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GEOTECHNICAL REPORT
MCFADDEN SEWER LIFT STATION (PHASE 2)
MCFADDEN AVENUE AND DAWSON LANE
HUNTINGTON BEACH, CA
AESCO PROJECT NO. 20240035-H6264/H7151/H8292

Prepared for:

City of Huntington Beach
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November 1, 2024
Revised July 3, 2025

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Ms. Lili Hernandez, PE
Principal Civil Engineer
City of Huntington Beach
2000 Main Street
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Subject: **Geotechnical Report**
McFadden Sewer Lift Station (Phase 2)
McFadden Avenue and Dawson Lane at Greer Park
Huntington Beach, California
AESCO Project No. 20240035-H6264/H7151/H8292

Dear Ms. Hernandez:

AESCO is pleased to provide you with the revised geotechnical report for the proposed lift to be constructed at the subject site. The project generally consists of constructing a new wet well, valve vault, meter vault, and gravity feed line. The wet well excavation will be approximately 25 feet below ground surface and about 20 by 40 feet in plan dimension for the wet well and vault.

Please do not hesitate to contact us if you have any questions or if we may be of any additional assistance. We look forward to assisting you during the construction of the proposed facility.

Sincerely,
AESCO

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Project Manager

Adam Chamaa, PE, GE
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Environmental Project Manager

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Appendix

Geotechnical Report
McFadden Sewer Lift Station (Phase 2) at Greer Park South
McFadden Avenue and Dawson Lane
Huntington Beach, CA

This report, authorized by the City of Huntington Beach, presents the results of a geotechnical investigation conducted by AESCO for the replacement of the existing McFadden Sewer Lift Station in Huntington Beach, CA. The layout of the proposed facility is illustrated in the Site Plan (Figure 2).

In 2022–2023, a contractor completed construction of the gravity sewer line and other associated improvements as part of Phase 1 of the McFadden Sewer Lift Station project. However, the wet well, meter vault, and the gravity line connection to the wet well were not constructed during Phase 1 and are now included in Phase 2.

This report documents the findings of those evaluations and provides updated recommendations for Phase 2 construction, including the use of the Deep Soil Mixing (DSM) method to address challenging subsurface conditions. Due to the unique geotechnical and hydrological conditions at the site, AESCO consulted with Keller USA (Keller), a specialty contractor in soil-cement deep mixing for groundwater stabilization during the preparation of this study.

The laboratory testing program for this study was shared with Keller for their constructability review and recommendations. The project generally consists of the construction of a new wet well, valve vault, a meter vault, and gravity sewer line connection to the wet well. The wet well excavation will be approximately 25 feet below ground surface and about 20 by 40 feet in plan dimension. Excavation activities will require groundwater mitigations and shoring. The scope of our services for this geotechnical report included the following:

- Coordinating site access for the field investigation;
- Obtaining utility clearances for the field investigation;
- Obtaining an encroachment permit from the City;
- Obtain a permit from Orange County Health Care Agency;
- Performing geotechnical drilling and sampling at the site;
- Installing groundwater monitoring wells;
- Field Investigation for DSM Mitigations;
- Performing laboratory testing of representative samples;

- Performing environmental laboratory analysis of water and soil samples;
- Performing two Cone Penetrometer Tests (CPT);
- Performing three Hydraulic Profiling Tests (HPT);
- Conducting a seismic hazard screening;
- Engineering analyses; and
- Preparing this report.

This report summarizes our findings and presents geotechnical recommendations for the shoring system to construct the new lift station.

2.1 FIELD INVESTIGATION

A field investigation was performed at the site to gather information on subsurface conditions. Boring locations were cleared through USA Dig Alert, and a Ground Penetrating Radar (GPR) survey was conducted prior to drilling activities in the northwest section of Greer Park South. On May 16, 2024, a Cone Penetration Test (CPT) was carried out, reaching a depth of 60 feet below the existing ground surface (bgs). A second CPT was conducted on May 17, 2024, also advanced to a depth of 60 feet bgs.

Between May 31 and June 5, 2024, four soil borings (PW-1 and O-1, O-2 and O-3) were drilled to a maximum depth of 60 feet bgs using a hollow stem auger, and all soil borings were subsequently converted into monitoring wells. PW-1 was continuously sampled in the upper 10 feet and at 5-foot on center thereafter to the bottom of the boring. O-1, O-2 and O-3 were continuously augured, and the soil samples were visually classified.

On June 6, 2024, three Hydraulic Profiling Tests (HPTs) were conducted, each extending to a depth of 50 feet below ground surface (bgs). On August 2, an additional four soil borings (S-1, S-2, S-3, and S-4) were drilled to a maximum depth of 25 feet to collect soil samples for evaluating subsoils for deep cement soil mixing, with bulk samples collected at five-foot intervals. The locations of the HPTs, soil borings, monitoring wells, and CPTs are shown on the Site Plan (Figure 2), which is based on a layout drawing dated November 2, 2021, by GHD Inc. The test locations were measured from existing landmarks to accurately depict their positions in the field.

AESCO personnel logged the borings, visually classified the subsurface materials encountered, and collected samples. The borings were backfilled with bentonite and cement. All field investigations were conducted outside the footprint of the proposed sewer lift station to prevent potential groundwater leaks during excavation. All logs of borings are included in the attached Appendix.

All soil cuttings from the subsurface exploration were carefully collected and placed in 55-gallon drums, each lined with durable plastic liners to ensure safe and secure transport to our facility. A total of 26 drums were utilized to store these soil samples. Subsequent environmental testing indicated that the soil cuttings were non-hazardous, classifying them as clean solid waste suitable for regular disposal processes. The collective weight of the soil transported amounted to approximately 8.6 tons.

Upon the completion of the subsurface explorations, the temporary construction fence that had been erected for site safety and security was dismantled. The site was then well cleaned and restored to its original condition. This involved the use of compact skid-steer loaders and a compact track loader, which efficiently removed any loose soils and leveled the ruts created by the heavy drilling equipment.

Drive samples were taken from the borings using either a Standard Penetration Test (SPT) sampler or a Modified California (MC) sampler. The sampler was driven 18 inches into the bottom of the borehole using a 140-pound hammer that fell a distance of 30 inches. The MC sampler barrel was lined with stainless steel liners to collect relatively undisturbed soil samples. All samples were sealed and packaged to help preserve their natural moisture content and protect them from further disturbance.   Bulk soil samples were collected from the auger borings.

2.2 CONE PENETRATION TEST RESULTS

CPT-1 revealed fill material at the surface, consisting of silty sands, to a depth of 2 feet. Beneath this layer, soft clays and silty clays were encountered up to 41 feet, with sandy layers interbedded at depths of 18 to 20 feet and 29 to 30 feet below grade. Below this, a coarse and dense sand zone was identified from 41 feet down to the maximum depth of 60 feet.

Similarly, CPT-2 showed comparable findings, with fill materials consisting of silty sands extending to a depth of 2 feet below grade. This was followed by soft clay and silty clay layers up to approximately 41.5 feet, incorporating interbedded sand and silty sand layers between 18 to 20 feet and 29 to 30 feet below grade. A coarse and dense sand layer was found from 41.5 feet to the full testing depth of 60 feet below existing grade.

Additionally, a pore pressure dissipation test was performed during CPT-1 at a depth of 40.5 feet and during CPT-2 at a depth of 43 feet below the existing grade. As the CPT cone penetrates the soil, it applies stress, resulting in an initial increase in pore water pressure. Over time, this excess pore water pressure dissipates. The results were plotted on a graph depicting pore pressure versus time.

For CPT-1, the pore pressure stabilized at 22 psi after 10 minutes, corresponding to a water head of 51 feet, which is 10.5 feet above grade level. In CPT-2, stabilization was reached after 5 minutes, with a pressure of 22.7 psi, indicating a head of 52.4 feet, or 9.3 feet above ground level. Based on the dissipation test results, it can be concluded that a confined, pressurized aquifer exists within the investigated layers. The aquifer is located approximately 41.5 feet below the existing grade and comprises a coarse and dense sand layer, extending from 41.5 feet to the full testing depth of 60 feet below the current grade.

Shear wave measurements were also obtained during the CPT tests using a specialized cone penetrometer equipped with sensors designed to measure shear wave velocity in the subsurface soils. Measurements were recorded at intervals of 10 feet during CPT-2. Based on the average internal shear wave velocities, along with laboratory test data and blow counts, it has been determined that the subject site falls within Site Class E according to the ASCE 7-16 standards.

2.3 HYDRAULIC PROFILING TEST (HPT) RESULTS

AESCO performed three hydraulic profiling tests (HPTs) using a probe equipped with pressure monitoring devices, which was inserted into the ground. During testing, water was injected at various pressures while flow rates were measured, providing information about the soil's hydraulic conductivity and permeability. Monitoring the flow of water into surrounding materials under different pressures allows for the differentiation of soil layers and yields valuable stratigraphic data.

The primary objective of the HPTs was to evaluate the dewatering potential of the site during excavation. Hydraulic profiling facilitates geohydrologic characterization of unconsolidated subsurface soils, helps identify zones suitable for slug tests, and determines the appropriate screen length for testing. The HPT system also collects static water pressure data at discrete intervals during logging, which can be used to calculate static water levels or create a hydrostatic profile to measure relative permeability or hydraulic conductivity.

Results from the HPTs indicated hydraulic conductivity (K) values ranging from approximately 0 to 40 ft/day, suggesting the presence of fine-grained soils. Notable increases in conductivity were observed between 11–13 feet and 18–20 feet below ground surface, indicating layers of coarse-grained soils such as silty sands. At a depth of 42 feet, hydraulic conductivity began to rise while electrical conductivity sharply decreased, suggesting saturated fine-grained soils. Additionally, the HPT flow increased to 300 mL/min, indicating a potential artesian condition within the coarse-grained soils. This suggests that conventional dewatering options are not feasible at the site.

These findings are consistent with the CPT analysis results. The results of the three HPTs are presented in the Appendix. The plots display HPT Flow Max (mL/min), Corrected HPT Pressure (psi), and the Coefficient of Permeability (ft/day) for the 50-foot-deep tests.

2.4 MONITORING WELL PUMPING

Boring PW-1 was converted to a 60-foot-deep monitoring well at the completion of the boring on May 31, 2024, and three additional monitoring wells (O-1, O-2 and O-3) were drilled on June 3 and June 5, 2024 (See Fig. 2) in the appendix. On June 5, 2024, AESCO collected a groundwater sample from monitoring well O-2 and transported it on ice to Advanced Technologies Laboratories for laboratory analyses with the proper chain-of-custody. Typical well details are in the appendix.

The monitoring wells displayed artesian conditions with water free flowing from the well and above the existing ground surface.

A high-capacity 3-horsepower pump was installed in one of the wells, but it was unable to keep up with the flow of water from the well or stop the water from freely flowing from the adjacent wells. Subsequently, a standpipe was connected to one of the well casings at the surface. The standpipe was 4 inches in diameter and 10 feet in length. The groundwater level in the casing rose to approximately 9 feet above ground surface.

After pumping one of the wells for about two hours, there was no change in the groundwater level in the standpipe, indicating that the aquifer is pressurized and that dewatering for groundwater control during excavation would not be feasible.

2.5 LABORATORY TESTING

All testing was conducted in accordance with ASTM Standards and California Test Methods. Laboratory testing, carried out at our Huntington Beach, California geotechnical laboratory, included the following assessments: water content (ASTM D4959), dry density (ASTM D2937), Atterberg Limits (ASTM D4318), direct shear (ASTM D3080), and washed sieve analysis (ASTM D1140). Additional tests were performed on the bulk samples to evaluate the suitability of the soils in the upper 25 feet for soil cement mixing. These included organic content tests, compressive strength tests, and falling head permeability tests. The results of these laboratory tests are summarized in the Boring Logs and are detailed in the attached Appendix. Furthermore, chemical analyses were conducted, including assessments for pH (ASTM D1293), soluble sulfates (CTM 417), soluble chlorides (CTM 422), and minimum resistivity (CT 643).

Groundwater from the monitoring well was tested for the following:

- EPA 6010B–Metals (by ICP)
- EPA 8015B–Diesel Range Organics (DRO) and Oil Range Organics (ORO)
- EPA 8015B (Modified)–Gasoline Range Organics (GRO)
- EPA 8260B–Benzene, Toluene, Ethylbenzene and Xylene (BTEX), and Methyl Tertiary-Butyl Ether (MTBE)
- EPA 7470A –Mercury (Cold Vapor)

Soil samples from the drilling activities were tested for the following:

- EPA 6010B–Metals (by ICP)
- EPA 8015B– Diesel Range (DRO) and Oil Range Organics (ORO)
- EPA 5030/8015B (Modified)–Gasoline Range Organics (GRO)
- EPA 7471A–Mercury (Cold Vapor)

The test results are presented in the appendix.

3.1 REGIONAL GEOLOGIC SETTING

The project site is located in Huntington Beach, California, within the southern portion of the Los Angeles basin, in the transition between the northern portion of the Peninsular Ranges physiographic province and the southern portion of the Transverse Ranges physiographic province. The project area is considered to be within the Transverse Ranges physiographic province by Norris and Webb (1990) and within the Peninsular Ranges physiographic province by Yerkes et al. (1965). These two physiographic provinces have contrasting tectonic characteristics that overlap within the Los Angeles basin resulting in a complex tectonic environment marked by active faulting and historic seismicity. Geologic materials at the ground surface in the vicinity of the site consist of Quaternary alluvial sediments deposited by the Santa Ana River or its tributaries.

Three aquifers are defined in Orange County with various characteristics:

Upper Aquifer System. This system includes Holocene alluvium, older alluvium, stream terraces, and the upper Pleistocene deposits represented by the La Habra Formation. It has an average thickness of about 800 feet and consists mostly of sand, gravel, and conglomerate with some silt and clay beds. Generally, the upper aquifer system contains a lower percentage of water-bearing strata in the northwest and coastal portions of the area where clays and clayey silts dominate. Accordingly, recharge from the surface to the groundwater basin may be minor in these areas. Recharge to the upper aquifer system occurs primarily in the northeastern portions of the basin (DWR 1967). The upper aquifer provides most of the irrigation water for the basin (Sharp 2000; OCWD 1999a,b). It appeared that this aquifer might be as shallow as 40 feet below the subject site.

Middle Aquifer System. This system includes the lower Pleistocene Coyote Hills and San Pedro Formations which have an average thickness of 1,600 feet and are composed of sand, gravel, and minor amounts of clay. The primary recharge of the middle aquifer system is derived from the Santa Ana River channel in the northeast near the town of Olive (DWR 1967). The middle aquifer system provides 90 to 95 percent of the groundwater for the basin (Sharp 2000; OCWD 1999a,b). In some cases, there is a high degree of hydraulic interconnection between the upper and middle aquifers in Orange County.

Lower Aquifer System. This system includes the Upper Fernando Group of upper Pliocene age and is composed of sand and conglomerate 350 to 500 feet thick. Electric logs of this aquifer indicate that it would probably yield large quantities of fresh water to wells (DWR 1967), but it is not utilized for groundwater production at present (Sharp 2000).

Groundwater conditions in the Orange County groundwater basin are influenced by the natural hydrologic conditions of rainfall, capture and recharge of Santa Ana River (SAR) and Santiago Creek stream flows, natural infiltration of surface water, and the transmissive capacity of the basin. The basin is also influenced by groundwater extraction and injection through wells, use of imported water for groundwater replenishment, wastewater reclamation and water conservation efforts and activities throughout OCWD's service area.

3.2 SITE AND SUBSURFACE CONDITIONS

The ground surface of the proposed lift station project is relatively flat and covered with dirt, with the possibility of underground utilities existing within the site boundary. Borehole PW-1 revealed a stratification of materials: soft to stiff sandy clay to a depth of 13 feet, followed by soft to stiff sandy silt and organic sandy silt to 28 feet, loose sandy silt to 33 feet, medium to stiff slightly sandy clay containing organics to 45 feet, and finally medium dense coarse silty sand extending to the total drilled depth of 60 feet below the existing ground surface. Borehole O-1 revealed a stratification of materials: sandy clay to a depth of 10 feet, followed by organic sandy silt and organic sandy silt to 28 feet, silty sand to 30 feet, sandy clay containing organics to 45 feet, and finally medium dense silty sand extending to the total drilled depth of 60 feet below the existing ground surface. Similar soils were encountered in O-2 and O-3.

Borehole S-1 revealed a stratification of materials: sandy clay to a depth of 10 feet, followed by sandy silt with sand lenses and organics contents extending to the total drilled depth of 25 feet below the existing ground surface. Similar soils were encountered in S-2 and S-3. Borehole S-4 revealed that the sandy clay extended to a depth of 15 feet followed by sandy silt and organics sand silt to the total depth of 25 feet below the existing ground surface.

Artesian groundwater conditions were encountered within the borings and the wells. The groundwater was freely flowing from all borings. The groundwater head based on the wells was approximately 8.9 feet above existing ground surface and similar head was discovered in the CPT tests. Note that based on regional data, groundwater is anticipated to occur at a depth of approximately 3 feet (CGS, 1998). Depth to groundwater may fluctuate, depending on rainfall, possible groundwater recharge, pumping into the replenishment injection wells, sea water tidal level fluctuation, or pumping activity in the site vicinity. For design purposes, groundwater should be assumed 10 feet above the ground surface.

4.1 SEISMIC DESIGN

A seismic hazards screening was performed for this site to evaluate potential seismic hazards. The seismic hazards screening consisted of reviewing available data published by the California Geological Survey (CGS), the 2022 California Building Code (CBC), the ASCI/SEI 7-16, and the 2022 International Building Code (IBC). The site is located in the United States Geological Survey Seal Beach Quadrangle. According to Section 11.4.8 of ASCE 7-16, a site response analysis is necessary for structures situated on Site Class "E" when the Spectral Response Acceleration at Short Periods (Ss) is equal to or exceeds 1.0, unless one of the following exceptions applies:

- Structures on Site Class E sites with Ss greater than equal to 1.0, provided the site coefficient Fa is taken as equal to that of Site Class C. (Exception 1)
- Structures on Site Class E sites with S1 greater than or equal to 0.2, provided that T is less than or equal to Ts and the equivalent static force procedure is used for design. (Exception 3)

In cases where these exceptions are applicable, the remaining seismic parameters may be determined using the procedures outlined in Section 11, negating the need for a site response analysis. The values for Ss, SMs, SM1, SDS, SD1, Fa, Fv, and SDC have been compiled in accordance with ASCE 7-16 guidelines, as shown in the table below. The Structural Engineer must verify the applicability of these exceptions, and the parameters provided to ensure compliance with local laws and ordinances.

Parameter	Value
Seismic Design Category	"E"
Spectral Response 'Ss'	1.418g
Spectral Response 'S_{Ms}'	1.702g
Spectral Response 'S_{DS}'	1.134g
Spectral Response 'S_{D1}'	0.740g
Spectral Response 'S_1'	0.509g
Spectral Response 'S_{M1}'	1.111g
Site Amplification Factor, Fa	1.200
Site Amplification Factor, Fv	2.182

Data published by the USGS was reviewed. Results of the fault search are presented in the Appendix. A listing of faults within 100 miles of the site is also included. The search indicates that the Newport Inglewood Connected alt 2 fault is 2.95 miles from the site.

The CGS (CDMG, 2000-003) does not delineate this site as being within an Alquist-Priolo Earthquake Fault Zone. However, with the active faults in the region, the site could be subjected to future strong ground shaking that may result from earthquakes on local to distant source.

4.2 LIQUEFACTION POTENTIAL

Liquefaction is a mode of ground failure that results from the generation of high pore water pressures during earthquake ground shaking, causing loss of shear strength. Liquefaction is typically a hazard where loose sandy soils exist below groundwater. The CGS has designated certain areas within southern California as potential liquefaction hazard zones. These are areas considered at risk of liquefaction-related ground failure during a seismic event, based upon mapped surficial deposits and the presence of a relatively shallow water table. The project site is located within a potential liquefaction hazard zone as designated by the CGS (1998). Artesian groundwater was encountered within all deep borings having a hydrostatic head of about 10 feet above the existing ground surface. Based on regional data, groundwater is anticipated to occur at a depth of approximately 3 feet (CGS, 1998). The liquefaction analysis was conducted using the software "CLIQ" by GeoLogismiki Geotechnical Software, utilizing soil data obtained from the CPT soundings. The analysis was based on the methodology outlined by Boulanger and Idriss (2014), with a safety factor of 1.3 against liquefaction. Our evaluation considered the soils encountered during the CPTs, which advanced to a maximum depth of 60 feet below ground surface (bgs). Artesian groundwater conditions were identified in all deep borings. For the settlement analysis, we assumed the groundwater at the surface. We calculated maximum acceleration using a peak ground acceleration (PGA) of 0.61g, corresponding to a hazard level of 2% probability of exceedance over 50 years, as determined by the USGS website. Liquefaction potential was evaluated from a depth of 0 to 50 feet bgs. The total liquefaction settlement varied between 6.6 inches and 6.7 inches, as calculated from the CPT data. Due to artesian groundwater condition at the site the liquefaction settlement is anticipated to be higher than the calculated values. The deep soil cement mixing is recommended to reduce the seismic induced settlement and provide suitable mitigations, however the areas outside the cement treated soils will experience higher settlements. Based on our analysis, we estimate that lateral spreading at the site during the design earthquake event will be negligible. To limit liquefaction-induced settlement to no more than 1 inch, we recommend implementing subgrade mitigation measures at the vault, and wet well extending to a minimum depth of 30 feet below ground surface (bgs). The DSM should extend to a minimum of 5 feet outside the footprint of the vault and wet well excavation footprint. These measures utilizing deep soil cement mixing will increase the soil’s strength, density and improve the soil's resistance to liquefaction induced settlement.

4.3 SUBGRADE MITIGATION DUE TO ARTESIAN GROUNDWATER

Due to the unique groundwater conditions encountered during the investigation, a typical excavation dewatering system would not be feasible. The most viable and cost-effective solution is to create a continuous groundwater barrier around and at the bottom of the excavation. AESCO evaluated several systems, including secant piles, grout injection, and Soil Cement Deep Mixing (DSM). We determined that the DSM method is the most economical option with lesser impact on the area.

DSM is a ground improvement technique designed to effectively control groundwater flow into deep excavations. It involves mixing soil with cementitious materials to create columns of enhanced soil, which improve strength, density and reduce permeability. The primary function of the soil-cement columns is to establish a high-strength, semi-impervious barrier. When cement is mixed with the soil, it fills voids and binds particles together, significantly reducing the hydraulic conductivity of the treated soil. This barrier limits the movement of groundwater from surrounding areas into the excavation site.

The cementation process substantially reduces the permeability of the soil matrix, thereby decreasing the amount of water that can migrate through the soil. This control helps manage the volume of water inflow into the excavation and minimizes the risk of flooding. Additionally, the DSM method increases the strength of the soil mixture to 5 to 10 times higher than that of the remolded native soil. By strengthening the surrounding soil, DSM enhances the stability of the excavation, mitigating the risk of collapse, providing a stable bottom to resist hydrostatic pressure, and delivering a higher bearing capacity for the structure.

Upon completion of construction, the soil-cement columns continue to provide groundwater control, maintaining the integrity of the structure and reducing flotation forces. The design of the depth, spacing, and diameter of the soil-cement columns should be conducted by a specialized design-build contractor experienced in DSM. This design must consider site conditions, soil types, groundwater pressure, excavation size, geologic conditions, groundwater conditions, and the relevant soil properties.

AESCO has been collaborating with Keller North America, a design-build soil stabilization firm, to address the parameters necessary for designing the DSM system for the proposed lift station structures. To evaluate the DSM technique option, four soil borings (S-1, S-2, S-3 and S-4) were drilled to a maximum depth of 25 feet below ground surface, and continuous bulk soil samples were collected at 5-foot intervals. The samples were tested for classification and organic content. The test results for organic content are detailed in the log of borings and in Table 1 below, with the maximum organic content recorded at 13.8% and an average of 7.3% across all borings.

Table 1
Organics Contents

Boring No.	Depth (ft)	% Organics	Boring No.	Depth (ft)	% Organics
S-1	0-5	4.3	**S-3**	0-5	6.3
	5-10	4.3		5-10	7.9
	10-15	4.6		10-15	4.7
	15-20	4.4		15-20	7.5
	20-25	9.1		20-25	7.5
S-2	0-5	4.5	**S-4**	0-5	5.8
	5-10	9.9		5-10	8.4
	10-15	10.8		10-15	6.3
	15-20	7.2		15-20	13.8
	20-25	9.5		20-25	9.4

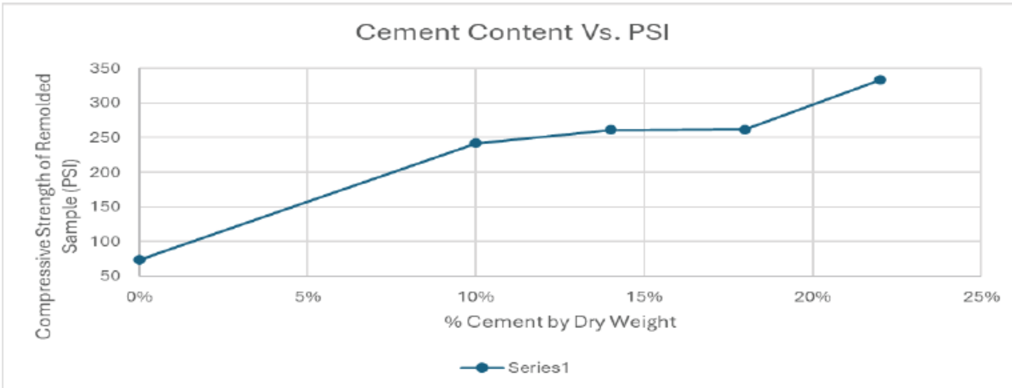
AESCO grouped the soil material obtained from the DSM borings (S-1, S-2, S-3, and S-4) and created composite samples for each 5-foot interval to evaluate the relative moisture-density relationship. The maximum density, measured at 117.0 pcf, was observed at a depth of 0 to 5 feet below the existing grade. Conversely, the minimum maximum density recorded was 91.0 pcf, occurring at depths between 20 and 25 feet below the existing grade. For design purposes, the maximum density of the soil mixtures should be considered as 90% of the average density of 103.4 pcf, which is 98.2 pcf. These maximum density values reflect the variability of the soils encountered within the borings. The results of the moisture-density relationship are tabulated in Table 2. The test results are in the appendix.

Table 2 MOISTURE-DENSITY RELATIONS ASTM D-1557			
Project Number: 20240035 Client Name: CITY OF HUNTINGTON BEACH		PROJECT DESCRIPTION GEO- McFadden Sewer Lift Station (CC-1610) Corner of Dawson & McFadden	
Number	Sample Location and Depth Range	Optimum Moisture (%)	Max Density (PCF)
H5437E	S-1, S-2, S-3, and S-4 Depth: 20-25ft.	**22.5**	**91.0**
H5437D	S-1, S-2, S-3, and S-4 Depth: 15-20 ft	**14.5**	**100.0**
H5437C	S-1, S-2, S-3, and S-4 Depth: 10-15 ft	**19.0**	**103.5**
H5437B	S-1, S-2, S-3, and S-4 Depth: 5-10 ft	**17.5**	**105.5**
H5437A	S-1, S-2, S-3, and S-4 Depth: 0-5 ft	**13.5**	**117.0**
Average Density (PCF)			**103.4**

A series of trial tests were conducted to determine the necessary percentage of cement required to achieve a minimum compressive strength of 250 psi for the soil-cement mixture. Initially, AESCO remolded the soil samples in accordance with ASTM D-1557 prior to adding the cement and then tested the molded samples for compressive strength. Samples were collected from each soil boring at five-foot intervals, with the compressive strength of the remolded soil samples (before cement addition) ranging from 41 to 91 psi. All samples were remolded to approximately 95% relative compaction, in accordance with ASTM D-1557 standards.

Various composite soil samples were then mixed with different concentrations of cement to evaluate their strength properties. The compressive strength of each mixture was tested across the full depth of the borings, with the collected data analyzed to identify the optimal cement content that would meet the desired strength criteria for the project. AESCO recommends that the soil-cement compressive strength be maintained at 250 psi for laboratory remolded samples for design purposes, with the soil-cement ratio falling within the range of 14% to 18% by dry weight. The compressive strengths versus the compressive strengths are plotted on Illustration 1:

Illustration 1



The soil-cement mixture remolded samples were tested for permeability using falling head permeability tests. Composite mixture samples from the upper 25 feet of the subgrade were remolded according to ASTM D-1557, utilizing a soil-cement ratio of 14% by dry weight. The tests were conducted at curing ages ranging from 1 to 7 days. The permeability results are summarized in Table 3. The moisture-density relationship tests for each composite sample from each boring, based on ASTM D-1557, can be found in the appendix.

Table 3 Cemented Treated Soil Permeability 14% Cement by Dry Weight		
Run No.	Age (day)	Average Permeability cm/sec
Run 1	1	$1.83x10^{-07}$
Run 2	4	$1.11x10^{-07}$
Run 3	7	$6.43x10^{-08}$

It must be noted that the test results are based on compacted remolded samples after the addition of the cementitious material. The permeability property of the mixture decreases by the sample age. At the age of 7 days the permeability was $6.43x10^{-8}$ cm/sec. The infield cemented soils may have higher permeability based on the field soil density after completion of the soil cement mixing. Potential water seeping will occur and can be pumped with a sump pump in the excavation. This value is considered acceptable to control the groundwater infiltration into the excavation. The thickness of the treated soils should be designed to provide a water barrier from the bottom and the wet wall of the excavation.

4.4 RECOMMENDATIONS FOR WET WELL AND VAULT FOUNDATION DESIGN AND INSTALLATION

The groundwater is pressurized (artesian conditions) to a hydrostatic head of approximately 10 feet above existing ground surface. Therefore, subgrade mitigation is required to stabilize the artesian condition of the groundwater prior to excavation. To stabilize the groundwater and the hydrostatic pressure, the subgrade should be strengthened and create a water barrier to control the groundwater infiltration. Cement Deep Soil Mixing (DSM) is the most economically feasible method and has the least impact on the nearby residents. The recommendations made in this section and subgrade/groundwater mitigations require very experienced contractors in DSM. We recommend that only contractors with at least 10 years of lift station installation experience in similar soil and groundwater conditions and specialized in DSM shall be considered for the DSM portion of the work.

The excavation depth for the bottom of the mat foundation of the well will be approximately 22 feet below existing grade, reaching an elevation of -2.71’ MSL. According to the preliminary design of the DSM by Keller, the DSM should extend to a depth of 32.5 feet below existing grade and reach at least five feet beyond the perimeter of the shored excavation footprint. The shoring system can be integrated into the DSM zone, as illustrated in Figure 6. Detailed specifications for the DSM are included in the appendix.

The DSM should be utilized for both the wet well, the vault structure, and the gravity line connection as depicted. During the DSM process, the shoring system should be installed to establish a bond between the DSM and the I-beams, allowing the DSM to function as lagging between the beams. Refer to Figure 6 for shoring schematics. The constructed DSM must achieve a minimum compressive strength of 200 psi and a permeability no greater than $1x10^{-7}$ cm/sec to effectively withstand groundwater hydraulic pressure and control water infiltration into the excavation.

The inlet sewer line will connect to the wet well at a depth of approximately 15 feet below existing grade. Water intrusion is anticipated during pipe excavation due to artesian groundwater and may be manageable at depths less than 8 feet below the existing grade.

It is recommended that Deep Soil Mixing (DSM) be extended from the wet well connection to the point where the pipe excavation reaches a depth of 8 feet or less. This approach will help mitigate and reduce groundwater infiltration into the trench excavation. The width of the DSM-treated area should be 1.5 times the width of the trench on each side, and 1.5 times the depth of the excavation. For example, if the trench excavation width is 2 feet, the DSM treatment width should be a minimum of 8 feet. The proposed sewer trench width must be determined prior to DSM treatment and cannot be modified afterward.

4.4.1 Mat Foundation

Based on the results of our investigation and subgrade mitigation, the proposed wet well may be supported on a structural mat foundation established at the planned bottom of the structure. The base of the lift station vault, assumed to be at a depth of approximately 22 to 25 feet, is expected to rest on cement-treated, slightly sandy clay with silt. It may also interface with loose silty sand or clayey sand beneath. Following subgrade compaction and densification methods (DSM), the mitigated subgrade is considered hard treated soils.

The thickness of the DSM beneath the base of the mat foundation should be designed to provide adequate resistance to hydrostatic groundwater pressure and to control groundwater infiltration. Excavation activities should be performed diligently to preserve the integrity of the DSM. Extending the excavation beyond the base of the mat could damage the DSM and result in significant groundwater intrusion into the wet well excavation.

The bottom of the excavation should be leveled and prepared with ¾-inch to 1-inch crushed rock placed directly on the DSM to create a working platform. The thickness of the crushed rock should not exceed 6 inches. Under static loading conditions, total settlement of up to one inch may be expected, while differential settlement should not exceed one-half inch. A Professional Engineer should design the mat foundation.

We recommend assuming a modulus of subgrade reaction of 150 tons per cubic foot for the DSM in the design. An allowable bearing pressure of 2000 psf may be used for the design of the lift station foundation supported on the DSM; uplift forces are likely to govern the vertical design (see Section 4.4.4 Uplift). Additionally, an allowable bearing pressure of 1800 psf may be assumed for the vault mat foundation supported by the DSM. A friction coefficient of 0.15 may be utilized to evaluate resistance to sliding for the lift station. For calculating passive pressure resistance, an equivalent fluid density of 150 pcf may be employed, with a maximum allowable passive pressure of 1500 psf for both the lift station and the vault, assuming a level surface.

4.4.2 Lateral Earth Pressures

Walls below grade will be subjected to lateral earth pressures from the retained soils, groundwater pressure, and surcharge loads. Accordingly, these structures should be designed to resist appropriate lateral earth pressures.

For design purposes, a triangular distribution of lateral earth pressures with a buoyant equivalent fluid pressure of 35 pounds per cubic foot (pcf) should be used in design of walls below grade for a restrained condition. For the active pressure condition a buoyant equivalent fluid pressure of 25 pcf is recommended. This assumes a horizontal grade behind the wall. Groundwater should also be assumed to be at 10 feet above the existing ground surface, exerting additional hydrostatic forces on the vault walls and base.

For the restrain condition the total lateral earth pressures acting on the wall during a seismic event will likely include the static force and the dynamic increment.

The dynamic increment, Pae $= \frac{1}{2}\ \gamma_b\ H^2\ (0.68\ PGA/g)$
Where γ_b = buoyant unit weight = 68 pcf
H = height of wet well = 25 feet
PGA = peak ground acceleration = $S_{DS}/2.5 = 1.134g/2.5 = 0.454g$
Pae = $\frac{1}{2}$ x 0.068 kcf 25^2 sq ft x 0.68 x 0.454g/g = 6.56 kips/ft, acting at 1/3 H above the base

The lateral earth pressures recommended above are based upon the assumption that the backfill is granular or 2-sack sand slurry backfill, the ground surface behind the wall is level, and the wall backfill is well drained.

Surcharge pressures (dead or live) should be added to the above lateral earth pressures where surcharge loads may be located adjacent to the wall. Surcharge pressures should be applied as a uniform (rectangular) pressure distribution by using a pressure equal to 0.5 times the surcharge pressures. Vertical surcharges set back behind the wall a horizontal distance greater than the wall height need not be added to the design pressure. The above coefficient assumes a uniform surcharge load.

4.4.3 Wall Backfill

Backfill behind walls below grade should consist of granular backfill. To reduce the potential for settlement of backfill, it is essential that wall backfill be properly compacted in lifts. The minimum compaction standard for wall backfill should be 90 percent relative compaction in accordance with ASTM D1557. Heavy compaction equipment should not be used within 5 feet of the wall. Small hand-operated compaction equipment should be used adjacent to the wall so as not to overstress the wall. The lift thickness with the smaller equipment should not be more than six inches.

Alternatively, a 2-sack sand-cement slurry can be used to backfill behind the wall.

4.4.4 Uplift

The mat foundation should be designed to resist uplift. Resistance to uplift may be accomplished by thickening the mat foundation and by extending the mat foundation to a selected distance beyond the exterior walls of the structure (flanges). The resistance to uplift may be taken as the sum of the weight of the lift station structure and the weight of the soil within the zone of influence of the flanges. The depth of the groundwater should be considered to have a head of 10 feet above the existing ground surface when calculating the factor of safety against uplift. A total soil unit weight (γ) of 120 pcf and submerged soil unit weight (γ_b) of 58 pcf may be used to calculate uplift load. To increase the uplift resistance of the well, the space may be backfilled with compacted crushed aggregate base (CAB) or 2-sack sand cement slurry. The CAB or sand cement unit weight (γ) of 130 pcf and submerged base unit weight (γ_b) of 68 pcf may be used to calculate uplift load.

4.4.5 Differential Settlement

Differential settlement between the walls of the structure and the pipeline connections should be anticipated. Movements as much as those estimated in Section 4.2, Liquefaction Potential, should be accounted for, such as using flexible pipe connections.

4.4.6 Sewer Line Excavation Groundwater Mitigations

A new 8-inch VCP gravity sewer line will be installed from the existing manhole to the new wet well. The anticipated sewer line depth will be approximately 12 feet at the existing manhole, gradually increasing to about 15 feet below existing grade at the wet well connection. Due to artesian groundwater conditions, dewatering the trench excavation may not be feasible. AESCO recommends employing the Deep Soil Mixing (DSM) subgrade stabilization method for the trench excavation.

The DSM treatment should extend from the wet well connection to the existing manhole, as shown in Figure 5. It is recommended that the DSM extend a minimum of 3 feet around the perimeter of the existing manhole to minimize groundwater intrusion into the trench excavation while protecting the manhole and the existing connection. The DSM treatment depth should be at least 1.5 times the depth of the new trench excavation.

The DSM zone should extend a minimum of 3 feet on each side of the proposed trench excavation. For example, if the trench width is 2 feet, the total width of the DSM should be 8 feet. The integrity of the DSM must be maintained during excavation; while DSM will help strengthen the excavation walls, it is not considered a shoring system. A shoring system, such as steel plates and hydraulic rams, should be designed and installed to support the excavation walls.

Proper protection of the trench walls during excavation is essential to minimize groundwater intrusion. Figure 5 illustrates the minimum limits of the DSM layout.

4.4.7 Pipe Bedding

The sewer line should be constructed as per the City of Huntington Beach Standard Plans 502 and 503.

4.5 EXCAVATION AND SHORING

The site is underlain by predominantly wet, saturated soil, which may require substantial pumping during site preparation. Temporary excavations should be evaluated in accordance with OSHA standards. It is essential that temporary cuts and trenches do not undermine the support of existing structures or improvements; thus, the setback requirements of governing jurisdictions and applicable building codes must be adhered to.

Historically, the high groundwater level has been recorded at a depth of 3 feet (CGS, 1998). However, findings from the geotechnical investigation indicate that the groundwater is pressurized and should be assumed to be at a level of 10 feet above the surface for design purposes. A dewatering system is not feasible for this site due to the presence of artesian groundwater. Therefore, any excavations deeper than 8 feet should be designed with subgrade mitigation measures (DSM) prior to excavation.

All excavations deeper than 4 feet must be shored. We anticipate that the installation of the lift station vault and wet well will generally involve excavating up to 22 feet below grade, primarily in saturated soft sandy clay with silt and loose silty sand materials. These materials can be classified as soil type (C) based on CAL-OSHA standards. Temporary construction slopes should not exceed a steepness of 1½:1 (H:V). Given the confined work area, shoring should be implemented to support the excavation. For the proposed vault and wet well excavation, shoring should consist of I-beam integrated into the DSM system to provide watertight system to retain the excavation sides and minimize water infiltration into the excavation. The shoring design should be prepared by a licensed engineer with expertise in shoring design combined experience in DSM, and it must be submitted for our review. It's recommended that no surcharge loads can be applied to the shoring system, such as stockpiled soil or construction materials, and that no loads act above a 1:1 (H:V) plane extending from the base of the shoring. Should surcharge loads be present, their impact must be considered in the lateral earth pressure calculations or increasing the footprint of the DSM to support the load. Excavation after DSM must begin no earlier than seven days after completion to allow for proper curing. Once excavation starts, construction activities within the DSM zone should proceed without delay to minimize the time the area is exposed. Prolonged exposure of the open excavation may compromise the stability of the DSM and increase the risk of water seepage, potentially leading to loss of DSM stability.

The design of the shored excavation must be conducted by an engineer who is knowledgeable about the on-site soil conditions, and groundwater conditions. The contractor should be aware that slope height, slope inclination, or excavation depths must not exceed those specified in local, state, or federal safety regulations, such as the OSHA Health and Safety Standards for Excavation (29 CFR Part 1926) or any successor regulations. Compliance with these regulations is strictly enforced; failure to adhere could result in substantial penalties for either the owner or the contractor.

4.6 EXISTING UTILITIES

The proposed wet well, new sewer line, and vault will be located near existing utilities. Care must be taken to avoid disturbing or damaging these utilities, and they should be properly supported during construction. The DSM contractor must be fully informed of all underground utilities prior to beginning DSM implementation, drilling, and mixing activities. The contractor should evaluate the location of existing utilities and establish procedures to protect them throughout the DSM operation.

4.7 SITE PREPARATION AND EARTHWORK

All grading and site preparation activities should be supervised by qualified personnel who report directly to the project as-needed Geotechnical Engineer. Our field monitoring services play a critical role in validating and correlating our findings and recommendations with the actual subsurface conditions encountered during construction. These services will also confirm that the subgrade mitigations are fully implemented and effectively established.

Given the high groundwater levels (artesian conditions) at the site, over-excavation and re-compaction of the subgrade present significant challenges. We anticipate soil pumping issues during compaction and grading operations. For the subgrade of shallow foundation structures, we recommend achieving a stabilization depth of at least five feet, or a minimum of three feet below the bottom of the foundation, utilizing Cement Deep Soil Mixing (DSM). This recommendation is suitable for structures such as equipment cabinet slabs.

Alternatively, the subgrade for these structures may be over-excavated to a depth of at least three feet below the bottom of the shallow foundation, not to exceed five feet, and then backfilled with crushed 1-inch rock. It is essential to cover the bottom of the excavation with geotechnical fabric, such as Mirafi 140N or an equivalent, to create a separation layer between the rock and the subgrade. A layer of geogrid, such as TriAx TX Type 2 Geogrid or an equivalent, should then be placed over the fabric. The crushed aggregate should be placed over the geogrid in loose 8-inch lifts and compacted to a minimum of 90% according to ASTM D1557 standards.

4.7.1 Assessment of Adjacent Structures

Adjacent structures (within 50 feet) should be monitored for vibrations and ground surface settlement due to construction of the lift station. The monitoring program could include seismographs, inclinometers, and other methods. Existing conditions should be documented prior to the start of construction. Documentation may include a crack survey, videotaping of deficiencies, floor level surveys, and other methods. The age and condition of existing utilities should also be documented.

4.7.2 Vibrations During Construction

Construction vibrations should be limited to a maximum of 0.2 inches per second to limit the amount of vibrations impacted by surrounding properties and settlement during construction. The use of seismographs located near residential properties in the vicinity of the construction can monitor the vibrations.

4.8 ENVIRONMENTAL TEST RESULTS AND CONCLUSIONS

4.8.1 Groundwater Test Results

Groundwater monitoring completed at the site has identified the following analytes in shallow groundwater.

- Barium at a maximum of 87 micrograms per liter (µg/L)
- Selenium at a maximum of 63 micrograms per liter (µg/L)

However, barium levels were below the MCL priority of 1,000 µg/L established by the San Francisco Bay Regional Water Quality Control Board and Selenium was below the Orange County Sanitation District's (OCSD) maximum allowable local non-domestic discharge limit of 3,900 µg/L. Therefore, barium and selenium are not considered constituents of concern (COCs). Additionally, the presence of gasoline range organics, diesel and oil range organics and BTEX compounds were not detected above the practical quantification limit (PQL) in the groundwater. Groundwater test results are found in the appendix.

4.8.2 Soil Test Results

Analysis of soil samples collected by AESCO during well installation activities did not identify the presence of gasoline range organics, diesel and oil range organics and mercury above the PQL in the soil. Metals detected in the soil samples included arsenic, barium, beryllium, chromium, cobalt, copper, lead, molybdenum, nickel, vanadium and zinc. The levels were found to fall below relevant screening levels and/or local landfill soil acceptance criteria. Therefore, the metals are not considered to be COCs. Soil test results are found in the appendix.

4.9 SOIL CORROSIVITY

The results of pH, soluble chloride and soluble sulfate laboratory tests on a sample of the near surface soils are summarized in the following table:

Soil Test	Test Results	Corrosion Potential
Soluble Sulfates (per CA 417)	1110 ppm	Severe sulfate attack on concrete.
Soluble Chlorides (per CA 422)	516 ppm	Very corrosive potential to buried ferrous metals
pH	7.7	Moderate corrosive potential to buried ferrous metals
Resistivity	727	Severe corrosion potential to buried ferrous metals

Concrete should be designed in accordance with the 2022 CBC, ACI 318 Section 19.3.1, Table 19.3.2.1 (2019). As the potential for sulfate attack on concrete appears very corrosive Type II/V Portland cement may be used with 0.45 maximum water to cement ratio for the purpose of sulfate attack abatement. The minimum compressive strength of concrete shall be 4,500 psi at 28 days and maximum slump during placement shall be five inches. A qualified inspector, under the supervision of a professional engineer, shall inspect the concrete placement.

The test results indicate that the onsite soils can be classified as very corrosive potential to buried metallic structures (e.g. pipes). As a minimum, buried metal piping should be protected with suitable coatings, wrappings, or seals. Epoxy-coated rebar is recommended for the steel reinforcement of the lift station to resist soil corrosivity. The utility piping may be buried in PVC lined trenches and backfilled with clean sand. The width of the trenches should be a minimum of three times the diameter of the pipes. A corrosion consultant should be retained if more detailed evaluation or a protection system is desired. AESCO recommends that additional corrosivity evaluation should be performed during grading operations and for any imported fill to ensure that corrosivity characteristics have not changed.

4.10 UTILITY TRENCHES

Any soft and/or unsuitable material encountered at the bottom of excavations for such facilities should be removed and be replaced with an adequate bedding material. A non-expansive granular material with a sand equivalent greater than 30 should be used for bedding and shading of utilities.

On-site material may NOT be suitable for backfill of utility and pipe trenches. The trench bottom and the trench backfill should be mechanically placed and compacted in 8-inch lifts to at least 90 percent of the maximum dry density as determined by ASTM Test Method D 1557 (i.e. 90 percent relative compaction). Where trenches are placed beneath slabs or footings the backfill shall satisfy the gradation and expansion index requirements of engineered fill (see Section 4.7). Flooding or jetting for placement and compaction of backfill is not recommended. Any trenches deeper than 8 feet may have excessive water infiltration due to the artesian groundwater condition. Deep trenches must be mitigated for groundwater as described in previous section.

Flexible connections should be used to account for any movement.

4.11 CONSTRUCTION PROCEDURES

The soils at the site are composed of a significant amount of fine materials. These soils are subject to extreme changes in shear strength with varying moisture conditions. The soils are saturated, and compaction operations can be seriously hampered by a tendency of the fine material to "pump". Consequently, it is recommended that adequate site drainage be established prior to and continued during and following construction operations to prevent ponding of water on or adjacent to the construction area and subsequent saturation of the soil. Compaction operations may be expedited by using light compaction equipment and thin lifts of soil. Rolling only as necessary to obtain compaction is advisable because further repetitive loading may cause the subgrade to "pump". Once the soil begins to "pump", it generally becomes necessary to undercut the poor soil, waste it and mitigate the saturated subgrade. The mitigation of wet subgrade may consist of over excavating a minimum of 2 feet and backfill with 2 feet of ¾-inch to 1-inch crushed rock encapsulated with geotextile fabric, such as Mirafi 1120N, or equivalent, to bridge over the pumping subgrade.

Compaction operations and installation of the foundations should be supervised by the Geotechnical Engineer. All foundation excavations should be inspected to verify cleaning and bearing stratum. Concrete should be placed in foundation excavations as soon as practical after forming and final clean-up have been approved to avoid prolonged exposure of the bearing stratum and possible disturbance due to standing water, desiccation or construction operations.

4.12 CONSTRUCTION OBSERVATIONS AND FIELD TESTING

As Geotechnical Engineer of record, construction observation and field testing services are an essential continuation of this geotechnical study to confirm and correlate our findings and recommendations with the actual subsurface conditions exposed during construction. As such, to maintain the status of geotechnical engineer of record, AESCO should be present to observe and provide testing during the following construction activities:

- Soil Cement Deep Mixing (DSM)
- Excavation and backfilling for equipment cabinets, wet well and vault
- Shoring installation
- Concrete placement
- Structural backfill
- Rebar placement
- Settlement and vibration monitoring
- Placement of all fill

5.0 LIMITATIONS

It is important to recognize that the conclusions drawn in this report are based on the conditions observed at the specific locations of the borings. In any subsurface investigation, it is necessary to assume that the subsoil conditions between borings do not change significantly. Additionally, groundwater levels are subject to fluctuation due to various factors, including pumping and injection activities.

The borings were strategically placed outside the footprint of the proposed structures due to groundwater conditions, as shown in Figure 2. It should be noted that the test locations are approximate, as they were determined by measuring distances from existing landmarks; surveying of the site was beyond the scope of our work.

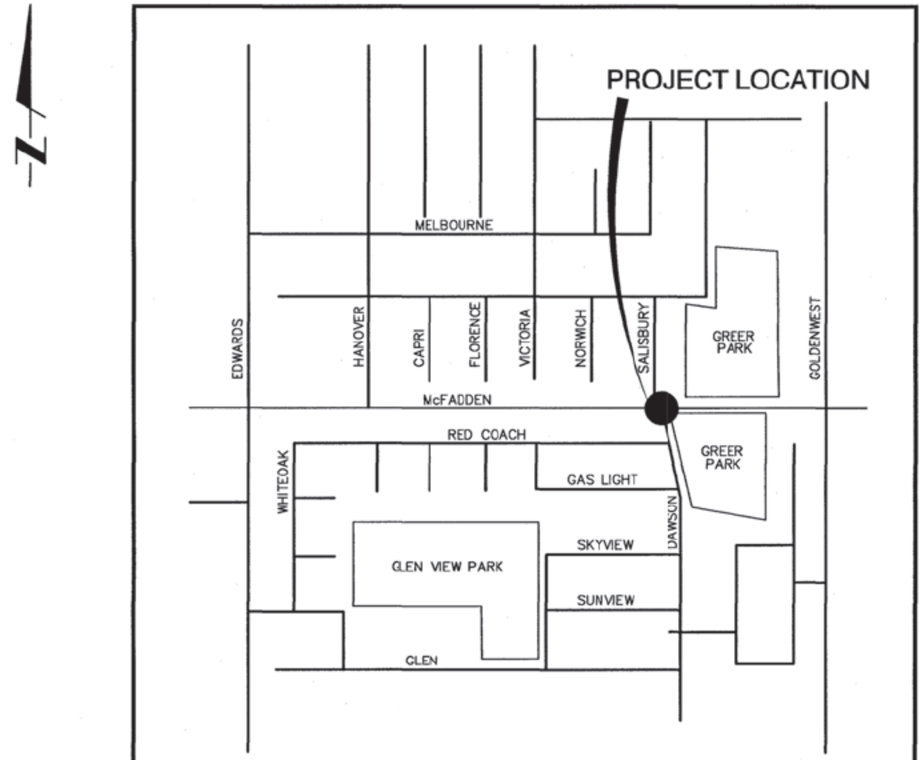
In the event of significant changes in design loads or structural characteristics, AESCO should be retained to review our original design recommendations for their applicability to any revised design plans. This proactive approach ensures that any necessary supplemental recommendations can be provided in a timely manner.

Should any unusual conditions arise during construction, it is essential that our office be notified immediately to allow for further investigation and the development of appropriate supplemental recommendations. Continuous geotechnical observation and testing should be performed during grading, excavation, DSM application, shoring, and foundation installation to ensure compliance with the recommendations provided in this report.

If parties other than AESCO are engaged to deliver geotechnical services during construction, they will assume full responsibility for the geotechnical aspects of the project. These parties must adhere to the recommendations outlined in this report, as AESCO cannot be held accountable for any discrepancies or issues that arise from services provided by others.

APPENDIX
SITE VICINITY MAP (Fig. 1)

VICINITY MAP
N.T.S.



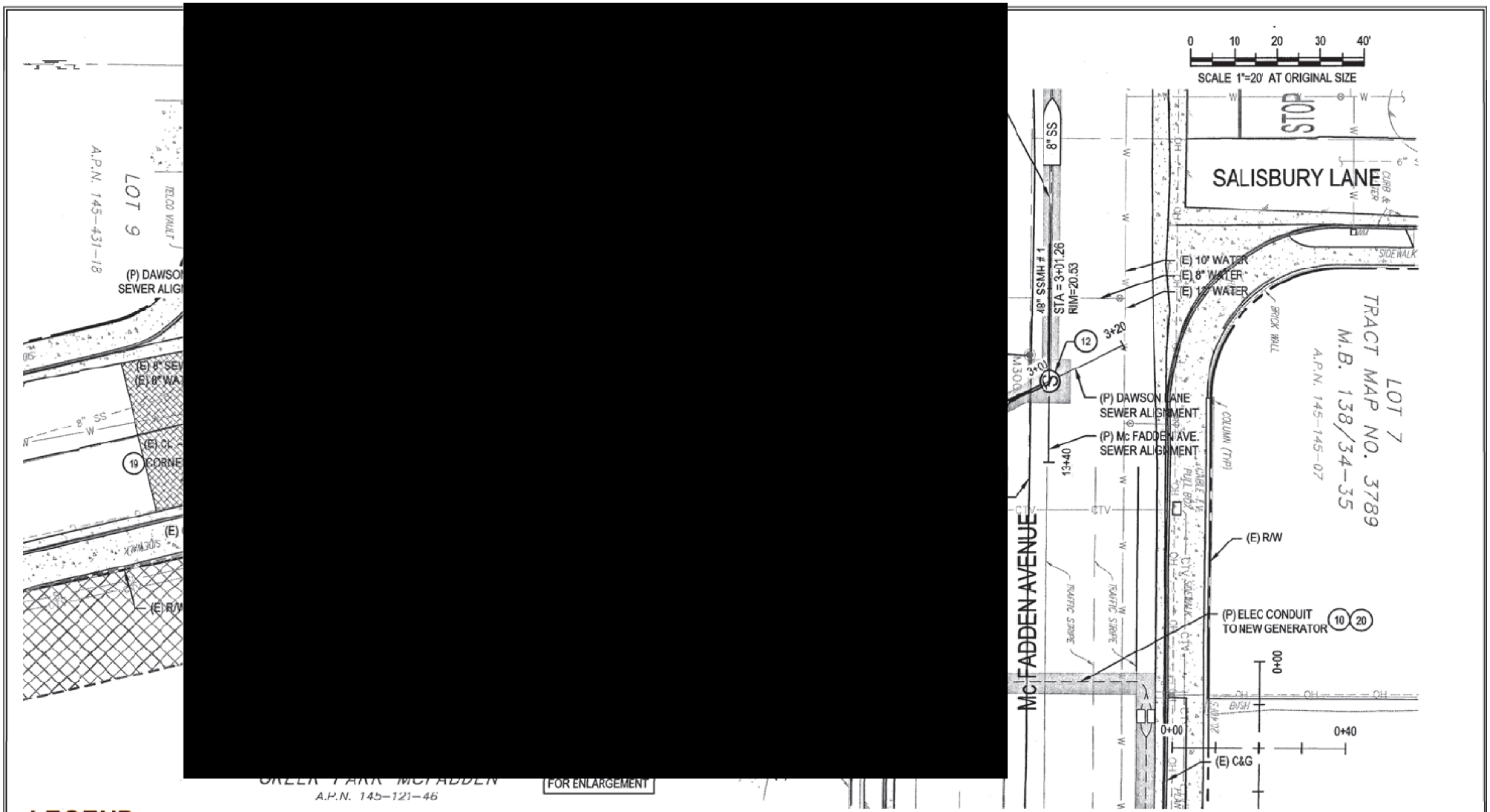
LOCATION MAP
N.T.S.

CITY OF HUNTINGTON BEACH		
Project No. : 20240035-H3462	Scale: *NTS*	
Site Name: McFadden Sewer Lift Station (CC-1610)		
Site Address: SE Corner of Dawson Lane and McFadden Avenue, Huntington Beach, CA 92647		
SITE VICINITY MAP	Date: 1-24-25	Figure 1

AESCO

APPENDIX

SITE PLAN (Fig. 2)



[redacted]

PLAN VIEW - DAWSON LANE SEWER

SCALE 1"=20'

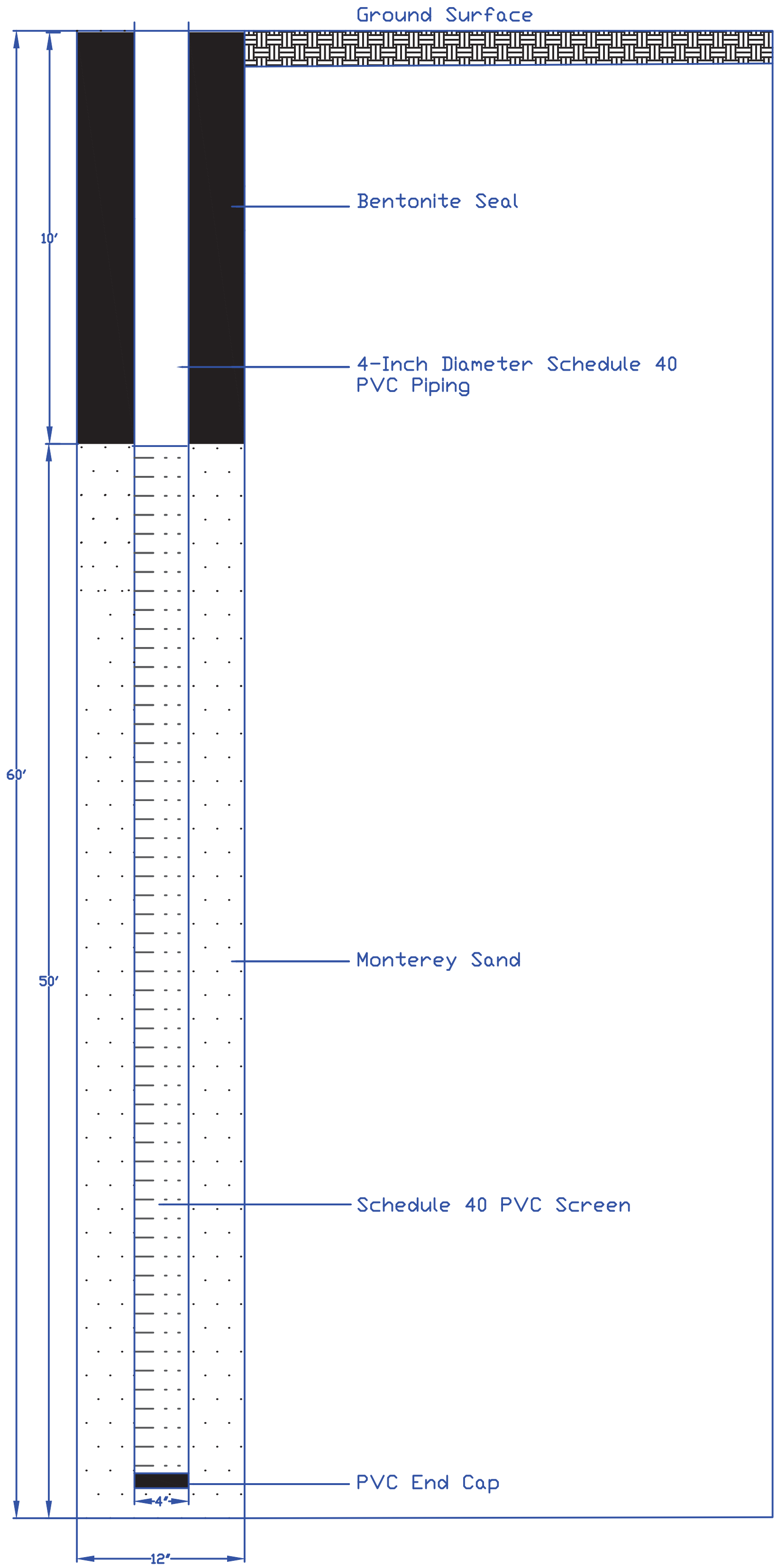
LEGEND

- PW-1 — Approximate Location of Pump and Observation Wells
- CPT-1 — Approximate Location of Cone Penetration Tests (CPT)
- HPT-1 — Approximate Location of Hydraulic Profiling Tool (HPT)
- S-1 — Approximate Location of Auger Samples

AESCO	CITY OF HUNTINGTON BEACH		
	Project No. : 20240035-H3462	Scale: *1 inch ≅ 35 feet*	
	Site Name: McFadden Sewer Lift Station (CC-1610)		
	Site Address: SE Corner of Dawson Lane and McFadden Avenue, Huntington Beach, CA 92647		
	SITE PLAN	Date: 10-10-24	Figure 2

APPENDIX

WELL DIAGRAM (Fig. 3)

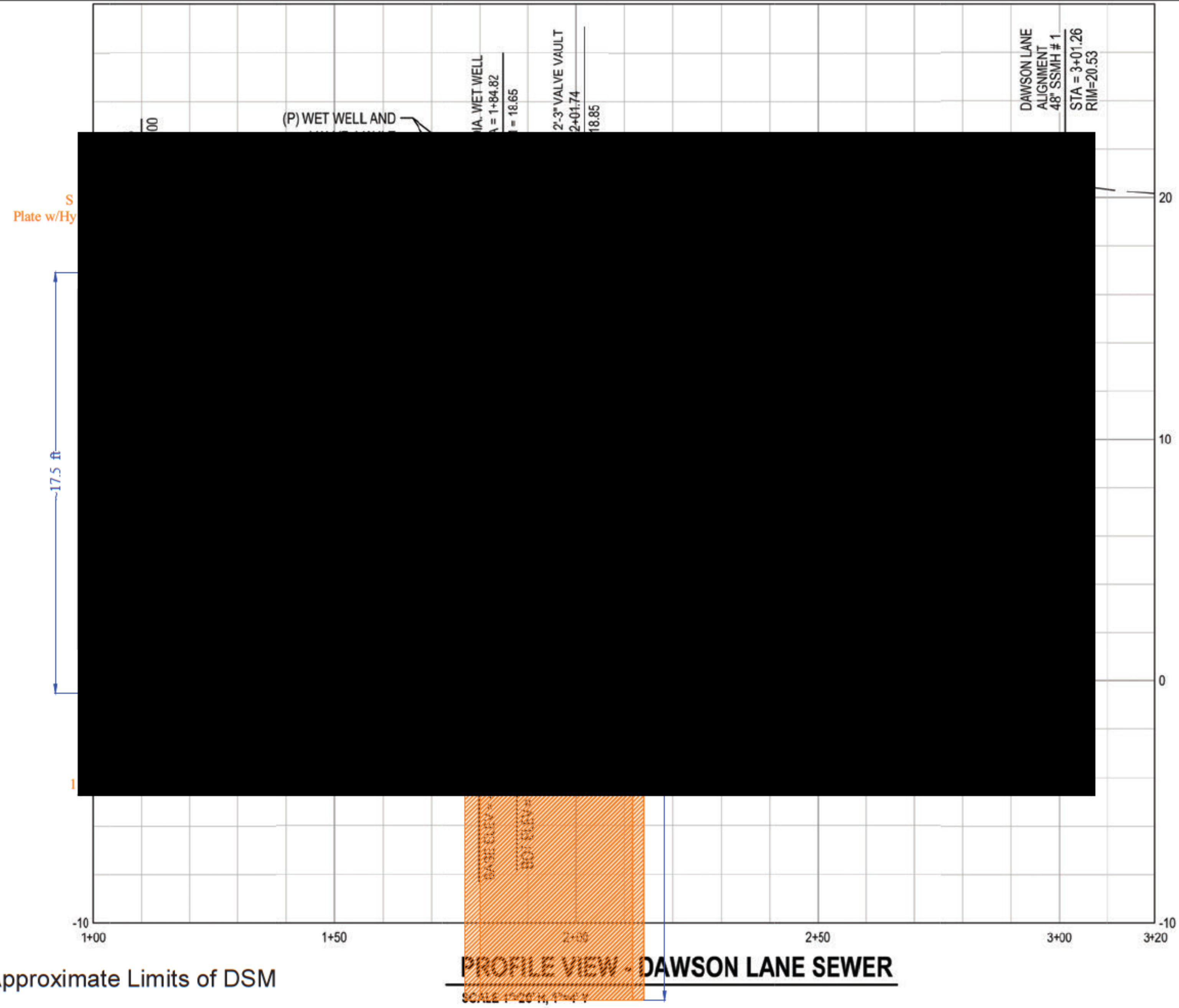


Well PW-1 thru PW-4: 4" Diameter Well

City of Huntington Beach		
Project No. : 20240035	Scale: *NTS*	
Site Name: McFadden Sewer Lift Station Replacement		
Site Address: 3862 McFadden Ave, Huntington Beach, CA 92646		
Typical Well Diagram	Date: 1-16-24	Figure 3

APPENDIX

Cross-Section View of DSM (Fig. 4)



[redacted]

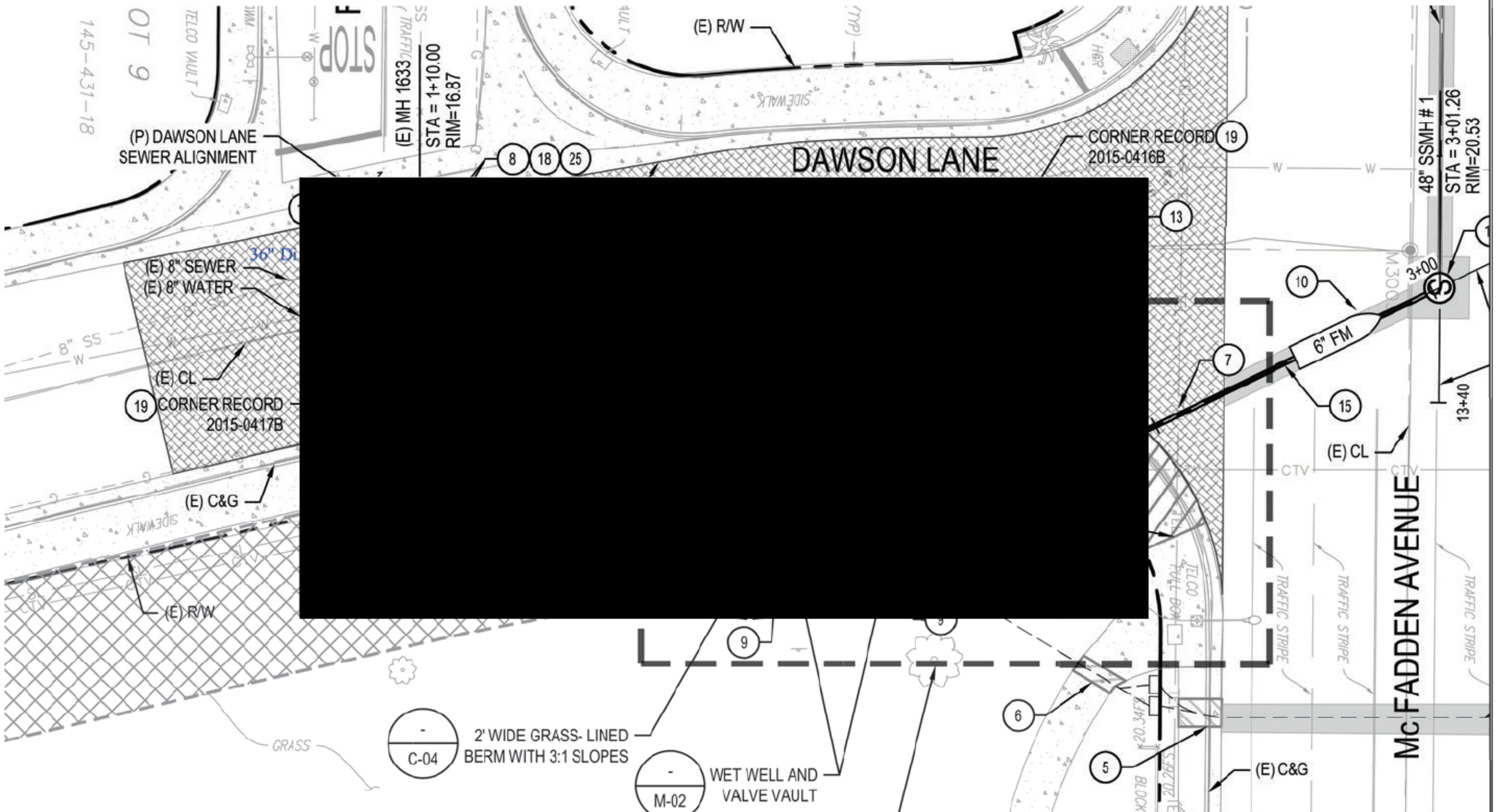
LEGEND

Approximate Limits of DSM

CITY OF HUNTINGTON BEACH	
Project No. : 20240035-H8292	Scale: *NTS*
Site Name: McFadden Sewer Lift Station (CC-1610)	
Site Address: SE Corner of Dawson Lane and McFadden Avenue, Huntington Beach, CA 92647	
Cross-Section View of DSM	Date: 6-19-25 / Figure 4

APPENDIX

Plan View Limits of DSM (Fig. 5)



[redacted]

LEGEND

- Approximate Limits of DSM
- Approximate Limits of Trench Zone

CITY OF HUNTINGTON BEACH		
Project No. : 20240035-H8292	Scale: *NTS*	
Site Name: McFadden Sewer Lift Station (CC-1610)		
Site Address: SE Corner of Dawson Lane and McFadden Avenue, Huntington Beach, CA 92647		
Plan View Limits of DSM	Date: 6-19-25	Figure 5

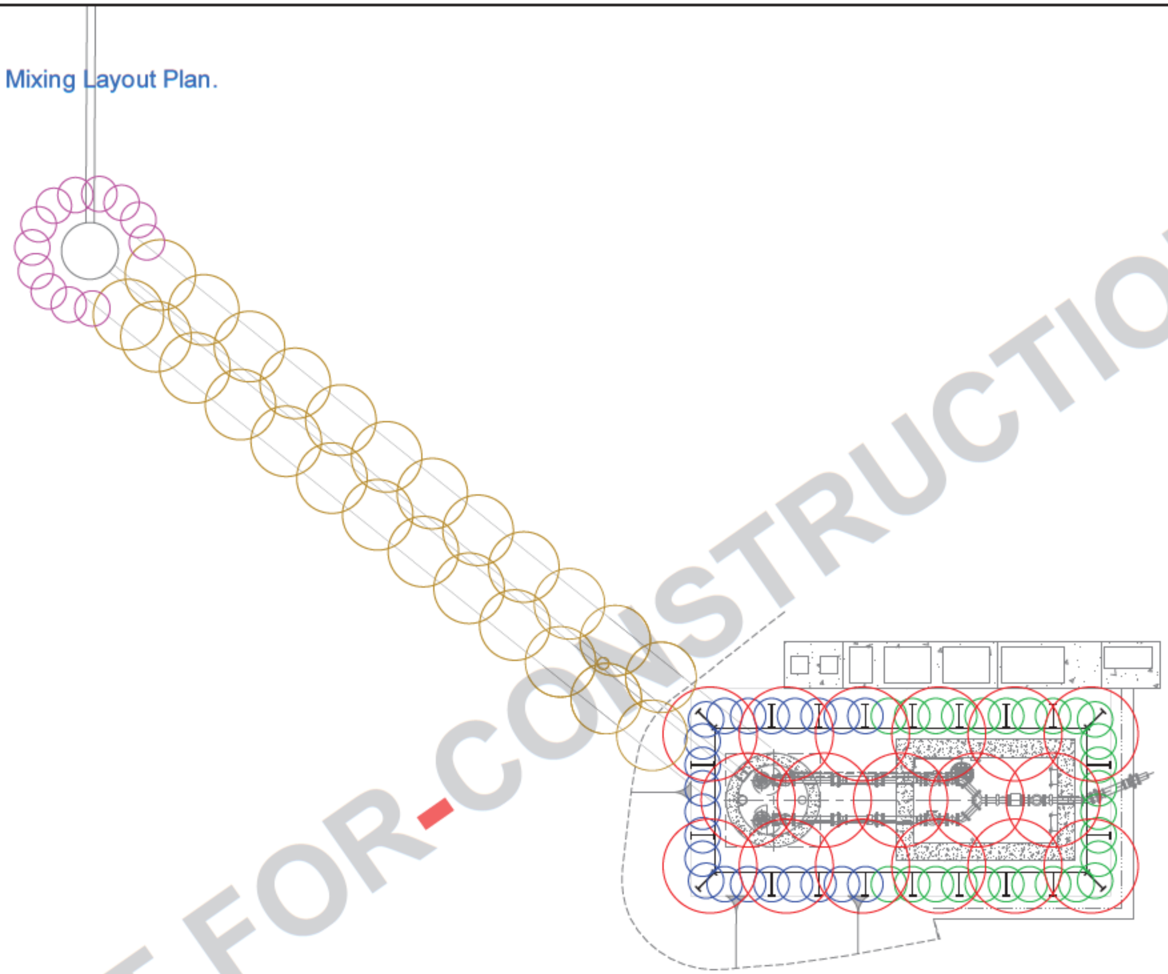
AESCO

APPENDIX

Deep Soil Mixing Layout Plan (KNA-2) (Fig. 6)

PLAN VIEW

Figure 6 - Deep Soil Mixing Layout Plan.



LEGEND:

- Ø8' DEEP SOIL MIXING LOCATION
- Ø6' DEEP SOIL MIXING LOCATION
- Ø3' DEEP SOIL MIXING LOCATION

0" 5'-0" 10'-0"
SCALE IN FEET

KELLER
17461 DERIAN AVENUE
SUITE 106
IRVINE, CA 92614
909-393-9300
www.Keller-na.com

Ground Improvement Engineer:
Sunil Arora

- PRELIMINARY - NOT FOR CONSTRUCTION

THIS DOCUMENT IS RELEASED FOR THE PURPOSE OF INTERIM REVIEW. IT IS NOT TO BE USED FOR CONSTRUCTION.
California

DEEP SOIL MIXING LAYOUT PLAN

McFADDEN SEWER LIFT STATION REPLACEMENT

McFADDEN AVE & DAWSON LN HUNTINGTON BEACH, CA 92647

No.	Description	Date
0	FOR SUBMITTAL	06/24/2025

Design by: GG
Approved by: SA
Drawn by: SPB
Checked by: SA
Project Number: OP0012141
Date: 06/24/2025
Sheet No.
KNA-2

APPENDIX
LOGS OF BORINGS

LOG OF BORING NO. PW - 1

AESCO

Project: McFadden Sewer Lift Station Replacement
City of Huntington Beach Project No. CC-1610

Location: Corner of Dawson Lane and McFadden Avenue, Huntington Beach, CA 92648

WATER: Encountered at 7 Feet
- Free water flowing from the boring upon completion

Client: City of Huntington Beach
Date: 05/31/24

Logger: Omar Chamaa
Project No. 20240035-H4028

DRILLING: Hollow Stem Auger

FIELD DATA: SOIL SYMBOL	DEPTH (FT)	TESTS: N= T= P=	MOISTURE CONTENT %	DRY DENSITY PCF	LIQUID LIMITS %	PLASTIC LIMITS %	PLASTICITY INDEX %	Unconfined Comp. TSF	Unconfined Comp. Strain %	PASSING 200 SIEVE %	DIRECT SHEAR COHESION PSF	DIRECT SHEAR ANGLE φ Deg	EXPANSION INDEX	DESCRIPTION OF STRATUM (Elevation ~ 17 ft. AMSL)
SC			9.3		38	21	17			23.9				Dark brown to Black clayey Sand (SC)
CL	3	N=13	28.1		50	24	26			75.7				Dark Brown sandy Clay (CL), stiff @ 2 feet
C	5	N=5 P=2.0	32.5	91.5	36	24	12			64.5	288	32.6		- medium @ 4 feet
▼	8	N=7	37.5		39	23	16			40.0				Dark Brown sandy Clay (CL) with sand lenses, medium @ 6 feet
C	10	N=4 P=1.5	49.7	74.7	49	28	21			88.6	708	17.1		Dark brown & black slightly sandy Clay (CL), soft @ 8 feet
	13													
ML/OL	15	N=4	53.9		54	41	13			57.3				Dark brown organic sandy Silt (ML/OL), soft @ 13 feet
	18													
C	20	N=14 P=3.0	30.8	92.5	30	26	4			81.4	648	15.3		Dark brown & black slightly sandy Silt (ML/OL), stiff @ 18 feet
	23													
	25	N=9	37.1		33	27	6			78.7				-inease in sand content, stiff @ 23 feet
	28													
C	30	N=8 P=2.5	33.2	89.8	26	22	4			34.5	330	22.5		Brown silty Sand (SM), loose at 28 feet
	33													
CL	35	N=11	33.3		31	24	7			62.1				Brown sandy Clay (CL), stiff @ 33 feet
	38													
C	40	N=7 P=3.0	37.9	86.0	32	22	10			60.0	84	25.9		- Medium soft @ 38 feet
	43													
	45	N=11	49.6		39	21	18			75.6				- Stiff @ 43 feet
														Brown coarse silty Sand (SM) @ 45', saturated
	48													
	50	N=14	13.3							33.9				- Medium dense
	55	N=17	12.9											- Medium dense
	60	N=19	14.7											- Medium dense

Boring Terminated at 60 Feet

TUBE SAMPLE
AUGER SAMPLE
C CALIFORNIA MODIFIED SAMPLER
SPLIT SPOON
NO RECOVERY

▼ Ground Water Level
▽ Hydrostatic Ground Water Level
———— Approximate Division of Soil Type

CL | SP | SC | ML/OL

N= SPT, BLOWS/FT
T= THD,BLOWS/FT
P= HAND PEN.,TSF

REMARKS:
NP: Non Plastic Materials
* Remolded Samples
Blow Counts Corrected for California Modified (0.6 multiplier), Auto-Hammer, 8" HAS

LOG OF BORING NO. O - 1

AESCO

Project: McFadden Sewer Lift Station Replacement
City of Huntington Beach Project No. CC-1610

Location: Corner of Dawson Lane and McFadden Avenue, Huntington Beach, CA 92648

WATER: Encountered at 7 Feet
- Free water flowing from the boring upon completion

Client: City of Huntington Beach

Date: 05/31/24

Logger: Omar Chamaa

Project No. 20240035-H4028

DRILLING: Hollow Stem Auger

FIELD DATA		TESTS												DESCRIPTION OF STRATUM
SOIL SYMBOL	DEPTH (FT)	N= T= P=	MOISTURE CONTENT %	DRY DENSITY PCF	LIQUID LIMITS %	PLASTIC LIMITS %	PLASTICITY INDEX %	Unconfined Comp. TSF	Strain %	PASSING 200 SIEVE %	DIRECT SHEAR COHESION PSF	DIRECT SHEAR ANGLE φ Deg	EXPANSION INDEX	Elevation ~ 17 ft. AMSL Visual Soil Classifications
	3													Dark Brown sandy Clay (CL)
	5													
▼	8													Dark brown & black slightly sandy Clay (CL)
	10													
	13.0													Dark brown organic sandy Silt (ML/OL)
	15													
	18													Dark brown & black slightly sandy Silt (ML/OL)
	20													
	23													
	25													-inease in sand content
	28													
	30													Brown silty Sand (SM)
	33													
	35													
	38													
	40													Brown sandy Clay (CL) with organics
	43													
	45													
	48													
	50													
														Brown coarse silty Sand (SM)
	55													
	60													

Boring Terminated at 60 Feet

TUBE SAMPLE
AUGER SAMPLE
CALIFORNIA MODIFIED SAMPLER
SPLIT SPOON
NO RECOVERY

▼ Ground Water Level
▽ Hydrostatic Ground Water Level
——— Approximate Division of Soil Type

CL   SP or SM   SC   ML/OL

N= SPT, BLOWS/FT
T= THD,BLOWS/FT
P= HAND PEN.,TSF

REMARKS:
NP: Non Plastic Materials
* Remolded Samples
Blow Counts Corrected for California Modified (0.6 multiplier). Auto-Hammer, 8" HAS

LOG OF BORING NO. O - 2

AESCO

Project: McFadden Sewer Lift Station Replacement
City of Huntington Beach Project No. CC-1610

Location: Corner of Dawson Lane and McFadden Avenue, Huntington Beach, CA 92648

WATER: Encountered at 7 Feet
- Free water flowing from the boring upon completion

Client: City of Huntington Beach
Date: 05/31/24

Logger: Omar Chamaa
Project No. 20240035-H4028

DRILLING:
Hollow Stem Auger

FIELD DATA: SOIL SYMBOL	DEPTH (FT)	TESTS: N= T= P=	MOISTURE CONTENT %	DRY DENSITY PCF	LIQUID LIMITS %	PLASTIC LIMITS %	PLASTICITY INDEX %	Unconfined Comp. TSF	Strain %	PASSING 200 SIEVE %	DIRECT SHEAR: COHESION PSF	ANGLE φ Deg	EXPANSION INDEX	DESCRIPTION OF STRATUM: Elevation ~ 17 ft. AMSL; Visual Soil Classifications
CL	3													Dark Brown sandy Clay (CL)
	5													
CL (▼ Ground Water Level)	8													Dark brown & black slightly sandy Clay (CL)
	10													
ML/OL	13.0													Dark brown organic sandy Silt (ML/OL)
	15													
	18													Dark brown & black slightly sandy Silt (ML/OL), with Organics
	20													
	23													
	25													- less organics
	28													
SP	30													Brown silty Sand (SM)
	33													
CL	35													
	38													
	40													Brown sandy Clay (CL)
	43													
	45													
SP	48													
	50													Brown coarse Sand (SP)
	55													
	60													

Boring Terminated at 60 Feet

TUBE SAMPLE
AUGER SAMPLE
CALIFORNIA MODIFIED SAMPLER
SPLIT SPOON
NO RECOVERY

▼ Ground Water Level
▽ Hydrostatic Ground Water Level
———— Approximate Division of Soil Type

CL · SP · SC · ML/OL

N= SPT, BLOWS/FT
T= THD,BLOWS/FT
P= HAND PEN.,TSF

REMARKS:
NP: Non Plastic Materials
* Remolded Samples
Blow Counts Corrected for California Modified (0.6 multiplier), Auto-Hammer, 8" HAS

LOG OF BORING NO. O - 3

AESCO

Project: McFadden Sewer Lift Station Replacement, City of Huntington Beach Project No. CC-1610

Location: Corner of Dawson Lane and McFadden Avenue, Huntington Beach, CA 92648

WATER: Encountered at 7 Feet
- Free water flowing from the boring upon completion

Client: City of Huntington Beach

Date: 05/31/24

Logger: Omar Chamaa

Project No. 20240035-H4028

DRILLING: Hollow Stem Auger

FIELD DATA		TESTS												DESCRIPTION OF STRATUM
SOIL SYMBOL	DEPTH (FT)	N= T= P=	MOISTURE CONTENT %	DRY DENSITY PCF	LIQUID LIMITS %	PLASTIC LIMITS %	PLASTICITY INDEX %	Unconfined Comp. TSF	Strain %	PASSING 200 SIEVE %	DIRECT SHEAR COHESION PSF	DIRECT SHEAR ANGLE φ Deg	EXPANSION INDEX	Elevation ~ 17 ft. AMSL Visual Soil Classifications
	3													Dark Brown sandy Clay (CL)
	5													
▼														
	8													Dark brown & black slightly sandy Clay (CL)
	10													
	13.0													Dark brown organic sandy Silt (ML/OL)
	15													
	18													Dark brown & black slightly sandy Silt (ML/OL), with Organics
	20													
	23													
	25													- less organics
	28													
	30													Brown silty Sand (SM)
	33													
	35													
	38													Brown sandy Clay (CL), sandy Silt (ML), Organic sany Silt (OL) with organics
	40													
	43													
	45													
	48													
	50													
														Brown coarse Sand (SP)
	55													
	60													

Boring Terminated at 60 Feet

TUBE SAMPLE
AUGER SAMPLE
CALIFORNIA MODIFIED SAMPLER
SPLIT SPOON
NO RECOVERY

▼ Ground Water Level   ▽ Hydrostatic Ground Water Level

——— Approximate Division of Soil Type

N= SPT, BLOWS/FT
T= THD,BLOWS/FT
P= HAND PEN.,TSF

CL   SP   SC   ML/OL

REMARKS:
NP: Non Plastic Materials
* Remolded Samples
Blow Counts Corrected for California Modified (0.6 multiplier), Auto-Hammer, 8" HAS

LOG OF BORING NO. S - 1

AESCO

Project: McFadden Sewer Lift Station Replacement
City of Huntington Beach Project No. CC-1610

Location: Corner of Dawson Lane and McFadden Avenue, Huntington Beach, CA

WATER: Encountered at 7 Feet

Client: City of Huntington Beach
Date: 09/13/24

Logger: Omar Chamaa
Project No. 20240035-H4028

DRILLING: Hollow Stem Auger

FIELD DATA		TESTS							DESCRIPTION OF STRATUM
SOIL SYMBOL	DEPTH (FT)	MOISTURE CONTENT %	REMOLDED MAXIMUM DENSITY PCF	PASSING 200 SIEVE %	LIQUID LIMITS %	PLASTIC LIMITS %	PLASTICITY INDEX %	ORGANIC %	Elevation ~ 17 ft. AMSL
CL	5	36.4	117.0	62.7	40	20	20	4.3	Dark Brown sandy Clay (CL)
CL	10	28.6	105.5	46.6	35	20	15	4.3	Dark brown to black slightly sandy Clay (CL), with sand lenses
ML/OL	15	42.0	103.5	46.4	27	23	4	4.6	Black sandy Silt (ML) with sand lenses
ML/OL	20	73.6	100.0	38.5	28	25	3	4.4	Black sandy silt (ML) with sand lenses
CL	25	38.9	91.0	63.6	41	31	10	9.1	Black sandy silt (ML), with organics

Boring Terminated at 25 Feet

TUBE SAMPLE
AUGER SAMPLE
C CALIFORNIA MODIFIED SAMPLER
SPLIT SPOON
NO RECOVERY

▼ Ground Water Level
▽ Hydrostatic Ground Water Level
——— Approximate Division of Soil Type

CL | SP | SC | ML/OL

N= SPT, BLOWS/FT
T= THD,BLOWS/FT
P= HAND PEN.,TSF

REMARKS:
NP: Non Plastic Materials
* Remolded Samples at 5' intevals of S-1 through S-4
Blow Counts Corrected for California Modified Sampler (0.6 multiplier), Auto-Hammer, 8" HAS

LOG OF BORING NO. S - 2

AESCO

Project: McFadden Sewer Lift Station Replacement
City of Huntington Beach Project No. CC-1610

Location: Corner of Dawson Lane and McFadden Avenue, Huntington Beach, CA

WATER: Encountered at 7 Feet

Client: City of Huntington Beach
Date: 09/13/24

Logger: Omar Chamaa
Project No. 20240035-H4028

DRILLING: Hollow Stem Auger

FIELD DATA		TESTS							DESCRIPTION OF STRATUM
SOIL SYMBOL	DEPTH (FT)	MOISTURE CONTENT %	REMOLDED MAXIMUM DENSITY PCF	PASSING 200 SIEVE %	LIQUID LIMITS %	PLASTIC LIMITS %	PLASTICITY INDEX %	ORGANIC %	Elevation ~ 17 ft. AMSL
CL	5	36.4	117.0	42.7	35	20	15	4.5	Dark Brown sandy Clay (CL)
CL	10	28.6	105.5	64.0	45	26	19	9.9	Dark brown to black slightly sandy Clay (CL), with sand lenses & organics
ML/OL	15	42.0	103.5	68.3	53	31	22	10.8	Black sandy Silt (MH) with sand & Organics
ML/OL	20	73.6	100.0	62.6	37	28	4	7.2	Black sandy silt (ML) with less organics
ML/OL	25	38.9	91.0	53.6	42	31	11	9.5	Dark brown very sandy Silt (ML), with organics

Boring Terminated at 25 Feet

TUBE SAMPLE
AUGER SAMPLE
C CALIFORNIA MODIFIED SAMPLER
SPLIT SPOON
NO RECOVERY

▼ Ground Water Level
▽ Hydrostatic Ground Water Level
—— Approximate Division of Soil Type

CL | SP | SC | ML/OL

N= SPT, BLOWS/FT
T= THD,BLOWS/FT
P= HAND PEN.,TSF

REMARKS:
NP: Non Plastic Materials
* Remolded Samples at 5' intevals of S-1 through S-4
Blow Counts Corrected for California Modified Sampler (0.6 multiplier) Auto-Hammer 8" HAS

LOG OF BORING NO. S - 3

AESCO

Project: McFadden Sewer Lift Station Replacement
City of Huntington Beach Project No. CC-1610

Location: Corner of Dawson Lane and McFadden Avenue, Huntington Beach, CA

WATER: Encountered at 7 Feet

Client: City of Huntington Beach
Date: 09/13/24

Logger: Omar Chamaa
Project No. 20240035-H4028

DRILLING: Hollow Stem Auger

FIELD DATA		TESTS							DESCRIPTION OF STRATUM
SOIL SYMBOL	DEPTH (FT)	MOISTURE CONTENT %	REMOLDED MAXIMUM DENSITY PCF	PASSING 200 SIEVE %	LIQUID LIMITS %	PLASTIC LIMITS %	PLASTICITY INDEX %	ORGANIC %	Elevation ~ 17 ft. AMSL
CL	5	36.4	117.0	62.2	40	20	20	6.3	Dark Brown sandy Clay (CL)
CL	10	28.6	105.5	64.1	41	26	15	7.9	Dark brown to black slightly sandy Clay (CL), with sand lenses & organics
ML/OL	15	42.0	103.5	57.4	25	21	4	4.7	Black sandy Silt (ML) with sand lenses & Organics
ML/OL	20	73.6	100.0	69.2	37	28	9	7.5	Black sandy silt (ML),increse in organics
ML/OL	25	38.9	91.0	75.5	46	30	16	7.5	Dark brown very sandy Silt (ML), with organics

Boring Terminated at 25 Feet

TUBE SAMPLE
AUGER SAMPLE
C CALIFORNIA MODIFIED SAMPLER
SPLIT SPOON
NO RECOVERY

▼ Ground Water Level
▽ Hydrostatic Ground Water Level
——— Approximate Division of Soil Type

CL | SP | SC | ML/OL

N= SPT, BLOWS/FT
T= THD,BLOWS/FT
P= HAND PEN.,TSF

REMARKS:
NP: Non Plastic Materials
* Remolded Samples at 5' intevals of S-1 through S-4
Blow Counts Corrected for California Modified Sampler (0.6 multiplier), Auto-Hammer, 8" HAS

LOG OF BORING NO. S - 4	AESCO
Project: McFadden Sewer Lift Station Replacement, City of Huntington Beach Project No. CC-1610 — **Location:** Corner of Dawson Lane and McFadden Avenue, Huntington Beach, CA	WATER: Encountered at 7 Feet
Client: City of Huntington Beach — **Logger:** Omar Chamaa	DRILLING:
Date: 09/13/24 — **Project No.** 20240035-H4028	Hollow Stem Auger

FIELD DATA		TESTS							DESCRIPTION OF STRATUM
SOIL SYMBOL	DEPTH (FT)	MOISTURE CONTENT %	REMOLDED MAXIMUM DENSITY PCF	PASSING 200 SIEVE %	LIQUID LIMITS %	PLASTIC LIMITS %	PLASTICITY INDEX %	ORGANIC %	Elevation ~ 17 ft. AMSL
	5	36.4	117.0	49.2	38	23	15	5.8	Dark Brown sandy Clay (CL) with sand lenses
	10	28.6	105.5	62.0	48	26	22	8.4	Dark brown to black slightly sandy Clay (CL), with sand lenses & organics
	15	42.0	103.5	62.2	42	26	16	6.3	Dark brown to black slightly sandy Clay (CL), with sand lenses & organics
	20	73.6	100.0	65.7	54	36	18	13.8	Black sandy silt (OL),increse in organics
	25	38.9	91.0	79.0	46	32	14	9.4	Black sandy silt (OL), with sand layers and organics

Boring Terminated at 25 Feet

TUBE SAMPLE
AUGER SAMPLE
C CALIFORNIA MODIFIED SAMPLER
SPLIT SPOON
NO RECOVERY

▼ Ground Water Level ▽ Hydrostatic Ground Water Level

——— Approximate Division of Soil Type

CL SP SC ML/OL

N= SPT, BLOWS/FT
T= THD,BLOWS/FT
P= HAND PEN.,TSF

REMARKS:
NP: Non Plastic Materials
* Remolded Samples at 5' intevals of S-1 through S-4
Blow Counts Corrected for California Modified Sampler (0.6 multiplier), Auto-Hammer, 8" HAS

APPENDIX
LABORATORY TEST DATA

AESCO
17782 Georgetown Ln.
Huntington Beach, California 92647
Telephone: (714) 375-3830
FAX: (714) 375-3831

REPORT OF MOISTURE-DENSITY RELATIONS

CLIENT: CITY OF HUNTINGTON BEACH
2000 MAIN STREET
DUANE WENTWORTH
HUNTINGTON BEAC, CA 92648

PROJECT NO.: 2024000035
REPORT NO.: H5437A
DATE OF SERVICE: 8/02/24
AUTHORIZATION:
REPORT DATE: 8/19/24

PROJECT: GEO- McFadden Sewer Lift Station (CC-1610) Corner of Dawson & McFadden

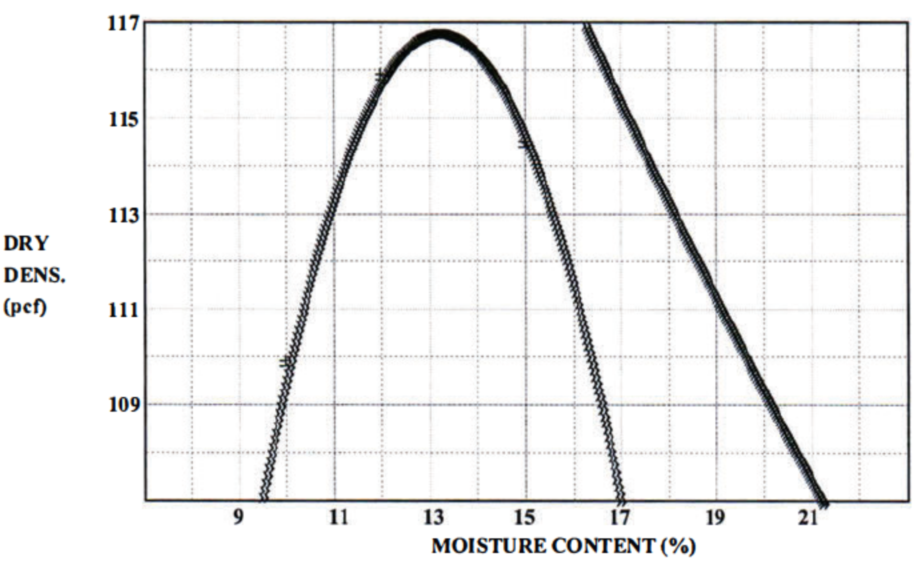
SERVICES: Obtain sample of material used for construction, prepare samples and perform moisture-density relations test to establish the maximum density and optimum moisture of the material.

PROJECT DATA

CONTRACTOR:
DATE SAMPLED: 8/02/24
SAMPLED BY: Omar Chamaa
TEST FOR: MD
SAMPLE LOCATION: S-1, S-2, S-3 & S-4

TEST DATE: 8/19/24
MATERIAL: 0-5 ft
CLASSIFICATION: Dark Gray Silty Clay
MATERIAL PREPARATION METHOD: Moist
RAMMER TYPE: Mechanical
METHOD OF TEST: ASTM D1557, Method B

REPORT OF TESTS



MAXIMUM DENSITY, PCF: 117.0

OPTIMUM MOISTURE (%): 13.5

E = Estimated Value

Comments:

Natural Moisture Content: 36.4

Technician: TARIQ ABDULLAH

Report Distribution:

AESCO

Aesco
Engineering Manager

AESCO
17782 Georgetown Ln.
Huntington Beach, California 92647
Telephone: (714) 375-3830
FAX: (714) 375-3831

REPORT OF MOISTURE-DENSITY RELATIONS

CLIENT: CITY OF HUNTINGTON BEACH
2000 MAIN STREET
DUANE WENTWORTH
HUNTINGTON BEAC, CA 92648

PROJECT NO.: 2024000035
REPORT NO.: H5437B
DATE OF SERVICE: 8/02/24
AUTHORIZATION:
REPORT DATE: 8/19/24

PROJECT: GEO- McFadden Sewer Lift Station (CC-1610) Corner of Dawson & McFadden

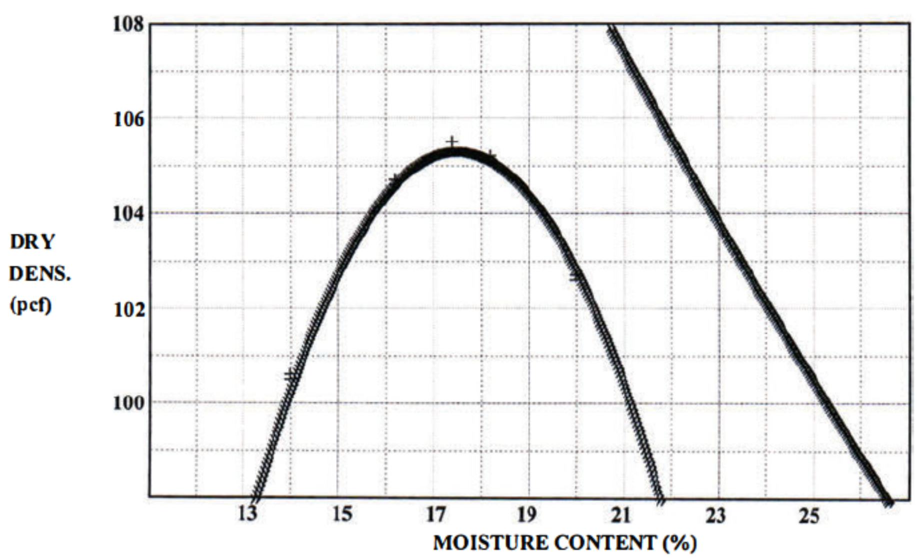
SERVICES: Obtain sample of material used for construction, prepare samples and perform moisture-density relations test to establish the maximum density and optimum moisture of the material.

PROJECT DATA

CONTRACTOR:
DATE SAMPLED: 8/02/24
SAMPLED BY: Omar Chamaa
TEST FOR: MD
SAMPLE LOCATION: S-1, S-2, S-3, S-4

TEST DATE: 8/19/24
MATERIAL: 5-10 ft
CLASSIFICATION: Dark Gray Silty CLAY
MATERIAL PREPARATION METHOD: Moist
RAMMER TYPE: Mechanical
METHOD OF TEST: ASTM D1557, Method B

REPORT OF TESTS



MAXIMUM DENSITY, PCF: 105.5

OPTIMUM MOISTURE (%): 17.5

E = Estimated Value

Comments:

Natural Moisture Content: 28. 6

Technician: TARIQ ABDULLAH

Report Distribution:

AESCO

Aesco
Engineering Manager

AESCO
17782 Georgetown Ln.
Huntington Beach, California 92647
Telephone: (714) 375-3830
FAX: (714) 375-3831

REPORT OF
MOISTURE-DENSITY RELATIONS

CLIENT: CITY OF HUNTINGTON BEACH
2000 MAIN STREET
DUANE WENTWORTH
HUNTINGTON BEAC, CA 92648

PROJECT NO.: 2024000035
REPORT NO.: H5437C
DATE OF SERVICE: 8/02/24
AUTHORIZATION:
REPORT DATE: 8/19/24

PROJECT: GEO- McFadden Sewer Lift Station (CC-1610) Corner of Dawson & McFadden

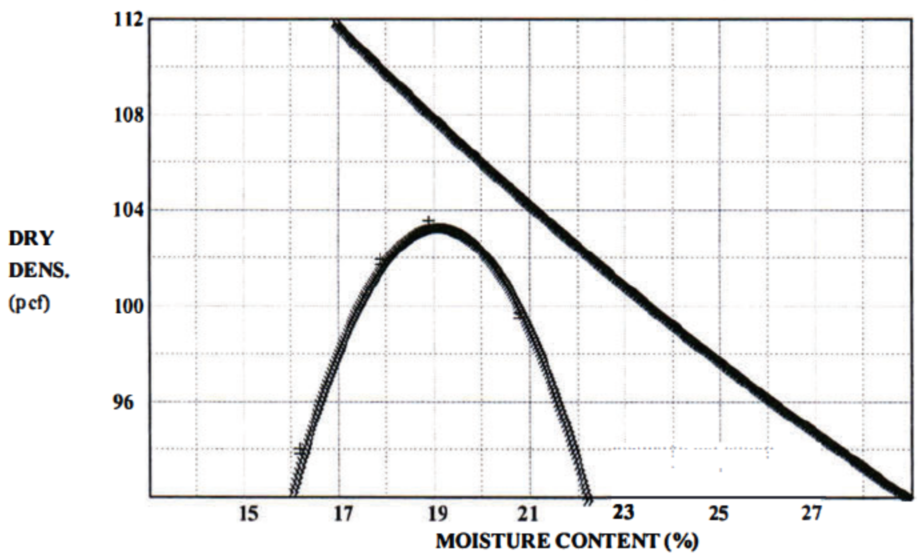
SERVICES: Obtain sample of material used for construction, prepare samples and perform moisture-density relations test to establish the maximum density and optimum moisture of the material.

PROJECT DATA

CONTRACTOR:
DATE SAMPLED: 8/02/24
SAMPLED BY: Omar Chamaa
TEST FOR: MD
SAMPLE LOCATION: S-1, S-2, S-3 & S-4

TEST DATE: 8/19/24
MATERIAL: 10-15 ft
CLASSIFICATION: Dark Gray Silty CALY
MATERIAL PREPARATION METHOD: Moist
RAMMER TYPE: Mechanical
METHOD OF TEST: ASTM D1557, Method B

REPORT OF TESTS



MAXIMUM DENSITY, PCF: 103.5

OPTIMUM MOISTURE (%): 19.0

E = Estimated Value

Comments:

Natural Moisture Content: 42.0

Technician: TARIQ ABDULLAH

Report Distribution:

AESCO

Aesco
Engineering Manager

AESCO
17782 Georgetown Ln.
Huntington Beach, California 92647
Telephone: (714) 375-3830
FAX: (714) 375-3831

REPORT OF MOISTURE-DENSITY RELATIONS

CLIENT: CITY OF HUNTINGTON BEACH
2000 MAIN STREET
DUANE WENTWORTH
HUNTINGTON BEAC, CA 92648

PROJECT NO.: 2024000035
REPORT NO.: H5437D
DATE OF SERVICE: 8/02/24
AUTHORIZATION:
REPORT DATE: 8/19/24

PROJECT: GEO- McFadden Sewer Lift Station (CC-1610) Corner of Dawson & McFadden

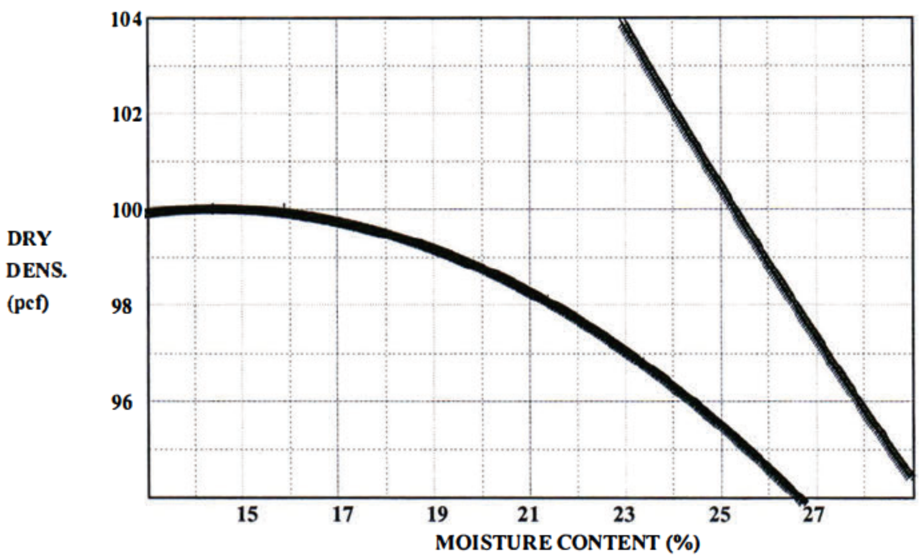
SERVICES: Obtain sample of material used for construction, prepare samples and perform moisture-density relations test to establish the maximum density and optimum moisture of the material.

PROJECT DATA

CONTRACTOR:
DATE SAMPLED: 8/02/24
SAMPLED BY: Omar Chamaa
TEST FOR: S 1-4
SAMPLE LOCATION: S-1, S-2,S-3, S-4

TEST DATE: 8/19/24
MATERIAL: 15-20 ft
CLASSIFICATION: Dark Gray Silty CLAY
MATERIAL PREPARATION METHOD: Moist
RAMMER TYPE: Mechanical
METHOD OF TEST: ASTM D1557, Method A

REPORT OF TESTS



MAXIMUM DENSITY, PCF: 100.0

OPTIMUM MOISTURE (%): 14.5

E = Estimated Value

Comments:

Natural Moisture Content: 73.6

Technician: TARIQ ABDULLAH

Report Distribution:

AESCO

Aesco
Engineering Manager

AESCO
17782 Georgetown Ln.
Huntington Beach, California 92647
Telephone: (714) 375-3830
FAX: (714) 375-3831

REPORT OF MOISTURE-DENSITY RELATIONS

CLIENT: CITY OF HUNTINGTON BEACH
2000 MAIN STREET
DUANE WENTWORTH
HUNTINGTON BEAC, CA 92648

PROJECT NO.: 2024000035
REPORT NO.: H5437E
DATE OF SERVICE: 8/02/24
AUTHORIZATION:
REPORT DATE: 8/19/24

PROJECT: GEO- McFadden Sewer Lift Station (CC-1610) Corner of Dawson & McFadden

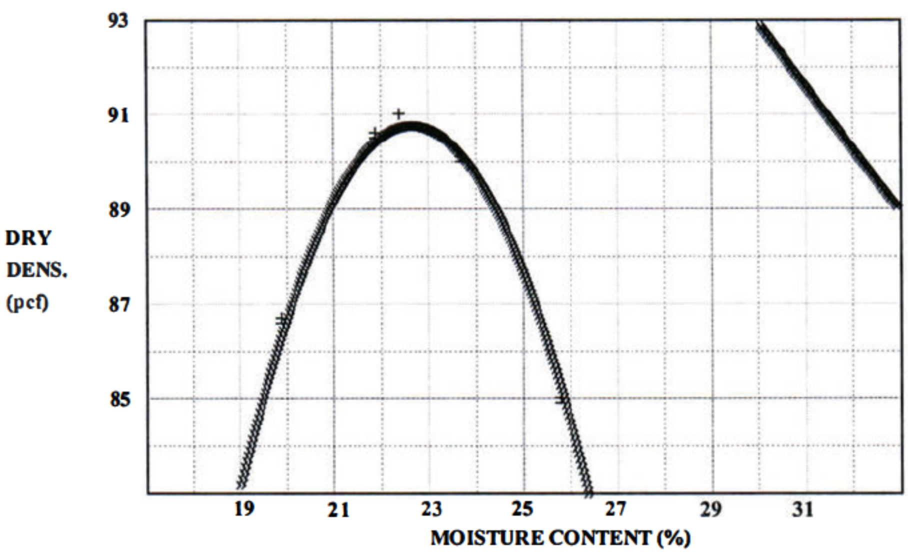
SERVICES: Obtain sample of material used for construction, prepare samples and perform moisture-density relations test to establish the maximum density and optimum moisture of the material.

PROJECT DATA

CONTRACTOR:
DATE SAMPLED: 8/02/24
SAMPLED BY: Omar Chamaa
TEST FOR: MD
SAMPLE LOCATION: S 1-4
20-25ft.

TEST DATE: 8/19/24
MATERIAL:
CLASSIFICATION: Subgrade
MATERIAL PREPARATION METHOD: Moist
RAMMER TYPE: Mechanical
METHOD OF TEST: ASTM D1557, Method A

REPORT OF TESTS



MAXIMUM DENSITY, PCF: 91.0

OPTIMUM MOISTURE (%): 22.5

E = Estimated Value

Comments:

Natural Moisture Content: 38.9

Technician: TARIQ ABDULLAH

Report Distribution:

AESCO

Aesco
Engineering Manager

APPENDIX

SOIL AND WATER ENVIRONMENTAL TEST RESULTS

ADVANCED TECHNOLOGY
LABORATORIES

June 10, 2024

Adam Chamaa
AESCO
17782 Georgetown Lane
Huntington Beach, CA 92647
Tel: (714) 375-3830
Fax:

ELAP No.: 3101
CSDLAC No.: 10196

Re: ATL Work Order Number : 2400892

Client Reference : McFadden Sewer Lift Station Replacement / 20240035

Enclosed are the results for sample(s) received on June 05, 2024 by Advanced Technology Laboratories. The sample(s) are tested for the parameters as indicated on the enclosed chain of custody in accordance with applicable laboratory certifications. The laboratory results contained in this report specifically pertains to the sample(s) submitted.

Thank you for the opportunity to serve the needs of your company. If you have any questions, please feel free to contact me or Project.Management@atlglobal.com.

Sincerely,

Lena Davidkov, Client Services
lena.davidkov@atlglobal.com
Authorized to Release on 06/10/24 21:13 on Behalf of

Amy Leung
Laboratory Director

Certificate of Analysis

AESCO	Project Number :	McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane	Report To :	Adam Chamaa
Huntington Beach , CA 92647	Reported :	06/10/2024

SUMMARY OF SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
H4760-01GW	2400892-01	Water	6/05/24 14:03	6/05/24 16:55

Certificate of Analysis

AESCO		Project Number :	McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane		Report To :	Adam Chamaa
Huntington Beach , CA 92647		Reported :	06/10/2024

Notes and Definitions

S12	Surrogate recovery outside in-house established limit but within method default criteria.
L3	Laboratory control sample outside in-house established limits but within method criteria.
B18	Associated method blank above MDL, but below half of the PQL value. Therefore, reanalysis is not necessary.
ND	Analyte is not detected at or above the Practical Quantitation Limit (PQL). When client requests quantitation against MDL, analyte is not detected at or above the Method Detection Limit (MDL)
PQL	Practical Quantitation Limit
MDL	Method Detection Limit
NR	Not Reported
RPD	Relative Percent Difference
CA2	CA-ELAP (CDPH)
OR1	OR-NELAP (OSPHL)

Notes:
(1) The reported MDL and PQL are based on prep ratio variation and analytical dilution.
(2) The suffix [2C] of specific analytes signifies that the reported result is taken from the instrument's second column.
(3) Results are wet unless otherwise specified.

Certificate of Analysis

AESCO		Project Number :	McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane		Report To :	Adam Chamaa
Huntington Beach , CA 92647		Reported :	06/10/2024

Mercury by AA (Cold Vapor) EPA 7470A

Analyte: Mercury **Analyst: AA**

Laboratory ID	Client Sample ID	Result	Units	PQL	Dilution	Batch	Prepared	Date/Time Analyzed	Notes
2400892-01	H4760-01GW	**ND**	ug/L	0.50	1	B4E1083	06/06/2024	06/10/24 18:54	

Certificate of Analysis

AESCO	Project Number :	McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane	Report To :	Adam Chamaa
Huntington Beach , CA 92647	Reported :	06/10/2024

Client Sample ID: H4760-01GW

Lab ID: 2400892-01

Title 22 Metals by ICP-AES EPA 6010B **Analyst: ICP**

Analyte	Result (mg/L)	PQL (mg/L)	Dilution	Batch	Prepared	Date/Time Analyzed	Notes
Antimony	ND	0.020	1	B4F0591	06/05/2024	06/08/24 17:37	
Arsenic	ND	0.020	1	B4F0591	06/05/2024	06/08/24 17:37	
Barium	**0.087**	0.020	1	B4F0591	06/05/2024	06/08/24 17:37	
Beryllium	ND	0.020	1	B4F0591	06/05/2024	06/08/24 17:37	
Cadmium	ND	0.020	1	B4F0591	06/05/2024	06/08/24 17:37	
Chromium	ND	0.020	1	B4F0591	06/05/2024	06/08/24 17:37	
Cobalt	ND	0.020	1	B4F0591	06/05/2024	06/08/24 17:37	
Copper	ND	0.020	1	B4F0591	06/05/2024	06/08/24 17:37	
Lead	ND	0.020	1	B4F0591	06/05/2024	06/08/24 17:37	
Molybdenum	ND	0.020	1	B4F0591	06/05/2024	06/08/24 17:37	
Nickel	ND	0.020	1	B4F0591	06/05/2024	06/08/24 17:37	
Selenium	**0.063**	0.020	1	B4F0591	06/05/2024	06/08/24 17:37	
Silver	ND	0.020	1	B4F0591	06/05/2024	06/08/24 17:37	
Thallium	ND	0.020	1	B4F0591	06/05/2024	06/08/24 17:37	
Vanadium	ND	0.020	1	B4F0591	06/05/2024	06/08/24 17:37	
Zinc	ND	0.020	1	B4F0591	06/05/2024	06/08/24 17:37	

Gasoline Range Organics by EPA 8015B (Modified) **Analyst: EB**

Analyte	Result (mg/L)	PQL (mg/L)	Dilution	Batch	Prepared	Date/Time Analyzed	Notes
Gasoline Range Organics	ND	0.20	1	B4F0620	06/06/2024	06/06/24 18:46	
Surrogate: 4-Bromofluorobenzene	*75.7 %*	*81.6 - 115*		B4F0620	06/06/2024	*06/06/24 18:46*	S12

Diesel and Oil Range Organics by EPA 8015B **Analyst: JF**

Analyte	Result (mg/L)	PQL (mg/L)	Dilution	Batch	Prepared	Date/Time Analyzed	Notes
DRO	ND	0.50	1	B4F0638	06/05/2024	06/06/24 13:21	
ORO	ND	0.50	1	B4F0638	06/05/2024	06/06/24 13:21	
Surrogate: p-Terphenyl	*36.0 %*	*6.37 - 125*		B4F0638	06/05/2024	*06/06/24 13:21*	

Volatile Organic Compounds by EPA 8260B **Analyst: EB**

Analyte	Result (ug/L)	PQL (ug/L)	Dilution	Batch	Prepared	Date/Time Analyzed	Notes
Benzene	ND	5.0	1	B4F0637	06/07/2024	06/07/24 11:03	
Ethylbenzene	ND	5.0	1	B4F0637	06/07/2024	06/07/24 11:03	

Certificate of Analysis

AESCO		Project Number :	McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane		Report To :	Adam Chamaa
Huntington Beach , CA 92647		Reported :	06/10/2024

Client Sample ID: H4760-01GW
Lab ID: 2400892-01

Volatile Organic Compounds by EPA 8260B **Analyst: EB**

Analyte	Result (ug/L)	PQL (ug/L)	Dilution	Batch	Prepared	Date/Time Analyzed	Notes
m,p-Xylene	ND	10	1	B4F0637	06/07/2024	06/07/24 11:03	
MTBE	ND	5.0	1	B4F0637	06/07/2024	06/07/24 11:03	
o-Xylene	ND	5.0	1	B4F0637	06/07/2024	06/07/24 11:03	
Toluene	ND	5.0	1	B4F0637	06/07/2024	06/07/24 11:03	
Xylenes, Total	ND	5.0	1	B4F0637	06/07/2024	06/07/24 11:03	
Surrogate: 1,2-Dichloroethane-d4	*118 %*	*72.2 - 121*		B4F0637	06/07/2024	*06/07/24 11:03*	
Surrogate: 4-Bromofluorobenzene	*102 %*	*80.1 - 115*		B4F0637	06/07/2024	*06/07/24 11:03*	
Surrogate: Dibromofluoromethane	*110 %*	*76.6 - 131*		B4F0637	06/07/2024	*06/07/24 11:03*	
Surrogate: Toluene-d8	*100 %*	*82.9 - 116*		B4F0637	06/07/2024	*06/07/24 11:03*	

QUALITY CONTROL SECTION

Title 22 Metals by ICP-AES EPA 6010B - Quality Control

Analyte	Result (mg/L)	PQL (mg/L)	MDL (mg/L)	Spike Level	Source Result	% Rec	% Rec Limits	RPD	RPD Limit	Notes
Batch B4F0591 - EPA 3010A_W										
Blank (B4F0591-BLK1)						Prepared: 6/3/2024 Analyzed: 6/8/2024				
Antimony	ND	0.020	0.014							
Arsenic	ND	0.020	0.0074							
Barium	ND	0.020	0.0015							
Beryllium	ND	0.020	0.0006							B18
Cadmium	ND	0.020	0.0010							
Chromium	ND	0.020	0.0019							
Cobalt	ND	0.020	0.0010							
Copper	ND	0.020	0.0021							
Lead	ND	0.020	0.0041							
Molybdenum	ND	0.020	0.0029							
Nickel	ND	0.020	0.0017							
Selenium	ND	0.020	0.014							
Silver	ND	0.020	0.0036							
Thallium	ND	0.020	0.011							
Vanadium	ND	0.020	0.0022							
Zinc	ND	0.020	0.0067							B18
LCS (B4F0591-BS1)						Prepared: 6/3/2024 Analyzed: 6/8/2024				
Antimony	0.479168	0.020	0.014	0.500000		95.8	80 - 120			
Arsenic	0.524326	0.020	0.0074	0.500000		105	80 - 120			
Barium	0.499020	0.020	0.0015	0.500000		99.8	80 - 120			
Beryllium	0.510150	0.020	0.0006	0.500000		102	80 - 120			
Cadmium	0.505048	0.020	0.0010	0.500000		101	80 - 120			
Chromium	0.525500	0.020	0.0019	0.500000		105	80 - 120			
Cobalt	0.513667	0.020	0.0010	0.500000		103	80 - 120			
Copper	0.515866	0.020	0.0021	0.500000		103	80 - 120			
Lead	0.517059	0.020	0.0041	0.500000		103	80 - 120			
Molybdenum	0.544151	0.020	0.0029	0.500000		109	80 - 120			
Nickel	0.558906	0.020	0.0017	0.500000		112	80 - 120			
Selenium	0.517963	0.020	0.014	0.500000		104	80 - 120			
Silver	0.211061	0.020	0.0036	0.250000		84.4	80 - 120			
Thallium	0.486876	0.020	0.011	0.500000		97.4	80 - 120			
Vanadium	0.466573	0.020	0.0022	0.500000		93.3	80 - 120			
Zinc	0.574440	0.020	0.0067	0.500000		115	80 - 120			
Matrix Spike (B4F0591-MS1)			Source: 2400866-06			Prepared: 6/3/2024 Analyzed: 6/8/2024				
Antimony	0.516556	0.020	0.014	0.500000	ND	103	75 - 125			
Arsenic	0.498058	0.020	0.0074	0.500000	ND	99.6	75 - 125			
Barium	0.481023	0.020	0.0015	0.500000	ND	96.2	75 - 125			
Beryllium	0.473105	0.020	0.0006	0.500000	0.008890	92.8	75 - 125			
Cadmium	0.486086	0.020	0.0010	0.500000	ND	97.2	75 - 125			
Chromium	0.506225	0.020	0.0019	0.500000	ND	101	75 - 125			

Certificate of Analysis

AESCO	Project Number :	McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane	Report To :	Adam Chamaa
Huntington Beach , CA 92647	Reported :	06/10/2024

Title 22 Metals by ICP-AES EPA 6010B - Quality Control (cont'd)

Analyte	Result (mg/L)	PQL (mg/L)	MDL (mg/L)	Spike Level	Source Result	% Rec	% Rec Limits	RPD	RPD Limit	Notes
Batch B4F0591 - EPA 3010A_W (continued)										
Matrix Spike (B4F0591-MS1) - Continued			**Source: 2400866-06**			Prepared: 6/3/2024 Analyzed: 6/8/2024				
Cobalt	0.494564	0.020	0.0010	0.500000	ND	98.9	75 - 125			
Copper	0.493981	0.020	0.0021	0.500000	ND	98.8	75 - 125			
Lead	0.493272	0.020	0.0041	0.500000	ND	98.7	75 - 125			
Molybdenum	0.549568	0.020	0.0029	0.500000	ND	110	75 - 125			
Nickel	0.536663	0.020	0.0017	0.500000	ND	107	75 - 125			
Selenium	0.487881	0.020	0.014	0.500000	ND	97.6	75 - 125			
Silver	0.192477	0.020	0.0036	0.250000	ND	77.0	75 - 125			
Thallium	0.461532	0.020	0.011	0.500000	ND	92.3	75 - 125			
Vanadium	0.457777	0.020	0.0022	0.500000	ND	91.6	75 - 125			
Zinc	0.547323	0.020	0.0067	0.500000	0.007374	108	75 - 125			
Matrix Spike Dup (B4F0591-MSD1)			**Source: 2400866-06**			Prepared: 6/3/2024 Analyzed: 6/8/2024				
Antimony	0.509051	0.020	0.014	0.500000	ND	102	75 - 125	1.46	20	
Arsenic	0.498352	0.020	0.0074	0.500000	ND	99.7	75 - 125	0.0591	20	
Barium	0.482492	0.020	0.0015	0.500000	ND	96.5	75 - 125	0.305	20	
Beryllium	0.474295	0.020	0.0006	0.500000	0.008890	93.1	75 - 125	0.251	20	
Cadmium	0.483995	0.020	0.0010	0.500000	ND	96.8	75 - 125	0.431	20	
Chromium	0.506773	0.020	0.0019	0.500000	ND	101	75 - 125	0.108	20	
Cobalt	0.492440	0.020	0.0010	0.500000	ND	98.5	75 - 125	0.430	20	
Copper	0.497573	0.020	0.0021	0.500000	ND	99.5	75 - 125	0.724	20	
Lead	0.489494	0.020	0.0041	0.500000	ND	97.9	75 - 125	0.769	20	
Molybdenum	0.552604	0.020	0.0029	0.500000	ND	111	75 - 125	0.551	20	
Nickel	0.535113	0.020	0.0017	0.500000	ND	107	75 - 125	0.289	20	
Selenium	0.495243	0.020	0.014	0.500000	ND	99.0	75 - 125	1.50	20	
Silver	0.194261	0.020	0.0036	0.250000	ND	77.7	75 - 125	0.922	20	
Thallium	0.455493	0.020	0.011	0.500000	ND	91.1	75 - 125	1.32	20	
Vanadium	0.455125	0.020	0.0022	0.500000	ND	91.0	75 - 125	0.581	20	
Zinc	0.544371	0.020	0.0067	0.500000	0.007374	107	75 - 125	0.541	20	

Certificate of Analysis

AESCO		Project Number :	McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane		Report To :	Adam Chamaa
Huntington Beach , CA 92647		Reported :	06/10/2024

Mercury by AA (Cold Vapor) EPA 7470A - Quality Control

Analyte	Result (ug/L)	PQL (ug/L)	MDL (ug/L)	Spike Level	Source Result	% Rec	% Rec Limits	RPD	RPD Limit	Notes
Batch B4E1083 - EPA 245.1/7470_W										
Blank (B4E1083-BLK1)						Prepared: 6/6/2024 Analyzed: 6/10/2024				
Mercury	ND	0.50	0.05							B18
LCS (B4E1083-BS1)						Prepared: 6/6/2024 Analyzed: 6/10/2024				
Mercury	5.65240	0.50	0.05	5.00000		113	85 - 115			
Matrix Spike (B4E1083-MS1)		**Source: 2400892-01**				Prepared: 6/6/2024 Analyzed: 6/10/2024				
Mercury	5.40753	0.50	0.05	5.00000	0.096366	106	-1.83 - 175			
Matrix Spike Dup (B4E1083-MSD1)		**Source: 2400892-01**				Prepared: 6/6/2024 Analyzed: 6/10/2024				
Mercury	5.44867	0.50	0.05	5.00000	0.096366	107	-1.83 - 175	0.758	20	
Post Spike (B4E1083-PS1)		**Source: 2400892-01**				Prepared: 6/6/2024 Analyzed: 6/10/2024				
Mercury	2.72110			2.50000	0.048183	107	35.9 - 174			

Certificate of Analysis

AESCO	Project Number : McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane	Report To : Adam Chamaa
Huntington Beach , CA 92647	Reported : 06/10/2024

Gasoline Range Organics by EPA 8015B (Modified) - Quality Control

Analyte	Result (mg/L)	PQL (mg/L)	MDL (mg/L)	Spike Level	Source Result	% Rec	% Rec Limits	RPD	RPD Limit	Notes
Batch B4F0620 - GCVOA_W										
Blank (B4F0620-BLK1)						Prepared: 6/6/2024 Analyzed: 6/6/2024				
Gasoline Range Organics	ND	0.20	0.03							
Surrogate: 4-Bromofluorobenzene	*0.2979*			*0.400000*		*74.5*	*81.6 - 115*			S12
LCS (B4F0620-BS1)						Prepared: 6/6/2024 Analyzed: 6/6/2024				
Gasoline Range Organics	0.868000	0.20	0.03	1.00000		86.8	66.6 - 122			
Surrogate: 4-Bromofluorobenzene	*0.3149*			*0.400000*		*78.7*	*81.6 - 115*			S12
LCS Dup (B4F0620-BSD1)						Prepared: 6/6/2024 Analyzed: 6/6/2024				
Gasoline Range Organics	0.859000	0.20	0.03	1.00000		85.9	66.6 - 122	1.04	20	
Surrogate: 4-Bromofluorobenzene	*0.3082*			*0.400000*		*77.1*	*81.6 - 115*			S12

Certificate of Analysis

AESCO	Project Number : McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane	Report To : Adam Chamaa
Huntington Beach , CA 92647	Reported : 06/10/2024

Diesel and Oil Range Organics by EPA 8015B - Quality Control

Analyte	Result (mg/L)	PQL (mg/L)	MDL (mg/L)	Spike Level	Source Result	% Rec	% Rec Limits	RPD	RPD Limit	Notes
Batch B4F0638 - GCSEMI_DRO_W										
Blank (B4F0638-BLK1)						Prepared: 6/5/2024 Analyzed: 6/6/2024				
DRO	ND	0.50	0.09							
ORO	ND	0.50	0.09							
Surrogate: p-Terphenyl	*0.02554*			*8.00000E-2*		*31.9*	*6.37 - 125*			
LCS (B4F0638-BS1)						Prepared: 6/5/2024 Analyzed: 6/6/2024				
DRO	0.328387	0.50	0.09	1.00000		32.8	4.81 - 112			
Surrogate: p-Terphenyl	*0.02286*			*8.00000E-2*		*28.6*	*6.37 - 125*			
LCS Dup (B4F0638-BSD1)						Prepared: 6/5/2024 Analyzed: 6/6/2024				
DRO	0.391268	0.50	0.09	1.00000		39.1	4.81 - 112	17.5	20	
Surrogate: p-Terphenyl	*0.02322*			*8.00000E-2*		*29.0*	*6.37 - 125*			

Certificate of Analysis

AESCO	Project Number :	McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane	Report To :	Adam Chamaa
Huntington Beach , CA 92647	Reported :	06/10/2024

Volatile Organic Compounds by EPA 8260B - Quality Control

Analyte	Result (ug/L)	PQL (ug/L)	MDL (ug/L)	Spike Level	Source Result	% Rec	% Rec Limits	RPD	RPD Limit	Notes
Batch B4F0637 - MSVOA_LL_W										
Blank (B4F0637-BLK1)						Prepared: 6/7/2024 Analyzed: 6/7/2024				
Benzene	ND	5.0	0.18							
Ethylbenzene	ND	5.0	0.22							
m,p-Xylene	ND	10	0.54							
MTBE	ND	5.0	0.32							
o-Xylene	ND	5.0	0.26							
Toluene	ND	5.0	0.33							
Xylenes, Total	ND	5.0	0.13							
Surrogate: 1,2-Dichloroethane-d4	*29.49*			*25.0000*		*118*	*72.2 - 121*			
Surrogate: 4-Bromofluorobenzene	*25.37*			*25.0000*		*101*	*80.1 - 115*			
Surrogate: Dibromofluoromethane	*26.70*			*25.0000*		*107*	*76.6 - 131*			
Surrogate: Toluene-d8	*25.53*			*25.0000*		*102*	*82.9 - 116*			
LCS (B4F0637-BS1)						Prepared: 6/7/2024 Analyzed: 6/7/2024				
Benzene	24.8100	5.0	0.18	20.0000		124	74.6 - 119			L3
Ethylbenzene	19.5600	5.0	0.22	20.0000		97.8	72.8 - 116			
m,p-Xylene	50.0200	10	0.54	40.0000		125	71.5 - 117			L3
MTBE	21.5600	5.0	0.32	20.0000		108	72.8 - 143			
o-Xylene	19.7800	5.0	0.26	20.0000		98.9	74.9 - 117			
Toluene	20.7900	5.0	0.33	20.0000		104	77.1 - 120			
Xylenes, Total	69.8000	5.0	0.13	60.0000		116	72 - 117			
Surrogate: 1,2-Dichloroethane-d4	*30.91*			*25.0000*		*124*	*72.2 - 121*			S12
Surrogate: 4-Bromofluorobenzene	*25.87*			*25.0000*		*103*	*80.1 - 115*			
Surrogate: Dibromofluoromethane	*26.49*			*25.0000*		*106*	*76.6 - 131*			
Surrogate: Toluene-d8	*25.94*			*25.0000*		*104*	*82.9 - 116*			
LCS Dup (B4F0637-BSD1)						Prepared: 6/7/2024 Analyzed: 6/7/2024				
Benzene	24.0100	5.0	0.18	20.0000		120	74.6 - 119	3.28	20	L3
Ethylbenzene	18.8700	5.0	0.22	20.0000		94.4	72.8 - 116	3.59	20	
m,p-Xylene	47.0700	10	0.54	40.0000		118	71.5 - 117	6.08	20	L3
MTBE	21.3600	5.0	0.32	20.0000		107	72.8 - 143	0.932	20	
o-Xylene	18.6200	5.0	0.26	20.0000		93.1	74.9 - 117	6.04	20	
Toluene	20.1700	5.0	0.33	20.0000		101	77.1 - 120	3.03	20	
Xylenes, Total	65.6900	5.0	0.13	60.0000		109	72 - 117	6.07	20	
Surrogate: 1,2-Dichloroethane-d4	*30.42*			*25.0000*		*122*	*72.2 - 121*			S12
Surrogate: 4-Bromofluorobenzene	*26.37*			*25.0000*		*105*	*80.1 - 115*			
Surrogate: Dibromofluoromethane	*26.48*			*25.0000*		*106*	*76.6 - 131*			
Surrogate: Toluene-d8	*25.35*			*25.0000*		*101*	*82.9 - 116*			

AESCO

17782 Georgetown Ln., Huntington Beach, CA 92647
(714) 375-3830 Fax: (714) 375-3831

2400892

CHAIN OF CUSTODY RECORD

Date: 6/5/2024
Page: 1 of 1

Client: City of Huntington Beach	Laboratory Name: Advanced Technology Laboratories, 3275 Walnut Avenue, Signal Hill CA 90755
Address: SE Corner Of Dawson Lane and McFadden Avenue, Huntington Beach, CA 92647	Project Manager: Adam Chamaa, P.E., G.E. Phone No. 714-375-3830
Project Name: McFadden Sewer Lift Station Replacement Aesco Project No. 20240035	Sampler: (signature) [signature] Rhys Kuzmic

Samples Intact Yes X No ___
County seals intact Yes N No ___
Sample Ambient ___ Cooled X Frozen ___
Same Day ___ 24Hr. X ___
Regular ___ 48Hr. ___

Sample ID	Depth	Description of Sample	DATE	TIME	SAMPLE TYPE: WATER	SAMPLE TYPE: AIR	SAMPLE TYPE: SOLID	No. of Cntnrs	Susp. Contam.	Test Requested: EPA 6010B/7471A–Heavy Metals; EPA 8015B–Total Petroleum Hydrocarbons Diesel (TPHd), Total Petroleum Hydrocarbons Motor Oil (TPHmo); EPA 8260B–Total Petroleum Hydrocarbons gas (TPHg), Benzene, Toluene, Ethylbenzene and Xylene (BTEX), and Methyl Tertiary-Butyl Ether (MTBE)
H4760-01GW	60 feet	Groundwater	6/5/2024	4:03PM	X			4 0.5 mL		VOCs
		Well No.2						1 1000 mL		TPH
								1 25 mL		Metals

Relinquished by: (signature) Rhys Kuzmic [signature] 06/05/24 4:55 PM	Received by: (signature) [signature]	Date/Time 6/5/24 16:55	I hereby authorize the performance of the above indicated work.
Relinquished by: (signature)	Received by Laboratory for analysis: (signature)	Date/Time	Quote # Water Samples 2024_24h rush

ADVANCED TECHNOLOGY LABORATORIES

June 14, 2024

Adam Chamaa
AESCO
17782 Georgetown Lane
Huntington Beach, CA 92647
Tel: (714) 375-3830
Fax:

ELAP No.: 3101
CSDLAC No.: 10196

Re: ATL Work Order Number : 2400895
Client Reference : McFadden Sewer Lift Station Replacement / 20240035

Enclosed are the results for sample(s) received on June 05, 2024 by Advanced Technology Laboratories. The sample(s) are tested for the parameters as indicated on the enclosed chain of custody in accordance with applicable laboratory certifications. The laboratory results contained in this report specifically pertains to the sample(s) submitted.

Thank you for the opportunity to serve the needs of your company. If you have any questions, please feel free to contact me or Project.Management@atlglobal.com.

Sincerely,

Lena Davidkov, Client Services
lena.davidkov@atlglobal.com
Authorized to Release on 06/14/24 07:18 on Behalf of

Amy Leung
Laboratory Director

Certificate of Analysis

AESCO		Project Number :	McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane		Report To :	Adam Chamaa
Huntington Beach , CA 92647		Reported :	06/14/2024

SUMMARY OF SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
H4761-01S	2400895-01	Soil	6/05/24 15:20	6/05/24 16:55
H4762-02S	2400895-02	Soil	6/05/24 15:20	6/05/24 16:55
H4763-03S	2400895-03	Soil	6/05/24 15:20	6/05/24 16:55
H4764-04S	2400895-04	Soil	6/05/24 15:20	6/05/24 16:55

Certificate of Analysis

AESCO		Project Number :	McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane		Report To :	Adam Chamaa
Huntington Beach , CA 92647		Reported :	06/14/2024

Notes and Definitions

R	RPD value outside acceptance criteria. Calculation is based on raw values. The analytical batch was validated by the Laboratory Control Sample (LCS).
M2	Matrix spike recovery outside of acceptance limit due to possible matrix interference. The analytical batch was validated by the laboratory control sample.
ND	Analyte is not detected at or above the Practical Quantitation Limit (PQL). When client requests quantitation against MDL, analyte is not detected at or above the Method Detection Limit (MDL)
PQL	Practical Quantitation Limit
MDL	Method Detection Limit
NR	Not Reported
RPD	Relative Percent Difference
CA2	CA-ELAP (CDPH)
OR1	OR-NELAP (OSPHL)

Notes:

(1) The reported MDL and PQL are based on prep ratio variation and analytical dilution.

(2) The suffix [2C] of specific analytes signifies that the reported result is taken from the instrument's second column.

(3) Results are wet unless otherwise specified.

Certificate of Analysis

AESCO		Project Number :	McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane		Report To :	Adam Chamaa
Huntington Beach , CA 92647		Reported :	06/14/2024

Mercury by AA (Cold Vapor) EPA 7471A

Analyte: Mercury **Analyst: AA**

Laboratory ID	Client Sample ID	Result	Units	PQL	Dilution	Batch	Prepared	Date/Time Analyzed	Notes
2400895-01	H4761-01S	**ND**	mg/kg	0.10	1	B4F0626	06/06/2024	06/06/24 17:48	
2400895-02	H4762-02S	**ND**	mg/kg	0.10	1	B4F0626	06/06/2024	06/06/24 17:51	
2400895-03	H4763-03S	**ND**	mg/kg	0.10	1	B4F0626	06/06/2024	06/06/24 17:54	
2400895-04	H4764-04S	**ND**	mg/kg	0.10	1	B4F0626	06/06/2024	06/06/24 17:56	

Certificate of Analysis

AESCO	Project Number :	McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane	Report To :	Adam Chamaa
Huntington Beach , CA 92647	Reported :	06/14/2024

Client Sample ID: H4761-01S

Lab ID: 2400895-01

Title 22 Metals by ICP-AES EPA 6010B **Analyst: ICP**

Analyte	Result (mg/kg)	PQL (mg/kg)	Dilution	Batch	Prepared	Date/Time Analyzed	Notes
Antimony	ND	2.0	1	B4F0627	06/06/2024	06/13/24 19:59	
Arsenic	**4.4**	2.0	1	B4F0627	06/06/2024	06/13/24 19:59	
Barium	**66**	1.0	1	B4F0627	06/06/2024	06/13/24 19:59	
Beryllium	**1.5**	1.0	1	B4F0627	06/06/2024	06/13/24 19:59	
Cadmium	ND	1.0	1	B4F0627	06/06/2024	06/13/24 19:59	
Chromium	**19**	1.0	1	B4F0627	06/06/2024	06/13/24 19:59	
Cobalt	**7.8**	1.0	1	B4F0627	06/06/2024	06/13/24 19:59	
Copper	**15**	1.0	1	B4F0627	06/06/2024	06/13/24 19:59	
Lead	**3.9**	1.0	1	B4F0627	06/06/2024	06/13/24 19:59	
Molybdenum	**3.7**	1.0	1	B4F0627	06/06/2024	06/13/24 19:59	
Nickel	**11**	1.0	1	B4F0627	06/06/2024	06/13/24 19:59	
Selenium	ND	2.0	1	B4F0627	06/06/2024	06/13/24 19:59	
Silver	ND	1.0	1	B4F0627	06/06/2024	06/13/24 19:59	
Thallium	ND	2.0	1	B4F0627	06/06/2024	06/13/24 19:59	
Vanadium	**37**	1.0	1	B4F0627	06/06/2024	06/13/24 19:59	
Zinc	**48**	2.0	1	B4F0627	06/06/2024	06/13/24 19:59	

Diesel and Oil Range Organics by EPA 8015B **Analyst: EB**

Analyte	Result (mg/kg)	PQL (mg/kg)	Dilution	Batch	Prepared	Date/Time Analyzed	Notes
DRO	ND	5.0	1	B4F0622	06/06/2024	06/07/24 18:25	
ORO	ND	5.0	1	B4F0622	06/06/2024	06/07/24 18:25	
Surrogate: p-Terphenyl	*78.1 %*	*-6.76 - 189*		B4F0622	06/06/2024	*06/07/24 18:25*	

Gasoline Range Organics by EPA 5030 / EPA 8015B (Modified) **Analyst: EB**

Analyte	Result (mg/kg)	PQL (mg/kg)	Dilution	Batch	Prepared	Date/Time Analyzed	Notes
Gasoline Range Organics	ND	1.0	1	B4F0639	06/06/2024	06/06/24 12:45	
Surrogate: 4-Bromofluorobenzene	*99.3 %*	*31 - 137*		B4F0639	06/06/2024	*06/06/24 12:45*	

Certificate of Analysis

AESCO	Project Number :	McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane	Report To :	Adam Chamaa
Huntington Beach , CA 92647	Reported :	06/14/2024

Client Sample ID: H4762-02S
Lab ID: 2400895-02

Title 22 Metals by ICP-AES EPA 6010B

Analyst: ICP

Analyte	Result (mg/kg)	PQL (mg/kg)	Dilution	Batch	Prepared	Date/Time Analyzed	Notes
Antimony	ND	2.0	1	B4F0627	06/06/2024	06/13/24 20:02	
Arsenic	**3.8**	2.0	1	B4F0627	06/06/2024	06/13/24 20:02	
Barium	**62**	1.0	1	B4F0627	06/06/2024	06/13/24 20:02	
Beryllium	**1.5**	1.0	1	B4F0627	06/06/2024	06/13/24 20:02	
Cadmium	ND	1.0	1	B4F0627	06/06/2024	06/13/24 20:02	
Chromium	**18**	1.0	1	B4F0627	06/06/2024	06/13/24 20:02	
Cobalt	**7.7**	1.0	1	B4F0627	06/06/2024	06/13/24 20:02	
Copper	**14**	1.0	1	B4F0627	06/06/2024	06/13/24 20:02	
Lead	**3.4**	1.0	1	B4F0627	06/06/2024	06/13/24 20:02	
Molybdenum	**2.2**	1.0	1	B4F0627	06/06/2024	06/13/24 20:02	
Nickel	**11**	1.0	1	B4F0627	06/06/2024	06/13/24 20:02	
Selenium	ND	2.0	1	B4F0627	06/06/2024	06/13/24 20:02	
Silver	ND	1.0	1	B4F0627	06/06/2024	06/13/24 20:02	
Thallium	ND	2.0	1	B4F0627	06/06/2024	06/13/24 20:02	
Vanadium	**35**	1.0	1	B4F0627	06/06/2024	06/13/24 20:02	
Zinc	**47**	2.0	1	B4F0627	06/06/2024	06/13/24 20:02	

Diesel and Oil Range Organics by EPA 8015B

Analyst: EB

Analyte	Result (mg/kg)	PQL (mg/kg)	Dilution	Batch	Prepared	Date/Time Analyzed	Notes
DRO	ND	5.0	1	B4F0622	06/06/2024	06/07/24 18:48	
ORO	ND	5.0	1	B4F0622	06/06/2024	06/07/24 18:48	
Surrogate: p-Terphenyl	*79.3 %*	*-6.76 - 189*		B4F0622	06/06/2024	*06/07/24 18:48*	

Gasoline Range Organics by EPA 5030 / EPA 8015B (Modified)

Analyst: EB

Analyte	Result (mg/kg)	PQL (mg/kg)	Dilution	Batch	Prepared	Date/Time Analyzed	Notes
Gasoline Range Organics	ND	1.0	1	B4F0639	06/06/2024	06/06/24 13:09	
Surrogate: 4-Bromofluorobenzene	*98.3 %*	*31 - 137*		B4F0639	06/06/2024	*06/06/24 13:09*	

Certificate of Analysis

AESCO	Project Number : McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane	Report To : Adam Chamaa
Huntington Beach , CA 92647	Reported : 06/14/2024

Client Sample ID: H4763-03S
Lab ID: 2400895-03

Title 22 Metals by ICP-AES EPA 6010B

Analyst: ICP

Analyte	Result (mg/kg)	PQL (mg/kg)	Dilution	Batch	Prepared	Date/Time Analyzed	Notes
Antimony	ND	2.0	1	B4F0627	06/06/2024	06/13/24 20:04	
Arsenic	**3.4**	2.0	1	B4F0627	06/06/2024	06/13/24 20:04	
Barium	**61**	1.0	1	B4F0627	06/06/2024	06/13/24 20:04	
Beryllium	**1.5**	1.0	1	B4F0627	06/06/2024	06/13/24 20:04	
Cadmium	ND	1.0	1	B4F0627	06/06/2024	06/13/24 20:04	
Chromium	**17**	1.0	1	B4F0627	06/06/2024	06/13/24 20:04	
Cobalt	**7.3**	1.0	1	B4F0627	06/06/2024	06/13/24 20:04	
Copper	**14**	1.0	1	B4F0627	06/06/2024	06/13/24 20:04	
Lead	**3.9**	1.0	1	B4F0627	06/06/2024	06/13/24 20:04	
Molybdenum	ND	1.0	1	B4F0627	06/06/2024	06/13/24 20:04	
Nickel	**10**	1.0	1	B4F0627	06/06/2024	06/13/24 20:04	
Selenium	ND	2.0	1	B4F0627	06/06/2024	06/13/24 20:04	
Silver	ND	1.0	1	B4F0627	06/06/2024	06/13/24 20:04	
Thallium	ND	2.0	1	B4F0627	06/06/2024	06/13/24 20:04	
Vanadium	**33**	1.0	1	B4F0627	06/06/2024	06/13/24 20:04	
Zinc	**43**	2.0	1	B4F0627	06/06/2024	06/13/24 20:04	

Diesel and Oil Range Organics by EPA 8015B

Analyst: EB

Analyte	Result (mg/kg)	PQL (mg/kg)	Dilution	Batch	Prepared	Date/Time Analyzed	Notes
DRO	ND	5.0	1	B4F0622	06/06/2024	06/07/24 19:10	
ORO	ND	5.0	1	B4F0622	06/06/2024	06/07/24 19:10	
Surrogate: p-Terphenyl	*80.0 %*	*-6.76 - 189*		B4F0622	06/06/2024	*06/07/24 19:10*	

Gasoline Range Organics by EPA 5030 / EPA 8015B (Modified)

Analyst: EB

Analyte	Result (mg/kg)	PQL (mg/kg)	Dilution	Batch	Prepared	Date/Time Analyzed	Notes
Gasoline Range Organics	ND	1.0	1	B4F0639	06/06/2024	06/06/24 13:33	
Surrogate: 4-Bromofluorobenzene	*94.7 %*	*31 - 137*		B4F0639	06/06/2024	*06/06/24 13:33*	

Certificate of Analysis

AESCO	Project Number :	McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane	Report To :	Adam Chamaa
Huntington Beach , CA 92647	Reported :	06/14/2024

Client Sample ID: H4764-04S

Lab ID: 2400895-04

Title 22 Metals by ICP-AES EPA 6010B — **Analyst: ICP**

Analyte	Result (mg/kg)	PQL (mg/kg)	Dilution	Batch	Prepared	Date/Time Analyzed	Notes
Antimony	ND	2.0	1	B4F0627	06/06/2024	06/13/24 20:07	
Arsenic	**3.8**	2.0	1	B4F0627	06/06/2024	06/13/24 20:07	
Barium	**64**	1.0	1	B4F0627	06/06/2024	06/13/24 20:07	
Beryllium	**1.5**	1.0	1	B4F0627	06/06/2024	06/13/24 20:07	
Cadmium	ND	1.0	1	B4F0627	06/06/2024	06/13/24 20:07	
Chromium	**18**	1.0	1	B4F0627	06/06/2024	06/13/24 20:07	
Cobalt	**7.5**	1.0	1	B4F0627	06/06/2024	06/13/24 20:07	
Copper	**16**	1.0	1	B4F0627	06/06/2024	06/13/24 20:07	
Lead	**4.7**	1.0	1	B4F0627	06/06/2024	06/13/24 20:07	
Molybdenum	**1.8**	1.0	1	B4F0627	06/06/2024	06/13/24 20:07	
Nickel	**11**	1.0	1	B4F0627	06/06/2024	06/13/24 20:07	
Selenium	ND	2.0	1	B4F0627	06/06/2024	06/13/24 20:07	
Silver	ND	1.0	1	B4F0627	06/06/2024	06/13/24 20:07	
Thallium	ND	2.0	1	B4F0627	06/06/2024	06/13/24 20:07	
Vanadium	**33**	1.0	1	B4F0627	06/06/2024	06/13/24 20:07	
Zinc	**45**	2.0	1	B4F0627	06/06/2024	06/13/24 20:07	

Diesel and Oil Range Organics by EPA 8015B — **Analyst: EB**

Analyte	Result (mg/kg)	PQL (mg/kg)	Dilution	Batch	Prepared	Date/Time Analyzed	Notes
DRO	ND	5.0	1	B4F0622	06/06/2024	06/07/24 19:32	
ORO	ND	5.0	1	B4F0622	06/06/2024	06/07/24 19:32	
Surrogate: p-Terphenyl	*77.3 %*	*-6.76 - 189*		B4F0622	06/06/2024	*06/07/24 19:32*	

Gasoline Range Organics by EPA 5030 / EPA 8015B (Modified) — **Analyst: EB**

Analyte	Result (mg/kg)	PQL (mg/kg)	Dilution	Batch	Prepared	Date/Time Analyzed	Notes
Gasoline Range Organics	ND	1.0	1	B4F0639	06/06/2024	06/06/24 13:58	
Surrogate: 4-Bromofluorobenzene	*92.8 %*	*31 - 137*		B4F0639	06/06/2024	*06/06/24 13:58*	

Certificate of Analysis

AESCO	Project Number : McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane	Report To : Adam Chamaa
Huntington Beach , CA 92647	Reported : 06/14/2024

QUALITY CONTROL SECTION

Gasoline Range Organics by EPA 5030 / EPA 8015B (Modified) - Quality Control

Analyte	Result (mg/kg)	PQL (mg/kg)	MDL (mg/kg)	Spike Level	Source Result	% Rec	% Rec Limits	RPD	RPD Limit	Notes
Batch B4F0639 - GCVOA_S										
Blank (B4F0639-BLK1)						Prepared: 6/6/2024 Analyzed: 6/6/2024				
Gasoline Range Organics	ND	1.0	0.02							
Surrogate: 4-Bromofluorobenzene	*0.8024*			*0.800000*		*100*	*31 - 137*			
LCS (B4F0639-BS1)						Prepared: 6/6/2024 Analyzed: 6/6/2024				
Gasoline Range Organics	4.12600	1.0	0.02	5.00000		82.5	79.8 - 112			
Surrogate: 4-Bromofluorobenzene	*0.8743*			*0.800000*		*109*	*31 - 137*			
LCS Dup (B4F0639-BSD1)						Prepared: 6/6/2024 Analyzed: 6/6/2024				
Gasoline Range Organics	4.16000	1.0	0.02	5.00000		83.2	79.8 - 112	0.821	20	
Surrogate: 4-Bromofluorobenzene	*0.8497*			*0.800000*		*106*	*31 - 137*			
Matrix Spike (B4F0639-MS1)		**Source: 2400895-01**				Prepared: 6/6/2024 Analyzed: 6/6/2024				
Gasoline Range Organics	2.42000	1.0	0.02	5.00000	0.061	47.2	3.3 - 122			
Surrogate: 4-Bromofluorobenzene	*0.6665*			*0.800000*		*83.3*	*31 - 137*			
Matrix Spike Dup (B4F0639-MSD1)		**Source: 2400895-01**				Prepared: 6/6/2024 Analyzed: 6/6/2024				
Gasoline Range Organics	3.76424	0.98	0.02	4.91159	0.061	75.4	3.3 - 122	43.5	20	R
Surrogate: 4-Bromofluorobenzene	*0.7378*			*0.800000*		*92.2*	*31 - 137*			

Certificate of Analysis

AESCO	Project Number :	McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane	Report To :	Adam Chamaa
Huntington Beach , CA 92647	Reported :	06/14/2024

Title 22 Metals by ICP-AES EPA 6010B - Quality Control

Analyte	Result (mg/kg)	PQL (mg/kg)	MDL (mg/kg)	Spike Level	Source Result	% Rec	% Rec Limits	RPD	RPD Limit	Notes
Batch B4F0627 - EPA 3050B_S										
Blank (B4F0627-BLK1)						Prepared: 6/5/2024 Analyzed: 6/13/2024				
Antimony	ND	2.0	0.77							
Arsenic	ND	2.0	0.71							
Barium	ND	1.0	0.06							
Beryllium	ND	1.0	0.03							
Cadmium	ND	1.0	0.06							
Chromium	ND	1.0	0.10							
Cobalt	ND	1.0	0.08							
Copper	ND	1.0	0.22							
Lead	ND	1.0	0.18							
Molybdenum	ND	1.0	0.10							
Nickel	ND	1.0	0.04							
Selenium	ND	2.0	0.82							
Silver	ND	1.0	0.27							
Thallium	ND	2.0	0.35							
Vanadium	ND	1.0	0.20							
Zinc	ND	2.0	0.30							
LCS (B4F0627-BS1)						Prepared: 6/5/2024 Analyzed: 6/13/2024				
Antimony	25.1168	2.0	0.77	25.0000		100	80 - 120			
Arsenic	23.9526	2.0	0.71	25.0000		95.8	80 - 120			
Barium	23.1402	1.0	0.06	25.0000		92.6	80 - 120			
Beryllium	23.8024	1.0	0.03	25.0000		95.2	80 - 120			
Cadmium	24.2772	1.0	0.06	25.0000		97.1	80 - 120			
Chromium	24.1978	1.0	0.10	25.0000		96.8	80 - 120			
Cobalt	25.3744	1.0	0.08	25.0000		101	80 - 120			
Copper	23.5279	1.0	0.22	25.0000		94.1	80 - 120			
Lead	23.8995	1.0	0.18	25.0000		95.6	80 - 120			
Molybdenum	26.1203	1.0	0.10	25.0000		104	80 - 120			
Nickel	25.6082	1.0	0.04	25.0000		102	80 - 120			
Selenium	23.1513	2.0	0.82	25.0000		92.6	80 - 120			
Silver	10.0840	1.0	0.27	12.5000		80.7	80 - 120			
Thallium	24.2161	2.0	0.35	25.0000		96.9	80 - 120			
Vanadium	22.1924	1.0	0.20	25.0000		88.8	80 - 120			
Zinc	24.2865	2.0	0.30	25.0000		97.1	80 - 120			
Matrix Spike (B4F0627-MS1)			**Source: 2400882-02**			Prepared: 6/5/2024 Analyzed: 6/13/2024				
Antimony	19.1473	2.0	0.77	25.0000	ND	76.6	75 - 125			
Arsenic	23.8493	2.0	0.71	25.0000	ND	95.4	75 - 125			
Barium	73.6380	1.0	0.06	25.0000	3.53294	280	75 - 125			M2
Beryllium	25.6925	1.0	0.03	25.0000	0.781990	99.6	75 - 125			
Cadmium	22.5920	1.0	0.06	25.0000	ND	90.4	75 - 125			
Chromium	31.2827	1.0	0.10	25.0000	ND	125	75 - 125			M2
Cobalt	26.2806	1.0	0.08	25.0000	ND	105	75 - 125			
Copper	29.7185	1.0	0.22	25.0000	0.833987	116	75 - 125			
Lead	25.9967	1.0	0.18	25.0000	ND	104	75 - 125			

Certificate of Analysis

AESCO	Project Number :	McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane	Report To :	Adam Chamaa
Huntington Beach , CA 92647	Reported :	06/14/2024

Title 22 Metals by ICP-AES EPA 6010B - Quality Control (cont'd)

Analyte	Result (mg/kg)	PQL (mg/kg)	MDL (mg/kg)	Spike Level	Source Result	% Rec	% Rec Limits	RPD	RPD Limit	Notes
Batch B4F0627 - EPA 3050B_S (continued)										
Matrix Spike (B4F0627-MS1) - Continued			**Source: 2400882-02**			**Prepared: 6/5/2024 Analyzed: 6/13/2024**				
Molybdenum	21.9630	1.0	0.10	25.0000	ND	87.9	75 - 125			
Nickel	26.3378	1.0	0.04	25.0000	ND	105	75 - 125			
Selenium	18.4855	2.0	0.82	25.0000	ND	73.9	75 - 125			M2
Silver	11.6768	1.0	0.27	12.5000	ND	93.4	75 - 125			
Thallium	18.0454	2.0	0.35	25.0000	ND	72.2	75 - 125			M2
Vanadium	43.4020	1.0	0.20	25.0000	ND	174	75 - 125			M2
Zinc	59.7502	2.0	0.30	25.0000	0.976296	235	75 - 125			M2
Matrix Spike Dup (B4F0627-MSD1)			**Source: 2400882-02**			**Prepared: 6/5/2024 Analyzed: 6/13/2024**				
Antimony	18.6887	2.0	0.77	25.0000	ND	74.8	75 - 125	2.42	20	M2
Arsenic	23.8477	2.0	0.71	25.0000	ND	95.4	75 - 125	0.00641	20	
Barium	72.0311	1.0	0.06	25.0000	3.53294	274	75 - 125	2.21	20	M2
Beryllium	25.9343	1.0	0.03	25.0000	0.781990	101	75 - 125	0.936	20	
Cadmium	22.7873	1.0	0.06	25.0000	ND	91.1	75 - 125	0.861	20	
Chromium	31.5523	1.0	0.10	25.0000	ND	126	75 - 125	0.858	20	M2
Cobalt	26.7304	1.0	0.08	25.0000	ND	107	75 - 125	1.70	20	
Copper	29.0764	1.0	0.22	25.0000	0.833987	113	75 - 125	2.18	20	
Lead	26.2952	1.0	0.18	25.0000	ND	105	75 - 125	1.14	20	
Molybdenum	22.3787	1.0	0.10	25.0000	ND	89.5	75 - 125	1.87	20	
Nickel	26.6141	1.0	0.04	25.0000	ND	106	75 - 125	1.04	20	
Selenium	18.5447	2.0	0.82	25.0000	ND	74.2	75 - 125	0.320	20	M2
Silver	11.8405	1.0	0.27	12.5000	ND	94.7	75 - 125	1.39	20	
Thallium	18.2953	2.0	0.35	25.0000	ND	73.2	75 - 125	1.37	20	M2
Vanadium	43.1533	1.0	0.20	25.0000	ND	173	75 - 125	0.575	20	M2
Zinc	59.4727	2.0	0.30	25.0000	0.976296	234	75 - 125	0.465	20	M2

Certificate of Analysis

AESCO	Project Number : McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane	Report To : Adam Chamaa
Huntington Beach , CA 92647	Reported : 06/14/2024

Mercury by AA (Cold Vapor) EPA 7471A - Quality Control

Analyte	Result (mg/kg)	PQL (mg/kg)	MDL (mg/kg)	Spike Level	Source Result	% Rec	% Rec Limits	RPD	RPD Limit	Notes
Batch B4F0626 - EPA 7471_S										
Blank (B4F0626-BLK1)						Prepared: 6/5/2024 Analyzed: 6/6/2024				
Mercury	ND	0.10	0.01							
LCS (B4F0626-BS1)						Prepared: 6/5/2024 Analyzed: 6/6/2024				
Mercury	0.466554	0.10	0.01	0.416667		112	75.1 - 123			
Matrix Spike (B4F0626-MS1)		**Source: 2400882-02**				Prepared: 6/5/2024 Analyzed: 6/6/2024				
Mercury	0.410096	0.10	0.01	0.416667	ND	98.4	15.2 - 179			
Matrix Spike Dup (B4F0626-MSD1)		**Source: 2400882-02**				Prepared: 6/5/2024 Analyzed: 6/6/2024				
Mercury	0.416900	0.10	0.01	0.416667	ND	100	15.2 - 179	1.65	20	

Certificate of Analysis

AESCO		Project Number :	McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane		Report To :	Adam Chamaa
Huntington Beach , CA 92647		Reported :	06/14/2024

Mercury by AA (Cold Vapor) EPA 7471A - Quality Control

Analyte	Result (mg/L)	PQL (mg/L)	Spike Level	Source Result	% Rec	% Rec Limits	RPD	RPD Limit	Notes
Batch B4F0626 - EPA 7471_S									
Post Spike (B4F0626-PS1)		**Source: 2400882-02**			Prepared: 6/5/2024 Analyzed: 6/6/2024				
Mercury	0.003920		5.00000E-3	-0.000047	78.4	85 - 115			M2

Certificate of Analysis

AESCO		Project Number :	McFadden Sewer Lift Station Replacement / 20240035
17782 Georgetown Lane		Report To :	Adam Chamaa
Huntington Beach , CA 92647		Reported :	06/14/2024

Diesel and Oil Range Organics by EPA 8015B - Quality Control

Analyte	Result (mg/kg)	PQL (mg/kg)	MDL (mg/kg)	Spike Level	Source Result	% Rec	% Rec Limits	RPD	RPD Limit	Notes
Batch B4F0622 - GCSEMI_DRO_S										
Blank (B4F0622-BLK1)						Prepared: 6/5/2024 Analyzed: 6/7/2024				
DRO	ND	5.0	0.02							
ORO	ND	5.0	0.02							
Surrogate: p-Terphenyl	*64.24*			*80.0000*		*80.3*	*-6.76 - 189*			
LCS (B4F0622-BS1)						Prepared: 6/5/2024 Analyzed: 6/7/2024				
DRO	781.290	5.0	0.02	1000.00		78.1	77.1 - 122			
Surrogate: p-Terphenyl	*66.59*			*80.0000*		*83.2*	*-6.76 - 189*			
Matrix Spike (B4F0622-MS1)			**Source: 2400882-02**			Prepared: 6/5/2024 Analyzed: 6/7/2024				
DRO	782.675	5.0	0.02	990.099	ND	79.1	37 - 159			
Surrogate: p-Terphenyl	*65.85*			*79.2079*		*83.1*	*-6.76 - 189*			
Matrix Spike Dup (B4F0622-MSD1)			**Source: 2400882-02**			Prepared: 6/5/2024 Analyzed: 6/7/2024				
DRO	818.541	5.0	0.02	1000.00	ND	81.9	37 - 159	4.48	20	
Surrogate: p-Terphenyl	*66.31*			*80.0000*		*82.9*	*-6.76 - 189*			

AESCO

17782 Georgetown Ln., Huntington Beach, CA 92647
(714) 375-3830 Fax: (714) 375-3831

CHAIN OF CUSTODY RECORD

Date: 6/5/2024
Page: 1 of 1

3.8°C

2400895

Client: City of Huntington Beach	Laboratory Name: Advanced Technology Laboratories, 3275 Walnut Avenue, Signal Hill CA 90755		
Address: SE Corner Of Dawson Lane and McFadden Avenue, Huntington Beach, CA 92647	Project Manager Adam Chamaa, P.E., G.E.	Samples Intact Yes X No ___	County seals intact Yes X No ___
	Phone No. 714-375-3830	Sample Ambient ___ Cooled X ___ Frozen ___	Same Day ___ 24Hr. ___
Project Name: McFadden Sewer Lift Station Replacement Aesco Project No. 20240035	Sampler: (signature) [signature] Rhys Kuzmic	Regular XX 5 Day	48Hr ___

Sample ID	Depth	Description of Sample	DATE	TIME	SAMPLE TYPE: WATER	SAMPLE TYPE: AIR	SAMPLE TYPE: SOLID	No. of Cntnrs	Susp. Contam.	Test Requested: EPA Test Method 8015B (Gasoline Range Organics (GC)); EPA Test Method 8015B (Diesel Range Organics (DRO)/Oil Range Organics (ORO)); EPA Test Method 6010B (Metals (ICP) (including Arsenic); EPA Test Method 7471A (Mercury (CVAA))
H4760-01S	N/A	Soil Drum #1	6/5/2024	3:20PM			X	1		
H4760-02S	N/A	Soil Drum #2	6/5/2024	3:20PM			X	1		
H4760-03S	N/A	Soil Drum #3	6/5/2024	3:20PM			X	1		
H4760-04S	N/A	Soil Drum #4	6/5/2024	3:20PM			X	1		

Relinquished by: (signature) Rhys Kuzmic [signature] 06/05/2024 4:55PM	Received by: (signature) Danngle 6/5/24 16:55	Date/Time 6/5/24 16:55	I hereby authorize the performance of the above indicated work.
Relinquished by: (signature)	Received by Laboratory for analysis: (signature)	Date/Time	

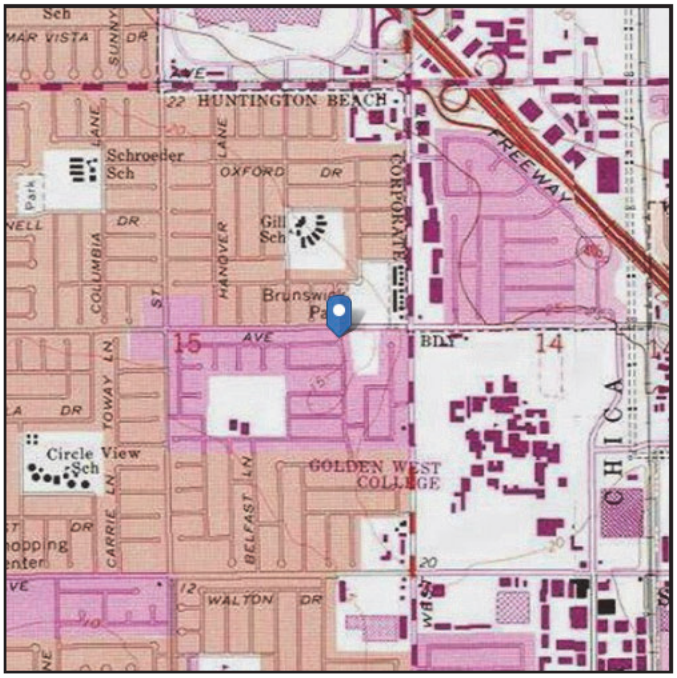
APPENDIX
SEISMIC DESIGN DATA

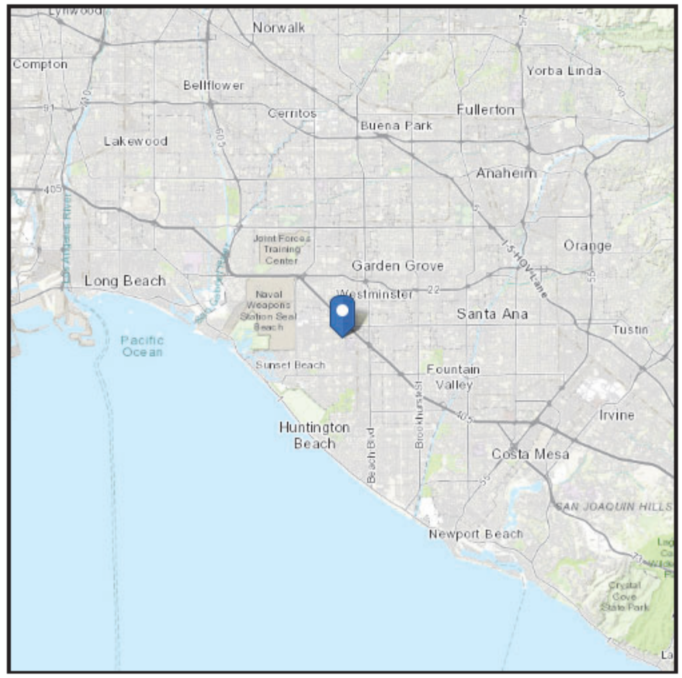
ASCE Hazards Report

Address:
No Address at This Location

Standard: ASCE/SEI 7-16
Risk Category: II
Soil Class: E - Soft Clay Soil

Latitude: 33.736998
Longitude: -118.009241
Elevation: 16.9401724909044 ft (NAVD 88)





ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

Seismic

Site Soil Class: E - Soft Clay Soil

Results:

S_S :	1.418	S_{D1} :	N/A
S_1 :	0.509	T_L :	8
F_a :	N/A	PGA :	0.612
F_v :	N/A	PGA_M :	0.673
S_{MS} :	N/A	F_{PGA} :	1.1
S_{M1} :	N/A	I_e :	1
S_{DS} :	N/A	C_v :	N/A

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Thu Oct 10 2024

Date Source: USGS Seismic Design Maps

The ASCE Hazard Tool is provided for your convenience, for informational purposes only, and is provided "as is" and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

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2008 National Seismic Hazard Maps - Source Parameters

New Search

Distance in Miles	Name	State	Pref Slip Rate (mm/yr)	Dip (degrees)	Dip Dir	Slip Sense	Rupture Top (km)	Rupture Bottom (km)	Length (km)
2.95	Newport Inglewood Connected alt 2	CA	1.3	90	V	strike slip	0	11	208
3.00	Newport-Inglewood, alt 1	CA	1	88		strike slip	0	15	65
3.00	Newport Inglewood Connected alt 1	CA	1.3	89		strike slip	0	11	208
5.21	San Joaquin Hills	CA	0.5	23	SW	thrust	2	13	27
9.75	Puente Hills (Coyote Hills)	CA	0.7	26	N	thrust	2.8	15	17
11.41	Newport-Inglewood (Offshore)	CA	1.5	90	V	strike slip	0	10	66
12.48	Palos Verdes Connected	CA	3	90	V	strike slip	0	10	285
12.48	Palos Verdes	CA	3	90	V	strike slip	0	14	99
12.97	Puente Hills (Santa Fe Springs)	CA	0.7	29	N	thrust	2.8	15	11
15.53	Elsinore;W+GI+T+J	CA	n/a	84	NE	strike slip	0	16	199
15.53	Elsinore;W	CA	2.5	75	NE	strike slip	0	14	46
15.53	Elsinore;W+GI	CA	n/a	81	NE	strike slip	0	14	83
15.53	Elsinore;W+GI+T+J+CM	CA	n/a	84	NE	strike slip	0	16	241
15.53	Elsinore;W+GI+T	CA	n/a	84	NE	strike slip	0	14	124
17.36	Puente Hills (LA)	CA	0.7	27	N	thrust	2.1	15	22
22.12	San Jose	CA	0.5	74	NW	strike slip	0	15	20
23.36	Chino, alt 1	CA	1	50	SW	strike slip	0	9	24
23.42	Elysian Park (Upper)	CA	1.3	50	NE	reverse	3	15	20

23.51	Chino, alt 2	CA	1	65	SW	strike slip	0	14	29
24.89	Elsinore;GI+T	CA	5	90	V	strike slip	0	14	78
24.89	Elsinore;GI+T+J	CA	n/a	86	NE	strike slip	0	17	153
24.89	Elsinore;GI	CA	5	90	V	strike slip	0	13	37
24.89	Elsinore;GI+T+J+CM	CA	n/a	86	NE	strike slip	0	16	195
27.18	Raymond	CA	1.5	79	N	strike slip	0	16	22
28.43	Verdugo	CA	0.5	55	NE	reverse	0	15	29
28.74	Sierra Madre Connected	CA	2	51		reverse	0	14	76
28.74	Sierra Madre	CA	2	53	N	reverse	0	14	57
29.27	Hollywood	CA	1	70	N	strike slip	0	17	17
30.16	Santa Monica Connected alt 2	CA	2.4	44		strike slip	0.8	11	93
30.38	Clamshell-Sawpit	CA	0.5	50	NW	reverse	0	14	16
31.21	Cucamonga	CA	5	45	N	thrust	0	8	28
31.94	Coronado Bank	CA	3	90	V	strike slip	0	9	186
32.58	Santa Monica Connected alt 1	CA	2.6	51		strike slip	0	16	79
32.58	Santa Monica, alt 1	CA	1	75	N	strike slip	0	18	14
35.87	Malibu Coast, alt 1	CA	0.3	75	N	strike slip	0	8	38
35.87	Malibu Coast, alt 2	CA	0.3	74	N	strike slip	0	16	38
36.00	Elsinore;T+J	CA	n/a	86	NE	strike slip	0	17	127
36.00	Elsinore;T+J+CM	CA	n/a	85	NE	strike slip	0	16	169
36.00	Elsinore;T	CA	5	90	V	strike slip	0	14	52
36.86	Anacapa-Dume, alt 2	CA	3	41	N	thrust	1.2	12	65

40.78	Sierra Madre (San Fernando)	CA	2	45	N	thrust	0	13	18
42.97	San Gabriel	CA	1	61	N	strike slip	0	15	71
42.98	Anacapa-Dume, alt 1	CA	3	45	N	thrust	0	16	51
44.81	Northridge	CA	1.5	35	S	thrust	7.4	17	33
45.79	San Jacinto;SBV	CA	6	90	V	strike slip	0	16	45
45.79	San Jacinto;SBV+SJV+A+C	CA	n/a	90	V	strike slip	0	17	181
45.79	San Jacinto;SBV+SJV+A+CC	CA	n/a	90	V	strike slip	0	16	181
45.79	San Jacinto;SBV+SJV+A	CA	n/a	90	V	strike slip	0	16	134
45.79	San Jacinto;SBV+SJV+A+CC+B+SM	CA	n/a	90	V	strike slip	0.1	15	241
45.79	San Jacinto;SBV+SJV	CA	n/a	90	V	strike slip	0	16	88
45.79	San Jacinto;SBV+SJV+A+CC+B	CA	n/a	90	V	strike slip	0.1	15	215
47.54	S. San Andreas;NM+SM	CA	n/a	90	V	strike slip	0	14	134
47.54	S. San Andreas;BB+NM+SM+NSB+SSB+BG+CO	CA	n/a	85		strike slip	0.1	13	390
47.54	S. San Andreas;BB+NM+SM+NSB+SSB+BG	CA	n/a	84		strike slip	0	14	321
47.54	S. San Andreas;BB+NM+SM+NSB+SSB	CA	n/a	90	V	strike slip	0	14	263
47.54	S. San Andreas;SM+NSB+SSB+BG+CO	CA	n/a	83		strike slip	0.1	13	303
47.54	S. San Andreas;SM+NSB+SSB+BG	CA	n/a	81		strike slip	0	13	234
47.54	S. San Andreas;SM+NSB+SSB	CA	n/a	90	V	strike slip	0	13	176
47.54	S. San Andreas;CH+CC+BB+NM+SM	CA	n/a	90	V	strike slip	0	14	306
47.54	S. San Andreas;CH+CC+BB+NM+SM+NSB+SSB+BG+CO	CA	n/a	86		strike slip	0.1	13	512
47.54	S. San Andreas;SM	CA	29	90	V	strike slip	0	13	98

47.54	S. San Andreas;SM+NSB	CA	n/a	90	V	strike slip	0	13	133
47.54	S. San Andreas;BB+NM+SM+NSB	CA	n/a	90	V	strike slip	0	14	220
47.54	S. San Andreas;PK+CH+CC+BB+NM+SM+NSB+SSB+BG+CO	CA	n/a	86		strike slip	0.1	13	548
47.54	S. San Andreas;PK+CH+CC+BB+NM+SM+NSB+SSB+BG	CA	n/a	86		strike slip	0.1	13	479
47.54	S. San Andreas;PK+CH+CC+BB+NM+SM+NSB+SSB	CA	n/a	90	V	strike slip	0.1	13	421
47.54	S. San Andreas;PK+CH+CC+BB+NM+SM+NSB	CA	n/a	90	V	strike slip	0.1	13	377
47.54	S. San Andreas;PK+CH+CC+BB+NM+SM	CA	n/a	90	V	strike slip	0.1	13	342
47.54	S. San Andreas;BB+NM+SM	CA	n/a	90	V	strike slip	0	14	184
47.54	S. San Andreas;NM+SM+NSB+SSB+BG+CO	CA	n/a	84		strike slip	0.1	13	340
47.54	S. San Andreas;CC+BB+NM+SM	CA	n/a	90	V	strike slip	0	14	243
47.54	S. San Andreas;CC+BB+NM+SM+NSB	CA	n/a	90	V	strike slip	0	14	279
47.54	S. San Andreas;CC+BB+NM+SM+NSB+SSB	CA	n/a	90	V	strike slip	0	14	322
47.54	S. San Andreas;CC+BB+NM+SM+NSB+SSB+BG	CA	n/a	85		strike slip	0	14	380
47.54	S. San Andreas;CC+BB+NM+SM+NSB+SSB+BG+CO	CA	n/a	86		strike slip	0.1	13	449
47.54	S. San Andreas;NM+SM+NSB+SSB+BG	CA	n/a	83		strike slip	0	14	271
47.54	S. San Andreas;NM+SM+NSB+SSB	CA	n/a	90	V	strike slip	0	13	213
47.54	S. San Andreas;CH+CC+BB+NM+SM+NSB	CA	n/a	90	V	strike slip	0	14	341
47.54	S. San Andreas;CH+CC+BB+NM+SM+NSB+SSB	CA	n/a	90	V	strike slip	0	14	384
47.54	S. San Andreas;CH+CC+BB+NM+SM+NSB+SSB+BG	CA	n/a	86		strike slip	0	14	442
47.54	S. San Andreas;NM+SM+NSB	CA	n/a	90	V	strike slip	0	13	170

47.84	S. San Andreas;NSB	CA	22	90	V	strike slip	0	13	35
47.84	S. San Andreas;NSB+SSB+BG+CO	CA	n/a	79		strike slip	0.2	12	206
47.84	S. San Andreas;NSB+SSB	CA	n/a	90	V	strike slip	0	13	79
47.84	S. San Andreas;NSB+SSB+BG	CA	n/a	75		strike slip	0	14	136
48.36	San Jacinto;SJV+A+CC+B	CA	n/a	90	V	strike slip	0.1	15	170
48.36	San Jacinto;SJV+A+CC+B+SM	CA	n/a	90	V	strike slip	0.1	15	196
48.36	San Jacinto;SJV+A+CC	CA	n/a	90	V	strike slip	0	16	136
48.36	San Jacinto;SJV+A	CA	n/a	90	V	strike slip	0	17	89
48.36	San Jacinto;SJV+A+C	CA	n/a	90	V	strike slip	0	17	136
48.36	San Jacinto;SJV	CA	18	90	V	strike slip	0	16	43
49.07	Santa Susana, alt 1	CA	5	55	N	reverse	0	16	27
50.41	Cleghorn	CA	3	90	V	strike slip	0	16	25
52.85	San Jacinto;A+CC+B+SM	CA	n/a	90	V	strike slip	0.1	15	178
52.85	San Jacinto;A+CC	CA	n/a	90	V	strike slip	0	16	118
52.85	San Jacinto;A+C	CA	n/a	90	V	strike slip	0	17	118
52.85	San Jacinto;A	CA	9	90	V	strike slip	0	17	71
52.85	San Jacinto;A+CC+B	CA	n/a	90	V	strike slip	0.1	15	152
53.39	S. San Andreas;SSB	CA	16	90	V	strike slip	0	13	43
53.39	S. San Andreas;SSB+BG+CO	CA	n/a	77		strike slip	0.2	12	170
53.39	S. San Andreas;SSB+BG	CA	n/a	71		strike slip	0	13	101

54.17	Rose Canyon	CA	1.5	90	V	strike slip	0	8	70
55.54	Simi-Santa Rosa	CA	1	60		strike slip	1	12	39
56.19	Holser, alt 1	CA	0.4	58	S	reverse	0	19	20
58.30	North Frontal (West)	CA	1	49	S	reverse	0	16	50
61.27	Oak Ridge Connected	CA	3.6	53		reverse	0.6	15	94
61.27	Oak Ridge (Onshore)	CA	4	65	S	reverse	1	19	49
63.85	Elsinore;J	CA	3	84	NE	strike slip	0	19	75
63.85	Elsinore;J+CM	CA	3	84	NE	strike slip	0	17	118
64.73	San Cayetano	CA	6	42	N	thrust	0	16	42
70.99	S. San Andreas;BG	CA	n/a	58		strike slip	0	13	56
70.99	S. San Andreas;BG+CO	CA	n/a	72		strike slip	0.3	12	125
72.20	S. San Andreas;BB+NM	CA	n/a	90	V	strike slip	0	15	87
72.20	S. San Andreas;NM	CA	27	90	V	strike slip	0	15	37
72.20	S. San Andreas;CC+BB+NM	CA	n/a	90	V	strike slip	0	15	146
72.20	S. San Andreas;PK+CH+CC+BB+NM	CA	n/a	90	V	strike slip	0.1	12	245
72.20	S. San Andreas;CH+CC+BB+NM	CA	n/a	90	V	strike slip	0	14	208
73.94	Santa Cruz Island	CA	1	90	V	strike slip	0	13	69
74.83	Channel Islands Thrust	CA	1.5	20	N	thrust	5	12	59
77.20	Pinto Mtn	CA	2.5	90	V	strike slip	0	16	74
77.28	Pitas Point Connected	CA	1	55		reverse	1.2	13	78
77.28	Ventura-Pitas Point	CA	1	64	N	reverse	1	15	44
77.38	Helendale-So Lockhart	CA	0.6	90	V	strike slip	0	13	114
77.73	Santa Ynez (East)	CA	2	70	S	strike slip	0	13	68

77.73	Santa Ynez Connected	CA	2	70		strike slip	0	11	132
80.74	North Frontal (East)	CA	0.5	41	S	thrust	0	16	27
80.81	Oak Ridge (Offshore)	CA	3	32	S	thrust	0	8	38
83.41	Mission Ridge-Arroyo Parida-Santa Ana	CA	0.4	70	S	reverse	0	8	69
85.13	Red Mountain	CA	2	56	N	reverse	0	14	101
86.50	San Jacinto;CC+B	CA	n/a	90	V	strike slip	0.2	14	77
86.50	San Jacinto;CC	CA	4	90	V	strike slip	0	16	43
86.50	San Jacinto;CC+B+SM	CA	n/a	90	V	strike slip	0.2	14	103
87.88	San Jacinto;C	CA	14	90	V	strike slip	0	17	47
89.00	Lenwood-Lockhart-Old Woman Springs	CA	0.9	90	V	strike slip	0	13	145
89.40	S. San Andreas;BB	CA	34	90	V	strike slip	0	15	50
89.40	S. San Andreas;PK+CH+CC+BB	CA	n/a	90	V	strike slip	0.1	12	208
89.40	S. San Andreas;CC+BB	CA	n/a	90	V	strike slip	0	15	109
89.40	S. San Andreas;CH+CC+BB	CA	n/a	90	V	strike slip	0	14	171
89.55	Pitas Point (Lower)-Montalvo	CA	2.5	16	N	thrust	0.4	13	30
89.72	Garlock;GC+GW	CA	n/a	90	V	strike slip	0.4	12	210
89.72	Garlock;GE+GC+GW	CA	n/a	90	V	strike slip	0.3	12	256
89.72	Garlock;GW	CA	6	90	V	strike slip	0.7	14	98
90.66	North Channel	CA	1	26	N	thrust	1.1	5	51
90.68	Earthquake Valley	CA	2	90	V	strike slip	0	19	20
93.48	Johnson Valley (No)	CA	0.6	90	V	strike slip	0	16	35
94.04	Burnt Mtn	CA	0.6	67	W	strike slip	0	16	21

95.64	Landers	CA	0.6	90	V	strike slip	0	15	95
96.43	Pleito	CA	2	46	S	reverse	0	14	44
96.45	Eureka Peak	CA	0.6	90	V	strike slip	0	15	19
98.48	Pitas Point (Upper)	CA	1	42	N	thrust	1.4	10	35
99.45	Gravel Hills-Harper Lk	CA	0.7	90	V	strike slip	0	11	65

2008 National Seismic Hazard Maps - Source Parameters

New Search

Fault Name	State
Newport Inglewood Connected alt 2	**California**

GEOMETRY	
Dip (degrees)	90
Dip direction	V
Sense of slip	strike slip
Rupture top (km)	0
Rupture bottom (km)	11
Rake (degrees)	180
Length (km)	208

MODEL VALUES		
Slip Rate	1.3	
Probability of activity	1	
	ELLSWORTH	HANKS
Minimum magnitude	6.5	6.5
Maximum magnitude	7.50	7.50
b-value	0.8	0.8

Fault Model	Deformation Model	Char Rate[1]	GR-a-value[1]	Weight
Stitched	2.4	3.81e-04 / 3.81e-04	1.885 / 1.885	0.50

[1] 1st Value is based on Ellsworth relation and 2nd value is based on Hanks and Bakun relation

Comments
Rose Canyon; Newport-Inglewood (Offshore); Newport-Inglewood, alt 2

Selected References

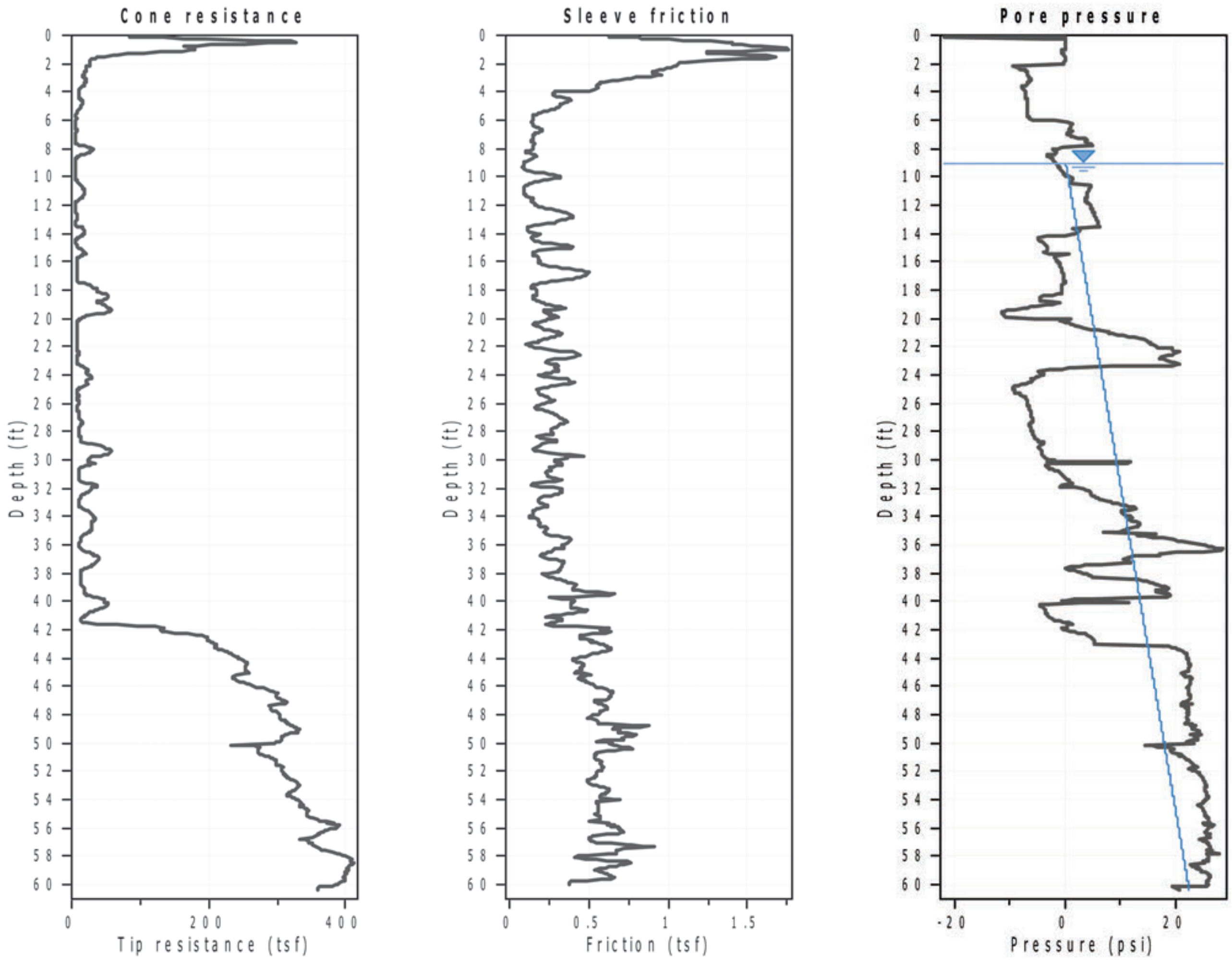
Working Group on California Earthquake Probabilities, 1995, Seismic hazards in southern California—Probable earthquakes, 1994 to 2024: Bulletin of the Seismological Society of America, v. 85, no. 2, p. 379-439.

APPENDIX
CPT TEST RESULTS

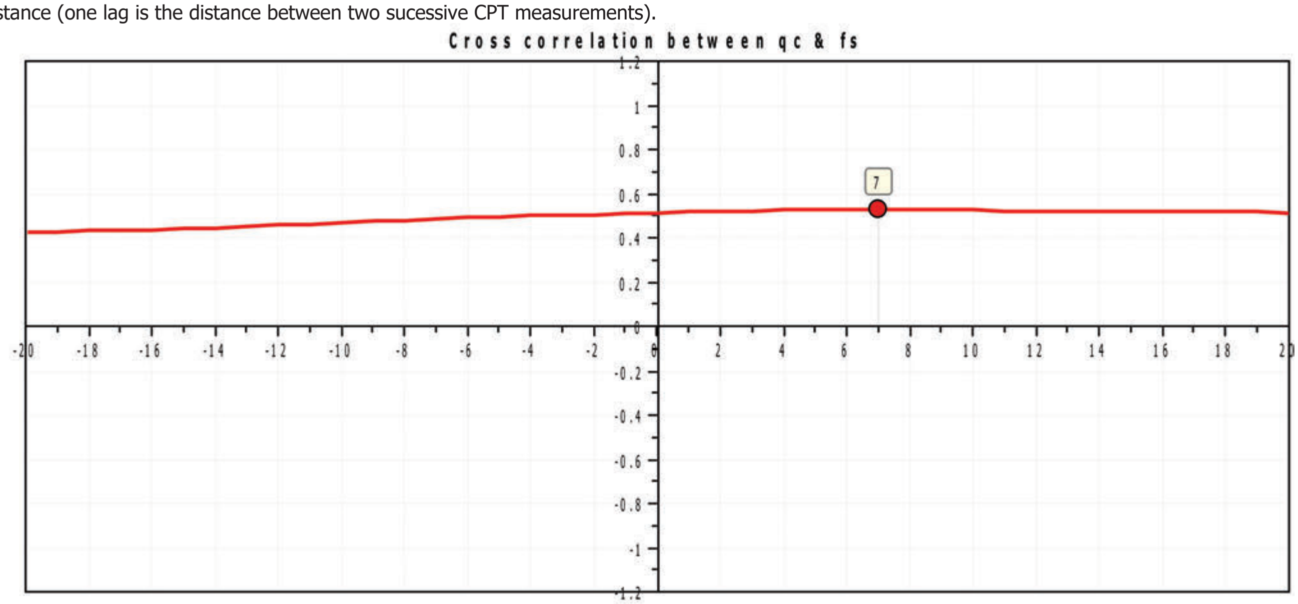
AESCO, Inc.
714-375-3830
omar.chamaa@aescotech.com
www.aescotech.com

CPT: CPT-1
Total depth: 60.49 ft, Date: 5/16/2024
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: 15 cm^2
Cone Operator: Kehoe Testing

Project: **McFadden Sewer lift Station (CC-1610)**
Location: **Dawson Lane & McFadden Ave, Huntington Beach, CA**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



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Project: **McFadden Sewer lift Station (CC-1610)**
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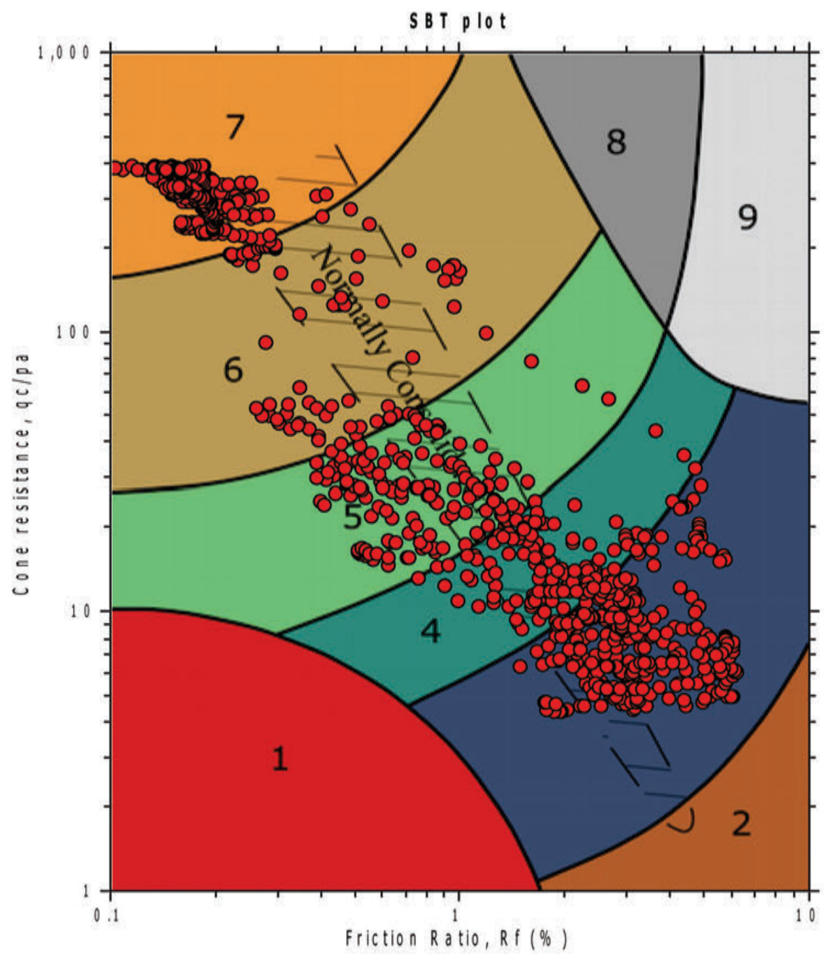
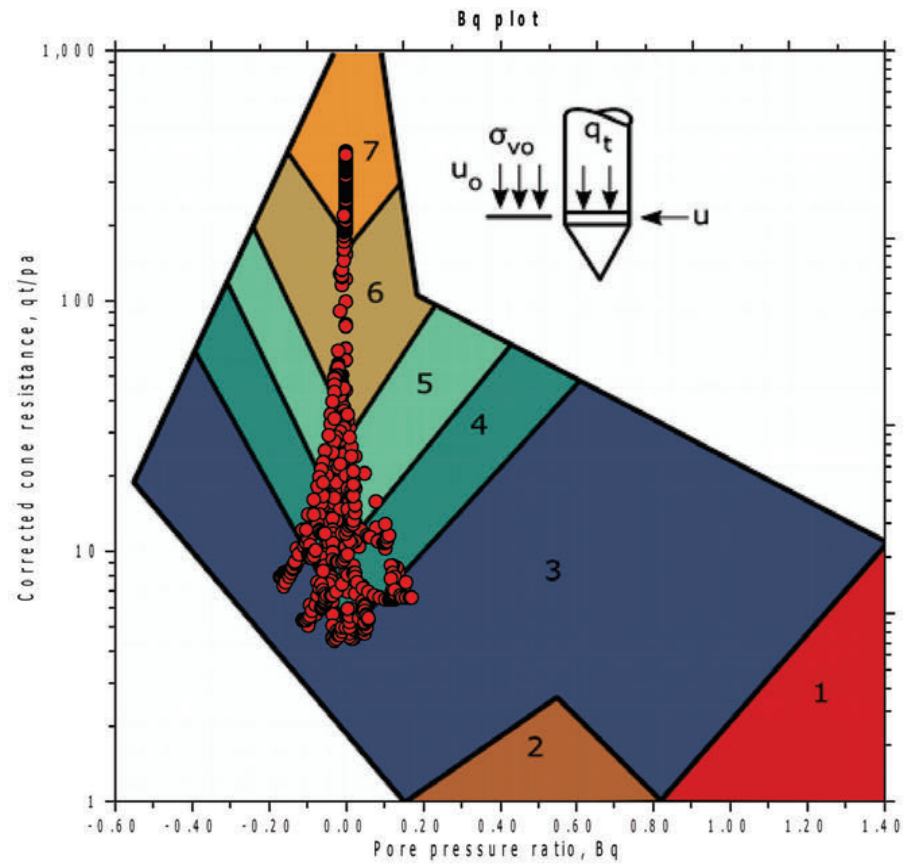
CPT: CPT-1
Total depth: 60.49 ft, Date: 5/16/2024
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: 15 cm^2
Cone Operator: Kehoe Testing

SBT - Bq plots





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

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Project: McFadden Sewer lift Station (CC-1610)
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CPT: CPT-1
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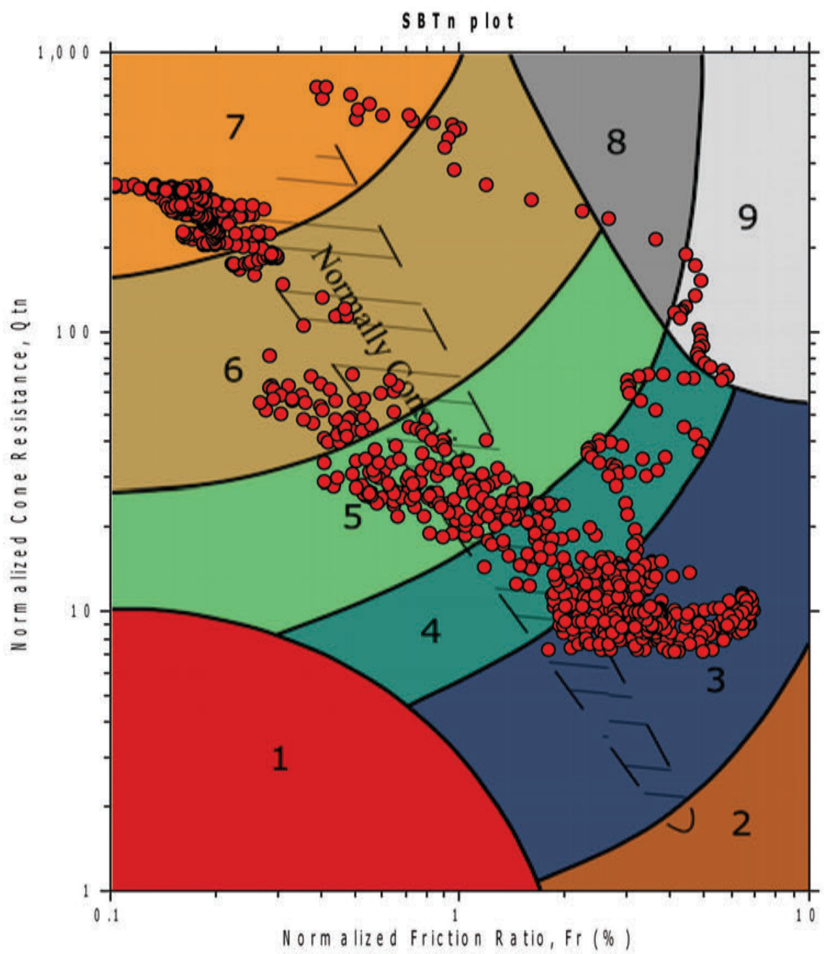
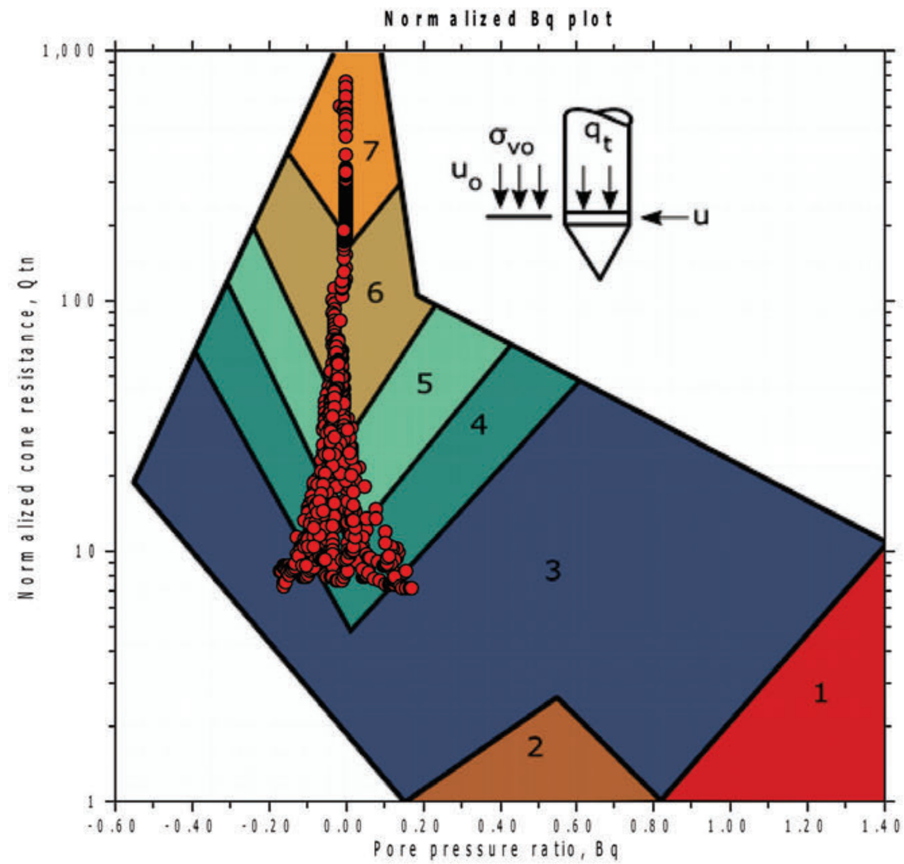
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: 15 cm^2
Cone Operator: Kehoe Testing

SBT - Bq plots (normalized)

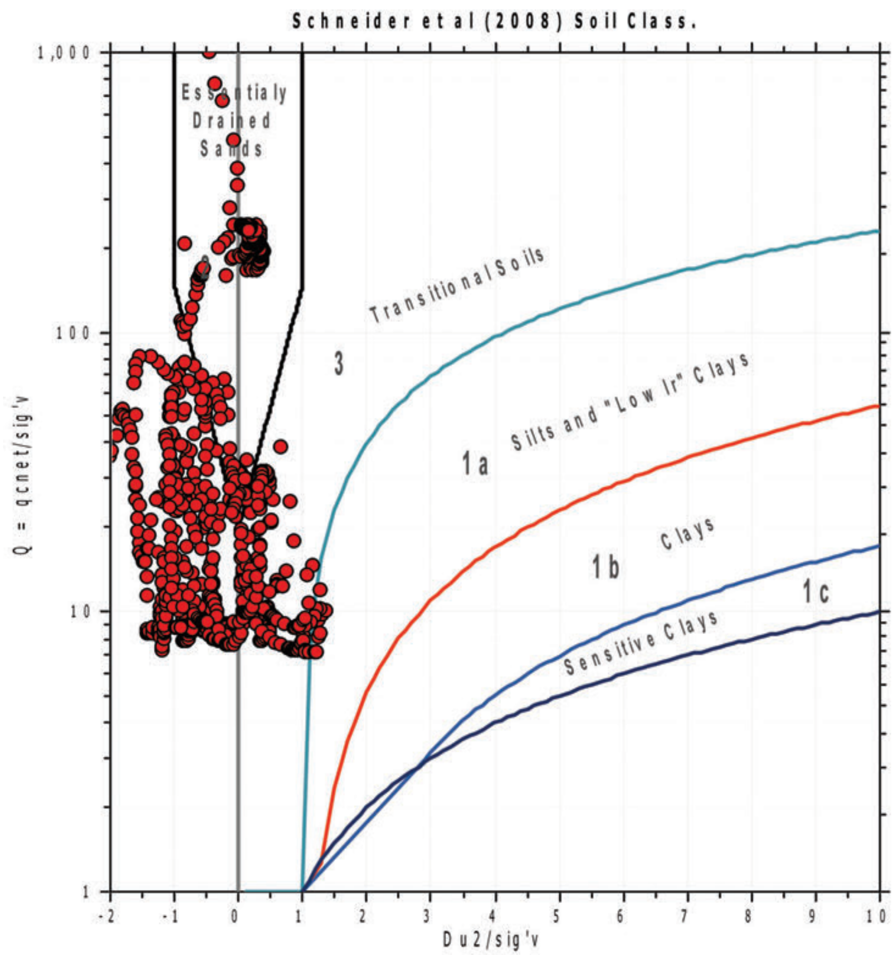


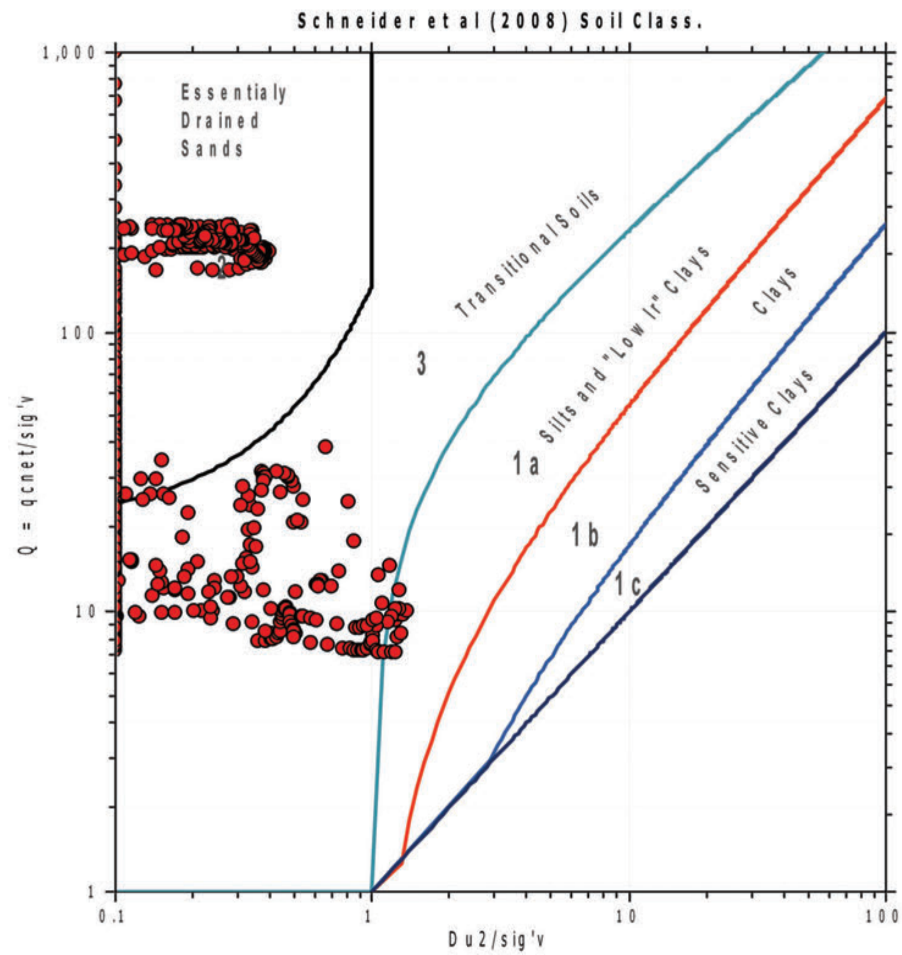


SBTn legend

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

Bq plots (Schneider)





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CPT: CPT-1
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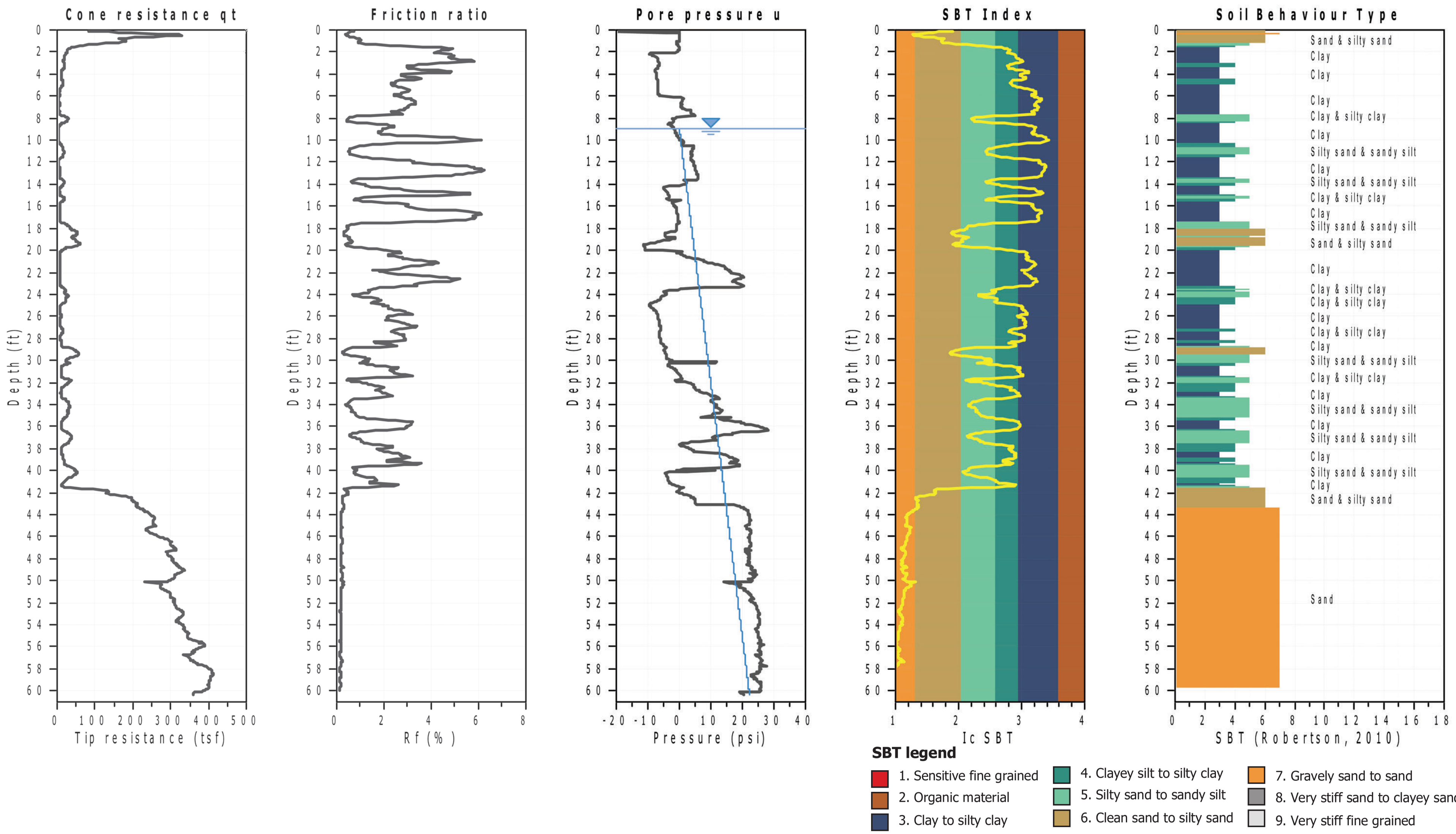
Cone Type: 15 cm^2
Cone Operator: Kehoe Testing

Project: McFadden Sewer lift Station (CC-1610)
Location: Dawson Lane & McFadden Ave, Huntington Beach, CA



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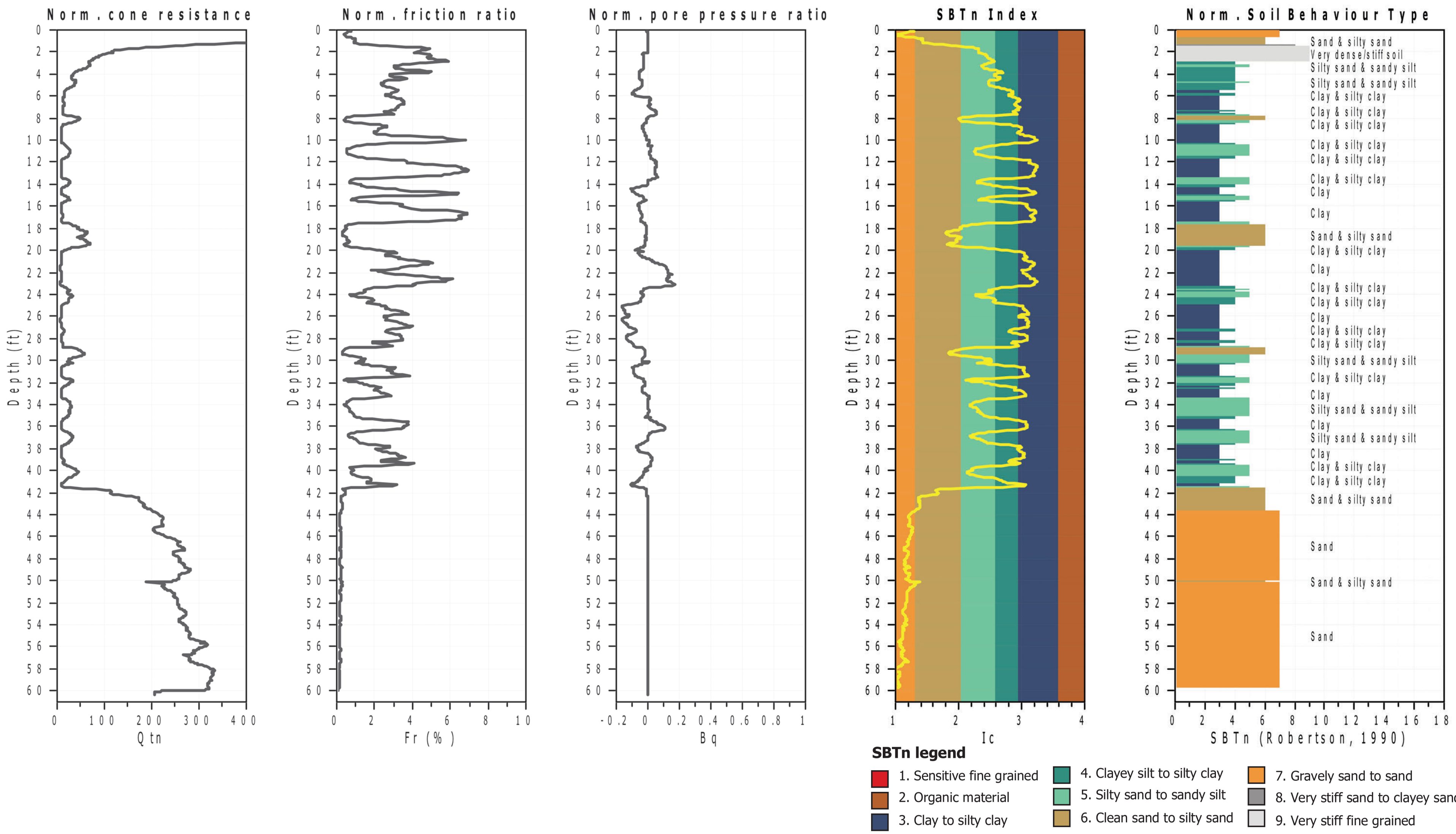

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Cone Type: 15 cm^2
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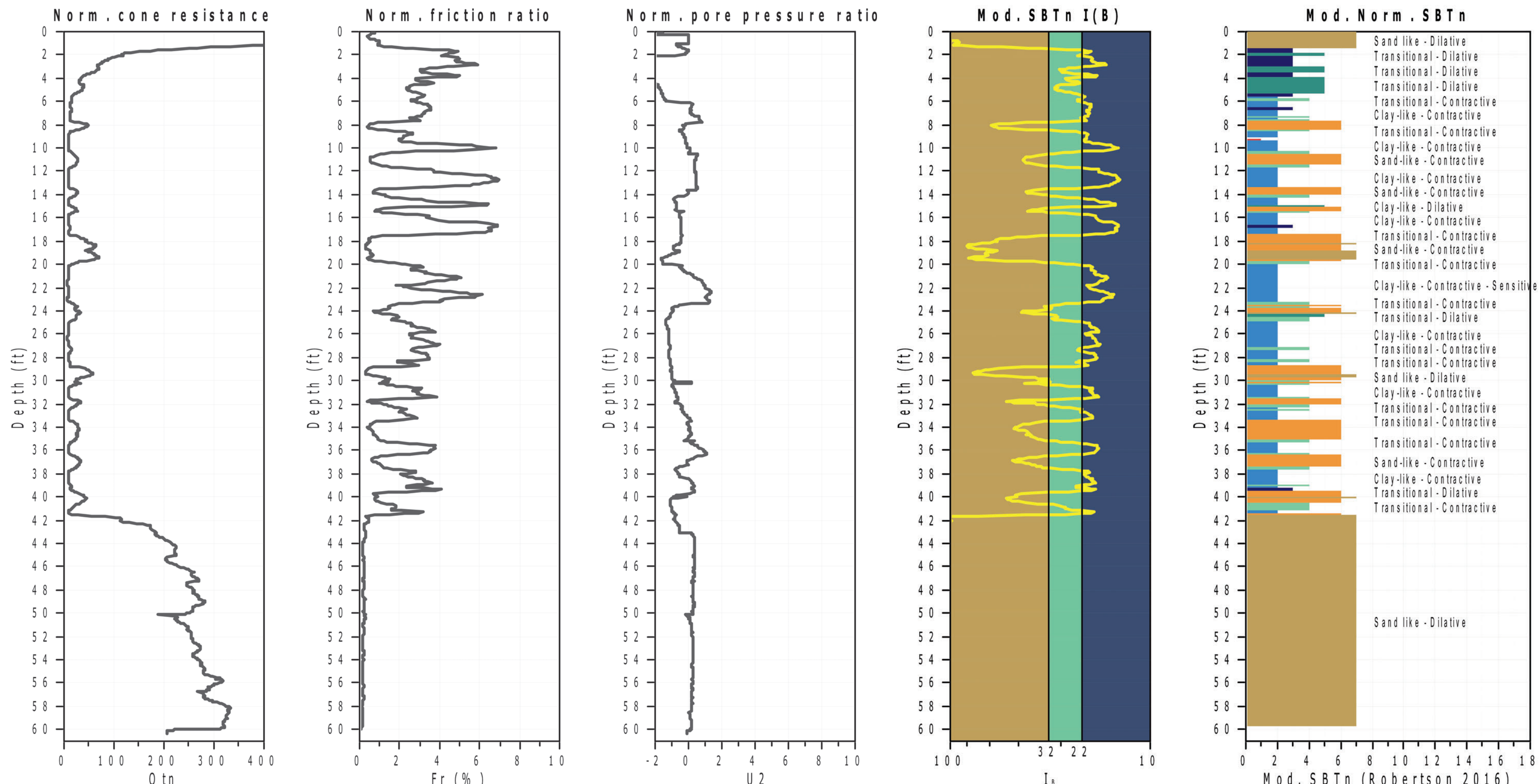
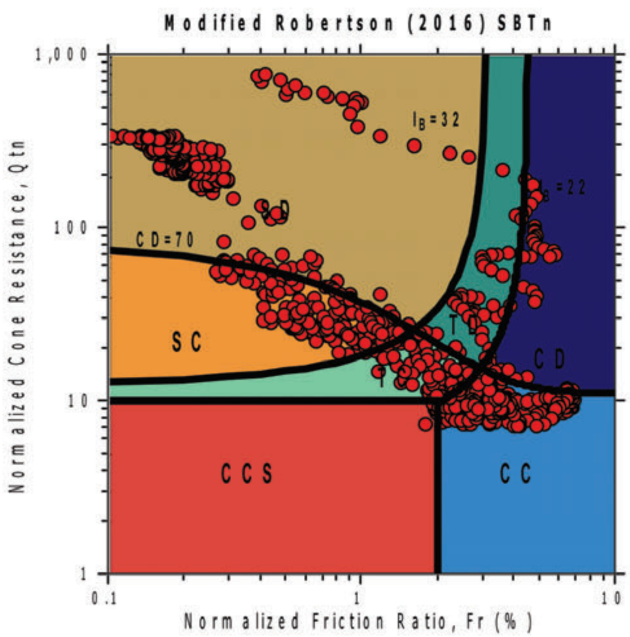
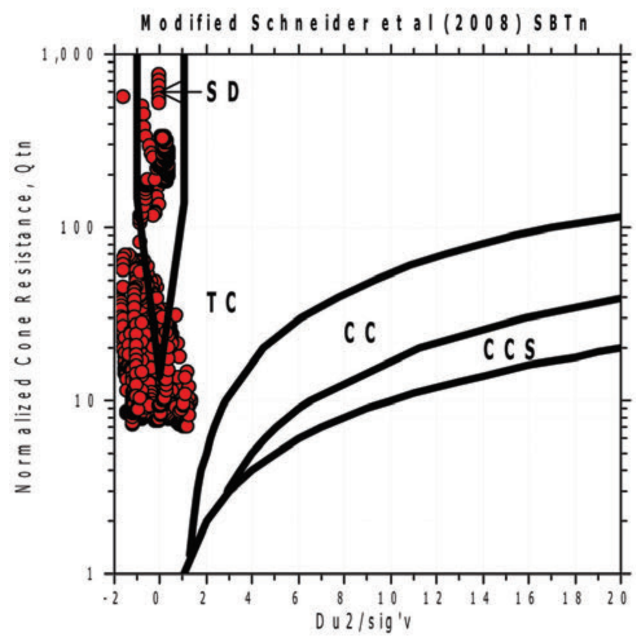
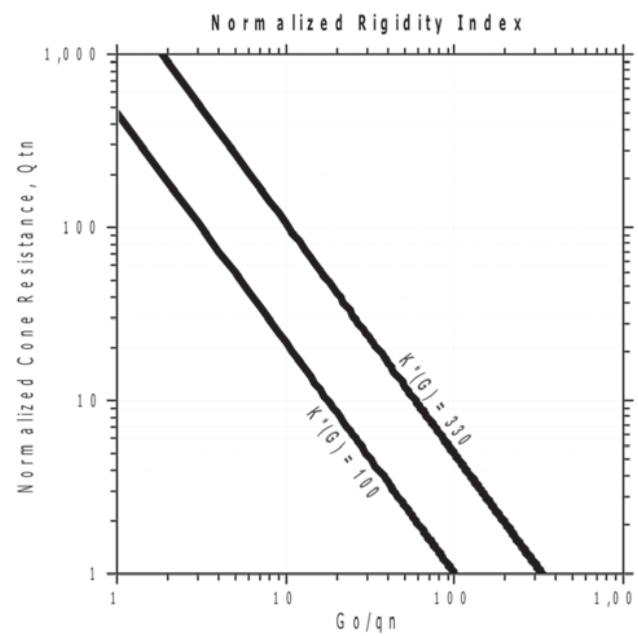


Mod. SBTn legend
1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

Updated SBTn plots







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

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

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CPT: CPT-1
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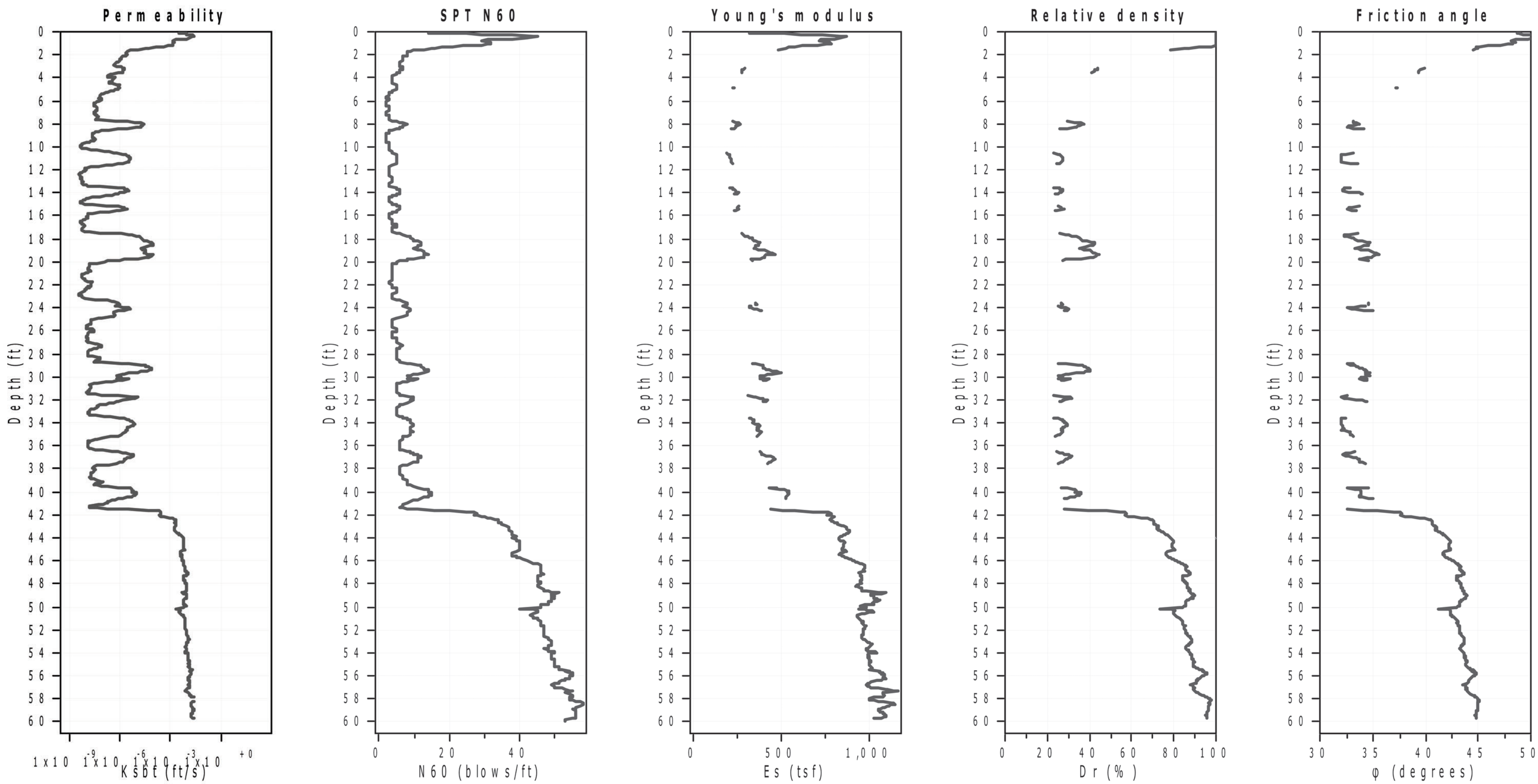
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: 15 cm^2
Cone Operator: Kehoe Testing

Project: **McFadden Sewer lift Station (CC-1610)**
Location: **Dawson Lane & McFadden Ave, Huntington Beach, CA**



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

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CPT: CPT-1
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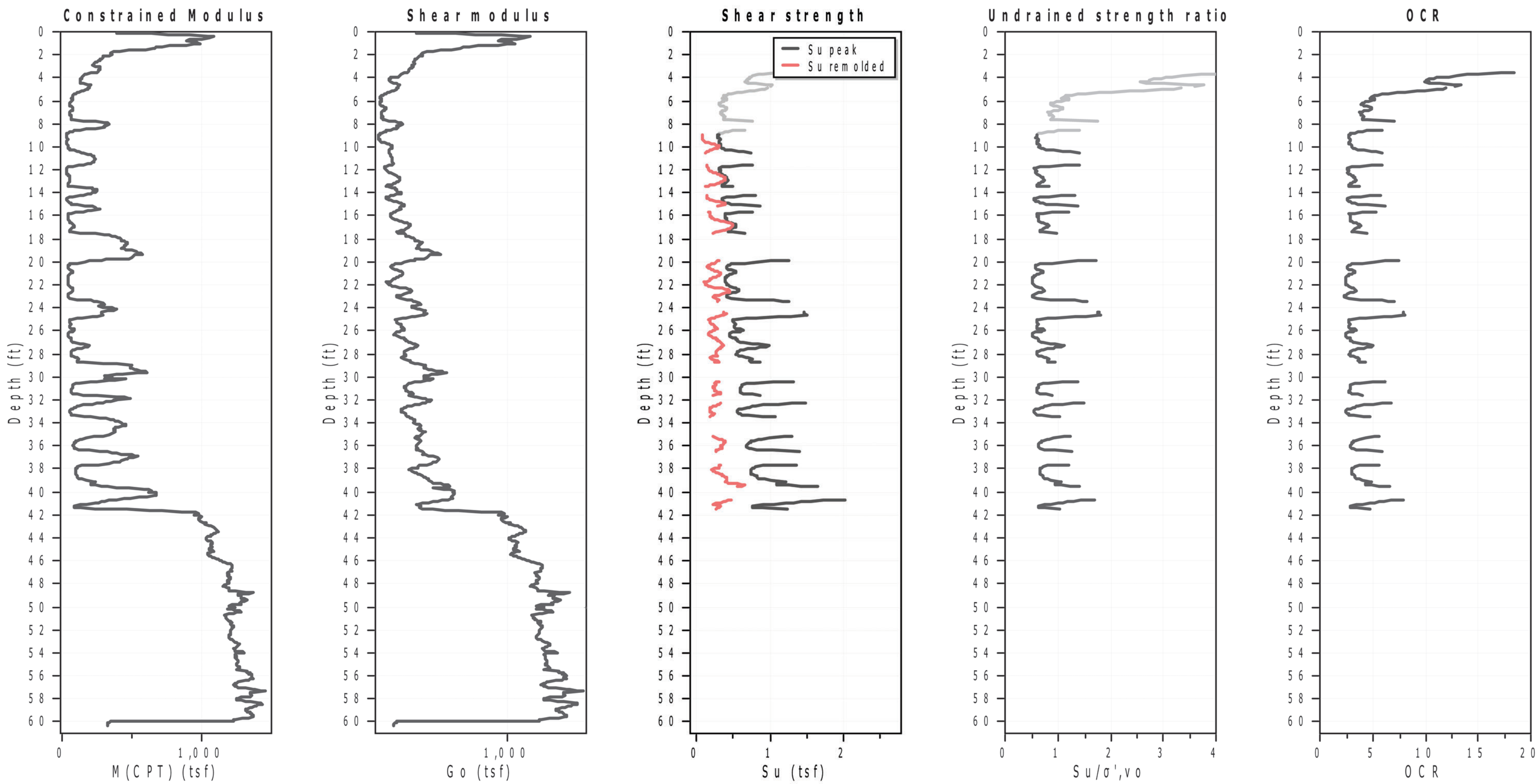
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: 15 cm^2
Cone Operator: Kehoe Testing

Project: **McFadden Sewer lift Station (CC-1610)**
Location: **Dawson Lane & McFadden Ave, Huntington Beach, CA**



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

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

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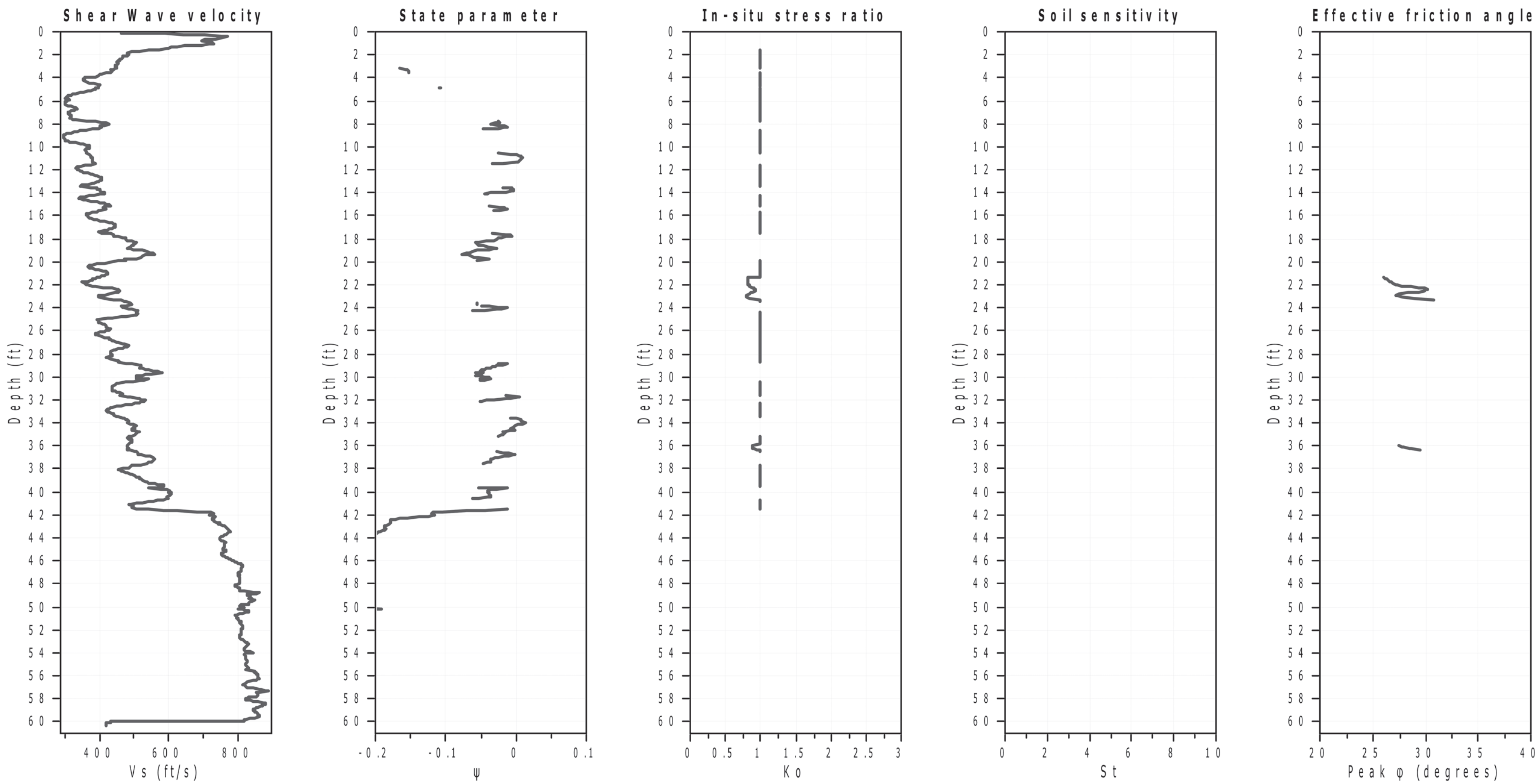
CPT: CPT-1
Total depth: 60.49 ft, Date: 5/16/2024
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: 15 cm^2
Cone Operator: Kehoe Testing

Project: McFadden Sewer lift Station (CC-1610)
Location: Dawson Lane & McFadden Ave, Huntington Beach, CA



Calculation parameters

Soil Sensitivity factor, N_S: 350.00

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Project: McFadden Sewer lift Station (CC-1610)
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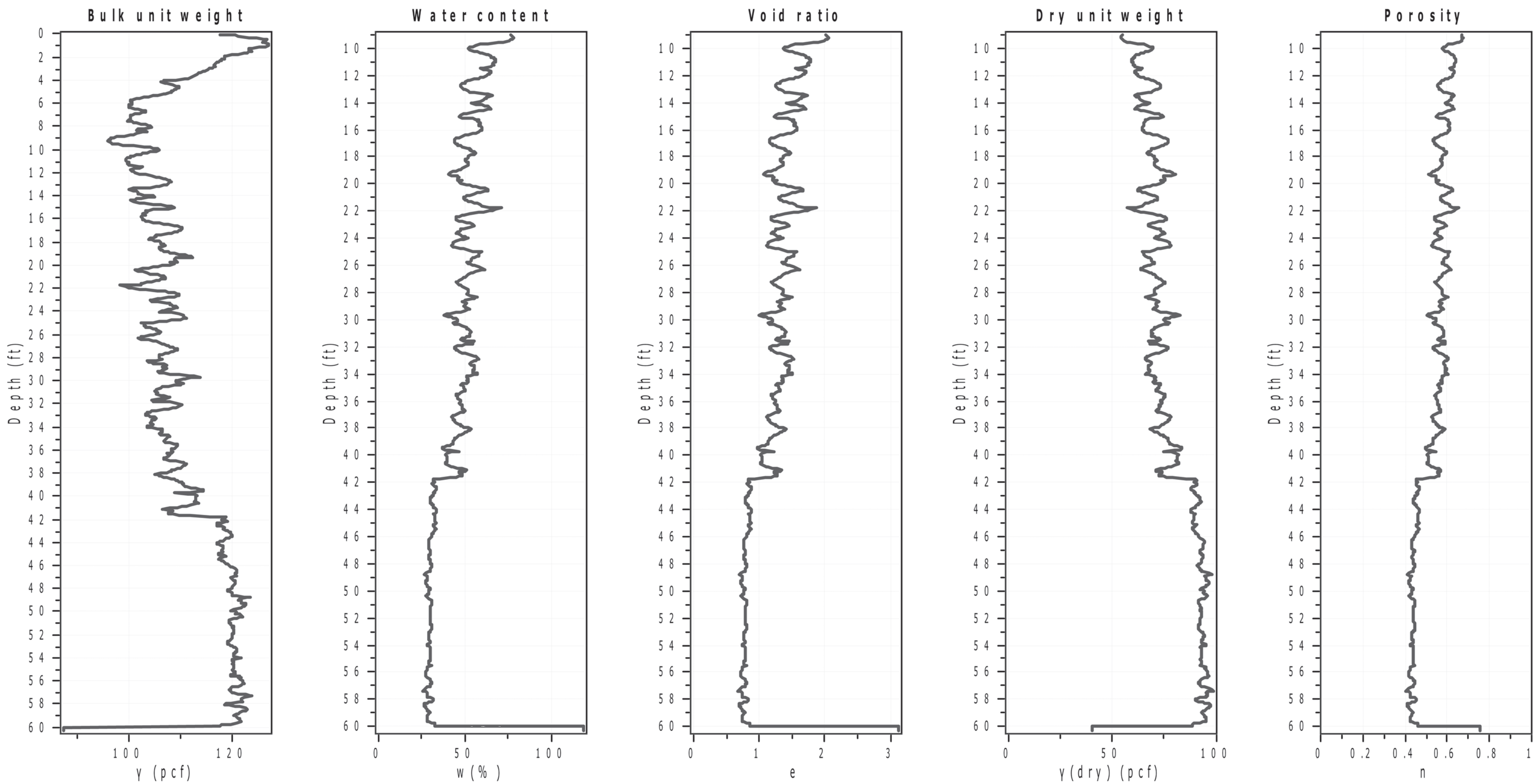
CPT: CPT-1
Total depth: 60.49 ft, Date: 5/16/2024
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: 15 cm^2
Cone Operator: Kehoe Testing



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CPT: CPT-1

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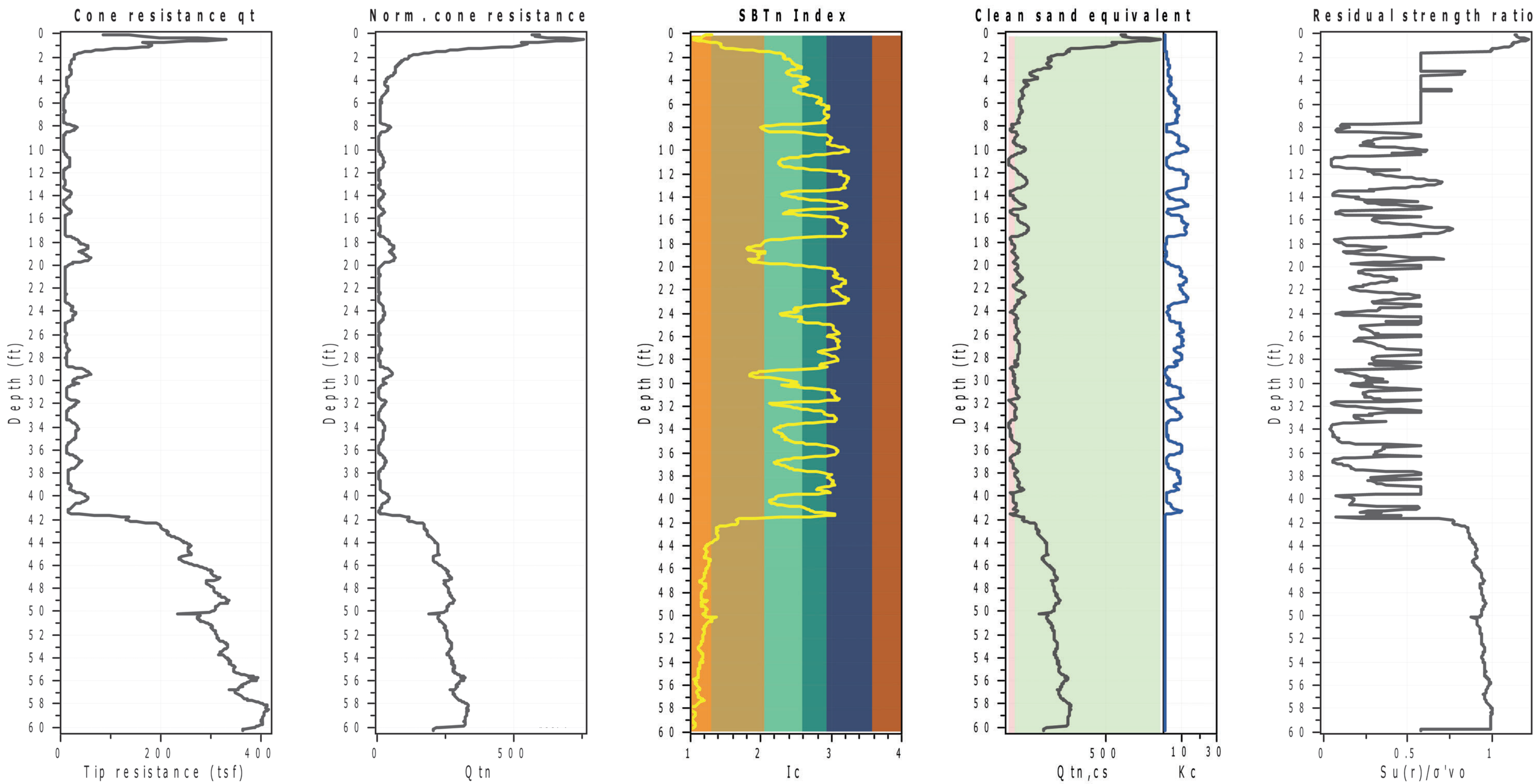
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: 15 cm^2
Cone Operator: Kehoe Testing

Project: McFadden Sewer lift Station (CC-1610)

Location: Dawson Lane & McFadden Ave, Huntington Beach, CA



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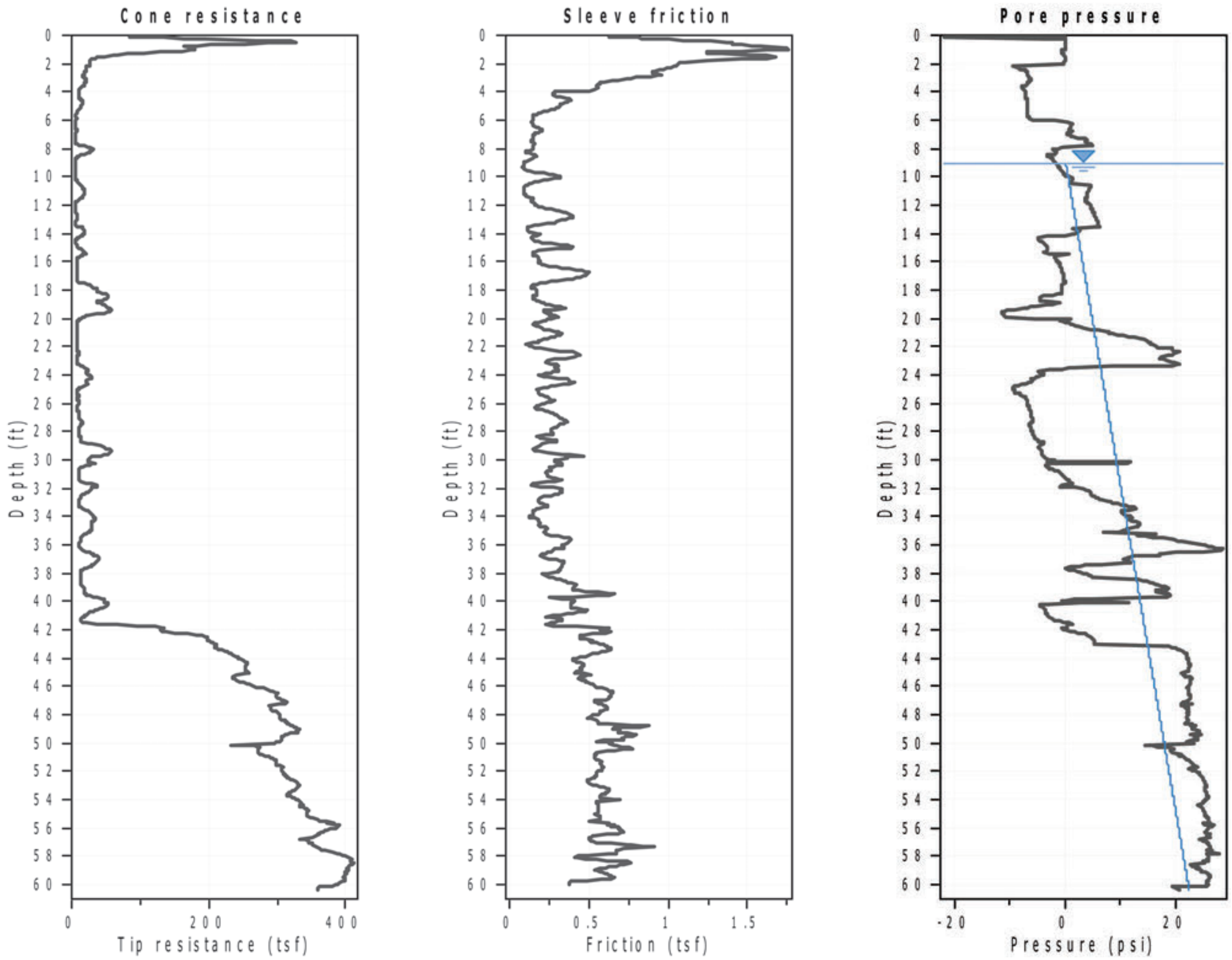
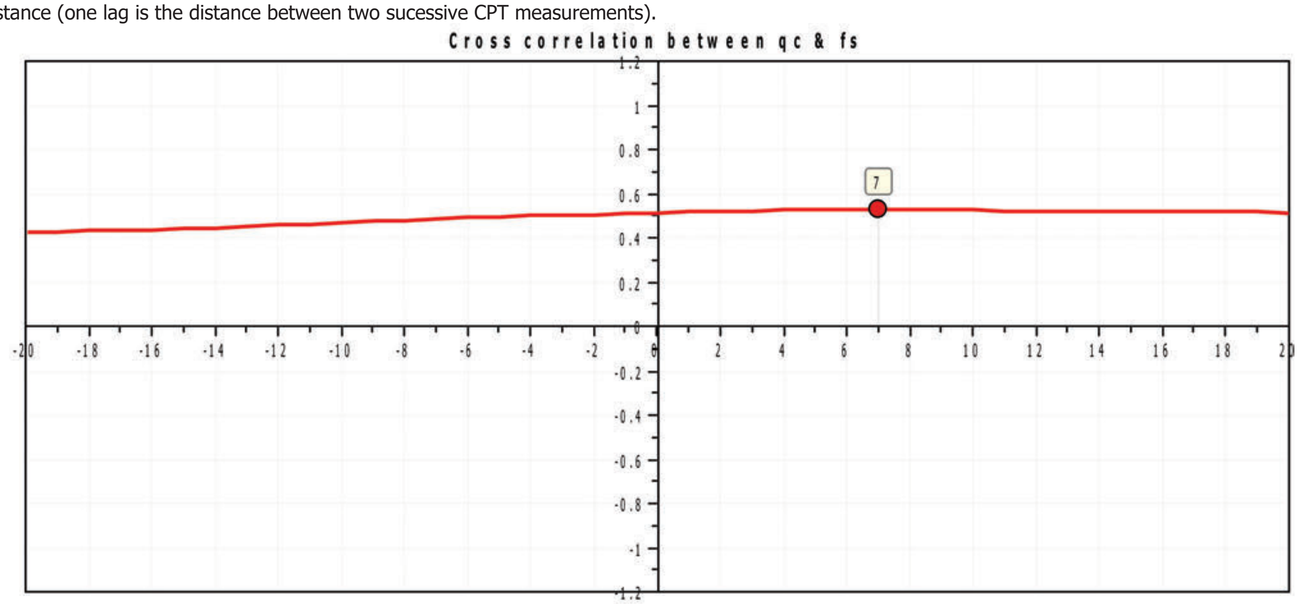
www.aescotech.com

CPT: CPT-2
Total depth: 60.31 ft, Date: 5/17/2024
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: 15 cm^2
Cone Operator: Kehoe Testing

Project: **McFadden Sewer lift Station (CC-1610)**
Location: **Dawson Lane & McFadden Ave, Huntington Beach, CA**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



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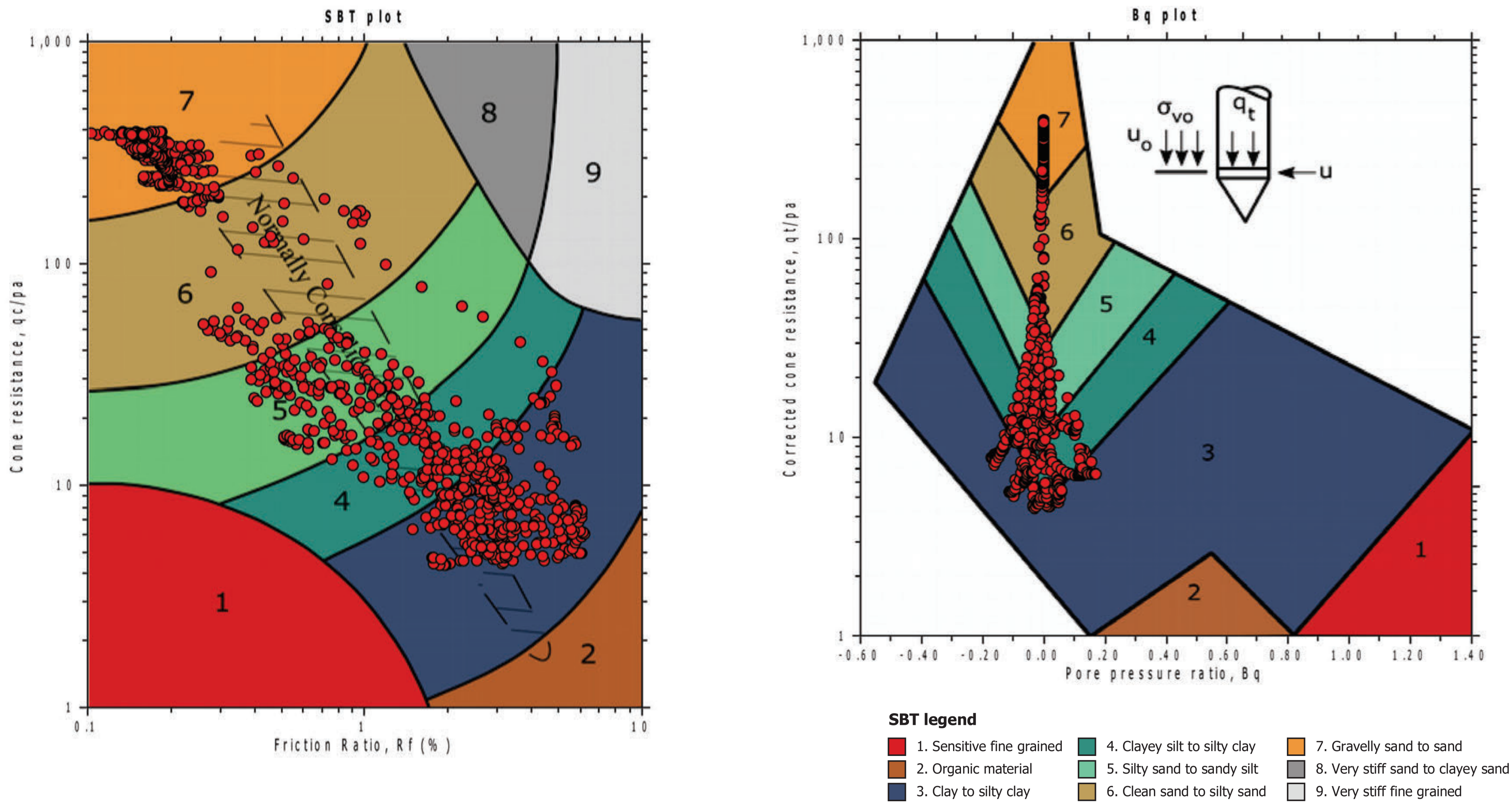
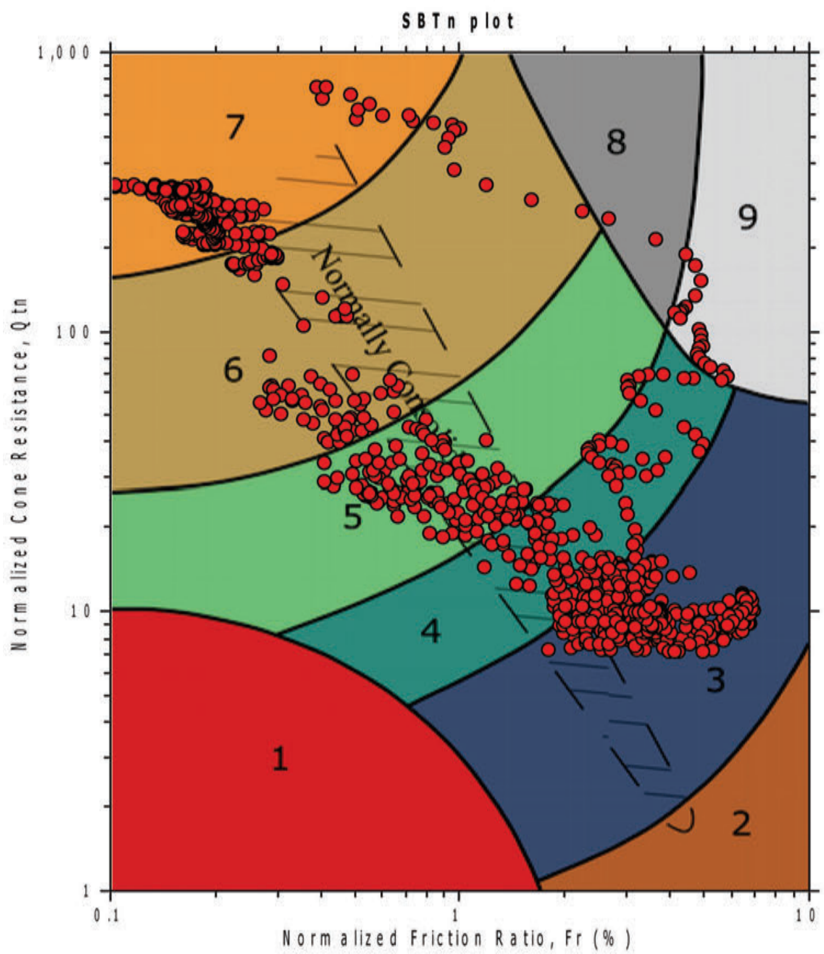
Project: McFadden Sewer lift Station (CC-1610)
Location: Dawson Lane & McFadden Ave, Huntington Beach, CA

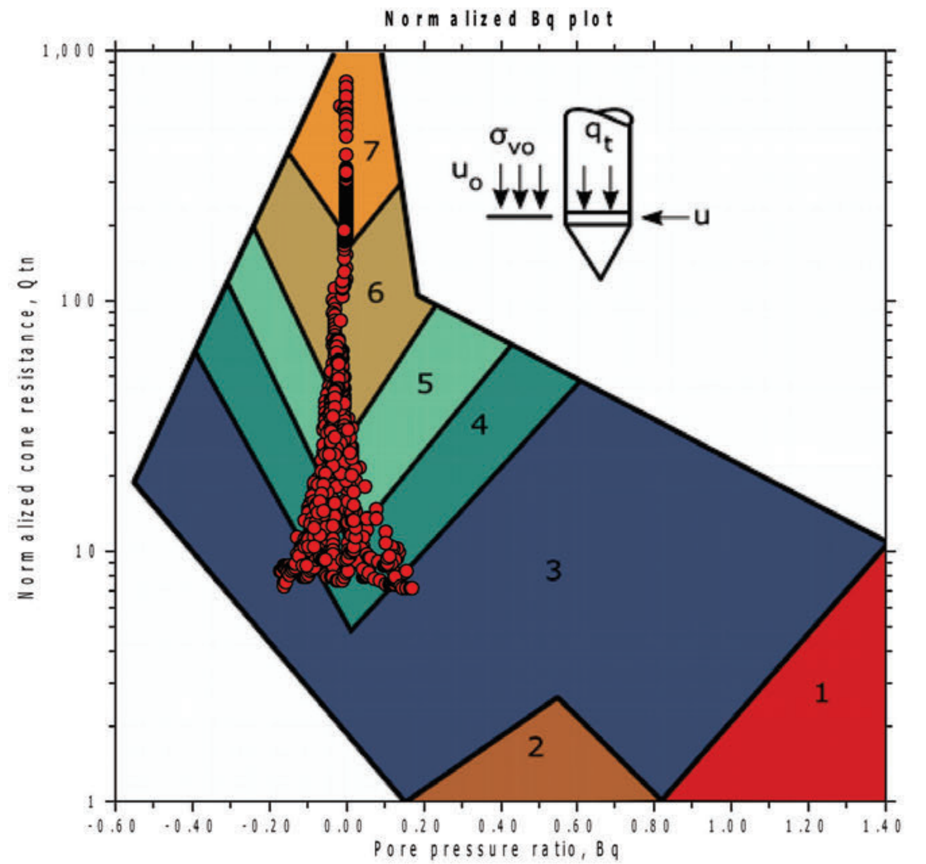
CPT: CPT-2
Total depth: 60.31 ft, Date: 5/17/2024
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: 15 cm^2
Cone Operator: Kehoe Testing

SBT - Bq plots



SBT - Bq plots (normalized)





SBTn legend

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

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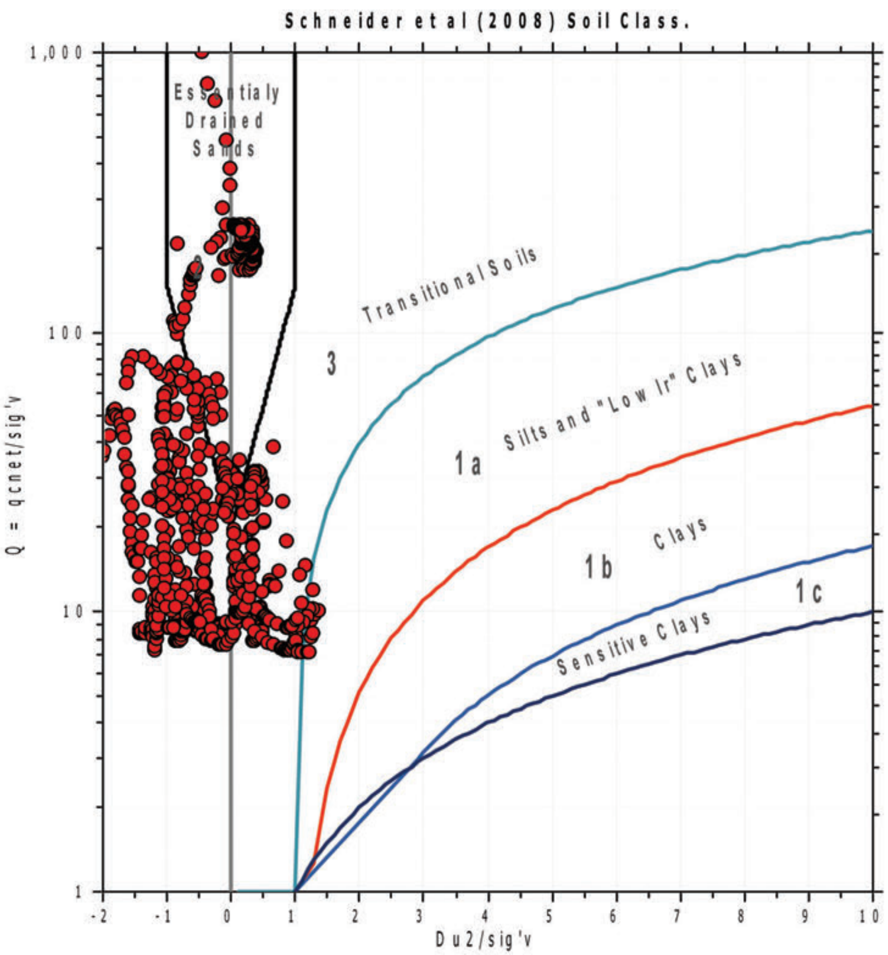
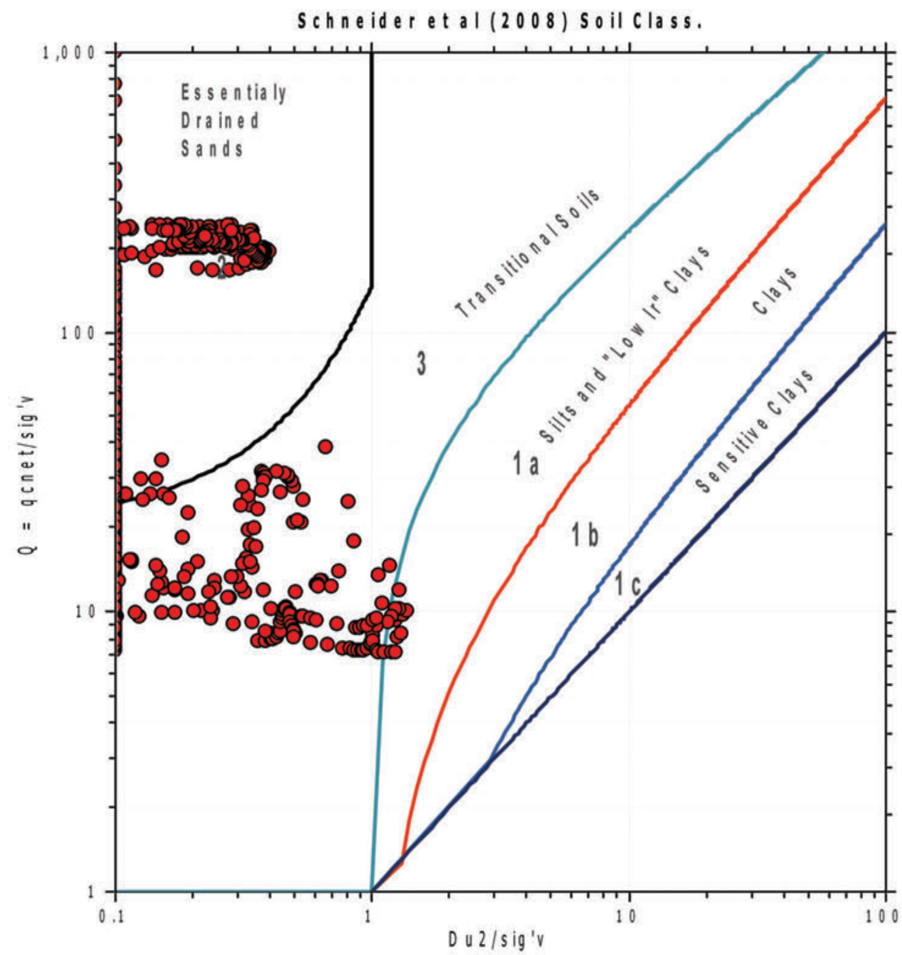
Total depth: 60.31 ft, Date: 5/17/2024
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: 15 cm^2
Cone Operator: Kehoe Testing

Bq plots (Schneider)





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Cone Type: 15 cm^2
Cone Operator: Kehoe Testing

Project: McFadden Sewer lift Station (CC-1610)
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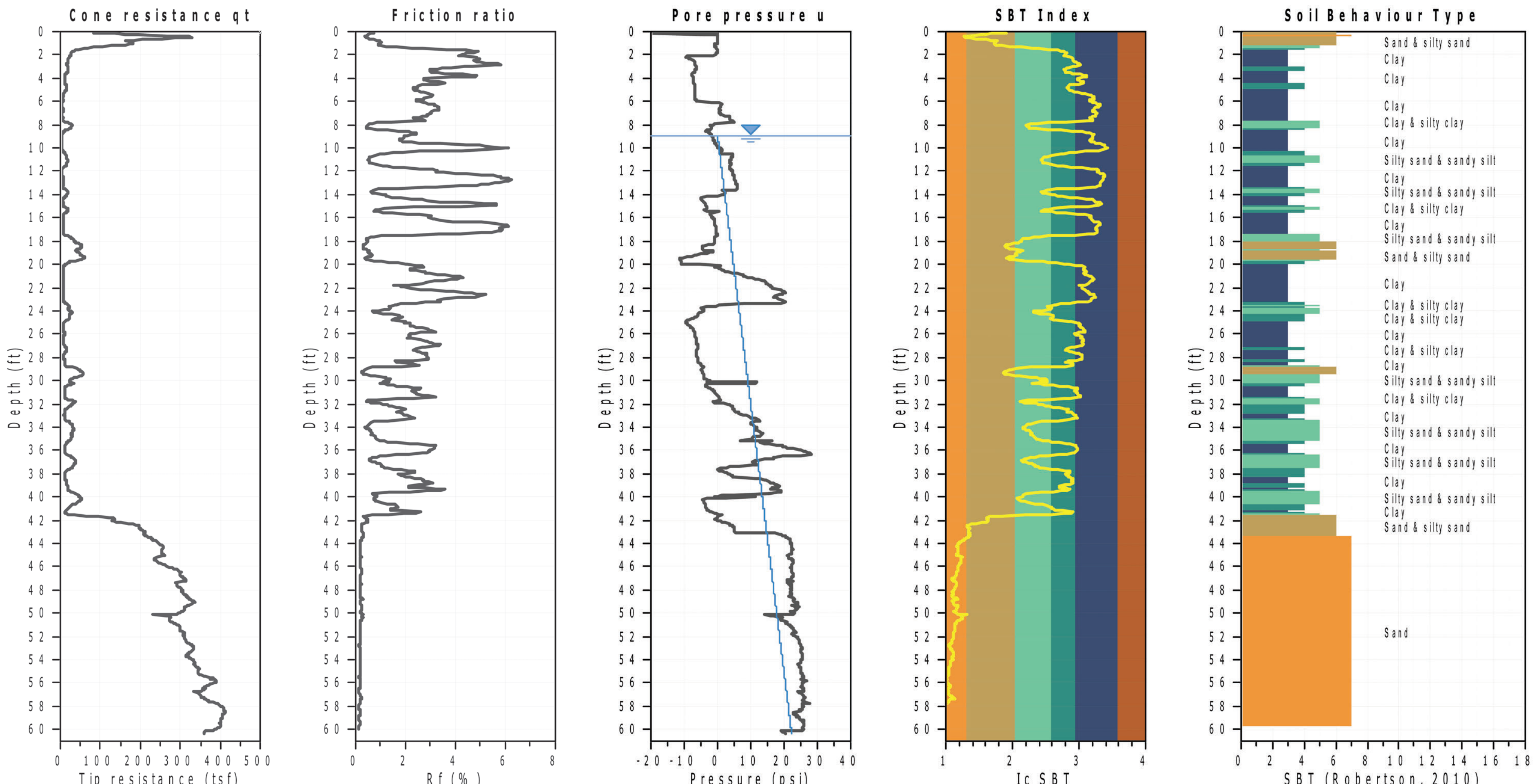

SBT legend

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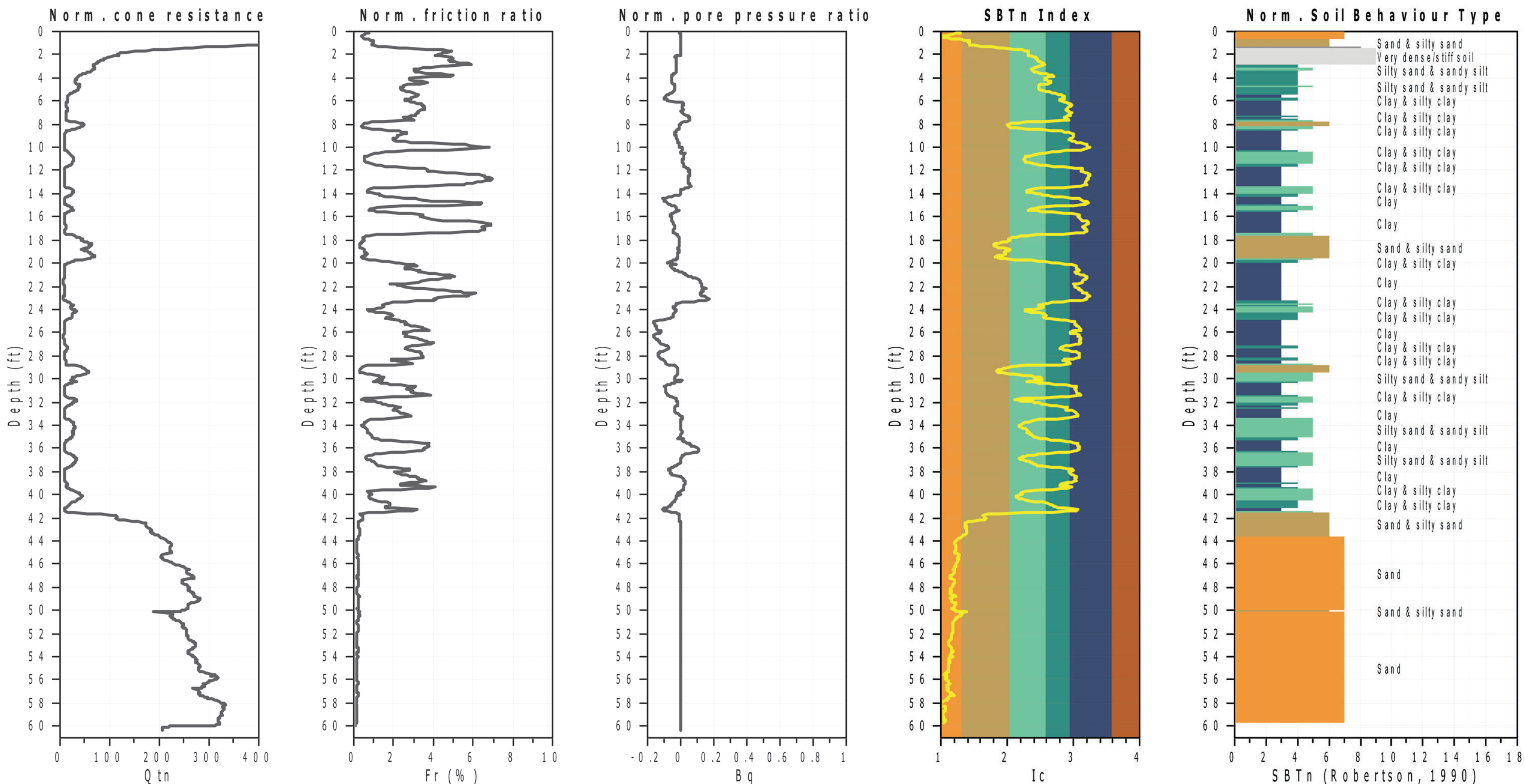

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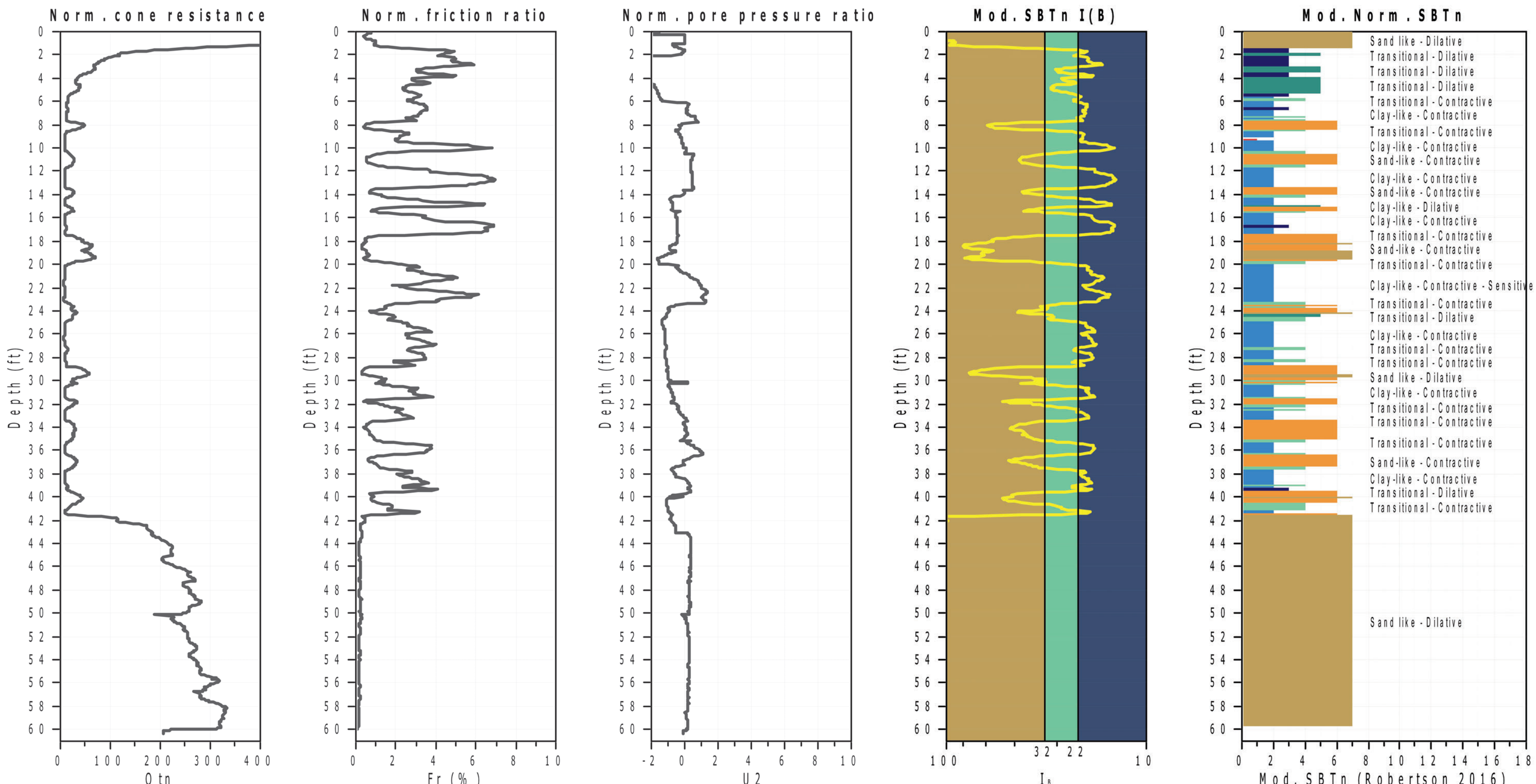

Mod. SBTn legend
1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

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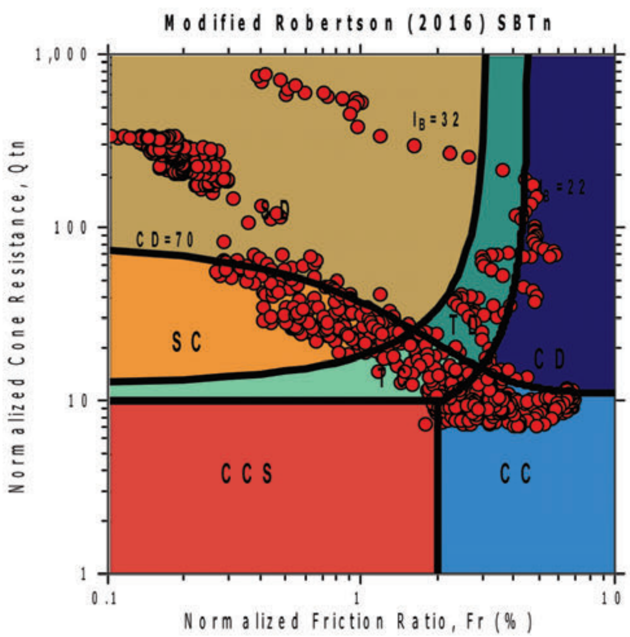
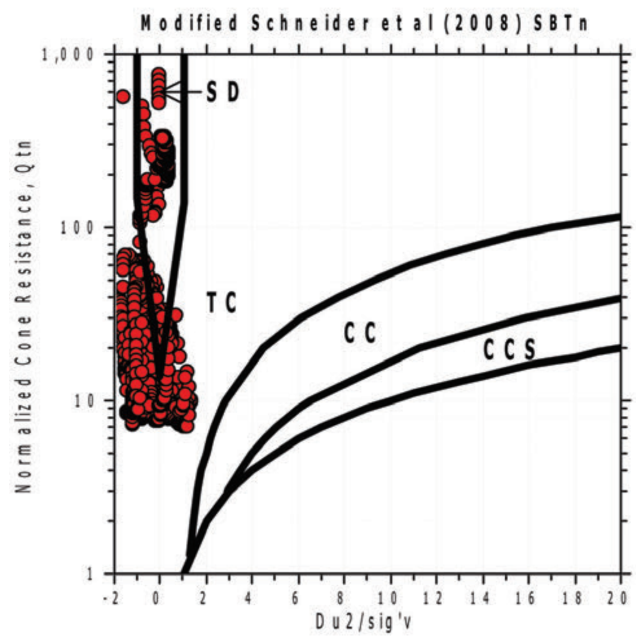
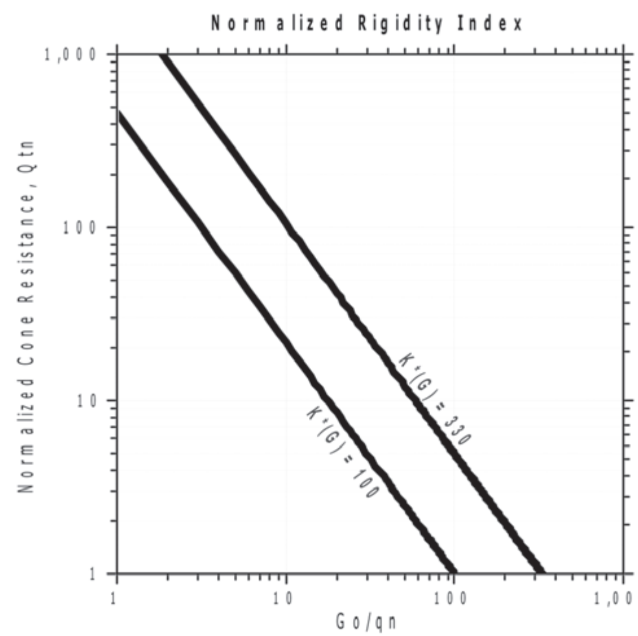
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: 15 cm^2
Cone Operator: Kehoe Testing

Updated SBTn plots







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

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

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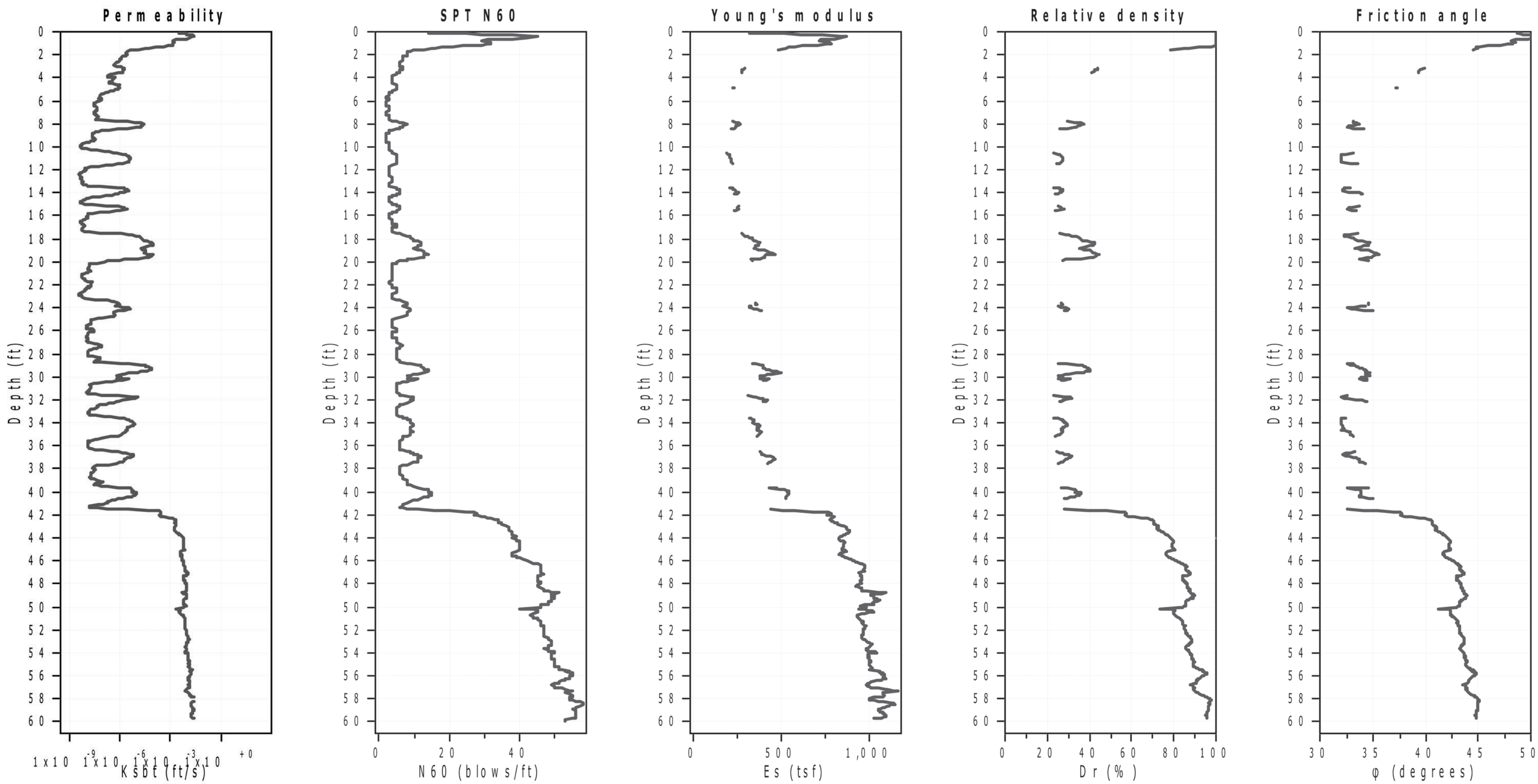
Coords: X:0.00, Y:0.00
Cone Type: 15 cm^2
Cone Operator: Kehoe Testing

Project: **McFadden Sewer lift Station (CC-1610)**
Location: **Dawson Lane & McFadden Ave, Huntington Beach, CA**



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

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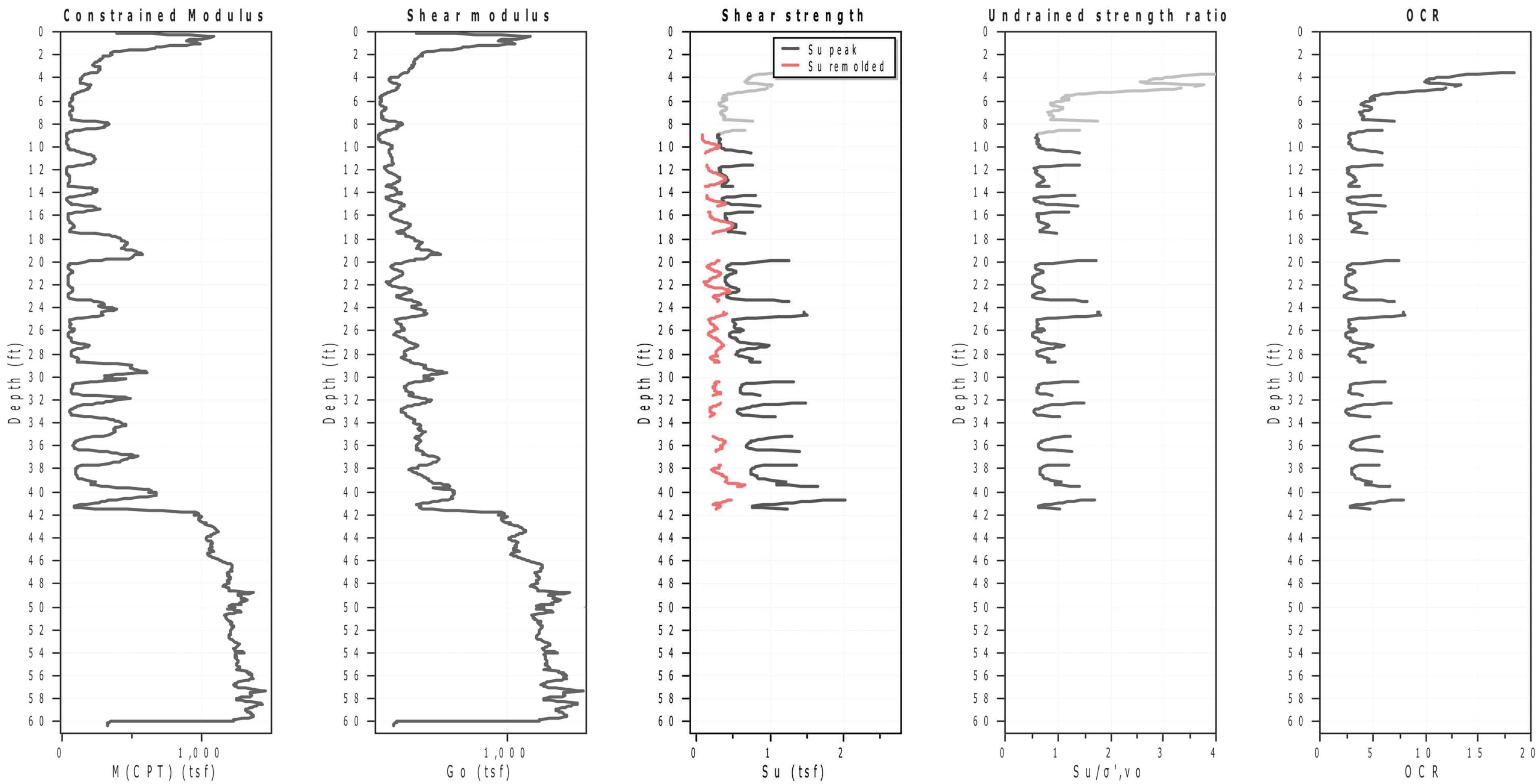
Coords: X:0.00, Y:0.00
Cone Type: 15 cm^2
Cone Operator: Kehoe Testing



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

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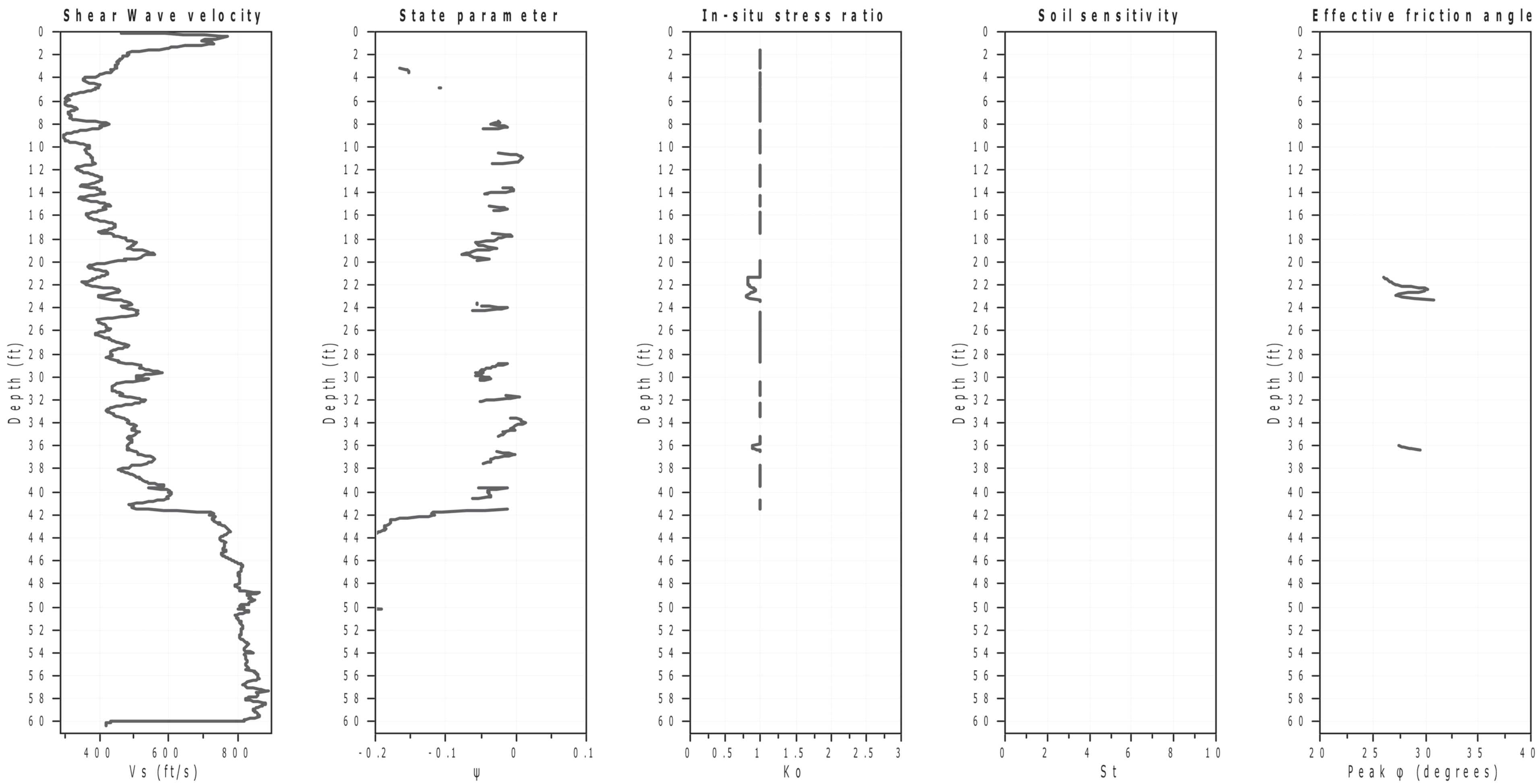
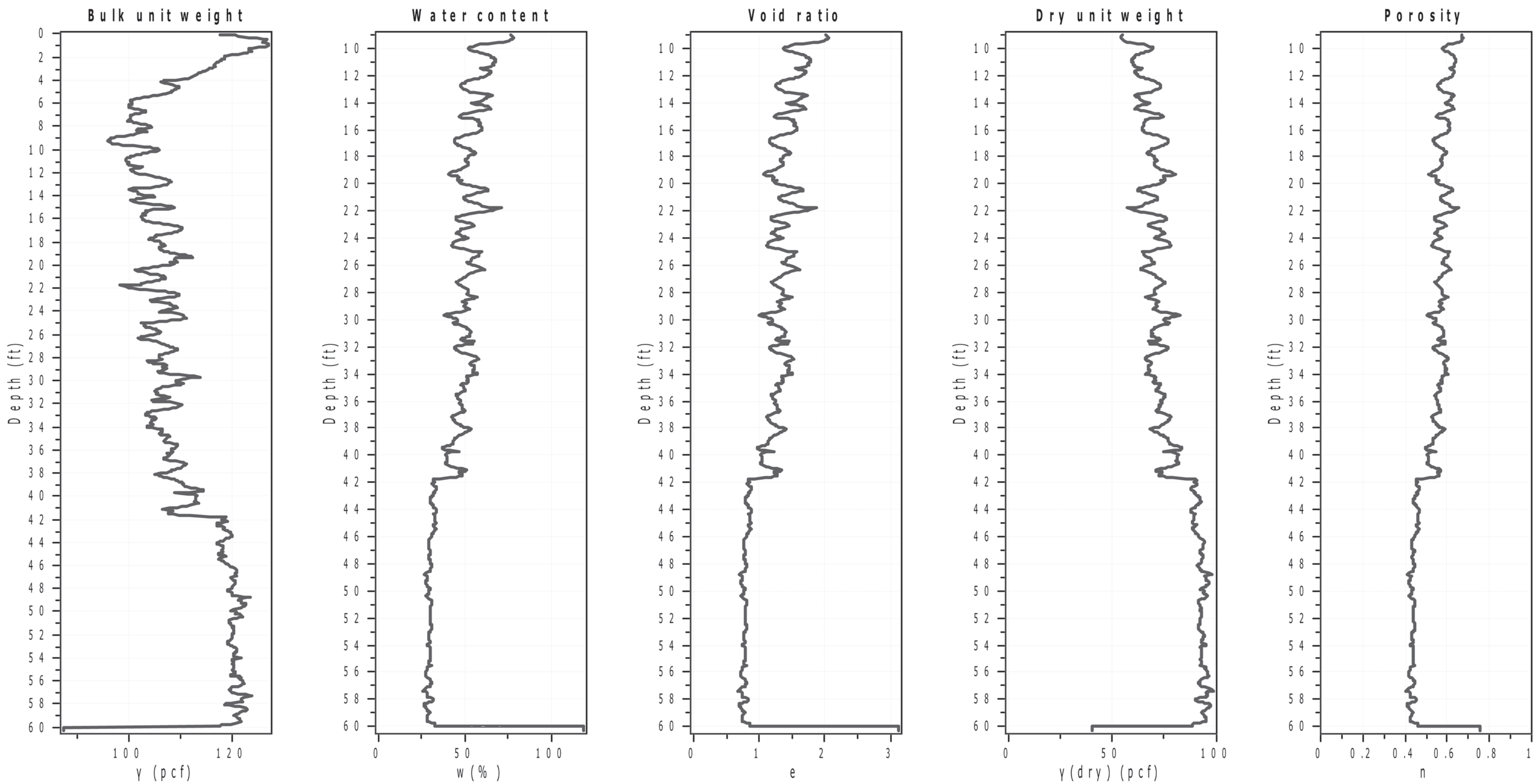
CPT: CPT-2
Total depth: 60.31 ft, Date: 5/17/2024
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: 15 cm^2
Cone Operator: Kehoe Testing

Project: **McFadden Sewer lift Station (CC-1610)**
Location: **Dawson Lane & McFadden Ave, Huntington Beach, CA**



Calculation parameters

Soil Sensitivity factor, N_S: 350.00


Bulk unit weight
Depth (ft)
γ (pcf)
Water content
w (%)
Void ratio
e
Dry unit weight
γ(dry) (pcf)
Porosity
n

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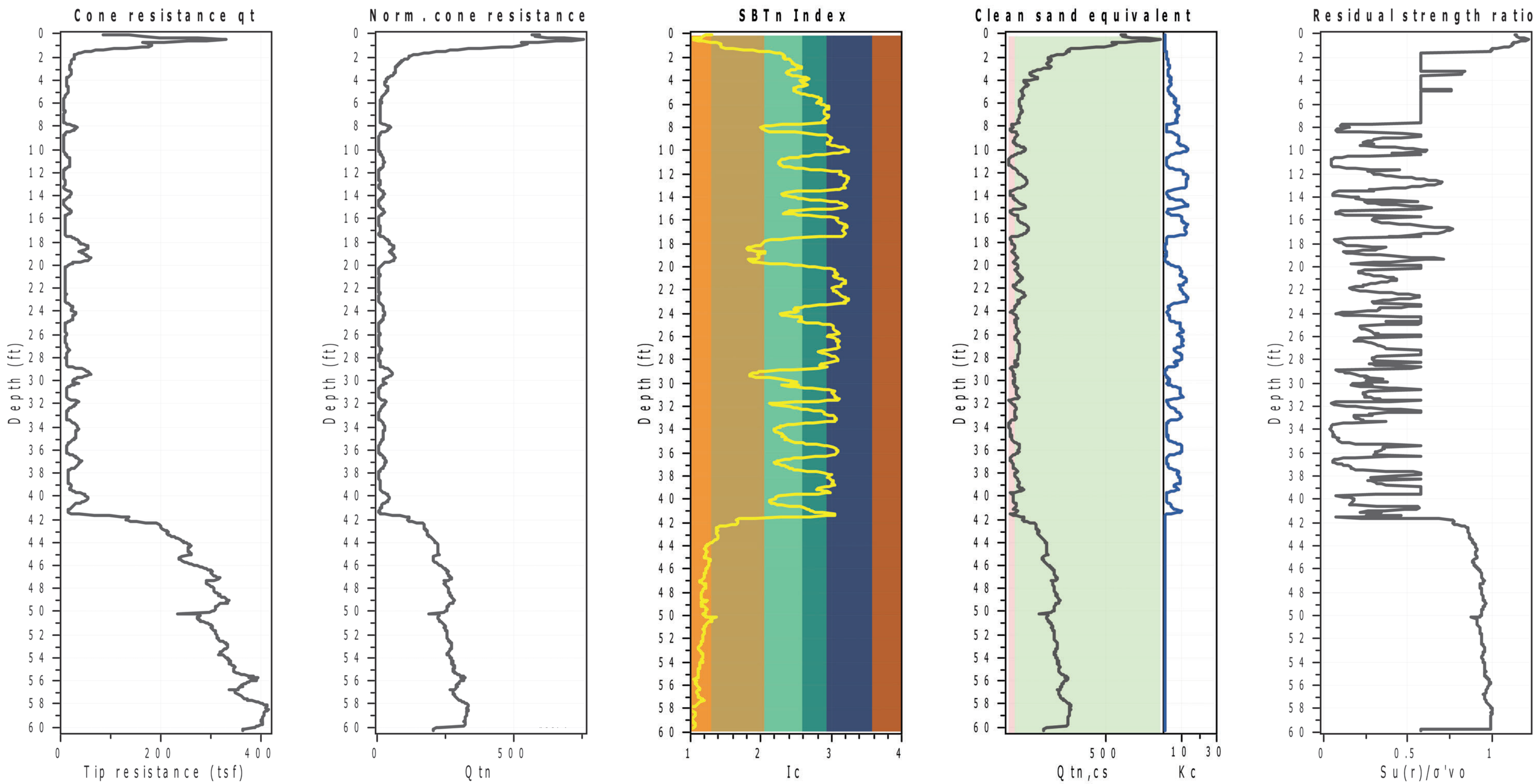
Project: McFadden Sewer lift Station (CC-1610)
Location: Dawson Lane & McFadden Ave, Huntington Beach, CA

CPT: CPT-2
Total depth: 60.31 ft, Date: 5/17/2024
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: 15 cm^2
Cone Operator: Kehoe Testing



Presented below is a list of formulas used for the estimation of various soil properties. The formulas are presented in SI unit system and assume that all components are expressed in the same units.

:: Unit Weight, g (kN/m³) ::

$$g = g_w \cdot \left(0.27 \cdot \log(R_f) + 0.36 \cdot \log(\frac{q_t}{p_a}) + 1.236 \right)$$

where g_w = water unit weight

:: Permeability, k (m/s) ::

$I_c < 3.27$ and $I_c > 1.00$ then $k = 10^{0.952-3.04 \cdot I_c}$

$I_c \leq 4.00$ and $I_c > 3.27$ then $k = 10^{-4.52-1.37 \cdot I_c}$

:: N_{SPT} (blows per 30 cm) ::

$$N_{60} = \left(\frac{q_c}{P_a}\right) \cdot \frac{1}{10^{1.1268-0.2817 \cdot I_c}}$$

$$N_{1(60)} = Q_{tn} \cdot \frac{1}{10^{1.1268-0.2817 \cdot I_c}}$$

:: Young's Modulus, Es (MPa) ::

$$(q_t - \sigma_v) \cdot 0.015 \cdot 10^{0.55 \cdot I_c + 1.68}$$

(applicable only to $I_c < I_{c\_cutoff}$)

:: Relative Density, Dr (%) ::

$$100 \cdot \sqrt{\frac{Q_{tn}}{k_{DR}}}$$

(applicable only to SBT_n: 5, 6, 7 and 8 or $I_c < I_{c\_cutoff}$)

:: State Parameter, ψ ::

$$\psi = 0.56 - 0.33 \cdot \log(Q_{tn,cs})$$

:: Drained Friction Angle, φ (°) ::

(applicable only to SBT_n: 5, 6, 7 and 8 or $I_c < I_{c\_cutoff}$)

:: 1-D constrained modulus, M (MPa) ::

If $I_c > 2.20$
$\alpha = 14$ for $Q_{tn} > 14$
$\alpha = Q_{tn}$ for $Q_{tn} \leq 14$
$M_{CPT} = \alpha \cdot (q_t - \sigma_v)$

If $I_c \geq 2.20$

:: Small strain shear Modulus, Go (MPa) ::

$$G_0 = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \cdot I_c + 1.68}$$

:: Shear Wave Velocity, Vs (m/s) ::

$$V_s = \left(\frac{G_0}{\rho}\right)^{0.50}$$

:: Undrained peak shear strength, Su (kPa) ::

$N_{kt} = 10.50 + 7 \cdot \log(F_r)$ or user defined

$$S_u = \frac{(q_t - \sigma_v)}{N_{kt}}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Remolded undrained shear strength, Su(rem) (kPa) ::

$S_{u(rem)} = f_s$ (applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Overconsolidation Ratio, OCR ::

$$k_{OCR} = \left[\frac{Q_{tn}^{0.20}}{0.25 \cdot (10.50 \cdot +7 \cdot \log(F_r))}\right]^{1.25}$$ or user defined

$$OCR = k_{OCR} \cdot Q_{tn}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: In situ Stress Ratio, Ko ::

$$K_O = (1 - \sin\varphi') \cdot OCR^{\sin\varphi'}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Soil Sensitivity, S_t ::

$$S_t = \frac{N_S}{F_r}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Peak Friction Angle, φ' (°) ::

$$\varphi' = 29.5° \cdot B_q^{0.121} \cdot (0.256 + 0.336 \cdot B_q + \log Q_t)$$

(applicable for $0.10 < B_q < 1.00$)

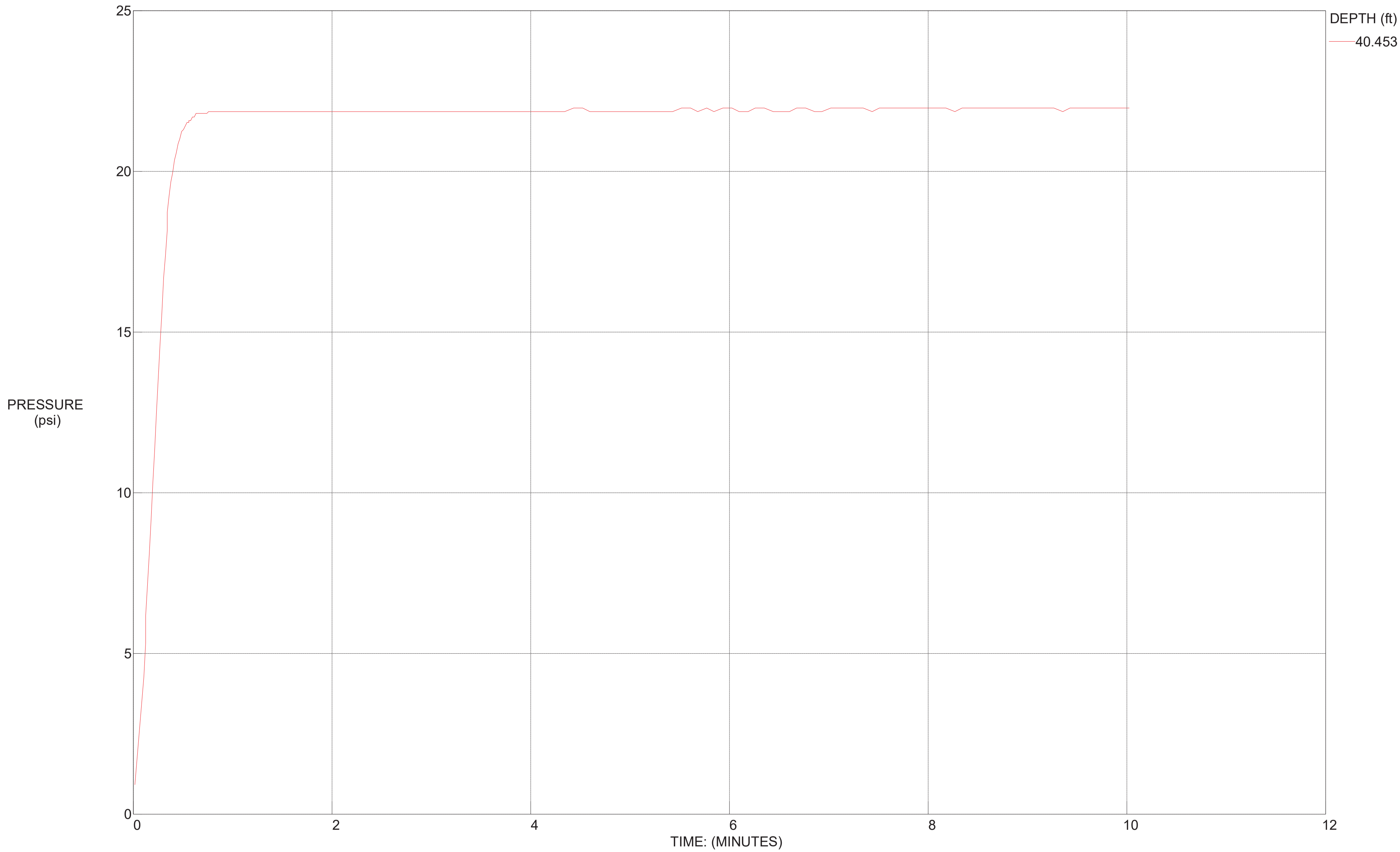
References

• Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012

• Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

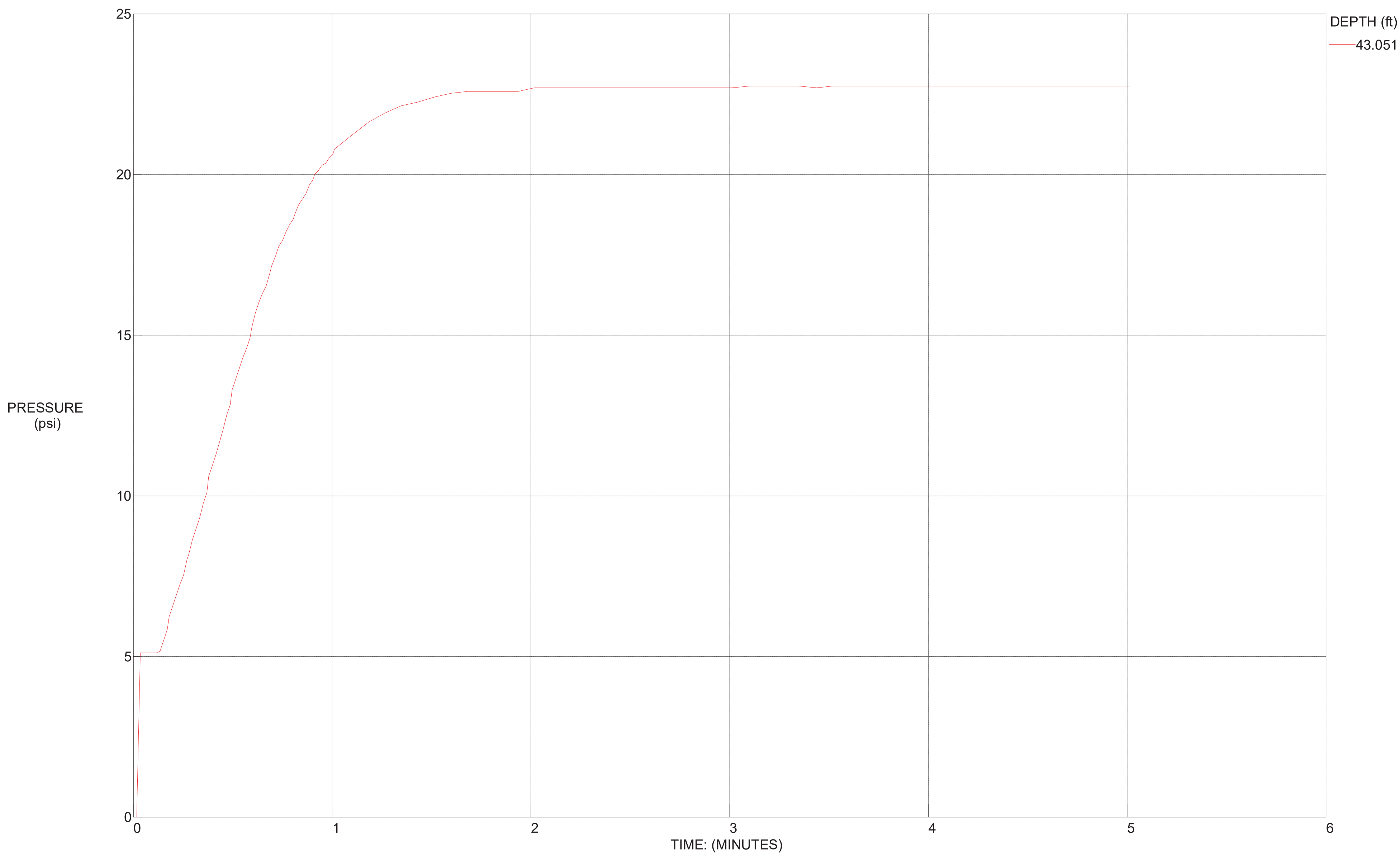
• N Barounis, J Philpot, Estimation of in-situ water content, void ratio, dry unit weight and porosity using CPT for saturated sands, Proc. 20th NZGS Geotechnical Symposium

TEST ID: CPT-1



PRESSURE
(psi)
25
20
15
10
5
0
0
2
4
6
8
10
12
TIME: (MINUTES)
DEPTH (ft)
40.453

TEST ID: CPT-2



PRESSURE
(psi)
25
20
15
10
5
0
0
1
2
3
4
5
6
TIME: (MINUTES)
DEPTH (ft)
43.051

APPENDIX
CPT LIQUEFACTION ANALYSIS

TABLE OF CONTENTS

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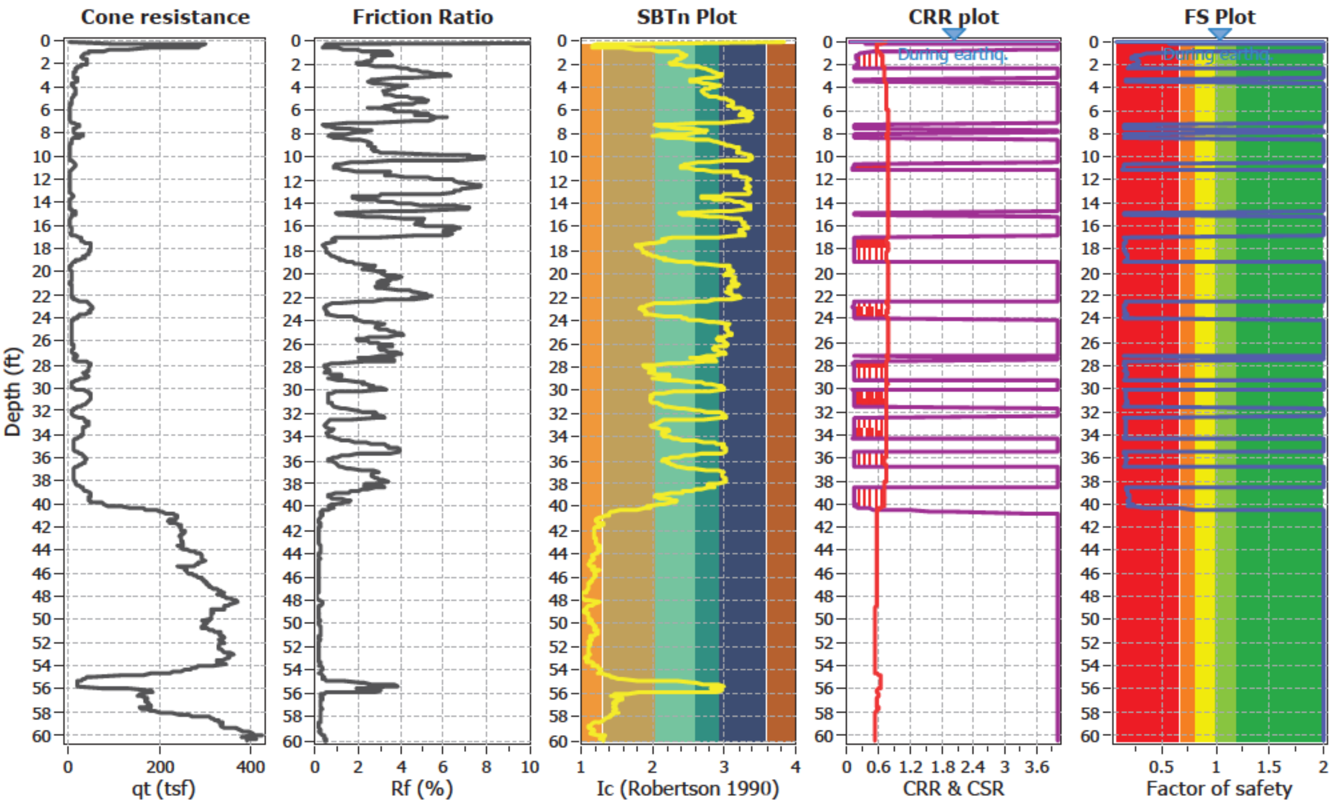
LIQUEFACTION ANALYSIS REPORT

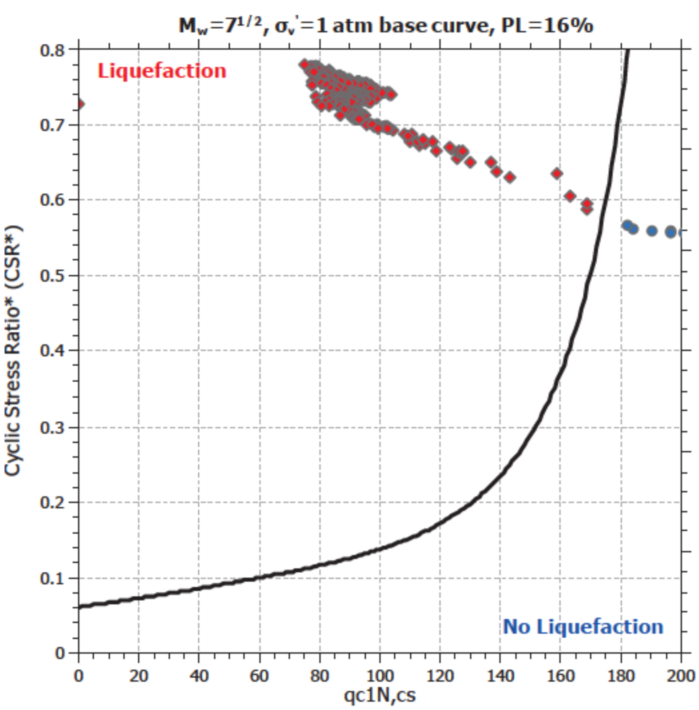
Project title : McFadden Sewer lift Station (CC-1610) **Location : Dawson Lane & McFadden Ave, Huntington Beach, CA**

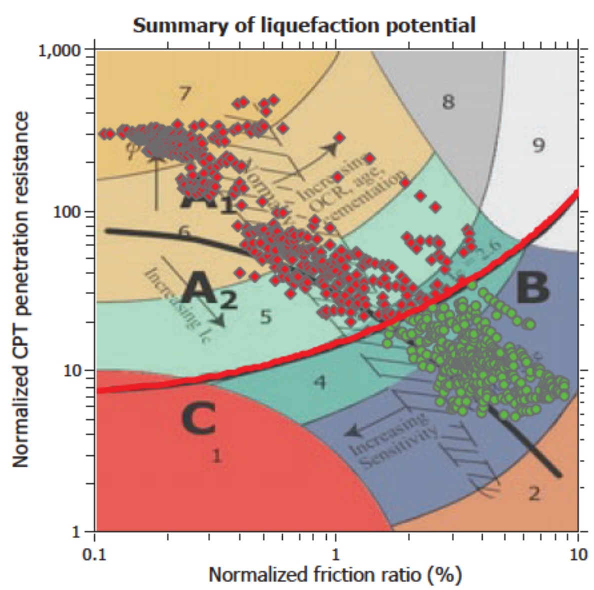
CPT file : CPT-1

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.00 ft	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	50.00 ft
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.61	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

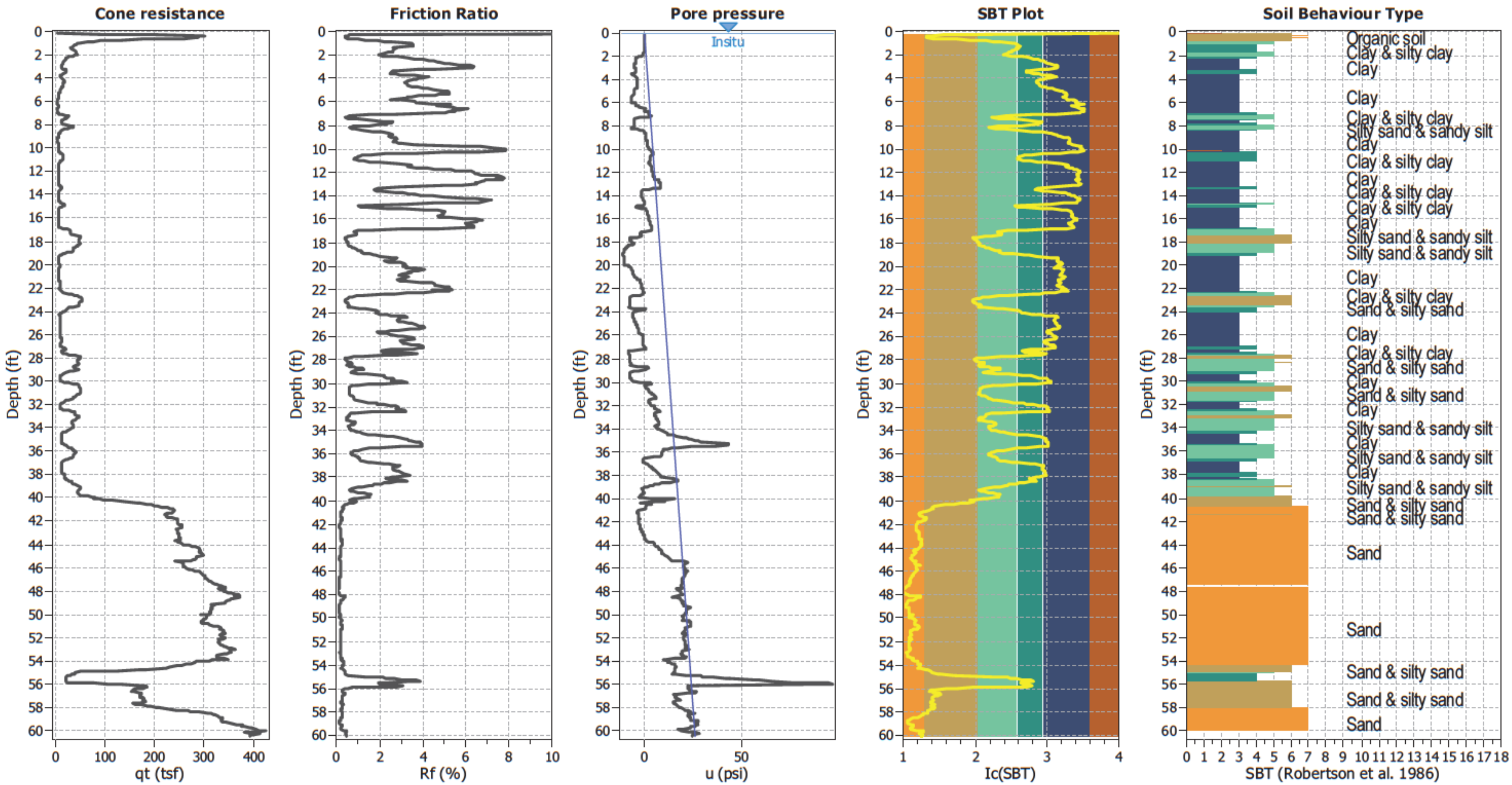






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



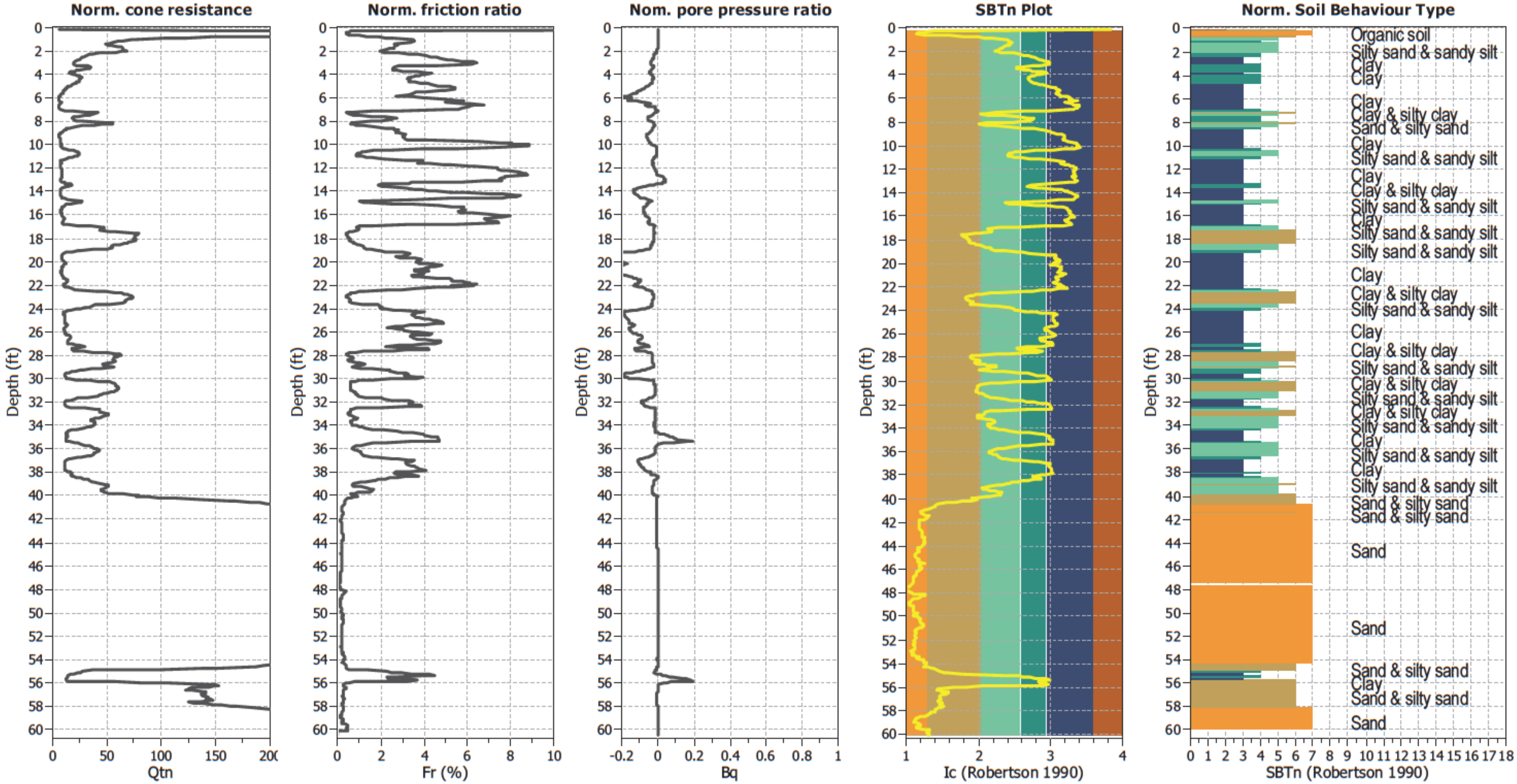
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	1	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_o applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.61	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	0.00 ft	Fill height:	N/A	Limit depth:	50.00 ft

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)



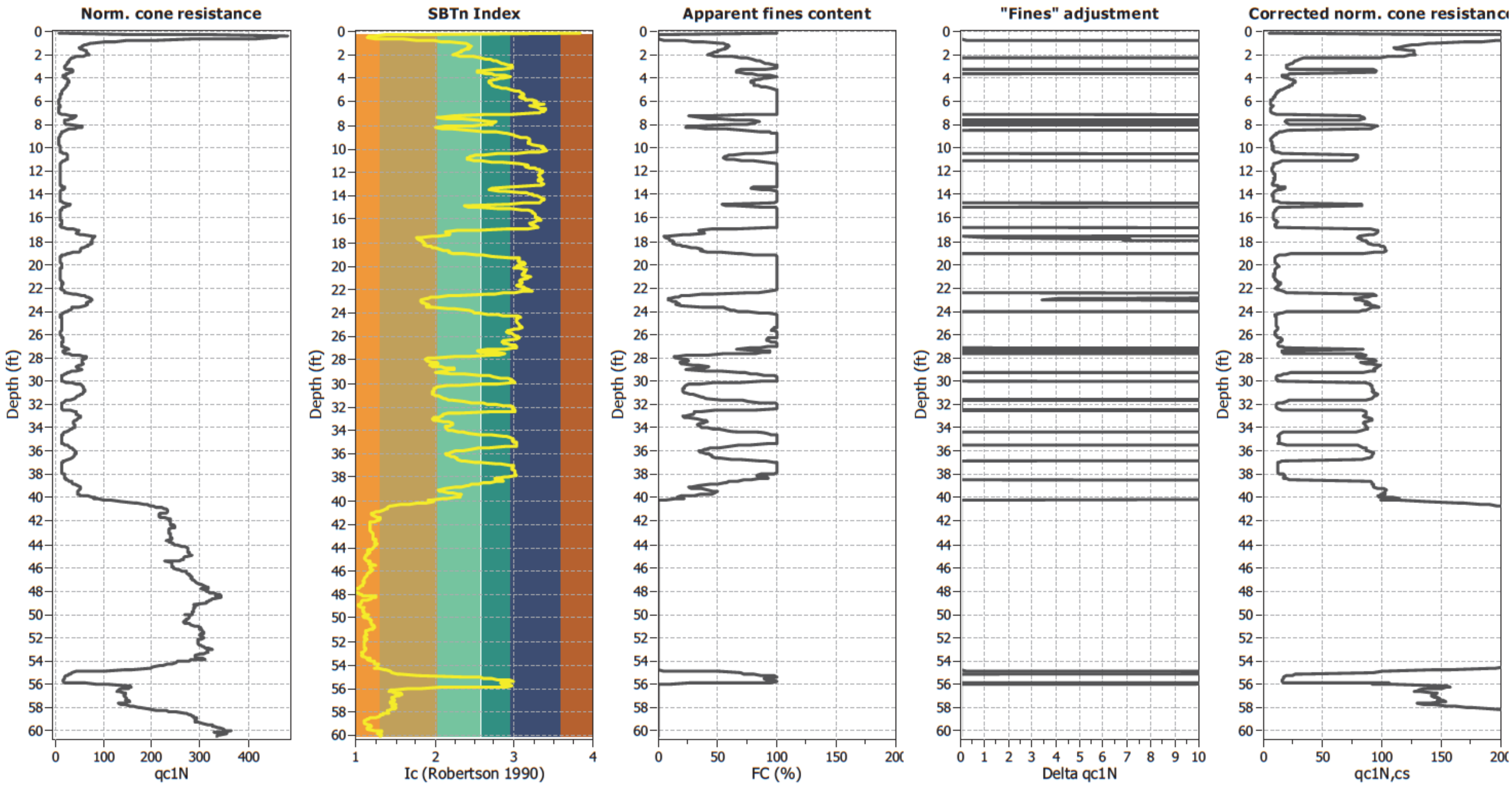
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	1	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_{σ} applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.61	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	0.00 ft	Fill height:	N/A	Limit depth:	50.00 ft

SBTn legend

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

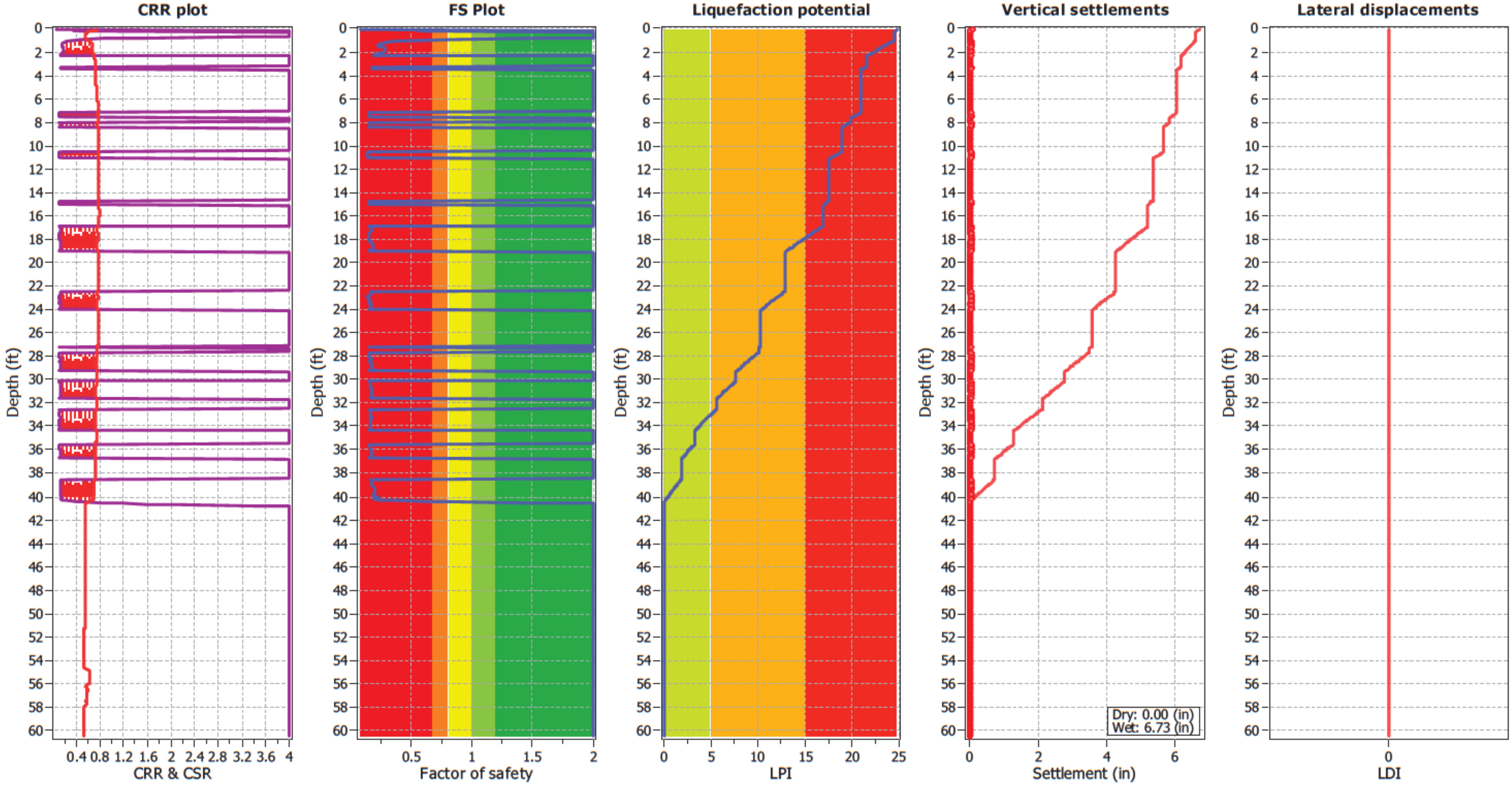
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	1	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.61	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	0.00 ft	Fill height:	N/A	Limit depth:	50.00 ft

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	1	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.61	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	0.00 ft	Fill height:	N/A	Limit depth:	50.00 ft

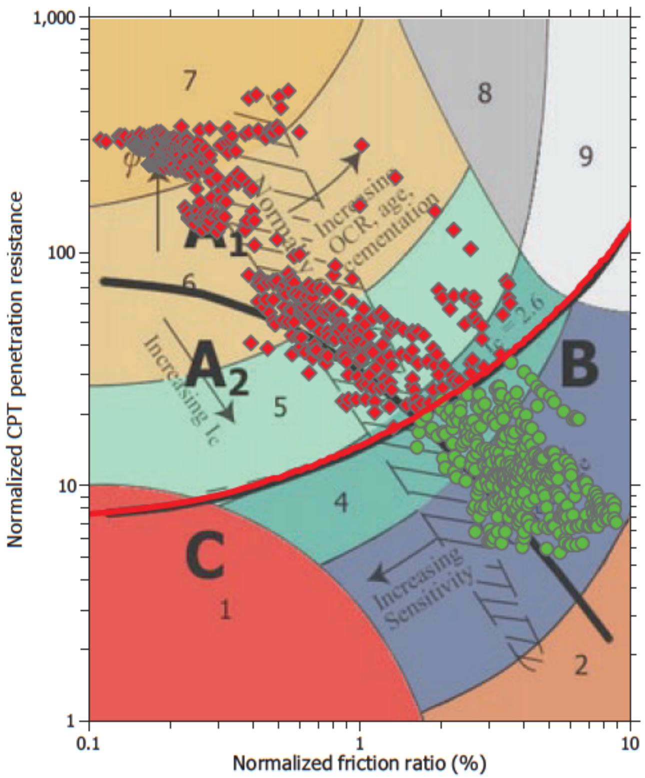
F.S. color scheme

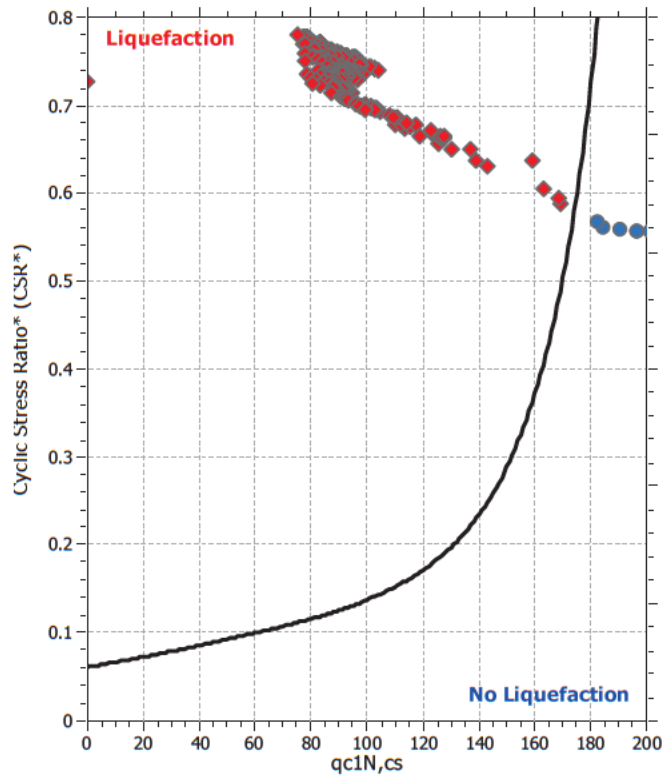
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

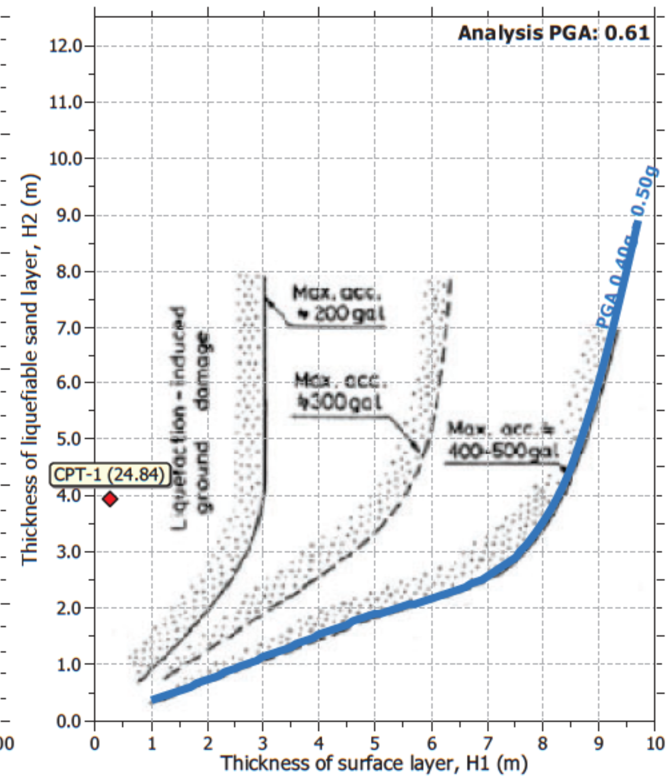
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



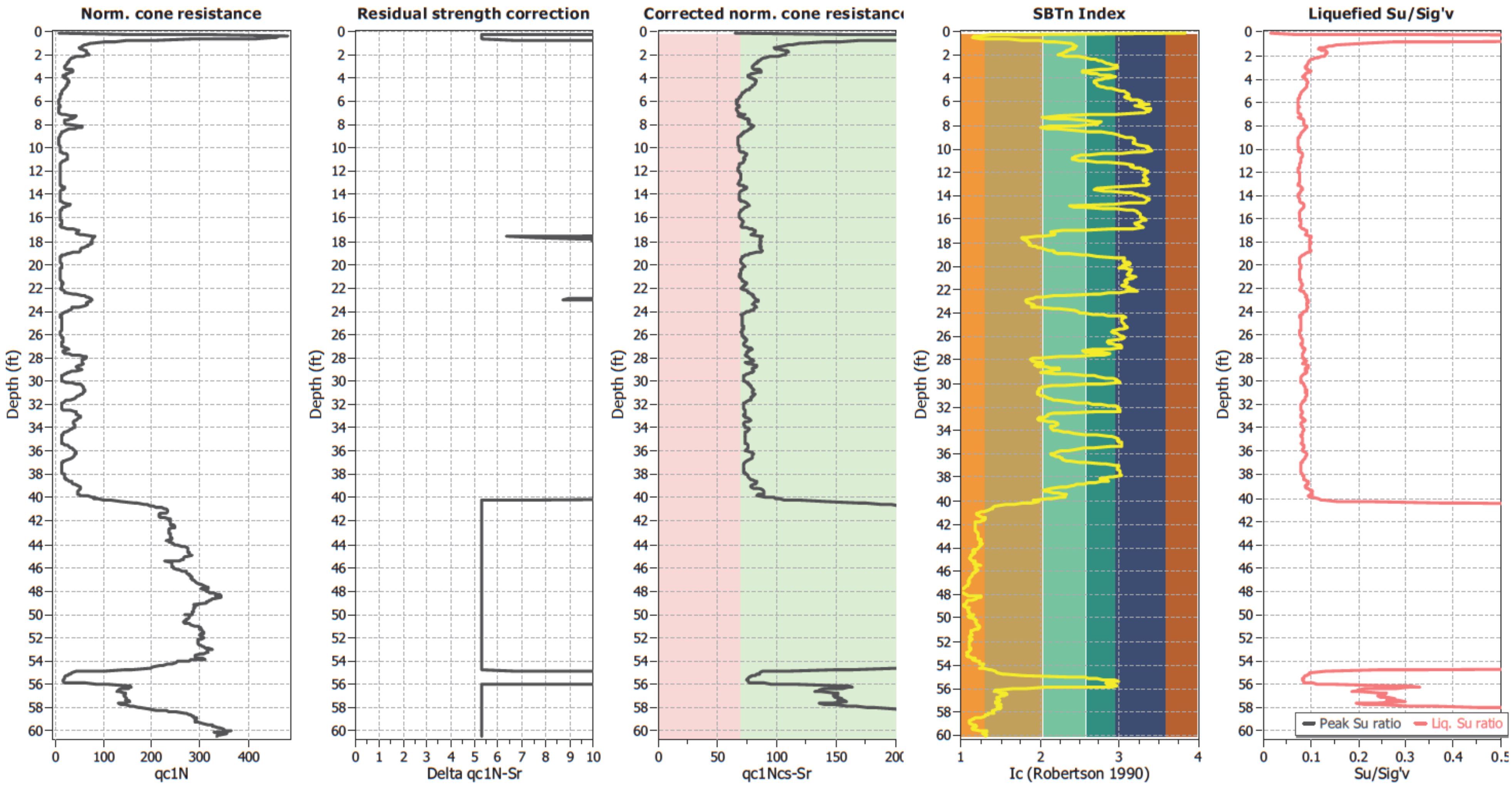




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	1	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_{σ} applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.61	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	0.00 ft	Fill height:	N/A	Limit depth:	50.00 ft

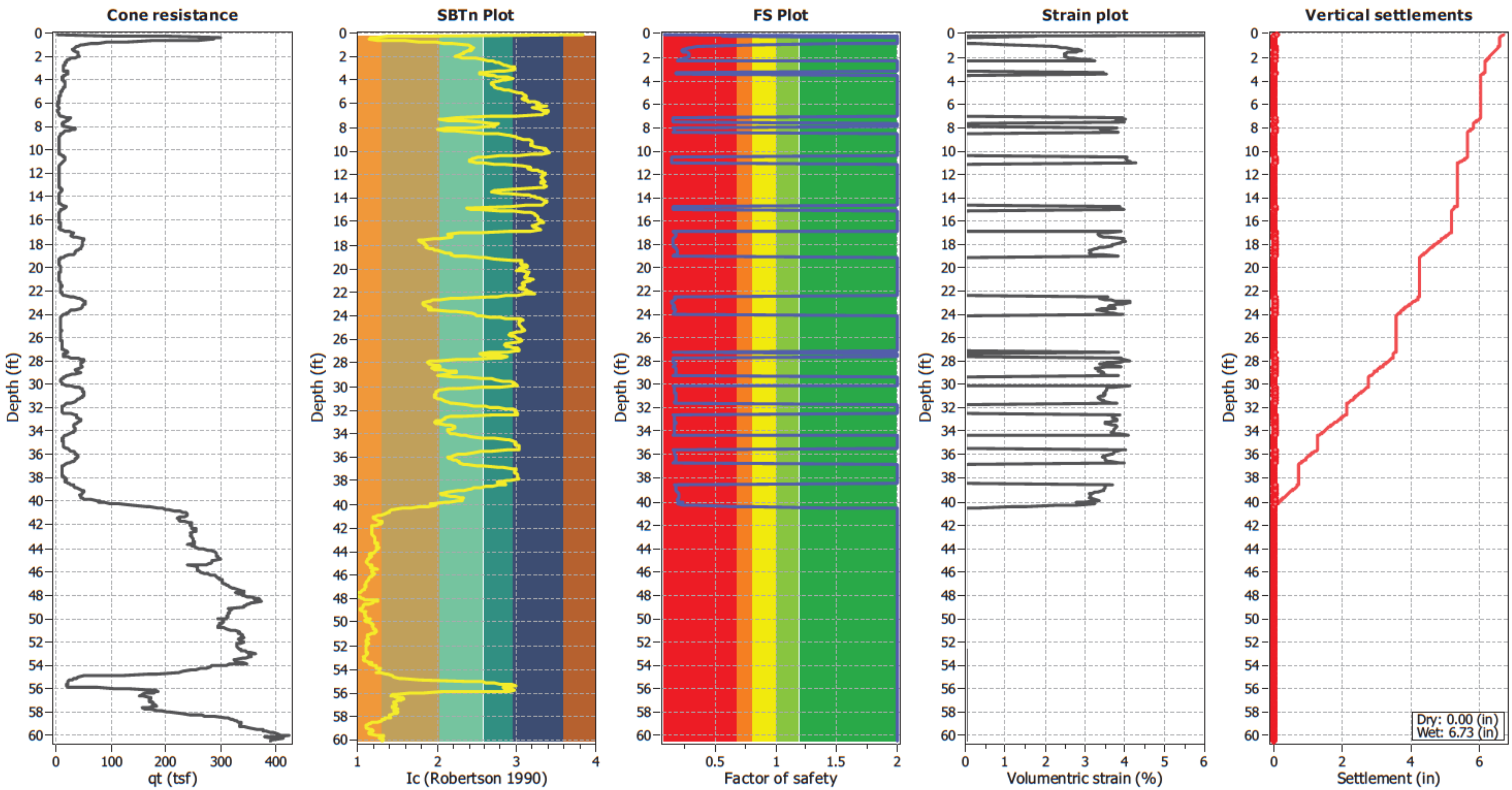
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	1	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.61	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	0.00 ft	Fill height:	N/A	Limit depth:	50.00 ft

Estimation of post-earthquake settlements



Abbreviations

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

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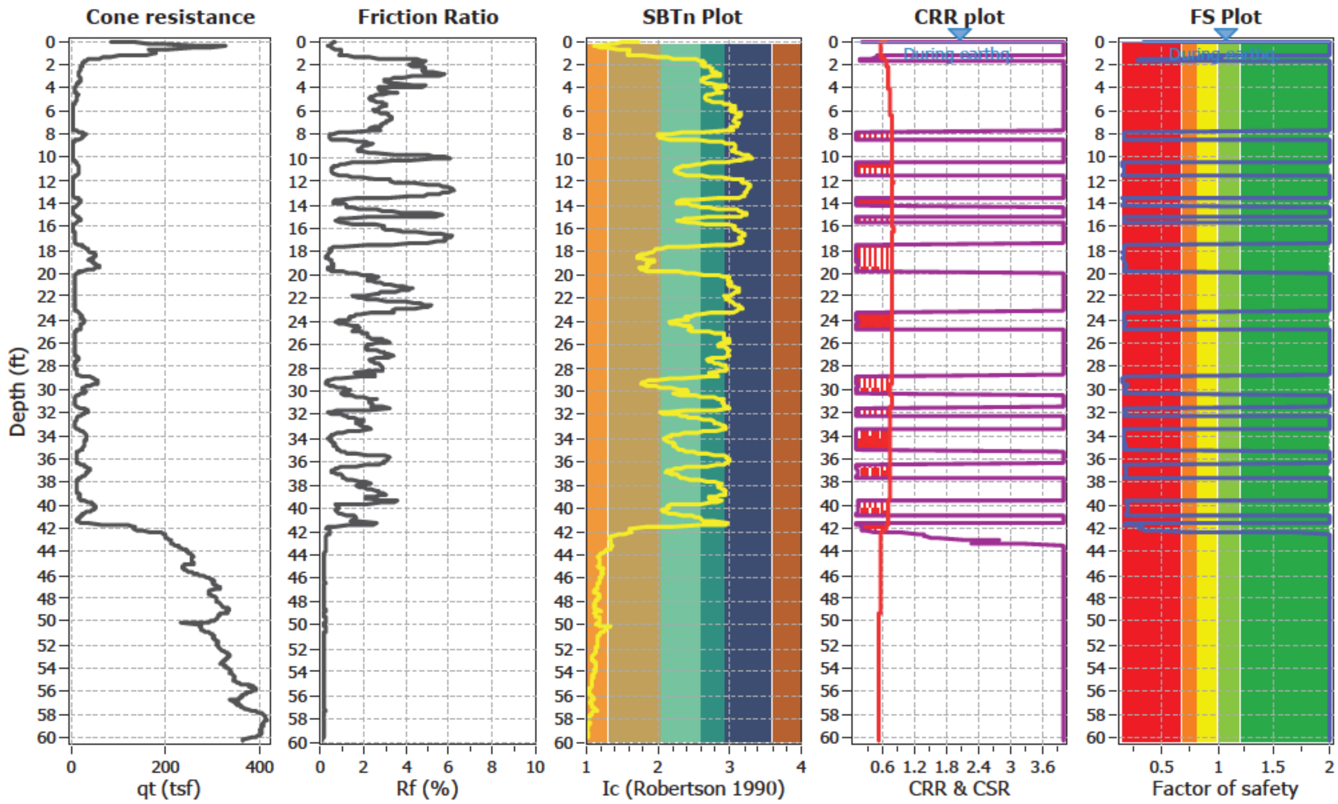
LIQUEFACTION ANALYSIS REPORT

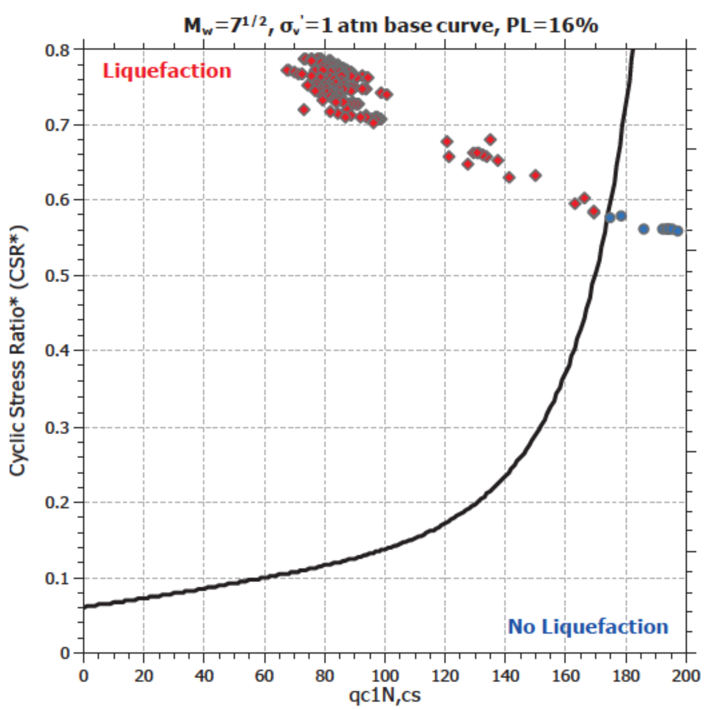
Project title : McFadden Sewer lift Station (CC-1610) **Location : Dawson Lane & McFadden Ave, Huntington Beach, CA**

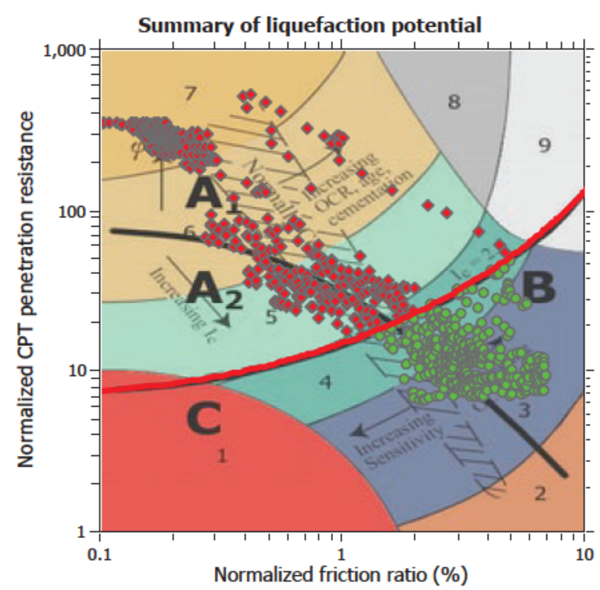
CPT file : CPT-2

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.00 ft	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	50.00 ft
Peak ground acceleration:	0.61	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

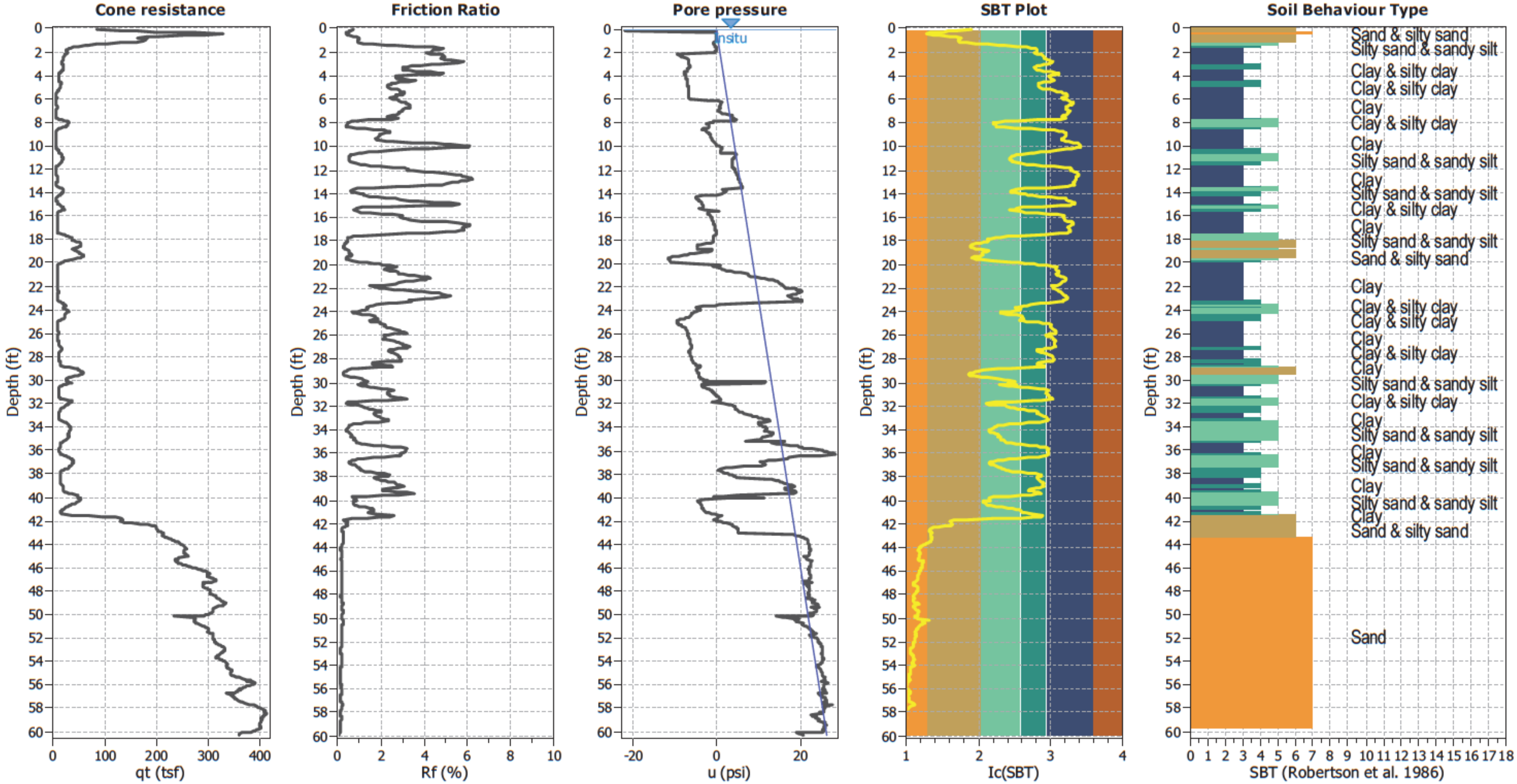






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



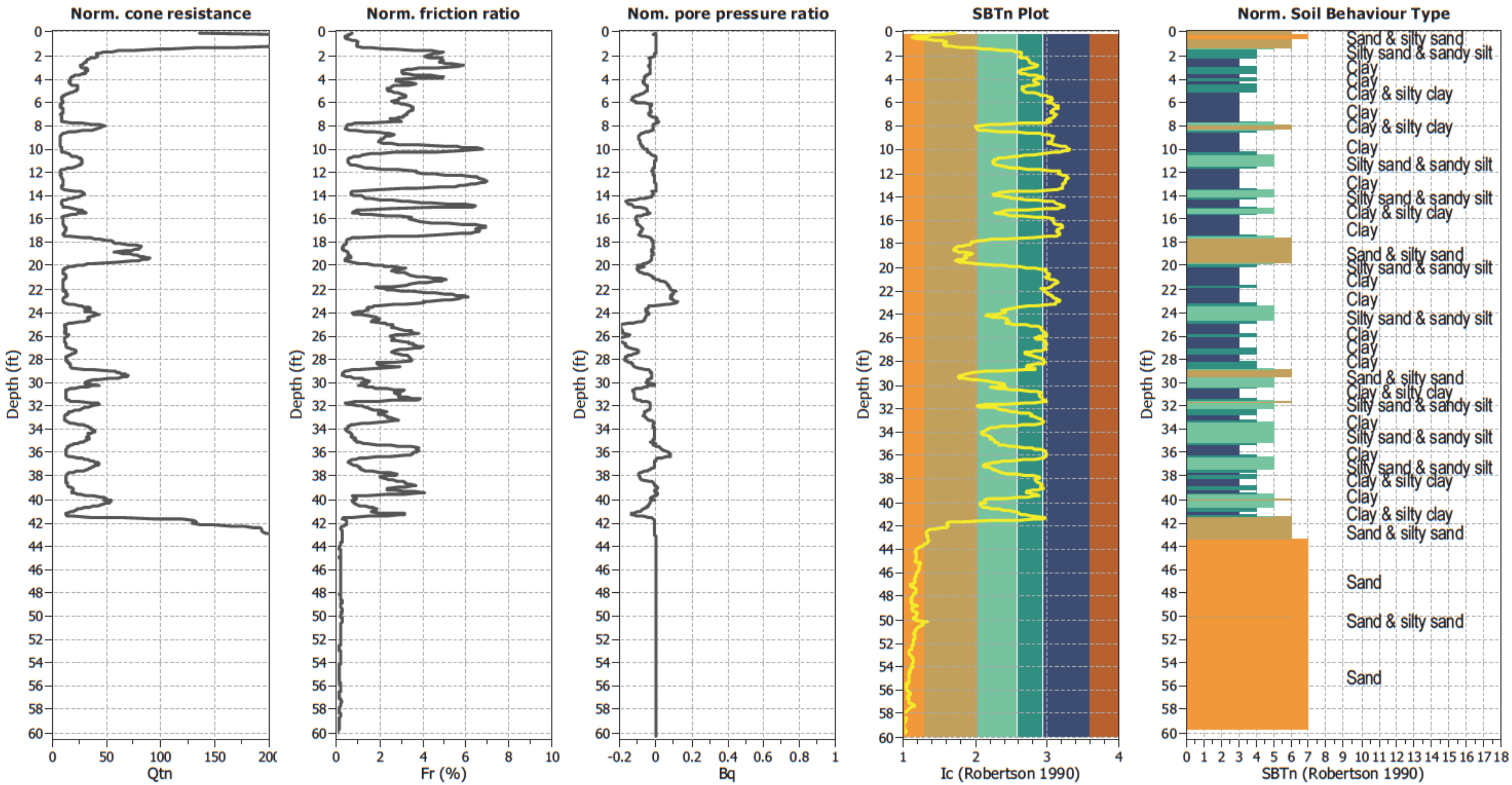
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	1	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.61	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	0.00 ft	Fill height:	N/A	Limit depth:	50.00 ft

SBT legend

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

CPT basic interpretation plots (normalized)



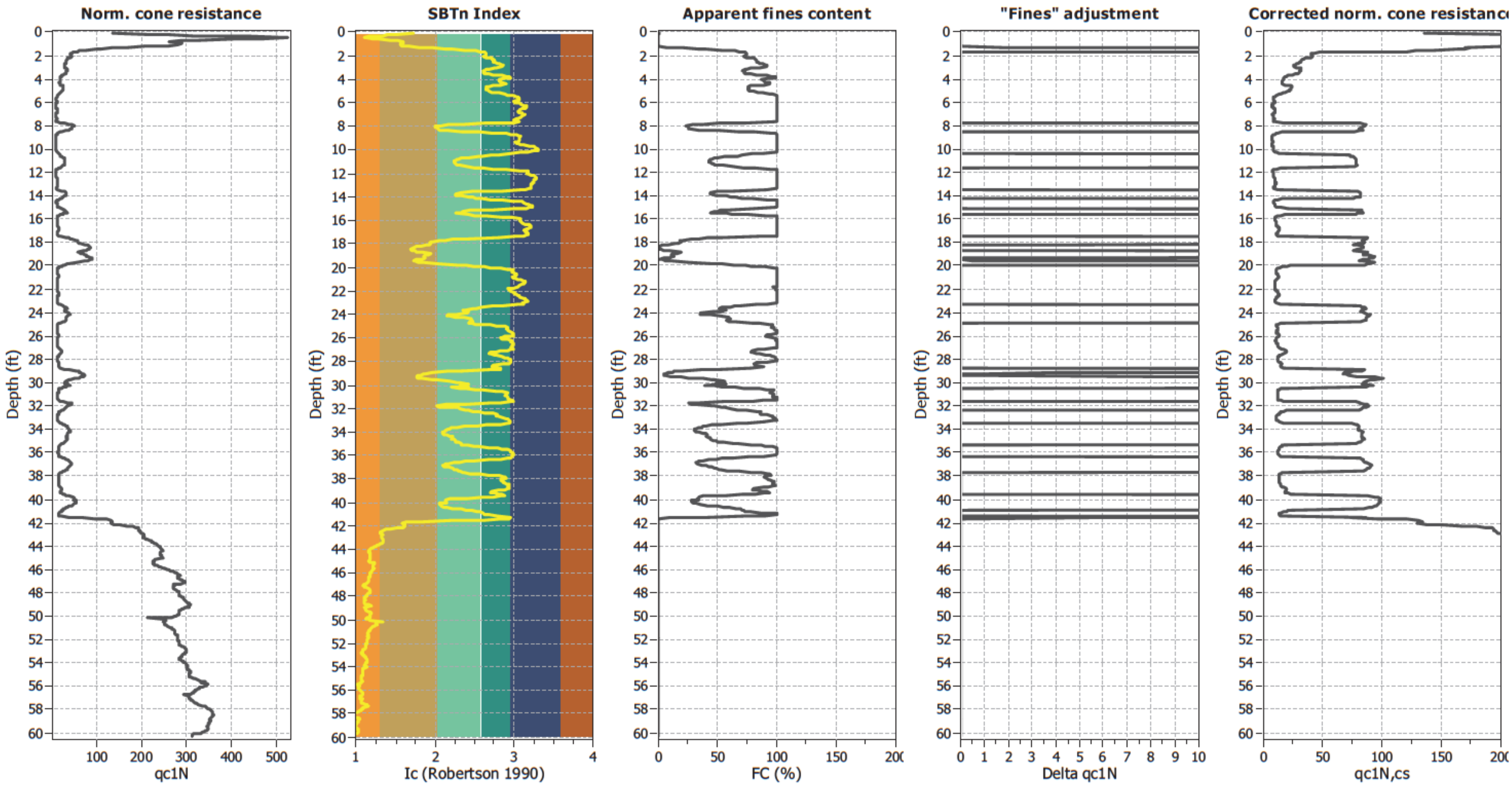
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	1	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.61	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	0.00 ft	Fill height:	N/A	Limit depth:	50.00 ft

SBTn legend

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

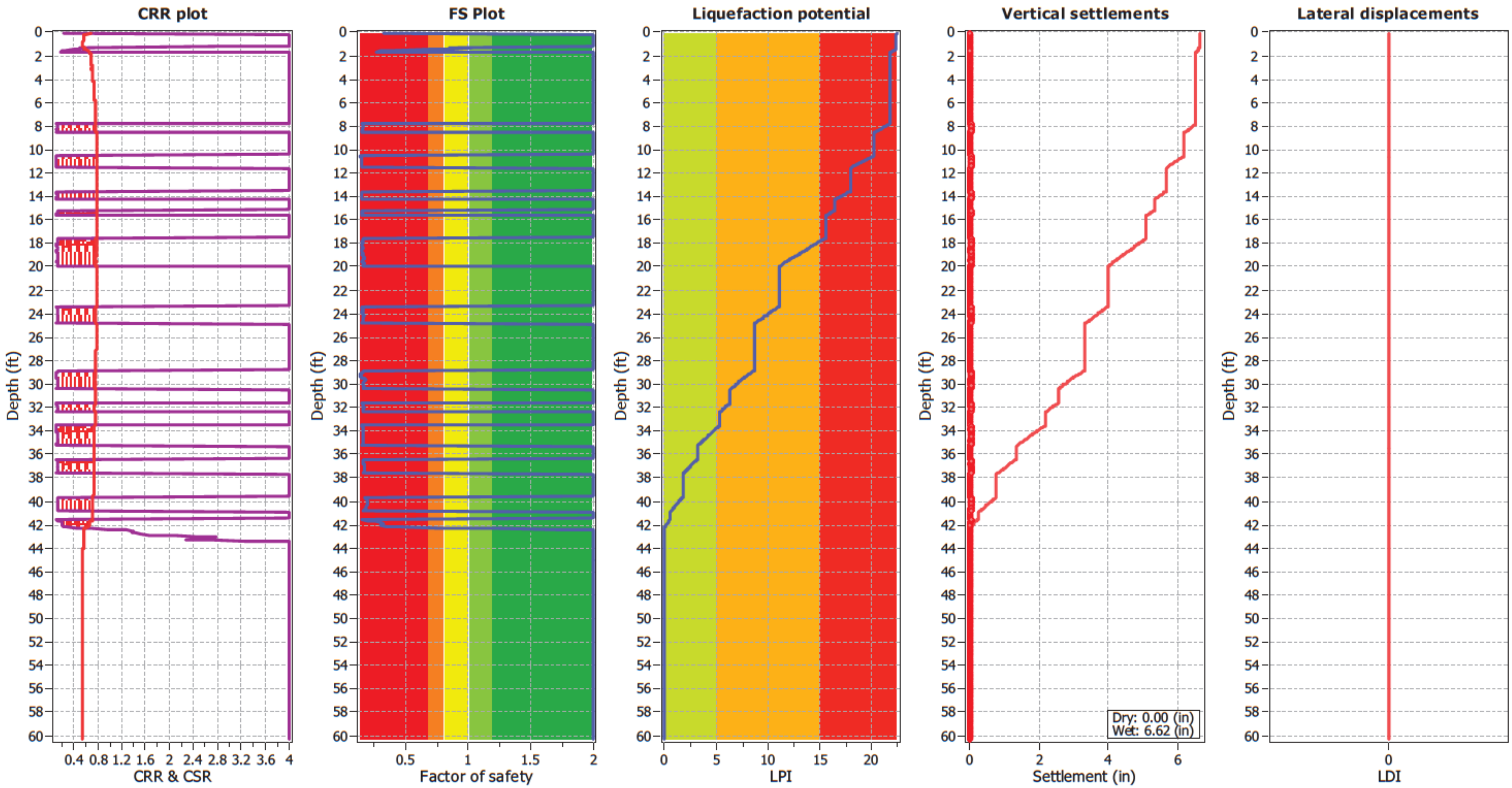
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	1	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.61	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	0.00 ft	Fill height:	N/A	Limit depth:	50.00 ft

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	1	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.61	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	0.00 ft	Fill height:	N/A	Limit depth:	50.00 ft

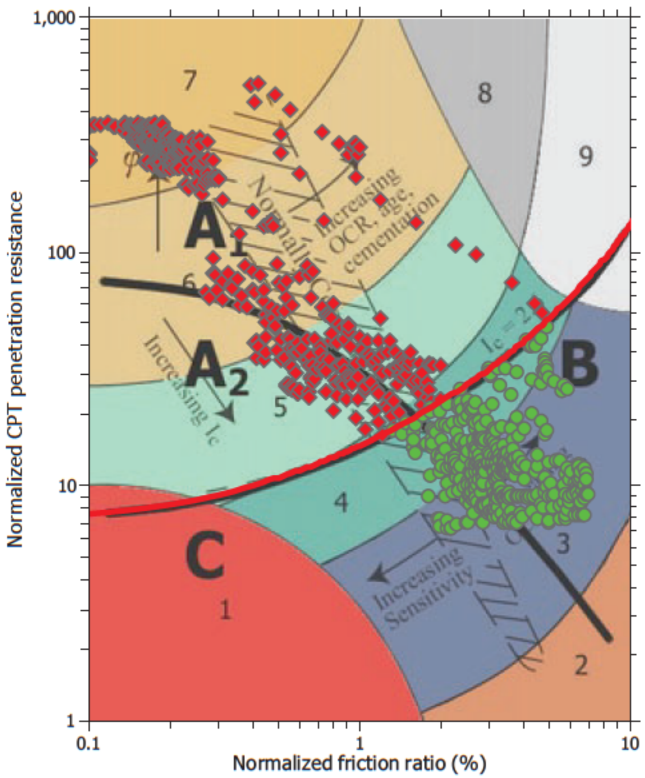
F.S. color scheme

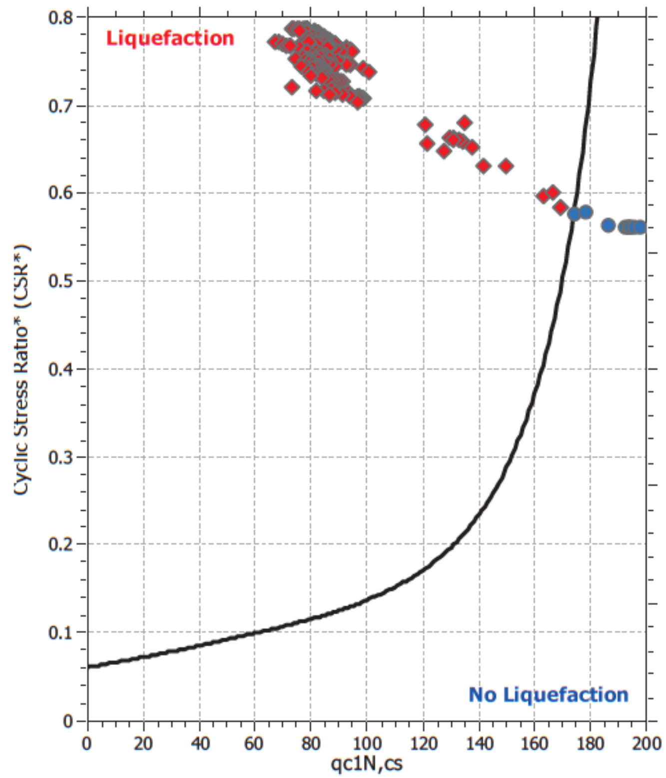
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

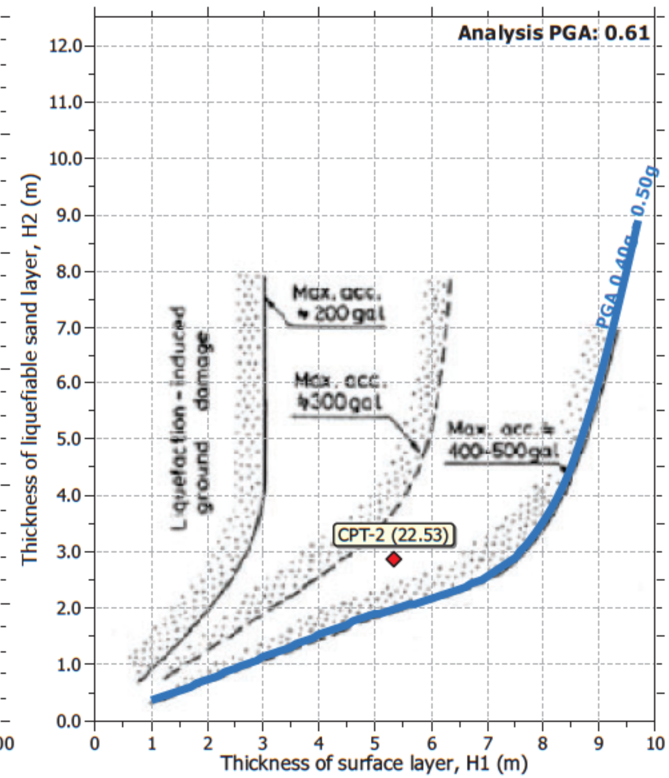
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



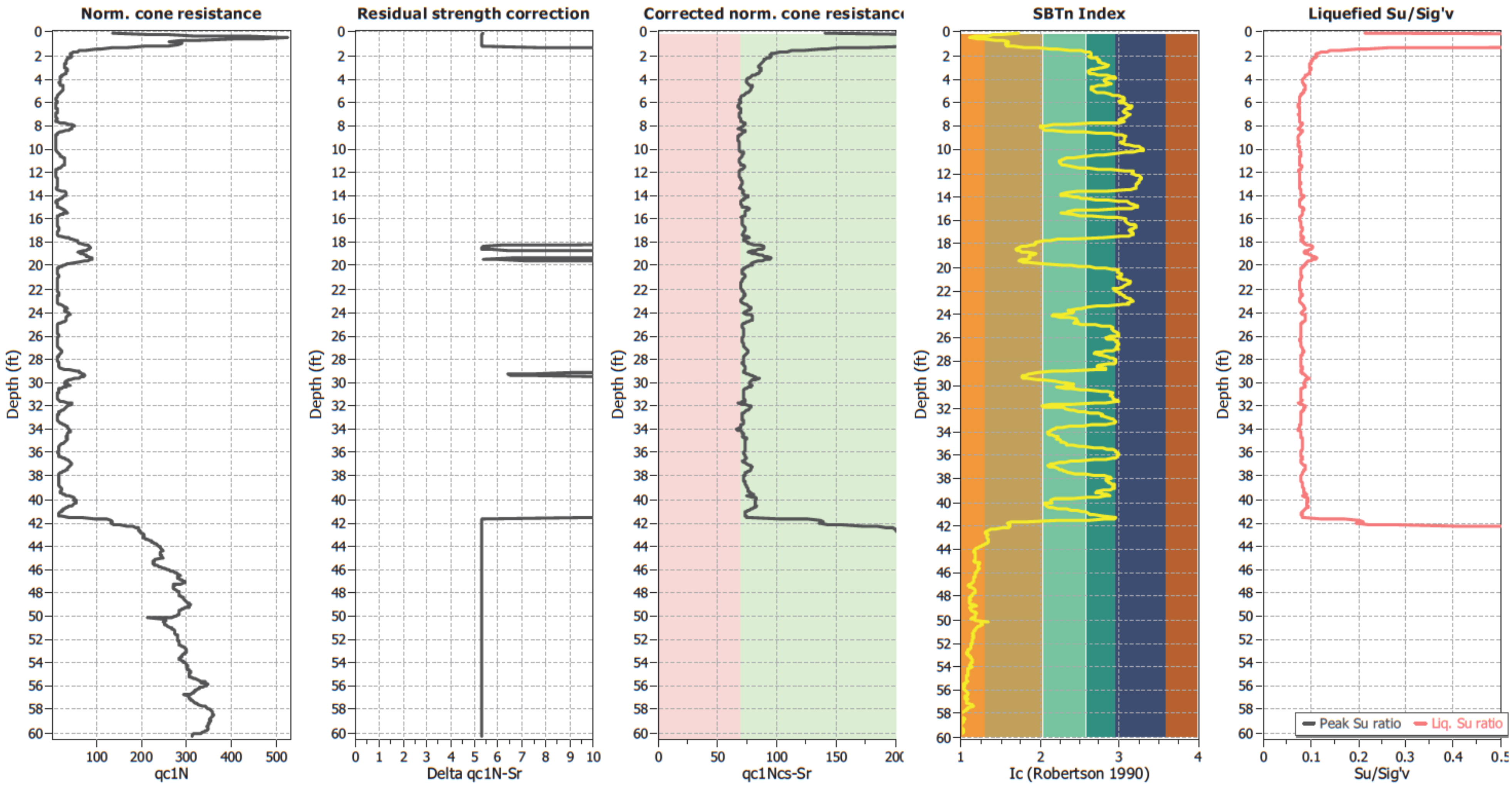




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	1	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_{σ} applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.61	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	0.00 ft	Fill height:	N/A	Limit depth:	50.00 ft

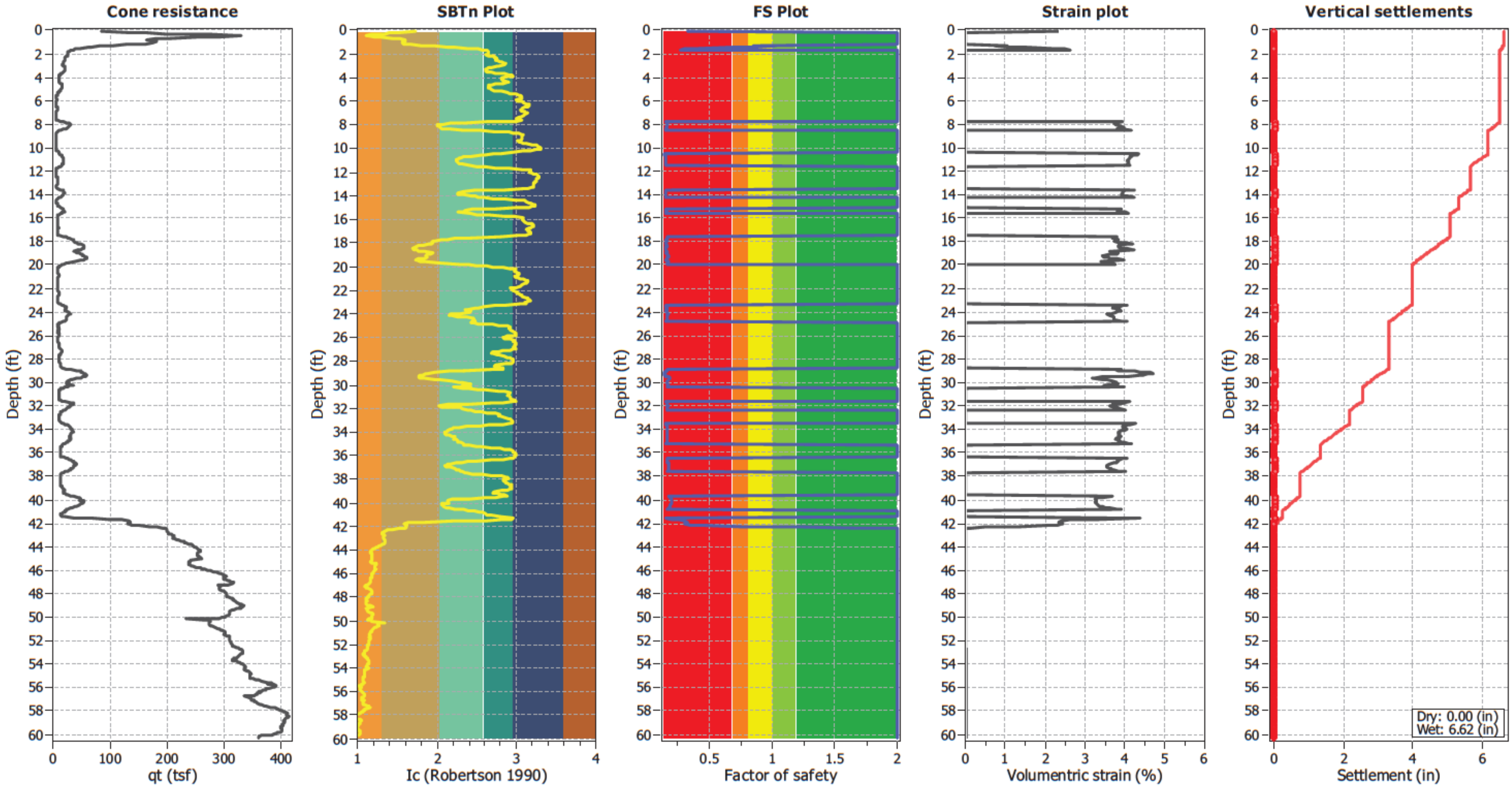
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	1	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.61	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	0.00 ft	Fill height:	N/A	Limit depth:	50.00 ft

Estimation of post-earthquake settlements

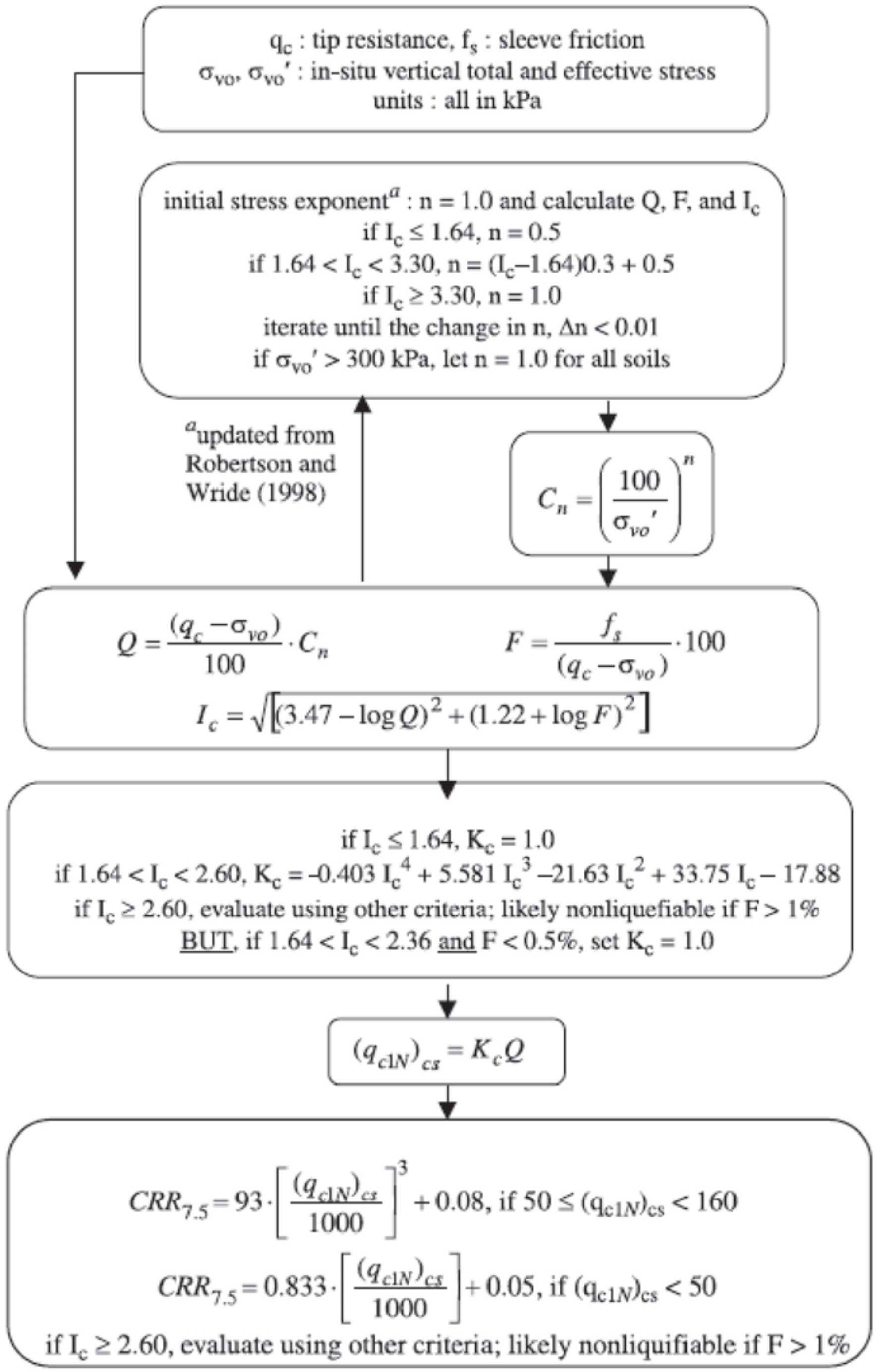


Abbreviations

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

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

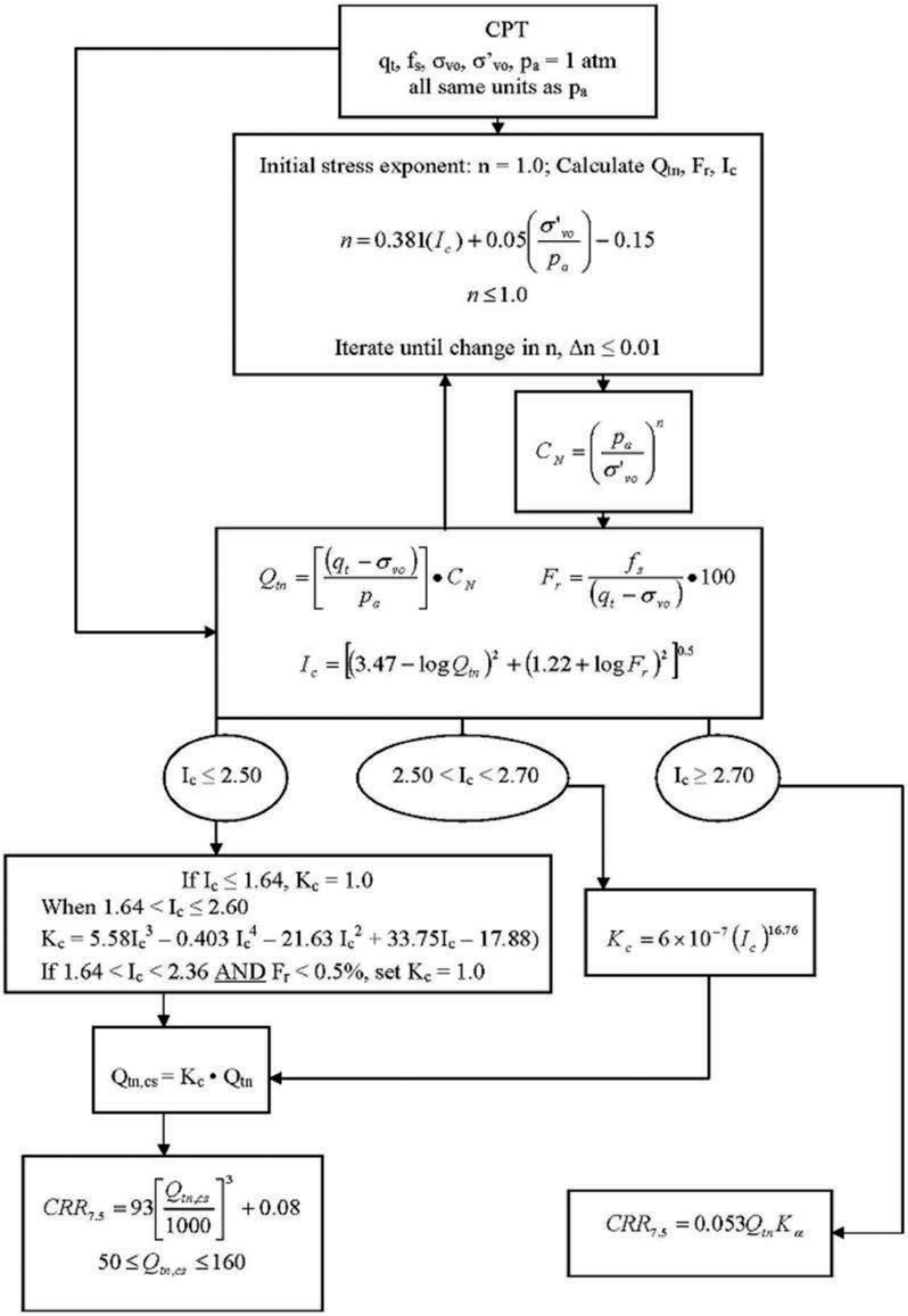
Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. The procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of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



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

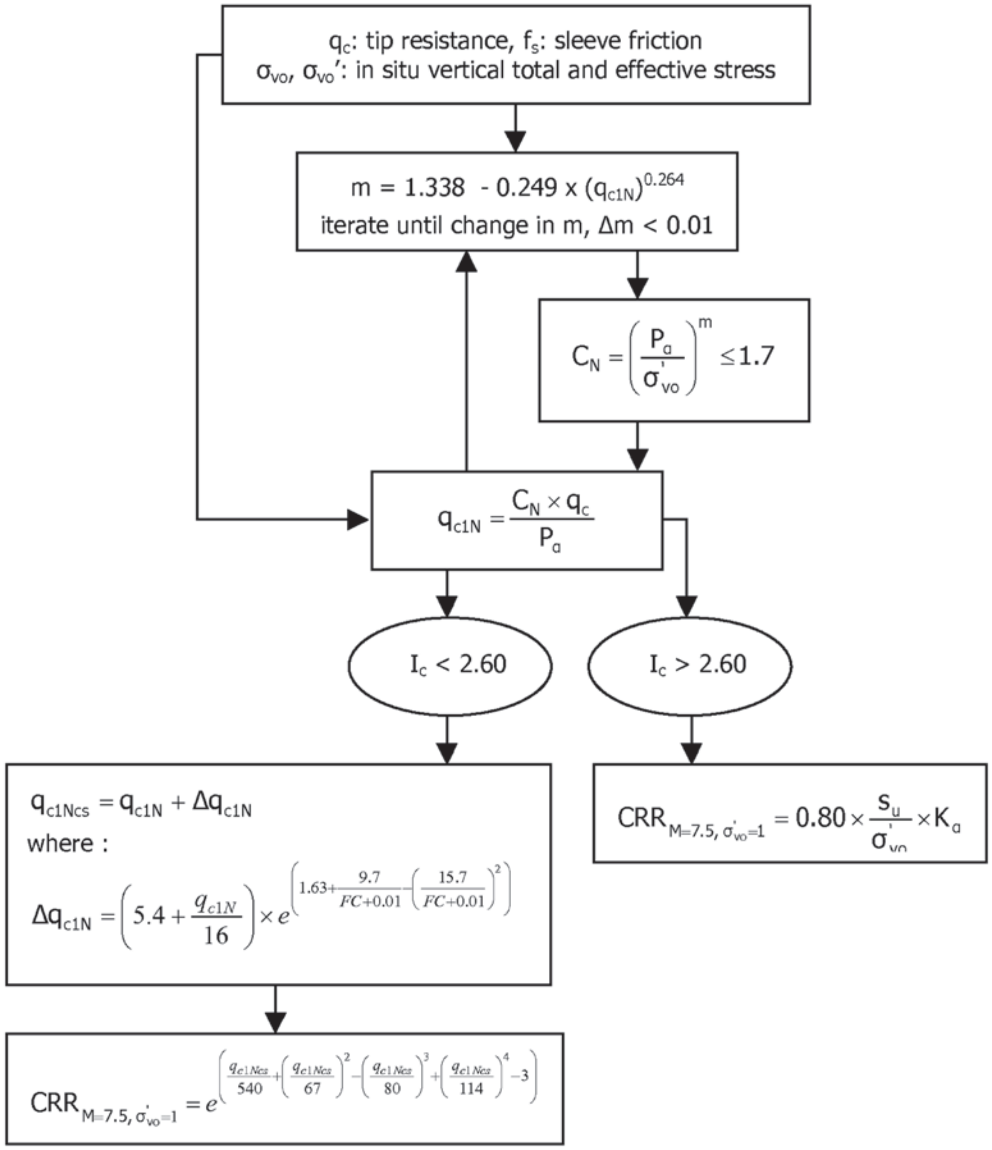
Procedure for the evaluation of soil liquefaction resistance (all soils), Robertson (2010)

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

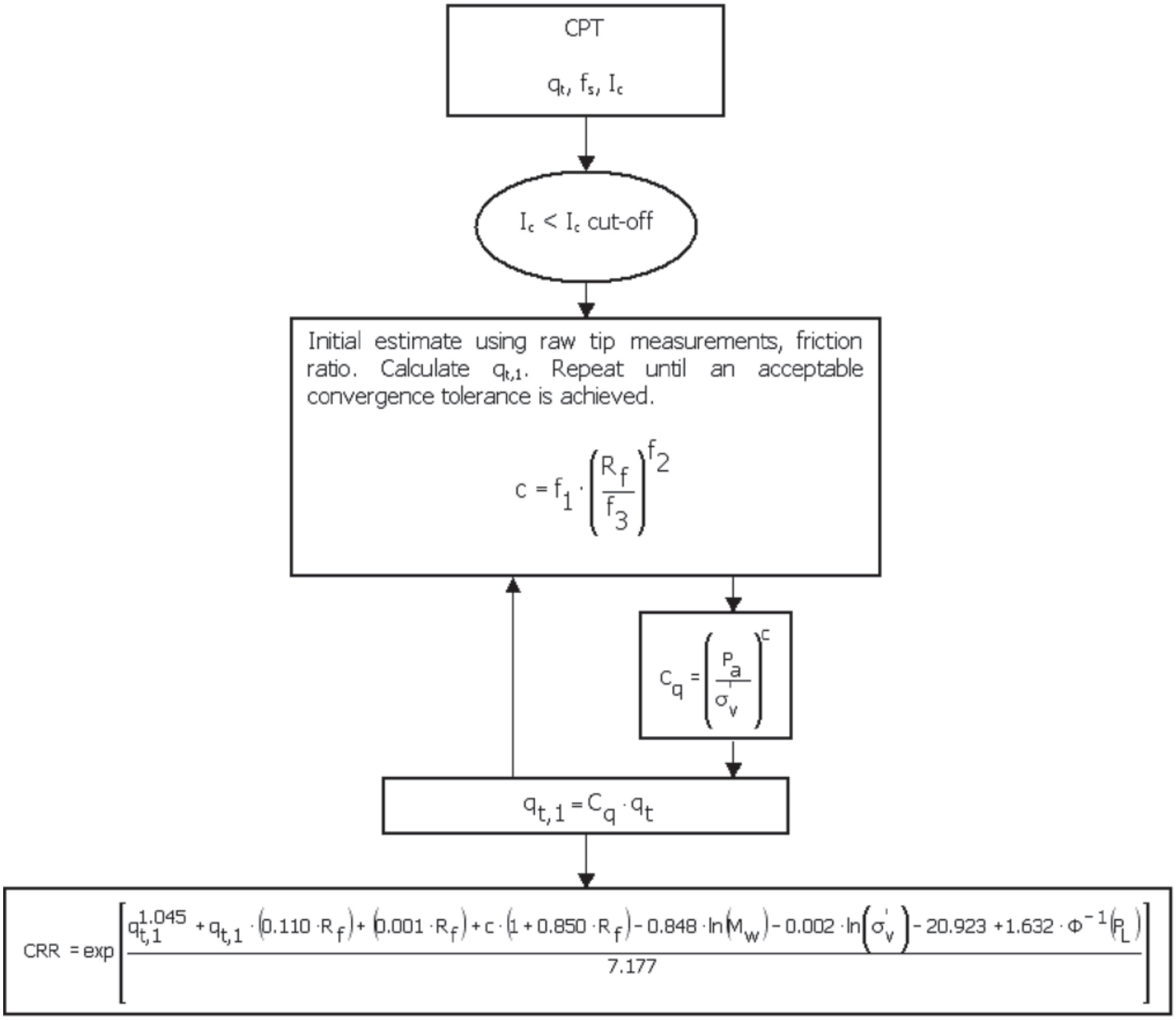


[1] P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering – from case history to practice, IS-Tokyo, June 2009

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



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



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

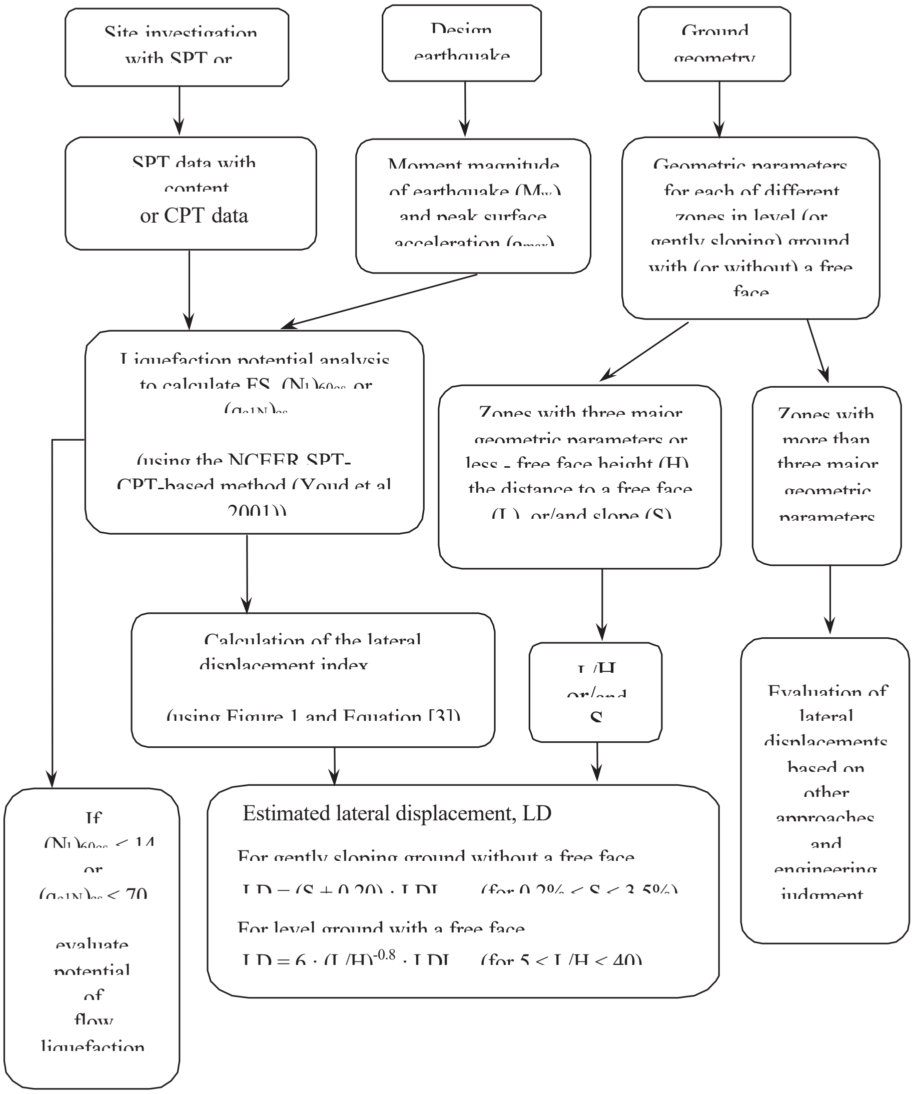
$$I_c = \left[\left(3.47 - \log(Q)\right)^2 + \left(1.22 + \log(F)\right)^2\right]^{0.5}$$

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

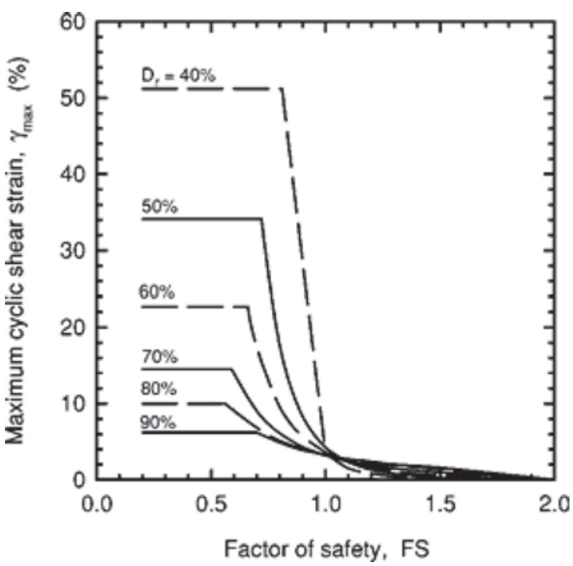
$$F = \left(\frac{f_s}{q_c - \sigma_{vc}}\right) \cdot 100\%$$

σ'_v *at time of CPT sounding*

Procedure for the evaluation of liquefaction-induced lateral spreading displacements



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



[1] **Figure 1**

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

[1] **Equation [3]**

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

Procedure for the estimation of seismic induced settlements in dry sands

Average shear stress, τ_{av}

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

↓

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))

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

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

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

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

↓

Estimate volumetric strain in 15 cycles

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

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

↓

Volumetric strain in design earthquake

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

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

↓

Seismic settlement, s

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

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

Liquefaction Potential Index (LPI) calculation procedure

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

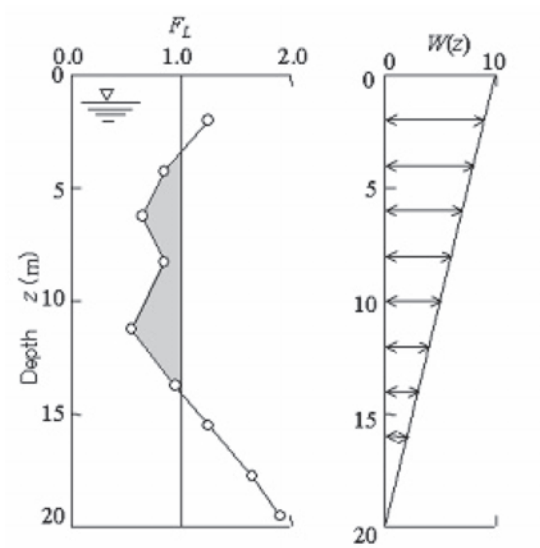
To estimate the severity of liquefaction extent at a given site, LPI is calculated based on the following equation:

$$\textbf{LPI} = \int_{0}^{20} (10 - 0{,}5_Z) \times F_L \times d_z$$

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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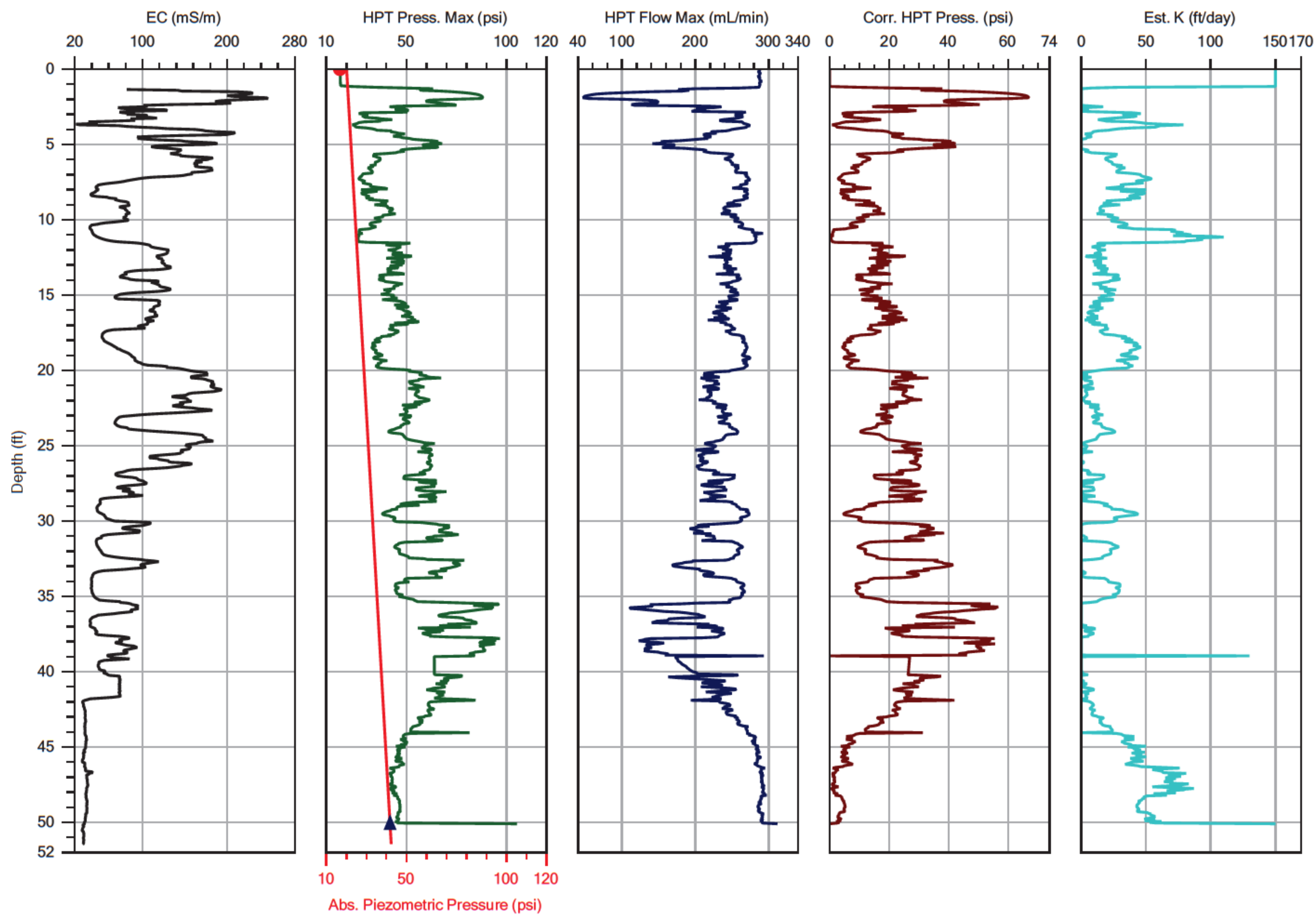
APPENDIX
HPT RESULTS



CASCADE DRILLING | TECHNICAL SERVICES

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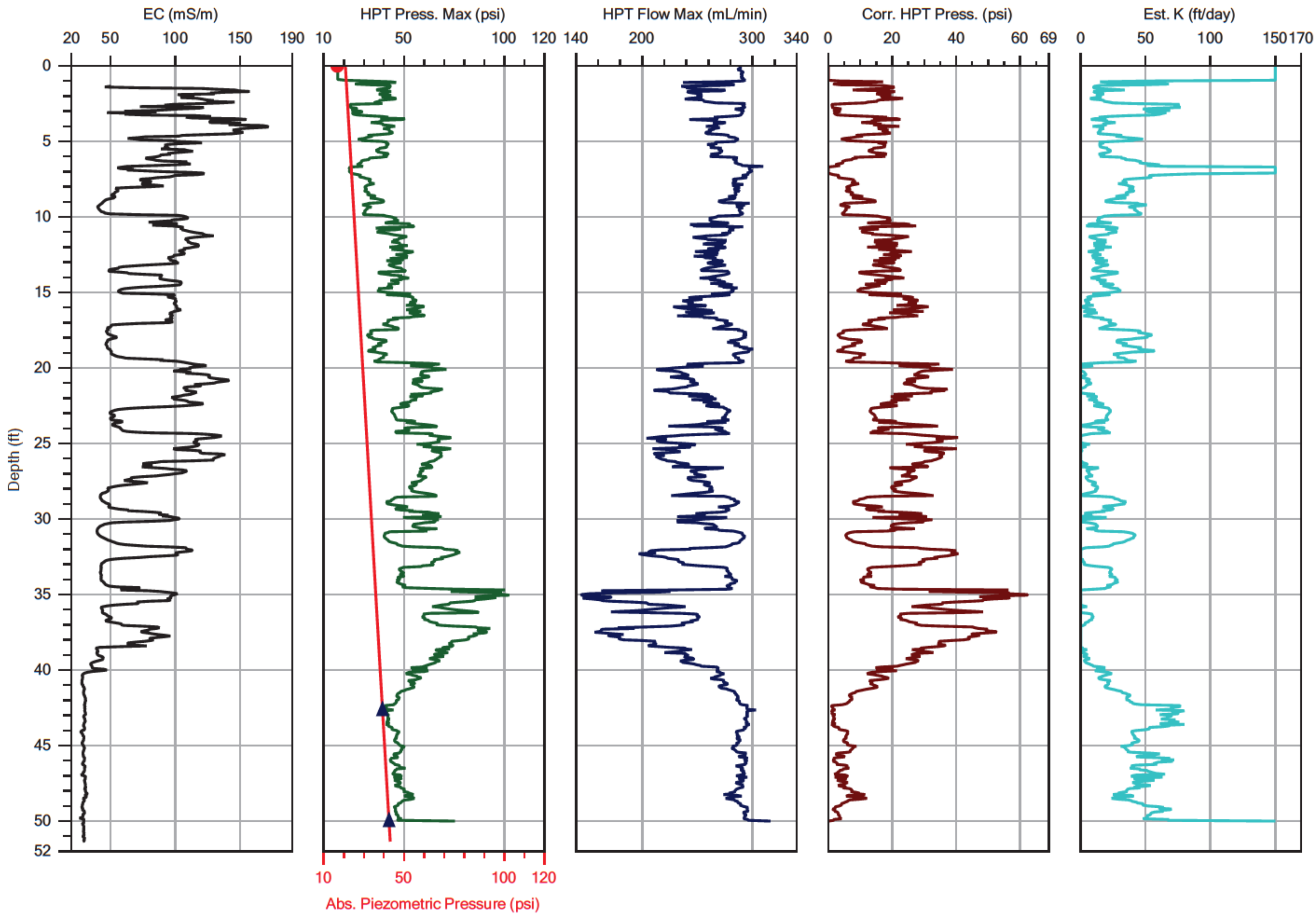
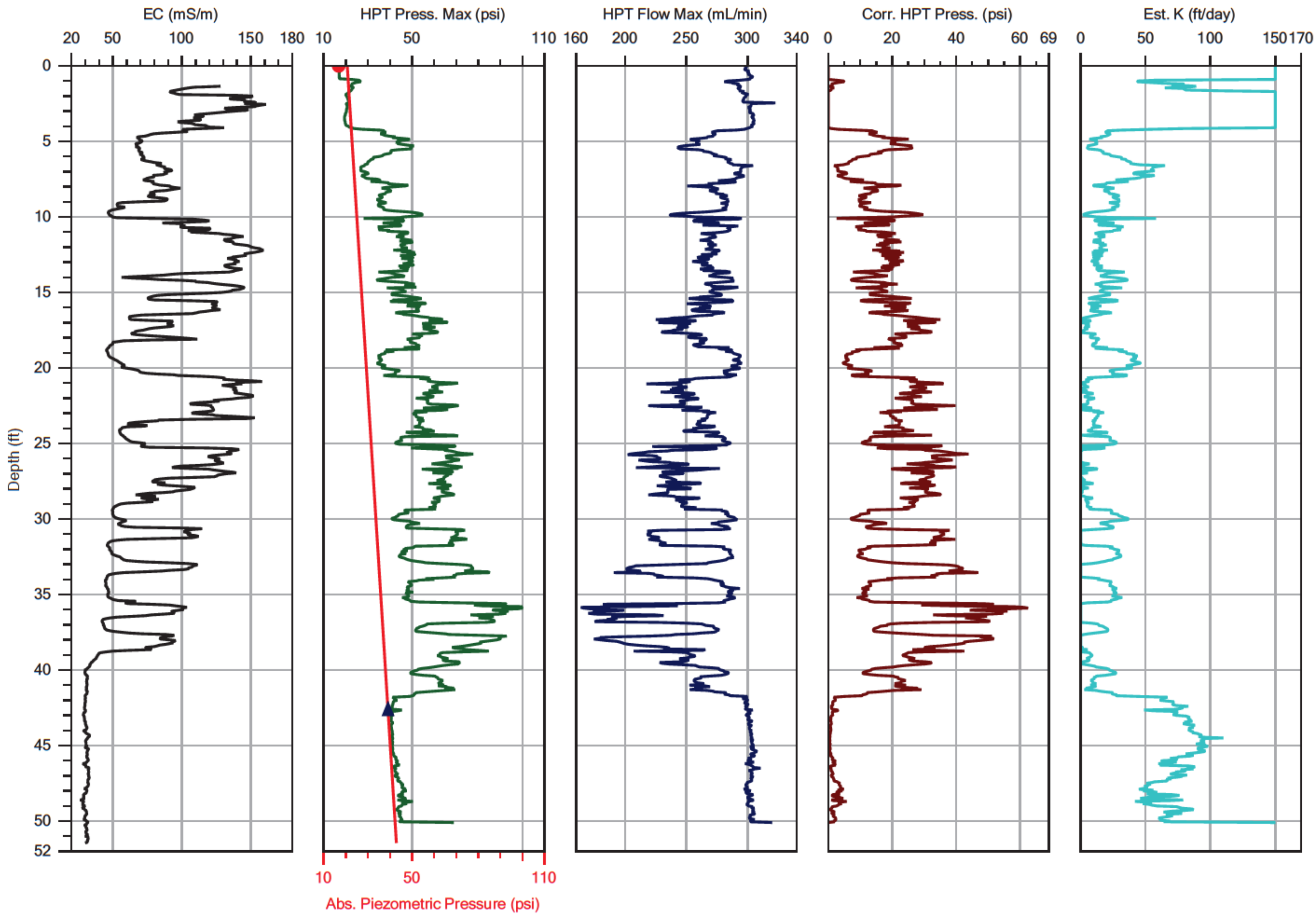
		Date: 06/05/24
Project ID: 304-24-1053	Client: Aesco	Location: Huntington Beach, CA



CASCADE DRILLING | TECHNICAL SERVICES

		File: HPT-2.HPT
Company: Cascade	Operator: Dan F.	Date: 06/05/24
Project ID: 304-24-1053	Client: Aesco	Location: Huntington Beach, CA



Company: Cascade	Operator: Dan F.	File: HPT-3.HPT
		Date: 06/05/24
Project ID: 304-24-1053	Client: Aesco	Location: Huntington Beach, CA

APPENDIX
DEEP SOIL MIXING (DSM) SPECIFICATIONS

DSM General Specifications

PART 1 - INTRODUCTION

1. Furnishing all labor, equipment, materials, and supplies necessary for soil stabilization by soil mixing as required to meet the project objectives as illustrated on the Drawings and specified herein.

2. The Work consists of installing, monitoring, and testing of soil mix columns within the limits illustrated on the Drawings.

3. In connection with the soil mixing program, as shown on the Drawings, the CONTRACTOR or a specialty Soil Mix Subcontractor hired by the CONTRACTOR shall provide all labor, materials and equipment to accomplish the following items of work:

a. Mobilization & Demobilization

b. Drilling

c. Soil Mixing

d. Quality Control/Quality Assurance and verification

e. Spoil containment, collection and disposal.

4. This section is intended for a performance type specification in so far that the soil mixing contractor shall be responsible for selecting soil mixing parameters, equipment, and construction methods of the soil mixed elements to meet the specified requirements of the GEOTECHNICAL ENGINEER. The GEOTECHNICAL ENGINEER is responsible for the design of the structure created by soil mixing.

B. Project objectives:

1. Construction of a soil-cement slab as overlapping columns in the designated volume, with the following characteristics:

a. 100% treatment.

b. Top and bottom elevations as specified on the drawings.

c. Minimum unconfined compressive strength: 200 psi at 7 days

d. Minimum hydraulic conductivity: $1x10^{-7}$ centimeters per second at 7 days

e. Minimum total unit weight:

(1) Bottom Seal: approximately 110 pcf

2. Construction of soil-cement columns and incorporate the shoring system as required to seal gaps in the cutter soil mix shoring wall at utility penetrations.

C. Job site conditions: Prior to submitting a bid price for the soil mixing, the soil mixing contractor shall conduct a site inspection and review available subsurface information (including all geotechnical engineering and data reports). Prior to bid, the soil mixing contractor shall verify the suitability of his methods for the project based on the conditions indicated by the subsurface information provided.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. The requirements of the following section apply to the Work of this section. Other sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this Work.

1. Section 02164 - Earth Anchors

2. Section 02210 - Excavation Support and Protection

3. Section 02211, Cutter Soil Mixing

1.3 REFERENCE CODES, REGULATIONS, AND STANDARDS

A. All Work specified herein shall meet or exceed the applicable requirements of the publications referenced in this Specifications section. The publication references are summarized in this article for convenience. CONTRACTOR shall be responsible for compliance with all requirements referenced in this Specifications section, even if they are not included in this summary article. If there is a conflict between the requirements of the referenced publications and other provisions of the Specifications, the other provisions shall prevail.

B. This Section incorporates by reference the latest revisions of the following documents.

1. ASTM International (ASTM):

ASTM C42 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

ASTM C150 Standard Specification for Portland Cement or AASHTO M85 Portland Cement

ASTM D469 Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression

ASTM C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete or AASHTO M295 Fly Ash

ASTM D1633 Standard Test Method for Compressive Strength of Molded Soil-Cement Cylinders

ASTM C2113 Practice for Diamond Core Drilling for Site Investigation

ASTM D3740 Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

ASTM D5084 Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

ASTM D6391 Standard Test Method for Field Measurement of Hydraulic Conductivity Using Borehole Infiltration, ASTM International

2. American Petroleum Institute (API):

API 13A Specification for Oil-Well Drilling-Fluid Materials

API 13B-1 Standard Procedures for Field Testing Water Based Drilling Fluids

3. American Concrete Institute (ACI):

ACI 233R Slag Cement in Concrete and Mortar or C989-99 Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars

4. American Association of State Highway and Transportation Officials (AASHTO): AASHTO T26 Water Testing of Non-Potable Water or ASTM C1602/C 1602M Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

5. US Dept of Interior, Bureau of Reclamation (USBR):

   USBR 7310-89 Procedure for Constant Head Hydraulic Conductivity Tests in Single Drill Holes

1.4 DEFINITIONS

A. Double fluid soil mixing: The soil mixing technique where one fluid, typically neat cement grout, is injected at high velocity through horizontal radial nozzle(s) and is assisted by a second fluid, typically air, delivered through a coaxial nozzle(s), to directly erode and mix with the in-situ soil.

B. Fresh-on-fresh sequence (also referred to as wet-on-wet): Method that involves soil mixing elements successively without waiting for the grout to harden in the overlapping elements.

C. Hydraulic conductivity: The k value used in Darcy's law for flow through soil. ASTM and many geotechnical engineers who deal with groundwater now use the term "hydraulic conductivity". The term "permeability" is reserved for those properties of soil and rock alone that determine the flow through it of any fluid including gas, water, oil and contaminants.

D. Soil mixed slab: A horizontal structure formed by vertical soil mixing. The primary role of a slab is frequently to minimize water inflow during excavation of the soil above it. Slabs can also serve as struts.

E. Soil Mixing: An in-situ drilling technique employed with specialized equipment that includes grout pump(s), grout mixer, drill rig, drill rods and injection monitor with vertical radial nozzles delivering high velocity fluids to erode, mix, and stabilize in-situ soils using an engineered grout slurry.

F. Soil mixing parameters: Flow rate of the fluid(s); grout composition; rotational speed of the soil mixing tool; rate of withdrawal or insertion of the soil mixing tool; and number and size of nozzles.

G. Soil mixing tool: Jointed rods with single, double or triple inner conduit that conveys the soil mixing fluid(s) to the monitor.

H. Soil mixing supervisor: The individual on site who is in practical and responsible charge for the soil mixing work with a minimum 5-year experience in deep soil mixing in similar soil conditions and groundwater conditions.

I. Pre-drilling: Method that utilizes traditional soil drilling techniques and/or equipment to pre-bore each soil mix hole.

J. Soil-cement element: A column, partial column (sector) or panel (planar shape also known as fans), of soil-cement formed by soil mixing, used as a component of a soil- cement structure.

K. Soil-cement structure: A single zone or block of soil mix elements that are partially or fully interlocked as indicated on the Drawings. Soil cement structures shall be comprised of soil cement elements of sufficient pattern and spacing as to stabilize the soil mass within the limits shown on the Drawings to meet the performance requirements specified herein and on the Drawings. The minimum percent cement should be 16% by soil dry weight.

L. Soil-cement: Mixture of grout slurry and in-situ soils formed by the soil mixing process.

M. Specific energy: pressure times flow divided by lift rate.

N. Spoil return: All materials including but not limited to liquids, semi-solids, and solids, which are discharged above ground surface during, or as a result of soil mixing. Spoils consist of native soil, ground water, cement, and erosional water (if any) injected as part of the soil mixing process.

O. Structural reinforcement: members inserted into the soil mix column to provide additional strength, including steel beams.

P. UCS: Unconfined compressive strength at 7 days.

Q. Uniformity: The amount of uniformly mixed material measured by core recovery. It is calculated as the total length of recovered core minus the sum of the lengths of unmixed soil regions or lumps that extend across the entire diameter of the core divided by the total core run length expressed as a percentage.

R. Young's modulus E50: Secant modulus of the stress strain curve at 50% of failure strength (UCS).

1.5 QUALITY ASSURANCE

A. Qualifications

1. Soil mixing supervisor must have at least five (5) years on site experience managing soil mixing field operations of similar size and scope and must have supervised at least two (2) projects within the past five (5) years employing the soil mixing technique proposed for this project. The supervisor shall have experience and knowledge of all aspects of soil mixing as required for the project and shall be present at the work site at all times during soil mixing operations.

1.6 SUBMITTALS

A. Submittals shall be made in accordance with the General Requirements, Additional General Requirements and as specified herein.

B. Qualifications:

1. Resumes of the management, supervisory, and key personnel.

C. Soil mixing equipment: Catalog cuts, details of grout mixers, pumps, drill rigs, and a plan view of the soil mix equipment arrangement proposed for use on this project, noting any equipment that has been modified or is of unique construction.

D. Sample field data collection forms and daily field reports.

E. Grout mix design:

1. Mix design for the project indicating sources and types of grout materials, including (if available) field test data from previous projects. If the soil mixing Contractor intends to deviate from the materials defined in Section 2.1 of this specification, it shall submit evidence of satisfactory use of the proposed material from past projects with similar soil conditions or pre-construction trials.

2. Method for verifying grout mix proportions.

F. Field demonstration test program:

1. Details of proposed field demonstration of testing program for soil mixing. This shall include location of test column layout of test pattern, soil mixing parameters used and variables to be tested during test program, and details of proposed quality control/quality assurance testing to meet acceptance criteria specified herein.

2. Following performance of the field demonstration test program and prior to beginning production soil mixing operations, submit a summary of the test program including details regarding as-built layout of test area, drilling procedures, grout mixture, soil mixing parameters, quality

control/quality assurance records and test results, and proposed soil mixing parameters for use in production grouting based on test program.

G. Soil mixing procedure:

1. General work procedures plan outlining the spacing, location, depth and general sequence to achieve the specified criteria detailed in this specification. Soil mix element locations shall be dimensionally referenced to the Drawings and shown on layout plans of suitable scale to effectively indicate the details of the layout. If pre- drilling of soil mix holes is required, describe the methods and type of equipment to be used.

2. A general soil mix spoil return management plan outlining waste containment methods during soil mixing and treatment and removal plans for soil mix spoil return. Include estimated width of annulus for spoil return and corrective actions to be taken if spoil return is not free-flowing, interrupted or episodic.

3. Soil mix site specific safety plan or job hazard analysis.

H. Quality assurance, quality control and verification procedures to be used for the field test and production work:

1. Details of the procedures to obtain soil-cement samples; and catalog cuts or shop fabrication drawings of the soil-cement sampling device and curing boxes.

2. Proposed details and formats of all required tabular and graphical data presentations that will be submitted during the course of the Work. This will include submittal of a copy of the reports used for data monitoring and recording.

3. Details for hydraulic conductivity testing and/or water-tightness testing if specified.

4. Details of column diameter and overlap verification

Daily reports: Submit daily reports within one business day after the end of a work shift.

PART 2 - PRODUCTS

2.1 MATERIALS

A. The grout slurry may consist of a homogeneous mixture of any of the following materials:

1. Portland cement, Type I or II or IV or IL: ASTM C150 or AASHTO M85

2. Ground granulated blast furnace slag: ASTM C989.

3. Fly ash Class C or F: ASTM C618 or AASHTO M295.

4. Potable Water or approved other source free of deleterious materials that may adversely affect the grout.

5. Bentonite: Powdered bentonite per API Standard 13A.

6. The ratios of the material components, by weight, shall be proposed by the soil mixing contractor and confirmed during the preconstruction test program. Once accepted, grout slurry composition shall not be changed unless requested in writing by the CONTRACTOR and accepted in writing by the GEOTECHNICAL ENGINEER.

2.2 EQUIPMENT

A. General: All equipment used for drilling boreholes; lowering, raising and rotating jet monitors; mixing grout; supplying pressurized grout and air-water to jet monitors; and jet monitors shall have proven performance records for use in Soil mixing work.

B. Drilling equipment: Use drilling equipment of a type and capacity suitable for drilling required hole diameters and depths, and lowering, raising, and rotating soil mix monitors to the depths and at the rates required to perform the work as shown on the Drawings and as specified herein. The drill rig shall be equipped with automated controls to regulate and maintain consistent rod lift rate and rod RPM and shall have pressure gauges and flow meters for all fluids injected.

C. Grout mixing and injection equipment: Use grout mixers and holding tanks, water tanks, air compressors, and pumps of sufficient capacity to ensure adequate supply of grout, air, and water at required pressure to the soil mixing monitors during a full work shift to produce grout elements of the quality and dimensions necessary.

D. Soil mixing pump: Shall be capable, with the nozzles proposed, of providing the required pressure and flow rate adequate for the execution of the work.

E. Compressor (for mixing): Shall be capable of producing the pressure and flow rate values proposed by the soil mixing contractor depending on the parameters chosen.

F. Soil mix tools: Use soil mixing monitors with appropriate nozzles with the capacity suitable for producing soil mix elements in the soil types to be treated, and of the size and depth proposed in the soil mixing contractor's plan. The drill hole diameter shall be sufficiently large to be a clear path for continuous spoil return during all jetting operations.

G. Equipment instrumentation: Provide instrumentation that allows continuous monitoring and automatic recording of data throughout the soil mixing operations. As a minimum, the following shall be provided:

1. Pressure gauges/devices at the drilling rig to automatically record pressures of grout slurry, water, and air during the grouting process.

2. Flow meter(s) to monitor and record the rate and total volume of grouting fluids through the grouting monitor at every element.

3. Devices that automatically monitor and record the rate of monitor rotation and withdrawal.

PART 3 - EXECUTION

3.1 TEST PROGRAM (If needed)

A. Prior to production work, conduct a test program in accordance with the accepted work plan. The test program shall be used to optimize/verify the various parameters including type of soil mixing being performed, grout mix composition, fluid(s) flows and pressures, rotational speed, lift rate, spoil return, grout, and number and size of nozzles; and confirm that resultant in situ soil-cement properties and dimensions meet required design criteria.

B. The test program will be observed, reviewed and verified for contract conformance by the GEOTECHNICAL ENGINEER. Install the test program in areas near the planned production work at a location agreed upon between the GEOTECHNICAL ENGINEER and soil mixing subcontractor and in representative soils and depths anticipated to be found during production work.

C. Each test section shall consist of a plan of elements suitable to demonstrate feasibility and installed to the same elevations specified for the production soil mixing work.

D. Expose the test elements by excavation (where possible) and measured for geometric properties. If full-depth excavation is not feasible, core samples or other testing method shall be used to demonstrate column size/geometry. In cases where excavation is not reasonable, coring at the centroid of a group of three (3) elements shall be carried out, as a minimum.

E. Where coring is used to verify diameter, verticality shall be measured for each test column and the coreholes to verify the location of the elements and depth.

F. Three acceptable/representative specimens from each column shall be sent to an independent laboratory for the tests required to satisfy the criteria specified herein.

G. Perform hydraulic conductivity testing as soil mixing is used for water cutoff purposes. Hydraulic conductivity testing procedures shall be proposed by the soil mixing contractor and approved by the GEOTECHNICAL ENGINEER.

H. The results of the test program and the recommended soil mixing parameters for the production work shall be submitted in a report to the GEOTECHNICAL ENGINEER for review. The soil mix contractor, at their expense, may be required to repeat the construction of a test section if the results of the test program do not meet the project requirements. The test program shall confirm that the resultant soil-cement properties met the required design criteria prior to the soil mix contractor proceeding with production work.

3.2 PRODUCTION WORK

A. Execute production soil mixing using the same soil mix tooling, materials, and procedures as demonstrated from the satisfactory set of test elements.

B. Install soil mix elements, such that continuous spoil return up the borehole annulus is achieved during all work. When spoils return is lost, the soil mixing contractor shall stop jetting and reestablish spoils return prior to resuming soil mixing.

C. Horizontal location and verticality/deviation shall meet the requirements of accepted work plan.

D. The sequence of soil mix column installation and the need to perform pre-jetting is the responsibility of the soil mixing contractor and will be based on the results of the successful test program.

E. Maintain a clean site and dispose of all spoil debris, water, and spilled material during soil mixing operations.

F. Equipment for mixing, holding, and pumping grout shall be in a secure location and shall be operated to minimize spillage of material. No material will be allowed to enter storm drains or other drainage courses.

G. The CONTRACTOR shall monitor nearby grade, structures and utilities during all jetting work.

H. If soil mixing is interrupted during the execution of a column, the re-start of the mixing shall be undertaken at least 6 inches below the stopping point.

I. Site access shall be provided to GEOTECHNICAL ENGINEER for observation of the work.

J. If reinforcement is required, the soil mixing contractor shall install it at the design location in the fresh column, immediately after the completion of the jet-grouted column or shall install in a borehole drilled in the hardened column.

3.3 QUALITY CONTROL/QUALITY ASSUSRANCE

A. Perform all soil mixing in the presence of the GEOTECHNICAL ENGINEER. Notify GEOTECHNICAL ENGINEER prior to initiating soil mixing. Monitoring and logging of soil mixing operations for both test areas and production work shall be performed by the soil mixing contractor.

B. The soil mixing contractor's equipment shall be configured to record and continuously show all fluid flows and pressures, rotational speed, depth and rod lift rates. The rod lift rate and rod RPM shall be set by the driller then automatically controlled by the drill rig and automatically recorded on the soil mix installation log during the entire soil mixing process. GEOTECHNICAL ENGINEER shall be provided means to monitor this information in real time on request.

C. All the data monitored and recorded shall be made available within one working day to the GEOTECHNICAL ENGINEER in a format previously agreed on prior to the work. The soil mixing contractor shall supply the GEOTECHNICAL ENGINEER with the software required for this task. The software shall be capable of processing the recorded data and presenting the data graphically in a satisfactory manner.

D. Grout mix proportions shall be measured and documented by the soil mixing contractor. Appropriate records shall be kept by the soil mixing contractor and submitted to the GEOTECHNICAL ENGINEER to verify that grout mixture(s) are as accepted. Include daily quantities of materials used in daily reports.

E. Throughout the soil mixing operations, perform continuous coring to full depth on 1-3 percent of production columns to obtain drill cores of the soil mixed soil. The core will be evaluated by the GEOTECHNICAL ENGINEER for compliance with specific acceptance criteria defined herein. The CONTRACTOR shall be notified immediately if the soil-cement samples do not meet the acceptance criteria outlined herein. CONTRACTOR shall backfill the core holes in the soil mix in such a manner as to equal or exceed the required properties of the material removed.

F. Perform hydraulic conductivity testing of production elements if soil mixing is used for soil-cement structures such as walls and slabs for water control purposes. Minimum number of tests required are: 6 for the Lift Station Base Seal, (20 total).

3.4 DAILY REPORTS

A. Within one business day of a work shift, submit summary daily reports during production soil mixing that provide the information listed below. A sample of the report form proposed for use by the soil mixing contractor shall be submitted to the GEOTECHNICAL ENGINEER for approval prior to the start of work.

B. Daily reports shall include the following:

1. Equipment and personnel on site

2. Work initiated and completed

3. Production interruptions

4. Grouting records

a. Soil mix column number, size and location.

b. Time and date of beginning and completion of each grout element, including interruptions to the soil mix process or material supply.

c. Grout mix data, including mix proportions and unit weight density measurements.

d. Flow rates of all fluids used to construct each grout element.

e. Rotation rate and lift rate of mixing tool for each mixed column.

f. Total grout quantity used for each element.

g. Top and bottom elevations of the soil mix column.

h. Whether flow of spoils return was continuous.

5. Total quantities of materials used for that day.

6. Observations of any unusual, or unanticipated conditions including obstructions, stoppages, loss of circulation, etc., impacts on instrumentation or monitoring.

7. Applicable verification testing done.

C. Continuous recording of soil mixing parameters shall be provided for each production column to verify consistency with the test program results.

3.5 ACCEPTANCE CRITERIA

A. Installation records and daily reports documenting that the selected parameters from the test program were accurately repeated for the production work

B. Coring / uniformity:

1. A total of 12 core samples retrieved by the contractor from the upper 25 feet shall be used to evaluate uniformity.

2. Core recovery (expressed as a percentage) is equal to the total length of recovered core divided by the total core run length. Length of recovered core includes lengths of treated and untreated soil.

3. Percent treatment is calculated as the total length of recovered core minus the sum of the lengths of unmixed soil regions or lumps that extend across the entire diameter of the core divided by the total core run length expressed as a percentage.

4. Uniformity is acceptable if percent treatment is at least 90 percent for every 5-ft core run.

5. If the contractor uses core runs shorter than 5 ft (e.g., 3 ft), then the recovery and percent treatment can be calculated by adding equal amounts of core run length on either side of the short core run length to make up a total 5-ft run length for calculation purposes.

C. Hydraulic conductivity: Verified by the Geotechnical Engineer.

D. Unconfined Compressive Strength of Soil Mix Soil Cement Mix: At least 90 percent of all soil mix samples tested shall have a minimum 7-day unconfined compressive strength as specified herein.

E. Unit Weight: At least 90 percent of all samples tested shall have a minimum unit weight equal to or greater than that specified herein.

F. Borehole deviation and horizontal tolerances: As required per the soil mixing contractor's layout plan.