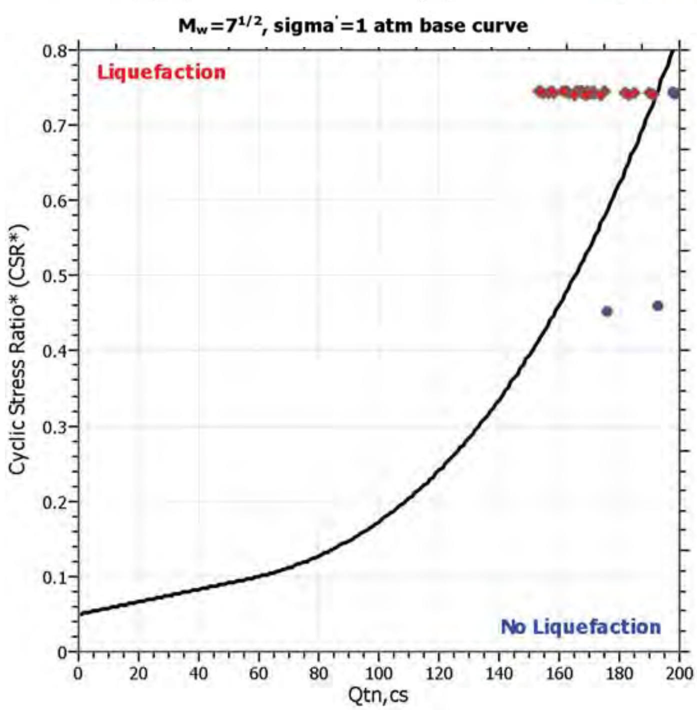
Project title : 315 D Street **Location : Petaluma, California**

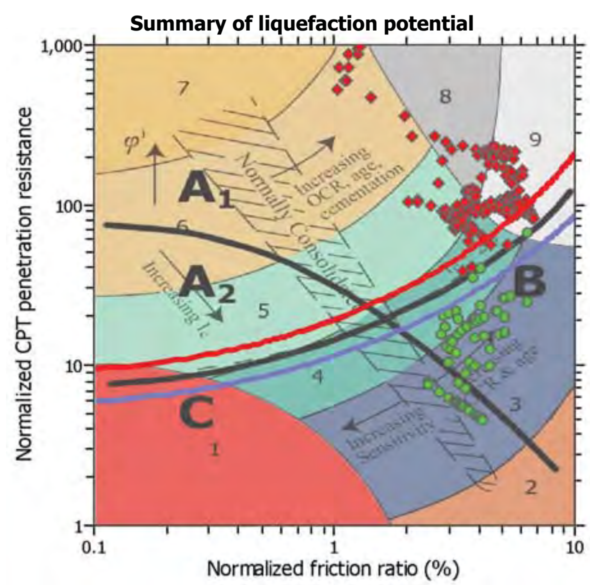
CPT file : 1-CPT3

Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	5.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	5.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.94	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.60	Unit weight calculation:	Based on SBT	K_σ applied:	No		

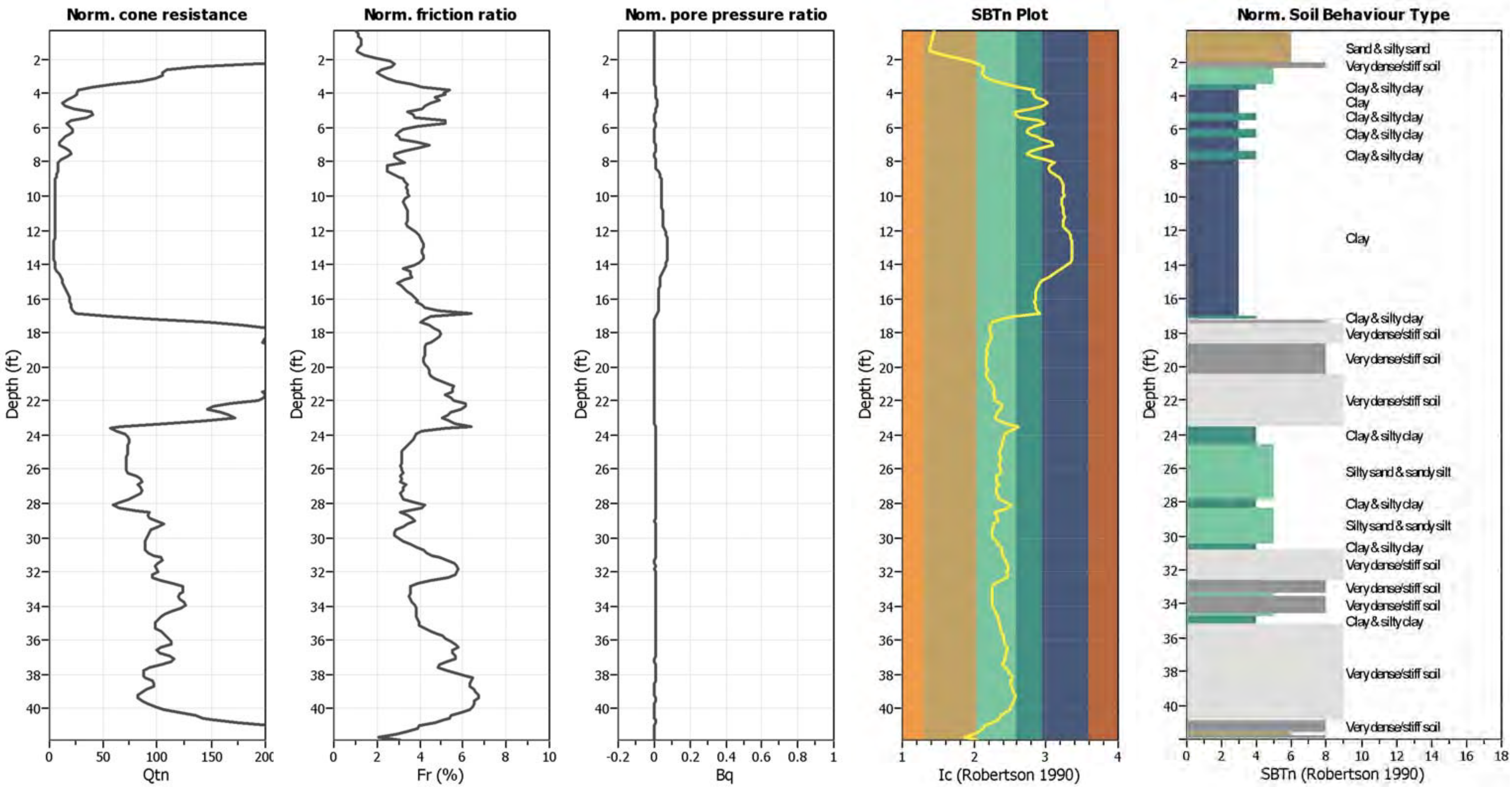






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots (normalized)



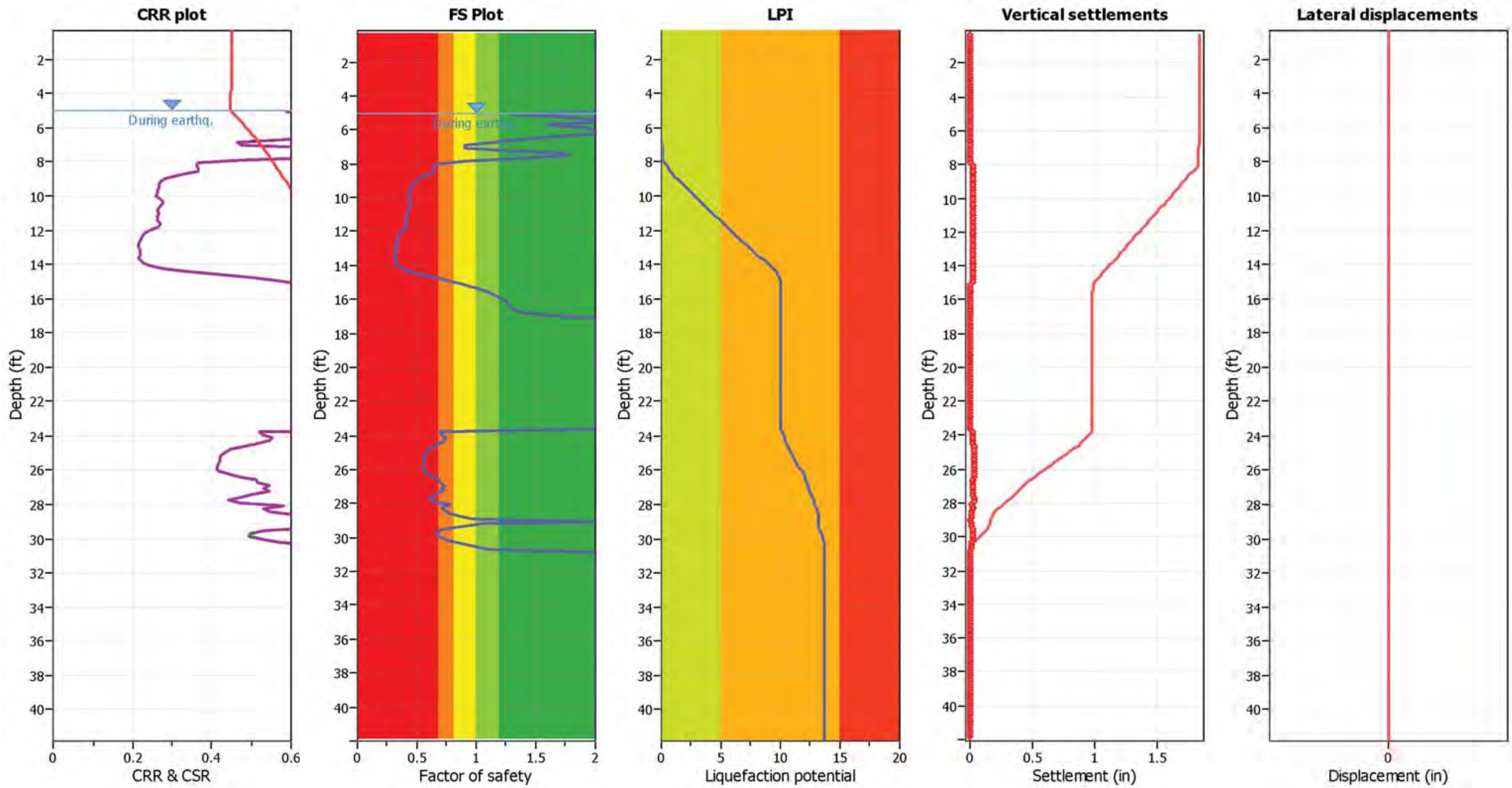
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.94	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.60	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.94	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.60	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

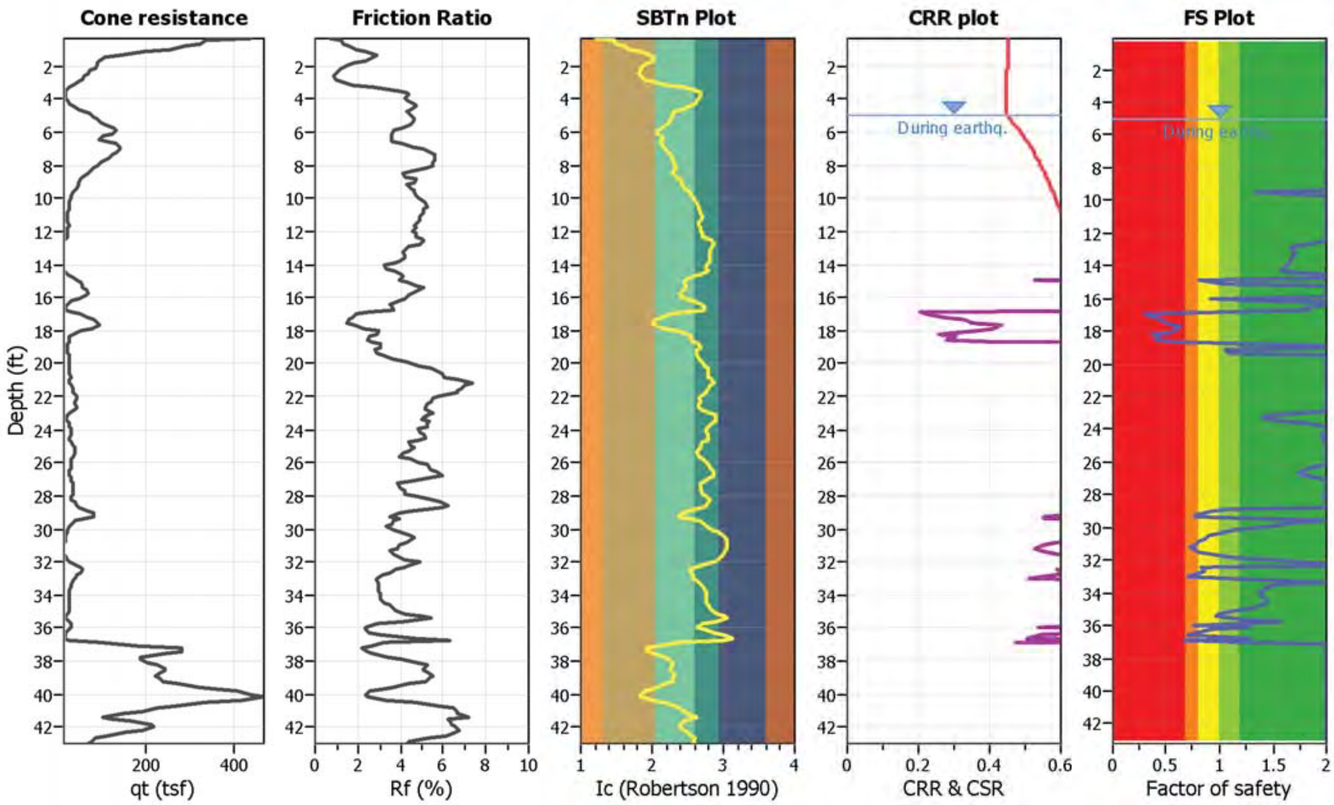
LIQUEFACTION ANALYSIS REPORT

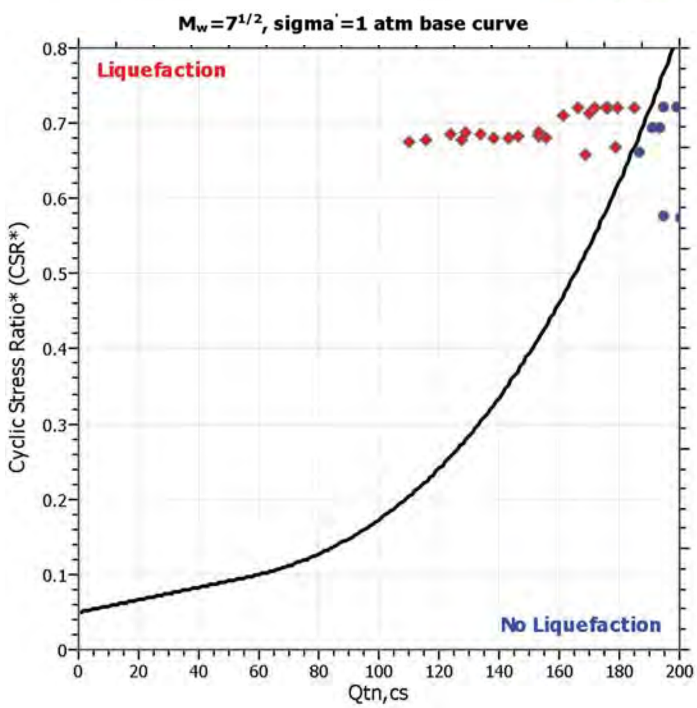
Project title : 315 D Street **Location : Petaluma, California**

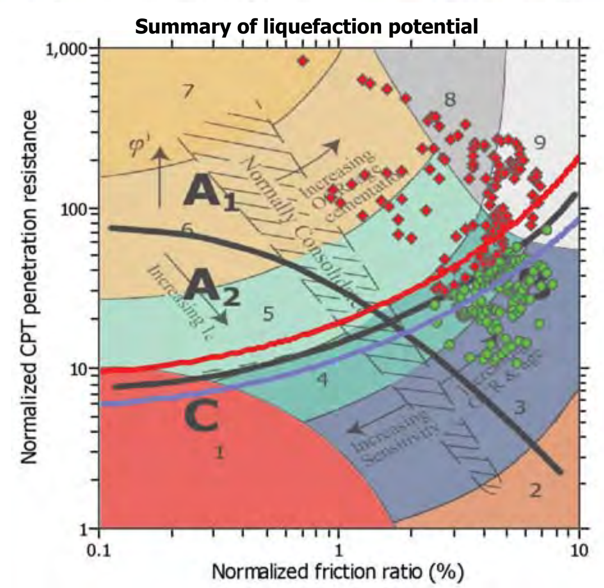
CPT file : 1-CPT4

Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	5.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	5.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.94	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.60	Unit weight calculation:	Based on SBT	K_σ applied:	No		

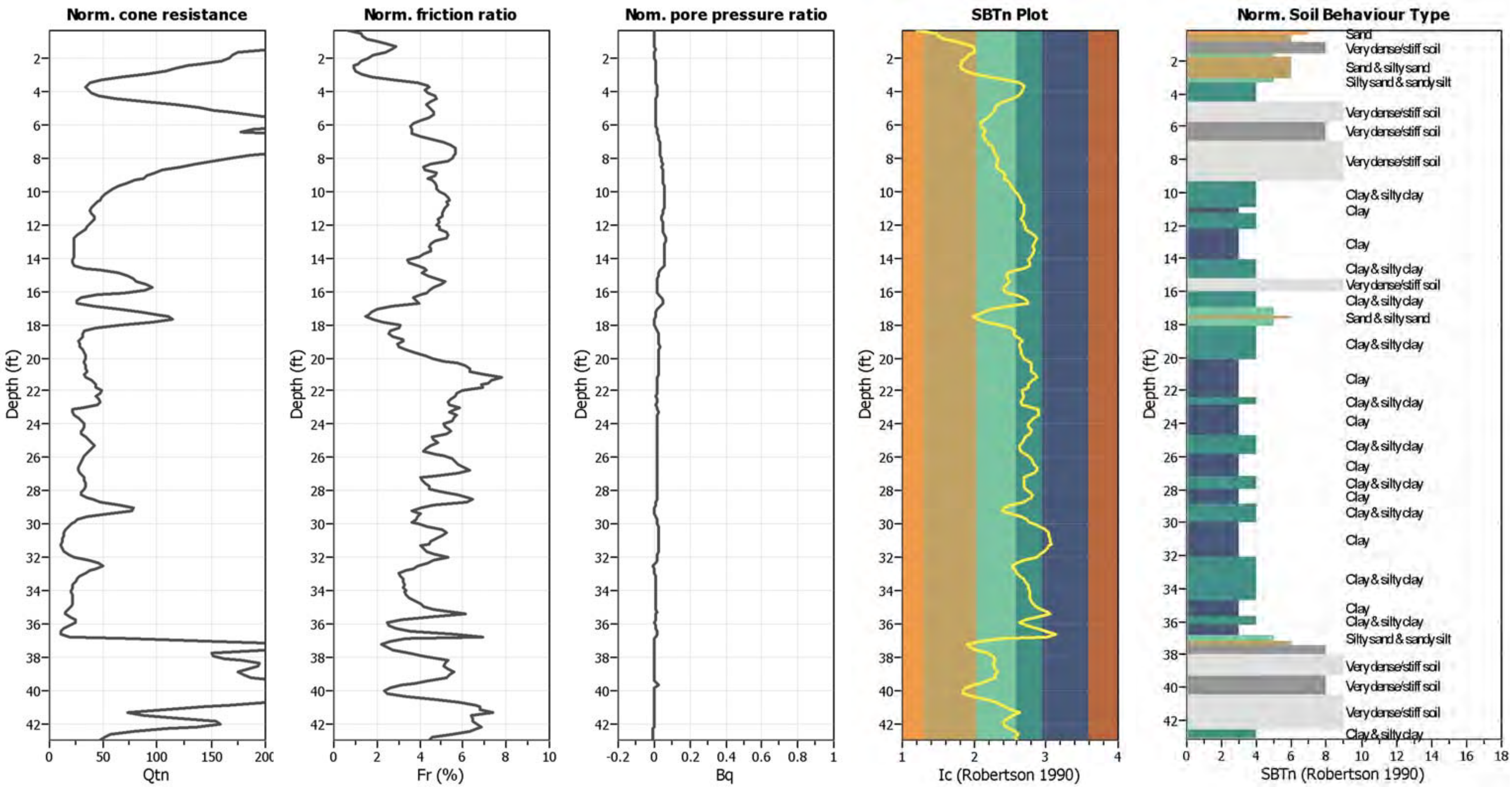






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots (normalized)



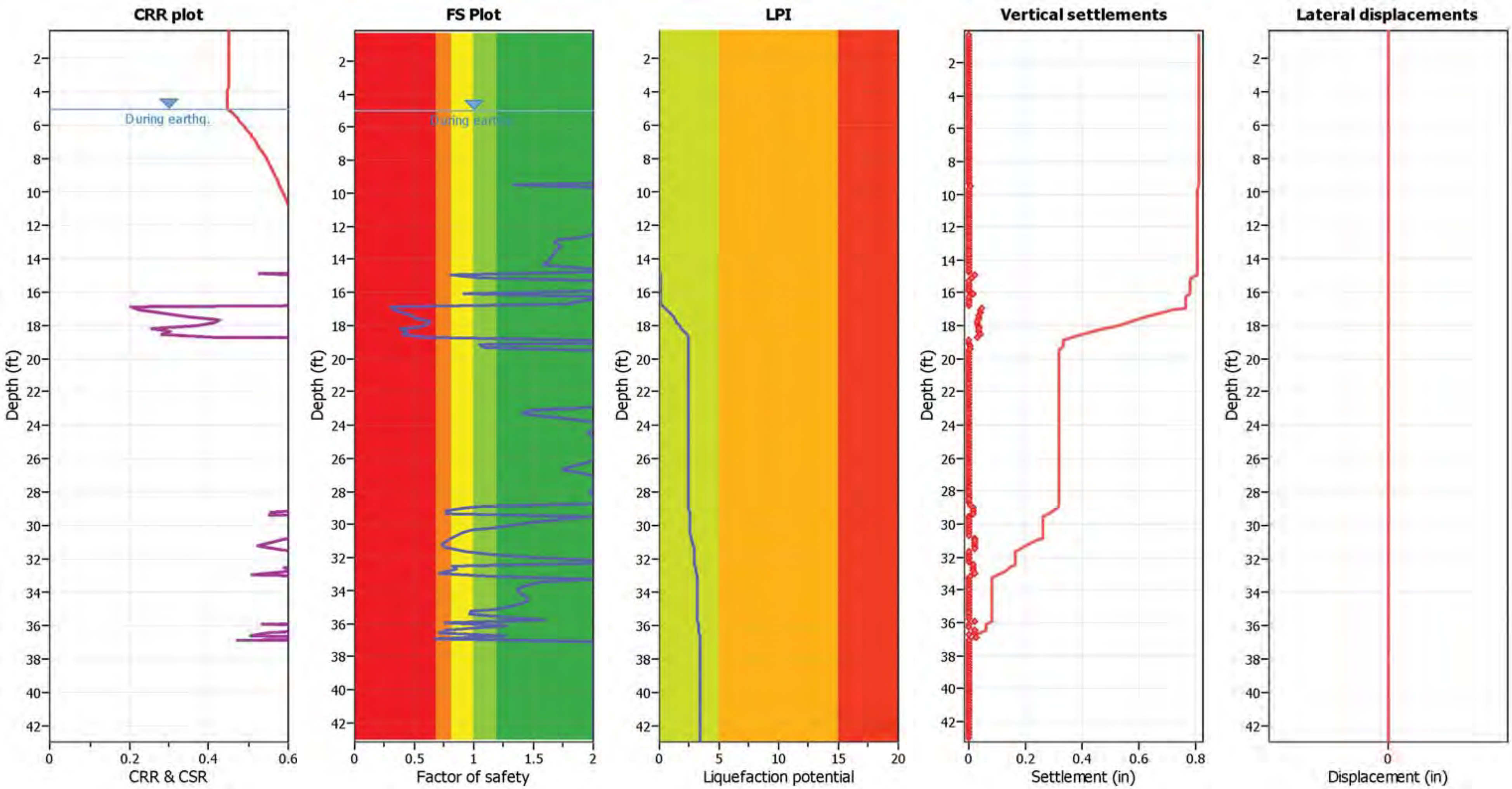
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_{σ} applied:	No
Earthquake magnitude M_w:	7.94	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.60	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.94	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.60	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

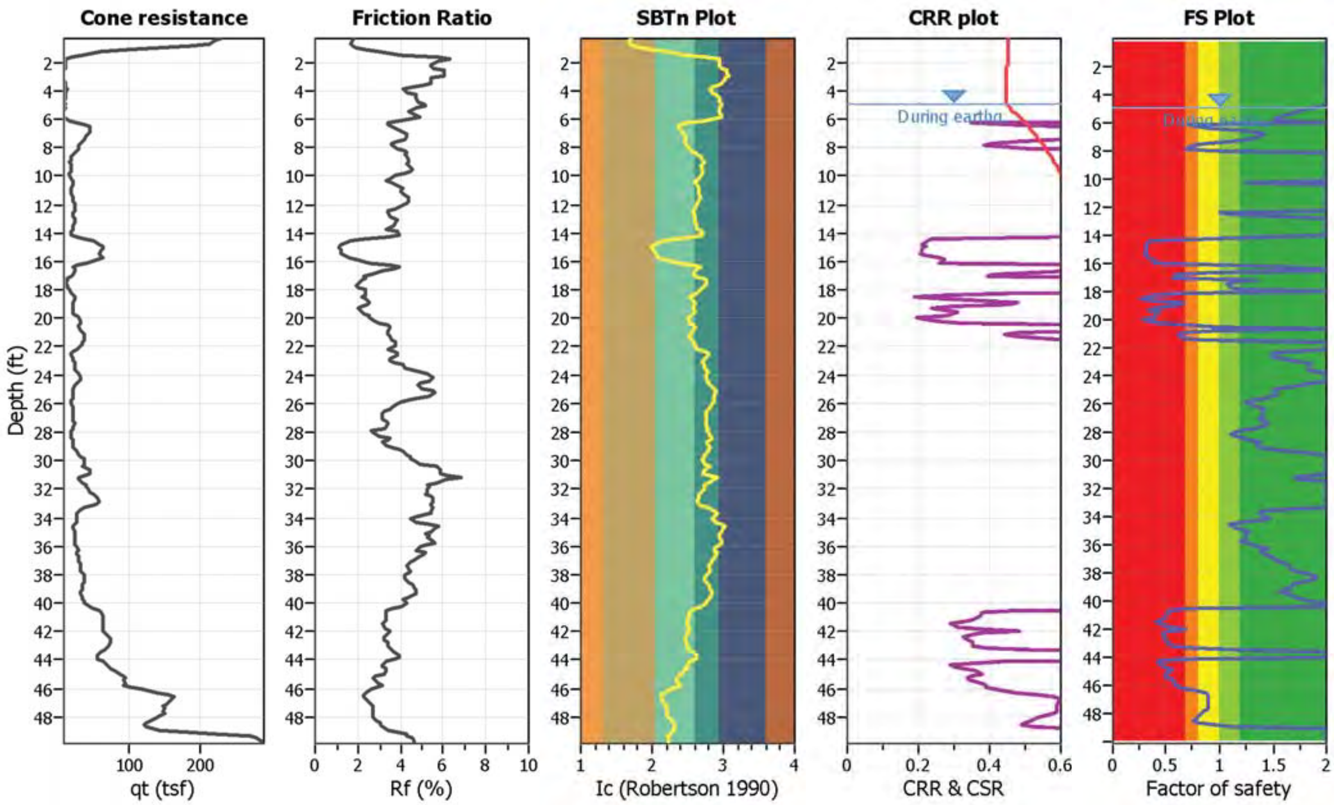
LIQUEFACTION ANALYSIS REPORT

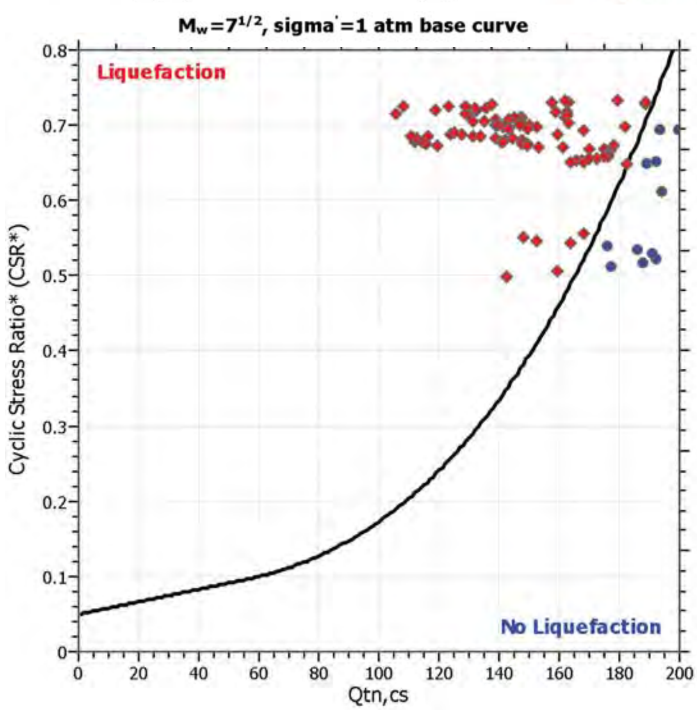
Project title : 315 D Street **Location : Petaluma, California**

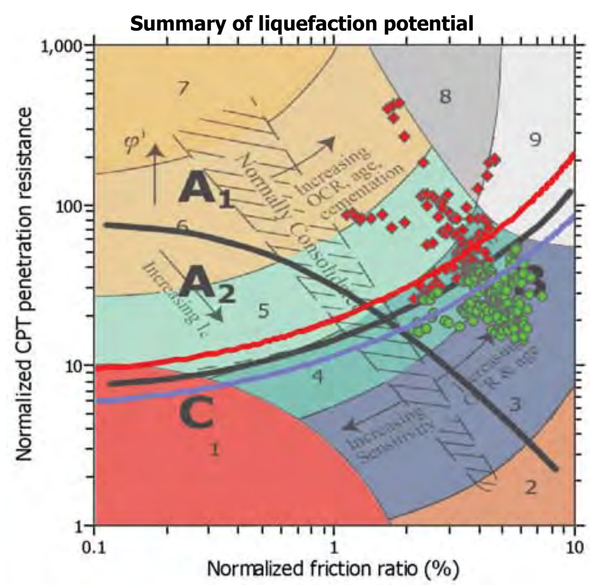
CPT file : 1-CPT5

Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	5.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	5.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.94	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.60	Unit weight calculation:	Based on SBT	K_σ applied:	No		

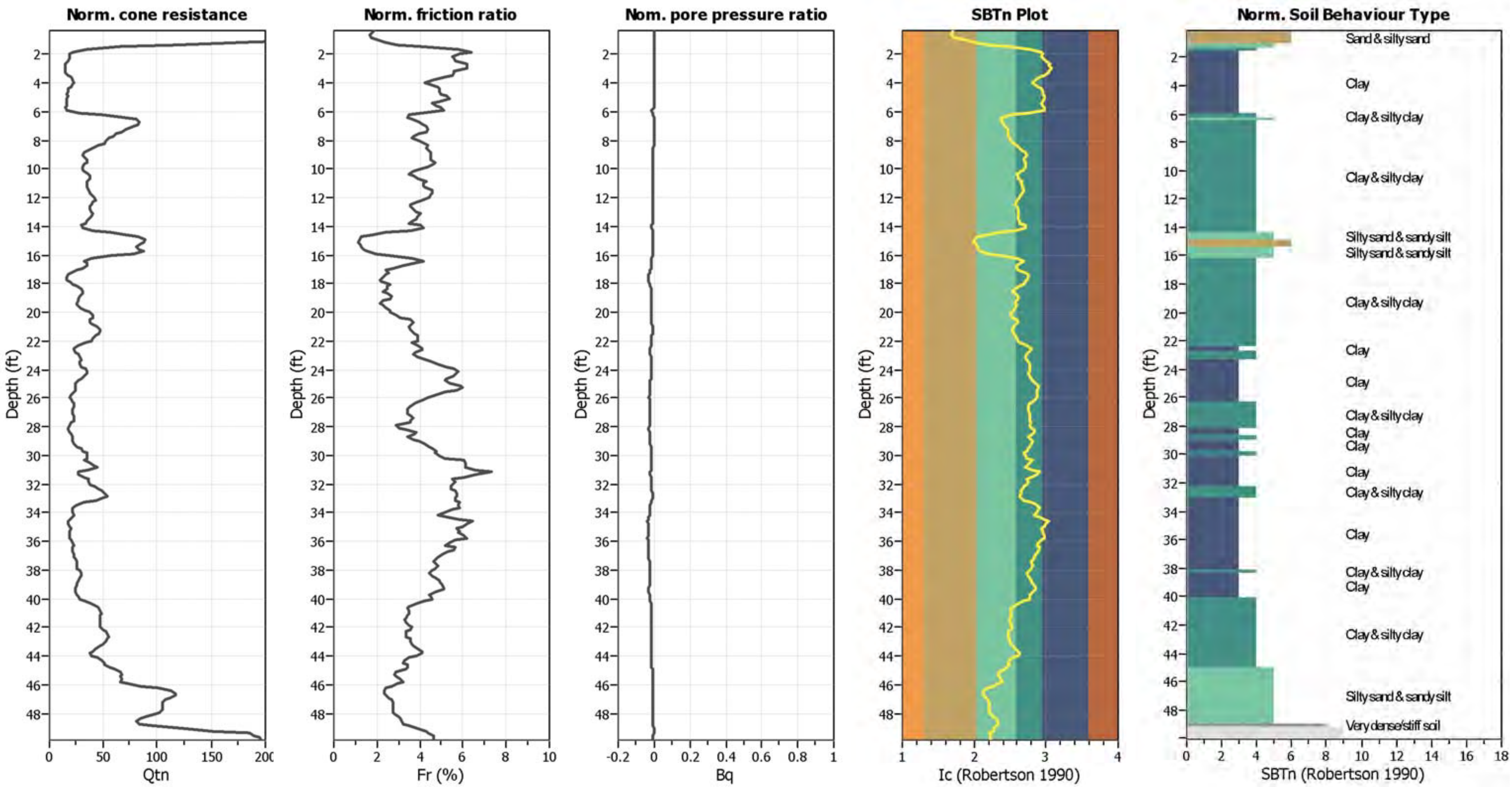






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots (normalized)



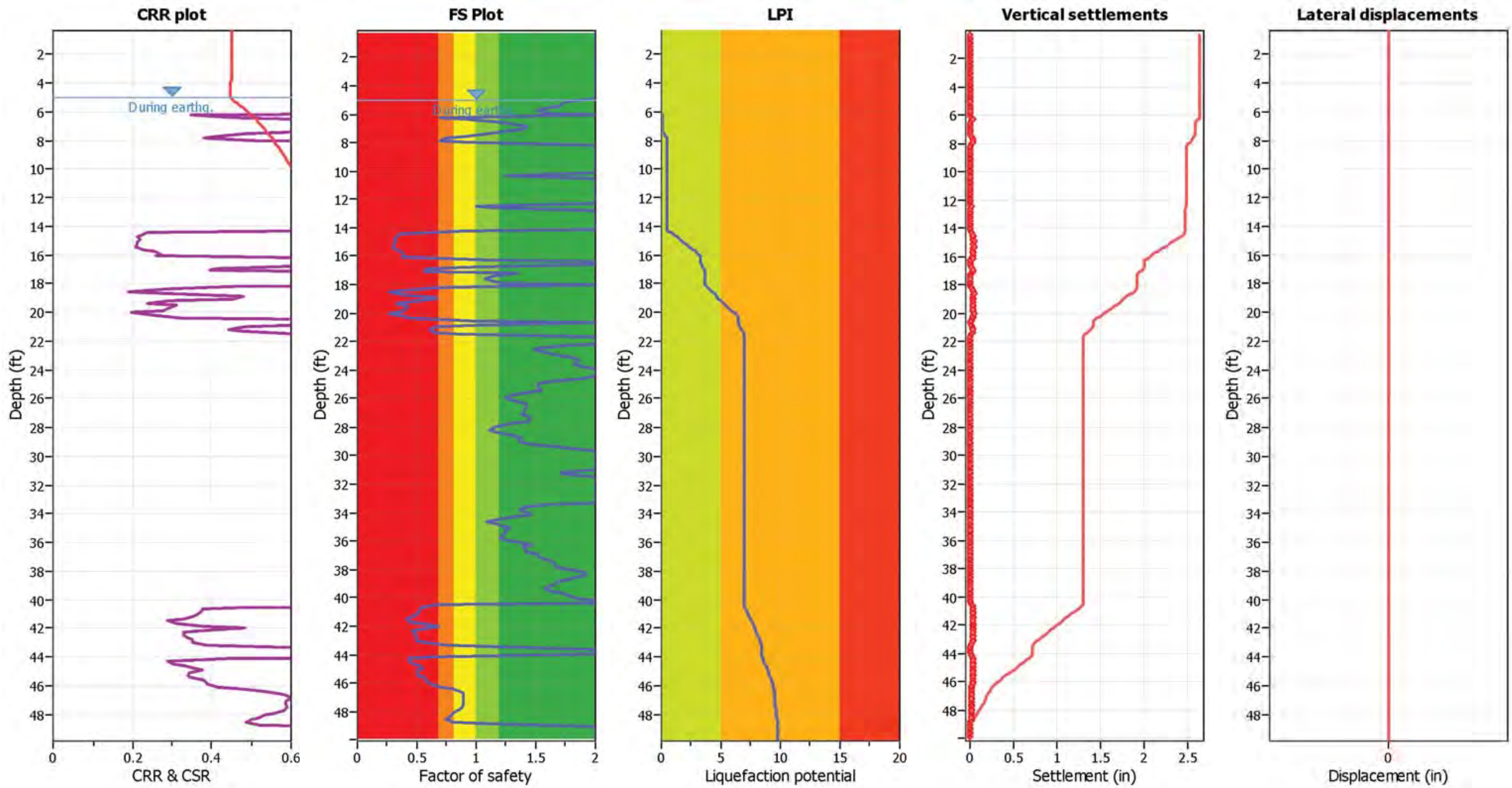
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.94	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.60	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

- 1. Sensitive fine grained
- 2. Organic material
- 3. Clay to silty clay
- 4. Clayey silt to silty
- 5. Silty sand to sandy silt
- 6. Clean sand to silty sand
- 7. Gravely sand to sand
- 8. Very stiff sand to
- 9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.94	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.60	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

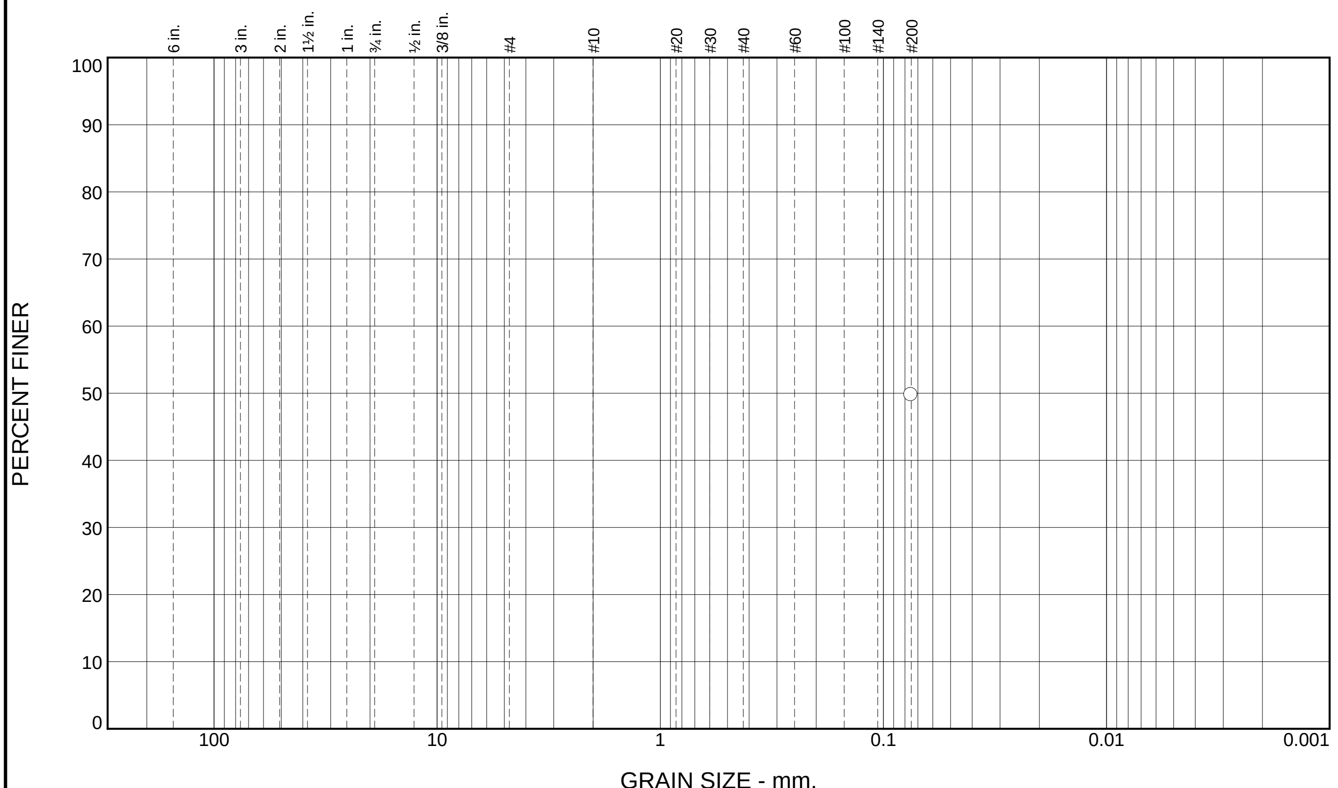
- Very high risk
- High risk
- Low risk

APPENDIX C

Laboratory Test Results

APPENDIX C

Particle Size Distribution Report



% +75mm	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						49.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	49.7		

* (no specification provided)

Soil Description

See exploration logs

Atterberg Limits

PL= 13 LL= 32 PI= 19

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

GS: ASTM D1140
PI: ASTM D4318, Wet method

Sample Number: 1-CPT1 @ 4.5 **Depth:** 4.5-5.0 feet

Date: 08/31/16

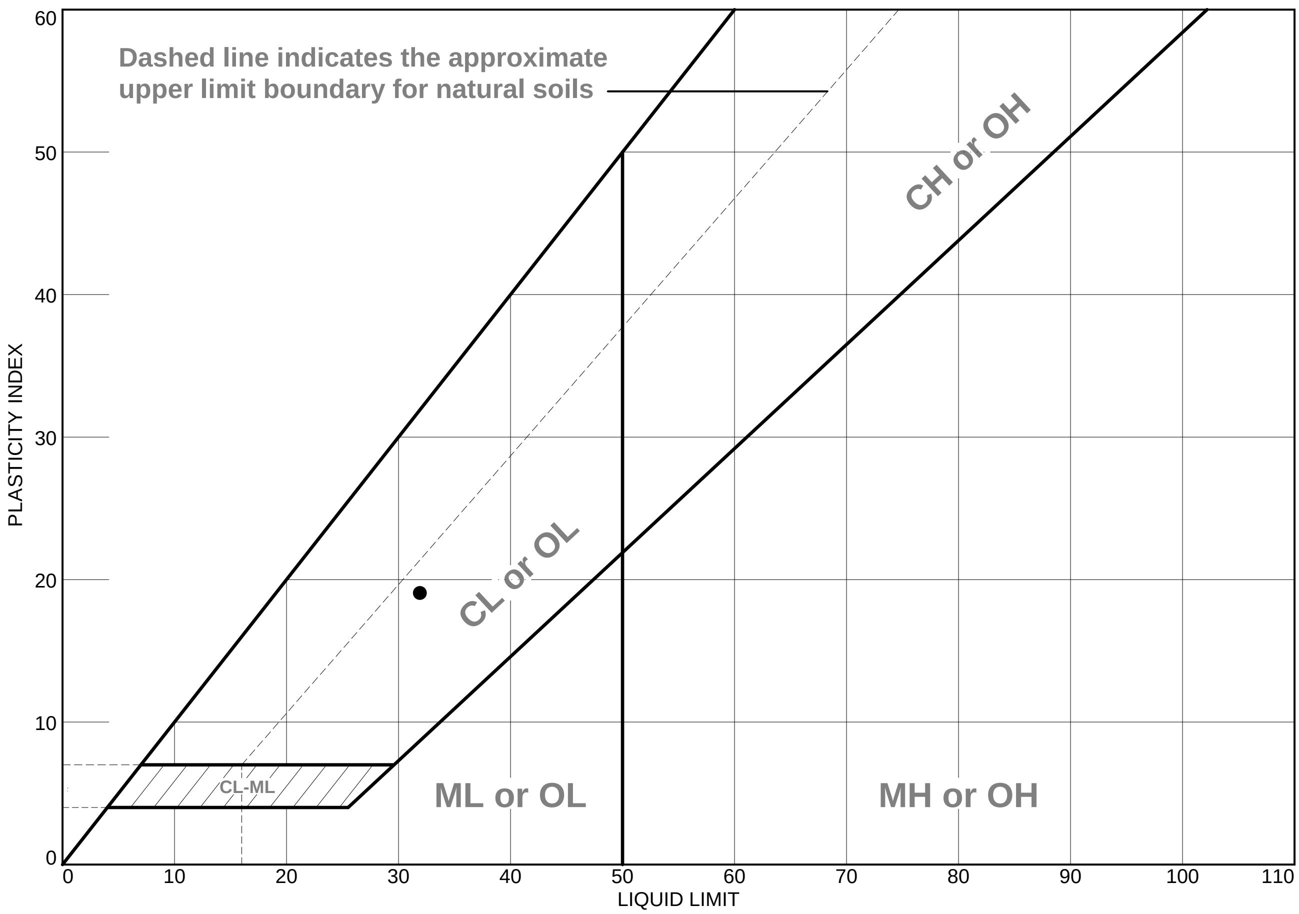
ENGEO INCORPORATED

Client: Loma Partners, LLC
Project: 315 D Street Petaluma

Project No: 13253.000.000

Tested By: G. Criste **Checked By:** D. Seibold

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	See exploration logs	32	13	19		49.7	

Project No. 13253.000.000 **Client:** Loma Partners, LLC

Project: 315 D Street Petaluma

●**Depth:** 4.5-5.0 feet **Sample Number:** 1-CPT1 @ 4.5

ENGEO INCORPORATED

Remarks:

●PI: ASTM D4318, Wet method
GS: ASTM D1140

Tested By: M. Quasem **Checked By:** G. Criste

APPENDIX B

PREVIOUS SUBSURFACE EXPLORATION AND LAB TESTING

BORINGS BY MILLER PACIFIC, 2016

BORING 1

EQUIPMENT: Truck-Mounted B54 Drill Rig with 6-inch hollow stem auger
DATE: 11/14/2016
ELEVATION: 10 - feet (+/-)*
*REFERENCE: ALTA Suvey by Cinquini and Passarino, Inc. dated February, 2016

DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (4)	DESCRIPTION	BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
0	0			4 in of Asphalt over 6 in of Aggregate Base						
				Clayey SAND with Gravel (SC) dark blue-gray to brown, moist, medium dense, fine- to coarse-grained sand, low plasticity clay [Fill]	18	114	11.6	500	10 (PI)	
1										
	5			Clayey SAND (SC) dark gray, wet, loose, fine-grained sand [Estuarine Deposits]	7	102	21.6		33.2% (P200)	
2					9		22.3			
				Poorly Graded SAND with Silt (SP-SM) gray-brown, saturated, medium dense, fine-grained sand [Estuarine Deposits]						
3	10				12		23.8		11.4% (P200)	
4										
	15									
5				CLAY with Sand (CH) brown, wet, stiff, medium to high plasticity [Estuarine Deposits]	18		42.4			
6	20									

NOTES: (1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(4) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

MPEG
MILLER PACIFIC ENGINEERING GROUP
504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

FILE: 2379.001 BL.dwg

BORING LOG

Adobe Road Winery
Petaluma, California

Project No. 2379.001 Date: 11/18/2016

Drawn RCA
Checked

A-3
FIGURE

BORING 1

EQUIPMENT: Truck-Mounted B54 Drill Rig with 6-inch hollow stem auger
DATE: 11/14/2016
ELEVATION: 10 - feet (+/-)*
*REFERENCE: ALTA Suvey by Cinquini and Passarino, Inc. dated February, 2016

DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	DESCRIPTION	BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
	20			CLAY with Sand (CH) brown, wet, stiff, medium to high plasticity [Estuarine Deposits]						
7										
	25									
8				CLAYSTONE gray-brown, wet, weak to friable, highly to completely weathered [Bedrock]						
					20		43.4			
9	30									
10										
					32		34.2			
	35			Boring terminated at 34.5 feet. Groundwater encountered at 6 feet below ground surface during drilling.						
11										
12	40									

NOTES: (1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(4) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

MPEG MILLER PACIFIC ENGINEERING GROUP
504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

FILE: 2379.001 BL.dwg

BORING LOG

Adobe Road Winery
Petaluma, California

Project No. 2379.001 Date: 11/18/2016

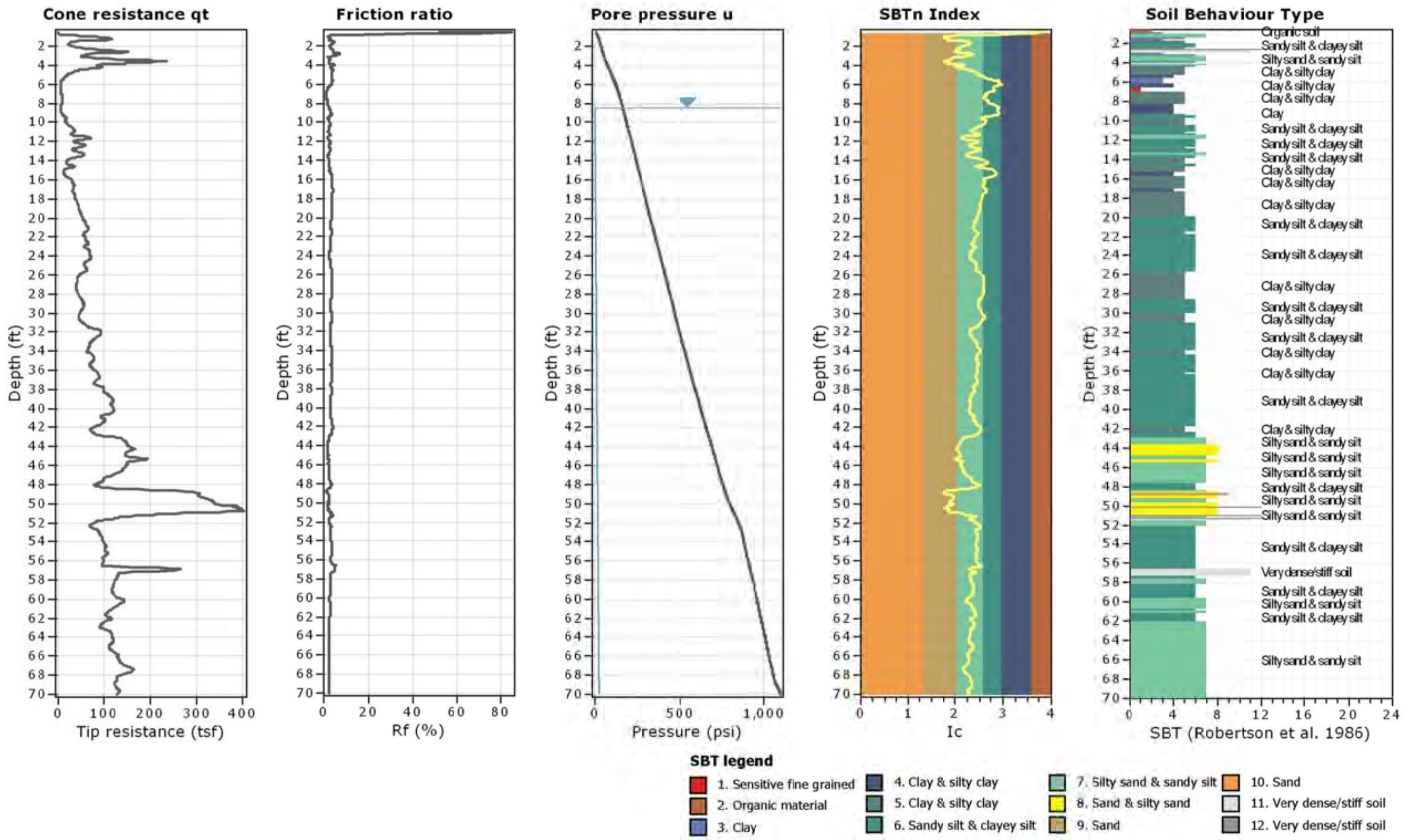
Drawn RCA
Checked

A-4
FIGURE

CPTS BY MILLER PACIFIC, 2011

Project: Petaluma Trestle Rehabilitation

CPT: CPT-01 - Total depth: 70.01 (ft)



CPeT-IT v.1.5.3.0 - CPTU data presentation & interpretation software - Report created on: 9/19/2011, 4:19:10 PM

Project file: H:\Jobs\1200-1299\1206.13\CPT\1206.13_CPT.cpt

Miller Pacific

ENGINEERING GROUP

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

FILE: 1206.13 A4-A6(CPT-Boring).dwg

CPT DATA LOGS

Petaluma Trestle Rehabilitation
Petaluma, California

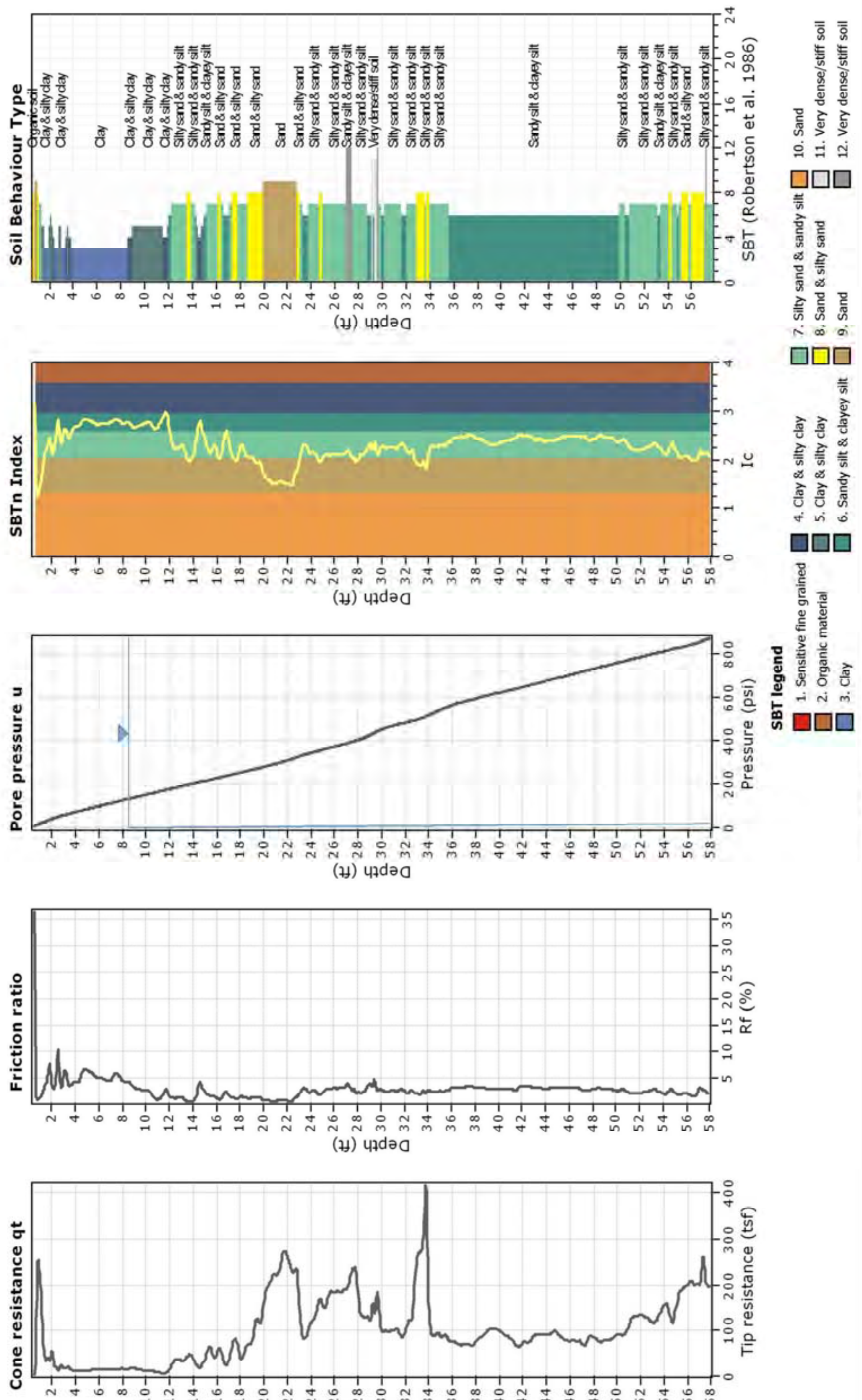
Project No. 1206.13 Date: 10/3/11

Drawn JTO
Checked

A-4
FIGURE

Project: Petaluma Trestle Rehabilitation

CPT: CPT-02 - Total depth: 57.84 (ft)



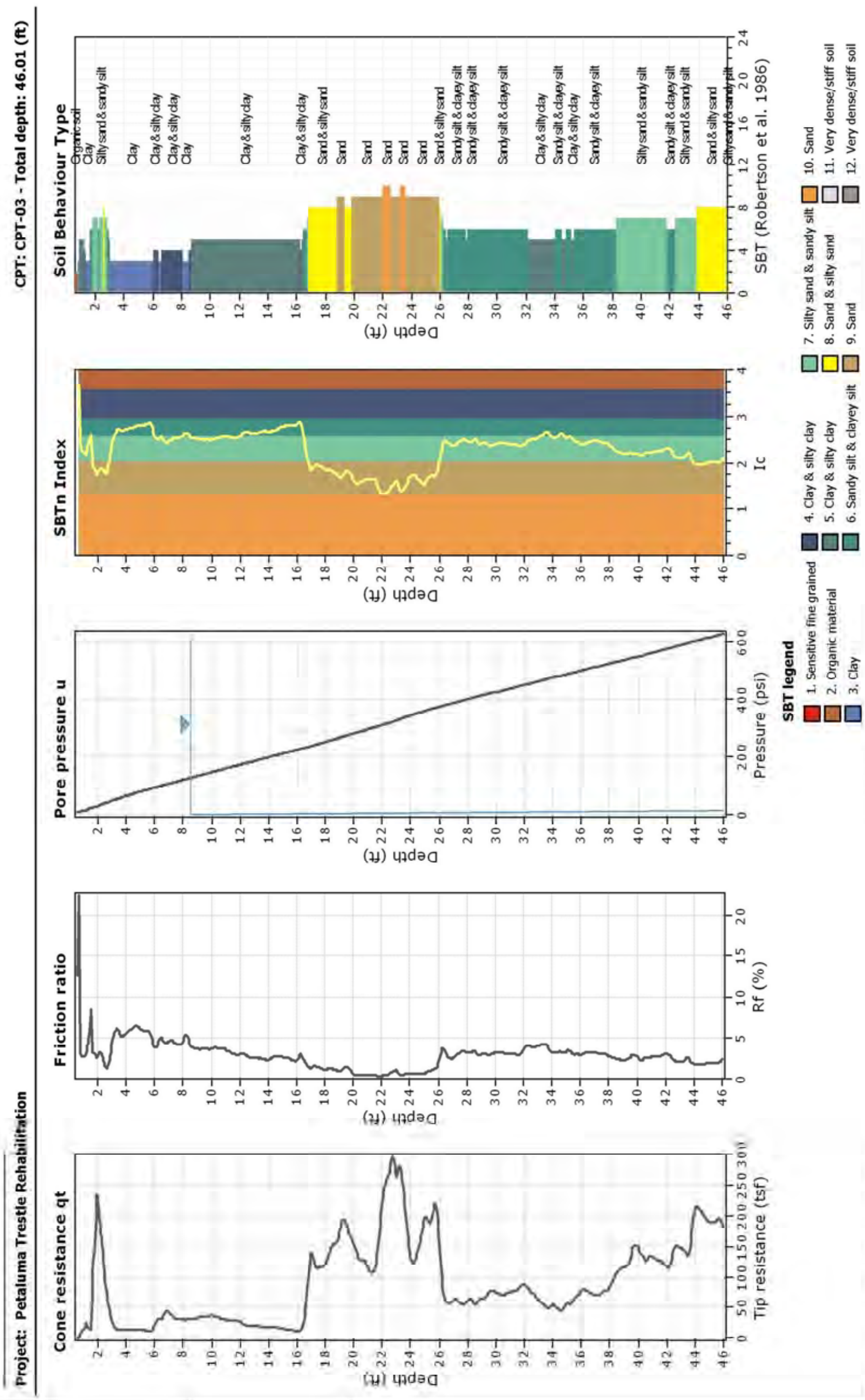
CPeT-IT v.1.5.3.0 - CPTU data presentation & interpretation software - Report created on: 9/19/2011, 4:19:11 PM

Project file: H:\Jobs\1200-1299\1206.13\CPT\1206.13_CPT.cpt

3

Miller Pacific ENGINEERING GROUP	504 Redwood Blvd. Suite 220 Novato, CA 94947 T 415 / 382-3444 F 415 / 382-3450 www.millerpac.com	CPT DATA LOGS Petaluma Trestle Rehabilitation Petaluma, California Project No. 1206.13 Date: 10/3/11	Drawn JTO Checked A-5 FIGURE

FILE: 1206.13 A4-A6(CPT-Boring).dwg



5

CPeT-IT v.1.5.3.0 - CPTU data presentation & interpretation software - Report created on: 9/19/2011, 4:19:12 PM

Project file: H:\Jobs\1200-1299\1206.13\CPT\1206.13_CPT.cpt

Miller Pacific
ENGINEERING GROUP

FILE: 1206.13 A4-A6(CPT-Boring).dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

CPT DATA LOGS

Petaluma Trestle Rehabilitation
Petaluma, California

Drawn JTO
Checked

Project No. 1206.13 Date: 10/3/11

A-6
FIGURE

BORINGS BY MILLER PACIFIC, 2004

BORING 1

EQUIPMENT: AT-600 Drill Rig

DATE: 4/24/03

ELEVATION: +12 feet

*REFERENCE: McNear Peninsula Phase I Impementation, NAVD88, 12/02/02

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	DESCRIPTION
					0	0			SILTY CLAY (CL) w/ SAND (FILL) medium olive-brown, moist, medium stiff, low plasticity, contains white shell fragments
		30	19.5	97	1		■		
		25	14.5	107		5	■		SANDY CLAY (CL) w/ GRAVEL (FILL) dark brown, moist, medium stiff, low plasticity
					2				CLAYEY SILT (MH-CH) w/ GRAVEL (FILL) dark gray to black, moist, soft to medium stiff, high plasticity (bay mud)
	560 (UC)	12	40.9	79			■		
					3	10			
	85 (UC)	9	25.7	104	4		■		
						15			SILTY CLAY (CL) w/ SAND mottled light gray and blue, moist, medium stiff, medium plasticity
					5				
	1095 (UC)	27	24.8	99	6	20	■		
									Bottom of hole at 19.5 feet Groundwater at 15 feet

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: 1039.01BL1.dwg

Miller Pacific
ENGINEERING GROUP

BORING LOG
Petaluma McNear
Petaluma, California

Project No. 1039.01 | Date 7/09/03 | Approved By: [signature]

Figure 3

BORING 2

EQUIPMENT: Drill Rig AT-600

DATE: 4/24/03

ELEVATION: +12 feet

*REFERENCE: McNear Peninsula Phase I Impementation, NAVD88, 12/02/02

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	DESCRIPTION
					0	0	SILTY CLAY w/ SAND (CL) (FILL) dark brown, moist, medium plasticity, medium stiff, contains roots
		19	28.9	80			
					1		
	1845 (UC)	51	29.4	87		5	same material w/ gravel, lighter brown, stiff
					2		
	410 (UC)	26	17.9	107			CLAYEY SAND (SC) dark olive brown, very moist, dense
					3	10	
	325 (UC)	13	24.3	96			same material w/ interbedded bay mud, dark gray-blue
							CLAYEY SILT (MH-CH) dark gray-blue, moist, high plasticity, soft, organics (roots) (bay mud)
					4		
						15	
	405 (UC)	12	56.7	64	5		same material w/ interbedded sand
	485 (UC)	19	70.2	57	6	20	same material w/o interbedded sand, yellow limonite (iron oxide) staining
							Bottom of hole at 20 feet
							Groundwater at 18 feet

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: 1039.01BL1.dwg

Miller Pacific
ENGINEERING GROUP

BORING LOG
Petaluma McNear
Petaluma, California

Project No. 1039.01 | Date 7/09/03 | Approved By: [illegible]

Figure 4

BORING 3

EQUIPMENT: AT-600 Drill Rig

DATE: 4/24/03

ELEVATION: +12 feet

*REFERENCE: McNear Peninsula Phase I Impementation, NAVD88, 12/02/02

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	DESCRIPTION
					0	0			CLAYEY SILT (ML) mottled white-olive brown, slightly moist, dense, contains white shell fragments
		33	0.0	000					
					1				
		30	17.2	107					CLAYEY SAND (SC) mottled dark brown-orange, coarse sand, contains white shell fragments and foam rubber debris
						5			CLAYEY SAND (SC) olive brown, moist, medium dense
		22	23.1	97	2				
									SILTY CLAY (CL) dark olive-brown, medium to high plasticity, medium stiff, contains small gravel and foam rubber debris
									Bottom of hole at 6.5 feet No groundwater encountered
					3	10			
					4				
						15			
					5				
					6	20			

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: 1039.01BL1.dwg

Miller Pacific
ENGINEERING GROUP

BORING LOG
Petaluma McNear
Petaluma, California

Project No. 1039.01 | Date 7/09/03 | Approved By: [signature]

Figure 5

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	BORING 4
					0	0			CLAYEY SANDY SILT (SM) olive-brown, slightly moist, contains small rounded gravel
		30	24.7	78			■		
					1				
		51	18.1	81		5	■		same material, less gravel, some organics (roots)
					2				
	460 (UC)	51	18.1	81			■		SILTY CLAY (MH-CH) dark gray-blue, moist, high plasticity, stiff, contains organics (roots)
					3	10			Bottom of hole at 8.5 feet No groundwater encountered
					4				
						15			
					5				
					6	20			

BORING 4

EQUIPMENT: AT-600 Drill Rig

DATE: 4/24/03

ELEVATION: +15 feet

*REFERENCE: McNear Peninsula Phase I Impementation, NAVD88, 12/02/02

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3= 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: 1039.01BL1.dwg

Miller Pacific
ENGINEERING GROUP

BORING LOG
Petaluma McNear
Petaluma, California

Project No. 1039.01 | Date 7/09/03 | Approved By: [signature]

Figure 6

BORINGS BY MILLER PACIFIC, 1999

BORING 3

EQUIPMENT: 6-inch Solid Auger
DATE: February 5, 1999
ELEVATION: +12.6 Feet*
*REFERENCE: Winzler & Kelly, Topographic Map, 1999

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters / feet	SAMPLE	SYMBOL (3)	DESCRIPTION
					0 / 0			3 inches asphalt concrete, 6 inches aggregate base
		34	6.5	103		▮		SANDY GRAVEL (GM) moist, medium dense to dense, brown (Fill)
		16	5.8	109	1 / 5	▮		POORLY-GRADED SAND (SP) moist, medium dense, brown (Trench Sand)
		17	22.9	103	2, 3 / 10	▮		CLAYEY SAND (SC) moist, medium dense, dark gray (Fill)
					4, 5, 6 / 15, 20			Bottom at 10.5 feet, no water encountered

FILE: 24319B3A.DW2

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m³ = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

BORING 4

EQUIPMENT: 6-inch Solid Auger
DATE: February 5, 1999
ELEVATION: +13.3 Feet*
*REFERENCE: Winzler & Kelly, Topographic Map, 1999

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters / feet	SAMPLE	SYMBOL (3)	Description
					0 / 0			2 inches asphalt concrete, 4 inches aggregate base
		50/2"	7.9	106				GRAVELLY SAND (SW) moist, very, dark brown with gravels to 1-1/2 inch (Fill)
		57	19.5	104	1			CLAYEY SAND (SC) moist, very dense, mottled rust and brown (Alluvium)
					5 (feet)			
		35	19.1	103	2			grades to fine sand with trace of clayey fines, moist to wet, medium dense to dense
		57	18.0	106	3 / 10			
								Bottom at 10.5 feet, no water encountered
					4			
					15 (feet)			
					5			
					6 / 20			

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: 24319B4A.DW2

Miller Pacific
ENGINEERING GROUP

BORING LOG
NWP Railroad Mainline Bridge
Petaluma, California

Figure A-6

Project No. 243.19 | Date 2/26/99 | Approved By: [signature]

BORINGS AND CPTS BY MILLER PACIFIC, 1996

SHEAR STRENGTH psf	BLOWS PER FOOT	MOIST. CONT. %	DRY DENSITY pcf	DEPTH feet	BORING 3 EQUIPMENT: 6-in. Rotary Wash DATE: July 3, 1995 ELEVATION: Approx. +12.5 feet
				0	0.5-in. Asphalt, 5-in. Baserock
UC=670	18	22.0	95		SILTY CLAY (CL) olive gray, moist to wet, medium stiff, minor fine sand grades dark brown
UC=750	17	25.8	87		
				5	
P200=50%	10	21.4	103	10	dark brown, little fine sand, some dark gray mottling Groundwater Encountered at 11.0 feet While Drilling
UC=2050	19	26.7	97	15	SANDY CLAY (CL) brown, moist to wet, stiff, fine sand, minor olive-gray mottling
UC=1880	35	21.8	104	20	light brown, wet, stiff, grades more sand
					SANDY GRAVEL (GP) (continued)

FILE: 243-03A.B3

MILLER PACIFIC ENGINEERING GROUP

BORING LOG
Petaluma Flood Control Project
Petaluma, California

A-3

Project No. 243.07 Date 06/06/96 Approved By: SKS

Figure

SHEAR STRENGTH psf	BLOWS PER FOOT	MOIST. CONT. %	DRY DENSITY pcf	DEPTH feet	BORING 3 (CONTINUED)
				23	**SANDY GRAVEL (GP)** drilling eases gray, wet, dense, gravels to 1/8 inch
DS=2650 ϕ'=49.0 deg.	47	14.0	119	25	larger gravels in cuttings (1/4"+)
					SILTY SAND (SM) greenish-gray, wet, medium dense, fine sand
	42	23.2	108	30	
				35	drilling hard, wet, gravels in cuttings light brown, very dense, fine and coarse sand, minor silt
	88	14.4	127	40	drilling very hard (350 psi)
				45	cemented sand and gravel on auger
FILE: 243-03B.B3					(continued)

MILLER PACIFIC ENGINEERING GROUP

BORING LOG
Petaluma Flood Control Project
Petaluma, California

A-4

Project No. 243.07 Date 06/06/96 Approved By: SAS

Figure

SHEAR STRENGTH psf	BLOWS PER FOOT	MOIST. CONT. %	DRY DENSITY pcf	DEPTH feet	BORING 3 (CONTINUED)
				46	SILTY SAND (SM)
					same, cemented
SA	64	19.7	112	50	
					Bottom of Boring at 50.5 feet
					Groundwater Encountered at 11.0 feet While Drilling
				55	
				60	
				65	

FILE: 243-03C.B3

MILLER PACIFIC ENGINEERING GROUP

BORING LOG
Petaluma Flood Control Project
Petaluma, California

A-5

Project No. 243.07 Date 06/06/96 Approved By: SAS

Figure

SHEAR STRENGTH psf	BLOWS PER FOOT	MOIST. CONT. %	DRY DENSITY pcf	DEPTH feet	BORING 4 EQUIPMENT: 6–in. Rotary Wash DATE: July 7, 1995 ELEVATION: Approx. +12.3 feet
				0	4–in. Baserock
					SILTY CLAY (CL) drilling soft
UC=1500	15	20.2	99		gray and olive gray, moist, medium stiff, minor fine sand grades to brown with more fine sand
				5	
					SANDY CLAY (CL) brown cuttings
					brown, moist, stiff, fine sand
	24			10	
					drilling soft
					SANDY SILT (ML) brown, moist to wet, stiff, fine sand, minor clay, few gravels
UU=700 σ3=1300	15	23.5	103	15	drilling soft
					Groundwater Encountered at 16.0 feet While Drilling
				20	
					SANDY GRAVEL (GP)
	60	16.4	113		olive gray, wet, loose, fine and coarse sand, 60% gravels to 1/8 inch, grades more gravels (continued)

FILE: 243-03A.B4

MILLER PACIFIC ENGINEERING GROUP

BORING LOG
Petaluma Flood Control Project
Petaluma, California

A-6

Project No. 243.07 Date 06/06/96 Approved By: SAS

Figure

SHEAR STRENGTH psf	BLOWS PER FOOT	MOIST. CONT. %	DRY DENSITY pcf	DEPTH feet	BORING 4 (CONTINUED)
				23	SANDY GRAVEL (GP) slight loss of water (15-20 gallons)
				25	gravels in cuttings
					SILTY SAND (SM)
				30	
					light brown, wet, dense, fine sand, gravels to 1/4 inch
	50/6"	20.3	108		
					grades more gravels
					drilling hard
				35	minor gravels in cuttings
				40	
					coarse sand, less gravels
SA	61	20.2	110		
					drilling hard (300 psi)
				45	
FILE: 243-03B.B4					(continued)

MILLER PACIFIC ENGINEERING GROUP

BORING LOG
Petaluma Flood Control Project
Petaluma, California

A-7

Project No. 243.07 Date 06/06/96 Approved By: SAS Figure

SHEAR STRENGTH psf	BLOWS PER FOOT	MOIST. CONT. %	DRY DENSITY pcf	DEPTH feet	BORING 4 (CONTINUED)
				46	SILTY SAND (SM)
					GRAVELLY SAND (SP) brown cuttings
				50	
	50/5"				no recovery, brown Gravelly Sand on Sampler
				55	
					more gravels in cuttings drilling eases slightly
					drilling hard drilling rate: 1 ft./min. less gravels in cuttings
				60	
SA	85	15.0	117		SAND (SW) brown, wet, dense, fine and coarse sand
				65	
FILE: 243-03C.B4					(continued)

MILLER PACIFIC ENGINEERING GROUP

BORING LOG
Petaluma Flood Control Project
Petaluma, California

Figure A-8

Project No. 243.07 Date 06/06/96 Approved By: SAS

SHEAR STRENGTH psf	BLOWS PER FOOT	MOIST. CONT. %	DRY DENSITY pcf	DEPTH feet	BORING 4 (CONTINUED)
				69	SAND (SW)
				70	GRAVELLY SAND (SP) drilling hard (300 psi) gravels in cuttings large gravels
				75	
				80	SILTY SAND AND SANDY SILT (SM-ML) dark gray, wet, dense, fine and coarse sand
	41	36.9	89		
					Bottom of Boring at 81.5 feet Groundwater Encountered at 16.0 feet While Drilling
				85	
				90	

FILE: 243-03D.B4

MILLER PACIFIC ENGINEERING GROUP

BORING LOG
Petaluma Flood Control Project
Petaluma, California

Project No. 243.07 | Date 06/06/96 | Approved By: SAS

Figure A-9

BORING 5

EQUIPMENT: 6-inch Rotary Wash
DATE: May 8, 1996
ELEVATION: +13.5 Feet*

*REFERENCE: Winzler & Kelly Topographic Map

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	DESCRIPTION
					0	0			SILTY CLAY (CL-CH) dark brown, moist to wet, soft
					1				
									CLAYEY SAND WITH GRAVELS (SC) olive gray, wet, loose, fine sand, gravels to 1/4 inch
						5			
	690 (UU) σ_3=500	17	21.4	98	2				
					3	10			
	1100 (UC)	19	24.0	98					
									SANDY CLAY (CL) dark gray, wet, soft to medium stiff, fine sand
					4				drilling soft
						15			
					5				
									Groundwater Observed at 19.0 Feet During Drilling
									SAND (SP) greenish-gray, wet, loose
					6	20			(continued)

FILE: 243B5-A.DW2

NOTES: (1) METRIC EQUIVALENT STRENGTH IS 0.0479 kPa
(2) METRIC EQUIVALENT DRY UNIT WEIGHT IS 0.1571 kN/m^3
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

MILLER PACIFIC ENGINEERING GROUP

BORING LOG
Petaluma Flood Control Project
Petaluma, California

A-10

Project No. 243.07 | Date 05/28/96 | Approved By: SAS

Figure

BORING 5 (CONTINUED)

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	DESCRIPTION
						20	SAND (SP) no recovery
		20					
		11	24.4				greenish-gray, wet, loose
					7		
						25	losing water: ~50 gallons
					8		SANDY GRAVEL (GP) greenish-gray, moist to wet, very dense, cemented, fine and coarse sand, rounded gravels to 1/2 inch
					9	30	
		50/4"	14.9	118			
					10		
						35	
					11		SANDY GRAVEL (GP) brownish yellow, wet, very dense, fine and coarse sand, rounded gravels to 1/2 inch, large gravels to 1.5 inches
					12	40	
							(continued)

NOTES: (1) METRIC EQUIVALENT STRENGTH IS 0.0479 kPa
(2) METRIC EQUIVALENT DRY UNIT WEIGHT IS 0.1571 kN/m^3
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: 243B5-B.DW2

MILLER PACIFIC ENGINEERING GROUP

BORING LOG
Petaluma Flood Control Project
Petaluma, California

A-11

Project No. 243.07 Date 05/28/96 Approved By: SAS

Figure

BORING 5
(CONTINUED)

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters / feet	SAMPLE	SYMBOL (3)	
		50/5"	10.4		40			SANDY GRAVEL (GP) brownish yellow, wet, very dense, fine and coarse sand, rounded gravels to 1/2 inch, large gravels to 1.5 inches
					13			
					45			
					14			large gravels, drilling hard
					15			drilling eases
		50/2"	12.1	108	50			less sands, gravels to 1/4 inch
					16			
					55			
					17			
								large gravels
					18			
					60			(continued)

NOTES: (1) METRIC EQUIVALENT STRENGTH IS 0.0479 kPa
(2) METRIC EQUIVALENT DRY UNIT WEIGHT IS 0.1571 kN/m^3
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: 24385-C.DW2

MILLER PACIFIC ENGINEERING GROUP

BORING LOG
Petaluma Flood Control Project
Petaluma, California

A-12

Project No. 243.07 Date 05/28/96 Approved By: SAS

Figure

BORING 5
(CONTINUED)

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters / feet	SAMPLE	SYMBOL (3)	
		50/3"	12.4	125	60			SANDY GRAVEL (GP) light brown, wet, very dense, cemented, fine and coarse sand, gravels to 1/8 inch
					19			large gravels
					65 / 20			drilling eases
								large gravels
					21			SILTSTONE gray, highly weathered, moderately strong, moderately hard
		94/9"	28.0		70			
					22			drilling very hard
					75 / 23			
		62	29.6	90				
			31.0	90				
								Bottom of Boring at 77.5 feet
					24			Groundwater Observed at 19.0 feet During Drilling
					80			

NOTES: (1) METRIC EQUIVALENT STRENGTH IS 0.0479 kPa
(2) METRIC EQUIVALENT DRY UNIT WEIGHT IS 0.1571 kN/m^3
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: 243B5-D.DW2

MILLER PACIFIC ENGINEERING GROUP

BORING LOG
Petaluma Flood Control Project
Petaluma, California

A-13
Figure

Project No. 243.07 Date 05/28/96 Approved By: SAS

BORING 7

EQUIPMENT: 6-inch Rotary Wash
DATE: May 13, 1996
ELEVATION: +13.5 Feet*

*REFERENCE: Winzler & Kelly Topographic Map

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	DESCRIPTION
					0	0			2-inch Basalt Gravels
									SILTY CLAY (CL) WITH GRAVELS dark brown, moist to wet, soft, gravels and debris to 2 inches
					1	5			
		37	11.7		2				SILTY CLAY (CL) dark brown, moist to wet, soft, minor gravels to 1/8 inch
		9	39.8	69	3	10			SANDY SILT (ML) brownish yellow, moist to wet, soft, fine sand
					4				Groundwater Observed at 14.0 Feet During Drilling
					5	15			
					6	20			SILTY SAND (SM) light brown, wet, loose, fine sand (continued)

FILE: 24387-A.DW2

NOTES: (1) METRIC EQUIVALENT STRENGTH IS 0.0479 kPa
(2) METRIC EQUIVALENT DRY UNIT WEIGHT IS 0.1571 kN/m^3
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

MILLER PACIFIC ENGINEERING GROUP

BORING LOG
Petaluma Flood Control Project
Petaluma, California

A-17 Figure

Project No. 243.07 | Date 05/28/96 | Approved By: SAS

BORING 7
(CONTINUED)

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	DESCRIPTION
						20	SILTY SAND (SM) light brown, wet, loose, fine sand
SA		19	23.4	105			
					7		
						25	SAND (SW-SM) mottled brown and light brown, wet, dense, fine and coarse sand, rounded gravels to 1/2 inch
					8		
					9		
						30	
		50/4"	9.3	132			
					10		less gravels
						35	
					11		
							more gravels
					12		
						40	(continued)

NOTES: (1) METRIC EQUIVALENT STRENGTH IS 0.0479 kPa
(2) METRIC EQUIVALENT DRY UNIT WEIGHT IS 0.1571 kN/m^3
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: 24387-B.DW2

MILLER PACIFIC ENGINEERING GROUP

BORING LOG
Petaluma Flood Control Project
Petaluma, California

Project No. 243.07 | Date 05/28/96 | Approved By: SAS

Figure A-18

BORING 7 (CONTINUED)

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters / feet	SAMPLE	SYMBOL (3)	
SA	2690 (DS)	50/3"	12.4	125	40			**SAND (SW-SM)** very dense, coarse sand, minor fine sand, gravels to 1/4 inch
					13			
					45			
					14			**SAND (SP) WITH GRAVELS** light brown, wet, dense, fine and coarse sand, minor gravels to 1/8 inch
					15			
					50			
		88/11"	12.1	108				
					16			losing water, ~40 gallons
								SANDY GRAVEL (GP) light brown, wet, very dense
					55			
					17			
					18			
					60			(continued)

NOTES: (1) METRIC EQUIVALENT STRENGTH IS 0.0479 kPa
(2) METRIC EQUIVALENT DRY UNIT WEIGHT IS 0.1571 kN/m³
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: 24387-C.DW2

MILLER PACIFIC ENGINEERING GROUP

BORING LOG
Petaluma Flood Control Project
Petaluma, California

A-19

Project No. 243.07 Date 05/28/96 Approved By: SKS

Figure

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	BORING 7 (CONTINUED)
						60			SANDY GRAVEL (GP) drilling rate: 5 minutes/foot
					19				
						65			SILTSTONE dark gray, highly weathered, hard, moderately strong
		42	35.1	82	20				
									Bottom of Boring at 66.5 feet
									Groundwater Observed at 14.0 feet 3.5 Hours After Drilling
					21				
						70			
					22				
						75			
					23				
					24				
						80			

NOTES: (1) METRIC EQUIVALENT STRENGTH IS 0.0479 kPa
(2) METRIC EQUIVALENT DRY UNIT WEIGHT IS 0.1571 kN/m^3
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: 24387-D.DW2

MILLER PACIFIC ENGINEERING GROUP

BORING LOG
Petaluma Flood Control Project
Petaluma, California

A-20
Figure

Project No. 243.07 | Date 05/28/96 | Approved By: SAS

BORING 7 (CONTINUED)

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	DESCRIPTION
						60			SANDY GRAVEL (GP) drilling rate: 5 minutes/foot
					19				
						65			SILTSTONE dark gray, highly weathered, hard, moderately strong
		42	35.1	82	20				
									Bottom of Boring at 66.5 feet
									Groundwater Observed at 14.0 feet During Drilling
					21				
						70			
					22				
						75			
					23				
					24				
						80			

NOTES: (1) METRIC EQUIVALENT STRENGTH IS 0.0479 kPa
(2) METRIC EQUIVALENT DRY UNIT WEIGHT IS 0.1571 kN/m^3
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: 243B7-D.DW2

MILLER PACIFIC ENGINEERING GROUP

BORING LOG
Petaluma Flood Control Project
Petaluma, California

Figure A-20

Project No. 243.07 | Date 05/28/96 | Approved By: SAS

BORING 10

EQUIPMENT: 3-inch Solid Augers
DATE: May 22, 1996
ELEVATION: +13.3 Feet*

*REFERENCE: Winzler & Kelly Topographic Map

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	DESCRIPTION
					0	0	SANDY CLAY (CL) brown, moist, soft, minor gravels to 1/2 inch
	560 (UC)	11	22.3	99			
					1		
	860 (UC)	14	21.4	97		5	brown to gray, medium stiff, fine sand
					2		SILTY CLAY (CH) gray, moist, soft to medium stiff, roots
	(UC) 280	11	34.7	84			
	410 (UU) σ_3=800		24.5	92			
					3	10	
	1000 (UC)	23	27.3	93			medium stiff, petroleum odor
					4		
						15	Groundwater Observed at 15.0 Feet During Drilling
	1500 (UC)	44	20.5	106	5		SILTY CLAY WITH SAND (CL) mottled light gray to light brown, moist, very stiff, fine sand
					6	20	
							(continued)

FILE: 243B10-A.DW2

NOTES: (1) METRIC EQUIVALENT STRENGTH IS 0.0479 kPa
(2) METRIC EQUIVALENT DRY UNIT WEIGHT IS 0.1571 kN/m^3
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

MILLER PACIFIC ENGINEERING GROUP

BORING LOG
Petaluma Flood Control Project
Petaluma, California

A-26

Project No. 243.07 Date 05/28/96 Approved By: SKS

Figure

BORING 10
(CONTINUED)

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	DESCRIPTION
						20			SILTY CLAY WITH SAND (CL) greenish gray, moist, stiff, gravels to 1/2 inch
	2000 (UC)	22	11.5	119					
									hole caved
					7				SILTY SAND WITH GRAVELS (SM)
						25			
					8				wet, gravels
		50/4"			9	30			no sample recovered
					10				
						35			
					11				Bottom of Boring at 36.0 feet
									Groundwater Observed at 15.0 feet Immediately After Drilling
					12	40			

NOTES: (1) METRIC EQUIVALENT STRENGTH IS 0.0479 kPa
(2) METRIC EQUIVALENT DRY UNIT WEIGHT IS 0.1571 kN/m^3
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

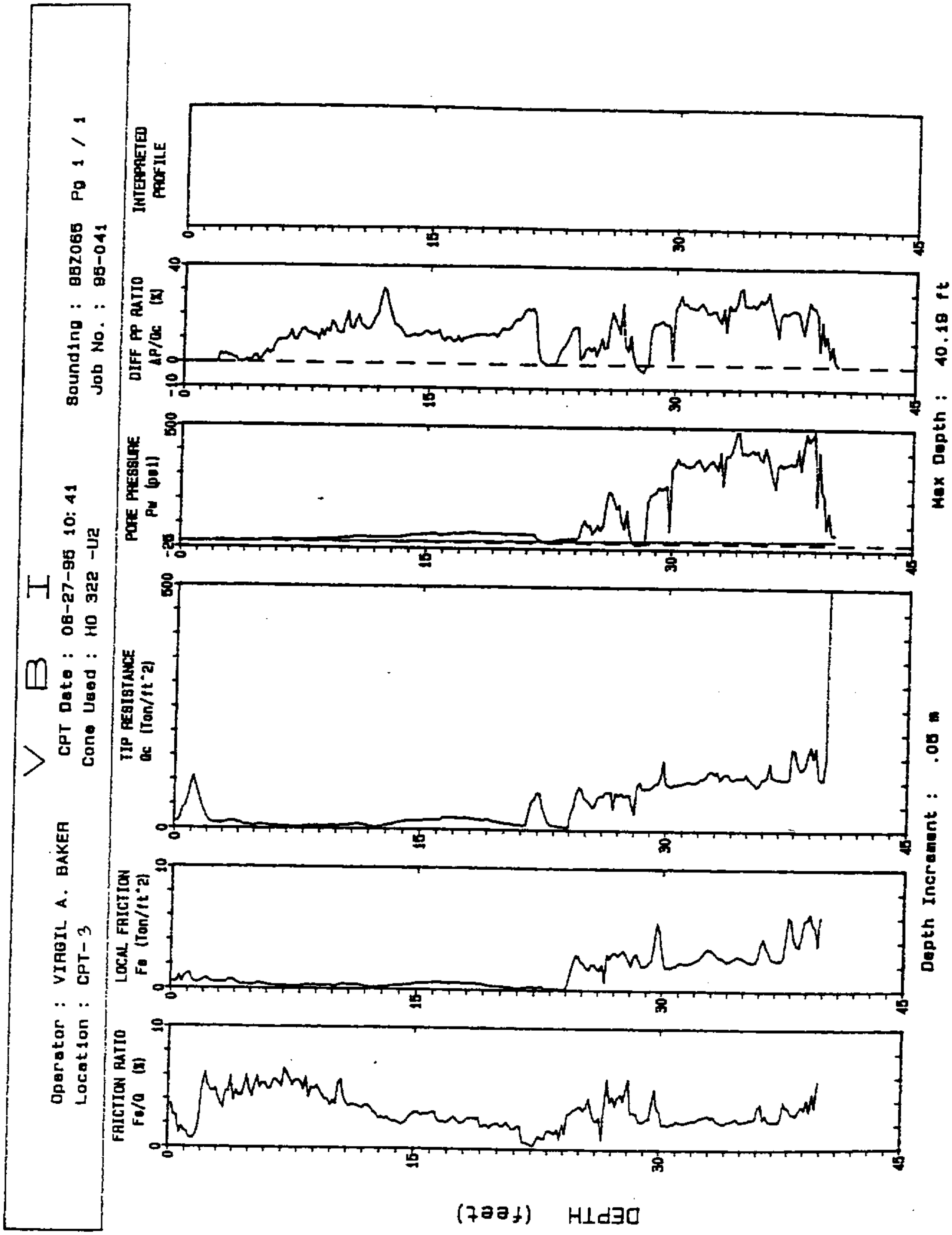
FILE: 243B10-B.DW2

MILLER PACIFIC ENGINEERING GROUP

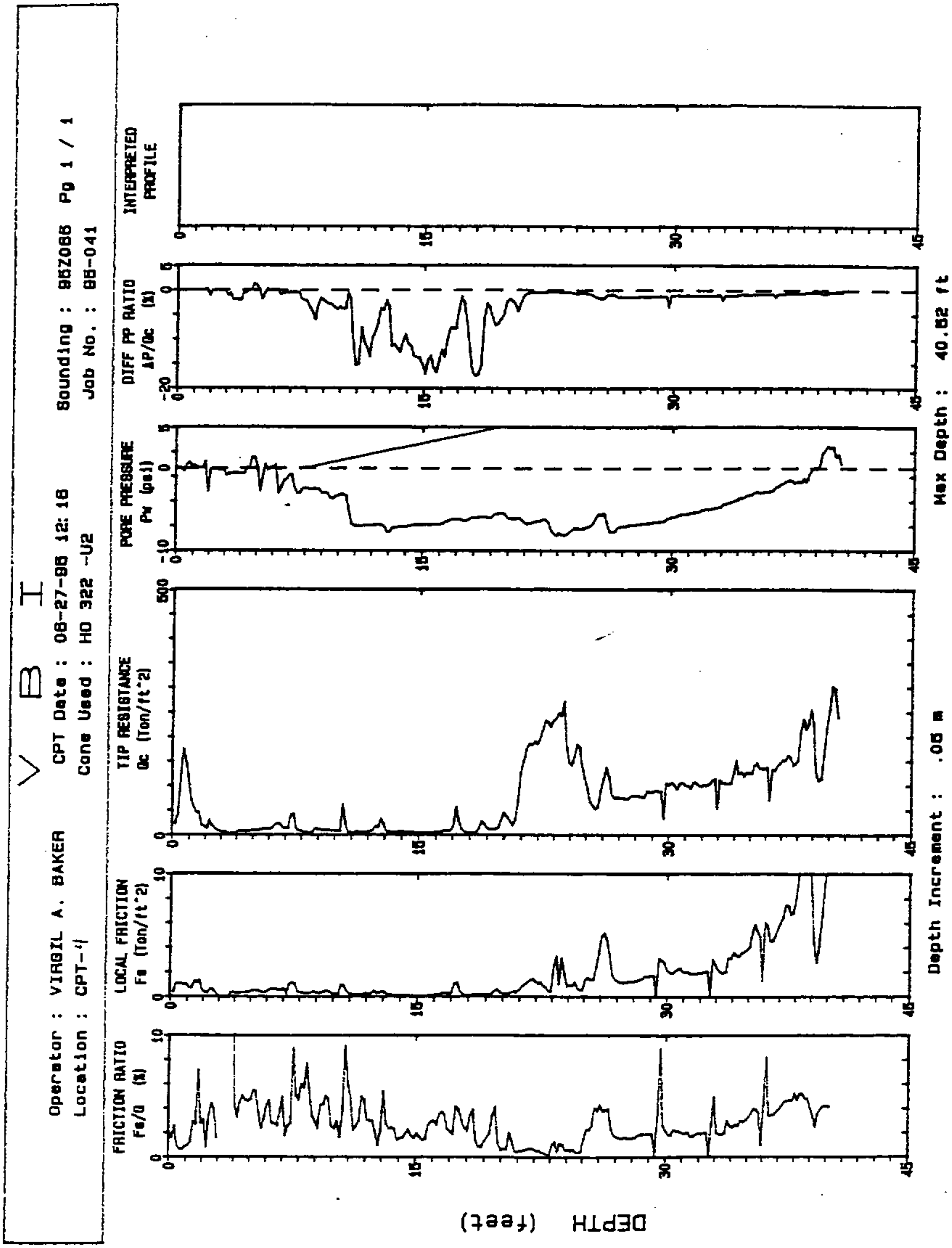
BORING LOG
Petaluma Flood Control Project
Petaluma, California

A-27
Figure

Project No. 243.07 Date 05/28/96 Approved By: SAS



MILLER PACIFIC ENGINEERING GROUP	CPT-3 FIELD DATA Petaluma Flood Control Project Petaluma, California	A-46
Project No. 243.07	Date 06/07/96	Approved By: SAS
		Figure



MILLER PACIFIC ENGINEERING GROUP

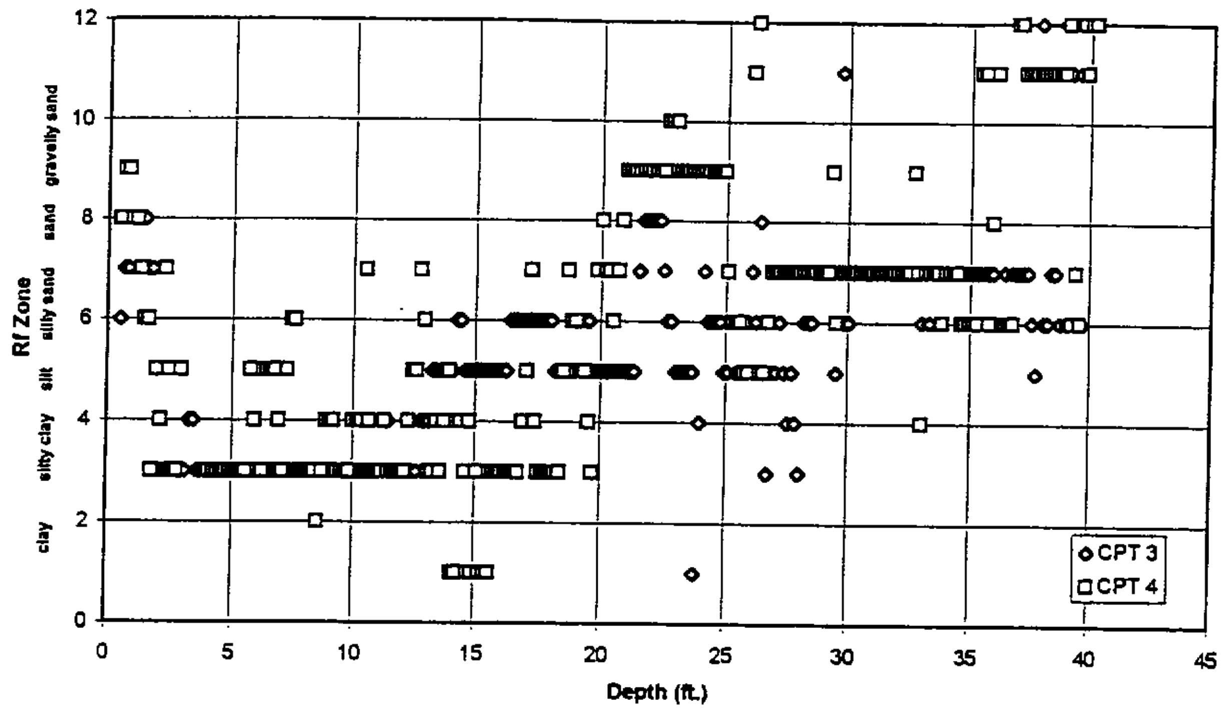
CPT-4 FIELD DATA
Petaluma Flood Control Project
Petaluma, California

A-47

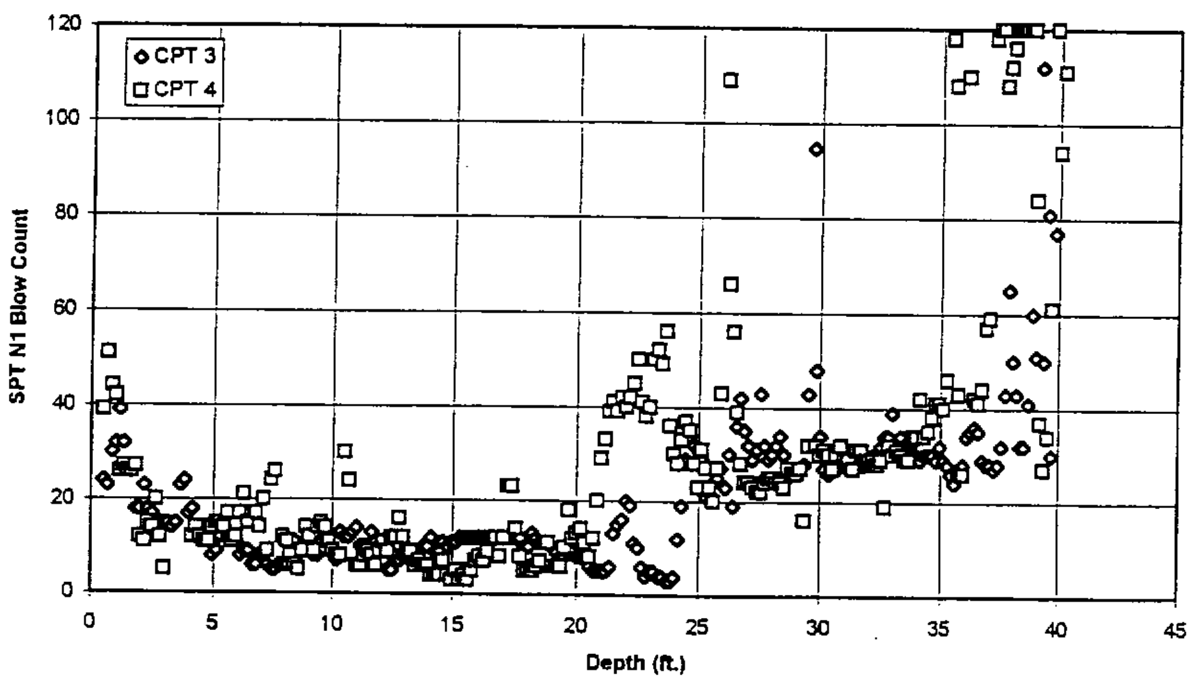
Project No. 243.07 | Date 06/07/96 | Approved By: SAS

Figure

Rf Zone vs Depth



SPT N1 Blow Counts vs. Depth



MILLER PACIFIC ENGINEERING GROUP

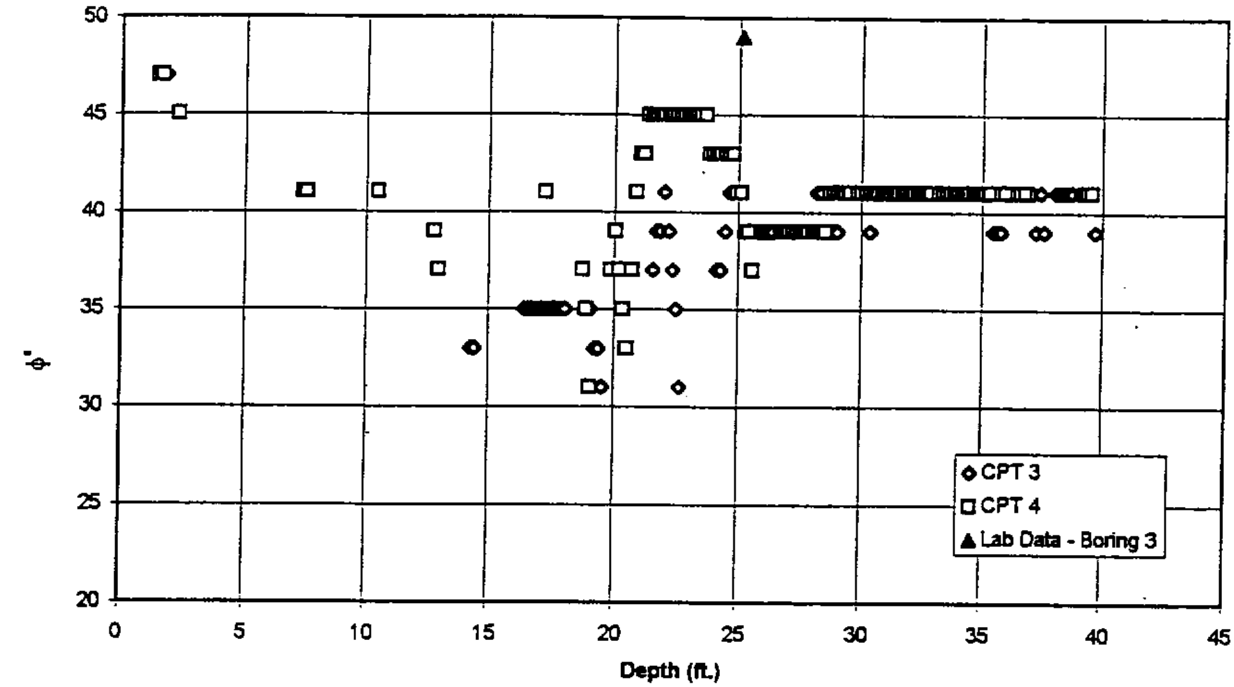
CPT INTERPRETED DATA
Petaluma Flood Control Project
Petaluma, California

A-48

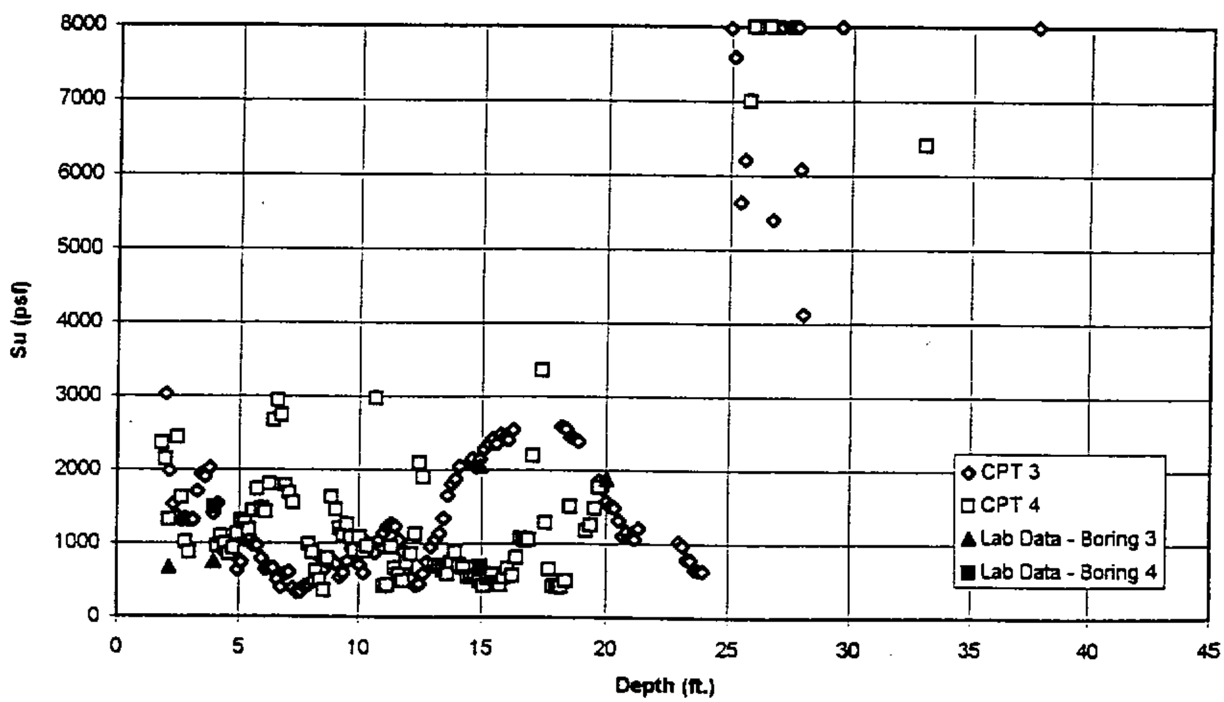
Project No. 243.07 | Date 06/07/96 | Approved By: SAC

Figure

Friction Angle vs. Depth



Undrained Shear Strength vs. Depth

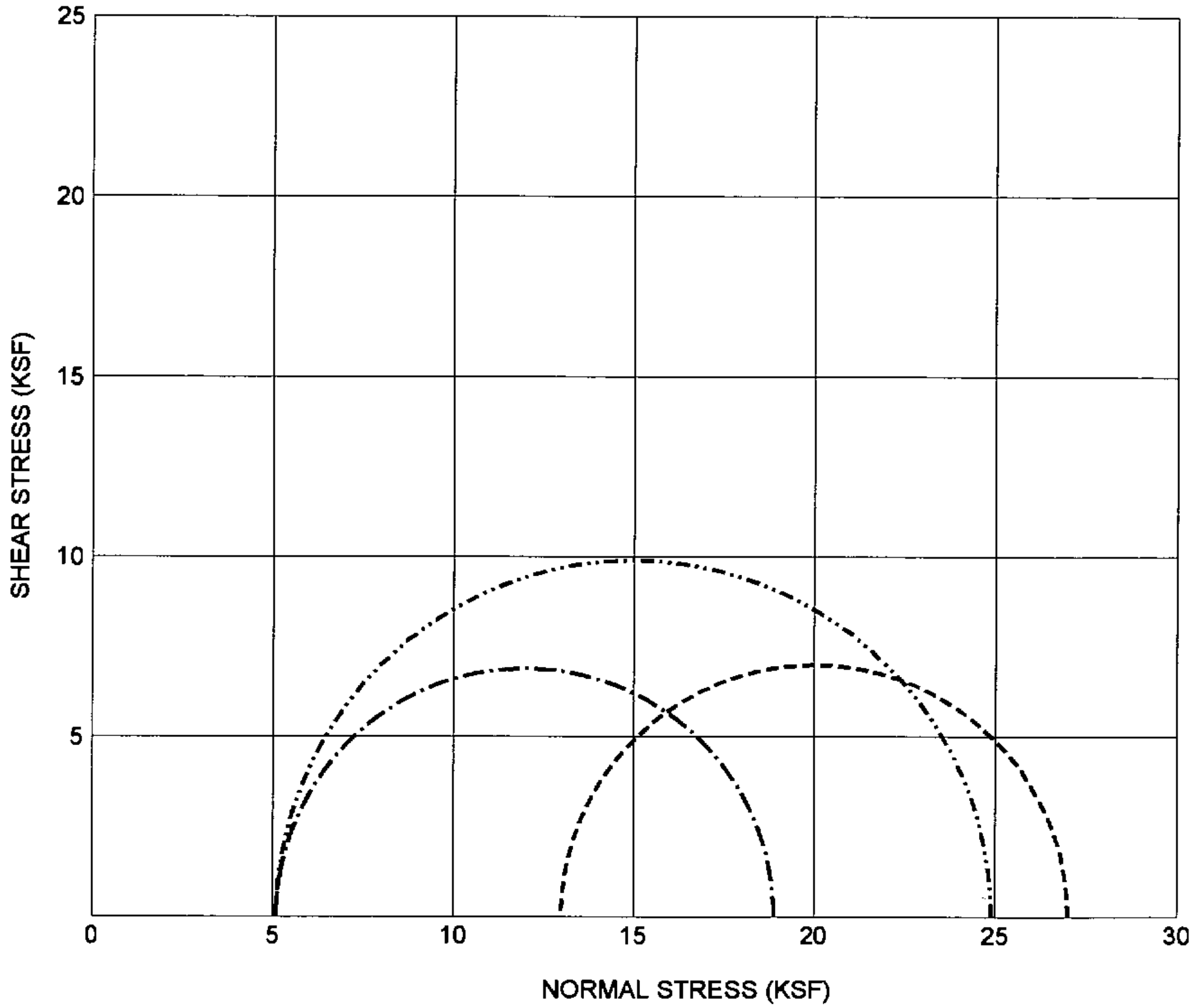


M I L L E R
P A C I F I C
E N G I N E E R I N G
G R O U P

CPT INTERPRETED DATA
Petaluma Flood Control Project
Petaluma, California

A-49
Figure

Project No. 243.07 | Date 06/07/96 | Approved By: SAS



SYMBOL	SAMPLE SOURCE	CLASSIFICATION	TOTAL STRESS (ksf)		EFFECTIVE STRESS (ksf)	
			C	ϕ	C'	ϕ'
------	BORING 4 14.5 feet	SANDY SILT (ML) brown, fine sand	0.70	- °	-	- °
—·—·—	BORING 5 5.5 feet	CLAYEY SAND (SC) olive gray, fine sand	0.69	- °	-	- °
—··—··—	BORING 6 5.5 feet	SANDY SILT (ML) dark brown, fine sand	0.99	- °	-	- °

FILE: 2437TRI1.DW2

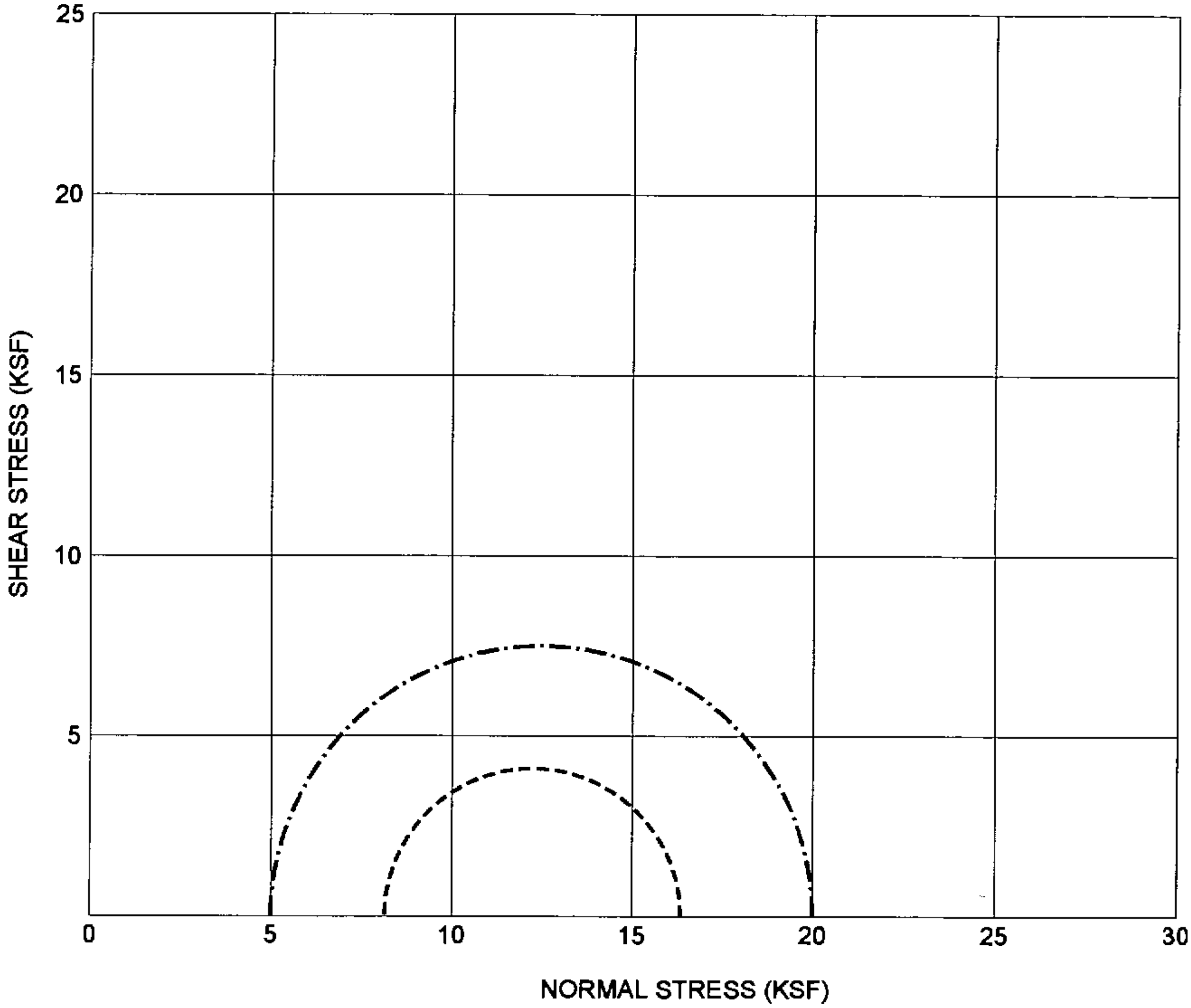
MILLER PACIFIC ENGINEERING GROUP

TRIAXIAL COMPRESSION TEST
Petaluma Flood Control Project
Petaluma, California

A-50

Project No. 243.07 Date 06/06/96 Approved By: SAS

Figure



SYMBOL	SAMPLE SOURCE	CLASSIFICATION	TOTAL STRESS (ksf)		EFFECTIVE STRESS (ksf)	
			C	ϕ	C'	ϕ'
- - - - - -	BORING 10 8.0 feet	SILTY CLAY (CL) brown, minor gravels	0.41	- °	-	- °
—·—·—	BORING 11 5.0 feet	SILTY SAND (SM) brown, fine sand	0.75	- °	-	- °

FILE: 2437TRI2.DW2

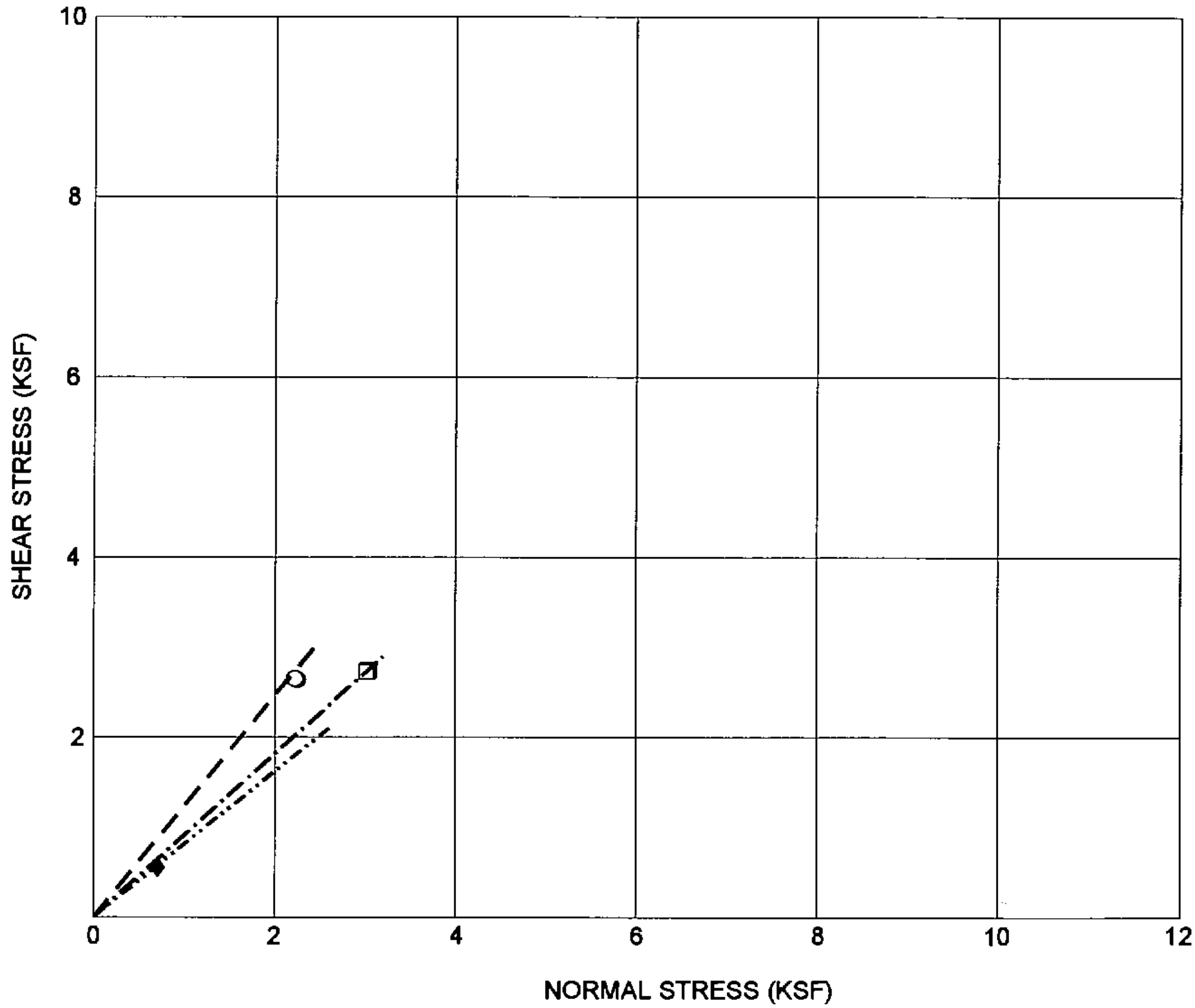
MILLER PACIFIC ENGINEERING GROUP

TRIAXIAL COMPRESSION TEST
Petaluma Flood Control Project
Petaluma, California

A-51

Project No. 243.07 Date 06/06/96 Approved By: SAS

Figure



SYMBOL	SAMPLE SOURCE	CLASSIFICATION	NORMAL STRESS (ksf)	RESIDUAL STRENGTH (ksf)	EFFECTIVE STRESS (ksf)	
					C'	ϕ'
—○—	BORING 3 24.5 feet	SANDY GRAVEL (GP) gray, gravels to 1/8 inch	2.3	2.7	0	49.0°
—·□·—	BORING 7 40.5 feet	SAND (SW-SM) light brown, coarse sand	3.0	2.7	0	42.0°
–··◆·–·	BORING 8 5.5 feet	SILTY SAND (SM) dark brown, fine sand	0.6	0.5	0	40.0°

FILE: 243-7ds1.dw2

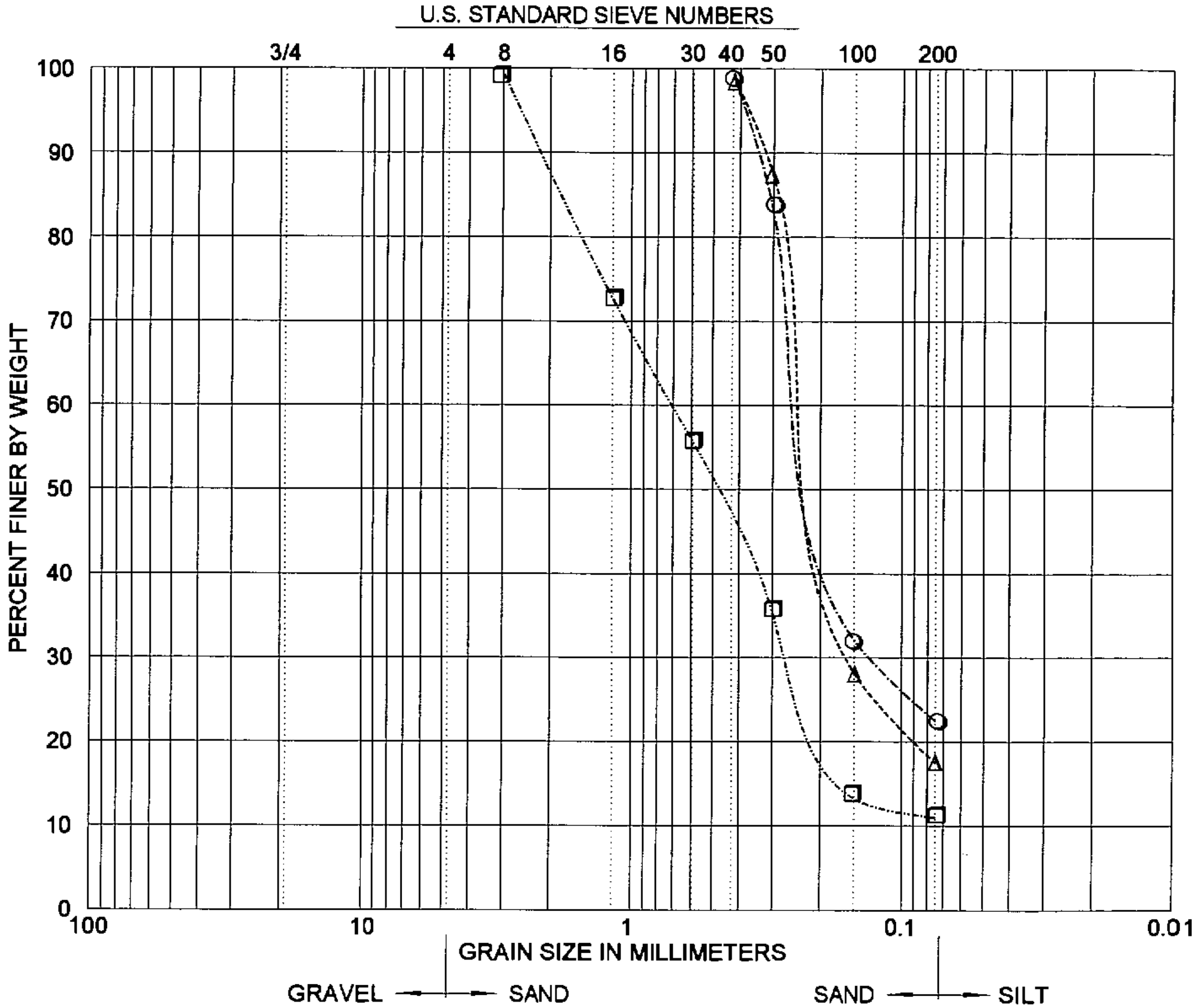
MILLER
PACIFIC
ENGINEERING
GROUP

DIRECT SHEAR TEST
Petaluma Flood Control Project
Petaluma, California

A-52

Project No. 243.07 Date 06/07/96 Approved By: SAS

Figure



SYMBOL	SAMPLE SOURCE	CLASSIFICATION
----△----	BORING 3 49.5 feet	SILTY SAND (SM)
---○---	BORING 4 41.5 feet	SILTY SAND (SM)
----□----	BORING 4 61 feet	WELL-GRADED SAND (SW)

FILE: 243-7SA1.DW2

MILLER PACIFIC ENGINEERING GROUP

SIEVE ANALYSIS
Petaluma River Flood Control
Petaluma, California

A-55

Project No. 243.07 Date 06/07/96 Approved By: SAS

Figure

BORINGS AND BY ARMY CORP, 1994

COE BORING PR-11

EQUIPMENT: 8-inch Rotary Wash
DATE: April 10, 1990
ELEVATION: +13.5 Feet*

*REFERENCE: Winzler and Kelly Topographic Map

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	DESCRIPTION
					0	0			CLAYEY SAND WITH GRAVEL (SC) very dark grayish brown, dry, medium and coarse sand, 15% clay, 15% angular gravel to 3/4 inch dia.
					1	5			
					2				POORLY GRADED SAND (SP) dark grayish brown, moist, medium sand
	1700 (DS)	7			3	10	■		
					4	15			POORLY GRADED SAND (SP) black, medium sand, 10% clay
		6			5		■		SILTY/CLAYEY SAND (SM/SC) very dark gray, moist to wet, medium sand, 20% clay
					6	20	■		(continued)

NOTES: (1) METRIC EQUIVALENT STRENGTH IS 0.0479 kPa
(2) METRIC EQUIVALENT DRY UNIT WEIGHT IS 0.1571 kN/m^3
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: 243CE11A.DW2

COE BORING PR-11 (CONTINUED)

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	DESCRIPTION
						20	SILTY/CLAYEY SAND (SM/SC) fat clay with sand, same color, wet, clay, 15% fine sand
					7		
							LEAN CLAY (CL) gray, moist, fine to coarse sand, 10% rounded gravel to 1-inch dia.
						25	well graded Sand, gray, moist, fine to coarse sand, 10% rounded gravel to 1-inch dia.
					8		
		40					well graded Sand, grayish brown, moist, medium sand, 20% coarse sand, 10% rounded gravel to 0.5-inch dia.
					9		
						30	
					10		POORLY GRADED SAND (SP) grayish brown, moist, medium and fine sand
	2400 (DS)	33					
						35	
					11		well graded Sand, 15% coarse sand, 10% subrounded gravel to 0.5-inch dia.
		51					
					12		
						40	

NOTES: (1) METRIC EQUIVALENT STRENGTH IS 0.0479 kPa
(2) METRIC EQUIVALENT DRY UNIT WEIGHT IS 0.1571 kN/m^3
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: 243CE11B.DW2

MILLER PACIFIC ENGINEERING GROUP

CORPS OF ENGINEERS BORING LOG
Petaluma Flood Control Project
Petaluma, California

A-35

Project No. 243.07 Date 06/10/96 Approved By: SAS

Figure

COE BORING PR-11 (CONTINUED)

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	
						40			POORLY GRADED SAND (SP) 10% coarse sand
					13				
		65/6"							
						45			
					14				interbeds of well graded sand, 15% coarse sand, 10% subrounded gravel to 3/8-inch dia.
	2200 (DS)	64			15	50			
					16				3-inch interbed of well graded sand, 50% coarse sand, 30% medium sand, 10% gravel
		50				55			
					17				
									interbed of well graded sand, 25% medium sand, 25% coarse sand, 25% sub-rounded gravel to 1/8-inch dia.
		71			18	60			
									(continued)

NOTES: (1) METRIC EQUIVALENT STRENGTH IS 0.0479 kPa
(2) METRIC EQUIVALENT DRY UNIT WEIGHT IS 0.1571 kN/m^3
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: 243CE11C.DW2

MILLER PACIFIC ENGINEERING GROUP

CORPS OF ENGINEERS BORING LOG
Petaluma Flood Control Project
Petaluma, California

A-36

Project No. 243.07 | Date 05/28/96 | Approved By: SAS | Figure

COE BORING PR-11 (CONTINUED)

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters / feet	SAMPLE	SYMBOL (3)	
					60 ft			**POORLY GRADED SAND (SP)** interbed of well graded sand, 25% medium sand, 25% coarse sand, 25% sub-rounded gravel to 1/8-inch dia.
					19 m			**WELL GRADED SAND (SW)** grayish brown and light olive brown, wet, 40% medium sand, 40% coarse sand, 15% rounded gravels to 0.5-inch diameter, 5% clay
		67/11"						
					65 ft			
					20 m			
								poorly graded sand, grayish brown, wet, medium and fine sand
					21 m			
		72/11"						
					70 ft			
					22 m			
								4-inch interbed of well graded sand with gravel, 60% coarse sand, 30% medium sand, 20% gravel
		85/11"						
					75 ft			
					23 m			
								poorly graded sand, light olive brown, wet, medium sand, medium compaction
					24 m			
					80 ft			**SILTSTONE** (continued)

NOTES: (1) METRIC EQUIVALENT STRENGTH IS 0.0479 kPa
(2) METRIC EQUIVALENT DRY UNIT WEIGHT IS 0.1571 kN/m^3
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: 243CE11D.DW2

MILLER PACIFIC ENGINEERING GROUP

CORPS OF ENIGNEERS BORING LOG
Petaluma Flood Control Project
Petaluma, California

A-37

Project No. 243.07 | Date 06/10/96 | Approved By: SAS

Figure

COE BORING PR-11
(CONTINUED)

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	DESCRIPTION
						80			SILTSTONE light olive brown, dry, strong compaction
					25				POORLY GRADED SAND (SP) light olive brown, wet, 80% medium sand, 20% fine sand, weak compaction
		83/11"							
					26	85			
		63							POORLY GRADED SAND (SP) light blue gray, wet, medium sand, 10% fine sand, 10% clay, trace coarse sand dark greenish gray, dry, 30% clay, low plasticity, medium compaction
					27				
						90			
					28				
					29	95			
					30				
		50/6"							LEAN CLAY (CL) dark greenish gray, very moist, clay, 20% silt, firm
						100			Bottom of Boring at 100 feet

NOTES: (1) METRIC EQUIVALENT STRENGTH IS 0.0479 kPa
(2) METRIC EQUIVALENT DRY UNIT WEIGHT IS 0.1571 kN/m^3
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: 243CE11E.DW2

MILLER PACIFIC ENGINEERING GROUP

CORPS OF ENIGNEERS BORING LOG
Petaluma Flood Control Project
Petaluma, California

Project No. 243.07 Date 06/10/96 Approved By: SAS

Figure A-38

,trace broken rounded
¼ diameter

BORING PR-13

23 APRIL 1990

DEPTH	ELEV MLLW	LAB	Gr	Sa	Fi	LL	PI	OO	FC	N	DESCRIPTION
0											LEAN CLAY with SAND Dark brown(10 YR 3/3),moist,dry,20% fine sand, low plasticity,firm,coarse gravel(?) in top 1 foot
		SM	0	66	32						POORLY GRADED SAND with SILT Pale brown(10 YR 6/3),dry,medium sand
5		CL				44	31			13	LEAN CLAY Very dark gray(10 YR 3/1),moist,dry,medium plasticity,firm
10		SM	0	35	65						POORLY-GRADED SAND with SILT Pale brown(10 YR 6/3),dry,medium sand,10% clay 20% clay
		SM	0	35	65						Wet
15		SM	0		44					16	10% clay
20										17	WELL-GRADED SILTY SAND Brown(10 YR 4/3),wet,medium and fine sand, 10% coarse sand,10% well-rounded gravels 2-inch thick lean clay(CL) bed
25		SW/SM	7	86	7					30	Fining upwards Mostly coarse sands and gravels below 24.5 feet
30		SW/SM	7	86	7					38	

BORING PR-14

PTH	ELEV MLLW	LAB	Ca.	Sa.	FL	LL	PI	DD	WC	N	DESCRIPTION
0											LEAN CLAY with GRAVEL and SAND Dark brown(7.5 YR 4/2),dry,clay,25% fine sand and fine gravel
5											POORLY-GRADED SAND Light yellowish brown(10 YR 6/4),dry,fine grained
0											LEAN CLAY Very dark grey(2.5 Y 3/0),moist,low plasticity,soft, 20% silt Decrease in silt content,wet
5										2 SPT	POORLY GRADED SAND Dark grey(2.5 Y N/4),wet,fine grained
)										7 SPT	WELL-GRADED SAND Dark grey(2.5 Y N/4),wet,80% fine to coarse sand, 10% fine subrounded gravel
5											POORLY GRADED GRAVEL wet,fine grained,subrounded to rounded,no sand
											[illegible],light olive brown(2.5 Y 5/4),wet,75-80% fine subrounded gravel,20-25% fine to coarse sand(20% silt at 27.5)
)											CLAYEY SAND with GRAVEL Pale olive (5 Y 6/3),wet,60% fine to coarse sand, 20% clay,20% fine gravel

BORING PR-15

9 APRIL 1990