Appendix 5.5-1 Geotechnical Report

Appendices

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UPDATE REPORT
GEOTECHNICAL INVESTIGATION

Proposed Multi-Story Tower and CUP Area
Inland Valley Regional Medical Center
36485 Inland Valley Drive, Wildomar, California

PREPARED FOR

INLAND VALLEY MEDICAL CENTER

UHS of Delaware, Inc.
C/O The Barrie Company
9434 Chesapeake Drive, Suite 1208
San Diego, CA 92123

PREPARED BY

NOVA

NOVA Services, Inc.
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NOVA Project No. 3019060

December 12, 2019

UHS of Delaware, Inc.
c/o The Barrie Company
9434 Chesapeake Drive, Suite 1208
San Diego, CA 92123

December 12, 2019
NOVA Project No. 3019060

Attention: Mrs. Elizabeth Barrie

Subject: Update Report
Geotechnical Investigation
Proposed Inland Valley Regional Medical Center Multi-Story Tower and CUP Area
36485 Inland Valley Drive, Wildomar, California

Dear Mrs. Barrie:

NOVA Services, Inc. (NOVA) is pleased to present herewith this report of its geotechnical investigation for the above-referenced project. The work reported therein was completed by NOVA for UHS of Delaware, Inc., in accordance with the scope of work identified in NOVA's proposal dated July 16, 2019, as authorized on July 26, 2019. This report has been updated and includes 2019 California Building Code (CBC) Seismic Design Parameters after ASCE 7-16.

NOVA appreciates the opportunity to be of continued service to The Barrie Company and UHS of Delaware, Inc. Should you have any questions, please do not hesitate to contact the undersigned at (949) 388-7710.

Sincerely,

NOVA Services, Inc.

Jesse D. Bearfield, R.C.E.
Senior Engineer

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UPDATE REPORT
GEOTECHNICAL INVESTIGATION

Proposed Multi-Story Tower and CUP Area
UHS Inland Valley Regional Medical Center
Wildomar, California

TABLE OF CONTENTS

List of Plates

List of Appendices

List of Tables

List of Figures

1.0 INTRODUCTION

1.1 Terms of Reference

This report presents the findings of a geotechnical investigation of the site of a proposed multi-story tower and CUP area, to be constructed within the southern central area of the Inland Valley Regional Medical Center campus.

The work reported herein was completed by NOVA Services, Inc. (NOVA) for UHS of Delaware, Inc. and The Barrie Company in accordance with the scope of work identified in NOVA's proposal dated July 16, 2019, as authorized on July 26, 2019.

Figure 1-1 depicts the vicinity of the Inland Valley Regional Medical Center campus.

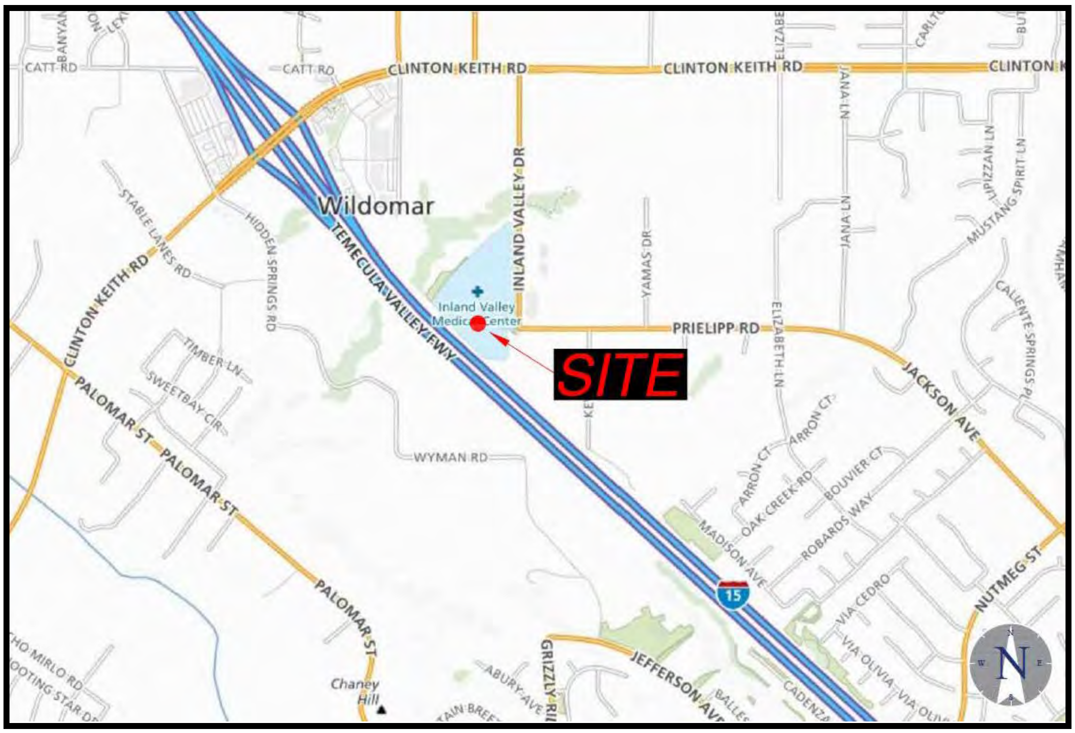


Figure 1-1. Vicinity Map

1.2 Objectives, Scope and Limitations of This Work

1.2.1 Objectives

The objectives of the work reported herein are twofold: (i) to characterize the subsurface conditions at the site in a manner sufficient to develop recommendations for geotechnical-related design and construction; and, (ii) to conduct percolation testing to support development of recommendations for siting and design of permanent stormwater infiltration Best Management Practices ('BMPs').

1.2.2 Scope

In order to accomplish the above objective, NOVA's undertook the task-based scope of services described below.

- Task 1, Review. Reviewed background data, including geotechnical reports, fault investigation reports and maps, topographic maps, geologic data, aerial photographs and preliminary development plans for the project. Coordinated with the Structural Engineer to obtain current structural information.

- Task 2, Field Exploration. Completed a subsurface exploration that included the subtasks listed below.

  - *Subtask 2-1, Reconnaissance.* Conducted a site reconnaissance, including layout of the engineering borings and soundings. Underground Service Alert was notified for utility mark-out services.

  - *Subtask 2-2, Engineering Borings.* Drilled, logged and sampled ten (10) engineering borings to depths of about 15 to 50 feet below existing ground surface (bgs). The borings were drilled and sampled using ASTM methodologies.

  - *Subtask 2-3, Soundings.* Advanced seven (7) static cone penetration test (CPT) soundings to depths of about 25 to 55 feet bgs after ASTM D5778.

  - *Subtask 2-4, Percolation Testing.* Drilled five (5) percolation test borings, following which percolation testing was completed in each boring.

  - *Subtask 2-5, Seismic Traverse.* Performed one (1) seismic refraction line to survey, verify and determine Site Class after 2019 California Building Code.

  - *Subtask 2-6, Closure.* The engineering borings and percolation test borings were each closed following completion. Closure consisted of backfilling the borings with a mix of bentonite and cuttings from the drilling, as required by the City of Temecula. Thereafter, the area around each boring was cleaned and restored to its approximate condition prior to drilling.

- Task 3, Laboratory Testing. Laboratory testing of both bulk and relatively undisturbed samples was completed using ASTM testing methods.

- Task 4, Engineering Evaluations. Utilizing the findings of the preceding tasks, conducted engineering evaluations that address the geotechnical-related aspects of the planned construction.

- Task 5, Reporting. Preparation of this report providing NOVA's findings and preliminary geotechnical recommendations completes the scope of work described in NOVA's proposal.

1.2.3 Limitations

The construction recommendations in this report are not final. These recommendations are developed by NOVA using judgment and opinion and based upon the limited information available from the borings and soundings. NOVA can finalize its recommendations only by observing actual subsurface conditions revealed during construction. At the time of preparation of this report, neither construction nor proposed plans had been developed for the site. NOVA cannot assume responsibility or liability for the report's recommendations if NOVA does not perform construction observation.

This report does not provide any environmental assessment or investigation of the presence or absence of hazardous or toxic materials in the soil, groundwater, or surface water within or beyond the site.

Appendix A to this report provides important additional guidance regarding the use and limitations of this report. This information should be reviewed by all users of the report.

1.3 Report Organization

The remainder of this report is organized as described below.

- Section 2 reviews the presently available project information.
- Section 3 describes the subsurface investigation and related laboratory testing.
- Section 4 describes the geologic setting and site-specific subsurface conditions.
- Section 5 reviews geologic, soil and siting-related hazards that commonly affect civil development in this region considering each for its potential to affect this site.
- Section 6 provides recommendations for earthwork and foundation-related design.
- Section 7 provides recommendations for development of stormwater infiltration BMPs.
- Section 8 provides recommendations for development of pavements.
- Section 9 lists the principal references utilized in preparation of this report.

Tables and figures that amplify discussion in the text of the report are embedded at the point at which they are referenced. Plates that provide larger scale views of certain figures are provided immediately following the text of the report.

The report is supported by six appendices.

- Appendix A presents guidance regarding use of this report.
- Appendix B provides logs of the engineering borings.
- Appendix C provides logs of the penetrometer soundings.
- Appendix D provides records of geotechnical laboratory testing.
- Appendix E provides documentation related to stormwater infiltration.
- Appendix F provides records of NOVA's assessment of liquefaction potential and seismic settlement.

2.0 PROJECT INFORMATION

2.1 Location

The Inland Valley Regional Medical Center is located at the address of 36485 Inland Valley Drive in the city of Wildomar, California. The proposed multi-story tower is to be located within the southern central portion of the campus currently occupied with a single-story structure and a small parking area. A proposed Conditional Use Permit (CUP) area is located at the undeveloped southwestern region of the site, designated as Parcel 2.

The medical campus and proposed project areas are bounded by Interstate 15 to the west and southwest, Inland Valley Drive to the east and, a drainage area adjacent to partially developed property to the north. Access to the medical campus is provided via Prielipp Road to the south and Inland Valley Drive to the east.

Figure 2-1 provides a recent aerial view that depicts the location and approximate limits of the approximate project area at the site.

Figure 2-1. Location and Limits of the Site
(Source: adapted from Google Earth 2019)

2.2 Current and Historic Site Use

2.2.1 Current

As is evident by review of Figure 2-1, the proposed project areas are currently developed with a single-story structure, asphalt covered parking areas, and landscaping space. The average ground surface elevation in the vicinity of the planned multi-story tower ranges between ±1,332 and ±1,334 feet mean sea level and the CUP area ranges between about ±1,334 and ±1,336 feet mean sea level (msl), respectively.

2.2.2 Historic

NOVA reviewed historic aerial photography and topographic mapping dating to 1938 as a basis for understanding historical uses of the site. This review indicates that prior to development of the Inland Valley Regional Medical Center during the period between 1982 and 1996, the site area had minimal development. Historic uses of the area appear to be agricultural and ranching-related.

Aerial photos of the site from 1982 indicate that there was a small water basin adjacent to the location of the proposed CUP building. Figure 2-2 below presents the approximate location of the proposed building overlaid on this aerial photo.

Based on review of referenced reporting documents, NOVA understands a geotechnical investigation report titled "*Preliminary Investigation for a Subject Site Located on Prielipp Road in Wildomar California,*" Academy Soils Engineering, Project No. F-8451-85 April 8, 1985 was prepared for the original development of the property. The reporting was not available for preparation of this report.

Figure 2-2. 1982 Aerial Photography and Approximate CUP Site

2.3 Previous Reporting

Previous geotechnical reporting for the development for some of the existing improvements and structures at Inland Valley Regional Medical Center campus were reviewed. References to these reports are presented below. Boring logs from previous reporting are included herein and are attached following NOVA Boring and Percolation logs in Appendix B and locations presented on Plate 1B.

- Leighton 1998. *Geotechnical Investigation Report for the Proposed O.R./Ambulatory Care Addition,* Leighton and Associates, Project No. 11980284-001, December 16, 1998.

- MACTEC 2003. *Report of Geotechnical Investigation, Proposed Additions,* MACTEC, Project 4953-03-1451, June 17, 2003.

- Twining 2008a. *Geotechnical Engineering Evaluation Report, Inland medical Center New Parking Lot,* Twining Laboratories, Project No.: 080154.3, March 26, 2008.

- Twining 2008b. *Recommendations for Site Pavements, Inland Valley Medical Center – ER, ICU, Radiology and CCU Expansion,* Twining Laboratories, Project No.: 080071.3, December 11, 2008.

2.4 Schematic Planning

2.4.1 General

NOVA's understanding of current planning for the new multi-story tower and CUP Area building is based upon discussions with Carrier Johnson, as well as review of the schematic design drawings that are listed below:

- HOK 2019. *Site Plan, Phase 3 Plan with Survey, Inland Valley Regional Medical Center*, HOK, undated.

- KH 2019. *Inland Valley Regional Medical Center – Rough Grading (North Option),* Kimley Horn and Associates, 2019.

- NV5. *As-Built Utility Plan, Inland Valley Regional Medical Center*, NV5, February 25, 2019.

2.4.2 Architectural

Plans for the development of the project are within the preliminary stages of development. Based on discussions with the project architect, NOVA understands the new tower structure will be 7 stories in height with 2 podium levels at the base of the structure. The CUP building will be one-story in height.

2.4.3 Structural

Limited information is available regarding structural concepts for the multi-story tower. Based upon experience with similar structures, NOVA expects that the new facility will be developed on shallow foundations, utilizing isolated and continuous foundations to support columns and walls. The interior floor slab will be a ground-supported mat. As noted above, it is expected that the structure will be steel framed.

Because design is still schematic, structural loads are unknown. However, Table 2-1 provides NOVA's estimate of the range of foundation reactions for this relatively light structure.

Table 2-1. Expected Column and Wall Loads (DL +LL)

Structure	Typical Exterior Col. Loads (kips)	Typical Interior Col. Loads (kips)	Typical Wall Loads (kips per lineal foot)
Multi-Story Tower	300 - 400	400 - 600	2 - 4
CUP Area Structure	25- 35	40 - 50	2 - 4

2.4.4 Civil

The layout and design for the new multi-story tower and CUP area building are not yet finalized. Current planning indicates the building footprints and finish floor elevations for the 1st level of the proposed structures. Figure 2-4 depicts one option that is under consideration for site development. Figures 2-3 and 2-4 present the layouts of the proposed new buildings.

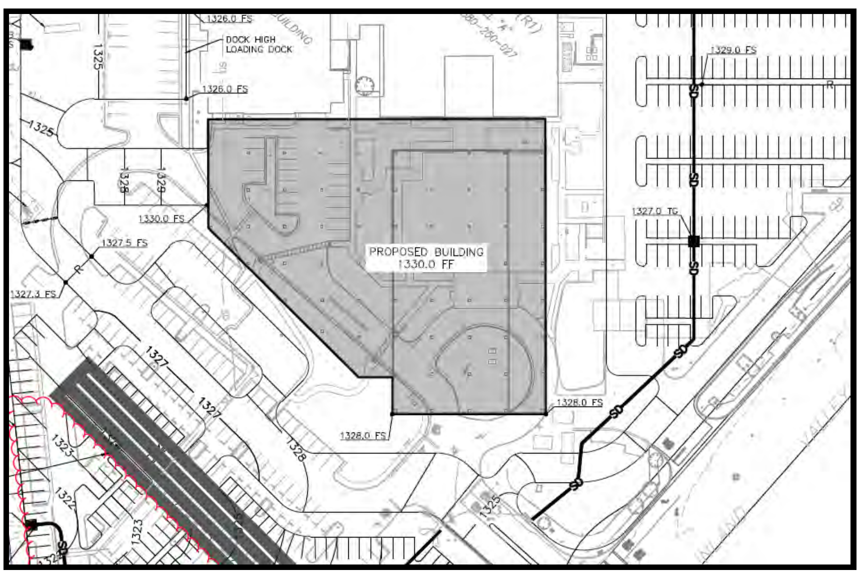


Figure 2-3. Proposed Multi-Story Tower
(Source: *Rough Grading, (South Option)*, Kimley Horn 2019)

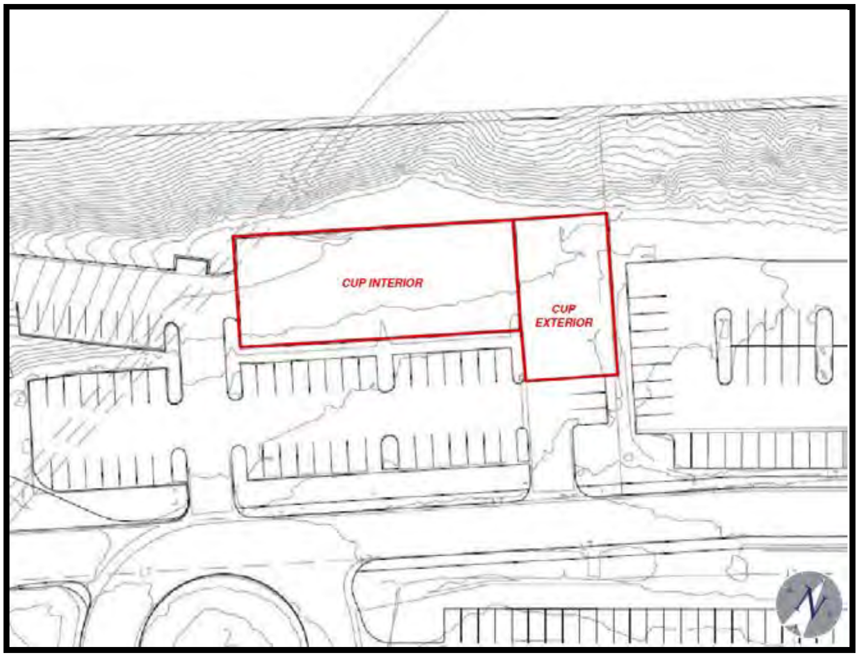


Figure 2-4. Proposed Building at CUP Area (North Option)

No below grade structures are depicted on the planning that has been reviewed by NOVA. Grading plans are not yet developed for the new facility. It is expected that development of the site will likely involve grading and placing about two to three feet of engineered fill to adapt the new buildings to the existing site and adjacent roadways.

There is a stormwater management area located southwest of the proposed tower. This area is conceptual as of the date of this report.

2.4.5 Demolition and Earthwork

Prior to the start of construction for the proposed site redevelopment, the existing structure, flatwork, and pavement in the areas of the new construction will be demolished. Existing utilities will be removed and realigned to accommodate the new site configuration.

3.0 FIELD EXPLORATION AND LABORATORY TESTING

3.1 Overview

The field exploration of the site was conducted over the period of August 9, August 27-28, October 7 and November 2, 2019. NOVA completed ten engineering borings (‘B-1’ through ‘B-10’), seven CPT soundings (‘CPT-1’ through ‘CPT-7’), five percolation tests (‘P-1’ through ‘P-5’), and one seismic traverse (ST-1). The borings were drilled to a maximum depth of 50 feet below existing ground surface (bgs). Laboratory testing was completed on samples recovered from the borings. The CPTs were advanced to depths of about 25 to 55 feet bgs. The seismic analysis provided shear wave velocity data to 220 feet below ground surface. Velocities in the top 100 feet were used to classify the site in accordance with ASCE 7-16 Table 20.3-1.

Figure 3-1 provides a plan view of the site indicating the locations of the engineering borings, CPT soundings, percolation test borings, and seismic traverse. Plate 1, provided immediately following the text of this report, provides this graphic in larger detail.

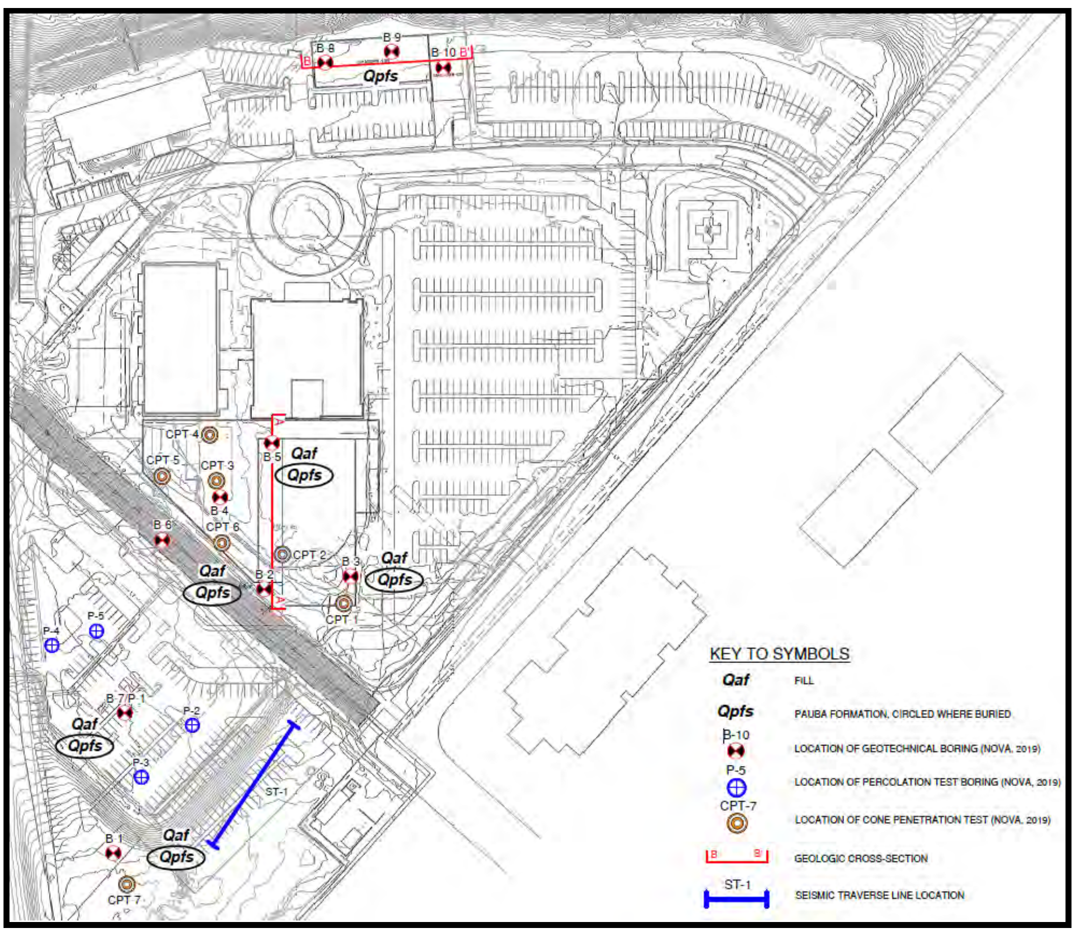


Figure 3-1. Engineering Borings, CPT Soundings, Percolation Test Boring and Seismic Traverse Locations

3.2 Engineering Borings

3.2.1 Drilling

The geotechnical borings were advanced with a truck-mounted drill rig utilizing hollow stem drilling equipment. The borings were drilled at locations determined in the field by a NOVA geologist, then completed under the surveillance of the geologist. Figure 3-2 depicts the drilling operation.

Figure 3-2. Geotechnical Test Boring B-1

Table 3-1 provides an abstract of the engineering borings.

Table 3-1. Abstract of the Engineering Borings

Ref	Approx. Elev. (feet, msl)	Depth (feet)*	Boring Termination Elev. (feet, msl)	Depth to Ground Water (feet)
B-1	± 1,329	50.0	± 1,279	Not Encountered
B-2	± 1,328	26.5	± 1,301	Not Encountered
B-3	± 1,328	26.5	± 1,301	Not Encountered
B-4	± 1,328	50.0	± 1,278	Not Encountered
B-5	± 1,329	26.0	± 1,303	Not Encountered
B-6	± 1,327	25.0	± 1,302	Not Encountered
B-7	± 1,325	15.0	± 1,310	Not Encountered
B-8	± 1,326	20.0	± 1,306	Not Encountered
B-9	± 1,326	50.0	± 1,276	47.6
B-10	± 1,327	20.0	± 1,307	Not Encountered

3.2.2 Sampling

Both disturbed and relatively undisturbed samples were recovered from the borings. Soil sampling was as described below.

1. The Modified California sampler ('ring sampler', after ASTM D 3550) was driven using a 140-pound hammer falling for 30 inches with a total penetration of 18 inches, recording blow counts for each 6 inches of penetration.

2. The Standard Penetration Test sampler ('SPT', after ASTM D1586) was driven in the same manner as the ring sampler, recording blow counts in the same fashion. SPT blow counts for the final 12-inches of penetration comprise the SPT 'N' value, an index of soil consistency.

3. Bulk samples were recovered from the subsurface soils, providing composite samples for index testing.

4. Figure 3-3. Sample from B-1 at 30' bgs

3.2.3 Closure

Upon completion, each boring was backfilled with a mix of bentonite and soil cuttings and patched to match the existing surfacing.

Records of the engineering borings are presented in Appendix B.

3.3 Cone Penetration Test Soundings

3.3.1 General

The CPT soundings were completed to depths of about 25 to 55 feet bgs. Like the engineering borings, the locations of the soundings were determined in the field by the NOVA geologist. The soundings were performed by a specialty subcontractor retained by NOVA working under the direction of the geologist.

Figure 3-4. CPT-3 Sounding

The soundings were completed in general conformance with ASTM D5778 "*Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils.*" NOVA employs this exploration tool to supplement engineering borings, providing continuous profiles, reliable and repeatable (i.e. the influence of the equipment operator is minimized) soil data, and a good estimate of common soil engineering properties.

Table 3-2 abstracts the indications of the soundings. Logs of the soundings are provided in Appendix C.

Table 3-2. Abstract of the CPT Soundings

Sounding	Approximate Elevation (feet, msl)	Total Depth (feet)	Termination Elevation (feet, msl)
CPT-1	±1,328	27.0	±1,301.0
CPT-2	±1,328	30.5	±1,297.5
CPT-3	±1,328	31.0	±1,297.0
CPT-4	±1,328	25.5	±1,302.5
CPT-5	±1,328	37.5	±1,290.5
CPT-6	±1,328	41.0	±1,287.0
CPT-7	±1,328	55.5	±1,272.5

3.3.2 Strength and Compressibility of the Subsurface

Figure 3-5 (following page) provides a summary graphic that indicates the variation of subsurface compressibility with depth. Review of Figure 3-5 indicates the following:

1. Compressibility. The subsurface materials at and below the planned structure are generally very dense- exhibiting very low potential for compressibility under the planned development. As may be seen by review of Figure 3-5, Young's modulus (E_s) of the soil below the foundation level is characteristically near 2,000 tons per square foot (tsf). This stiffness is characteristic of very dense, relatively unyielding soils.

2. Strength. The soils reflected by Figure 3-5 will behave as sands, with shear strength (τ) developing as a function of soil confining stress (σ'), cohesion (c') and angle of friction (ϕ'), where t = c' + σ' tan (ϕ'). As may also be seen by review of Figure 3-2, the soil mass in the near surface is of higher relative density (D_r), and capable of developing very high strength by virtue of the high angle of friction.

Section 4 discusses the geology and soils of the site in more detail. As discussed in Section 4, the soils are comprised entirely of sandy soils of Holocene age.

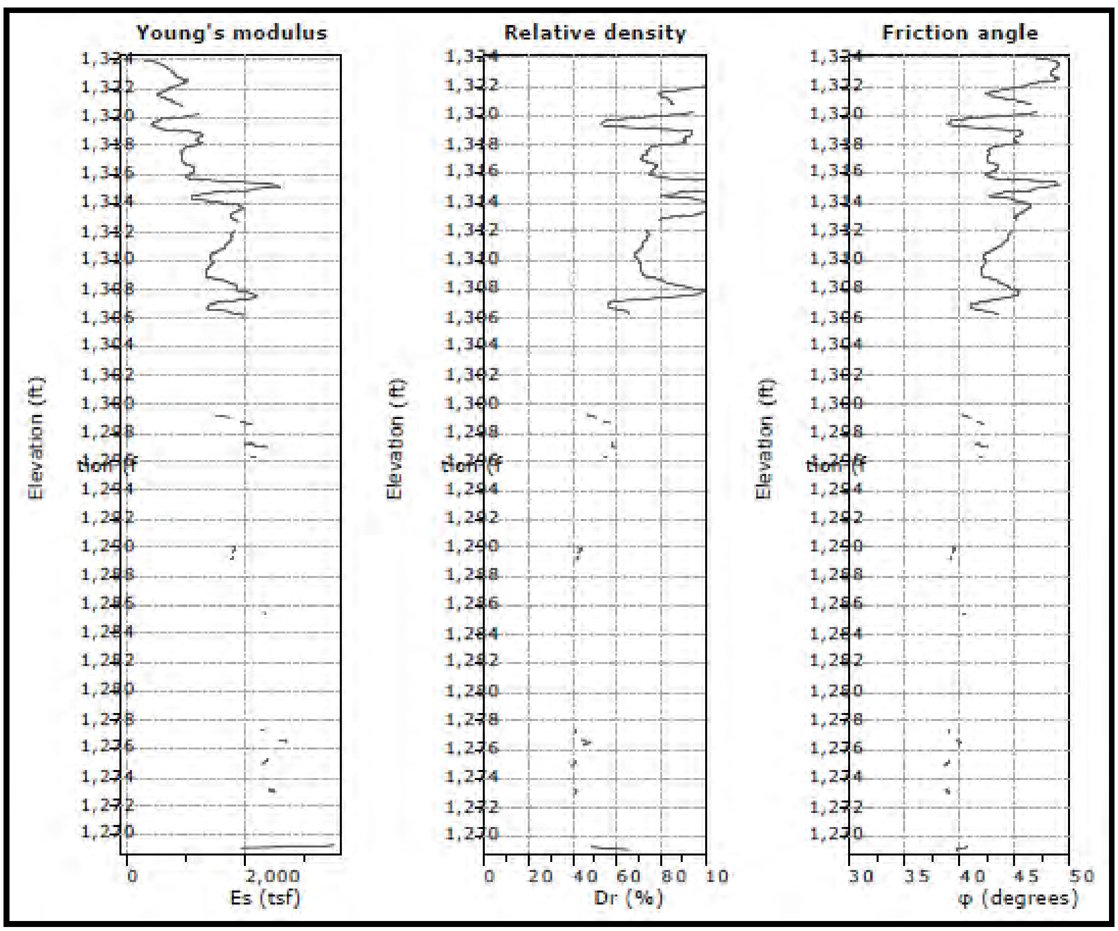


Figure 3-5. Compressibility and Strength of the Subsurface, CPT-2

3.4 Percolation Testing

3.4.1 General

NOVA directed the excavation and construction of five (5) percolation test borings, following the recommendations for percolation testing presented in the *Riverside County, Santa Margarita River Watershed Region Design Handbook for Low Impact Development, Best Management Practices*, Riverside County Flood Control and Water Conservation District, Revised June 2018. The locations of these borings are shown in Figure 3-1.

3.4.2 Drilling

Borings were drilled with a truck mounted 8-inch hollow stem auger to the level of the base of expected stormwater infiltration BMPs, about 10-15 feet bgs. Field measurements were taken to confirm that the borings were excavated to approximately 8-inches in diameter.

The borings were logged by a NOVA geologist, who observed and recorded exposed soil cuttings and the boring conditions.

3.4.3 Conversion to Percolation Wells

Once the test borings were drilled to the design depth, the percolation test borings were converted to percolation wells by placing an approximately 2-inch layer of ¾-inch gravel on the bottom, then extending 3-inch diameter Schedule 40 perforated PVC pipe to the ground surface. The ¾-inch gravel was used to partially fill the annular space around the perforated pipe below existing grade to minimize the potential of soil caving.

3.4.4 Percolation Testing

The percolation test borings were pre-soaked by filling the holes with water to the ground surface elevation. Testing was conducted the following day, within a 24-hour window.

Water levels were recorded every 30 minutes for 6 hours (minimum of 12 readings), or until the water percolation stabilized after each reading. At the start of each half-hour test interval, the water level was raised to approximately the same height of previous tests, in order to maintain a near constant head during the 6 hour test. Water level (depth) measurements were obtained from the top of the pipe. Table 3-3 (following page) abstracts the indications of the percolation testing.

Table 3-3. Abstract of the Percolation Testing

Boring	Approx. Elevation (feet, msl) [2]	Total Depth (feet)	Approximate Percolation Test Elev. (feet, msl)	Percolation Rate (in/hour)	Subsurface Unit Tested[1]
P-1	± 1,325	15.0	± 1,310	4.66	Qpfs
P-2	± 1,327	10.0	± 1,317	0.72	Qpfs
P-3	± 1,327	10.0	± 1,317	0.41	Qpfs
P-4	± 1,322	11.0	± 1,311	1.27	Qpfs
P-5	± 1,324	10.0	± 1,314	0.64	Qpfs

Notes:
1. 'Qpfs' indicates 'Pauba Formation', occurring as a dense sandstone
2. Percolation test elevations are estimated.

3.4.5 Closure

At the conclusion of the percolation testing, the upper sections of the PVC pipe were removed and the resulting holes backfilled with soil cuttings and patched to match the existing surfacing.

3.5 Shear Wave Velocity Analysis

3.5.1 General

A seismic shear wave survey was performed on November 2, 2019 by a Professional Geophysicist (PGP). The purpose of the survey was to assess the one-dimensional average shear-wave velocity of the underlying site soils to a minimum depth of 100 feet bgs in order to classify the site in accordance with ASCE 7-16 Table 20.3-1. Multi-channel analysis of surface waves (MASW) and microtremor array measurement (MAM) methods were used for the analysis. Combining results of both methods maximizes the depth and resolution of the data.

Figure 3-6. Seismic Survey Line, View Towards the North

The seismic survey of the subject site included one seismic shear wave survey traverse, approximately 220 feet in length. The approximate location is shown on Figure 3-7 and Plates 1A and 1B. A 24-channel Geometrics StrataVisor NZXP model signal-enhancement refraction seismograph was used in conjunction with 24 4.5-Hz geophones spaced at regular intervals. For the MASW survey, two seismic records were obtained by multiple hammer strikes of a 16-pound sledge hammer on steel plates positioned 25 feet from the end of each terminus of the seismic line. Vibrations were recorded using a one second record length at a sampling rate of 0.5 milliseconds. The MAM survey records vibrations from background and ambient noise. The ground vibrations were recorded using 32-second record length at 2-milisecond sampling rate with 30 separate records obtained for quality control purposes.

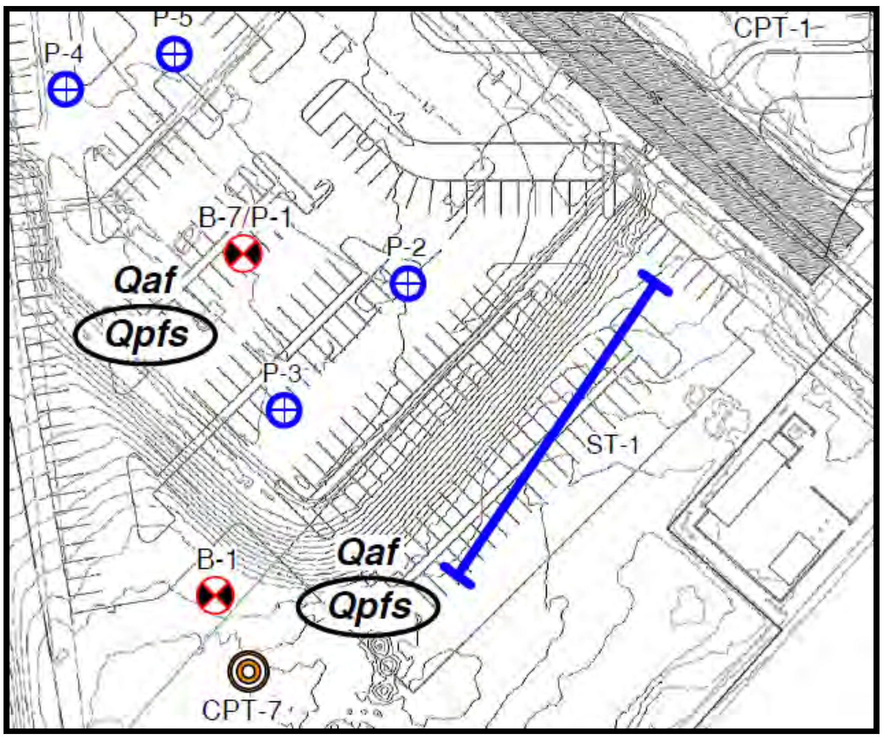


Figure 3-7. Approximate Seismic Traverse Location

After the field data was collected, the geophysicist combined the MASW and MAM survey results using specialized software specific to this purpose. The weighted average for velocity in the upper 100 feet of the site (referred to as V_{100} or V_s30) was computed from ASCE 7-16 Equation 20.4-1. The seismic model indicates that the average shear-wave velocity (weighted average) in the upper 100 feet is 1462.3 feet/sec. This average velocity classifies the underlying soils as Site Class C. Figure 3-8 presents the results of the shear-wave analysis.

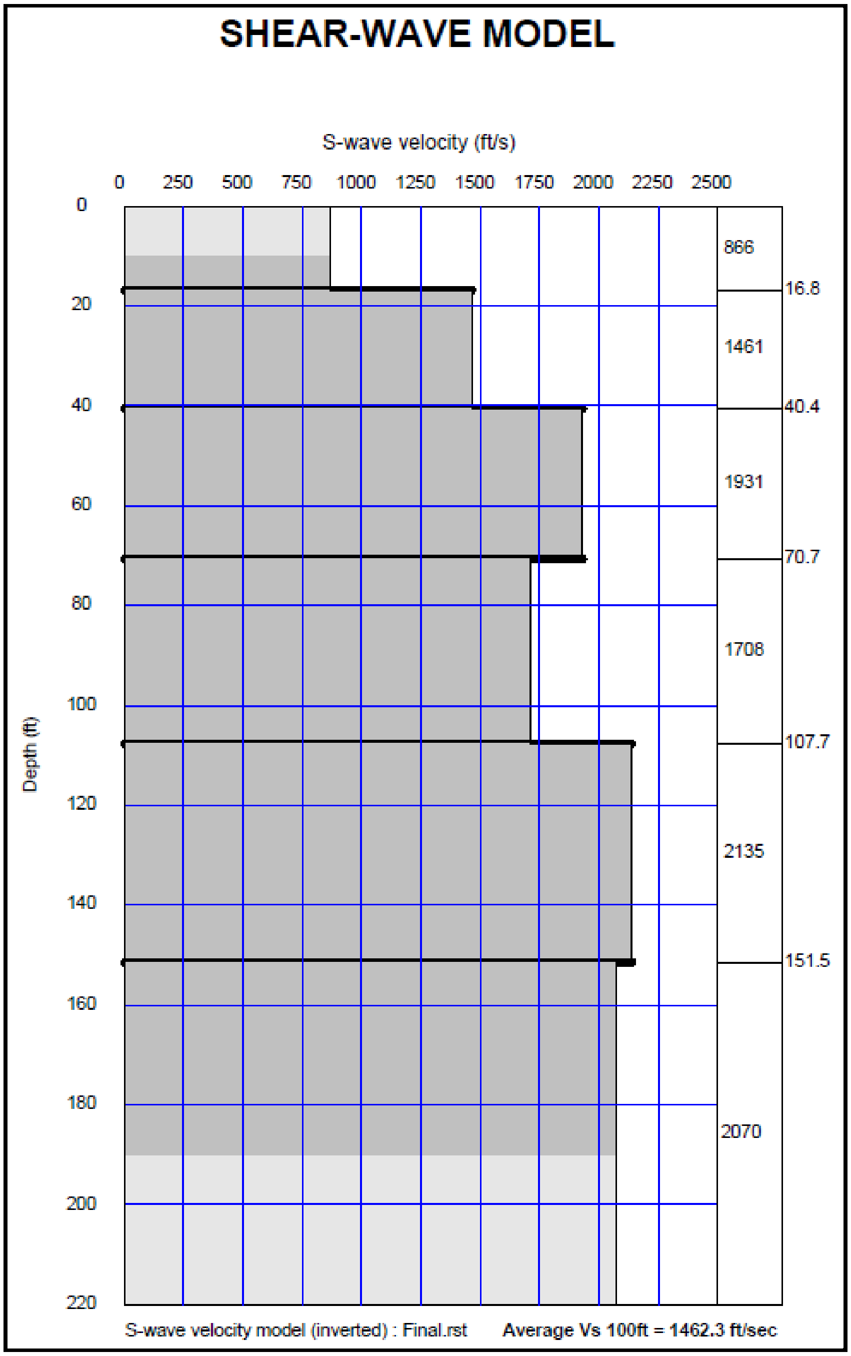


Figure 3-8. Shear Wave Model

3.6 Laboratory Testing

3.6.1 General

Following completion of the fieldwork, representative samples of the subsurface soils recovered from the engineering borings were transferred to NOVA's geotechnical laboratory for testing.

An experienced geotechnical engineer classified each soil sample on the basis of texture and plasticity in accordance with the Unified Soil Classification System (USCS). The group symbols for each soil type are indicated on the boring logs. The geotechnical engineer grouped the various soil types into the major zones noted on the boring logs. The stratification lines designating the interfaces between earth materials on the boring logs and profiles are approximate; *in-situ*, the transitions may be gradual.

Representative soil samples were selected and tested in NOVA's materials laboratory to check visual classifications and to determine pertinent engineering properties. The laboratory work included visual classifications of all soil samples as well as strength and index testing on selected soil samples. Testing was performed in general accordance with ASTM standards.

Records of the geotechnical laboratory testing are presented in Appendix D.

3.6.2 Gradation

The visual classifications were supplemented by soil gradation analyses after ASTM D6913. The results of these analyses were used to support soil classification after ASTM D2488. Table 3-4 summarizes the results of this testing.

Table 3-4. Summary of the Soil Gradation Testing

Sample Reference		Percent Finer Than the U.S. No 200 Sieve	Classification after ASTM D2488
Boring	Depth (feet)		
1	0 - 5	39	SM
6	15 - 20	34	SM

Note 1: The U.S. # 200 sieve is 0.074 mm,
Note 2. Gradation testing after ASTM D6913.

3.6.3 Moisture Density Relationships of the Near Surface Soils

Laboratory compaction testing was completed after ASTM D1557 on a composite sample of soil from the upper five feet of B-1. This testing indicated an optimum dry unit weight ($\gamma_{dry\ opt}$) of 120.7 lb/ft^3 at a moisture content of 13.2%. A second sample from of soil from the upper five feet of B-5 was tested and indicated an optimum dry unit weight ($\gamma_{dry\ opt}$) of 128.9 lb/ft^3 at a moisture content of 7.3%.

Table 3-5. Optimum Moisture Content and Maximum Dry Density

Sample Reference		Optimum Percent Moisture	Density (pcf)
Boring	Depth (feet)		
1	0 - 5	13.2	120.7
5	0 - 5	7.3	128.9

3.6.4 *In Situ* Moisture and Density

In-situ moisture content and dry unit weight testing were performed within NOVA's laboratory. Table 3-5 summarizes the results of this testing.

Table 3-6. In-Situ Moisture and Density

Sample Reference		Percent Moisture	Density (pcf)
Boring	Depth (feet)		
1	5	3.7	125.6
1	15	7.5	119.2
1	25	14.1	122.9
1	35	17.6	110.4
1	45	19.4	108.3
4	10	33.1	81.5
4	20	13.0	123.8
4	30	8.8	127.8
4	40	13.0	119.0
5	5	6.4	117.3

Note 1: The U.S. # 200 sieve is 0.074 mm,
Note 2. Gradation testing after ASTM D6913.

3.6.5 Corrosivity Testing

Resistivity, sulfate content and chloride contents were determined to estimate the potential corrosivity of on-site soils. These chemical tests were performed on a representative sample of the near-surface soils by Clarkson Laboratory and Supply, Inc. Table 3-7 summarizes the results of this testing.

Table 3-7. Summary of Corrosivity Testing of the Near Surface Soil

Parameter	Units	Boring B-1, 0-5 feet	Boring B-5, 0-5'
pH	standard unit	7.1	7.9
Resistivity	Ohm-cm	860	1800
Water Soluble Chloride	ppm	130	21
Water Soluble Sulfate	ppm	87	30

4.0 SITE CONDITIONS

4.1 Geologic Setting

4.1.1 Regional

The site is located within the northern portion of the Peninsular Range Geomorphic Province. This province, which stretches from the Los Angeles basin to the tip of Baja California, is characterized by a series of northwest trending mountain ranges separated by subparallel fault zones, and a coastal plain of subdued landforms. The mountain ranges are underlain primarily by Mesozoic metamorphic rocks that were intruded by plutonic rocks of the southern California batholith. The active Elsinore fault zone, considered part of the larger San Andreas fault system, divides the Santa Ana Mountains block to the west from the Perris block to the east.

4.1.2 Site Specific

Bedrock underlying the site is the sandstone member of the Pauba Formation (Qpfs). The Pauba Formation was deposited during the early to middle Pleistocene and primarily consists of alluvial stream deposits composed of interbeds and mixtures of brownish siltstones, sandstones, and conglomerates that are moderately cemented. The Pauba Formation includes two informal members: an upper sandstone member consisting of brown, moderately well-indurated, cross-bedded sandstone with sparse cobble to boulder conglomerate interbeds; and a lower fanglomerate member (Qpf) consisting of grayish brown, well-indurated, poorly sorted fanglomerate and mudstone. According to Kennedy and Morton, only the upper sandstone member is exposed near the site (CGS, 2003). Figure 4-1 presents the geologic mapping in the site vicinity.

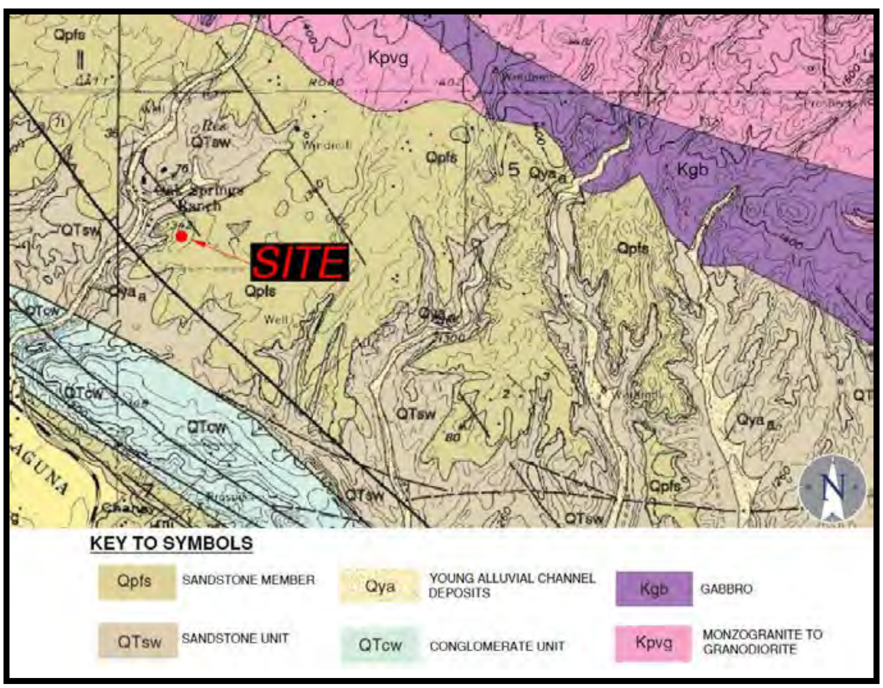


Figure 4-1. Geologic Map of the Site Area
(source: USGS Geologic Map of the Murrieta 7.5' Quadrangle, 2003)

4.1.3 Faulting

There are no known active faults underlying the property. The nearest mapped active fault zone is the Elsinore fault zone, Temecula section (Wildomar Fault), about 0.63 miles to the southwest.

Figure 4-2 maps faulting in the site area. Active faults are shown in orange, and late Quaternary faults, not considered active, are shown in green.

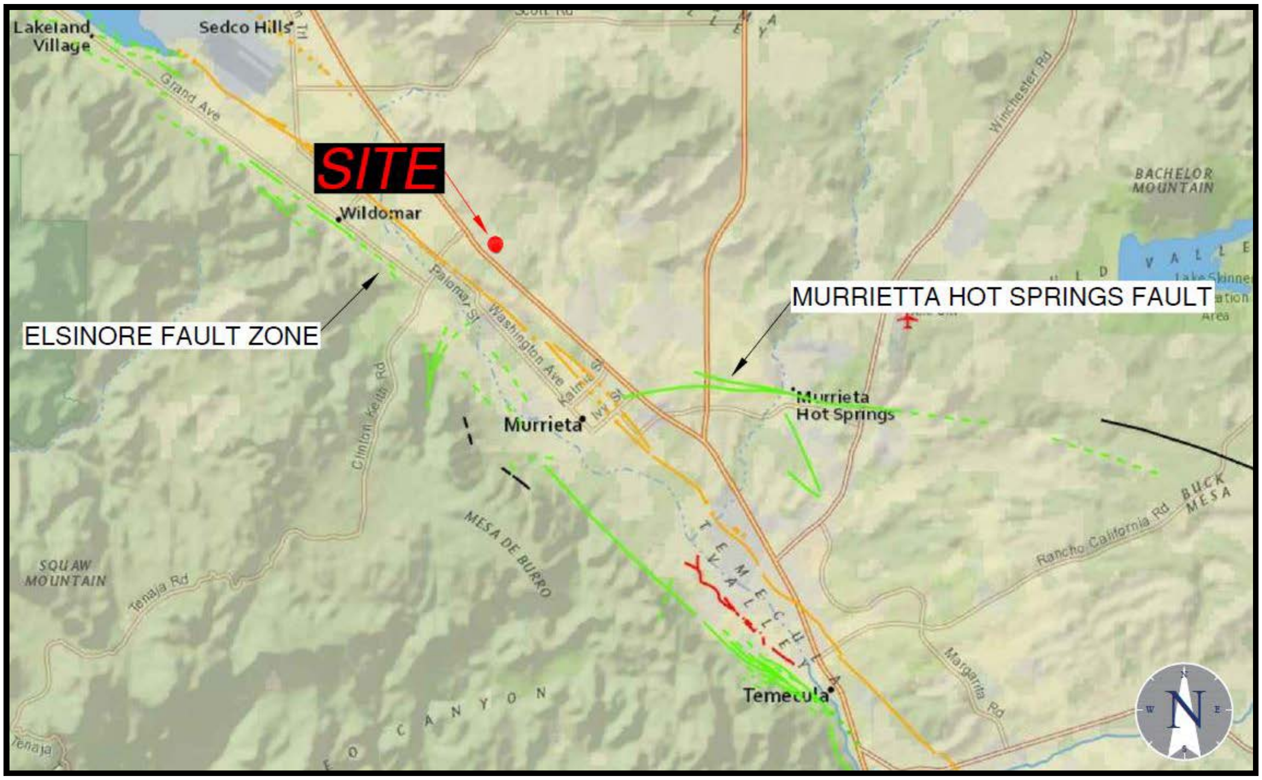


Figure 4-2. Fault Proximity Map
(source: *USGS Quaternary Fault Maps*, 2014)

4.1.4 Seismic Hazard Mapping

Seismic hazard mapping developed by the California Geological Survey indicates the site is not located in an area at risk for liquefaction in the event of a severe seismic event. This highly seismic area can expect ground surface accelerations (‘a’) on the order of ~ 0.85g during a Magnitude 7 earthquake. Liquefaction refers to the loss of soil strength and related subsidence that occurs when saturated (i.e., below the water table), predominately sandy soils are subject to earthquake shaking.

Figure 4-3 (following page) reproduces liquefaction hazard mapping of the general site area. Recognizing the identified hazard for liquefaction, Section 5 of this report provides detailed evaluation of this risk.

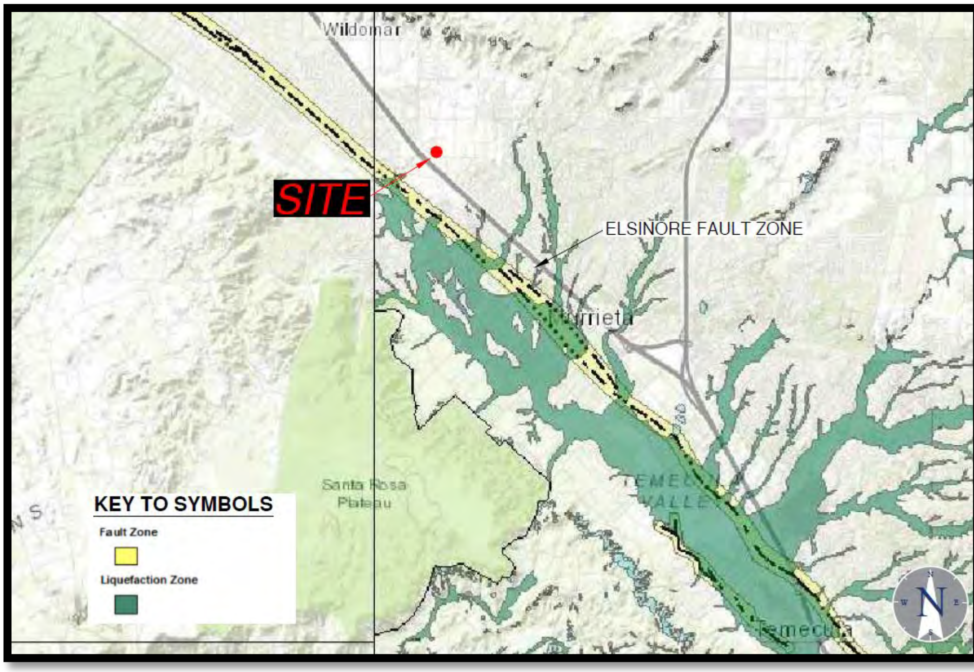


Figure 4-3. Liquefaction Hazard Mapping of the Site Area
(Source: *California Geological Survey AP Zone, Murrieta Quadrangle*, Jan. 11, 2018)

4.2 Site Conditions

4.2.1 Surface

As discussed in Section 2, the site is currently developed with a single-story structure and asphalt covered parking areas, and landscaping space. Review of aerial photography dating to 1938 indicates that the site has had minimal historical development. Development of the site occurred with relatively recent construction of the medical center.

The ground surface across the site is relatively level, descending from a high elevation of about +1,335 feet msl at the northeast corner of the site to about +1,322 feet msl at the southwest corner.

4.2.2 Subsurface

For the purposes of this report, the sequence of soils that underlie the site may be described as follows.

- Unit 1, Fill (Qaf). The upper approximately 1 foot to about 11 feet of the subsurface is silty and sandy fill. The CPT tip resistance (Qt_{ave}) is generally near at least 75 tsf over this interval with much of the material with at least 200-300 tsf. The materials characteristic of a relatively dense sands and stiff silts.
- Unit 2, Pauba Formation (Qpfs). Light to dark brown and reddish-brown siltstone and sandstone of the Pauba Formation was encountered below the overlying fill materials. $Qt_{ave} \sim$ 150 tsf over this interval. As encountered in NOVA's field exploration the unit was found to consist of very dense sands and very stiff silts/clays, with $qt_{ave} > 200$tsf.

Figure 4-4 (following page) provides a statistical summary of the tip resistance encountered by the CPT soundings.

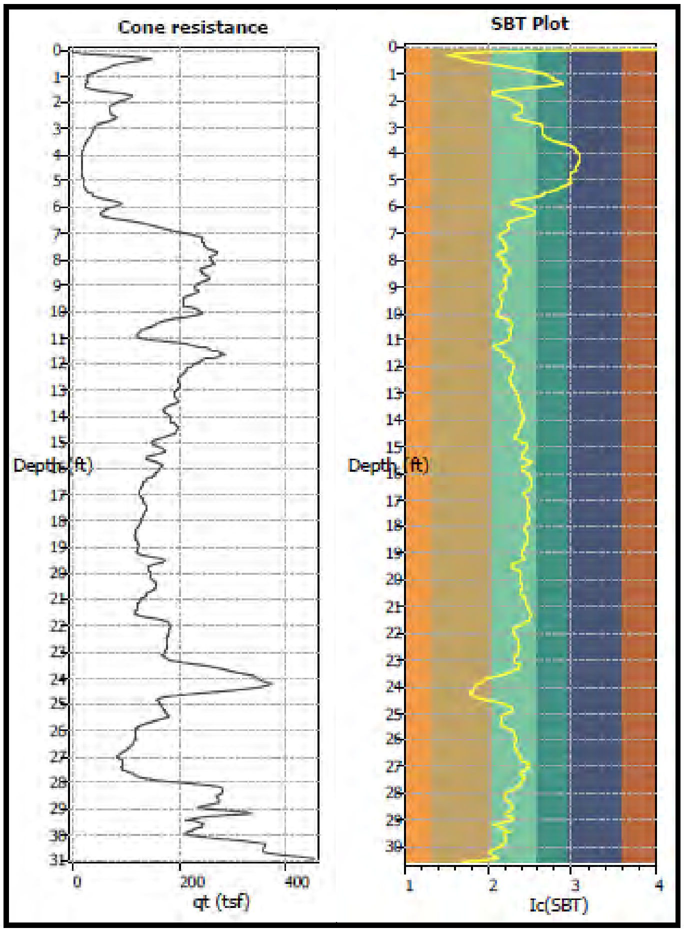


Figure 4-4. Numerical Average CPT Profile, CPT-3

4.2.3 Groundwater

Groundwater was encountered in engineering boring B-9 at a depth of approximately 47 feet bgs (elevation +1279 MSL) during NOVA's subsurface investigation.

NOVA has reviewed previous reporting and other available references (CDWR 2015). State Well Number 07S03W06E001S, is located about 1,100 feet of the site. Data for this well indicates that groundwater was at a depth of 16 feet bgs (1,274 feet MSL) measured on February 1, 1968. Data from previous reporting has indicated groundwater at elevations of about 1,298 feet MSL or deeper. Based on this review depth to historic groundwater is estimated to be at least 29 feet bgs.

4.2.4 Surface Water

No surface water was evident on the site at the time of NOVA's work. There was no evidence of springs, seeps, surface erosion, or staining that would indicate historic or current problems with surface water.

5.0 REVIEW OF GEOLOGIC, SOIL AND SITING HAZARDS

5.1 General

This section provides a review of soil, geologic and siting-related hazards common to this region of California, considering each for its potential to affect the planned facility. The primary hazards identified by this review are abstracted below.

1. Strong Ground Motion. The site is at risk for moderate-to-severe ground shaking in response to a large-magnitude earthquake during the lifetime of the planned development. The expectation of strong ground motion is common to all civil works in this area of California.

2. Liquefaction. Strong ground motion associated with a large magnitude earthquake will effect some liquefaction and related ground settlement. However, ground movements will be small- about 0.6 inches or less- and will not threaten the integrity of the planned structure.

The following subsections describe NOVA's review of soil and geologic hazards.

5.2 Geologic Hazards

5.2.1 Strong Ground Motion

The site is not located within a currently designated Alquist-Priolo Earthquake Zone (CGS, 2018). No known active faults are mapped on the site.

The nearest known active fault to the site is the Temecula section of the Elsinore Fault Zone, located approximately 0.6 miles to the southwest of the subject site at its closest point. This fault strand generally trend northwest. The Elsinore Fault system has the potential to be a source of strong ground motion, generating an earthquake of Richter magnitude (M) of about M = 6.8, with a risk-based peak ground acceleration (PGA_M) of PGA_M = 0.85g.

5.2.2 Fault Rupture

There are no known active faults mapped as crossing the subject property and the property is not located within an Alquist-Priolo earthquake fault zone. NOVA's site reconnaissance did not present any indications of active faulting. In consideration of these findings, NOVA does not consider the potential for onsite surface rupture from a seismic event a significant hazard.

5.2.3 Landslide

As used herein, 'landslide' describes downslope displacement of a mass of rock, soil, and/or debris by sliding, flowing, or falling. Such mass earth movements are greater than about 10 feet thick and larger than 300 feet across. Landslides typically include cohesive block glides and disrupted slumps that are formed by translation or rotation of the slope materials along one or more slip surfaces.

The causes of classic landslides start with a preexisting condition- characteristically a plane of weak soil or rock inherent within the rock or soil mass. Thereafter, movement may be precipitated by earthquakes, wet weather, and changes to the structure or loading conditions on a slope (e.g., by erosion, cutting, filling, release of water from broken pipes, etc.). The site is set in a relatively flat area, in a geologic unit not generally recognized to have potential for landslides. NOVA considers the landslide hazard to be 'low' for the site and the surrounding area in their current condition.

5.3 Soil Hazards

5.3.1 Liquefaction

General

"Liquefaction" refers to the loss of soil strength during a seismic event. The phenomenon is observed in geologically 'young' soils that include a shallow water table and coarse grained (i.e., 'sandy') soils of loose to medium dense consistency. Earthquake ground motions increase soil water pressures, decreasing grain-to-grain contact among the soil particles, causing the soil mass to lose strength. Liquefaction resistance increases with increasing soil density, plasticity (associated with clay-sized particles), geologic age, cementation, and stress history.

As is discussed in Section 4.1, the site is NOT mapped in an area that is identified by the State of California to be at risk for liquefaction.

Liquefaction Analyses

NOVA utilized the information obtained from the CPT soundings to complete quantitative analyses of liquefaction potential. The principal elements of these analyses are abstracted below.

- Seismic Event. Analyses utilized the ground surface acceleration (PGA_M) for the Maximum Considered Earthquake (MCE). As is discussed in Section 5.2, the expected ground surface acceleration associated with this event is $PGA_M = 0.85g$.

- Groundwater. As discussed in Section 3, groundwater was not encountered. Review of recent historic ground water levels in the site area indicates that groundwater may have been as high as 29 feet below existing ground within the general site area. Conservatively, liquefaction analyses were completed assuming groundwater at 12 feet depth bgs (i.e., at about +1,316 feet msl).

Records of NOVA's assessment of liquefaction potential are included in Appendix F.

Lateral Spreading

Lateral spreading is a phenomenon in which large blocks of intact, non-liquefied soil move downslope on a liquefied soil layer. Lateral spreading is often a regional event. For lateral spreading to occur, a liquefiable soil zone must be laterally continuous, unconstrained laterally, and free to move along sloping ground.

Settlement related to liquefaction will minimal. Based on the potential for liquefaction to occur the potential for lateral spreading is very low.

5.3.2 Expansive Soils

Expansive soils are characteristically clayey, able to undergo significant volume changes (shrinking or swelling) due to variations in soil moisture content (drying or wetting). These volume changes can be damaging to structures. Nationally, the value of property damage caused by expansive soils is exceeded only by that caused by termites.

In consideration of the largely sandy soils that comprise the subsurface at this site, as supported by the index testing provided in Section 3, the potential for problems associated with soil expansivity is low. Surface reconnaissance and the subsurface investigation did not reveal the presence of potentially expansive soils that could affect development. Based on visual observation and laboratory testing of a representative near surface sample, soils are not considered to be expansive.

5.3.3 Embankment Stability

As used herein, 'embankment stability' is intended to mean the safety of localized natural or man-made embankments against failure. Unlike landslides described above, embankment stability can include smaller scale slope failures such as erosion-related washouts and more subtle, less evident processes such as slope 'creep.'

No permanent slopes are planned as part of the proposed development. There is no risk of embankment instability for permanent construction. Section 7 provides guidance for management of the stability of temporary embankments and excavations during construction.

5.3.4 Collapsible Soils

Hydro-collapsible soils are common in the arid climates of the western United States in specific depositional environments (principally, in areas of young alluvial fans, debris flow sediments, and loess (wind-blown sediment)) deposits. These soils are characterized by low *in situ* density, low moisture contents and relatively high unwetted strength.

The soil grains of hydro-collapsible soils were initially deposited in a loose state (i.e., high initial 'void ratio') and thereafter lightly bonded by water sensitive binding agents (e.g., clay particles, low-grade cementation, etc.). While relatively strong in a dry state, the introduction of water into these soils causes the binding agents to fail. Destruction of the bonds/binding causes relatively rapid densification and volume loss (collapse) of the soil. This change is manifested at the ground surface as subsidence or settlement. Ground settlements from the wetting can be damaging to structures and civil works. Human activities that can facilitate soil collapse include: irrigation, water impoundment, changes to the natural drainage, disposal of wastewater, etc.

Based upon the indications of the CPT soundings, the site soils are not at risk for hydro-collapse.

5.3.5 Corrosive Soils

Chemical testing of the near surface soils indicates the soils contain low concentrations of soluble sulfates and chlorides. The tested soils will be corrosive to embedded metals, but not to embedded concrete. Section 6 addresses this consideration in more detail.

5.4 Siting Hazards

5.4.1 Effect on Adjacent Properties

The proposed project will not affect the structural integrity of adjacent properties or existing public improvements and public right-of-ways located adjacent to the site if the recommendations of this report are incorporated into project design.

5.4.2 Flood

The site is located within a flood zone designated as Flood "Zone X" (FEMA, Map 06065C2705G, effective 08/28/08). Zone X describes "*Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.*" Figure 5-3 reproduces flood mapping of the site area.

Figure 5-1. Flood Mapping of the Site Area
(source: FEMA, Map 06065C3305G, effective 08/28/2008)

6.0 EARTHWORK AND FOUNDATIONS

6.1 Overview

6.1.1 Review of Site Hazards

Section 5 provides a review of soil and geologic hazards common to development of civil works in the project area. The primary hazards identified by that review are abstracted below.

1. Strong Ground Motion. The site is at risk for moderate-to-severe ground shaking in response to a large-magnitude earthquake during the lifetime of the planned development. The expectation of strong ground motion is common to all civil works in this area of California. Section 6.2 addresses seismic design parameters

2. Liquefaction. Strong ground motion associated with a large magnitude earthquake will affect some liquefaction and related ground settlement. However, ground movements will be small- about 1 inch or less- and will not threaten the integrity of the planned structure. With this consideration, the site is suitable for development of the facility on shallow foundations. Section 6.5 addresses design parameters for shallow foundations.

6.1.2 Site Suitability

Based upon the indications of the field and laboratory data developed for this investigation, as well as review of previously developed subsurface information, it is the opinion of NOVA that the site is suitable for development of the planned structure on shallow foundations, provided the geotechnical recommendations described herein are followed.

6.1.3 Review and Surveillance

The subsections following provide geotechnical recommendations for the planned development as it is now understood. It is intended that these recommendations provide sufficient geotechnical information to develop the project in general accordance with 2016 California Building Code (CBC) requirements.

NOVA should be given the opportunity to review the grading plan, foundation plan, and geotechnical-related specifications as they become available to confirm that the recommendations presented in this report have been incorporated into the plans prepared for the project.

All earthwork related to site and foundation preparation should be completed under the observation of NOVA.

6.2 Seismic Design Parameters

6.2.1 Site Class

From site-specific test boring data, the Site Class was determined from ASCE 7-16, Table 20.3-1. The site-specific data used to determine the Site Class typically includes borings drilled to 100 feet or a seismic refraction study to determine shear wave velocities (Vs30 or V_{100}) for the upper 100 feet of the subsurface. A shear wave analysis was performed on the site by a California Professional Geophysicist, with the calculated velocity for the underlying 100 feet of soils (V_{100}) to be 1462.3 feet/sec, classifying this site as Site Class C.

6.2.2 Seismic Design Parameters

Table 6-1 provides seismic design parameters for the site in accordance after ASCE 7-16 utilizing resource provided by the USGS and SEAOC for this determination (found at: https://seismicmaps.org/).

Table 6-1. Seismic Design Parameters
Site Class C, Risk Category IV after ASCE 7-16 and 2019 CBC

Parameter	Symbol	Value
Site Latitude (decimal degrees)	---	33.592°N
Site Longitude (decimal degrees)	---	-117.238°W
Site Coefficient	F_a	1.2
Site Coefficient	F_v	1.4
Mapped Spectral Acceleration Value, Period = 0.2 sec	S_S	1.619g
Mapped Spectral Acceleration Value, Period = 1.0 sec	S_1	0.605g
Short Period Spectral Acceleration Adjusted for Site Class, Period = 0.2 sec	S_{MS}	1.943g
Spectral Acceleration Adjusted for Site Class, Period = 1.0 (sec)	S_{M1}	0.847g
Design Spectral Response Acceleration Occupancy Category IV per 2016 CBC Table 1604A.5 Period = 0.2 (sec)	S_{DS}	1.295g
Design Spectral Response Acceleration Occupancy Category IV per 2016 CBC Table 1604A.5 Period = 1.0 (sec)	S_{D1}	0.565g
Peak Ground Acceleration Adjusted for Site Class Effects	PGA_M	0.852g

6.3 Corrosivity and Sulfates

6.3.1 Corrosivity

Electrical resistivity, chloride content, sulfate contents and pH level are all indicators of a soil's tendency to corrode/attack metals and concrete. Chemical testing was performed on representative samples of soils from the site. The results of the testing are tabulated on Table 6-2.

Table 6-2. Summary of Corrosivity Testing of the Unit 1 Soil

Parameter	Units	Boring B-1, 0-5	Boring B-5, 0-5'	Boring B-9, 1-5'
pH	standard unit	7.1	7.9	N/A
Resistivity	Ohm-cm	860	1800	N/A
Water Soluble	ppm	130	21	27
Water Soluble Sulfate	ppm	87	30	N/A

6.3.2 Metals

Caltrans considers a site to be corrosive if one or more of the following conditions exist for representative soil and/or water samples:

- chloride concentration is 500 parts per million (ppm) or greater;

- sulfate concentration is 2,000 ppm (0.2%) or greater; or,
- the pH is 5.5 or less.

Based on the Caltrans criteria, the on-site soils would not be considered corrosive to buried metals. Records of this testing are provided in Appendix D. These records include estimates of the life expectancy of buried metal culverts of varying gauge.

In addition to the above parameters, the risk of soil corrosivity buried metals is considered by determination of electrical resistivity (ρ). Soil resistivity may be used to express the corrosivity of soil only in unsaturated soils. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of DC electrical current from the metal into the soil. As the resistivity of the soil decreases, the corrosivity generally increases. A common qualitative correlation (cited in Romanoff 1989, NACE 2007) between soil resistivity and corrosivity to ferrous metals is tabulated below.

Table 6-3. Soil Resistivity and Corrosion Potential

Minimum Soil Resistivity (Ω-cm)	**Qualitative Corrosion Potential**
0 to 2,000	Severe
2,000 to 10,000	Moderate
10,000 to 30,000	Mild
Over 30,000	Not Likely

The resistivity testing summarized on Table 6-2 suggests that design should consider that the soils may be corrosive to embedded metals. Typical recommendations for mitigation of such corrosion potential in embedded ferrous metals include:

- a high quality protective coating such as an 18 mil plastic tape, extruded polyethylene, coal tar enamel, or Portland cement mortar;

- electrical isolation from above grade ferrous metals and other dissimilar metals by means of dielectric fittings in utilities and exposed metal structures breaking grade; and,

- steel and wire reinforcement within concrete having contact with the site soils should have at least 2 inches of concrete cover.

If extremely sensitive ferrous metals are expected be placed in contact with the site soils, it may be desirable to consult a corrosion specialist regarding choosing the construction materials and/or protection design for the objects of concern

6.3.3 Sulfate Attack

As shown on Table 6-2, the soil sample tested indicated water-soluble sulfate (SO_4) content of the soils than 0.01 percent by weight. With $SO_4 < 0.10$ percent by weight, the American Concrete Institute (ACI) publication ACI 318-08 considers a soil to have no potential (S0) for sulfate attack. Table 6-4 reproduces the sulfate Exposure Categories considered by ACI.

Table 6-4. Exposure Categories and Requirements for Water-Soluble Sulfates

Exposure Category	Class	Water-Soluble Sulfate (SO_4) In Soil (percent by weight)	Cement Type (ASTM C150)	Max Water-Cement Ratio	Min. f'_c (psi)
Not Applicable	S0	$SO_4 < 0.10$	-	-	-
Moderate	S1	$0.10 \leq SO_4 < 0.20$	II	0.50	4,000
Severe	S2	$0.20 \leq SO_4 \leq 2.00$	V	0.45	4,500
Very severe	S3	$SO_4 > 2.0$	V + pozzolan	0.45	4,500

Adapted from: ACI 318-08, Building Code Requirements for Structural Concrete

6.3.4 Limitations

Testing to determine several chemical parameters that indicate a potential for soils to be corrosive to construction materials are traditionally completed by the Geotechnical Engineer, comparing testing results with a variety of indices regarding corrosion potential.

Like most geotechnical consultants, NOVA does not practice in the field of corrosion protection, since this is not specifically a geotechnical issue. Should more information be required, a specialty corrosion consultant should be retained to address these issues.

6.4 Earthwork

6.4.1 General

Earthwork should be performed in accordance with Section 300 of the most recent approved edition of the "*Standard Specifications for Public Works Construction*" and "*Regional Supplement Amendments*."

6.4.2 Select Fill

Materials

Any engineered fill should be 'Select'; i.e., soil with at least 40 percent of the material less than ¼-inches in size, a maximum particle size of 1 inch, with an expansion index ('EI', after ASTM D4829) of EI < 20. Select Fill should not include fibrous organic, perishable, spongy, deleterious, environmentally affected, or otherwise unsuitable material.

The sandy Unit 1 soils will be suitable for use as Select Fill. If a detention pond is developed on site, this feature may be a good source of Select Fill.

Placement

All engineered fill should be compacted to a minimum of 90% relative compaction after ASTM D1557 (the 'modified Proctor') following moisture conditioning to at least 2% above the optimum moisture content.

Fill should be placed in loose lifts no thicker than the ability of the compaction equipment to thoroughly densify the lift. For most construction equipment, this limit loose lifts to on the order of 10-inches or less. Fill placed in relatively constrained areas (for example, utility trenches or backfill around manholes) demanding the use of hand-operated equipment will require loose lifts on the order of 4 inches or less.

Fill should be densified with task-specific equipment. Densification of the characteristically sandy fill at this site will require the use of vibratory equipment to achieve adequate densification.

6.4.3 Site Preparation and Remedial Grading

Any abandoned utilities should be removed and properly disposed off-site before the start of excavation operations. The area planned for structures and pavements should be cleared of vegetative material, including the root zone. Thereafter, remedial grading to improve and proof the quality of the Unit 1 fill should be undertaken in the step-wise manner described below.

1. Step 1, Excavation/Densification. For the proposed tower structure, the upper 5 feet of the Unit 1/Unit 2 soil or 3 feet below deepest planned foundation element, whichever is greater, should be removed within the limits of planned tower structure should be excavated and staged for later replacement. Laterally, removals should extend outward at least 5 feet for of the tower structure footprint.

   Remedial grading for the CUP area building should consist of removing the existing fill to contact with competent Pauba Formation extending outward at least 3 feet of the proposed structure. Removed soils may be reused as structural fill and compacted to at least 90 percent relative compaction.

   Based on review of the historic aerial photographs (Figure 2-2), a water basin was located within close proximity of the proposed CUP structure. Foundations or grading based on this historic use may require deepened removals and excavation within the southern portion of this area.

   Removals for areas receiving pavements should extend to at least 2 feet below existing or proposed grade, whichever is deeper. Laterally, removals should extend outward at least 2 feet for pavements and flatwork.

   The exposed ground surface disturbed by excavations should be densified to at 90% relative compaction after ASTM D1557 (the ‘modified Proctor’) following moisture conditioning to 2% above the optimum moisture content.

2. Step 2, Proof-Rolling. After the completion of compaction/densification of the excavated surface, the area should be proof-rolled. A loaded dump truck or similar should be used to aid in identifying localized soft or unsuitable material. Any soft or unsuitable materials encountered during this proof-rolling should be removed, replaced with an approved backfill, and compacted.

3. Step 3, Replacement. The soil excavated by Step 2 should be replaced in conformance with the criteria identified in Section 6.4.2 and Section 6.4.3.

6.4.4 New Fill

New fill to establish site grades should be placed in conformance with the criteria identified in Section 6.4.2 and Section 6.4.3.

Shallow foundations should be constructed as soon as possible following subgrade approval. The Contractor should be responsible for maintaining the subgrade in its approved condition (i.e., at the compacted moisture content, frees of disturbance, etc.) until foundations are constructed.

6.4.5 Trenching and Backfilling for Utilities

Excavation for utility trenches must be performed in conformance with OSHA regulations contained in 29 CFR Part 1926.

Utility trench excavations have the potential to degrade the properties of the adjacent soils. Utility trench walls that are allowed to move laterally will reduce the bearing capacity and increase settlement of adjacent footings and overlying slabs.

Backfill for utility trenches is as important as the original subgrade preparation or engineered fill placed to support either a foundation or slab. Backfill for utility trenches must be placed to meet the project specifications for the engineered fill of this project. Unless otherwise specified, the backfill for the utility trenches should be placed in 4 to 6-inch loose lifts and compacted to a minimum of 90 percent relative compaction after ASTM D1557 (the 'modified Proctor') at soil moisture +2 percent of the optimum moisture content. Up to 4 inches of bedding material placed directly under the pipes or conduits placed in the utility trench can be compacted to 90 percent relative compaction with respect to the Modified Proctor.

6.4.6 Flatwork

Prior to casting exterior flatwork, the upper one foot of subgrade soils- either Unit 1 sands or Select Fill- should be moisture conditioned densified as recommended in Section 6.4.2. Concrete slabs for pedestrian traffic or landscaping should be at least four (4) inches thick.

6.5 Shallow Foundations

6.5.1 Isolated and Continuous Foundations

Unit 1 fill improved as described in Section 6.4 and any new fill placed as described in Section 6.4 may be used to support isolated and continuous footings, as described below. Additionally, foundations may be founded and deepened into competent Unit 2 Pauba Formation. All foundations should be founded entirely in uniform bearing strata consisting entirely of fill or Pauba Formation.

<u>Isolated Foundations</u>
Isolated foundations for interior columns may be designed for an allowable contact stress of 3,000 psf for dead and commonly applied live loads (DL+LL). This bearing values may be increased by one-third for transient loads such as wind and seismic. These foundation units for the tower should have a minimum width of 30 inches, embedded a minimum of 24 inches below surrounding grade.

<u>Continuous Foundations</u>
Continuous foundations may be designed for an allowable contact stress of 2,500 psf for dead and commonly applied live loads (DL+LL). This bearing value may be increased by one-third for transient loads such as wind and seismic.

Continous footings for the tower structure must be a minimum of 18 inches in width and embedded a minimum of 24 inches below surrounding grade. Foundations for the CUP area structure should have a minimum width of 15 inches, embedded a minimum of 18 inches below surrounding grade and be founded at least 6-inches into competent Pauba Formation.

<u>Retaining Walls and Ancillary Structures</u>

Bearing values for these structures may be designed for an allowable contact stress of 2,5000 psf for dead and commonly applied live loads (DL+LL). Continuous foundations for retaining walls and ancillary structures should have a minimum width of 15 inches, embedded a minimum of 18 inches below surrounding grade. Isolated foundations for ancillary structures should be a minimum with of 24 inches embedded at least 24 inches below surrounding grade.

Resistance to Lateral Loads

Lateral loads to shallow foundations may be resisted by passive earth pressure against the face of the footing, calculated as a fluid density of 200 psf per foot of depth, neglecting the upper 1 foot of soil below surrounding grade in this calculation. Additionally, a coefficient of friction of 0.30 between soil and the concrete base of the footing may be used with dead loads.

Settlement

Supported as recommended above, the structure will settle on the order of 0.5 inch. This movement will occur elastically, as dead load (DL) and permanent live loads (LL) are applied. In usual circumstance, about 50% of this settlement will occur during the construction period. Angular distortion due to differential settlement of adjacent, unevenly loaded footings should be less than 1 inch in 40 feet (i.e., Δ/L less than 1:480).

6.5.2 Ground Supported Slabs

The ground level of the planned facility may employ a conventional on-grade (ground-supported) slab designed using a modulus of subgrade reaction (k) of 150 pounds per cubic inch (i.e., k = 150 pci).

The actual slab thickness and reinforcement should be designed by the Structural Engineer. NOVA recommends the slab be a minimum 5 inches thick, reinforced by at least #4 bars placed at 16 inches on center each way within the middle third of the slabs by supporting the steel on chairs or concrete blocks ("dobies").

Minor cracking of concrete after curing due to drying and shrinkage is normal. Cracking is aggravated by a variety of factors, including high water/cement ratio, high concrete temperature at the time of placement, small nominal aggregate size, and rapid moisture loss due during curing. The use of low-slump concrete or low water/cement ratios can reduce the potential for shrinkage cracking.

To reduce the potential for excessive cracking, concrete slabs-on-grade should be provided with construction or ‘weakened plane’ joints at frequent intervals. Joints should be laid out to form approximately square panels and never exceeding a length to width ratio of 1.5 to 1. Proper joint spacing and depth are essential to effective control of random cracking. Joints are commonly spaced at distances equal to 24 to 30 times the slab thickness. Joint spacing that is greater than 15 feet should include the use of load transfer devices (dowels or diamond plates). Contraction/ control joints must be established to a depth of ¼ the slab thickness as depicted in Figure 6-1.

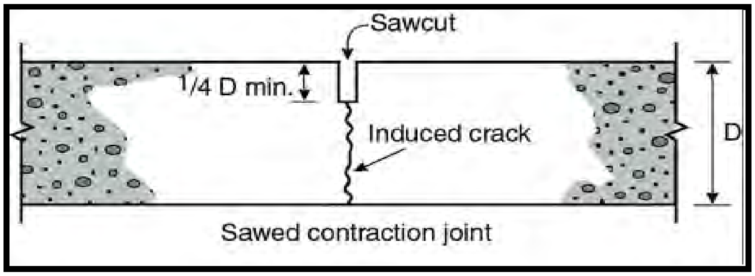


Figure 6-1. Sawed Contraction Joint

6.6 Capillary Break and Underslab Vapor Retarder

6.6.1 Capillary Break

The requirements for a capillary break ('sand layer') beneath the ground supported slab should be determined in accordance with ACI Publication 302 "*Guide for Concrete Floor and Slab Construction*."

A capillary break may consist of a 4-inch thick layer of compacted, well-graded sand should be placed below the floor slab. This porous fill should be clean coarse sand or sound, durable gravel with not more than 5 percent coarser than the 1-inch sieve or more than 10 percent finer than the No. 4 sieve, such as AASHTO Coarse Aggregate No. 57.

6.6.2 Vapor Retarder

Responsibility

Soil moisture vapor that penetrates ground-supported concrete slabs can result in damage to moisture-sensitive floors, some floor sealers, or sensitive equipment in direct contact with the floor. It is not the responsibility of the geotechnical consultant to provide recommendations for vapor retarders to address this concern. This responsibility usually falls to the Architect. Decisions regarding the appropriate vapor retarder are principally driven by the nature of the building space above the slab, floor coverings, anticipated penetrations, concerns for mold or soil gas, and a variety of other environmental, aesthetic and materials factors known only to the Architect.

Products

A variety of specialty polyethylene (polyolefin)-based vapor retarding products are available to retard moisture transmission into and through concrete slabs. This remainder of this section provides an overview of design and installation guidance, and considers the use of vapor retarders in the building construction in the San Diego area.

Detail to support selection of vapor retarders and to address the issue of moisture transmission into and through concrete slabs is provided in a variety of publications by the American Society for Testing and Materials (ASTM) and the American Concrete Institute (ACI). A partial listing of those publications is provided below.

- ASTM E1745-97 (2009). *Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.*

- ASTM E154-88 (2005). *Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.*

- ASTM E96-95 (2005). *Standard Test Methods for Water Vapor Transmission of Materials.*

- ASTM E1643-98 (2009). *Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.*

- ACI 302.2R-06. *Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.*

Vapor retarders employed for ground supported slabs are commonly specified as minimum 15 mil polyolefin plastic that conforms to the requirements of ASTM E1745 as a Class A vapor retarder (i.e., a maximum vapor permeance of 0.1 perms, minimum 45 lb/in tensile strength and 2,200 grams puncture resistance). Among the commercial products that meet this requirement are the series of Yellow Guard® vapor retarders vended by Poly-America, L.P.; the Perminator® products by W. R. Meadows; and, Stego®Wrap products by Stego Industries, LLC. The person responsible for design of the vapor barrier should consult with product vendors to ensure selection of the vapor retarder that best meets the project requirements. For example, concrete slabs with particularly sensitive floor coverings may require lower permeance or other performance-related factors are specified by the ASTM E1745 class rating.

The performance of vapor retarders is particularly sensitive to the quality of installation. Installation should be performed in accordance with the vendor's recommendations under full-time surveillance.

6.7 Control of Moisture Around Foundations

6.7.1 Erosion and Moisture Control During Construction

Surface water should be controlled during construction, via berms, gravel/sandbags, silt fences, straw wattles, siltation basins, positive surface grades, or other methods to avoid damage to the finish work or adjoining properties. The Contractor should take measures to prevent erosion of graded areas until such time as permanent drainage and erosion control measures have been installed. After grading, all excavated surfaces should exhibit positive drainage and eliminate areas where water might pond.

6.7.2 Design

Design for the structure should include care to control accumulations of moisture around and below the garage. Such design will require coordination from among the Design Team; at a minimum to include the Architect, the Civil Engineer, and the Landscape Architect.

Design for the areas around foundations should be undertaken with a view to the maintenance of an environment that encourages drainage away from below grade walls. Roof and surface drainage, landscaping, and utility connections should be designed to limit the potential for mounding of water near subterranean walls. In particular, rainfall to roofs should be collected in gutters and discharged away from foundations.

Proper surface drainage will be required to minimize the potential of water seeking the level of the garage walls and pavements. In areas where sidewalks or paving do not immediately adjoin the structure, protective slopes should be provided with a minimum grade (away from the structure) of approximately 3 percent for at least 5 feet. A minimum gradient of 1 percent is recommended in hardscape areas.

6.8 Retaining Walls

6.8.1 Lateral Pressures

Lateral earth pressures for retaining walls are related to the type of backfill, drainage conditions, slope of the backfill surface, and the allowable rotation of the wall. Table 6-5 provides recommendations for lateral soil for retaining walls with level backfill for varying conditions of wall yield.

Table 6-5. Lateral Earth Pressures to Retaining Walls

Condition	Equivalent Fluid Pressure (psf/foot) for Approved Backfill Notes A, B	
	Level Backfill	2:1 Backfill Sloping Upwards
Active	35	55
At Rest	55	80
Passive	250	300

Note A: site-sourced Unit 1 sands or similar imported soil.
Note B: assumes wall includes appropriate drainage and no hydrostatic pressure.

If footings or other surcharge loads are located a short distance outside the wall, these influences should be added to the lateral stress considered in the design of the wall. Surcharge loading should consider wall loads that may develop from adjacent streets and sidewalks. To account for such potential loads, a surcharge pressure of 75 psf can be applied uniformly over the wall to a depth of about 12 feet.

6.8.2 Seismic Increment

The seismic load increment should be calculated as a uniform 22H psf (with H the height of the wall in feet).

6.8.3 Drainage

Design for retaining walls should include drainage to limit accumulation of water behind the wall. Figure 6-3 provides guidance for such design. Note that the guidance provided on Figure 6-3 is conceptual. A variety of options are available to drain permanent below grade walls.

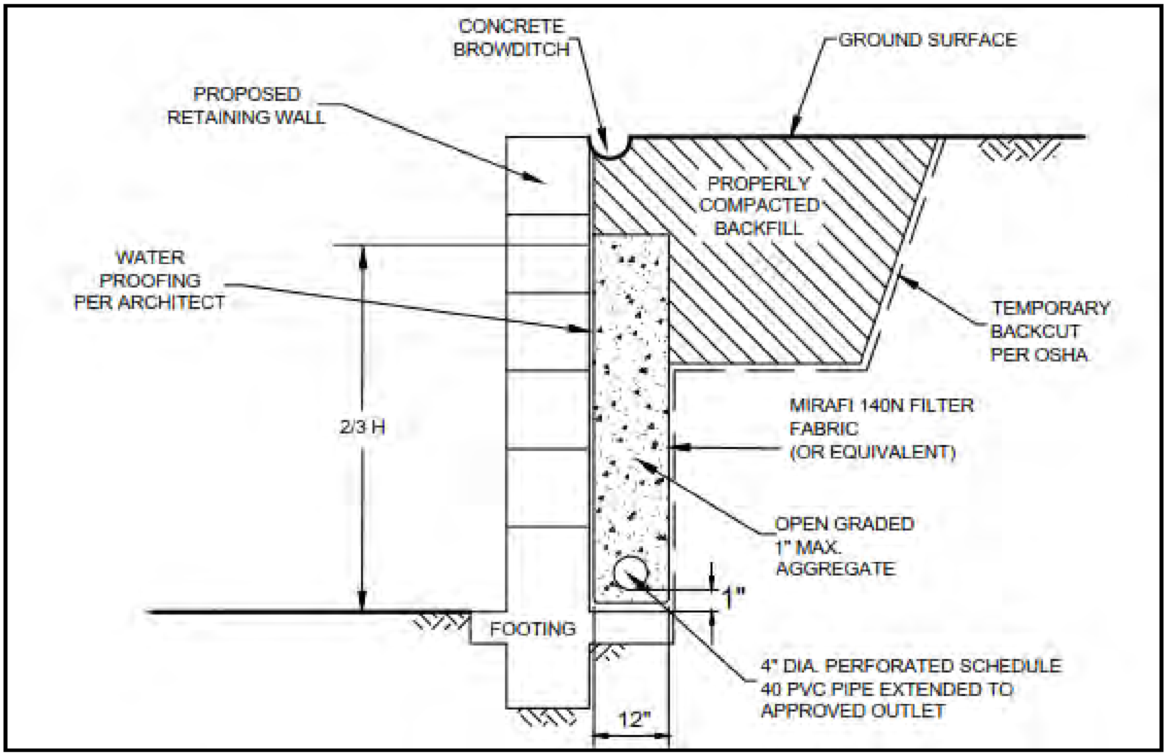


Figure 6-2. Conceptual Design for Retaining Wall Drainage

6.8.4 Elevator Pits

Elevators will likely be included within the projects final design. Elevators may require pits that extend below the lowest slab level. An elevator pit slab and related retaining wall footings will derive suitable support from the Unit 2 sandstones around it. Design for the elevator pit walls should consider the circumstances and conditions described below.

1. Wall Yield. NOVA expects that proper function of the elevator pit should not allow yielding of the elevator pit walls. As such, walls should be designed to resist 'at rest' lateral soil pressures and seismic pressures provided above, also allowing for any structural surcharge.

2. Construction. Design of the elevator pit walls should include consideration for surcharge conditions that will occur during and after construction.

6.9 Temporary Slopes

Any temporary slopes should be made in conformance with OSHA requirements. All temporary excavations should comply with local safety ordinances, as well all Occupational Safety and Health Administration (OSHA) requirements, as applied to California. These requirements may be found at http://www.dir.ca.gov/title8/sb4a6.html.

7.0 STORMWATER INFILTRATION

7.1 Overview

Based upon the indications of the field exploration and laboratory testing reported herein, NOVA has evaluated the site as abstracted below after guidance contained in *Riverside County, Santa Margarita River Watershed Region Design Handbook for Low Impact Development, Best Management Practices*, Riverside County Flood Control and Water Conservation District, Revised June 2018 (hereafter, 'the BMP Manual').

Appendix A provides a description of the fieldwork undertaken to complete the testing. Figure 3-1 depicts the location of the testing. This section provides the results of that testing and related recommendations for management of stormwater in conformance with the BMP Manual.

As is well-established in the BMP Manual, the feasibility of stormwater infiltration is principally dependent on geotechnical and hydrogeologic conditions at the project site. In consideration of the measured infiltration rates at this site, NOVA concludes that the site is not feasible for development of permanent stormwater infiltration BMPs.

This section provides NOVA's assessment of the feasibility of stormwater infiltration BMPs utilizing the information developed by the field exploration described in Section 3.4, as well as other elements of the site assessment.

7.2 Infiltration Rates

7.2.1 General

The percolation rate of a soil profile is not the same as its infiltration rate ('I'). Therefore, the measured/calculated field percolation rate (see Table 3-3) was converted to an estimated infiltration rate utilizing the Porchet Method in accordance with guidance contained in the BMP Manual. Table 7-1 provides a summary of the infiltration rates determined by the percolation testing.

Table 7-1. Infiltration Rates Determined by Percolation Testing

Boring	Approximate Ground Elevation (feet, msl)	Depth of Test (feet)	Approximate Test Elevation (feet, msl)	Infiltration Rate (inches/hour)	Design Infiltration Rate (in/hour, F=3*)
P-1	± 1325	15.0	± 1310	0.08	0.03
P-2	± 1327	10.5	± 1316.5	0.02	0.01
P-3	± 1327	10.0	± 1317	0.01	0.00
P-4	± 1322	10.5	± 1311.5	0.03	0.01
P-5	± 1324	9.0	± 1315	0.02	0.01

Notes: (1) 'F' indicates 'Factor of Safety' (2) elevations are approximate and should be reviewed

7.2.2 Design Infiltration Rate

As may be seen by review of Table 7-1, in consideration of the nature and variability of subsurface materials, as well as the natural tendency of infiltration structures to become less efficient with time, the infiltration rates measured in the testing should be modified to use at least a factor of safety (F) of F=3 for preliminary design purposes.

The preliminary design basis infiltration rates are 0.03, 0.01, 0.00, 0.01 and 0.01 inches per hour for P-1 through P-5 respectively, using a preliminary F = 3, as is indicated in Table 7-1.

7.3 Review of Geotechnical Feasibility Criteria

7.3.1 Overview

It is common that seven factors be considered by the project geotechnical professional while assessing the feasibility of infiltration related to geotechnical conditions. These factors are:

1) Soil and Geologic Conditions
2) Settlement and Volume Change
3) Slope Stability
4) Utility Considerations
5) Groundwater Mounding
6) Retaining Walls and Foundations
7) Other Factors

The above geotechnical feasibility criteria are reviewed in the following subsections.

7.3.2 Soil and Conditions

The soil borings, CPT soundings and percolation tests borings completed for this assessment disclose the sequence of soil units described below.

- Unit 1, Fill (Qaf). The upper approximately 1 foot to about 11 feet of the subsurface is silty and sandy fill. The CPT tip resistance (Qt_{ave}) is generally near at least 75 tsf over this interval with much of the material with at least 200-300 tsf. The materials characteristic of a relatively dense sands and stiff silts.
- Unit 2, Pauba Formation (Qpfs). Light to dark brown and reddish-brown siltstone and sandstone of the Pauba Formation was encountered below the overlying fill materials. $Qt_{ave} \sim$ 150 tsf over this interval. The base of this layer is characterized by the occurrence of very dense sands and very stiff silts/clays, with $qt_{ave} > 200$tsf.

7.3.3 Settlement and Volume Change

The sandy Unit 1 soils have very low expansion potential. These soils will not be prone to swelling upon wetting. These soils will not be prone to hydro-collapse on wetting.

7.3.4 Slope Stability

BMPs will not be located near slopes. There are no material slopes on site, nor are any planned.

7.3.5 Utilities

Infiltration can potentially damage subsurface and underground utilities. BMPs should be sited a minimum of 10 feet away from underground utilities.

7.3.6 Groundwater Mounding

Stormwater infiltration can result in groundwater mounding during wet periods, affecting utilities, pavements, flat work, and foundations.

7.3.7 Retaining Walls and Foundations

BMPs should not be located near foundations. BMPs should be sited a minimum of 25 feet away from any foundations or retaining walls.

7.4 Suitability of the Site for Stormwater Infiltration

It is NOVA's judgment that the site is not suitable for development of stormwater infiltration BMP's. This judgment is based upon consideration of the variety of factors detailed above, most significantly (i) the low design infiltration rate (I) of I = 0.00 to 0.03 – inches per hour and related potential for groundwater mounding, and (ii) the limited space to achieve the minimum setbacks of stormwater infiltration BMP's from foundations, retaining walls, slopes and underground utilities.

Appendix E provides completed forms related to stormwater infiltration.

8.0 PAVEMENTS

8.1 Overview

8.1.1 General

The structural design of pavement sections depends primarily on anticipated traffic conditions, subgrade soils, and construction materials. For the purposes of the preliminary evaluation provided in this section, NOVA has assumed a Traffic Index (TI) of 5.0 for passenger car parking, and 6.0 for the driveways. These traffic indices should be confirmed by the project civil engineer prior to final design.

8.1.2 Design to Limit Infiltration

The surface grades of pavements and related design features to limit infiltration should conform with the concepts discussed in Section 6.

An important consideration in the design and construction of pavements is surface and subsurface drainage. Where standing water develops, either on the pavement surface or within the base course, softening of the subgrade and other problems related to the deterioration of the pavement can be expected. Furthermore, good drainage should minimize the risk of the subgrade materials becoming saturated over a long period of time. The following recommendations should be considered to limit the amount of excess moisture, which can reach the subgrade soils:

- site grading at a minimum 2% grade away from the pavements;
- compaction of any utility trenches for landscaped areas to the same criteria as the pavement subgrade;
- sealing all landscaped areas in or adjacent to pavements to minimize or prevent moisture migration to subgrade soils near pavements; and,
- concrete curbs bordering landscaped areas should have a deepened edge to provide a cutoff for moisture flow beneath pavements (generally, the edge of the curb can be extended an additional twelve inches below the base of the curb).

8.1.3 Maintenance

Preventative maintenance should be planned and provided for. Preventative maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Preventative maintenance consists of both localized maintenance (e.g. crack sealing and patching) and global maintenance (e.g. surface sealing). Preventative maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements.

8.1.4 Review and Surveillance

The Geotechnical Engineer-of-Record should review the planning and design for pavement to confirm that the recommendations presented in this report have been incorporated into the plans prepared for the project. The preparation of subgrades for roadways should be observed on a full-time basis by a representative of the Geotechnical Engineer-of-Record.

8.2 Subgrade Preparation

8.2.1 Control of Moisture

Moisture must be controlled around and beneath pavements. Moreover, where standing water develops either on the pavement surface or within the base course, softening of the subgrade and other problems related to the deterioration of the pavement can be expected. Furthermore, good drainage should minimize the risk of the subgrade materials becoming saturated and weakened over a long period of time.

The following recommendations should be considered to limit the amount of excess moisture which can reach the subgrade soils:

- maintain surface gradients at a minimum 2% grade away from the pavements;
- compact utility trenches for landscaped areas to the same criteria as the pavement subgrade;
- seal all landscaped areas in or adjacent to pavements to minimize or prevent moisture migration to subgrade soils;
- planters should not be located next to pavements (otherwise, subdrains should be used to drain the planter to appropriate outlets);
- place compacted backfill against the exterior side of curbs and gutters; and
- concrete curbs bordering landscaped areas should have a deepened edge to provide a cutoff for moisture flow beneath pavements (generally, the edge of the curb can be extended an additional twelve inches below the base of the curb).

8.2.2 Planning for Preventive Maintenance

Preventative maintenance should be planned and provided for. Preventative maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Preventative maintenance consists of both localized maintenance (e.g. crack sealing and patching) and global maintenance (e.g. surface sealing). Preventative maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements.

8.2.3 Rough Grading

Grading for paved areas should be as described in Section 6.4, densifying pavement subgrade to at least 95% relative compaction after ASTM D 1557 (the ‘modified Proctor’).

After the completion of compaction/densification, areas to receive pavements should be proof-rolled. A loaded dump truck or similar should be used to aid in identifying localized soft or unsuitable material. Any soft or unsuitable materials encountered during this proof-rolling should be removed, replaced with an approved backfill, and compacted. The Geotechnical Engineer can provide alternative options such as using geogrid and/or geotextile to stabilize the subgrade at the time of construction, if necessary.

Construction should be managed such that preparation of the subgrade immediately precedes placement of the base course. Proper drainage of the paved areas should be provided to reduce moisture infiltration to the subgrade.

The preparation of roadway and parking area subgrades should be observed on a full-time basis by a representative of NOVA to confirm that any unsuitable materials have been removed and that the subgrade is suitable for support of the proposed driveways and parking areas.

8.3 Flexible Pavements

Previous R-Value testing was performed at the site as referenced within both Twining 2008a and Twining 2008b. The results of this testing are summarized in Table 8-1 below. Additional R-value testing should be performed on actual soils during grading at the design subgrade levels to confirm the pavement design.

Table 8-1. R-Value Test Results

Ref:	Test Location	R-Value
Leighton 1998	Boring B-2 @ 2' – 5'	34
Twining 2008a	Boring B-1 @ 0'-5'	22
	Boring B-4 @ 0'-5'	5
	Boring B-5 @ 5'-10'	22
	Boring B-6 @ 2.5'–7'	8
Twining 2008b	Stockpile	26

Provided the subgrade in paved areas is prepared per the recommendations in Section 8.2, and based on the locations and results of previous testing NOVA recommends that an R-value of 5 can be assumed. Table 8-2 provides recommended sections for flexible pavements. The recommended pavement sections are for planning purposes only.

Table 8-2. Preliminary Recommendations for Flexible Pavements

Area	Assumed Subgrade R-Value	Traffic Index	Asphalt Thickness (in)	Base Course Thickness (in)
Auto Driveways/Parking	5	5.0	4.0	7.5
Roadways	5	6.0	4.0	11.5

The above sections assume properly prepared subgrade consisting of at least 12 inches of select soil compacted to a minimum of 95% relative compaction. The aggregate base materials should also be placed at a minimum relative compaction of 95%. Construction materials (asphalt and aggregate base) should conform to the current *Standard Specifications for Public Works Construction (Green Book)*.

8.4 Rigid Pavements

The flexible pavement specifications used in roadways and parking stalls may not be adequate for truck loading and turnaround areas, if such features are planned. In this event, NOVA recommends that a rigid concrete pavement section be provided. The pavement section should consist of 6 inches of concrete over a 6-inch base course. The aggregate base materials should also be placed at a minimum relative compaction of 95%. The concrete should be obtained from a mix design that conforms with the minimum properties shown in Table 8-2.

Longitudinal and transverse joints should be provided as needed in concrete pavements for expansion/ contraction and isolation. Sawed joints should be cut within 24-hours of concrete placement, and should be a minimum of 25% of slab thickness plus 1/4 inch. All joints should be sealed to prevent entry of foreign material and doweled where necessary for load transfer. Where dowels cannot be used at joints accessible to wheel loads, pavement thickness should be increased by 25 percent at the joints and tapered to regular thickness in 5 feet.

Table 8-2. Recommendations for Concrete Pavements

Property	Recommended Requirement
Compressive Strength @ 28 days	3,250 psi minimum
Strength Requirements	ASTM C94
Minimum Cement Content	5.5 sacks/cu. yd.
Cement Type	Type V Portland
Concrete Aggregate	ASTM C33
Aggregate Size	1-inch maximum
Maximum Water Content	0.5 lb/lb of cement
Maximum Allowable Slump	4 inches

9.0 REFERENCES

9.1 Project Specific

9.1.1 Previous Reporting

Leighton 1998. *Geotechnical Investigation Report for the Proposed O.R./Ambulatory Care Addition,* Leighton and Associates, Project No. 11980284-001, December 16, 1998.

MACTEC 2003. *Report of Geotechnical Investigation, Proposed Additions,* MACTEC, Project 4953-03-1451, June 17, 2003.

Twining 2008a. *Geotechnical Engineering Evaluation Report, Inland medical Center New Parking Lot,* Twining Laboratories, Project No.: 080154.3, March 26, 2008.

Twining 2008b. *Recommendations for Site Pavements, Inland Valley Medical Center – ER, ICU, Radiology and CCU Expansion,* Twining Laboratories, Project No.: 080071.3, December 11, 2008.

9.1.2 Project Plans

HOK 2019. *Site Plan, Phase 3 Plan with Survey, Inland Valley Regional Medical Center*, HOK, undated.

KH 2019. *Inland Valley Regional Medical Center – Rough Grading (South Option)*, Kimley Horn and Associates, undated.

NV5. A*s-Built Utility Plan, Inland Valley Regional Medical Center,* NV5, February 25, 2019.
Geotechnical/Structural

9.2 Geotechnical/Structural

American Concrete Institute, 2002, *Building Code Requirements for Structural Concrete* (ACI 318-02) and Commentary (ACI 318R-02).

American Concrete Institute, 2015, *Guide to Concrete Floor and Slab Construction,* ACI Publication 302.1R-15.

American Concrete Institute, 2016, *Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials* (ACI 302.2R-06)

ASTM, 2005, *Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover*, ASTM E154-88.

ASTM, 2005, *Standard Test Methods for Water Vapor Transmission of Materials*, ASTM E96-95

ASTM, 2009, *Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs*, ASTM E1643-98

ASTM, 2009, *Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs*, ASTM E1745-97

American Public Works Association, Standard Specifications for Public Works Construction (Green Book).

American Society of Civil Engineers (ASCE), 2016, Minimum Design Loads for Buildings and Other Structures, SEI/ASCE 7-16.

California Building Standards Commission, 2019, California Building Code, Title 24, Part 2, Vol. 1 & 2.

California Department of Transportation (Caltrans), 2003, *Corrosion Guidelines*, Version 1.0, found at http://www.dot.ca.gov/hq/esc/ttsb/corrosion/pdf/2012-11-19-Corrosion-Guidelines.pdf.

California Occupational Safety and Health Administration (Cal/OSHA), description of soil types relative to excavation safety, found at: https://www.dir.ca.gov/title8/1541_1d.html

Duncan, J. M., 2000, *Factors of Safety and Reliability in Geotechnical Engineering*, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 126, No. 4.2.

Hasek, M. J., 2016, *Age-related Liquefaction Resistance of Pleistocene Coastal Plain Sands in South Carolina*, Hasek, M.J., Doctoral Dissertation, University of South Carolina.

Ishihara, K. and Yoshimine, M., 1992, *Evaluation of Settlements in Sand Deposits Following Liquefaction During Earthquakes*, Soils and Foundations, JSSMFE, Vo l. 32, No. 1, March.

Martin, G.R., and Lew, M. (Co-chairs and Editors), 1999, *Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California,* Southern California Earthquake Center, University of Southern California. March 1999.

OSHA Technical Manual, *Excavations: Hazard Recognition in Trenching and Shoring*, OSHA Instruction TED 01-00-015, Section V, Chapter 2. Found at: https://www.osha.gov/dts/osta/otm/otm_v/otm_v_2.html#1

Riverside County – Low Impact Development BMP Design Handbook, Sept 2011.

Riverside County Flood Control and Water Conservation District, Riverside County, Santa Margarita River Watershed Region Design Handbook for Low Impact Development, Best Management Practices, Revised June 2018,

Romanoff, Melvin. *Underground Corrosion*, NBS Circular 579. Reprinted by NACE, Houston, 1989.

Terzaghi, Karl, *Evaluating Coefficients of Subgrade Reaction,* Geotechnique, Vol 5, 1955, pp 297-326.

United States Geological Survey, 2015, *Ground Motion Parameter Calculator*, USGS web site, found at *http://earthquake.usgs.gov/ designmaps*.

Youd, T. L. and Idriss, I .M. (Editors), 1997, Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils, Salt Lake City, UT, January 5-6, 1996, NCEER Technical Report NCEER-97 – 0022, Buffalo, New York.

9.3 Geology

California Geological Survey (CGS), 2000, *Geologic Map of Temecula 7.5' Quadrangle San Diego and Riverside Counties, California.*

CGS, 2003, *Preliminary Geologic Map of the Murrieta 7.5' Quadrangle, Riverside County, California.*

CGS, 2007, *Seismic Hazard Zone Report For The Murrieta 7.5-Minute Quadrangle, Riverside County, California*.

California Geological Survey (CGS), *2008, Guidelines for Evaluating and Mitigating Seismic Hazards in California,* Special Publication 117A.

CGS, *2018, Earthquake Zones of Required Investigation, Murrieta Quadrangle, Riverside County, California.*

9.4 Site Setting

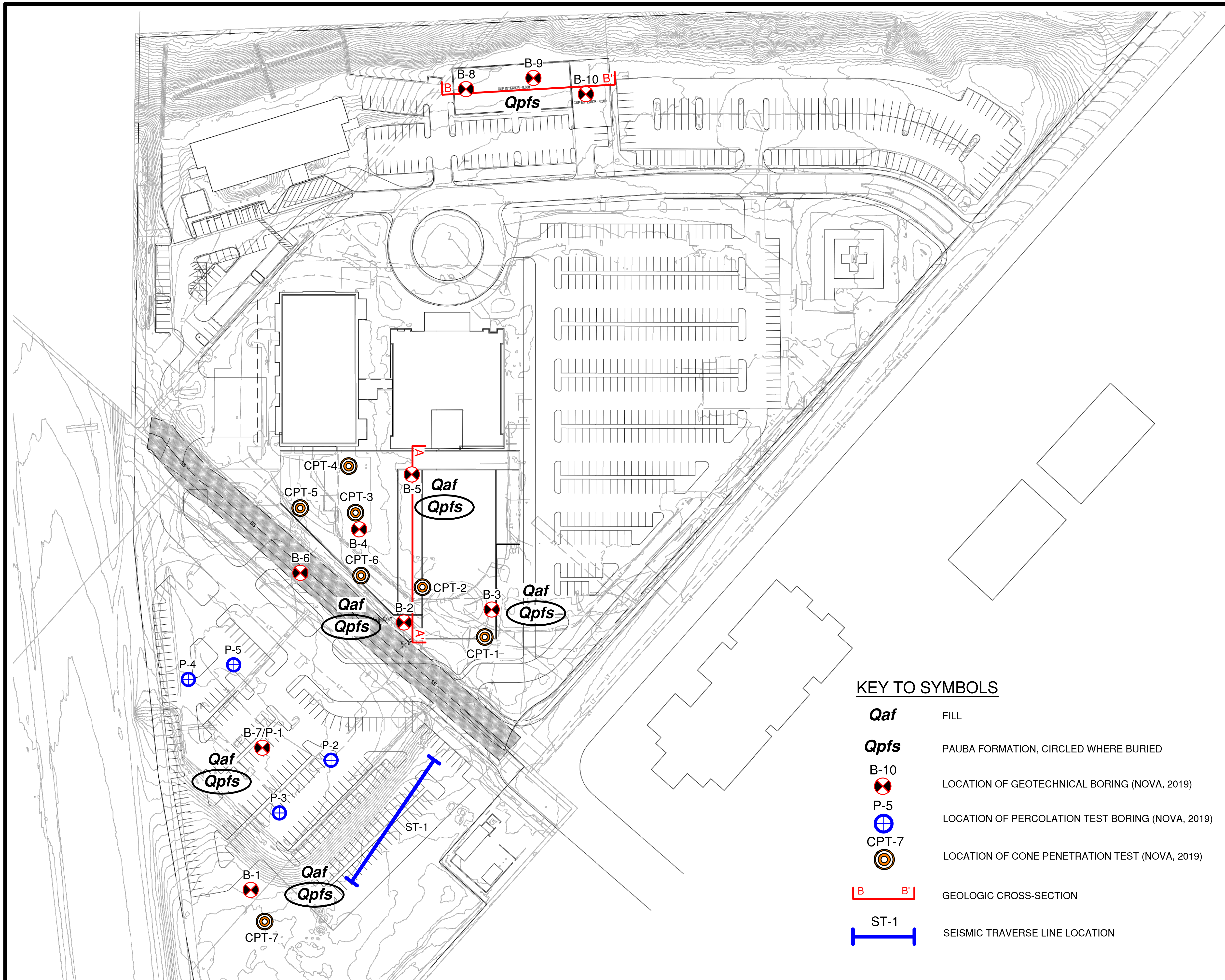
California Department of Water Resources CDWR, 2015, *Water Data Library, http://www.water.ca.gov/*

County of Riverside Environmental Impact Report No. 521, *Existing Environmental Setting – Geology and Soils,* March 2014.

Federal Emergency Management Agency, Flood Map 06065C3305G, effective 08/28/2008.

State Water Resources Control Board, - Geo Tracker, August 25, 2011, *Arco #5695 Well Abandonment and Remediation Systems Removal Report.*

PLATES



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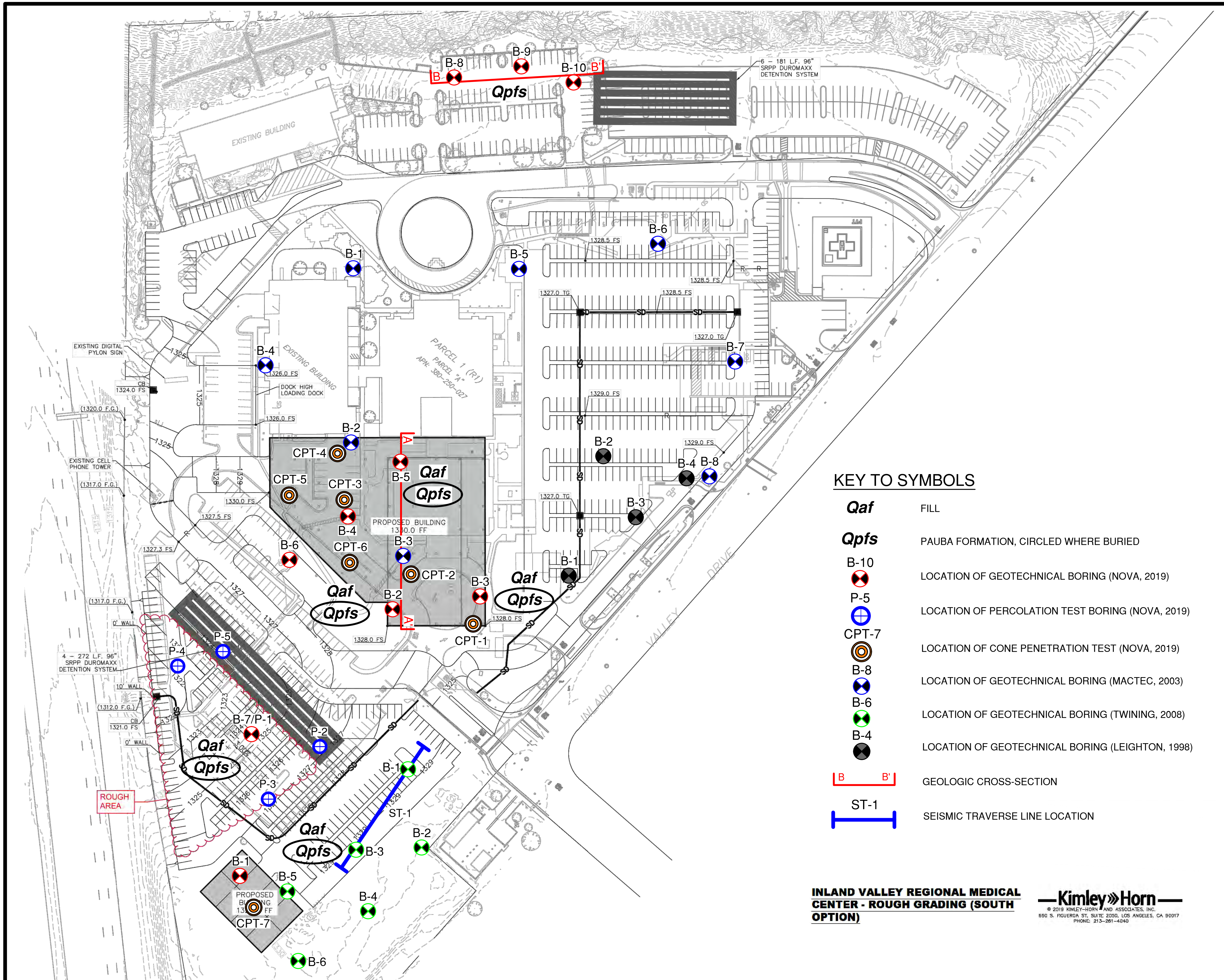
36485 INLAND VALLEY DRIVE
WILDOMAR, CALIFORNIA

PROJECT NO:	3019060
DATE:	DEC 2019
DRAWN BY:	DTW
REVIEWED BY:	JDB

NOVA SUBSURFACE EXPLORATION MAP ON UPDATED PLAN

0 120' 240'

PLATE 1A



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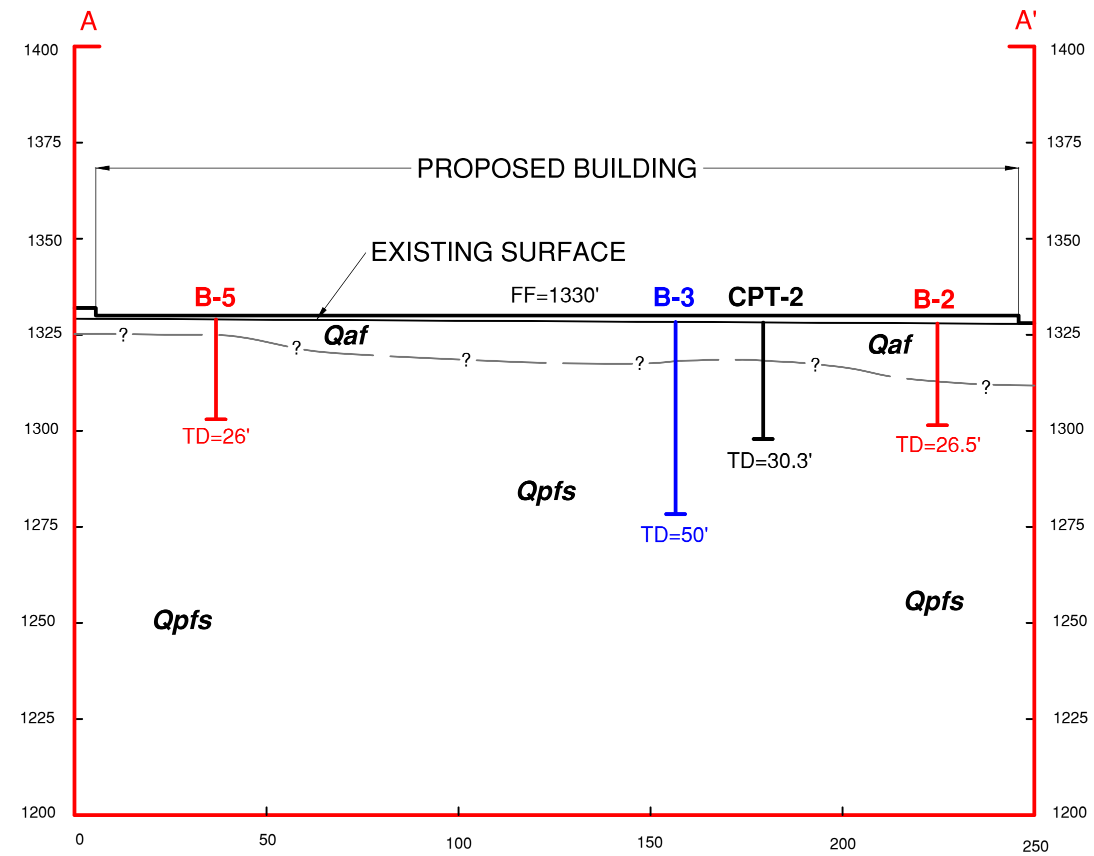
COLLABORATIVE SUBSURFACE EXPLORATION MAP

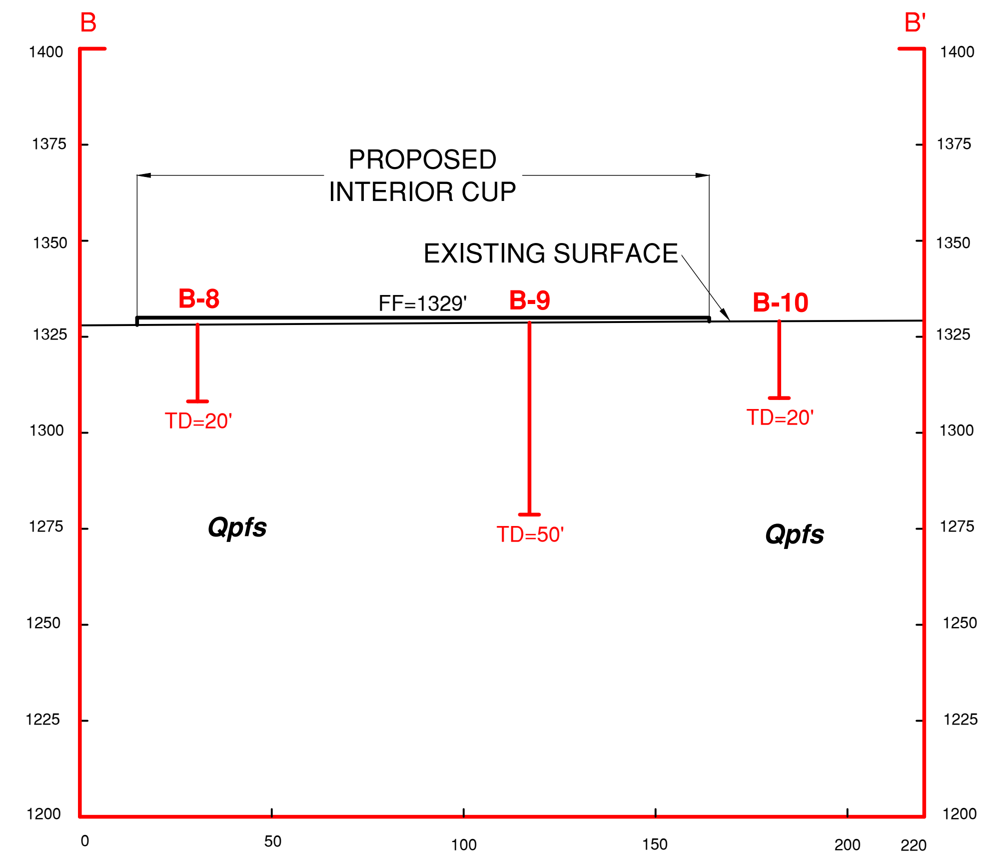
0 120' 240'

PLATE 1B

GEOLOGIC CROSS-SECTION AA'



GEOLOGIC CROSS-SECTION BB'



KEY TO SYMBOLS

Qaf FILL

Qpfs PAUBA FORMATION

B-10 LOCATION OF GEOTECHNICAL BORING (NOVA, 2019)

B-3 LOCATION OF GEOTECHNICAL BORING (MACTEC, 2003)

CPT-2 LOCATION OF CONE PENETRATION TEST (NOVA, 2019)

? GEOLOGIC CONTACT, QUERIED WHERE INFERRED

NOVA

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PROJECT NO:	3019060
DATE:	DEC 2019
DRAWN BY:	DTW
REVIEWED BY:	JDB

GEOLOGIC
CROSS-SECTION AA' & BB'

0 50' 100'

PLATE 2

APPENDIX A

USE OF THE GEOTECHNICAL REPORT

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org

APPENDIX B

LOGS OF BORINGS

BORING LOG B-1

DATE EXCAVATED:	AUGUST 27, 2019	**EQUIPMENT:**	CME 75 DRILL RIG
EXCAVATION DESCRIPTION:	8 INCH DIAMETER AUGER BORING	**GPS COORD.:**	
GROUNDWATER DEPTH:	NOT ENCOUNTERED	**ELEVATION:**	± 1329 FT MSL

LAB TEST ABBREVIATIONS

CR	CORROSIVITY
MD	MAXIMUM DENSITY
DS	DIRECT SHEAR
EI	EXPANSION INDEX
AL	ATTERBERG LIMITS
SA	SIEVE ANALYSIS
RV	RESISTANCE VALUE
CN	CONSOLIDATION
SE	SAND EQUIVALENT

DEPTH (FT)	GRAPHIC LOG	BULK SAMPLE	CAL/SPT SAMPLE	SOIL CLASS. (USCS)	BLOWS PER 12-INCHES	**SOIL DESCRIPTION** *SUMMARY OF SUBSURFACE CONDITIONS (USCS; COLOR, MOISTURE, DENSITY, GRAIN SIZE, OTHER)*	LABORATORY	REMARKS
0				ML		**FILL (Qaf):** SANDY SILT; YELLOW BROWN, DAMP, VERY DENSE, FINE TO MEDIUM GRAINED, TRACE GRAVEL.		
				SM		**PAUBA FORMATION (Qpfs):** SANDSTONE; RED BROWN, DRY, VERY DENSE, FINE TO COARSE GRAINED, TRACE GRAVEL, ABUNDANT IRON STAINING.		
					>70#		MD RV CR SA	120.7 PCF, @ 13.2% RV = 30 SO_4 = 0.009% (87 PPM)
5					>70#			125.6 PCF, @ 3.7%
10					>50	SCATTERED GRAVEL.		
15					>70	SILTY SANDSTONE; GRAY GREEN, DAMP, FINE GRAINED, SOME MEDIUM TO COARSE GRAINS.		119.2 PCF, @ 7.5%
20				SM	24	SANDY SILTSTONE; OLIVE GRAY, MOIST, VERY STIFF, FINE GRAINED, SCATTERED IRON STAINING.		
25					>70	SOME MICA, SCATTERED COARSE GRAINED SAND.		122.9 PCF, @ 14.1%
30								

KEY TO SYMBOLS

▼/▽	GROUNDWATER / STABILIZED	#	ERRONEOUS BLOW COUNT
☒	BULK SAMPLE	*	NO SAMPLE RECOVERY
⍁	SPT SAMPLE (ASTM D1586)	———	GEOLOGIC CONTACT
■	CAL. MOD. SAMPLE (ASTM D3550)	— — —	SOIL TYPE CHANGE

36485 INLAND VALLEY DRIVE
WILDOMAR, CALIFORNIA

LOGGED BY:	TDT	DATE:	DEC 2019
REVIEWED BY:	JDB	PROJECT NO.:	3019060

NOVA

APPENDIX B.1

CONTINUED BORING LOG B-1

DATE EXCAVATED: AUGUST 27, 2019
EQUIPMENT: CME 75 DRILL RIG
EXCAVATION DESCRIPTION: 8 INCH DIAMETER AUGER BORING
GPS COORD.:
GROUNDWATER DEPTH: NOT ENCOUNTERED
ELEVATION: ± 1329 FT MSL

LAB TEST ABBREVIATIONS

CR	CORROSIVITY
MD	MAXIMUM DENSITY
DS	DIRECT SHEAR
EI	EXPANSION INDEX
AL	ATTERBERG LIMITS
SA	SIEVE ANALYSIS
RV	RESISTANCE VALUE
CN	CONSOLIDATION
SE	SAND EQUIVALENT

DEPTH (FT)	GRAPHIC LOG	BULK SAMPLE	CAL/SPT SAMPLE	SOIL CLASS. (USCS)	BLOWS PER 12-INCHES	SOIL DESCRIPTION *SUMMARY OF SUBSURFACE CONDITIONS* *(USCS; COLOR, MOISTURE, DENSITY, GRAIN SIZE, OTHER)*	LABORATORY	REMARKS
30			SPT	SM	>50#	SILTSTONE; OLIVE GRAY, MOIST, HARD, FINE GRAINED, SOME MICA, SCATTERED COARSE SAND GRAINS, SHATTERED ROCK WITHIN SAMPLER.	SA	
35			CAL. MOD.		>70	TRACE FINE GRAINED SAND.		110.4 PCF, @ 17.6%
40			SPT		42			
45			CAL. MOD.		>70			108.3 PCF, @ 19.4%
			SPT		>50	DARK GRAY, MOIST TO WET, SCATTERED MICA.		
50						BORING TERMINATED AT 50 FT. NO GROUNDWATER ENCOUNTERED. NO CAVING. BACKFILLED WITH BORING CUTTINGS.		
55								
60								

KEY TO SYMBOLS

▼/▽	GROUNDWATER / STABILIZED	#	ERRONEOUS BLOW COUNT
⊠	BULK SAMPLE	*	NO SAMPLE RECOVERY
⧄	SPT SAMPLE (ASTM D1586)	———	GEOLOGIC CONTACT
■	CAL. MOD. SAMPLE (ASTM D3550)	— — —	SOIL TYPE CHANGE

36485 INLAND VALLEY DRIVE
WILDOMAR, CALIFORNIA

LOGGED BY:	TDT	DATE:	DEC 2019
REVIEWED BY:	JDB	PROJECT NO.:	3019060

NOVA

APPENDIX B.2

BORING LOG B-2

DATE EXCAVATED:	AUGUST 27, 2019	**EQUIPMENT:**	CME 75 DRILL RIG
EXCAVATION DESCRIPTION:	8 INCH DIAMETER AUGER BORING	**GPS COORD.:**	
GROUNDWATER DEPTH:	NOT ENCOUNTERED	**ELEVATION:**	± 1328 FT MSL

LAB TEST ABBREVIATIONS

CR	CORROSIVITY
MD	MAXIMUM DENSITY
DS	DIRECT SHEAR
EI	EXPANSION INDEX
AL	ATTERBERG LIMITS
SA	SIEVE ANALYSIS
RV	RESISTANCE VALUE
CN	CONSOLIDATION
SE	SAND EQUIVALENT

DEPTH (FT)	GRAPHIC LOG	BULK SAMPLE	CAL/SPT SAMPLE	SOIL CLASS. (USCS)	BLOWS PER 12-INCHES	SOIL DESCRIPTION *SUMMARY OF SUBSURFACE CONDITIONS* *(USCS; COLOR, MOISTURE, DENSITY, GRAIN SIZE, OTHER)*	LABORATORY	REMARKS
0				SM		**FILL (Qaf):** SILTY SAND; LIGHT BROWN, DAMP, LOOSE, FINE TO COARSE GRAINED, SCATTERED MICA.		
			SPT		10			
5			CAL. MOD.		36			
10			SPT	CL	8	SANDY CLAY; DARK BROWN, MOIST, FIRM, FINE TO MEDIUM GRAINED.		
15			SPT	SM	30	**PAUBA FORMATION (Qpfs):** SANDSTONE; BROWN TO DARK BROWN, MOIST, MEDIUM DENSE, FINE GRAINED, TRACE MICA.		
20			SPT		>50	CALICHE BLEBS.		
25			SPT		>50	SILTY SANDSTONE; LIGHT BROWN, DAMP, VERY DENSE, FINE TO MEDIUM GRAINED, SCATTERED MICA.		
						BORING TERMINATED AT 26.5 FT. NO GROUNDWATER ENCOUNTERED. NO CAVING. BACKFILLED WITH BORING CUTTINGS.		
30								

KEY TO SYMBOLS

▼/▽	GROUNDWATER / STABILIZED	#	ERRONEOUS BLOW COUNT
⊠	BULK SAMPLE	*	NO SAMPLE RECOVERY
▱	SPT SAMPLE (ASTM D1586)	———	GEOLOGIC CONTACT
■	CAL. MOD. SAMPLE (ASTM D3550)	— — —	SOIL TYPE CHANGE

36485 INALND VALLEY DRIVE

WILDOMAR, CALIFORNIA

LOGGED BY:	TDT	DATE:	DEC 2019
REVIEWED BY:	JDB	PROJECT NO.: 3019060	

NOVA

APPENDIX B.3

BORING LOG B-3

DATE EXCAVATED:	AUGUST 27, 2019	**EQUIPMENT:**	CME 75 DRILL RIG
EXCAVATION DESCRIPTION:	8 INCH DIAMETER AUGER BORING	**GPS COORD.:**	
GROUNDWATER DEPTH:	NOT ENCOUNTERED	**ELEVATION:**	± 1328 FT MSL

LAB TEST ABBREVIATIONS

CR	CORROSIVITY
MD	MAXIMUM DENSITY
DS	DIRECT SHEAR
EI	EXPANSION INDEX
AL	ATTERBERG LIMITS
SA	SIEVE ANALYSIS
RV	RESISTANCE VALUE
CN	CONSOLIDATION
SE	SAND EQUIVALENT

DEPTH (FT)	GRAPHIC LOG	BULK SAMPLE	CAL/SPT SAMPLE	SOIL CLASS. (USCS)	BLOWS PER 12-INCHES	SOIL DESCRIPTION *SUMMARY OF SUBSURFACE CONDITIONS (USCS; COLOR, MOISTURE, DENSITY, GRAIN SIZE, OTHER)*	LABORATORY	REMARKS
0						**ASPHALT: 5 INCHES, AGGREGATE BASE; 7 INCHES**		
				SM		**FILL (Qaf):** SILTY SAND; LIGHT BROWN, DAMP TO MOIST, MEDIUM DENSE, FINE TO COARSE GRAINED, TRACE CLAY, SCATTERED MICA, TRACE GRAVEL.		
			SPT		11			
5			CAL. MOD.	SP	14	POORLY GRADED SAND; LIGHT TO DARK BROWN, MOIST, MEDIUM DENSE, FINE TO COARSE GRAINED, TRACE CLAY.		
				CL		CLAY; DARK BROWN, MOIST, FIRM, TRACE MICA.		
10			SPT	SM	36	**PAUBA FORMATION (Qpfs):** SANDSTONE; LIGHT TO DARK BROWN, DAMP, DENSE, FINE TO COARSE GRAINED, SCATTERED MICA.		
15			SPT		47			
20			SPT		>50	OLIVE BROWN, DAMP, VERY DENSE, FINE GRAINED, SOME MICA.		
25			SPT		>50	TRACE IRON STAINING.		
						BORING TERMINATED AT 26.5 FT. NO GROUNDWATER ENCOUNTERED. NO CAVING. BACKFILLED WITH BORING CUTTINGS. CAPPED WITH AC COLD PATCH.		
30								

KEY TO SYMBOLS

▼/▽	GROUNDWATER / STABILIZED	#	ERRONEOUS BLOW COUNT
☒	BULK SAMPLE	*	NO SAMPLE RECOVERY
◫	SPT SAMPLE (ASTM D1586)	———	GEOLOGIC CONTACT
■	CAL. MOD. SAMPLE (ASTM D3550)	— — —	SOIL TYPE CHANGE

36485 INLAND VALLEY DRIVE
WILDOMAR, CALIFORNIA

NOVA

LOGGED BY:	TDT	DATE:	DEC 2019
REVIEWED BY:	JDB	PROJECT NO.:	3019060

APPENDIX B.4

BORING LOG B-4

DATE EXCAVATED:	AUGUST 27, 2019	**EQUIPMENT:**	CME 75 DRILL RIG
EXCAVATION DESCRIPTION:	8 INCH DIAMETER AUGER BORING	**GPS COORD.:**	
GROUNDWATER DEPTH:	NOT ENCOUNTERED	**ELEVATION:**	± 1328 FT MSL

LAB TEST ABBREVIATIONS

CR	CORROSIVITY
MD	MAXIMUM DENSITY
DS	DIRECT SHEAR
EI	EXPANSION INDEX
AL	ATTERBERG LIMITS
SA	SIEVE ANALYSIS
RV	RESISTANCE VALUE
CN	CONSOLIDATION
SE	SAND EQUIVALENT

DEPTH (FT)	GRAPHIC LOG	BULK SAMPLE	CAL/SPT SAMPLE	SOIL CLASS. (USCS)	BLOWS PER 12-INCHES	SOIL DESCRIPTION *SUMMARY OF SUBSURFACE CONDITIONS (USCS; COLOR, MOISTURE, DENSITY, GRAIN SIZE, OTHER)*	LABORATORY	REMARKS
0						**ASPHALT: 5 INCHES, AGGREGATE BASE; 7 INCHES**		
				SM		**FILL (Qaf):** SILTY SAND; LIGHT BROWN TO LIGHT GRAY, MOIST, MEDIUM DENSE, FINE TO COARSE GRAINED, TRACE TO SCATTERED CLAY.		
			CAL. MOD.		20			
5			SPT	CL	7	SILTY CLAY; DARK BROWN, MOIST, STIFF, TRACE FINE GRAINS.	EI SA	
10						MOIST TO WET.		81.5 PCF, @ 33.1%
			CAL. MOD.	ML	>70	**PAUBA FORMATION (Qpfs):** SILTSTONE; LIGHT BROWN, DAMP TO MOIST, HARD, FINE GRAINED.	DS	
15			SPT	SM	>50	SANDSTONE; LIGHT TO DARK BROWN, DAMP TO MOIST, VERY DENSE, FINE GRAINED, ABUNDANT MICA.		
20			CAL. MOD.		>70	SANDSTONE WITH SILTSTONE INTERBEDS; LIGHT BROWN, MOIST, VERY DENSE, FINE GRAINED, INDISTINCT LENSE OF MEDIUM TO COARSE GRAINS.		123.8 PCF, @ 13.0%
25			SPT		45			
30								

KEY TO SYMBOLS

▼/▽	GROUNDWATER / STABILIZED	#	ERRONEOUS BLOW COUNT
☒	BULK SAMPLE	*	NO SAMPLE RECOVERY
◫	SPT SAMPLE (ASTM D1586)	———	GEOLOGIC CONTACT
■	CAL. MOD. SAMPLE (ASTM D3550)	— — —	SOIL TYPE CHANGE

36485 INLAND VALLEY DRIVE

WILDOMAR, CALIFORNIA

LOGGED BY:	TDT	DATE:	DEC 2019
REVIEWED BY:	JDB	PROJECT NO.:	3019060

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APPENDIX B.5

CONTINUED BORING LOG B-4

DATE EXCAVATED: AUGUST 27, 2019 | **EQUIPMENT:** CME 75 DRILL RIG

EXCAVATION DESCRIPTION: 8 INCH DIAMETER AUGER BORING | **GPS COORD.:**

GROUNDWATER DEPTH: NOT ENCOUNTERED | **ELEVATION:** ± 1328 FT MSL

LAB TEST ABBREVIATIONS

CR	CORROSIVITY
MD	MAXIMUM DENSITY
DS	DIRECT SHEAR
EI	EXPANSION INDEX
AL	ATTERBERG LIMITS
SA	SIEVE ANALYSIS
RV	RESISTANCE VALUE
CN	CONSOLIDATION
SE	SAND EQUIVALENT

DEPTH (FT)	GRAPHIC LOG	BULK SAMPLE	CAL/SPT SAMPLE	SOIL CLASS. (USCS)	BLOWS PER 12-INCHES	SOIL DESCRIPTION *SUMMARY OF SUBSURFACE CONDITIONS* *(USCS; COLOR, MOISTURE, DENSITY, GRAIN SIZE, OTHER)*	LABORATORY	REMARKS
30			CAL. MOD.	SW	>70	WELL GRADED SAND; LIGHT TO DARK GRAY, DAMP, VERY DENSE, FINE TO MEDIUM GRAINED, SOME CLAYSTONE LENSES.		127.8 PCF, @ 8.8%
35			SPT		>50#	CLAYSTONE LENSES NOT PRESENT, SHATTERED ROCK IN UPPER PORTION OF SAMPLER.		
40			CAL. MOD.	ML	>70	SILTSTONE; BROWN TO DARK BROWN, DAMP, HARD, FINE TO MEDIUM GRAINED SAND LENSES.		119.0 PCF, @ 13.0%
45			SPT	SM	>50	SANDSTONE; LIGHT TO DARK GRAY, DAMP, VERY DENSE, MEDIUM TO COARSE GRAINED, SOME MICA, TRACE IRON STAINING.		
			SPT		50/4"			
50						BORING TERMINATED AT 50 FT. NO GROUNDWATER ENCOUNTERED. NO CAVING. BACKFILLED WITH BORING CUTTINGS. CAPPED WITH AC COLD PATCH.		
55								
60								

KEY TO SYMBOLS

▼/▽	GROUNDWATER / STABILIZED	#	ERRONEOUS BLOW COUNT
☒	BULK SAMPLE	*	NO SAMPLE RECOVERY
◸	SPT SAMPLE (ASTM D1586)	———	GEOLOGIC CONTACT
■	CAL. MOD. SAMPLE (ASTM D3550)	— — —	SOIL TYPE CHANGE

36485 INLAND VALLEY DRIVE

WILDOMAR, CALIFORNIA

NOVA

LOGGED BY:	TDT	DATE:	DEC 2019
REVIEWED BY:	JDB	PROJECT NO.:	3019060

APPENDIX B.6

BORING LOG B-5

DATE EXCAVATED:	AUGUST 27, 2019	**EQUIPMENT:**	CME 75 DRILL RIG
EXCAVATION DESCRIPTION:	8 INCH DIAMETER AUGER BORING	**GPS COORD.:**	
GROUNDWATER DEPTH:	NOT ENCOUNTERED	**ELEVATION:**	± 1329 FT MSL

LAB TEST ABBREVIATIONS

CR	CORROSIVITY
MD	MAXIMUM DENSITY
DS	DIRECT SHEAR
EI	EXPANSION INDEX
AL	ATTERBERG LIMITS
SA	SIEVE ANALYSIS
RV	RESISTANCE VALUE
CN	CONSOLIDATION
SE	SAND EQUIVALENT

DEPTH (FT)	GRAPHIC LOG	BULK SAMPLE	CAL/SPT SAMPLE	SOIL CLASS. (USCS)	BLOWS PER 12-INCHES	**SOIL DESCRIPTION** *SUMMARY OF SUBSURFACE CONDITIONS (USCS; COLOR, MOISTURE, DENSITY, GRAIN SIZE, OTHER)*	LABORATORY	REMARKS
0		☒		SM		**FILL (Qaf):** SILTY SAND; LIGHT BROWN, DAMP, VERY DENSE, MEDIUM TO COARSE GRAINED, SCATTERED FINE GRAINS.	MD CR	128.9 PCF, @ 7.3% SO_4 = 0.003% (30 PPM)
5			CAL	SM	>70	**PAUBA FORMATION (Qpfs):** SANDSTONE; BROWN, DAMP TO MOIST, VERY DENSE, FINE GRAINED, TRACE MICA, SCATTERED IRON STAINING, SILTSTONE INTERBEDS, ABUNDANT MICA.		117.3 PCF, @ 6.4%
10			SPT		22			
15			SPT		37	SANDY SILTSTONE INTERBEDS; RED BROWN, DAMP STIFF, FINE GRAINED, SCATTERED MICA, TRACE IRON STAINING.		
20			SPT		>50	SANDSTONE; LIGHT GRAY TO LIGHT BROWN, DAMP, MEDIUM DENSE, FINE TO MEDIUM GRAINED, ABUNDANT MICA, TRACE IRON STAINING.		
25			CAL		50/3"	SANDSTONE; WELL GRADED, LIGHT GRAY, DAMP, VERY DENSE, MEDIUM TO COARSE GRAINED, TRACE FINE GRAINED LENSES.		
						BORING TERMINATED AT 26.0 FT. NO GROUNDWATER ENCOUNTERED. NO CAVING. BACKFILLED WITH BORING CUTTINGS.		
30								

KEY TO SYMBOLS

▼/▽	GROUNDWATER / STABILIZED	#	ERRONEOUS BLOW COUNT
☒	BULK SAMPLE	*	NO SAMPLE RECOVERY
◪	SPT SAMPLE (ASTM D1586)	———	GEOLOGIC CONTACT
■	CAL. MOD. SAMPLE (ASTM D3550)	— — —	SOIL TYPE CHANGE

36485 INLAND VALLEY DRIVE
WILDOMAR, CALIFORNIA

LOGGED BY:	TDT	DATE:	DEC 2019
REVIEWED BY:	JDB	PROJECT NO.:	3019060

NOVA

APPENDIX B.7

BORING LOG B-6

DATE EXCAVATED:	AUGUST 27, 2019	**EQUIPMENT:**	CME 75 DRILL RIG
EXCAVATION DESCRIPTION:	8 INCH DIAMETER AUGER BORING	**GPS COORD.:**	
GROUNDWATER DEPTH:	NOT ENCOUNTERED	**ELEVATION:**	± 1327 FT MSL

LAB TEST ABBREVIATIONS

CR	CORROSIVITY
MD	MAXIMUM DENSITY
DS	DIRECT SHEAR
EI	EXPANSION INDEX
AL	ATTERBERG LIMITS
SA	SIEVE ANALYSIS
RV	RESISTANCE VALUE
CN	CONSOLIDATION
SE	SAND EQUIVALENT

DEPTH (FT)	GRAPHIC LOG	BULK SAMPLE	CAL/SPT SAMPLE	SOIL CLASS. (USCS)	BLOWS PER 12-INCHES	**SOIL DESCRIPTION** *SUMMARY OF SUBSURFACE CONDITIONS* *(USCS; COLOR, MOISTURE, DENSITY, GRAIN SIZE, OTHER)*	LABORATORY	REMARKS
0						**ASPHALT: 4.5 INCHES, AGGREGATE BASE; 4.5 INCHES**		
				SM		**FILL (Qaf):** SILTY SAND; LIGHT BROWN, MOIST, LOOSE, FINE TO MEDIUM GRAINED, SCATTERED MICA.		
			SPT SAMPLE		8			
5			CAL. MOD. SAMPLE	SM	41	**PAUBA FORMATION (Qpfs):** SANDSTONE; LIGHT GRAY, DAMP, DENSE, FINE GRAINED, SOME MICA, SILTSTONE INTERBEDS.		
10		BULK SAMPLE	SPT SAMPLE	SM	42	SANDSTONE; LIGHT TO DARK BROWN, DENSE, FINE TO MEDIUM GRAINED, SOME MICA, SCATTERED IRON STAINING, TRACE GRAVEL.		
15			SPT SAMPLE		38	MEDIUM GRAINED, SOME FINE GRAINS, SOME SILT.	SA	
20			SPT SAMPLE		50/4"#	SHATTERED ROCK IN SAMPLER.		
			SPT SAMPLE	SM	>50	SILTY SANDSTONE; RED BROWN, DAMP, VERY DENSE, FINE TO MEDIUM GRAINED, SOME MICA, SOME IRON STAINING.		
25						BORING TERMINATED AT 25 FT. NO GROUNDWATER ENCOUNTERED. NO CAVING. BACKFILLED WITH BORING CUTTINGS. CAPPED WITH AC COLD PATCH.		
30								

KEY TO SYMBOLS

▼/▽	GROUNDWATER / STABILIZED	#	ERRONEOUS BLOW COUNT
⊠	BULK SAMPLE	*	NO SAMPLE RECOVERY
⧄	SPT SAMPLE (ASTM D1586)	———	GEOLOGIC CONTACT
■	CAL. MOD. SAMPLE (ASTM D3550)	— — —	SOIL TYPE CHANGE

36485 INLAND VALLEY DRIVE

WILDOMAR, CALIFORNIA

LOGGED BY:	TDT	DATE:	DEC 2019
REVIEWED BY:	JDB	PROJECT NO.:	3019060

NOVA

APPENDIX B.8

BORING LOG B-7/ P-1

DATE EXCAVATED:	AUGUST 27, 2019	**EQUIPMENT:**	CME 75 DRILL RIG
EXCAVATION DESCRIPTION:	8 INCH DIAMETER AUGER BORING	**GPS COORD.:**	
GROUNDWATER DEPTH:	NOT ENCOUNTERED	**ELEVATION:**	± 1325 FT MSL

LAB TEST ABBREVIATIONS

CR	CORROSIVITY
MD	MAXIMUM DENSITY
DS	DIRECT SHEAR
EI	EXPANSION INDEX
AL	ATTERBERG LIMITS
SA	SIEVE ANALYSIS
RV	RESISTANCE VALUE
CN	CONSOLIDATION
SE	SAND EQUIVALENT

DEPTH (FT)	GRAPHIC LOG	BULK SAMPLE	CAL/SPT SAMPLE	SOIL CLASS. (USCS)	BLOWS PER 12-INCHES	**SOIL DESCRIPTION** *SUMMARY OF SUBSURFACE CONDITIONS* *(USCS; COLOR, MOISTURE, DENSITY, GRAIN SIZE, OTHER)*	LABORATORY	REMARKS
0						**ASPHALT: 3 INCHES; AGGREGATE BASE: 9 INCHES**		
				ML		**FILL (Qaf):** SANDY SILT; YELLOW BROWN, DAMP, HARD, FINE TO MEDIUM GRAINED, TRACE GRAVEL.		
5				SM	35	**PAUBA FORMATION (Qpfs):** SANDSTONE; LIGHT TO DARK BROWN, DAMP, DENSE, FINE TO COARSE GRAINED, SCATTERED MICA, TRACE GRAVEL.		
10				ML	41	TRACE MICA, TRACE IRON STAINING.	SA	
15						BORING TERMINATED AT 15 FT. NO GROUNDWATER ENCOUNTERED. NO CAVING. BACKFILLED WITH CUTTINGS. CAPPED WITH AC COLD PATCH.		
20								
25								
30								

KEY TO SYMBOLS

▼/▽	GROUNDWATER / STABILIZED	#	ERRONEOUS BLOW COUNT
⊠	BULK SAMPLE	*	NO SAMPLE RECOVERY
◪	SPT SAMPLE (ASTM D1586)	———	GEOLOGIC CONTACT
■	CAL. MOD. SAMPLE (ASTM D3550)	— — —	SOIL TYPE CHANGE

36485 INLAND VALLEY DRIVE
WILDOMAR, CALIFORNIA

NOVA

LOGGED BY: TDT	DATE: DEC 2019		
REVIEWED BY: JDB	PROJECT NO.: 3019060	APPENDIX B.9	

BORING LOG B-8

DATE EXCAVATED: OCTOBER 7, 2019

EQUIPMENT: CME 75 DRILL RIG

EXCAVATION DESCRIPTION: 8 INCH DIAMETER AUGER BORING

GPS COORD.:

GROUNDWATER DEPTH: NOT ENCOUNTERED

ELEVATION: ± 1326 FT MSL

LAB TEST ABBREVIATIONS

CR	CORROSIVITY
MD	MAXIMUM DENSITY
DS	DIRECT SHEAR
EI	EXPANSION INDEX
AL	ATTERBERG LIMITS
SA	SIEVE ANALYSIS
RV	RESISTANCE VALUE
CN	CONSOLIDATION
SE	SAND EQUIVALENT

DEPTH (FT)	GRAPHIC LOG	BULK SAMPLE	CAL/SPT SAMPLE	SOIL CLASS. (USCS)	BLOWS PER 12-INCHES	SOIL DESCRIPTION *SUMMARY OF SUBSURFACE CONDITIONS* *(USCS; COLOR, MOISTURE, DENSITY, GRAIN SIZE, OTHER)*	LABORATORY	REMARKS
0						**ASPHALT: 2.5 INCHES, AGGREGATE BASE; 9 INCHES**		
				SM		**PAUBA FORMATION (Qpfs):** SILTY SANDSTONE, YELLOW-BROWN, DAMP, VERY DENSE, FINE TO COARSE GRAINED, SOME MICA.		
			CAL. MOD.		> 70			
5			CAL. MOD.	SP	> 70	POORLY GRADED SANDSTONE, LIGHT GRAY, DAMP, VERY DENSE, FINE TO COARSE GRAINED, SOME MICA.		
10			SPT		> 50	SOME SILT.		
15			CAL. MOD.		> 70	RED-BROWN, TRACE MICA.		
			SPT		> 50	SCATTERED MICA.		
20						BORING TERMINATED AT 20 FT. NO GROUNDWATER ENCOUNTERED. NO CAVING. BACKFILLED WITH BORING CUTTINGS.		
25								
30								

KEY TO SYMBOLS

▼/▽	GROUNDWATER / STABILIZED	#	ERRONEOUS BLOW COUNT
☒	BULK SAMPLE	*	NO SAMPLE RECOVERY
▨	SPT SAMPLE (ASTM D1586)	———	GEOLOGIC CONTACT
■	CAL. MOD. SAMPLE (ASTM D3550)	— — —	SOIL TYPE CHANGE

36485 INLAND VALLEY DRIVE

WILDOMAR, CALIFORNIA

NOVA

LOGGED BY: TDT	DATE: DEC 2019		
REVIEWED BY: JDB	PROJECT NO.: 3019060	APPENDIX B.10	

BORING LOG B-9

DATE EXCAVATED: OCTOBER 7, 2019
EQUIPMENT: CME 75 DRILL RIG
EXCAVATION DESCRIPTION: 8 INCH DIAMETER AUGER BORING
GPS COORD.:
GROUNDWATER DEPTH: 47.5'
ELEVATION: ±1326 FT MSL

LAB TEST ABBREVIATIONS

CR	CORROSIVITY
MD	MAXIMUM DENSITY
DS	DIRECT SHEAR
EI	EXPANSION INDEX
AL	ATTERBERG LIMITS
SA	SIEVE ANALYSIS
RV	RESISTANCE VALUE
CN	CONSOLIDATION
SE	SAND EQUIVALENT

DEPTH (FT)	GRAPHIC LOG	BULK SAMPLE	CAL/SPT SAMPLE	SOIL CLASS. (USCS)	BLOWS PER 12-INCHES	**SOIL DESCRIPTION** *SUMMARY OF SUBSURFACE CONDITIONS (USCS; COLOR, MOISTURE, DENSITY, GRAIN SIZE, OTHER)*	LABORATORY	REMARKS
0						**ASPHALT: 2.5 INCHES, AGGREGATE BASE; 11.0 INCHES**		
		BULK		SP		**PAUBA FORMATION (Qpfs):** SILTY SANDSTONE, YELLOW-BROWN, DAMP, VERY DENSE, FINE TO COARSE GRAINED, TRACE GRAVEL, SCATTERED IRON STAINING.	EI CR	EI = 0, VERY LOW; SO_4 = 0.003% (27 PPM), LOW
			CAL		> 70#			
5			CAL		> 70	LIGHT GRAY, NO IRON STAINING.		
10			CAL		> 70			
15			SPT		> 50#	BROKEN GRANITE ROCK IN SAMPLE		
20			CAL		> 70			
25			SPT		> 50	TRACE MICA, TRACE CLAY.		
30								

KEY TO SYMBOLS

▼/▽	GROUNDWATER / STABILIZED	#	ERRONEOUS BLOW COUNT
☒	BULK SAMPLE	*	NO SAMPLE RECOVERY
⧄	SPT SAMPLE (ASTM D1586)	———	GEOLOGIC CONTACT
■	CAL. MOD. SAMPLE (ASTM D3550)	— — —	SOIL TYPE CHANGE

36485 INLAND VALLEY DRIVE
WILDOMAR, CALIFORNIA

LOGGED BY:	TDT	DATE:	DEC 2019
REVIEWED BY:	JDB	PROJECT NO.:	3019060

NOVA

APPENDIX B.11

CONTINUED BORING LOG B-9

DATE EXCAVATED:	OCTOBER 7, 2019	**EQUIPMENT:**	CME 75 DRILL RIG
EXCAVATION DESCRIPTION:	8 INCH DIAMETER AUGER BORING	**GPS COORD.:**	
GROUNDWATER DEPTH:	47.5'	**ELEVATION:**	±1326 FT MSL

LAB TEST ABBREVIATIONS

CR	CORROSIVITY
MD	MAXIMUM DENSITY
DS	DIRECT SHEAR
EI	EXPANSION INDEX
AL	ATTERBERG LIMITS
SA	SIEVE ANALYSIS
RV	RESISTANCE VALUE
CN	CONSOLIDATION
SE	SAND EQUIVALENT

SOIL DESCRIPTION
SUMMARY OF SUBSURFACE CONDITIONS
(USCS; COLOR, MOISTURE, DENSITY, GRAIN SIZE, OTHER)

DEPTH (FT)	GRAPHIC LOG	BULK SAMPLE	CAL/SPT SAMPLE	SOIL CLASS. (USCS)	BLOWS PER 12-INCHES	SOIL DESCRIPTION	LABORATORY	REMARKS
30			CAL. MOD. SAMPLE	SP	50/ 6"	**PAUBA FORMATION (Qpfs):** SILTY SANDSTONE, YELLOW-BROWN, DAMP, VERY DENSE, FINE TO COARSE GRAINED.		
35			SPT SAMPLE		50/ 6"	TRACE GRAVEL.		
40			CAL. MOD. SAMPLE		50/ 4"	BROWN, MOIST, POCKET OF FINE GRAINED SAND.		
45			SPT SAMPLE		> 50	WET, THIN LENSES OF FINE GRAINED SAND, SOME MICA.		
▽ / ▼								
			SPT SAMPLE		> 50	TRACE GRAVEL, SCATTERED MICA.		
50						BORING TERMINATED AT 50 FT. GROUNDWATER ENCOUNTERED AT 48.2 FT, STABILIZED AT 47.6 FT, BACKFILLED WITH BORING CUTTINGS.		
55								
60								

KEY TO SYMBOLS

▼/▽	GROUNDWATER / STABILIZED	#	ERRONEOUS BLOW COUNT
⊠	BULK SAMPLE	*	NO SAMPLE RECOVERY
◪	SPT SAMPLE (ASTM D1586)	———	GEOLOGIC CONTACT
■	CAL. MOD. SAMPLE (ASTM D3550)	— — —	SOIL TYPE CHANGE

36485 INLAND VALLEY DRIVE
WILDOMAR, CALIFORNIA

NOVA

LOGGED BY: TDT	DATE: DEC 2019		
REVIEWED BY: JDB	PROJECT NO.: 3019060	APPENDIX B.12	

BORING LOG B-10

DATE EXCAVATED:	OCTOBER 7, 2019	EQUIPMENT:	CME 75 DRILL RIG
EXCAVATION DESCRIPTION:	8 INCH DIAMETER AUGER BORING	GPS COORD.:	
GROUNDWATER DEPTH:	NOT ENCOUNTERED	ELEVATION:	±1327 FT MSL

LAB TEST ABBREVIATIONS

CR	CORROSIVITY
MD	MAXIMUM DENSITY
DS	DIRECT SHEAR
EI	EXPANSION INDEX
AL	ATTERBERG LIMITS
SA	SIEVE ANALYSIS
RV	RESISTANCE VALUE
CN	CONSOLIDATION
SE	SAND EQUIVALENT

DEPTH (FT)	GRAPHIC LOG	BULK SAMPLE	CAL/SPT SAMPLE	SOIL CLASS. (USCS)	BLOWS PER 12-INCHES	SOIL DESCRIPTION *SUMMARY OF SUBSURFACE CONDITIONS* *(USCS; COLOR, MOISTURE, DENSITY, GRAIN SIZE, OTHER)*	LABORATORY	REMARKS
0						**ASPHALT: 2.5 INCHES, AGGREGATE BASE; 10 INCHES**		
				SP		**PAUBA FORMATION (Qpfs):** POORLY GRADED SANDSTONE; LIGHT BROWN TO LIGHT GRAY, DAMP, VERY DENSE, FINE TO COARSE GRAINED, SCATTERED MICA, TRACE GRAVEL.		
			CAL		> 70			
5			CAL		> 70	SOME TO ABUNDANT MICA.		
10			SPT		> 50	SCATTERED IRON STAINING.		
15			SPT	SM	> 50	SILTY SANDSTONE; LIGHT GRAY, DAMP, VERY DENSE, FINE TO MEDIUM GRAINED, SCATTERED MICA, TRACE COARSE GRAINED SAND.		
			SPT	SP	> 50	POORLY GRADED SANDSTONE; LIGHT GRAY, DAMP, VERY DENSE, FINE TO COARSE GRAINED, SCATTERED MICA.		
20						BORING TERMINATED AT 20 FT. NO GROUNDWATER ENCOUNTERED. NO CAVING. BACKFILLED WITH BORING CUTTINGS.		
25								
30								

KEY TO SYMBOLS

▼/▽	GROUNDWATER / STABILIZED	#	ERRONEOUS BLOW COUNT
☒	BULK SAMPLE	*	NO SAMPLE RECOVERY
◪	SPT SAMPLE (ASTM D1586)	———	GEOLOGIC CONTACT
■	CAL. MOD. SAMPLE (ASTM D3550)	— — —	SOIL TYPE CHANGE

36485 INLAND VALLEY DRIVE

WILDOMAR, CALIFORNIA

LOGGED BY:	TDT	DATE:	DEC 2019
REVIEWED BY:	JDB	PROJECT NO.:	3019060

NOVA

APPENDIX B.13

BORING LOG B-7/ P-1

DATE EXCAVATED: AUGUST 27, 2019
EQUIPMENT: CME 75 DRILL RIG
EXCAVATION DESCRIPTION: 8 INCH DIAMETER AUGER BORING
GPS COORD.:
GROUNDWATER DEPTH: NOT ENCOUNTERED
ELEVATION: ± 1325 FT MSL

LAB TEST ABBREVIATIONS	
CR	CORROSIVITY
MD	MAXIMUM DENSITY
DS	DIRECT SHEAR
EI	EXPANSION INDEX
AL	ATTERBERG LIMITS
SA	SIEVE ANALYSIS
RV	RESISTANCE VALUE
CN	CONSOLIDATION
SE	SAND EQUIVALENT

DEPTH (FT)	GRAPHIC LOG	BULK SAMPLE	CAL/SPT SAMPLE	SOIL CLASS. (USCS)	BLOWS PER 12-INCHES	SOIL DESCRIPTION *SUMMARY OF SUBSURFACE CONDITIONS* *(USCS; COLOR, MOISTURE, DENSITY, GRAIN SIZE, OTHER)*	LABORATORY	REMARKS
0						**ASPHALT: 3 INCHES; AGGREGATE BASE: 9 INCHES**		
				ML		**FILL (Qaf):** SANDY SILT; YELLOW BROWN, DAMP, HARD, FINE TO MEDIUM GRAINED, TRACE GRAVEL.		
5		☒	◪	SM	35	**PAUBA FORMATION (Qpfs):** SANDSTONE; LIGHT TO DARK BROWN, DAMP, DENSE, FINE TO COARSE GRAINED, SCATTERED MICA, TRACE GRAVEL.		
10		☒	◪	ML	41	TRACE MICA, TRACE IRON STAINING.	SA	
15						BORING TERMINATED AT 15 FT. NO GROUNDWATER ENCOUNTERED. NO CAVING. BACKFILLED WITH CUTTINGS. CAPPED WITH AC COLD PATCH.		
20								
25								
30								

KEY TO SYMBOLS

▼/▽	GROUNDWATER / STABILIZED	#	ERRONEOUS BLOW COUNT
☒	BULK SAMPLE	*	NO SAMPLE RECOVERY
◪	SPT SAMPLE (ASTM D1586)	———	GEOLOGIC CONTACT
■	CAL. MOD. SAMPLE (ASTM D3550)	— — —	SOIL TYPE CHANGE

36485 INLAND VALLEY DRIVE
WILDOMAR, CALIFORNIA

NOVA

LOGGED BY:	TDT	DATE:	DEC 2019
REVIEWED BY:	JDB	PROJECT NO.:	3019060

BORING LOG P-2

DATE EXCAVATED:	AUGUST 27, 2019	**EQUIPMENT:**	CME 75 DRILL RIG
EXCAVATION DESCRIPTION:	8 INCH DIAMETER AUGER BORING	**GPS COORD.:**	
GROUNDWATER DEPTH:	NOT ENCOUNTERED	**ELEVATION:**	± 1327 FT MSL

LAB TEST ABBREVIATIONS

CR	CORROSIVITY
MD	MAXIMUM DENSITY
DS	DIRECT SHEAR
EI	EXPANSION INDEX
AL	ATTERBERG LIMITS
SA	SIEVE ANALYSIS
RV	RESISTANCE VALUE
CN	CONSOLIDATION
SE	SAND EQUIVALENT

DEPTH (FT)	GRAPHIC LOG	BULK SAMPLE	CAL/SPT SAMPLE	SOIL CLASS. (USCS)	BLOWS PER 12-INCHES	**SOIL DESCRIPTION** *SUMMARY OF SUBSURFACE CONDITIONS* *(USCS; COLOR, MOISTURE, DENSITY, GRAIN SIZE, OTHER)*	LABORATORY	REMARKS
0						**ASPHALT: 4 INCHES, AGGREGATE BASE: 6 INCHES**		
				SC		**FILL (Qaf):** CLAYEY SAND; RED BROWN, DAMP, LOOSE TO MEDIUM DENSE, FINE TO COARSE GRAINED, TRACE MICA.		
5								
				SM		**PAUBA FORMATION (Qpfs):** SANDSTONE; LIGHT TO DARK BROWN, MOIST, MEDIUM DENSE TO DENSE, FINE TO COARSE GRAINED.		
10						BORING TERMINATED AT 10 FT. NO GROUNDWATER ENCOUNTERED. NO CAVING. BACKFILLED WITH CUTTINGS. CAPPED WITH AC COLD PATCH.		
15								
20								
25								
30								

KEY TO SYMBOLS

▼/▽	GROUNDWATER / STABILIZED	#	ERRONEOUS BLOW COUNT
⊠	BULK SAMPLE	*	NO SAMPLE RECOVERY
◿	SPT SAMPLE (ASTM D1586)	———	GEOLOGIC CONTACT
■	CAL. MOD. SAMPLE (ASTM D3550)	— — —	SOIL TYPE CHANGE

36485 INLAND VALLEY DRIVE

WILDOMAR, CALIFORNIA

LOGGED BY:	TDT	DATE:	DEC 2019
REVIEWED BY:	JDB	PROJECT NO.: 3019060	

NOVA

APPENDIX B.15

BORING LOG P-3

DATE EXCAVATED:	AUGUST 27, 2019	**EQUIPMENT:**	CME 75 DRILL RIG
EXCAVATION DESCRIPTION:	8 INCH DIAMETER AUGER BORING	**GPS COORD.:**	
GROUNDWATER DEPTH:	NOT ENCOUNTERED	**ELEVATION:**	± 1327 FT MSL

LAB TEST ABBREVIATIONS

CR	CORROSIVITY
MD	MAXIMUM DENSITY
DS	DIRECT SHEAR
EI	EXPANSION INDEX
AL	ATTERBERG LIMITS
SA	SIEVE ANALYSIS
RV	RESISTANCE VALUE
CN	CONSOLIDATION
SE	SAND EQUIVALENT

DEPTH (FT)	GRAPHIC LOG	BULK SAMPLE	CAL/SPT SAMPLE	SOIL CLASS. (USCS)	BLOWS PER 12-INCHES	SOIL DESCRIPTION *SUMMARY OF SUBSURFACE CONDITIONS* *(USCS; COLOR, MOISTURE, DENSITY, GRAIN SIZE, OTHER)*	LABORATORY	REMARKS
0						**ASPHALT: 4 INCHES, AGGREGATE BASE: 9 INCHES**		
				SC		**FILL (Qaf):** CLAYEY SAND; RED BROWN, DAMP, LOOSE TO MEDIUM DENSE, FINE TO COARSE GRAINED, TRACE MICA.		
5				SM		**PAUBA FORMATION (Qpfs):** SANDSTONE; LIGHT TO DARK BROWN, MOIST, MEDIUM DENSE TO DENSE, FINE TO COARSE GRAINED.		
10						BORING TERMINATED AT 10 FT. NO GROUNDWATER ENCOUNTERED. NO CAVING. BACKFILLED WITH CUTTINGS. CAPPED WITH AC COLD PATCH.		
15								
20								
25								
30								

KEY TO SYMBOLS

▼/▽	GROUNDWATER / STABILIZED	#	ERRONEOUS BLOW COUNT
☒	BULK SAMPLE	*	NO SAMPLE RECOVERY
⧄	SPT SAMPLE (ASTM D1586)	———	GEOLOGIC CONTACT
■	CAL. MOD. SAMPLE (ASTM D3550)	— — —	SOIL TYPE CHANGE

36485 INLAND VALLEY DRIVE
WILDOMAR, CALIFORNIA

NOVA

LOGGED BY:	TDT	DATE:	DEC 2019
REVIEWED BY:	JDB	PROJECT NO.: 3019060	APPENDIX B.16

BORING LOG P-4

DATE EXCAVATED: AUGUST 27, 2019 **EQUIPMENT:** CME 75 DRILL RIG

EXCAVATION DESCRIPTION: 8 INCH DIAMETER AUGER BORING **GPS COORD.:**

GROUNDWATER DEPTH: NOT ENCOUNTERED **ELEVATION:** ± 1322 FT MSL

LAB TEST ABBREVIATIONS

CR	CORROSIVITY
MD	MAXIMUM DENSITY
DS	DIRECT SHEAR
EI	EXPANSION INDEX
AL	ATTERBERG LIMITS
SA	SIEVE ANALYSIS
RV	RESISTANCE VALUE
CN	CONSOLIDATION
SE	SAND EQUIVALENT

DEPTH (FT)	GRAPHIC LOG	BULK SAMPLE	CAL/SPT SAMPLE	SOIL CLASS. (USCS)	BLOWS PER 12-INCHES	**SOIL DESCRIPTION** *SUMMARY OF SUBSURFACE CONDITIONS* *(USCS; COLOR, MOISTURE, DENSITY, GRAIN SIZE, OTHER)*	LABORATORY	REMARKS
0						**ASPHALT: 3 INCHES, AGGREGATE BASE: 10 INCHES**		
				SC		**FILL (Qaf):** CLAYEY SAND; BROWN TO RED BROWN, MOIST, LOOSE TO MEDIUM DENSE, FINE TO COARSE GRAINED, TRACE MICA, TRACE GRAVEL.		
5								
				SM		**PAUBA FORMATION (Qpfs):** SANDSTONE; LIGHT BROWN, MOIST, MEDIUM DENSE TO DENSE, FINE TO MEDIUM GRAINED, SCATTERED COARSE GRAINS.		
10								
						BORING TERMINATED AT 11 FT. NO GROUNDWATER ENCOUNTERED. NO CAVING. BACKFILLED WITH CUTTINGS. CAPPED WITH AC COLD PATCH		
15								
20								
25								
30								

KEY TO SYMBOLS

▼/▽	GROUNDWATER / STABILIZED	#	ERRONEOUS BLOW COUNT
☒	BULK SAMPLE	*	NO SAMPLE RECOVERY
◸	SPT SAMPLE (ASTM D1586)	———	GEOLOGIC CONTACT
■	CAL. MOD. SAMPLE (ASTM D3550)	— — —	SOIL TYPE CHANGE

36485 INLAND VALLEY DRIVE

WILDOMAR, CALIFORNIA

NOVA

LOGGED BY:	TDT	DATE:	DEC 2019
REVIEWED BY:	JDB	PROJECT NO.: 3019060	APPENDIX B.17

BORING LOG P-5

DATE EXCAVATED: AUGUST 27, 2019
EQUIPMENT: CME 75 DRILL RIG
EXCAVATION DESCRIPTION: 8 INCH DIAMETER AUGER BORING
GPS COORD.:
GROUNDWATER DEPTH: NOT ENCOUNTERED
ELEVATION: ± 1324 FT MSL

LAB TEST ABBREVIATIONS

CR	CORROSIVITY
MD	MAXIMUM DENSITY
DS	DIRECT SHEAR
EI	EXPANSION INDEX
AL	ATTERBERG LIMITS
SA	SIEVE ANALYSIS
RV	RESISTANCE VALUE
CN	CONSOLIDATION
SE	SAND EQUIVALENT

DEPTH (FT)	GRAPHIC LOG	BULK SAMPLE	CAL/SPT SAMPLE	SOIL CLASS. (USCS)	BLOWS PER 12-INCHES	SOIL DESCRIPTION *SUMMARY OF SUBSURFACE CONDITIONS* *(USCS; COLOR, MOISTURE, DENSITY, GRAIN SIZE, OTHER)*	LABORATORY	REMARKS
0						**ASPHALT: 3 INCHES, AGGREGATE BASE: 9 INCHES**		
				SC		**FILL (Qaf):** CLAYEY SAND; LIGHT TO DARK BROWN, MOIST, LOOSE TO MEDIUM DENSE, FINE TO COARSE GRAINED, TRACE MICA.		
5								
				SM		**PAUBA FORMATION (Qpfs):** SANDSTONE; LIGHT TO DARK BROWN, MOIST, MEDIUM DENSE TO DENSE, FINE TO MEDIUM GRAINED.		
10						BORING TERMINATED AT 10 FT. NO GROUNDWATER ENCOUNTERED. NO CAVING. BACKFILLED WITH CUTTINGS. CAPPED WITH AC COLD PATCH.		
15								
20								
25								
30								

KEY TO SYMBOLS

▼/▽	GROUNDWATER / STABILIZED	#	ERRONEOUS BLOW COUNT
☒	BULK SAMPLE	*	NO SAMPLE RECOVERY
⧄	SPT SAMPLE (ASTM D1586)	———	GEOLOGIC CONTACT
■	CAL. MOD. SAMPLE (ASTM D3550)	— — —	SOIL TYPE CHANGE

36485 INLAND VALLEY DRIVE
WILDOMAR, CALIFORNIA

NOVA

LOGGED BY:	TDT	DATE:	DEC 2019
REVIEWED BY:	JDB	PROJECT NO.: 3019060	APPENDIX B.18

GEOTECHNICAL BORING LOG B-1

Date 11-11-98 | Sheet 1 of 2
Project INLAND VALLEY MEDICAL CENTER AMBULATORY CARE ADDITION | Project No. 11980284-001
Drilling Co. WEST HAZMAT | Type of Rig HSA
Hole Diameter 8 in. | Drive Weight 140 lbs | Drop 30 in.
Elevation Top of Hole +/- ft. | Ref. or Datum See Geotechnical Map

Logged By SER
Sampled By SER

Elevation Feet	Depth Feet	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION	Type of Tests
	0							TOPSOIL	
		Bag 3 @ 1-4'	1	54	115.3	12.0	SM/SC	@ 2': Dark brown to red-brown, wet, medium dense to dense, clayey SAND; abundant roots and organic material	
	5		2	90	103.3	15.5	SC	@ 5': Same as above, increased percent of clay, red clay pockets observed, dense to very dense	
								UNNAMED SANDSTONE	
	10		4	92			SM	@ 10': Brown, moist, dense to very dense, silty SAND; fine to medium grained	
	15							BEDROCK GRANITICS	
			5	82	110.7	15.9	SM	@ 15': Brown to dark brown, moist, dense to very dense, silty SAND; fine to coarse grained, some pockets of olive clay and coarse sand material	
	20		6	92		11.0	SP	@ 20': Light brown to brown, dry to moist, very dense SAND; medium to coarse grained, slightly to non-weathered	
	25		7	99	117.5	14.4	SP	@ 25': Same as above	
	30								

SAMPLE TYPES:
- S SPLIT SPOON
- D RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- RV R VALUE
- EI EXPANSION INDEX

GEOTECHNICAL BORING LOG B-1

Date 11-11-98 | Sheet 2 of 2
Project INLAND VALLEY MEDICAL CENTER AMBULATORY CARE ADDITION | Project No. 11980284-001
Drilling Co. WEST HAZMAT | Type of Rig HSA
Hole Diameter 8 in. | Drive Weight 140 lbs | Drop 30 in.
Elevation Top of Hole +/- ft. | Ref. or Datum See Geotechnical Map

Logged By SER
Sampled By SER

Elevation Feet	Depth Feet	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION	Type of Tests
	30			8	88		16.3	SP	@ 30': Light brown to brown, moist to wet, very dense, SAND, medium to coarse grained, slightly to non-weathered	
									Boring Terminated @ 31' No Groundwater Encountered No Caving Backfilled 11-11-98	
	35									
	40									
	45									
	50									
	55									
	60									

SAMPLE TYPES:
- S SPLIT SPOON
- D RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- RV R VALUE
- EI EXPANSION INDEX

GEOTECHNICAL BORING LOG B-2

Date 11-17-98 | Sheet 1 of 2
Project INLAND VALLEY MEDICAL CENTER AMBULATORY CARE ADDITION | Project No. 11980284-001
Drilling Co. 2R DRILLING | Type of Rig HSA
Hole Diameter 8 in. | Drive Weight 140 lbs | Drop 30 in.
Elevation Top of Hole +/- ft. | Ref. or Datum See Geotechnical Map

Logged By SER
Sampled By SER

Elevation Feet	Depth Feet	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION	Type of Tests
	0								TOPSOIL	
			Bag 2 @ 2-5'					SC	@ 2': Dark brown to red-brown, wet, loose to medium dense, clayey SAND; abundant organic material	
									BEDROCK GRANITICS	
	5			1	50/5"	107.1	7.5	SM/SC	@ 5': Light brown, moist, very dense, silty SAND with clay; fine to coarse grained, rock fragments up to 2" in diameter	
	10			3	56		11.2	SP	@ 10': White to light brown, damp, dense, SAND; medium to coarse greined	
	15			4	40	108.2	14.7	SP	@ 15': Same as above; iron-staining present	
	20			5	50/6"		12.5	SP	@ 20': White to light brown, damp, very dense, SAND; medium to coarse grained, iron-staining	
	25				50/4"			SP	@ 25': Same as above; (no recovery)	
▽									@ 29': Groundwater Encountered	
	30									

SAMPLE TYPES:
- S SPLIT SPOON
- D RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- RV R VALUE
- EI EXPANSION INDEX

GEOTECHNICAL BORING LOG B-2

Date 11-17-98 | Sheet 2 of 2
Project INLAND VALLEY MEDICAL CENTER AMBULATORY CARE ADDITION | Project No. 11980284-001
Drilling Co. 2R DRILLING | Type of Rig HSA
Hole Diameter 8 in. | Drive Weight 140 lbs | Drop 30 in.
Elevation Top of Hole +/- ft. | Ref. or Datum See Geotechnical Map

Logged By SER
Sampled By SER

Elevation Feet	Depth Feet	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION	Type of Tests
	30			6	67		16.7	SP	@ 30': Light brown, wet, very dense, SAND; medium to coarse grained	
	35			7	50/5"	108.2	19.9	SP	@ 35': Same as above (partial recovery)	
	40								@ 40': difficult drilling	
									Boring Terminated @ 41.5' Groundwater Encountered @ 29' Backfilled 11-17-98	
	45									
	50									
	55									
	60									

SAMPLE TYPES:
- S SPLIT SPOON
- D RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- RV R VALUE
- EI EXPANSION INDEX

GEOTECHNICAL BORING LOG B-3

Date 11-17-98 | Sheet 1 of 1

Project INLAND VALLEY MEDICAL CENTER AMBULATORY CARE ADDITION | Project No. 11980284-001

Drilling Co. 2R DRILLING | Type of Rig HSA

Hole Diameter 8 in. | Drive Weight 140 lbs | Drop 30 in.

Elevation Top of Hole +/- ft. | Ref. or Datum See Geotechnical Map

Logged By SER
Sampled By SER

Elevation Feet	Depth Feet	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION	Type of Tests
	0								TOPSOIL	
				1	50	113.4	11.1	SC	@ 2': Light brown to red, moist, loose to medium dense, sandy CLAY; pockets of red clay observed, abundant organic material small rock fragments (.5-1")	
	5			2	85		12.1	SP	BEDROCK GRANITICS @ 5': Light brown, moist, dense to very dense, SAND; sharp distinct transition from red clay topsoil to sand, small rock fragments observed (<.5")	
	10			3	55	119.1	10.9	SP	@ 10': Brown to red, moist, dense SAND; with some clay, minor root material	
	15			4	69		9.3	SP	@ 15': Light brown to red-brown, moist, dense SAND; medium to coarse grained, iron-staining present	
	20			5	54	111.6	12.7	SP	@ 20': Same as above, minor amount of clay	
	25			6	70		10.3	SP	@ 25': Same as above	
									Boring Terminated @ 26' No Groundwater Encountered Backfilled 11-17-98	
	30									

SAMPLE TYPES:
- S SPLIT SPOON
- D RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- RV R VALUE
- EI EXPANSION INDEX

505A(11/77)

LEIGHTON & ASSOCIATES

GEOTECHNICAL BORING LOG B-4

Date 11-17-98 | Sheet 1 of 1
Project INLAND VALLEY MEDICAL CENTER AMBULATORY CARE ADDITION | Project No. 11980284-001
Drilling Co. 2R DRILLING | Type of Rig HSA
Hole Diameter 8 in. | Drive Weight 140 lbs | Drop 30 in.
Elevation Top of Hole +/- ft. | Ref. or Datum See Geotechnical Map

Logged By SER
Sampled By SER

Elevation Feet	Depth Feet	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION	Type of Tests
	0								TOPSOIL	
				1	36	117.1	14.0	SC	@ 2': Brown to red, moist to wet, loose to medium dense, sandy CLAY; abundant root and organic material	
	5			2	50/4"	110.6	12.8	SP	@ 5': Layer of gravel observed (< 1" in diameter)	
									UNNAMED SANDSTONE @ 5 1/2': White to light brown, moist, very dense, SAND; minor root material, rock fragments up to 1" observed, iron-staining present, medium to coarse grained	
	10			3	50/5"		12.2	SP	@ 10': White to light brown, moist, very dense, SAND; medium to coarse grained, iron-staining present (partial recovery)	
	15			4	50/6"	111.4	9.6	SP	@ 15': Same as above	
									Boring Terminated @ 15.5' No Groundwater Encountered Backfilled 11-17-98	
	20									
	25									
	30									

SAMPLE TYPES:
- S SPLIT SPOON
- D RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- RV R VALUE
- EI EXPANSION INDEX

BORING 1

DATE DRILLED: April 21, 2003
EQUIPMENT USED: Hollow Stem Auger
HOLE DIAMETER (in.): 8
ELEVATION: 1,326.5**

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	USCS	DESCRIPTION
							4" Thick Asphalt Concrete - 4" Thick Base Course
1325			10.9	114	15	SM	FILL - SILTY SAND - loose, moist, light brown
	5		14.2	111	16		becomes medium dense
1320			13.6	118	15		becomes loose
	10		13.7	114	15		
1315						SW	WELL-GRADED SAND - medium dense, slightly moist, light brown and white, few gravel
			5.1	118	41		
1310	15	47	10.9				becomes dense, becomes moist
	20		6.5	121	88		becomes very dense, becomes slightly moist
1305		58	9.1				
1300	25		9.2	113	75		
							4" thick layer of lean clay
	30	78	13.5				becomes moist
1295							END OF BORING AT 30½'.
1290	35						
	40						

NOTES:

Water not encountered. No caving. Boring backfilled with soil cuttings, tamped, and patched.

* Number of blows required to drive the Crandall sampler 12 inches using a 140 pound hammer falling 30 inches.

** Elevations based on topographic map provided by Nicholas J. Nowicki, Limited.

Field Tech: GMC
Prepared By: MM
Checked By: VA

B12SOIL CRANDALL 31451.GPJ LAW CRAN.GDT 6/17/03

Inland Valley Medical Center
Wildomar, California

MACTEC

LOG OF BORING
Project: 4953-03-1451 Figure: A-1.1

BORING 2

DATE DRILLED: April 21, 2003
EQUIPMENT USED: Hollow Stem Auger
HOLE DIAMETER (in.): 8
ELEVATION: 1,325.0**

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	SAMPLE LOC.	USCS	DESCRIPTION
								3" Thick Asphalt Concrete - 3½" Thick Base Course
							CL	SANDY LEAN CLAY - hard, moist, light brown, some cemented layers some sandier layers
			12.8	115	65	⊠		(LL = 32; PI = 9)
1320	5		31.5	90	22	⊠		(55% passing No. 200 sieve) becomes stiff
							SW	WELL-GRADED SAND - very dense, moist, light brown and white, thin layers of light brown clay
			10.6	120	75/11"	⊠		
1315	10		10.1	116	90/11"	⊠		
1310	15		5.7	117	60/6"	⊠		becomes slightly moist
							CL	SANDY LEAN CLAY - hard, moist, light brown, layers of well-graded sand
1305	20		13.9	118	85/9"	⊠		
							SW	WELL-GRADED SAND - very dense, slightly moist, white, lenses of clay
1300	25		6.2	110	60/6"	⊠		
							CL	SANDY LEAN CLAY - hard, moist, light brown
							SW	WELL-GRADED SAND - very dense, slightly moist, white
1295	30		6.9	107	60/6"	⊠		END OF BORING AT 30'
1290	35							
	40							

NOTES:

Water not encountered. No caving. Boring backfilled with soil cuttings, tamped, and patched.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Field Tech: GMC
Prepared By: MM
Checked By: JA

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

BORING 3

DATE DRILLED: April 21, 2003
EQUIPMENT USED: Hollow Stem Auger
HOLE DIAMETER (in.): 8
ELEVATION: 1,327.0**

Elevation scale (ft): 1325, 1320, 1315, 1310, 1305, 1300, 1295, 1290
Depth scale (ft): 5, 10, 15, 20, 25, 30, 35, 40

"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	USCS	DESCRIPTION
				SM	HAND AUGERED 0-5' FILL - SILTY SAND - loose, very moist, mottled grey and brown, few gravel
					cobbles up to 6" in size
	5.2	126	26	SM	SILTY SAND - medium dense, slightly moist, grey to dark grey, rootlets and charcoal fragments
				CL	SANDY LEAN CLAY - hard, moist, light brown
	14.1	121	88/9"		
	15.3	114	85/9"		
57	13.7				
	20.9	109	85		(56% passing No. 200 sieve)
67	18.3				
				SC	CLAYEY SAND - very dense, slightly moist, light brown
	9.0	122	60/6"		(14% passing No. 200 sieve)
				CL	SANDY LEAN CLAY - hard, moist, light brown
36	19.5				
	27.8	96	50		
33	21.7				
	29.7	92	87	SC	CLAYEY SAND - very dense, moist, brown
57	14.8				
				CL	SANDY LEAN CLAY - hard, moist, light brown

Field Tech: GMC
Prepared By: MM
Checked By: VA

(CONTINUED ON FOLLOWING FIGURE)

Inland Valley Medical Center
Wildomar, California

MACTEC

LOG OF BORING
Project: 4953-03-1451 Figure: A-1.3a

BORING 3 (Continued)

DATE DRILLED: April 21, 2003
EQUIPMENT USED: Hollow Stem Auger
HOLE DIAMETER (in.): 8
ELEVATION: 1,327.0**

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	SAMPLE LOC.
1285			22.3	103	56	⊠
	45	31	40.0			⊠
1280						
	50		37.0	87	76/11"	⊠
1275						
	55					
1270						
	60					
1265						
	65					
1260						
	70					
1255						
	75					
1250						
	80					

END OF BORING AT 50'

NOTES:

Water not encountered. No caving. Boring backfilled with soil cuttings, tamped, and patched.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Field Tech: GMC
Prepared By: MM
Checked By: JA

BORING 4

DATE DRILLED: April 21, 2003
EQUIPMENT USED: Hollow Stem Auger
HOLE DIAMETER (in.): 8
ELEVATION: 1,324.5 **

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	SAMPLE LOC.	USCS	DESCRIPTION
	0						4" Thick Asphalt Concrete - 4" Thick Base Course
						SW	WELL-GRADED SAND - very dense, moist, light brown and white
		10.0	122	78	⊠		
1320	5	9.2	116	60	⊠		becomes dense, becomes slightly moist
		9.2	120	81/11"	⊠		becomes very dense
1315	10	8.2	115	66	⊠		becomes dense
1310	15	8.7	118	60	⊠		
1305	20	6.9	112	83/11"	⊠		becomes very dense
						CL	LEAN CLAY - hard, moist, light brown
1300	25	23.6	105	70	⊠		
						SW	WELL-GRADED SAND - dense, slightly moist, white
1295	30	5.4	108	72	⊠		
							END OF BORING AT 30'
1290	35						
1285	40						

NOTES:

Water not encountered. No caving. Boring backfilled with soil cuttings, tamped, and patched.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Field Tech: GMC
Prepared By: MM
Checked By: JA

BORING 5

DATE DRILLED: May 20, 2003
EQUIPMENT USED: Hollow Stem Auger
HOLE DIAMETER (in.): 8
ELEVATION: 1,327.5 **

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	SAMPLE LOC.		DESCRIPTION
						SM	3" Thick Asphalt Concrete FILL - SILTY SAND - medium dense, moist, ligth brown
1325		15.0	110	20	☒	SW	concrete fragment encountered - boring moved 2' north WELL-GRADED SAND - medium dense, moist, light brown few gravel
	5						
1320		7.3	118	37	☒		becomes slightly moist
	10	6.7	117	60	☒		becomes dense
1315		7.4	114	55	☒		
	15	9.1	113	78	☒		becomes very dense
1310							
	20	5.9	116	70	☒		becomes dense
1305							
	25	6.6	115	79	☒		becomes very dense
1300							
	30	9.5	107	75/10"	☒		END OF BORING AT 30'
1295							
	35						
1290							
	40						

NOTES:

Water not encountered. No caving. Boring backfilled with soil cuttings, tamped, and patched.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Field Tech: GMC
Prepared By: MM
Checked By: JA

BORING 6

DATE DRILLED: May 20, 2003
EQUIPMENT USED: Hollow Stem Auger
HOLE DIAMETER (in.): 8
ELEVATION: 1,326.5**

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	SAMPLE LOC.		DESCRIPTION
								4" Thick Asphalt Concrete
1325							SM	FILL - SILTY SAND - medium dense, moist, light brown
							SM	SILTY SAND - medium dense, moist, light brown, thin layers of sandy lean clay
			16.4	98	16			(16% passing No. 200 sieve)
	5							
1320			6.5	116	68/11"			becomes dense, few gravel
							SW	WELL-GRADED SAND - dense, slightly moist, light brown layers with small cobbles
	10		5.1	121	50			
1315		51	6.5					becomes very dense
	15		10.5	124	54			becomes dense, becomes moist
1310								
	20	50	9.3					becomes very dense, becomes slightly moist
1305								
	25		6.9	115	82/11"			
1300								
	30	51	8.1					
1295								
	35		9.9	111	77			
1290								
	40	36	17.6					thin layers of lean clay

Field Tech: GMC
Prepared By: MM
Checked By: JA

(CONTINUED ON FOLLOWING FIGURE)

BORING 6 (Continued)

DATE DRILLED: May 20, 2003
EQUIPMENT USED: Hollow Stem Auger
HOLE DIAMETER (in.): 8
ELEVATION: 1,326.5**

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	DESCRIPTION
						(37% passing No. 200 sieve) becomes dense
1285						
	45		18.1	110	66	
1280						
	50	85 for 11"	15.6			becomes very dense
						END OF BORING AT 50'
1275						
	55					
1270						
	60					
1265						
	65					
1260						
	70					
1255						
	75					
1250						
	80					

NOTES:

Water measured at a depth of 42½' 10 minutes after completion of drilling. No caving. Boring backfilled with soil cuttings, tamped, and patched.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Field Tech: GMC
Prepared By: MM
Checked By: JA

BORING 7

DATE DRILLED: May 20, 2003
EQUIPMENT USED: Hollow Stem Auger
HOLE DIAMETER (in.): 8
ELEVATION: 1,028.5**

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	SAMPLE LOC.	USCS	DESCRIPTION
	0							4" Thick Asphalt Concrete
							SM	FILL - SILTY SAND - medium dense, moist, light brown
							SW	WELL-GRADED SAND - medium dense, slightly moist, light yellowish-brown
1025			7.9	114	45	☒		
	5		7.8	112	43	☒		
1020			5.8	120	75	☒		becomes dense
	10		11.9	117	72	☒		becomes moist
1015	15		10.0	111	70	☒		
1010	20		8.6	108	80/11"	☒		becomes very dense, becomes slightly moist
1005	25		3.5	113	90/9"	☒		
1000	30		7.7	103	88/9"	☒		END OF BORING AT 30'
995	35							
990	40							

NOTES:

Water not encountered. No caving. Boring backfilled with soil cuttings, tamped, and patched.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Field Tech: GMC
Prepared By: MM
Checked By: JA

BORING 8

DATE DRILLED: May 20, 2003
EQUIPMENT USED: Hollow Stem Auger
HOLE DIAMETER (in.): 8
ELEVATION: 1,329.0 **

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	SAMPLE LOC.	USCS	DESCRIPTION
1329	0						4" Thick Asphalt Paving
						SM	FILL - SILTY SAND - medium dense, moist, light brown
						SW	WELL-GRADED SAND - dense, moist, light yellowish-brown
1325	5	12.0	119	60	⊠		
		8.8	112	60	⊠		becomes slightly moist
1320	10	11.5	110	59	⊠		becomes moist
1315		7.3	111	67	⊠		becomes slightly moist
	15						
1310		8.4	111	81/10"	⊠		becomes very dense
	20						
1305		3.5	119	88/10"	⊠		
	25						
1300		12.6	118	85/11"	⊠		becomes moist END OF BORING AT 29'
	30						
1295							
	35						
1290	40						

NOTES:

Water not encountered. No caving. Boring backfilled with soil cuttings, tamped, and patched.

Field Tech: GMC
Prepared By: MM
Checked By: JA

B11SOIL CRANDALL 31451.GPJ LAW CRAN.GDT 6/17/03

DATE DRILLED	2/18/08	LOGGED BY	SP	BORING NO.	B-1
DRIVE WEIGHT	140 lbs.	DROP	30 inches	DEPTH TO GROUNDWATER	NE
DRILLING METHOD	Hollow Stem Auger	DRILLER	JET Drilling, Inc.	SURFACE ELEVATION	1325 ft ±(MSL)*

ELEVATION (feet)	DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS / FOOT	MOISTURE (%)	DRY DENSITY (pcf)	ADDITIONAL TESTS	GRAPHIC LOG	U.S.C.S. CLASSIFICATION	DESCRIPTION
	0						EI, RV		SM	ALLUVIUM: Silty SAND, red-brown, moist; fine-grained
										- light brown
1320	5		X	75	9.2	110.1				- very dense; rust and black staining; fine to medium-grained
1315	10		X	75	10.3	112.6				- fine-grained
										Total Depth = 11.5 feet Groundwater not encountered Backfilled on 2/18/2008
1310	15									
1305	20									
1300	25									
1295	30									
1290	35									

* Note: Elevation based on plan provided by Nicholas J. Nowickl, Ltd.

TWINING LABORATORIES OF SOUTHERN CALIFORNIA

LOG OF BORING

Inland Valley Medical Center New Parking Lot
36485 Inland Valley Drive
Wildomar, California

PROJECT NO.	REPORT DATE	FIGURE A-2
080154.3	March 2008	Sheet 1 of 1

DATE DRILLED	2/18/08	LOGGED BY	SP	BORING NO.	B-2
DRIVE WEIGHT	140 lbs.	DROP	30 inches	DEPTH TO GROUNDWATER	NE
DRILLING METHOD	Hollow Stem Auger	DRILLER	JET Drilling, Inc.	SURFACE ELEVATION	1325 ft ±(MSL)*

ELEVATION (feet)	DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS / FOOT	MOISTURE (%)	DRY DENSITY (pcf)	ADDITIONAL TESTS	GRAPHIC LOG	U.S.C.S. CLASSIFICATION	DESCRIPTION
	0	X					MAX		SM	ALLUVIUM: Silty SAND, red-brown, moist; fine-grained
										- light brown
1320	5		X	50	12.5	96.4				- dark brown, dense
1315	10		X	44	12.6	107.3				- dense
										Total Depth = 11.5 feet Groundwater not encountered Backfilled on 2/18/2008
1310	15									
1305	20									
1300	25									
1295	30									
1290	35									* Note: Elevation based on plan provided by Nicholas J. Nowickl, Ltd.

TWINING LABORATORIES OF SOUTHERN CALIFORNIA

LOG OF BORING

Inland Valley Medical Center New Parking Lot
36485 Inland Valley Drive
Wildomar, California

PROJECT NO.	REPORT DATE	FIGURE A-3
080154.3	March 2008	Sheet 1 of 1

DATE DRILLED	2/18/08	LOGGED BY	SP	BORING NO.	B-3
DRIVE WEIGHT	140 lbs.	DROP	30 inches	DEPTH TO GROUNDWATER	NE
DRILLING METHOD	Hollow Stem Auger	DRILLER	JET Drilling, Inc.	SURFACE ELEVATION	1325 ft ±(MSL)*

ELEVATION (feet)	DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS / FOOT	MOISTURE (%)	DRY DENSITY (pcf)	ADDITIONAL TESTS	GRAPHIC LOG	U.S.C.S. CLASSIFICATION	DESCRIPTION
									SM	ALLUVIUM: Silty SAND, brown to red-brown, moist, fine-grained
			X	32	8.2	126.1	WASH			- red-brown, medium dense; fine to medium-grained
1320	5		X	41	11.2	98.8				
1315	10			28						- fine to coarse-grained
										Total Depth = 11.5 feet Groundwater not encountered Backfilled on 2/18/2008
1310	15									
1305	20									
1300	25									
1295	30									
1290	35									* Note: Elevation based on plan provided by Nicholas J. Nowickl, Ltd.

TWINING LABORATORIES OF SOUTHERN CALIFORNIA

LOG OF BORING

Inland Valley Medical Center New Parking Lot
36485 Inland Valley Drive
Wildomar, California

PROJECT NO.	REPORT DATE	FIGURE A-4
080154.3	March 2008	Sheet 1 of 1

DATE DRILLED	2/18/08	LOGGED BY	SP	**BORING NO.**	**B-4**
DRIVE WEIGHT	140 lbs.	DROP	30 inches	DEPTH TO GROUNDWATER	NE
DRILLING METHOD	Hollow Stem Auger	DRILLER	JET Drilling, Inc.	SURFACE ELEVATION	1325 ft ±(MSL)*

ELEVATION (feet)	DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS / FOOT	MOISTURE (%)	DRY DENSITY (pcf)	ADDITIONAL TESTS	GRAPHIC LOG	U.S.C.S. CLASSIFICATION	DESCRIPTION
	0	X					ATT, EI, MAX, RV, WASH		CL	FILL: Sandy Lean CLAY, dark brown, moist
1320	5		X	27	9.3	106.7			SM	ALLUVIUM: Silty SAND, dark-brown, moist, medium dense; fine-grained
1315	10		X	46						- brown
										Total Depth = 11.5 feet Groundwater not encountered Backfilled on 2/18/2008
1310	15									
1305	20									
1300	25									
1295	30									
1290	35									* Note: Elevation based on plan provided by Nicholas J. Nowickl, Ltd.

TWINING LABORATORIES OF SOUTHERN CALIFORNIA

LOG OF BORING

Inland Valley Medical Center New Parking Lot
36485 Inland Valley Drive
Wildomar, California

PROJECT NO.	REPORT DATE	FIGURE A-5
080154.3	March 2008	Sheet 1 of 1

DATE DRILLED	2/18/08	LOGGED BY	SP	BORING NO.	B-5
DRIVE WEIGHT	140 lbs.	DROP	30 inches	DEPTH TO GROUNDWATER	NE
DRILLING METHOD	Hollow Stem Auger	DRILLER	JET Drilling, Inc.	SURFACE ELEVATION	1325 ft +(MSL)*

ELEVATION (feet)	DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS / FOOT	MOISTURE (%)	DRY DENSITY (pcf)	ADDITIONAL TESTS	GRAPHIC LOG	U.S.C.S. CLASSIFICATION	DESCRIPTION
									SM	ALLUVIUM: Silty SAND, red-brown, moist; fine-grained
			X	36	7.0	124.8	WASH			- some gravel, medium dense
1320	5	X	X	36	9.0	105.4	RV			- rusty and black staining
1315	10			27						- fine to coarse-grained
										Total Depth = 11.5 feet Groundwater not encountered Backfilled on 2/18/2008
1310	15									
1305	20									
1300	25									
1295	30									
1290	35									* Note: Elevation based on plan provided by Nicholas J. Nowickl, Ltd.

TWINING LABORATORIES OF SOUTHERN CALIFORNIA

LOG OF BORING

Inland Valley Medical Center New Parking Lot
36485 Inland Valley Drive
Wildomar, California

PROJECT NO.	REPORT DATE	FIGURE A-6
080154.3	March 2008	Sheet 1 of 1

DATE DRILLED	2/18/08	LOGGED BY	SP	**BORING NO.**	**B-6**
DRIVE WEIGHT	140 lbs.	DROP	30 inches	DEPTH TO GROUNDWATER	NE
DRILLING METHOD	Hollow Stem Auger	DRILLER	JET Drilling, Inc.	SURFACE ELEVATION	1325 ft ±(MSL)*

ELEVATION (feet)	DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS / FOOT	MOISTURE (%)	DRY DENSITY (pcf)	ADDITIONAL TESTS	GRAPHIC LOG	U.S.C.S. CLASSIFICATION	DESCRIPTION
	0								SM	FILL: Silty SAND, brown, moist; fine-grained
									CL	Sandy Lean CLAY, gray, moist
				32	12.3	111.0	ATT, EI, RV, WASH			- very stiff
1320	5			26	17.3	105.9	CORR, WASH			
									SM	ALLUVIUM: Silty SAND, red-brown, moist, very dense; fine-grained
1315	10			75/11"						
										Total Depth = 10.9 feet Groundwater not encountered Backfilled on 2/18/2008
1310	15									
1305	20									
1300	25									
1295	30									
1290	35									* Note: Elevation based on plan provided by Nicholas J. Nowickl, Ltd.

TWINING LABORATORIES OF SOUTHERN CALIFORNIA

LOG OF BORING

Inland Valley Medical Center New Parking Lot
36485 Inland Valley Drive
Wildomar, California

PROJECT NO.	REPORT DATE	FIGURE A-7
080154.3	March 2008	Sheet 1 of 1

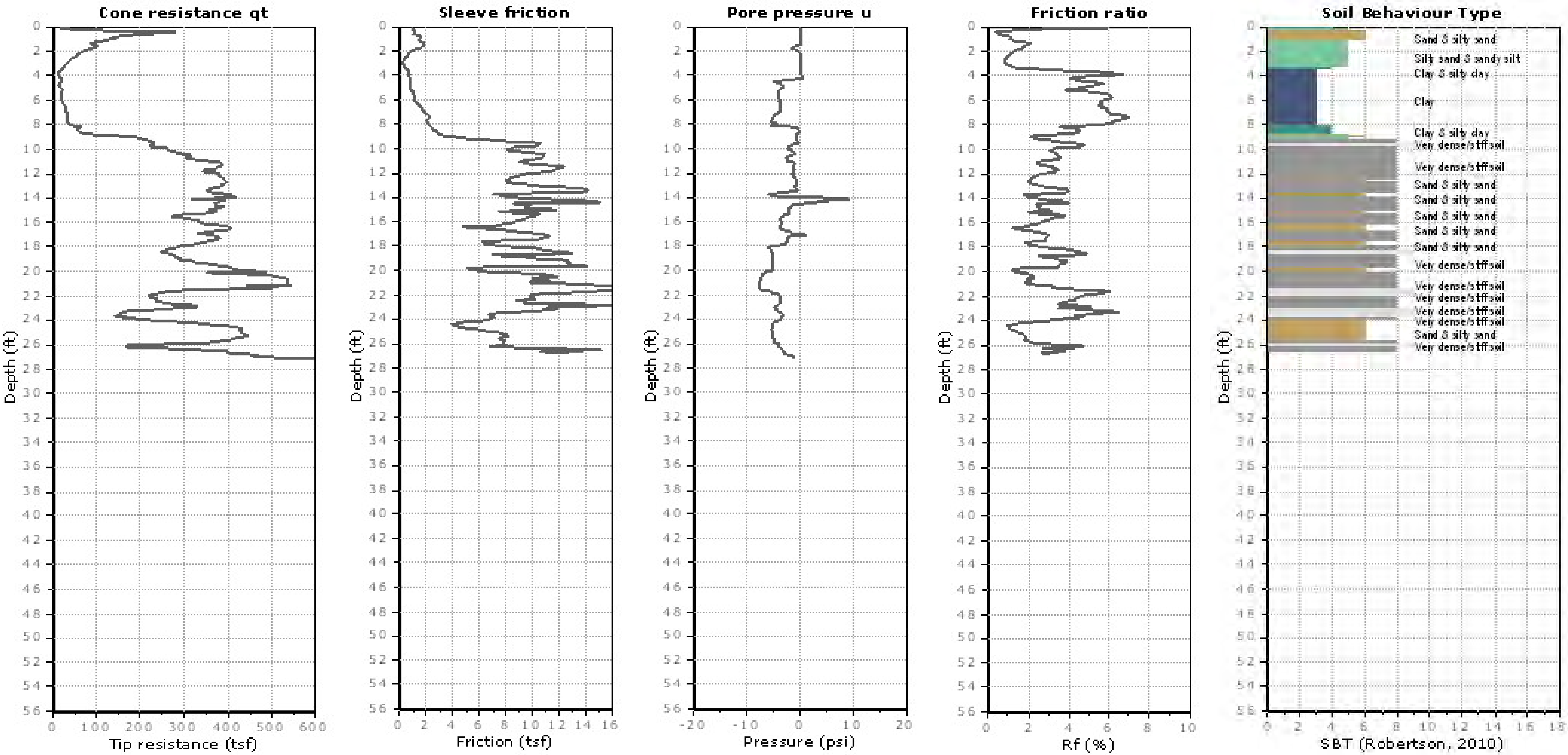
APPENDIX C

LOGS OF CONE PENETROMETER SOUNDINGS

Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: **Nova Services** | **CPT-1**

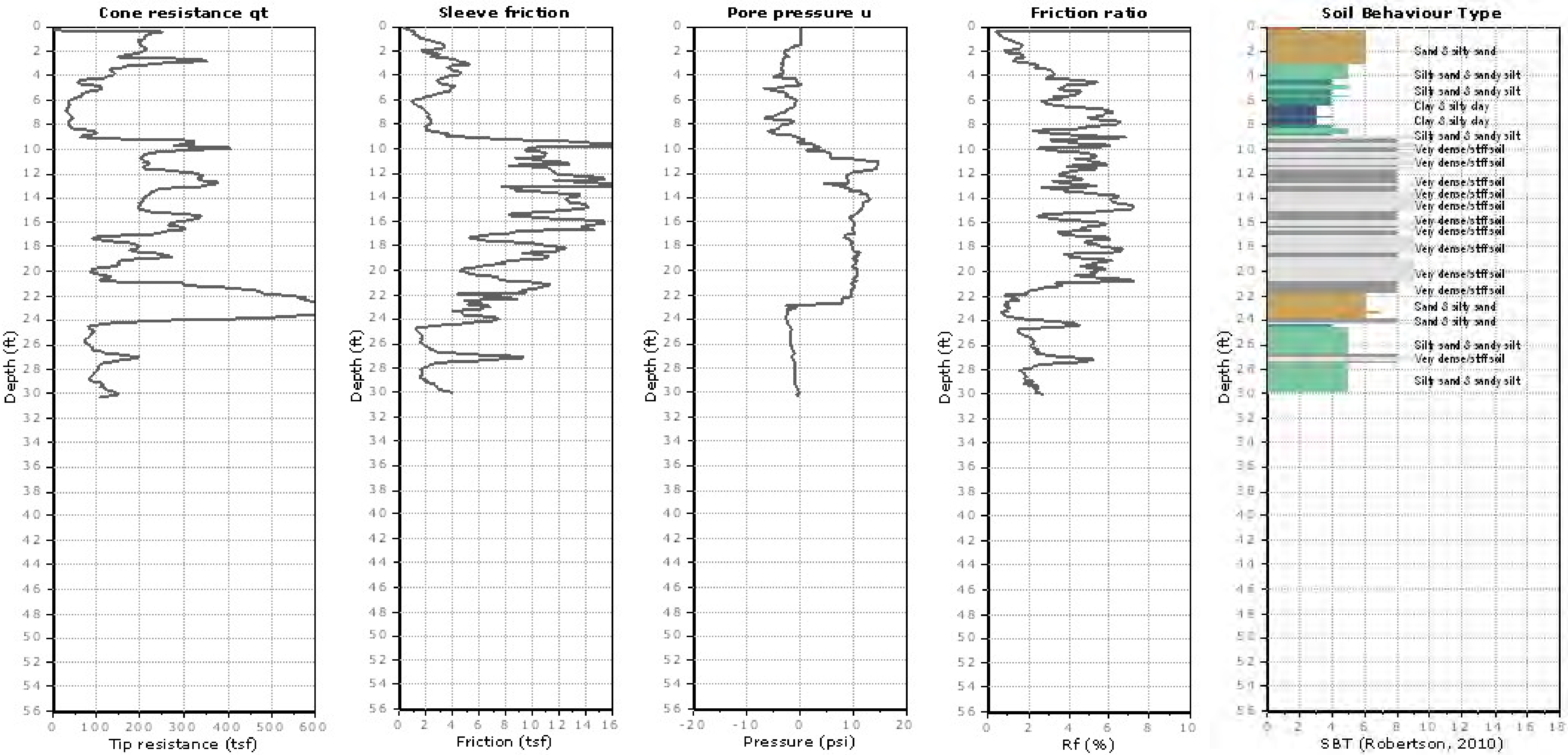
Location: **36845 Inland Valley Dr, Wildomar, CA** | Total depth: 27.10 ft, Date: 8/9/2019



Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: **Nova Services** **CPT-2**

Location: **36845 Inland Valley Dr, Wildomar, CA** Total depth: 30.34 ft, Date: 8/9/2019



Kehoe Testing and Engineering
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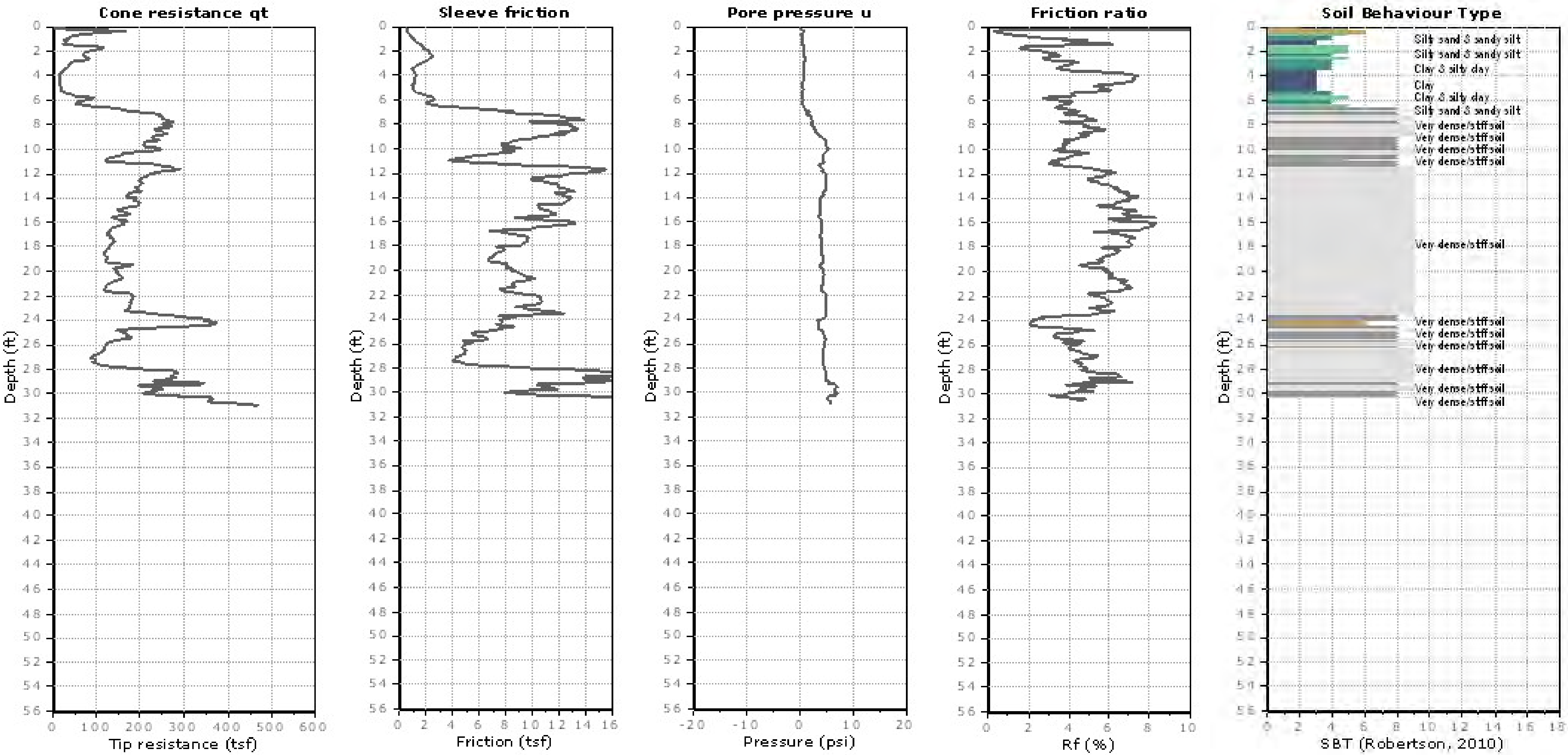
Project: Nova Services
Location: 36845 Inland Valley Dr, Wildomar, CA

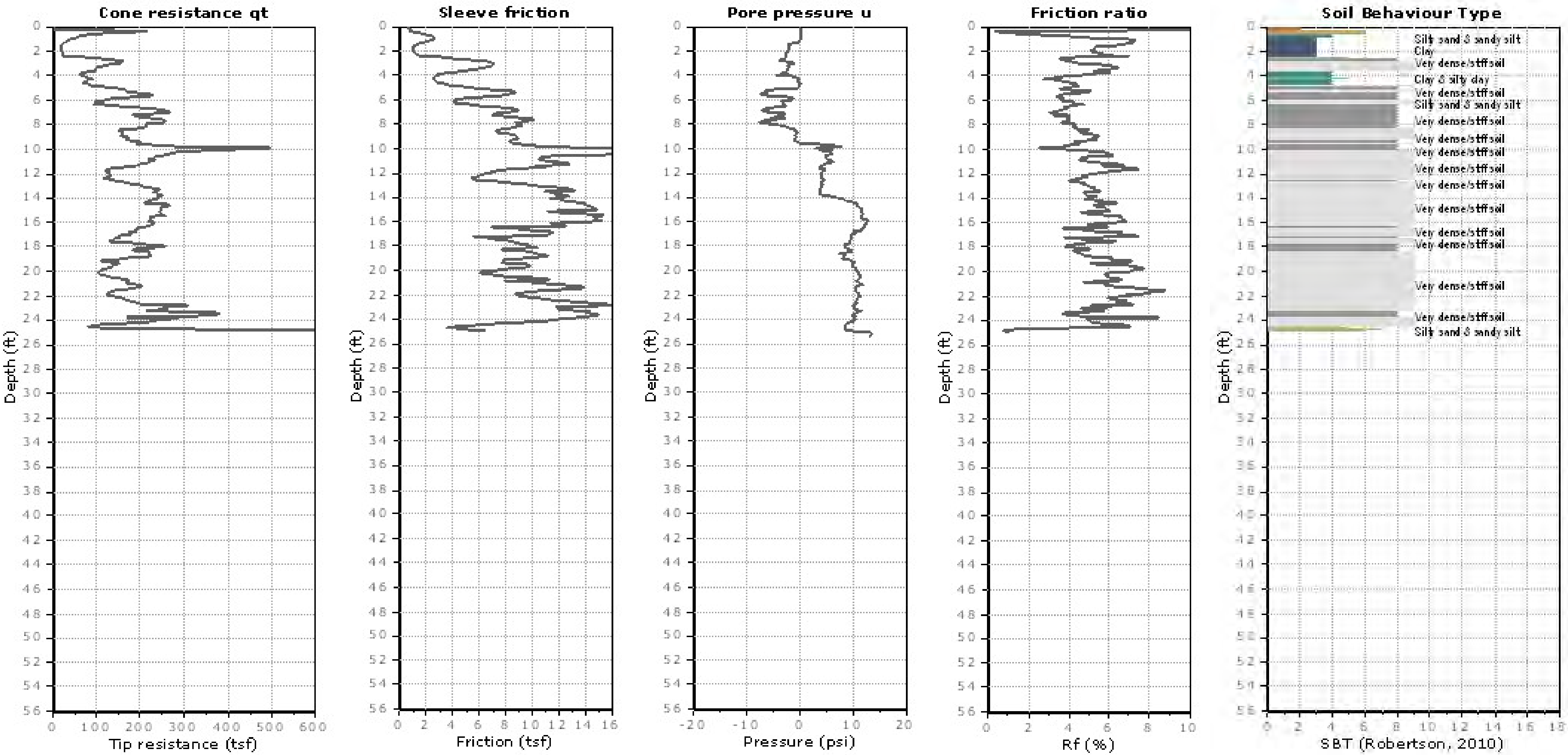
CPT-3
Total depth: 30.91 ft, Date: 8/9/2019



Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: Nova Services **CPT-4**

Location: 36845 Inland Valley Dr, Wildomar, CA Total depth: 25.33 ft, Date: 8/9/2019



Kehoe Testing and Engineering
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steve@kehoetesting.com
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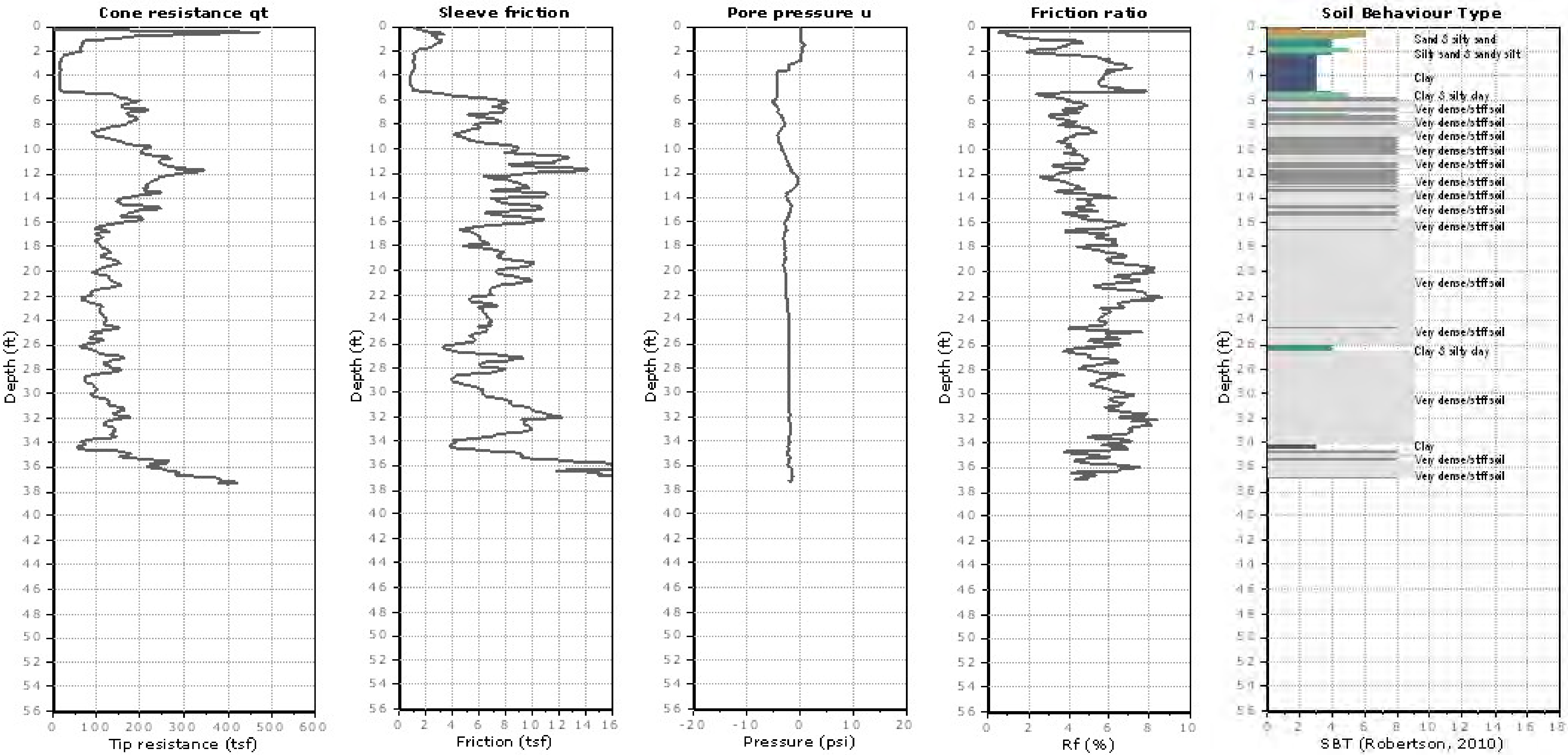
Project: Nova Services **CPT-5**

Location: 36845 Inland Valley Dr, Wildomar, CA Total depth: 37.41 ft, Date: 8/9/2019



Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
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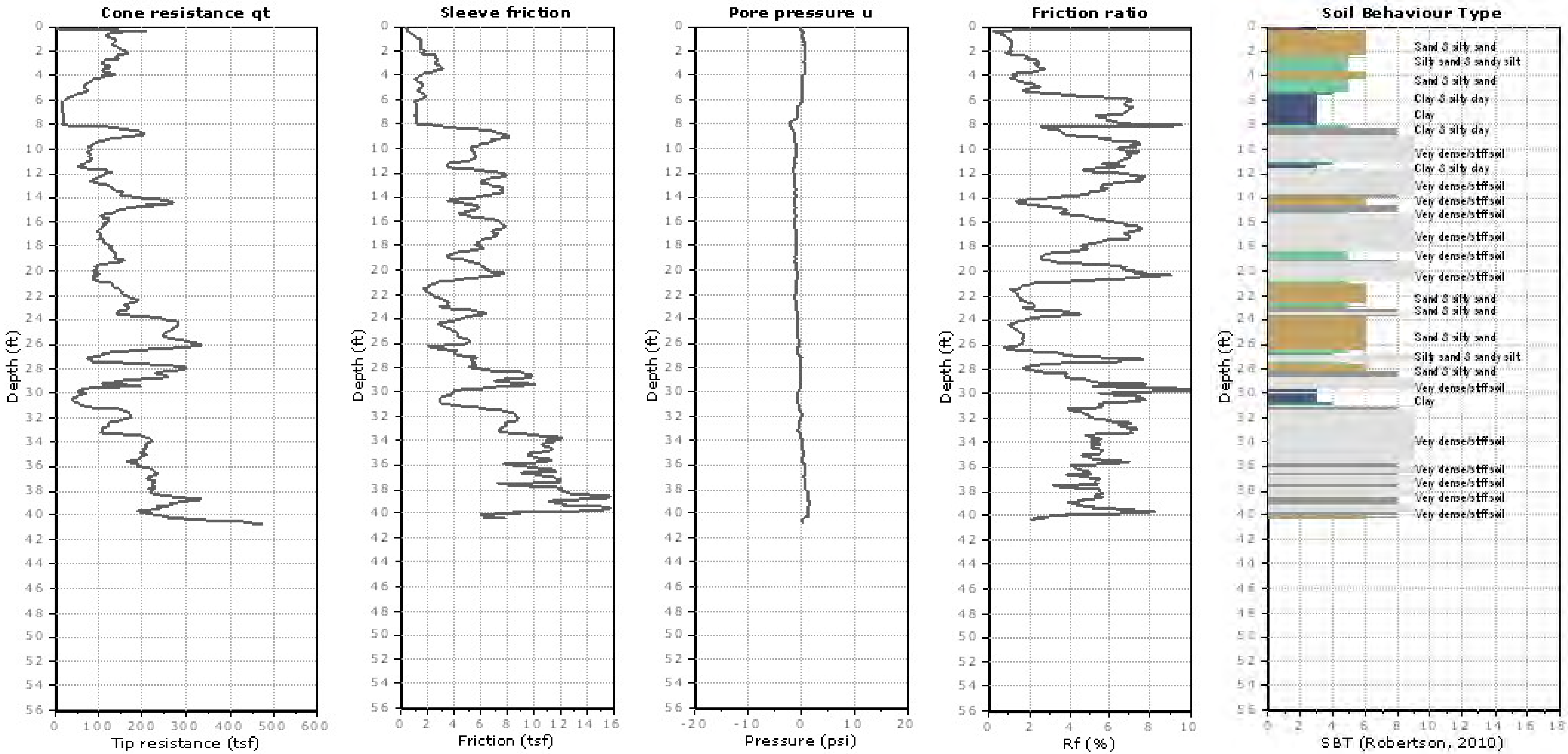
Project: Nova Services **CPT-6**

Location: 36845 Inland Valley Dr, Wildomar, CA

Total depth: 40.75 ft, Date: 8/9/2019



Kehoe Testing and Engineering
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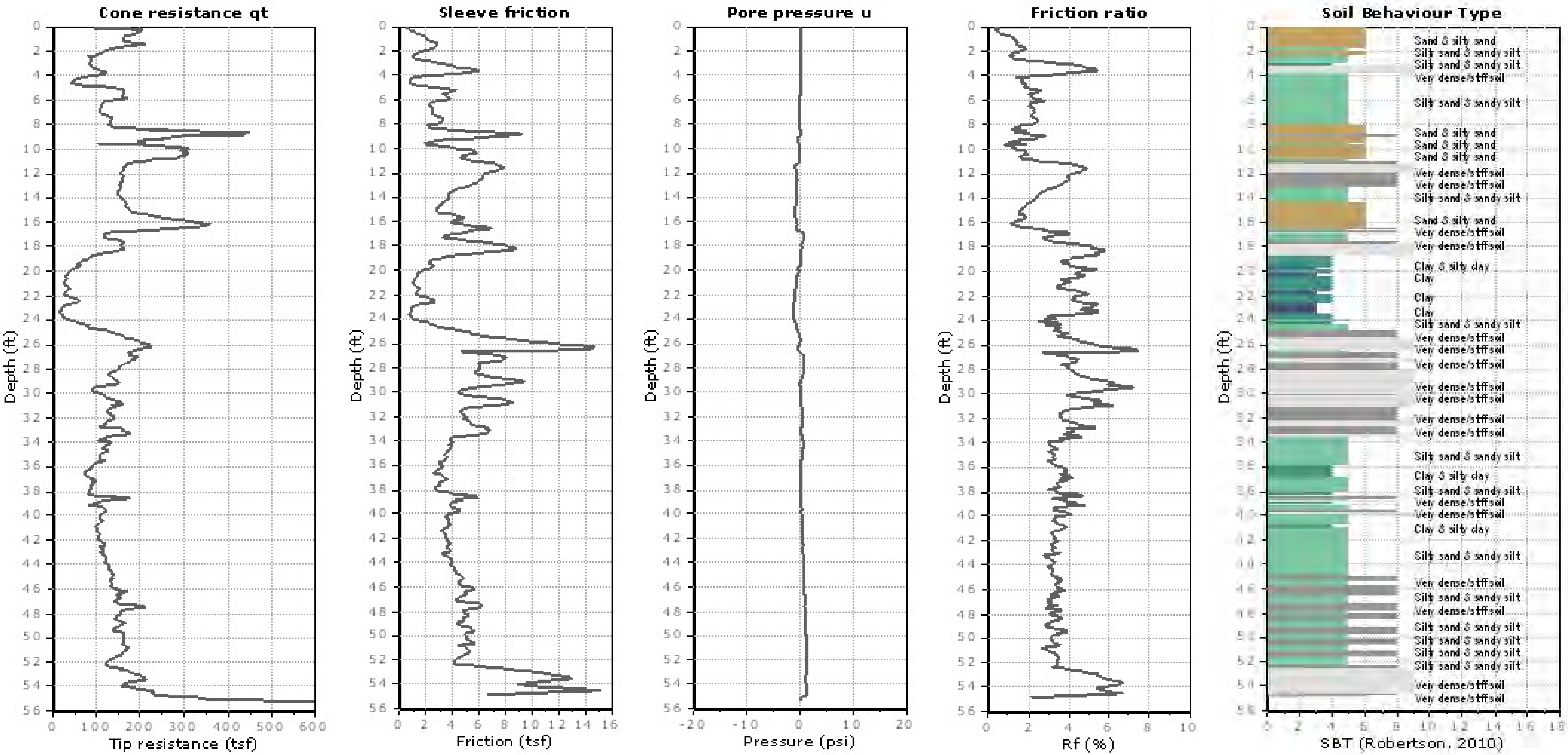
steve@kehoetesting.com
www.kehoetesting.com

Project: Nova Services **CPT-7**

Location: 36845 Inland Valley Dr, Wildomar, CA Total depth: 55.25 ft, Date: 8/9/2019



APPENDIX D

LABORATORY ANALYTICAL RESULTS

Laboratory tests were performed in accordance with the generally accepted American Society for Testing and Materials (ASTM) test methods or suggested procedures. Brief descriptions of the tests performed are presented below:

- **CLASSIFICATION:** *Field classifications were verified in the laboratory by visual examination. The final soil classifications are in accordance with the Unified Soils Classification System and are presented in the exploration logs.*
- **DENSITY OF SOIL IN PLACE (ASTM D2937):** *In-place moisture contents and dry densities were determined for representative soil samples. This information was an aid to classification and permitted recognition of variations in material consistency with depth. The dry unit weight is determined in pounds per cubic foot, and the in-place moisture content is determined as a percentage of the soil's dry weight. The results are summarized in the exploration logs.*
- **MAXIMUM DENSITY AND OPTIMUM MOISTURE CONTENT (ASTM D1557 METHOD A,B,C):** *The maximum dry density and optimum moisture content of typical soils were determined in the laboratory in accordance with ASTM Standard Test D1557, Method A, Method B, Method C.*
- **DIRECT SHEAR TEST (ASTM D3080):** *Direct shear tests were performed on remolded and relatively undisturbed samples in general accordance with ASTM D3080 to evaluate the shear stregth characteristics of selected materials. The samples were inundated during shearing to represent adverse field conditions.*
- **CORROSIVITY TEST (CAL. TEST METHOD 417, 422, 643):** *Soil PH, and minimum resistivity tests were performed on a representative soil sample in general accordance with test method CT 643. The sulfate and chloride content of the selected sample were evaluated in general accordance with CT 417 and CT 422, respectively.*
- **R-VALUE (ASTM D2844):** *The resistance Value, or R-Value, for near-surface site soils were evaluated in general accordance with California Test (CT) 301 and ASTM D2844. Samples were prepared and evaluated for exudation pressure and expansion pressure. The equilibrium R-value is reported as the lesser or more conservative of the two calculated results.*
- **EXPANSION INDEX (ASTM D 4829):** *The expansion index of selected materials was evaluated in general accordance with ASTM D 4829. Specimens were molded under a specified compactive energy at approximately 50 percent saturation (plus or minus 1 percent). The prepared 1-inch thich by 4-inch diameter specimens were loaded with a surcharge of 144 pounds per square foot and were inundated with tap water. Readings of volumetric swell were made for a period of 24 hours.*
- **GRADATION ANALYSIS (ASTM C 136 and/or ASTM D422):** *Tests were performed on selected representative soil samples in general accordance with ASTM D422. The grain size distributions of selected samples were determined in accordance with ASTM C 136 and/or ASTM D422.*

Expansion Index (ASTM D4829)

Sample Location	Sample Depth (ft.)	Expansion Index	Expansion Potential
B-9	1.0'-5.0'	0	Very Low

Density of Soil in Place (ASTM D2937)

Sample Location	Sample Depth (ft)	Moisture (%)	Dry Density (pcf)
B-1	5.0'	3.7	125.6
B-1	15.0'	7.5	119.2
B-1	25.0	14.1	122.9
B-1	35.0'	17.6	110.4
B-1	45.0'	19.4	108.3
B-4	10.0'	33.1	81.5
B-4	20.0'	13.0	123.8
B-4	30.0'	8.8	127.8
B-4	40.0'	13.0	119.0
B-5	5.0'	6.4	117.3

Resistance Value (Cal. Test Method 301 & ASTM D2844)

Sample Location	Sample Depth (ft.)	R-Value
B-1	0.0'-5.0'	30

Maximum Dry Density and Optimum Moisture Content (ASTM D1557)

Sample Location	Sample Depth (ft.)	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
B-1	0.0' - 5.0'	120.7	13.2
B-5	0.0' - 5.0'	128.9	7.3

Direct Shear (ASTM D3080)

Sample Location	Depth (feet)	Friction Angle (degrees)	Apparent Cohesion (psf)
B-4	10.0'	39	397

Corrosivity (Cal. Test Method 417,422,643)

Sample Location	Sample Depth (ft.)	pH	Resistivity (Ohm-cm)	Sulfate Content (ppm)	Sulfate Content (%)	Chloride Content (ppm)	Chloride Content (%)
B-1	0.0'-5.0'	7.1	860	87	0.009	130	0.013
B-5	0.0'-5.0'	7.9	1800	30	0.003	21	0.002
B-9	1.0'-5.0'	N/A	N/A	27	0.003	N/A	N/A

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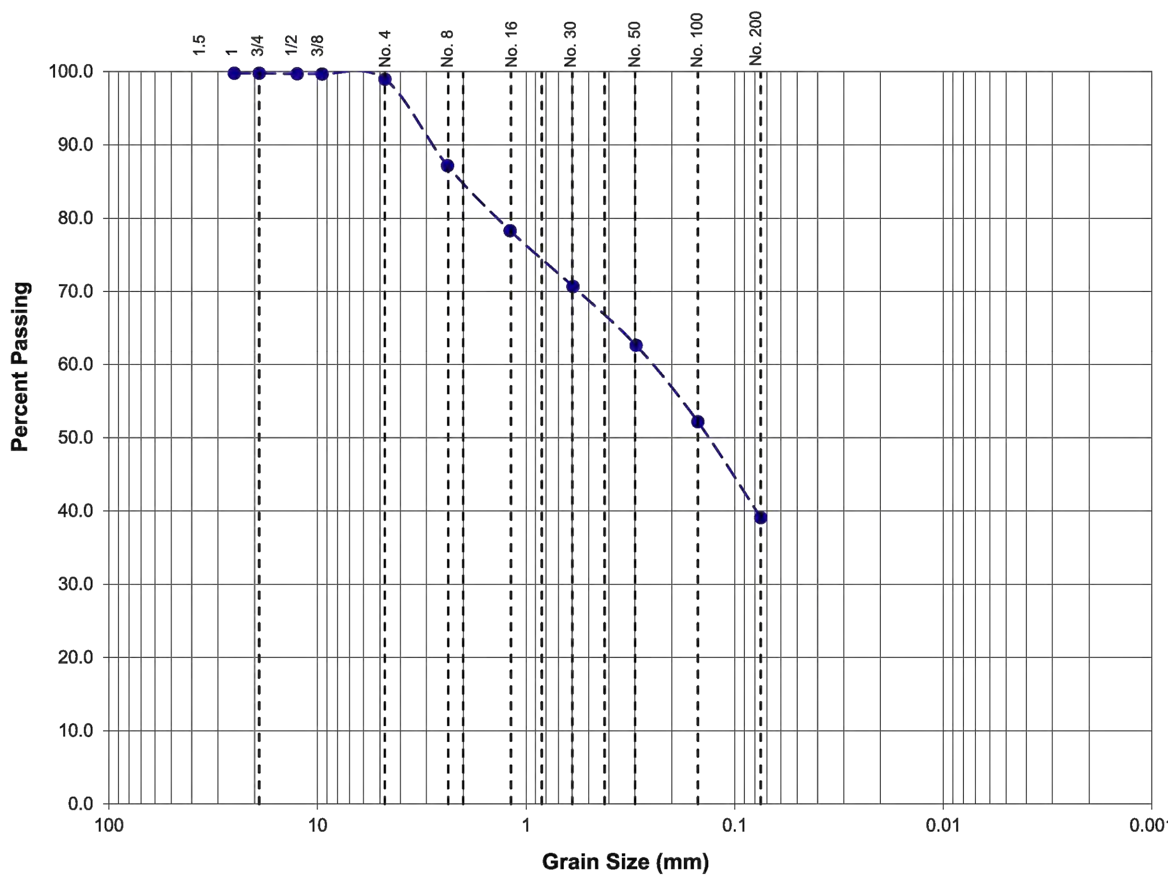
LAB TEST RESULTS

UHS TOWER & CUP AREA
36485 INLAND VALLEY DRIVE
WILDOMAR, CALIFORNIA

BY: DTW | DATE: DECEMBER 2019 | PROJECT: 3019060



Gravel		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample Location: B-1

Depth (ft): 0.0'-5.0'

USCS Soil Type: SM

Passing No. 200 (%): 39

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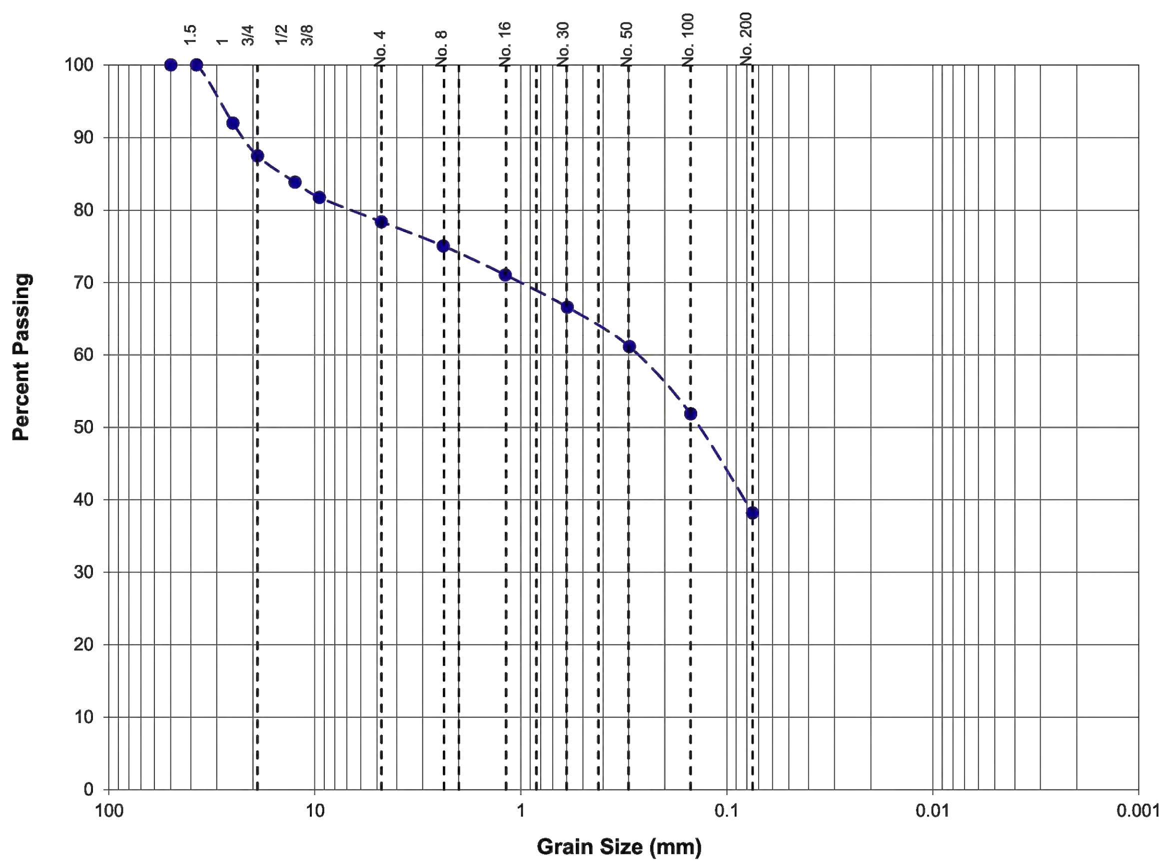
GRADATION ANALYSIS TEST RESULTS

UHS TOWER & CUP AREA
36485 INLAND VALLEY DRIVE
WILDOMAR, CALIFORNIA

BY: DTW	DATE: DECEMBER 2019	PROJECT: 3019060



Gravel		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample Location: B-1

Depth (ft): 30.0'

USCS Soil Type: SM

Passing No. 200 (%): 38

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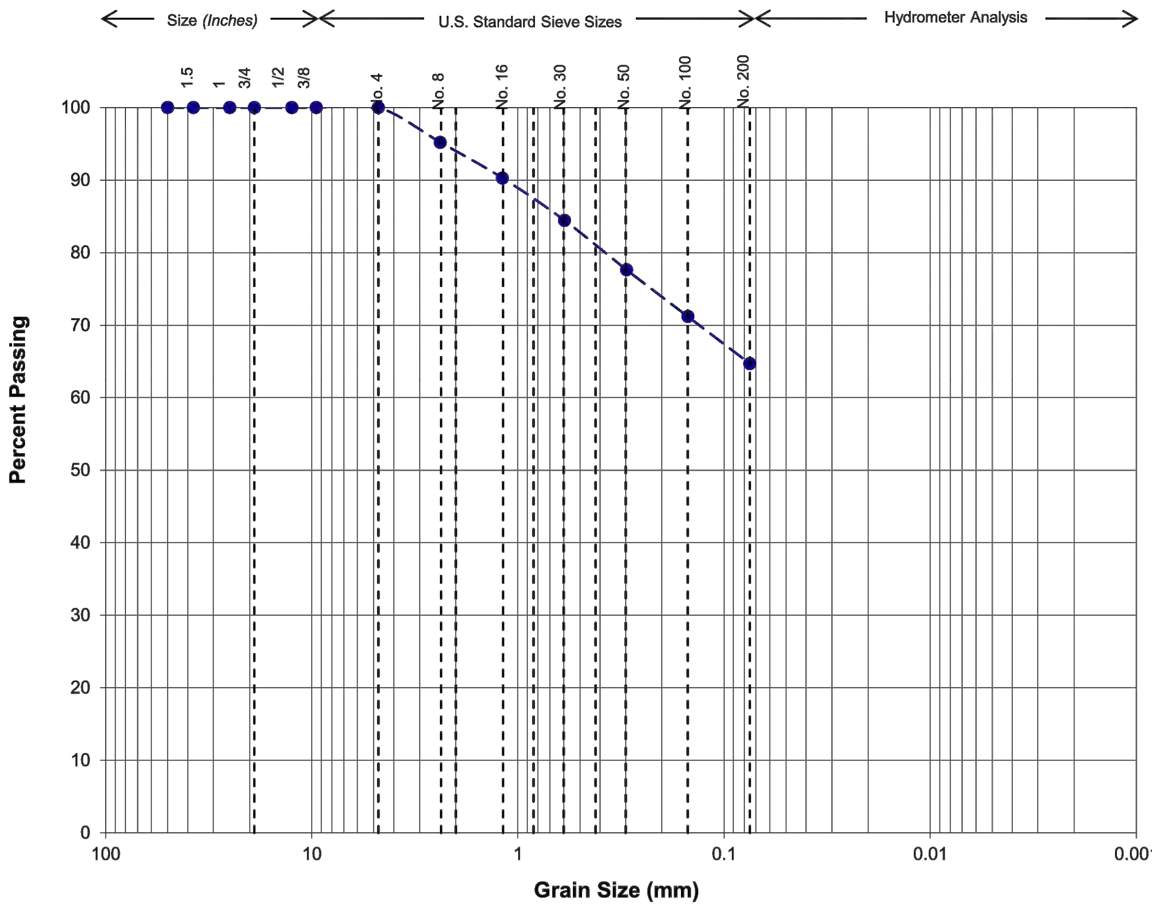
GRADATION ANALYSIS TEST RESULTS

UHS TOWER & CUP AREA
36485 INLAND VALLEY DRIVE
WILDOMAR, CALIFORNIA

BY: DTW	DATE: DECEMBER 2019	PROJECT: 3019060



Gravel		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample Location: B-4

Depth (ft): 5.0'

USCS Soil Type: CL

Passing No. 200 (%): 65

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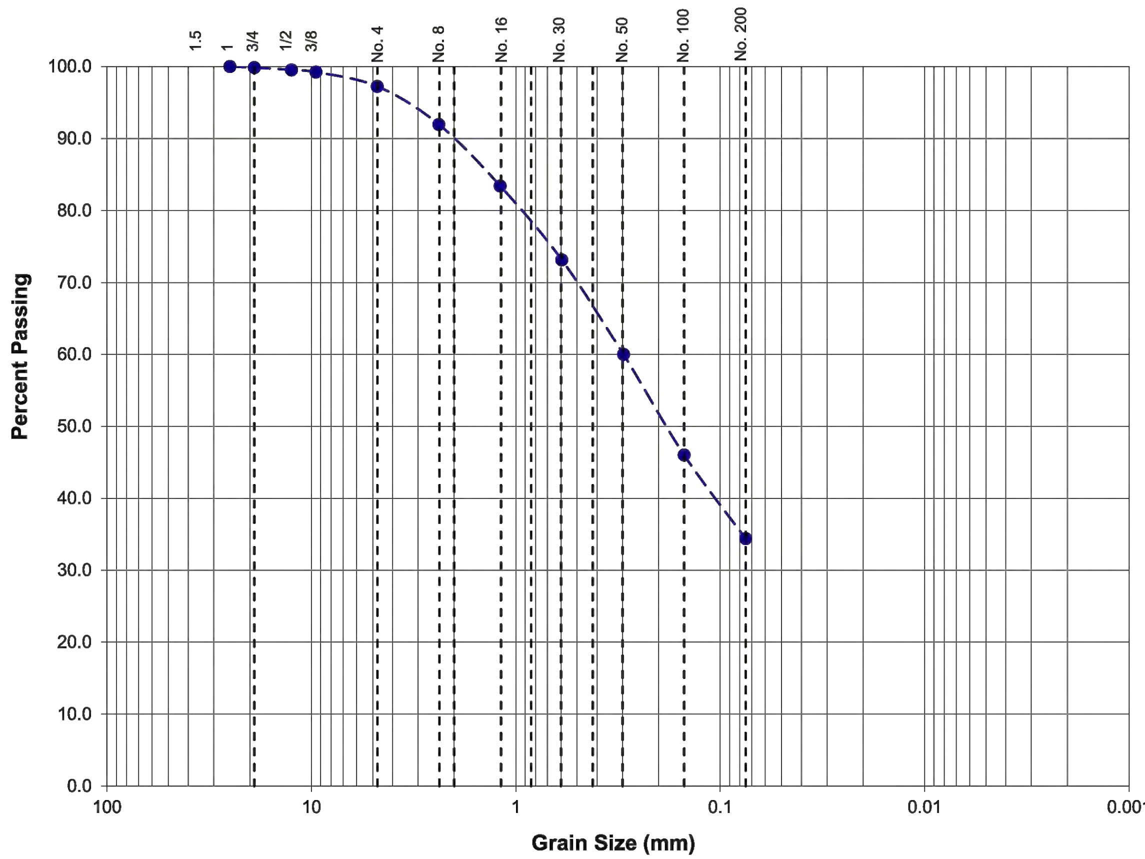
GRADATION ANALYSIS TEST RESULTS

UHS TOWER & CUP AREA

36485 INLAND VALLEY DRIVE

WILDOMAR, CALIFORNIA

BY: DTW	DATE: DECEMBER 2019	PROJECT: 3019060



Gravel		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample Location: B-6

Depth (ft): 10.0'-15.0

USCS Soil Type: SM

Passing No. 200 (%): 34

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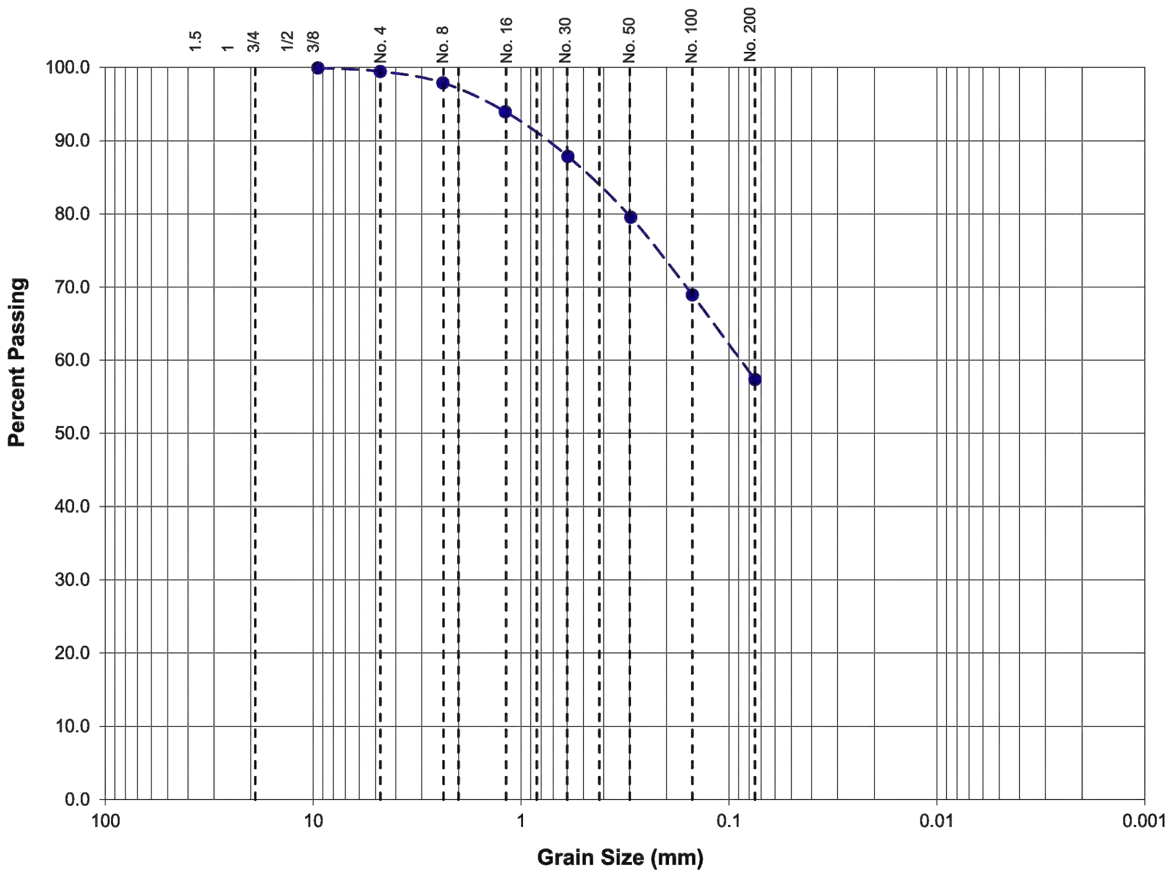
GRADATION ANALYSIS TEST RESULTS

UHS TOWER & CUP AREA
36485 INLAND VALLEY DRIVE
WILDOMAR, CALIFORNIA

BY: DTW	DATE: DECEMBER 2019	PROJECT: 3019060



Gravel		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

Sample Location: B-7

Depth (ft): 10.0'-15.0'

USCS Soil Type: ML

Passing No. 200 (%): 57

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GRADATION ANALYSIS TEST RESULTS

UHS TOWER & CUP AREA
36485 INLAND VALLEY DRIVE
WILDOMAR, CALIFORNIA

BY: DTW	DATE: DECEMBER 2019	PROJECT: 3019060

APPENDIX E

STORMWATER INFILTRATION

PERCOLATION TEST DATA SHEET

P - 1

Project:	36485 Inland Valley		Project No:	3019060		Date:	8/28/2019
Test Hole No: P - 1			Tested By:	Tim Tavernetti			
Depth of test Hole:		15' (180")	USCS Soil Classification: Sandy Silt (ML)				
Test Hole Dimensions (inches)						Length	Width
Diameter (if round) =		8	Sides (if rectangular) =				
Sandy Soil Criteria Test*							
Trail No.	Start Time	Stop Time	Time Interval (min.)	Intital Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or Equal to 6"? (y/n)
1							
2							

* If two consecutive measurements show that six inches of water seps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at lease 0.25".

Trail No.	Start Time	Stop Time	Time Interval (min)	Initial Depth to Water (ft)	Final Depth to Water (ft)	Change in Water Level (in)	Percolation Rate (min/ in)
1	8:21	8:40	19	4.55	4.56	0.12	0.01
2	8:41	9:15	34	4.56	4.65	1.08	0.03
3	9:16	9:49	33	4.65	4.70	0.60	0.02
4	9:50	10:20	30	4.70	4.72	0.24	0.01
5	10:20	10:50	30	4.72	4.80	0.96	0.03
6	10:50	11:20	30	4.80	5.00	2.40	0.08
7	22:20	11:52	32	5.00	5.30	3.60	0.11
8	11:52	12:28	36	5.30	5.46	1.92	0.05
9	12:29	12:55	26	5.46	5.53	0.84	0.03
10	12:55	13:26	31			0.00	0.00
11	13:26	13:49	25	4.79	5.06	3.24	0.13
12	13:49	14:23	34	5.06	5.28	2.64	0.08

Error in reading 10; Line omitted

PERCOLATION TEST DATA SHEET P - __2___

Project:	36485 Inland Valley		Project No:	3019060		Date:	8/28/2019
Test Hole No: P - 2			Tested By:	Tim Tavernetti			
Depth of test Hole:		10.5' (126")	USCS Soil Classification: Silty Sand (SM)				
Test Hole Dimensions (inches)						Length	Width
Diameter (if round) =		8	Sides (if rectangular) =				
Sandy Soil Criteria Test*							
Trail No.	Start Time	Stop Time	Time Interval (min.)	Intital Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or Equal to 6"? (y/n)
1							
2							

* If two consecutive measurements show that six inches of water seps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at lease 0.25".

Trail No.	Start Time	Stop Time	Time Interval (min)	Initial Depth to Water (ft)	Final Depth to Water (ft)	Change in Water Level (in)	Percolation Rate (min/ in)
1	8:22	8:39	17	3.65	3.75	1.20	14.17
2	8:40	9:10	30	3.75	3.80	0.60	50.00
3	9:11	9:41	30	3.80	4.00	2.40	12.50
4	9:45	10:15	30	3.60	3.82	2.64	11.36
5	10:17	10:46	29	3.59	3.87	3.36	8.63
6	10:46	11:16	30	3.60	3.62	0.24	125.00
7	11:16	11:48	32	3.62	4.05	5.16	6.20
8	11:49	12:21	32	4.05	4.15	1.20	26.67
9	12:22	12:52	30	3.80	4.00	2.40	12.50
10	12:52	13:22	30	4.00	4.15	1.80	16.67
11	13:22	13:46	24	4.15	4.19	0.48	50.00
12	13:46	14:16	30	4.19	4.22	0.36	83.33

PERCOLATION TEST DATA SHEET P - __3___

Project:	36485 Inland Valley		Project No:	3019060		Date:	8/28/2019
Test Hole No: P - 3			Tested By:	Tim Tavernetti			
Depth of test Hole:		10' (120")	USCS Soil Classification: Silty Sand (SM)				
Test Hole Dimensions (inches)						Length	Width
Diameter (if round) =		8	Sides (if rectangular) =				
Sandy Soil Criteria Test*							
Trail No.	Start Time	Stop Time	Time Interval (min.)	Intital Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or Equal to 6"? (y/n)
1							
2							

* If two consecutive measurements show that six inches of water seps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at lease 0.25".

Trail No.	Start Time	Stop Time	Time Interval (min)	Initial Depth to Water (ft)	Final Depth to Water (ft)	Change in Water Level (in)	Percolation Rate (min/ in)
1	8:22	8:44	22	2.65	2.69	0.48	45.83
2	8:45	9:17	32	2.69	2.75	0.72	44.44
3	9:18	9:51	33	2.75	2.80	0.60	55.00
4	9:51	10:21	30	2.80	2.85	0.60	50.00
5	10:22	10:51	29	2.85	2.90	0.60	48.33
6	10:51	11:21	30	2.90	2.92	0.24	125.00
7	11:21	11:52	31	2.92	2.98	0.72	43.06
8	11:52	12:30	38	2.98	3.05	0.84	45.24
9	12:31	12:56	25	3.05	3.05	0.00	0.00
10	12:56	13:29	33	3.05	3.09	0.48	68.75
11	13:29	13:50	31	3.09	3.13	0.48	64.58
12	13:50	14:25	35	3.13	3.15	0.24	145.83

PERCOLATION TEST DATA SHEET

P - __4___

Project:	36485 Inland Valley		Project No:	3019060		Date:	8/28/2019
Test Hole No: P - 4			Tested By:	Tim Tavernetti			
Depth of test Hole:		10.5' (126")	USCS Soil Classification: Silty Sand (SM)				
Test Hole Dimensions (inches)						Length	Width
Diameter (if round) =		8	Sides (if rectangular) =				
Sandy Soil Criteria Test*							

Trail No.	Start Time	Stop Time	Time Interval (min.)	Intital Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or Equal to 6"? (y/n)
1							
2							

* If two consecutive measurements show that six inches of water seps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at lease 0.25".

Trail No.	Start Time	Stop Time	Time Interval (min)	Initial Depth to Water (ft)	Final Depth to Water (ft)	Change in Water Level (in)	Percolation Rate (min/ in)
1	8:20	8:42	22	2.50	2.56	0.72	30.56
2	8:43	9:13	30	2.56	2.63	0.84	35.71
3	9:14	9:47	33	2.63	2.70	0.84	39.29
4	9:48	10:19	31	2.70	2.71	0.12	258.33
5	10:20	10:48	28	2.71	2.74	0.36	77.78
6	10:49	11:19	30	2.74	2.79	0.60	50.00
7	11:19	11:51	32	2.79	2.82	0.36	88.89
8	11:51	12:23	33	2.82	2.86	0.48	68.75
9	12:24	12:53	29	2.86	2.90	0.48	0.00
10	12:53	13:26	33	2.90	2.94	0.48	68.75
11	13:26	13:47	21	2.94	3.00	0.72	29.17
12	13:48	14:22	34	3.00	3.06	0.72	47.22

PERCOLATION TEST DATA SHEET P - 5

Project:	36485 Inland Valley		Project No:	3019060		Date:	8/28/2019
Test Hole No: P - 5			Tested By:	Tim Tavernetti			
Depth of test Hole:		9.0' (108")	USCS Soil Classification: Silty Sand (SM)				
Test Hole Dimensions (inches)						Length	Width
Diameter (if round) =		8	Sides (if rectangular) =				
Sandy Soil Criteria Test*							
Trail No.	Start Time	Stop Time	Time Interval (min.)	Intital Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or Equal to 6"? (y/n)
1							
2							

* If two consecutive measurements show that six inches of water seps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at lease 0.25".

Trail No.	Start Time	Stop Time	Time Interval (min)	Initial Depth to Water (ft)	Final Depth to Water (ft)	Change in Water Level (in)	Percolation Rate (min/ in)
1	8:18	8:41	23	2.30	2.39	1.08	21.30
2	8:42	9:12	30	2.39	2.40	0.12	250.00
3	9:13	9:46	33	2.40	2.43	0.36	91.67
4	9:46	10:18	32	2.43	2.49	0.72	44.44
5	10:19	10:48	29	2.49	2.55	0.72	40.28
6	10:48	11:18	30	2.55	2.56	0.12	250.00
7	11:18	11:50	32	2.56	2.60	0.48	66.67
8	11:50	12:23	33	2.60	2.65	0.60	55.00
9	12:24	12:53	29	2.65	2.69	0.48	0.00
10	12:53	13:23	30	2.69	2.72	0.36	83.33
11	13:23	13:47	24	2.72	2.73	0.12	200.00
12	13:47	14:21	34	2.73	2.76	0.36	94.44

APPENDIX F

ASSESSMENT OF LIQUEFACTION POTENTIAL

TABLE OF CONTENTS

NOVA Services, Inc.
4373 Viewridge, Suite B
San Diego, CA 92123
858-292-7575

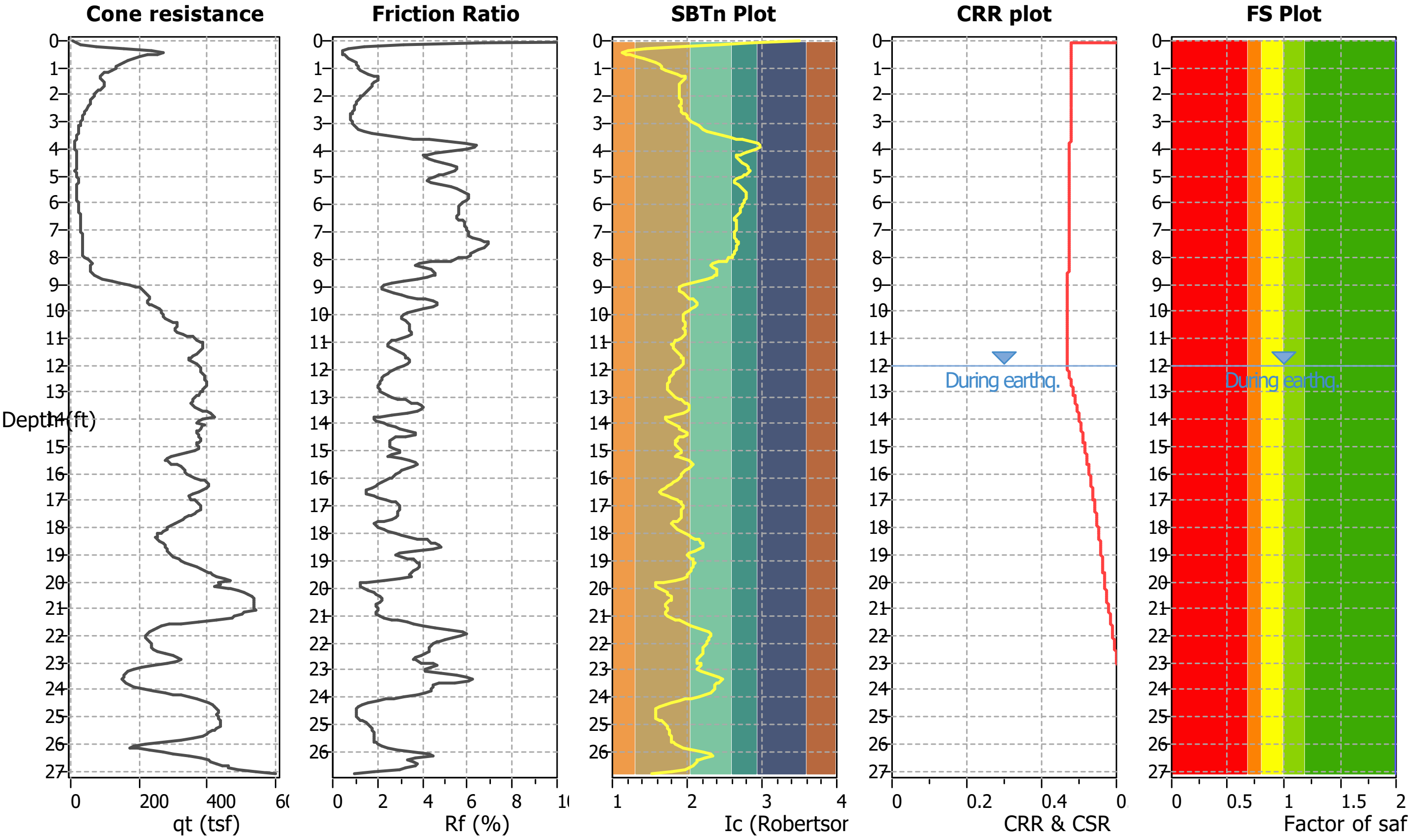
LIQUEFACTION ANALYSIS REPORT

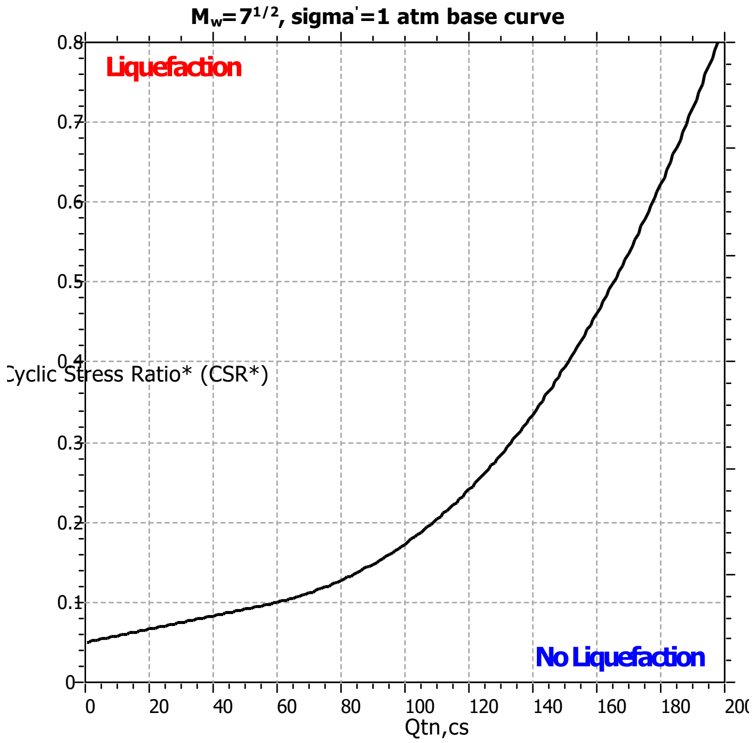
Project title : UHS Inland Valley Reg. Med. Center **Location : 36485 Inland Valley Dr., Wildomar, CA**

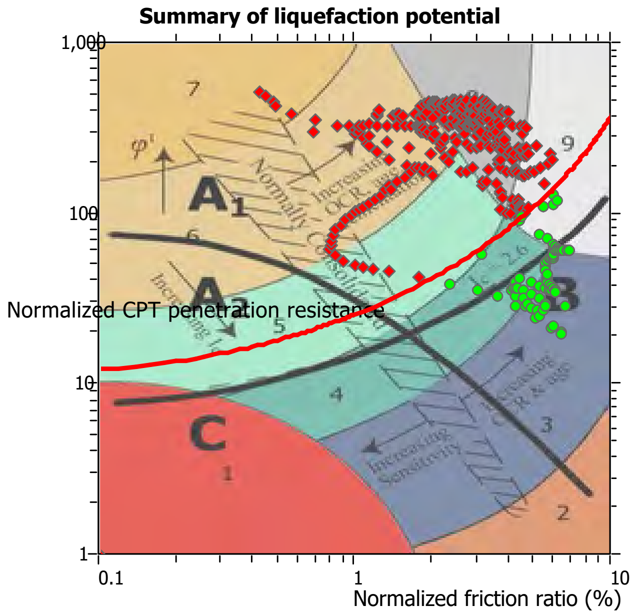
CPT file : CPT-1

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	60.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	12.00 ft	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	40.00 ft
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.40	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.88	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

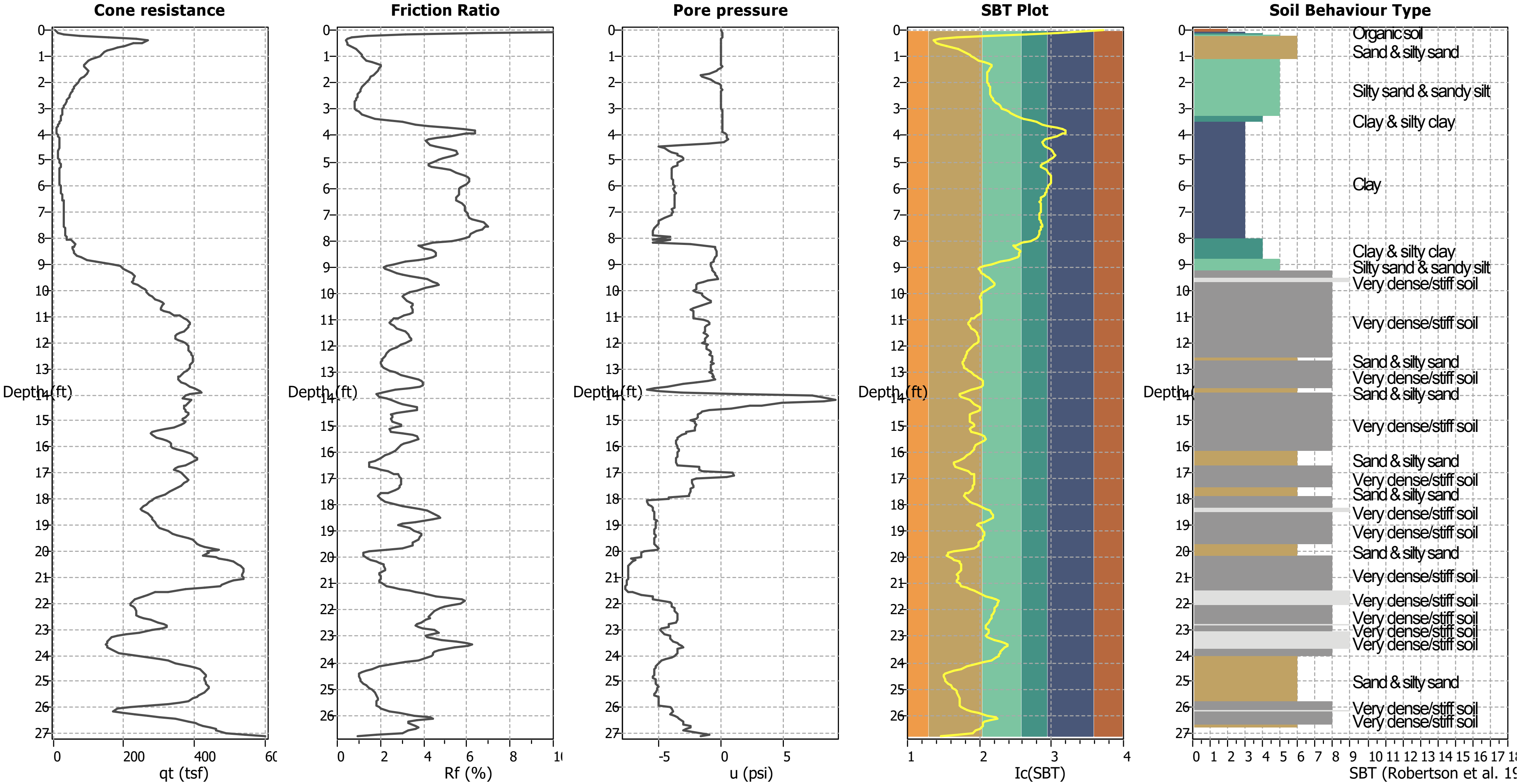






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



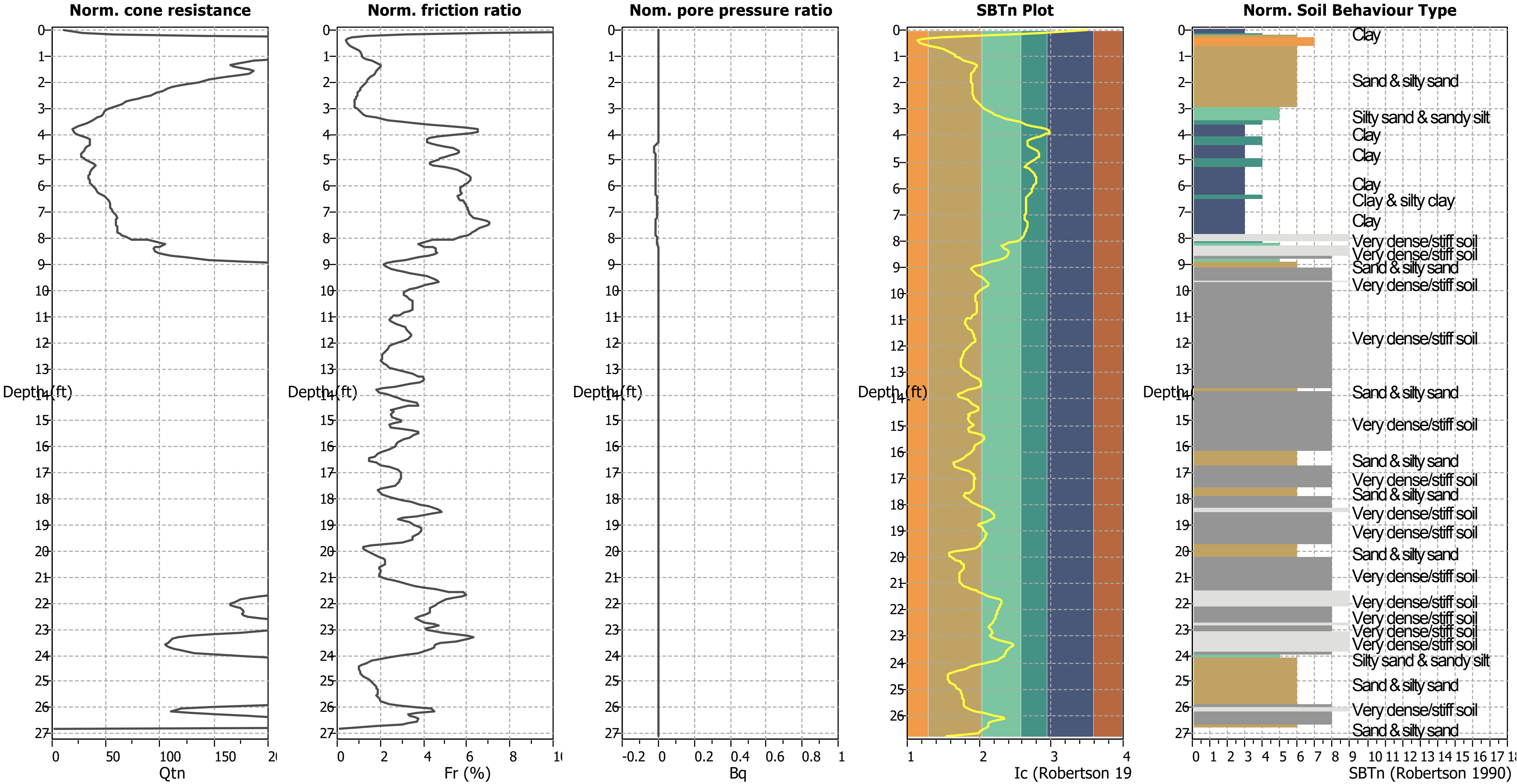
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_{σ} applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

SBT 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

CPT basic interpretation plots (normalized)



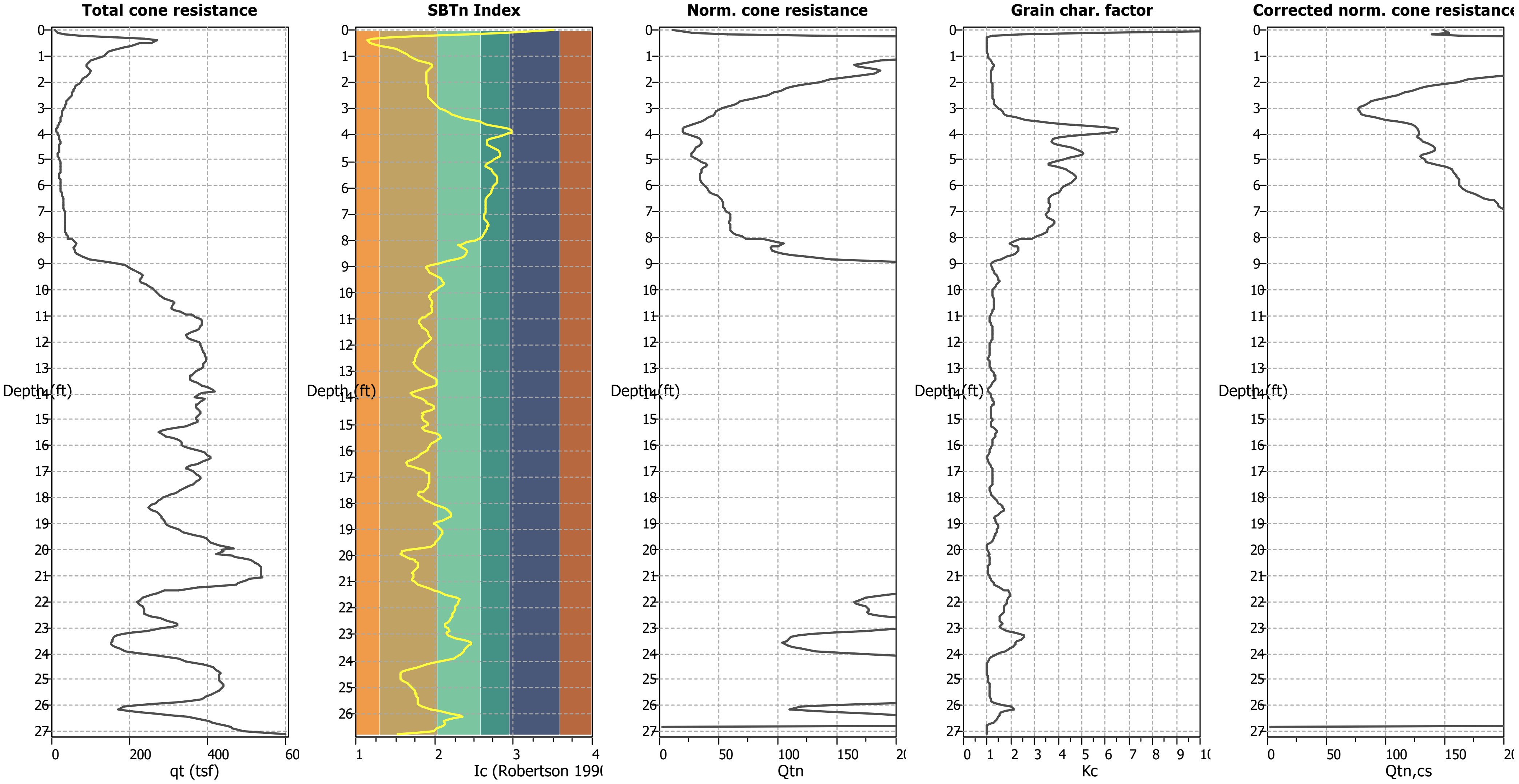
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

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

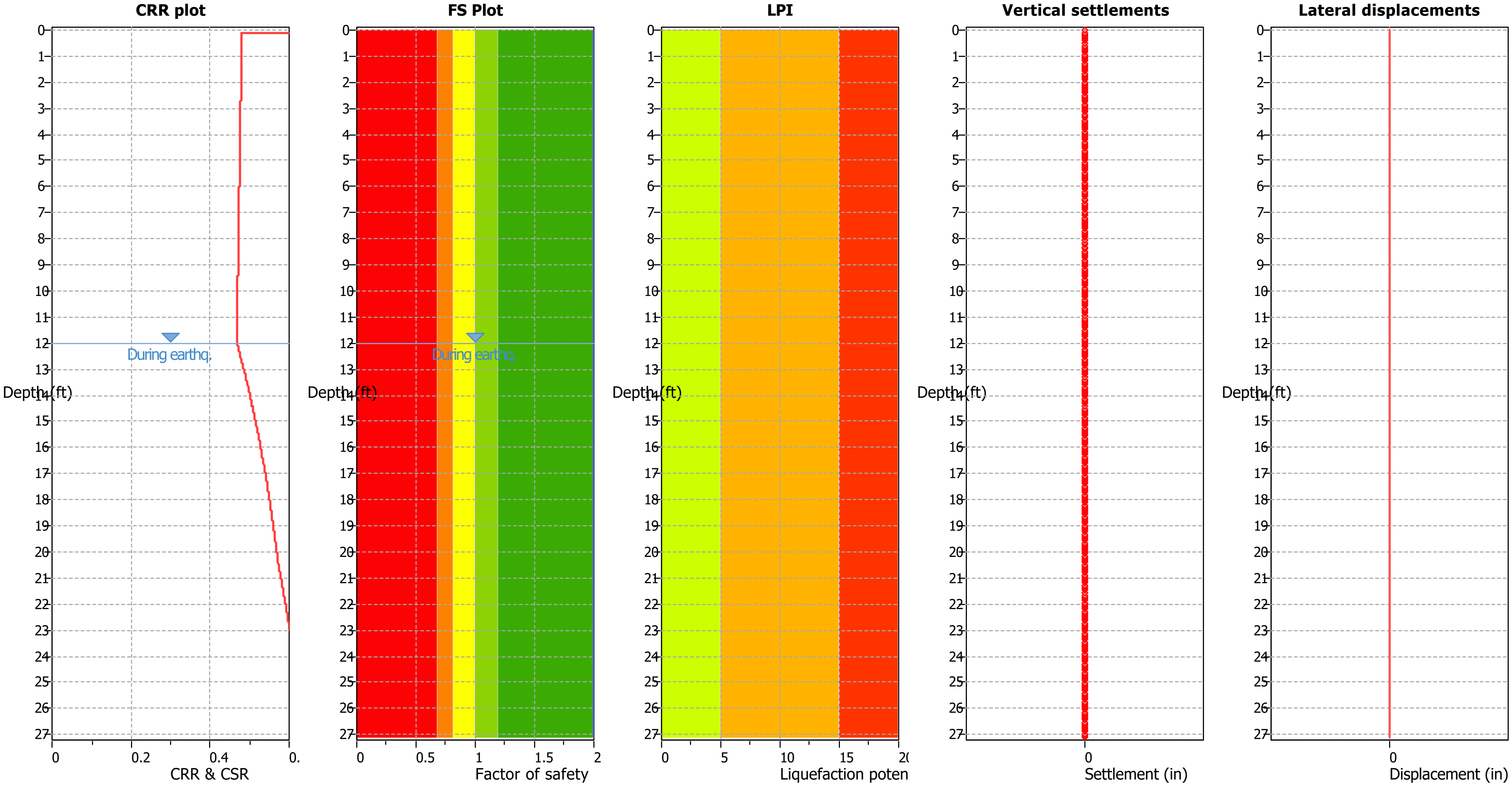
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

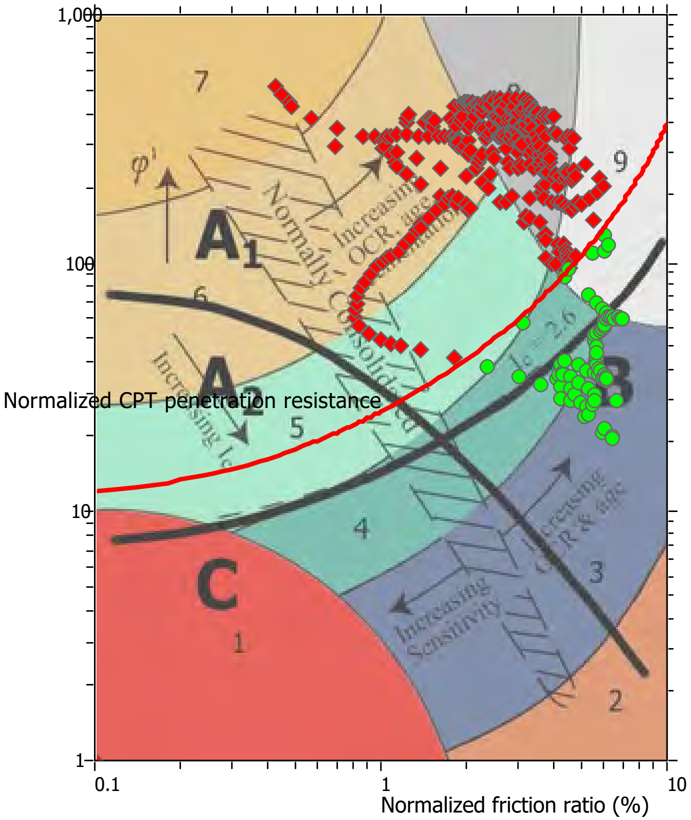
F.S. color scheme

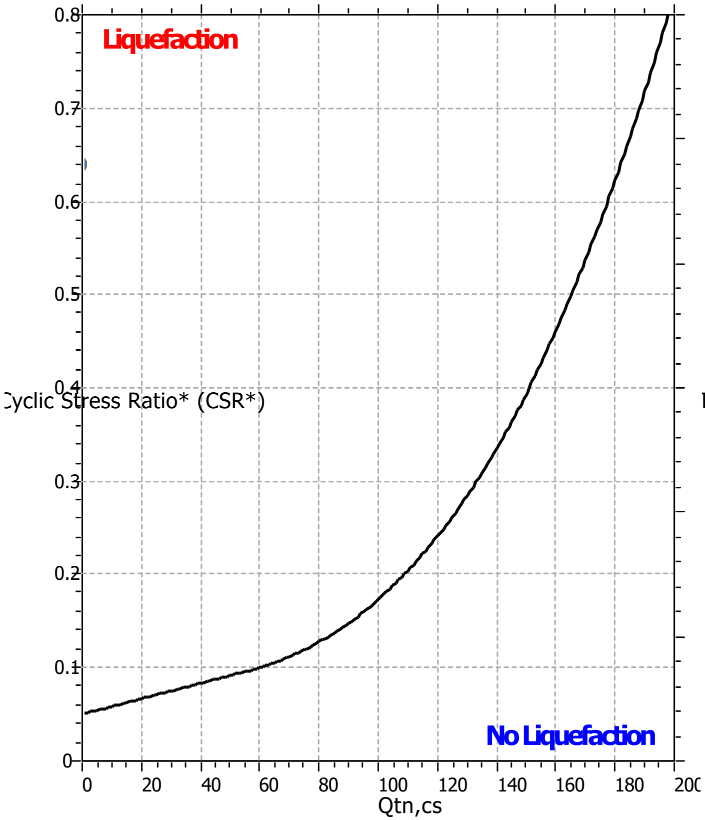
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

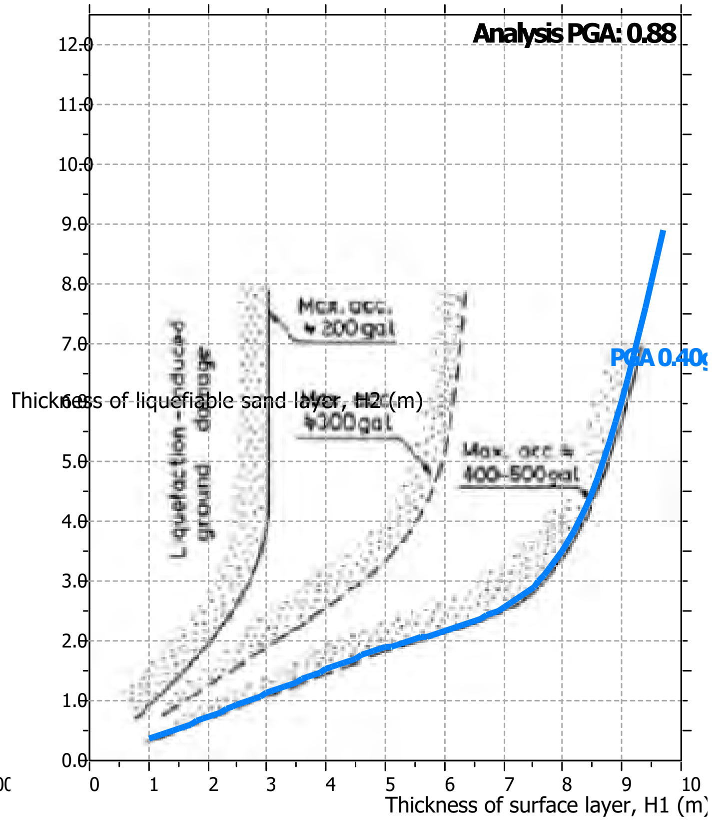
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



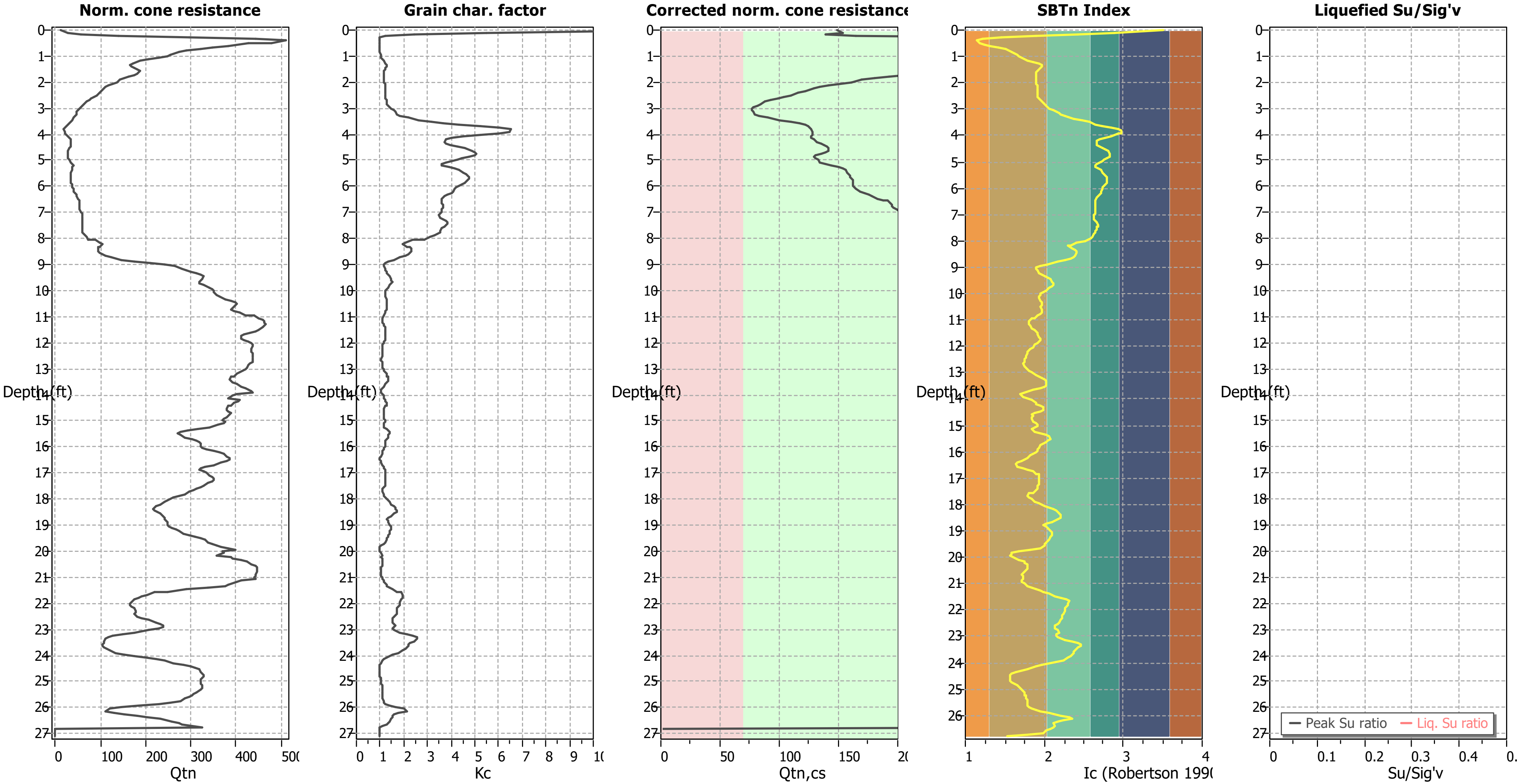




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

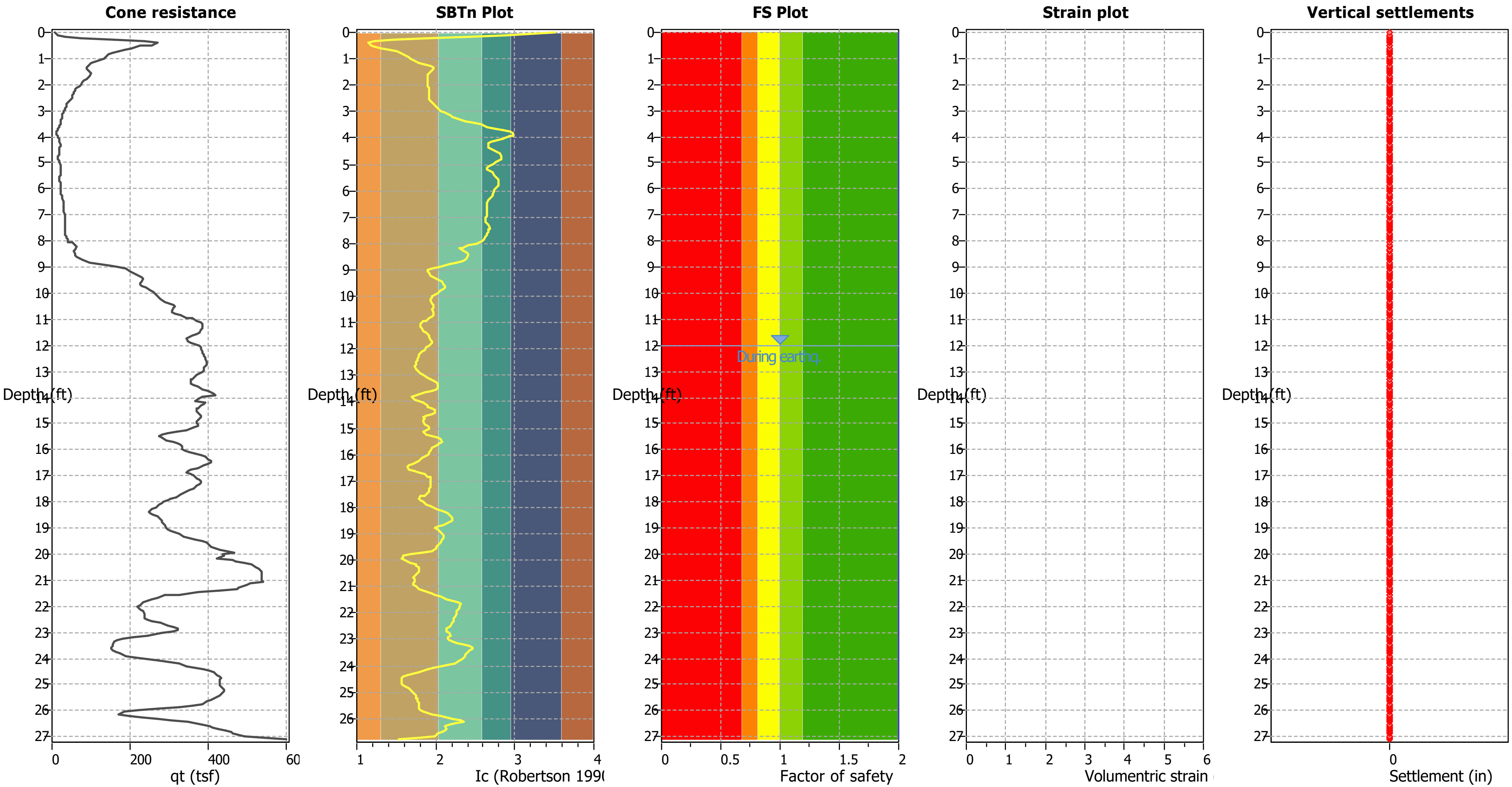
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

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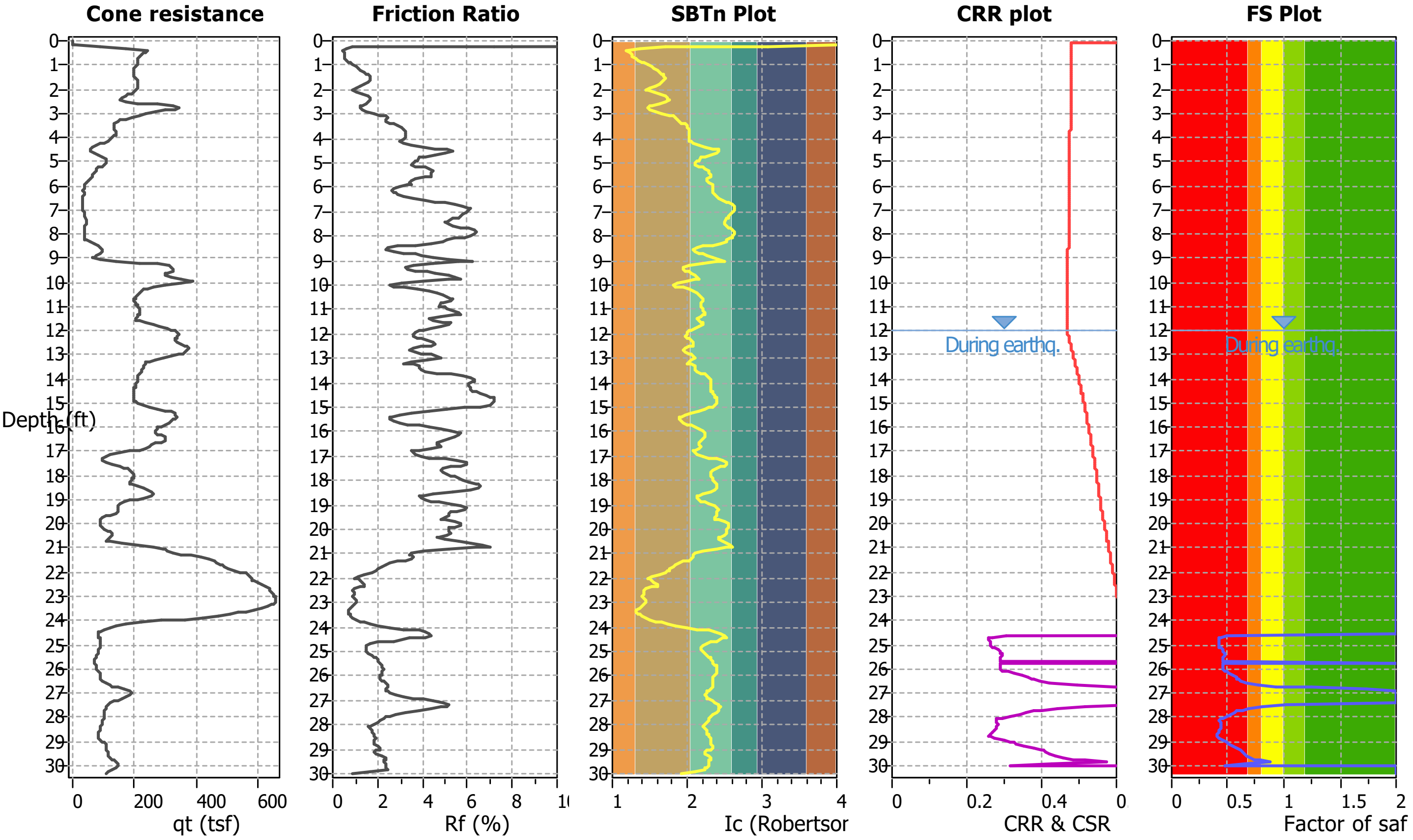
LIQUEFACTION ANALYSIS REPORT

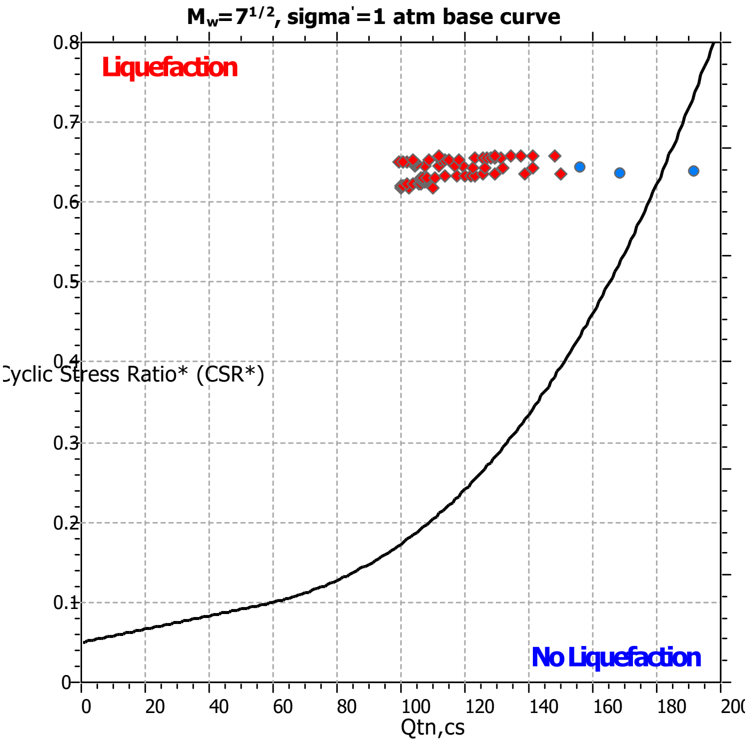
Project title : UHS Inland Valley Reg. Med. Center **Location : 36485 Inland Valley Dr., Wildomar, CA**

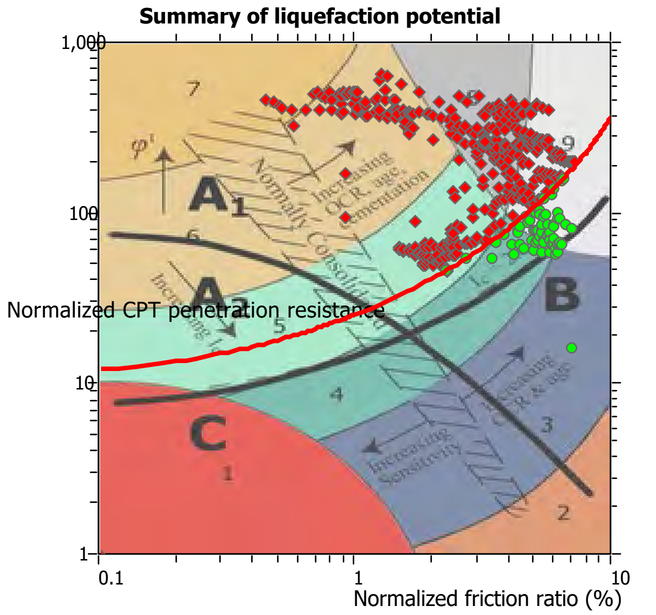
CPT file : CPT-2

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	60.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	12.00 ft	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	40.00 ft
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.40	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.88	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

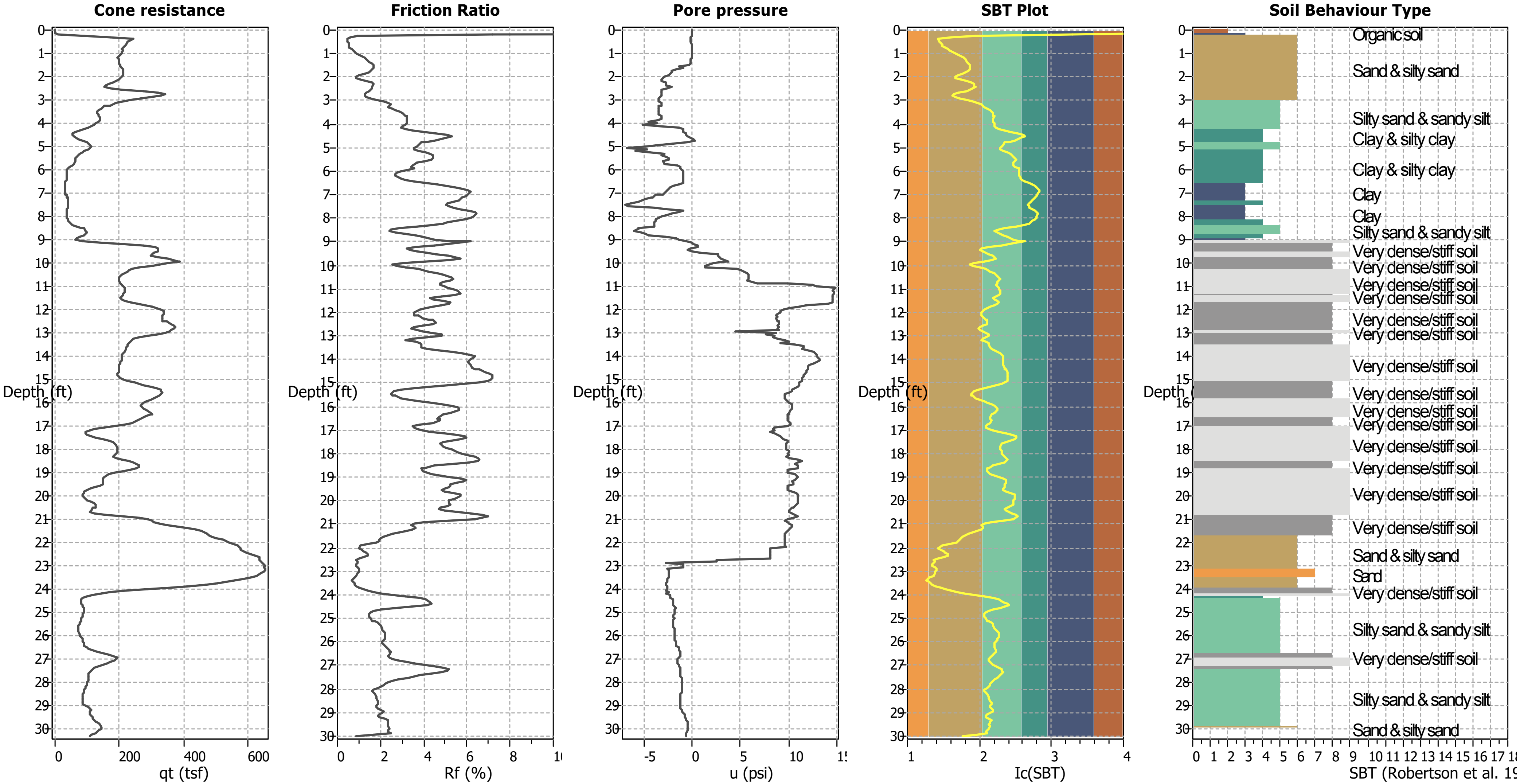






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



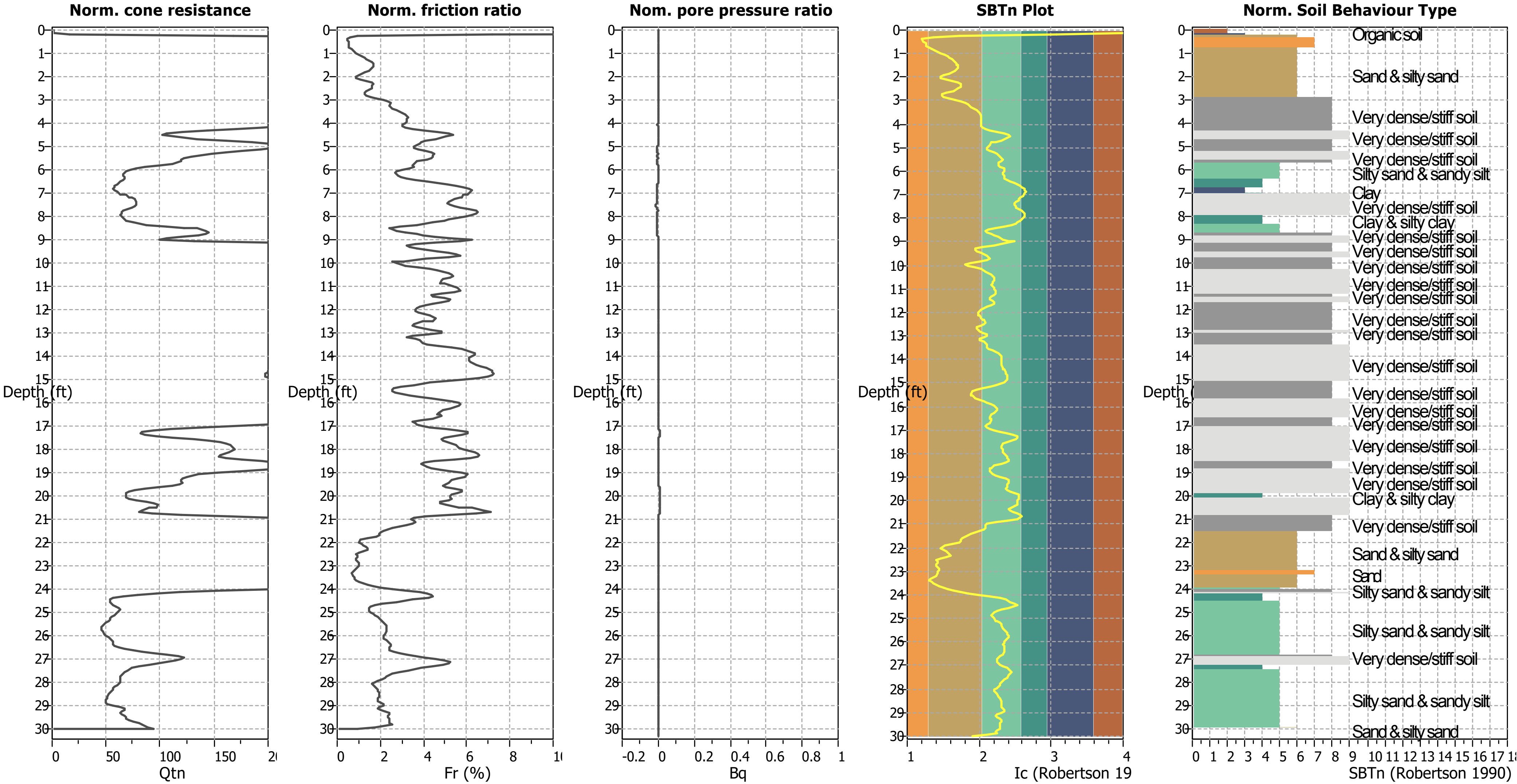
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

SBT 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

CPT basic interpretation plots (normalized)



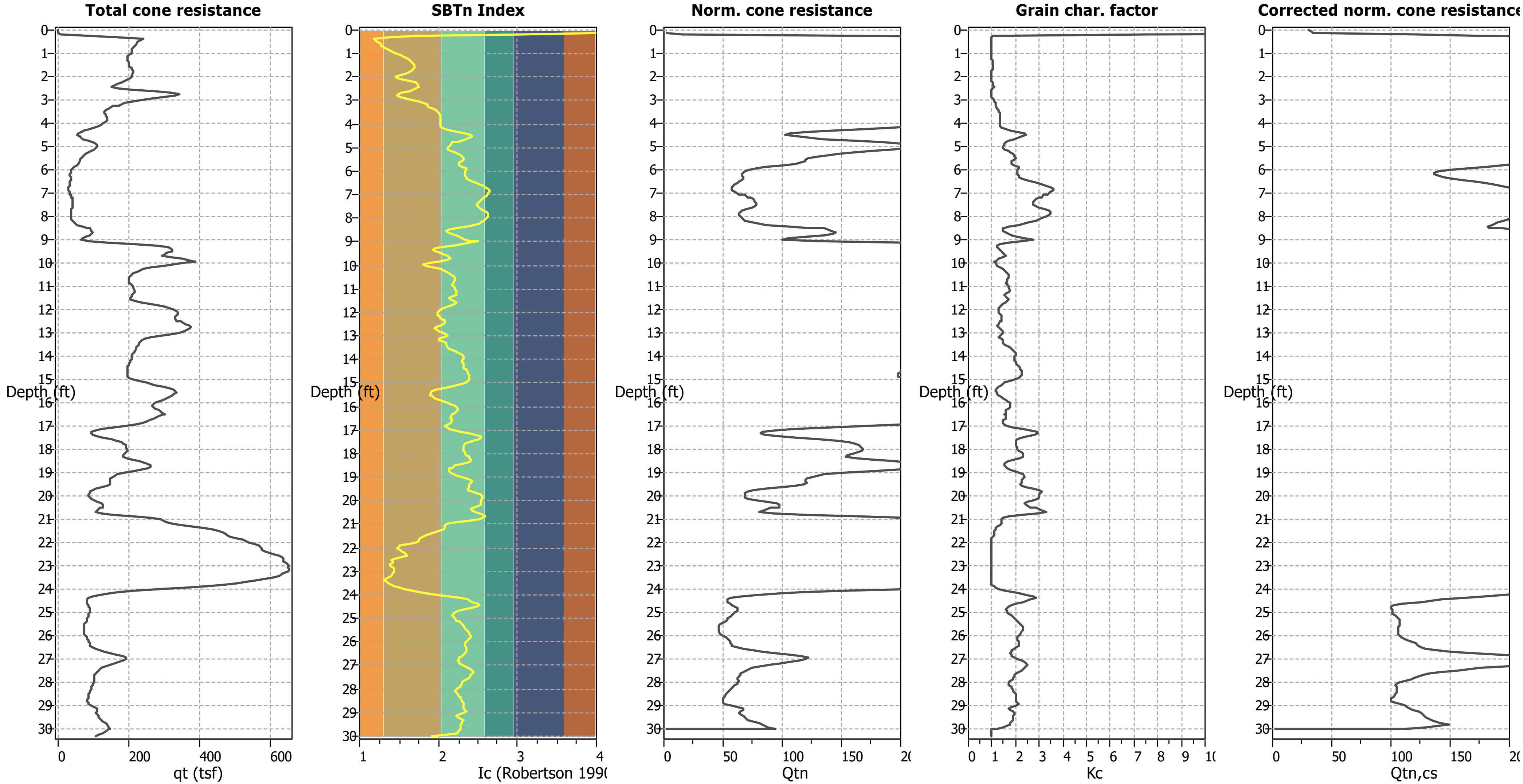
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

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

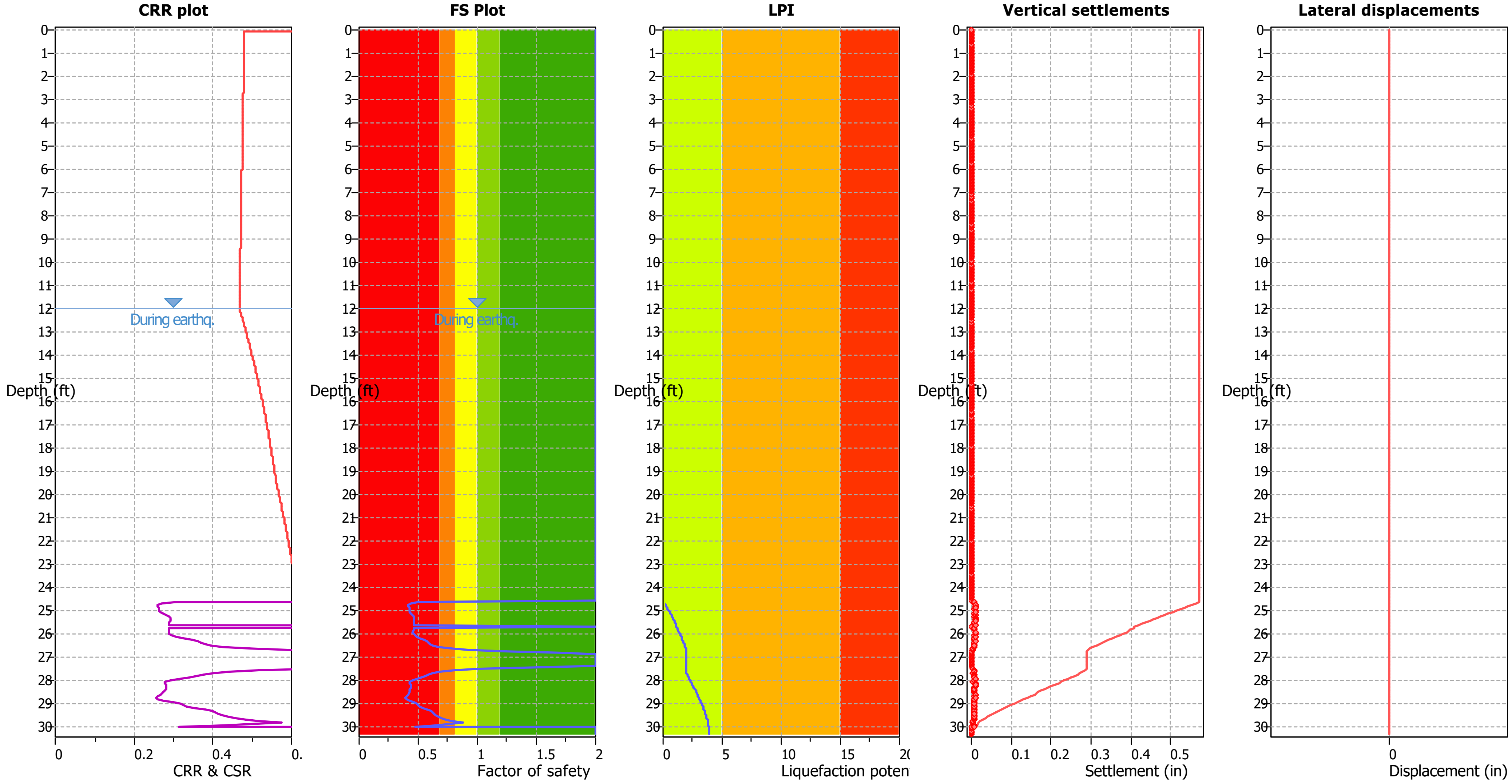
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

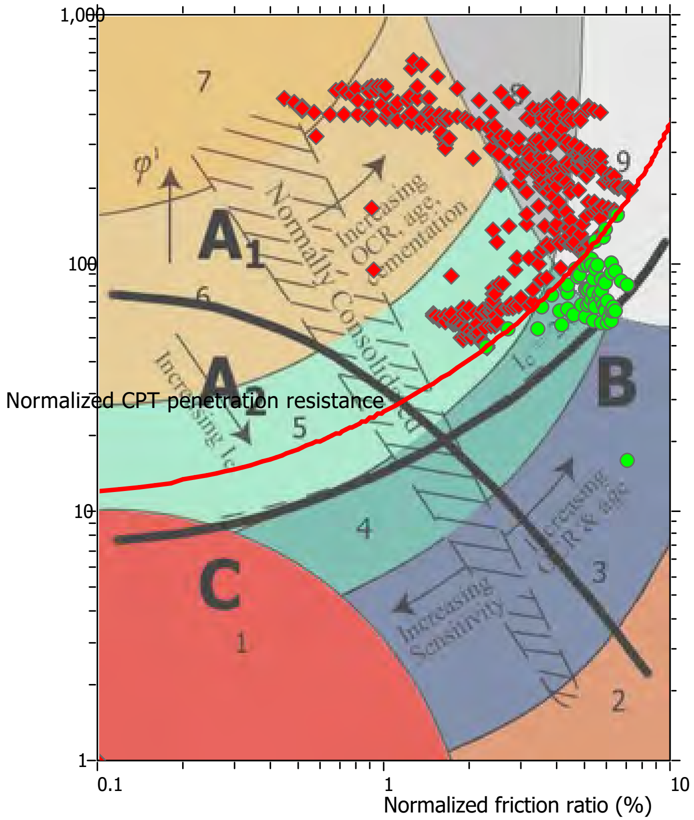
F.S. color scheme

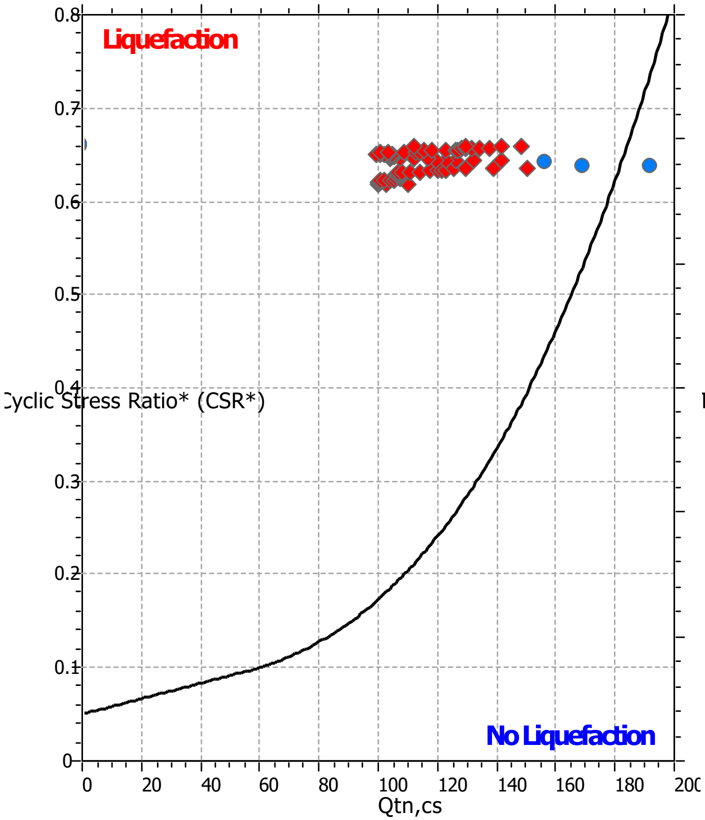
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

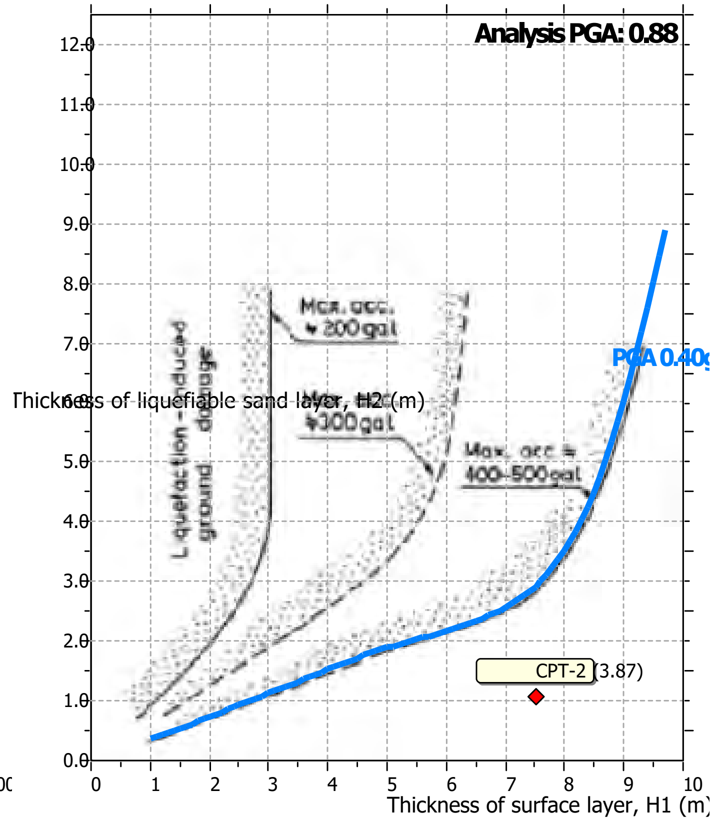
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



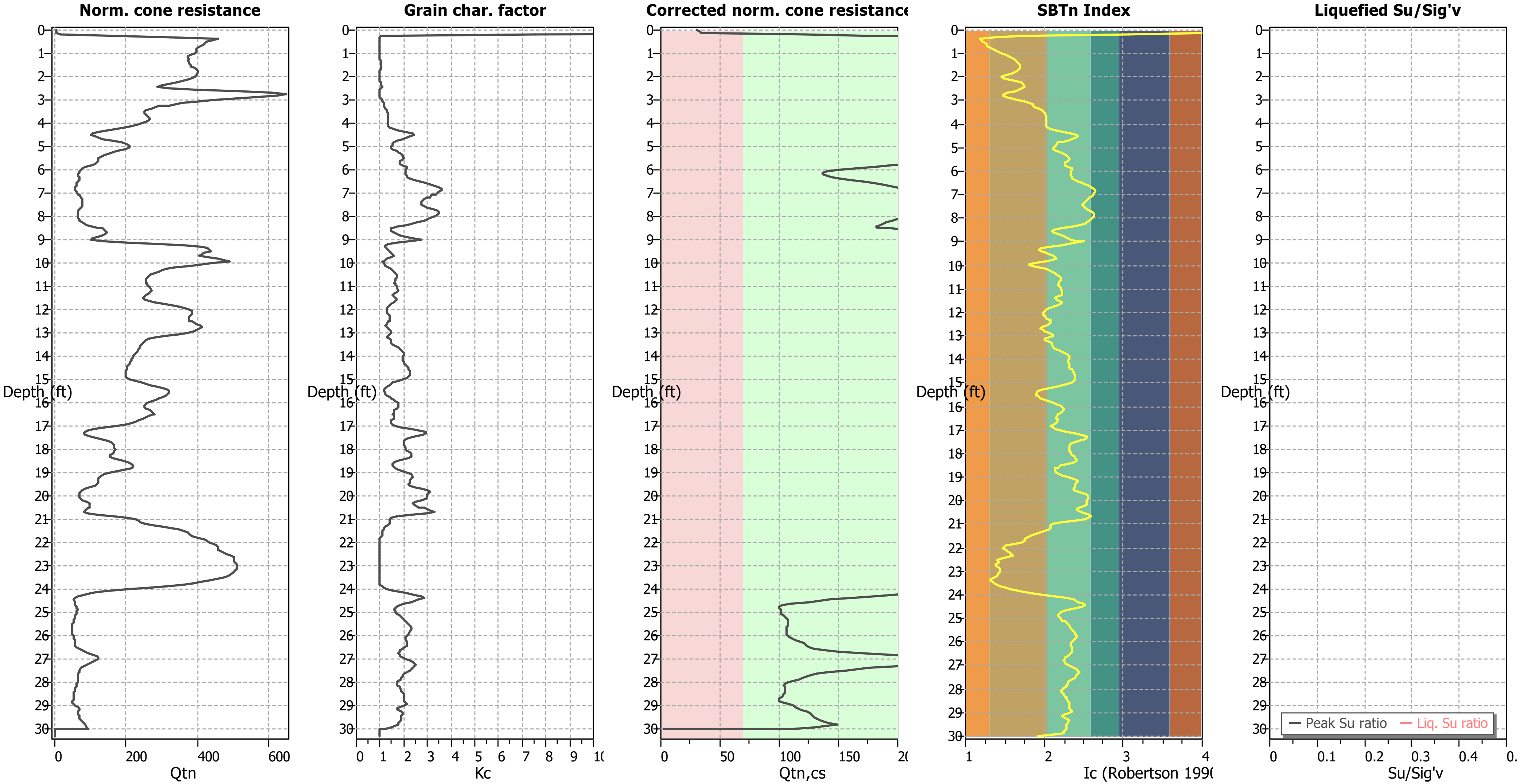




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

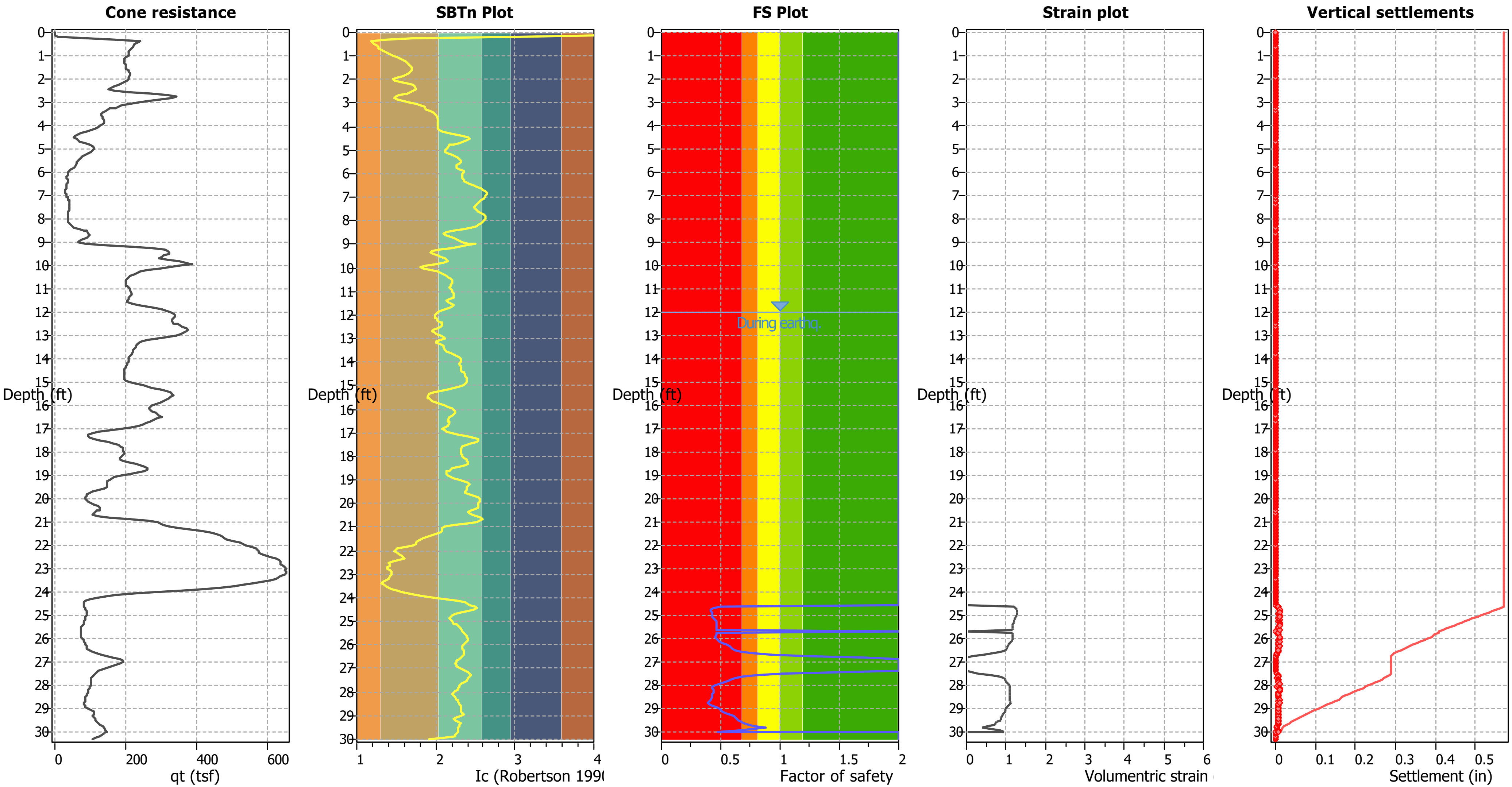
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

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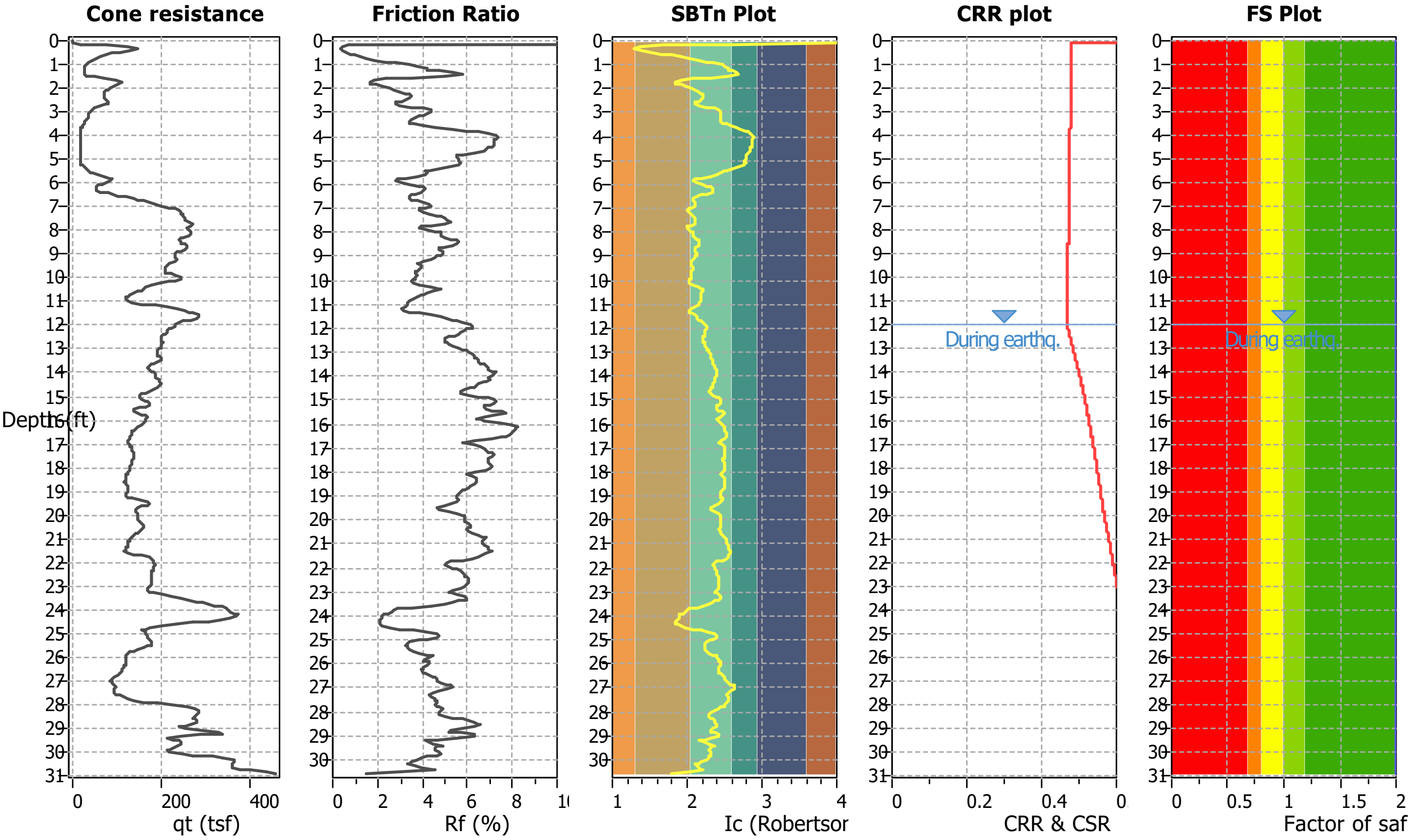
LIQUEFACTION ANALYSIS REPORT

Project title : UHS Inland Valley Reg. Med. Center **Location : 36485 Inland Valley Dr., Wildomar, CA**

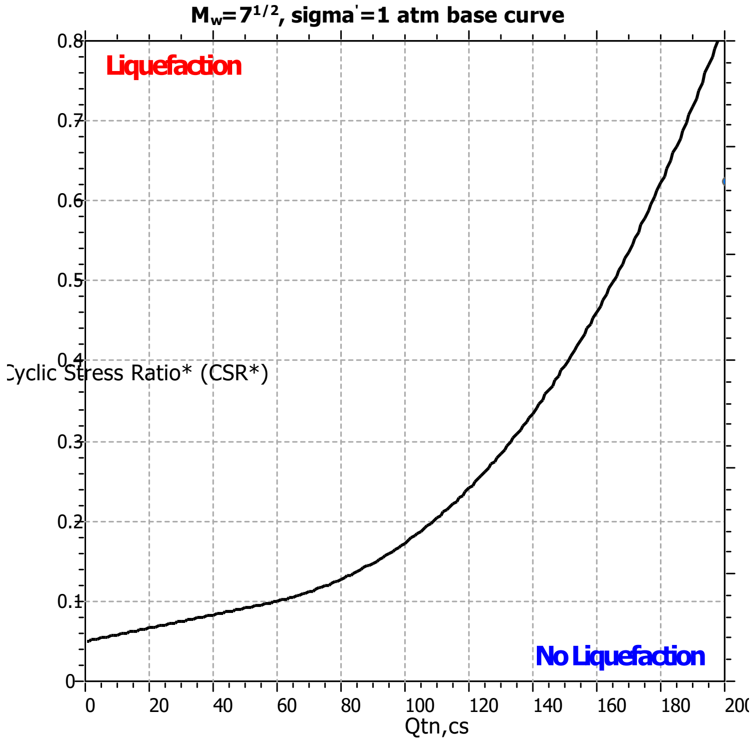
CPT file : CPT-3

Input parameters and analysis data

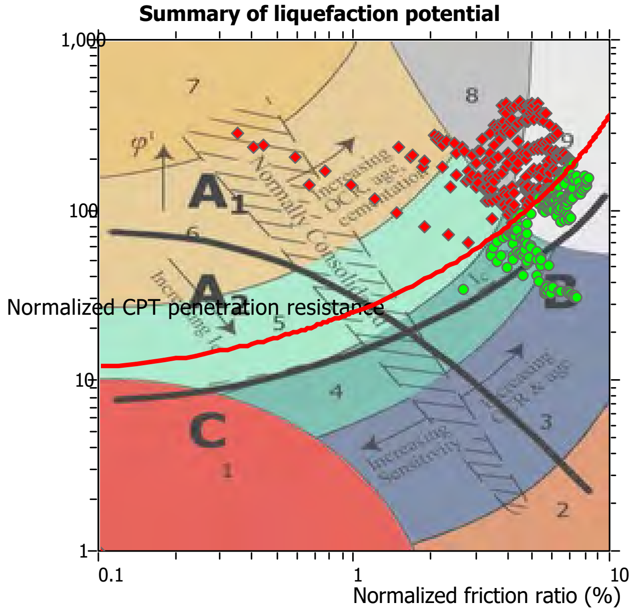
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	60.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	12.00 ft	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	40.00 ft
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.40	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.88	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		



M_w=7$^{1/2}$, sigma'=1 atm base curve

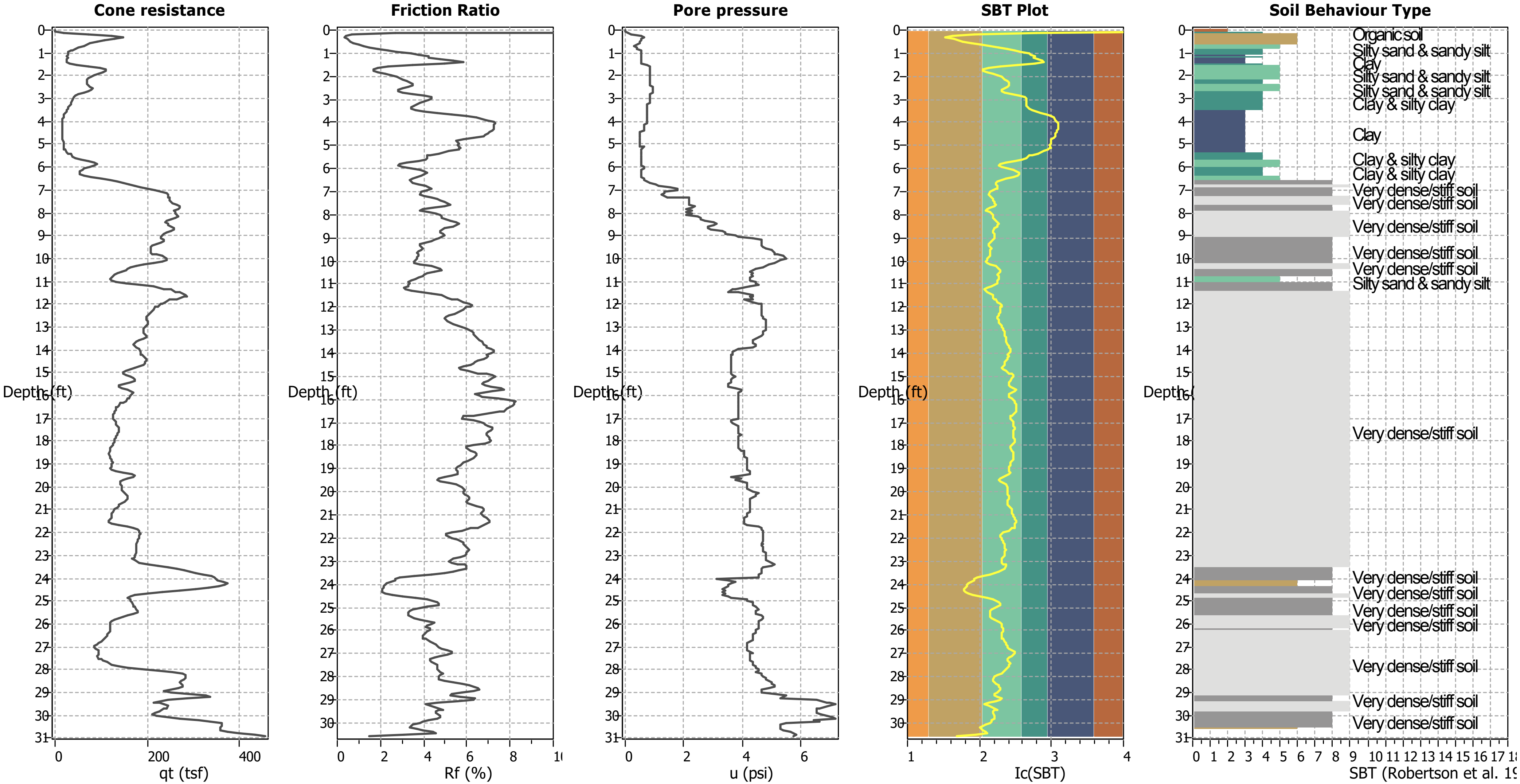


Summary of liquefaction potential



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



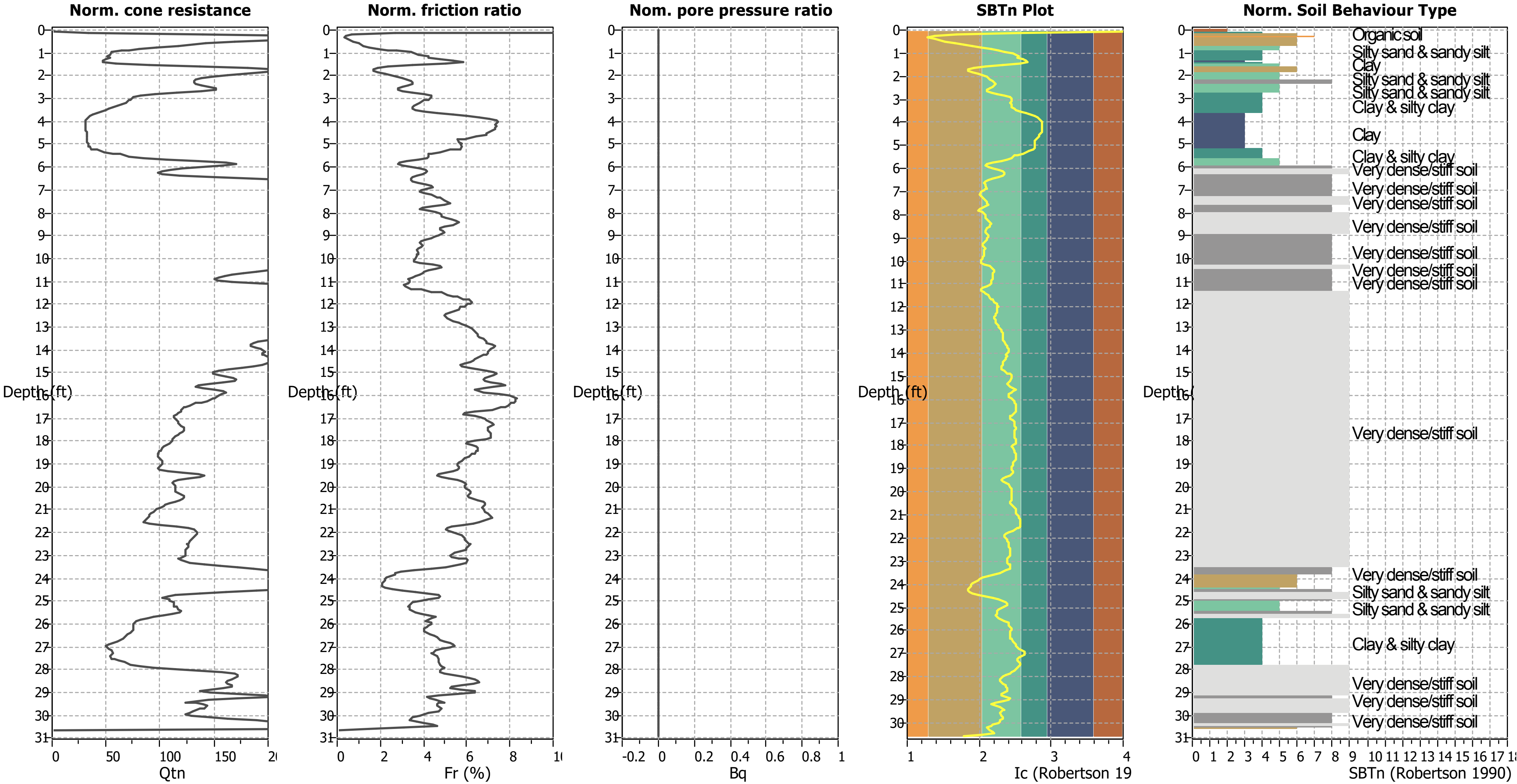
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

SBT 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

CPT basic interpretation plots (normalized)



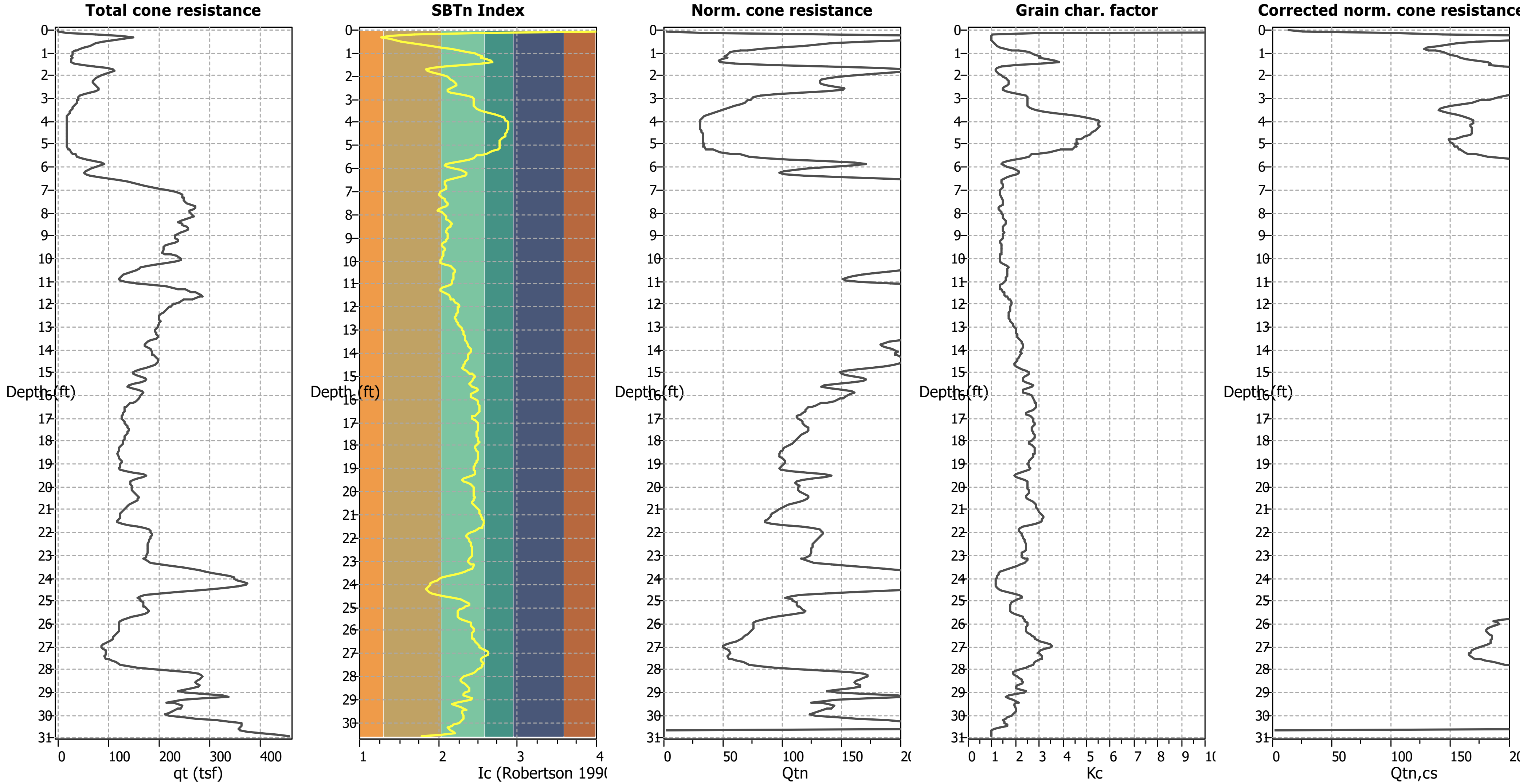
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

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

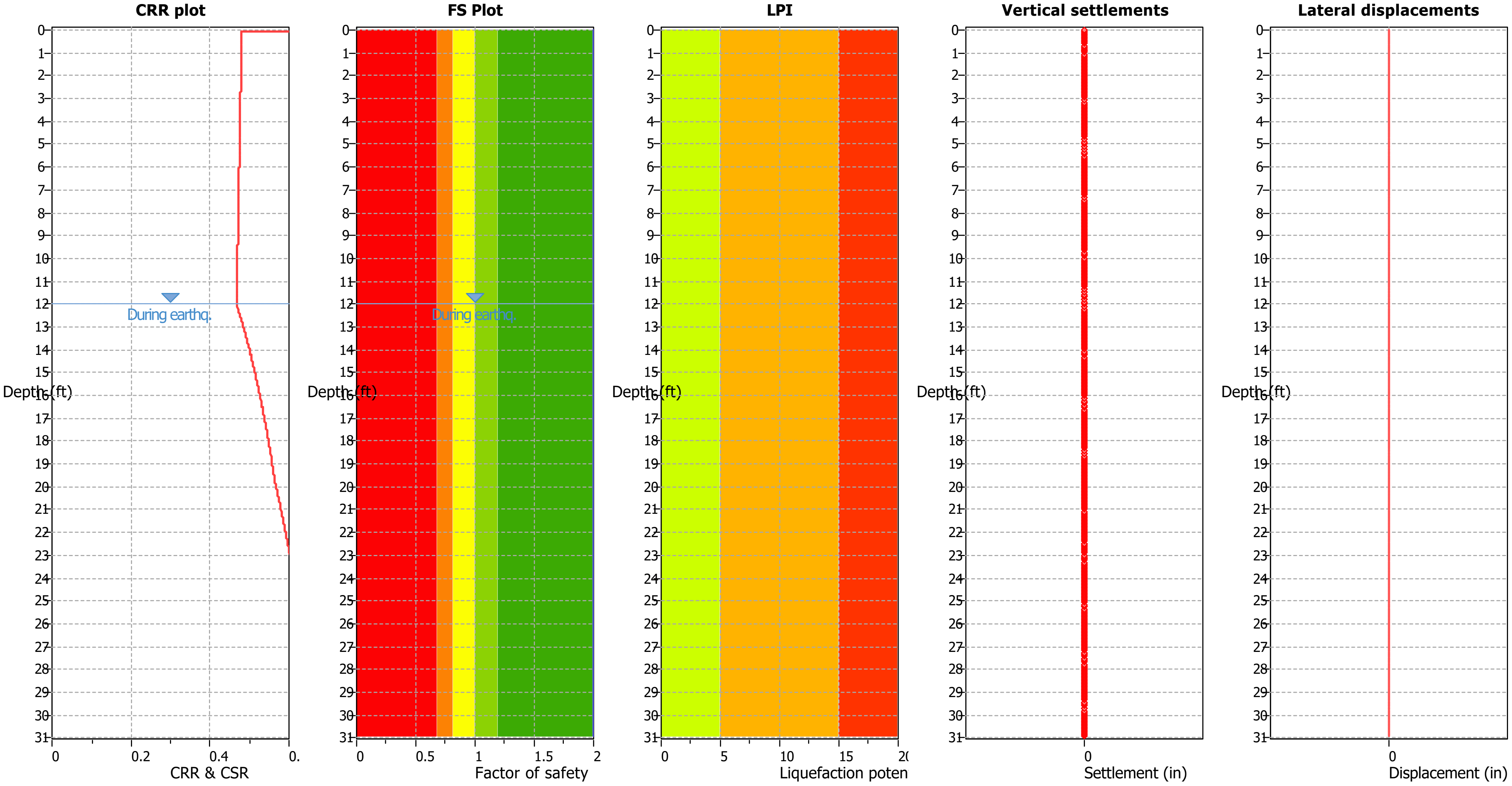
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

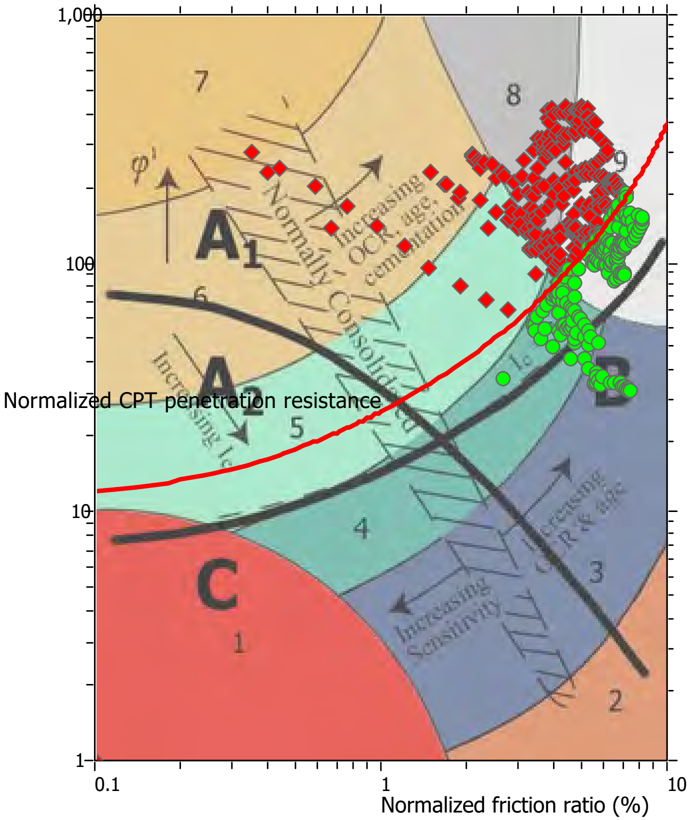
F.S. color scheme

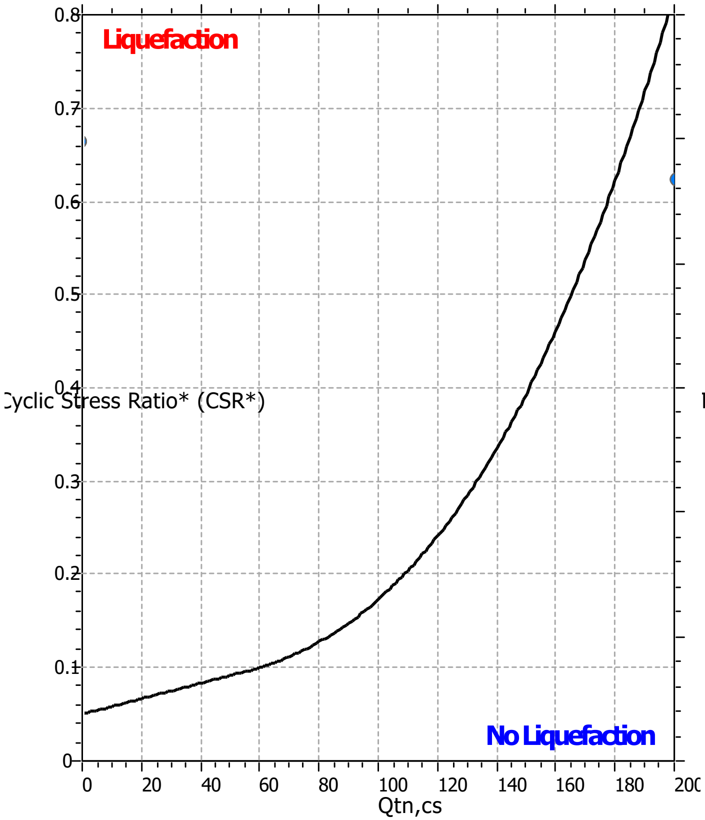
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

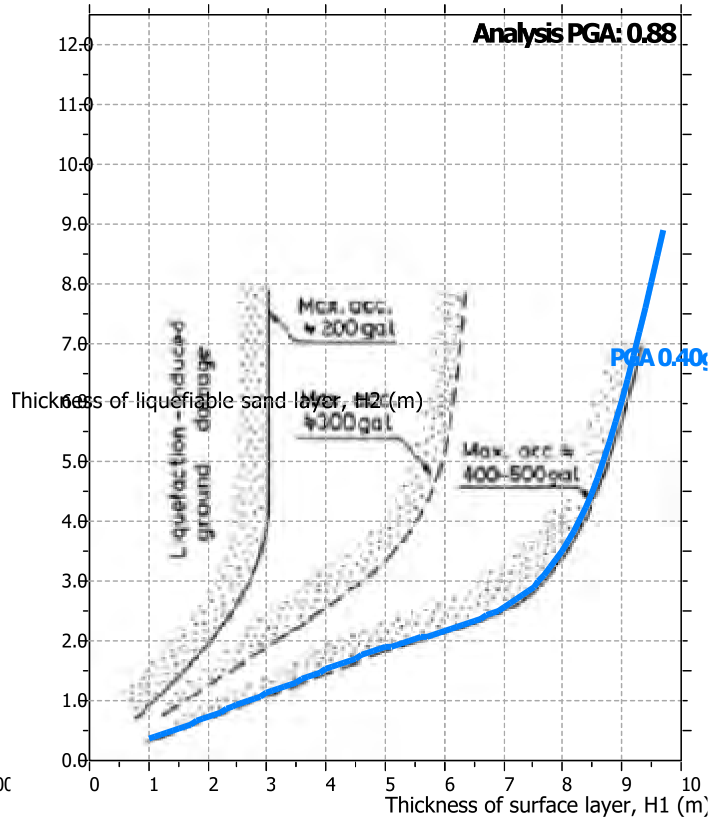
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



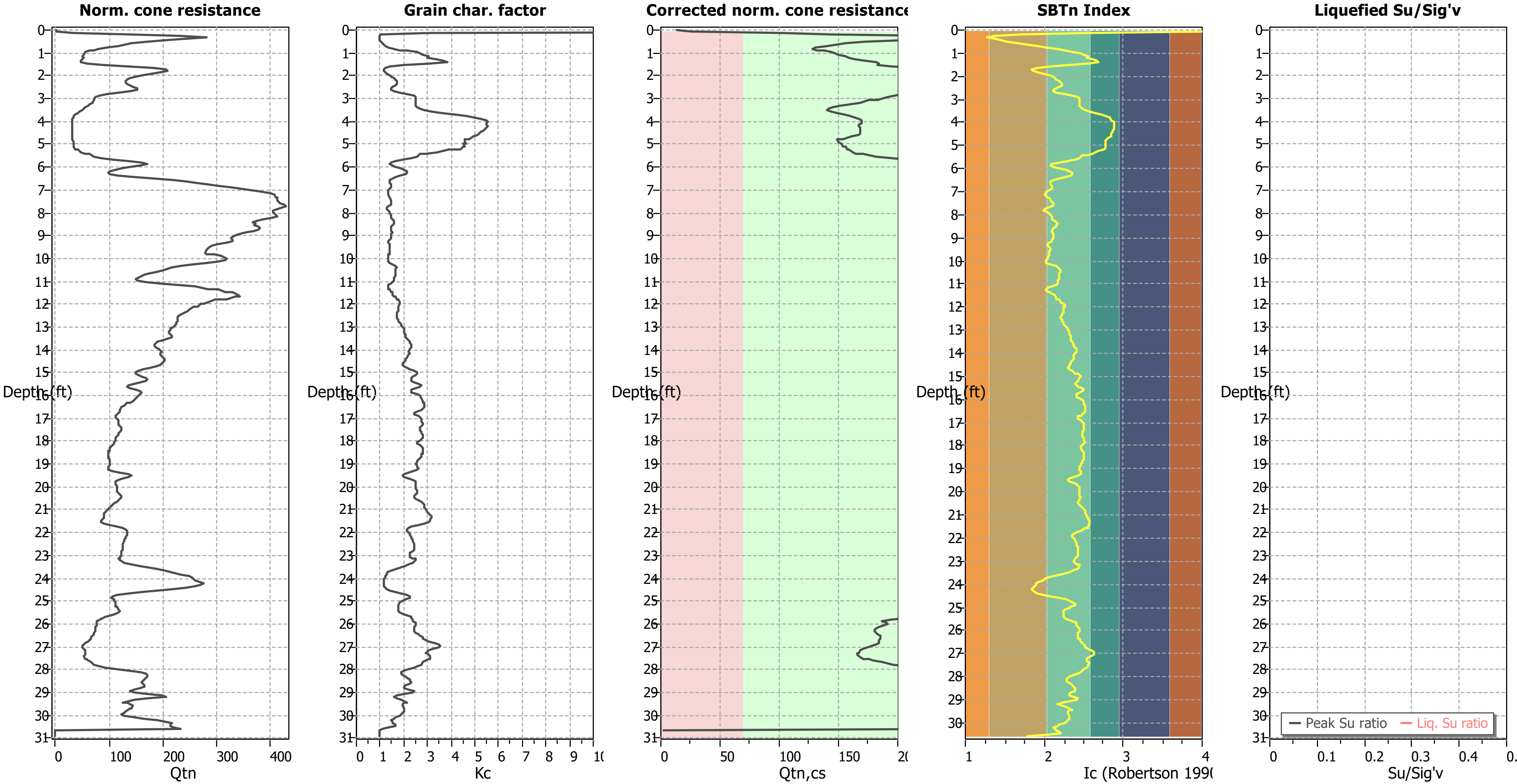




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

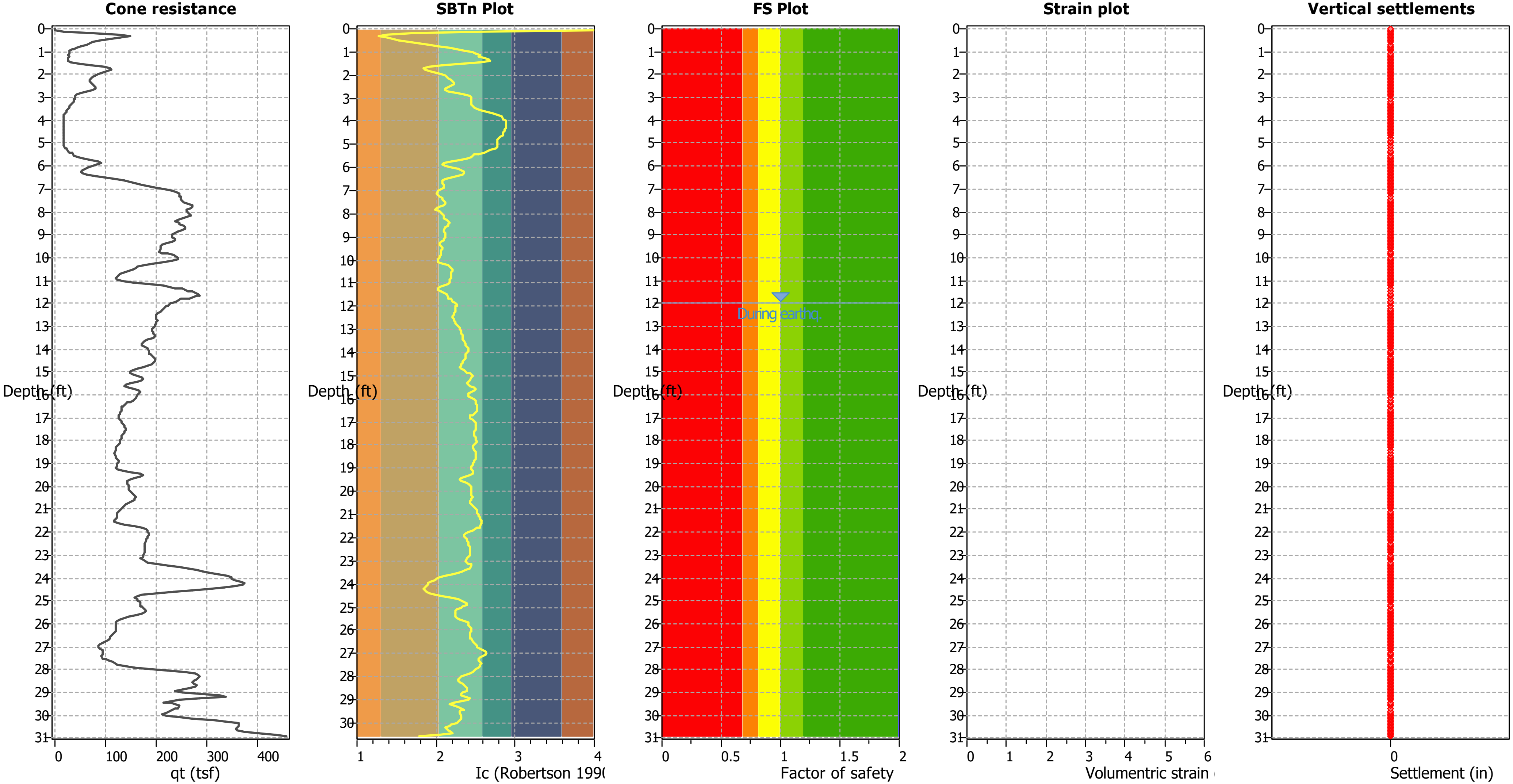
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

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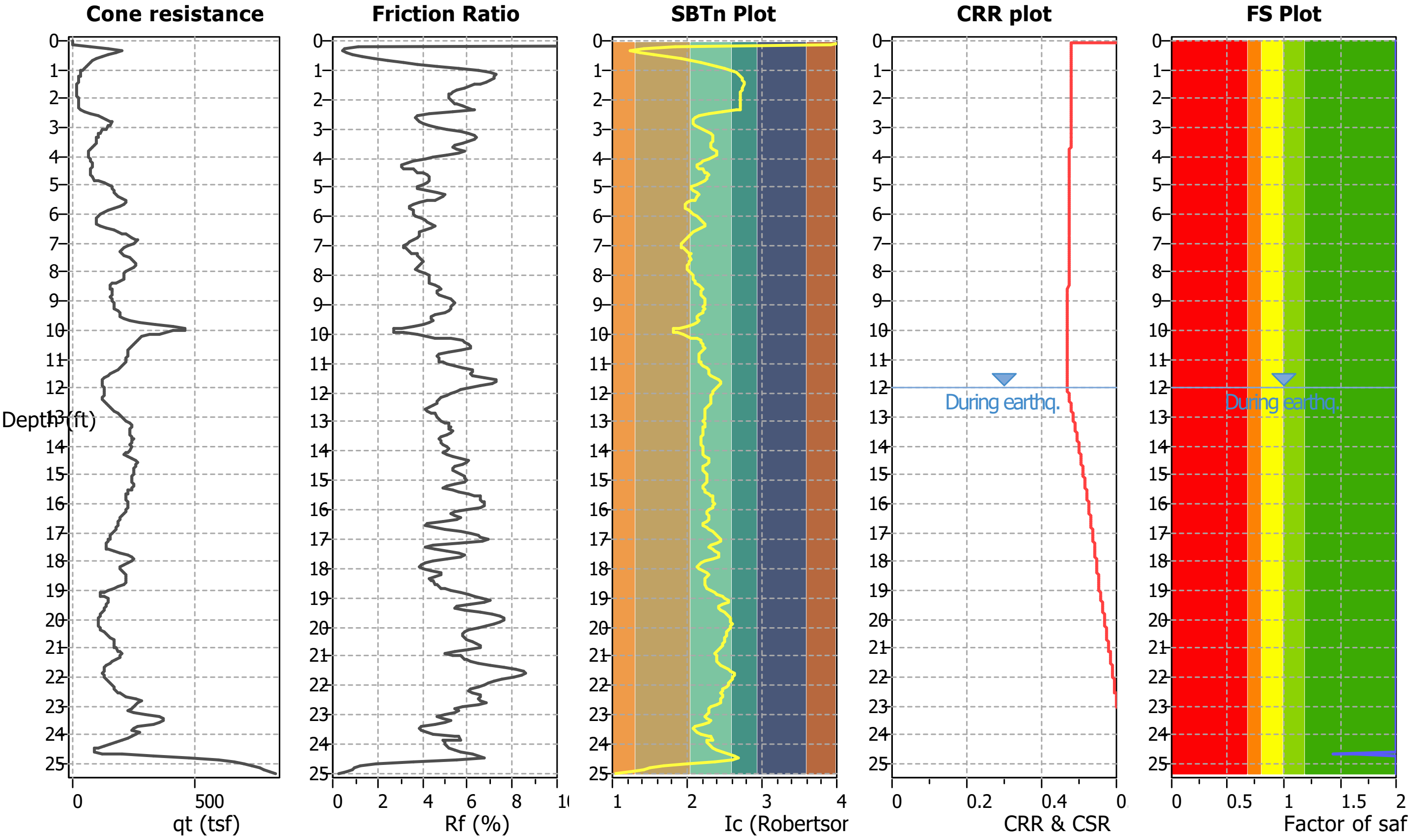
LIQUEFACTION ANALYSIS REPORT

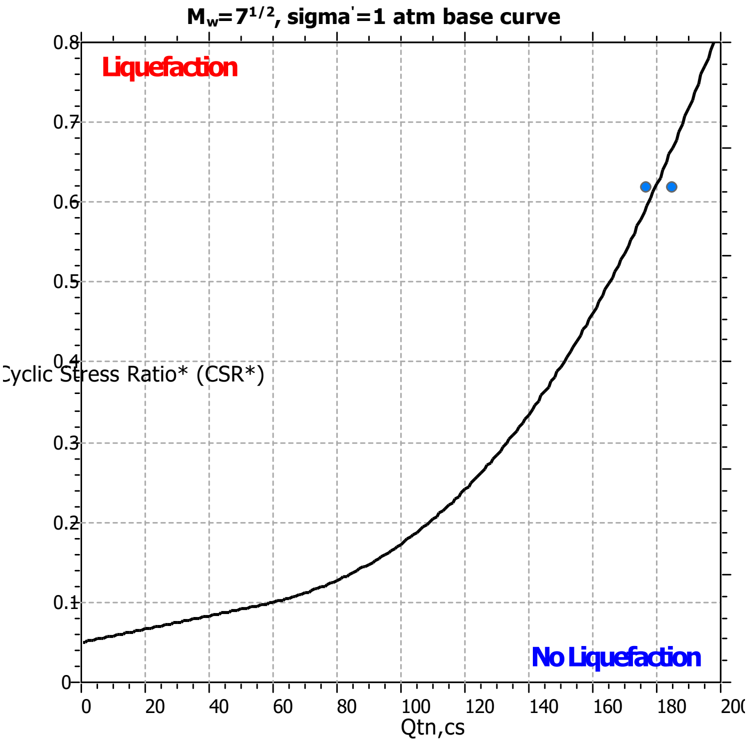
Project title : UHS Inland Valley Reg. Med. Center **Location : 36485 Inland Valley Dr., Wildomar, CA**

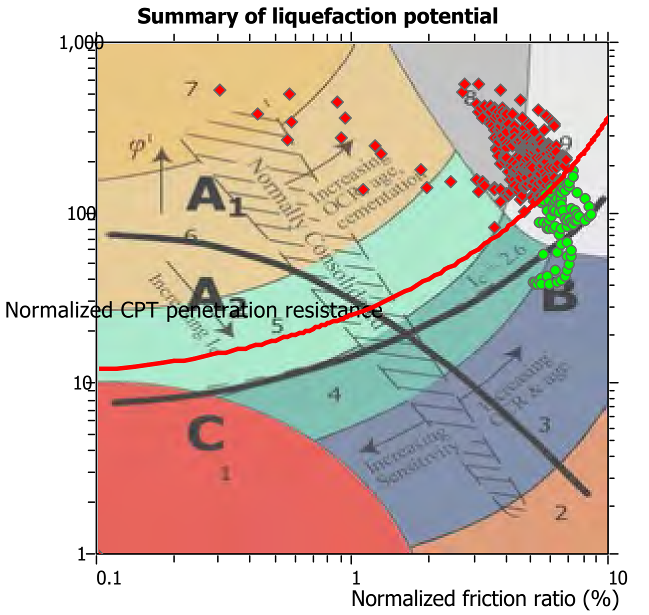
CPT file : CPT-4

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	60.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	12.00 ft	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	40.00 ft
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.40	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.88	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

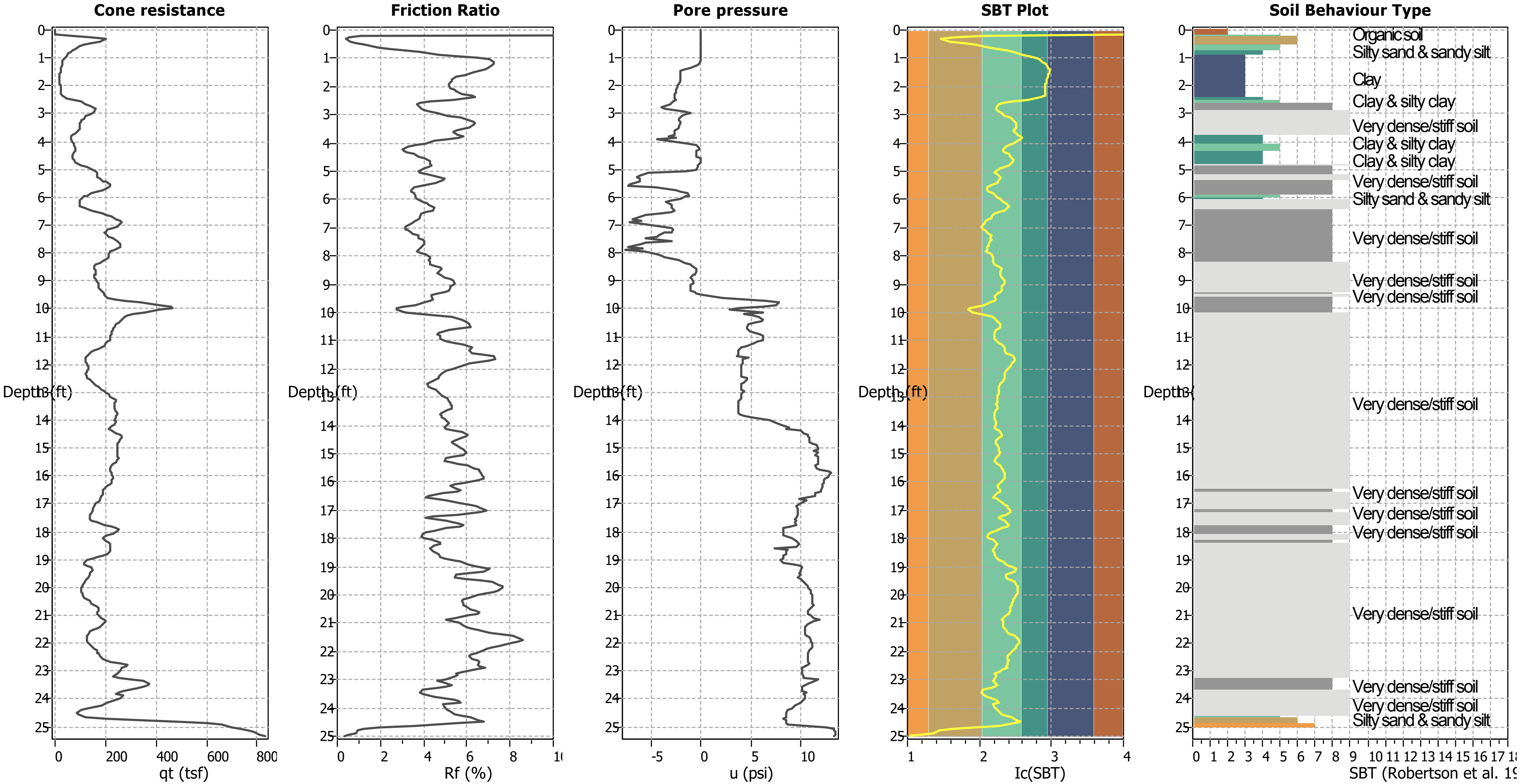






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



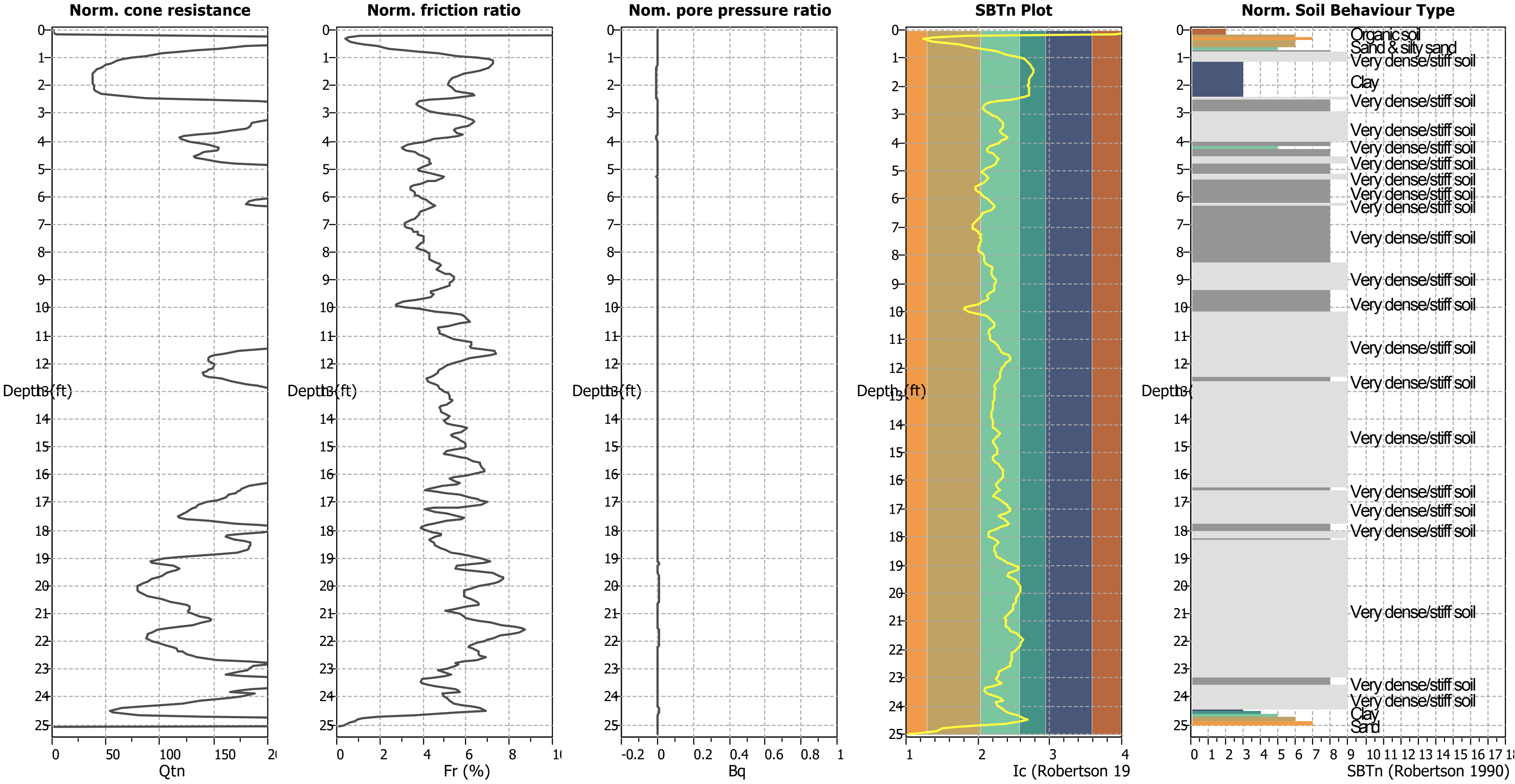
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

SBT 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

CPT basic interpretation plots (normalized)



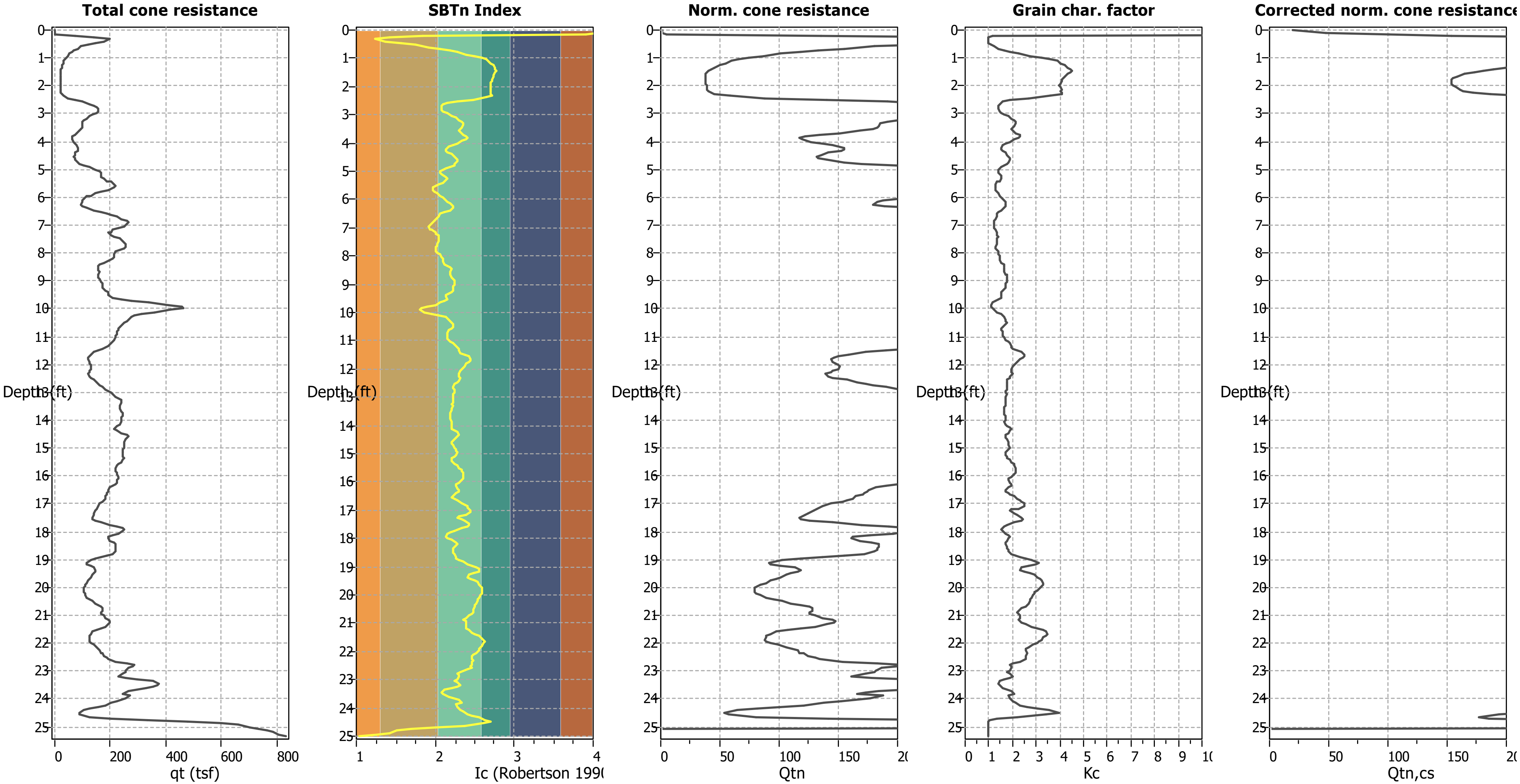
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

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

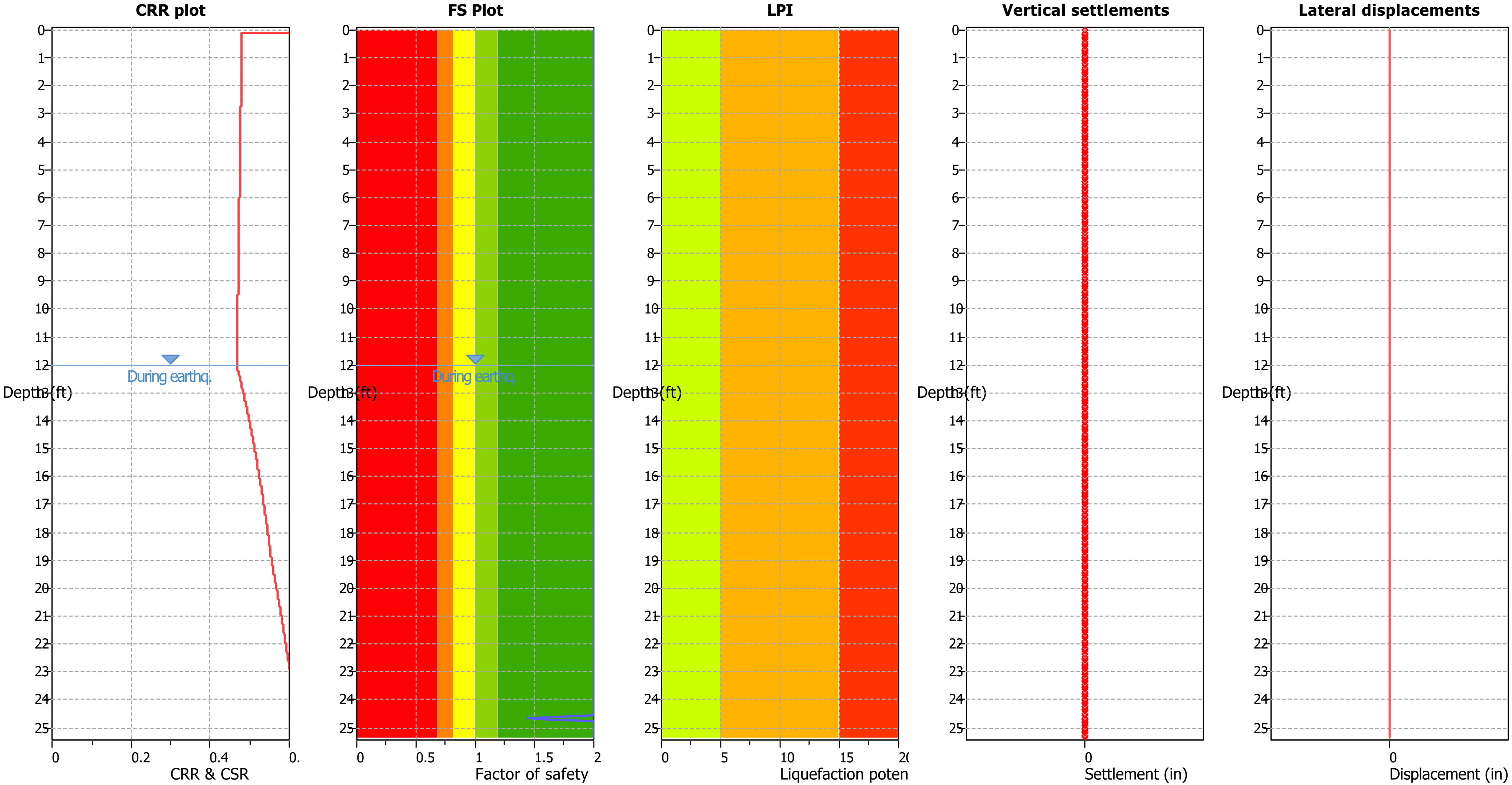
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

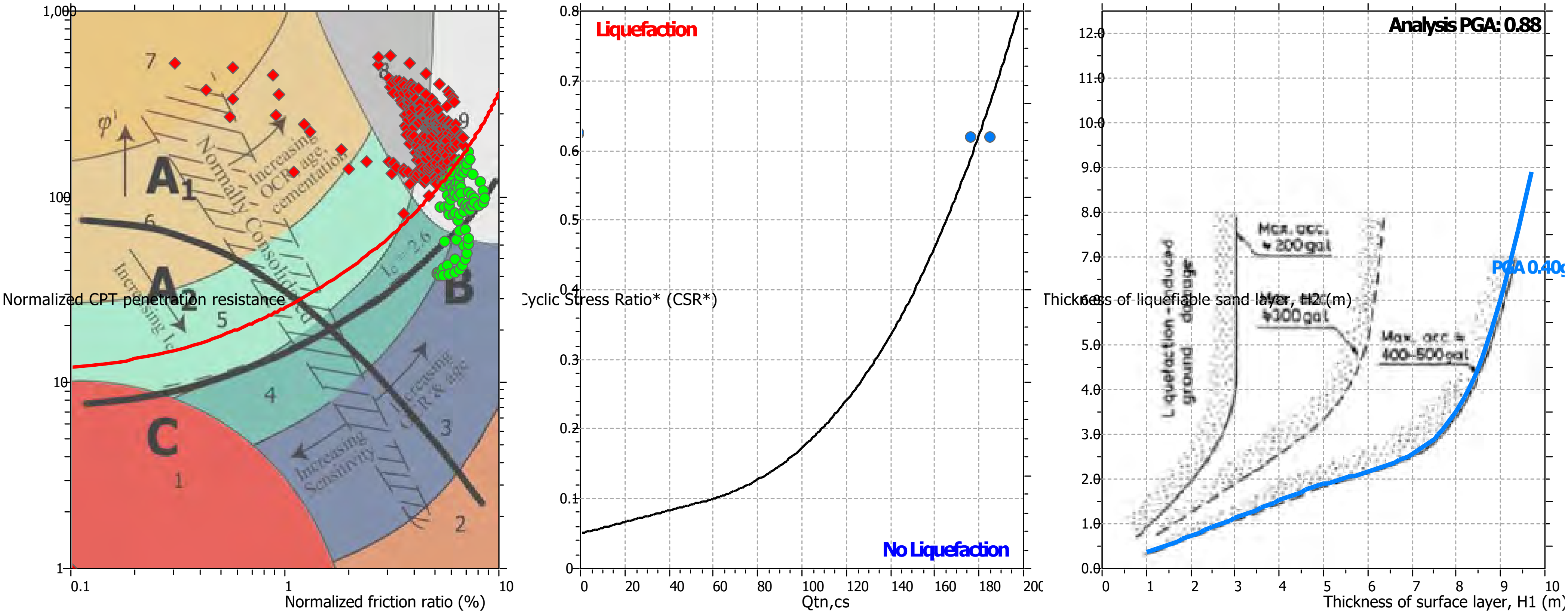
F.S. color scheme

- 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

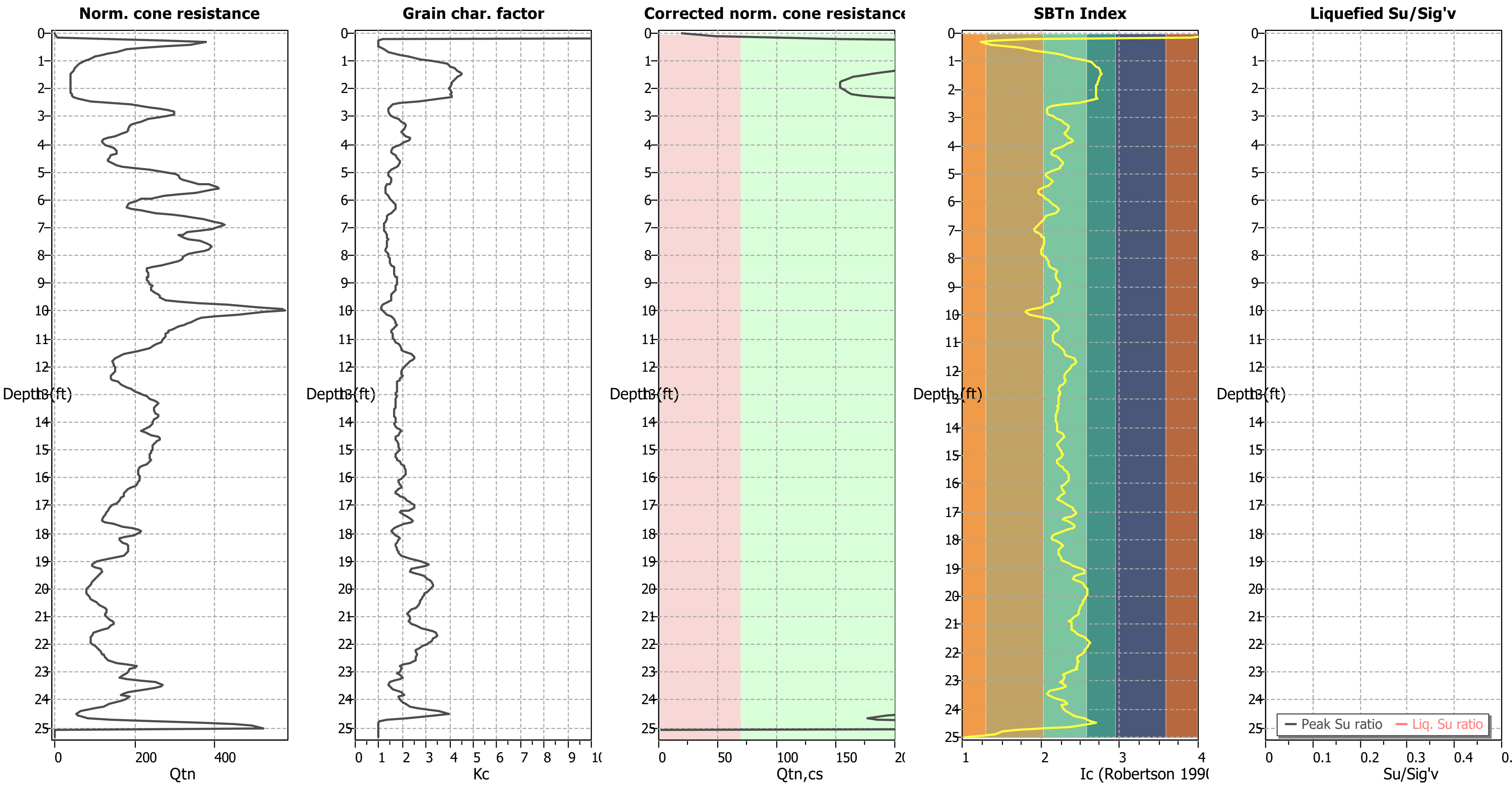
Liquefaction analysis summary plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

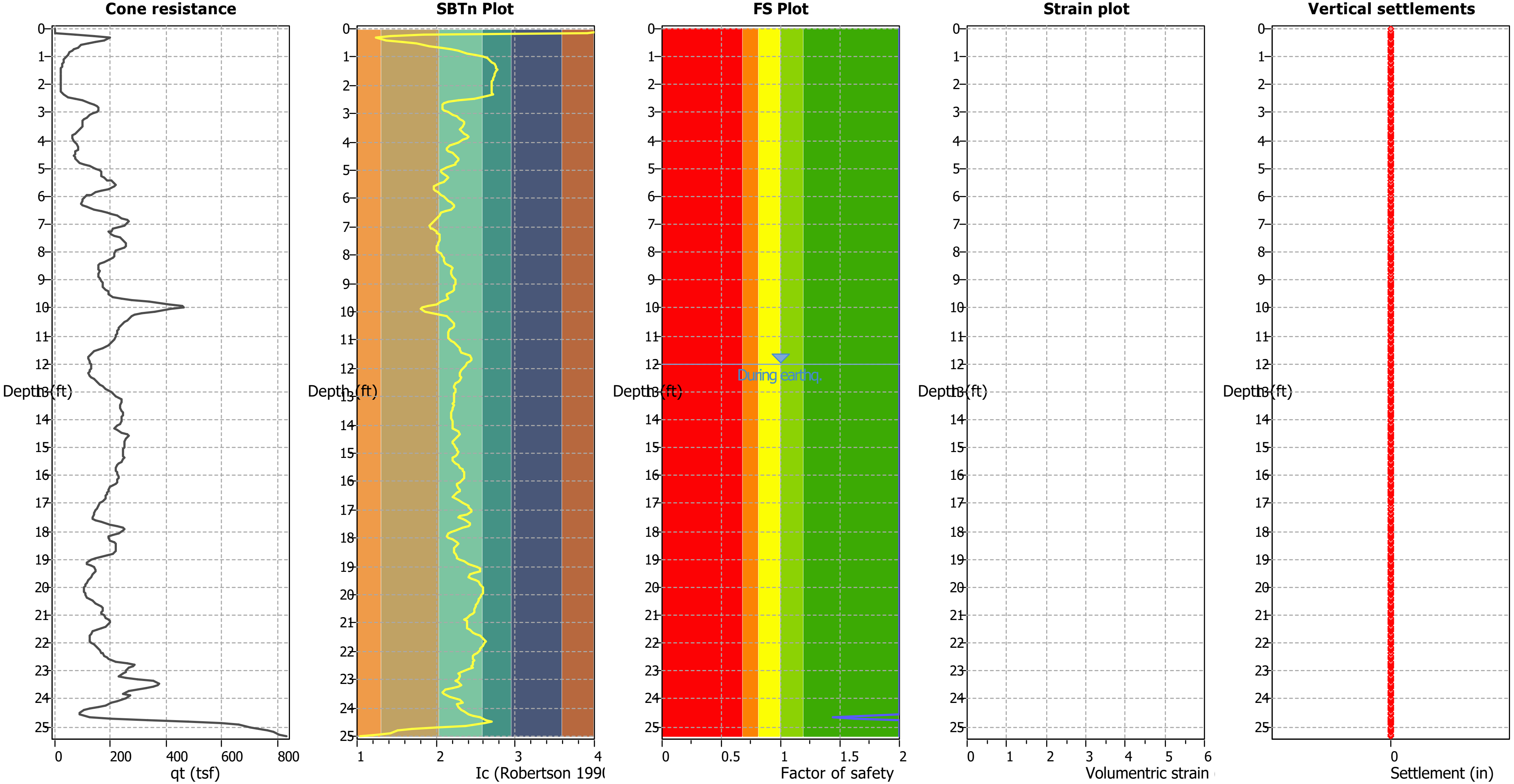
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

Estimation of post-earthquake settlements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
FS: Calculated Factor of Safety against liquefaction
Volumentric strain: Post-liquefaction volumentric strain

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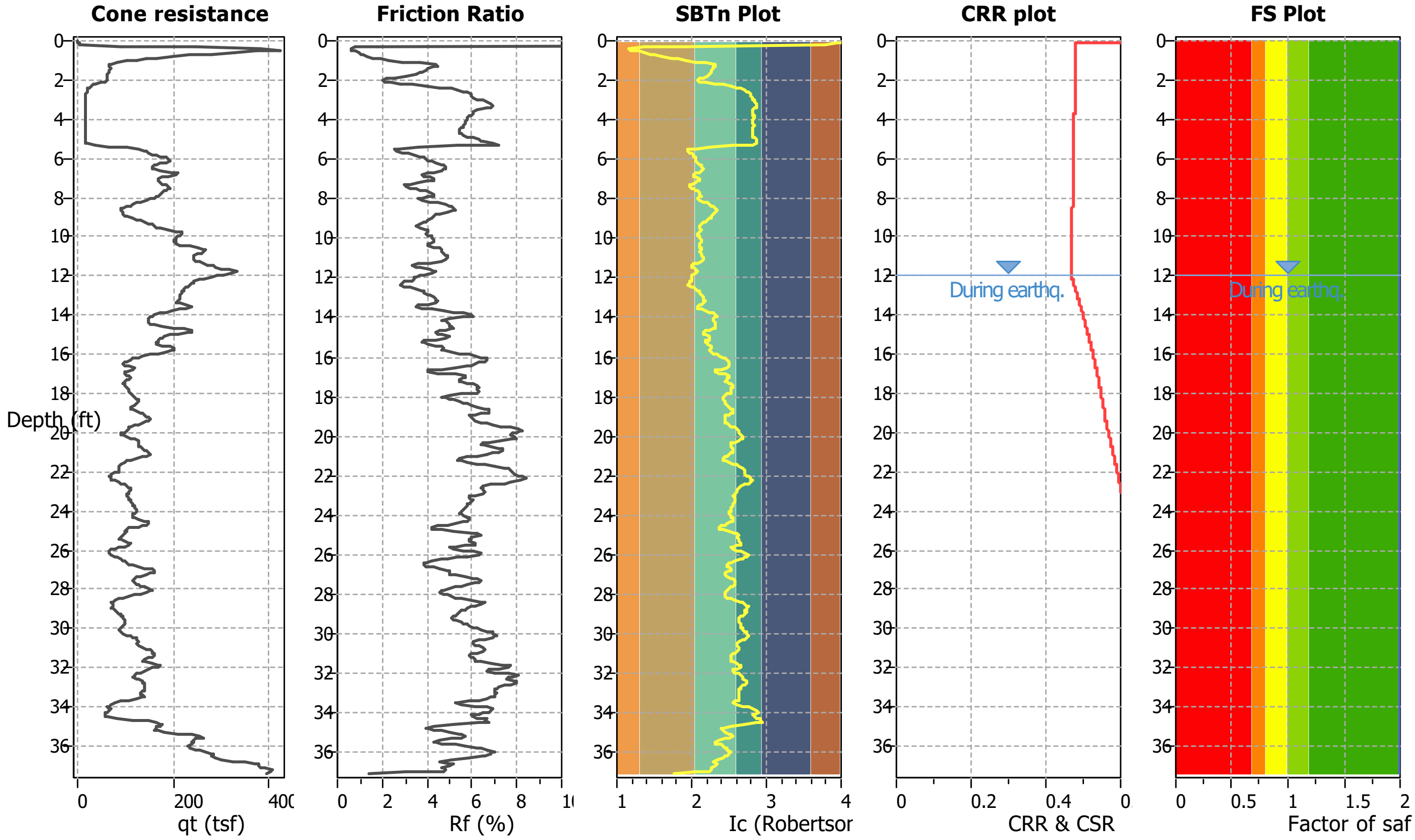
LIQUEFACTION ANALYSIS REPORT

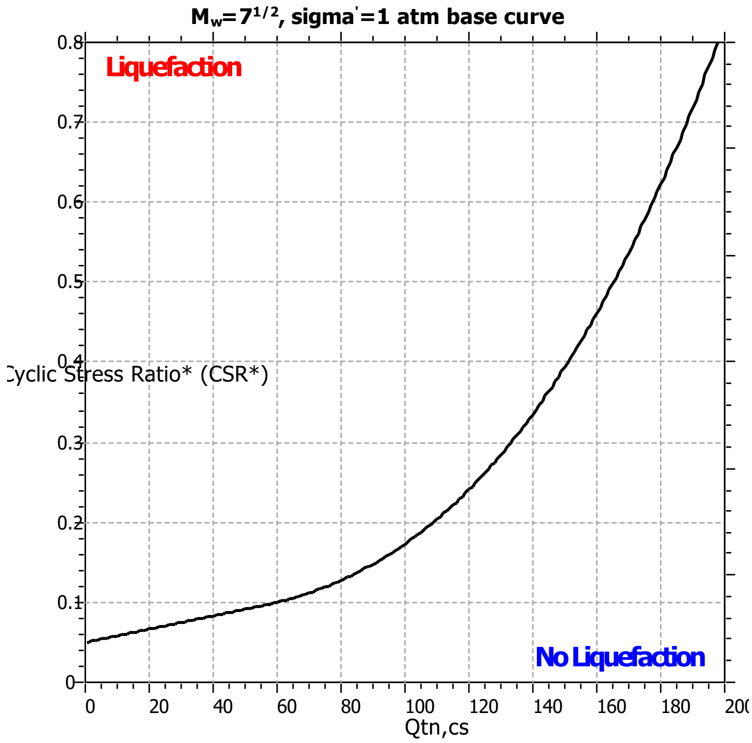
Project title : UHS Inland Valley Reg. Med. Center **Location : 36485 Inland Valley Dr., Wildomar, CA**

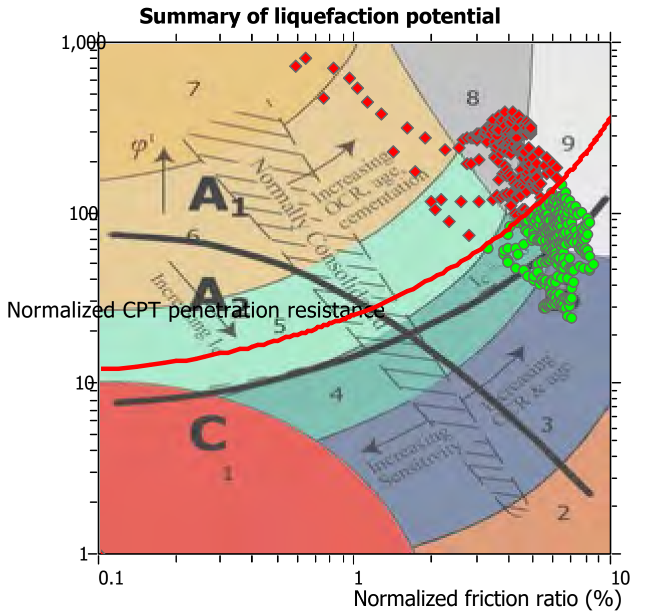
CPT file : CPT-5

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	60.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	12.00 ft	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	40.00 ft
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.40	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.88	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

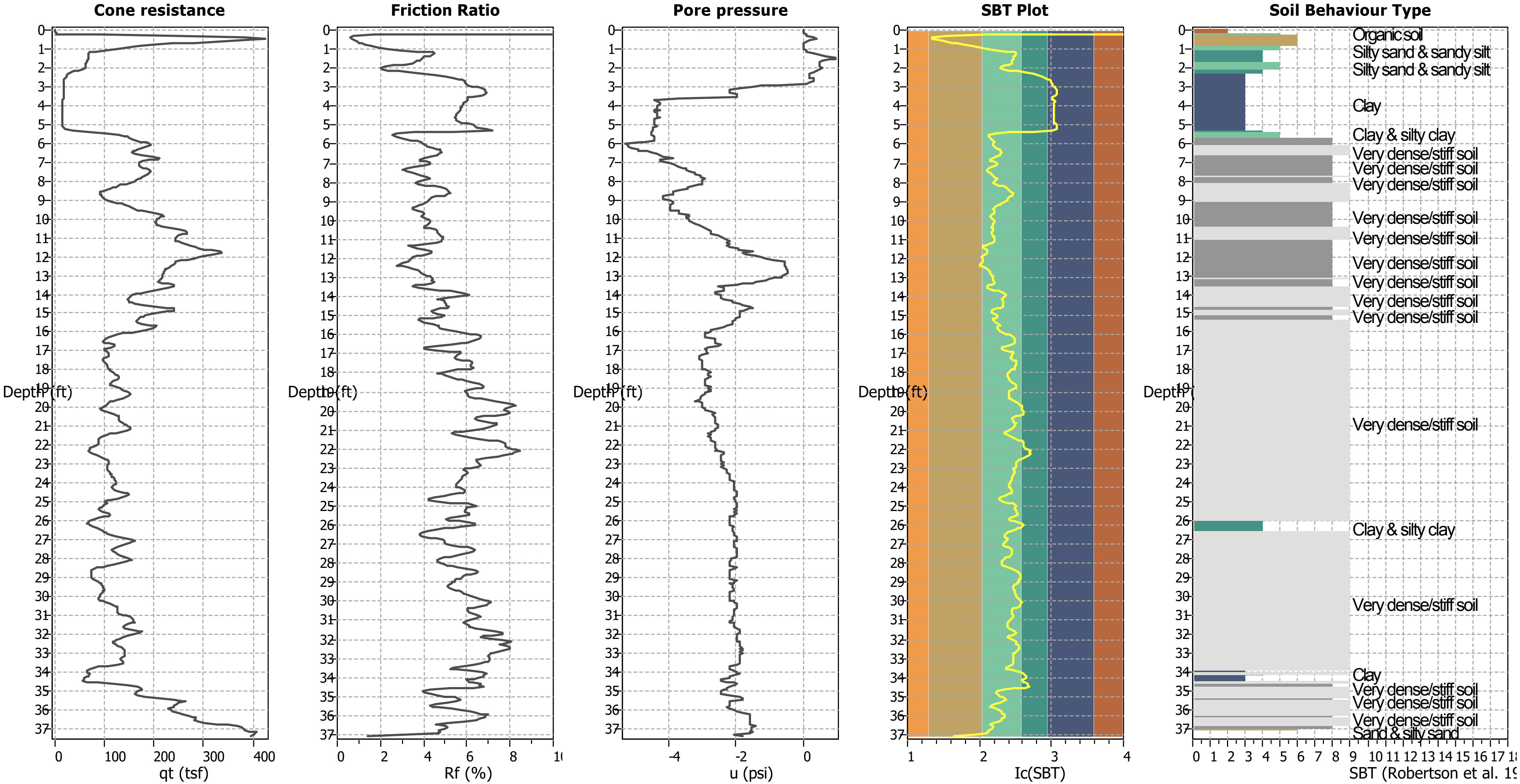






Zone A_1 : Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



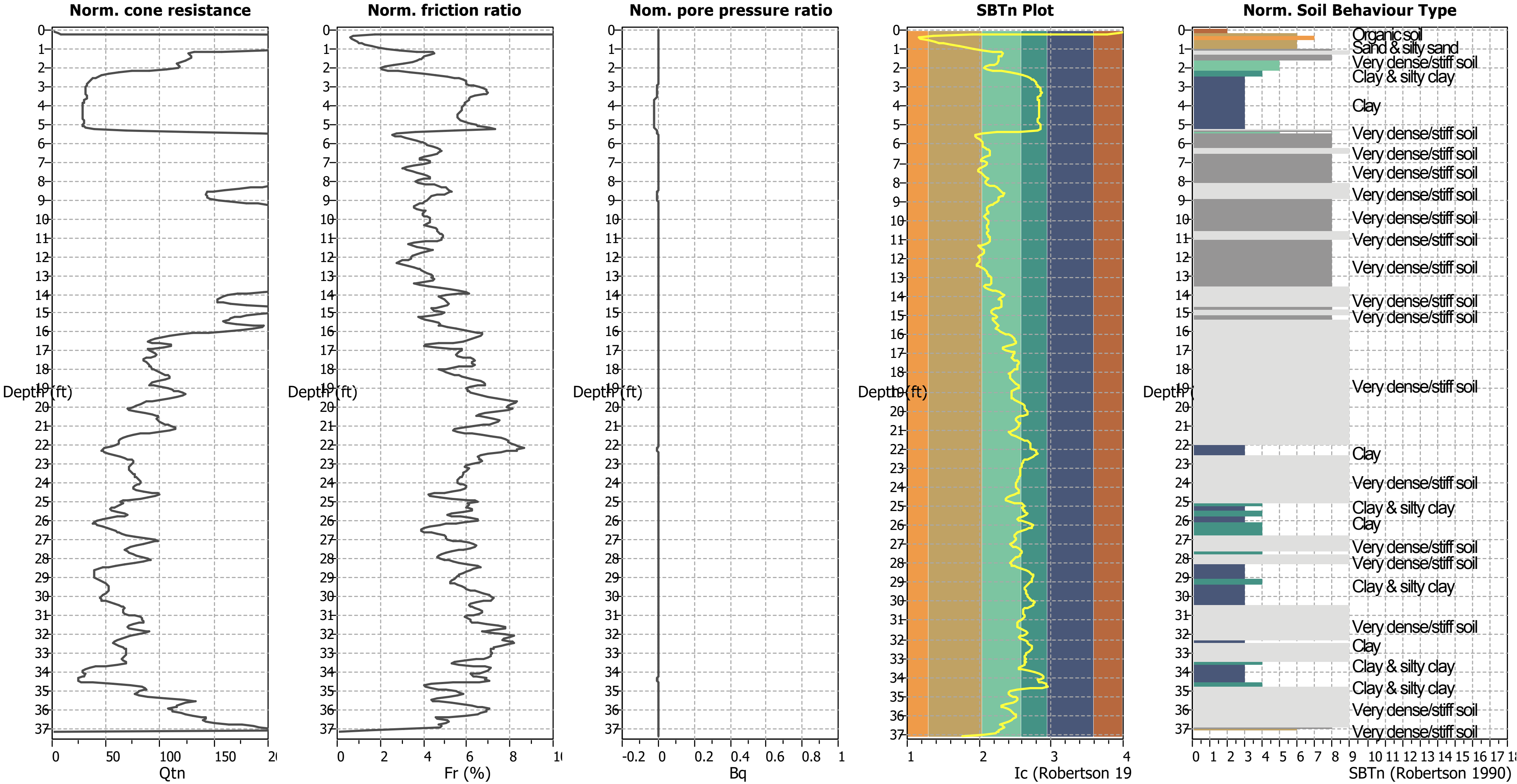
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

SBT 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

CPT basic interpretation plots (normalized)



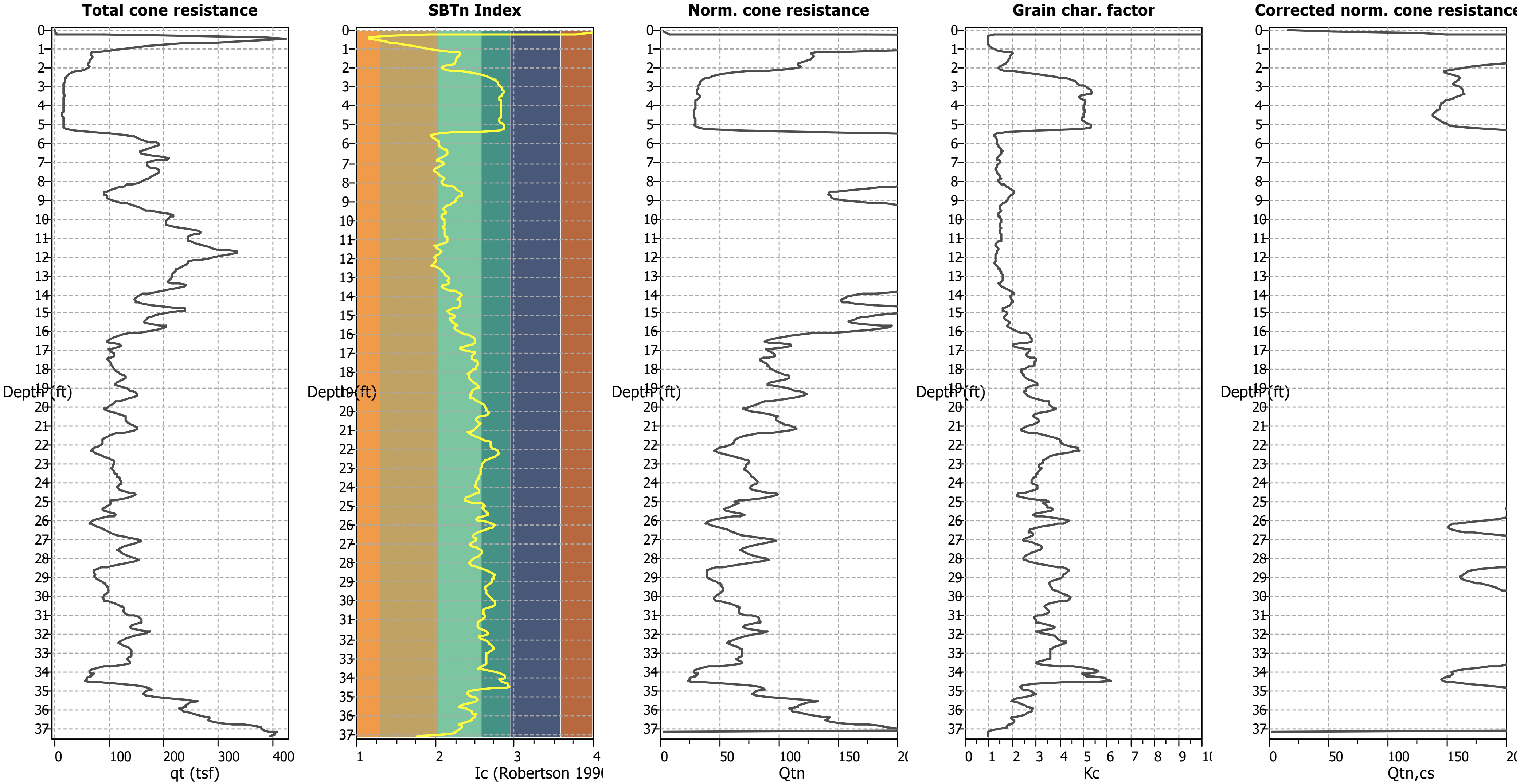
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

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

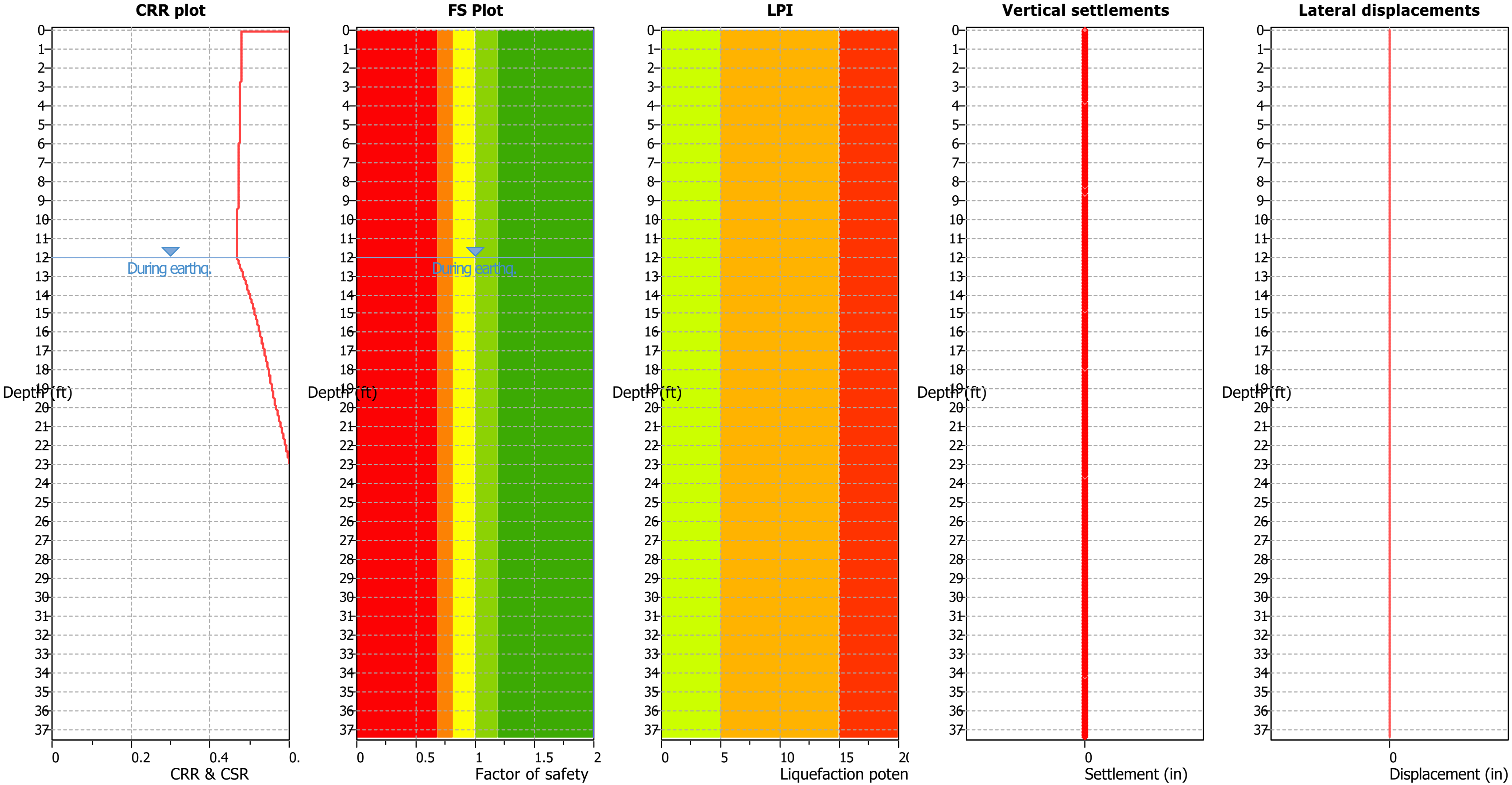
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

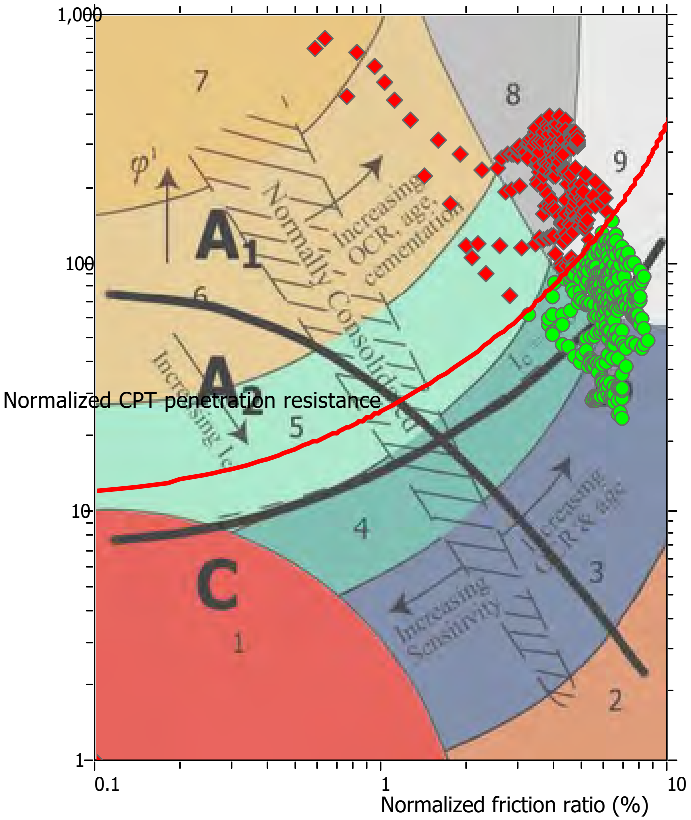
F.S. color scheme

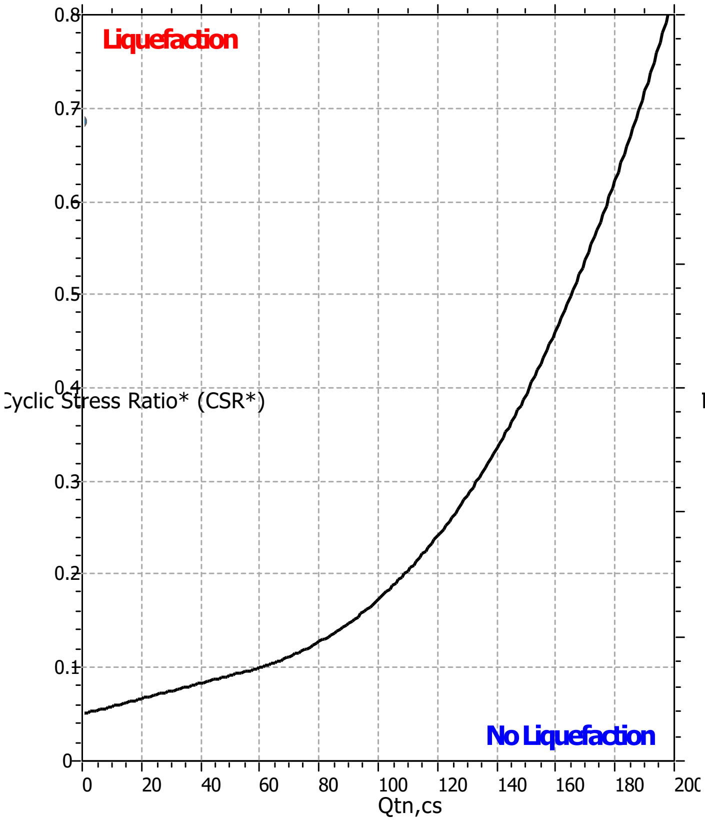
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

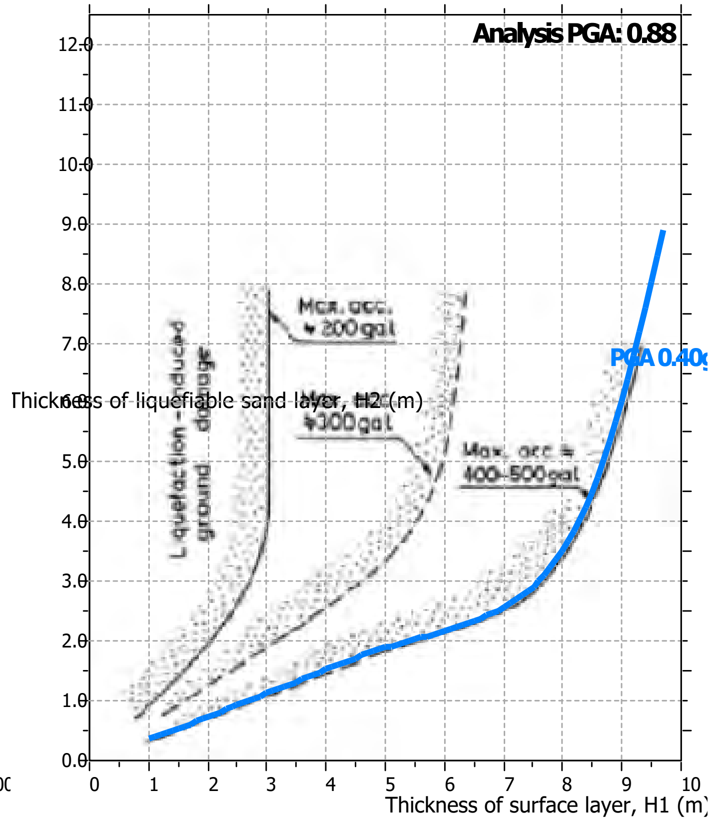
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



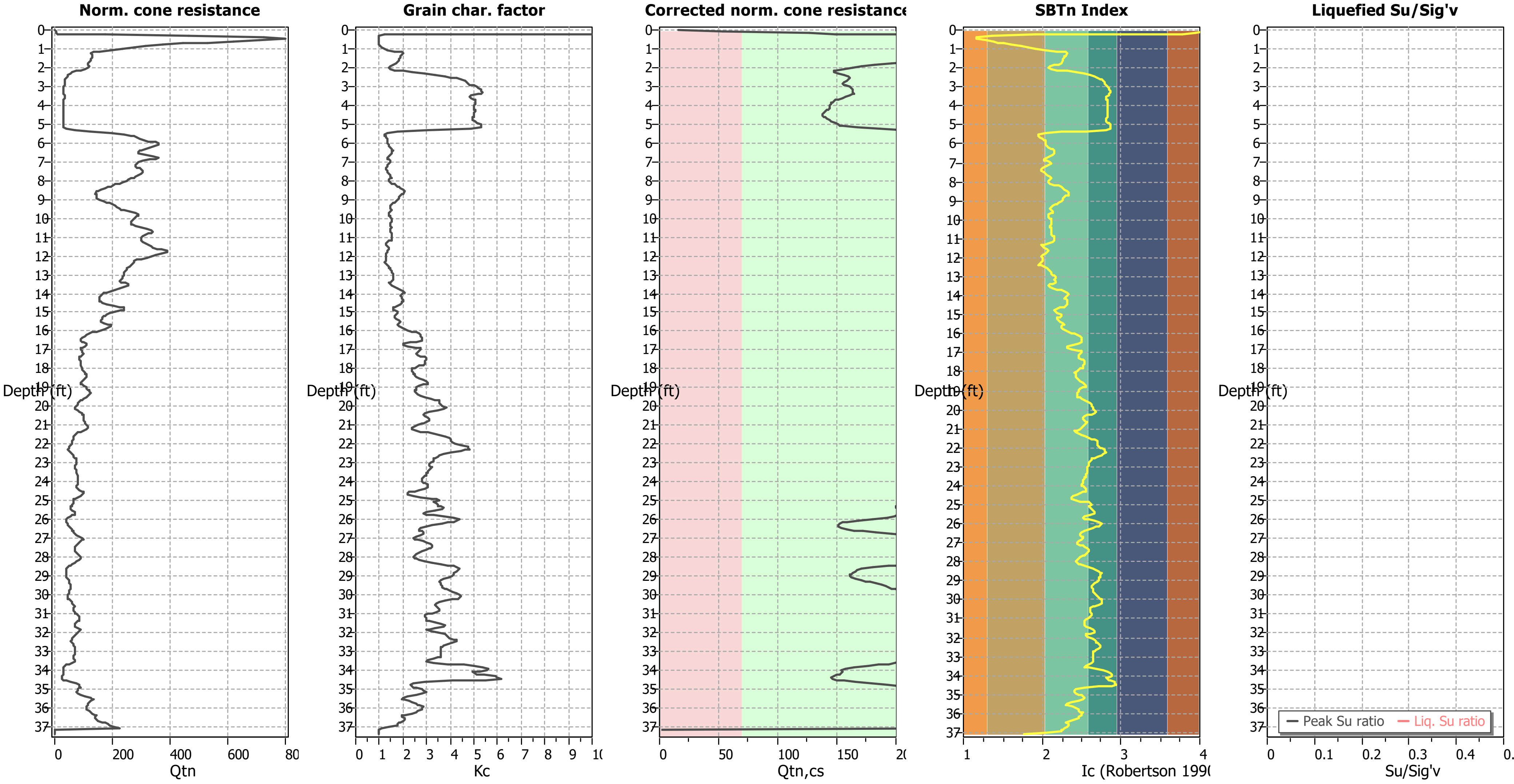




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

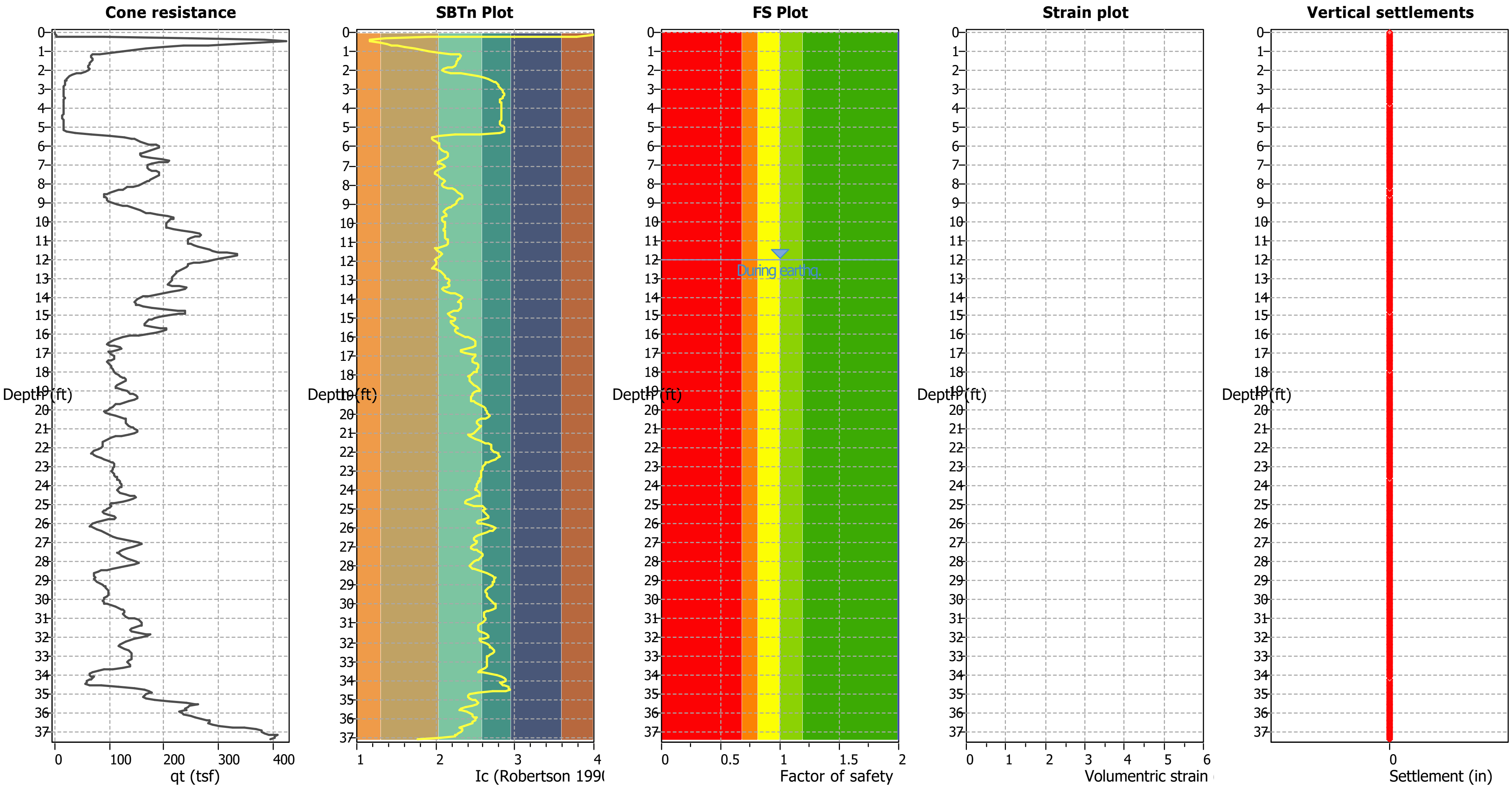
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

Estimation of post-earthquake settlements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
FS: Calculated Factor of Safety against liquefaction
Volumentric strain: Post-liquefaction volumentric strain

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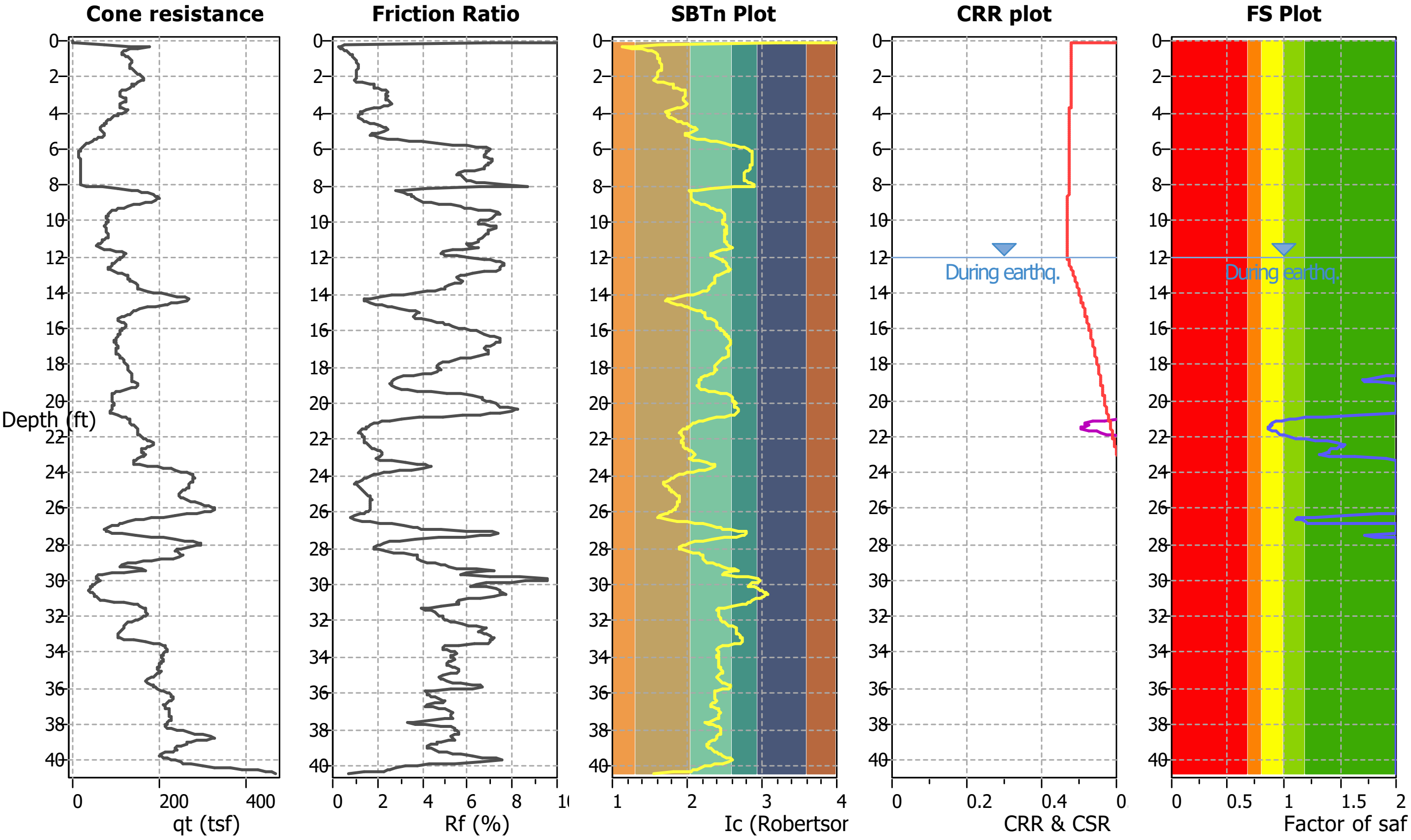
LIQUEFACTION ANALYSIS REPORT

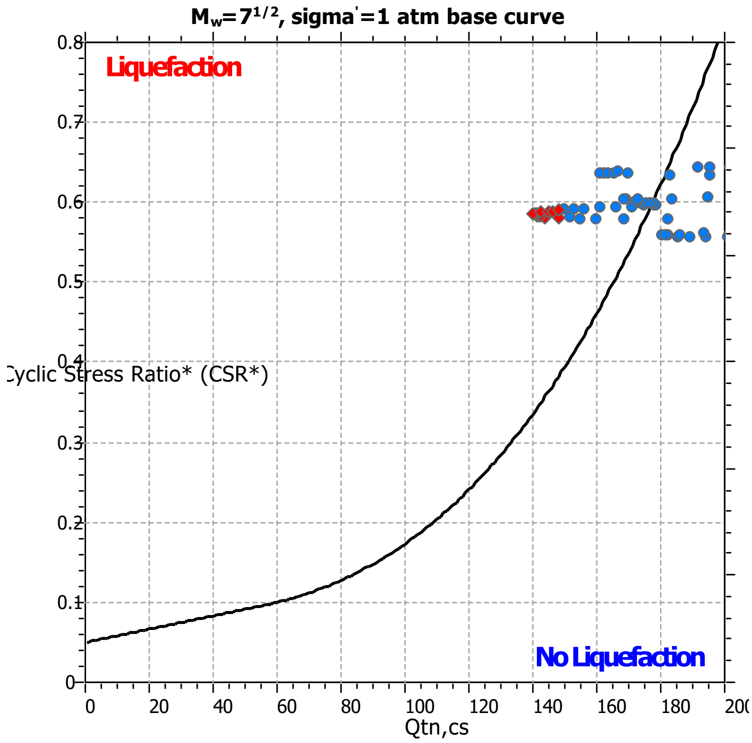
Project title : UHS Inland Valley Reg. Med. Center **Location : 36485 Inland Valley Dr., Wildomar, CA**

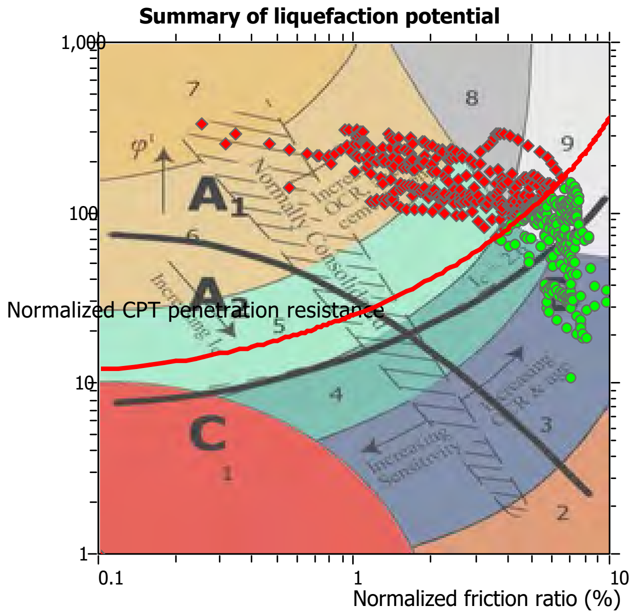
CPT file : CPT-6

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	60.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	12.00 ft	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	40.00 ft
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.40	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.88	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

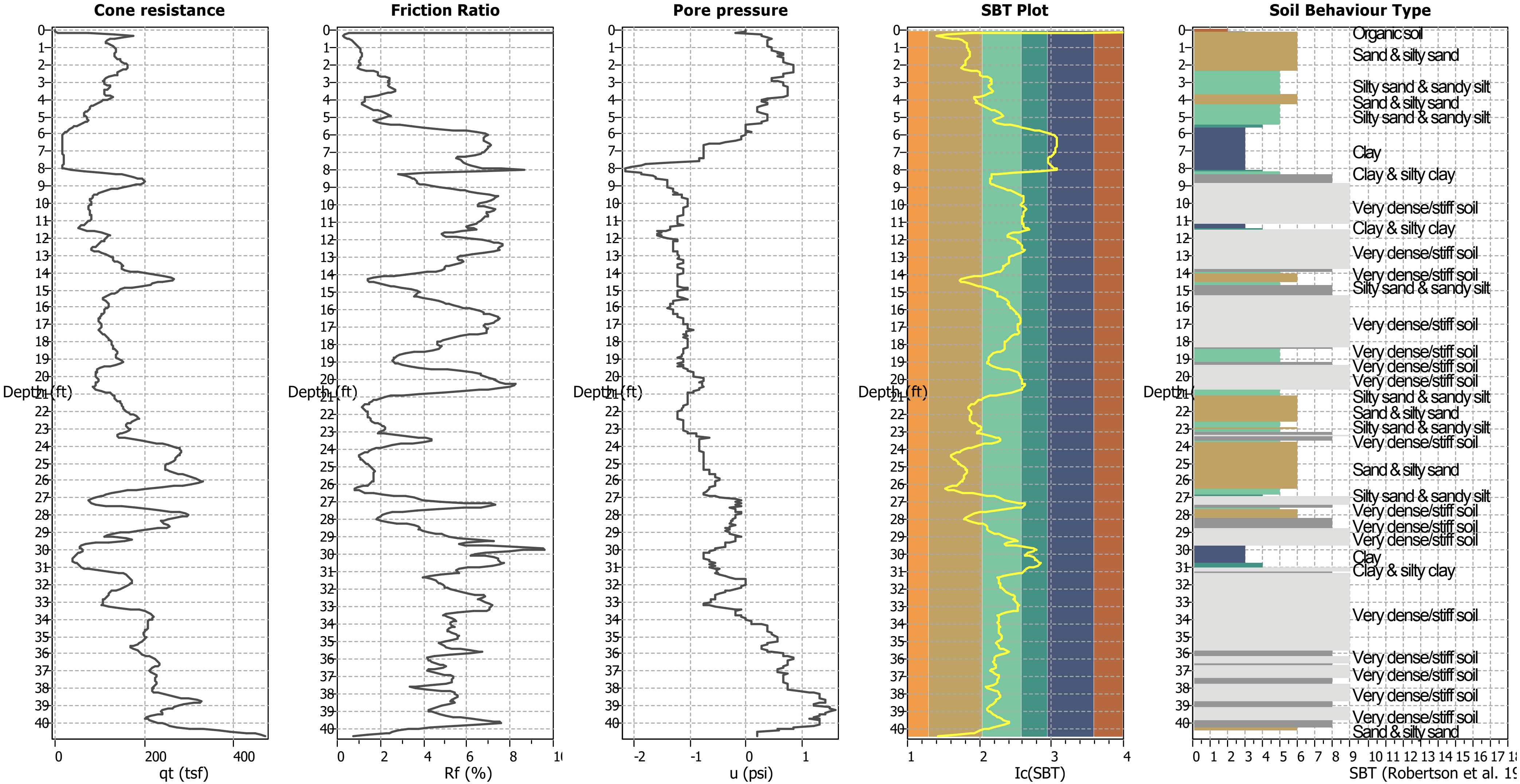






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



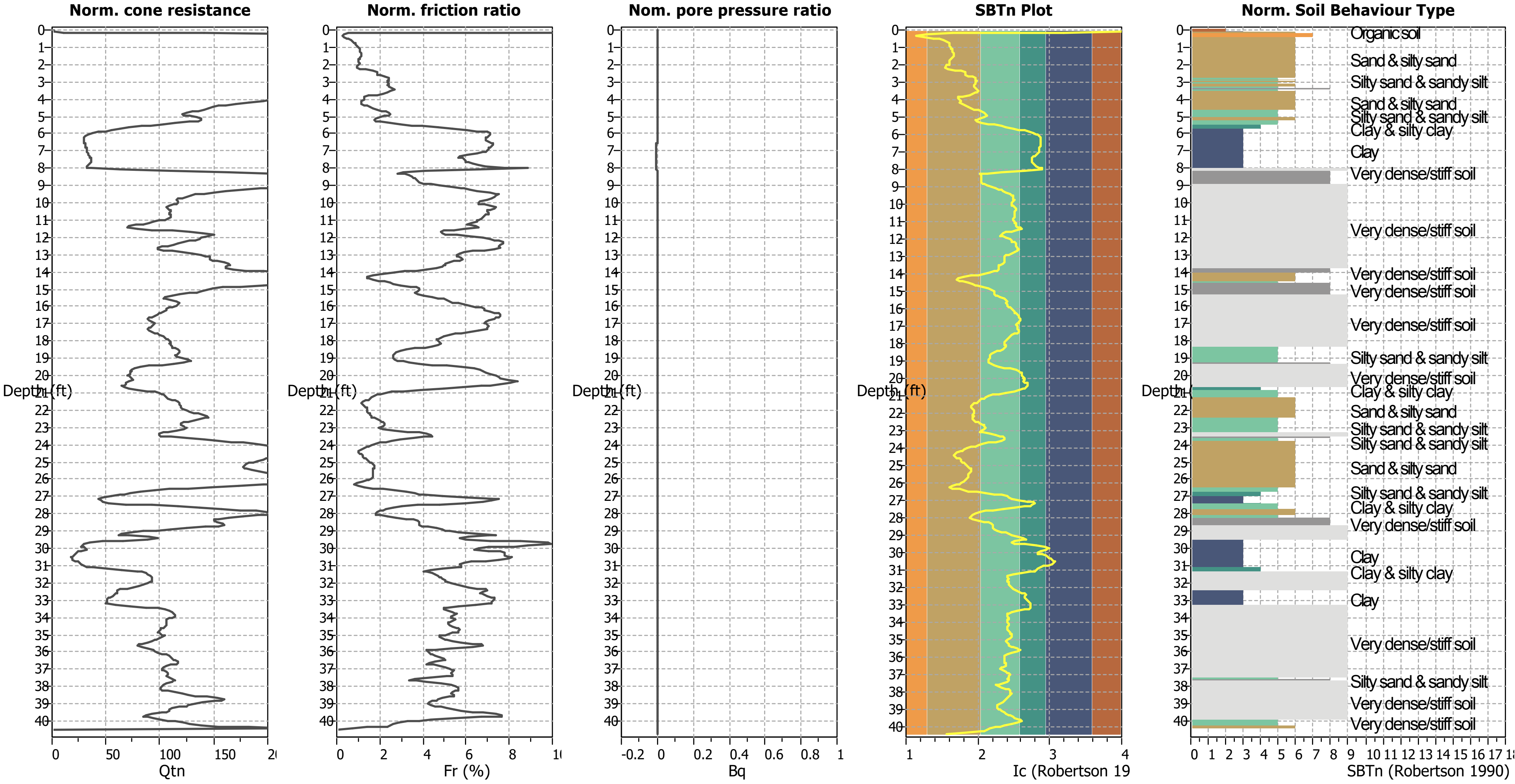
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

SBT 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

CPT basic interpretation plots (normalized)



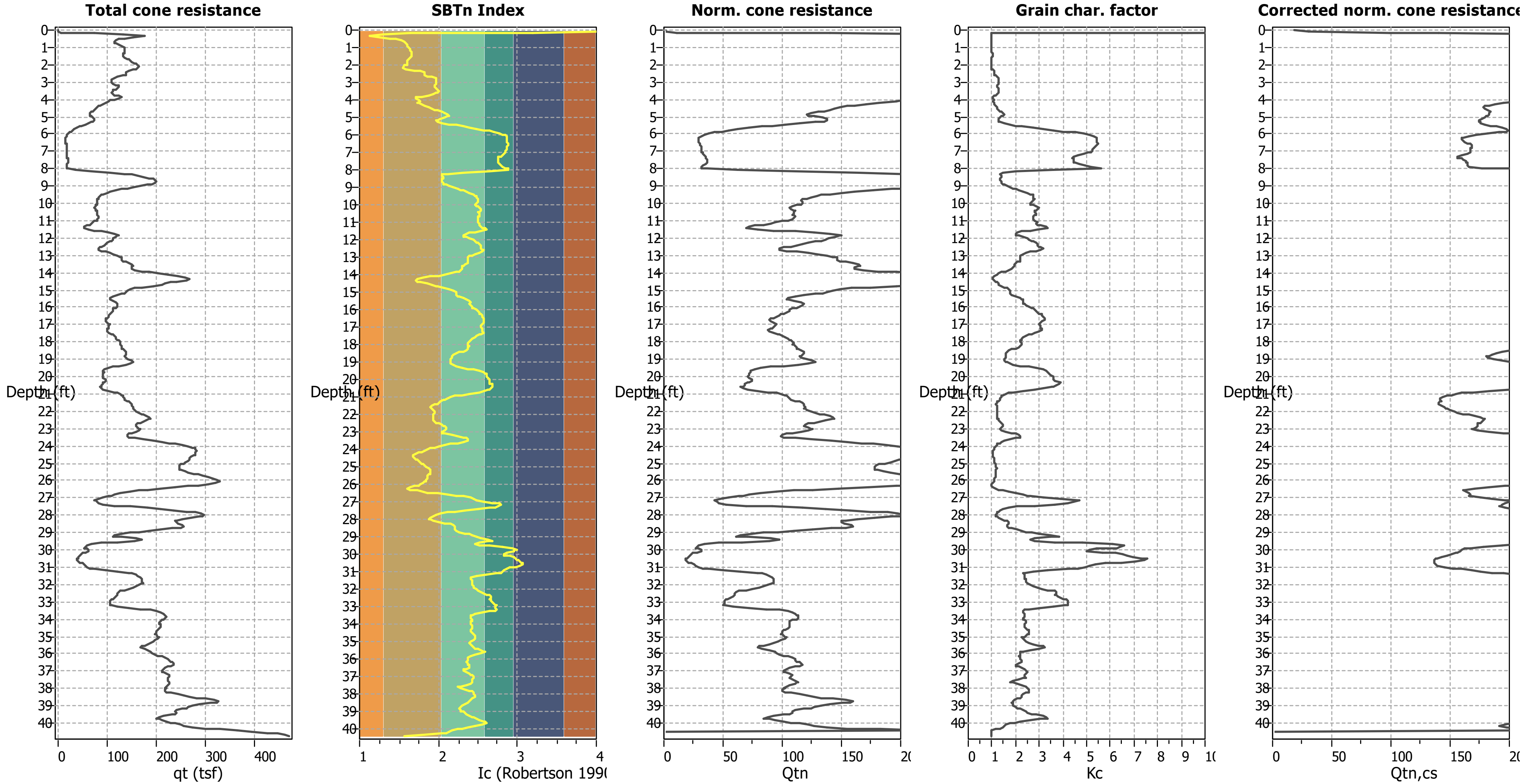
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

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

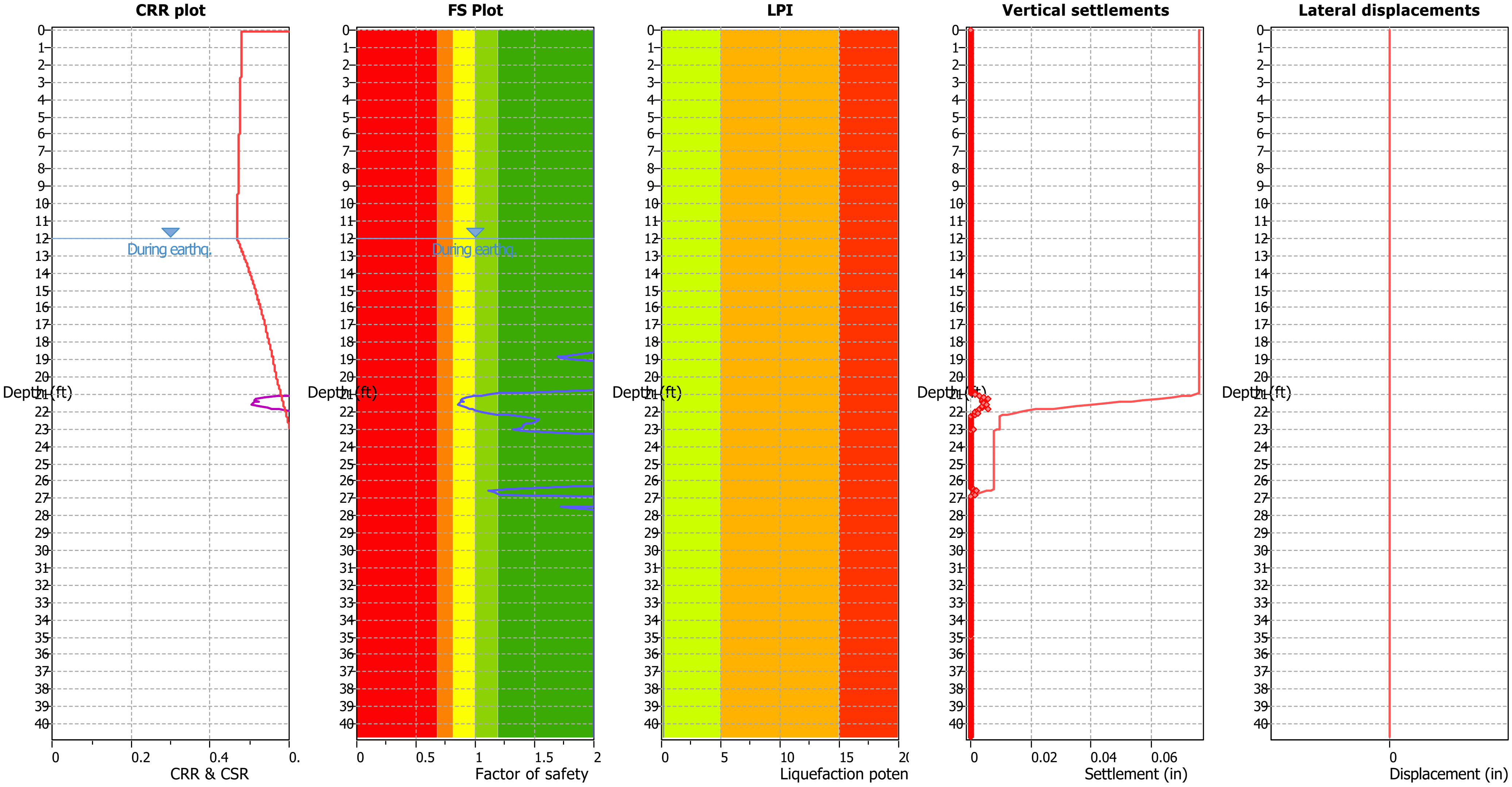
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

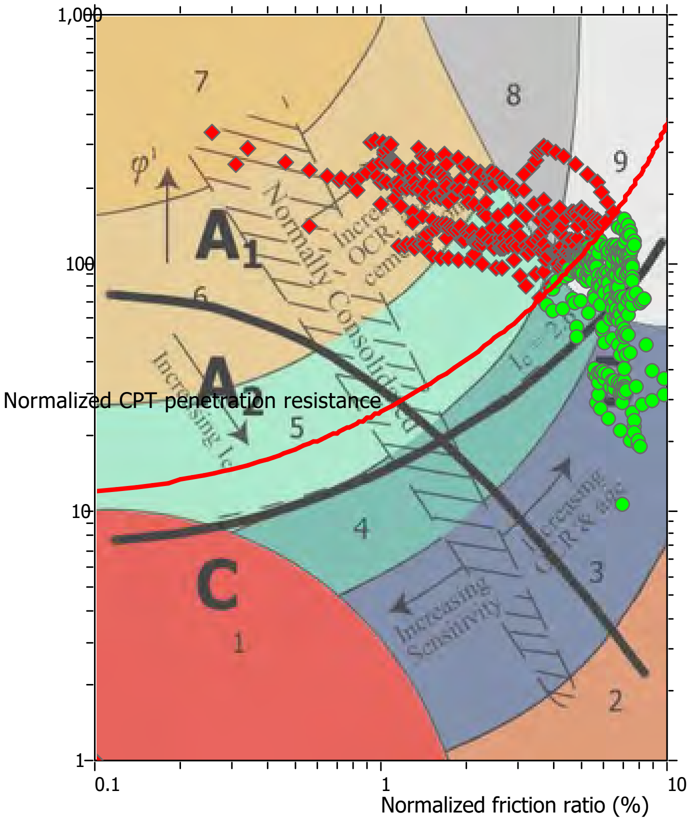
F.S. color scheme

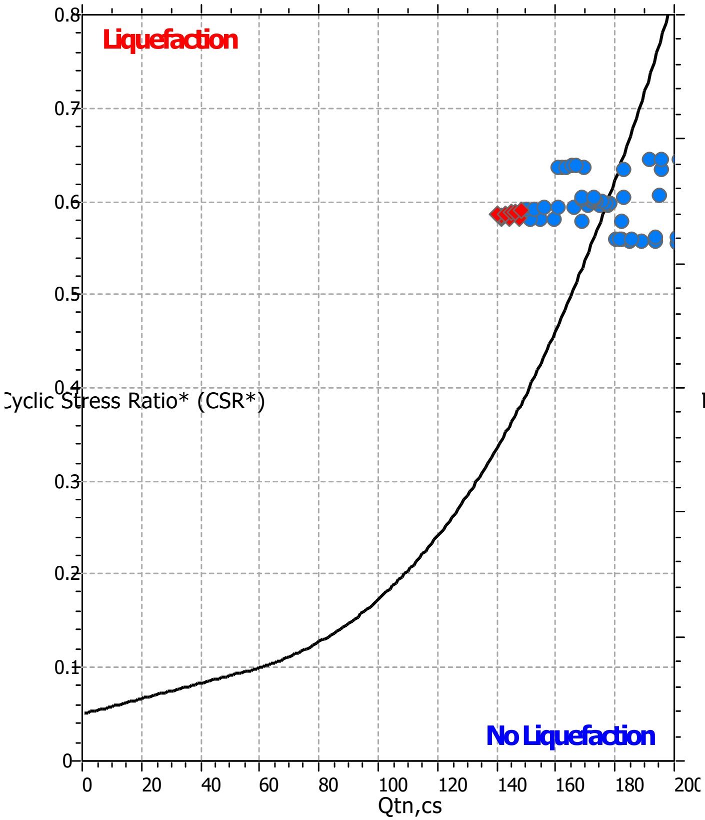
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

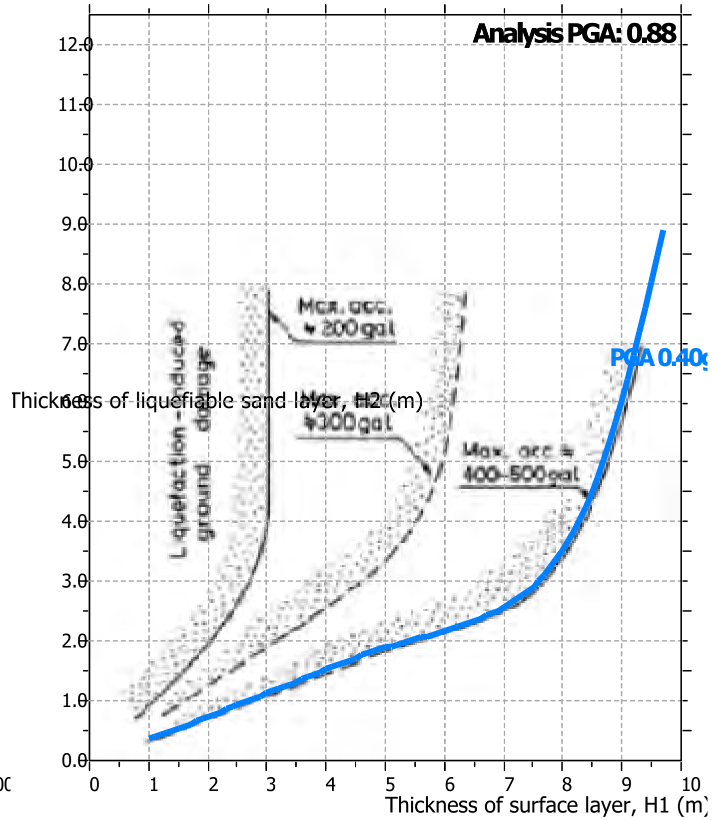
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



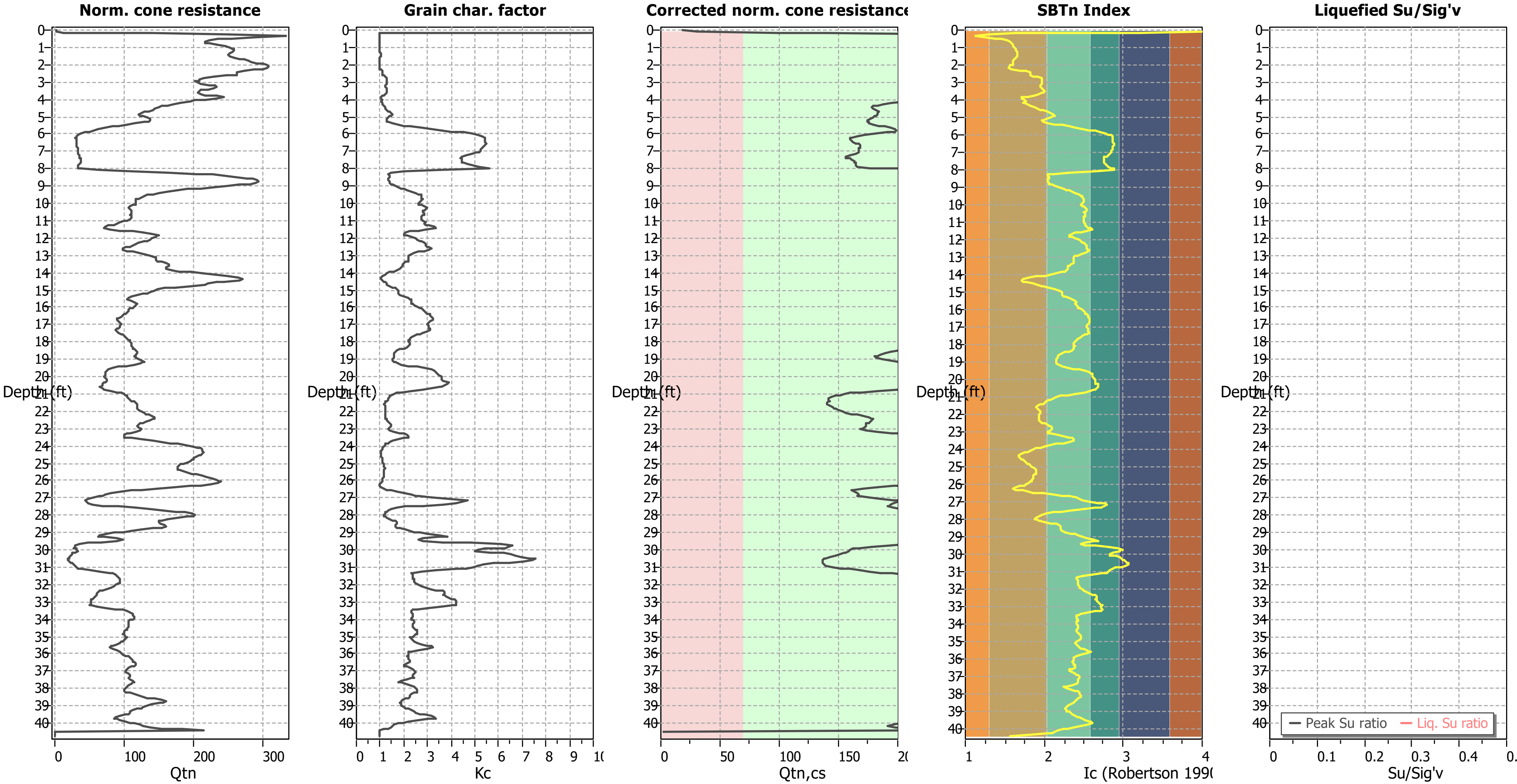




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

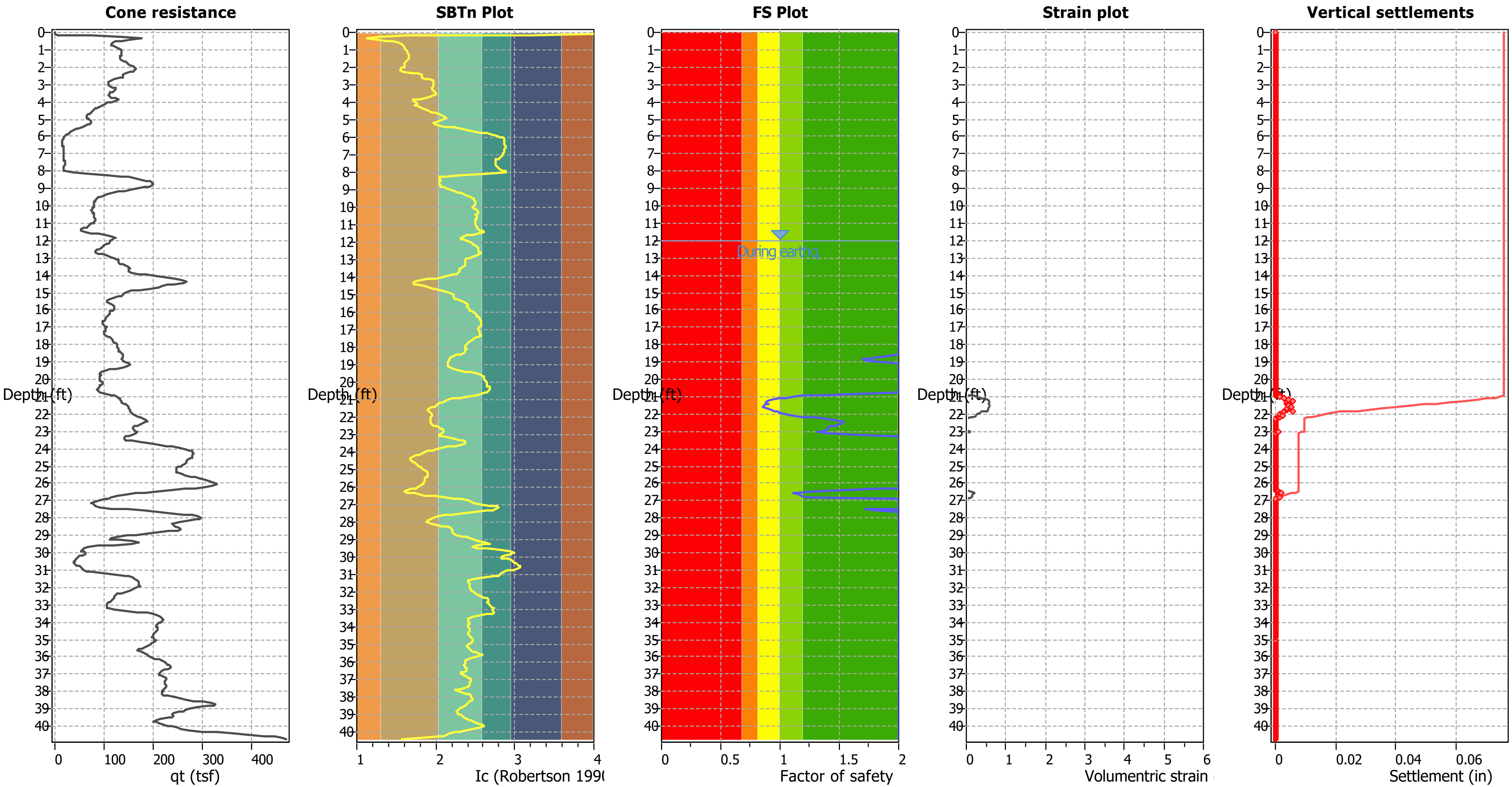
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_{σ} applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

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San Diego, CA 92123
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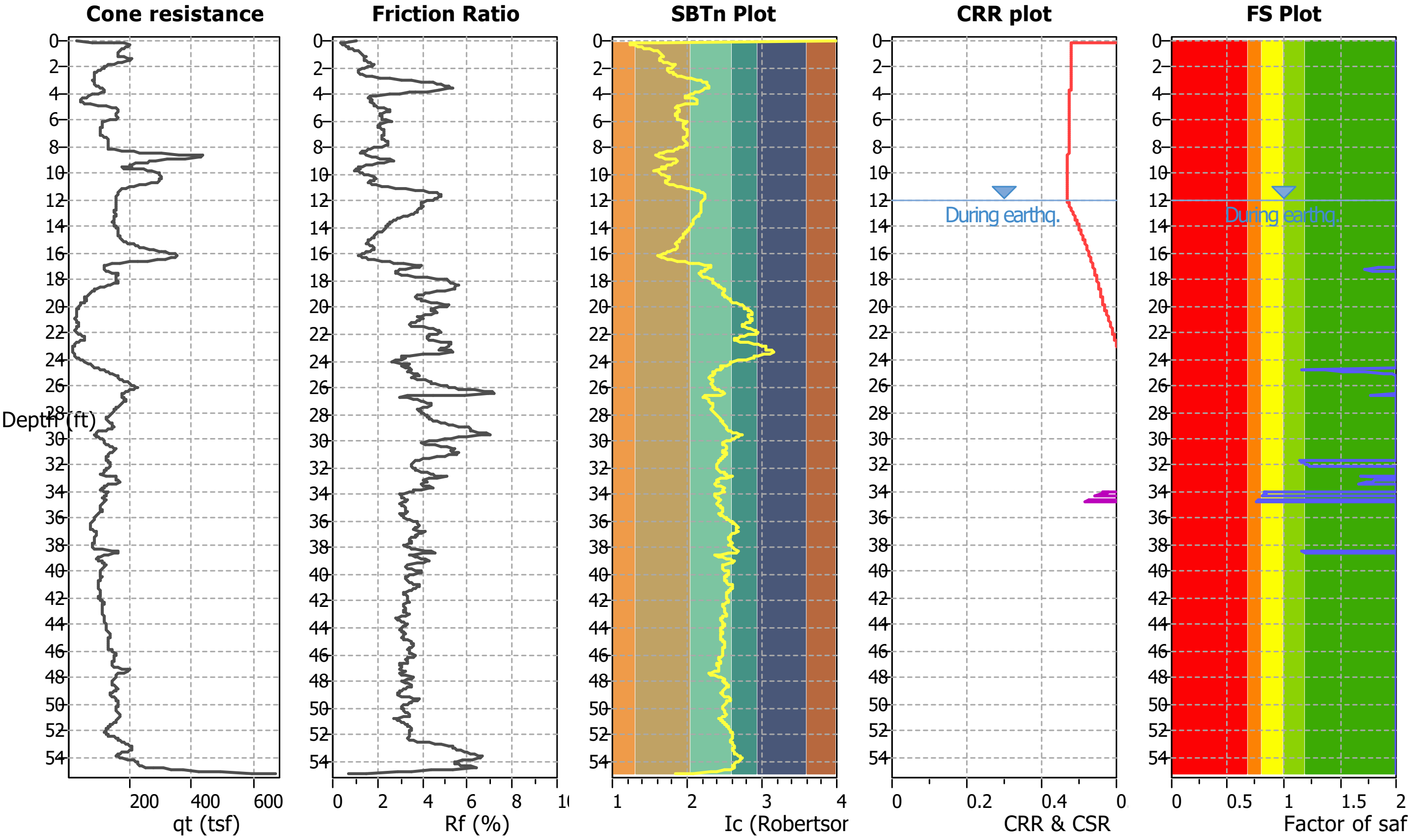
LIQUEFACTION ANALYSIS REPORT

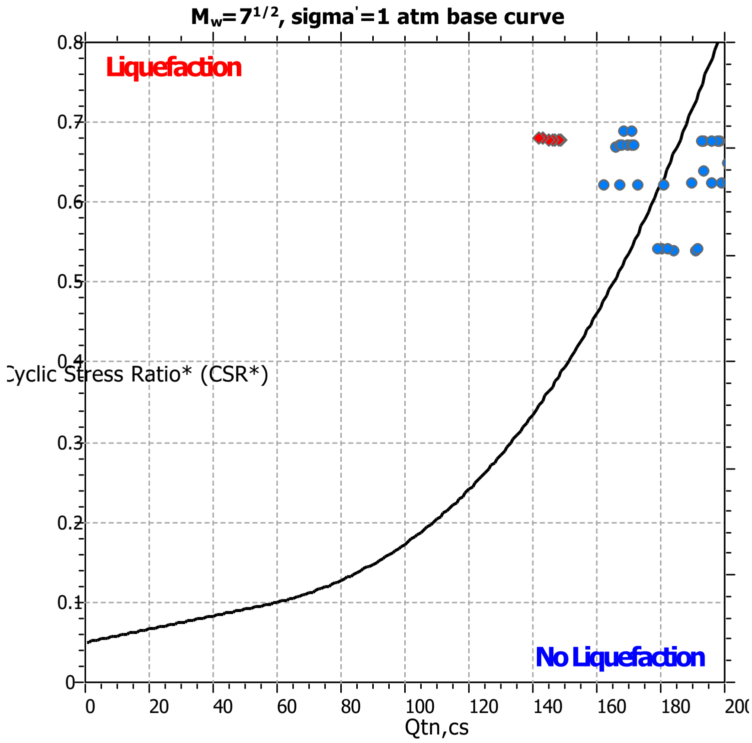
Project title : UHS Inland Valley Reg. Med. Center **Location : 36485 Inland Valley Dr., Wildomar, CA**

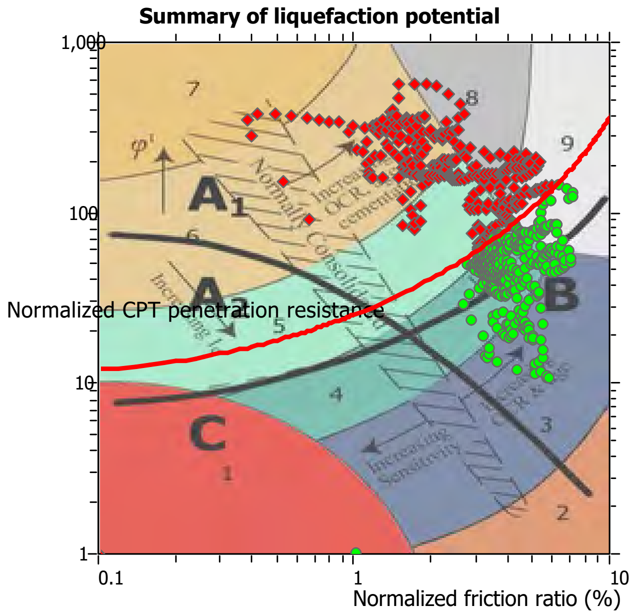
CPT file : CPT-7

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	60.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	12.00 ft	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	40.00 ft
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.40	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.88	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

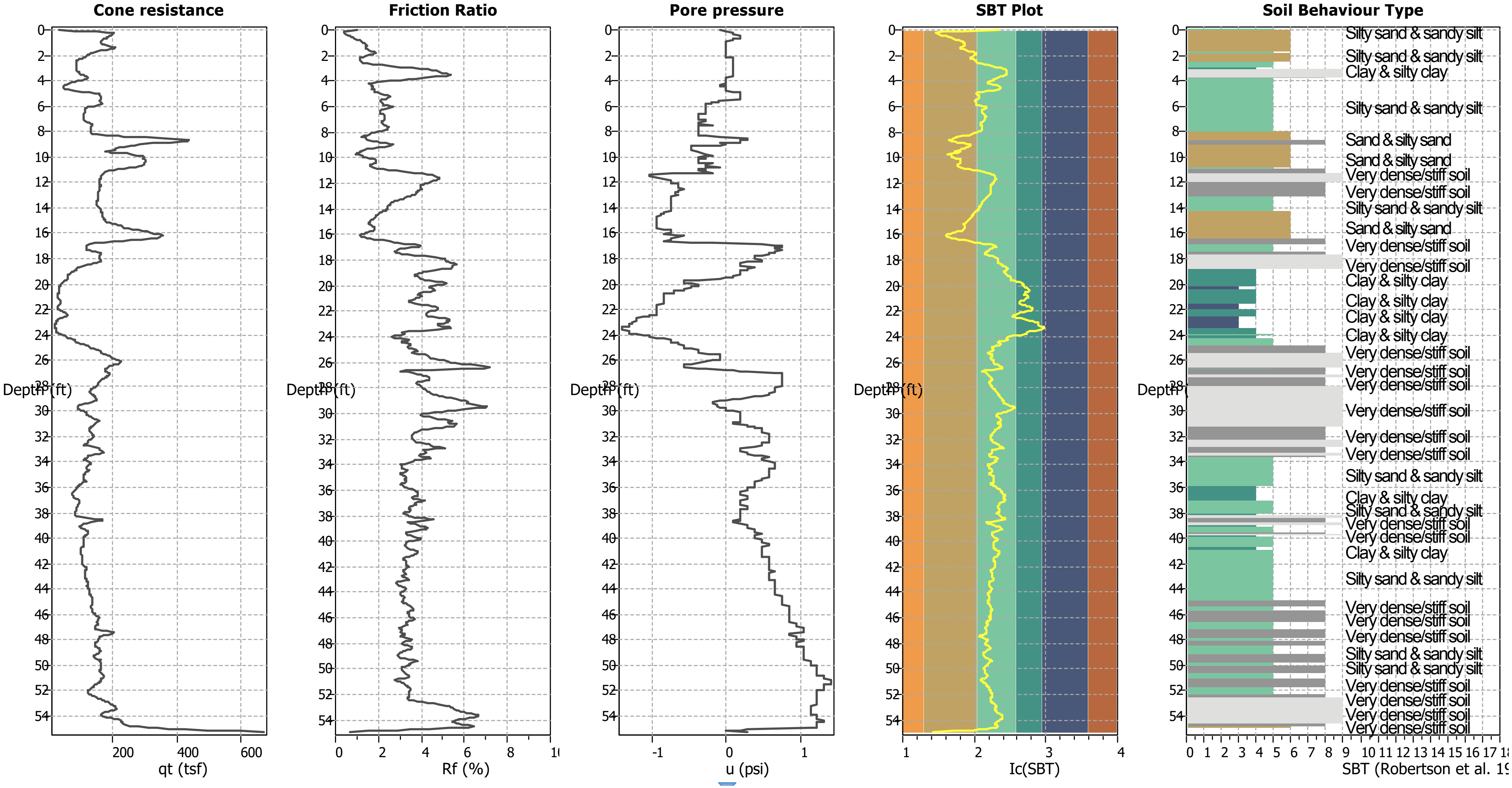






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



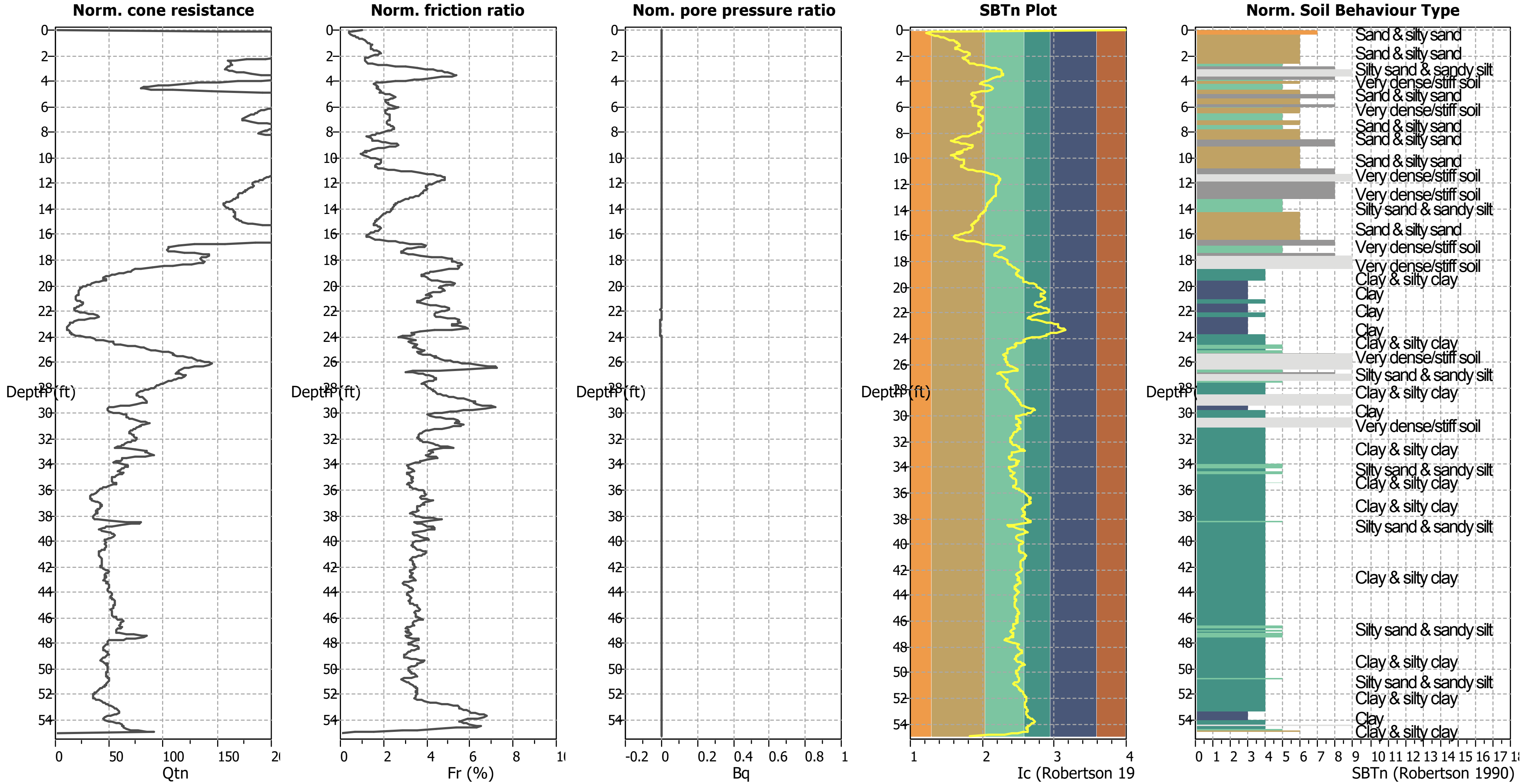
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

SBT 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

CPT basic interpretation plots (normalized)



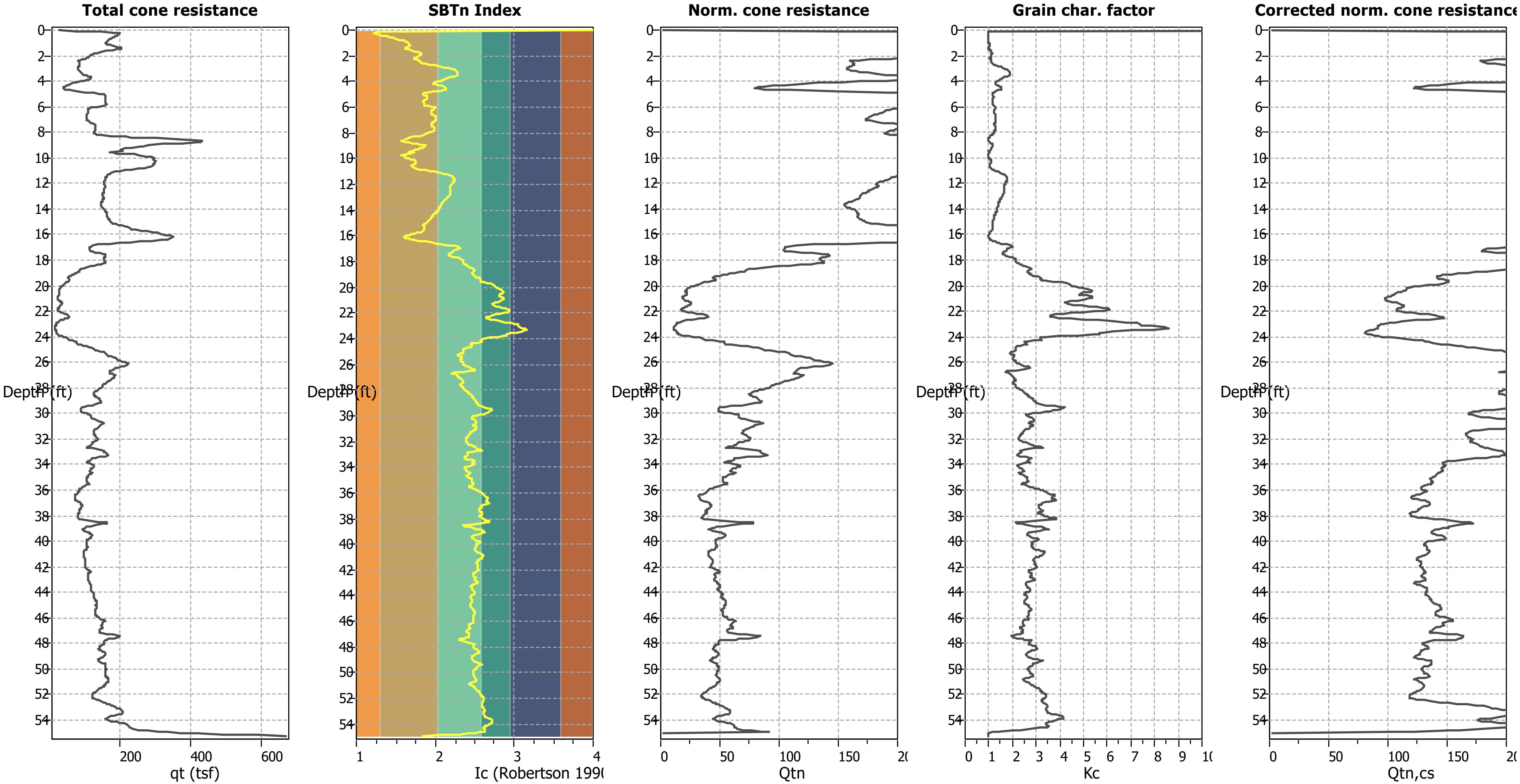
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

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

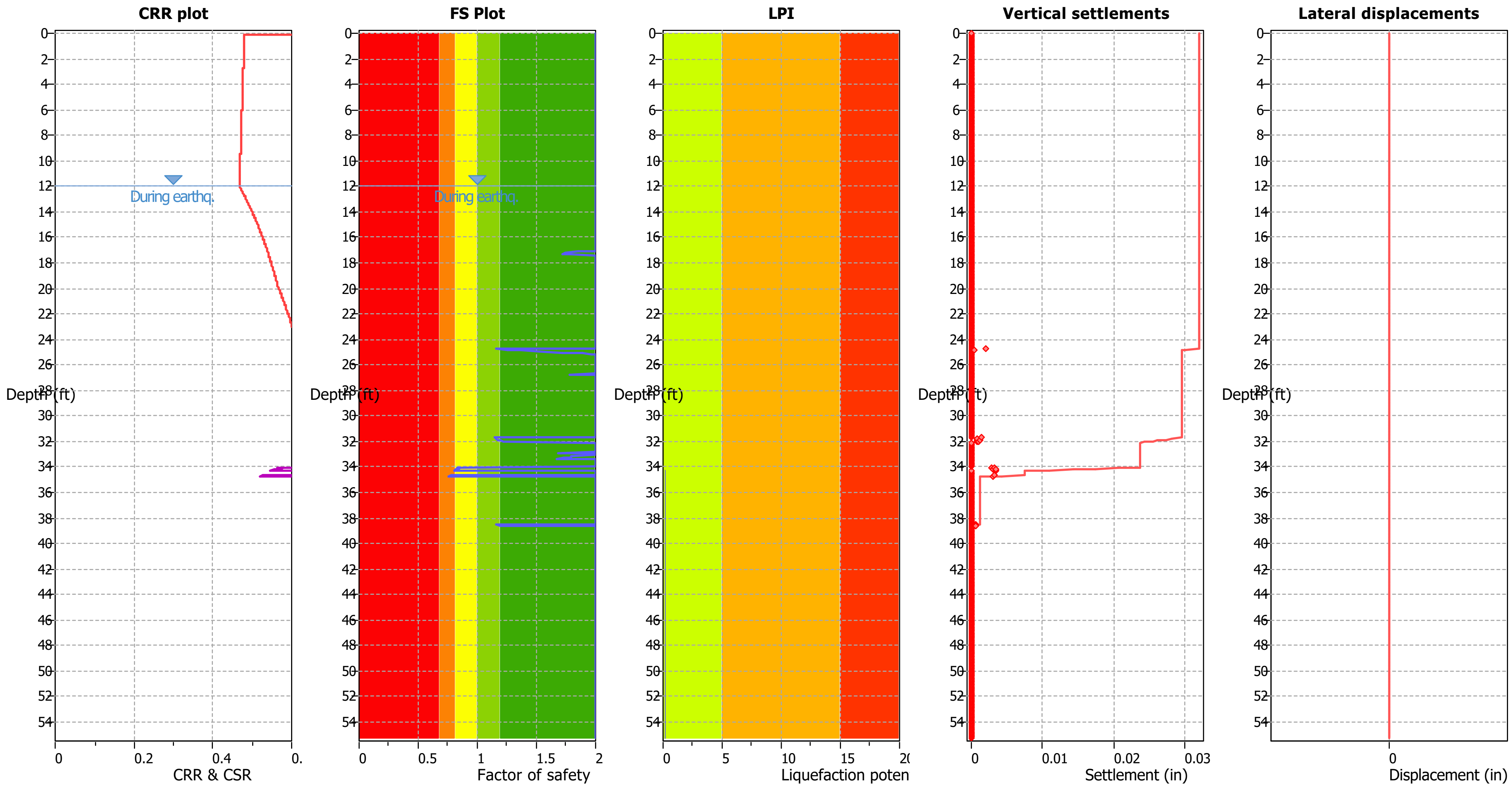
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

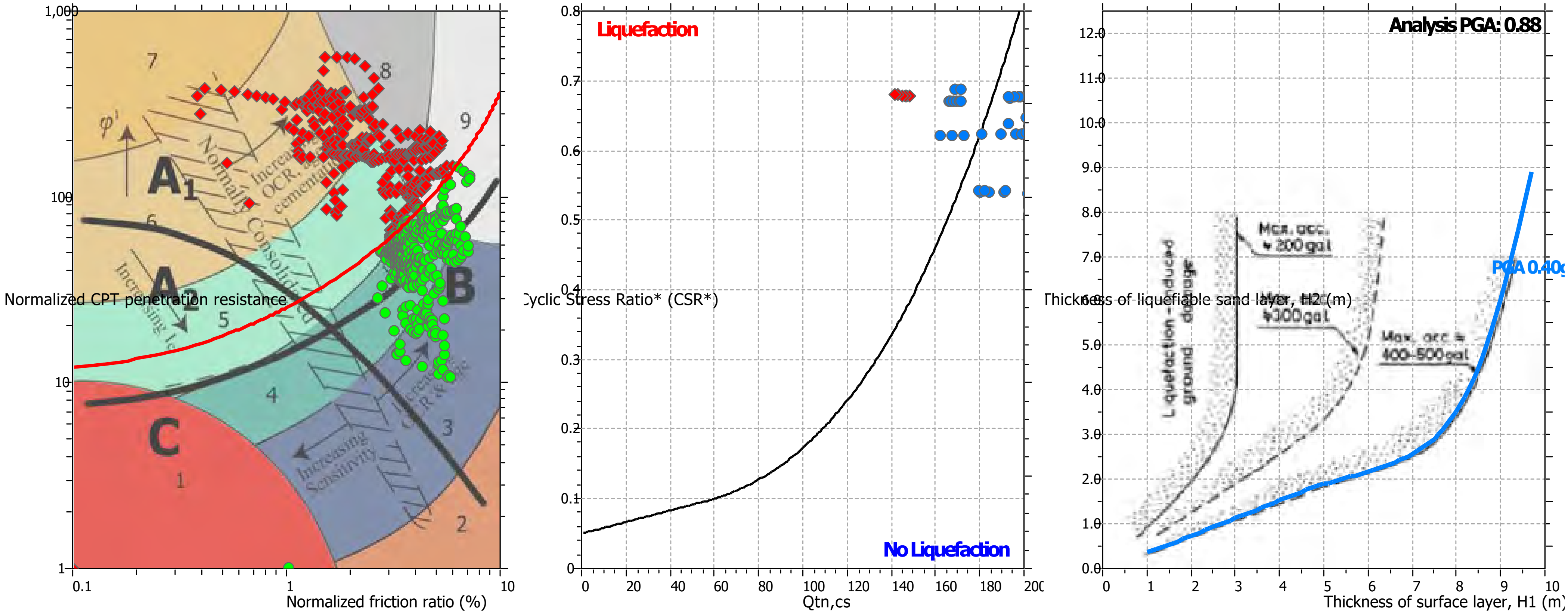
F.S. color scheme

- 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

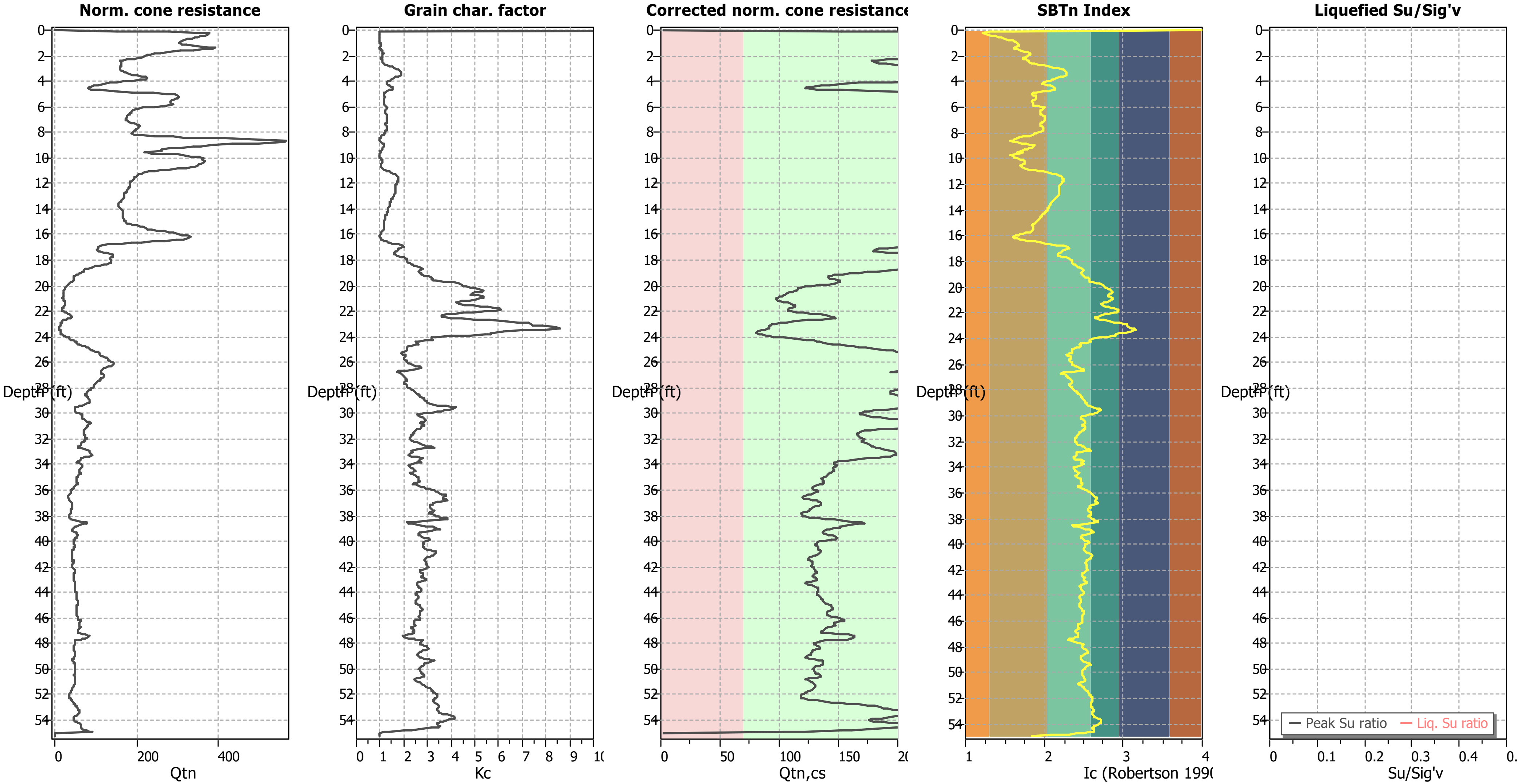
Liquefaction analysis summary plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

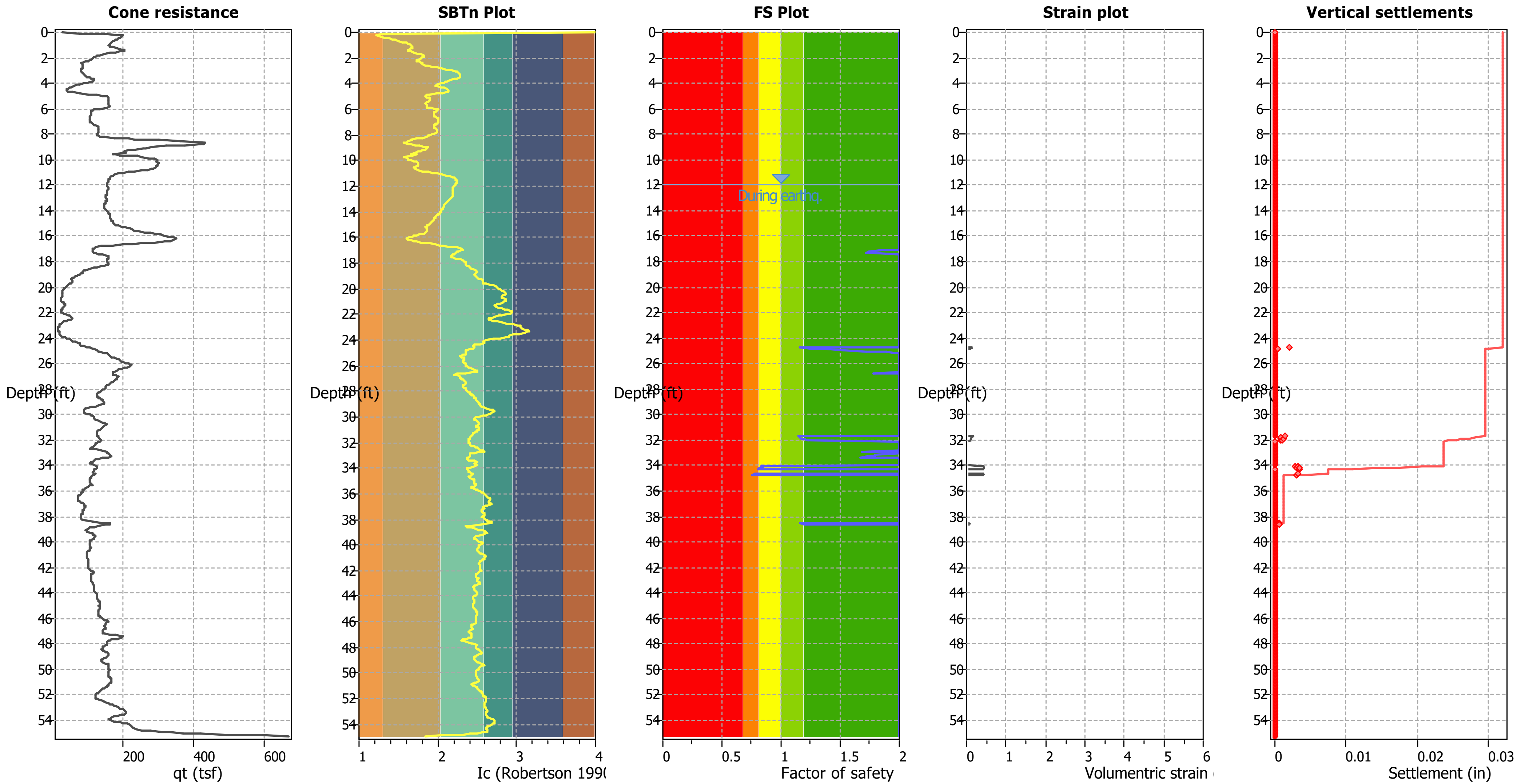
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.40	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.88	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	60.00 ft	Fill height:	N/A	Limit depth:	40.00 ft

Estimation of post-earthquake settlements

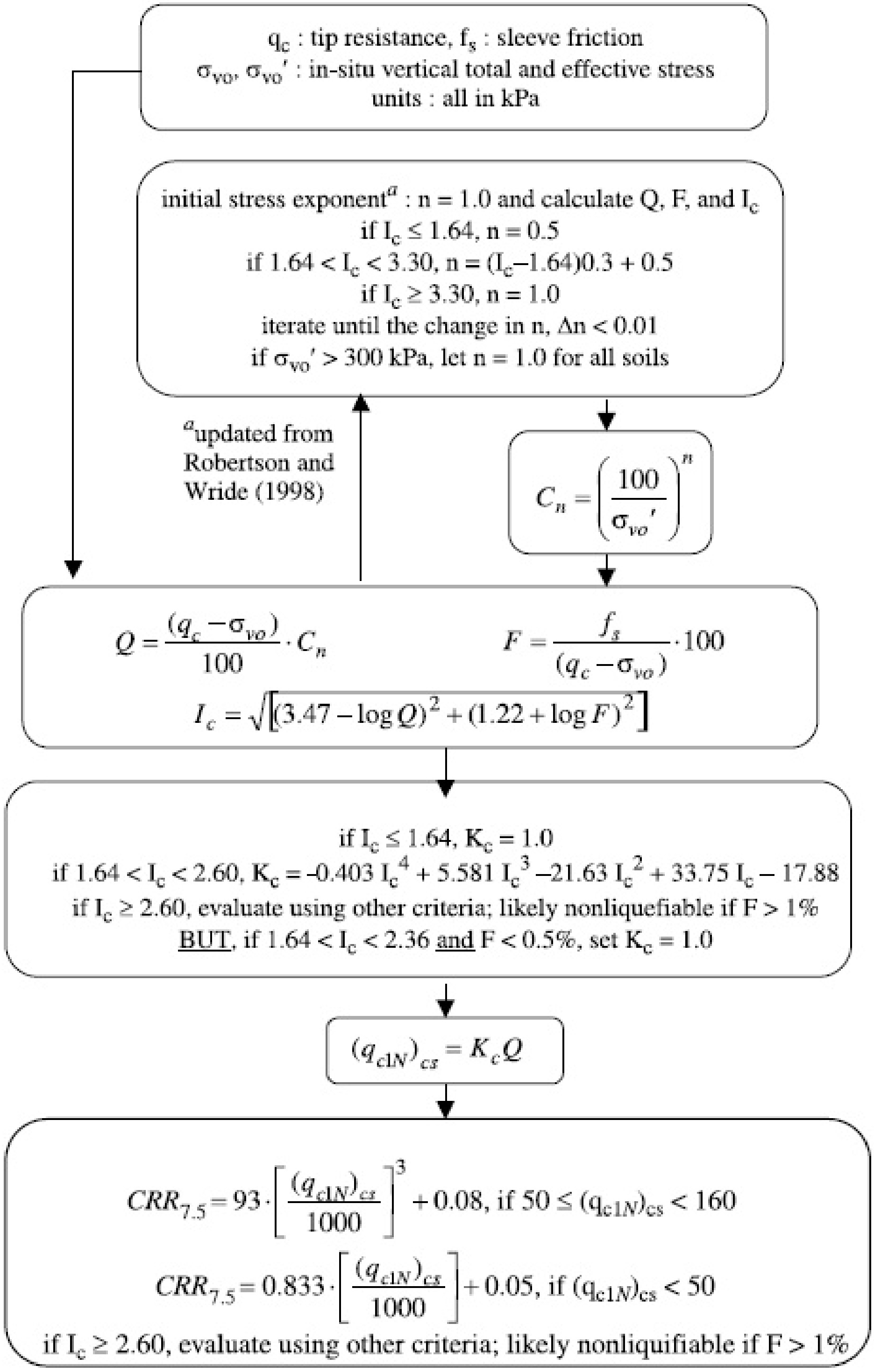


Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
FS: Calculated Factor of Safety against liquefaction
Volumentric strain: Post-liquefaction volumentric strain

Procedure for the evaluation of soil liquefaction resistance, NCEER (1998)

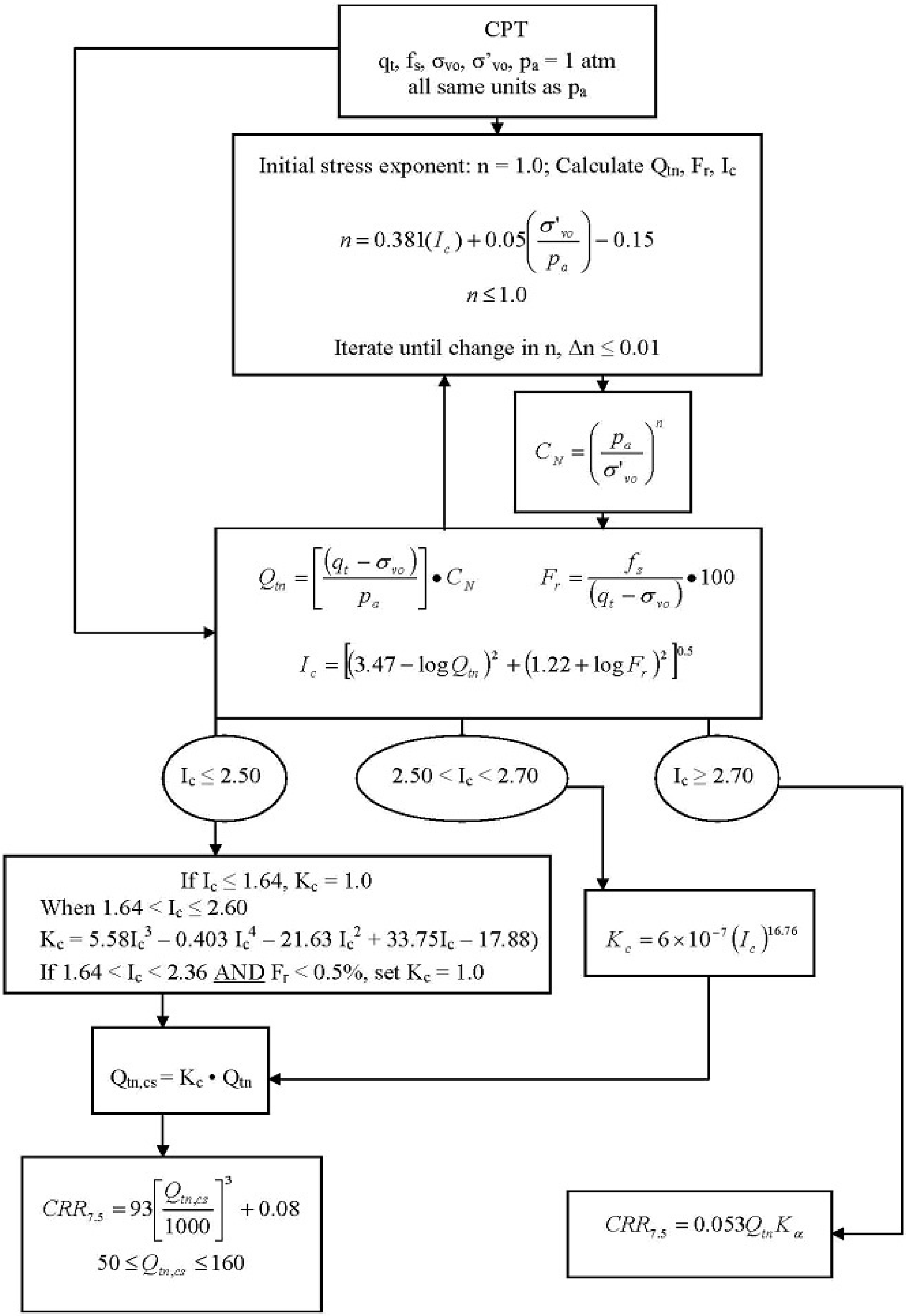
Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. The procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:



[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

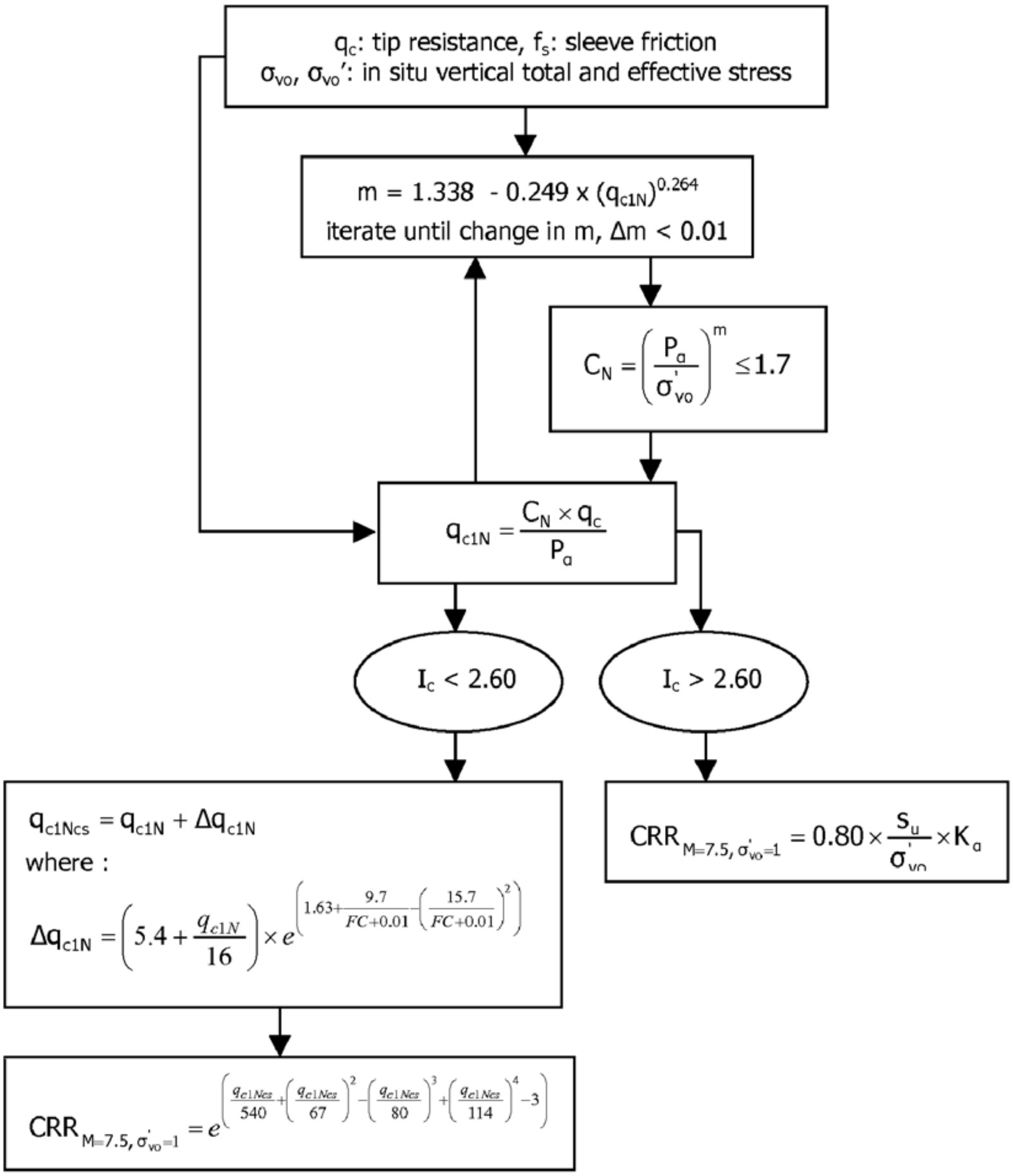
Procedure for the evaluation of soil liquefaction resistance (all soils), Robertson (2010)

Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. This procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:

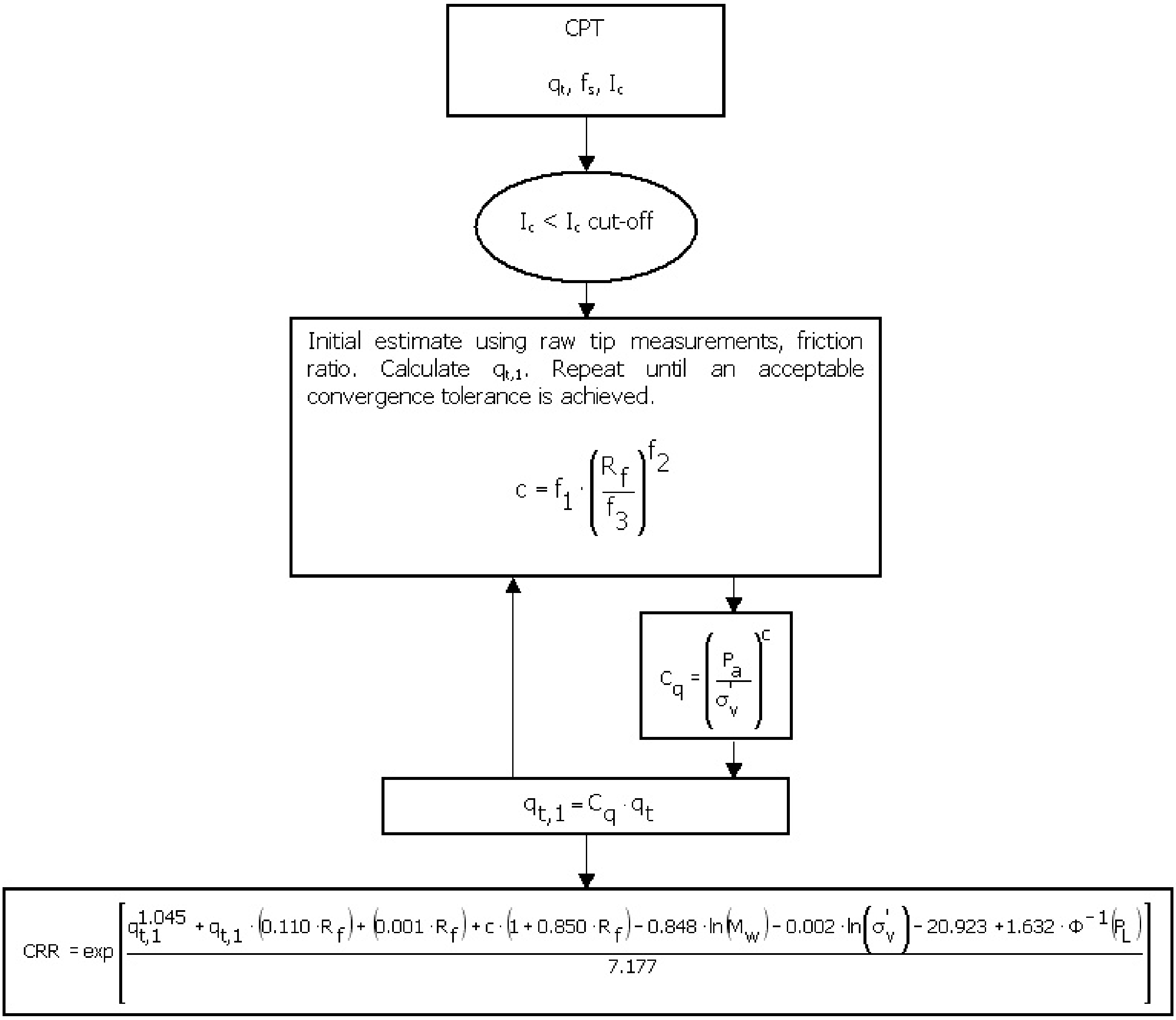


[1] P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering – from case history to practice, IS-Tokyo, June 2009

Procedure for the evaluation of soil liquefaction resistance, Idriss & Boulanger (2008)



Procedure for the evaluation of soil liquefaction resistance (sandy soils), Moss et al. (2006)



Procedure for the evaluation of soil liquefaction resistance, Boulanger & Idriss(2014)

$$FS_{liq} = \frac{CRR_{M=7.5,\sigma'_v=1atm}}{CSR_{M=7.5,\sigma'_v=1atm}}$$

$$CSR_{M=7.5,\sigma'_v=1atm} = 0.65 \frac{\sigma_v}{\sigma'_v} \frac{a_{\max}}{g} r_d \frac{1}{MSF} \frac{1}{K_\sigma}$$

$$r_d = \exp\left[\alpha(z) + \beta(z) \cdot M\right]$$

$$\alpha(z) = -1.012 - 1.126 \sin\left(\frac{z}{11.73} + 5.133\right)$$

$$\beta(z) = 0.106 + 0.118 \sin\left(\frac{z}{11.28} + 5.142\right)$$

$$K_\sigma = 1 - C_\sigma \ln\left(\frac{\sigma'_v}{P_a}\right) \leq 1.1$$

$$C_\sigma = \frac{1}{37.3 - 8.27\left(q_{c1Ncs}\right)^{0.264}} \leq 0.3$$

$$MSF = 1 + \left(MSF_{max} - 1\right)\left(8.64 \exp\left(\frac{-M}{4}\right) - 1.325\right)$$

$$MSF_{max} = 1.09 + \left(\frac{q_{c1Ncs}}{180}\right)^3 \leq 2.2$$

σ'_v *and* σ_v *at start of earthquake shaking*

$$CRR_{M=7.5,\sigma'_v=1atm} = \exp\left(\frac{q_{c1Ncs}}{113} + \left(\frac{q_{c1Ncs}}{1000}\right)^2 - \left(\frac{q_{c1Ncs}}{140}\right)^3 + \left(\frac{q_{c1Ncs}}{137}\right)^4 - 2.80\right)$$

$$q_{c1Ncs} = q_{c1N} + \Delta q_{c1N}$$

$$\Delta q_{c1N} = \left(11.9 + \frac{q_{c1N}}{14.6}\right) \exp\left(1.63 - \frac{9.7}{FC+2} - \left(\frac{15.7}{FC+2}\right)^2\right)$$

$$q_{c1N} = C_{N} \frac{q_c}{P_a}$$

$$C_{N} = \left(\frac{P_a}{\sigma'_v}\right)^m \leq 1.7$$

$$m = 1.338 - 0.249\left(q_{c1Ncs}\right)^{0.264} \quad with \quad 0.264 \leq m \leq 0.782$$

$$FC = 80\left(I_C + C_{FC}\right) - 137 \quad with \quad 0\% \leq FC \leq 100\%$$

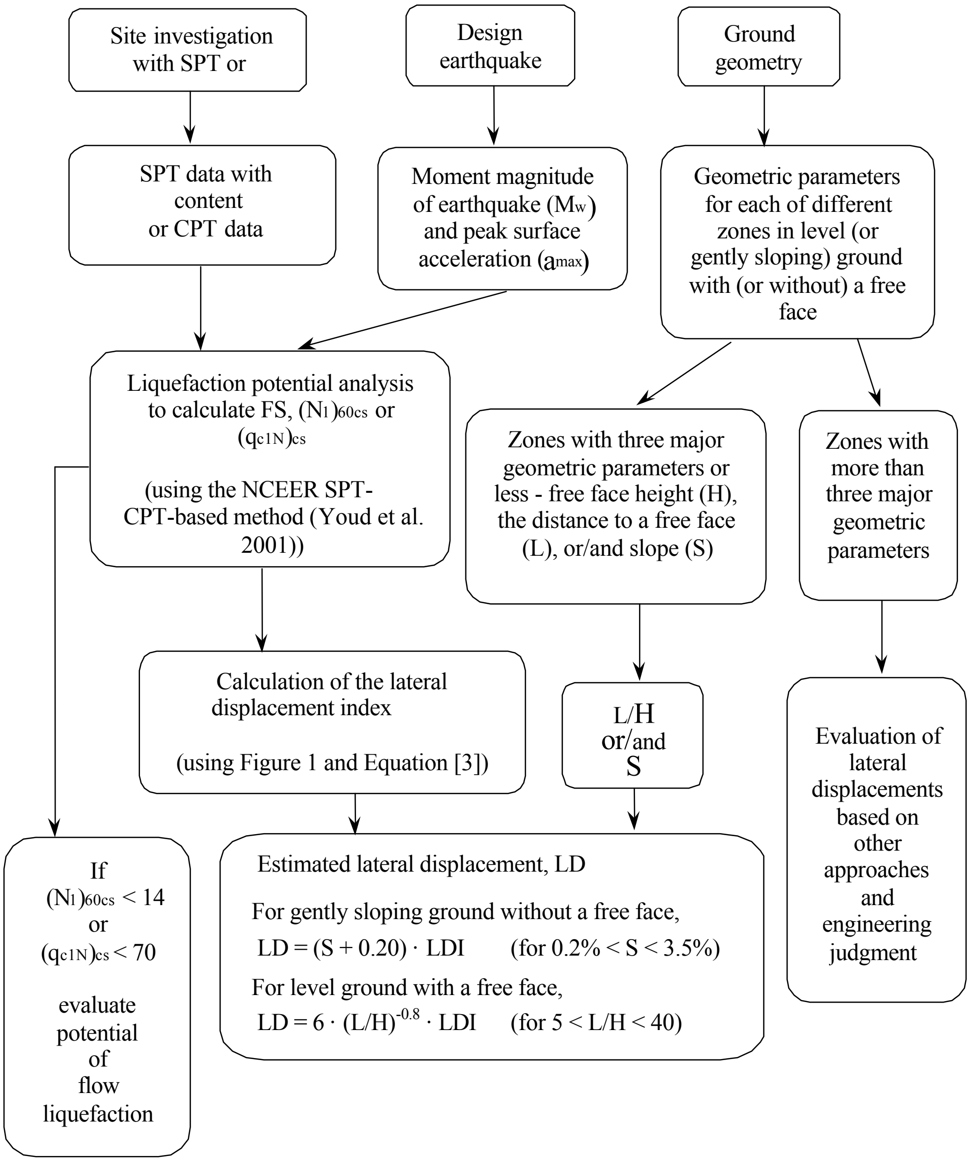
$$I_c = \left[\left(3.47 - \log(Q)\right)^2 + \left(1.22 + \log(F)\right)^2\right]^{0.5}$$

$$Q = \left(\frac{q_c - \sigma_{vc}}{P_a}\right)\left(\frac{P_a}{\sigma'_{vc}}\right)^n \quad with\ 0.5 \leq n \leq 1.0\ per\ Robertson\ \&\ Wride\ (1998)$$

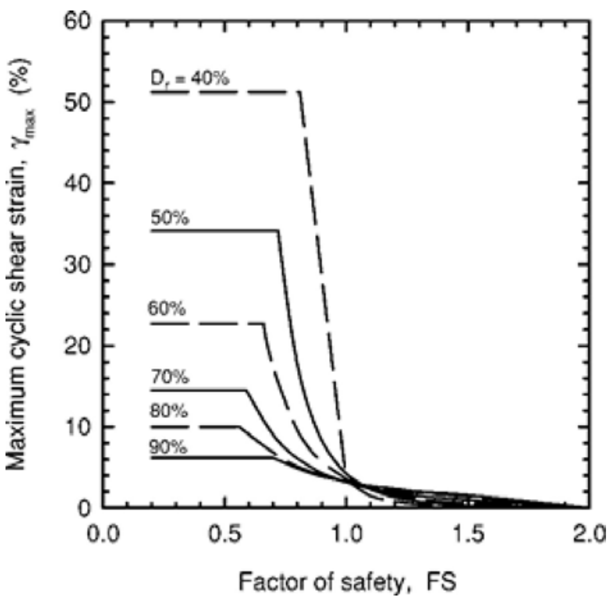
$$F = \left(\frac{f_s}{q_c - \sigma_{vc}}\right) \cdot 100\%$$

σ'_v *at time of CPT sounding*

Procedure for the evaluation of liquefaction-induced lateral spreading displacements



[1] Flow chart illustrating major steps in estimating liquefaction-induced lateral spreading displacements using the proposed approach



[1] **Figure 1**

$$LDI = \int_0^{Z_{max}} \gamma_{max} \, dz$$

[1] **Equation [3]**

[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

Procedure for the estimation of seismic induced settlements in dry sands

Average shear stress, τ_{av}

$$\tau_{av} = CSR^{*} \cdot \sigma_{v0}' = 0.65 \cdot \frac{\alpha_{max}}{g} \cdot \sigma_{v0} \cdot \tau_{a}$$

↓

Estimate small shear strain modulus, G_0

$$G_0 = 0.0188 \cdot \left[10^{(0.55 I_c - 1.68)}\right] \cdot (q_t - \sigma_v)$$

↓

Estimate shear strain amplitude, γ

(based on Pradel (1998))

$$\gamma = \left[\frac{1 + \alpha \cdot e^{bR}}{1 + \alpha}\right] \cdot R \cdot 100\ (\%)$$

$$R = \frac{\tau_{av}}{G_0} \text{ (Note } \tau_{av} \text{ and } G_0 \text{ same units)}$$

$$\alpha = 0.0389 \cdot \left(\frac{\sigma_v}{p_a}\right) + 0.124$$

$$b = 6400 \cdot \left(\frac{\sigma_v}{p_a}\right)$$

↓

Estimate volumetric strain in 15 cycles

$$\varepsilon_{vol(15)} = \gamma \cdot \left[\frac{(N_1)_{60,cs}}{20}\right]^{-1.20}$$

$$(N_1)_{60,cs} = \frac{Q_{tn,cs}}{8.5 \cdot \left[1 - \frac{I_c}{4.6}\right]}$$

↓

Volumetric strain in design earthquake

$$\Sigma_{vol} = \varepsilon_{vol(15)} \cdot \left[\frac{N_c}{15}\right]^{0.45}$$

$$N_c = (M - 4)^{2.17}$$

↓

Seismic settlement, s

$$s = 2 \cdot \int_0^{GWT} \Sigma_{vol} \cdot dz$$

Robertson, P.K. and Lisheng, S., 2010, "Estimation of seismic compression in dry soils using the CPT" FIFTH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS, Symposium in honor of professor I. M. Idriss, San Diego, CA

Liquefaction Potential Index (LPI) calculation procedure

Calculation of the Liquefaction Potential Index (LPI) is used to interpret the liquefaction assessment calculations in terms of severity over depth. The calculation procedure is based on the methology developed by Iwasaki (1982) and is adopted by AFPS.

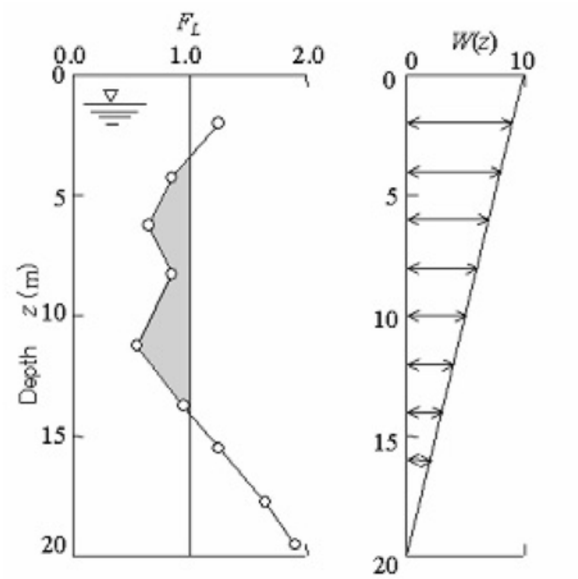
To estimate the severity of liquefaction extent at a given site, LPI is calculated based on the following equation:

$$\mathbf{LPI} = \int_{0}^{20} (10 - 0{,}5_{z}) \times F_{L} \times d_{z}$$

where:
F_L = 1 - F.S. when F.S. less than 1
F_L = 0 when F.S. greater than 1
z depth of measurment in meters

Values of LPI range between zero (0) when no test point is characterized as liquefiable and 100 when all points are characterized as susceptible to liquefaction. Iwasaki proposed four (4) discrete categories based on the numeric value of LPI:

- LPI = 0 : Liquefaction risk is very low
- 0 < LPI <= 5 : Liquefaction risk is low
- 5 < LPI <= 15 : Liquefaction risk is high
- LPI > 15 : Liquefaction risk is very high



Graphical presentation of the LPI calculation procedure

Shear-Induced Building Settlement (Ds) calculation procedure

The shear-induced building settlement (Ds) due to liquefaction below the building can be estimated using the relationship developed by Bray and Macedo (2017):

$$Ln(Ds) = c1 + c2 * LBS + 0.58 * Ln\left(Tanh\left(\frac{HL}{6}\right)\right) + 4.59 * Ln(Q) - 0.42 * Ln(Q)^2 - 0.02 * B + 0.84 * Ln(CAVdp) + 0.41 * Ln(Sa1) + \varepsilon$$

where Ds is in the units of mm, c1= -8.35 and c2= 0.072 for LBS ≤ 16, and c1= -7.48 and c2= 0.014 otherwise. Q is the building contact pressure in units of kPa, HL is the cumulative thickness of the liquefiable layers in the units of m, B is the building width in the units of m, CAVdp is a standardized version of the cumulative absolute velocity in the units of g-s, Sa1 is 5%-damped pseudo-acceleration response spectral value at a period of 1 s in the units of g, and ε is a normal random variable with zero mean and 0.50 standard deviation in Ln units. The liquefaction-induced building settlement index (LBS) is:

$$LBS = \sum W * \frac{\varepsilon_{shear}}{z} dz$$

where z (m) is the depth measured from the ground surface > 0, W is a foundation-weighting factor wherein W = 0.0 for z less than Df, which is the embedment depth of the foundation, and W = 1.0 otherwise. The shear strain parameter (ε_shear) is the liquefaction-induced free-field shear strain (in %) estimated using Zhang et al. (2004). It is calculated based on the estimated Dr of the liquefied soil layer and the calculated safety factor against liquefaction triggering (FSL).

References

- Lunne, T., Robertson, P.K., and Powell, J.J.M 1997. Cone penetration testing in geotechnical practice, E & FN Spon Routledge, 352 p, ISBN 0-7514-0393-8.

- Boulanger, R.W. and Idriss, I. M., 2007. Evaluation of Cyclic Softening in Silts and Clays. ASCE Journal of Geotechnical and Geoenvironmental Engineering June, Vol. 133, No. 6 pp 641-652

- Boulanger, R.W. and Idriss, I. M., 2014. CPT AND SPT BASED LIQUEFACTION TRIGGERING PROCEDURES. DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING COLLEGE OF ENGINEERING UNIVERSITY OF CALIFORNIA AT DAVIS

- Robertson, P.K. and Cabal, K.L., 2007, Guide to Cone Penetration Testing for Geotechnical Engineering. Available at no cost at http://www.geologismiki.gr/

- Robertson, P.K. 1990. Soil classification using the cone penetration test. Canadian Geotechnical Journal, 27 (1), 151-8.

- Robertson, P.K. and Wride, C.E., 1998. Cyclic Liquefaction and its Evaluation based on the CPT Canadian Geotechnical Journal, 1998, Vol. 35, August.

- Youd, T.L., Idriss, I.M., Andrus, R.D., Arango, I., Castro, G., Christian, J.T., Dobry, R., Finn, W.D.L., Harder, L.F., Hynes, M.E., Ishihara, K., Koester, J., Liao, S., Marcuson III, W.F., Martin, G.R., Mitchell, J.K., Moriwaki, Y., Power, M.S., Robertson, P.K., Seed, R., and Stokoe, K.H., Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshop on Evaluation of Liquefaction Resistance of Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 127, October, pp 817-833

- Zhang, G., Robertson. P.K., Brachman, R., 2002, Estimating Liquefaction Induced Ground Settlements from the CPT, Canadian Geotechnical Journal, 39: pp 1168-1180

- Zhang, G., Robertson. P.K., Brachman, R., 2004, Estimating Liquefaction Induced Lateral Displacements using the SPT and CPT, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 130, No. 8, 861-871

- Pradel, D., 1998, Procedure to Evaluate Earthquake-Induced Settlements in Dry Sandy Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 124, No. 4, 364-368

- Iwasaki, T., 1986, Soil liquefaction studies in Japan: state-of-the-art, Soil Dynamics and Earthquake Engineering, Vol. 5, No. 1, 2-70

- Papathanassiou G., 2008, LPI-based approach for calibrating the severity of liquefaction-induced failures and for assessing the probability of liquefaction surface evidence, Eng. Geol. 96:94–104

- P.K. Robertson, 2009, Interpretation of Cone Penetration Tests - a unified approach., Canadian Geotechnical Journal, Vol. 46, No. 11, pp 1337-1355

- P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering - from case history to practice, IS-Tokyo, June 2009

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- R. E. S. Moss, R. B. Seed, R. E. Kayen, J. P. Stewart, A. Der Kiureghian, K. O. Cetin, CPT-Based Probabilistic and Deterministic Assessment of In Situ Seismic Soil Liquefaction Potential, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 132, No. 8, August 1, 2006

- I. M. Idriss and R. W. Boulanger, 2008. Soil liquefaction during earthquakes, Earthquake Engineering Research Institute MNO-12

- Jonathan D. Bray & Jorge Macedo, Department of Civil & Environmental Engineering, Univ. of California, Berkeley, CA, USA, Simplified procedure for estimating liquefaction -induced building settlement, *Proceedings of the 19th International Conference on Soil Mechanics and Geotechnical Engineering, Seoul 201*

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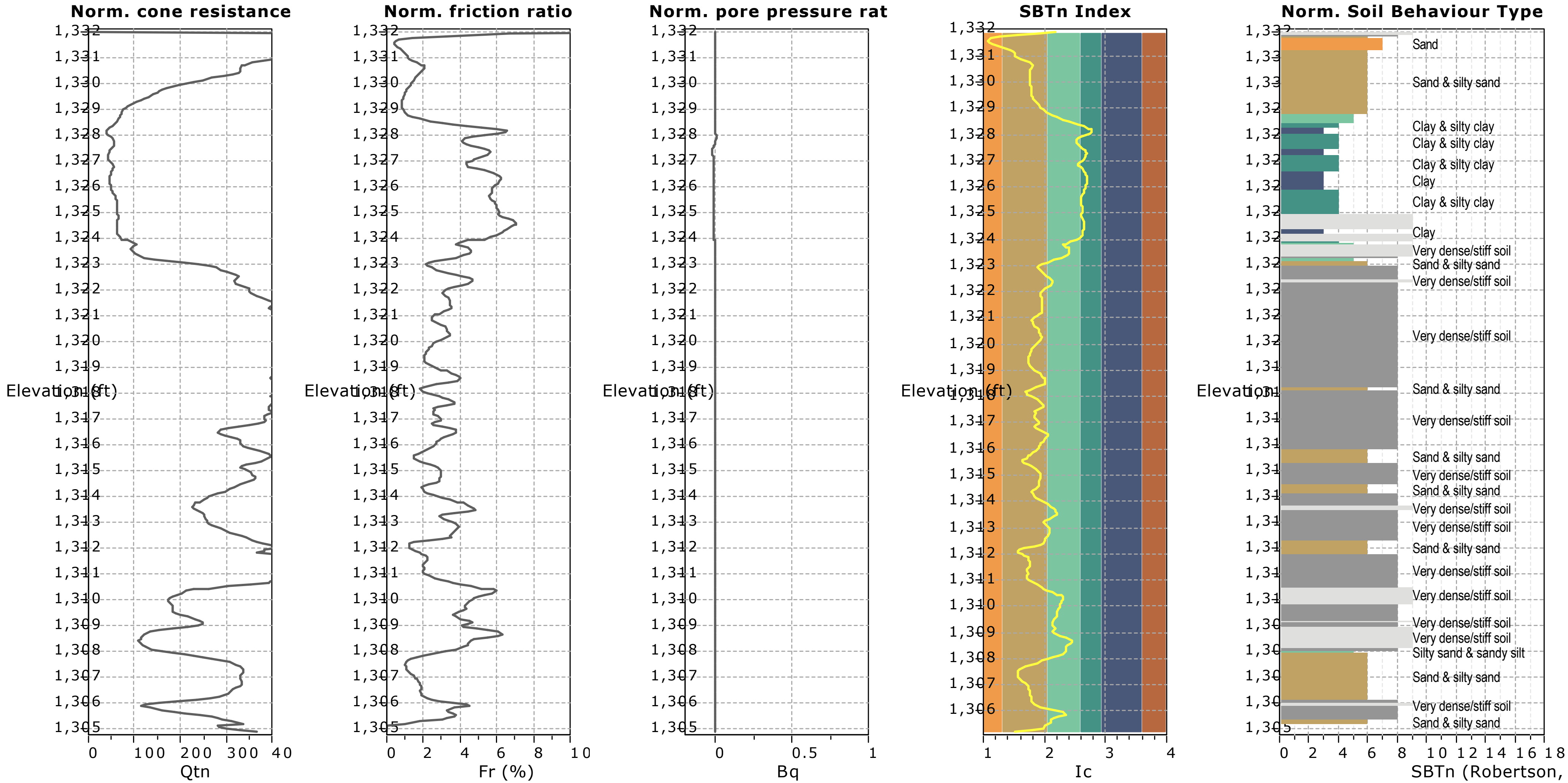
858-292-7575

CPT: CPT-1
Total depth: 27.10 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Project: UHS Inland Valley Reg. Med. Center
Location: 36485 Inland Valley Dr., Wildomar, CA



SBTn legend

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

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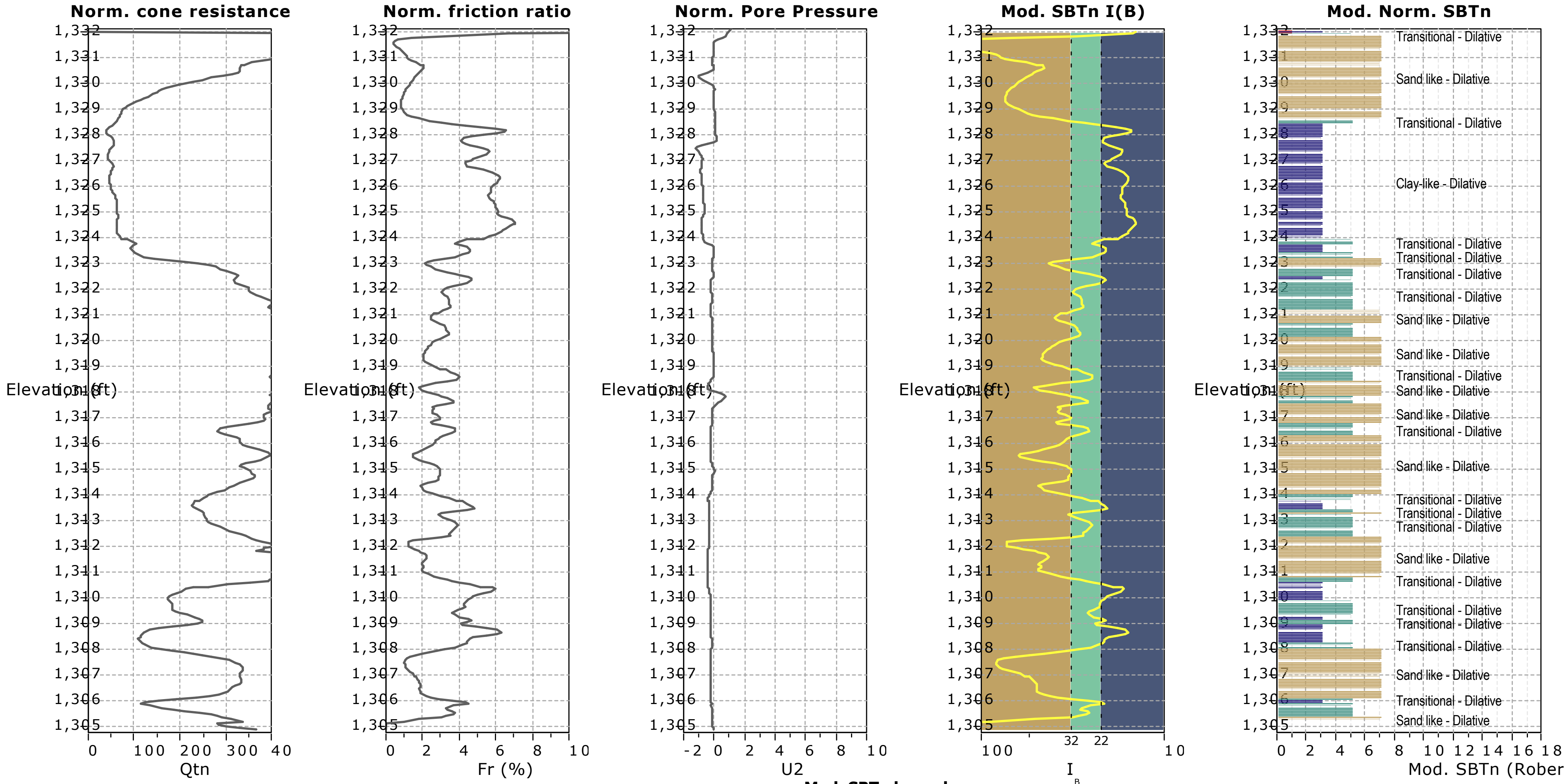

Mod. SBTn legend

1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

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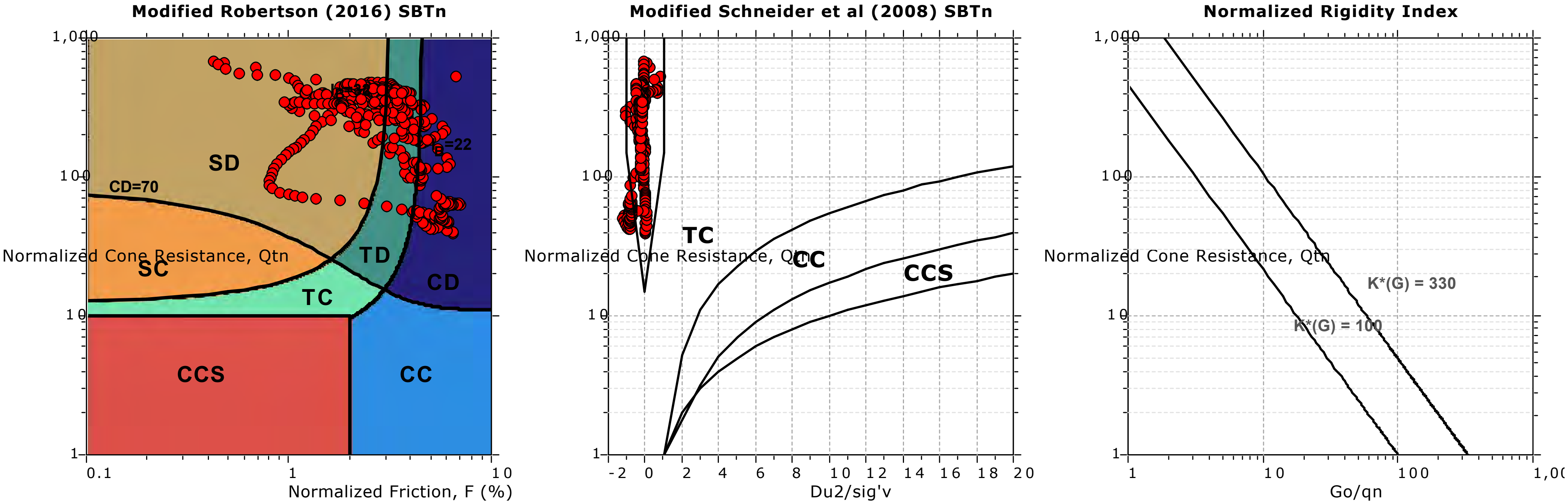
Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
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K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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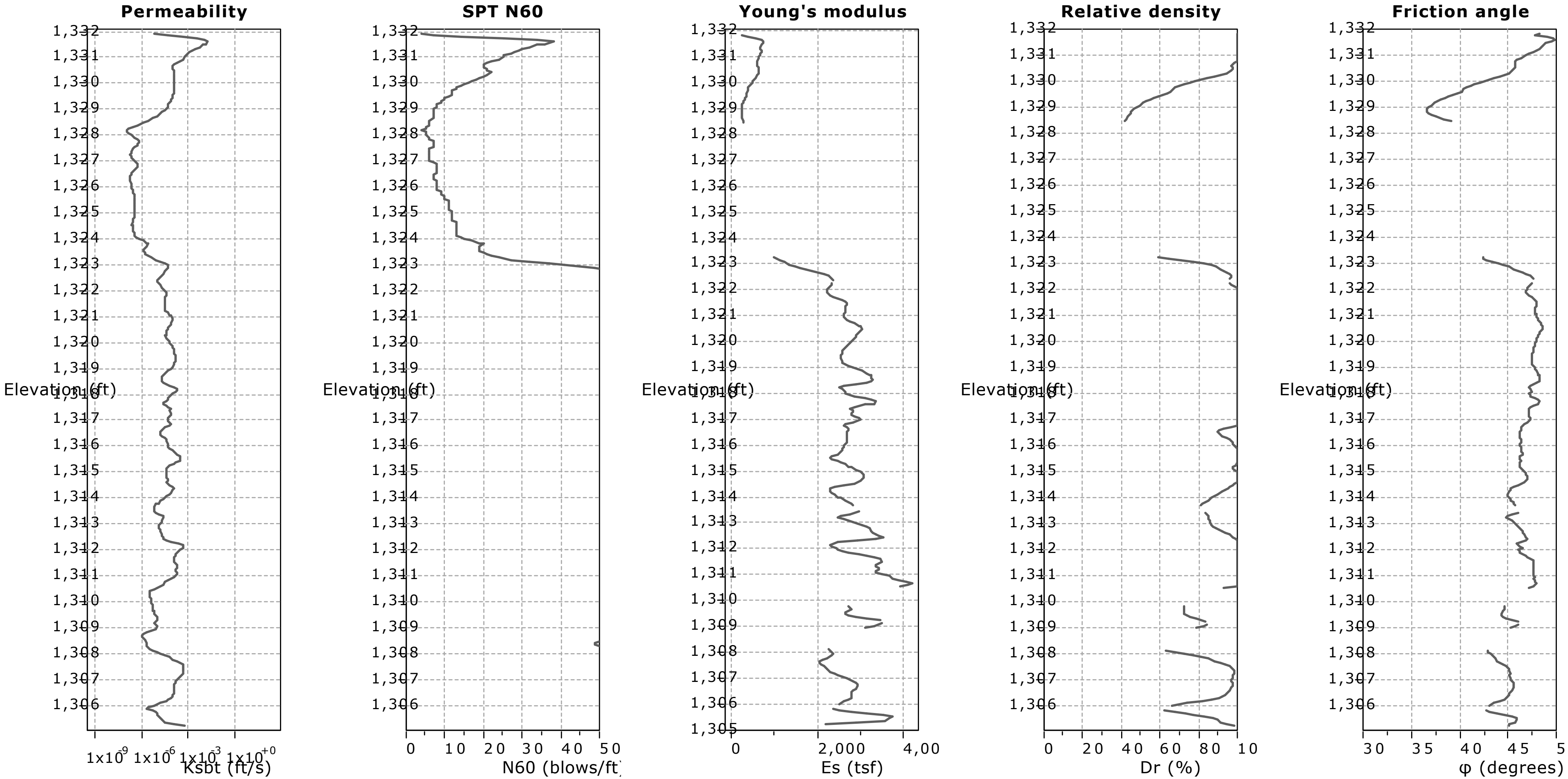

Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

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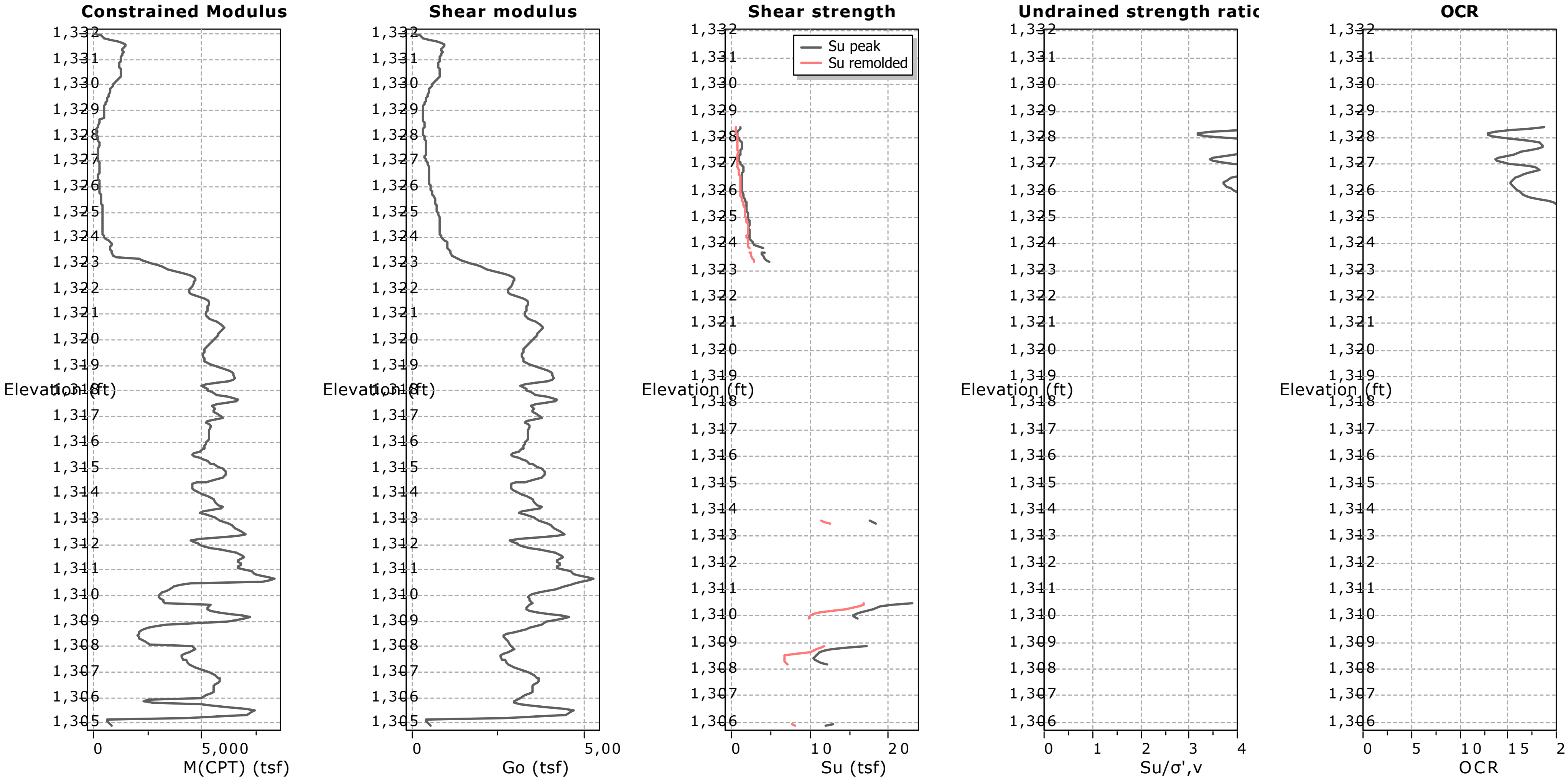

Calculation parameters

Constrained modulus: Based on variable alpha using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable alpha using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

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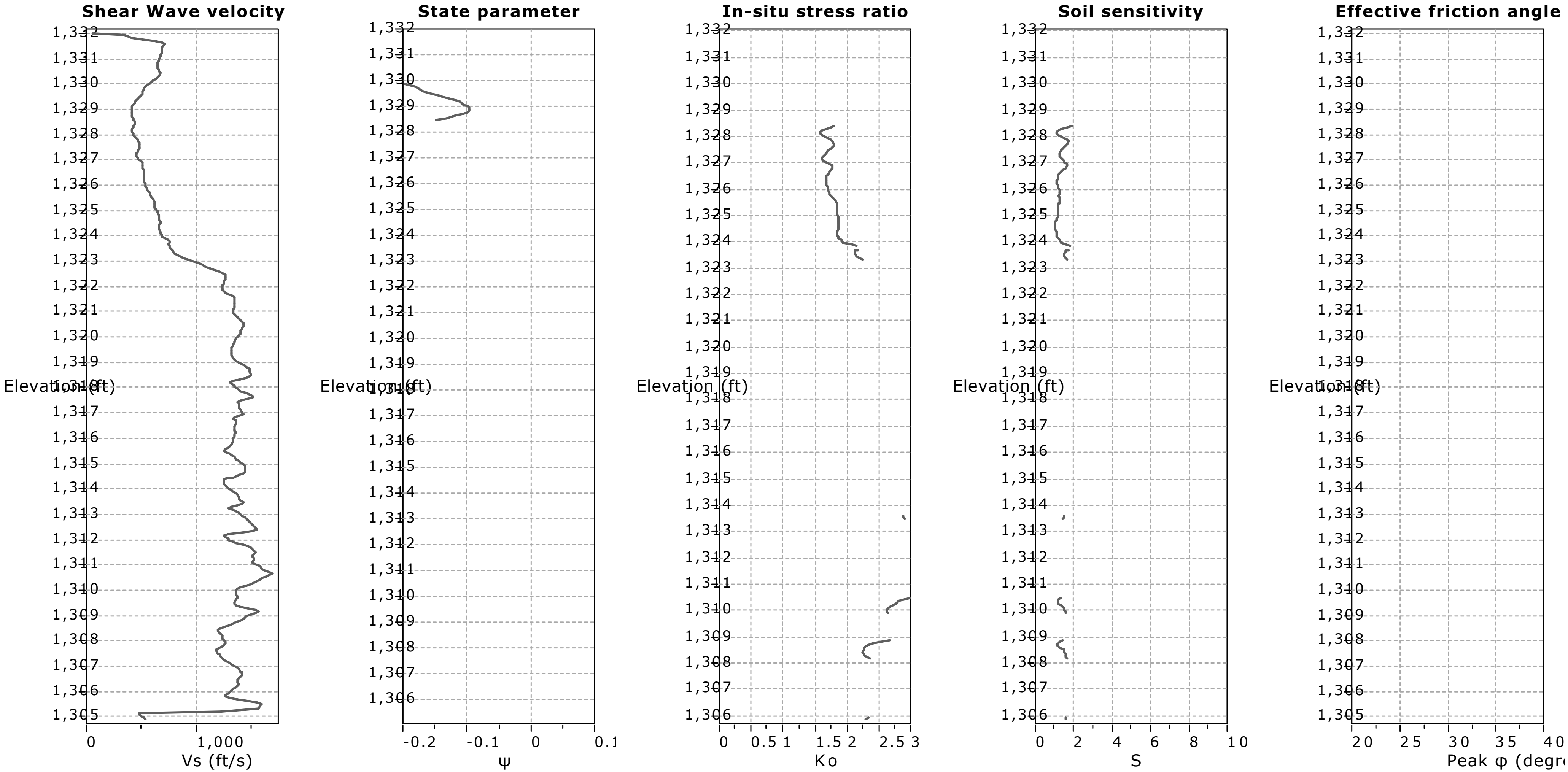

Calculation parameters

Soil Sensitivity factor, N_S: 7.00

User defined estimation data

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CPT: CPT-2
Total depth: 30.34 ft, Date: 8/9/2019
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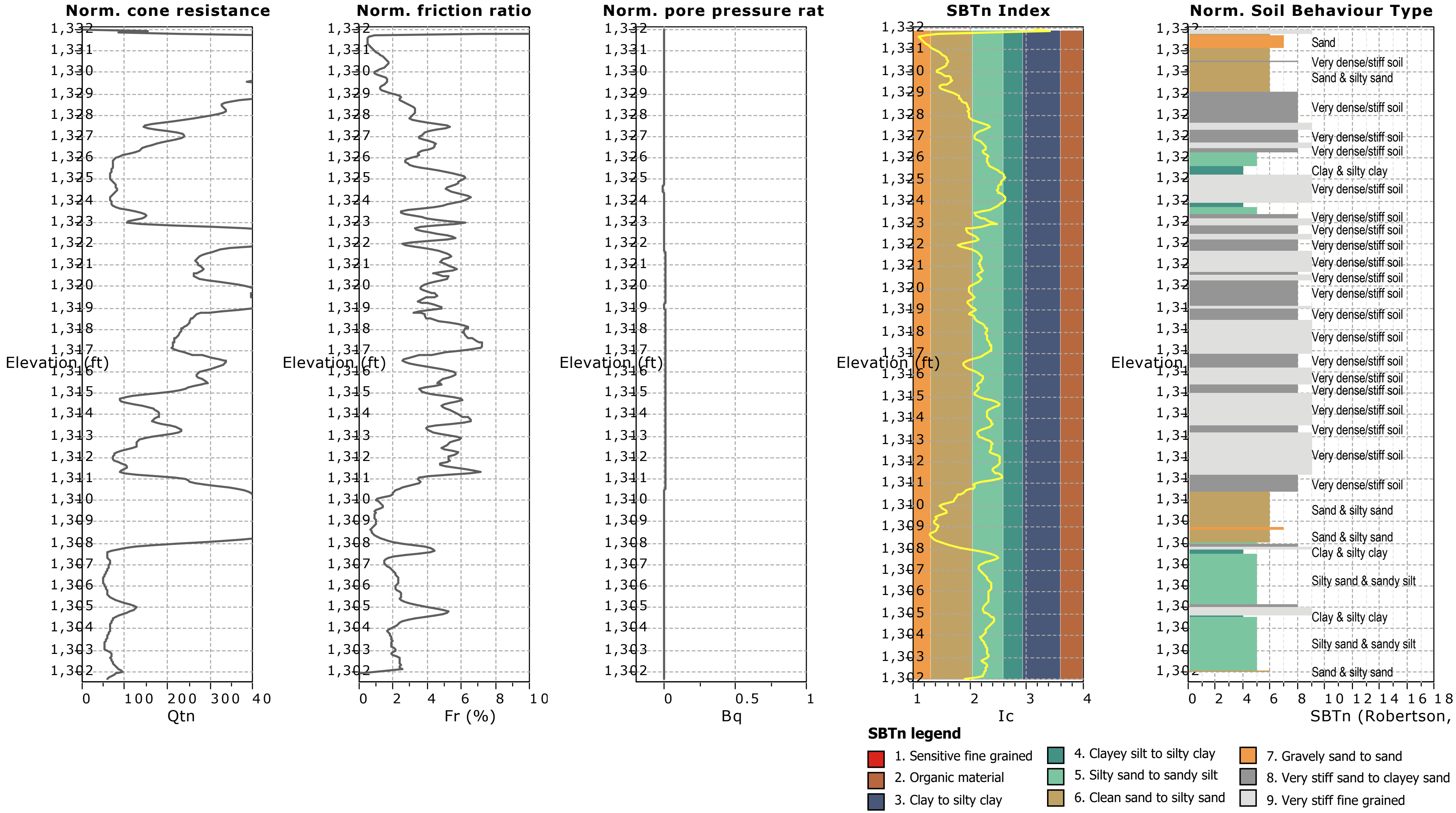

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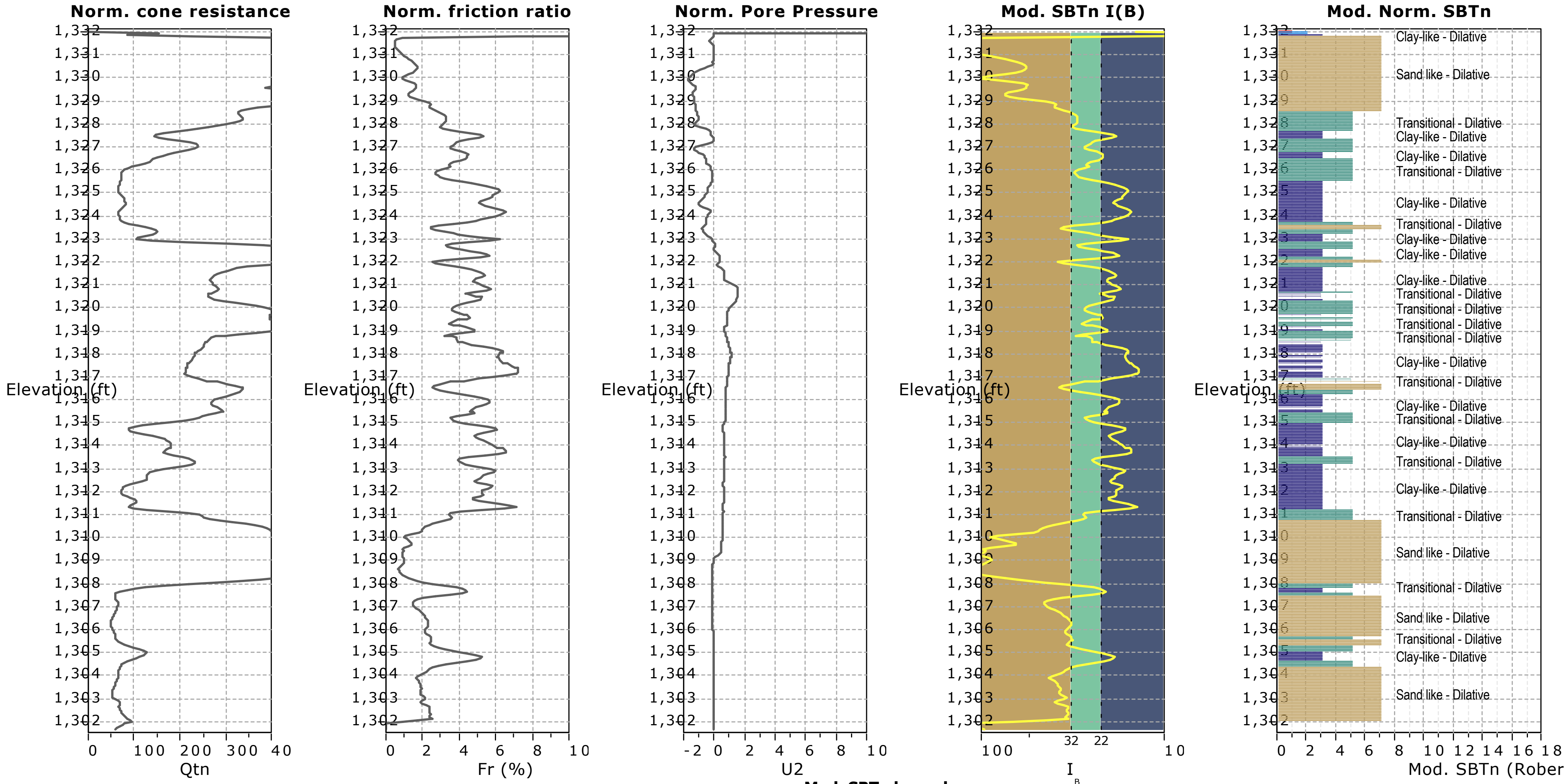

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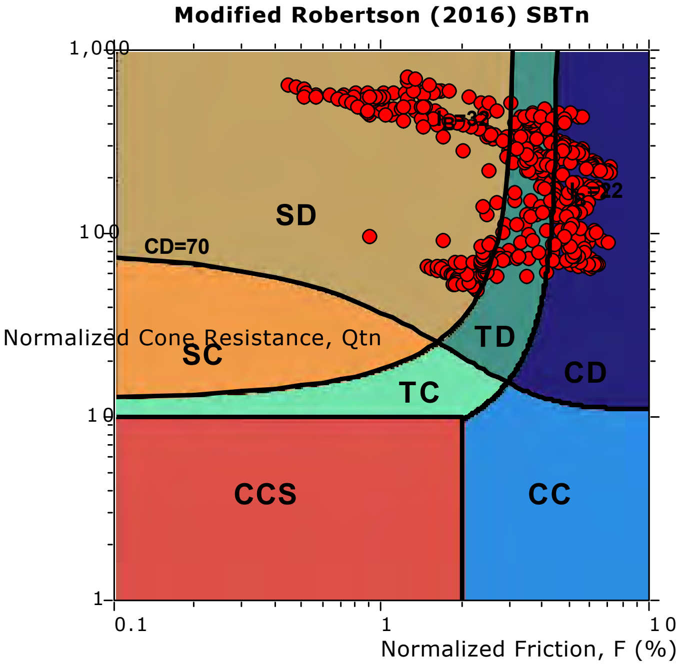
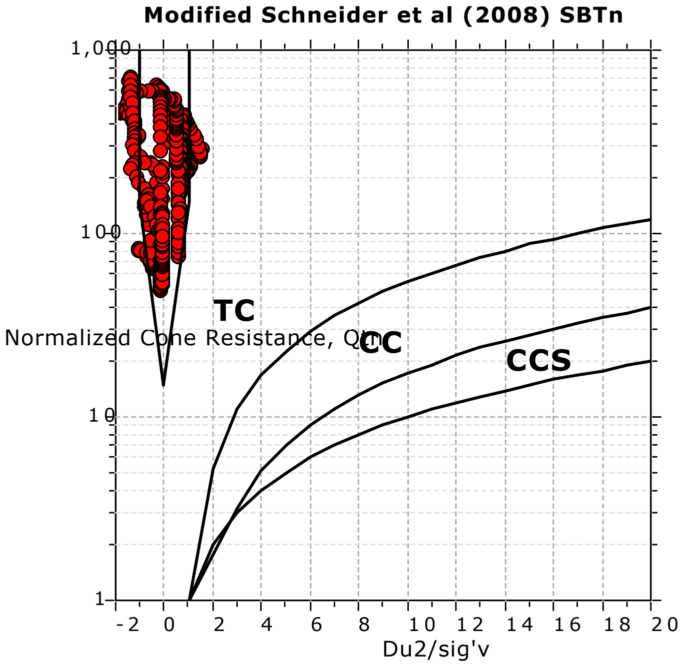
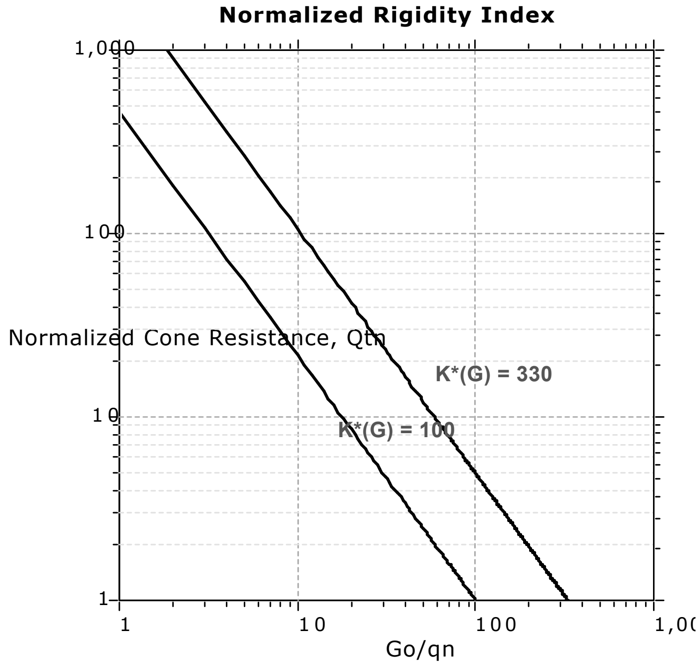
Updated SBTn plots







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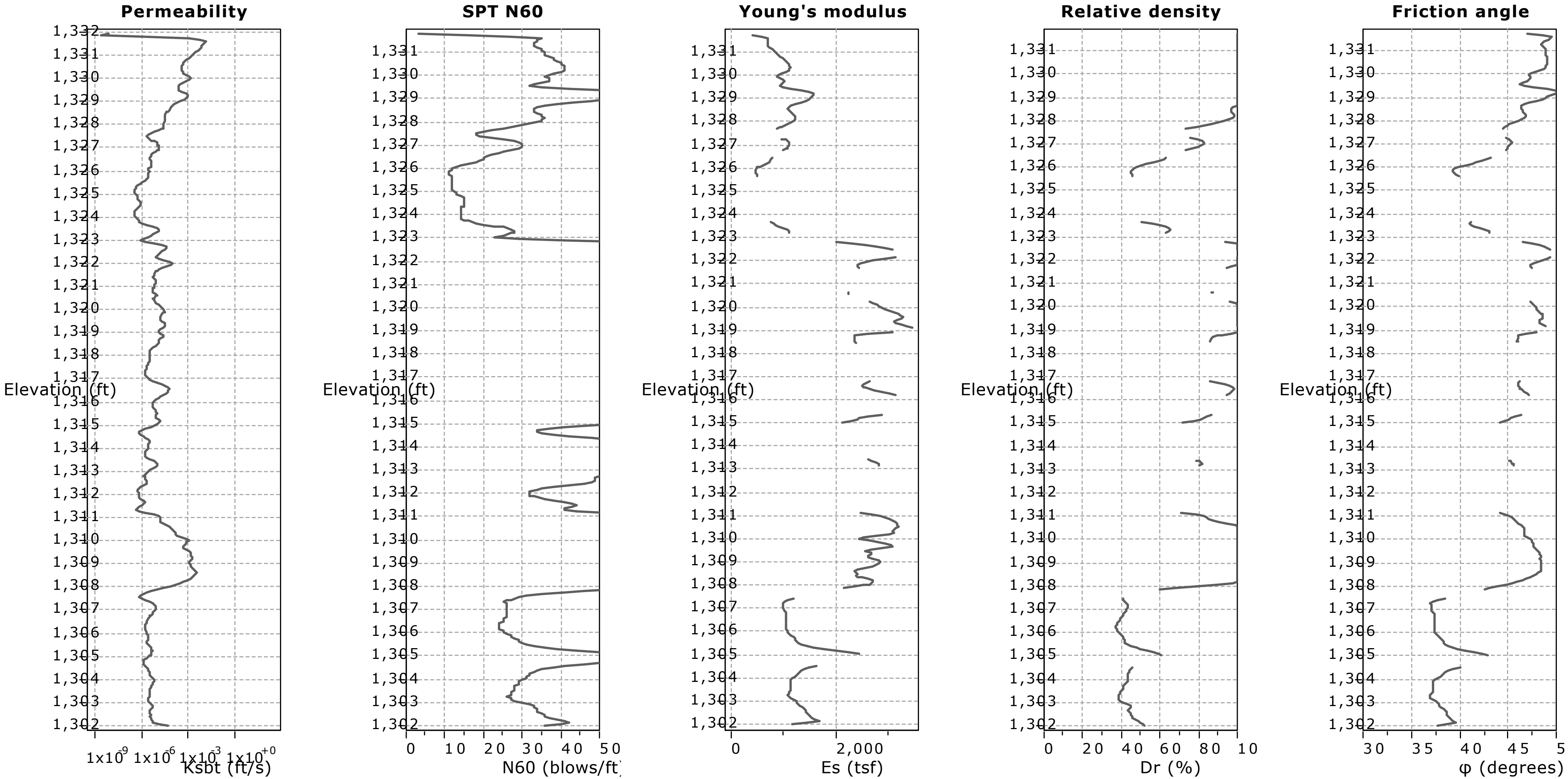

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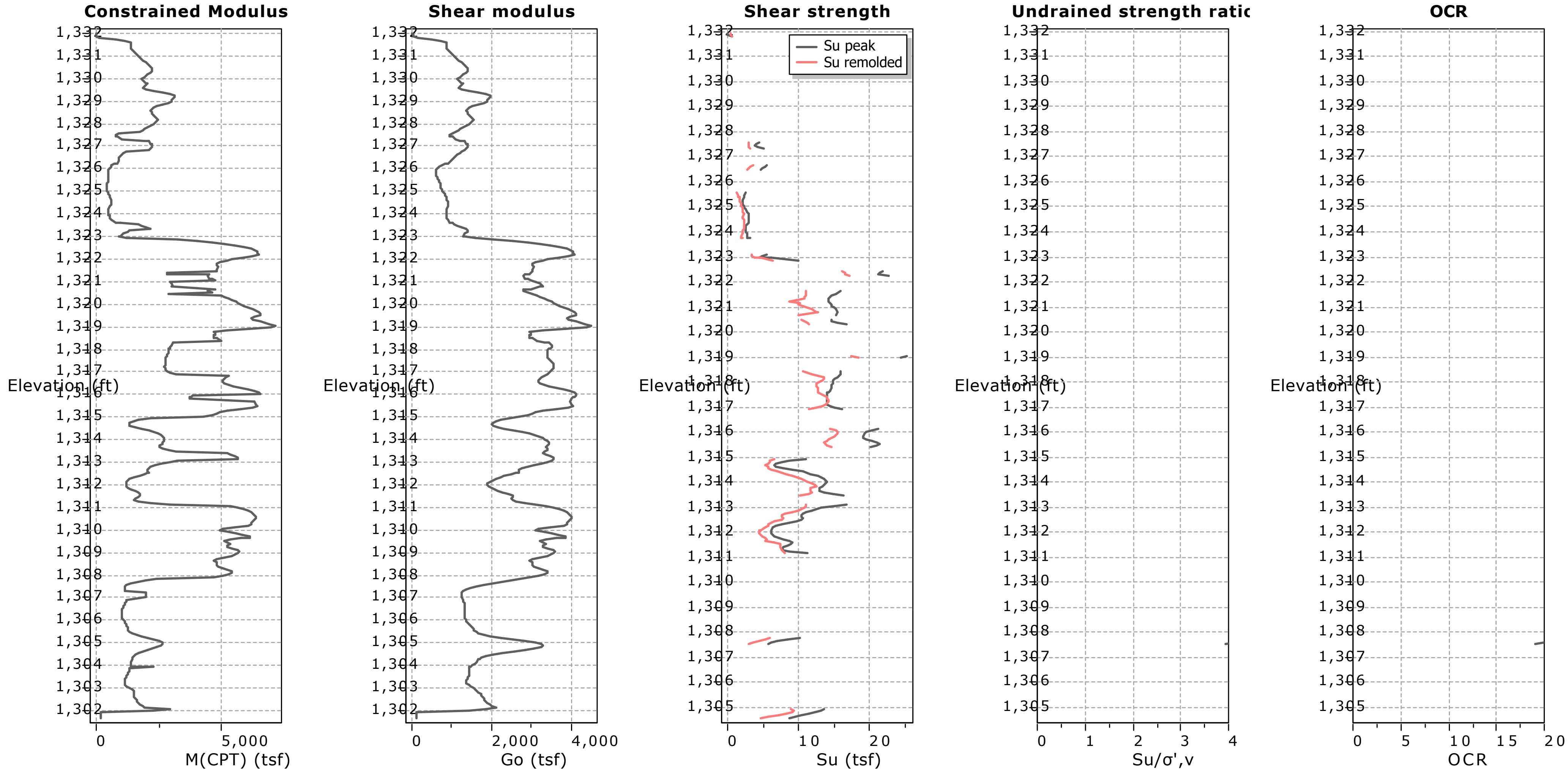

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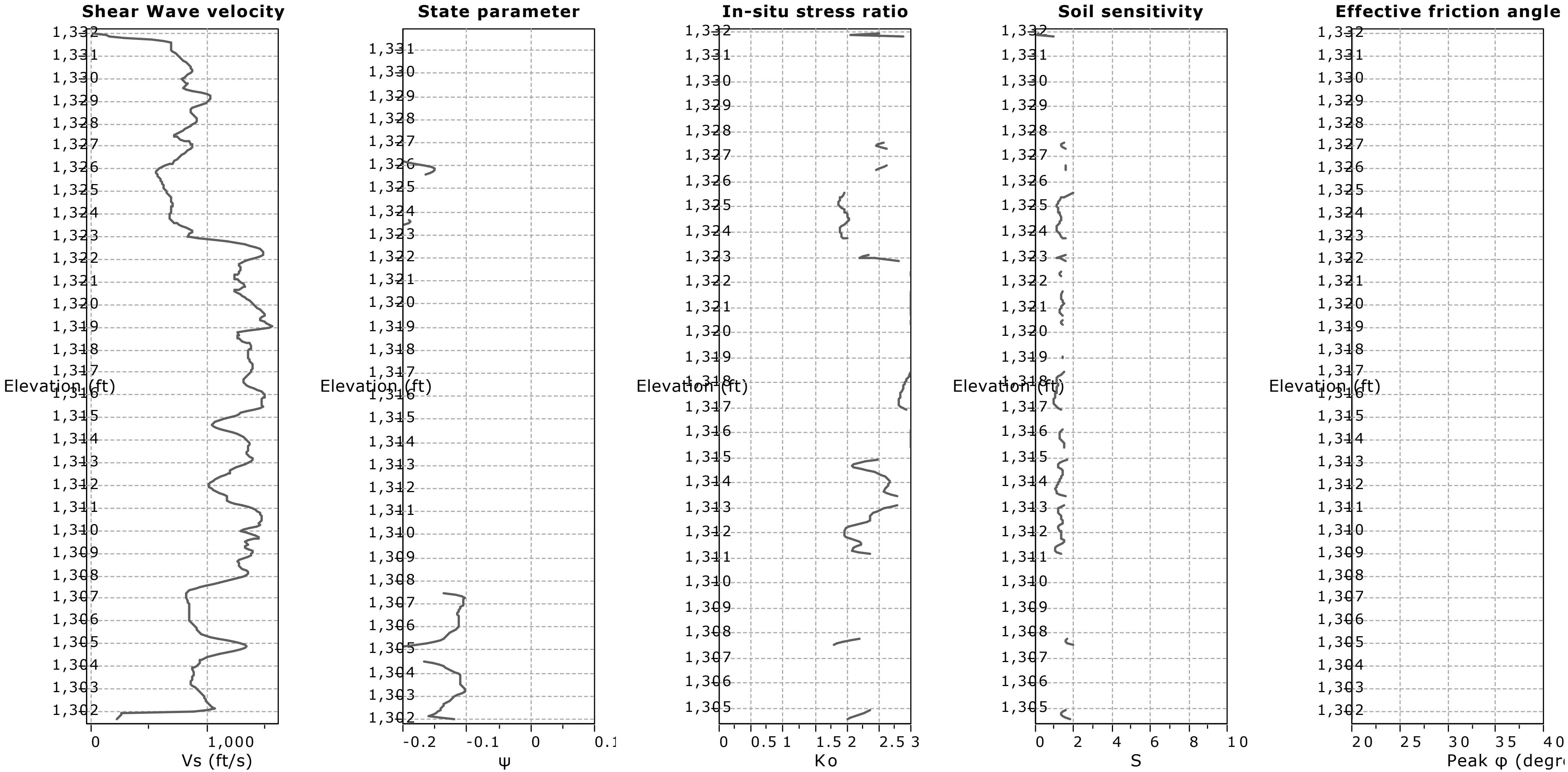
CPT: CPT-2

Total depth: 30.34 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Project: **UHS Inland Valley Reg. Med. Center**
Location: **36485 Inland Valley Dr., Wildomar, CA**



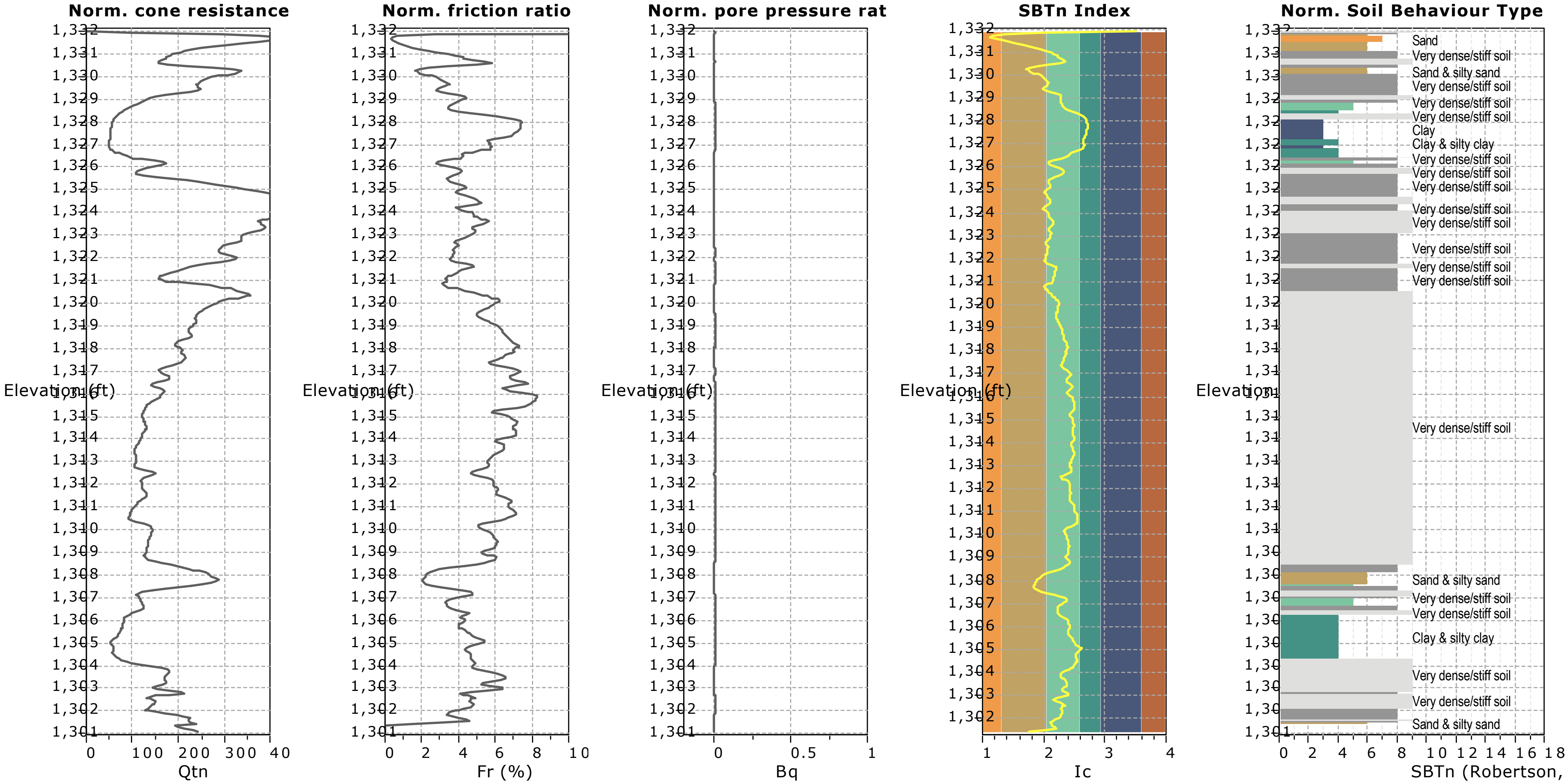
Calculation parameters

Soil Sensitivity factor, N_S: 7.00
User defined estimation data

NOVA Services, Inc.
4373 Viewridge, Suite B
San Diego, CA 92123
858-292-7575

CPT: CPT-3
Total depth: 30.91 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Project: **UHS Inland Valley Reg. Med. Center**
Location: **36485 Inland Valley Dr., Wildomar, CA**



SBTn legend

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

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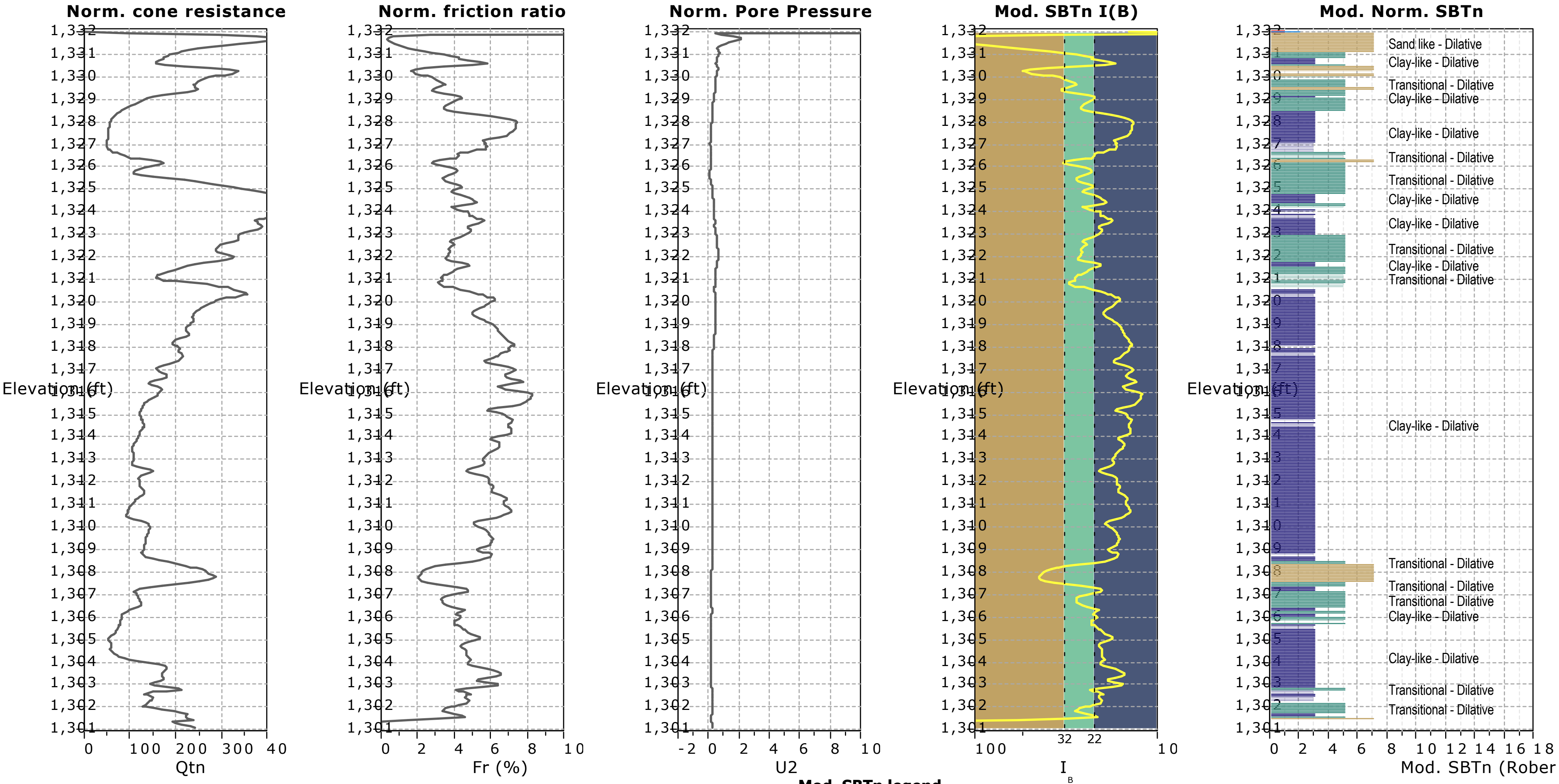
858-292-7575

Project: UHS Inland Valley Reg. Med. Center
Location: 36485 Inland Valley Dr., Wildomar, CA

CPT: CPT-3
Total depth: 30.91 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering



Mod. SBTn legend

- 1. CCS: ClayLike - Contractive, Sensitive
- 2. CC: Clay-like - Contractive
- 3. CD: Clay-Like: Dilative
- 4. TC: Transitional - Contractive
- 5. TD: Transitional - Dilative
- 6. SC: Sand-like - Contractive
- 7. SD: Sand-like - Dilative

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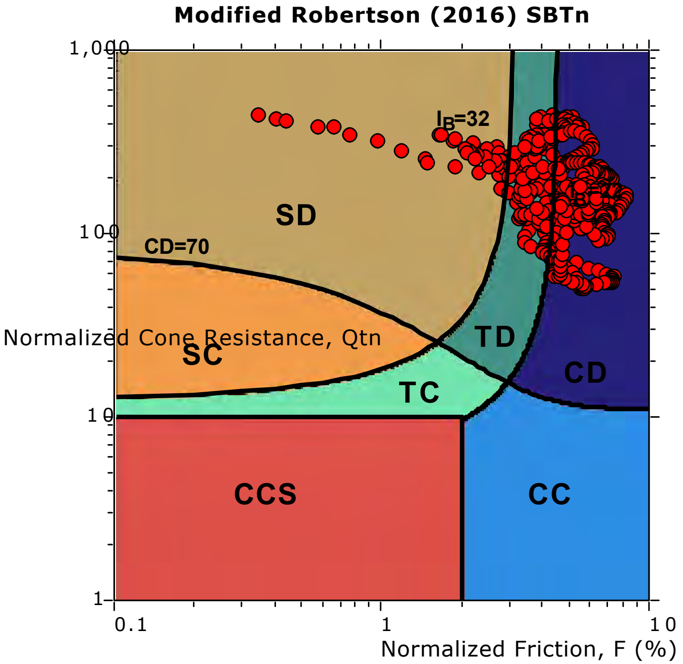
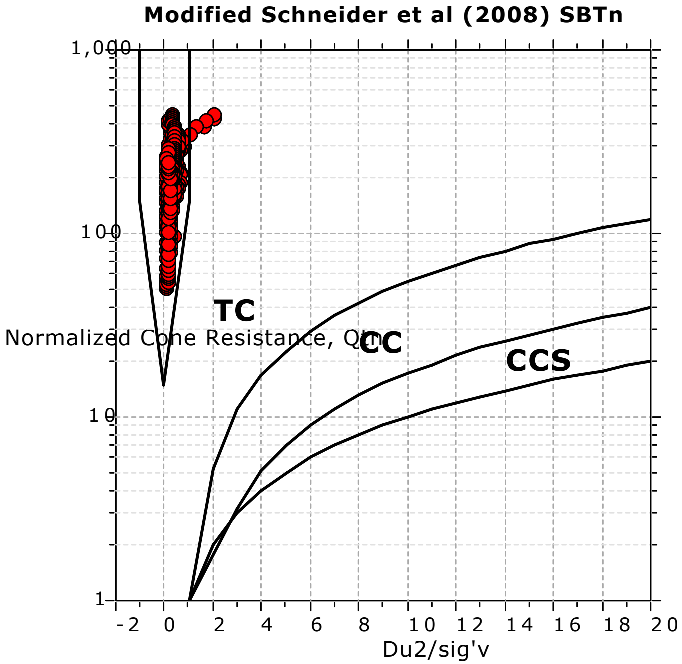
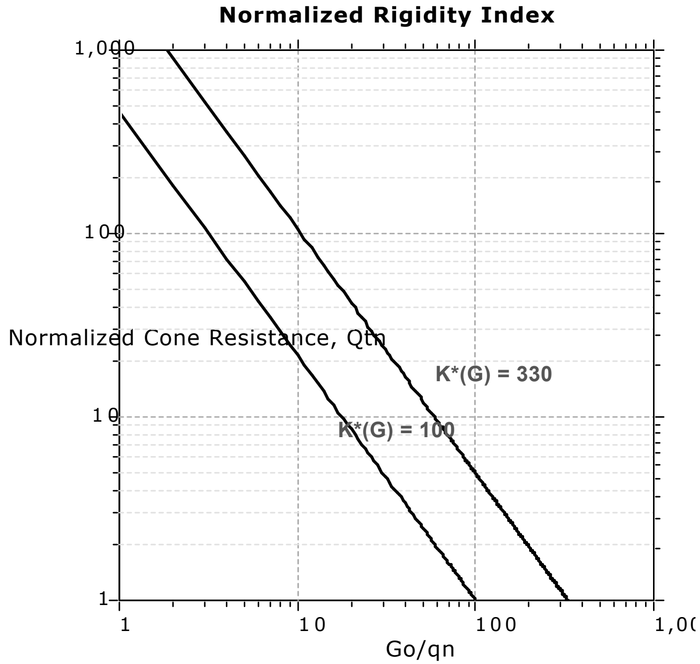
CPT: CPT-3
Total depth: 30.91 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Project: **UHS Inland Valley Reg. Med. Center**
Location: **36485 Inland Valley Dr., Wildomar, CA**

Updated SBTn plots







CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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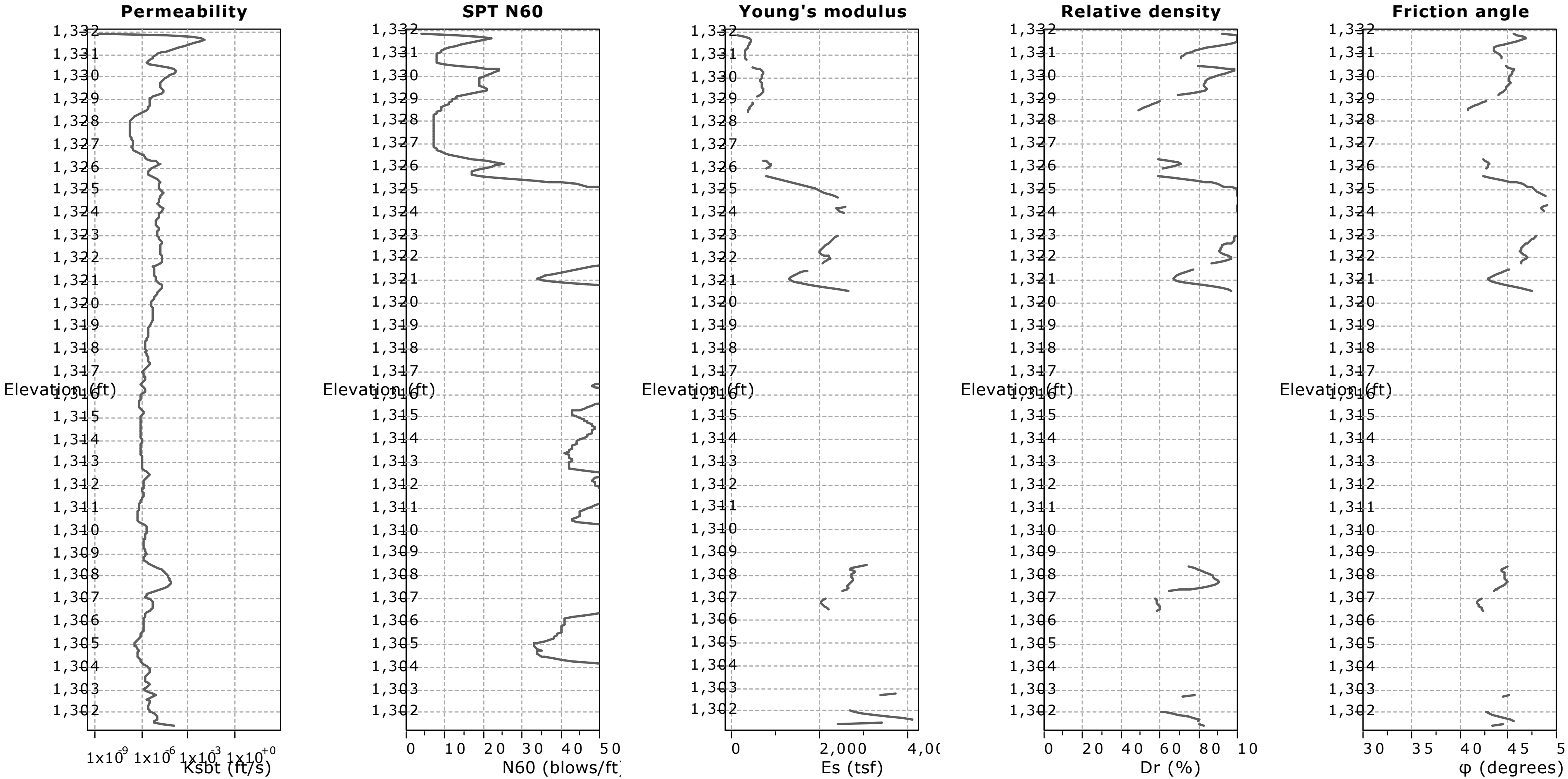
San Diego, CA 92123
858-292-7575

CPT: CPT-3
Total depth: 30.91 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Project: **UHS Inland Valley Reg. Med. Center**
Location: **36485 Inland Valley Dr., Wildomar, CA**



Calculation parameters
Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

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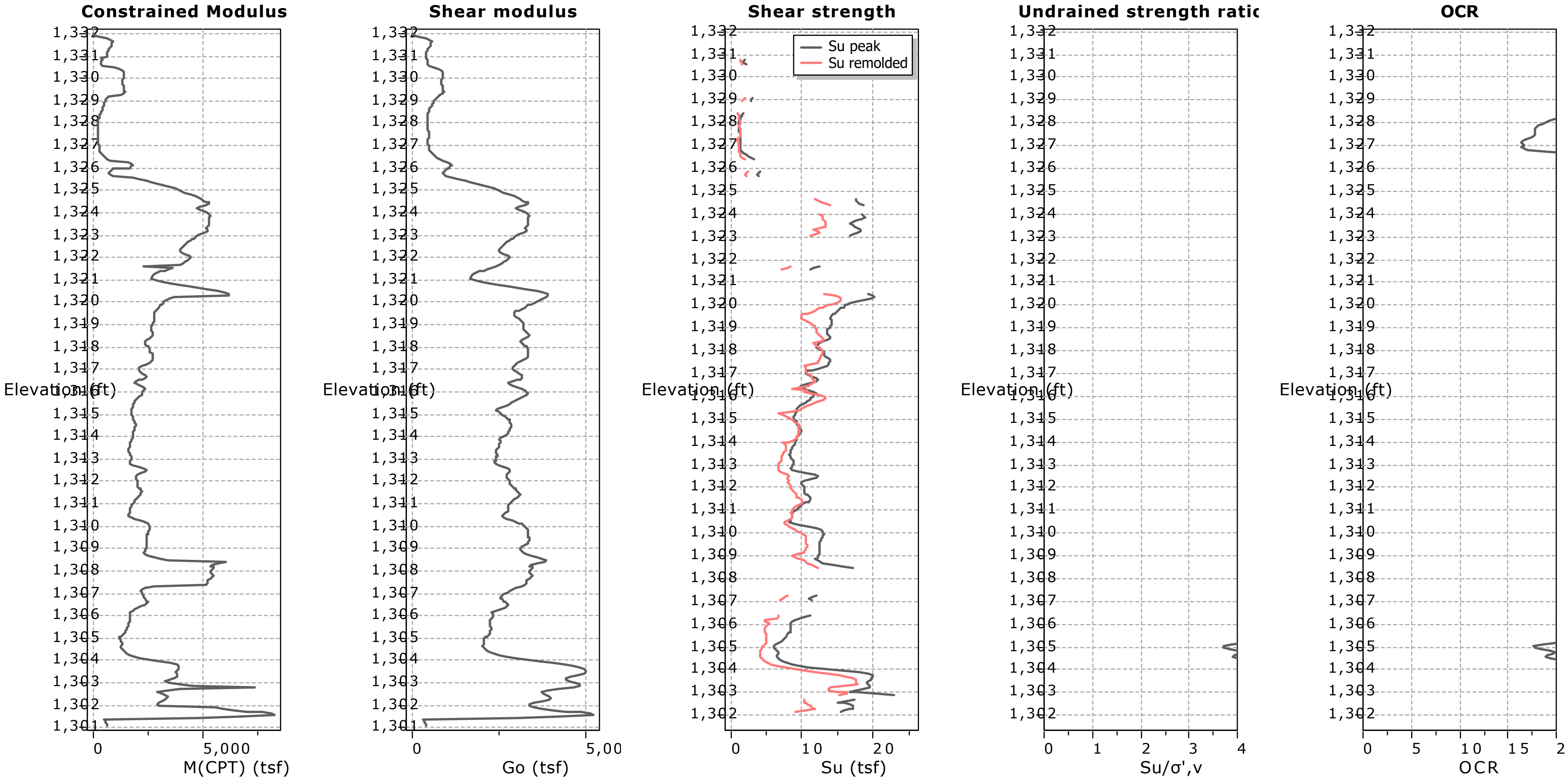
San Diego, CA 92123
858-292-7575

CPT: CPT-3
Total depth: 30.91 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Project: UHS Inland Valley Reg. Med. Center
Location: 36485 Inland Valley Dr., Wildomar, CA



Calculation parameters

Constrained modulus: Based on variable alpha using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable alpha using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

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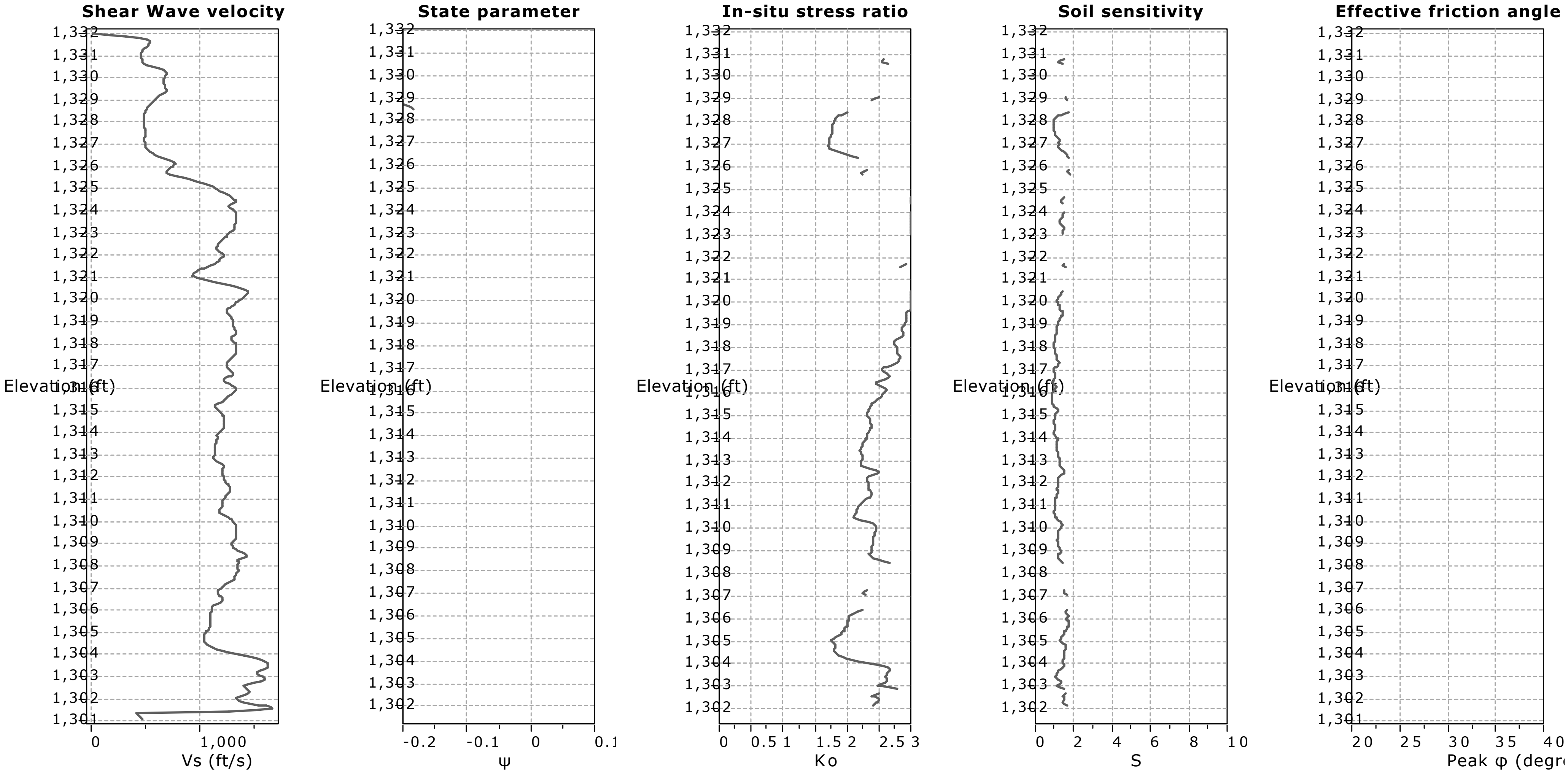
San Diego, CA 92123
858-292-7575

CPT: CPT-3
Total depth: 30.91 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Project: **UHS Inland Valley Reg. Med. Center**
Location: **36485 Inland Valley Dr., Wildomar, CA**



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

User defined estimation data

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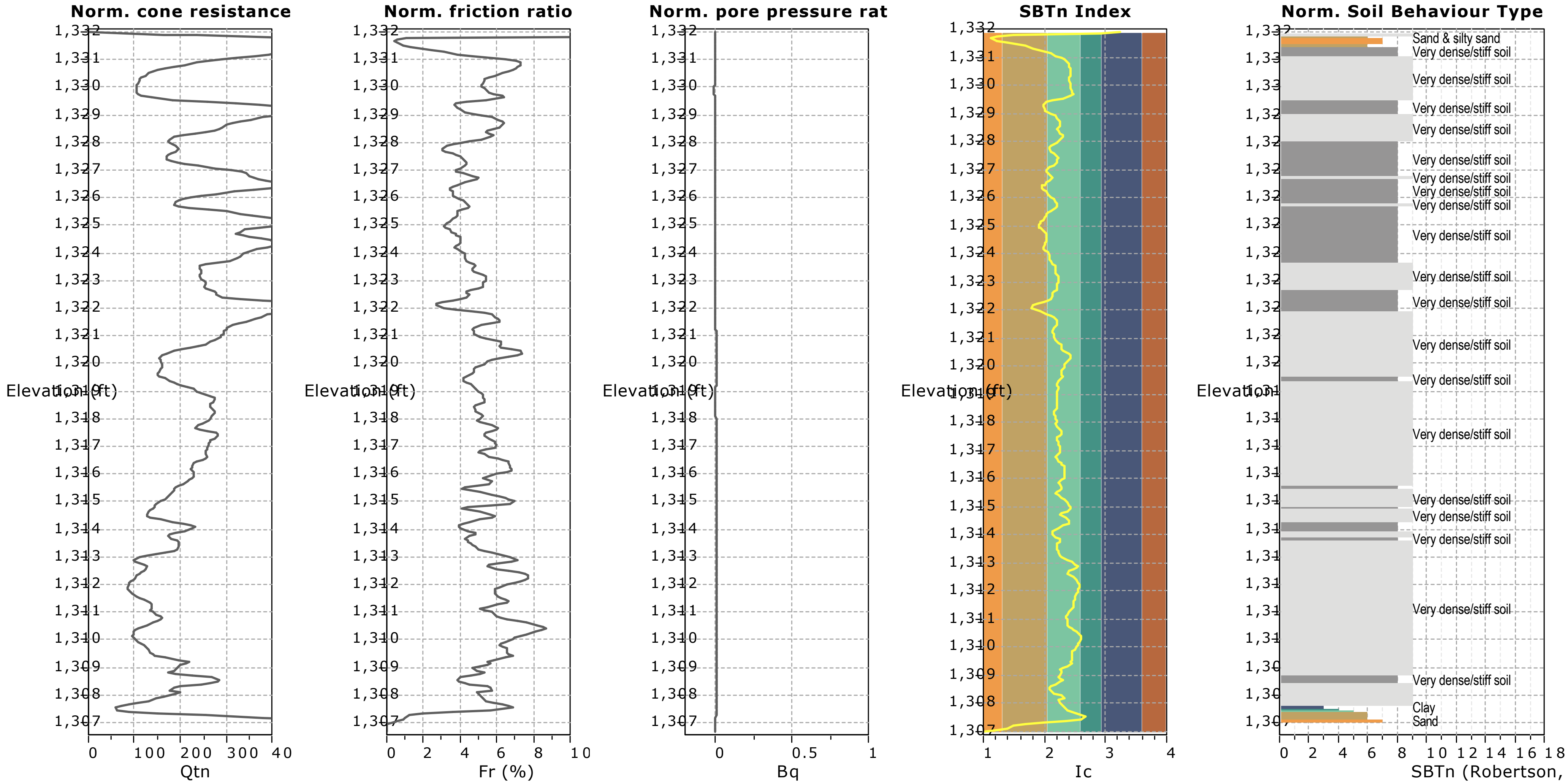
San Diego, CA 92123
858-292-7575

CPT: CPT-4
Total depth: 25.33 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Project: UHS Inland Valley Reg. Med. Center
Location: 36485 Inland Valley Dr., Wildomar, CA



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

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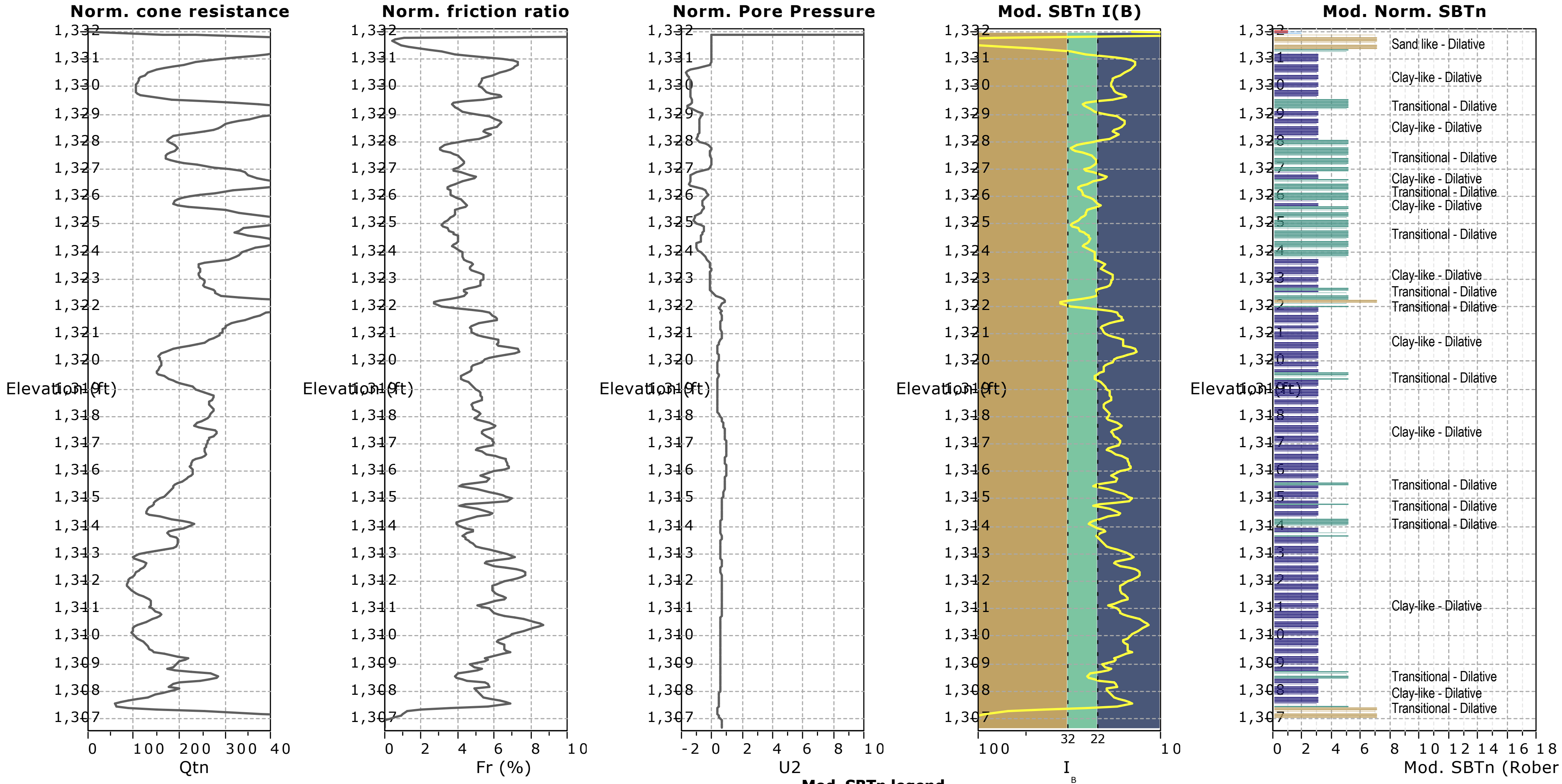
858-292-7575

CPT: CPT-4

Total depth: 25.33 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Project: UHS Inland Valley Reg. Med. Center
Location: 36485 Inland Valley Dr., Wildomar, CA



Mod. SBTn legend

- 1. CCS: ClayLike - Contractive, Sensitive
- 2. CC: Clay-like - Contractive
- 3. CD: Clay-Like: Dilative
- 4. TC: Transitional - Contractive
- 5. TD: Transitional - Dilative
- 6. SC: Sand-like - Contractive
- 7. SD: Sand-like - Dilative

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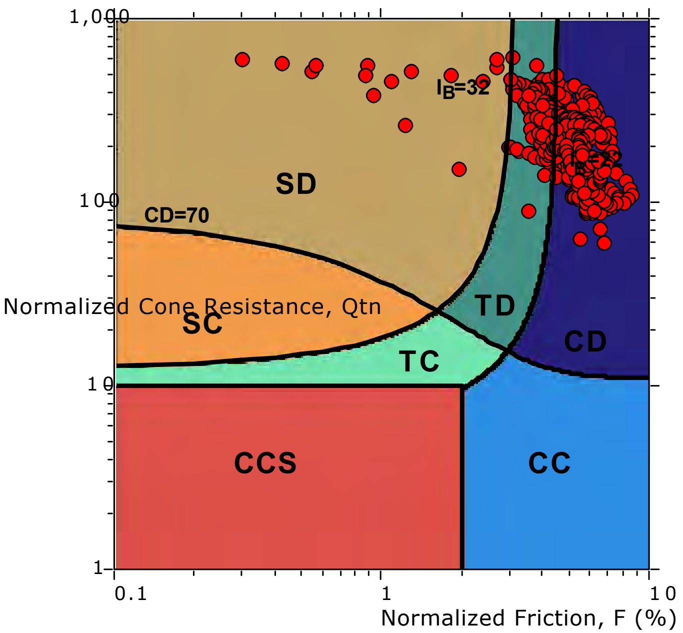
Project: UHS Inland Valley Reg. Med. Center
Location: 36485 Inland Valley Dr., Wildomar, CA

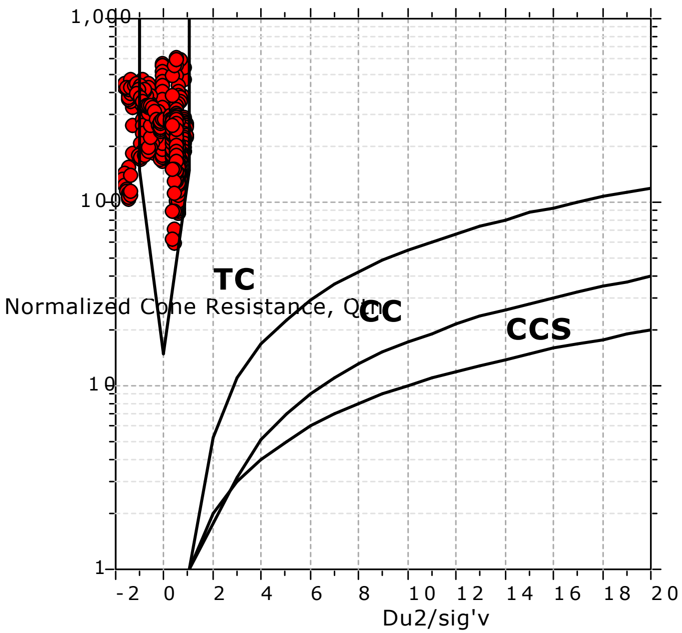
CPT: CPT-4
Total depth: 25.33 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Updated SBTn plots

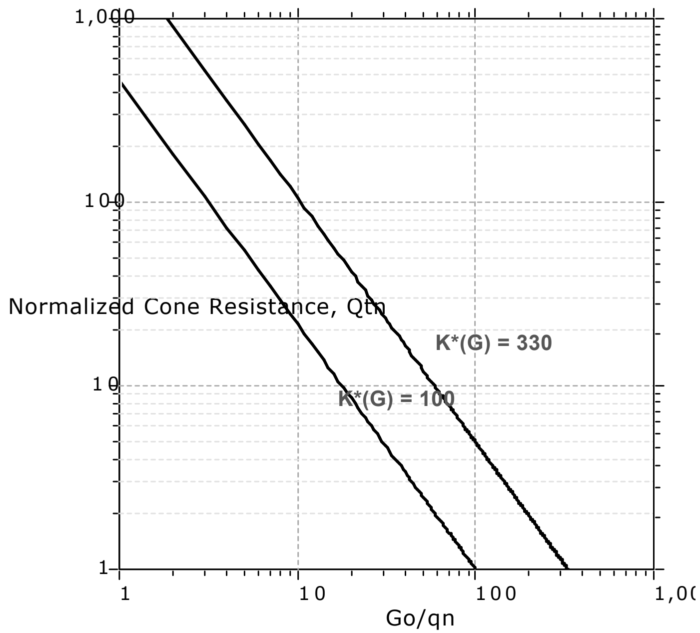
Modified Robertson (2016) SBTn



Modified Schneider et al (2008) SBTn



Normalized Rigidity Index



CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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San Diego, CA 92123
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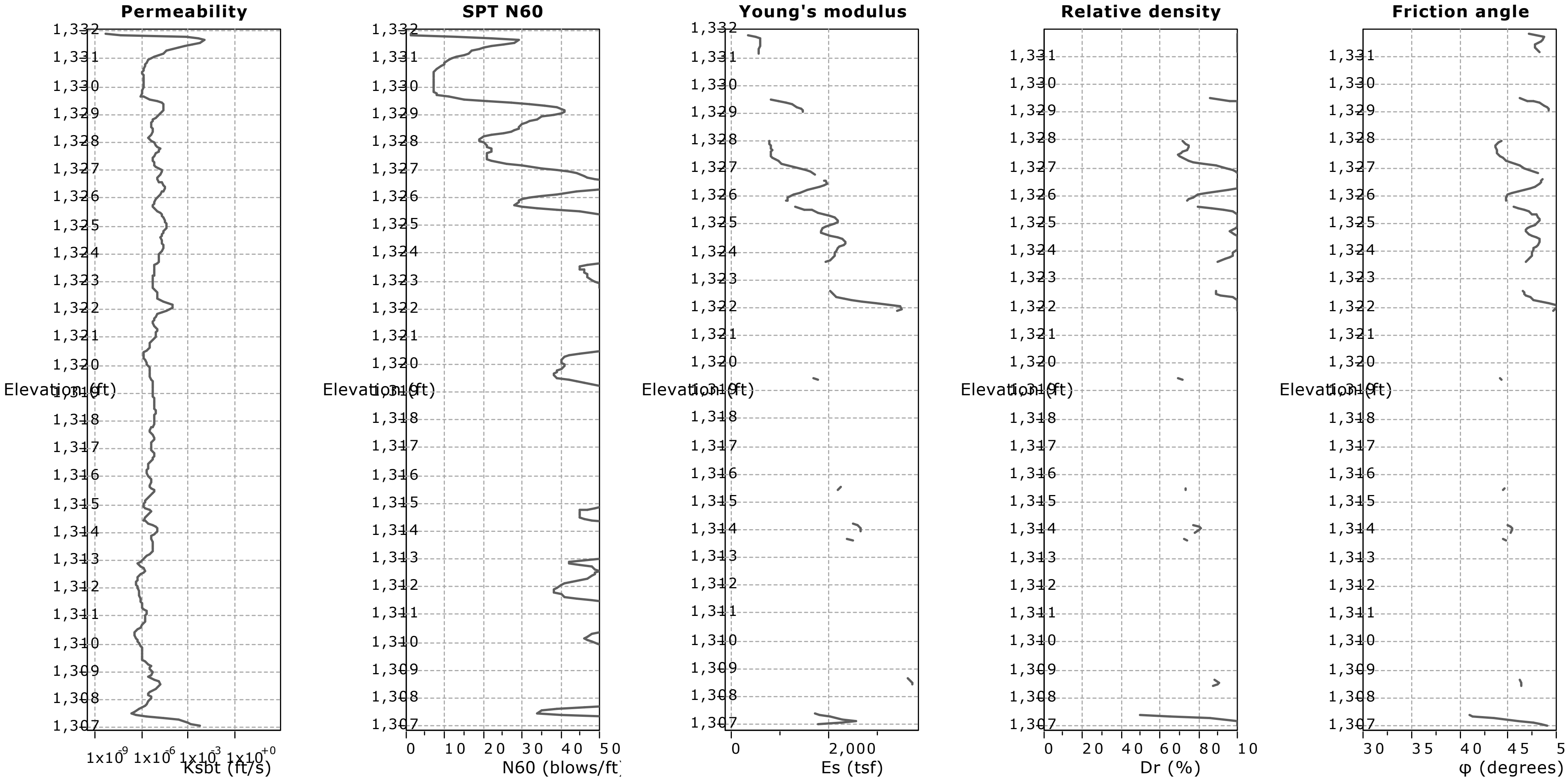
CPT: CPT-4
Total depth: 25.33 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Project: **UHS Inland Valley Reg. Med. Center**
Location: **36485 Inland Valley Dr., Wildomar, CA**



Calculation parameters
Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

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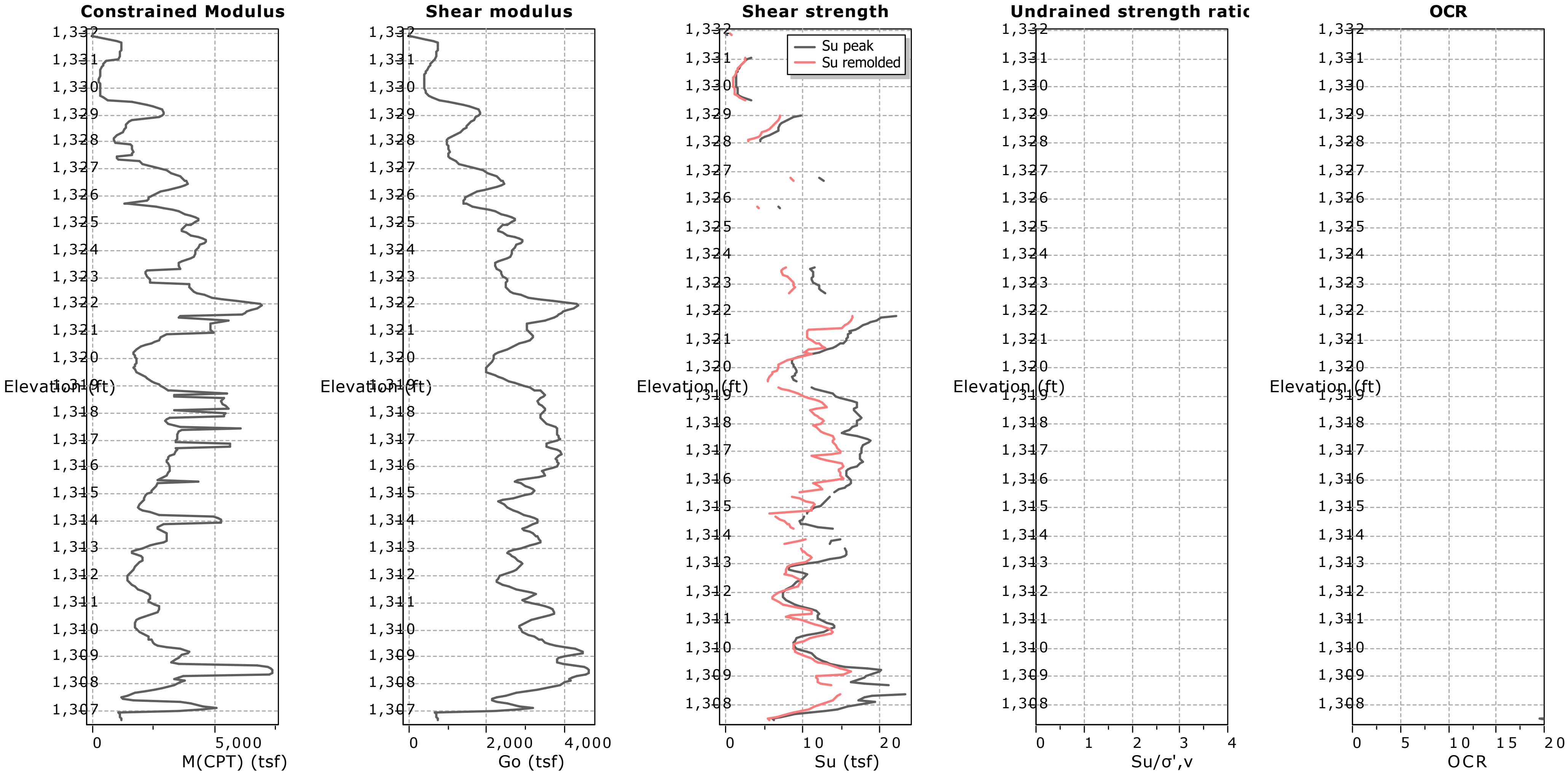
San Diego, CA 92123
858-292-7575

CPT: CPT-4
Total depth: 25.33 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Project: **UHS Inland Valley Reg. Med. Center**
Location: **36485 Inland Valley Dr., Wildomar, CA**



Calculation parameters

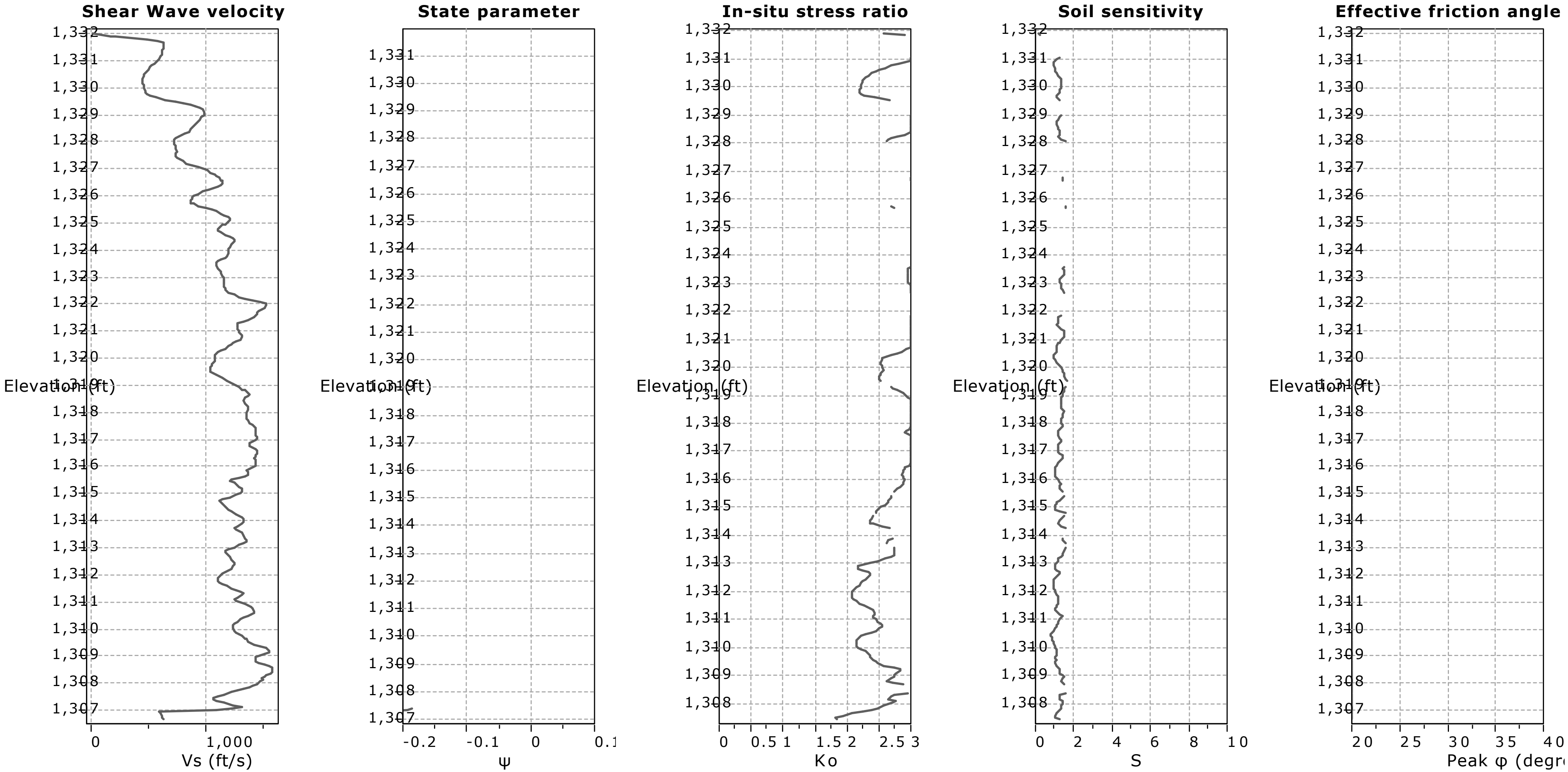
Constrained modulus: Based on variable alpha using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable alpha using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14
OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

NOVA Services, Inc.
4373 Viewridge, Suite B
San Diego, CA 92123
858-292-7575

CPT: CPT-4

Total depth: 25.33 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Project: UHS Inland Valley Reg. Med. Center
Location: 36485 Inland Valley Dr., Wildomar, CA



Calculation parameters

Soil Sensitivity factor, N_S: 7.00
User defined estimation data

NOVA Services, Inc.
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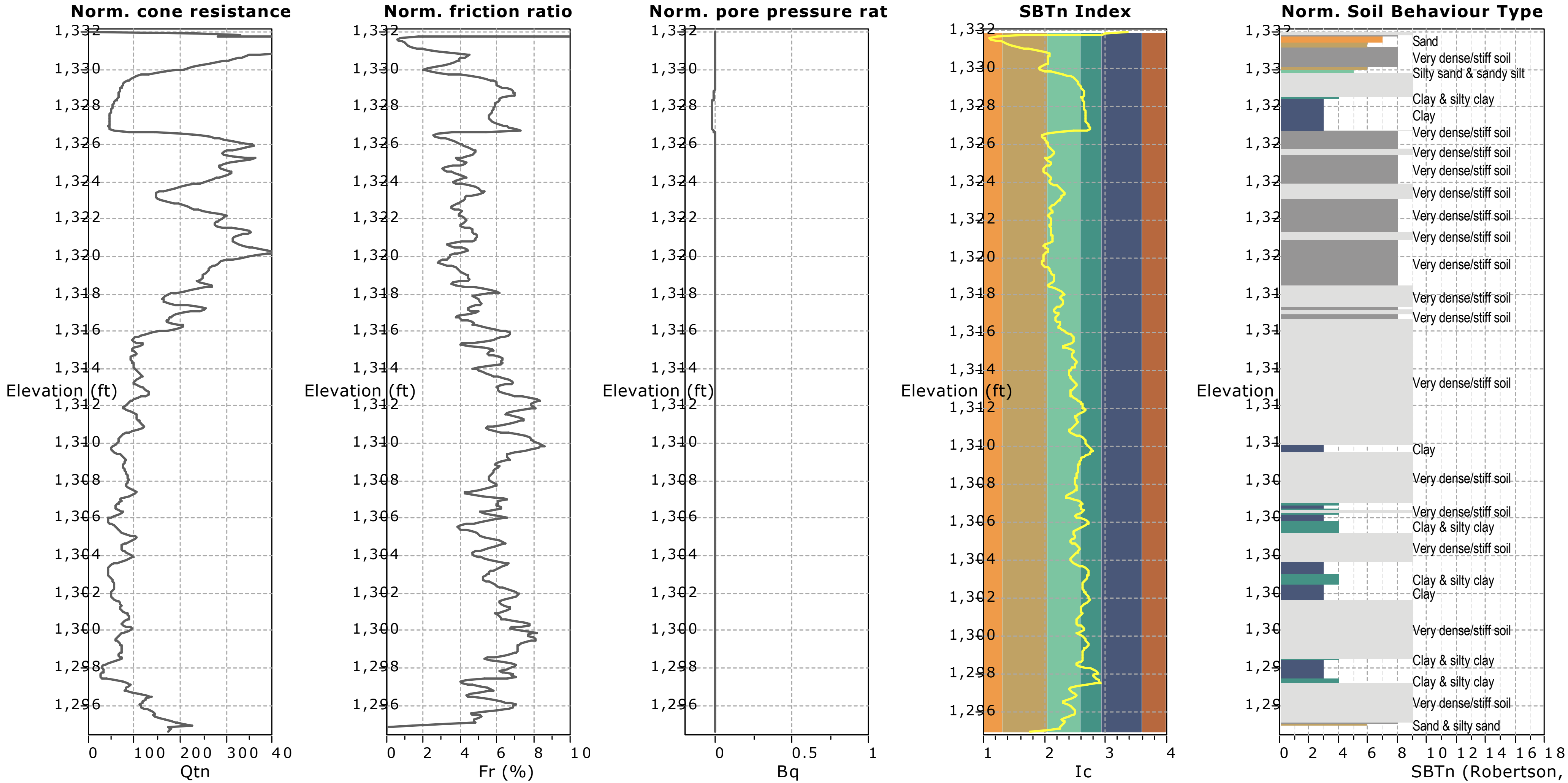
San Diego, CA 92123
858-292-7575

CPT: CPT-5
Total depth: 37.41 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Project: UHS Inland Valley Reg. Med. Center
Location: 36485 Inland Valley Dr., Wildomar, CA



SBTn legend

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

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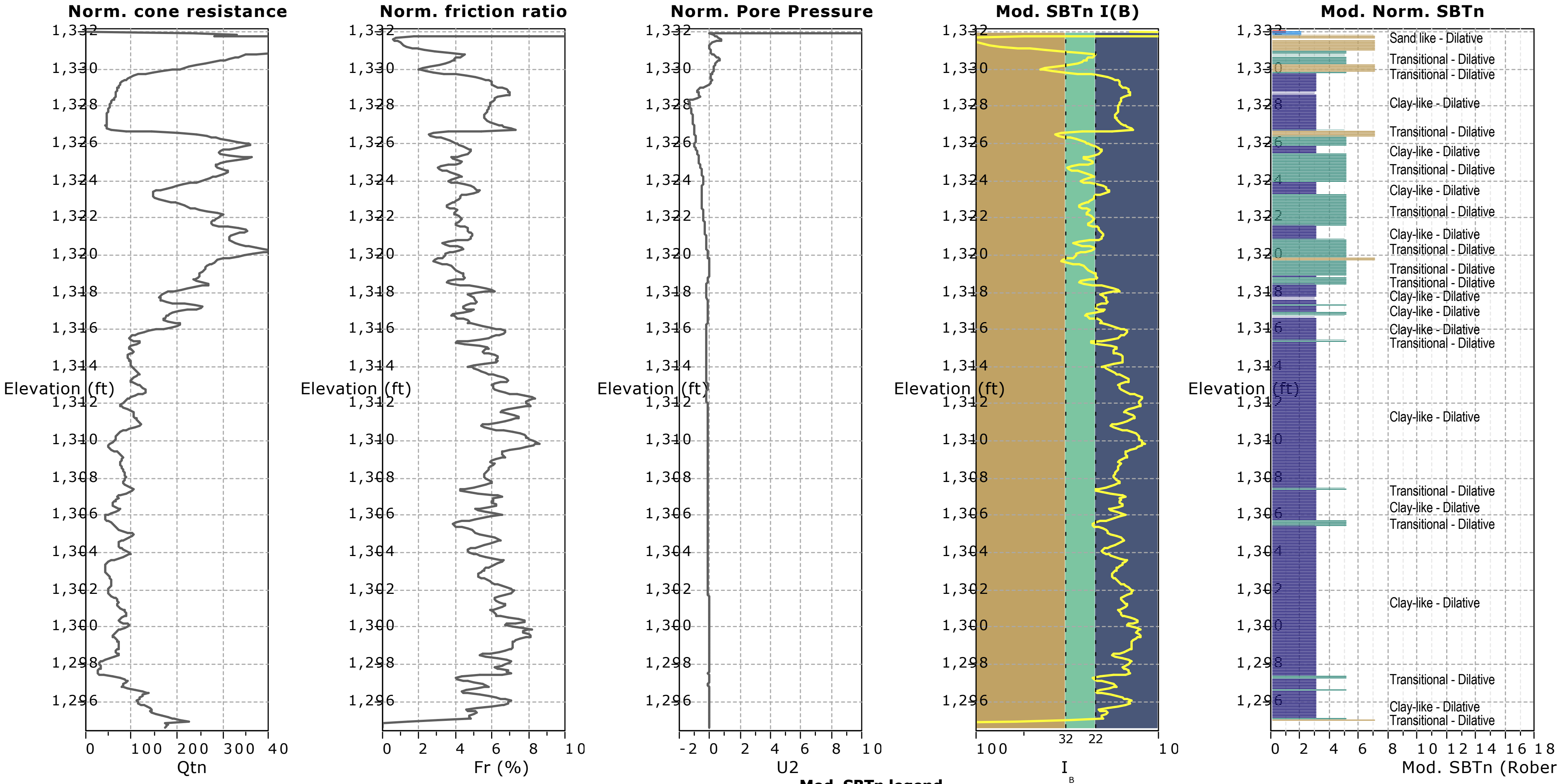
San Diego, CA 92123
858-292-7575

CPT: CPT-5
Total depth: 37.41 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Project: UHS Inland Valley Reg. Med. Center
Location: 36485 Inland Valley Dr., Wildomar, CA



Mod. SBTn legend
1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

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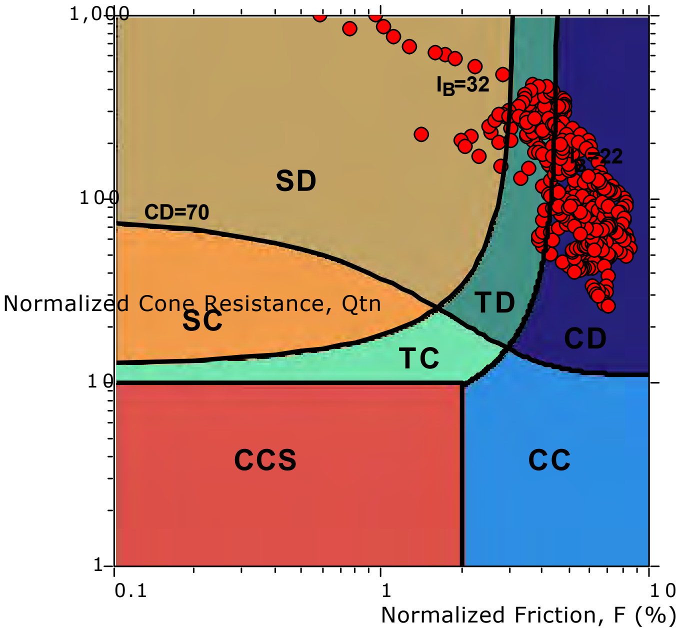
San Diego, CA 92123
858-292-7575

Project: **UHS Inland Valley Reg. Med. Center**
Location: **36485 Inland Valley Dr., Wildomar, CA**

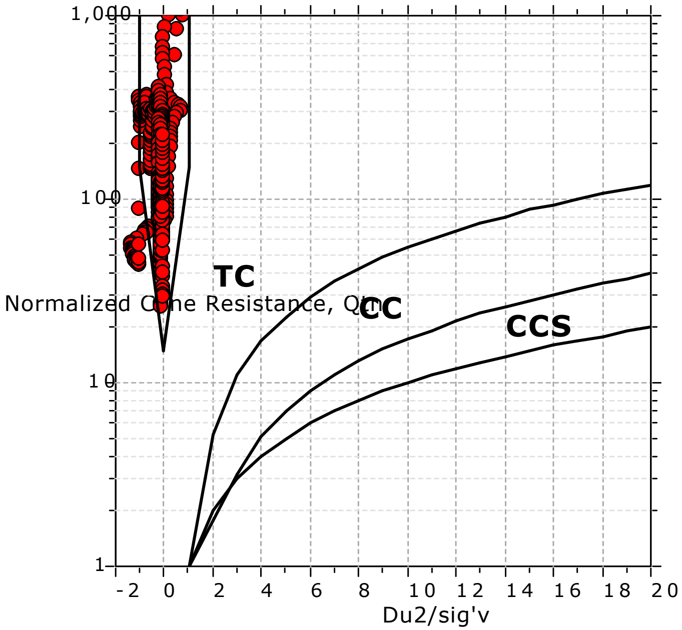
CPT: CPT-5
Total depth: 37.41 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Updated SBTn plots

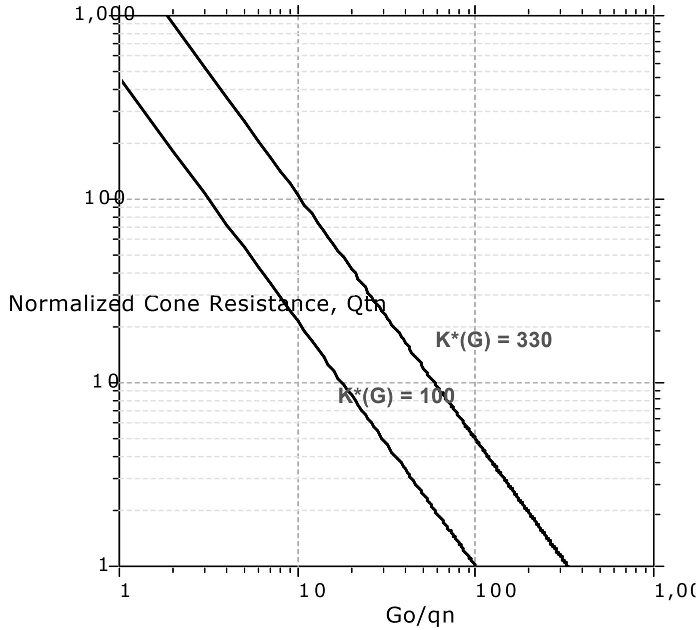
Modified Robertson (2016) SBTn



Modified Schneider et al (2008) SBTn



Normalized Rigidity Index



CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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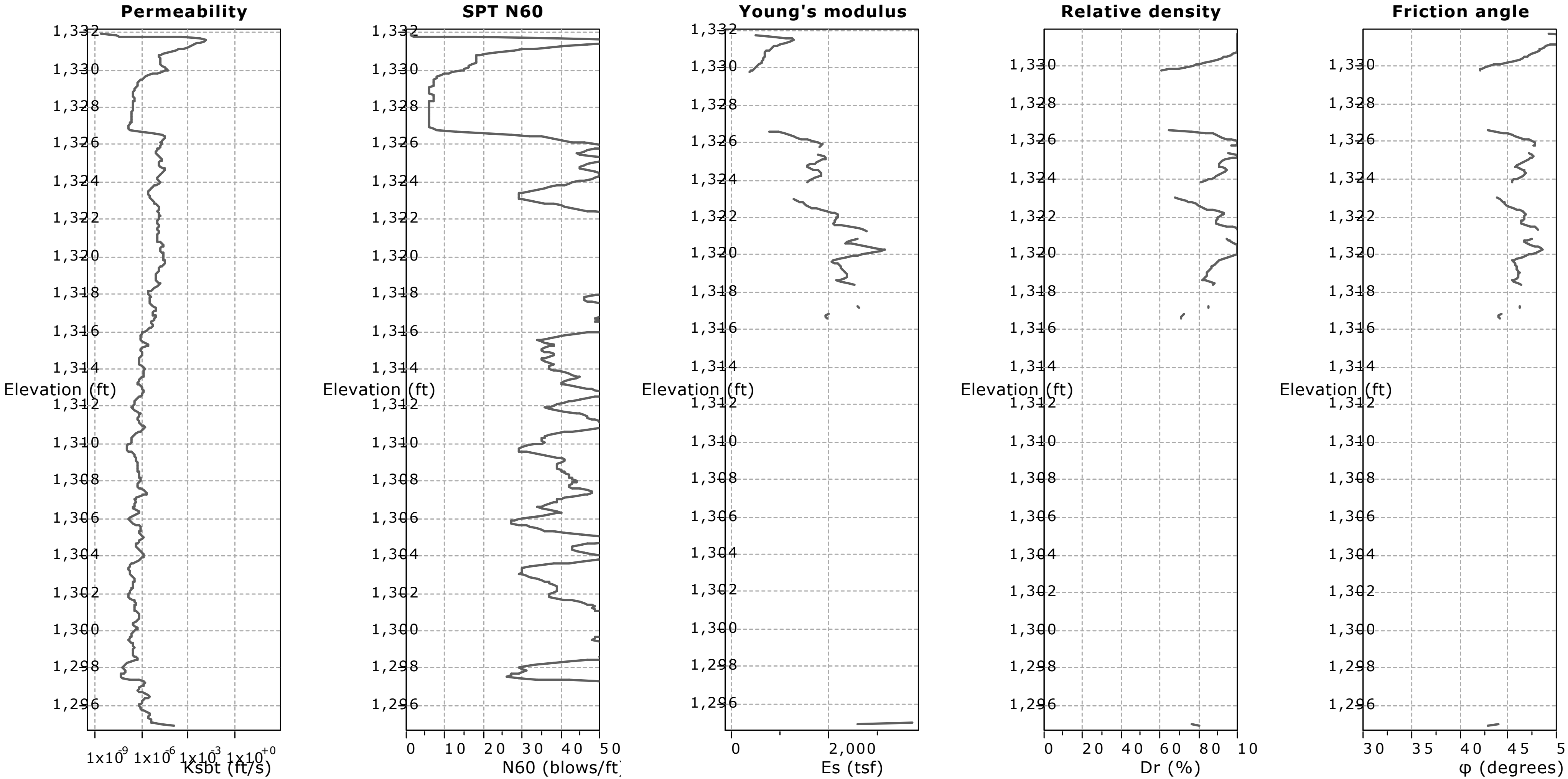
4373 Viewridge, Suite B
San Diego, CA 92123
858-292-7575

CPT: CPT-5

Total depth: 37.41 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Project: **UHS Inland Valley Reg. Med. Center**
Location: **36485 Inland Valley Dr., Wildomar, CA**



Calculation parameters

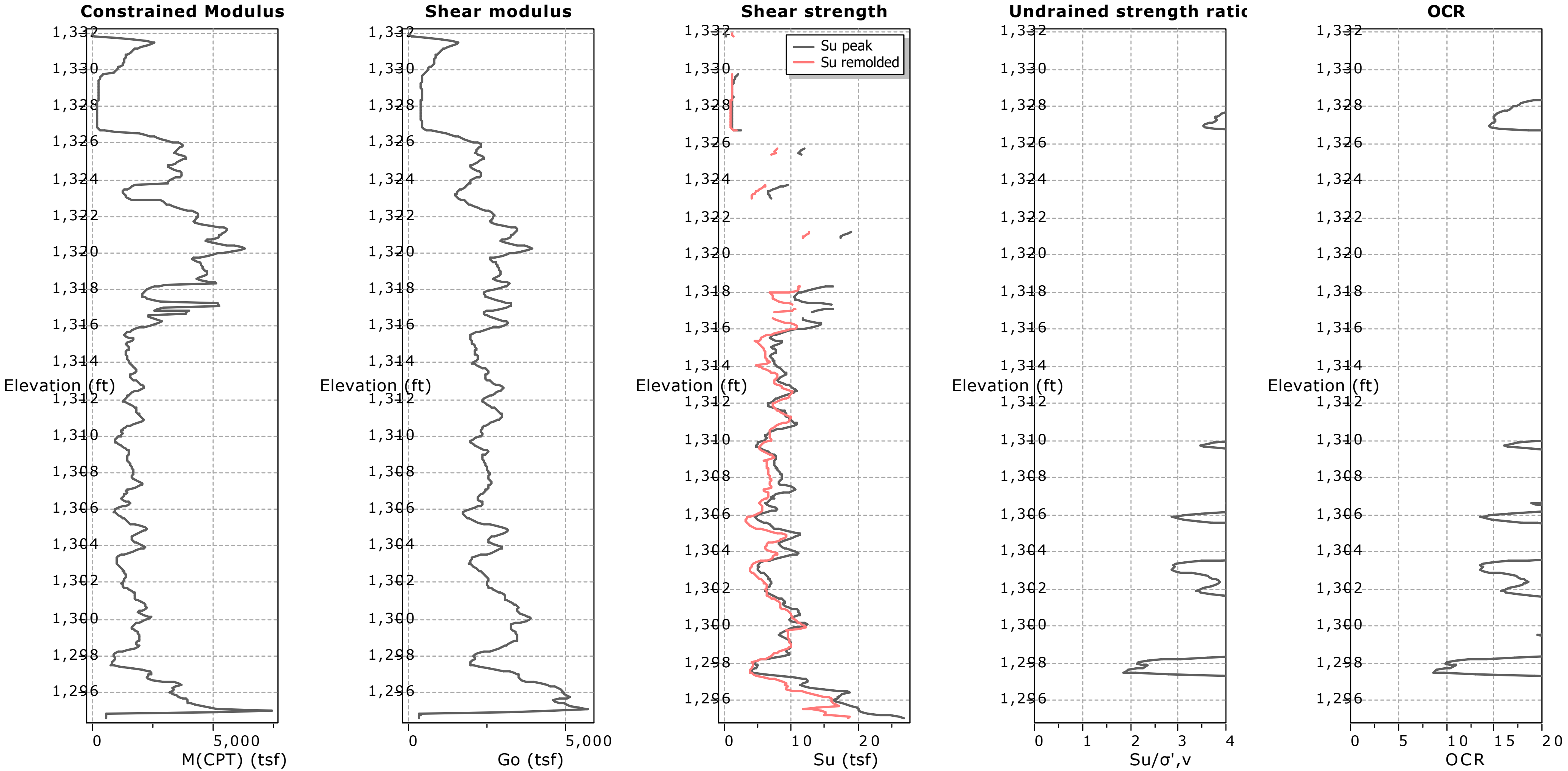
Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

NOVA Services, Inc.
4373 Viewridge, Suite B
San Diego, CA 92123
858-292-7575

CPT: CPT-5

Total depth: 37.41 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Project: **UHS Inland Valley Reg. Med. Center**
Location: **36485 Inland Valley Dr., Wildomar, CA**



Calculation parameters

Constrained modulus: Based on variable alpha using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable alpha using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

NOVA Services, Inc.
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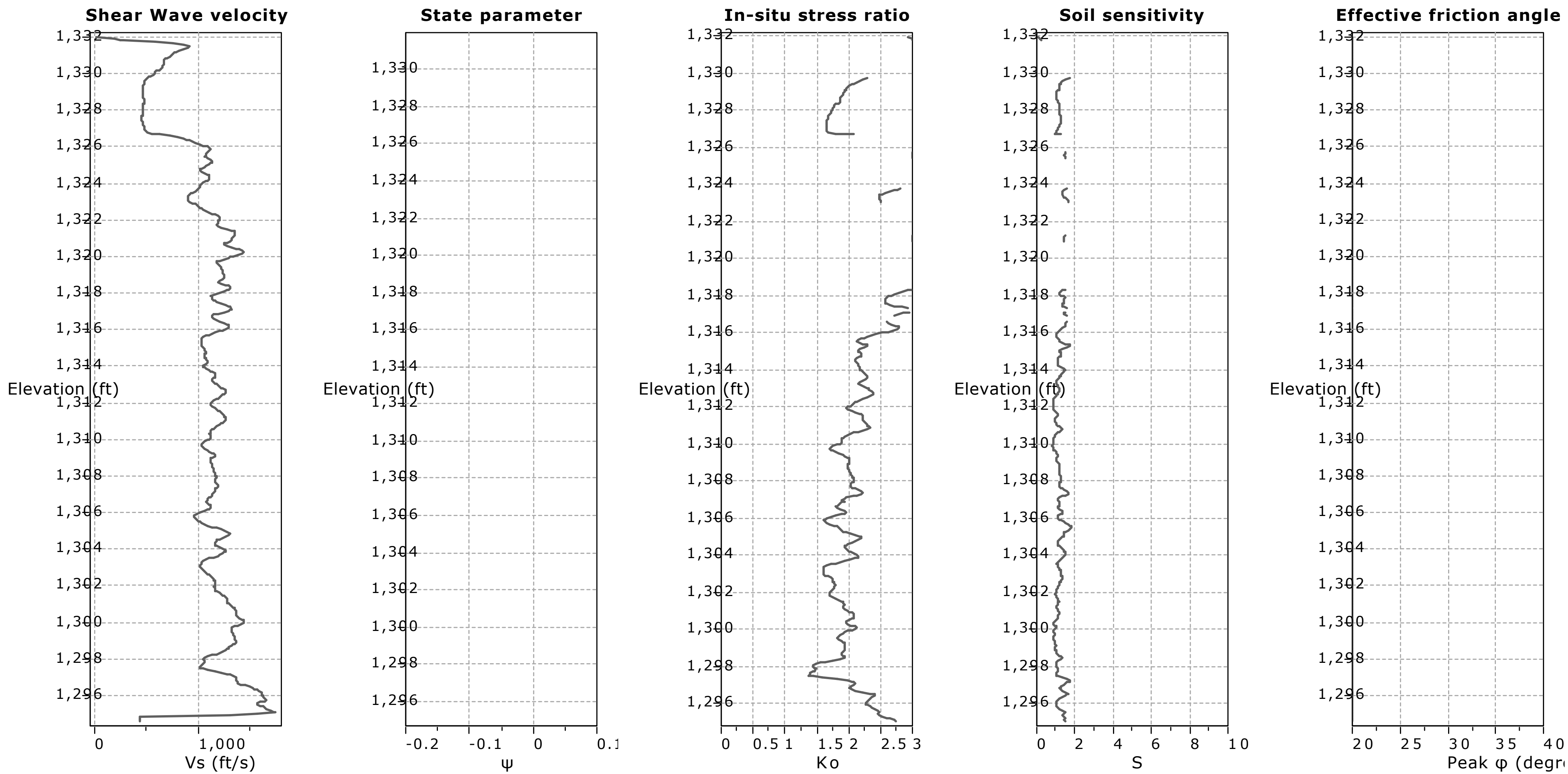
San Diego, CA 92123
858-292-7575

CPT: CPT-5
Total depth: 37.41 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Project: **UHS Inland Valley Reg. Med. Center**
Location: **36485 Inland Valley Dr., Wildomar, CA**



Calculation parameters

Soil Sensitivity factor, N_S: 7.00
User defined estimation data

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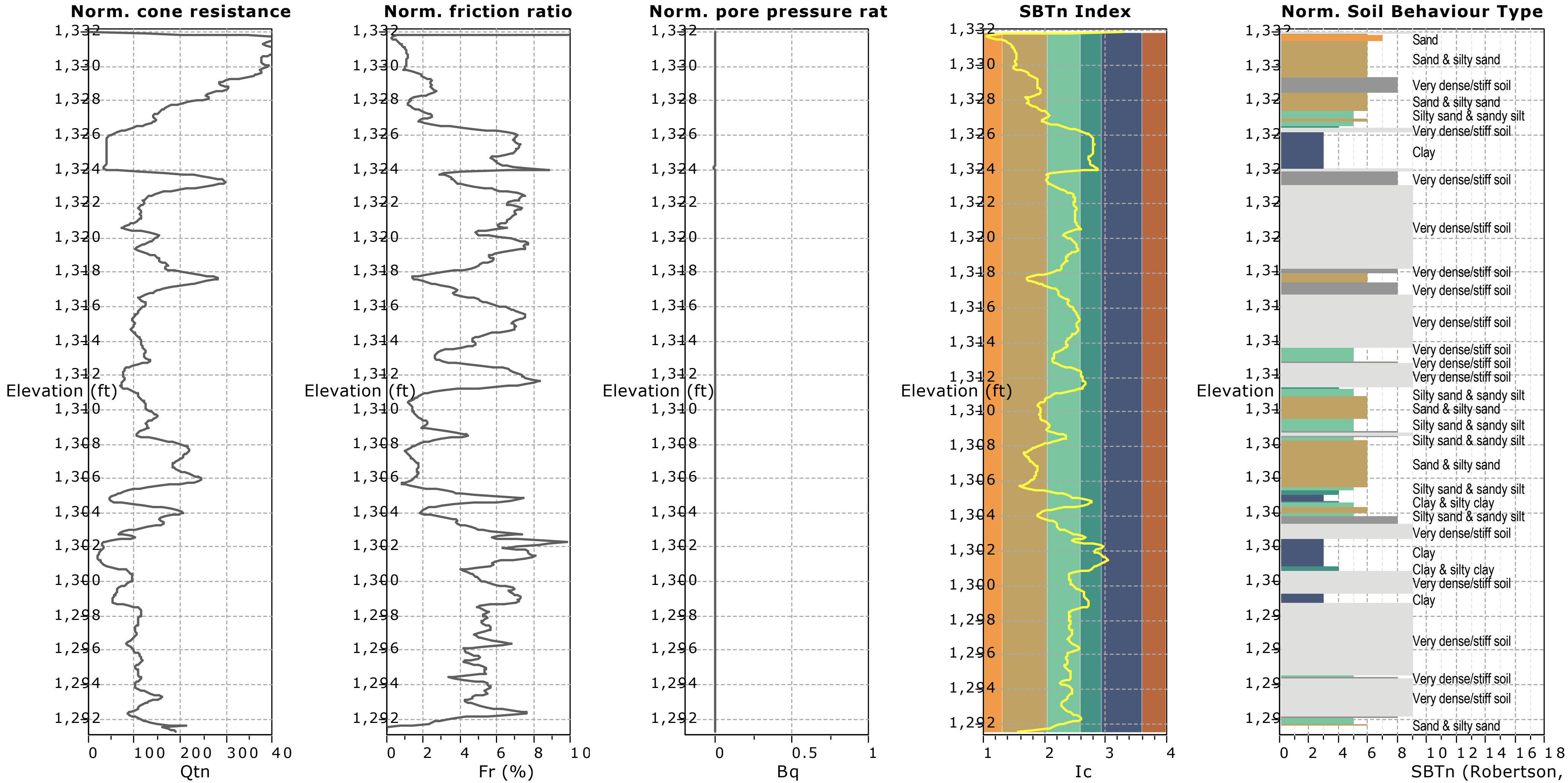
San Diego, CA 92123
858-292-7575

Project: UHS Inland Valley Reg. Med. Center
Location: 36485 Inland Valley Dr., Wildomar, CA

CPT: CPT-6
Total depth: 40.75 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering



SBTn legend

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

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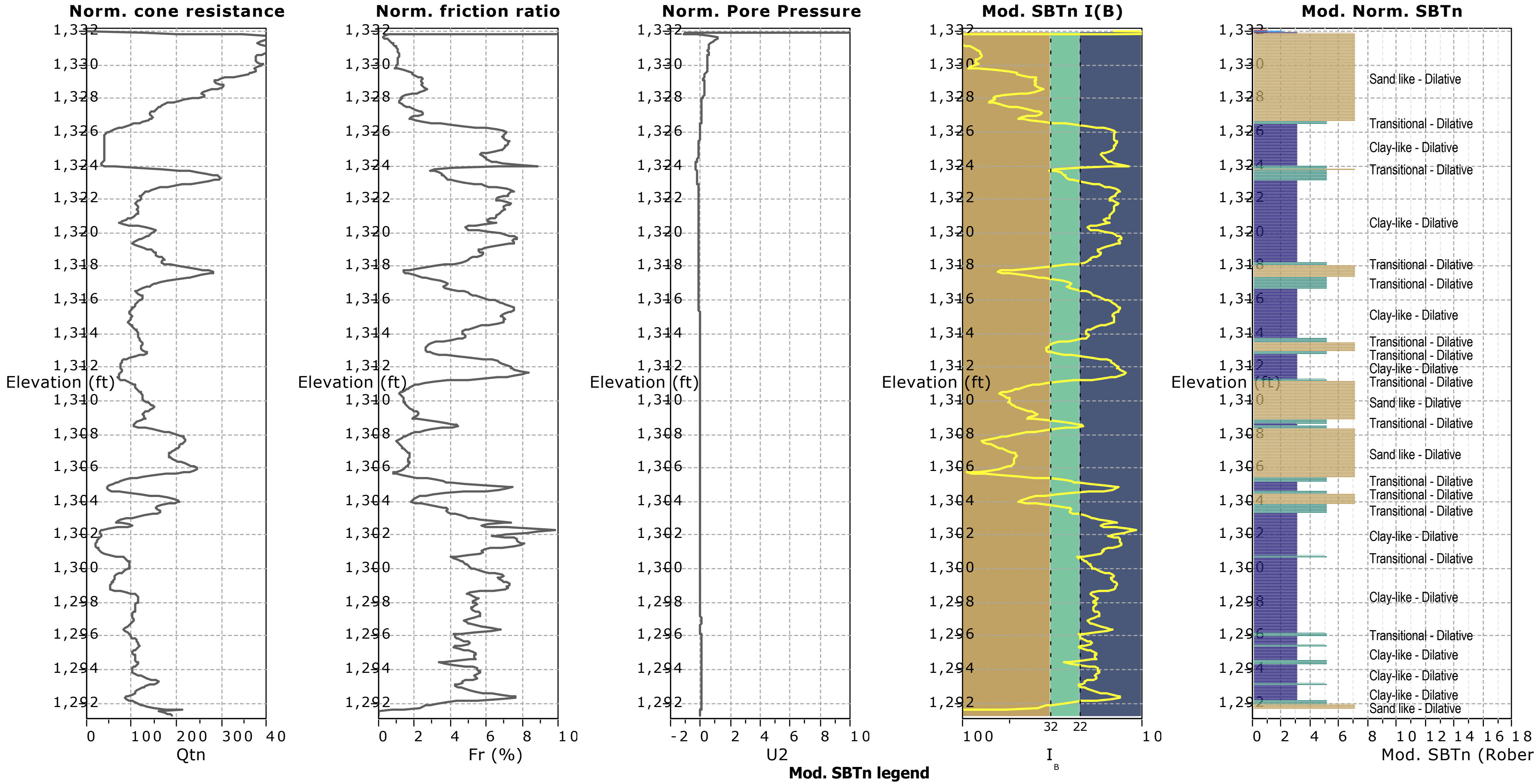
CPT: CPT-6
Total depth: 40.75 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Project: UHS Inland Valley Reg. Med. Center
Location: 36485 Inland Valley Dr., Wildomar, CA



Mod. SBTn legend

1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

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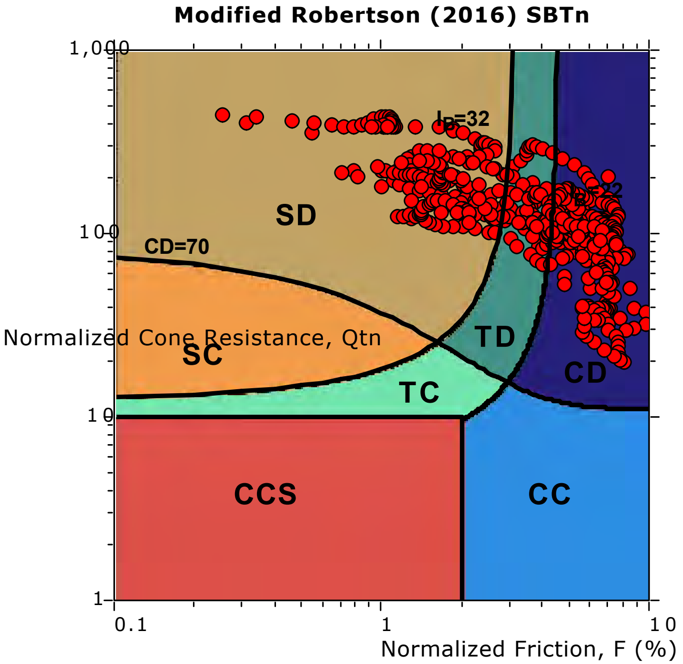
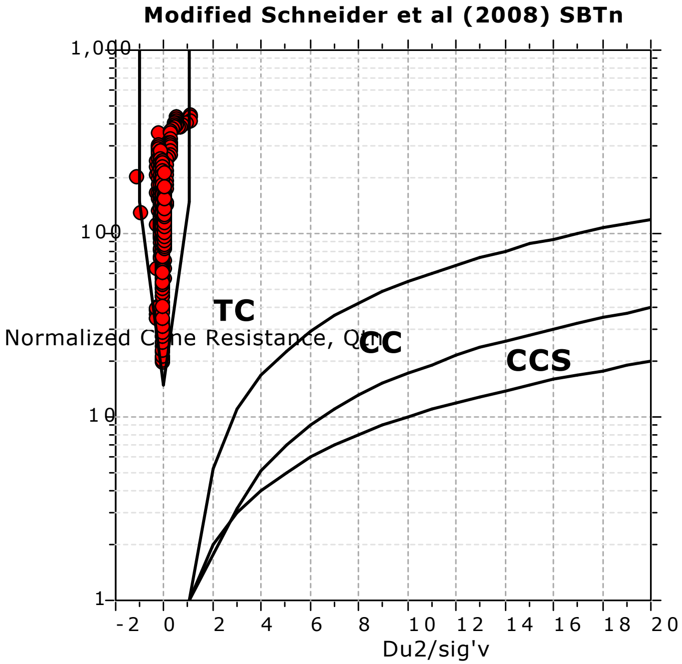
San Diego, CA 92123
858-292-7575

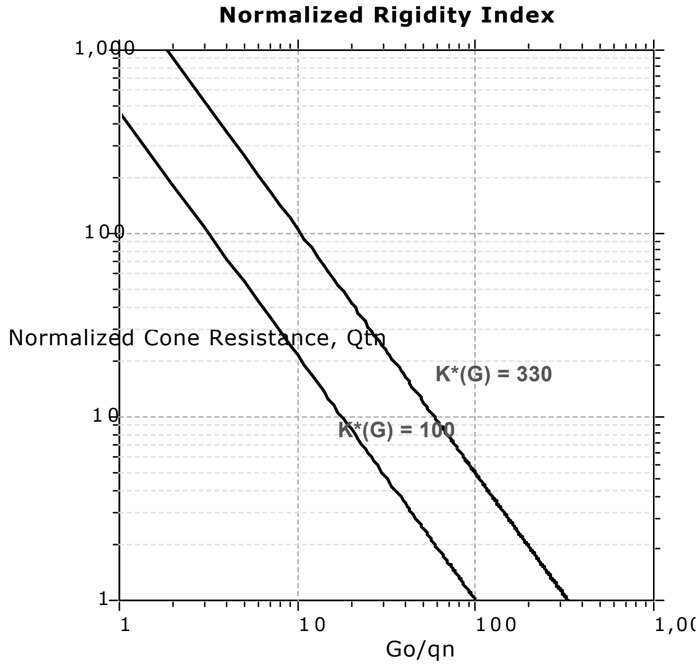
CPT: CPT-6
Total depth: 40.75 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Project: UHS Inland Valley Reg. Med. Center
Location: 36485 Inland Valley Dr., Wildomar, CA

Updated SBTn plots







CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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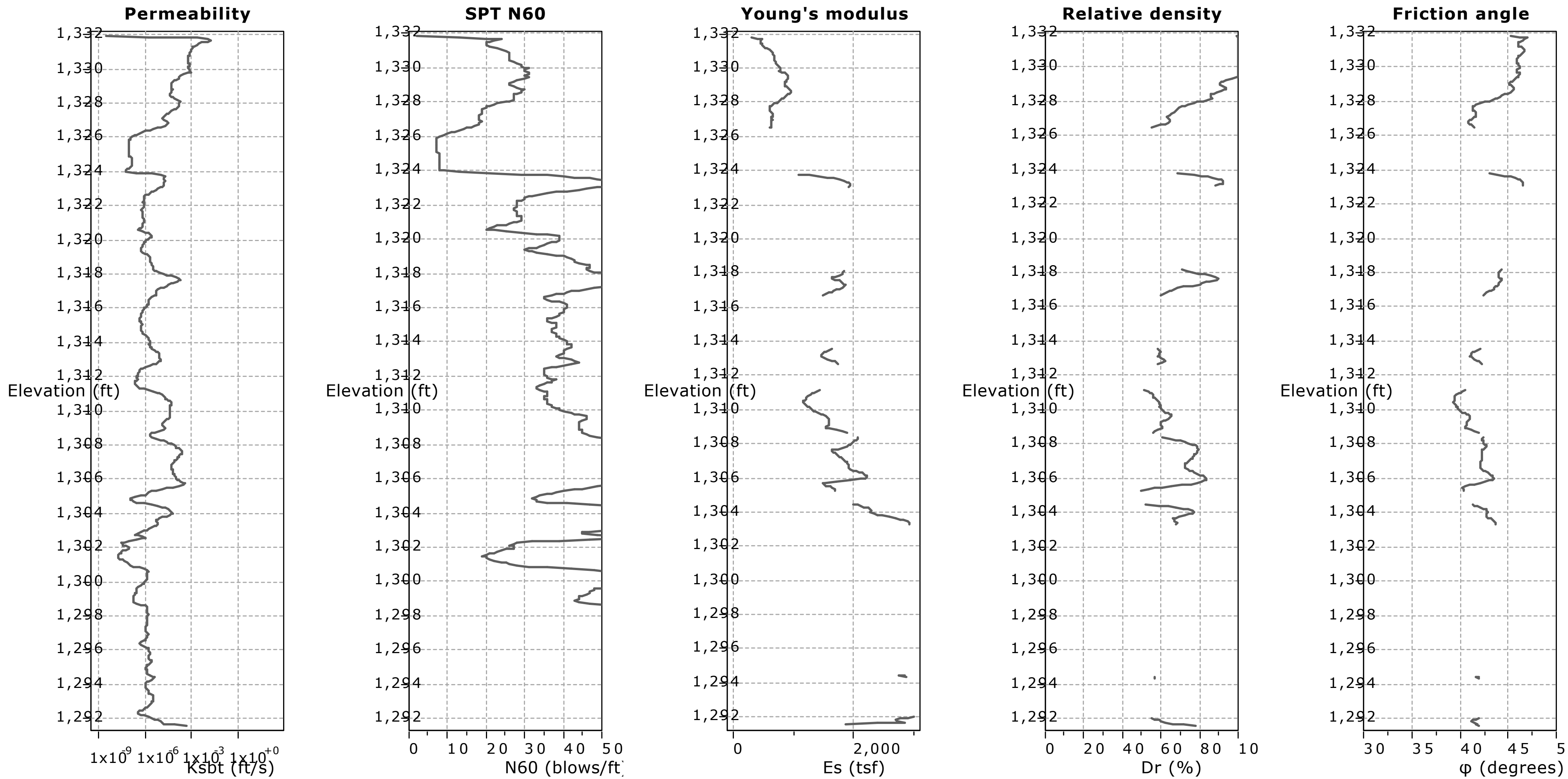
4373 Viewridge, Suite B
San Diego, CA 92123
858-292-7575

CPT: CPT-6

Total depth: 40.75 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Project: **UHS Inland Valley Reg. Med. Center**
Location: **36485 Inland Valley Dr., Wildomar, CA**



Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

NOVA Services, Inc.
4373 Viewridge, Suite B
San Diego, CA 92123
858-292-7575

CPT: CPT-6
Total depth: 40.75 ft, Date: 8/9/2019
Surface Elevation: 1332.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

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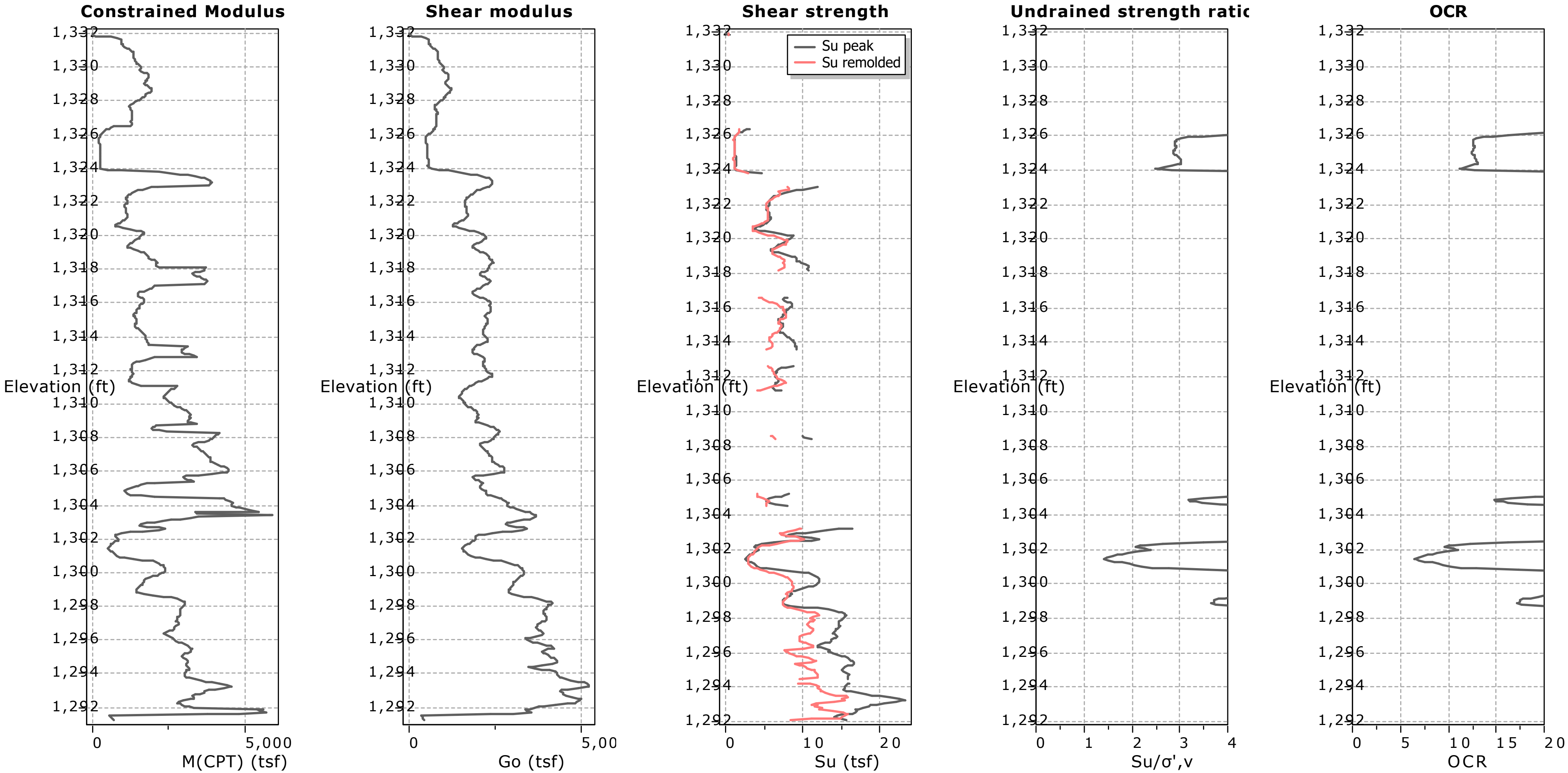
Location: **36485 Inland Valley Dr., Wildomar, CA**



Calculation parameters
Constrained modulus: Based on variable alpha using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable alpha using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

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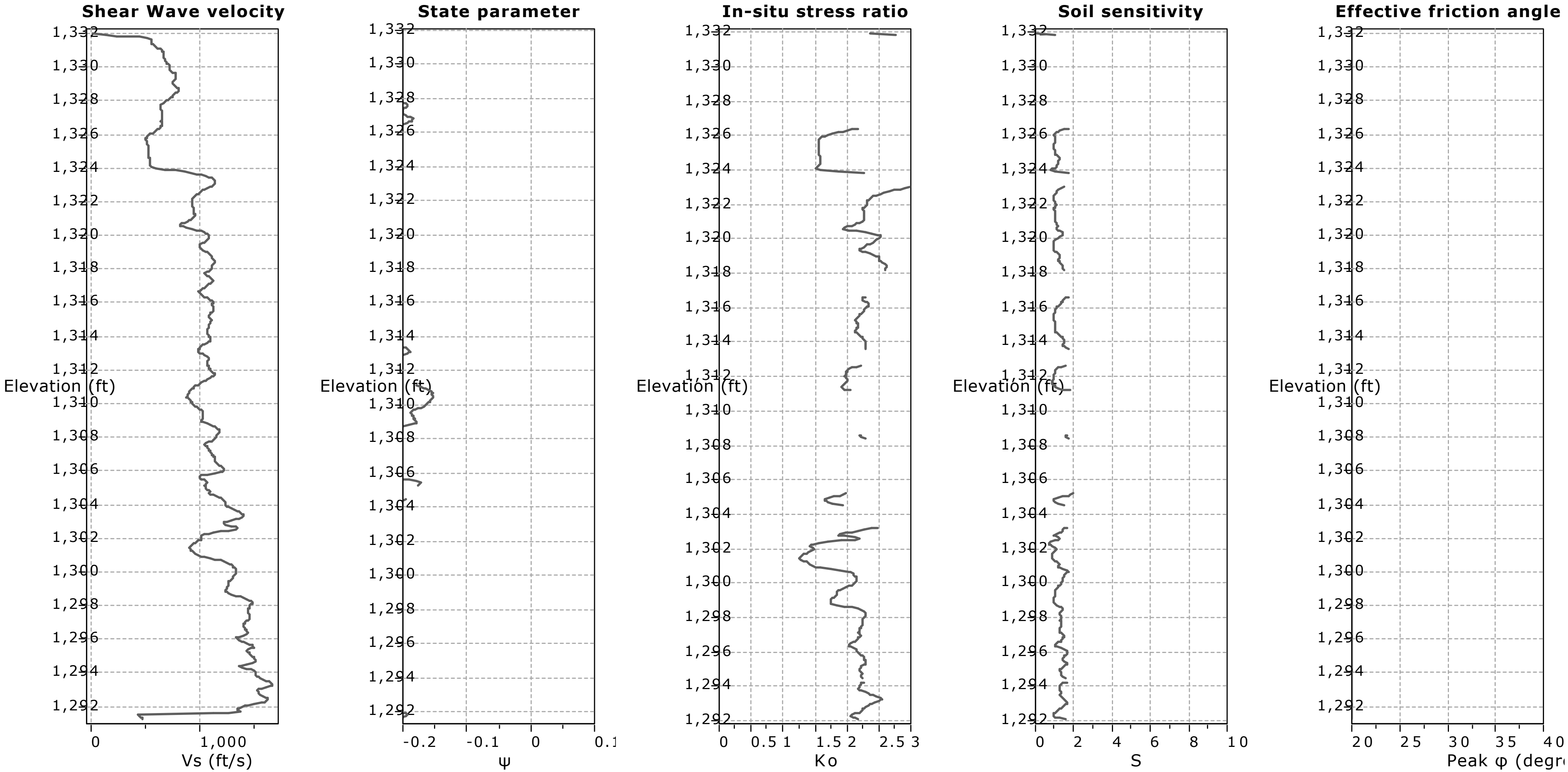


Calculation parameters

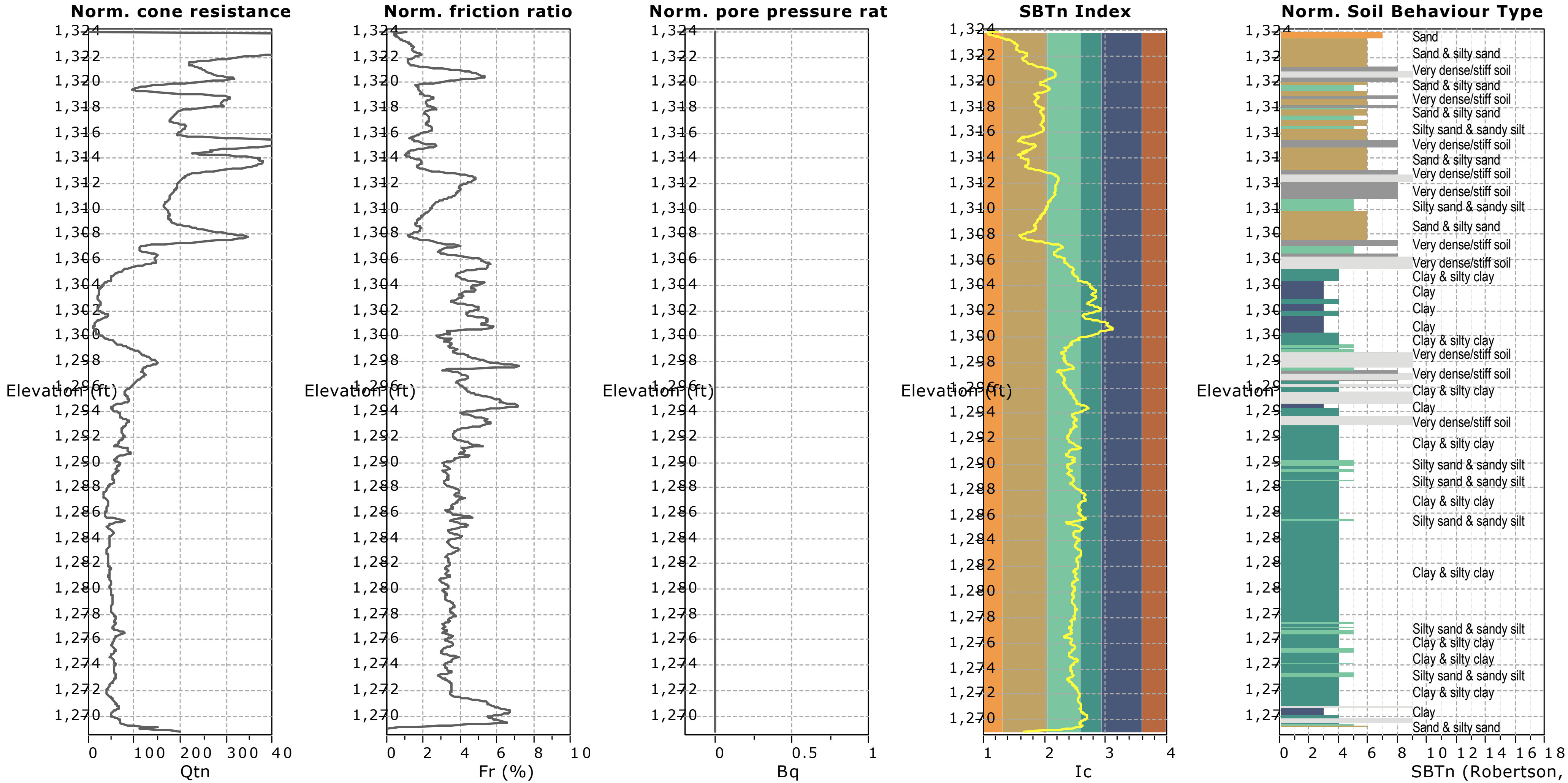
Soil Sensitivity factor, N_S: 7.00

User defined estimation data

NOVA Services, Inc.
4373 Viewridge, Suite B
San Diego, CA 92123
858-292-7575

CPT: CPT-7
Total depth: 55.25 ft, Date: 8/9/2019
Surface Elevation: 1324.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertec
Cone Operator: Kehoe Testing & Engineering

Project: **UHS Inland Valley Reg. Med. Center**
Location: **36485 Inland Valley Dr., Wildomar, CA**



SBTn legend

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

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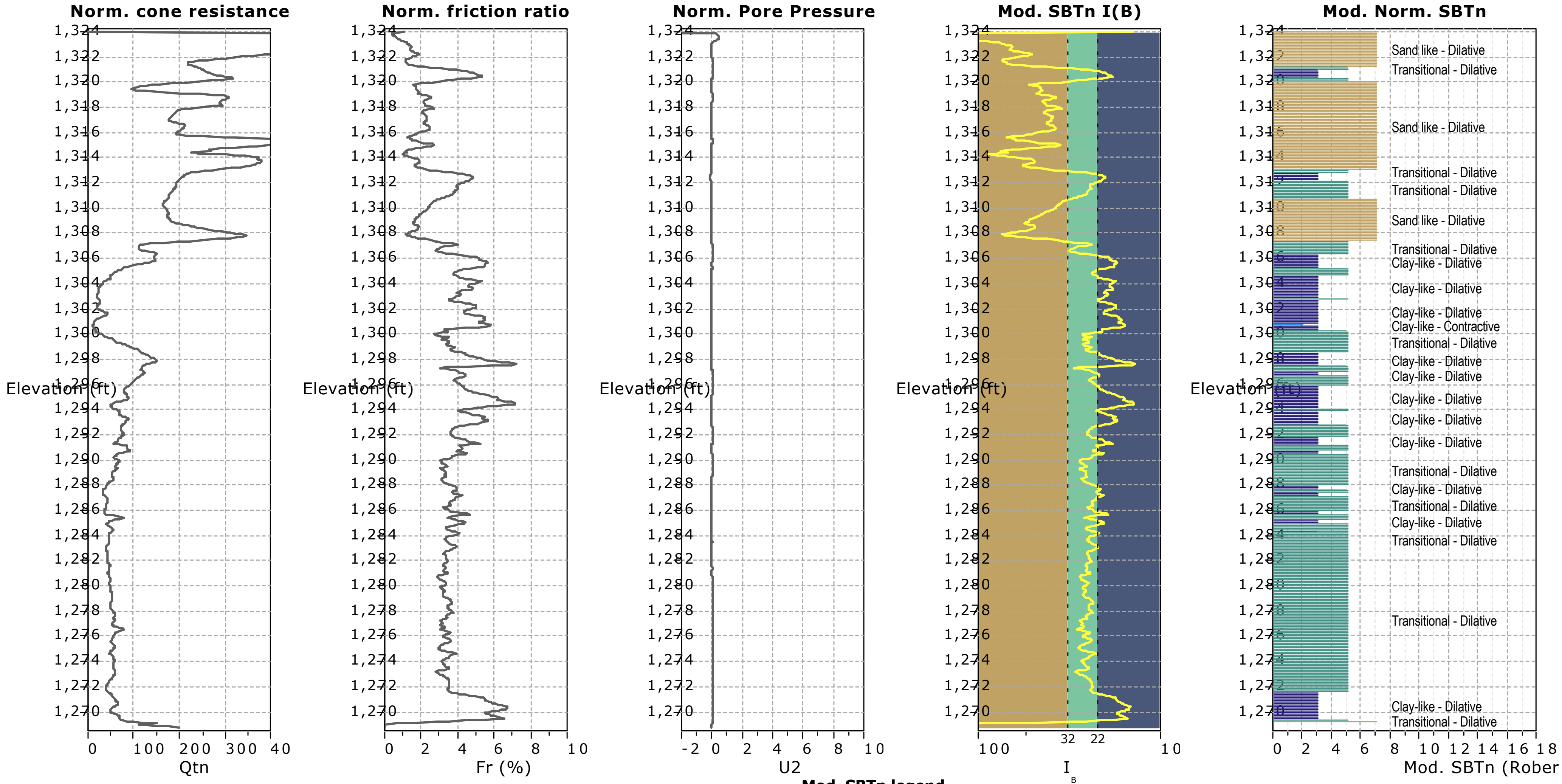

Mod. SBTn legend

1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

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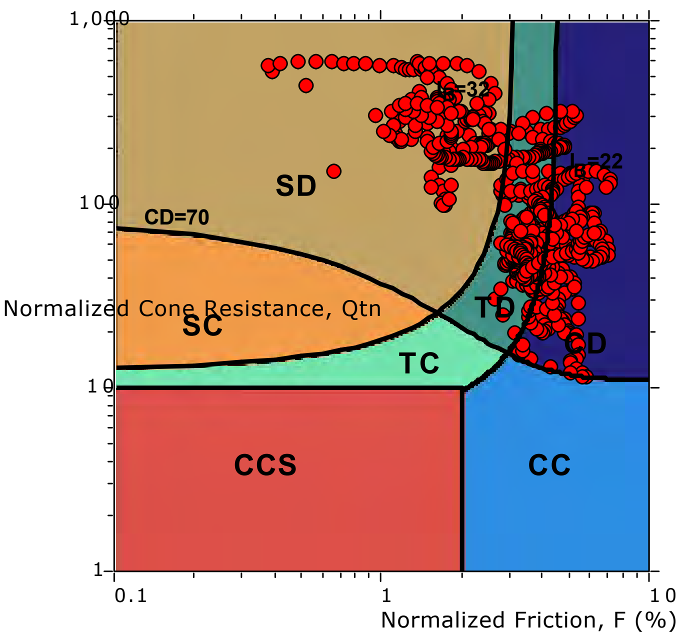
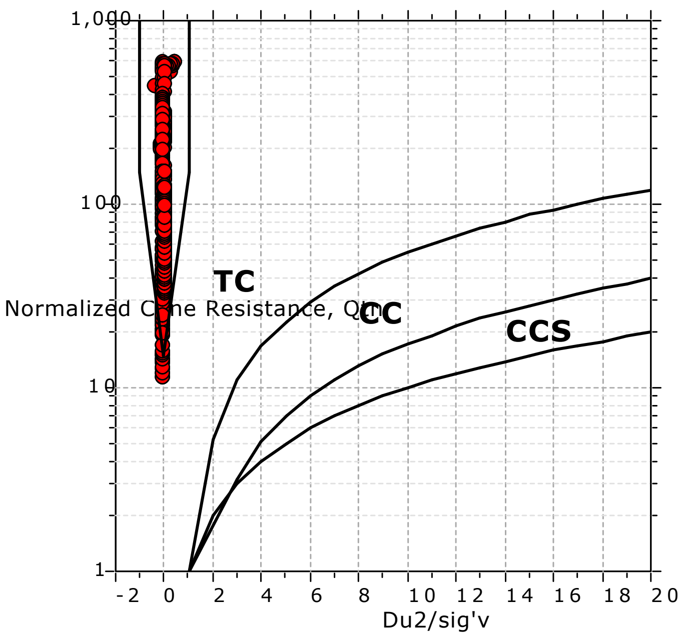
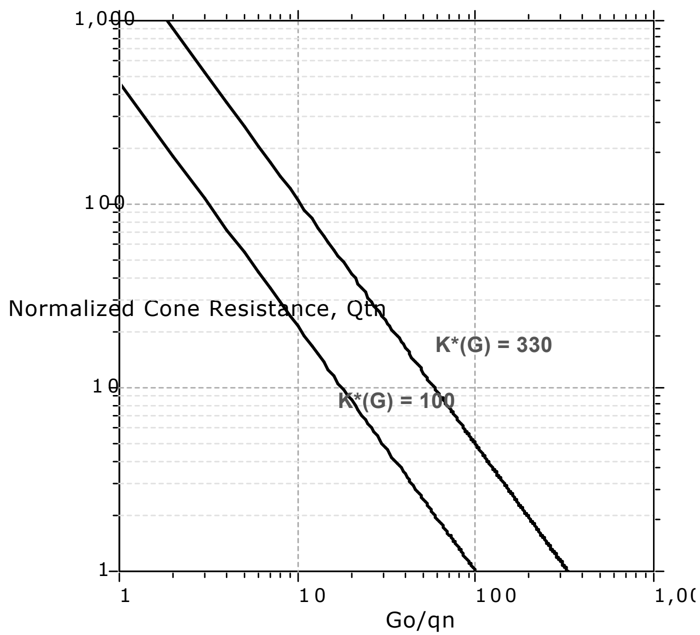
Updated SBTn plots







CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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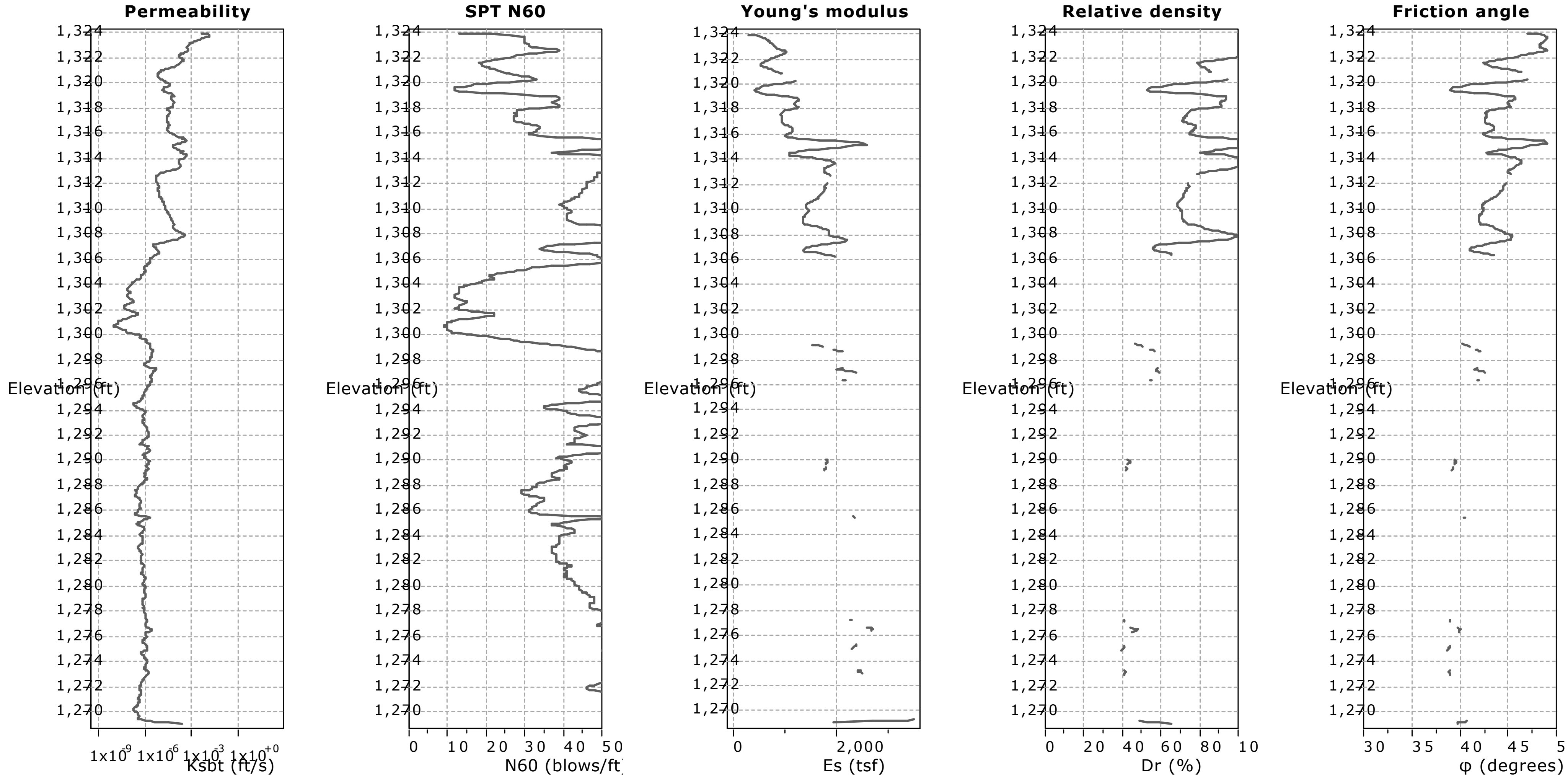

Calculation parameters
Permeability: Based on SBT_n
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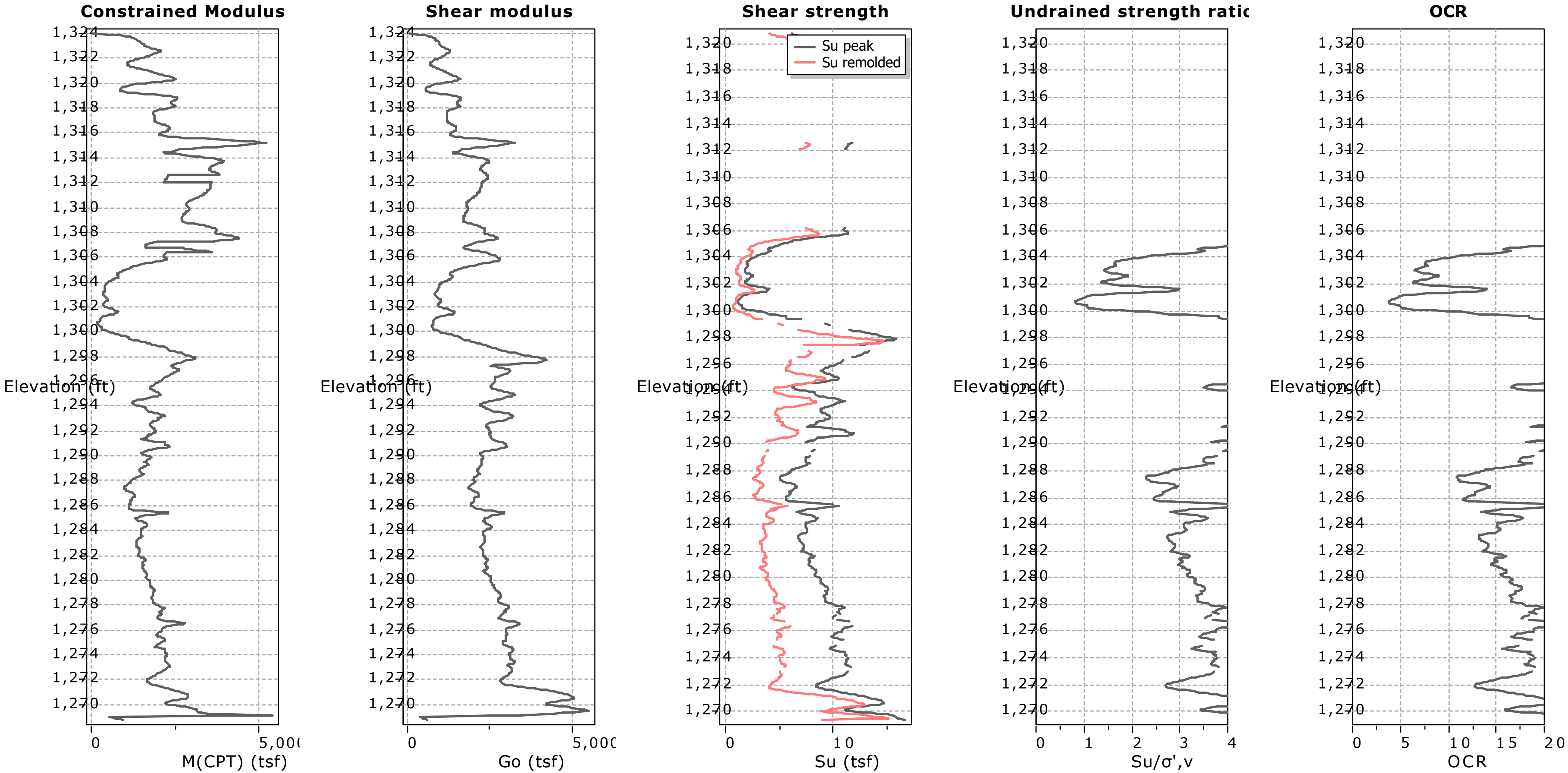

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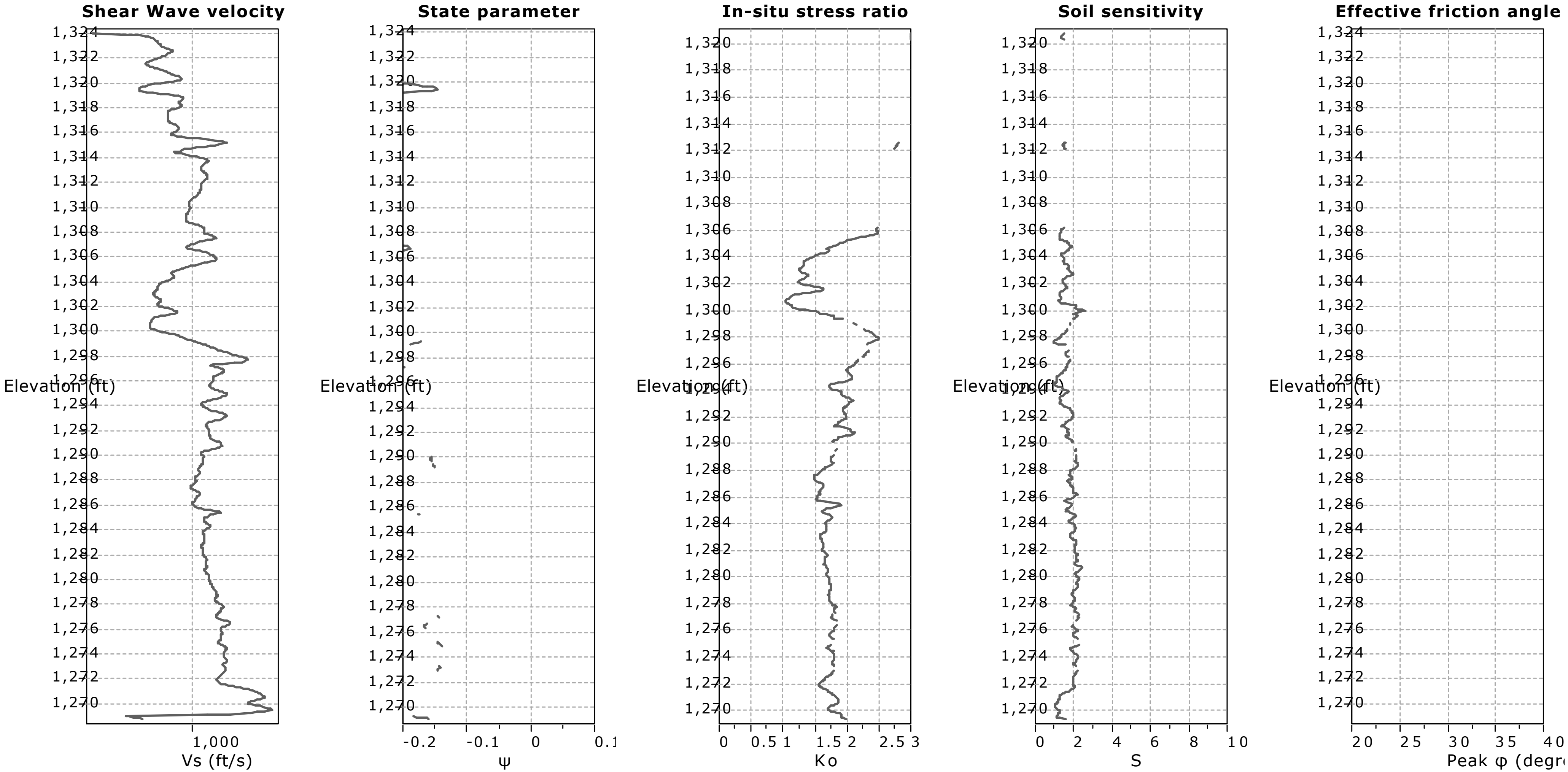

Calculation parameters

Soil Sensitivity factor, N_S: 7.00

User defined estimation data

Presented below is a list of formulas used for the estimation of various soil properties. The formulas are presented in SI unit system and assume that all components are expressed in the same units.

:: Unit Weight, g (kN/m³) ::

$$g = g_w \cdot \left(0.27 \cdot \log(R_f) + 0.36 \cdot \log(\frac{q_t}{p_a}) + 1.236\right)$$

where g_w = water unit weight

:: Permeability, k (m/s) ::

$I_c < 3.27$ and $I_c > 1.00$ then $k = 10^{0.952-3.04 \cdot I_c}$

$I_c \leq 4.00$ and $I_c > 3.27$ then $k = 10^{-4.52-1.37 \cdot I_c}$

:: N_{SPT} (blows per 30 cm) ::

$$N_{60} = \left(\frac{q_c}{P_a}\right) \cdot \frac{1}{10^{1.1268-0.2817 \cdot I_c}}$$

$$N_{1(60)} = Q_{tn} \cdot \frac{1}{10^{1.1268-0.2817 \cdot I_c}}$$

:: Young's Modulus, Es (MPa) ::

$$(q_t - \sigma_v) \cdot 0.015 \cdot 10^{0.55 \cdot I_c + 1.68}$$

(applicable only to $I_c < I_{c\_cutoff}$)

:: Relative Density, Dr (%) ::

$$100 \cdot \sqrt{\frac{Q_{tn}}{k_{DR}}}$$

(applicable only to SBT_n: 5, 6, 7 and 8 or $I_c < I_{c\_cutoff}$)

:: State Parameter, ψ ::

$$\psi = 0.56 - 0.33 \cdot \log(Q_{tn,cs})$$

:: Peak drained friction angle, φ (°) ::

$$\varphi = 17.60 + 11 \cdot \log(Q_{tn})$$

(applicable only to SBT_n: 5, 6, 7 and 8)

:: 1-D constrained modulus, M (MPa) ::

If $I_c > 2.20$

$a = 14$ for $Q_{tn} > 14$

$a = Q_{tn}$ for $Q_{tn} \leq 14$

$M_{CPT} = a \cdot (q_t - \sigma_v)$

If $I_c \leq 2.20$

$M_{CPT} = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \cdot I_c + 1.68}$

:: Small strain shear Modulus, Go (MPa) ::

$$G_0 = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \cdot I_c + 1.68}$$

:: Shear Wave Velocity, Vs (m/s) ::

$$V_s = \left(\frac{G_0}{\rho}\right)^{0.50}$$

:: Undrained peak shear strength, Su (kPa) ::

$N_{kt} = 10.50 + 7 \cdot \log(F_r)$ or user defined

$$S_u = \frac{(q_t - \sigma_v)}{N_{kt}}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Remolded undrained shear strength, Su(rem) (kPa) ::

$S_{u(rem)} = f_s$ (applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Overconsolidation Ratio, OCR ::

$$k_{OCR} = \left[\frac{Q_{tn}^{0.20}}{0.25 \cdot (10.50 \cdot + 7 \cdot \log(F_r))}\right]^{1.25}$$ or user defined

$OCR = k_{OCR} \cdot Q_{tn}$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: In situ Stress Ratio, Ko ::

$$K_O = (1 - \sin\varphi') \cdot OCR^{\sin\varphi'}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Soil Sensitivity, S_t ::

$$S_t = \frac{N_S}{F_r}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Effective Stress Friction Angle, φ<sun>' (°) ::

$$\varphi' = 29.5^\circ \cdot B_q^{0.121} \cdot (0.256 + 0.336 \cdot B_q + \log Q_t)$$

(applicable for $0.10<B_q<1.00$)

References

• Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012
• Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)