PETRA GEOSCIENCES INC.

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REVISED PLANNING LEVEL GEOTECHNICAL ASSESSMENT

THE RIDGE
APPROXIMATE 36-ACRE PARCEL, ASSESSOR PARCEL NUMBER 568-070-021
LAKE HEMET AREA, RIVERSIDE COUNTY, CALIFORNIA

MS. CAROLINE LEGRAND

October 5, 2022
J.N. 20-227
Revision 1

ENGINEERS + GEOLOGISTS + ENVIRONMENTAL SCIENTISTS

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J.N. 20-227
Revision 1

MS. CAROLINE LEGRAND
8407 Wyndham Road
Los Angeles, California 90046

Subject: **Revised Planning Level Geotechnical Assessment: *The Ridge*, Approximate 36-acre Parcel, Assessor Parcel Number 568-070-021, Lake Hemet Area, Riverside County, California**

Dear Ms. Legrand:

We are submitting our planning level geotechnical assessment report for the subject property located on Apple Canyon Road in the Lake Hemet area of Riverside County. Our work was performed in accordance with the scope of work outlined in our Proposal No. 20-227P, dated June 9, 2020, and supplemental proposal dated April 21, 2021. This report presents the results of our field investigation, laboratory testing, and our engineering judgment, opinions, conclusions, and recommendations about geotechnical design aspects of the proposed development.

It has been a pleasure to be of service to you on this project. Should you have any questions regarding the contents of this report or should you require additional information, please do not hesitate to contact us.

Respectfully submitted,

PETRA GEOSCIENCES, INC.

Alan Pace
Vice President

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PLANNING LEVEL GEOTECHNICAL ASSESSMENT

THE RIDGE
APPROXIMATELY 36 ACRE PARCEL, ASSESSOR PARCEL NUMBER 568-070-021
LAKE HEMET AREA, RIVERSIDE COUNTY, CALIFORNIA

INTRODUCTION

Petra Geosciences, Inc. (Petra) is presenting herein the results of our planning level geotechnical assessment of the subject property. The purposes of this assessment were to determine the nature of subsurface soils and evaluate their in-place characteristics, to provide planning level geotechnical recommendations with respect to site clearing and grading, and for the design and construction of building foundations.

SITE LOCATION AND DESCRIPTION

The subject site is a vacant, approximately 36-acre rectangular-shaped lot. It is located south of Apple Canyon Road, in the Lake Hemet area of Riverside County. The site is bounded by Apple Canyon Road on the north and by vacant land to the east and southeast. It is transected along the southwesterly side by State Highway 74, with a small portion of the parcel located southwesterly of that highway at the intersection with Lake Hemet Drive. On the western side is additional vacant property ascending uphill from the subject site. Several horse corals and other ancillary structures were observed onsite. A wide drainage feature transects the site in the middle, flowing from north to south, that empties into Lake Hemet. The location of the site is shown on Figure 1, below.

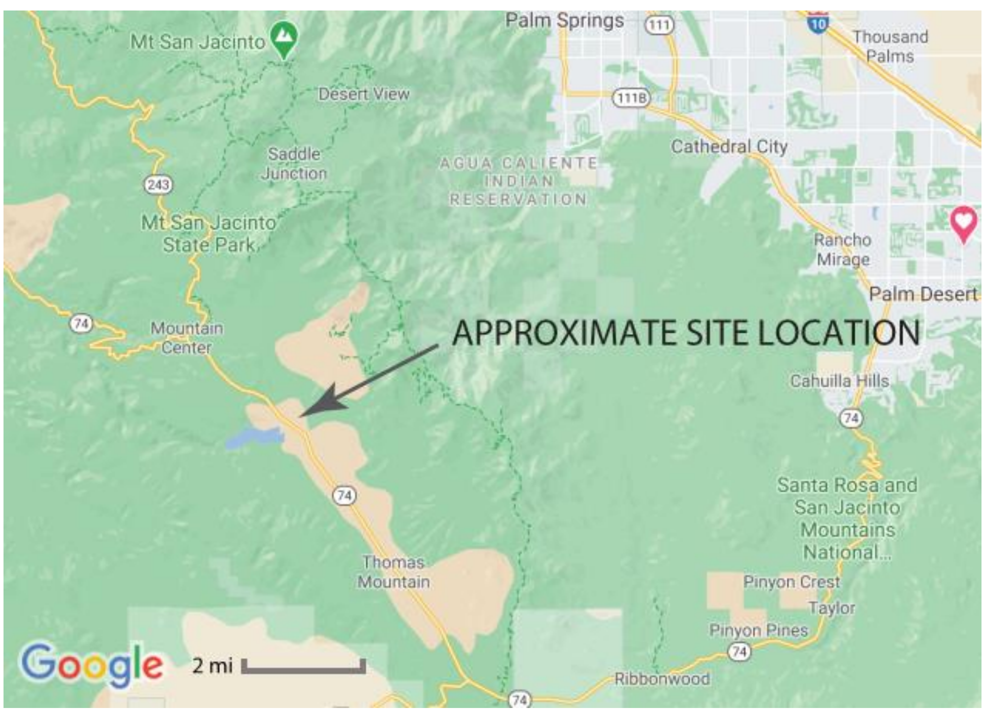

Figure 1 – Site Location Map

Topographically, site elevations range from a low of approximately 4,349 feet above mean sea level (msl) near the middle of the southern boundary to a high of 4,407 feet above msl along the middle of the western boundary, with overall relief on the order of 58 feet. The majority of the parcel, located on the eastern side of the main drainage, slopes very gently at an approximate 1 percent gradient from the northern property boundary to the southern property boundary.

PROPOSED CONSTRUCTION AND GRADING

Based on our review of the site plan prepared by MCE/ Assaro, dated July 1, 2022, the development of the site is planned as a guest ranch, with lodging facilities, a kitchen, welcome/receiving and administration building, storage, various activity buildings, tent structures, and other site improvements. The Ridge will be a recreation and education-based healing ranch with 36 guest accommodations. We understand that the proposed new buildings will be wooden structures primarily with concrete floor slabs on grade. Associated site improvements consist of retaining walls up to approximately 6 feet high, access drives and parking stalls, a swimming pool and restroom building, activity areas, exterior concrete walkways and patios, fence/screen walls, courtyards, planter areas, greenhouses, and landscaping. Other proposed improvements include stormwater management systems and above-ground domestic water tanks. Sewage will be managed through various onsite treatment systems. Additionally, a transformer pad and switchgear may be needed.

A grading plan, dated 9-19-22, has been prepared by JLC Engineering. This plan shows site grading will consist of cuts and fills generally less than 5 feet. It should be noted, however, that the ultimate fill thicknesses throughout the site will be greater due to the required remedial grading (i.e., removal and recompaction of existing unsuitable surficial soils, etc.) as recommended in subsequent sections of this report.

Preliminary recommendations for site grading and the design and construction of building foundations are presented in the "Conclusions and Recommendations" section of this report. These preliminary recommendations are based on assumptions on the design grades (as noted above) and from our understanding of the proposed construction.

REQUIRED ZONES OF INVESTIGATION

The site is located in an area identified by the County of Riverside (County) and State of California (State) with active faulting requiring site-specific investigation of the property prior to any development The fault investigation for The Ridge has been completed (Petra,2020) and a building restriction zone identified. The fault investigation report has been reviewed and approved by the County. The site is not located within a designed Liquefaction Hazard Zone, or Landslide Hazard Zone, by the State of California. The location of the site regarding Fault Hazard zones is shown below on Figure 2.

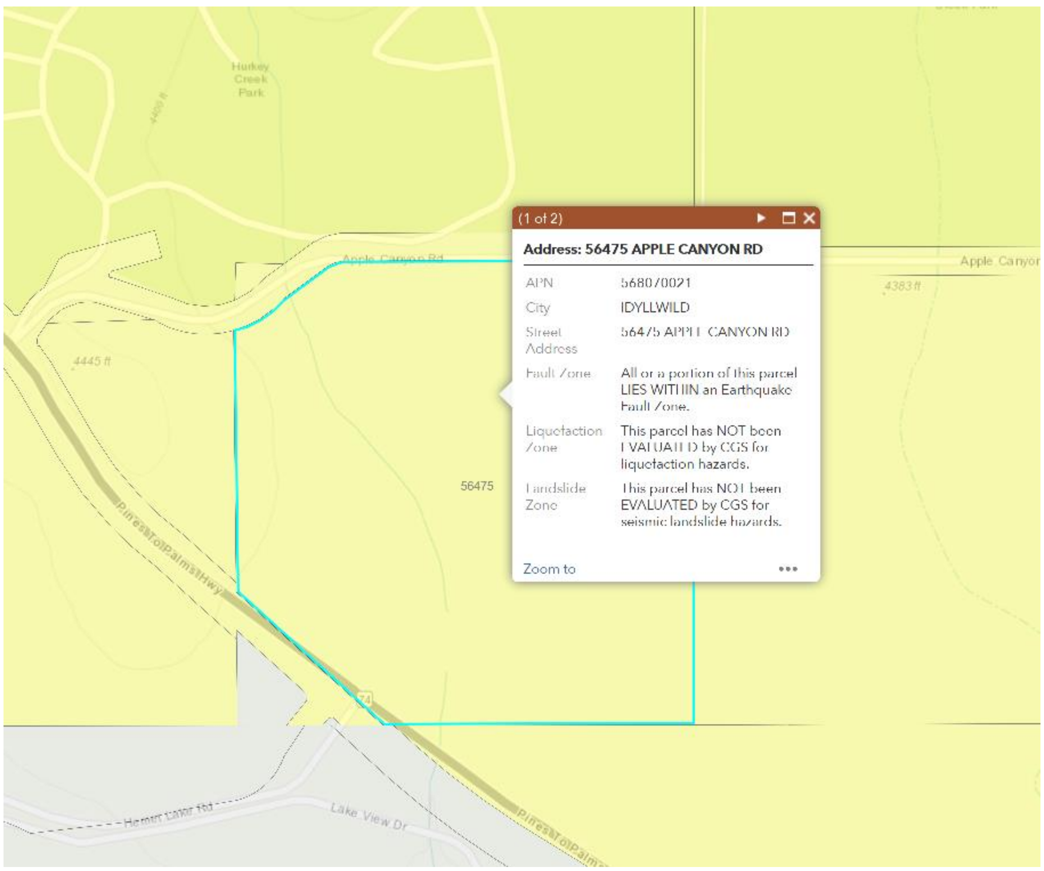

Figure 2 – State of California Earthquake Zones of Required Investigation

The County of Riverside also has not mapped the subject property area as susceptible to liquefaction hazards. The site location in relation to that mapping is shown below. There appears to be a mismatch between the area's shown by the County as potentially liquefiable, and the general underlying geology.

Figure 3 – Riverside County Liquefaction Susceptibility Map

Although though not mapped as susceptible to liquefaction, due to anticipated site conditions Petra conducted subsurface exploration during this current assessment to evaluate the site susceptibility to liquefaction.

SUBSURFACE EXPLORATION

Our subsurface exploration was performed in several stages. The previous exploration for our fault study included a seismic reflection line (Petra 2020) [See Appendix A2]. For the current exploration reported herein, percolation testing within two test pits was conducted on August 17, 2020. Further exploration by excavation of additional test pits occurred on May 7, 2021. On June 7, 2021, and on August 31, 2021, hollow stem auger drilling was conducted. CPT soundings were conducted on June 16, 2021, and August 30, 2021. The following summarizes the scope of each type of exploration method.

- Excavation and logging of a total of seven test pits. Six test pits were used to assess percolation rates at depths ranging from 2.5 to 3.2 feet.
- Conducted six dual-ring infiltrometer percolation tests to observe infiltration characteristics of subsurface materials that will be utilized in the design of the infiltration system, and to determine if subsurface sewage disposal systems were feasible.
- Drilling and sampling of seven borings (B-1through B-7) to depths ranging from 21.5 to 51 feet below the existing ground surface (bgs). All of the borings were drilled utilizing a truck-mounted, hollow-stem auger drill rig.

- Drill and install one groundwater monitoring well (MW-1) in the northeastern portion of the subject property at a depth of 40.5 feet bgs.

- Advanced seventeen Cone Penetrometer Test (CPT) soundings to depths ranging from 8 to 40 feet.

Earth materials encountered in each of the exploratory borings were field classified and logged in accordance with Unified Soil Classification System procedures. In addition, our subsurface exploration included the collection of bulk samples and relatively undisturbed samples of the subsurface soils for laboratory testing purposes. Bulk samples consisted of selected earth materials obtained at various depth intervals from selected borings. Relatively undisturbed samples were collected using a 3-inch, outside-diameter, modified California split-spoon soil sampler lined with 1-inch high brass rings. The modified sampler was driven with successive 30-inch drops of a hydraulically operated 140-pound automatic trip hammer. Blow counts for each 6-inch driving increment were recorded on the field logs. The number of blows required to drive the standard split-spoon sampler for the last 12 of the 18 inches was identified as the uncorrected standard penetration resistance (N). The central portions of the driven core samples were placed in sealed containers and transported to our laboratory for testing. The approximate locations of the exploratory borings are shown on the attached geotechnical map (Plate 1), and descriptive exploration logs are presented in Appendix A1.

In addition to the above sampling method, Standard Penetration Tests (SPT's) were also performed at selected depth intervals in accordance with the American Society for Testing Materials (ASTM) Standard Procedure D 1586. This method consists of mechanically driving an unlined standard split-barrel sampler 18 inches into the soil with successive 30-inch drops of the 140-pound automatic trip hammer. Blow counts for each 6-inch driving increment were recorded on the exploration logs. Disturbed soil samples from the unlined standard split-spoon (SPT) sampler were placed in plastic bags and transported to our laboratory for testing.

LABORATORY TESTING

To evaluate the engineering properties of site soils, several laboratory tests were performed on selected samples considered representative of those encountered. Laboratory tests included the determination of maximum dry density and optimum moisture content, grain-size analysis, soluble sulfate and chloride contents, pH, resistivity, collapse testing, and shear strength analysis. A description of laboratory test criteria is given in Appendix B1. Laboratory test data are summarized in Appendix B1 and on the Exploration Logs in Appendix A1. An evaluation of the data is reflected throughout the "Conclusions and Recommendations" section of this report.

Monitoring Well

A monitoring well was installed onsite to determine groundwater levels for use in the liquefaction studies. A pump test was conducted on the water to determine flow rates and pore pressures and recovery rates for the in-situ soils. As part of these studies, a water quality sample was collected for potential use in liquefaction mitigation strategies. The results are reported in Appendix B-2. The pump test description and results are discussed and shown in Appendix C.

PRELIMINARY INFILTRATION RATES

Shallow Infiltration Test Results

Two dual ring infiltrometer tests (DRI) were performed on August 17, 2020 within the northeastern portion of the subject property (DR-1 and DR-2). Four additional DRI test were performed on July 2, 2021 along the eastern portion of the subject site (TP/P-1, TP/P-2, TP/P-3, and TP/P-4). Test depths ranged from 2.5 to 3.2 feet below the ground surface (bgs).

Testing was conducted using a dual-ring infiltrometer in accordance with ASTM Test Method D3385-09 and the soils encountered were predominantly moist, loose silty fine-grain sands with some medium-grain sand. The un-factored test results are summarized in Table 1 and Appendix D contains the field test data calculations.

TABLE 1

Test No.	Approximate Test Location (see Figure 2)	Test Zone Depth	Infiltration Rate, I_t(1) (in./hr.)
DR-1	Near N.E. Site Boundary	2.5’	25
DR-2	Central Area of N. Site Boundary	5’	29
TP/P-1	Central Portion Near E. Site Boundary	2’ 11”	3
TP/P-2	SE Portion of Site	3’ 2”	2
TP/P-3	SE Portion of Site	3’ 2”	1
TP/P-4	SE Portion of Site	2’ 8”	Too rapid to measure

(1) No Factor of Safety Applied

FINDINGS

Regional Geology

Geologically, the site lies within an elongated valley in the San Jacinto Mountains of southern California. The San Jacinto Mountain range is a fault block of granitic rocks squeezed between the San Jacinto fault on the west and the San Andreas fault system on the east. The fault scarp on the northern and eastern side is one of the most abrupt in North America, going from sea level to 10,000 feet in a few miles. The height and steepness of the range points out that the San Jacinto fault and San Andreas fault are very active and capable of producing major earthquakes (in excess of magnitude 7). The last massive quake struck the southern segment of the San Andreas-San Jacinto fault complex more than 200 years ago.

Local Geology and Subsurface Conditions

Young alluvial soils underlie the subject site. The soils are fine to coarse grained. Below the alluvium are Cretaceous-age granitic rocks mapped as Quartz Diorite to Granodiorite (Dibblee 2008). This subsurface profile was generally confirmed during the site-specific assessment recently conducted by our firm.

Alluvium

In general, the soil materials underlying the site as encountered in our borings were observed to consist of loose to very dense, light brown to brown, poorly graded sands, from dry to wet, with trace to few gravels. A few fine-grained soil layers (silt and clay) were noted primarily towards the bottom of the CPT-4 sounding.

Granitic Bedrock

Bedrock was encountered at depth of 8 to 40 feet. Bedrock consisted of granitic rock that was weathered in the upper zone where first encountered and penetrated by the drilling equipment. However, it became hard and less weathered rapidly with depth. The bedrock was generally yellowish brown, and fine to coarse grained. Bedrock depths were observed in our borings or interpreted from the CPT soundings as shown in Table 3 below. Interpreted approximate bedrock depth contours are depicted on Plate 1.

TABLE 2A

Bedrock Depths Directly Observed in Borings

Boring or CPT ID	Depth to Bedrock (ft)
B-1	37
B-3	40
B-6	31
MW-1	36

TABLE 2B

Bedrock Depth Interpreted from CPT Soundings

Boring or CPT ID	Depth to Bedrock (ft)
CPT-1	35
CPT-2	39
CPT-3	40
CPT-4	28
CPT-5	26
CPT-6	35
CPT-7	36
CPT-8	17
CPT-9	23
CPT-10	32
CPT-11	21
CPT-12	8
CPT-13	22
CPT-14	22
CPT-15	39
CPT-16	39
CPT-17	36

Note: CPT depths are interpreted based on rapid refusal of tip.

Groundwater

Free ground water was encountered in our borings during our field exploration. Groundwater was found shallower than 10 feet below the existing ground surface. Groundwater levels were also established based on the pore pressure dissipation tests in several of the CPT soundings. Fluctuations in the level of ground water can occur due to seasonal climatic variations, changes in land use, and other factors. Groundwater levels observed during this investigation are shown in Table 4 below.

TABLE 3A

Groundwater Levels Observed in Borings

Boring ID	Groundwater Depth (ft)
B-1	12.5
B-2	9.8
B-3	8.7
B-4	10.4
B-5	10.8
B-6	11.0
B-7	12.5
MW-1	11.0

TABLE 3B

Groundwater Levels Established from PPD[1] Tests in CPT Soundings

CPT ID	Groundwater Depth (ft)
CPT-1	7.6
CPT-2	9.9
CPT-3	9.7
CPT-4	11.0

Note: [1] Pore pressure dissipation. PPD tests were attempted in later CPT soundings; however, the data was judged to be suspect.

Flooding

The site and vicinity are located within FEMA National Flood Hazard Layer FIRMette No.06065C0065G (dated August 28, 2008). The subject site is depicted within Zone D, defined as “An area of undetermined flood hazard.”

The California Department of Water Resources - Division of Dam Safety, Dam Breech Inundation Map Web Publisher (DDS, 2021), lists the downstream hazard of flooding from the Lake Hemet as “extremely high.” The subject property is located up-gradient from the lake and not affected by a potential dam breech.

Faulting

An active fault, identified as the Hot Springs Fault (Anza) segment of the San Jacinto Fault zone crosses through the subject property. Specific information is provided in Petra's fault investigation reports (Petra 2020, 2021). The location of the fault and Earthquake Hazard Zone is provided on the Geologic Map, Plate 1.

It should be noted that according to the USGS Unified Hazard Tool website and/or 2010 CGS Fault Activity Map of California, the San Jacinto Fault zone, a portion of which transects the southern subject property, would probably generate the most severe site ground motions and, therefore, is the majority contributor to the deterministic minimum component of the ground motion models. This fault is capable of producing Magnitudes up to MW 8.1. The subject site is located at a distance of less than 6.25 miles (10 km) from the surface projection of this fault system, which is capable of producing magnitude 6 or larger events with a slip rate along the fault greater than 0.04 inch per year. As such, the site should be considered as a **Near-Fault Site** in accordance with ASCE 7-16, Section 11.4.1.

Seismically-Induced Flooding

The types of seismically induced flooding which may be considered as potential hazards to a particular site normally includes flooding due to a tsunami (seismic sea wave), a seiche, or failure of a major reservoir or other water retention structure upstream of the site. Since the site lies more than 80 kilometers (50 miles) inland from the Pacific Ocean at a minimum elevation of approximately 4,349 feet above sea level and does not lie in close proximity to an enclosed body of water or downstream of a major reservoir or other retention structure, the probability of flooding from a tsunami, seiche or dam-break is considered to be very low.

Earthquake Loads

Earthquake loads on earthen structures and buildings are a function of ground acceleration which may be determined from the site-specific ground motion analysis. Alternatively, a design response spectrum can be developed for certain sites based on the code guidelines. To provide the design team with the parameters necessary to construct the design acceleration response spectrum for this project, we used two computer applications. Specifically, the first computer application, which was jointly developed by Structural Engineering Association of California (SEAOC) and California's Office of Statewide Health Planning and Development (OSHPD), the SEA/OSHPD Seismic Design Maps Tool website, https://seismicmaps.org, is used to calculate the ground motion parameters (see Appendix D). The second computer application, the United Stated Geological Survey (USGS) Unified Hazard Tool website, https://earthquake.usgs.gov/hazards/interactive/, is used to estimate the earthquake magnitude and the distance to surface projection of the fault (also see Appendix D).

To run the above computer applications, site latitude and longitude, seismic risk category and knowledge of site class are required. The site class definition depends on the direct measurement and the ASCE 7-16 recommended procedure for calculating average small-strain shear wave velocity, Vs30, within the upper 30 meters (approximately 100 feet) of site soils.

A seismic risk category of II was assigned to the proposed building in accordance with 2019 CBC, Table 1604.5. No shear wave velocity measurement was performed at the site, however, the subsurface materials at the site appears to exhibit the characteristics of stiff soils condition for Site Class D designation. Therefore, an average shear wave velocity of 600 to 1,200 feet per second for the upper 100 feet was assigned to the site based on engineering judgment and geophysical experience. As such, in accordance with ASCE 7-16, Table 20.3-1, Site Class D (D as per SEA/OSHPD software) has been assigned to the subject site.

The following table, Table 4, provides parameters required to construct the seismic response coefficient, C_s, curve based on ASCE 7-16, Article 12.8 guidelines.

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TABLE 4

Seismic Design Parameters

Ground Motion Parameters	Specific Reference	Parameter Value	Unit
Site Latitude (North)	-	33.674	°
Site Longitude (West)	-	-116.667	°
Site Class Definition	Section 1613.2.2 (1), Chapter 20 (2)	D (4)	-
Assumed Seismic Risk Category	Table 1604.5 (1)	II	-
M_w - Earthquake Magnitude	USGS Unified Hazard Tool (3)	7.79 (3)	-
R – Distance to Surface Projection of Fault	USGS Unified Hazard Tool (3)	7.34 (3)	km
S_s - Mapped Spectral Response Acceleration Short Period (0.2 second)	Figure 1613.2.1(1) (1)	1.641 (4)	g
S_1 - Mapped Spectral Response Acceleration Long Period (1.0 second)	Figure 1613.2.1(2) (1)	0.639 (4)	g
F_a – Short Period (0.2 second) Site Coefficient	Table 1613.2.3(1) (1)	1.0 (4)	-
F_v – Long Period (1.0 second) Site Coefficient	Table 1613.2.3(2) (1)	Null (4)	-
S_{MS} – MCE_R Spectral Response Acceleration Parameter Adjusted for Site Class Effect (0.2 second)	Equation 16-36 (1)	1.641 (4)	g
S_{M1} - MCE_R Spectral Response Acceleration Parameter Adjusted for Site Class Effect (1.0 second)	Equation 16-37 (1)	Null (4)	g
S_{DS} - Design Spectral Response Acceleration at 0.2-s	Equation 16-38 (1)	1.094(4)	g
S_{D1} - Design Spectral Response Acceleration at 1-s	Equation 16-39 (1)	Null (4)	g
$T_o = 0.2\ S_{D1}/\ S_{DS}$	Section 11.4.6 (2)	Null	s
$T_s = S_{D1}/\ S_{DS}$	Section 11.4.6 (2)	Null	s
T_L - Long Period Transition Period	Figure 22-14 (2)	8 (4)	s
PGA - Peak Ground Acceleration at MCE_G (*)	Figure 22-9 (2)	0.695	g
F_{PGA} - Site Coefficient Adjusted for Site Class Effect (2)	Table 11.8-1 (2)	1.1 (4)	-
PGA_M –Peak Ground Acceleration (2) Adjusted for Site Class Effect	Equation 11.8-1 (2)	0.765 (4)	g
Design PGA ≈ (⅔ PGA_M) (†)	Similar to Eqs. 16-38 & 16-39 (2)	0.51	g
Design PGA ≈ (0.4 S_{DS}) – Short Retaining Walls (‡)	Equation 11.4-5 (2)	0.438	g
C_{RS} - Short Period Risk Coefficient	Figure 22-18A (2)	0.908 (4)	-
C_{R1} - Long Period Risk Coefficient	Figure 22-19A (2)	0.89 (4)	-
SDC - Seismic Design Category (§)	Section 1613.2.5 (1)	Null (4)	-

References:
(1) California Building Code (CBC), 2019, California Code of Regulations, Title 24, Part 2, Volume I and II.
(2) American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI), 2016, Minimum Design Loads and Associated Criteria for Buildings and Other Structures, Standards 7-16.
(3) USGS Unified Hazard Tool - https://earthquake.usgs.gov/hazards/interactive/
(4) SEI/OSHPD Seismic Design Map Application – https://seismicmaps.org
Related References:
Federal Emergency Management Agency (FEMA), 2015, NEHERP (National Earthquake Hazards Reduction Program) Recommended Seismic Provision for New Building and Other Structures (FEMA P-1050).

Notes:
* PGA Calculated at the MCE return period of 2475 years (2 percent chance of exceedance in 50 years).
† PGA Calculated at the Design Level of ⅔ of MCE; approximately equivalent to a return period of 475 years (10 percent chance of exceedance in 50 years).
‡ PGA Calculated for short, stubby retaining walls with an infinitesimal (zero) fundamental period.
§ The designation provided herein may be superseded by the structural engineer in accordance with Section 1613.2.5.1, if applicable.

Discussion - General

Owing to the characteristics of the subsurface soils, as defined by Site Class D-Stiff Soil designation, and the proximity of the site to the sources of major ground shaking, the site is expected to experience strong ground shaking during its anticipated life span. Under these circumstances, where the code-specified design response spectrum may not adequately characterize site response, the 2019 CBC typically requires a site-specific seismic response analysis to be performed. This requirement is signified/identified by the "null" values that are output using SEA/OSHPD software in determination of short period, but mostly, in determination of long period seismic parameters (see Table 4).

For conditions where a "null" value is reported for the site, a variety of design approaches are permitted by 2019 CBC and ASCE 7-16 in lieu of a site-specific seismic hazard analysis. For any specific site, these alternative design approaches, which include Equivalent Lateral Force (ELF) procedure, Modal Response Spectrum Analysis (MRSA) procedure, Linear Response History Analysis (LRHA) procedure and Simplified Design procedure, among other methods, are expected to provide results that may or may not be more economical than those that are obtained if a site-specific seismic hazards analysis is performed. These design approaches and their limitations should be evaluated by the project structural engineer.

Discussion – Seismic Design Category

Please note that the Seismic Design Category, SDC, is also designated as "null" in Table 4. For condition where the mapped spectral response acceleration parameter at 1 – second period, S_1, is less than 0.75, the 2019 CBC, Section 1613.2.5.1 allows that seismic design category to be determined from Table 1613.2.5(1) alone provided that all four requirements concerning fundamental period of structure, story drift, seismic response coefficient, and relative rigidity of the diaphragms are met. Our interpretation of ASCE 7-16 is that for conditions where one or more of these four conditions are not met, seismic design category should be assigned based on: 1) 2019 CBC, Table 1613.2.5(1), 2) structure's risk category and 3) the value of S_{DS}, at the discretion of the project structural engineer.

Discussion – Equivalent Lateral Force Method

Should the Equivalent Lateral Force (ELF) method be used for seismic design of structural elements, the value of Constant Velocity Domain Transition Period, T_s, is estimated to be 0.66 seconds and the value of Long Period Transition Period, T_L, is provided in Table 4 for construction of Seismic Response Coefficient – Period (C_s -T) curve that is used in the ELF procedure.

As stated herein, the subject site is considered to be within a Site Class D-Stiff Soil. A site-specific ground motion hazard analysis is not required for structures on Site Class D-Stiff Soil with $S_1 \geq 0.2$ provided that the Seismic Response Coefficient, C_s, is determined in accordance with ASCE 7-16, Article 12.8 and structural design is performed in accordance with Equivalent Lateral Force (ELF) procedure.

Liquefaction and Seismically-Induced Settlement

Assessment of liquefaction potential for a particular site requires knowledge of a number of regional as well as site-specific parameters, including the estimated design earthquake magnitude, the distance to the assumed causative fault and the associated probable peak horizontal ground acceleration at the site, subsurface stratigraphy and soil characteristics and groundwater elevation. Parameters such as distance to causative faults and estimated probable peak horizontal ground acceleration can readily be determined using published references, or by utilizing a commercially available computer program specifically designed to perform a probabilistic analysis. Stratigraphy and soil characteristics can only be accurately determined utilizing a site-specific subsurface evaluation combined with appropriate laboratory analysis of representative samples of onsite soils.

Liquefaction occurs when dynamic loading of saturated sand or silt causes pore-water pressures to increase to levels where grain-to-grain contact is lost, and material temporarily behaves as a viscous fluid. Liquefaction can cause settlement of the ground surface, settlement, and tilting of engineered structures, flotation of buoyant buried structures, and fissuring of the ground surface. A common manifestation of liquefaction is the formation of sand boils – short-lived fountains of soil and water that emerge from fissures or vents and leave freshly deposited conical mounds of sand or silt on the ground surface.

Riverside County identifies the subject property within a zone of liquefaction potential (County of Riverside Mapping Portal, 2021). Given the depth to groundwater and unconsolidated to consolidated young alluvium encountered during our field exploration, the potential for manifestation of liquefaction-induced features and dynamic settlement is anticipated to be high.

Site-Specific Liquefaction Analysis

In April 1991, the State of California enacted the Seismic Hazards Mapping Act (Public Resources Code, Division 2, Chapters 7-8). The purpose of the Act is to protect public safety from the effects of strong ground shaking, liquefaction, landslides, or other ground failure. The Act defines mitigation as "… *those measures that are consistent with established practice and reduce seismic risk to acceptable levels.*" An acceptable level of risk is defined as "*that level that provides reasonable protection of the public safety,* *though it does not necessarily ensure continued structural integrity and functionality of the project [California Code of Regulations; Section 3721 (a)]*." In the context of that Act, mitigation of the potential liquefaction hazards at this site to appropriate levels of risk can be accomplished through appropriate foundation and/or subsurface improvement design.

Based on site exploration, this site is considered susceptible to seismic liquefaction. This is due primarily to the documented presence of unconsolidated granular (sandy) soils in the area, the shallow groundwater conditions, and to the proximity of seismic sources. For this reason, a site-specific liquefaction analysis was performed as part of this evaluation.

Assessment of liquefaction potential for a particular site requires knowledge of a number of regional as well as site-specific parameters, including the estimated design earthquake magnitude, and the associated probable peak horizontal ground acceleration at the site, subsurface stratigraphy and soil characteristics. Parameters such as estimated probable peak horizontal ground acceleration can readily be determined using published references, or by utilizing a commercially available computer program specifically designed to perform a probabilistic analysis. On the other hand, stratigraphy and soil characteristics can only be accurately determined utilizing a site-specific subsurface evaluation combined with appropriate laboratory analysis of representative samples of onsite soils.

Propagating earthquake waves induce shearing stresses and strains in soil materials during strong ground shaking. This process rearranges the structure of granular soils such that there is an increase in density, with a corresponding decrease in volume, which results in vertical settlement. Dynamic settlement has been well documented in wet, sandy deposits undergoing liquefaction (see Tokimatsu and Seed, 1987) and in relatively dry sediments as well (Stewart et al, 1996). Specific methods to analyze potential wet and dry dynamic settlement are reported in Tokimatsu and Seed (1987), and specifically dry settlement in Pradel (1998) and Stewart et al. (2001; 2002) respectively. Most of the referenced papers focus on the seismic effects on dry, clean sands of a uniform grain size, though several reports extend the literature to fine-grained soils (Stewart et al., 2001 & 2002). State guidelines for evaluating dynamic settlement are provided in the California Geological Survey Special Publication 117A (CGS, 2008).

As noted previously herein, groundwater was observed to be at depths of 7.6 to 12.5 feet at the time of field assessment. We have used a conservative value of 7 feet for our liquefaction analysis.

Analyses Using CPT Sounding Results

Six CPT soundings at the site were used in the liquefaction analysis. Our analysis using the CPT data provides *continuous* penetration resistance data rather than borehole data using SPT sampling that must be averaged over discrete sampling increments (e.g., 5 or 10 feet). A variety of computer programs are available that were developed specifically for liquefaction and seismic settlement analyses. For purposes of this study, we selected the commercially available software program CLiq Version 1.7.6.34 (GeoLogismiki, 2014) that implements updated versions of the NCEER procedure as recommended by Dr. Peter Robertson (2010), or that of Professors Idriss and Boulanger (2008, 2014). The procedures were based on the methods originally recommended by Seed and Idriss (1982). Calculations using CPT data are provided in Appendix F.

Analysis Results and Assessment of Liquefaction Effects

Section 1803.5.12.3 of the 2019 CBC requires the “assessment of potential consequences of liquefaction and soil strength loss, including, but not limited to” the following items, which we will discuss in the order that they appear in the code.

2019 CBC Section 1803.5.12.3 – 3.1 – Estimation of total and differential settlement;
Analyses with historic high groundwater estimated at 7 feet below the ground surface indicated that the major potentially liquefiable zones are from approximately 7 to 35 feet below the ground surface in CPT-1 through CPT-17. A factor of safety of 1.3 was used in our analysis in accordance with the procedures of CGS publication SP117A.

To determine the estimated seismically induced settlement from the CPT soundings we used the Robertson (2009) modifications to the NCEER procedure to estimate the free field settlement. Tabulated results of the estimated settlement for this analysis method are provided in Appendix F of this report and are shown in Figure 4 below. The results of the other methods are shown on the summary comparison plot printouts. Please note, total seismic settlement is based on the depth of our evaluation at each location. Our analysis also included the potential settlement of any dry sand above the water table.

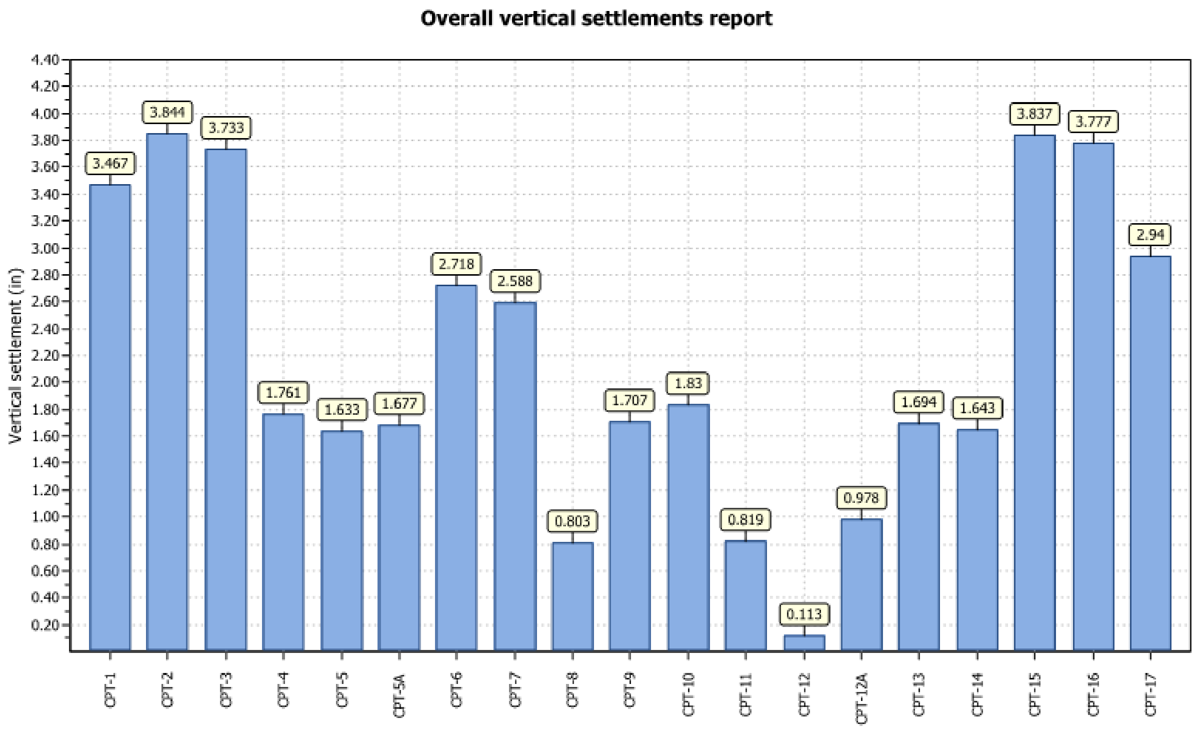

Figure 4 - Seismically Induced Settlement

Based on our calculations, total seismically induced settlement at the six CPT locations is considered excessive in accordance with guidelines provided in the California Geotechnical Survey Special Publication 117A (CGA, 2008). As noted from the figure above, differential settlements of up to 4 inches may be experienced within the footprint of the area to be developed. This is generally beyond the levels typically expected to be tolerated by conventional shallow slab-on-grade foundations.

The minimum goal of liquefaction mitigation should be to provide a foundation system that can withstand the expected movement without causing such structural damage so as to pose a life-safety hazard (such as structural collapse from excessive drift). A mitigation strategy by ground improvement is discussed in a later section of this report.

Soil Strength Loss

The results of our analysis show that subsurface soils are subject to significant strength loss during a strong seismic event. The fine-grained soils at the site are prone to cyclical softening and strength loss in addition to the classical strength loss of the sandy soils. As a result, the post-liquefaction bearing capacity for shallow foundation elements will be significantly reduced from the static condition. Mitigation measures are outlined in the Ground Modifications section of this report.

Surface Manifestation of Liquefaction

Based on the method outlined by Ishihara (1985) and considering the depth of the shallow liquefiable layers identified by the results of CPT soundings (approximately 7 to 30 feet below the existing ground surface), the overall depth of underlying liquefiable layers, the thickness of the non-liquefiable layers above the upper liquefiable zone are not sufficient to prevent significant surface manifestation of liquefaction. Additional distress to structures located at the surface is likely to occur beyond that which may be imposed by ground surface settlement. Therefore mitigation measures should be undertaken to alleviate the distress from surface manifestation of liquefaction. Liquefaction mitigation measure are discussed in a later section of this report.

2019 CBC Section 1803.5.12.3 – 3.2 – Lateral soil movement;
Lateral spreading is the movement of the ground surface down a gentle slope or toward an open free face during a seismic event that causes soil liquefaction. Therefore, given the depths and thicknesses of the liquefiable layers identified and the gently sloping ground surface we can conclude that lateral spreading is an issue likely to occur at this site.

In accordance with California Geological Survey (CGS) requirements, we performed an additional analysis to determine if lateral spreading is likely to accompany earthquake-induced liquefaction at the site. Amounts of calculated lateral spreading is provided below in Figure 5. As can be seen from the estimates on the figure, the range of lateral spreading varied from 0 to 52 inches across the site. The amount of lateral spreading estimated is beyond that typically tolerable for slab-on-grade construction. Mitigation measures will be discussed in a later section of this report.

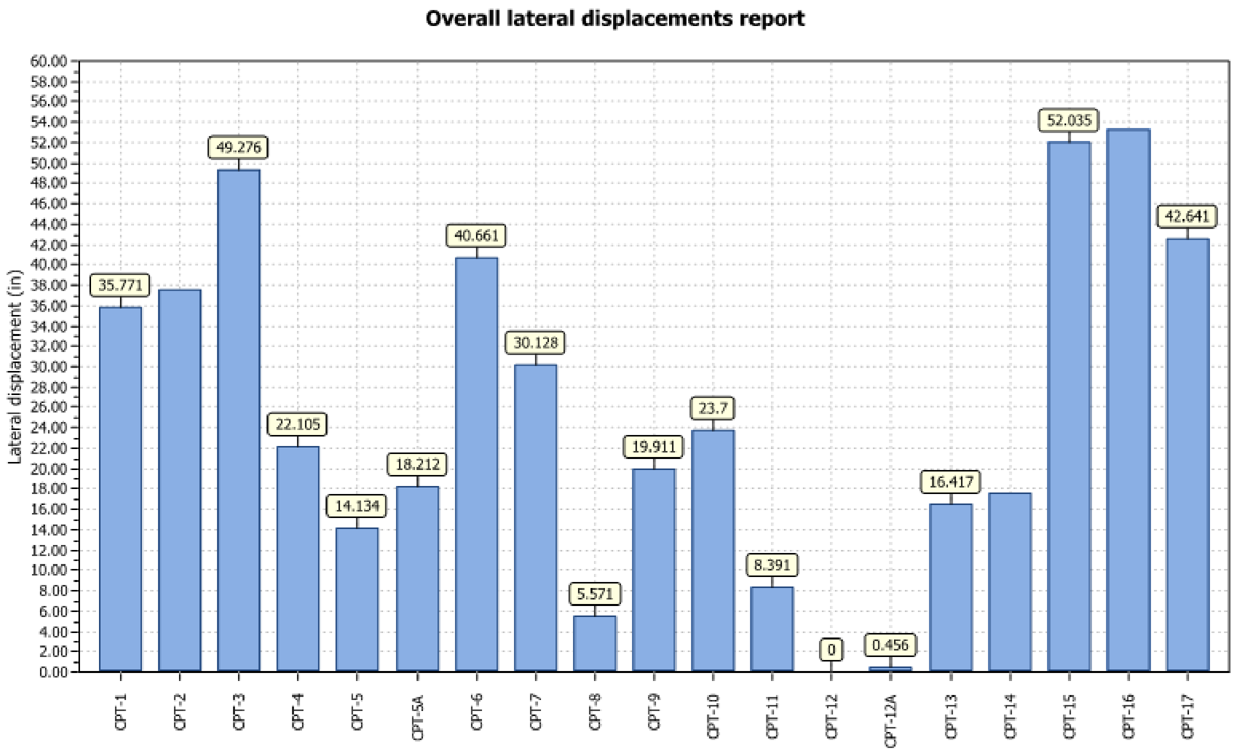

Figure 5 – Lateral Spreading Estimates

2019 CBC Section 1803.5.12.3 – 3.3 – Lateral soil loads on foundations;

Basement structures are not planned for this site; therefore, lateral load effects on basement foundations are not applicable.

2019 CBC Section 1803.5.12.3 – 3.4 – Reduction in foundation soil-bearing capacity and lateral soil reaction;

Without corrective grading and/or ground improvement the site would have a reduce or non-existent bearing capacity. Recommendations presented later on for a ground improvement program to mitigate these effects.

2019 CBC Section 1803.5.12.3 – 3.4 – Soil downdrag and reduction in axial and lateral soil reaction for pile foundations;

Pile foundations are not proposed as foundations for the proposed structures; therefore, soil downdrag and reduction in axial and lateral soil reaction for pile foundations will not be applicable.

2019 CBC Section 1803.5.12.3 – 3.5 – Increases in soil lateral pressures on retaining walls;

Rough grading and/or retaining wall plans are not available at this time. Increase in soil lateral pressures on retaining walls over a height of 6 feet is recommended. This is discussed later in this report.

2019 CBC Section 1803.5.12.3 – 3.6 – Flotation of buried structures;

Structures that enclose a void space such as pipelines, manholes, or buried vaults may be subject to buoyant forces if they are located below 7± feet from the ground surface where we noted that liquefaction was likely to occur for this site. Such structures may need to be anchored if they are not located within areas mitigated by remedial grading or ground improvements.

CONCLUSIONS AND RECOMMENDATIONS

General

From a soils engineering and engineering geologic standpoint, the subject property is considered suitable for the proposed construction provided the following conclusions and recommendations are incorporated into the design criteria and project specifications.

Grading Plan Review

The following recommendations are based on a review of the architectural site plan prepared by MCE/ and Assaro Architects dated July 1, 2022, and the rough grading plans by JLC Engineering dated September 19, 2022. As such, the recommendations provided in this report should be considered tentative until a finalized precise grading plan is available and reviewed by the project geotechnical consultant. Depending on the results of the grading plan review, revised and/or additional recommendations should be prepared by the geotechnical consultant as deemed appropriate.

Effect of Proposed Grading on Adjacent Properties

Provided that proposed grades are as anticipated in this report, it is our opinion that the proposed grading and construction will not adversely affect the stability of adjoining properties in an adverse manner provided grading and construction are performed in accordance with current standards of practice, all applicable grading ordinances and the recommendations presented in this report. However, if the final grades adjacent to the property lines are lowered or raised, it should be brought to the attention of the project geotechnical consultant in order to evaluate the potential effects of the grade changes on adjacent properties or rights-of-way.

Ground Improvement Program

Since the site is subject to significant distress from the liquefiable soils during an earthquake, mitigation measures are recommended to improve the ground and alleviate the distress potential. A mitigation program should be undertaken by a specialty geotechnical contractor with extensive knowledge and experience in ground improvement. For this site we recommend that such a program would most likely consist of deep dynamic compaction to densify the soils below the site to a level where more conventional foundations may be used. Deep dynamic compaction generally consists of the use of a large crane which drops a large dead weight from a great height onto the ground surface. The large energy developed from such a weight drop can densify the ground sometimes as deep as 30 feet or so. The weight drops would be done in an overlapping pattern in the general footprint area of the planned structures. The specialty contractor should be responsible for developing the drop grid pattern and providing a shop drawing for the engineers review prior to implementation. The following criteria should be used for the design and implementation of such a program.

- The densification pattern should be extended beyond the edge of the building footprints laterally to the extent of approximately 1/3 to ½ of the depth of the improvement.
- The ground improvement should be conducted in such a way as to reduce impacts on the nearby trees.
- The ground improvement program should target the following design criteria for the amount of settlement and lateral spreading that would remain as potentially possible after an earthquake.
  - For a 20 percent chance in 50 years earthquake, the differential settlement should be reduced to less than 1 inch in a span of 40 feet. The lateral spreading should be reduced to less than 6 inches.
  - For a 2 percent chance in 50 years earthquake, the ground should be improved to reduce the settlement to less than 4 inches total, with a differential of less than 2 inches in 40 feet. The lateral spreading should be reduced to less than 18 inches.
- The level of ground improvement achieved should be evaluated by the use of CPT's conducted after the deep dynamic compaction.

Earthwork Recommendations

Earthwork Specifications

All earthwork and grading should be performed in accordance with the applicable requirements of County of Riverside, in compliance with all applicable provisions of the 2019 California Building Code (CBC) and in accordance with the following recommendations prepared by this firm.

Site Clearing

Clearing operations should include the removal of all vegetation and any existing structural features where found within planned building envelopes. Large shrubs or trees, when removed, should be grubbed out to include their stumps and major root systems.

Should any unusual conditions or subsurface structures be encountered during demolition operations or during grading that are not described or anticipated herein, these conditions should be brought to the immediate attention of the project geotechnical consultant for corrective recommendations.

Ground Preparation – Buildings and Structure Areas

The ground improvement will cause significant disturbance to the near surface soils in the footprints of the improvement areas. Therefore, in order to mitigate possible distress to the proposed building footings and floor slabs and exterior improvements it is recommended that all unsuitable surficial materials be removed down to competent densified sand deposits and then replaced as properly compacted fill. This may be accomplished by over-excavating the ground surface to a depth of at least 5 to 10 feet below existing grades or at least 24 inches below the bottoms of the proposed footings, whichever is deeper, and then reprocessing the next underlying 6 inches in place. That is, prior to replacing the excavated materials as compacted fill, the exposed bottom surface should be scarified to a depth of at least 6 inches, watered as necessary to achieve slightly above optimum moisture conditions, and then recompacted in-place to a minimum relative compaction of 90 percent. In order to provide adequate support for sidewalks, patios, and similar improvements, overexcavation and recompaction of the existing ground surface should essentially include building envelopes and concrete flatwork that are sensitive to settlement.

It should be noted that the DDC likely would cause a cratering pattern in the near surface soils. The ground in this pattern of improvement would also typically include significant volume loss due to the densification. Therefore to achieve the design grades fill may be necessary to achieve the design grades beyond that typically done general removal and recomapction efforts if ground improvement was not done.

Ground Preparation – Roadways and Flatwork not in Ground Improved Areas

For proposed roadways, the existing ground surfaces should be over-excavated to a minimum depth of 12 inches below the existing ground surface or 2 feet below the proposed subgrade elevations, whichever is deeper. After completion of over-excavation, the areas should be scarified to a minimum depth of 6 inches, moisture-conditioned, and recompacted to a minimum 95 percent relative compaction. The excavated materials may be replaced as properly compacted fill. The horizontal limits of over-excavation should extend to a minimum horizontal distance of 12 inches beyond the perimeter of the proposed improvements.

All fills should be placed in 6- to 8-inch-thick lifts, watered or air dried as necessary to achieve slightly above-optimum moisture conditions, and then compacted to a minimum relative compaction of 95 percent per ASTM D 1557. The laboratory maximum dry density and optimum moisture content for each change in soil type should be determined in accordance with Test Method ASTM D 1557.

Excavation Characteristics

The existing site soils are expected to be readily excavated with conventional earthmoving equipment. Very loose and dry to slightly moist, silty sandy and gravelly sandy soils are anticipated to be encountered within near surface soils across the site. If oversize rocks (i.e., 12-inches in one dimension or greater) are encountered they should either be stockpiled for use in landscaping, disposed of offsite, or properly buried within the planned deeper fills or ground improvement craters in an approved engineered fashion, a minimum of 10 feet below finish pad grades.

Suitability of Site Soils as Fill

Site soils are suitable for use in engineered fills provided they are clean from organics and/or debris.

Fill Placement and Testing

New engineered fills should be placed in lifts not exceeding 6 inches in thickness, watered or air dried as necessary to achieve near optimum moisture conditions, and then compacted in place to a minimum relative compaction of 90 percent. Each fill lift should be treated in a similar manner. Subsequent lifts should not be placed until the preceding lift has been tested by the project geotechnical consultant to document that the required 90 percent relative compaction has been achieved. The laboratory maximum dry density and optimum moisture content for each change in soil type should be determined in accordance with Test Method ASTM D 1557.

Imported soils, if any, should consist of clean granular materials exhibiting a Very Low expansion potential (Expansion Index less than 20). Soils to be imported should be observed and, if deemed necessary, tested by the project geotechnical consultant prior to importation to determine whether the material meets project specifications.

Temporary Excavations

Temporary excavations up to a depth of 10 feet below existing grades may be required to accommodate the recommended over-excavation. Based on the physical properties of onsite soils, temporary excavation slopes which are constructed exceeding 4 feet in height, should be cut back to an inclination of 1:1 (h:v) or flatter for the duration of the over-excavation of unsuitable soil material and replacement as compacted fill, as well as placement of underground utilities. However, the temporary excavations should be observed by a representative of the project geotechnical consultant for evidence of potential instability. Depending on the results of these observations, revised slope configurations may be necessary. Other factors which should be considered with respect to the stability of the temporary slopes include construction traffic and/or storage of materials on or near the tops of slopes, construction scheduling, presence of nearby walls or structures on adjacent properties and weather conditions at the time of construction. Applicable requirements of the California Construction and General Industry Safety Orders, the Occupational Safety and Health act of 1970 and the Construction Safety Act should also be followed.

Slope Construction

Fill Slopes

For fill slopes exceeding 5 feet in height, a fill key excavated a depth of 2 feet or more into competent alluvial deposits is recommended at the base of the fill slope. The width of the fill key should be equal to one-half the slope height or 15 feet, whichever is greater. To obtain proper compaction to the face of fill slopes, low-height fill slopes should be overfilled during construction and then trimmed-back to the compacted inner core.

Cut Slopes

Observations during grading of individual cut slopes by the project engineering geologist to document favorable geologic structure or soil conditions of the exposed conditions is recommended. Where cohesionless sandy soil materials are observed, the cut slopes in question may require stabilization by means of a compacted stabilization fill.

Shrinkage and Subsidence

An average shrinkage on the order of about 15 to 20 percent may occur when excavated onsite soils are replaced (removed and recompacted) as properly compacted fill. A subsidence estimated of approximately 0.2 may also be expected when exposed bottom surfaces in removal areas are scarified and re-compacted as recommended herein. The above estimates of shrinkage and subsidence are intended as an aid for project planners in determining the earthwork quantities. However, these estimates should be used with some caution since they are not absolute values.

Oversize Material

Based upon our field observations and subsurface conditions encountered in our borings, oversize rock fragments were not visible on the surface and were not encountered in our shallow test pits.

However, if encountered, oversize material defined as rock, or other irreducible material with a maximum dimension greater than 12 inches in diameter, shall be taken offsite or placed in accordance with the recommendations of the Geotechnical Consultant in areas designated as suitable for rock disposal (typical details for Rock Disposal are given on Plate SG-4, Appendix D).

Rock fragments less than 12 inches in diameter may be utilized in the fill provided, they are not nested or placed in concentrated pockets, they are surrounded by compacted fine-grained soil material and the distribution of rocks is approved by the Geotechnical Consultant.

Geotechnical Observations

Exposed bottom surfaces in each removal area should be observed by the project geotechnical consultant prior to placing fill. No fills should be placed without prior approval from the geotechnical consultant. The project geotechnical consultant should also be present on site during grading operations to observe proper placement and compaction of fill, as well as to document compliance with the recommendations presented herein.

PRELIMINARY FOUNDATION DESIGN GUIDELINES

Allowable Bearing Capacity, Estimated Settlement, and Lateral Resistance

Based on Petra's evaluation of the engineering characteristics of the site soils, we have provided recommendations for a conventional shallow foundation system. Other foundation system options, such as post-tensioned, can be provided upon request.

Allowable Soil Bearing Capacities

Pad Footings

An allowable soil bearing capacity of 1,500 pounds per square foot may be utilized for design of isolated 24-inch-square footings founded at a minimum depth of 12 inches below the lowest adjacent final grade for pad footings that are not a part of the slab system and are used for support of such features as roof overhang, second-story decks, patio covers, etc. This value may be increased by 20 percent for each additional foot of depth and by 10 percent for each additional foot of width, to a maximum value of 2,500 pounds per square foot. The recommended allowable bearing value includes both dead and live loads and may be increased by one-third for short duration wind and seismic forces.

Continuous Footings

An allowable soil bearing capacity of 1,500 pounds per square foot may be utilized for design of continuous footings founded at a minimum depth of 12 inches below the lowest adjacent final grade. This value may be increased by 20 percent for each additional foot of depth and by 10 percent for each additional foot of width, to a maximum value of 2,500 pounds per square foot. The recommended allowable bearing value includes both dead and live loads and may be increased by one-third for short duration wind and seismic forces.

Static Settlement

Under the above recommended bearing values, total static settlements due to new building loads are expected to be less than 1 of an inch, and differential settlement between adjacent footings is expected to be less than 1/2 of an inch over a span of 40 feet. The majority of the anticipated settlement is expected to take place during construction as building loads are applied.

Dynamic (Seismically-Induced) Settlement

As stated previously in this report, the maximum differential settlement is estimated to be approximately one inch over a horizontal span of approximately 40 feet, with a corresponding equivalent angular distortion ratio of approximately 1:480 for a moderate earthquake. For a large earthquake the differential settlement should be less than 2 inches in 40 feet for an angular distortion ratio of 1:240. The project structural engineer should determine whether the static and dynamic settlement estimates provided herein should be considered additive for purposes of their structural design.

Lateral Resistance

A passive earth pressure of 300 pounds per square foot, per foot of depth, to a maximum value of 3,000 pounds per square foot, may be used to determine lateral bearing resistance for footings. In addition, a coefficient of friction of 0.35 times the dead load forces may be used between concrete and the supporting soils to determine lateral sliding resistance. The above values may be increased by one-third when designing for short duration wind or seismic forces. The above values are based on footings placed directly against compacted fill to be compacted to at least 90 percent of maximum dry density. The upper foot of passive soil resistance should be neglected where soil adjacent to the footing is not covered and protected by a concrete slab or pavement. The above values given for coefficient of friction and passive soil resistance are allowable values with a factor of safety of 1.5 and the designer may choose an appropriate factor of safety based on the loadings.

Preliminary Guidelines for Footings and Slabs on-Grade Design and Construction

The results of our laboratory tests performed on representative samples of near-surface soils within the subject site during our evaluation indicate that these materials predominantly exhibit expansion indices that are less than 20. As indicated in Section 1803.5.3 of 2019 California Building Code (2019 CBC), these soils are considered non-expansive and, as such, the design of slabs on-grade is considered to be exempt from the procedures outlined in Sections 1808.6.2 of the 2019 CBC and may be performed using any method deemed rational and appropriate by the project structural engineer. However, the following minimum recommendations are presented herein for conditions where the project design team may require geotechnical engineering guidelines for design and construction of footings and slabs on-grade the project site.

The design and construction guidelines that follow are based on the above soil conditions and may be considered for reducing the effects of variability in fabric, composition and, therefore, the detrimental behavior of the site soils such as excessive short- and long-term total and differential heave or settlement. These guidelines have been developed on the basis of the previous experience of this firm on projects with similar soil conditions. Although construction performed in accordance with these guidelines has been found to reduce post-construction movement and/or distress, they generally do not positively eliminate all potential effects of variability in soils characteristics and future heave or settlement.

It should also be noted that the suggestions for dimension and reinforcement provided herein are performance-based and intended only as preliminary guidelines to achieve adequate performance under the anticipated soil conditions. However, they should not be construed as replacement for structural engineering analyses, experience, and judgment. The project structural engineer, architect and/or civil engineer should make appropriate adjustments to slab and footing dimensions, and reinforcement type, size and spacing to account for internal concrete forces (e.g., thermal, shrinkage and expansion) as well as external forces (e.g., applied loads) as deemed necessary. Consideration should also be given to minimum design criteria as dictated by local building code requirements.

Conventional Slab-on-Grade System

Given the expansion index of less than 20, as generally exhibited by onsite soils, we recommend that footings and floor slabs be designed and constructed in accordance with the following minimum criteria.

Footings

1. Exterior continuous footings supporting one- and two-story structures should be founded at a minimum depth of 12 inches below the lowest adjacent final grade, respectively. Interior continuous footings may be founded at a minimum depth of 10 inches below the top of the adjacent finish floor slabs.

2. In accordance with Table 1809.7 of 2019 CBC for light-frame construction, and regarding the earthquake potential, all continuous footings should have minimum widths of 12 inches for one- and two-story construction. We recommend all continuous footings should be reinforced with a minimum of four No. 4 bars, two top and two bottom.

3. A minimum 12-inch-wide grade beam founded at the same depth as adjacent footings should be provided across garage entrances or similar openings (such as large doors or bay windows). The grade beam should be reinforced with a similar manner as provided above.

4. Interior isolated pad footings, if required, should be a minimum of 24 inches square and founded at a minimum depth of 12 inches below the bottoms of the adjacent floor slabs for one- and two-story buildings. Pad footings should be reinforced with No. 4 bars spaced a maximum of 18 inches on centers, both ways, placed near the bottoms of the footings.

5. Exterior isolated pad footings intended for support of roof overhangs such as second-story decks, patio covers, and similar construction should be a minimum of 24 inches square and founded at a minimum depth of 18 inches below the lowest adjacent final grade. The pad footings should be reinforced with No. 4 bars spaced a maximum of 18 inches on centers, both ways, placed near the bottoms of the footings. Exterior isolated pad footings may need to be connected to adjacent pad and/or continuous footings via tie beams at the discretion of the project structural engineer.

6. The minimum footing dimensions and reinforcement recommended herein may be modified (increased or decreased subject to the constraints of Chapter 18 of the 2019 CBC) by the structural engineer responsible for foundation design based on his/her calculations, engineering experience and judgment.

<u>Building Floor Slabs</u>

1. Concrete floor slabs should be a minimum 4 inches thick and reinforced with No. 4 bars spaced a maximum of 18 inches on centers, both ways. All slab reinforcement should be supported on concrete chairs or brick to ensure the desired placement near mid-depth.

   Slab dimension, reinforcement type, size and spacing need to account for internal concrete forces (e.g., thermal, shrinkage and expansion) as well as external forces (e.g., applied loads), as deemed necessary.

2. Living area concrete floor slabs and areas to receive moisture sensitive floor covering should be underlain with a moisture vapor retarder consisting of a minimum 10-mil-thick polyethylene or polyolefin membrane that meets the minimum requirements of ASTM E96 and ASTM E1745 for vapor retarders (such as Husky Yellow Guard®, Stego® Wrap, or equivalent). All laps within the membrane should be sealed, and at least 2 inches of clean sand should be placed over the membrane to promote uniform curing of the concrete. To reduce the potential for punctures, the membrane should be placed on a pad surface that has been graded smooth without any sharp protrusions. If a smooth surface cannot be achieved by grading, consideration should be given to lowering the pad finished grade an additional inch and then placing a 1-inch-thick leveling course of sand across the pad surface prior to the placement of the membrane.

   At the present time, some slab designers, geotechnical professionals, and concrete experts view the sand layer below the slab (blotting sand) as a place for entrapment of excess moisture that could adversely impact moisture-sensitive floor coverings. As a preventive measure, the potential for moisture intrusion into the concrete slab could be reduced if the concrete is placed *directly on the vapor retarder. However, if this sand layer is omitted, appropriate curing methods must be implemented to ensure that the concrete slab cures uniformly. A qualified materials engineer with experience in slab design and construction should provide recommendations for alternative methods of curing and supervise the construction process to ensure uniform slab curing. Additional steps would also need to be taken to prevent puncturing of the vapor retarder during concrete placement.*

3. Garage floor slabs should be a minimum 4 inches thick and reinforced in a similar manner as living area floor slabs. Garage slabs should also be poured separately from adjacent wall footings with a positive separation maintained using ¾-inch-minimum felt expansion joint material. To control the propagation of shrinkage cracks, garage floor slabs should be quartered with weakened plane joints. Consideration should be given to placement of a moisture vapor retarder below the garage slab, similar to that provided in Item 2 above, should the garage slab be overlain with moisture sensitive floor covering.

4. Presaturation of the subgrade below floor slabs will not be required; however, prior to placing concrete, the subgrade below all dwelling and garage floor slab areas should be thoroughly moistened to achieve a moisture content that is at least equal to or slightly greater than optimum moisture content. This moisture content should penetrate to a minimum depth of 12 inches below the bottoms of the slabs.

The minimum dimensions and reinforcement recommended herein for building floor slabs may be modified (increased or decreased subject to the constraints of Chapter 18 of the 2019 CBC) by the structural engineer responsible for foundation design based on his/her calculations, engineering experience and judgment.

Posts or Pole Foundations

Ancillary improvements such as lights, fences, poles for sports and equipment, or some light structures etc. may be mounted on posts or poles.

CIDH Design

Cast-in-drilled-hole (CIDH) concrete piers may be required for light poles, signs, posts, and utility poles. Shallow piers are usually designed based on rigid body mechanics. Piers or piles generally act as rigid bodies when the length to width ratio is less than 10. Equations for lateral resistance design are given in 2019 CBC section 1807.3. The code limits the use of these equations to piers that are less than 12 feet in length. If piers deeper than 12 feet are required, we can provide supplemental recommendations as needed.

A minimum diameter of 24 inches is recommended for such piers. The 24-inch-diameter is recommended to allow in-hole observations by the project engineering geologist and to allow proper cleanout by the contractor. Pier depth and spacing should be determined by the project structural engineer based on total loads and lateral loading. However, minimum clear spacing between piers should be two pier diameters, sidewall to sidewall. Reinforcement for piers should be determined by the project structural engineer with regard to strengthening the concrete to resist lateral forces.

For concrete piers founded in existing alluvial or fill soils, the following design values may tentatively be used:

- End Bearing: An end bearing pressure of 500 pounds per square foot (psf) may be assumed for the bottom of the piers. End bearing capacity and skin friction may be combined to determine allowable pier capacities provided the minimum caisson diameter is 24 inches.

- Adhesion: An adhesion value of 100 psf may be assumed for skin frictional resistance at the interface between the concrete pier and the surrounding soils.

- Passive Pressure: A variable passive resistance of 150 pounds per square foot, per foot of depth, may be used for design purposes. The maximum total passive pressure should not exceed a value of 2,000 psf at any depth. This includes a safety factor of 1.5.

- Point of Fixity: The point of fixity for the caissons should be determined by the project structural engineer. It should be noted that caissons that have a slenderness ratio less than 10 (length divided by diameter) may tend to act in a rigid manner; therefore, a point of fixity may not be an accurate model of pier performance.

- Uplift: Caissons may be considered to resist uplift forces equal to the skin friction between the concrete pier and the surrounding fill as described above. Allowable uplift capacity should not exceed 90 percent of the allowable downward capacity.

Additional Design and Construction Recommendations for CIDH Piers and Piles

Recommendations concerning the construction of cast-in-place concrete caisson are outlined below. CIDH piles should be constructed in accordance with Section 49 of the Caltrans Standard Specifications, and the following recommendations.

1. Caisson drilling should be conducted under the continuous observation of the project geotechnical engineer. Caisson excavations should not remain open overnight.

2. With groundwater detected as shallow as 7 feet from the CPT data, below the ground surface, caving can be expected. Thus, casing or the use of drilling mud may be necessary during construction.

3. Prior to rebar cage and concrete installation, the shaft walls and base should be observed for anomalies, unexpected soft soil conditions, or caving.

4. The bottom of the drilled shafts should be cleared of all loose soil material prior to the concrete pour.

5. Concrete should not be allowed to free fall more than 4 feet and should not be allowed to hit the sidewalls of the excavation. For this reason, it is recommended that the concrete be placed using a tremie pipe. The tremie pipe should be submerged a minimum of 4 feet during concrete placement.

6. The rebar cage must be prevented from buckling during the concrete pour.

7. The volume of concrete should be checked to ensure voids did not result during extraction of any casing. Pulling of casing with insufficient concrete inside should be restricted.

8. If groundwater has entered the shaft, concrete must be tremied into place with an adequate head to displace water or slurry. Tremie pipe should be watertight and should be fitted with a valve at the lower end.

9. Piles should be checked for alignment and plumbness. The amount of acceptable horizontal misalignment of a CIDH pile is approximately 2 to 3 inches from the exact location and it is usually acceptable for the pile to be out of plumb 1 percent of the depth of the pile.

Footing Observations

Foundation footing trenches should be observed by the project geotechnical consultant to document into competent bearing-soils. The foundation excavations should be observed prior to the placement of forms, reinforcement, or concrete. The excavations should be trimmed neat, level, and square. Prior to placing concrete, all loose, sloughed, or softened soils and/or construction debris should be removed. Excavated soils derived from footing and utility trench excavations should not be placed in slab-on-grade areas unless the soils are compacted to a relative compaction of 90 percent or more.

General Corrosivity Screening

As a screening level study, very limited chemical and electrical tests were performed on several samples considered representative of the onsite soils to identify potential corrosive characteristics of these soils. The common indicators associated with soil corrosivity include water-soluble sulfate and chloride levels, pH (a measure of acidity), and minimum electrical resistivity. Test results are presented in Table 7 below.

It should be noted that Petra does not practice corrosion engineering; therefore, the test results, opinion and engineering judgment provided herein should be considered as general guidelines only. Additional analyses would be warranted, especially, for cases where buried metallic building materials (such as copper and cast or ductile iron pipes) in contact with site soils are planned for the project.

In many cases, the project geotechnical engineer may not be informed of these choices. Therefore, for conditions where such elements are considered, we recommend that other, relevant project design professionals (e.g., the architect, landscape architect, civil and/or structural engineer) also consider recommending a qualified corrosion engineer to conduct additional sampling and testing of near-surface soils during the final stages of site grading to provide a complete assessment of *soil corrosivity. Recommendations to mitigate the detrimental effects of corrosive soils on buried metallic and other building materials that may be exposed to corrosive soils should be provided by the corrosion engineer as deemed appropriate.*

In general, a soil's water-soluble sulfate levels and pH relate to the potential for concrete degradation; water-soluble chlorides in soils impact ferrous metals embedded or encased in concrete, e.g., reinforcing steel; and electrical resistivity is a measure of a soil's corrosion potential to a variety of buried metals used in the building industry, such as copper tubing and cast or ductile iron pipes. Table 5, below, presents test results. with an interpretation of current code indicators and guidelines that are commonly used in this industry. The table includes the classifications of the soils as they relate to the various tests, as well as a general recommendation for possible mitigation measures in view of the potential adverse impact on various components of the proposed structures in direct contact with site soils. The guidelines provided herein should be evaluated and confirmed, or modified, in their entirety by the project structural engineer, corrosion engineer and/or the contractor responsible for concrete placement for structural concrete used in exterior and interior footings, interior slabs on-ground, garage slabs, wall foundations and concrete exposed to weather such as driveways, patios, porches, walkways, ramps, steps, curbs, etc.

TABLE 5

Soil Corrosivity Screening Results

Test	Test Results	Classification	General Recommendations
Soluble Sulfates (Cal 417)	0.0006 percent	S0[1]	Type II cement; min. f'_c = 2,500 psi; no water/cement ratio restrictions
pH (Cal 643)	7.75	Slightly Alkaline	No special recommendations
Soluble Chloride (Cal 422)	227.7 ppm	C1[2]	Residence: No special recommendations, minimum concrete cover on reinforcement
Resistivity (Cal 643)	10,000 ohm-cm	Mildly Corrosive[3]	Protective wrapping/coating of buried pipes; corrosion resistant materials

Notes:
1. ACI 318-14, Section 19.3
2. ACI 318-14, Section 19.3
3. Pierre R. Roberge, "Handbook of Corrosion Engineering"

Retaining Walls

Allowable Bearing Values

Proposed retaining walls should be supported on spread footings using the design criteria recommended previously for building footings; however, when calculating passive resistance, the passive earth pressure should be reduced to 150 pounds per square foot, per foot of depth, to a maximum value of 1,500 pounds per square foot.

Active and At-Rest Earth Pressures

1. On-Site Soils Used for Backfill

   On-site earth materials are considered to have a moderate expansion potential and are not recommended for use as backfill. However, if these materials are used as backfill, active earth pressures equivalent to fluids having densities of 35 and 60 pounds per cubic foot should be used for design of cantilevered walls retaining a level backfill and ascending 2:1 backfill, respectively. For walls that are restrained at the top, at-rest earth pressures of 55 and 85 pounds per cubic foot (equivalent fluid pressures) should be used. The above values are for retaining walls that have been supplied with a proper subdrain system (see Figure RW-1). All walls should be designed to support any adjacent structural surcharge loads imposed by other nearby walls or footings in addition to the active and at-rest earth pressures.

2. Imported Sand, Pea Gravel, or Rock Used for Wall Backfill

   Imported clean sand exhibiting a sand equivalent value (SE) of 30 or greater, pea gravel, or crushed rock may be used for wall backfill to reduce the lateral earth pressures provided these granular backfill materials extend behind the walls to a minimum horizontal distance equal to one-half the wall height. In addition, the sand, pea gravel, or rock backfill materials should extend behind the walls to a minimum horizontal distance of 2 feet at the base of the wall or to a horizontal distance equal to the heel width of the footing, whichever is greater (see Figures RW-2 and RW-3). For the above conditions, cantilevered walls retaining a level backfill and ascending 2:1 backfill may be designed to resist active earth pressures equivalent to fluids having densities of 30 and 41 pounds per cubic foot, respectively. For walls that are restrained at the top, at-rest earth pressures equivalent to fluids having densities of 45 and 62 pounds per cubic foot are recommended for design of restrained walls supporting a level backfill and ascending 2:1 backfill, respectively. These values are also for retaining walls supplied with a proper subdrain system.

Furthermore, as with existing soil backfill, the walls should be designed to support any adjacent structural surcharge loads imposed by other nearby walls or footings in addition to the recommended active and at-rest earth pressures. All structural calculations and details should be provided to this firm for verification purposes prior to grading and construction phases.

Earthquake Loads on Retaining Walls

Note 1 of Section 1803.5.12 of the 2019 CBC indicates that the dynamic seismic lateral earth pressures on foundation walls and retaining walls supporting more than 6 feet of backfill height due to design earthquake ground motions be determined. It is unlikely that any wall retaining 6 or more feet of backfill will be constructed onsite. Accordingly, dynamic seismic lateral earth pressures are not considered necessary for this project.

Subdrainage

Perforated pipe and gravel subdrains should be installed behind all retaining walls to prevent entrapment of water in the backfill (see Figures RW-1 through RW-3). Perforated pipe should consist of 4-inch-minimum diameter PVC Schedule 40, or SDR-35, with the perforations laid down. The pipe should be encased in a 1-foot-wide column of ¾-inch to 1½-inch open-graded gravel. If on-site soils are used as backfill, the open-graded gravel should extend above the wall footings to a minimum height equal to one-third the wall height or to a minimum height of 1.5 feet above the footing, whichever is greater. If imported sand, pea gravel, or crushed rock is used as backfill, subdrain details shown on Figures RW-2 and RW-3 should be utilized. The open-graded gravel should be completely wrapped in filter fabric consisting of Mirafi 140N or equivalent. Solid outlet pipes should be connected to the subdrains and then routed to a suitable area for discharge of accumulated water.

If a limited area exists behind the walls for installation of a pipe and gravel subdrain, a geotextile drain mat such as Mirafi Miradrain, or equivalent, can be used in lieu of drainage gravel. The drain mat should extend the full height and lengths of the walls and the filter fabric side of the drain mat should be placed up against the backcut. The perforated pipe drain line placed at the bottom of the drain mat should consist of 4-inch minimum diameter PVC Schedule 40 or SDR-35. The filter fabric on the drain mat should be peeled back and then wrapped around the drain line.

Waterproofing

The portions of retaining walls supporting backfill should be coated with an approved waterproofing compound or covered with a similar material to inhibit infiltration of moisture through the walls.

Wall Backfill

Where the onsite soils materials or imported sand (with a Sand Equivalent of 30 or greater) are used as backfill behind the proposed retaining walls, the backfill materials should be placed in approximately 6- to 8-inch-thick maximum lifts, watered as necessary to achieve above optimum moisture conditions, and then mechanically compacted in place to a minimum relative compaction of 90 percent. Flooding or jetting of the backfill materials should be avoided. A representative of the project geotechnical consultant should observe the backfill procedures and test the wall backfill to verify adequate compaction.

If imported pea gravel or rock is used for backfill, the gravel should be placed in approximately 2- to 3-foot-thick lifts, thoroughly wetted but not flooded, and then mechanically tamped or vibrated into place. A representative of the project geotechnical consultant should observe the backfill procedures and probe the backfill to determine that an adequate degree of compaction is achieved.

To reduce the potential for the direct infiltration of surface water into the backfill, imported sand, gravel, or rock backfill should be capped with at least 12 inches of on-site soil. Filter fabric such as Mirafi 140N or equivalent, should be placed between the soil and the imported gravel or rock to prevent fines from penetrating into the backfill.

Geotechnical Observation and Testing

All grading and construction phases associated with retaining wall construction, including backcut excavations, footing trenches, installation of the subdrainage systems, and placement of backfill should be observed and tested by a representative of the project geotechnical consultant.

Masonry Block Walls

Footings for free-standing masonry block walls and other rigid structures should be designed and reinforced utilizing the criteria recommended for conventional building foundations. Where existing surface soils are not removed and re-compacted as recommended herein, the footings should be extended through these loose surface soils and founded in underlying competent materials. Positive separations in walls should also be provided at corners and at horizontal spacing of approximately 25 feet to permit relative movement. The separations should be provided in the blocks and not extend through the footings. The footings should be poured monolithically with continuous rebars to serve as effective “grade beams” below the walls.

Where remedial grading cannot be performed due to site constraints, a reduced bearing value of 1,200 pounds per square foot should be used for 12-inch-wide continuous footings founded at a minimum depth of 12 inches below the lowest adjacent final grade. No increase in bearing value may be used for wider or deeper footings for this condition. The recommended allowable bearing value includes both dead and live loads, and may be increased by one-third for short duration wind and seismic forces. In addition, a reduced passive earth pressure of 175 pounds per square foot per foot of depth, to a maximum value of 1,750 pounds per square foot, should be used to resist lateral loads. A coefficient of friction of 0.3 times the dead load forces may still be used between concrete and the supporting soils to determine lateral sliding resistance. An increase of one-third of the above values may also be used when designing for short duration wind or seismic forces.

Exterior Concrete Flatwork

Subgrade Preparation

Compaction

To reduce the potential for distress to concrete flatwork, the subgrade soils below concrete flatwork areas to a minimum depth of 12 inches (or deeper, as either prescribed elsewhere in this report or determined in the field) should be moisture conditioned to at least equal to, or slightly greater than, the optimum moisture content and then compacted to a minimum relative compaction of 90 percent. Where concrete public roads, concrete segments of roads and/or concrete access driveways are proposed, the upper 6 inches of subgrade soil should be compacted to a minimum 95 percent relative compaction.

Pre-Moistening

As a further measure to reduce the potential for concrete flatwork cracking, subgrade soils should be thoroughly moistened prior to placing concrete. The moisture content of the soils should be at least the optimum moisture content to a minimum depth of 12 inches into the subgrade. Flooding or ponding of the subgrade is not considered feasible to achieve the above moisture conditions since this method would likely require construction of numerous earth berms to contain the water. Therefore, moisture conditioning should be achieved with sprinklers, or a light spray applied to the subgrade over a period of few to several days just prior to pouring concrete. Pre-watering of the soils is intended to promote uniform curing of the concrete, reduce the development of shrinkage cracks and reduce the potential for differential expansion pressure on freshly poured flatwork. A representative of the project geotechnical consultant should observe and verify the density and moisture content of the soils, and the depth of moisture penetration prior to pouring concrete.

Drainage

Drainage from patios and other flatwork areas should be directed to local area drains and/or graded earth swales designed to carry runoff water to the adjacent streets or other approved drainage structures. The concrete flatwork should be sloped at a minimum gradient of one percent, or as prescribed by project civil engineer or local codes, away from building foundations, retaining walls, masonry garden walls and slope areas.

Thickness and Joint Spacing

To reduce the potential of unsightly cracking, concrete walkways, patio-type slabs, large decorative slabs and concrete sub-slabs to be covered with decorative pavers should be at least 4 inches thick and provided with construction joints or expansion joints every 6 feet or less. Private driveways that will be designed for the use of passenger cars for access to private garages should also be at least 4 inches thick and provided with construction joints or expansion joints every 10 feet or less. Concrete pavement that will be designed based on an unlimited number of applications of an 18-kip single-axle load in public access areas, segments of road that will be paved with concrete (such as bus stops and cross-walks) or access roads that will be subject to heavy truck loadings should have a minimum thickness of 5 inches and be provided with control joints spaced at maximum 10-foot intervals. A modulus of subgrade reaction of 125 pounds per cubic foot may be used for design of the public and access roads.

Reinforcement

All concrete flatwork having their largest plan-view panel dimension exceeding 10 feet should be reinforced with a minimum of No. 3 bars spaced 24 inches on centers, both ways. Alternatively, the slab reinforcement may consist of welded wire mesh of the sheet type (not rolled) with 6x6/W1.4xW1.4 designation in accordance with the Wire Reinforcement Institute (WRI). The reinforcement should be properly positioned near the middle of the slabs.

The reinforcement recommendations provided herein are intended as guidelines to achieve adequate performance for anticipated soil conditions. The project architect, civil and/or structural engineer should make appropriate adjustments in reinforcement type, size and spacing to account for concrete internal (e.g., shrinkage and thermal) and external (e.g., applied loads) forces as deemed necessary.

Edge Beams (Optional)

Where the outer edges of concrete flatwork are to be bordered by landscaping, it is recommended that consideration be given to the use of edge beams (thickened edges) to prevent excessive infiltration and accumulation of water under the slabs. Edge beams, if used, should be 6 to 8 inches wide, extend 8 inches below the tops of the finish slab surfaces. Edge beams are not mandatory; however, their inclusion in flatwork construction adjacent to landscaped areas is intended to reduce the potential for vertical and horizontal movement and subsequent cracking of the flatwork related to uplift forces that can develop in expansive soils.

Tree Wells

Tree wells are not recommended in concrete flatwork areas since they introduce excessive water into the subgrade soils and allow root invasion, both of which can cause heaving and cracking of the flatwork.

Utility Trench Backfill

All utility trench backfill should be compacted to a minimum relative compaction of 90 percent. Onsite earth materials cannot be densified adequately by flooding and jetting techniques. Therefore, trench backfill should be placed in lifts no greater than 6 inches in thickness, watered or air-dried as necessary to achieve near optimum moisture conditions, and mechanically compacted in place to a minimum relative compaction of 90 percent. A representative of the project geotechnical consultant should probe and test the trench backfills to document that adequate compaction has been achieved.

As an alternative for shallow trenches where pipe or utility lines may be damaged by mechanical compaction equipment, such as under building floor slabs, imported clean sand having a sand equivalent (SE) value of 30 or greater may be utilized. The sand backfill materials should be watered to achieve near optimum moisture conditions and then tamped into place. No specific relative compaction will be required; however, observation, probing, and if deemed necessary, testing should be performed by a representative of the project geotechnical consultant to verify an adequate degree of compaction.

If clean, imported sand is to be used for backfill of exterior utility trenches, it is recommended that the upper 12 inches of trench backfill materials consist of properly compacted onsite soil materials. This is to mitigate infiltration of irrigation and rainwater into granular trench backfill materials.

Where an interior or exterior utility trench is proposed parallel to a building footing, the bottom of the trench should not be located below a 1:1 plane projected downward from the outside bottom edge of the adjacent footing. Where this condition exists, the adjacent footing should be deepened such that the bottom of the utility trench is located above the 1:1 projection. Where utility trenches cross under a building footing, these trenches should be backfilled with on-site soils at the point where the trench crosses under the footing to reduce the potential for water to migrate under the floor slabs.

Site Drainage

Positive surface drainage systems consisting of a combination of sloped concrete flatwork/asphalt pavement, sheet flow gradients, swales and surface area drains (where needed) should be provided around the building and within the planter areas to collect and direct all surface waters to an appropriate drainage facility as determined by the project civil engineer. The ground surfaces of planter and landscape areas that are located within 10 feet of building foundations should be sloped at a minimum gradient of 5 percent away from the foundations and towards the nearest area drains. The ground surfaces of planter and landscape areas that are located more than 10 feet away from building foundations may be sloped at a minimum gradient of 2 percent away from the foundations and towards the nearest area drains.

Concrete flatwork surfaces that are located within 10 feet of building foundations should be inclined at a minimum gradient of 2 percent away from the building foundations and towards the nearest area drains. Concrete flatwork surfaces that are located more than 10 feet away from building foundations may be sloped at a minimum gradient of 1 percent away from the foundations and towards the nearest area drains. Surface waters should not be allowed to collect or pond against building foundations and within the level areas of the site. All drainage devices should be properly maintained throughout the lifetime of the development. Future changes to site improvements, or planting and watering practices, should not be allowed to cause over-saturation of site soils adjacent to the structures.

<u>Bottomless Trench Drains</u>

When gravel filled bottomless infiltration systems are constructed near foundations, a potential exists for oversaturation of the foundation soils which conflicts with the intended purpose of onsite drainage facilities. In addition, it has been our experience that a leading cause of distress to buildings and foundations is due to poor management of water next to building foundations. Petra recommends a setback of at least 15 feet between any infiltration system and building foundations. If this setback distance cannot be maintained, then a modified foundation system may be required to alleviate any distress that could be caused by infiltration of water near the footing. A modified foundation system could consist of constructing deepened footings within 15 feet of the infiltration system and installing extra reinforcement. Design of a modified foundation system is referred to the project structural engineer.

Swimming Pool and Spa

Allowable Bearing and Settlement

Based on the currently proposed pool location, the pool may be designed as a conventional pool shell founded on improved ground. Any loose sand below the pool shell should be removed and replaced with engineered fill. Therefore, the pool shell may be designed using an allowable bearing value of 1,500 pounds per square foot. A potential for seismic differential settlement on the order of one inch to occur across the pool/spa shells should be considered in the design.

Lateral Earth Pressures

The pool walls should be designed assuming that an earth pressure equivalent to a fluid having a density of 90 pounds per cubic foot is acting on the outer surface of the pool walls. For this long-term condition, the walls should be designed using a lateral earth pressure of 62.4H pounds per square foot (where "H" equals the vertical depth in feet below the ground surface) that is acting on the inner surface of the pool walls. Pool walls should also be designed to resist lateral surcharge pressures imposed by any adjacent footings or structures in addition to the above lateral earth pressures.

Stability of Temporary Excavation

The pool excavation is expected to expose compacted fill. Based on the anticipated physical characteristics of these materials, the pool excavation sidewalls may be cut at 4 foot vertical with sloping sidewalls above per the previous recommendations for temporary excavation stability. Therefore, the temporary excavation sidewalls should be sloped at a slope ratio of 2:1 (horizontal to vertical) or flatter before forming of the pool walls.

Temporary Access Ramps

It is essential that all backfill placed within temporary access ramps extending into the pool excavation be properly compacted and tested. This will reduce the potential for excessive settlement of the backfill and subsequent damage to pool decking or other structures placed on the backfill.

Pool Bottom

It is expected that the swimming pool bottom will rest entirely on medium dense to dense dune sand deposits. Therefore, care should be taken while excavating these structures to prevent disturbance of subgrade soils exposed at grade in the pool bottom.

Pool Decking

Pool decking should be constructed in accordance with the recommendations presented in the "Exterior Concrete Flatwork" section of this report.

Plumbing Fixtures

Leakage from the swimming pool or from any of the appurtenant plumbing could create adverse saturated conditions of the surrounding subgrade soils. Localized areas of oversaturation can lead to differential expansion (heave) of the subgrade soils and subsequent raising and shifting of concrete flatwork. Therefore, it is essential that all plumbing and pool fixtures be absolutely leak-free. For similar reasons, drainage from pool deck areas should be directed to local area drains and/or graded earth swales designed to carry runoff water to a suitable discharge point.

Preliminary Pavement Design

Onsite soil is highly granular and R-values of future access road subgrades following site grading are expected to be over 50. The access roadway is expected to be classified as 'Local' and associated Traffic Indices (TI) are expected to be 5. A tentative structural pavement section for the roadway is 3 inches of asphalt over 4 inches of base material. Final pavement design should be performed at the completion of rough grading with final R-value testing.

Subgrade soils immediately below the aggregate base, to a minimum depth of 12 inches, should be compacted to a minimum relative compaction of 95 percent based on ASTM D1557. Final subgrade compaction should be performed prior to placing base materials and after utility-trench backfills have been compacted and tested.

The base materials should meet the specifications for Crushed Aggregate Base, Crushed Miscellaneous Base or Processed Miscellaneous Base as defined in Section 200-2 of the current edition of the Standard Specifications for Public Works Construction (Greenbook). The base course should be compacted to 95 percent or more of the maximum dry density as evaluated by ASTM D1557. Asphaltic concrete materials and construction should conform to Section 203 of the Greenbook or by County of Riverside specifications.

EVALUATION LIMITATIONS

This report is based on the proposed project and geotechnical data as described herein. The materials encountered on the project site, described in other literature, and utilized in our laboratory assessment are believed representative of the project area, and the conclusions and recommendations contained in this report are presented on that basis. However, soil materials can vary in characteristics between points of exploration, both laterally and vertically, and those variations could affect the conclusions and recommendations contained herein. As such, observation and testing by a geotechnical consultant during the grading and construction phases of the project are essential to confirming the basis of this report. Without this confirmation, this report is to be considered incomplete and this firm and the undersigned professionals assume no responsibility for its use.

This report has been prepared consistent with that level of care being provided by other professionals providing similar services at the same locale and time period. The contents of this report are professional opinions and as such, are not to be considered a guarantee or warranty. This report should be reviewed and updated after a period of one year or if the project concept changes from that described herein.

The information contained herein has not been prepared for use by parties or projects other than those named or described herein. This report may not contain sufficient information for other parties or other purposes. In addition, this report should be reviewed and updated after a period of one year, or sooner if the site ownership or project concept changes from that described herein.

This opportunity to be of service is sincerely appreciated. Please call if you have any questions pertaining to this report.

Respectfully submitted,

PETRA GEOSCIENCES, INC.

10/5/22

J. Montgomery Schultz
Associate Engineer
GE 2941

Alan Pace
Senior Associate Geologist
CEG 1952

JMS/AP/lv

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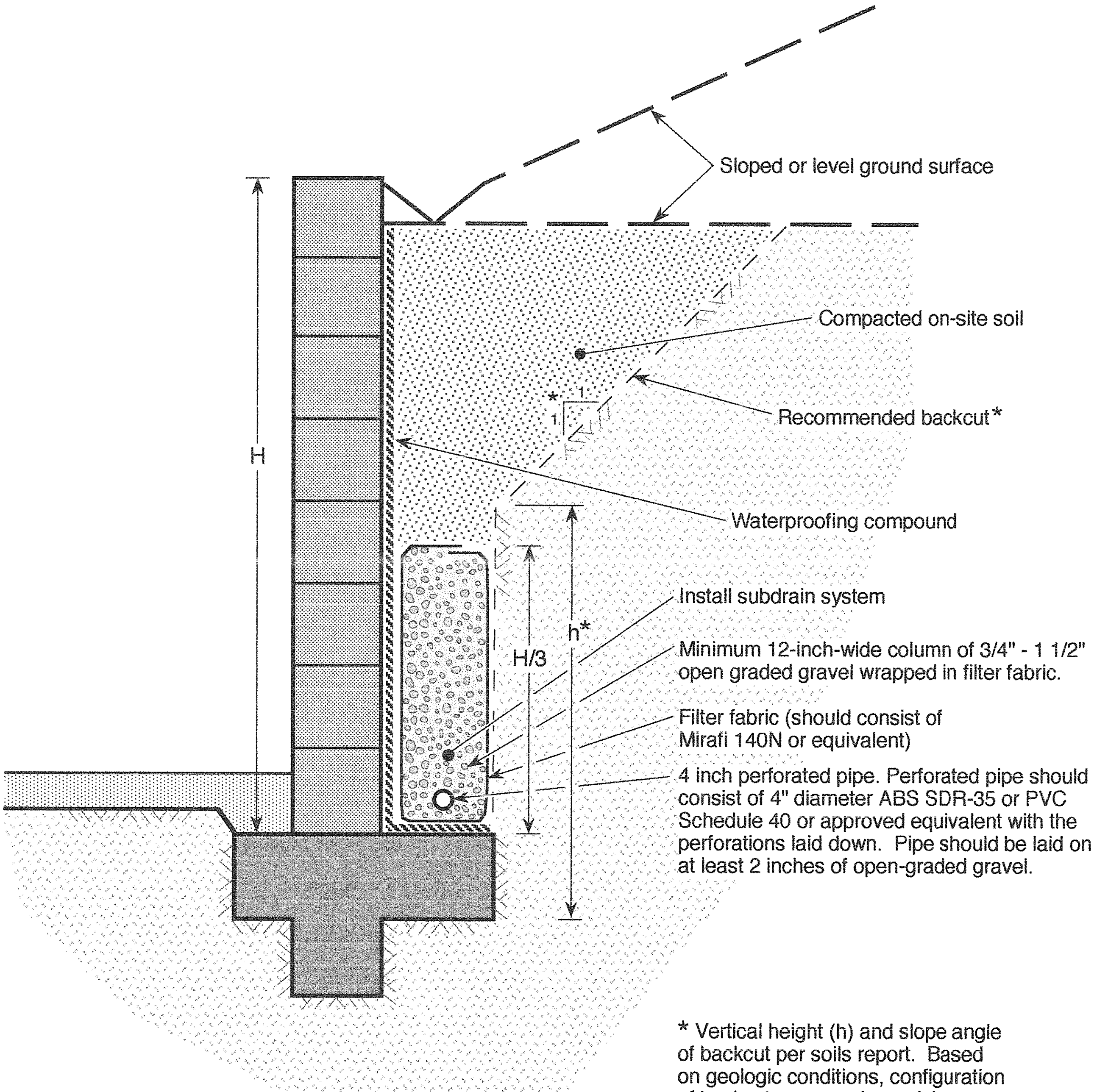
FIGURES

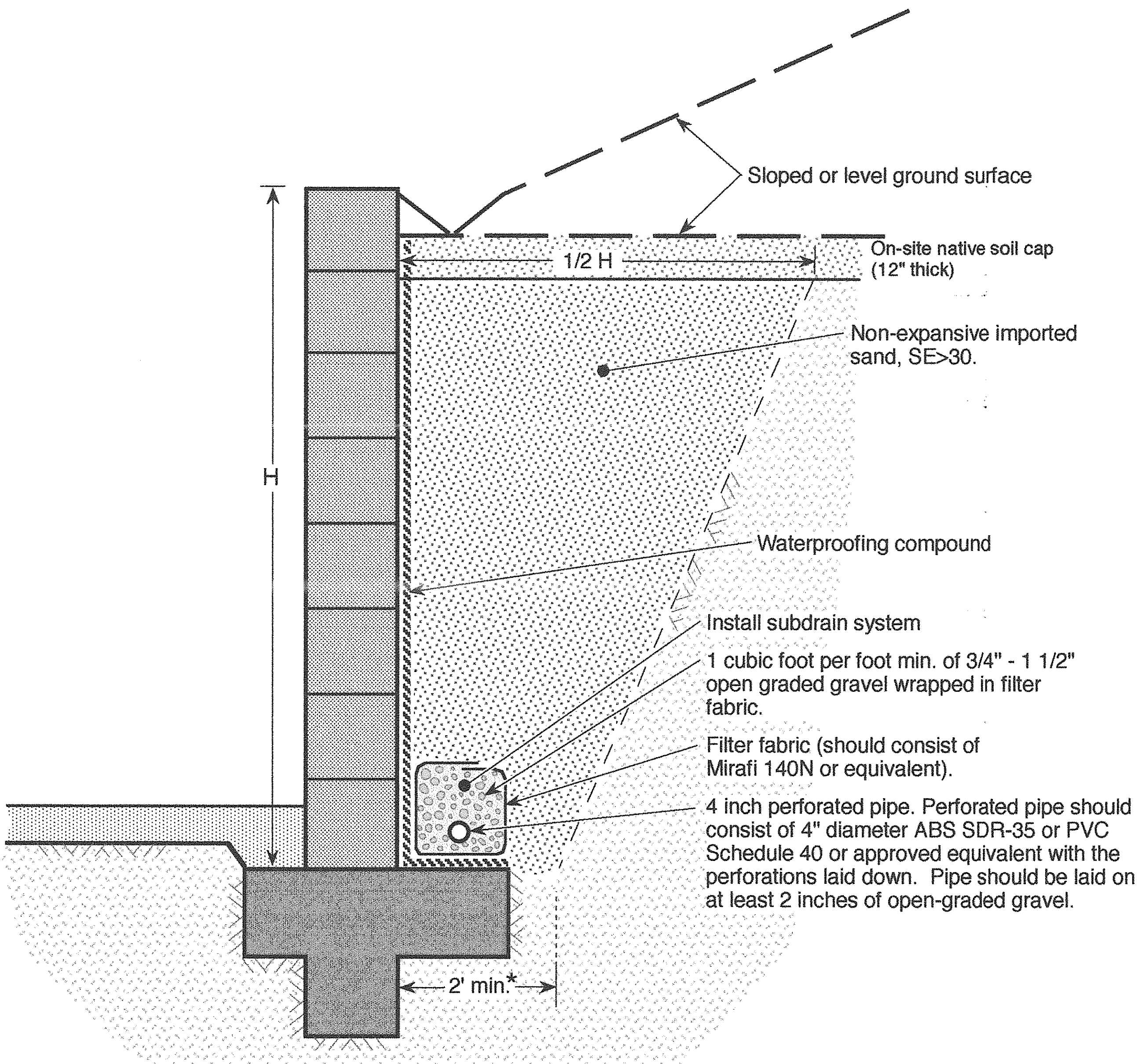
NATIVE SOIL BACKFILL



* Vertical height (h) and slope angle of backcut per soils report. Based on geologic conditions, configuration of backcut may require revisions (i.e. reduced vertical height, revised slope angle, etc.)

PETRA	RETAINING WALL BACKFILL AND SUBDRAIN DETAILS	FIGURE RW-1

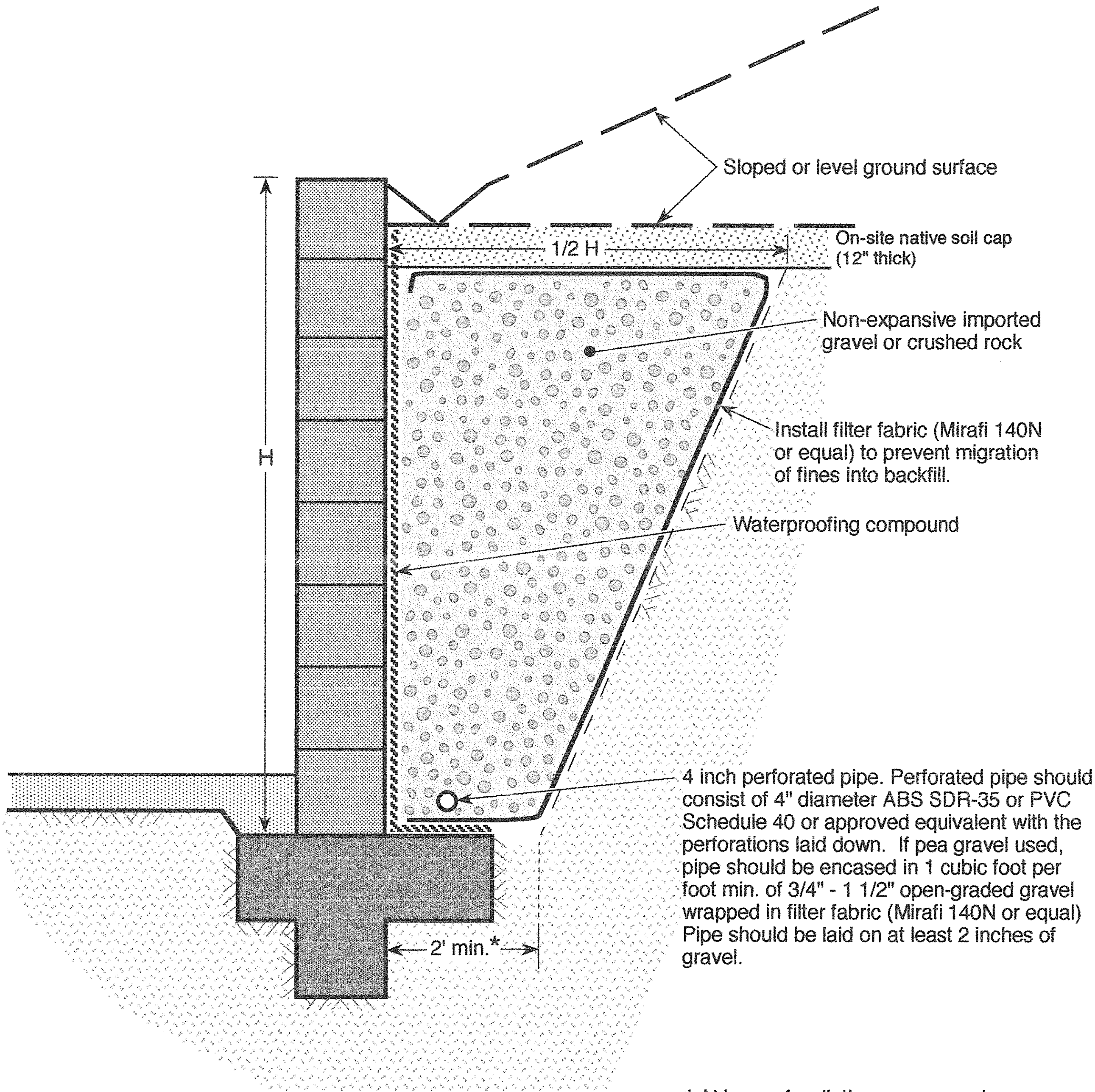
IMPORTED SAND BACKFILL



* At base of wall, the non-expansive backfill materials should extend to a min. distance of 2' or to a horizontal distance equal to the heel width of the footing, whichever is greater.

PETRA	RETAINING WALL BACKFILL AND SUBDRAIN DETAILS	FIGURE RW-2

IMPORTED GRAVEL OR CRUSHED ROCK BACKFILL



* At base of wall, the non-expansive backfill materials should extend to a min. distance of 2' or to a horizontal distance equal to the heel width of the footing, whichever is greater.

PETRA	RETAINING WALL BACKFILL AND SUBDRAIN DETAILS	FIGURE RW-3

APPENDIX A-1

EXPLORATION (BORING) LOGS

CPT SOUNDING LOGS

Soil Classification

PETRA

4 Moisture Content

Dry
Slightly Moist
Moist
Very Moist
Wet (Saturated)

Modifiers

Trace	< 1 %
Few	1 - 5%
Some	5 - 12 %
Numerous	12 - 20 %

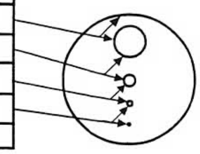
Soil Classification Should Include:

PREFERRED ORDER

1. Group Name
2. Group Symbol
3. Color
4. Moisture Content
5. Relative Density / Consistency
6. Grain Size Range
7. Structure
8. Odor
9. Additional comments indicating soil characteristics which might affect engineering properties

6 Grain Size

Description		Sieve Size	Grain Size	Approximate Size
Boulders		>12"	>12"	Larger than basketball-sized
Cobbles		3 - 12"	3 - 12"	Fist-sized to basketball-sized
Gravel	coarse	3/4 - 3"	3/4 - 3"	Thumb-sized to fist-sized
	fine	#4 - 3/4"	0.19 - 0.75"	Pea-sized to thumb-sized
Sand	coarse	#10 - #4	0.079 - 0.19"	Rock salt-sized to pea-sized
	medium	#40 - #10	0.017 - 0.079"	Sugar-sized to rock salt-sized
	fine	#200 - #40	0.0029 - 0.017"	Flour-sized to sugar-sized to
Fines		Passing #200	<0.0029"	Flour-sized and smaller



1 2 Unified Soil Classification System

Coarse-grained Soils > 1/2 of materials is larger than #200 sieve	The No. 200 U.S. Standard Sieve is about the smallest particle visible to the naked eye	GRAVELS more than half of coarse fraction is larger than #4 sieve	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
				GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
			Gravels with fines	GM	Silty Gravels, poorly-graded gravel-sand-silt mixtures
				GC	Clayey Gravels, poorly-graded gravel-sand-clay mixtures
		SANDS more than half of coarse fraction is smaller than #4 sieve	Clean Sands (less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
				SP	Poorly-graded sands, gravelly sands, little or no fines
			Sands with fines	SM	Silty Sands, poorly-graded sand-gravel-silt mixtures
				SC	Clayey Sands, poorly-graded sand-gravel-clay mixtures
		SILTS & CLAYS Liquid Limit Less Than 50		ML	Inorganic silts & very fine sands, silty or clayey fine sands, clayey silts with slight plasticity
Fine-grained Soils > 1/2 of materials is smaller than #200 sieve				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
				OL	Organic siltys & clays of low plasticity
		SILTS & CLAYS Liquid Limit GreaterThan 50		MH	Inorganic silts, micaceous or diatomaceous fine sand or silt
				CH	Inorganice clays of high plasticity, fat clays
				OH	Organic silts and clays of medium-to-high plasticity
Highly Organic Soils				PT	Peat, humus swamp soils with high organic content

5 Consistency - Fine Grained Soils

Apparent Density	SPT (# blows/foot)	Modified CA Sampler (# blows/foot)	Field Test
Very Soft	<2	<3	Easily penetrated by thumb; exudes between thumb and fingers when squeezed in hand
Soft	2-4	3-6	Easily penetrated one inch by thumb; molded by light finger pressure
Firm	5-8	7-12	Penetrated over 1/2 inch by thumb with moderate effort; molded by strong finger pressure
Stiff	9-15	13-25	Indented about 1/2 inch by thumb but penetrated only with great effort
Very Stiff	16-30	26-50	Readily indented by thumbnail
Hard	>30	>50	Indented with difficulty by thumbnail

5 Relative Density - Coarse Grained Soils

Apparent Density	SPT (# blows/foot)	Modified CA Sampler (# blows/foot)	Field Test
Very Loose	<4	<5	Easily penetrated with 1/2-inch reinforcing rod pushed by hand
Loose	4-10	5-12	Easily penetrated with 1/2-inch reinforcing rod pushed by hand
Medium Dense	11-30	13-35	Easily penetrated 1-foot with 1/2-inch reinforcing rod driven with a 5-lb hammer
Dense	31-50	36-60	Difficult to penetrated 1-foot with 1/2-inch reinforcing rod driven with a 5-lb hammer
Very Dense	>50	>60	Penetrated only a few inches with 1/2-inch reinforcing rod driven with a 5-lb hammer

TEST PIT LOG

Project: **Wellness Center**		Boring No.:	**B-1**
Location: **Lake Hemet**		Elevation:	**±4382'**
Job No.: **20-227**	Client:	Date:	**6/7/2021**
Drill Method: **8" Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Silty Clay (ML): Brown, slightly moist, firm, fine-grained sand.		8 13 14	■	X	4.6	114.5	MAX, EI, AT, HYD, S04, CL, RES, pH
5		Sand (SP): Gray, moist, medium-dense, fine- to medium-grained sand, trace gravel up to 1/4" in diameter.		8 8 10	■		3.1	106.7	200
		Becomes off-white, fine- to medium-grained.		8 10 20	■		2.5	108.2	
10		Silty Sand (SM): Gray, wet, medium-dense, medium- to coarse-grained.		11 15 18	■		14.5	111.0	MA
		@12.5' Groundwater encountered.	▽						
15		Same as above.		4 10 15	■		14.4	117.2	200
20		Same as above.		4 9 9	■				200
25		No recovery (likely rock encountered).		36 50/5"	■				
30		Sand with Silt & Gravel (SP-SM): Gray, wet, medium-dense, fine- to medium-grained.		7 9 11	■				MA
35		Silty Sand (SM): Grayish-brown, wet, medium-dense to dense, fine- to		7	■				

Petra Geosciences, Inc.

T E S T P I T L O G

Project:	**Wellness Center**	Boring No.:	**B-1**
Location:	**Lake Hemet**	Elevation:	**±4382'**
Job No.: **20-227**	Client:	Date:	**6/7/2021**
Drill Method: **8" Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		medium-grained.		16 26	■		11.2	125.5	200
40		**BEDROCK - Granitics (Kgr)** Off-white, coarse-grained, very hard, slightly weathered, Drill begins to struggle.							
45		Total Depth= 40'5" Groundwater @ 12.5' Boring backfilled with cuttings.							
50									
55									
60									
65									
70									

PLATE A-1

Petra Geosciences, Inc.

TEST PIT LOG

Project: **Wellness Center**		Boring No.:	**B-2**
Location: **Lake Hemet**		Elevation:	**±4381'**
Job No.: **20-227**	Client:	Date:	**6/7/2021**
Drill Method: **8" Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Sandy Silt (ML): Brown, moist, firm, fine-grained.							
		Silty Sand (SM): Grayish-brown, wet, medium-dense, fine-to medium-grained, (Sample was possibly wet from previous boring carry over).		11 13 15	■		7.1	118.9	CON
5		Silty Sand (SM): Brown, moist, medium-dense, fine- to coarse-grained.		10 12 17	■		4.7	115.2	MA
		Becomes fine- to coarse-grained, dark gray and wet.		10 12 17	■		17.0	114.9	DSU
10		@9'8" Groundwater encountered. Becomes off-white and coarse-grained. Silty Sand (SM): Dark gray, wet, medium-dense, fine-grained.	▽	7 10 16	■		14.9	115.8	
15		Sand (SP): Gray, wet, medium-dense, medium- to coarse-grained.		7 12 12	■		12.2	110.9	
20		Same as above.		13 30 32	■		14.8	122.3	
25		Total Depth= 25' Reusal due to heaving sands clogging auger Groundwater @ 9'8" Boring backfilled with cuttings.							
30									
35									

PLATE A-2

TEST PIT LOG

Project: **Wellness Center**		Boring No.: **B-3**
Location: **Lake Hemet**		Elevation: **±4377'**
Job No.: **20-227**	Client:	Date: **6/7/2021**
Drill Method: **8" Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By: **KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Sandy Silt (ML): Brown, slightly moist, firm, fine-grained sand.							
		Silty Sand (SM): Dark brown, moisst, medium-dense, fine- to medium-grained.		10 13 13	■		7.7	120.9	
5									
		Sand (SP): Grayish-brown, very moist, medium-dense, medium- to coarse-grained, trace gravel up to 1" in diameter = 1%.		6 9 10	■		10.5	107.6	
		@8'8" Groundwater encountered. Becomes gray with orange oxidation staining, medium-grained.	▽	10 11 17	■		15.1	112.8	
10									
		Becomes dark gray to black.		9 10 9	■		21.7	105.8	
15		Becomes grayish-brown and medium to coarse-grained. @16' Drill struggles for approximately 1' and then proceeds as normal.		4 8 14	■		12.8	118.5	
20		Becomes fine- to coarse-grained.		7 13 18	■		13.6	117.5	
25		Becomes fine- to medium-grained, micaceous.		10 17 22	■		17.1	115.6	
30		Becomes fine- to coarse-grained.		11 16 24	■		15.7	118.2	
35		Silty Sand (SM): Dark yellowish-brown, wet, medium-dense, fine- to coarse-		7	■				

Petra Geosciences, Inc.

TEST PIT LOG

Project:	**Wellness Center**	Boring No.:	**B-3**
Location:	**Lake Hemet**	Elevation:	**±4377'**
Job No.: **20-227**	Client:	Date:	**6/7/2021**
Drill Method: **8" Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**KTM**

Depth (Feet)	Lithology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		grained.		12 10	■		16.4	114.1	
40		**BEDROCK - Granitics (Kgr)** Granite: Yellowish-brown, fine- to coarse-grained, hard, highly weathered. Drill begins to struggle.		22 50/4"	■		9.6	132.4	
45		Same as above.		50/4"	■		11.1	129.4	
50		Becomes slightly weathered.		50/5"	■		18.4	115.5	
		Total Depth= 51' Refusal due to hard bedrock Ground water @ 8'8" Boring backfilled with cuttings.							
55									
60									
65									
70									

TEST PIT LOG

Project: **Wellness Center**		Boring No.:	**B-4**
Location: **Lake Hemet**		Elevation:	**±4382'**
Job No.: **20-227**	Client:	Date:	**6/7/2021**
Drill Method: **8" Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Sand (SP): Gray, dry, loose, fine- to coarse-grained. Becomes brown and moist.							
		Becomes grayish-brown.		7 7 8	■		4.5	107.5	
5		Becomes yellowish-gray, medium- to coarse-grained.		8 12 16	■		6.2	107.1	
		Silty Sand (SM): Dark grayish-brown, very moist, medium-dense, fine-grained.		8 11 14	■		17.9	108.6	
10		Sand (SP): Brown, wet, medium-dense, fine- to medium-grained. @10'4" Groundwater encontered.	▽	7 14 16	■		15.2	116.3	
15		Becomes dark gray.		10 25 36	■		16.5	114.1	
20		Silty Sand (SM): Brown, wet, medium-dense.		4 10 30	■		15.5	117.8	
		Total Depth= 21.5' Groundwater @ 10'4" Boring backfilled with cuttings.							
25									
30									
35									

PLATE A-4

Petra Geosciences, Inc.

TEST PIT LOG

Project: **Wellness Center**		Boring No.:	**B-5**
Location: **Lake Hemet**		Elevation:	**±4393'**
Job No.: **20-227**	Client:	Date:	**6/7/2021**
Drill Method: **8" Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By:	**KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Sand (SP): Brown, dry, medium-dense, fine-grained.							
		Becomes wet.		5 6 8	■		6.1	97.5	
5		Becomes fine-grained & micaceous.		6 7 9	■		6.7	94.8	
		Becomes off-white & coarse-grained. Becomes grayish-brown.		10 18 24	■		12.7	118.9	
10		Becomes wet with trace gravel up to 2" in diameter =2%. @10'9" Groundwater encountered.	▽	15 18 50	■		14.6	113.1	
15		Beomes medium- to coarse-grained. @16' Drill begins to chatter and struggle.		7 12 23	■		12.9	118.1	
		@19' Drill continues as normal.							
20		Becomes medium-dense to dense.		34 30 38	■		16.8	116.2	
		Total Depth= 21.5' Groundwater encountered @ 10'9" Boring backfilled with cuttings.							
25									
30									
35									

PLATE A-5

Petra Geosciences, Inc.

TEST PIT LOG

Project:	Wellness Center	Boring No.:	B-6
Location:	Lake Hemet	Elevation:	±4373'
Job No.: 20-227	Client:	Date:	8/31/2021
Drill Method: 8" Hollow Stem Auger	Driving Weight: 140lbs/30"	Logged By:	KTM

Depth (Feet)	Material Description	Water	Blows per 6 in.	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
0	**ALLUVIUM (Qal)** Silty Sand (SM): Brown, dry to slightly moist, loose, fine- to medium-grained sand.							
	Sand with Silt (SP-SM): Grayish-brown, slightly moist, medium-dense, fine- to medium-grained sand.		5 6 10	■				DSU
5	Sand (SP): Pinkish-gray, dry, medium-dense, fine- to coarse-grained.		7 8 12	■		2.3	104.8	
	Sand with Silt (SP-SM): Dark yellowish-brown, moist, medium-dense, fine- to medium-grained.		10 12 14	■		4.2	107.2	
10	Silty Sand (SM): Gray, wet, medium-dense, fine- to coarse-grained.	▽	7 12 16	■		15.5	114.1	
15	Sand with Silt (SP-SM): Grayish-brown, wet, medium-dense, fine- to coarse-grained, trace angular graverl up to 3/4" in diameter.		13 18 21	■		14.6	115.7	
20	Sand (SP): Dark gray, wet, medium-dense, medium-grained.		7 12 12	■				
25	Sand with Silt (SP-SM): Gray, wet, medium-dense, fine- to coarse-grained.		10 14 25	■		22.0	105.6	
	@29' drill begins to struggle.							
30			15 33 33	■				
	BEDROCK - Granitics (Kgr) Off-white & black, moist, fine- to coarse-grained, moderately hard, .							
35	Becomes off-white and very hard.		33	■				

PLATE A-6

TEST PIT LOG

Project:	Wellness Center		Boring No.:	B-6
Location:	Lake Hemet		Elevation:	±4373'
Job No.:	20-227	Client:	Date:	8/31/2021
Drill Method:	8" Hollow Stem Auger	Driving Weight: 140lbs/30"	Logged By:	KTM

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
				50/5"	■		9.9	123.7	
		Total Depth= 36' Refusal due to hard bedrock Groundwater @ 11' Boring backfilled with cuttings.							
40									
45									
50									
55									
60									
65									
70									

PLATE A-6

TEST PIT LOG

Project:	Wellness Center		Boring No.:	B-7
Location:	Lake Hemet		Elevation:	±4373'
Job No.:	20-227	Client:	Date:	8/31/2022
Drill Method:	8" Hollow Stem Auger	Driving Weight: 140lbs/30"	Logged By:	KTM

Depth (Feet)	Lithology	Material Description	WATER	Blows per 6 in.	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
0		**ALLUVIUM (Qal)** Silty Sand (SM): Grayish-brown, slightly moist, medium-dense, fine-grained sand, trace medium-grained sand, trace gravel up to 1" in diameter.							
		Same as above.		8 12 10	■		2.9	104.0	
5		Same as above.		7 11 17	■		3.4	106.1	
		Sand with Silt (SP-SM): Gray, moist, medium-dense, fine- to coarse-grained.		6 12 20	■		4.4	117.9	
10		Becomes black & gray with trace gravel up to 3/4" in diameter.		15 25 20	■		9.8	122.3	
			▽						
15		Sand with Silt (SP-SM): Grayish-brown, wet, medium-dense, fine- to coarse-grained sand.					9.8	117.6	
		Total Depth= 16.5' Groundwater @ 12.5' Boring backfilled with cuttings.							
20									
25									
30									
35									

Petra Geosciences, Inc.

TEST PIT LOG

Project: Wellness Center		Boring No.: MW-1
Location: Lake Hemet		Elevation: ±4376'
Job No.: 20-227	Client:	Date: 8/31/2022
Drill Method: 8" Hollow Stem Auger	Driving Weight: 140lbs/30"	Logged By: KTM

Depth (Feet)	Lithology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Silty Sand (SM): Brown, dry to slightly moist, loose, fine- to medium-grained.							
5		Sand (SP): Grayish-brown, moist, medium-dense, fine- to coarse-grained.		6 7 9	■		3.4	108.0	
10			▽	12 16 16	■		5.4	108.5	HYD
15		Sand with Silt (SP-SM): Gray, wet, medium-dense, fine- to coarse-grained.		3 6 5	■				HYD
20		Same as above.		5 9 12	■				HYD
25		Same as above.		7 8 12	■				HYD
30		Same as above.		18 12 20	■				HYD
35				25	■				

PLATE A-8

Petra Geosciences, Inc.

TEST PIT LOG

Project:	Wellness Center	Boring No.:	MW-1
Location:	Lake Hemet	Elevation:	±4376'
Job No.:	20-227	Client:	Date: 8/31/2022
Drill Method:	8" Hollow Stem Auger	Driving Weight: 140lbs/30"	Logged By: KTM

Depth (Feet)	Lith-ology	Material Description	WATER	Blows per 6 in.	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		BEDROCK - Granitics (Kgr) Off-white to yellowish-brown, moist, fine-grained, , hard, moderately weathered.		50/5"	■				HYD
40		Becomes very hard.		50/5"	■				
		Total Depth= 40.5' Groundwater encountered @ 11' After the completion of drilling, the borehole was converted into a monitoring well with the following construction: 38.5 feet of 2"-diameter PVC casing was installed; solid from 0 to 28.5 feet and 2-mm slotted from 28.5 to 38.5 feet. The annulus space consisted of sand (#50) to 8 feet bgs; bentonite to 1.5 feet bgs; capped with concrete to surface Well casing covered with a locking cap							
45									
50									
55									
60									
65									
70									

PLATE A-8

TEST PIT LOG

Project: **Wellness Center**		Boring No.:	**TP-1**
Location: **Lake Hemet**		Elevation:	**±4383'**
Job No.: **20-227**	Client:	Date:	**5/7/2021**
Drill Method: **Backhoe**	Driving Weight: **Not Applicable**	Logged By:	**KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**TOPSOIL** Silty Sand (SM): Brown, dry, fine-grained, few rootlets.							
		ALLUVIUM (Qal) Silty Sand (SM): Brown, moist, loose, fine-grained, with trace medium-grained sand.							
		Total Depth= 2'11" No groundwater encountered Dual ring infiltration test ran on bottom of test pit.							
5									
10									
15									
20									
25									
30									
35									

PLATE A-9

Petra Geosciences, Inc.

TEST PIT LOG

Project:	**Wellness Center**			Boring No.:	**TP-2**
Location:	**Lake Hemet**			Elevation:	**±4381'**
Job No.:	**20-227**	Client:		Date:	**5/7/2021**
Drill Method:	**Backhoe**	Driving Weight:	**Not Applicable**	Logged By:	**KTM**

Depth (Feet)	Lithology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**TOPSOIL** Silty Sand (SM): Brown, dry, fine-grained, few rootlets.							
		ALLUVIUM (Qal) Silty Sand (SM): Brown, moist, loose, fine-grained, with trace medium-grained sand.							
		Total Depth= 3'2" No groundwater encountered Dual ring infiltration test ran on bottom of test pit.							
5									
10									
15									
20									
25									
30									
35									

PLATE A-10

Petra Geosciences, Inc.

TEST PIT LOG

Project:	**Wellness Center**	Boring No.:	**TP-3**
Location:	**Lake Hemet**	Elevation:	**±4,368'**
Job No.: **20-227**	Client:	Date:	**5/7/2021**
Drill Method: **Backhoe**	Driving Weight: **Not Applicable**	Logged By:	**KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**TOPSOIL** Silty Sand (SM): Brown, dry, fine-grained, few rootlets.							
		ALLUVIUM (Qal) Silty Sand (SM): Brown, moist, loose, fine-grained, with trace medium-grained sand.							
		Total Depth= 3'2" No groundwater encountered Dual ring infiltration test ran on bottom of test pit.							
5									
10									
15									
20									
25									
30									
35									

PLATE A-11

Petra Geosciences, Inc.

TEST PIT LOG

Project: **Wellness Center**		Boring No.:	**TP-4**
Location: **Lake Hemet**		Elevation:	**±4,379'**
Job No.: **20-227**	Client:	Date:	**5/7/2021**
Drill Method: **Backhoe**	Driving Weight: **Not Applicable**	Logged By:	**KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**TOPSOIL** Silty Sand (SM): Brown, dry, fine-grained, few rootlets.							
		ALLUVIUM (Qal) Sand (SP): Brown, moist, loose, fine- to medium-grained, with trace medium-grained sand.							
		Total Depth= 2'8" No groundwater encountered Dual ring infiltration test ran on bottom of test pit.							
5									
10									
15									
20									
25									
30									
35									

Petra Geosciences, Inc.

TEST PIT LOG

Project:	Wellness Center			Boring No.:	TP-5
Location:	Lake Hemet			Elevation:	±4,383'
Job No.:	20-227	Client:		Date:	5/7/2021
Drill Method:	Backhoe	Driving Weight:	Not Applicable	Logged By:	KTM

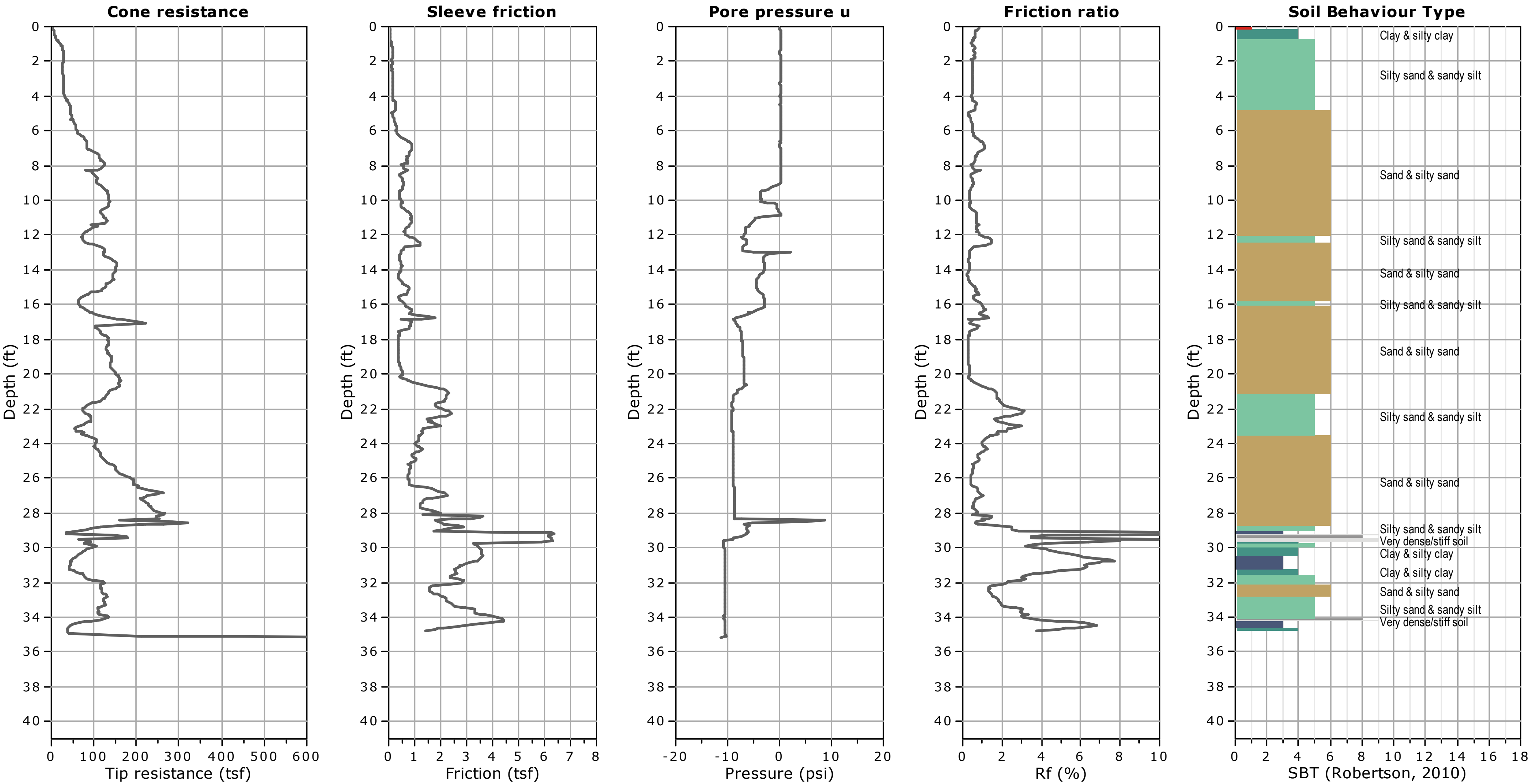
Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**TOPSOIL** Silty Sand (SM): Brown, dry, fine-grained, few rootlets.							
		ALLUVIUM (Qal) Sand (SP): Grayish-brown, moist, loose, fine- to coarse-grained.							
		Total Depth= 2'5" No groundwater encountered.							
5									
10									
15									
20									
25									
30									
35									

Petra Geosciences, Inc.

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

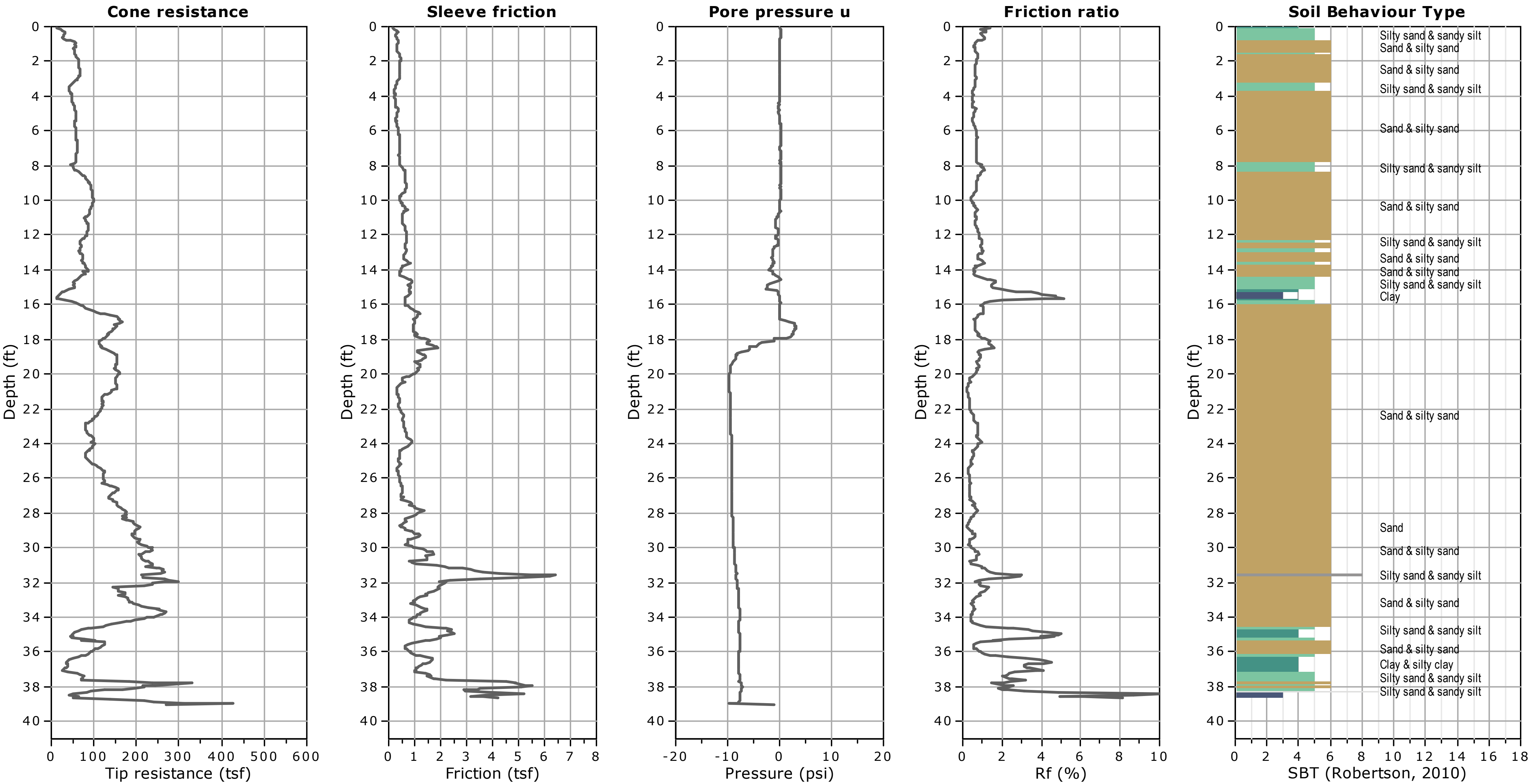
Project: **Petra Geosciences / Apple Canyon**
Location: **Lake Hemet, CA**

CPT-1
Total depth: 35.17 ft, Date: 6/16/2021



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

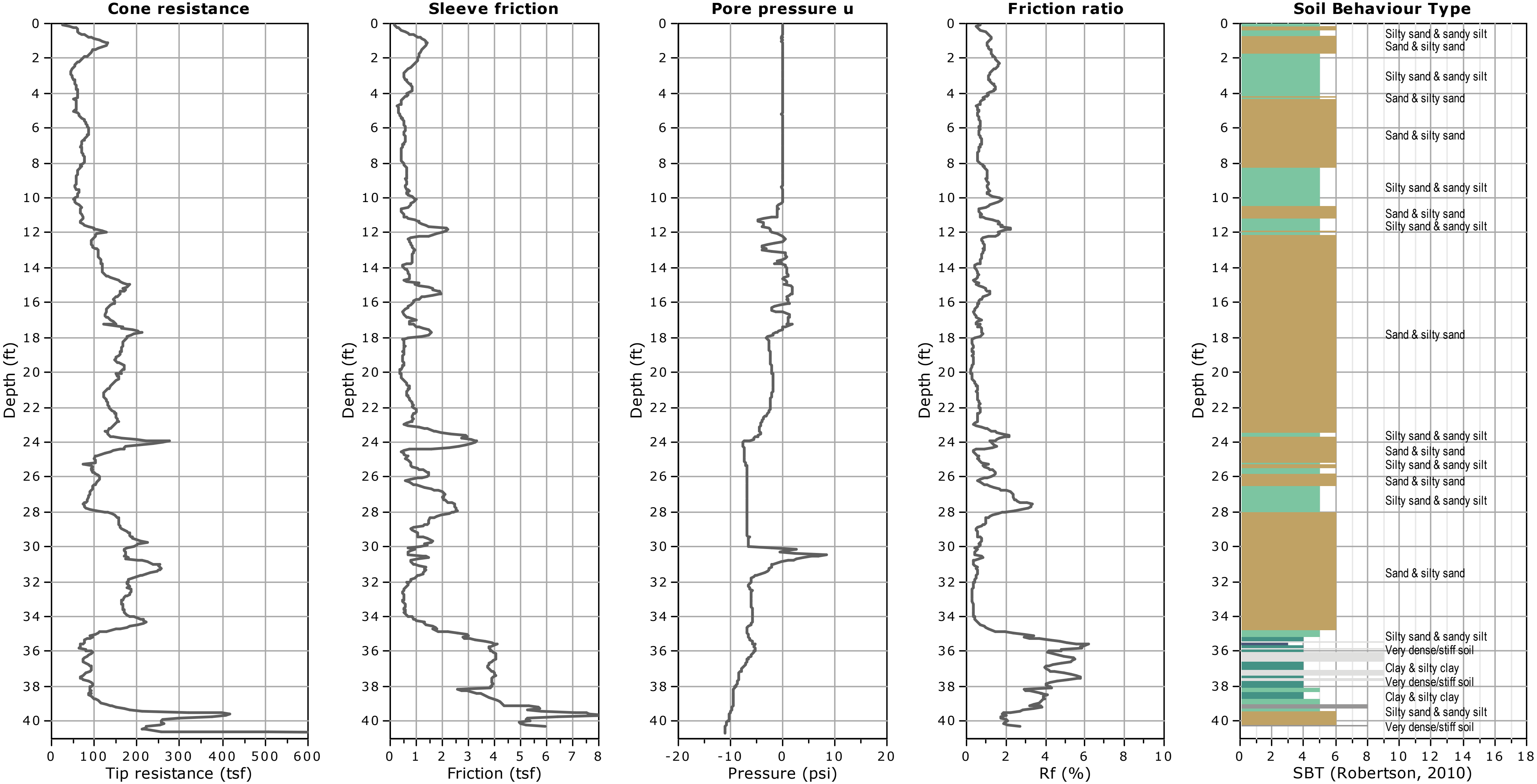
Project: **Petra Geosciences / Apple Canyon** **CPT-2**
Location: **Lake Hemet, CA** Total depth: 39.05 ft, Date: 6/16/2021



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

Project: Petra Geosciences / Apple Canyon
Location: Lake Hemet, CA

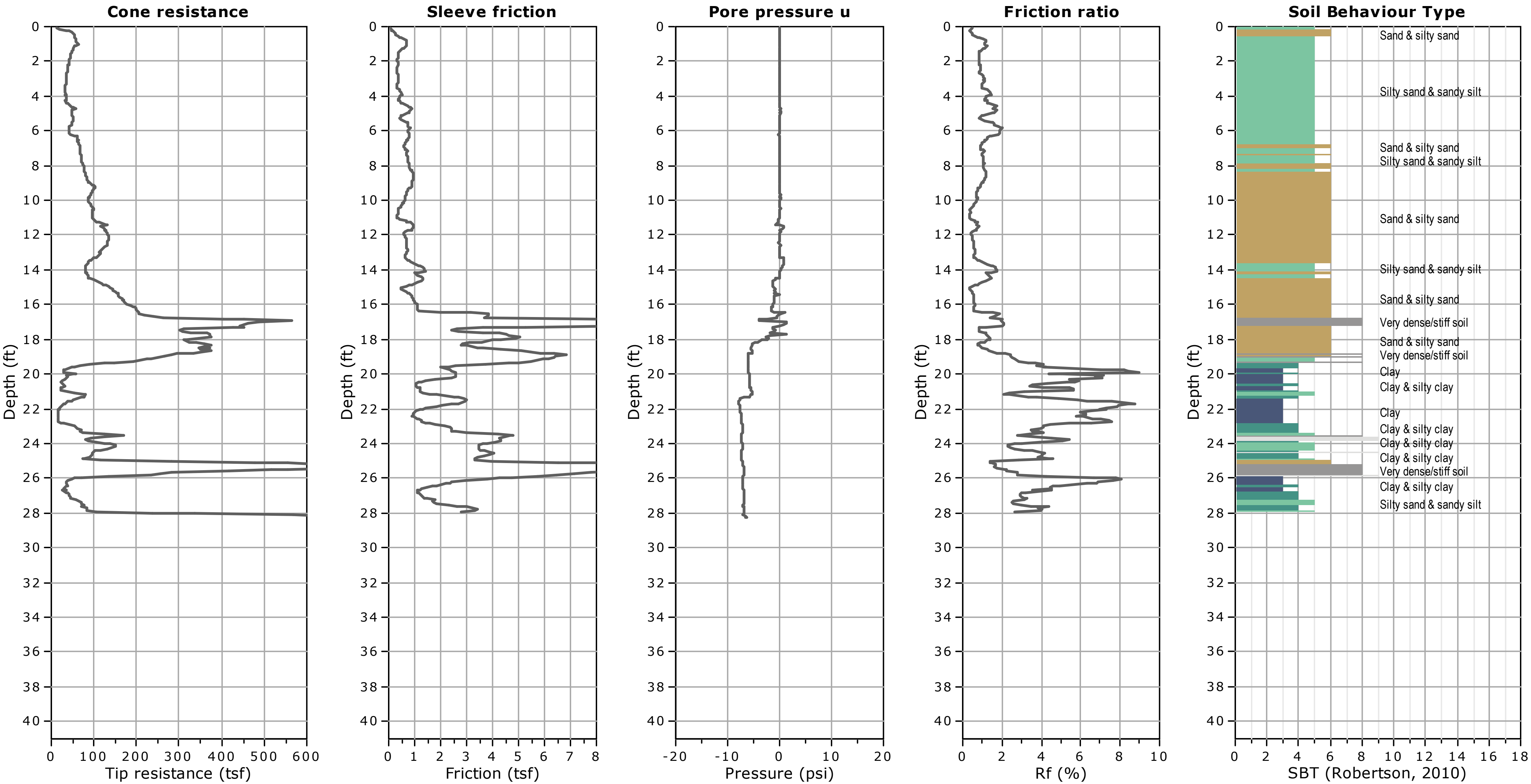
CPT-3
Total depth: 40.67 ft, Date: 6/16/2021



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

Project: Petra Geosciences / Apple Canyon
Location: Lake Hemet, CA

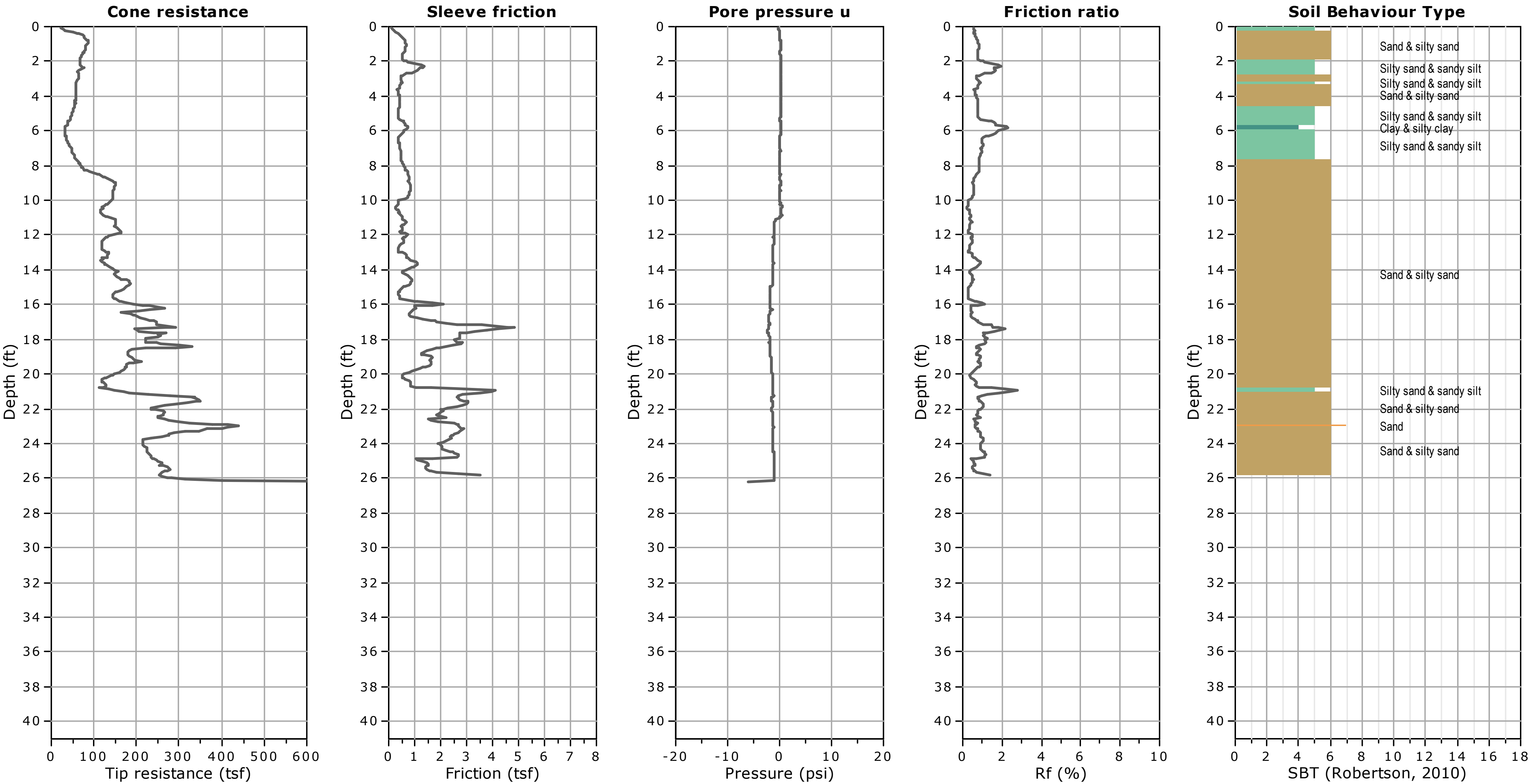
CPT-4
Total depth: 28.28 ft, Date: 6/16/2021



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

Project: Petra Geosciences / Apple Canyon **CPT-5**

Location: Lake Hemet, CA Total depth: 26.19 ft, Date: 6/16/2021



Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
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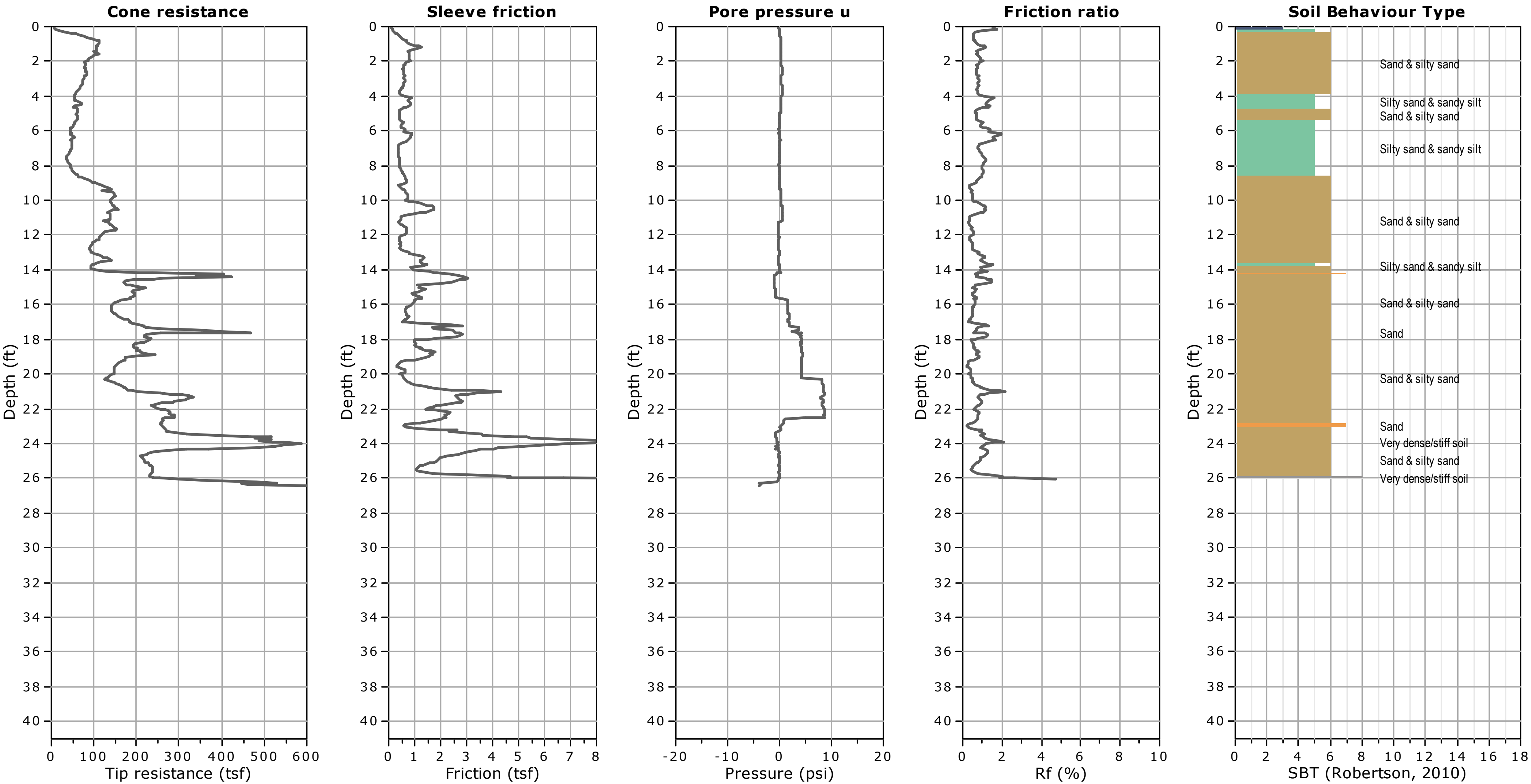
Project: Petra Geosciences / Apple Canyon
Location: Lake Hemet, CA

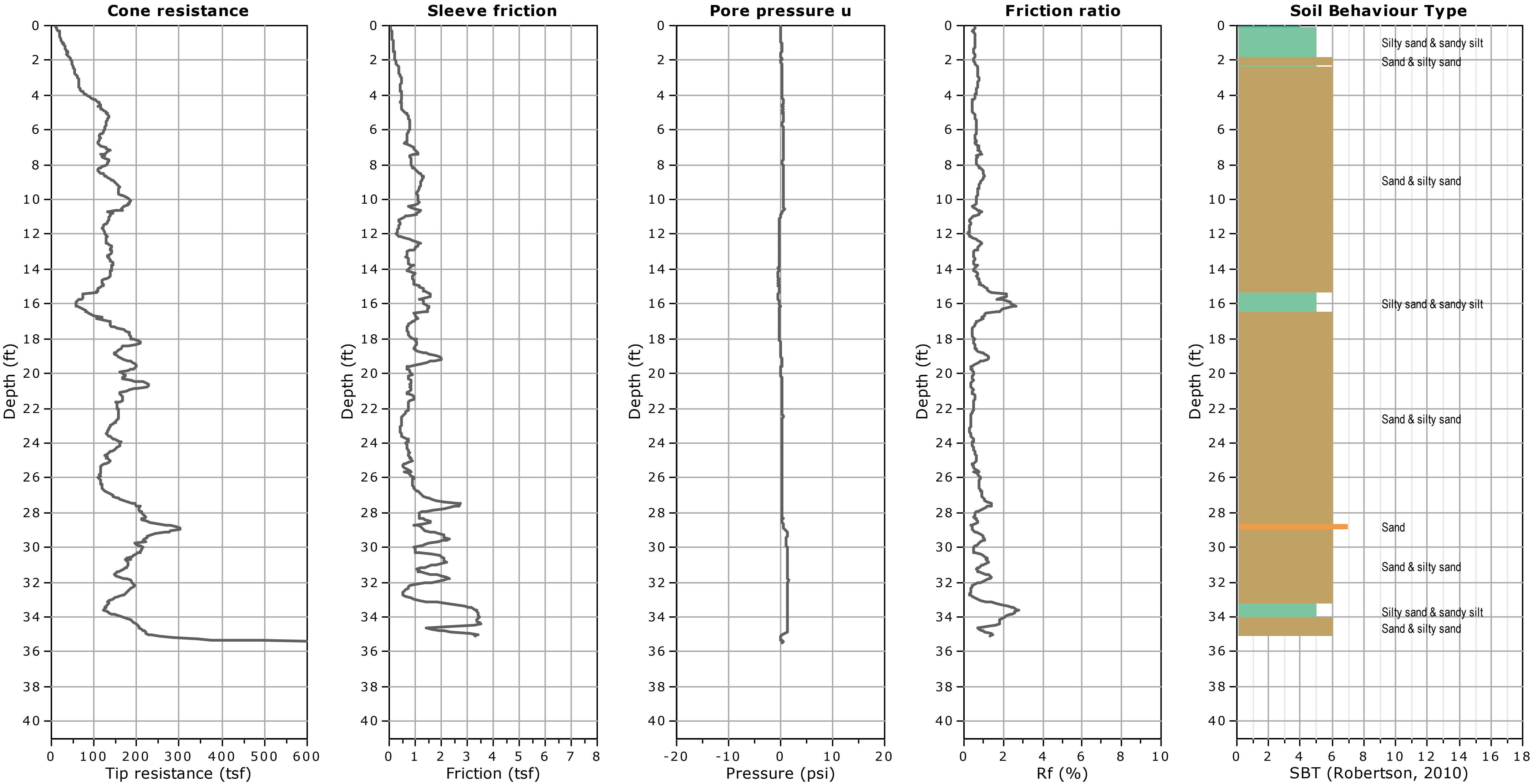
CPT-5A
Total depth: 26.45 ft, Date: 6/16/2021



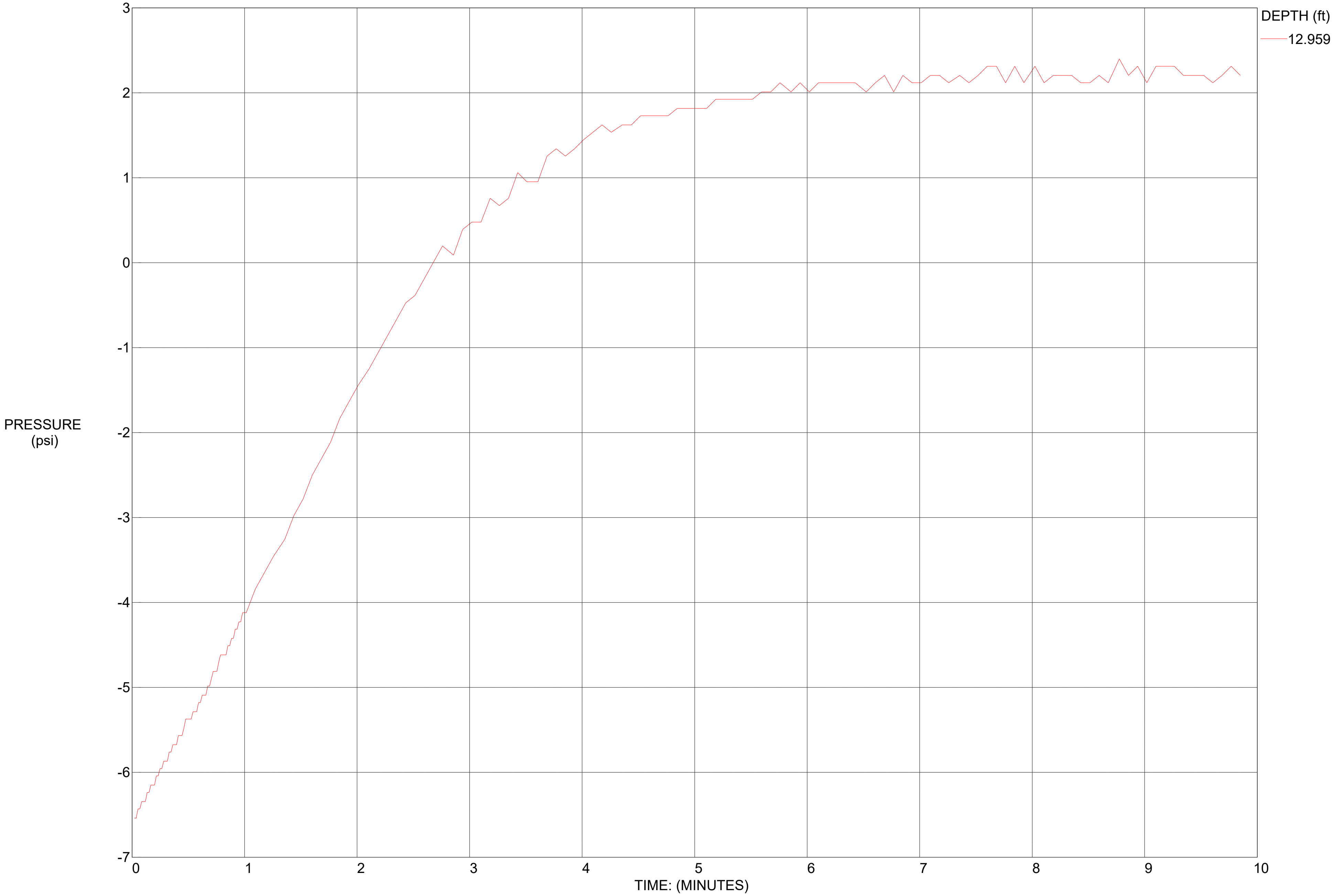
Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: **Petra Geosciences / Apple Canyon**
Location: **Lake Hemet, CA**

CPT-6
Total depth: 35.50 ft, Date: 6/16/2021

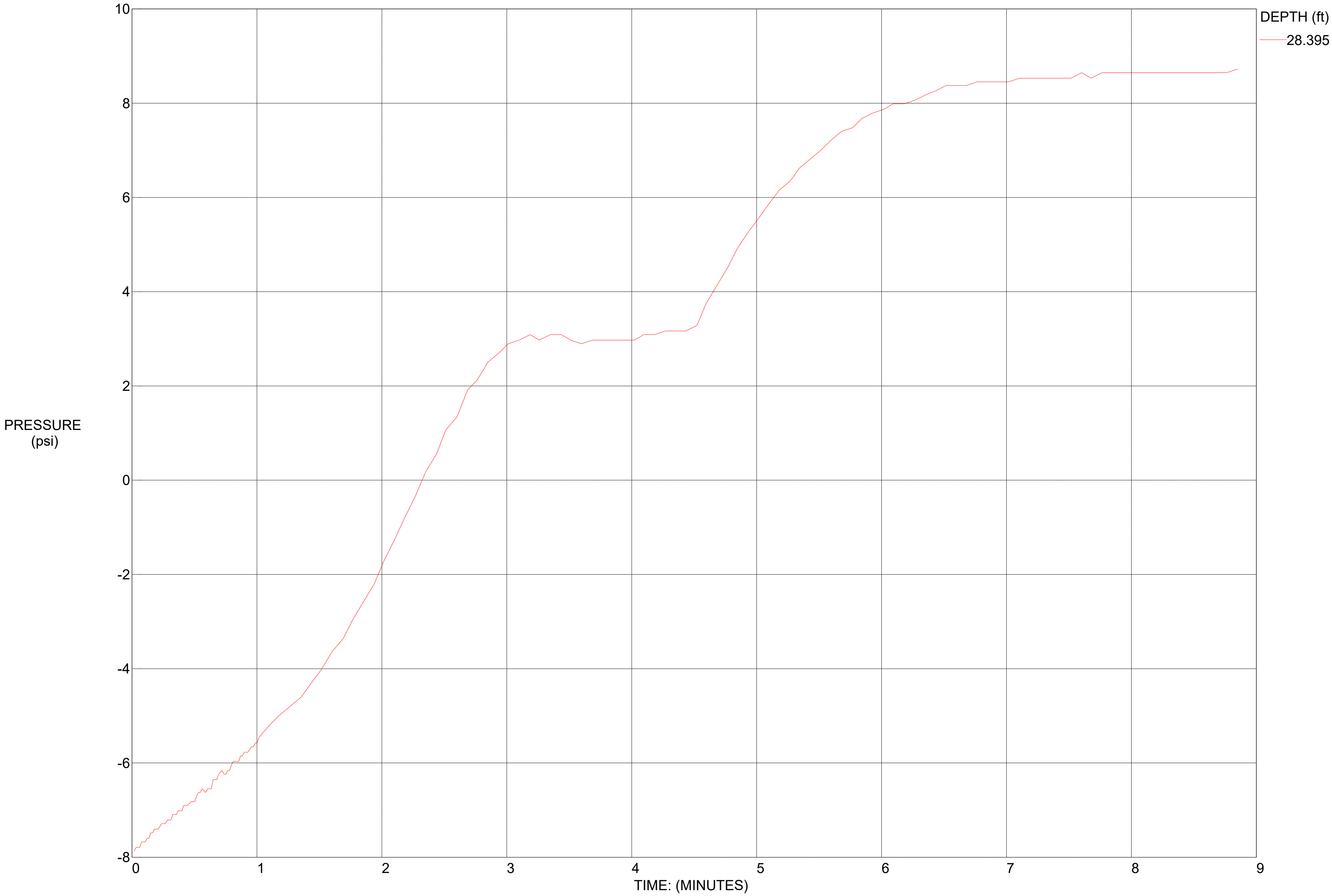


TEST ID: CPT-1



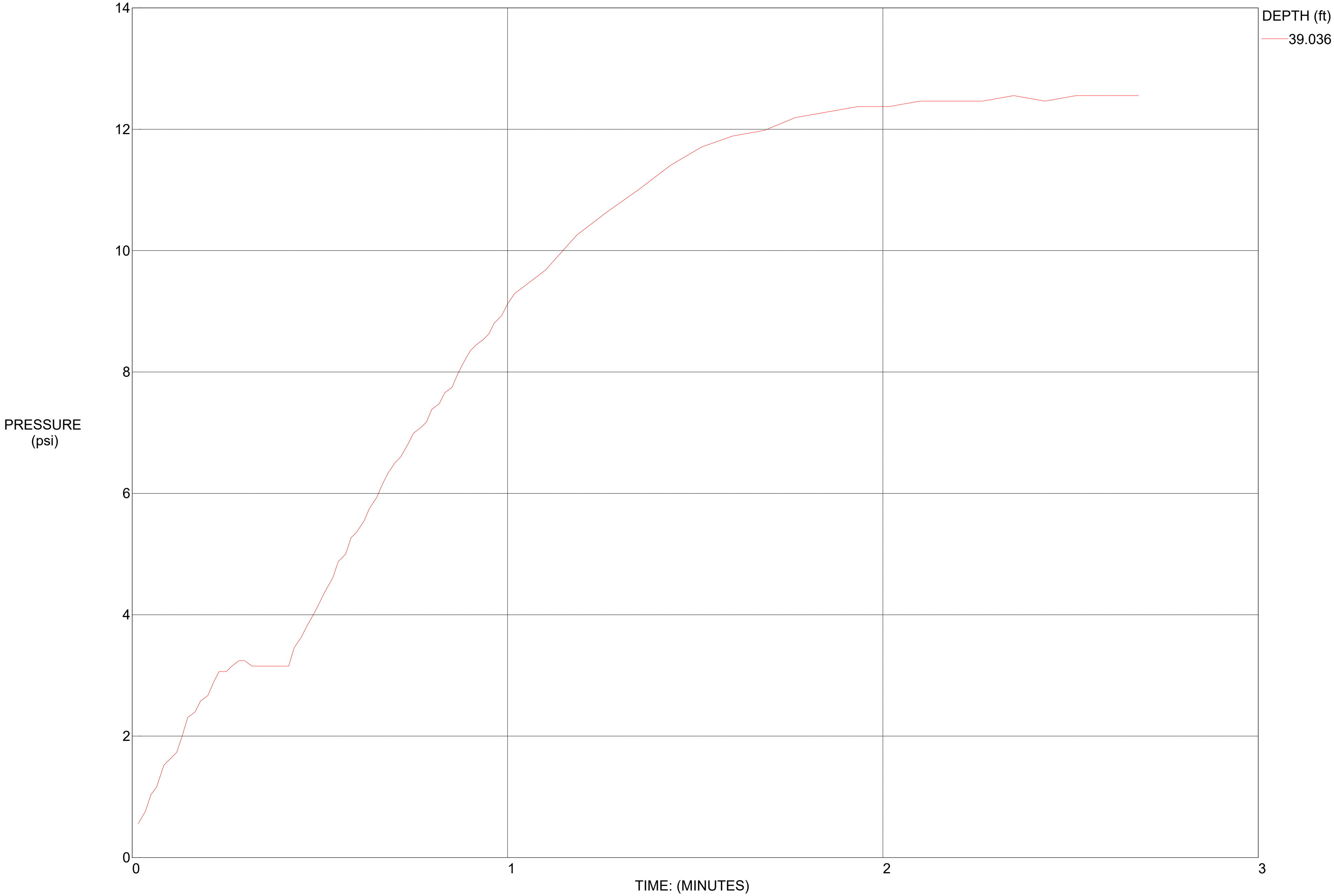
DEPTH (ft)
12.959
PRESSURE (psi)
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
0
1
2
3
4
5
6
7
8
9
10
TIME: (MINUTES)

TEST ID: CPT-1

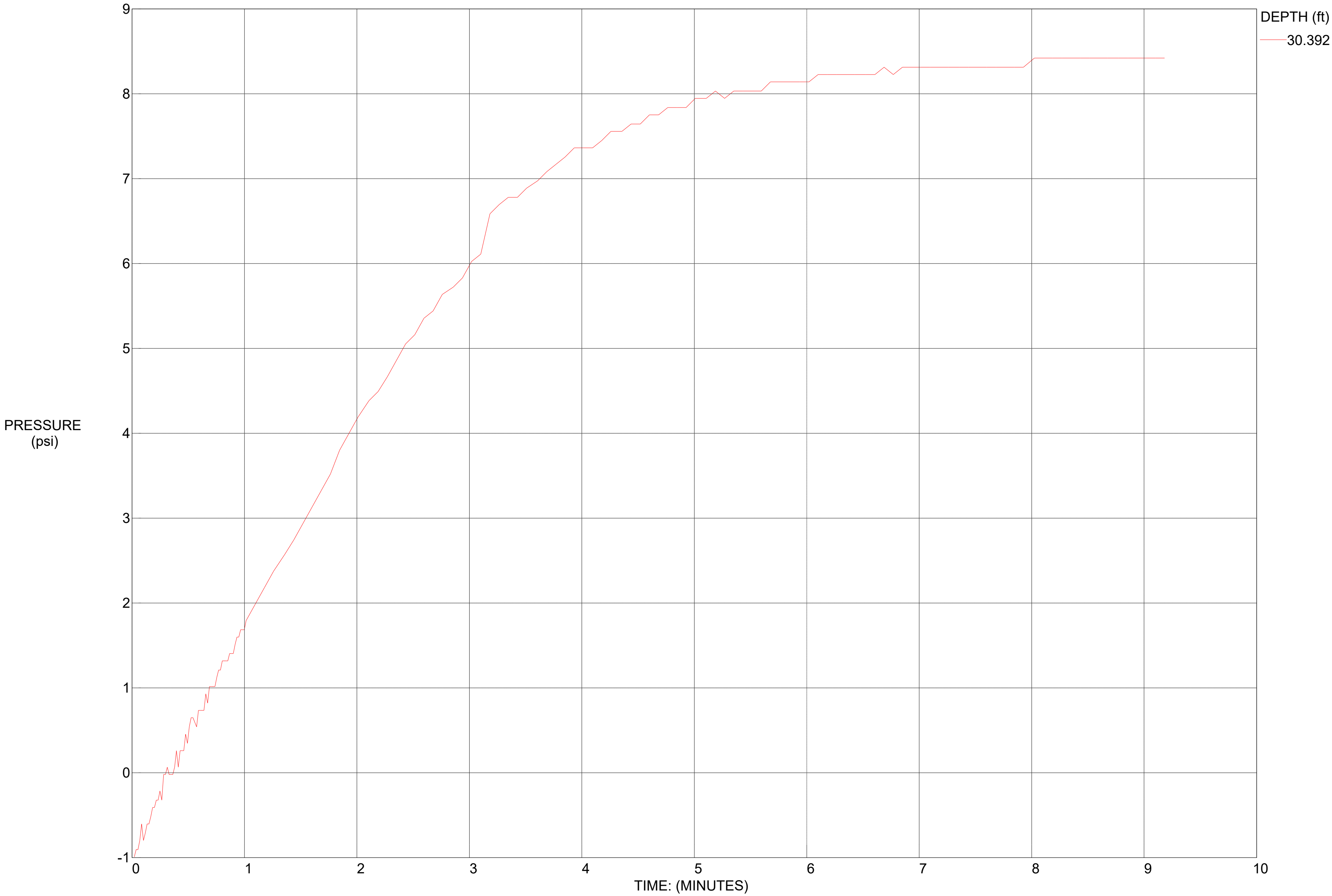


PRESSURE (psi)
10
8
6
4
2
0
-2
-4
-6
-8
0
1
2
3
4
5
6
7
8
9
TIME: (MINUTES)
DEPTH (ft)
28.395

TEST ID: CPT-2

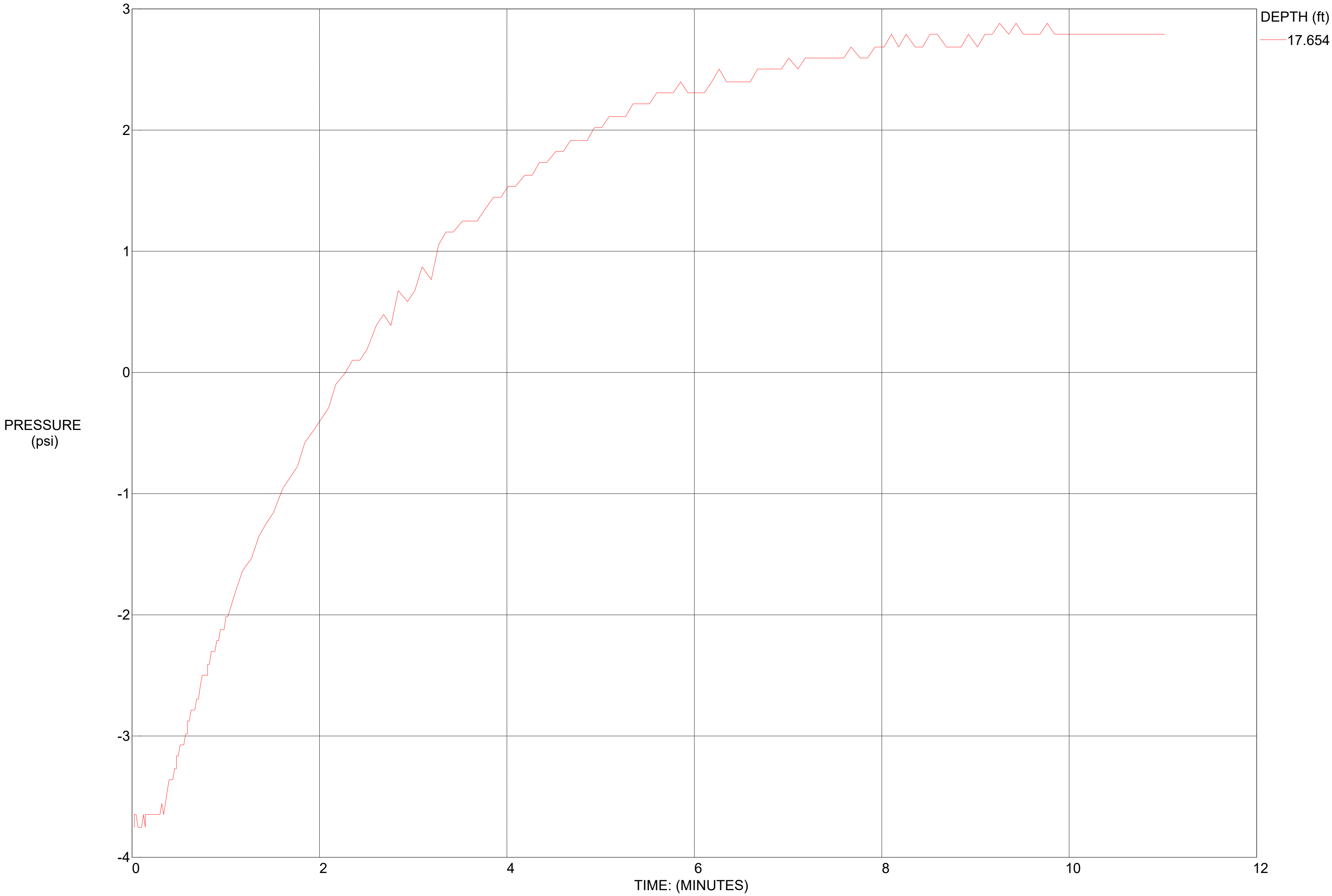


TEST ID: CPT-3



PRESSURE
(psi)
9
8
7
6
5
4
3
2
1
0
-1
0
1
2
3
4
5
6
7
8
9
10
TIME: (MINUTES)
DEPTH (ft)
30.392

TEST ID: CPT-4



PRESSURE
(psi)
3
2
1
0
-1
-2
-3
-4
0
2
4
6
8
10
12
TIME: (MINUTES)
DEPTH (ft)
17.654

Petra Geosciences
Apple Canyon
Lake Hemit, CA

CPT Shear Wave Measurements

Location	Tip Depth (ft)	Geophone Depth (ft)	Travel Distance (ft)	S-Wave Arrival (msec)	S-Wave Velocity from Surface (ft/sec)	Interval S-Wave Velocity (ft/sec)
CPT-3	5.02	4.02	4.49	5.68	790	
	10.01	9.01	9.23	12.20	757	727
	15.09	14.09	14.23	20.12	707	632
	20.11	19.11	19.21	26.98	712	726
	25.16	24.16	24.24	34.04	712	712
	30.09	29.09	29.16	40.04	728	819
	35.04	34.04	34.10	46.24	737	797
	40.06	39.06	39.11	50.84	769	1090

Shear Wave Source Offset - 2 ft

S-Wave Velocity from Surface = Travel Distance/S-Wave Arrival
Interval S-Wave Velocity = (Travel Dist2-Travel Dist1)/(Time2-Time1)

[illegible]

[illegible]

Project:

[illegible]

Prepared for:

[illegible]

Prepared by:

KEHOE TESTING & ENGINEERING

5415 Industrial Drive
Huntington Beach, CA 92649-1518
Office (714) 901-7270 / Fax (714) 901-7289
www.kehoetesting.com

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

- CPT Plots
- CPT Classification/Soil Behavior Chart
- Summary of Shear Wave Velocities
- CPT Data Files (sent via email)

[illegible]

[illegible]

[illegible]

[illegible]

This report presents the results of a Cone Penetration Test (CPT) program carried out for the Apple Canyon Lake Hemet project located in Lake Hemet, California. The work was performed by Kehoe Testing & Engineering (KTE) on August 30, 2021. The scope of work was performed as directed by Petra Geosciences, Inc. personnel.

[illegible]

The fieldwork consisted of performing CPT soundings at 12 locations to determine the soil lithology. A summary is provided in [illegible].

[illegible]	[illegible]	[illegible]
[illegible]	35	Refusal
[illegible]	17	Refusal
[illegible]	23	Refusal
[illegible]	31	Refusal
[illegible]	20	Refusal
[illegible]	7	Refusal
[illegible]	8	Refusal
[illegible]	22	Refusal
[illegible]	22	Refusal
[illegible]	38	Refusal
[illegible]	39	Refusal
[illegible]	36	Refusal

[illegible]

[illegible]

The CPT soundings were carried out by [illegible] using an integrated electronic cone system manufactured by Vertek. The CPT soundings were performed in accordance with ASTM standards (D5778). The cone penetrometers were pushed using a 30-ton CPT rig. The cone used during the program was a 15 cm^2 cone with a cone net area ratio of 0.83. The following parameters were recorded at approximately 2.5 cm depth intervals:

- Cone Resistance (qc)
- Sleeve Friction (fs)
- Dynamic Pore Pressure (u)
- Inclination
- Penetration Speed

At location CPT-7, shear wave measurements were obtained at approximately 5-foot intervals. The shear wave is generated using an air-actuated hammer, which is located inside the front jack of the CPT rig. The cone has a triaxial geophone, which recorded the shear wave signal generated by the air hammer.

The above parameters were recorded and viewed in real time using a laptop computer. Data is stored at the KTE office for up to 2 years for future analysis and reference. A complete set of baseline readings was taken prior to each sounding to determine temperature shifts and any zero load offsets. Monitoring base line readings ensures that the cone electronics are operating properly.

[illegible]

The Cone Penetration Test data is presented in graphical form in the attached Appendix. These plots were generated using the CPeT-IT program. Penetration depths are referenced to ground surface. The soil behavior type on the CPT plots is derived from the attached CPT SBT plot (Robertson, “Interpretation of Cone Penetration Test…”, 2009) and presents major soil lithologic changes. The stratigraphic interpretation is based on relationships between cone resistance (qc), sleeve friction (fs), and penetration pore pressure (u). The friction ratio (Rf), which is sleeve friction divided by cone resistance, is a calculated parameter that is used along with cone resistance to infer soil behavior type. Generally, cohesive soils (clays) have high friction ratios, low cone resistance and generate excess pore water pressures. Cohesionless soils (sands) have lower friction ratios, high cone bearing and generate little (or negative) excess pore water pressures.

The CPT data files have also been provided. These files can be imported in CPeT-IT (software by GeoLogismiki) and other programs to calculate various geotechnical parameters.

It should be noted that it is not always possible to clearly identify a soil type based on qc, fs and u. In these situations, experience, judgement and an assessment of the pore pressure data should be used to infer the soil behavior type.

If you have any questions regarding this information, please do not hesitate to call our office at (714) 901-7270.

Sincerely,

KEHOE TESTING & ENGINEERING

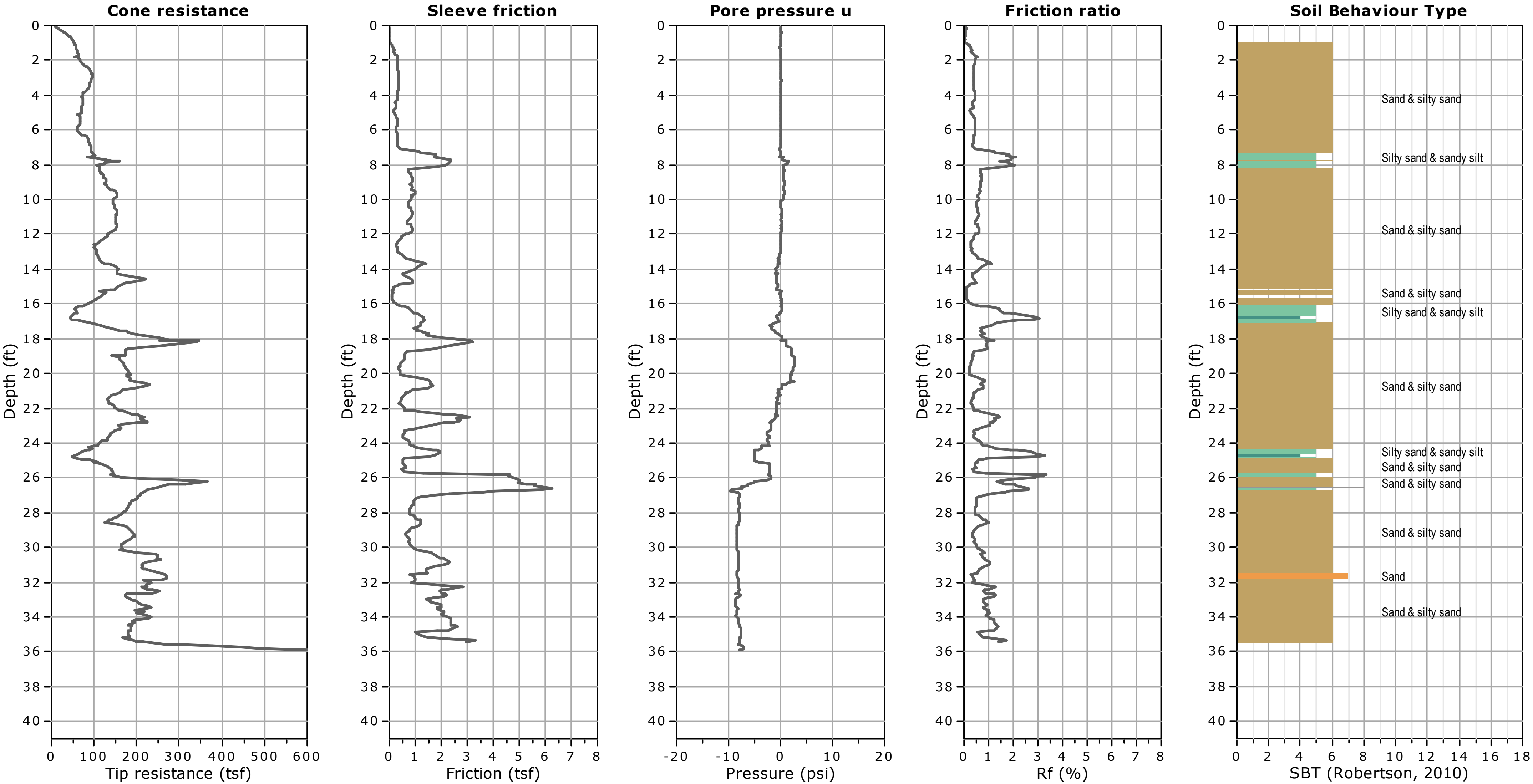
Steven P. Kehoe
President

09/03/21-hh-2936-2

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

Project: **Petra Geosciences / Apple Canyon**
Location: **Lake Hemet, CA**

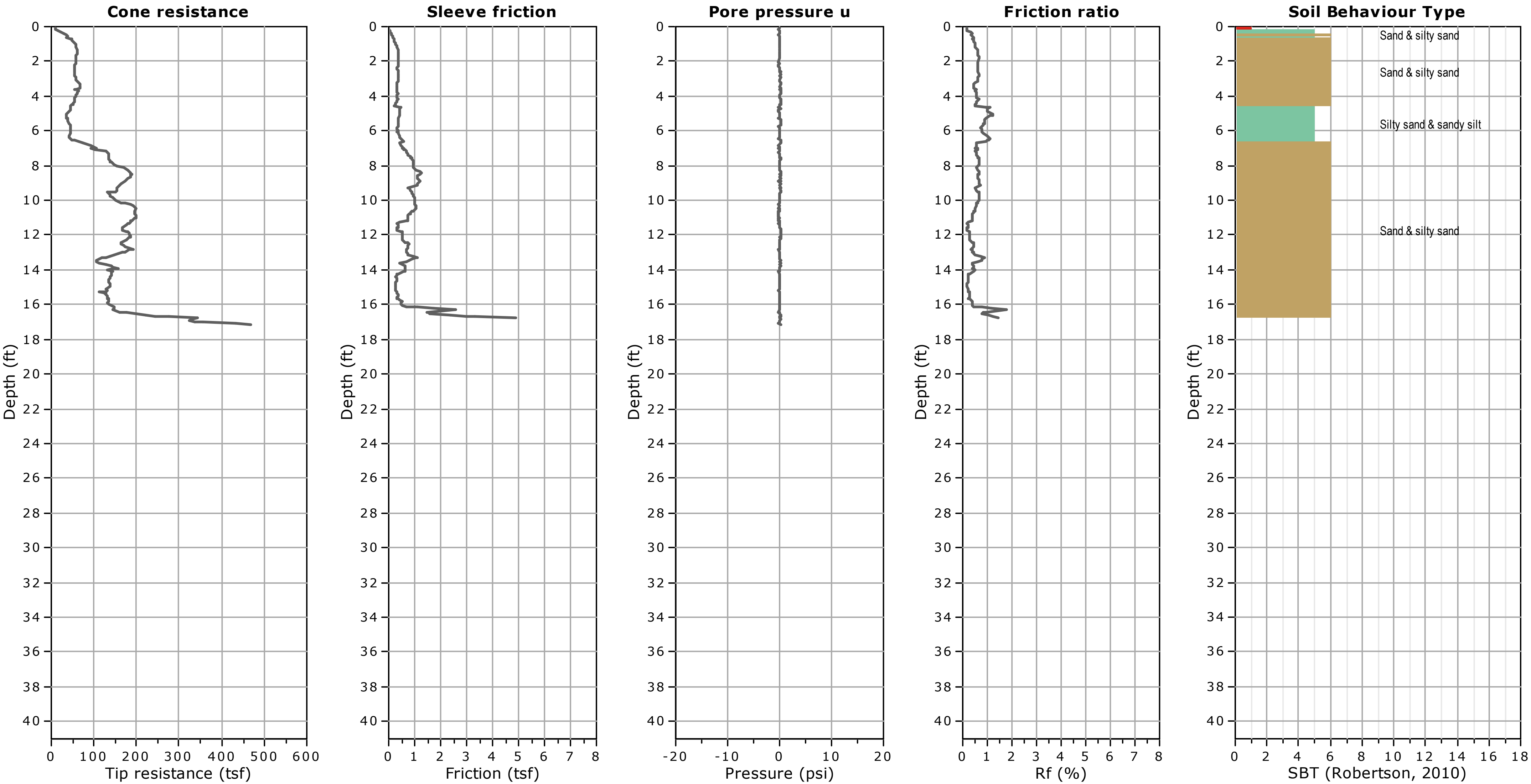
CPT-7
Total depth: 35.91 ft, Date: 8/30/2021



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

Project: Petra Geosciences / Apple Canyon
Location: Lake Hemet, CA

CPT-8
Total depth: 17.14 ft, Date: 8/30/2021



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steve@kehoetesting.com
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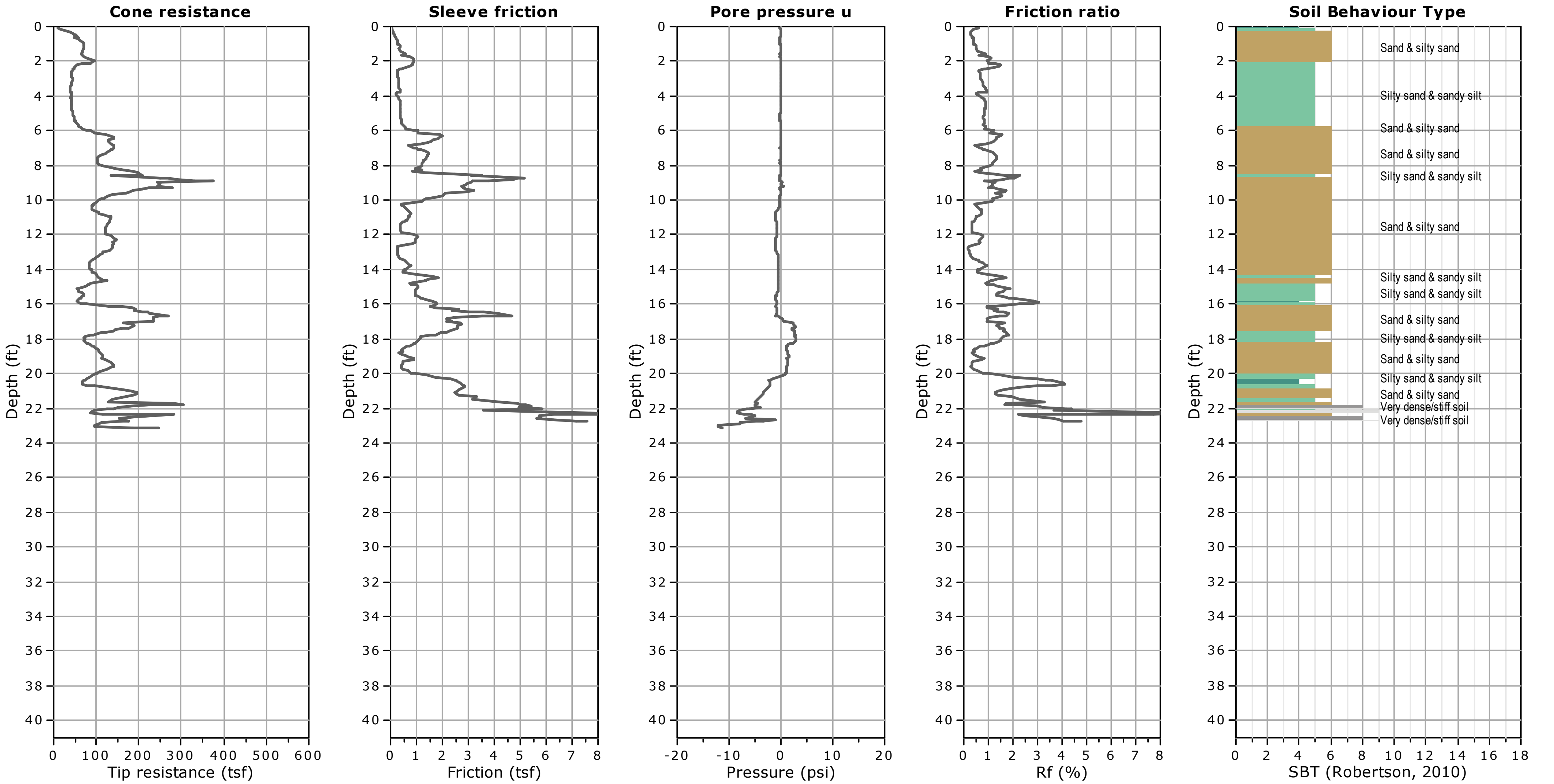
Project: Petra Geosciences / Apple Canyon
Location: Lake Hemet, CA

CPT-9
Total depth: 23.18 ft, Date: 8/30/2021



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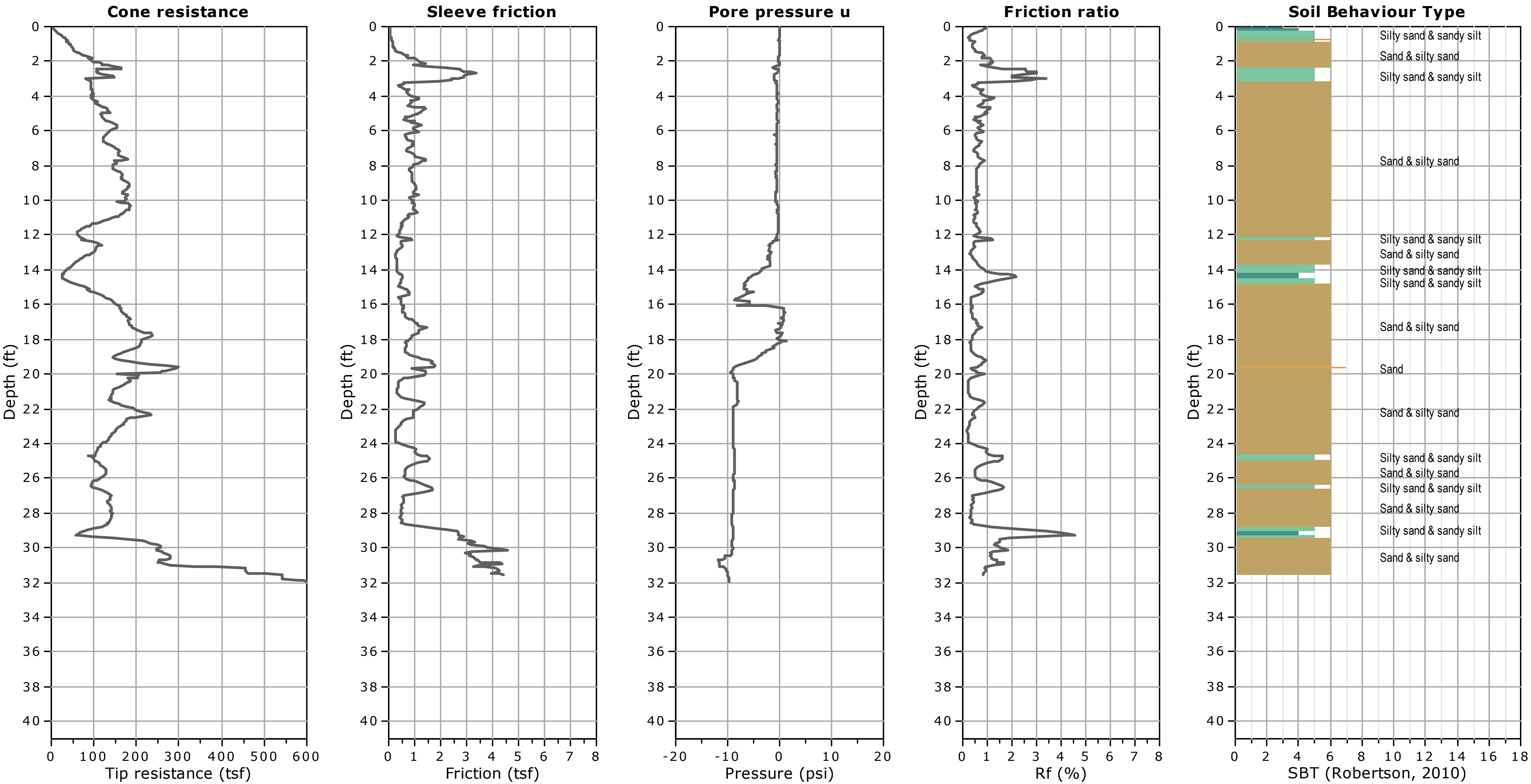
steve@kehoetesting.com
www.kehoetesting.com

Project: Petra Geosciences / Apple Canyon **CPT-10**

Location: Lake Hemet, CA Total depth: 31.97 ft, Date: 8/30/2021



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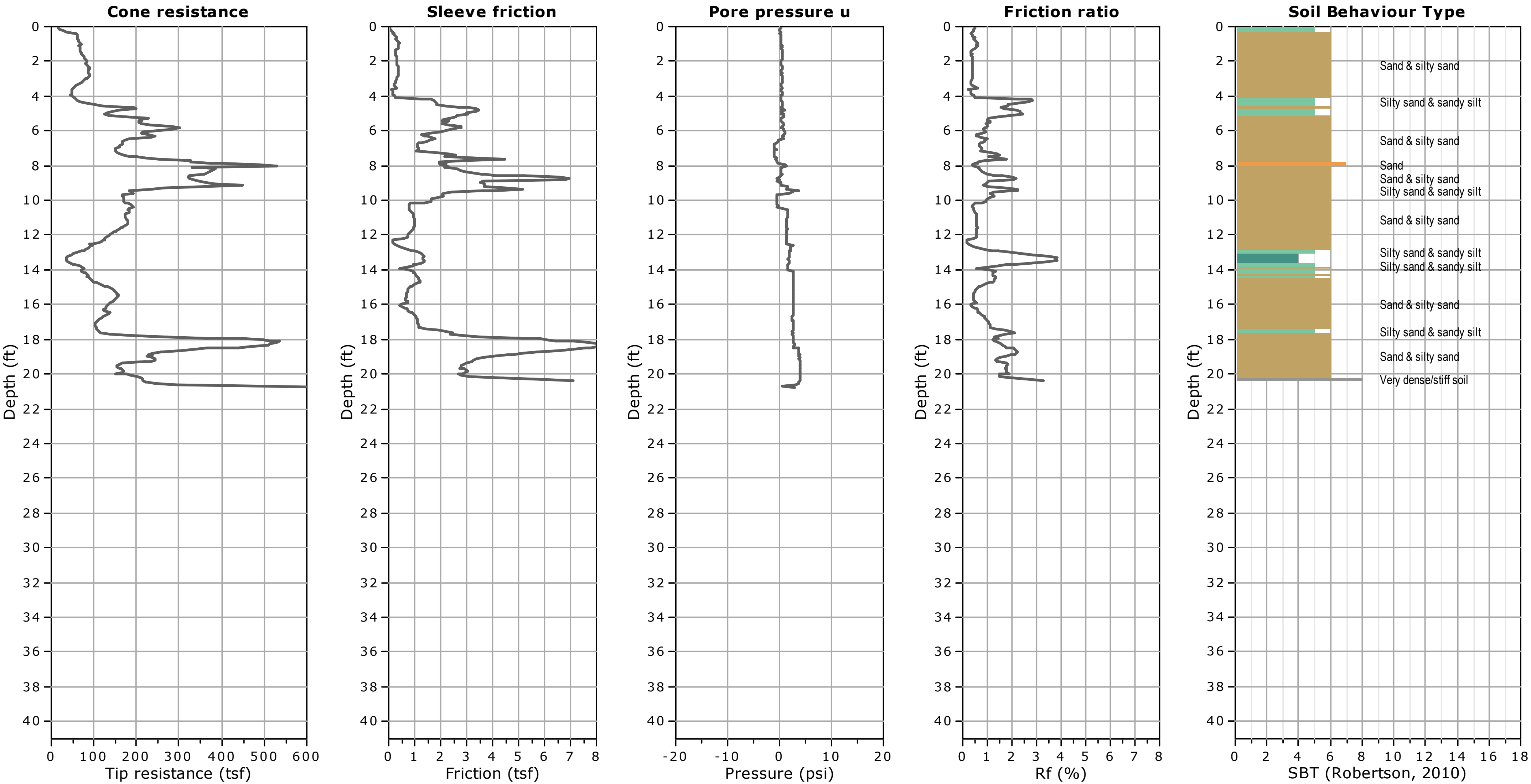
steve@kehoetesting.com
www.kehoetesting.com

Project: **Petra Geosciences / Apple Canyon**
Location: **Lake Hemet, CA**

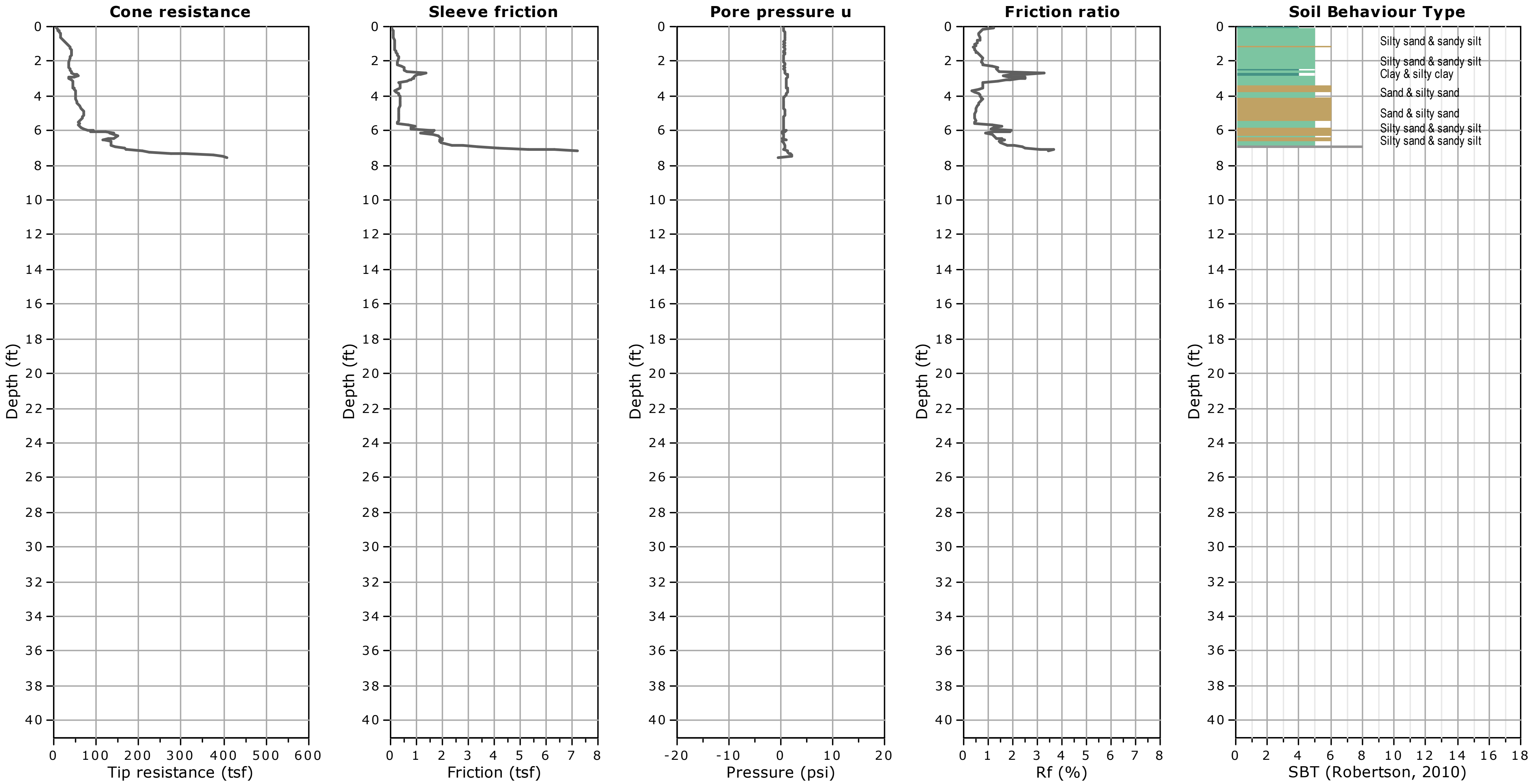
CPT-11
Total depth: 20.74 ft, Date: 8/30/2021



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

Project: Petra Geosciences / Apple Canyon **CPT-12**

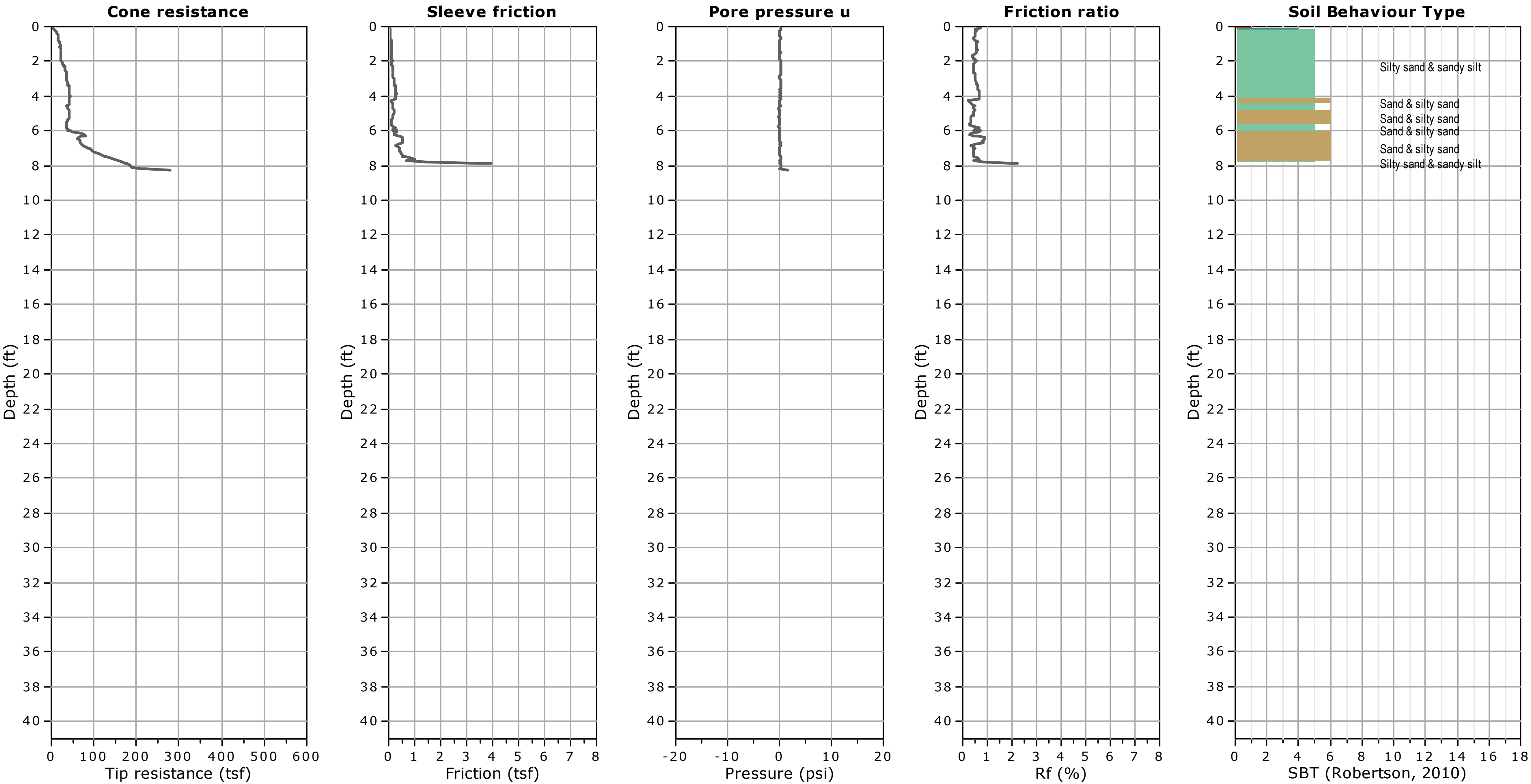
Location: Lake Hemet, CA Total depth: 7.55 ft, Date: 8/30/2021



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

Project: Petra Geosciences / Apple Canyon
Location: Lake Hemet, CA

CPT-12A
Total depth: 8.28 ft, Date: 8/30/2021



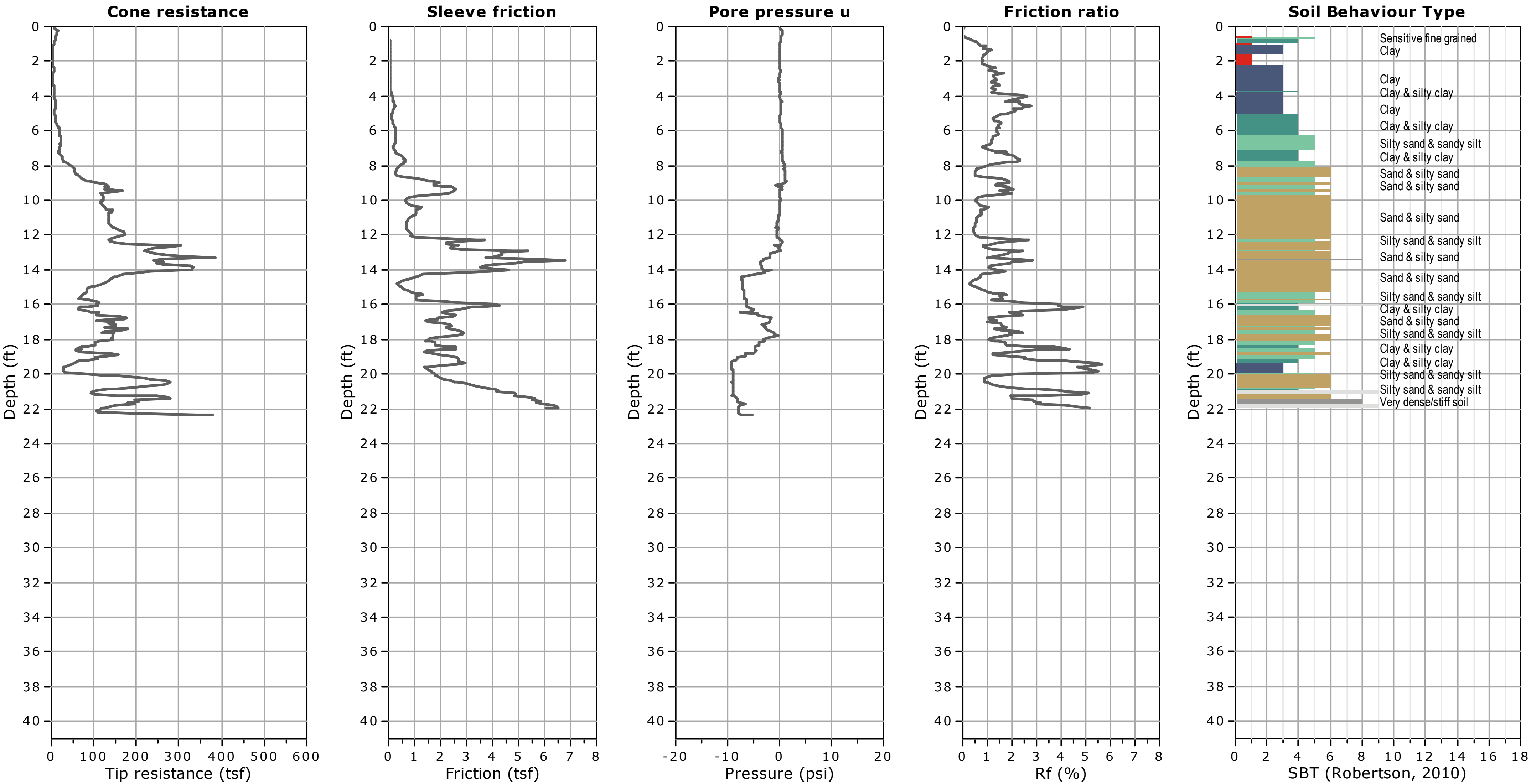
Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: Petra Geosciences / Apple Canyon

Location: Lake Hemet, CA

CPT-13

Total depth: 22.38 ft, Date: 8/30/2021



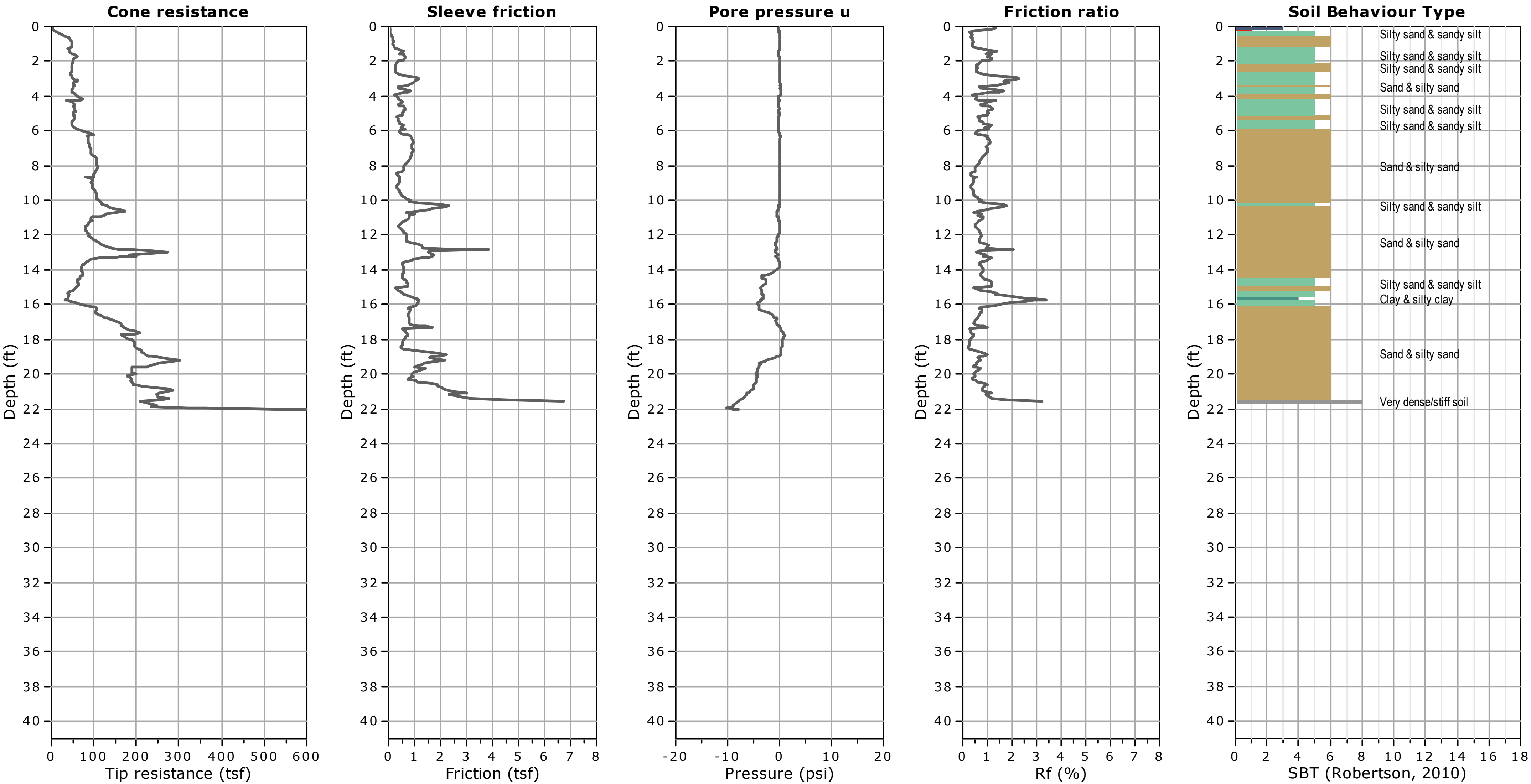
Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: Petra Geosciences / Apple Canyon

Location: Lake Hemet, CA

CPT-14

Total depth: 22.06 ft, Date: 8/30/2021



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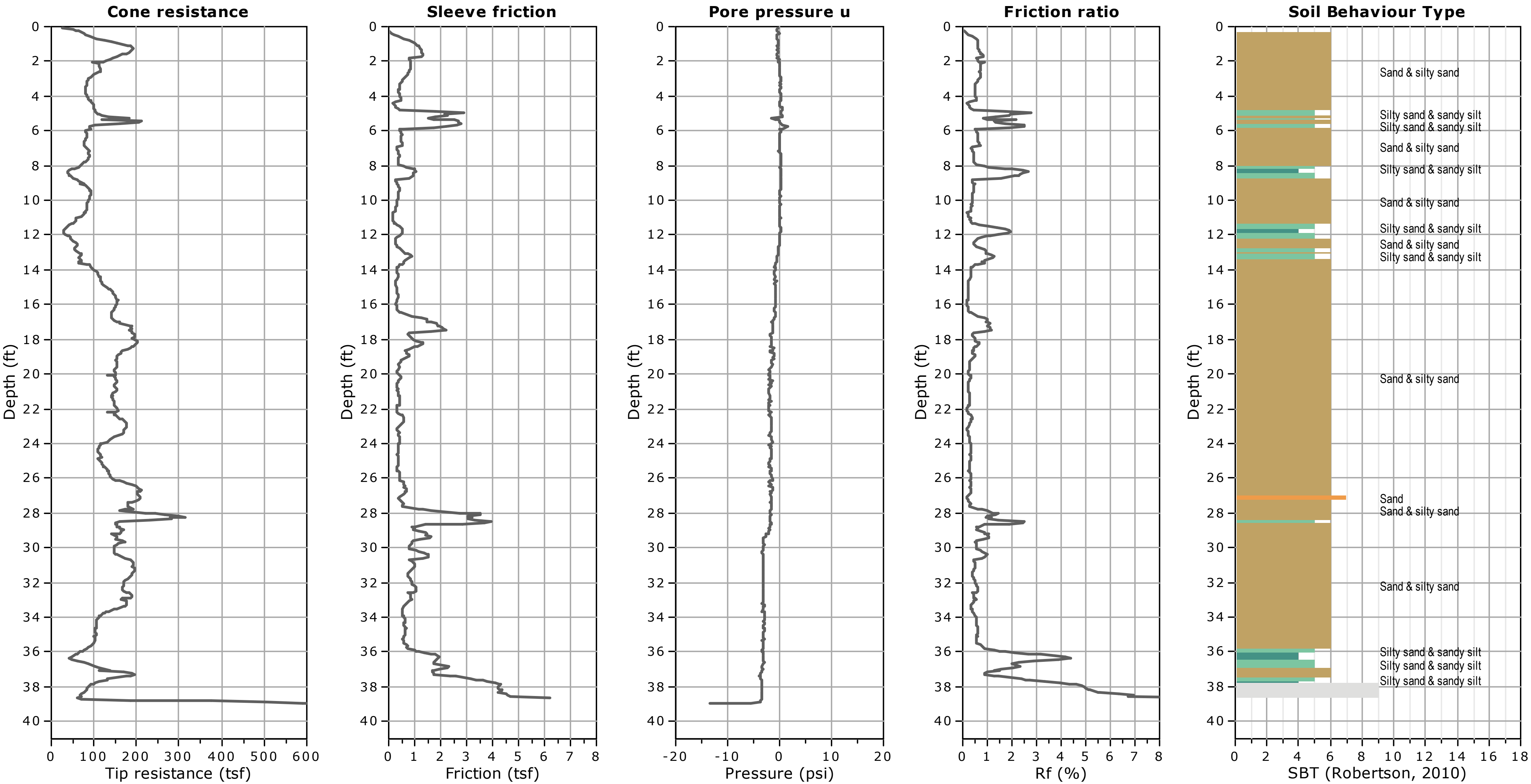
steve@kehoetesting.com
www.kehoetesting.com

Project: Petra Geosciences / Apple Canyon

Location: Lake Hemet, CA

CPT-15

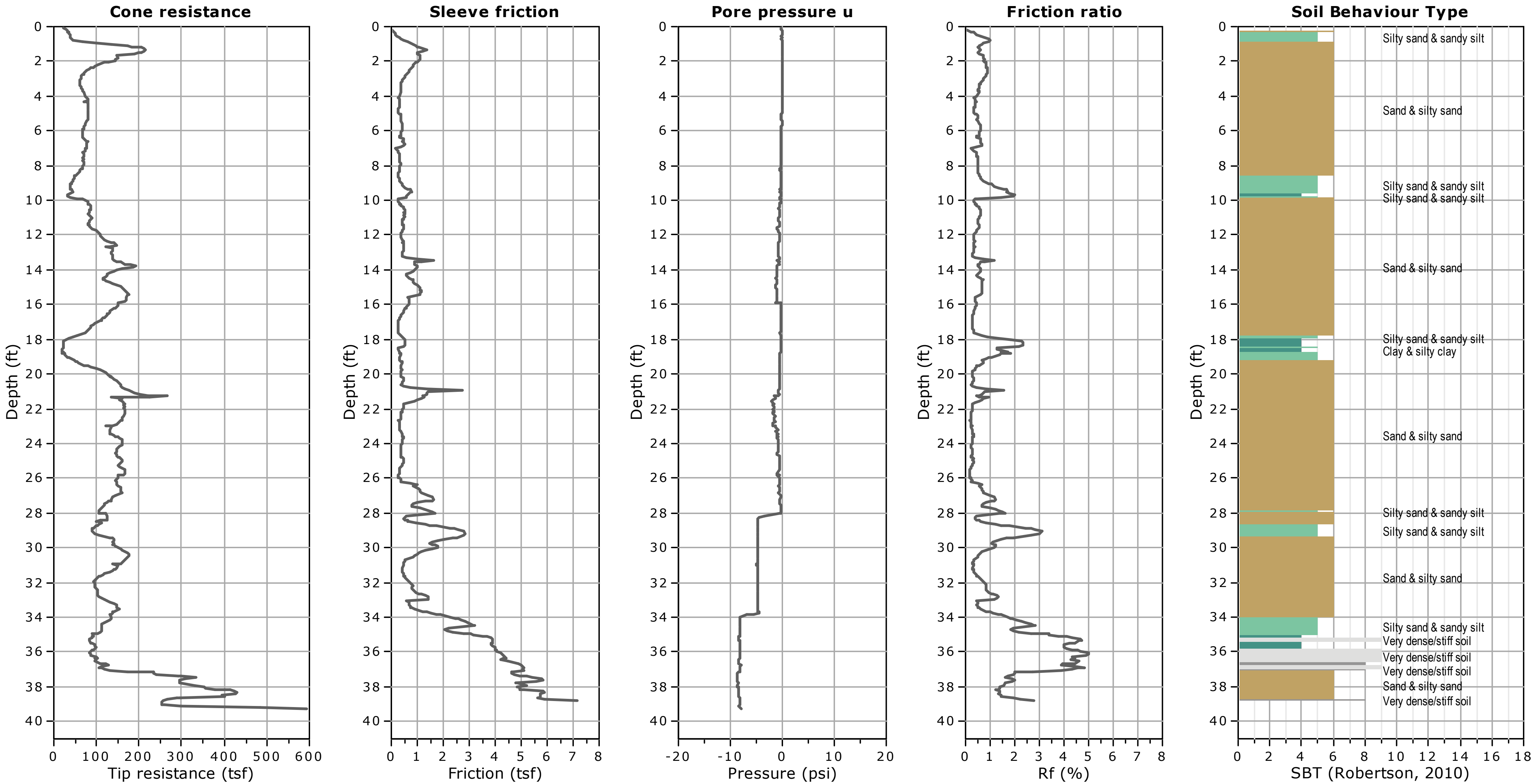
Total depth: 38.98 ft, Date: 8/30/2021



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

Project: Petra Geosciences / Apple Canyon
Location: Lake Hemet, CA

CPT-16
Total depth: 39.24 ft, Date: 8/30/2021



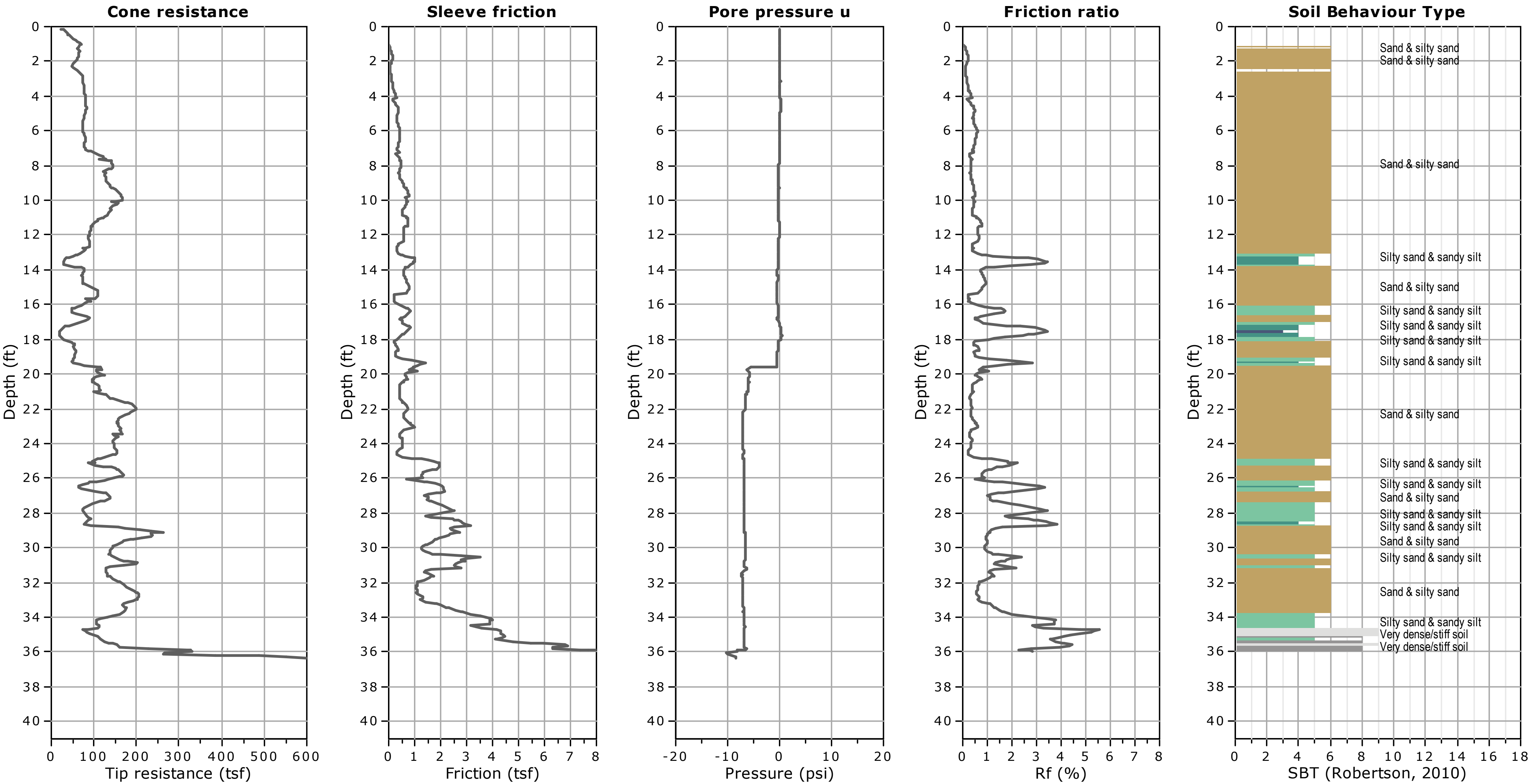
Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: Petra Geosciences / Apple Canyon

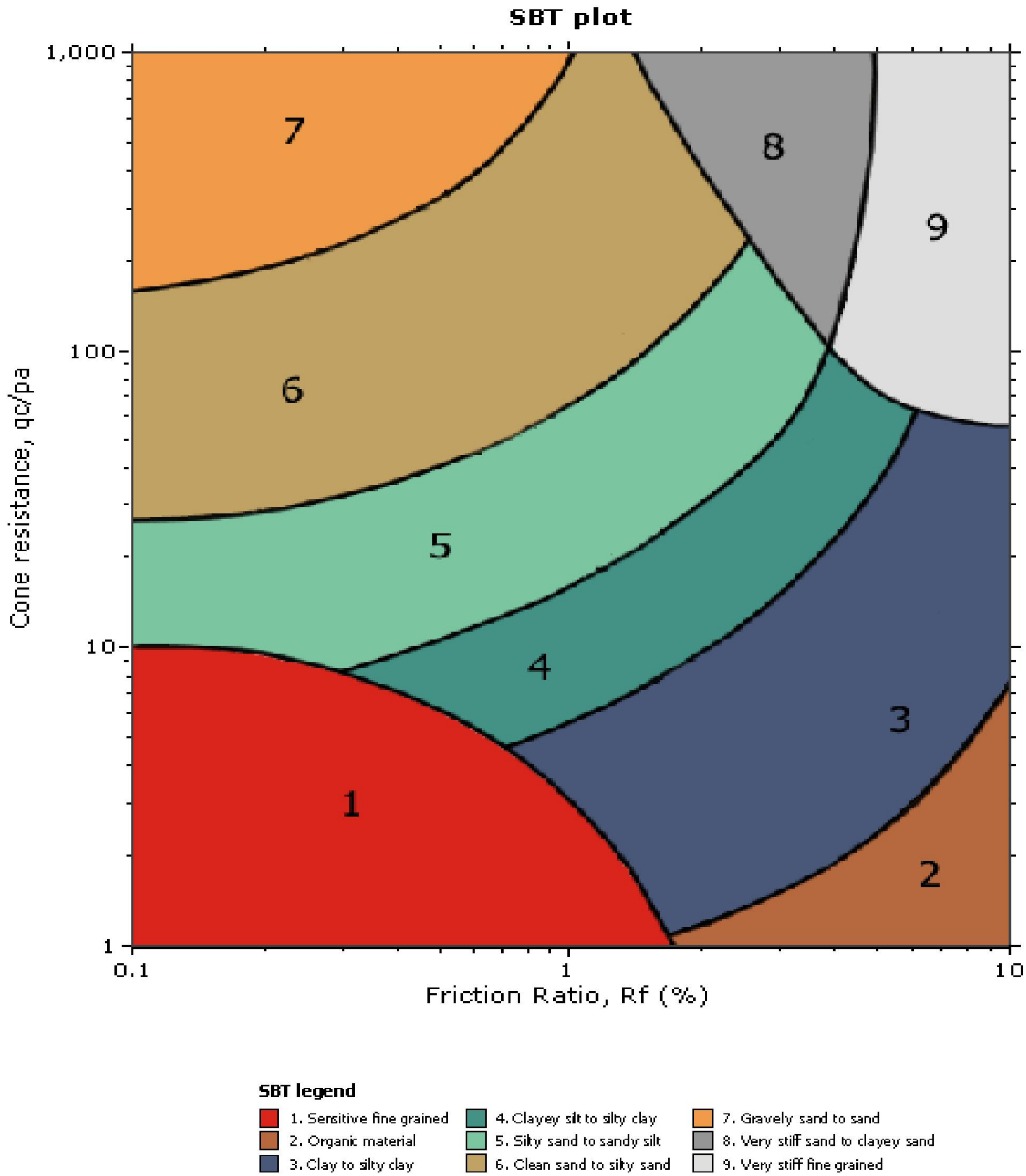
Location: Lake Hemet, CA

CPT-17

Total depth: 36.35 ft, Date: 8/30/2021



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



Petra Geosciences
Apple Canyon
Lake Hemet, CA

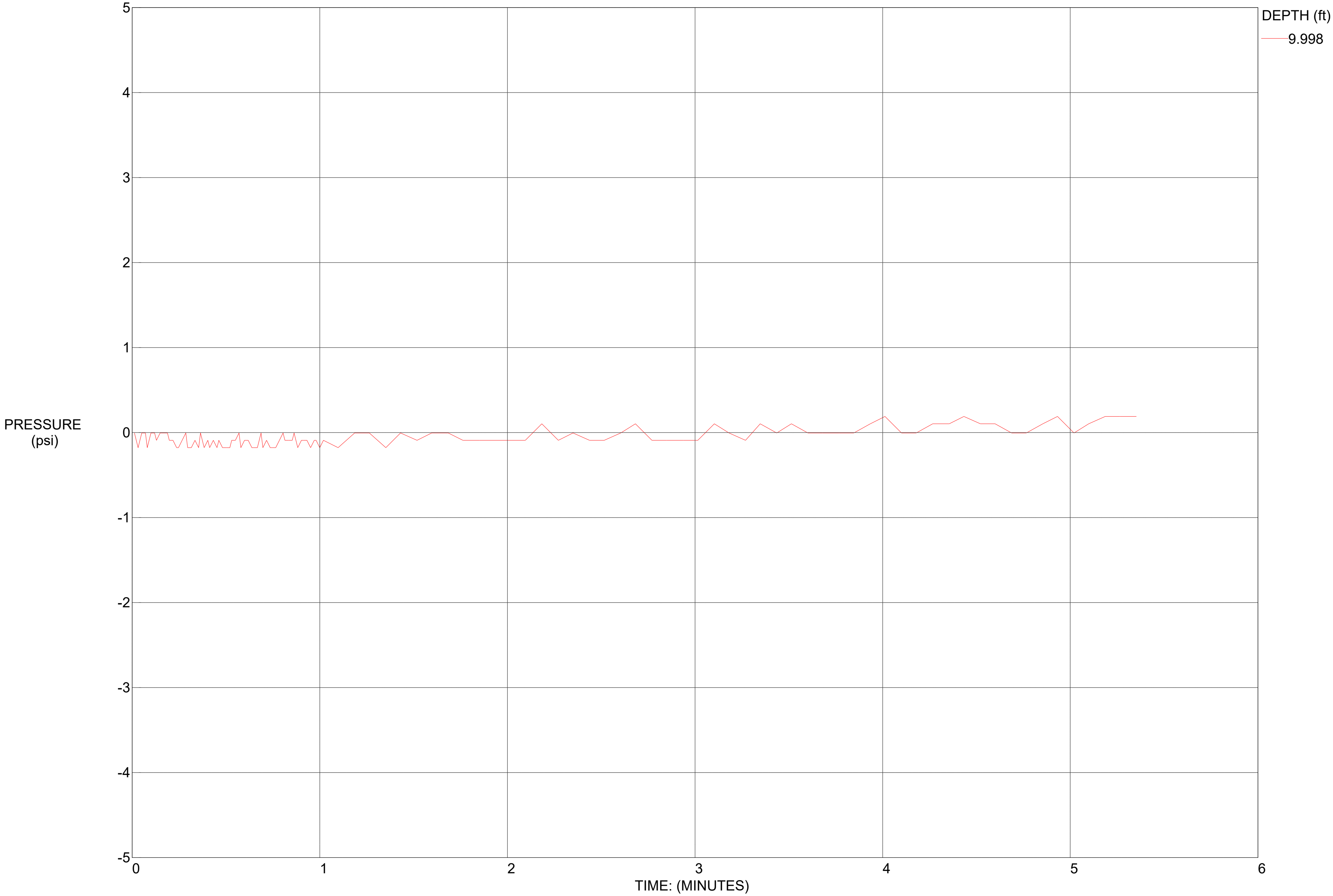
CPT Shear Wave Measurements

Location	Tip Depth (ft)	Geophone Depth (ft)	Travel Distance (ft)	S-Wave Arrival (msec)	S-Wave Velocity from Surface (ft/sec)	Interval S-Wave Velocity (ft/sec)
CPT-7	5.09	4.09	4.55	6.84	666	
	10.01	9.01	9.23	13.26	696	728
	15.12	14.12	14.26	20.42	698	703
	20.37	19.37	19.47	29.20	667	594
	25.13	24.13	24.21	34.68	698	865
	30.05	29.05	29.12	41.44	703	726
	35.20	34.20	34.26	46.76	733	966

Shear Wave Source Offset - 2 ft

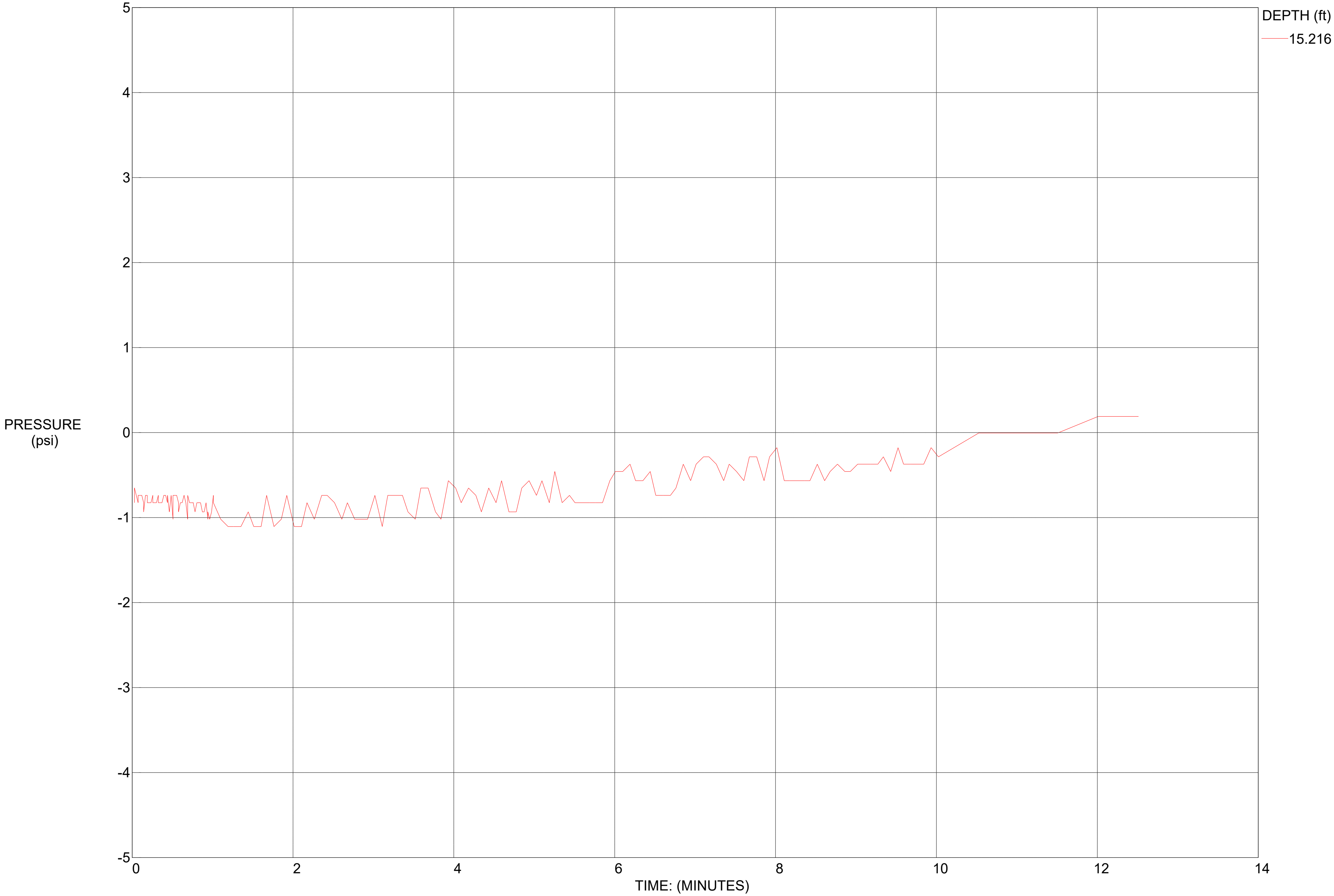
S-Wave Velocity from Surface = Travel Distance/S-Wave Arrival
Interval S-Wave Velocity = (Travel Dist2-Travel Dist1)/(Time2-Time1)

TEST ID: CPT-7

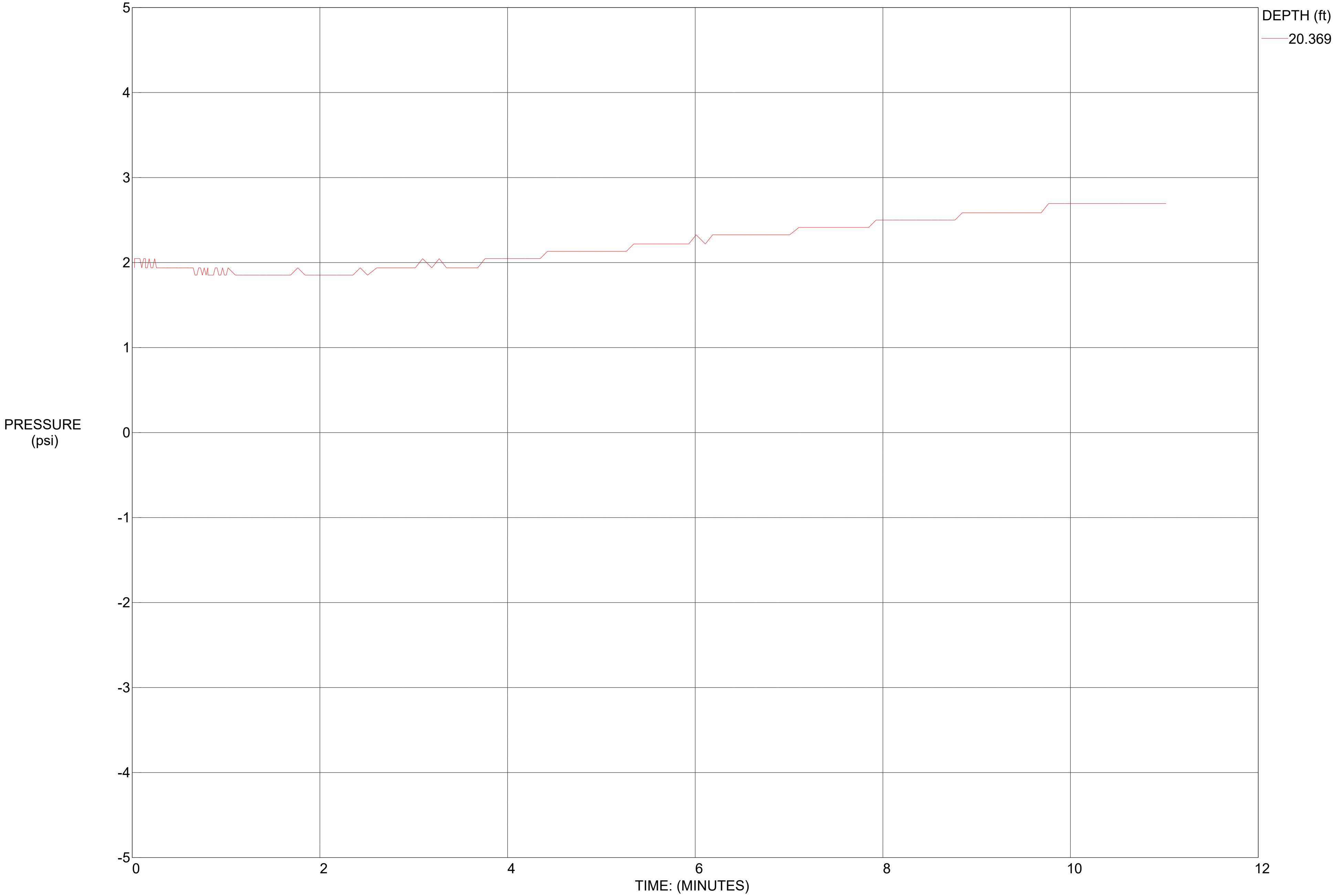


5
4
3
2
1
0
-1
-2
-3
-4
-5
PRESSURE (psi)
0
1
2
3
4
5
6
TIME: (MINUTES)
DEPTH (ft)
9.998

TEST ID: CPT-7

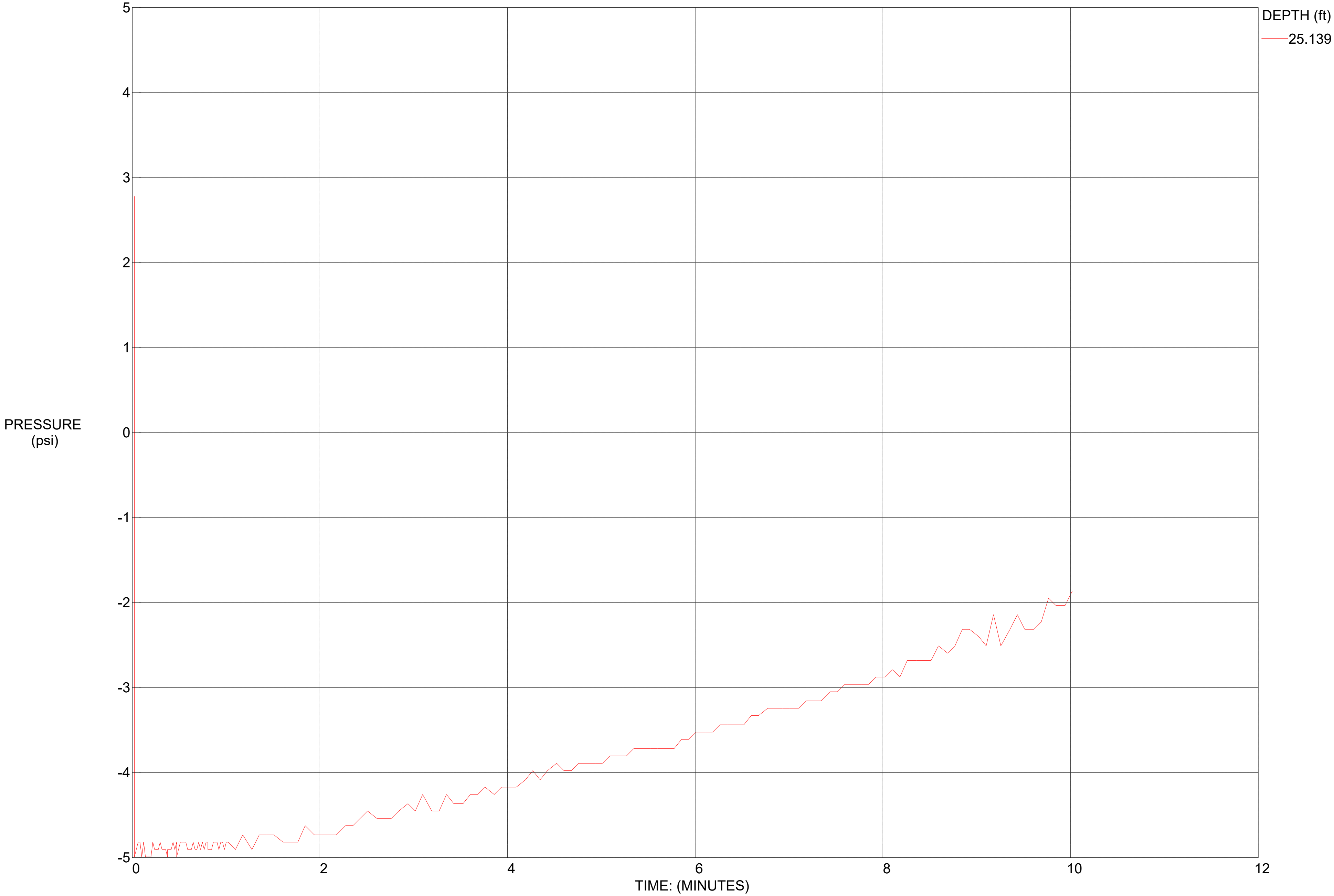

DEPTH (ft)
15.216
PRESSURE
(psi)
5
4
3
2
1
0
-1
-2
-3
-4
-5
0
2
4
6
8
10
12
14
TIME: (MINUTES)

TEST ID: CPT-7



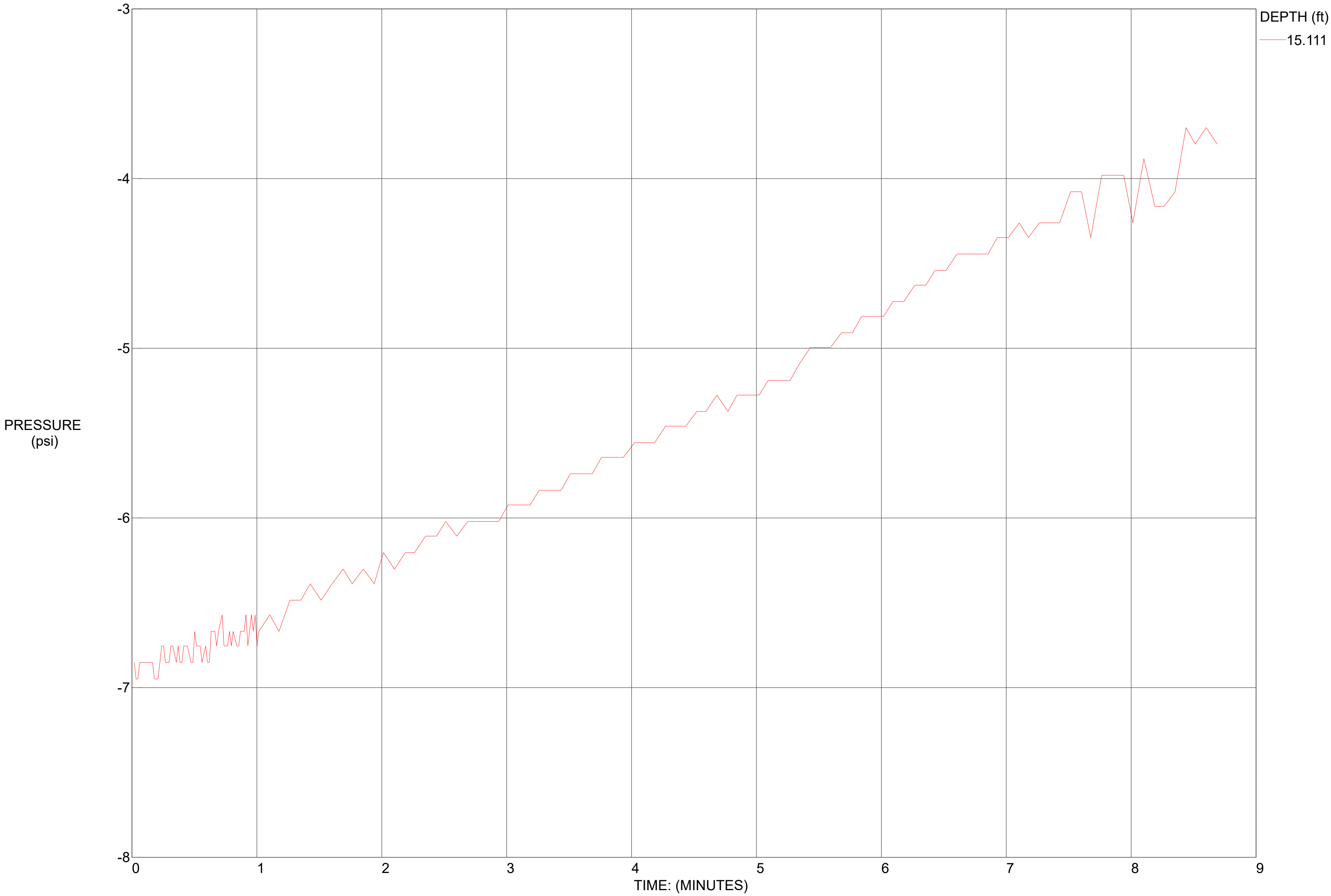
DEPTH (ft)
20.369
PRESSURE
(psi)
5
4
3
2
1
0
-1
-2
-3
-4
-5
0
2
4
6
8
10
12
TIME: (MINUTES)

TEST ID: CPT-7

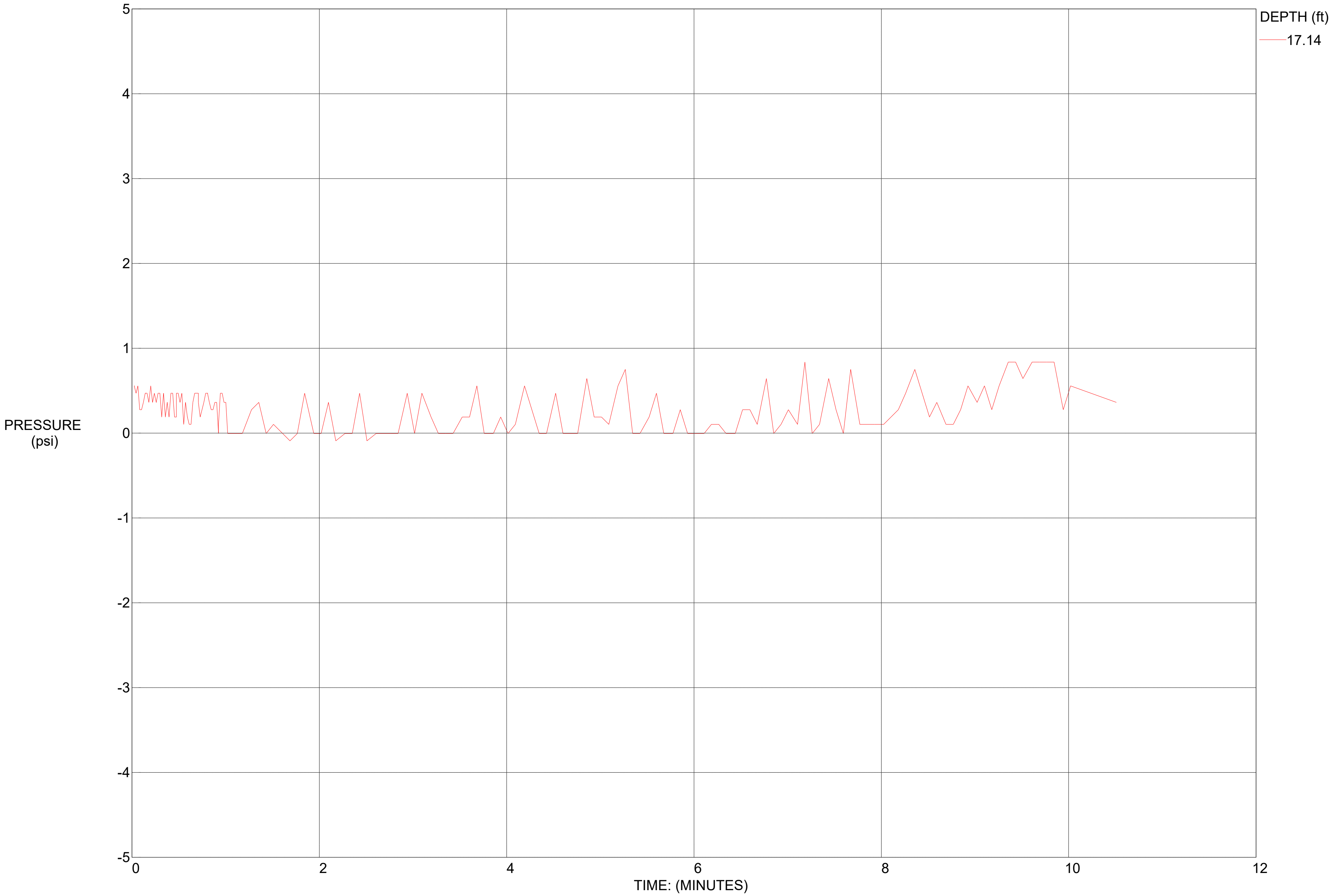


PRESSURE
(psi)
5
4
3
2
1
0
-1
-2
-3
-4
-5
0
2
4
6
8
10
12
TIME: (MINUTES)
DEPTH (ft)
25.139

TEST ID: CPT-10

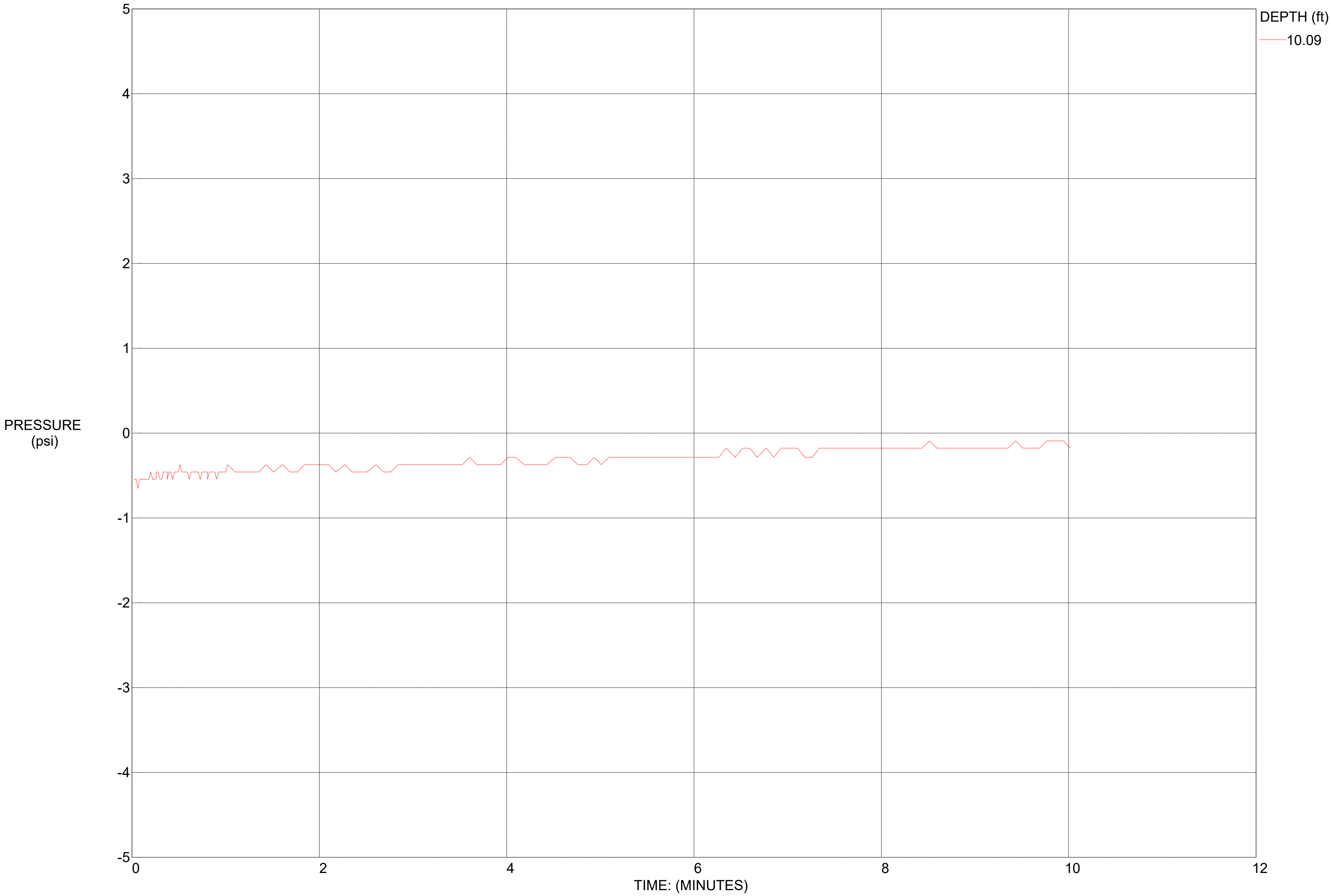


TEST ID: CPT-8

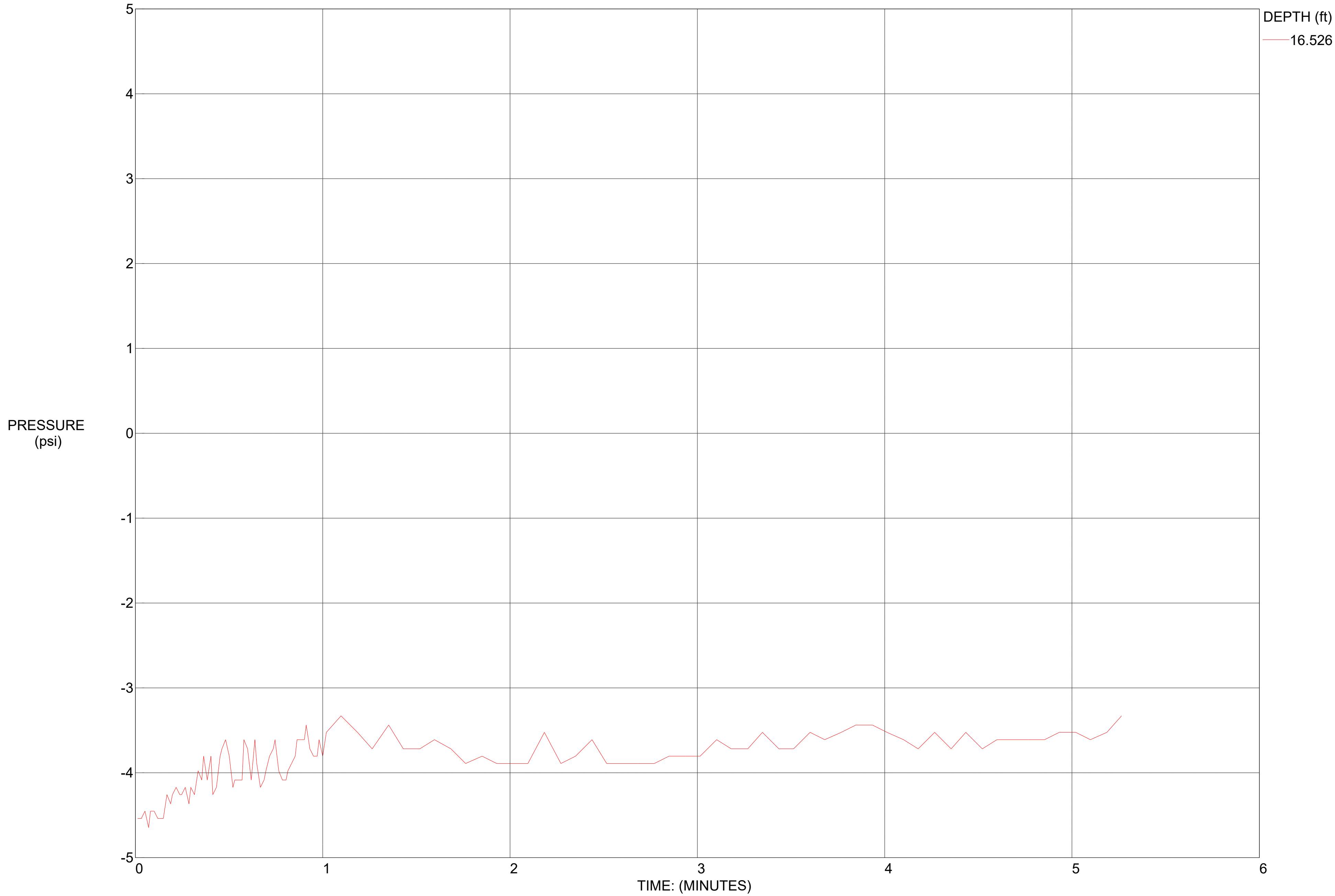


PRESSURE (psi)
5
4
3
2
1
0
-1
-2
-3
-4
-5
0
2
4
6
8
10
12
TIME: (MINUTES)
DEPTH (ft)
17.14

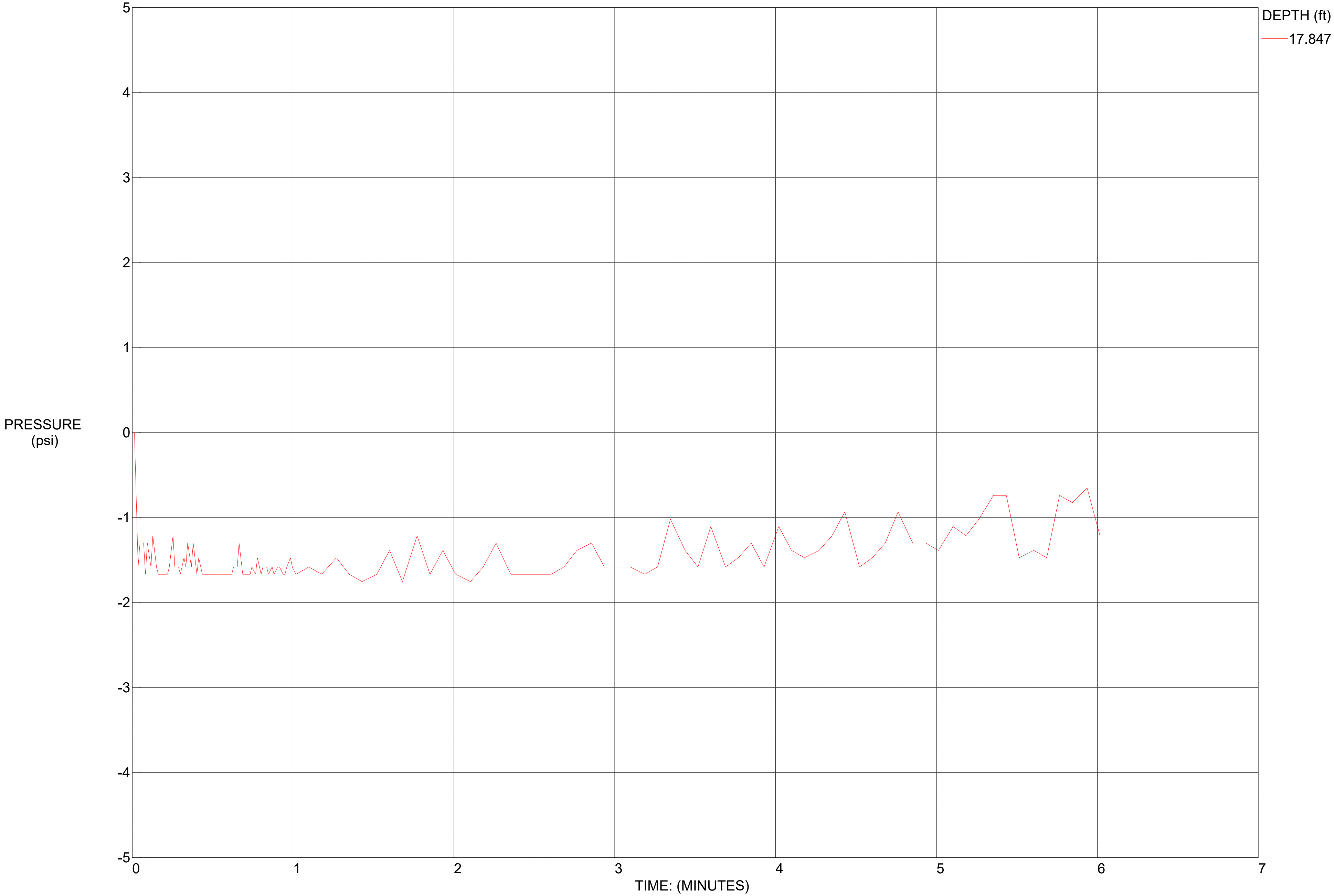
TEST ID: CPT-10



TEST ID: CPT-13



TEST ID: CPT-15



APPENDIX A-2

GEOPHYSICISTS REFLECTION LINE REPORT

[illegible]

[illegible]

Lake Hemet, California

[illegible]

Petra, Inc.
42-240 Green Way, Suite E
Palm Desert, CA 92211

[illegible]

Atlas Technical Consultants, LLC
6280 Riverdale Street
San Diego, CA 92120

[illegible]

ATLAS

6280 Riverdale Street
San Diego, CA 92120
(877) 215-4321 | oneatlas.com

October 12, 2020

Atlas No. 120361SWG
Report No. 1

MR. ALAN PACE
[illegible]
42-240 GREEN WAY, SUITE E
PALM DESERT, CA 92211

[illegible] [illegible]
[illegible]
[illegible]

Dear Mr. Pace:

In accordance with your authorization, Atlas Technical Consultants (Atlas) has performed a geophysical study pertaining to the proposed Lake Hemet Wellness Center located in Lake Hemet, California. Specifically, our study included evaluating the presence of faulting at a portion of the project site through the collection of seismic reflection data. The field work was conducted on August 17 through 20, 2020. This data report presents our survey methodology, equipment used, analysis, and results.

If you have any questions, please call us at (858) 527-0849.

Respectfully submitted,
[illegible]

Eric Carlson
Project Geologist/Geophysicist

Hans van de Vrugt, C.E.G., P.Gp.
Principal Geologist/Geophysicist

HV:ERC:hv:ds

Distribution: Apace@petra-inc.com

[illegible]

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1.0 INTRODUCTION

In accordance with your authorization, Atlas Technical Consultants (Atlas) has performed a geophysical study pertaining to the proposed Lake Hemet Wellness Center located in Lake Hemet, California (Figure 1). Specifically, our study included evaluating the presence of faulting at a portion of the project site through the collection of seismic reflection data. The field work was conducted on August 17 through 20, 2020. This data report presents our survey methodology, equipment used, analysis, and results.

2.0 SCOPE OF SERVICES

Our scope of services included:

- Review of background project information, including maps, provided by your office.
- Conducting a seismic reflection line across a portion of the project site.
- Compiling and analyzing the data collected.
- Preparing this illustrated data report presenting our findings and conclusions.

3.0 SITE AND PROJECT DESCRIPTION

The project site is located to the northeast of the Lake Hemet reservoir and is in between Apple Canyon Road and Highway 74 (Figure 1). The study area, which was selected by your office, included a portion of the property. Specifically, the seismic traverse crossed the study area southwest to northeast, roughly perpendicular to possible faulting in the area (Figure 2). The study area is relatively flat, and vegetation includes scattered brush and trees, and annual grass. Overhead electric lines are located just to the west of the seismic traverse. Figures 2 and 3 depict the general site conditions in the study area.

Based on our discussions with you, it is our understanding that faulting has been mapped in or near the study area. Is also our understanding that your office is conducting a fault hazard evaluation for the proposed development.

4.0 [illegible]

Our evaluation included the assessing the presence of faulting at the project site through the collection of seismic reflection data. The seismic reflection method uses body waves which are generated, typically at the surface, and then recorded using an array of vertical component geophones (receivers). When the propagating wave encounters a change in acoustic impedance (impedance is equal to the product of a materials density and velocity) some of the wave energy is reflected back to the surface and detected by the geophones and recorded with a data logging instrument (seismograph). During the acquisition of seismic reflection data, the seismic waves recorded from each geophone are gathered into groups that have a common source point (source record). The individual traces within the source records are subsequently regrouped into gathers that have the midpoint between their source and receiver locations in common (termed common-midpoint [CMP] or common-depth-point [CDP] gathers). The differences in times of arrivals at variable source points to geophone distances along reflection paths are termed “moveout” and are hyperbolic (if reflecting geologic strata dips and source-receiver offsets distances are not too large). Moveout depends upon velocity, dip (to a lesser extent), and offset distance and decreases with increased reflection time.

Once the seismic traces have been grouped (sorted) into CDP gathers, analyses of the moveout of reflections within the dataset provides velocities that are used to flatten the hyperbolic moveout on adjacent traces to a common two-way travel time (time it takes seismic energy to travel from a point on the surface to a reflector and back to the same point on the surface). These correction velocities consider the approximate root-mean-square (rms) velocities of all the overlying layers, and the moveout correction is termed normal moveout or NMO. Corrected traces can be summed horizontally, or CDP stacked, to attenuate random effects and non-primary reflection NMO from other wave types (e.g., multiple reflections, surface waves, refractions, diffractions, etc.), and to increase the signal-to-noise (S/N) ratio. The amount of horizontal summing, or CDP fold, is dependent upon the number of seismograph channels (i.e., number of geophones), and the location and number of source points. Each CDP gather then becomes one stacked trace with reflected energy at two-way travel time. A seismic reflection section consists of stacked CDP gathers along the length of the line.

Signals can be enhanced through vertical stacking, which involves repeated source impacts at the same point into the same set of geophones. For each source point the stacked data are recorded into the same seismic data file and theoretically the seismic signal arrives at the same time from each impact, and thus is enhanced, while noise is random and tends to be reduced or canceled.

The quality of seismic data can be adversely affected by spurious vibrations from nearby vehicular or aircraft traffic, machinery, or wind. If the seismic noise sources are sporadic, acquisition can be timed to when the noise is at a minimum. Under conditions of constant noise, the number of stacks can be increased, or at last resort filtering can be applied.

The seismic reflection data for our study were acquired along a linear geophone spread. Five Geometrics Geode signal-enhancement seismographs and 120 40-Hz vertical component geophones spaced 8 feet apart were used. Shots were conducted between each geophone pair along the array and off the ends of the geophone spread. A 20-pound sledgehammer and aluminum impact plate were used as a seismic source (shot).

After initial in-field testing, data were independently acquired five times at each source point. Only data of high quality were vertically stacked (i.e., the records at each source point were stacked together) during processing although for most source points that included each record. Each geophone location and elevation along the line were recorded. The overall quality of the reflection seismic data collected is considered good to excellent.

The collected reflection seismic data were processed by Columbia Geophysical, LLC, Englewood, Colorado. Columbia Geophysical's UNIX workstation-based ProMAX reflection seismic software package was used to process the data and offered the opportunity to perform extensive testing in a short period of time.

The seismic data processing sequence applied is as follows (** = testing steps):

1. Format conversion from SEG2 to SEG-Y
2. Geometry definition and application
3. Trace editing
4. ***Spectral analysis and filter analysis to determine frequency range*
5. ***First break picking and refraction statics calculation*
6. Statics calculations: datum = 0 feet, velocity = 4,200 ft/sec
7. Gain recovery and spherical divergence correction
8. ***Deconvolution (testing)*
9. Surface consistent spiking deconvolution
10. Zero phase spectral whitening: 6-10-130-150 Hz range
11. Long gate trace balance
12. Common-Depth-Point (CDP) sort
13. Interactive velocity analysis
14. ***First break mute analysis*
15. Preliminary brute stack with datum statics and mutes
16. Surface consistent residual autostatics
17. Interactive velocity analysis with autostatics applied
18. Q.C. of shot records and CDP gathers
19. Normal moveout (NMO) corrections
20. ***Final first break mute analysis*
21. Final mute application
22. CDP stack
23. ***Spectral analysis and filter testing on unfiltered final stack*
24. Bandpass filter application (20-30-150-200 Hz), 0 to 500 milliseconds (ms)
25. FX noise attenuation
26. Time variant scaling
27. SEG-Y digital output.

Spectral analyses and filter tests are conducted upon individual records in order to determine the quality of the data, the amount of information present, and to design a preliminary data processing flow. Elevation statics are used to determine surface consistent residual statics that are applied after interactive velocity analysis. Statics are corrections applied to seismic data to compensate for the effects of variations in elevation, weathering thickness, weathering velocity and reference to a datum. The objective is to determine the reflection arrival times which would have been observed if all measurements had been made on a (usually) flat plane with no weathering or low velocity material present. Surface consistent means that the statics take into account time delays from both source and geophone locations.

Normal moveout (NMO) is described as the variation of reflection arrival time because of different source point to geophone distances. To determine the NMO correction, velocity analyses of the CDP gathers are conducted by stacking several velocities and choosing those velocities where the coherency of the NMO for selected reflectors is maximized. These velocities are further refined via narrow and/or full-line CDP gather panel analyses to arrive at the final stacking velocities along the lines. The first-break mute excludes traces that are dominated by refraction arrivals or contain frequencies after NMO correction that are appreciably lower than the other surrounding traces.

In filter testing, narrow bandpass filters were applied to the data to determine the optimum frequency filtering interval(s) that can be used on the data to enhance any possible reflections and reduce noise. For the processing flow used in this project (and typically for most seismic data processing), the data are bandpass filtered after CDP stacking.

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As previously discussed, the purpose of our geophysical study was to assess the presence of faulting within the study area through the collection of seismic reflection data. The reflection results are presented in Figure 4 as a model comprised of continuous and discontinuous reflectors (orange and black bands). Please note that the reflection profile vertical scale is two-way travel time (TWTT) in milliseconds (ms) and that absent specific subsurface velocity information, an accurate depth scale is not provided. For rough estimating purposes only, the two-way travel time multiplied by two approximates the near surface depth in feet. This multiplier increases with depth and increased velocity. It should also be noted that the data near the beginning and the end of the section is generally incoherent because the CDP fold is low near the ends of the line. Consequently, interpretations of the sections near the ends of lines are questionable or not possible.

As illustrated in Figure 4, a very strong reflector is present at approximately 45ms (TWTT). This reflector is continuous across the profile and likely represents the contact with or within the granitic rock. Based on our discussions with you, it is understanding that the site is likely underlain by massive alluvial soils over granitic rock, with varied degrees of weathering. The depth to this bright reflector is on the order of 90 feet, which would suggest that the alluvium is 90 feet thick if the reflector represents the top of the granitic rock. As part of our evaluation we conducted some limited refraction analyses on the collected data and found that there is a substantial increase in P-wave velocity from 5,000 to 7,000 feet per second at 35 to 40 feet below the ground surface. These velocities are typical of weathered granitic bedrock. Consequently, the strong reflector, observed at 45ms likely represents a transition from weathered to non, or slightly, weathered rock rather than the top of the rock.

Based on our results, two possible somewhat subtle fault splays are observed in the data, and are shown in blue on Figure 4. These two features appear to disrupt the granitic rock. The surface projection of these features are shown on Figure 2 as the limits of a possible fault zone.

It should be noted that the picking, or tracing, of reflectors and faulting in high resolution data may be considered a combination of art and science and it is possible that other geophysicists or geologists might trace features differently along some portions of the line, although the general nature of the subsurface interpretation of the seismic data will not appreciably change.

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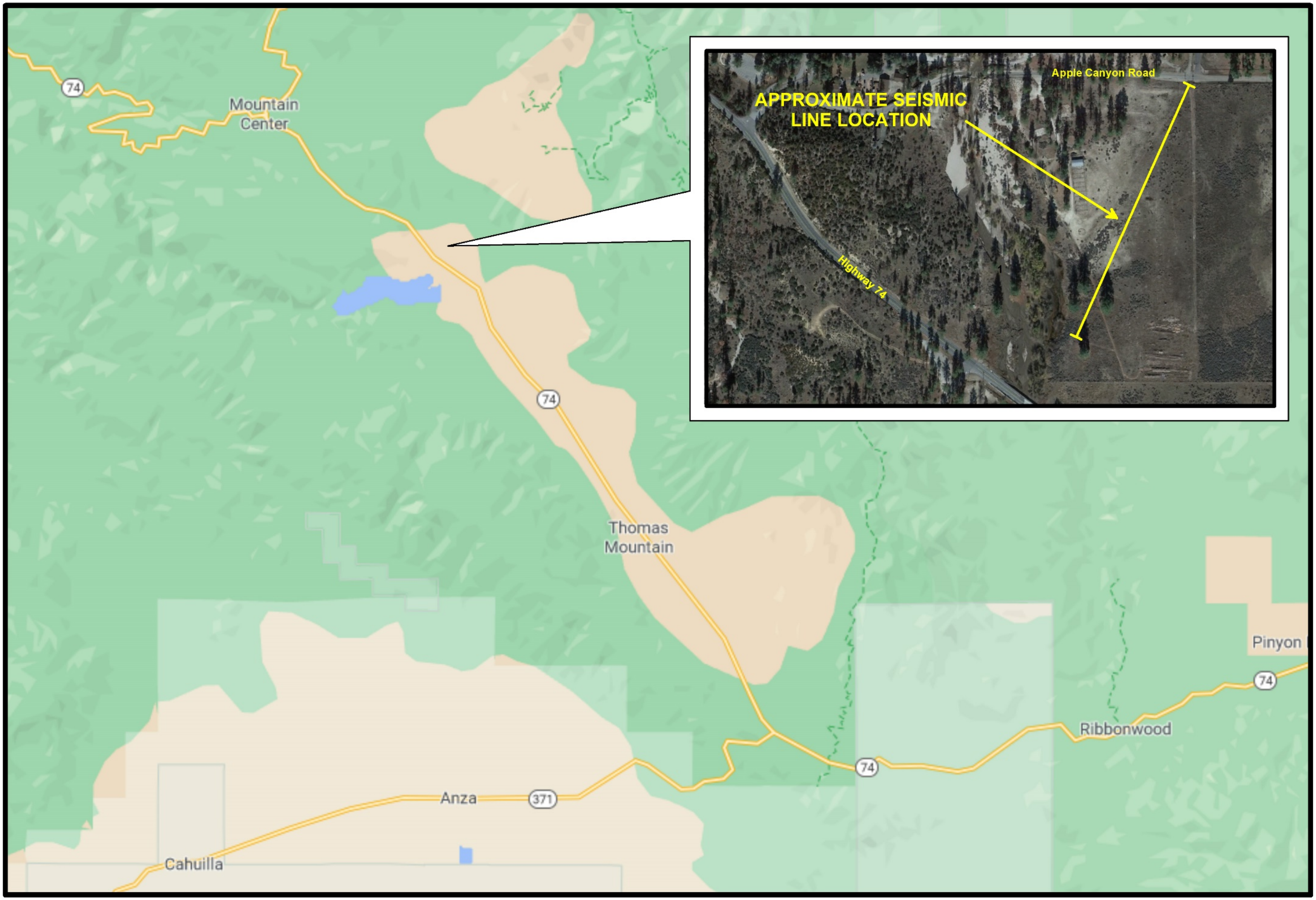
The field evaluation and geophysical analyses presented in this report have been conducted in general accordance with current practice and the standard of care exercised by consultants performing similar tasks in the project area. No warranty, express or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be present. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface surveying will be performed upon request.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Atlas should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document. This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.



SITE LOCATION MAP

N

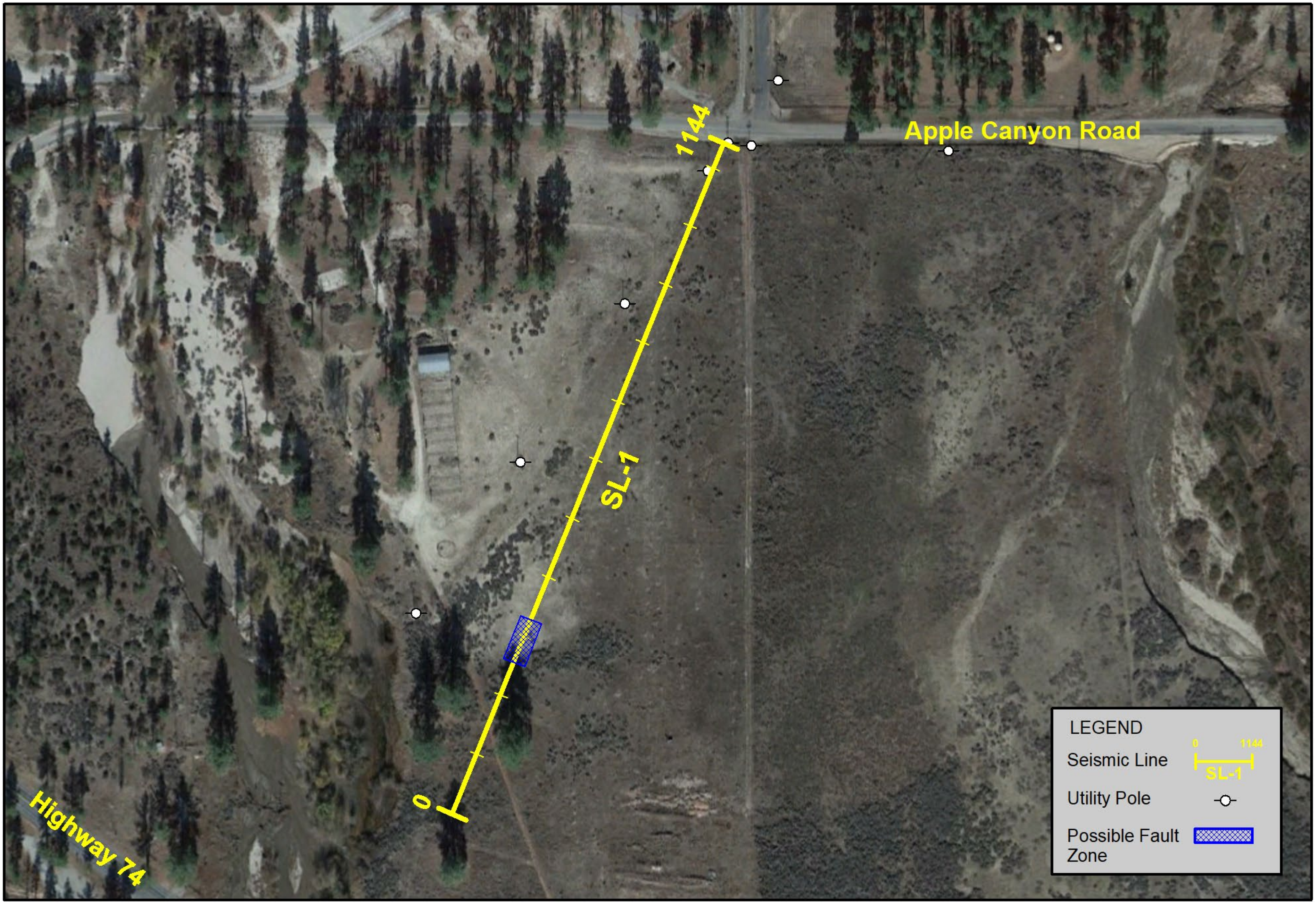
Lake Hemet Wellness Center
Lake Hemet, California

Project No.: 120361SWG

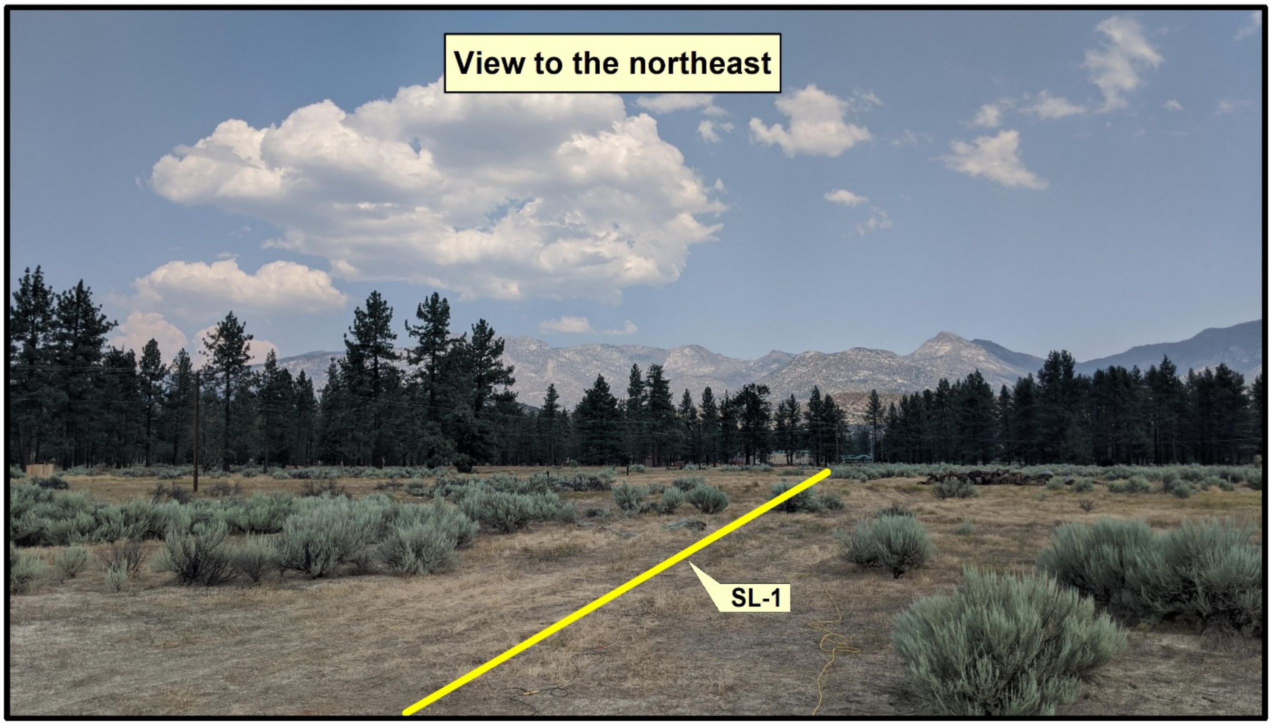
Date: 10/20

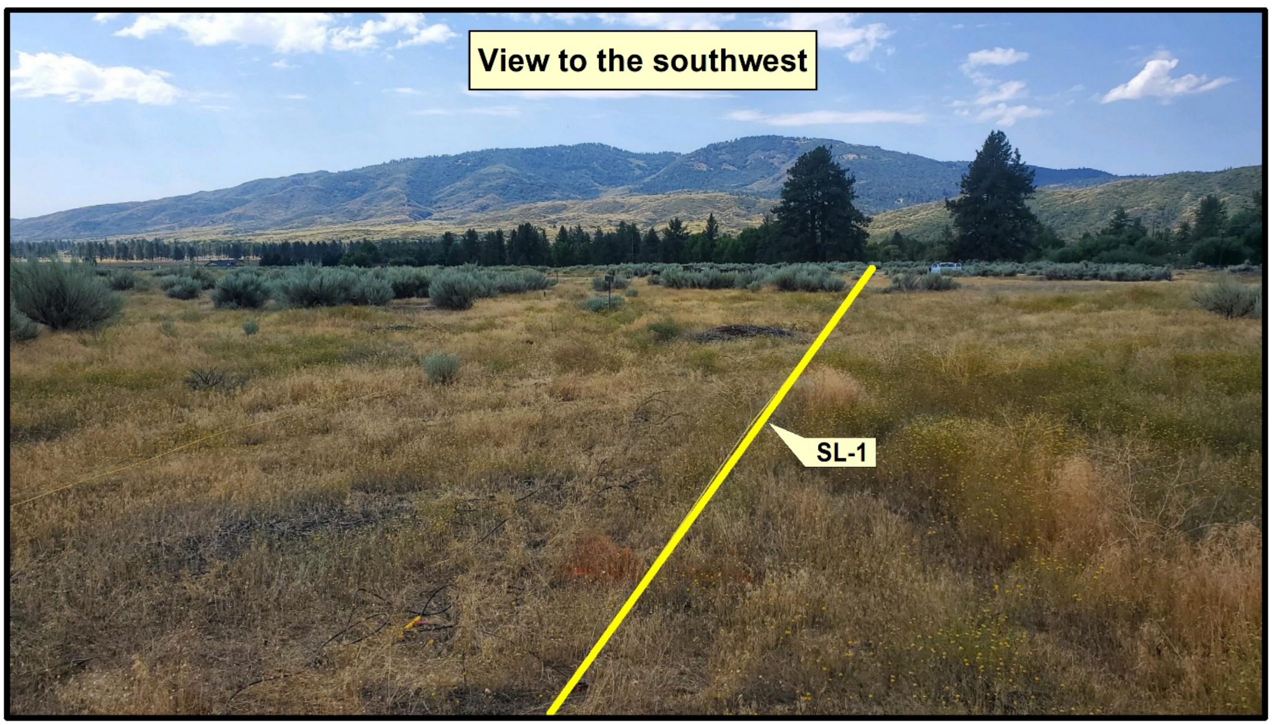
ATLAS

Figure 1

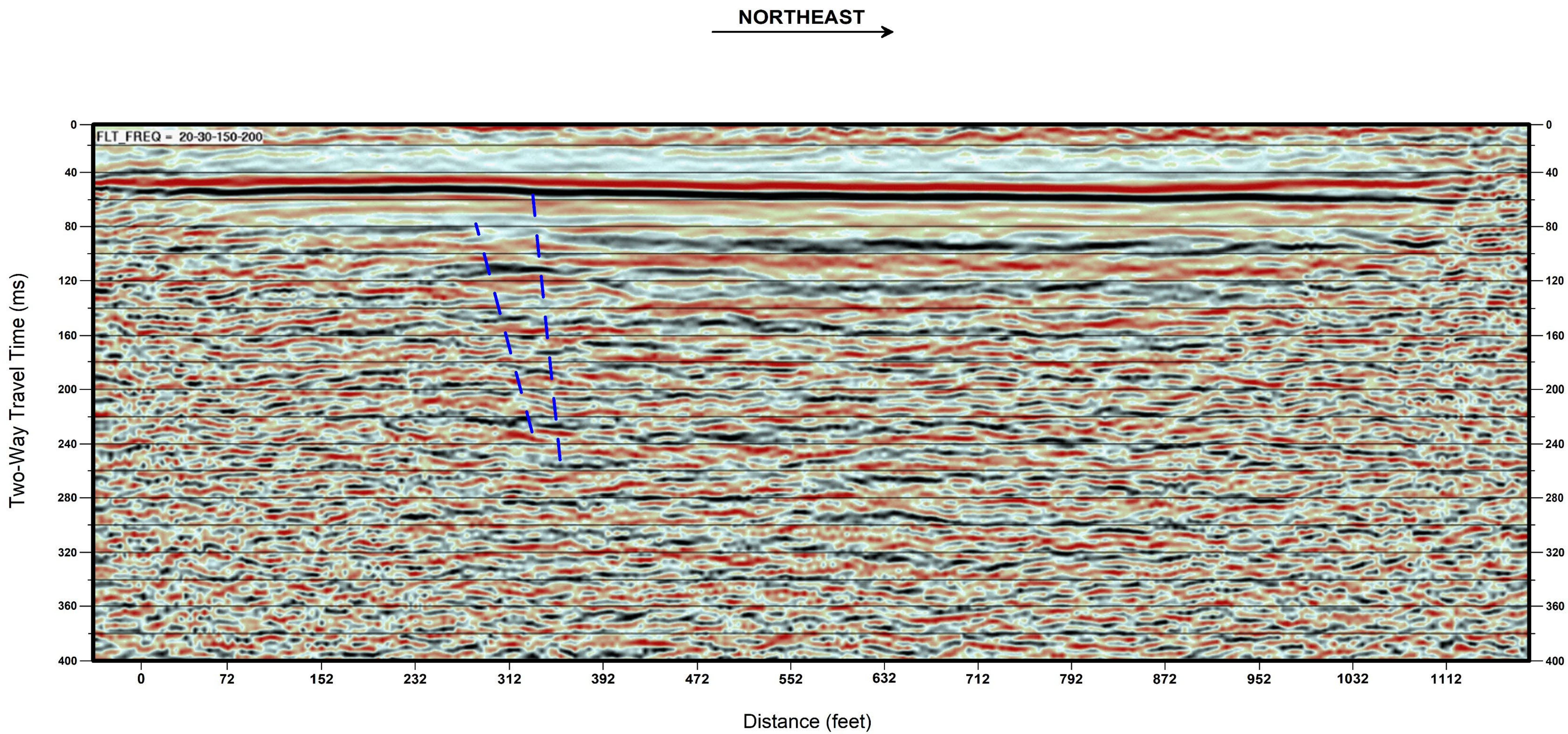


LINE LOCATION MAP	N	Lake Hemet Wellness Center Lake Hemet, California Project No.: 120361SWG Date: 10/20	ATLAS Figure 2	0 200 400 approximate scale in feet





SITE PHOTOGRAPHS	Lake Hemet Wellness Center Lake Hemet, California Project No.: 120361SWG — Date: 10/20	ATLAS Figure 3



Legend

Possible Fault

SEISMIC REFLECTION PROFILE SL-1	Lake Hemet Wellness Center Lake Hemet, California Project No.: 120361SWG · Date: 10/20	ATLAS Figure 4

APPENDIX B-1

LABORATORY TEST PROCEDURES

LABORATORY DATA SUMMARY

LABORATORY TEST PROCEDURES

Soil Classification

Soil materials encountered within the property were classified and described in accordance with the Unified Soil Classification System and in general accordance with the current version of Test Method ASTM D 2488. The assigned group symbols are presented in the exploration logs, Appendix A.

Moisture Content and In Situ Moisture Content and Dry Unit Weight

Moisture content of selected bulk samples and in-place moisture content and dry unit weight of selected, relatively undisturbed soil samples were determined in accordance with the current version of the Test Method ASTM D 2435 and Test Method ASTM D 2216, respectively. Test data are presented on the exploration logs, Appendix A.

Laboratory Maximum Dry Unit Weight and Optimum Moisture Content

The maximum dry unit weight and optimum moisture content of the on-site soils were determined for a selected bulk sample in accordance with current version of Method A of ASTM D 1557. The results of these tests are presented on Plate B-1 and B-2.

Corrosivity Screening

Chemical and electrical analyses were performed on a selected bulk sample of onsite soils to determine their soluble sulfate content, chloride content, pH (acidity), and minimum electrical resistivity. These tests were performed in accordance with the current versions of California Test Method Nos. CTM 417, CTM 422 and CTM 643, respectively. The results of these tests are included on Plate B-1.

Grain Size Distribution

A grain size analysis was performed on a selected bulk sample of onsite soils in accordance with the current versions of Test Method ASTM D 136 and/or Test Method ASTM D 422. The test result is graphically presented on Plate B-3 through B-12.

Expansion Index

Expansion index tests were performed on selected bulk samples of the on-site soils in accordance with the latest version of Test Method ASTM D4829. The test results are presented on Plate B-1.

Percent Passing No. 200 Sieve

Selected samples were run through a number 200 sieve in general accordance with the latest version of Test Method ASTM D 1140. The results of these tests are included on Plate B-1.

Direct Shear

The Coulomb shear strength parameters, i.e., angle of internal friction and cohesion, were determined for selected, relatively undisturbed and/or reconstituted-bulk samples of onsite soil. This test was performed in general accordance with the latest version of Test Method ASTM D 3080. Three specimens were prepared for each test. The test specimens were inundated and then sheared under various normal loads at a constant strain rate of 0.005 inch per minute. The results of the direct shear test are graphically presented on Plates B-13 and 14.

Consolidation

Volume change (settlement or heave) characteristics of select undisturbed soils were determined by one-dimensional consolidation tests. These tests were performed in general accordance with the latest version of the Test Method ASTM D 2435. Additionally, heave or hydro-consolidation tests were performed in general accordance with the latest version of Test Method ASTM D 4546, or ASTM D 5333 respectively. Axial loads were applied in several increments to laterally restrained 1-inch-high samples. The resulting deformations were recorded at selected time intervals. The test samples were inundated at the approximate in-situ and/or anticipated design overburden pressure in order to evaluate the effect of an increase in moisture content, e.g., hydro-consolidation potential or heave. Results of these tests are graphically presented on Plates B-15.

LABORATORY DATA SUMMARY*														
Boring Number	Sample Depth (ft.)	Soil Description[1]	Compaction[3]		Expansion[4]		Atterberg Limits[5]			Corrosivity Screening				Percent Passing No. 200 Sieve[9]
			Maximum Dry Unit Weight (pcf)	Optimum Moisture (%)	Index	Potential	LL	PL	PI	Soluble Sulfate Content[6] (%)	Chloride Content[7] (ppm)	pH[8] (Acidity)	Minimum Resistivity[8] (Ohm-cm)	
B-1	0-5.0	Silty fine to coarse Sand with trace Clay (SM)	129.2	8.4	0	Very Low	-	-	-	0.0006	277.5	7.75	10000	-
B-1	5	-	-	-	-	-	-	-	-	-	-	-	-	20.7
B-1	15	-	-	-	-	-	-	-	-	-	-	-	-	7.2
B-1	20	-	-	-	-	-	-	-	-	-	-	-	-	36.2
B-1	35	-	-	-	-	-	-	-	-	-	-	-	-	1.7

*Note: Laboratory data pertaining to in-place soil moisture content and dry density are provided on the exploration logs included in Appendix A of this report.

Test Procedures:

[1] Per Test Method ASTM D 2488
[3] Per Test Method ASTM D 1557
[4] Per Test Method ASTM D 4829
[5] Per Test Method ASTM D 4318
[6] Per California Test Method CTM 417
[7] Per California Test Method CTM 422
[8] Per California Test Method CTM 643
[9] Per Test Method ASTM D 1140

COMPACTION TEST REPORT

Project No.: 20-227 **Date:** 6/15/2021
Project: The Ridge Wellness Center
Client: Caroline Legrand
Source of Sample: Phase 110 **Depth:** 0-5'
Sample Number: B-1
Remarks:

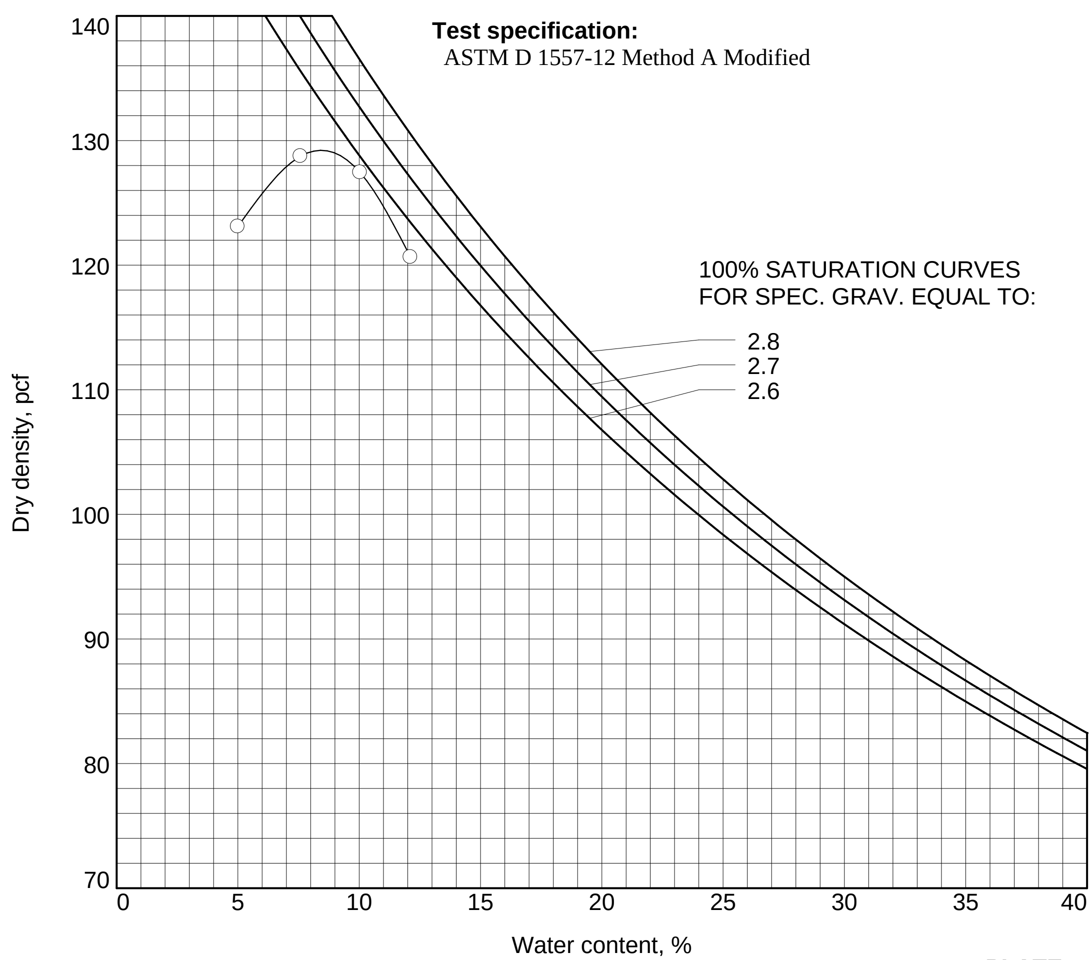
MATERIAL DESCRIPTION

Description: Dark Gray, Silty fine to coarse Sand with trace Clay

Classifications - **USCS:** SM **AASHTO:**
Nat. Moist. = **Sp.G. =**
Liquid Limit = **Plasticity Index =**
% < No.200 = 25.9 %

TEST RESULTS
Maximum dry density = 129.2 pcf
Optimum moisture = 8.4 %

Test specification:
ASTM D 1557-12 Method A Modified

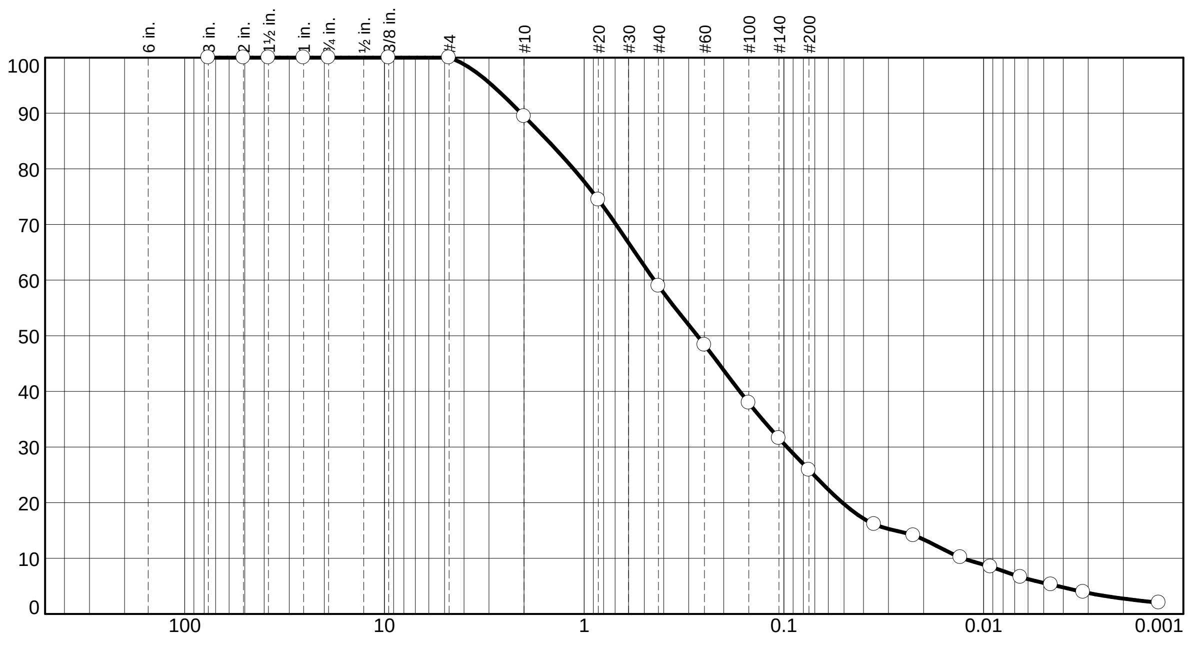


Laboratory:
1251 West Pomona Road, Unit #103, Corona, Ca 92882 Phone #. 714.549.8921

PLATE B-2

Petra Geosciences, Inc.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	10.5	30.5	33.1	20.3	5.6

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
.75	100.0		
.375	100.0		
#4	100.0		
#10	89.5		
#20	74.5		
#40	59.0		
#60	48.4		
#100	37.9		
#140	31.6		
#200	25.9		
0.0354 mm.	16.1		
0.0225 mm.	14.1		
0.0131 mm.	10.2		
0.0092 mm.	8.5		
0.0065 mm.	6.6		
0.0046 mm.	5.3		
0.0032 mm.	3.9		
0.0013 mm.	2.0		

* (no specification provided)

Material Description

Dark Gray, Silty fine to coarse Sand with trace Clay

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SM **AASHTO (M 145)=**

Coefficients

D_{90}= 2.0702 D_{85}= 1.5142 D_{60}= 0.4459
D_{50}= 0.2714 D_{30}= 0.0965 D_{15}= 0.0278
D_{10}= 0.0127 C_u= 35.10 C_c= 1.64

Remarks

Date Received: ______ **Date Tested:** ______
Tested By: ______
Checked By: ______
Title: ______

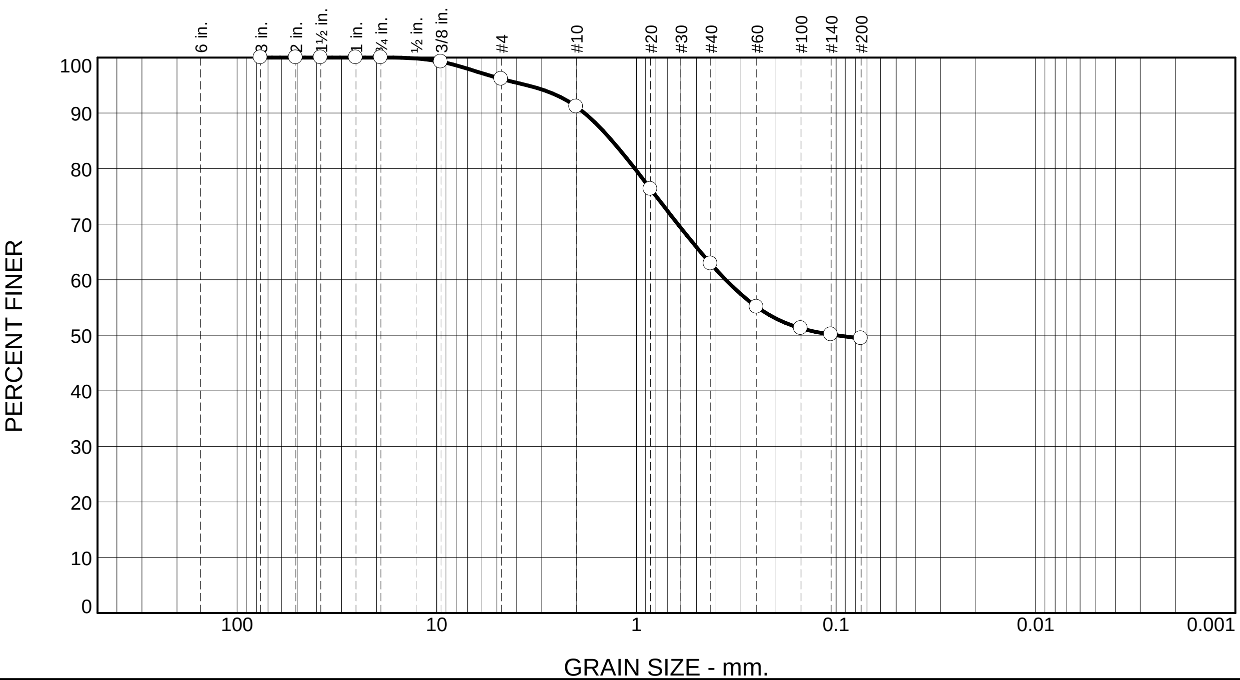
Source of Sample: Phase 110 **Depth:** 0-5'
Sample Number: B-1
Date Sampled: 6/17/2021

PETRA GEOSCIENCES INC.

Client: Caroline Legrand
Project: The Ridge Wellness Center
Project No: 20-227 **PLATE** B-3

Laboratory:
1251 West Pomona Road, Unit #103, Corona, Ca 92882 Phone #. 714.549.8921

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.9	4.9	28.3	13.5	49.4	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
.75	100.0		
.375	99.2		
#4	96.1		
#10	91.2		
#20	76.3		
#40	62.9		
#60	55.1		
#100	51.3		
#140	50.1		
#200	49.4		

* (no specification provided)

Material Description

Brown,Silty fine to coarse Sand with trace Gravel

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SM **AASHTO (M 145)=**

Coefficients

D_{90}= 1.8180 D_{85}= 1.3238 D_{60}= 0.3574
D_{50}= 0.0998 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: ______ **Date Tested:** ______
Tested By: ______
Checked By: ______
Title: ______

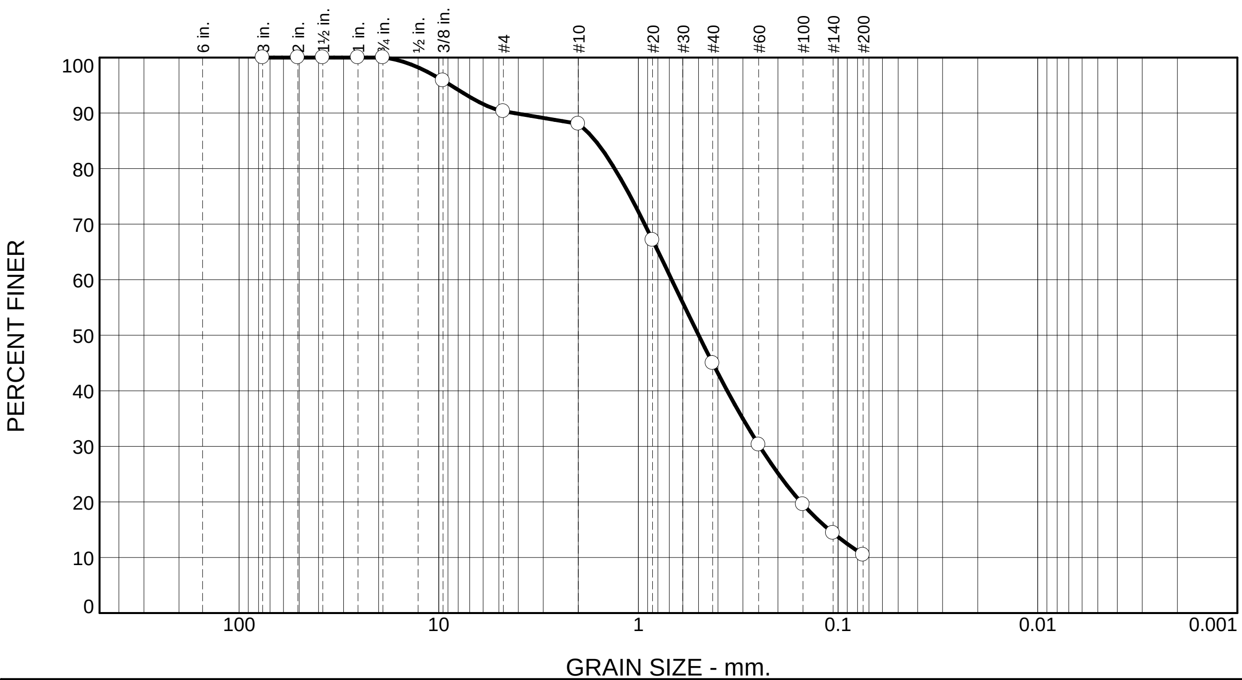
Source of Sample: Phase 110 **Depth:** 10 **Date Sampled:** 06/22/2021
Sample Number: B-1

PETRA GEOSCIENCES INC.

Client: Caroline Legrand
Project: The Ridge Wellness Center
Project No: 20-227 **PLATE** B-4

Laboratory:
1251 West Pomona Road, Unit #103, Corona, Ca 92882 Phone #. 714.549.8921

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	9.7	2.2	43.1	34.5	10.5	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
.75	100.0		
.375	95.9		
#4	90.3		
#10	88.1		
#20	67.1		
#40	45.0		
#60	30.3		
#100	19.6		
#140	14.4		
#200	10.5		

* (no specification provided)

Material Description

Light Brown, fine to coarse Sand with Silt and fine Gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= SP AASHTO (M 145)=

Coefficients

D_{90}= 4.2018 D_{85}= 1.6414 D_{60}= 0.6814
D_{50}= 0.4995 D_{30}= 0.2470 D_{15}= 0.1110
D_{10}= C_u= C_c=

Remarks

Date Received: ____ **Date Tested:** ____
Tested By: ____
Checked By: ____
Title: ____

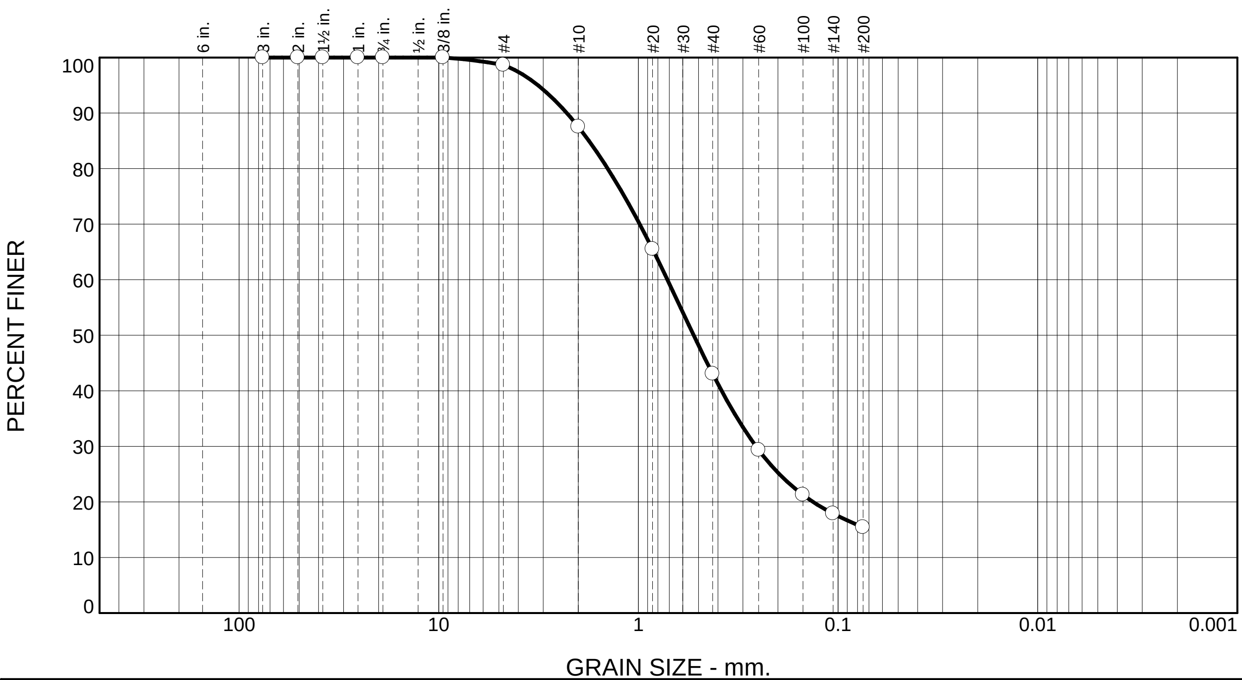
Source of Sample: Phase 110 **Depth:** 30 **Date Sampled:** 06/22/2021
Sample Number: B-1

PETRA GEOSCIENCES INC.

Client: Caroline Legrand
Project: The Ridge Wellness Center
Project No: 20-227 **PLATE** B-5

Laboratory:
1251 West Pomona Road, Unit #103, Corona, Ca 92882 Phone #. 714.549.8921

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.3	11.2	44.4	27.7	15.4	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
.75	100.0		
.375	100.0		
#4	98.7		
#10	87.5		
#20	65.5		
#40	43.1		
#60	29.3		
#100	21.3		
#140	17.9		
#200	15.4		

* (no specification provided)

Material Description

Brown Silty fine to coarse Sand

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SM **AASHTO (M 145)=**

Coefficients

D_{90}= 2.2836 D_{85}= 1.7697 D_{60}= 0.7162
D_{50}= 0.5291 D_{30}= 0.2579 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: ____ **Date Tested:** ____
Tested By: ____
Checked By: ____
Title: ____

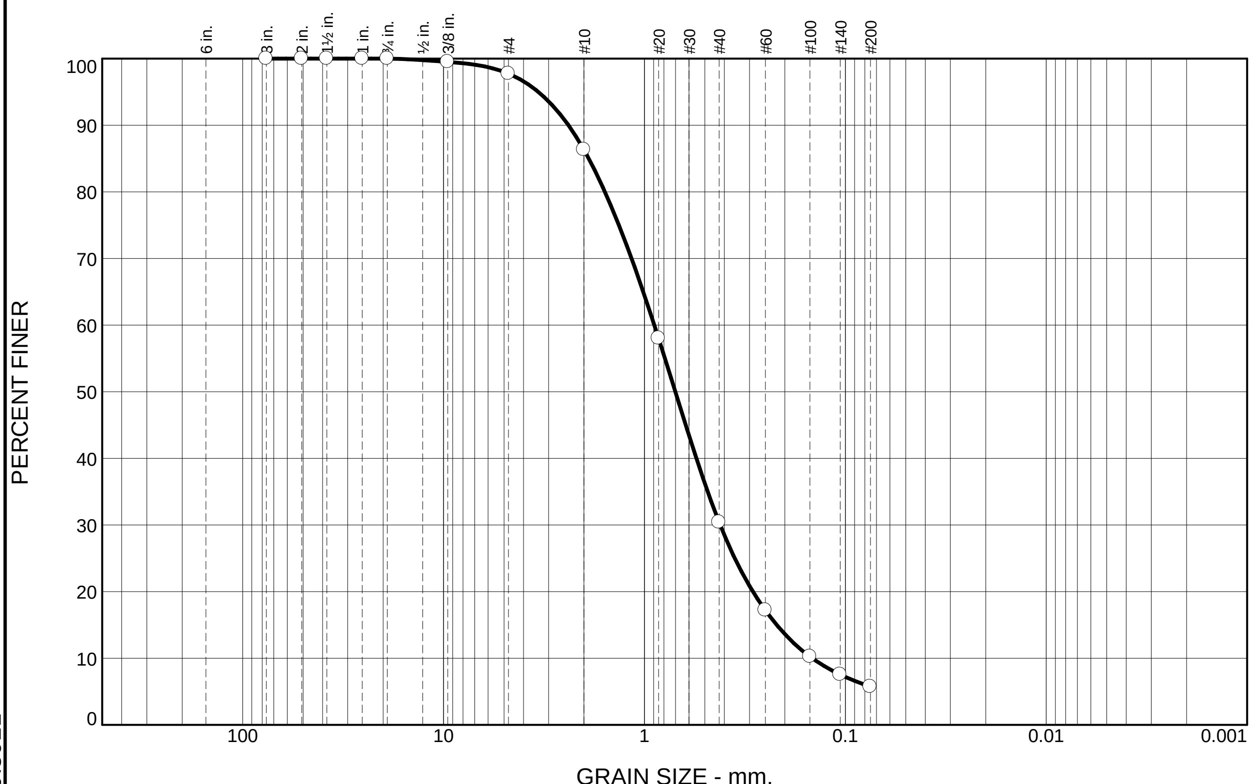
Source of Sample: Phase 110 **Depth:** 5
Sample Number: B-2
Date Sampled: 06/22/2021

PETRA GEOSCIENCES INC.

Client: Caroline Legrand
Project: The Ridge Wellness Center
Project No: 20-227 **PLATE** B-6

Laboratory:
1251 West Pomona Road, Unit #103, Corona, Ca 92882 Phone #. 714.549.8921

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	11.7	57.2	25.2	5.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
.75	100.0		
.375	99.5		
#4	97.7		
#10	86.3		
#20	58.0		
#40	30.4		
#60	17.2		
#100	10.2		
#140	7.5		
#200	5.7		

* (no specification provided)

Material Description

Brown fine to coarse Sand with trace Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 2.1516 D_{85}= 1.7592 D_{60}= 0.8631
D_{50}= 0.6827 D_{30}= 0.4112 D_{15}= 0.2148
D_{10}= 0.1427 C_u= 6.05 C_c= 1.37

Classification

USCS= SP AASHTO=

Remarks

Source of Sample: L-21-306 (100) **Depth:** 10
Sample Number: MW-1

Date: 09/21/2021

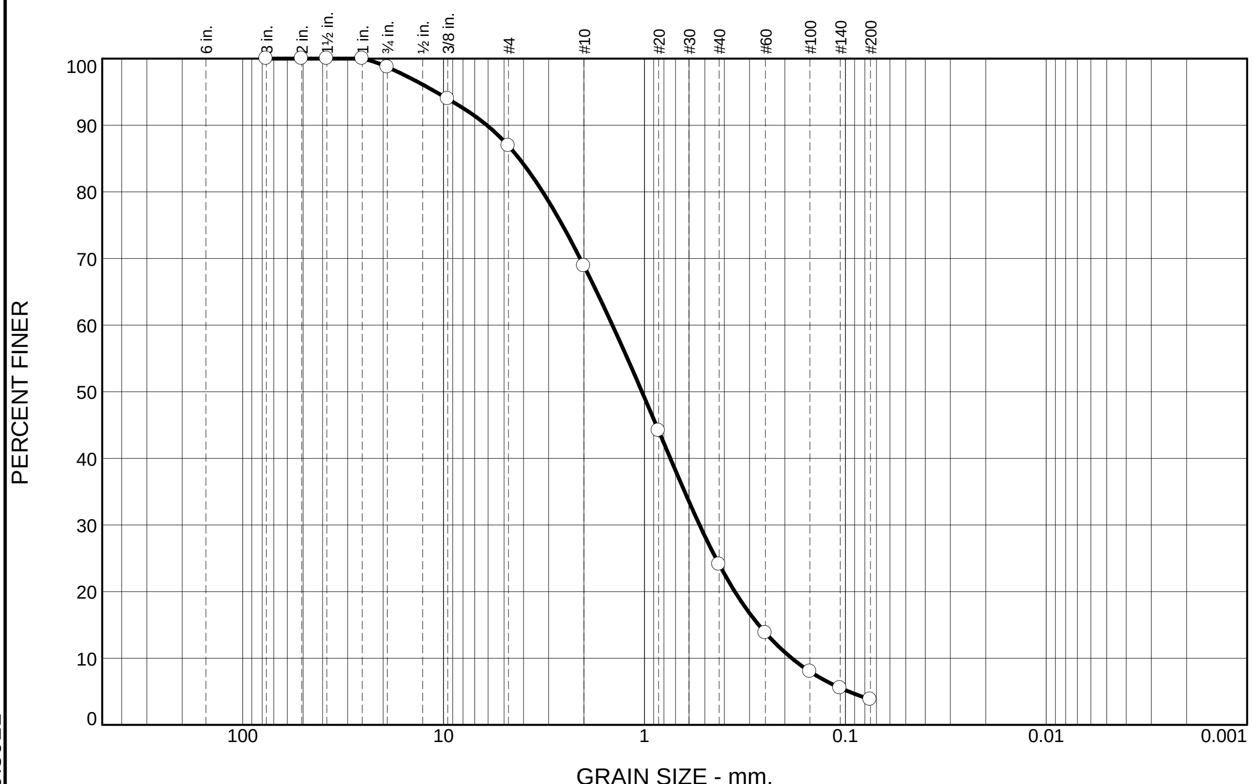
PETRA GEOSCIENCES INC.

Client: Caroline Legrand
Project: The Ridge Wellness Center
Project No: 20-227 **Figure** B-7

Laboratory: 1251 West Pomona Road, Unit #103, Corona, Ca 92882 Phone #. 714.549.8921

Tested By: SB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	20.7	51.6	23.3	4.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
.75	98.7		
.375	94.0		
#4	86.9		
#10	68.9		
#20	44.2		
#40	24.1		
#60	13.8		
#100	8.0		
#140	5.5		
#200	3.8		

* (no specification provided)

Material Description

Brown fine to coarse Sand with trace Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 2.8558 D_{85}= 2.4035 D_{60}= 1.1097
D_{50}= 0.8304 D_{30}= 0.4598 D_{15}= 0.2368
D_{10}= 0.1620 C_u= 6.85 C_c= 1.18

Classification

USCS= SW AASHTO=

Remarks

Source of Sample: L-21-306 (100) **Depth:** 15
Sample Number: MW-1

Date: 09/20/2021

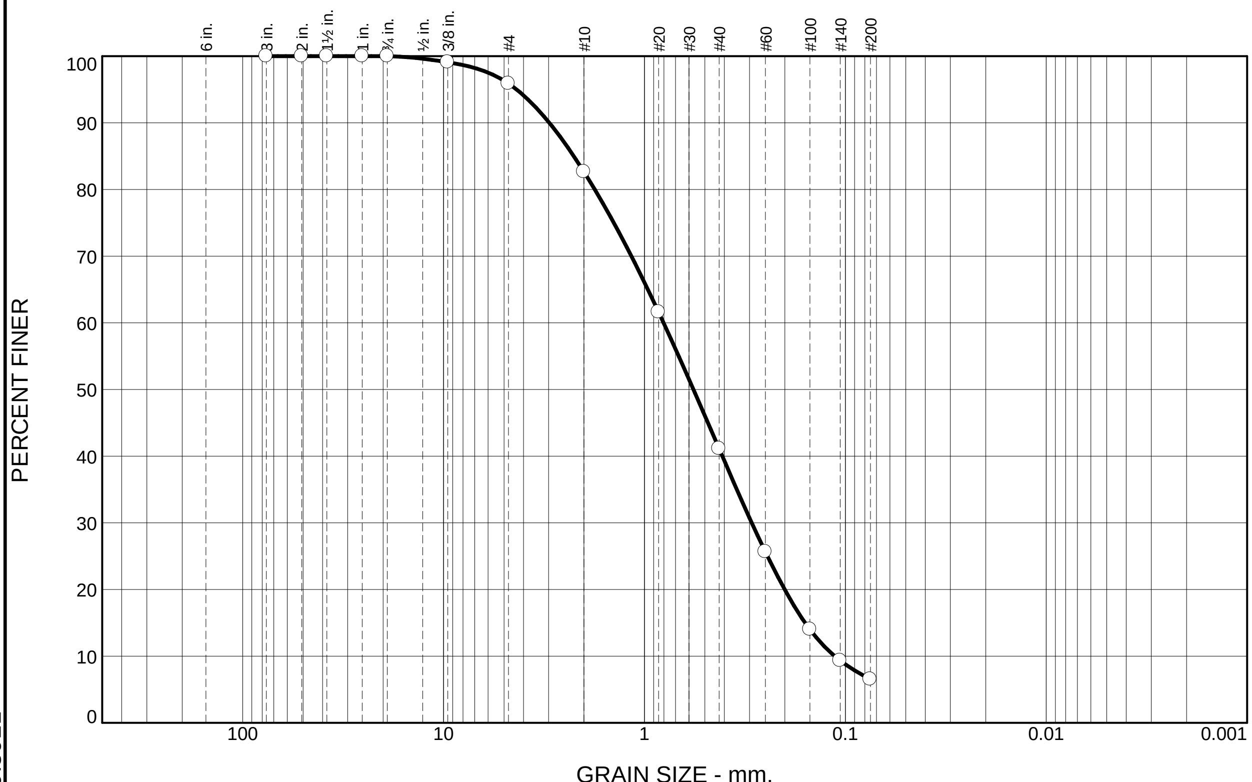
PETRA GEOSCIENCES INC.

Client: Caroline Legrand
Project: The Ridge Wellness Center
Project No: 20-227 **Figure** B-8

Laboratory: 1251 West Pomona Road, Unit #103, Corona, Ca 92882 Phone #. 714.549.8921

Tested By: SB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	13.8	43.3	36.1	6.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
.75	100.0		
.375	99.1		
#4	95.9		
#10	82.6		
#20	61.6		
#40	41.1		
#60	25.6		
#100	14.0		
#140	9.3		
#200	6.5		

* (no specification provided)

Material Description

Brown fine to coarse Sand with trace Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 2.3850 D_{85}= 1.8980 D_{60}= 0.7361
D_{50}= 0.5323 D_{30}= 0.2800 D_{15}= 0.1534
D_{10}= 0.1087 C_u= 6.77 C_c= 0.98

Classification

USCS= AASHTO=

Remarks

Source of Sample: L-21-306 (100) **Depth:** 20
Sample Number: MW-1

Date: 09/20/2021

PETRA GEOSCIENCES INC.

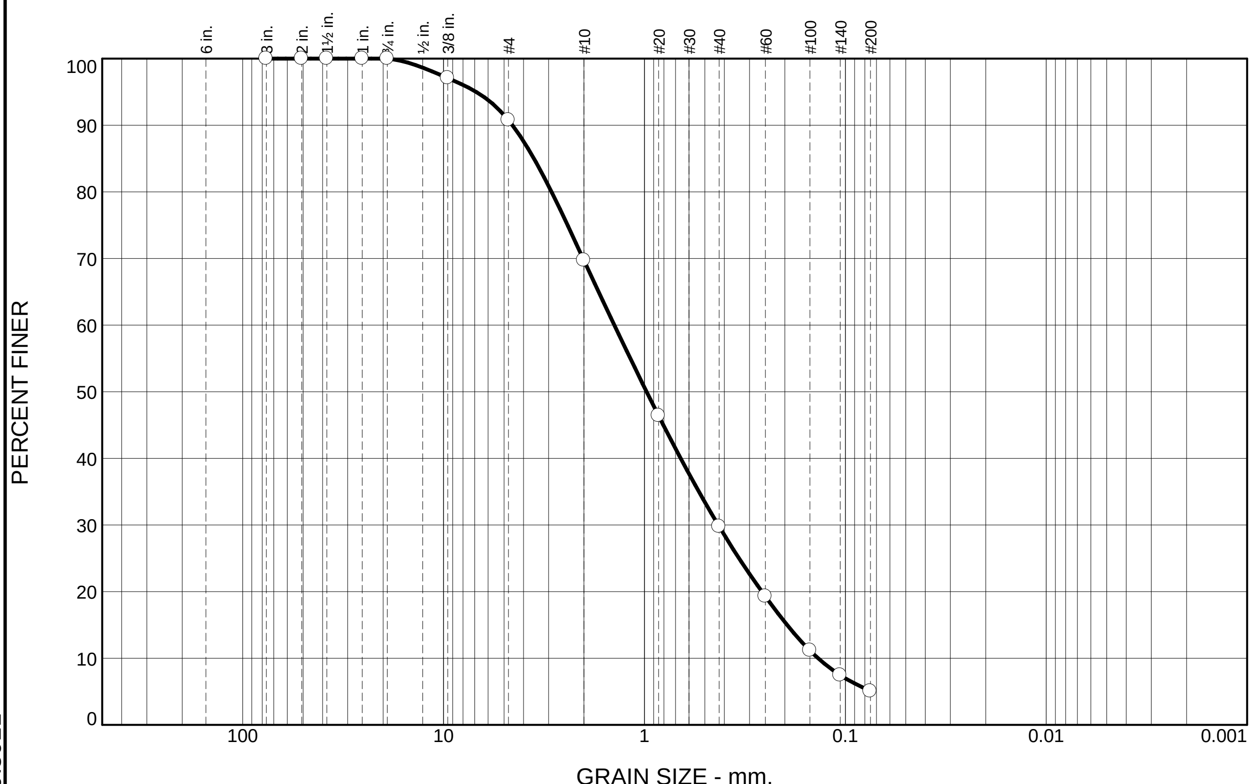
Client: Caroline Legrand
Project: The Ridge Wellness Center

Project No: 20-227 **Figure** B-9

Laboratory:
1251 West Pomona Road, Unit #103, Corona, Ca 92882 Phone #. 714.549.8921

Tested By: SB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	9.2	21.1	39.9	24.7	5.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
.75	100.0		
.375	97.1		
#4	90.8		
#10	69.7		
#20	46.4		
#40	29.8		
#60	19.3		
#100	11.1		
#140	7.5		
#200	5.1		

* (no specification provided)

Material Description

Yellowish brown fine to coarse Sand with Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 4.5362 D_{85}= 3.5493 D_{60}= 1.4125
D_{50}= 0.9753 D_{30}= 0.4295 D_{15}= 0.1950
D_{10}= 0.1367 C_u= 10.33 C_c= 0.96

Classification

USCS= AASHTO=

Remarks

Source of Sample: L-21-306 (100) **Depth:** 25
Sample Number: MW-1

Date: 09/20/2021

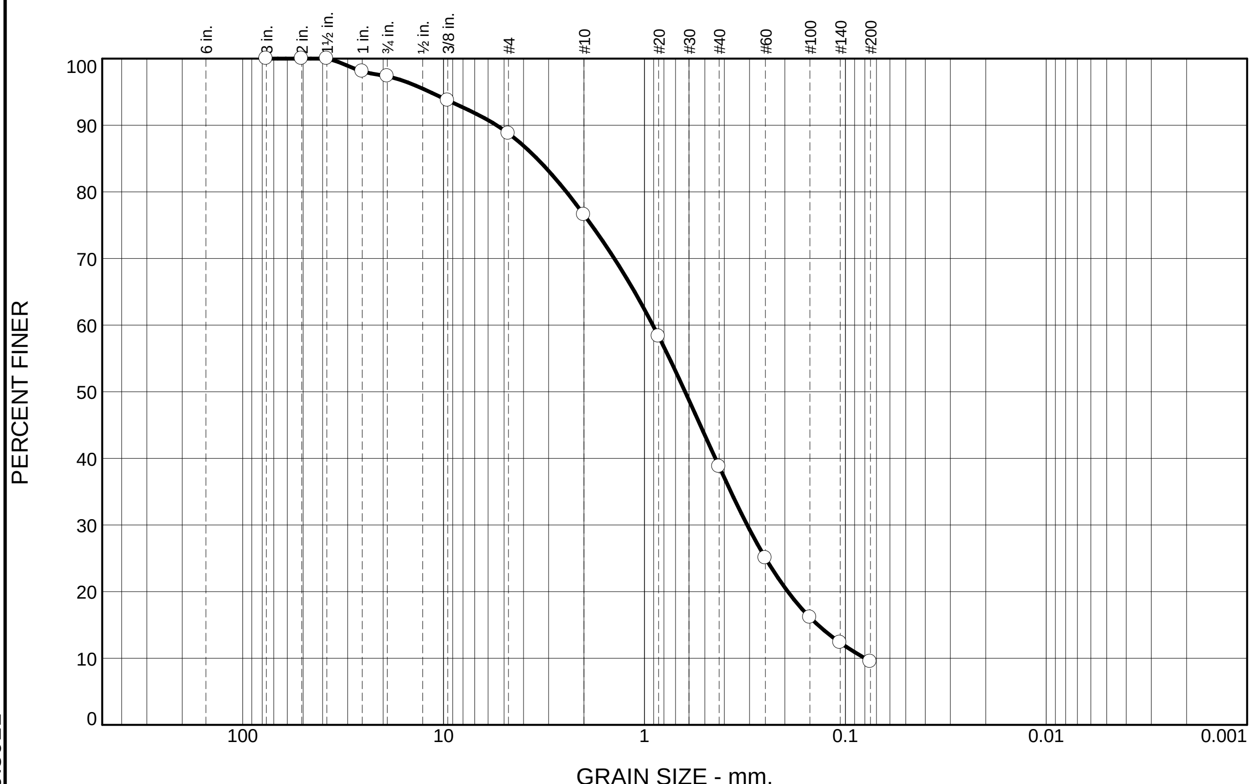
PETRA GEOSCIENCES INC.

Client: Caroline Legrand
Project: The Ridge Wellness Center
Project No: 20-227 **Figure** B-10

Laboratory: 1251 West Pomona Road, Unit #103, Corona, Ca 92882 Phone #. 714.549.8921

Tested By: SB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.7	8.5	12.2	37.8	29.3	9.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	100.0		
1.5	100.0		
1	98.1		
.75	97.3		
.375	93.7		
#4	88.8		
#10	76.6		
#20	58.3		
#40	38.8		
#60	25.0		
#100	16.1		
#140	12.3		
#200	9.5		

* (no specification provided)

Material Description

brown Silty fine to coarse Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 5.4473 D_{85}= 3.4278 D_{60}= 0.9076
D_{50}= 0.6272 D_{30}= 0.3078 D_{15}= 0.1370
D_{10}= 0.0800 C_u= 11.34 C_c= 1.30

Classification

USCS= AASHTO=

Remarks

Source of Sample: L-21-306 (100) **Depth:** 30
Sample Number: MW-1 **Date:** 09/20/2021

PETRA GEOSCIENCES INC.

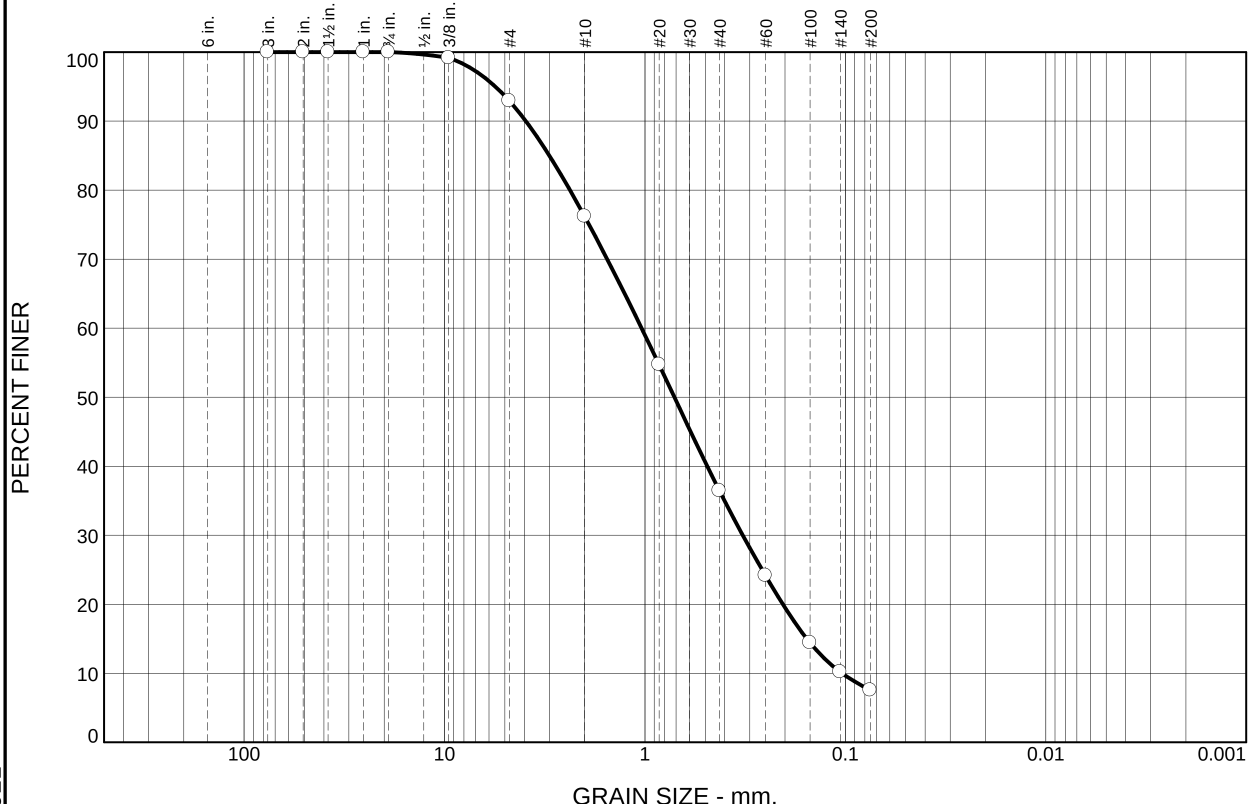
Client: Caroline Legrand
Project: The Ridge Wellness Center

Project No: 20-227 **Figure** B-11

Laboratory: 1251 West Pomona Road, Unit #103, Corona, Ca 92882 Phone #. 714.549.8921

Tested By: SB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	7.1	16.7	39.8	28.9	7.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
.75	100.0		
.375	99.2		
#4	92.9		
#10	76.2		
#20	54.7		
#40	36.4		
#60	24.1		
#100	14.4		
#140	10.2		
#200	7.5		

* (no specification provided)

Material Description

Brown, fine to coarse Sand with Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 3.9299 D_{85}= 2.9986 D_{60}= 1.0393
D_{50}= 0.7130 D_{30}= 0.3250 D_{15}= 0.1558
D_{10}= 0.1038 C_u= 10.01 C_c= 0.98

Classification

USCS= AASHTO=

Remarks

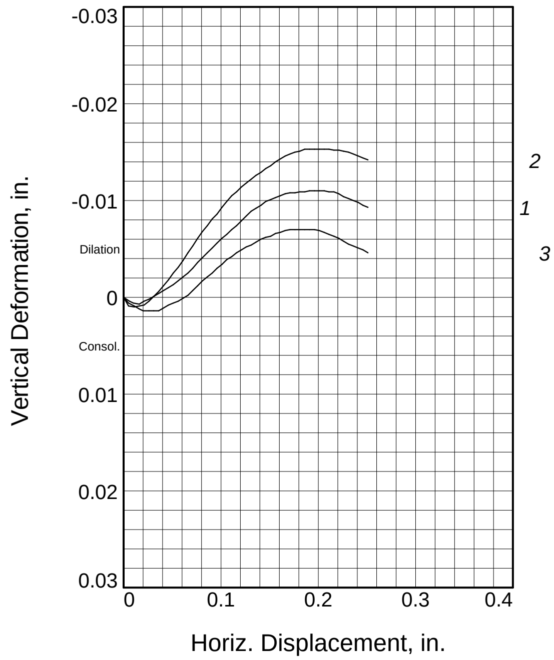
Source of Sample: L-21-306 (100) **Depth:** 35
Sample Number: MW-1

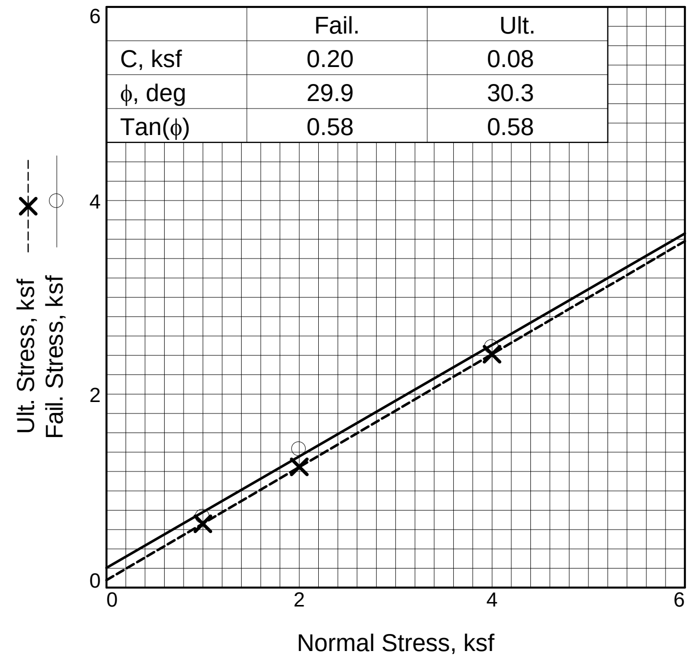
Date: 9/22/2021

PETRA GEOSCIENCES INC.

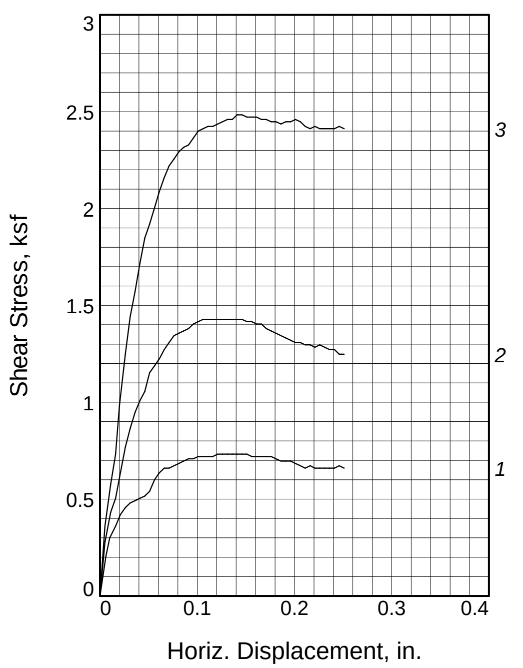
Client: Caroline Legrand
Project: The Ridge Wellness Center
Project No: 20-227 **Figure** B-12

Laboratory:
1251 West Pomona Road, Unit #103, Corona, Ca 92882 Phone #. 714.549.8921





	Fail.	Ult.
C, ksf	0.20	0.08
ϕ, deg	29.9	30.3
Tan(ϕ)	0.58	0.58



	Sample No.	1	2	3
Initial	Water Content, %	4.7	4.7	4.7
	Dry Density, pcf	110.3	123.1	113.7
	Saturation, %	25.2	36.6	27.7
	Void Ratio	0.4998	0.3439	0.4545
	Diameter, in.	2.42	2.42	2.42
	Height, in.	0.98	0.97	0.99
At Test	Water Content, %	18.8	13.0	17.1
	Dry Density, pcf	110.3	123.1	113.7
	Saturation, %	99.7	99.8	99.5
	Void Ratio	0.4998	0.3439	0.4545
	Diameter, in.	2.42	2.42	2.42
	Height, in.	0.98	0.97	0.99
Normal Stress, ksf		1.00	2.00	4.00
Fail. Stress, ksf		0.73	1.43	2.48
Displacement, in.		0.15	0.15	0.14
Ult. Stress, ksf		0.66	1.25	2.41
Displacement, in.		0.25	0.25	0.25
Strain rate, in./min.		0.040	0.040	0.040

Sample Type:

Description: Brown Silty fine to coarse Sand

Assumed Specific Gravity= 2.65

Remarks:

PLATE B-13

Client: Caroline Legrand

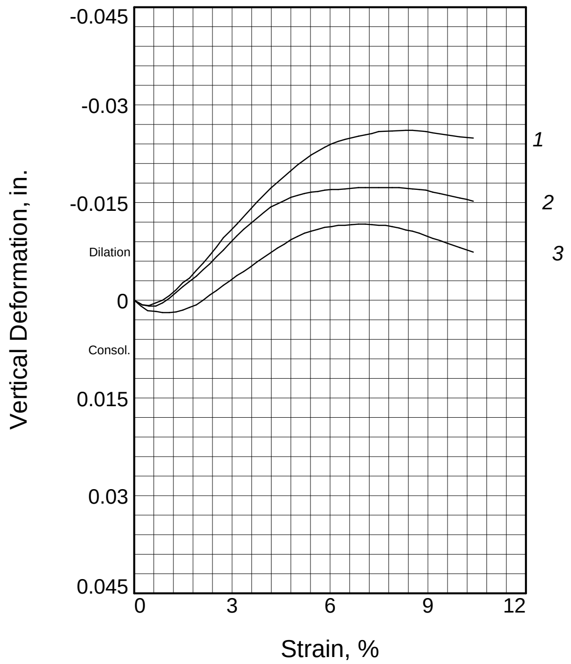
Project: The Ridge Wellness Center

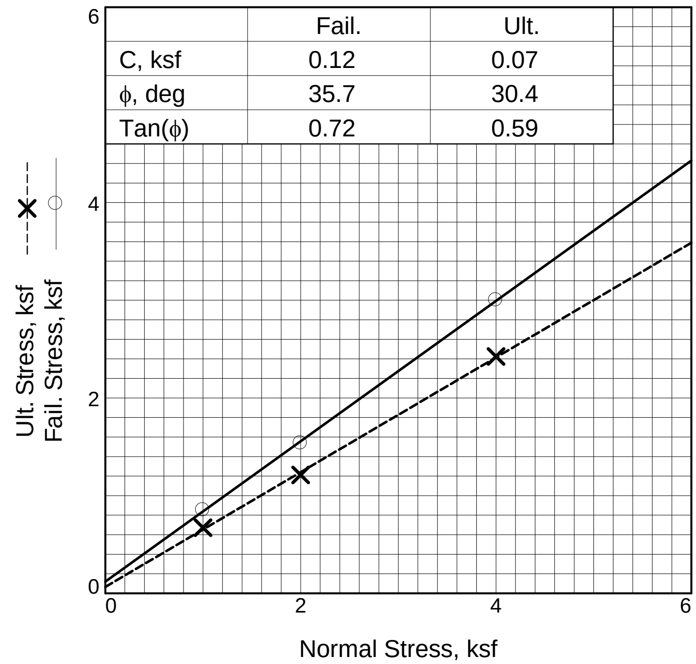
Source of Sample: Phase 110 **Depth:** 5

Sample Number: B-2

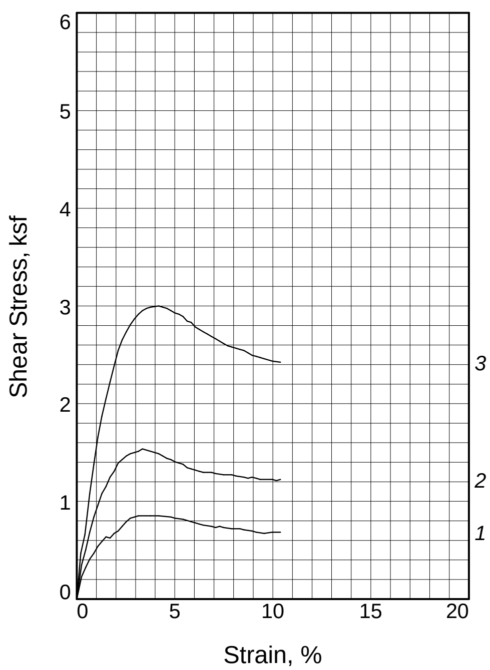
Proj. No.: 20-227 **Date Sampled:** 06/22/2021

PETRA GEOSCIENCES INC.





	Fail.	Ult.
C, ksf	0.12	0.07
ϕ, deg	35.7	30.4
Tan(ϕ)	0.72	0.59



	Sample No.	1	2	3
Initial	Water Content, %	3.4	3.4	3.4
	Dry Density, pcf	110.0	105.1	99.6
	Saturation, %	17.8	15.6	13.5
	Void Ratio	0.5033	0.5738	0.6618
	Diameter, in.	2.42	2.42	2.42
	Height, in.	0.97	0.97	0.97
At Test	Water Content, %	18.5	20.8	22.7
	Dry Density, pcf	110.9	106.7	103.2
	Saturation, %	99.6	99.9	99.7
	Void Ratio	0.4912	0.5512	0.6035
	Diameter, in.	2.42	2.42	2.42
	Height, in.	0.97	0.96	0.93
	Normal Stress, ksf	1.00	2.00	4.00
	Fail. Stress, ksf	0.85	1.54	3.00
	Strain, %	3.8	3.4	4.2
	Ult. Stress, ksf	0.67	1.21	2.42
	Strain, %	9.6	10.2	10.4
	Strain rate, in./min.	0.040	0.040	0.040

Sample Type: Undisturbed

Description: Grayish Brown, fine to coarse Sand with Silt

Specific Gravity= 2.65

Remarks:

Figure B-14

Client: Caroline Legrand

Project: The Ridge Wellness Center

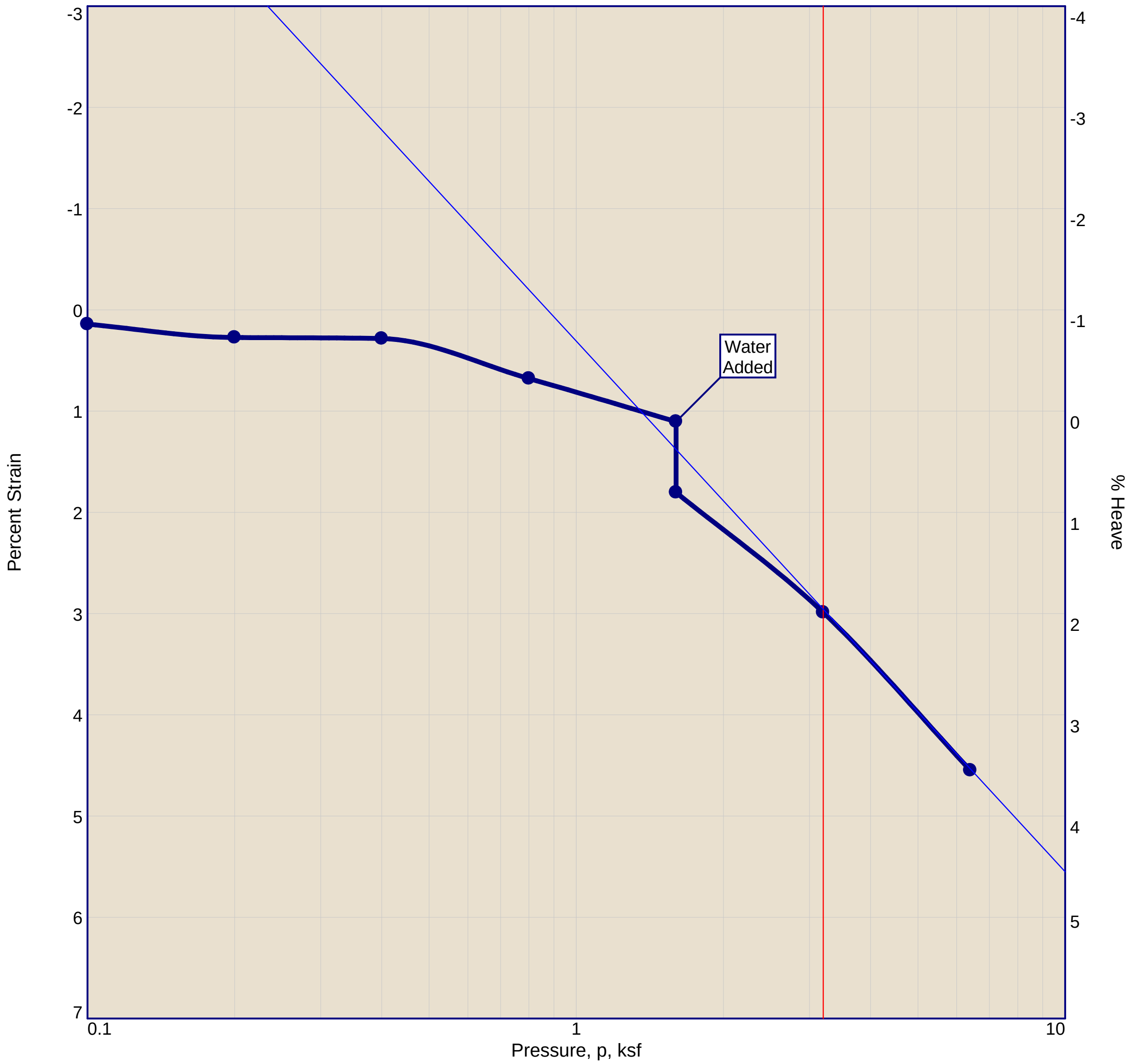
Source of Sample: L-21-306 (100) **Depth:** 5

Sample Number: B-7

Proj. No.: 20-227 **Date Sampled:** 9/22/2021

PETRA GEOSCIENCES INC.

COLLAPSE TEST REPORT



SUMMARY OF TEST RESULTS

	DRY DENSITY (pcf)	MOISTURE CONTENT, (%)	SATURATION (%)	VOID RATIO	SPECIFIC GRAVITY	OVERBURDEN (ksf)	P_C (ksf)	C_C	SWELL PRESS. (ksf)
INITIAL	118.9	7.1	45.4	0.412	2.65	0.31	3.3	0.07	
FINAL		15.3	100.0	0.348					

Source of Sample: Phase 110 **Depth:** 2.5 **Sample Number:** B-2
Material Description: Brown Silty fine to coarse Sand **USCS:** SM **AASHTO:**
Remarks:

Laboratory:
1251 West Pomona Road, Unit #103, Corona, Ca 92882 Phone #. 714.549.8921

PETRA GEOSCIENCES INC.

Client: Caroline Legrand
Project: The Ridge Wellness Center
Project No.: 20-227 **PLATE** B-15

APPENDIX B-2

LABORATORY TEST RESULTS – WATER SAMPLES FROM MW-1

Orange Coast Analytical, Inc.
3002 Dow, Suite 532, Tustin, CA 92780 (714) 832-0064 Fax (714) 832-0067
4620 E. Elwood, Suite 4, Phoenix, AZ 85040 (480) 736-0960 Fax (480) 736-0970

LABORATORY REPORT FORM

ORANGE COAST ANALYTICAL, INC.

3002 Dow Suite 532 Tustin, CA 92780

(714) 832-0064

Laboratory Certification (ELAP) No.:2576
Expiration Date: 2023
Los Angeles County Sanitation District Lab ID# 10206

Laboratory Director's Name:
Mark Noorani

Client:	Petra Geosciences, Inc.
Laboratory Reference:	PTE 26382
Project Name:	The Ridge Wellness Center
Project Number:	20-227
Date Received:	9/23/2021
Date Reported:	10/5/2021
Chain of Custody Received:	☑
Analytical Method:	300.0, 120.1, 353.2,

Mark Noorani, Laboratory Director

 Rev1.0

Mr. Kurtis Morenz
Petra Geosciences, Inc.
3786 Airway Ave Suite K
Costa Mesa, CA, 92626

Lab Reference #: PTE 26382
Project Name: The Ridge Wellness Center
Project #: 20-227

Case Narrative

Sample Receipt:

All samples on the Chain of Custody were received by OCA at 6ºC, on ice.

Holding Times:

All samples were analyzed within required holding times unless otherwise noted in the data qualifier section of the report.

Analytical Methods:

Sample analysis was performed following the analytical methods listed on the cover page.

Data Qualifiers:

Within this report, data qualifiers may have been assigned to clarify deviations in common laboratory procedures or any divergence from laboratory QA/QC criteria. If a data qualifier has been used, it will appear in the back of the report along with its description. All method QA/QC criteria have been met unless otherwise noted in the data qualifier section.

Definition of Terms:

The definitions of common terms and acronyms used in the report have been placed at the back of the report to assist data users.

Comments:

None

Mr. Kurtis Morenz
Petra Geosciences, Inc.
3786 Airway Ave Suite K
Costa Mesa, CA, 92626

Lab Reference #: PTE 26382
Project Name: The Ridge Wellness Center
Project #: 20-227

Client Sample Summary

Client Sample ID	Lab Sample Number	Date Received	Date Sampled	Matrix
1A	26382-001	9/23/2021	9/23/2021	Water
2A	26382-002	9/23/2021	9/23/2021	Water
3A	26382-003	9/23/2021	9/23/2021	Water

Mr. Kurtis Morenz
Petra Geosciences, Inc.
3786 Airway Ave Suite K
Costa Mesa, CA, 92626

Lab Reference #: PTE 26382
Project Name: The Ridge Wellness Center
Project #: 20-227

Inorganics

Client Sample ID	Lab Sample Number	Date Received		Date Sampled		Matrix
1A	26382-001	9/23/2021	11:31	9/23/2021	8:40	Water

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Nitrite as N	353.2	<0.10	mg/L	09/24/21 14:00	09/24/21 14:51	--	1

Client Sample ID	Lab Sample Number	Date Received		Date Sampled		Matrix
2A	26382-002	9/23/2021	11:31	9/23/2021	8:41	Water

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Nitrate as N	353.2	<0.10	mg/L	09/24/21 14:00	09/24/21 17:12	--	1

Client Sample ID	Lab Sample Number	Date Received		Date Sampled		Matrix
3A	26382-003	9/23/2021	11:31	9/23/2021	8:42	Water

ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
Chloride	300.0	10	mg/L	09/27/21 10:00	09/27/21 14:02	D1,	5
Conductivity	120.1	170	µmhos/cm	09/23/21 12:15	09/23/21 12:15	--	1
Sulfate	300.0	3.7	mg/L	10/01/21 10:00	10/01/21 15:36	--	1

Method Blank — Water

MB ID	ANALYTE	EPA Method	Result	Units	Date Extracted	Date Analyzed	Qual	DF
MBRL0927211	Chloride	300.0	<0.50	mg/L	09/27/21 10:00	09/27/21 12:53	--	1
MBHC0924211	Nitrate as N	353.2	<0.10	mg/L	09/24/21 14:00	09/24/21 14:33	--	1
MBHC0924211	Nitrite as N	353.2	<0.10	mg/L	09/24/21 14:00	09/24/21 14:33	--	1
MBRL1001212	Sulfate	300.0	<0.20	mg/L	10/01/21 10:00	10/01/21 13:57	--	1

QA/QC Report
for Inorganics

Reference #: PTE 26382 Reporting units: ppm

Matrix Spike (MS) / Matrix Spike Duplicate (MSD)

Analyte	Date of Extraction	MS Date of Analysis	MSD Date of Analysis	Laboratory Sample #	R1	SPC CONC	MS	MSD	%MS	%MSD	RPD	ACP %MS	ACP RPD	Qual
Chloride	9/27/2021 10:00	9/27/2021 14:15	9/27/2021 14:28	26382-003	10.0	12.5	22.7	22.8	102	102	0	90-110	20	--
Nitrate as N	9/24/2021 14:00	9/24/2021 17:12	9/24/2021 17:12	26382-001	0.0710	2.50	2.71	2.43	106	94	11	90-110	20	--
Nitrite as N	9/24/2021 14:00	9/24/2021 16:49	9/24/2021 16:50	26382-001	0.00	2.50	3.13	2.79	125	112	11	90-110	20	M1,
Sulfate	10/1/2021 10:00	10/1/2021 16:34	10/1/2021 16:47	26382-003	3.70	5.00	8.39	8.49	94	96	1	90-110	20	--

Laboratory Control Spike (LCS) / Laboratory Control Spike Duplicate (LCSD)

Analyte	Date of Extraction	LCS Date of Analysis	LCSD Date of Analysis	Laboratory Sample #	SPC CONC	LCS	LCSD	%LCS	% LCSD	RPD	ACP %LCS	ACP RPD	Qual
Chloride	9/27/2021 10:00	9/27/2021 13:06	9/27/2021 13:19	RL0927211	2.50	2.50	2.60	100	104	4	90-110	20	--
Nitrate as N	9/24/2021 14:00	9/24/2021 17:12	9/24/2021 17:12	HC0924211	2.50	2.21	2.33	88	93	5	90-110	20	L2,
Nitrite as N	9/24/2021 16:46	9/24/2021 16:46	9/24/2021 16:47	HC0924211	2.50	2.66	2.86	106	114	7	90-110	20	L1,
Sulfate	10/1/2021 10:00	10/1/2021 14:11	10/1/2021 14:24	RL1001212	2.50	2.39	2.42	96	97	1	90-110	20	--

Data Qualifier Definitions

Qualifier

D1 = Sample required dilution due to matrix.

L1 = The associated blank spike recovery was above laboratory acceptance limits.

HC0924211	353.2	Nitrite as N	LCSD

L2 = The associated blank spike recovery was below laboratory acceptance limits.

HC0924211	353.2	Nitrate as N	LCS

M1 = Matrix spike recovery was high, the associated blank spike recovery was acceptable.

26382-001	353.2	Nitrite as N	MS/MSD

Definition of terms:

R1	Result of unspiked laboratory sample used for matrix spike determination.
SP CONC (or Spike Conc.)	Spike concentration added to sample or blank
MS	Matrix Spike sample result
MSD	Matrix Spike Duplicate sample result
%MS	Percent recovery of MS: {(MS-R1) / SP CONC} x100
%MSD	Percent recovery of MSD: {(MSD-R1) / SP CONC} x 100
RPD (for MS/MSD)	Relative Percent Difference: {(MS-MSD) / (MS+MSD)} x 100 x 2
LCS	Laboratory Control Sample result
LCSD	Laboratory Control Sample Duplicate result
%LCS	Percent recovery of LCS: {(LCS) / SP CONC} x100
%LCSD	Percent recovery of LCSD: {(LCSD) / SP CONC} x 100
RPD (for LCS/LCSD)	Relative Percent Difference: {(LCS-LCSD) / (LCS+LCSD)} x 100 x 2
ACP %LCS	Acceptable percent recovery range for Laboratory Control Samples.
ACP %MS	Acceptable percent recovery range for Matrix Spike samples
ACP RPD	Acceptable Relative Percent Difference
D	Detectable, result must be greater than zero
Qual	A checked box indicates a data qualifier was utilized and/or required for this analyte see attached explanation.
ND	Analyte Not Detected

Analysis Request and Chain of Custody Record

ORANGE COAST ANALYTICAL, INC. www.ocalab.com

3002 Dow, Suite 532
Tustin, CA 92780
(714) 832-0064 Fax (714) 832-0067

4620 E. Elwood, Suite 4
Phoenix, AZ 85040
(480) 736-0960 Fax (480) 736-0970

Lab Job No: 26382
Page ______ of ______

REQUIRED TURN AROUND TIME: Standard: ______
72 Hours: ______ 48 Hours: ______ 24 Hours: ______

CUSTOMER INFORMATION		PROJECT INFORMATION	
COMPANY:	Petra Geosciences, Inc.	PROJECT NAME:	The Ridge Wellnes Center
SEND REPORT TO:	~~kmorenz@p~~ Kurtis Morenz	NUMBER:	20-227
EMAIL:	kmorenz@petra-inc.com	ADDRESS:	Lake Hemet
ADDRESS:	386 Airway Ave., suite K		
	Costa Mesa, CA 92626	P.O. #:	21-1136
PHONE:	714-951-6194 FAX:	SAMPLED BY:	Kurtis Morenz

ANALYSIS REQUEST / PRESERVATIVE

SAMPLE ID	NO. OF CONTAINERS	SAMPLE DATE	SAMPLE TIME	SAMPLE MATRIX	CONTAINER TYPE	Nitrate	Nitrite	Cl	SO4	Conductivity						REMARKS/PRECAUTIONS
1A	1	9/23/21	8:40	H_2O	HDPE		/									
2A	1	9/23/21	8:41	H_2O	HDPE	/										
3A	1	9/23/21	8:42	H_2O	HDPE			/	/	/						

Total No. of Samples: 3 Method of Shipment:

Preservative: 1 = Ice 2 = HCl 3 = HNO_3 4 = H_2SO_4 5 = NaOH 6 = Other

Relinquished By:	Date/Time:	Received By:	Date/Time:
[signature]	9/23/21 11:31 AM		
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received For Lab By:	Date/Time:
		[signature] OCA, CA	9-23-21 1131

Sample Matrix:
GW - Groundwater
WW - Wastewater
SW - Stormwater
DW - Drinking Water
W - Water
SS - Soil/Solid
OT - Other

Sample Integrity: 6+0=6.0 °C IR#3
Intact: ______ On Ice (Yes) No @ ______ °C

Sample Receipt Report

Laboratory Reference: **PTE 26382**

Logged in by: HC

Received:	09/23/21 11:31	Company Name:	Petra Geosciences, Inc.
Method of Shipment:	Hand Delivered	Project Manager:	Mr. Kurtis Morenz
Shipping Container:	Cooler	Project Name:	The Ridge Wellness Center
# Shipping Containers:	1	Project #:	20-227

Sample Quantity

3 Water

Chain of Custody	Complete ☑	Incomplete ☐	None ☐
Samples On Ice	Yes, Wet ☑	Yes, Blue ☐	No ☐
Observed Temp. (ºC): 6	Thermometer ID: IR#3	Adjusted Temp.: 6+0=6	
Shipping Intact	Yes ☑	N/A ☐	No ☐
Shipping Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Samples Intact	Yes ☑		No ☐
Sample Custody Seals Intact	Yes ☐	N/A ☑	No ☐
Custody Seals Signed & Dated	Yes ☐	N/A ☑	No ☐
Proper Test Containers	Yes ☑		No ☐
Proper Test Preservations	Yes ☑		No ☐
Samples Within Hold Times	Yes ☑		No ☐
VOAs Have Zero Headspace	Yes ☐	N/A ☑	No ☐
Sample Labels	Complete ☑	Incomplete ☐	None ☐
Sample Information Matches COC	Yes ☑	N/A ☐	No ☐

Notes

Client Notified ______ By ______ On ______

APPENDIX C

PUMP TEST RESULTS MW-1

APPENDIX C

Monitoring Well MW-1 Installation Data and Pump Test

Pump Specifications

Proactive Super Twister 12v Groundwater Pump (up to 85 feet) using 100 feet of ½" clear vinyl tubing.

Table C-1

Pumping Depth in Feet DTW (Depth to Water)	Gallons per Minute At 12.5 Volts at the Source
3	4.0
10	3.50
20	3.00
30	2.90
40	2.75
50	2.40
60	2.00
70	1.50
80	1.00
85	0.60

Well Specifications

TD = 40.5 feet

Groundwater= 11 feet

Installation Notes

An 8-inch diameter hollow stem auger was used to install 30 feet of solid 2-inch PVC pipe, and 10 feet of 2-inch screened PVC pipe.

During removal of hollow-stem augers, the well pipe pulled up approximately 1.5 feet. As well, the surrounding sand caved to a depth of 20 feet. Total depth of the pipe came to 38.5 feet.

From there, sand (#50) was added to a depth of 8 feet.

6.5 feet of bentonite was brought to within 1.5 feet of the surface.

The upper 1.5 feet was capped with concrete.

Pipe was then capped.

Pump Test Notes

Pumped on September 20, 2021.

Pump was placed 30 feet deep and ran for two and one-half hours.

Table C-2

Start Time	End Time	Time Interval (minutes)	Elapsed Time (minutes)	Depth to Water (ft) @ Start	Depth to Water (ft) @ End
8:05	8:35	30	30	11.1	15.5
8:35	9:05	30	60	15.5	17.2
9:05	9:35	30	90	17.2	17.2
9:35	10:05	30	120	17.2	17.2
10:05	10:35	30	150	17.2	17.2
10:35	11:05	30	180	17.2	17.2
11:05	11:35	30	210	17.2	17.2
11:35	11:50	15	225	17.2	11.1

After 1 hour, the depth stabilized at 17.2 feet and would not progress.

On September 23, 2021, the geologist returned to collect the water samples from the well.

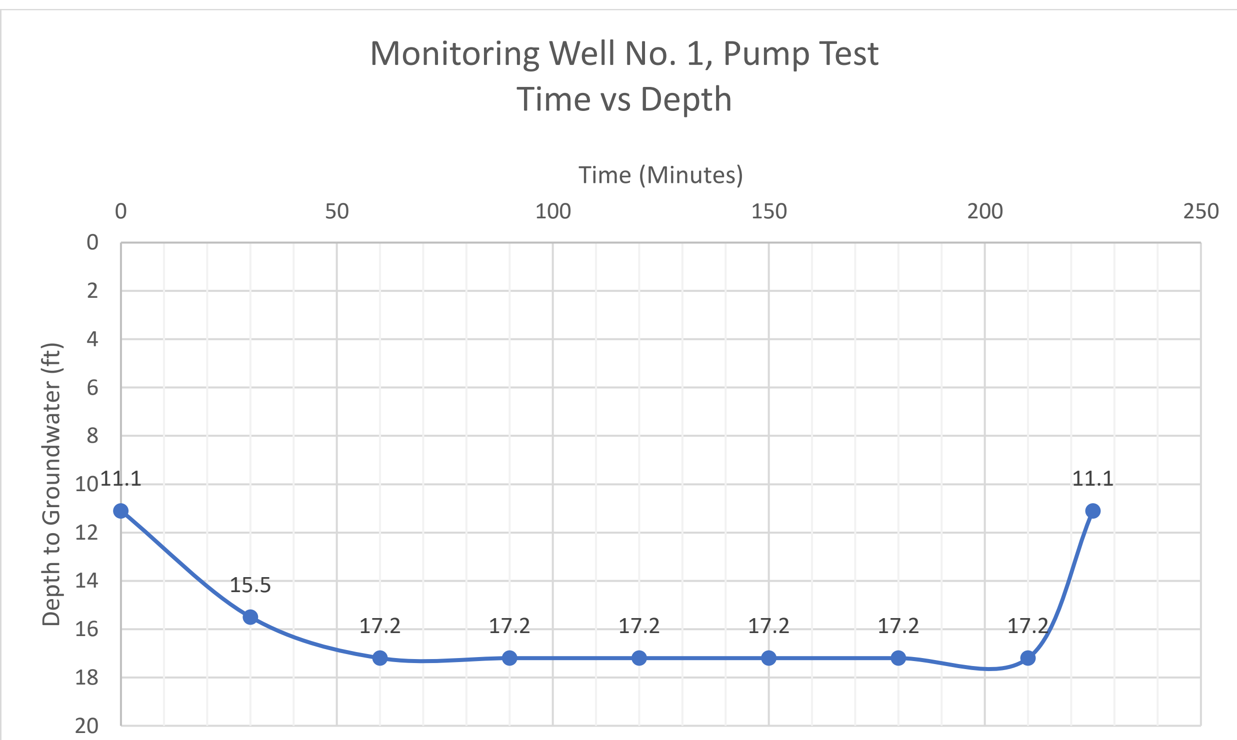
Samples were immediately taken to Orange Coast Analytical, Inc.

Rebound Tested

Start Time	End Time	Time Interval (minutes)	Elapsed Time (minutes)	Depth to Water (ft) @ Start	Depth to Water (ft) @ End
11:35	11:50	15	225	17.2	11.1

Speed Test

Filling a 5-gallon bucket took 1 minute, 46 seconds (2.8 gal./minute)



APPENDIX D

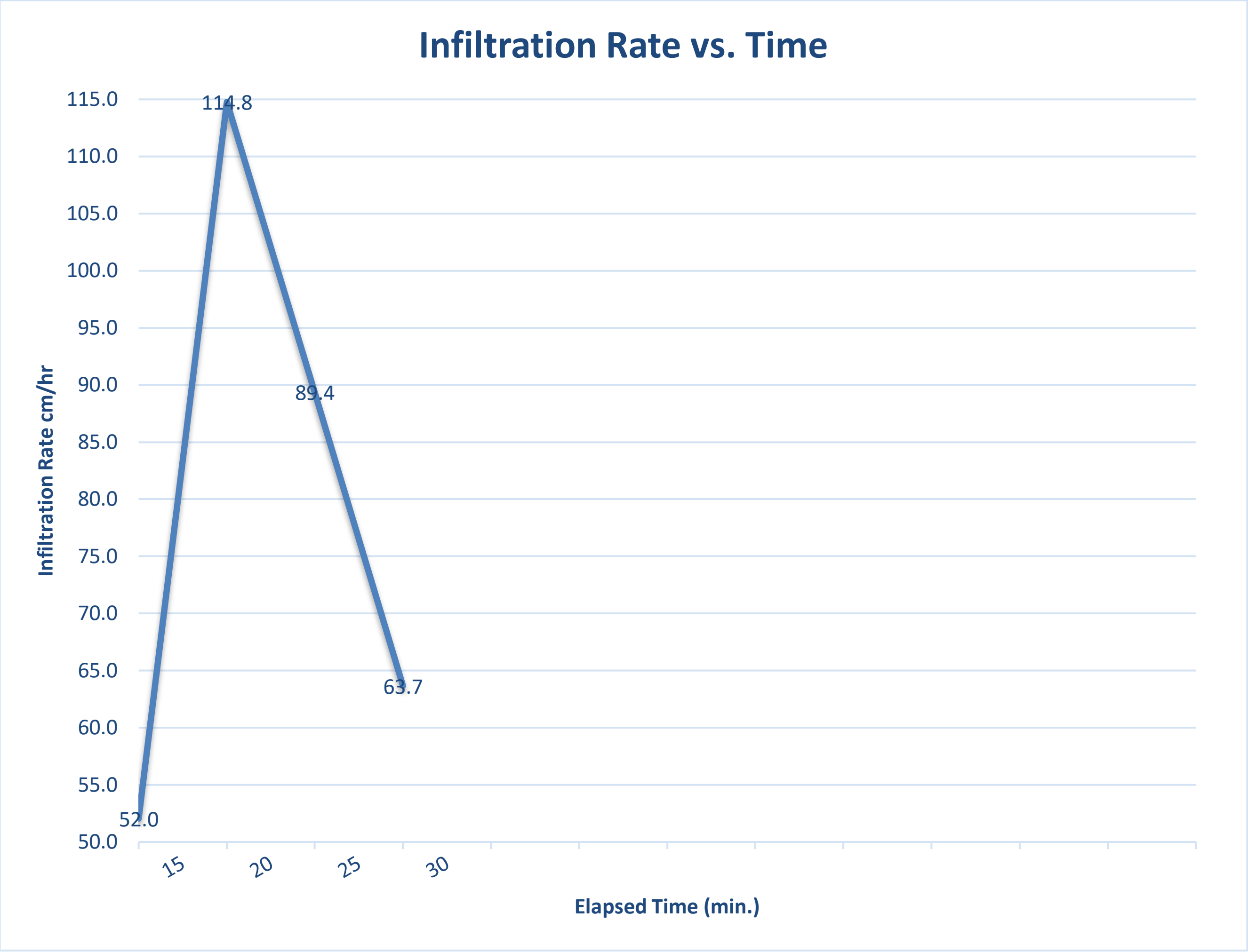
PERCOLATION TEST SUMMARY

Lake Hemet Wellness Center
JN 20-227
Tested by L. Holmes, August 17, 2020

Infiltration Test DRI-1

Double-Ring Infiltrometer Test, ASTM D3385-09

Time (m)	Δ Time (m)	Elapsed Time (m)	Inner Ring (cm)	Volume Inner (cm^3)	Rate Inner (cm/h)
11:16	15		58.0	9012.4	52.0
11:31		15	7.0		
11:48	5		59.4	6626.8	114.8
11:53		20	21.9		
12:01	5		59.0	5160.1	89.4
12:06		25	29.8		
12:06	5		29.8	3675.7	63.7
12:11		30	9.0		



Area of Inner Ring (cm^2)
692.8

Area of Annular Space (cm^2)
2120.5

Infiltration Rate	**64**	**cm/hr**
	2E-02	**cm/sec**
	25	**in/hr**
	375	**gal/day/ft²**

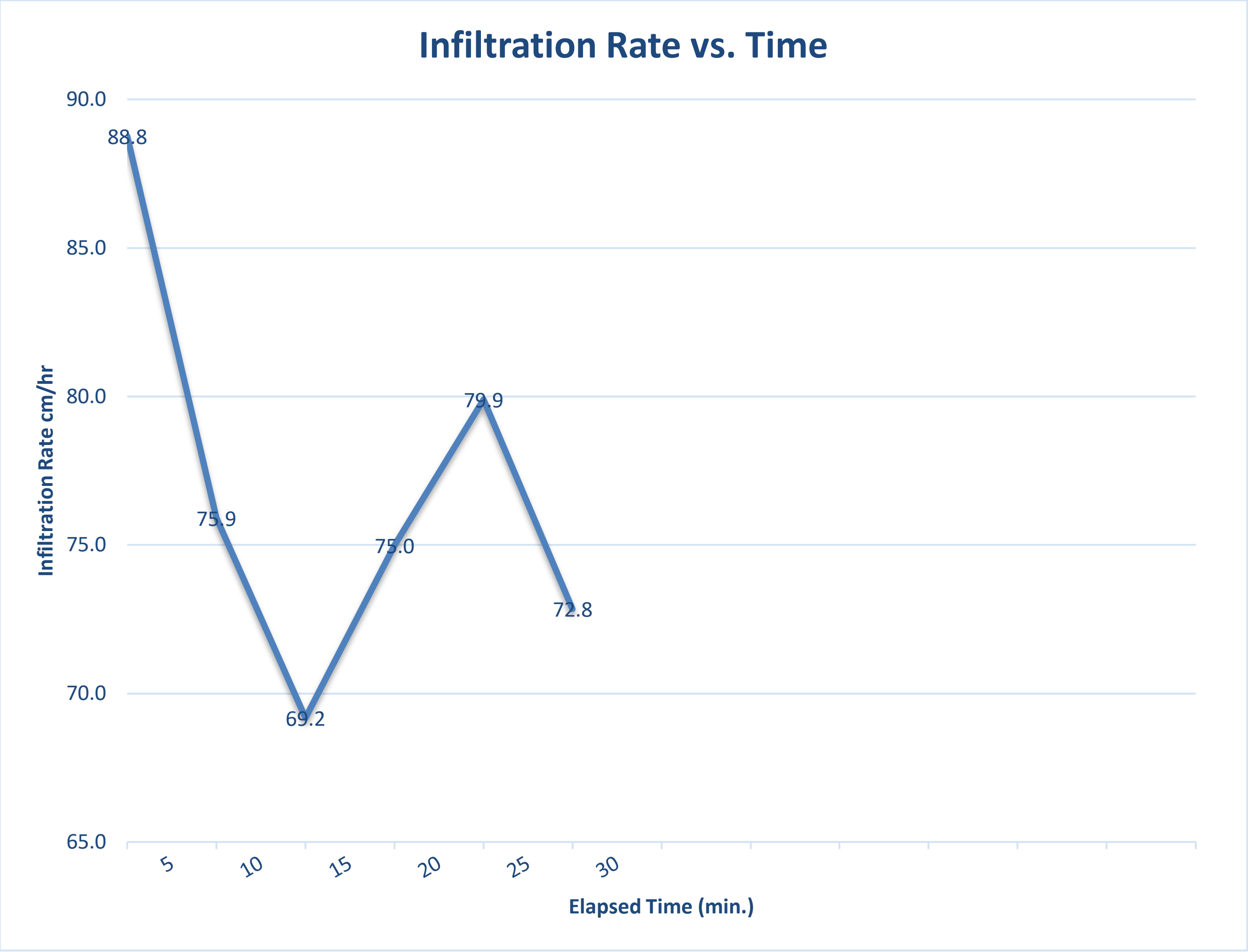
PETRA GEOSCIENCES INC.

Lake Hemet Wellness Center
JN 20-227
Tested by L. Holmes, August 18, 2020

Infiltration Test DRI-2

Double-Ring Infiltrometer Test, ASTM D3385-09

Time (m)	Δ Time (m)	Elapsed Time (m)	Inner Ring (cm)	Volume Inner (cm^3)	Rate Inner (cm/h)
9:36	5		59.0	5124.7	88.8
9:41		5	30.0		
9:44	5		57.6	4382.5	75.9
9:49		10	32.8		
9:53	5		58.9	3993.7	69.2
9:58		15	36.3		
10:01	5		59.0	4329.5	75.0
10:06		20	34.5		
10:09	5		57.4	4612.3	79.9
10:14		25	31.3		
10:15	5		31.3	4205.8	72.8
10:20		30	7.5		



Area of Inner Ring (cm^2)
692.8

Area of Annular Space (cm^2)
2120.5

Infiltration Rate	**73**	**cm/hr**
	2.0E-02	**cm/sec**
	29	**in/hr**
	430	**gal/day/ft^2**

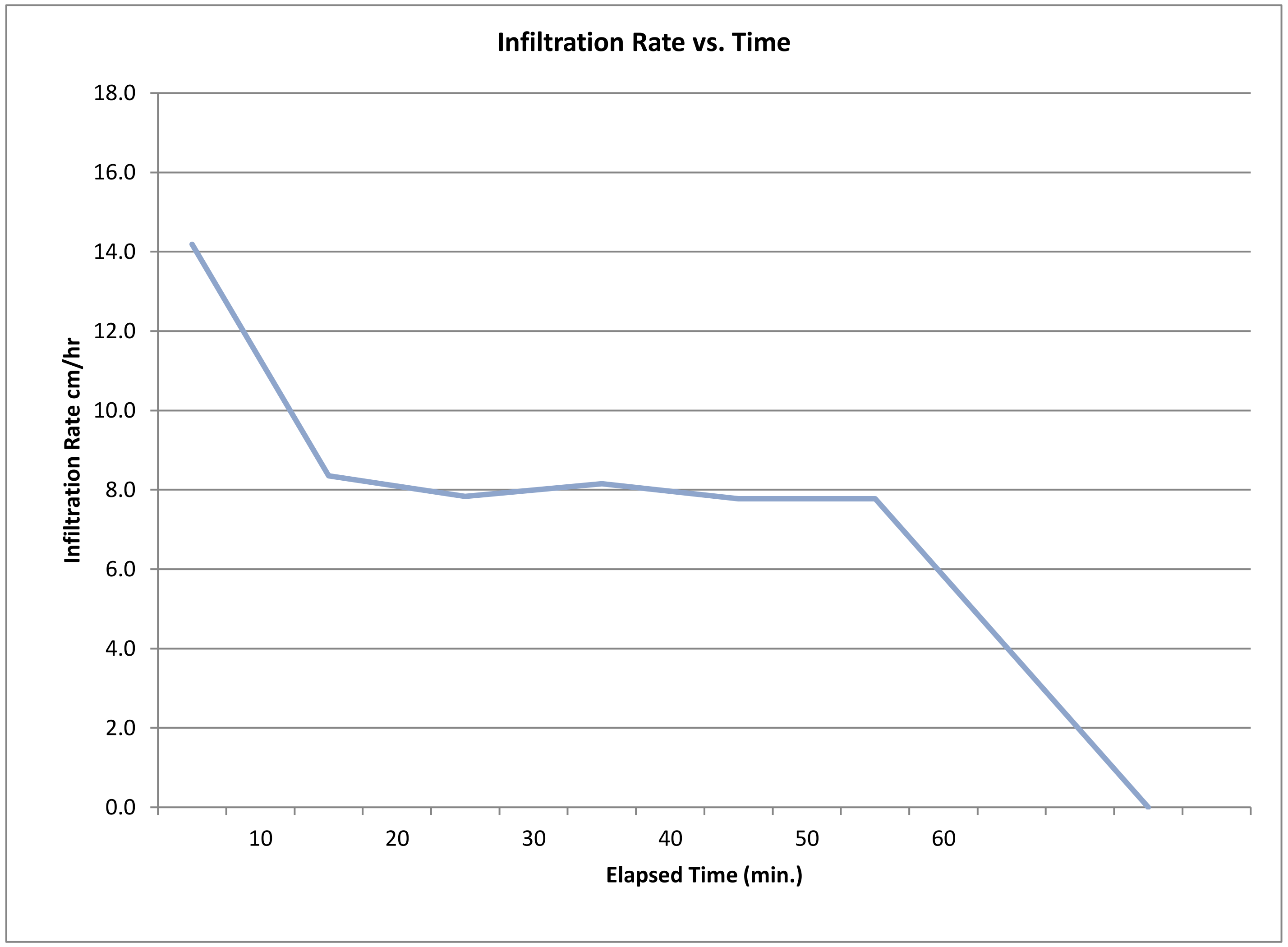
PETRA GEOSCIENCES INC.

Lake Hemet, CA 20-227
P-1

Infiltration Test P-1

Double-Ring Infiltrometer Test, ASTM D3385-09

Time (m)	Δ Time (m)	Elapsed Time (m)	Inner Ring (cm)	Volume Inner (cm^3)	Rate Inner (cm/h)
9:47 9:57	10	10	10.2 0.9	1638.3	14.2
10:00 10:10	10	20	6.7 1.3	964.9	8.4
10:13 10:23	10	30	10.2 5.08	904.8	7.8
10:27 10:37	10	40	12.7 7.37	941.9	8.2
10:42 10:52	10	50	11.43 6.4	897.7	7.8
10:56 11:06	10	60	12.7 7.6	897.7	7.8



Area of Inner Ring (cm^2)
692.8

Area of Annular Space (cm^2)
2120.5

Tested by KTM, 5-7-2021

Infiltration Rate

8	**cm/hr**
0.002	**cm/sec**
3	**in/hr**
46	**gal/day/ft^2**

PETRA GEOTECHNICAL, INC.

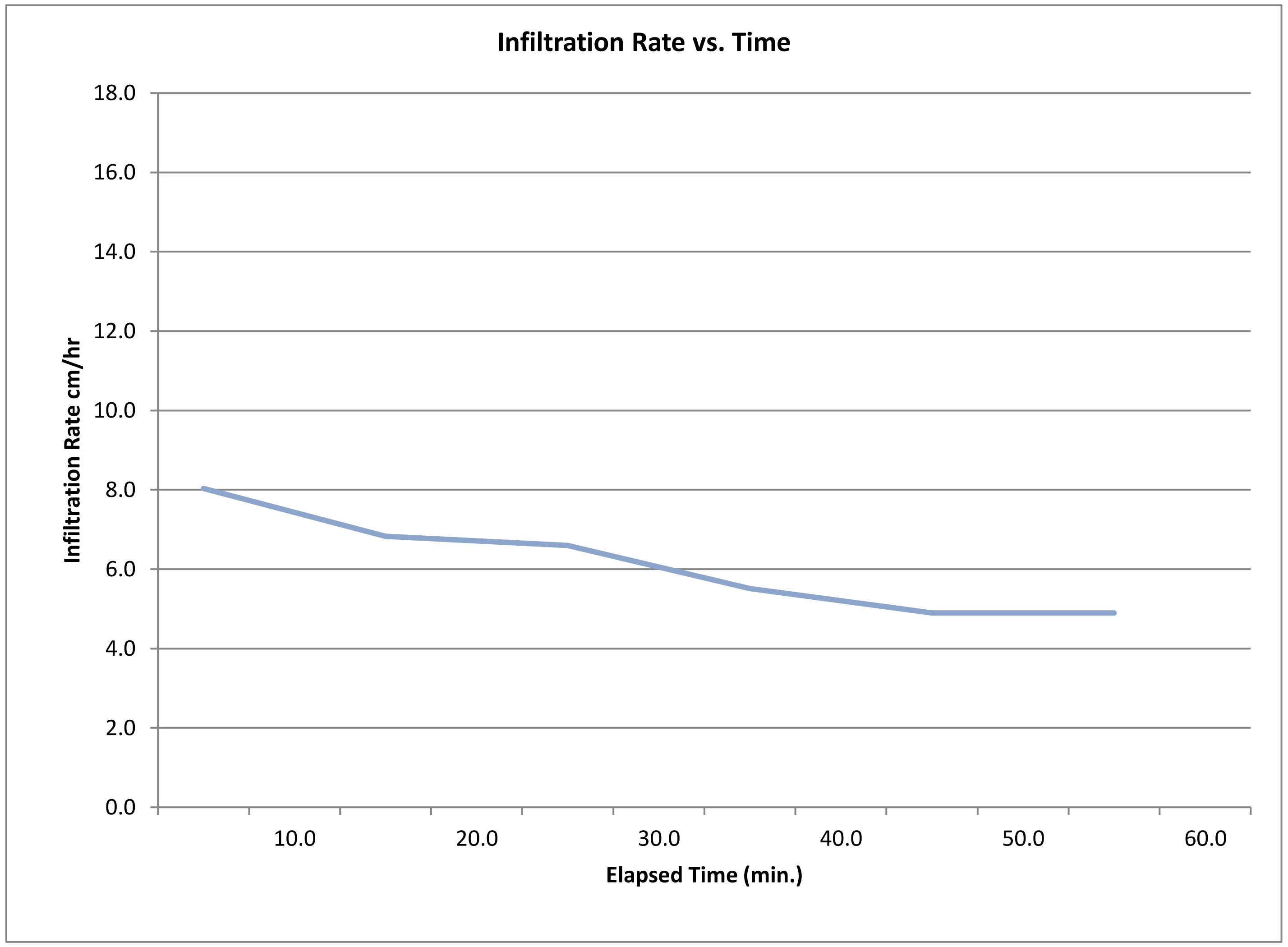
Lake Hemet, CA
DRI-2

20-227

Infiltration Test P-2

Double-Ring Infiltrometer Test, ASTM D3385-09

Time (m)	Δ Time (m)	Elapsed Time (m)	Inner Ring (cm)	Volume Inner (cm^3)	Rate Inner (cm/h)
11:13 11:23	10	10	13.0 7.8	927.8	8.0
11:26 11:36	10	20	15.0 10.5	788.1	6.8
11:40 11:50	10	30	14.6 10.29	761.6	6.6
11:55 12:05	10	40	13.3 9.7	636.2	5.5
12:08 12:18	10	50	14 10.8	565.5	4.9
12:22 12:16	10	60	14.2 11.0	565.5	4.9



Area of Inner Ring (cm^2)
692.8

Area of Annular Space (cm^2)
2120.5

Tested by KTM, 5-7-2021

Infiltration Rate

5	**cm/hr**
1E-03	**cm/sec**
2	**in/hr**
29	**gal/day/ft^2**

PETRA GEOTECHNICAL, INC.

Infiltration Test P-3

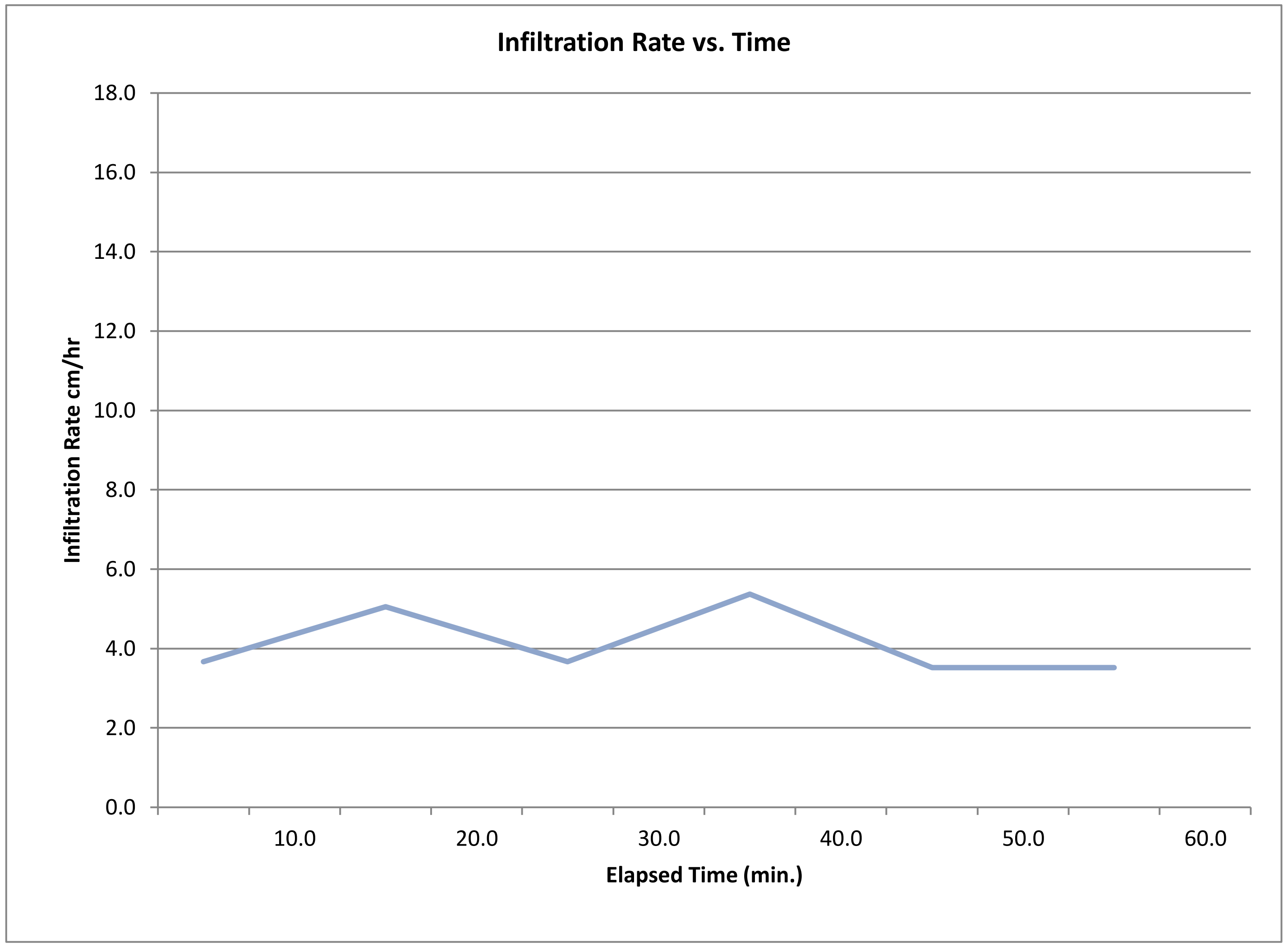
Double-Ring Infiltrometer Test, ASTM D3385-09

Time (m)	Δ Time (m)	Elapsed Time (m)	Inner Ring (cm)	Volume Inner (cm^3)	Rate Inner (cm/h)
12:44 12:54	10	10	14.7 12.3	424.1	3.7
13:11 13:21	10	20	20.3 17.0	583.2	5.1
13:24 13:34	10	30	15.1 12.7	424.1	3.7
13:37 13:47	10	40	16.5 13	620.3	5.4
13:52 14:02	10	50	14.7 12.4	406.4	3.5
14:05 14:15	10	60	15.0 12.7	406.4	3.5

Area of Inner Ring (cm^2)
692.8

Area of Annular Space (cm^2)
2120.5

Tested by KTM, 5-7-2021



Infiltration Rate

4	**cm/hr**
1E-03	**cm/sec**
1	**in/hr**
21	**gal/day/ft^2**

PETRA GEOTECHNICAL, INC.

APPENDIX E

SEISMIC DESIGN PARAMETERS

PETRA GEOSCIENCES INC

SITE CLASSIFICATION DETERMINATION BASED ON N-SPT FOR SEISMIC DESIGN

Per Table 20.3-1 and Section 20.4.2 of ASCE 7-16

J.N: 20-227 **Project: The Ridge** **Date: 7/2/2021**

Boring: B-3 Total Depth of Boring: 51 feet SPT Test Interval: every 5 feet

Layer No. (i)	Depth to Soil/Rock Layer		Layer Thickness (d_i)	$\sum_{i=1}^{n} d_i$	Mod. Cal. Sampler Blow Counts[1]	Equivalent N-SPT[2] (N_i)	N-SPT[3] (N_i)	$\sum_{i=1}^{n} \frac{d_i}{N_i}$
	Top	Bottom						
	ft	ft	ft	ft	blows/ft	blows/ft	blows/ft	
1	0	5	5	5.0	26	17		0.29
2	5	8	3	8.0	19	12		0.54
3	8	11	3	11.0	28	18		0.71
4	11	15	4	15.0	19	12		1.04
5	15	20	5	20.0	22	14		1.40
6	20	25	5	25.0	31	20		1.65
7	25	30	5	30.0	39	25		1.85
8	30	35	5	35.0	40	26		2.04
9	35	40	5	40.0	22	14		2.40
10	40	45	5	45.0	Refusal	100		2.45
11	45	50	5	50.0	Refusal	100		2.50
12	50	100	50	100.0	Refusal	100		3.00
13	0	0	0	0.0		0		0.00
14	0	0	0	0.0		0		0.00
15	0	0	0	0.0		0		0.00

Average Field Standard Penetration Resistance (blows/ft)		Site Classification Per Table 20.3-1
$\bar{N} = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{N_i}}$ =	33	D

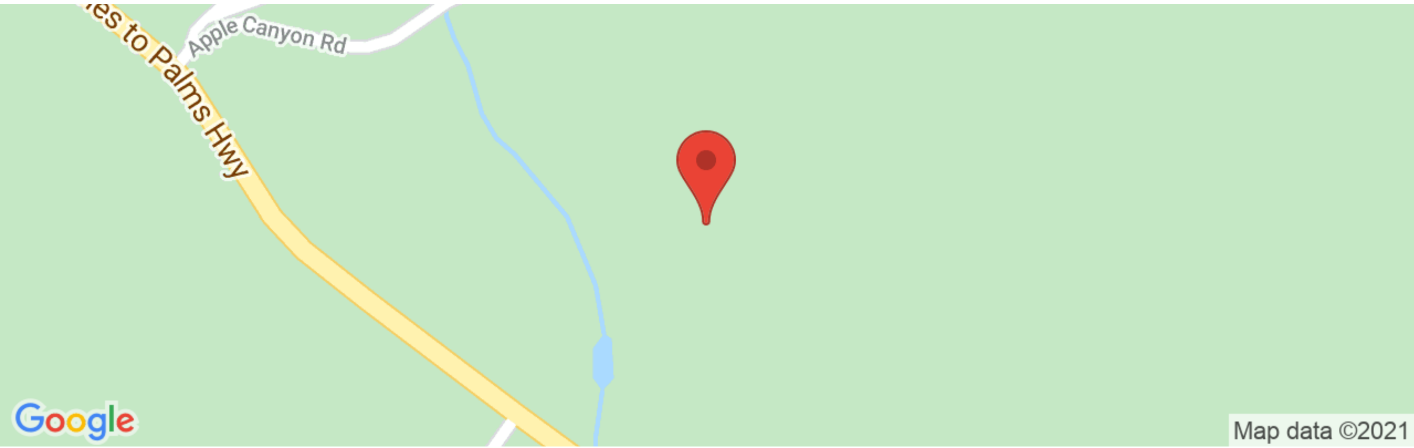
1 Modified California sampler blow counts as directly measured in the field without corrections.

2 Equivalent SPT blow counts are calculated from field measured Modified California sampler blow counts using the standard Burmister formula (Burmister, 1948).
Eq. N-SPT = 0.651 x (Mod. Cal. Sampler Blow Counts)

3 Standard penetration resistance (ASTM D1586) not to exceed 100 blows /ft (305 blows /m) as directly measured in the field without corrections. When Refusal is met for a rock layer, this value shall be taken as 100 blows /ft (305 blows /m).

The Ridge

Latitude, Longitude: 33.674, -116.677



Date	7/2/2021, 2:21:22 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S_S	1.641	MCE_R ground motion. (for 0.2 second period)
S_1	0.639	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.641	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	1.094	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.695	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.765	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.994	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	2.196	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.641	Factored deterministic acceleration value. (0.2 second)
S1RT	0.757	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.85	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.639	Factored deterministic acceleration value. (1.0 second)
PGAd	0.695	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.908	Mapped value of the risk coefficient at short periods
C_{R1}	0.89	Mapped value of the risk coefficient at a period of 1 s

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U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Dynamic: Conterminous U.S. 2014 (update) (v...

Spectral Period

Peak Ground Acceleration

Latitude

Decimal degrees

33.674

Time Horizon

Return period in years

2475

Longitude

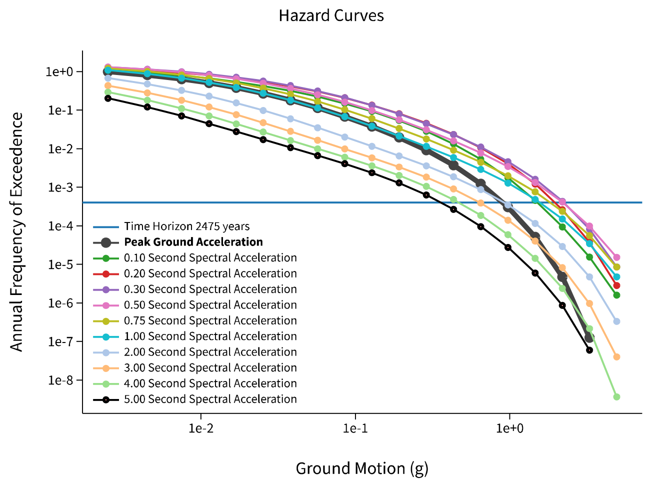
Decimal degrees, negative values for western longitudes

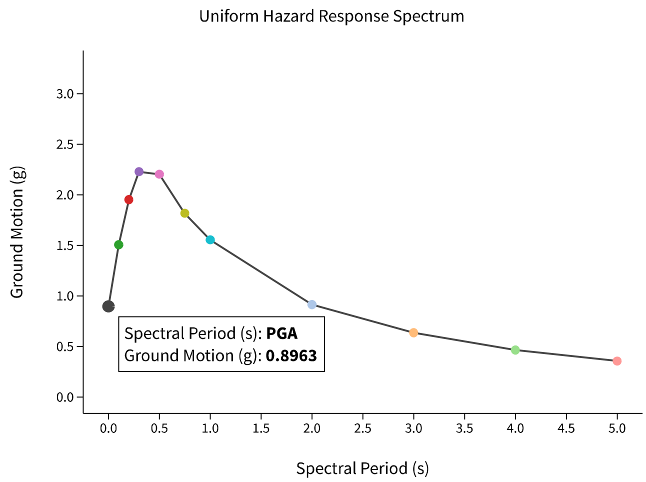
-116.677

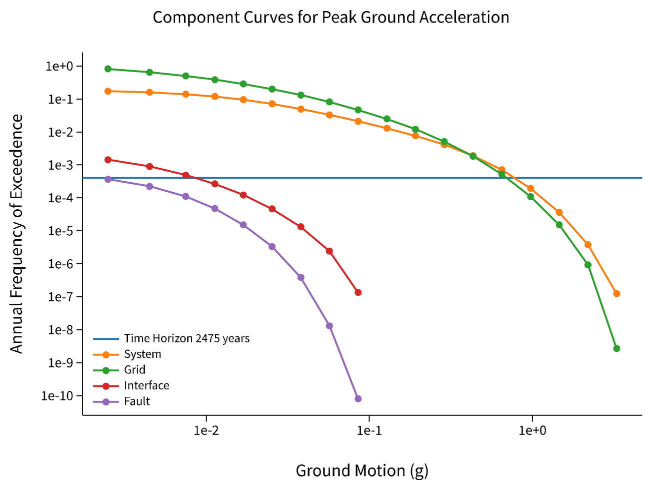
Site Class

259 m/s (Site class D)

Hazard Curve





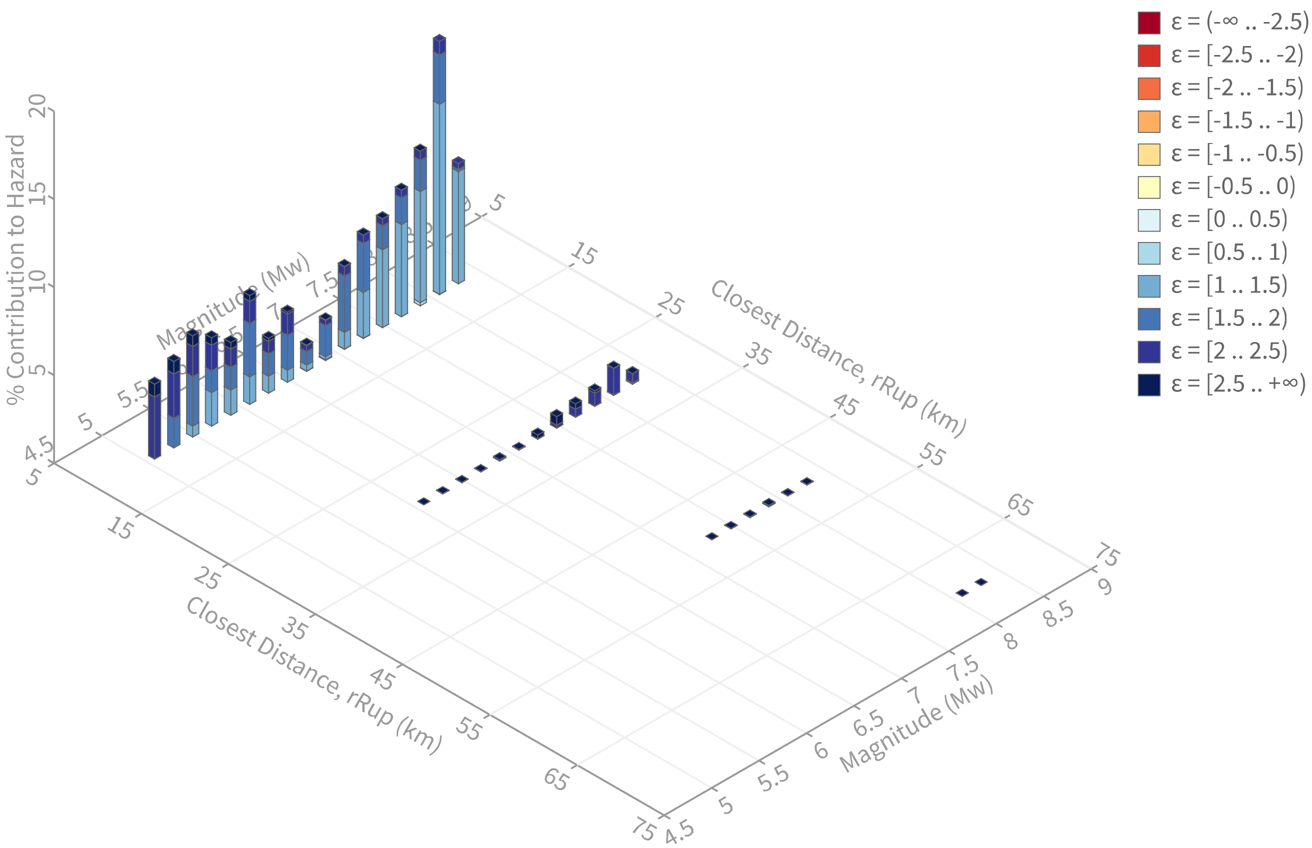


View Raw Data

^ Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.89631882 g

Recovered targets

Return period: 3202.5687 yrs
Exceedance rate: 0.00031224935 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.04 %

Mean (over all sources)

m: 7
r: 8.67 km
ε_0: 1.66 σ

Mode (largest m-r bin)

m: 8.1
r: 7.36 km
ε_0: 1.31 σ
Contribution: 14.39 %

Mode (largest m-r-ε_0 bin)

m: 8.1
r: 7.36 km
ε_0: 1.19 σ
Contribution: 10.8 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
UC33brAvg_FM31	System							31.27
San Jacinto (Anza) rev [2]		7.34	7.79	1.40	116.721°W	33.619°N	213.82	25.88
San Jacinto (Anza) rev [3]		7.46	6.97	1.70	116.713°W	33.614°N	206.40	2.60
San Andreas (San Gorgonio Pass-Garnet HIll) [4]		28.06	7.92	2.32	116.568°W	33.909°N	21.09	1.72
UC33brAvg_FM32	System							31.12
San Jacinto (Anza) rev [2]		7.34	7.79	1.40	116.721°W	33.619°N	213.82	25.85
San Jacinto (Anza) rev [3]		7.46	6.98	1.70	116.713°W	33.614°N	206.40	2.52
San Andreas (San Gorgonio Pass-Garnet HIll) [4]		28.06	7.92	2.32	116.568°W	33.909°N	21.09	1.72
UC33brAvg_FM31 (opt)	Grid							18.81
PointSourceFinite: -116.677, 33.705		6.22	5.65	1.73	116.677°W	33.705°N	0.00	5.39
PointSourceFinite: -116.677, 33.705		6.22	5.65	1.73	116.677°W	33.705°N	0.00	5.38
PointSourceFinite: -116.677, 33.741		8.26	5.93	1.96	116.677°W	33.741°N	0.00	1.30
PointSourceFinite: -116.677, 33.741		8.26	5.93	1.96	116.677°W	33.741°N	0.00	1.29
UC33brAvg_FM32 (opt)	Grid							18.80
PointSourceFinite: -116.677, 33.705		6.22	5.65	1.73	116.677°W	33.705°N	0.00	5.38
PointSourceFinite: -116.677, 33.705		6.22	5.65	1.73	116.677°W	33.705°N	0.00	5.38
PointSourceFinite: -116.677, 33.741		8.26	5.93	1.96	116.677°W	33.741°N	0.00	1.29
PointSourceFinite: -116.677, 33.741		8.26	5.93	1.96	116.677°W	33.741°N	0.00	1.29

APPENDIX F

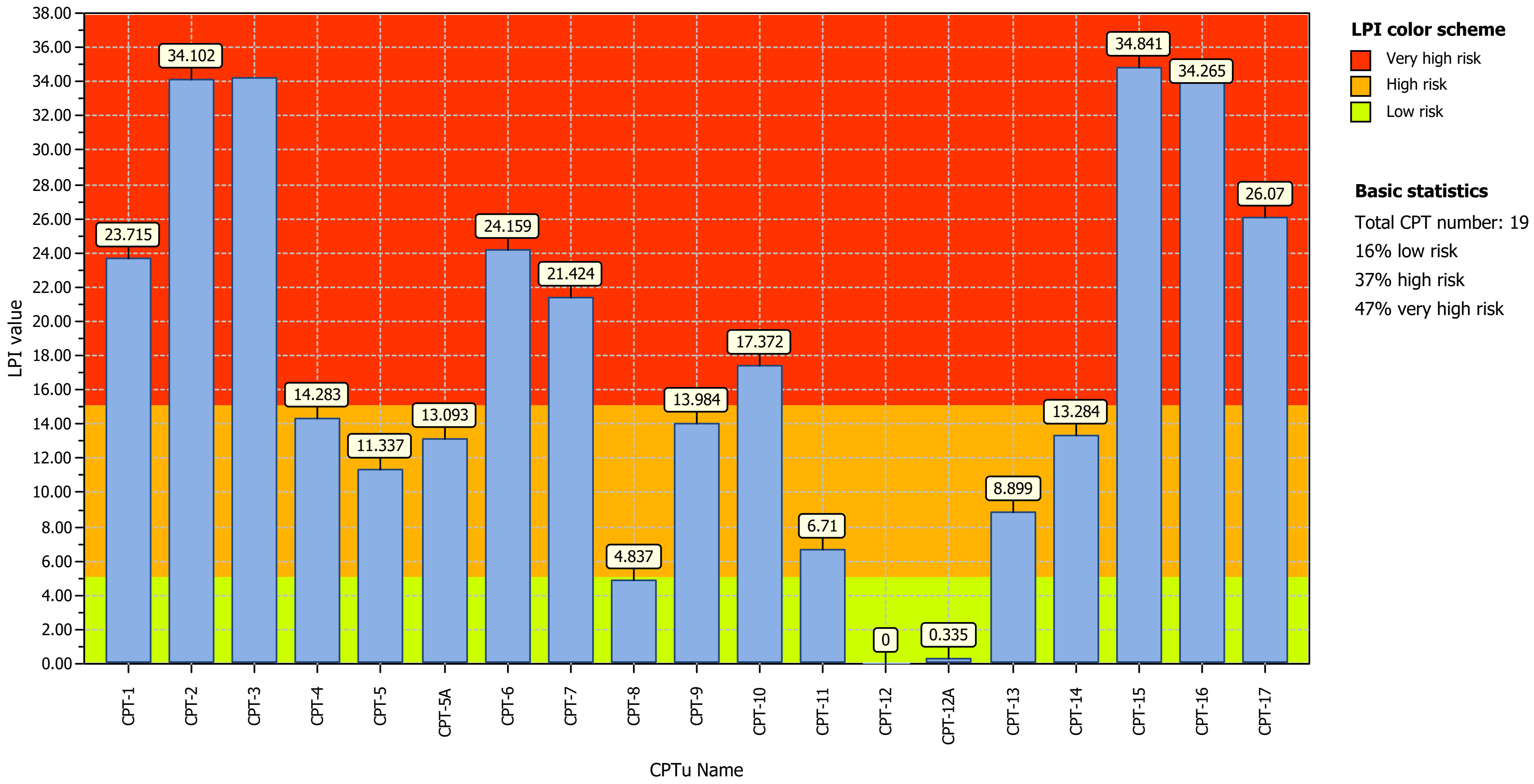
LIQUEFACTION ANALYSIS

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

Project title : Petra Geosciences / Apple Canyon

Location : Lake Hemet, CA

Overall Liquefaction Potential Index report



Basic statistics

Total CPT number: 19

16% low risk

37% high risk

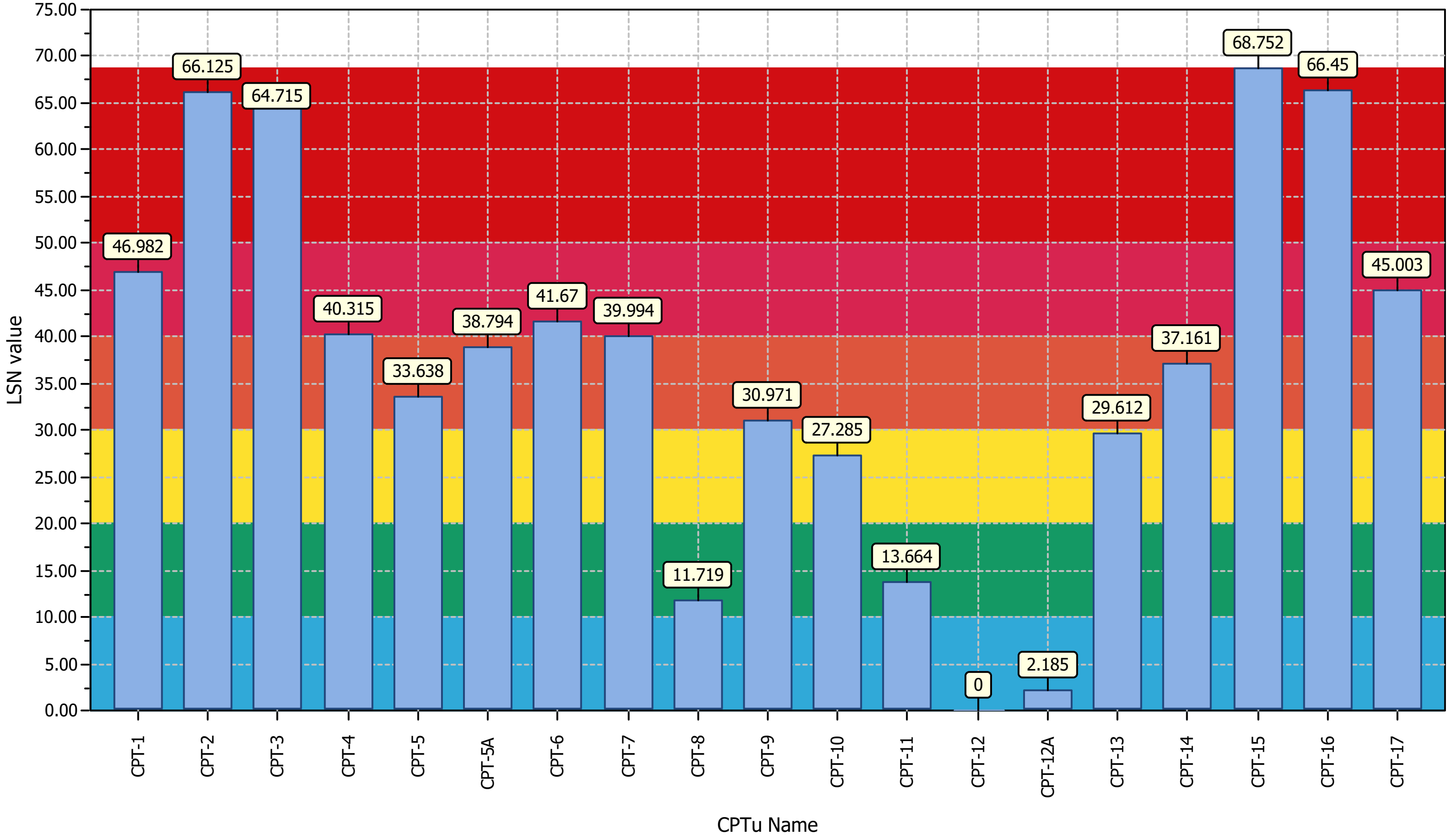
47% very high risk

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

Project title : Petra Geosciences / Apple Canyon

Location : Lake Hemet, CA

Overall Liquefaction Severity Number report



LSN color scheme

- Severe damage
- Major expression of liquefaction
- Moderate to severe exp. of liquefaction
- Moderate expression of liquefaction
- Minor expression of liquefaction
- Little to no expression of liquefaction

Basic statistics

Total CPT number: 19

11% little liquefaction

11% minor liquefaction

11% moderate liquefaction

26% moderate to major liquefaction

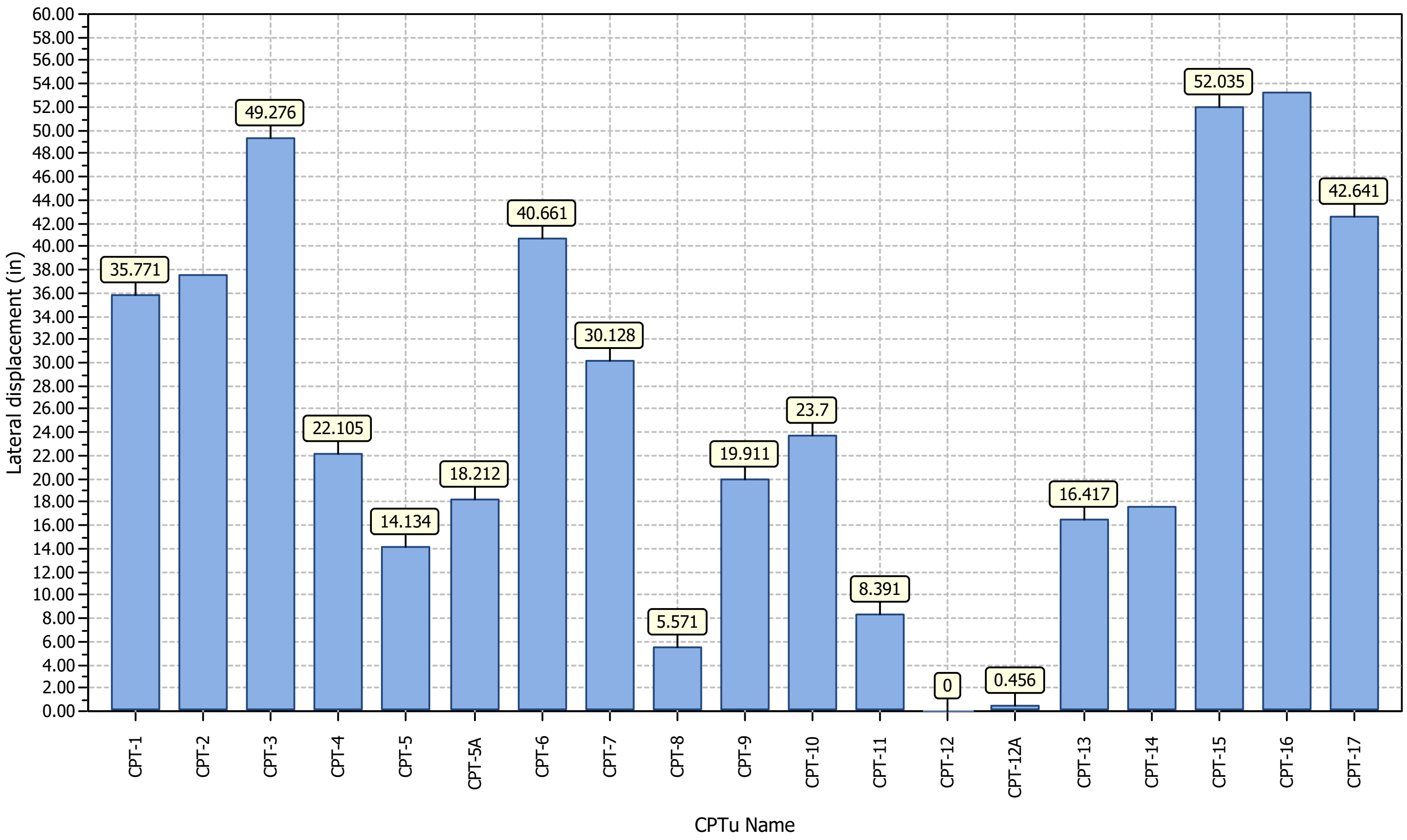
21% major liquefaction

21% severe liquefaction

Project title : Petra Geosciences / Apple Canyon

Location : Lake Hemet, CA

Overall lateral displacements report

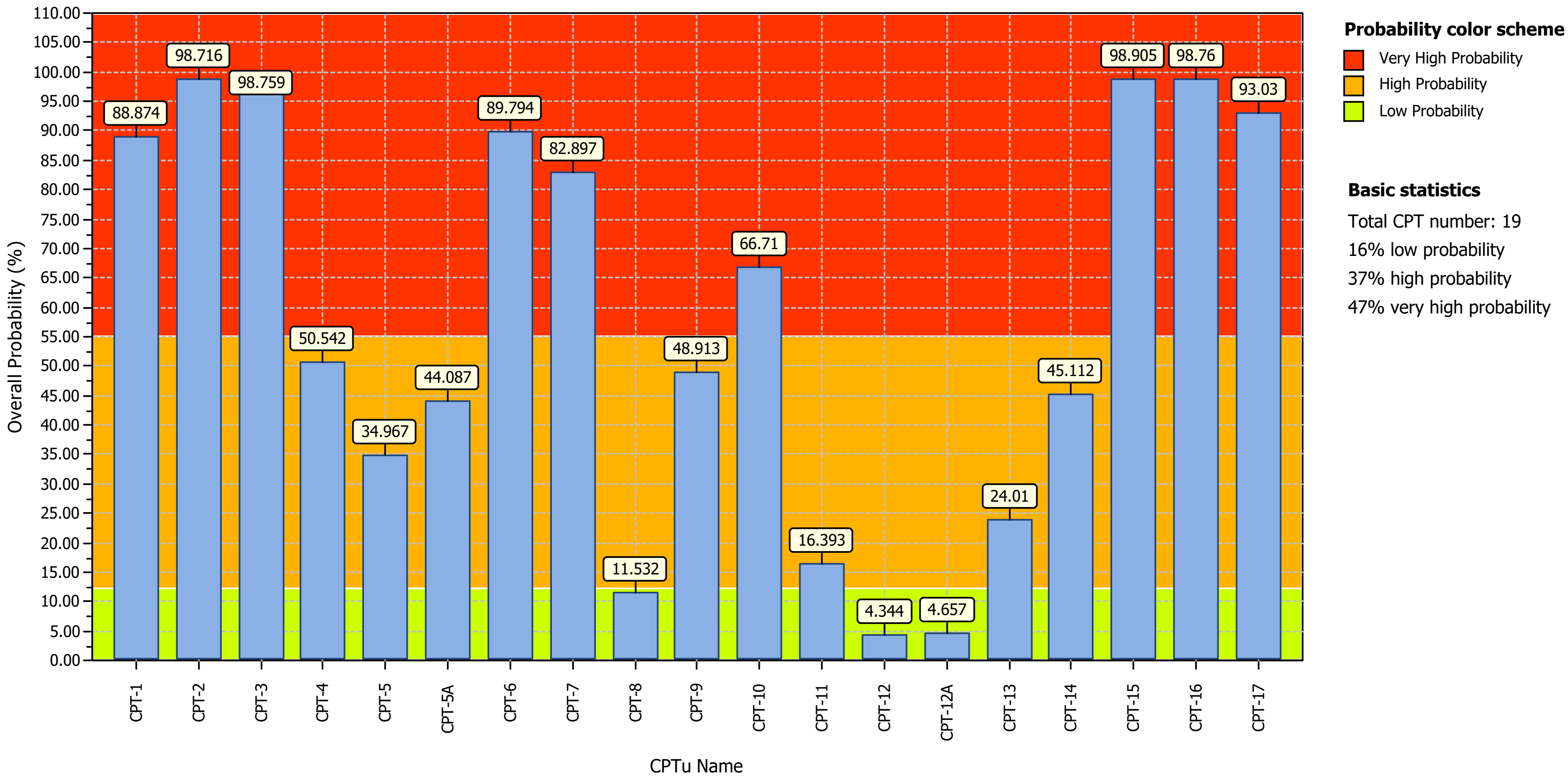


Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project title : Petra Geosciences / Apple Canyon

Location : Lake Hemet, CA

Overall Probability for Liquefaction report



Basic statistics

Total CPT number: 19

16% low probability

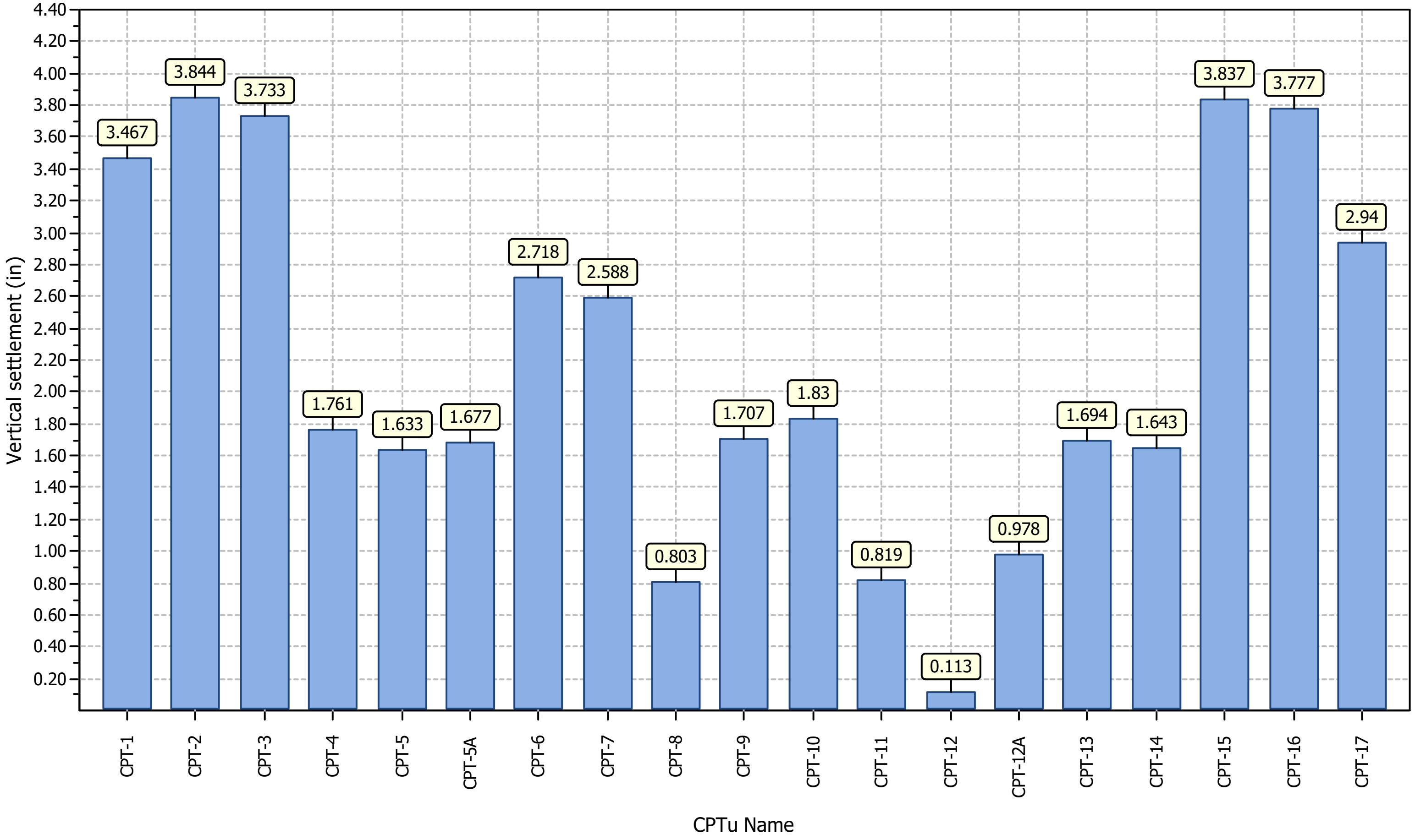
37% high probability

47% very high probability

Project title : Petra Geosciences / Apple Canyon

Location : Lake Hemet, CA

Overall vertical settlements report



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steve@kehoetesting.com
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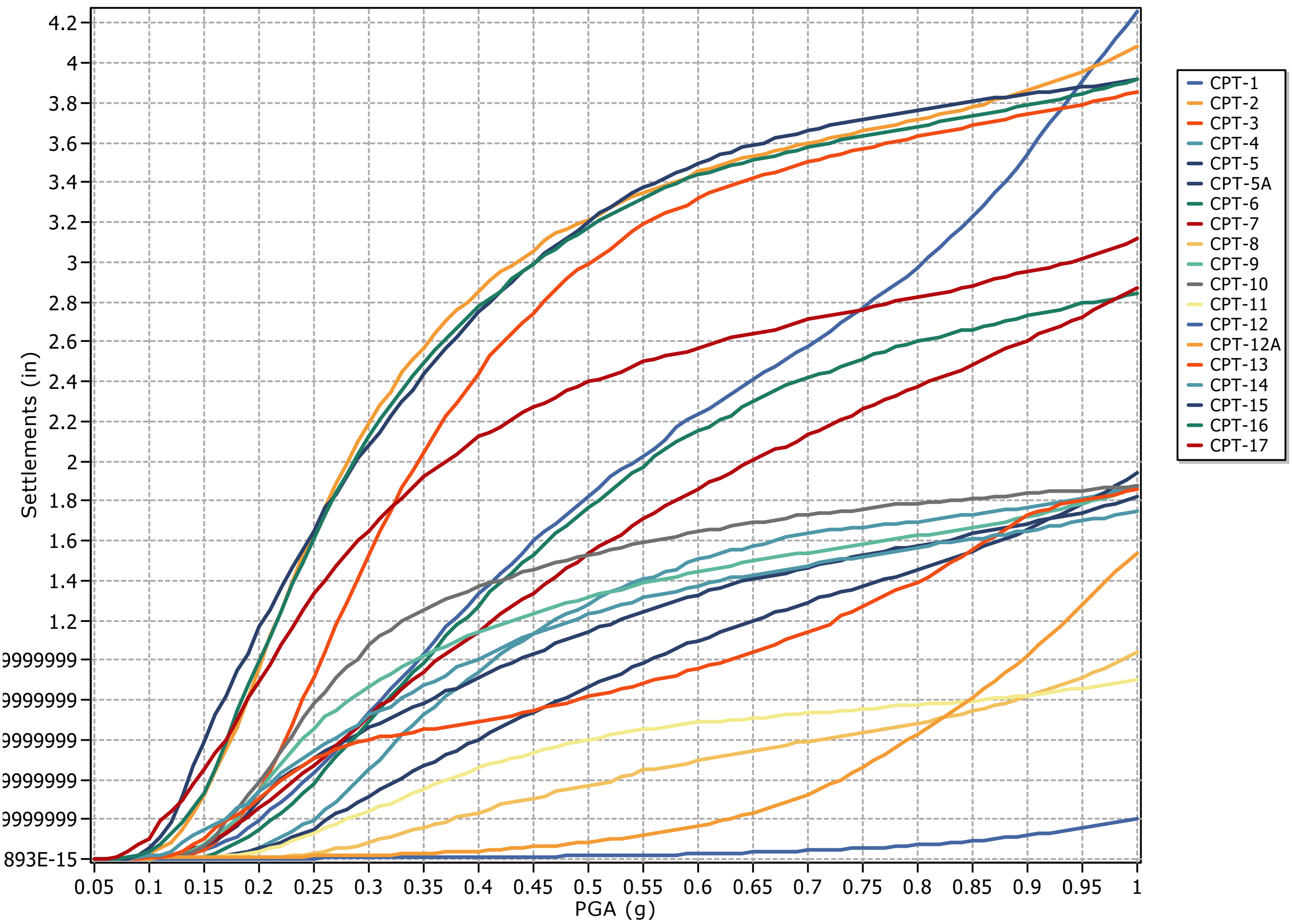
PGA Based Parametric Analysis

Settlements vs PGA



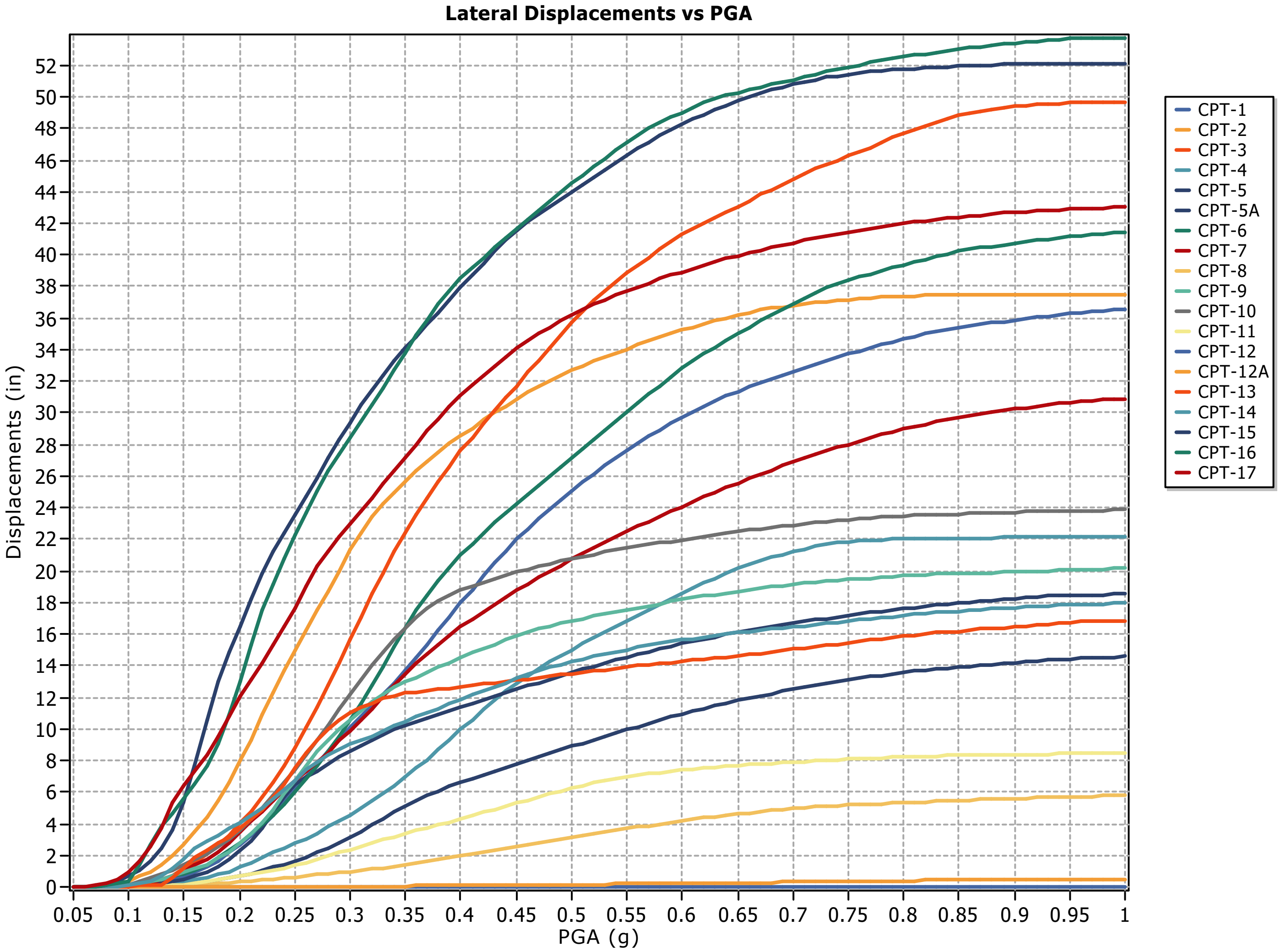
:: CPT main liquefaction parameters details ::

CPT Name	Assesment method	Earthquake Mag.	GWT in situ (ft)	GWT earthq. (ft)
CPT-1	NCEER (1998)	8.10	7.60	7.00
CPT-2	NCEER (1998)	8.10	9.90	7.00
CPT-3	NCEER (1998)	8.10	9.70	7.00
CPT-4	NCEER (1998)	8.10	11.00	7.00
CPT-5	NCEER (1998)	8.10	10.50	7.00
CPT-5A	NCEER (1998)	8.10	10.50	7.00
CPT-6	NCEER (1998)	8.10	10.50	7.00
CPT-7	NCEER (1998)	8.10	11.00	7.00
CPT-8	NCEER (1998)	8.10	11.00	7.00
CPT-9	NCEER (1998)	8.10	12.50	7.00
CPT-10	NCEER (1998)	8.10	10.50	7.00
CPT-11	NCEER (1998)	8.10	11.00	7.00
CPT-12	NCEER (1998)	8.10	12.00	7.00
CPT-12A	NCEER (1998)	8.10	12.00	7.00
CPT-13	NCEER (1998)	8.10	12.00	7.00

PGA Based Parametric Analysis

CPT-14	NCEER (1998)	8.10	9.50	7.00
CPT-15	NCEER (1998)	8.10	9.00	7.00
CPT-16	NCEER (1998)	8.10	9.80	7.00
CPT-17	NCEER (1998)	8.10	12.50	7.00

PGA Based Parametric Analysis



:: CPT main liquefaction parameters details ::

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CPT-5	NCEER (1998)	8.10	10.50	7.00
CPT-5A	NCEER (1998)	8.10	10.50	7.00
CPT-6	NCEER (1998)	8.10	10.50	7.00
CPT-7	NCEER (1998)	8.10	11.00	7.00
CPT-8	NCEER (1998)	8.10	11.00	7.00
CPT-9	NCEER (1998)	8.10	12.50	7.00
CPT-10	NCEER (1998)	8.10	10.50	7.00
CPT-11	NCEER (1998)	8.10	11.00	7.00
CPT-12	NCEER (1998)	8.10	12.00	7.00
CPT-12A	NCEER (1998)	8.10	12.00	7.00
CPT-13	NCEER (1998)	8.10	12.00	7.00

PGA Based Parametric Analysis

CPT-14	NCEER (1998)	8.10	9.50	7.00
CPT-15	NCEER (1998)	8.10	9.00	7.00
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CPT-17	NCEER (1998)	8.10	12.50	7.00

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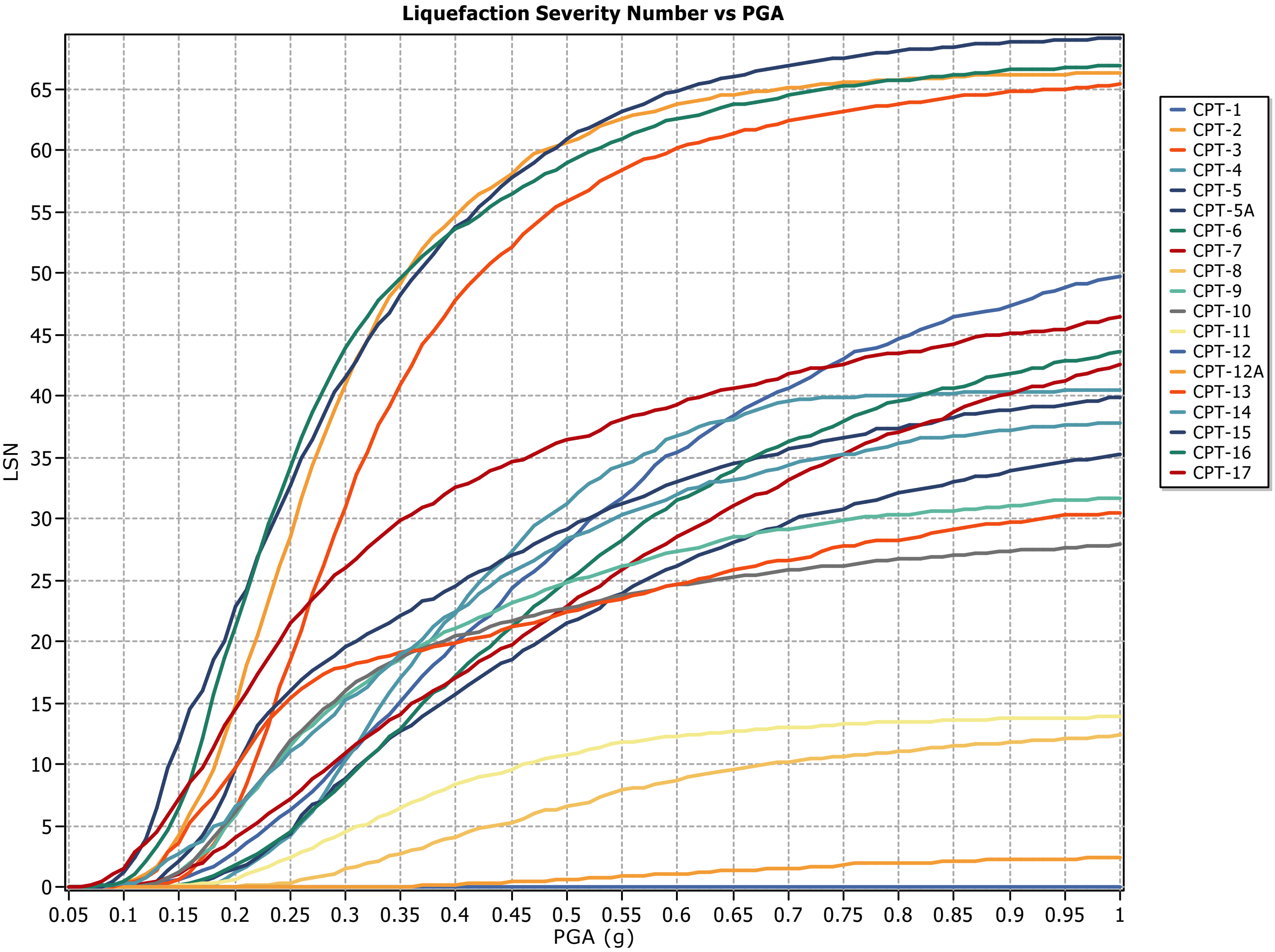
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

PGA Based Parametric Analysis



:: CPT main liquefaction parameters details ::

CPT Name	Assesment method	Earthquake Mag.	GWT in situ (ft)	GWT earthq. (ft)
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CPT-9	NCEER (1998)	8.10	12.50	7.00
CPT-10	NCEER (1998)	8.10	10.50	7.00
CPT-11	NCEER (1998)	8.10	11.00	7.00
CPT-12	NCEER (1998)	8.10	12.00	7.00
CPT-12A	NCEER (1998)	8.10	12.00	7.00
CPT-13	NCEER (1998)	8.10	12.00	7.00

PGA Based Parametric Analysis

CPT-14	NCEER (1998)	8.10	9.50	7.00
CPT-15	NCEER (1998)	8.10	9.00	7.00
CPT-16	NCEER (1998)	8.10	9.80	7.00
CPT-17	NCEER (1998)	8.10	12.50	7.00

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

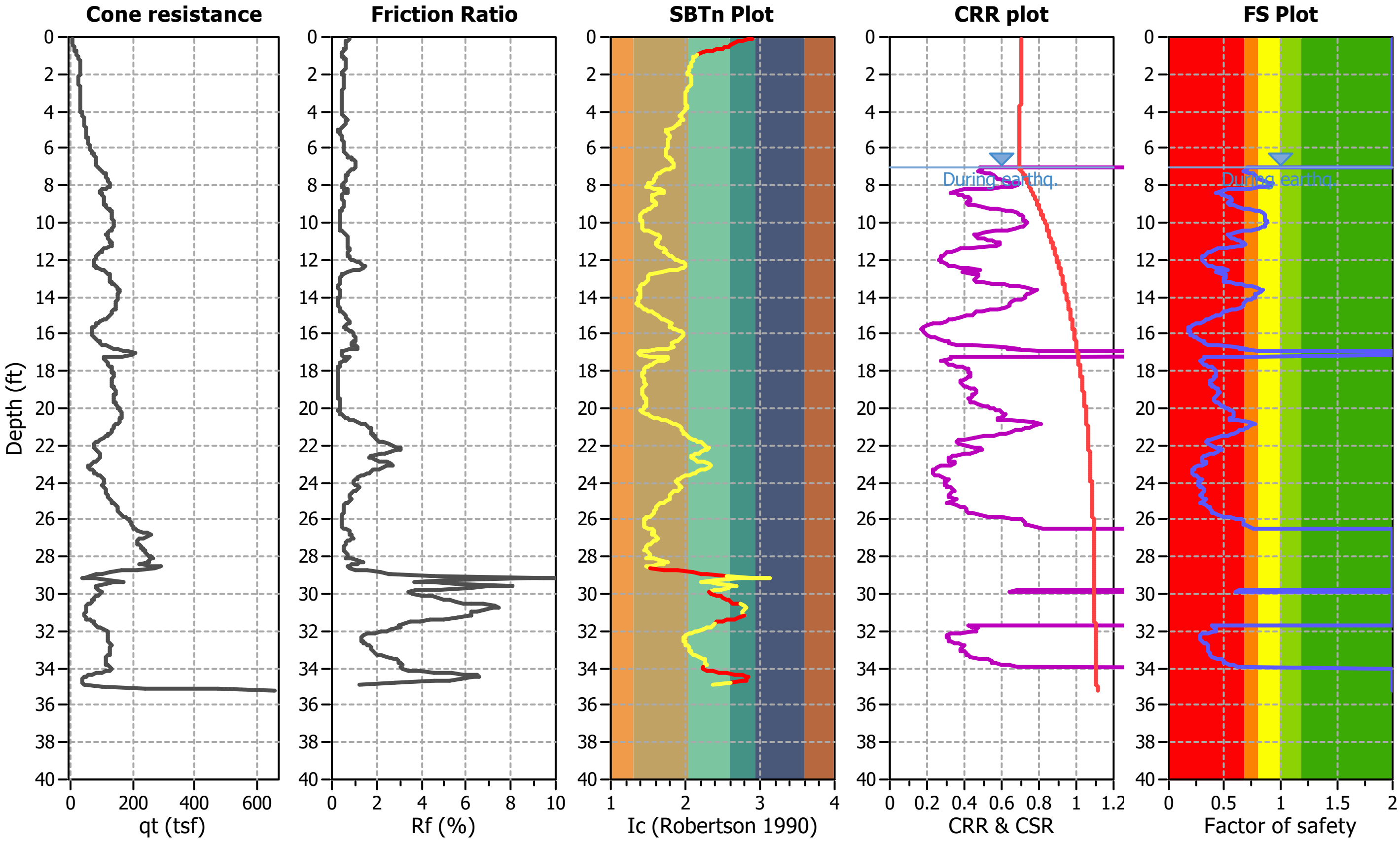
LIQUEFACTION ANALYSIS REPORT

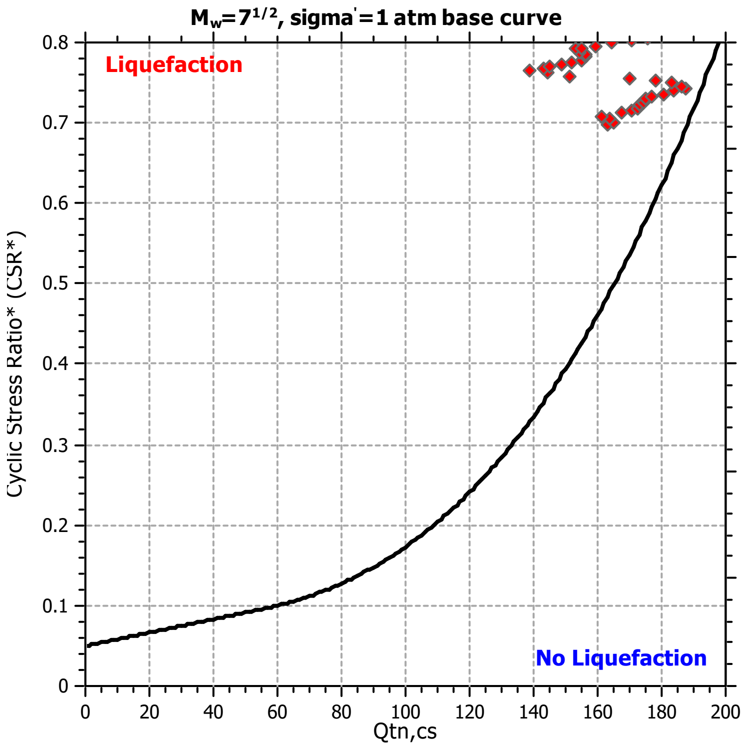
Project title : Petra Geosciences / Apple Canyon **Location : Lake Hemet, CA**

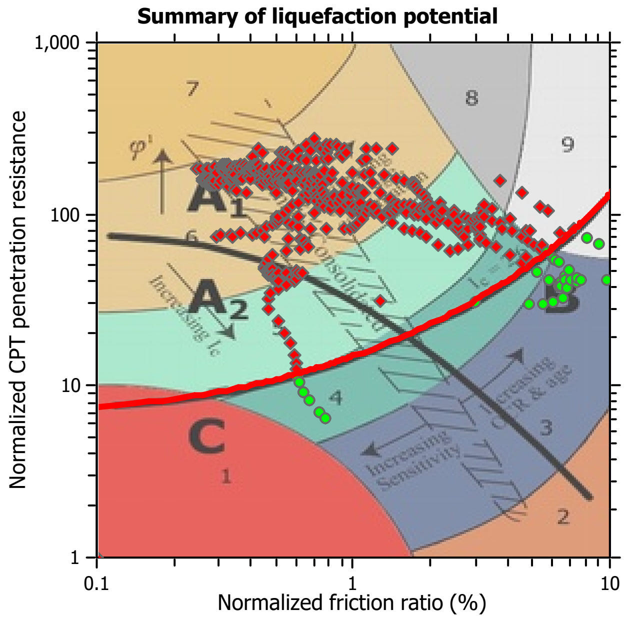
CPT file : CPT-1

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	7.60 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	8.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.89	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

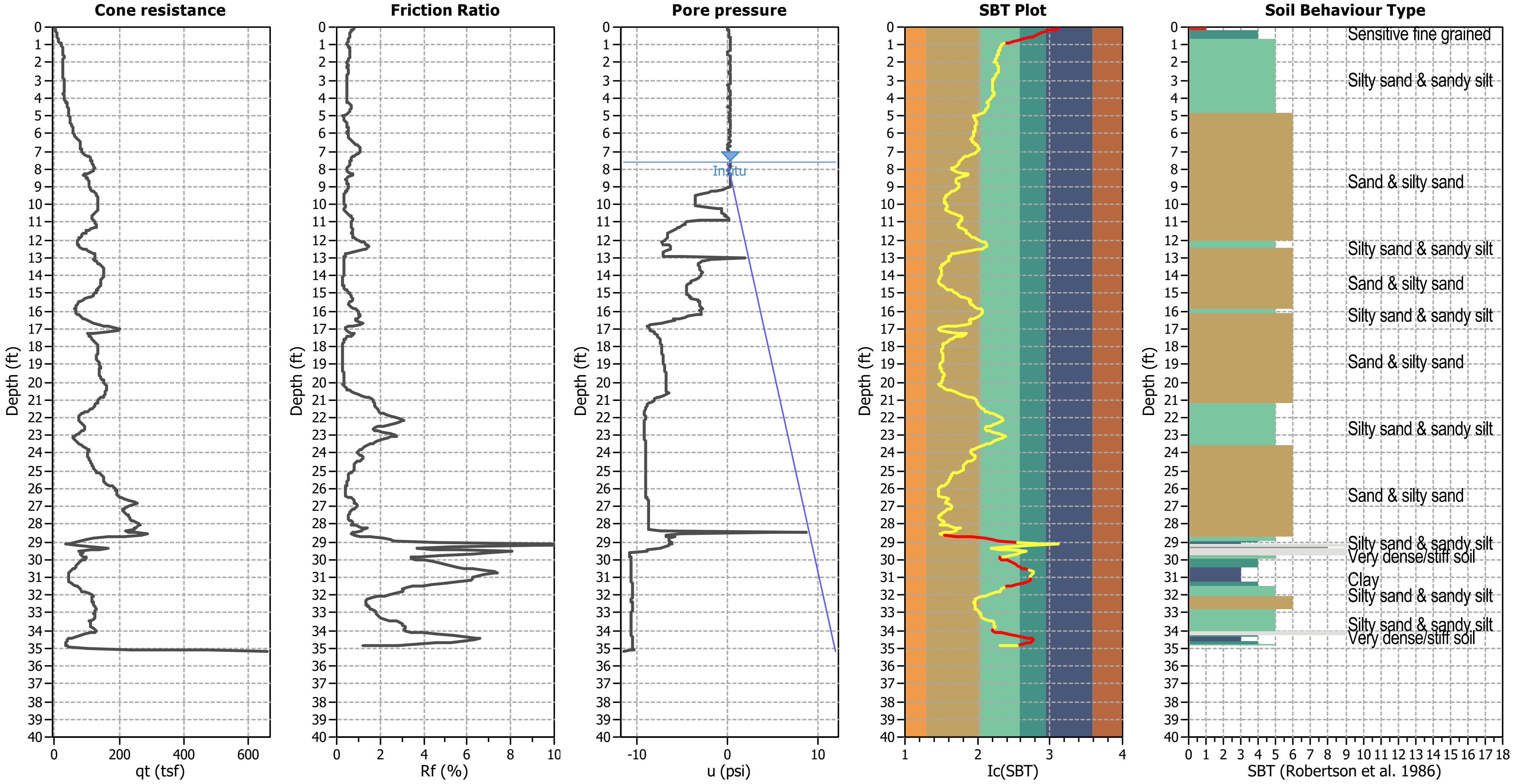






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



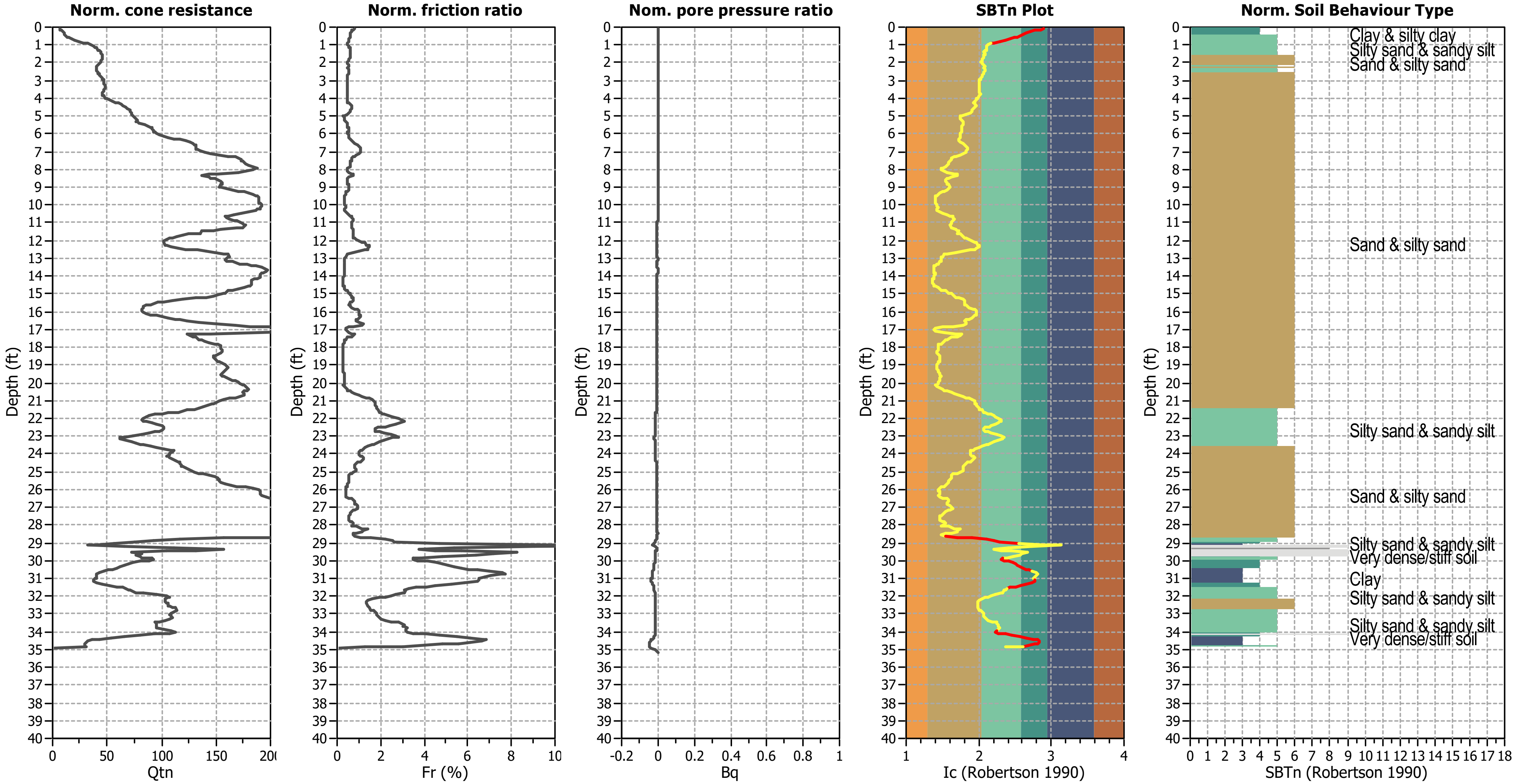
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.60 ft	Fill height:	N/A	Limit depth:	N/A

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)



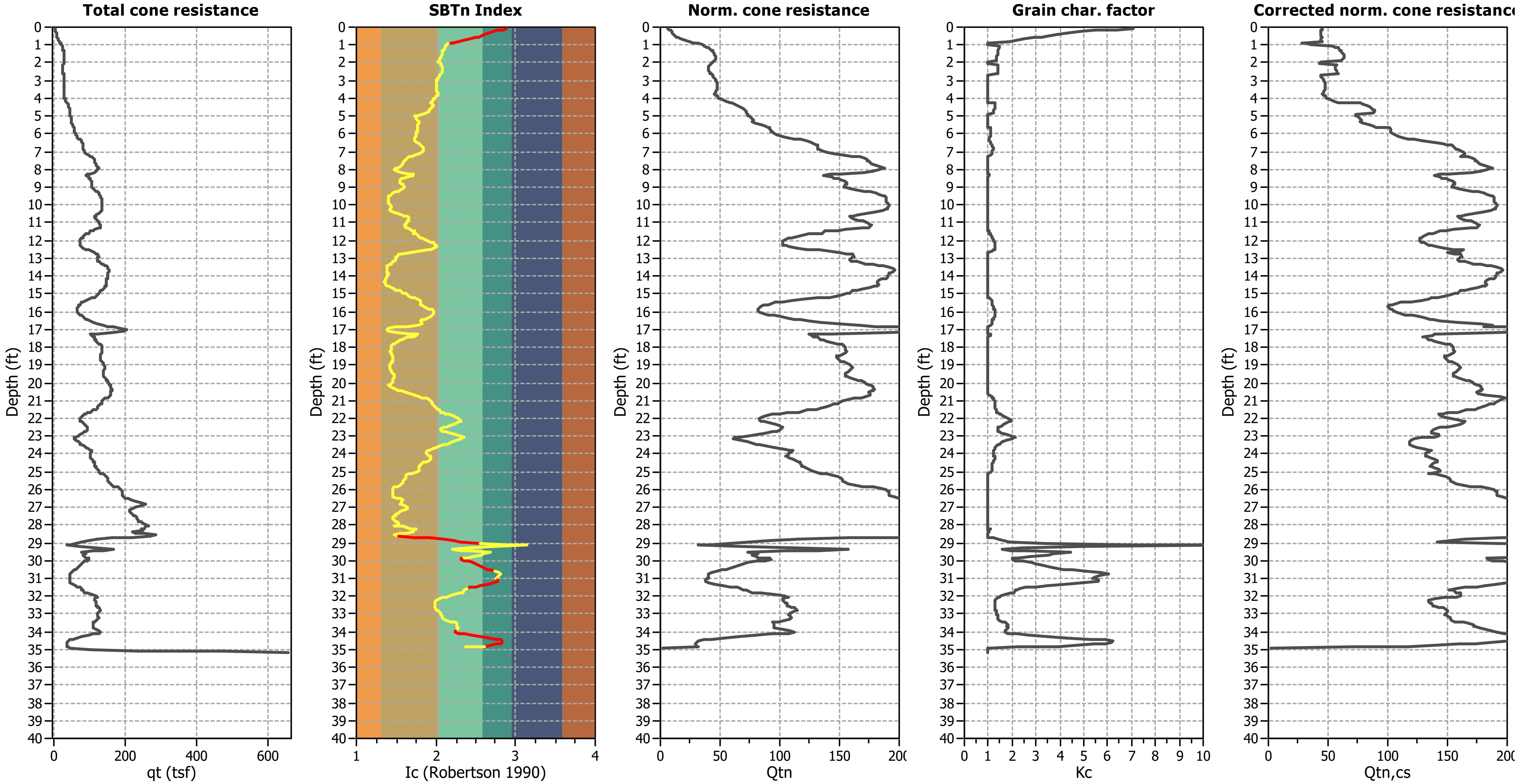
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.60 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

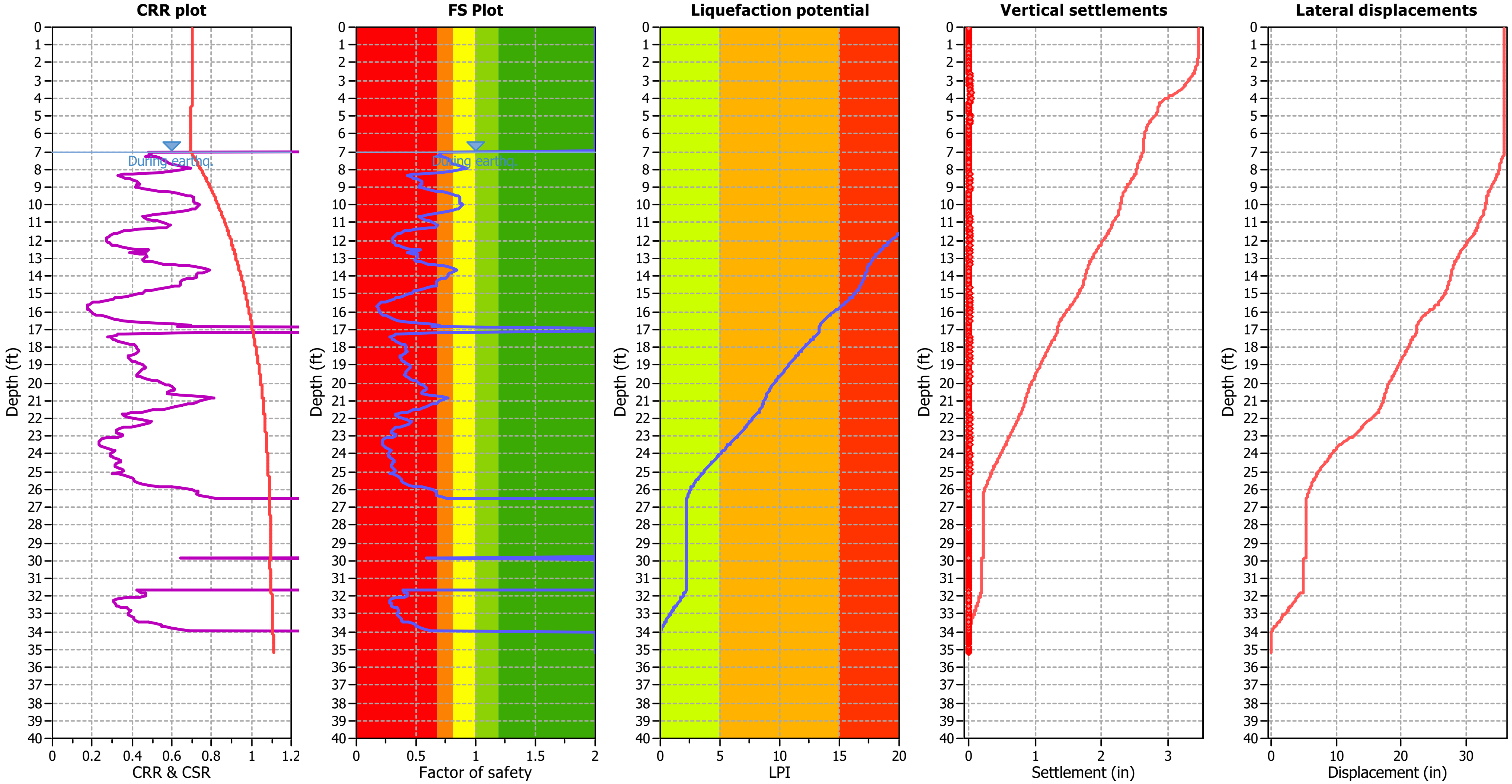
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.60 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_{σ} applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.60 ft	Fill height:	N/A	Limit depth:	N/A

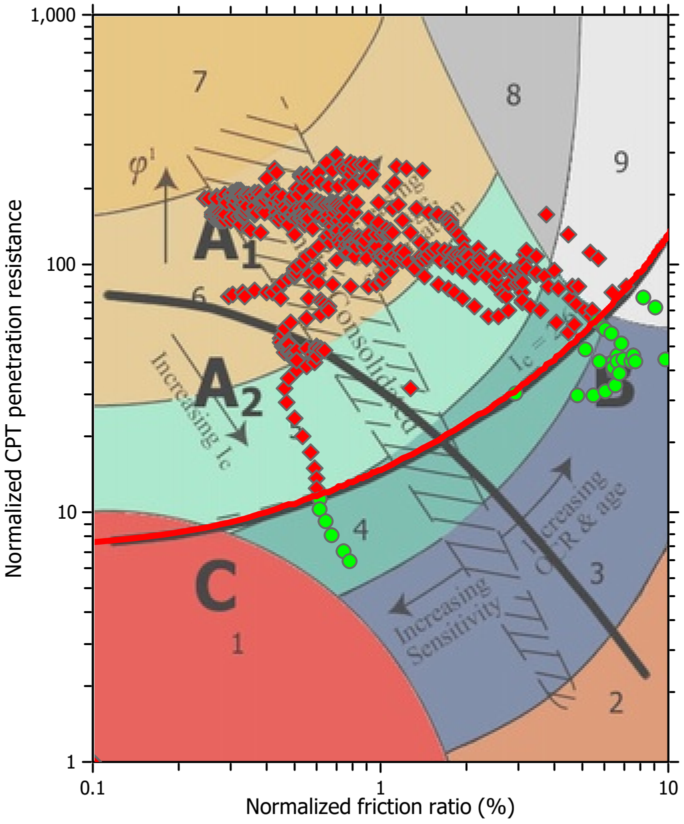
F.S. color scheme

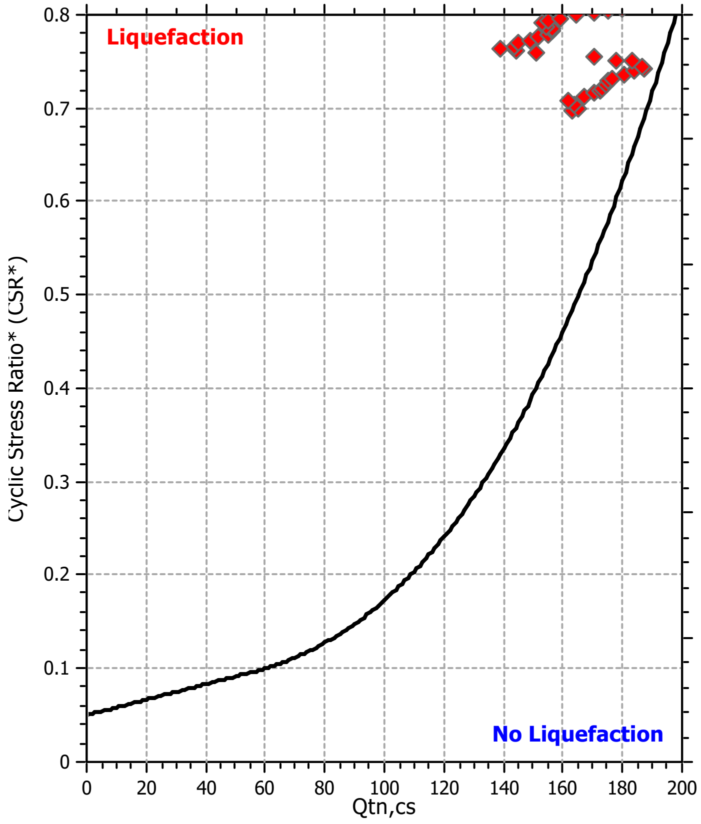
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

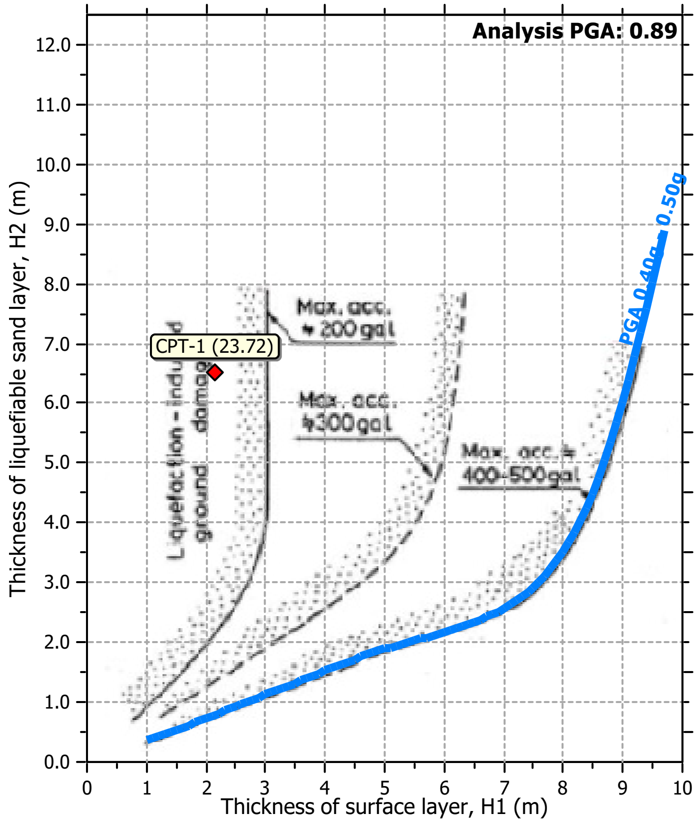
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



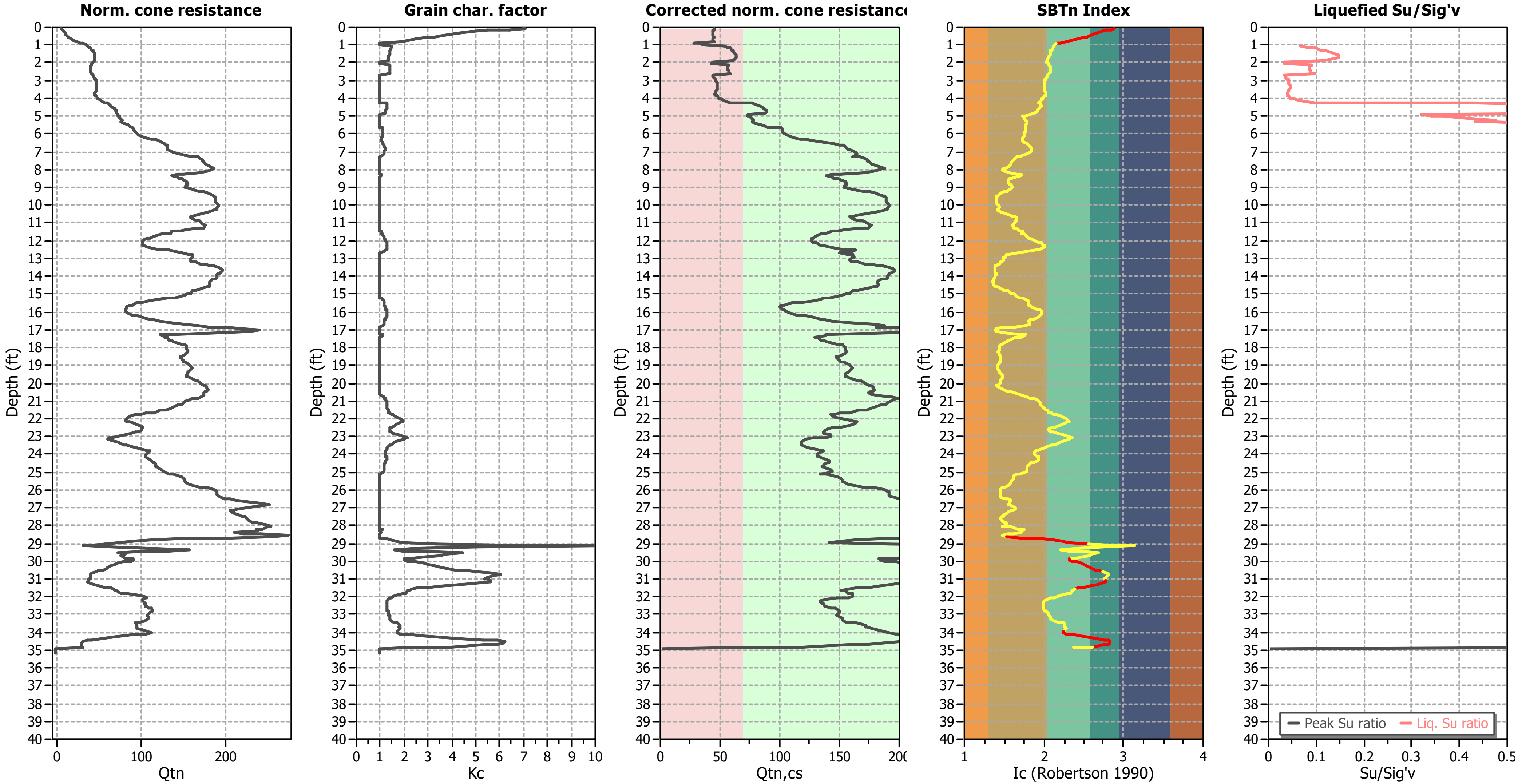




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.60 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

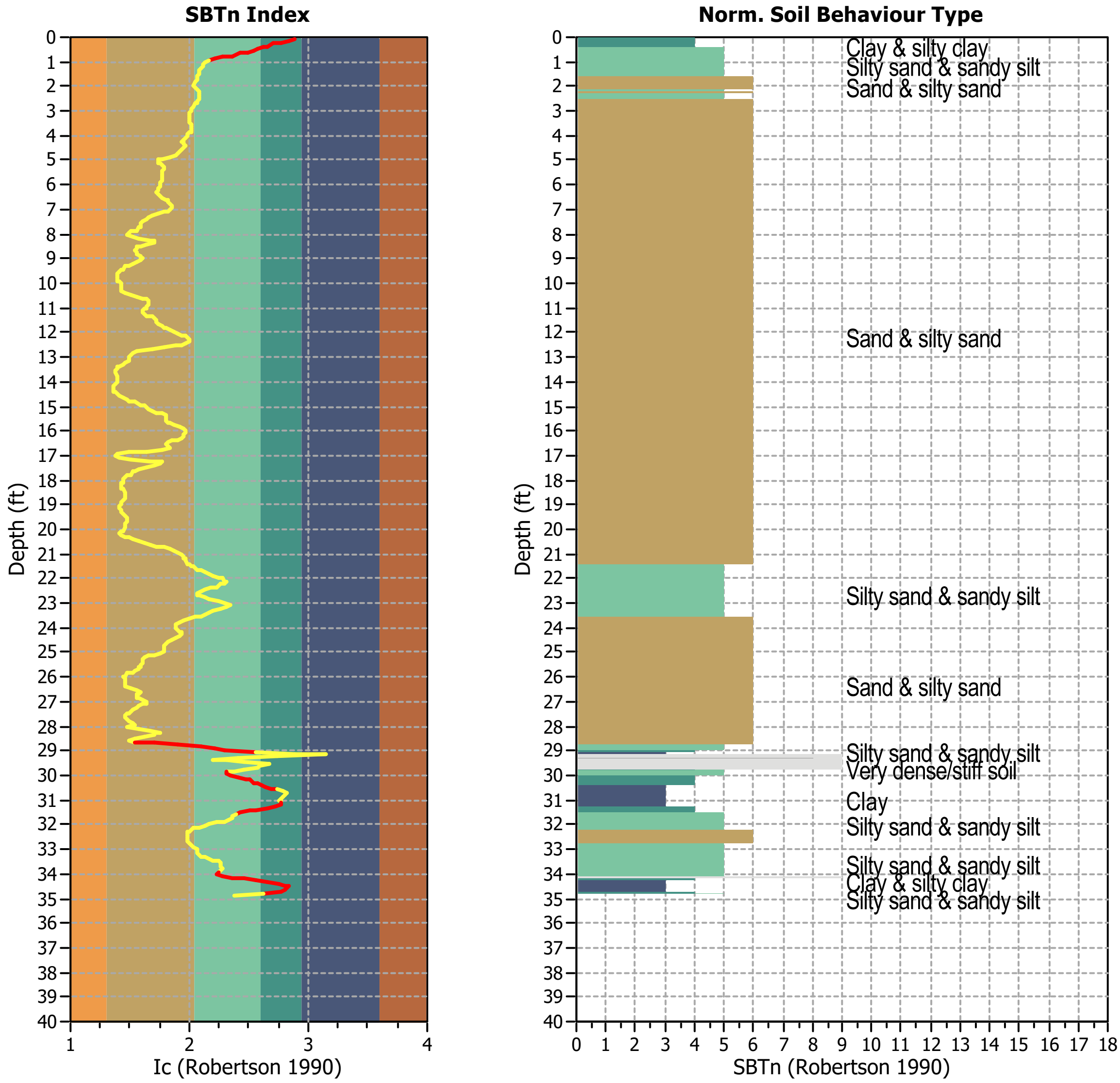
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.60 ft	Fill height:	N/A	Limit depth:	N/A

TRANSITION LAYER DETECTION ALGORITHM REPORT
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between $1.80 < I_c < 3.0$) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.



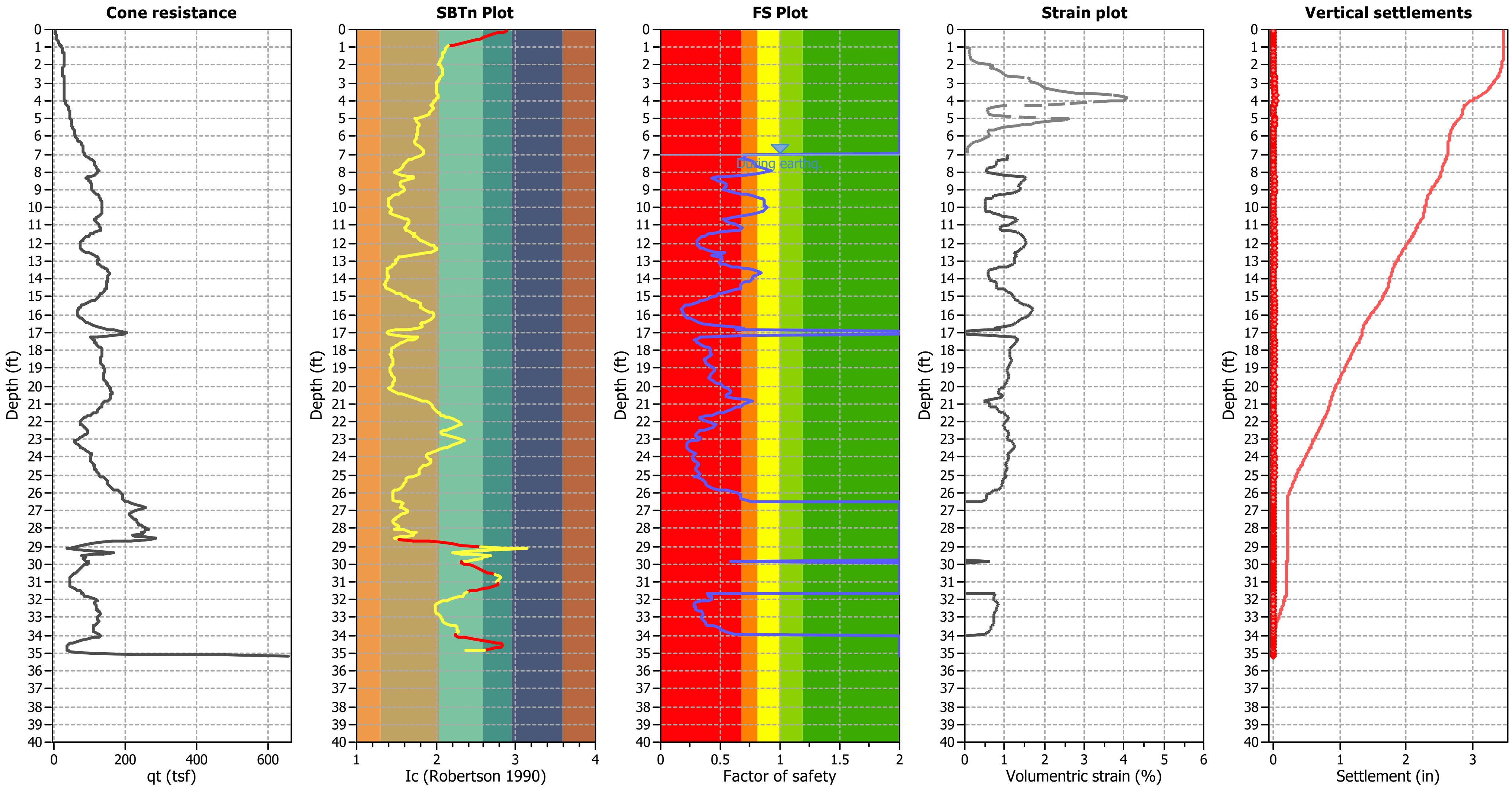
Transition layer algorithm properties

I_c minimum check value:	1.70
I_c maximum check value:	3.00
I_c change ratio value:	0.0250
Minimum number of points in layer:	4

General statistics

Total points in CPT file:	536
Total points excluded:	56
Exclusion percentage:	10.45%
Number of layers detected:	6

Estimation of post-earthquake settlements

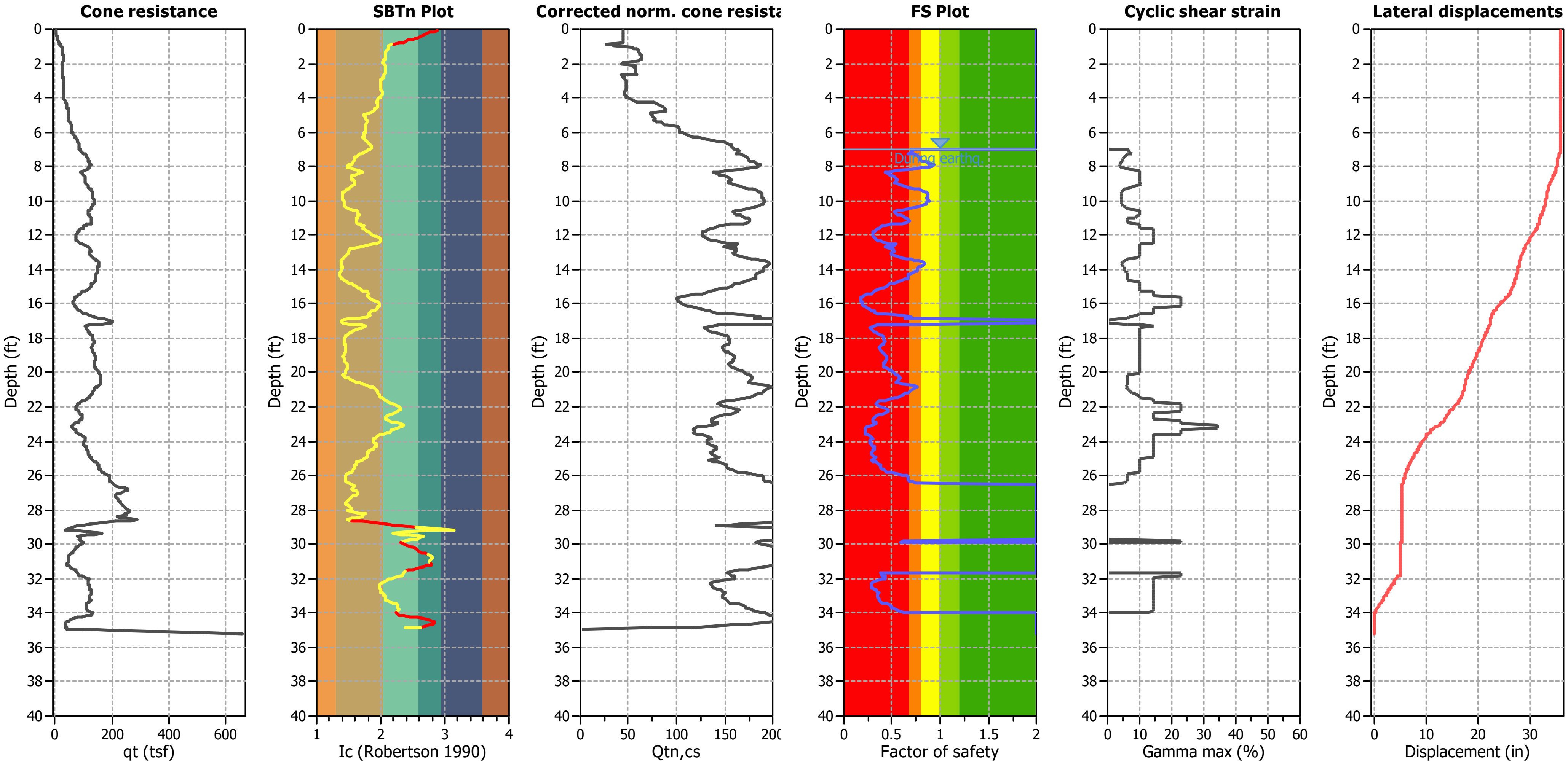


Abbreviations

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

Estimation of post-earthquake lateral Displacements

Geometric parameters: Gently sloping ground without free face (Slope 1.00 %)



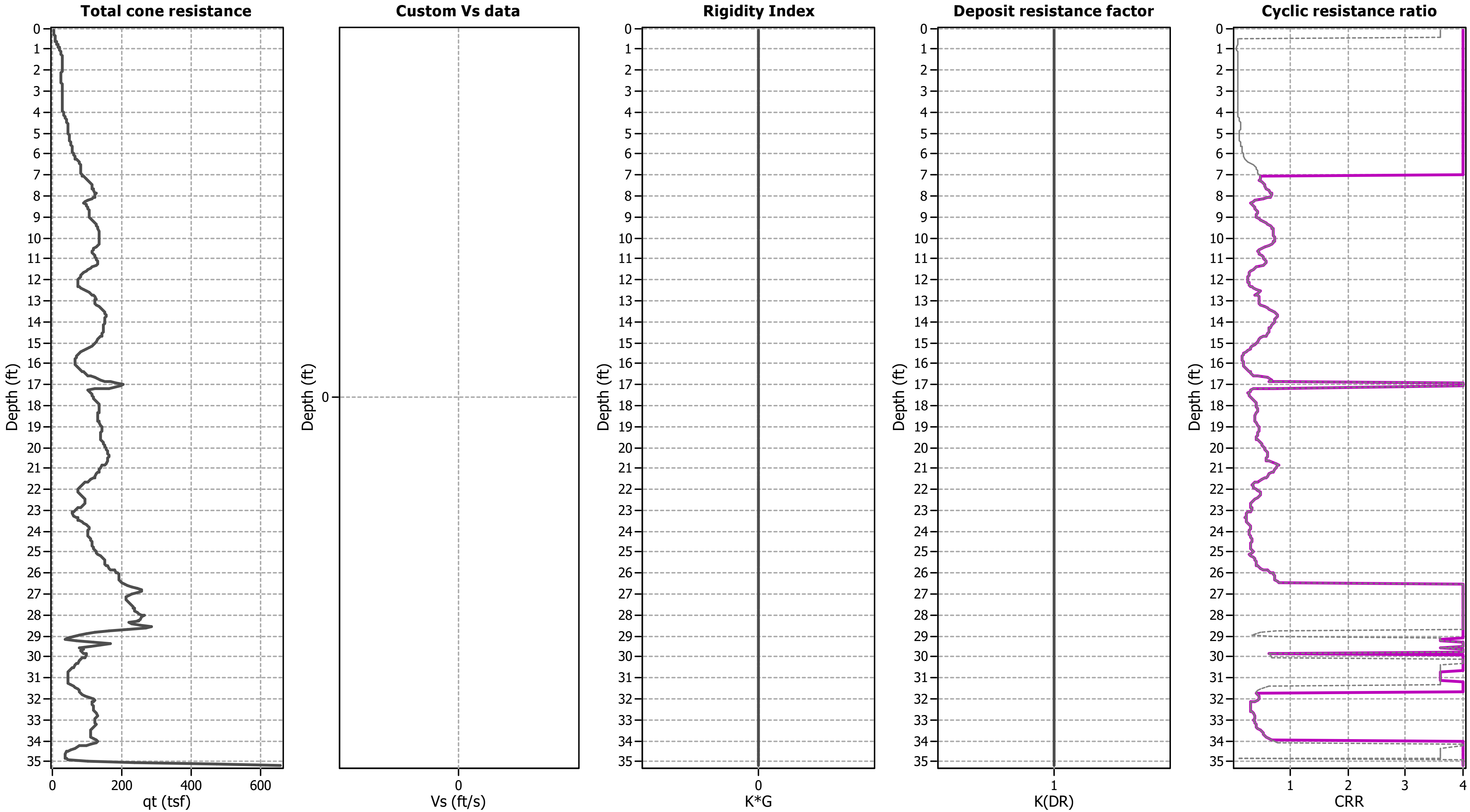
Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance

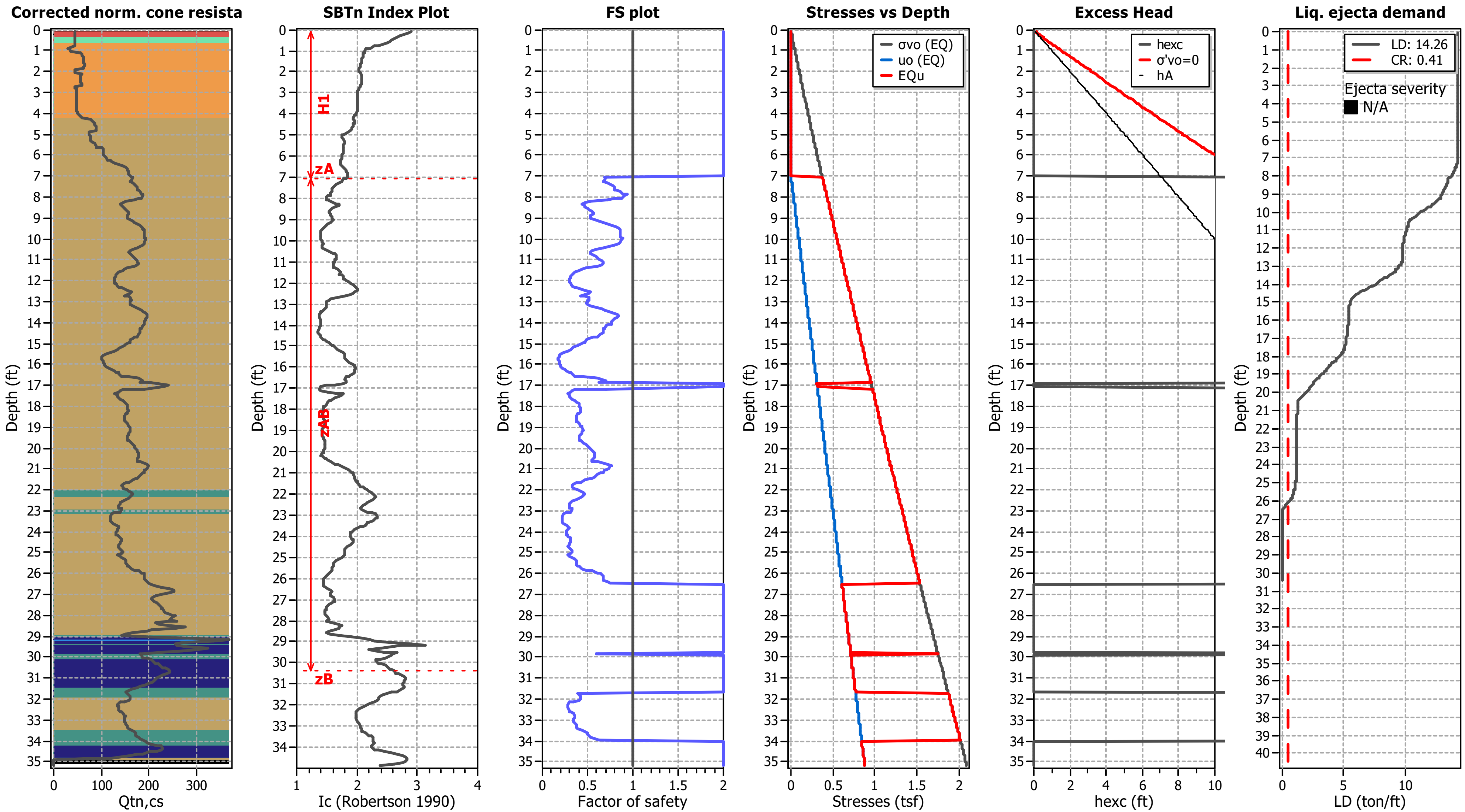
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

Surface condition

Aging Calculation Estimation



Ejecta Severity Estimation



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

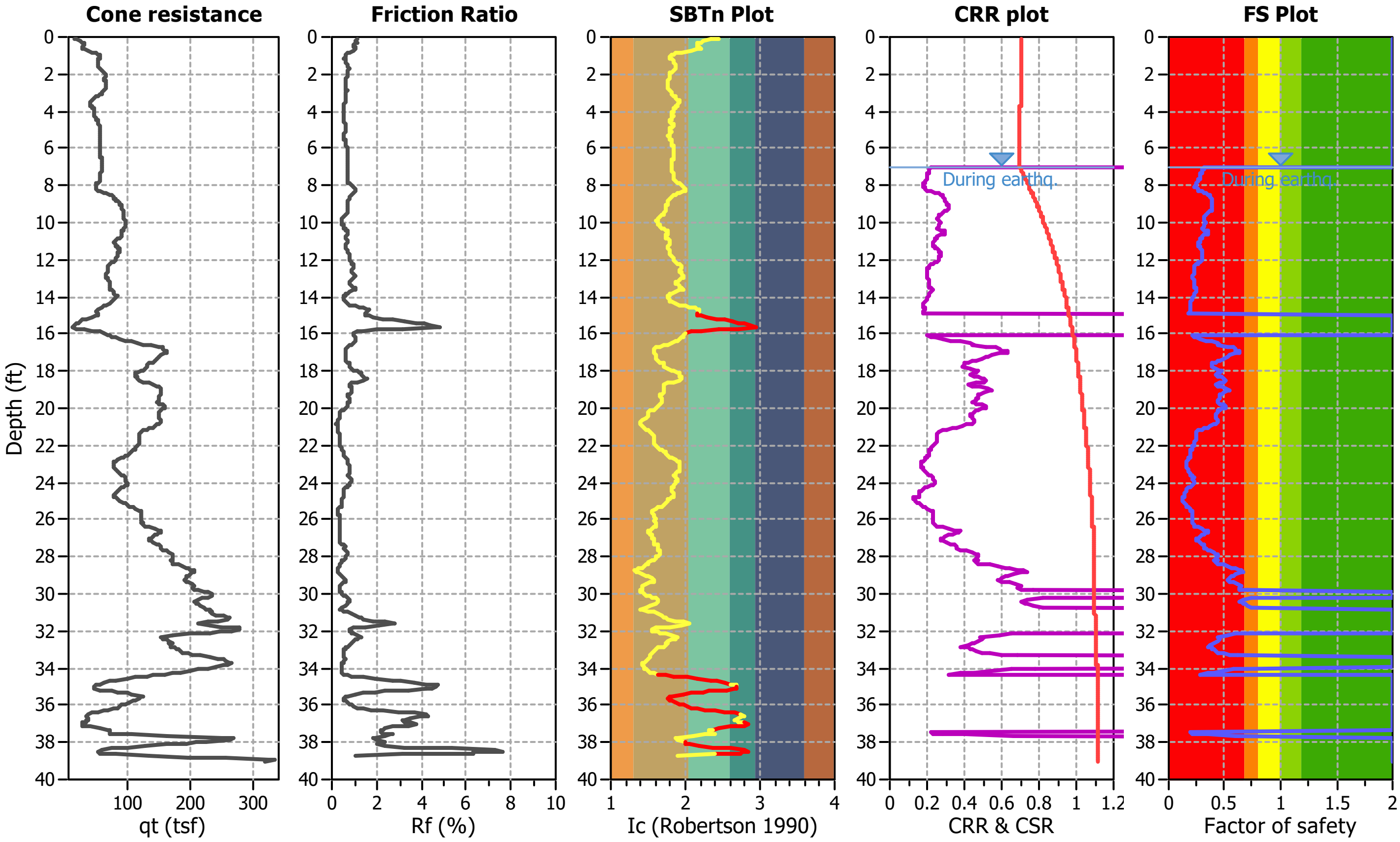
LIQUEFACTION ANALYSIS REPORT

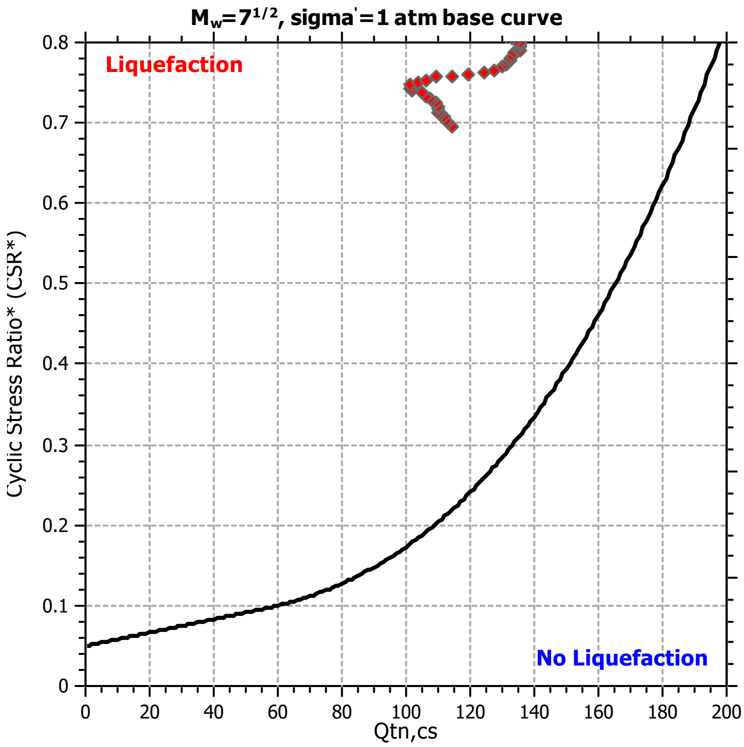
Project title : Petra Geosciences / Apple Canyon **Location : Lake Hemet, CA**

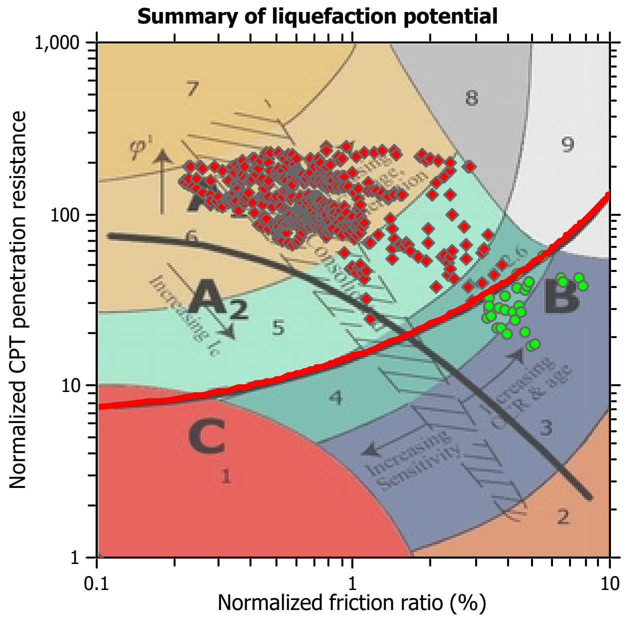
CPT file : CPT-2

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	9.90 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	8.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.89	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

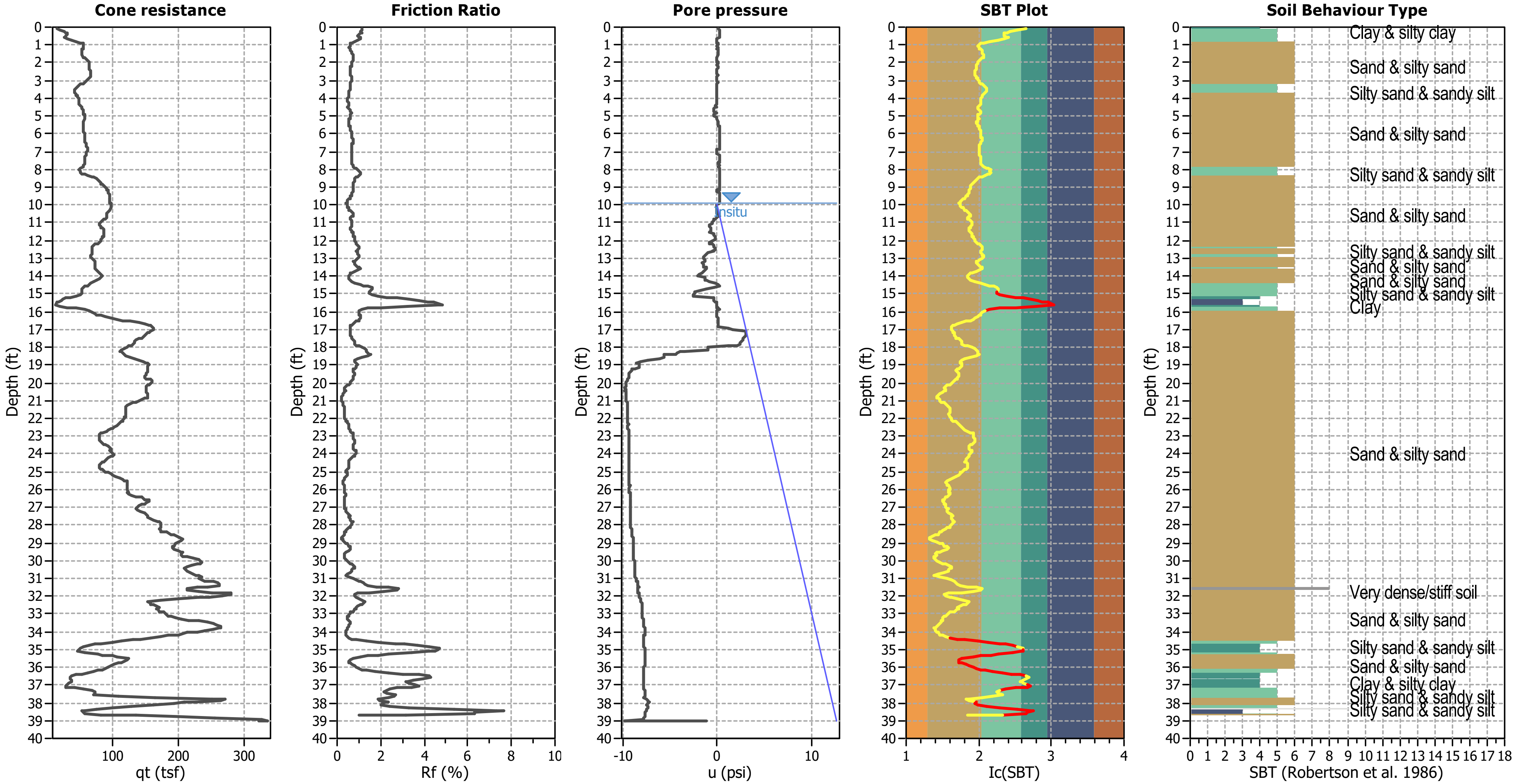






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



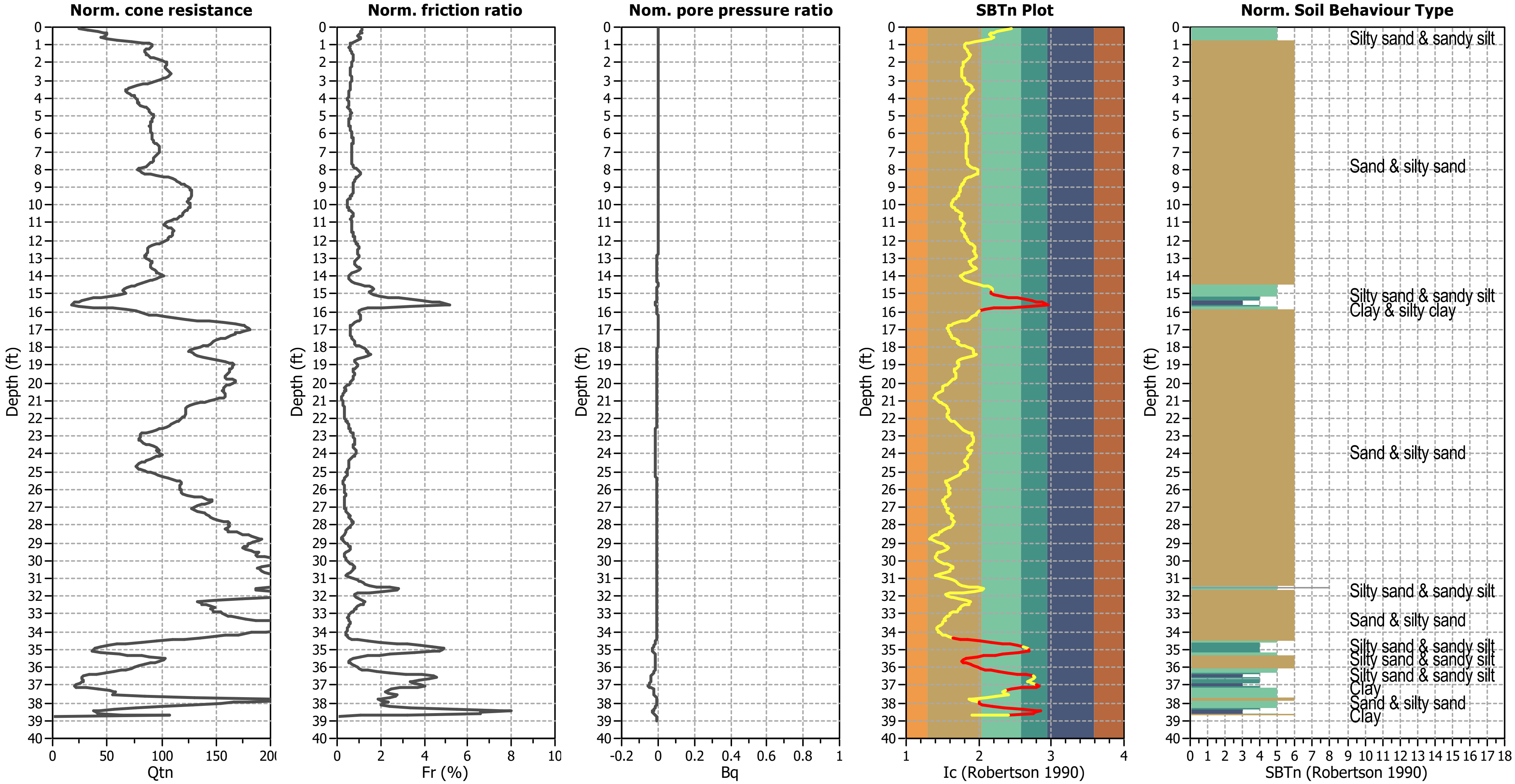
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.90 ft	Fill height:	N/A	Limit depth:	N/A

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)



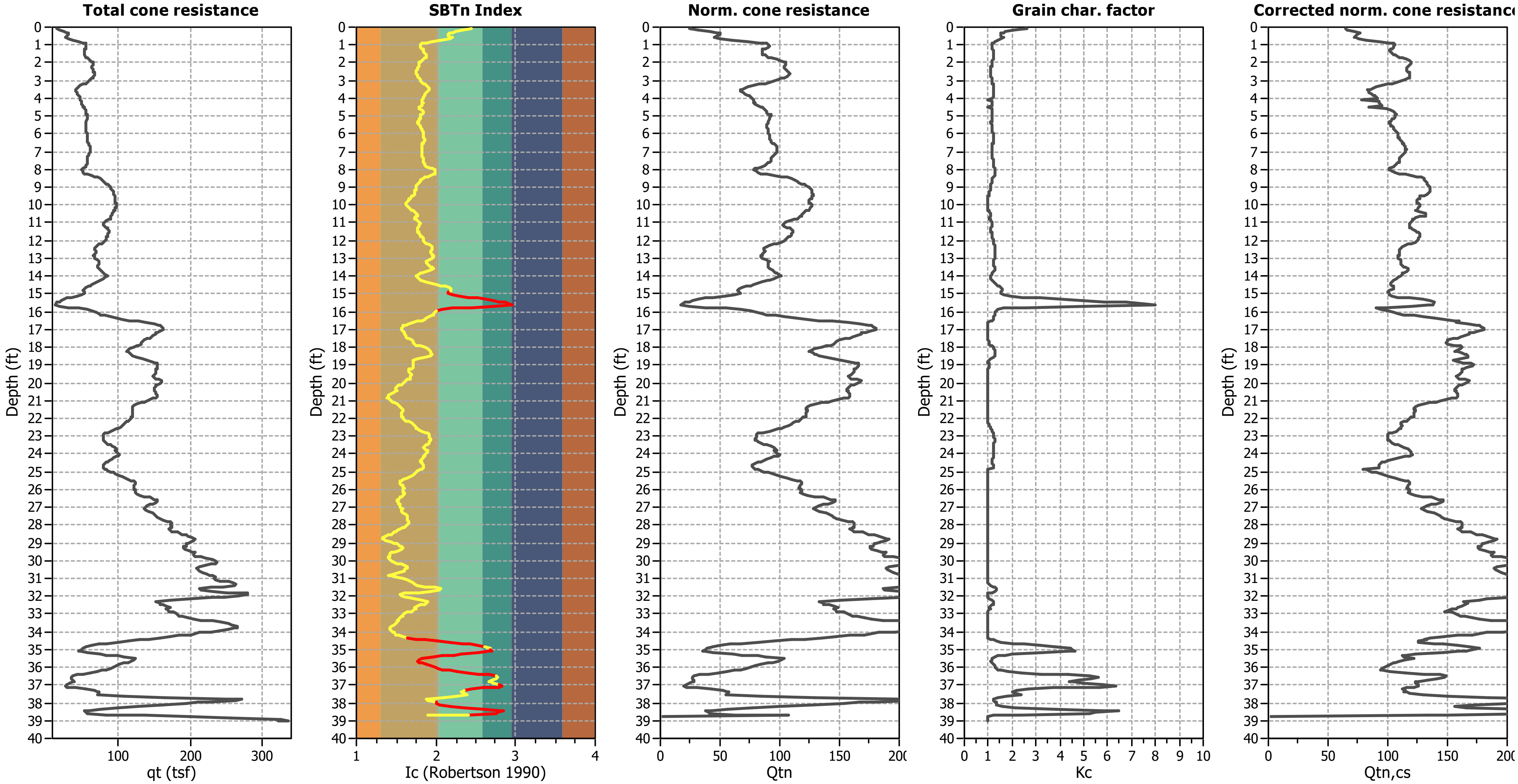
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.90 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

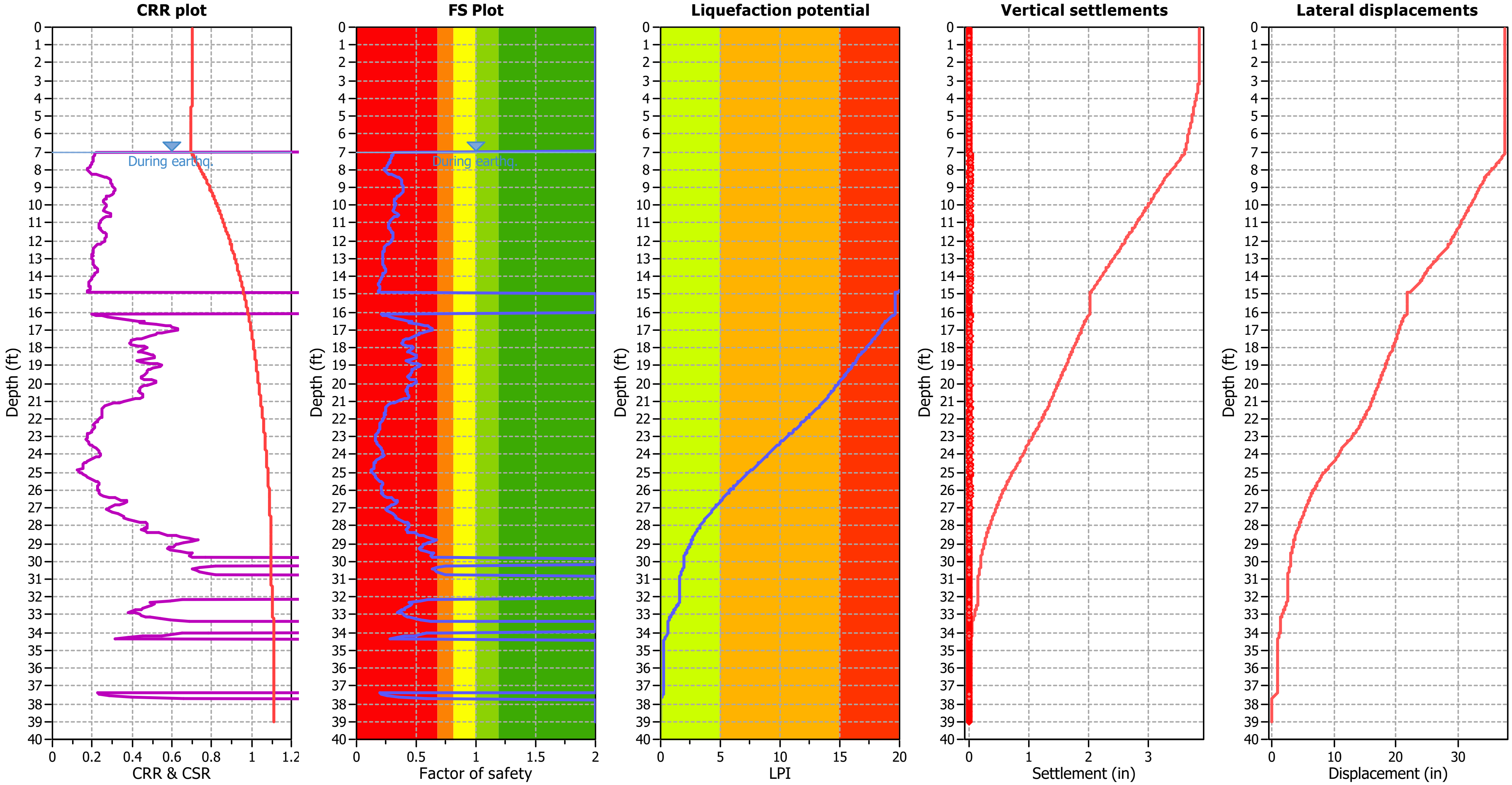
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.90 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.90 ft	Fill height:	N/A	Limit depth:	N/A

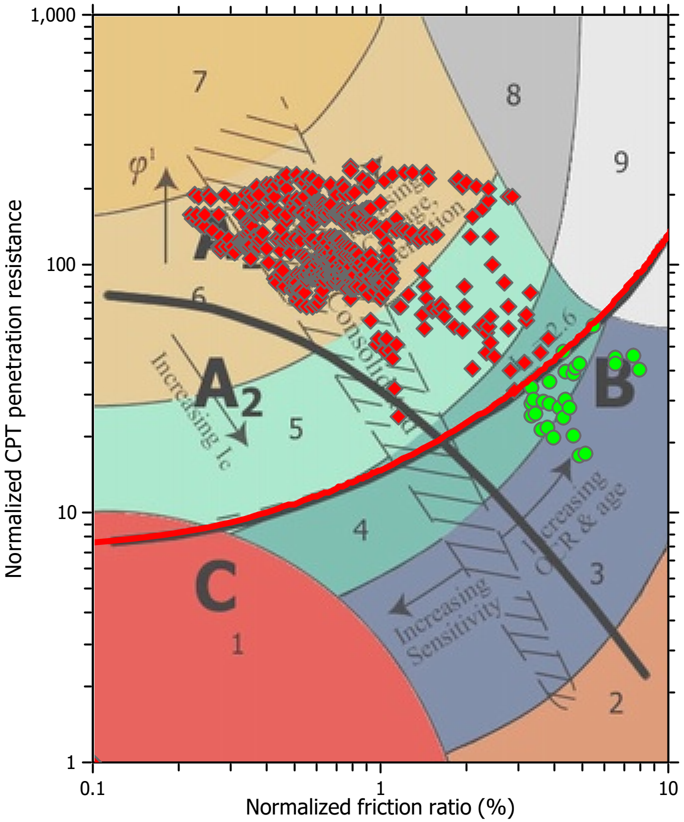
F.S. color scheme

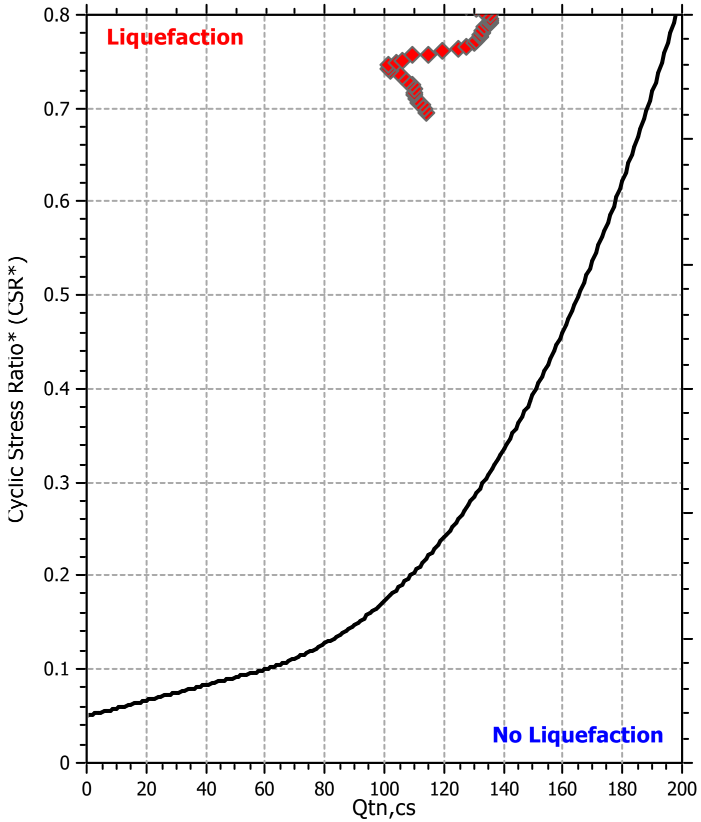
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

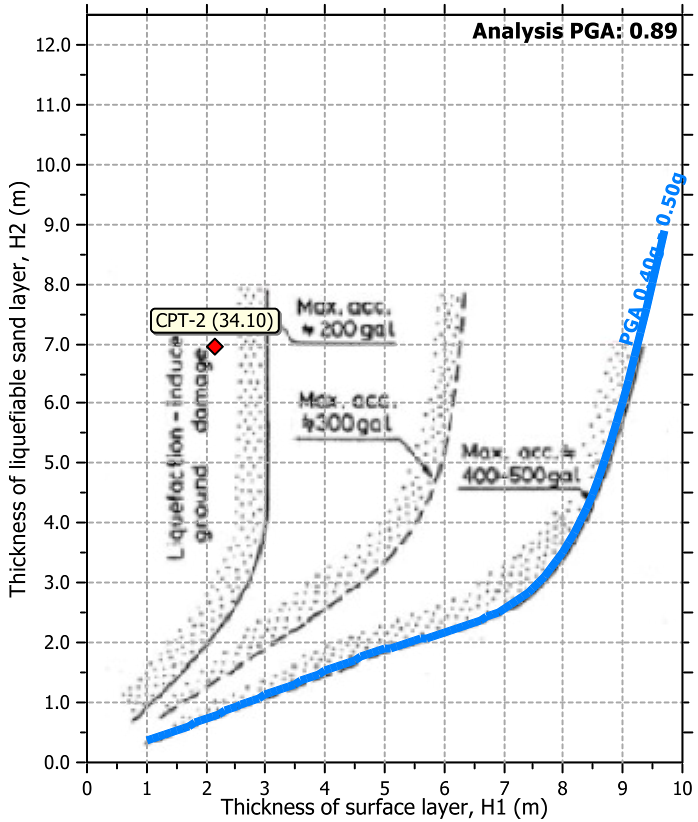
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



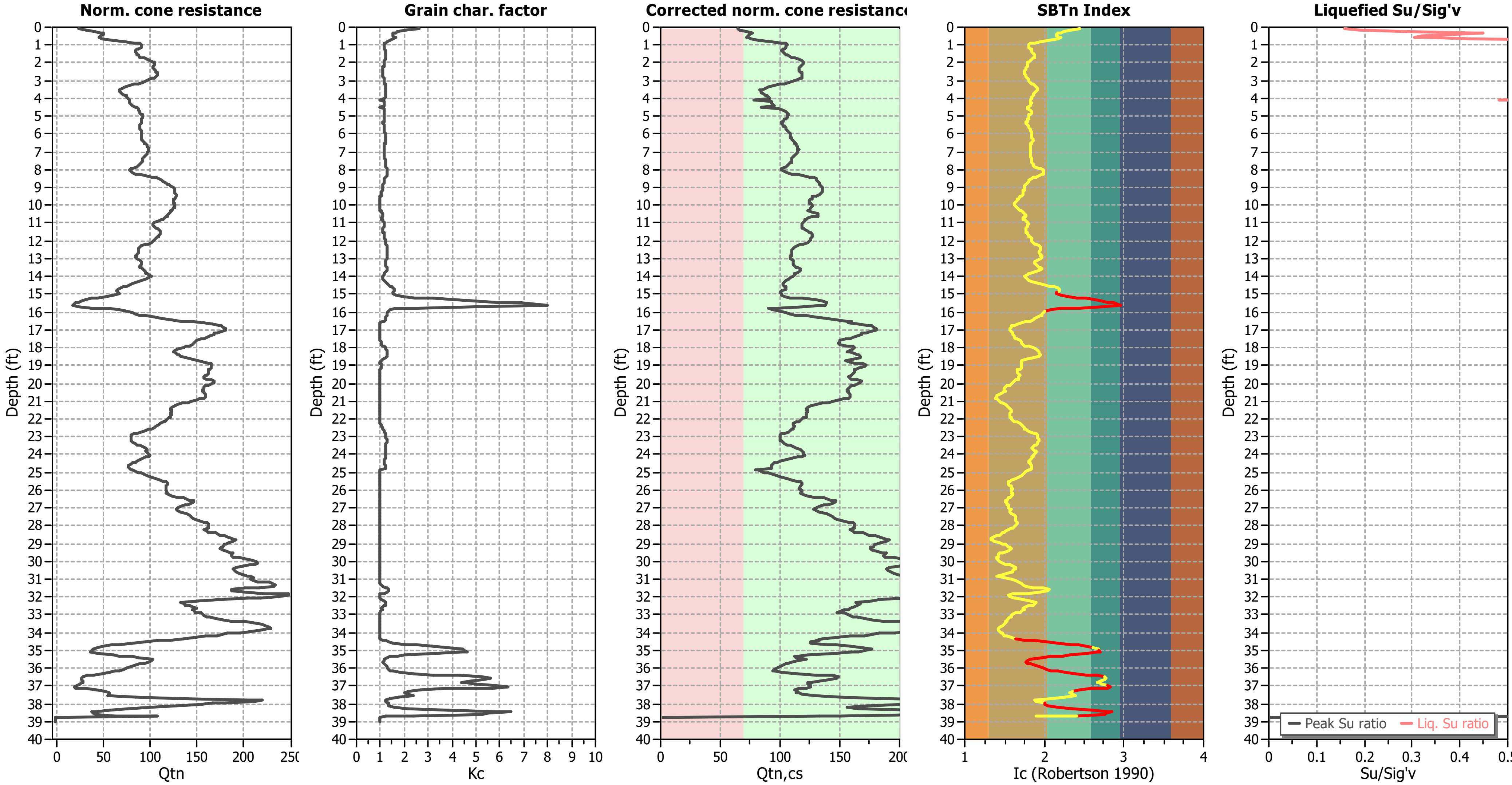




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.90 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

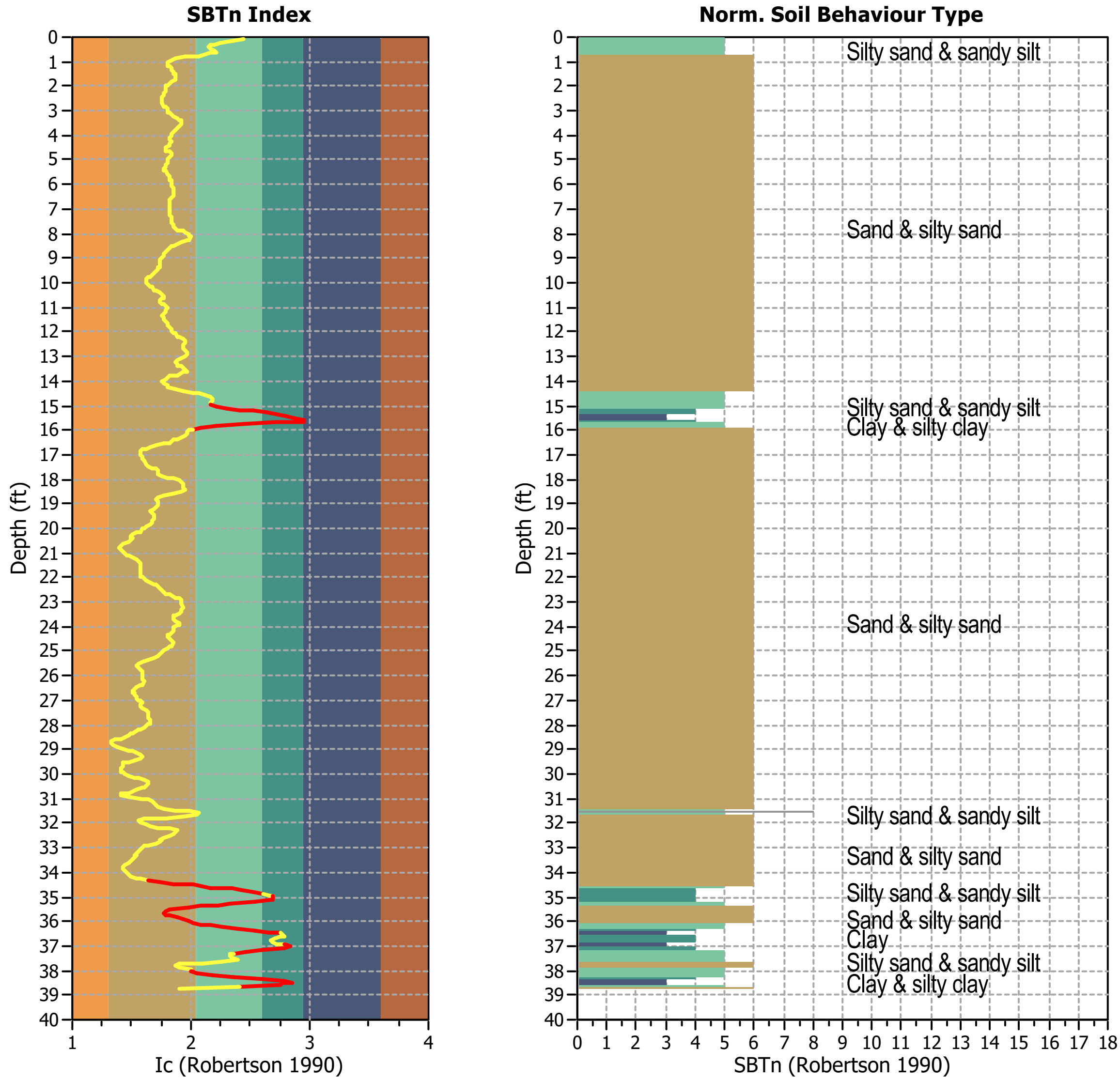
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.90 ft	Fill height:	N/A	Limit depth:	N/A

TRANSITION LAYER DETECTION ALGORITHM REPORT
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between 1.80 < I_c < 3.0) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.



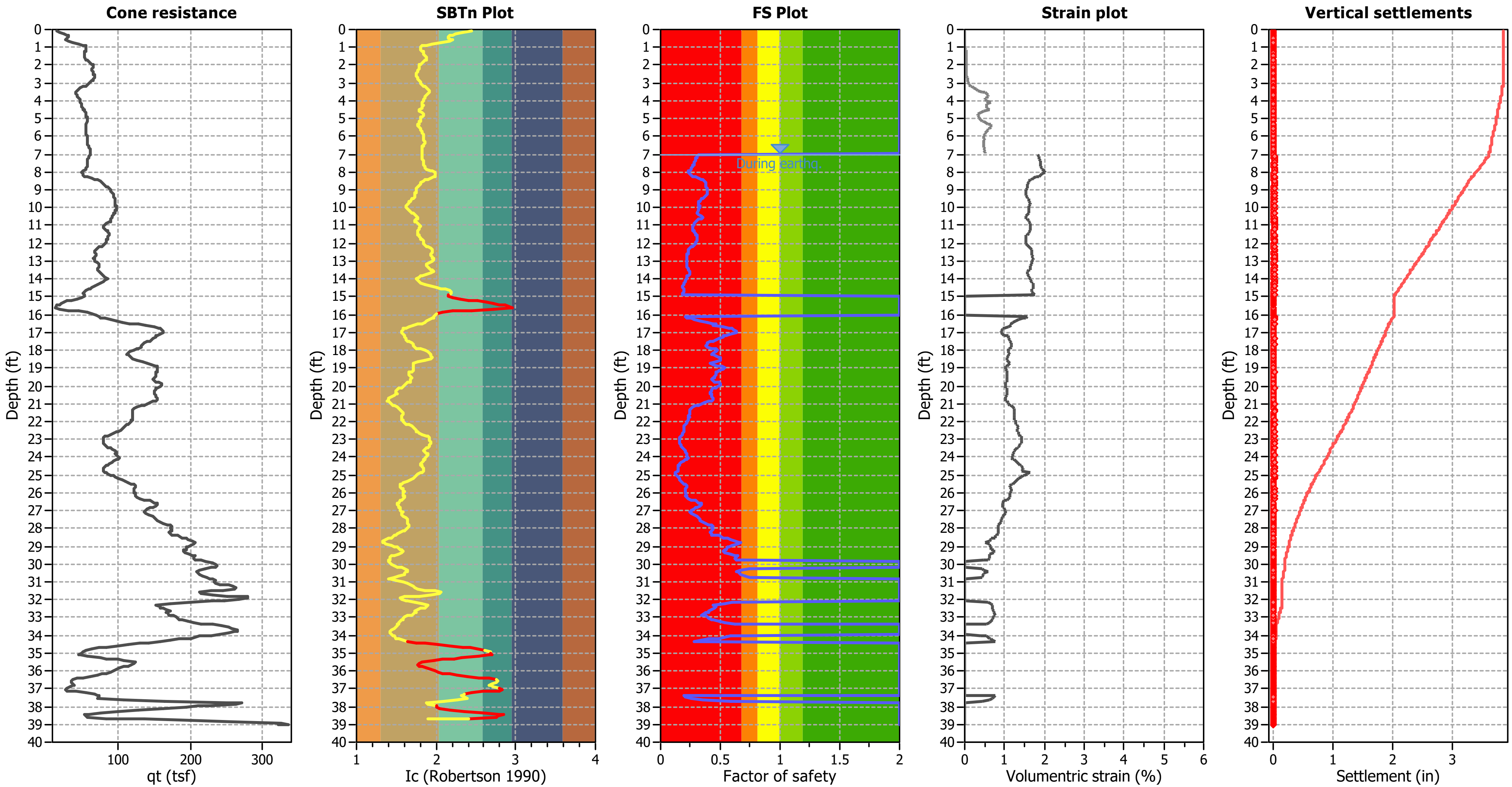
Transition layer algorithm properties

I_c minimum check value:	1.70
I_c maximum check value:	3.00
I_c change ratio value:	0.0250
Minimum number of points in layer:	4

General statistics

Total points in CPT file:	595
Total points excluded:	68
Exclusion percentage:	11.43%
Number of layers detected:	8

Estimation of post-earthquake settlements

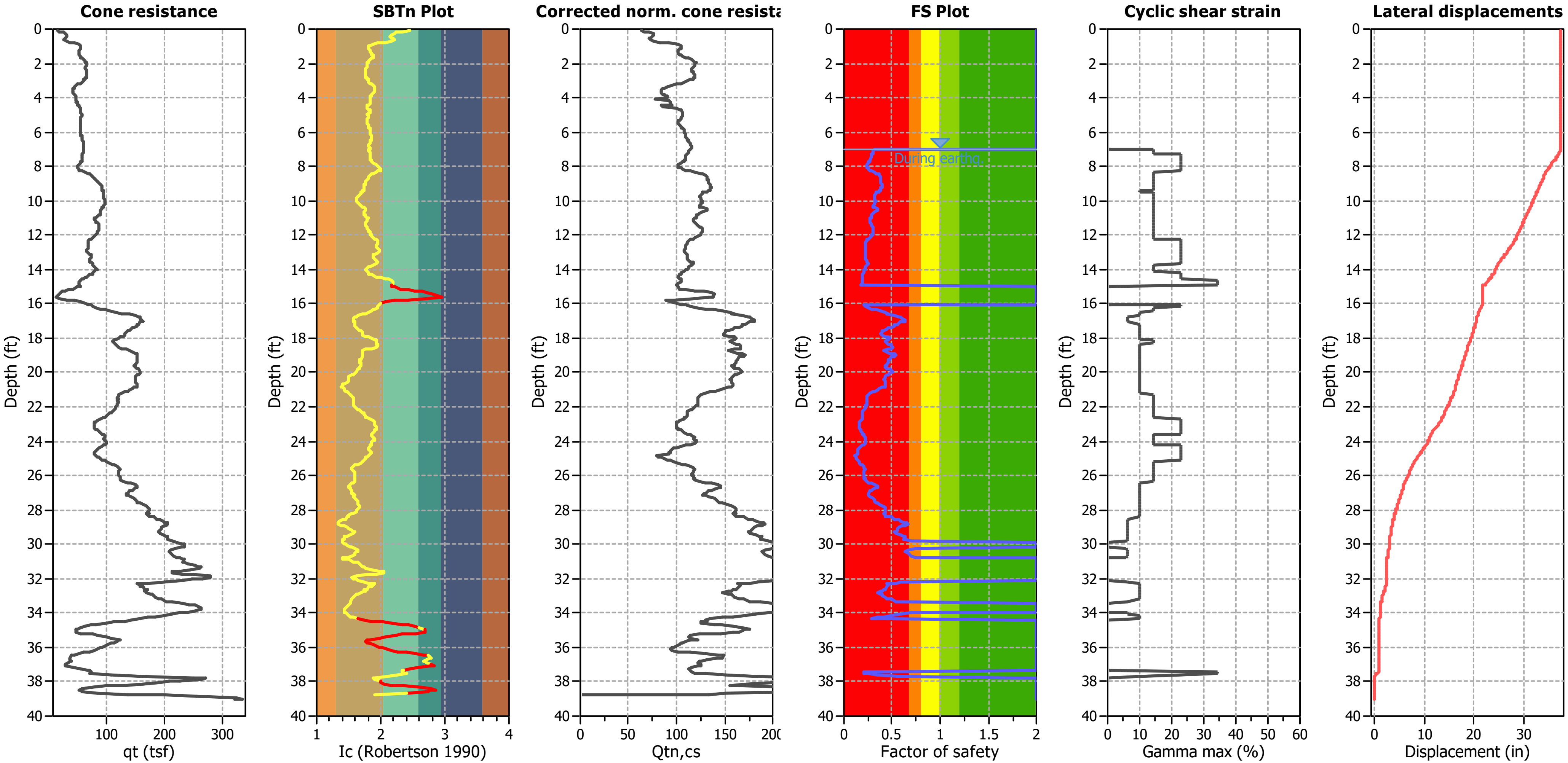


Abbreviations

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

Estimation of post-earthquake lateral Displacements

Geometric parameters: Gently sloping ground without free face (Slope 0.70 %)

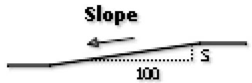


Abbreviations

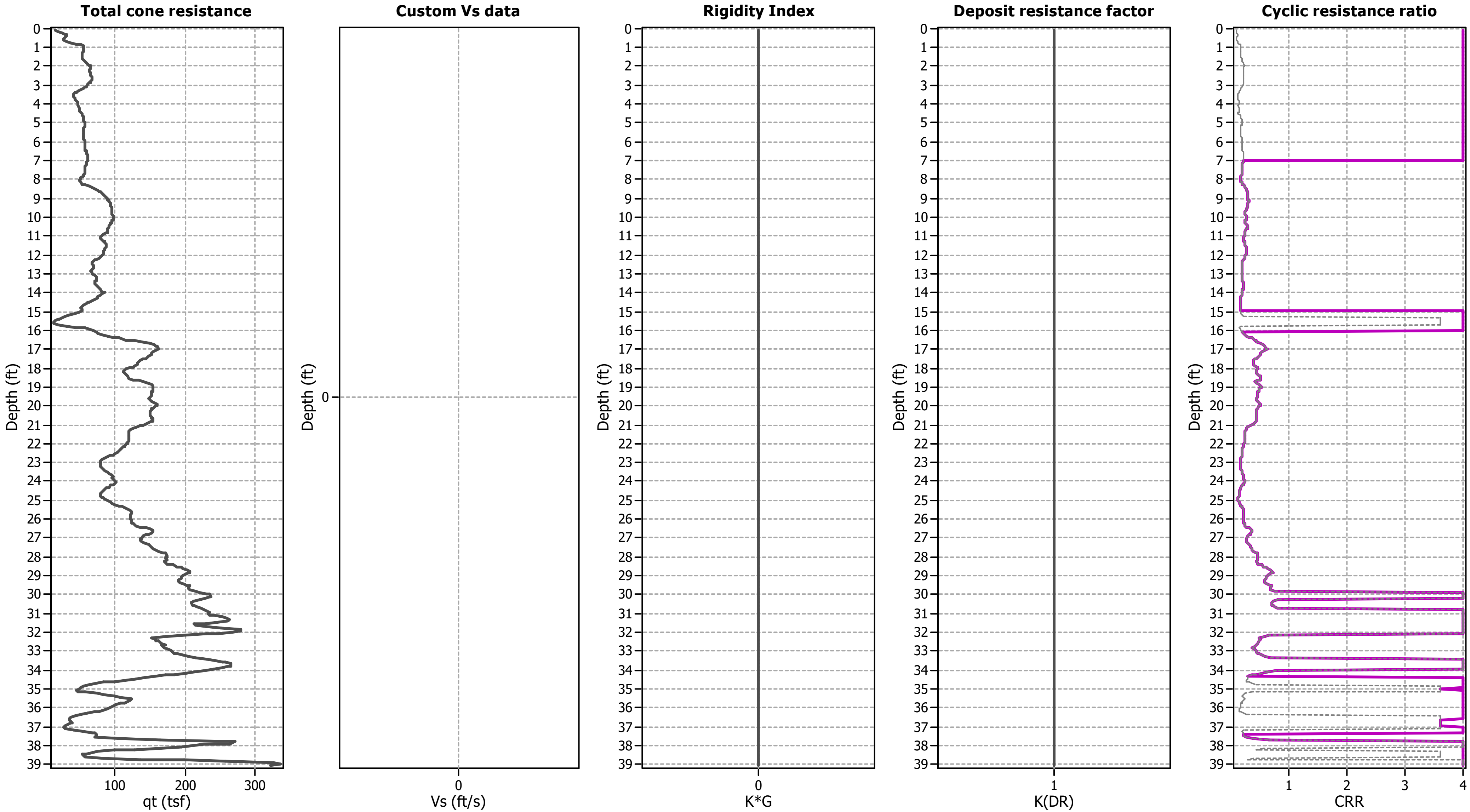
q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance

F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

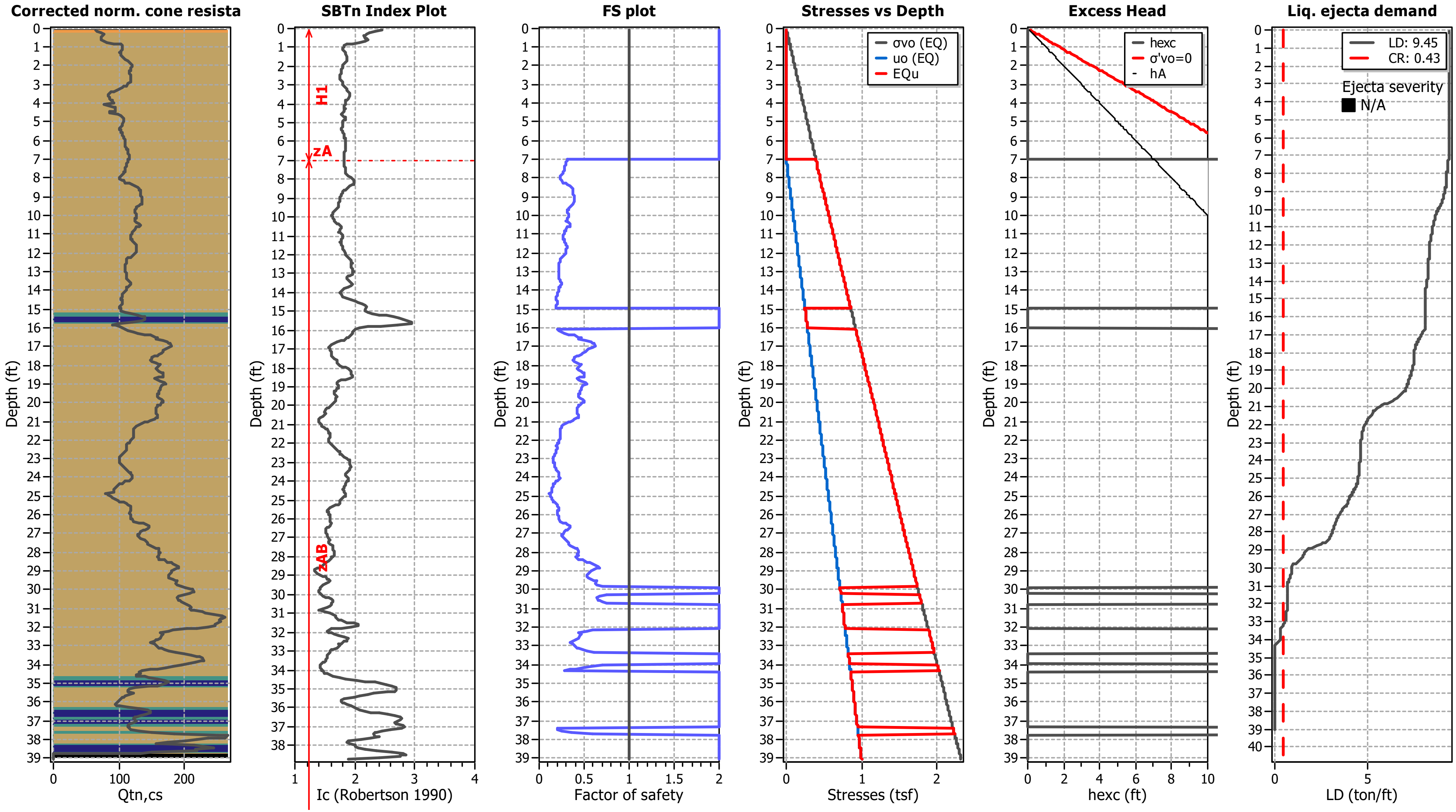
Surface condition



Aging Calculation Estimation



Ejecta Severity Estimation



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

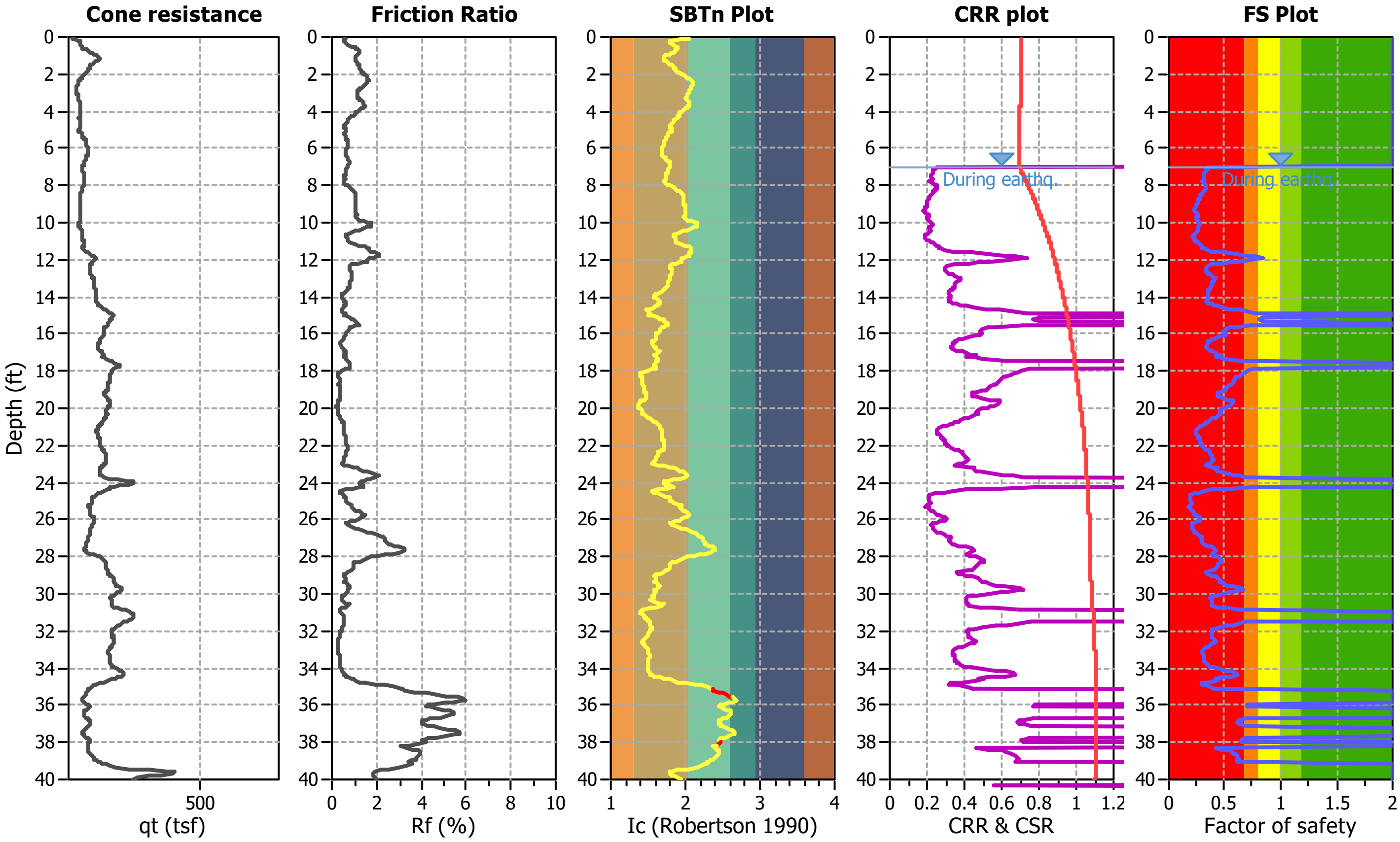
LIQUEFACTION ANALYSIS REPORT

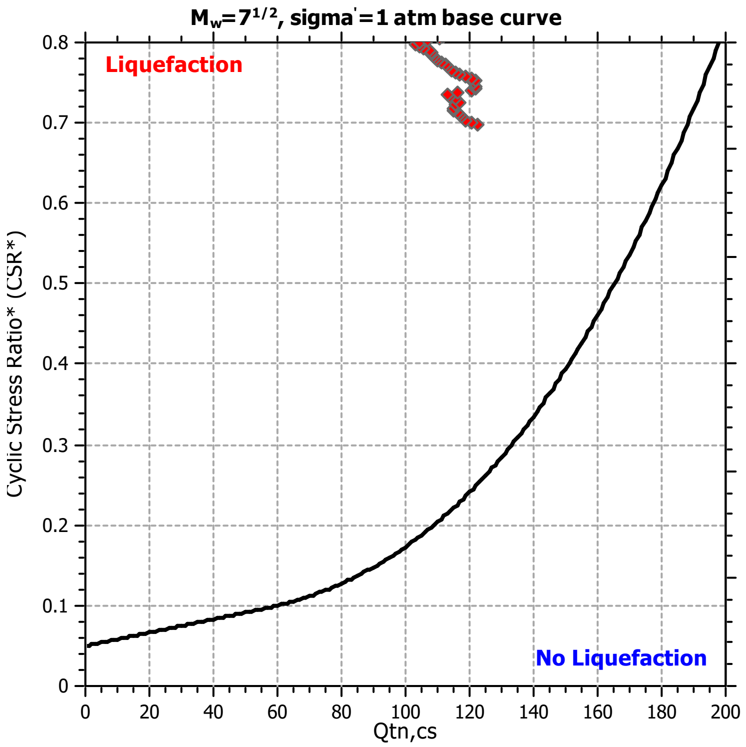
Project title : Petra Geosciences / Apple Canyon **Location : Lake Hemet, CA**

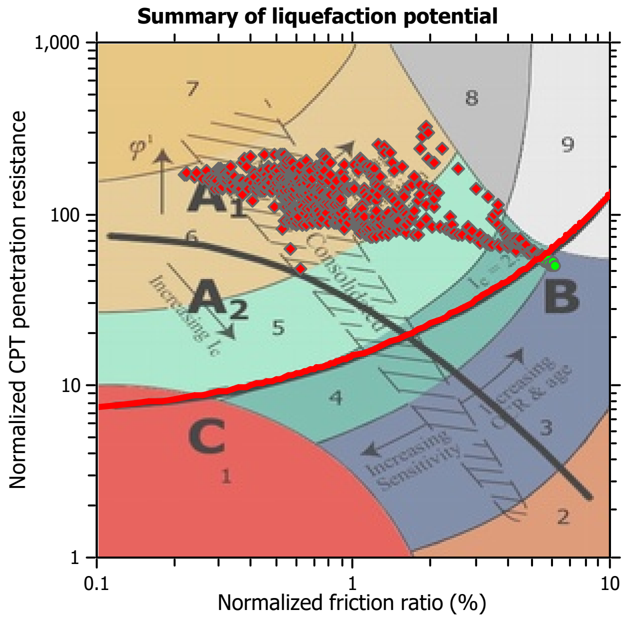
CPT file : CPT-3

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	9.70 ft	Use fill:	No	Clay like behavior	
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	8.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.89	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

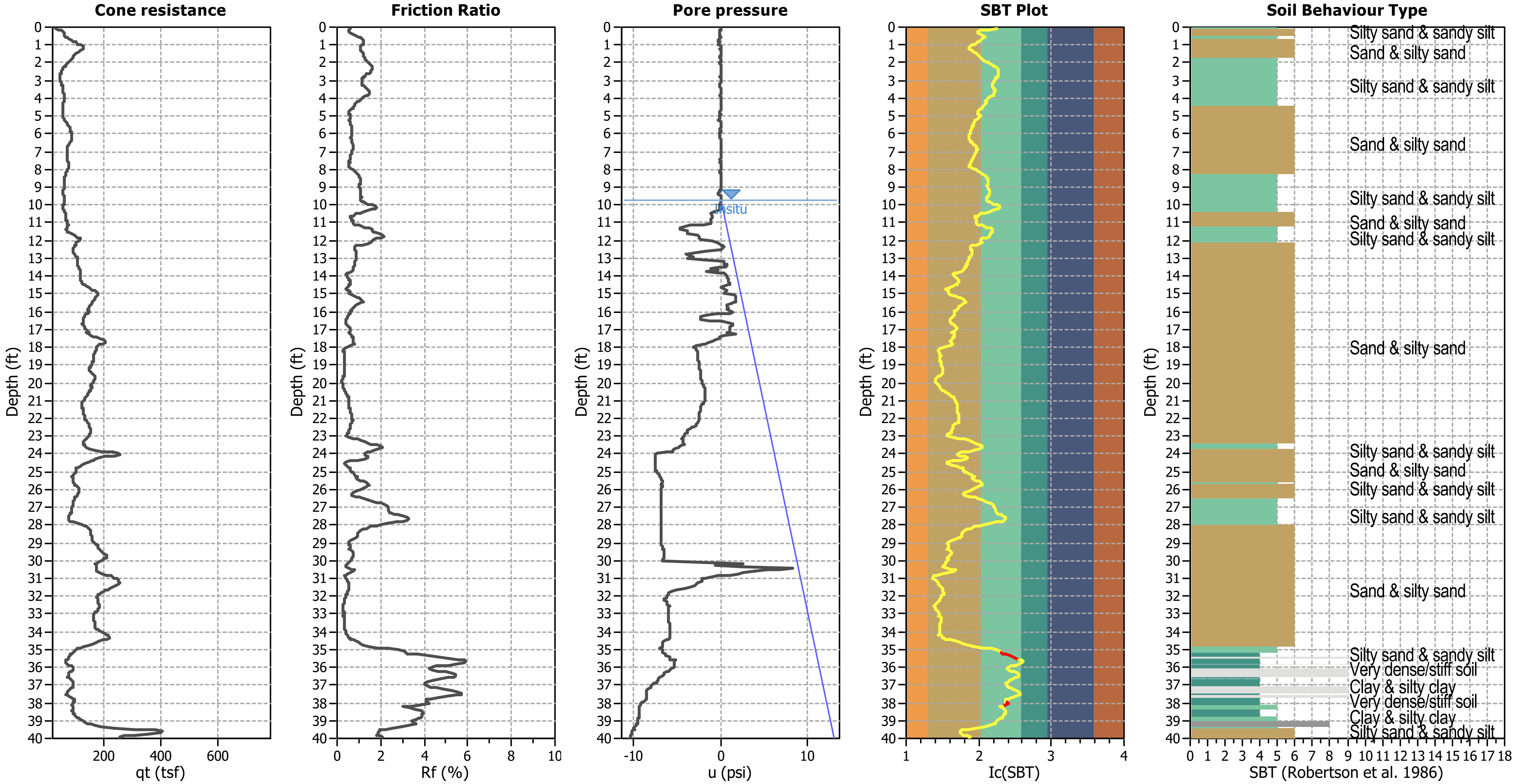






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



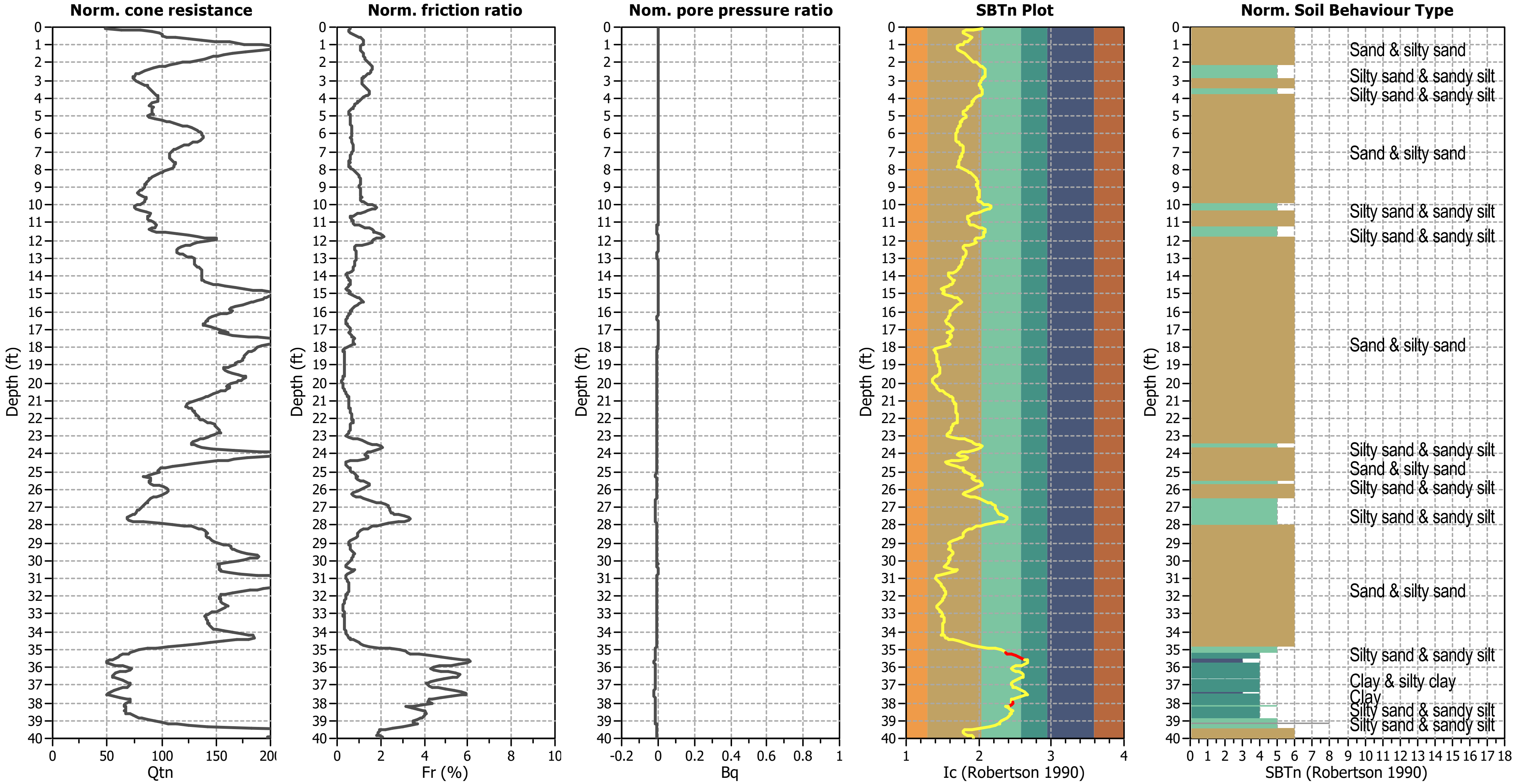
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.70 ft	Fill height:	N/A	Limit depth:	N/A

SBT 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

CPT basic interpretation plots (normalized)



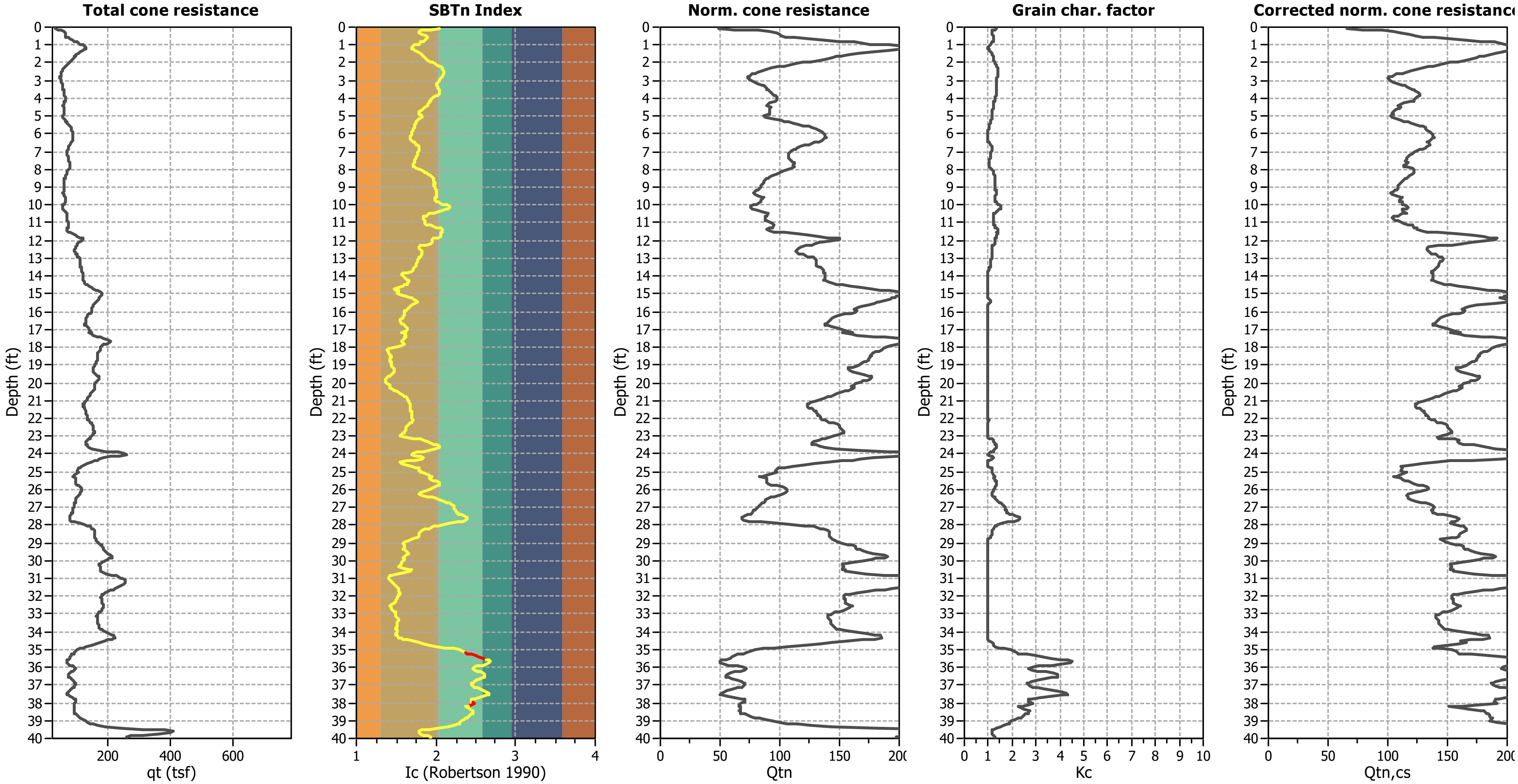
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.70 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

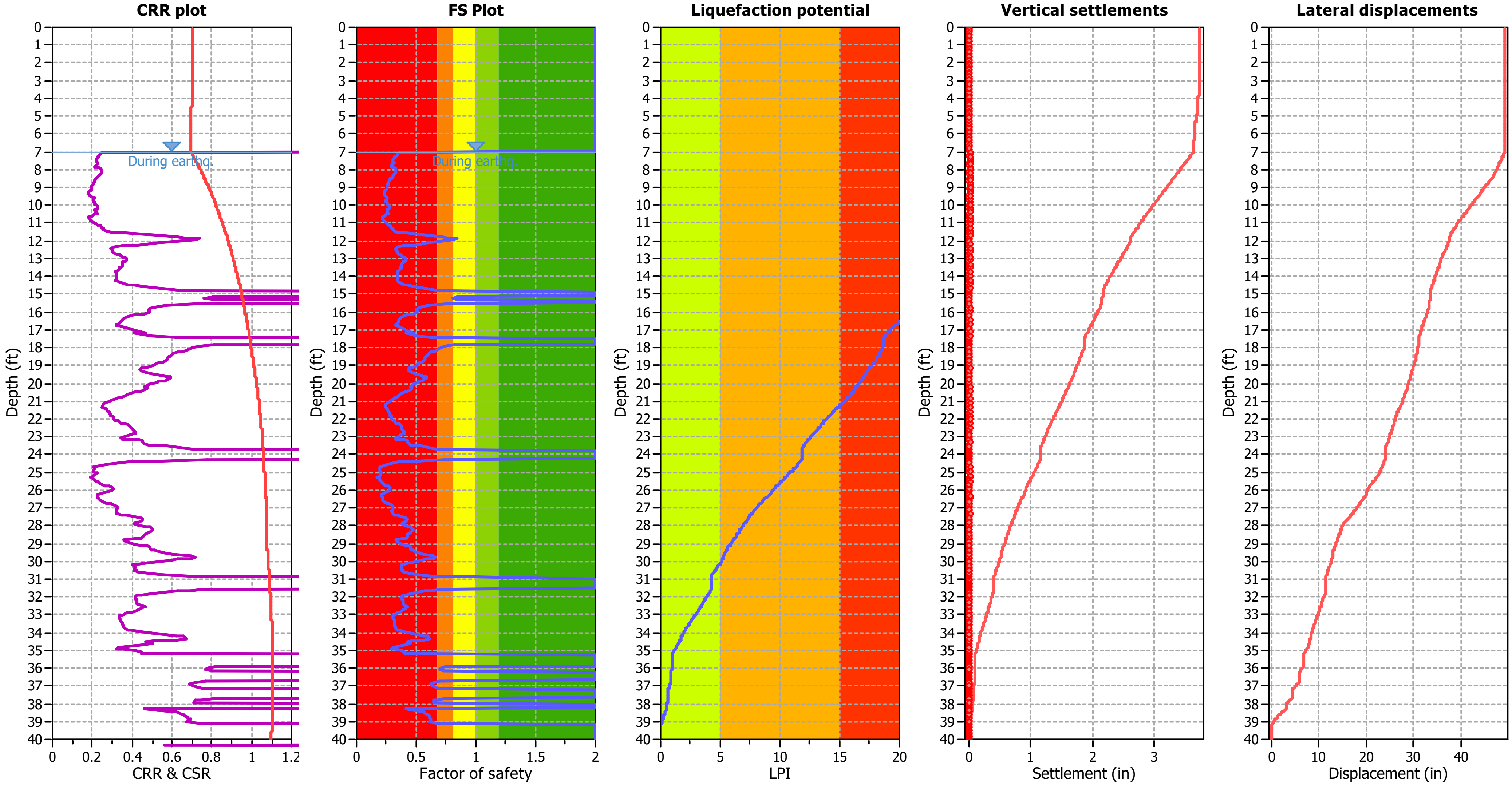
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.70 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.70 ft	Fill height:	N/A	Limit depth:	N/A

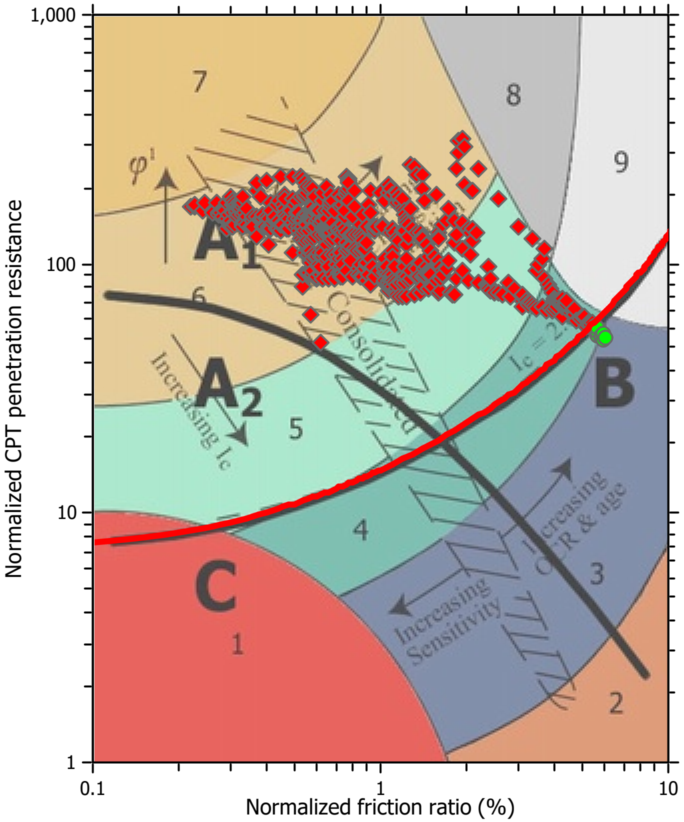
F.S. color scheme

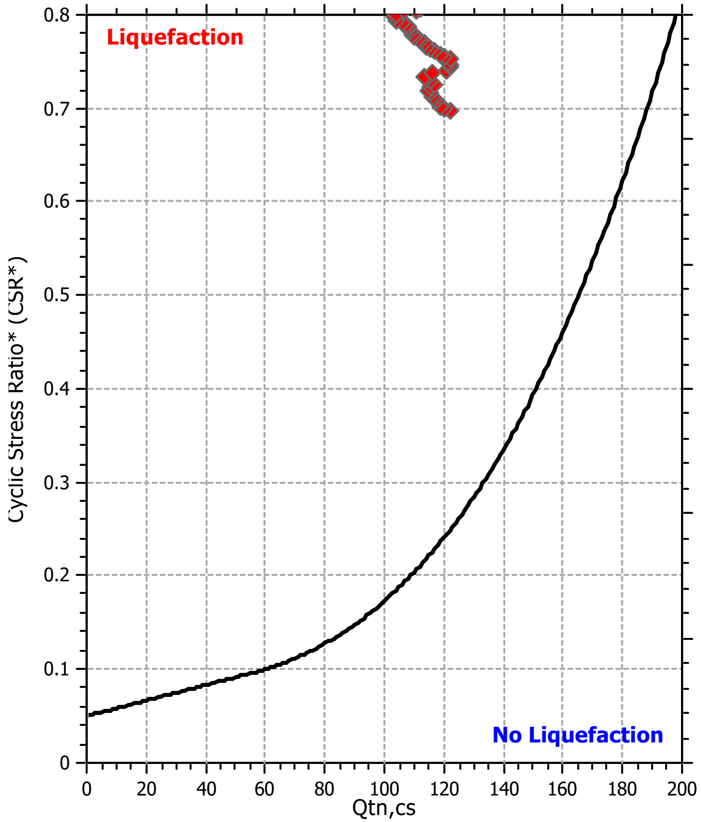
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

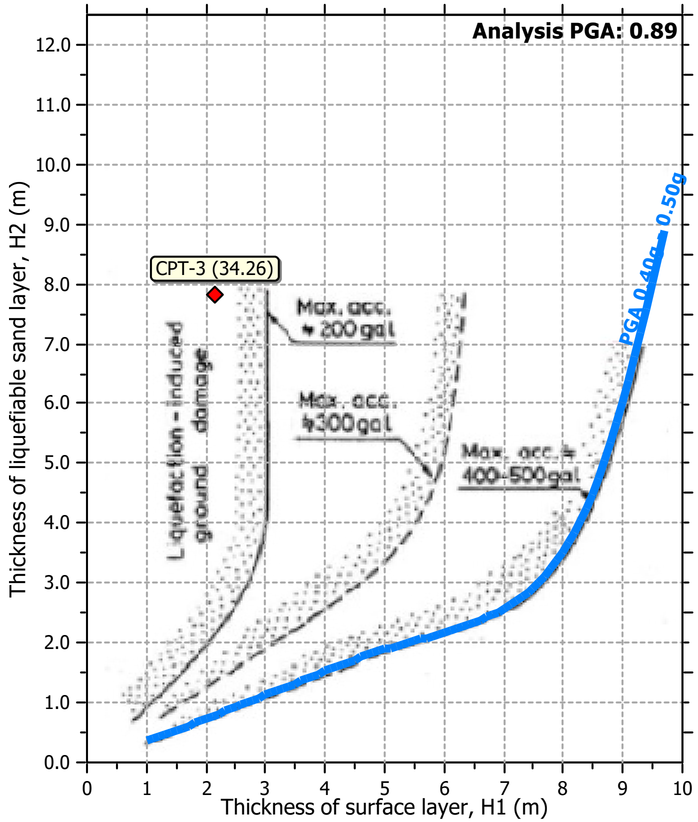
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



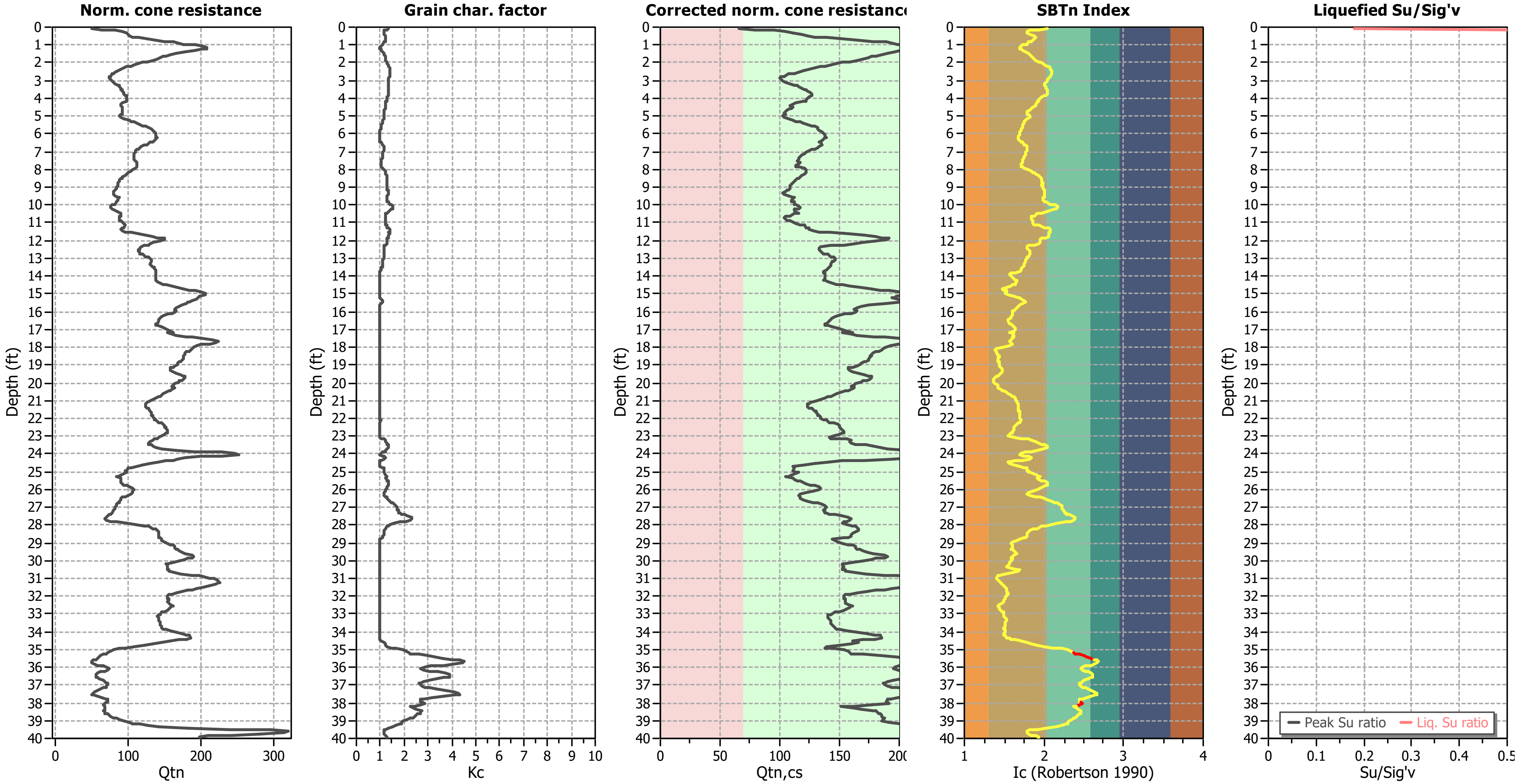




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.70 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

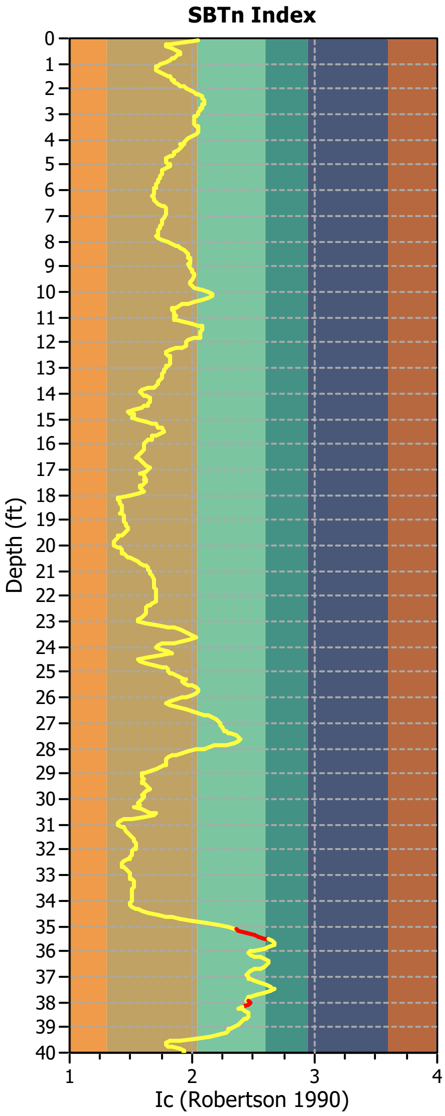
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.70 ft	Fill height:	N/A	Limit depth:	N/A

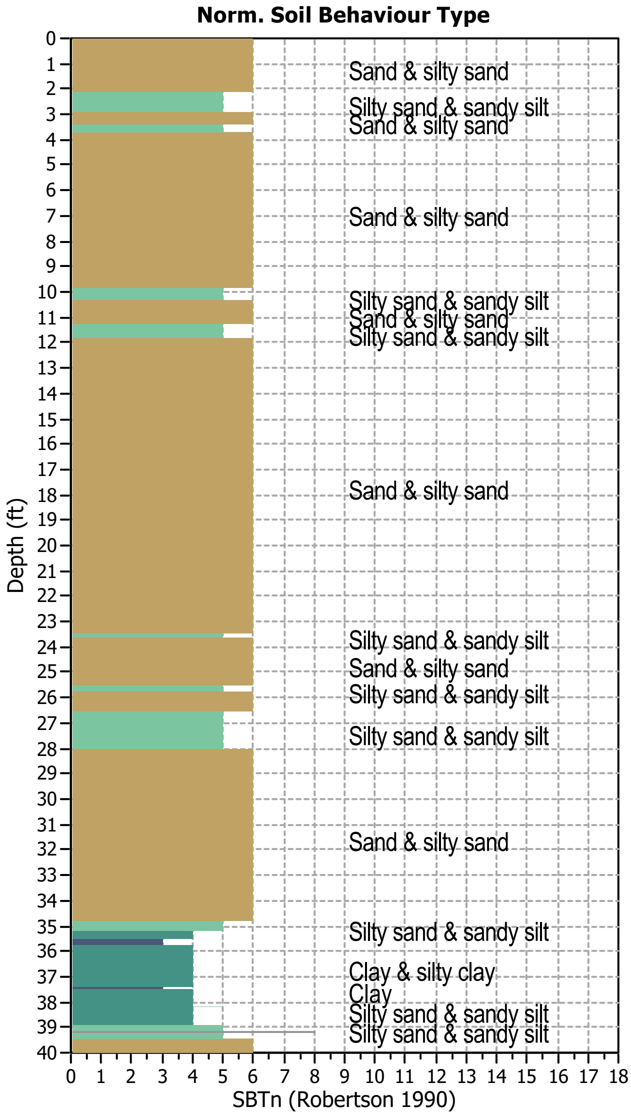
TRANSITION LAYER DETECTION ALGORITHM REPORT
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between 1.80 < I_c < 3.0) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.





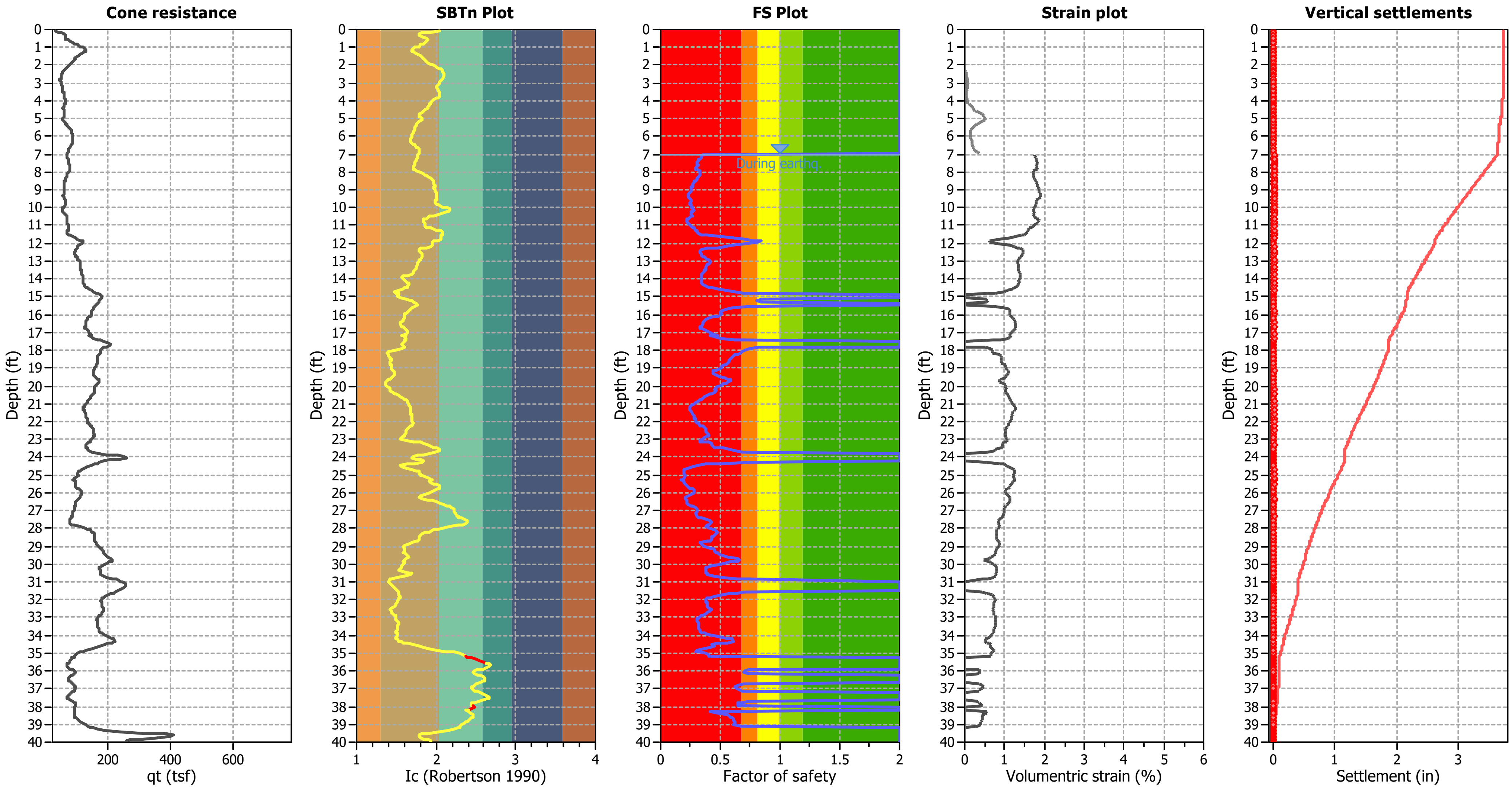
Transition layer algorithm properties

I_c minimum check value:	1.70
I_c maximum check value:	3.00
I_c change ratio value:	0.0250
Minimum number of points in layer:	4

General statistics

Total points in CPT file:	618
Total points excluded:	11
Exclusion percentage:	1.78%
Number of layers detected:	2

Estimation of post-earthquake settlements

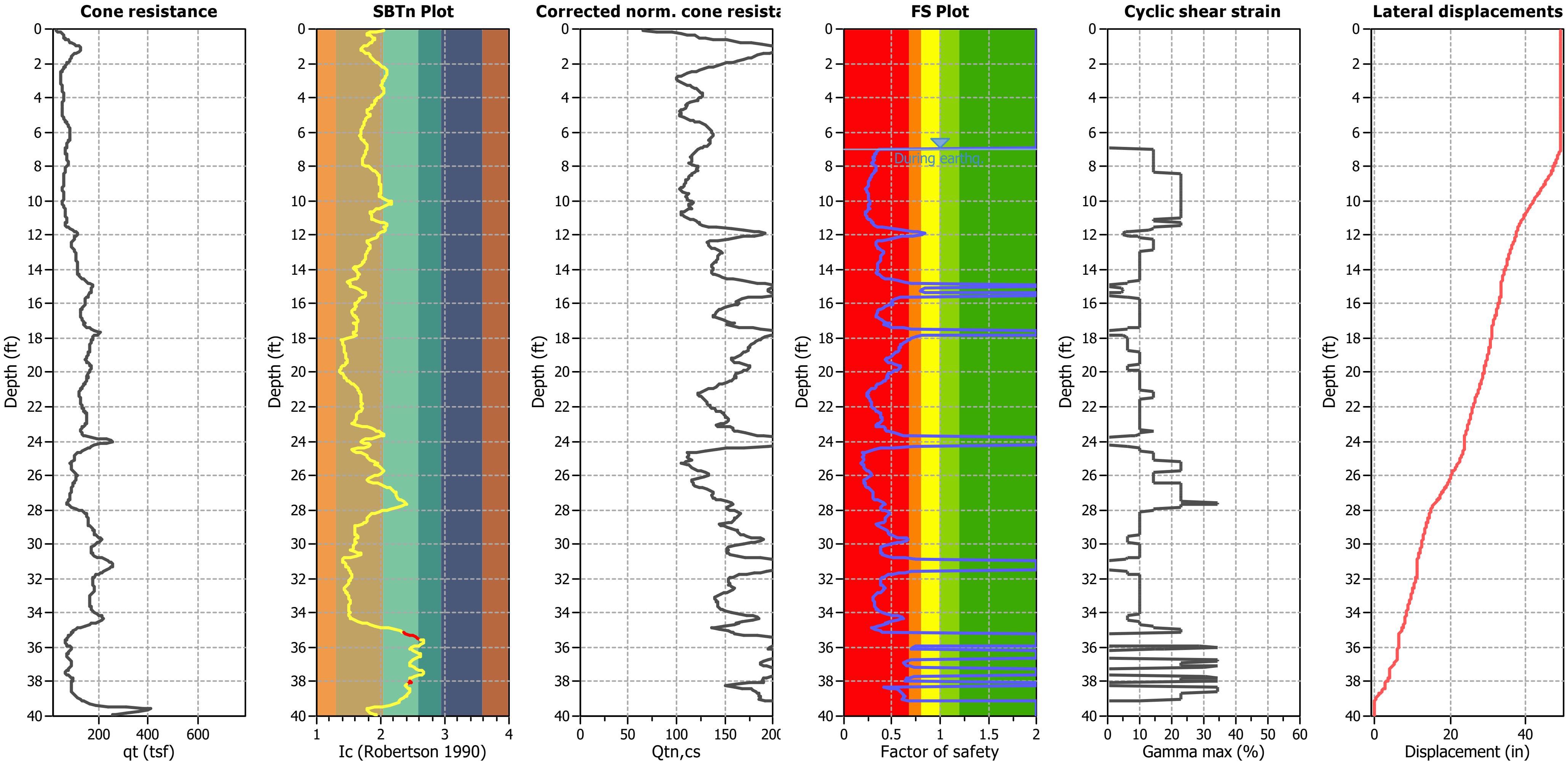


Abbreviations

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

Estimation of post-earthquake lateral Displacements

Geometric parameters: Gently sloping ground without free face (Slope 0.85 %)

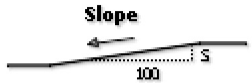


Abbreviations

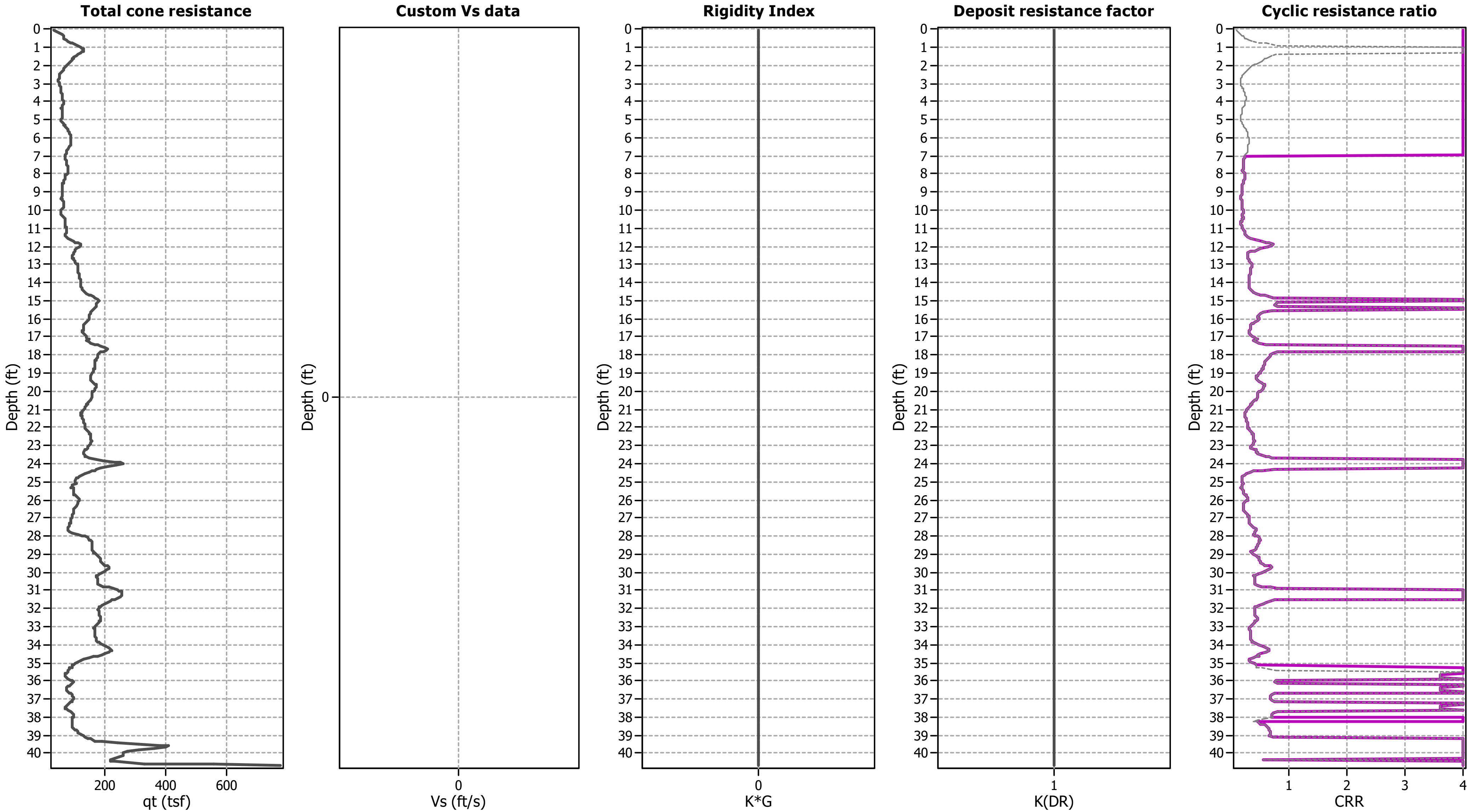
q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance

F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

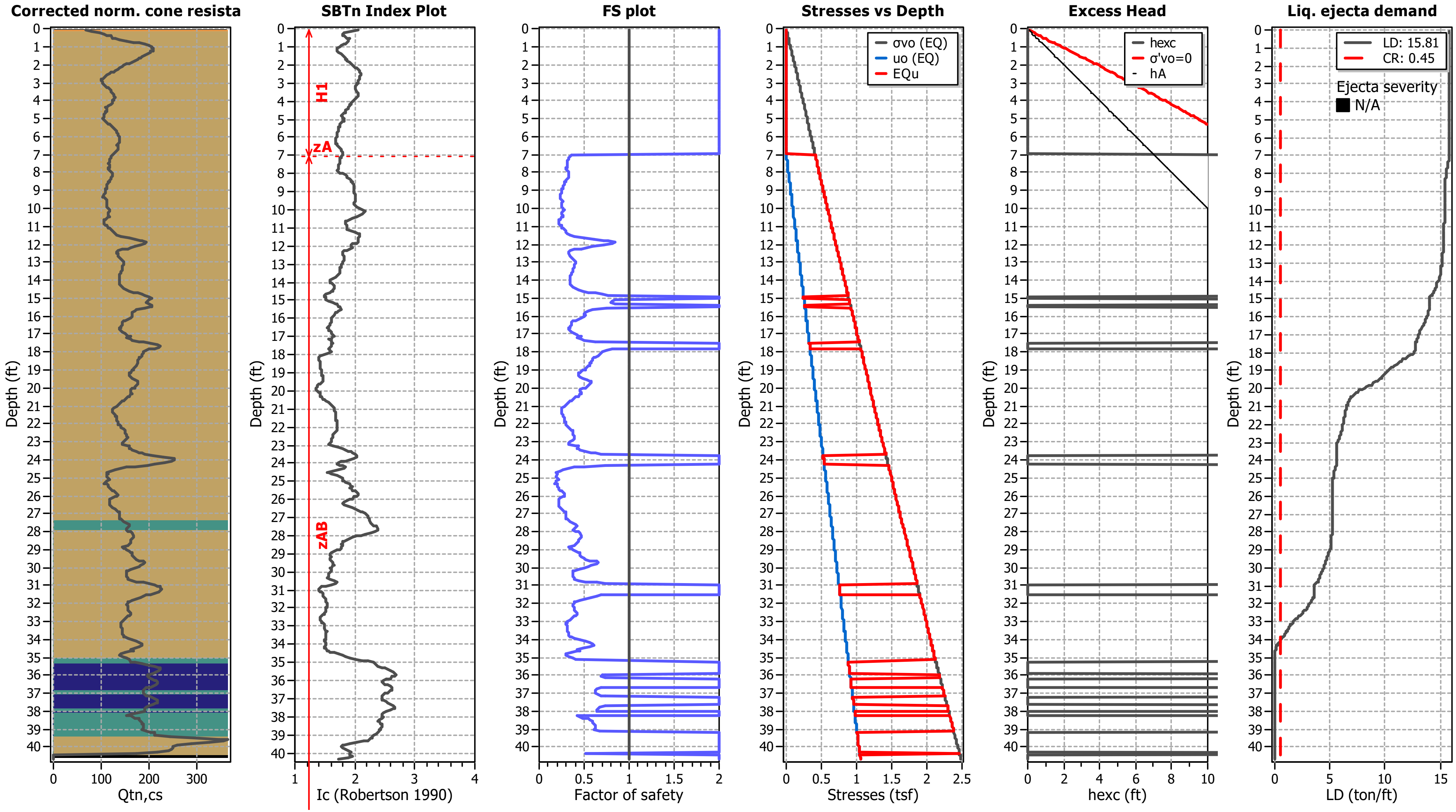
Surface condition



Aging Calculation Estimation



Ejecta Severity Estimation



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

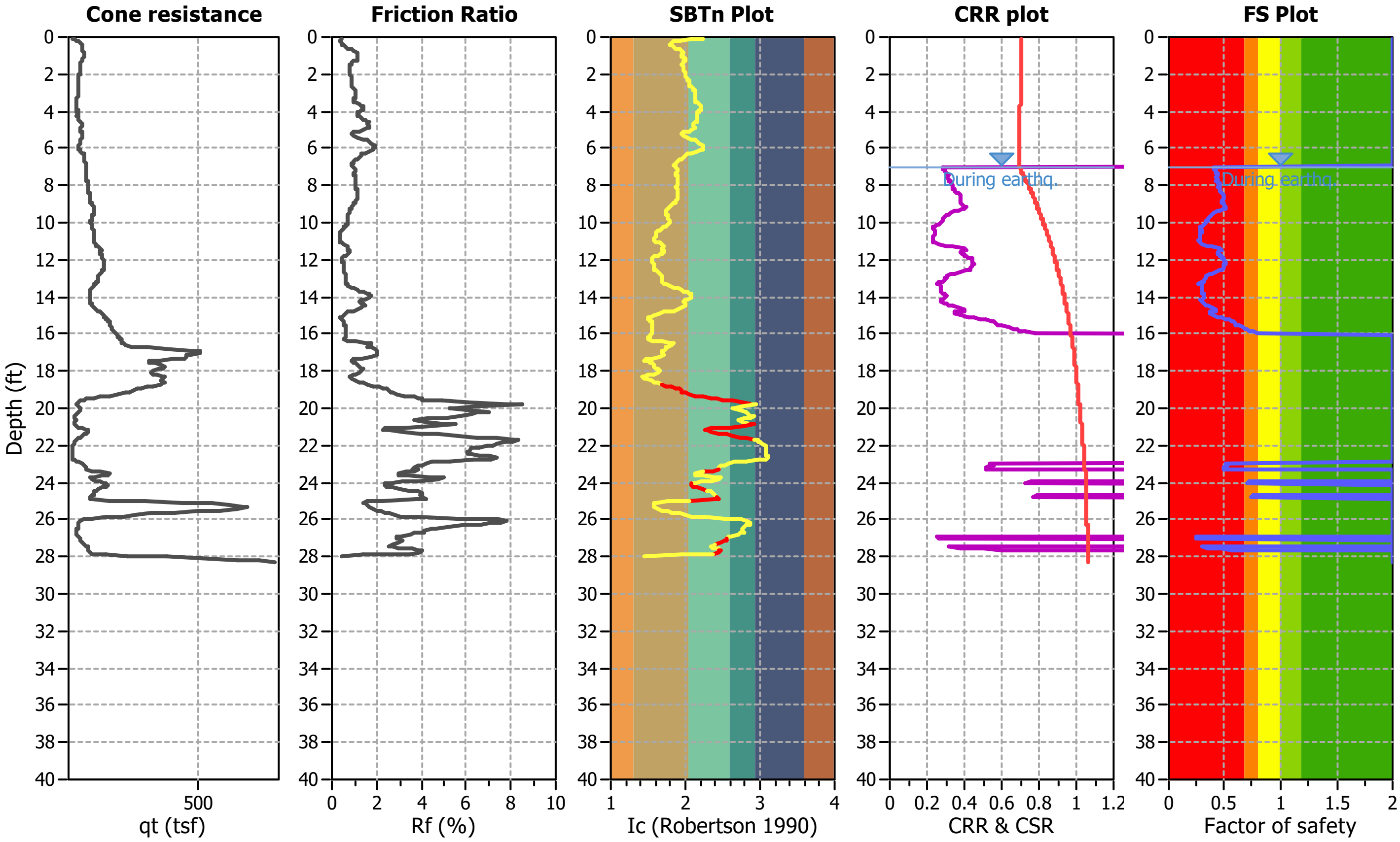
LIQUEFACTION ANALYSIS REPORT

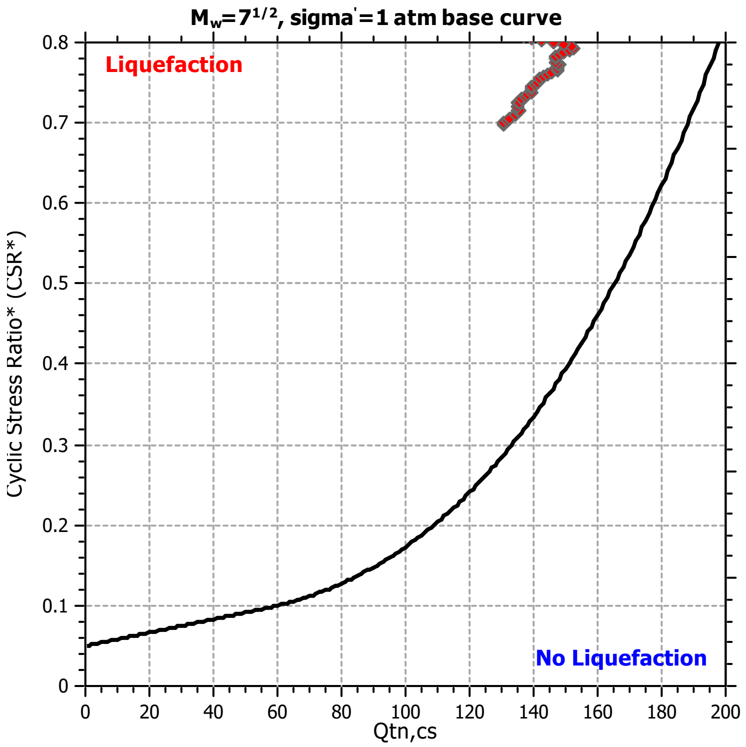
Project title : Petra Geosciences / Apple Canyon **Location : Lake Hemet, CA**

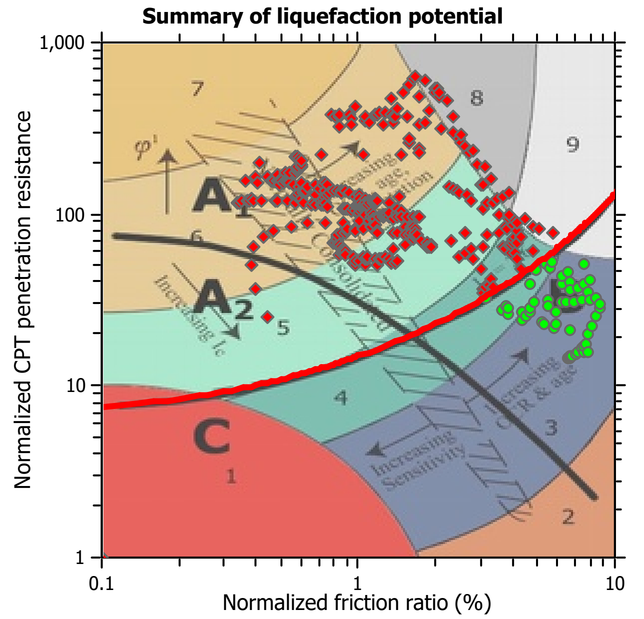
CPT file : CPT-4

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	11.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	8.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.89	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

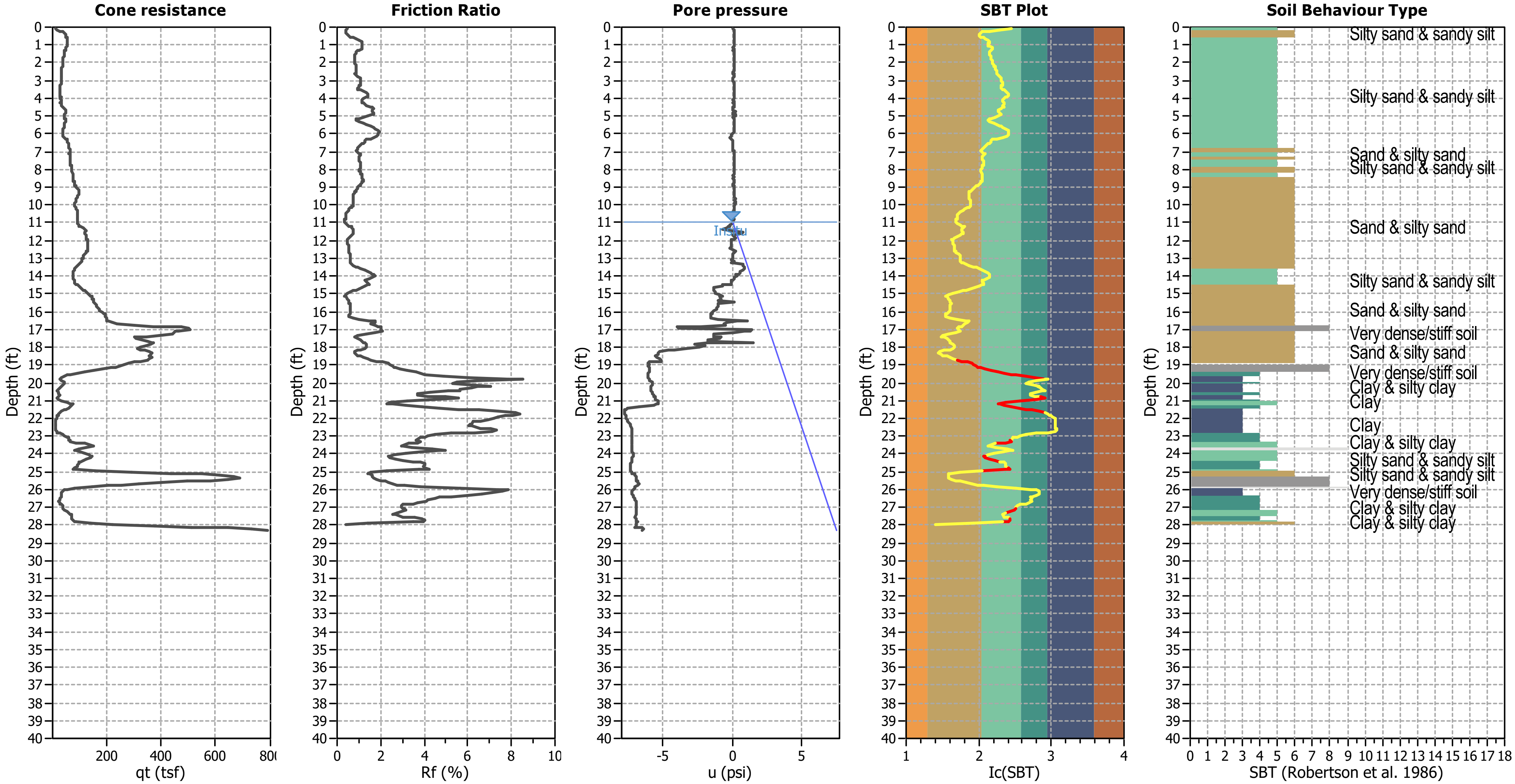






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



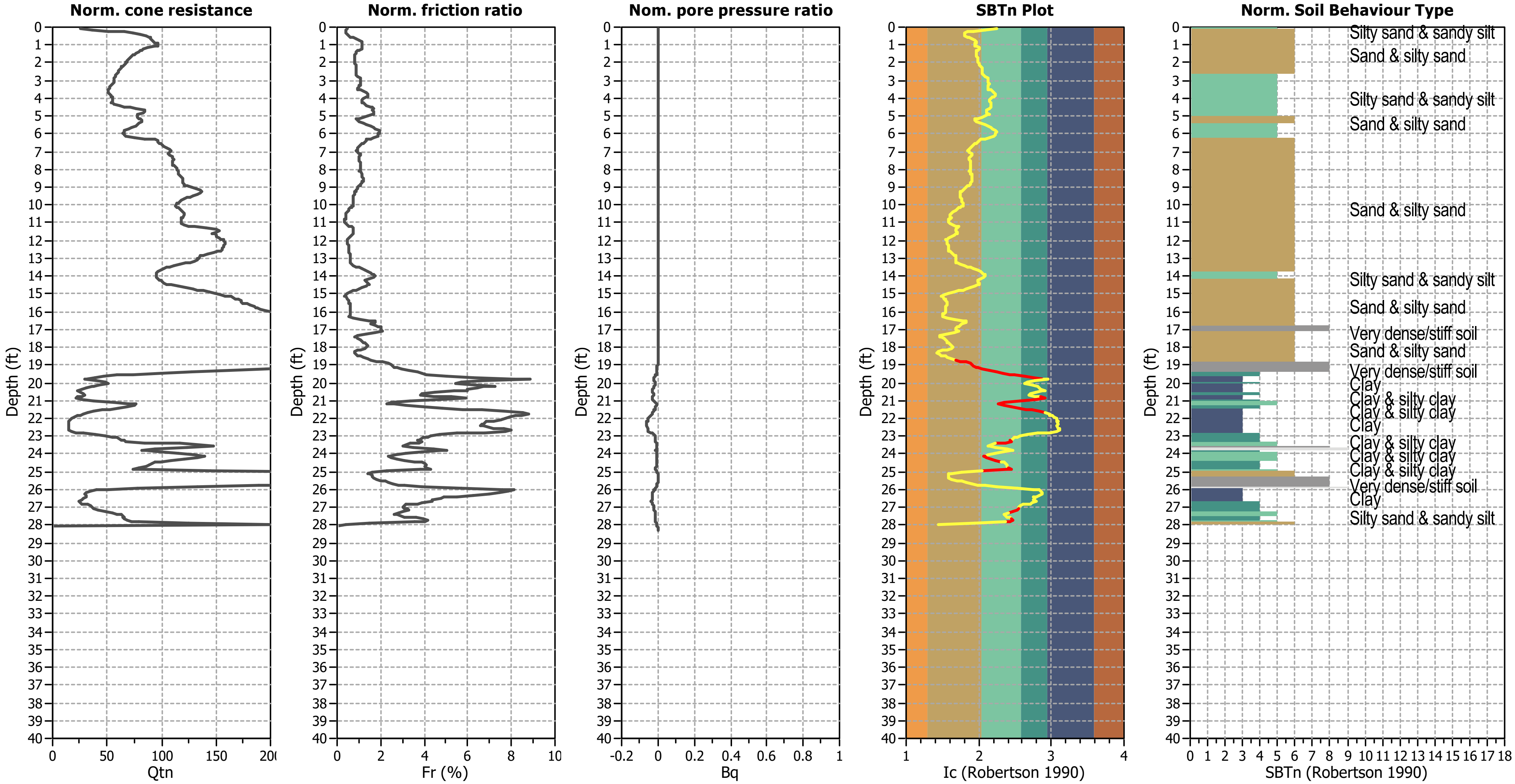
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

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)



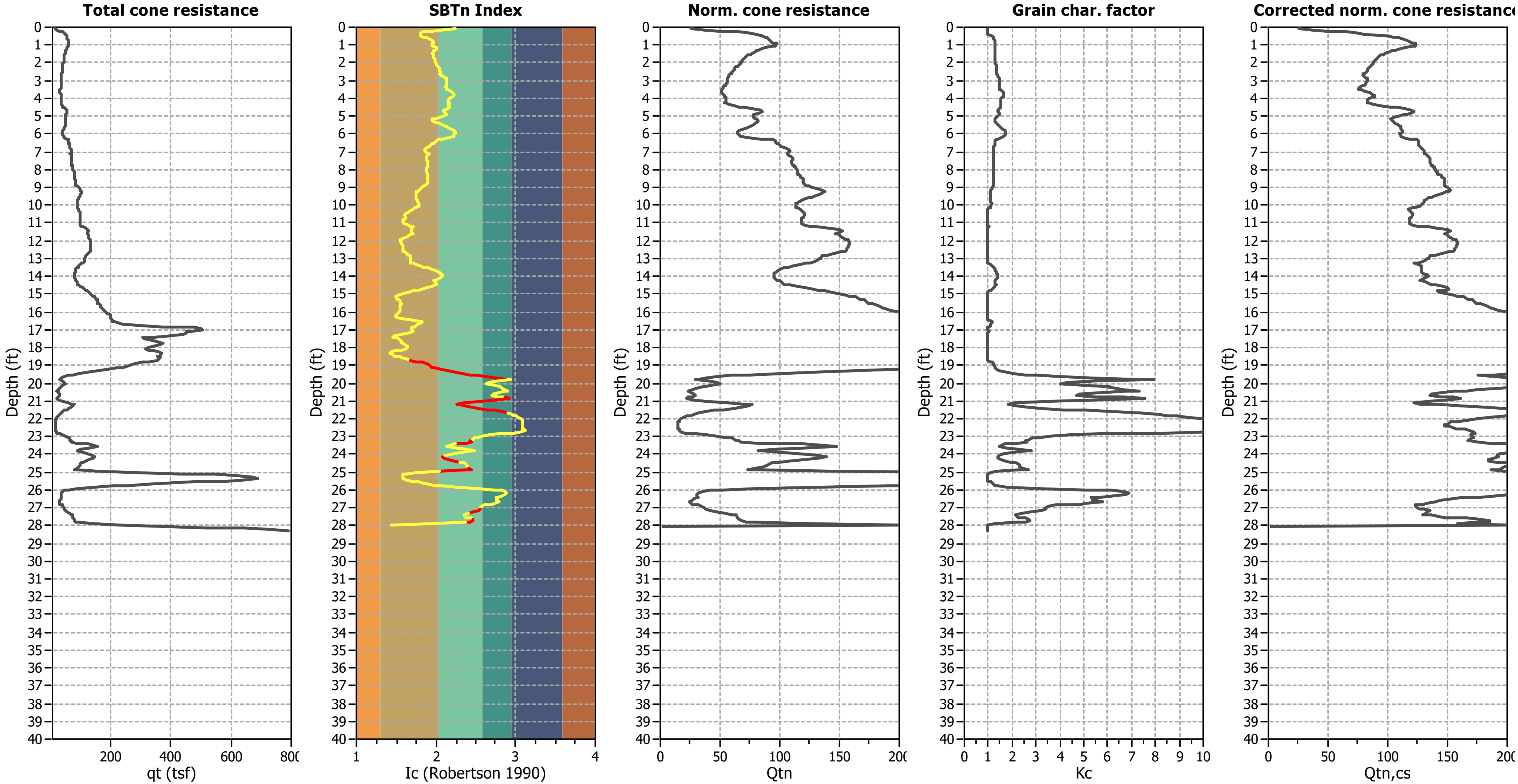
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

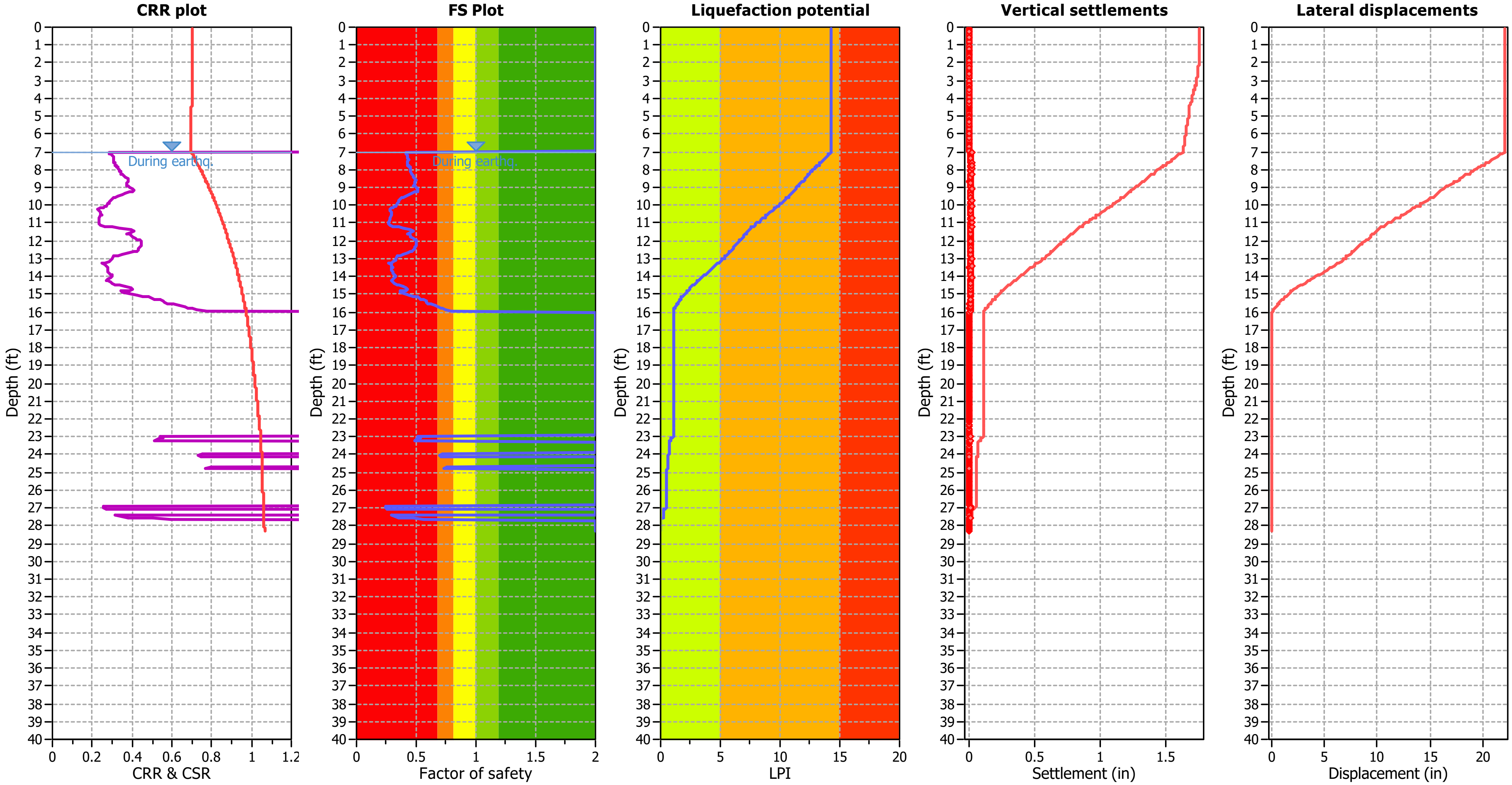
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_{σ} applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

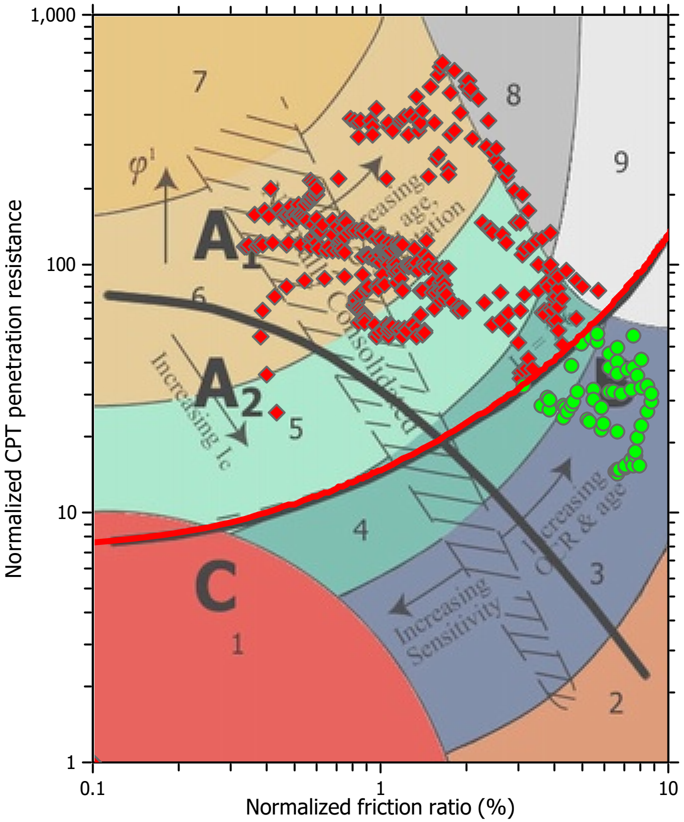
F.S. color scheme

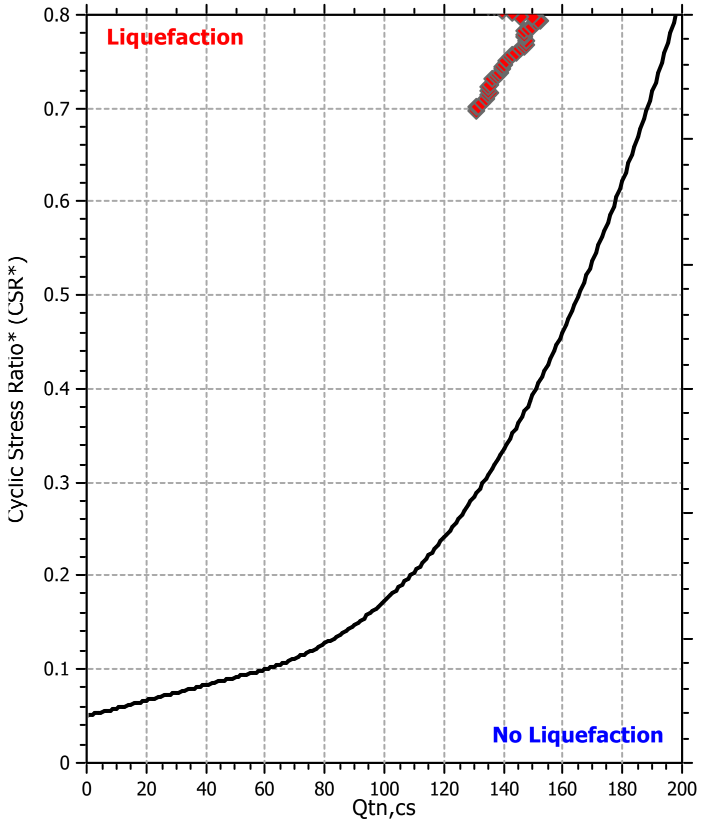
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

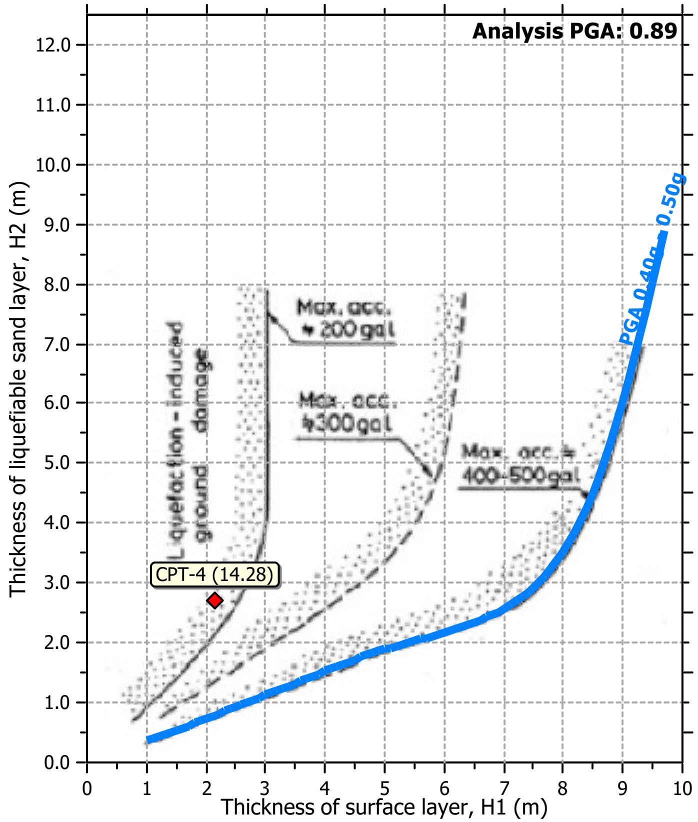
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



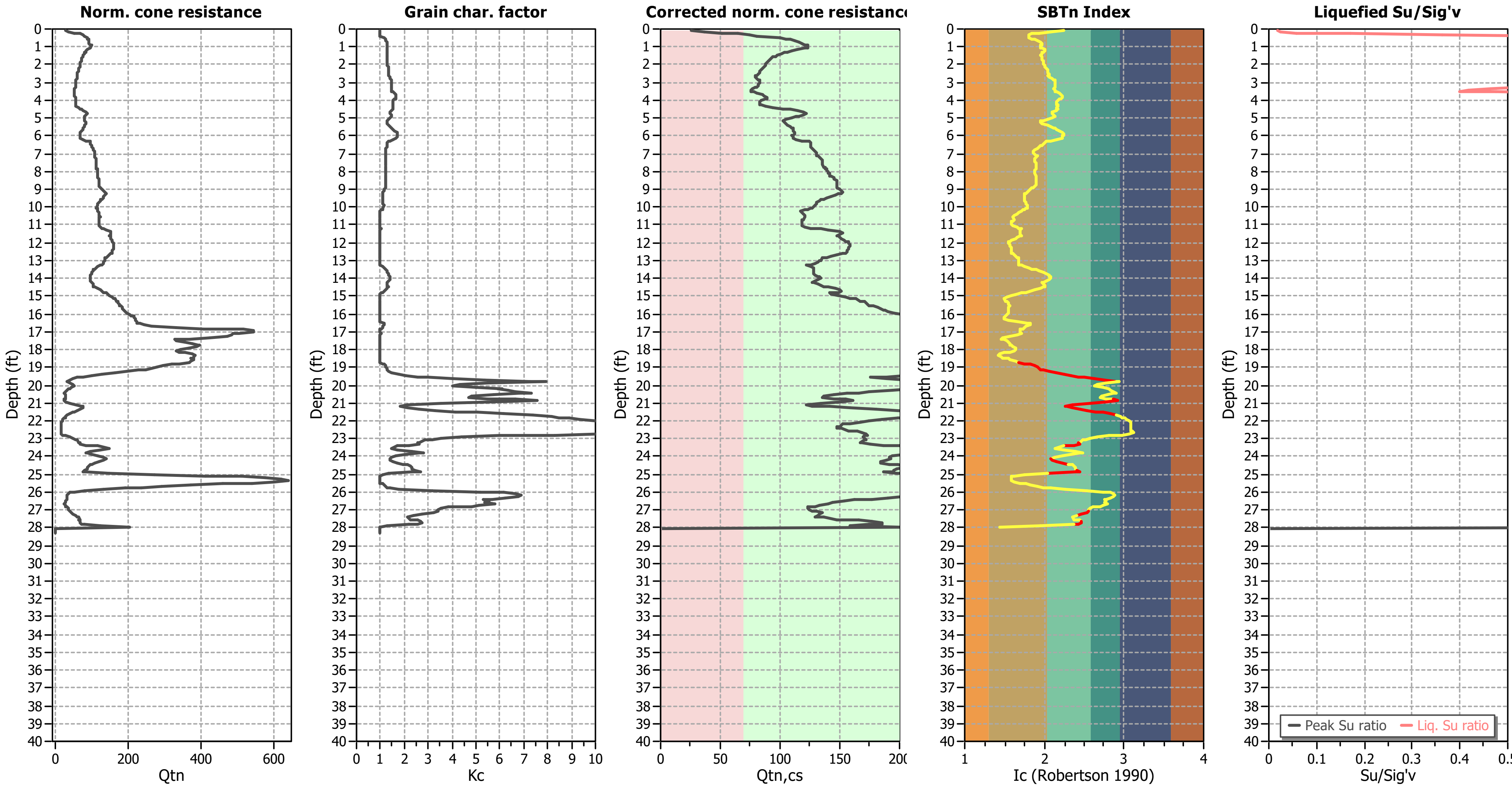




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

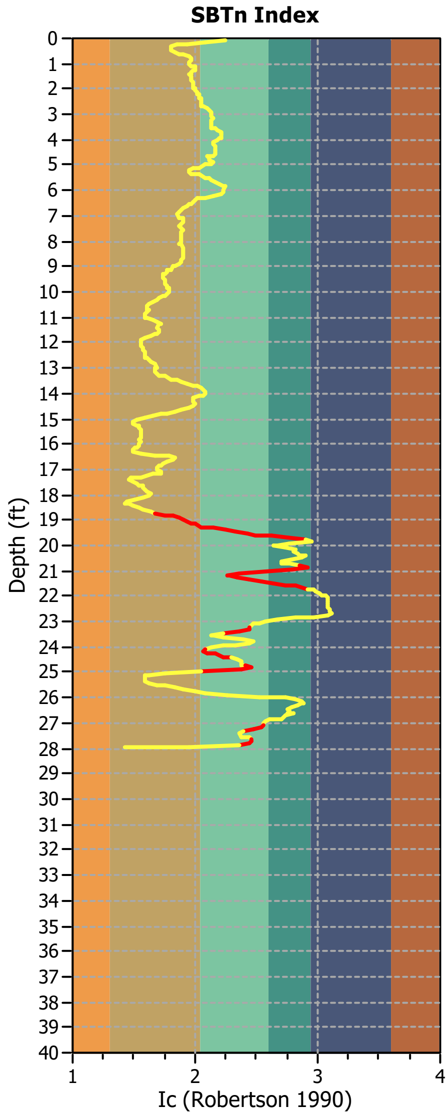
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

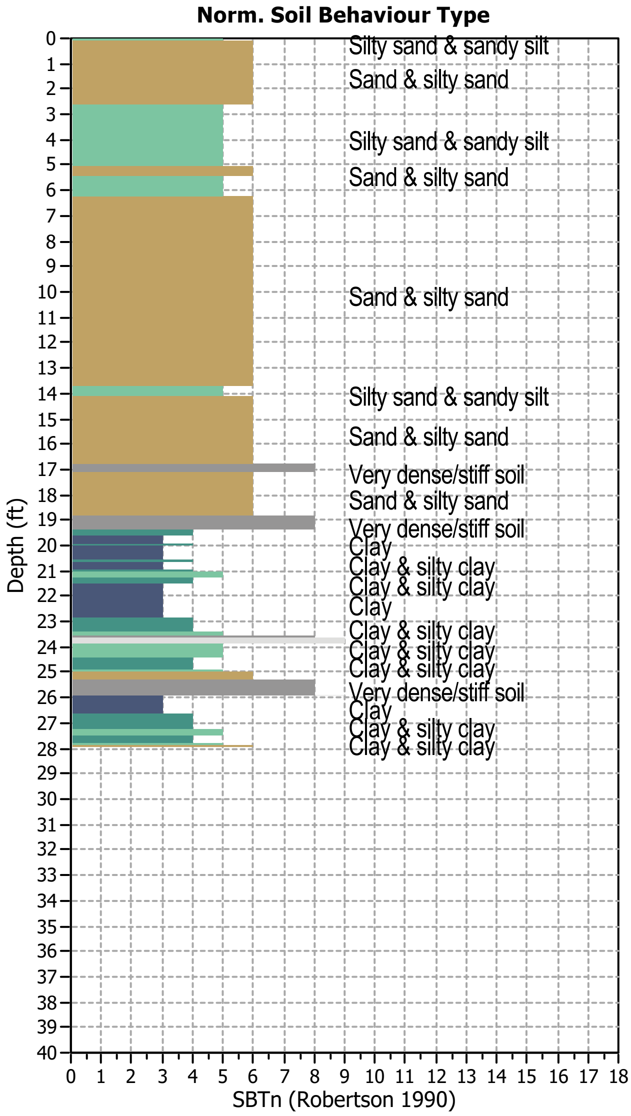
TRANSITION LAYER DETECTION ALGORITHM REPORT
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between 1.80 < I_c < 3.0) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.





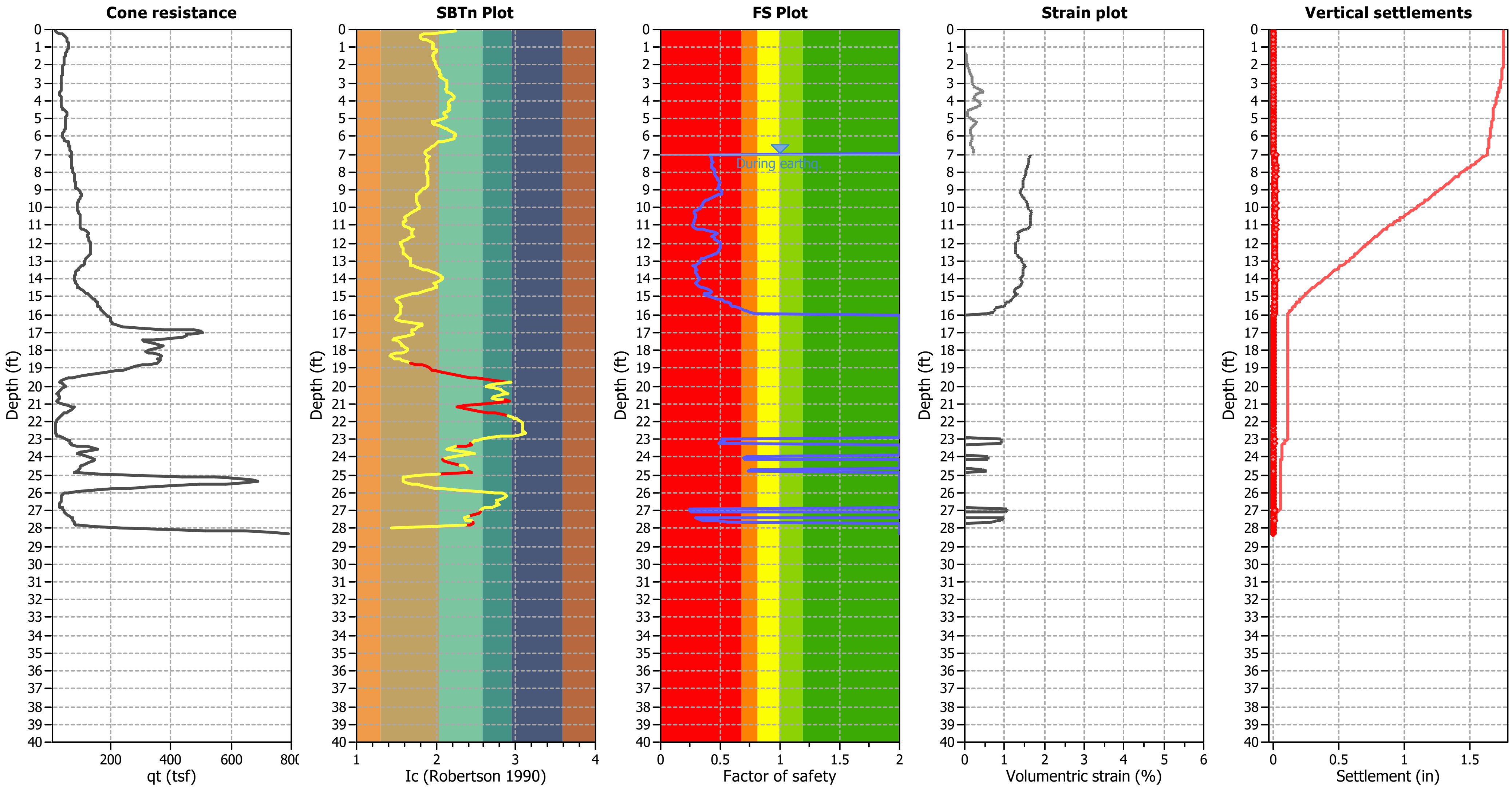
Transition layer algorithm properties

I_c minimum check value:	1.70
I_c maximum check value:	3.00
I_c change ratio value:	0.0250
Minimum number of points in layer:	4

General statistics

Total points in CPT file:	431
Total points excluded:	54
Exclusion percentage:	12.53%
Number of layers detected:	8

Estimation of post-earthquake settlements

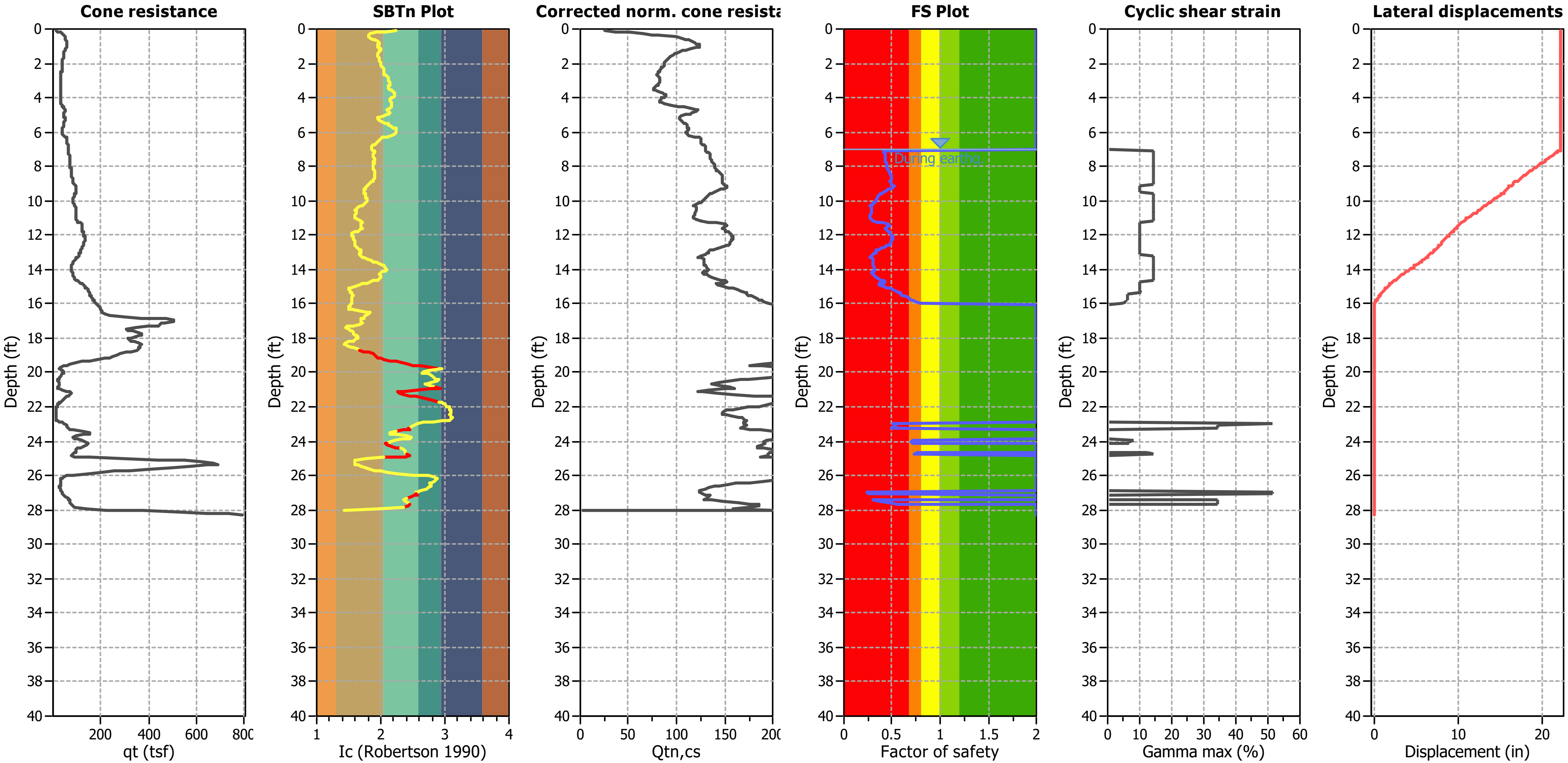


Abbreviations

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

Estimation of post-earthquake lateral Displacements

Geometric parameters: Level ground (or gently sloping) with free face (L: 40.00 ft - H: 8.00 ft)

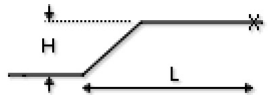


Abbreviations

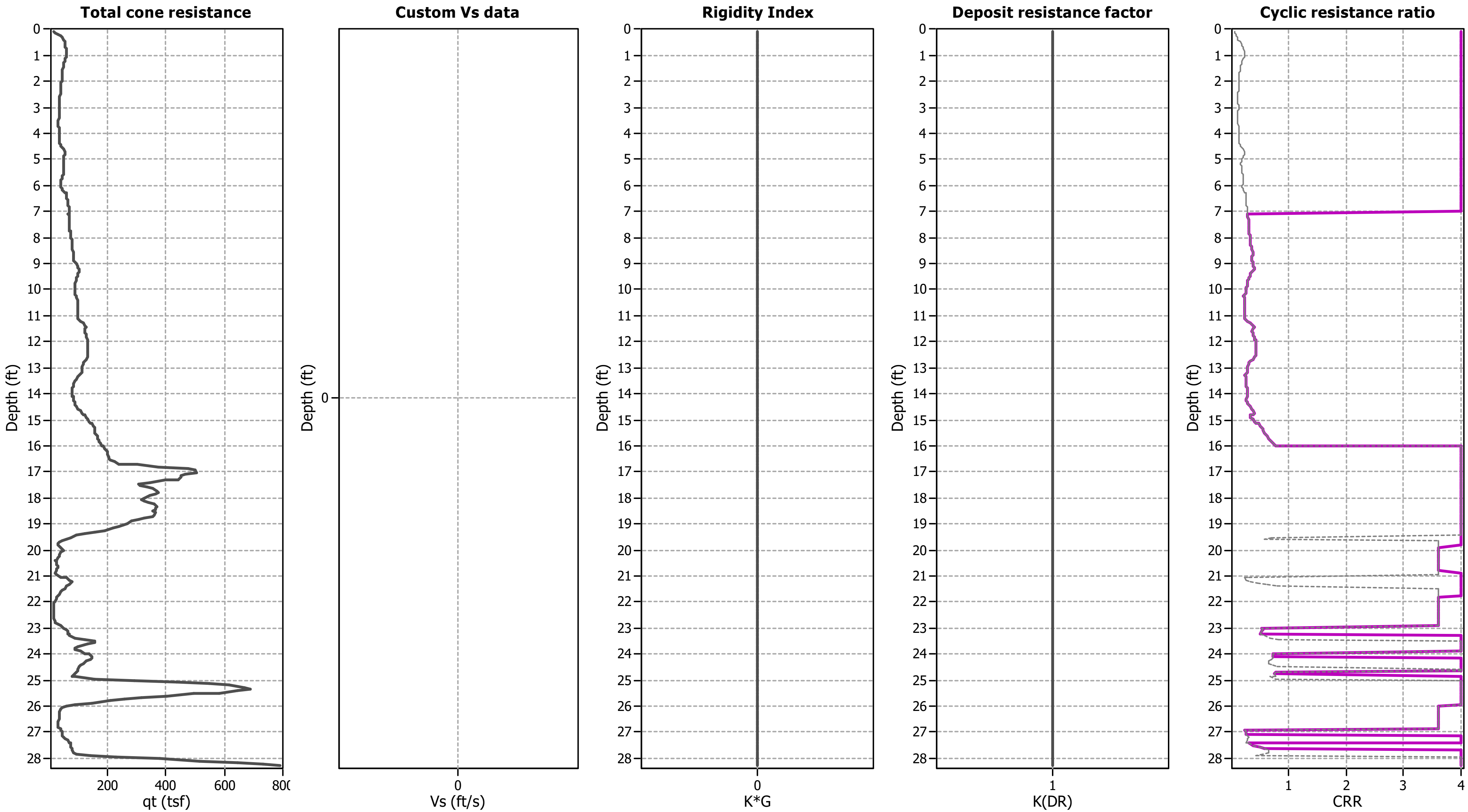
q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance

F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

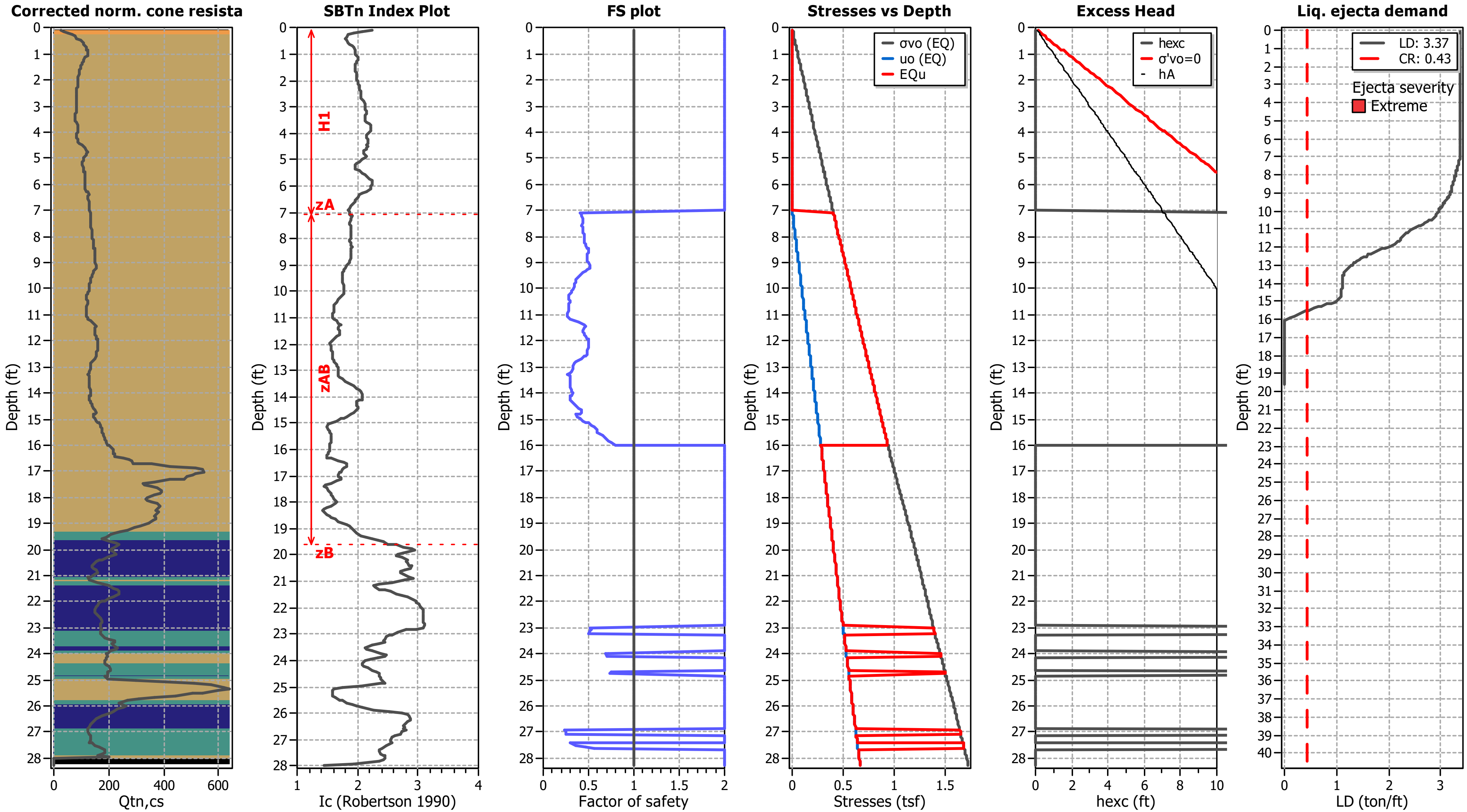
Surface condition



Aging Calculation Estimation



Ejecta Severity Estimation



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

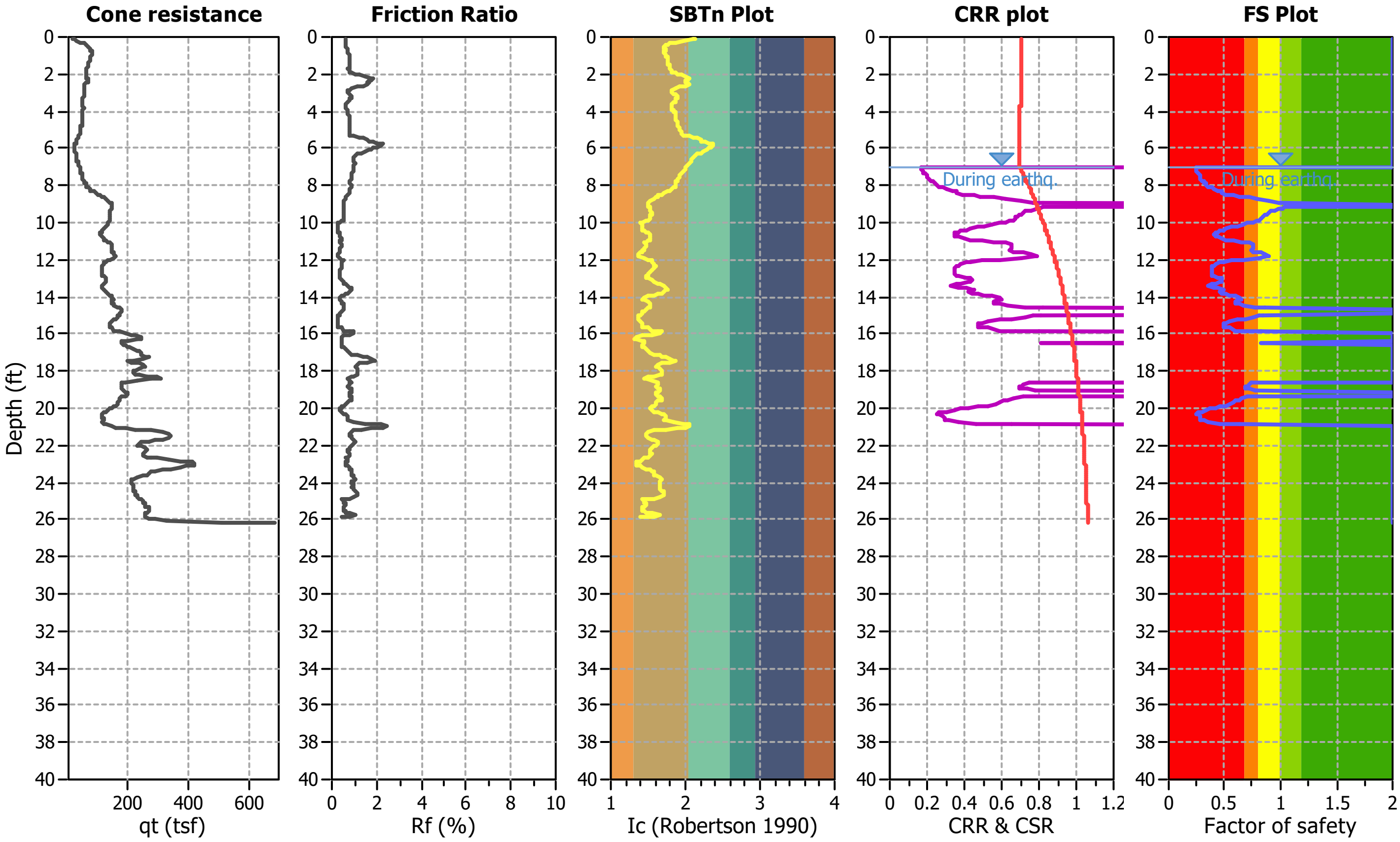
LIQUEFACTION ANALYSIS REPORT

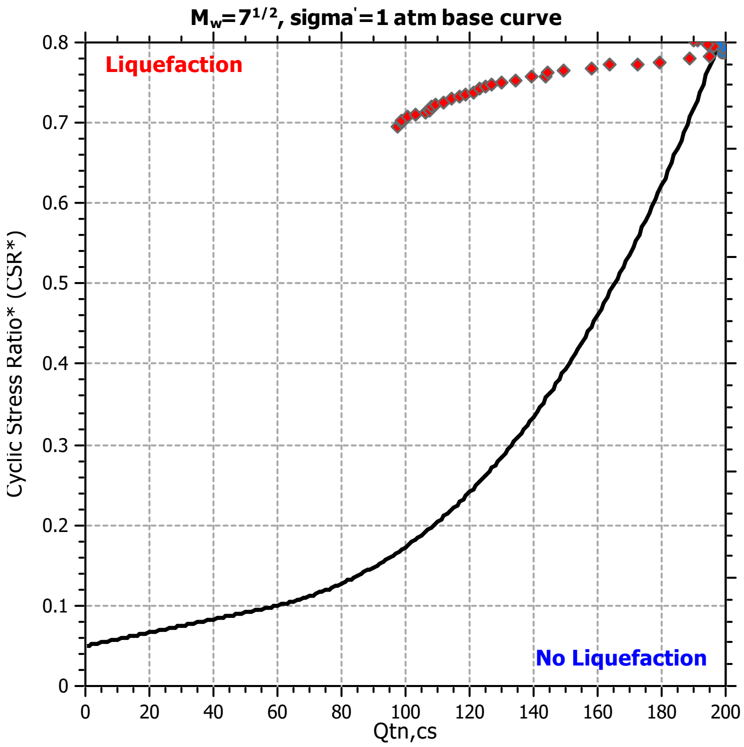
Project title : Petra Geosciences / Apple Canyon **Location : Lake Hemet, CA**

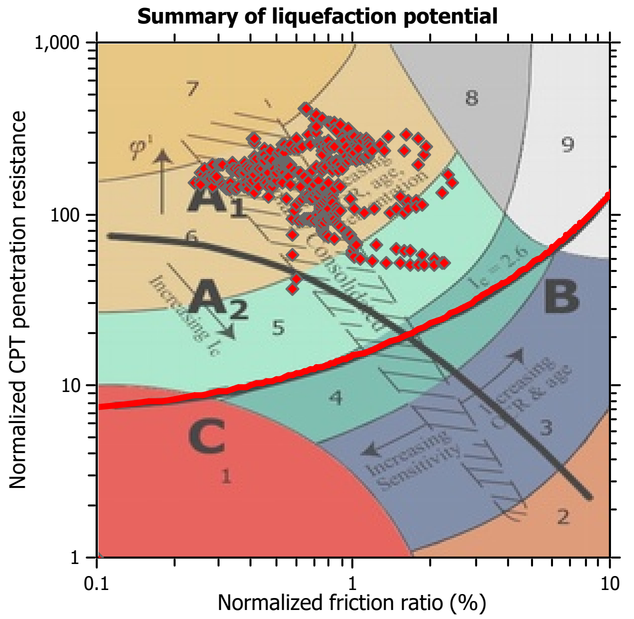
CPT file : CPT-5

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	10.50 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	8.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.89	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

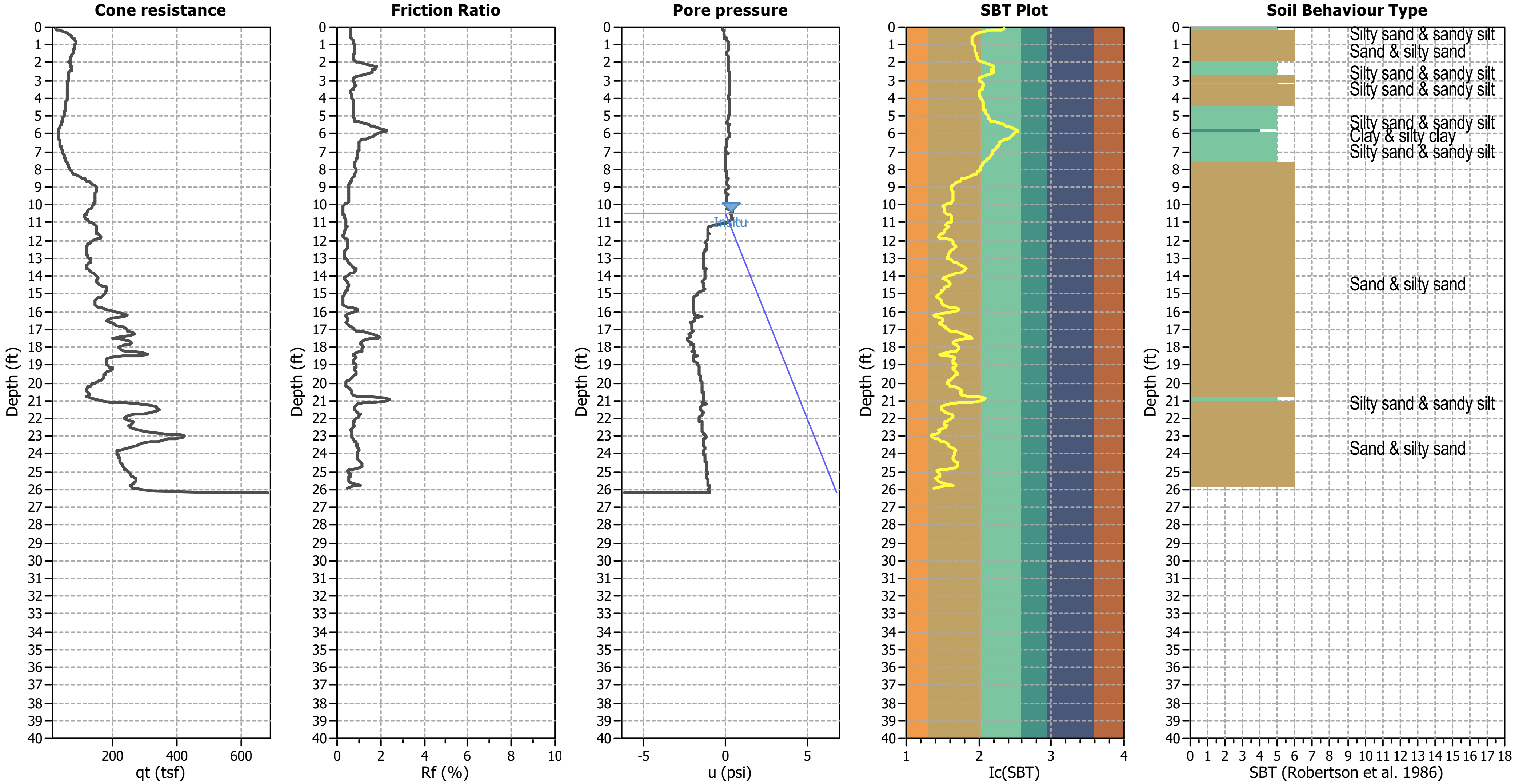






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



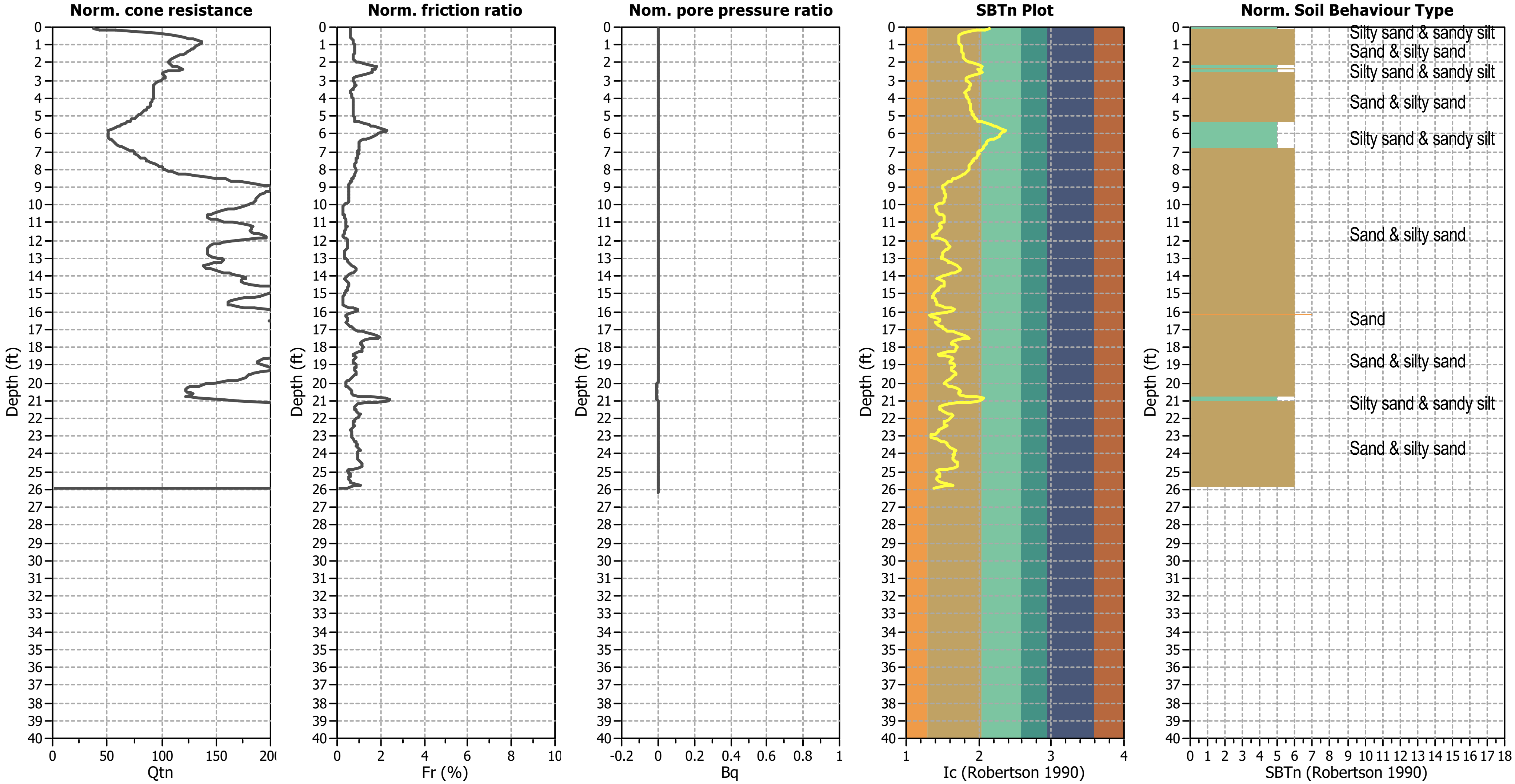
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

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)



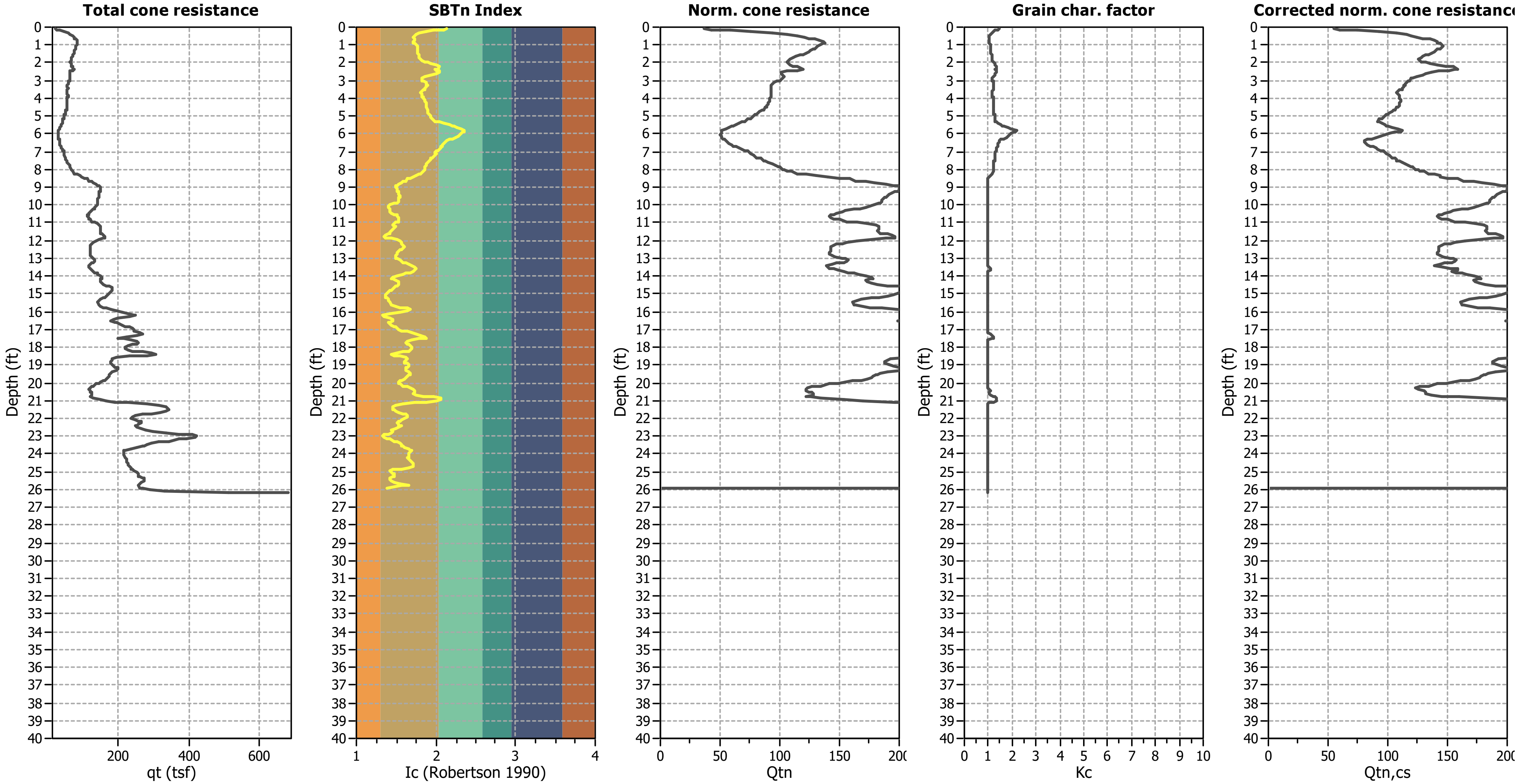
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

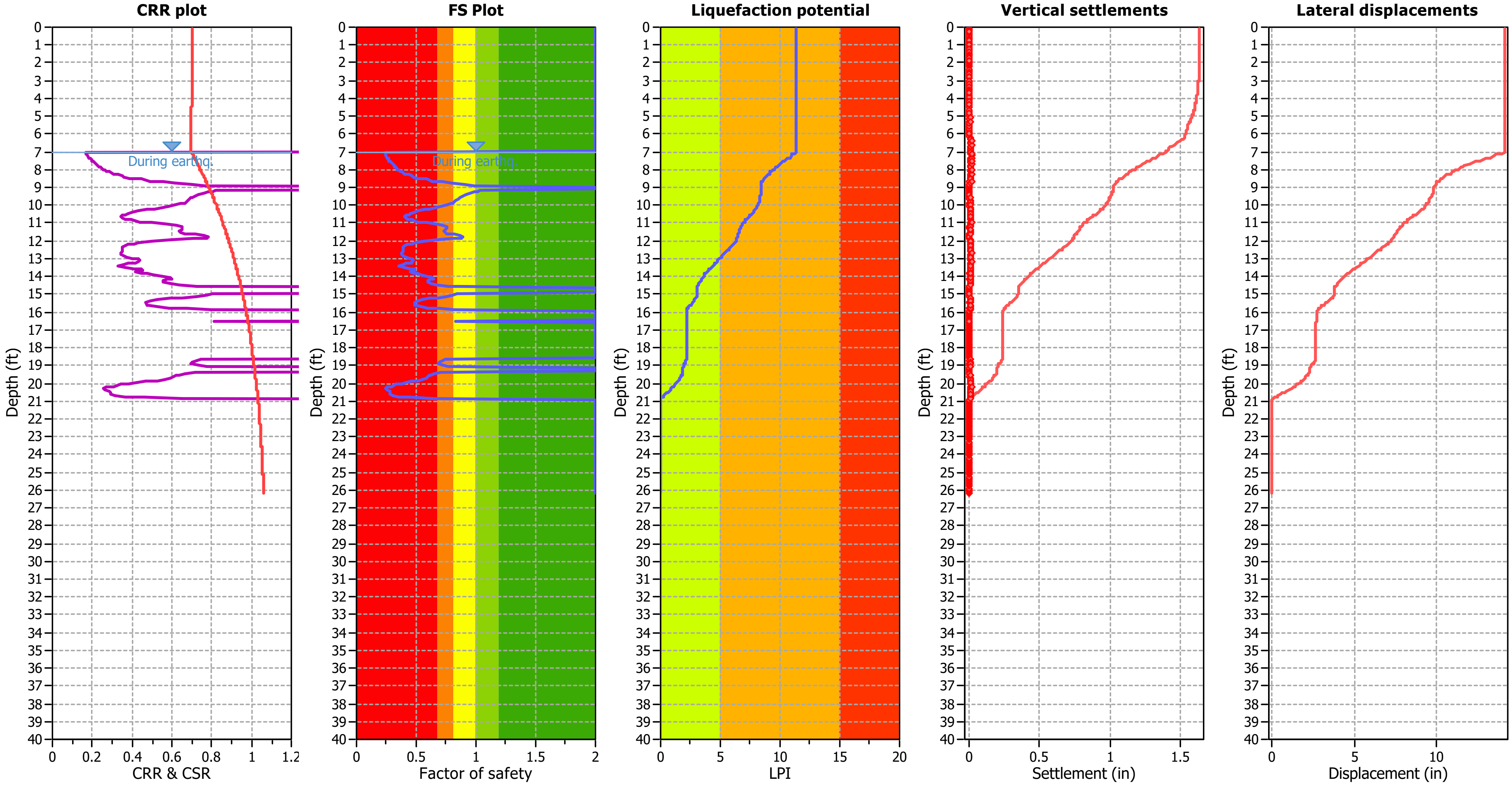
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

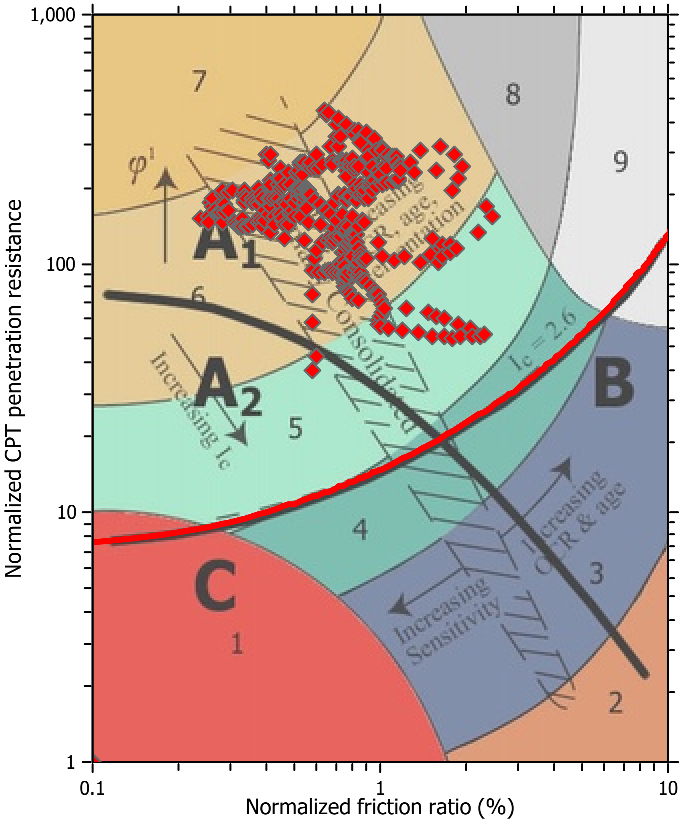
F.S. color scheme

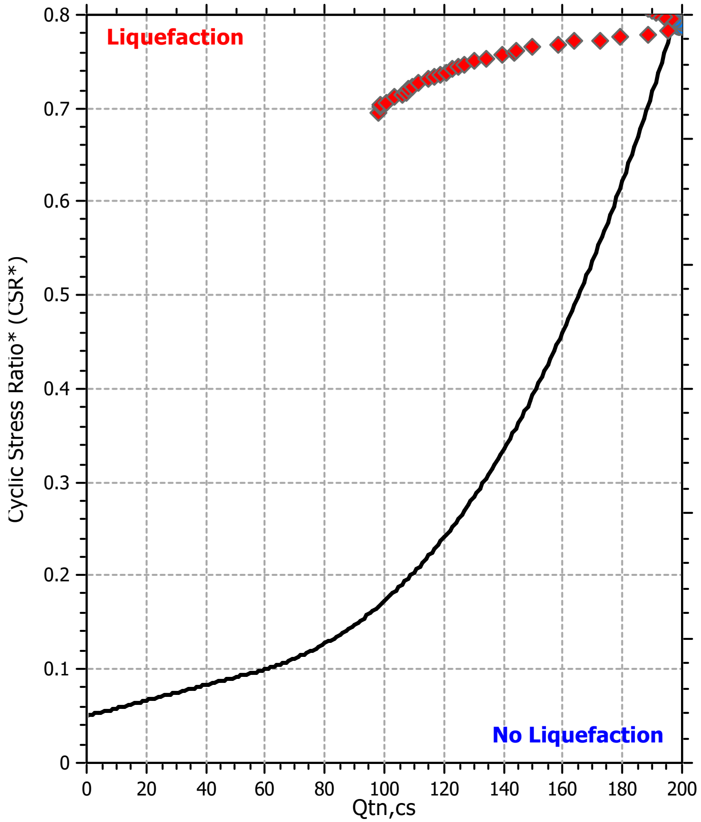
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

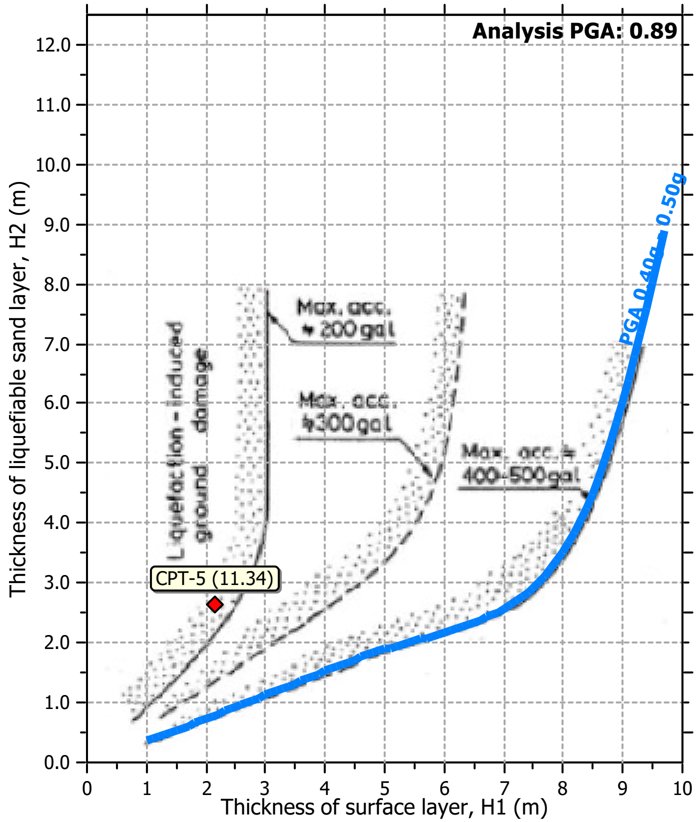
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



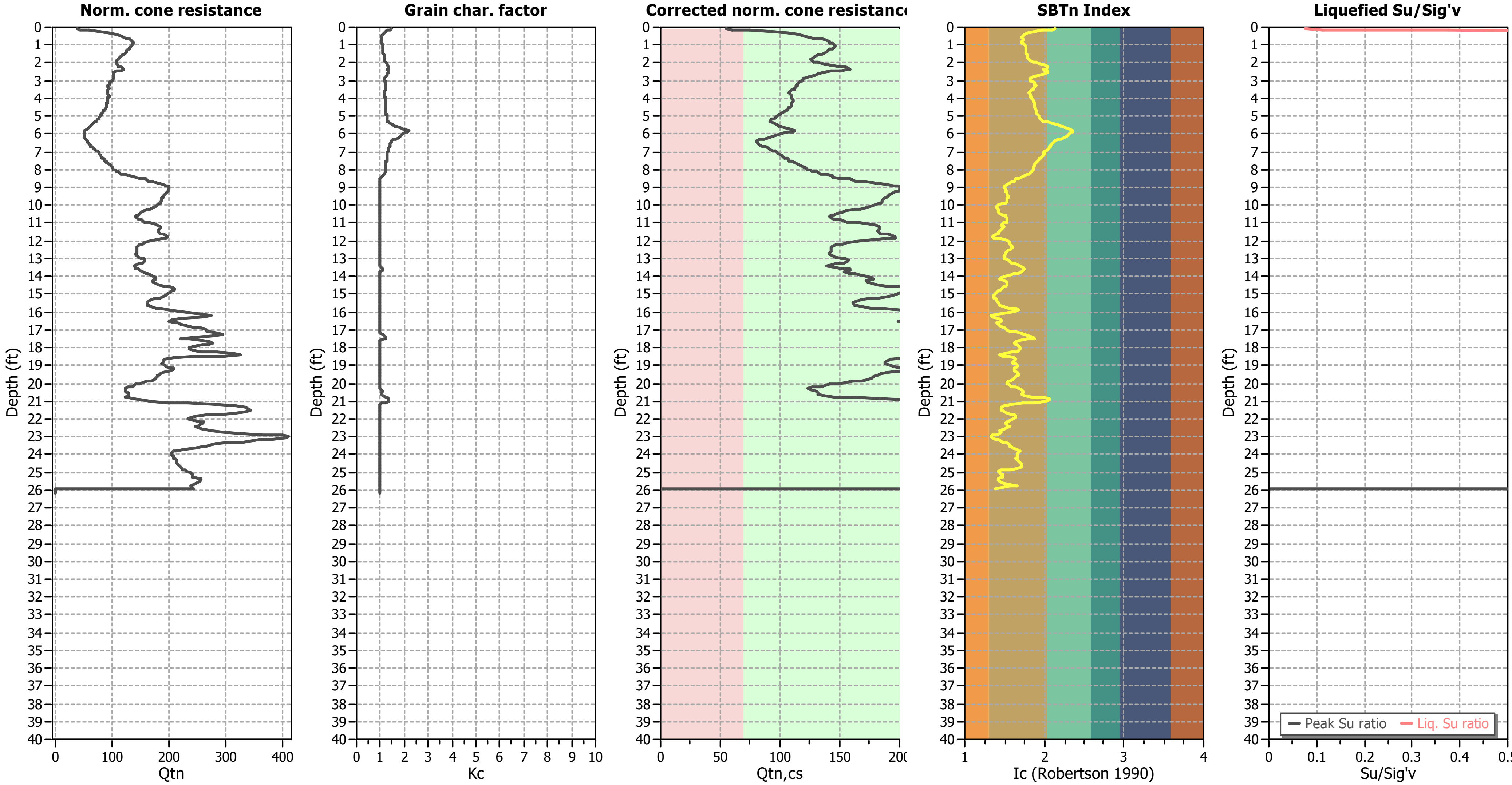




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

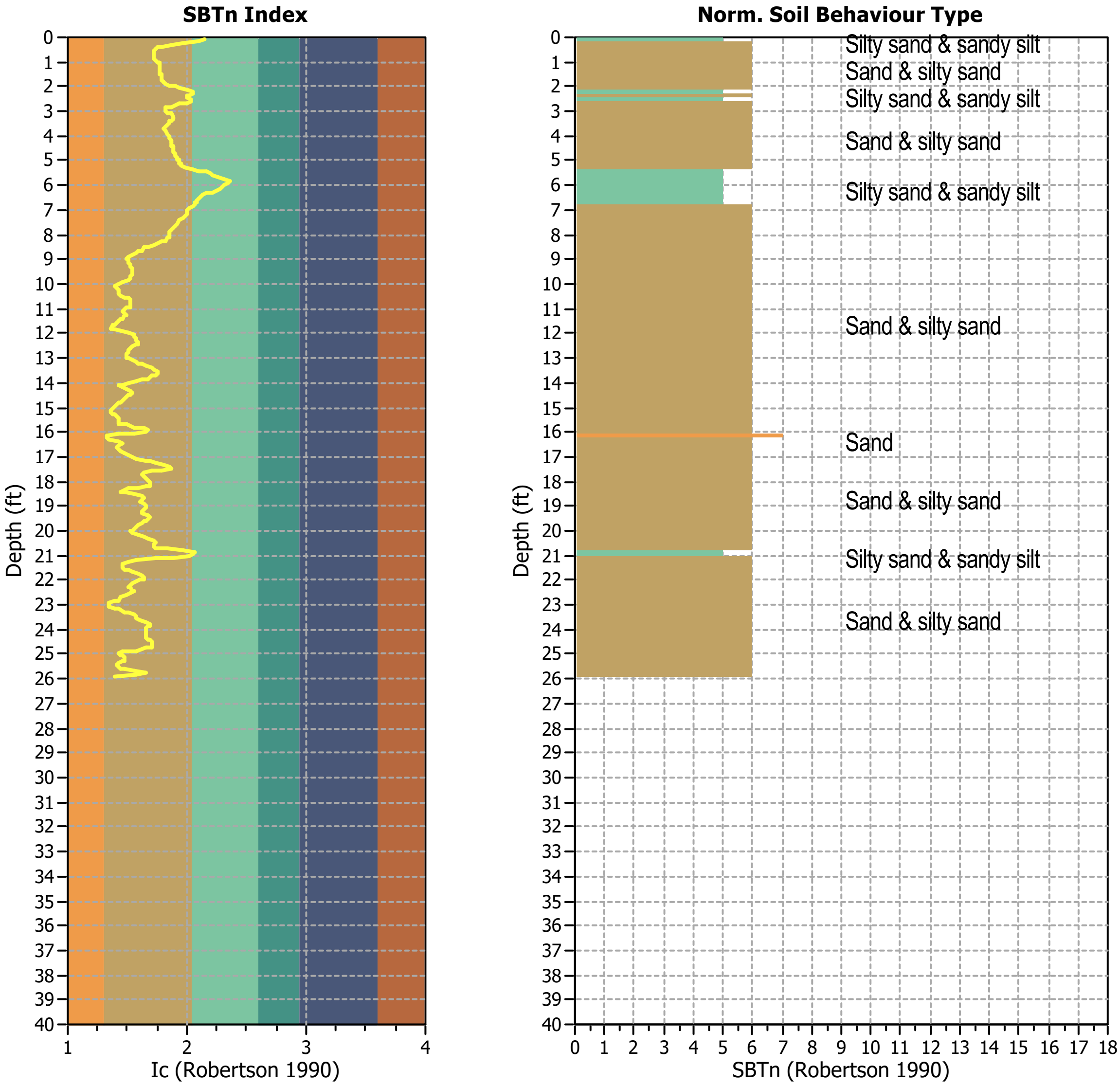
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

TRANSITION LAYER DETECTION ALGORITHM REPORT
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between 1.80 < I_c < 3.0) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.



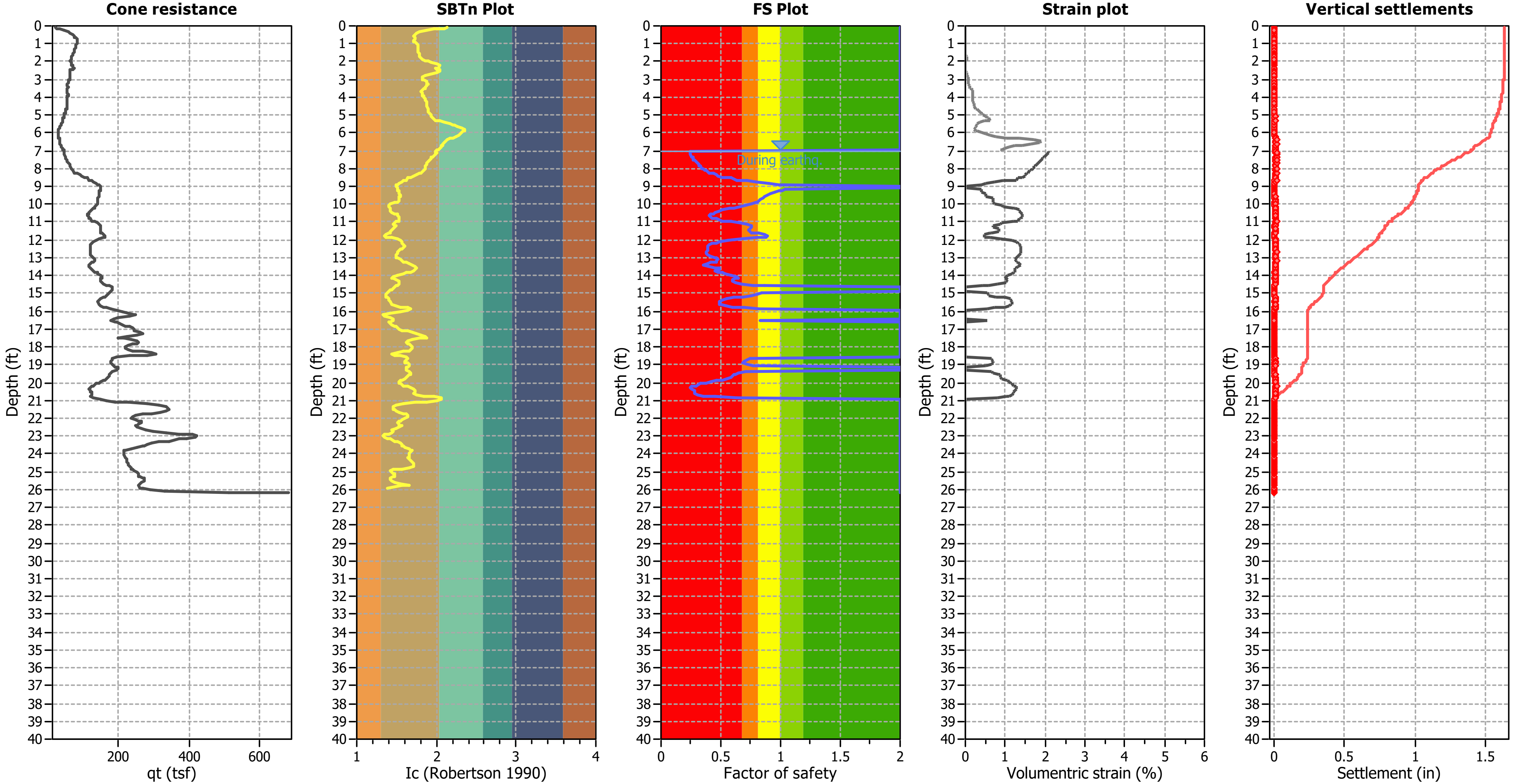
Transition layer algorithm properties

I_c minimum check value:	1.70
I_c maximum check value:	3.00
I_c change ratio value:	0.0250
Minimum number of points in layer:	4

General statistics

Total points in CPT file:	399
Total points excluded:	0
Exclusion percentage:	0.00%
Number of layers detected:	0

Estimation of post-earthquake settlements

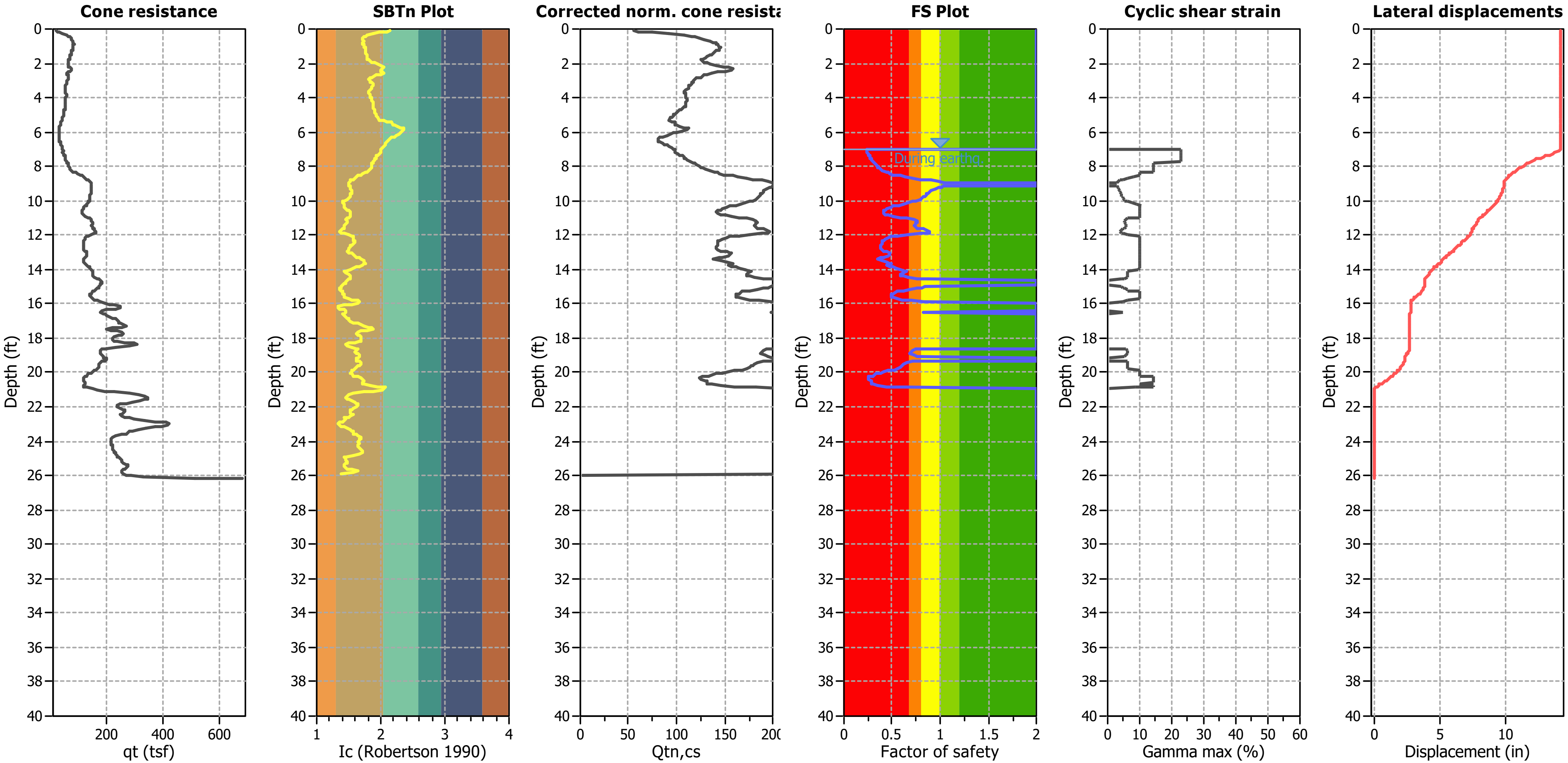


Abbreviations

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

Estimation of post-earthquake lateral Displacements

Geometric parameters: Gently sloping ground without free face (Slope 1.00 %)



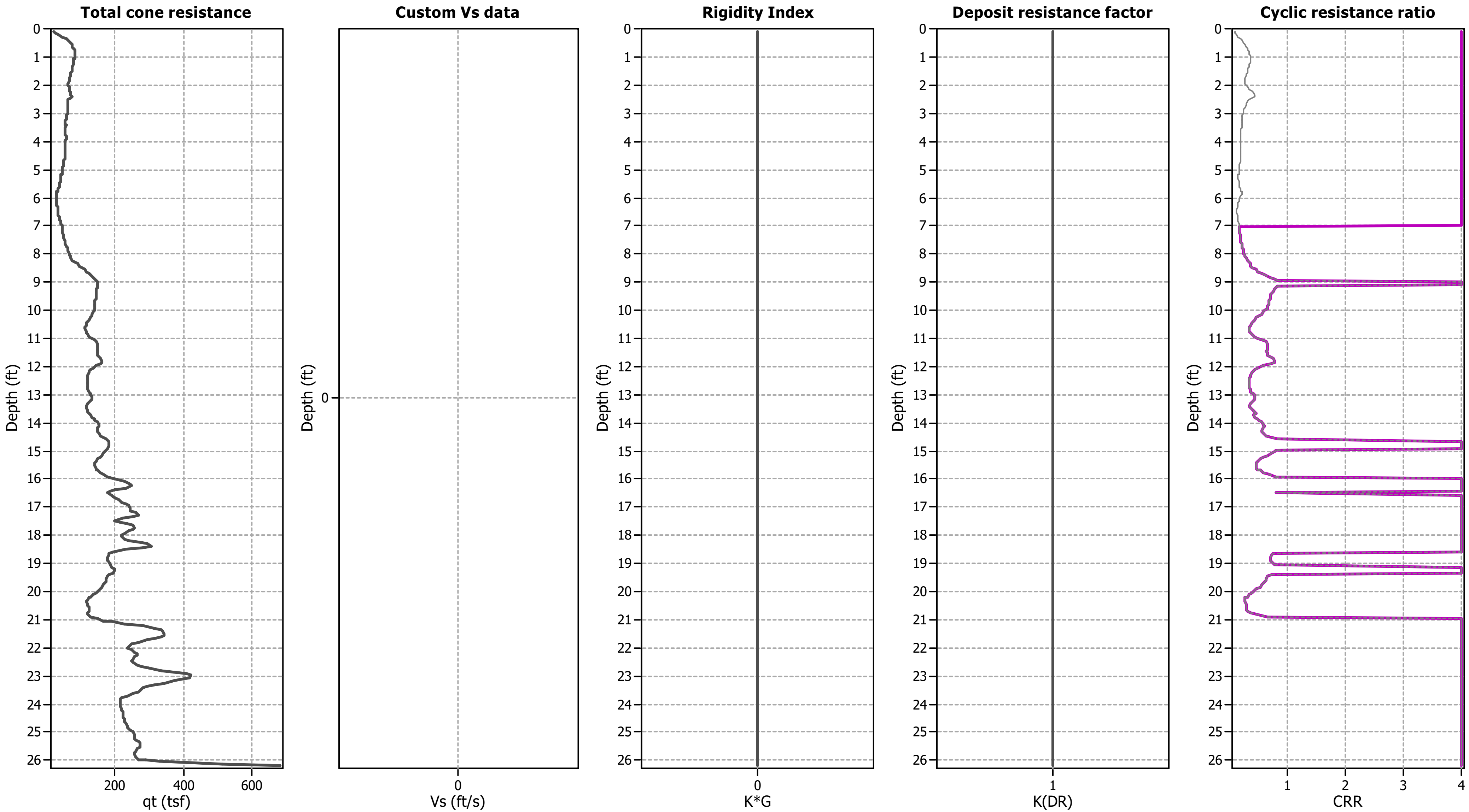
Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance

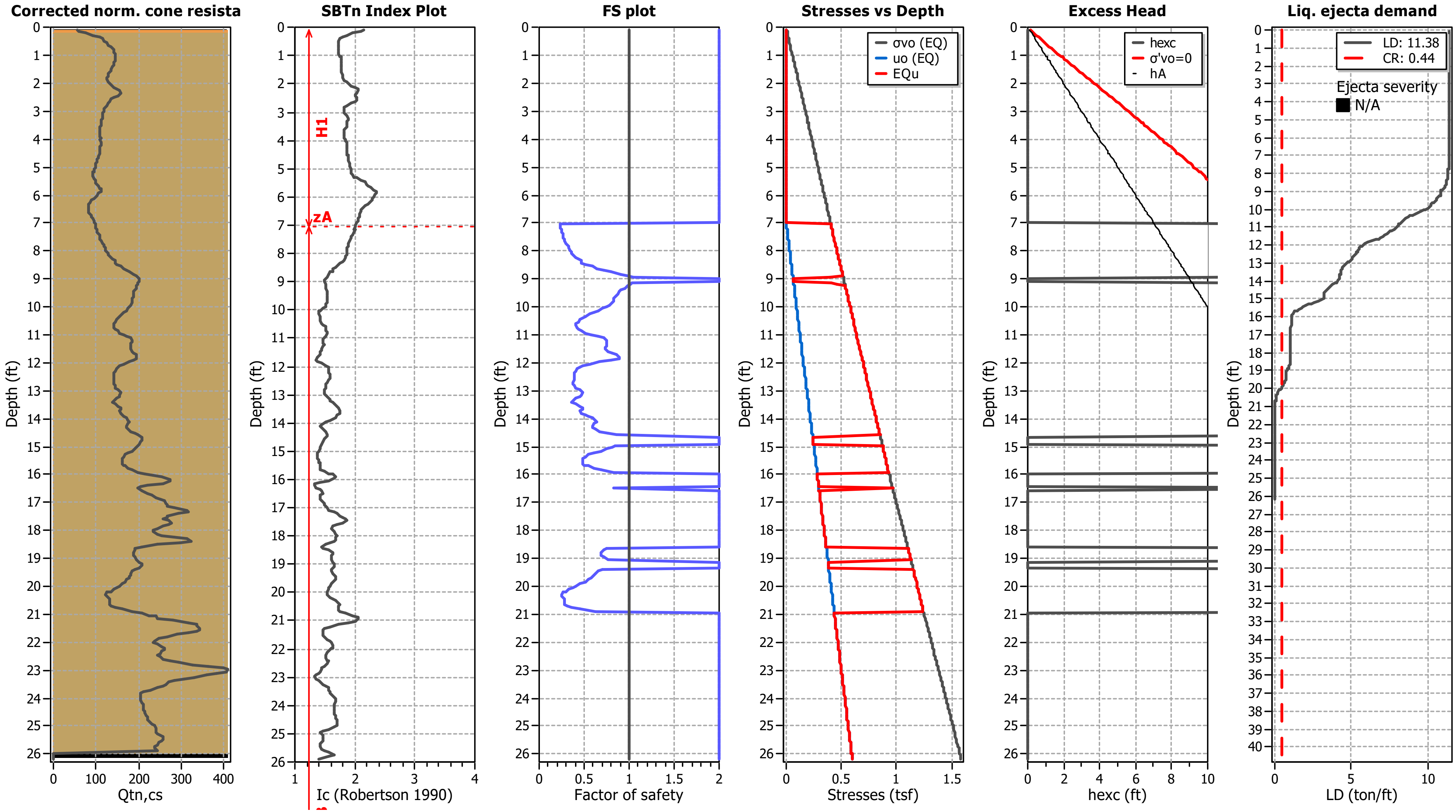
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

Surface condition

Aging Calculation Estimation



Ejecta Severity Estimation



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

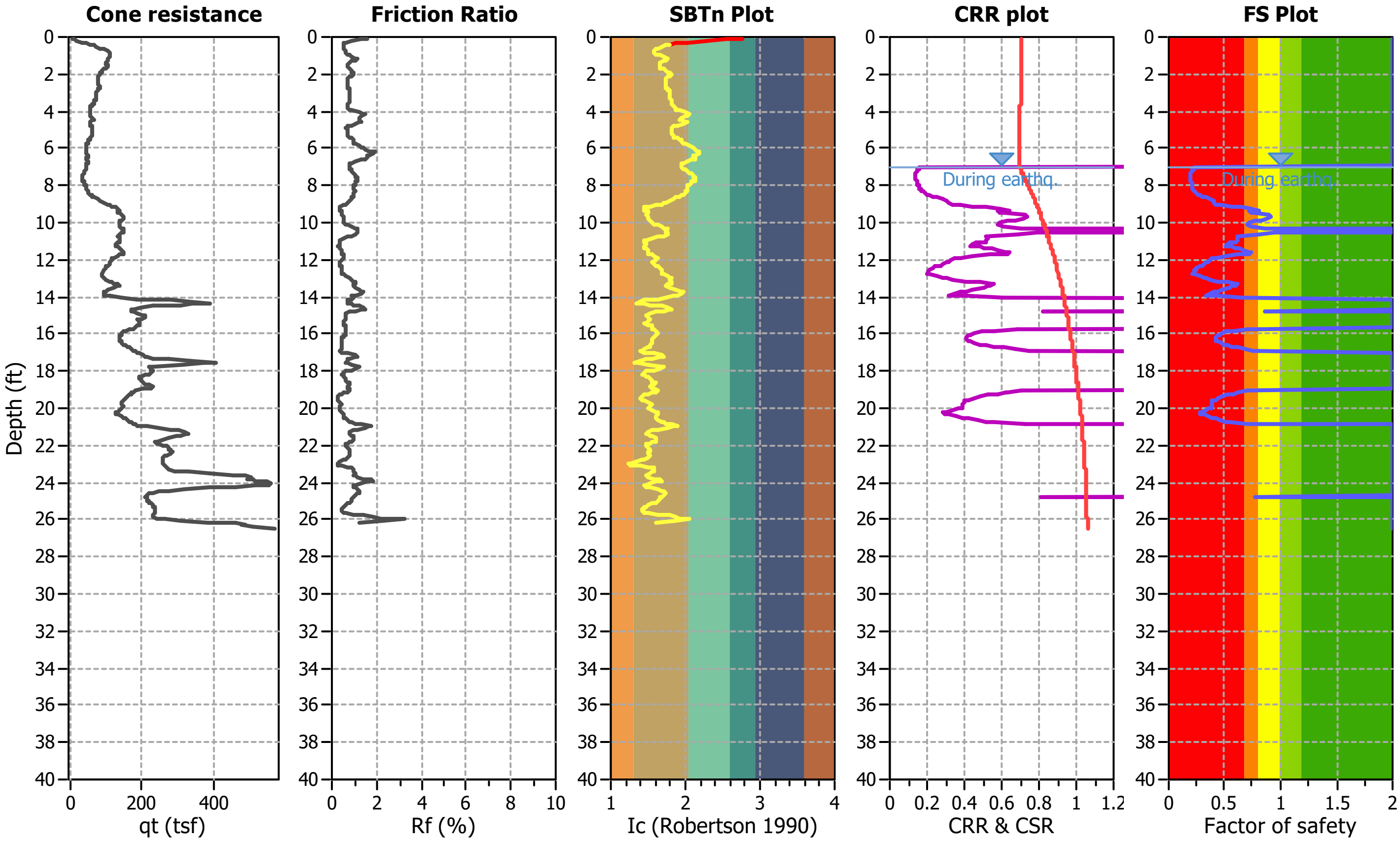
LIQUEFACTION ANALYSIS REPORT

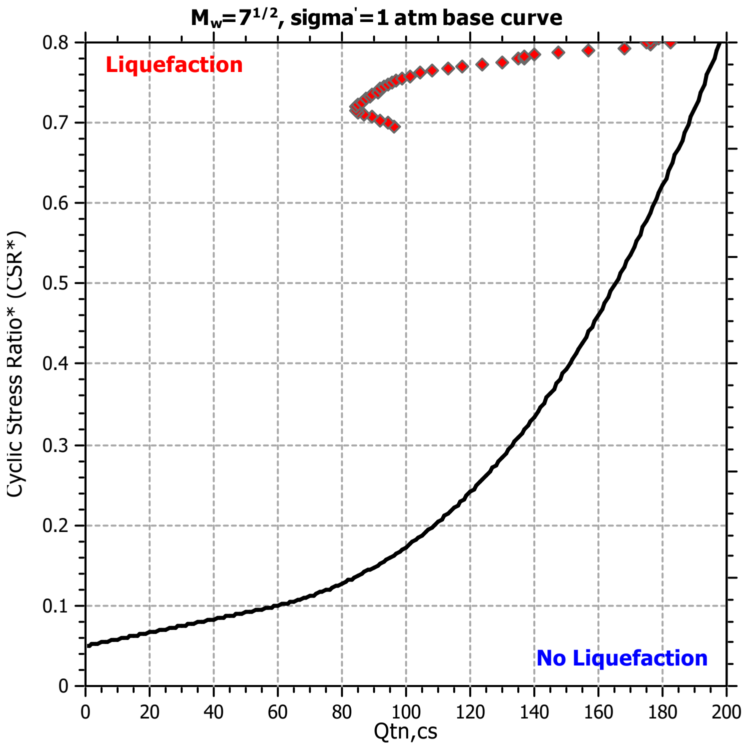
Project title : Petra Geosciences / Apple Canyon **Location : Lake Hemet, CA**

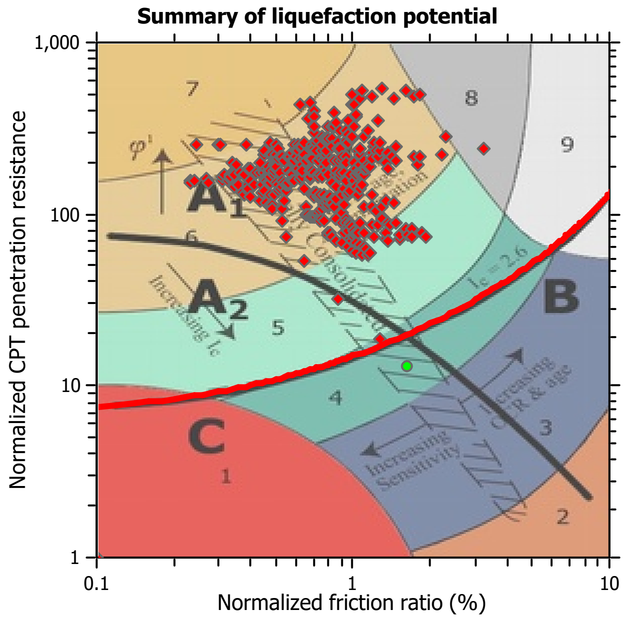
CPT file : CPT-5A

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	10.50 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	8.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.89	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

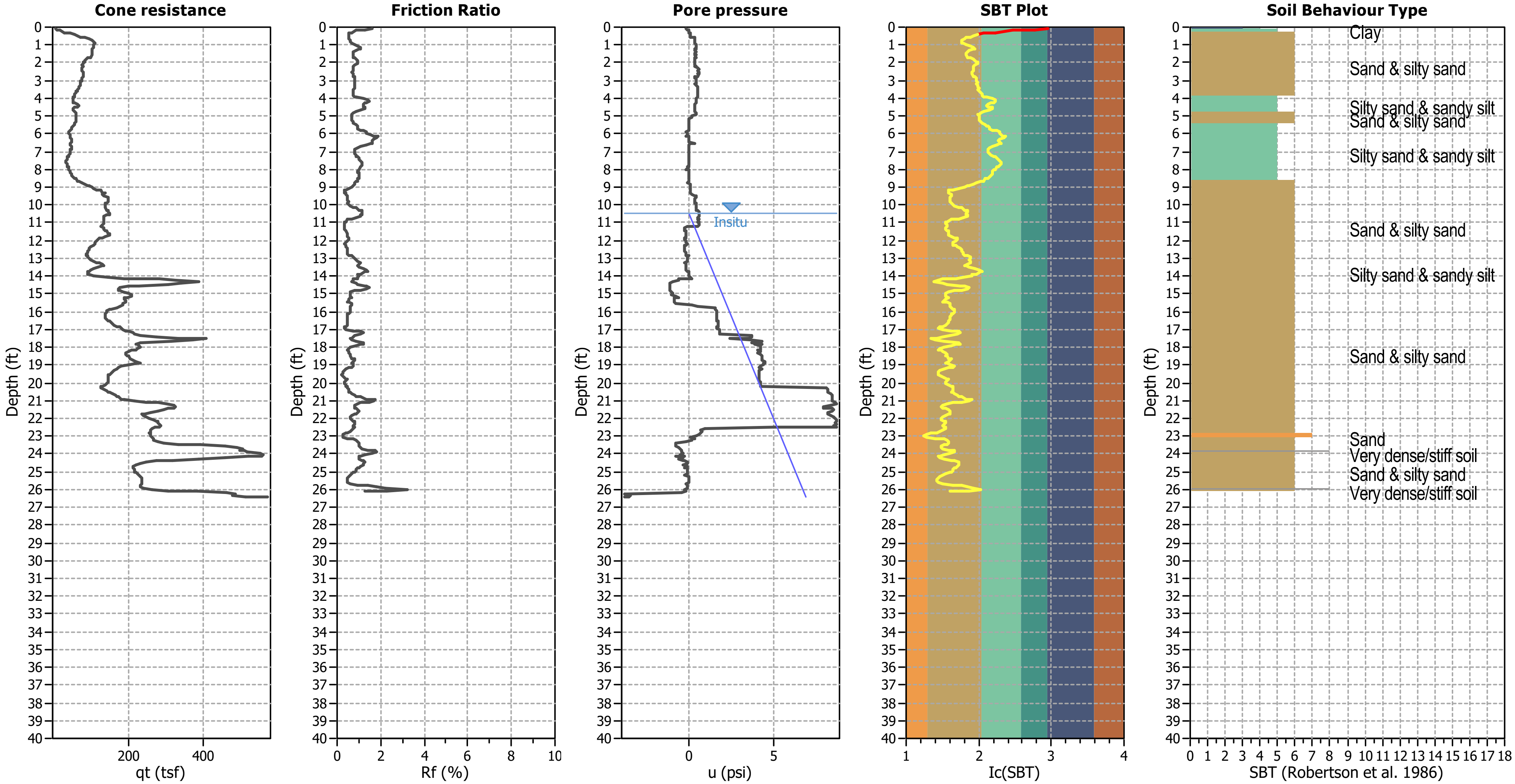






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



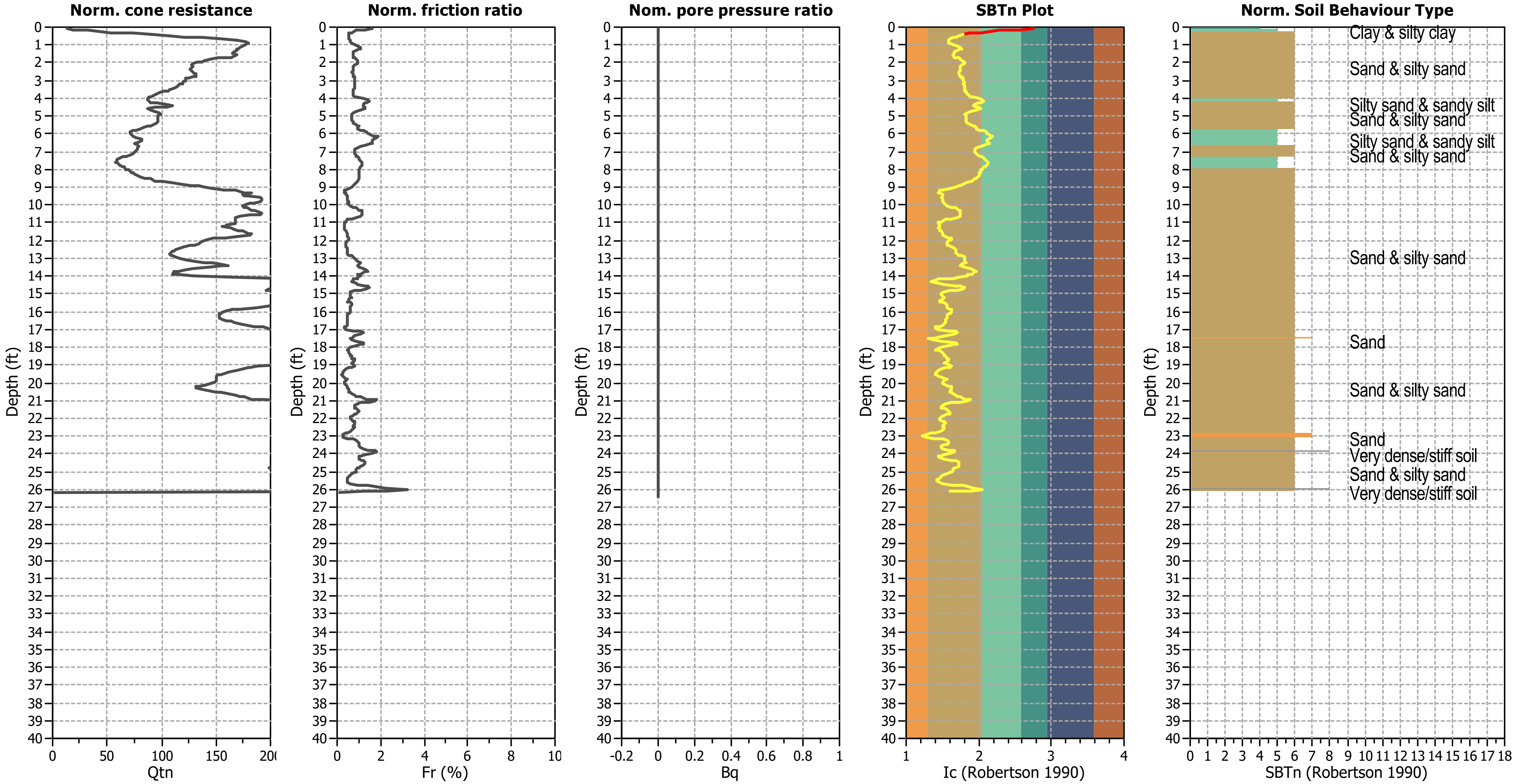
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

SBT 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

CPT basic interpretation plots (normalized)



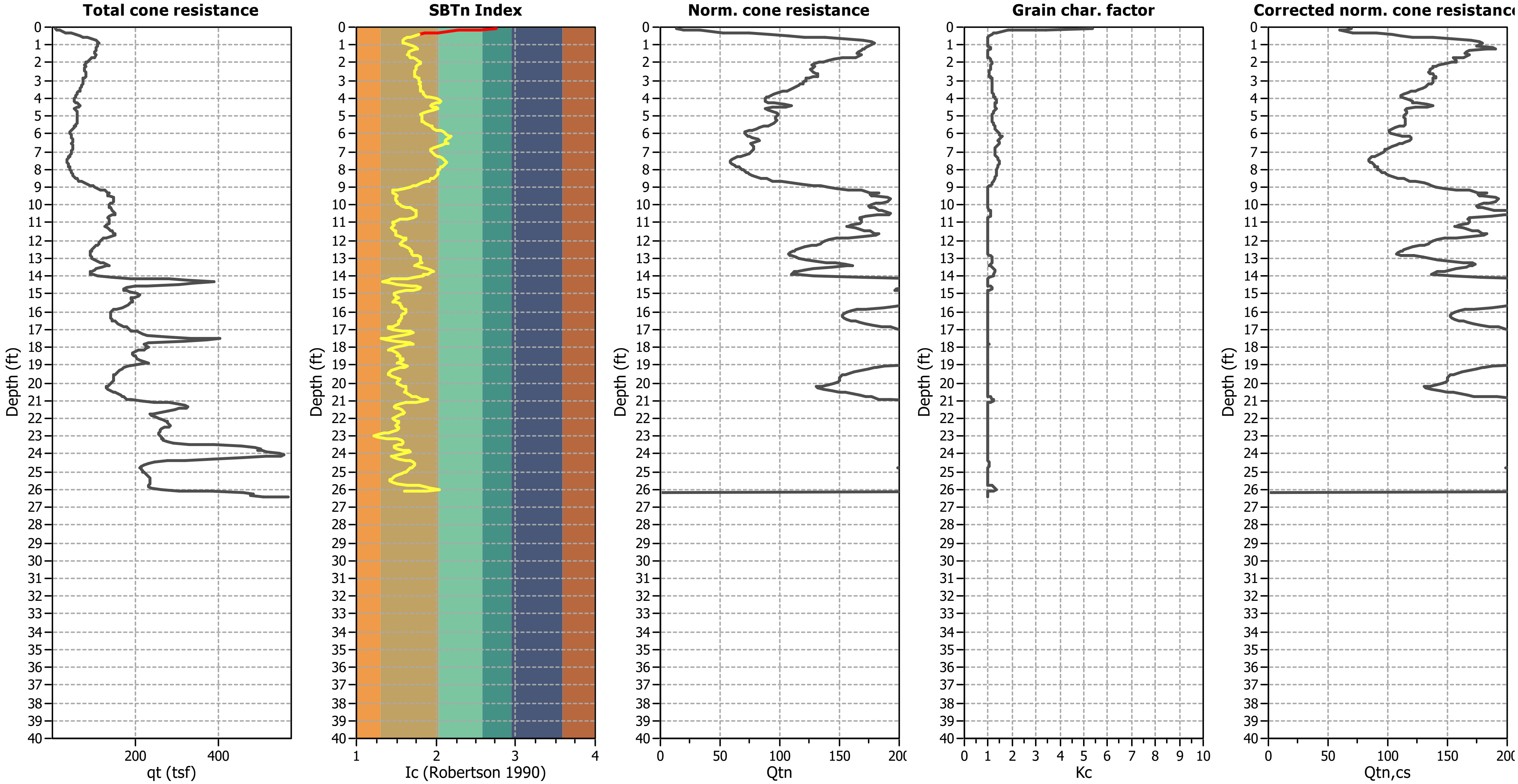
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

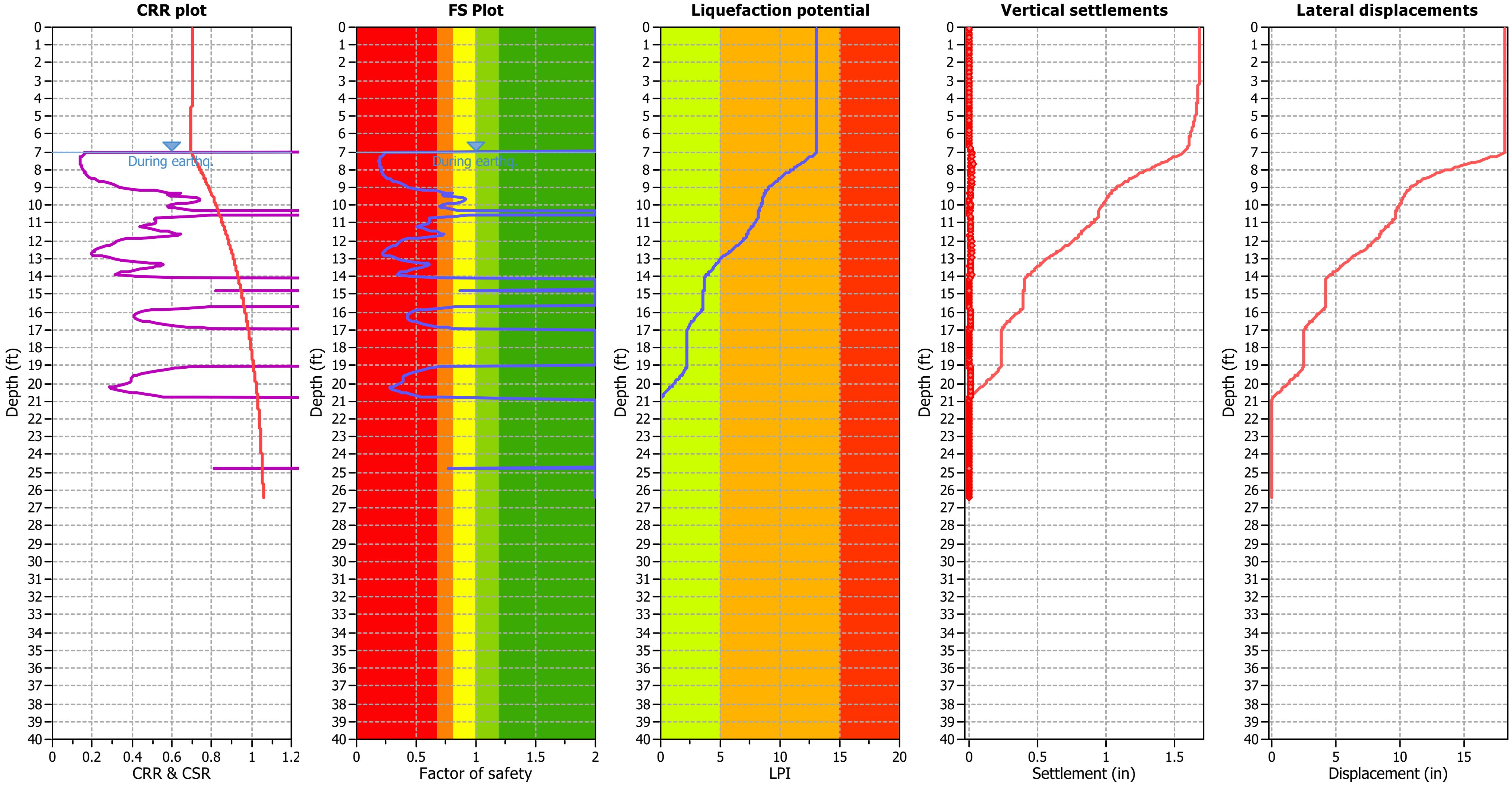
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

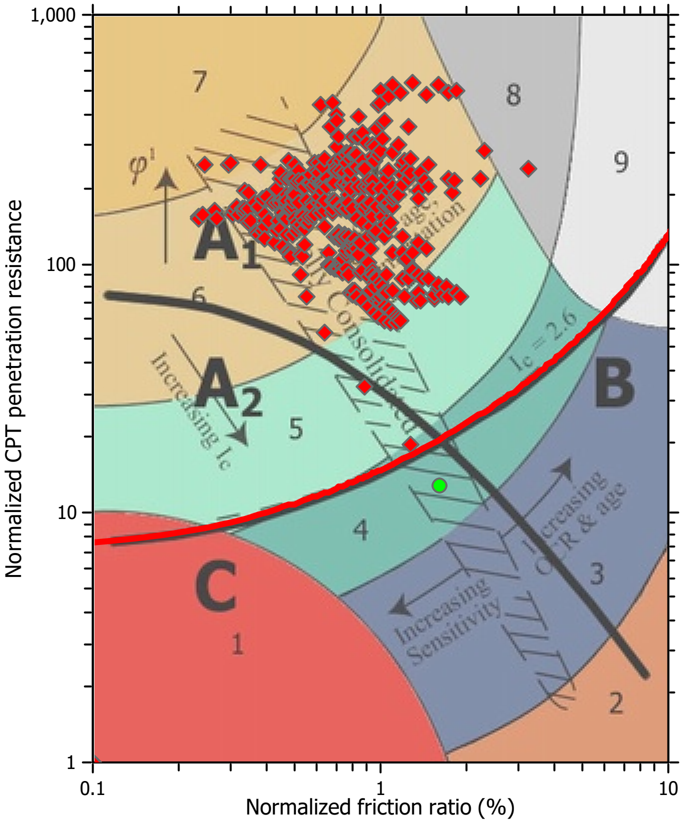
F.S. color scheme

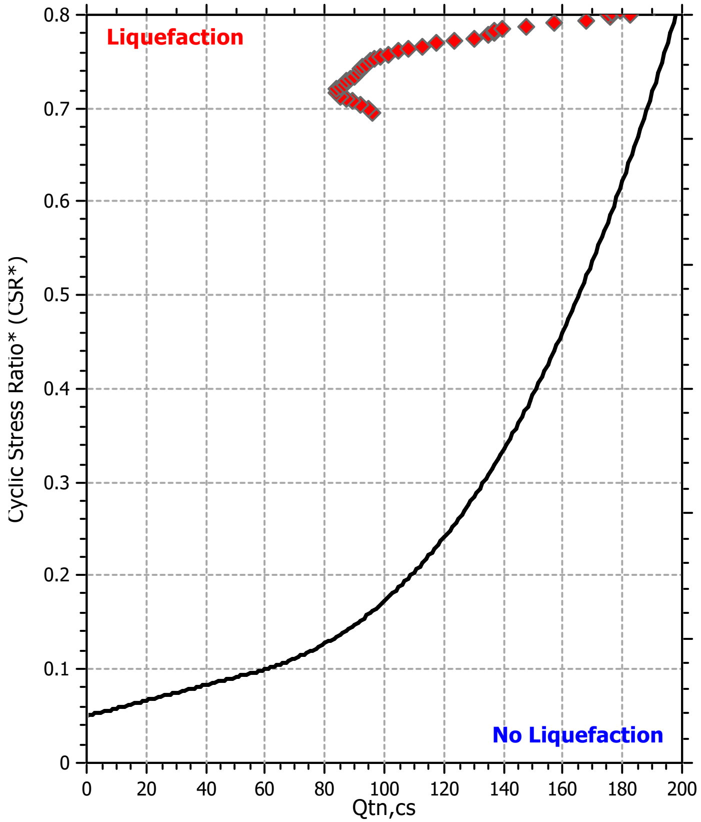
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

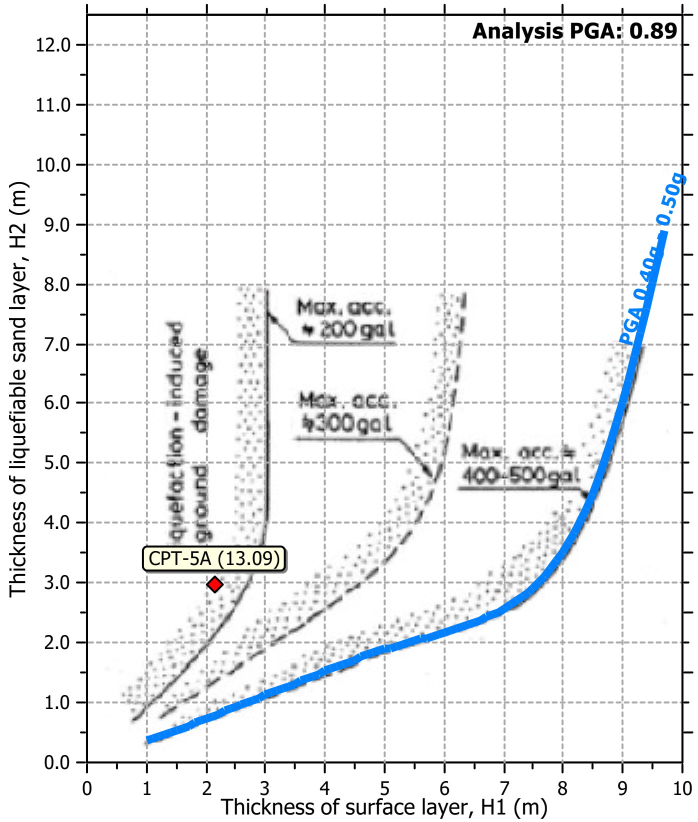
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



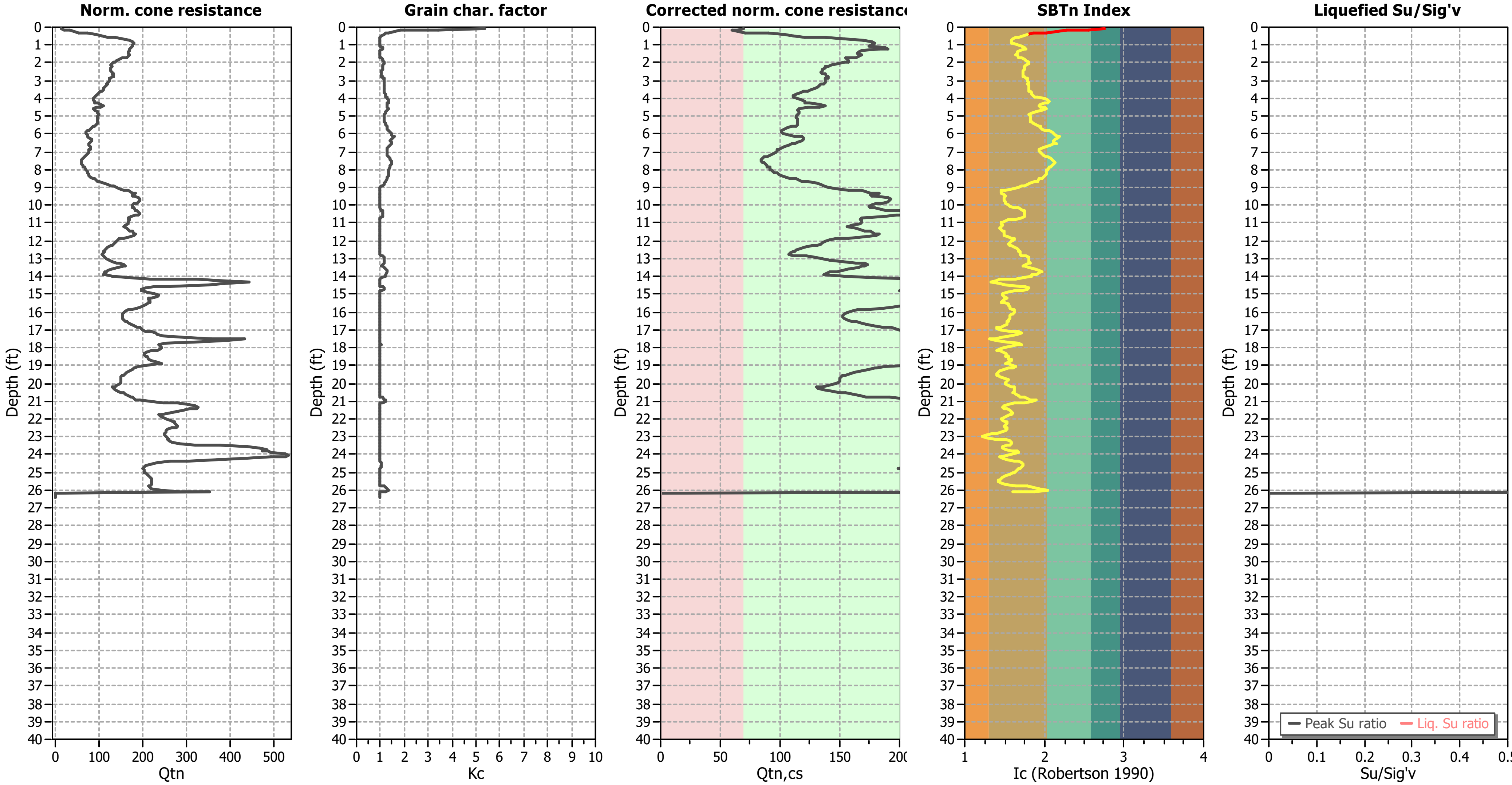




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

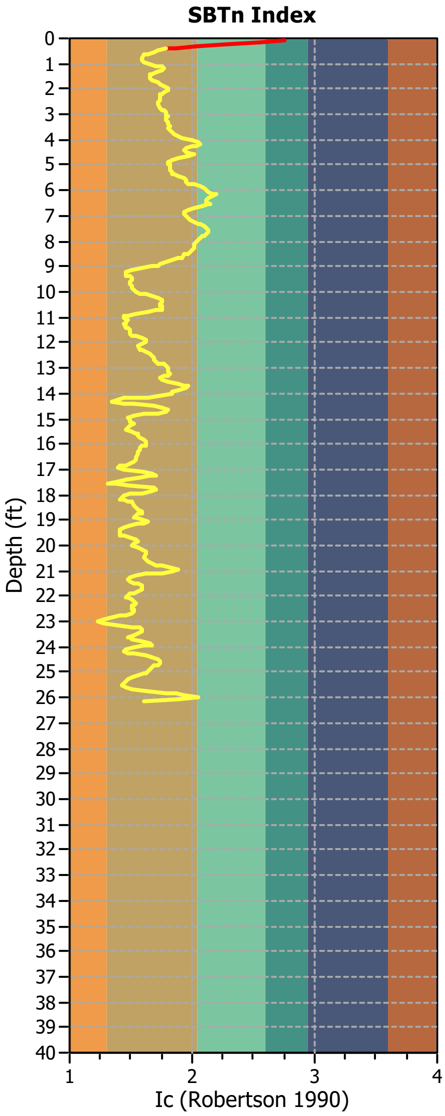
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

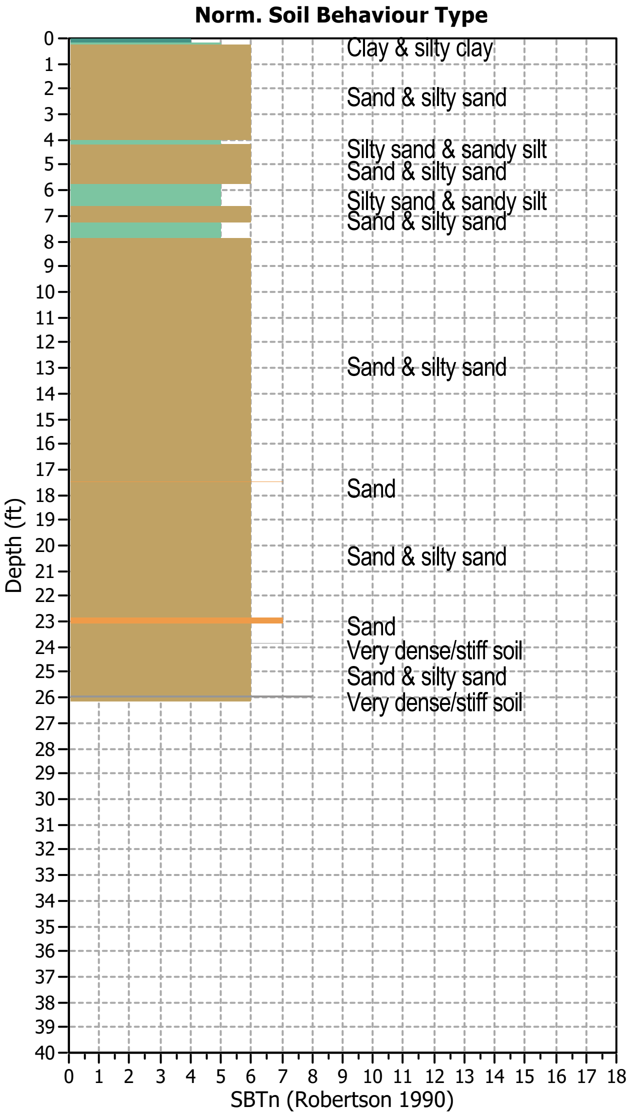
TRANSITION LAYER DETECTION ALGORITHM REPORT
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between 1.80 < I_c < 3.0) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

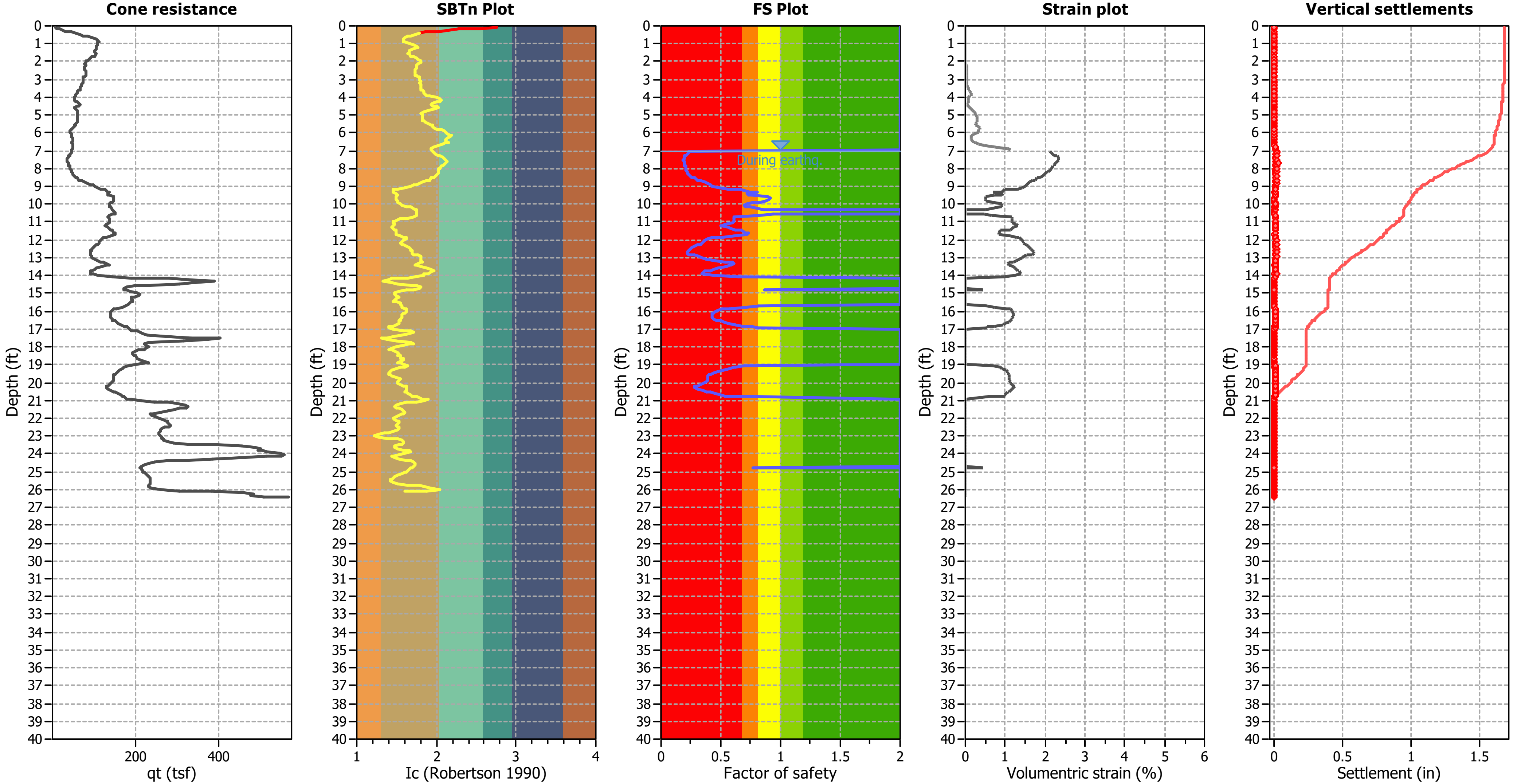
The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.





Transition layer algorithm properties		General statistics	
I_c minimum check value:	1.70	Total points in CPT file:	403
I_c maximum check value:	3.00	Total points excluded:	7
I_c change ratio value:	0.0250	Exclusion percentage:	1.74%
Minimum number of points in layer:	4	Number of layers detected:	1

Estimation of post-earthquake settlements

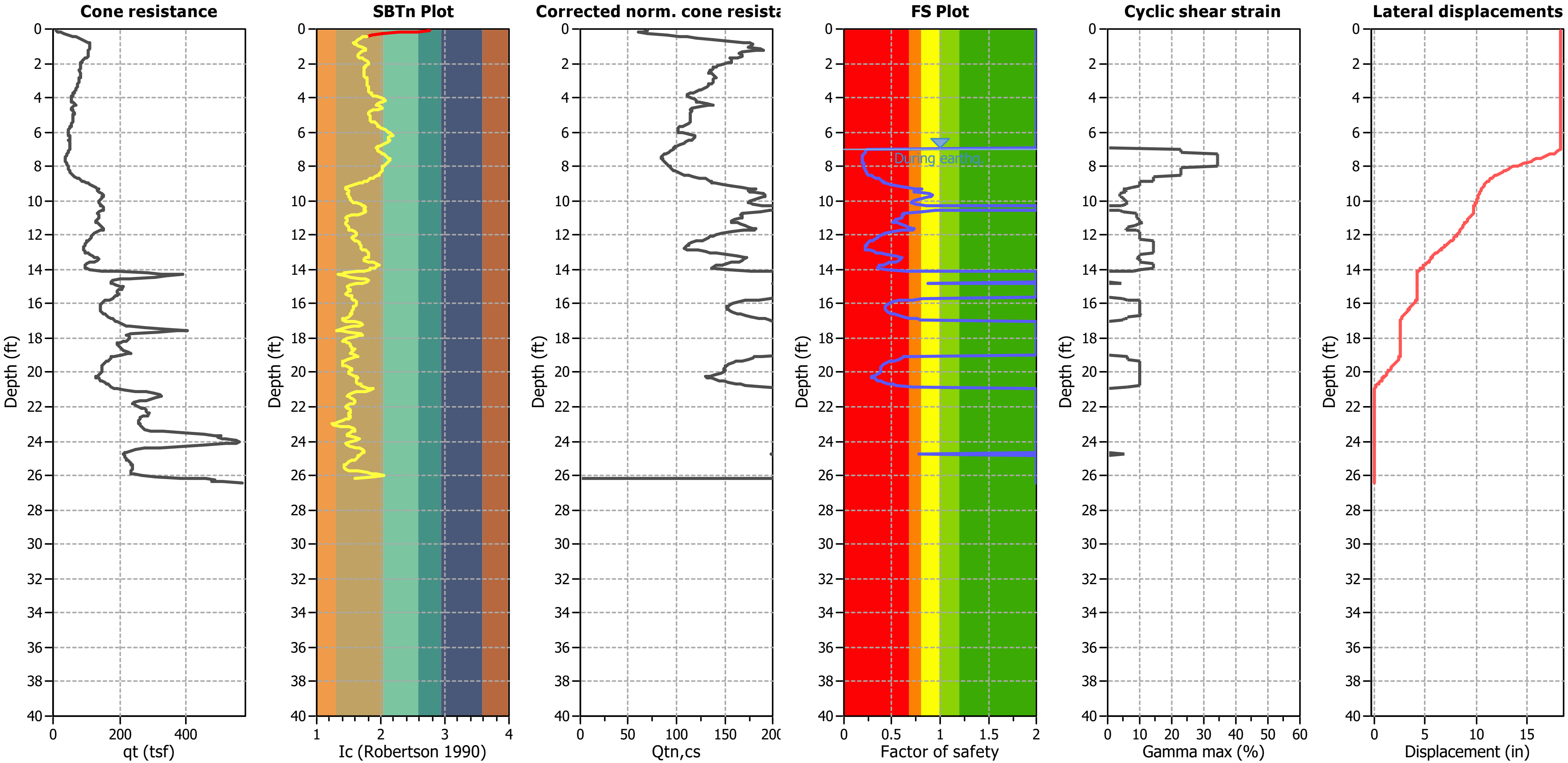


Abbreviations

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

Estimation of post-earthquake lateral Displacements

Geometric parameters: Gently sloping ground without free face (Slope 1.00 %)

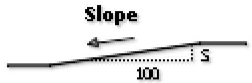


Abbreviations

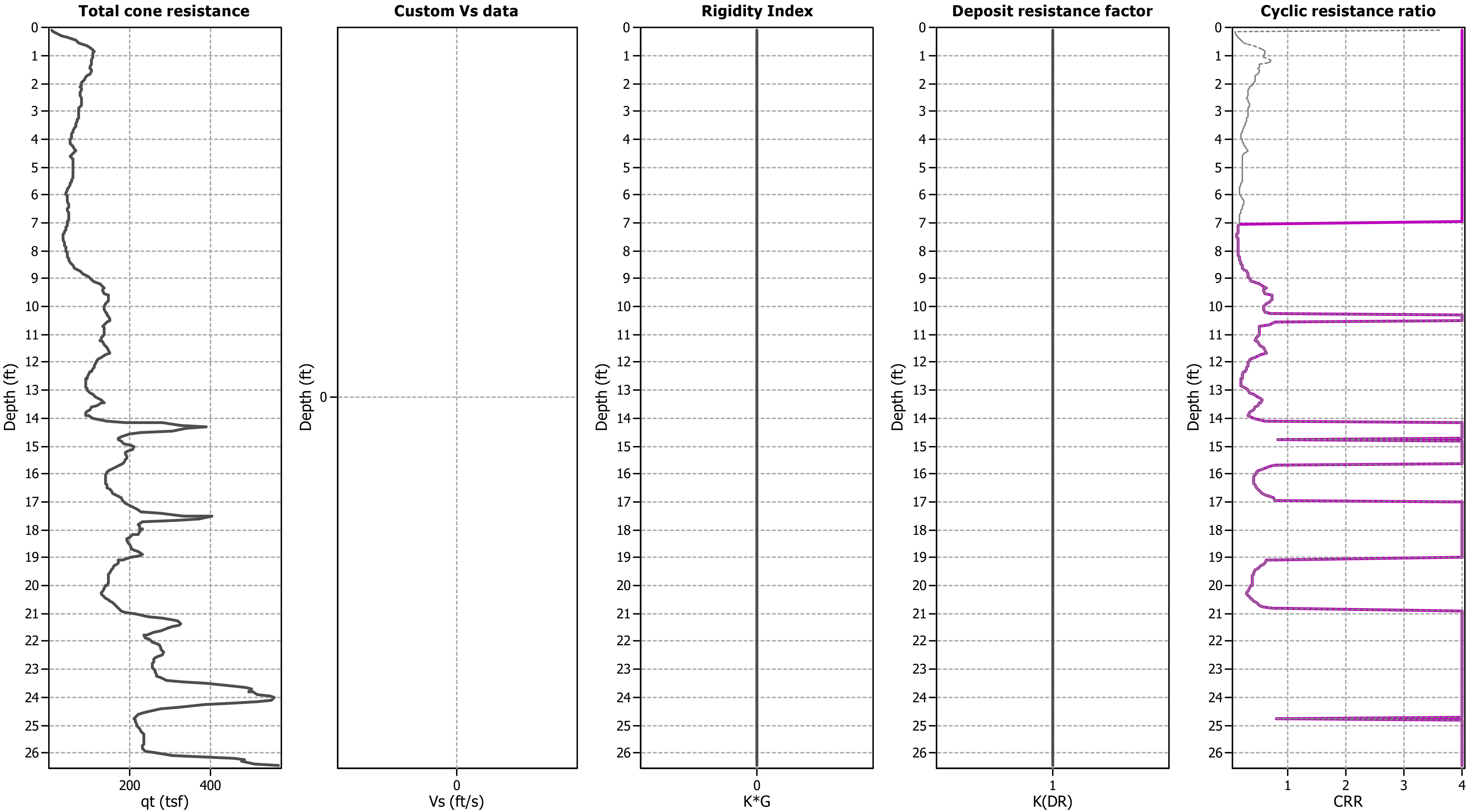
q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance

F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

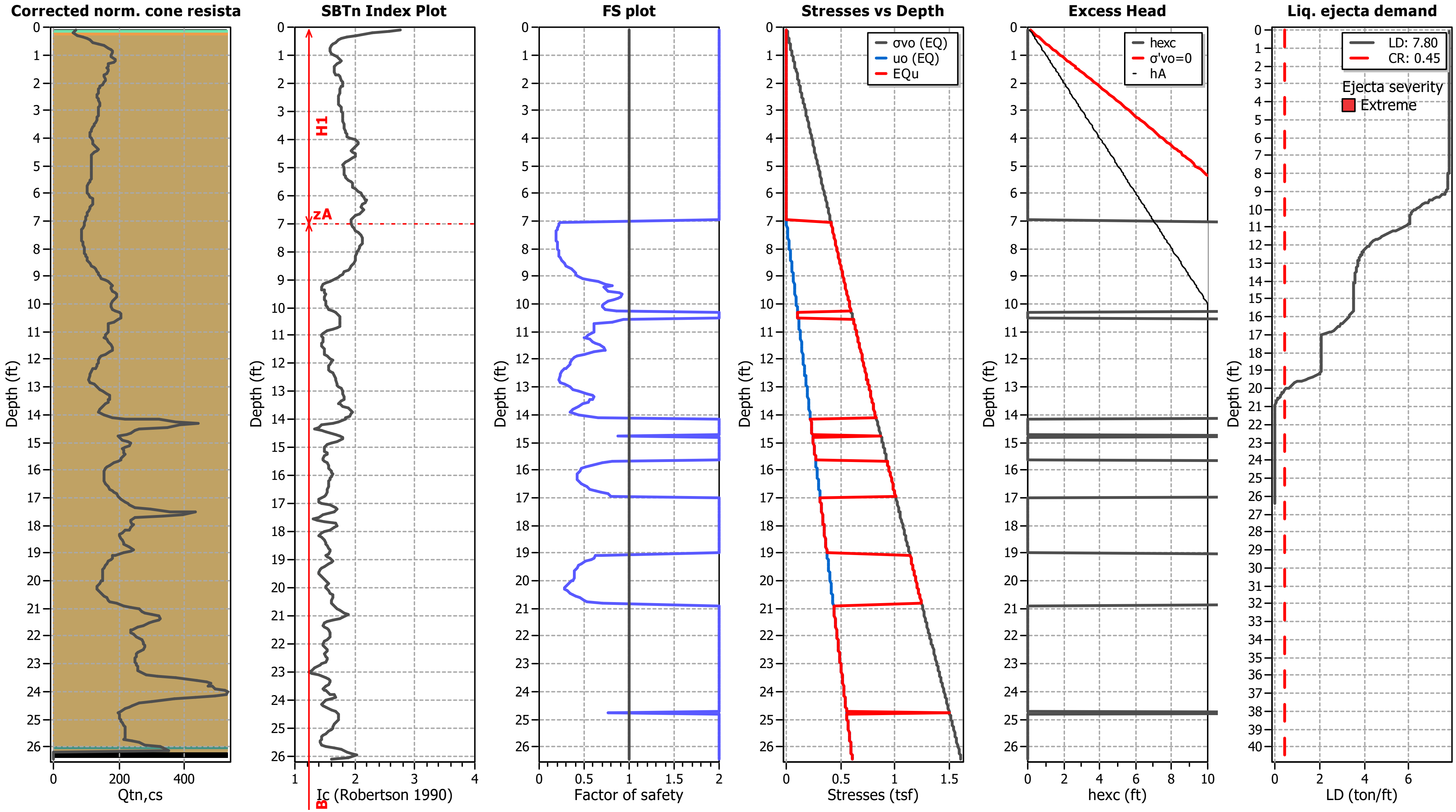
Surface condition



Aging Calculation Estimation



Ejecta Severity Estimation



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

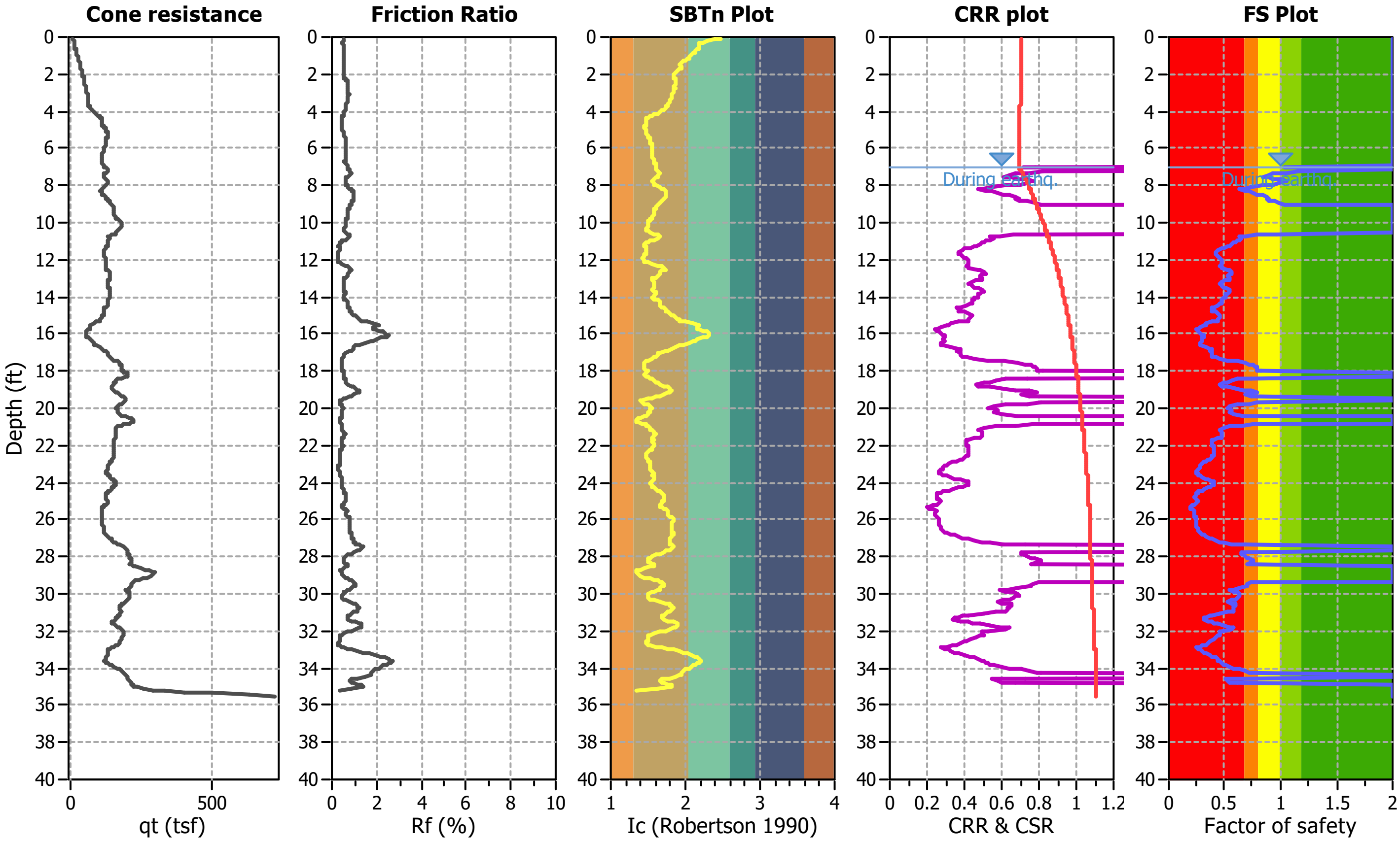
LIQUEFACTION ANALYSIS REPORT

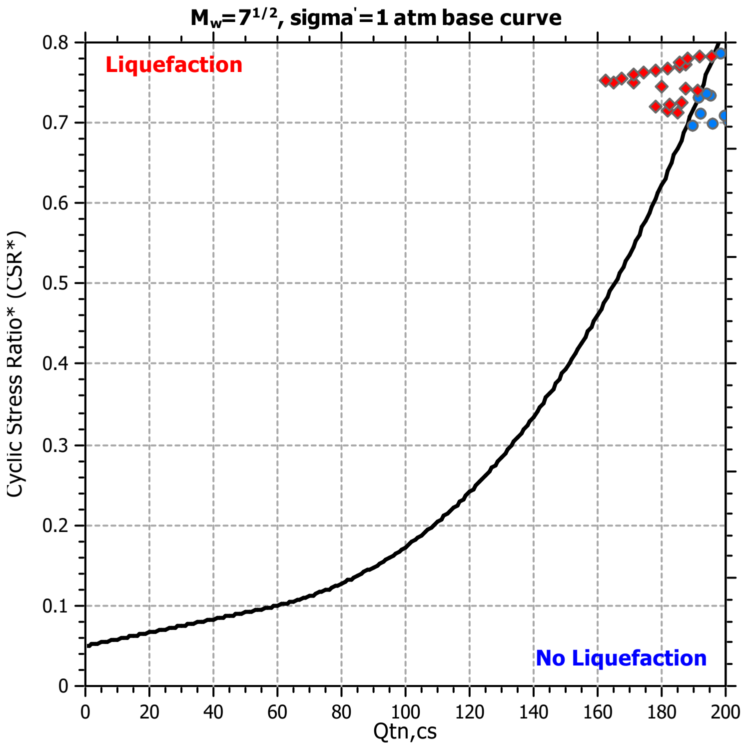
Project title : Petra Geosciences / Apple Canyon **Location : Lake Hemet, CA**

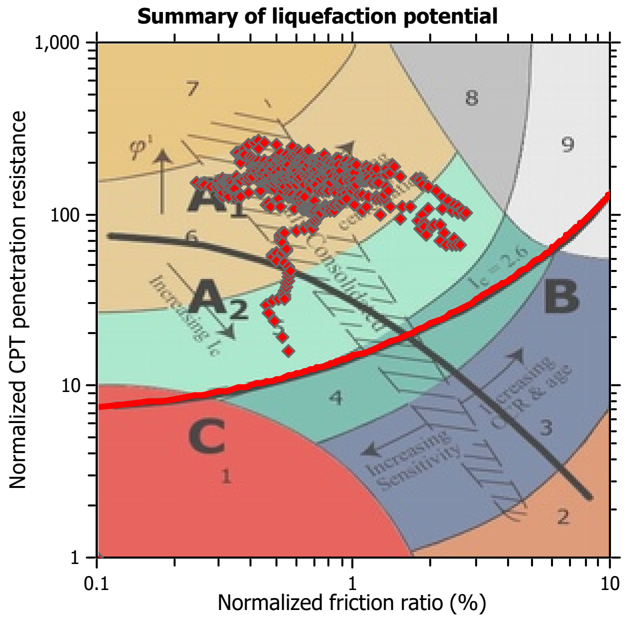
CPT file : CPT-6

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	10.50 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	8.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.89	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

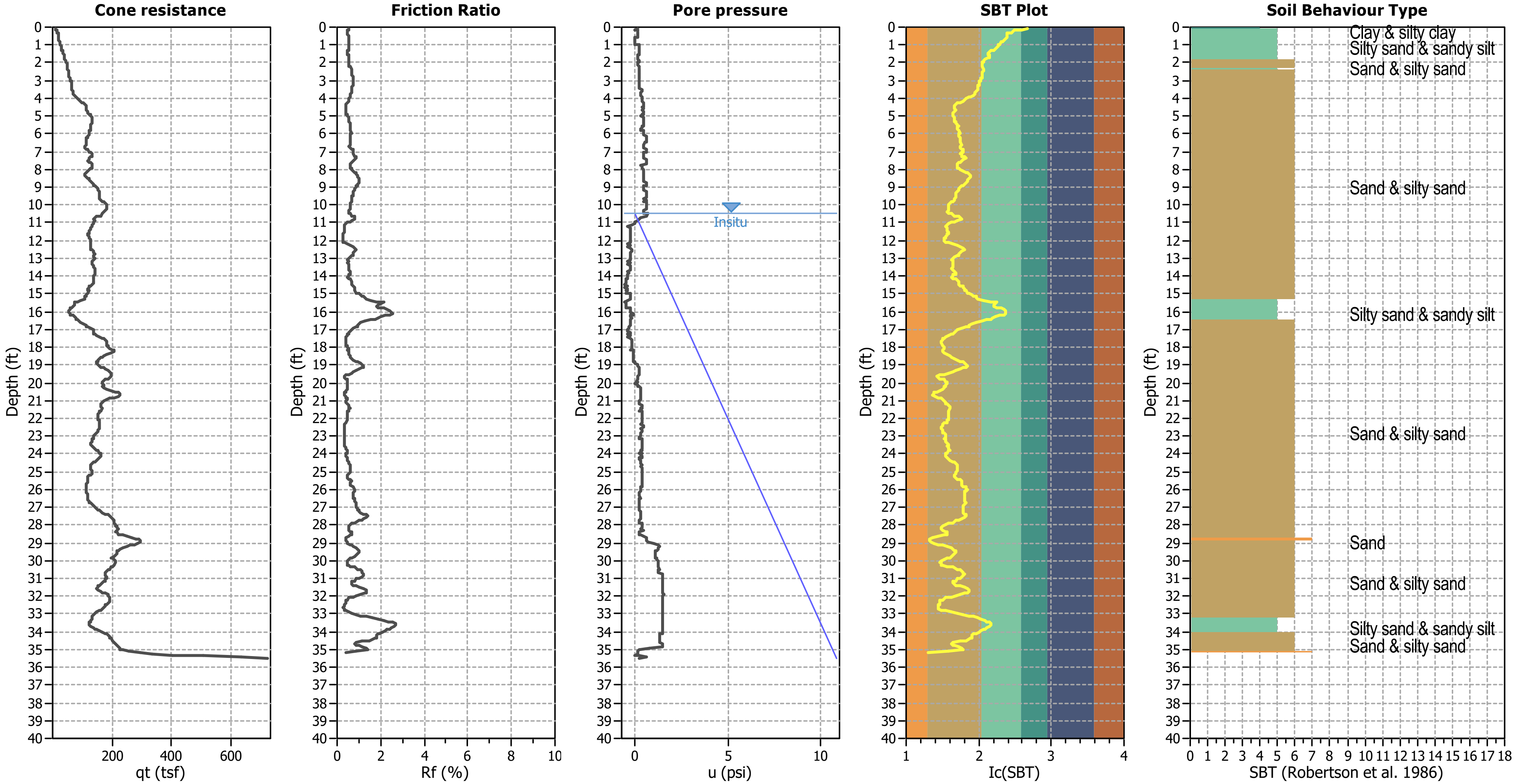






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



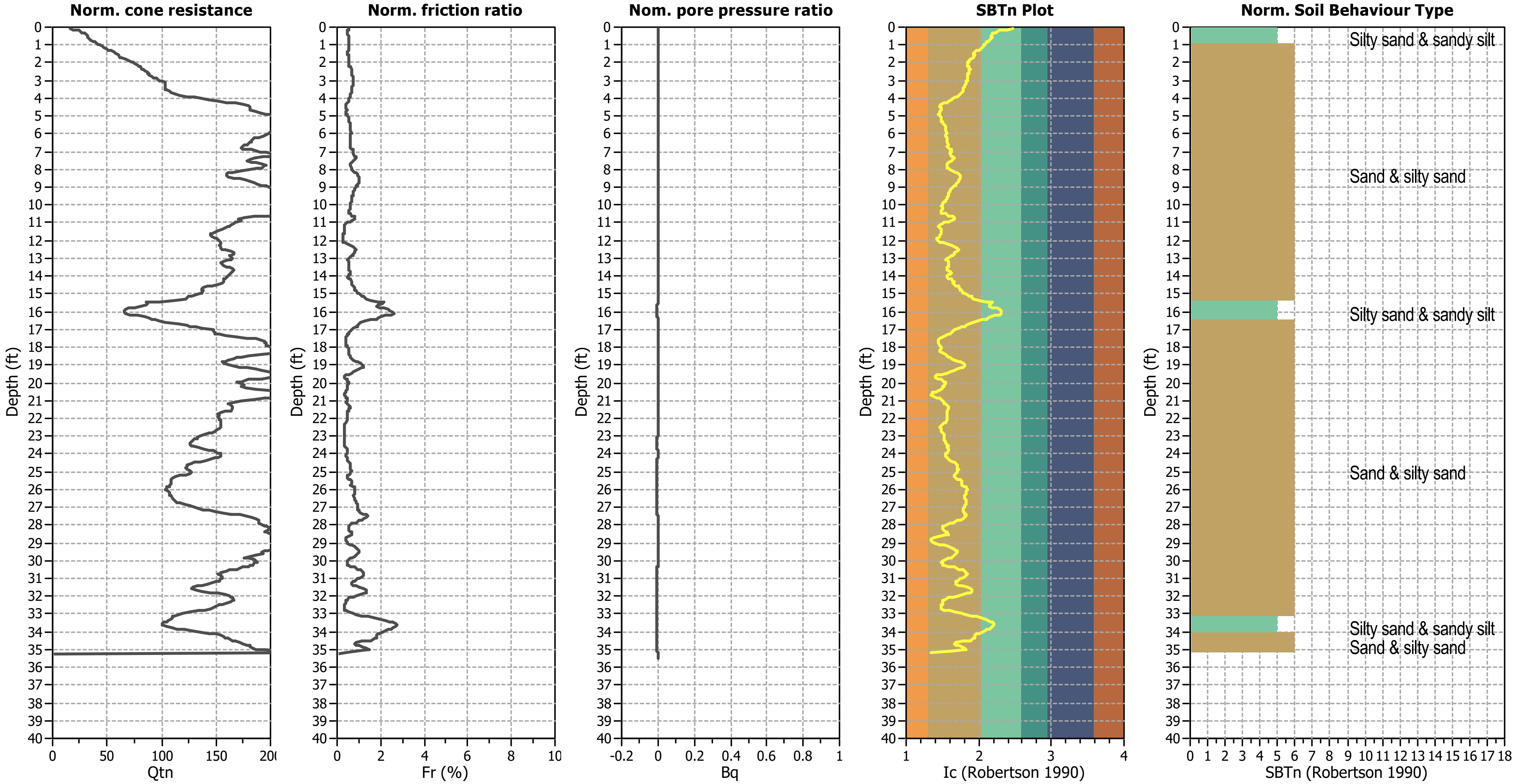
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

SBT 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

CPT basic interpretation plots (normalized)



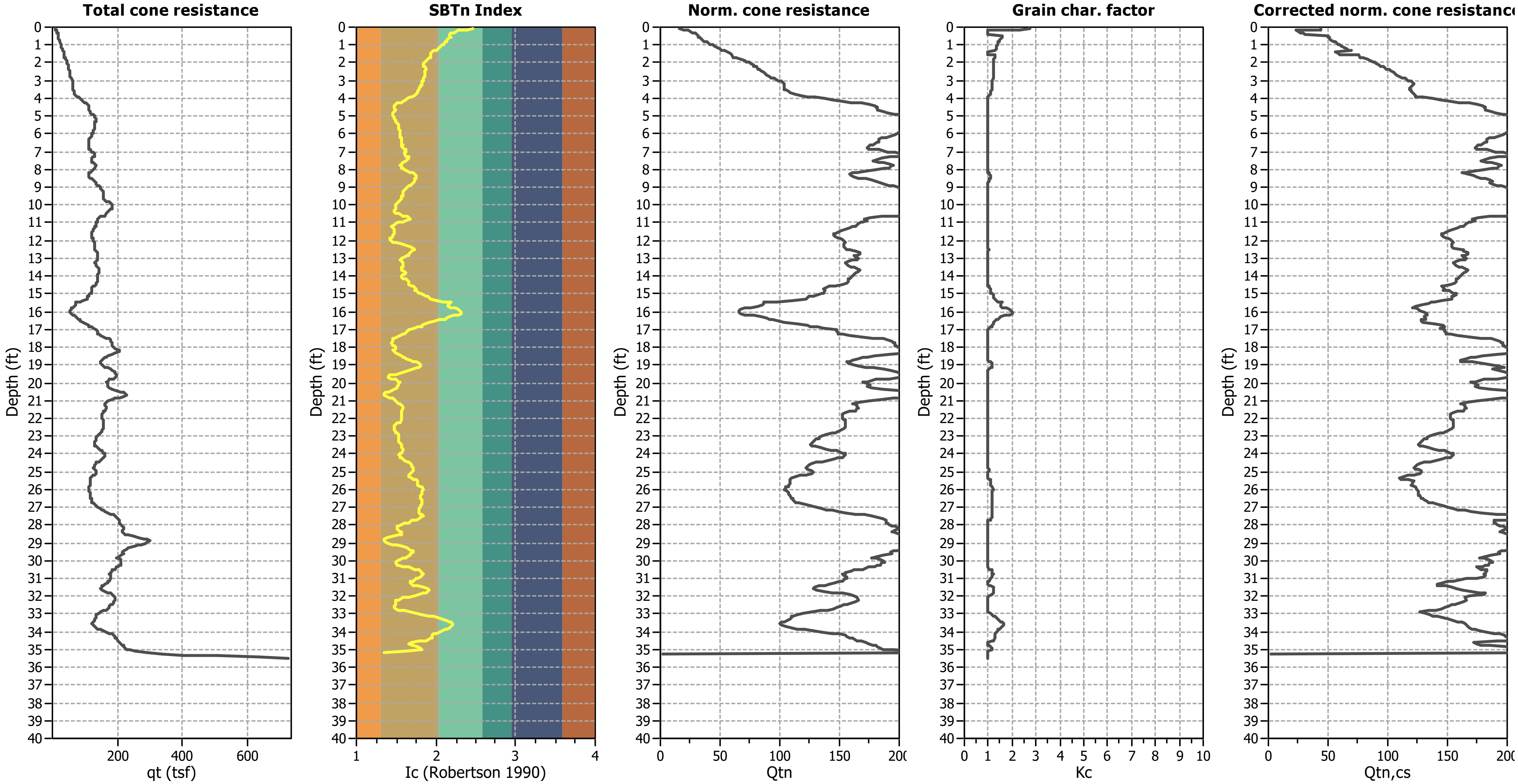
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

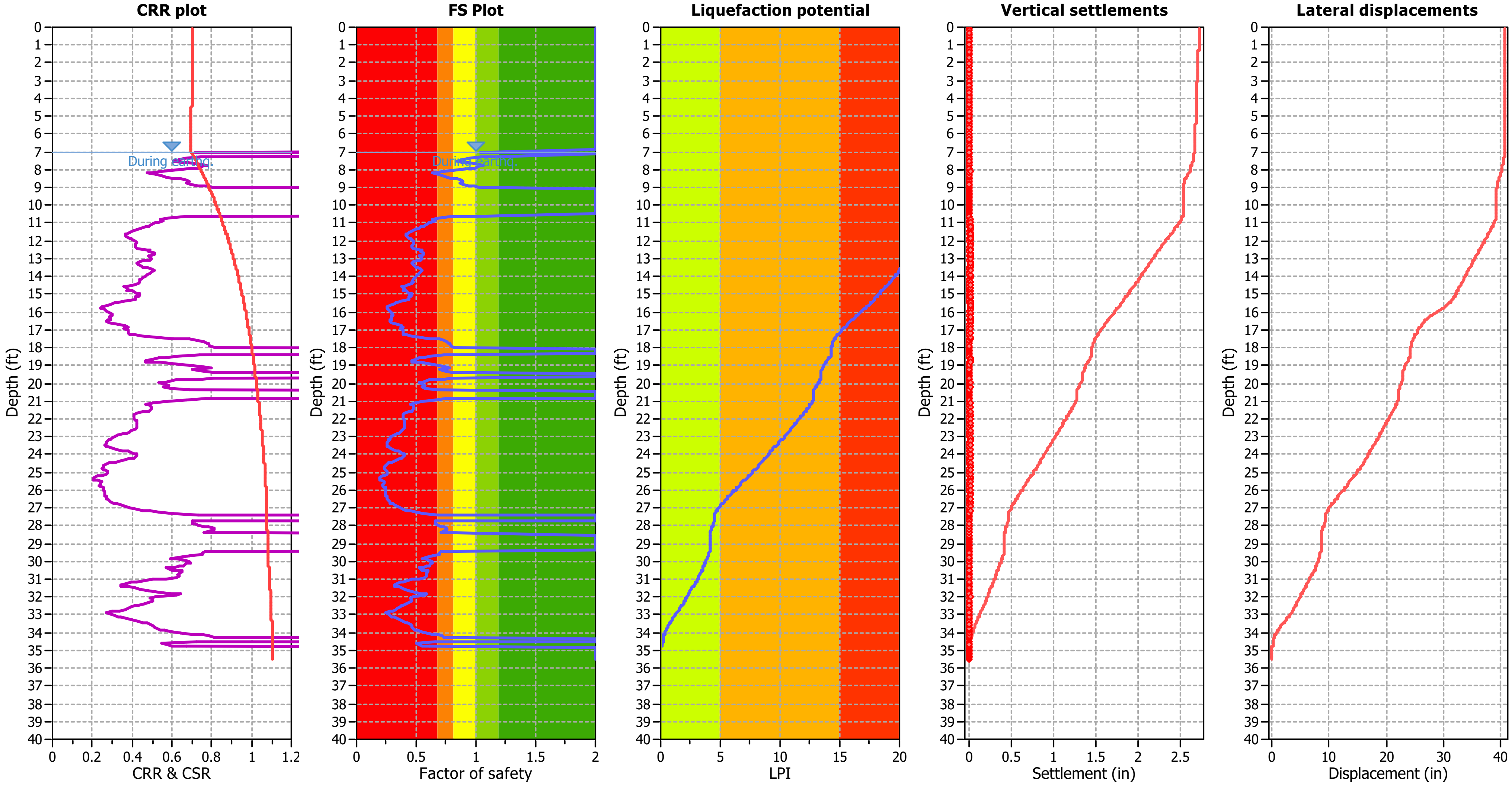
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



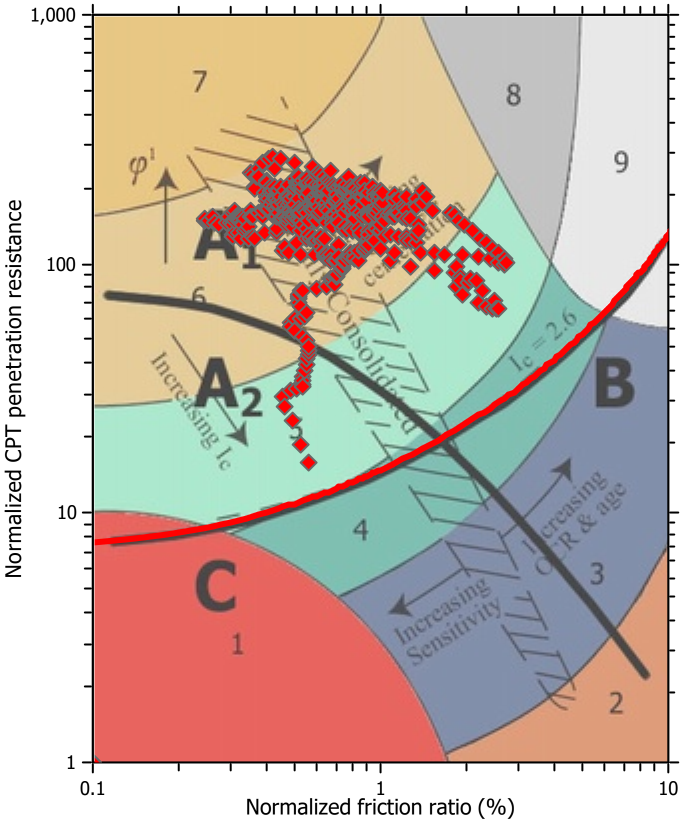
Input parameters and analysis data

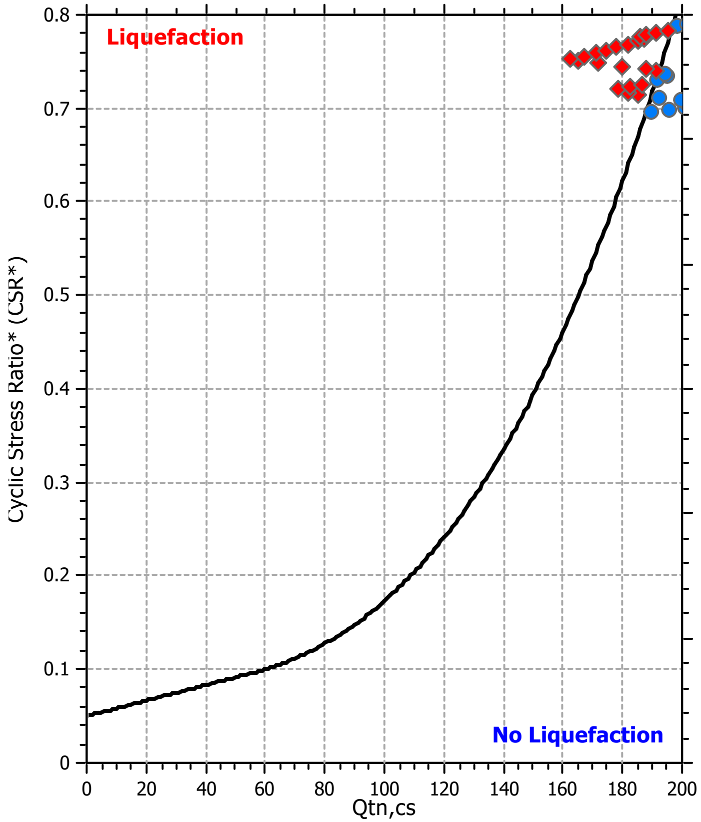
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

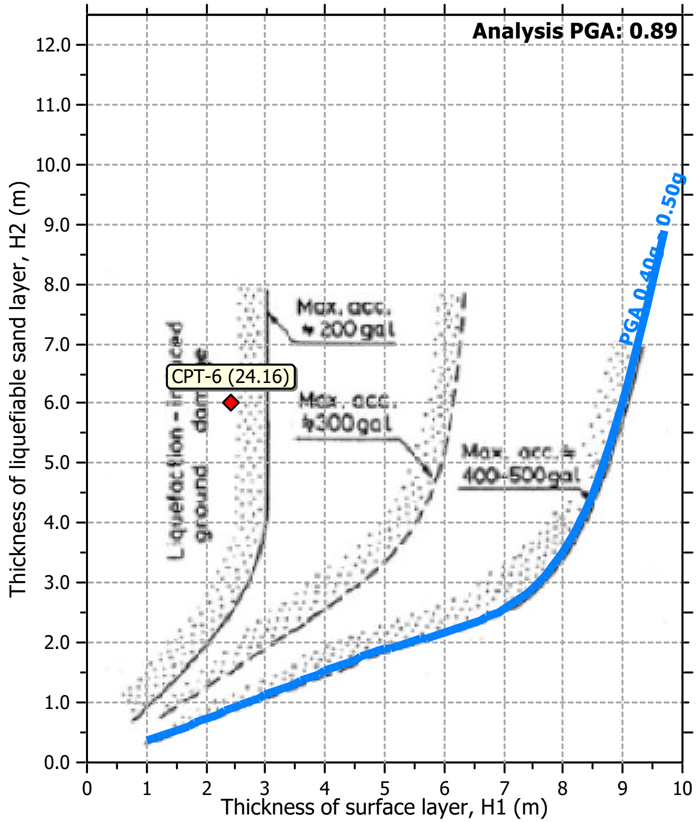
F.S. color scheme
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme
- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



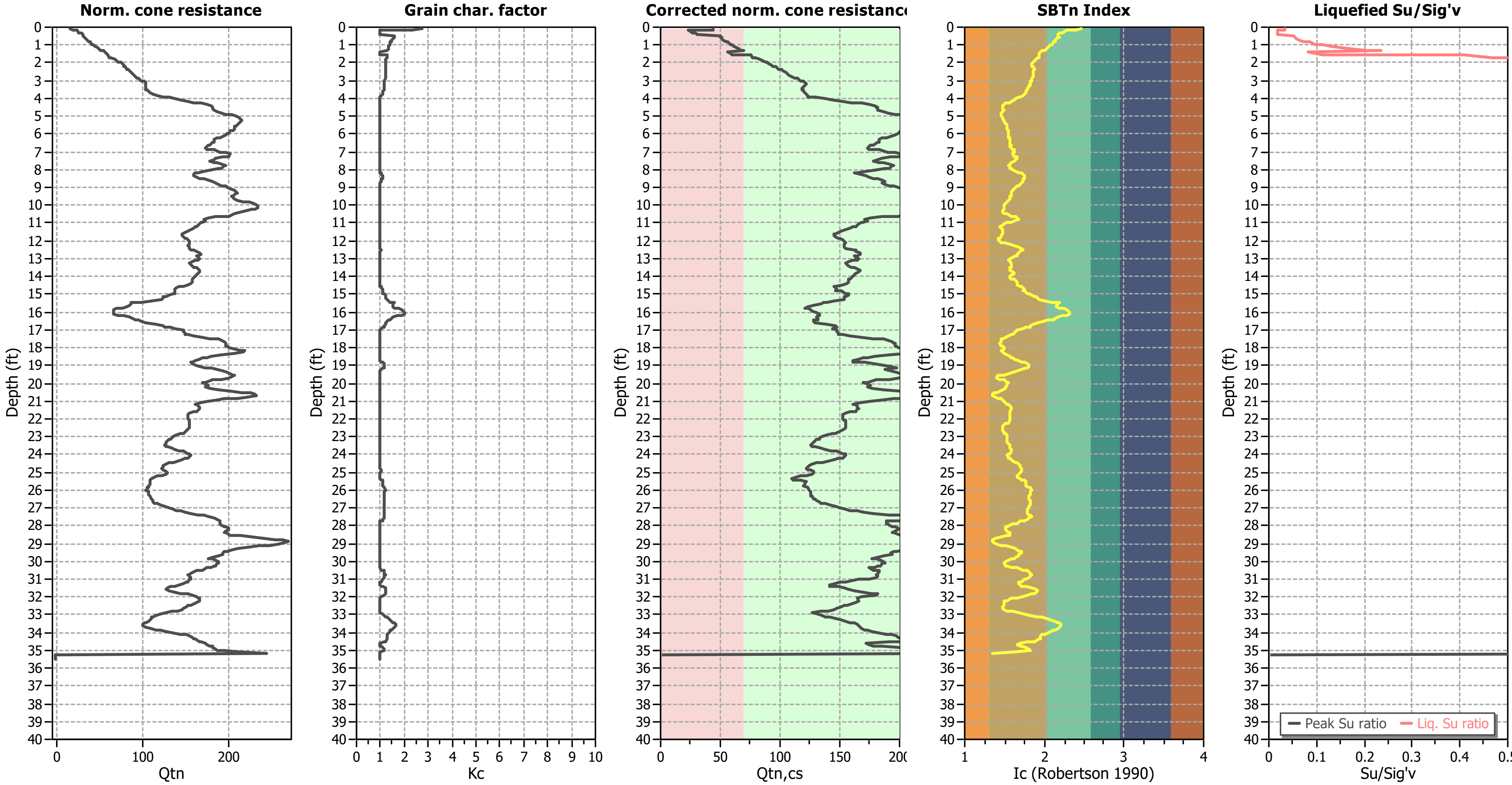




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_{σ} applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

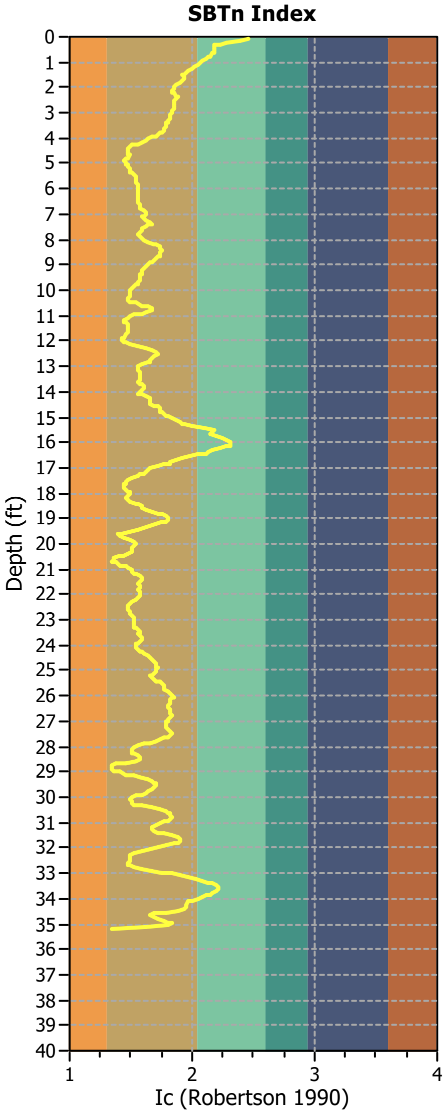
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

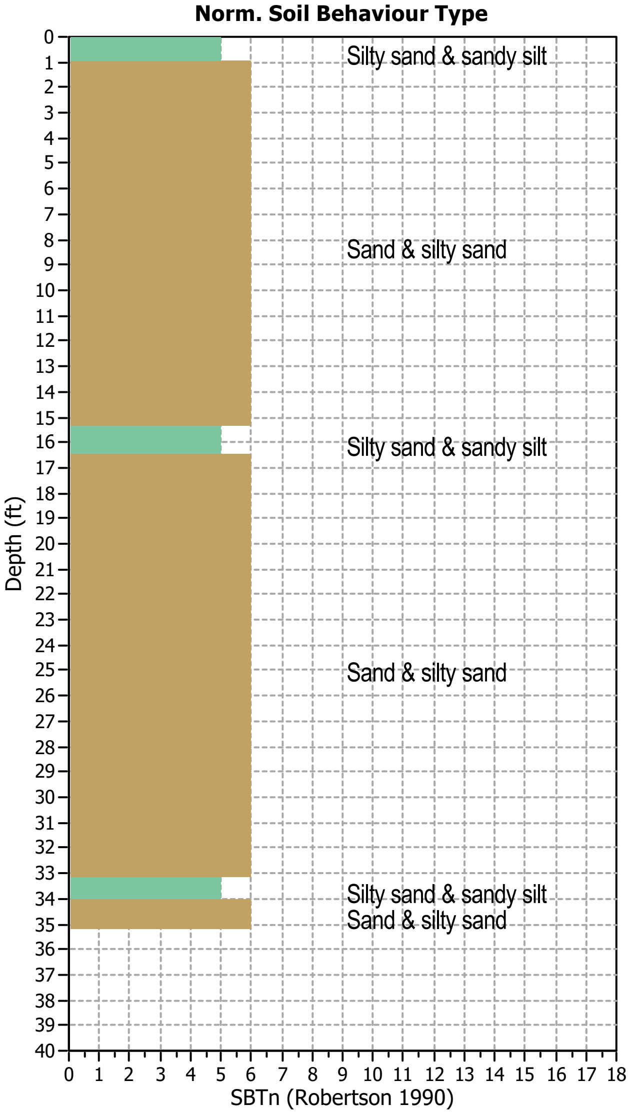
TRANSITION LAYER DETECTION ALGORITHM REPORT
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between 1.80 < I_c < 3.0) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.





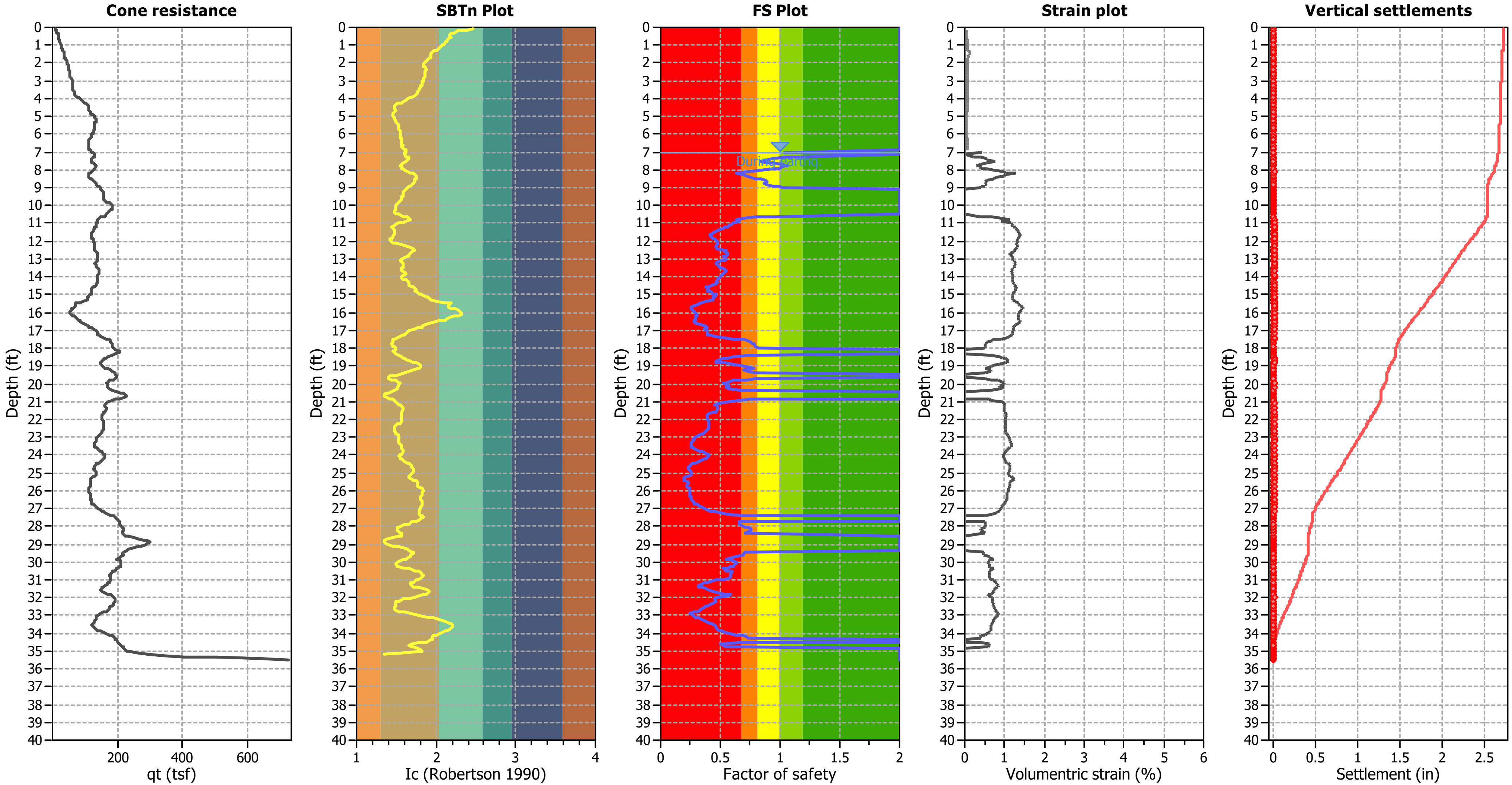
Transition layer algorithm properties

I_c minimum check value:	1.70
I_c maximum check value:	3.00
I_c change ratio value:	0.0250
Minimum number of points in layer:	4

General statistics

Total points in CPT file:	541
Total points excluded:	0
Exclusion percentage:	0.00%
Number of layers detected:	0

Estimation of post-earthquake settlements

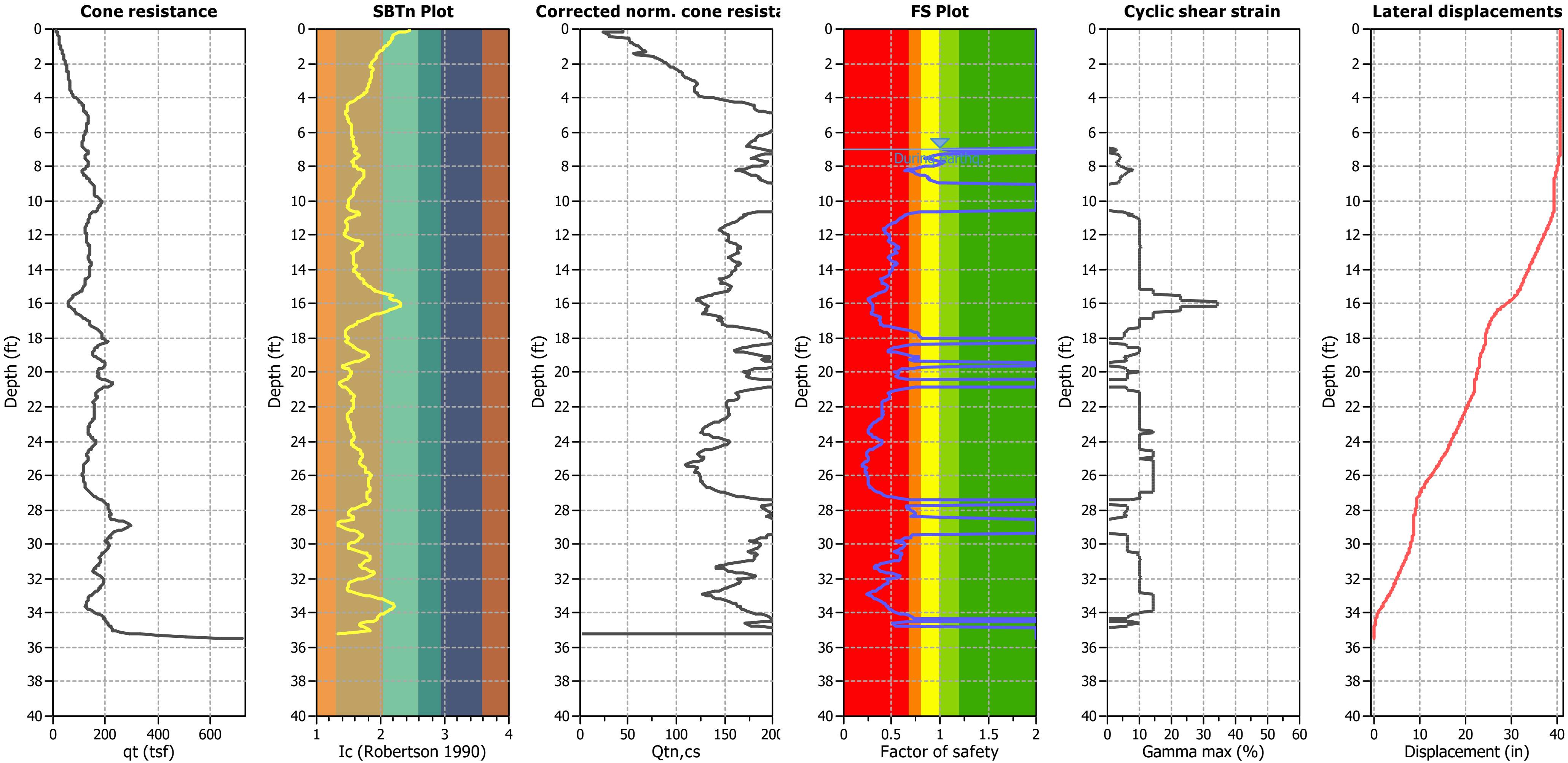


Abbreviations

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

Estimation of post-earthquake lateral Displacements

Geometric parameters: Gently sloping ground without free face (Slope 1.20 %)

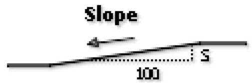


Abbreviations

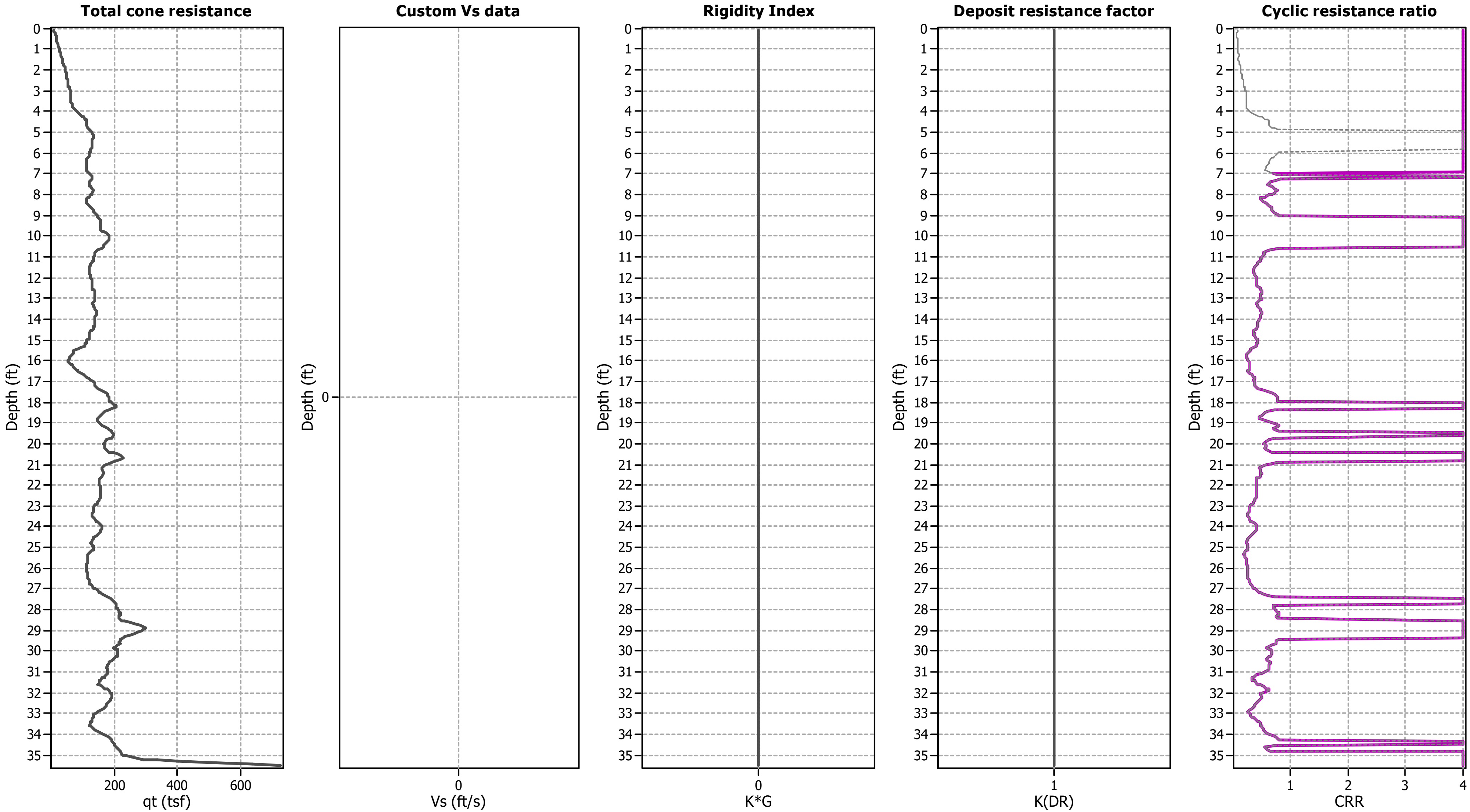
q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance

F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

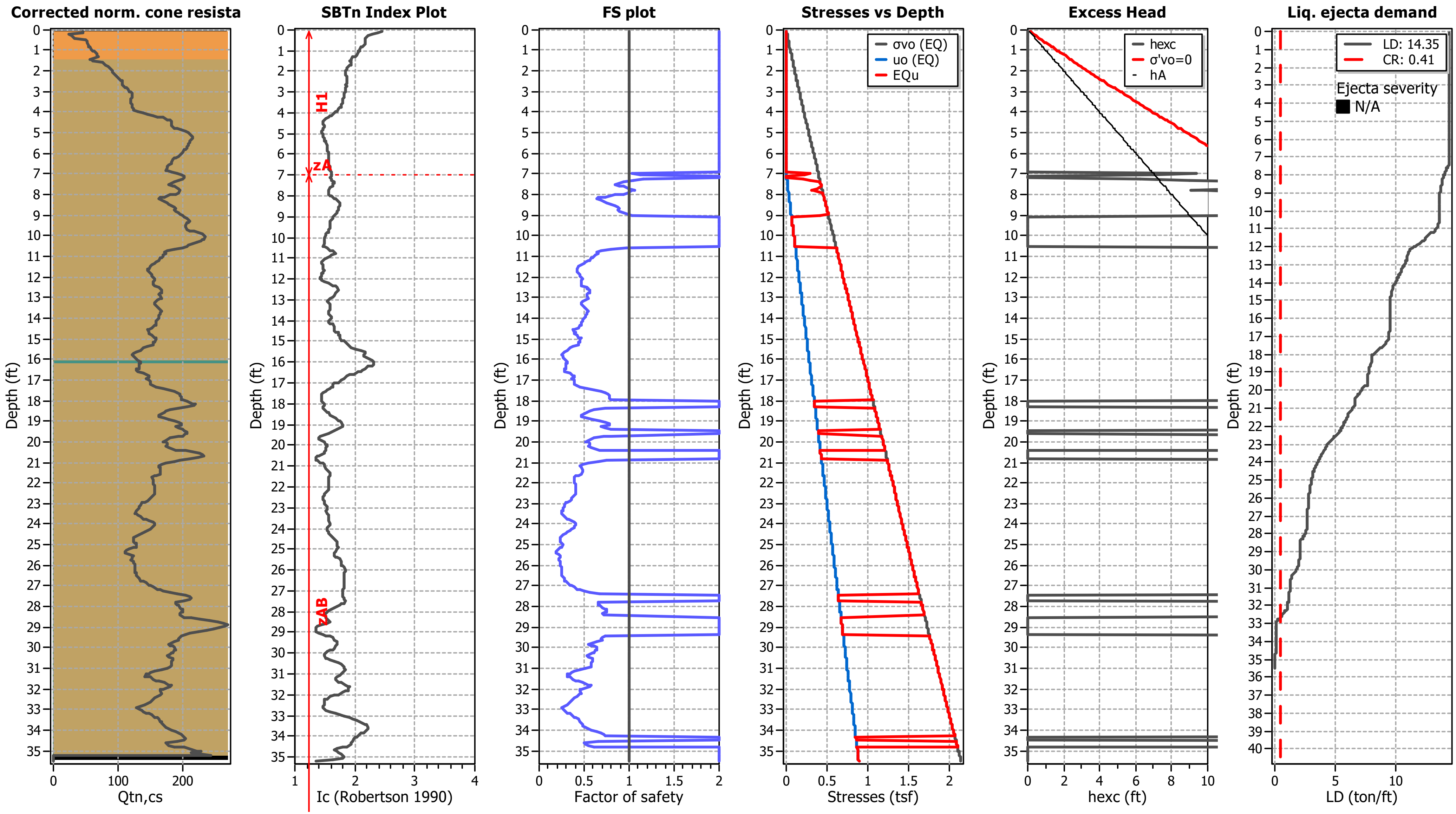
Surface condition



Aging Calculation Estimation



Ejecta Severity Estimation



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

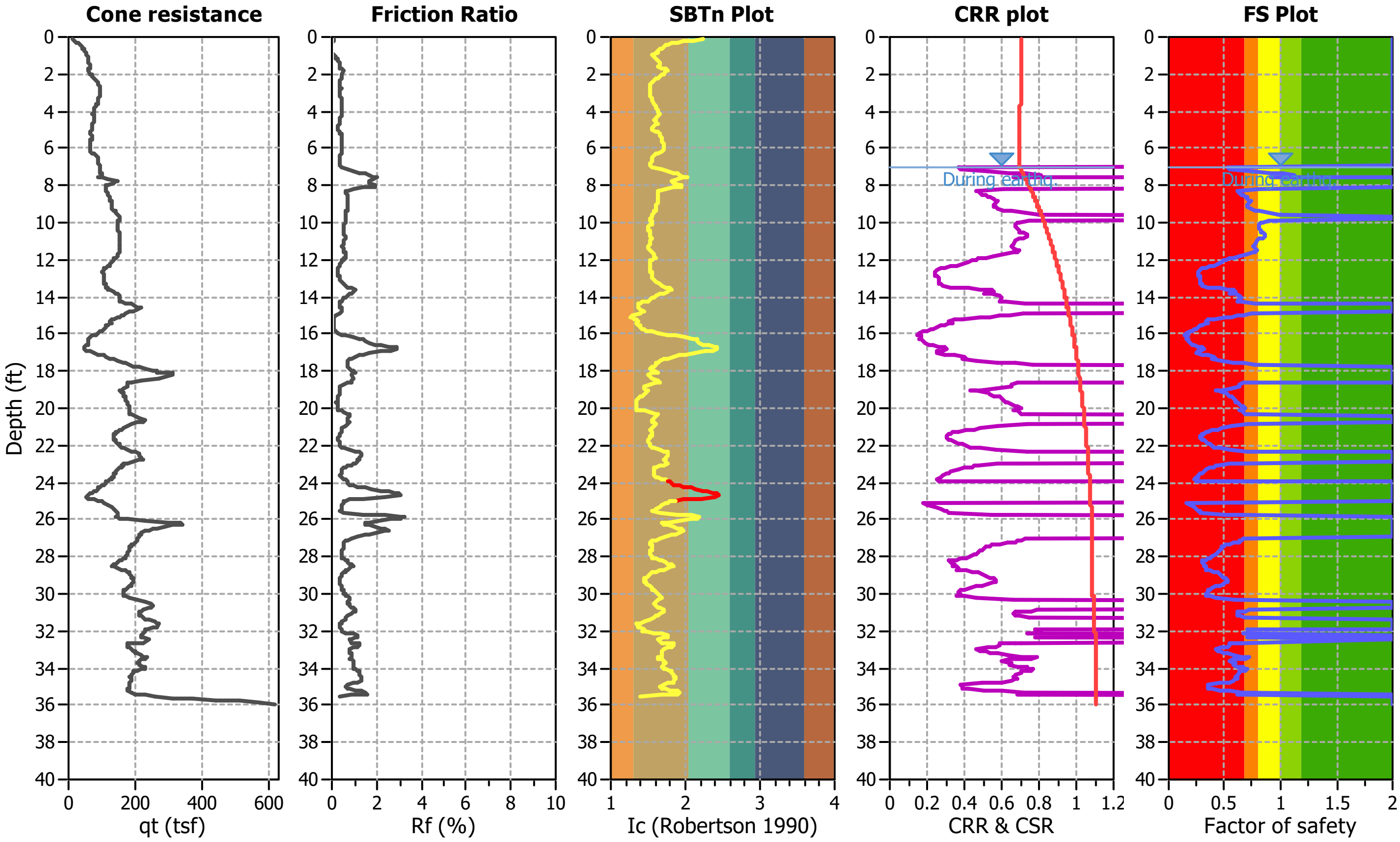
LIQUEFACTION ANALYSIS REPORT

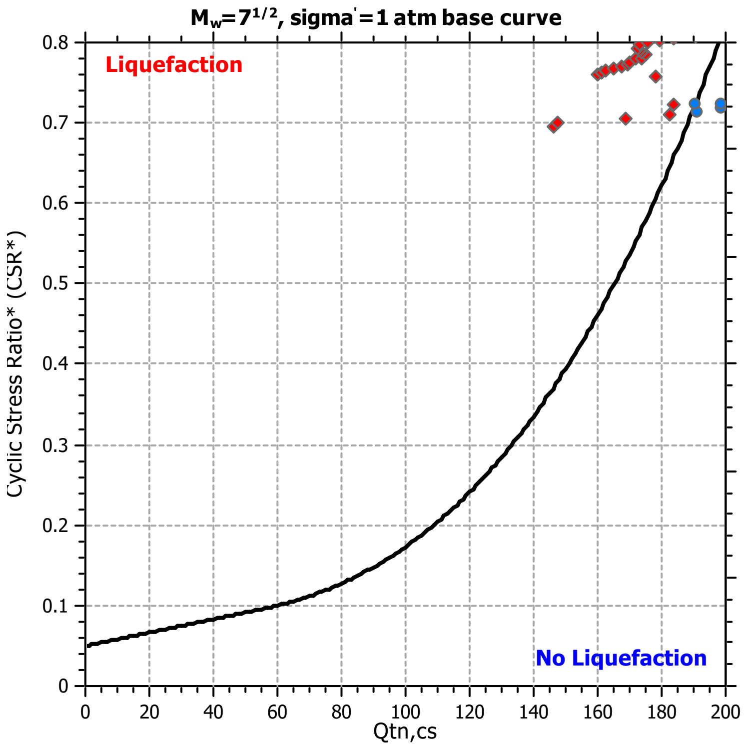
Project title : Petra Geosciences / Apple Canyon **Location : Lake Hemet, CA**

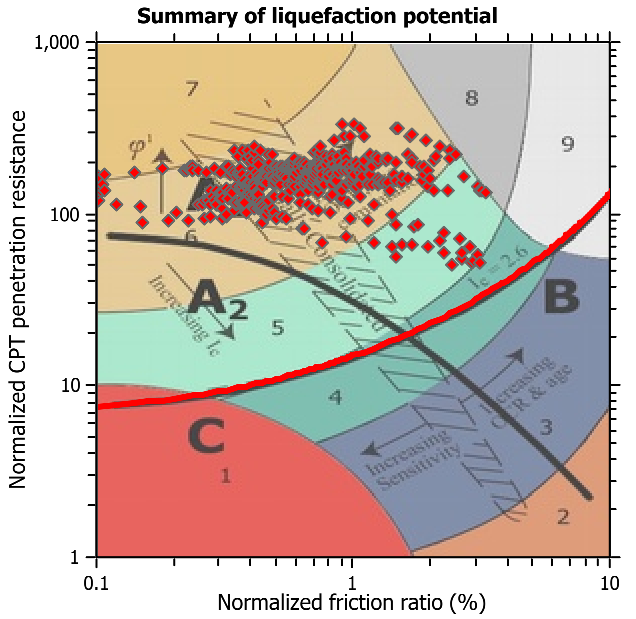
CPT file : CPT-7

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	11.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	8.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.89	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

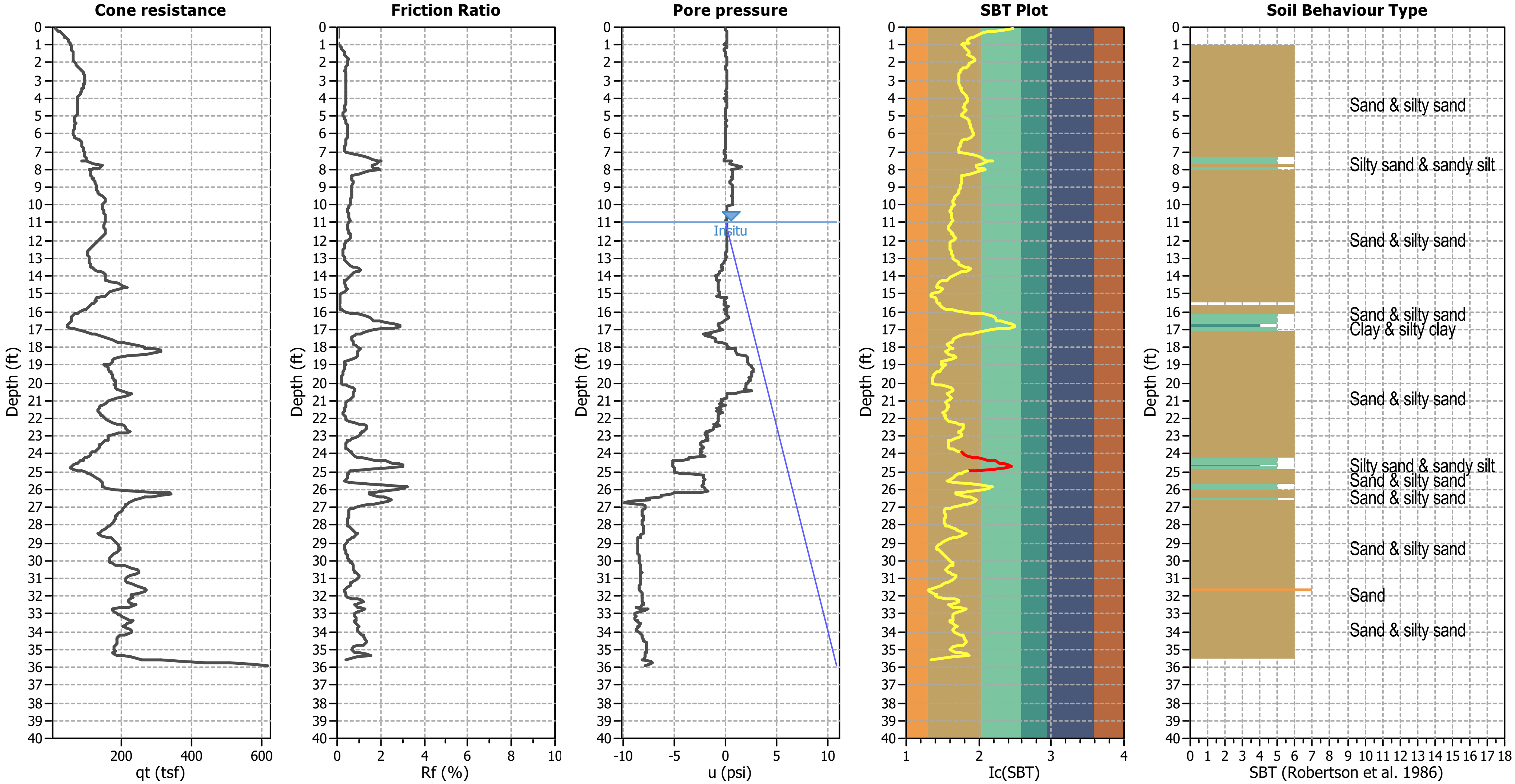






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



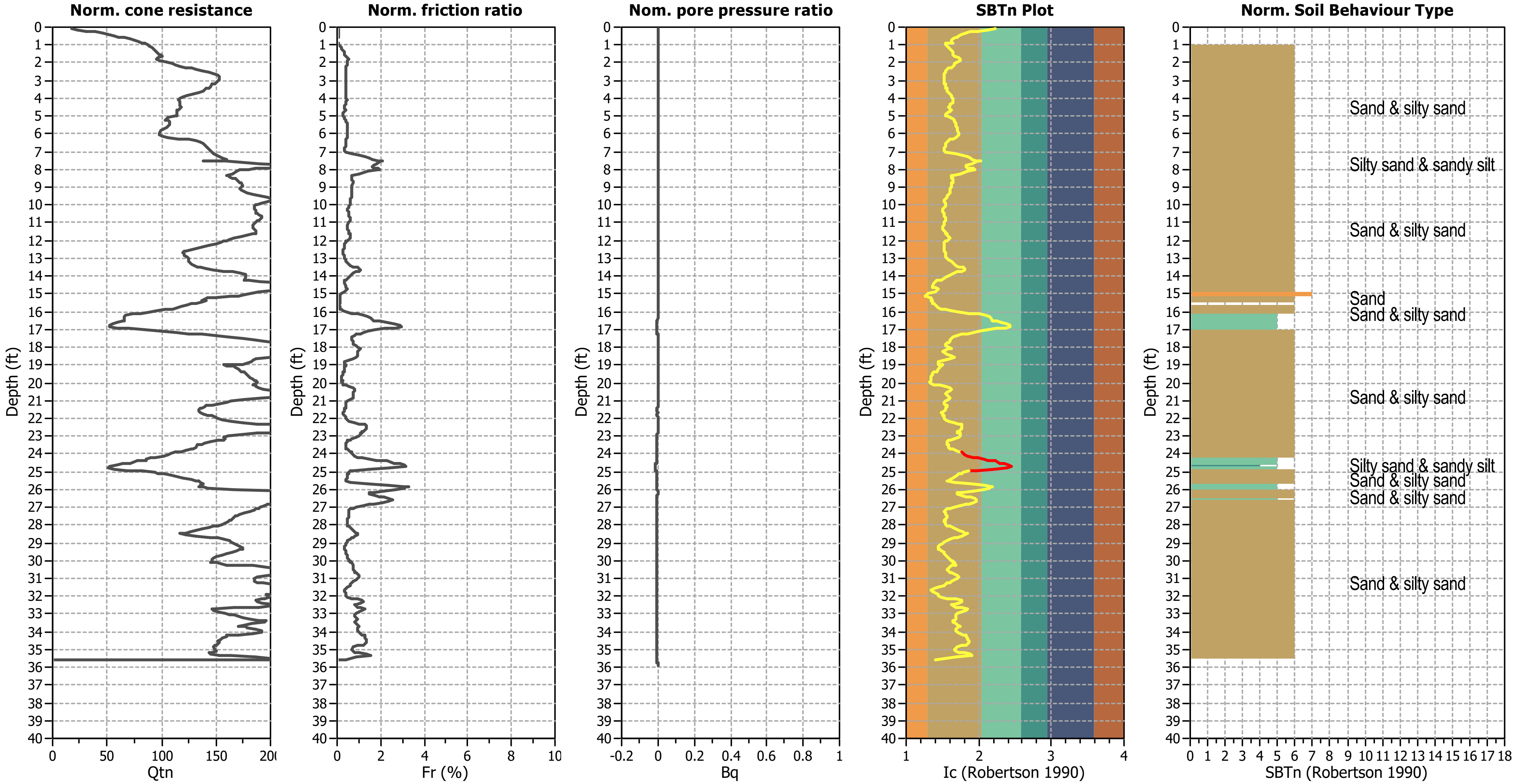
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT 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

CPT basic interpretation plots (normalized)



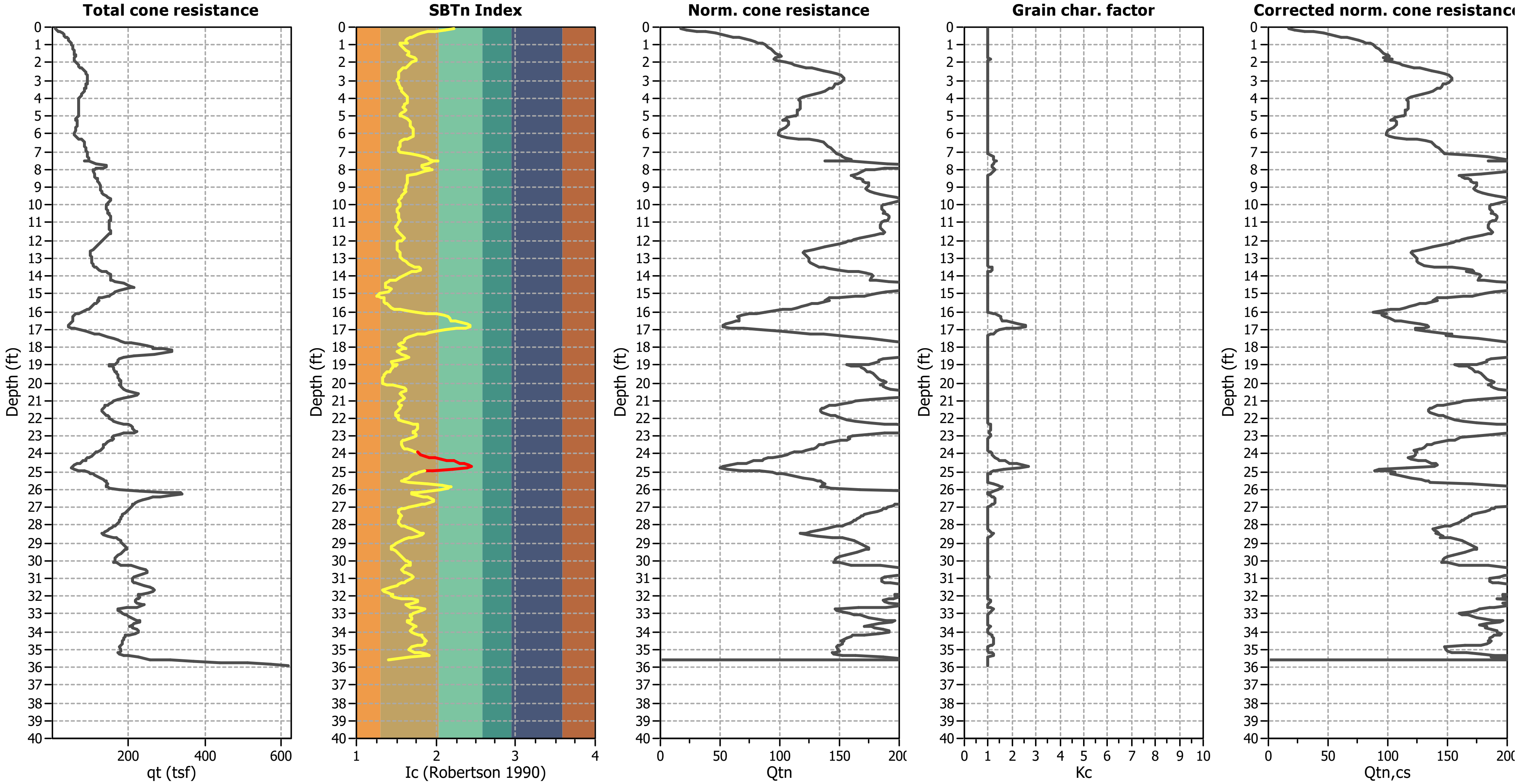
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

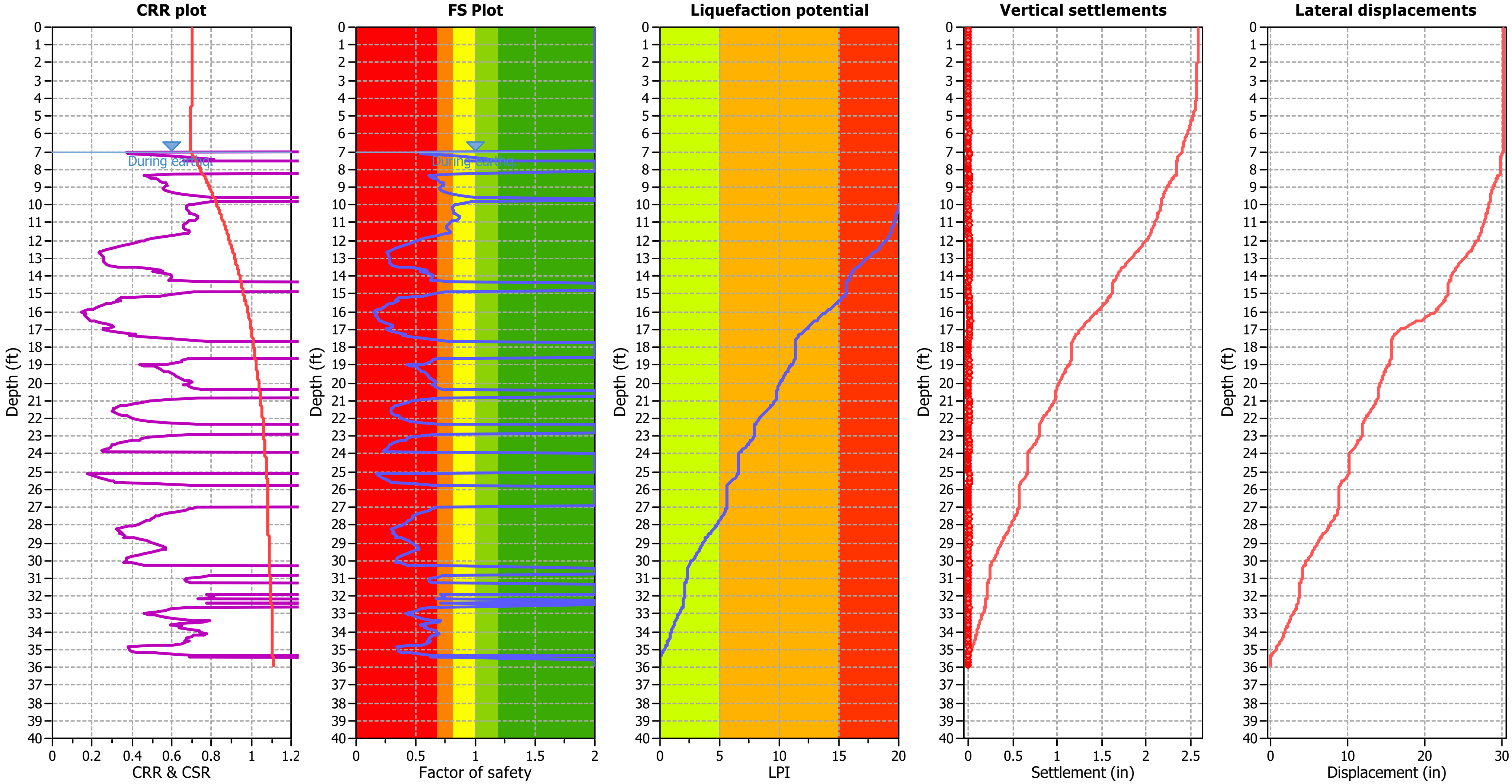
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

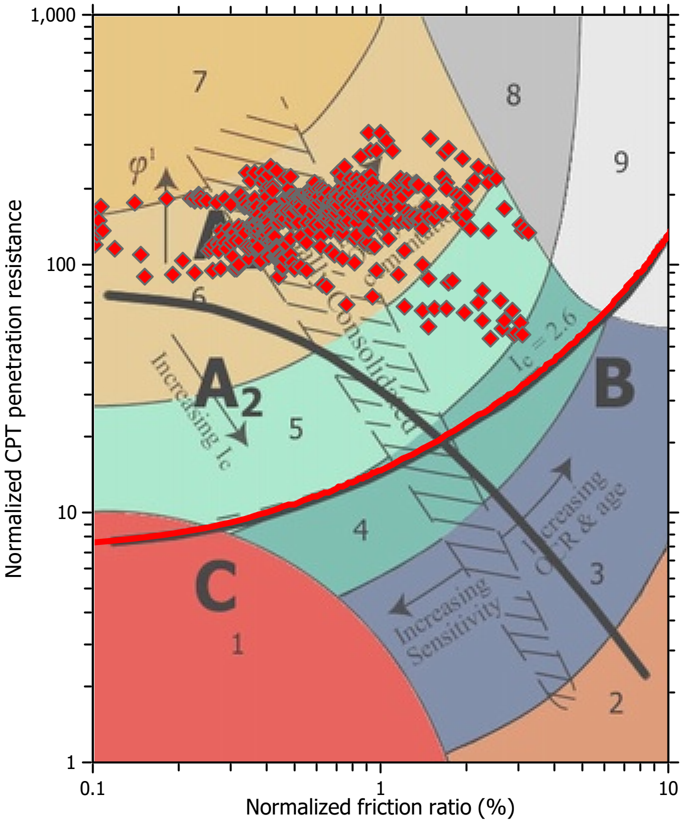
F.S. color scheme

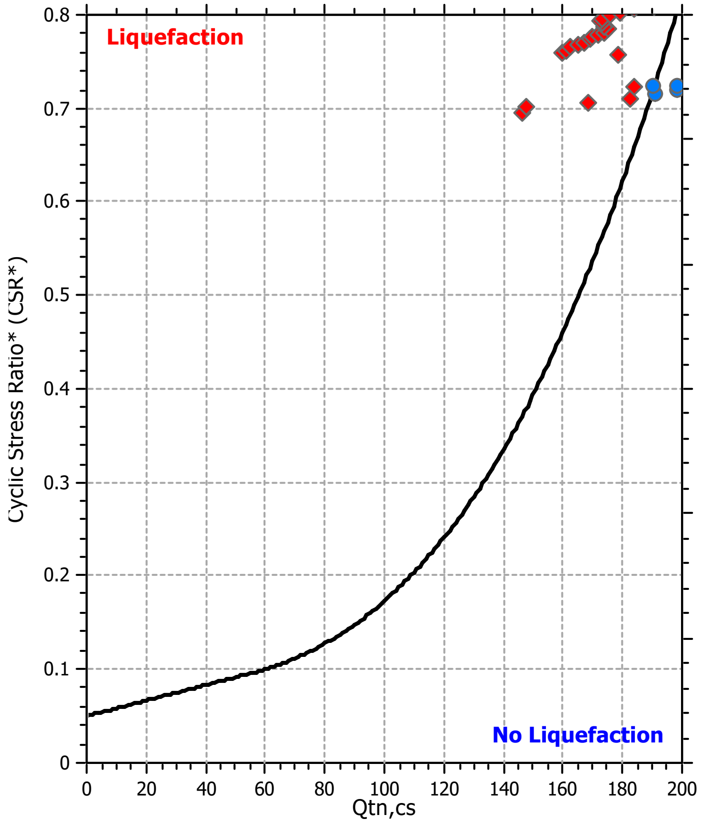
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

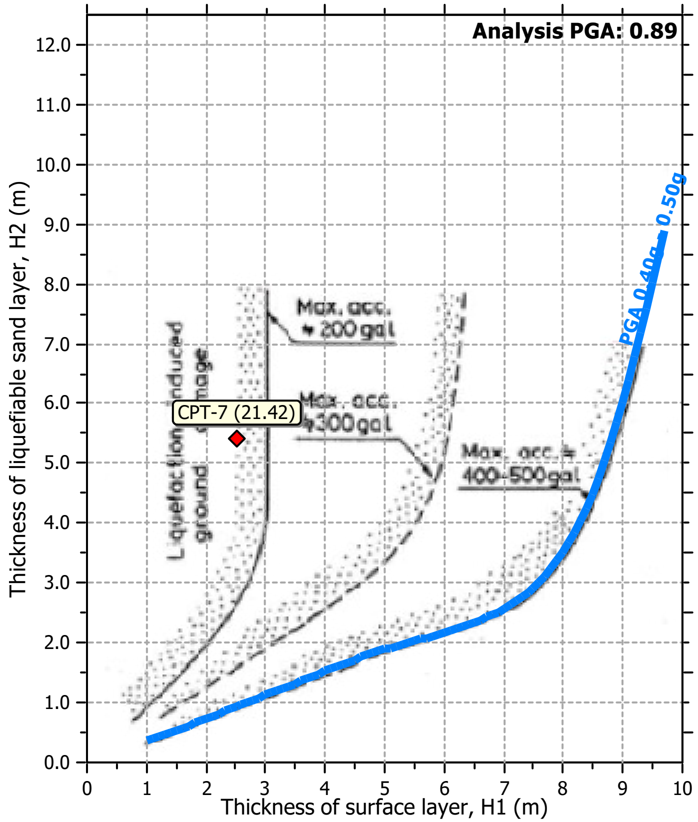
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



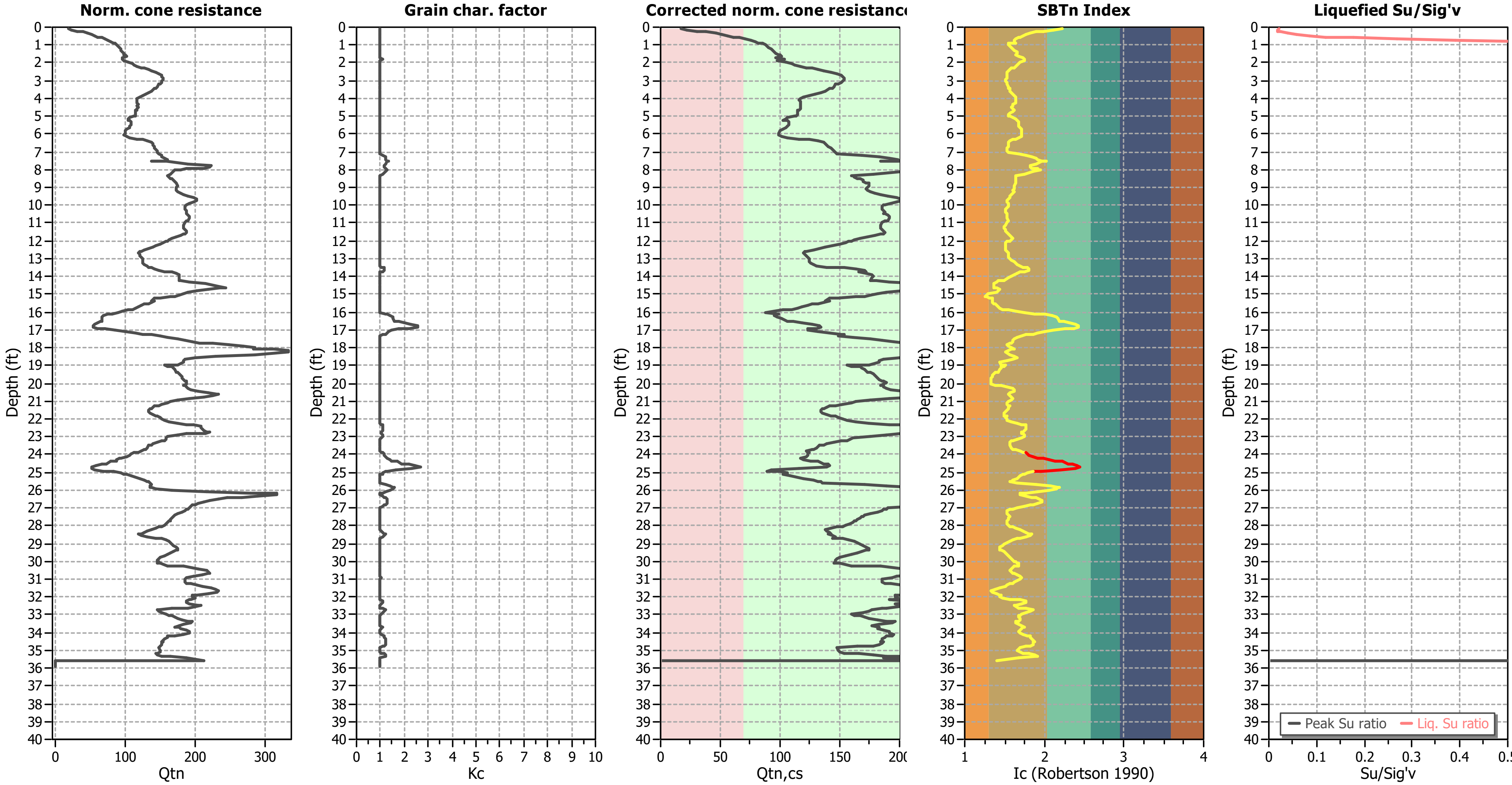




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

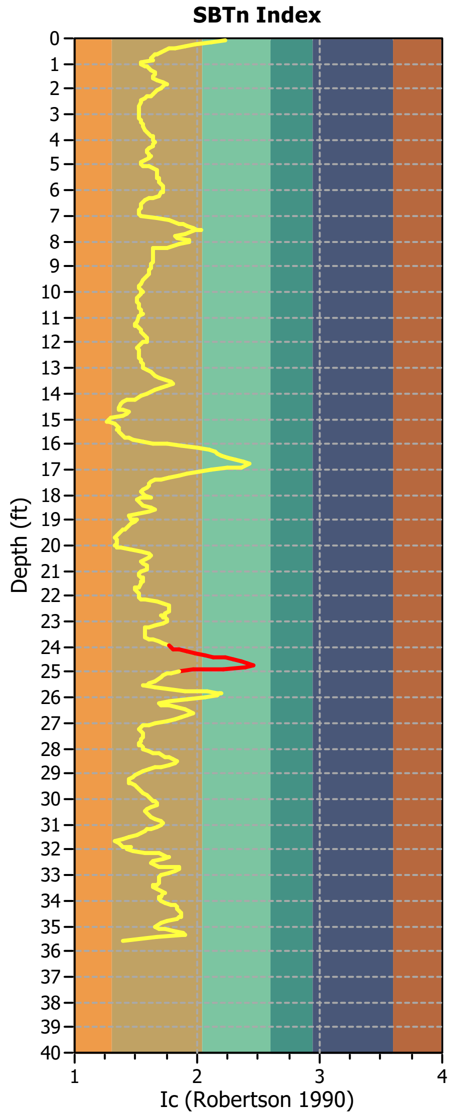
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_{σ} applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

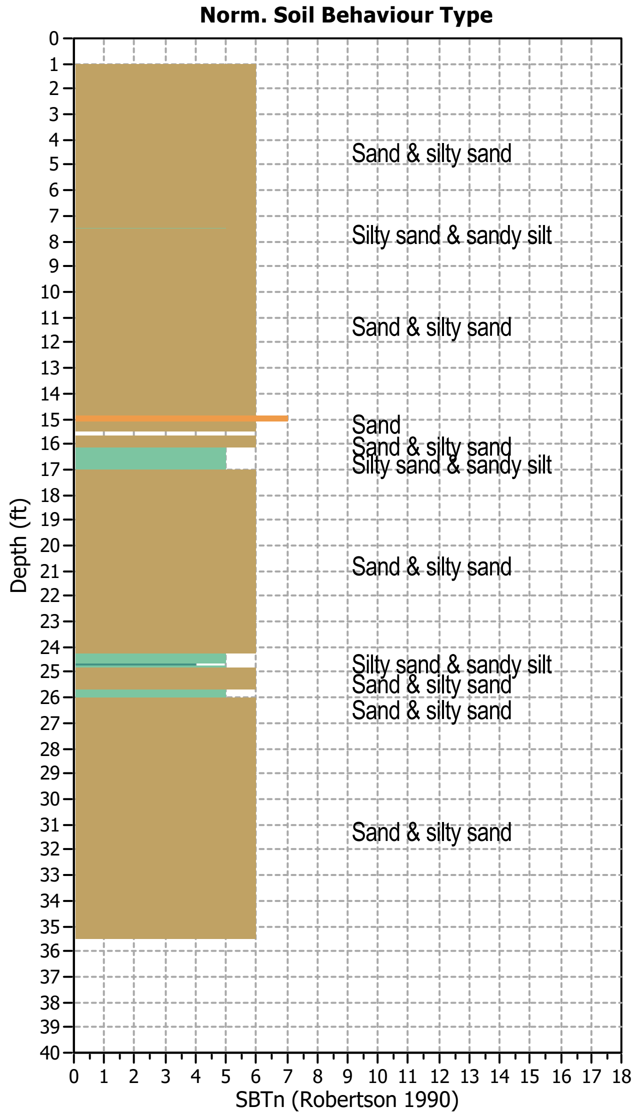
TRANSITION LAYER DETECTION ALGORITHM REPORT
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between 1.80 < I_c < 3.0) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.





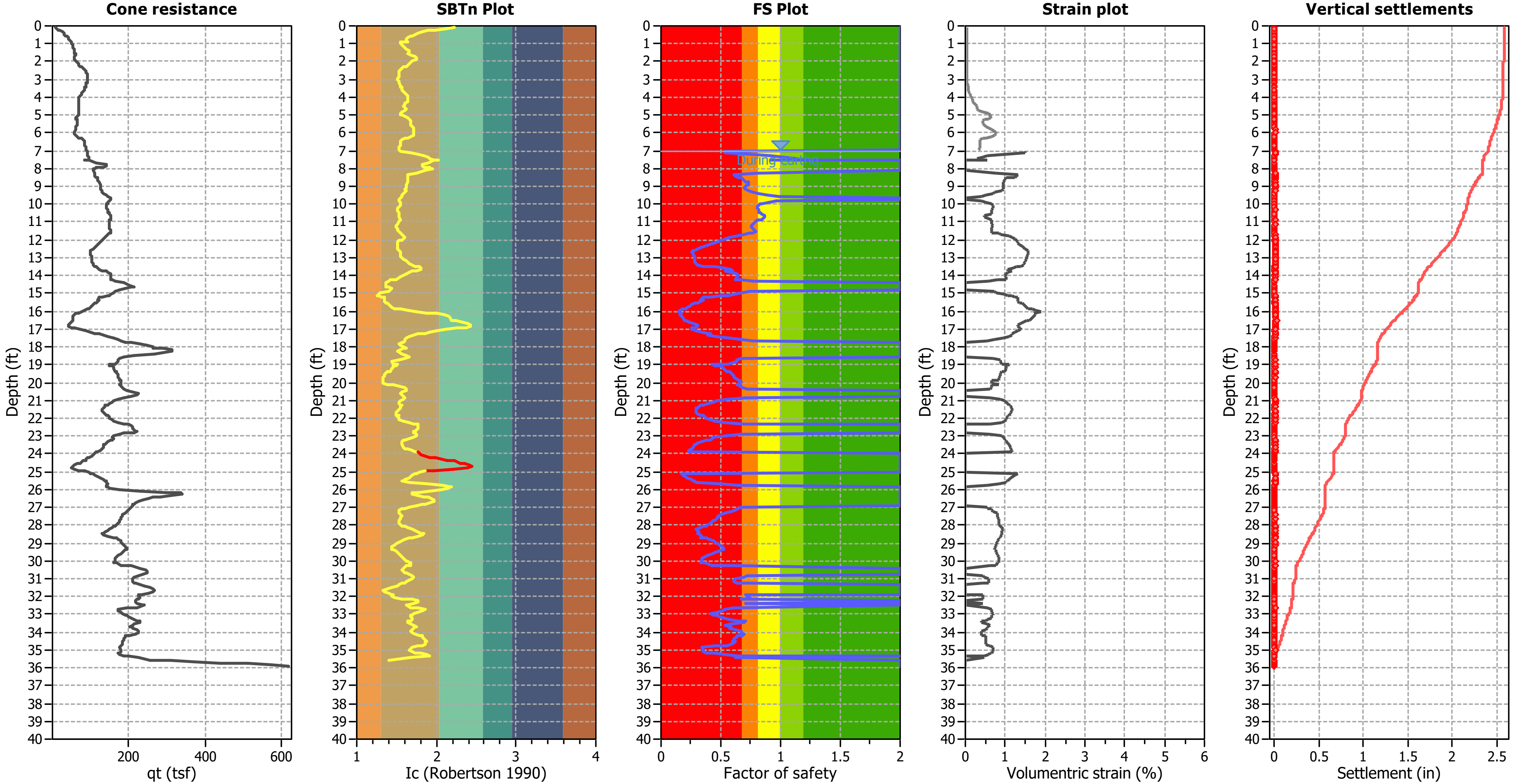
Transition layer algorithm properties

I_c minimum check value:	1.70
I_c maximum check value:	3.00
I_c change ratio value:	0.0250
Minimum number of points in layer:	4

General statistics

Total points in CPT file:	514
Total points excluded:	18
Exclusion percentage:	3.50%
Number of layers detected:	2

Estimation of post-earthquake settlements

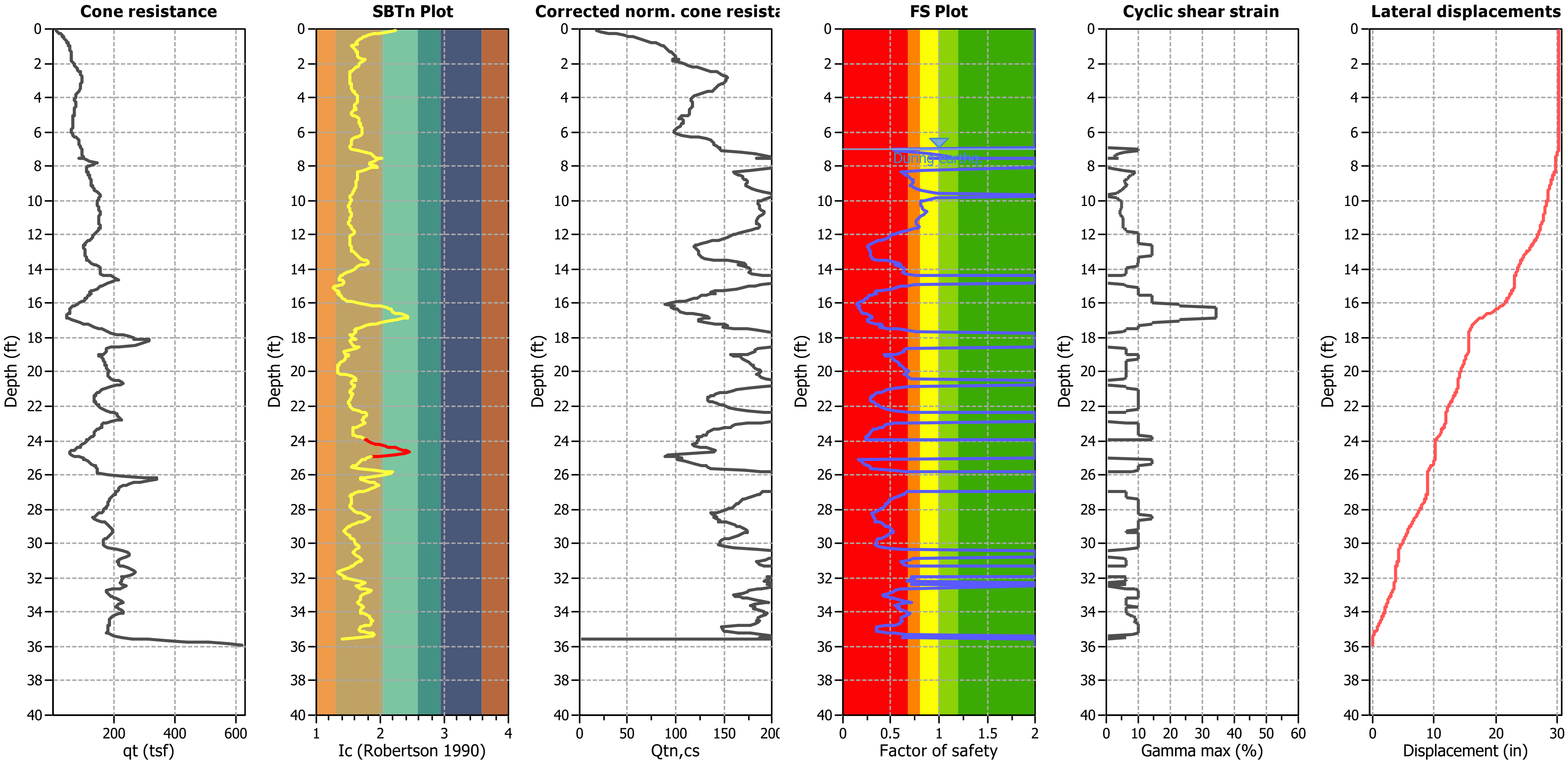


Abbreviations

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

Estimation of post-earthquake lateral Displacements

Geometric parameters: Gently sloping ground without free face (Slope 1.00 %)

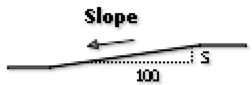


Abbreviations

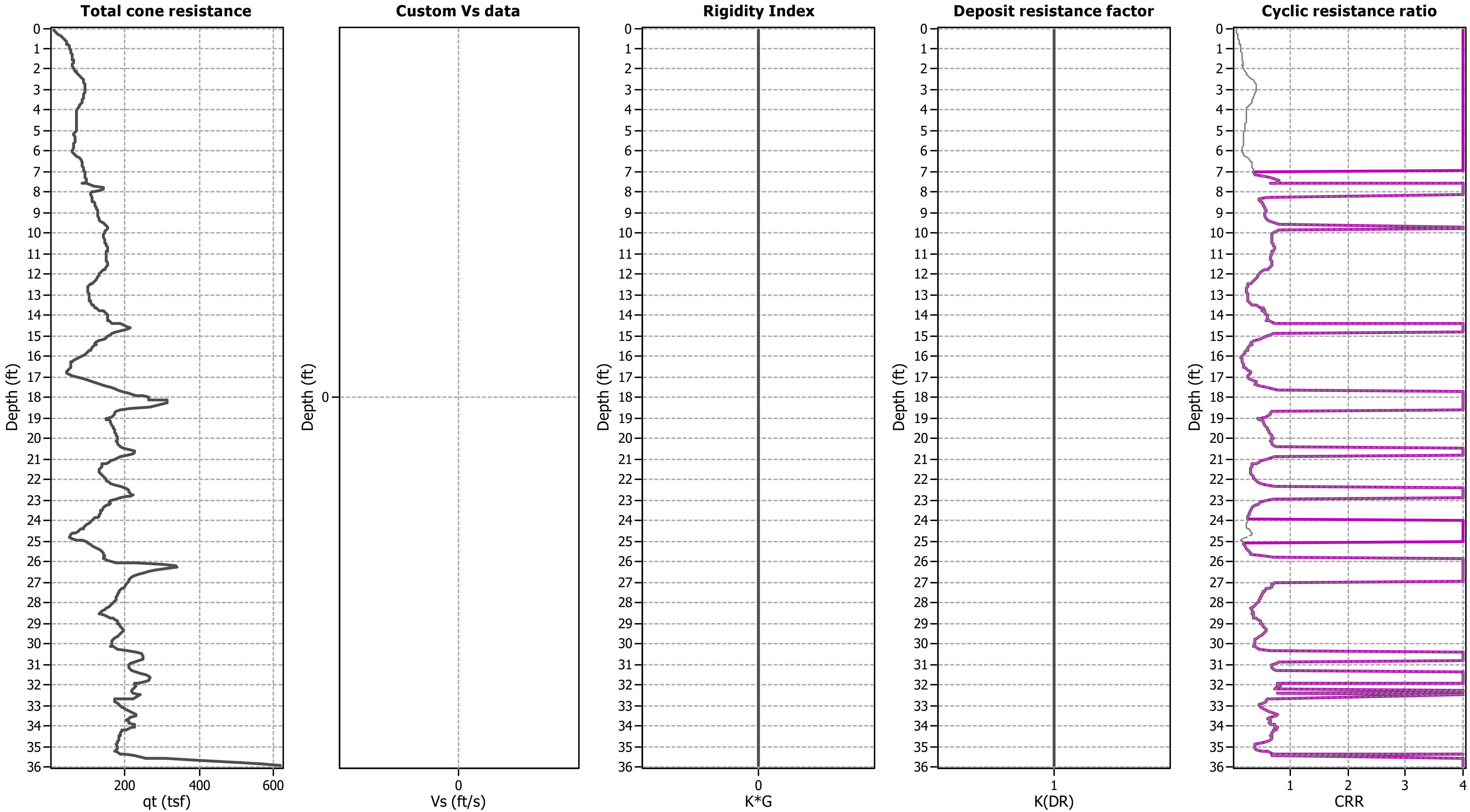
q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance

F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

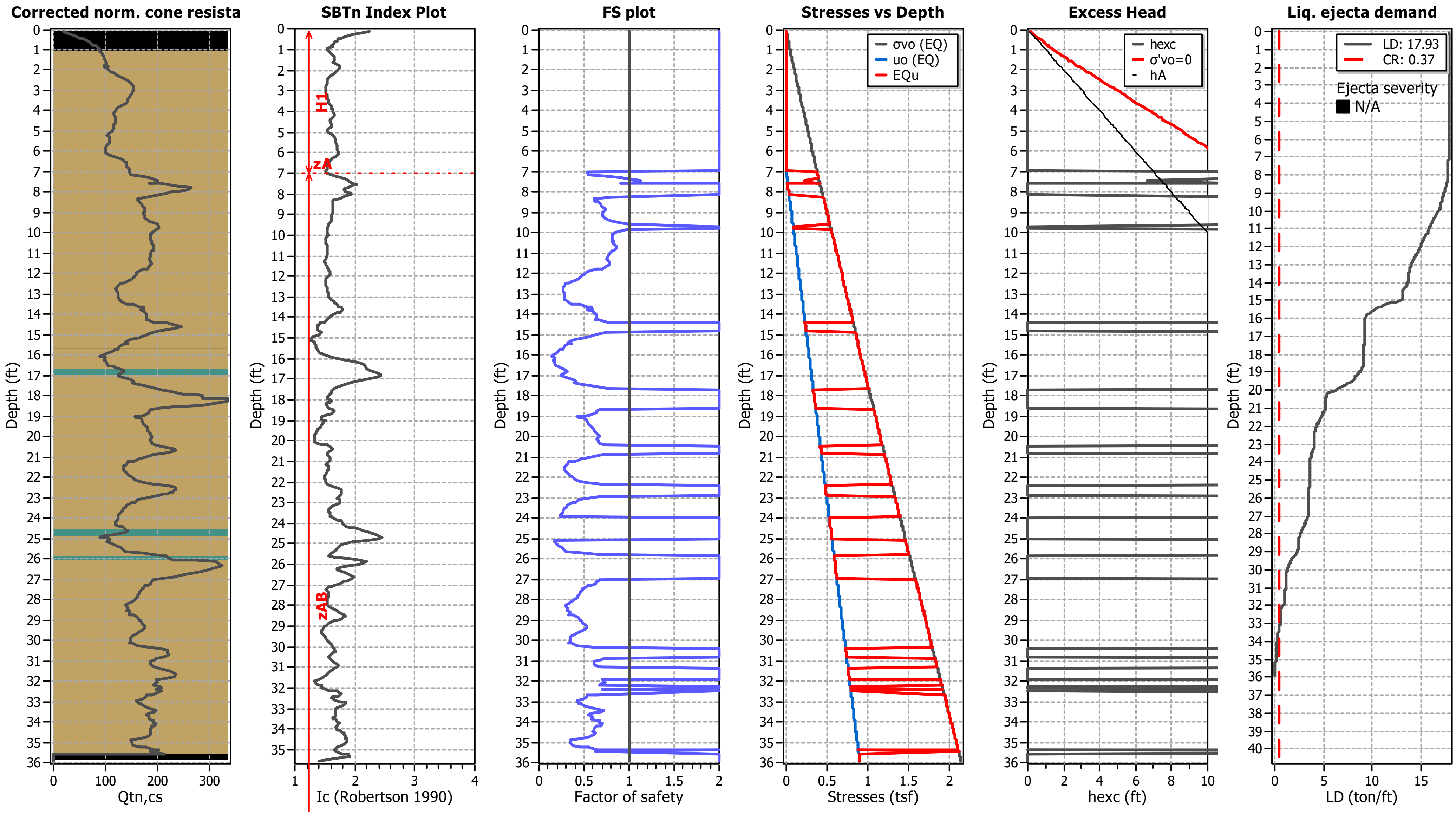
Surface condition



Aging Calculation Estimation



Ejecta Severity Estimation



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

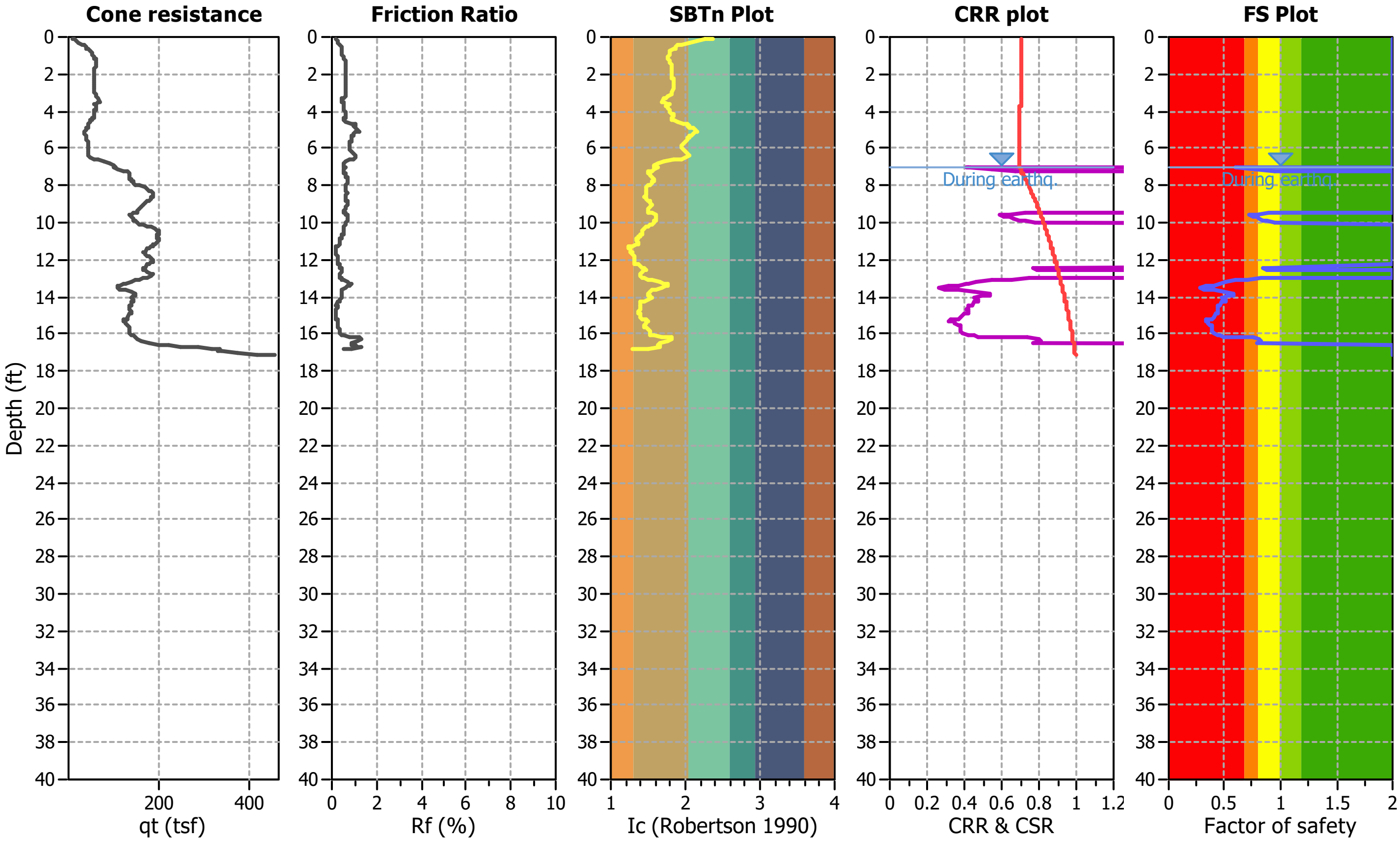
LIQUEFACTION ANALYSIS REPORT

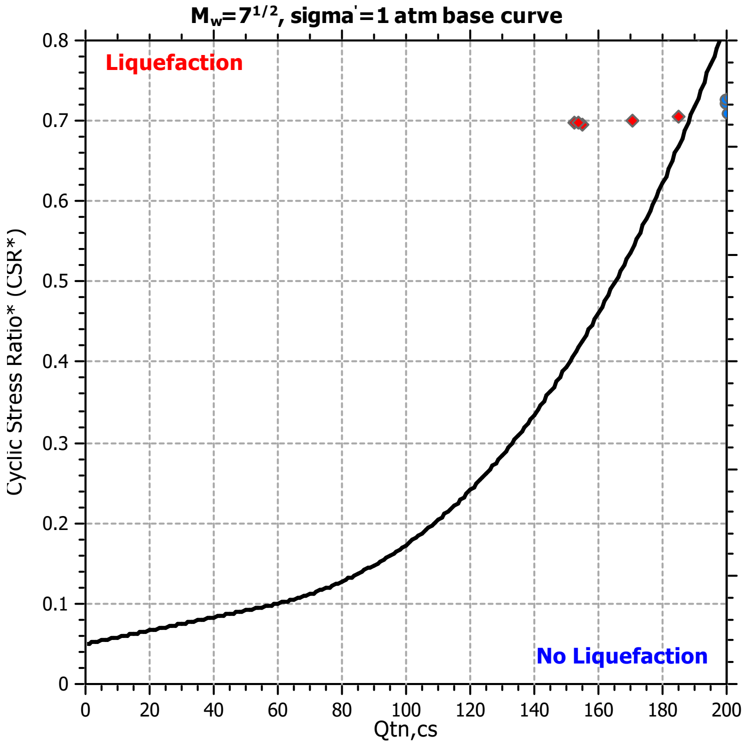
Project title : Petra Geosciences / Apple Canyon **Location : Lake Hemet, CA**

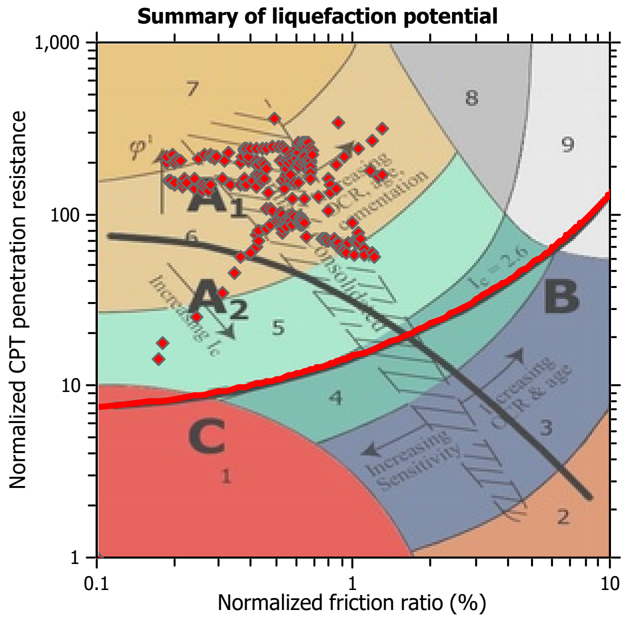
CPT file : CPT-8

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	11.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	8.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.89	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

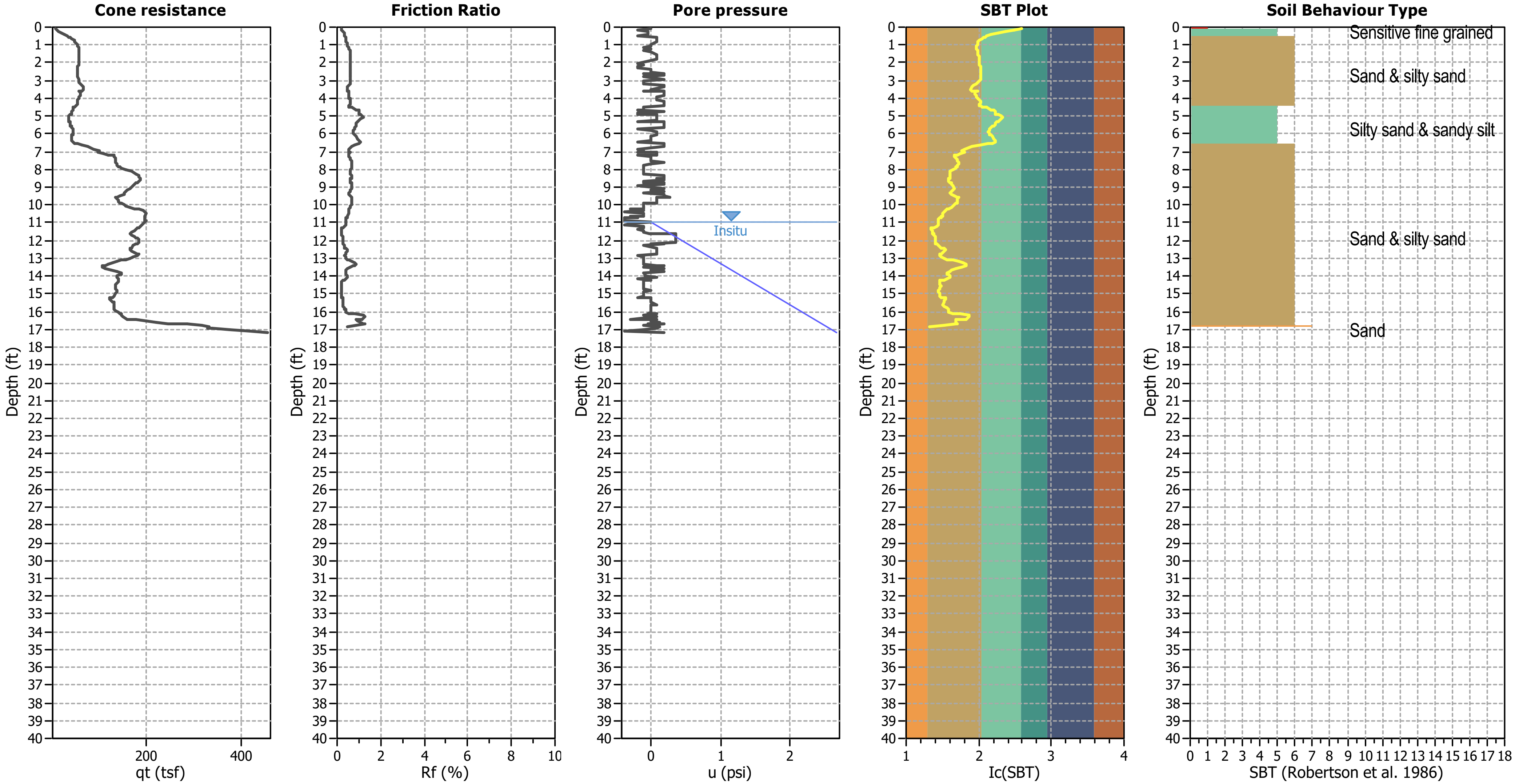






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



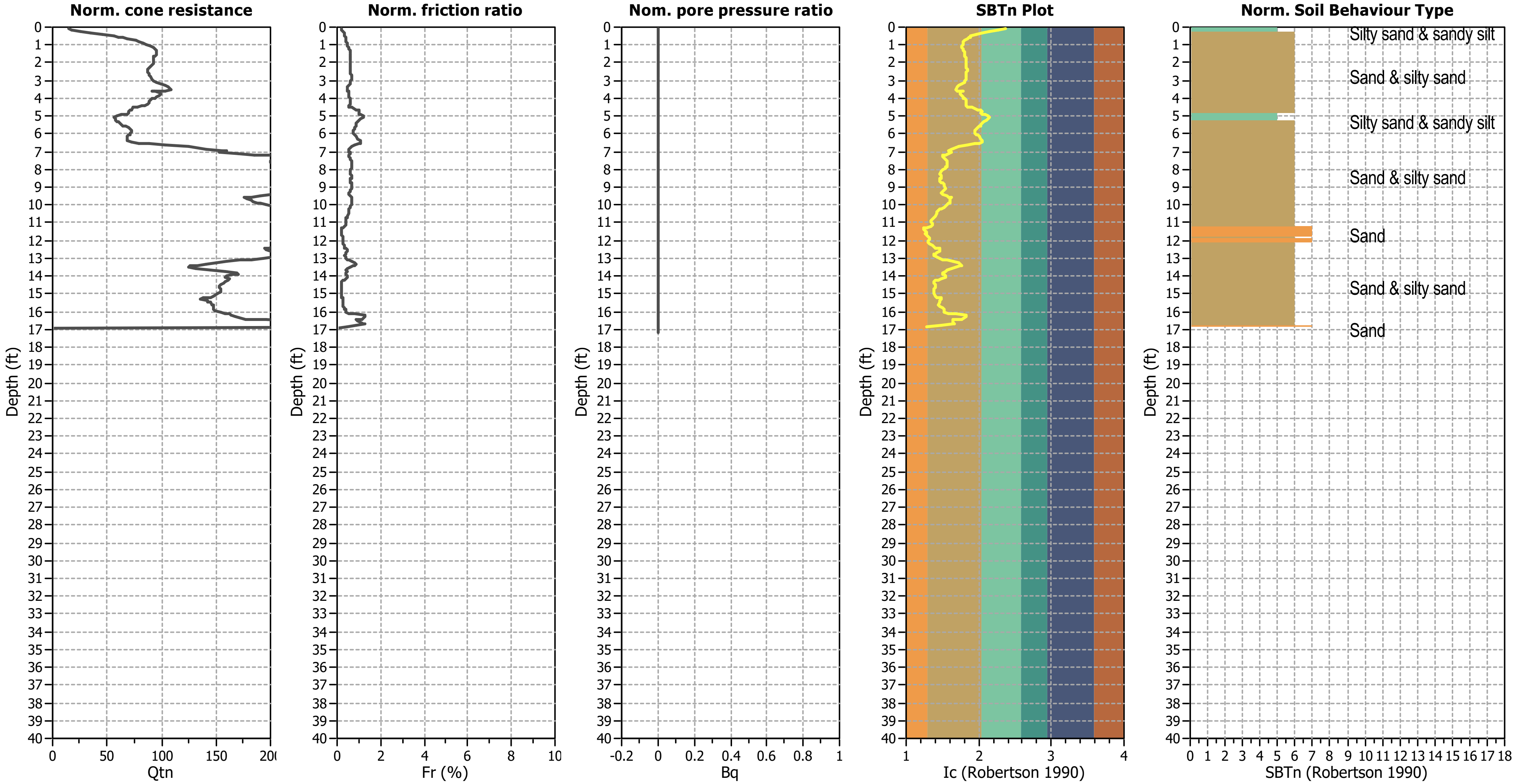
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

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)



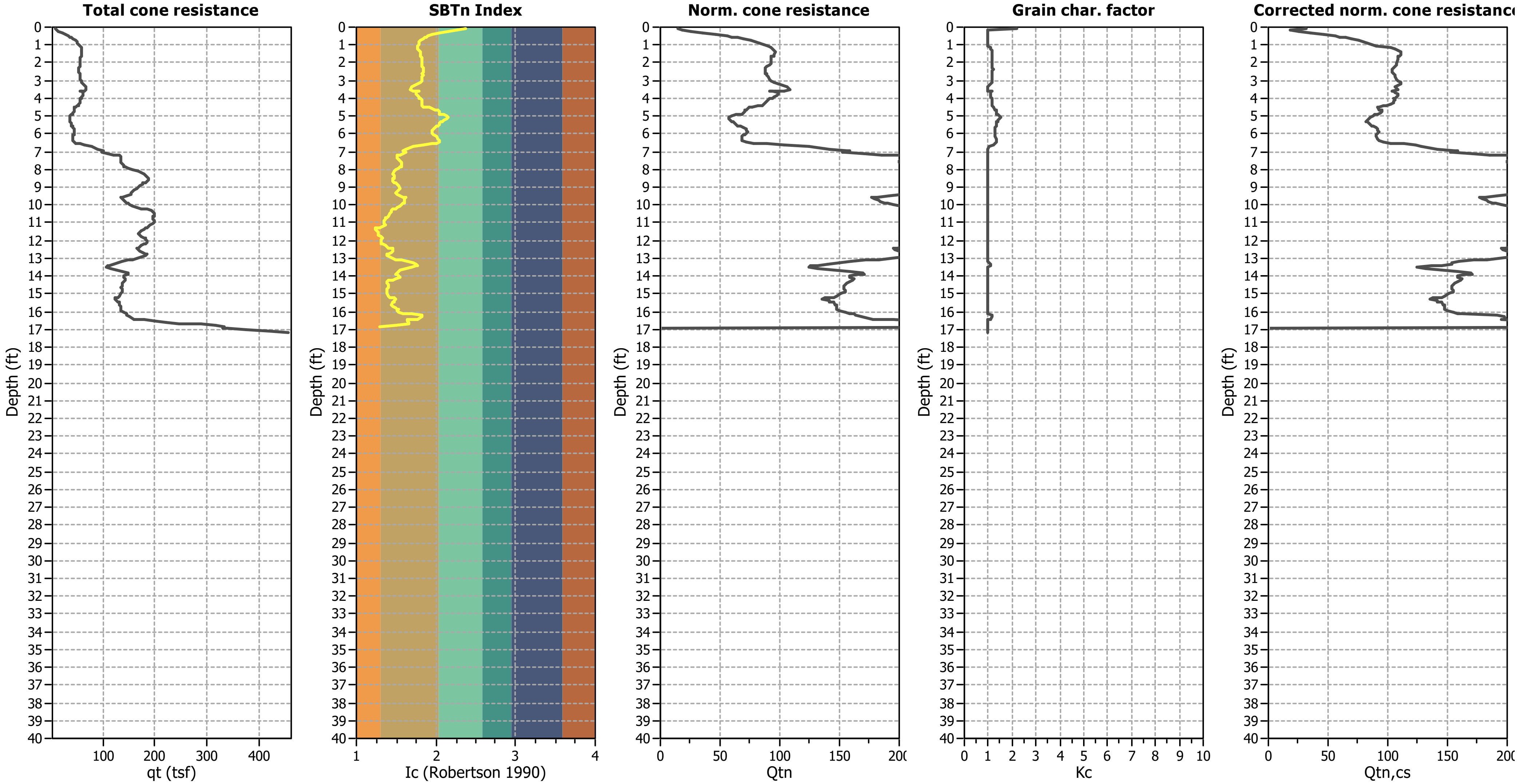
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

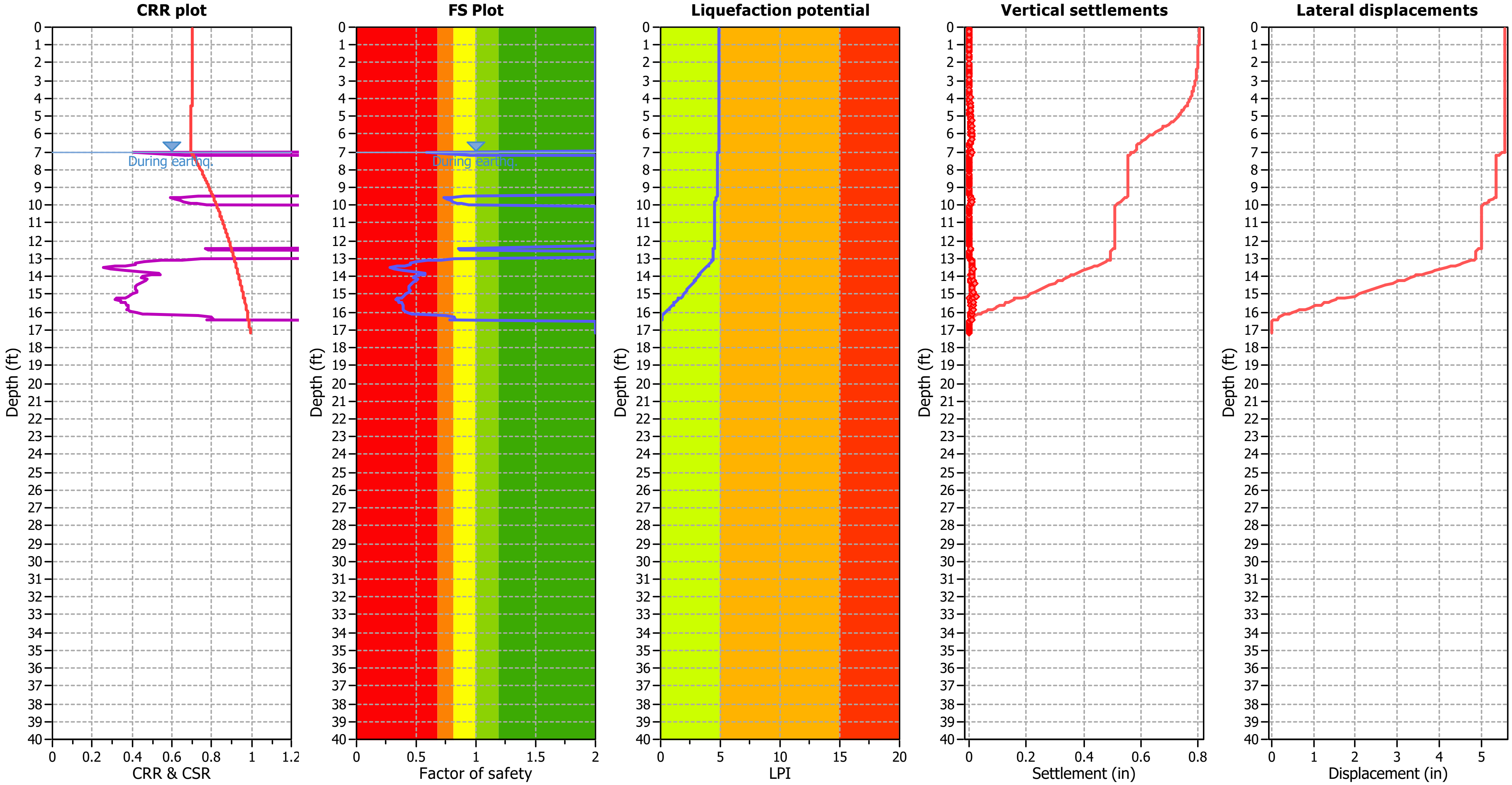
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

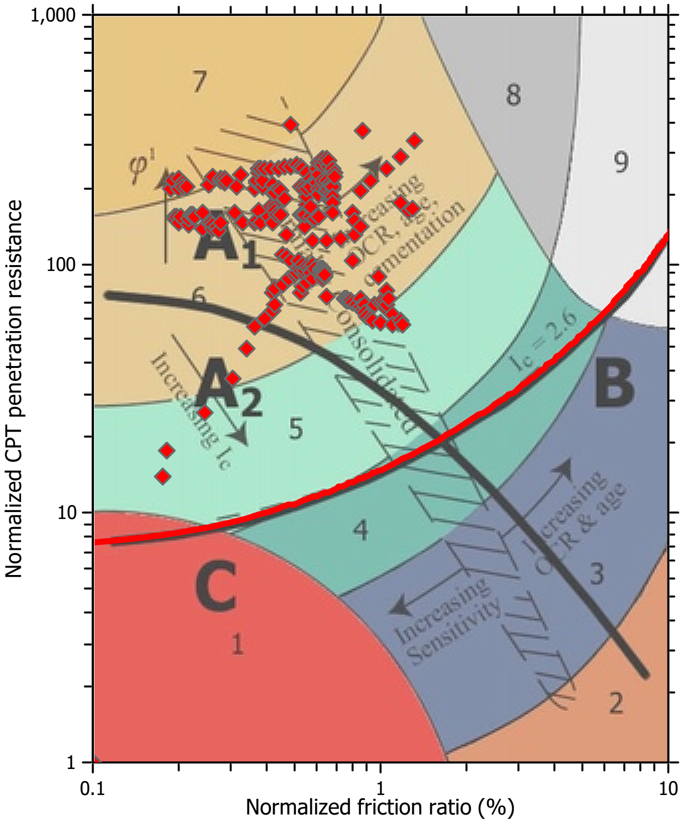
F.S. color scheme

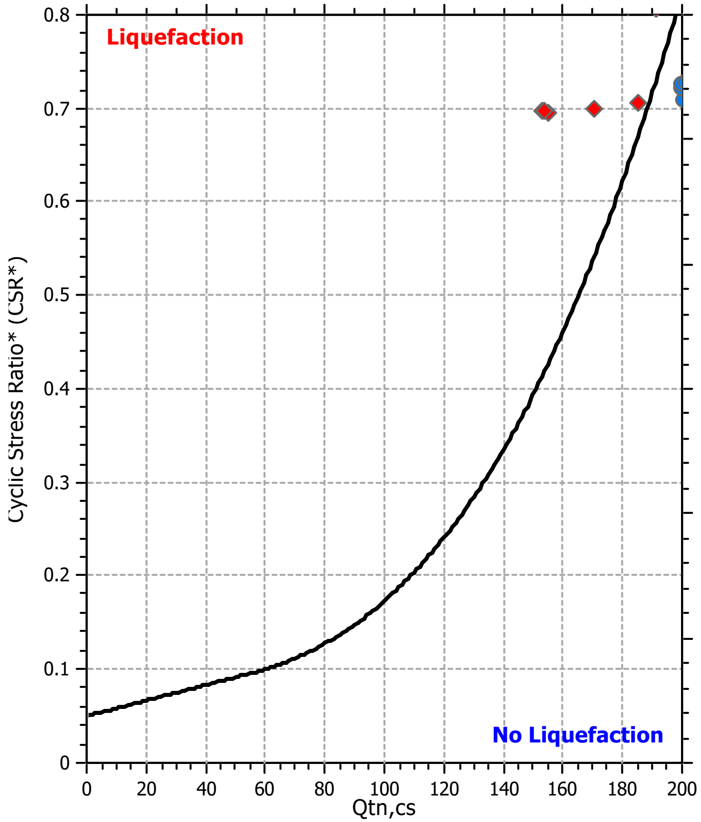
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

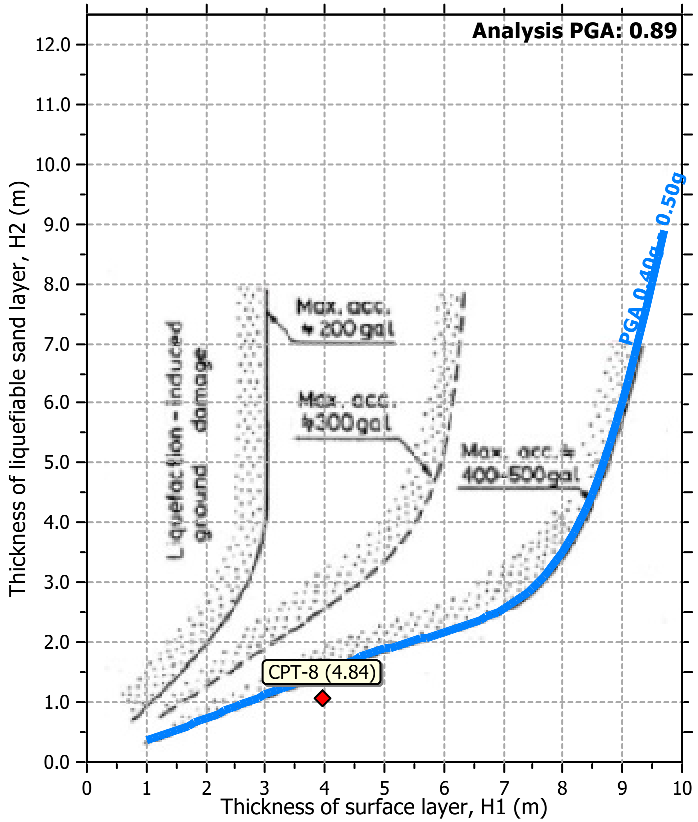
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



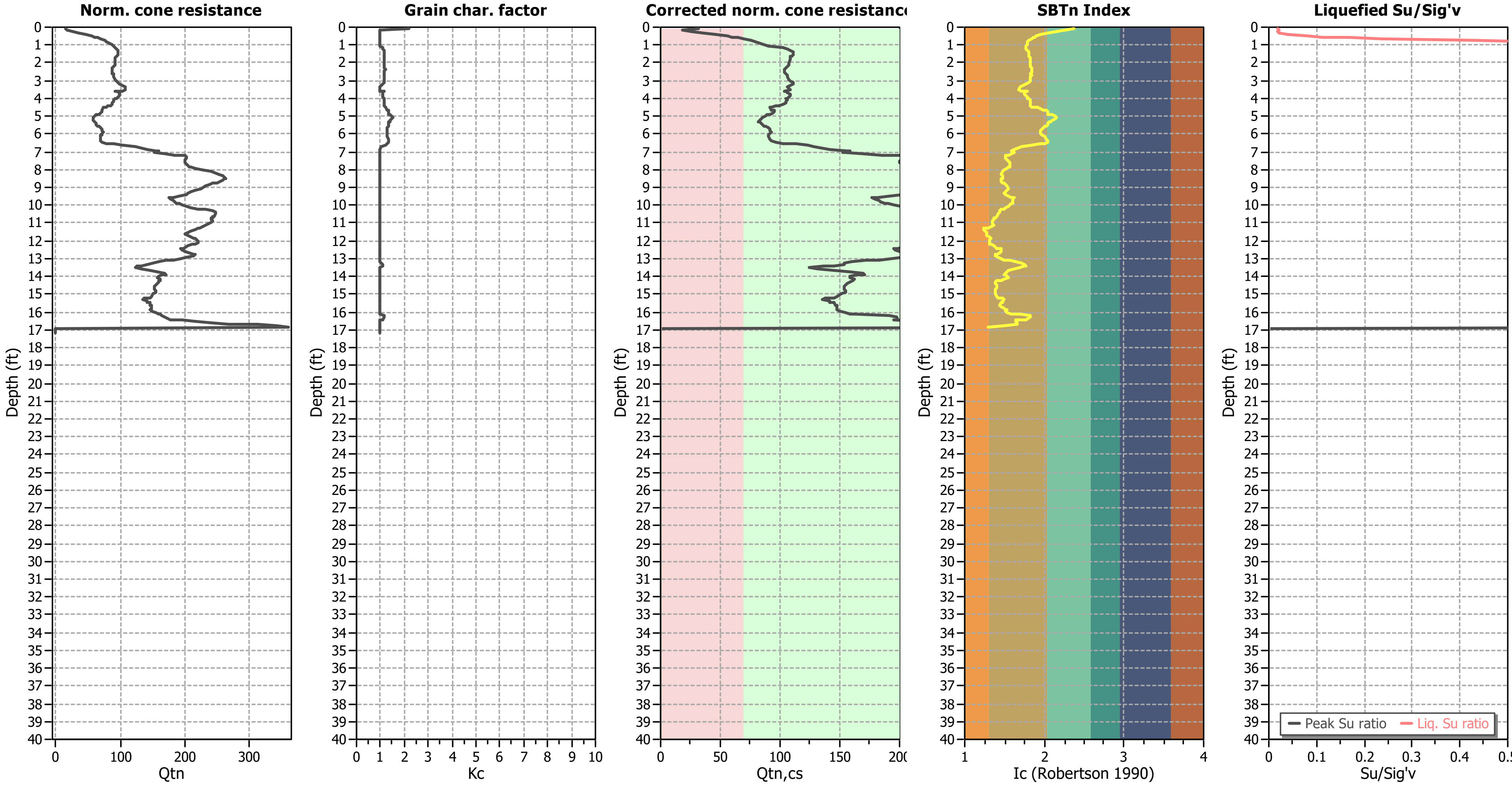




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

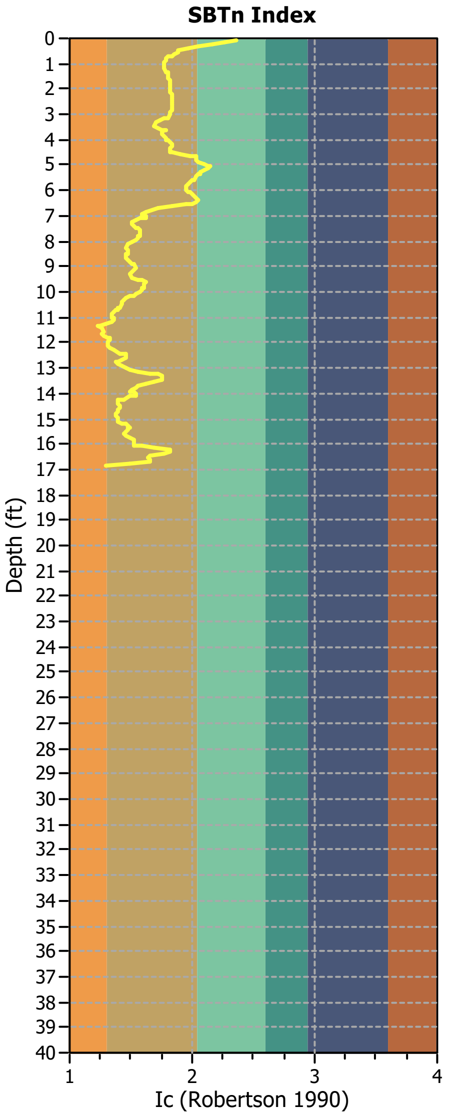
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

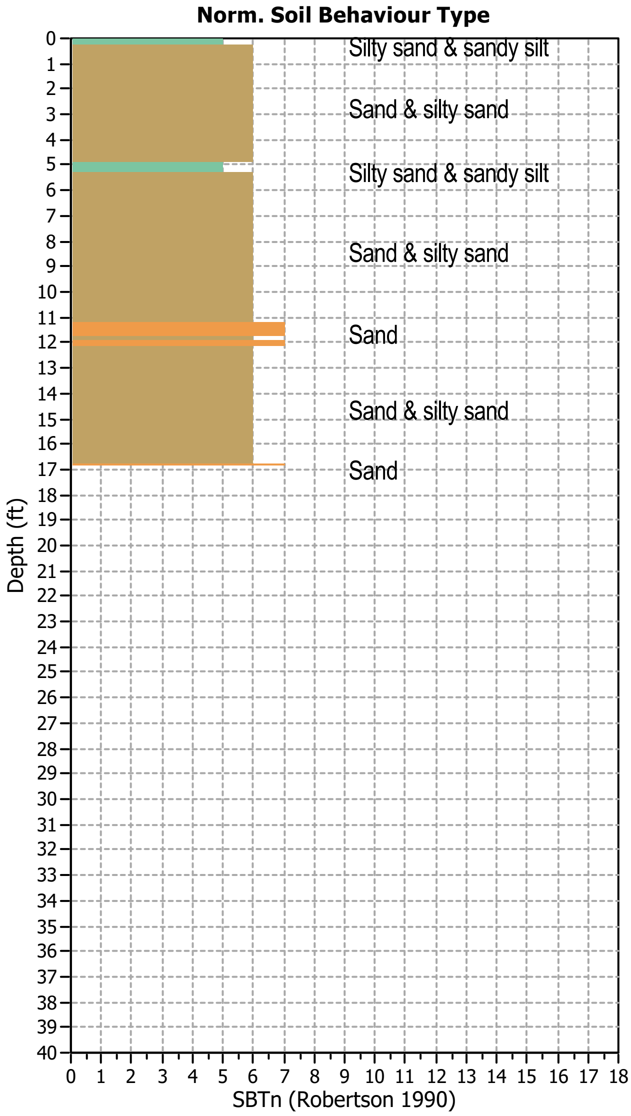
TRANSITION LAYER DETECTION ALGORITHM REPORT
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between 1.80 < I_c < 3.0) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.





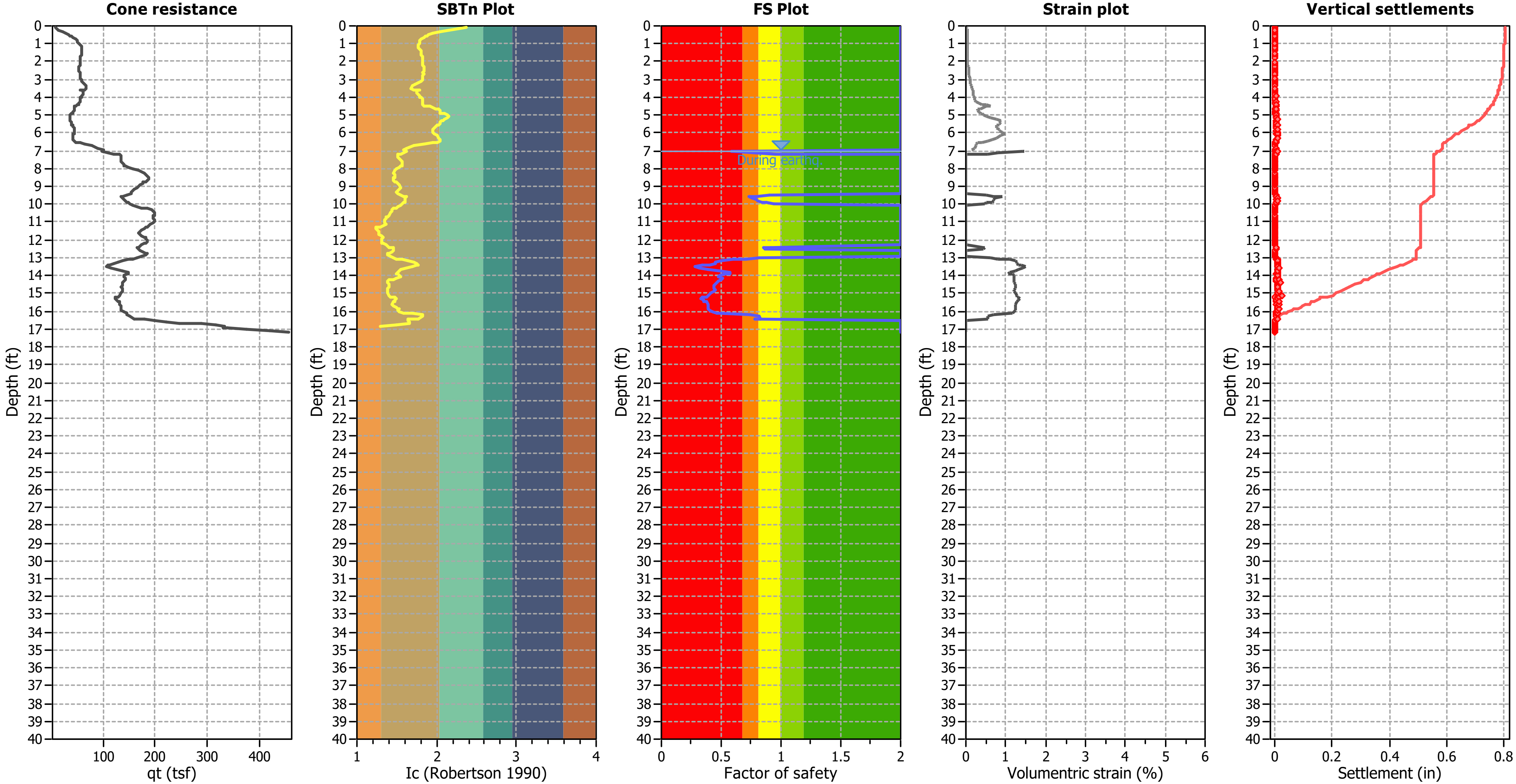
Transition layer algorithm properties

I_c minimum check value:	1.70
I_c maximum check value:	3.00
I_c change ratio value:	0.0250
Minimum number of points in layer:	4

General statistics

Total points in CPT file:	243
Total points excluded:	0
Exclusion percentage:	0.00%
Number of layers detected:	0

Estimation of post-earthquake settlements

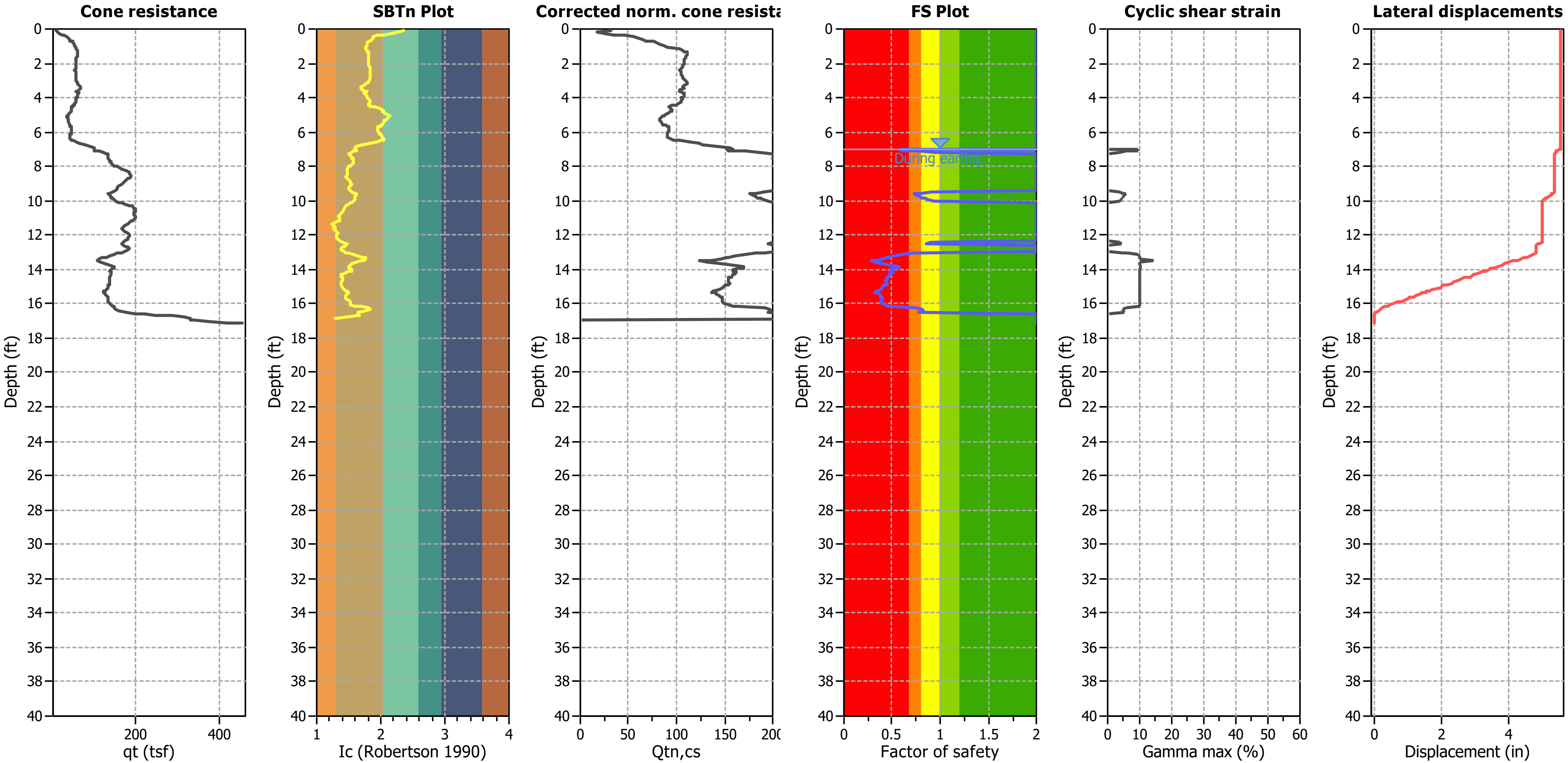


Abbreviations

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

Estimation of post-earthquake lateral Displacements

Geometric parameters: Gently sloping ground without free face (Slope 1.00 %)

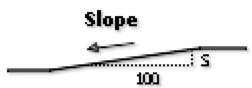


Abbreviations

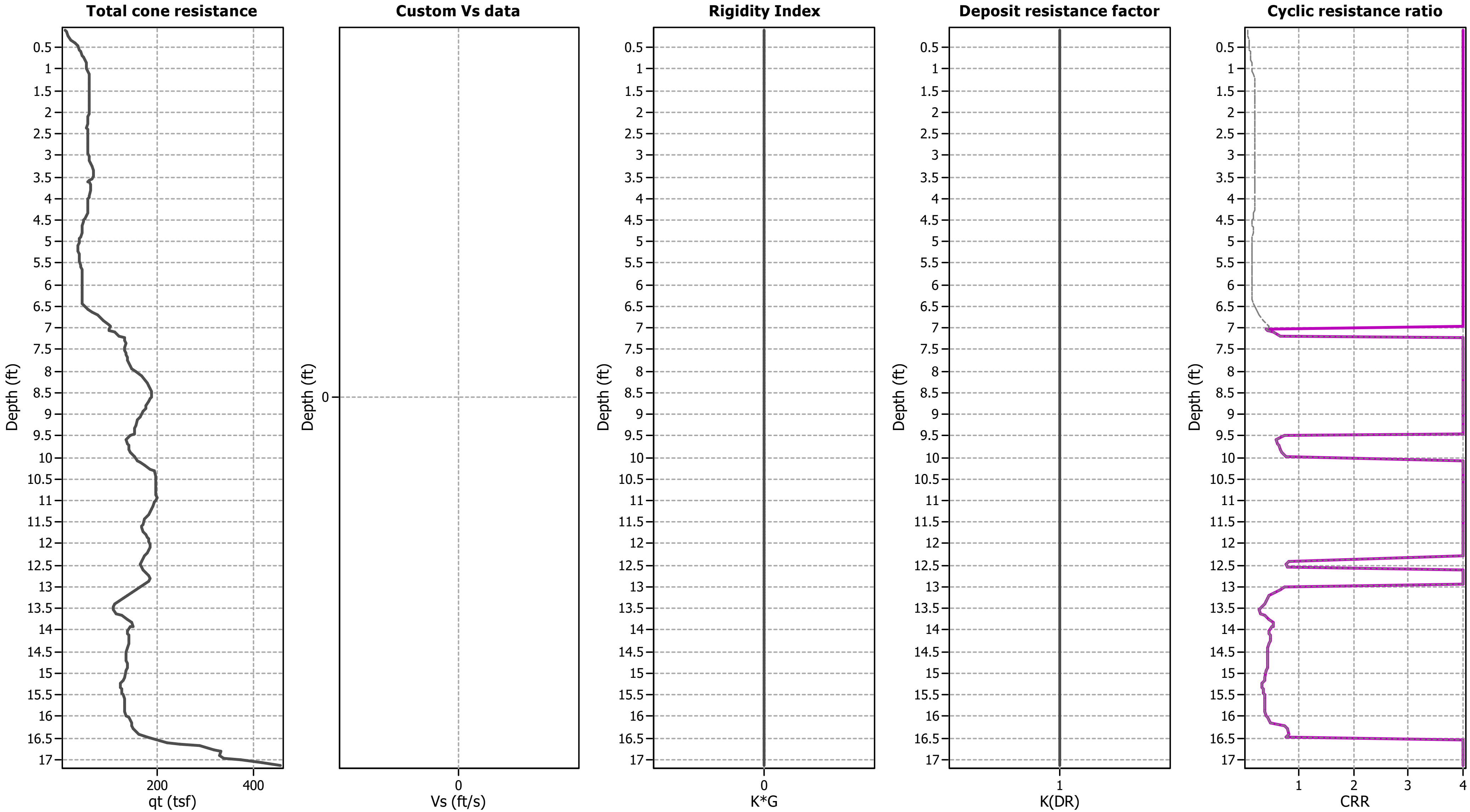
q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance

F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

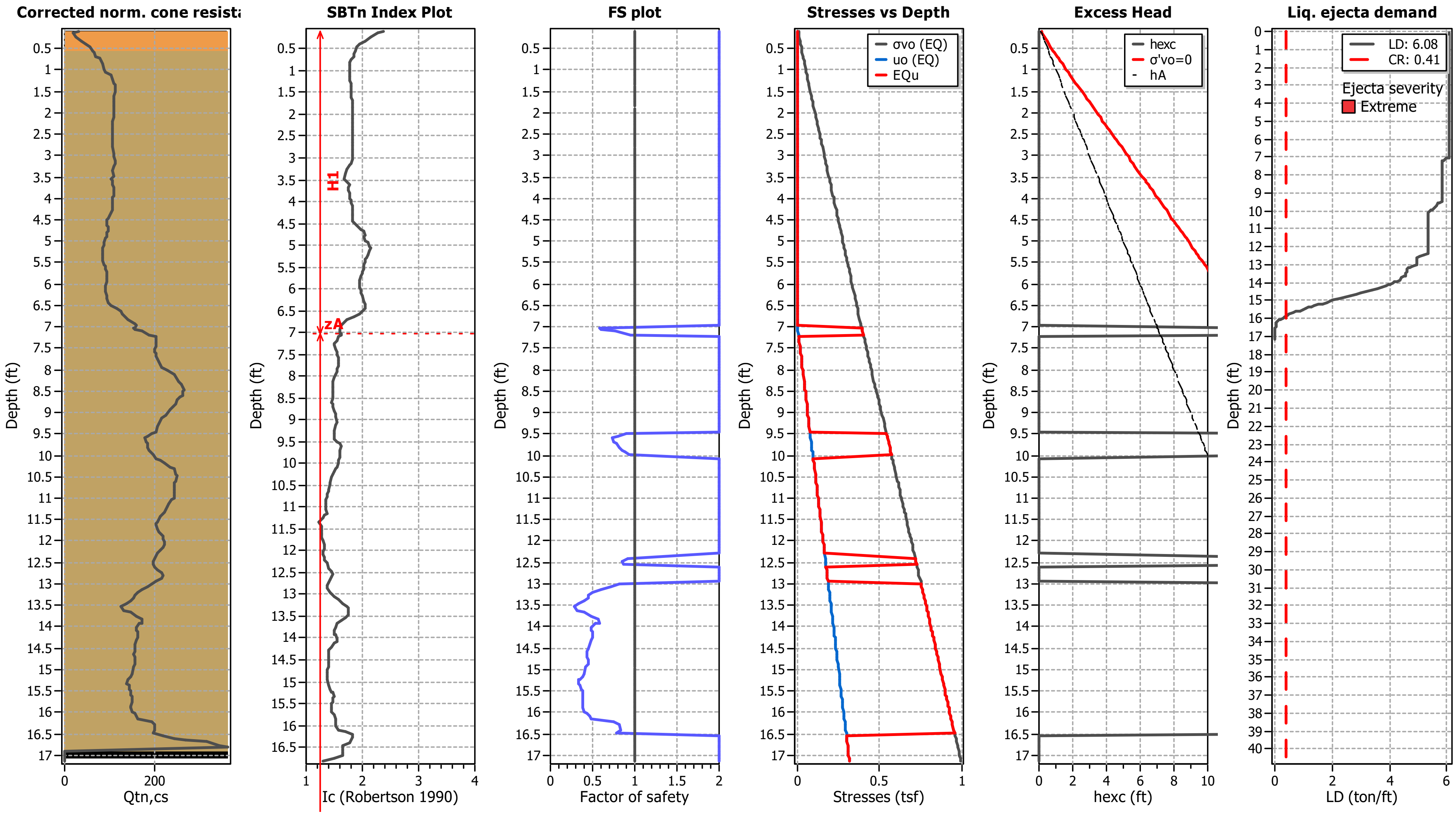
Surface condition



Aging Calculation Estimation



Ejecta Severity Estimation



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

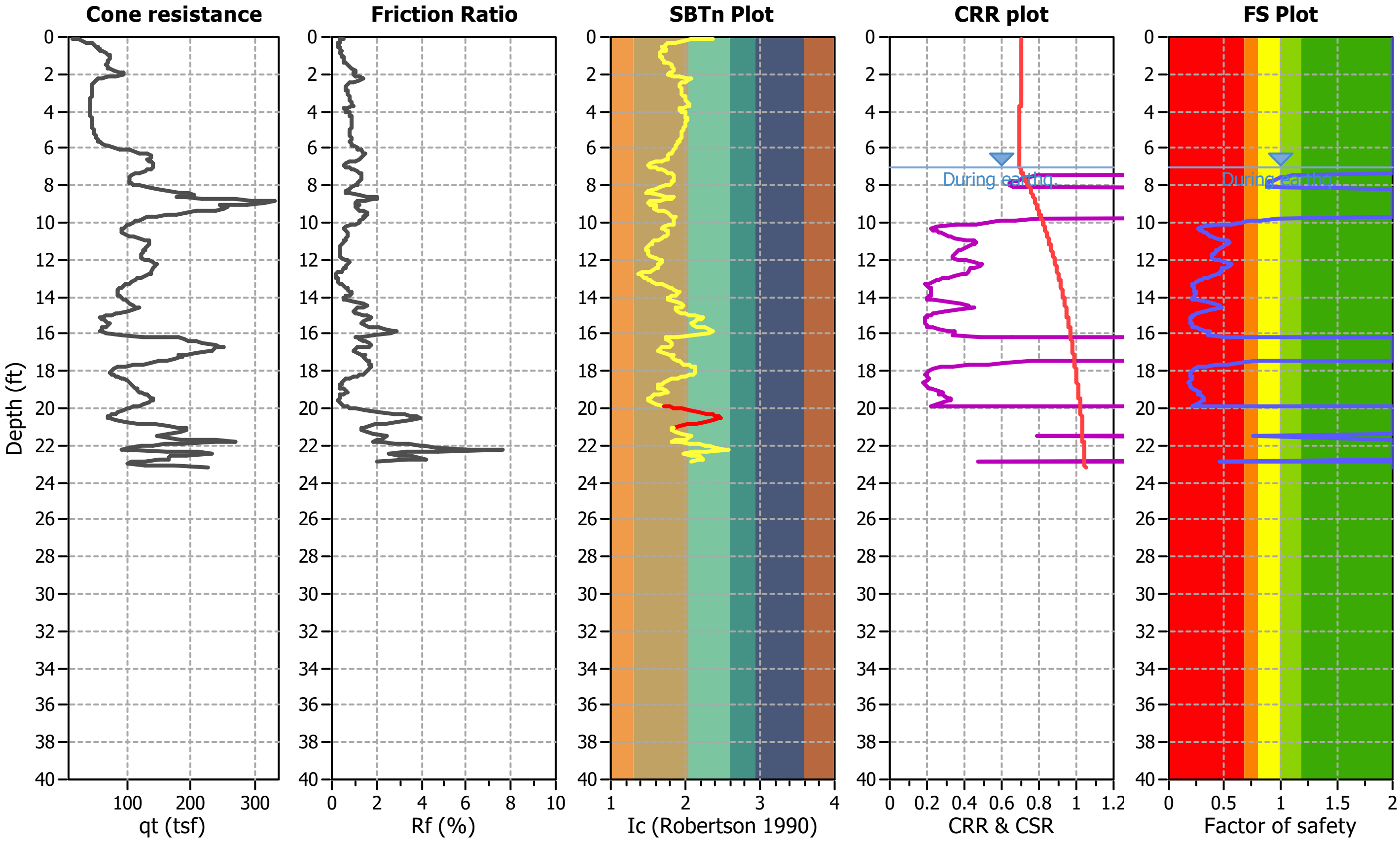
LIQUEFACTION ANALYSIS REPORT

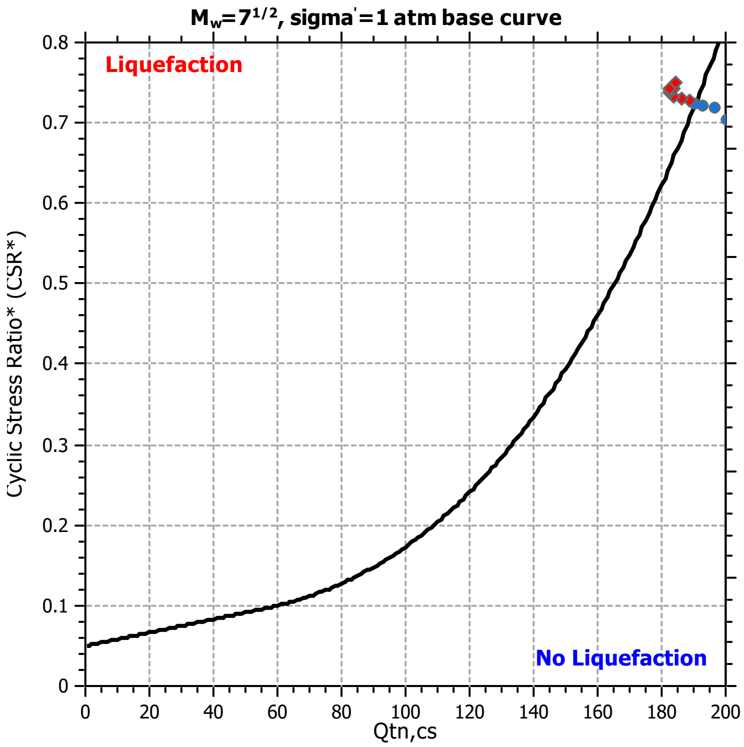
Project title : Petra Geosciences / Apple Canyon **Location : Lake Hemet, CA**

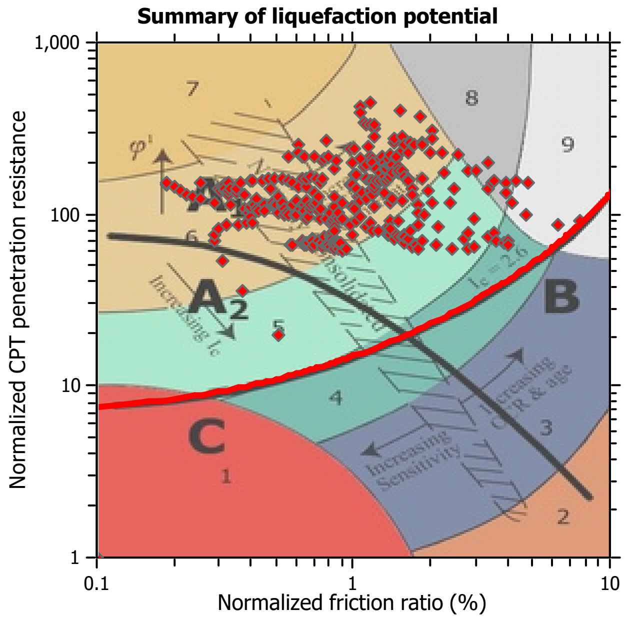
CPT file : CPT-9

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	12.50 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	8.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.89	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

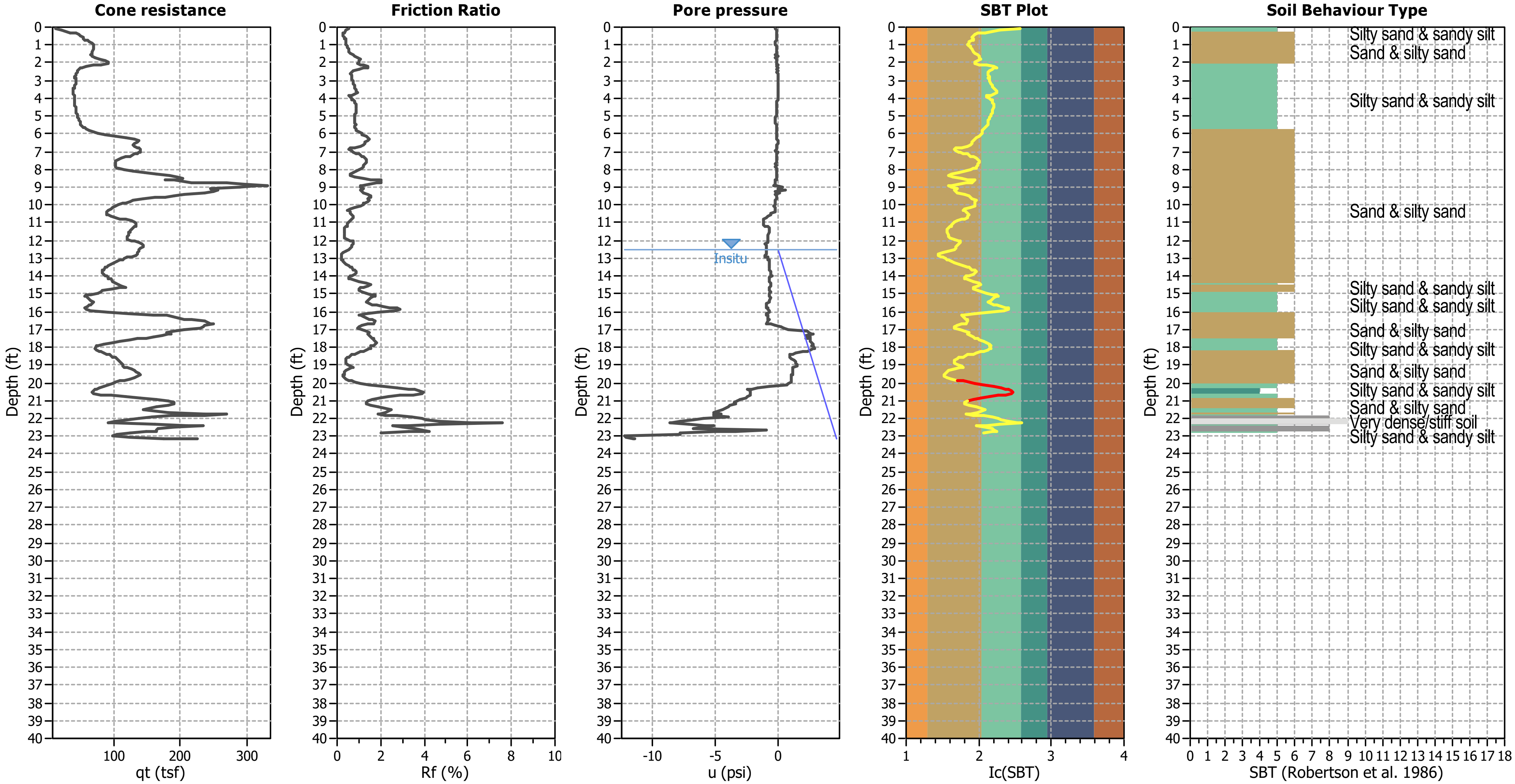






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



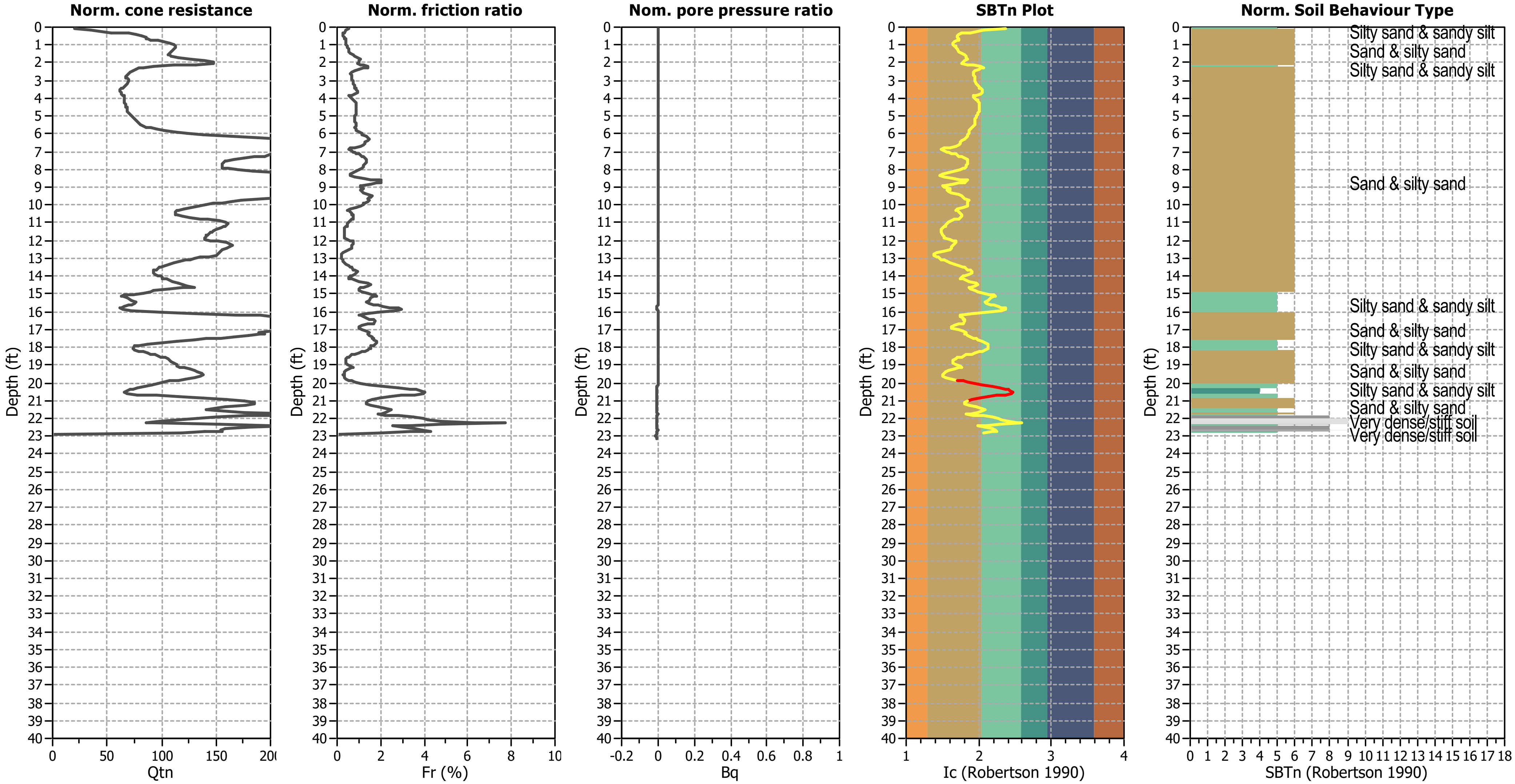
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.50 ft	Fill height:	N/A	Limit depth:	N/A

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)



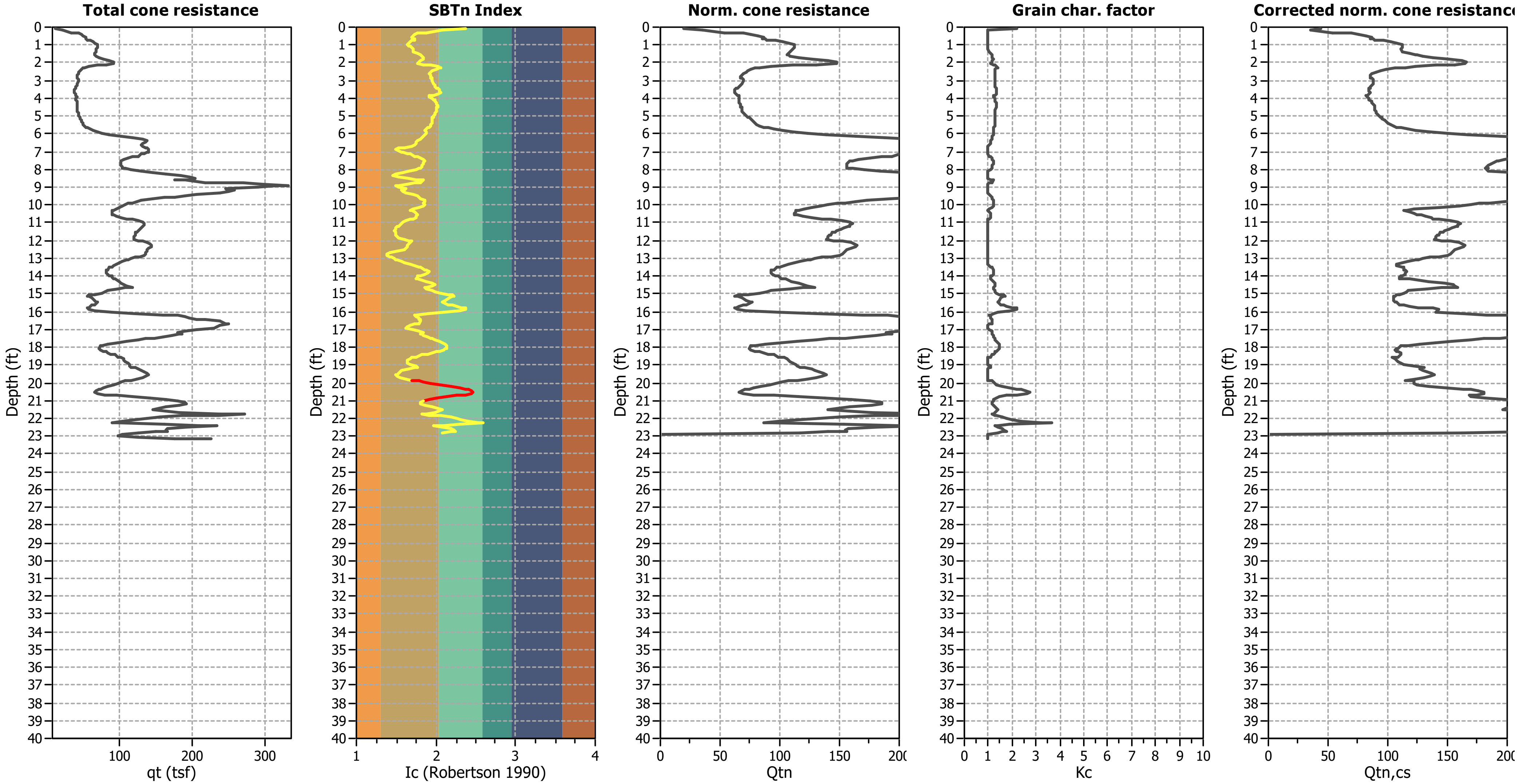
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.50 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

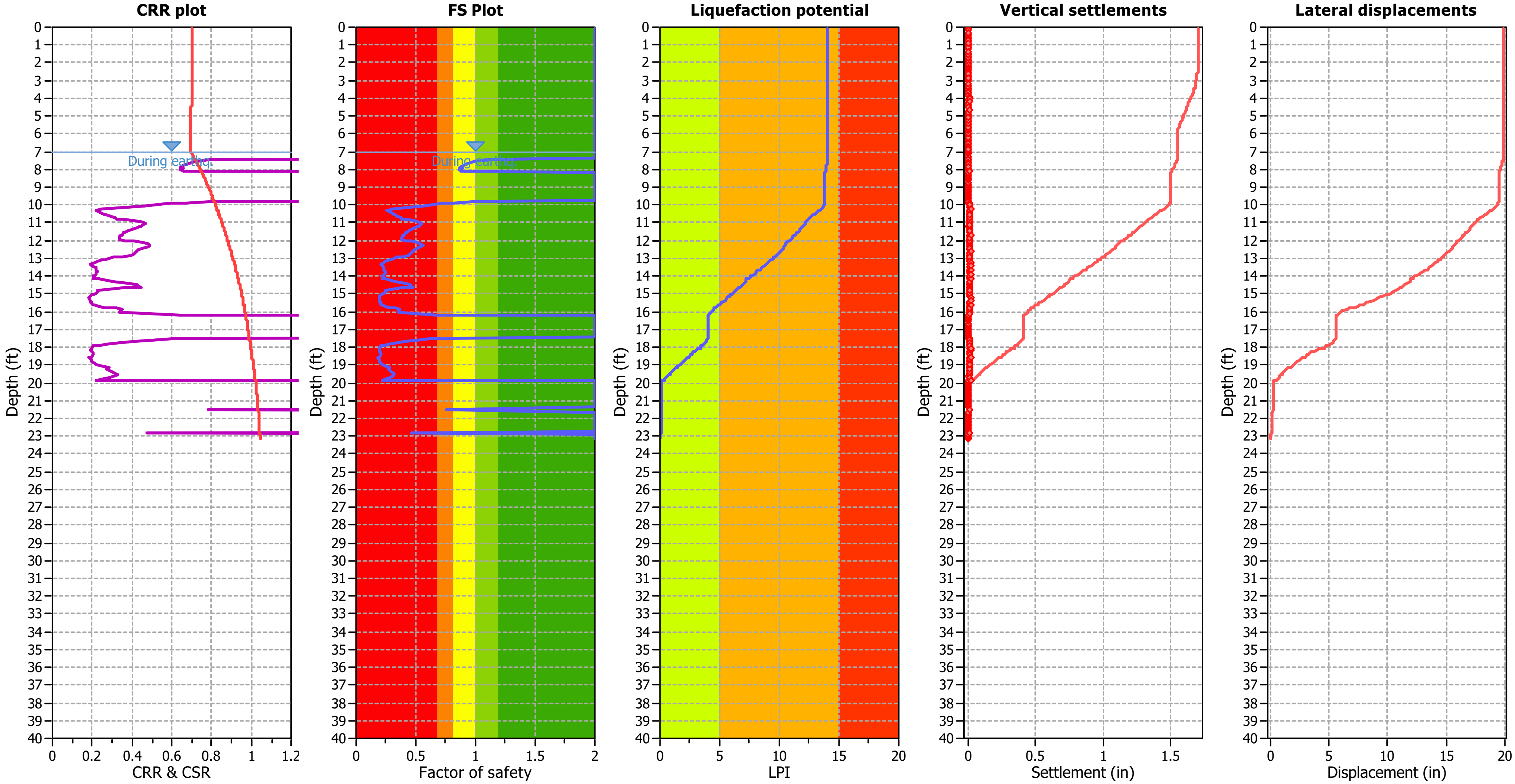
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.50 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.50 ft	Fill height:	N/A	Limit depth:	N/A

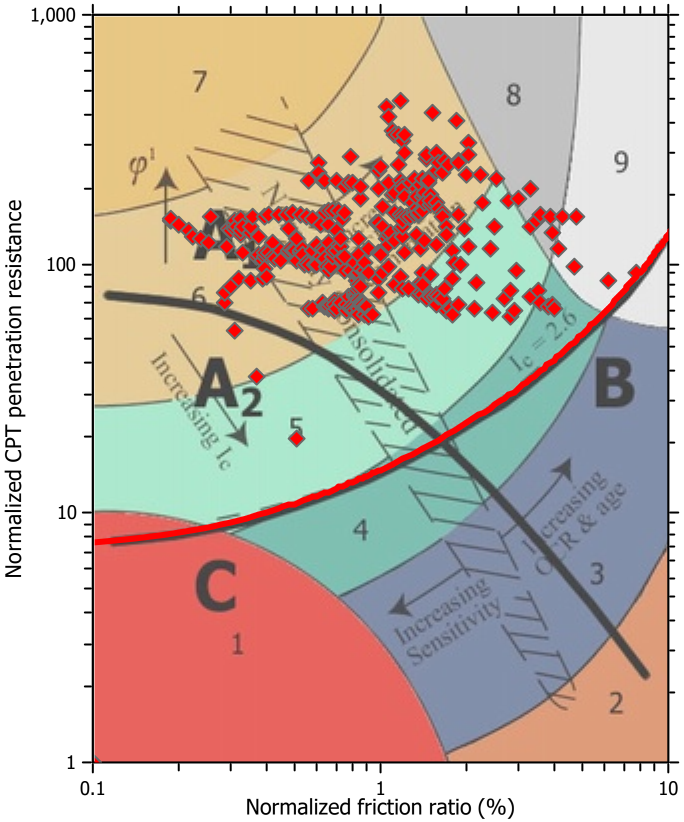
F.S. color scheme

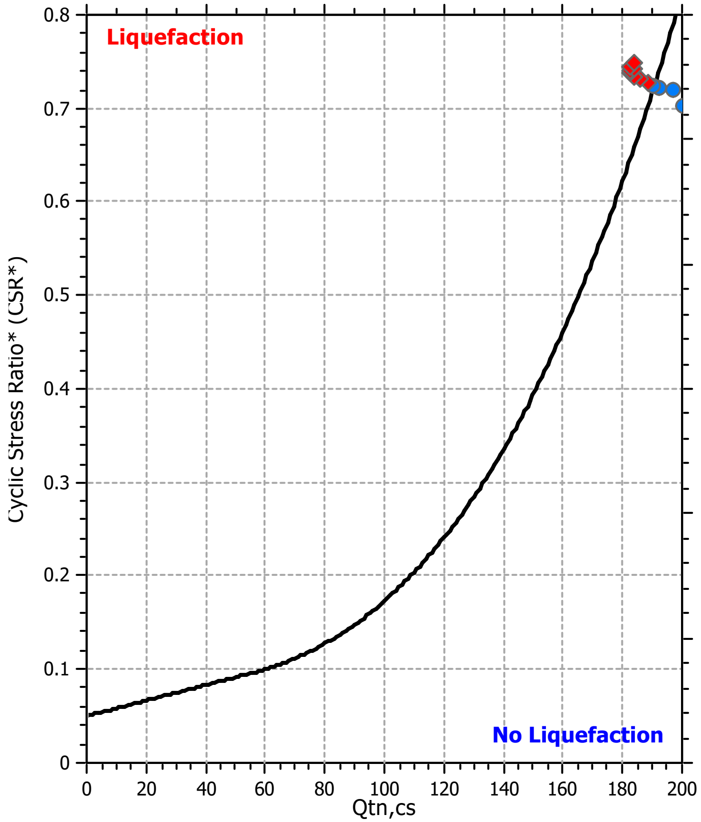
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

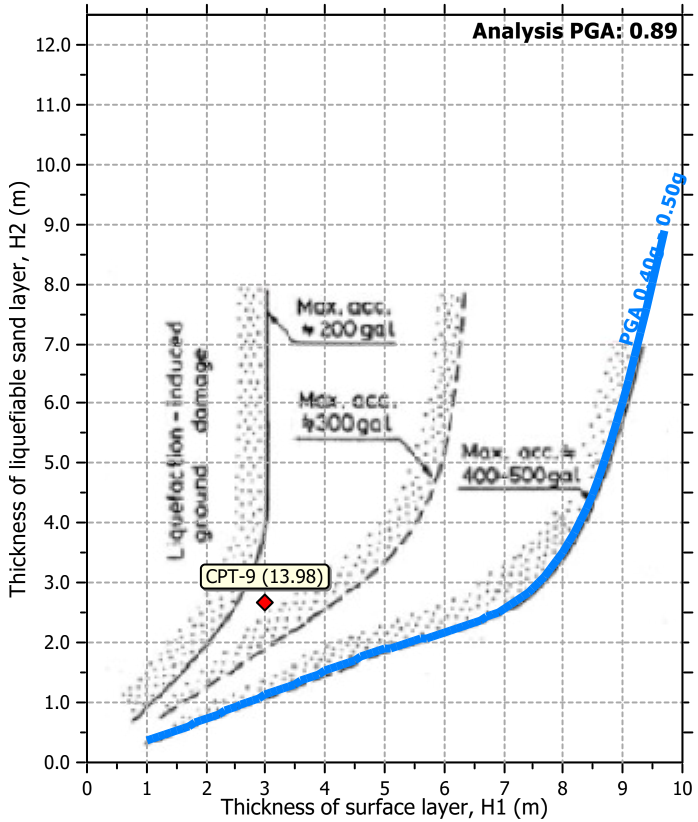
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



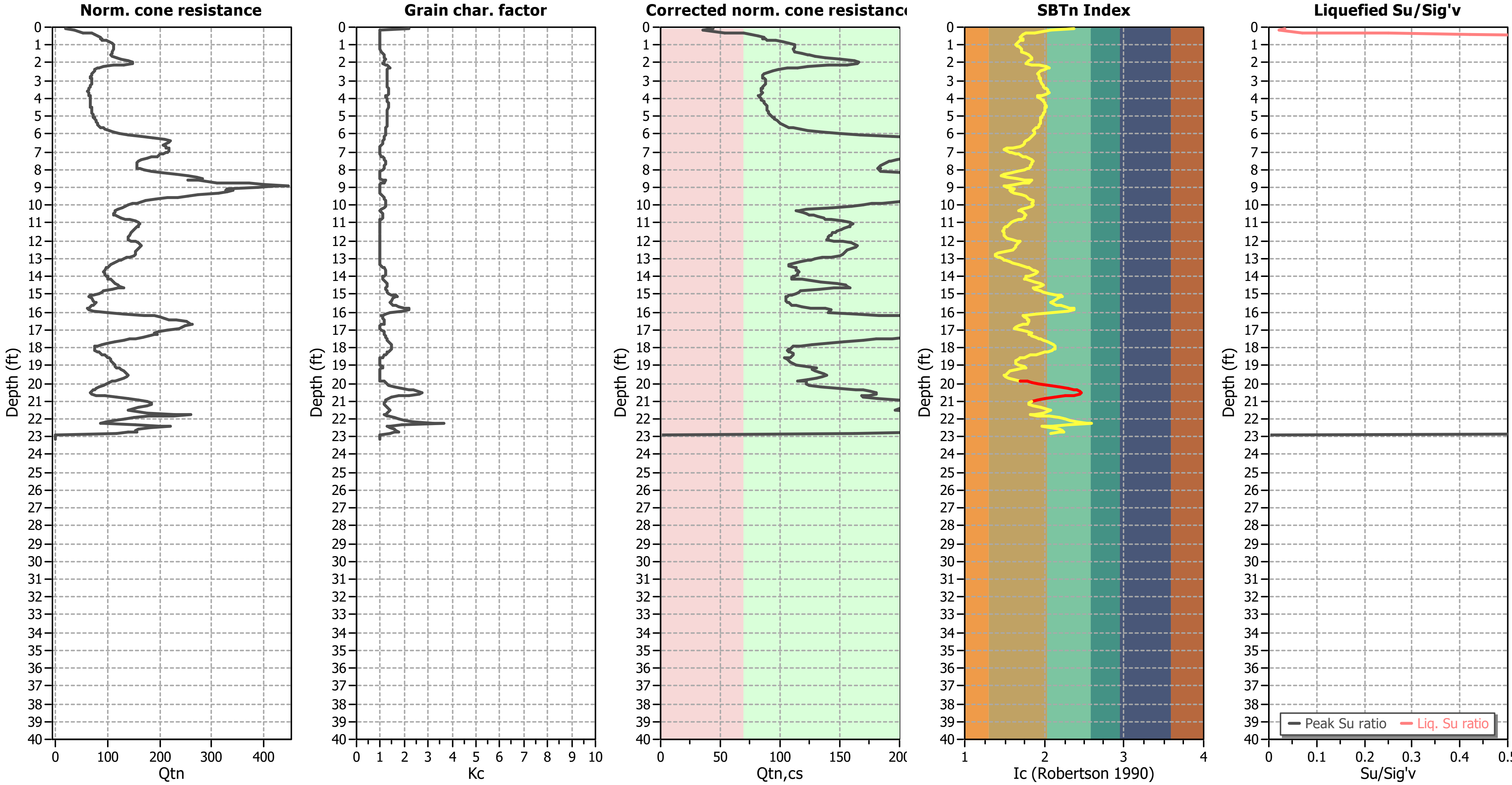




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.50 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

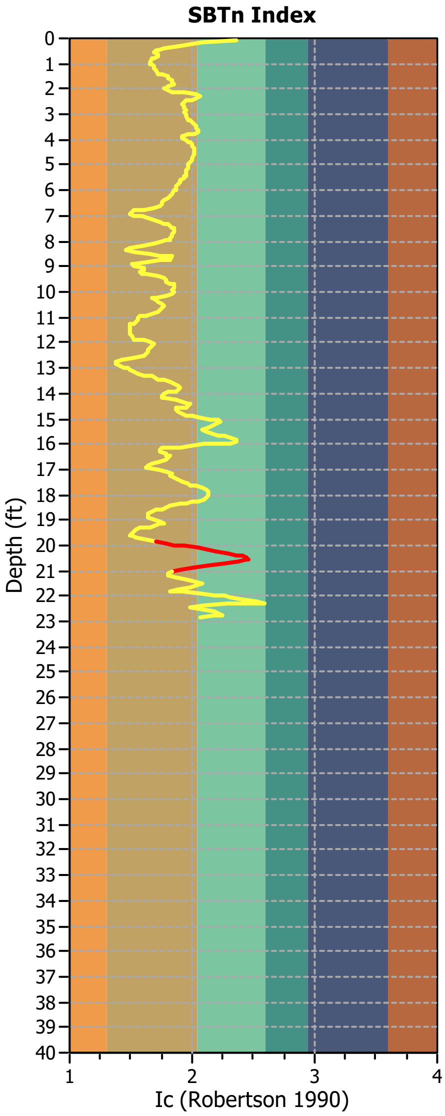
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.50 ft	Fill height:	N/A	Limit depth:	N/A

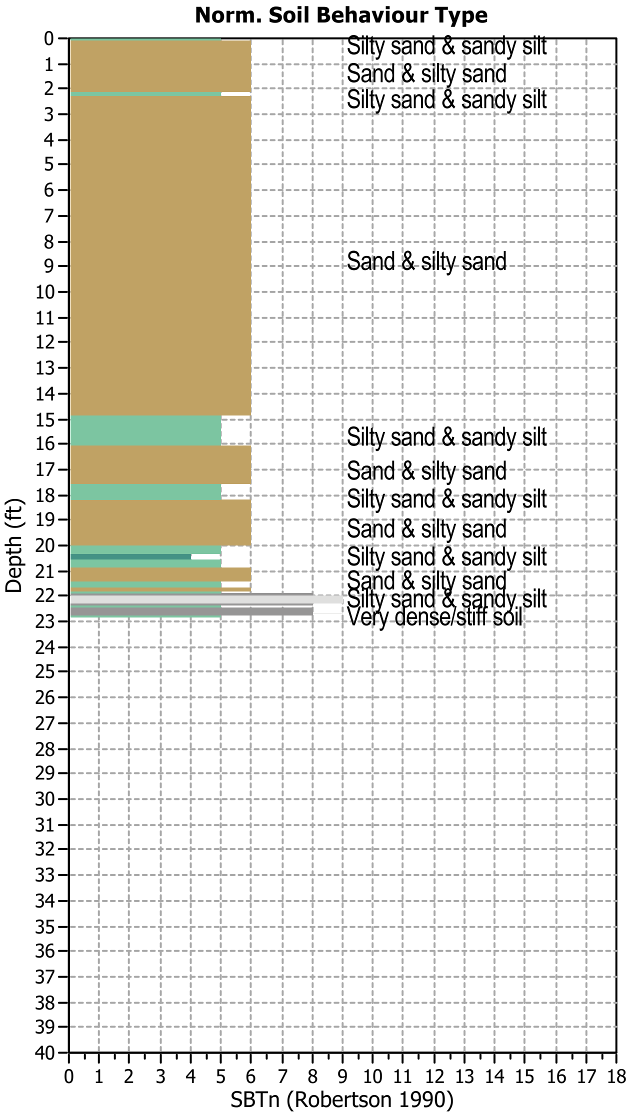
TRANSITION LAYER DETECTION ALGORITHM REPORT
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between 1.80 < I_c < 3.0) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

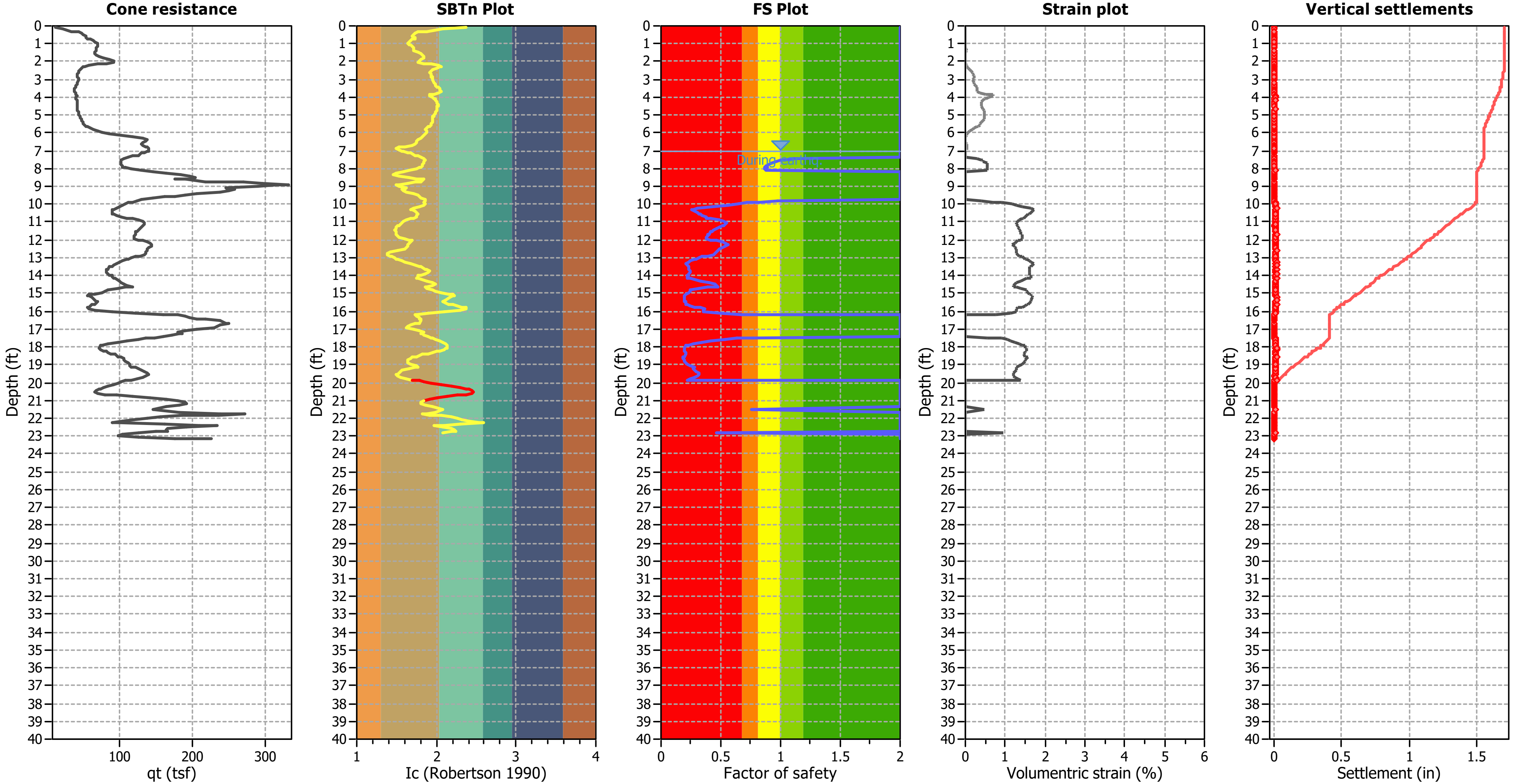
The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.





Transition layer algorithm properties		**General statistics**	
I_c minimum check value:	1.70	Total points in CPT file:	335
I_c maximum check value:	3.00	Total points excluded:	18
I_c change ratio value:	0.0250	Exclusion percentage:	5.37%
Minimum number of points in layer:	4	Number of layers detected:	2

Estimation of post-earthquake settlements

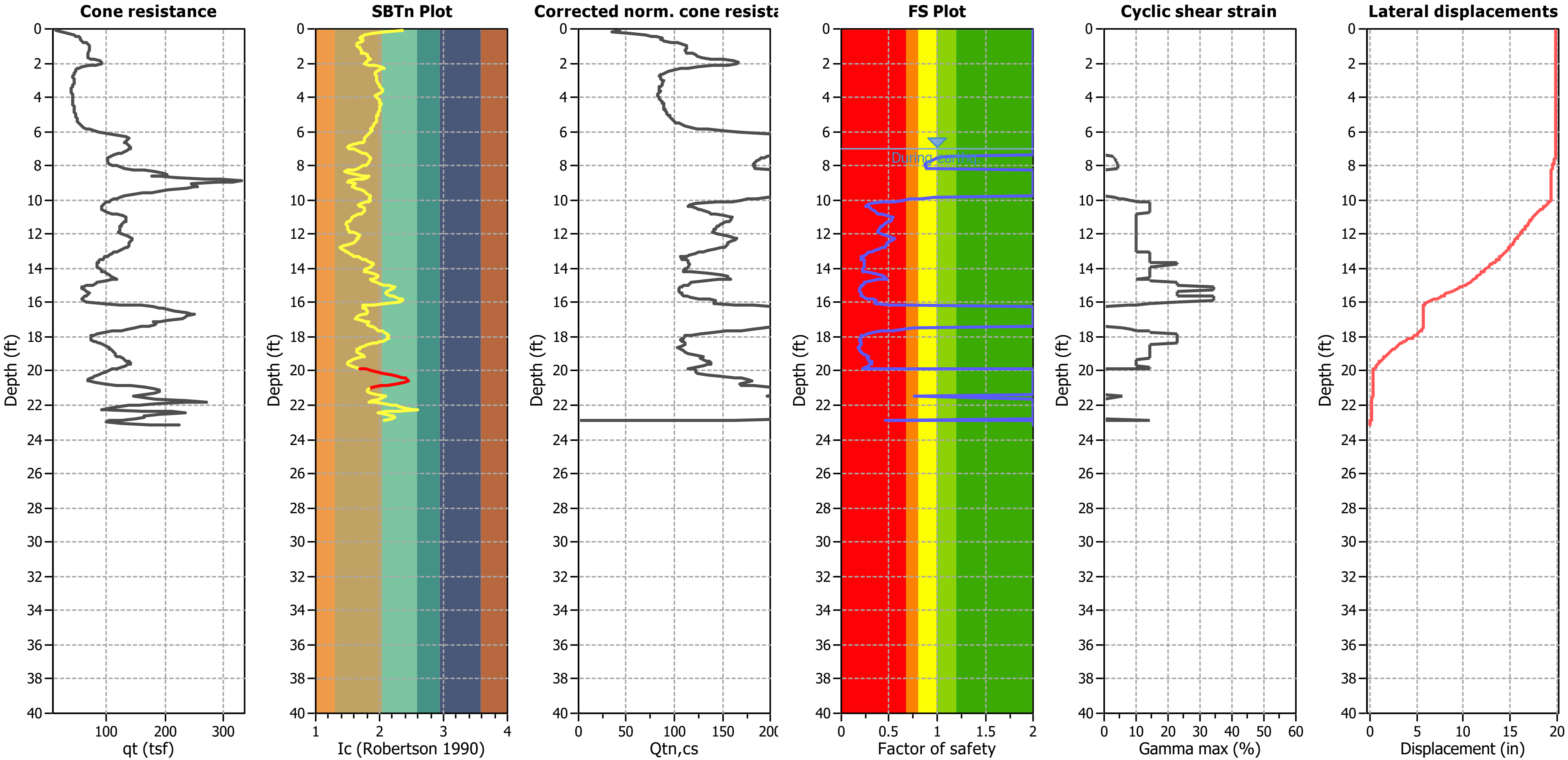


Abbreviations

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

Estimation of post-earthquake lateral Displacements

Geometric parameters: Gently sloping ground without free face (Slope 1.00 %)

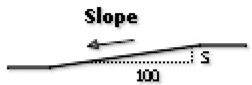


Abbreviations

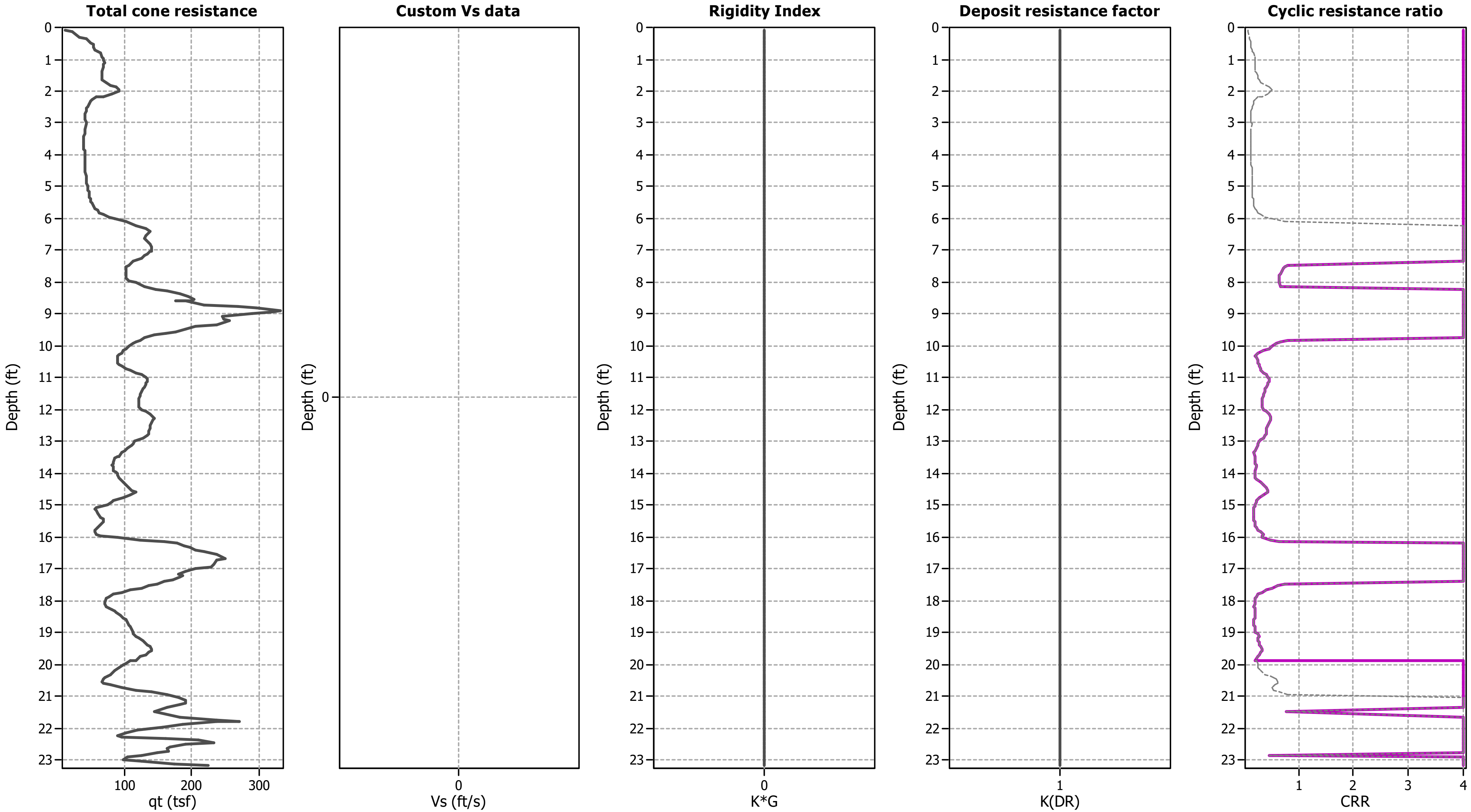
q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance

F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

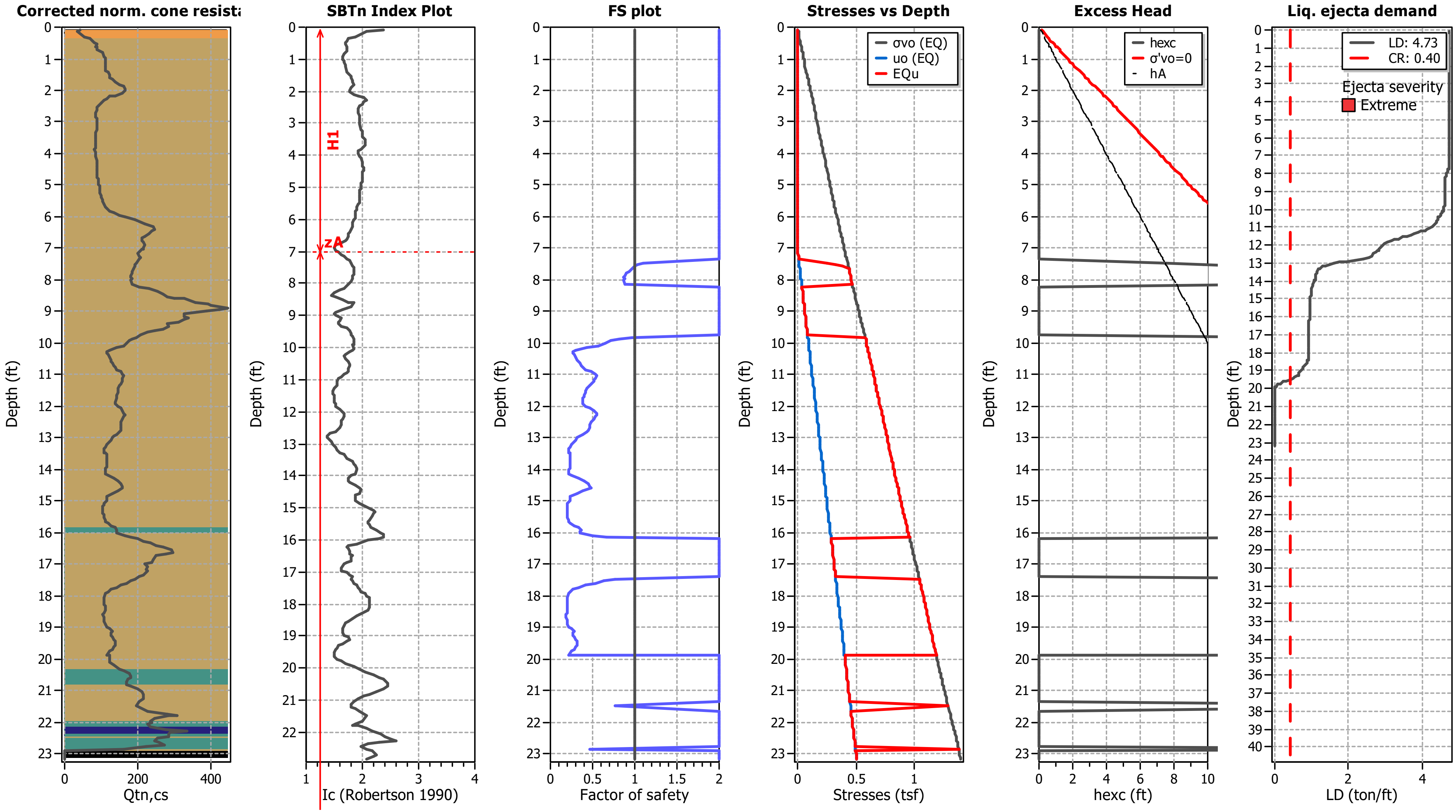
Surface condition



Aging Calculation Estimation



Ejecta Severity Estimation



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

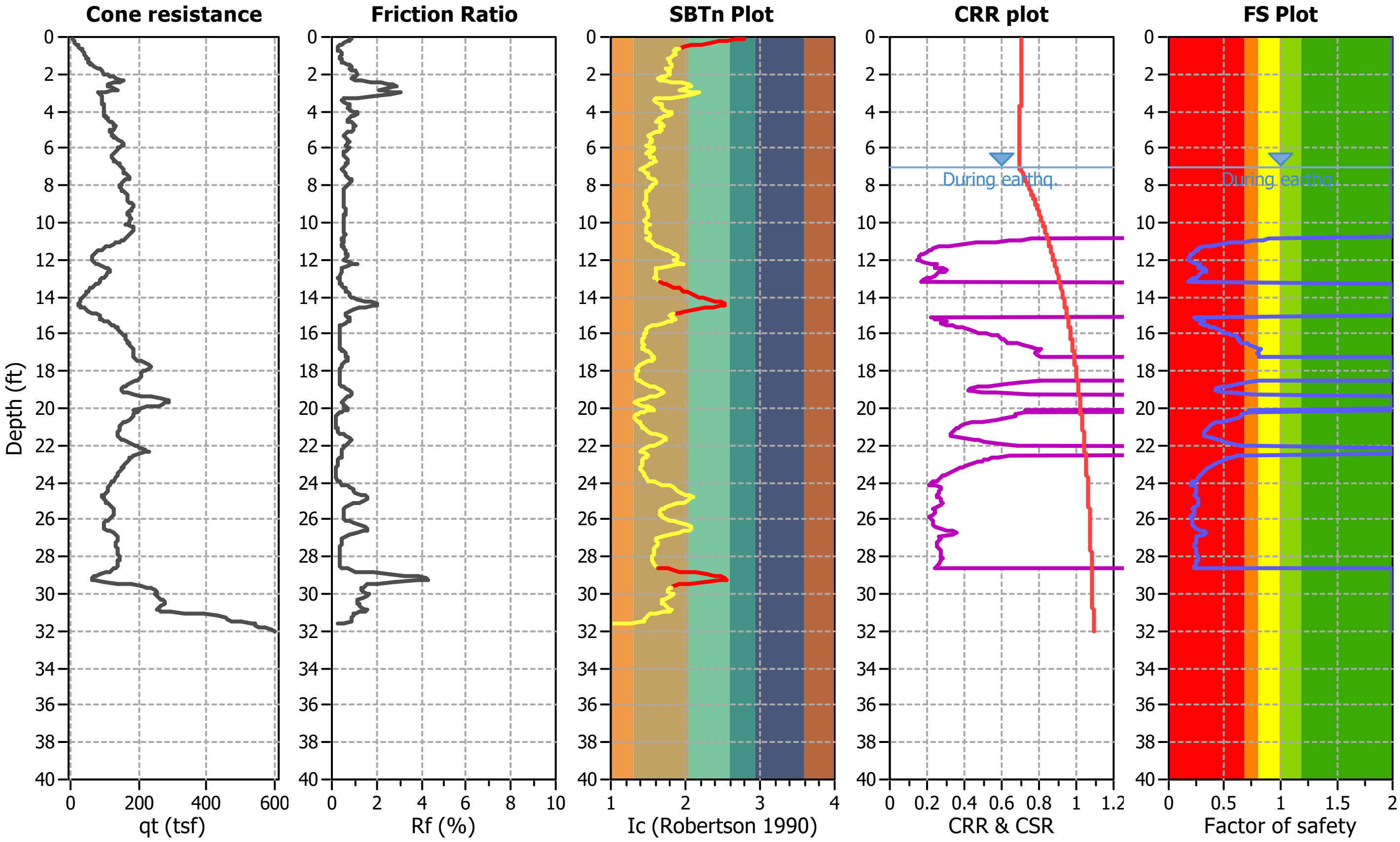
LIQUEFACTION ANALYSIS REPORT

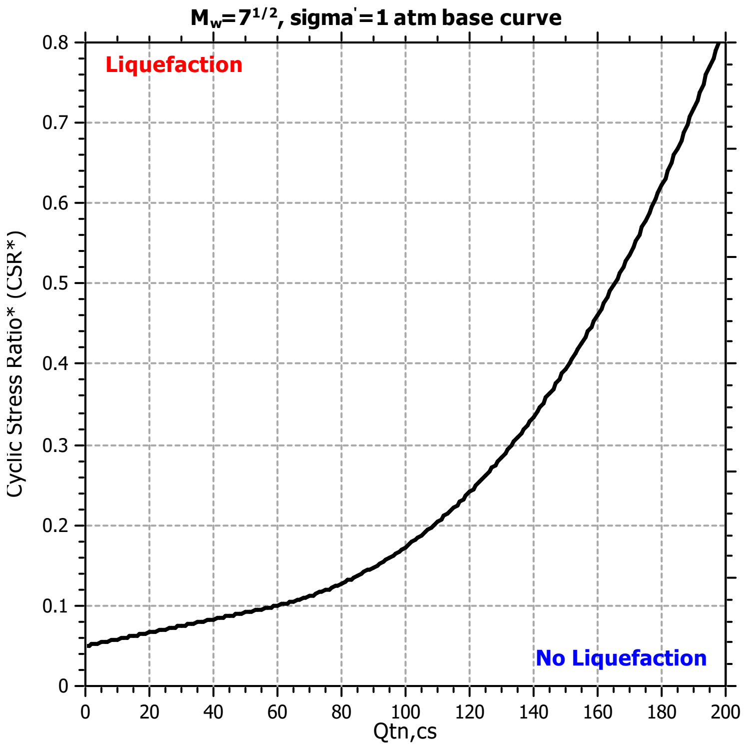
Project title : Petra Geosciences / Apple Canyon **Location : Lake Hemet, CA**

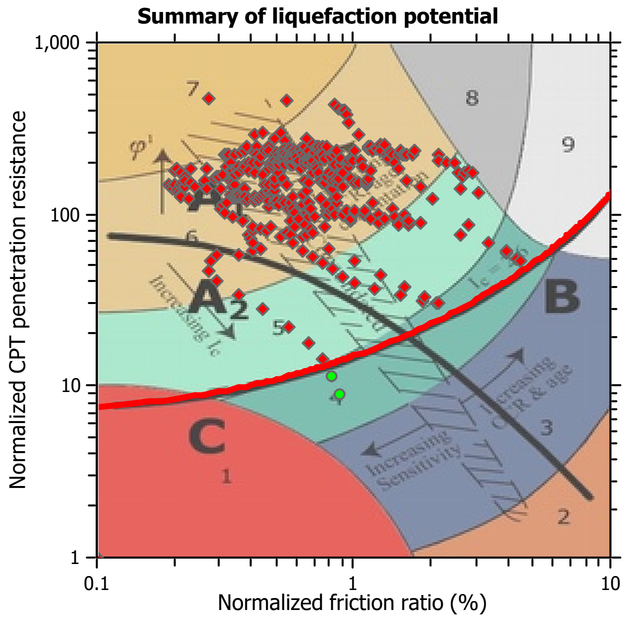
CPT file : CPT-10

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	10.50 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	8.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.89	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

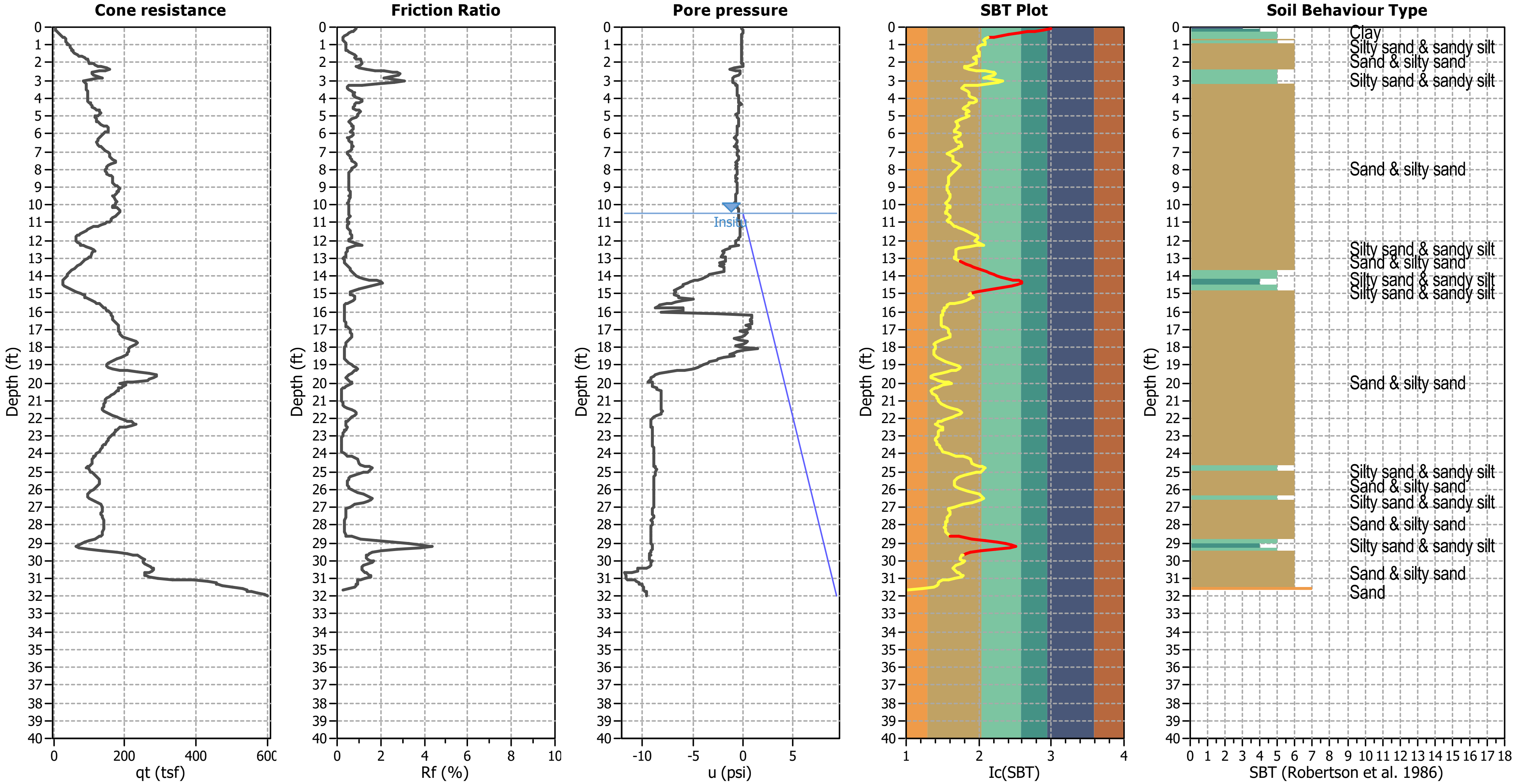






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



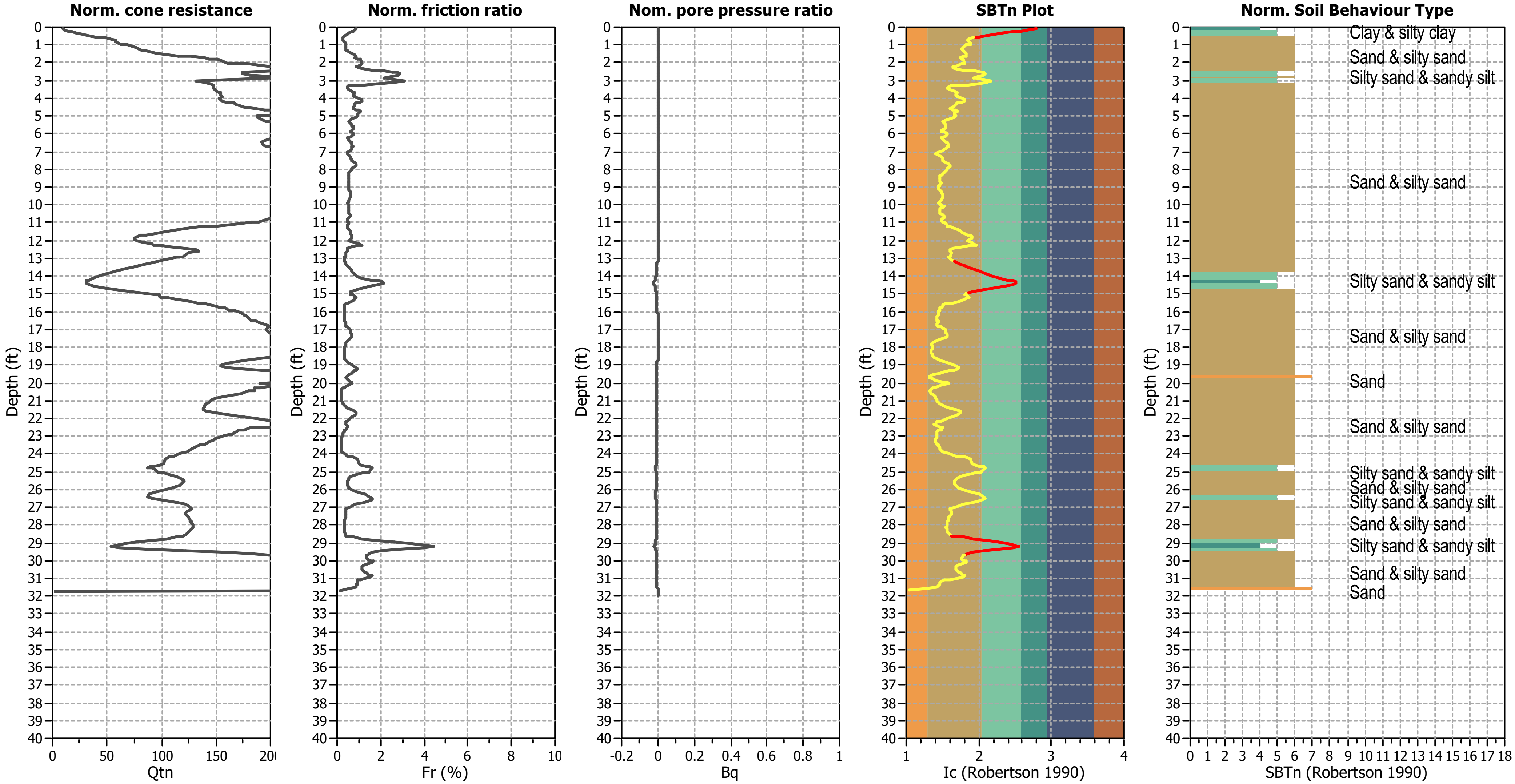
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

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)



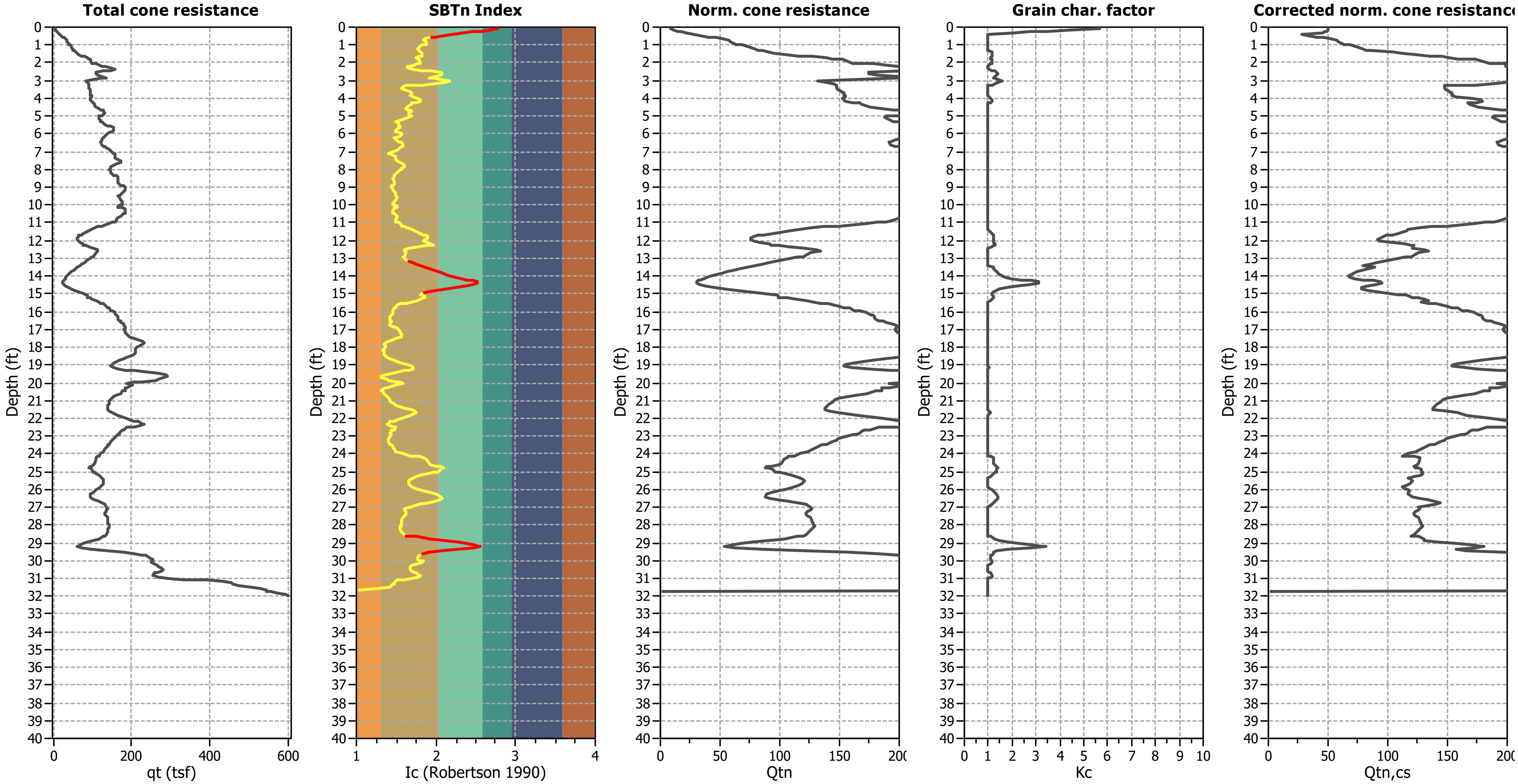
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

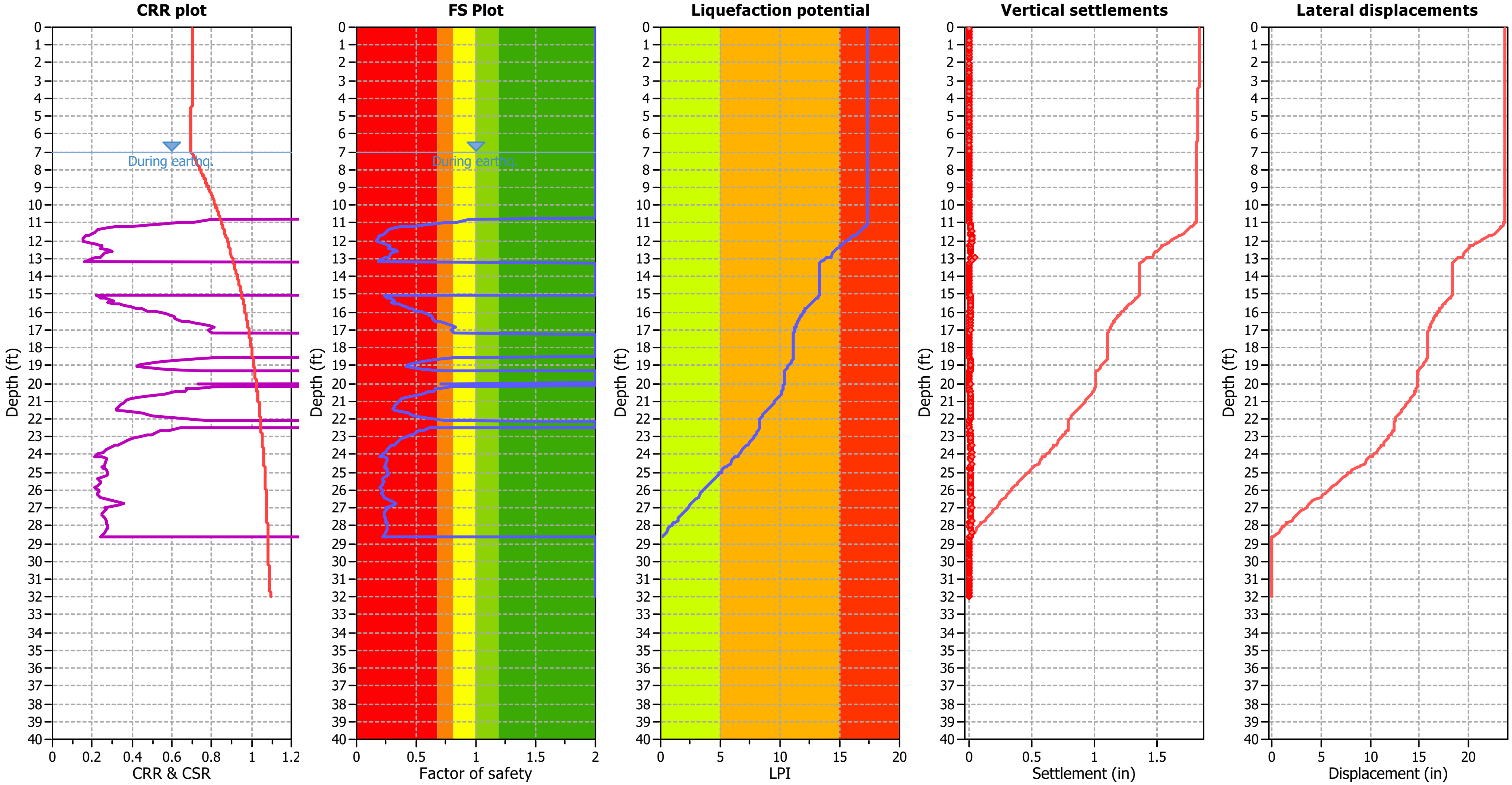
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

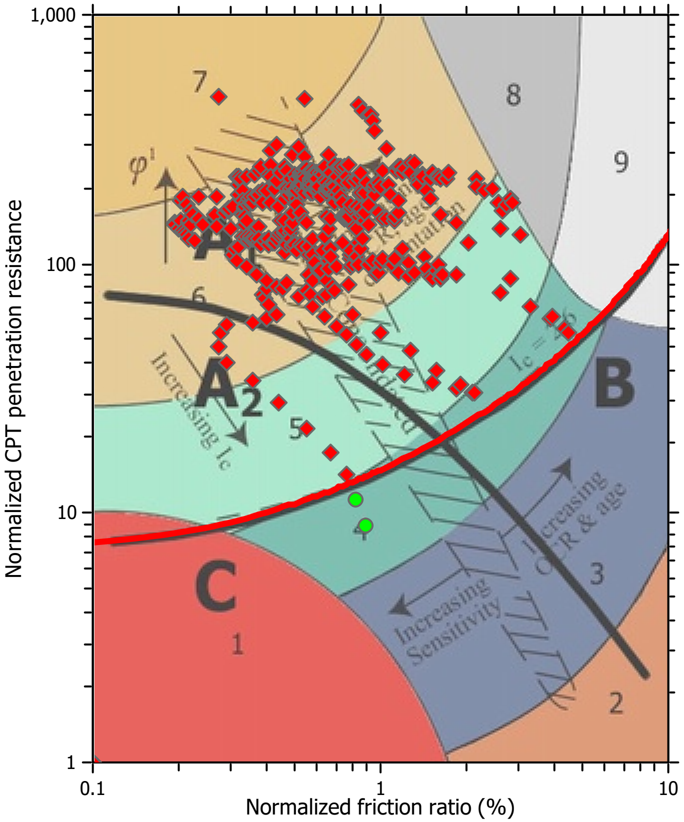
F.S. color scheme

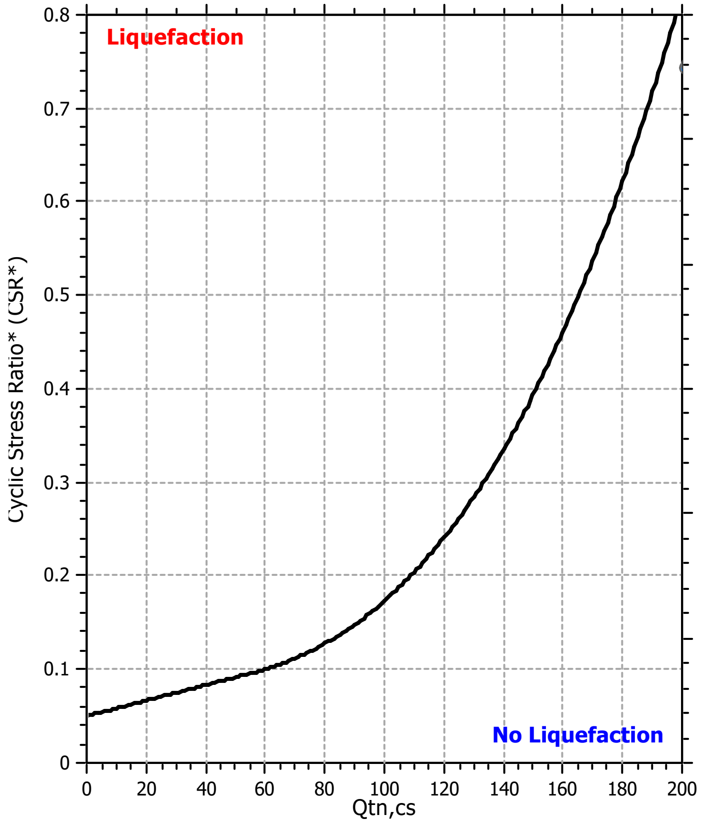
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

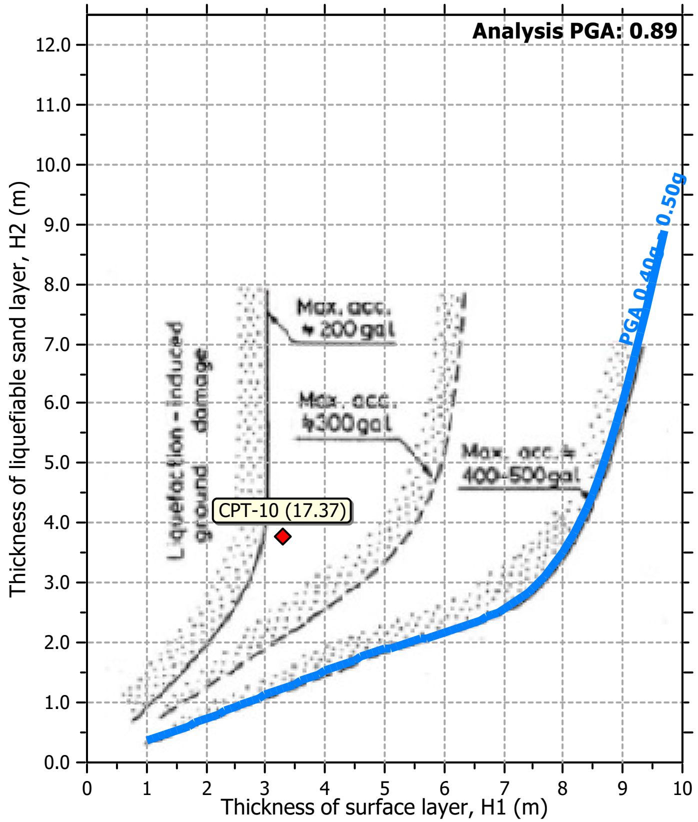
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



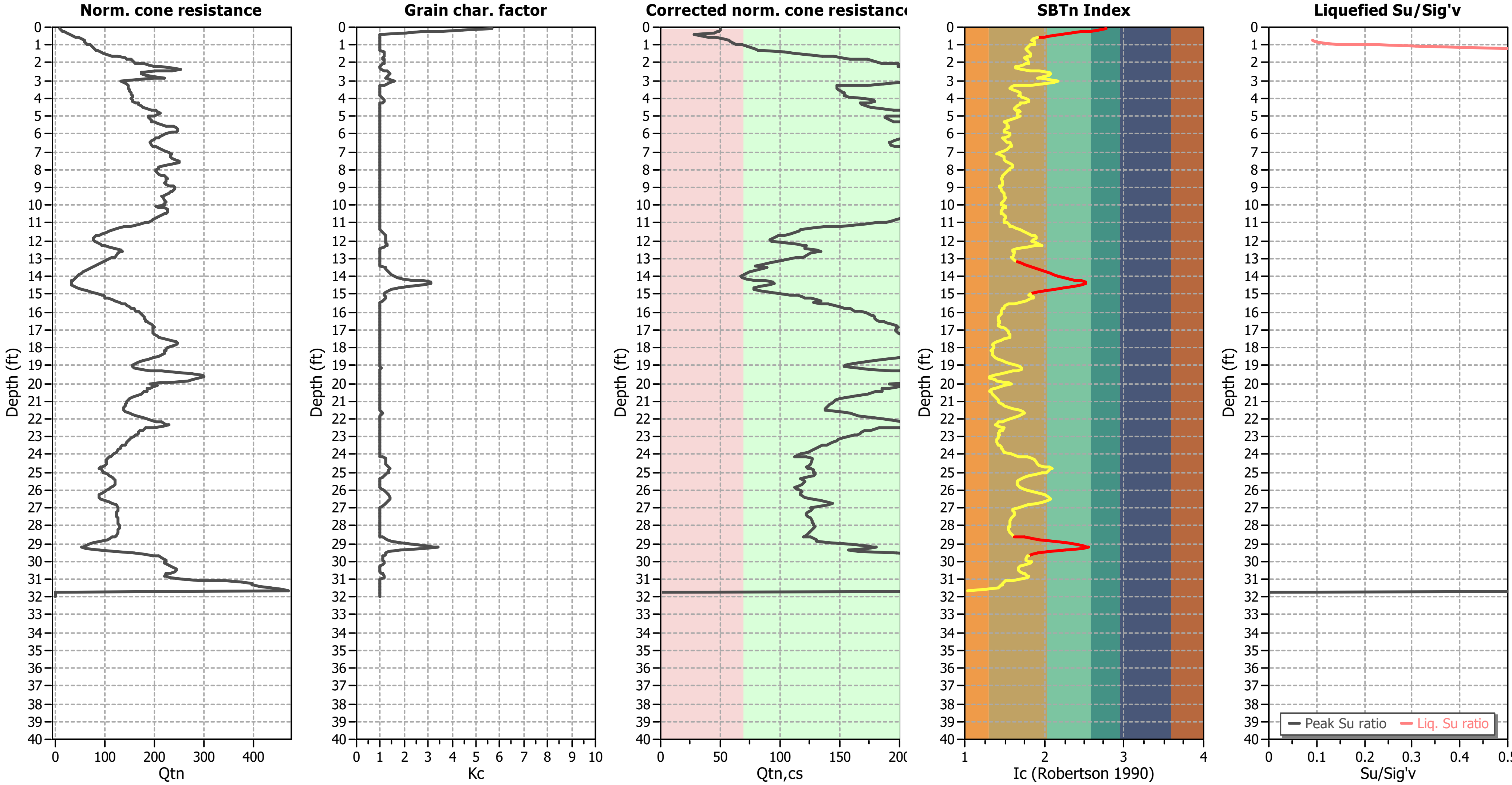




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

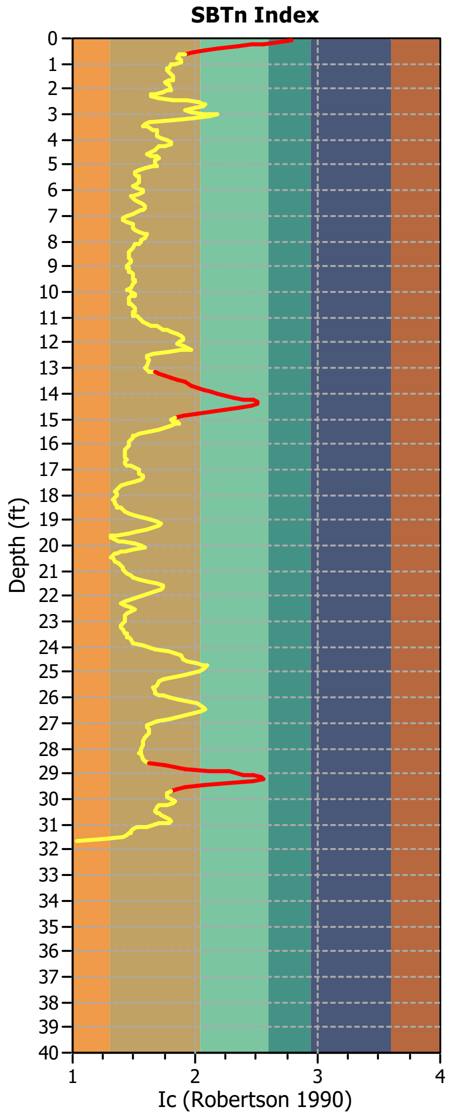
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	N/A	Limit depth:	N/A

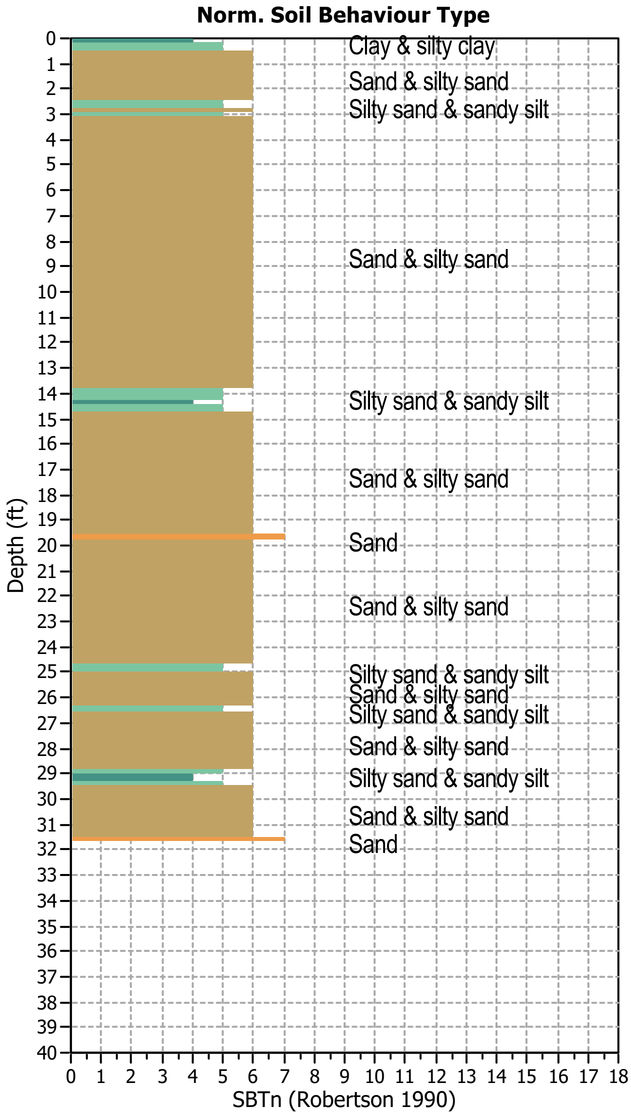
TRANSITION LAYER DETECTION ALGORITHM REPORT
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between $1.80 < I_c < 3.0$) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.





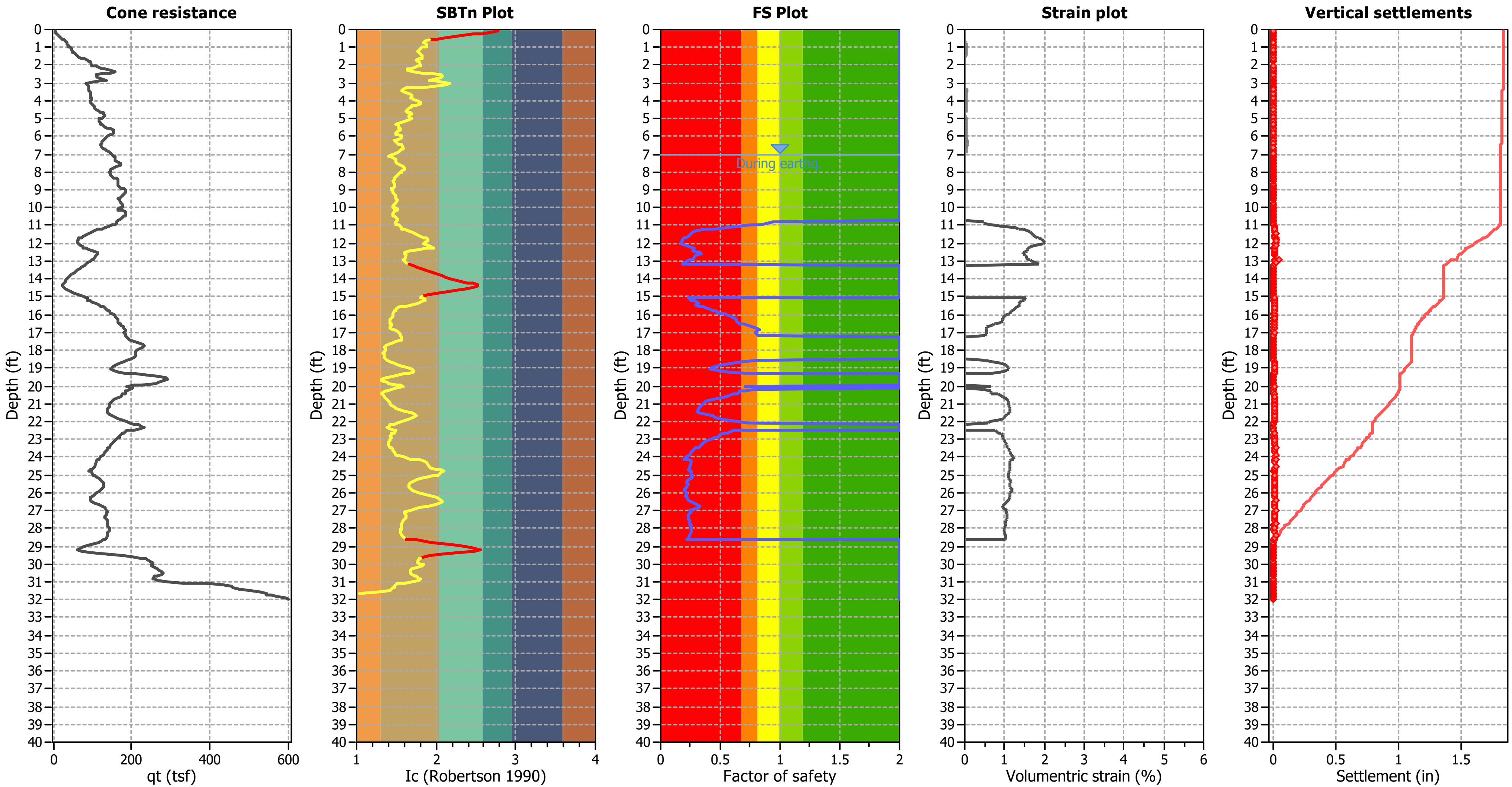
Transition layer algorithm properties

I_c minimum check value:	1.70
I_c maximum check value:	3.00
I_c change ratio value:	0.0250
Minimum number of points in layer:	4

General statistics

Total points in CPT file:	443
Total points excluded:	49
Exclusion percentage:	11.06%
Number of layers detected:	5

Estimation of post-earthquake settlements

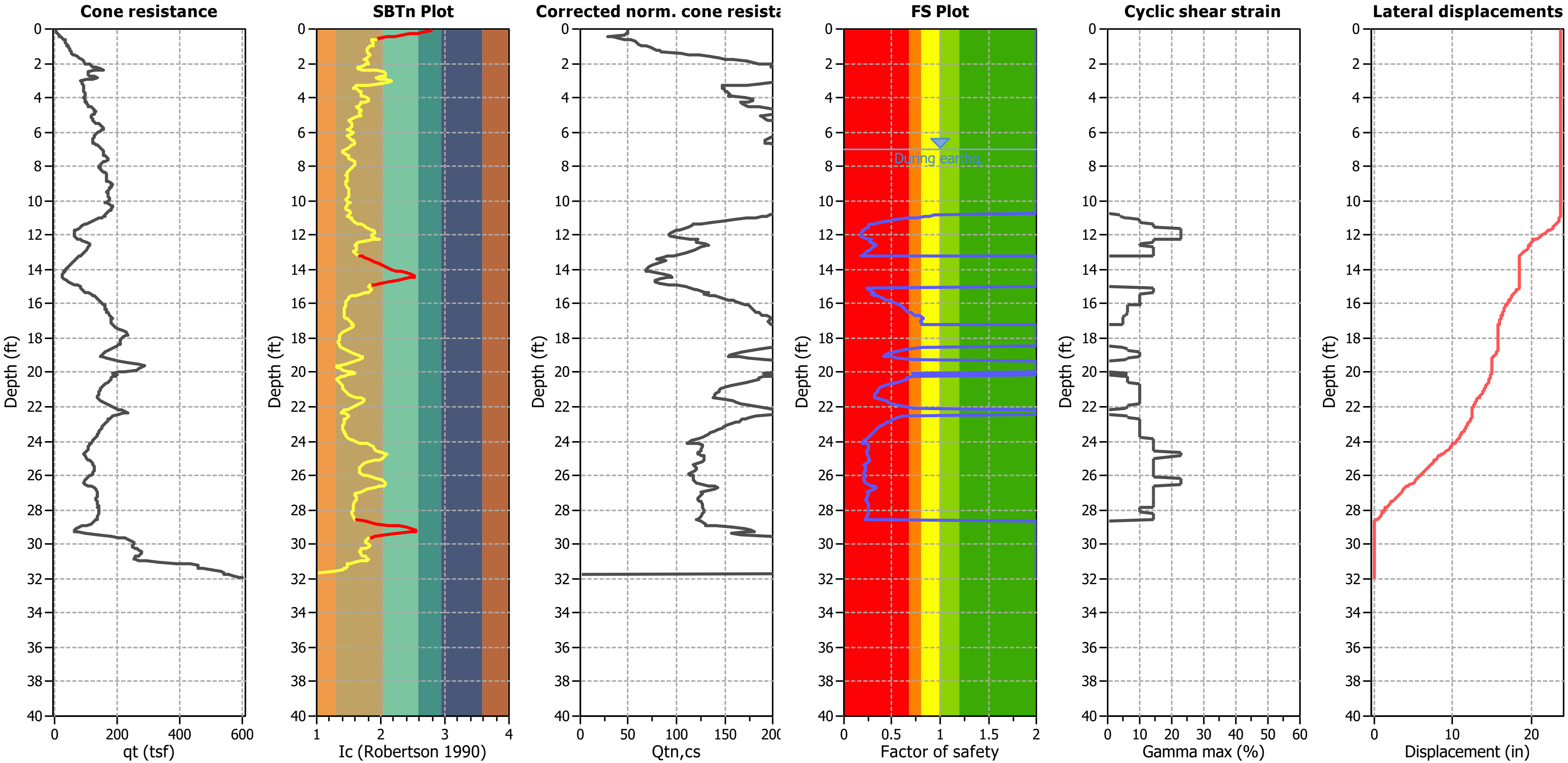


Abbreviations

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

Estimation of post-earthquake lateral Displacements

Geometric parameters: Gently sloping ground without free face (Slope 1.00 %)



Abbreviations

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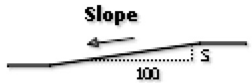
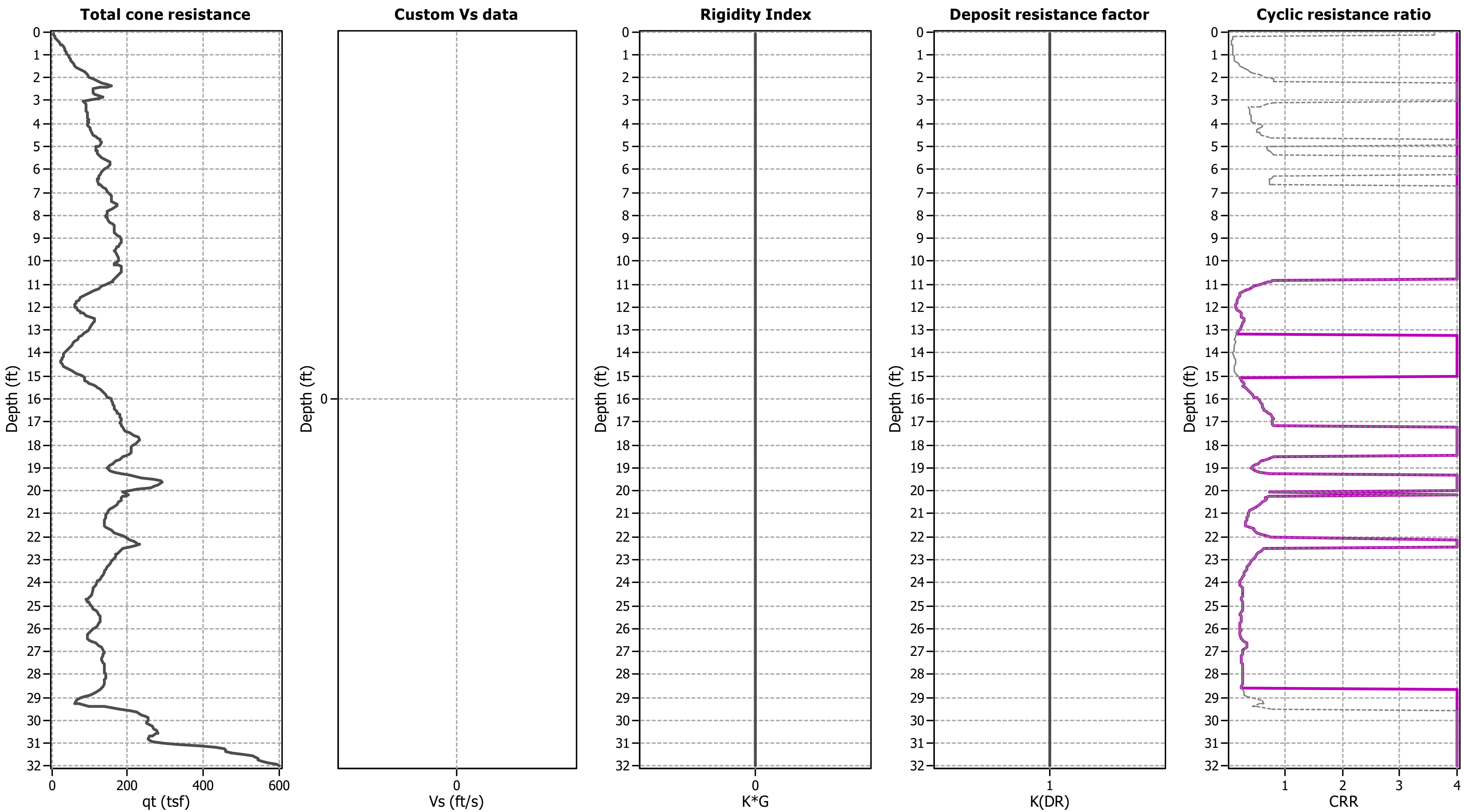
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance

F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

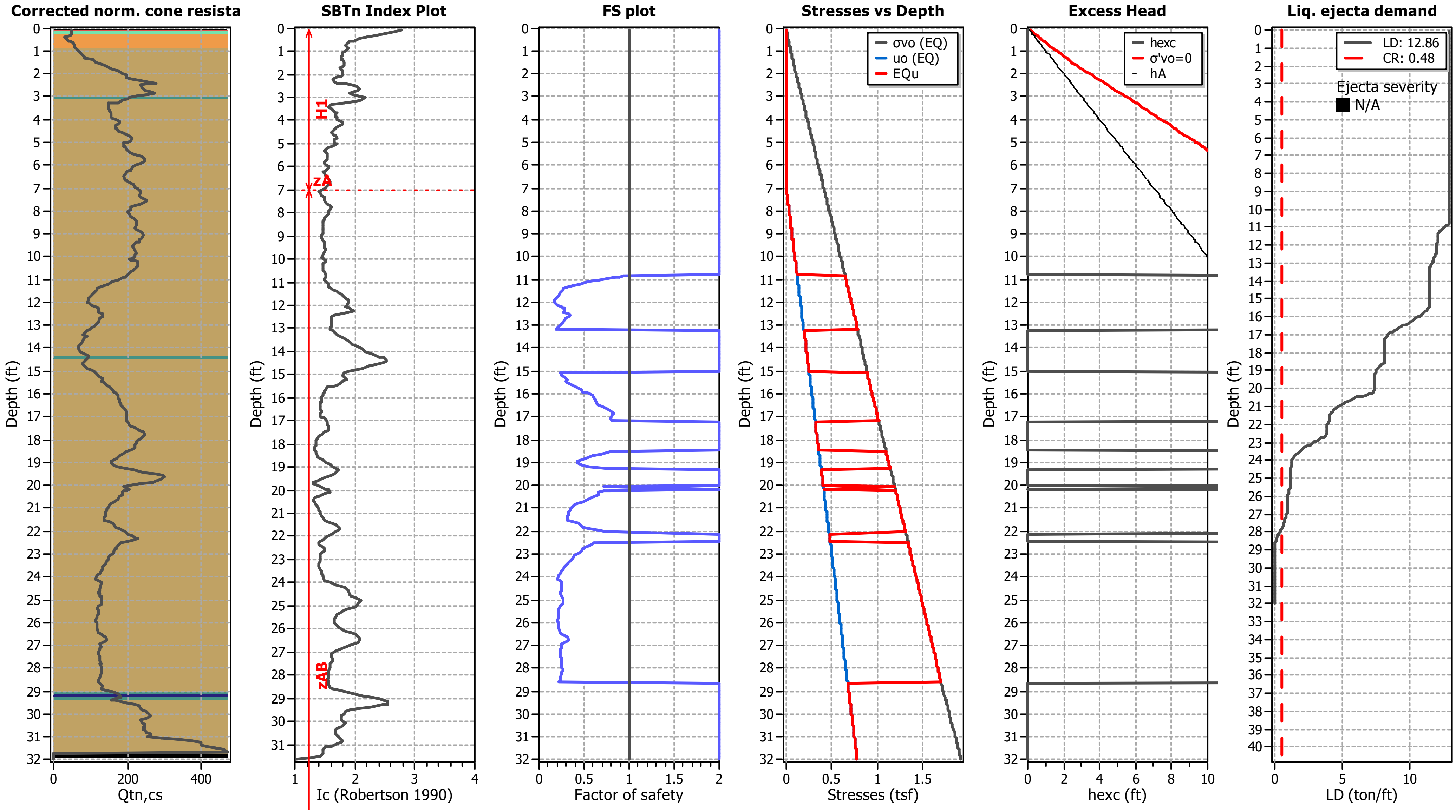
Surface condition



Aging Calculation Estimation



Ejecta Severity Estimation



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

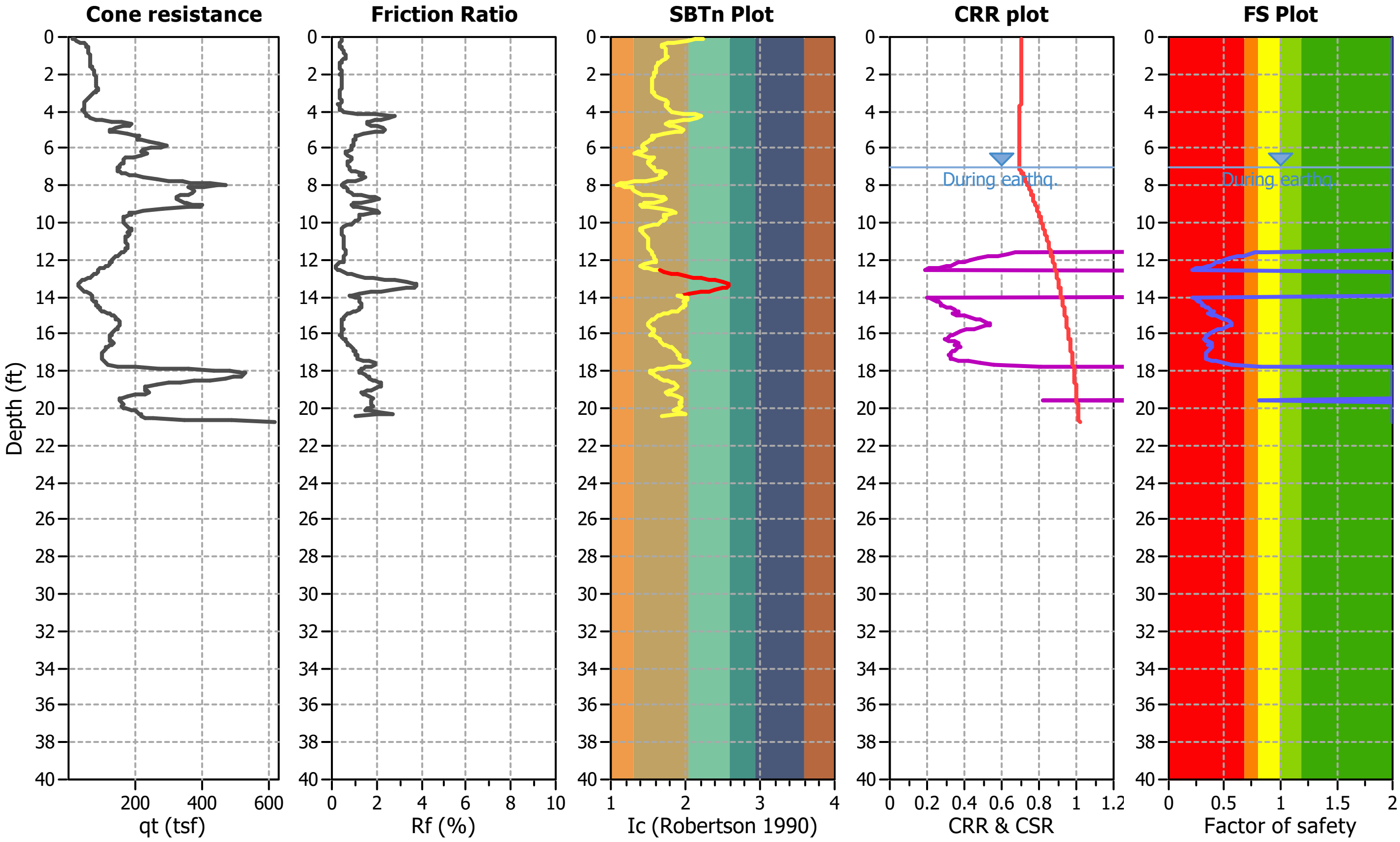
LIQUEFACTION ANALYSIS REPORT

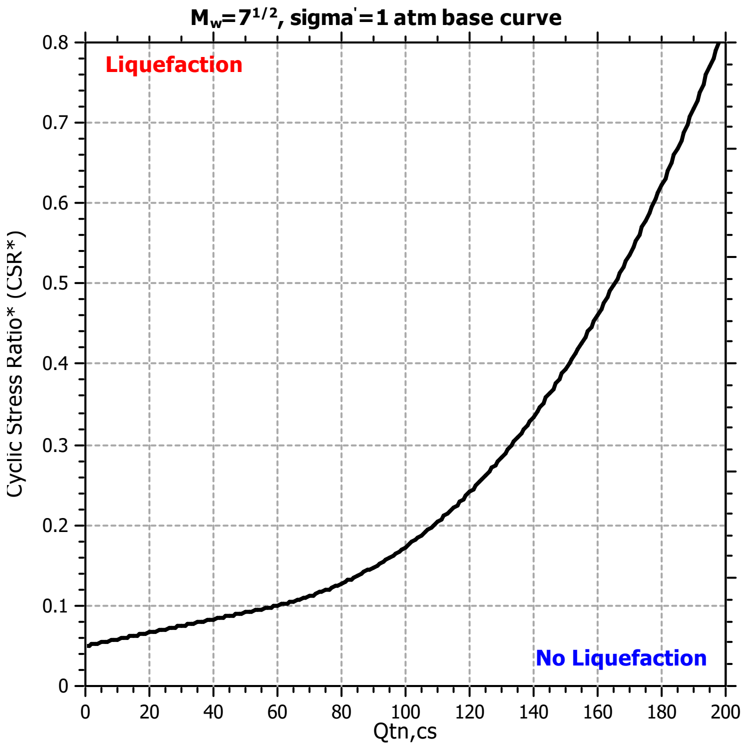
Project title : Petra Geosciences / Apple Canyon **Location : Lake Hemet, CA**

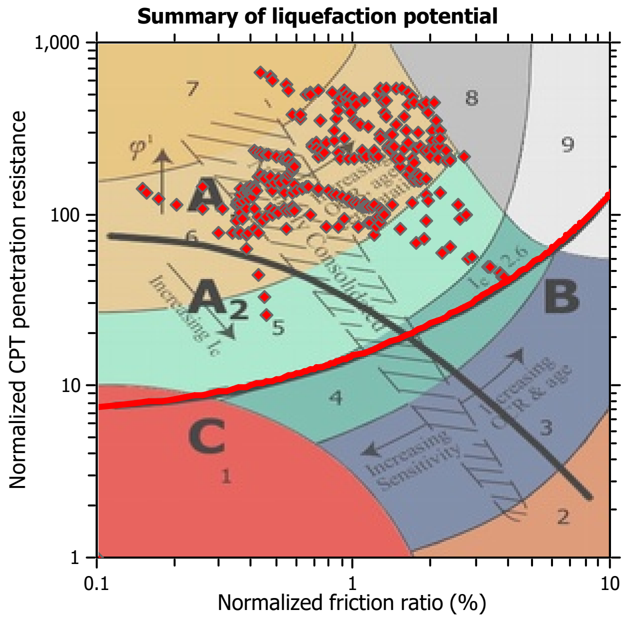
CPT file : CPT-11

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	11.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	8.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.89	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

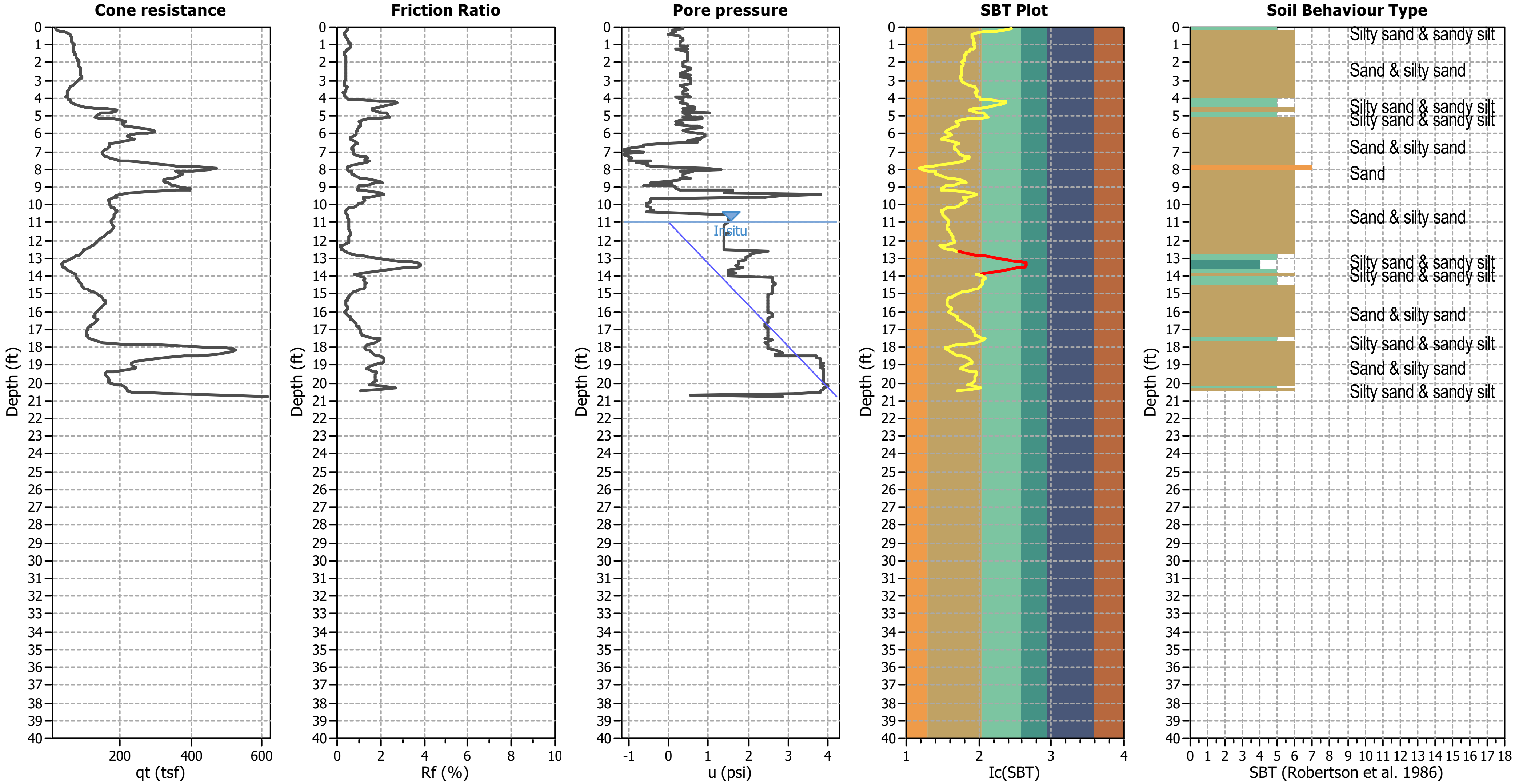






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



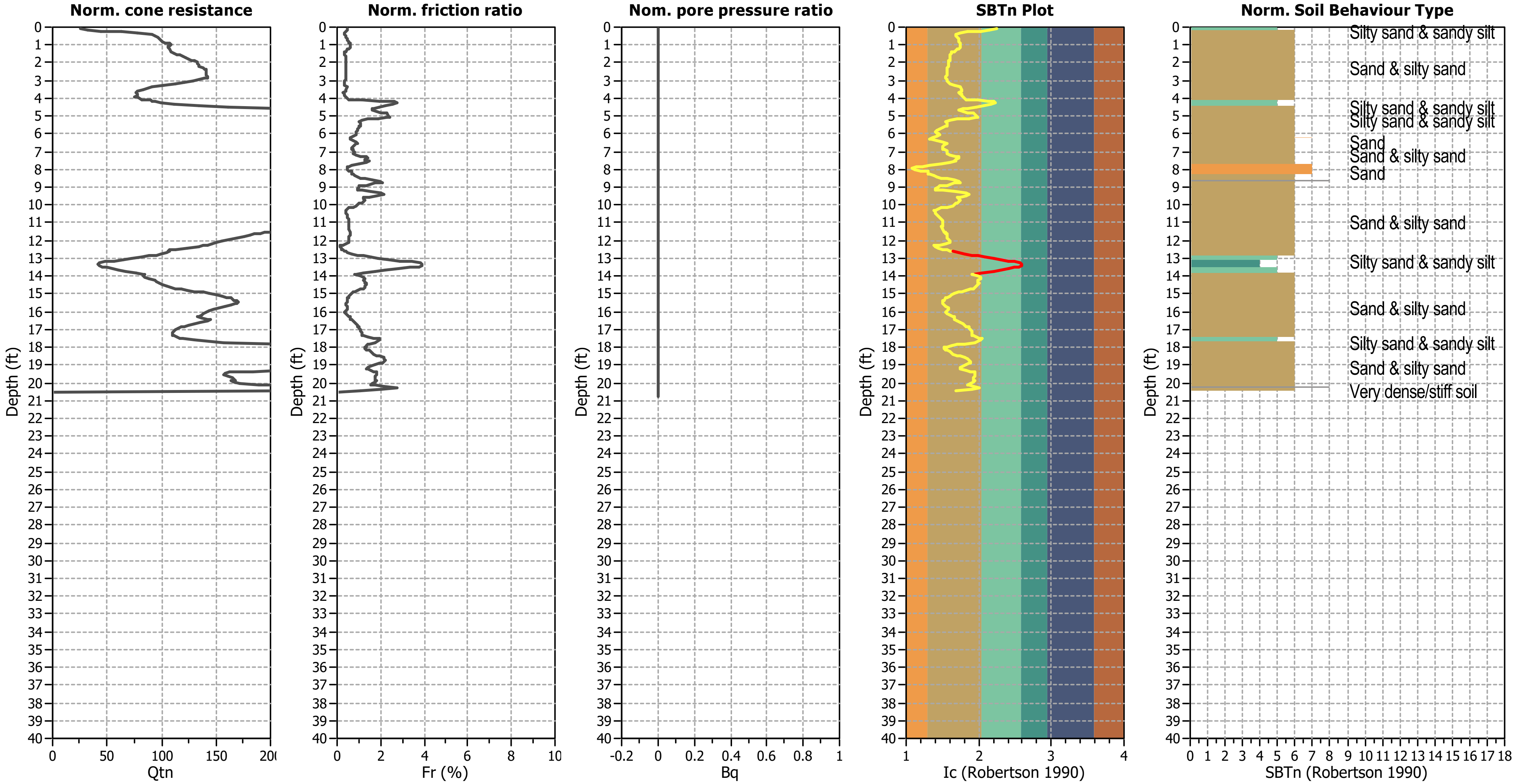
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

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)



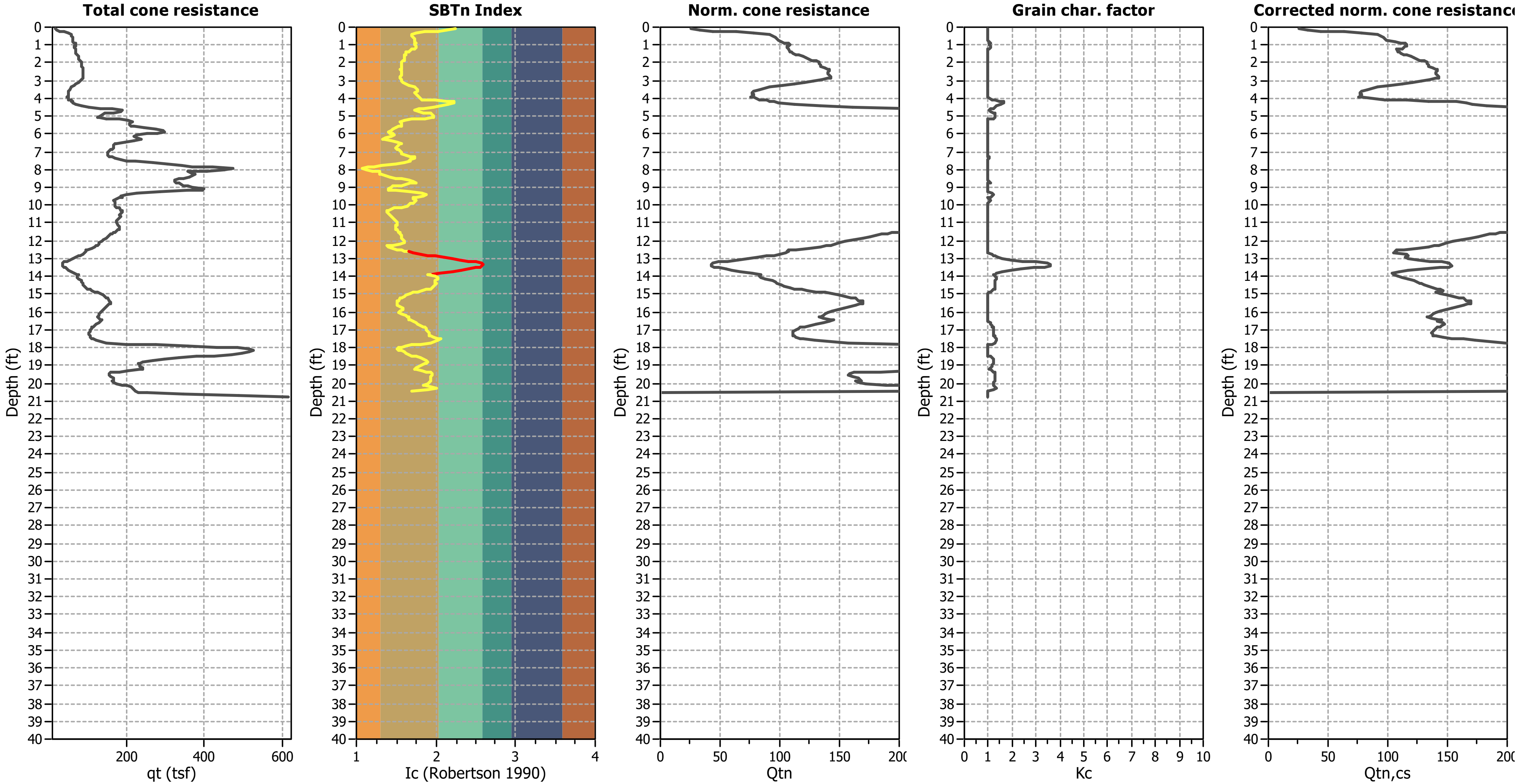
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

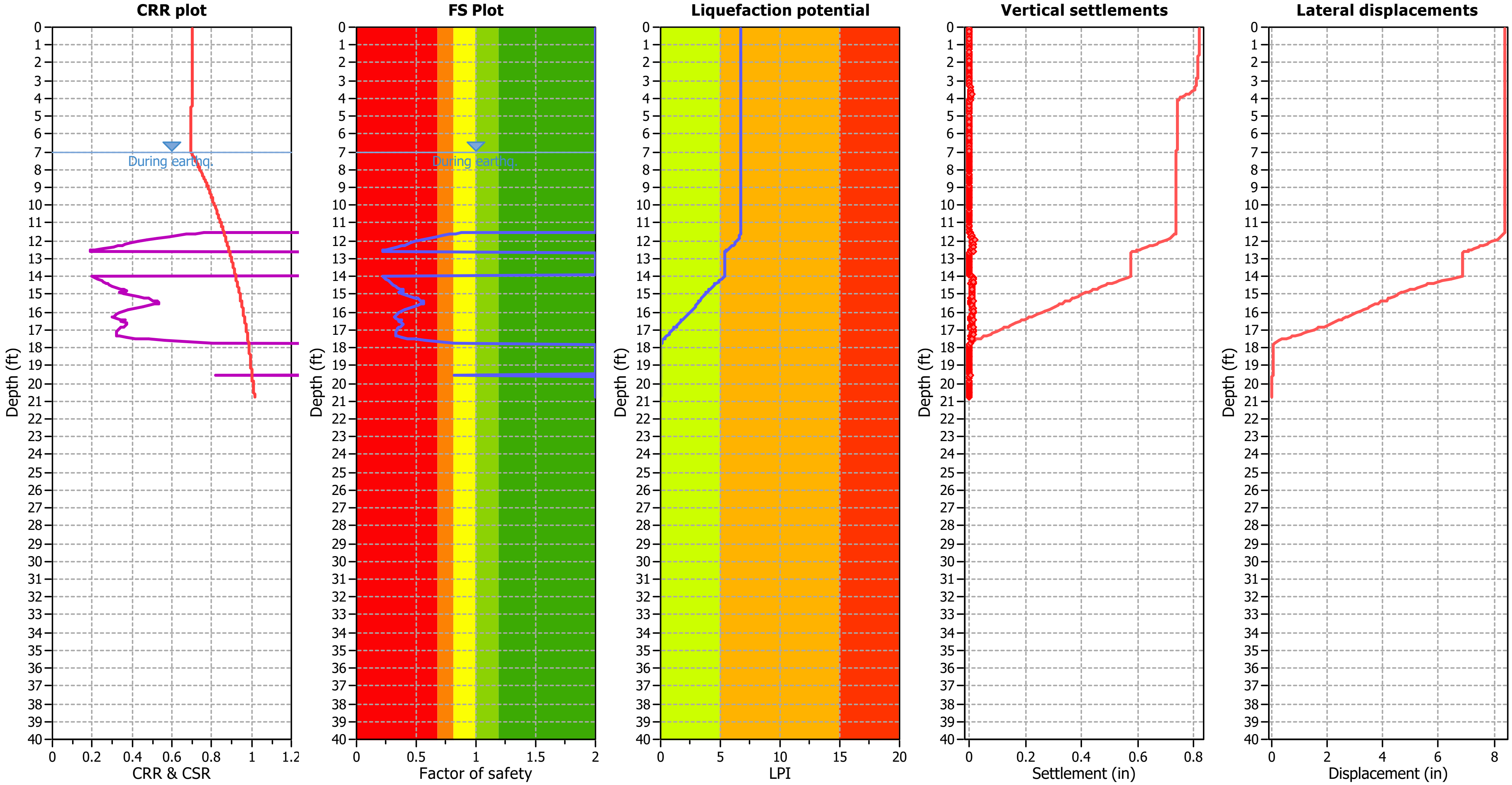
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_{σ} applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

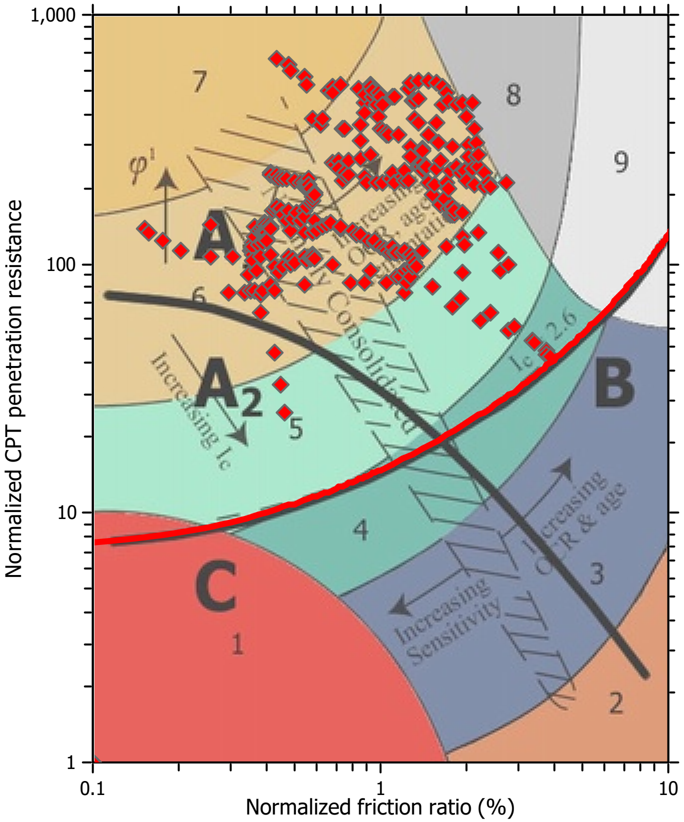
F.S. color scheme

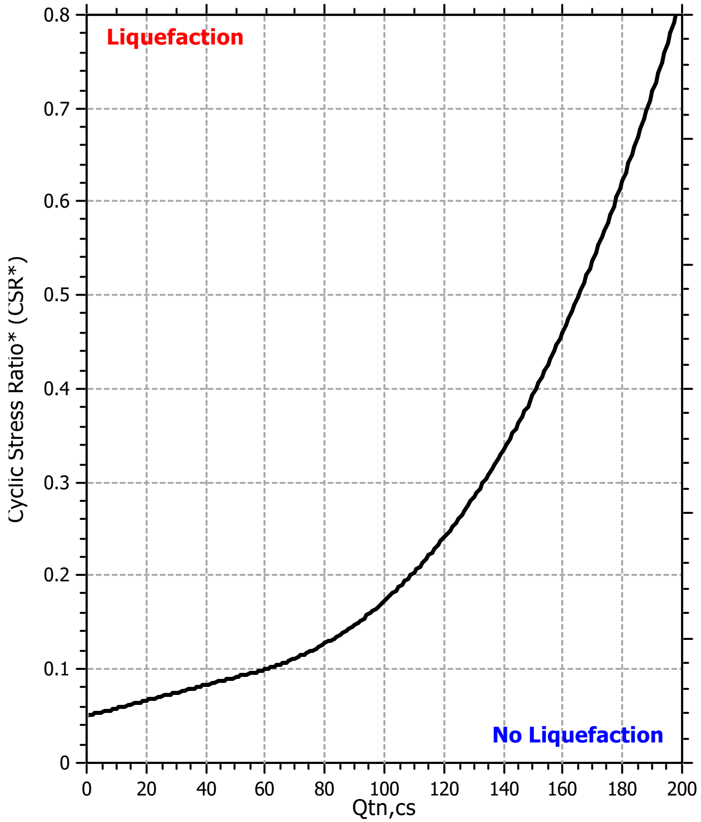
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

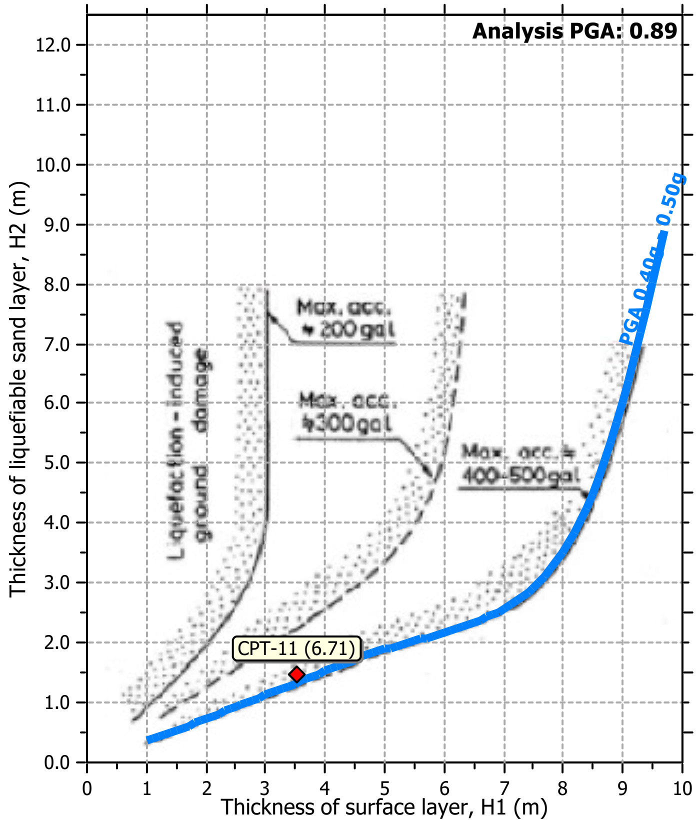
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



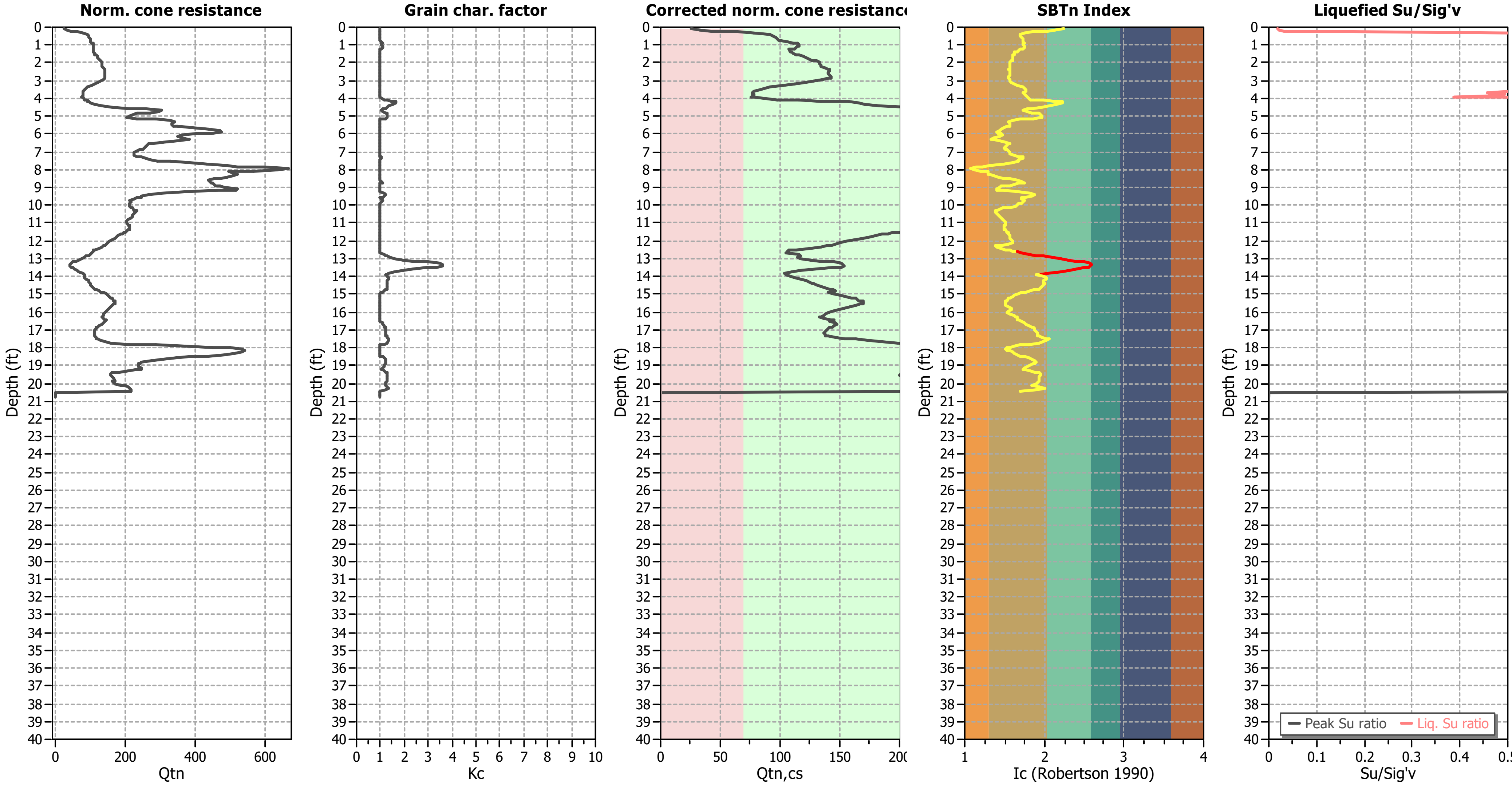




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

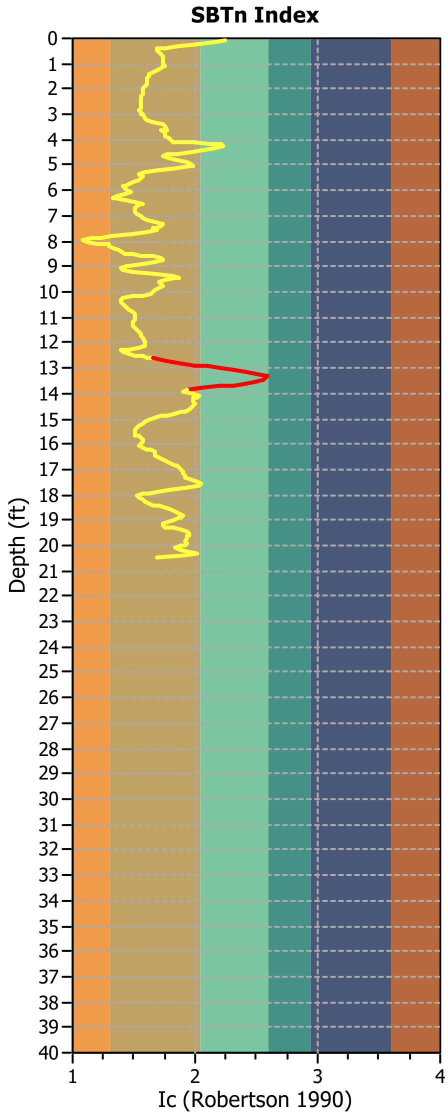
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_{σ} applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	11.00 ft	Fill height:	N/A	Limit depth:	N/A

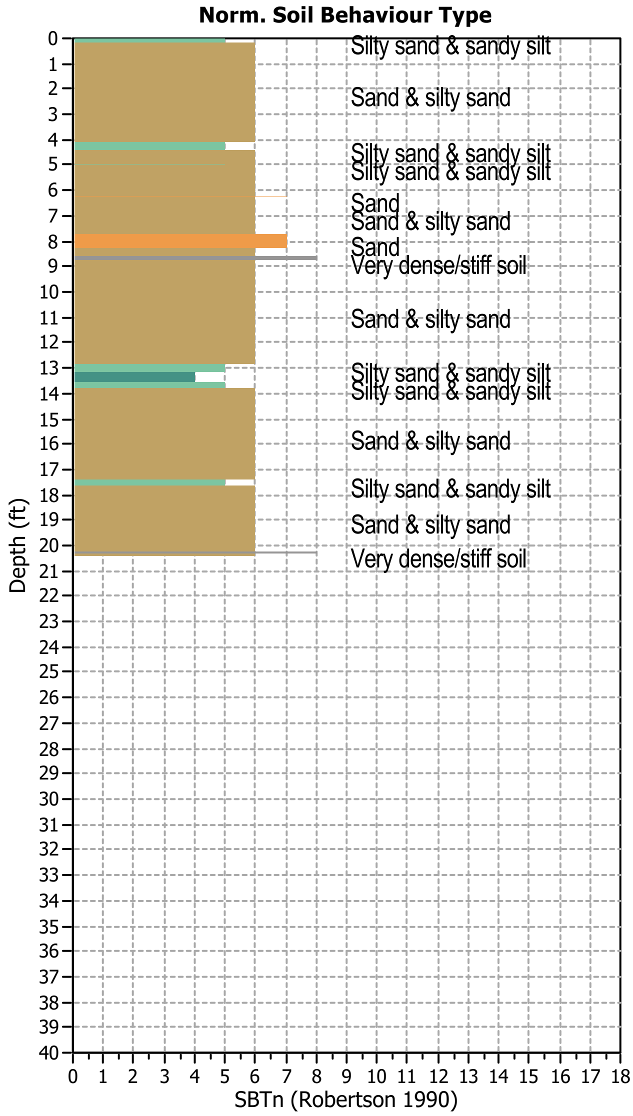
TRANSITION LAYER DETECTION ALGORITHM REPORT
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between 1.80 < I_c < 3.0) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

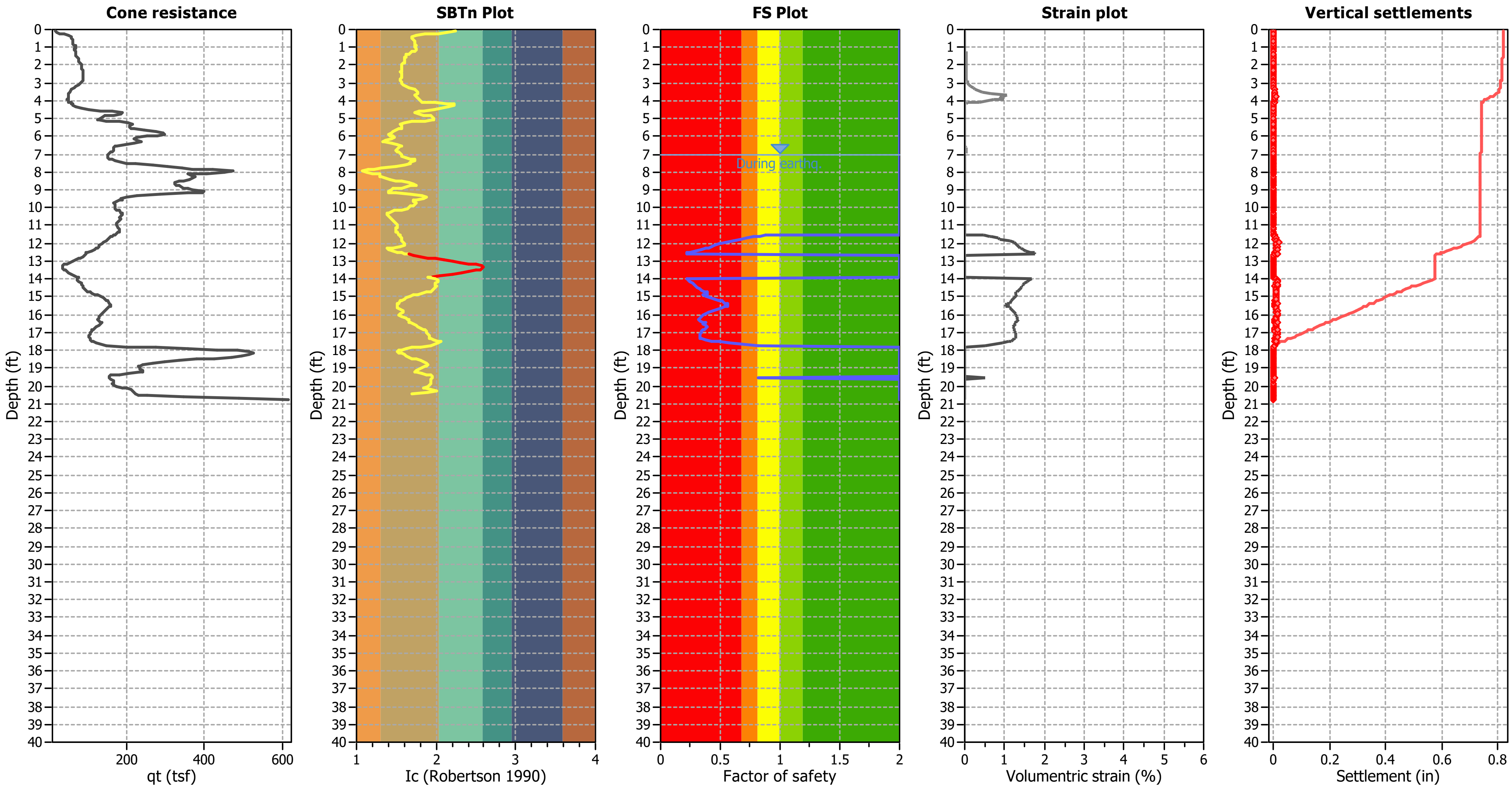
The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.





Transition layer algorithm properties		**General statistics**	
I_c minimum check value:	1.70	Total points in CPT file:	311
I_c maximum check value:	3.00	Total points excluded:	20
I_c change ratio value:	0.0250	Exclusion percentage:	6.43%
Minimum number of points in layer:	4	Number of layers detected:	2

Estimation of post-earthquake settlements

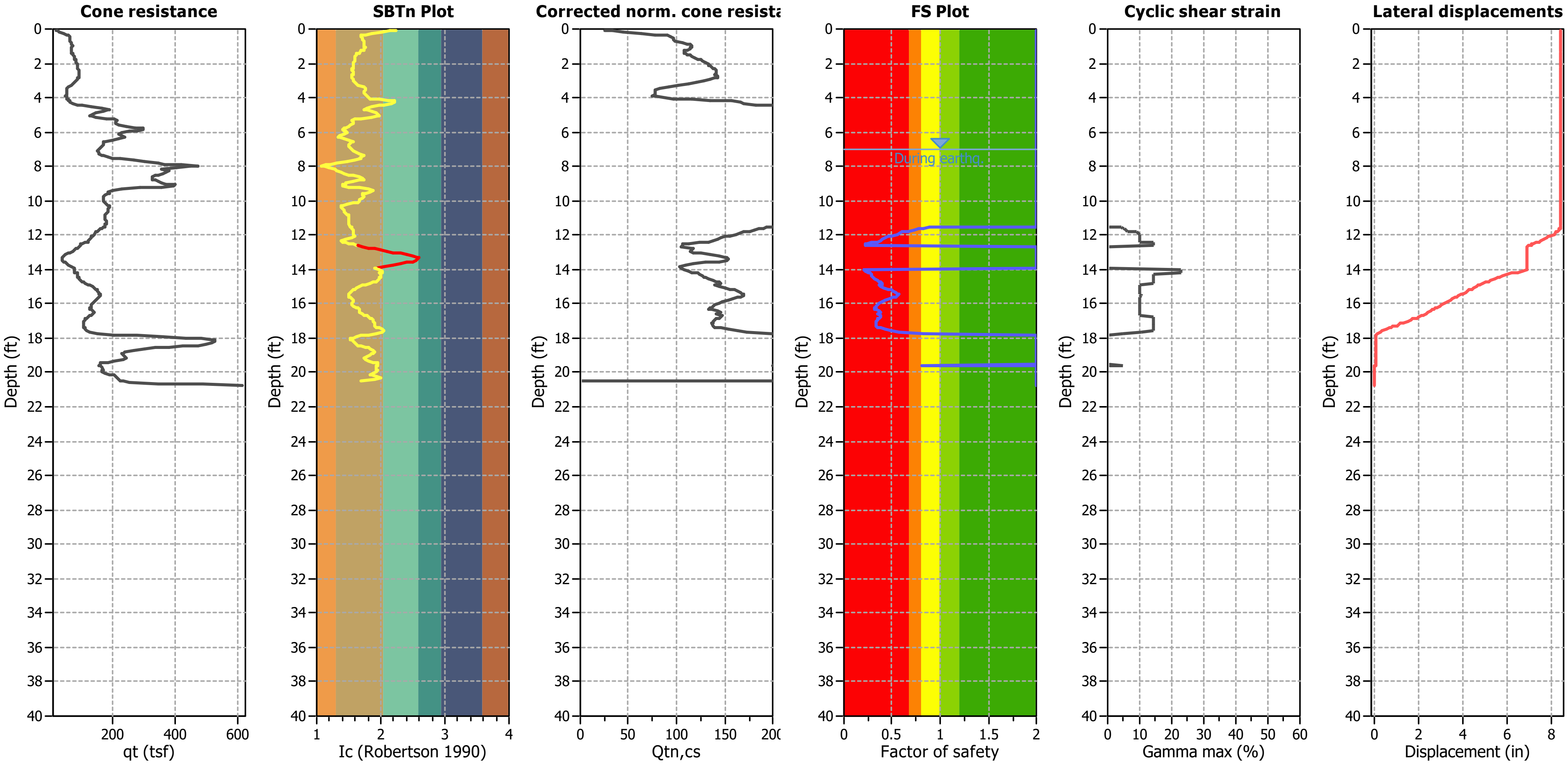


Abbreviations

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

Estimation of post-earthquake lateral Displacements

Geometric parameters: Gently sloping ground without free face (Slope 1.00 %)

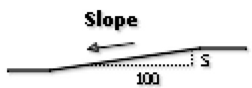


Abbreviations

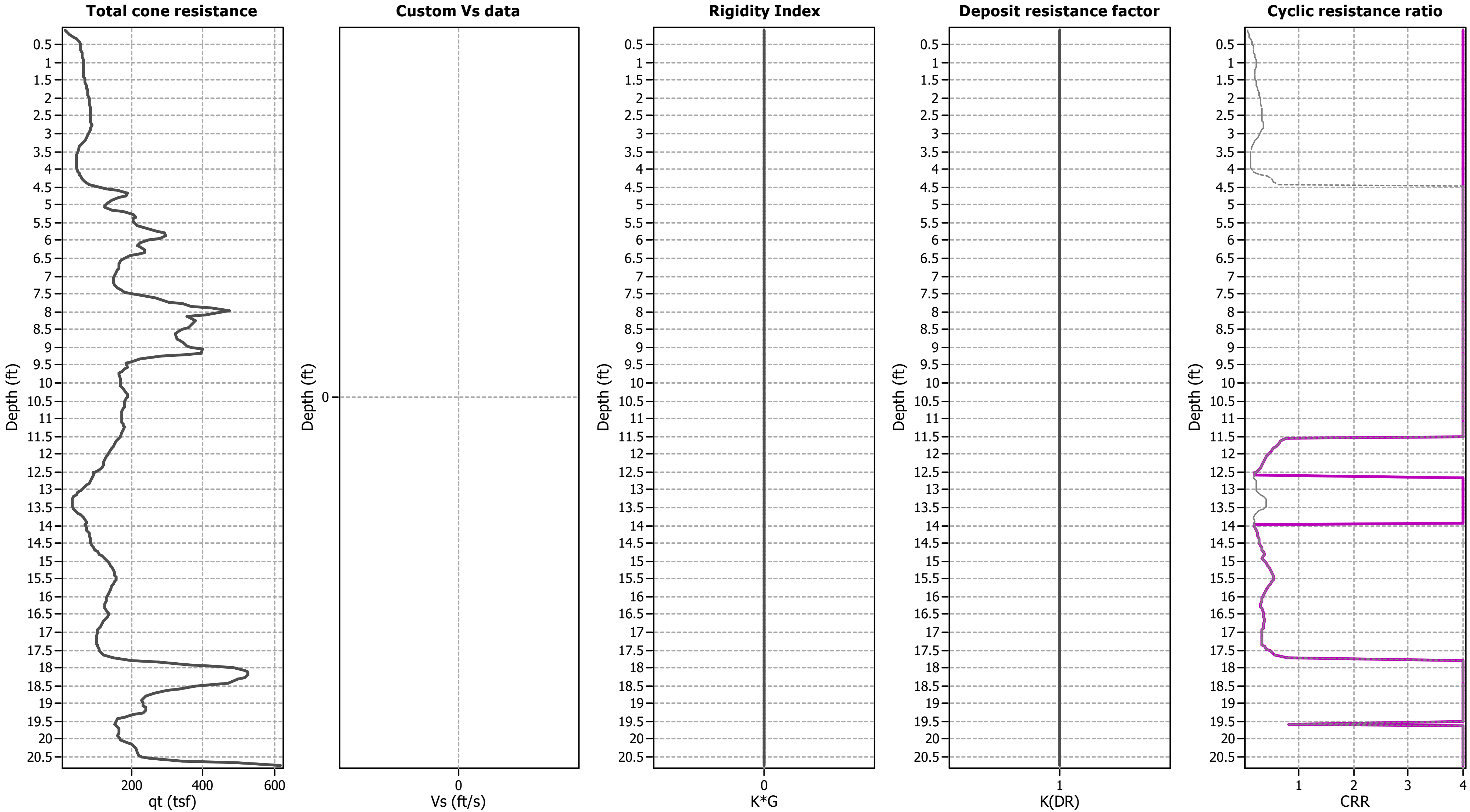
q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance

F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

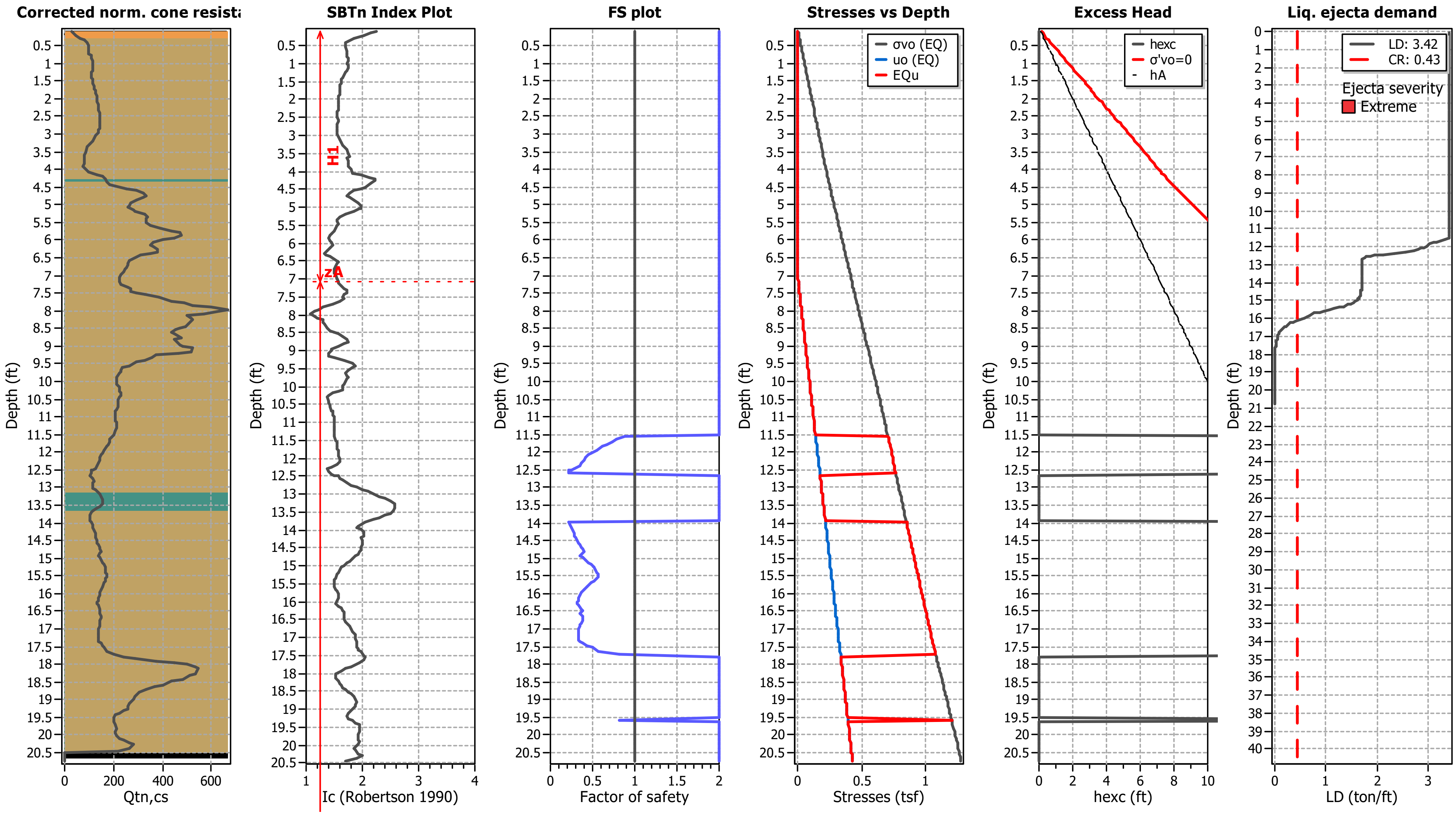
Surface condition



Aging Calculation Estimation



Ejecta Severity Estimation



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

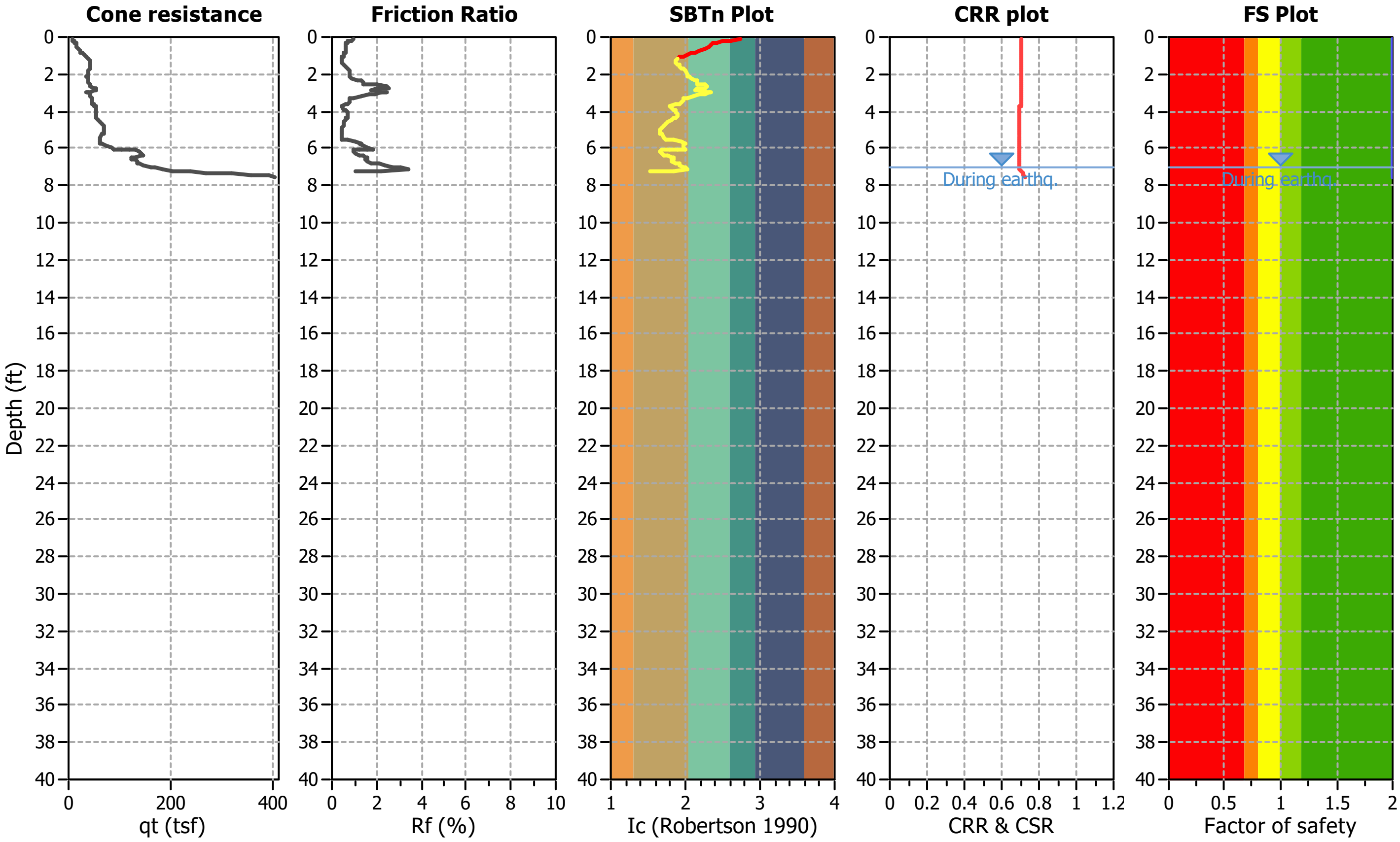
LIQUEFACTION ANALYSIS REPORT

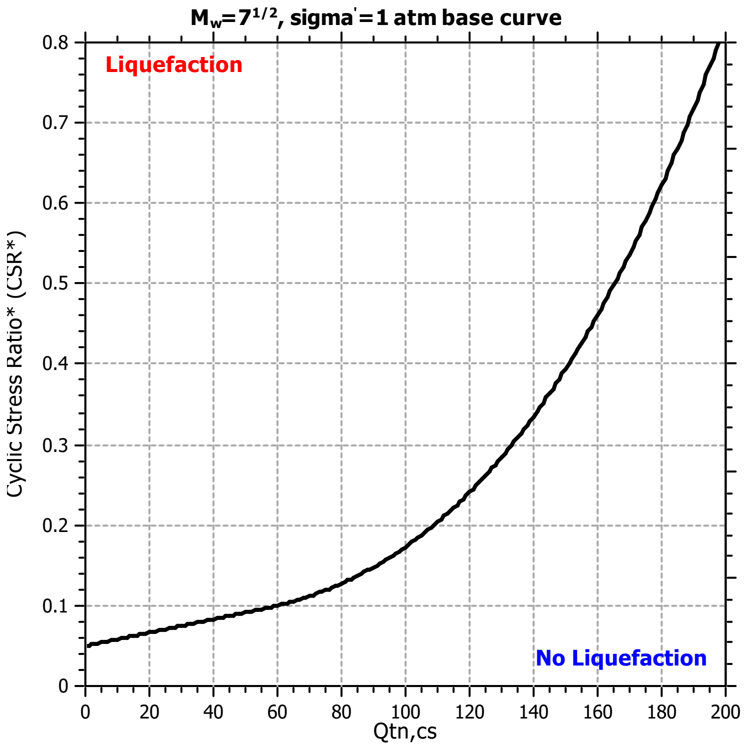
Project title : Petra Geosciences / Apple Canyon **Location : Lake Hemet, CA**

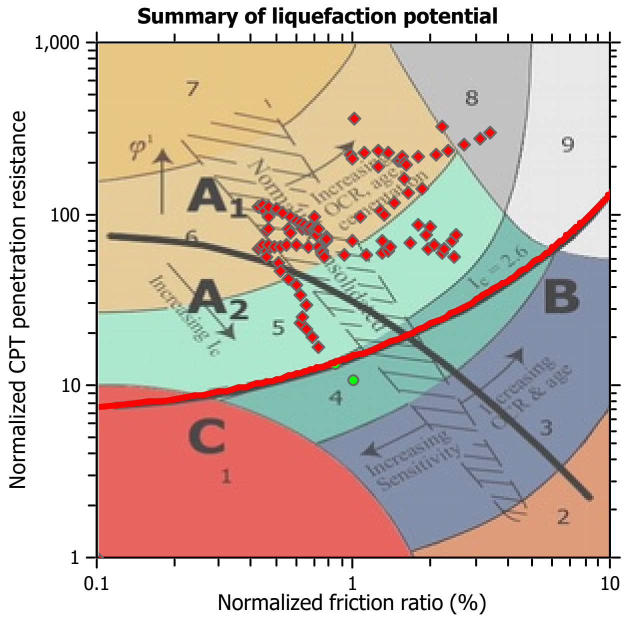
CPT file : CPT-12

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	12.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	8.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.89	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

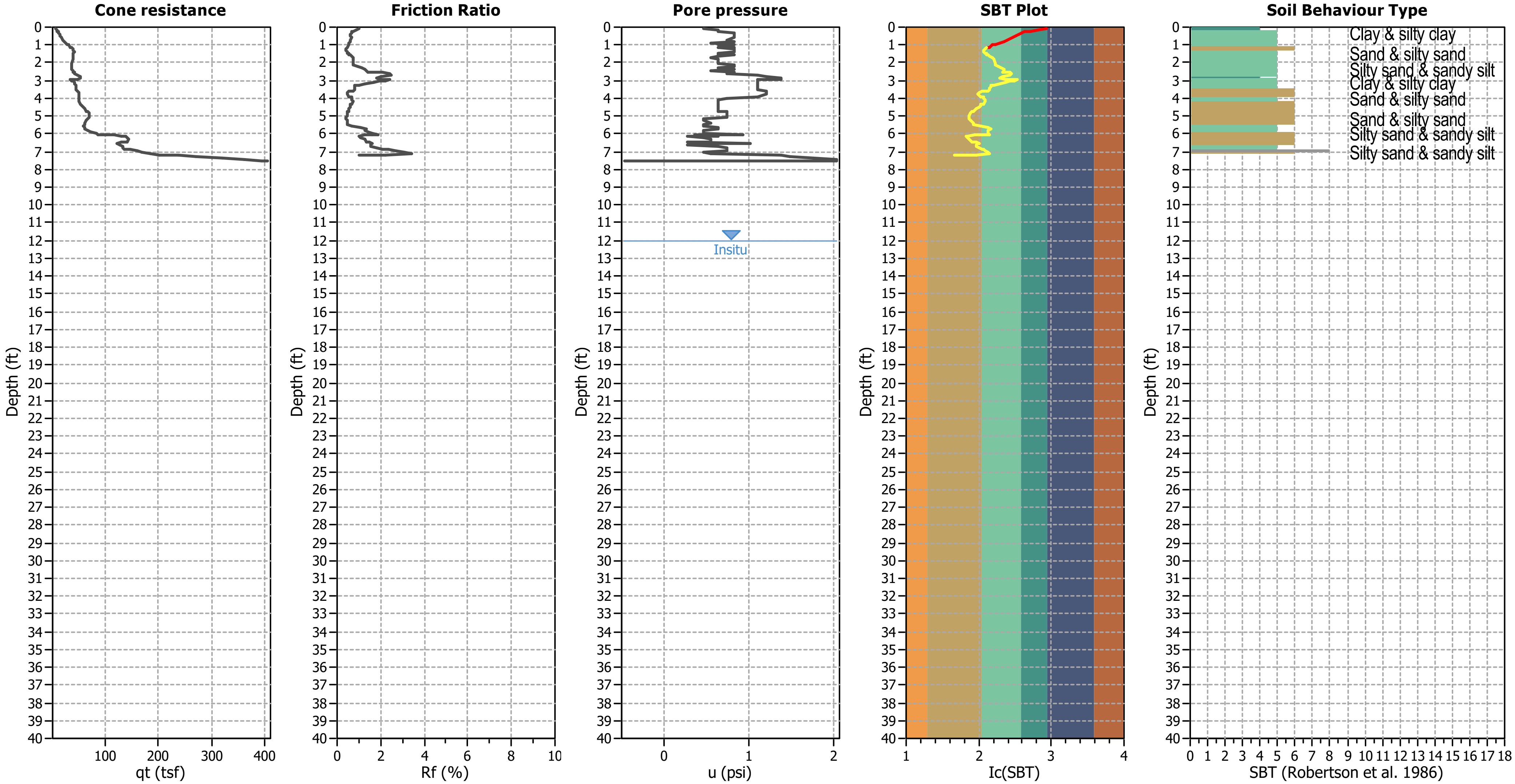






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



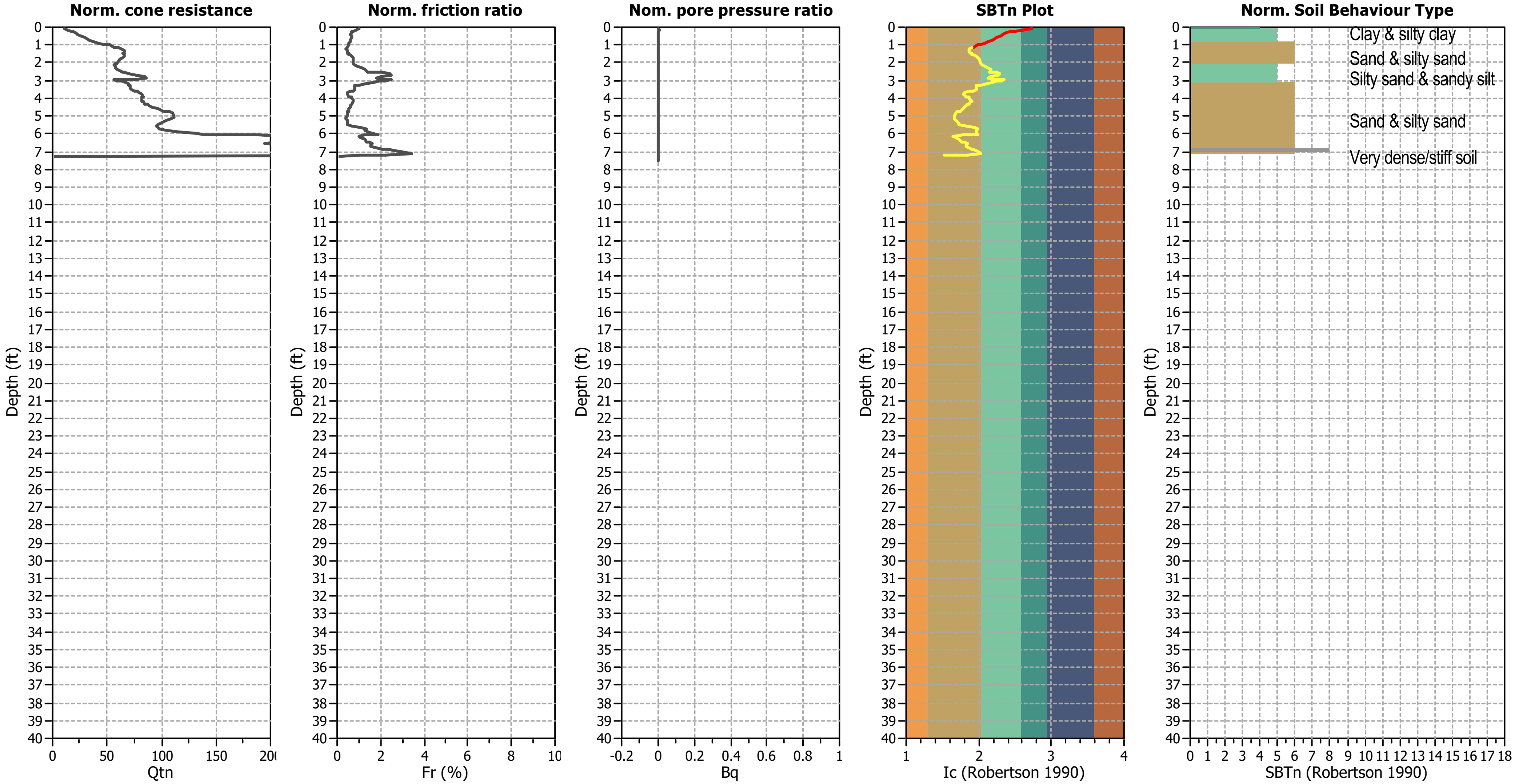
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

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)



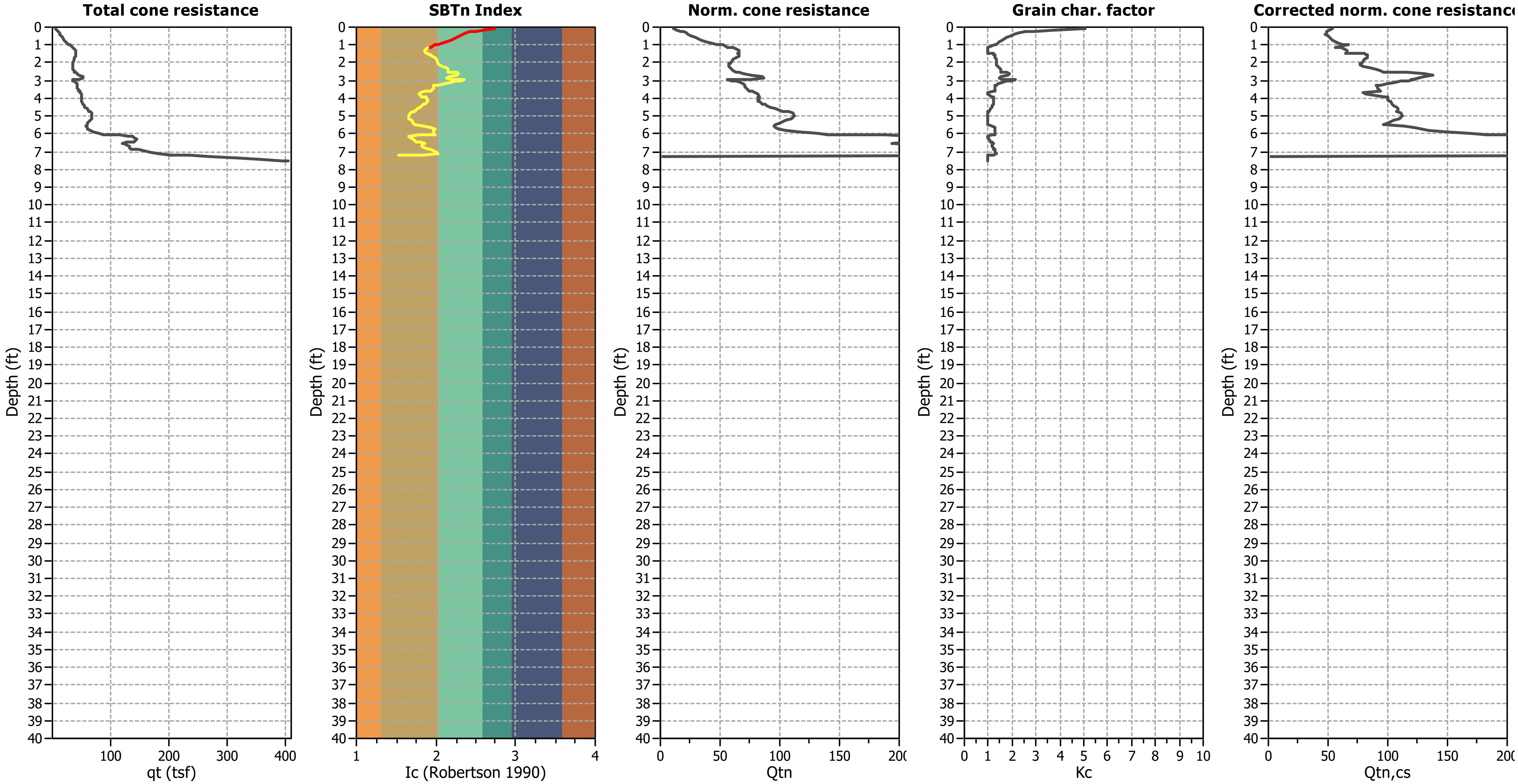
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

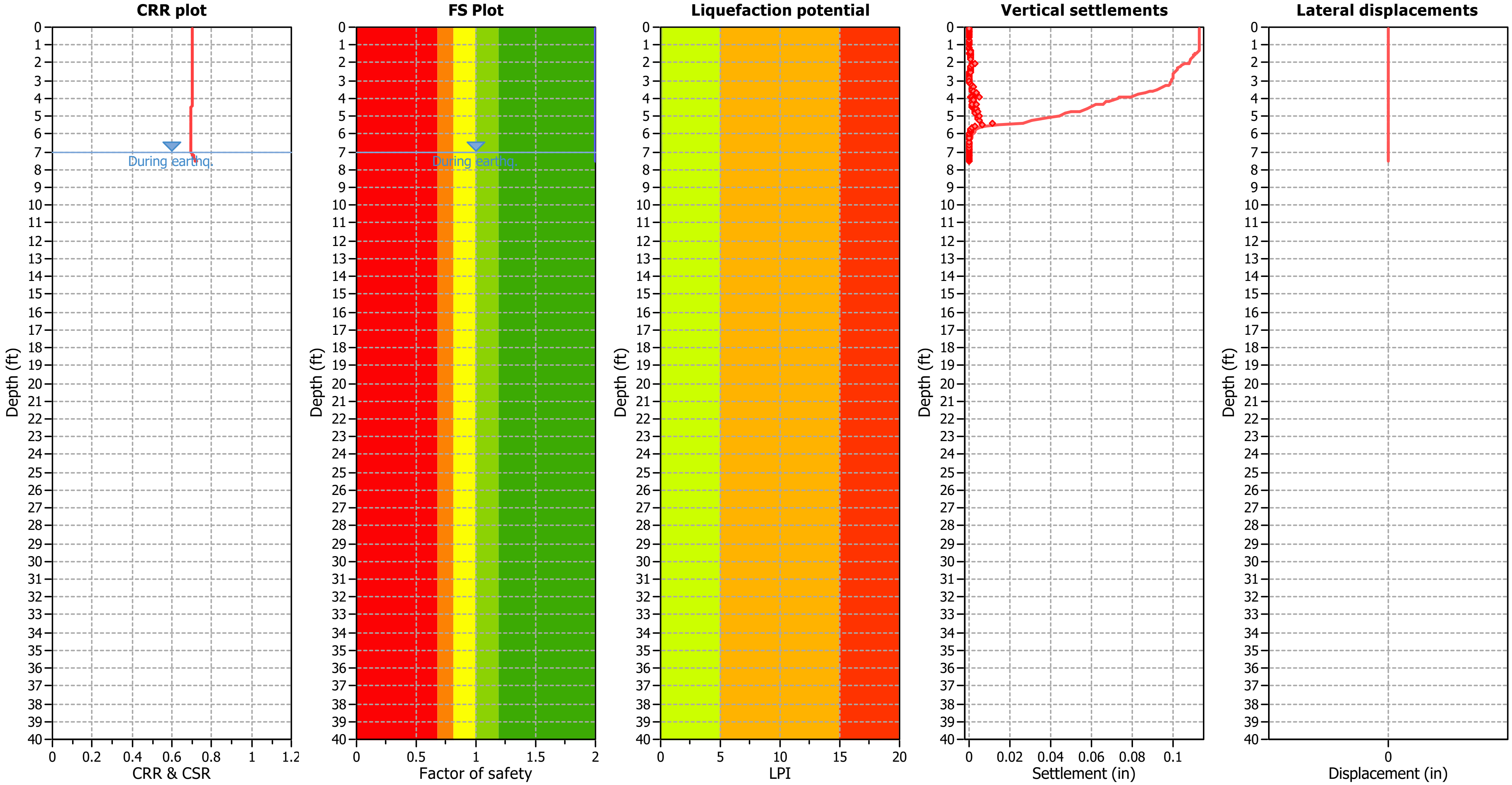
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

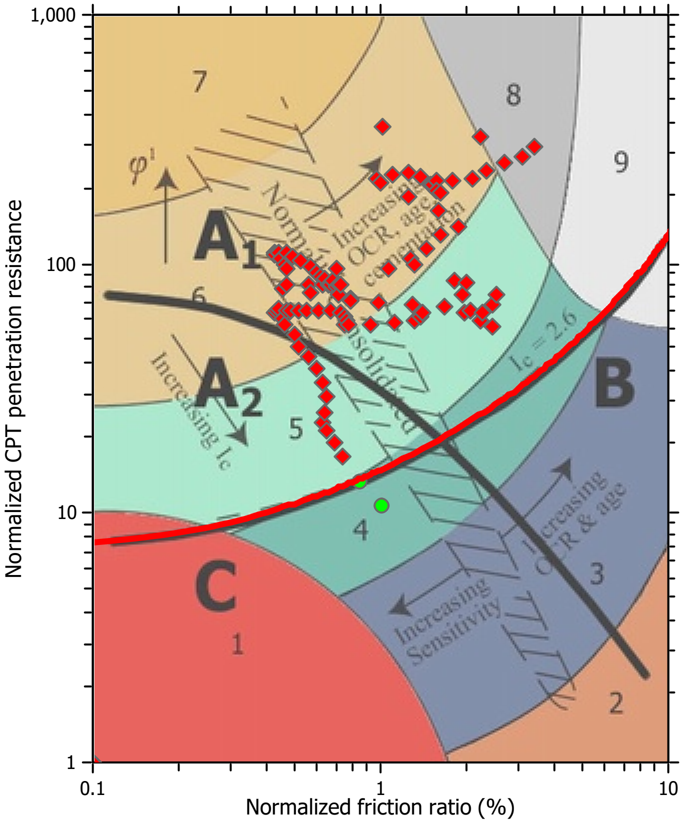
F.S. color scheme

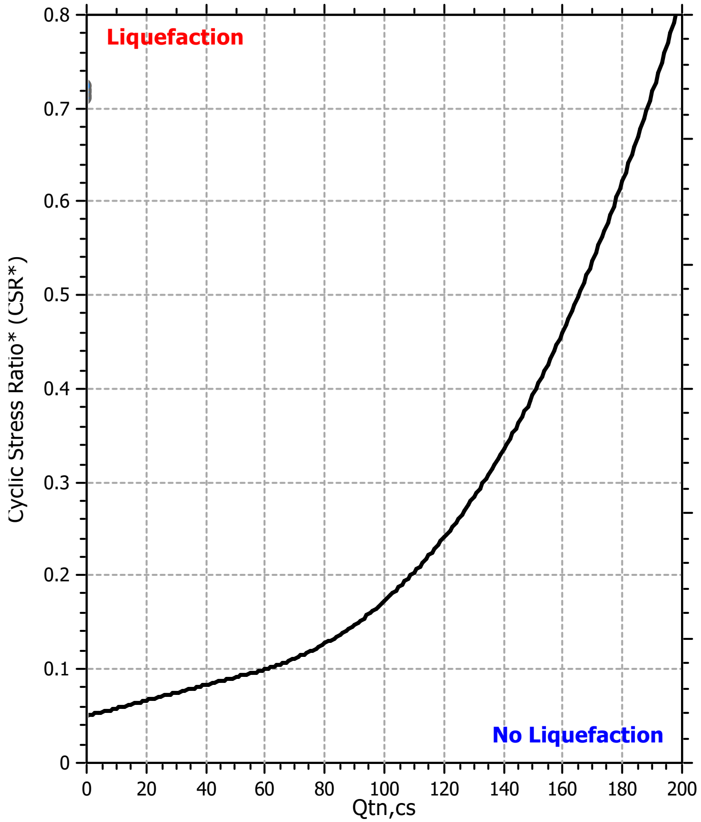
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

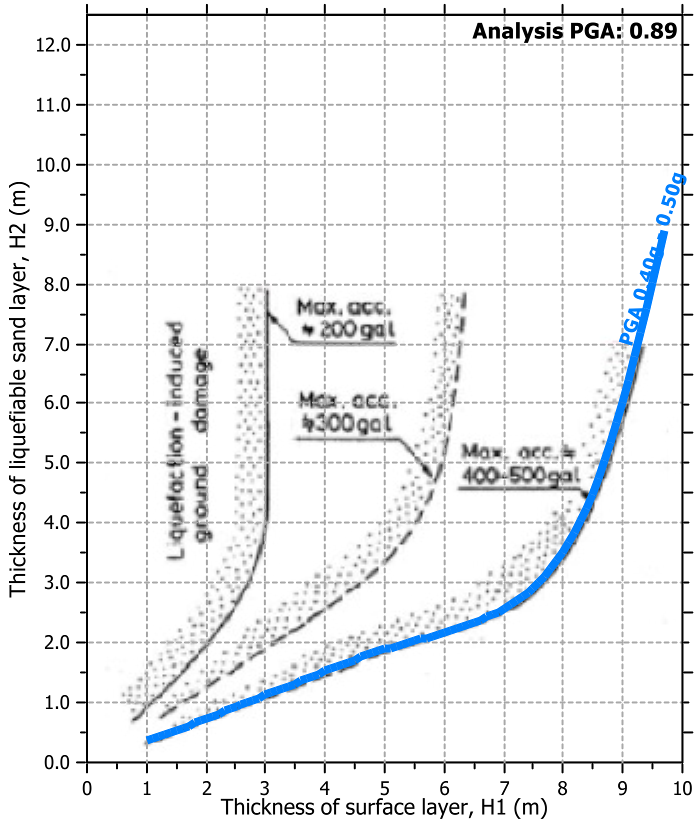
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



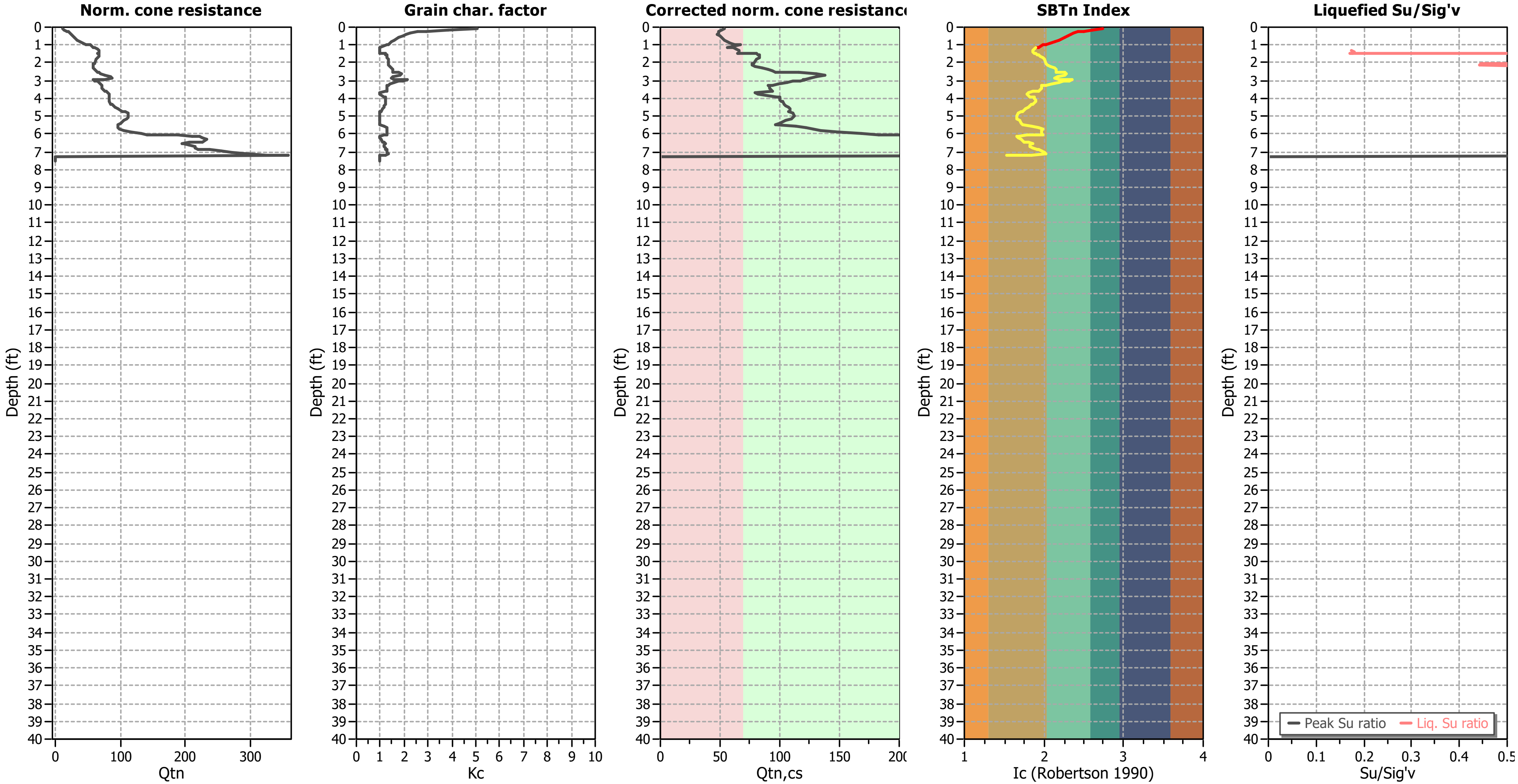




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

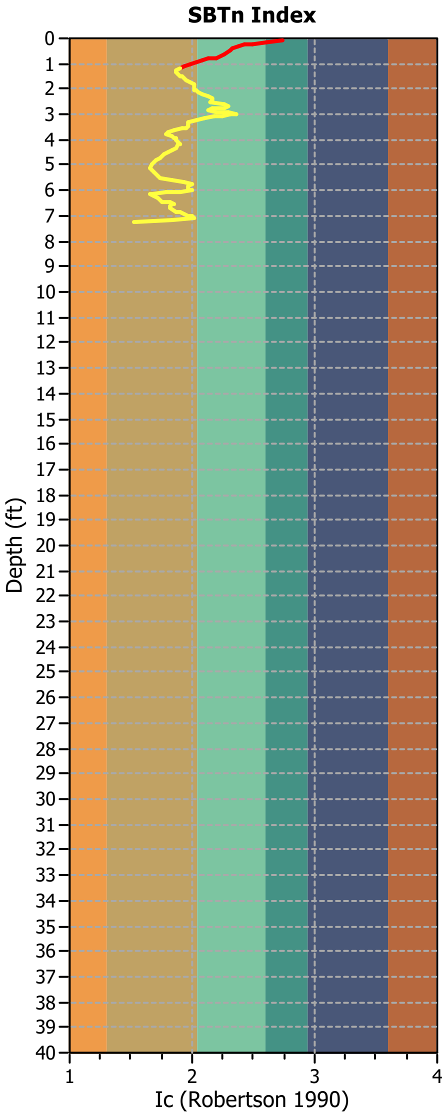
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

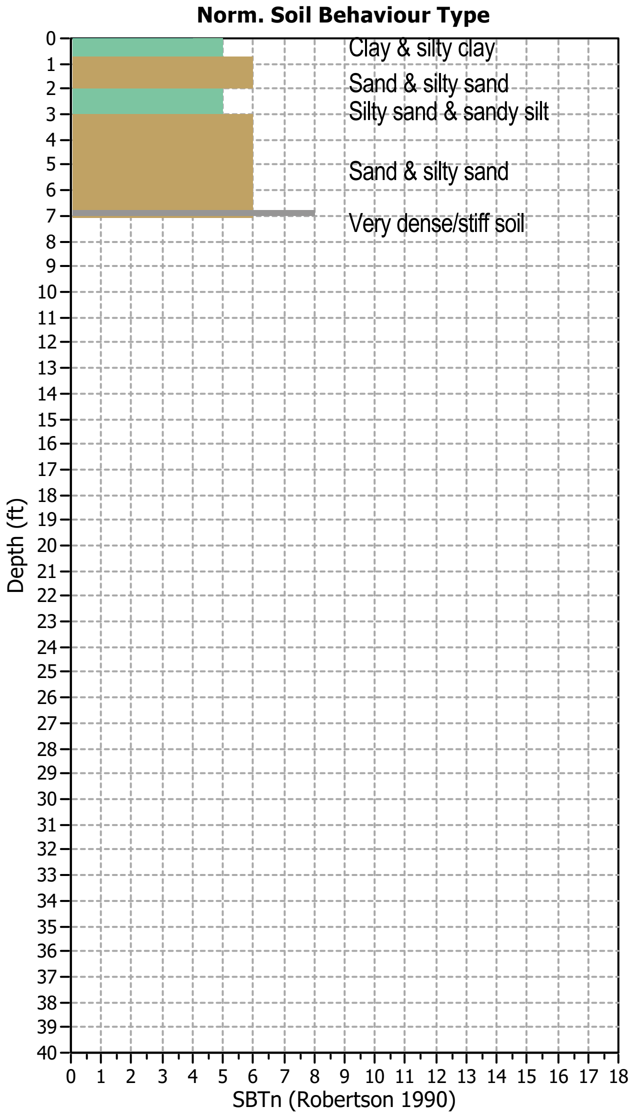
TRANSITION LAYER DETECTION ALGORITHM REPORT
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between 1.80 < I_c < 3.0) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.





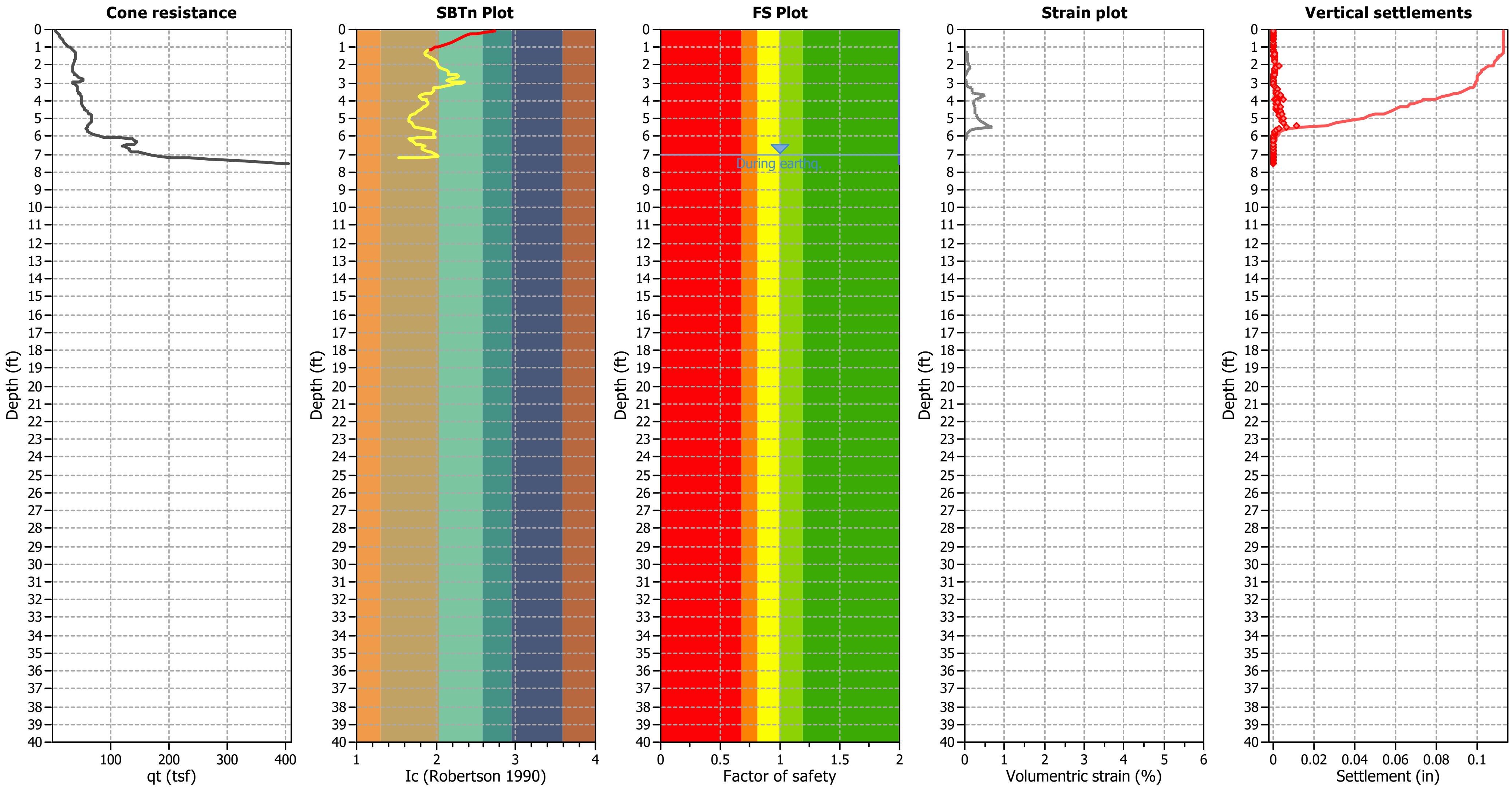
Transition layer algorithm properties

I_c minimum check value:	1.70
I_c maximum check value:	3.00
I_c change ratio value:	0.0250
Minimum number of points in layer:	4

General statistics

Total points in CPT file:	108
Total points excluded:	16
Exclusion percentage:	14.81%
Number of layers detected:	1

Estimation of post-earthquake settlements

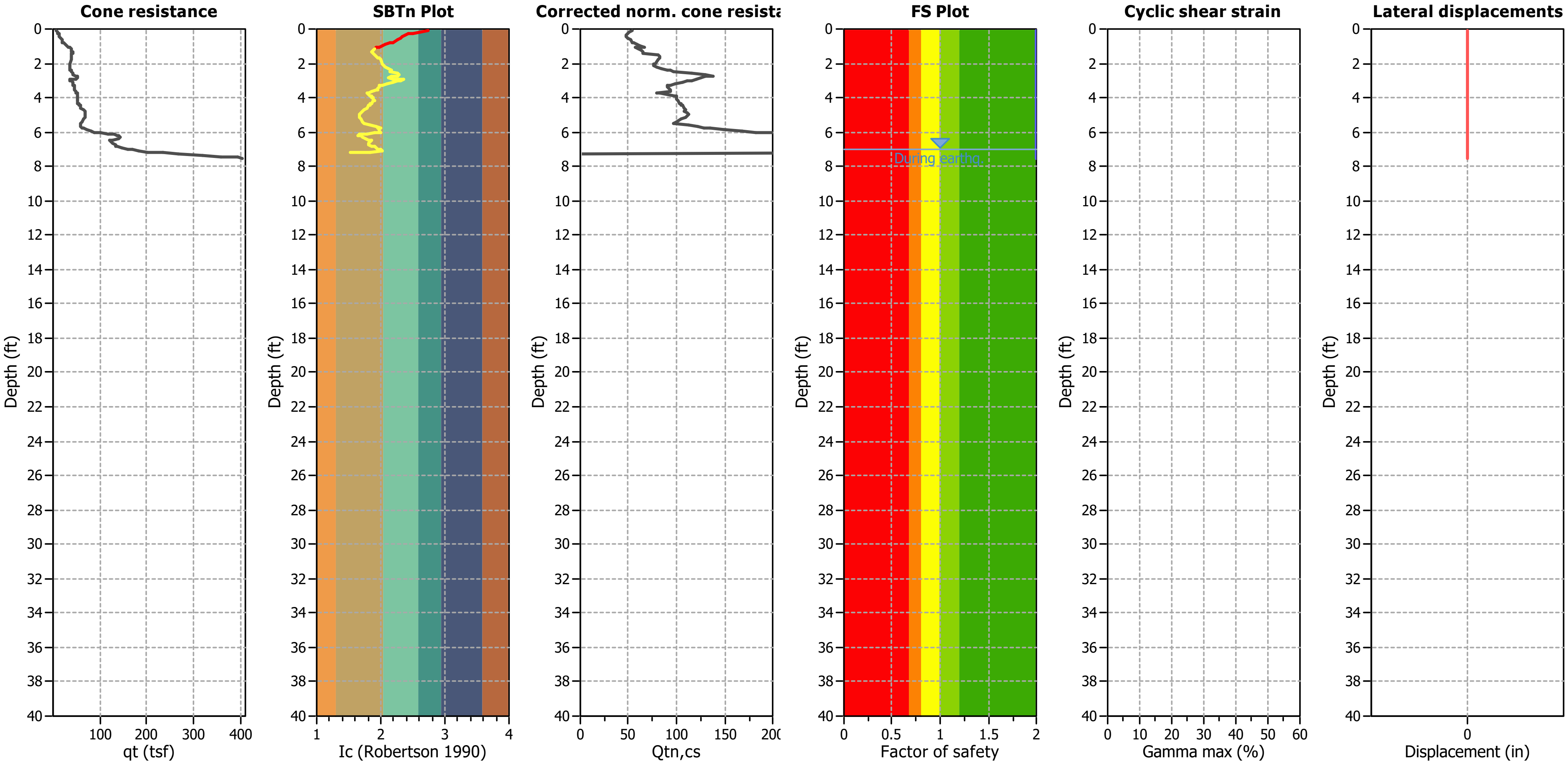


Abbreviations

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

Estimation of post-earthquake lateral Displacements

Geometric parameters: Gently sloping ground without free face (Slope 1.00 %)

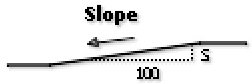


Abbreviations

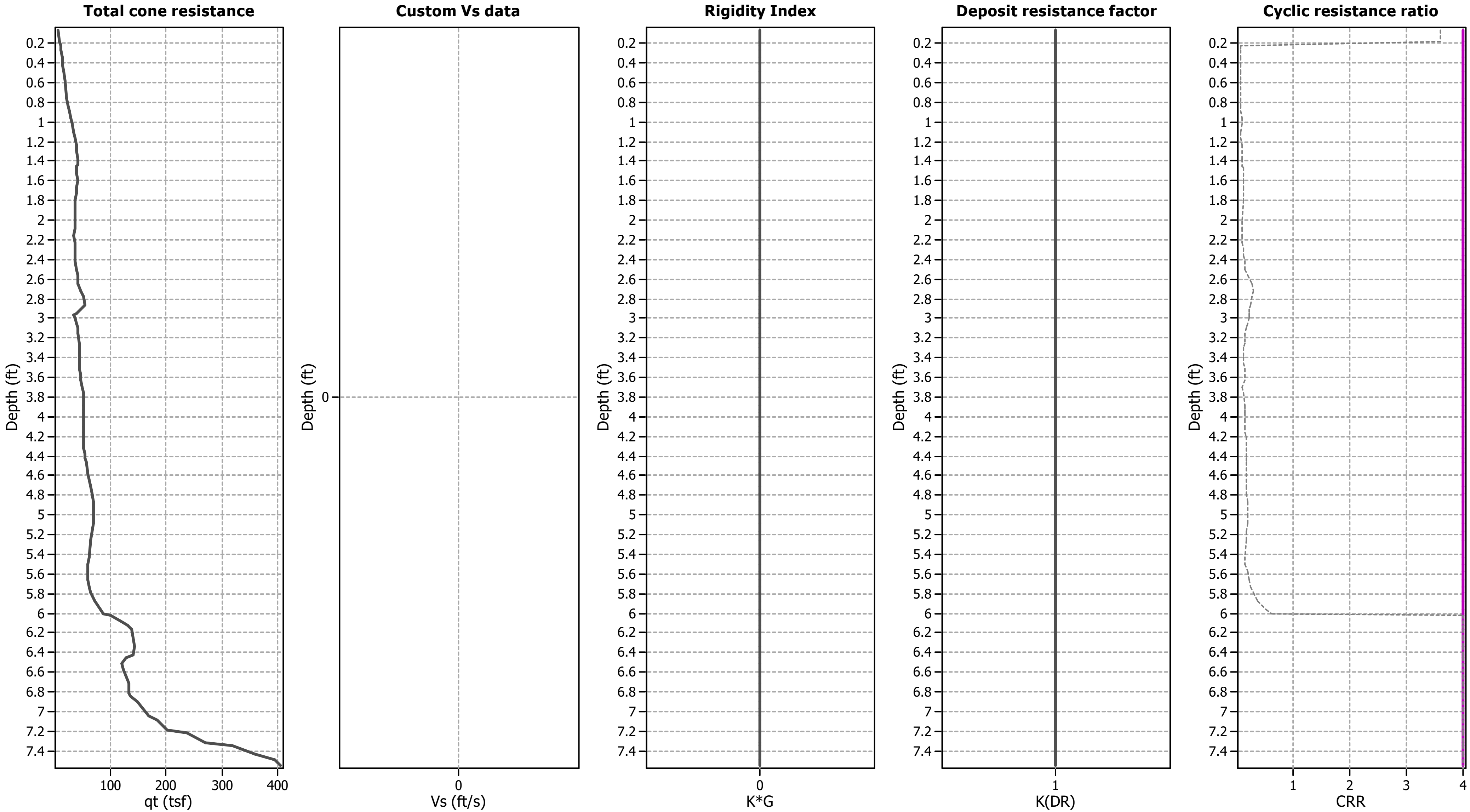
q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance

F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

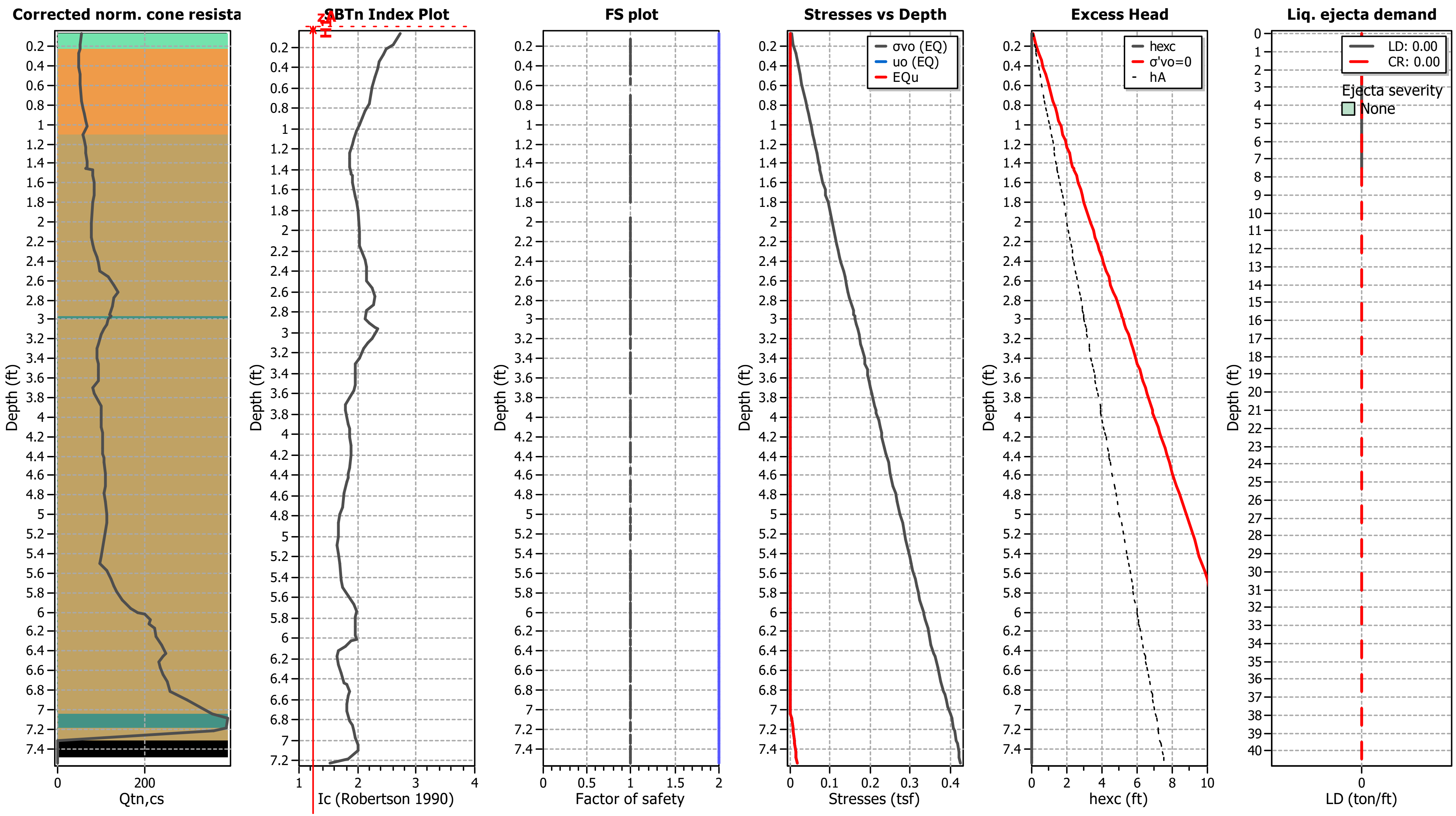
Surface condition



Aging Calculation Estimation



Ejecta Severity Estimation



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

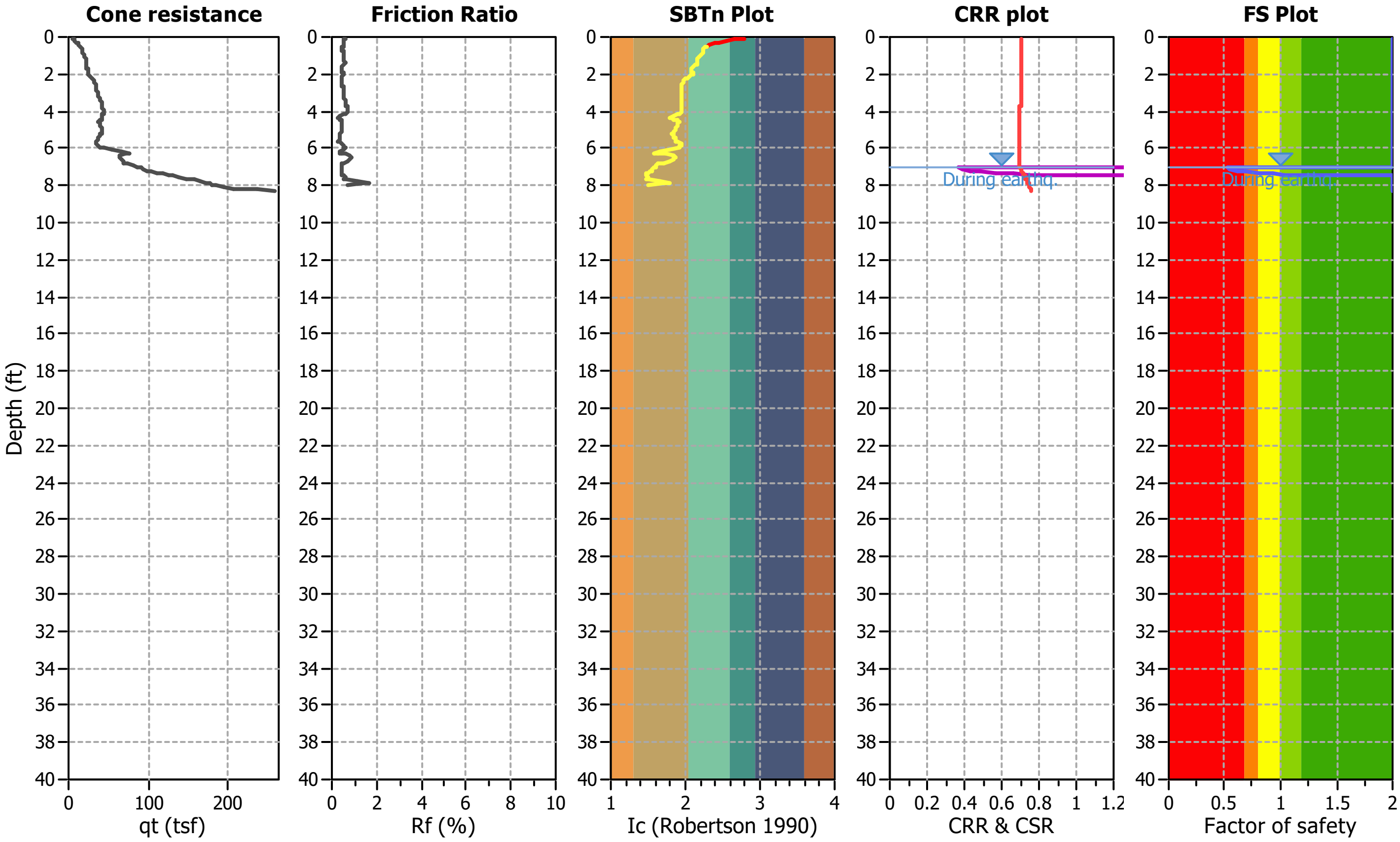
LIQUEFACTION ANALYSIS REPORT

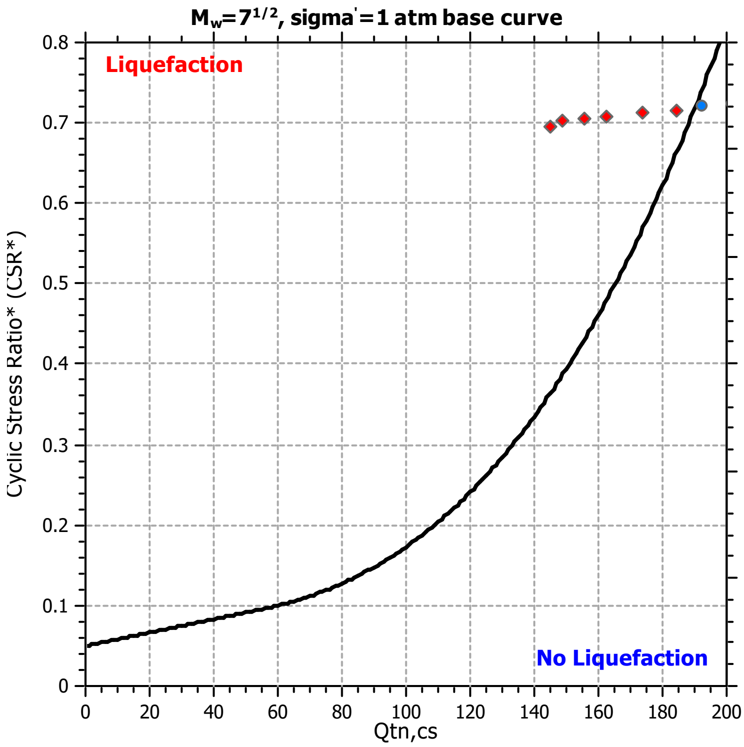
Project title : Petra Geosciences / Apple Canyon **Location : Lake Hemet, CA**

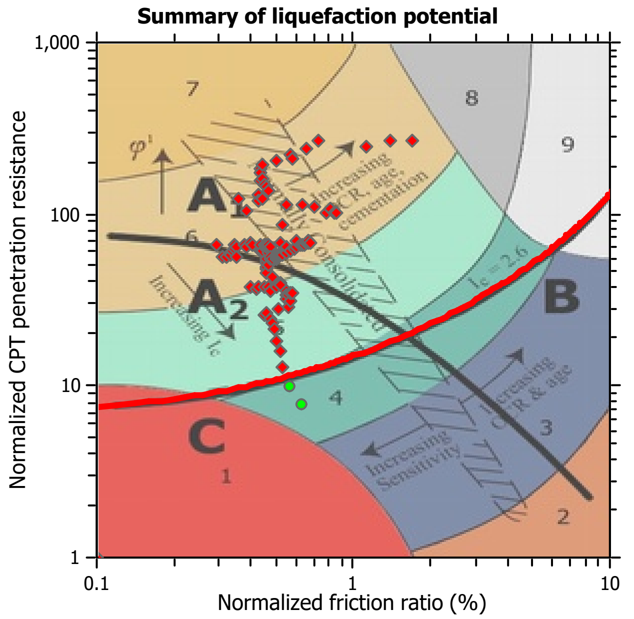
CPT file : CPT-12A

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	12.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	8.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.89	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

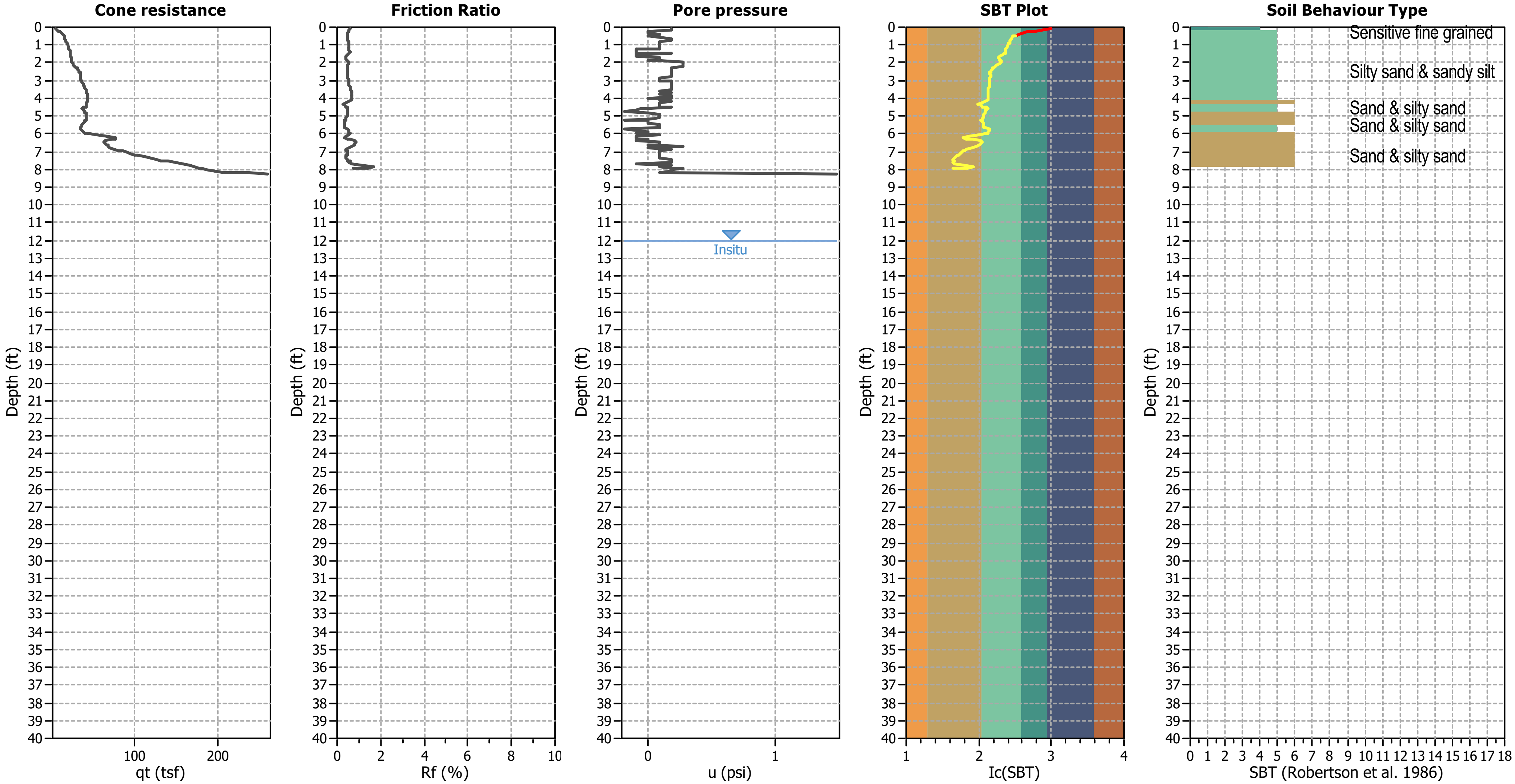






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



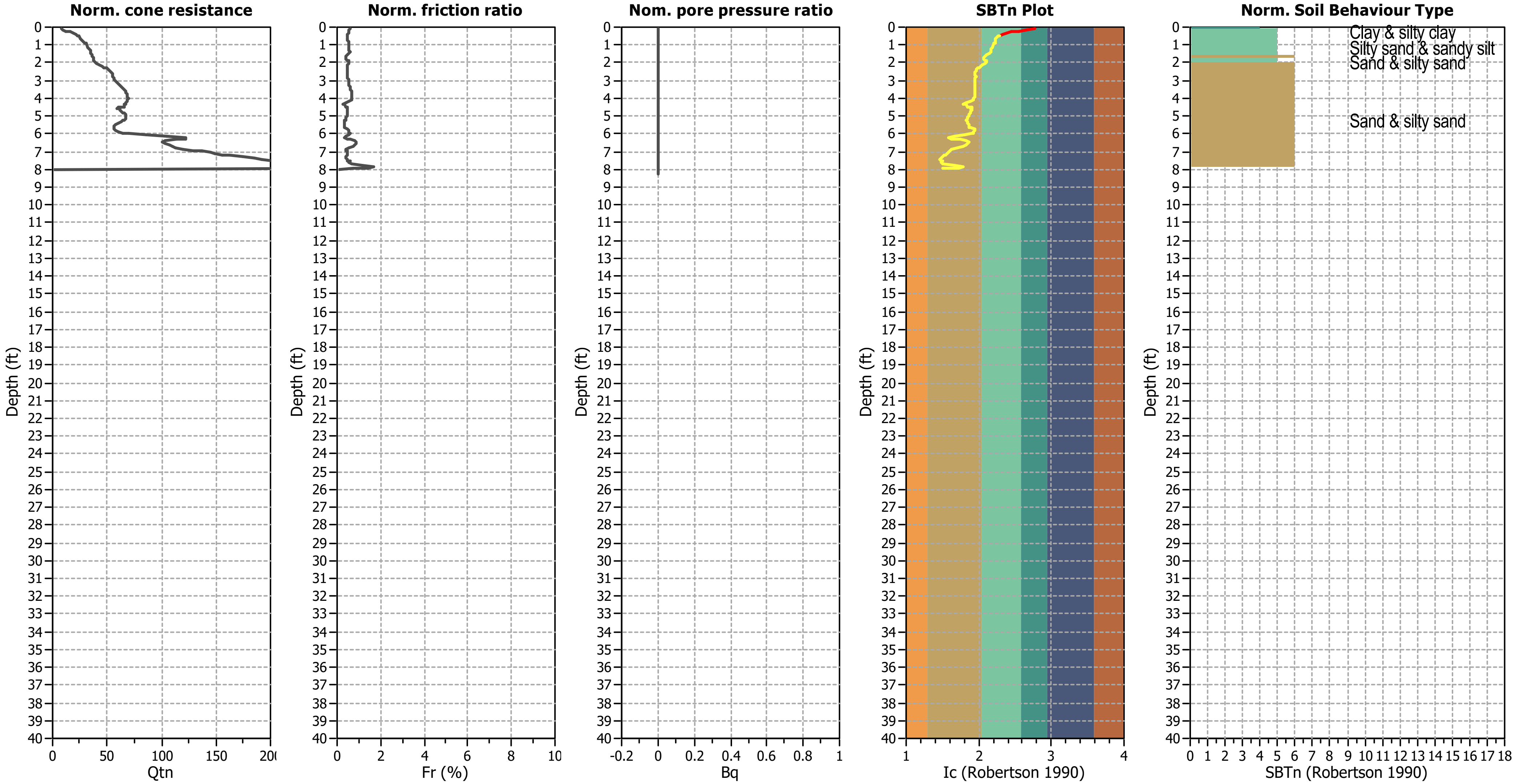
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT 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

CPT basic interpretation plots (normalized)



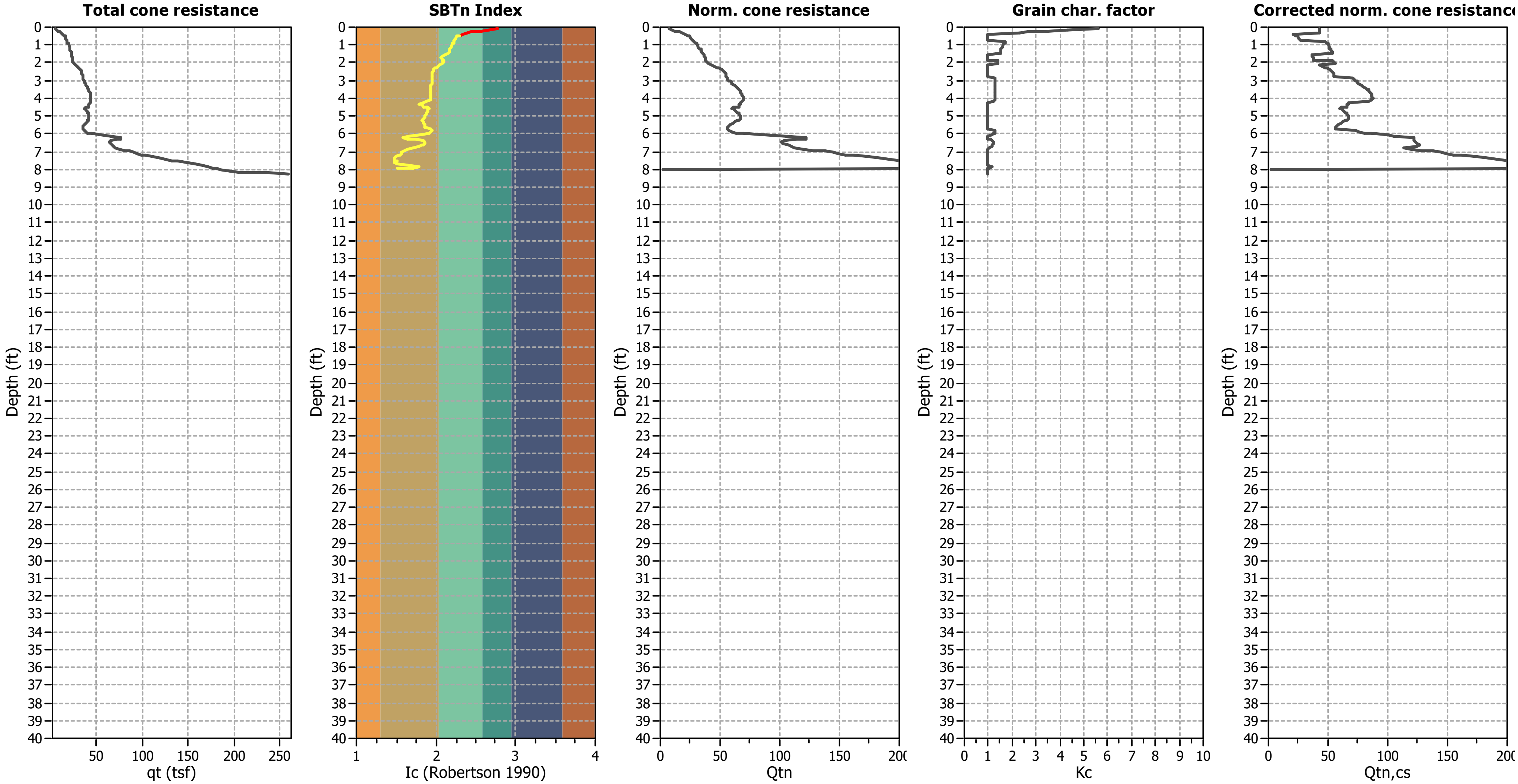
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

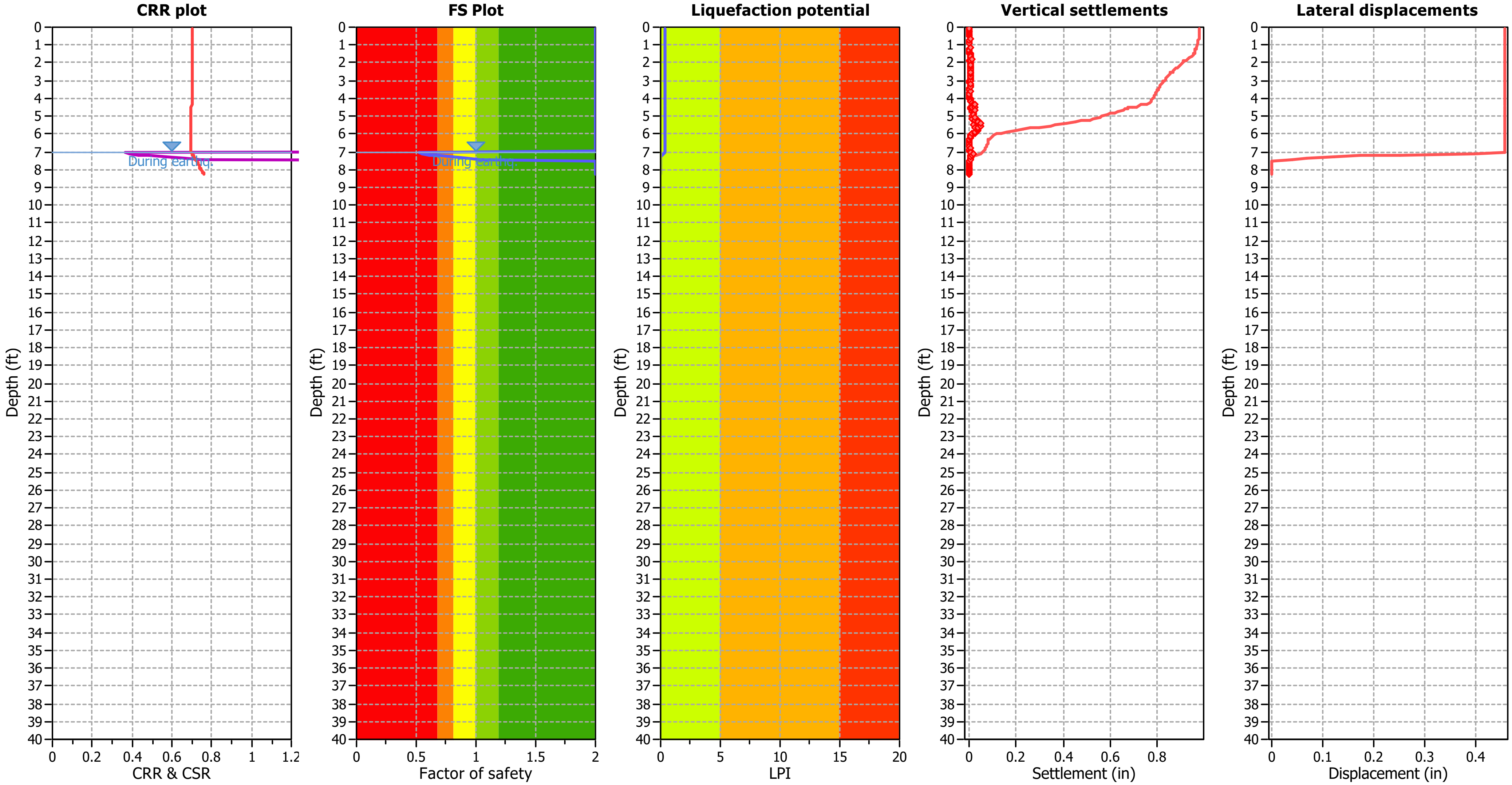
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

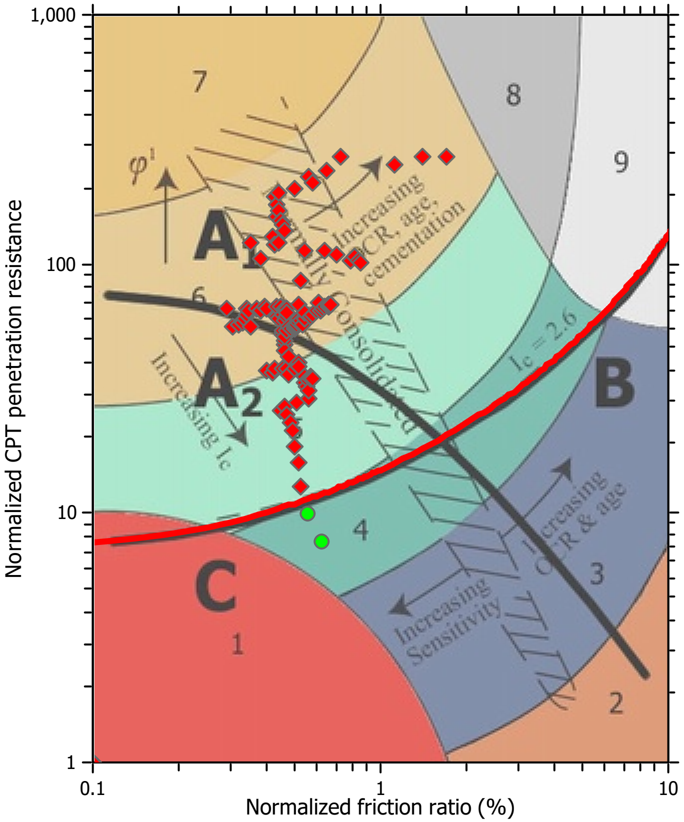
F.S. color scheme

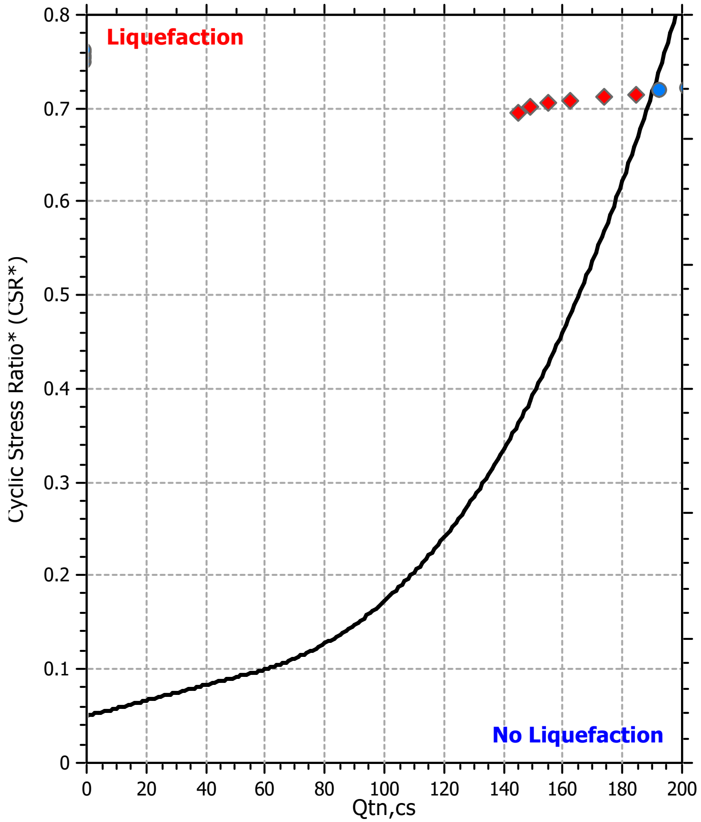
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

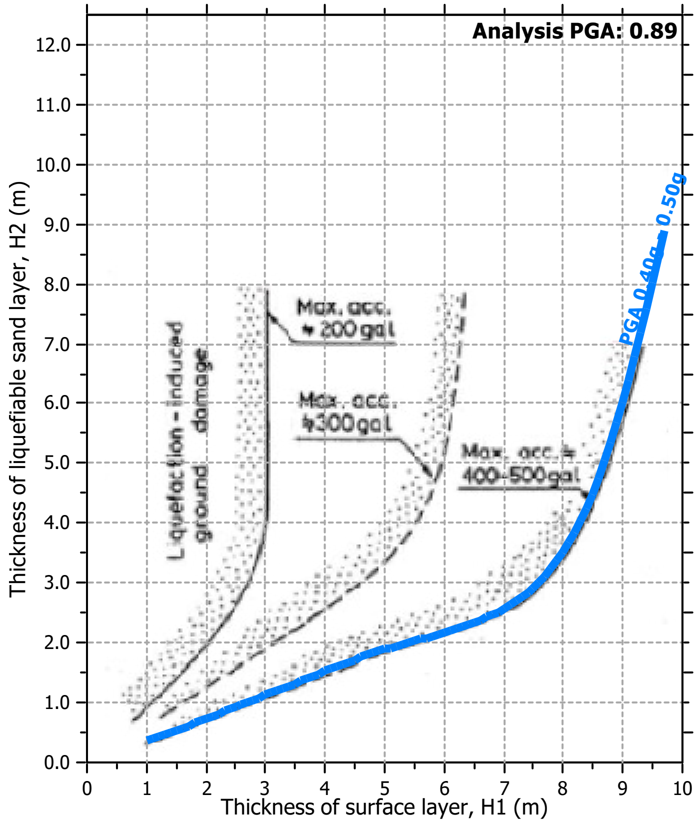
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



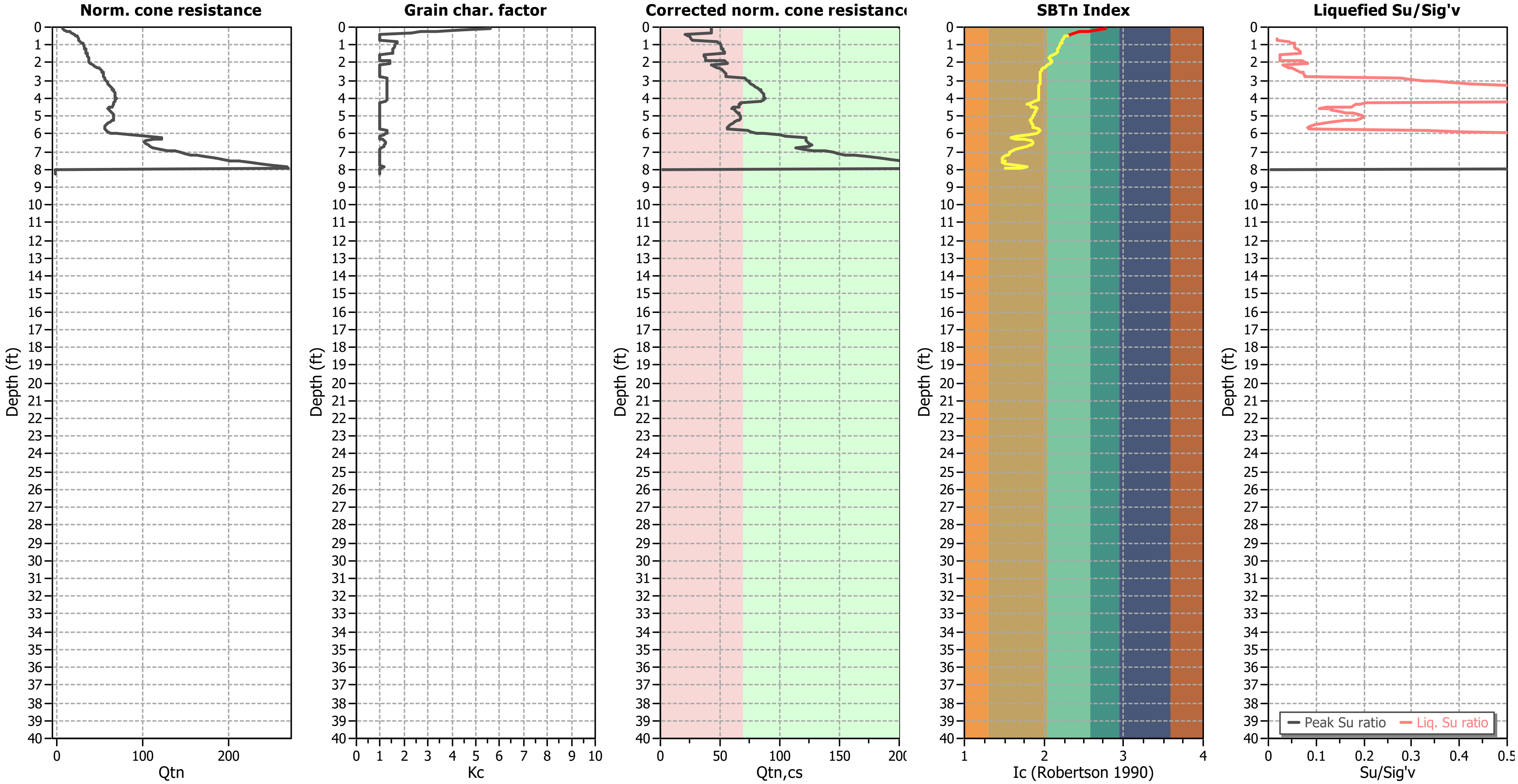




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

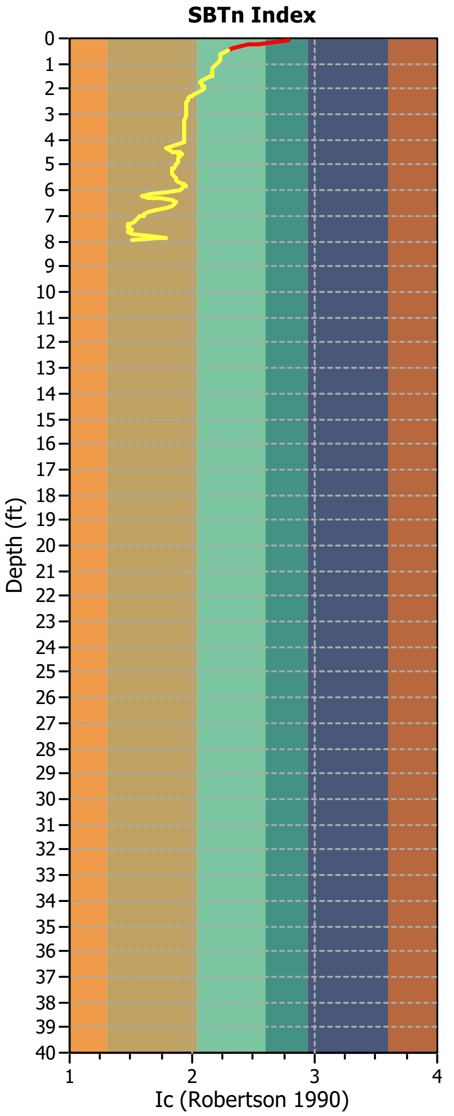
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

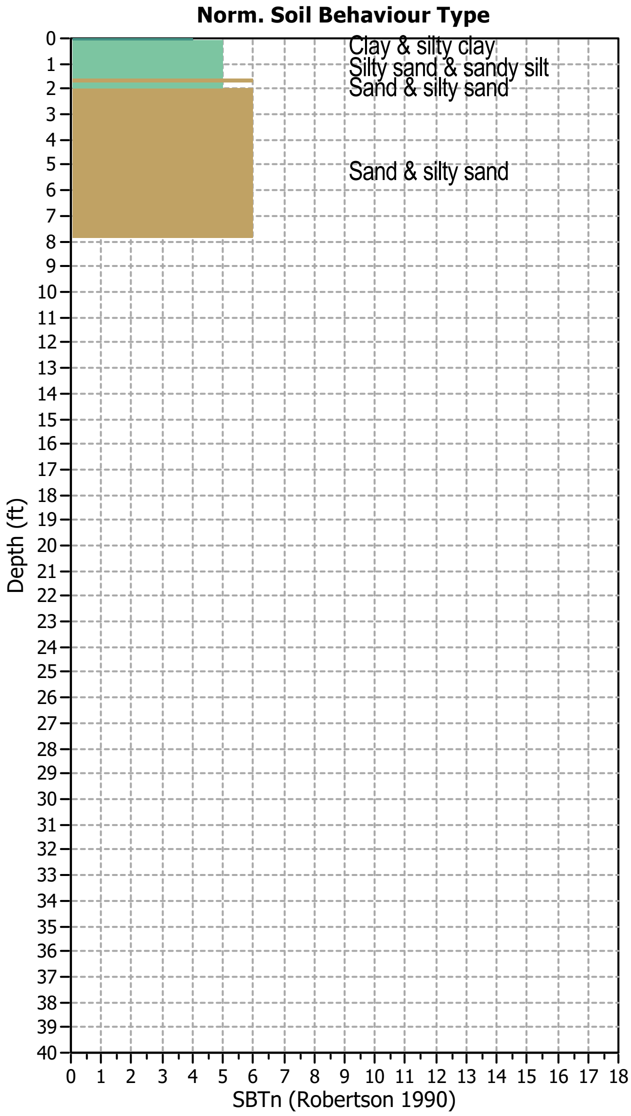
TRANSITION LAYER DETECTION ALGORITHM REPORT
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between 1.80 < I_c < 3.0) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.





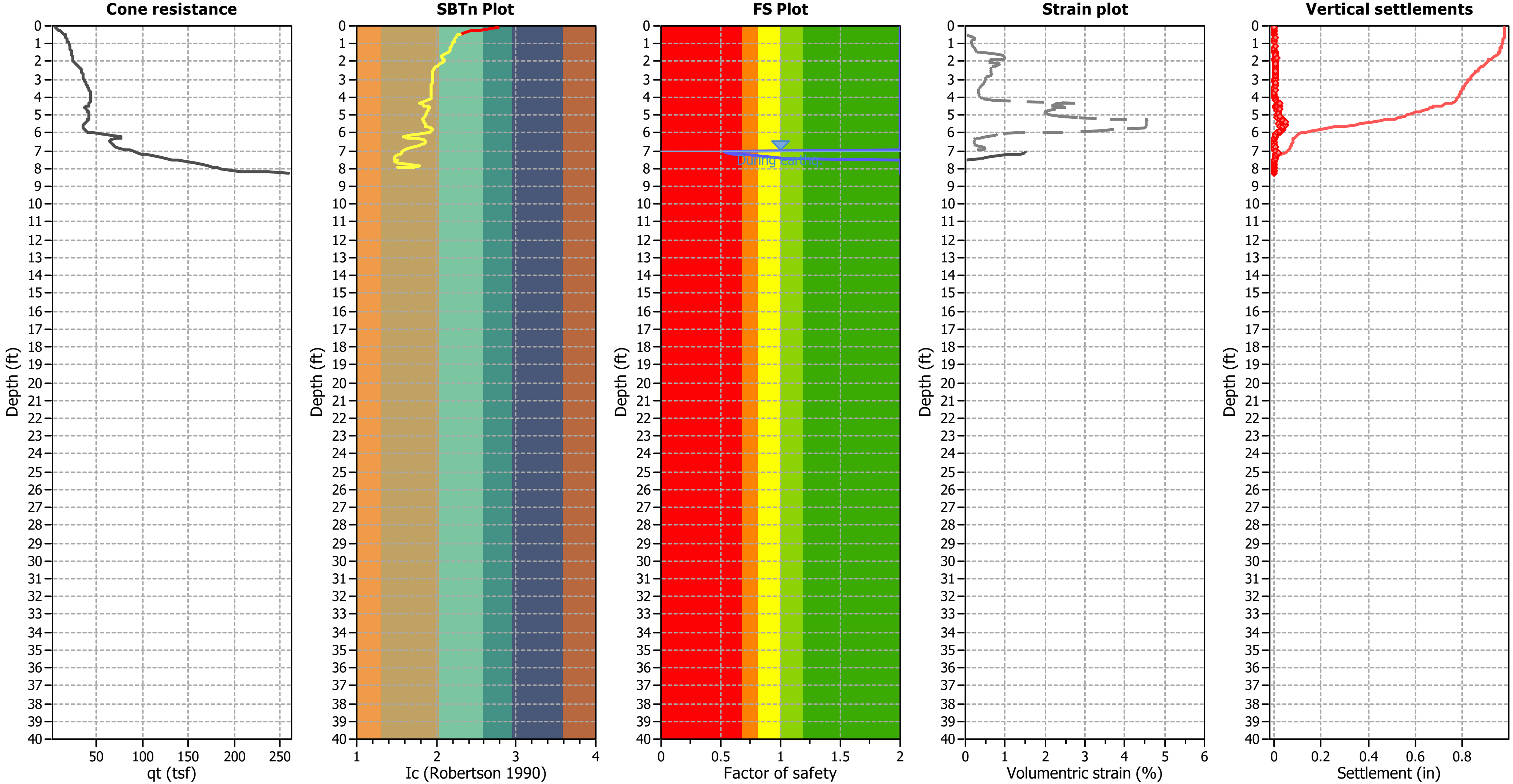
Transition layer algorithm properties

I_c minimum check value:	1.70
I_c maximum check value:	3.00
I_c change ratio value:	0.0250
Minimum number of points in layer:	4

General statistics

Total points in CPT file:	124
Total points excluded:	8
Exclusion percentage:	6.45%
Number of layers detected:	1

Estimation of post-earthquake settlements

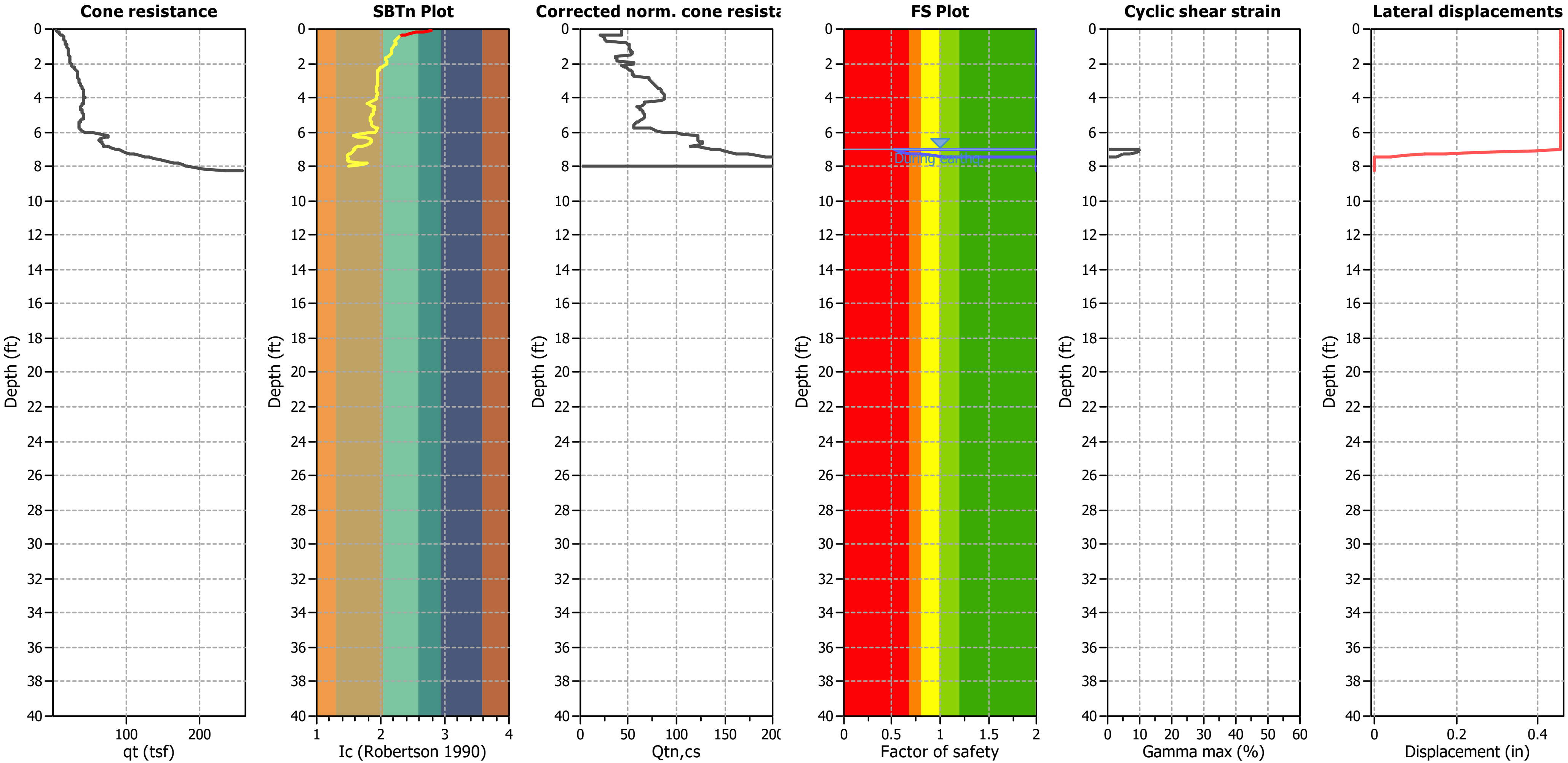


Abbreviations

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

Estimation of post-earthquake lateral Displacements

Geometric parameters: Gently sloping ground without free face (Slope 1.00 %)

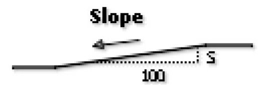


Abbreviations

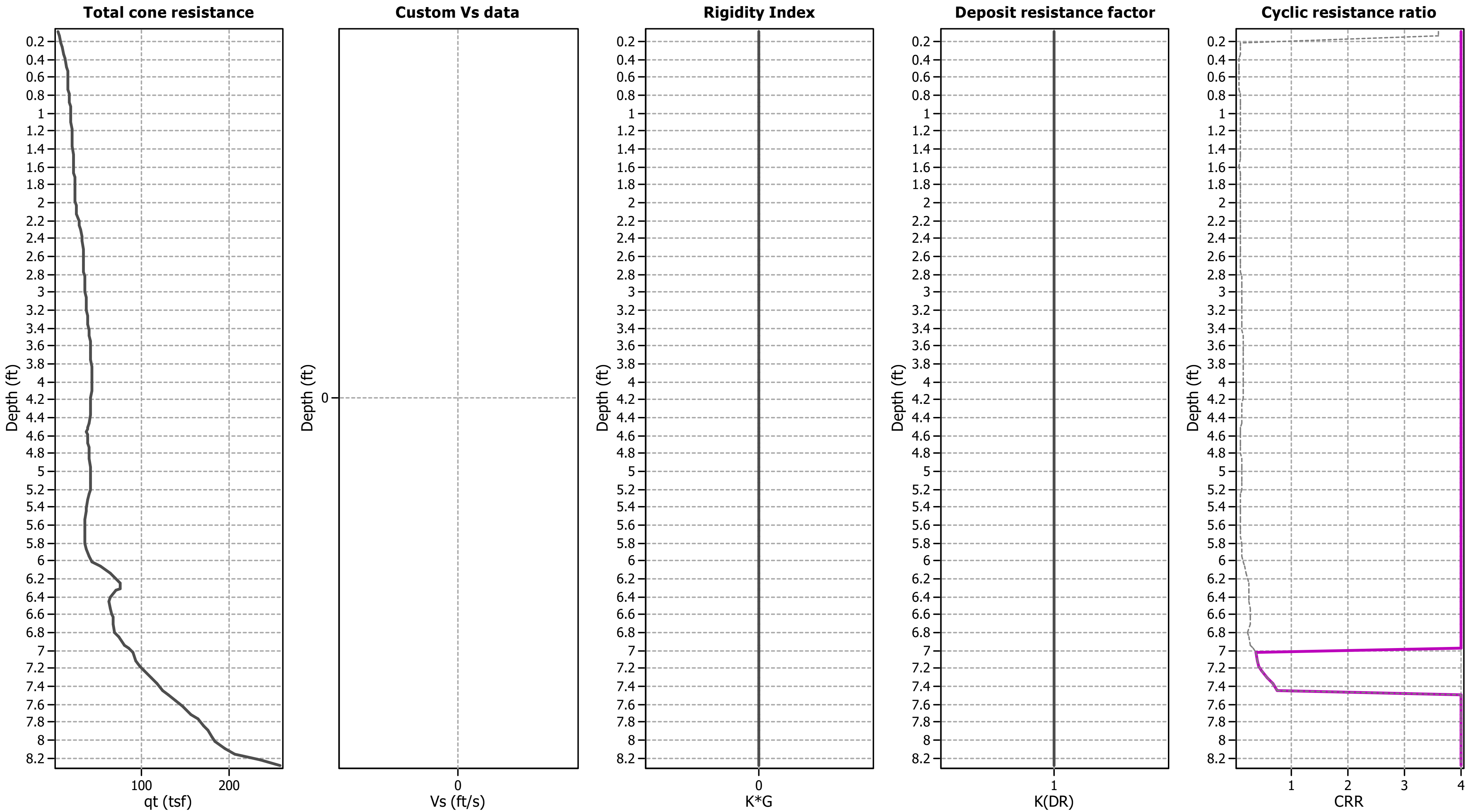
q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance

F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

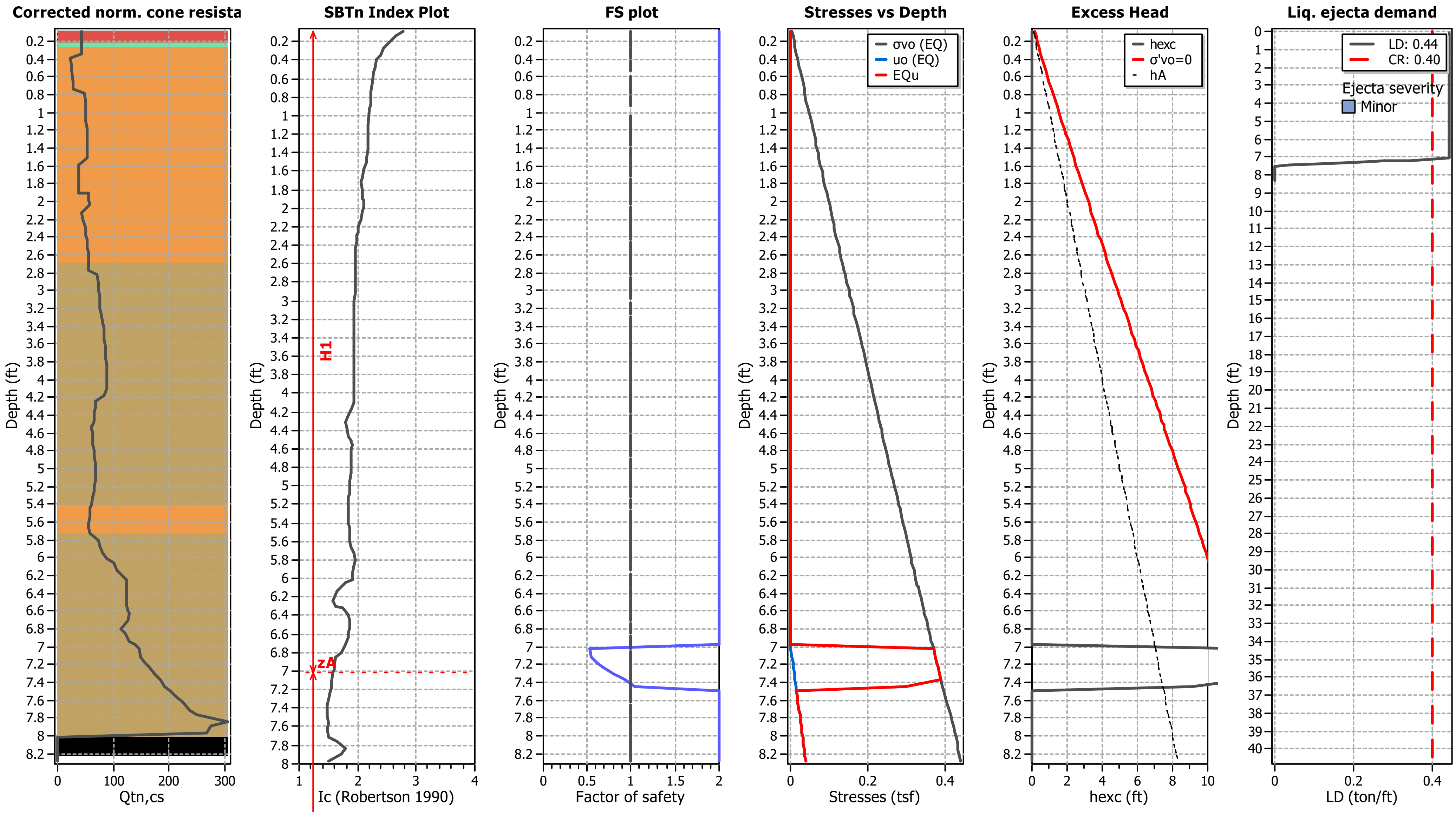
Surface condition



Aging Calculation Estimation



Ejecta Severity Estimation



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

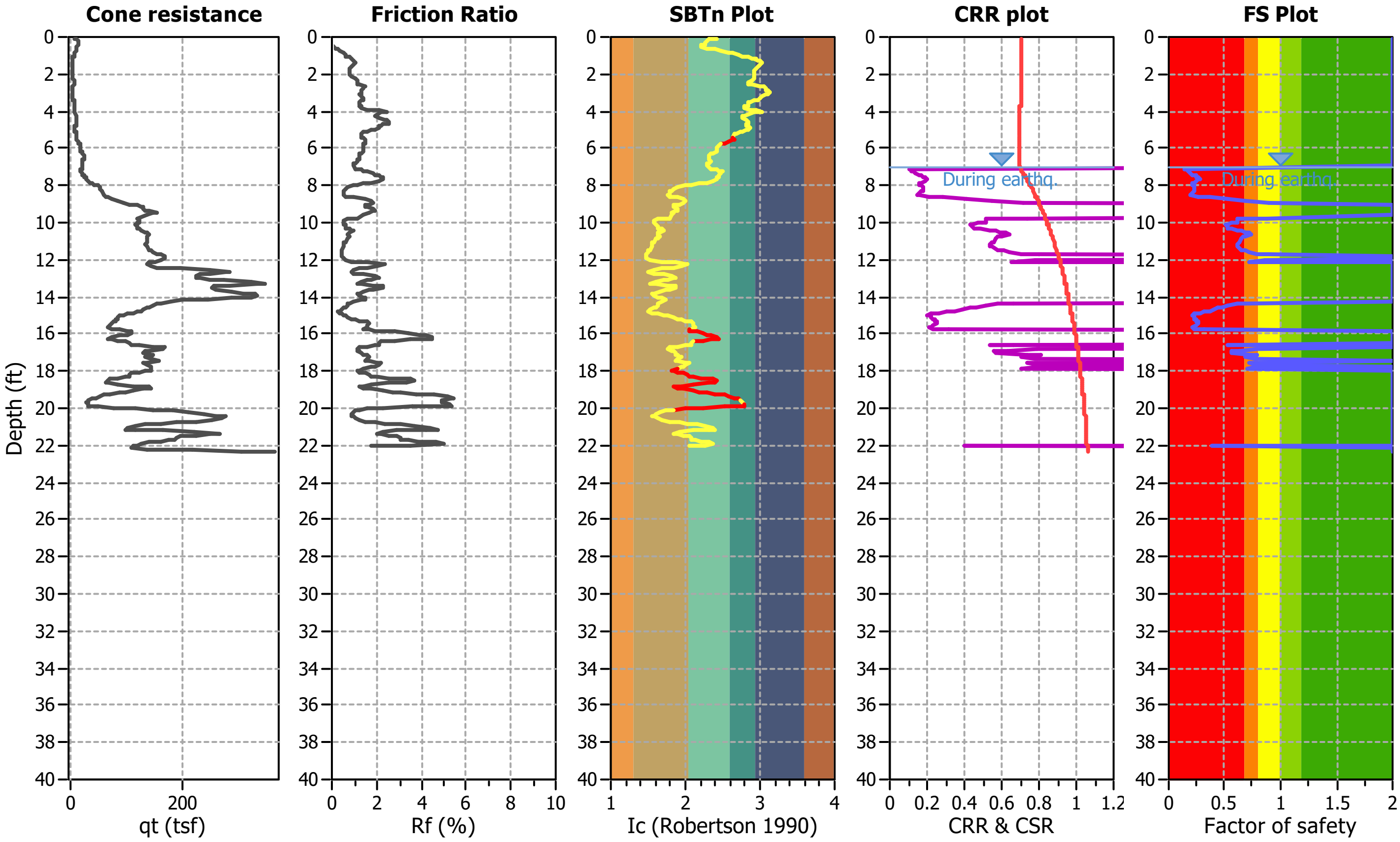
LIQUEFACTION ANALYSIS REPORT

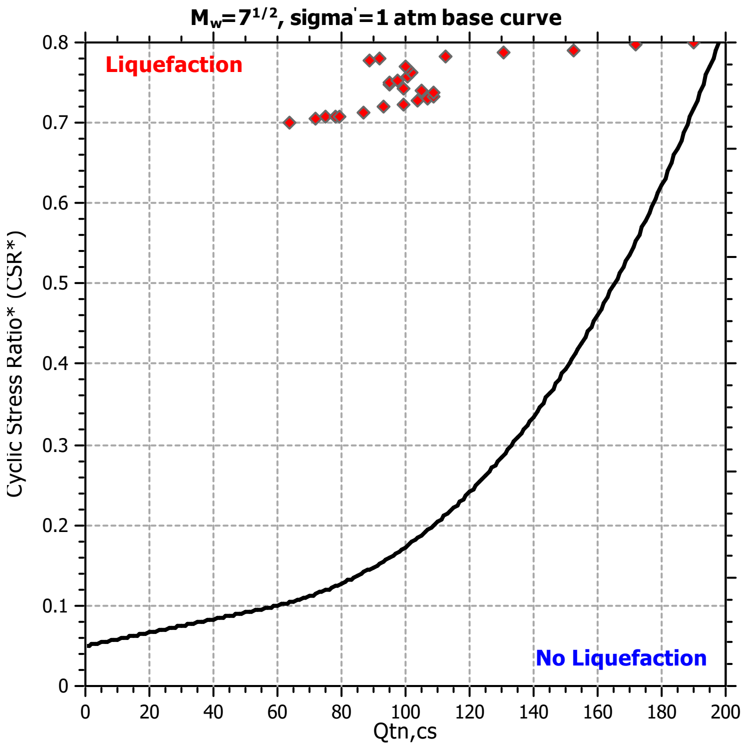
Project title : Petra Geosciences / Apple Canyon **Location : Lake Hemet, CA**

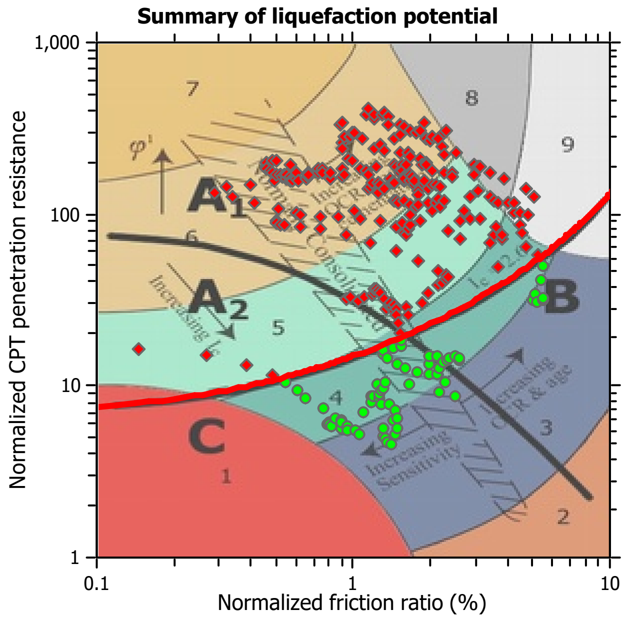
CPT file : CPT-13

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	12.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	8.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.89	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

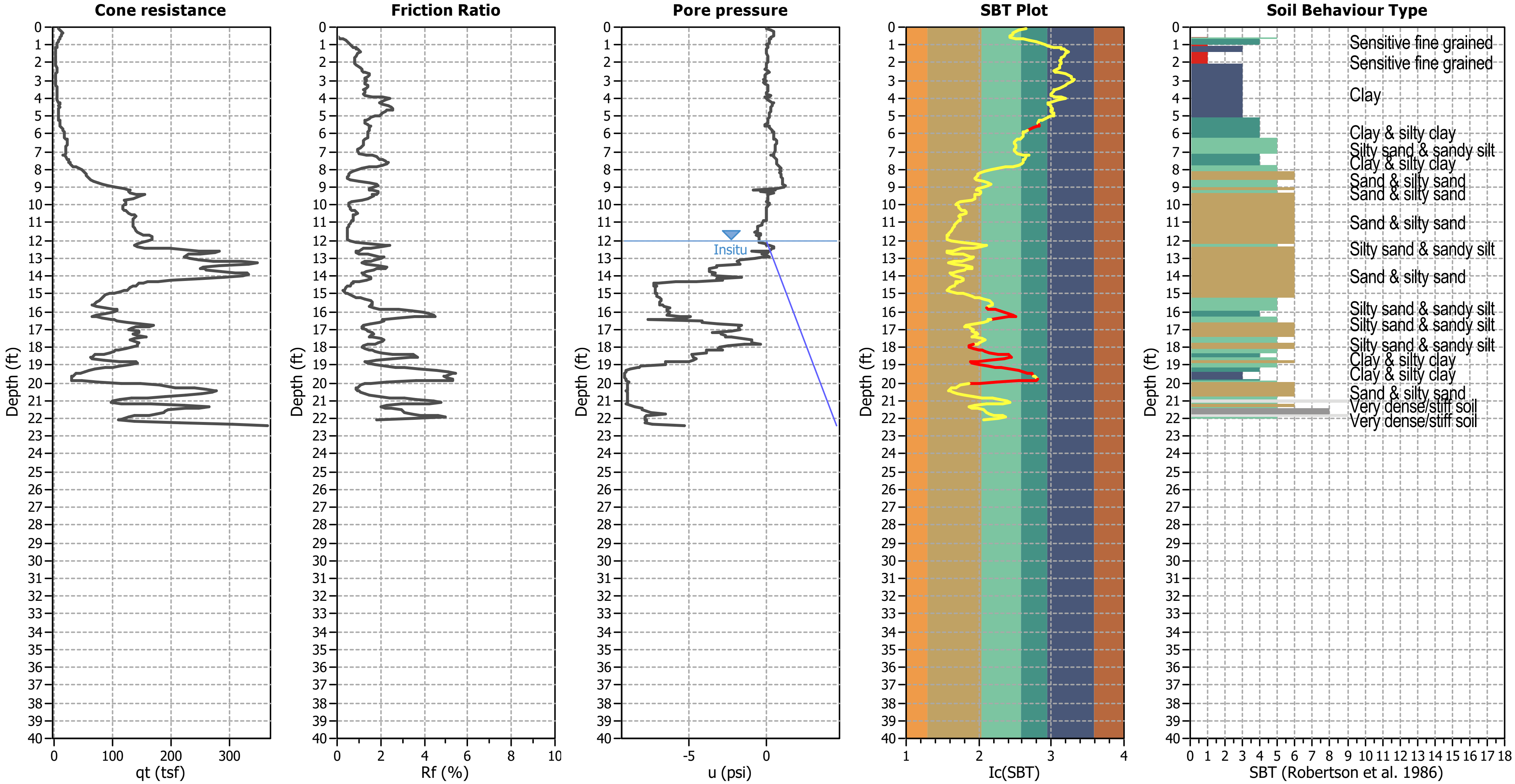






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



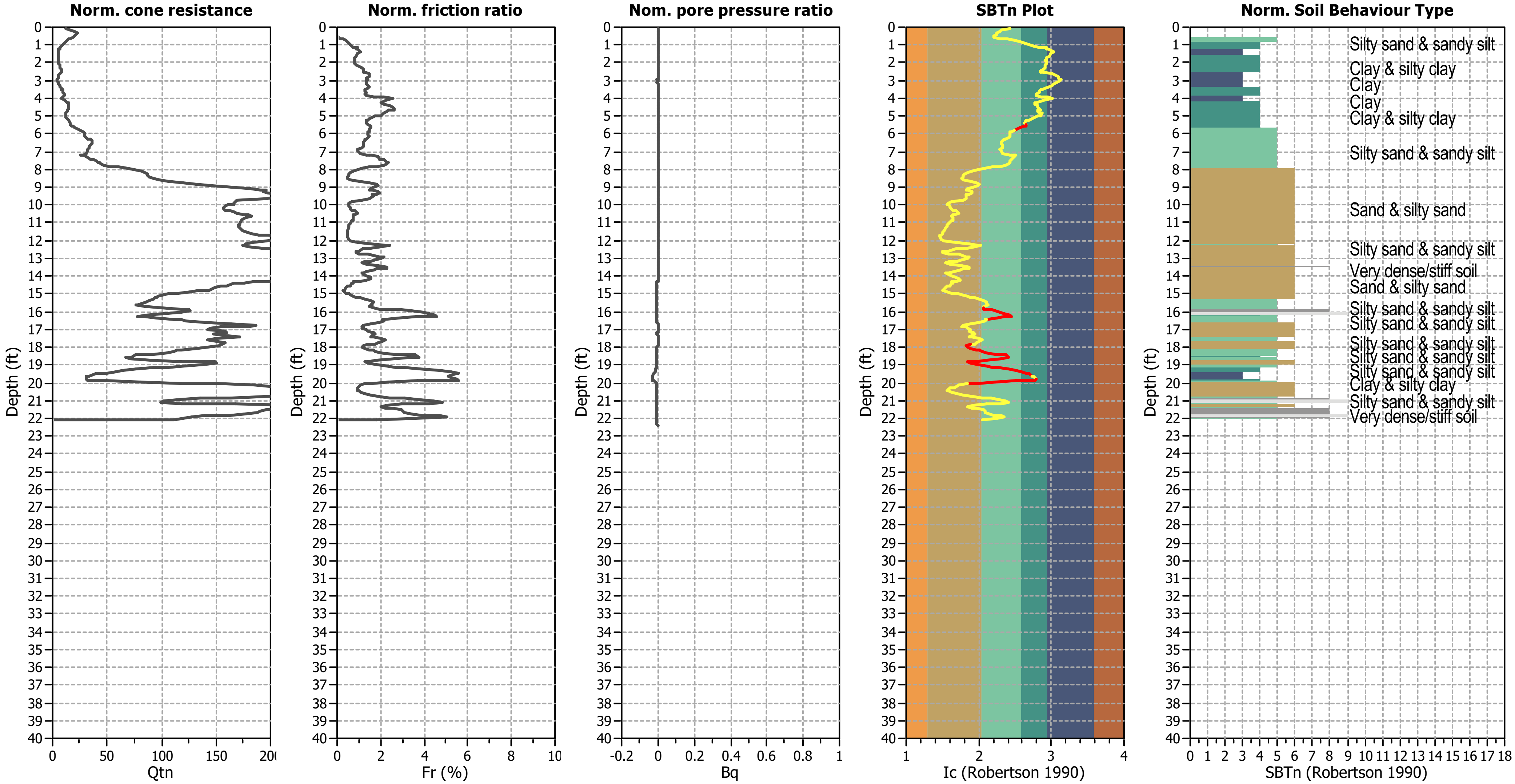
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT 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

CPT basic interpretation plots (normalized)



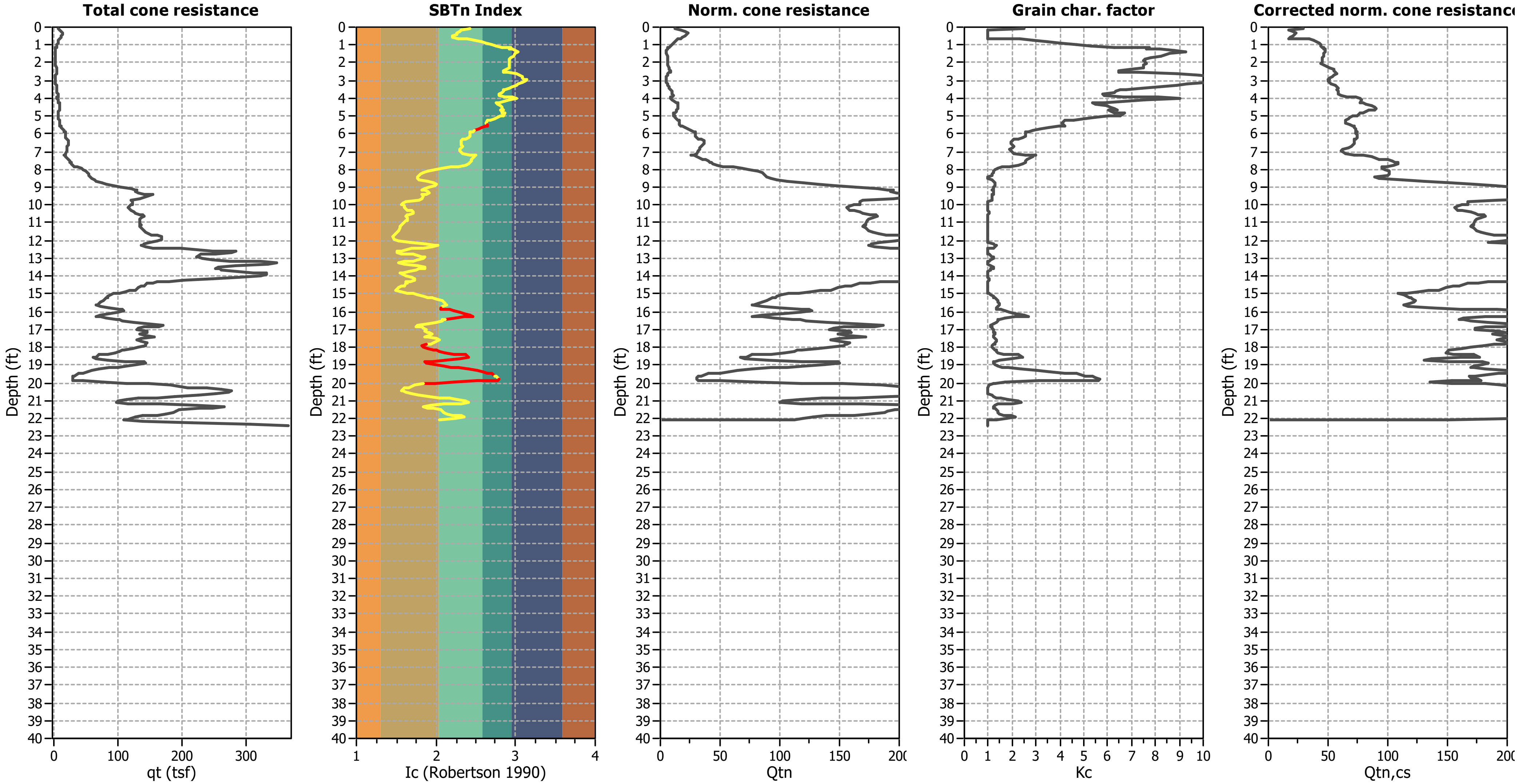
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

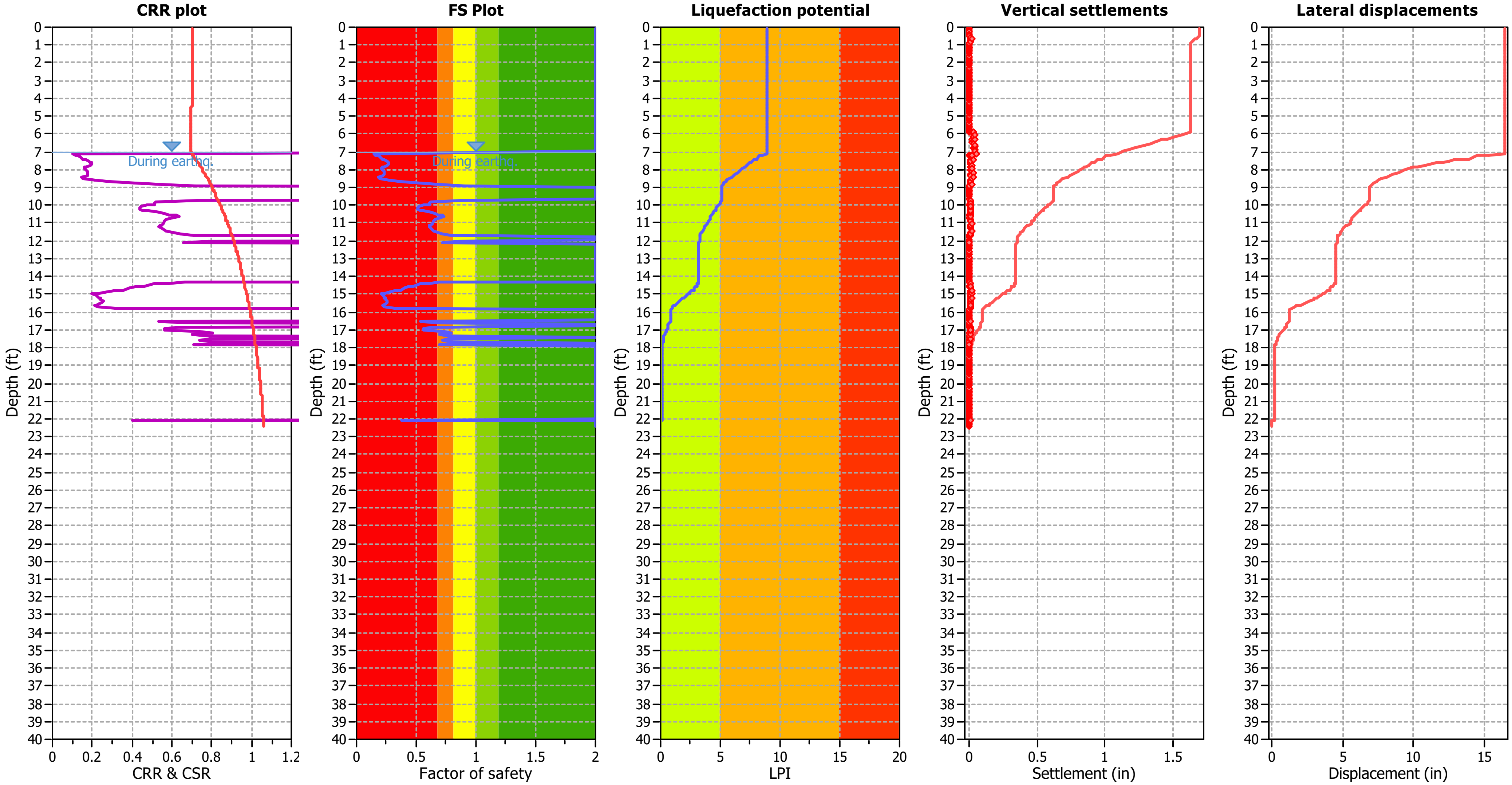
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

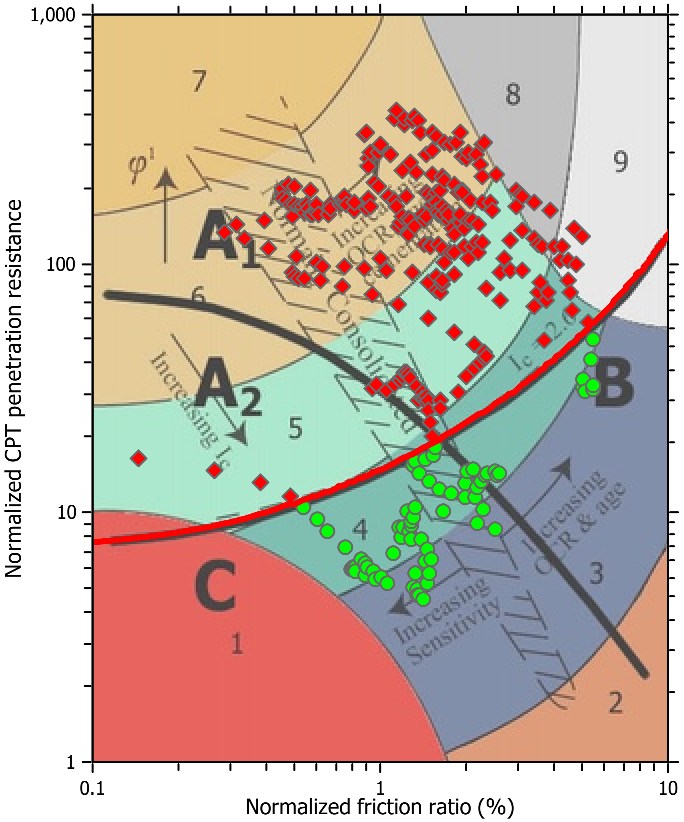
F.S. color scheme

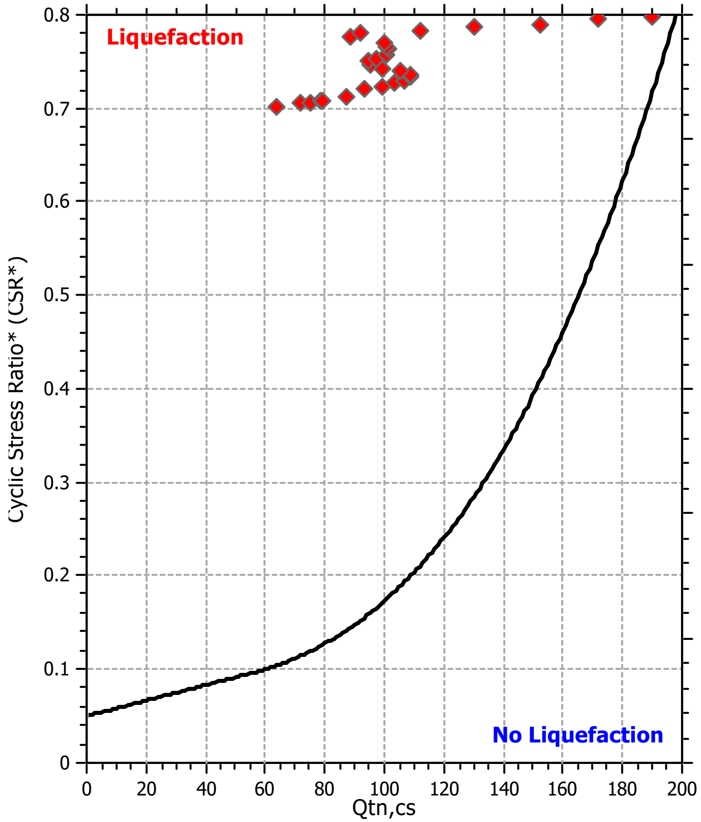
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

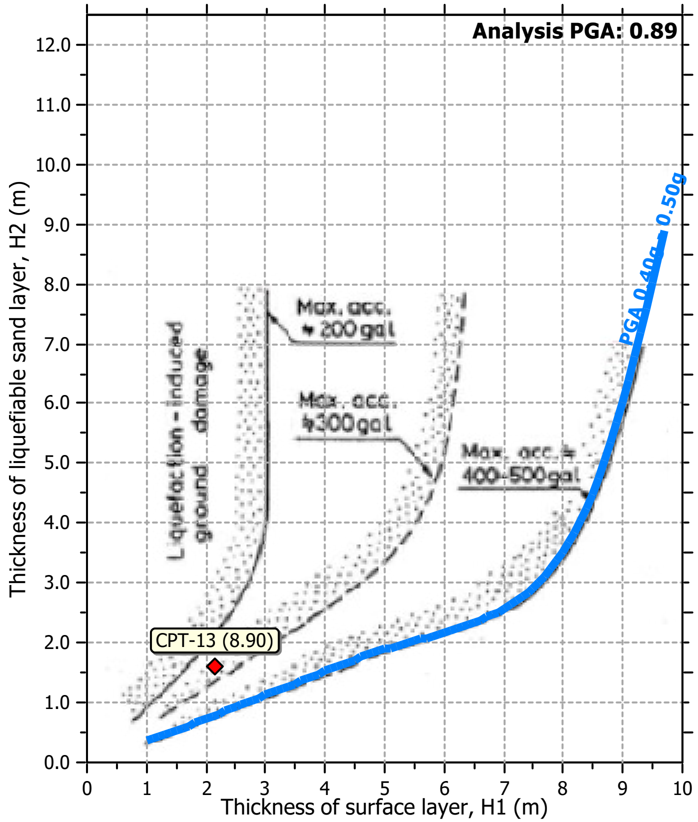
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



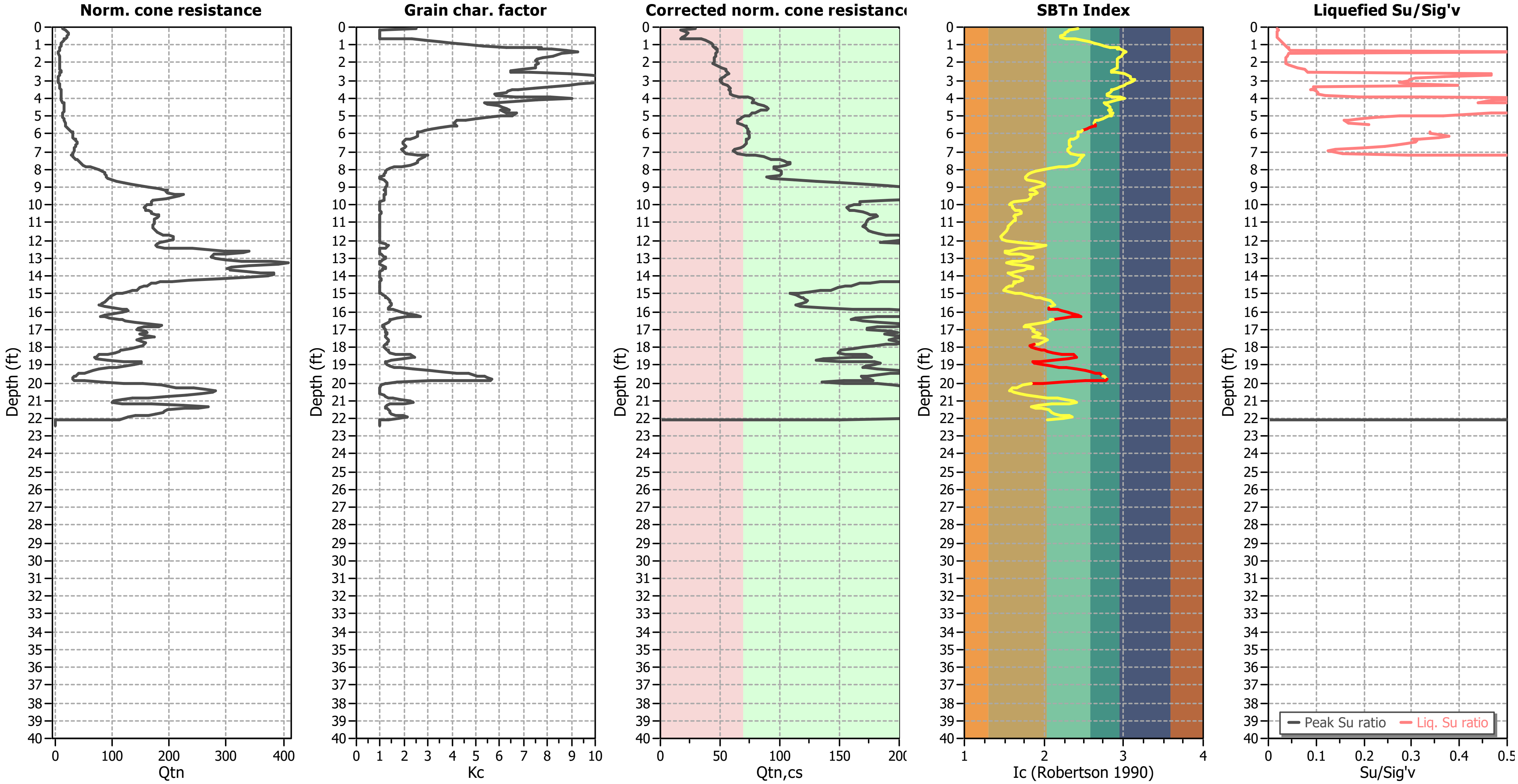




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_{σ} applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

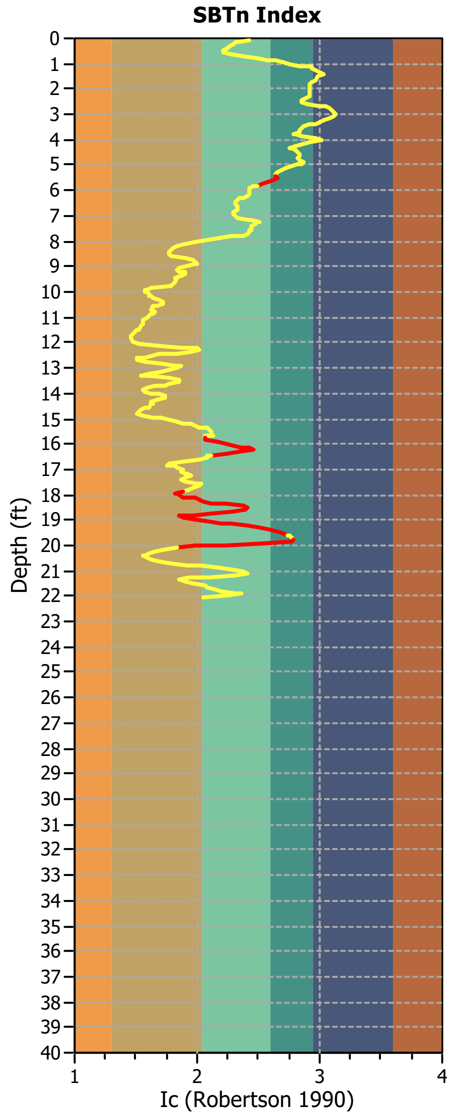
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	N/A

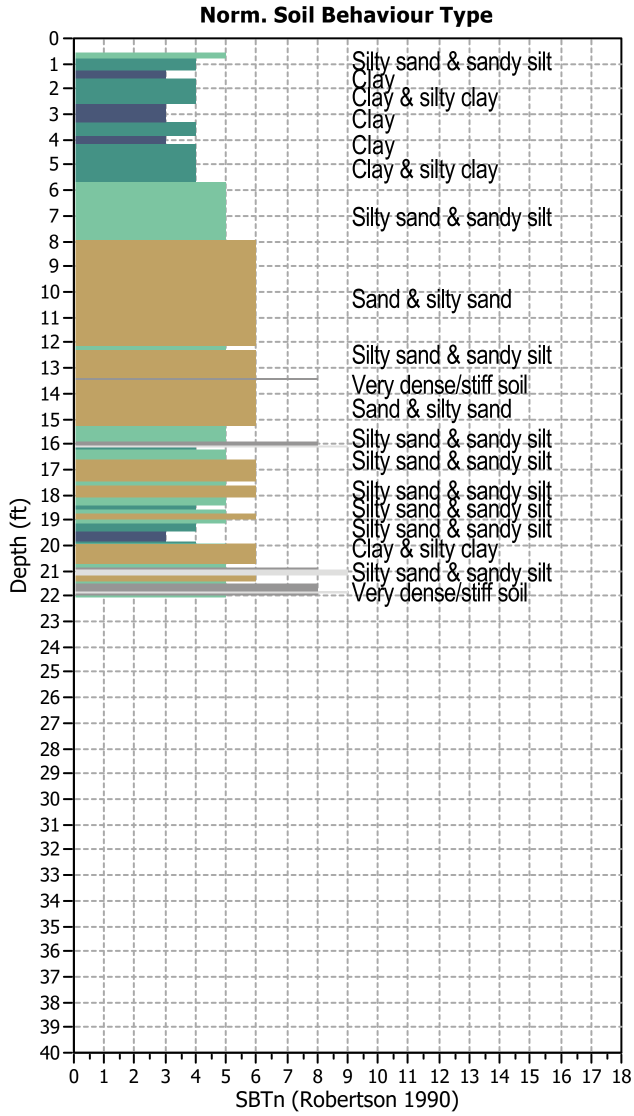
TRANSITION LAYER DETECTION ALGORITHM REPORT
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between 1.80 < I_c < 3.0) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.





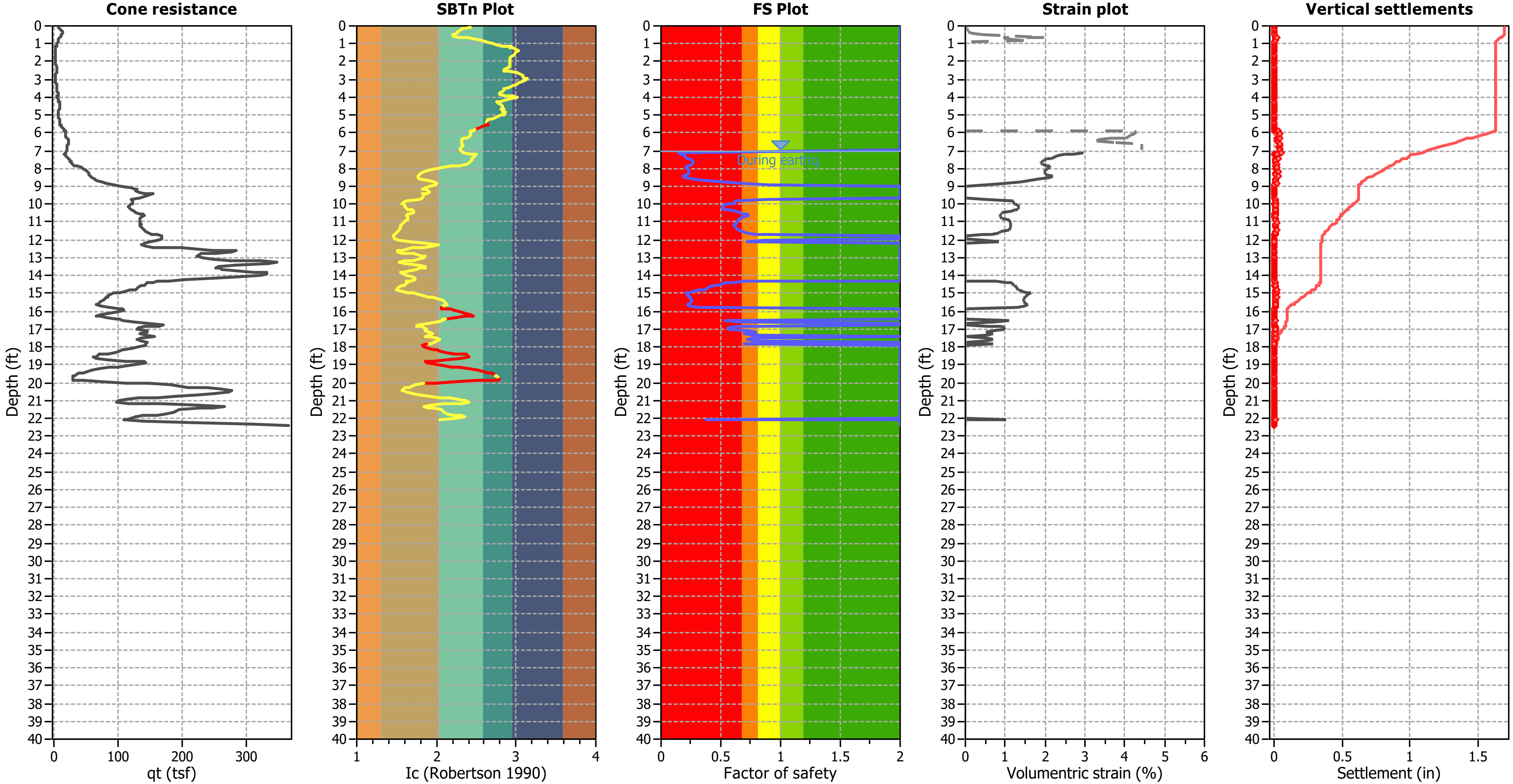
Transition layer algorithm properties

I_c minimum check value:	1.70
I_c maximum check value:	3.00
I_c change ratio value:	0.0250
Minimum number of points in layer:	4

General statistics

Total points in CPT file:	326
Total points excluded:	53
Exclusion percentage:	16.26%
Number of layers detected:	7

Estimation of post-earthquake settlements

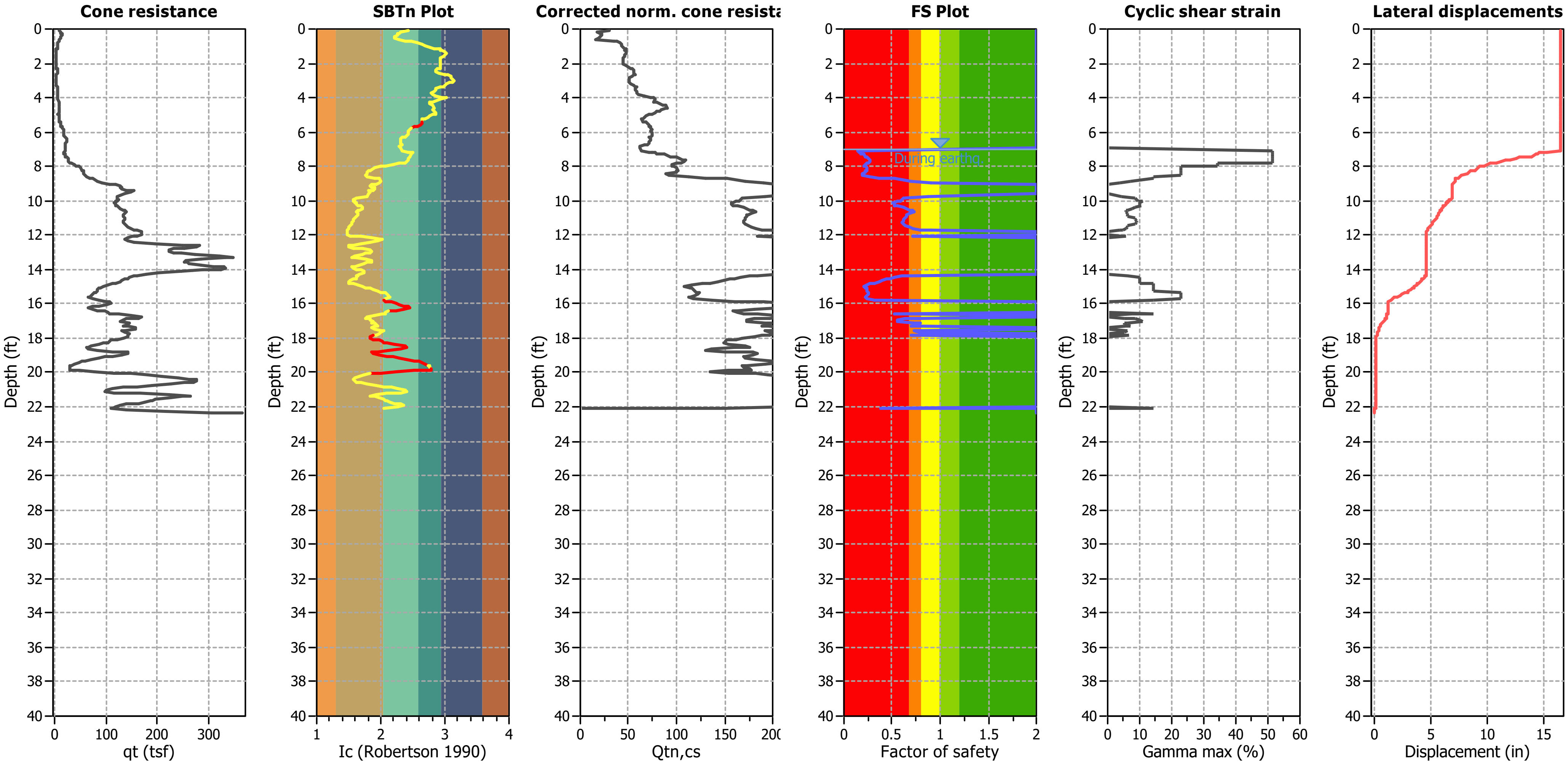


Abbreviations

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

Estimation of post-earthquake lateral Displacements

Geometric parameters: Gently sloping ground without free face (Slope 1.00 %)

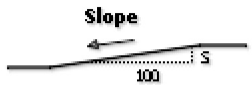


Abbreviations

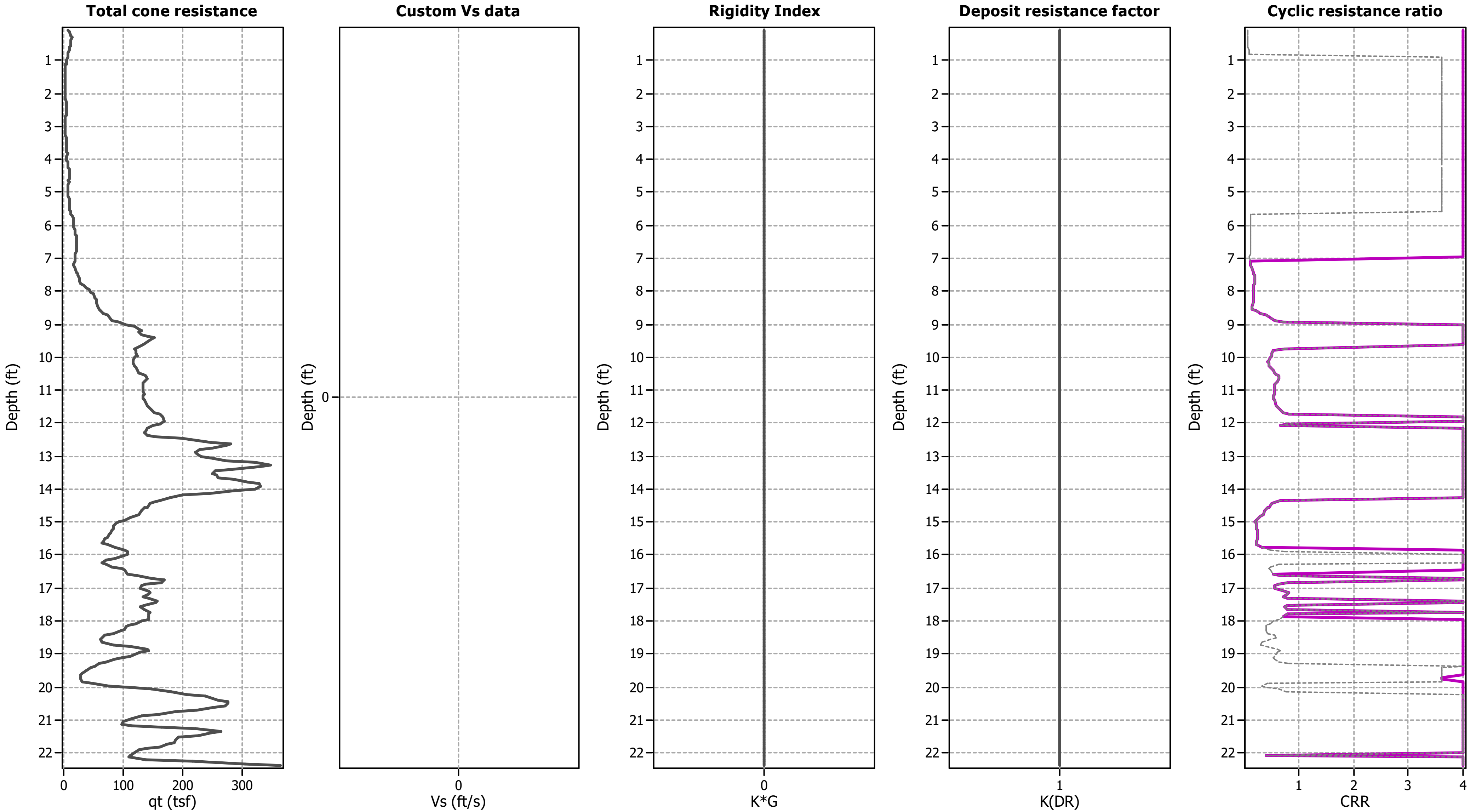
q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance

F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

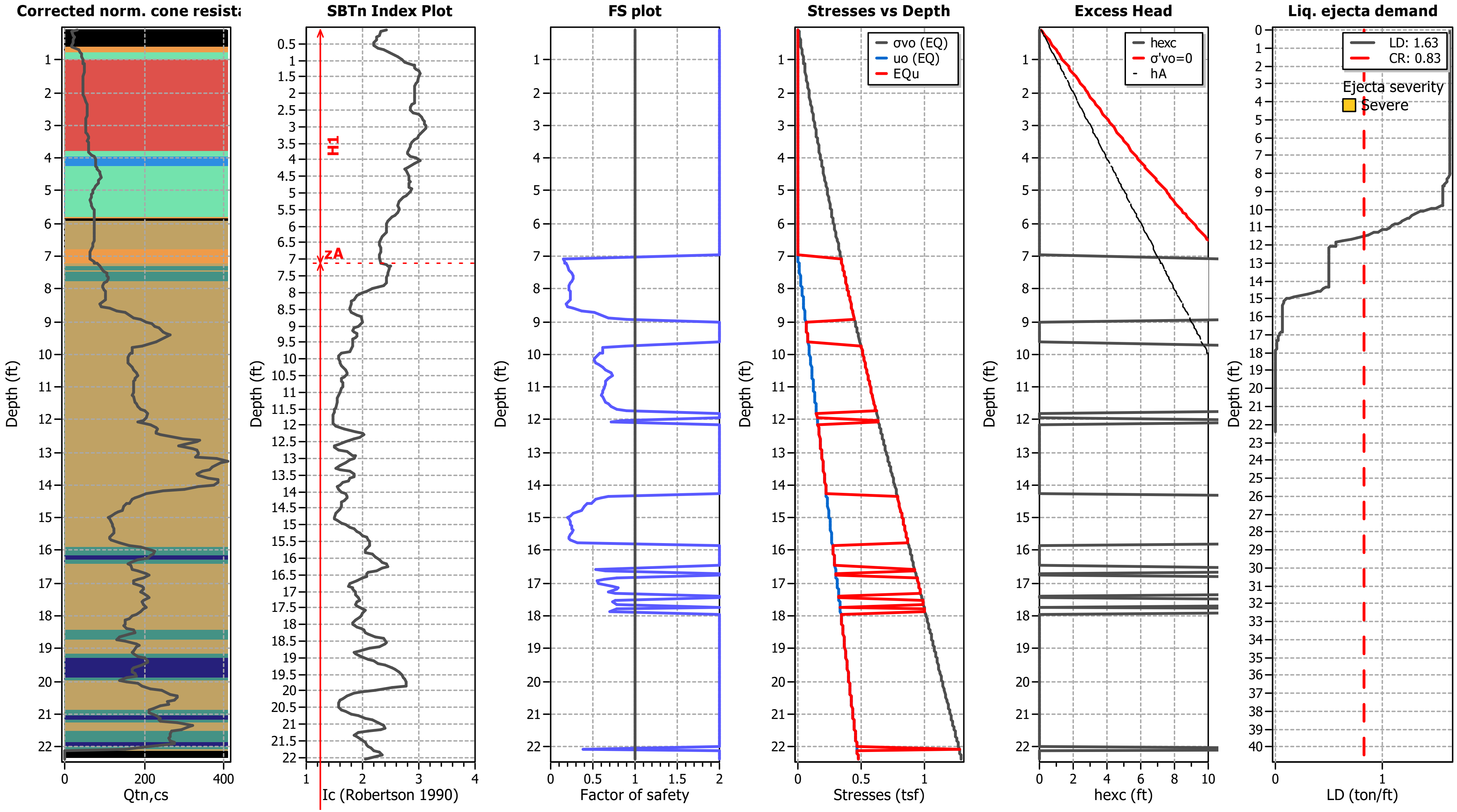
Surface condition



Aging Calculation Estimation



Ejecta Severity Estimation



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

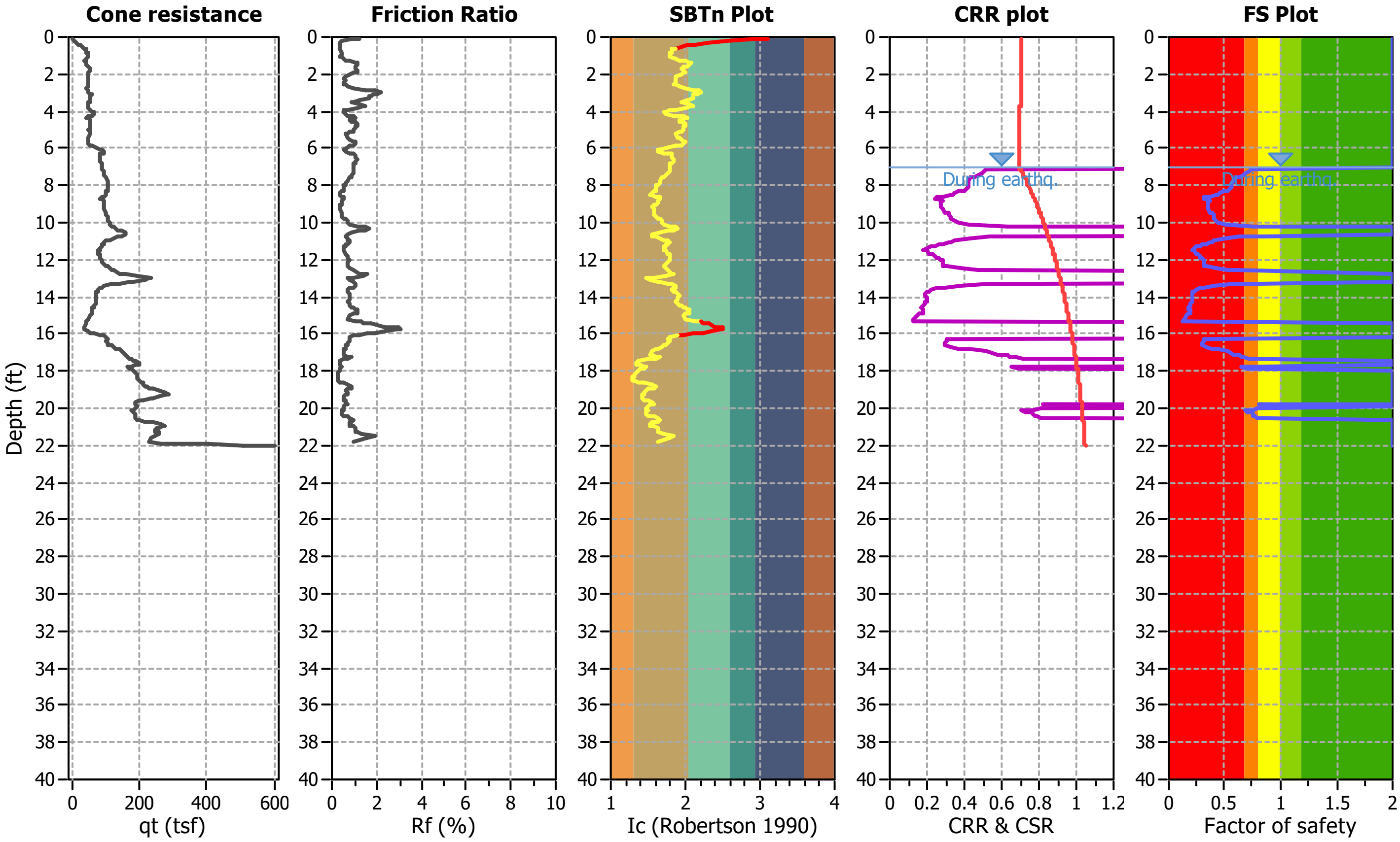
LIQUEFACTION ANALYSIS REPORT

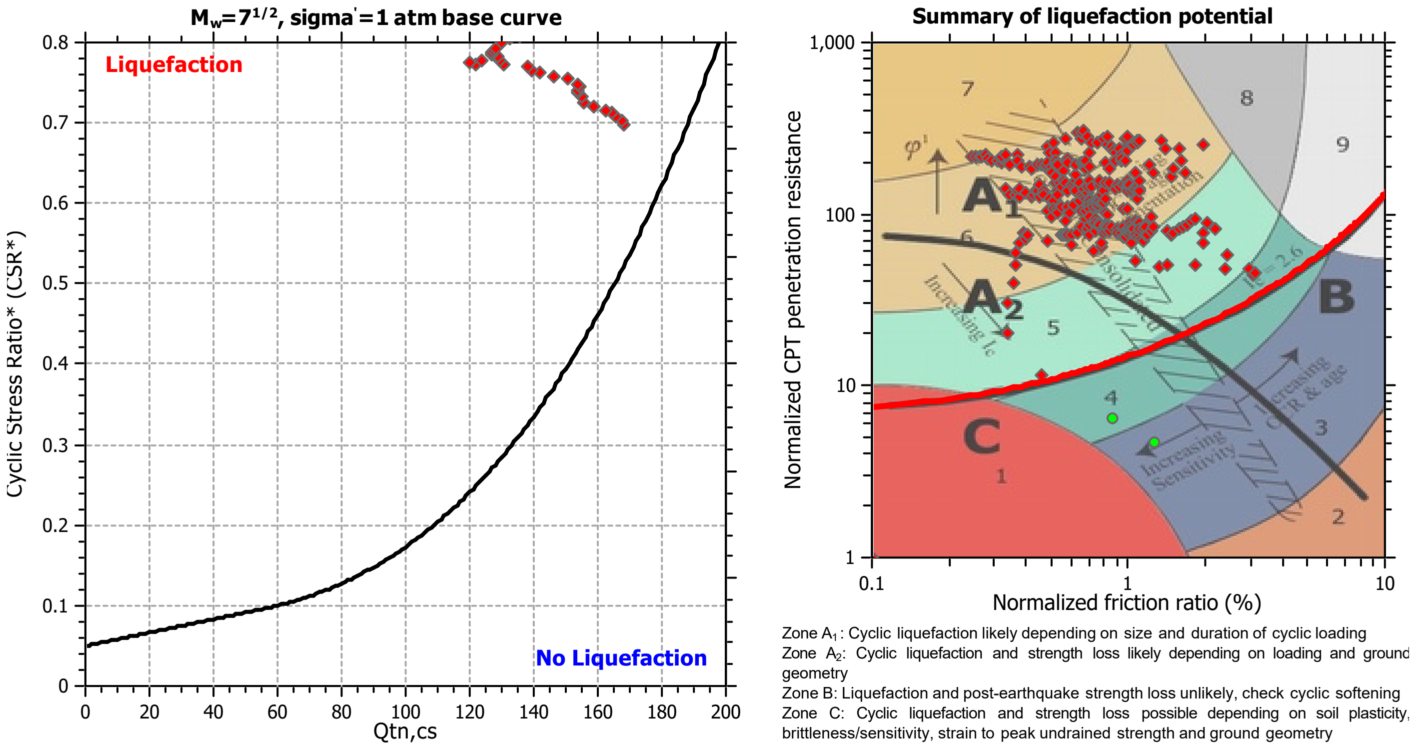
Project title : Petra Geosciences / Apple Canyon **Location : Lake Hemet, CA**

CPT file : CPT-14

Input parameters and analysis data

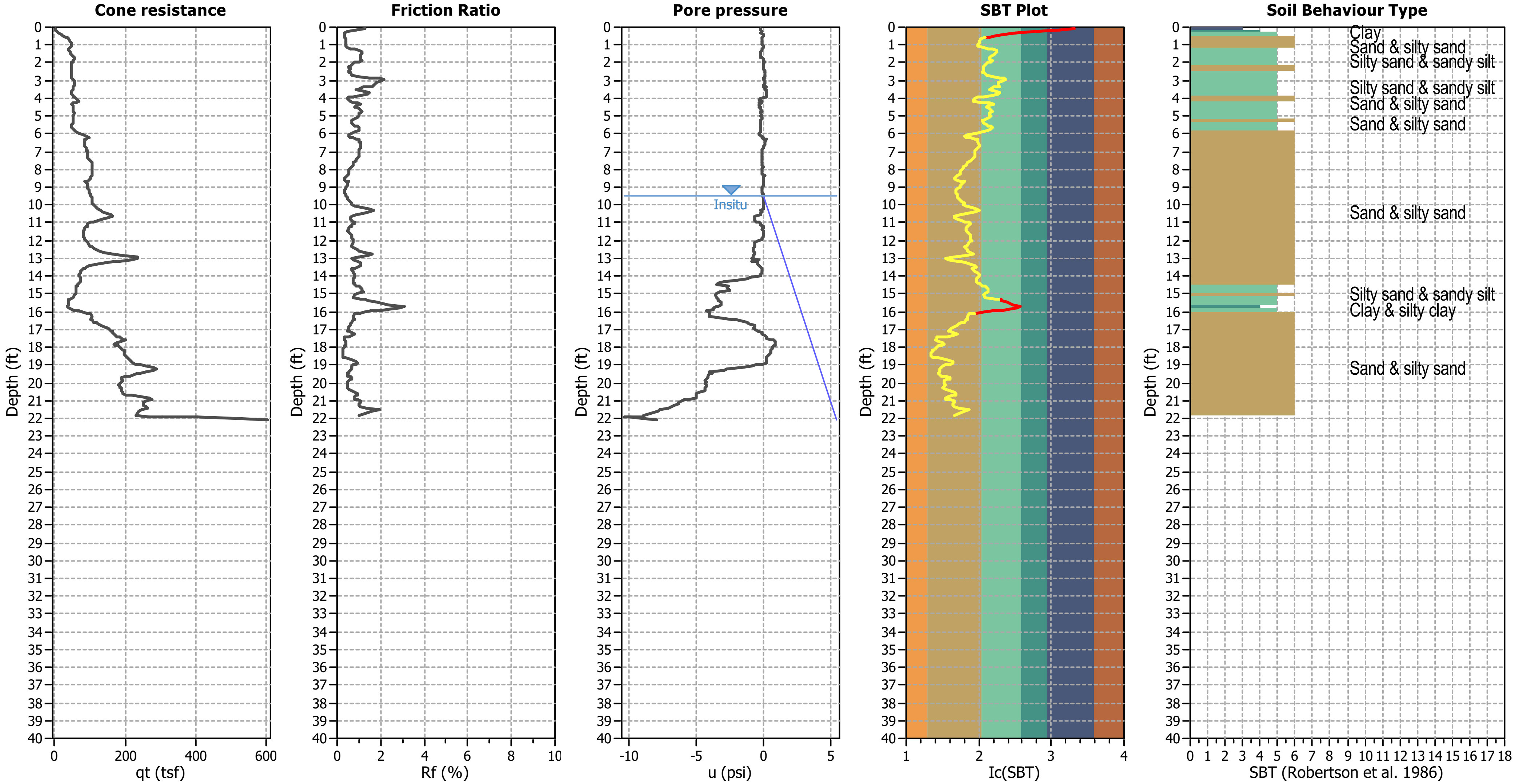
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	9.50 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	8.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.89	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



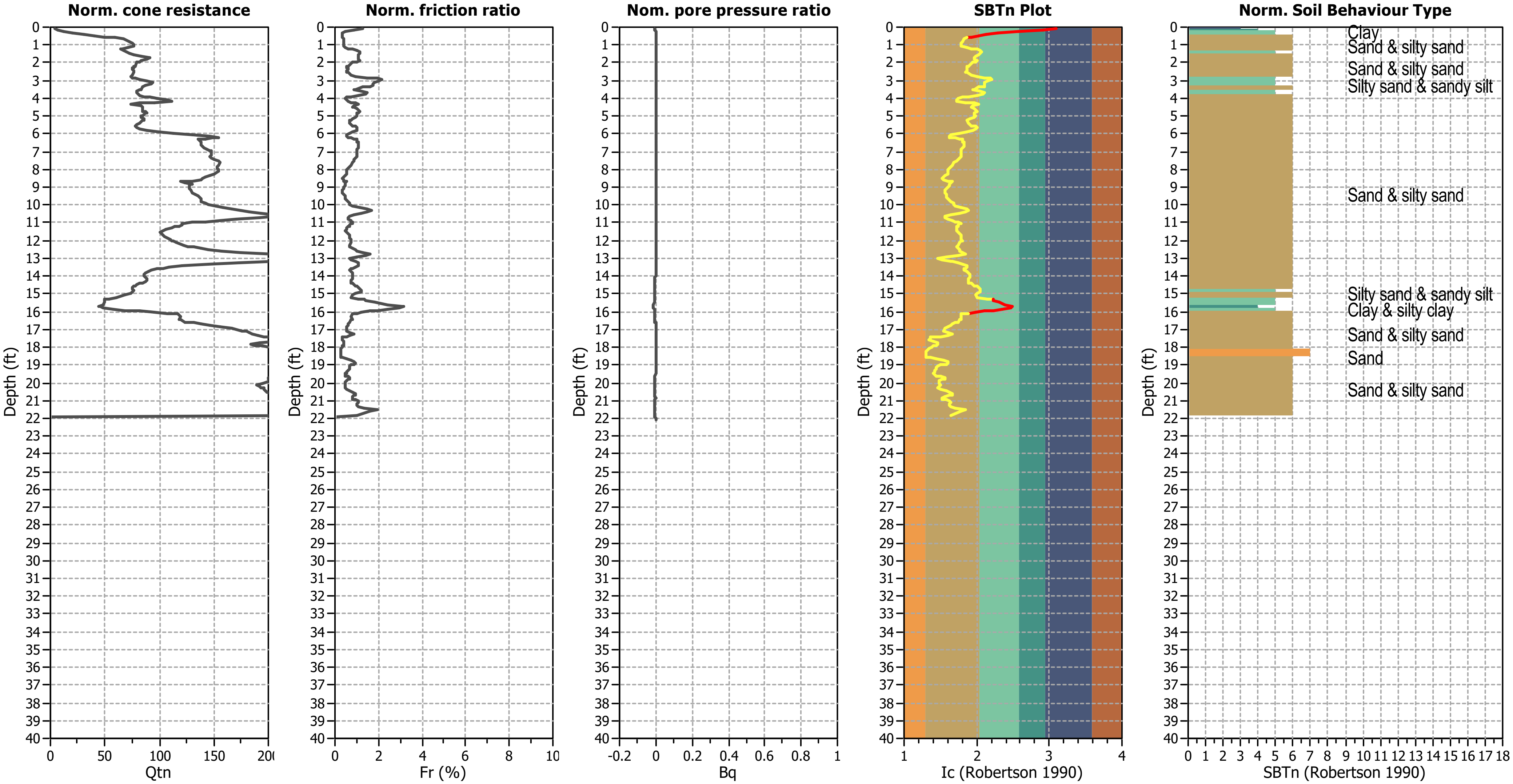
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.50 ft	Fill height:	N/A	Limit depth:	N/A

SBT 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

CPT basic interpretation plots (normalized)



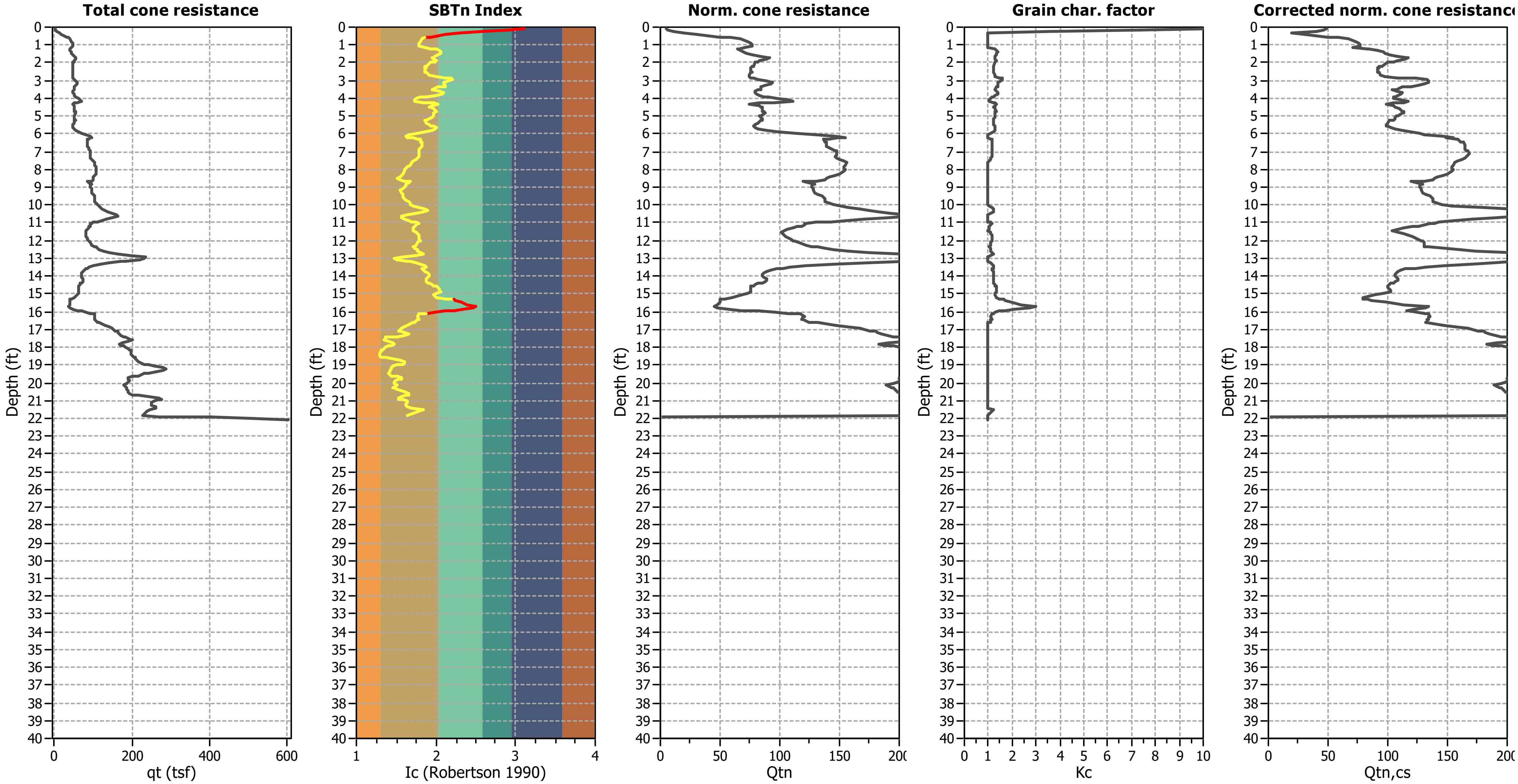
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.50 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

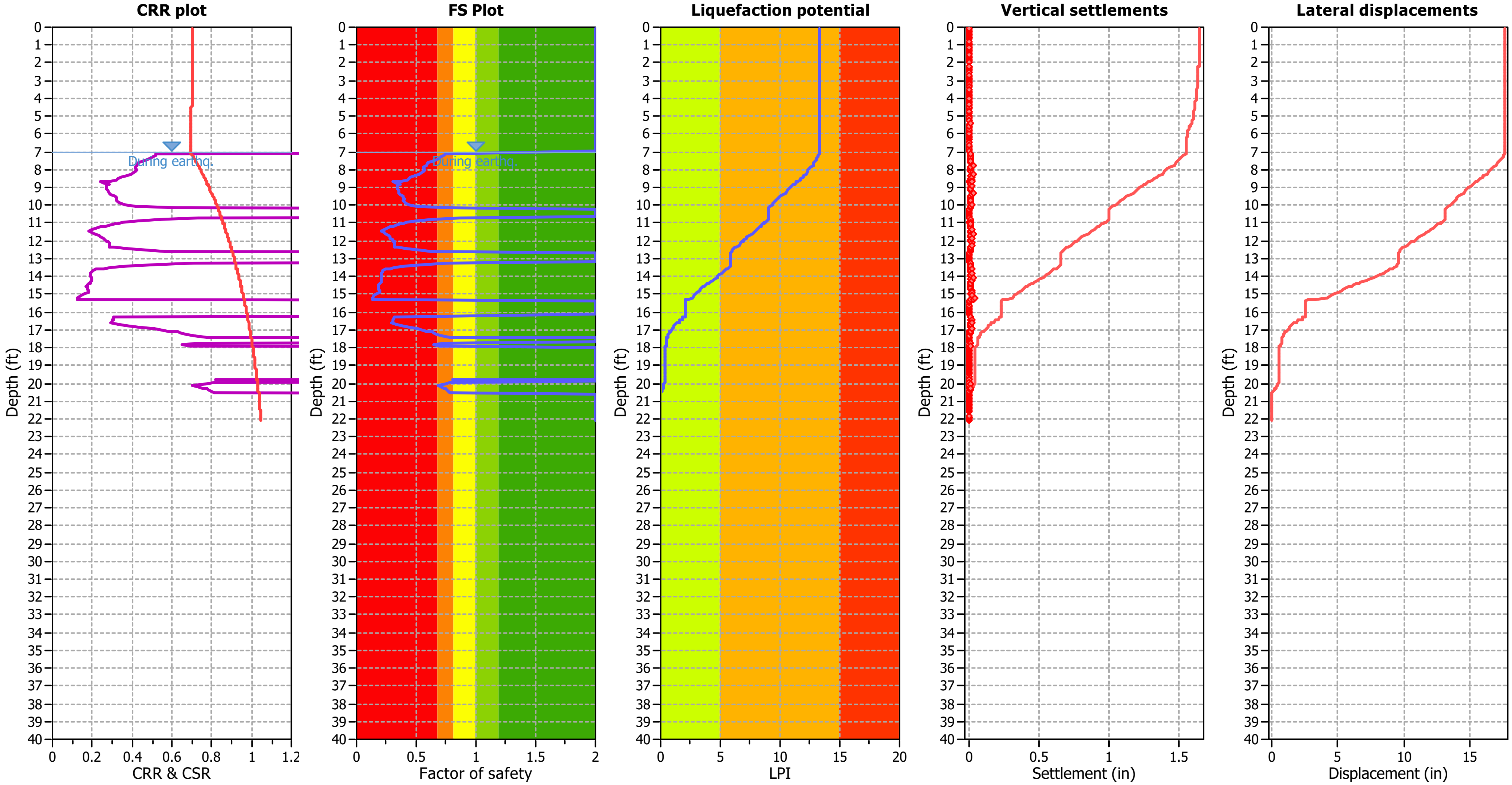
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.50 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.50 ft	Fill height:	N/A	Limit depth:	N/A

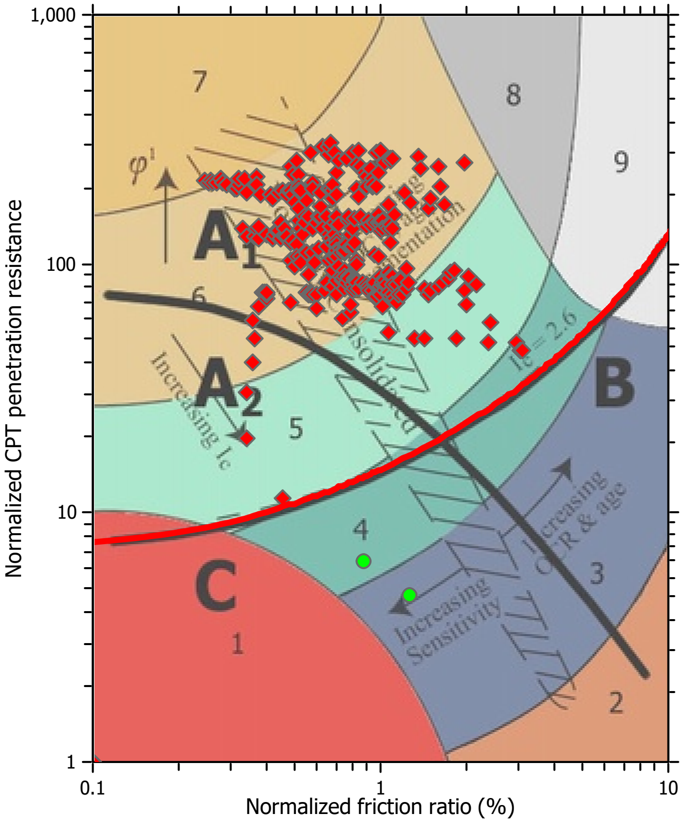
F.S. color scheme

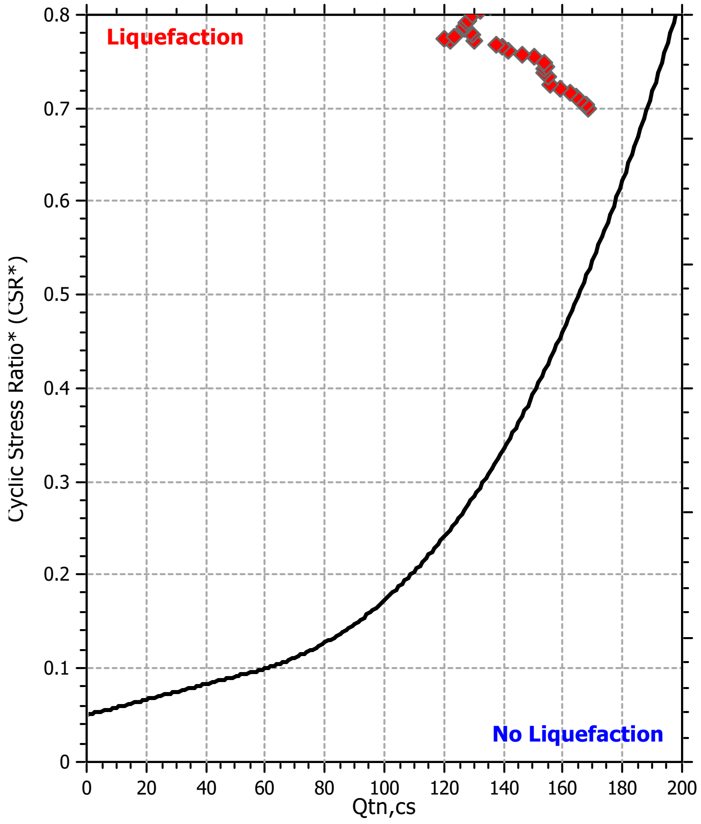
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

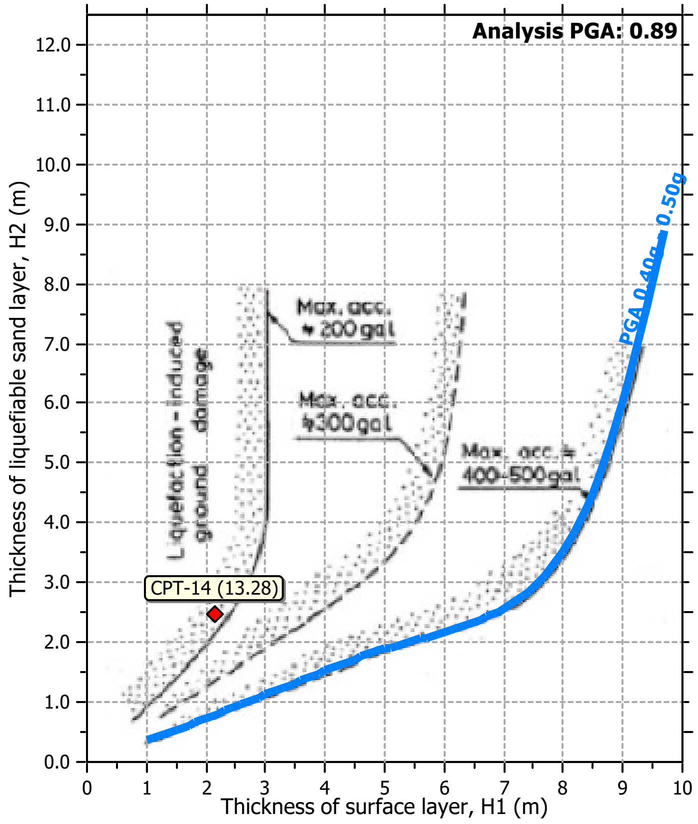
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



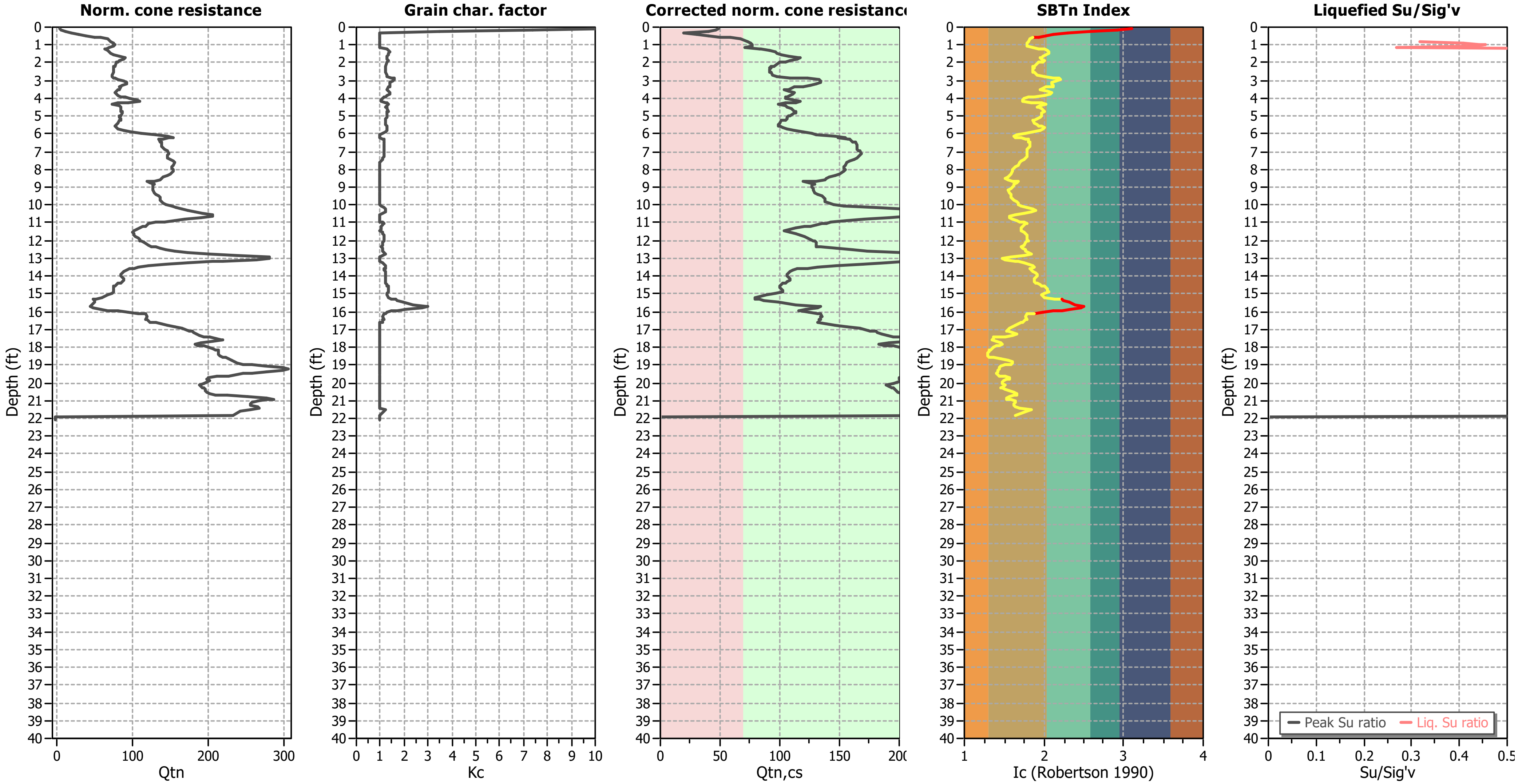




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.50 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

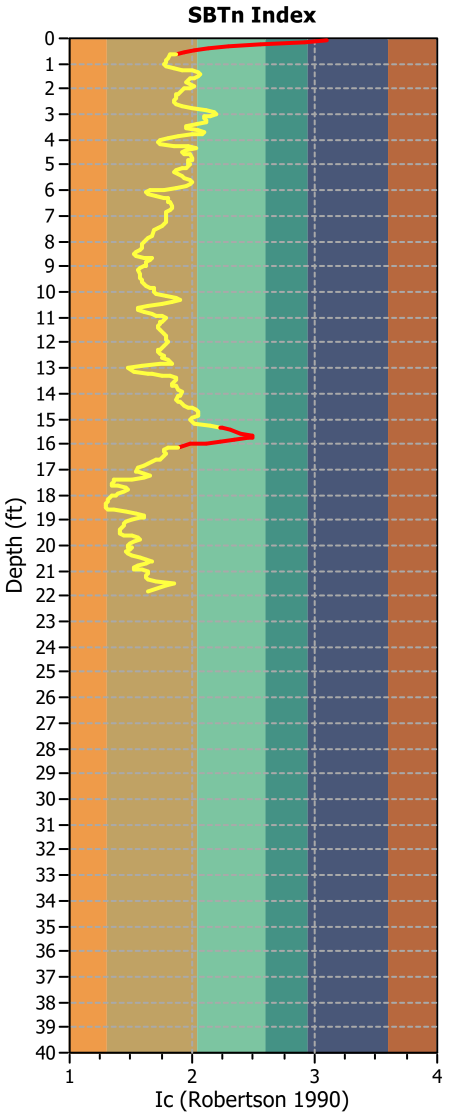
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.50 ft	Fill height:	N/A	Limit depth:	N/A

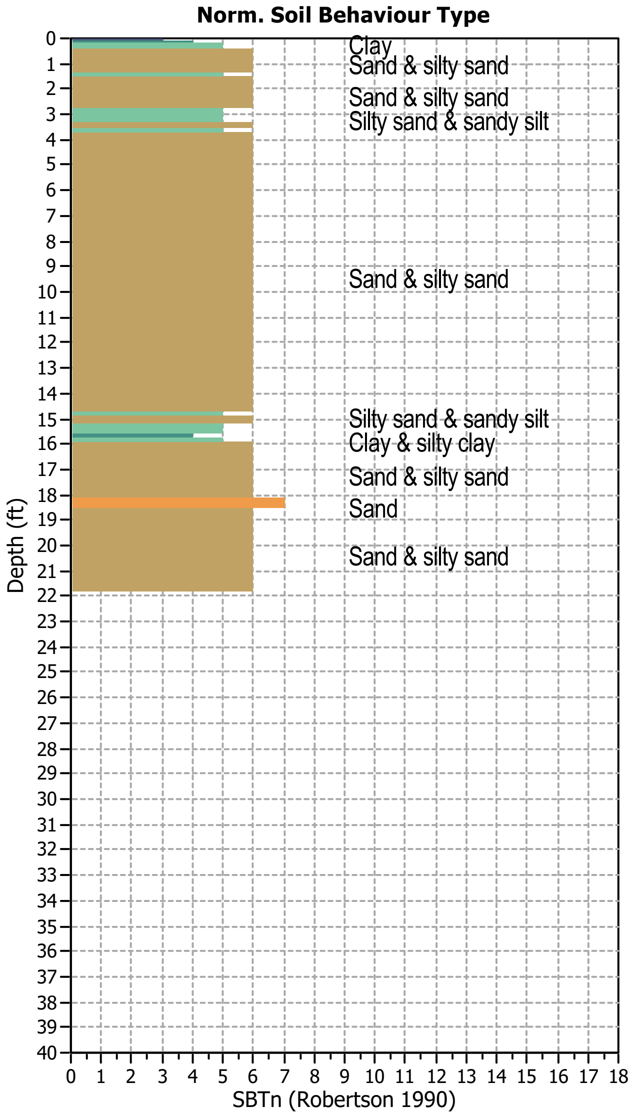
TRANSITION LAYER DETECTION ALGORITHM REPORT
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between 1.80 < I_c < 3.0) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.





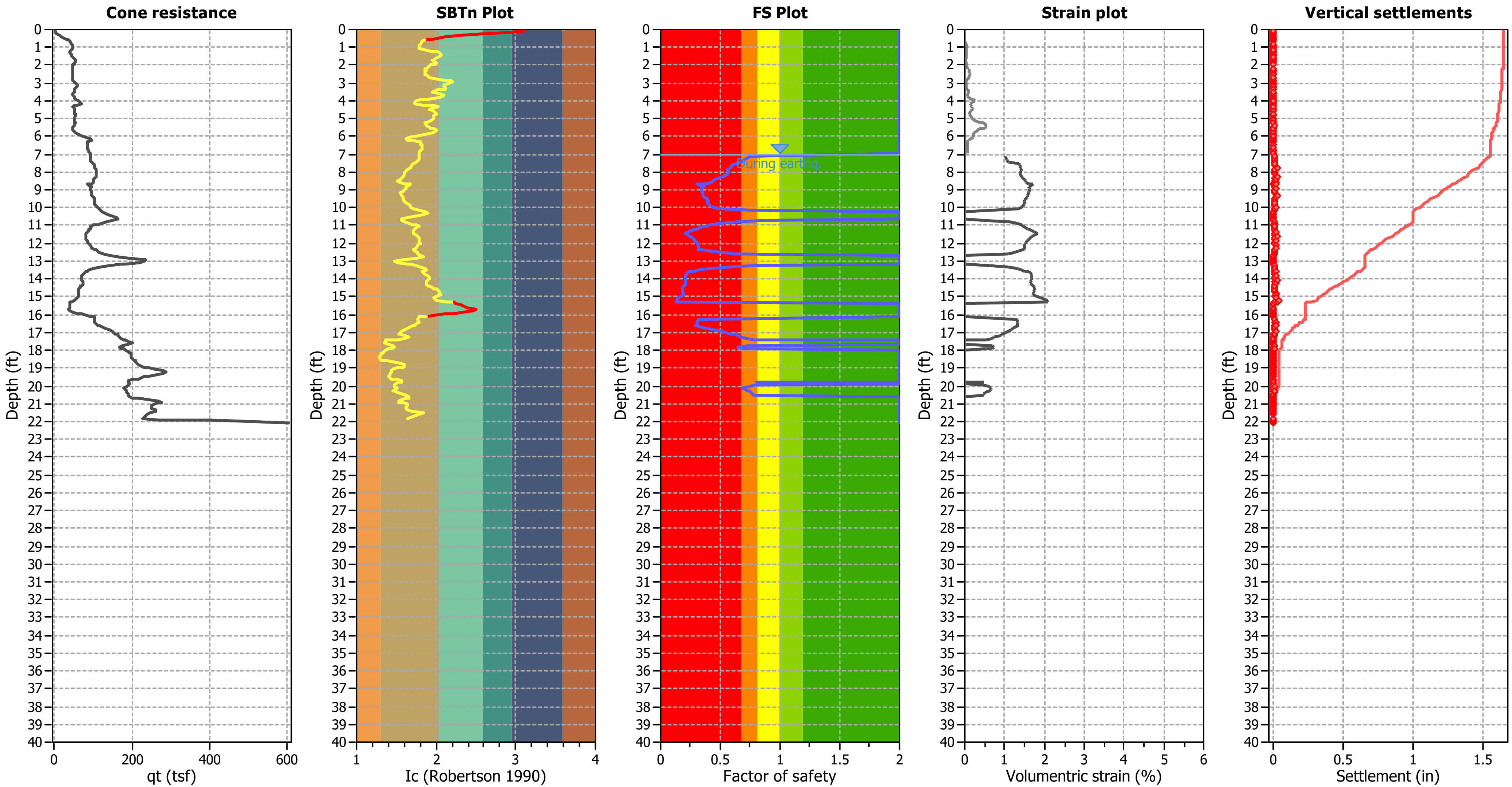
Transition layer algorithm properties

I_c minimum check value:	1.70
I_c maximum check value:	3.00
I_c change ratio value:	0.0250
Minimum number of points in layer:	4

General statistics

Total points in CPT file:	304
Total points excluded:	20
Exclusion percentage:	6.58%
Number of layers detected:	3

Estimation of post-earthquake settlements

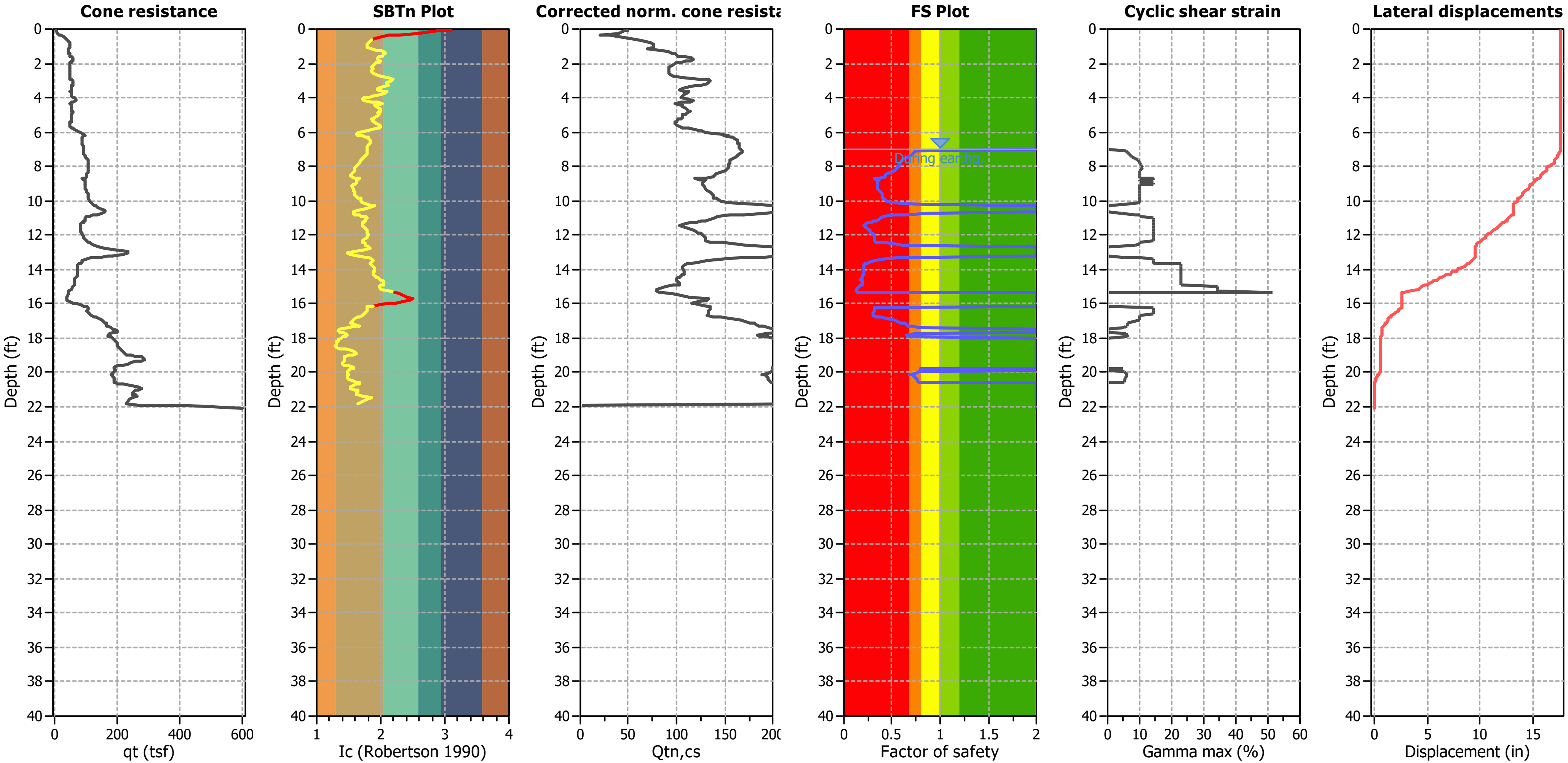


Abbreviations

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

Estimation of post-earthquake lateral Displacements

Geometric parameters: Gently sloping ground without free face (Slope 1.00 %)

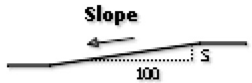


Abbreviations

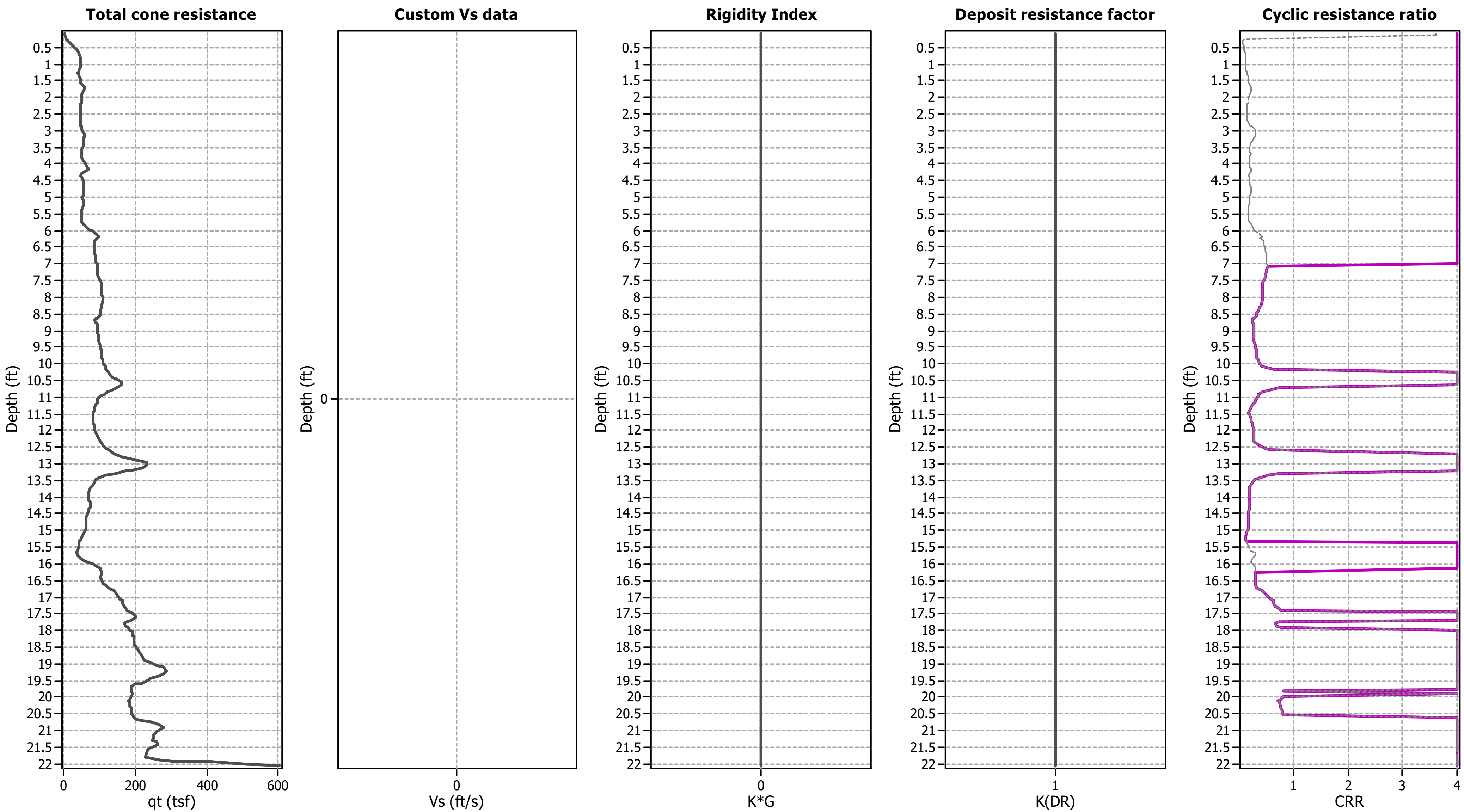
q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance

F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

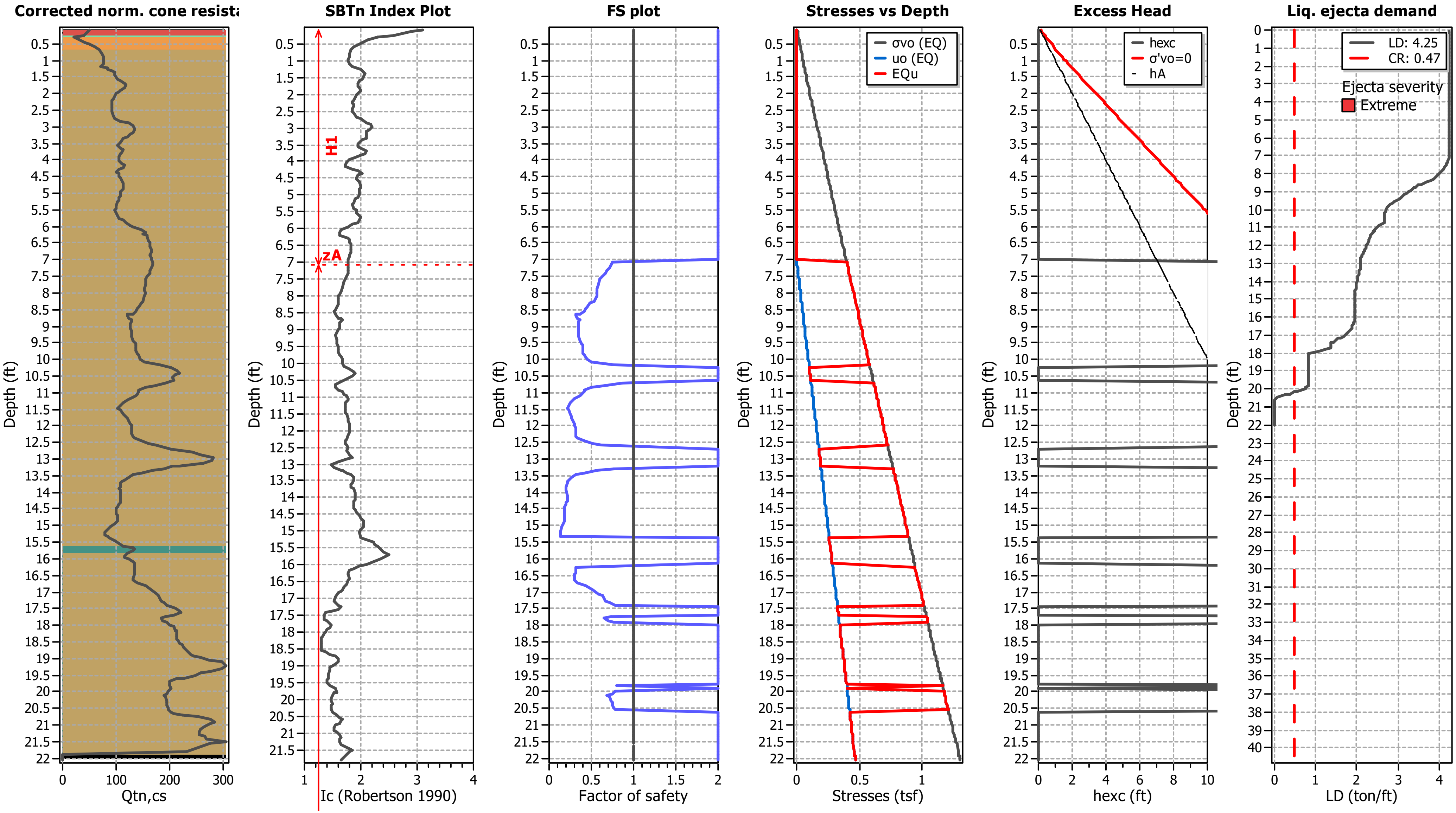
Surface condition



Aging Calculation Estimation



Ejecta Severity Estimation



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

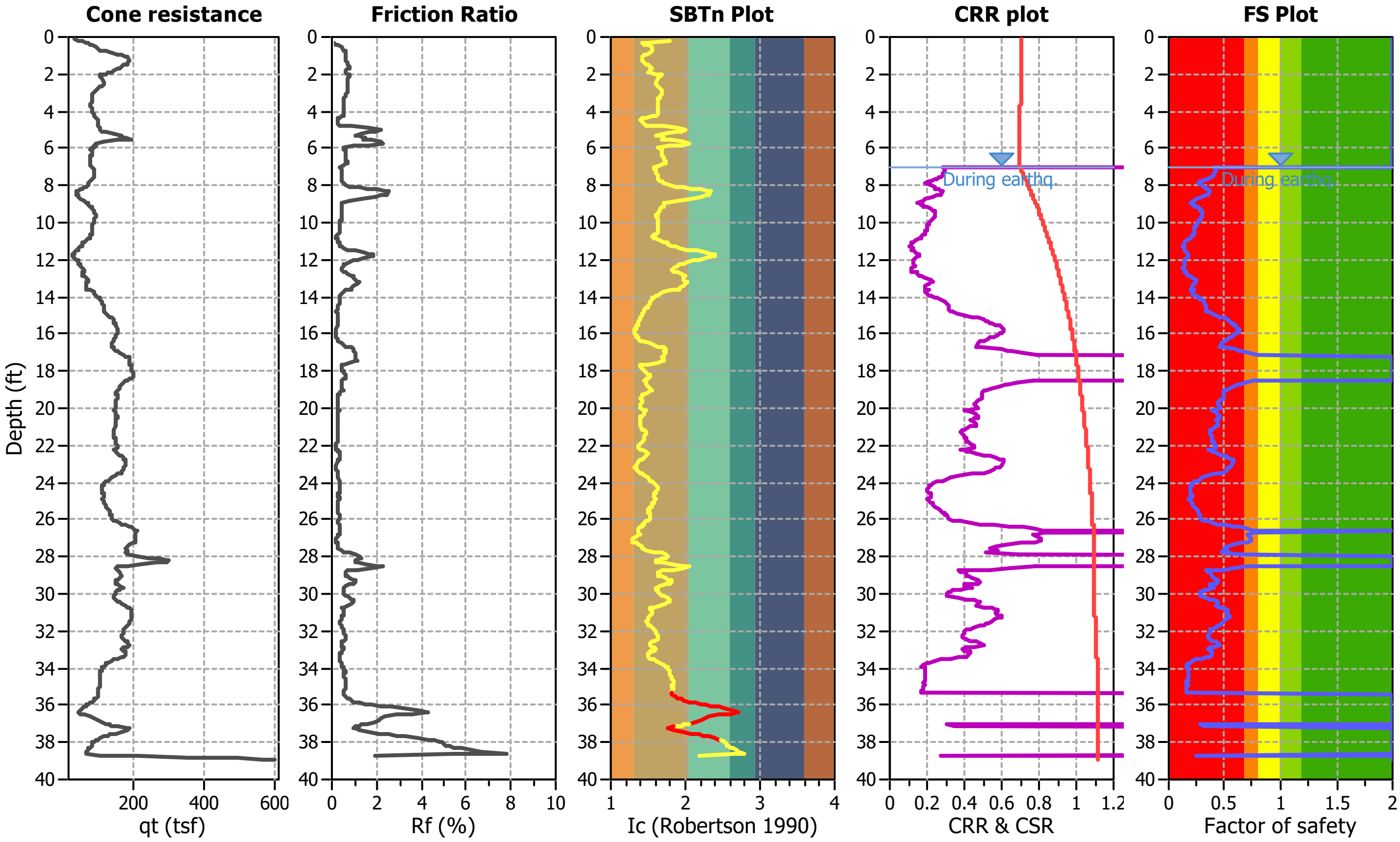
LIQUEFACTION ANALYSIS REPORT

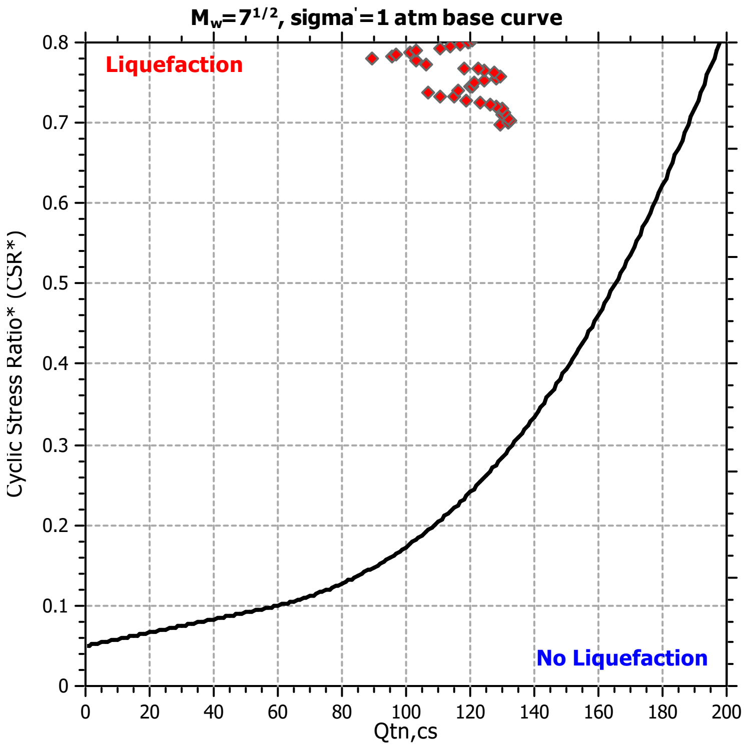
Project title : Petra Geosciences / Apple Canyon **Location : Lake Hemet, CA**

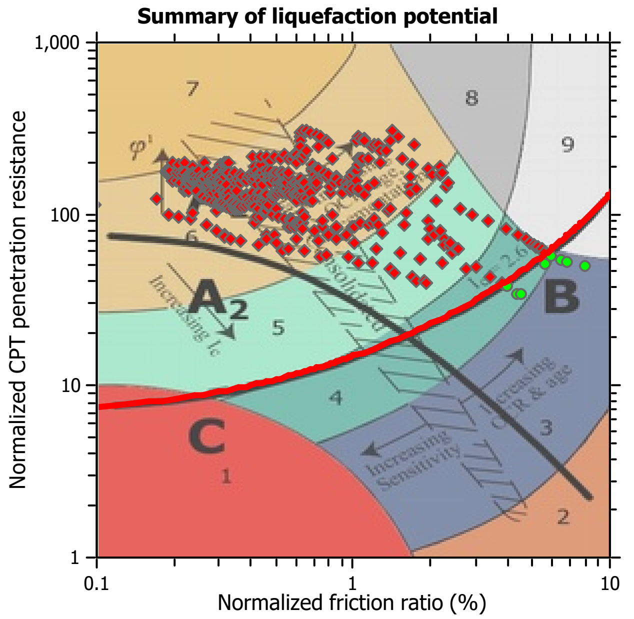
CPT file : CPT-15

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	9.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	8.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.89	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

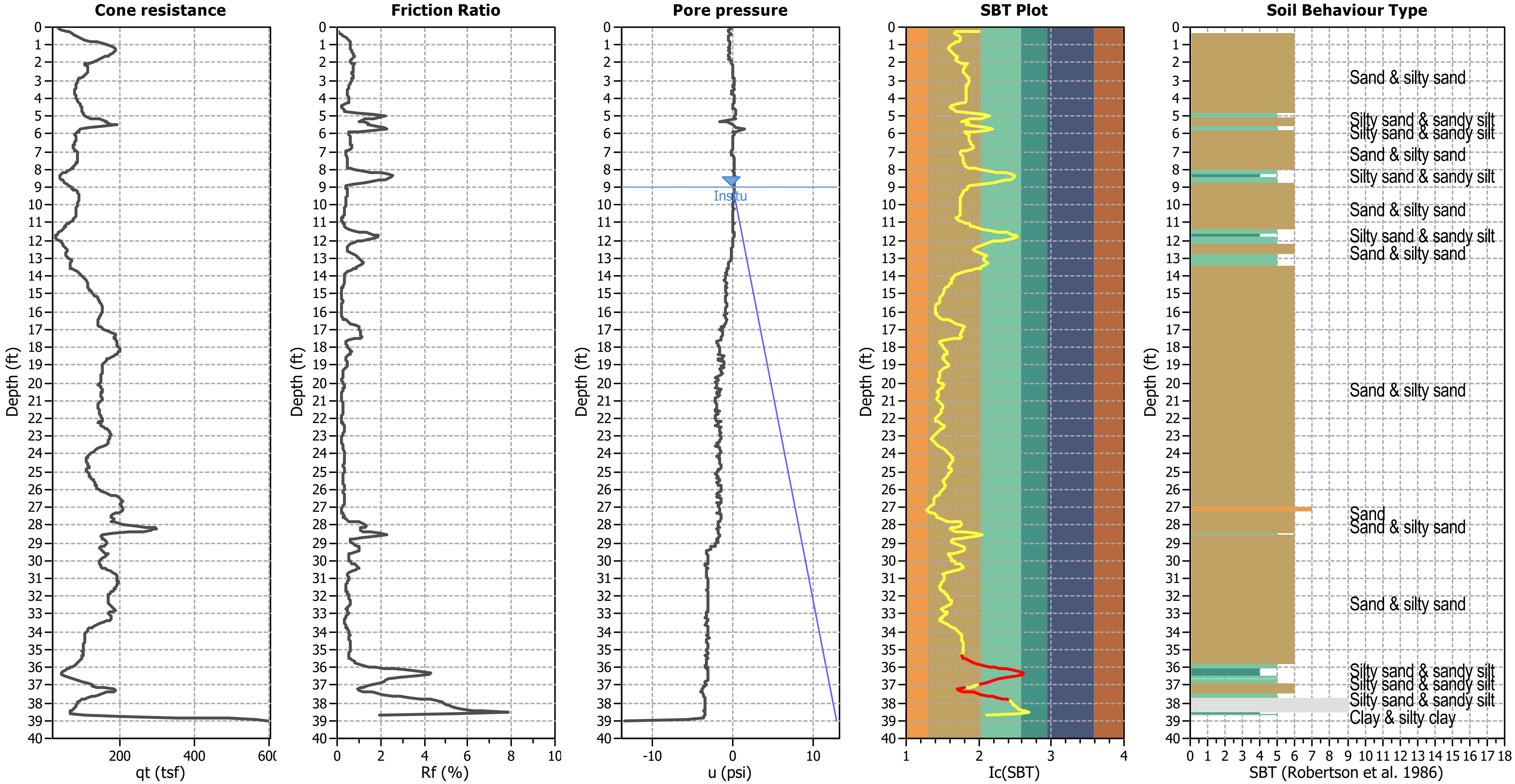






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



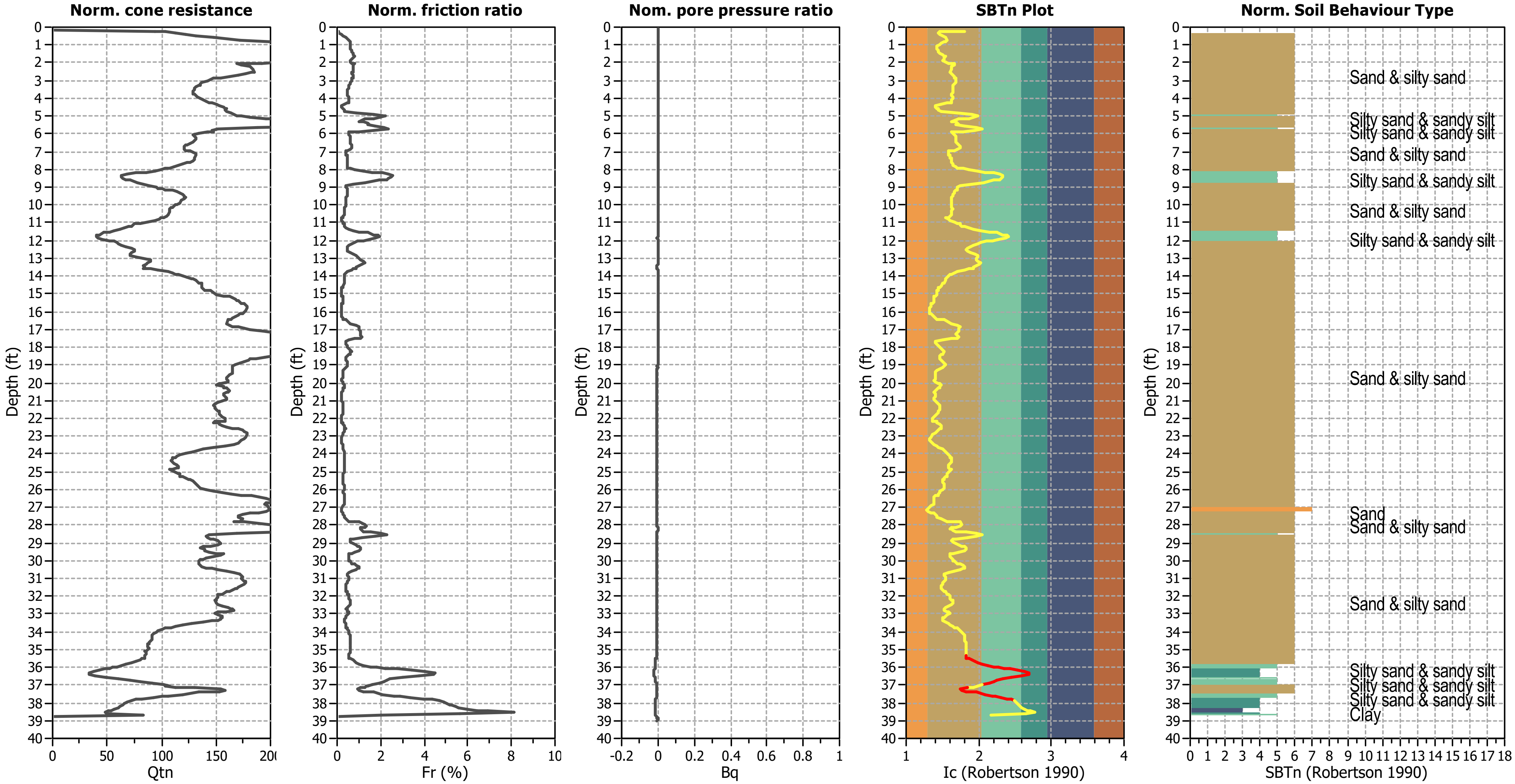
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

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)



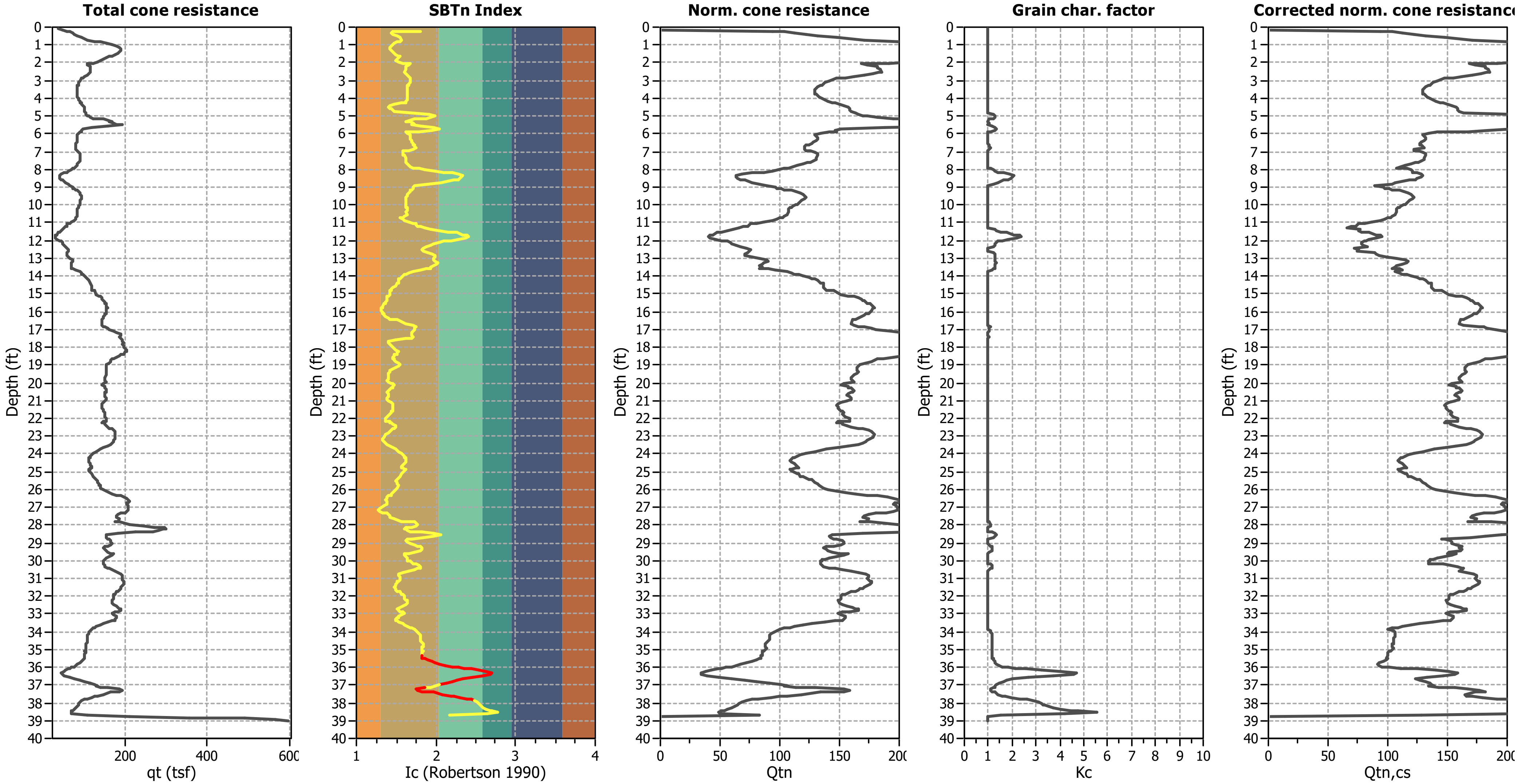
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

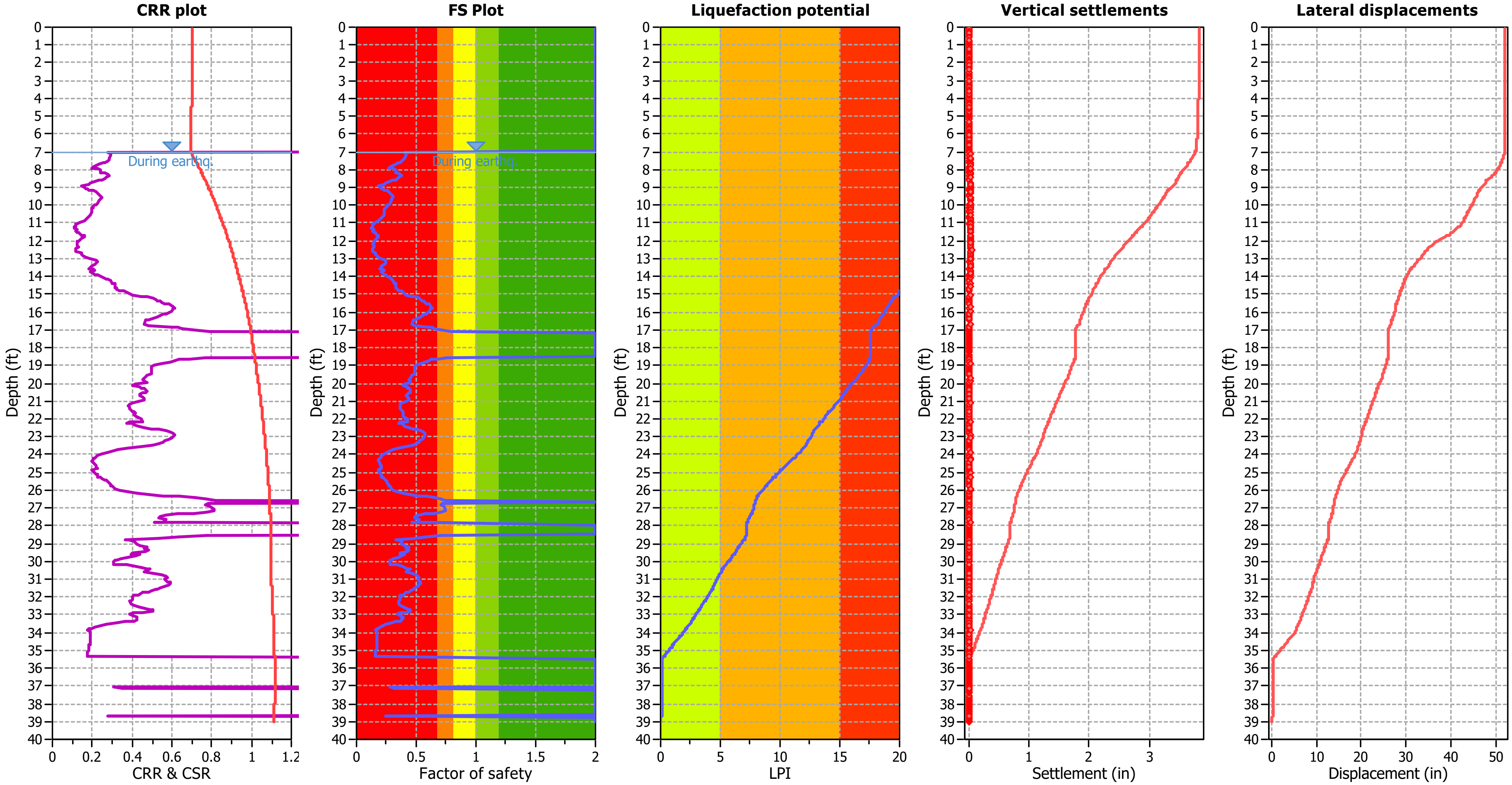
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

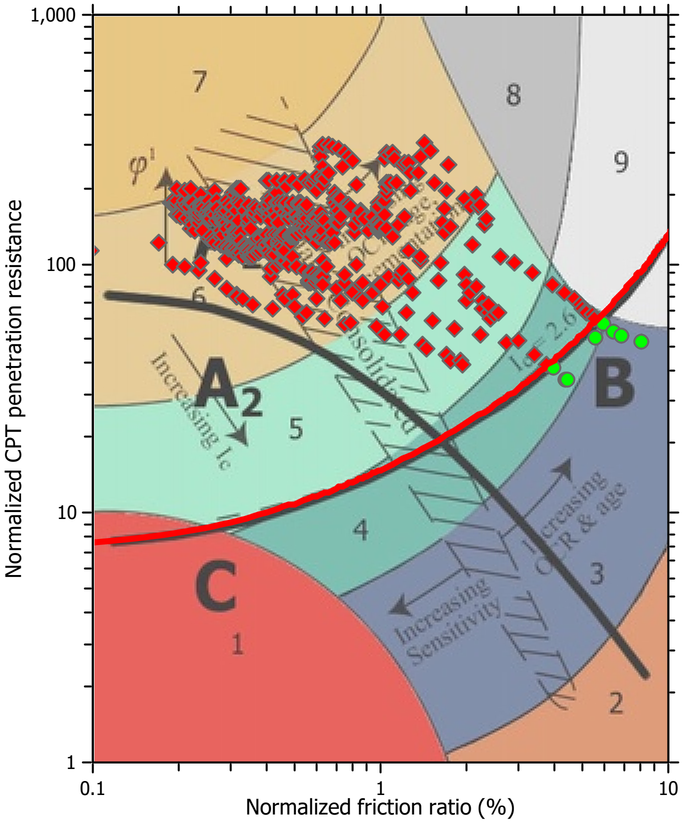
F.S. color scheme

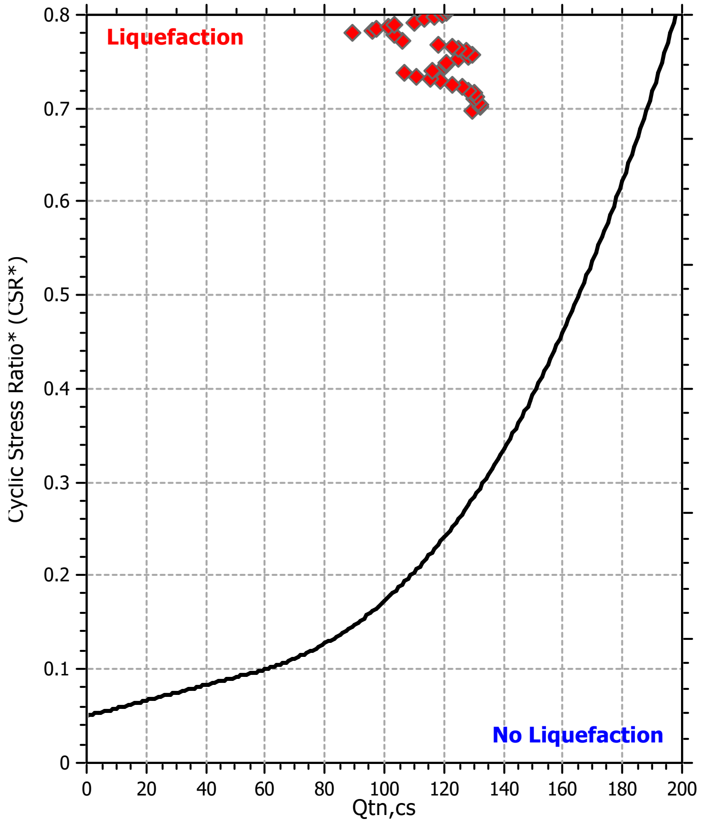
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

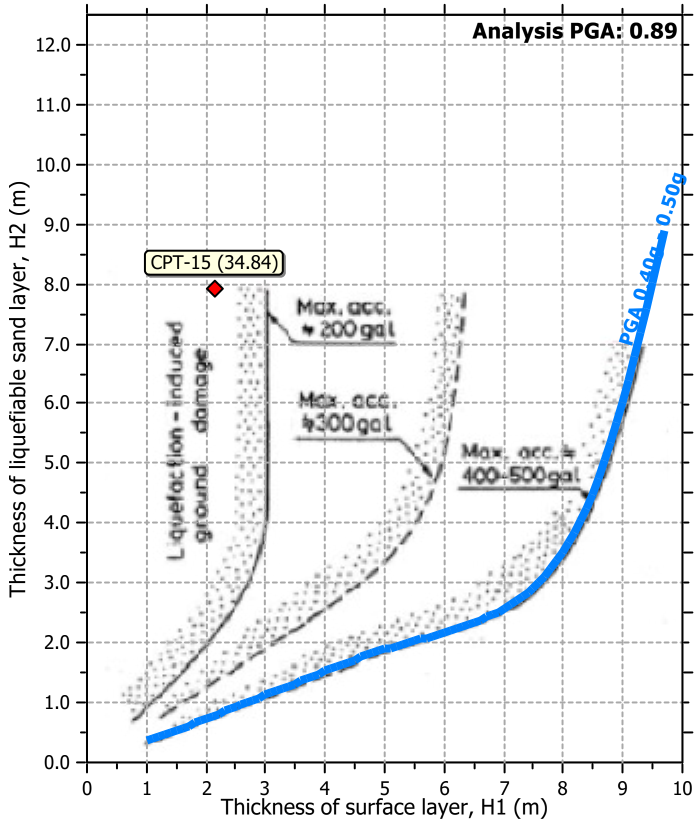
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



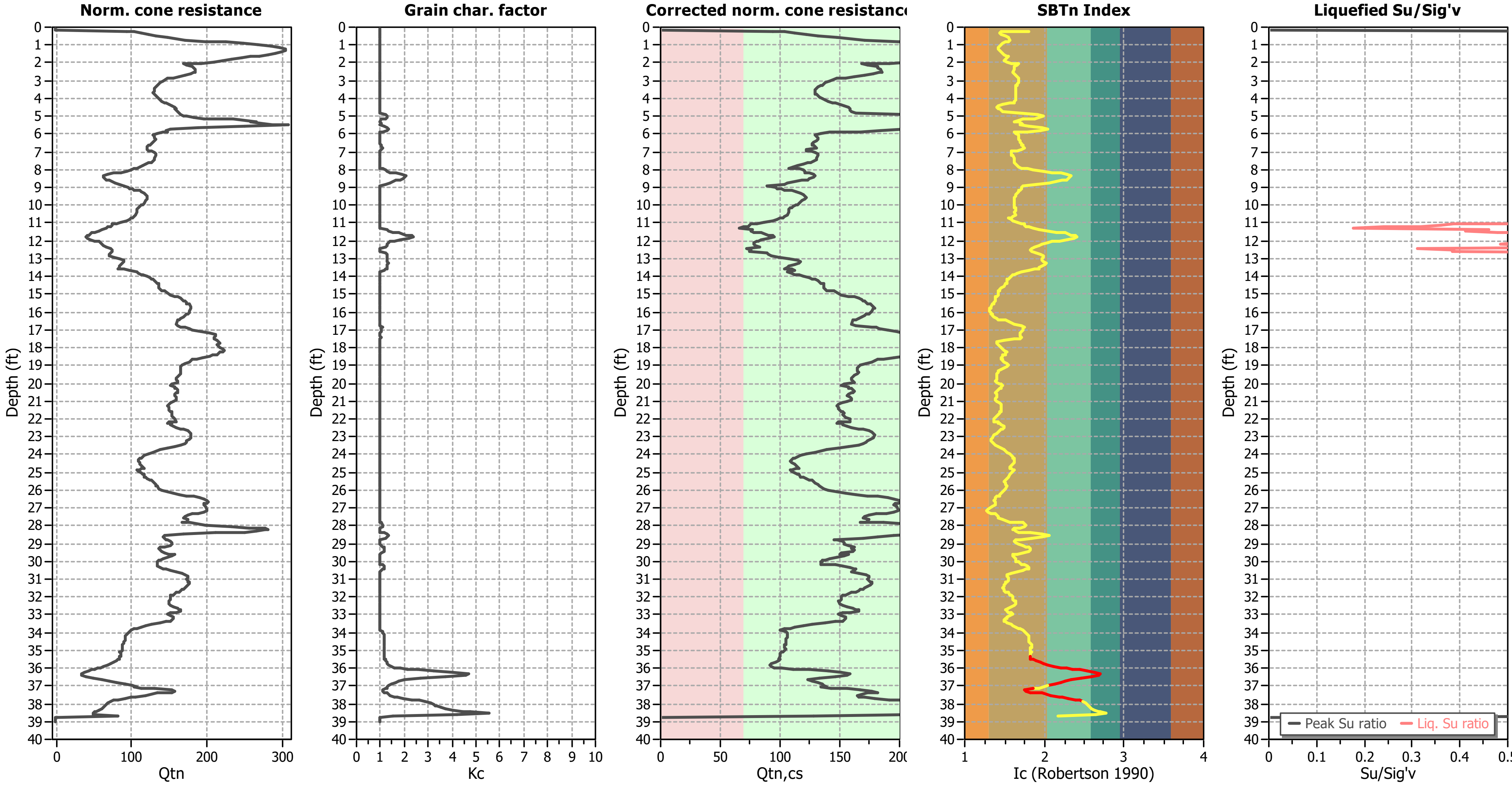




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

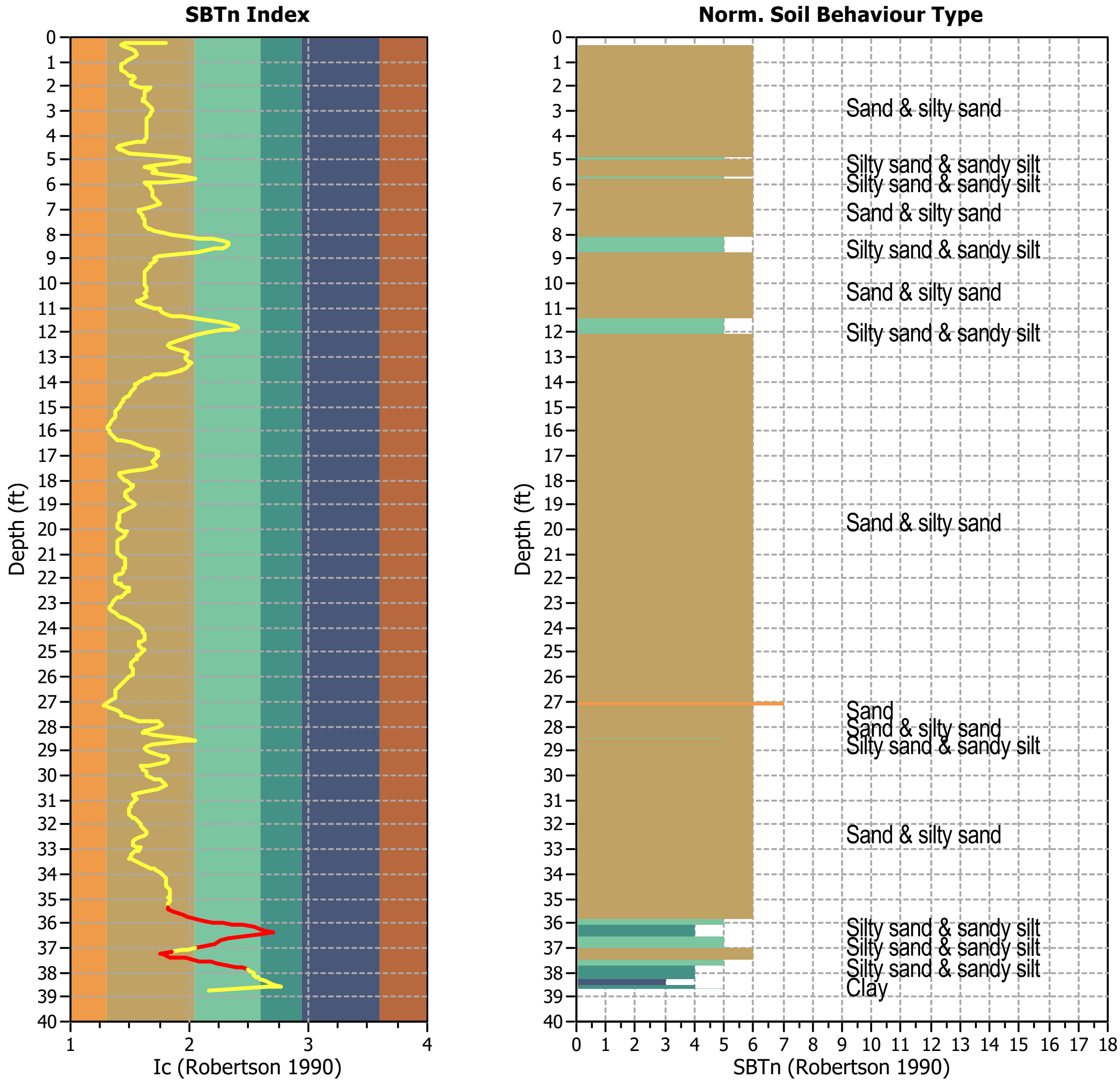
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

TRANSITION LAYER DETECTION ALGORITHM REPORT
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between 1.80 < I_c < 3.0) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.



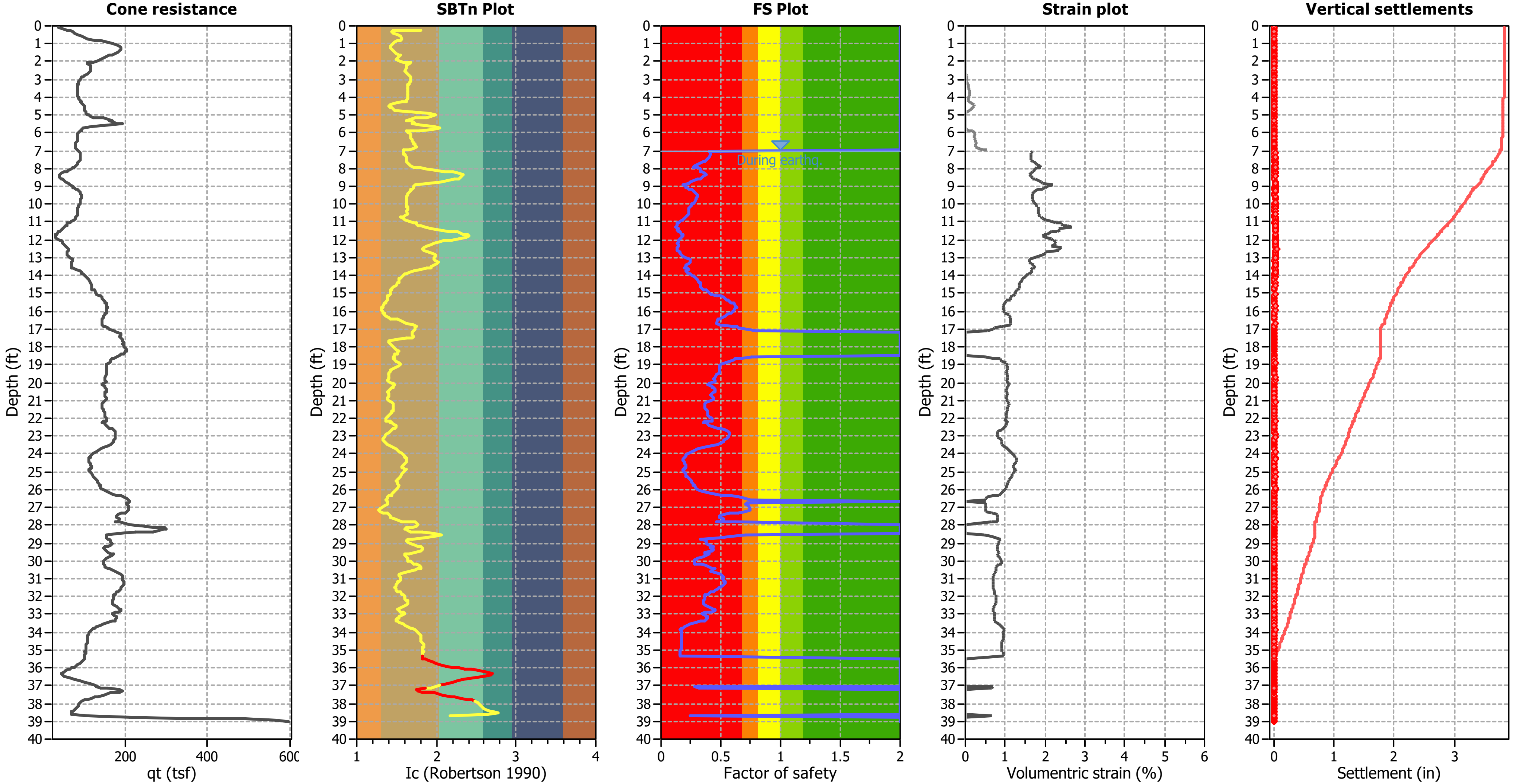
Transition layer algorithm properties

I_c minimum check value:	1.70
I_c maximum check value:	3.00
I_c change ratio value:	0.0250
Minimum number of points in layer:	4

General statistics

Total points in CPT file:	557
Total points excluded:	35
Exclusion percentage:	6.28%
Number of layers detected:	3

Estimation of post-earthquake settlements

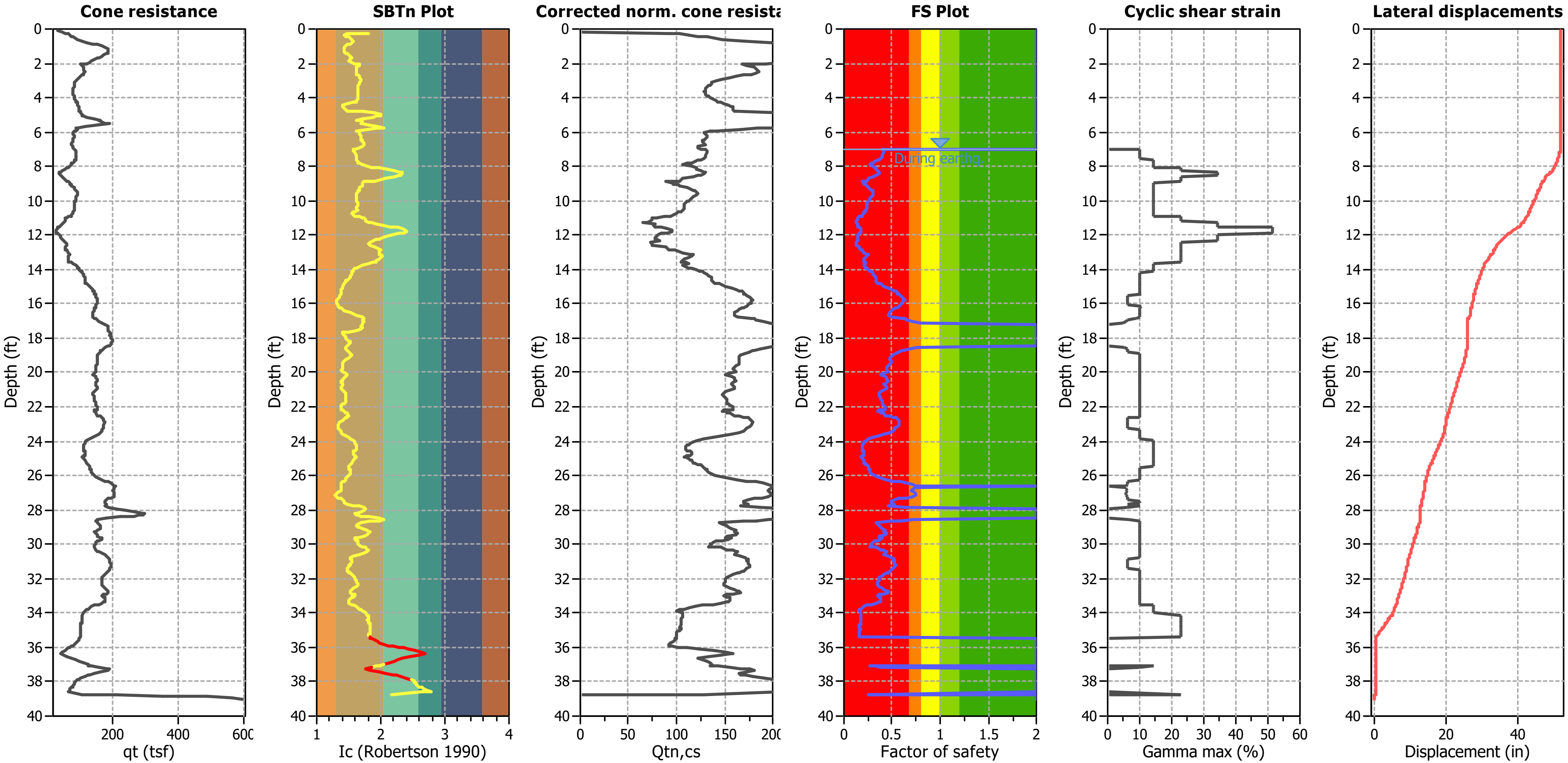


Abbreviations

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

Estimation of post-earthquake lateral Displacements

Geometric parameters: Gently sloping ground without free face (Slope 1.00 %)

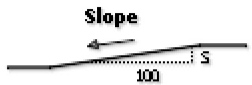


Abbreviations

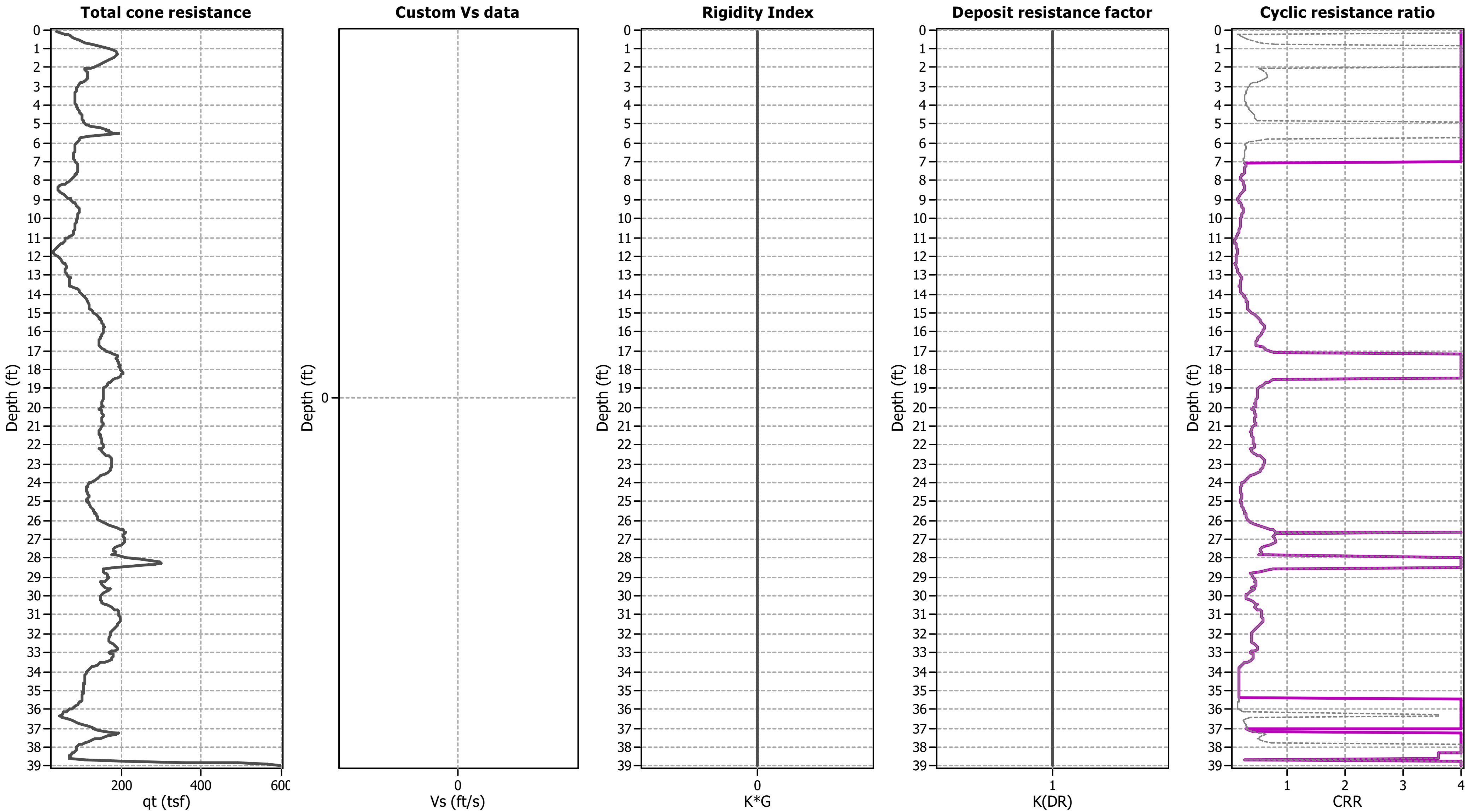
q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance

F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

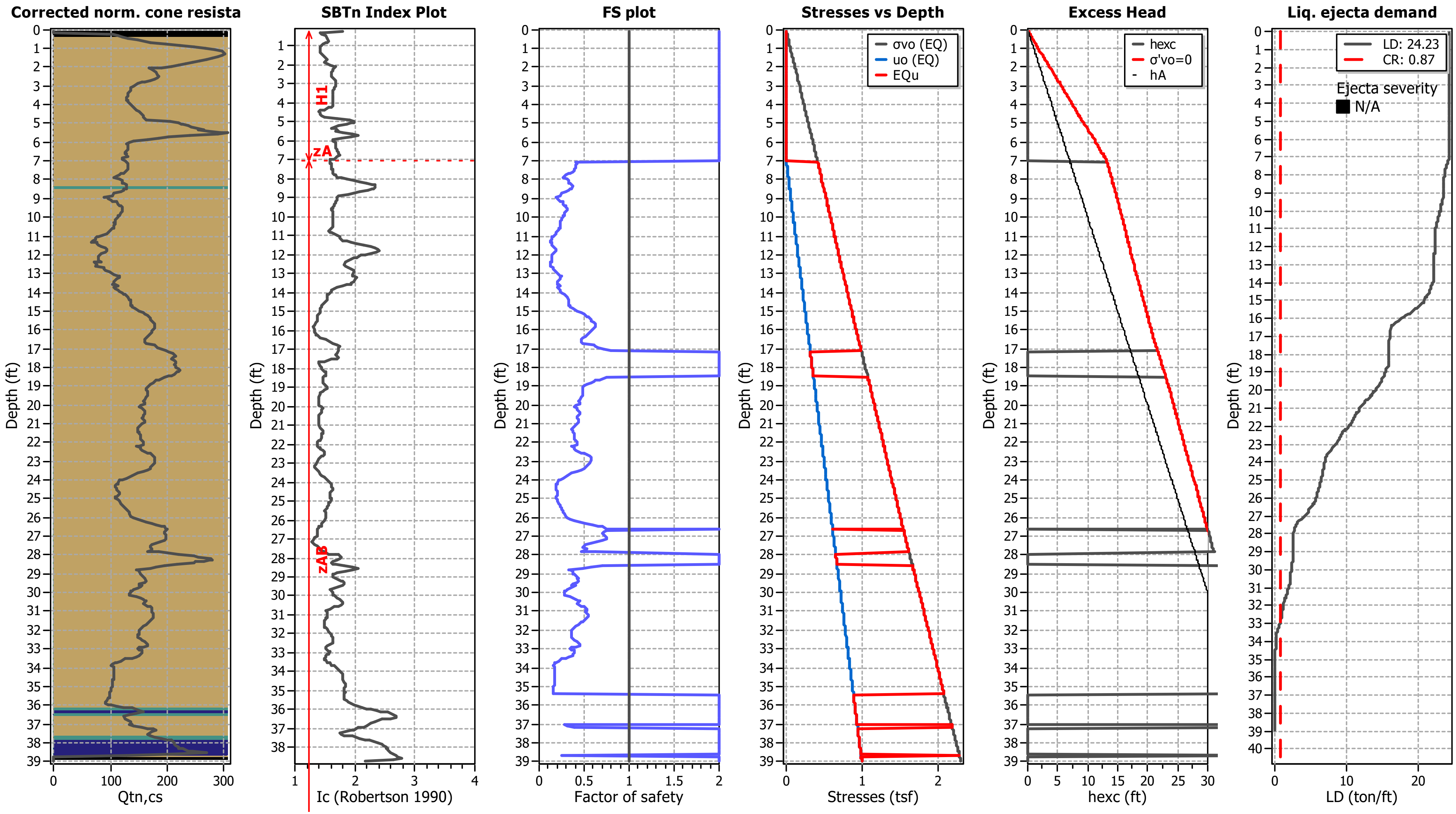
Surface condition



Aging Calculation Estimation



Ejecta Severity Estimation



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

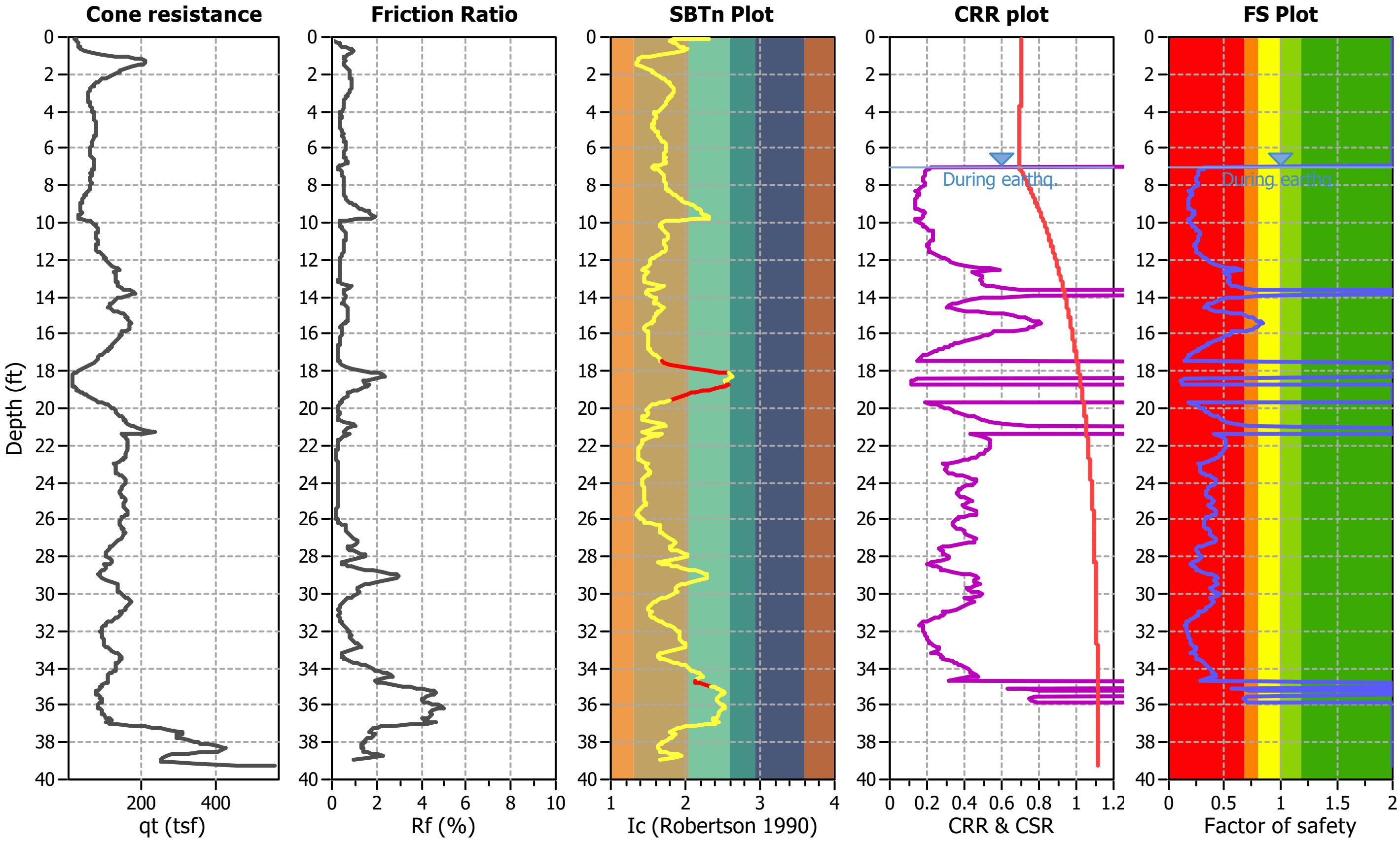
LIQUEFACTION ANALYSIS REPORT

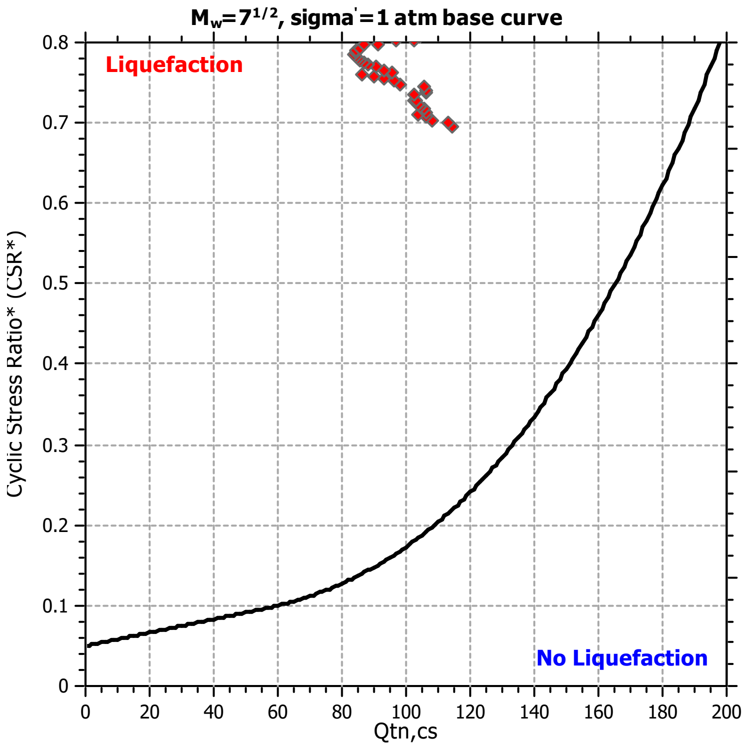
Project title : Petra Geosciences / Apple Canyon **Location : Lake Hemet, CA**

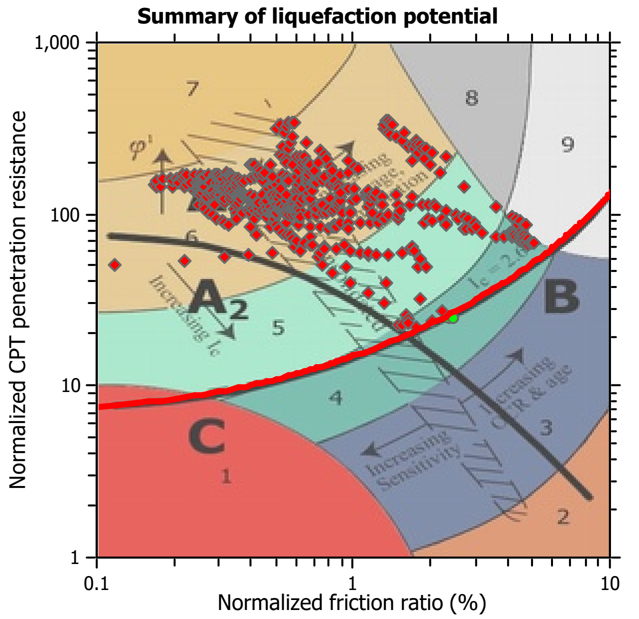
CPT file : CPT-16

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	9.80 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	8.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.89	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

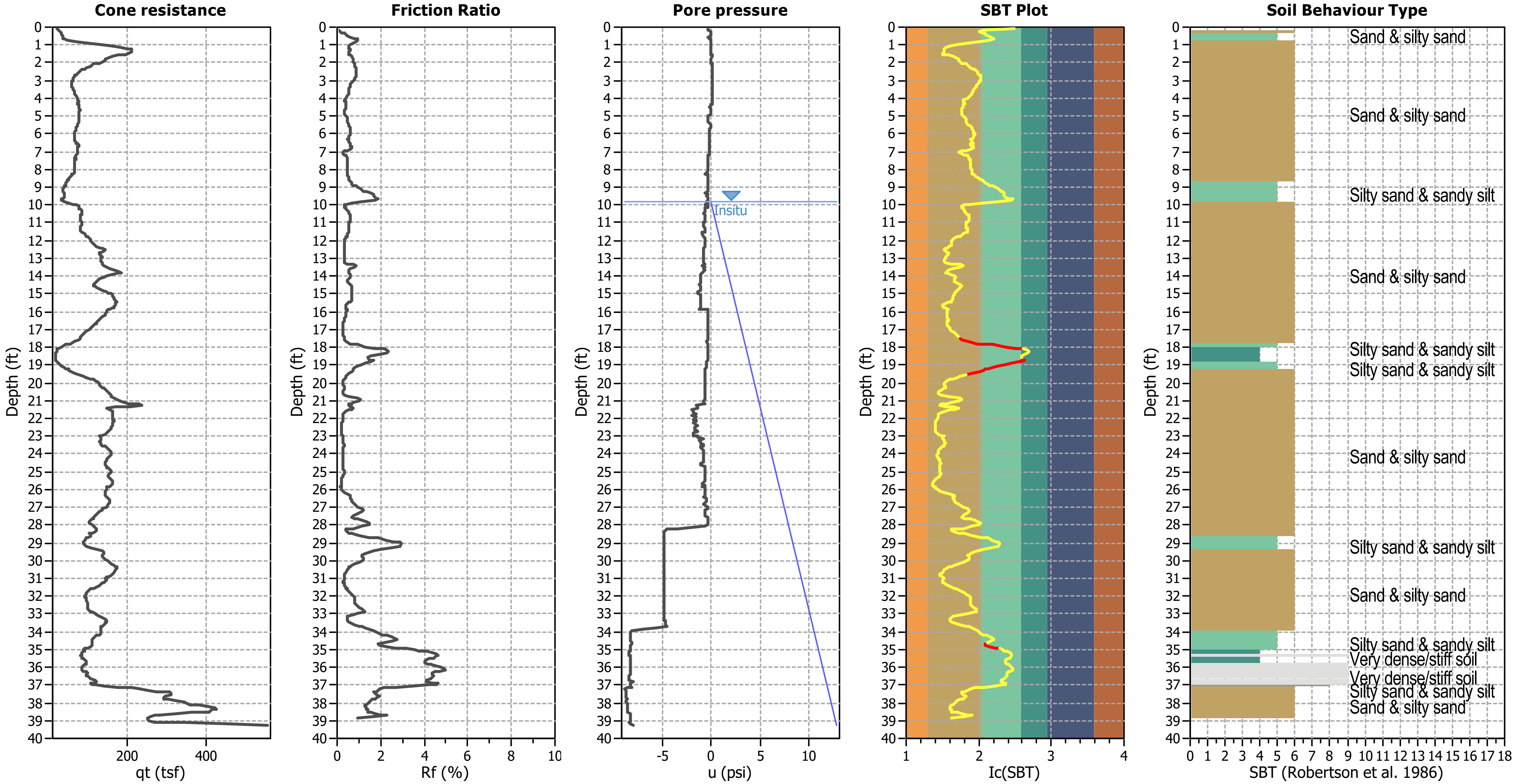






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



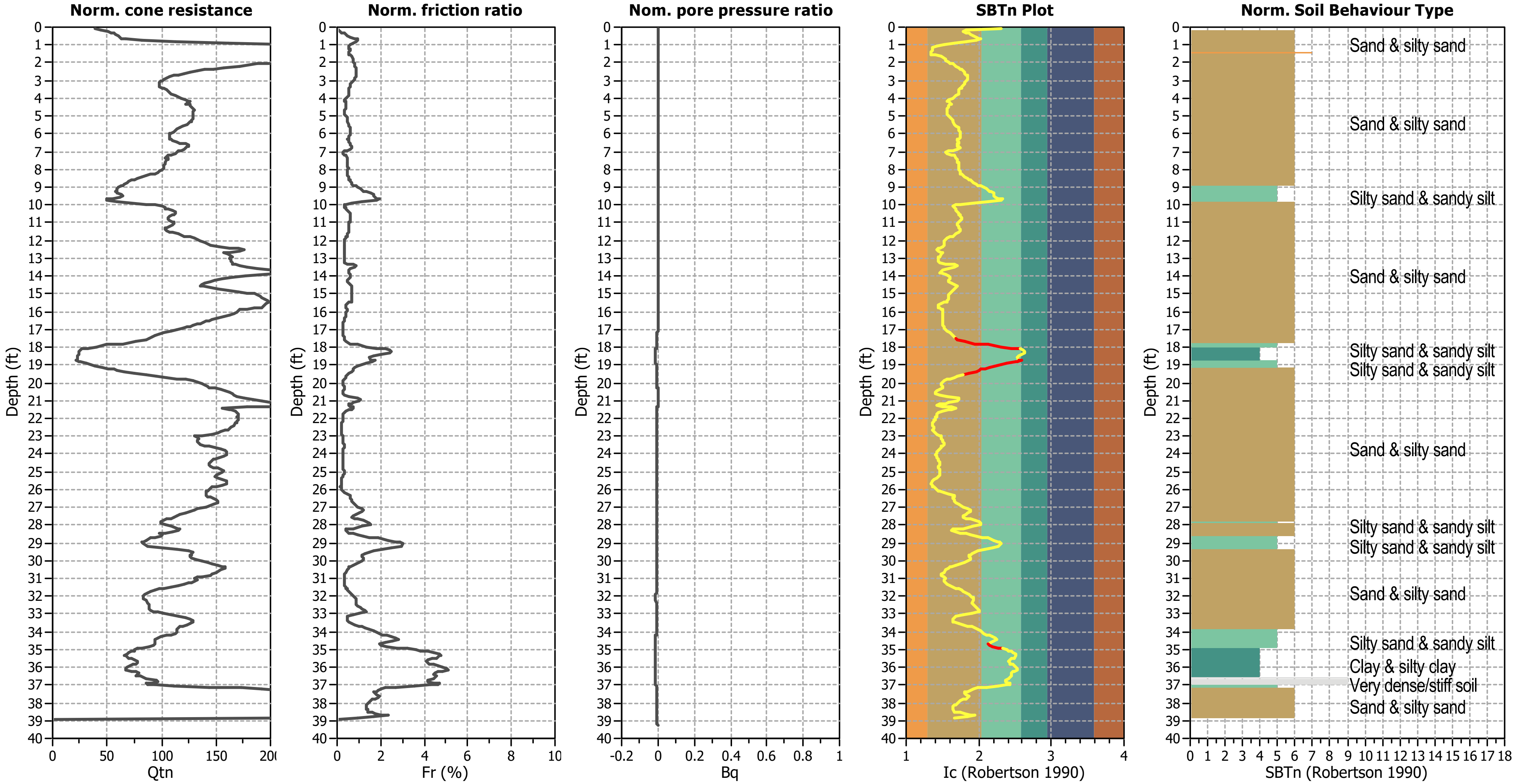
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.80 ft	Fill height:	N/A	Limit depth:	N/A

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)



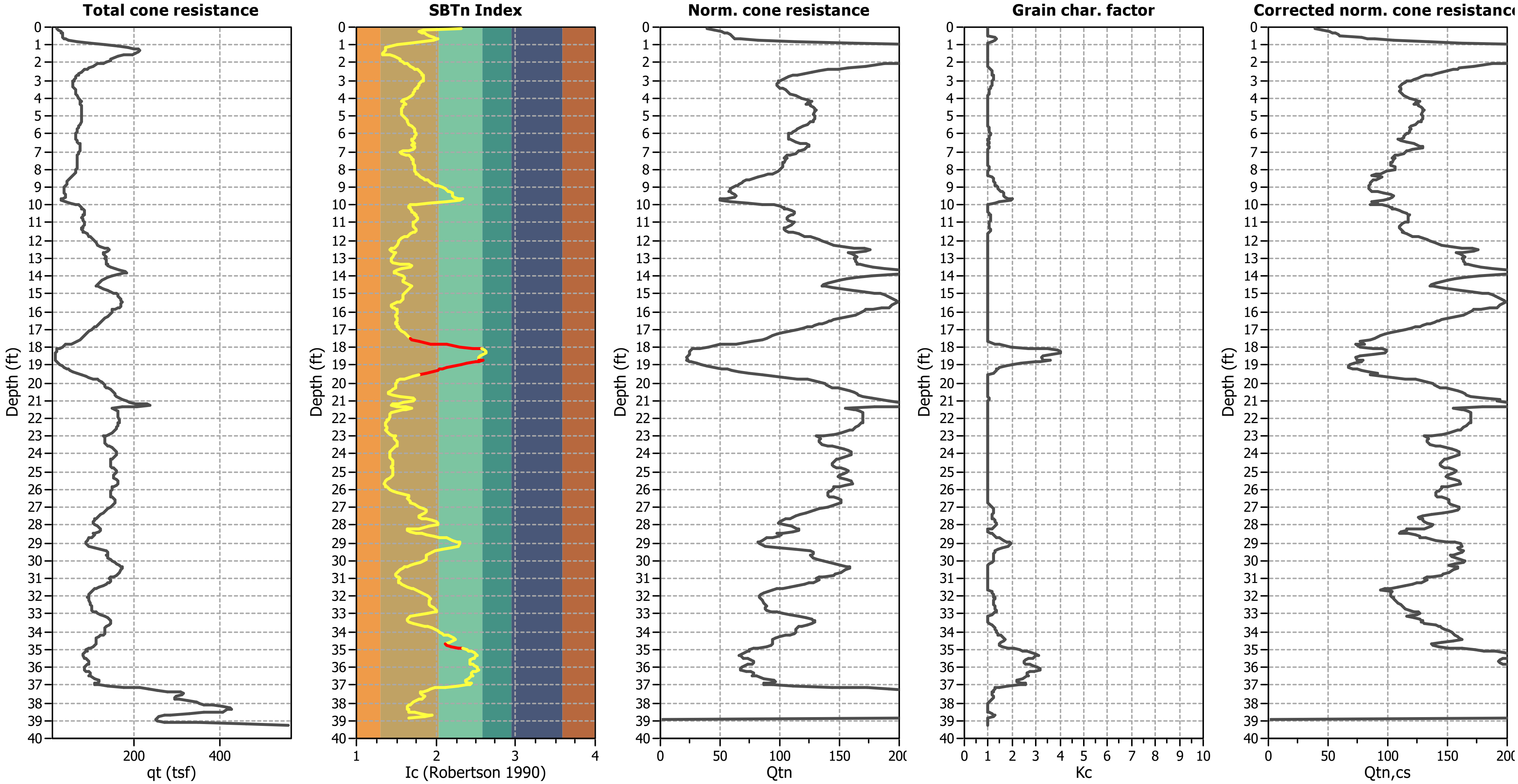
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.80 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

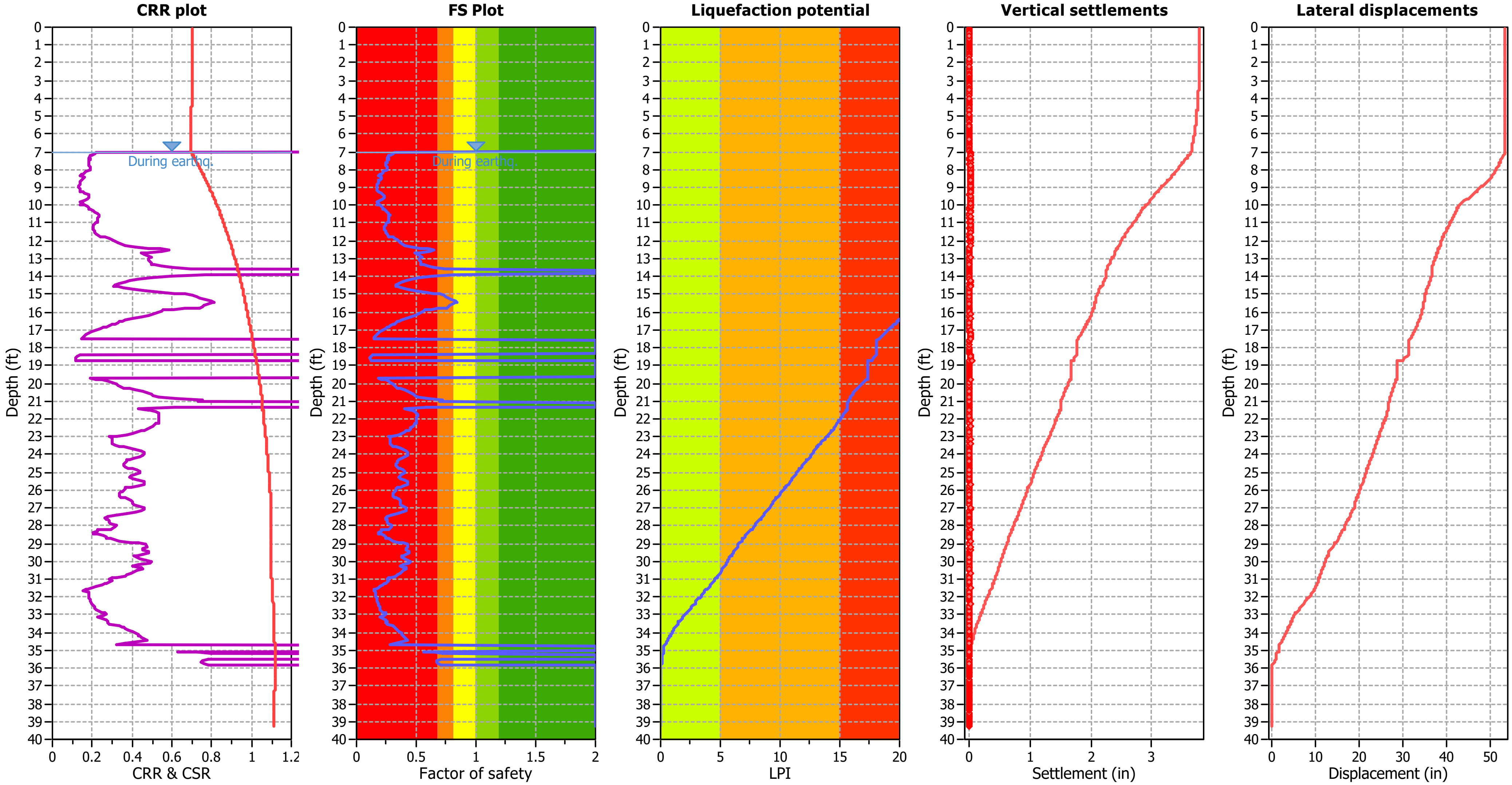
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.80 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.80 ft	Fill height:	N/A	Limit depth:	N/A

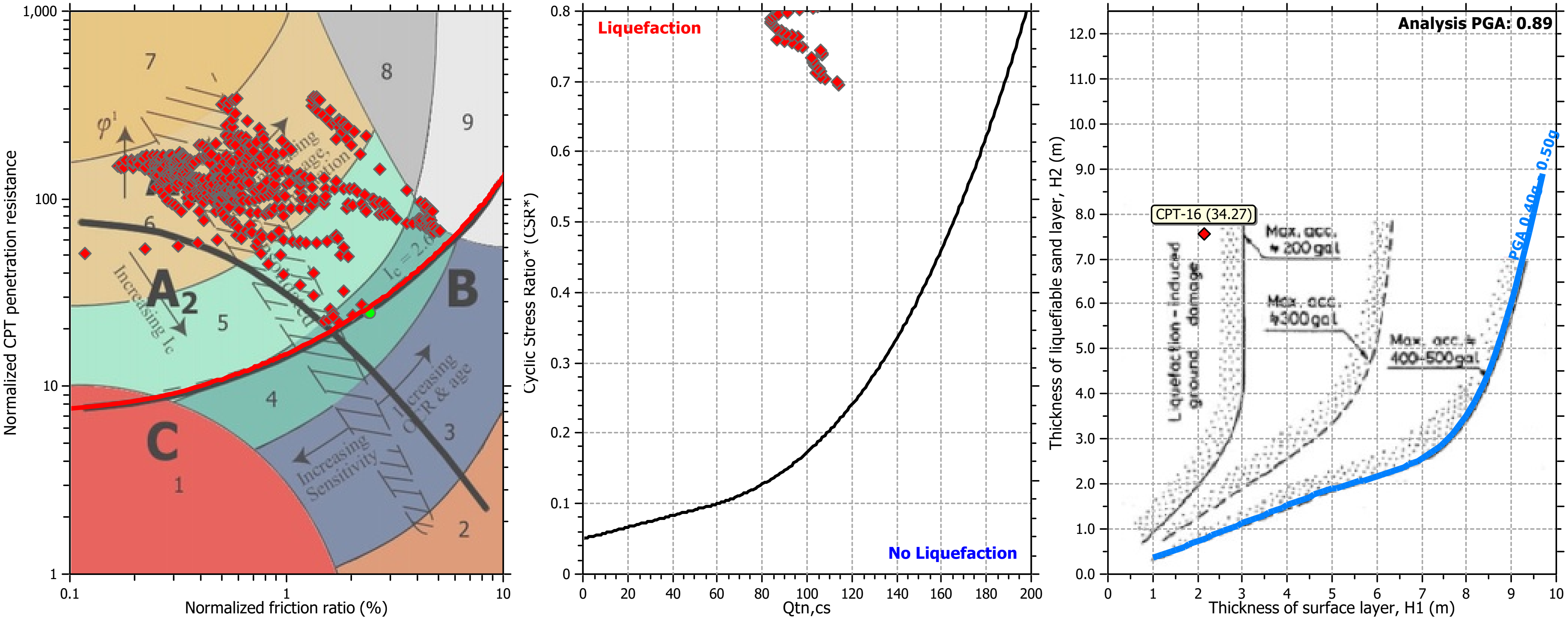
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

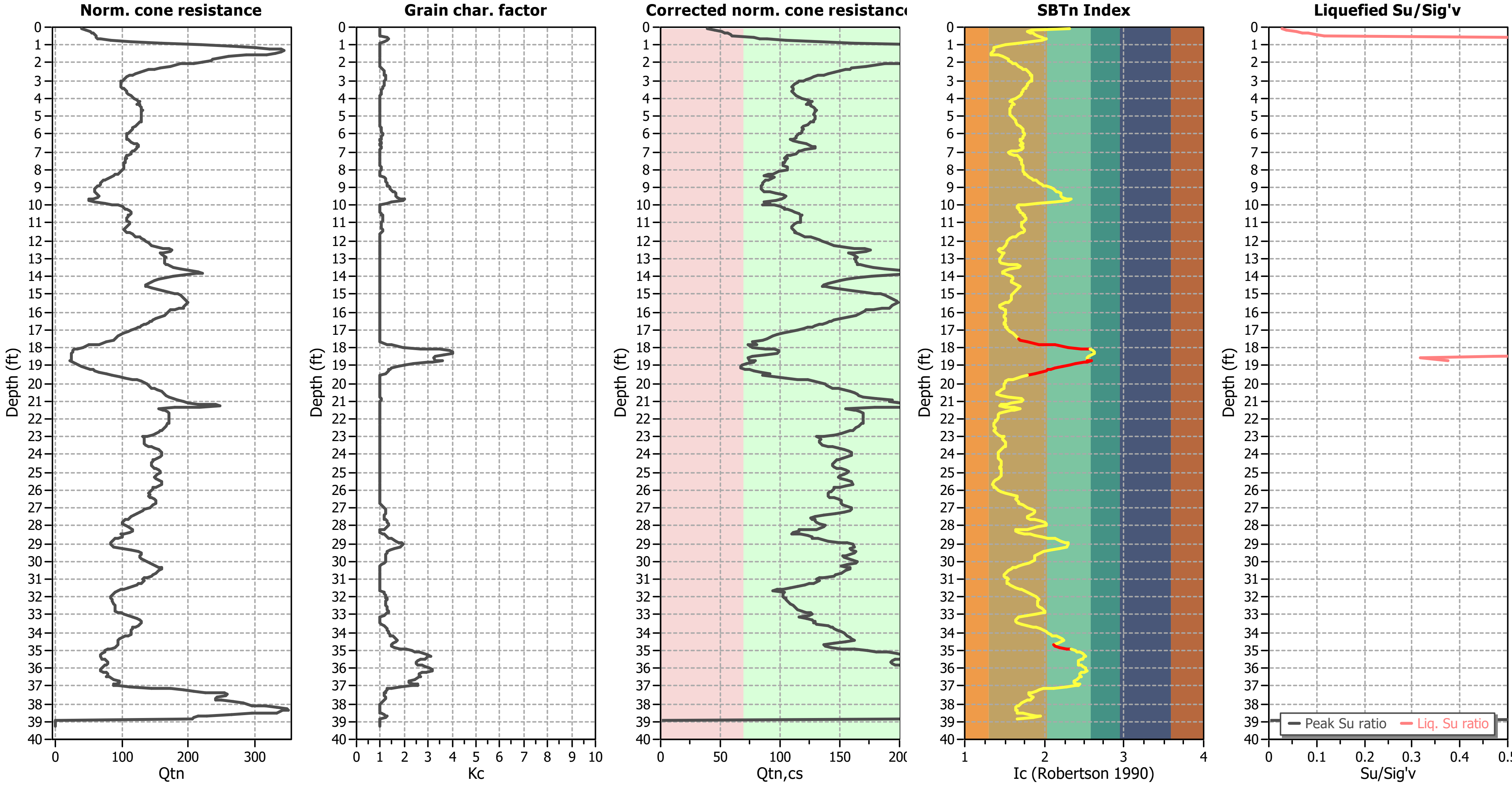
Liquefaction analysis summary plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.80 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

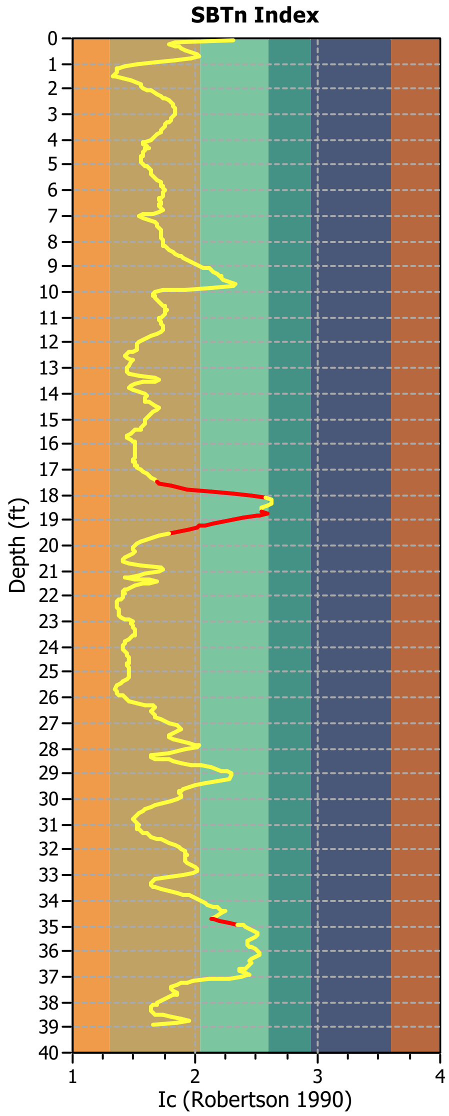
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.80 ft	Fill height:	N/A	Limit depth:	N/A

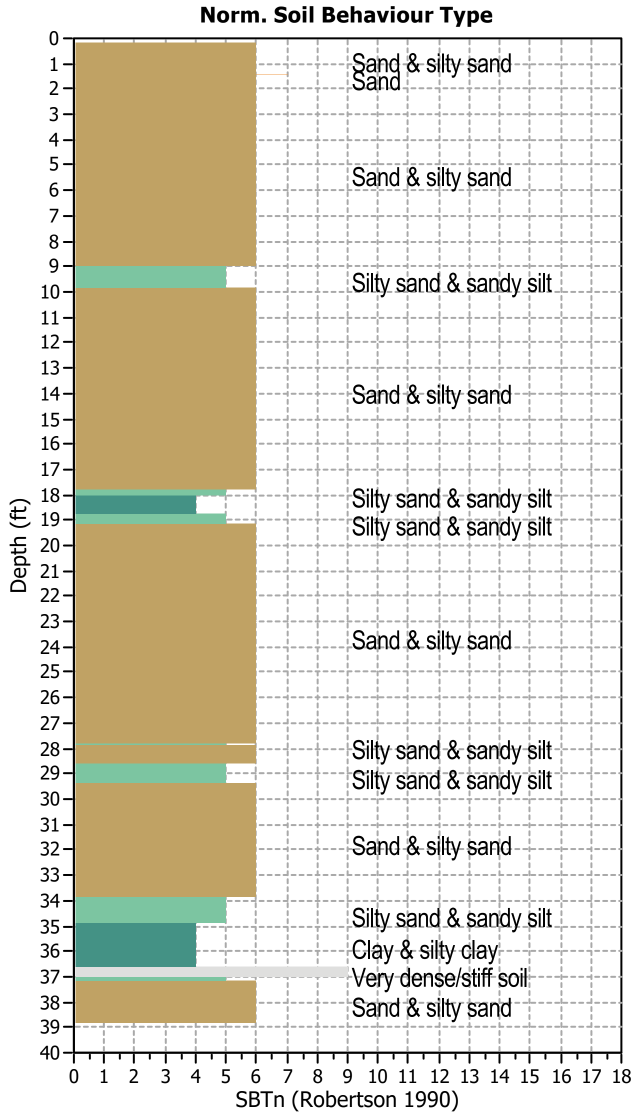
TRANSITION LAYER DETECTION ALGORITHM REPORT
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between 1.80 < I_c < 3.0) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.





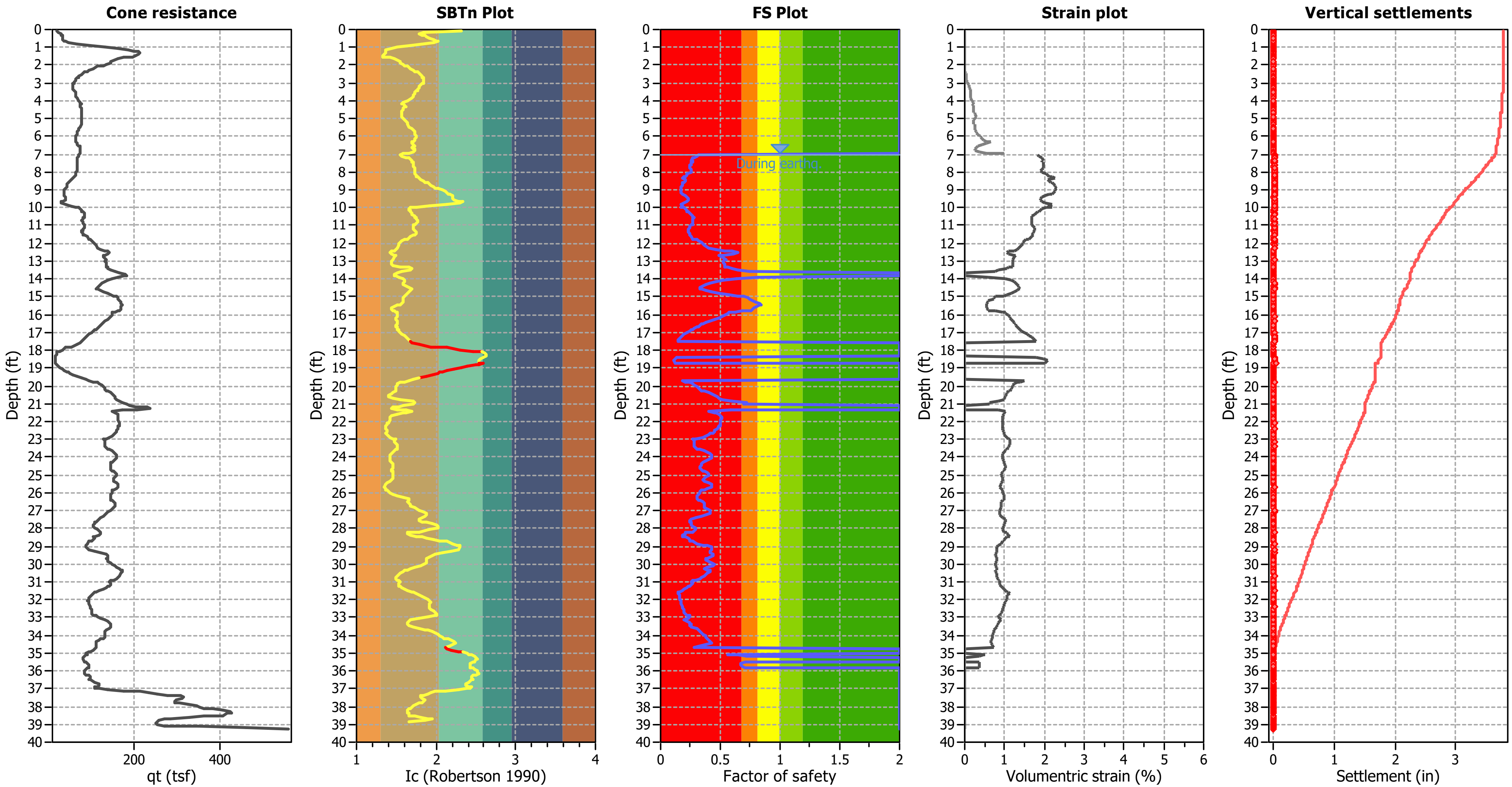
Transition layer algorithm properties

I_c minimum check value:	1.70
I_c maximum check value:	3.00
I_c change ratio value:	0.0250
Minimum number of points in layer:	4

General statistics

Total points in CPT file:	563
Total points excluded:	27
Exclusion percentage:	4.80%
Number of layers detected:	3

Estimation of post-earthquake settlements

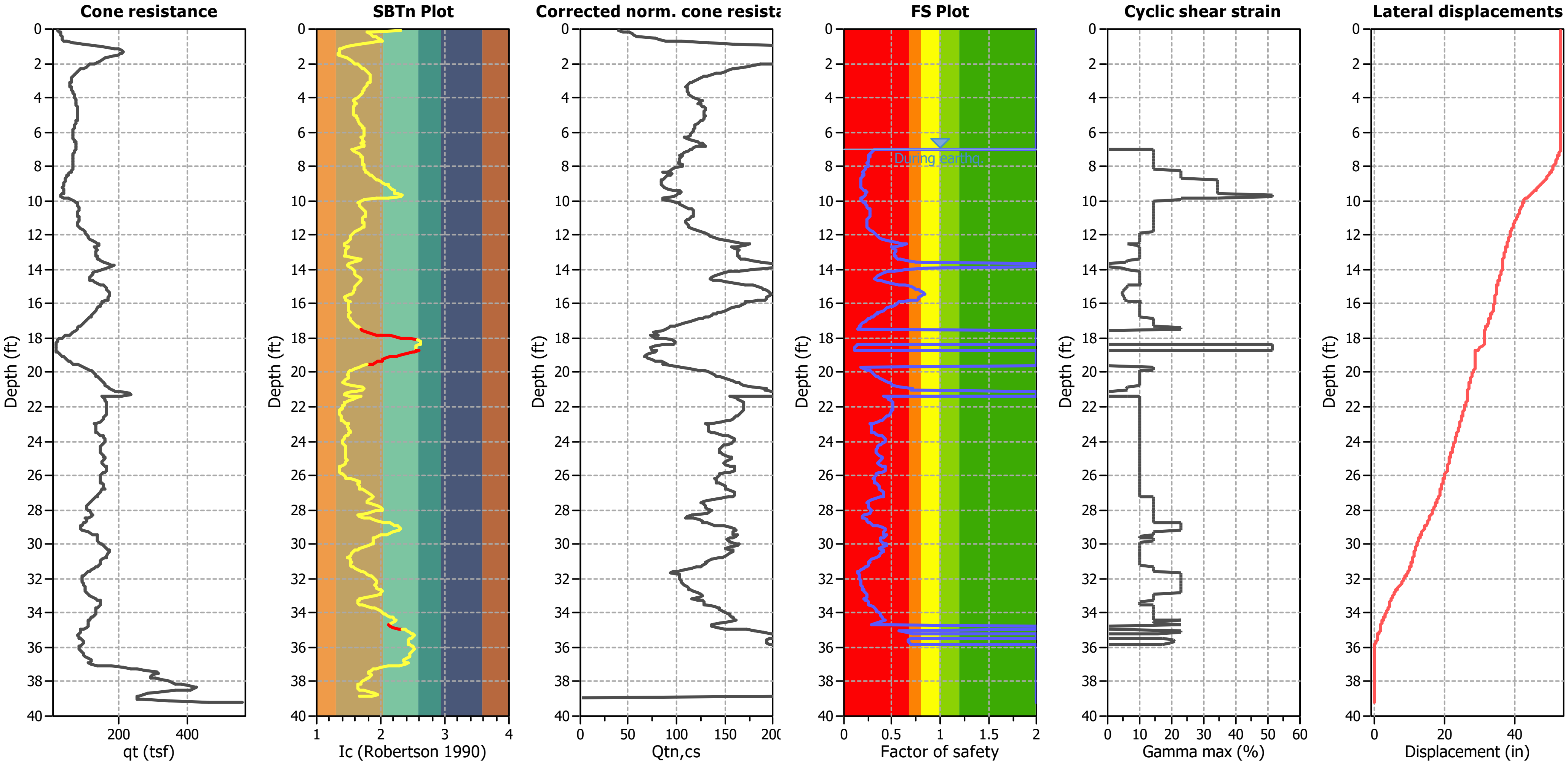


Abbreviations

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

Estimation of post-earthquake lateral Displacements

Geometric parameters: Gently sloping ground without free face (Slope 1.00 %)

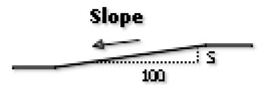


Abbreviations

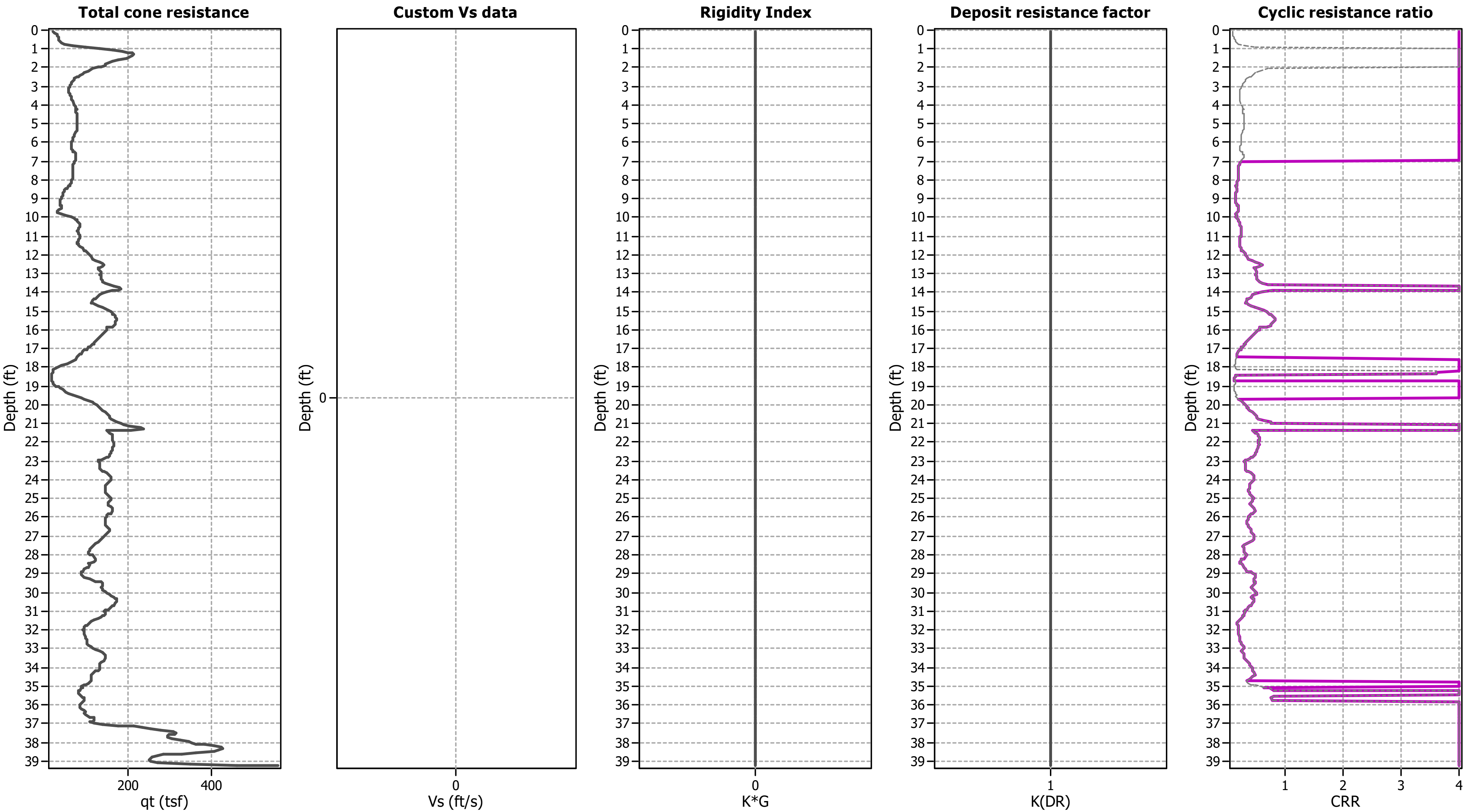
q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance

F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

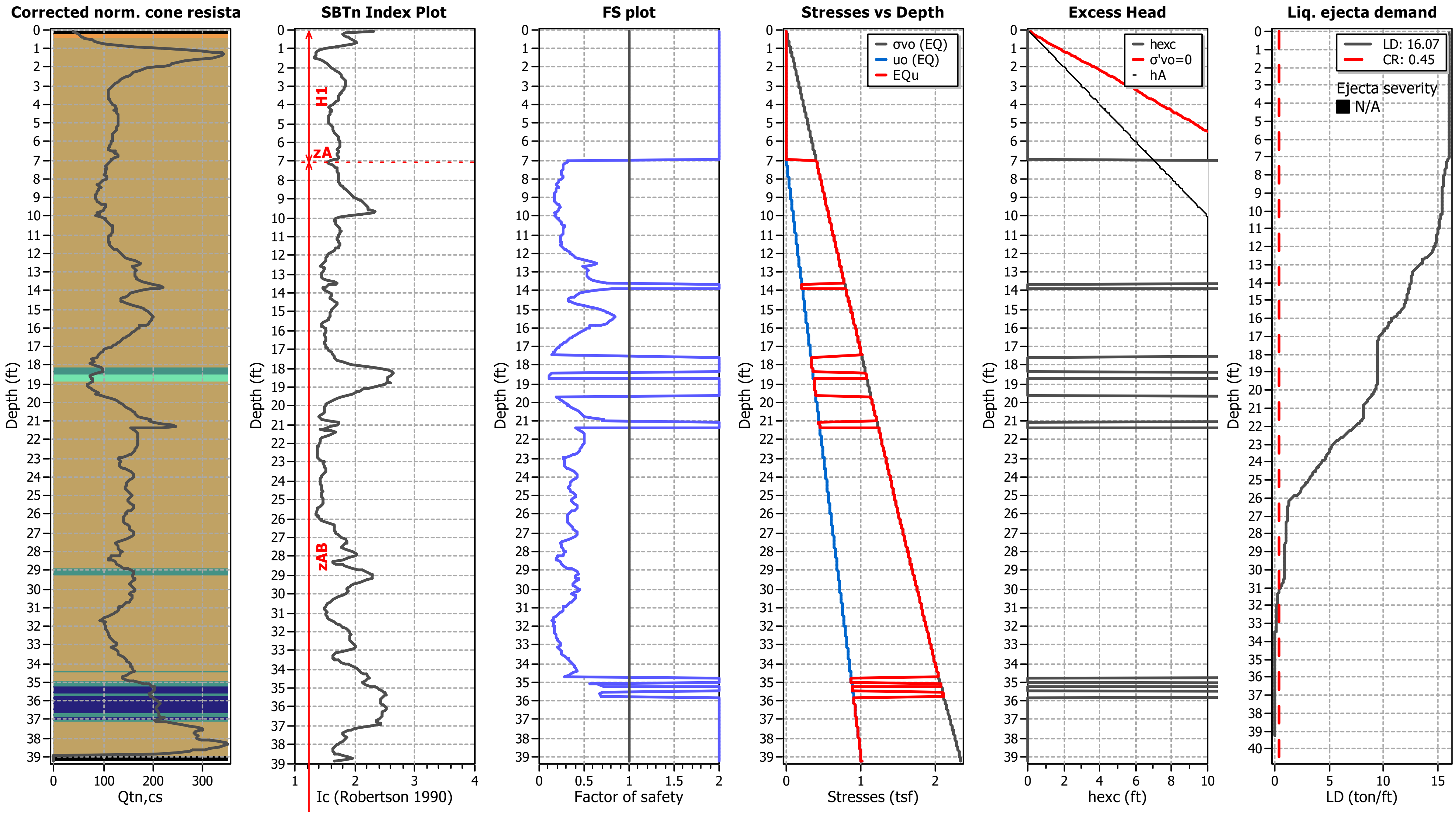
Surface condition



Aging Calculation Estimation



Ejecta Severity Estimation



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

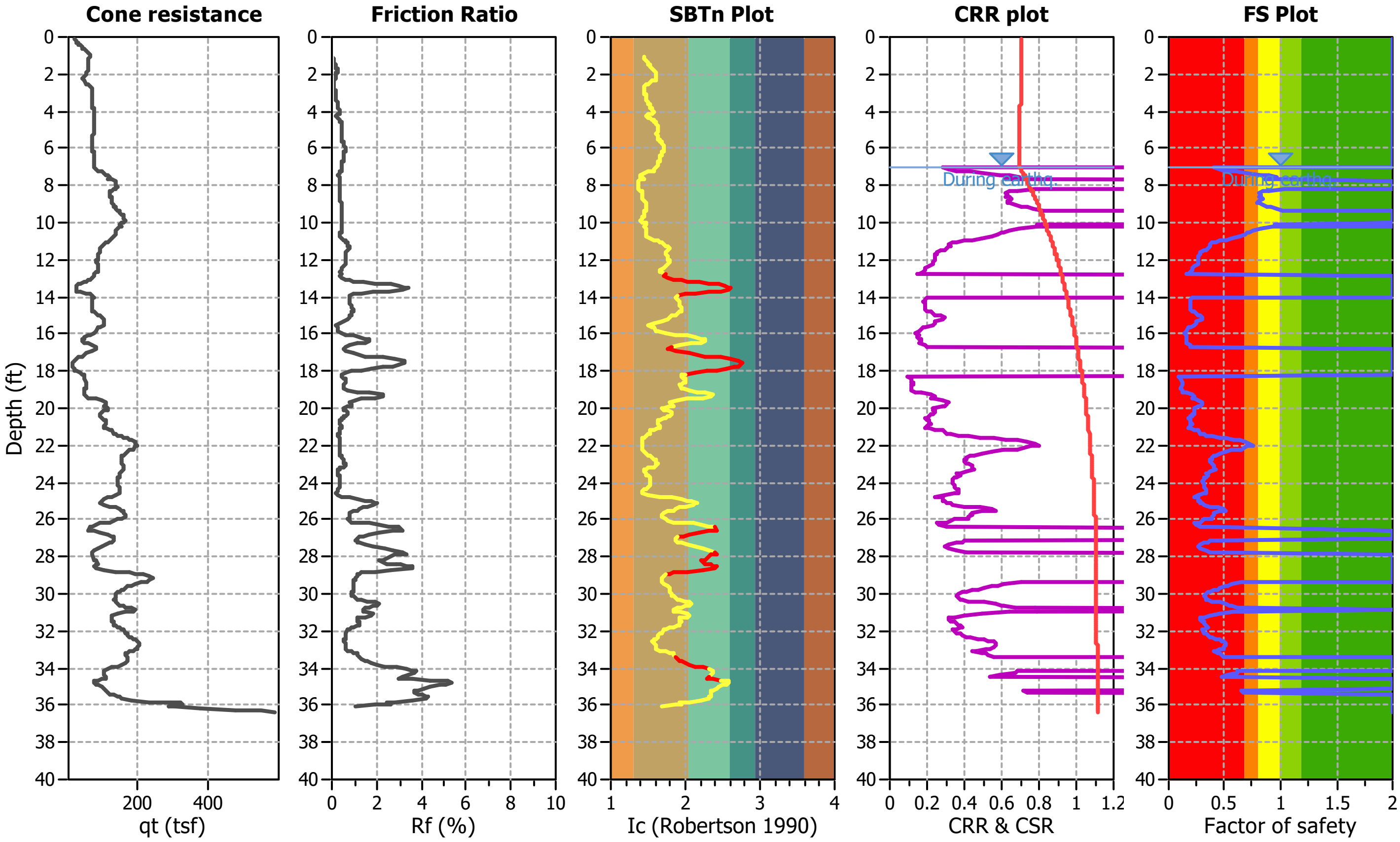
LIQUEFACTION ANALYSIS REPORT

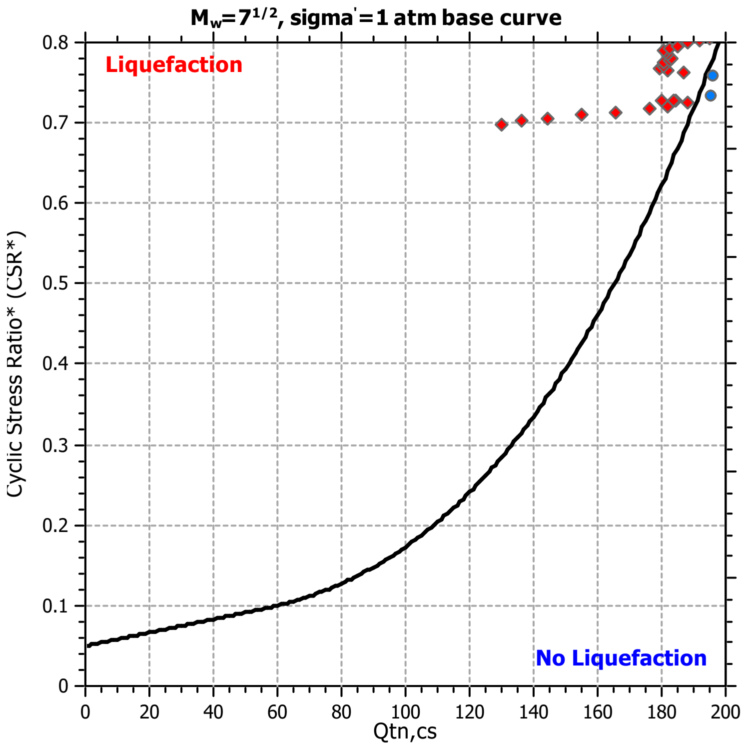
Project title : Petra Geosciences / Apple Canyon **Location : Lake Hemet, CA**

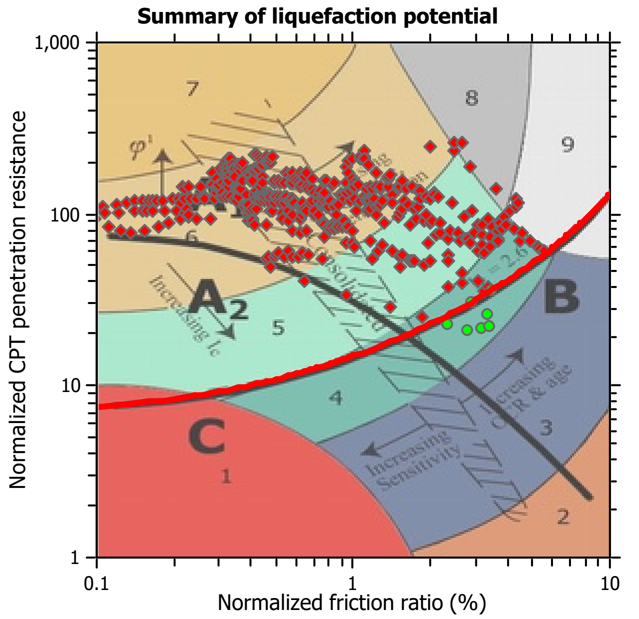
CPT file : CPT-17

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	12.50 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	8.10	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.89	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

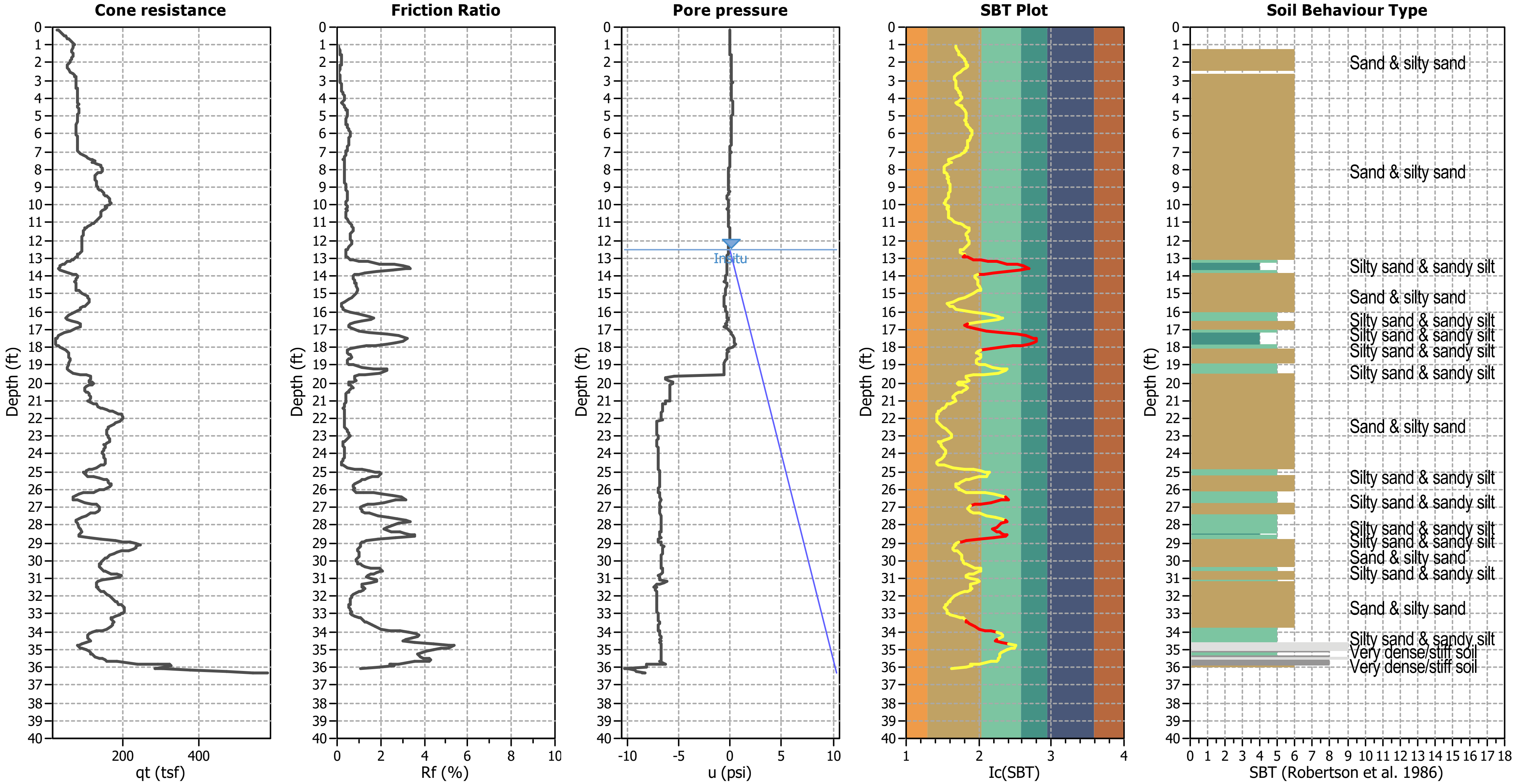






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



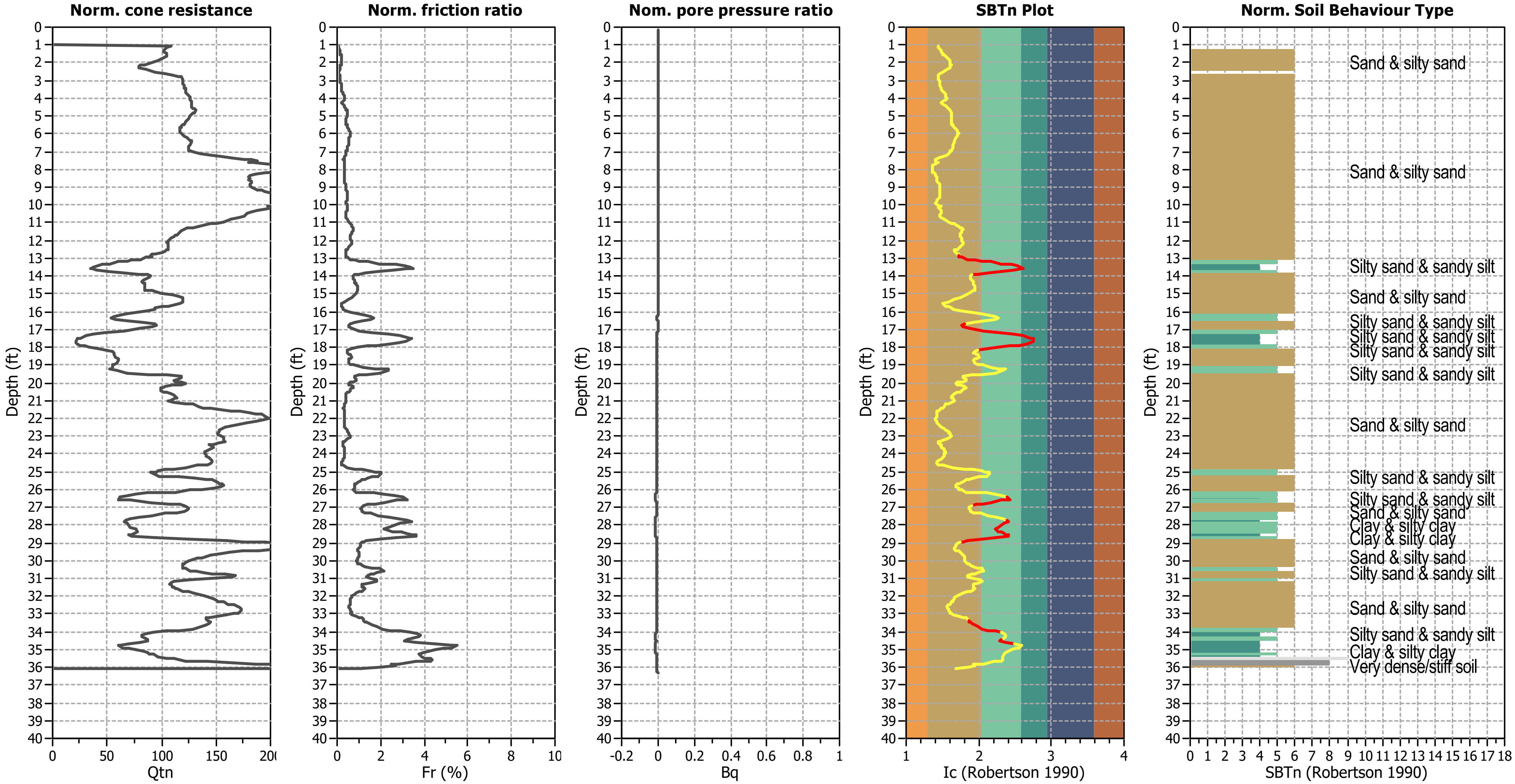
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.50 ft	Fill height:	N/A	Limit depth:	N/A

SBT 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

CPT basic interpretation plots (normalized)



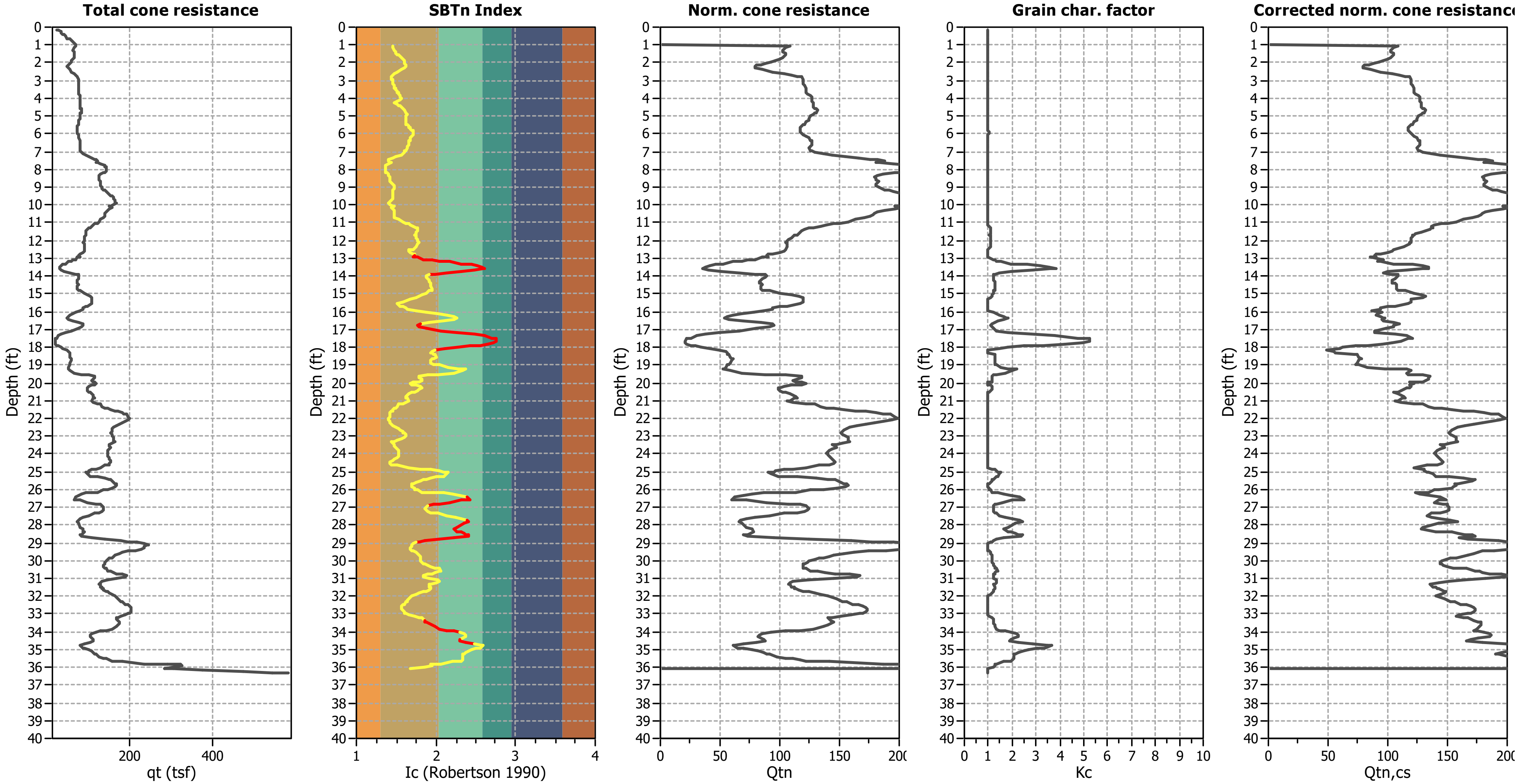
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.50 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

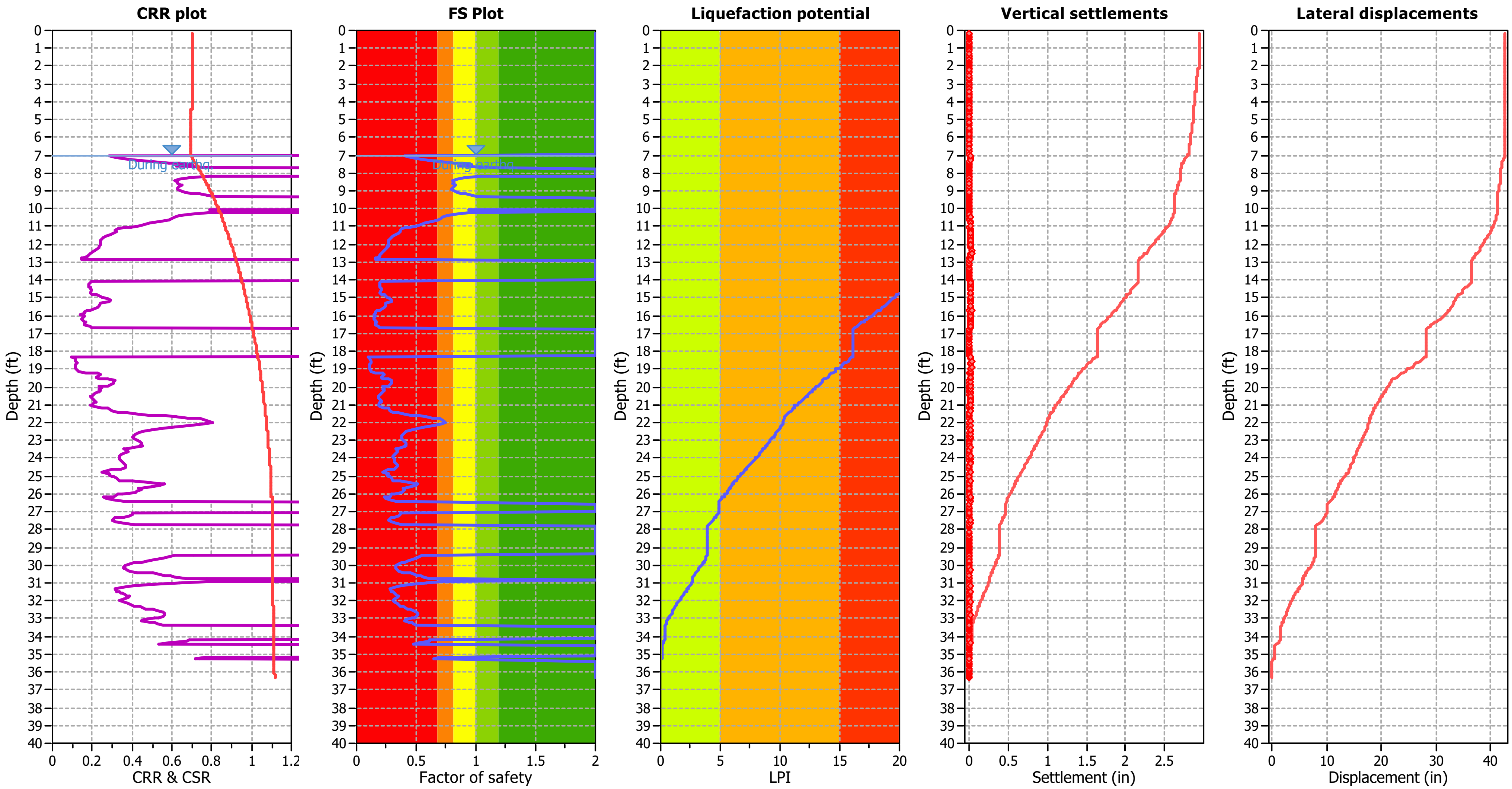
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.50 ft	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.50 ft	Fill height:	N/A	Limit depth:	N/A

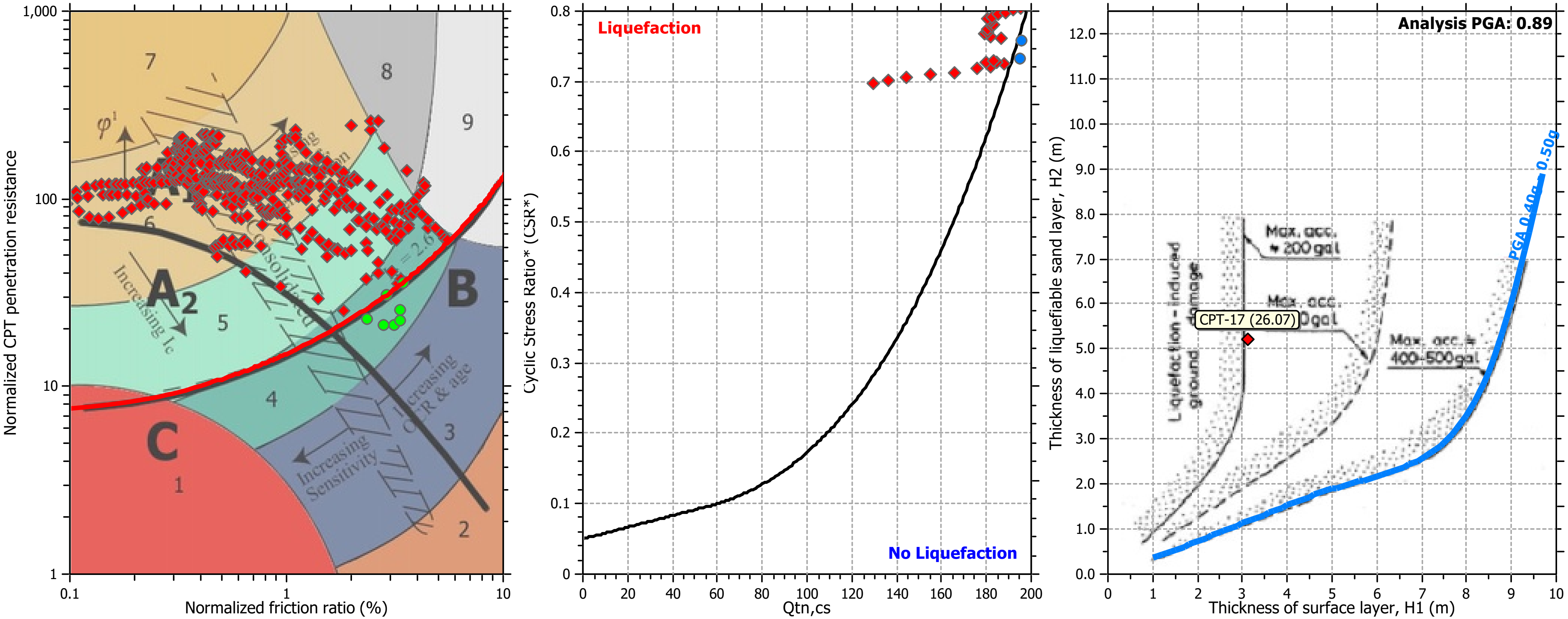
F.S. color scheme

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

LPI color scheme

- Very high risk
- High risk
- Low risk

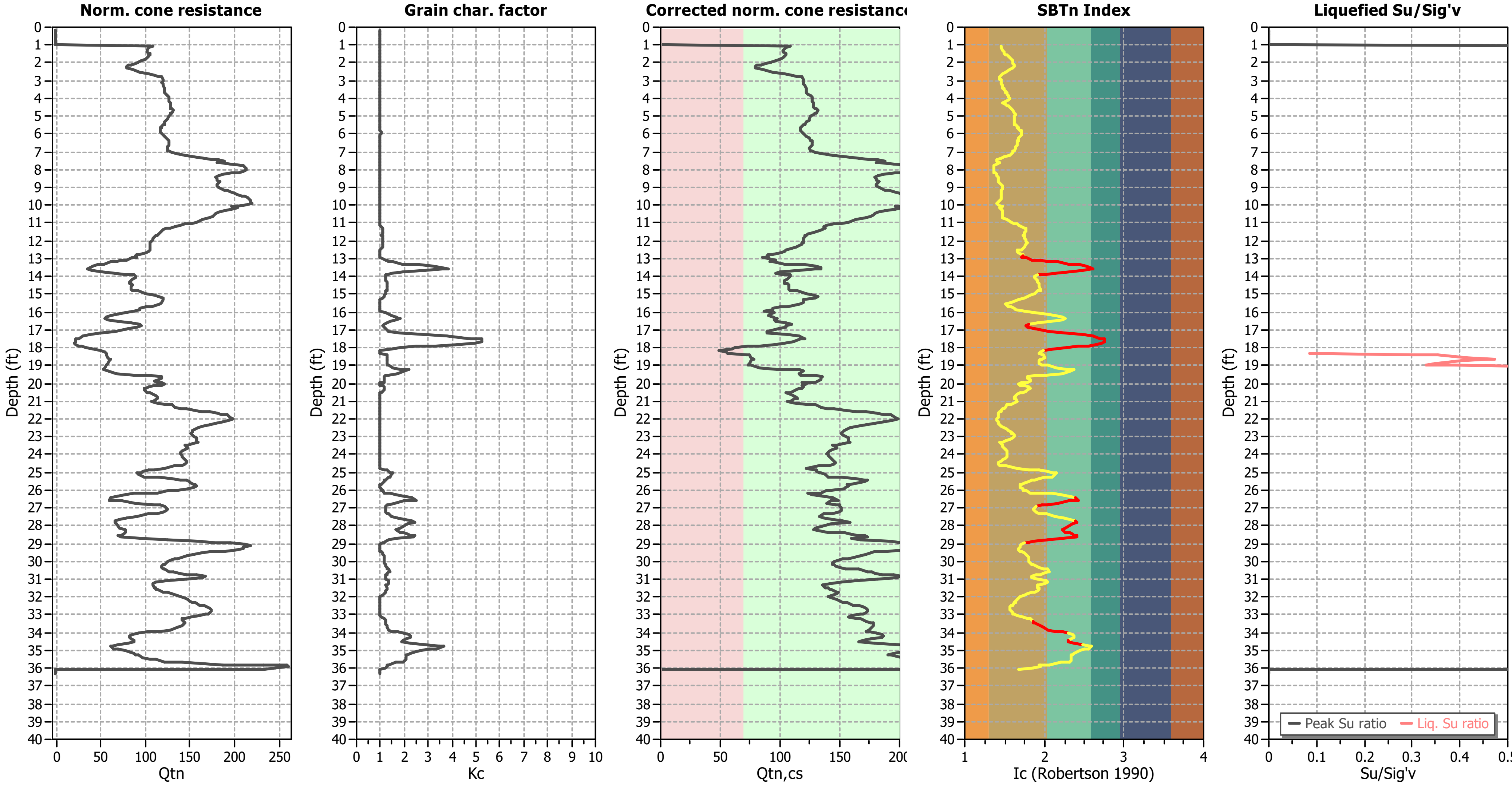
Liquefaction analysis summary plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.50 ft	Fill height:	N/A	Limit depth:	N/A

Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

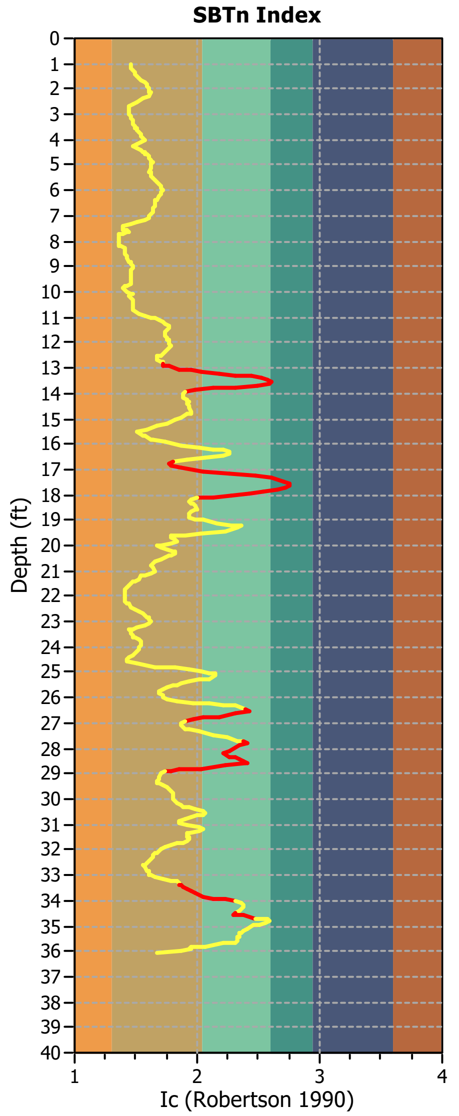
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	8.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.89	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	12.50 ft	Fill height:	N/A	Limit depth:	N/A

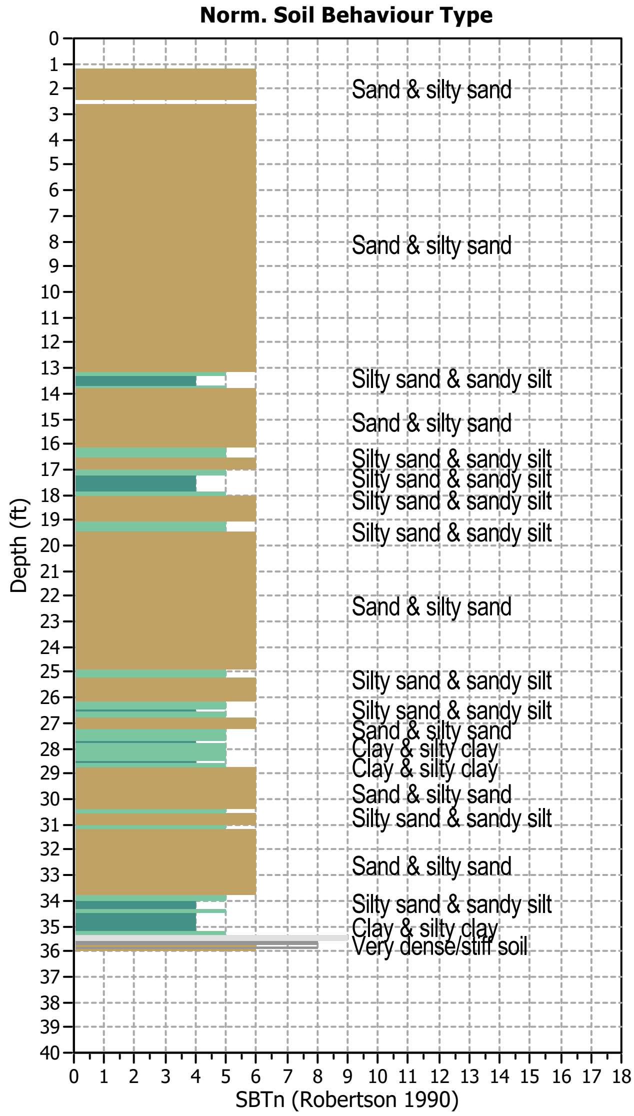
TRANSITION LAYER DETECTION ALGORITHM REPORT
Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vise-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between $1.80 < I_c < 3.0$) and a rate of change of I_c. Transitions typically occur when the rate of change of I_c is fast (i.e. delta I_c is small).

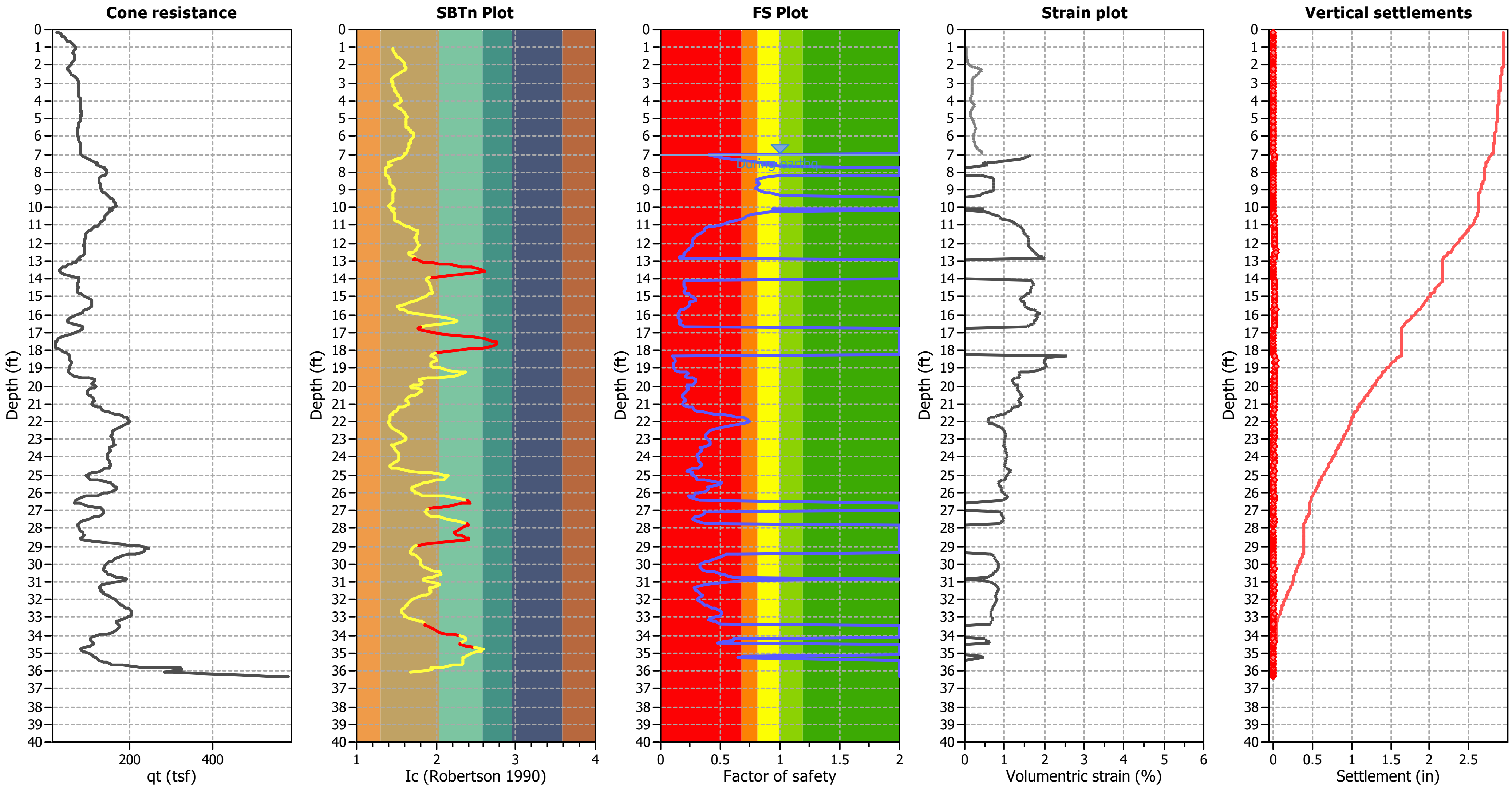
The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.





Transition layer algorithm properties		**General statistics**	
I_c minimum check value:	1.70	Total points in CPT file:	509
I_c maximum check value:	3.00	Total points excluded:	75
I_c change ratio value:	0.0250	Exclusion percentage:	14.73%
Minimum number of points in layer:	4	Number of layers detected:	10

Estimation of post-earthquake settlements

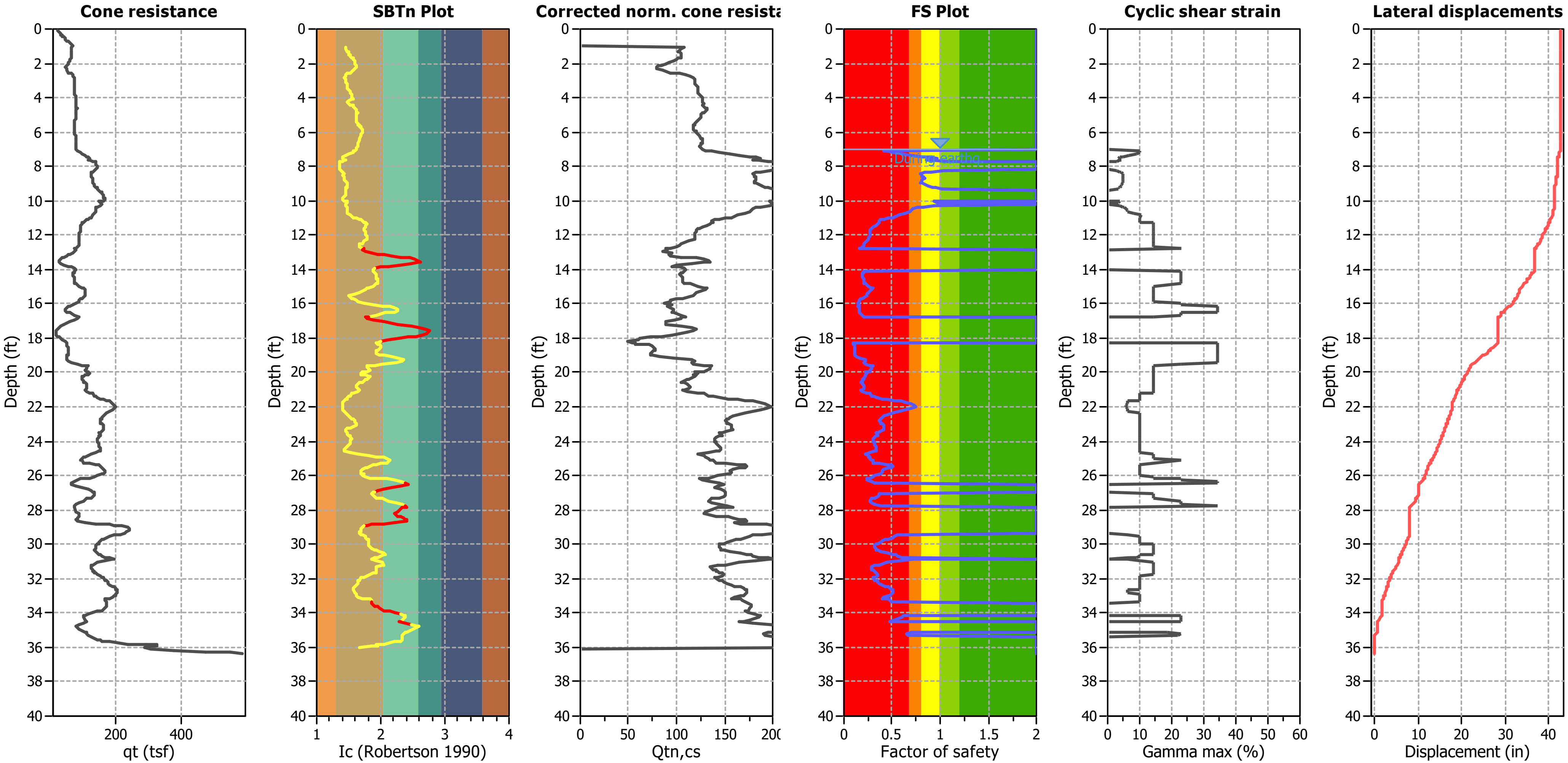


Abbreviations

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

Estimation of post-earthquake lateral Displacements

Geometric parameters: Gently sloping ground without free face (Slope 1.00 %)

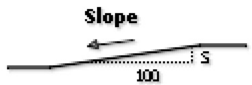


Abbreviations

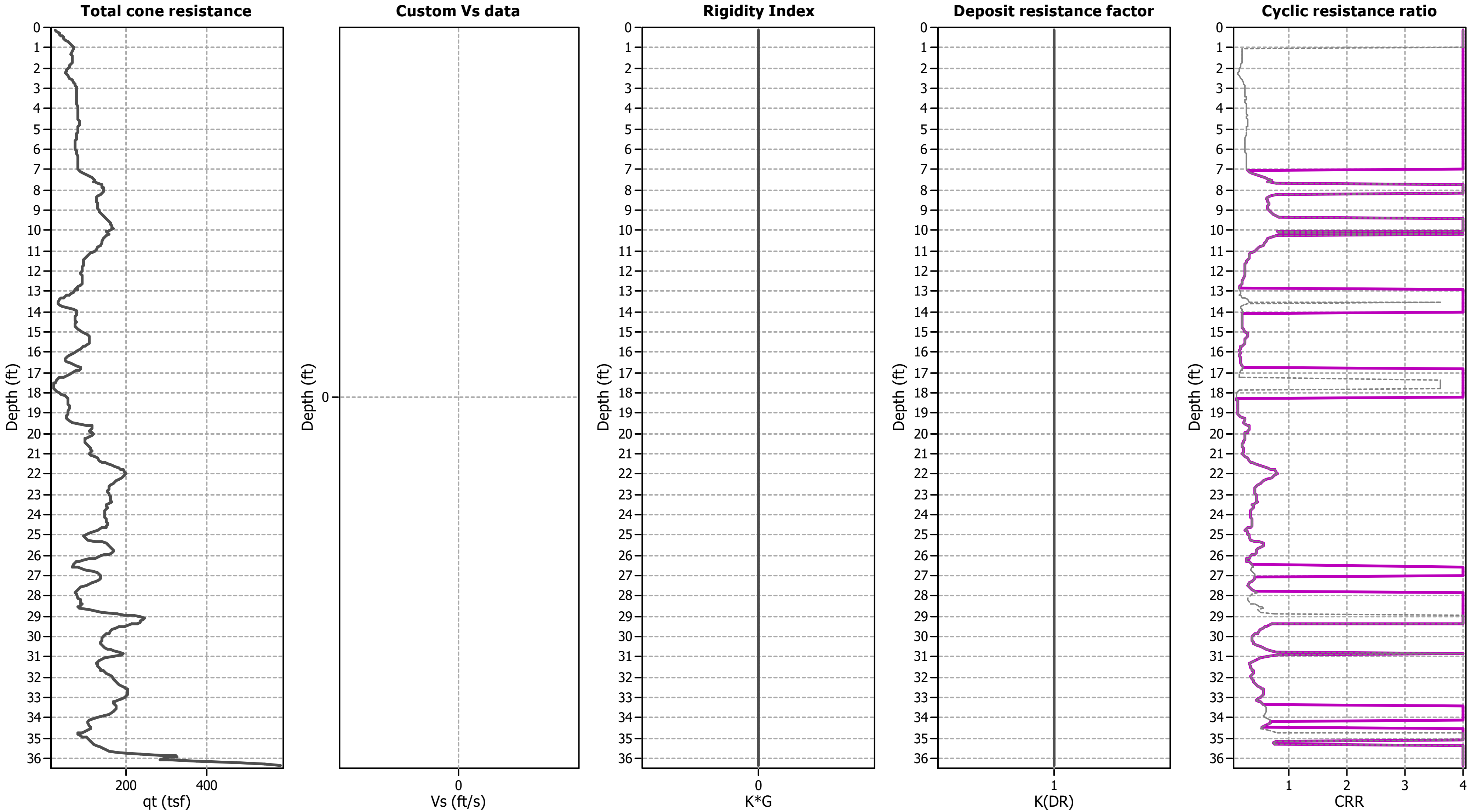
q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance

F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

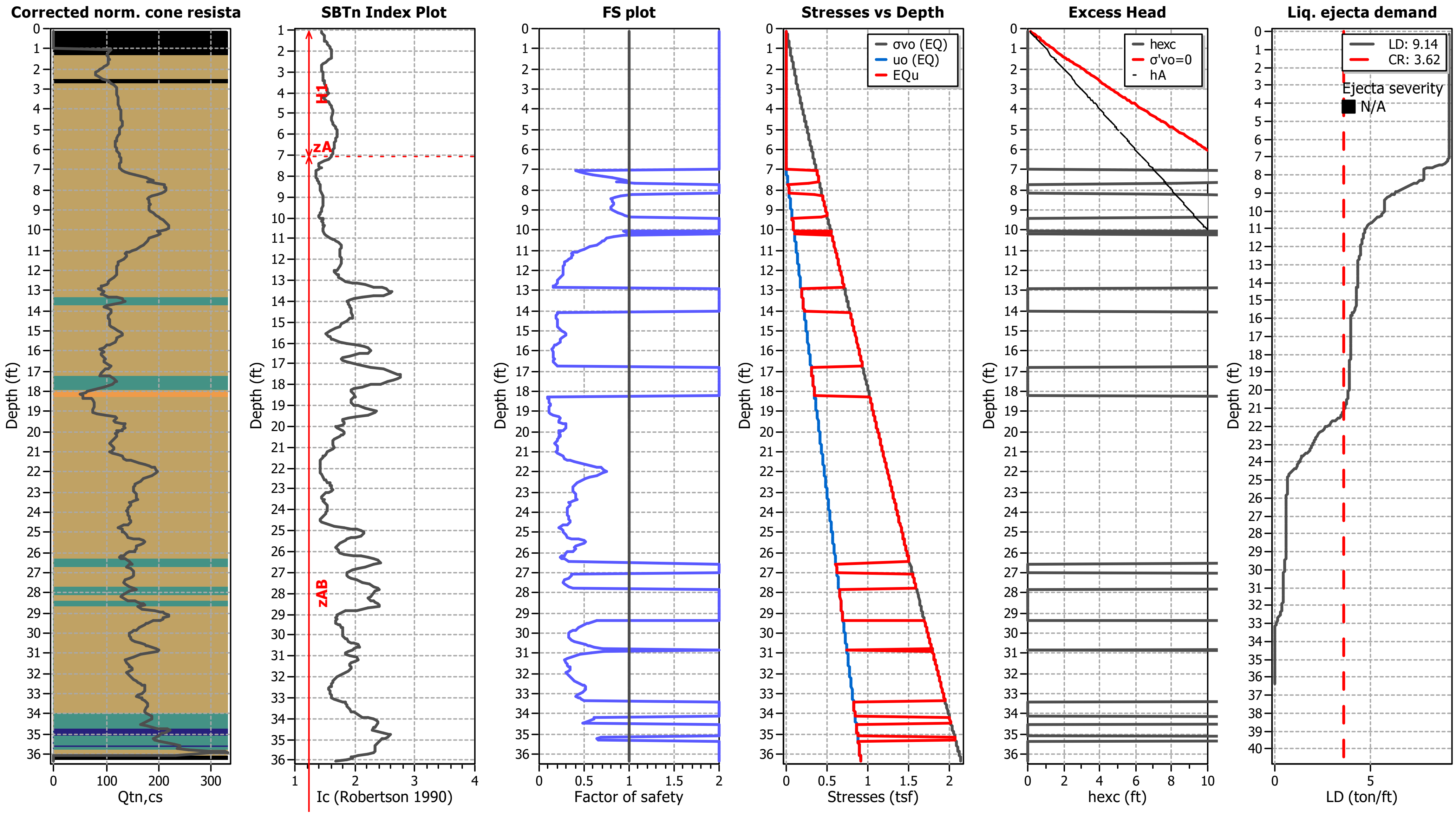
Surface condition



Aging Calculation Estimation

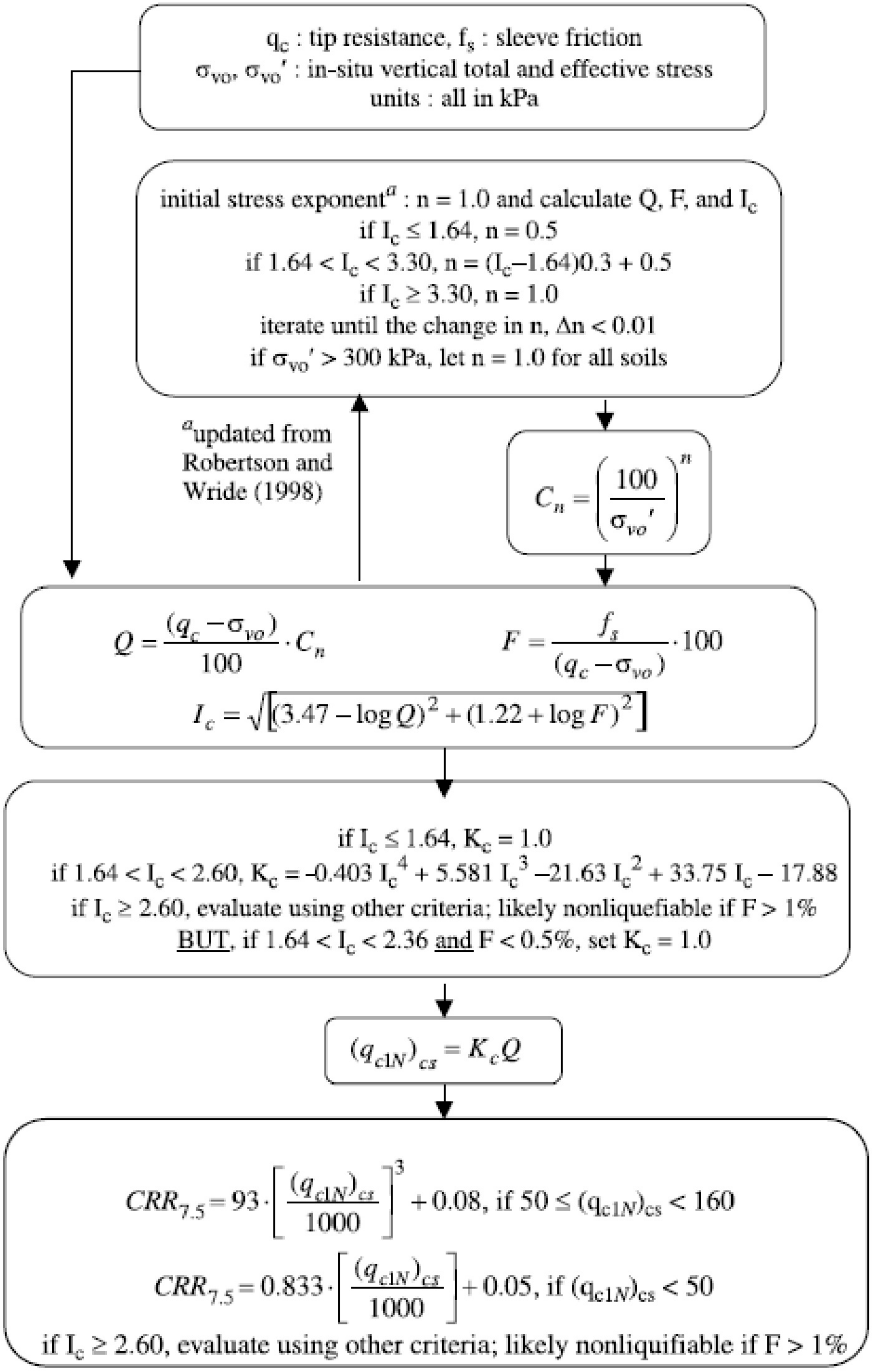


Ejecta Severity Estimation



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

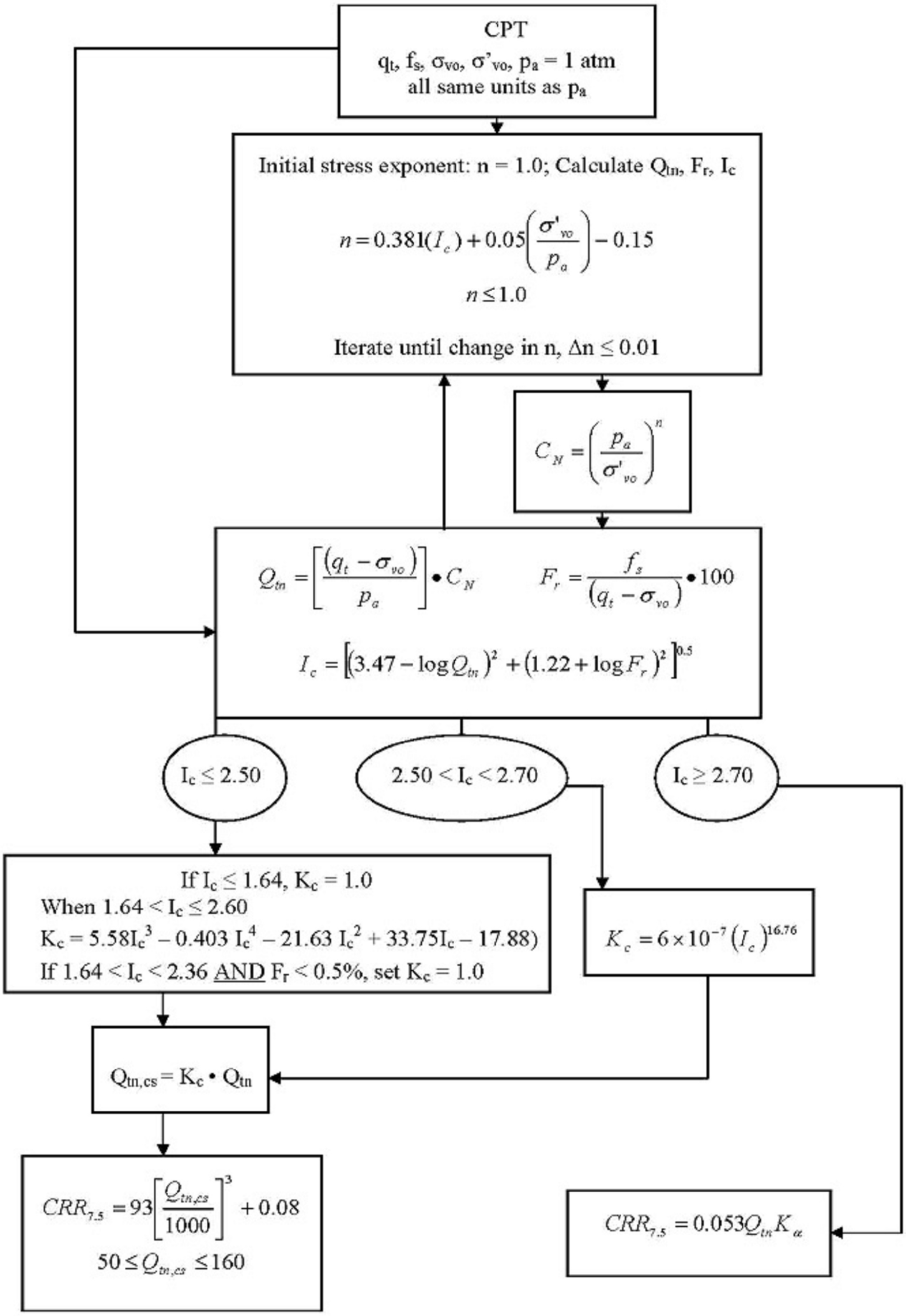
Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. The procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of 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

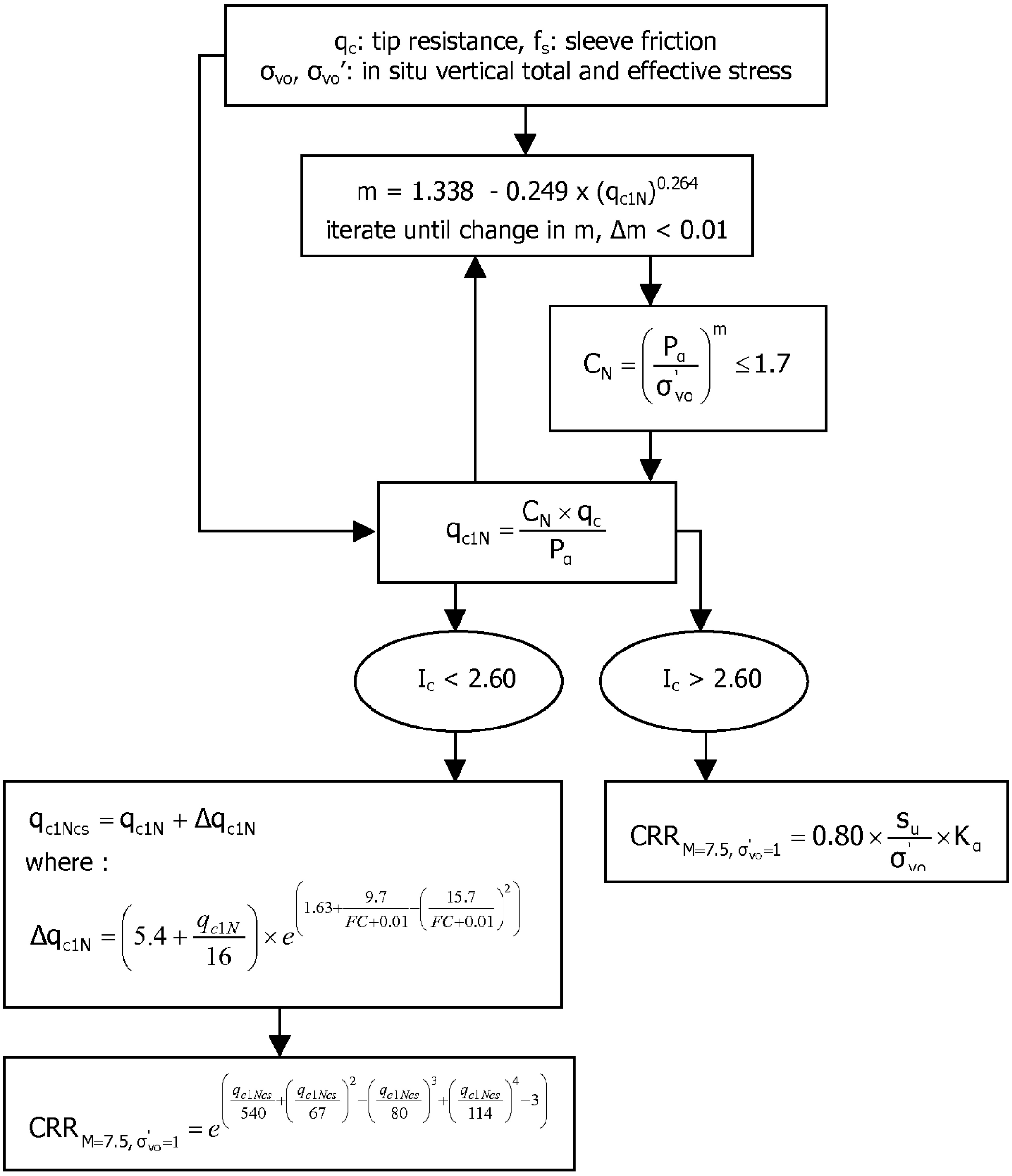
Procedure for the evaluation of soil liquefaction resistance (all soils), Robertson (2010)

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]:

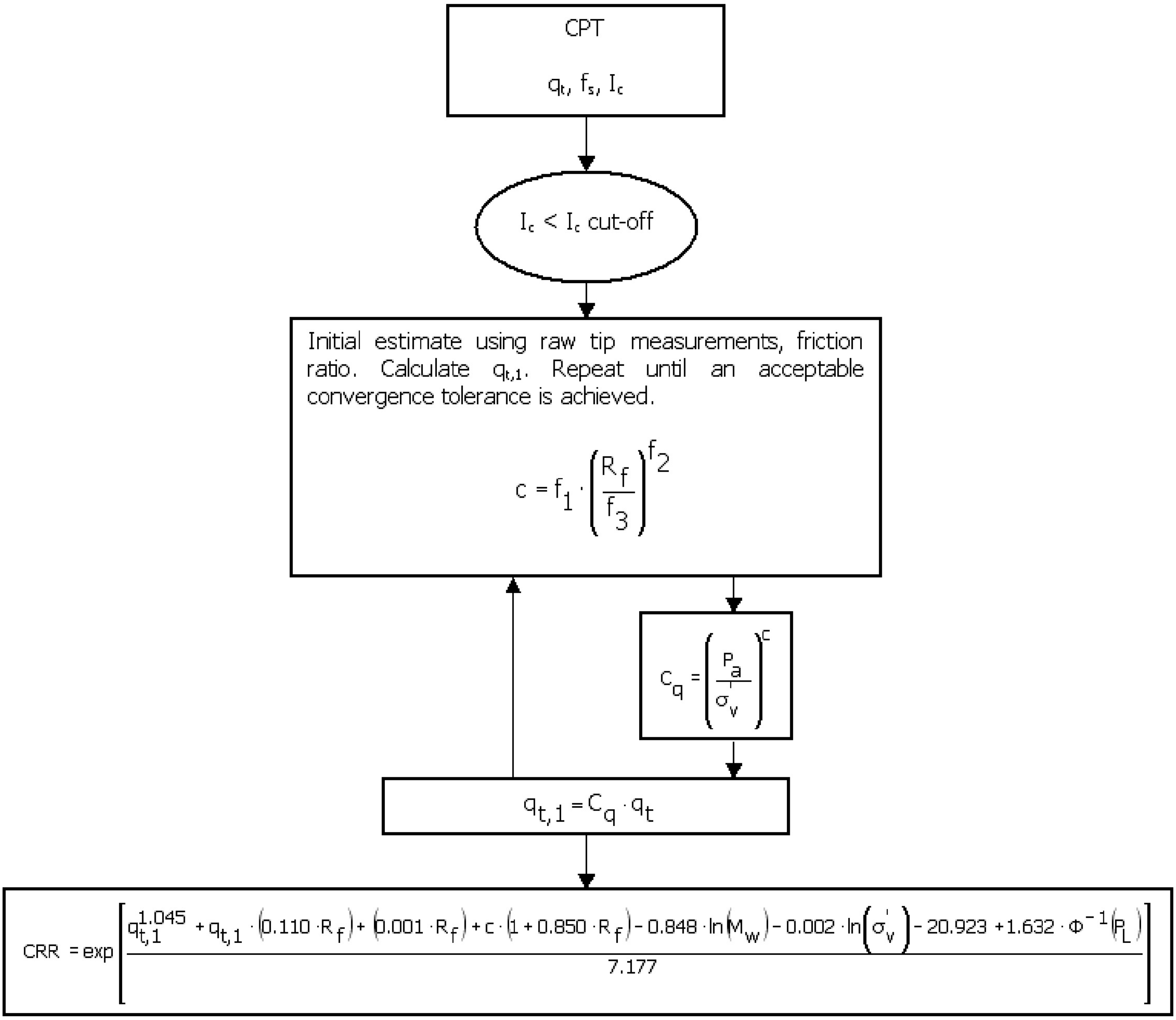


[1] P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering – from case history to practice, IS-Tokyo, June 2009

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)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

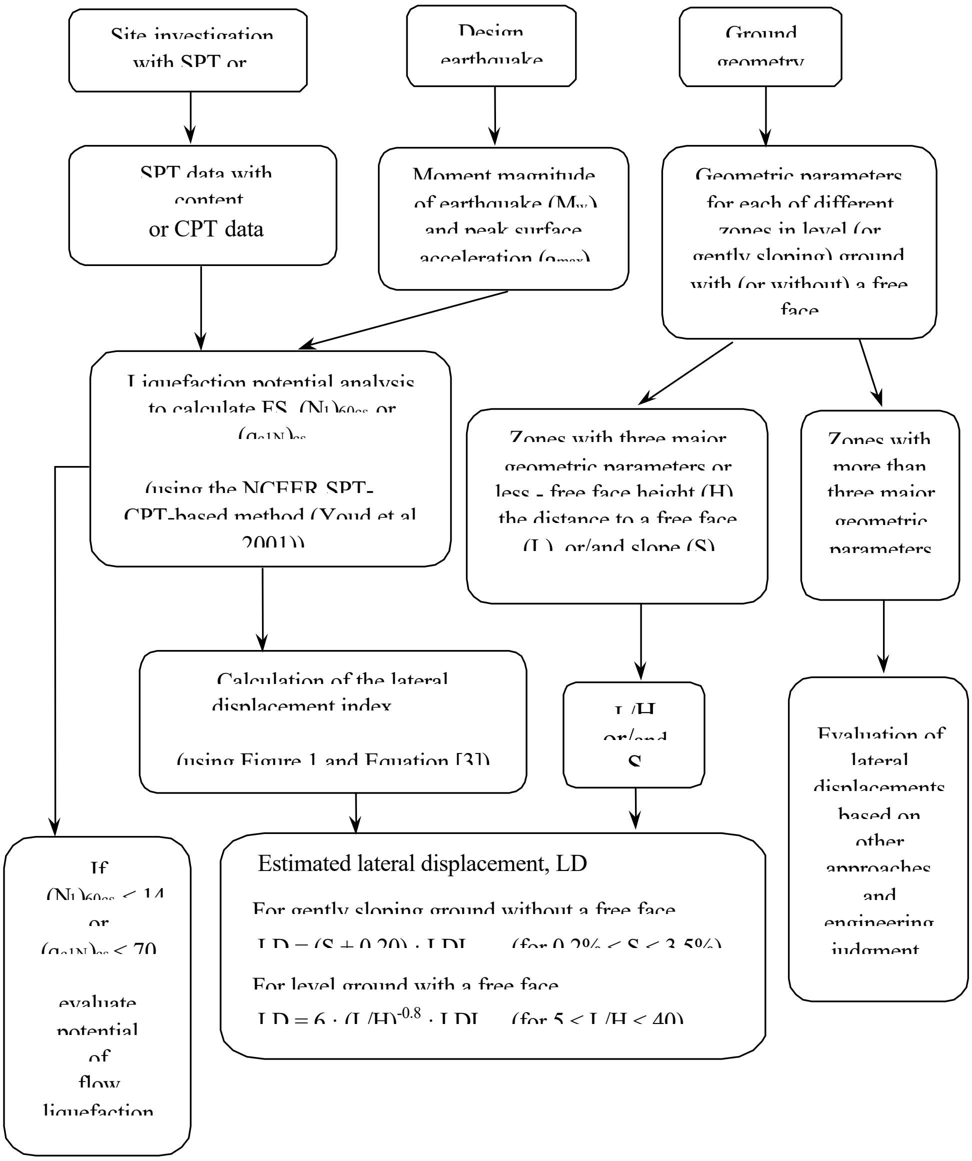
$$I_c = \left[\left(3.47-\log(Q)\right)^2+\left(1.22+\log(F)\right)^2\right]^{0.5}$$

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

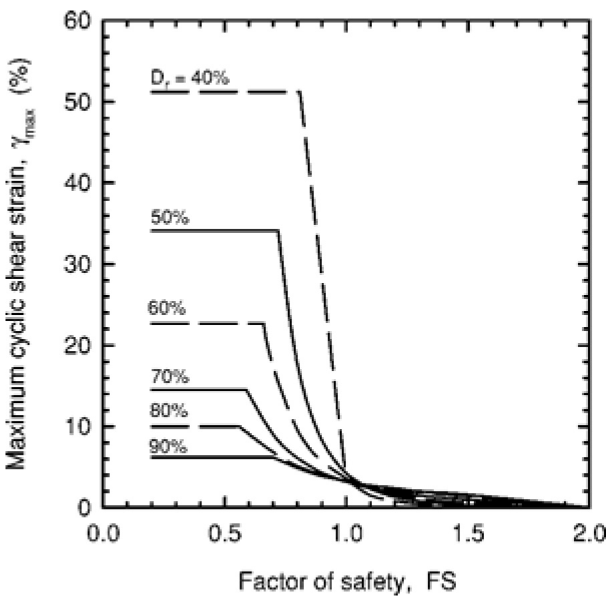
$$F = \left(\frac{f_s}{q_c-\sigma_{vo}}\right)\cdot 100\%$$

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}

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

↓

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))

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

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

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

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

↓

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.

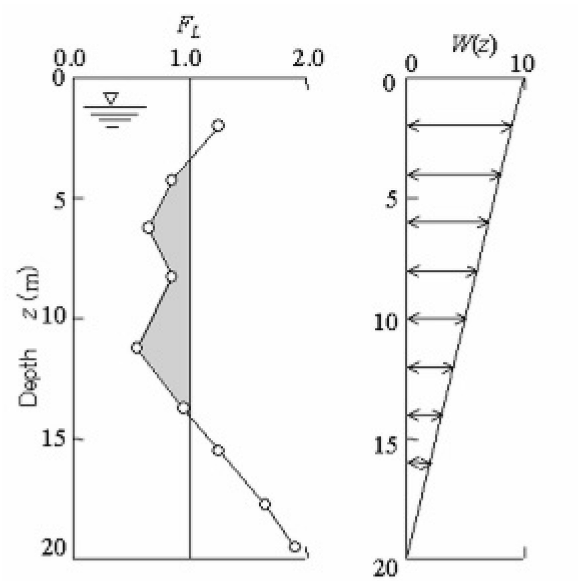
To estimate the severity of liquefaction extent at a given site, LPI is calculated based on the following equation:

$$\textbf{LPI} = \int_0^{20} (10 - 0{,}5_z) \times F_L \times d_z$$

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).

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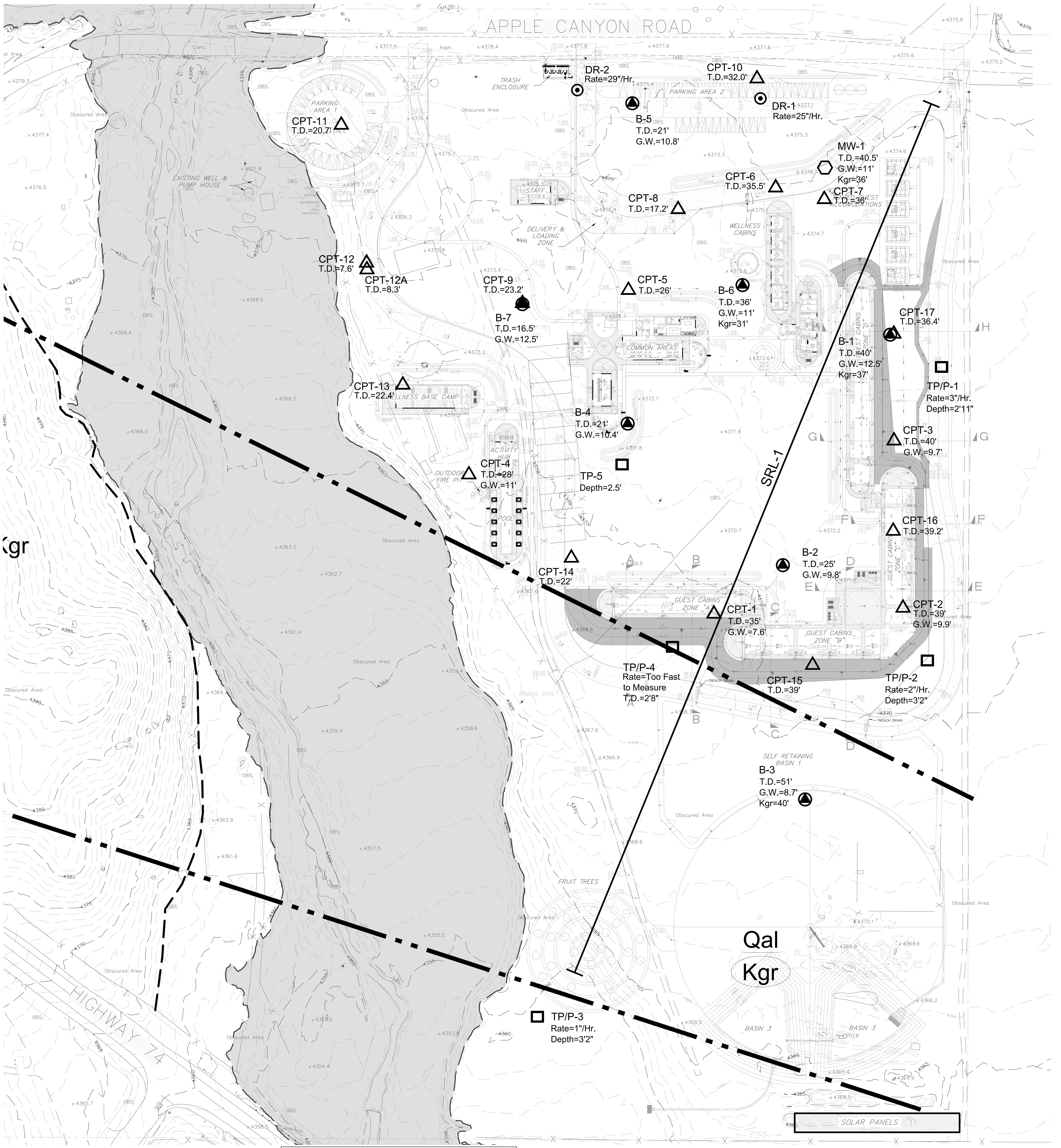
COUNTY OF RIVERSIDE
THE RIDGE

56475 APPLE CANYON ROAD MOUNTAIN CENTER, CA
SECTION 4, TOWNSHIP 6 SOUTH, RANGE 3 EAST



LEGEND

- SLOPE 4:1 MAX
- SLOPE 2:1
- SLOPE 10:1
- *SLOPE 2%

NOTE
* THE 2% SLOPE WILL BE ACHIEVED DURING PRECISE GRADING.

LEGEND

Symbol	Description
B-1	Hollow Stem Auger (Petra, 2021)
TP/P-1	Backhoe Test Pit/Dual Ring Infiltrometer Test (Petra, 2021)
CPT-1	Cone Penetration Test (Petra, 2021)
DR-1	Dual Ring Infiltrometer (Petra, 2020)
MW-1	Monitoring Wells (Petra, 2021)
T.D.	Total Depth
G.W.	Ground Water
	Seismic Reflection Line
Qal	Alluvium
Kgr	Granitic Bedrock-Circled where buried
	Geotechnical Contact

Reference List of Base CAD files used provided by:
JLC, Engineering & Consultant, Inc. received 9-19-2022

220713TRSD - Materplan Ground Floor.dwg
302.01.21_Architect_Site Plan.dwg
302.01.21_base_line_plan.dwg
302.01.21_flood_plain.dwg
302.01.21_sd_blp.dwg
302.01.21_topo_blp.dwg
SearlBio_PotentialSeedingSite

GRAPHIC SCALE
80' 0 40' 80' 160'
1" = 80'

N

PETRA GEOSCIENCES, INC.
3186 Airway Avenue, Suite K
Costa Mesa, California 92626
PHONE: (714) 549-8921
COSTA MESA TEMECULA VALENCIA PALM DESERT CORONA

GEOTECHNICAL MAP

The Ridge
County of Riverside, CALIFORNIA

DATE: Oct. 2022
J.N: 20-227
PLATE 1

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

CUP NO. 21.010.000

GRADING EXHIBIT