NMG
Geotechnical, Inc.

November 27, 2019

Project No. 11077-02

To: SD Riverwalk, LLC
4747 Executive Drive, Suite 410
San Diego, California 92121

Attention: Mr. Pete Shearer

Subject: Preliminary Geotechnical Investigation and Review of the Updated Grading Plan, Proposed Mixed-Use Redevelopment Project at Riverwalk Golf Course, City of San Diego, California

In accordance with your authorization, NMG Geotechnical, Inc. (NMG) has prepared this updated report for use in preparation of the project Environmental Impact Report (EIR) for the proposed mixed-use redevelopment at the Riverwalk Golf Course, in the city of San Diego, California. We have reviewed the grading plan in light of the geotechnical conditions at the site to provide geotechnical recommendations for the proposed grading and development. This report is essentially the same as the prior geotechnical report by NMG, dated April 12, 2019 which was recently approved by the City. The only update includes the project description, as shown in the first two paragraphs of Section 2.4, for consistency with the other technical documents. The geotechnical findings, conclusions and recommendations have not been revised and remain valid for the proposed development.

NMG previously prepared two reports (2017 and 2018) that were submitted to the City of San Diego during the Mandatory Initial Review (MIR) process. Those reports were reviewed and approved by the City. This report combines the two prior reports and provides our geotechnical review of the updated grading plan and supplemental exploration data. This report will serve as the technical appendix for the EIR.

We have reviewed the updated grading plan by Project Design Consultants (PDC), received by NMG on April 5, 2019. We have performed an additional geotechnical investigation to address this updated plan. The additional investigation included excavation of two hollow-stem auger borings and advancement of four Cone Penetrometer Test (CPT) probes in the western portion of the golf course, south of the trolley line, in an area where an additional building and trolley bridge are proposed.

The updated 60-scale grading plan was used as the base map to present the boring and CPT locations and the geotechnical mapping for the site on the Updated Geotechnical Map (Plates 1 through 4). This plan was also used as a base for the 100-scale Preliminary Remedial Measures

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and Ground Improvement Map (Plate 5). Plates 6 through 8 include the updated geotechnical cross-sections.

This report presents the findings of our studies and provides alternatives for remedial grading and foundation design for the proposed development concept. Based on our findings, we conclude that the proposed mixed-use development is feasible provided it is designed, graded and constructed in accordance with the preliminary geotechnical recommendations in this report. Additional geotechnical review and investigation will need to be performed as the design level plans become available. The recommendations provided herein will then be confirmed and/or updated as necessary based on our findings. NMG will work with the project team to review design level plans and determine the ultimate remedial solutions.

If you have any questions regarding this report, please contact our office. We appreciate the opportunity to provide our services.

Respectfully submitted,

NMG GEOTECHNICAL, INC.

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1.0 EXECUTIVE SUMMARY

The proposed development is separated into three districts, which include the following:

- The North District, located between Friars Road and the trolley rail line, which includes multi-family residential, neighborhood retail, and a trolley station development.
- The Central District, located between the trolley and the San Diego River, which includes multi-family residential, reuse of the clubhouse for a community amenity, and park.
- The South District, located south of the river, which includes commercial development in the southeast corner and park development for the remainder of the area.

The development will include:

- Buildings that may have either at-grade structures or have one subterranean level for parking below the pad grades shown, which will be determined during the design phase. Residential buildings will be 3 to 7 stories and the commercial buildings may be up to 15 stories.
- Two vehicular trolley crossings; one at-grade crossing to the east near the clubhouse and one bridge to the west where a grade-separation underpass of the trolley tracks is planned.
- One vehicular culvert/bridge crossing on Fashion Valley Road, where it crosses the San Diego River.
- A large river park within the Central and South Districts and several recreational areas and parks throughout the development.

The geotechnical conditions and constraints for the proposed development are as follows:

- Multiple earth units were encountered at the site during our exploration, including up to 15 feet of undocumented golf course fill overlying older river terrace deposits to the north, and alluvium below the remainder of the site. The alluvium extends to depths of up to 80± feet below existing ground surface (bgs). The central portion of the North District is underlain by dense terrace deposits. The westerly and easterly ends of the North District are underlain by alluvium. The Central District is mostly underlain by alluvium except near the existing clubhouse parking lot, which is underlain by terrace deposits. The South District is entirely underlain by alluvium.

- The alluvium is potentially liquefiable during a future large earthquake event. Preliminary seismic settlements are estimated up to 3.5 inches within the proposed development areas and up to 8.0 inches within the proposed river park. There is also potential for lateral spread and flow liquefaction for the proposed fill slopes next to the river in the Central and South Districts. The designed structural slopes will need to have additional remediation to address the potential for lateral spread or flow.

- A major geotechnical and hydrologic issue for the site is the flood potential of the San Diego River. We understand that the proposed residential and commercial developments are being raised above flood levels. The majority of the park will also be lowered during grading. Portions of the park will remain within the mapped potential flood zone. Proposed structural slopes below these elevations will need to be protected from future flood flows and scour.

- Shallow groundwater was encountered in areas underlain by alluvium at depths between 5 and 15 feet bgs. Groundwater is deeper in the river terrace deposits, largely due to the higher ground elevations in this area. Groundwater was not encountered in Borings B-6, B-7 or B-8, drilled to depths of up to 26.5 feet into the terrace deposits, where refusal was encountered. Boring B-5 was drilled through terrace deposits and into bedrock where groundwater was encountered at a depth of 47 feet bgs. Borings B-2 and B-4 are located within mapped terrace deposits, near the alluvial contact, and encountered groundwater at depths of 11 and 25.6 feet bgs.

- Installation of deeper utilities or structures (i.e., elevator shafts, etc.) may extend into the groundwater table and will need to be evaluated during the design phase to determine the need for dewatering.

- Excavations into the dense terrace deposits will likely require ripping with large bulldozers (D-9 and D-10 dozers) prior to picking up with scrapers. Some layers within the terrace deposits are difficult to excavate with a backhoe and/or drilling rig due to the hard cobbles and cementation.

- The alluvium has a potential for static settlements on the order of 1 inch or less, after remedial removals and fill placement to finish grades.

- Preliminary settlement analysis indicates that potential impacts to the trolley and the 78-inch trunk sewer are minimal, on the order of 0.35 to 0.75 inches, respectively.

- Impacts to the existing improvements (i.e., the perimeter streets and developments, the trolley rail line, the clubhouse, etc.) were analyzed and the temporary slopes for remedial grading are recommended to be 1.5H:1V where they will expose alluvium and 1H:1V in terrace and fill materials. Where constrained by property lines or other improvements, shoring or other methods of slope stabilization should be evaluated.

- There are no major or active faults mapped at the site. However, the seismically active Rose Canyon Fault is mapped approximately one mile to the west of the site. The site is subject to high seismic ground shaking during future earthquakes on this or other regionally active faults.

- The site is not suitable for Water Quality Management Plan (WQMP) infiltration BMPs due to the shallow groundwater and the recommendation for remedial removals to near the groundwater table. Infiltration is not recommended into compacted fill and requires a minimum 10-foot separation between the bottom of the BMP and the groundwater table. Infiltration rates into river terrace deposits is expected to be very low due to the high density and cementation.

- Expansion potential of the site soils varies between "very low" and "medium." As a result, we anticipate that the proposed buildings may need to be designed with post tensioned or wire reinforced slab/foundations. This will need to be further evaluated during the design phase of the project.

The following includes the geotechnical conditions and constraints for each area.

North District: This district has the most favorable geotechnical conditions, since the majority of this area is underlain by dense river terrace deposits that are not liquefiable and have static and seismic settlement potential of less than 1 inch. The development pads proposed at the eastern and western ends of the North District are underlain by alluvium that is potentially liquefiable.

Remedial grading for the pads underlain by river terrace deposits should remove the undocumented fill and the upper 5 to 10 feet of weathered terrace deposits in design fill areas, and a minimum of a 3-foot overexcavation/lot capping in the design cut areas. Where proposed building foundations or utilities are deeper than 3 feet, deeper overexcavation should be considered.

Remedial grading in the areas underlain by alluvium may extend 2 to 3 feet above the groundwater (5 to 20 feet bgs) in order to reduce the amount and/or depths of ground improvements. After this grading, the static and seismic settlements in areas underlain by alluvium are expected to be on the order of 3.0 to 4.0 inches with differential settlements on the order of 1.75 to 2.0 inches over a span of 40 feet. In order to reduce the total and differential settlement to 1 inch over a span of 40 feet, respectively, and also to provide higher foundation bearing capacity in the areas underlain by alluvium, ground improvement should be performed below the removal bottom. The recommended depths of ground improvement are 10 feet below the removal bottom on the western end and 20 feet below the removal bottom on the eastern end. Alternatively, the buildings could be designed to accommodate the higher settlements in lieu of the ground improvements.

There is also an abandoned sewer line that crosses the North District. This pipeline and associated backfill material will need to be removed and the trench backfilled with compacted fill during grading.

Structural Portions of Central and South Districts: The Central District is mostly underlain by alluvium with some river terrace in the central portion near the clubhouse parking lot, while the South District is entirely underlain by alluvium. In the areas underlain by terrace deposits, a minimum 3-foot overexcavation/fill cap is recommended in cut areas, and where proposed building foundations or utilities are deeper than 3 feet, deeper overexcavation should be considered.

Building or structural portions of the Central and South Districts that are underlain by alluvium should have remedial grading performed to 2 to 3 feet above the groundwater table. This will result in a fill cap below the pads that is 5 to 30 feet thick. After the proposed remedial grading, the static and seismic settlements in areas underlain by alluvium are expected to be on the order of 2.0 to 4.5 inches, with differential settlements on the order of 1.0 to 2.25 inches over a span of 40 feet. In order to reduce the total and differential settlement to 1 inch over a span of 40 feet and also to provide higher foundation bearing capacity in the areas underlain by alluvium, ground improvement should be performed below the removal bottom. The recommended depths of ground improvement are 20 feet below the removal bottom in the Central District and 15 feet below the removal bottom in the South District. Alternatively, the buildings could be designed to accommodate the higher settlements in lieu of the ground improvements. Please note that lowering the design grades could adversely impact the amount of potential near-surface/shallow seismic settlement.

We understand that the commercial buildings proposed in the South District may be up to 15 stories high and constructed of steel, concrete or wood frame. These buildings are anticipated to have higher loads and therefore, may require deep foundations and/or a combination of thicker mat slabs, deeper ground improvement and pile foundations.

There is a potential for lateral spread adjacent to the river in the Central District and the South District. Deeper ground improvements will be required under the structural fill slopes next to the river in order to address the potential for seismically induced lateral spread and flow liquefaction. Based on our review of the CPT and boring data, we anticipate the ground improvement will need to extend on the order of 50 feet below the toe of the design fill slopes. The ground improvement should at minimum, consist of 3 to 4 rows of stone columns, geopiers or deep soil-cement mix columns. This will need to be further evaluated during the design-level study.

Parks in the Central and South Districts: In the non-structural portions of the proposed river park, remedial grading will be limited to removal of the turf, vegetation, rootballs, heavy roots and topsoil to expose less weathered fill or alluvium. There is high static and seismic-induced settlement potential in the river park, at the location of CPT-20, -21, -22, -28 through -31, -39 and -40. With the design cuts into the alluvium, there are areas that will encounter groundwater. The park is subject to flooding during a heavy rainfall event. There is also a potential for ground manifestations due to liquefaction during a future earthquake event. Planting with landscape and vegetation soon after grading will help reduce the erosion potential.

The proposed park and associated improvements are considered non-habitable. Thus, ground improvements are not recommended in those areas. Where structures are planned in the park (if any), remedial grading/removals may be necessary for proposed non-habitable structures, which will need to be determined as the park plans are developed. We also understand that the existing clubhouse and bridges are founded on piles and will remain in place.

Two parks were added in the Central District between existing building pads. The eastern park near the clubhouse is underlain by dense cobbly terrace deposits. Where the cut extends into terrace deposits, the area may be overexcavated 3 feet and replaced with compacted fill without cobbles to facilitate irrigation and planting.

2.0 INTRODUCTION

2.1 Purpose and Scope of Work

NMG Geotechnical, Inc. (NMG) has prepared this report of preliminary geotechnical investigation and review of the updated grading plan for the proposed mixed-use development at the existing Riverwalk Golf Course in the city of San Diego, California. We have reviewed the updated grading plan in light of the geotechnical conditions at the site in order to provide geotechnical recommendations for the proposed grading and development.

NMG previously prepared two reports (2017 and 2018) that were submitted to the City of San Diego during the Mandatory Initial Review (MIR) process. These reports were reviewed and approved by the City. This report combines the two prior reports and provides our geotechnical review of the updated grading plan. In addition, we have performed a supplemental geotechnical investigation to address this updated grading plan. This report will serve as the technical appendix for the EIR.

We have reviewed the updated grading plan prepared by Project Design Consultants (PDC), received by NMG on April 5, 2019. The updated 60-scale grading plan was used as the base map to present the boring and CPT locations and the geotechnical mapping for the site on the Updated Geotechnical Map (Plates 1 through 4). The updated grading plan was also used as a base for the 100-scale Preliminary Remedial Measures and Ground Improvement Map (Plate 5). We have prepared four vertically exaggerated cross-sections to illustrate the general geotechnical conditions at the site, and fourteen 40-scale cross-sections to show details along the trolley, river and around the perimeter of the site (Plates 6 through 8).

Our scope of work was as follows:

- Acquisition, review and compilation of available geotechnical reports and maps for the subject site and surrounding area. A list of references is included in Appendix A. The Updated Geotechnical Map (Plates 1 through 4) provide a compilation of the boring and CPT locations at and adjacent to the site from this and previous geotechnical studies.

- Review of historic aerial photographs dating back to the late 1940s. A list of reviewed photographs is included in Appendix A.

- Review of the recently published (January 2018) City of San Diego Storm Water Standards. This document provided updates to geotechnical and groundwater investigation requirements and approved infiltration rate assessment methods for planning and design level selection.

- Site reconnaissance to identify the existing site conditions and mark boring and CPT locations prior to excavation. Notification and coordination with the onsite management and Underground Service Alert to identify and locate any underground utilities was performed prior to the field exploration. Drilling permits were also acquired through the County of San Diego for geotechnical borings and CPTs below the groundwater table. Based on conversations with the City of San Diego, a City permit was not required to drill.

- Drilling, sampling and logging of 31 hollow-stem auger borings (B-1 through B-29, P-1 and P-2) to depths of 16.5 to 81.5 feet. The borings were geotechnically logged and sampled. The approximate locations of our borings are provided on the Updated Geotechnical Map (Plates 1 through 4) and the logs are included in Appendix B.

- Advancement of CPTs at 43 locations throughout the golf course (CPT-1 through CPT-18 and CPT-20 through CPT-44). CPT-19 was not performed due to steep terrain and utility conflicts. Shear wave velocities were measured through four CPTs at 10-foot intervals to determine the seismic site class per 2016 California Building Code (CBC). The CPT depths varied from 6 to 86.4 feet bgs. The approximate locations of our borings are provided on the Updated Geotechnical Map (Plates 1 through 4) and the logs are included in the Appendix B.

- Laboratory testing of selected samples to classify the onsite soils, including grain size distribution, Atterberg limits, direct shear, consolidation, maximum density and optimum moisture content, hydraulic conductivity (permeability), R-value, expansion index, and soluble sulfate content. Laboratory test results by NMG and others are included in Appendix C, and the moisture density test results are included on the boring logs in Appendix B.

- Evaluation of faulting and seismicity in accordance with the 2016 CBC and the current standard of practice.

- Geotechnical review of the updated grading plan. The cross-sections (Plates 6 through 8) were updated to highlight the planned grading and the recommended remedial grading and ground improvement. The map and cross-sections were also updated to show the Limits of Remedial Grading.

- Geotechnical evaluation and analysis of the compiled data with respect to the proposed development and anticipated improvements. Geologic analysis included preparation of an updated geotechnical map and cross-sections. Prior data was compiled and boring logs for the recent exploration were prepared for inclusion in this report. Geotechnical evaluation included liquefaction and settlement analysis, groundwater conditions, slope stability analysis, preliminary grading recommendations, and alternatives for foundation and ground improvements. In addition, the potential for utilization of infiltration BMPs were evaluated based on the site conditions and the City of San Diego Storm Water Standard (2018). Slope stability analysis results are included in Appendix D, the seismic data in Appendix E, the liquefaction analysis in Appendix F and the General Earthwork and Grading Specifications in Appendix G.

- Preparation of this report with our findings, conclusions, and recommendations for the subject development. This report includes pertinent geotechnical maps, figures and appendices.

2.2 Site Location and Description

The project site encompasses the approximately 195-acre Riverwalk Golf Course, situated in the western portion of Mission Valley. The project site abuts Friars Road on the north; Fashion Valley Road on the east; a portion of Hotel Circle North and privately-owned developed property to the south; and Metropolitan Transit System and other privately-owned undeveloped property to the west. The San Diego River and a segment of Green Line Trolley traverse the central and northern portions of the project site in an east-west direction.

The site lies between 4 and 5 miles inland from the ocean. The golf course ground surface slopes gently toward the river, which curves through the central portion of the site. Elevations vary between 67 feet above msl along the northern side of the project, to a low of near 16 feet msl near the western river edge. The average (non-flood) river water level varies from 12 feet msl in the west to 15 feet msl in the east. The drainage sheet flows over the land surface toward the river, which flows to the west emptying into the ocean.

The site may currently be accessed at four locations:

- The maintenance facility in the northwest portion, off of Friars Road;

- Riverwalk Drive off of Fashion Valley Road that extends to the central portion of the site with the clubhouse and associated parking lot;

- Through a pump station site off of Hotel Circle North; and

- Through an equipment yard entrance off of Fashion Valley Road, north of Riverwalk Drive, that is a leased gravel covered lot.

There may be other entrances that we did not use during our investigation. The majority of the site is fenced with both chain link, and locally, with a higher netting fence for errant golf balls.

The San Diego Metro Green Line Trolley crosses the site subparallel to the river, approximately 400 to 800 feet north of the river. The trolley rail line was constructed on a raised berm across the site and is powered by overhead electric lines. There are two small existing under-crossing/tunnels large enough for two golf carts or landscape equipment carts. There are two bridges over the river which also can support golf carts and light weight vehicles.

The golf course is covered with turf and local trees and brush. There are three nine-hole courses, including the Friars Course in the north, the Presidio Course in the middle-western area, and the Mission Course in the south. There are numerous sand traps, water features, irrigation pipes and sprinklers throughout the course. We understand that in the past, the majority of the irrigation water has come from two wells onsite, with supplement from domestic water. Both of these wells may no longer be in service due to brackish conditions of the groundwater. We also understand that approximately 500,000 gallons of water is used to irrigate the course daily during dry months and less during winter.

There are numerous existing utilities at the site. There is an abandoned sewer line that crosses the North District in an east-west direction, and several electric and water lines that cross the site. There are also several sewer and water lines that run along Riverwalk Drive into the site, and an active 78-inch trunk sewer line that parallels the trolley on the south.

2.3 Site History and Prior Investigations/Grading

Based on historic aerial photographs dating back to the 1930s and historic topographic maps dating back to the early 1900s, the following site history can be detailed:

- The earliest topographic map obtained was from 1903. The natural river channel appears in roughly the same location as it is today. A two-lane road was in place near the current location of Interstate 8 (I-8), and a second two-lane road was in place near Friars Road. There were two structures along the south side of Friars Road, in the northern portion of the site.
- In 1941, the site appears to be in its natural condition, with the main river channel in its present location. The channel appeared wider with several small meanders. The area north of the river up to Friars Road is higher in elevation, and the limits of the river terrace materials can be mapped from the difference in relief.
- In 1946, the site looked roughly plowed with several small circular features, which were in similar locations of the golf course greens in the later photos. There was a structure to the south, near the present day Handlery Hotel. There were also several small bridge crossings over the river channel.
- By 1953, the I-8 freeway appears to have been constructed to the south of the site. The site had a hummocky appearance in the photos, with several different water features. The 1953 topographic map shows a channel of the river in the southwest corner of the site, extending subparallel to the four-lane I-8 freeway.
- By 1958, a portion of the golf course was constructed and the river was channelized.
- In 1964, the Stardust Hotel was constructed and there was a graded golf course in the vicinity of the Presidio and Mission Courses (the Central and South Districts), with some holes in the Friars Course (North District). There were a couple of buildings near the present-day maintenance facility off of Friars Road. Hotel Circle North was also constructed.
- In 1974, Friars Road was widened and locally realigned along the northern property boundary. The small retail and apartment development in the northeast and the apartments in the south were constructed.
- In 1994, the trolley was not yet constructed; however, the 1996 topographic map shows the trolley rail line in-place across the site. In 1996, there was a new large water feature to the north of the Stardust hotel and the golf course remained similar to the 1964 to 1974 conditions.
- By 2005, the golf course was re-graded to near the existing conditions, with the river and water features in the existing conditions. The golf clubhouse, associated parking lot and Riverwalk Drive were constructed. The golf course was graded with cut and fill depths typically about 5 to 15 feet. The Presidio Apartments along the southern boundary were under construction.

We have compiled and reviewed the data from numerous geotechnical studies performed at and near the site. A summary of the reports obtained and the investigations performed is presented below. A complete reference list is provided in Appendix A. The boring and CPT logs by others are included in Appendix B of this report and the laboratory data by others is included in Appendix C.

- Woodward Clyde Consultants (1975) performed a geotechnical investigation for the Friars Village Condominiums (now Mission Greens) to the northeast of the site. They drilled seven flight-auger borings to depths of 6 to 34 feet. A supplemental investigation was prepared in 1977 (WCC, 1977a); however, the boring logs from this investigation were not available for our review.

- Woodward Clyde Consultants (1977b, and 1977c) also performed geotechnical observation and testing during grading for the same condominiums, known as Mission Greens. They recommended a mat of compacted fill under the buildings and spread footings for the foundations.

- In 1995 and 1997, there were two investigations by Leighton and Associates, including two borings for the golf clubhouse and four borings for the pedestrian bridge additions. The borings were drilled to depths of between 18.5 and 83 feet deep. Their final as graded report (2001) indicates the areas were graded, and the building and bridge structures were supported on pile foundations.

- Geocon, Inc. (1998) performed a geotechnical investigation for the Handlery Hotel and Proposed Apartment Complex along Hotel Circle North. Their preliminary investigation included drilling of three rotary wash borings to depths of 52 to 56 feet.

- Geocon, Inc. (2003) performed additional investigation for the Presidio View Apartments next to the Handlery Hotel. This investigation included drilling of four additional rotary wash borings to depths of 21.5 to 36.5 feet.

- Between 1998 through 2003, Shepardson Engineering Associates, Inc. performed an investigation for a commercial development within the northeast portion of the site, in the area of the currently leased equipment yard. They drilled eight hollow-stem borings to depths of between 5.5 and 90.5 feet at two different times. Their compaction report (2001) indicates the upper portion of the alluvium was removed down to 2 feet above the groundwater or near elevation of 15 feet msl and compacted fill was place to near existing grade.

- Group Delta (2014a) performed a preliminary geotechnical investigation for the Riverwalk Development that covered the area north of the San Diego River, North and Central Districts. They drilled five rotary wash borings (23 to 56.5 feet deep) and ten CPTs (11 to 74 feet deep) throughout the northern portion of the site.

- Group Delta (2015) later performed a more detailed investigation for the western portion of the North District, north of the trolley line. In this area, they drilled another five rotary wash borings (23 to 51.5 feet deep) and 10 CPTs (11 to 81 feet deep).

2.4 Proposed Conceptual Development and Grading

The Riverwalk project proposes an amendment to the existing Levi-Cushman Specific Plan to replace the 195-acre Riverwalk property with the Riverwalk Specific Plan and redevelop the existing golf course as a walkable, transit-centric, and modern live-work-play mixed-use neighborhood that features an expansive River Park along the San Diego River. The mix and quantity of land uses would change from what is approved in the existing Levi-Cushman Specific Plan to include 4,300 multi-family residential dwelling units; 152,000 square feet of commercial retail space; 1,000,000 square feet of office and non-retail commercial; approximately 95 acres of park, open space, and trails; adaptive reuse of the existing golf clubhouse into a community amenity; and a new Green Line Trolley stop within the development. Improvements to surrounding public infrastructure and roadways would be implemented as part of the Riverwalk project, including improvements to the Fashion Valley Road crossing of the San Diego River as a 10- to 15-year storm event crossing. The project would also include a habitat restoration effort on-site to create and/or enhance 25.16 acres of native habitats along the San Diego River, within and adjacent to the MHPA, and setting aside area for establishing a future wetland habitat mitigation bank.

The project would establish Irrevocable Offers of Dedication (IODs) for two Community Plan Circulation Element roadways envisioned in the Mission Valley Community Plan Update: future Riverwalk Street "J," which would cross the San Diego River in a north-south direction; and future Riverwalk Street "U," which would travel approximately east-west along the southern project site boundary and connect to future Street "J." Street "J" would be an elevated roadway crossing the river valley. Per the City’s Planning Department, these roads are regional facilities with uncertain funding, design, and construction timing. While these improvements would not be constructed as part of the project, the project would grant the City IODs for the required rights-of-way to construct these roads in the future.

The mixed-use residential buildings in the North and Central Districts will typically consist of large, three- to seven-story wood-framed buildings, with either separate internal parking structures (wrap product) or built over two levels of concrete parking structure (podium product). We understand that several pools, spas and landscape areas are planned around the multi-family buildings. There are also areas of neighborhood retail and a trolley station in the central portion of the site that may include smaller wood-framed structures or retail below multi-family housing. Per the current plan, there are two trolley crossings, one at-grade to the east and one bridge to the west. The existing Riverwalk Drive will be slightly realigned and extended to the western property line. Access to the North and Central Districts will be from Friars Road and Fashion Valley Road.

We understand the commercial buildings in the South District are planned to be 6 to 15 stories, constructed of concrete, steel and/or wood-framed structures, with two large parking structure and at-grade parking lots. Access to the South District site will be from Fashion Valley Road and Hotel Circle North.

The proposed trolley bridge will consist of a prefabricated bridge supported on four cast-in-drilled-hole (CIDH) piles. We understand that after the bridge is constructed the opening below the bridge will be excavated to planned street grades. The abutments are proposed to be formed utilizing soil nail walls or tieback anchors using shotcrete and top-down construction.

The proposed park will include a network of trails and non-habitable structures, such as parking lots, trellis/shade structures, picnic areas, restroom buildings, etc. The actual layout of structures in the park area is not finalized at this time. However, we understand the two existing bridge/ river crossings will remain as part of the park development. Access to the park will be from Fashion

Valley Road. The existing clubhouse building will also remain as a community building. The two bridges and the clubhouse building are supported on pile foundations.

The overall grading will consist primarily of design fill of up to 25 feet above existing topography to create pads. There are design cuts within the North and Central Districts, both in the buildings and for the pads below Friars Road and the Trolley. These design cuts will be up to 13 feet deep. Design cuts up to 21 feet and fills up to 4 feet are proposed for the parks. The preliminary grading plan shows a fill slope extending down to existing elevations at an inclination of 2H:1V along the river that is up to 20 feet high. There will likely be some cut slopes or retaining walls in the cut areas.

The building pads will be graded to minimum elevations of 31 feet above msl in the Central District, and 32 feet msl in the South District in order to bring the pads above the flood levels. In addition, there will be cuts made in the park near the river. This grading will allow the river to be contained in the park area below the proposed development during rainy periods.

The Fashion Valley Road culvert/bridge crossing over the San Diego River is anticipated to consist of a precast concrete arch. The arch will provide a long-span, low-rise, open bottom river crossing and will likely be supported on ground improvements.

The main changes to the plan since our addendum report (NMG, 2018) include:

- The addition of the park grading to the grading plan in the Central and South Districts;
- Addition of a trolley bridge with a road undercrossing, connecting the North District to the western portion of the Central District;
- Addition of a bridge/culvert at Fashion Valley Road, where it crosses the San Diego River;
- Minor changes to the pads and parks in the North District;
- Shifting of the building pads and the addition of two parks to the Central District; and
- Modification to the building layouts in the commercial area.

2.5 Field Investigation

Our field investigation performed at three different times (in 2014, 2017 and 2019) consisted of excavation of thirty-one 8-inch-diameter, hollow-stem auger borings to depths of 16.5 to 81.5 feet bgs. The borings were geotechnically logged, and samples were taken at selected intervals. Relatively undisturbed soil ring samples were obtained from the exploratory borings with a 2.5-inch-inside-diameter, split-barrel sampler. The samplers were driven into the soil with a 140-pound automatic safety hammer, free-falling 30 inches. The drive samples were also used to obtain a measure of resistance of the soil to penetration (recorded as blows-per-foot on our geotechnical boring logs). Representative bulk samples of onsite soil were collected from the drill cuttings and used for additional soil identification purposes. The approximate locations of the borings are shown on Plates 1 through 4 and the logs are presented in Appendix B.

NMG also advanced 43 CPT soundings (CPT-1 through CPT-18, and CPT-20 through CPT-44) to depths of up to 86.4 feet bgs. CPT-19 was not performed due to access restrictions and existing utility conflict. NMG used the continuous CPT data for identifying the soil stratigraphy and for evaluating liquefaction, and seismic and static settlement potential. Seismic cones were used on CPT-7, CPT-17, CPT-32, and CPT-41 to collect shear-wave velocities at 10-foot intervals down to 67, 86, 67, and 76 feet, respectively. We were planning to measure the shear wave velocities to depths of 100 feet, but were not able to due to shallower refusal. The approximate locations of the CPT soundings are shown on Plates 1 through 4. CPT logs and shear wave velocity measurements are presented in Appendix B.

The borings and CPTs were backfilled with bentonite grout and/or neat cement. The only exceptions are in a few shallow borings where groundwater was not encountered, these borings were backfilled with cuttings. The borings and CPTs in the parking lot were capped with an asphalt patch where drilled within pavement areas.

2.6 Laboratory Testing

We performed laboratory testing on representative samples of onsite soils collected during our field exploration to characterize their engineering properties. Laboratory tests performed on selected relatively undisturbed and bulk soil samples included:

- Moisture content and dry density;
- Grain-size distribution;
- Atterberg limits;
- Direct shear (undisturbed and remolded samples);
- Consolidation;
- Soluble Sulfate;
- Expansion Index;
- R-Value;
- Permeability testing; and
- Maximum dry density and optimum moisture content.

Laboratory tests were conducted in general conformance with applicable American Society for Testing and Materials (ASTM) standard test methods. Laboratory test results for this study are provided in Appendix C. In-situ moisture content and dry density data are included on the geotechnical boring logs (Appendix B).

3.0 GEOTECHNICAL FINDINGS

3.1 Geologic Setting and Soil Mapping

The site is located within the Peninsular Range Geomorphic Provence of southern California. This province is characterized by a series of northwest trending mountain ranges, separated by northwest trending faults. The area is underlain by sedimentary deposits of Eocene-, Pliocene-, Pleistocene-, and Holocene- age. The site is located near the San Diego embayment, which is characterized by marine, lagoonal and non-marine deposits.

The golf course is located in a wide alluvial valley referred to as Mission Valley, along the lower reaches of the San Diego River, approximately 4 miles inland from the coastline (Pacific Ocean). The river valley is broad in this location with hillsides to the north and south extending up to higher mesas. The valley was down cut significantly in the past during a time of low sea level, as evidenced by the deep alluvium to elevations of nearly minus 80 feet (below current day sea level). As sea level has fluctuated during the late Quaternary era, several levels of alluvium have been deposited and then eroded so that there is older alluvium underlying the younger Holocene-age alluvium and there are older river terrace deposits remaining along the northern side of the canyon.

Based on soil mapping by the U.S. Department of Agriculture (USDA), the near-surface soils over the low-lying portions of the site are comprised of Tujunga sand. This material is generally granular and subject to erosion. Soils along the northern, higher elevations of the site are mapped as the Huerhuero-Urban land complex. These soils are formed on marine terraces and consist primarily of clayey loam and sandy loam.

3.2 Earth Units

The earth units encountered in our borings include young alluvium, older alluvium, river terrace deposits and bedrock, which is believed to be the Scripps Formation. Artificial fill associated with golf course use overlies these native deposits. The earth units that were encountered are described below, in the order of oldest to youngest. The approximate limits of these earth units are shown on the Updated Geotechnical Map (Plates 1 through 4) and Cross-Sections (Plates 6 through 8).

Bedrock: Our original report (NMG, 2017) included the older geologic mapping by Kennedy (1975) and is included herein as Figure 2A. We have reviewed the more recent mapping by California Geological Survey (CGS) and the U.S. Geological Survey (Kennedy and Tan, 2008). This new mapping is presented on Figure 2B. The 2008 map shows the onsite geology essentially the same as the prior mapping by Kennedy (1975). However, some of the geologic mapping has changed to the north of Friars Road. The bedding attitudes to the north of the site were modified, but the bedding still generally strikes north and dips 5 to 7 degrees east.

The previously mapped Bay Point Formation, as shown on Kennedy (1975) to the northwest of the site, is now mapped as the Nestor marine terrace deposit (Qop6), which also indicates this unit is about 120,000 years old with basal elevations of 33 to 72 feet msl. Therefore, we conclude that a different bedrock formation, other than the Bay Point Formation (NMG, 2017), underlies the site at depth. The very dense sandstone bedrock encountered in some of the borings may be another bedrock unit, such as the Scripps Formation (Tsc). The previously published boring logs in

Appendix B may indicate the Bay Point Formation and the newer boring (B-29), the Scripps Formation. This bedrock will not be encountered during future grading or construction. The change in formation name does not impact our geotechnical evaluation and analysis.

Bedrock was encountered at depth below the terrace deposits or alluvium in borings drilled by NMG, including B-5 drilled near Friars Road, B-24 drilled near the clubhouse, and B-29 drilled in the western portion of the Central District. Borings SB-4 and SB-102 drilled by others in the northeast portion of the site were also excavated deep and encountered bedrock below the alluvium. The bedrock consists of yellow brown to dark gray silty fine to medium sandstone that is very moist and dense. The bedrock in our Boring B-5 had abundant bivalve shell fossils.

River Terrace Deposits (Qtr) were encountered throughout the northern central portion of the site within much of the North District and a portion of the Central District and were encountered in Borings B-2, B-4, B-5, B-6, B-7, B-8, B-20, B-23 and B-24. The limits of these deposits are shown on Plates 1 and 2 and were defined by the density and composition of the materials, higher ground elevations, and review of historic aerial photographs prior to development in the area. Others have identified this earth unit as older alluvium. This earth unit is mapped as general alluvium by CGS (Figures 2A and 2B). However, due to the density and the cemented and/or cobbly nature of the materials, we opted to designate these materials as river terrace deposits. However, due to the proximity to the ocean, the terrace deposits are likely a mixture of terrestrial and shallow marine sourced material.

The river terrace deposits were typically dense to very dense and consisted of reddish-brown to yellowish-brown silty and clayey fine to coarse-grained sand that was moist and very dense. Fine to coarse subrounded gravels and cobbles were present throughout this unit. The drill and CPT rigs had refusal in most borings in the terrace deposits at depths of 12 to 30 feet deep. We were able to drill one boring (B-5) to a depth of 61 feet; however, the auger was broken from the drilling stem and the rig was down for four days to repair. This deeper boring encountered bedrock below the river terrace deposits. Bedrock is believed to underlie the river terrace deposits throughout most of this mapped unit.

Older Alluvium (Qalo) was encountered at depth (between 50 and 75 feet deep) in several of our borings (B-3, B-12, B-13, B-14, B-15, B-17, B-21, B-22 and B-28) below the younger alluvium (see cross-sections on Plates 6 through 8). This older material varied in composition from sandy silt, silty sand, and gravelly sand that was generally denser than the overlying younger alluvium.

Alluvium (Qal) was the most prevalent earth unit throughout the site. Alluvium was encountered to the bottom of Borings B-1, B-3, B-9 through B-27, P-1 and P-2. Alluvium underlies the majority of the site to depths of 50 to 90± feet bgs. The alluvium consists of loose to medium dense fine-grained clayey sand, silty sand and clean sand that is highly micaceous. In the western portions of the North and South Districts (Borings B-1 and B-15), there are layers of dark gray sandy clay near and below sea level elevation (-5 to -35 feet msl), that have numerous gastropod shells. These interlayers are believed to be estuary muds that were deposited during ancient times of low sea level. There are also few local layers of gravelly sand in the alluvium. The younger alluvium is underlain by older alluvium, terrace deposits and/or bedrock.

Artificial Fills: There are several different generations of artificial fills on site, including the undocumented fill and three generations of compacted fill. Shallow undocumented fills **(Afu)** on the order of 2 to 15 feet thick associated with the golf course contour grading exists within most of the site. We understand that the golf course has been regraded several times over the past 70 years. During grading of the golf course clubhouse, parking lot, entry street and bridges, compacted fill **(AfL)** was placed under the observation and testing of Leighton and Associates (2001). We obtained the report for this grading, but it did not have a map showing the limits of fill, and therefore, the limits shown on Plate 1 are considered approximate. Around the same time period, fill materials **(Aft)** were placed across the site for construction of the trolley improvements. The report documenting the trolley grading was not obtained, this fill was mapped based on contours and appears to be a compacted fill berm with slopes up to 25 feet high along the sides of the tracks. The fills generally consist of medium dense silty or clayey sand, with significant amounts of gravel and cobble, locally.

The compacted fill encountered in the northeast portion of the site **(Af)** and within the eastern pad on the North District (encountered in Borings B-9, P-2, CPT-15 through CPT-18), consisted of silty and clayey sand with local gravel and cobbles. This fill was compacted to a minimum 90 percent relative compaction under the geotechnical observation and testing of Shepardson Engineering (2001). This fill extended to depths of up to 20 feet and was generally dense, except for the upper 1 to 2 feet that was weathered and dry.

3.3 Groundwater and Surface Water/Flood Potential

Groundwater: The subject site lies within the Mission Valley Groundwater Basin, in the east-west trending valley drained by the San Diego River. The primary source of groundwater recharge to this basin is the infiltration of the river flow and golf course irrigation. There are two groundwater wells located in the eastern portion of the site, Well-1 and Well-2, just south of the river, which have been historically used for irrigation of the golf course. Based on prior studies, Well-1 was being pumped at rates of 575 gallons per minute (Worley Parsons, 2013) and is slightly brackish. This water is supplemented by cleaner domestic water. Approximately 500,000 gallons of water per day is reportedly used for irrigation of the golf course during dry periods.

Groundwater was encountered during drilling of borings into the alluvium. Groundwater was encountered at depths of 5 to 10 feet bgs near the river and between 10 and 25 feet bgs away from the river. Across the site, groundwater varied in elevation from approximately 6.0 feet msl to 15.0 feet msl in the alluvium.

Borings B-6, B-7 and B-8 drilled into the dense river terrace deposits to depths of up to 26.5 feet did not encounter groundwater. This is most likely due to the higher ground elevations and shallow refusal depths. Boring B-5 was drilled through the terrace deposits in which the groundwater was encountered at 47 feet bgs, at an elevation of 11 feet msl. Groundwater was also encountered in Borings B-2 and B-4 drilled into the terrace deposits at depths of 11 and 25.6 feet (elevations of 14 and 6 feet msl), respectively.

The groundwater table fluctuates both seasonally and annually. Based on review of available GeoTracker data along Friars Road, groundwater levels have been monitored over the past several years and were found to fluctuate depending upon the season and annual rainfall. Groundwater ranges from 22 to 35 feet deep to the east, near the intersection of Friars Road and Fashion Valley Road. Groundwater was found to fluctuate up to 3 feet, recorded quarterly between 2003 and 2009. Also, based on review of onsite boring data drilled over the years, the groundwater appears to vary 3 to 4 feet from high to low levels.

Surface Water and Flood Potential: Based on U.S. Federal Emergency Management Agency mapping (USFEMA, 2012), a large portion of the site is delineated as a Special Flood Hazard zone and is subject to inundation. This zone is subject to 1 percent annual chance flood (100-year flood), also known as the base flood. This zone covers small portions of the North District, large portions of the Central District except those underlain by river terrace deposits, and all of the South District. Development in these zoned areas are planned to be raised above flood level elevations of 24 feet msl at the west end of the site, to nearly 30 feet msl near the east end.

There are numerous accounts of the area being flooded dating back to the 1800s. Coastal San Diego County is subject to sudden and severe floods. Mean seasonal precipitation varies with elevation from about 10 inches along the coast to 35 inches in the mountains. As recently as 2010, there was a 100-year flood event that covered most of the golf course south of the trolley line. This flood was well documented with photographs.

During our most recent investigation in 2019, there were several heavy rain events during which the San Diego River overtopped the river bank, flooding the lower elevation portions of the golf course and creating temporary water features in the western portion of the site.

3.4 Regional Faulting and Seismicity

Faulting: There are no major or active faults mapped at the subject site by NMG or others. The site is not located within a fault-rupture hazard zone as defined by the Alquist-Priolo Special Studies Zones Act (CGS, 2018) or within an active or potentially active fault zone defined by the City of San Diego (2008).

There are several regionally active faults that could produce an earthquake that results in ground shaking at the site. The closest seismically active faults are the north-south trending Rose Canyon Fault located 1.75 km (approximately 1 mile) to the west and the Coronado Bank Fault located 22 km west (offshore), as shown on Figure 3 (Jennings and Bryan, 2010). Based on the USGS Deaggregation program (USGS, 2017), the Rose Canyon Fault is the controlling fault for seismic design. The Rose Canyon Fault is mapped within a Fault Rupture Hazard zone as defined by CGS, to the north and south of Mission Valley, but not across Mission Valley. The other regionally active, more distant faults that could produce ground shaking at the site include, but are not limited to, the Elsinore, San Jacinto, and San Andreas Faults.

Seismicity: Properties in southern California are subject to seismic hazards of varying degrees depending upon the proximity, degree of activity, and capability of nearby faults. These hazards can be primary (i.e., directly related to the energy release of an earthquake such as surface rupture and ground shaking) or secondary (i.e., related to the effect of earthquake energy on the physical world, which can cause phenomena such as liquefaction and ground lurching). Since there are no active faults at the site, the potential for primary ground rupture is considered very low. The primary seismic hazard for this site is ground shaking due to a future earthquake on one of the major regional active faults listed above.

Using the USGS computer program (USGS, 2017) and the site coordinates of 32.7653 degrees north latitude and -117.1794 degrees west longitude, the controlling fault for the site is the Rose Canyon Fault, with the maximum moment magnitude of 6.8 M_W.

Based on CPTs by NMG and others, the average shear wave velocity of the underlying soils up to 87 feet bgs varies from 600 to 800 feet per second (ft/sec) in alluvium, and up to 1,400 ft/sec in the dense river terrace deposits. Per the 2016 CBC, the underlying soils may be classified as Site Class D.

Secondary Seismic Hazards: The City of San Diego Seismic Safety Study, Geologic Hazards and Faults dated April 3, 2008 (City of San Diego, 2008) has mapped the alluvium in the valley as having a high potential for liquefaction, based on "shallow groundwater" in "major drainages" (Figure 4). Based on this document, a geotechnical investigation is required to evaluate the potential for liquefaction in accordance with California Building Code and State Guidelines. Liquefaction is discussed in detail in Section 3.7.

The potential for other secondary seismic hazards, such as tsunami and seiche, are considered very low, as the site is located away from the ocean and is at an elevation of 16 feet or higher above msl. The project is located outside of the mapped tsunami inundation zones (CGS, 2009). The site is not located adjacent to a confined body of water; therefore, the potential for seismic hazard of a seiche (an oscillation of a body of water in an enclosed basin) is considered very low.

3.5 Laboratory Testing and Soil Properties

Laboratory tests performed on selected relatively undisturbed soil samples include in-situ moisture content and dry density, grain-size distribution, Atterberg limits, consolidation and direct shear. Laboratory tests performed on selected bulk samples include maximum density and optimum moisture content, grain size distribution, Atterberg limits, permeability, R-value, expansion index and soluble sulfate content. Laboratory tests were conducted in general conformance with applicable ASTM International standards and the results are presented in Appendix C. In-situ moisture and dry density results are included on the geotechnical boring logs (Appendix B).

The onsite alluvium predominantly consisted of silty, clayey and clean sands with moisture contents and dry densities ranging from 3.4 to 54.5 percent and 76.2 to 123.7 pounds-per-cubic-foot (pcf), respectively. Blow counts in this material varied from 5 to 100+ blows per foot. Interlayers of sandy silt and silty clay were also encountered in the borings, with moisture contents and dry densities ranging from 16.6 to 48.0 percent and 71.9 to 111.0 pcf, respectively, with blow counts in the range of 2 to 42 blows per foot. Both the sandy and fine-grained material encountered were generally moist to wet above the groundwater table, and saturated below.

The older alluvium and river terrace deposit materials generally consisted of gravelly, silty and clayey sands that have higher density and lower moisture than the younger alluvium. Moisture contents and dry densities varied from 3.4 to 54.5 percent and 71.6 to 144.5 pcf, respectively, with blow counts varying between 19 to 100+ blows per foot. These materials were generally moist to very moist above and saturated below the groundwater table.

Moisture contents within bedrock ranged from 15.6 to 32.6 percent and dry densities ranged from 101.4 to 110.4 pcf, with blow counts between 75 and 100+ blows per foot.

Grain Size Distribution: Grain-size distribution tests were conducted on 64 bulk and/or ring samples. Of these samples, 32 samples were classified as poorly or well-graded sands with fines contents (passing Sieve No. 200) of 12 percent or less (USCS classification of SW, SP, SW-SM, or SP-SM). Twenty-four of the samples were classified as silty or clayey sands with fines contents in the range of 16 to 44 percent (USCS classification of SM or SC). Eight of the samples were classified as sandy silts and clays (USCS classification of ML, CL, and CH) with fines contents in the range of 59 to 82 percent.

The Atterberg limits test was performed on 17 samples. The samples had liquid limits in the range of 29 to 53 percent and plasticity indices in the range of 14 to 35. Eight samples were non-plastic.

Maximum Density and Optimum Moisture Content: The results of the maximum dry density testing indicate that the near-surface soils, at depths of 0 to 5 feet, have maximum dry densities ranging from 107.0 to 129.0 pcf with optimum moisture contents of 9 to 14.0 percent.

Consolidation: The consolidation test results indicate relatively low consolidation potential for the onsite native silty sand and sandy soils. Some of the more clayey and silty layers had moderate consolidation potential; however, these layers are relatively thin and not continuous. Also, the soils had collapse potential of less than 0.67 percent and swell potential of less than 0.1 percent upon addition of water at 1.6 and 3.2 kilo pounds per square foot (ksf).

Shear Strength: Direct shear testing was conducted on five relatively undisturbed ring samples and two remolded samples in order to evaluate the strength properties of the subsurface materials at the site. The direct shear test results on the undisturbed sandy soil samples indicate ultimate internal friction angles of 28 to 32 degrees with cohesions of 0 to 100 pounds-per-square-foot (psf). The samples have peak internal friction angles of 31 to 42 degrees with cohesions of 0 to 300 psf. The direct shear test results on the remolded poorly graded sand samples indicate ultimate internal friction angle of 28 and 29 degrees with a cohesion of 100 and 50 psf, respectively. The remolded samples had peak internal friction angles of 27 and 28 degrees with cohesions of 200 and 100 psf, respectively.

R-Value: One sample collected near-surface in Boring B-1 had an R-value of 6. Laboratory testing by others (Geocon, 2003 and Group Delta, 2014a and 2015) had R-values ranging from 11 to 75.

Expansion Potential: Our laboratory test on near-surface soil samples indicates expansion indices varying from 0 to 54, which indicates an expansion potential in the "Very Low" to "Medium" range. Prior laboratory testing (Geocon, 2003, and Group Delta, 2014a and 2015) on soil samples taken at the subject site, obtained expansion index values that varied from 0 to 23, which indicate expansion potential in the "Very Low" to "Low" range in accordance with ASTM D4829 test method.

Soluble Sulfate: Laboratory testing of the soil samples by NMG and others (Geocon, 2003 and Group Delta, 2014a and 2015), indicates that the soluble sulfate exposure of onsite soils are classified as "S0" to "S1" per Table 19.3.1.1 of ACI-318-14. Also, based on review of the previous laboratory test data by others (Leighton, 1997, Geocon, 2003 and Group Delta, 2014a and 2015), the onsite soils are considered to be corrosive to severely corrosive to ferrous metals.

Shrinkage and Bulking: Based on the laboratory test results, we anticipate that the river terrace deposits will bulk on the order of 1 to 5 percent and the alluvium will shrink on the order of 5 to 15 percent when excavated and recompacted to 90 percent relative compaction. Excavation and recompaction of the existing fills are anticipated to vary from 2 percent shrinkage to 2 percent bulking. The amounts are preliminary at this point and should be further evaluated during future investigations and earthwork studies.

Permeability Testing: As part of the permeability evaluation, grain-size distribution tests were conducted on seven selected samples collected within the relatively sandy alluvium. The fines content (passing No. 200 sieve) varied from 4 to 64 percent.

Maximum density and optimum moisture content testing was performed on three near-surface (upper 5 feet) bulk samples in order to remold samples to 90 percent relative compaction, representative of the future compacted fill. The samples had maximum dry density and optimum moisture contents ranging from 107 to 127.5 pcf and 10 to 14 percent, respectively.

These three bulk samples were compacted to approximately 90 percent of the maximum dry density to simulate compacted fill. Permeability testing was then performed on these three compacted samples for evaluation of shallow fill materials with respect to storm water infiltration. One sample (Boring B-27, Sample B-1) was tested per ASTM D-2434, due to its low fines content. Two additional samples (Boring B-19, Sample B-1 and Boring B-26, Sample B-1) were over the 10 percent fines criteria (per ASTM D-2434) and were tested per ASTM D-5084. Based on the results of these tests, the hydraulic conductivity (permeability) was found to range from 0.027 to 1.01 inches per hour.

Available laboratory test results from reports of previous investigations by others are also included in Appendix C, including Woodward Clyde (1975), Leighton and Associates, Inc. (1995 and 1997), Shepardson (1998 and 2003), Geocon (1998 and 2003), and Group Delta (2014a and 2015).

3.6 Slope Stability

Permanent Structural Slopes: There are planned 2H:1V fill slopes up to 20 feet high in the Central and South Districts. These slopes are underlain by alluvium and shallow groundwater. The alluvium is potentially liquefiable and is subject to lateral spread. We have performed preliminary slope stability analysis considering static, seismic induced liquefaction (strength loss), and liquefaction-induced post-seismic flow conditions. The proposed slopes are considered stable under static conditions, with a factor-of-safety greater than 1.5, provided the remedial grading recommendations included in this report are implemented during grading of the site. However, as discussed previously, ground improvement will need to be performed for these structural slopes in order to address the seismic induced lateral spread and flow conditions as a result of liquefaction. Using a design peak ground acceleration of 0.37g (2/3 of Mapped MCE Geometric Mean Peak

Ground Acceleration) and considering the layers with strength loss as a result of liquefaction, our preliminary assessment is that ground improvement on the order of 50 feet below the toe of the slopes will be necessary to provide adequate factor of safety (greater than 1.0) under a strong shaking event. Ground improvement is anticipated to significantly reduce the potential lateral spread at the site and provide stable conditions and address the flow liquefaction. Our analysis was performed using the data presented on Cross-Section 7-7'. A more detailed evaluation and additional analysis will need to be performed at the design level study.

Permanent Park Slopes: There are minor slopes planned in the river park, generally less than 15 feet high and at inclination of 3H:1V or flatter. These slopes are considered grossly stable. The slopes are subject to erosion during flooding; however, we understand they will be landscaped or planted with vegetation for protection.

Temporary Slopes: Temporary excavations will expose varying earth materials, including compacted fill, undocumented golf course fill, alluvium and terrace deposits. Many of the planned excavations will be made during remedial grading and are anticipated to be up to 20 feet high and most will extend down to near the groundwater table. The temporary slopes exposing compacted fill or river terrace are anticipated to be more stable and may be cut at angles of 1H:1V. Temporary slopes in alluvium are anticipated to be subject to slope failure especially if groundwater and/or clean sands are encountered. Several 40-scale cross-sections were prepared around the perimeter of the site and next to the trolley line to show the existing conditions and the temporary slopes needed during remedial grading. We have analyzed the temporary slope stability associated with the remedial removals and grading as shown on Cross-Section 15-15'. This cross-section represents the highest temporary cut slope below the trolley line. Our analysis indicates that for the temporary conditions, the slopes associated with grading and remedial removals next to the trolley line will have a minimum factor-of-safety of 1.37. The slope stability analysis is included in Appendix D of this report.

Temporary slopes should be excavated at slope angles as shown on the cross-sections. The excavations for remedial grading below the trolley fill embankments, including the ones for the proposed bridge and Friars Road, will need to be evaluated closely prior to and during grading. Shoring and other methods of slope stabilizations should be evaluated at the design level study.

Some of the building excavations are anticipated to expose compacted fill, trolley fill and lesser amounts of native soils (terrace and alluvium). These excavations are believed to be above the groundwater table. Where the perimeter building excavations cannot be laid back to 1H:1V in the terrace and fill or 1.5H:1V in the alluvium, the excavations will need to be shored. Some of these excavations are close to the existing roads, trolley, utilities, and other existing improvements. Shoring should be designed for minimal lateral movements. Monitoring of the adjacent improvements should be considered prior, during, and at the completion of excavation and backfill.

3.7 Liquefaction Analysis and Seismic Settlement/Lateral Spread

General Discussion: Liquefaction is a phenomenon in which earthquake-induced cyclic stresses generate excess pore-water pressure in low density (loose), saturated, sandy soils and soft silts below the water table. This causes a loss of shear strength and, in many cases, ground settlement. For liquefaction to occur, all of the following four conditions must be present:

- There must be severe ground shaking, such as occurs during a strong earthquake.
- The soil material must be saturated or nearly saturated, generally below the water table.
- The corrected normalized standard penetration test (SPT) blow counts (N_1) or the CPT tip resistance (Q) must be relatively low.
- The soil material must be granular (usually sands or silts) with, at most, only low plasticity. Clayey soils and silts of relatively high plasticity are generally not subject to liquefaction.

There are four possible adverse consequences of liquefaction of sandy soil layers that are addressed below:

- Liquefaction-induced settlements;
- Loss of bearing and other disruptions of the ground surface (sand boils);
- Lateral spreading; and
- Global slope instability due to flow liquefaction or lateral spread.

Based on the County of San Diego Guidelines for Determining Significance of Geologic Hazards (2007), liquefaction is not known to have occurred historically in San Diego County, although has occurred in the Imperial Valley in response to earthquakes with a magnitude of 6 or higher. Historically, seismic shaking levels within the County have not been sufficient to trigger liquefaction. Based on mapping by the City of San Diego, the site lies within a potential liquefaction area (Figure 4).

Investigation and Analysis: The liquefaction potential at the site was assessed based on 43 CPTs (CPT-1 through CPT-18 and CPT-20 through CPT-44). The nearby hollow-stem auger borings as well as the prior data included in the reports by others were utilized to verify the empirical soil material descriptions presented on the CPT logs.

Our liquefaction potential assessment was performed using the computer program CLiq version 2.2.0.18 developed by Geologismiki which provides results and plots of the calculations. The liquefaction potential analysis is performed using the Robertson (2009) method. We also implemented the depth weighting factor for calculation of the equivalent volumetric strain of the soil profile included in the program and per the study by Cetin, et. Al. (Cetin, 2009). The program provides the basic CPT data interpretation through final plots of factor of safety, liquefaction potential index and post-earthquake displacements including vertical settlement. The design groundwater levels used are shown on the liquefaction analysis included in Appendix F.

Laboratory testing consisting of grain size distribution and Atterberg limits was performed to verify the classification of soil materials at locations where misclassification of soil types from CPTs was suspected. Soil materials were collected through hollow-stem auger borings. The liquefaction potential of the onsite soils was estimated based on a site peak ground acceleration of 0.55g and a maximum earthquake magnitude of 6.8, as determined in our site seismicity analysis discussed in Sections 3.4 and 4.17.

Based on the results of our analysis, the liquefaction potential at the site is considered moderate. In general, the potentially liquefiable soil layers consist of younger alluvial soils that were deposited at the site during the meandering of the San Diego River and during the flooding events as discussed in Section 3.3. The liquefiable layers generally range from 0.5 to 2.5 feet thick and locally up to 10 feet thick. The shallower liquefiable layers at the site have lower shear strength loss from liquefaction. Our analysis will need to be updated at the design level investigation and once the project plans are available. In general, lowering the design elevations (less fill thickness) may result in higher seismic settlements near-surface.

Seismic Settlement: The results of our analysis indicate that the liquefiable layers in the alluvium, when subjected to the high ground accelerations of a large earthquake event near the site, will be subject to settlement. Based on our calculations included in Appendix F and discussed further in Section 3.8, the settlement due to liquefaction is anticipated to range from less than one inch to greater than 4.5 inches in the alluvium. Liquefaction settlement of up to 8.0 inches was estimated at the CPT-21 location, which is located in the park in the Central District. Seismic settlement is not anticipated in the river terrace materials, older alluvium, or bedrock.

Loss of Bearing: The potential for loss of bearing was reviewed based on the thickness of the liquefiable layers that will be left-in-place, versus the amount of fill and non-liquefiable alluvium that will overlie the liquefiable soils. Local surface disruptions and loss of bearing strength at the surface are unlikely at the completion of the project since the potentially liquefiable layers will be overlain by thicker, non-liquefiable fill material within the building sites. The recommended ground improvement below the remedial removals will further reduce the potential impacts of seismic induced liquefaction at the site.

Lateral Spread: There is a moderate potential for lateral spread for the design 2H:1V fill slope along the river. With the recommended remedial removals and ground improvements along the proposed design slopes and building pads, we anticipate that the potential for lateral spread will be reduced to an acceptable level.

Flow Liquefaction: The potential for local flow-type failures adjacent to the San Diego River, due to loss of liquefied soil strengths following a large seismic event near the site, cannot be ruled out. Based on our evaluation and analysis, the potential for flow liquefaction at the site is considered to be minor for the structural development once the recommended remedial removals and ground improvements are performed at the site, including the proposed slope areas. This is further discussed in Sections 3.6 and 4.3.6. The proposed ground improvement areas and depths are presented on Plate 5.

3.8 Settlement and Foundation Considerations

The site is generally underlain by three earth units, including the river terrace deposits, alluvium and artificial fill materials that are primarily silty and clayey sand, clean sand and some clay and silt layers.

The computer programs Unisettle by Unisoft Geotechnical Solutions Ltd. (Version 4.0) and CPet-it by Geologismiki (Version 2.0.1.61) were used to calculate the static settlement of the onsite soils under the foundation loads. We calculate less than one inch of consolidation settlement for foundation loads of up to 800 kips and bearing capacity of 2,500 psf for areas underlain by alluvial deposits with no ground improvement, and 4,500 psf for areas underlain by river terrace deposits.

Also, one inch of consolidation settlement is anticipated for the foundation loads of up to 800 kips and bearing capacity of 4,500 psf within alluvial deposits considering ground improvement will be performed as recommended in Section 4.4 of this report.

As discussed previously, the potential for seismically induced settlement as a result of liquefaction was evaluated using Cliq program. Using a peak ground acceleration of 0.55g, a maximum earthquake magnitude of 6.8 Mw, and considering the preliminary design grades, the potential for seismic settlement for various areas, as well as the recommended foundation type for buildings and parking structures, is as follows:

North District: The potential for seismic settlements within the North District are anticipated to vary from 0 within the river terrace deposit area, to up to 3.0 inches within the eastern areas underlain by alluvial deposits with no ground improvement. In the western portion of the North District, the seismic settlement is estimated to be up to 2.0 inches with no ground improvement. With the implementation of ground improvements, as recommended in Section 4.4 of this report, the liquefaction induced settlement is anticipated to be reduced to less than 1 inch throughout the North District.

Central District: The potential for seismic settlement within the Central District is anticipated to vary from 0 within areas of the river terrace deposit, to generally up to 3.5 inches within the areas underlain by alluvial deposits with no ground improvement. Larger seismic settlements, up to 8.0 inches, were calculated at CPT-21 location and the surrounding park areas (CPT-20 through -22). Per our review of the updated grading plan, the proposed building pads are not located within the area with higher seismic settlement potential. When ground improvement is performed as recommended in Section 4.4 of this report, the liquefaction induced settlement is anticipated to be less than 1 inch.

South District: The potential for seismic settlement within the South District is anticipated to generally vary from 2.3 to 3.5 inches with no ground improvement. Larger seismic settlements, up to 7.1 inches, were calculated at CPT-30 within the park area. Per our review of the preliminary grading plan, the proposed building pads are not located within the area with higher seismic settlement potential. When ground improvement is performed, as recommended in Section 4.4 of this report, the liquefaction induced settlement is anticipated to be less than 1 inch.

The amount of expected settlement will also depend partly upon the type of foundation(s) selected. Additional evaluation will need to be performed once the actual design grades, foundation type, foundation loads and layouts are known. The recommended total and differential settlement that should be used for design of building foundations and slabs are discussed in Section 4.6 of this report. In general, post-tensioned or mat foundations should be considered for residential buildings for the areas underlain by alluvium and ground improvement. The parking structures, commercial buildings, hotels, etc., up to seven stories, may be founded on conventional shallow foundations in these areas; however, this should be further evaluated based on actual design loads. Buildings with eight or more stories, or those with large foundation loads, may need to be provided with a combination of mat slab, deeper ground improvements and/or pile foundations.

If no ground improvement is performed in the areas underlain by alluvial deposits, stiffened post-tensioned and mat foundations should be used for residential buildings and parking/commercial structures that have six stories or less, respectively. The foundations should be designed to tolerate the total and differential settlements discussed in Section 4.6 of this report.

Consideration should also be given to ground improvement below the utility lines. Otherwise, the utility lines and connections should be designed to tolerate the higher total settlement discussed in Section 4.6.

Settlement of Existing Sewer, Trolley Line and Perimeter Roads: We have prepared eighteen 40-scale cross-sections for this report, 13 of which involve grading over the 78-inch-diameter trunk sewer line. Cross-Sections 1-1', 4-4', 5-5', and 6-6', and 16-16' do not have any design fill placed over the sewer line, and Cross-Sections 2-2' and 15-15' show design cuts of 12 to 18 feet over the pipeline. Cross-Sections 3-3', 9-9', 10-10' and 11-11' show between 1 to 12 feet of fill planned over the pipeline; however, the pipe is underlain by dense terrace deposits and/or bedrock. Cross-Section 8-8' shows 13 feet of planned fill over the pipeline, with between 23 to 40 feet of alluvium under the pipeline.

Cross-Section 8-8' shows 13 feet of fill over the pipeline and 40 feet of saturated alluvium underlying the pipeline. For purposes of preliminary analysis, up to 60 feet of alluvium was assumed under the pipeline (rather than 40 feet) and the potential total settlement was calculated to be less than 0.75 inches below the sewer pipeline. Please note that this represents a relatively conservative value for settlement and will be refined during the design phase.

The design fills on the north side of the trolley line generally vary between 0 and 15 feet thick within 30 horizontal feet of the trolley easement. Cross-section 7-7' shows the most planned fill next to the northern side of the trolley line. The potential settlement below the existing trolley line associated with this proposed fill is considered minor (0.35 inches under the trolley line). The settlement associated with the proposed trolley line bridge is also anticipated to be minor since the structure will have deep footings. However, the settlement should be evaluated once the plans are prepared and the actual loads are calculated.

Settlement potential of perimeter roads and adjacent buildings is also anticipated to be minor as a result of the proposed grading. The impact to adjacent properties will need to be evaluated during the design phase and once the foundation loads from the proposed structures are calculated. Based on our review of the current project plans, we anticipate little to no settlement impacts to the adjacent properties.

3.9 Erosion Potential

The alluvium at the site is considered highly erodible in cuts exposing sandy soils. The compacted fill and river terrace deposits are subject to less erosion. Sandy fill slopes along the river for the structural development will require additional measures to reduce the erosion and scour potential. See recommendations for ground improvement for these fill slopes in Section 4.4.

Minor cut slopes and excavations are planned in the park areas next to the river that are anticipated to expose fill and/or alluvium. We understand these slopes will be planted with wetlands vegetation and/or turf which will help reduce the erosion potential.

3.10 Rippability

The onsite earth units are anticipated to be rippable with conventional earthmoving equipment. The alluvium is anticipated to be excavatable with scrapers, excavators and backhoes. The river terrace deposits and some of the compacted fills are generally very dense. Terrace deposits may be difficult to rip with bulldozers (D-9 and D-10) and will likely require heavy ripping prior to loading with scrapers.

Test pits could be made with a backhoe/excavator during grading to determine if hard/cemented layers are difficult to excavate. Consideration should then be given to overexcavation of streets to the depths of the deepest utilities in the areas underlain by terrace deposits. Deep overexcavation would help reduce the excavation efforts needed for the utility construction after grading is completed.

3.11 Infiltration Feasibility

General: NMG has performed a planning level evaluation of storm water infiltration feasibility in accordance with the City of San Diego Storm Water Standards (Part 1: BMP Design Manual, City of San Diego, 2017b). The simple feasibility criteria presented in the design manual document state that Full and Partial Infiltration BMPs:

- Shall not be placed at a site with existing fill materials greater than 5 feet thick;
- Shall not be proposed within 10 feet of utilities, structures or retaining walls;
- Shall not be proposed within 50 feet of natural slopes or a distance of 1.5H from graded fill slopes where H is the height of slope;
- Shall not be proposed within 100 feet of contaminated soil or groundwater; or
- Where there are other impairments.

In addition, the design manual indicates that infiltration should not be proposed where the following conditions occur:

- Less than a 10-foot separation between the bottom of the infiltration BMP and the groundwater table or where groundwater mounding could occur;
- The near-surface soils mapped by the USDA have a Hydrologic Group C or D type soil;
- The site has a geotechnical factor where infiltration may increase adverse effects, such as consolidation/collapse, expansive soils, liquefaction, adverse slope stability, potential soil piping, etc.;
- Where infiltration could damage underground utilities and vaults, wires/conduit and above-ground wiring, etc.; and
- Several other issues as listed in Section C.2 of the Design Manual.

The following discussion includes our assessment of infiltration feasibility for areas underlain by different earth units and per the above guidelines.

Areas Underlain by Compacted Fill: For the evaluation of compacted fill, NMG performed the above laboratory testing and the results are included in Appendix C. Hydraulic conductivity was estimated directly from laboratory testing of remolded samples representing future compacted fill. The BMP Design Manual indicates that for purposes of infiltration assessment, saturated hydraulic conductivity and infiltration rate can be assumed to be equal. The laboratory tests indicate that the hydraulic conductivity ranges from 0.027 to 1.01 inches per hour for silty sandy fill compacted to approximately 90 percent relative compaction. Applying a minimum factor of safety of 2, as required, the infiltration rates will be in the range 0.01 to 0.50 inches per hour. In addition, based on our experience with sandy soils, we anticipate the actual relative compaction of the fill (after grading of the site) will be somewhat higher and typically in the range of 90 to 95 percent. The higher relative compaction will result in lower infiltration rates. These infiltration values are below the reliable rates for Full Infiltration BMPs, as discussed in the guideline. Partial Infiltration BMPs would be allowed if there were no other factors. However, other constraints exist and are discussed below:

- The thickness of compacted fill throughout most of the residential and commercial developments will be more than 5 feet;
- Fill will generally be placed to within 2 to 3 feet of the groundwater table in areas of alluvium;
- The buildings and/or lower level parking may be subterranean and potential infiltration near these buildings could produce long-term seepage and drainage problems; and
- There may be numerous retaining walls and utilities placed around and beneath the buildings and roadways.

Areas Underlain by River Terrace Deposits: The terrace materials in the northern portion of the site are dense, consolidated/cemented, and a mixture of cobbles and fine-grained matrix. During drilling, it was difficult to drive a sampler to collect in-situ samples and samples typically had high blow counts for only a few inches of recovery. The drill rig often encountered refusal at shallow depths (10 to 20 feet deep). Infiltration rates in these types of material are anticipated to be very low.

The USDA soil mapping for the topsoil overlying the terrace deposits is also the Huerhuero-Urban land complex, which is classified as hydrologic group Type D (USDA, 1973). Our field exploration confirms that this unit generally consists of silty and clayey sandy matrix around river cobbles.

Grading and construction issues regarding potential infiltration in areas underlain by terrace deposits include:

- The thickness of compacted fill overlying the terrace deposits will typically be more than 5 feet thick.
- The buildings and/or lower level parking may be subterranean and potential infiltration near these buildings could produce long-term seepage and drainage problems.

- There may be numerous retaining walls and utilities placed around and beneath the buildings and roadways.
- Due to the difficulty of drilling into the terrace deposits, field testing and installation of dry well infiltration BMPs would be very difficult to implement.

Areas Underlain by Alluvium: The natural soils overlying the alluvium throughout the remainder of the site are mapped as the Tujunga sand and are classified as hydrologic group Type A (USDA, 1973). Grain size test results indicate that the material may be permeable and potentially acceptable for infiltration BMPs. We understand that during the mid-1990s, fill was imported during regrading of the golf course. Throughout much of the golf course, the upper 1 to 10 feet is composed of imported compacted fill from off-site sources (University of San Diego and I-15 near University Drive). This material is generally finer grained and is believed to reduce the overall infiltration of the native soils.

Within the residential and commercial development areas, remedial removals will extend to just above the groundwater table. In addition, ground improvements (such as geopiers, soil mixing or stone columns) will be installed into the saturated alluvium below the proposed building areas (see Plates 5 through 8).

There is also a significant potential for liquefaction of the alluvium throughout the site. Infiltration into the alluvium may raise the groundwater table locally, which may increase the potential for liquefaction and seismically induced settlements.

In the park areas, we understand that the proposed grading will level out the existing contoured mounds, resulting in approximately 4 to 8 feet of fill over the park site. Since groundwater is shallow in this area, potential infiltration BMPs would have less than the required 10 feet of separation between the bottom of the BMP and the groundwater table. We anticipate that the majority of the park area will continue to be irrigated and some of the applied water will infiltrate down through the shallow fill and into the alluvium.

4.0 CONCLUSION AND PRELIMINARY RECOMMENDATIONS

4.1 General Conclusion and Recommendation

Based on our study, the site is considered geotechnically suitable for the proposed mixed-use development provided the preliminary geotechnical recommendations in this report are implemented during design, grading and construction. The information and recommendations provided herein merge those of the prior geotechnical reports (NMG, 2017 and 2018) and also address the geotechnical review comments prepared by the City of San Diego during the MIR process. This report should serve as the geotechnical appendix for the project EIR.

The majority of the recommendations below are based on development in the three areas per the updated grading plan. The recommendations for ground improvement are depicted on the Preliminary Remedial Measures and Ground Improvement Map (Plate 5). Geotechnical observation/testing and mapping during grading is essential to verify the anticipated conditions and evaluate the recommended remedial design measures. The recommendations in this report are considered minimum and may be superseded by more restrictive requirements of others. These preliminary recommendations will need to be confirmed and updated as necessary during the design phase and through additional geotechnical investigation, testing and analysis.

4.2 Earthwork and Grading Specifications

General: Grading and excavations should be performed in accordance with the City of San Diego Grading Procedures and Regulations and the General Earthwork and Grading Specifications in Appendix G. Clearing and grubbing of the site should include removal of pavement and concrete, turf, landscaping, miscellaneous trash and debris, and disposal of this deleterious material offsite. After removals and overexcavation, the bottoms should be scarified and moisture-conditioned prior to placement of fill. The fill should be placed in nearly horizontal loose lifts less than 8 inches in thickness, moisture-conditioned and compacted to a minimum relative compaction of 90 percent (per ASTM D1557). The fills placed against ground sloping more than 5H:1V should be keyed and benched into competent material as the new fill is placed. Heavy benching is recommended into the existing slopes to expose competent materials prior to placement of new fill.

Onsite soil materials are considered suitable to be used as fill materials below the building slabs and footings. The soils should be mixed to provide a uniform blend of material.

We understand that import material will be needed for grading of the site. The soil engineering properties of imported soil should be evaluated to determine if any of the recommendations provided herein will need modification.

Fill Compaction within the Flood Zone: A comment by the City reviewer stated that the fill placed to create building pads within a Special Flood Hazard Area must be compacted to 95 percent of the maximum density obtained with the Standard Proctor Test fill method, per the ASTM D-698.

Fill placed and compacted to 90 percent relative compaction per ASTM D-1557 (Modified Proctor) as recommended, is considered equivalent to, if not denser, than fill compacted to 95 percent of the maximum density obtained with the Standard Proctor Test (ASTM D-698) considering the nature of the onsite soils. Also, since the park will be in the flood zone, the removal bottom should be scarified and recompacted prior to placement of fill and the surface of the cut areas should also be scarified, moisture-conditioned and recompacted. Thus, it is our geotechnical opinion that fills placed in accordance with our recommendations (NMG, 2017) is suitable for the intended use in the flood zones. Structural fill slopes within the flood zone will also be provided with erosion protection that will satisfy the applicable agency(s). Please note that these recommendations were approved by the City previously.

4.3 Remedial Grading and Slope Stabilization

4.3.1 Removals in Structural Areas

Unsuitable earth materials should be removed prior to placement of compacted fill. Unsuitable materials at the site include undocumented fills, weathered compacted fill, loose and collapsible alluvium, and weathered river terrace materials. In general, estimated removal depths vary from 2 to 20 feet across the site. The minimum removals would be in areas of existing compacted fill that is degraded and has dried out near-surface. The undocumented golf course fills are estimated at 3 to 15 feet thick and should be entirely removed. The weathered compacted fill, native alluvium and river terrace materials should be removed down to competent native materials prior to fill placement.

In order to reduce the depths of ground improvements in areas underlain by alluvium, remedial removals should be made down to 2 to 3 feet above the groundwater, or where the native soils under the scrapers start pumping on the removal bottom. If the removal bottom exposes disturbed, soft and saturated alluvium, a layer of granular materials, gravel or geofabric may need to be placed in order to provide a workable condition prior to installation of ground improvements (Section 4.4) or placement of compacted fill. The Preliminary Remedial Measures and Ground Improvement Map (Plate 5) shows the anticipated elevations of removal bottoms extending to near the groundwater table. These grading recommendations are based on the understanding that a grading alternative is usually more cost effective than additional depths of ground improvement. The depths of the removals and ground improvements are consistent with the recommendations in our prior reports (NMG, 2017 and 2018) and as shown on the Preliminary Remedial Measures and Ground Improvement Map (Plate 5); however, they may be subject to revision once the building size, type, and location are determined.

Rough grading in areas underlain by river terrace deposits should remove the overlying undocumented fill and weathered terrace deposits. The undocumented golf course fill should be completely removed. The upper 5 to 10 feet of the weathered terrace deposits should be removed prior to placement of compacted fill. In areas of planned cut where river terrace is exposed, there should be a minimum 3-foot overexcavation below finish pad/floor grade to provide a uniform fill cap under the lots and building slabs. Where proposed building foundations or utilities are deeper than 3 feet, deeper overexcavation should be considered in order to facilitate foundation and utility excavations with a backhoe.

The eastern-most portion of the North District has 12 to 20 feet of compacted fill that was placed between 1998 and 2000 (Shepardson, 2001). At minimum, the upper 2 feet of this fill material is dry and degraded and should be removed and replaced as compacted fill prior to placing additional fill. Within the building footprints, this fill will be removed to install the ground improvements, unless the buildings are designed to accommodate the potential settlement.

The central portion of the Central District also has existing compacted fill associated with the golf course clubhouse and parking lot that was placed over terrace deposit and alluvium. This fill should be removed down to competent native materials within the proposed structural area. Where alluvium is encountered, the removals should be made to 2 to 3 feet above the groundwater table. Where terrace deposits are encountered, the removals should extend to competent materials. The clubhouse will be protected in-place and removals around this area should be performed with care, protecting the building and its pile foundations.

There is an abandoned sewer line that crosses the North District, as shown on the cross-sections (Plates 6 through 8). In proposed structural and roadway areas, this pipe and associated undocumented backfill materials should be removed and the trench excavation should be backfilled with compacted fill during grading. NMG will review the conditions during grading and provide recommendations for the remaining areas, as needed.

4.3.2 General Grading for the Park

The river park grading will be a general reshaping of the existing golf course, with leveling of many existing mounds to create a natural-looking landscaped area with a network of trails. The majority of the park grading will be cut with some fill areas. Planned slopes within the park are generally low inclination, between 3.5H:1V to 5H:1V and less than 15 feet high. The majority of the park will be considered non-structural, and therefore, remedial grading and ground improvements are not shown for this area (Plate 5). Prior to grading in the park, the turf and vegetation should be removed. In cut areas, the surface should be reprocessed (scarified to a depth of 6 to 8 inches, moisture-conditioned and recompacted). In fill areas, the exposed surface should also be reprocessed prior to placement of additional fill. The reworked fill will need to be compacted to a minimum of 90 percent relative compaction per ASTM D-1557.

Some of the park design grades near the river will extend down to or below the groundwater table. This design cut into undocumented fill and alluvium will be saturated and it is likely that grading in these areas will require specialized equipment/handling (i.e., swamp cats, excavators with top loading, etc.). The excavated materials will need to be dried back or mixed with drier materials prior to placement as compacted fill. We understand these areas will be replanted with wetlands type vegetation or landscaping to help with the erosion potential along the river.

Once the locations of structures within the park are determined, the areas will need to be reviewed and geotechnical recommendations for remedial grading and ground improvements will be provided at that time. Where concrete trails are recommended, there should be at least 2 feet of compacted fill below the pavement. Where non-habitable structures (such as restrooms) are planned, remedial removals will need to be performed; however, ground improvement may not be needed. Where habitable structures are planned, ground improvement or other mitigation measures should be anticipated.

4.3.3 Limits of Remedial Grading for Structural and Park Areas

The Limits of Remedial Grading are shown on Plates 1 through 5 of this report. The limits extend to the perimeter property lines, street right-of-way lines, and to the trolley easement lines. In the park areas, the limit of remedial grading coincides with the grading daylight line. Locally, the limits extend between 10 and 20 feet (measured horizontally) outside the toe of the structural fill slopes. The cross-sections were updated to highlight the general grading and remedial grading conditions, including the design fill (in green), the recommended remedial removals that will be replaced with compacted fill (in yellow), and the approximate areas of recommended ground improvement (in red).

4.3.4 Staged Grading and Ground Improvements

There are a few areas in the northwest portion of the site where buildings are planned close to the adjacent roadways and trolley line. In these areas, the recommended temporary slopes cannot be excavated to the elevations indicated on Plate 5, to allow the installation of the ground improvements (see Section 4.4) under the buildings. The grading and ground improvements in these areas will need to be installed with staged construction, or shoring would be needed. The ground improvements are shown on the cross-sections (Plates 6 through 8) to be under the building areas, extending to a minimum of 5 feet outside the building edge, and to the recommended elevations shown on Plate 5. The temporary slope excavations will need an additional 5 to 10 feet of horizontal work space at the bottom (toe of slope) to install the ground improvements.

The remedial grading and ground improvement operations may be staged with an increased thickness of ground improvements along the perimeter of the lots as shown on Cross-Sections 1-1', 7-7', 8-8' and 16-16'. Excavations should be made down to a temporary level bench in order to install the ground improvements. Upon the installation of the longer ground improvements, the grading contractor may excavate down to the removal elevation shown on Plate 5, at the recommended slope angles, in order to complete the ground improvements. This staged grading is anticipated to be needed in the northwestern portion of the site and locally below the trolley line easement.

Alternatively, these areas would need temporary shoring installed to complete the remedial grading and installation of the ground improvement. Shoring recommendations are provided in Section 4.12.

4.3.5 Temporary Slope Excavations

In general, temporary slopes needed to perform remedial grading and ground improvement should be excavated as follows:

- Within the compacted fill and terrace deposits, the temporary slopes may be excavated at 1H:1V inclination, as shown on the cross-sections.
- For slopes adjacent to the trolley easement, existing structures, or those within alluvium, the inclination should not be steeper than 1.5H:1V.

Based on our review, the highest temporary slope at 1.5H:1V inclination will be on the order of 40 feet. Slope stability analysis for this condition shows a minimum factor-of-safety of 1.37, which is considered geotechnically acceptable. The temporary slope stability should also be reviewed and approved by the Metropolitan Transit System (MTS) prior to excavation and grading.

These temporary slopes should be mapped by the geotechnical consultant as they are being excavated. They will be open for a period of time in order to install the ground improvements and should also be monitored periodically during that time.

The excavations for remedial grading below the trolley fill embankments, especially those exposing alluvium with shallow groundwater, will need to be evaluated closely prior to and during grading. Excavations located adjacent to existing structures (roadways and utilities) should be reviewed by the geotechnical consultant to evaluate the potential for failure/distress. If evidence of instability (such as ground cracks or failures) is observed, recommendations for additional shoring or other appropriate measures will be provided.

4.3.6 Slope Stabilization

As discussed previously, the proposed slopes, as shown on the preliminary grading plan, are anticipated to be grossly stable under static and pseudo-static loading conditions, provided the remedial removals recommended in this report are performed and the slopes are adequately compacted.

In order to mitigate the potential for flow liquefaction and lateral spread as a result of seismic shaking and seismic liquefaction, ground improvement on the order of 50 feet below the toe of slope will be needed for structural fill slopes adjacent to the river (Plate 5). The ground improvement should, at minimum, consist of 3 to 4 rows of stone columns, geopiers or deep soil-cement mix columns. This will need to be further evaluated during the design level study. Based on conversations with Hayward Baker, deep soil-cement mixing will also provide scour protection along the river.

4.4 Ground Improvement Alternatives

In order to reduce seismic settlement potential within alluvial deposits to approximately 1 inch or less, we recommend that ground improvement be performed below the remedial removal bottoms.

Alternatively, if the slabs and foundation are designed to tolerate the estimated settlement values provided in Section 4.6, ground improvement would not be needed. Ground improvement will need to be provided for the proposed slopes in order to reduce the potential for lateral spread or flow conditions during a strong seismic shaking, and as a result of liquefaction.

The ground improvement recommendations are presented below. Plate 5 shows the depths of improvements below the removal bottom elevations, by area. Ground improvement for the proposed structural slopes is discussed in Section 4.3.6.

North District: The majority of this area is underlain by dense terrace deposits that will not need ground improvement. Remedial grading should be performed as discussed in Section 4.3 and shown on Plate 5. The ground improvements could consist of geopiers, stone columns, drilled displacement columns, deep soil-cement mix or other similar methods. These ground improvements should, at minimum, be performed under the building footprints and extended 5 feet laterally outside the building footprints. The combination of compacted fill and ground improvement will provide an approximately 30-foot-thick zone of compacted and densified materials under the finish grades. Alternatively, if the buildings in the eastern pad have subterranean levels supported on exterior and interior column footings, the ground improvement may be placed directly under the footings. However, this will need to be evaluated during the design phase.

Central District: Ground improvement is recommended below the removal bottoms in alluvium to depths of 20 feet or refusal, whichever is shallower (Plate 5). These ground improvements should be performed under the building footprints and extended 5 feet laterally outside the building footprints. The fill slope near the river will need to have additional ground improvement to mitigate the potential for lateral spread (see Section 4.3.6). No ground improvement will be needed in areas underlain by the river terrace deposits.

South District: Ground improvement is recommended below the removal bottoms in alluvium to depths of 15 feet (Plate 5). These ground improvements should be performed under the building footprints and extended 5 feet laterally outside the building footprints. Commercial buildings that have eight stories or more or those with large foundation loads may need to be founded on piles or provided with a combination of deeper ground improvements and mat foundations. This will need to be assessed as the building plans are developed. The fill slope near the river will need to have additional ground improvement to mitigate the potential for lateral spread (see Section 4.3.6).

Please also note that if the utility lines and connections cannot tolerate the settlements discussed in Section 4.6, the ground improvement should be extended to these areas. This includes the utility lines in all three areas.

4.5 Groundwater Conditions

As discussed previously, the groundwater table across the site is believed to vary in elevation from approximately 6 feet msl to 15 feet msl in alluvial areas. These elevations are based on boring data between 1975, 2015, 2017 and 2019. Groundwater levels are believed to vary 3 to 4 feet both seasonally and annually.

The structural development is being raised above existing ground surface elevations. As a result, the potential finish floor elevations are anticipated to be more than five feet above the groundwater table. Subdrains are recommended below the subterranean finish floor elevations as a precaution and recommendations will be provided during the future design phases.

Groundwater may be encountered during remedial grading in areas underlain by alluvium. We recommend that the golf course irrigation be stopped prior to grading in order to potentially lower the groundwater table. The type of ground improvements utilized should also take into account the groundwater depths and should plan for wet conditions.

Deep utilities or deep excavations for building structures, such as elevator pits, may extend into the groundwater table. Temporary construction dewatering may be needed in these areas and should be evaluated prior to excavation.

Groundwater is anticipated to be encountered during grading in the park areas near the river. Finish grades are locally 2 to 3 feet below the groundwater table. Grading within these areas are discussed in Section 4.3.2.

4.6 Static and Seismic Settlement

4.6.1 Structural Areas

As discussed in Section 3.8, the settlement as a result of fill placement in the areas underlain by river terrace deposits is calculated to be less than ½-inch. Based on our review of the updated grading plan, up to 20 feet of fill may be placed over alluvium. Per our analysis and calculations, we anticipate a total settlement on the order of less than 1 inch as a result of fill placement over alluvium material. The differential settlement is anticipated to be minor and less than half of the total settlements discussed here, over a span of 40-feet.

Using a foundation load of 800 kips, design allowable bearing capacity of 4,500 psf, considering that the remedial removals discussed in Section 4.3 and ground improvement discussed in Section 4.4 are performed, we anticipate that the total and differential settlement combining both static and seismic conditions for the entire site to be on the order of 1 inch and ½-inch over a span of 40-foot, respectively. The foundation and slabs should be designed to tolerate these settlements. Buildings with eight stories or more or those with high foundation loads will need to be founded on piles or, alternatively, a combination of deeper ground improvement, and mat foundations should be provided. The type of foundations will need to be further evaluated at the design level study and once the building plans are developed and the structural loads are calculated.

The following table includes the design total and differential settlements for various areas within the site considering the recommended remedial removals discussed in Section 4.3 are performed with no ground improvement measures. The foundations and slabs for proposed residential, commercial buildings, parking structures, etc. should be designed to tolerate the total and differential settlements shown in the following table, if ground improvement alternative is not performed. The following table does not apply to high rise buildings or those with foundation loads greater than 800 kips, as discussed above.

Foundation Design Settlement with Remedial Removals and No Ground Improvement							
District	**Underlying Geologic Unit**	**Maximum Foundation Load**	**Maximum Allowable Bearing Capacity**	**Total Static Settlement**	**Total Seismic Settlement**	**Total Design Settlement**	**Design Differential Settlement (over a 40-foot span)**
North	River Terrace	800 kips	4,500 psf	≤ 1"	~ 0	1"	½"
	Alluvium	800 kips	2,500 psf	≤ 1"	≤ 2.0"	3.0"	1.5"
	Fill over Alluvium (eastern pad)	800 kips	2,500 psf	≤ 1"	≤ 3"	4"	2"
Central	River Terrace	800 kips	4,500 psf	≤ 1"	~ 0	1"	½"
	Alluvium	800 kips	2,500 psf	≤ 1"	1.0 to 3.5"	4.5"	2.25"
South	Alluvium	800 kips	2,500 psf	≤ 1"	2.3 to 3.5"	4.5"	2.25"

As discussed previously, the amount of anticipated settlement will also depend on the type of foundation(s) selected. Additional evaluation will need to be performed once the actual design grades, foundation type, foundation loads and layouts are known.

4.6.2 78-Inch Trunk Sewer and Trolley Line

Based on our settlement analysis and as discussed previously, the maximum potential total settlement under the sewer pipeline is on the order of 0.75 inches and below the trolley line is 0.35 inches. The existing sewer line and trolley line are anticipated to tolerate these amounts of settlement. However, this should be reviewed and approved by the pipeline owner and MTS prior to grading and construction.

4.7 Foundation Design

The design of foundation and slabs is the purview of the project structural engineer. The recommendations provided herein apply to structures that are up to seven stories in height. For higher structures, additional recommendations will be provided at a later time based on the structural loads and layouts. A combination of pile foundation and/or deeper ground improvements with mat slabs will need to be evaluated for such structures. Expansive soil conditions, and settlement (discussed in Section 4.6.1) are expected to govern foundation and slab-on-grade design from a geotechnical standpoint.

The sizing of foundations may be based on the following equation:

$$q = 200 + 400B + 900D \leq \text{to values discussed in Section 4.6}$$

where, D = Embedment Depth and B = Width

The design is based on a soil unit weight of 120 pcf, an internal friction angle of 30 degrees and cohesion of 25 psf. The maximum allowable bearing capacity is limited by the total and differential settlements included in the previous section (Section 4.6).

The allowable bearing pressure may be increased by one-third for wind and seismic loading. The allowable bearing pressure may also be applied to post-tensioned and mat slabs if needed for design. The footings of freestanding structures (including walls and pilasters) should have a minimum embedment depth of 24 inches into approved soils.

For lateral resistance against sliding, a friction coefficient of 0.38 may be used at the soil-foundation interface. This value may be increase by one-third for wind and seismic loading.

The following table provides our general guidelines and recommendations for design of post-tensioned foundations and slabs on expansive soil in accordance with the 2016 CBC and Post-Tension Institute (PTI) DC 10.5 Edition provisions. The parameters may also be used for design of mat slabs and foundations for commercial, hotel and parking structures.

GEOTECHNICAL GUIDELINES FOR DESIGN OF POST-TENSIONED SLABS* AND MAT FOUNDATIONS

Parameter	*Recommendation*
Center Lift	
* Edge Moisture Variation Distance, e_m	9.0 feet
* Center Lift, y_m	0.60 inches
Edge Lift	
* Edge Moisture Variation Distance, e_m	4.9 feet
* Edge Lift, y_m	0.80 inch
Subgrade Modulus, k	75 pci
Modulus of Elasticity of Soils, Es	1,500 psi
Presaturation, as needed, to obtain the minimum moisture down to the minimum depth	1.2 x optimum down to 12 inches

****Based on method in CBC 2016***

For uniform-thickness post-tensioned slabs, we recommend that the slabs have a thickened edge such that the slab is embedded a minimum of 12 inches below the lowest adjacent grade. The thickened edge should be tapered and have a minimum width of 12 inches. If non-uniform (ribbed) post-tensioned slabs are used, we recommend minimum embedment of 18 inches below adjacent grades for the thickened edges.

For non-post-tensioned slabs-on-grade and foundations, in accordance with Wire Reinforcement Institute (WRI) method (per the 2016 California Building Code), an effective Plasticity Index of 20 is considered appropriate for the upper 15 feet of soil. For such slabs, we recommend a minimum embedment of 18 inches below the lowest adjacent grade for the perimeter footings.

The slabs should also be designed to satisfy the settlement criteria presented in Section 4.6 of these recommendations. We anticipate that stiffened post-tensioned slabs and mat foundations will need to be designed if no ground improvement is performed at the site.

4.8 Storm Water Infiltration Feasibility

Based on the results obtained from the laboratory hydraulic conductivity testing of proposed fill material, design infiltration rates for the compacted fill are between 0.01 and 0.50 inches per hour. Per the design manual, these infiltration values are below the reliable rates for Full Infiltration BMPs, but would be allowed for Partial Infiltration BMPs if there were no other constraints at the site, as discussed previously (Section 3.11) and summarized below.

The anticipated remedial grading for the majority of the residential and commercial development will include remedial removals down to saturated alluvium. This will result in less than 3 to 4 feet separation between the bottom of the fill and the groundwater table. Also, the fill thicknesses will generally be greater than 5 feet. Both the fill thickness and separation between the BMP and groundwater table will not meet the requirements of the design manual.

The planned development may include podium-type buildings with subterranean parking levels, retaining walls, and underground utilities. Infiltration is not recommended in these areas per the design manual. There is also a potential for long-term seepage and drainage problems in the subterranean levels if infiltration BMPs were implemented next to the buildings.

Our prior experience in consolidated terrace materials, with respect to infiltration, has resulted in generally very low infiltration rates that are not reliable and typically the result of fracture permeability. The soils overlying the terrace materials are also classified as Type D (USDA, 1973), and confirmed to be generally silty and clayey sands during prior exploration. In addition, drilling was very difficult in the terrace materials and slow drilling rates and refusal was encountered in most of the borings drilled into these deposits.

Based on review of available groundwater data presented in our prior report (NMG, 2017), maintaining the minimum 10-foot vertical separation from the bottom of a proposed infiltration system to the groundwater table, even in the areas with less than 5 feet of planned fill, is not feasible given the existing site conditions (i.e., topography, existing golf course undocumented fill).

More importantly, the alluvium at the site is potentially liquefiable and mitigation measures to reduce the potential adverse impacts are significant. Installation of infiltration BMPs can raise the groundwater table or result in mounding, locally, which will negatively impact this geotechnical hazard.

Based on the above, the use of Full or Partial Infiltration BMPs at the site is not considered geotechnically acceptable or suitable.

4.9 Construction Dewatering

As previously mentioned, the remedial grading operations should stop 2 to 3 feet above the groundwater table. Therefore, dewatering is not anticipated to be needed during grading, except possibly along the river if graded in the rainy season or if removals extend deeper than anticipated. The ground improvement alternatives discussed in this report are methods we anticipate could be performed below the groundwater table without construction dewatering.

If there are deep utilities or structures (i.e., elevator shafts, etc.) that extend below the groundwater table, construction dewatering may be necessary. The need for dewatering will be further evaluated during the design phase.

Based on prior studies by others, the groundwater is anticipated to be brackish. The Worley Parsons report gives some information about the water quality onsite. Permitting for discharge of this water will be an issue, with testing requirements that will need to be further explored by the project team, unless it can be reused onsite. If dewatering is needed, the produced water could be used onsite for grading and/or will need to be discharged into the river downstream of the site. As a result of the high permeability of the alluvial soils, the amount of discharged water is anticipated to be a high volume. Based on prior studies onsite, groundwater Well-1 used by the golf course is 105 feet deep and produces 575 gallons per minute (Worley Parsons, 2013).

4.10 Trench Excavations and Backfill

Excavations should conform to all applicable safety requirements. Trench excavations are anticipated to vary between 3 and 20 feet deep and will expose varying earth units and local seepage.

Where these excavations expose alluvium they are considered Type C soils per Cal/OSHA regulations and should be excavated at 1.5H:1V or flatter, with no vertical excavation near the bottom. If the excavations cannot be made within the subject site, temporary shoring would be needed. The shoring would likely require shields or lagging for potential running sands. Locally, especially in the deeper excavations extending into the alluvium, Type C soils (running sands and/or groundwater) may be encountered. Some zones of relatively clean sands were encountered in our investigation (see boring logs). Where excavations extend below the groundwater table in the alluvium, dewatering is anticipated (see Section 4.9).

The compacted fill and river terrace deposits may be classified as Type B for CalOSHA trench excavation requirements. Temporary removal slopes could be excavated at 1H:1V where they expose compacted fill or river terrace deposits.

Native soils should be suitable for use as trench backfill. The cobbly materials may be difficult to use without mixing with cleaner sands. Cobbles larger than 3 inches in size should not be placed within the pipe zone. Trenches, including interior utility lines, should be either backfilled with native soil and compacted to 90 percent relative compaction, or backfilled with clean sand (SE 30 or better), which can be densified with water jetting and flooding. Trenches excavated next to structures and foundations should also be properly backfilled and compacted to provide full lateral support and reduce settlement potential.

4.11 Lateral Earth Pressures for Permanent Retaining Structures

The recommended lateral earth pressures for the drained onsite materials are as follows:

Equivalent Fluid Pressure (psf/ft)

Conditions	*Level*	*2:1 Sloping*
Active	40	65
At-Rest	60	85
Passive	360	180 sloping down

These parameters are based on a soil internal friction angle of 30 degrees and soil unit weight of 120 pcf. The above parameters do not apply for backfill that is highly expansive.

To design an unrestrained retaining wall, such as a cantilever wall, the active earth pressure may be used. For a restrained retaining wall, such as a vault, basement or at restrained wall corners, the at-rest pressure should be used. Passive pressure is used to compute lateral soils resistance developed against lateral structural movement. Passive pressure may be increased by one-third for wind and seismic loading. Future landscaping/planting and improvements adjacent to retaining walls should also be taken into account in the design of the retaining walls. Excessive soil disturbance, trenches (excavation and backfill), future landscaping adjacent to footings, and over-saturation can adversely impact retaining structures and result in reduced lateral resistance.

For sliding resistance, the friction coefficient of 0.38 may be used at the concrete and soil interface. This value may be increased by one-third for wind and seismic loading. The passive resistance is taken into account only if it is ensured that the soil against embedded structure will remain intact with time. The retaining walls will also need to be designed for additional lateral loads if other structures or walls are planned within a 1H:1V projection.

The seismic lateral earth pressure for walls retaining more than 6 feet of soil may be estimated to be an additional 15 pcf for active and at-rest conditions. The earthquake soil pressure has a triangular distribution and is added to the static pressures. For the active and at-rest conditions, the additional earthquake loading is zero at the top and maximum at the base. The seismic lateral earth pressure does not apply to walls retaining less than 6 feet of soil (2016 CBC Section 1803.5.12).

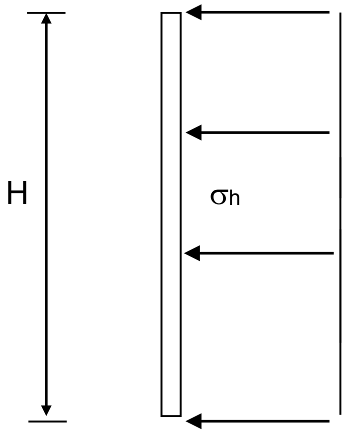
The retaining structures should be waterproofed and provided with suitable backdrain systems to reduce the potential hydrostatic pressure on the walls. Figure 5 presents alternatives for wall-backdrain systems. Specific drainage connections, outlets and avoiding open joints should be considered for the retaining wall design.

4.12 Temporary Shoring Design/Construction

Temporary excavations exposing alluvium should not be sloped steeper than 1.5H:1V (Horizontal to Vertical). Where slope laybacks are limited by property lines and/or adjacent improvements that are to be protected in-place, shoring will likely be needed for construction. Where shoring is required, it should be designed by a structural engineer with expertise in shoring design.

For soldier piles with no more than one level of tiebacks, a triangular stress distribution may be used for the soil loading with the equivalent fluid pressures (psf/ft) provided in Section 4.11 of this report. These values may be adjusted depending on the shoring height and location at the design level study.

For braced or tie-back shoring (with two or more levels of tie-back), the pressure diagram below may be used. For design, an equivalent fluid pressure (EFP) of 360 psf/ft for passive pressure and considering level conditions (in front) may be used for above groundwater conditions. The passive pressure below groundwater should be reduced to 240 psf/ft. The passive earth pressure may be doubled in value, provided that the soldier piles are approximately three pile diameters or more apart from one another. In addition, the depth at which the passive resistance will be mobilized may be assumed to be approximately 3 feet for level ground in front of the soldier piles; however, the soil materials above 3 feet may be assumed as surcharge load in front of the piles.



PRESSURE DIAGRAM

Where σ_h is equal to:

- 26H for level and drained conditions;
- 54H for level and undrained conditions;
- 42H for 2H:1V sloping above the shoring and drained conditions; and
- 61H for 2H:1V sloping above the shoring and undrained conditions.

For design of wood lagging, the above applied pressures may be reduced by 40 percent.

When designing the shoring in areas with sloping ground on top, the active earth pressure for the sloping ground should be used. Where a slope behind the shoring is small in comparison to the height of the shoring, the sloped soil may be considered as a surcharge with the level ground condition. In addition to the above lateral forces due to retained earth, the influence of surcharge due to other loads such as vehicular traffic or stockpile material should be considered during the design of shoring.

As mentioned above, clean sands and localized layers of gravel will be exposed between the shoring as the vertical excavations are made into alluvial deposits. The materials will have the tendency to fail in the vertical condition. As a result, lagging between the shores is recommended in areas of saturated and clean sandy soils. Care should be taken at all times by personnel and/or equipment operators working adjacent to these excavations.

During grading and construction, the deep excavation slopes located adjacent to existing structures (roadways and utilities) should be reviewed closely by the geotechnical consultant to evaluate the potential for failure. If evidence of instability (such as ground cracks or failures) is observed, then recommendations for additional shoring or other appropriate measures should be provided by the geotechnical consultant.

4.13 Garage Concrete Slab-on-Grade

The design of the lower garage concrete slab-on-grade is the purview of the structural engineer. At minimum, the concrete slab should be a minimum of 5 inches thick and reinforced with No. 4 bars at 18 inches on-center both ways. The garage slab should be underlain with a minimum of 6 inches of crushed rock or pea gravel placed over compacted subgrade. A subdrain system, as discussed in Section 4.18, is also recommended below the subgrade of the lower subterranean garages. The subgrade soils should be pre-saturated to a minimum of 120 percent of the optimum moisture content to a minimum depth of 12 inches below the granular layer of the slab. Please note that these recommendations are not valid for slabs below the groundwater table. Recommendations for slabs below the groundwater table will be provided during the design phases and as needed.

4.14 Proposed Bridges

We understand the proposed trolley bridge will be a prefabricated bridge and the general construction of the bridge and roadway undercrossing will be performed as follows:

- Four CIDH piles will be installed at the corners of the abutments, two on each side of the trolley line.
- The bridge will be installed over a short period of time.
- After the bridge is in place, the opening below the bridge will be excavated to planned street grade.
- The abutments or sides of the undercrossing are proposed to be formed utilizing soil nail walls or tieback anchors using shotcrete and top-down construction.

We also understand that this type of bridge construction has been performed at other locations along railway lines successfully.

An additional bridge/culvert is proposed for Fashion Valley Road where it crosses the San Diego River. The proposed bridge is anticipated to consist of a precast concrete arch that will provide a long-span, low-rise, open bottom channel crossing. The ends of the arch will be fitted with precast concrete headwalls supporting the soil/roadway above. The arch culvert unit footings are anticipated to be supported on ground improvement.

The geotechnical design parameters for the bridges will be provided during the future design phases of the project, and as the plans are developed. We anticipate that the construction of the proposed bridge is feasible provided that the design and construction are performed in accordance with the geotechnical recommendations, which will be provided during the design phase.

4.15 Preliminary Pavement Design

A preliminary pavement section consisting of 5 inches of asphalt concrete over 10 inches of aggregate base may be assumed for the main drive areas and roadways. For the private courts, and parking lots, a pavement section consisting of 4 inches of asphalt concrete over 6 inches of aggregate base may be assumed. The final pavement section recommendations should be based on the anticipated Traffic Index (TI) of the roadways and the R-value of the subgrade soils. Pavement design and construction should be performed in accordance with the requirements of the City of San Diego and the Greenbook.

4.16 Structural Setbacks

The footings of structures (including retaining walls) located above descending slopes should be setback from the slope face. The setback distance is measured from the outside edge of the footing bottom along a horizontal line to the face of the slope. The table below summarizes the minimum setback criteria for structures above descending slopes.

Structural Setback Requirements for Footings Above Descending Slopes

Slope Height [H] (feet)	Minimum Setback from Slope Face (feet)
Less than 10	5
10 to 20	½ * H
20 to 30	10
30 to 120	⅓ * H
More than 120	40

If retaining walls are planned next to the river, the foundations will need to be evaluated for liquefaction/lateral spread and shallow groundwater conditions. These walls, if any, will need to be reviewed on an individual basis during the design phase. Deep foundations and/or ground improvement may be necessary.

4.17 Seismic Design Guidelines

The following table summarizes the seismic design criteria for the subject site. The seismic design parameters are developed in accordance with ASCE 7-10 and 2016 CBC.

Selected Seismic Design Parameters from 2016 CBC/ASCE 7-10	*Seismic Design Values*	*Reference*
Latitude	32.7634 North	
Longitude	117.1794 West	
Controlling Seismic Source	Rose Canyon Fault	USGS, 2017
Distance to Nearest Seismic Source	1 mi (1.75 km)	USGS, 2017
Site Class per Table 20.3-1 of ASCE 7-10	D	SEA/OSHPD, 2019
Spectral Acceleration for Short Periods (Ss)	1.23 g	SEA/OSHPD, 2019
Spectral Accelerations for 1-Second Periods (S1)	0.48 g	SEA/OSHPD, 2019
Site Coefficient F_a, Table 11.4-1 of ASCE 7-10	1.009	SEA/OSHPD, 2019
Site Coefficient F_v, Table 11.4-2 of ASCE 7-10	1.526	SEA/OSHPD, 2019
Design Spectral Response Acceleration at Short Periods (S_{DS}) from Equation 11.4-3 of ASCE 7-10	0.83 g	SEA/OSHPD, 2019
Design Spectral Response Acceleration at 1-Second Period (S_{D1}) from Equation 11.4-4 of ASCE 7-10	0.48 g	SEA/OSHPD, 2019
Peak Ground Acceleration (PGA_M) Corrected for Site Class Effects from Equation 11.8-1 of ASCE 7-10	0.55 g	SEA/OSHPD, 2019
Seismic Design Category, Section 11.6 of ASCE 7-10	D	SEA/OSHPD, 2019

4.18 Permanent Subdrains for Retaining Walls and Subterranean Buildings

A typical retaining wall drainage detail is included as Figure 5 (rear of text). Proper surface drainage, such as a concrete V-ditch, should also be provided along the top of walls. Down drains (outlets) for surface drainage should not be tied into the subdrain system for walls. (They should be outlet separately.)

The use of the drainage composite with the bottom-flow collector is anticipated to be utilized behind subterranean building walls at the subject site. The above-mentioned drainage system is considered suitable, provided the drainage composite core is in direct contact with the bottom-flow collector core and the fabrics are glued or heat-bonded to one another such that no soil materials may enter the cores of the drainage system or the bottom-flow collector. Proper surface drainage, such as a concrete V-ditch, should also be provided along the top of walls. Down drains (outlets) for surface drainage should not be tied into the subdrain system for walls (they should be outlet separately).

Subdrains should also be placed below the lower-level subterranean garage and building slabs where the groundwater is within 10 feet of the subgrade. Our review of the preliminary grading plan indicates this condition may occur in the eastern pad of the North District. These subdrains, as designed by the civil engineer, should consist of trenches excavated to 3 feet below subgrade and should outlet into the sump areas. The subdrain trenches should be backfilled with granular material up to its connection with the crushed rock or pea gravel material below the slab. The subdrains should consist of 4-inch perforated pipe in at least 1 cubic foot per lineal foot of Class 2 permeable material or ¾- to 1½-inch gravel wrapped in filter fabric (Mirafi 140N or equivalent). The collector pipe should be installed with the perforations down and have a minimum 1 percent gradient, with the low end of the trench to outlet into the sump areas.

4.19 Expansion Potential

Based on laboratory testing, the expansion potential of onsite soils is anticipated to generally range from "Very Low" to "Medium". Additional laboratory testing should be performed following completion of grading operations around the building to determine the expansion potential of the near-surface soils.

4.20 Cement Type and Corrosivity

Based on our laboratory testing, soluble sulfates exposure in the onsite soils are classified as "S0" to "S1" per Table 19.3.1.1 of ACI-318-14. Structural concrete elements in contact with soil include footings and building slabs-on-grade. Concrete mix for these elements should be based on the "**S1**" soluble sulfate exposure class of Table 19.3.2.1 in ACI-318-14. Other ACI guidelines for structural concrete are recommended.

Also, the site soils are corrosive to very corrosive to ferrous metals and may also be deleterious to copper. Where metals will be in contact with onsite soils for a long period of time (such as buried iron or steel pipe), corrosion-control measures should be taken to prolong their life.

Additional laboratory testing should be performed following completion of grading operations to determine the corrosion potential of onsite soils and to provide recommendations for corrosion protection.

4.21 Exterior Concrete

Exterior concrete elements, such as curb and gutter, driveways, sidewalks and patios, are susceptible to lifting and cracking when constructed over expansive soils. With expansive soils, the impacts to flatwork/hardscape can be significant, generally requiring removal and replacement of the affected improvements. Please also note that reducing concrete problems is often a function of proper slab design, concrete mix design, placement, and curing/finishing practices. Adherence to guidelines of the American Concrete Institute (ACI) is recommended. Also, the amount of post-construction watering, or lack thereof, can have a very significant impact on the adjacent concrete flatwork.

For reducing the potential effects of expansive soils, we recommend a combination of presaturation of subgrade soils; reinforcement; moisture barriers/drains; and a sublayer of granular material. Though these types of measures may not completely eliminate adverse impacts, application of these measures can significantly reduce the impacts from post-construction expansion of soil. The degrees and combinations of these measures will depend upon:

- The expansion potential of the subgrade soils;
- The potential for moisture migration to the subgrade;
- The feasibility of the measures (especially presaturation); and
- The economics of these measures versus the benefits.

These factors should be weighed by the project owner determining the measures to be applied on a project-by-project basis, subject to the requirements of the local building/grading department.

The following table provides our recommendations for varying expansion characteristics of subgrade soils. Additional considerations are also provided after the table. We recommend that the "**Medium**" category be used during design and construction.

TYPICAL RECOMMENDATIONS FOR CONCRETE FLATWORK/HARDSCAPE

Recommendations	Expansion Potential (Index)				
	Very Low (< 20)	*Low (20 – 50)*	***Medium (51 – 90)***	*High (91 – 130)*	*Very High (> 130)*
Slab Thickness (Min.): Nominal thickness except where noted.	4"	4"	**4"**	4"	4" Full
Subbase: Thickness of sand or gravel layer below concrete	N/A	N/A	**Optional**	2" – 4"	2" – 4"
Presaturation: Degree of optimum moisture content (opt.) and depth of saturation	Pre-wet Only	1.1 x opt. to 6"	**1.2 x opt. to 12"**	1.3 x opt. to 18"	1.4 x opt. to 24"
Joints: Maximum spacing of control joints. Joint should be ¼ of total thickness	10'	10'	**8'**	6'	6'
Reinforcement: Rebar or equivalent welded wire mesh placed near mid-height of slab	N/A	N/A	**Optional (WWF 6 x 6 – W1.4xW1.4)**	No. 3 rebar, 24" O.C. both ways or equivalent wire mesh	No. 3 rebar, 24" O.C. both ways
Restraint: Slip dowels across cold joints; between sidewalk and curb	N/A	N/A	**Optional**	Across cold joints	Across cold joints (and into curb)

The more expansive soils, because they are clayey, can take significantly longer to achieve recommended presaturation levels. Therefore, the procedure and timing should be carefully planned in advance of construction. For exterior slabs, the use of a granular sublayer is primarily intended to facilitate presaturation and subsequent construction by providing a better working surface over the saturated soil. It also helps retain the added moisture in the native soil in the event that the slab is not placed immediately. Where these factors are not significant, the layer may be omitted.

On projects with highly expansive soils, additional measures such as thickened concrete edges/footings, subdrains and/or moisture barriers should be considered where planter or natural areas with irrigation are located adjacent to the concrete improvements. Design and maintenance of proper surface drainage is also very important. If the concrete will be subject to heavy loading from cars/trucks or other heavy objects, thicker slabs should be used.

The above recommendations typically are not applied to curb and gutter, but should be considered in areas with highly expansive soils.

4.22 Surface Drainage and Irrigation

Inadequate control of run-off water, heavy irrigation after development of the site, or regional groundwater level changes may result in shallow groundwater conditions where previously none existed. Maintaining adequate surface drainage, proper disposal of run-off water, and control of irrigation will help reduce the potential for future moisture-related problems and differential movements from soil heave/settlement.

Surface drainage should be carefully taken into consideration during grading, landscaping, and building construction. Positive surface drainage should be provided to direct surface water away from structures and slopes and toward the street or suitable drainage devices. Ponding of water adjacent to the structures should not be allowed. Buildings should have roof gutter systems and the run-off should be directed to parking lot/street gutters by area drain pipes or by sheet flow over paved areas. Paved areas should be provided with adequate drainage devices, gradients, and curbing to prevent run-off flowing from paved areas onto adjacent unpaved areas.

Foundation performance is also dependent upon maintaining adequate surface drainage away from structures. The minimum gradient within 10 feet of the building will depend upon surface landscaping. In general, we suggest that unpaved lawn and landscape areas have a minimum gradient of 2 percent away from structures. This also applies to concrete flatwork construction adjacent to the building.

Construction of planter areas immediately adjacent to structures should be avoided if possible. If planter boxes are constructed adjacent to or near buildings, the planters should be provided with controls to prevent excessive penetration of the irrigation water into the foundation and flatwork subgrades. Provisions should be made to drain excess irrigation water from the planters without saturating the subgrade below or adjacent to the planters. Raised planter boxes may be drained with weepholes. Deep planters (such as palm tree planters) should be drained with below-ground, water-tight drainage lines connected to a suitable outlet. Moisture barriers should also be considered.

It is also important to maintain a consistent level of soil moisture, not allowing the subgrade soils to become overly dry or overly wet. Properly designed landscaping and irrigation systems can help in that regard.

4.23 Additional Geotechnical Investigation and Plan Reviews

Additional geotechnical evaluation and investigation are recommended during the design phase of work. This additional analysis and investigation would occur after entitlement, when grading and building plans are in progress or finalized, and before obtaining grading permits. The general areas that may need more evaluation/investigation include the following:

- Along the north side of the trolley line in the area of Lots 23 through 28, in order to further evaluate the contact between alluvium and bedrock and to determine the extent of ground improvement needed below the proposed building areas. We will attempt to acquire the geologic data collected during the grading operations for the trolley embankment to better determine the fill conditions and the alluvium/bedrock contact. Excavation of additional borings may be necessary during the design phase of work to supplement the collected data and/or if the prior reports and information are not available.
- Along the northwest side of Lot 1, in order to evaluate the alluvium and terrace contact and to better determine the extent of ground improvement needed in this area.
- In the bridge area, to evaluate the compacted fill under the trolley and provide geotechnical design parameters for soil nails/tie backs.
- Along Fashion Valley Road, in order to evaluate the alluvium within the vicinity of the proposed culvert/bridge.
- Within the park areas, where/if structures are planned. This will be determined once the park plan becomes available.

NMG should also review the project plans during the design phase including but not limited to the following:

- Grading plans, including rough and precise grading plans;
- Foundation and structural plans;
- Ground improvement plans;
- Bridge plans, including the foundation and walls;
- Shoring and retaining wall plans; and
- Street and utility plans.

Geotechnical review reports will be prepared for these plan reviews, which will be submitted to the City for review and approval.

4.24 Geotechnical Observation and Testing During Grading and Construction

Geotechnical observation and testing should be performed by the geotechnical consultant during the following phases of grading and construction:

- During site demolition, preparation and clearing;
- During earthwork operations, including remedial removals and pad overexcavation;
- During all fill placement;
- During construction of temporary excavations and slope stabilization measures;
- During trolley bridge and caisson construction;
- During Fashion Valley Road culvert/bridge/headwalls construction;

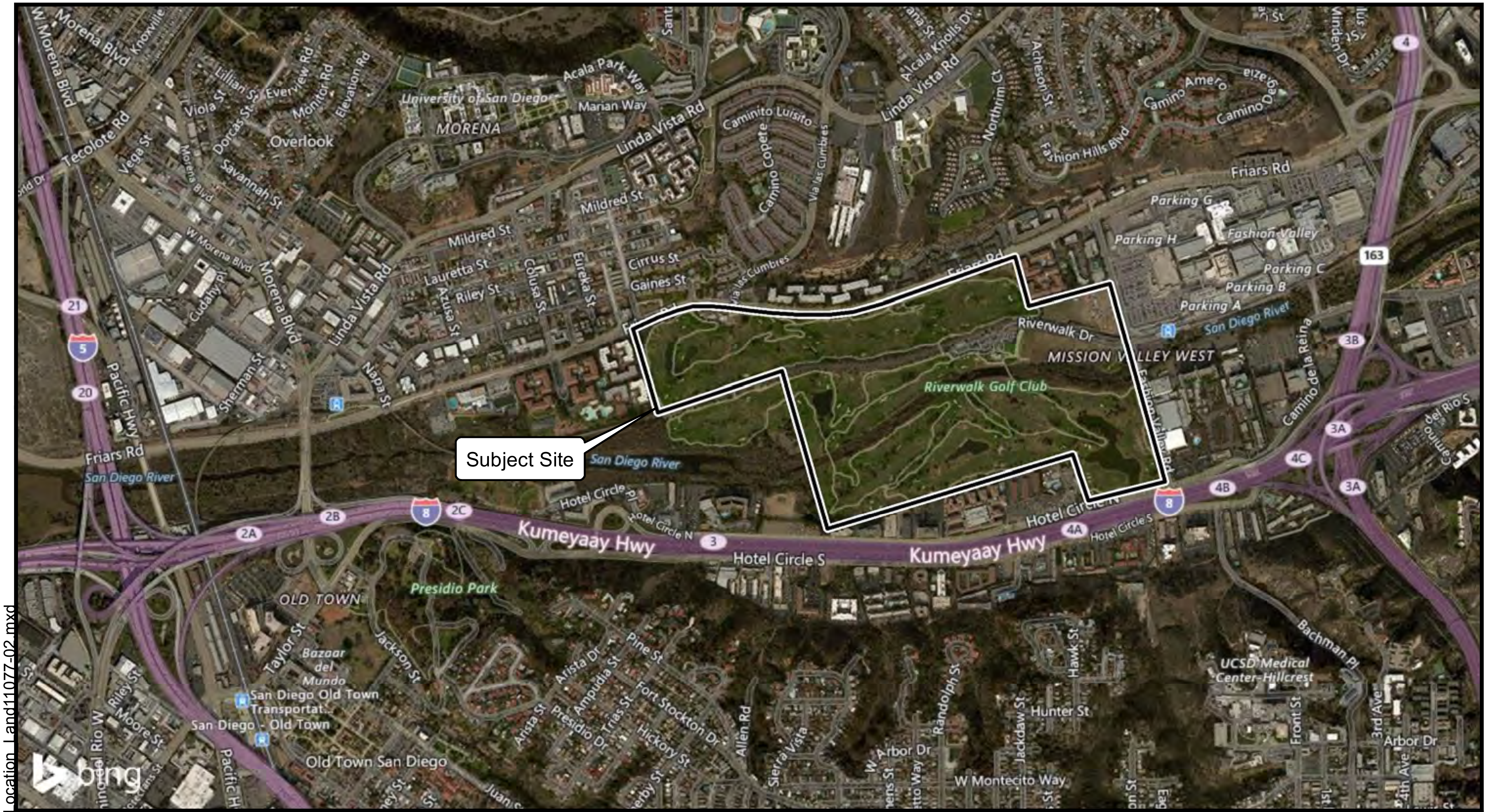
- During construction of ground improvements;
- During installation of subdrains;
- Upon completion of any excavation for buildings or retaining walls prior to pouring concrete;
- During slab and pavement subgrade preparation (including presoaking), prior to pouring of concrete;
- During and after installation of subdrains for retaining walls and building subgrade;
- During placement of backfill for utility trenches and retaining walls; and
- When any unusual soil conditions are encountered.

5.0 LIMITATIONS

This report has been prepared for the exclusive use of our client, SD Riverwalk, LLC, within the specific scope of services requested by our client for the planning study discussed in this report. This report or its contents should not be used or relied upon for other projects or purposes or by other parties without the written consent of NMG. Our methodology for this study is based on local geotechnical standards of practice, care, and requirements of governing agencies. No warranty or guarantee, express or implied is given.

The findings, conclusions, and recommendations are professional opinions based on interpretations and inferences made from geologic and engineering data from specific locations and depths, observed or collected at a given time. By nature, geologic conditions can be very different in between points, and can also change over time. Our conclusions and recommendations are subject to verification and/or modification with more exploration and/or during grading and construction when more subsurface conditions are exposed.

NMG's expertise and scope of services did not include assessment of potential subsurface environmental contaminants or environmental health hazards.



0 1,500 3,000 Feet

1 inch = 1,500 feet

N

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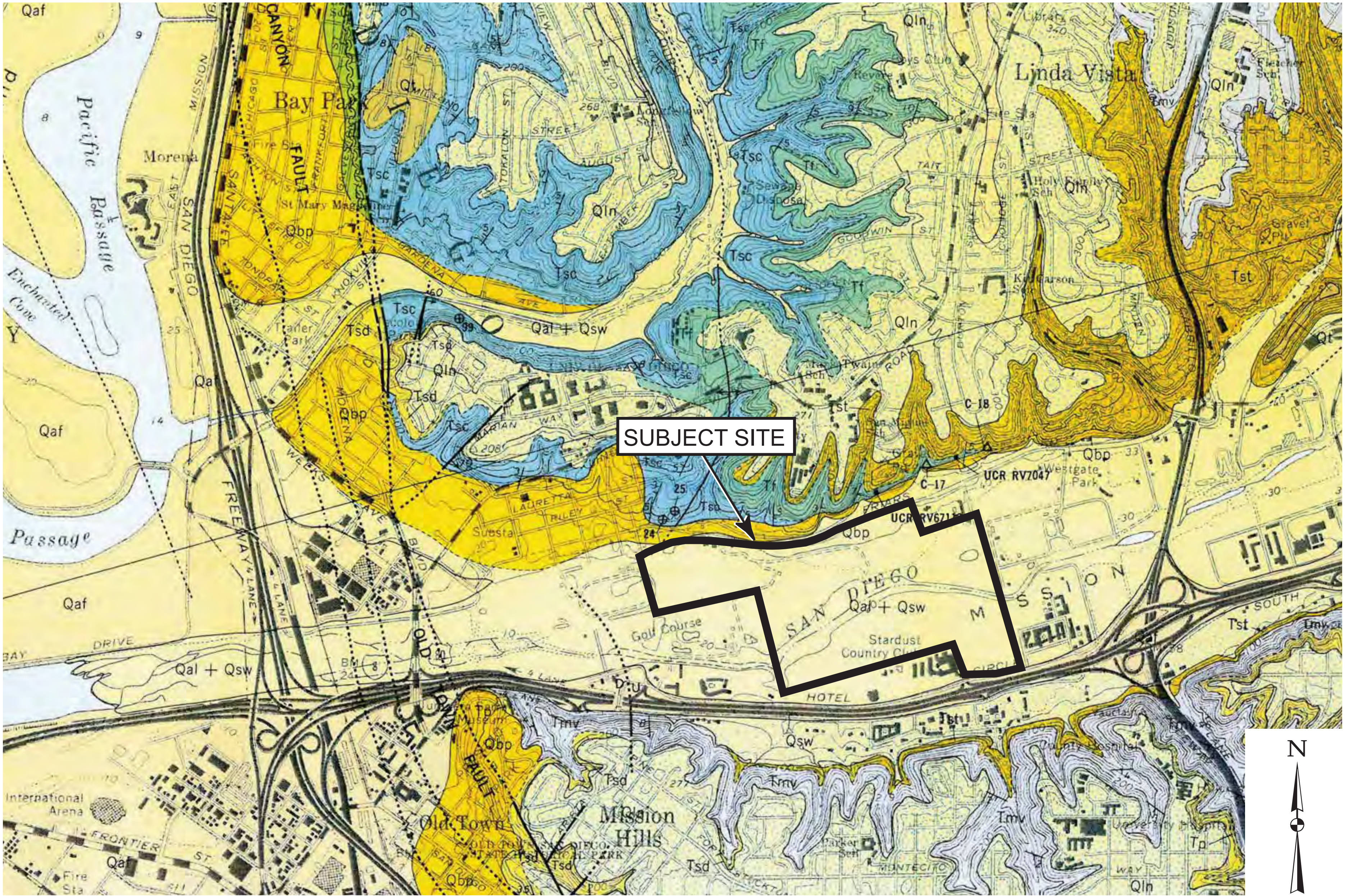
SITE LOCATION MAP

PROPOSED MIXED-USE DEVELOPMENT
RIVERWALK GOLF COURSE
CITY OF SAN DIEGO, CALIFORNIA

Project Number: 11077-02
Project Name: Hines/
Riverwalk Date: 11/27/2019
By: RS/TW
Figure 1

NMG

P:\2011\11077-02\Drafting\GIS\SiteLocation_Land11077-02.mxd



BASE MAP: Kennedy, M.P., 1975, Geology of the La Jolla Quadrangle, San Diego County, CA

Scale: 1"=2000'

GEOLOGIC MAP

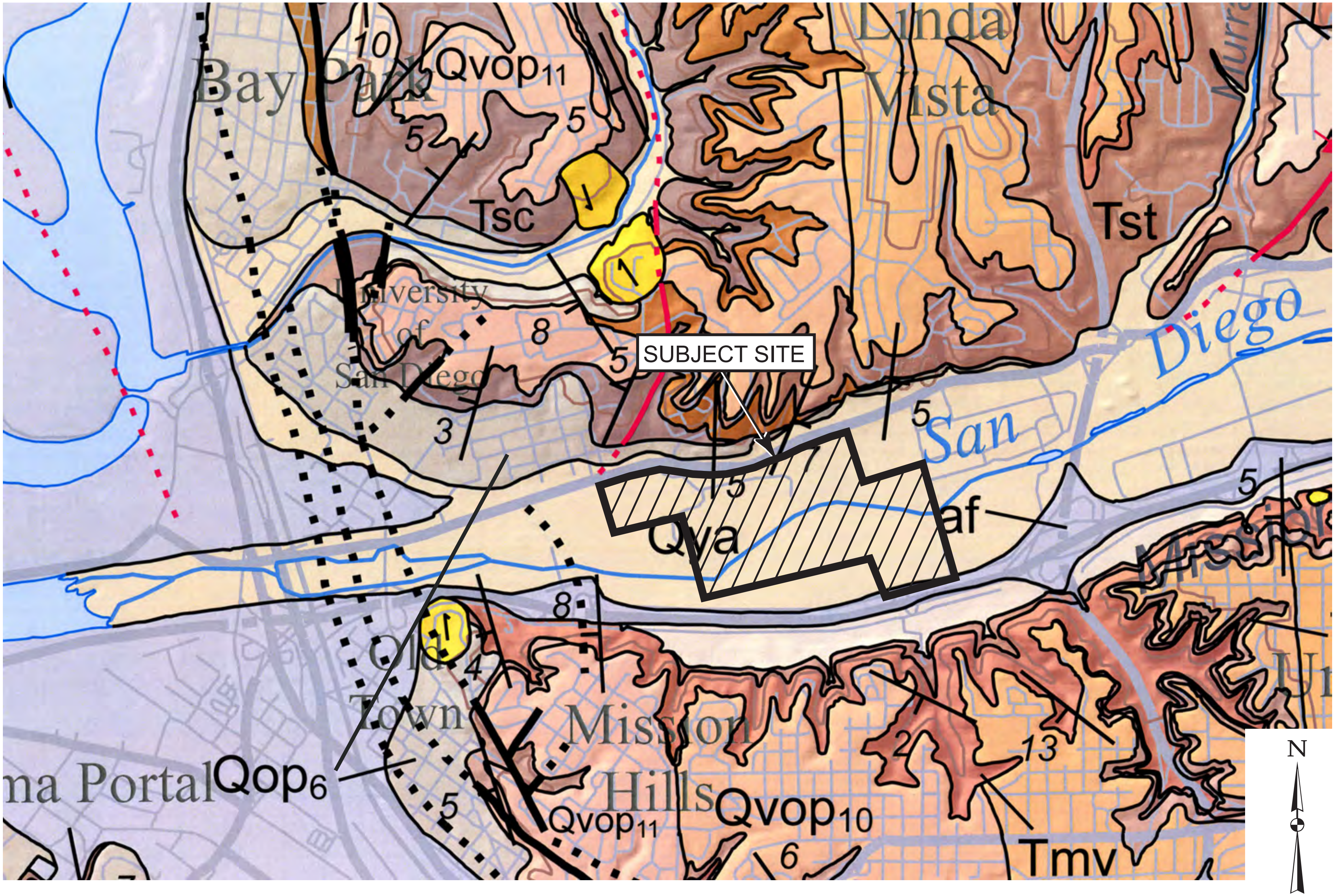
PROPOSED MIXED USE DEVELOPMENT
RIVERWALK GOLF COURSE
CITY OF SAN DIEGO, CALIFORNIA

Project Number: 11077-02

Project Name: Hines / Riverwalk

Date: 11/27/19 Figure No. 2A

NMG
Geotechnical, Inc.



BASE MAP: Kennedy and Tan, 2008, Geologic Map of the San Diego 30'x60' Quadrangle, CA

Scale: 1"=2000'

GEOLOGIC MAP AFTER KENNEDY AND TAN 2008
PROPOSED RIVERWALK MIXED USE DEVELOPMENT
CITY OF SAN DIEGO, CALIFORNIA

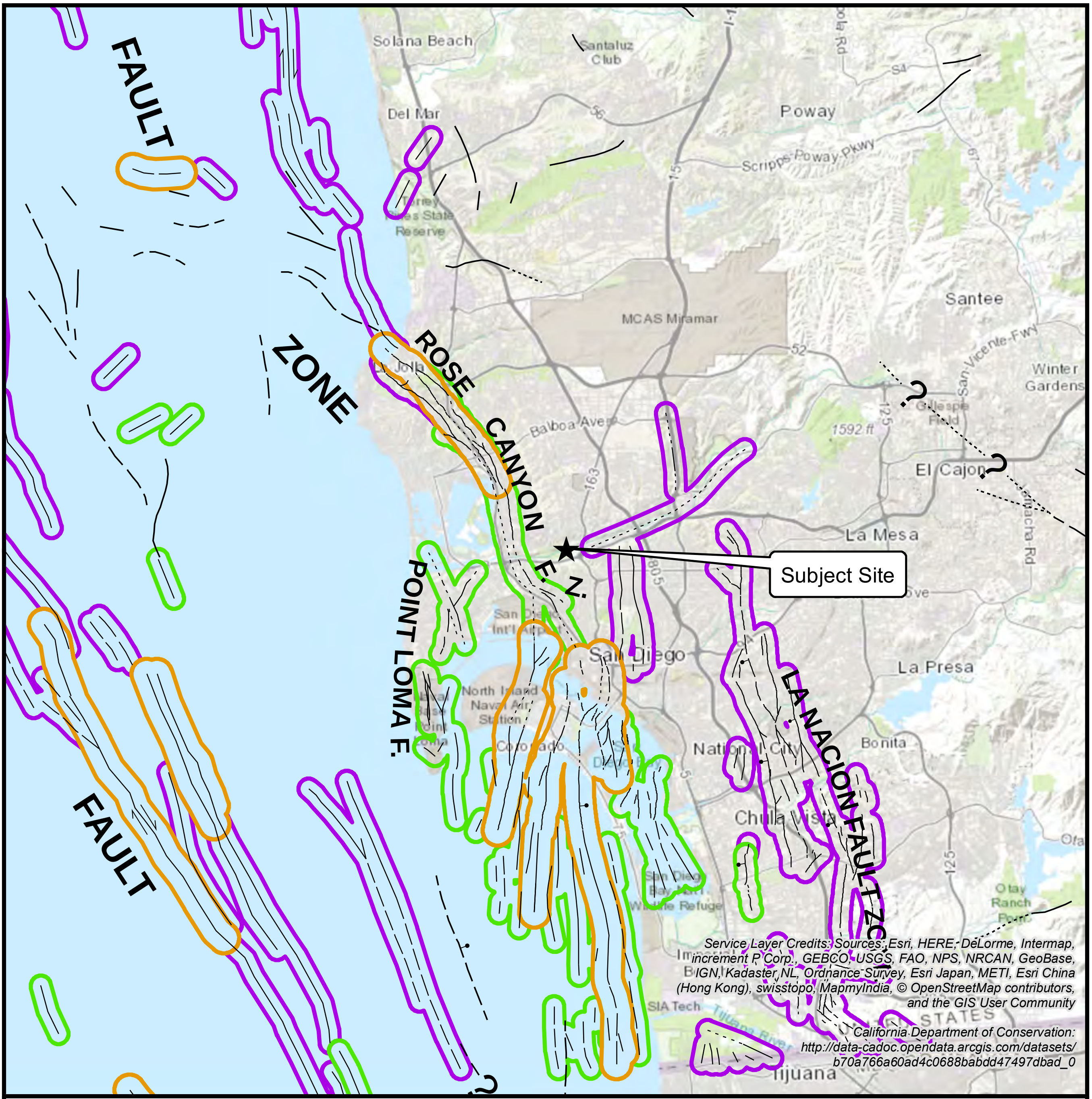
Project Number: 11077-02

Project Name: Hines / Riverwalk

Date: 11/27/19

Figure No. 2B

NMG
Geotechnical, Inc.



Service Layer Credits: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

California Department of Conservation: http://data-cadoc.opendata.arcgis.com/datasets/b70a766a60ad4c0688babdd47497dbad_0

Legend

Faults

—— Certain

— — Approximately Located

...... Concealed

Recency of Movement

🟥 Historic

🟧 Holocene

🟩 Late Quaternary

🟪 Quaternary

0 2.5 5 Miles

1 inch = 5 miles

N

REGIONAL FAULT MAP

Base: California Geological Survey, Fault Activity Map of California, 2010

PROPOSED MIXED USE DEVELOPMENT
RIVERWALK GOLF COURSE
CITY OF SAN DIEGO, CALIFORNIA

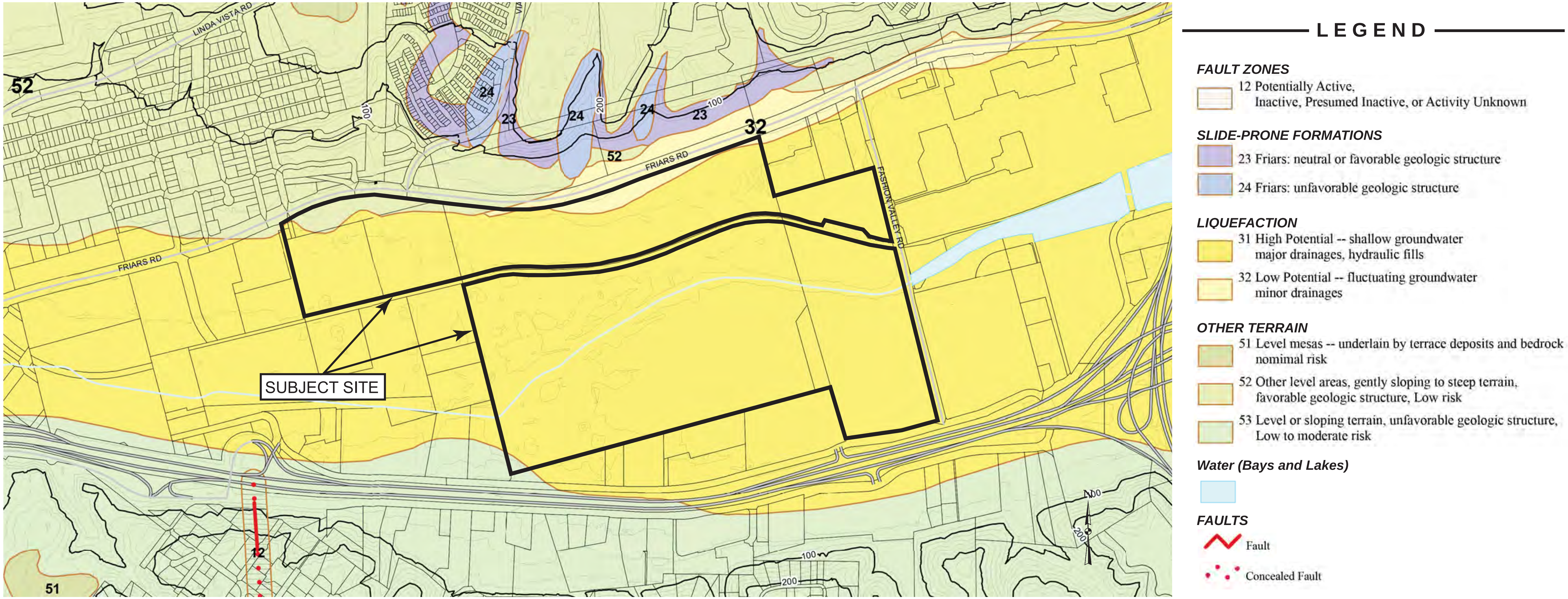
Project Number: 11077-02 By: RS/TW

Project Name: Hines/

Riverwalk Date: 11/27/2019 Figure 3

NMG

P:\2011\11077-02\Drafting\GIS\RegionalFault11077-02.mxd



Base: City of San Diego Seismic Safety Study

N

Not to Scale

GEOHAZARD MAP
PROPOSED MIXED USE DEVELOPMENT
RIVERWALK GOLF COURSE
CITY OF SAN DIEGO, CALIFORNIA

Project Number: 11077-02
Project Name:Hines /
Riverwalk Date: 11/27/19 Figure No. 4

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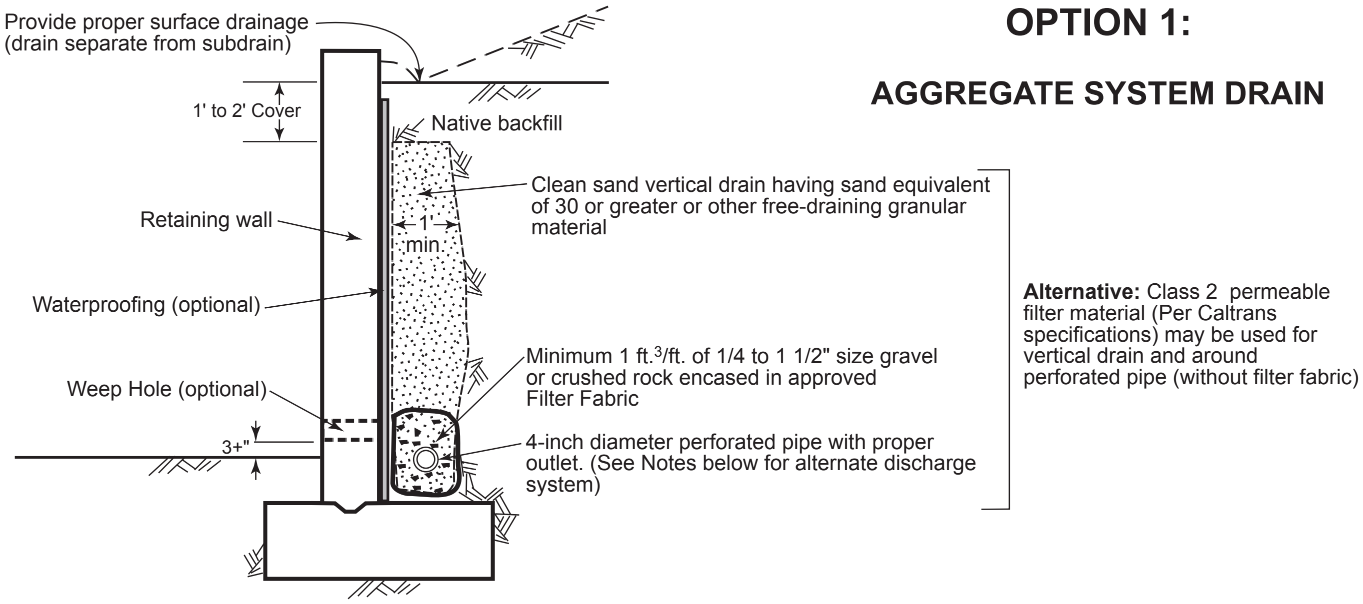
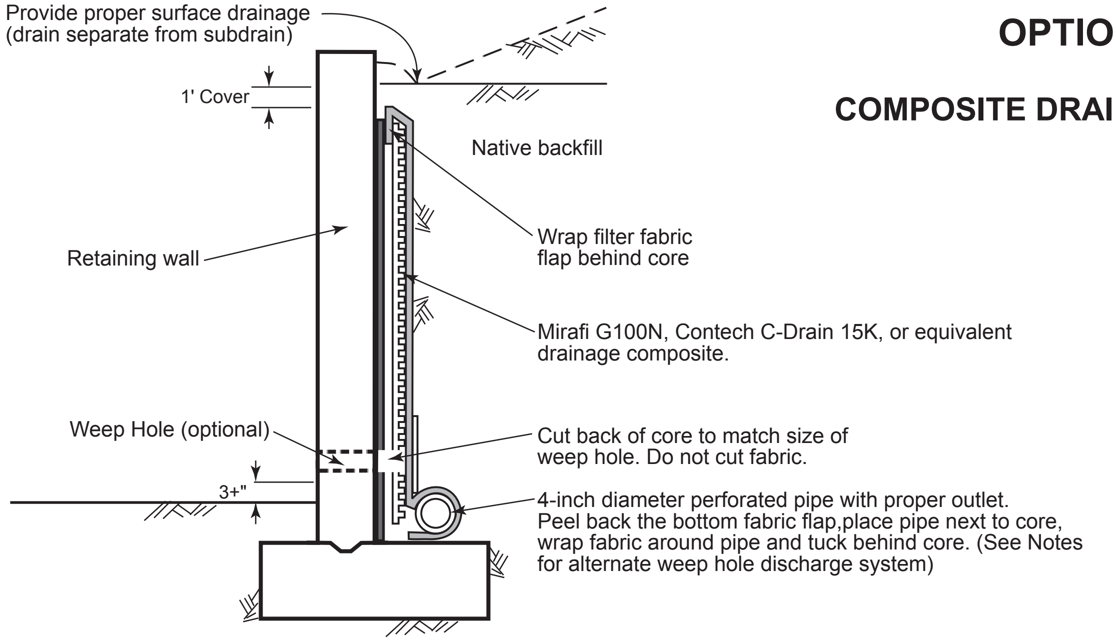
OPTION 1:

AGGREGATE SYSTEM DRAIN



OPTION 2:

COMPOSITE DRAINAGE SYSTEM



NOTES:

1. PIPE TYPE SHOULD BE PVC OR ABS, SCHEDULE 40 OR SDR35 SATISFYING THE REQUIREMENTS OF ASTM TEST STANDARD D1527, D1785, D2751 , OR D3034.
2. FILTER FABRIC SHALL BE APPROVED PERMEABLE NON-WOVEN POLYESTER, NYLON, OR POLYPROPYLENE MATERIAL.
3. DRAIN PIPE SHOULD HAVE A GRADIENT OF 1 PERCENT MINIMUM.
4. WATERPROOFING MEMBRANE MAY BE REQUIRED FOR A SPECIFIC RETAINING WALL (SUCH AS A STUCCO OR BASEMENT WALL).
5. WEEP HOLES MAY BE PROVIDED FOR LOW RETAINING WALLS (LESS THAN 3 FEET IN HEIGHT) IN LIEU OF A VERTICAL DRAIN AND PIPE AND WHERE POTENTIAL WATER FROM BEHIND THE RETAINING WALL WILL NOT CREATE A NUISANCE WATER CONDITION. IF EXPOSURE IS NOT PERMITTED, A PROPER SUBDRAIN OUTLET SYSTEM SHOULD BE PROVIDED.
6. IF EXPOSURE IS PERMITTED, WEEP HOLES SHOULD BE 2-INCH MINIMUM DIAMETER AND PROVIDED AT 25-FOOT MAXIMUM SPACING ALONG WALL. WEEP HOLES SHOULD BE LOCATED 3+ INCHES ABOVE FINISHED GRADE.
7. SCREENING SUCH AS WITH A FILTER FABRIC SHOULD BE PROVIDED FOR WEEP HOLES/OPEN JOINTS TO PREVENT EARTH MATERIALS FROM ENTERING THE HOLES/JOINTS.
8. OPEN VERTICAL MASONRY JOINTS (I.E., OMIT MORTAR FROM JOINTS OF FIRST COURSE ABOVE FINISHED GRADE) AT 32-INCH MAXIMUM INTERVALS MAY BE SUBSTITUTED FOR WEEP HOLES.
9 THE GEOTECHNICAL CONSULTANT MAY PROVIDE ADDITIONAL RECOMMENDATIONS FOR RETAINING WALLS DESIGNED FOR SELECT SAND BACKFILL.

RETAINING WALL DRAINAGE DETAIL

NMG
Geotechnical, Inc.

FIGURE 5

3/05 RETAINING WALL DRAINAGE.ai

APPENDIX A

APPENDIX A

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AERIAL PHOTOGRAPHS REVEIWED

Date	*Flight*	*Photographs*	*Scale*	*Source*
1/3/41	C-6850	84, 85	1"=1,500'	Fairchild
11/11/53	C-19500	T-4-SD-1-10, 1-11	1"=1,000'	Fairchild
3/4/58	C-23023	XI-SD-12-84 and -85	1"=3,000'	Fairchild
7/25/63	T-9-SD	38, 39		Continental Aerial
4/16/72	107-5	17, 18		Continental Aerial
8/17/78	210-21B.	27, 28	1"=1,000'	Continental Aerial
12/17/79	FC-SD-61	15, 16	1"=2,000'	Continental Aerial
1/4/88	SD-4	23		Continental Aerial
10/21/93	C-97-7	268, 269		Continental Aerial
7/9/98	C-120-7	52, 53		Continental Aerial

APPENDIX B

BORINGS AND CPTs

THIS INVESTIGATION

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	*GRAVEL AND GRAVELLY SOILS* MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	*CLEAN GRAVELS* (LITTLE OR NO FINES)	**GW**	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	**GM**	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	*CLEAN SANDS* (LITTLE OR NO FINES)	**SW**	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	**SM**	SILTY SANDS, SAND - SILT MIXTURES
			SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	*SILTS AND CLAYS*	LIQUID LIMIT LESS THAN 50	**ML**	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	**MH**	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			**PT**	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: Dual symbols are used to indicate gravels or sand with 5-12% fines and soils with fines classifying as CL-ML. Symbols separated by a slash indicate borderline soil classifications.

Sampler and Symbol Descriptions

- ■ Modified California sample (D-#)
- ◩ Standard Penetration Test (S-#)
- ▯ Undisturbed pushed tube sample (U-#)
- ▩ Large bulk sample (B-#)
- ☒ Small bulk sample (b-#)
- ▽ Approximate depth of groundwater during drilling
- ▼ Approximate depth of static groundwater

Note: Number of blows required to advance driven sample 12 inches (or length noted) is recorded.

Laboratory and Field Test Abbreviations

AL	Atterberg limits
CC	Chemical Testing incl. Soluble Sulfate
CN	Consolidation test
DS	Direct shear test
EI	Expansion Index
GS	Grain Size Analysis (Sieve, Hydro. and/or -No. 200)
MD	Compaction test
RV	Resistance Value (R-Value)
SE	Sand Equivalent
UU	Unconsolidated Shear Strength

GENERAL NOTES

1. Soil classifications are based on the Unified Soil System and include color, moisture, and relative density or consistency. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate. Bedrock descriptions are based on visual classification and include rock type, moisture, color, grain size, strength, and weathering.
2. Descriptions on these boring logs apply only at the specific boring locations and at the time the borings were made. They are not warranted to be representative of subsurface conditions at other locations or times.

KEY TO LOG OF BORING

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

NMG Geotechnical, Inc.

Date(s) Drilled	**10/14/15**	Logged By	**TBF**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**8"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California, Bulk**		
Approximate Groundwater Depth:	**Groundwater at 14.6 Feet, 20 Minutes after Drilling.**		
Comments			

B- 1

Sheet 1 of 3

Total Depth Drilled (ft)	**81.5**
Approximate Ground Surface Elevation (ft)	**23.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	Number	Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0	▨				SM	Surface: Turf. **Undocumented Artificial Fill (Afu)** Brown silty fine SAND, damp, micaceous.			
20		▨	B-1			SC	**Alluvium (Qal)**			B-1 @ 0-5' RV, MD, GS, AL, EI, CC
	5	■	D-1	44			@ 5': Brownish yellow clayey fine SAND, moist, medium dense, micaceous, trace fine gravel. Tip: Mottled dark brown to dark gray to greenish gray clayey fine SAND, moist, medium dense.	10.6	119.2	
	10	■	D-2	11		CL	@ 10': Black silty CLAY, wet, medium stiff, micaceous, abundant to few roots up to 1/8" diameter.	40.8	71.9	AL, CN, GS
						SM	Tip: Yellowish brown silty fine SAND.			
10							▼			
	15	■	D-3	22			@ 15': Upper: Dark gray to gray silty fine SAND, wet, medium dense, ▽ micaceous, trace roots up to 1/4" diameter.	20.8	99.4	
	20	■	D-4	71		SP	@ 20': Upper: Dark gray silty fine SAND, saturated, dense.	19.1	104.7	
						SM	Lower: Dark yellowish brown silty fine SAND, saturated, dense, micaceous.			
0										
	25	■	D-5	53		SP-SM	@ 25': Dark olive brown silty fine SAND, saturated, dense, graded to dark yellowish brown with fewer fines towards lower sample.	24.7	99.6	GS
	30									

LOG OF BORING

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG

Elevation (ft)	Depth (ft)	SAMPLES Type	Number	Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30	■	D-6	7		SP-SM CL	@ 30': Upper (in waste barrel): Very dark grayish brown silty fine to coarse SAND, saturated, loose, micaceous, subrounded to well rounded grains. Lower: Black silty CLAY, saturated, soft to medium stiff, micaceous.	48.0	76.1	
-10										
	35	■	D-7	7		SM	@ 35': Upper: Dark brown to black silty CLAY, saturated, medium stiff, micaceous, gastropod shells. (Interlayers of estuary deposits) Lower: Dark brown to black silty fine SAND, saturated, loose, micaceous.	39.5	81.8	
	40	■	D-8	10			@ 40': Very dark gray silty fine SAND, saturated, loose to medium dense, micaceous.	35.1	89.0	GS, AL
-20										
	45	■	D-9	50/5"		SP-SM	@ 45': Upper: Dark gray silty fine to coarse SAND, saturated, dense to very dense. Lower: Dark gray silty fine SAND, saturated, dense to very dense, micaceous.	22.3	103.2	GS
	50	■	D-10	9		SM	@ 50': Black clayey silty fine SAND, saturated, loose, mica, trace gastropod shell fragments and fine subangular to subrounded gravel. (Interlayers of estuary deposits)	25.5	96.4	
-30										
	55	■	D-11	14		CH	@ 55': Dark gray fine sandy silty CLAY, saturated, stiff, micaceous, highly plastic.	29.5	93.8	GS, AL
	60	■	D-12	43		SP	@ 60': Gray to dark gray fine to coarse SAND, saturated, medium dense, micaceous, well rounded to subrounded grains. (Qalo?)	18.2	106.5	
-40										
	65									

LOG OF BORING
Riverwalk
San Diego, CA

PROJECT NO. 11077-01

NMG

Riverwalk **San Diego, CA**

B- 1
Sheet 3 of 3

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	65	■	D-13	16		ML	@ 65': Dark gray clayey SILT, saturated, stiff, micaceous, trace subangular to subrounded fine gravel.	34.3	90.5	
	70	■	D-14	14		SC	@ 70': Dark yellowish brown clayey SAND, saturated, medium dense, micaceous.	17.6	112.6	GS, AL
-50										
	75	■	D-15	16		ML	@ 75': Dark brown sandy SILT, saturated, stiff, micaceous, subangular gravel measuring 1" in diameter.	23.5	105.9	
	80	■	D-16	46		SM	@ 80': Brown silty fine SAND, saturated, medium dense, micaceous.	21.4	106.4	
-60							Notes: Total Depth: 81.5 Feet. Groundwater First Encountered at 16 Feet and Stabilized at 14.6 Feet After 20 Minutes. Backfilled with Bentonite Grout.			
	85									
	90									
-70										
	95									
	100									

LOG OF BORING

Riverwalk
San Diego, CA

PROJECT NO. 11077-01

Date(s) Drilled	**10/19/15**	Logged By	**TBF**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**8"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California, Bulk**		
Approximate Groundwater Depth:	**Groundwater Encountered at 11 Feet.**		
Comments			

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Sheet 1 of 1

Total Depth Drilled (ft)	**23.0**
Approximate Ground Surface Elevation (ft)	**25.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0	▨				SM	Surface: Turf. **Undocumented Artificial Fill (Afu)** Brown silty fine SAND, moist, loose to medium dense.			
		▨	B-1							B-1 @ 0-5' GS, MD, AL, EI, CC
						SC	**River Terrace Deposit (Qtr)**			
20	5	■	B-2 D-1	49			@ 5': Upper: Dark brown clayey fine to medium SAND, moist, medium dense. Lower: Dark red clayey fine to medium SAND, moist, dense.	11.5	84.3	B-2 @ 5-6'
	10	■	D-2	49		SM	@ 10': Upper: Dark red silty fine to medium SAND, moist, dense.	5.6	109.7	
						GW	▼ Lower: Dark red fine to medium sandy GRAVEL, moist, very dense, 2" diameter reddish pink gravel.			
10	15	■	D-3	50/4"			@ 15: No ring sample recovery.	24.1		
		◩	SPT-1	27		SM	@ 15.5: Dark brown clayey and silty fine to medium SAND, saturated, gravelly.			
	20	■	D-4	50/2.5"			@ 20': Dark gray silty and gravelly fine to coarse SAND, saturated, very dense.	14.4		
0	25						Notes: Total Depth: 23 Feet (Refusal). Groundwater Measured at 11 Feet. Backfilled with Bentonite Grout.			
	30									

LOG OF BORING

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NMG

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Date(s) Drilled	**10/19/15**	Logged By	**TBF**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**8"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California, Bulk**		
Approximate Groundwater Depth:	**Groundwater at 14.75 Feet, 15 Minutes after Drilling.**		
Comments			

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Sheet 1 of 3

Total Depth Drilled (ft)	**71.5**
Approximate Ground Surface Elevation (ft)	**26.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	Number	Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0	▨	B-1			SM	Surface: Turf. **Undocumented Artificial Fill (Afu)** Dark brown to black silty fine SAND, moist, trace wood debris, fine to coarse gravel.			B-1 @ 0-5' GS, AL
20	5	■	D-1	21		SM	**Alluvium (Qal)** @ 5': Dark brown fine SAND, wet to saturated, medium dense, micaceous, trace root hairs.	31.0	89.9	GS
	10	■	D-2	12			@ 10': Dark brown silty fine SAND, wet, loose to medium dense, micaceous, trace root hairs and pinhole pores, grades to cleaner sand.	20.9	95.8	CN
10	15	■	D-3	12			▼ @ 15': Dark brown silty fine SAND, saturated, loose to medium dense, highly micaceous. ▽	26.0	99.2	
	20	■	D-4	11		SP-SM	@ 20': Dark brown silty fine to medium SAND, saturated, loose, highly micaceous.	31.1	91.8	CN, AL
0	25	■	D-5	31		SP	@ 25': Dark brown to black fine to medium SAND, saturated, medium dense, highly micaceous.	23.9	101.4	
	30									

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Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30	▮	D-6	19		SP	@ 30': No ring sample recovery. Loose material in rings was dark gray fine to medium SAND, saturated, highly micaceous.			
	35	▮	D-7	6			@ 35': Upper: Dark gray fine to medium SAND, saturated, medium dense, highly micaceous.	20.6	111.6	
-10						GC	Lower: Dark gray sandy and clayey fine to coarse GRAVEL, saturated, medium dense.			
	40	▮	D-8	14		SC	@ 40': Very dark gray clayey fine SAND, saturated, medium dense, trace mica, subrounded fine to coarse gravel.	19.4	110.9	
	45	▮	D-9	66		SM	@ 45': Dark gray silty fine to coarse SAND, saturated, dense, subrounded fine to coarse gravel.	13.1	113.9	
-20										
	50	▮	D-10	36			@ 50': No ring sample recovery.	14.6		
		◪	SPT-1				@ 52': Dark gray silty fine to coarse SAND, saturated, medium dense, some fine to coarse gravel.			
	55	▮	D-11	16			@ 55': Dark gray fine to coarse SAND, saturated, stiff, subrounded to rounded fine gravel.	19.3	113.8	
-30										
	60	▮	D-12	42		CL	@ 60': Dark brown fine sandy CLAY, saturated, very stiff, fine gravel.	16.6	109.5	GS, AL
	65									

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
-40	65	■	D-13	19	▨	CL	**Older Alluvium (Qalo)** @ 65: Dark gray to yellow fine sandy CLAY, saturated, very stiff, subrounded to rounded fine to coarse gravel.	22.4	109.7	
	70	■	D-14	24	▨		@ 70': Ring samples disturbed. Dark gray to yellow fine sandy CLAY, saturated, very stiff, subrounded to rounded fine to coarse gravel.	23.2	105.2	SB-1 @ 70'
-50	75						Notes: Total Depth: 71.5 Feet. Groundwater First Encountered at 17.0 Feet and 14.75 Feet After 15 Minutes. Backfilled with Bentonite Grout.			
	80									
-60	85									
	90									
-70	95									
	100									

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Date(s) Drilled	**10/22/15**	Logged By	**TBF**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**8"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California**		
Approximate Groundwater Depth:	**Groundwater at 25.6 Feet, 10 Minutes after Drilling.**		
Comments			

Total Depth Drilled (ft)	**29.5**
Approximate Ground Surface Elevation (ft)	**31.5 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	Number	Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0				░	SM	Surface: Turf. **River Terrace Deposit (Qtr)**			
30										
	5	■	D-1	43			@ 5': Dark red silty fine SAND, damp, medium dense, micaceous.	5.0	120.0	
	10	■	D-2	39			@ 10': Upper: Yellowish red silty fine to coarse SAND, damp, medium dense.	6.0	110.9	
					▨	SC	Lower: Gray clayey fine SAND, damp, medium dense, micaceous.			
20										
	15	■	D-3	87	░	SM	@ 15': Yellowish red clayey silty fine SAND, wet to saturated, very dense, micaceous.	14.6	119.2	
	20	■	D-4	31	░	SP-SM	@ 20': Brown silty fine to coarse SAND, saturated, medium dense, micaceous.	15.2	118.9	GS
10										
	25	■	D-5	55	▨	SC	▼@ 25': Upper: Light olive brown clayey fine to coarse SAND, saturated, dense. Lower: Light olive brown clayey fine to coarse SAND, saturated, dense, fine to coarse rounded gravel.	10.6	126.8	
		◪	SPT-1	50/4"			@ 29': No recovery of SPT sample.			
	30									

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Elevation (ft)	Depth (ft)	SAMPLES			Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number	Blows per foot						
	30									
0							Notes: Total Depth: 29.5 Feet (Refusal). Groundwater First Encountered at 25.8 Feet and 25.6 Feet After 10 Minutes. Backfilled with Bentonite Grout.			
	35									
	40									
-10										
	45									
	50									
-20										
	55									
	60									
-30										
	65									

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Date(s) Drilled	**10/22/2015 & 10/26/2015**	Logged By	**TBF**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**8"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California, Bulk**		
Approximate Groundwater Depth:	**Groundwater at 47 Feet, 15 Minutes after Drilling.**		
Comments			

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Sheet 1 of 2

Total Depth Drilled (ft)	**61.0**
Approximate Ground Surface Elevation (ft)	**58.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0					SM	Surface: Turf. **Undocumented Artificial Fill (Afu)**			
	5	■	D-1	29		SP-GP	**Undocumented Artificial Fill (Afu)?/River Terrace Deposit (Qtr)** @ 5': Red to dark red gravelly fine to coarse SAND/sandy fine to coarse GRAVEL, damp, medium dense, trace mica, subrounded to rounded gravel.	4.4	119.8	
50										
	10	■	D-2	44		SC	**River Terrace Deposit (Qtr)** @ 10': Dark gray, yellow, and brownish red silty and clayey fine to medium SAND, moist, medium dense, mottled, micaceous, fine to coarse subrounded gravel.	13.1	119.1	
	15	■	D-3	47			@ 15': Gray and reddish brown clayey fine to coarse SAND, very moist, dense, mottled, trace fine to coarse rounded gravel.	16.4	113.1	GS, AL
40										
	20	■	D-4	43			@ 20': Dark gray to gray silty and clayey fine to coarse SAND, moist, medium dense, angular fine to coarse gravel.	9.6	120.9	
	25	■	D-5	46			@ 25': Reddish brown and gray clayey fine to coarse SAND, moist, dense, mottled, some mica.	10.7	121.6	
30										
	30									

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Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30	■	D-6	86	SM	@ 30': Reddish brown silty fine to coarse SAND, moist, very dense.	9.0	110.9	
		▨							
	35	▨ ■	B-1 D-7	64		@ 35': Red clayey and silty fine to coarse SAND, moist, very dense.	9.2	117.0	B-1 @ 30'-40'
20		▨							
	40	■	D-8	50		@ 40': Red silty fine to coarse SAND, very moist, dense, micaceous.	12.9	112.7	
	45	■	D-9	82/11.5"	SW-SM	@ 45': Brownish yellow silty fine to coarse SAND, very moist, very dense, mostly quartz subangular to rounded grains, trace mica, subangular to subrounded fine to coarse gravel.	6.0	129.1	GS
						▼			
10						∇			
	50	■	D-10	14		@ 50': No ring sample recovery.			
		◩	SPT-1	50/3"	SM	@ 51.5': Brown silty fine to coarse SAND, wet, dense, subangular to subrounded fine to coarse gravel.			SB-1 @ 51.5'-53'
	55	■	D-11	50/3"	SM	**Bay Point Formation (Qbp)** @ 55': Dark gray silty fine SANDSTONE, very moist, very dense, abundant bivalve shells, micaceous.	15.6	101.4	
0									
	60	■	D-12	50/2"		@ 60': Dark gray silty fine SANDSTONE, wet, very dense, micaceous.	18.3	109.8	
						Notes: Total Depth: 61 Feet. Groundwater First Encountered at 49 Feet and 47 Feet After 15 Minutes. Backfilled with Bentonite Grout.			
	65								

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Date(s) Drilled	**10/27/15**	Logged By	**TBF**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**8"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California**		
Approximate Groundwater Depth:	**Groundwater Not Encountered**		
Comments			

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Sheet 1 of 1

Total Depth Drilled (ft)	**22.0**
Approximate Ground Surface Elevation (ft)	**39.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0					SM	Surface: Turf. **Undocumented Artificial FIll (Afu)**			
						SC	**River Terrace Deposit (Qtr)**			
	5	■	D-1	36			@ 5': Dark reddish brown clayey fine to coarse SAND, moist, medium dense, few fine subrounded gravel.	13.4	120.6	CN, GS
30										
	10	■	D-2	41			@ 10': Dark reddish brown clayey fine to coarse SAND, moist, medium dense, few fine subrounded gravel, coarser than above sample.	12.6	120.2	AL
	15	■	D-3	47			@ 15': Upper: Dark brown and dark gray clayey fine to coarse SAND, moist, dense. Lower: Mostly dark brown with some dark gray and light red clayey fine to coarse SAND, moist, dense, trace mica, mostly fine grained.	12.6	121.6	
20										
	20	■	D-4	50/6"		GM	@ 20': Brown silty clayey fine to medium sandy GRAVEL, moist, dense, subangular to subrounded fine to coarse gravel, fine mica.	4.2	137.2	
	25						Notes: Total Depth: 22 Feet (Refusal). Groundwater Not Encountered. Backfilled with Cuttings and Tamped.			
10										
	30									

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Date(s) Drilled	**10/26/2015 - 10/27/2015**	Logged By	**TBF**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**8"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California**		
Approximate Groundwater Depth:	**Groundwater Not Encountered**		
Comments			

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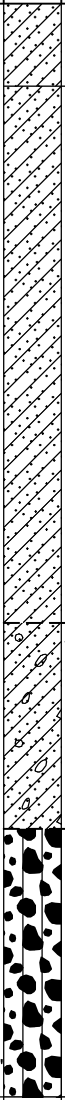
Sheet 1 of 1

Total Depth Drilled (ft)	**26.5**
Approximate Ground Surface Elevation (ft)	**41.0 msl**



Elevation (ft)	Depth (ft)	SAMPLES Type	Number	Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0					SC	Surface: Turf. **Undocumented Artificial Fill (Afu)** Reddish brown to dark brown silty clayey fine to coarse SAND, damp to moist, loose, trace root hairs from grass in upper foot.			
40										
						SC	**River Terrace Deposit (Qtr)**			
	5	■	D-1	33			@ 5': Reddish brown clayey fine to medium SAND, damp, medium dense, trace angular fine gravel.	12.4	123.3	
	10	■	D-2	70/10"			@ 10': Dark brown to dark reddish brown clayey fine to coarse SAND, moist, dense, subrounded fine gravel.	4.5	124.5	
30										
	15	■	D-3	66/12"		SC-GC	@ 15': Dark brown to dark reddish brown clayey fine to coarse SAND/clayey GRAVEL, very moist to wet, very dense, fine to coarse gravel.	11.1	120.8	
	20	■	D-4	90/10"		GM	@ 20': Dark brown clayey fine to coarse sandy GRAVEL, moist, very dense, subrounded gravel.	8.8	122.8	
20										
	25	■	D-5	100/11"			@ 25': Dark brown clayey fine to coarse sandy GRAVEL, moist, very dense, subrounded gravel.	10.5		
							Notes: Total Depth: 26.5 Feet (Refusal). Groundwater Not Encountered. Backfilled with Bentonite Grout.			
	30									

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Date(s) Drilled	**10/26/15**	Logged By	**TBF**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**8"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California, Bulk**		
Approximate Groundwater Depth:	**Groundwater Not Encountered**		
Comments			

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Sheet 1 of 1

Total Depth Drilled (ft)	**16.5**
Approximate Ground Surface Elevation (ft)	**47.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	Number	Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0	▨	B-1			SM	Surface: Turf. **River Terrace Deposit (Qtr)** Brown silty SAND, moist, subrounded to rounded cobbles			B-1 @ 0-5' EI, CC
	5	■	D-1	82		SC	@ 5': Dark yellowish brown silty and clayey fine to medium SAND, moist, medium dense to dense, few fine gravel.	10.7	89.4	
40										
	10	■	D-2	67			@ 10': Reddish brown clayey fine to medium SAND, wet, very dense, fine gravel.	12.8	122.2	
	15	■ ◩	D-3 SPT-1	50/3" 50/3"			@ 15': No SPT or ring sample recovery. Coarse gravels in sampler.			
30							Notes: Total Depth: 16.5 Feet (Refusal). Groundwater Not Encountered. Backfilled with Bentonite Grout.			
	20									
	25									
20										
	30									

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Date(s) Drilled	**10/27/15**	Logged By	**TBF**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**8"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California**		
Approximate Groundwater Depth:	**Groundwater at 18.0 Feet, 19 Minutes after Drilling.**		
Comments			

Total Depth Drilled (ft)	**81.5**
Approximate Ground Surface Elevation (ft)	**30.5 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	Number	Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
30	0					SM	Surface: Vacant Graded Lot with 3/4" crushed rock. **Artificial FIll (Af)** @ 0-2': Yellow silty fine SAND, damp, loose. @ 2-5': Brownish yellow silty fine SAND, damp, loose.			
	5	■	D-1	33		SC	@ 5': Brownish yellow clayey fine to medium SAND, moist, medium dense, few subrounded coarse gravel.	15.8	104.0	CN, GS
		■	D-2	45			@ 7.5': Brownish yellow silty clayey fine to coarse SAND, moist, medium dense, fine to coarse subrounded to rounded gravel.	12.4	111.9	DS
20	10	☐		50/3"			@ 10': No ring sample recovery.			
		■	D-3	50			@ 12.5': Upper: Mottled brown to pink to olive to gray clayey fine to coarse SAND, moist, medium dense.	4.0	106.1	
						SP	**Alluvium (Qal)** Tip: White to black fine to to coarse SAND, moist, medium dense, few fine subangular gravel.			
	15	☐		13			@ 15': No sample recovery. White to black fine to to coarse SAND, moist, medium dense, few fine subangular gravel, grains generally coarsen.			
		■	D-4	27		SM	▼@ 17.5': Gray with patches of reddish brown slightly silty fine to medium SAND, saturated, medium dense. ∇	22.7	102.5	
10	20	■	D-5	24		SP	@ 20': Dark gray to dark brown fine to coarse SAND, saturated, medium dense, micaceous.	24.2	99.7	GS
	25	■	D-6	48			@ 25': Gray fine to coarse SAND, saturated, dense, micaceous.	23.9	102.2	
	30									

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Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
0	30	■	D-7	48		SP	@ 30': Gray fine to coarse SAND, saturated, dense, micaceous.	22.4	104.7	
	35	■	D-8	31		SP-SM	@ 35': Dark gray slightly silty fine to coarse SAND, saturated, medium dense, micaceous.	19.4	106.9	
-10	40	■	D-9	32			@ 40': Dark gray slightly silty fine to medium SAND, saturated, medium dense.	21.1	107.4	
	45	■	D-10	24		SM	@ 45': Very dark gray clayey silty fine to coarse SAND, saturated, medium dense, micaceous, abundant subangular to subrounded orange coarse sand to fine gravel, fine gravel.	22.1	103.2	
-20	50	■	D-11	36			@ 50': Very dark gray silty fine to coarse SAND, saturated, medium dense, micaceous. (Qalo?)	23.7		
	55	■	D-12	36			@ 55': Very dark silty fine to medium SAND, saturated, medium dense, localized areas of clayey fine sand.	22.3	103.8	
-30	60	■	D-13	62			@ 60': Very dark gray silty fine to medium SAND, saturated, dense, micaceous.	17.5	111.8	
	65									

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Elevation (ft)	Depth (ft)	SAMPLES Type	Number	Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	65	■	D-14	41		SM	@ 65': Dark gray silty fine to coarse SAND, saturated, medium dense.	20.2	104.0	
-40	70	■	D-15	25			@ 70': Dark gray silty fine to medium SAND, saturated, dense, micaceous.	27.8	96.1	
	75	■	D-16	50			@ 75': Dark gray silty fine to medium SAND, saturated, dense, micaceous.	22.3	103.7	
-50	80	■	D-17	87/10"		SP	@ 80': Gray fine to coarse SAND, saturated dense, micaceous. Tip: Gray fine to coarse SAND, saturated, dense, gravel.	4.9	123.7	
							Notes Total Depth: 81.5 Feet. Groundwater First Encountered at 19.5 Feet and Stabilized at 18.0 Feet After 19 minutes. Backfilled with Bentonite Grout.			
	85									
-60	90									
	95									
	100									

Report: HOLLOW STEM; Project: 11077-01.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 2/27/19

LOG OF BORING

Riverwalk
San Diego, CA

PROJECT NO. 11077-01

NMG

Date(s) Drilled	**10/21/15**	Logged By	**TBF**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**8"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California, Bulk**		
Approximate Groundwater Depth:	**Groundwater at 13.7 Feet, 20 Minutes after Drilling.**		
Comments			

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Sheet 1 of 3

Total Depth Drilled (ft)	**80.5**
Approximate Ground Surface Elevation (ft)	**23.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0	▨				SM	Surface: Turf. **Undocumented Artificial Fill (Afu)** Brown silty fine SAND, damp, micaceous.			
20		▨	B-1			SM	**Alluvium (Qal)**			B-1 @ 0-5'
	5	■	D-1	5			@ 5': Brown silty fine SAND, moist, loose, micaceous.	14.3	92.2	
	10	■	D-2	8		SP	@ 10': Dark grayish brown fine to medium SAND, wet, loose, micaceous.	21.5	92.3	CN, AL, GS
10							▼ ▽			
	15	■	D-3	8		SM	@ 15': Very dark gray silty fine to medium SAND, saturated, loose, micaceous.	29.1	94.5	
	20	■	D-4	23		SP-SM	@ 20': Dark gray silty fine to coarse SAND, saturated, medium dense, micaceous.	20.9	104.4	CN, GS
0										
	25	■	D-5	17			@ 25': Very dark gray silty fine to medium SAND, saturated, medium dense, micaceous, trace coarse sand grains.	20.2	103.8	
	30									

LOG OF BORING

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NMG

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30	■	D-6	26		SP	@ 30': Dark gray fine SAND, saturated, medium dense, micaceous.	27.5	90.1	
-10										
	35	■	D-7	67			@ 35': No ring sample recovery.	30.1		
	40	■	D-8	10			@ 40': Upper: Dark gray fine SAND, saturated, medium dense, micaceous.	24.9	94.0	
						SM	Lower: Very dark gray silty fine SAND, saturated, loose to medium dense, micaceous.			
-20										
	45	■	D-9	28			@ 45': Very dark gray silty fine SAND, saturated, medium dense, micaceous.	29.6	93.6	
	50	■	D-10	29			@ 50': Very dark gray silty fine to coarse SAND, saturated, medium dense, micaceous. Tip: Dark gray silty fine SAND, saturated, medium dense.	32.2	93.5	GS
-30										
	55	■	D-11	30		SP-SM	@ 55': Dark gray silty fine to medium SAND, saturated, medium dense, highly micaceous.	21.6	100.8	
						SM	Tip: Dark gray silty fine SAND, saturated, medium dense, micaceous.			
	60	■	D-12	24		SP-SM	@ 60': Upper: Very dark gray silty fine to coarse SAND, saturated, medium dense, micaceous, flat white shell fragments.	23.5	98.4	
						SM	Lower: Very dark gray silty fine SAND, saturated, medium dense, micaceous.			
-40										
	65									

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NMG

Riverwalk **San Diego, CA**

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Sheet 3 of 3

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	65	■	D-13	15		SP-SM	@ 65': Dark gray silty fine to coarse SAND, saturated, medium dense, micaceous, trace fine gravel and charcoal.	36.9	91.9	GS
	70	■	D-14	51			@ 70': Dark gray silty fine to coarse SAND, saturated, dense, subangular fine gravel.	18.3	111.9	
-50										
	75	■	D-15	41		SP	@ 75': Dark gray fine to coarse SAND, saturated, dense, micaceous, few fine subrounded gravel.	15.6	120.7	
	80	■	D-16	50/1.5"			@ 80': Dark gray fine to coarse SAND, saturated, dense, micaceous, fine to coarse gravel.	11.0	113.3	
-60							Notes: Total Depth: 80.5 Feet. Groundwater First Encountered at 15 Feet and 13.7 Feet After 20 Minutes. Backfilled with Bentonite Grout.			
	85									
	90									
-70										
	95									
	100									

LOG OF BORING

Riverwalk
San Diego, CA

PROJECT NO. 11077-01

Date(s) Drilled	**10/28/15**	Logged By	**TBF**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**8"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California**		
Approximate Groundwater Depth:	**Groundwater at 8.25' Feet, 20 Minutes after Drilling.**		
Comments			

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Sheet 1 of 2

Total Depth Drilled (ft)	**51.5**
Approximate Ground Surface Elevation (ft)	**20.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
20	0					SM	Surface: Turf. **Undocumented Artificial Fill (Afu)** @ 0-2': Dark brown silty fine medium SAND, moist, loose, few coarse sand grains.			
						SM	**Alluvium (Qal)**			
	5	■	D-1	10			@ 5': Dark grayish brown silty fine to medium SAND, very moist, loose, highly micaceous, pores up to 1/8", organics that are reddish brown at approximately .25" wide and very soft.	17.2	107.7	CN
							▼ ∇			
10	10	■	D-2	18		SP	@ 10': Brown to dark brown fine to coarse SAND, wet, medium dense, highly micaceous, sand is composed largely of quartz grains.	18.5	108.0	CN
	15	■	D-3	39			@ 15': Brown to dark brown fine to coarse SAND, wet, medium dense, highly micaceous, sand is composed largely of quartz grains.	19.1	107.6	
0	20	■	D-4	44		SP-SM	@ 20': Brown to dark brown to gray silty fine to coarse SAND, saturated, medium dense, highly micaceous.	25.0	101.4	
	25	■	D-5	14			@ 25': Dark gray silty fine to coarse SAND, saturated, loose, micaceous.	24.6	94.3	
-10	30									

LOG OF BORING

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Report: HOLLOW STEM; Project: 11077-01.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 2/27/19

Riverwalk **San Diego, CA**

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Sheet 2 of 2

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
-10	30	■	D-6	41		SP-SM	@ 30': Dark gray silty fine to medium SAND, saturated, medium dense, micaceous.	24.7	101.0	
						SM	Tip: Dark gray slightly silty fine SAND, saturated, medium dense, micaceous.			
	35	■	D-7	15			@ 35': Dark gray slightly silty fine SAND, saturated, medium dense, micaceous, few subrounded gravel.	25.4	100.1	
-20	40	■	D-8	12		SM-SC	@ 40': Dark gray silty fine SAND/clayey fine SAND, saturated, loose.	23.7	98.7	
	45	■	D-9	13		CL	@ 45': Black silty CLAY, very moist, stiff, micaceous, trace flat white bivalve.	34.4	87.0	
						SM-SC	Tip: Black silty and clayey fine SAND, saturated, medium dense.			
-30	50	■	D-10	18		SM	@ 50': Very dark gray silty fine to medium SAND, saturated, medium dense.	29.4	96.8	
							Notes: Total Depth: 51.5 Feet. Groundwater First Encountered at 8.9 Feet and Stabilized at 8.25 Feet after 20 minutes. Backfilled with Bentonite Grout.			
	55									
-40	60									
	65									

LOG OF BORING
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PROJECT NO. 11077-01

Date(s) Drilled	**10/21/15**	Logged By	**TBF**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**8"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California, Bulk**		
Approximate Groundwater Depth:	**Groundwater at 8.8 Feet, 17 Minutes after Drilling.**		
Comments			

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Sheet 1 of 2

Total Depth Drilled (ft)	**61.5**
Approximate Ground Surface Elevation (ft)	**17.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0	▨				SM	Surface: Turf. **Alluvium (Qal)**			
		▨	B-1							B-1 @ 0-5' EI, CC
	5	■	D-1	11			@ 5': Dark brown clayey/silty fine SAND, wet, loose, micaceous.	22.2	100.9	
10										
							▼ ▽			
	10	■	D-2	14			@ 10': Upper: Dark brown silty fine SAND, saturated, loose, micaceous.	30.0	93.3	
						SP	Lower: Dark brown fine to medium SAND, saturated, loose, micaceous.			
	15	■	D-3	10			@ 15': Dark brown fine to medium SAND, saturated, loose, micaceous, few coarse sand grains.	27.8	97.5	GS
0										
	20	■	D-4	22		SM	@ 20': Dark gray silty fine to coarse SAND, saturated, medium dense.	23.3	98.7	
	25	■	D-5	29		SP	@ 25': Dark gray fine to coarse SAND, saturated, medium dense, micaceous.	23.6	97.0	
-10										
	30									

LOG OF BORING

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Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30		D-6	16		SP	@ 30': Dark gray fine to coarse SAND, saturated, medium dense, micaceous.	21.6	101.4	
	35		D-7	12		CL	@ 35': Very dark gray fine sandy CLAY, saturated, medium stiff, trace mica.	34.1	86.3	GS, AL
-20										
	40		D-8	21		SP	@ 40': Upper: Very dark gray fine sandy CLAY, saturated, medium stiff, micaceous. Lower: Dark gray fine to medium SAND, saturated, medium dense, micaceous.	21.9	104.2	
	45		D-9	13		SM	@ 45': Upper: Dark gray fine to medium SAND, saturated, medium dense, micaceous. Lower: Very dark gray clayey and silty fine to medium SAND, saturated, medium dense, micaceous.	29.7	92.8	
-30										
	50		D-10	66		SP	**Older Alluvium (Qalo)** @ 50': Dark gray fine to coarse SAND, saturated, dense, fine to coarse gravel.	18.8	109.1	
	55		D-11	65		GM	@ 55': Dark gray silty fine to coarse sandy GRAVEL, saturated, dense, fine to coarse gravel.	3.8	144.5	
-40										
	60		SPT-1	88			@ 60': Dark gray silty fine to coarse sandy GRAVEL, saturated, dense, fine to coarse gravel.	7.9		
	65						Notes: Total Depth: 61.5 Feet (Refusal). Groundwater First Encountered at 9.8 Feet and 8.8 Feet After 17 Minutes. Backfilled with Bentonite Grout.			

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NMG

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Date(s) Drilled	**10/20/15**	Logged By	**TBF**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**8"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California, Bulk**		
Approximate Groundwater Depth:	**Groundwater at 6.5 Feet, 22 Minutes after Drilling.**		
Comments			

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Sheet 1 of 3

Total Depth Drilled (ft)	**75.5**
Approximate Ground Surface Elevation (ft)	**16.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0	▨					Surface: Turf. **Undocumented Artificial Fill (Afu)** Dark brown clayey fine SAND, very moist, micaceous.			
		▨				SM-ML	**Alluvium (Qal)**			
	5	▨ ■	B-1 D-1	20			@ 5': Upper: Dark brown to dark gray fine sandy SILT/silty SAND, wet, medium dense, highly micaceous.	24.6	98.2	B-1 @ 0-10'
10		▨				SP	▼ Lower: Gray fine to coarse SAND, wet, medium dense, micaceous. ∇			
	10	■	D-2	6			@ 10': Gray fine to coarse SAND, saturated, loose, micaceous.	23.5	98.8	CN, GS
	15	■	D-3	32			@ 15': Gray fine to coarse SAND, saturated, medium dense, micaceous, trace fine angular gravel.	16.7	110.2	
0						SM	Tip: Very dark gray silty fine SAND, saturated, medium dense, highly micaceous.			
	20	■	D-4	13			@ 20': Upper: Gray silty fine to coarse SAND, saturated, medium dense, micaceous. Lower: Black silty fine SAND, saturated, loose to medium dense, highly micaceous.	34.4	89.9	
	25	■	D-5	6			@ 25': Black silty fine SAND, saturated, loose, trace mica.	41.0	79.8	GS, AL
-10										
	30									

LOG OF BORING

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NMG

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30	■	D-6	20		SP	@ 30': Dark gray fine to medium SAND, saturated, medium dense, micaceous, coarsens downward.	25.7	96.1	GS
-20	35	■	D-7	22			@ 35': Dark gray fine to medium SAND, saturated, medium dense, micaceous.	23.1	100.3	
	40	■	D-8	30			@ 40': Upper: Dark gray fine SAND, saturated, medium dense, micaceous.	26.9	97.1	
						SM	Lower: Dark gray silty fine SAND, saturated, medium dense, micaceous.			
-30	45	■	D-9	31		SP-SM	@ 45': Very dark gray silty fine to medium SAND, saturated, medium dense, micaceous.	26.0	97.6	
	50	■	D-10	35		SP	@ 50': Dark gray fine to medium SAND, saturated, medium dense, micaceous.	23.2	104.4	
-40	55	■	D-11	39		SP-SM	@ 55': Dark gray silty fine to medium SAND, saturated, medium dense, micaceous.	31.7	94.4	GS
	60	■	D-12	41		SP	@ 60': Dark gray fine to medium SAND, saturated, medium dense, micaceous, fine gravel in sampler tip.	21.7	108.2	
	65									

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Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	65	■	D-13	46		SP	@ 65': Dark gray fine to coarse SAND, saturated, dense, micaceous.	19.9	106.6	
-50										
	70	■	D-14	83			@ 70': Dark gray fine to medium SAND, saturated, very dense, micaceous, subrounded coarse gravel.	12.7	132.0	
	75	■	D-15	50/3"		SP	**Older Alluvium (Qalo)** @ 75': No ring sample recovery. Drilling became very difficult at 75'.			
-60										
							Notes: Total Depth: 75.5 Feet (Refusal). Groundwater First Encountered at 7.4 Feet and 6.5 Feet After 22 Minutes. Backfilled with Bentonite Grout.			
	80									
	85									
-70										
	90									
	95									
-80										
	100									

LOG OF BORING

Riverwalk
San Diego, CA

PROJECT NO. 11077-01

NMG

Date(s) Drilled	10/29/15	Logged By	TBF
Drilling Company	2R Drilling	Drill Bit Size/Type	8"
Drill Rig Type	CME 75 Hollow Stem	Hammer Data	140 lbs @ 30" Drop
Sampling Method(s)	Modified California, Bulk		

Approximate Groundwater Depth: **Groundwater at 10.9 Feet, 16 Minutes after Drilling.**

Comments

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Sheet 1 of 3

Total Depth Drilled (ft)	76.5
Approximate Ground Surface Elevation (ft)	24.0 msl

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0						Surface: Asphalt Parking Lot; 5" AC over 4" AB.			
		▨				SP	**Undocumented Artificial Fill (Afu)** @ 1': Brown fine to medium silty SAND, damp, loose.			B-1 @ 1-5'
		▨	B-1			SP	**Alluvium (Qal)**			
20										
	5	■	D-1	17			@ 5': Yellowish brown fine SAND, damp, loose, micaceous.	5.1	90.0	
	10	■	D-2	9			▽ @ 10': Brown fine to coarse SAND, wet, loose, micaceous.	20.4	102.9	
10										
	15	■	D-3	11			@ 15': Grayish brown fine to coarse SAND, saturated, loose, micaceous, few fine to coarse gravel.	19.4	101.3	CN
	20	■	D-4	22			@ 20': Grayish brown fine to coarse SAND, saturated, loose, micaceous, few fine to coarse gravel, trace red wood fragments approximately 1/5" long .	21.2	105.2	
0										
	25	■	D-5	42		SP-SM	@ 25': Gray silty fine to coarse SAND, saturated, medium dense, micaceous.	24.0	103.5	GS
	30									

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NMG

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Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30	■	D-6	18		SP-SM	@ 30': Upper: Brown to gray silty fine to coarse SAND, saturated, medium dense, micaceous. Lower: Gray silty fine to coarse SAND, saturated, medium dense, micaceous, trace pink to purple wood fragments approximately less than 1/5" long.	23.3	102.8	
-10										
	35	■	D-7	10		SM	@ 35': Upper: Gray silty fine to medium SAND, saturated, medium dense, micaceous, fine angular gravel.	27.1	93.3	
						SC	Tip: Upper: Gray clayey fine to medium SAND, saturated, medium dense, fine angular gravel.			
	40	■	D-8	28		SP-SM	@ 40': Gray to brown silty fine to medium SAND, saturated, medium dense, highly micaceous.	28.0	98.6	
-20										
	45	■	D-9	54		SP	@ 45': Very dark brown fine to medium SAND, saturated, dense, micaceous.	22.2	105.6	
	50	■	D-10	33			@ 50': Upper: Dark gray fine to coarse SAND, saturated, medium dense, micaceous.	26.5	96.8	
						SM	Lower: Dark gray silty fine SAND, saturated, medium dense, micaceous.			
-30										
	55	■	D-11	67		SP-SM	@ 55': Very dark gray silty fine to medium SAND, saturated, dense, micaceous.	24.3	96.2	
	60	■	D-12	47		SP	@ 60': Dark gray fine to medium SAND, saturated, dense, trace subrounded medium gravel.	21.6	104.8	
-40										
	65									

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Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	65	■	D-13	48		SP	**Older Alluvium (Qalo)** @ 65': Upper: Very dark gray fine to coarse SAND, wet, dense.	13.4	115.2	
						SC	Tip: Very dark gray clayey fine SAND, saturated, dense, subrounded fine to medium gravel.			
	70	■	D-14	77/11"		SP	@ 70': Very dark gray fine to medium SAND, saturated, very dense, micaceous, few fine to coarse subrounded gravel.	14.1	117.7	
						SC	Tip: Very dark clayey fine SAND, saturated, very dense, micaceous.			
-50										
	75	■	D-15	100/7"		GM	@ 75': Very dark gray fine to coarse sandy GRAVEL, saturated, very dense, micaceous, subangular to subrounded fine to coarse gravel.	13.5	125.8	
							Notes: Total Depth: 76.5 Feet (Refusal). Groundwater First Encountered at 10.5 Feet and at 10.9 Feet After 16 minutes. Backfilled with Bentonite Grout and Patched with AC.			
	80									
-60										
	85									
	90									
-70										
	95									
	100									

LOG OF BORING
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PROJECT NO. 11077-01

Date(s) Drilled	**10/28/15**	Logged By	**TBF**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**8"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California, Bulk**		
Approximate Groundwater Depth:	**Groundwater at 7.4 Feet, 22 Mnutes after Drilling.**		
Comments			

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Sheet 1 of 2

Total Depth Drilled (ft)	**51.5**
Approximate Ground Surface Elevation (ft)	**19.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0	▨			⁘	SM	Surface: Turf. **Undocumented Artificial Fill (Afu)** Brown silty fine to medium SAND, damp.			
		▨	B-1		⁘	SP	**Alluvium (Qal)**			B-1 @ 0-5'
	5	■	D-1	28	⁘		@ 5': Grayish brown to dark grayish brown fine to medium SAND, moist, medium dense, micaceous.	8.2	102.5	DS
					⁘		▼			
10					⁘					
	10	■	D-2	13	⁘	SP-SM	▽ @ 10': Dark gray fine to medium SAND, saturated, loose, micaceous.	25.9	98.2	
	15	■	D-3	17	⁘		@ 15': Dark gray fine to medium SAND, saturated, loose, micaceous.	23.9	100.1	CN
0					⁘					
	20	■	D-4	6	⁘		@ 20': Dark gray silty fine to medium SAND, saturated, loose, micaceous.	35.2	89.8	GS
	25	■	D-5	13	▨	SC	@ 25': Very dark gray clayey SAND, saturated, medium dense, trace mica, abundant gastropod shells.	29.8	91.7	GS, CN
-10					▨					
	30									

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NMG

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Elevation (ft)	Depth (ft)	SAMPLES			Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number	Blows per foot						
	30	■	D-6	19		SM	@ 30': Very dark gray silty fine SAND, saturated, medium dense, micaceous.	33.4	89.8	
	35	■	D-7	26		SC	@ 35': Very dark gray clayey fine SAND, saturated, medium dense, micaceous, broken white bivalve shells.	23.1	101.0	
-20										
	40	■	D-8	15		SP	@ 40': Very dark gray fine to medium SAND, saturated, medium dense, micaceous.	20.2	104.3	CN
	45	■	D-9	68/11"		SC	**Older Alluvium (Qalo)** @ 45': Dark gray clayey fine to medium SAND, saturated, dense, micaceous, trace coarse gravel.	19.4	110.8	
-30										
	50	■	D-10	80/6"			@ 50': No recovery.			
							Notes: Total Depth: 51.5 Feet. Groundwater First Encountered at 10.2 Feet and at 7.4 Feet After 22 minutes. Backfilled with Bentonite Grout.			
	55									
-40										
	60									
	65									

LOG OF BORING

Riverwalk
San Diego, CA

PROJECT NO. 11077-01

NMG

Report: HOLLOW STEM; Project: 11077-01.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 2/27/19

Date(s) Drilled	**10/15/15**	Logged By	**TBF**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**8"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California, Bulk**		
Approximate Groundwater Depth:	**Groundwater at 10.25 Feet, 15 Minutes after Drilling.**		
Comments			

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Sheet 1 of 2

Total Depth Drilled (ft)	**51.5**
Approximate Ground Surface Elevation (ft)	**22.5 msl**

Elevation (ft)	Depth (ft)	SAMPLES			Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number	Blows per foot						
	0	▨				SM-SC	Surface: Grass Golf Course **Undocumented Artificial Fill (Afu)** Dark brown clayey and silty fine to medium SAND, moist.			
20		▨	B-1							B-1 @ 0-5'
						SM	**Alluvium (Qal)**			
	5	■	D-1	16			@ 5': Dark grayish brown slightly silty fine SAND, very moist, loose to medium dense, abundant mica.	10.2	91.9	
	10	■	D-2	17			▼ ▽ @ 10': Very dark grayish brown silty fine SAND, wet to saturated, medium dense, abundant mica.	27.5	95.8	GS
10										
	15	■	D-3	8			@ 15': Very dark grayish brown silty fine SAND, saturated, medium dense, abundant mica, trace medium grained sand.	27.8		
	20	■	D-4	41			@ 20': Very dark grayish brown silty fine SAND, saturated, medium dense, abundant mica.	22.2	104.3	GS
0										
	25	■	D-5	38			@ 25': Very dark gray silty fine to medium SAND, saturated, medium dense, abundant mica.	23.6	104.3	
	30									

LOG OF BORING

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG

Report: HOLLOW STEM; Project: 11077-01.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 2/27/19

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30	■	D-6	12		SM	@ 30': Very dark gray silty fine to medium SAND, saturated, loose.	25.6	96.0	
						ML	Tip: Very dark gray clayey SILT, saturated, stiff, abundant mica.			
-10										
	35	■	D-7	28		SM	@ 35': Very dark gray silty fine SAND, saturated, medium dense, abundant mica.	36.8	84.4	CN, AL
	40	■	D-8	38		SP	@ 40': Very dark gray fine to medium SAND, saturated, medium dense, abundant mica.	23.1	101.3	
-20										
	45	■	D-9	20		SM	@ 45': Very dark gray to black silty fine SAND, saturated, medium dense, micaceous.	24.7	104.3	
	50	■	D-10	33		ML	@ 50': Very dark gray fine sandy SILT, saturated, stiff, micaceous layers in soil.	34.3	86.7	
-30							Notes: Total Depth: 51.5 Feet. Groundwater First Encountered at 11.0 Feet and 10.25 Feet After 15 Minutes. Backfilled with Bentonite Grout.			
	55									
	60									
-40										
	65									

LOG OF BORING
Riverwalk
San Diego, CA

PROJECT NO. 11077-01

NMG

Date(s) Drilled	10/15/15	Logged By	TBF
Drilling Company	2R Drilling	Drill Bit Size/Type	8"
Drill Rig Type	CME 75 Hollow Stem	Hammer Data	140 lbs @ 30" Drop
Sampling Method(s)	Modified California, Bulk		
Approximate Groundwater Depth:	Groundwater at 10.4 Feet, 15 Minutes after Drilling.		
Comments			

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Sheet 1 of 3

Total Depth Drilled (ft)	74.0
Approximate Ground Surface Elevation (ft)	24.0 msl

Elevation (ft)	Depth (ft)	SAMPLES Type	Number	Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0	▨				SM-SC	Surface: Turf. **Undocumented Artificial Fill (Afu)** Brown silty fine to medium SAND, damp, micaceous.			
		▨	B-1							B-1 @ 0-5' EI, CC
20		▨				SP-SM	**Alluvium (Qal)**			
	5	■	D-1	20			@ 5': Dark brown silty fine SAND, moist, medium dense, micaceous. Tip: Light brown silty fine SAND, moist, medium dense, micaceous.	11.0	91.2	GS, CN
	10	■	D-2	15		SM	▼ @ 10': Brown silty fine SAND, wet to saturated, loose to medium dense, abundant mica.	26.3	96.3	
10										
	15	■	D-3	46			@ 15': Dark brown silty fine to medium SAND, saturated, dense, micaceous.	23.9	101.7	
	20	■	D-4	58		SP	@ 20': Dark gray fine to coarse SAND, saturated, dense, micaceous.	21.9	104.9	
0										
	25	■	D-5	32			@ 25': Very dark gray fine to coarse SAND, saturated, medium dense, micaceous.	25.2	98.5	GS
	30									

LOG OF BORING

Riverwalk

San Diego, CA

PROJECT NO. 11077-01

NMG

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30	■	D-6	35		SP	@ 30': No ring sample recovery.			
-10										
	35	■	D-7	17		SM	@ 35': Upper: Dark gray slightly silty fine to medium SAND, saturated, medium dense, micaceous.	24.4	101.0	
						ML	Tip: Dark gray fine sandy SILT, saturated, stiff, micaceous.			
	40	■	D-8	19			@ 40': Dark gray fine sandy SILT, saturated, stiff, micaceous.	35.0	90.1	GS
-20										
	45	■	D-9	20		ML-CL	@ 45': Dark gray fine sandy clayey SILT/silty CLAY, saturated, stiff, micaceous.	33.4	92.4	
	50	■	D-10	27		SM	@ 50': Dark gray silty fine SAND, saturated, medium dense, micaceous.	25.3	101.9	
-30										
	55	■	D-11	92			@ 55': Very dark gray silty fine to medium SAND, saturated, very dense, micaceous.	18.4	113.6	
	60	■	D-12	29			@ 60': Very dark gray silty fine to coarse SAND, saturated, medium dense, micaceous.	18.4	106.1	
						CL	Tip: Very dark gray fine to medium sandy CLAY, saturated, very stiff, micaceous.			
-40										
	65									

LOG OF BORING

Riverwalk
San Diego, CA

PROJECT NO. 11077-01

NMG

Elevation (ft)	Depth (ft)	SAMPLES Type	Number	Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	65	■	D-13	18	▨	CL	@ 65': Very dark gray silty CLAY, saturated, stiff, micaceous, caliche.	36.6	85.6	
	70	■	D-14	38	░	SM	@ 70': Upper: Dark gray silty fine to medium SAND, saturated, medium dense, micaceous.	19.1	108.9	
					●	GM	**Older Alluvium (Qalo)** Lower: Dark gray fine to coarse sandy fine GRAVEL, saturated, medium dense, subrounded fine gravel, micaceous.			
-50										
	75						Notes: Total Depth: 74 Feet (Refusal). Groundwater First Encountered at 10.7 Feet and 10.4 Feet After 15 Minutes. Backfilled with Bentonite Grout.			
	80									
-60										
	85									
	90									
-70										
	95									
	100									

LOG OF BORING

Riverwalk
San Diego, CA

PROJECT NO. 11077-01

NMG

Date(s) Drilled	**10/16/15**	Logged By	**TBF**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**8"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California**		
Approximate Groundwater Depth:	**Groundwater Encountered at 11.1 Feet During Drilling.**		
Comments			

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Sheet 1 of 2

Total Depth Drilled (ft)	**53.0**
Approximate Ground Surface Elevation (ft)	**26.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0					SM-SC	Surface: Grass Golf Course **Undocumented Artificial Fill (Afu)**			
						SM	**Alluvium (Qal)**			
20	5	■	D-1	20			@ 5': Dark brown silty fine SAND, very moist to wet, medium dense, micaceous, minor roots up to 1/8" diameter.	20.0	104.3	
	10	■	D-2	13		SP	@ 10': Light olive brown fine to medium SAND, wet, loose, micaceous. ▼	26.1	88.0	GS
10	15	■	D-3	8		SP-SM	@ 15': Upper: Dark gray silty fine to medium SAND, saturated, loose, micaceous.	29.5	91.2	CN
	20	■	D-4	29		SP	@ 20': Dark gray silty fine to medium SAND, saturated, medium dense, micaceous.	24.7	100.6	
0	25	■	D-5	50			@ 25': Dark gray silty fine to medium SAND, saturated, medium dense, micaceous.	23.0	101.0	
	30									

LOG OF BORING

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

Riverwalk **San Diego, CA**

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Sheet 2 of 2

Elevation (ft)	Depth (ft)	SAMPLES			Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number	Blows per foot						
	30	■	D-6	33		SP	@ 30': Very dark gray silty fine to medium SAND, saturated, medium dense, micaceous.			
-10	35	■	D-7	19		SM	@ 35': Dark gray silty fine SAND, saturated, medium dense, micaceous.	33.0	88.6	
	40	■	D-8	16		SM-ML	@ 40': Very dark gray silty fine SAND/sandy SILT, saturated, medium dense/stiff, micaceous.	31.0	97.0	
-20	45	■	D-9	31		CL	@ 45': Dark gray fine sandy CLAY, saturated, stiff, fine subrounded to subangular gravels in sampler tip.	18.7	111.0	
	50	■	D-10	67		SP	@ 50': Brown fine SAND, saturated, dense, micaceous, sampler tip had yellow coarse gravel.	13.6	111.1	
-30	55						Notes: Total Depth: 53 Feet (Refusal). Groundwater Encountered at 11.1 Feet. Backfilled with Bentonite Grout.			
	60									
	65									

LOG OF BORING
Riverwalk
San Diego, CA

PROJECT NO. 11077-01

NMG

Date(s) Drilled	8/7/17	Logged By	ZKH
Drilling Company	2R Drilling	Drill Bit Size/Type	10"
Drill Rig Type	CME 75 Hollow Stem	Hammer Data	140 lbs @ 30" Drop
Sampling Method(s)	Modified California, Bulk		
Approximate Groundwater Depth:	11.7 Feet		
Comments			

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Sheet 1 of 2

Total Depth Drilled (ft)	61.5
Approximate Ground Surface Elevation (ft)	22.0 msl

Elevation (ft)	Depth (ft)	SAMPLES			Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number	Blows per foot						
	0	▨				SM	Surface: Turf **Alluvium (Qal)**			B-1 @ 0'-5'
20										
		■	B-1 D-1	36			@ 2.5': Very dark grayish brown silty fine SAND, moist, medium dense, laminated with slightly clayey layers, roots, pinhole pores.	12.6	119.3	
		▨								
	5	■	D-2	15			@ 5': Dark gray silty fine SAND, moist, loose, micaceous layers, pores with roots.	15.4	97.7	
		■	D-3	5			@ 7.5': Dark gray silty fine SAND, moist to very moist, loose, micaceous. trace roots and pores. Tip: Highly micaceous.	16.0	96.9	
	10	■	D-4	2		CL	@ 10': Upper: Dark gray CLAY, wet, very soft, micaceous.	34.5	87.4	CN
						SM-SC	▼ Lower: Dark yellowish brown silty/clayey SAND, saturated, very loose, pinhole pores, micaceous. ▽			
10										
	15	■	D-5	15		SP	@ 15': Olive to gray fine to coarse SAND, saturated, loose to medium dense, friable, trace gravel and cobbles, micaceous.	15.6	107.4	GS
	20	■	D-6	17		SP-SM	@ 20': Gray silty to clean fine to medium SAND, saturated, medium dense, friable, micaceous.	23.0	96.9	CN, GS
0										
	25	■	D-7	9		SM	@ 25': Gray silty fine to coarse SAND, saturated, loose to medium dense, friable, micaceous.	20.4	103.4	
	30									

LOG OF BORING

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

NMG

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30	■	D-8	14			@ 30': Dark gray silty fine SAND, saturated, loose to medium dense, micaceous.	20.5	103.2	
-10										
	35	■	D-9	22			@ 35': Dark yellowish brown silty fine to coarse SAND, saturated, medium dense, friable, micaceous.	21.4	103.8	
	40	■	D-10	24			@ 40': Dark yellow brown silty fine to coarse SAND, saturated, medium dense, friable, micaceous.	23.1	103.3	
						ML	Tip: Dark yellow to brown sandy SILT, saturated, very stiff, micaceous.			
						SM				
-20										
	45	■	D-11	9			@ 45': Dark olive gray silty fine to medium SAND, saturated, loose to medium dense, friable.	23.0	102.5	
	50	■	D-12	14		SM-SC	@ 50': Dark olive gray silty/clayey fine to medium SAND, saturated, medium dense, friable micaceous.	18.3	110.4	
-30										
	55	■	D-13	6		SC	@ 55': Dark gray clayey fine to coarse SAND, saturated, loose, trace gravel, micaceous.	17.9	113.4	CN, GS
	60	■	D-14	22		SM-ML	@ 60': Dark olive gray silty fine SAND/fine sandy SILT, saturated, medium dense/stiff, micaceous, trace roots.	23.1	105.5	
-40							Notes: Total Depth 61.5 Feet. Groundwater Encountered at 12.6'. Groundwater Stabilized at 11.7' After 10 Minutes. Backfilled With Neat Cement Slurry on 8/7/2017.			
	65									

LOG OF BORING

Hines/Riverwalk
San Diego, California

PROJECT NO. 11077-02

Report: HOLLOW STEM; Project: 11077-02-CONVERTED.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 2/27/19

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Sheet 1 of 2

Date(s) Drilled	**8/8/17**	Logged By	**ZKH**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**10"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California, Bulk**		
Approximate Groundwater Depth:	**12.6 Feet**		
Comments			

Total Depth Drilled (ft)	**56.5**
Approximate Ground Surface Elevation (ft)	**22.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES			Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number	Blows per foot						
	0	▨				SM-ML	Surface: Turf **Alluvium (Qal)**			B-1 @ 0'-5'
20										
		▨ ■	B-1 D-1	39			@ 2.5': Dark olive gray silty fine SAND/SILT, wet, medium dense/very stiff, micaceous, pinhole pores, roots.	23.6	103.3	
	5	■	D-2	11			@ 5': Dark olive gray silty fine SAND/SILT, moist, loose/medium stiff micaceous, pinhole pores, roots.	11.8	103.2	
		■	D-3	8		SM	@ 7.5': Dark brown silty fine to medium SAND, moist, loose, friable, some thin lenses of clean sand.	10.2	100.6	
	10	■	D-4	7		SM-ML	@ 10': Dark brown silty fine to medium SAND/fine to medium sandy SILT, very moist to saturated, loose/medium stiff, micaceous, pinhole pores, laminated lenses of silt/sand.	28.0	94.7	CN, GS
10										
							▼			
							▽			
	15	■	D-5	15		SM	@ 15': Dark brownish gray silty very fine SAND, saturated, loose, micaceous, pinhole pores.	23.5	99.4	
	20	■	D-6	9		SP	@ 20': Gray fine to coarse SAND, saturated, loose, friable, micaceous.	17.3	107.9	GS
0										
	25	■	D-7	47		SP	@ 25': Gray fine to coarse SAND, saturated, medium dense, friable, micaceous. Tip: Silty SAND.	19.5		
	30									

LOG OF BORING

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

Report: HOLLOW STEM; Project: 11077-02-CONVERTED.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 2/27/19

Elevation (ft)	Depth (ft)	SAMPLES Type	Number	Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30	▮	D-8	17			@ 30': Gray fine to coarse SAND, saturated, medium dense, friable, micaceous.	21.8	106.3	GS
-10										
	35	▮	D-9	11		ML-CL	@ 35': Upper: Dark brown fine sandy SILT/CLAY, saturated, medium stiff, micaceous.	31.7	83.5	
						SM	Lower: Dark brown silty fine to coarse SAND, saturated, medium dense, micaceous. Cobble layer, difficult drilling from 37' to 40'.			
	40	▮	D-10	12		SC-CL	@ 40': Brown clayey fine to medium SAND/CLAY, saturated, medium dense/medium stiff, gravel and cobbles.	16.2	122.8	GS
-20										
	45	▮	D-11	13		SC-GC	@ 45': No Recovery.			
	50	▮	D-12	26			@ 50': No Recovery. Driller pushed sampler back onto unrecovered soil and recovered a disturbed sample. Brown gravelly, clayey, fine to medium SAND, saturated, medium dense.			
-30										
	55	▮	D-13	71			**River Terrace Deposits? (Qtr)** @ 55': Gray to olive fine to coarse SAND, saturated, very dense, friable, some gravel.	10.7	124.7	
							Notes: Total Depth: 56.5 Feet. Groundwater Encountered at 13.8'. Groundwater Stabilized at 12.6' After 10 Minutes. Backfilled with Neat Cement Slurry on 8/8/17.			
	60									
-40										
	65									

LOG OF BORING

Hines/Riverwalk
San Diego, California

PROJECT NO. 11077-02

Report: HOLLOW STEM; Project: 11077-02-CONVERTED.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 2/27/19

Date(s) Drilled	**8/8/17**	Logged By	**ZKH**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**10"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California, Bulk**		
Approximate Groundwater Depth:	**18.6 Feet**		
Comments			

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Sheet 1 of 2

Total Depth Drilled (ft): **51.5**

Approximate Ground Surface Elevation (ft): **33.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
30	0	▨	B-1			SM	Surface: Turf **Alluvium (Qal)** Hand-Augered from 0 to 5 Feet. Bag sample was yellowish brown silty SAND.			B-1 @ 0'-5'
	5	■	D-1	58		SM-ML	@ 5': Dark yellowish brown silty very fine SAND/sandy SILT, moist, dense/hard, micaceous rich layers, moderately friable.	16.6	100.9	GS
		■	D-2	35		SM	@ 7.5': Dark brown silty fine SAND, wet, medium dense, micaceous.	54.5	78.5	
20	10	■	D-3	52		SM-SC	@ 10': Mottled olive brown to dark yellowish brown silty/clayey fine SAND, very moist, dense, roots, micaceous, white fragments in sample?	12.9	103.2	
	15	■	D-4	20		SP	@ 15': Yellowish brown fine SAND, wet, medium dense, friable, micaceous. ▼	6.1	93.4	
10	20	■	D-5	24		SM	@ 20': Olive brown to dark yellowish brown silty fine SAND, saturated, medium dense, friable, micaceous.	29.4	94.9	
	25	■	D-6	24		SP	@ 25': Gray fine to medium SAND, saturated, medium dense, friable, micaceous.	25.3	97.1	GS
	30									

LOG OF BORING

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

Report: HOLLOW STEM; Project: 11077-02-CONVERTED.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 2/27/19

Hines/Riverwalk **San Diego, California**

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Sheet 2 of 2

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30	■	D-7	45		SP-SM	@ 30': Olive brown silty to clean fine to medium SAND, saturated, medium dense, friable, micaceous.	20.9	104.9	
0										
	35	■	D-8	35		SP	@ 35': Dark gray to yellowish brown fine to medium SAND, saturated, medium dense, friable, micaceous.	19.0	109.3	
	40	■	D-9	23		SM	@ 40': Dark gray silty very fine to fine SAND, saturated, medium dense, friable, highly micaceous.	28.2	94.7	
-10										
	45	■	D-10	14		SP-SM	@ 45': Dark gray silty to clean fine to medium SAND, saturated, medium dense, friable, micaceous.	25.0	95.4	
	50	■	D-11	50		SM	**Older Alluvium (Qalo)** @ 50': Dark gray silty very fine SAND, saturated, very dense, highly micaceous, moderately friable.	26.3	98.8	
							Notes: Total Depth: 51.5 Feet. Groundwater Encountered at 18.7 Feet. Groundwater Stabilized at 18.6 Feet. Backfilled with Neat Cement Slurry on 8/8/17.			
-20										
	55									
	60									
-30										
	65									

LOG OF BORING

Hines/Riverwalk
San Diego, California

PROJECT NO. 11077-02

Report: HOLLOW STEM; Project: 11077-02-CONVERTED.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 2/27/19

Date(s) Drilled	**8/8/17**	Logged By	**ZKH**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**10"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California, Bulk**		
Approximate Groundwater Depth:	**9.0 Feet**		
Comments			

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Sheet 1 of 2

Total Depth Drilled (ft)	**56.5**
Approximate Ground Surface Elevation (ft)	**21.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0	▨				SP	Surface: Turf. **Alluvium (Qal)** 0'-2' cobbles and sand.			B-1 @ 0'-5'
20										
		▨ ■	B-1 D-1	31			@ 2.5': Light gray fine SAND, damp, medium dense, friable, trace micaceous laminations.	10.4	101.9	
	5	■	D-2	23			@ 5': Yellowish brown fine SAND, damp to moist, medium dense, friable, trace micaceous laminations.	4.4	102.8	
		■	D-3	8			@ 7.5': Yellowish brown fine to coarse SAND, moist, loose, friable, micaceous. ▼	21.8	95.7	GS
	10	■	D-4	8			@ 10': No Recovery.			
10										
	15	■	D-5	33			@ 15': Yellowish brown fine to coarse SAND, saturated, medium dense, friable, micaceous.	14.8	110.7	
	20	■	D-6	58			@ 20': Yellowish brown fine to coarse SAND, saturated, medium dense, friable, micaceous.	18.3	106.0	GS
0										
	25	■	D-7	50		SP	@ 25': Dark olive brown to dark gray very fine to medium SAND, saturated, dense, slightly silty laminations, micaceous.	23.4	103.6	
	30									

LOG OF BORING

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

NMG

Elevation (ft)	Depth (ft)	SAMPLES Type	Number	Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
-10	30	■	D-8	86		SP-SM	@ 30': Dark olive brown to dark gray silty to clean very fine to medium SAND saturated, very dense, micaceous.	21.0	108.4	
	35	■	D-9	56			@ 35': Dark olive brown to dark gray silty to clean very fine to medium SAND saturated, very dense, micaceous.	20.6	105.9	GS
-20	40	■	D-10	44			@ 40': Dark olive brown to dark gray silty to clean very fine to medium SAND saturated, very dense, micaceous. Tip: Large cobble in sampler tip.	7.0	119.8	
	45	■	D-11	44			@ 45': Dark olive brown to dark gray silty to clean very fine to medium SAND saturated, very dense, micaceous.	19.0	113.7	
						SM	Tip: Silty very fine to medium SAND, saturated, medium dense.			
-30	50	■	D-12	11			@ 50': Dark gray silty fine to medium SAND, saturated, loose/medium dense, friable, trace clay, micaceous.	20.8	104.3	GS
	55	■	D-13	46		SP	@ 55': Dark gray fine to medium SAND, saturated, medium dense, friable, trace silt, micaceous.	20.5	104.0	
							Notes: Total Depth: 56.5 Feet. Groundwater Encountered at 9.1'. Groundwater Stabilized at 9.0' After 10 Minutes. Backfilled with Neat Cement Slurry on 8/8/17.			
-40	60									
	65									

Report: HOLLOW STEM; Project: 11077-02-CONVERTED.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 2/27/19

Date(s) Drilled	8/10/17	Logged By	ZKH
Drilling Company	2R Drilling	Drill Bit Size/Type	10"
Drill Rig Type	CME 75 Hollow Stem	Hammer Data	140 lbs @ 30" Drop
Sampling Method(s)	Modified California, Bulk		
Approximate Groundwater Depth:	24.3 Feet		
Comments			

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Sheet 1 of 2

Total Depth Drilled (ft)	28.0
Approximate Ground Surface Elevation (ft)	36.8 msl

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0	▨					Surface: Asphalt Parking Lot. 4" of AC over 7" AB.			B-1 @ 0'-5'
		▨	B-1			SM-SC	**Artificial Fill (Af_L)** Hand Augered from 0' to 5'.			
	5	■	D-1	21		CL	@ 5': Upper: Gray silty CLAY, very moist, stiff, plastic, micaceous.	22.7	105.4	
30						SC	Lower: Reddish yellow clayey fine to medium SAND, very moist, medium dense, micaceous, cobble in sampler tip.			
	10	■	D-2	36		CL	@ 10': Black gravelly/sandy CLAY, very moist, very stiff, micaceous, abundant gravel. @ 12'-13', abundant cobbles, difficult drilling.	16.4	111.7	
						SM	**Alluvium (Qal)**			
	15	■	D-3	10			@ 15': Gray silty fine SAND, moist, medium dense, friable, micaceous, root hairs.	12.7	88.8	CN, GS
20										
	20	■	D-4	10		SC	@ 20': Gray clayey fine to medium SAND, very moist to wet, loose to medium dense, micaceous, trace coarse sand.	13.9	116.2	CN
						SM-SC	**River Terrace Deposits (Qtr)** ▼ ▽			
	25	■	D-5	85/8.5"		SM-SC	@ 25': Yellow silty/clayey fine to coarse SAND, saturated, very dense, micaceous, abundant cobbles/gravel. Took 1 hour to drill to 2 more feet, extremely difficult drilling due to cobbles/gravel.	9.9	121.4	
10										
	30									

LOG OF BORING

Hines/Riverwalk
San Diego, California
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Elevation (ft)	Depth (ft)	SAMPLES Type Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30					Notes: Total Depth: 28.0 Feet. Groundwater Encountered at 24.8'. Groundwater Stabilized at 24.3' After 10 Minutes. Backfilled with Neat Cement Slurry and Patched with AC.			
	35								
0									
	40								
	45								
-10									
	50								
	55								
-20									
	60								
	65								

LOG OF BORING

Hines/Riverwalk
San Diego, California

PROJECT NO. 11077-02

NMG

Report: HOLLOW STEM; Project: 11077-02-CONVERTED.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 2/27/19

Date(s) Drilled	**8/10/17**	Logged By	**ZKH**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**10"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California, Bulk**		
Approximate Groundwater Depth:	**21.8 Feet**		
Comments			

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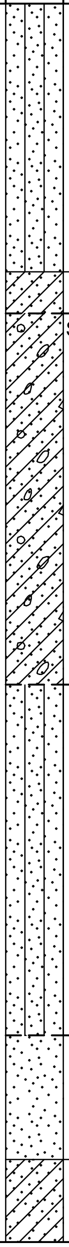
Sheet 1 of 2

Total Depth Drilled (ft)	**40.5**
Approximate Ground Surface Elevation (ft)	**33.0 msl**



Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0	▨				SM	Surface: Turf, Driving Range Tee. **Artificial Fill, Undocumented (Afu)**			B-1 @ 0'-5'
30		▨ ■	B-1 D-1	11			@ 2.5': Olive silty fine SAND, very moist, loose to medium dense, micaceous, trace debris (flat, hard piece of plastic?).	15.9	107.0	
	5	▨ ■	D-2	36			@ 5': Gray silty fine SAND, very moist, medium dense, micaceous.	17.8	110.4	B-2 @ 5'-10'
		▨				SC	**Alluvium (Qal)** Tip: Light yellowish brown clayey fine SAND, very moist, medium dense, micaceous, cobbles and gravel abundant.			
		■	B-2 D-3	61		SC-GC	@ 7.5': No Recovery.			
	10	▨ ■	D-4	20			@ 10': Dark gray clayey fine to medium SAND/GRAVEL, very moist, medium dense, trace root hairs, micaceous.	13.9	106.8	
20										
	15						Difficult drilling from 12' to 16', cobbles and gravel. Too gravelly to sample at 15'.			
		■	D-5	15		SM	@ 16.5': Grayish brown silty fine SAND, moist, medium dense, friable, highly micaceous. Tip: Sandy SILT, highly micaceous.	4.4	98.4	
	20	■	D-6	14			@ 20': Gray(salt and pepper) to yellowish brown and olive silty fine to medium SAND, saturated, medium dense, friable, micaceous. ▼	27.4	91.2	
10										
	25	■	D-7	15		SP	@ 20': Light olive brown to olive fine to coarse SAND, saturated, medium dense, friable, micaceous.	14.0	116.3	
						SC	**River Terrace Deposit (Qtr)** Difficult drilling from 28' to 30'.			
	30									

LOG OF BORING

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Report: HOLLOW STEM; Project: 11077-02-CONVERTED.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 2/27/19

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30	■	D-8	85/10"			@ 30': Gravelly, clayey fine SAND, saturated, very dense, micaceous. Sample stuck inside sampler, not recovered.			
0										
	35	■	D-9	81		SM	**Bay Point Formation (Qbp)** @ 35': Yellow silty fine SAND, saturated, very dense, FeO stained.	18.4	110.4	
	40	■	D-10	50/6"			@ 40': Yellow silty fine SAND, saturated, very dense, FeO stained.	18.9	108.5	
-10							Notes: Total Depth: 40.5 Feet. Groundwater Encountered at 22.1'. Groundwater Stablilized at 21.8'. Backfilled with Neat Cement Slurry on 8/10/17.			
	45									
	50									
-20										
	55									
	60									
-30										
	65									

LOG OF BORING

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Date(s) Drilled	**8/10/17**	Logged By	**ZKH**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**10"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California, Bulk**		
Approximate Groundwater Depth:	**9.6 Feet**		
Comments			

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Sheet 1 of 2

Total Depth Drilled (ft)	**51.5**
Approximate Ground Surface Elevation (ft)	**23.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES			Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number	Blows per foot						
	0	▨				SP-SM	Surface: Turf, Driving Range. **Alluvium (Qal)**			B-1 @ 0'-5'
20		▨ ■	B-1 D-1	22			@ 2.5': Olive brown silty fine SAND, damp, medium dense, friable, micaceous.	3.4	98.9	
	5	■	D-2	12			@ 5': Olive brown silty fine SAND, damp, medium dense, friable, micaceous.	4.3	97.6	
		■	D-3	14			@ 7.5': Olive brown silty fine SAND, very moist to wet, medium dense, friable, micaceous. ▼	22.5	100.9	
	10	■	D-4	3		SM-ML	▽ @ 10': Dark olive brown silty fine to coarse SAND/SILT, saturated, loose/very soft, defined silt/sand lenses, friable, trace clean sands in lenses.	21.3	98.3	CN
10										
	15	■	D-5	25		SP	@ 15': Olive brown fine to coarse SAND, saturated, medium dense, friable, micaceous. Tip: Slightly silty fine to coarse SAND.	18.8	107.8	GS
	20	■	D-6	18		SM	@ 20': Gray to olive brown silty fine to medium SAND, saturated, medium dense, friable, FeO stained, micaceous.	22.5	100.2	
0										
	25	■	D-7	18		SP	@ 25': Upper: Gray fine to coarse SAND, saturated, medium dense, friable, micaceous.	19.3	101.7	
						SM	Lower: Gray silty fine to medium SAND, saturated, medium dense, highly micaceous, not as friable.			
						SP-SM				
	30									

LOG OF BORING

Hines/Riverwalk

San Diego, California

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Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30	■	D-8	21			@ 30': Gray silty to clean, fine to coarse SAND, saturated, medium dense, friable, micaceous, interbedded sands and silts.	16.7	105.6	
-10										
	35	■	D-9	45		SM	@ 35': Gray fine to medium silty SAND, saturated, medium dense, friable, micaceous. Trace clayey sand in upper rings (not in sample).	21.3	105.9	
	40	■	D-10	21			@ 40': Gray fine to medium silty SAND, saturated, medium dense, friable, micaceous.	25.3	100.2	
-20										
	45	■	D-11	21			@ 45': Gray silty very fine to fine SAND, saturated, medium dense, friable, micaceous.	26.1	99.1	
	50	■	D-12	32			@ 50': Gray silty fine to medium SAND, saturated, medium dense, micaceous, friable.	20.4	106.0	
							Notes: Total Depth: 51.5 Feet. Groundwater Encountered at 10.7'. Groundwater Stabilized at 9.6' After 10 Minutes. Backfilled with Neat Cement Slurry on 8/10/17.			
-30										
	55									
	60									
-40										
	65									

LOG OF BORING

Hines/Riverwalk
San Diego, California

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NMG

Date(s) Drilled	8/9/17	Logged By	ZKH
Drilling Company	2R Drilling	Drill Bit Size/Type	10"
Drill Rig Type	CME 75 Hollow Stem	Hammer Data	140 lbs @ 30" Drop
Sampling Method(s)	Modified California, Bulk		
Approximate Groundwater Depth:	10.7 Feet		
Comments			

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Sheet 1 of 2

Total Depth Drilled (ft)	51.5
Approximate Ground Surface Elevation (ft)	21.0 msl

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0	▨			▒	SM	Surface: Turf. **Artificial Fill, Undocumented (Afu)**			B-1 @ 0'-5'
20					▒					
		▨	B-1		▒					
		■	D-1	16	▒		@ 2.5': Yellowish brown silty fine SAND, moist, medium dense, slightly mottled, micaceous, friable, trace roots.	6.0	97.4	
	5	■	D-2	8	▨	ML-CL	@ 5': Olive brown clayey SILT/silty CLAY, very moist to wet, medium stiff, roots, mottled with lenses of sand, jointed/chaotic texture.	48.1	79.3	
					▒	SM	**Alluvium (Qal)**			
		■	D-3	13	▒		@ 7.5': Dark yellowish brown silty fine to medium SAND, wet to saturated, loose to medium dense, friable, micaceous, roots.	22.8	101.1	DS, GS
	10	■	D-4	11	▒		▼ @ 10': Olive brown silty fine to medium SAND, saturated, loose to medium dense, friable, micaceous, roots.	20.3	103.5	CN
10					▒					
	15	■	D-5	22	▒		@ 15': Olive gray silty very fine to fine SAND, saturated, medium dense, friable, micaceous.	24.7	99.0	
	20	■	D-6	21	▒		@ 20': Olive gray silty very fine to fine SAND, saturated, medium dense, friable, micaceous.	23.3	101.6	
0					▒					
	25	■	D-7	16	▒		@ 25': Olive gray silty very fine to fine SAND, saturated, medium dense, friable, micaceous.	25.3	98.3	
	30									

LOG OF BORING

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Report: HOLLOW STEM; Project: 11077-02-CONVERTED.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 2/27/19

Elevation (ft)	Depth (ft)	SAMPLES			Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number	Blows per foot						
-10	30	■	D-8	7	▨	ML-CL	@ 30': Dark gray SILT/CLAY, saturated, medium stiff, slimy, organic odor, micaceous, soft feeling.	31.3	91.8	AL, GS
	35	■	D-9	7	░	SM	@ 35': Dark gray silty very fine SAND, saturated, loose, micaceous, trace silt lenses.	23.9	100.9	CN, GS
-20	40	■	D-10	31	░		@ 40': Gray silty very fine SAND, saturated, medium dense, micaceous, trace silt lenses.	24.4	100.6	
	45	■	D-11	65	░		@ 45': Gray silty very fine SAND, saturated, medium dense, micaceous, trace silt lenses, trace root hair.	24.8	101.9	
-30	50	■	D-12	27	░		@ 50': Gray silty very fine SAND, saturated, medium dense, micaceous, trace silt lenses.	29.9	94.5	
							Notes: Total Depth: 51.5 Feet. Groundwater Encountered at 10.8'. Groundwater Stabilized at 10.7' After 10 Minutes. Backfilled with Neat Cement Slurry on 8/9/17.			
	55									
-40	60									
	65									

LOG OF BORING

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San Diego, California

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Report: HOLLOW STEM; Project: 11077-02-CONVERTED.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 2/27/19

Date(s) Drilled	**8/9/17**	Logged By	**ZKH**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**10"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California, Bulk**		
Approximate Groundwater Depth:	**14.0 Feet**		
Comments			

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Sheet 1 of 2

Total Depth Drilled (ft)	**51.5**
Approximate Ground Surface Elevation (ft)	**23.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES			Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number	Blows per foot						
	0	▨				SM	Surface: Turf. **Alluvium (Qal)**			B-1 @ 0'-5'
20		▨ ■	B-1 D-1	26			@ 2.5': Olive brown silty fine SAND, damp, medium dense, friable, micaceous.	5.9	103.5	
	5	■	D-2	18		SP	@ 5': Yellowish brown fine SAND, damp, medium dense, friable, micaceous.	3.5	94.9	DS, GS
		■	D-3	10			@ 7.5': Yellowish brown fine SAND, damp, loose to medium dense, friable, micaceous.	3.6	91.0	
	10	■	D-4	6			@ 10': No Recovery.			
10							▼ ▽			
	15	■	D-5	33		SM	@ 15': Black to olive brown silty fine SAND, saturated, medium dense, micaceous, slightly friable.	26.1	100.7	
	20	■	D-6	17			@ 20': Dark olive brown silty fine SAND, saturated, medium dense, micaceous, trace FeO staining, slightly friable.	25.2	98.6	DS
0										
	25	■	D-7	9			@ 25': Dark olive brown silty very fine SAND, saturated, loose, micaceous, trace FeO stained, slightly friable.	31.0	91.1	
	30									

LOG OF BORING

Hines/Riverwalk

San Diego, California

PROJECT NO. 11077-02

NMG

Report: HOLLOW STEM; Project: 11077-02-CONVERTED.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 2/27/19

Hines/Riverwalk **San Diego, California**

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Sheet 2 of 2

Elevation (ft)	Depth (ft)	SAMPLES Type	Number	Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30	■	D-8	7	▨	ML-CL	@ 35': Dark gray sandy SILT/CLAY, saturated, medium stiff, micaceous, trace organics.	48.8	71.6	
-10										
	35	■	D-9	12	⁙	SM	@ 35': Dark gray silty very fine SAND, saturated, medium dense, micaceous, trace clayey sand in some lenses.	33.2	92.5	
	40	■	D-10	22	⁙		@ 40': Dark gray silty fine to medium SAND, saturated, medium dense, friable, micaceous.	25.8	96.0	
-20										
	45	■	D-11	22	⁙		@ 45': No Recovery.			
	50	■	D-12	43	⁙		@ 50': Dark gray silty/gravelly SAND, saturated, medium dense, micaceous, abundant gravel and cobbles in sampler tip.	23.1		
							Notes: Total Depth: 51.5 Feet. Groundwater Encountered at 14.6'. Groundwater Stabilized at 14.0'. Backfilled with Neat Cement Slurry on 8/9/17.			
-30										
	55									
	60									
-40										
	65									

LOG OF BORING
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San Diego, California

PROJECT NO. 11077-02

NMG

Report: HOLLOW STEM; Project: 11077-02-CONVERTED.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 3/6/19

Date(s) Drilled	**2/7/19**	Logged By	**ZKH**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**10"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**SPT, Modified California, Bulk**		
Approximate Groundwater Depth:	**14.7 Feet**		
Comments			

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Sheet 1 of 3

Total Depth Drilled (ft)	**80.8**
Approximate Ground Surface Elevation (ft)	**29.5 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	Number	Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0					SM	Surface: Golf Course Turf. **Artificial Fill, Undocumented (Afu)** @ 0'-2': Black to dark gray silty SAND.			
						SM	**Alluvium (Qal)**			
	5	■	D-1	90/9"			@ 5': Black to very dark gray silty fine to medium SAND, moist, very dense, micaceous, FeO stained, trace roots.	12.3	95.8	
20										
	10	■	D-2	35			@ 10': Very dark gray to dark gray silty fine to medium SAND, moist, medium dense, abundant rootlets, micaceous.	8.3	107.6	CN
		▨	B-1							B-1 @ 10'-15'
							▼			
	15	◪	S-1	11			▽ @ 15': Dark gray silty fine to medium SAND, saturated, medium dense.	27.7		
10										
	20	■	D-3	5			@ 20': Upper: Gray silty fine to medium SAND, saturated, loose, micaceous.	18.8	99.4	GS
						SM-ML	Lower: Gray silty very fine SAND with sandy SILT, saturated, loose, micaceous.			
		◪	S-2	18		SM	@ 22.5': Gray silty fine to medium SAND, saturated, medium dense, micaceous.	24.5		
	25	◪	S-3	13			@ 25': Gray silty fine to medium SAND, saturated, medium dense, dark laminations/micaceous bedding.	23.6		
0										
	30									

LOG OF BORING

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San Diego, California
PROJECT NO. 11077-02

NMG

Report: HOLLOW STEM; Project: 11077-02-CONVERTED.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 3/6/19

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30	■	D-4	59		SM	@ 30': Gray silty fine to medium SAND, saturated, medium dense to dense, micaceous.	23.9	102.1	
	35	◩	S-4	16			@ 35': Gray silty fine SAND, saturated, medium dense, micaceous.	23.7		
-10										
	40	■	D-5	20			@ 40': Gray silty fine SAND, saturated, medium dense, micaceous.	24.1	98.5	
	45	◩	S-5	7			@ 45': Upper: Gray silty fine SAND, saturated, medium dense, micaceous.	26.7		
						ML	Lower: Dark gray sandy SILT, saturated, medium stiff, highly micaceous.			
-20										
	50	■	D-6	17		SM	@ 50': Gray silty fine to medium SAND, saturated, medium dense, micaceous. Tip: Highly micaceous silty very fine SAND.	22.5	103.9	
	55	◩	S-6	7			@ 55': Gray silty fine to medium SAND, saturated, medium dense, micaceous, some 1/8" thick clay lenses, trace caliche in clay.	28.6		
-30										
	60	■	D-7	24			@ 60': Gray silty fine to medium SAND, saturated, medium dense, micaceous, trace fine gravel.	19.4	106.8	
							@ 64' Driller notes gravel.			
	65									

LOG OF BORING
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San Diego, California

PROJECT NO. 11077-02

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	65		S-7	7		SM	@ 65': Gray silty fine to medium SAND, saturated, loose, some slightly cemented lenses. Tip: Sandy SILT.	18.5		
-40										
	70		D-8	24		ML-CL	@ 70': Olive brown fine sandy SILT/CLAY, saturated, stiff, micaceous, trace bluish gray CLAY in tip, 1/8" thick.	22.1	106.9	
	75		S-8	40		SM-GM	**Older Alluvium (Qalo)** @ 75': Olive gray silty fine to medium SAND with GRAVEL, saturated, very dense, red to yellow to gray subrounded meta-volcanic gravel, micaceous. @ 75'-80': Driller notes hard drilling, cobbles.	20.7		
-50										
	80		D-9	50/4"			@ 80': Olive gray silty fine to medium SAND with GRAVEL, saturated, very dense, red to yellow to gray subrounded meta-volcanic gravel.	16.9	116.7	
			S-9	120/6"			@ 80.3': Olive gray silty fine to medium SAND with GRAVEL, saturated, very dense, red to yellow to gray subrounded meta-volcanic gravel.	11.0		
	85						Notes: Total Depth: 80.8 Feet. Groundwater First Encountered at 15.8 Feet. Static Groundwater at 14.7 Feet. Backfilled with Neat Cement.			
-60	90									
	95									
-70	100									

Report: HOLLOW STEM; Project: 11077-02-CONVERTED.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 3/6/19

LOG OF BORING

Hines/Riverwalk
San Diego, California

PROJECT NO. 11077-02

NMG

Report: HOLLOW STEM; Project: 11077-02-CONVERTED.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 3/6/19

Date(s) Drilled	2/7/19	Logged By	ZKH
Drilling Company	2R Drilling	Drill Bit Size/Type	10"
Drill Rig Type	CME 75 Hollow Stem	Hammer Data	140 lbs @ 30" Drop
Sampling Method(s)	SPT, Modified California, Bulk		
Approximate Groundwater Depth:	6.2 Feet		
Comments			

B-29

Sheet 1 of 3

Total Depth Drilled (ft)	81.0
Approximate Ground Surface Elevation (ft)	20.5 msl

Elevation (ft)	Depth (ft)	SAMPLES			Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
		Type	Number	Blows per foot						
20	0	▨			░	SM	Surface: Golf Course Turf. **Artificial Fill, Undocumented (Afu)** @ 0'-2': Black to dark gray silty SAND.			
		▨	B-1		░	SM	**Alluvium (Qal)**			B-1 @ 0'-5'
	5	■	D-1	5	░		@ 5': Upper: Gray silty fine to medium SAND, saturated, loose, micaceous.	49.9	76.2	AL, GS, CN
					▨	CL	▼ ▽ Lower: Olive gray sandy/silty CLAY, saturated, soft, highly micaceous.			
10	10	■	D-2	23	░	SM	@ 10': Gray silty fine to medium SAND, saturated, loose to medium dense, micaceous.	26.0	97.2	DS
	15	■	D-3	15	░		@ 15': Gray silty fine to medium SAND, saturated, loose to medium dense, micaceous.	23.4	101.3	CN
0	20	◪	S-1	6	░		@ 20': Gray silty fine SAND, saturated, loose, micaceous, trace rootlets.	30.0		
	25	■	D-4	25	░		@ 25': Gray silty fine to medium SAND, saturated, medium dense, micaceous.	10.5	112.6	
	30									

LOG OF BORING

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

NMG

Report: HOLLOW STEM; Project: 11077-02-CONVERTED.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 3/6/19

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
-10	30	◢	S-2	16		SM	@ 30': Gray silty fine SAND, saturated, medium dense, micaceous.	24.3		
	35	■	D-5	8		ML	@ 35': Upper (Not in Sample): Gray to dark gray sandy/clayey SILT, saturated, medium stiff, micaceous.	42.7	77.7	
						CL	Lower: Dark gray sandy/silty CLAY, saturated, medium stiff, highly micaceous.			
-20	40	◢	S-3	6		SM	@ 40': Gray silty fine SAND, saturated, loose, micaceous, trace silt/clay laminations.	27.3		
	45	■	D-6	11			@ 45': Gray silty fine SAND, saturated, loose, micaceous.	22.8	102.9	
-30	50	◢	S-4	23			@ 50': Gray silty fine SAND, saturated, medium dense, micaceous.	25.2		
	55	■	D-7	44			@ 55': Gray silty fine to medium SAND, saturated, medium dense, micaceous.	25.5	99.4	
-40	60	◢	S-5	14			@ 60': Gray silty fine SAND, saturated, medium dense, micaceous.	24.0		
	65									

LOG OF BORING

Hines/Riverwalk
San Diego, California

PROJECT NO. 11077-02

NMG

Report: HOLLOW STEM; Project: 11077-02-CONVERTED.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 3/6/19

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	65	■	D-8	12		SM	@ 65': Gray silty fine SAND, saturated, loose, micaceous. Tip: 1/4" thick clay lense.	25.1	103.6	
-50	70	◩	S-6	16			@ 70': Gray silty fine SAND, saturated, medium dense. Tip: Olive brown CLAY.	22.1		
						CL				
						CL	**Scripps Formation (Tsc)** Hard Drilling at 73'.			
	75	■	D-9	70/5"			@ 75': Gray silty/sandy CLAYSTONE, saturated, hard, moderately bedded.	32.6		
-60	80	◩	S-7	75		SM SM-ML	@ 80': Upper: Olive gray silty fine SANDSTONE, saturated, very dense, FeO stained, cemented. Lower: Gray SANDSTONE/SILTSTONE, saturated, very dense/hard, thin clay interbeds.	23.1		
	85									
-70	90									
	95									
	100									

Notes:
Total Depth: 81.0 Feet.
Groundwater Encountered at 6.9 Feet.
Static Groundwater at 6.2 Feet.
Backfilled with Neat Cement.

LOG OF BORING

Hines/Riverwalk
San Diego, California

PROJECT NO. 11077-02

Date(s) Drilled	**10/19/15**	Logged By	**TBF**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**8"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California**		
Approximate Groundwater Depth:	**Groundwater at 12.6 Feet, 25 Minutes after Drilling.**		
Comments			

P-1

Sheet 1 of 1

Total Depth Drilled (ft)	**21.5**
Approximate Ground Surface Elevation (ft)	**23.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0					SM	Surface: Turf. **Alluvium (Qal)**			
20										
	5	■	D-1	23			@ 5': Dark brown silty fine SAND, moist, medium dense, micaceous, few roots/root hairs.	11.5	84.3	
	10	■	D-2	12		SP	@ 10': Dark gray SAND, loose to medium dense, moist, highly micaceous.	5.6	109.7	
							▼			
10										
							▽			
	15	■	D-3	34			@ 15': Brown fine to medium SAND, saturated, medium dense, highly micaceous.	24.1		
	20	■	D-4	51			@ 20': Brown fine to medium SAND, saturated, medium dense, highly micaceous.	14.4		
0										
	25						Notes: Total Depth: 21.5 Feet. Groundwater First Encountered at 13.9 Feet and 12.6 Feet After 22 Minutes. Backfilled with Bentonite Grout.			
	30									

LOG OF BORING

Riverwalk

San Diego, CA

PROJECT NO. 11077-01

Report: HOLLOW STEM; Project: 11077-01.GPJ; Data Template: NMG_GINT_2016.GDT; Printed: 2/27/19

Date(s) Drilled	**10/20/15**	Logged By	**TBF**
Drilling Company	**2R Drilling**	Drill Bit Size/Type	**8"**
Drill Rig Type	**CME 75 Hollow Stem**	Hammer Data	**140 lbs @ 30" Drop**
Sampling Method(s)	**Modified California, Bulk**		
Approximate Groundwater Depth:	**Groundwater Not Encountered**		
Comments			

P-2

Sheet 1 of 1

Total Depth Drilled (ft)	**21.5**
Approximate Ground Surface Elevation (ft)	**35.0 msl**

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0	▨	B-1			SC	Surface: Vacant graded lot. **Artificial Fill (Af)**			B-1 @ 0-5' MD
30	5	■	D-1	40		SM	@ 5': Yellow fine SAND, moist, medium dense, some mica, few fine gravel.	11.0	116.3	GS
	10	■	D-2	50/4"			@ 10': Black silty fine SAND, damp, dense, micaceous, few subrounded to well rounded fine gravel.	10.7	118.3	
20	15	■	D-3	43			@ 15': Upper: Black clayey and silty fine SAND, damp, medium dense, trace wood debris and organics, fine subrounded gravel.	12.8	107.7	
						SP	Lower: Gray and black fine SAND, damp, medium dense, mottled.			
	20	■	D-4	15		SP	**Alluvium (Qal)** @ 20': Dark gray fine to medium SAND, wet, loose, micaceous.	23.8	101.5	
10	25						Notes: Total Depth: 21.5 Feet. Groundwater Not Encountered; Sample at 20 Feet Saturated. Backfilled with Bentonite Grout.			
	30									

LOG OF BORING

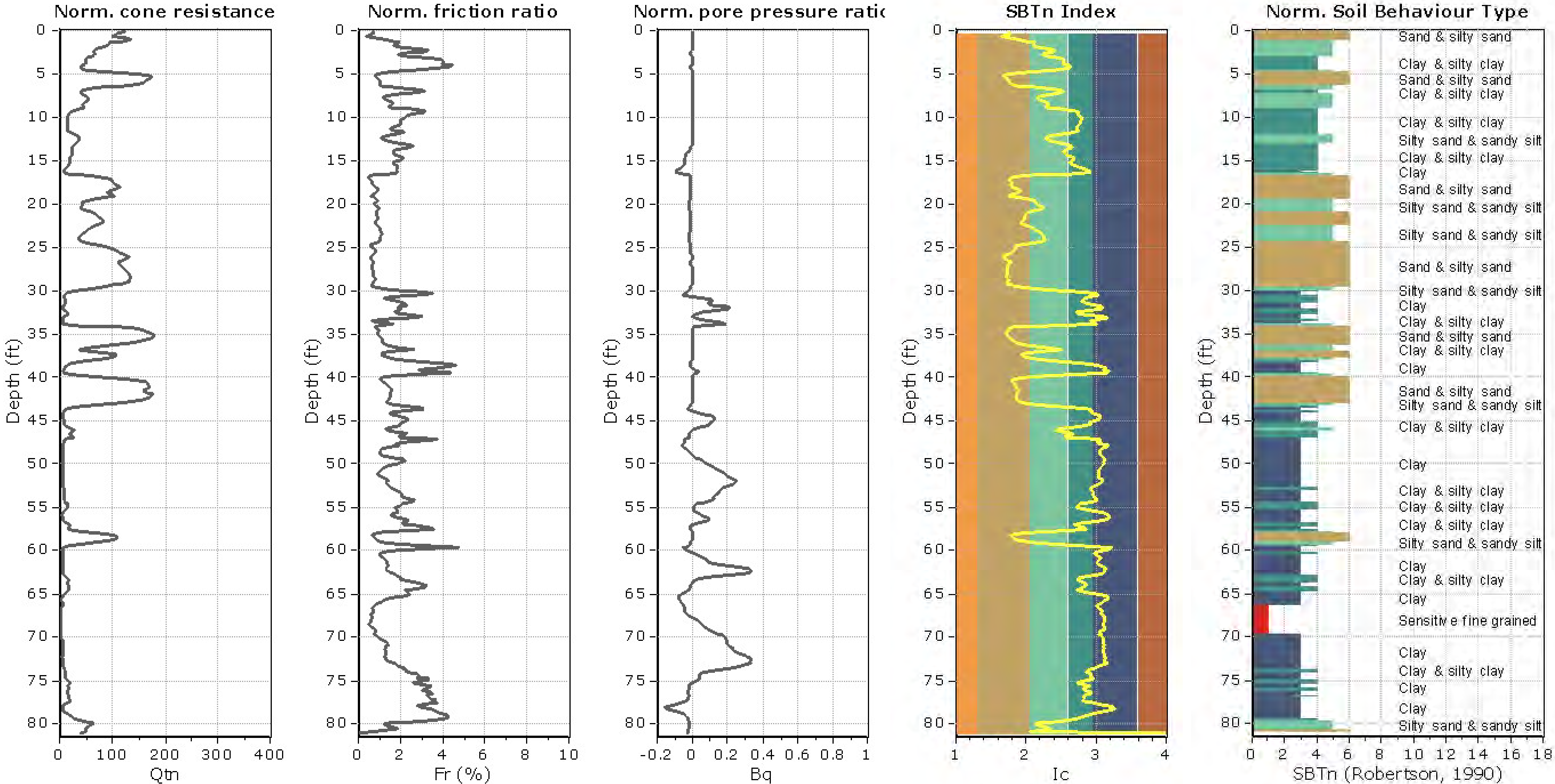
Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG

NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

CPT: CPT- 1
Total depth: 81.04 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



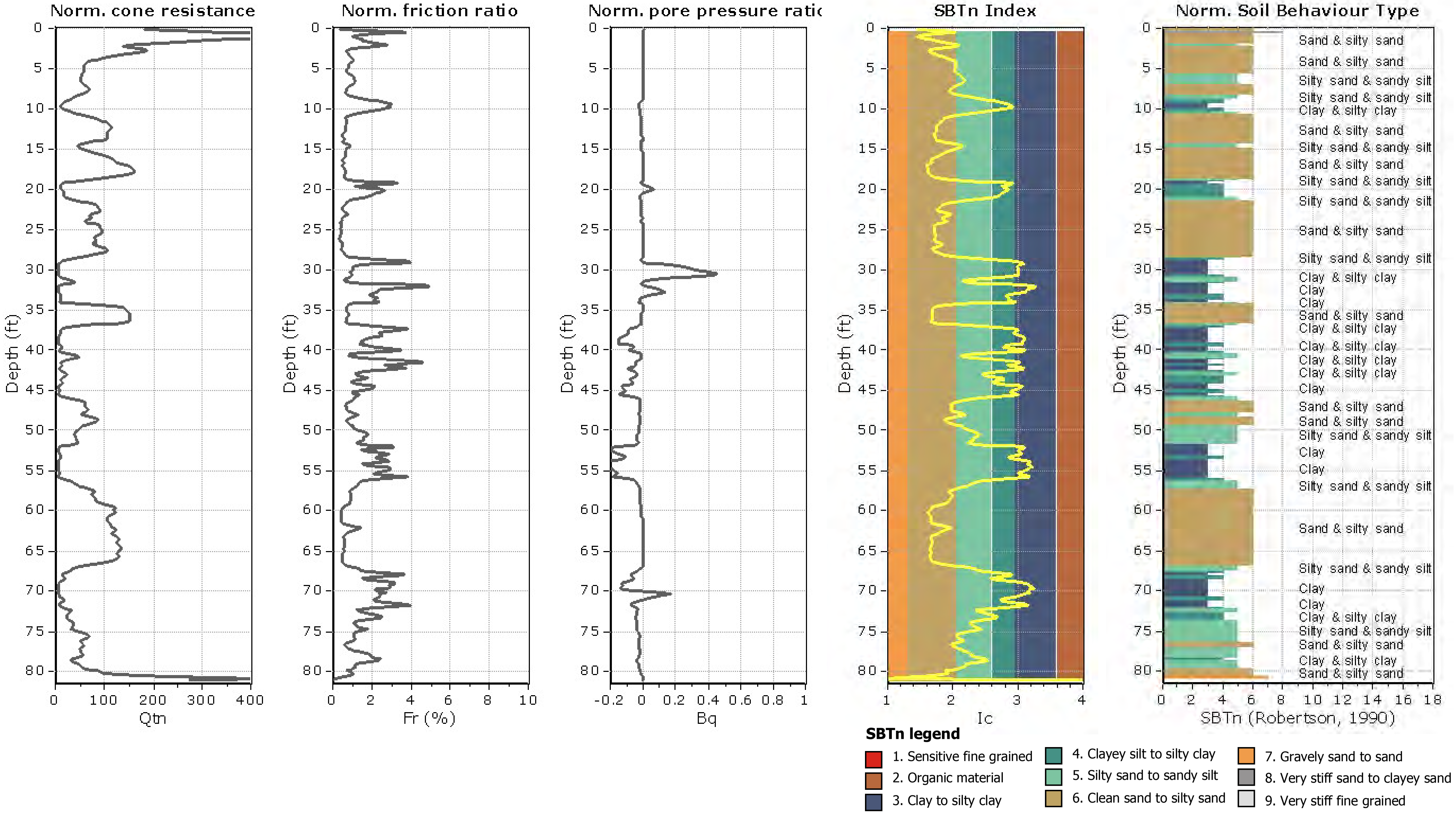
SBTn legend

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

NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

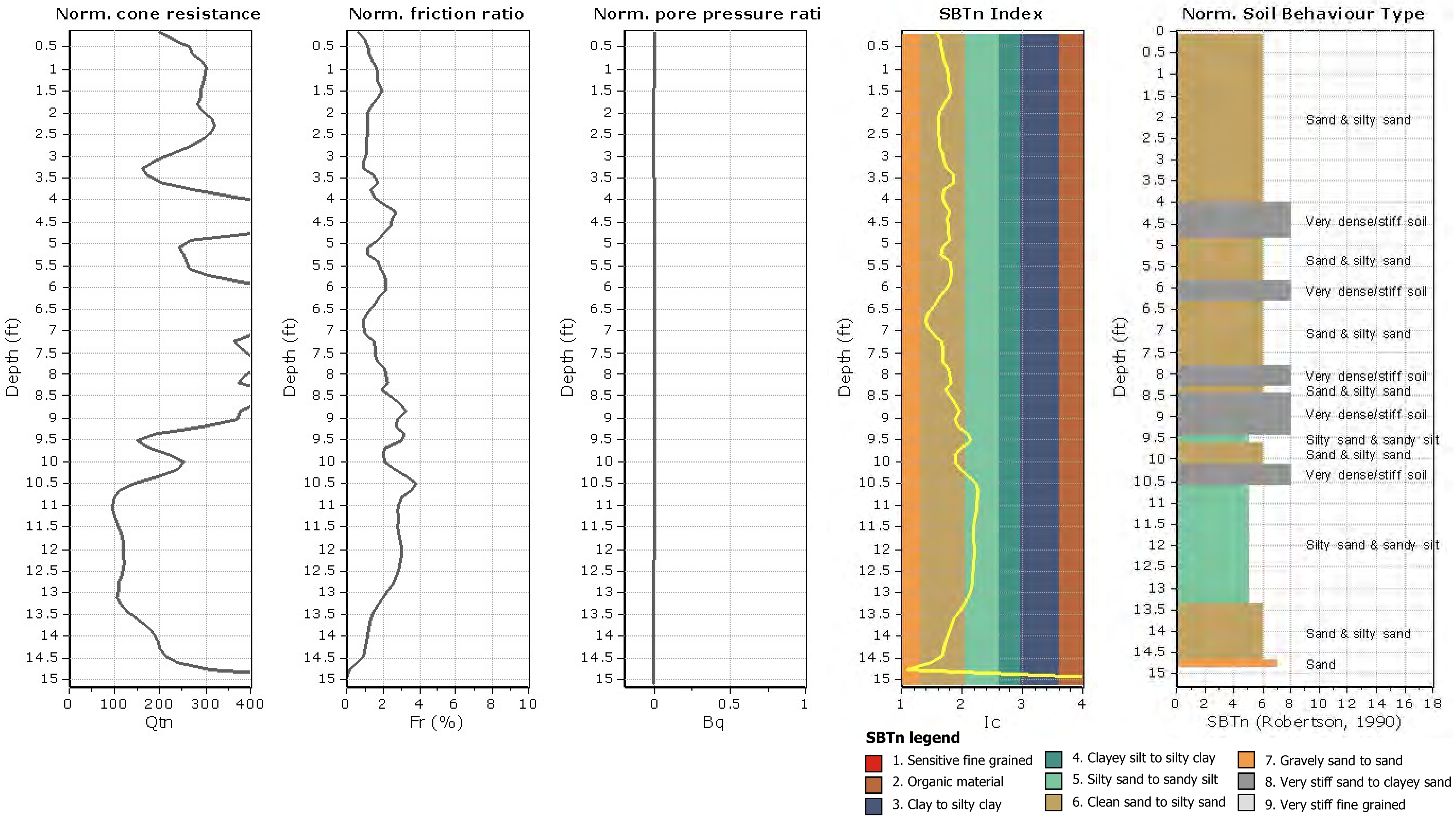
CPT: CPT- 2
Total depth: 81.04 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

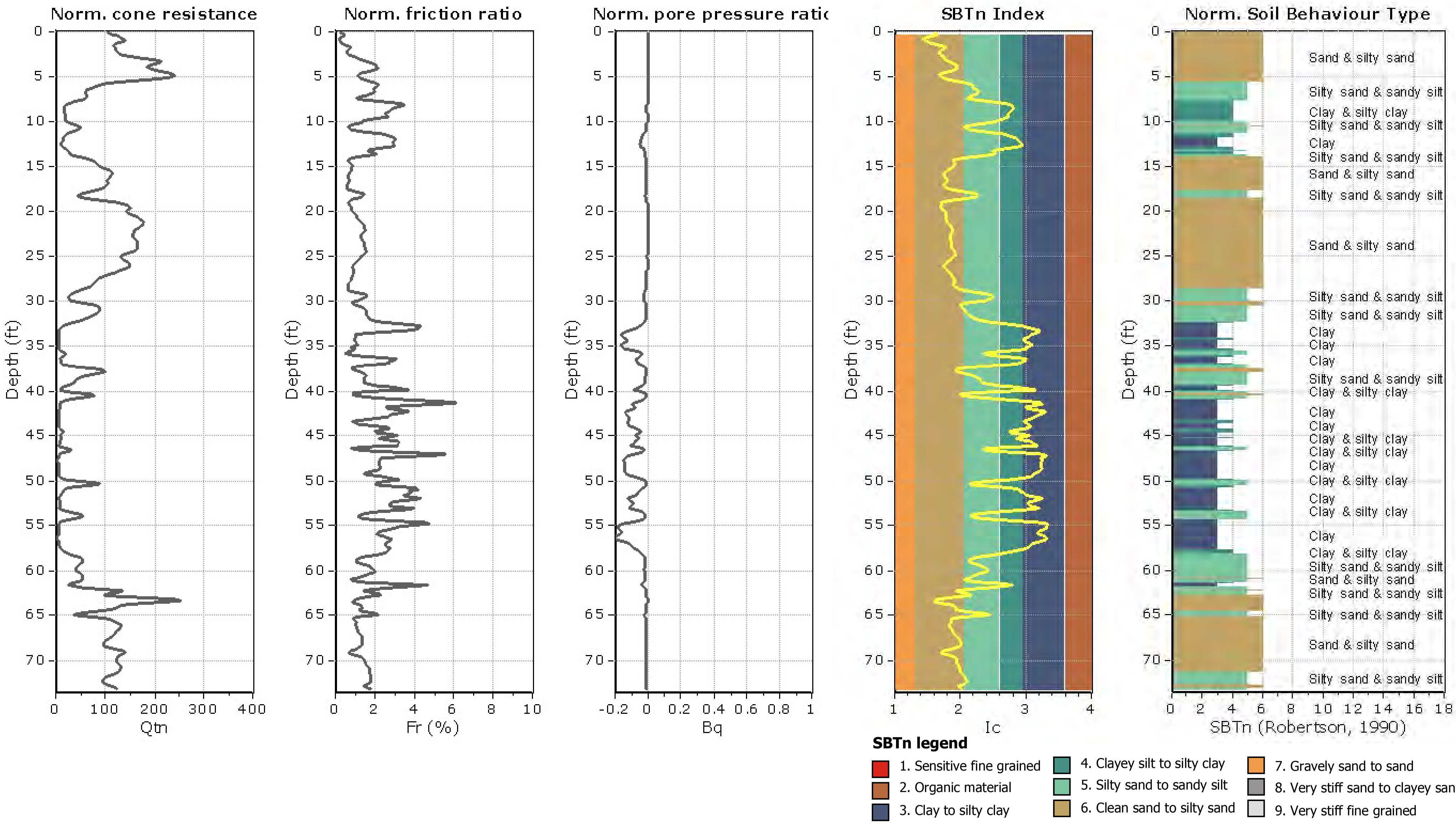
CPT: CPT- 3
Total depth: 15.09 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

CPT: CPT- 4
Total depth: 73.16 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



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NMG Geotechnical, Inc.
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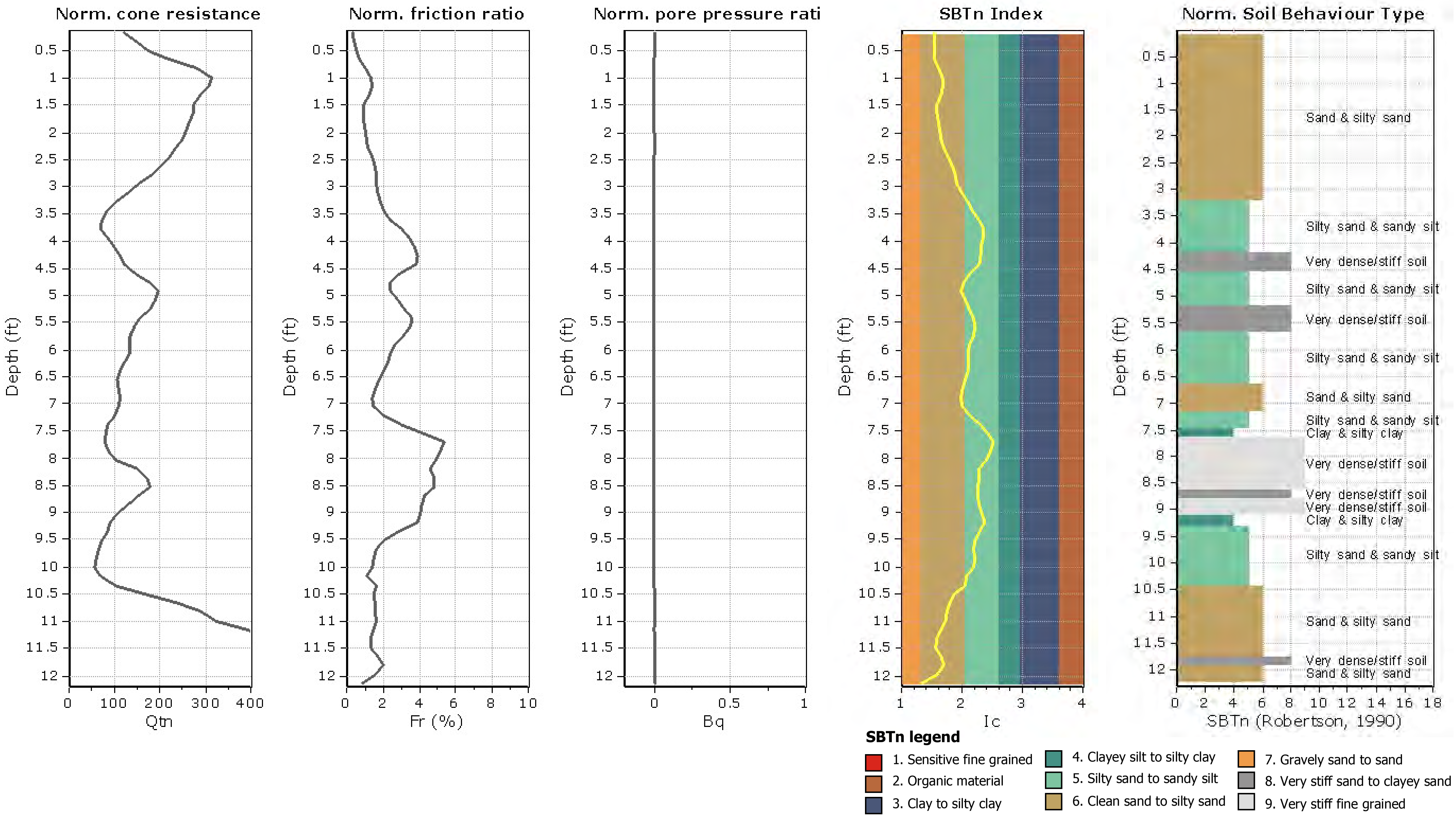
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

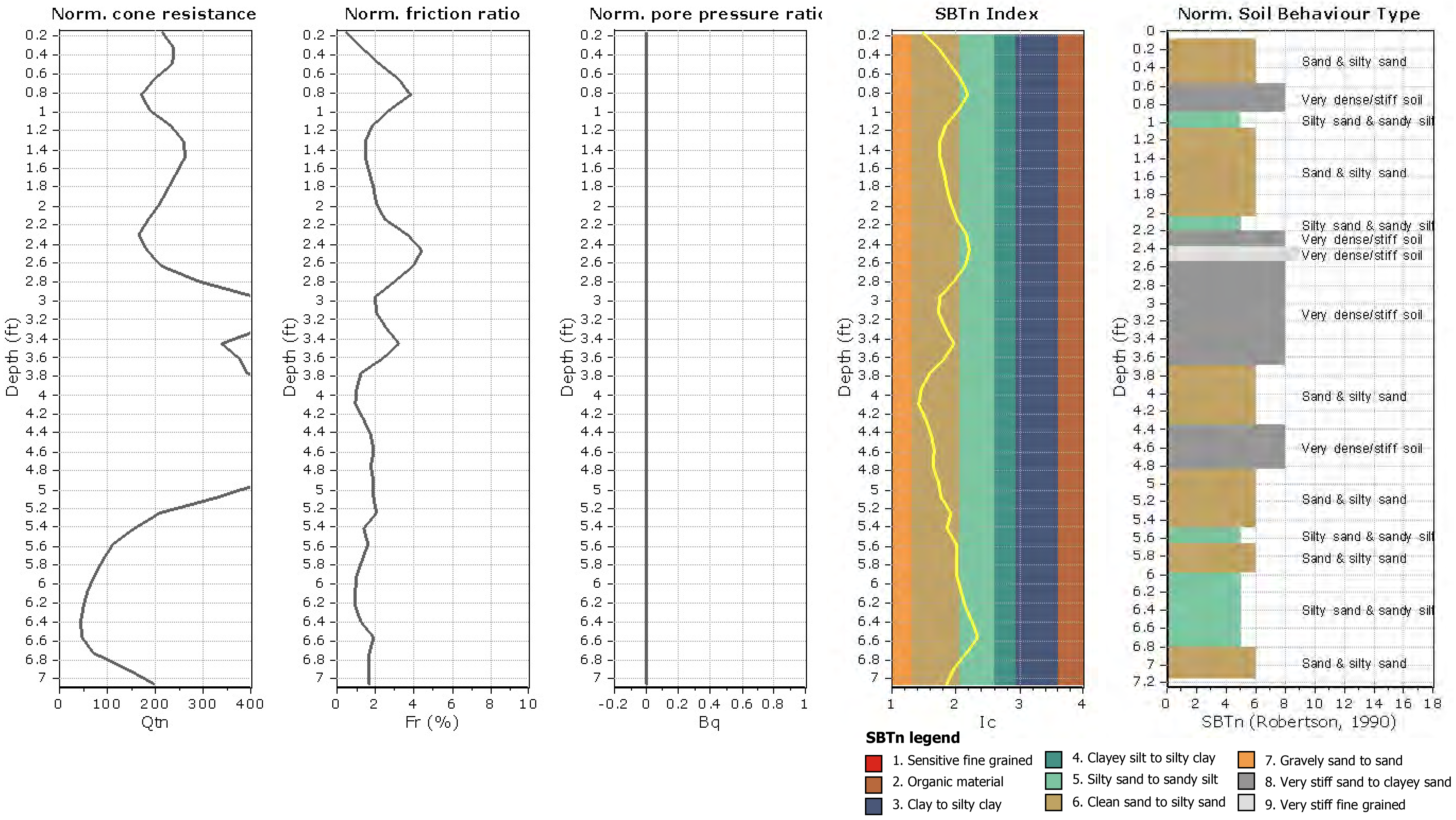
CPT: CPT- 5
Total depth: 12.14 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

CPT: CPT- 6
Total depth: 7.05 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



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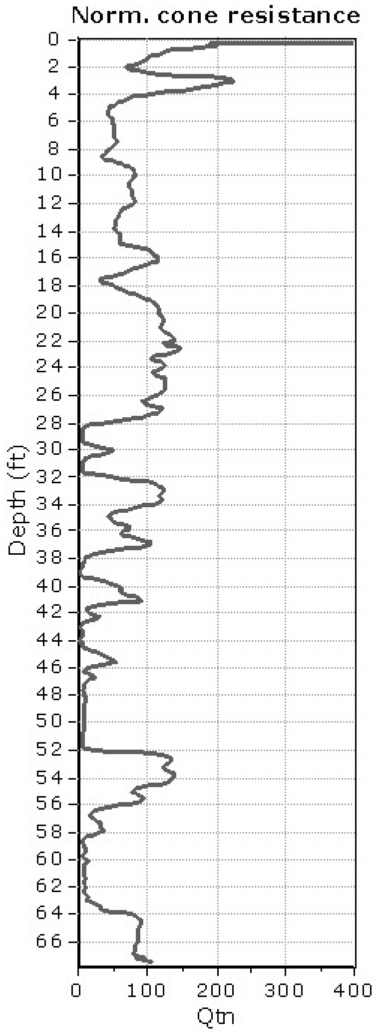
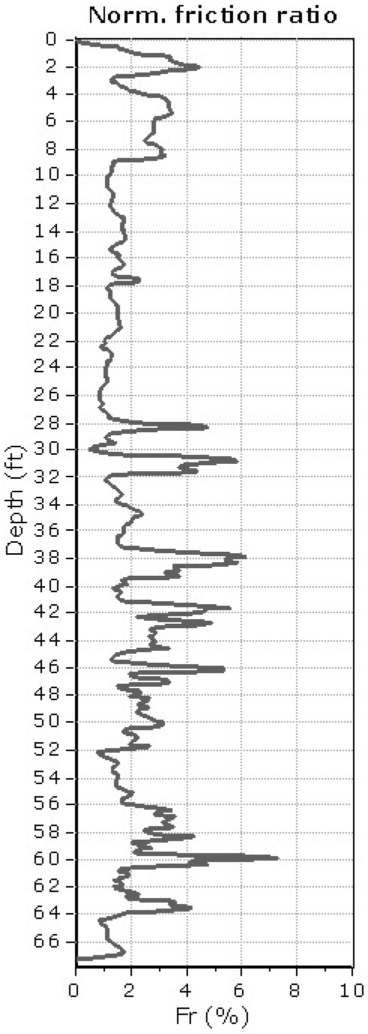
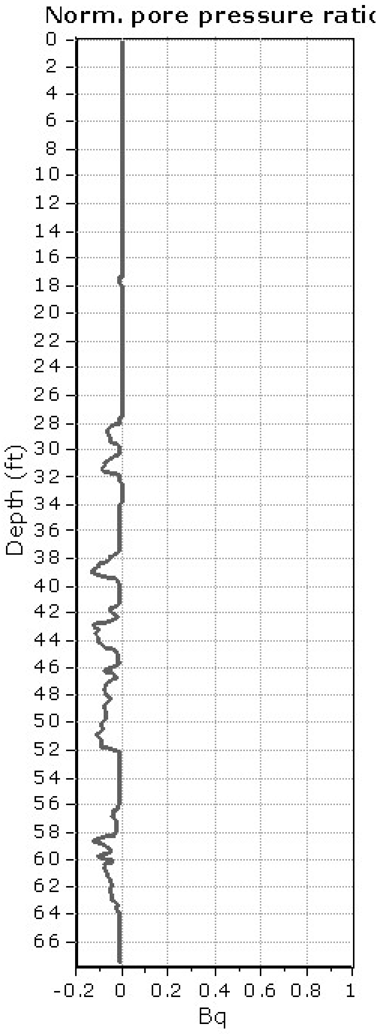
Irvine, CA 92614

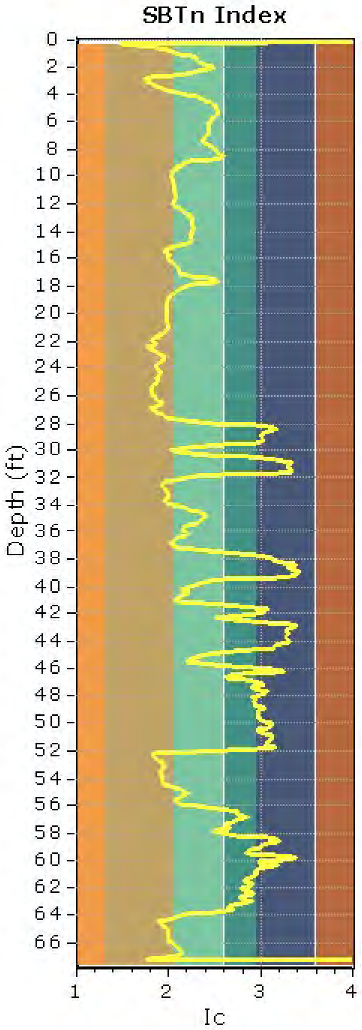
Project: **Riverwalk**
Location: **San Diego, CA**

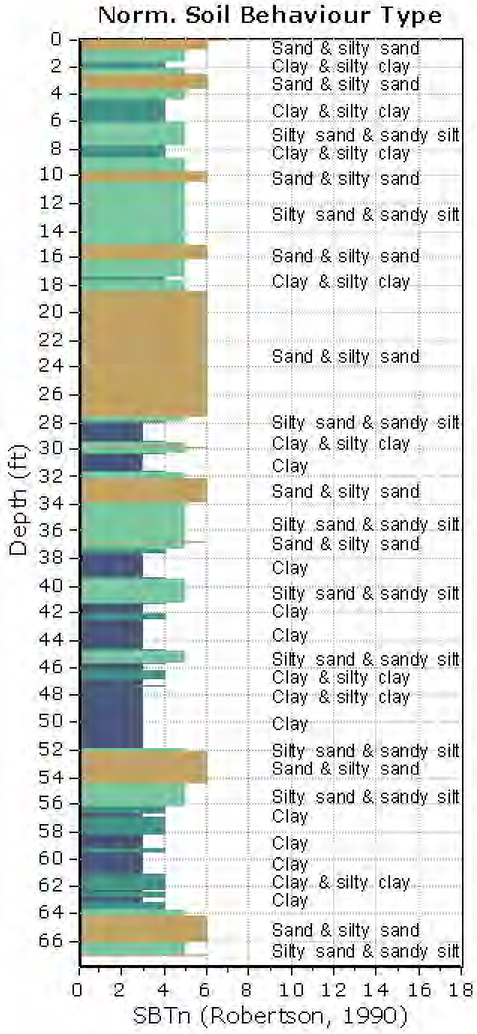
CPT: CPT- 7
Total depth: 67.51 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown


Norm. cone resistance


Norm. friction ratio


Norm. pore pressure ratic


SBTn Index


Norm. Soil Behaviour Type

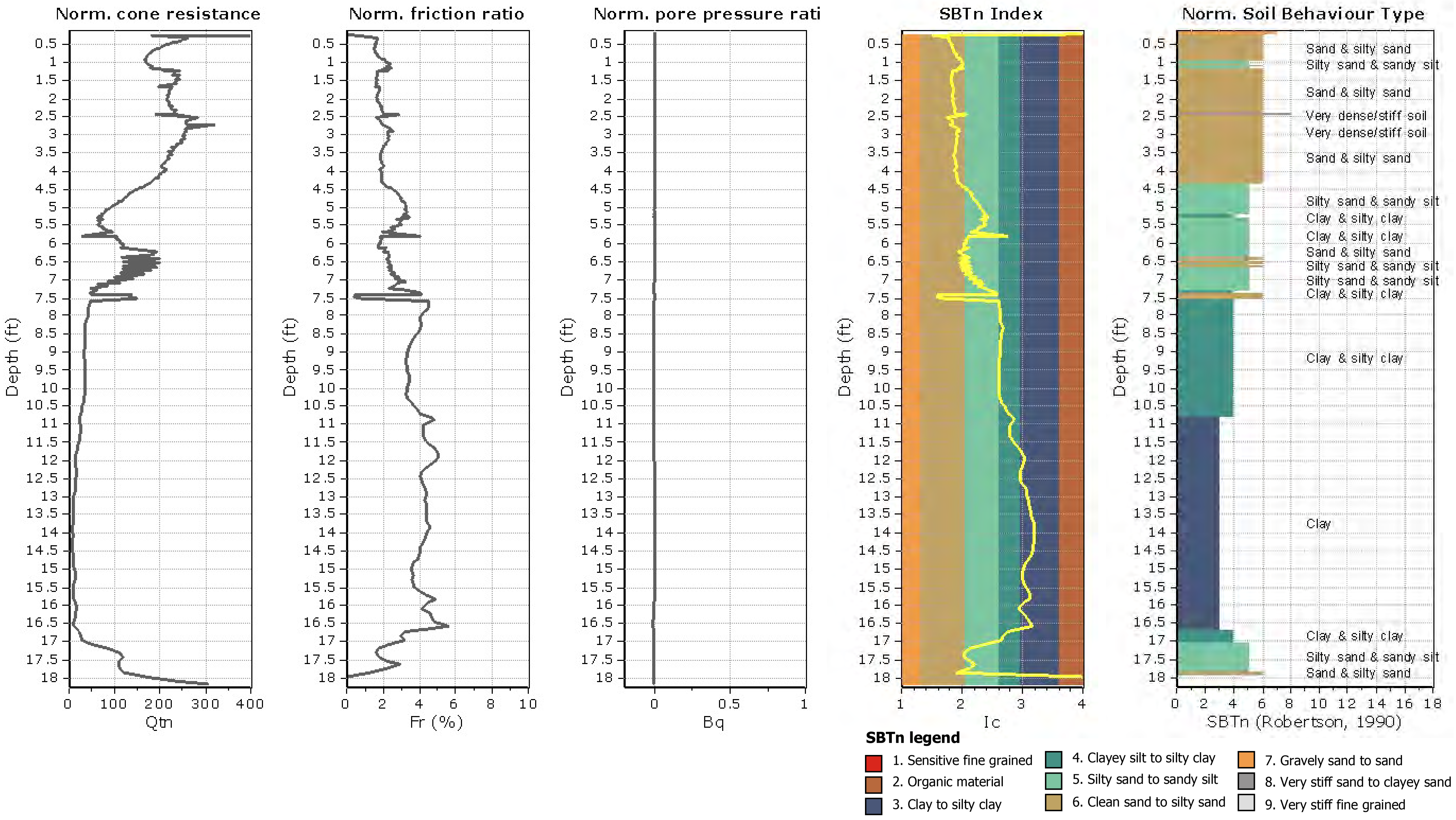
SBTn legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟨 6. Clean sand to silty sand
- 🟧 7. Gravely sand to sand
- ⬛ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

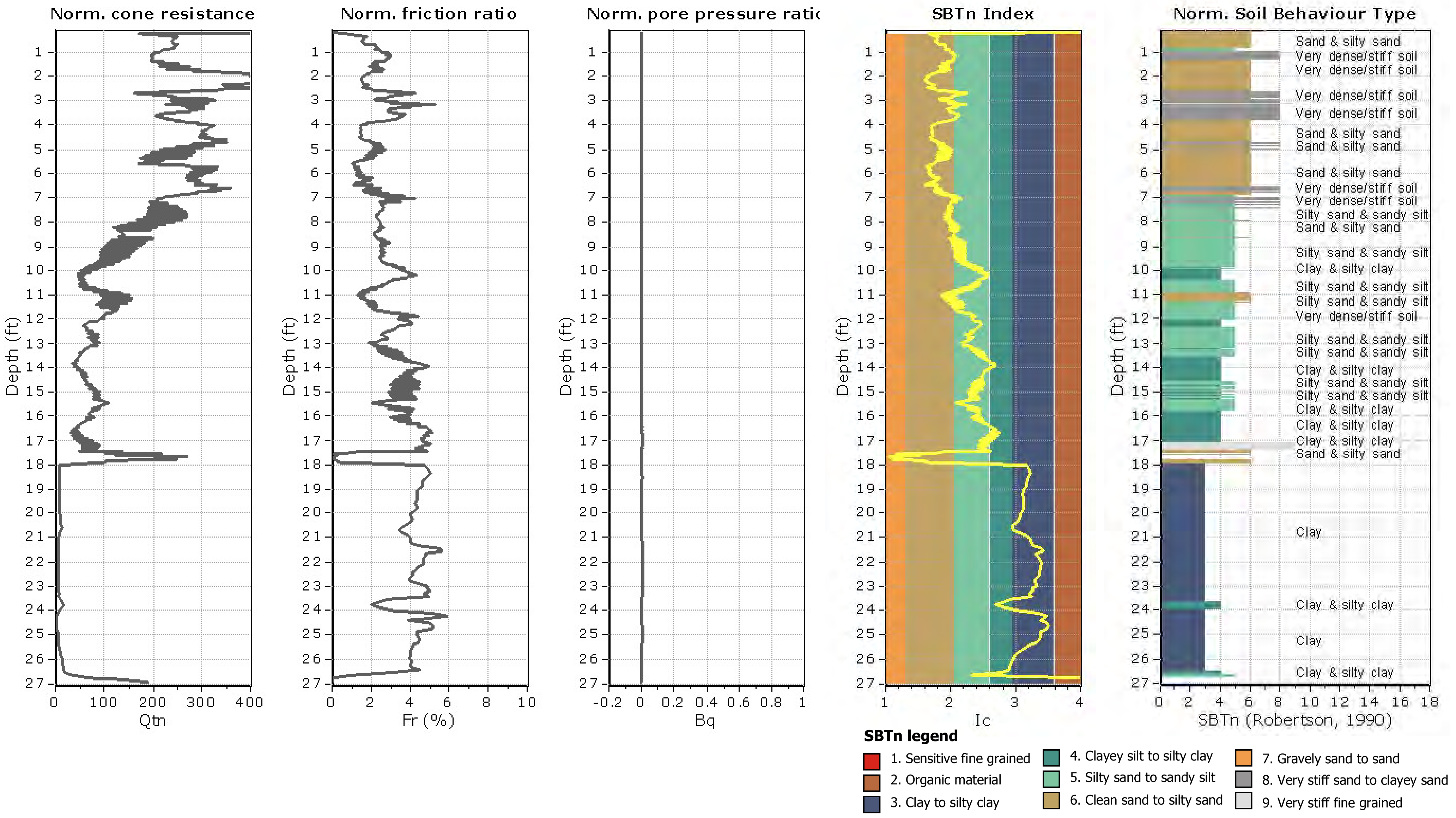
CPT: CPT- 8
Total depth: 18.17 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

CPT: CPT- 9
Total depth: 26.95 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



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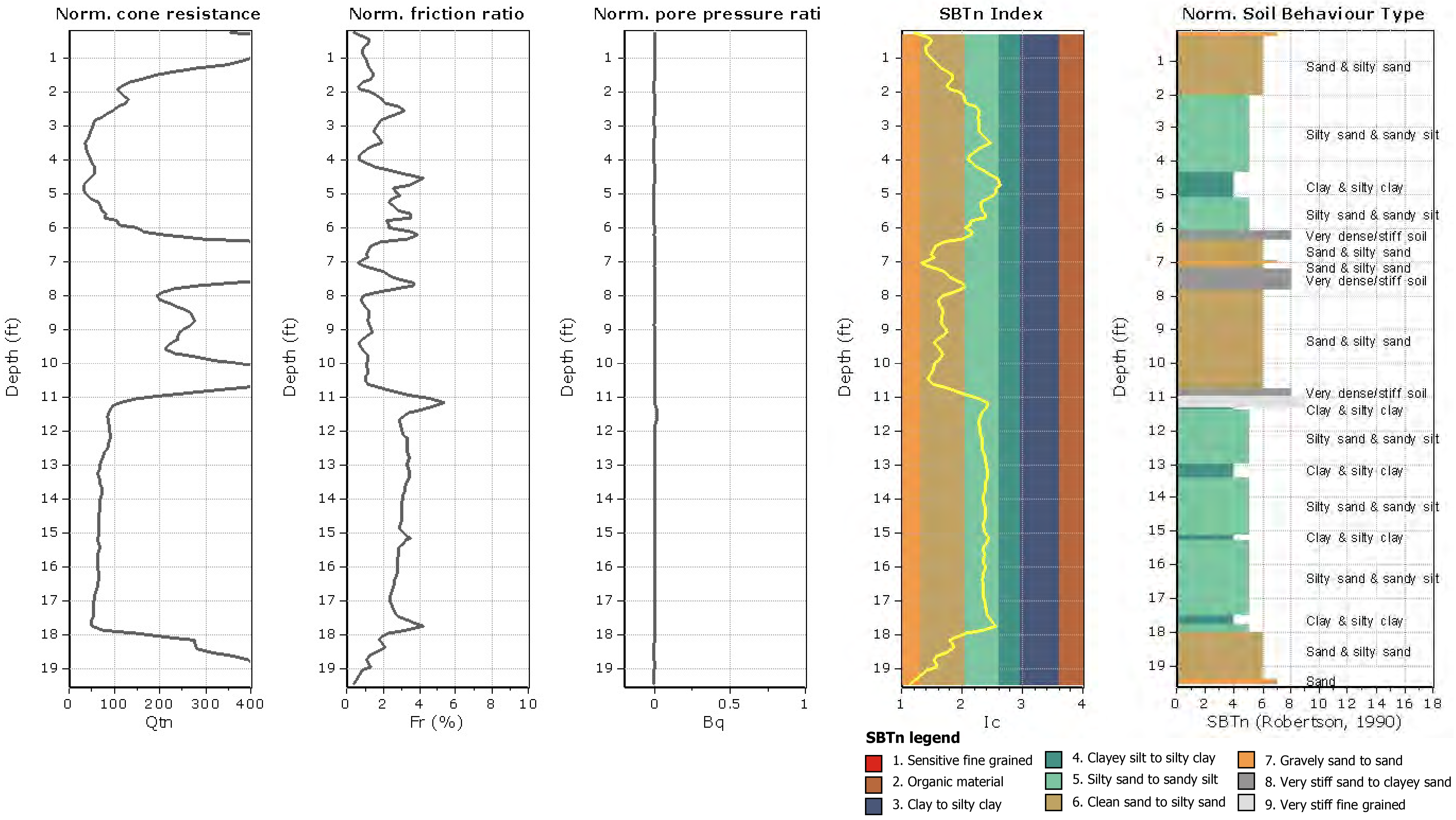
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

CPT: CPT-10
Total depth: 19.44 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



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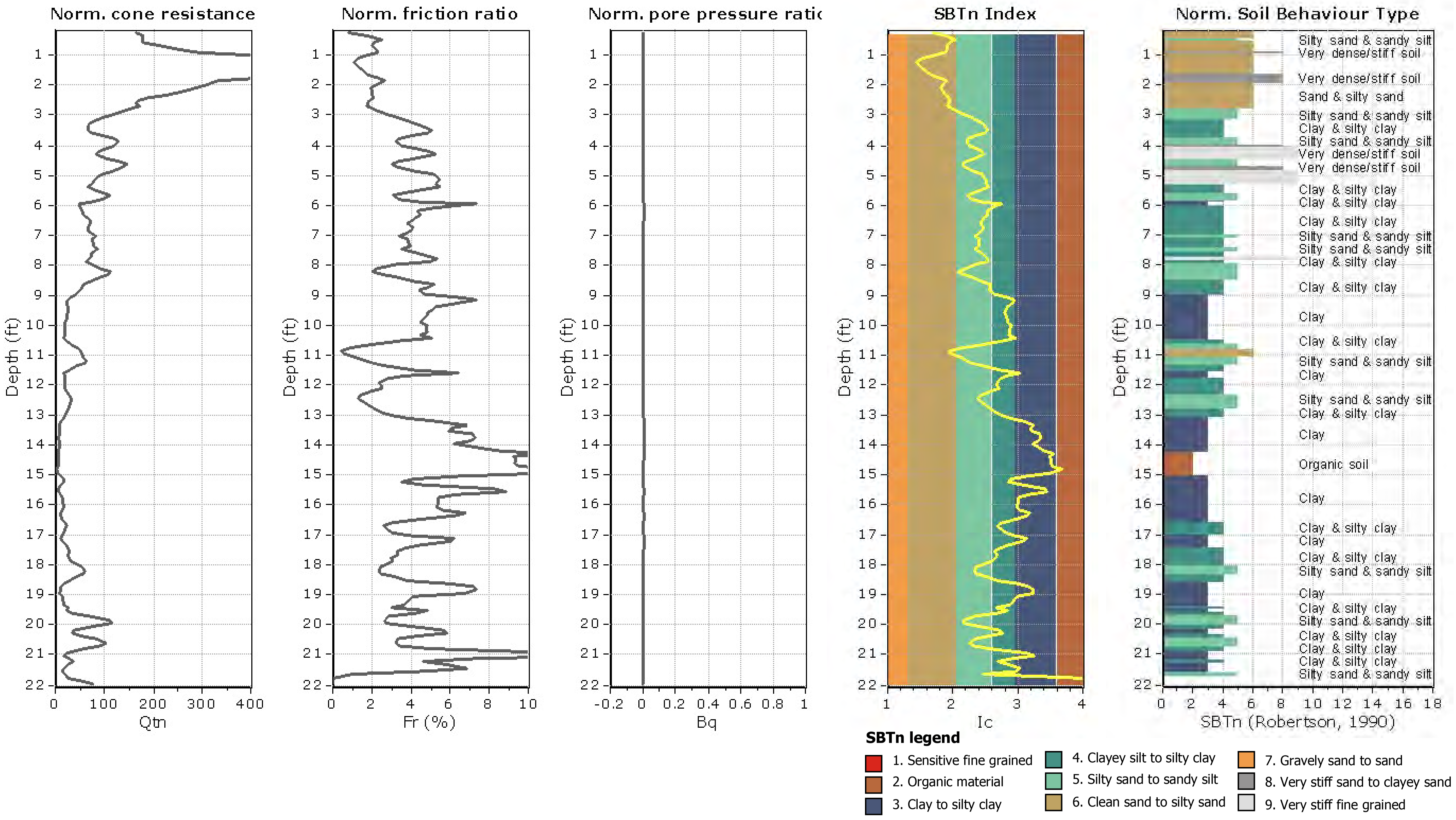
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

CPT: CPT-11
Total depth: 21.97 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



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Project file: P:\2011\11077-02\CPet-It\170920.cpt

NMG Geotechnical, Inc.
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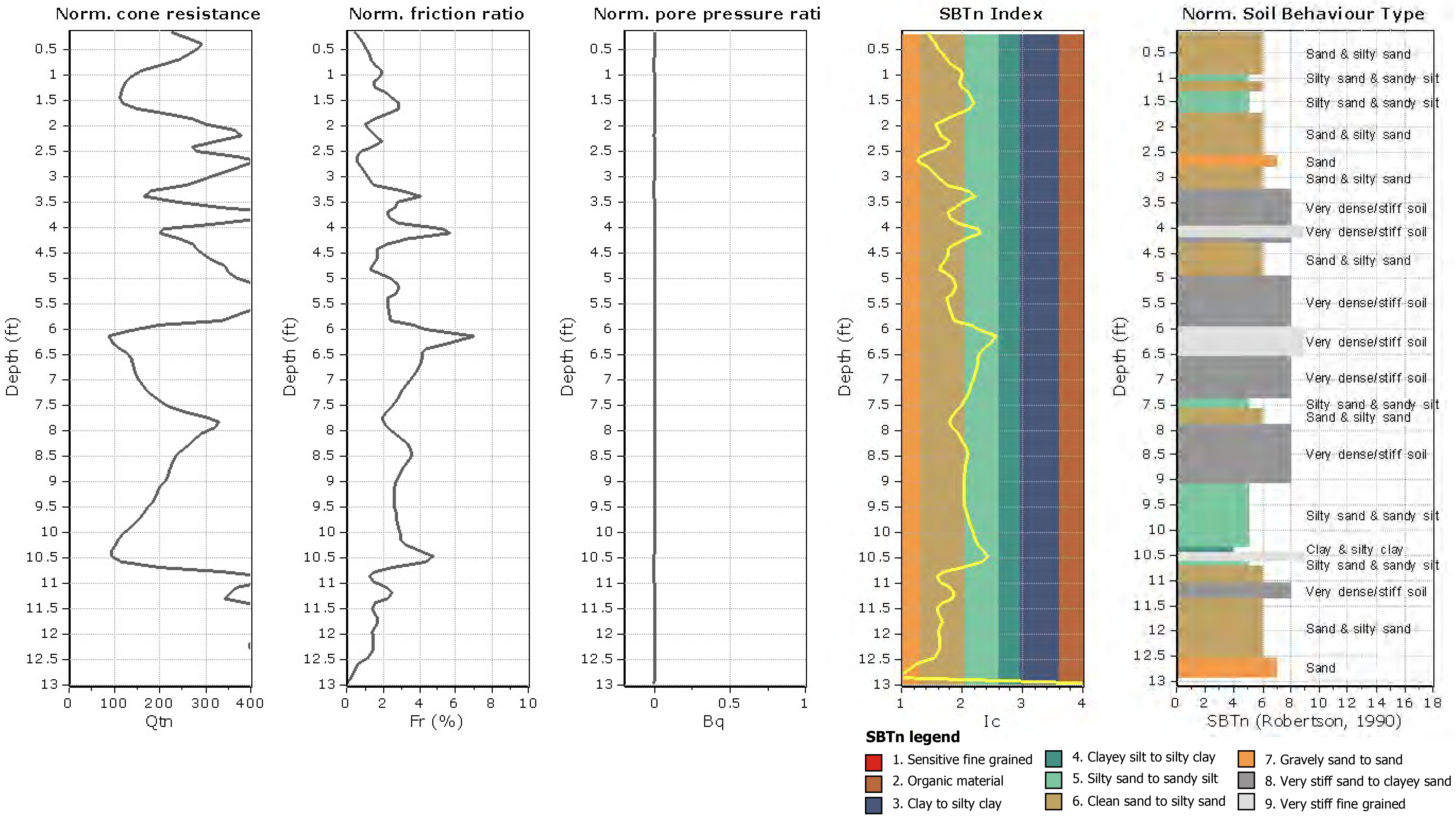
Irvine, CA 92614

CPT: CPT-12
Total depth: 12.97 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

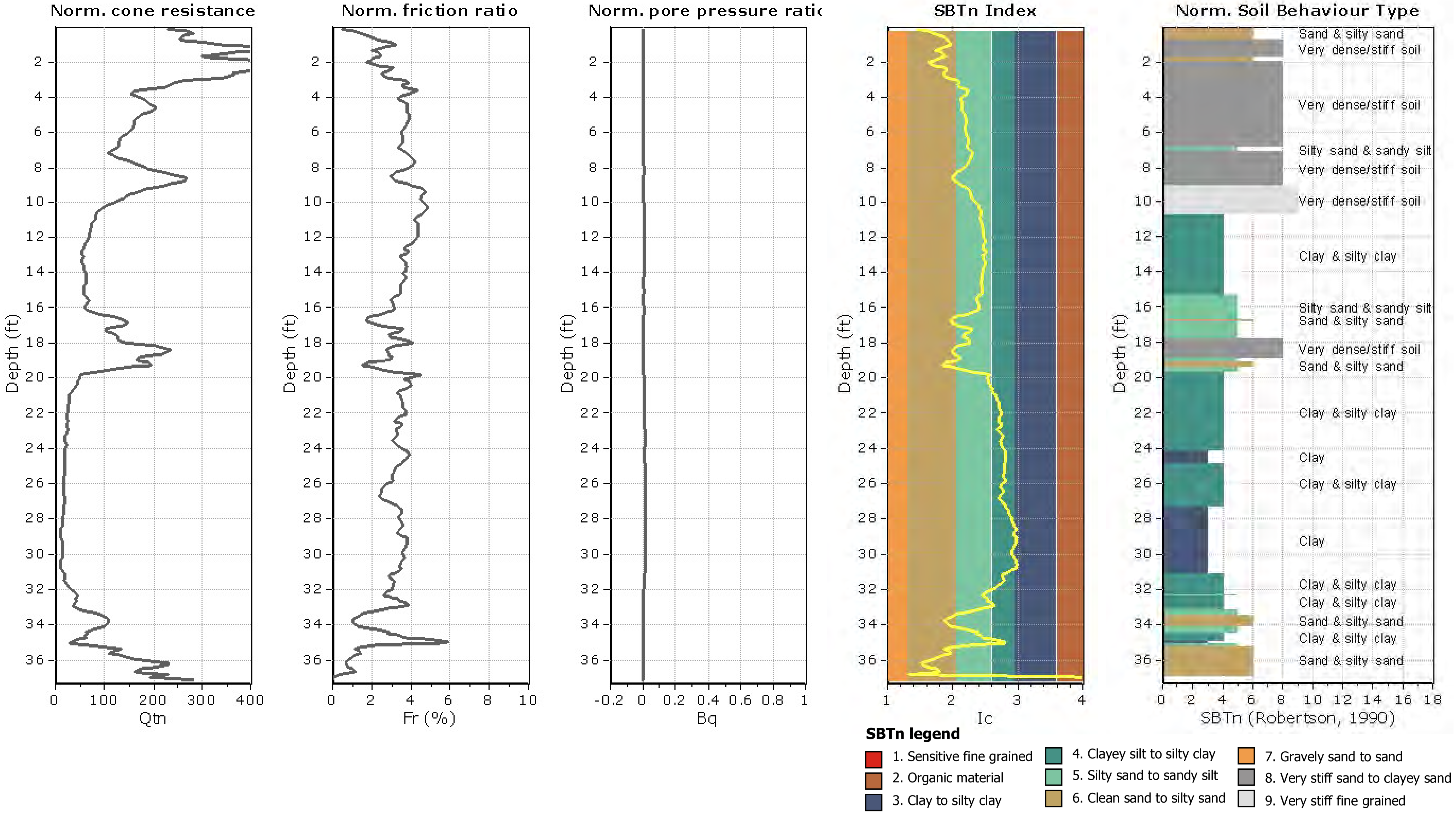
Project: **Riverwalk**
Location: **San Diego, CA**



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

CPT: CPT-13
Total depth: 37.14 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



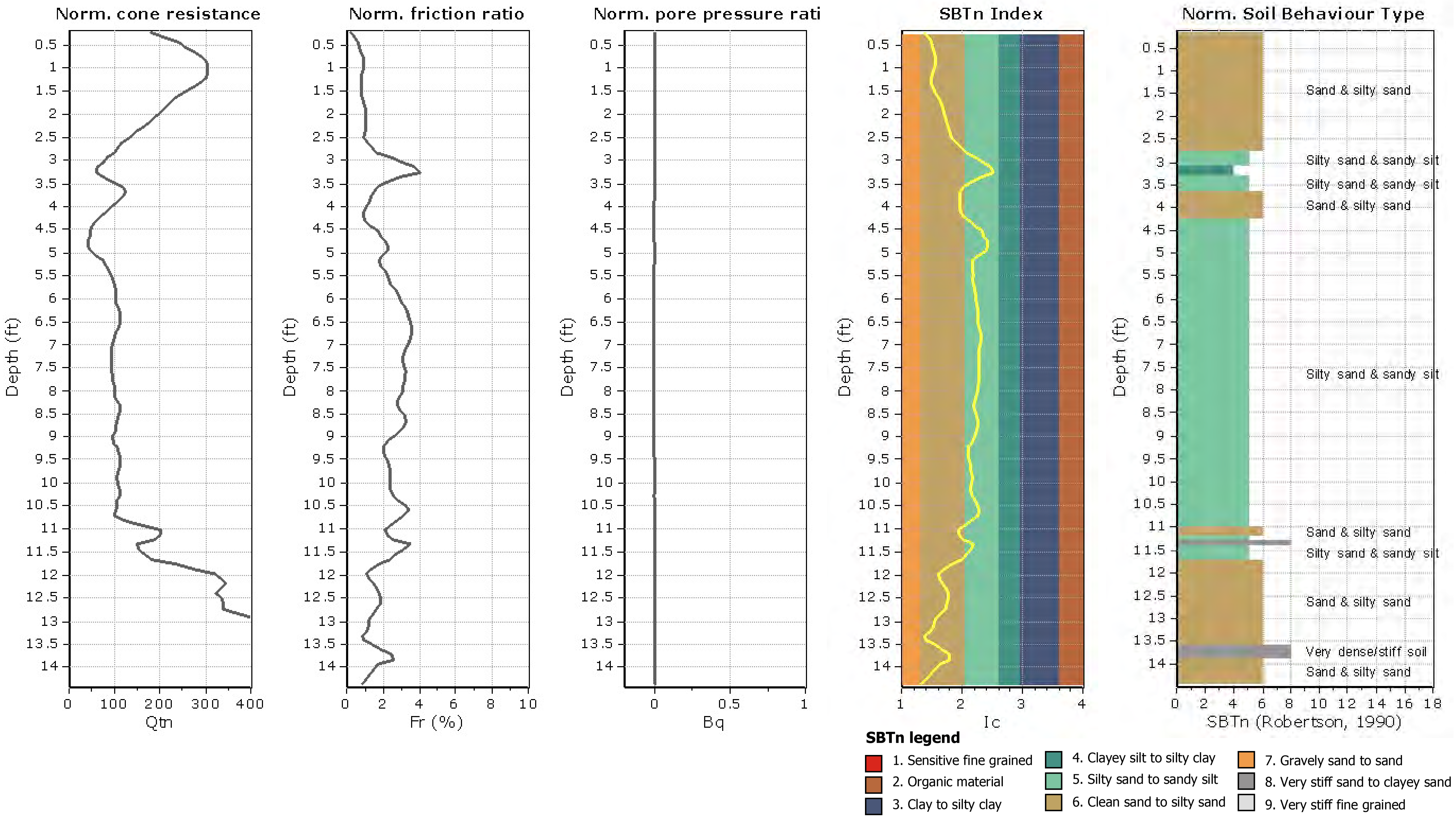
SBTn legend

🟥 1. Sensitive fine grained	🟩 4. Clayey silt to silty clay	🟧 7. Gravely sand to sand
🟫 2. Organic material	🟩 5. Silty sand to sandy silt	⬛ 8. Very stiff sand to clayey sand
🟦 3. Clay to silty clay	🟨 6. Clean sand to silty sand	⬜ 9. Very stiff fine grained

NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

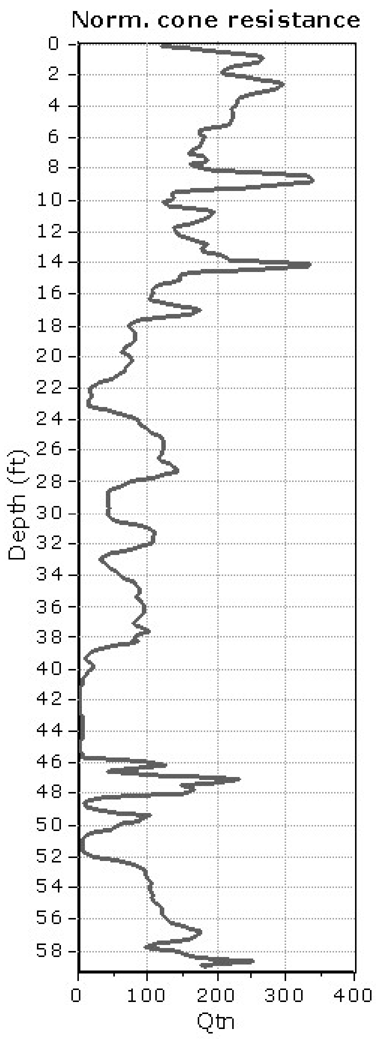
CPT: CPT-14
Total depth: 14.36 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

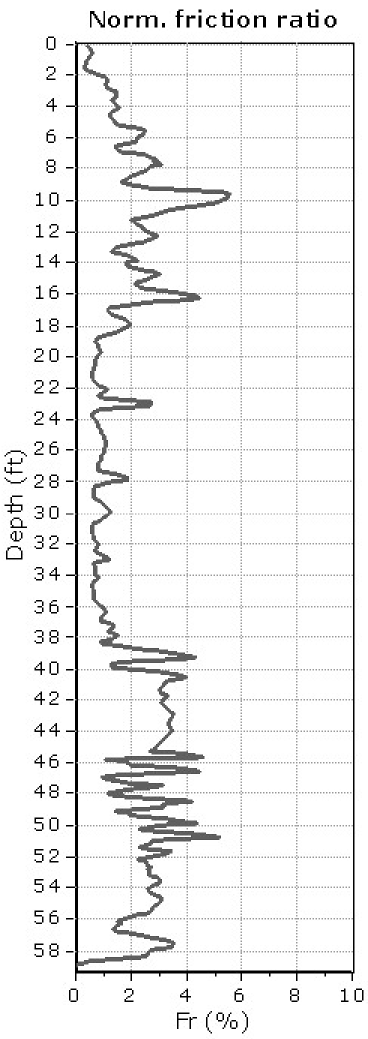


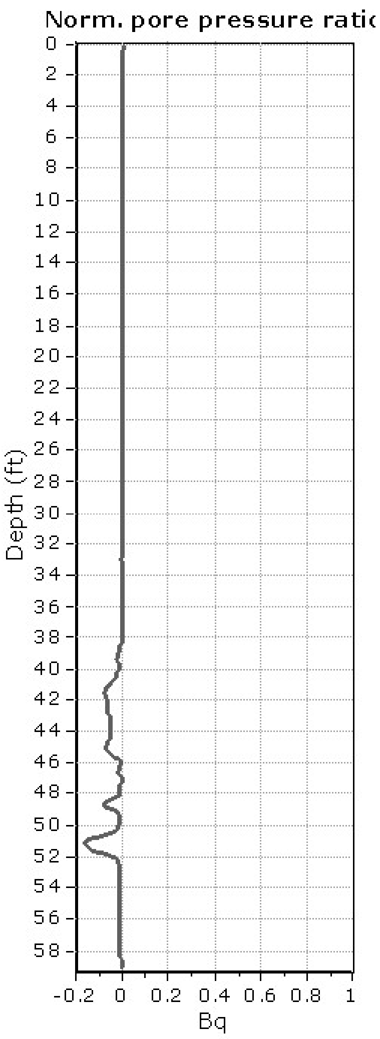
NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

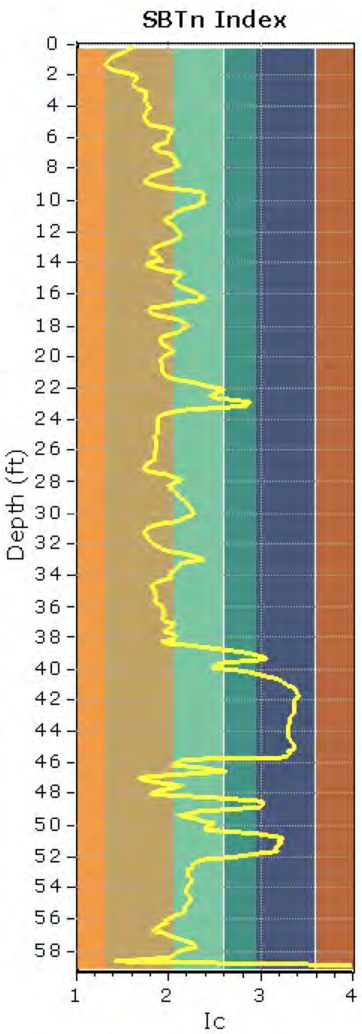
Project: **Riverwalk**
Location: **San Diego, CA**

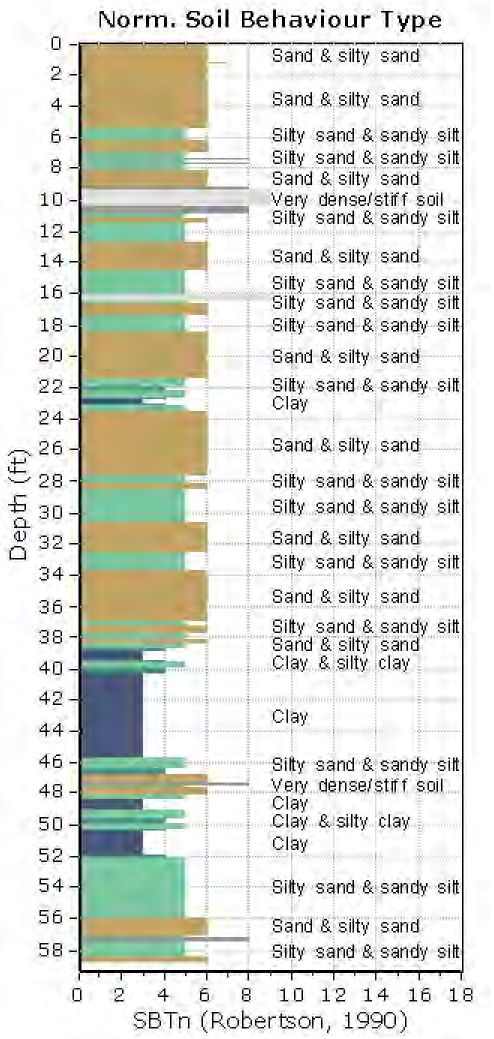
CPT: CPT-15
Total depth: 59.06 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown











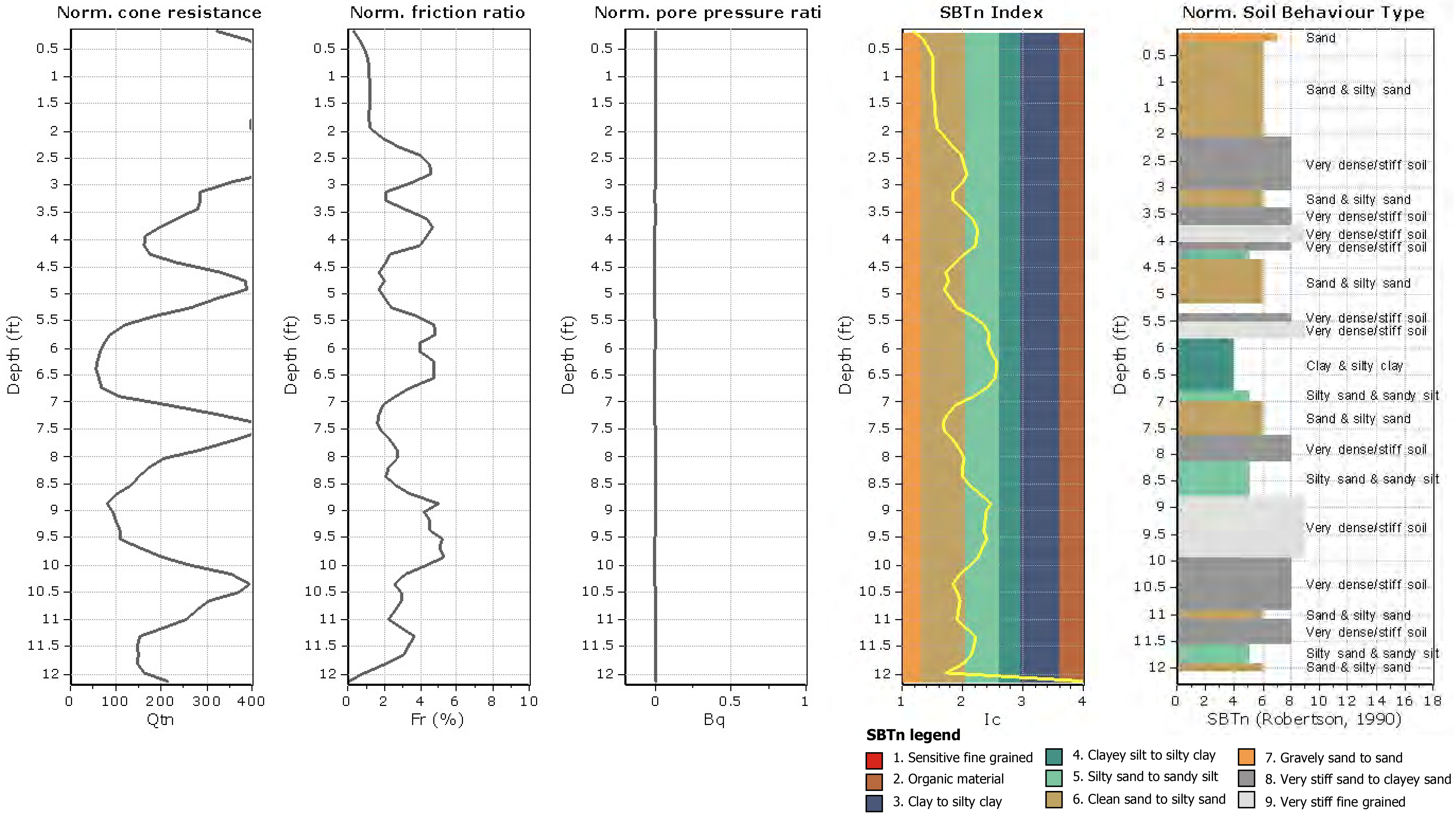
SBTn legend

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

NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

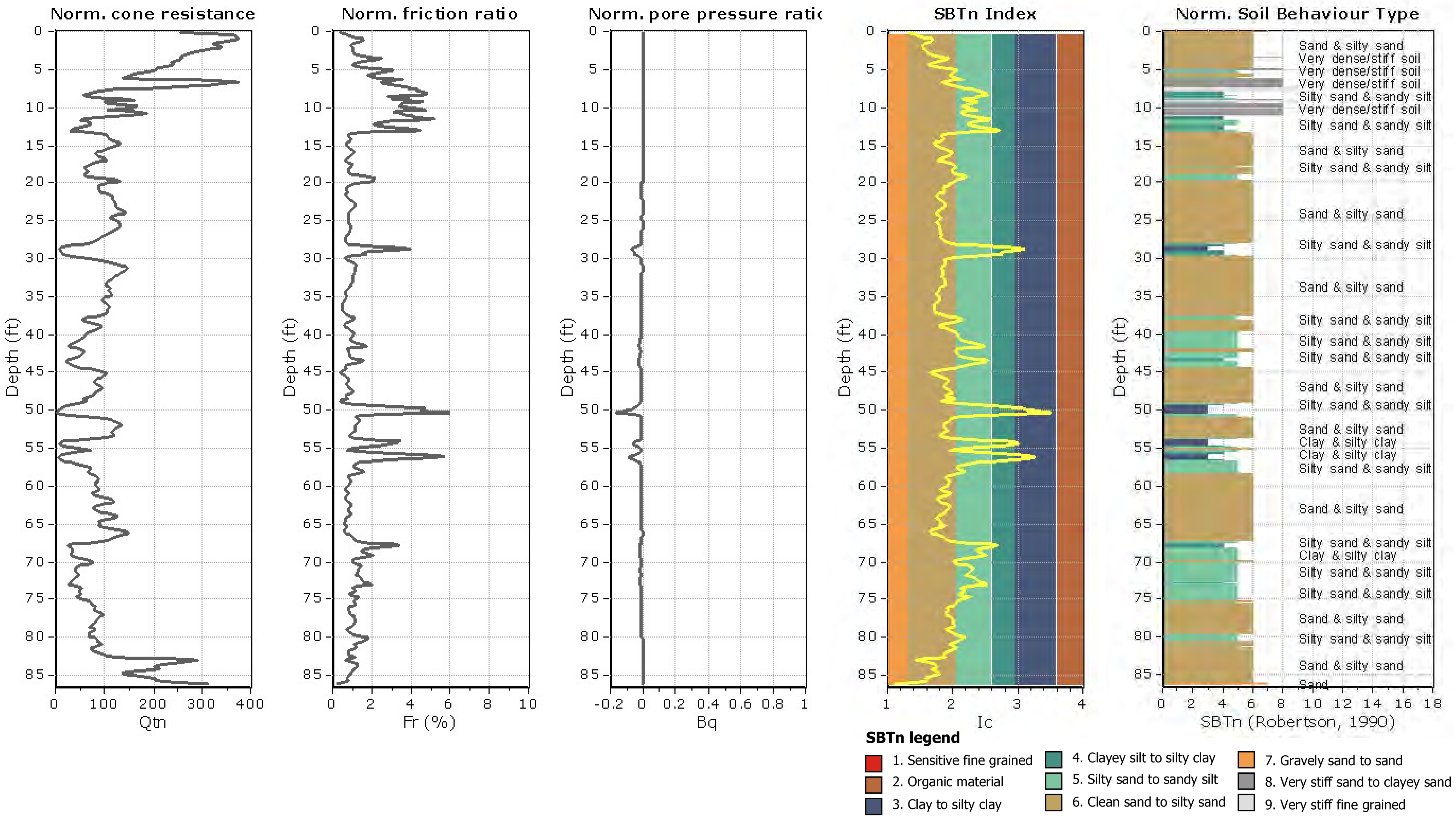
CPT: CPT-16
Total depth: 12.14 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

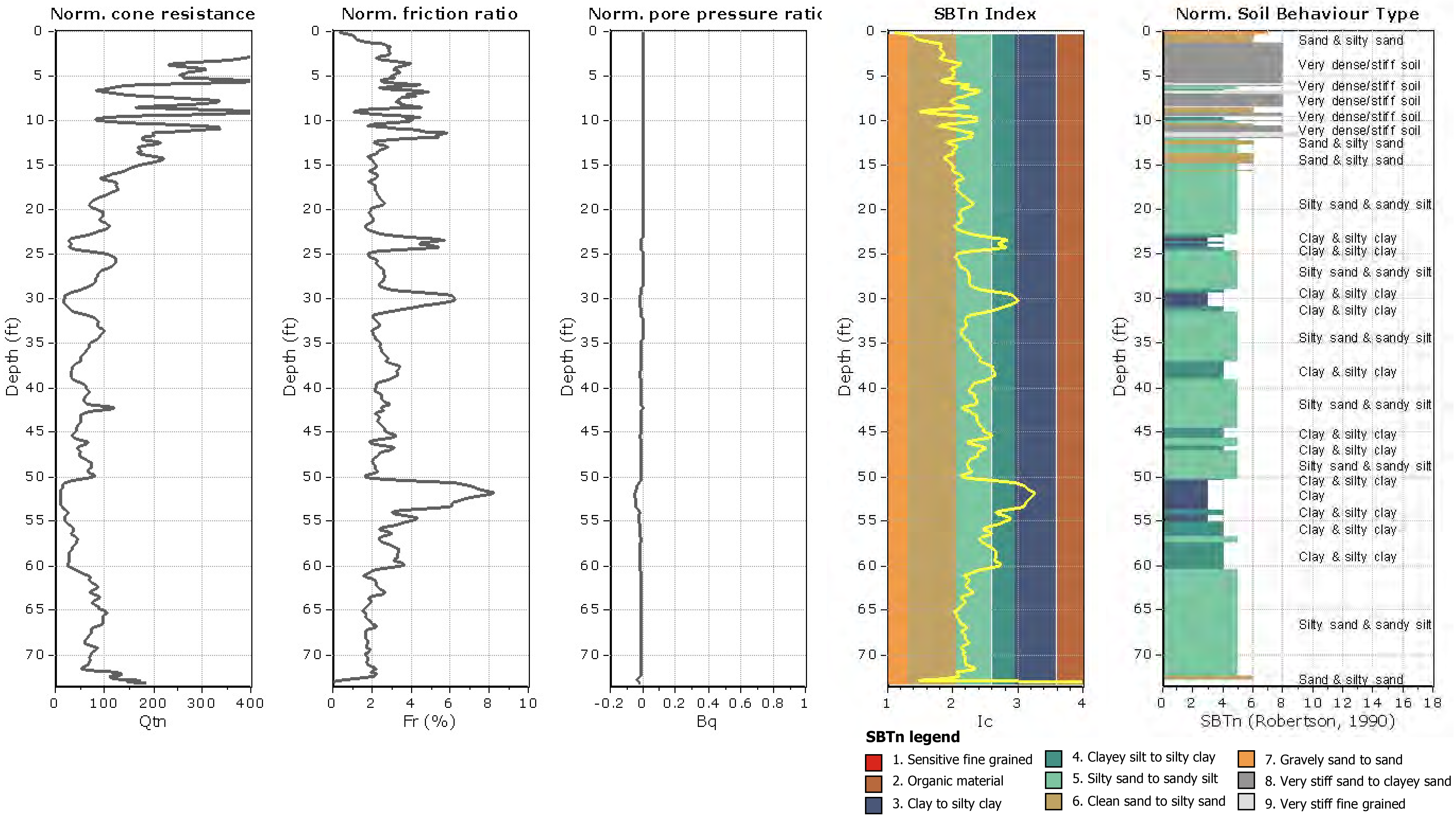
CPT: CPT-17
Total depth: 86.12 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

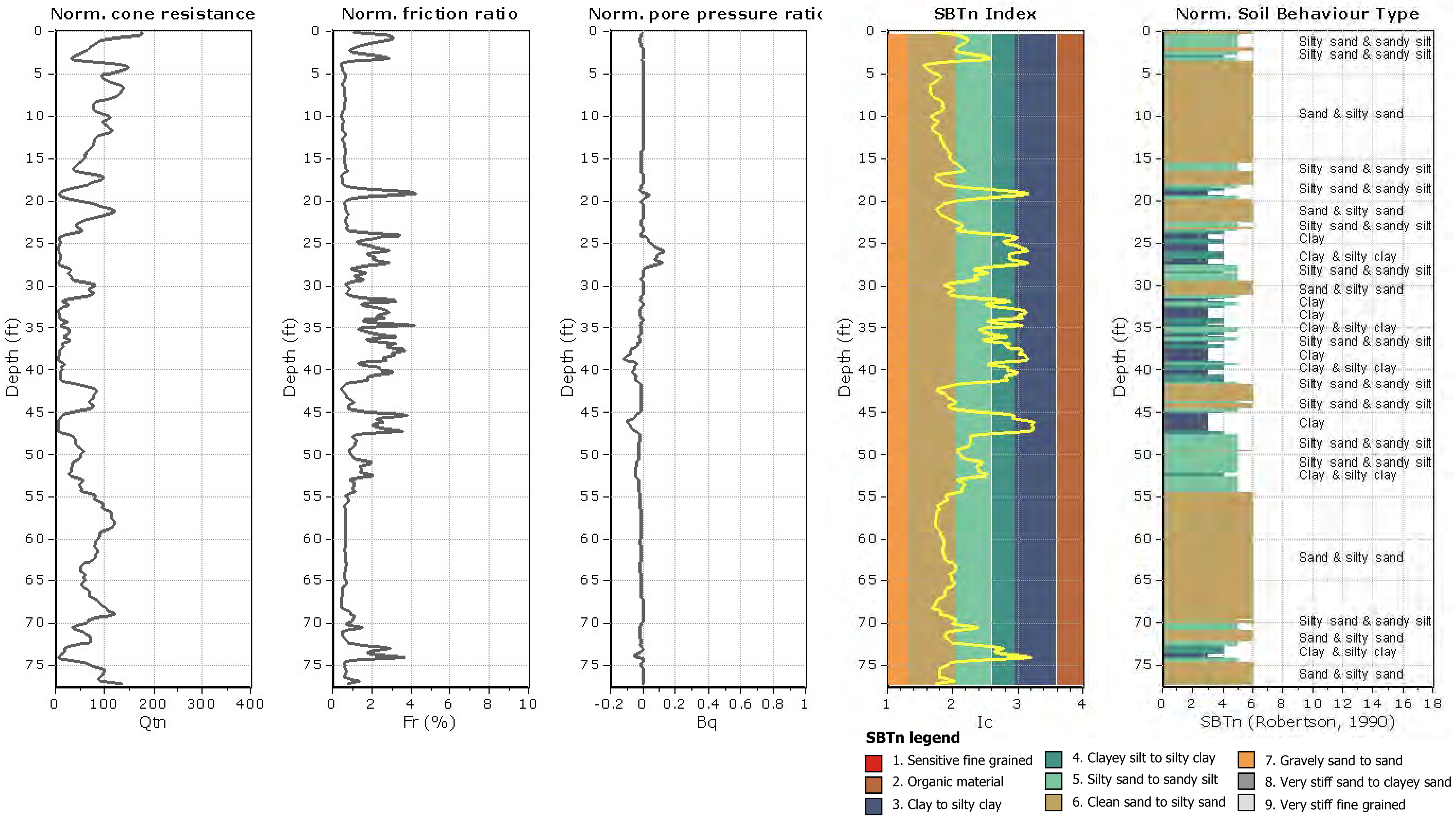
CPT: CPT-18
Total depth: 73.16 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

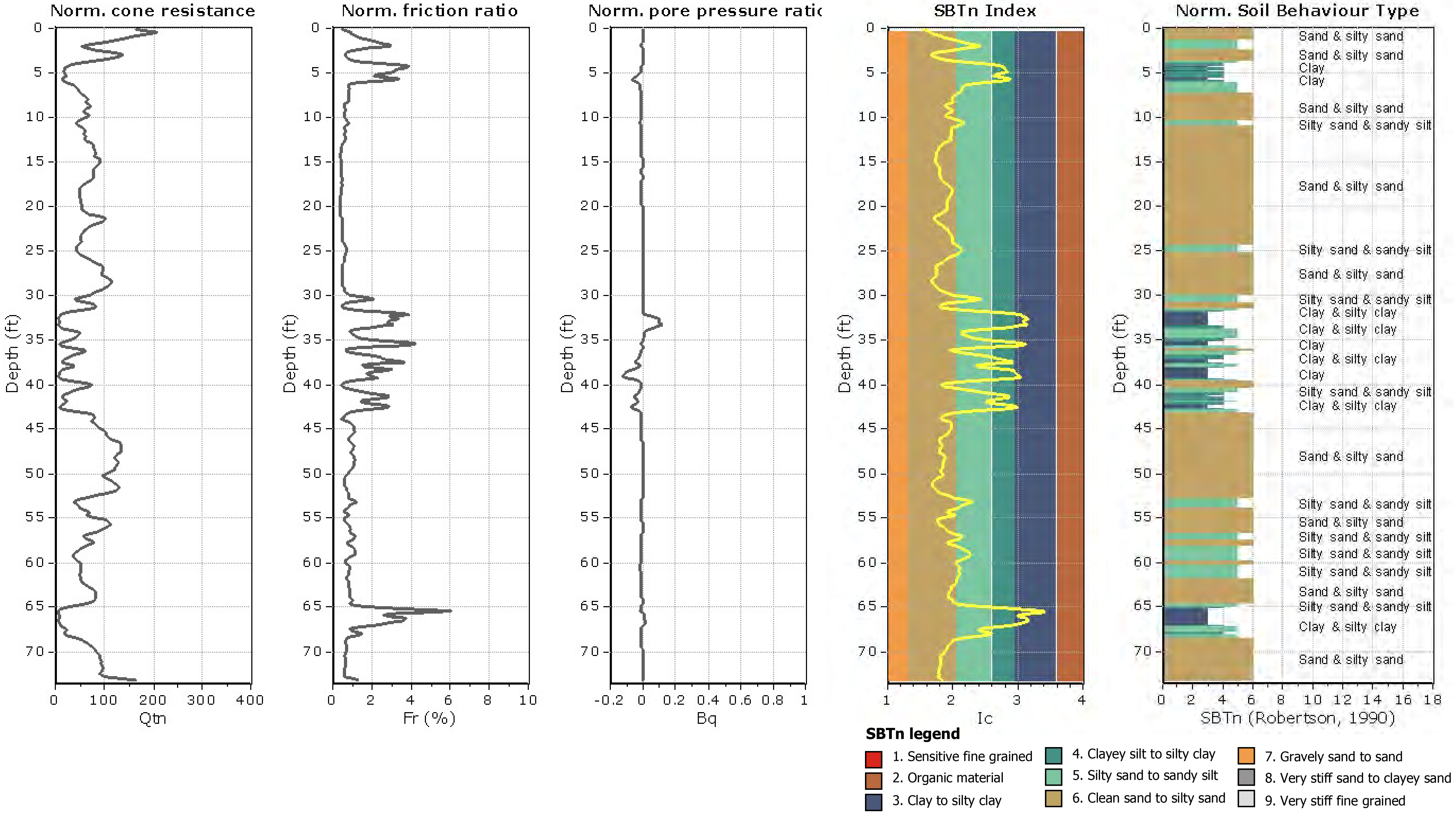
CPT: CPT-20
Total depth: 77.10 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

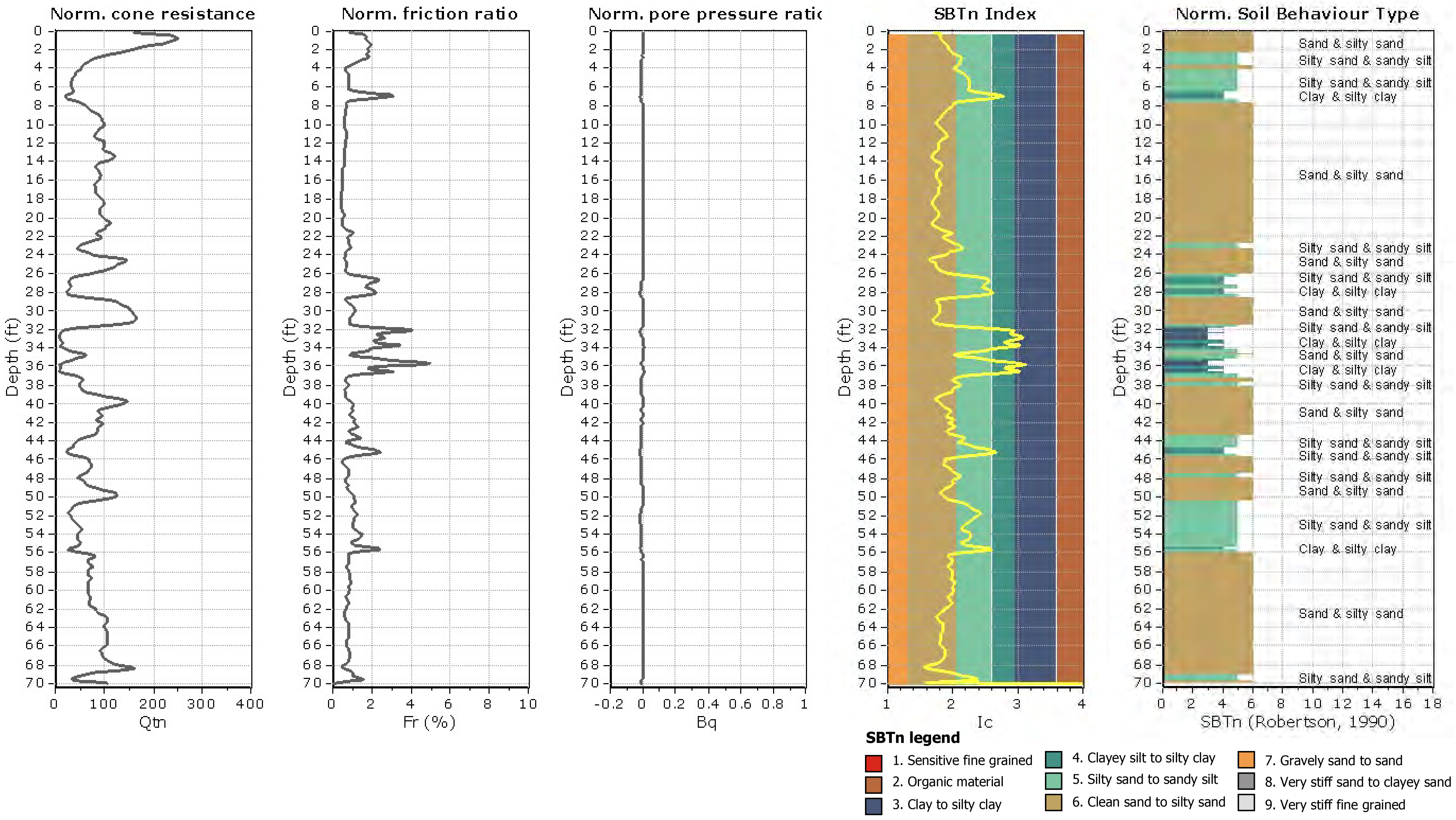
CPT: CPT-21
Total depth: 73.16 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

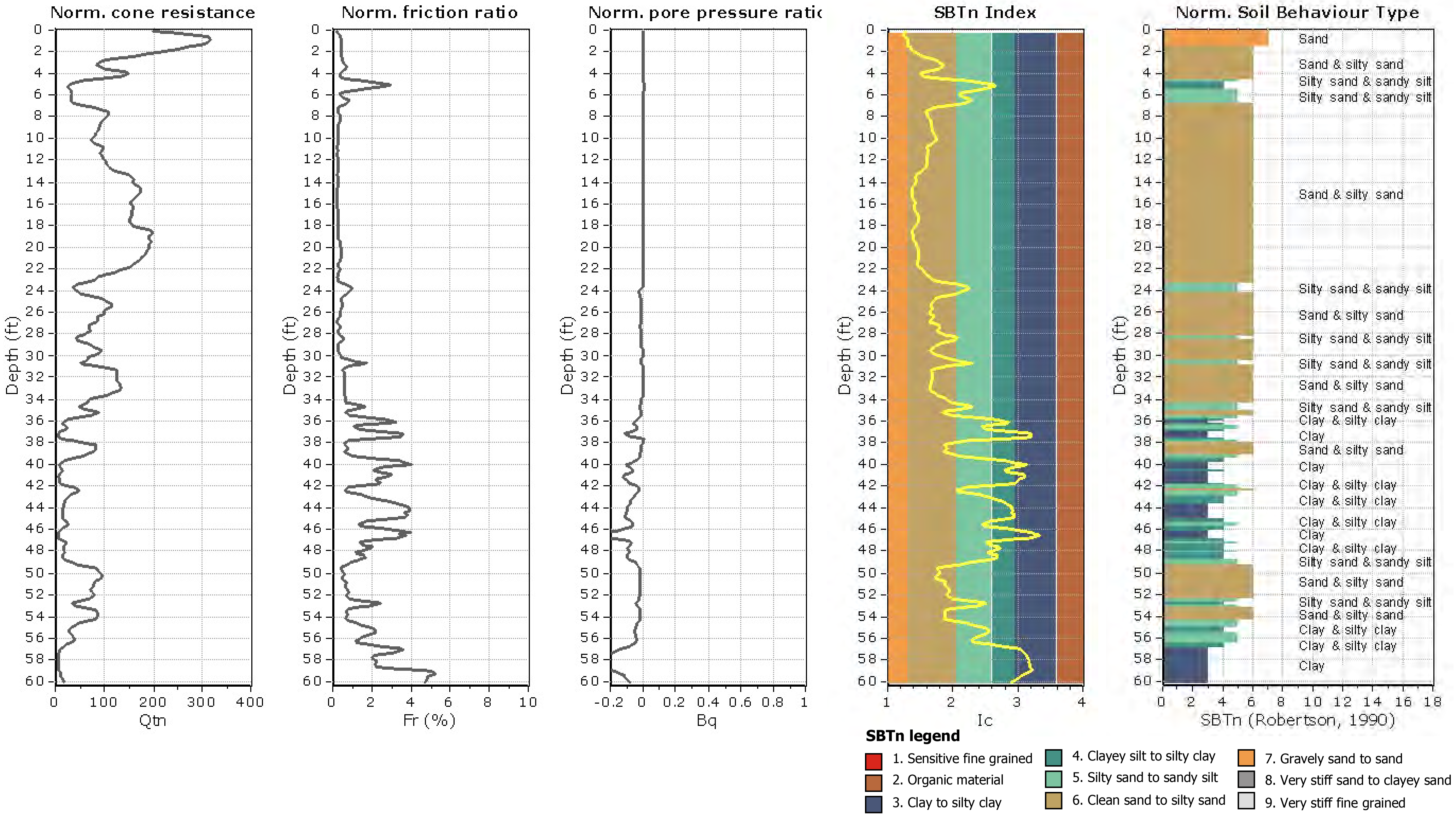
CPT: CPT-22
Total depth: 70.05 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

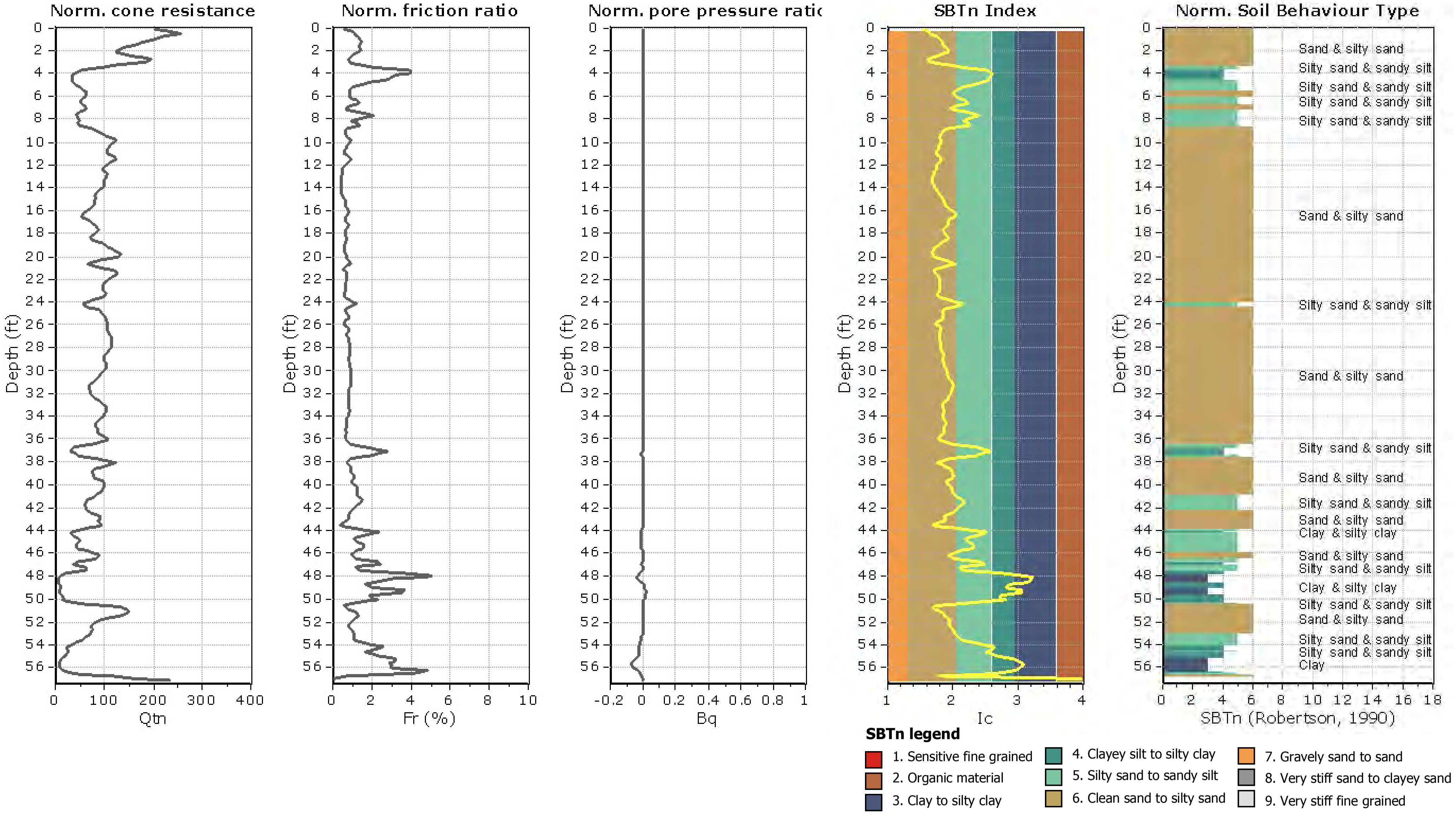
CPT: CPT-23
Total depth: 60.04 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

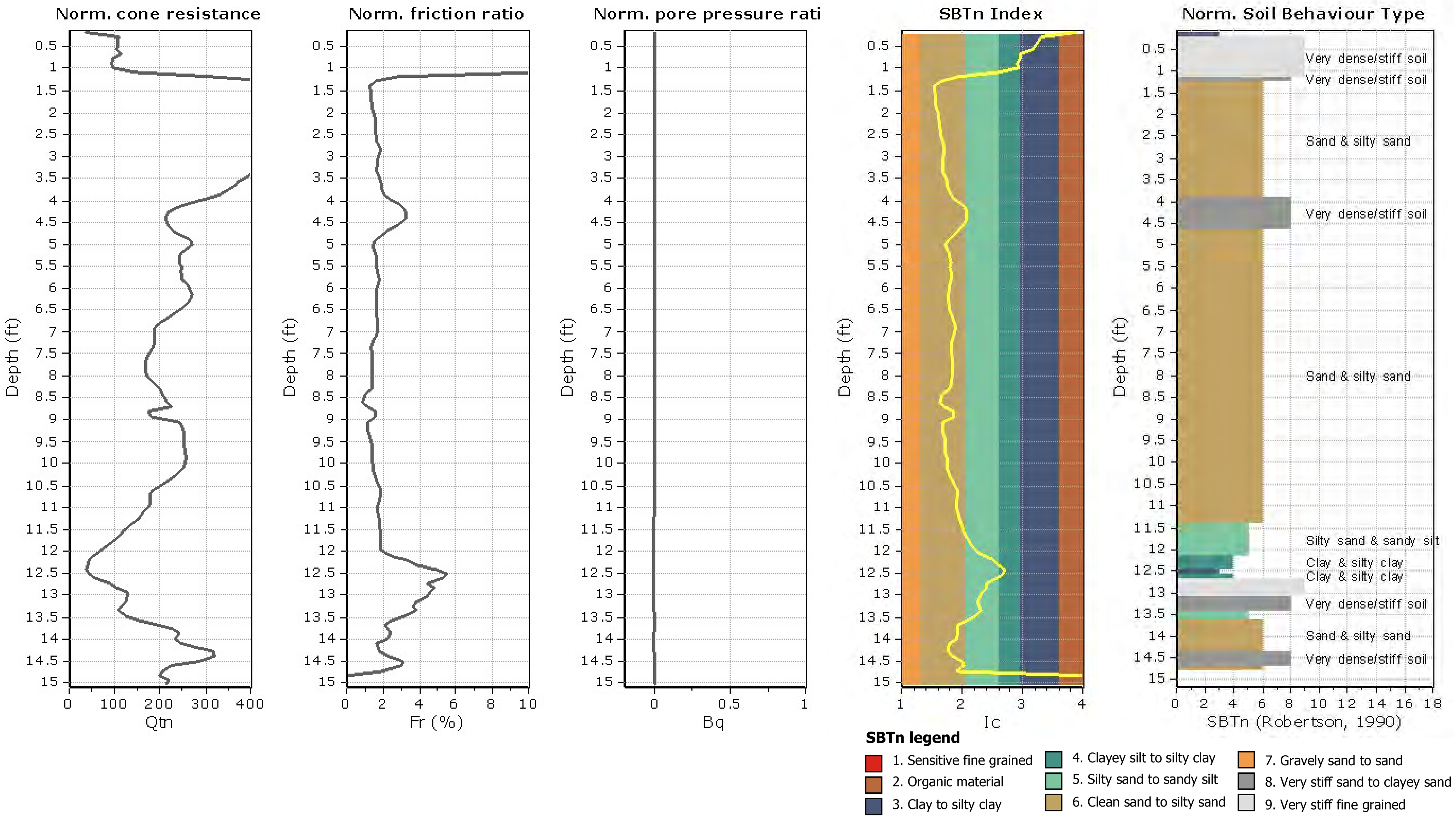
CPT: CPT-24
Total depth: 57.09 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

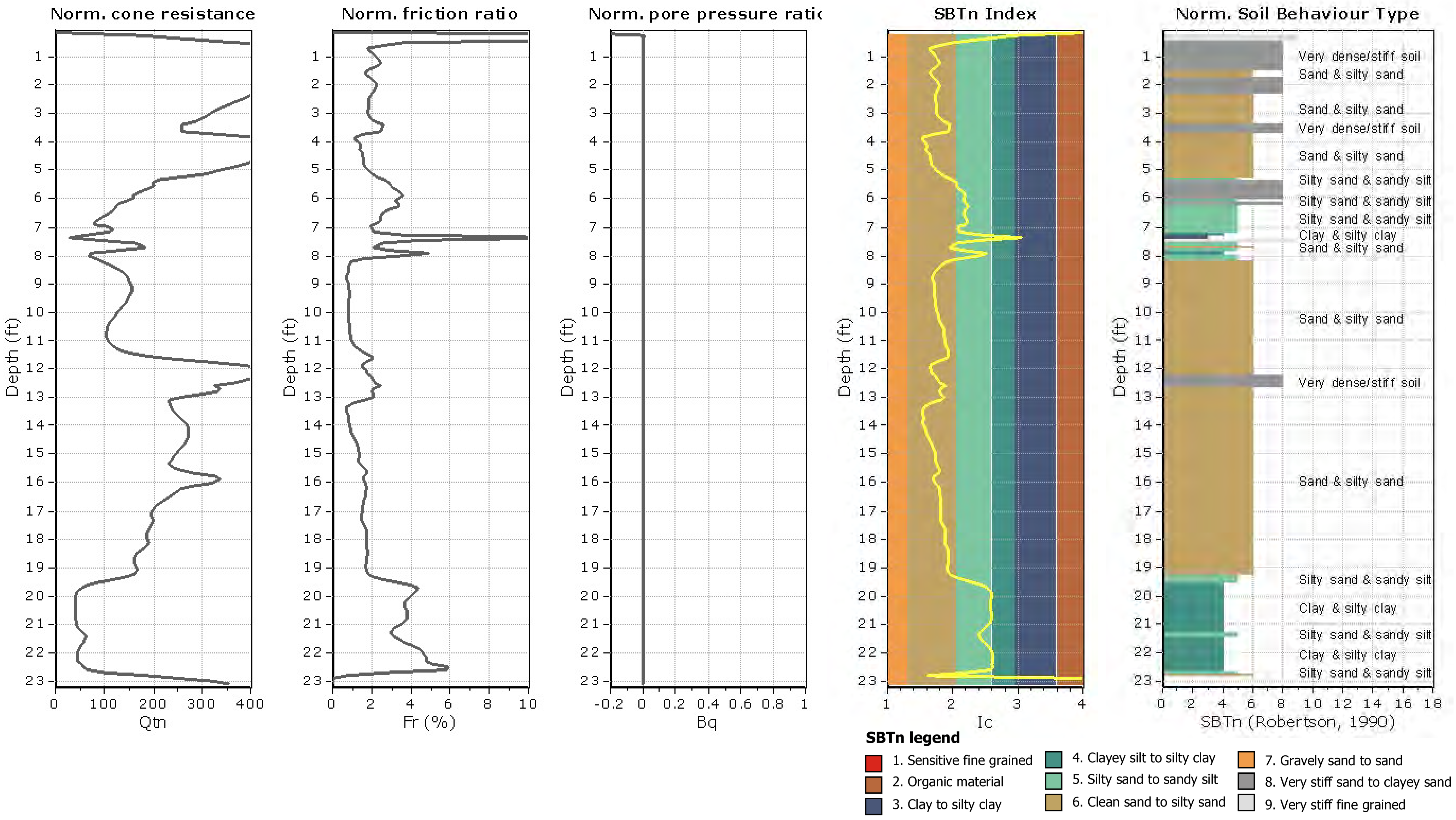
CPT: CPT-25
Total depth: 15.02 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

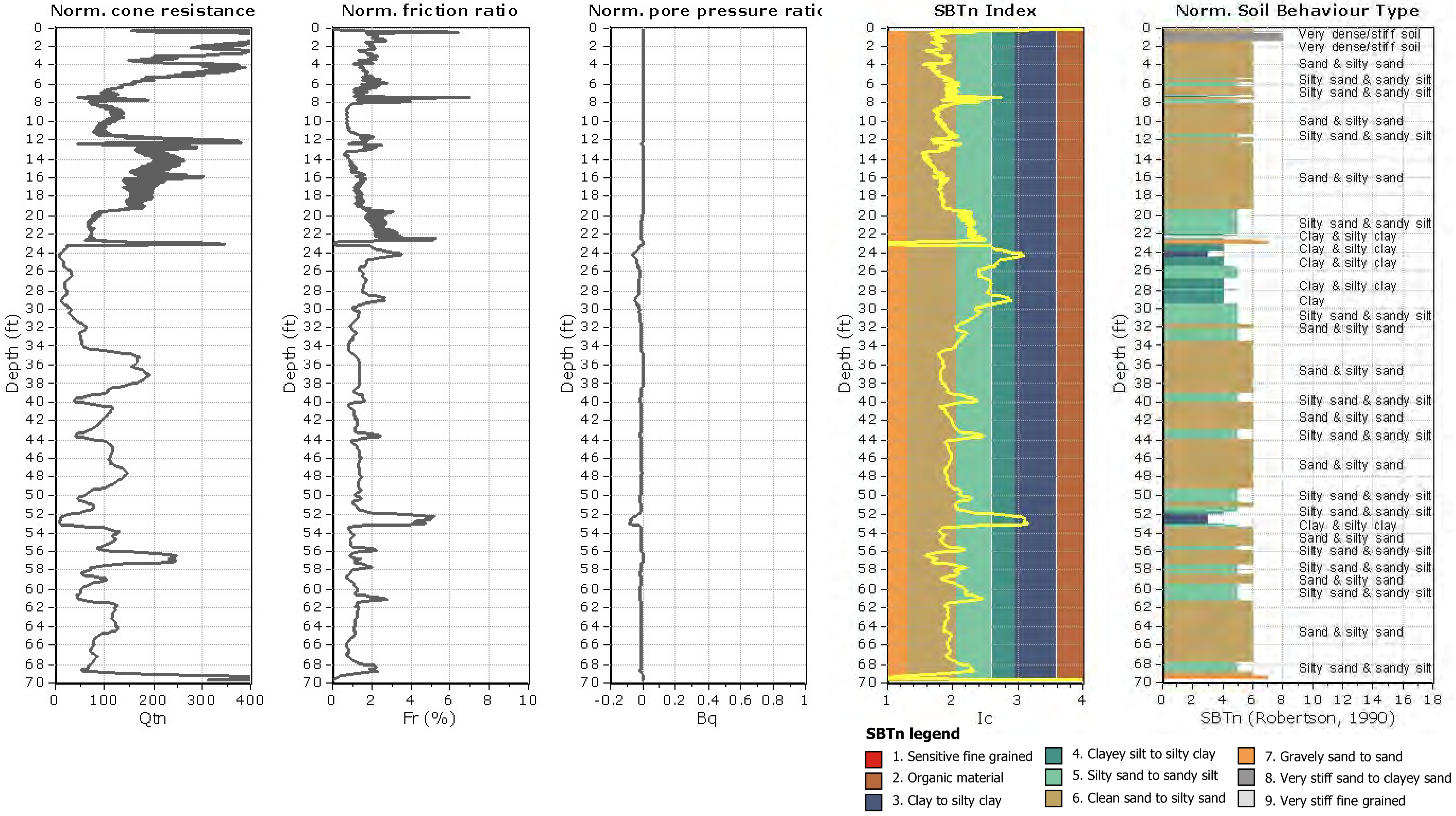
CPT: CPT-26
Total depth: 23.09 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

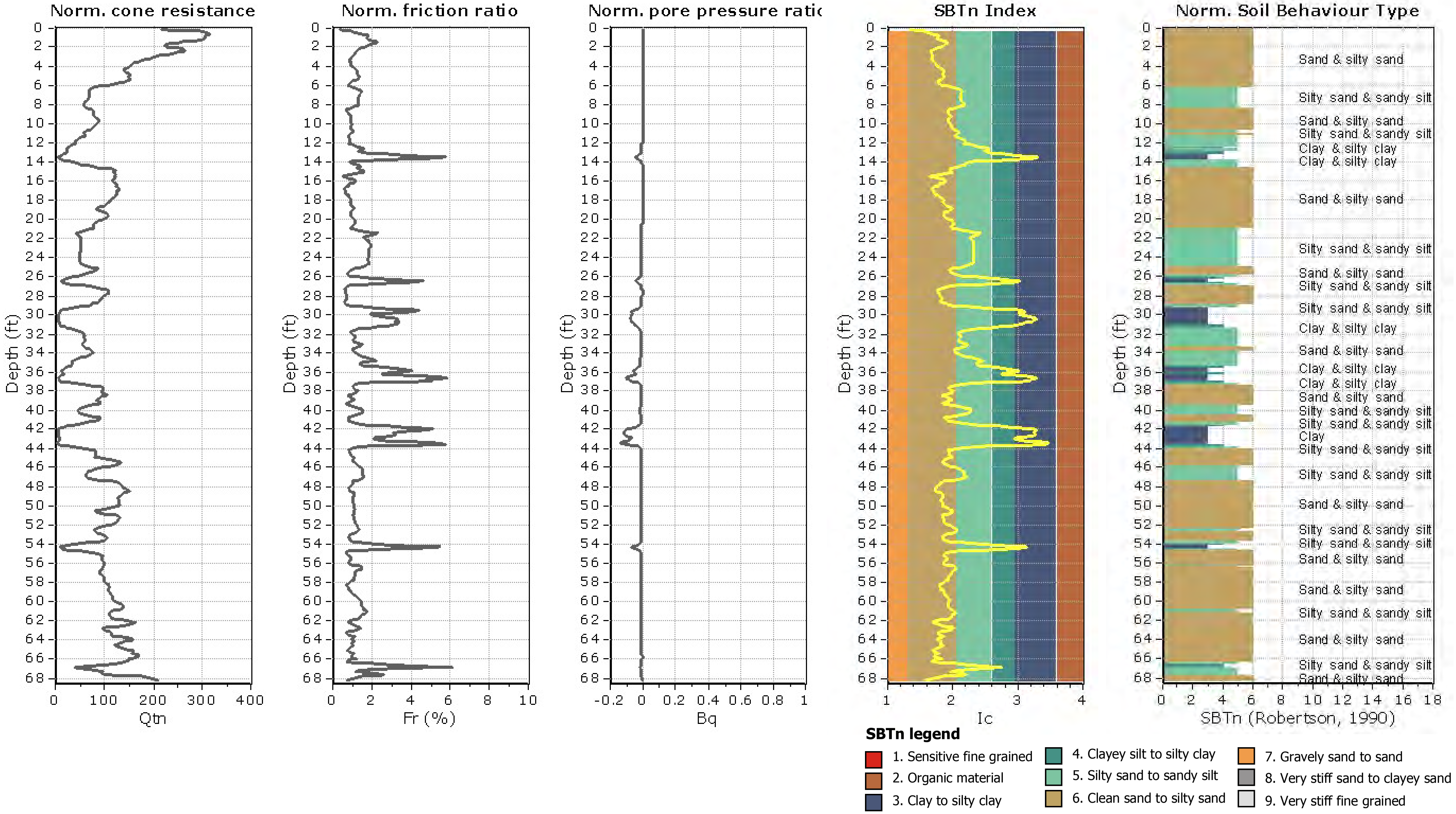
CPT: CPT-27
Total depth: 69.71 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

CPT: CPT-28
Total depth: 68.22 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



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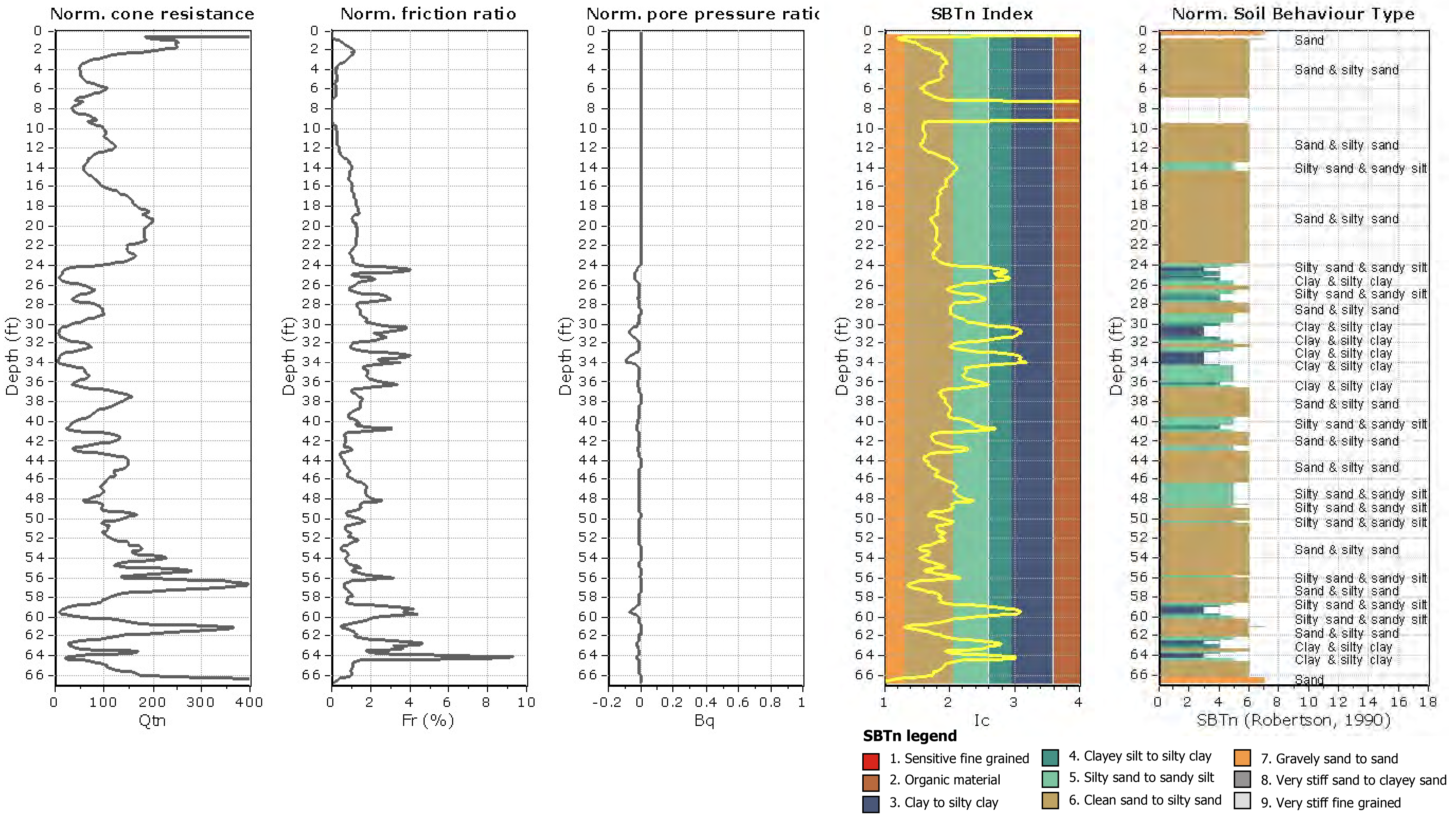
Project file: P:\2011\11077-02\CPet-It\170920.cpt

NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

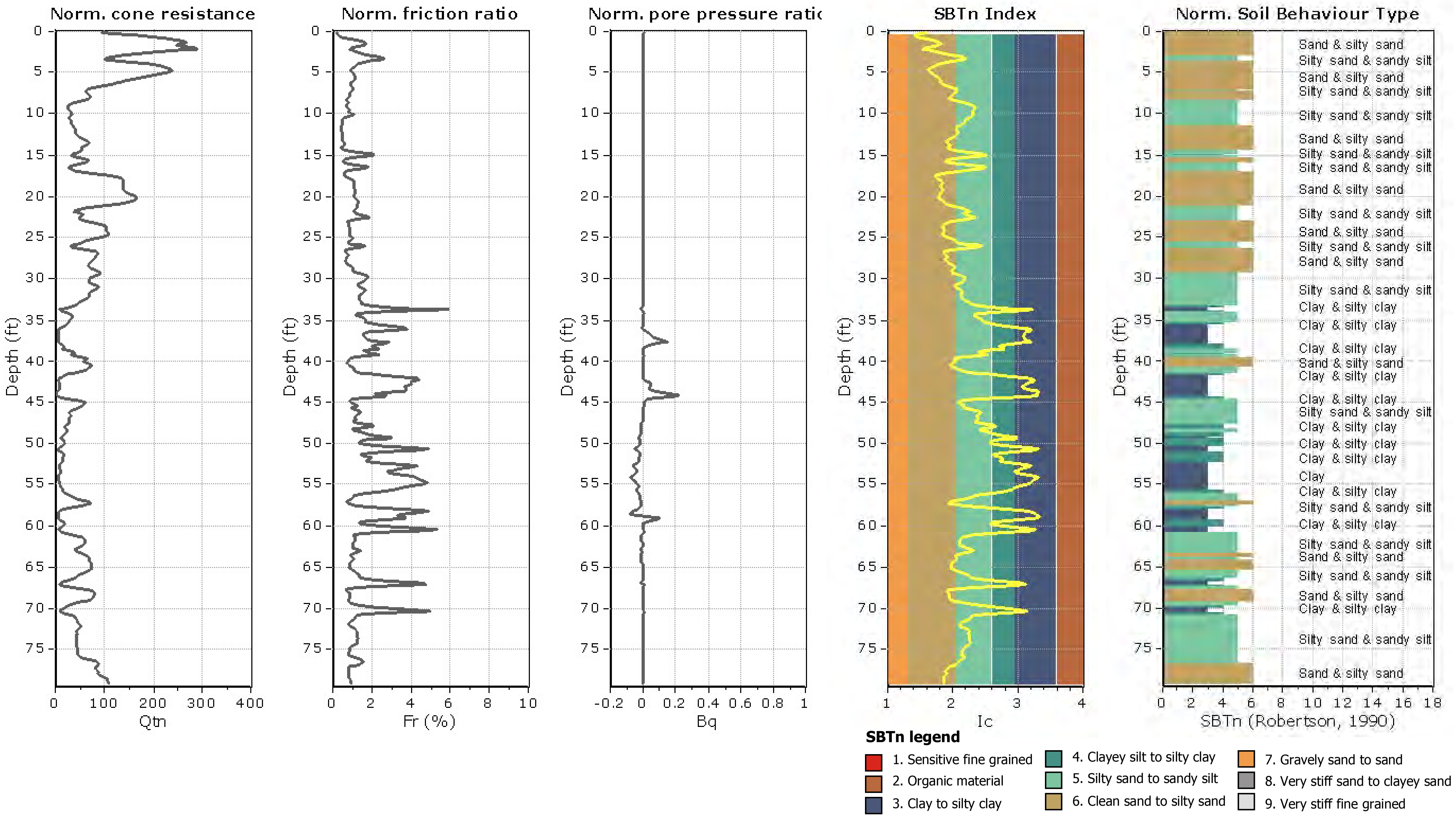
CPT: CPT-29
Total depth: 66.70 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

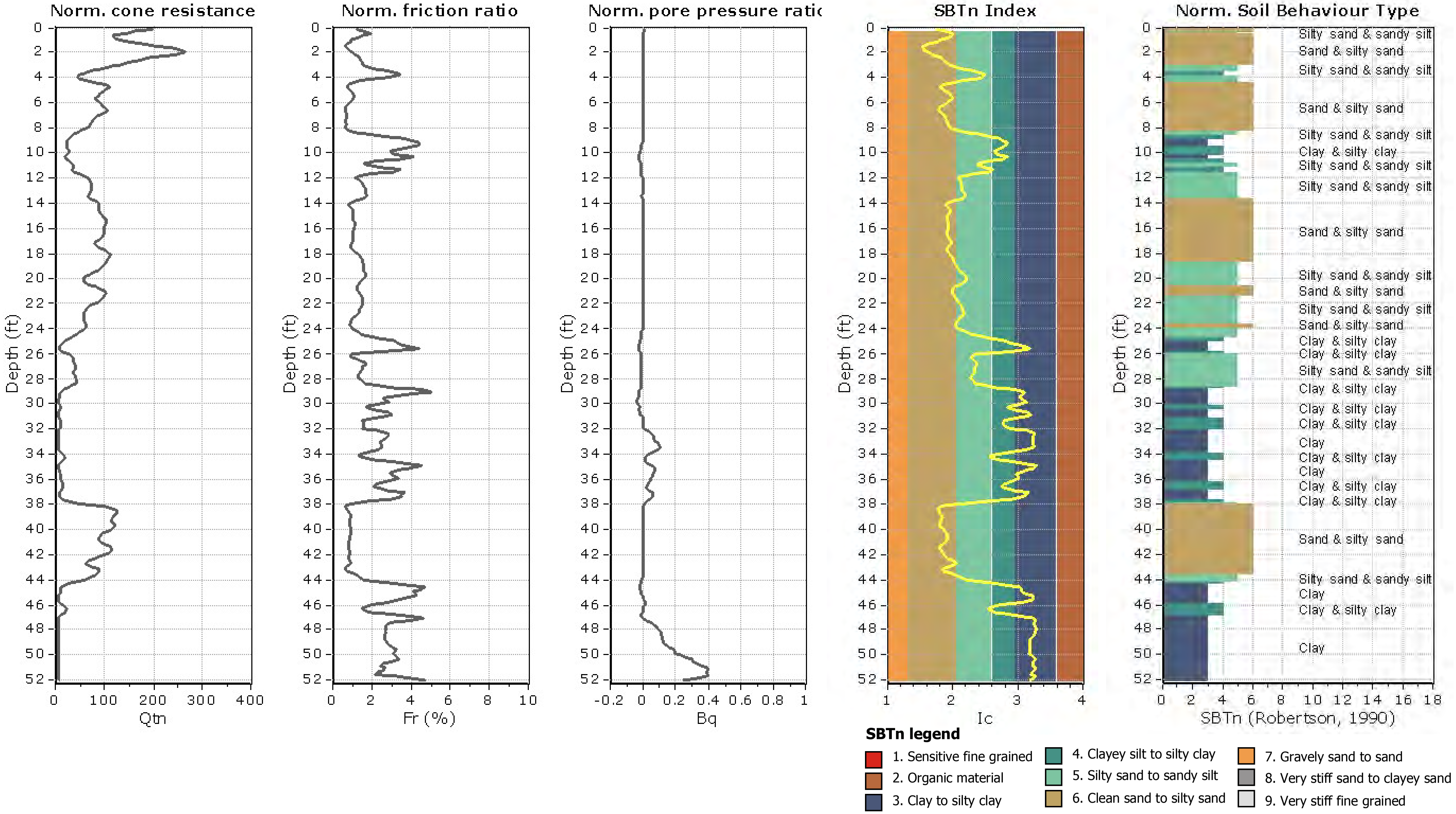
CPT: CPT-30
Total depth: 79.07 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

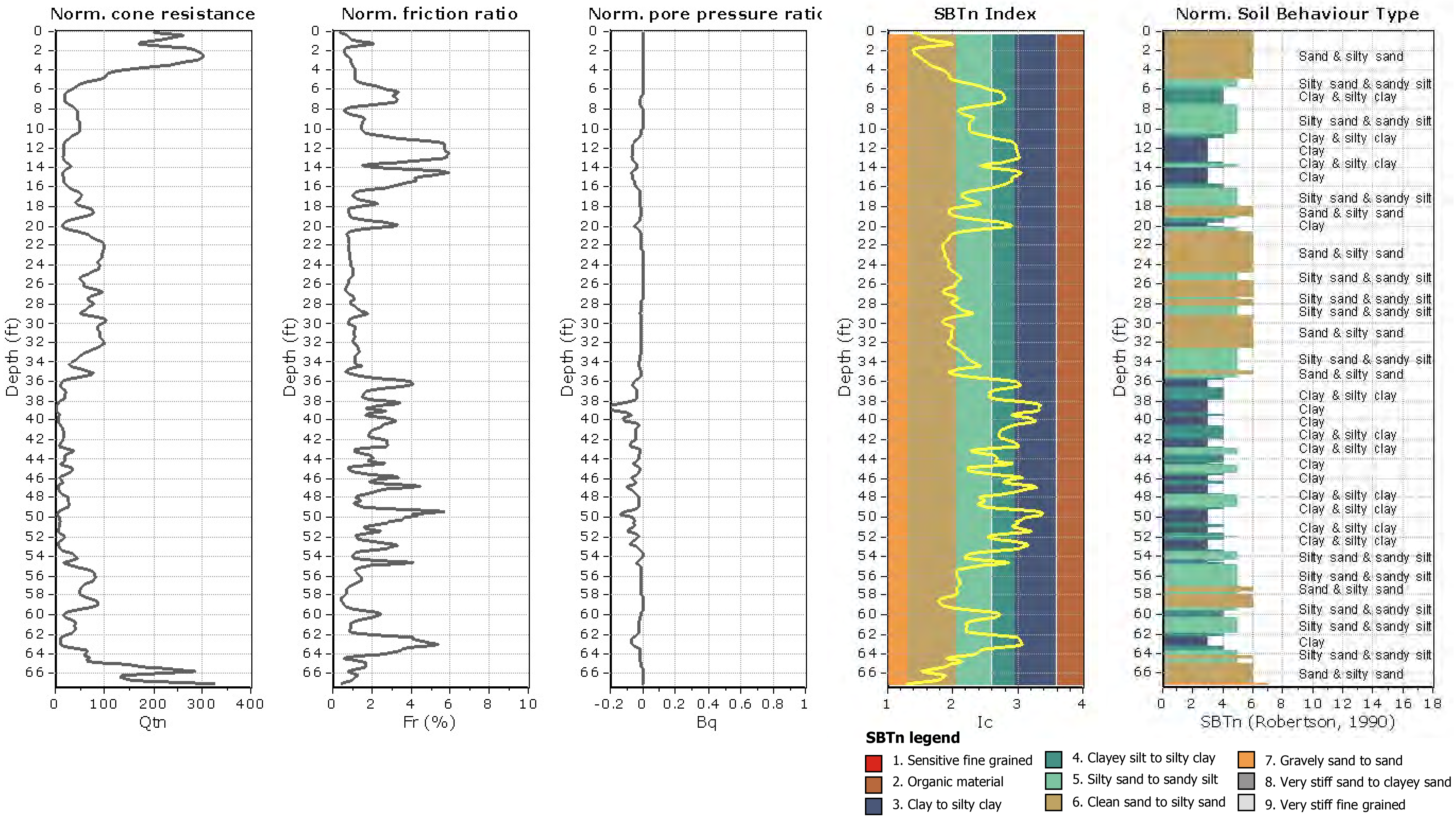
CPT: CPT-31
Total depth: 52.00 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

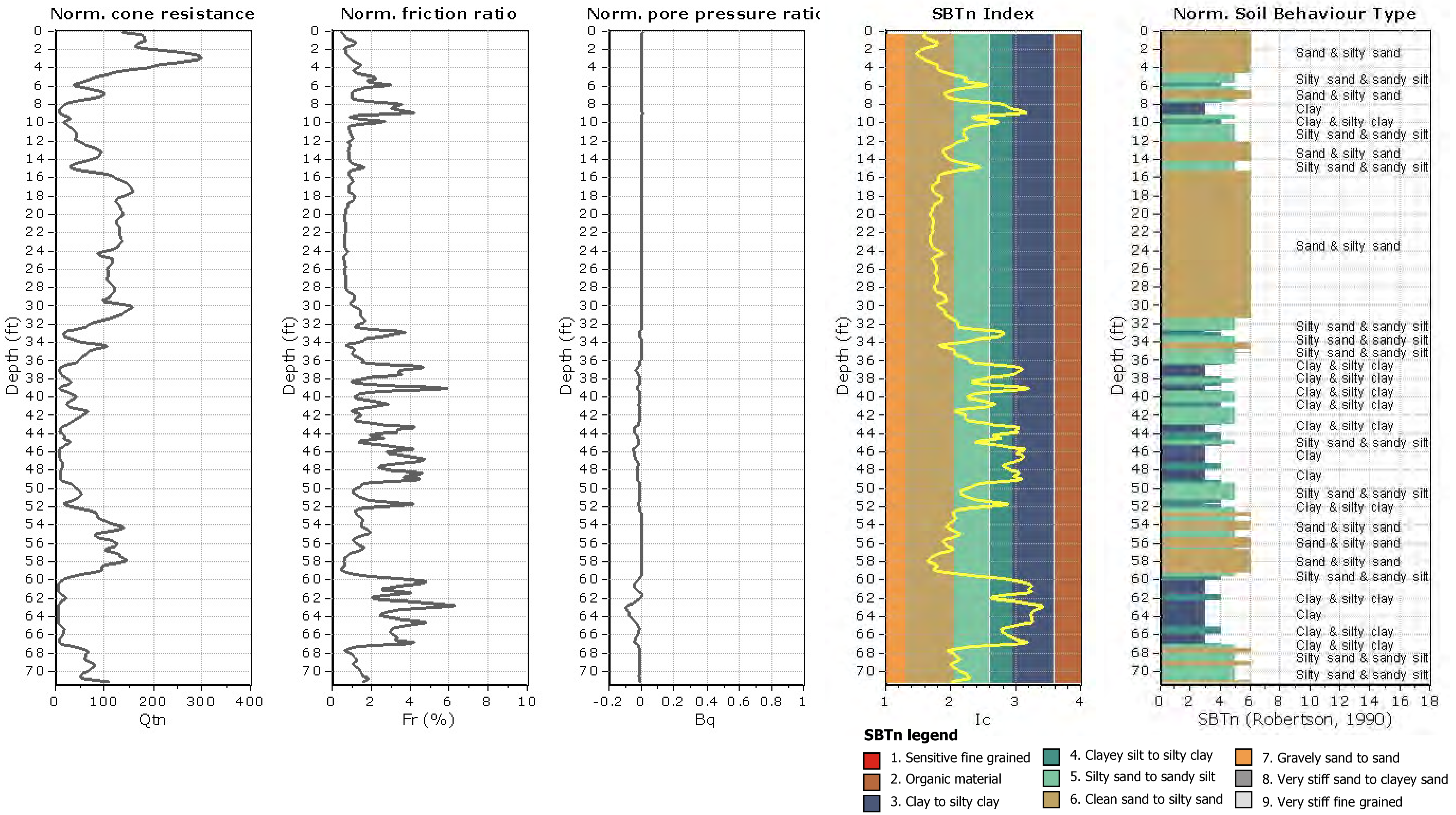
CPT: CPT-32
Total depth: 67.09 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

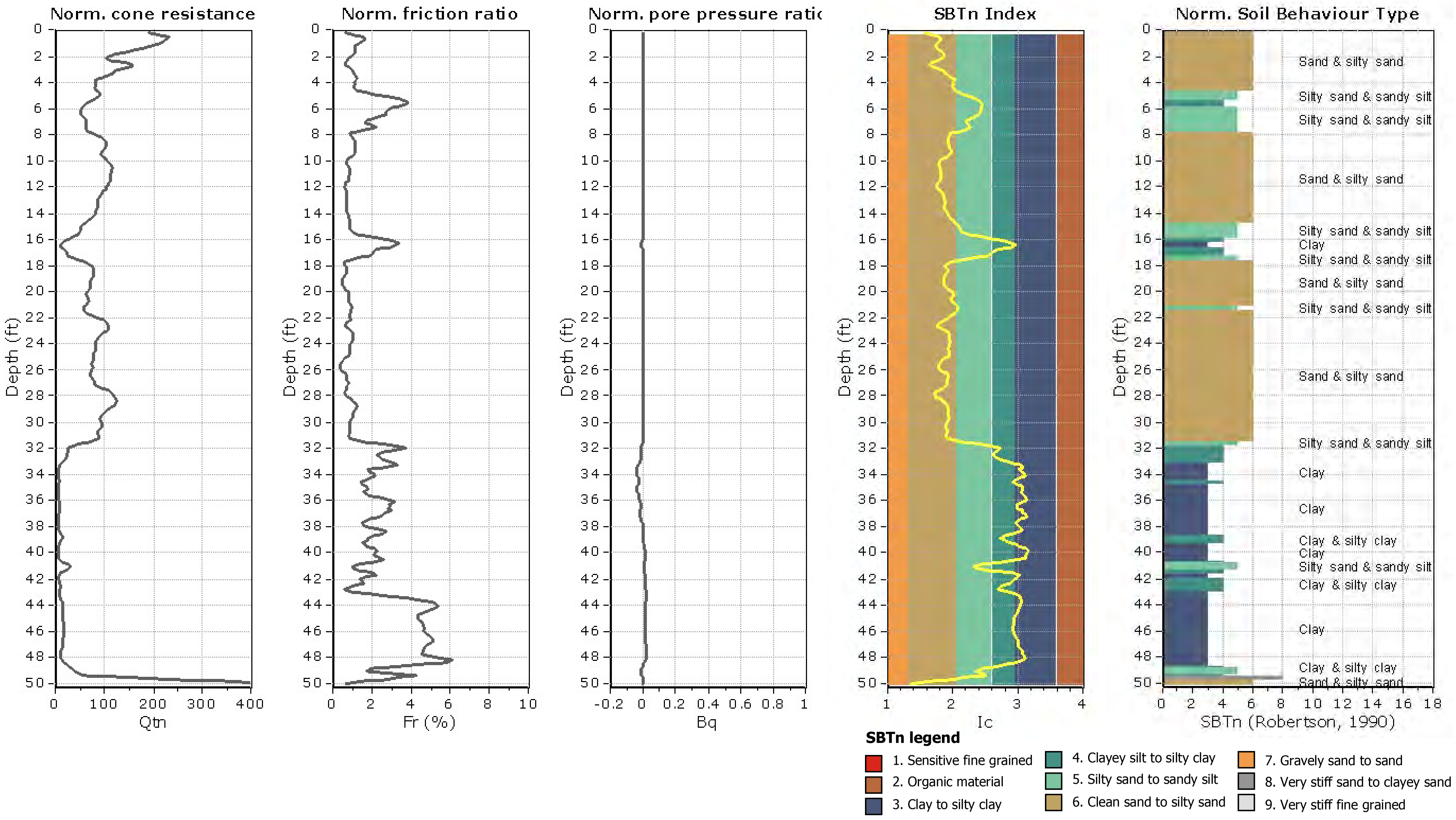
CPT: CPT-33
Total depth: 71.03 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

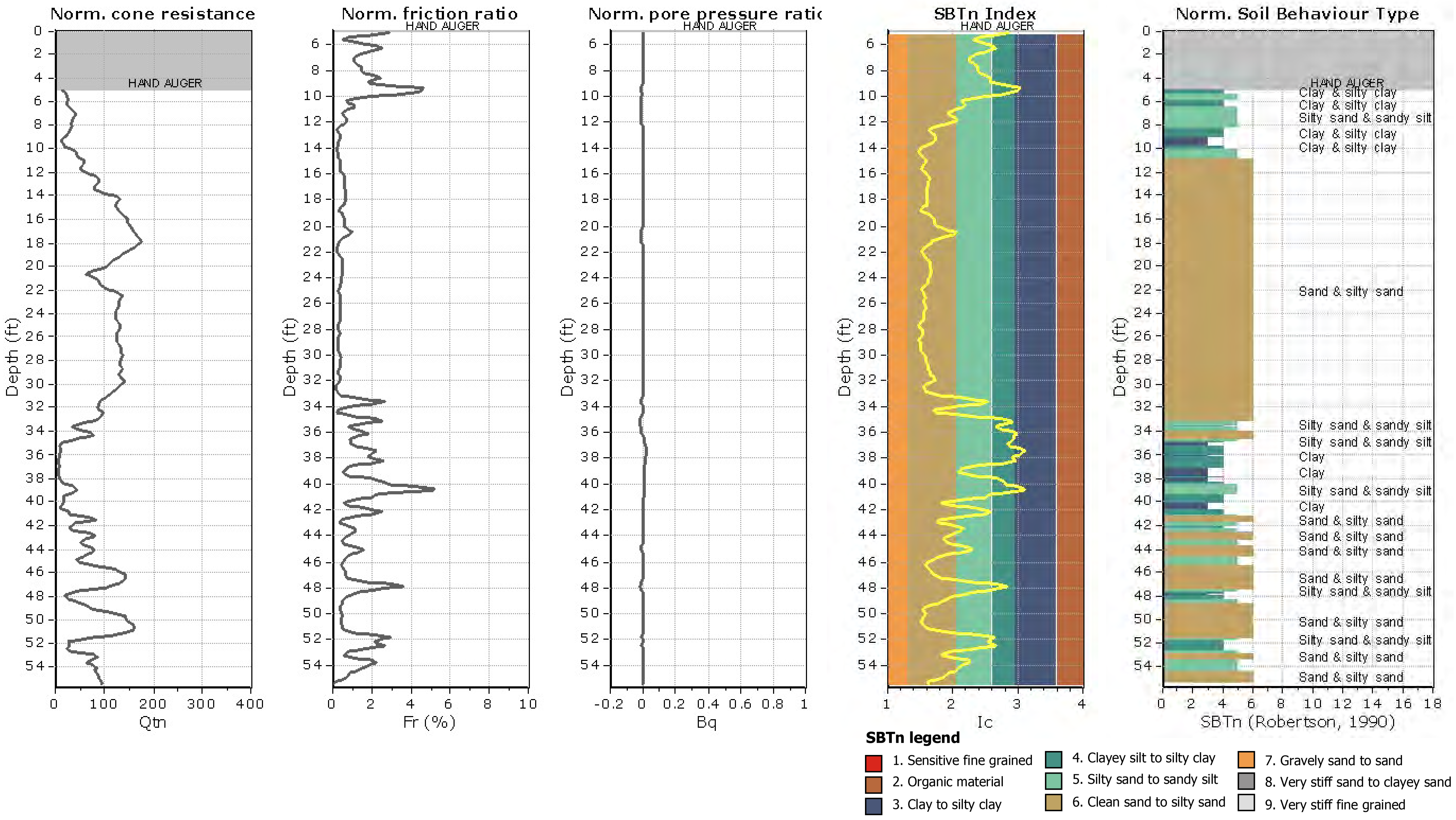
CPT: CPT-34
Total depth: 50.03 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

CPT: CPT-35
Total depth: 55.45 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

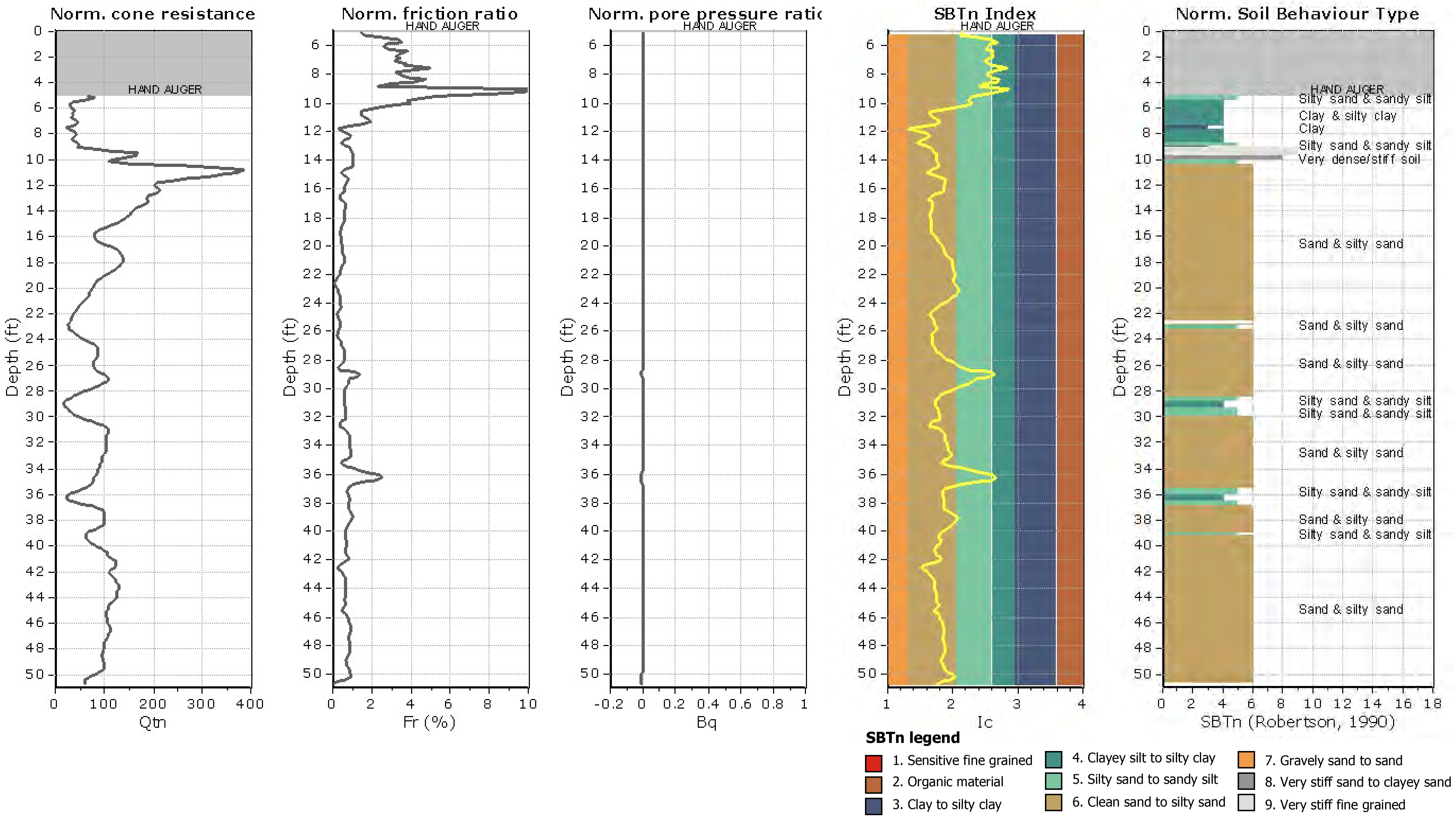


CPeT-IT v.2.0.2.10 - CPTU data presentation & interpretation software - Report created on: 2/26/2019, 5:59:15 PM
Project file: P:\2011\11077-02\CPet-It\170920.cpt

NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

CPT: CPT-36
Total depth: 50.69 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

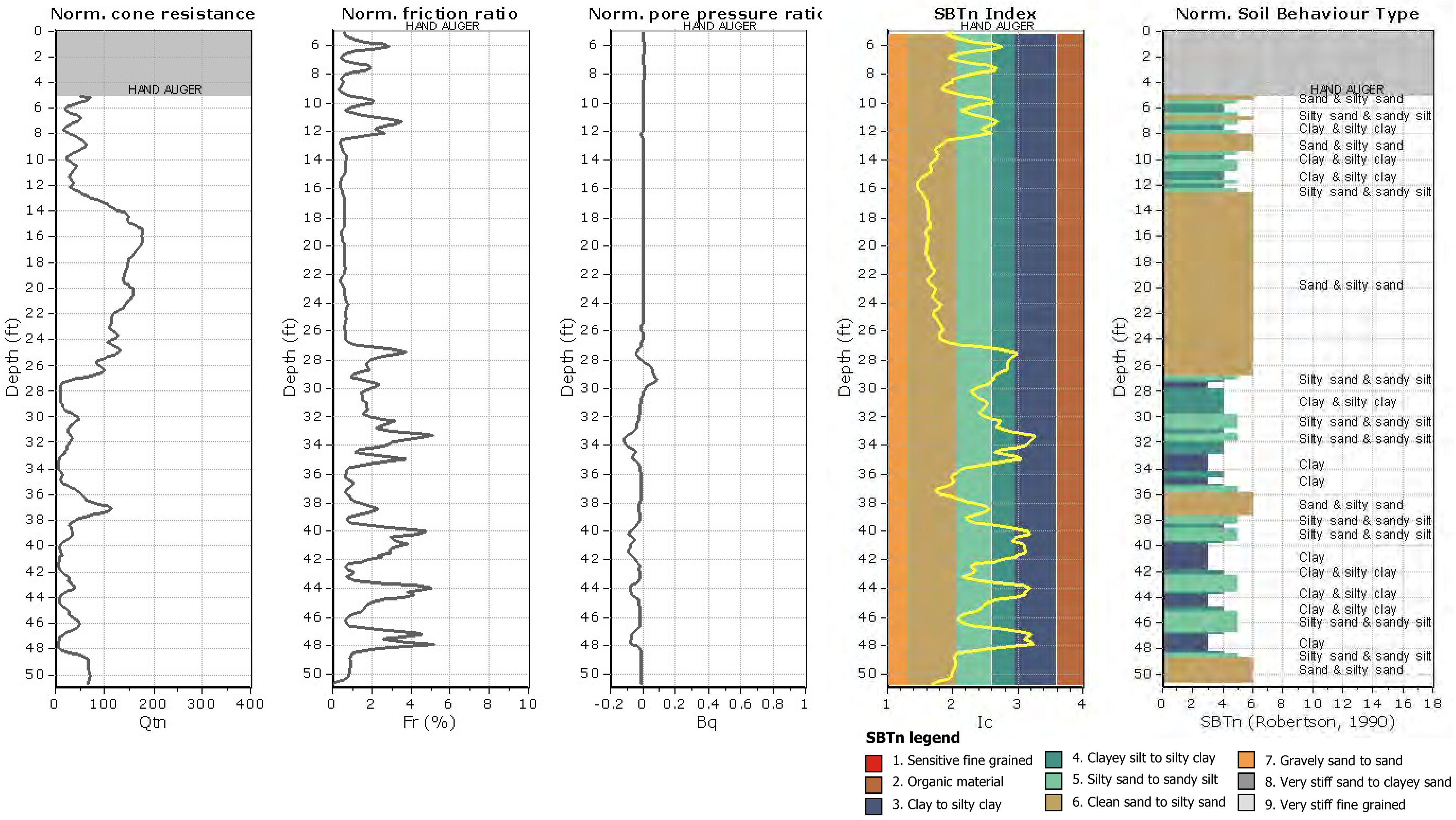


Project file: P:\2011\11077-02\CPet-It\170920.cpt

NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

CPT: CPT-37
Total depth: 50.69 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

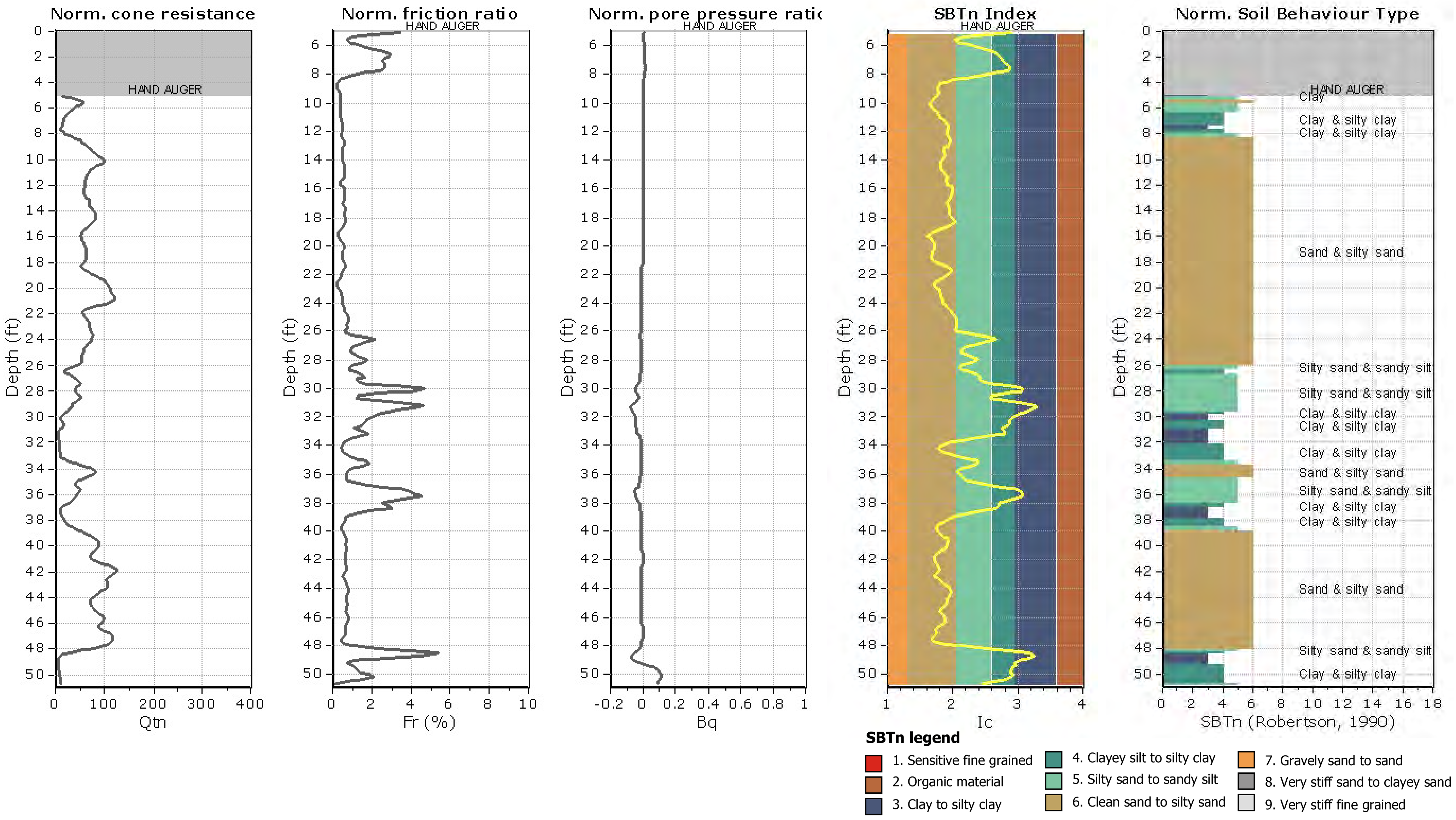


CPeT-IT v.2.0.2.10 - CPTU data presentation & interpretation software - Report created on: 2/26/2019, 5:59:16 PM
Project file: P:\2011\11077-02\CPet-It\170920.cpt

NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

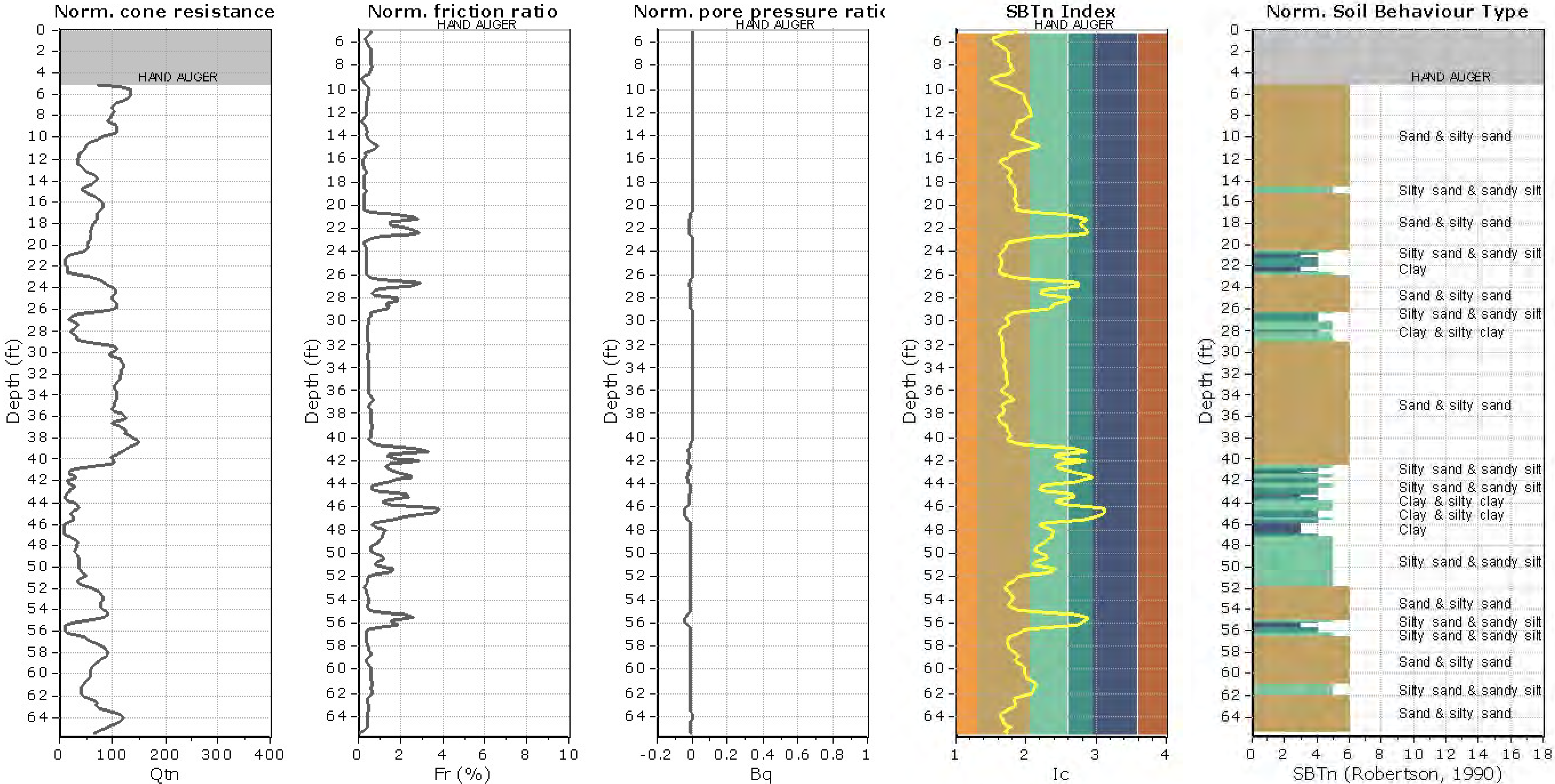
CPT: CPT-38
Total depth: 50.69 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

CPT: CPT-39
Total depth: 65.45 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



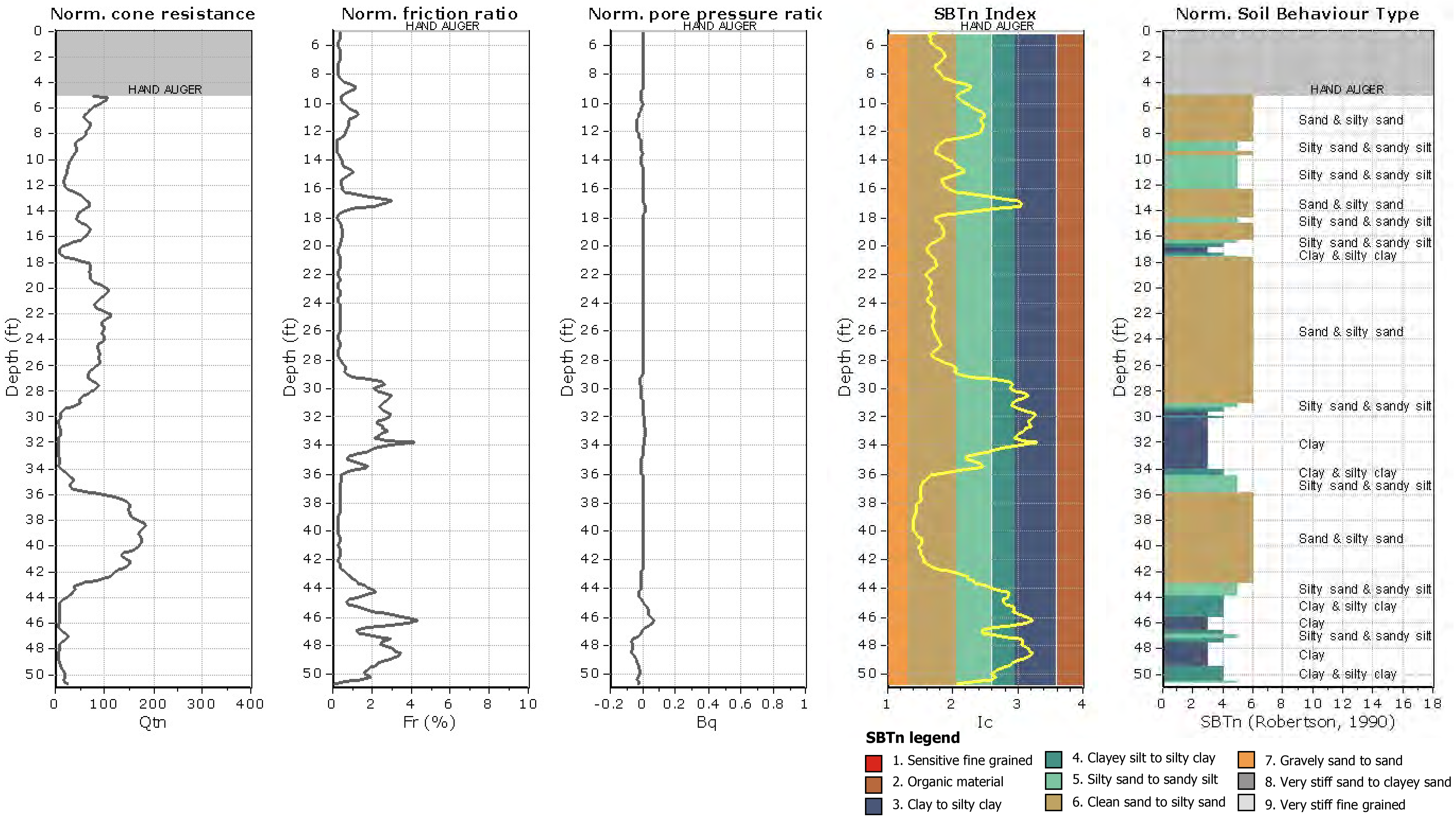
SBTn legend

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

NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

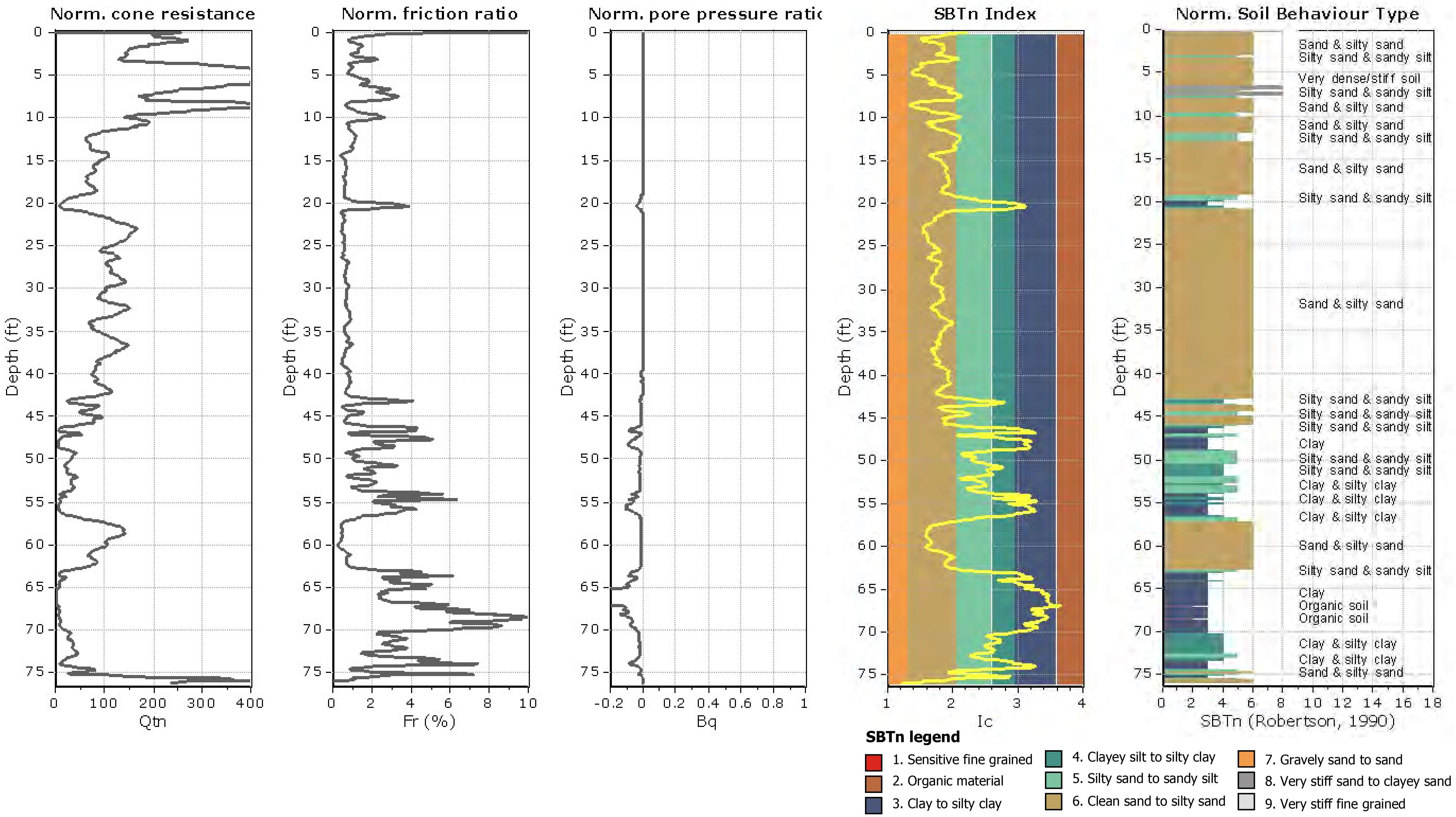
CPT: CPT-40
Total depth: 50.69 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

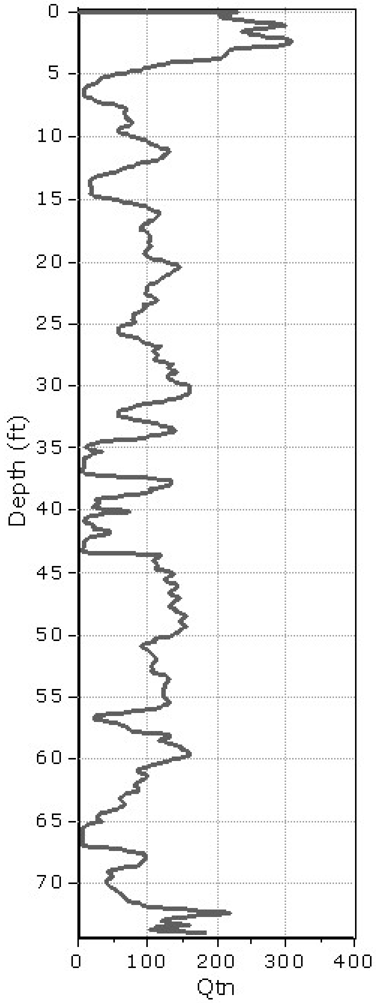
CPT: CPT-41
Total depth: 76.25 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertek
Cone Operator: Kehoe Testing

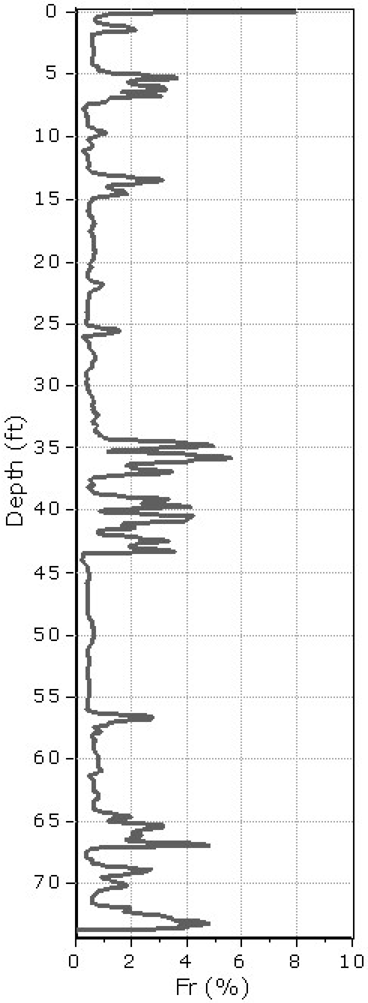


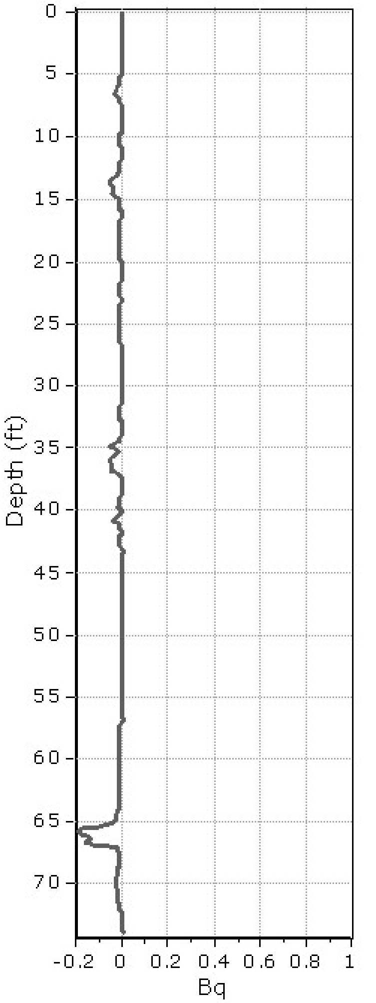
NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

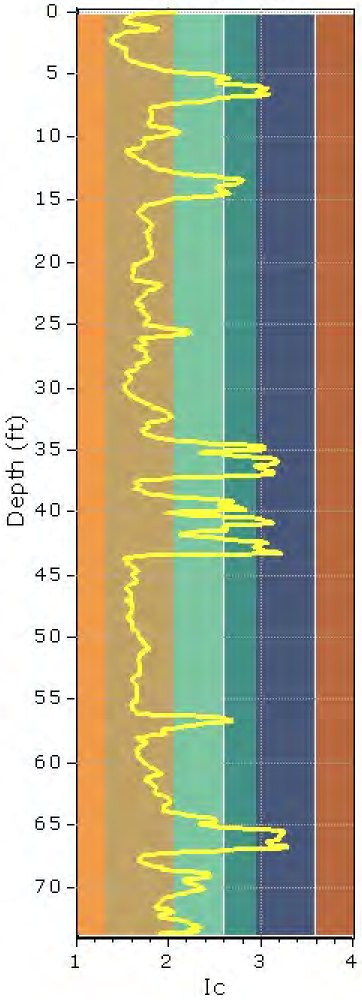
Project: **Riverwalk**
Location: **San Diego, CA**

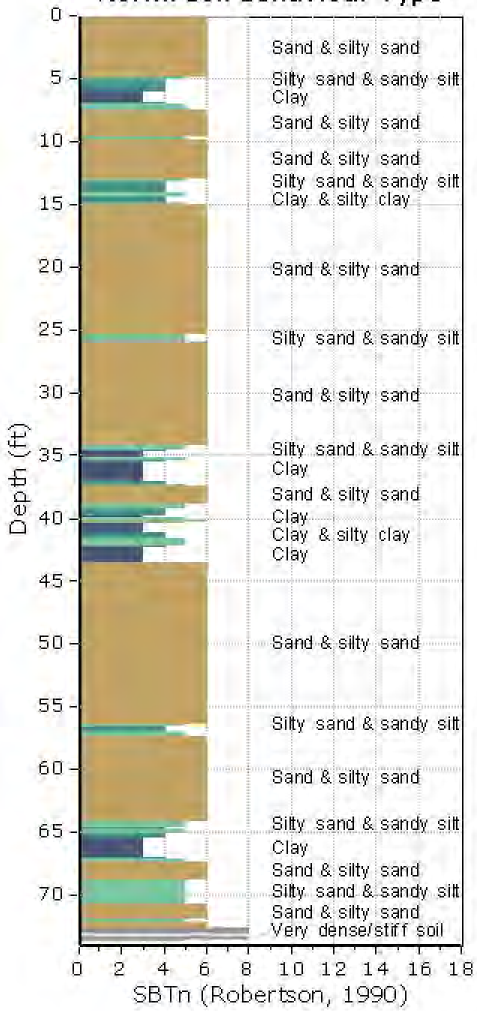
CPT: CPT-42
Total depth: 73.96 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertek
Cone Operator: Kehoe Testing


Norm. cone resistance


Norm. friction ratio


Norm. pore pressure ratio


SBTn Index


Norm. Soil Behaviour Type

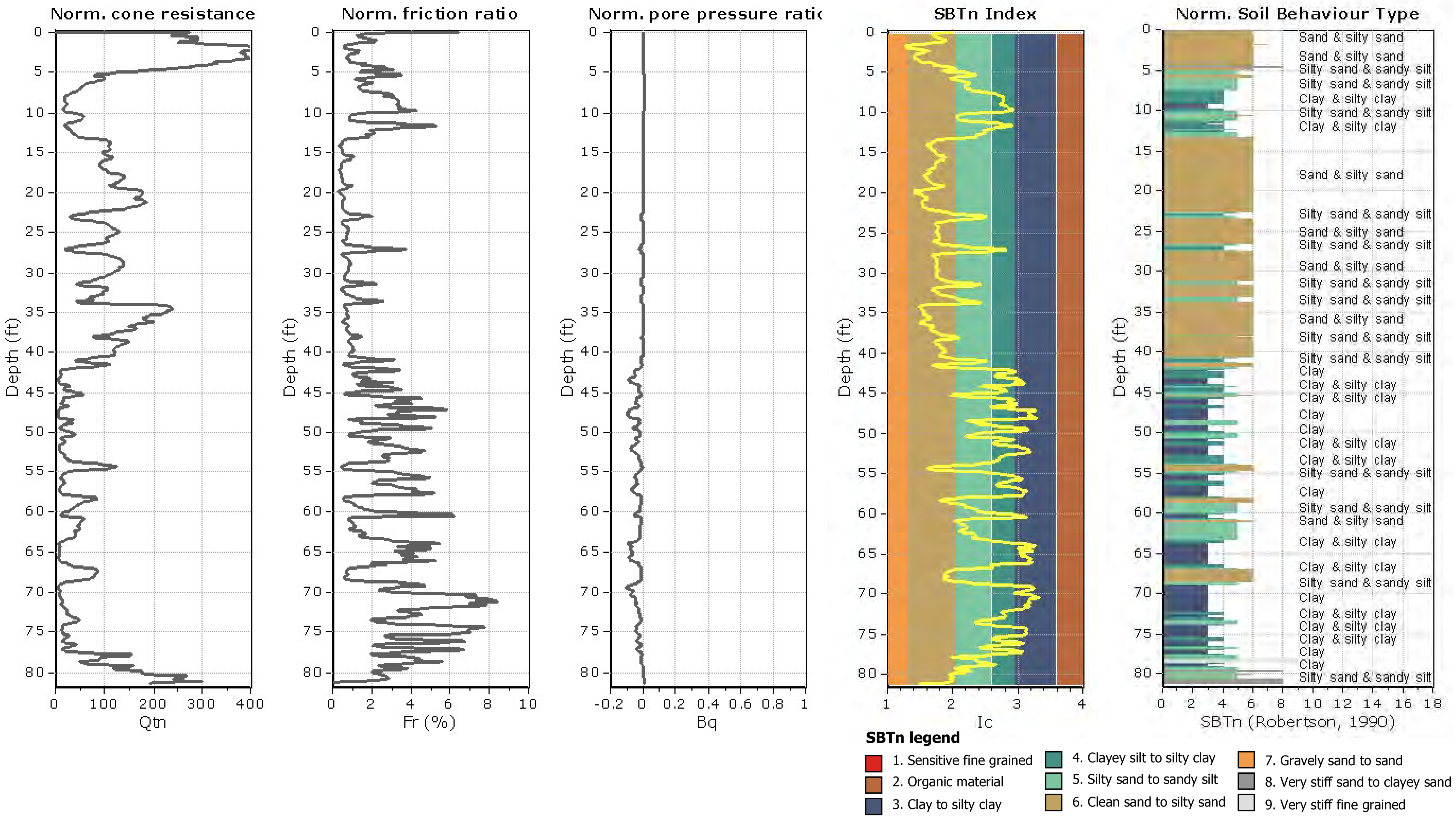
SBTn legend

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

NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

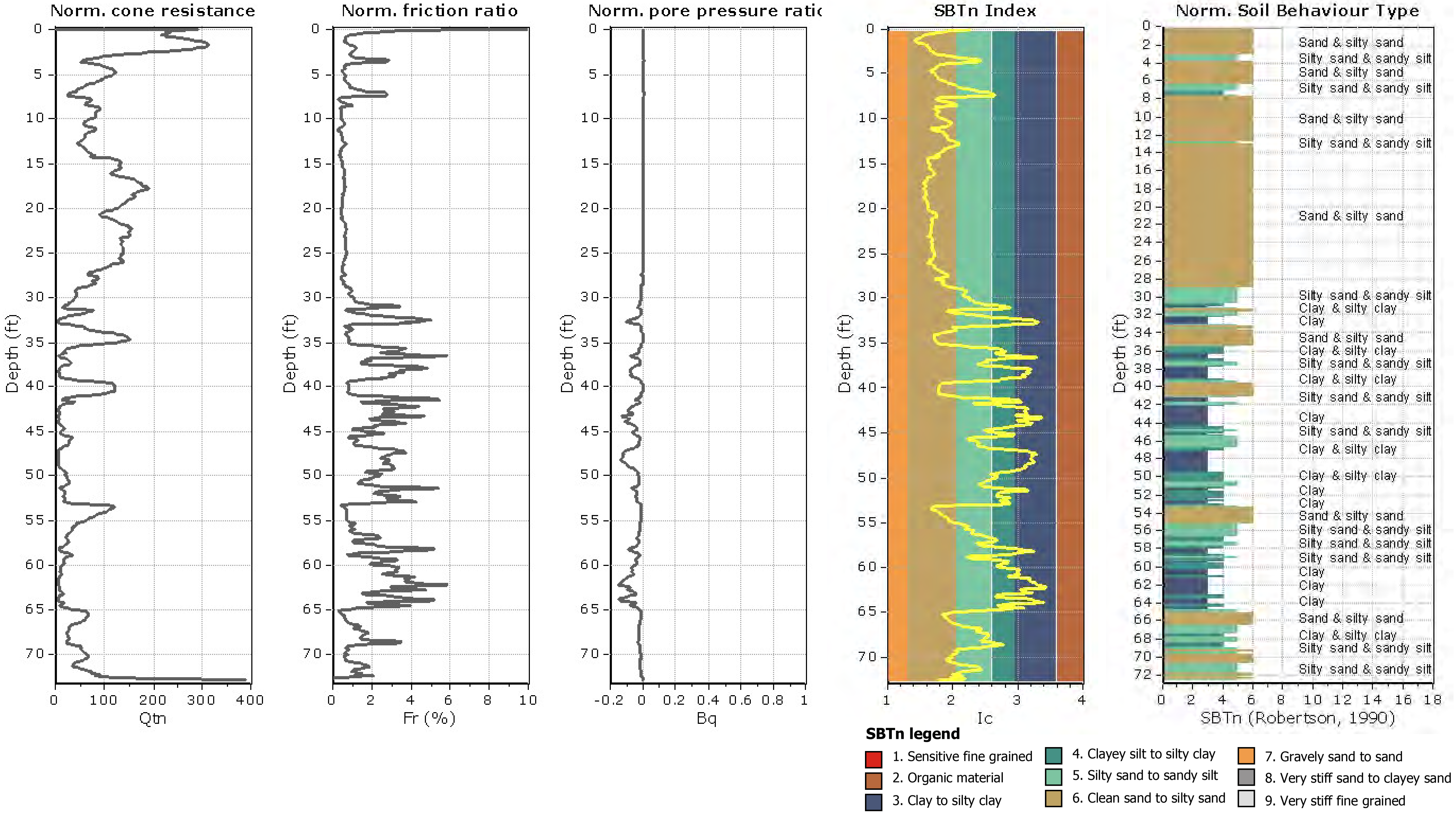
CPT: CPT-43
Total depth: 81.50 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertek
Cone Operator: Kehoe Testing



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

Project: **Riverwalk**
Location: **San Diego, CA**

CPT: CPT-44
Total depth: 72.84 ft, Date: 9/20/2017
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Vertek
Cone Operator: Kehoe Testing



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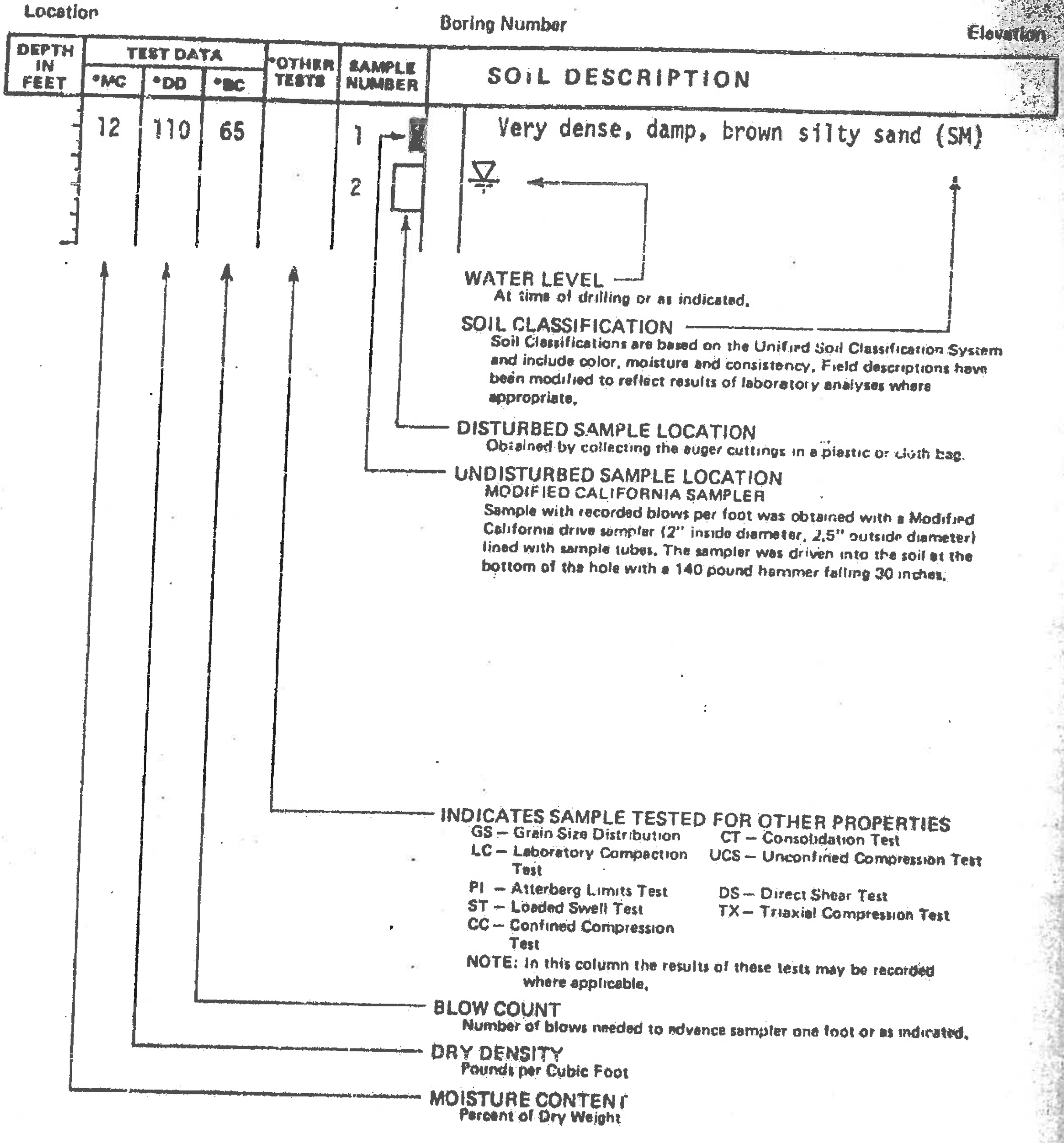
Project file: P:\2011\11077-02\CPet-It\170920.cpt

BORING AND CPT LOGS BY OTHERS

BORING LOGS
BY WOODWARD CLYDE (1975)



WATER LEVEL
At time of drilling or as indicated.

SOIL CLASSIFICATION
Soil Classifications are based on the Unified Soil Classification System and include color, moisture and consistency. Field descriptions have been modified to reflect results of laboratory analyses where appropriate.

DISTURBED SAMPLE LOCATION
Obtained by collecting the auger cuttings in a plastic or cloth bag.

UNDISTURBED SAMPLE LOCATION
MODIFIED CALIFORNIA SAMPLER
Sample with recorded blows per foot was obtained with a Modified California drive sampler (2" inside diameter, 2.5" outside diameter) lined with sample tubes. The sampler was driven into the soil at the bottom of the hole with a 140 pound hammer falling 30 inches.

INDICATES SAMPLE TESTED FOR OTHER PROPERTIES

GS – Grain Size Distribution	CT – Consolidation Test
LC – Laboratory Compaction Test	UCS – Unconfined Compression Test
PI – Atterberg Limits Test	DS – Direct Shear Test
ST – Loaded Swell Test	TX – Triaxial Compression Test
CC – Confined Compression Test	

NOTE: In this column the results of these tests may be recorded where applicable.

BLOW COUNT
Number of blows needed to advance sampler one foot or as indicated.

DRY DENSITY
Pounds per Cubic Foot

MOISTURE CONTENT
Percent of Dry Weight

NOTES ON FIELD INVESTIGATION

1. REFUSAL indicates the inability to extend excavation, practically, with equipment being used in the investigation.

KEY TO LOGS
FRIARS VILLAGE CONDOMINIUMS

DRAWN BY: ALS	CHECKED BY: A.M.	PROJECT NO: 73-240A	DATE: 6-11-75	FIGURE NO: 2

WOODWARD-CLYDE CONSULTA

11 26 2000

Boring 1

W-1

DEPTH IN FEET	TEST DATA *MC	*DD	*BC	*OTHER TESTS	SAMPLE NUMBER	SOIL DESCRIPTION
						Damp, brown silty sand FILL
5						
						Medium dense, damp, dark brown sandy gravel (GM-GW)
10						
						Medium dense, damp, brown clayey sand (SC)
15						Medium dense, damp, brown clayey gravel with interbedded clayey sand (GC)
						Very dense, damp, brown clayey sand (SC)
20	12	123	57	UCS= 7750 LL=28 PI=13	1-1	
25						
						▽ Dense, saturated, brown silty to clayey sand (SM-SC) with gravel
	17	108	26		1-2	
30						grading to silty to sandy gravel (GM)
34						Refusal

*For description of symbols, see Figure 2.

LOG OF TEST BORING 1
FRIARS VILLAGE CONDOMINIUMS

DRAWN BY: ALS	CHECKED BY: [illegible]	PROJECT NO: 73-240A	DATE: 6-11-75	FIGURE NO. [illegible]

WOODWARD-CLYDE CONSULTANTS

W-1

Boring 2

DEPTH IN FEET	TEST DATA			*OTHER TESTS	SAMPLE NUMBER	SOIL DESCRIPTION
	*MC	*DD	*BC			
						Damp, brown silty sand with gravel FILL
5						Dense, damp, brown clayey fine sand (SC) Porous
	12	115	30	GS,CC LL=27 PI=12	2-1	
10						
						Dense, damp, gray-brown fine sandy silt (ML)
15						Dense, damp, brown silty sand with gravel to sandy gravel (SM-GM)
20						
23						Refusal

*For description of symbols, see Figure 2.

LOG OF TEST BORING 2
FRIARS VILLAGE CONDOMINIUMS

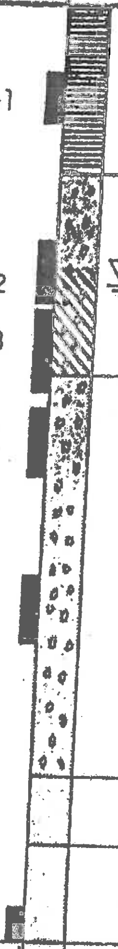
DRAWN BY: ALS	CHECKED BY: [illegible]	PROJECT NO: 73-240A	DATE: 6-11-75	FIGURE NO: [illegible]

WOODWARD-CLYDE CONSULTANTS

11 28 2006

W-3

Boring 3



DEPTH IN FEET	TEST DATA *MC	 *DD	 *BC	*OTHER TESTS	SAMPLE NUMBER	SOIL DESCRIPTION
	17	104	10		3-1	Loose, moist, dark brown fine sandy silt (ML) with micaceous zones
5						
			15		3-2	Loose, saturated, dark brown clayey sand (SC) with some fine gravel ▽ grading to Soft, saturated, gray-brown sandy clay (CL) with gravel Porous
10					3-3	
	9	128	15		3-4	Medium dense, saturated, brown silty sand (SM) with gravel
15						
	14	91	18	GS	3-5	
20						
						Very dense, saturated, brown clayey sand (SC)
25						
	23	103	57		3-6	Very dense, saturated, brown silty fine sand (SM)
28						Bottom of Hole

*For description of symbols, see Figure 2.

LOG OF TEST BORING 3
FRIARS VILLAGE CONDOMINIUMS

DRAWN BY: ALS | CHECKED BY: | PROJECT NO: 73-240A | DATE: 6-11-75 | FIGURE NO: 5

WOODWARD-CLYDE CONSULTANTS

Boring 4

W-4

DEPTH IN FEET	TEST DATA *MC	*DD	*BC	*OTHER TESTS	SAMPLE NUMBER	SOIL DESCRIPTION
						Loose, damp, dark brown fine sandy silt with gravel (ML)
5						Loose, damp, brown silty fine sand (SM)
						Loose, moist, dark brown fine sandy silt (ML)
						grading to sandy to silty clay (CL-ML)
10						
	29				4-1a	
	35	86		GS,CT LL=33 PI= 9	4-1b	
13						Bottom of Hole

Boring 5

W-5

DEPTH IN FEET	TEST DATA *MC	*DD	*BC	*OTHER TESTS	SAMPLE NUMBER	SOIL DESCRIPTION
						Loose to medium dense, damp, brown silty fine sand (SM) with gravel
5						
6						Refusal

*For description of symbols, see Figure 2.

LOGS OF TEST BORINGS 4 AND 5
FRIARS VILLAGE CONDOMINIUMS

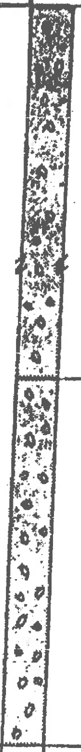
DRAWN BY: ALS | **CHECKED BY:** | **PROJECT NO:** 73-240A | **DATE:** 6-11-75 | **FIGURE NO:**

WOODWARD-CLYDE CONSULTANTS

Boring 6

W-6

DEPTH IN FEET	TEST DATA *MC	*DD	*BC	*OTHER TESTS	SAMPLE NUMBER	SOIL DESCRIPTION
						Loose to medium dense, damp, brown silty sand (SM) with gravel
5						
15						
						Very dense, saturated, brown sandy gravel (GM)
20						
25						
27						Bottom of Hole



*For description of symbols, see Figure 2.

LOG OF TEST BOIRNG 6
FRIARS VILLAGE CONDOMINIUMS

DRAWN BY: ALS | CHECKED BY: | PROJECT NO: 73-240A | DATE: 6-11-75 | FIGURE NO: 7

WOODWARD-CLYDE CONSULTANTS

W-7

Boring 7

DEPTH IN FEET	TEST DATA *MC	TEST DATA *DD	TEST DATA *BC	*OTHER TESTS	SAMPLE NUMBER	SOIL DESCRIPTION
						Damp, brown sandy gravel FILL
5						Medium dense to dense, damp to moist, brown sandy gravel (GM)
10					7-3	Medium dense, damp, gray-brown fine sandy silt (ML)
			28		7-1	Firm to stiff, moist, brown sandy clay (CL)
15						Medium dense, saturated, red-brown clayey fine sand (SC) ▽
19	16	118	16	GS	7-2	
						Bottom of Hole

*For description of symbols, see Figure 2.

LOG OF TEST BOIRNG 7
FRIARS VILLAGE CONDOMINIUMS

DRAWN BY: ALS | CHECKED BY: | PROJECT NO: 73-240A | DATE: 6-11-75 | FIGURE NO: [illegible]

WOODWARD-CLYDE CONSULTANTS

BORING LOGS
BY LEIGHTON & ASSOCIATES (1995, 1997)

GEOTECHNICAL BORING LOG LB-1

Date 11-10-95

Sheet 1 of 2

Project Stardust Golf Course

Project No. 4950109-002

Drilling Co. Barge's Drilling Service

Type of Rig Hollow-Stem Auger

Hole Diameter 8 in.

Drive Weight 140 pounds

Drop 30 in.

Elevation Top of Hole +/- 20 ft.

Ref. or Datum Mean Sea Level

Logged By KBC

Sampled By KBC

Elevation (feet)	Depth (feet)	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
20	0							SM	QUATERNARY ALLUVIUM @ 0': Light brown, damp, loose, silty fine to medium SAND; rootlets common
				1 Bag-2 @2'-5'	37			SW	@ 2': Very light brown, moist, medium dense, medium to coarse SAND; micaceous
				3	11	92.5	10.9		@ 4': Light brown, wet, loose, fine to coarse SAND; highly micaceous
15	5								
				4	4		▽	SP	@ 6': Light brown, saturated, very loose, coarse SAND; micaceous
				5	15				@ 8': Light brown, saturated, loose to medium dense, coarse SAND; few rootlets
10	10			6	14			SW	@ 10': Gray-brown, saturated, loose, medium to coarse SAND; micaceous
5	15			7	18				@ 15': Gray-brown, saturated, medium dense, medium to very coarse SAND; micaceous
0	20			8	23	101.1	26.3		@ 20': Gray-brown, saturated, medium dense, medium to coarse SAND; few very fine gravels; micaceous
-5	25			9	27				@ 25': Gray, saturated, medium dense, medium to coarse SAND; micaceous
-10	30								

505A(11/77)

LEIGHTON & ASSOCIATES

GEOTECHNICAL BORING LOG LB-1

Date 11-10-95
Project Stardust Golf Course
Drilling Co. Barge's Drilling Service
Hole Diameter 8 in.
Drive Weight 140 pounds
Elevation Top of Hole +/- 20 ft.
Ref. or Datum Mean Sea Level
Sheet 2 of 2
Project No. 4950109-002
Type of Rig Hollow-Stem Auger
Drop 30 in.

GEOTECHNICAL DESCRIPTION

Logged By KBC
Sampled By KBC

Elevation (feet)	Depth (feet)	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	Geotechnical Description
-10	30			10	36			SW	<u>QUATERNARY ALLUVIUM Continued</u> @ 30': Gray, saturated, medium dense, fine to medium SAND; micaceous
-15	35			11	35				@ 35': Gray, saturated, dense, fine to medium SAND; micaceous
-20	40			12	28				@ 40': Gray, saturated, medium dense, fine to medium SAND; micaceous
									Total Depth = 41 Feet Ground Water Encountered at 6-1/2 Feet Backfilled on November 10, 1995
-25	45								
-30	50								
-35	55								
-40	60								

GEOTECHNICAL BORING LOG LB-2

Date 11-10-95
Project Stardust Golf Course
Drilling Co. Barge's Drilling Service
Hole Diameter 8 in.
Drive Weight 140 pounds
Elevation Top of Hole +/- 25 ft.
Ref. or Datum Mean Sea Level
Sheet 1 of 1
Project No. 4950109-002
Type of Rig Hollow-Stem Auger
Drop 30 in.

GEOTECHNICAL DESCRIPTION

Logged By KBC
Sampled By KBC

Elevation (feet)	Depth (feet)	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
25	0							SM	ARTIFICIAL FILL @ 0': Brown, damp, loose, silty, very fine SAND; organic rich @ 1': Large cobbles encountered @ 1-1/2': Light brown, damp, medium dense, fine to coarse gravelly, silty, fine to medium SAND; rootlets common
								GM	
20	5								
				1	26				
				2 Bag-3 @8'-11'	25			ML/SM	QUATERNARY ALLUVIUM @ 8': Gray-brown, moist, medium dense, fine sandy SILT to silty fine SAND; very micaceous, rootlets common
15	10			4	32			SM	@ 10': Light brown, moist, medium dense, gravelly, silty fine SAND; micaceous
10	15			5	16/6"		▽		@ 15': Cobbles common
5	20								Total Depth = 18-1/2 Feet Ground Water Encountered at 16 Feet Backfilled on November 10, 1995
0	25								
-5	30								

LB-1a

GEOTECHNICAL BORING LOG B-1

Date 4-3-97

Project Stardust Golf Course Bridge Abutments

Drilling Co. Barges Drilling Service

Hole Diameter 8 in.

Drive Weight 140 pounds

Elevation Top of Hole +/- 20 ft.

Ref. or Datum Mean Sea Level

Sheet 1 of 3

Project No. 4950109-003

Type of Rig Hollow-Stem Auger

Drop 30 in.

GEOTECHNICAL DESCRIPTION

Logged By KAB

Sampled By KAB

Elevation (feet)	Depth (feet)	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	Geotechnical Description
20	0							SM/ML	QUATERNARY ALLUVIUM (Qal) @0': Gray-brown, damp to moist, fine to medium sandy SILT to very silty SAND, micaceous
15	5			1	42			ML	@ 5': Gray to brown, moist, dense, fine sandy SILT, very micaceous
							∇		@ 8': Ground water encountered
10	10			2	16			SM	@ 10': Dark gray, saturated, medium dense, silty, medium to coarse SAND
5	15			3	22				@ 15': Dark gray, saturated, medium dense, silty fine to coarse SAND; slightly micaceous
0	20			4	28				@ 20': As at 15 feet
-5	25			5	20				@ 25': As at 20 feet
-10	30								

505A(11/77)

LEIGHTON & ASSOCIATES

GEOTECHNICAL BORING LOG B-1

Date 4-3-97
Project Stardust Golf Course Bridge Abutments
Drilling Co. Barges Drilling Service
Hole Diameter 8 in.
Drive Weight 140 pounds
Elevation Top of Hole +/- 20 ft.
Ref. or Datum Mean Sea Level

Sheet 2 of 3
Project No. 4950109-003
Type of Rig Hollow-Stem Auger
Drop 30 in.

GEOTECHNICAL DESCRIPTION

Logged By KAB
Sampled By KAB

Elevation (feet)	Depth (feet)	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	Geotechnical Description
-10	30			6	10			SM	QUATERNARY ALLUVIUM (Qal) Continued @ 30': Dark gray to light gray, saturated, loose, silty, fine to medium, micaceous SAND with black silt at 3' of tip of sample
-15	35			7	23				@ 35': Dark gray, saturated, medium dense, silty, medium SAND
-20	40			8	15			ML	@ 40': Dark gray to black, saturated, medium dense, fine sandy SILT, very micaceous
-25	45			9	21				@ 45': As at 40 feet
-30	50			10	19			ML	@ 50': Dark gray to black wet to saturated, medium dense to stiff, fine sandy SILT with interbedded stiff black silty clay; very micaceous
-35	55			11	50/5"				
-40	60								

GEOTECHNICAL BORING LOG B-1

Date 4-3-97
Project Stardust Golf Course Bridge Abutments
Drilling Co. Barges Drilling Service
Hole Diameter 8 in.
Drive Weight 140 pounds
Elevation Top of Hole +/- 20 ft.
Ref. or Datum Mean Sea Level

Sheet 3 of 3
Project No. 4950109-003
Type of Rig Hollow-Stem Auger
Drop 30 in.

GEOTECHNICAL DESCRIPTION

Logged By KAB
Sampled By KAB

Elevation (feet)	Depth (feet)	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
-40	60	▨		12	33			SM	<u>QUATERNARY ALLUVIUM (Qal) Continued</u> @ 60': Dark gray, wet, medium dense to dense, silty fine to medium SAND
									Total Depth = 61'6" Ground Water Encountered at 8' Backfilled: 4/3/97
-45	65								
-50	70								
-55	75								
-60	80								
-65	85								
-70	90								

LB-2a

GEOTECHNICAL BORING LOG B-2

Date 4-3-97
Project Stardust Golf Course Bridge Abutments
Drilling Co. Barges Drilling Service
Hole Diameter 8 in.
Drive Weight 140 pounds
Elevation Top of Hole +/- 21 ft.
Ref. or Datum Mean Sea Level

Sheet 1 of 3
Project No. 4950109-003
Type of Rig Hollow-Stem Auger
Drop 30 in.

GEOTECHNICAL DESCRIPTION

Logged By KAB
Sampled By KAB

Elevation (feet)	Depth (feet)	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
20	0							SM	ARTIFICIAL FILL (Af) @ 0': Gray, moist, loose, silty fine to coarse SAND
15	5			1	18			SM	QUATERNARY ALLUVIUM (Qal) @ 5': Tan to light gray, damp, medium dense, silty fine to medium SAND
							▽		@ 8': Ground water encountered
10	10			2	15				@ 10': Brown to olive-brown, wet, medium dense, silty, fine to medium SAND
5	15			3	22			SW	@ 15': Olive green-gray, wet, medium dense, fine to coarse SAND, trace of silt
0	20			4	20				@20': As at 15' fine to medium SAND
-5	25			5	18				@ 25': No recovery but material in spoils is essentially as in 20'
	30								

GEOTECHNICAL BORING LOG B-2

Date 4-3-97
Project Stardust Golf Course Bridge Abutments
Drilling Co. Barges Drilling Service
Hole Diameter 8 in. Drive Weight 140 pounds
Elevation Top of Hole +/- 21 ft. Ref. or Datum Mean Sea Level

Sheet 2 of 3
Project No. 4950109-003
Type of Rig Hollow-Stem Auger
Drop 30 in.

GEOTECHNICAL DESCRIPTION

Logged By KAB
Sampled By KAB

Elevation (feet)	Depth (feet)	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	Geotechnical Description
	30			6	36			SM/ML	QUATERNARY ALLUVIUM (Qal) Continued @ 30': Dark olive-green, wet, dense, fine sandy SILT to silty fine SAND; very micaceous
-10									
	35			7	18			ML	@ 35': Dark olive-green, wet, medium dense, sandy SILT
-15									
	40			8	22			SM/ML	@ 40': Dark gray to light gray, wet, medium dense, thinly bedded, fine to medium SAND and fine sandy SILT
-20									
	45			9	46				@ 45': As at 40'
-25									
	50			10	39			SM	@ 50': Dark gray to olive-gray, wet, dense, silty fine to medium SAND
-30									
	55			11	50/5"	105.7	24.5		@ 55': As at 50', ring sample taken
-35									
	60								

GEOTECHNICAL BORING LOG B-2

Date 4-3-97

Project Stardust Golf Course Bridge Abutments

Drilling Co. Barges Drilling Service

Hole Diameter 8 in.

Drive Weight 140 pounds

Elevation Top of Hole +/- 21 ft.

Ref. or Datum Mean Sea Level

Sheet 3 of 3

Project No. 4950109-003

Type of Rig Hollow-Stem Auger

Drop 30 in.

GEOTECHNICAL DESCRIPTION

Logged By KAB

Sampled By KAB

Elevation (feet)	Depth (feet)	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
-40	60	▨		12	50/5"			SW	QUATERNARY ALLUVIUM (Qal) Continued @ 60': Light gray to dark gray, wet, dense, fine to coarse SAND (rock in tip of sampler)
									Total Depth = 61'6" Ground Water Encountered at 8' Backfilled: 4/3/97
-45	65								
-50	70								
-55	75								
-60	80								
-65	85								
	90								

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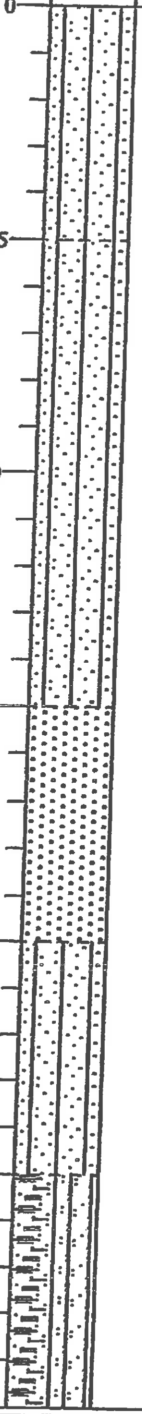
LEIGHTON & ASSOCIATES

LB-3a

GEOTECHNICAL BORING LOG B-3

Date 4-8-97
Project Stardust Golf Course Bridge Abutments
Drilling Co. Barges Drilling Service
Hole Diameter 8 in.
Drive Weight 140 pounds
Elevation Top of Hole +/- 22 ft.
Ref. or Datum Mean Sea Level

Sheet 1 of 3
Project No. 4950109-003
Type of Rig Hollow-Stem Auger
Drop 30 in.



GEOTECHNICAL DESCRIPTION

Logged By KAB
Sampled By KAB

Elevation (feet)	Depth (feet)	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
	0							SM	ARTIFICIAL FILL (Af) @ 0': Light brown, dry, loose, silty fine to medium SAND
20									
	5			1	42			SM	QUATERNARY ALLUVIUM (Qal) @ 5': Olive green-gray to brown, moist, dense, silty, fine to medium SAND
15									
							▽		@ 8': Ground water encountered
	10			2	28				@ 10': Brown, wet, medium dense, silty, fine to medium SAND
10									
	15			3	22			SW	@ 15': Olive-gray, saturated, medium dense, silty, fine to coarse SAND, very micaceous, trace of silt
5									
	20			4	37			SM	@ 20': Brown, well, dense, silty, fine to coarse SAND
0									
	25			5	70			SW-SM	@ 25': Brown, wet, very dense, fine to coarse SAND, trace of silt
-5									
	30								

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LEIGHTON & ASSOCIATES

GEOTECHNICAL BORING LOG B-3

Date 4-8-97
Sheet 2 of 3
Project Stardust Golf Course Bridge Abutments
Project No. 4950109-003
Drilling Co. Barges Drilling Service
Type of Rig Hollow-Stem Auger
Hole Diameter 8 in.
Drive Weight 140 pounds
Drop 30 in
Elevation Top of Hole +/- 22 ft.
Ref. or Datum Mean Sea Level

Logged By KAB
Sampled By KAB

Elevation (feet)	Depth (feet)	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
	30			6	36			SW-ML	QUATERNARY ALLUVIUM (Qal) Continued @ 30': Olive-gray to light brown, wet, dense, interbedded SILT and medium to coarse SAND
-10									
	35			7	32				@ 35': No sample recovered
-15									
	40			8	6			ML	@ 40': Gray to black, saturated, medium dense, to loose fine sandy SILT
-20									
	45			9	25			SM	@ 45': Very dark gray, wet to saturated, medium dense to dense, silty fine to coarse SAND
-25									
	50			10	21			SW	@ 50': Olive-green, wet, medium dense, fine to coarse SAND
-30									
	55			11	30			SM	@ 55': Boring heaving, difficult drilling, olive-gray, wet, medium dense, silty fine SAND
-35									
	60								

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LEIGHTON & ASSOCIATES

GEOTECHNICAL BORING LOG B-3

Date 4-8-97

Project Stardust Golf Course Bridge Abutments

Drilling Co. Barges Drilling Service

Hole Diameter 8 in.

Drive Weight 140 pounds

Elevation Top of Hole +/- 22 ft.

Ref. or Datum Mean Sea Level

Sheet 3 of 3

Project No. 4950109-003

Type of Rig Hollow-Stem Auger

Drop 30 in.

GEOTECHNICAL DESCRIPTION

Logged By KAB

Sampled By KAB

Elevation (feet)	Depth (feet)	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	Geotechnical Description
	60			12	28	105.0	25.1	SW	QUATERNARY ALLUVIUM (Qal) Continued @ 60': Olive-gray, saturated, medium dense, fine to medium SAND
-40									
	65			13	52/6"				@ 65': Gray, wet, dense to very dense, fine to coarse gravelly SAND
-45									
	70			14	75				@ 70': Very dark gray, wet, very dense medium SAND with scattered gravel
-50									
	75			15	89				@ 75': As in 70' sample
-55									
	80			16	50/5"				@ 80': Gray, wet, very dense, fine to coarse gravelly SAND
-60									@ 82': Refusal Total Depth = 82' Ground Water Encountered at 10' Backfilled: 4/8/97
	85								
-65									
	90								

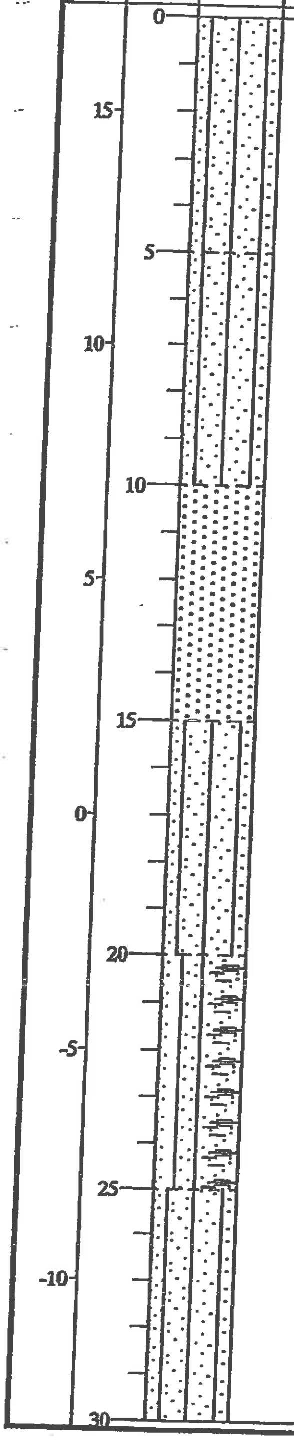
LB-4a

GEOTECHNICAL BORING LOG B-4

Date 4-8-97
Project Stardust Golf Course Bridge Abutments
Drilling Co. Barges Drilling Service
Hole Diameter 8 in.
Elevation Top of Hole +/- 17 ft.
Drive Weight 140 pounds
Ref. or Datum Mean Sea Level
Sheet 1 of 3
Project No. 4950109-003
Type of Rig Hollow-Stem Auger
Drop 30 in.

GEOTECHNICAL DESCRIPTION

Logged By KAB
Sampled By KAB



Depth (feet)	Notes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	Geotechnical Description
0						SM	**ARTIFICIAL FILL (Af)** @ 0': Loose, dry, brown, silty SAND; very micaceous
5		1	29			SM	**QUATERNARY ALLUVIUM (Qal)** @ 5': Damp, medium dense, silty fine SAND
9					▽		@ 9': Ground water encountered
10		2	4			SW	@ 10': Tan to light gray, loose, fine to coarse SAND; slightly micaceous, trace of silt
15		3	23			SM	@ 15': Gray, wet, medium dense, silty fine to coarse SAND
20		4	40			SM-SW	@ 20': Dark gray, wet, dense, fine to medium SAND to silty SAND
25		5	22			SM	@ 25': Dark gray, wet, medium dense to dense, silty fine to coarse SAND with silt lens 3-10 cm thick in sample tube

505A(11/77)

LEIGHTON & ASSOCIATES

GEOTECHNICAL BORING LOG B-4

Date 4-8-97

Project Stardust Golf Course Bridge Abutments

Drilling Co. Barges Drilling Service

Hole Diameter 8 in.

Drive Weight 140 pounds

Elevation Top of Hole +/- 17 ft.

Ref. or Datum Mean Sea Level

Sheet 2 of 3

Project No. 4950109-003

Type of Rig Hollow-Stem Auger

Drop 30 in.

GEOTECHNICAL DESCRIPTION

Logged By KAB

Sampled By KAB

Elevation (feet)	Depth (feet)	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
	30			6	28			SW	QUATERNARY ALLUVIUM (Qal) Continued @ 30': Olive-gray, wet, medium dense to dense, fine to medium SAND, trace of silt
-15									
	35			7	20			SM	@ 35': 10-15cm thick, black silt layer, interbedded with fine SAND
-20									
	40			8	32	107.5	22.7	SW	@ 40': Light gray, wet, medium dense, fine to medium SAND
-25									
	45			9	14			SM	@ 45': Olive-gray, saturated, medium dense, silty, fine to medium SAND with scattered gravel clasts
-30									
	50			10	39/5"			SM	@ 50': Gray, wet, silty, fine to medium SAND (rock in sample tip)
-35									
	55			11	37			SW	@ 55': Gray, wet, dense, fine to medium SAND
-40									
	60								

GEOTECHNICAL BORING LOG B-4

Date 4-8-97
Project Stardust Golf Course Bridge Abutments
Drilling Co. Barges Drilling Service
Hole Diameter 8 in.
Elevation Top of Hole +/- 17 ft.
Drive Weight 140 pounds
Ref. or Datum Mean Sea Level
Sheet 3 of 3
Project No. 4950109-003
Type of Rig Hollow-Stem Auge
Drop 30 in

Logged By KAB
Sampled By KAB

Elevation (feet)	Depth (feet)	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
	60							SW	QUATERNARY ALLUVIUM (Qal) Continued @ 60': No recovery
-45									
	65			12	50/5"			SP	@ 65': Dark gray, wet, very dense, fine SAND
-50									
	70			13	38			SM	@ 70': Olive-gray, wet, dense, silty fine to coarse SAND
-55									
	75								@ 75': Rock in boring, no sample attempted, very difficult drilling
-60									
	80				50/3"				@ 80': Gravel to cobble in boring, no sample recovery
-65									
									@ 83': Practical drilling refusal
	85								
-70									
	90								

Total Depth = 83'
Ground Water Encountered at 9'
Backfilled: 4/8/97
Practical Refusal at 83'

BORING LOGS
BY SHEPARDSON (1998, 2003)

SB-1

LOG OF TEST BORING NO. B- 1

Drilling Date(s): 08/17/98 Drilling Equipment: Mobile B-61 Surface Elevation: ~23'
Logged By: BMH Method/Hole Size: Hollow stem auger/8" Bottom Elevation: ~1'

Depth (feet)	Sample Type	Blow Count (/foot)	Dry Density (pcf)	Moisture Content (%)	Lab Tests	USCS	Graphic Log	MATERIAL DESCRIPTION
						SM		ALLUVIUM: silty fine sand, loose, moist, medium brown
2								
4						SW		: well-graded sand, loose, moist, light gray
6	☒ H	9	89	3.2				
8								
	☒ H	7	83	9.0				:brownish-gray
10								
	☒ H	7					∇	:yellow-brown
12								
14						GW		: sandy gravels, medium dense, saturated, light gray
16	☒ H	16						
18								
20	☒ SS	16						
22						SM		: medium to coarse-grained sand, medium dense, saturated, light gray; interlayered with sandy silt to silty sand, medium dense, saturated, blue gray
								Refusal on heavy cobble and gravel
24								
26								
28								
30								
32								
34								
36								
38								
40								

Drive Energy Data: Hammer Type Cable
Weight 140 lbs.
Drop 30 in.

Please refer to symbols and note limitations shown on "Explanation of Logs"

SHEPARDSON
ENGINEERING ASSOCIATES INC.

Geotechnical Consultants:
Engineers-Geologists

Date: August, 1998

Project No.: 97149-01

Log of Test Boring No. B- 1
RIVERWALK COMMERCIAL CENTER

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BL3 98

SB-2

LOG OF TEST BORING NO. B- 2

Drilling Date(s): 08/17/98 Drilling Equipment: Mobile B-61 Surface Elevation: ~27'
Logged By: BMH Method/Hole Size: Hollow stem auger/8" Bottom Elevation: ~-54'

Depth (feet)	Sample Type	Blow Count (/foot)	Dry Density (pcf)	Moisture Content (%)	Lab Tests	USCS	Graphic Log	MATERIAL DESCRIPTION
	B					SP		ALLUVIUM: poorly graded fine sand, loose, humid, yellow gray
2								
4								
6	H	10	89	6.2				:medium-grained, loose, moist, light gray
8								
	H	13	104	21.4				
10								
	H	11	91	31.2		SM-ML		: silty fine sand to sandy silt, micaceous, loose, wet, dark gray
12							∇	
								:saturated
14								
	SS	16				SM		:traces of gravel
16						SM-SW		: silty fine sand, loose, saturated, dark gray to black
								: well-graded, gravelly sand, medium dense, saturated, yellow gray
18								
								:gravel lens to 19.5
20	SS	38						:silty fine sand and medium-grained laminated sand, interbedded, medium dense, saturated, dark gray
22						SM-SW		: silty sand and medium-grained sand, medium dense, saturated, dark gray and blue gray
24								
26	SS	33						
28								
30	SS	23						:medium-grained sand
32								
						GW		: gravel
34						ML		: silt, medium stiff, saturated, dark gray; contains thin partings of yellow and brown silt, small mollusk shells
36	SS	5						
38								
						SM		: silty fine sand, medium dense, saturated, blue gray
40								
	H	43	96	27.9				

Drive Energy Data: Hammer Type Cable
Weight 140 lbs.
Drop 30 in.

Please refer to symbols and note limitations shown on "Explanation of Logs"

SHEPARDSON
ENGINEERING ASSOCIATES INC.
Geotechnical Consultants:
Engineers-Geologists

Date: August, 1998 Project No.: 97149-01

Log of Test Boring No. B- 2

RIVERWALK COMMERCIAL CENTER

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BL3 98

LOG OF TEST BORING NO. B- 2

Drilling Date(s): 08/17/98 Drilling Equipment: Mobile B-61 Surface Elevation: ~27'
Logged By: BMH Method/Hole Size: Hollow stem auger/8" Bottom Elevation: ~-54'

Depth (feet)	Sample Type	Blow Count (/foot)	Dry Density (pcf)	Moisture Content (%)	Lab Tests	USCS	Graphic Log	MATERIAL DESCRIPTION
44								ALLUVIUM: silty fine sand, medium dense, saturated, blue gray
50	SS	11				SM-ML		: silt, stiff, saturated; finely laminated, dark and light layers, gray
61	H	36						:interlayered silt and fine sand, medium dense, saturated, blue gray
64						SW		: fine to medium grained, well-graded sand, medium dense, saturated, blue gray
70	SS	22						
78						GW		: gravelly, 1" to 3" gravels
80	SS	50/4"						
								Refusal on heavy gravels

Drive Energy Data: Hammer Type Cable
Weight 140 lbs.
Drop 30 in.

Please refer to symbols and note limitations shown on "Explanation of Logs"

SHEPARDSON
ENGINEERING ASSOCIATES INC.

Geotechnical Consultants:
Engineers-Geologists

Date: August, 1998 | Project No.: 97149-01

Log of Test Boring No. B- 2
RIVERWALK COMMERCIAL CENTER

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BL3 98

SB-3

LOG OF TEST BORING NO. B- 3

Drilling Date(s): 08/18/98 Drilling Equipment: Mobile B-61 Surface Elevation: ~25'

Logged By: BMH Method/Hole Size: Hollow stem auger/8" Bottom Elevation: ~-52'

Depth (feet)	Sample Type	Blow Count (/foot)	Dry Density (pcf)	Moisture Content (%)	Lab Tests	USCS	Graphic Log	MATERIAL DESCRIPTION
	B					SP		<u>ALLUVIUM:</u> fine-grained sand, loose, humid to moist, yellow gray
2								
	H	14						
4								
						SW		: well-graded sand, loose, moist, light gray
6								
8								
	H	16						
10								
12							∇	
	H	20	102	25.1				
14								
16								
								:becomes medium dense
18	H	47						
20								
22	SS	29						:stratified, light yellow-gray
24								
26								
	SS	23						
28								:fine to medium-grained
30								
32								
	H	39	106	20.9				
34								:contains scattered 1/4" pebbles
36								
38	H	33	99	27.8				
40								

Drive Energy Data: Hammer Type Cable
Weight 140 lbs.
Drop 30 in.

Please refer to symbols and note limitations shown on "Explanation of Logs"

SHEPARDSON
ENGINEERING ASSOCIATES INC.

Geotechnical Consultants:
Engineers-Geologists

Date: August, 1998 | Project No.: 97149-01

Log of Test Boring No. B- 3

RIVERWALK COMMERCIAL CENTER

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BL3 98

LOG OF TEST BORING NO. B- 3

Drilling Date(s): 08/18/98 Drilling Equipment: Mobile B-61 Surface Elevation: ~25'
Logged By: BMH Method/Hole Size: Hollow stem auger/8" Bottom Elevation: ~-52'

Depth (feet)	Sample Type	Blow Count (/foot)	Dry Density (pcf)	Moisture Content (%)	Lab Tests	USCS	Graphic Log	MATERIAL DESCRIPTION
	SS	20						ALLUVIUM: clean sand, loose, no sample recovery
44								
46								
48	H	35	102	24.4				
50								
52	SS	33						:interlayered fine-grained and medium-grained sand, medium dense, saturated
54								
56								
58								
60								:trace of gravel
62	SS	38						:coarse sand with scattered 1/4" gravels
64								
66						GW		: sand and gravel, 2", medium dense, saturated, light gray
68								
70								
72								:heavier gravels
74								
76								
78								Refusal on gravel and cobble
80								
82								

Drive Energy Data: Hammer Type Cable
Weight 140 lbs.
Drop 30 in.

Please refer to symbols and note limitations shown on "Explanation of Logs"

SHEPARDSON
ENGINEERING ASSOCIATES INC.
Geotechnical Consultants:
Engineers-Geologists

Date: August, 1998

Project No.: 97149-01

Log of Test Boring No. B- 3

RIVERWALK COMMERCIAL CENTER

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SB-4

LOG OF TEST BORING NO. B- 4

Drilling Date(s): 08/19/98 Drilling Equipment: Mobile B-61 Surface Elevation: ~18'
Logged By: BMH Method/Hole Size: Hollow stem auger/8" Bottom Elevation: ~-64'

Depth (feet)	Sample Type	Blow Count (/foot)	Dry Density (pcf)	Moisture Content (%)	Lab Tests	USCS	Graphic Log	MATERIAL DESCRIPTION
						SW		<u>ALLUVIUM:</u> fine well-graded sand, loose, moist, yellow brown to light gray with orange oxidation staining
2								
4								
	H	14						:medium-grained sand
6								
							∇	water table
8								:sand becomes saturated
	H	8				SM-ML		:siltier sand, loose, saturated, dark gray to medium gray with orange oxidation staining; interbedded with silt
10								
12	SS	29						:no sample :becomes medium dense
14								
						SW		:well-graded sand, fine-grained to coarse, medium dense, saturated, light gray
16								
18	H	48	102	23.7				
20								
22	SS	21				SM-SW		:silty fine sand to well-graded sand, medium dense, saturated, dark gray to medium gray
24								
26								:light gray
	SS	27						
28								
30								
32								
	H	50	109	20.1				
34								
36								:interbedded medium-grained, well-graded sand and silty fine sand, medium dense, saturated, light gray
38	H	31	100	24.6				
40								

Drive Energy Data: Hammer Type Cable
Weight 140 lbs.
Drop 30 in.

Please refer to symbols and note limitations shown on "Explanation of Logs"

SHEPARDSON ENGINEERING ASSOCIATES INC.
Geotechnical Consultants: Engineers-Geologists

Date: August, 1998 | Project No.: 97149-01

Log of Test Boring No. B- 4
RIVERWALK COMMERCIAL CENTER

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BL3 98

LOG OF TEST BORING NO. B- 4

Drilling Date(s): 08/19/98
Drilling Equipment: Mobile B-61
Surface Elevation: ~18'
Logged By: BMH
Method/Hole Size: Hollow stem auger/8"
Bottom Elevation: ~-64'

Depth (feet)	Sample Type	Blow Count (/foot)	Dry Density (pcf)	Moisture Content (%)	Lab Tests	USCS	MATERIAL DESCRIPTION
	SS	46					
-44-							
-46-							ALLUVIUM: interbedded well-graded sand and silty fine sand, medium dense, saturated, light gray
						SW-GW	:becomes dense
-48-							:traces of gravel at 47 to 48 feet
-50-							
-52-	SS	71					
-54-							
-56-							:medium to coarse sand, dense, saturated, light gray
-58-							:occasional gravel layers
-60-							
-62-							
	H	88		18.8		GW	:sandy gravels, dense, saturated, light gray; gravels up to 1" in sampler
-64-							
-66-							
-68-							
-70-							
-72-	SS	5/6" refusal				SM	:sample refusal at 72 feet QUATERNARY BAY POINT FORMATION(?) silty fine-grained sandstone, very dense, saturated, medium gray
-74-							
-76-							
-78-							
-80-							
-82-	SS	75/4.5"					End of boring at 82.3 feet

Drive Energy Data: Hammer Type Cable
Weight 140 lbs.
Drop 30 in.

Please refer to symbols and note limitations shown on "Explanation of Logs"

SHEPARDSON
ENGINEERING ASSOCIATES INC.

Geotechnical Consultants:
Engineers-Geologists

Date: August, 1998

Project No.: 97149-01

Log of Test Boring No. B- 4
RIVERWALK COMMERCIAL CENTER

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SB-101

LOG OF TEST BORING NO. B-101

Drilling Date(s): 12/8/03 Drilling Equipment: B-61 Surface Elevation: ~35'
Logged By: BMH Method/Hole Size: Hollow Stem Auger/8" Bottom Elevation: ~24'

Depth (feet)	Sample Type	Blow Count (/foot)	Dry Density (pcf)	Moisture Content (%)	Lab Tests	USCS	Graphic Log	MATERIAL DESCRIPTION
					DS,CH	SW		**ARTIFICIAL FILL:** silty fine to coarse sand, dense, moist, yellow gray to light yellow; contains gravel
	CA	66						
						SM-GM		**ARTIFICIAL FILL:** silty gravelly sand, dense, moist, dark brown; contains scattered blebs of red brown silty clay, fragments of metavolcanic rock
10	CA	35 50/4"						
								Refusal at 11 feet on rocky fill

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24

Remarks:

Please refer to symbols and note limitations shown on "Explanation of Logs"

SHEPARDSON
ENGINEERING ASSOCIATES INC.

Geotechnical Consultants:
Engineers-Geologists

Date: December, 2003 Project No.: 97149-03

Log of Test Boring No. B-101

RIVERWALK COMMERCIAL CENTER

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BL1 03

SB-102

LOG OF TEST BORING NO. B-102

Drilling Date(s): 12/8/03 Drilling Equipment: B-61 Surface Elevation: ~35'
Logged By: BMH Method/Hole Size: Hollow Stem Auger/8" Bottom Elevation: ~-30'

Depth (feet)	Sample Type	Blow Count (/foot)	Dry Density (pcf)	Moisture Content (%)	Lab Tests	USCS	Graphic Log	MATERIAL DESCRIPTION
						SW		**ARTIFICIAL FILL:** silty fine to coarse sand, medium dense to dense, moist , yellow gray to light yellow
2								
4								
6								
8								
						SM-GM		**ARTIFICIAL FILL:** silty gravelly sand, medium dense to dense, moist, dark gray; contains some blebs of blue gray and red brown clay, fragments of metavolcanic rock; slight organic odor
10								
12								
14								
						SW		**ALLUVIUM (Qal):** well-graded sand, medium dense to dense, moist to saturated, light grayish-yellow, light gray
16								
18								
20	☒ SS	13			SA			▼
								Groundwater at 21 feet
22								
24								
26	☒ SS	38						
28								
30	☒ SS	37						
32								
34								
36								
38								
40	☒ SS	15			SA			
						SM-ML		**ALLUVIUM (Qal):** silty sand to sandy silt, medium dense, saturated, dark gray
42								
						GW		**ALLUVIUM (Qal):** sandy gravels, contains gravel and cobbles of 1" or more; dense, saturated, light gray
44								
46								
48								

Remarks:

Please refer to symbols and note limitations shown on "Explanation of Logs"

S H E P A R D S O N
ENGINEERING ASSOCIATES INC.

Geotechnical Consultants:
Engineers-Geologists

Date: December, 2003 Project No.: 97149-03

Log of Test Boring No. B-102

RIVERWALK COMMERCIAL CENTER

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BL1 03

LOG OF TEST BORING NO. B-102

Drilling Date(s): 12/8/03 Drilling Equipment: B-61 Surface Elevation: ~35'

Logged By: BMH Method/Hole Size: Hollow Stem Auger/8" Bottom Elevation: ~-30'

Depth (feet)	Sample Type	Blow Count (/foot)	Dry Density (pcf)	Moisture Content (%)	Lab Tests	USCS	Graphic Log	MATERIAL DESCRIPTION
	☒ SS	42						
52						GW		**ALLUVIUM (Qal):** sandy gravels, contains gravel and cobbles of 1" or more; dense, saturated, light gray
54								
56								
58								
60	☒ SS	50 45/5"						
62						SM		**QUATERNARY BAY POINT FORMATION:** silty fine-grained sandstone, very dense, saturated, medium gray
64								
66	☒ SS	105/6"						Refusal to auger at 65 feet
68								
70								
72								
74								
76								
78								
80								
82								
84								
86								
88								
90								
92								
94								
96								
98								

Remarks:

Please refer to symbols and note limitations shown on "Explanation of Logs"

SHEPARDSON
ENGINEERING ASSOCIATES INC.

Geotechnical Consultants:
Engineers-Geologists

Date: December, 2003 Project No.: 97149-03

Log of Test Boring No. B-102
RIVERWALK COMMERCIAL CENTER

Plate
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BL1 03

SB-103

LOG OF TEST BORING NO. B-103

Drilling Date(s):	12/9/03	Drilling Equipment:	B-61	Surface Elevation:	~35'
Logged By:	BMH	Method/Hole Size:	Hollow Stem Auger/8"	Bottom Elevation:	~-56'

Depth (feet)	Sample Type	Blow Count (/foot)	Dry Density (pcf)	Moisture Content (%)	Lab Tests	USCS	Graphic Log	MATERIAL DESCRIPTION
						SM-GM		**ARTIFICIAL FILL:** silty sand, gravelly, dense, moist, brown-yellow, gray-yellow to medium brown; contains scattered blebs of gray clay
2								
4								
6	CA	73						
8								
10	CA	78						
12						GW		**ARTIFICIAL FILL:** gravelly sand to sandy gravel, dense, moist, dark gray; contains some clay, slight organic odor
14								
16	CA	80						
18						SW		**ALLUVIUM (Qal):** well graded sand, medium dense to dense, moist to saturated, medium gray
20	SS	14			SA			▼
22								Groundwater at 21 feet
24								:interlayered fine and coarse sands
26								
28								
30	SS	61						
32								
34								
36								:medium to coarse sand
38								
40	SS	29			SA			
42								
44								
46								
48								

Remarks:

Please refer to symbols and note limitations shown on "Explanation of Logs"

SHEPARDSON
ENGINEERING ASSOCIATES INC.

Geotechnical Consultants:
Engineers-Geologists

Date: December, 2003 | Project No.: 97149-03

Log of Test Boring No. B-103

RIVERWALK COMMERCIAL CENTER

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BL1 03

LOG OF TEST BORING NO. B-103

Drilling Date(s): 12/9/03 Drilling Equipment: B-61 Surface Elevation: ~35'
Logged By: BMH Method/Hole Size: Hollow Stem Auger/8" Bottom Elevation: ~-56'

Depth (feet)	Sample Type	Blow Count (/foot)	Dry Density (pcf)	Moisture Content (%)	Lab Tests	USCS	Graphic Log	MATERIAL DESCRIPTION
	☒ SS	65				SW		**ALLUVIUM (Qal):**slightly finer, laminated sands
52								
54								
56								
58								
60	☒ SS	28						
62								
64								
66								
68								
70	☒ SS	75						:scattered gravel
72								
74								
76								
78								
80	☒ SS	35						
82								
84								
86								
88						GW		**ALLUVIUM (Qal):** sandy gravels, dense, saturated, medium gray
90								
92								Refusal on cobble at 90.5
94								
96								
98								

Remarks:

Please refer to symbols and note limitations shown on "Explanation of Logs"

SHEPARDSON
ENGINEERING ASSOCIATES INC.

Geotechnical Consultants:
Engineers-Geologists

Date: December, 2003 Project No.: 97149-03

Log of Test Boring No. B-103
RIVERWALK COMMERCIAL CENTER

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BL1 03

SB-104

LOG OF TEST BORING NO. B-104

Drilling Date(s): 12/9/03 Drilling Equipment: B-61 Surface Elevation: ~30'

Logged By: BMH Method/Hole Size: Hollow Stem Auger/8" Bottom Elevation: ~25'

Depth (feet)	Sample Type	Blow Count (/foot)	Dry Density (pcf)	Moisture Content (%)	Lab Tests	USCS	Graphic Log	MATERIAL DESCRIPTION
	B				DS	SM-GM	▨	**ARTIFICIAL FILL:** silty sand to gravelly sand, dense, moist, orange brown
2							▨	
	CA	50/5"					▨	
4							▨	
6								Refusal on rocky fill at 5.5 feet
8								
10								
12								
14								
16								
18								
20								
22								
24								

Remarks:

Please refer to symbols and note limitations shown on "Explanation of Logs"

SHEPARDSON
ENGINEERING ASSOCIATES INC.

Geotechnical Consultants:
Engineers-Geologists

Date: December, 2003 Project No.: 97149-03

Log of Test Boring No. B-104

RIVERWALK COMMERCIAL CENTER

Plate
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BL1 03

BORING LOGS
BY GEOCON (1998, 2003)

03 09 2001

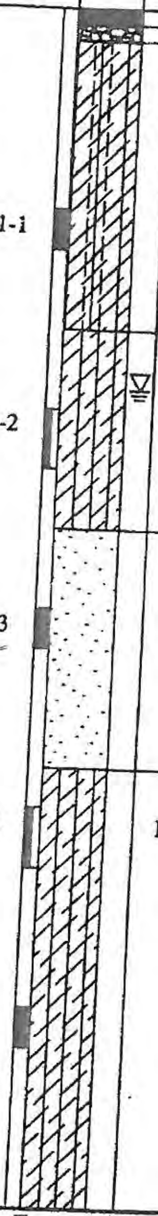
GCB-1

PROJECT NO. 06219-22-01

BORING B 1

ELEV. (MSL.) 22 DATE COMPLETED 11/4/98

EQUIPMENT ROTARY WASH



DEPTH IN FEET	SAMPLE NO.	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0			4" ASPHALT CONCRETE 4" BASE MATERIAL			
2		CL/ML	ALLUVIUM Firm, moist, dark brown, Silty CLAY/Clayey SILT, trace fine sand			
6	B1-1			7	92.0	32.5
9		ML	Firm, moist to saturated, Clayey SILT, micaceous			
11	B1-2			7		
14		SP	Dense, saturated, olive-brown, very fine to medium SAND, trace silt			
16	B1-3			31	103.0	24.1
20	B1-4	ML	Soft, to stiff, saturated, olive-brown to gray-brown, Clayey SILT, trace to some sand, trace gravel to 1.5 inches	3		
26	B1-5		-1.5 inches piece of gravel at 25.5 feet in tip	12	107.9	22.0

Figure A-1, Log of Boring B 1

SAMPLE SYMBOLS
☐ ... SAMPLING UNSUCCESSFUL
▨ ... DISTURBED OR BAG SAMPLE
◧ ... STANDARD PENETRATION TEST
◩ ... CHUNK SAMPLE
■ ... DRIVE SAMPLE (UNDISTURBED)
▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

03 09 2001

GCB-1

PROJECT NO. 06219-22-01

BORING B 1

ELEV. (MSL.) 22 DATE COMPLETED 11/4/98

EQUIPMENT ROTARY WASH

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B1-6			ML		7		
34	B1-7			ML	Very stiff, saturated, brown, very Sandy SILT, some to trace clay	24	116.2	17.7
40	B1-8					18		
42	B1-9			ML	Very stiff, saturated, olive-brown, SILT, some to trace very fine sand and clay	20	104.9	24.8
49	B1-10			GP	Very dense, saturated, olive-brown, very fine Sandy GRAVEL, some silt, angular -Difficult drilling from 51 to 56 feet, gravel and rock	87		
56					BORING TERMINATED AT 56 FEET REFUSAL Groundwater at 9.5 feet			

Figure A-2, Log of Boring B 1

SAMPLE SYMBOLS
☐ ... SAMPLING UNSUCCESSFUL
▨ ... DISTURBED OR BAG SAMPLE
◧ ... STANDARD PENETRATION TEST
◩ ... CHUNK SAMPLE
■ ... DRIVE SAMPLE (UNDISTURBED)
▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

03 09 2001

GCB-2

PROJECT NO. 06219-22-01

BORING B 2

ELEV. (MSL.) 2[illegible] DATE COMPLETED 11/4/98

EQUIPMENT ROTARY WASH

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					4" ASPHALT CONCRETE 8" BASE MATERIAL			
2 4				ML	FILL Brown, Sandy SILT 2 to 3 feet possible old asphalt layer/concrete slab			
6	B2-1			ML	ALLUVIUM Loose, moist, olive-brown, very fine Sandy SILT, micaceous	9	100.3	26.2
8 10 12	B2-2		▽	SM	Loose, moist to saturated, olive-brown, Silty, fine to medium SAND, some clay, micaceous	5		
14 16	B2-3			SP	Moderately dense, saturated, olive-brown, very fine to medium SAND, trace silt, cohesionless	19	103.3	22.3
18 20 22	B2-4			ML	Loose, saturated, olive-brown, Sandy SILT, some clay, trace fine gravel	6		
24 26 28	B2-5			SM	Moderately dense, saturated, olive-brown, Silty, very fine SAND, trace fine gravel, micaceous	19	94.2	[illegible]

Figure A-3, Log of Boring B 2

SAMPLE SYMBOLS ☐ ... SAMPLING UNSUCCESSFUL ◧ ... STANDARD PENETRATION TEST ■ ... DRIVE SAMPLE (UNDISTURBED)
▨ ... DISTURBED OR BAG SAMPLE ◩ ... CHUNK SAMPLE ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

03 09 2001

GCB-2

PROJECT NO. 06219-22-01

BORING B 2

ELEV. (MSL.) 24 DATE COMPLETED 11/4/98

EQUIPMENT ROTARY WASH

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B2-6			ML	Firm, saturated, gray-brown, Clayey SILT, micaceous	8		
36	B2-7					7	93.2	33.2
38					Very stiff, saturated, olive-brown, Clayey SILT, some fine sand			
40	B2-8			ML		17		
43					Hard, saturated, brown, fine Sandy CLAY, some silt			
46	B2-9			CL		34	110.4	19.8
49								
50	B2-10			GP	Very dense, saturated, brown to pink-brown, Sandy, fine to coarse GRAVEL, angular			
52					BORING TERMINATED AT 52 FEET REFUSAL Groundwater at 9.0 feet			

Figure A-4, Log of Boring B 2

SAMPLE SYMBOLS
☐ ... SAMPLING UNSUCCESSFUL
▩ ... DISTURBED OR BAG SAMPLE
◧ ... STANDARD PENETRATION TEST
◩ ... CHUNK SAMPLE
■ ... DRIVE SAMPLE (UNDISTURBED)
▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

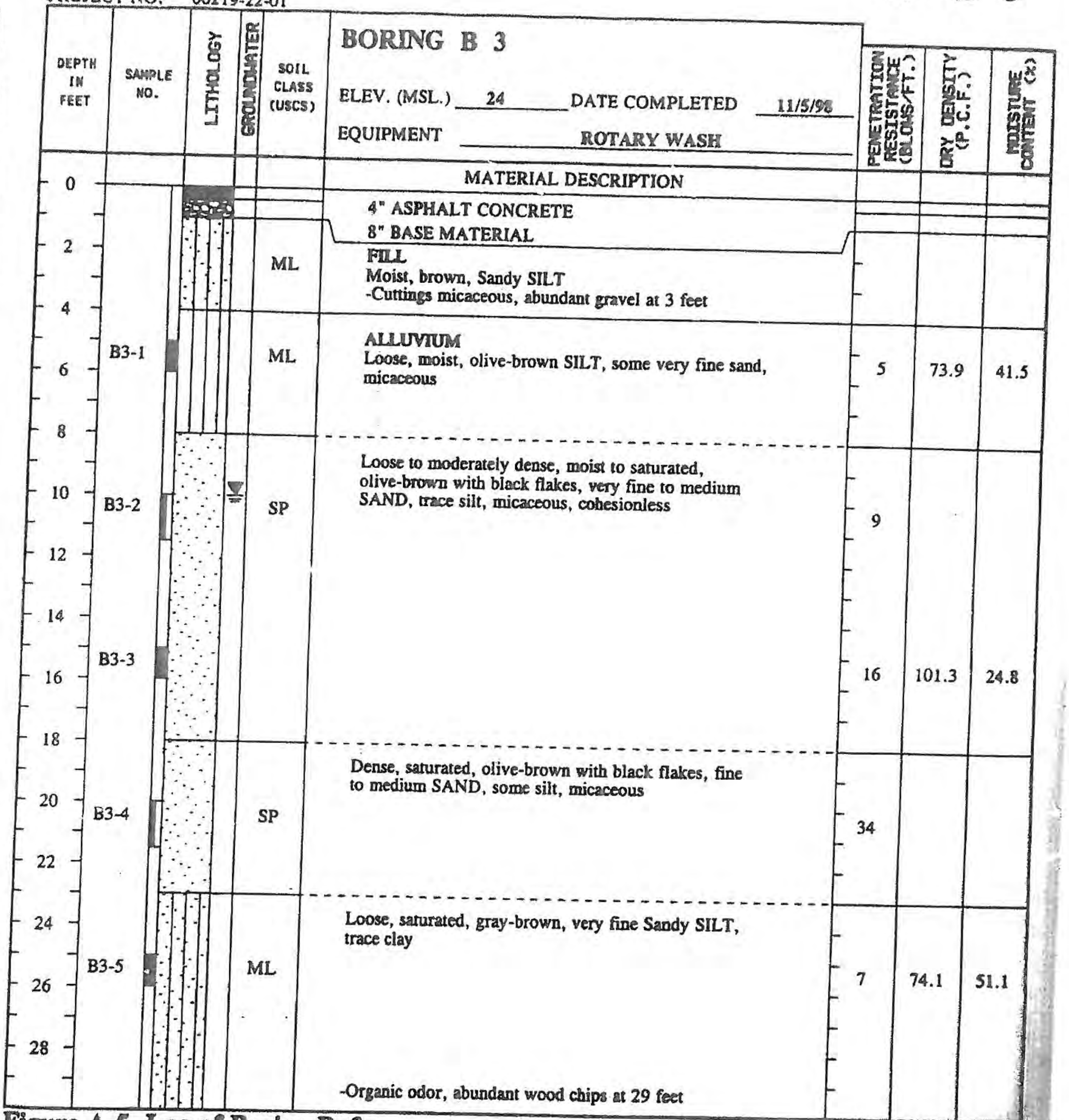
GCB-3

PROJECT NO. 06219-22-01

BORING B 3

ELEV. (MSL.) 24 DATE COMPLETED 11/5/98

EQUIPMENT ROTARY WASH



DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					4" ASPHALT CONCRETE 8" BASE MATERIAL			
2				ML	**FILL** Moist, brown, Sandy SILT -Cuttings micaceous, abundant gravel at 3 feet			
4								
6	B3-1			ML	**ALLUVIUM** Loose, moist, olive-brown SILT, some very fine sand, micaceous	5	73.9	41.5
8								
10	B3-2		▽	SP	Loose to moderately dense, moist to saturated, olive-brown with black flakes, very fine to medium SAND, trace silt, micaceous, cohesionless	9		
12								
14								
16	B3-3					16	101.3	24.8
18								
20	B3-4			SP	Dense, saturated, olive-brown with black flakes, fine to medium SAND, some silt, micaceous	34		
22								
24					Loose, saturated, gray-brown, very fine Sandy SILT, trace clay			
26	B3-5			ML		7	74.1	51.1
28					-Organic odor, abundant wood chips at 29 feet			

Figure A-5, Log of Boring B 3

SAMPLE SYMBOLS	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	▨ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▽ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

03 09 2001

GCB-3

PROJECT NO. 06219-22-01

BORING B 3

ELEV. (MSL.) 24 DATE COMPLETED 11/5/98

EQUIPMENT ROTARY WASH

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B3-6					12		
32				ML	Moderately dense, saturated, dark gray SILT, trace very fine sand and clay, micaceous			
34								
36	B3-7			SP	Very dense, saturated, dark gray, very fine to medium SAND, some silt	90	107.2	21.4
38					Loose, saturated, gray with silver flakes, SILT and fine SAND			
40	B3-8			ML		8		
42								
44					Firm, saturated, dark gray with silver flakes, Clayey SILT, trace very fine sand			
46	B3-9			ML		8	98.1	27.9
48								
50	B3-10					45		
52				SM	Dense, saturated, dark brown, Silty, fine to coarse SAND, organics, wood, hair fiber			
54	B3-11			GP	Very dense, saturated, brown to pink-brown, Sandy, fine to coarse GRAVEL to 1.5 inches, angular	50/2"		

BORING TERMINATED AT 55 FEET
REFUSAL
Groundwater at 10 feet

Figure A-6, Log of Boring B 3

SAMPLE SYMBOLS
☐ ... SAMPLING UNSUCCESSFUL
▨ ... DISTURBED OR BAG SAMPLE
◧ ... STANDARD PENETRATION TEST
◪ ... CHUNK SAMPLE
■ ... DRIVE SAMPLE (UNDISTURBED)
▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

03 09 2001

GSB-1

PROJECT NO. 06219-22-02

BORING SB 1

ELEV. (MSL.) -21.5 ft DATE COMPLETED 12/16/02

EQUIPMENT CME 55

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					4" ASPHALT CONCRETE			
2	SB1-1			SM	FILL Loose to medium dense, moist, brown, Silty, fine to medium SAND, trace clay			
4					ALLUVIUM Loose, moist to saturated, dark gray, Silty, fine SAND, trace gravel			
6	SB1-2					8	91.4	25.9
8	SB1-3		▼	SM	-Groundwater encountered at 8 feet			
10						11		
12					-No recovery			
14				ML	Soft to firm, saturated, dark gray, Clayey SILT with some fine sand			
16	SB1-4				Loose, saturated, brown, fine to medium SAND, micaceous	9		
18				SP				
20	SB1-5				Medium dense, saturated, brown, Silty, fine SAND, micaceous	14		
22				SM				
24								
26	SB1-6				Soft to firm, saturated, dark brown, fine Sandy to Silty CLAY	6		
28				CL				
30	SB1-7					9		
					BORING TERMINATED AT 31.5 FEET			

PREDV.GPJ

Figure A-1,
Log of Boring SB 1, Page 1 of 1

SAMPLE SYMBOLS	☐ ... SAMPLING UNSUCCESSFUL	▯ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	▨ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

03 09 2001

GCSB-2

PROJECT NO. 06219-22-02

BORING SB 2

ELEV. (MSL.) ~19.5 ft DATE COMPLETED 12/16/02

EQUIPMENT CME 55

DEPTH IN FEET	SAMPLE NO.	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				4" ASPHALT CONCRETE			
	SB2-1		SM	FILL Loose to medium dense, moist, brown, Silty, fine to medium SAND, trace clay and gravel			
4			ML	ALLUVIUM Soft, moist, gray, fine Sandy SILT, micaceous	5		
				-No recovery			
	SB2-2	▼		-Groundwater encountered at 7.5 feet			
				-Becomes very soft, saturated, with clay			
10	SB2-3		SP	Very loose to loose, saturated, brown, fine to medium SAND, trace gravel	8	101.6	22.5
	SB2-4				3		
20	SB2-5		ML	Firm, saturated, dark gray, fine Sandy SILT, micaceous	7		
	SB2-6			-Becomes stiff	17	97.5	28.4
30	SB2-7		CL	Soft, saturated, gray, fine Sandy to Silty CLAY	4		

PREEV.GPJ

Figure A-2,
Log of Boring SB 2, Page 1 of 2

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL

▨ ... DISTURBED OR BAG SAMPLE

◧ ... STANDARD PENETRATION TEST

◪ ... CHUNK SAMPLE

■ ... DRIVE SAMPLE (UNDISTURBED)

▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

03 09 2001

GCSB-2

PROJECT NO. 06219-22-02

BORING SB 2

ELEV. (MSL.) ~19.5 ft DATE COMPLETED 12/16/02

EQUIPMENT CME 55

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
34								
36	SB2-8	▨				2		
					BORING TERMINATED AT 36.5 FEET			

PREBV.DPJ

Figure A-2,
Log of Boring SB 2, Page 2 of 2

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL
▨ ... DISTURBED OR BAG SAMPLE
◨ ... STANDARD PENETRATION TEST
◩ ... CHUNK SAMPLE
■ ... DRIVE SAMPLE (UNDISTURBED)
▽ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED.
IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

03 09 2001

GCSB-3

PROJECT NO. 08219-22-02

BORING SB 3

ELEV. (MSL.) -20.3 ft DATE COMPLETED 12/16/02

EQUIPMENT CME 55

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					4" ASPHALT CONCRETE			
	SB3-1			ML	FILL Soft, moist, brown, SILT with some gravel			
2								
4					ALLUVIUM Soft to firm, moist, dark brown, fine Sandy to Clayey SILT			
	SB3-2					9	98.1	27.0
6								
	SB3-3		▼	ML				
8					-Groundwater encountered at 7.5 feet			
10	SB3-4				Stiff, saturated, brown, fine Sandy SILT	14		
12				ML				
14								
	SB3-5				Medium dense, saturated, brown, Silty, fine SAND	23		
16								
18				SM				
20	SB3-6					21	90.0	33.7
					BORING TERMINATED AT 21.5 FEET			

Figure A-3,
Log of Boring SB 3, Page 1 of 1

FREEV.GPJ

SAMPLE SYMBOLS
☐ ... SAMPLING UNSUCCESSFUL
▨ ... DISTURBED OR BAG SAMPLE
◨ ... STANDARD PENETRATION TEST
◩ ... CHUNK SAMPLE
■ ... DRIVE SAMPLE (UNDISTURBED)
▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED.
IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GCSB-4

PROJECT NO. 06219-22-02

BORING SB 4

ELEV. (MSL.) -19.5 ft DATE COMPLETED 12/16/02

EQUIPMENT CME 55

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					4" ASPHALT CONCRETE			
2	SB4-1			ML	FILL Firm, damp to moist, brown, fine Sandy SILT			
4					ALLUVIUM Medium dense, moist, light brown, fine SAND			
6	SB4-2			SP		23	90.4	4.9
8			▼		-Groundwater encountered at 7.5 feet			
10	SB4-3				Firm, saturated, brown, fine Sandy SILT	14		
12								
14				ML				
16	SB4-4					9		
18								
20					Very soft, saturated, dark gray, Clayey SILT, trace sand -No recovery	2		
22				ML				
24								
26	SB4-5			SM	Medium dense, saturated, gray, Silty, fine SAND	25	95.7	28.9
					BORING TERMINATED AT 26.5 FEET			

Figure A-4,
Log of Boring SB 4, Page 1 of 1

SAMPLE SYMBOLS	☐ ... SAMPLING UNSUCCESSFUL	▯ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	▨ ... DISTURBED OR BAG SAMPLE	◩ ... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED.
IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING AND CPT LOGS
BY GROUP DELTA (2014, 2015)

BORING RECORD

PROJECT NAME: San Diego Riverwalk Development
PROJECT NUMBER: IR619
BORING: B-01*
SITE LOCATION: 1150 Fashion Valley Road
START: 9/4/2014
FINISH: 9/4/2014
SHEET NO.: 1 of 3
DRILLING COMPANY: Pacific Drilling
DRILLING METHOD: Rotary Wash
LOGGED BY: TSL
CHECKED BY: MAF
DRILLING EQUIPMENT: Diedrich D50 Truck Rig
BORING DIA. (in): 6
TOTAL DEPTH (ft): 51.5
GROUND ELEV (ft): 24
DEPTH/*ELEV.* GROUND WATER (ft): ▼ 13.0 / *11.0*
SAMPLING METHOD: Hammer: 140 lbs., Drop: 30 in. (Automatic)
NOTES: ETR ~ 80%, N_{60} ~ 80/60 * N ~ 1.33 * N

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
												FILL: CLAYEY SAND (SC); medium dense; brown; moist; mostly fine to medium SAND; some fines; trace GRAVEL; low plasticity.
			B-1						PA CR EI R~36			(4% Gravel; 59% Sand; 37% Fines)
			S-2	4 4 8	12	16						
	20											
5										5		**ALLUVIUM:** SANDY SILT (ML); loose; light brown; moist; mostly fines; some SAND; low plasticity.
			R-3	4 4 3	7	6	25.8	79	DS			
	15											Interbedded SILTY SAND (SM) and SANDY SILT (ML); loose; dark brown; moist; mostly fine to medium SAND; some fines; low plasticity; micaceous.
10										10		
			S-4	4 3 4	7	9						
											▼	SILTY SAND (SM); medium dense; dark brown; moist to wet; mostly fine to medium SAND; some fines; low plasticity.
	10											
15										15		POORLY GRADED SAND (SP); medium dense; light yellow brown; wet; mostly fine to medium SAND; few fines; nonplastic.
			S-5	1 3 6	9	12			PA			(0% Gravel; 95% Sand; 5% Fines)
	5											

GDC_LOG_BORING_MMX_SOIL_SD IR619 LOGS.GPJ GDCLOG.GDT 9/22/14

GROUP DELTA CONSULTANTS, INC.
9245 Activity Road, Suite 103
San Diego, CA 92126

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE
A-1 a

BORING RECORD

PROJECT NAME San Diego Riverwalk Development
PROJECT NUMBER IR619
BORING B-01 *
SITE LOCATION 1150 Fashion Valley Road
START 9/4/2014
FINISH 9/4/2014
SHEET NO. 2 of 3
DRILLING COMPANY Pacific Drilling
DRILLING METHOD Rotary Wash
LOGGED BY TSL
CHECKED BY MAF
DRILLING EQUIPMENT Diedrich D50 Truck Rig
BORING DIA. (in) 6
TOTAL DEPTH (ft) 51.5
GROUND ELEV (ft) 24
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ 13.0 / *11.0*
SAMPLING METHOD Hammer: 140 lbs., Drop: 30 in. (Automatic)
NOTES ETR ~ 80%, N_{60} ~ 80/60 * N ~ 1.33 * N

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		⧗	R-6	3 8 19	27	24	22.9	100	DS			**ALLUVIUM:** POORLY GRADED SAND WITH SILT (SP-SM); medium dense to dense; light yellow to gray brown; wet; mostly fine to medium SAND; few fines; nonplastic.
	0											
25										25		
		☒	S-7	10 12 14	26	35			PA			(0% Gravel; 92% Sand; 8% Fines)
	-5											
												SANDY SILT (ML); loose to medium dense; dark gray; wet; mostly fines; some SAND; low plasticity; micaceous.
30										30		
		☒	S-8	2 3 8	11	15						
	-10											
35										35		
		☒	S-9	1 1 3	4	5			PA			(0% Gravel; 35% Sand; 65% Fines)
												POORLY GRADED SAND (SP); medium dense; dark gray; wet; mostly fine to medium SAND; trace fines; nonplastic.
	-15											

GROUP DELTA CONSULTANTS, INC.
9245 Activity Road, Suite 103
San Diego, CA 92126

BORING RECORD

PROJECT NAME San Diego Riverwalk Development
PROJECT NUMBER IR619
BORING B-01 *
SITE LOCATION 1150 Fashion Valley Road
START 9/4/2014
FINISH 9/4/2014
SHEET NO. 3 of 3
DRILLING COMPANY Pacific Drilling
DRILLING METHOD Rotary Wash
LOGGED BY TSL
CHECKED BY MAF
DRILLING EQUIPMENT Diedrich D50 Truck Rig
BORING DIA. (in) 6
TOTAL DEPTH (ft) 51.5
GROUND ELEV (ft) 24
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ 13.0 / *11.0*
SAMPLING METHOD Hammer: 140 lbs., Drop: 30 in. (Automatic)
NOTES ETR ~ 80%, N_{60} ~ 80/60 * N ~ 1.33 * N

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	S-10	8 9 6	15	20						**ALLUVIUM:** SILTY SAND (SM); medium dense; dark gray; wet; mostly fine to medium SAND; some fines; low plasticity.
	-20											SILT (ML); loose to medium dense; dark gray; wet; mostly fines; little SAND; low plasticity; micaceous.
45										45		
		☒	S-11	1 1 4	5	7			PA			(0% Gravel; 13% Sand; 87% Fines)
	-25											SILTY SAND (SM); medium dense to dense; dark gray; wet; mostly fine to medium SAND; little fines; low plasticity.
50										50		
		☒	S-12	7 10 12	22	29						
												Total Depth: 51½ Feet Groundwater at Elevation 11 Feet
	-30											
55										55		
	-35											

GROUP DELTA CONSULTANTS, INC.
9245 Activity Road, Suite 103
San Diego, CA 92126

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FIGURE

A-1 c

BORING RECORD

PROJECT NAME San Diego Riverwalk Development
PROJECT NUMBER IR619
BORING B-02
SITE LOCATION 1150 Fashion Valley Road
START 9/5/2014
FINISH 9/5/2014
SHEET NO. 1 of 2
DRILLING COMPANY Pacific Drilling
DRILLING METHOD Rotary Wash
LOGGED BY TSL
CHECKED BY MAF
DRILLING EQUIPMENT Diedrich D50 Truck Rig
BORING DIA. (in) 6
TOTAL DEPTH (ft) 23
GROUND ELEV (ft) 32
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ N/A / *na*
SAMPLING METHOD Hammer: 140 lbs., Drop: 30 in. (Automatic)
NOTES ETR ~ 80%, N_{60} ~ 80/60 * N ~ 1.33 * N

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
		▨	B-1						PA CR EI	**FILL:** SILTY SAND (SM); loose; grayish brown; moist; mostly fine to medium SAND; little fines; few GRAVEL; nonplastic; micaceous. (5% Gravel; 69% Sand; 26% Fines)
	30									
		☒	S-2	3 4 3	7	9				**ALLUVIUM:** SILTY SAND (SM); loose; gray brown; moist; mostly fine SAND; some fines; few GRAVEL; low plasticity.
		▨								
5										
		☒	S-3	5 3 2	5	7			PA	(12% Gravel; 59% Sand; 29% Fines)
	25									
										SILT (ML); loose; gray brown; moist; mostly fines; little SAND; low plasticity.
10										
		☒	S-4	11 22 33	55	73				POORLY GRADED GRAVEL (GP); very dense; gray brown; moist; mostly GRAVEL; some SAND; few fines; nonplastic.
	20									
15										
		☒	S-5	32 27 39	66	88				
	15									
										SILTY SAND (SM); medium dense; yellowish and gray brown; moist; mostly SAND; some fines; low plasticity.

GROUP DELTA CONSULTANTS, INC.
9245 Activity Road, Suite 103
San Diego, CA 92126

FIGURE A-2 a

BORING RECORD

PROJECT NAME San Diego Riverwalk Development
PROJECT NUMBER IR619
BORING B-02*
SITE LOCATION 1150 Fashion Valley Road
START 9/5/2014
FINISH 9/5/2014
SHEET NO. 2 of 2
DRILLING COMPANY Pacific Drilling
DRILLING METHOD Rotary Wash
LOGGED BY TSL
CHECKED BY MAF
DRILLING EQUIPMENT Diedrich D50 Truck Rig
BORING DIA. (in) 6
TOTAL DEPTH (ft) 23
GROUND ELEV (ft) 32
DEPTH/*ELEV.* GROUND WATER (ft) ▽ N/A / *na*
SAMPLING METHOD Hammer: 140 lbs., Drop: 30 in. (Automatic)
NOTES ETR ~ 80%, N_{60} ~ 80/60 * N ~ 1.33 * N

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	S-6	22 (5")	53	70						**ALLUVIUM**: POORLY GRADED GRAVEL (GP); very dense; gray brown; moist; mostly GRAVEL; some SANDS; few fines; nonplastic.
	10											
												Total Depth: 23 Feet No Groundwater Encountered Drilling Refusal at 23 Feet
25										25		
	5											
30										30		
	0											
35										35		
	-5											

FIGURE

A-2 b

BORING RECORD

PROJECT NAME San Diego Riverwalk Development
PROJECT NUMBER IR619
BORING B-03 ✱
SITE LOCATION 1150 Fashion Valley Road
START 9/3/2014
FINISH 9/3/2014
SHEET NO. 1 of 3
DRILLING COMPANY Pacific Drilling
DRILLING METHOD Rotary Wash
LOGGED BY TSL
CHECKED BY MAF
DRILLING EQUIPMENT Diedrich D50 Truck Rig
BORING DIA. (in) 6
TOTAL DEPTH (ft) 51.5
GROUND ELEV (ft) 31
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ 17.0 / *14.0*
SAMPLING METHOD Hammer: 140 lbs., Drop: 30 in. (Automatic)
NOTES ETR ~ 80%, N_{60} ~ 80/60 * N ~ 1.33 * N

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	30											**FILL:** CLAYEY SAND (SC); dense; yellow brown; moist; mostly fine to medium SAND; few GRAVEL; little fines; nonplastic. (12% Gravel; 68% Sand; 20% Fines) LL~29, PL~17, PI~12
			B-1						PA PI CR EI R~30			
5	25		S-2	8 14 10	24	32				5		
												POORLY GRADED GRAVEL (GP); dense; gray brown; moist; mostly GRAVEL; some SAND; few fines; nonplastic.
10	20		S-3	6 24 13	37	49				10		SILTY SAND WITH GRAVEL (SM); dense; orangish to gray brown; moist; mostly fine to medium SAND; little fines; little GRAVEL; low plasticity.
15	15		S-4	11 11 10	21	28			PA	15		**ALLUVIUM:** POORLY GRADED SAND (SP); medium dense; orangish brown; moist to wet; mostly fine to medium SAND; few fines; trace GRAVEL; nonplastic. (2% Gravel; 92% Sand; 6% Fines)

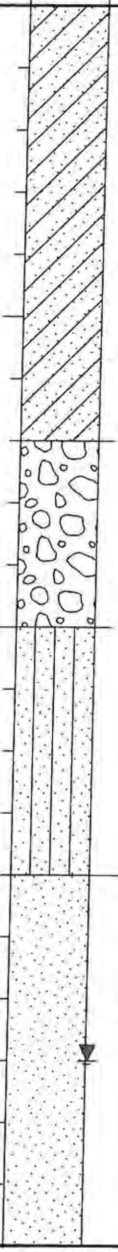

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FIGURE A-3 a

BORING RECORD

PROJECT NAME: San Diego Riverwalk Development
PROJECT NUMBER: IR619
BORING: B-03*
SITE LOCATION: 1150 Fashion Valley Road
START: 9/3/2014
FINISH: 9/3/2014
SHEET NO.: 2 of 3
DRILLING COMPANY: Pacific Drilling
DRILLING METHOD: Rotary Wash
LOGGED BY: TSL
CHECKED BY: MAF
DRILLING EQUIPMENT: Diedrich D50 Truck Rig
BORING DIA. (in): 6
TOTAL DEPTH (ft): 51.5
GROUND ELEV (ft): 31
DEPTH/*ELEV.* GROUND WATER (ft): ⊻ 17.0 / *14.0*
SAMPLING METHOD: Hammer: 140 lbs., Drop: 30 in. (Automatic)
NOTES: ETR ~ 80%, N_{60} ~ 80/60 * N ~ 1.33 * N

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	10	☒	S-5	7 8 10	18	24						**ALLUVIUM:** SILTY SAND (SM); medium dense; dark grayish brown; wet; mostly fine to medium SAND; little fines; trace GRAVEL; low plasticity; micaceous.
25										25		
	5	☒	S-6	4 8 13	21	28			PA			(1% Gravel; 85% Sand; 14% Fines)
												SILTY SAND (SM); dense; yellow brown to gray brown; wet; mostly fine to medium SAND; little fines; nonplastic.
30										30		
	0	⧗	R-7	14 22 22	44	39	---	---	---			Disturbed sample.
35										35		
	-5	☒	S-8	9 12 14	26	35			PA			(0% Gravel; 85% Sand; 15% Fines)

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FIGURE A-3 b

BORING RECORD

PROJECT NAME San Diego Riverwalk Development

PROJECT NUMBER IR619

BORING B-03*

SITE LOCATION 1150 Fashion Valley Road

START 9/3/2014

FINISH 9/3/2014

SHEET NO. 3 of 3

DRILLING COMPANY Pacific Drilling

DRILLING METHOD Rotary Wash

LOGGED BY TSL

CHECKED BY MAF

DRILLING EQUIPMENT Diedrich D50 Truck Rig

BORING DIA. (in) 6

TOTAL DEPTH (ft) 51.5

GROUND ELEV (ft) 31

DEPTH/*ELEV.* GROUND WATER (ft) ▼ 17.0 / *14.0*

SAMPLING METHOD Hammer: 140 lbs., Drop: 30 in. (Automatic)

NOTES ETR ~ 80%, N_{60} ~ 80/60 * N ~ 1.33 * N

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-10	☒	S-9	9 9 9	18	24						**ALLUVIUM:** POORLY GRADED SAND (SP); medium dense; dark grayish brown; wet; mostly fine to medium SAND; few fines; nonplastic.
45										45		
	-15	☒	S-10	2 6 8	14	19			PA			(0% Gravel; 94% Sand; 6% Fines)
50										50		
	-20	☒	S-11	8 10 8	18	24						
												Total Depth: 51½ Feet Groundwater at Elevation 14 Feet
55										55		
	-25											

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FIGURE

A-3 c

BORING RECORD

PROJECT NAME San Diego Riverwalk Development		**PROJECT NUMBER** IR619		**BORING** B-04 ✳
SITE LOCATION 1150 Fashion Valley Road	**START** 9/4/2014	**FINISH** 9/4/2014		**SHEET NO.** 1 of 3
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Rotary Wash	**LOGGED BY** TSL		**CHECKED BY** MAF
DRILLING EQUIPMENT Diedrich D50 Truck Rig	**BORING DIA. (in)** 6	**TOTAL DEPTH (ft)** 51.5	**GROUND ELEV (ft)** 18	**DEPTH/*ELEV.* GROUND WATER (ft)** ▼ 5.0 / *13.0*
SAMPLING METHOD Hammer: 140 lbs., Drop: 30 in. (Automatic)	**NOTES** ETR ~ 80%, N_{60} ~ 80/60 * N ~ 1.33 * N			

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		▩	B-1						PA CR EI R~75			**FILL:** POORLY GRADED SAND (SP); medium dense; dark brown; moist; mostly fine to medium SAND; few GRAVEL; trace fines; nonplastic.
	15	☒	S-2	5 5 4	9	12						**ALLUVIUM:** POORLY GRADED SAND WITH SILT (SP-SM); loose to medium dense; yellowish brown; moist to wet; mostly fine to medium SAND; few fines; little GRAVEL; nonplastic. (13% Gravel; 81% Sand; 6% Fines)
		▩										
5										5	▼	
		⧗	R-3	4 7 9	16	14	18.8	104	DS			
	10											
10										10		
		☒	S-4	3 3 4	7	9			PA			(0% Gravel; 96% Sand; 4% Fines)
	5											SILTY SAND WITH GRAVEL (SM); dense; grayish brown; wet; mostly fine to medium SAND; some GRAVEL; little fines; nonplastic.
15										15		SILTY SAND (SM); medium dense; gray brown and yellow brown; wet; mostly fine SAND; some fines; nonplastic; micaceous.
		☒	S-5	5 7 9	16	21						
	0											

FIGURE

A-4 a

BORING RECORD

PROJECT NAME San Diego Riverwalk Development
PROJECT NUMBER IR619
BORING B-04*
SITE LOCATION 1150 Fashion Valley Road
START 9/4/2014
FINISH 9/4/2014
SHEET NO. 2 of 3
DRILLING COMPANY Pacific Drilling
DRILLING METHOD Rotary Wash
LOGGED BY TSL
CHECKED BY MAF
DRILLING EQUIPMENT Diedrich D50 Truck Rig
BORING DIA. (in) 6
TOTAL DEPTH (ft) 51.5
GROUND ELEV (ft) 18
DEPTH/*ELEV.* GROUND WATER (ft) ▼ 5.0 / *13.0*
SAMPLING METHOD Hammer: 140 lbs., Drop: 30 in. (Automatic)
NOTES ETR ~ 80%, N_{60} ~ 80/60 * N ~ 1.33 * N

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	S-6	5 8 8	16	21			PA			**ALLUVIUM:** POORLY GRADED SAND WITH SILT (SP-SM); medium dense; dark gray; wet; mostly fine to medium SAND; few fines; nonplastic. (0% Gravel; 90% Sand; 10% Fines)
	-5											
25										25		
		☒	S-7	4 4 9	13	17						
	-10											
												SILTY SAND (SM); loose to medium dense; dark gray; wet; mostly fine SAND; little fines; nonplastic; micaceous. (0% Gravel; 82% Sand; 18% Fines)
30										30		
		☒	S-8	5 3 3	6	8			PA			
	-15											
35										35		
		☒	S-9	6 11 13	24	32						
	-20											

BORING RECORD

PROJECT NAME San Diego Riverwalk Development
PROJECT NUMBER IR619
BORING B-04*
SITE LOCATION 1150 Fashion Valley Road
START 9/4/2014
FINISH 9/4/2014
SHEET NO. 3 of 3
DRILLING COMPANY Pacific Drilling
DRILLING METHOD Rotary Wash
LOGGED BY TSL
CHECKED BY MAF
DRILLING EQUIPMENT Diedrich D50 Truck Rig
BORING DIA. (in) 6
TOTAL DEPTH (ft) 51.5
GROUND ELEV (ft) 18
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ 5.0 / *13.0*
SAMPLING METHOD Hammer: 140 lbs., Drop: 30 in. (Automatic)
NOTES ETR ~ 80%, N_{60} ~ 80/60 * N ~ 1.33 * N

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	S-10	6 7 6	13	17			PA			**ALLUVIUM:** SILTY SAND (SM); medium dense; dark gray; wet; mostly fine to medium SAND; little fines; nonplastic. (0% Gravel; 85% Sand; 15% Fines)
	-25											
45										45		POORLY GRADED SAND WITH SILT (SP-SM); medium dense to dense; light gray; wet; mostly fine to coarse SAND; few fines; nonplastic.
		☒	S-11	7 9 11	20	27						
	-30											
50										50		
		☒	S-12	11 12 15	27	36			PA			(0% Gravel; 92% Sand; 8% Fines)
												Total Depth: 51½ Feet Groundwater at Elevation 13 Feet
	-35											
55										55		
	-40											

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FIGURE

A-4 c

BORING RECORD

PROJECT NAME San Diego Riverwalk Development
PROJECT NUMBER IR619
BORING B-05 *
SITE LOCATION 1150 Fashion Valley Road
START 9/3/2014
FINISH 9/3/2014
SHEET NO. 1 of 3
DRILLING COMPANY Pacific Drilling
DRILLING METHOD Rotary Wash
LOGGED BY TSL
CHECKED BY MAF
DRILLING EQUIPMENT Diedrich D50 Truck Rig
BORING DIA. (in) 6
TOTAL DEPTH (ft) 56.5
GROUND ELEV (ft) 20
DEPTH/*ELEV.* GROUND WATER (ft) ▼ 9.0 / *11.0*
SAMPLING METHOD Hammer: 140 lbs., Drop: 30 in. (Automatic)
NOTES ETR ~ 80%, N_{60} ~ 80/60 * N ~ 1.33 * N

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		▨	B-1						PA PI CR EI			**FILL:** SILTY SAND (SM); loose; brown; moist; mostly fine SAND; some fines; nonplastic; micaceous. (0% Gravel; 55% Sand; 45% Fines)
		☒	S-2	2 1 2	3	4						**ALLUVIUM:** SILT WITH SAND (ML); loose; brown; moist to wet; mostly fines; little SAND; low plasticity. (0% Gravel; 27% Sand; 73% Fines)
		▨										
5	15									5		
		☒	S-3	1 1 1	2	3			PA			
											▼	
10	10									10		
		☒	S-4	2 3 4	7	9						
												POORLY GRADED SAND (SP); loose to medium dense; gray; wet; mostly fine to medium SAND; trace fines; nonplastic.
15	5									15		
		☒	S-5	4 4 5	9	12			PA			(0% Gravel; 96% Sand; 4% Fines)

GDC_LOG_BORING_MMX_SOIL_SD IR619 LOGS.GPJ GDCLOG.GDT 9/22/14

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE A-5 a

BORING RECORD

PROJECT NAME: San Diego Riverwalk Development
PROJECT NUMBER: IR619
BORING: B-05
SITE LOCATION: 1150 Fashion Valley Road
START: 9/3/2014
FINISH: 9/3/2014
SHEET NO.: 2 of 3
DRILLING COMPANY: Pacific Drilling
DRILLING METHOD: Rotary Wash
LOGGED BY: TSL
CHECKED BY: MAF
DRILLING EQUIPMENT: Diedrich D50 Truck Rig
BORING DIA. (in): 6
TOTAL DEPTH (ft): 56.5
GROUND ELEV (ft): 20
DEPTH/*ELEV.* GROUND WATER (ft): ⊻ 9.0 / *11.0*
SAMPLING METHOD: Hammer: 140 lbs., Drop: 30 in. (Automatic)
NOTES: ETR ~ 80%, N_{60} ~ 80/60 * N ~ 1.33 * N

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	S-6	3 3 5	8	11						**ALLUVIUM**: POORLY GRADED SAND WITH SILT (SP-SM); medium dense; gray; wet; mostly fine to medium SAND; few fines; nonplastic.
25	-5	☒	S-7	4 4 5	9	12			PA	25		(0% Gravel; 93% Sand; 7% Fines)
												SANDY SILT (ML) interbedded with SILTY SAND (SM); loose; dark grayish brown; wet; mostly fines; some SAND; trace GRAVEL; low plasticity. Thin layer of gravel at 28 feet.
30	-10	☒	S-8	4 3 4	7	9				30		
35	-15	☒	S-9	3 2 2	4	5			PA	35		(0% Gravel; 57% Sand; 43% Fines)

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FIGURE A-5 b

BORING RECORD

PROJECT NAME San Diego Riverwalk Development
PROJECT NUMBER IR619
BORING B-05 *
SITE LOCATION 1150 Fashion Valley Road
START 9/3/2014
FINISH 9/3/2014
SHEET NO. 3 of 3
DRILLING COMPANY Pacific Drilling
DRILLING METHOD Rotary Wash
LOGGED BY TSL
CHECKED BY MAF
DRILLING EQUIPMENT Diedrich D50 Truck Rig
BORING DIA. (in) 6
TOTAL DEPTH (ft) 56.5
GROUND ELEV (ft) 20
DEPTH/*ELEV.* GROUND WATER (ft) ▼ 9.0 / *11.0*
SAMPLING METHOD Hammer: 140 lbs., Drop: 30 in. (Automatic)
NOTES ETR ~ 80%, N_{60} ~ 80/60 * N ~ 1.33 * N

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-10	4 5 7	12	11	35.5	84	DS			**ALLUVIUM:** SILTY SAND (SM) interbedded with SANDY SILT (ML); medium dense; dark grayish brown; wet; mostly SAND; some fines; nonplastic.
45	-25									45		
			S-11	3 3 8	11	15			PA			(0% Gravel; 58% Sand; 42% Fines)
												POORLY GRADED SAND (SP); medium dense to dense; grayish brown; wet; mostly fine to medium SAND; few fines; nonplastic.
50	-30									50		
			S-12	8 9 11	20	27						
55	-35									55		
			S-13	9 11 15	26	35						
												Total Depth: 56½ Feet Groundwater at Elevation 11 Feet

GDC_LOG_BORING_MMX_SOIL_SD IR619 LOGS.GPJ GDCLOG.GDT 9/22/14

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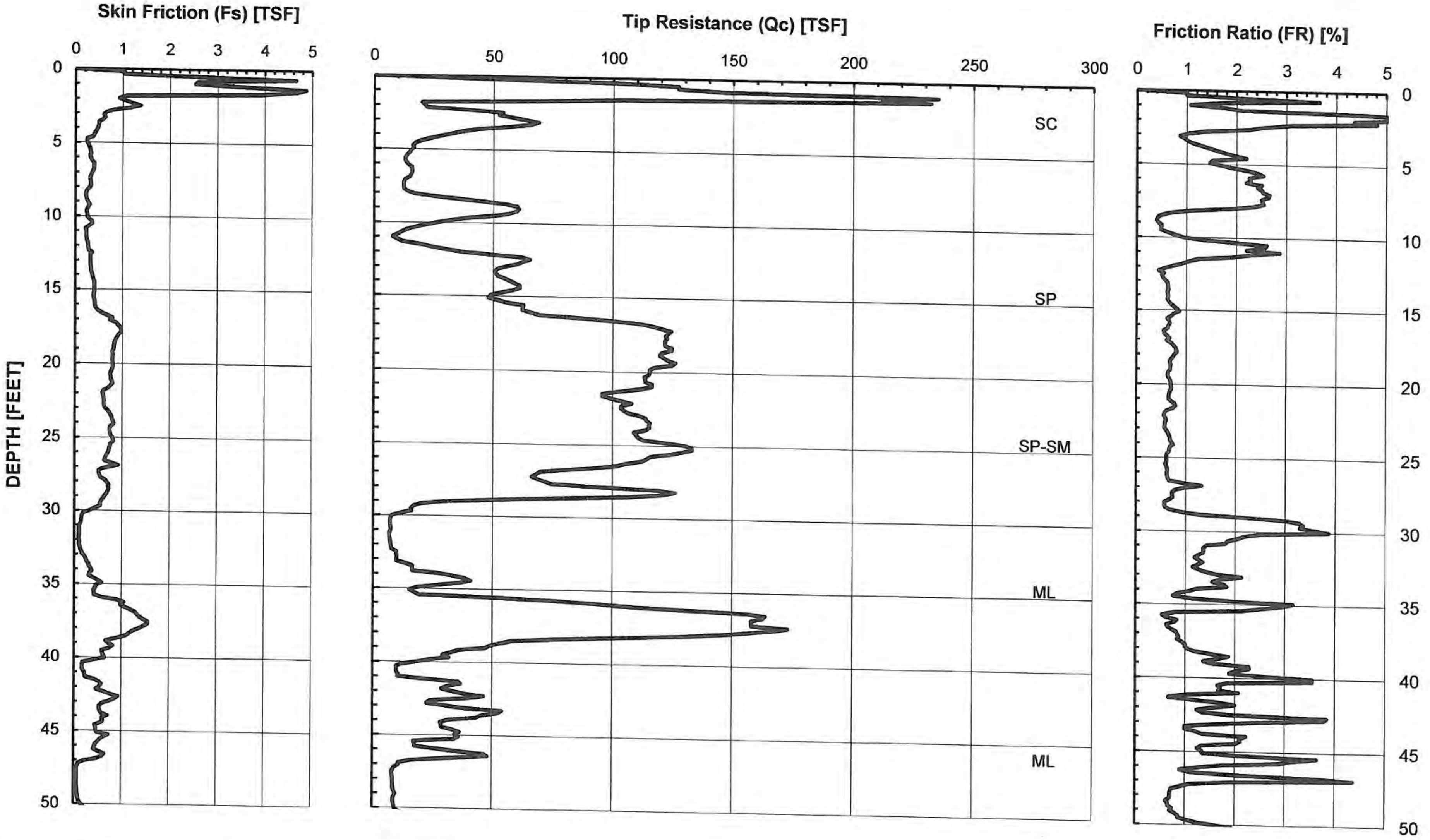
THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

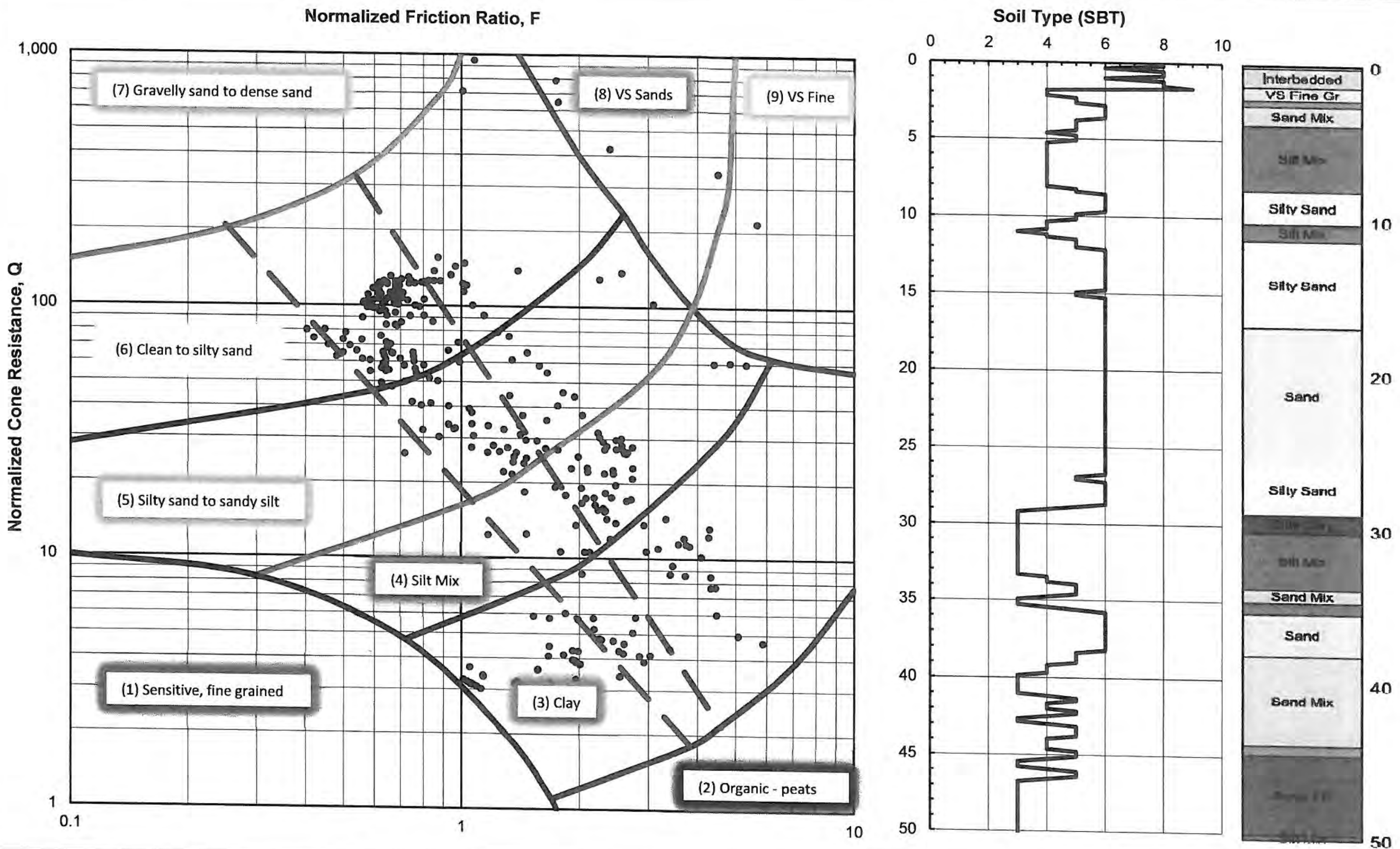
FIGURE
A-5 c



GROUP DELTA

CONE PENETOMETER DATA (CPT-1)*

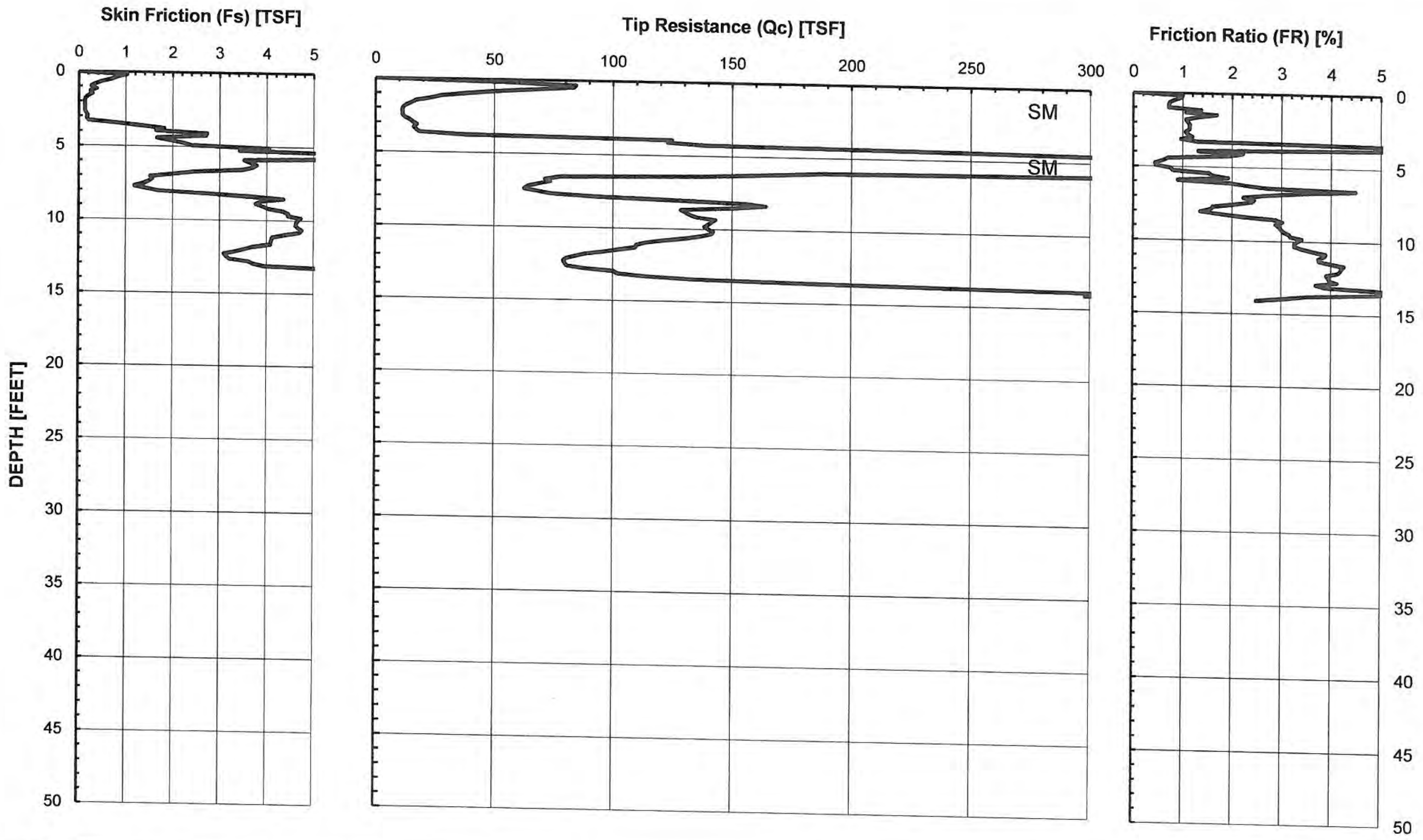
Document No. 14-0153
Project No. IR619
FIGURE A-6a



GROUP DELTA

SOIL CLASSIFICATION (CPT-1) ✱

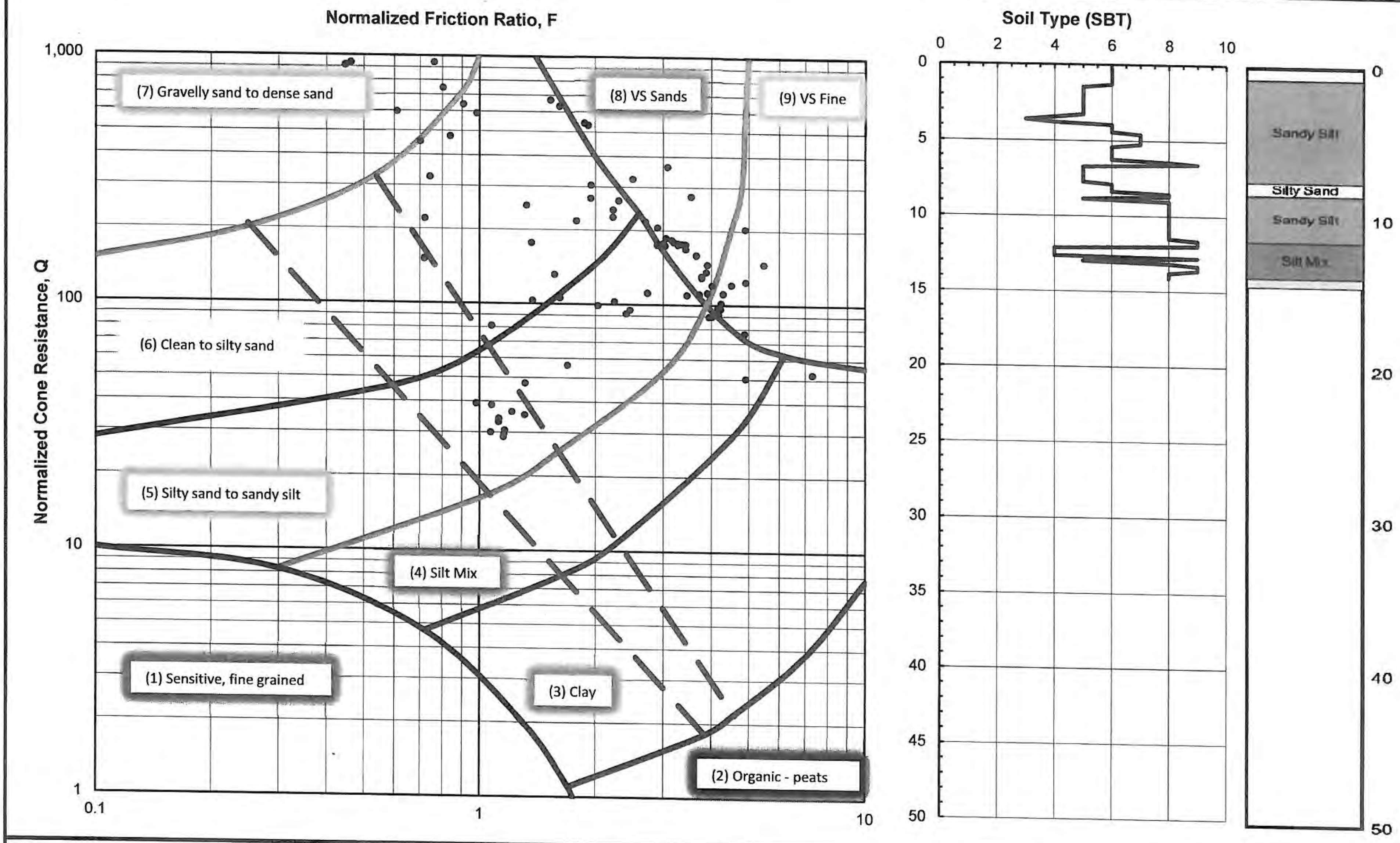
Document No. 14-0153
Project No. IR619
FIGURE A-6b



GROUP DELTA

CONE PENETOMETER DATA (CPT-2) *

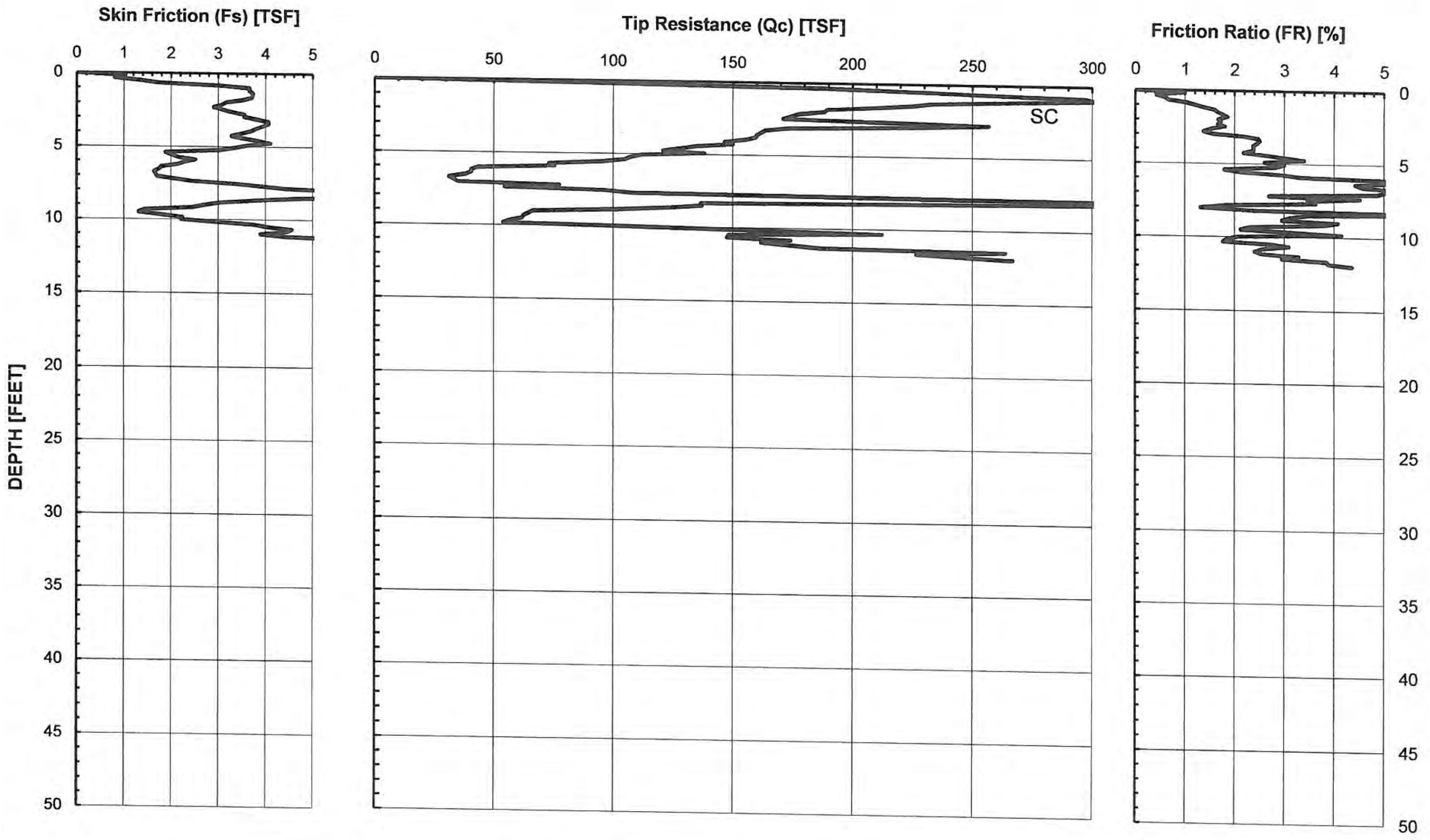
Document No. 14-0153
Project No. IR619
FIGURE A-7a



GROUP DELTA

SOIL CLASSIFICATION (CPT-2) *

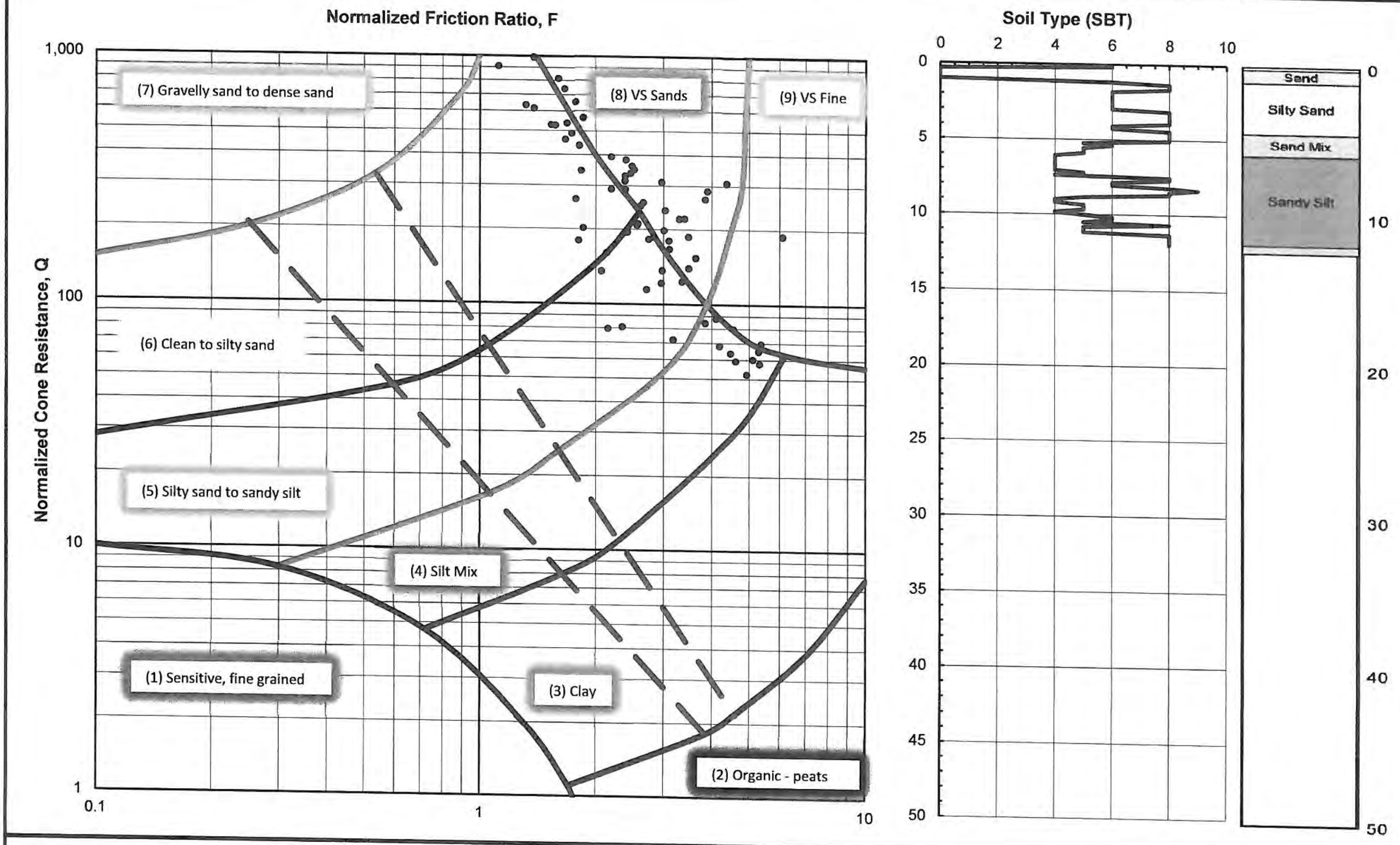
Document No. 14-0153
Project No. IR619
FIGURE A-7b



GROUP DELTA

CONE PENETOMETER DATA (CPT-3)*

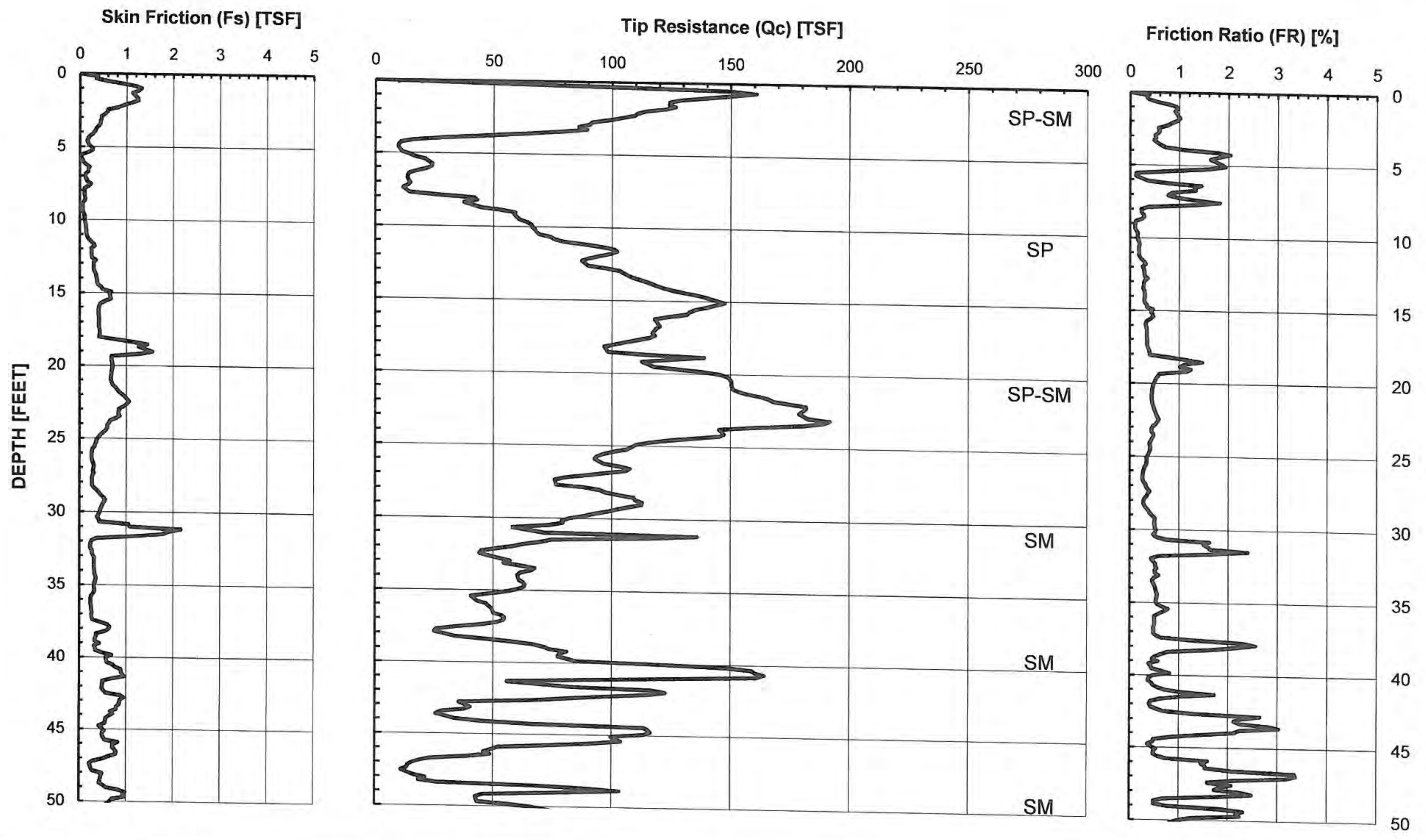
Document No. 14-0153
Project No. IR619
FIGURE A-8a



GROUP DELTA

SOIL CLASSIFICATION (CPT-3) *

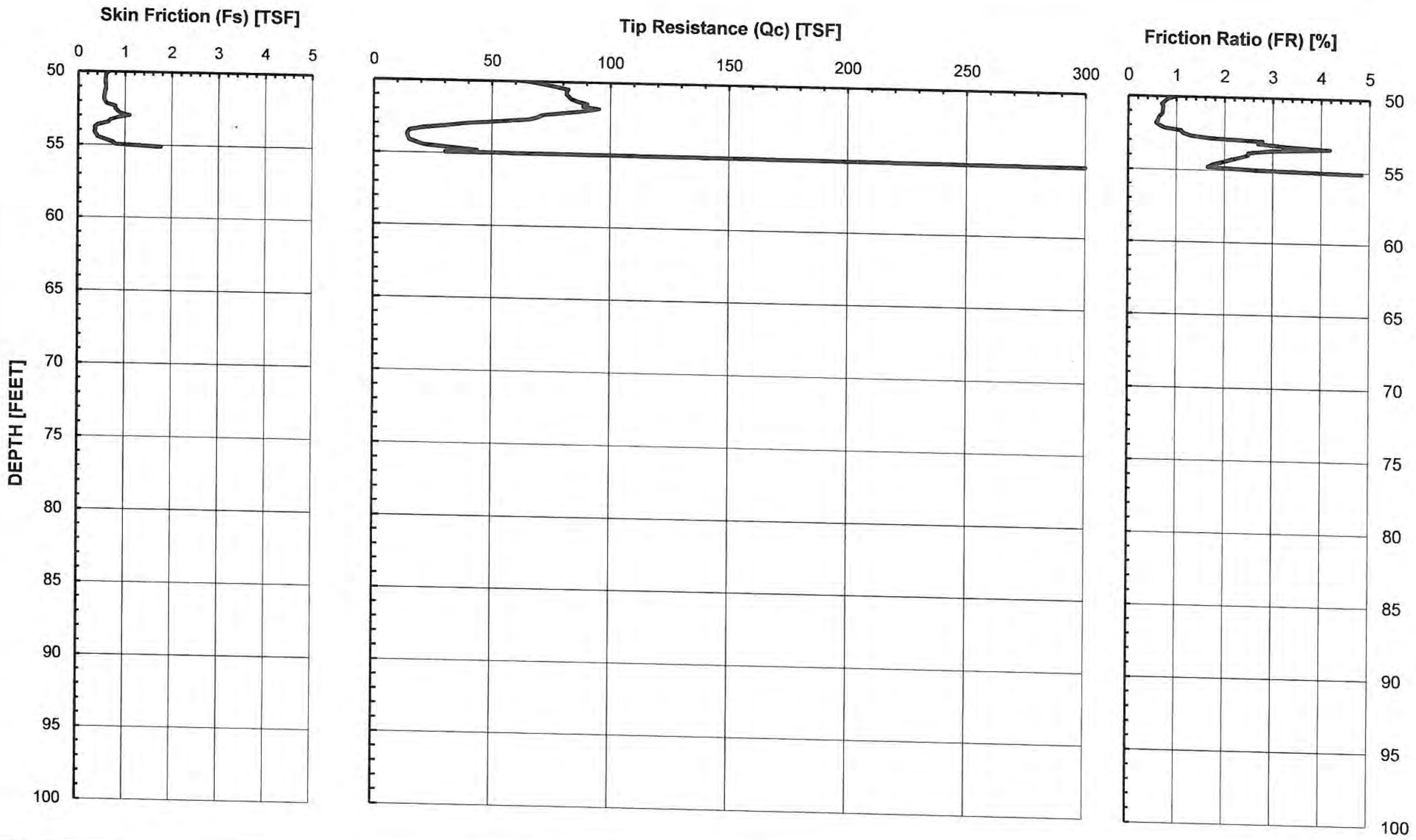
Document No. 14-0153
Project No. IR619
FIGURE A-8b



GROUP DELTA

CONE PENETOMETER DATA (CPT-4)*

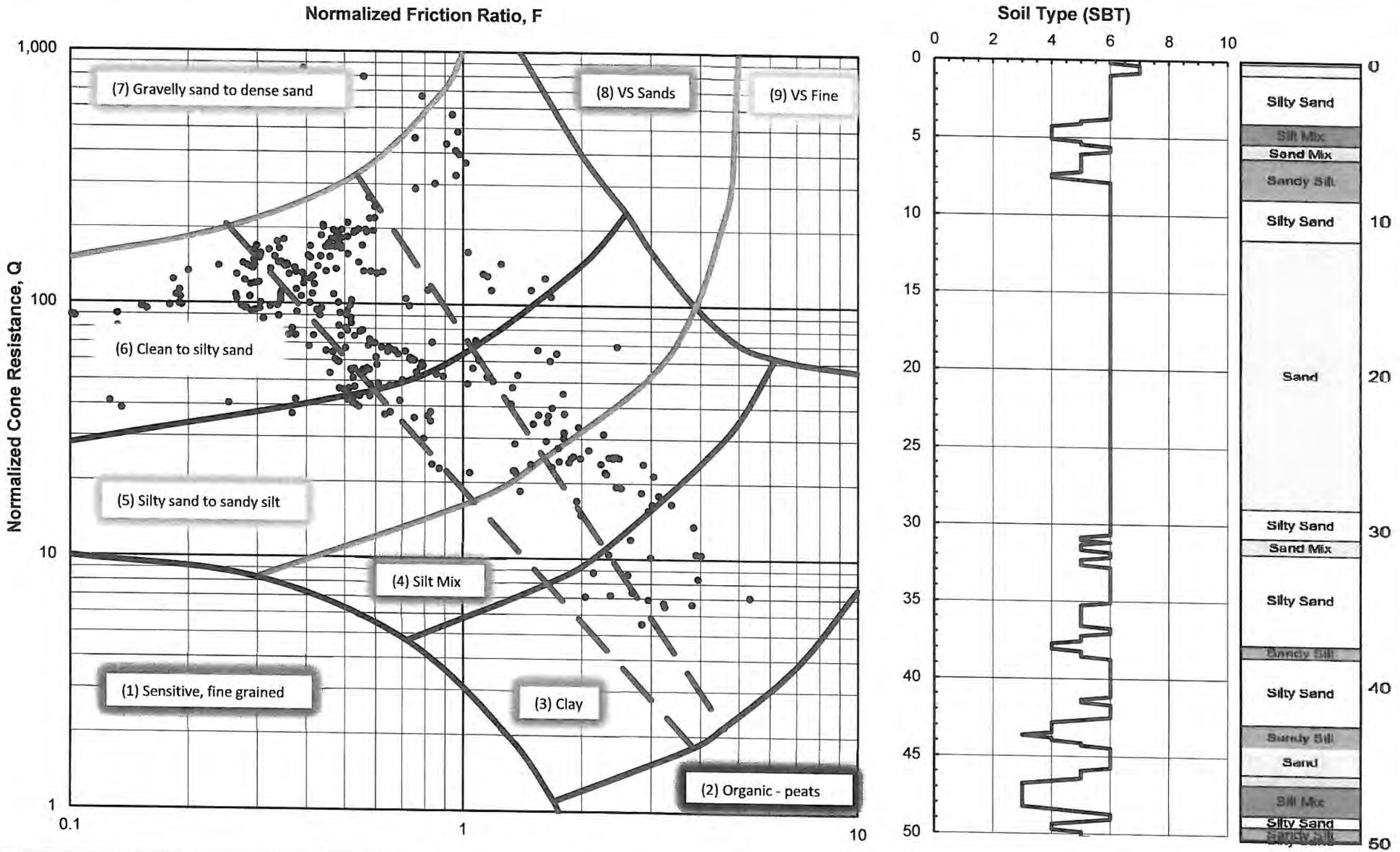
Document No. 14-0153
Project No. IR619
FIGURE A-9a



GROUP DELTA

CONE PENETOMETER DATA (CPT-4)*

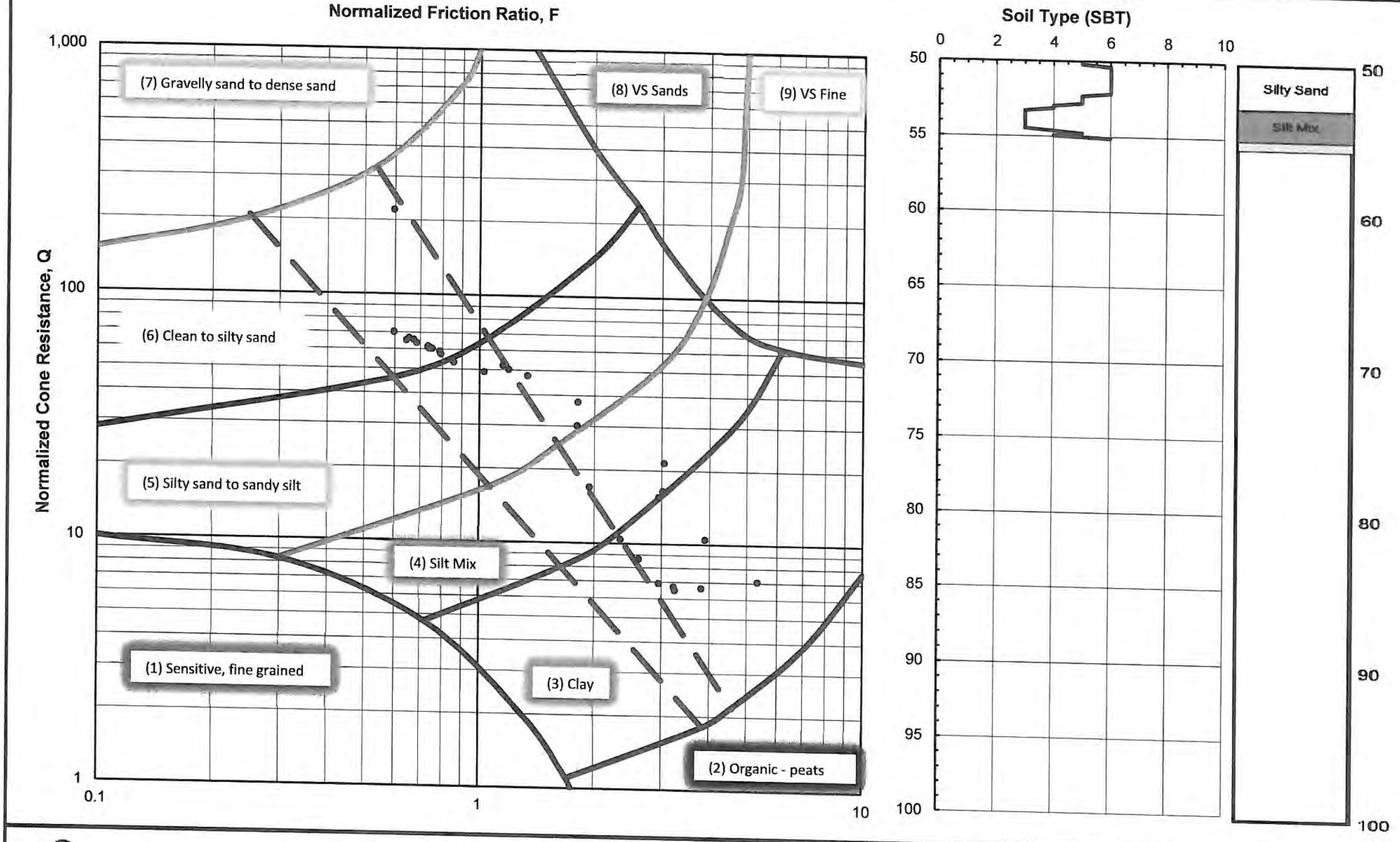
Document No. 14-0153
Project No. IR619
FIGURE A-9a



GROUP DELTA

SOIL CLASSIFICATION (CPT-4)*

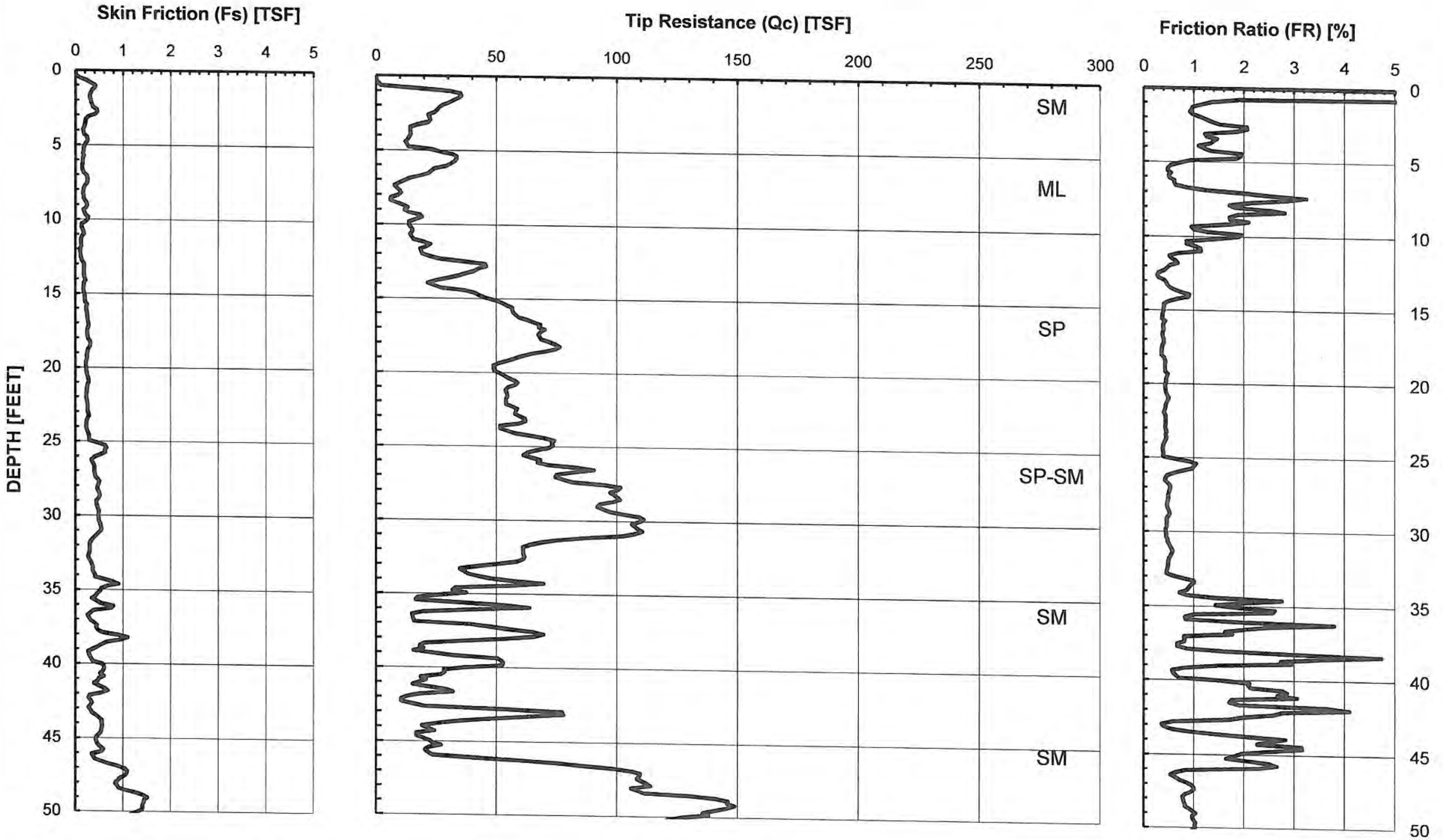
Document No. 14-0153
Project No. IR619
FIGURE A-9b



GROUP DELTA

SOIL CLASSIFICATION (CPT-4)*

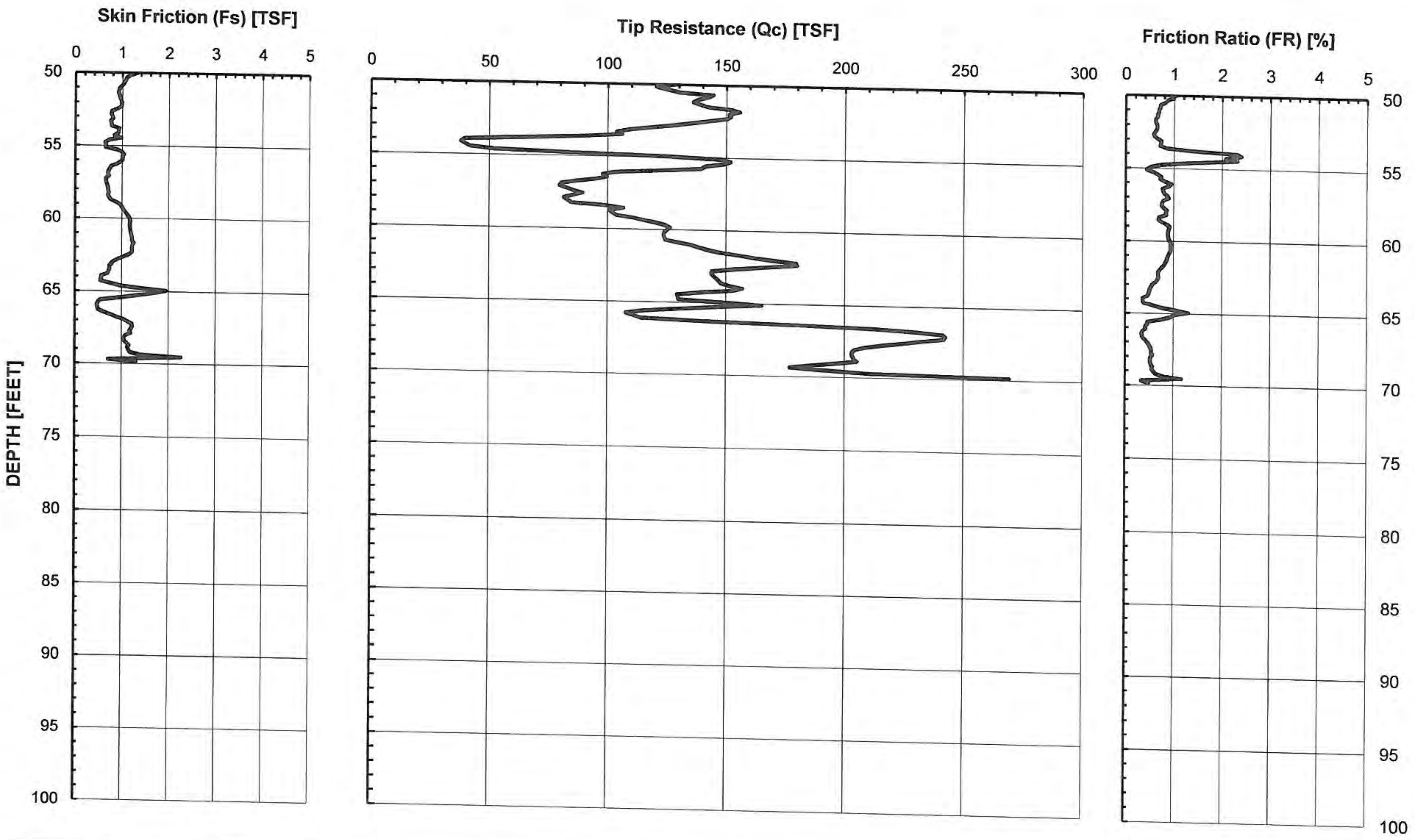
Document No. 14-0153
Project No. IR619
FIGURE A-9b



GROUP DELTA

CONE PENETOMETER DATA (CPT-5)*

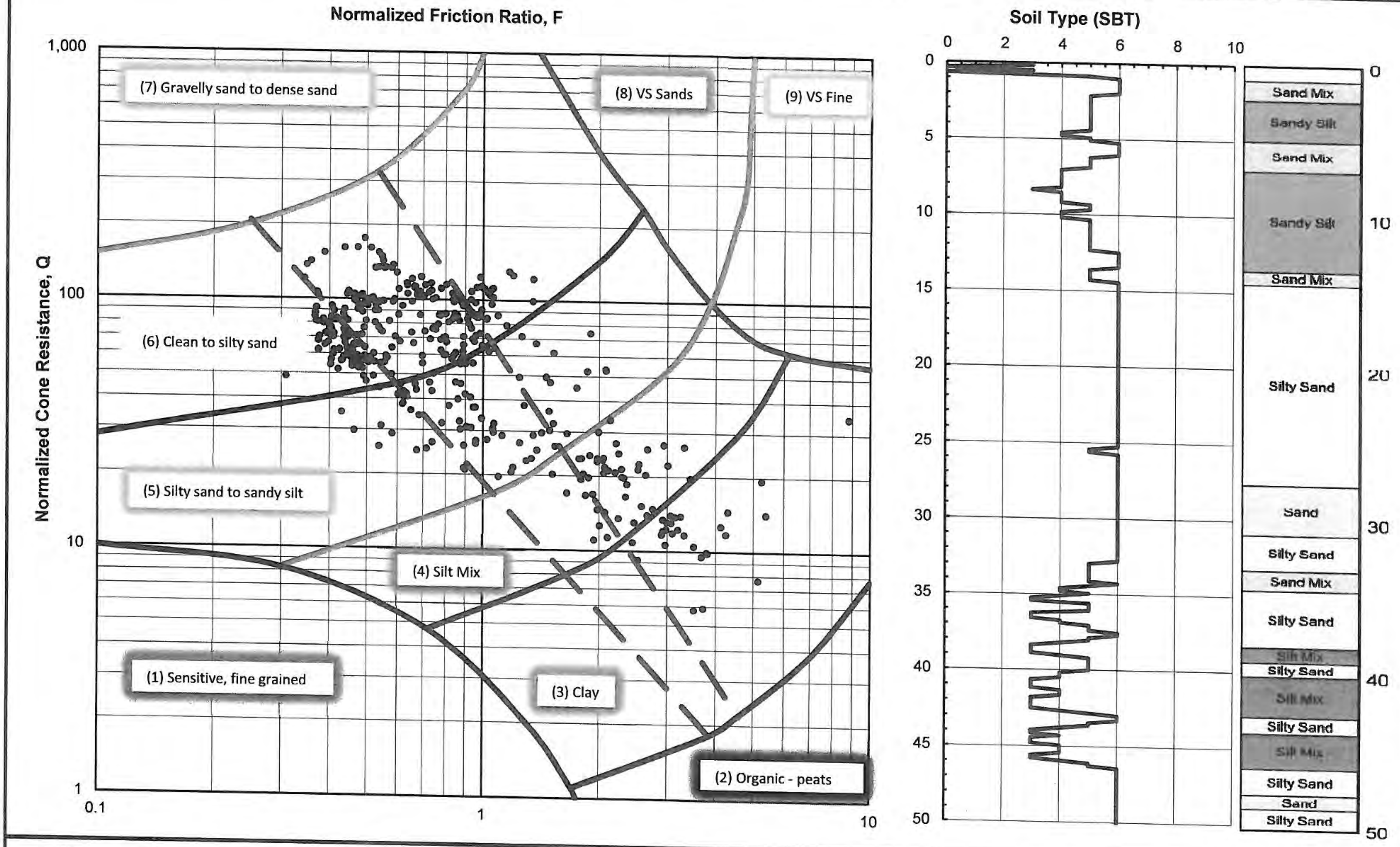
Document No. 14-0153
Project No. IR619
FIGURE A-10a



GROUP DELTA

CONE PENETOMETER DATA (CPT-5)*

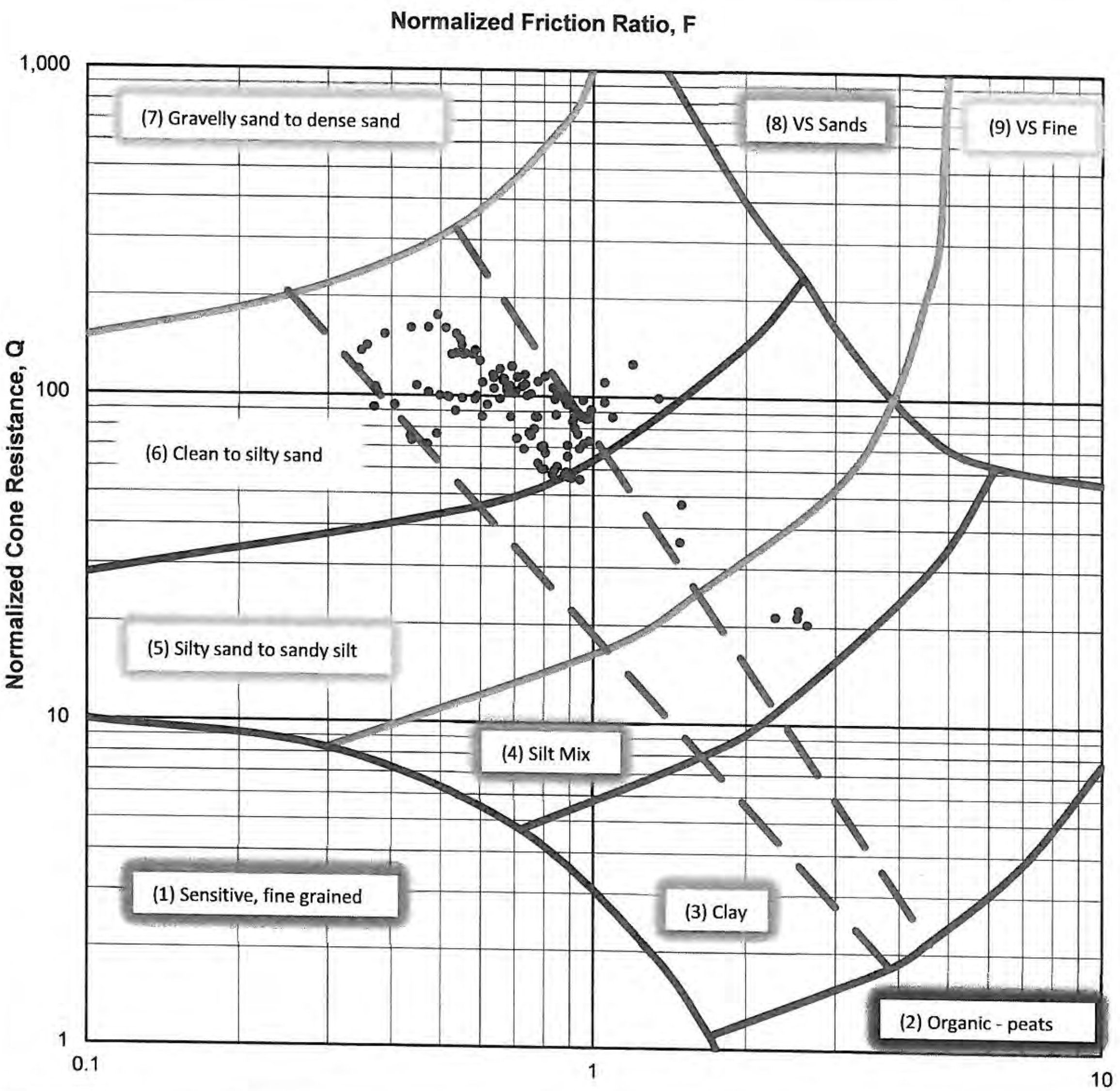
Document No. 14-0153
Project No. IR619
FIGURE A-10a

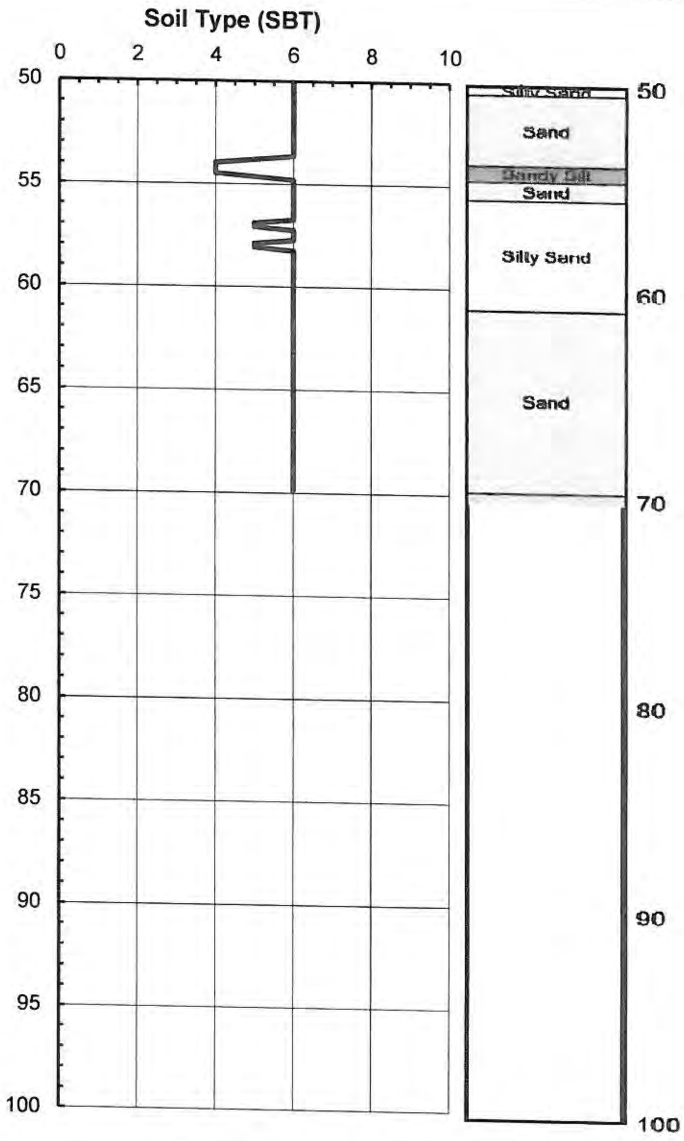


GROUP DELTA

SOIL CLASSIFICATION (CPT-5)*

Document No. 14-0153
Project No. IR619
FIGURE A-10b

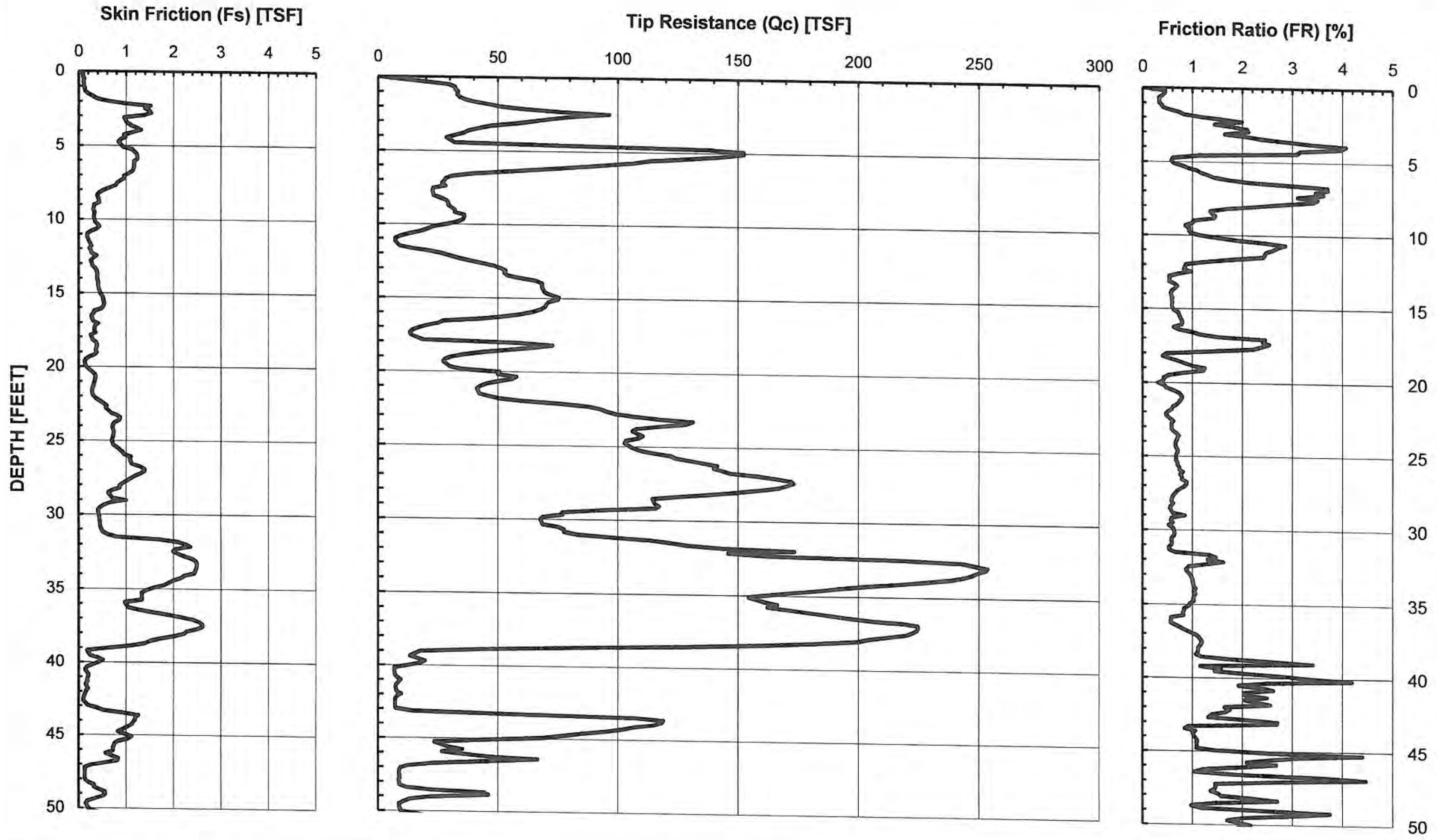




GROUP DELTA

SOIL CLASSIFICATION (CPT-5) *

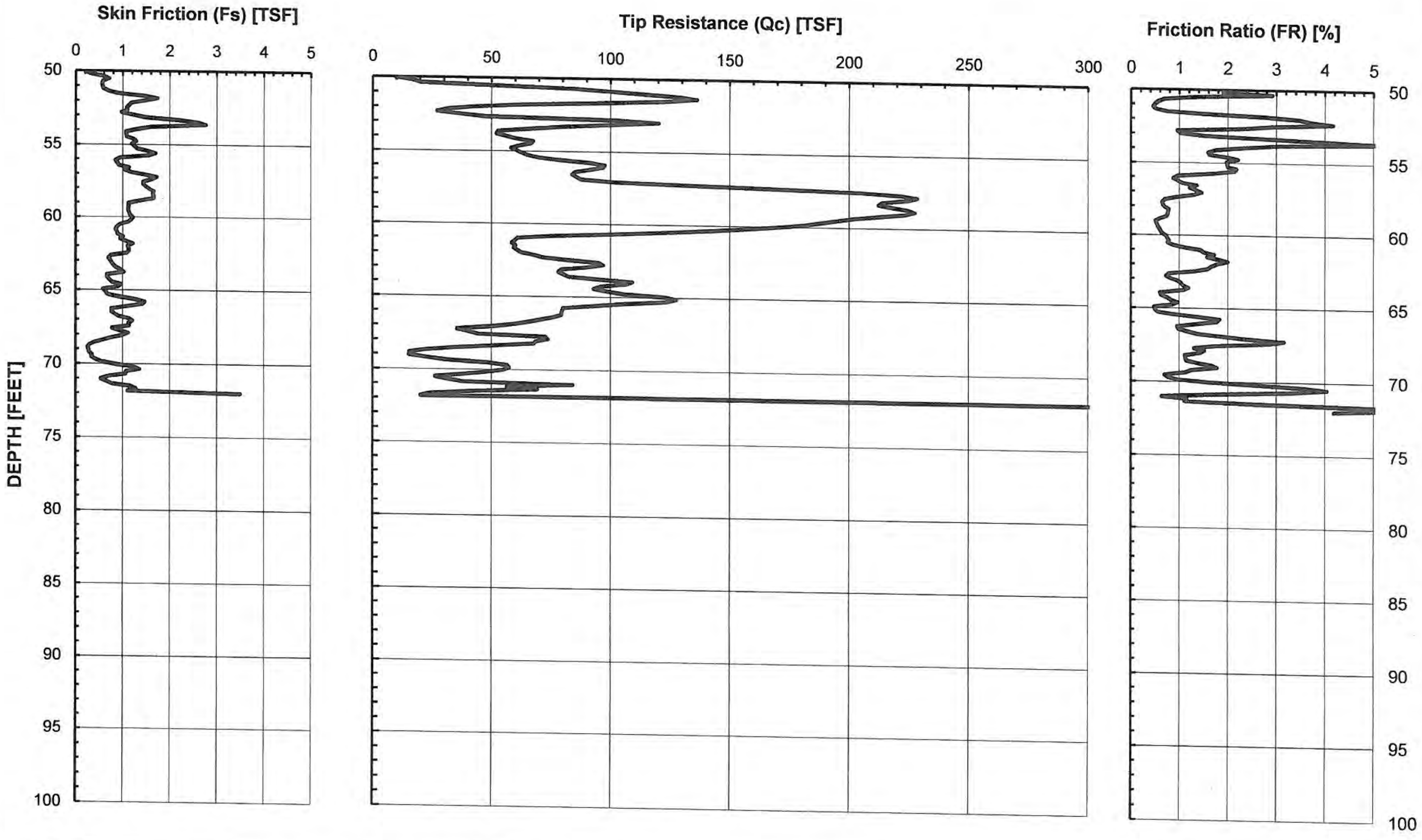
Document No. 14-0153
Project No. IR619
FIGURE A-10b



GROUP DELTA

CONE PENETOMETER DATA (CPT-6)*

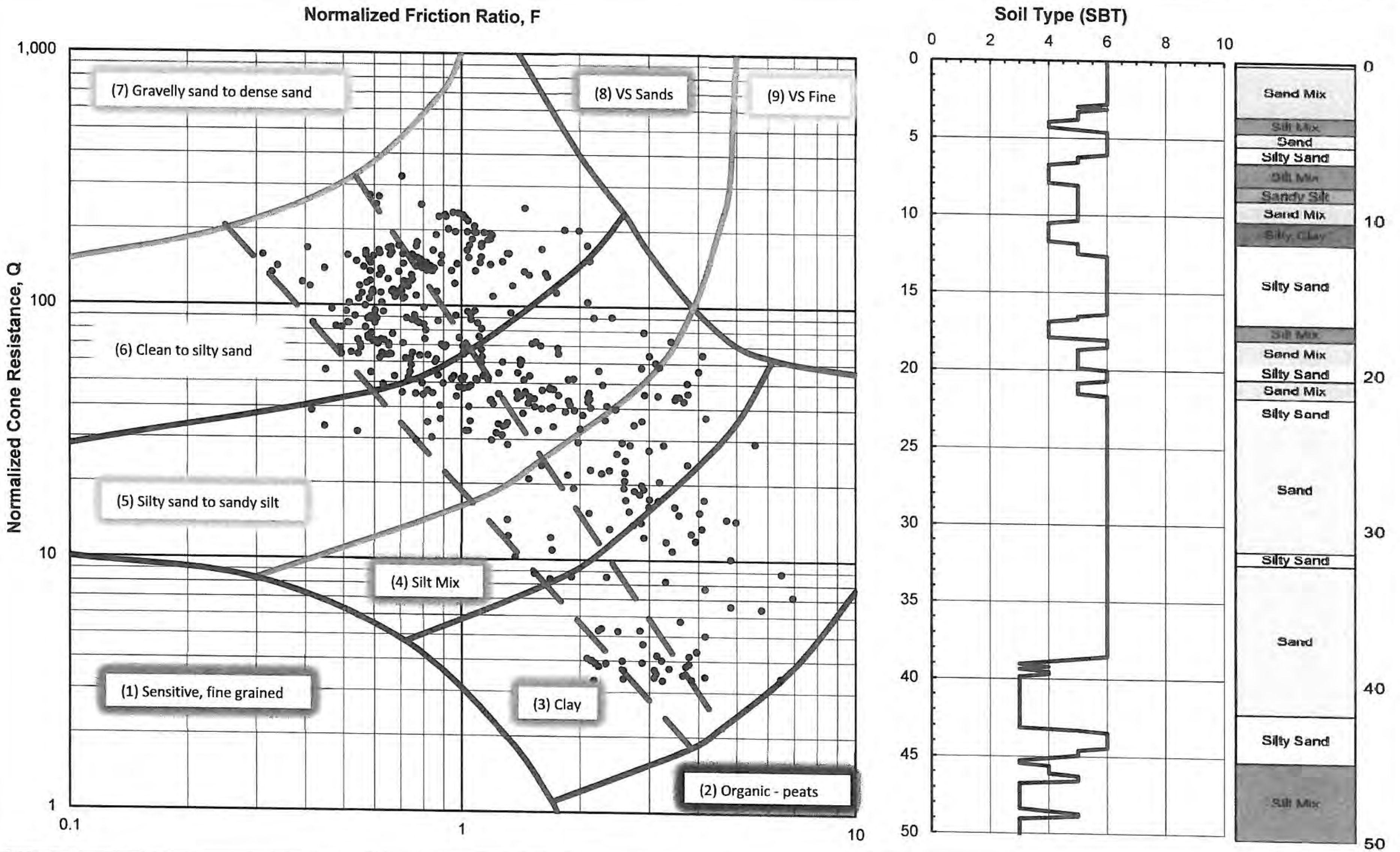
Document No. 14-0153
Project No. IR619
FIGURE A-11a



GROUP DELTA

CONE PENETOMETER DATA (CPT-6)*

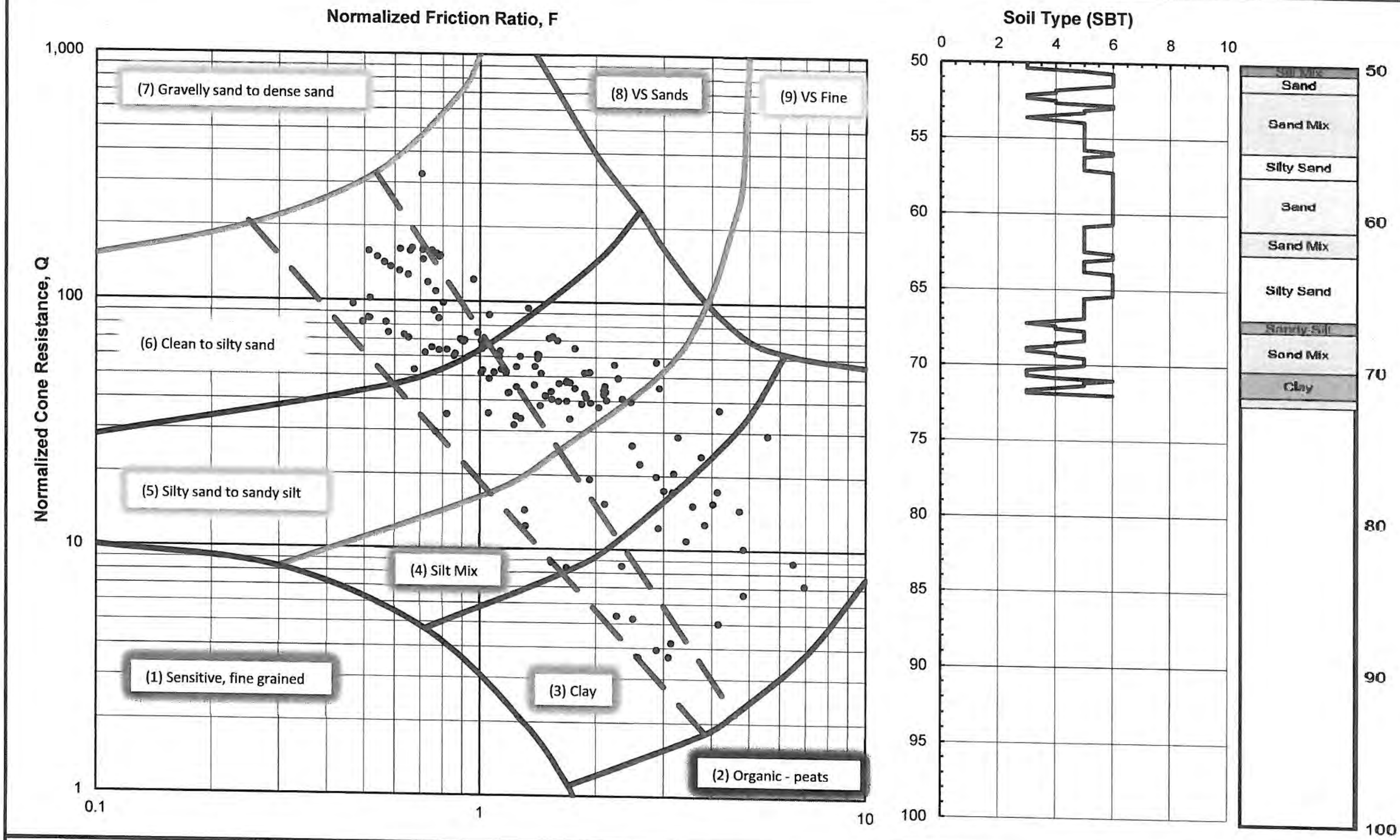
Document No. 14-0153
Project No. IR619
FIGURE A-11a



GROUP DELTA

SOIL CLASSIFICATION (CPT-6) *

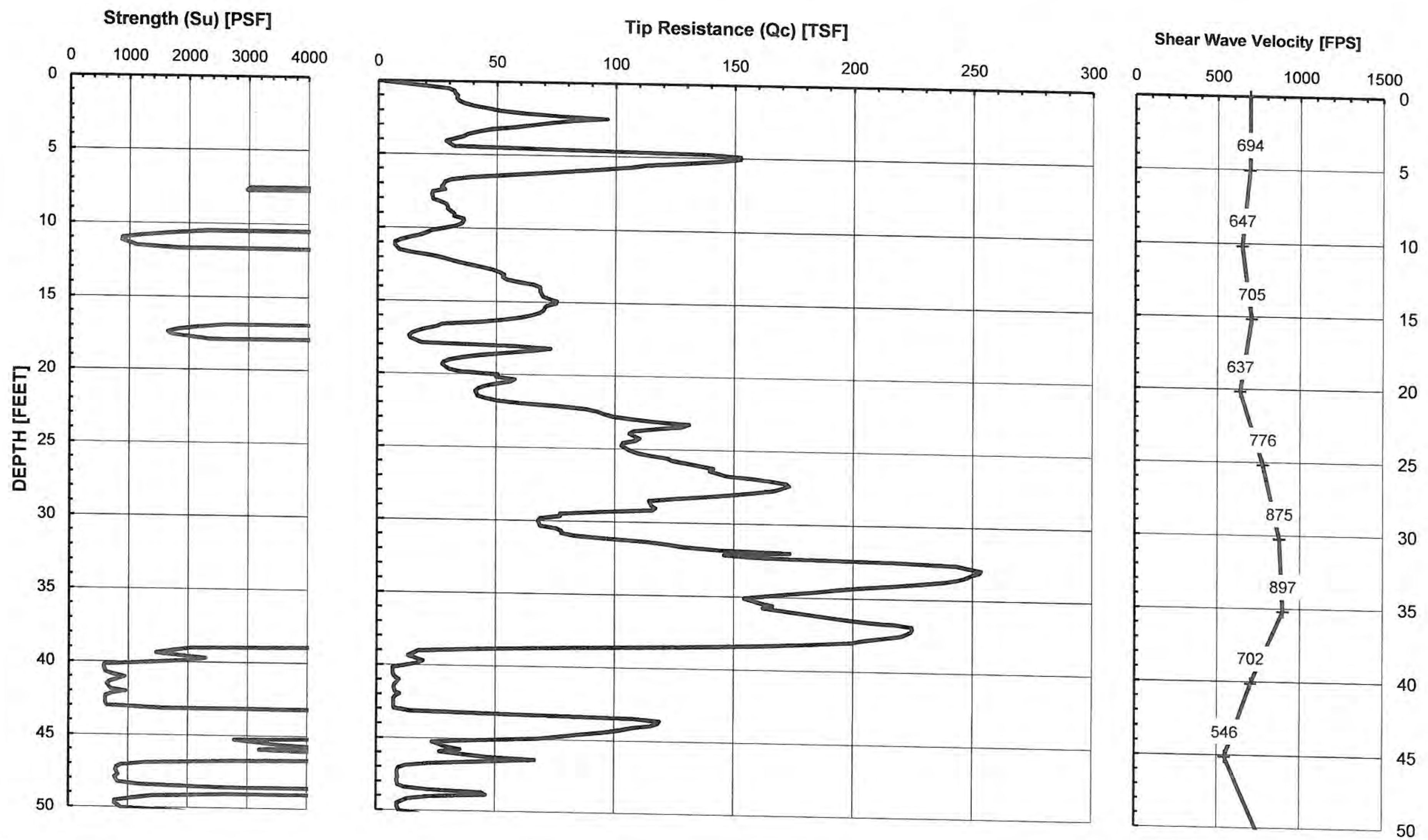
Document No. 14-0153
Project No. IR619
FIGURE A-11b



GROUP DELTA

SOIL CLASSIFICATION (CPT-6)*

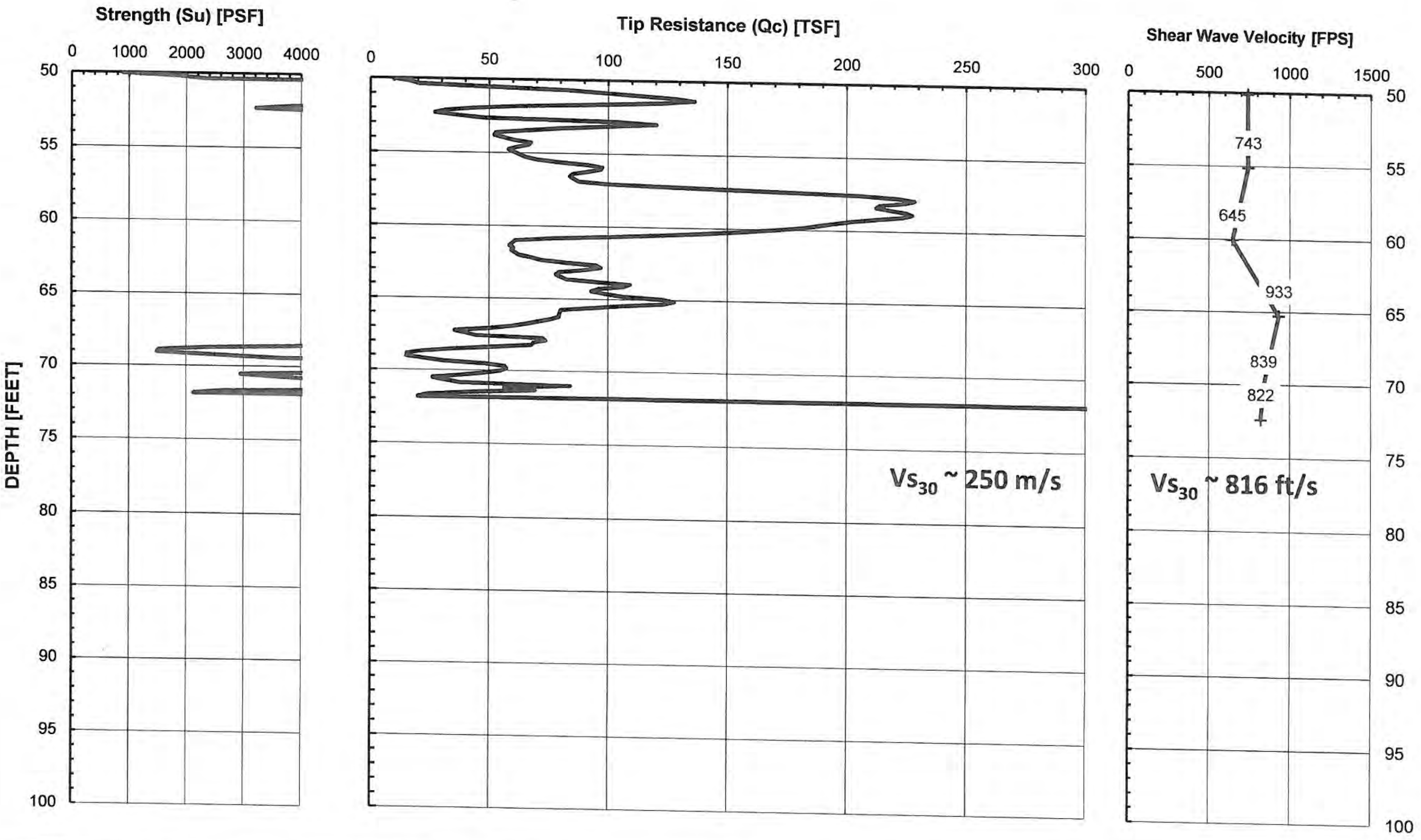
Document No. 14-0153
Project No. IR619
FIGURE A-11b



GROUP DELTA

SHEAR WAVE VELOCITY DATA (CPT-6)*

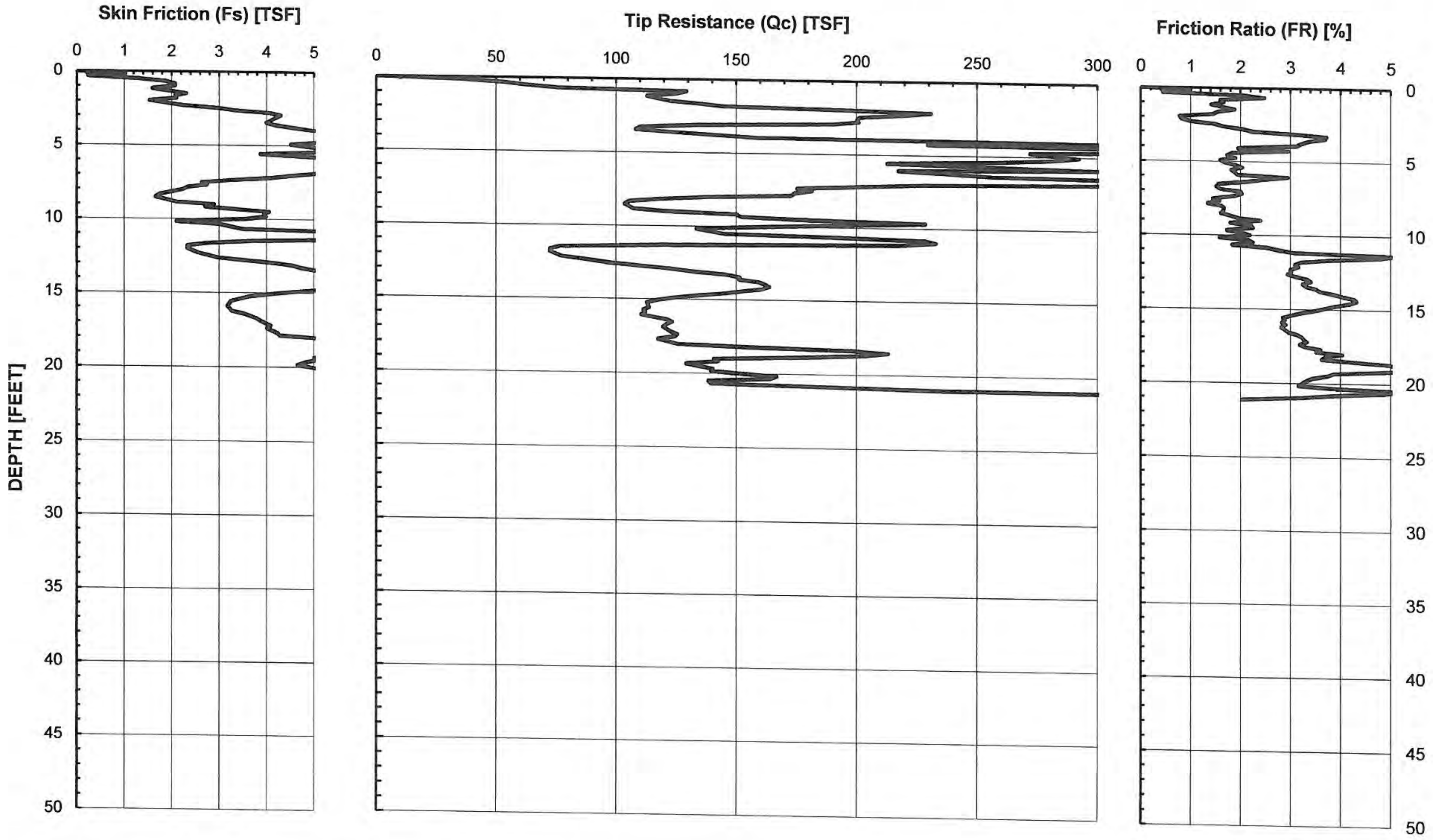
Document No. 14-0153
Project No. IR619
FIGURE A-11c



GROUP DELTA

SHEAR WAVE VELOCITY DATA (CPT-6)✳

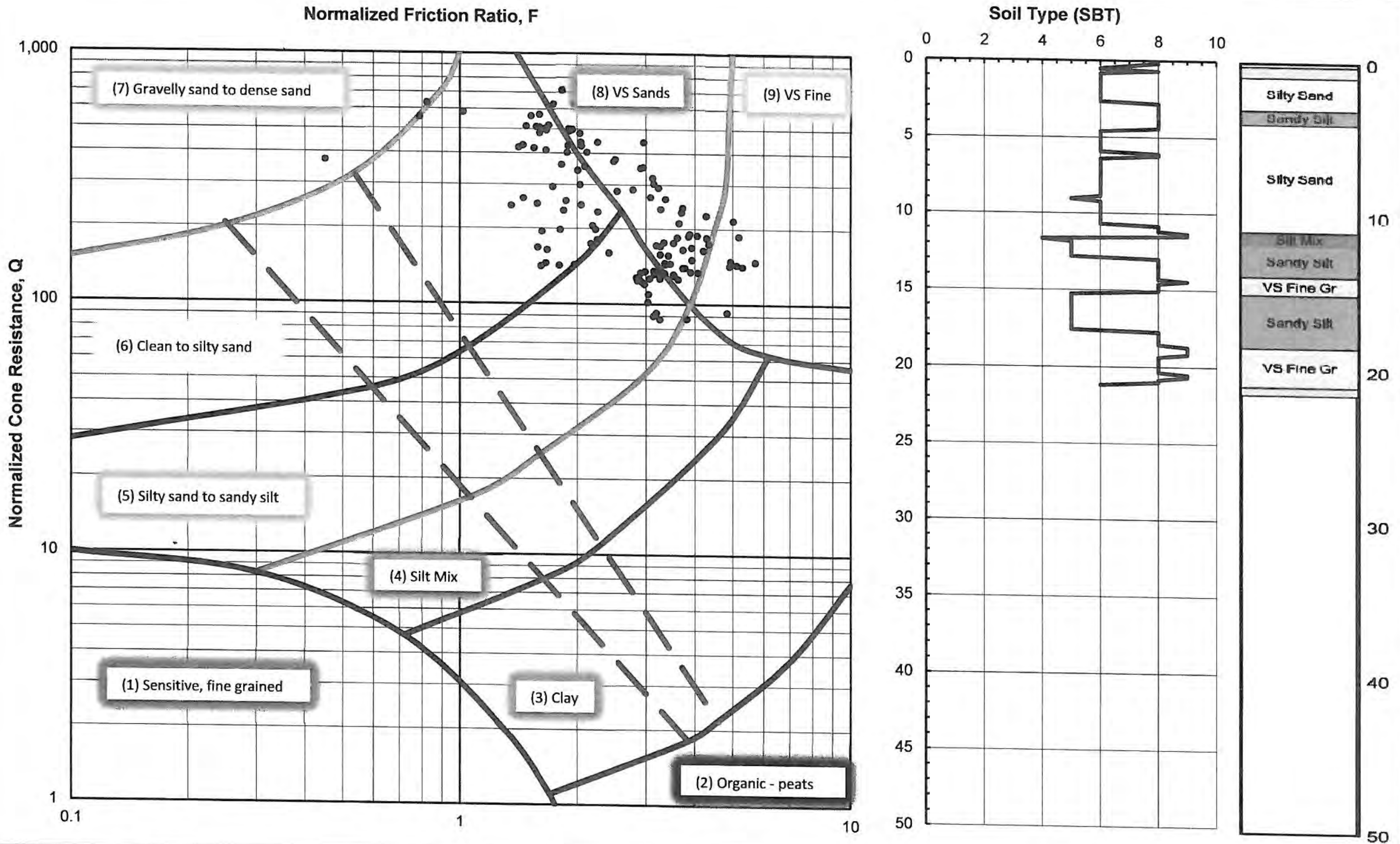
Document No. 14-0153
Project No. IR619
FIGURE A-11c



GROUP DELTA

CONE PENETOMETER DATA (CPT-7)*

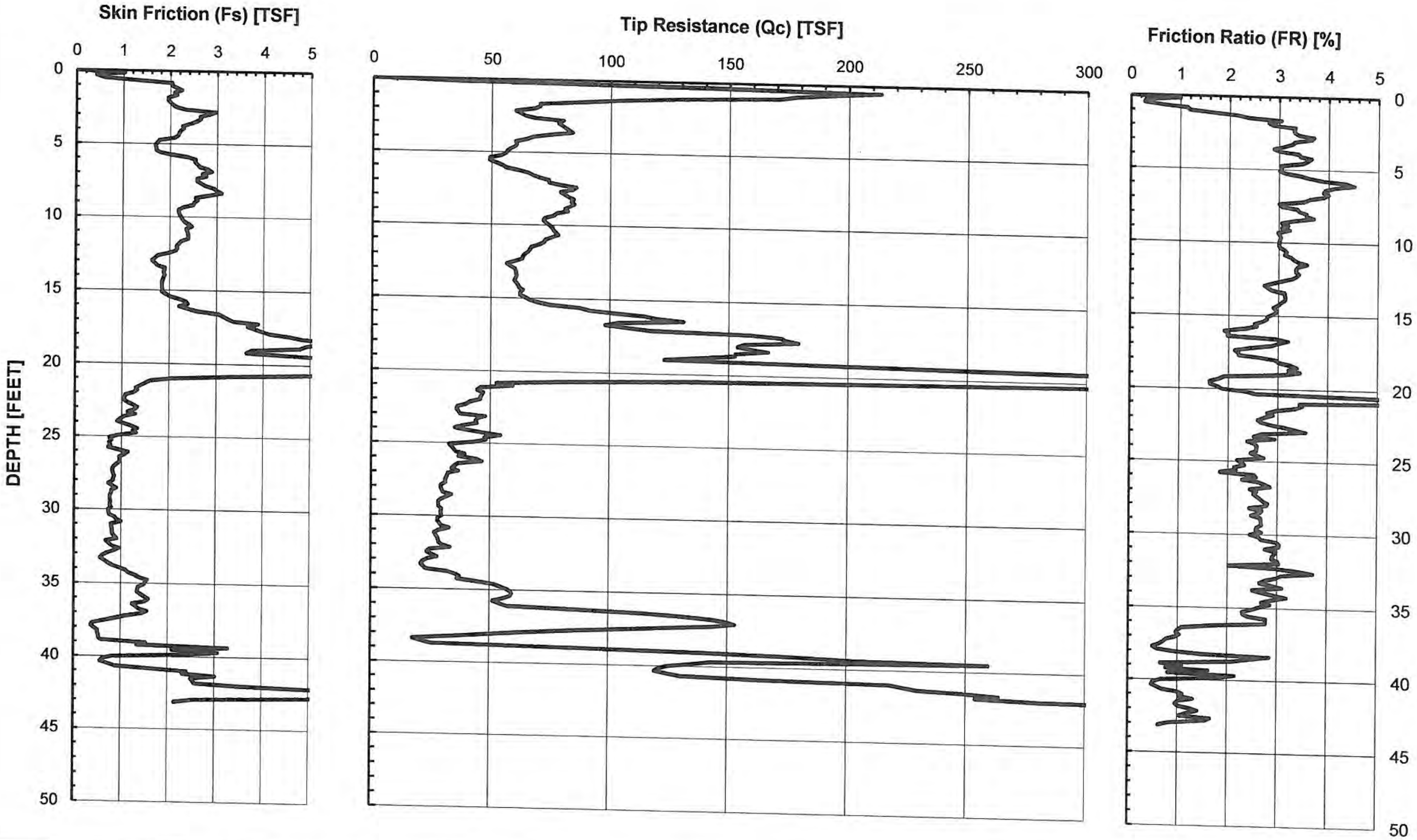
Document No. 14-0153
Project No. IR619
FIGURE A-12a



GROUP DELTA

SOIL CLASSIFICATION (CPT-7) *

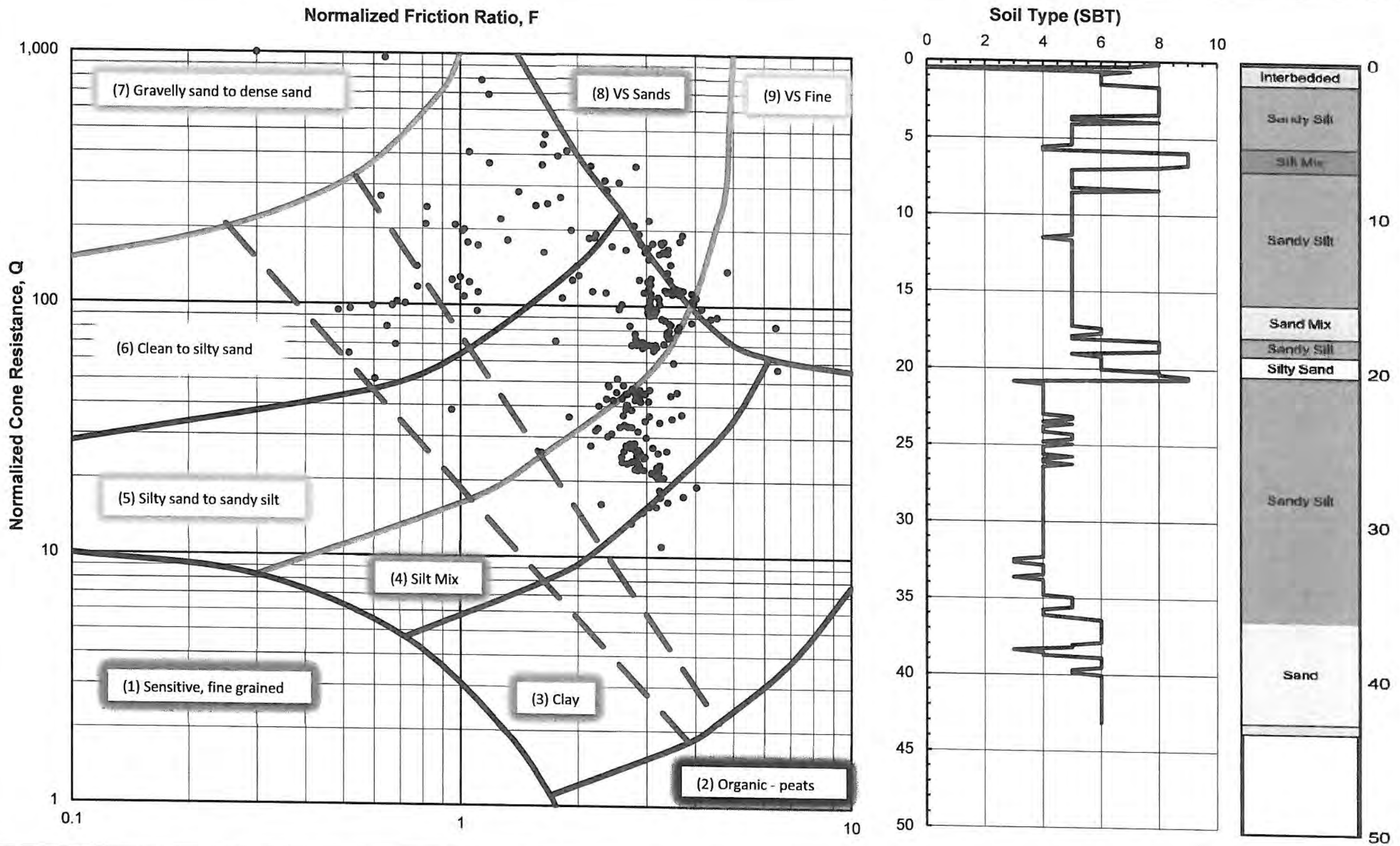
Document No. 14-0153
Project No. IR619
FIGURE A-12b



GROUP DELTA

CONE PENETOMETER DATA (CPT-8)*

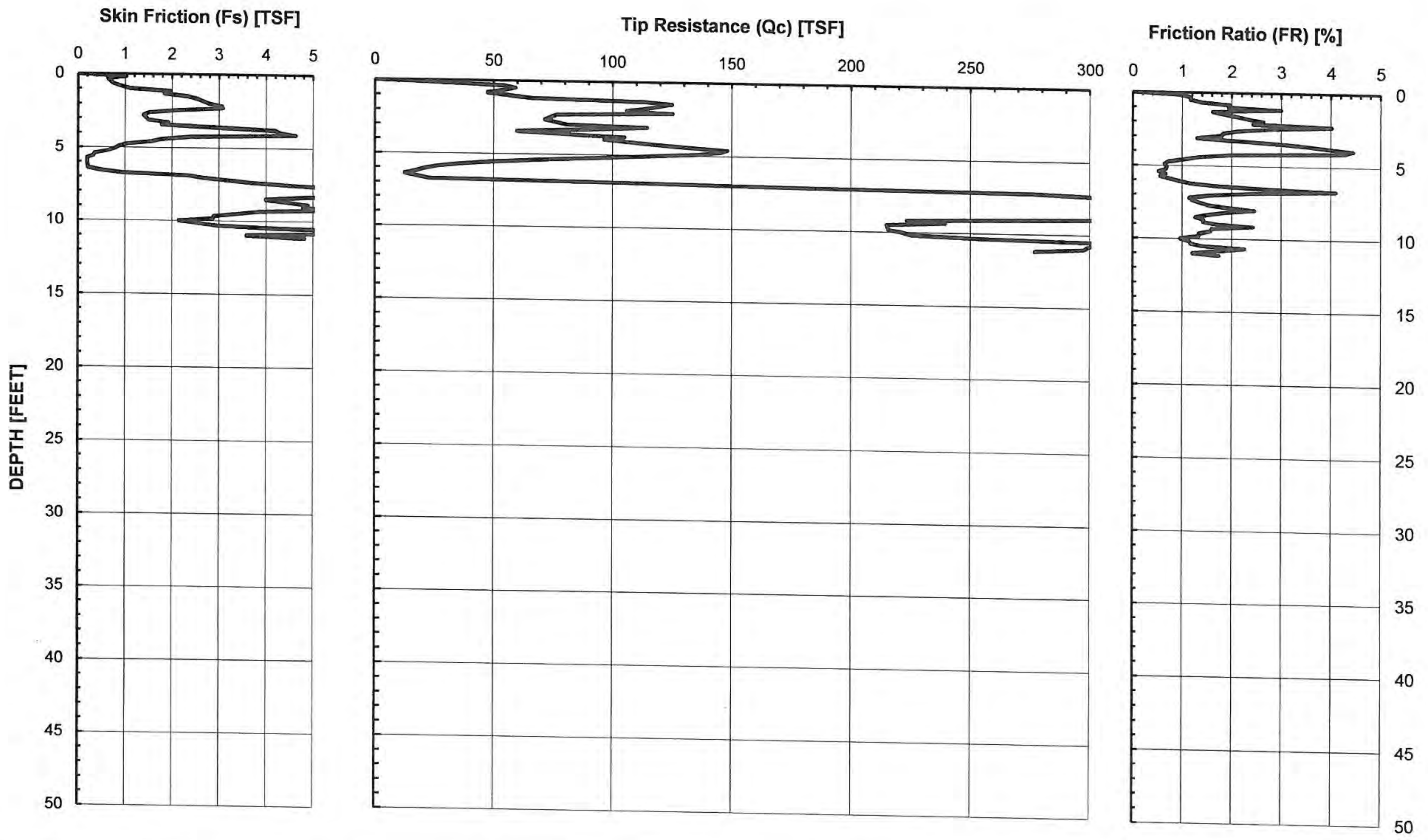
Document No. 14-0153
Project No. IR619
FIGURE A-13a



GROUP DELTA

SOIL CLASSIFICATION (CPT-8) *

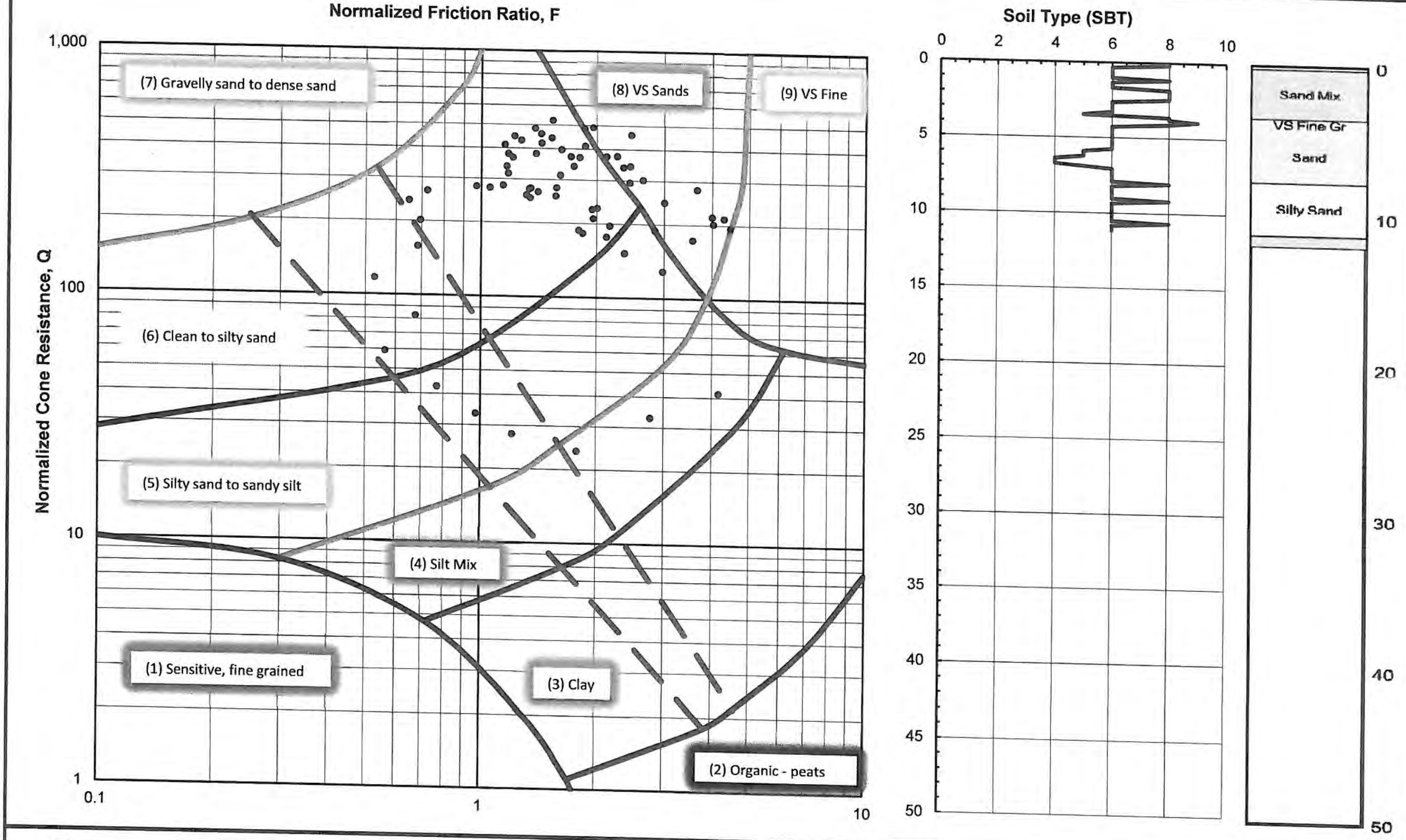
Document No. 14-0153
Project No. IR619
FIGURE A-13b



GROUP DELTA

CONE PENETOMETER DATA (CPT-9) *

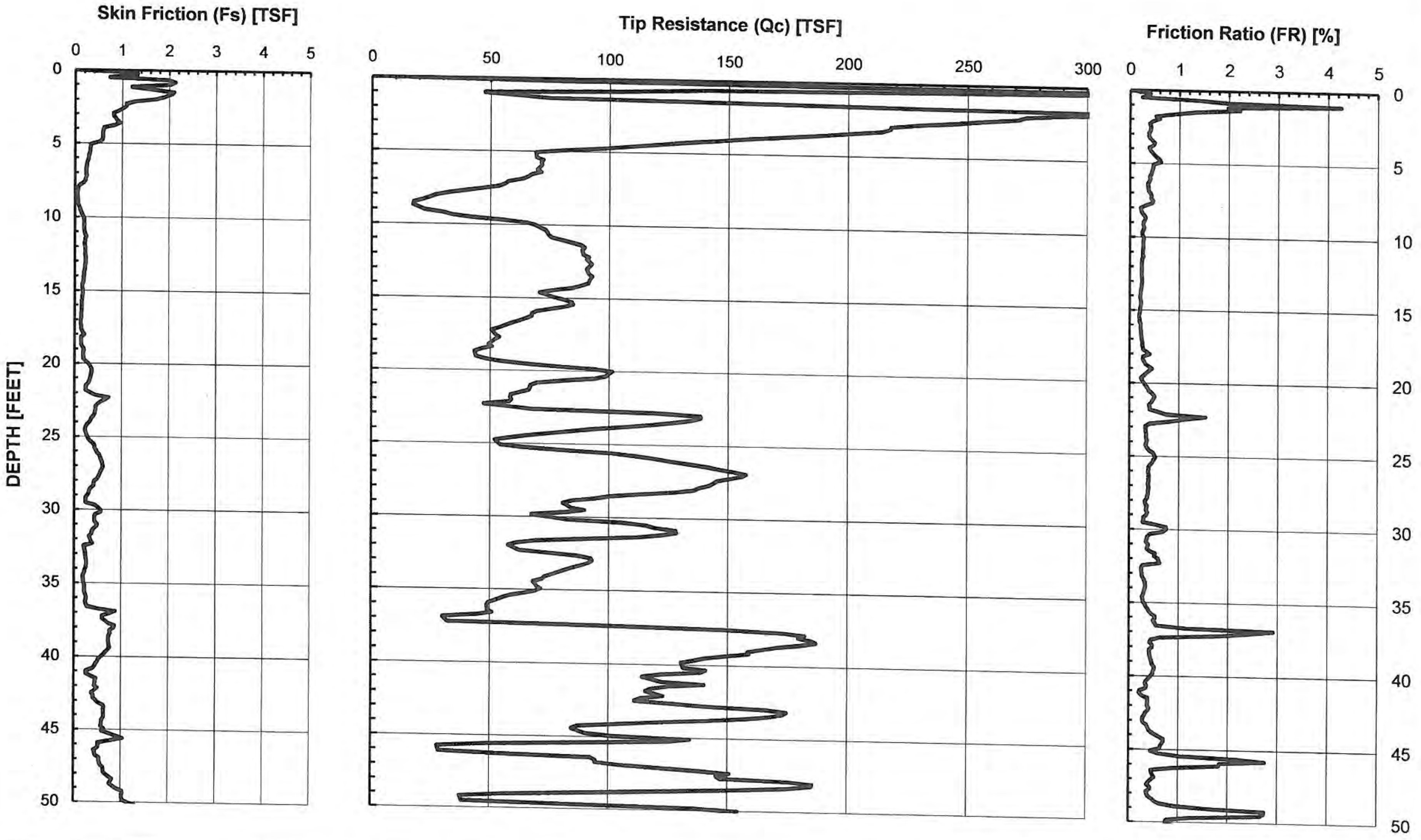
Document No. 14-0153
Project No. IR619
FIGURE A-14a



GROUP DELTA

SOIL CLASSIFICATION (CPT-9) *

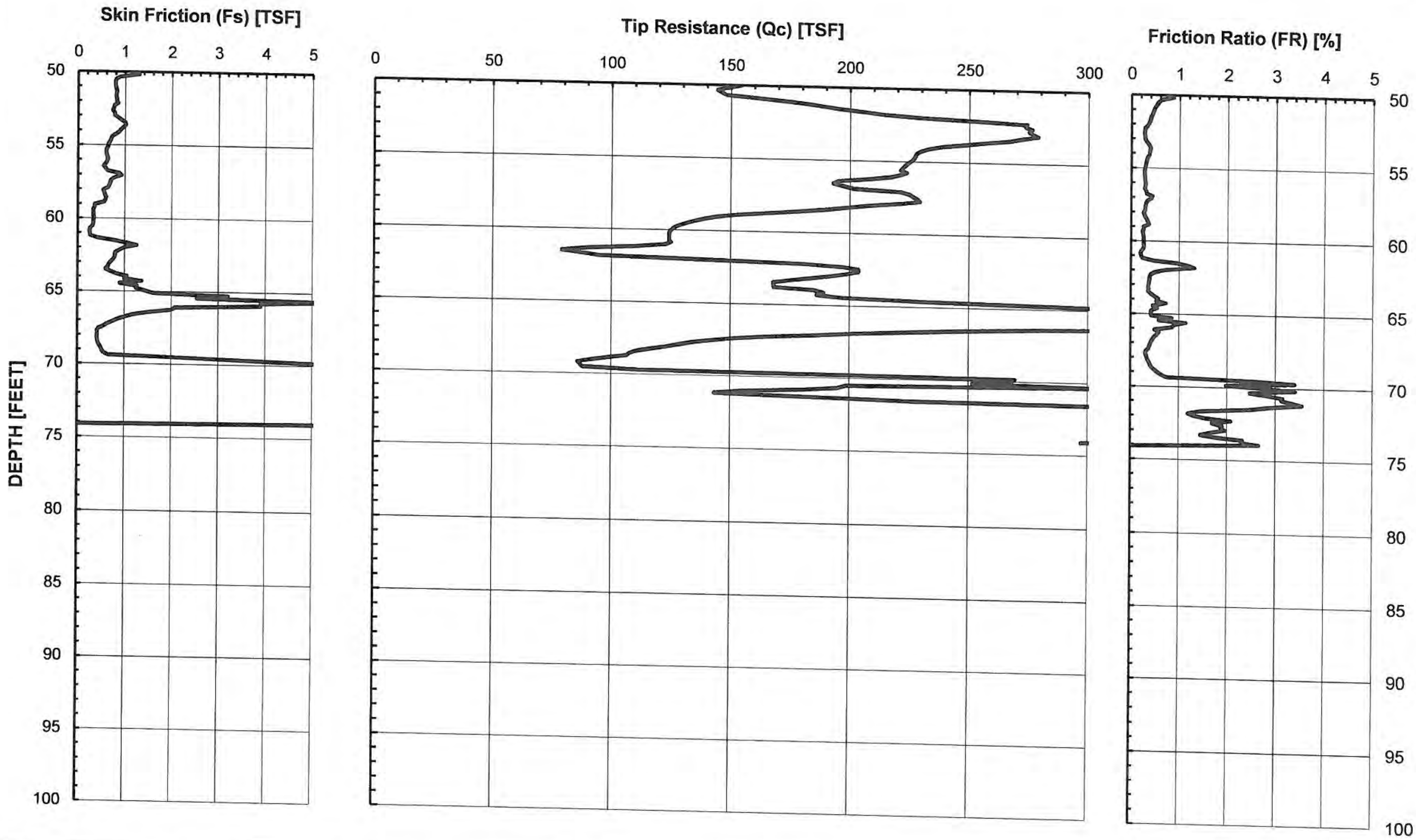
Document No. 14-0153
Project No. IR619
FIGURE A-14b



GROUP DELTA

CONE PENETOMETER DATA (CPT-10)*

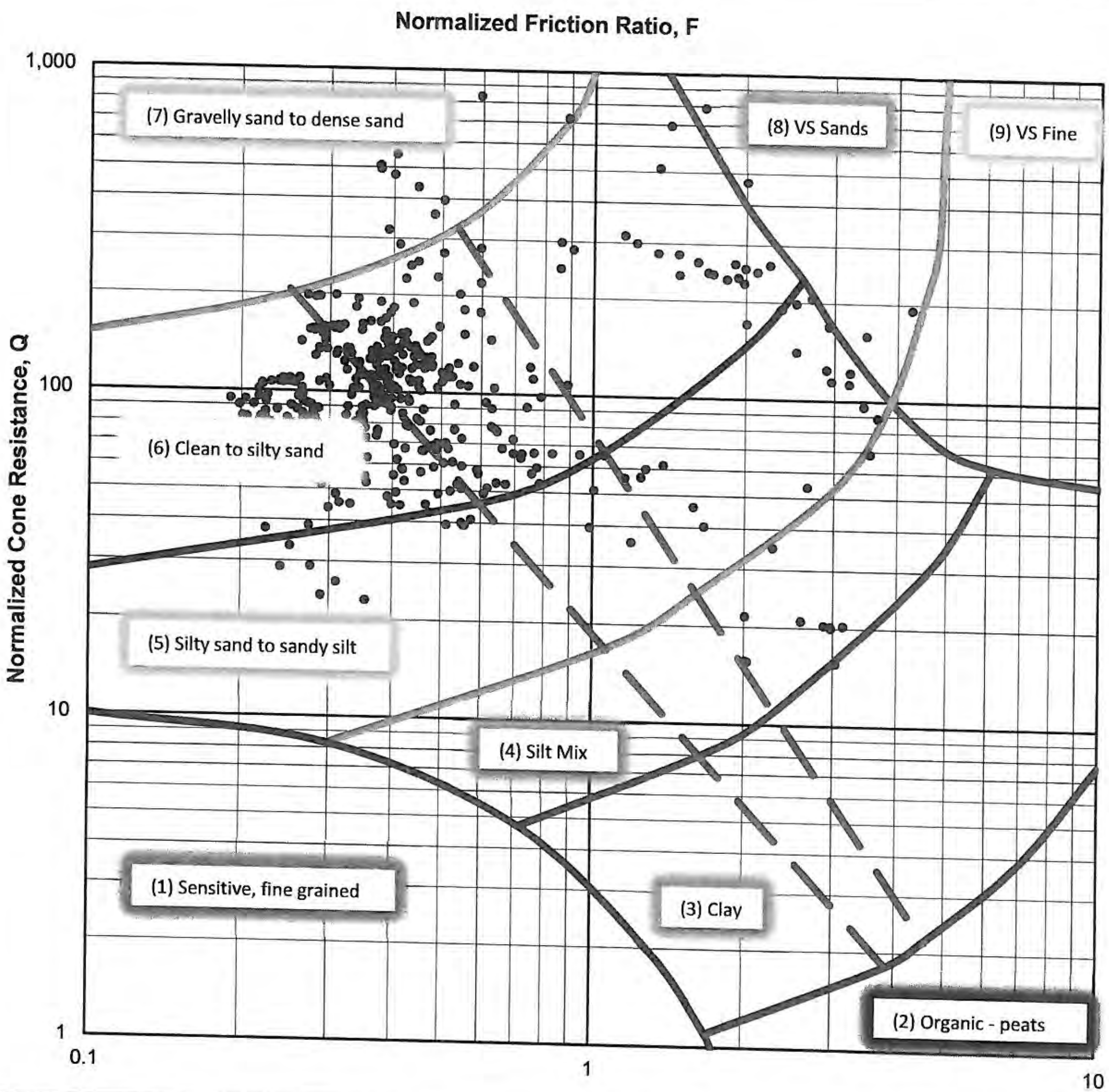
Document No. 14-0153
Project No. IR619
FIGURE A-15a

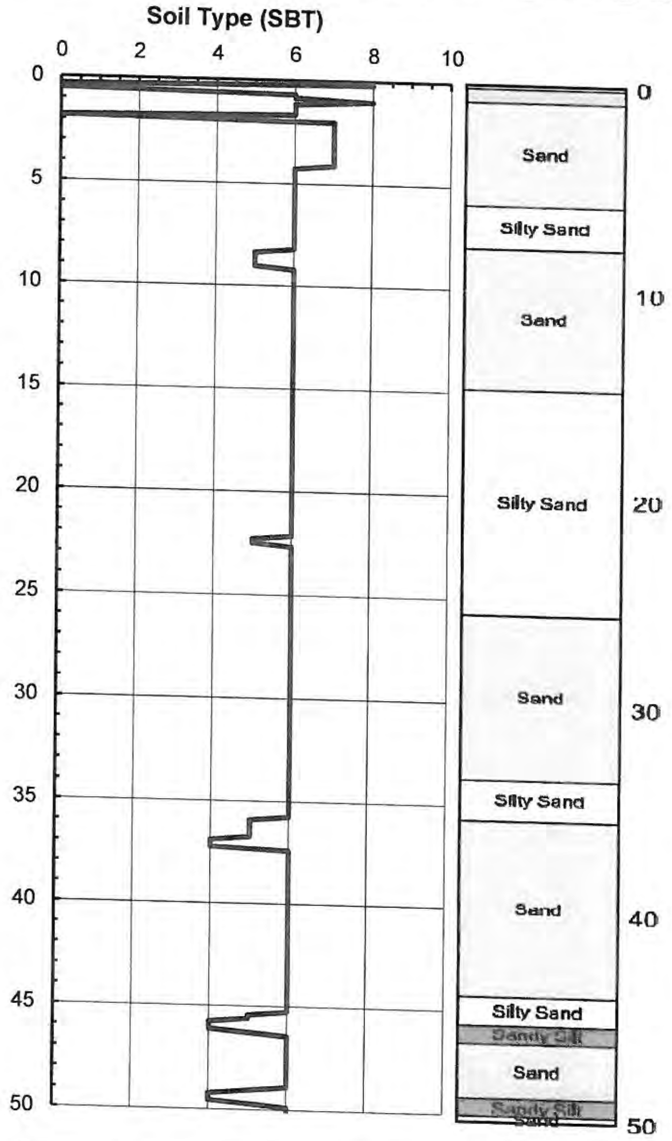


GROUP DELTA

CONE PENETOMETER DATA (CPT-10) *

Document No. 14-0153
Project No. IR619
FIGURE A-15a

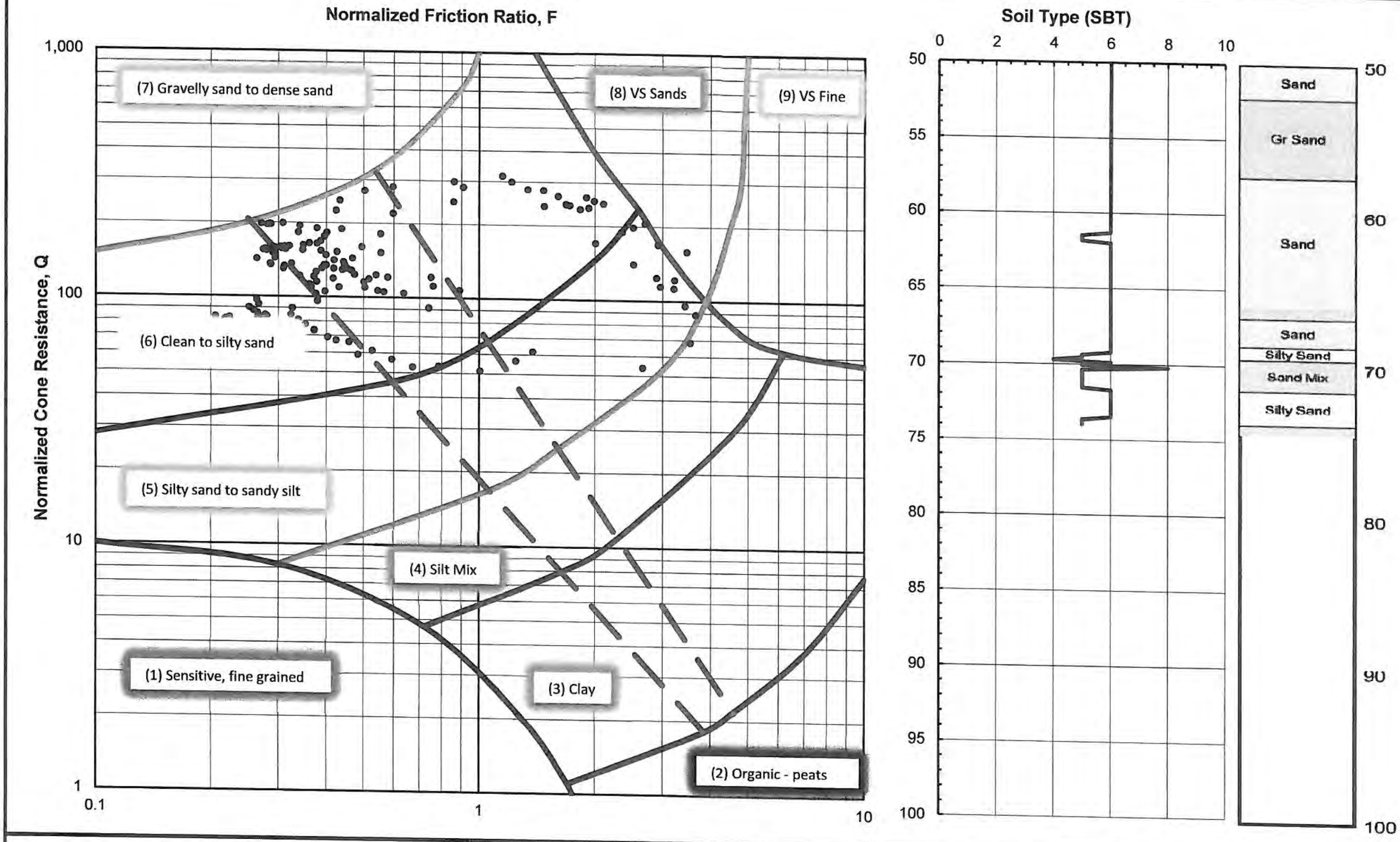




GROUP DELTA

SOIL CLASSIFICATION (CPT-10) *

Document No. 14-0153
Project No. IR619
FIGURE A-15b



GROUP DELTA

SOIL CLASSIFICATION (CPT-10) *

Document No. 14-0153
Project No. IR619
FIGURE A-15b

SOIL IDENTIFICATION AND DESCRIPTION SEQUENCE

Sequence	Identification Components	Refer to Section		Required	Optional
		Field	Lab		
1	Group Name	2.5.2	3.2.2	●	
2	Group Symbol	2.5.2	3.2.2	●	
	Description Components				
3	Consistency of Cohesive Soil	2.5.3	3.2.3	●	
4	Apparent Density of Cohesionless Soil	2.5.4		●	
5	Color	2.5.5		●	
6	Moisture	2.5.6		●	
7	Percent or Proportion of Soil	2.5.7	3.2.4	●	⭘
	Particle Size	2.5.8	2.5.8	●	⭘
	Particle Angularity	2.5.9			○
	Particle Shape	2.5.10			○
8	Plasticity (for fine-grained soil)	2.5.11	3.2.5		○
9	Dry Strength (for fine-grained soil)	2.5.12			○
10	Dilatency (for fine-grained soil)	2.5.13			○
11	Toughness (for fine-grained soil)	2.5.14			○
12	Structure	2.5.15			○
13	Cementation	2.5.16		●	
14	Percent of Cobbles and Boulders	2.5.17		●	
	Description of Cobbles and Boulders	2.5.18		●	
15	Consistency Field Test Result	2.5.3		●	
16	Additional Comments	2.5.19			○

Describe the soil using descriptive terms in the order shown

Minimum Required Sequence:

USCS Group Name (Group Symbol); Consistency or Density; Color; Moisture; Percent or Proportion of Soil; Particle Size; Plasticity (optional).

⭘ = optional for non-Caltrans projects

Where applicable:

Cementation; % cobbles & boulders; Description of cobbles & boulders; Consistency field test result

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010).

HOLE IDENTIFICATION

Holes are identified using the following convention:

H – YY – NNN

Where:

H: Hole Type Code

YY: 2-digit year

NNN: 3-digit number (001-999)

Hole Type Code and Description

Hole Type Code	Description
A	Auger boring (hollow or solid stem, bucket)
R	Rotary drilled boring (conventional)
RC	Rotary core (self-cased wire-line, continuously-sampled)
RW	Rotary core (self-cased wire-line, not continuously sampled)
P	Rotary percussion boring (Air)
HD	Hand driven (1-inch soil tube)
HA	Hand auger
D	Driven (dynamic cone penetrometer)
CPT	Cone Penetration Test
O	Other (note on LOTB)

Description Sequence Examples:

SANDY lean CLAY (CL); very stiff; yellowish brown; moist; mostly fines; some SAND, from fine to medium; few gravels; medium plasticity; PP=2.75.

Well-graded SAND with SILT and GRAVEL and COBBLES (SW-SM); dense; brown; moist; mostly SAND, from fine to coarse; some fine GRAVEL; few fines; weak cementation; 10% GRANITE COBBLES; 3 to 6 inches; hard; subrounded.

Clayey SAND (SC); medium dense, light brown; wet; mostly fine sand,; little fines; low plasticity.

GROUP DELTA

Project No. IR619

San Diego Riverwalk Development
Related of California

BORING RECORD LEGEND #1

GROUP SYMBOLS AND NAMES

Graphic / Symbol	Group Names	Graphic / Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY elastic ELASTIC SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

C	Consolidation (ASTM D 2435)
CL	Collapse Potential (ASTM D 5333)
CP	Compaction Curve (CTM 216)
CR	Corrosion, Sulfates, Chlorides (CTM 643, CTM 417, CTM 422)
CU	Consolidated Undrained Triaxial (ASTM D 4767)
DS	Direct Shear (ASTM D 3080)
EI	Expansion Index (ASTM D 4829)
M	Moisture Content (ASTM D 2216)
OC	Organic Content (ASTM D 2974)
P	Permeability (CTM 220)
PA	Particle Size Analysis (ASTM D 422)
PI	Liquid Limit, Plastic Limit, Plasticity Index (AASHTO T 89, AASHTO T 90)
PL	Point Load Index (ASTM D 5731)
PM	Pressure Meter
R	R-Value (CTM 301)
SE	Sand Equivalent (CTM 217)
SG	Specific Gravity (AASHTO T 100)
SL	Shrinkage Limit (ASTM D 427)
SW	Swell Potential (ASTM D 4546)
UC	Unconfined Compression - Soil (ASTM D 2166) Unconfined Compression - Rock (ASTM D 2938)
UU	Unconsolidated Undrained Triaxial (ASTM D 2850)
UW	Unit Weight (ASTM D 4767)

SAMPLER GRAPHIC SYMBOLS

- Standard Penetration Test (SPT)
- Standard California Sampler
- Modified California Sampler (2.4" ID, 3" OD)
- Shelby Tube
- Piston Sampler
- NX Rock Core
- HQ Rock Core
- Bulk Sample
- Other (see remarks)

DRILLING METHOD SYMBOLS

- Auger Drilling
- Rotary Drilling
- Dynamic Cone or Hand Driven
- Diamond Core

WATER LEVEL SYMBOLS

▽ First Water Level Reading (during drilling)

▼ Static Water Level Reading (after drilling, date)

Definitions for Change in Material

Term	Definition	Symbol
Material Change	Change in material is observed in the sample or core and the location of change can be accurately located.	————
Estimated Material Change	Change in material cannot be accurately located either because the change is gradational or because of limitations of the drilling and sampling methods.	— — — —
Soil / Rock Boundary	Material changes from soil characteristics to rock characteristics.	～～

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010).

GROUP DELTA

Project No. IR619

San Diego Riverwalk Development
Related of California

BORING RECORD LEGEND #2

CONSISTENCY OF COHESIVE SOILS

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

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (blows / 12 inches)
Very Loose	0 - 5
Loose	5 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Greater than 50

MOISTURE

Description	Criteria
Dry	No discernable moisture
Moist	Moisture present, but no free water
Wet	Visible free water

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 - 10%
Little	15 - 25%
Some	30 - 45%
Mostly	50 - 100%

PARTICLE SIZE

Description		Size (in)
Boulder		Greater than 12
Cobble		3 - 12
Gravel	Coarse	3/4 - 3
	Fine	1/5 - 3/4
Sand	Coarse	1/16 - 1/5
	Medium	1/64 - 1/16
	Fine	1/300 - 1/64
Silt and Clay		Less than 1/300

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010), with the exception of consistency of cohesive soils vs. N_{60}.

Plasticity

Description	Criteria
Nonplastic	A 1/8-in. thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

CONSISTENCY OF COHESIVE SOILS

Description	SPT N_{60} (blows/12 inches)
Very Soft	0 - 2
Soft	2 - 4
Medium Stiff	4 - 8
Stiff	8 - 15
Very Stiff	15 - 30
Hard	Greater than 30

Ref: Peck, Hansen, and Thornburn, 1974, "Foundation Engineering," Second Edition.

Note: Only to be used (with caution) when pocket penetrometer or other data on undrained shear strength are unavailable. Not allowed by Caltrans Soil and Rock Logging and Classification Manual, 2010.

GROUP DELTA

Project No. IR619

San Diego Riverwalk Development
Related of California

BORING RECORD LEGEND #3

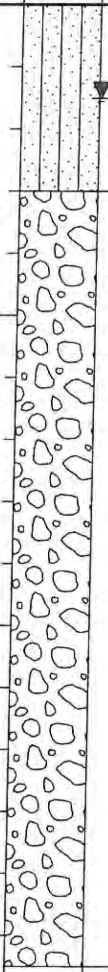
BORING RECORD

PROJECT NAME Riverwalk Development, Phase 1A
PROJECT NUMBER IR619
BORING **B-01**
SITE LOCATION 1150 Fashion Valley Road
START 1/16/2015
FINISH 1/16/2015
SHEET NO. 1 of 2
DRILLING COMPANY Pacific Drilling
DRILLING METHOD Rotary Wash
LOGGED BY TSL
CHECKED BY MAF
DRILLING EQUIPMENT Unimog
BORING DIA. (in) 6
TOTAL DEPTH (ft) 35.5
GROUND ELEV (ft) 35
DEPTH/*ELEV.* GROUND WATER (ft) ▼ 21.5 / *13.5*
SAMPLING METHOD Hammer: 140 lbs., Drop: 30 in. (Automatic)
NOTES ETR ~ 82%, N_{60} ~ 82/60 * N ~ 1.37 * N

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
												FILL: SILTY SAND (SM); dark brown; moist; mostly fine to medium grained SAND; little to some fines; nonplastic; vegetative debris. (1% Gravel; 64% Sand; 35% Fines)
		▨	B-1						PA CR EI			
5	30	☒	S-2	8 11 9	20	27				5		Medium dense; brown; little fines; no organics.
												ALLUVIUM: CLAYEY SAND with GRAVEL (SC); dense; brown; moist; mostly fine grained SAND; little to some fines; low plasticity; little fine GRAVEL. PP~4¼ tsf
10	25	☒	S-3	7 11 14	25	34				10		
15	20	☒	S-4	4 8 10	18	25			PA	15		LEAN CLAY (CL); very stiff (PP~2½ tsf) ; grayish brown; moist; mostly fines; few fine grained SAND; low plasticity. (0% Gravel; 8% Sand; 92% Fines)
												SILTY SAND (SM); medium dense; light grayish brown; moist; mostly fine to coarse grained SAND; some fines; nonplastic.

BORING RECORD

PROJECT NAME Riverwalk Development, Phase 1A
PROJECT NUMBER IR619
BORING B-01
SITE LOCATION 1150 Fashion Valley Road
START 1/16/2015
FINISH 1/16/2015
SHEET NO. 2 of 2
DRILLING COMPANY Pacific Drilling
DRILLING METHOD Rotary Wash
LOGGED BY TSL
CHECKED BY MAF
DRILLING EQUIPMENT Unimog
BORING DIA. (in) 6
TOTAL DEPTH (ft) 35.5
GROUND ELEV (ft) 35
DEPTH/*ELEV.* GROUND WATER (ft) ▼ 21.5 / *13.5*
SAMPLING METHOD Hammer: 140 lbs., Drop: 30 in. (Automatic)
NOTES ETR ~ 82%, N_{60} ~ 82/60 * N ~ 1.37 * N



DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	S-5	6 9 9	18	25			PA		▼	**ALLUVIUM:** SILTY SAND (SM); medium dense; light grayish brown; moist; mostly fine grained SAND; some fines; nonplastic; micaceous. (0% Gravel; 68% Sand; 32% Fines)
												OLD ALLUVIUM: WELL GRADED SAND with GRAVEL (SW); very dense; light orangish brown; wet; mostly fine to coarse grained SAND; trace fines; nonplastic; little GRAVEL.
25	10	☒	S-6	23 36 50	86	118				25		
30	5	☒	S-7	50 (3")	200	274				30		
35	0	☒	S-8	50 (5")	120	164				35		Light brown; little to some GRAVEL.
												Total Depth: 35½ Feet Groundwater at Elevation 8½ Feet

GROUP DELTA CONSULTANTS, INC.
9245 Activity Road, Suite 103
San Diego, CA 92126

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE
A-3 b

BORING RECORD

PROJECT NAME Riverwalk Development, Phase 1A
PROJECT NUMBER IR619
BORING B-02
SITE LOCATION 1150 Fashion Valley Road
START 1/16/2015
FINISH 1/16/2015
SHEET NO. 1 of 2
DRILLING COMPANY Pacific Drilling
DRILLING METHOD Rotary Wash
LOGGED BY TSL
CHECKED BY MAF
DRILLING EQUIPMENT Unimog
BORING DIA. (in) 6
TOTAL DEPTH (ft) 30
GROUND ELEV (ft) 32
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ N/A / *na*
SAMPLING METHOD Hammer: 140 lbs., Drop: 30 in. (Automatic)
NOTES ETR ~ 82%, N_{60} ~ 82/60 * N ~ 1.37 * N

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		▩										**FILL:** SILTY SAND (SM); dark brown; moist; mostly fine to medium grained SAND; little fines; nonplastic; organics.
	30	▩	B-1						PA CR CP DS EI			(11% Gravel; 59% Sand; 30% Fines)
5										5		Trace GRAVEL; angular; no organics.
		☒	S-2	6 7 7	14	19						
	25											
												ALLUVIUM: LEAN CLAY (CL); dense; dark brown with white staining; moist; mostly fines, trace fine grained SAND; low plasticity.
10										10		(0% Gravel; 5% Sand; 95% Fines)
		☒	S-3	8 11 14	25	34			PA			
	20											SILTY SAND (SM); dense; orangish brown; moist; mostly fine to medium grained SAND, some fines; nonplastic.
												(0% Gravel; 63% Sand; 37% Fines)
15										15		
		☒	S-4	9 10 15	25	34			PA			
	15											
												OLD ALLUVIUM: CLAYEY SAND with GRAVEL (SC); very dense; orangish brown; moist; mostly fine to coarse grained SAND; some fines; nonplastic; some GRAVEL; subangular.

GDC_LOG_BORING_MMX_SOIL_SD IR619 PHASE 1A LOGS.GPJ GDCLOG.GDT 2/5/15

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FIGURE
A-4 a

BORING RECORD

PROJECT NAME Riverwalk Development, Phase 1A	PROJECT NUMBER IR619	BORING **B-02**	
SITE LOCATION 1150 Fashion Valley Road	START 1/16/2015	FINISH 1/16/2015	SHEET NO. 2 of 2
DRILLING COMPANY Pacific Drilling	DRILLING METHOD Rotary Wash	LOGGED BY TSL	CHECKED BY MAF
DRILLING EQUIPMENT Unimog	BORING DIA. (in) 6	TOTAL DEPTH (ft) 30	GROUND ELEV (ft) 32
DEPTH/*ELEV.* GROUND WATER (ft) ▼ N/A / *na*			
SAMPLING METHOD Hammer: 140 lbs., Drop: 30 in. (Automatic)	NOTES ETR ~ 82%, N_{60} ~ 82/60 * N ~ 1.37 * N		

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	S-5	30 50 (6")	100	137						**OLD ALLUVIUM:** CLAYEY SAND with GRAVEL (SC); very dense; orangish brown; moist; mostly fine to coarse grained SAND; some fines; nonplastic; some GRAVEL; subangular.
	10											
25										25		
		☒	S-6	25 50 (2")	300	411						
	5											
30		☒	S-7	50 (1")	600	822				30		Total Depth: 30 Feet No Groundwater Observed
	0											
35										35		
	-5											

FIGURE

A-4 b

BORING RECORD

PROJECT NAME: Riverwalk Development, Phase 1A
PROJECT NUMBER: IR619
BORING: **B-03**
SITE LOCATION: 1150 Fashion Valley Road
START: 1/19/2015
FINISH: 1/19/2015
SHEET NO.: 1 of 2
DRILLING COMPANY: Pacific Drilling
DRILLING METHOD: Rotary Wash
LOGGED BY: TSL
CHECKED BY: MAF
DRILLING EQUIPMENT: Unimog
BORING DIA. (in): 6
TOTAL DEPTH (ft): 31
GROUND ELEV (ft): 44
DEPTH/*ELEV.* GROUND WATER (ft): ⊻ N/A / *na*
SAMPLING METHOD: Hammer: 140 lbs., Drop: 30 in. (Automatic)
NOTES: ETR ~ 82%, N_{60} ~ 82/60 * N ~ 1.37 * N

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1						PA CR EI R			**FILL:** CLAYEY SAND (SC); medium dense; dark brown; moist; mostly fine to medium grained SAND; some fines; medium plasticity. (0% Gravel; 65% Sand; 35% Fines)
	40											
5										5		
			R-2	7 13 18	31	28	13.9	111				Contains few GRAVEL.
												ALLUVIUM: CLAYEY SAND (SC); medium dense; dark orangish brown; moist; mostly fine to medium grained SAND; some fines; low plasticity. (7% Gravel; 57% Sand; 36% Fines) Interbedded with LEAN CLAY with SAND (CL); very stiff (PP~3½ tsf); brown; moist; mostly fines; few fine to medium grained SAND; medium plasticity.
	35											
10										10		
			S-3	3 4 5	9	12						
	30											
15										15		
			S-4	7 8 11	19	26						CLAYEY SAND (SC); medium dense; dark brown; moist; mostly fine to medium grained SAND; some fines; low plasticity.
	25											

GDC_LOG_BORING_MMX_SOIL_SD IR619 PHASE 1A LOGS.GPJ GDCLOG.GDT 2/5/15

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FIGURE

A-5 a

BORING RECORD

PROJECT NAME Riverwalk Development, Phase 1A
PROJECT NUMBER IR619
BORING B-03
SITE LOCATION 1150 Fashion Valley Road
START 1/19/2015
FINISH 1/19/2015
SHEET NO. 2 of 2
DRILLING COMPANY Pacific Drilling
DRILLING METHOD Rotary Wash
LOGGED BY TSL
CHECKED BY MAF
DRILLING EQUIPMENT Unimog
BORING DIA. (in) 6
TOTAL DEPTH (ft) 31
GROUND ELEV (ft) 44
DEPTH/*ELEV.* GROUND WATER (ft) ▼ N/A / *na*
SAMPLING METHOD Hammer: 140 lbs., Drop: 30 in. (Automatic)
NOTES ETR ~ 82%, N_{60} ~ 82/60 * N ~ 1.37 * N

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	S-5	6 7 11	18	25						**ALLUVIUM:** CLAYEY SAND (SC); medium dense; dark orangish brown; moist; mostly fine to medium grained SAND; some fines; low plasticity. (0% Gravel; 56% Sand; 44% Fines)
	20											
25										25		
		☒	S-6	16 15 13	28	38						
												OLD ALLUVIUM: WELL GRADED SAND with SILT and GRAVEL (SW); dense; orangish brown; moist; mostly fine to coarse grained SAND; few fines; few GRAVEL; subangular.
	15											
30										30		
		☒	S-7	50 (6")	100	137						
												Total Depth: 31 Feet No Groundwater Observed
	10											
35										35		
	5											

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FIGURE

A-5 b

BORING RECORD

PROJECT NAME: Riverwalk Development, Phase 1A
PROJECT NUMBER: IR619
BORING: **B-04**
SITE LOCATION: 1150 Fashion Valley Road
START: 1/16/2015
FINISH: 1/16/2015
SHEET NO.: 1 of 3
DRILLING COMPANY: Pacific Drilling
DRILLING METHOD: Rotary Wash
LOGGED BY: TSL
CHECKED BY: MAF
DRILLING EQUIPMENT: Unimog
BORING DIA. (in): 6
TOTAL DEPTH (ft): 51.5
GROUND ELEV (ft): 24
DEPTH/*ELEV.* GROUND WATER (ft): ▼ 13.0 / *11.0*
SAMPLING METHOD: Hammer: 140 lbs., Drop: 30 in. (Automatic)
NOTES: ETR ~ 82%, N_{60} ~ 82/60 * N ~ 1.37 * N

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
												FILL: SILTY SAND (SM); brown; moist; mostly fine grained SAND; little fines; nonplastic; micca. (0% Gravel; 69% Sand; 31% Fines)
			B-1						PA CR EI			
	20											
5			R-2	11 7 5	12	11	13.4	106	DS	5		**ALLUVIUM:** CLAYEY SAND (SC); medium dense; dark brown; moist; mostly fine grained SAND; some fines; nonplastic to low plasticity; micca.
	15											
10			S-3	2 2 4	6	8			PA	10		POORLY GRADED SAND with SILT (SP-SM); loose; brown; moist to wet; mostly fine to medium grained SAND; trace to few fines; nonplastic; micca. (0% Gravel; 93% Sand; 7% Fines)
											▼	
	10											
15			S-4	3 2 1	3	4			PA	15		Very loose; wet.
	5											

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FIGURE
A-6 a

BORING RECORD

PROJECT NAME: Riverwalk Development, Phase 1A
PROJECT NUMBER: IR619
BORING: **B-04**
SITE LOCATION: 1150 Fashion Valley Road
START: 1/16/2015
FINISH: 1/16/2015
SHEET NO.: 2 of 3
DRILLING COMPANY: Pacific Drilling
DRILLING METHOD: Rotary Wash
LOGGED BY: TSL
CHECKED BY: MAF
DRILLING EQUIPMENT: Unimog
BORING DIA. (in): 6
TOTAL DEPTH (ft): 51.5
GROUND ELEV (ft): 24
DEPTH/*ELEV.* GROUND WATER (ft): ▼ 13.0 / *11.0*
SAMPLING METHOD: Hammer: 140 lbs., Drop: 30 in. (Automatic)
NOTES: ETR ~ 82%, N_{60} ~ 82/60 * N ~ 1.37 * N

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	S-5	3 4 7	11	15			PA			**ALLUVIUM:** POORLY GRADED SAND with SILT (SP-SM); medium dense; gray and dark gray; wet; mostly fine to medium grained SAND; trace to few fines; nonplastic; micca. (0% Gravel; 89% Sand; 11% Fines)
	0											
25										25		(0% Gravel; 92% Sand; 8% Fines)
		☒	S-6	2 4 5	9	12			PA			
	-5											
30										30		SILTY SAND (SM); very loose; gray; wet; mostly fine to medium grained SAND; some fines; nonplastic; micca in layers. (0% Gravel; 55% Sand; 45% Fines)
		☒	S-7	2 2 1	3	4			PA			
	-10											SILT with SAND (ML); soft to medium stiff (PP~¼ tsf); gray; wet; mostly fines; little fine grained SAND; low plasticity; micca in layers with trace SAND. (0% Gravel; 17% Sand; 83% Fines)
35										35		
		☒	S-8	2 1 1	2	3			PA			
	-15											

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FIGURE
A-6 b

BORING RECORD

PROJECT NAME Riverwalk Development, Phase 1A

PROJECT NUMBER IR619

BORING **B-04**

SITE LOCATION 1150 Fashion Valley Road

START 1/16/2015

FINISH 1/16/2015

SHEET NO. 3 of 3

DRILLING COMPANY Pacific Drilling

DRILLING METHOD Rotary Wash

LOGGED BY TSL

CHECKED BY MAF

DRILLING EQUIPMENT Unimog

BORING DIA. (in) 6

TOTAL DEPTH (ft) 51.5

GROUND ELEV (ft) 24

DEPTH/*ELEV.* GROUND WATER (ft) ▼ 13.0 / *11.0*

SAMPLING METHOD Hammer: 140 lbs., Drop: 30 in. (Automatic)

NOTES ETR ~ 82%, N_{60} ~ 82/60 * N ~ 1.37 * N

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	R-9	4 7 11	18	16			PA			**ALLUVIUM:** SILTY SAND (SM); medium dense; gray; wet; mostly fine to medium grained SAND; some fines; nonplastic to low plasticity; few GRAVEL. (12% Gravel; 56% Sand; 32% Fines)
	-20											
45										45		
		☒	S-10	6 8 8	16	22			PA			
	-25											
50										50		SANDY SILT (ML); medium stiff to stiff (PP~½ tsf); grayish brown; wet; mostly fines; some fine grained SAND; low plasticity; trace GRAVEL. (7% Gravel; 37% Sand; 56% fines)
		☒	S-11	2 3 3	6	8			PA			
												Total Depth: 51½ Feet Groundwater at Elevation 12 Feet
	-30											
55										55		
	-35											

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FIGURE
A-6 c

BORING RECORD

PROJECT NAME Riverwalk Development, Phase 1A
PROJECT NUMBER IR619
BORING B-05
SITE LOCATION 1150 Fashion Valley Road
START 1/19/2015
FINISH 1/19/2015
SHEET NO. 1 of 2
DRILLING COMPANY Pacific Drilling
DRILLING METHOD Rotary Wash
LOGGED BY TSL
CHECKED BY MAF
DRILLING EQUIPMENT Unimog
BORING DIA. (in) 6
TOTAL DEPTH (ft) 23
GROUND ELEV (ft) 32
DEPTH/*ELEV.* GROUND WATER (ft) ▼ N/A / *na*
SAMPLING METHOD Hammer: 140 lbs., Drop: 30 in. (Automatic)
NOTES ETR ~ 82%, N_{60} ~ 82/60 * N ~ 1.37 * N

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
												FILL: CLAYEY SAND with GRAVEL (SC); dark brown; moist; mostly fine to coarse grained SAND; some fines; nonplastic; cobbles; subrounded.
	30											
5										5		
		⧗	R-1	5 7 22	29	26	12.6	112	DS			
	25											
												ALLUVIUM: LEAN CLAY with SAND (CL); very stiff (PP~3½ tsf); light gray with orange staining; moist; mostly fines; little fine to coarse SAND; trace GRAVEL; medium plasticity.
10										10		(2% Gravel; 21% Sand; 77% Fines)
		☒	S-2	16 11 13	24	33			PA			
												Hard (PP~4½ tsf)
	20											
15										15		
		☒	S-3	7 15 17	32	44						CLAYEY SAND (SC); dense; brown; moist; mostly fine grained SAND; some fines; nonplastic.
	15											

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FIGURE
A-7 a

BORING RECORD

PROJECT NAME Riverwalk Development, Phase 1A	**PROJECT NUMBER** IR619	**BORING** **B-05**	
SITE LOCATION 1150 Fashion Valley Road	**START** 1/19/2015	**FINISH** 1/19/2015	**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Rotary Wash	**LOGGED BY** TSL	**CHECKED BY** MAF
DRILLING EQUIPMENT Unimog	**BORING DIA. (in)** 6	**TOTAL DEPTH (ft)** 23	**GROUND ELEV (ft)** 32
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ N/A / *na*			
SAMPLING METHOD Hammer: 140 lbs., Drop: 30 in. (Automatic)	**NOTES** ETR ~ 82%, N_{60} ~ 82/60 * N ~ 1.37 * N		

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	N_{60}	MOISTURE (%)	DRY DENSITY (pcf)	OTHER TESTS	DEPTH (feet)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	S-4	9 14 60	74	101			PA		▨	**OLD ALLUVIUM**: CLAYEY SAND (SC); dense; brown; moist; mostly fine to medium grained SAND; little fines; little GRAVEL; nonplastic; increased moisture. (12% Gravel; 67% Sand; 21% Fines)
	10										▨	
												Total Depth: 23 Feet No Groundwater Observed
25										25		
	5											
30										30		
	0											
35										35		
	-5											

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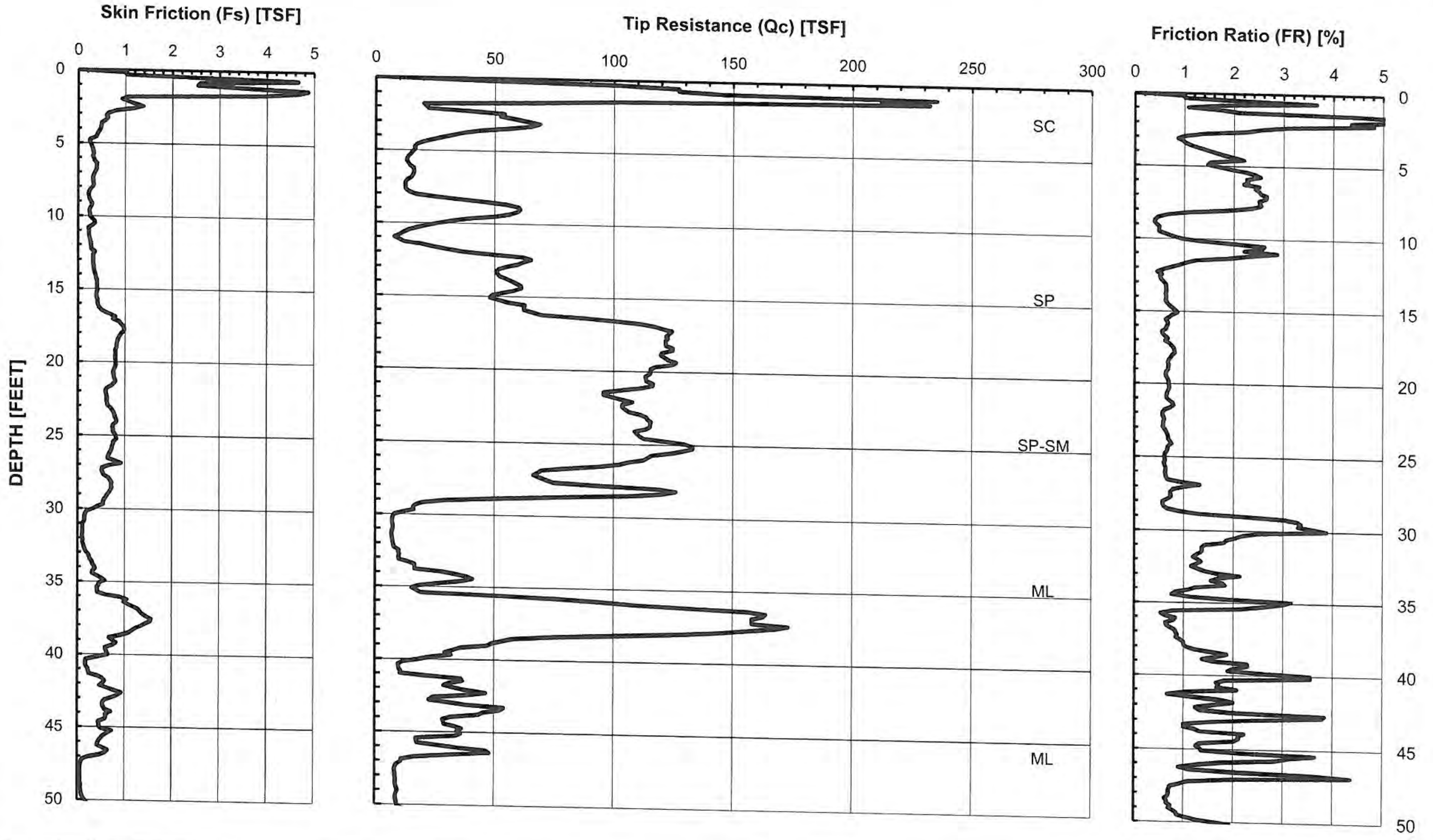
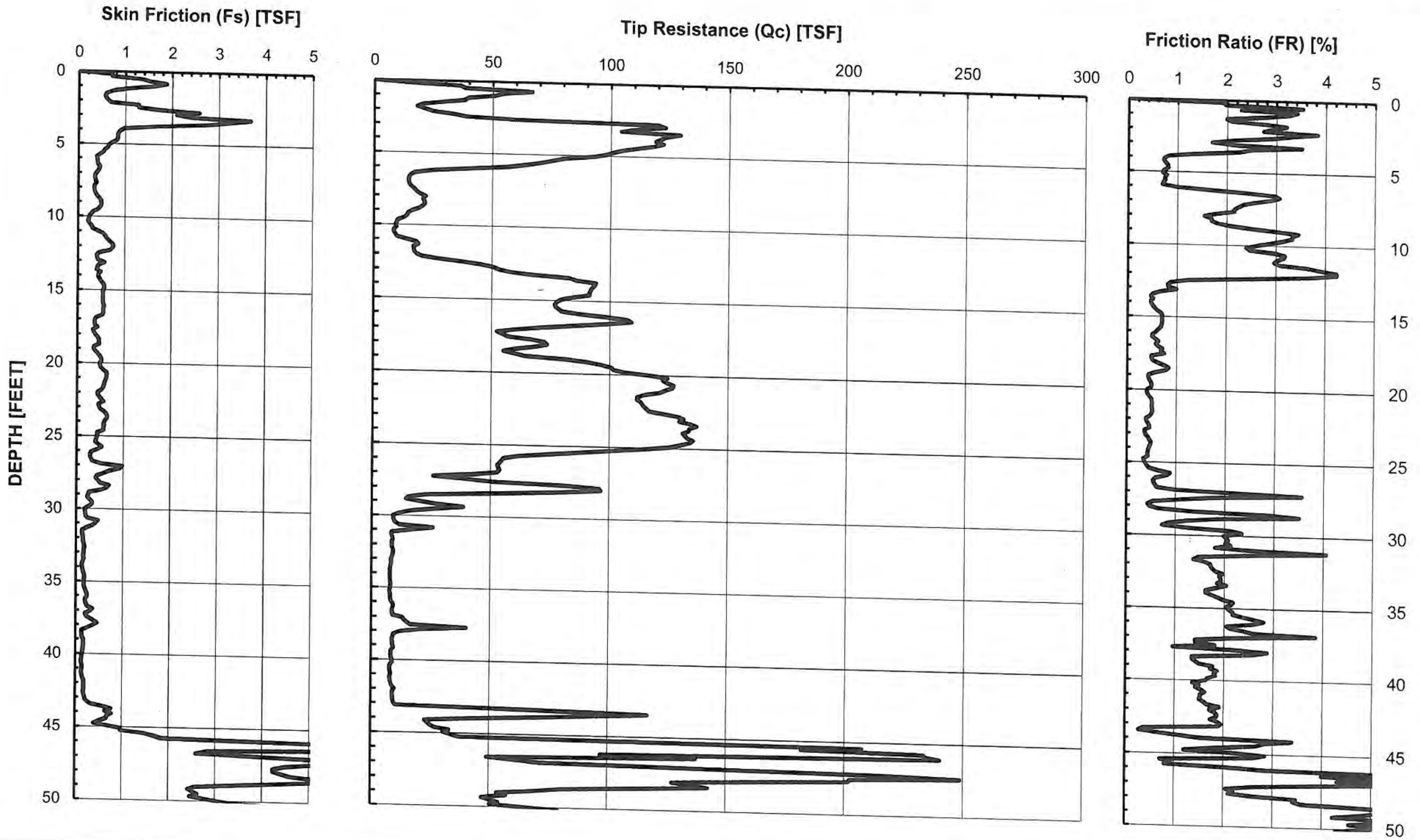
FIGURE
A-7 b



GROUP DELTA

CONE PENETOMETER DATA (CPT-1*)

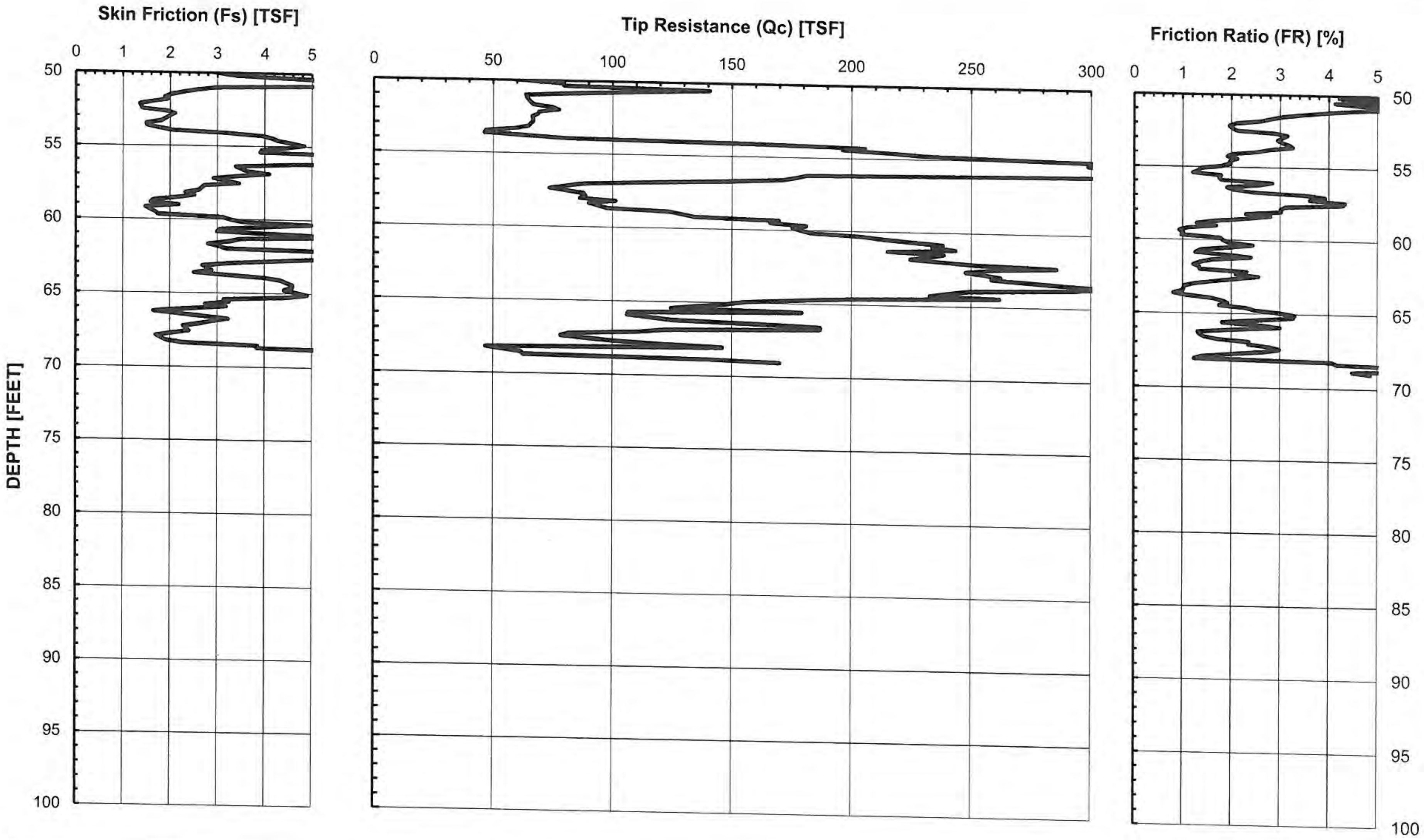
Document No. 15-0006
Project No. IR619
FIGURE A-8a



GROUP DELTA

CONE PENETOMETER DATA (CPT-1)

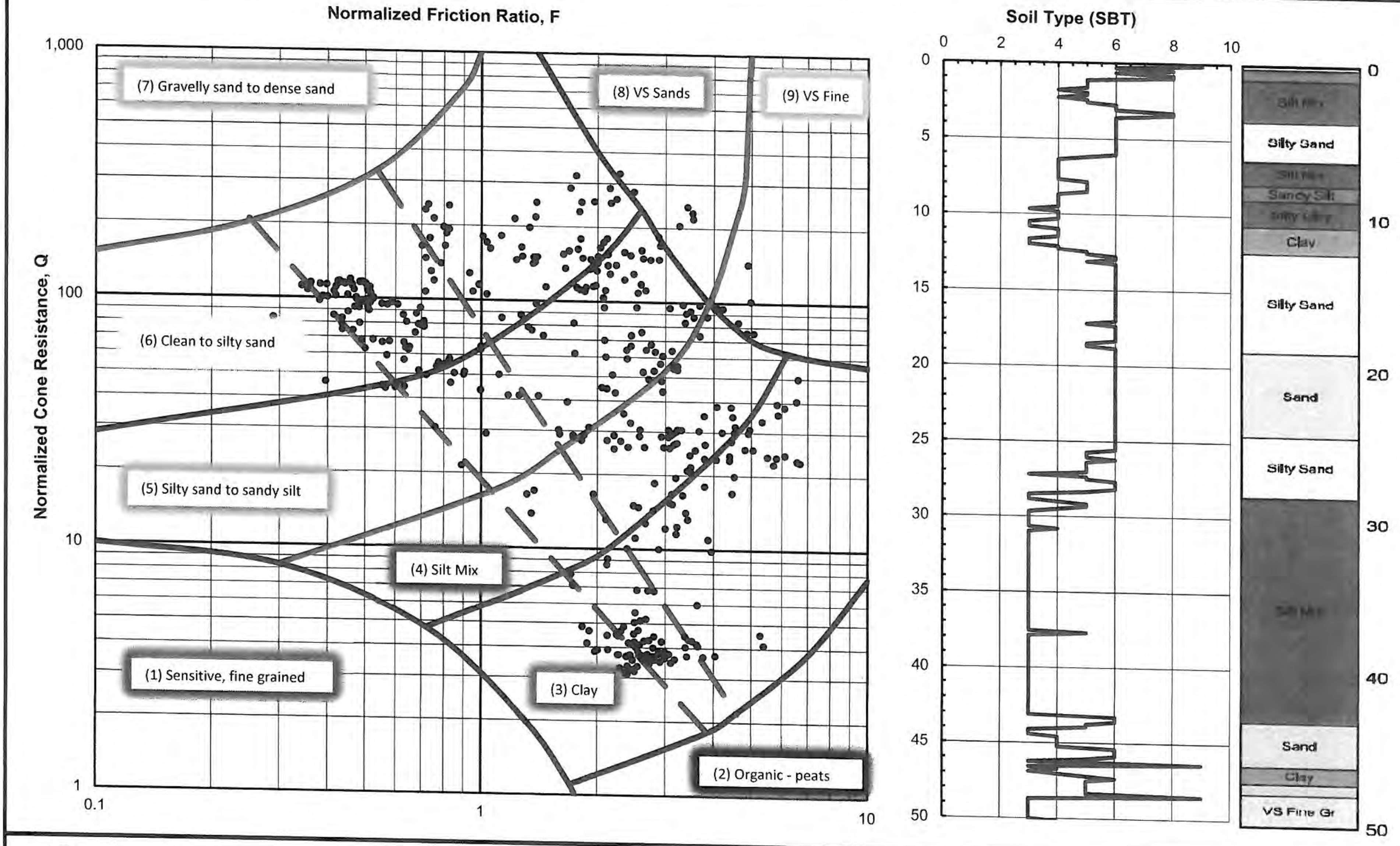
Document No. 15-0006
Project No. IR619
FIGURE A-12a



GROUP DELTA

CONE PENETOMETER DATA (CPT-1)

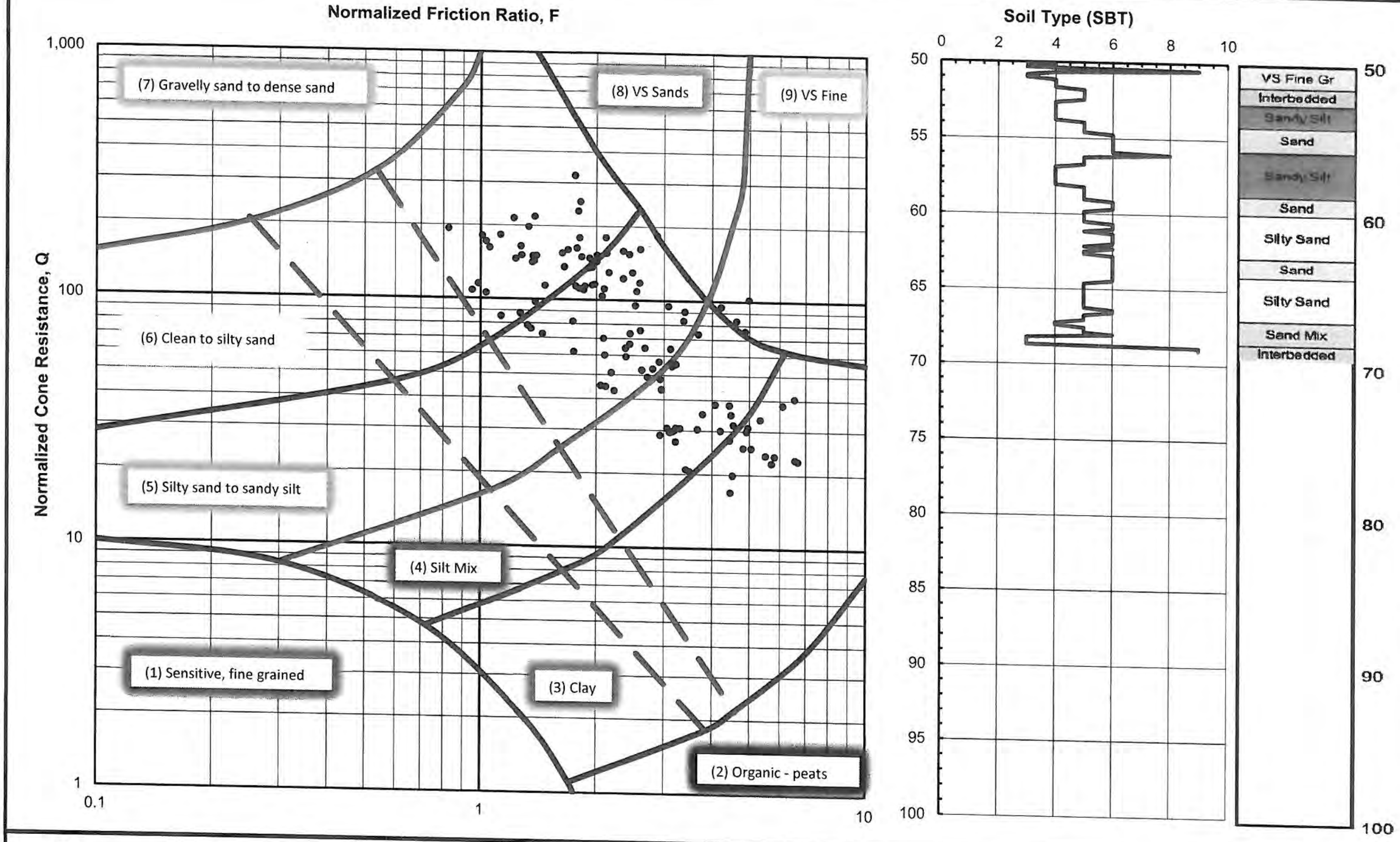
Document No. 15-0006
Project No. IR619
FIGURE A-12a



GROUP DELTA

SOIL CLASSIFICATION (CPT-1)

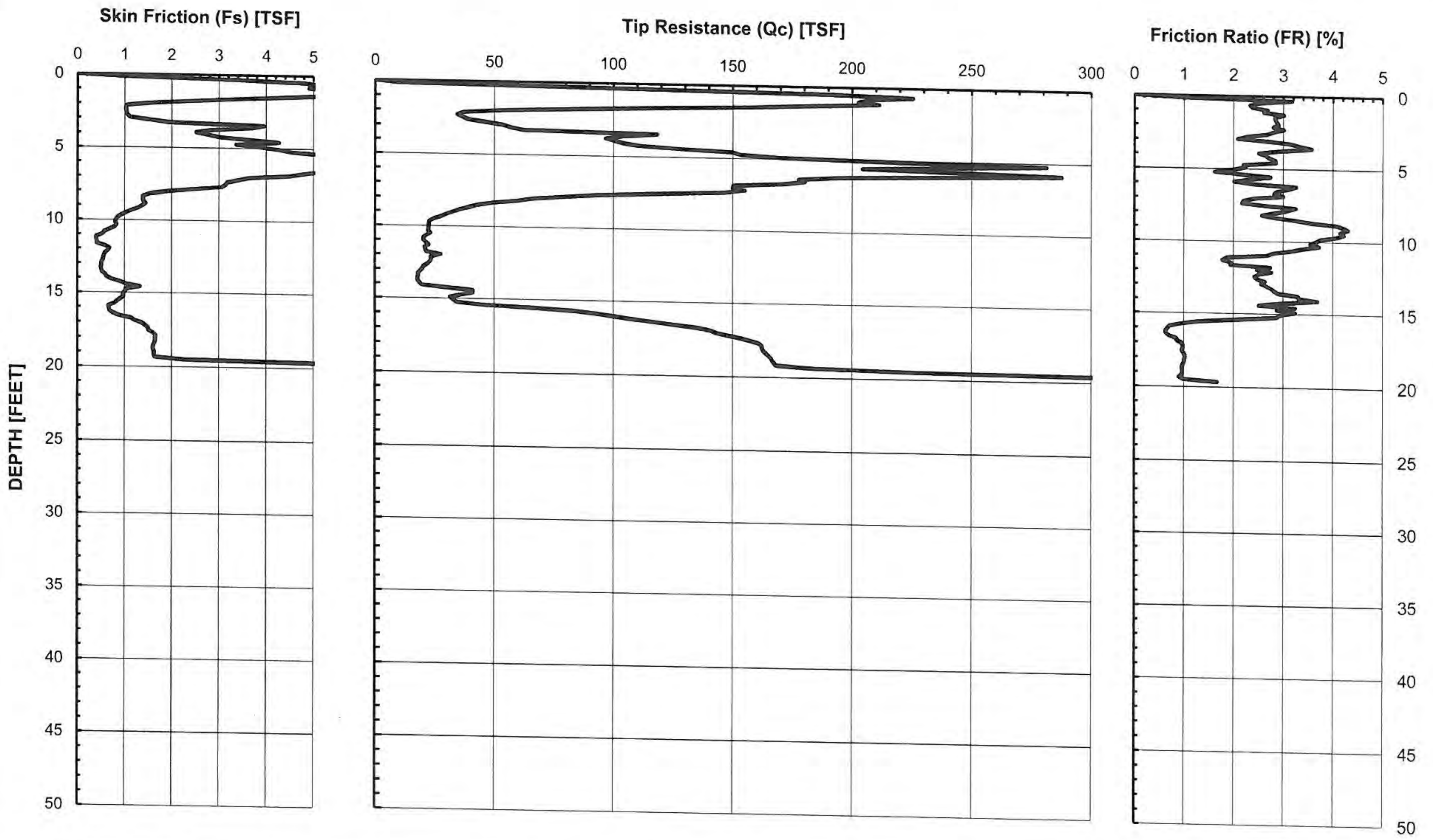
Document No. 15-0006
Project No. IR619
FIGURE A-12b



GROUP DELTA

SOIL CLASSIFICATION (CPT-1)

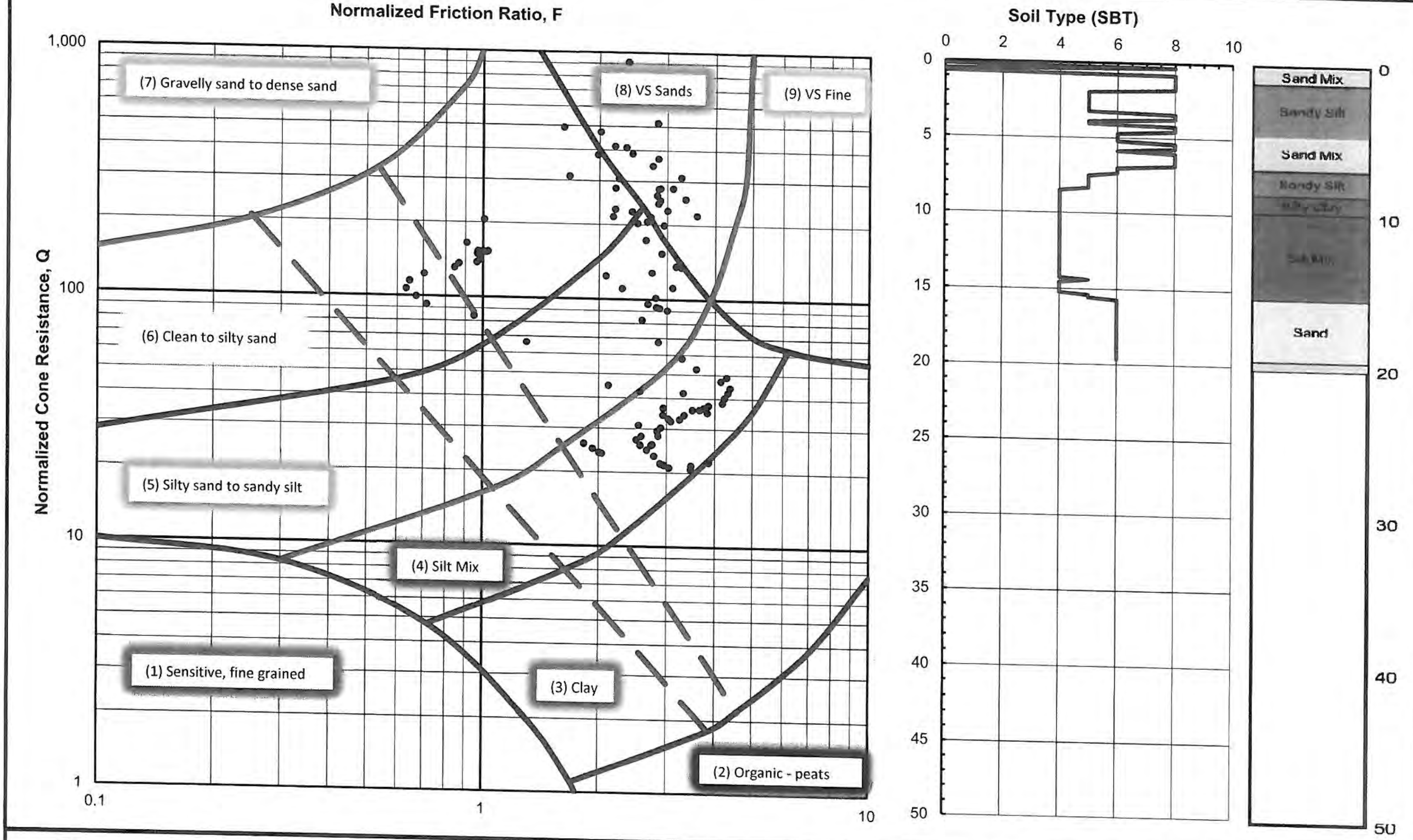
Document No. 15-0006
Project No. IR619
FIGURE A-12b



GROUP DELTA

CONE PENETOMETER DATA (CPT-2)

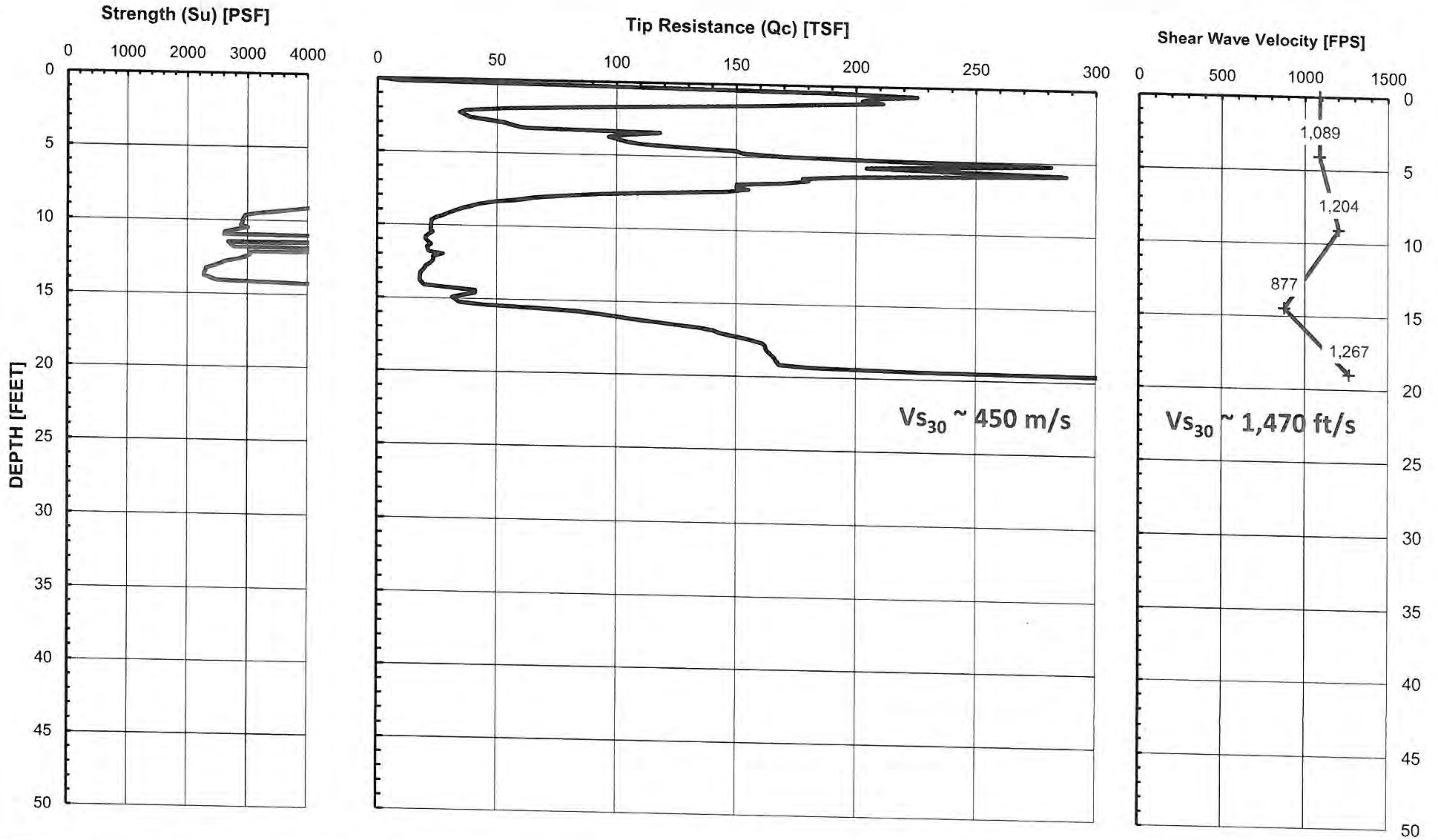
Document No. 15-0006
Project No. IR619
FIGURE A-13a



GROUP DELTA

SOIL CLASSIFICATION (CPT-2)

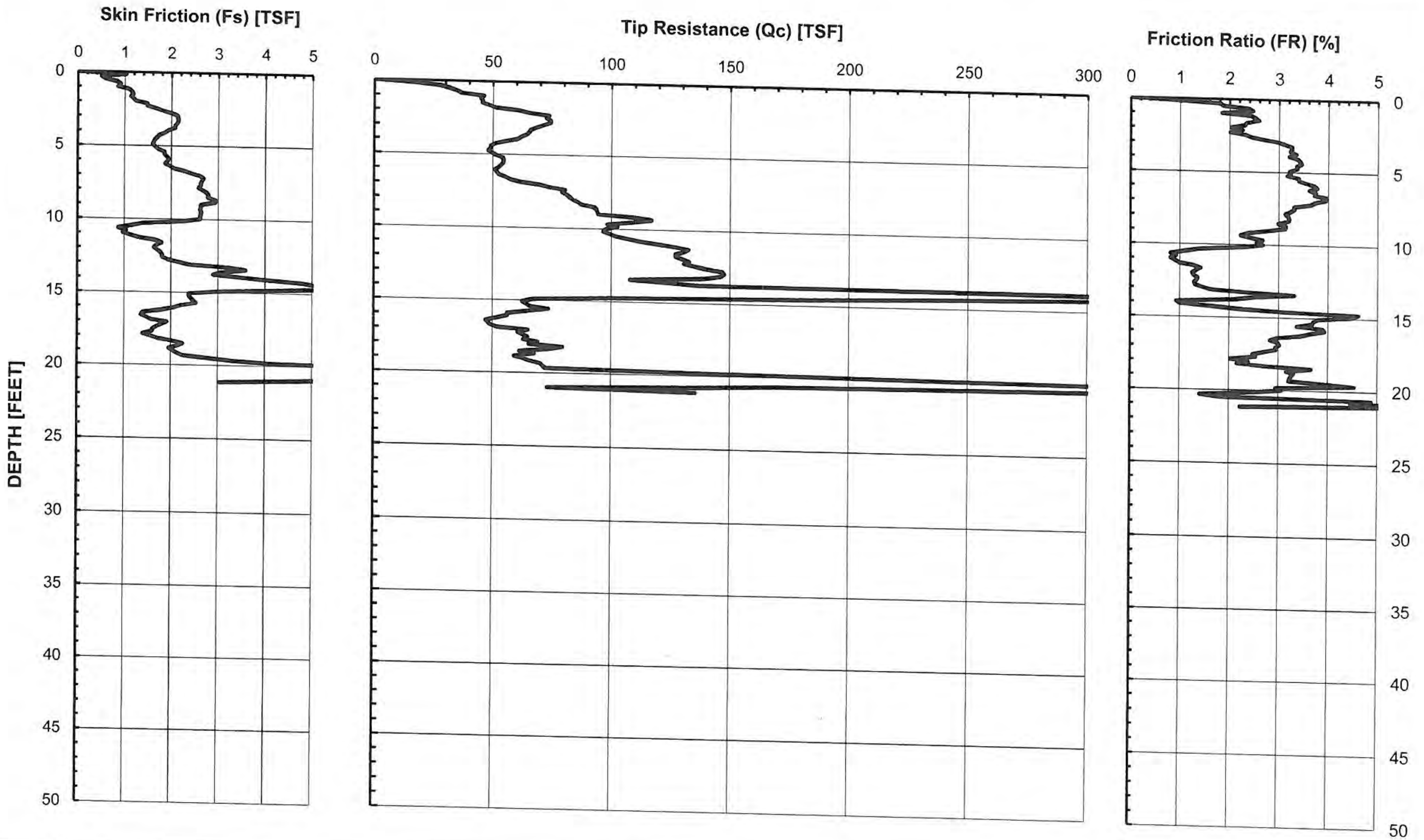
Document No. 15-0006
Project No. IR619
FIGURE A-13b



GROUP DELTA

SHEAR WAVE VELOCITY DATA (CPT-2)

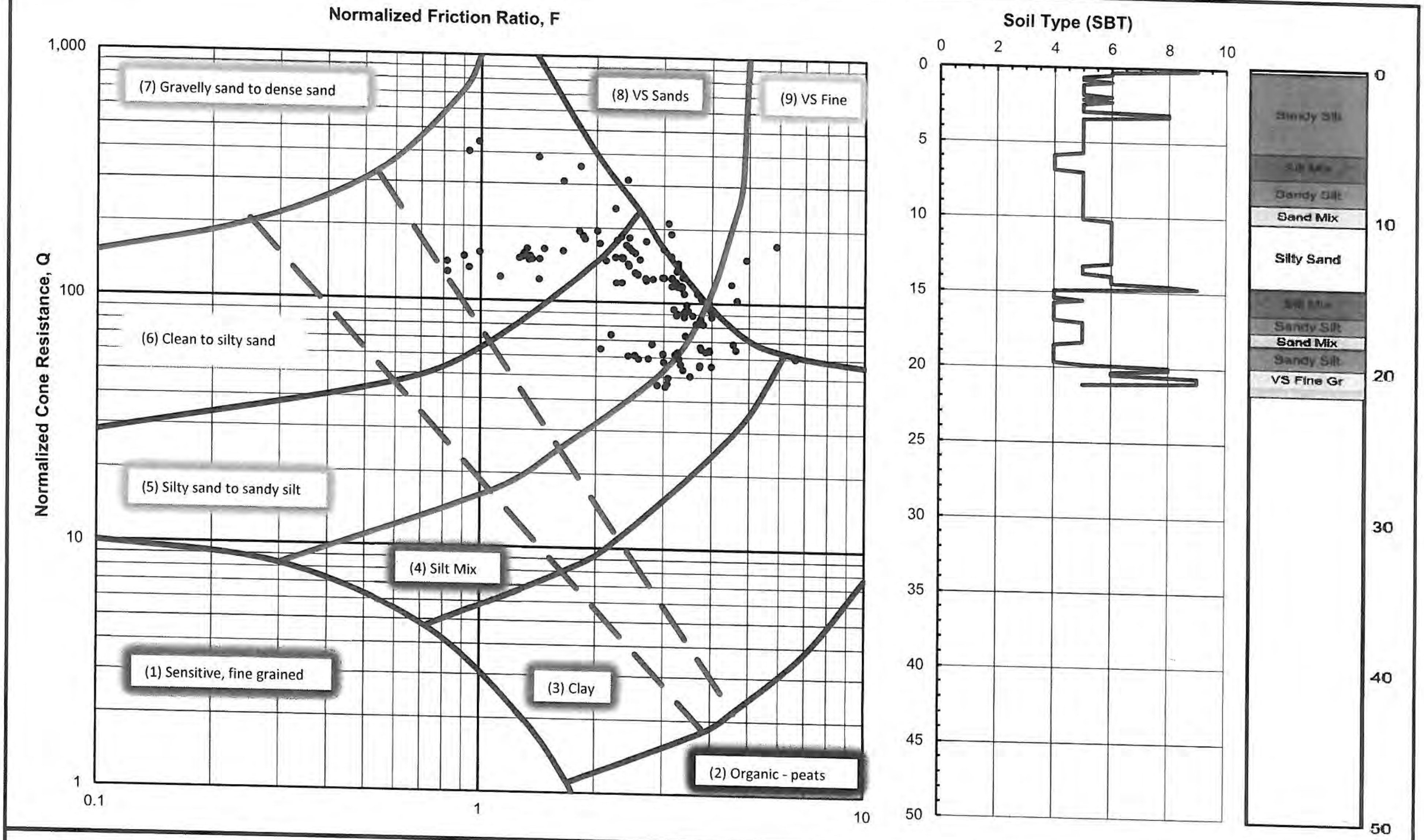
Document No. 15-0006
Project No. IR619
FIGURE A-13c



GROUP DELTA

CONE PENETOMETER DATA (CPT-3)

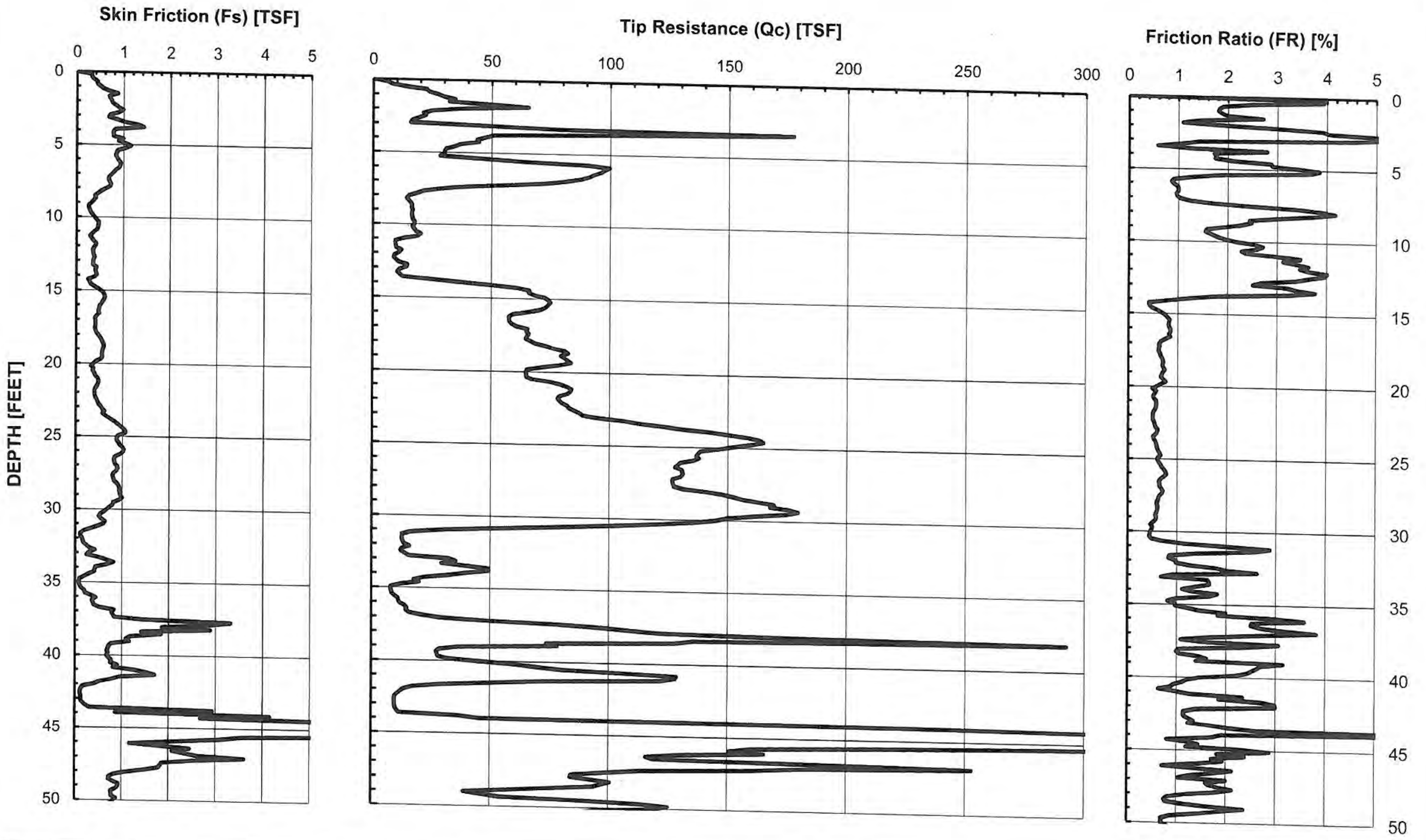
Document No. 15-0006
Project No. IR619
FIGURE A-14a



GROUP DELTA

SOIL CLASSIFICATION (CPT-3)

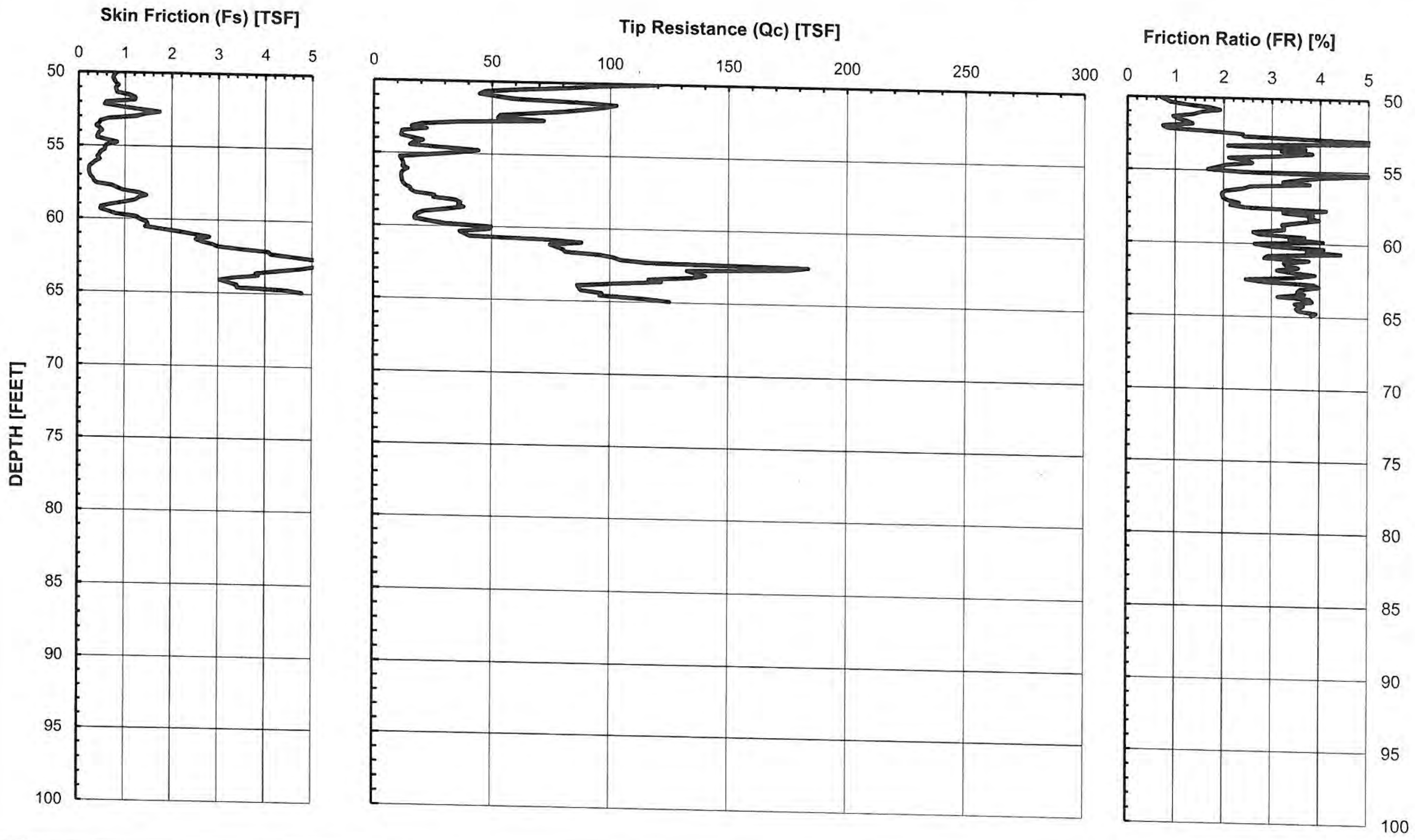
Document No. 15-0006
Project No. IR619
FIGURE A-14b



GROUP DELTA

CONE PENETOMETER DATA (CPT-4)

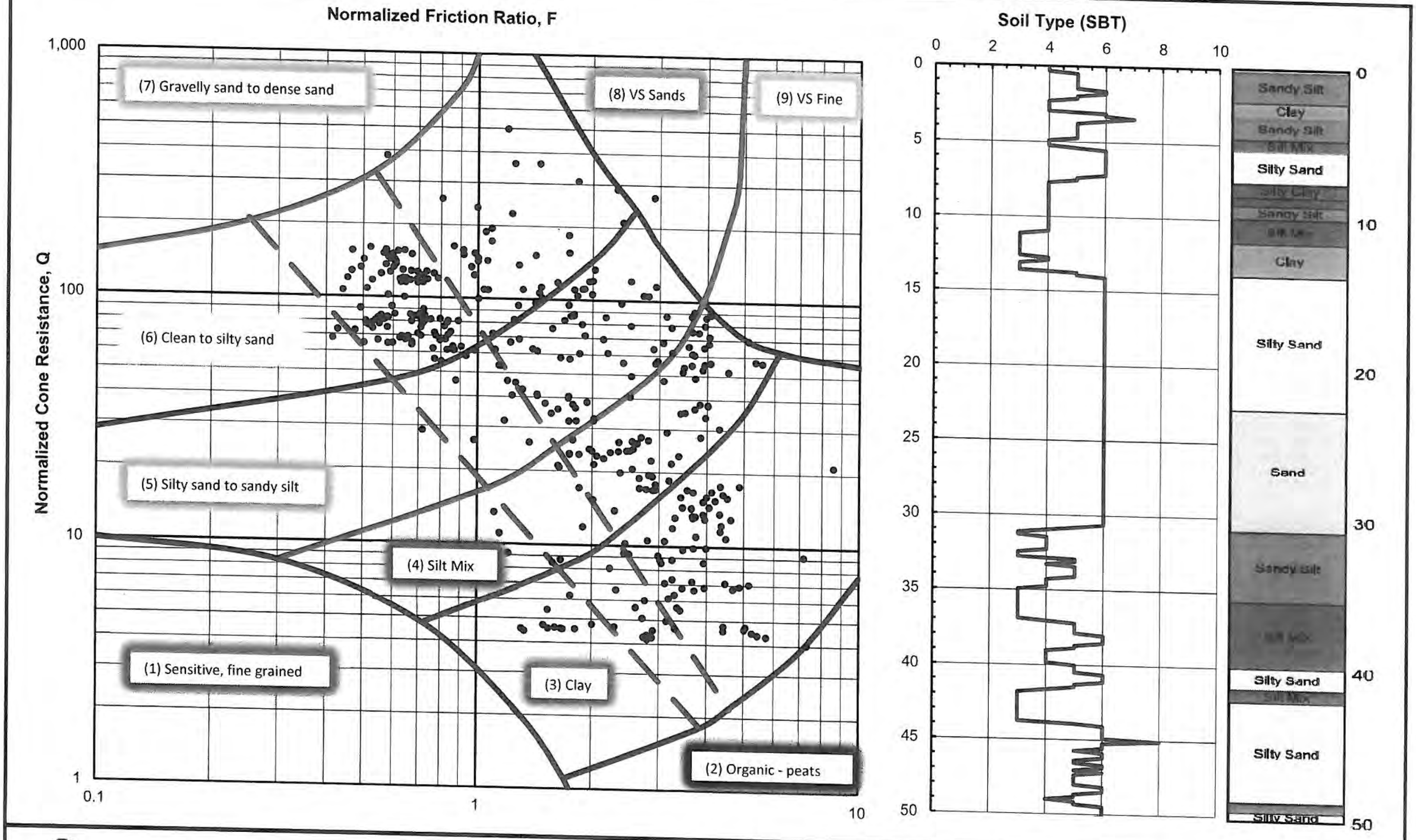
Document No. 15-0006
Project No. IR619
FIGURE A-15a



GROUP DELTA

CONE PENETOMETER DATA (CPT-4)

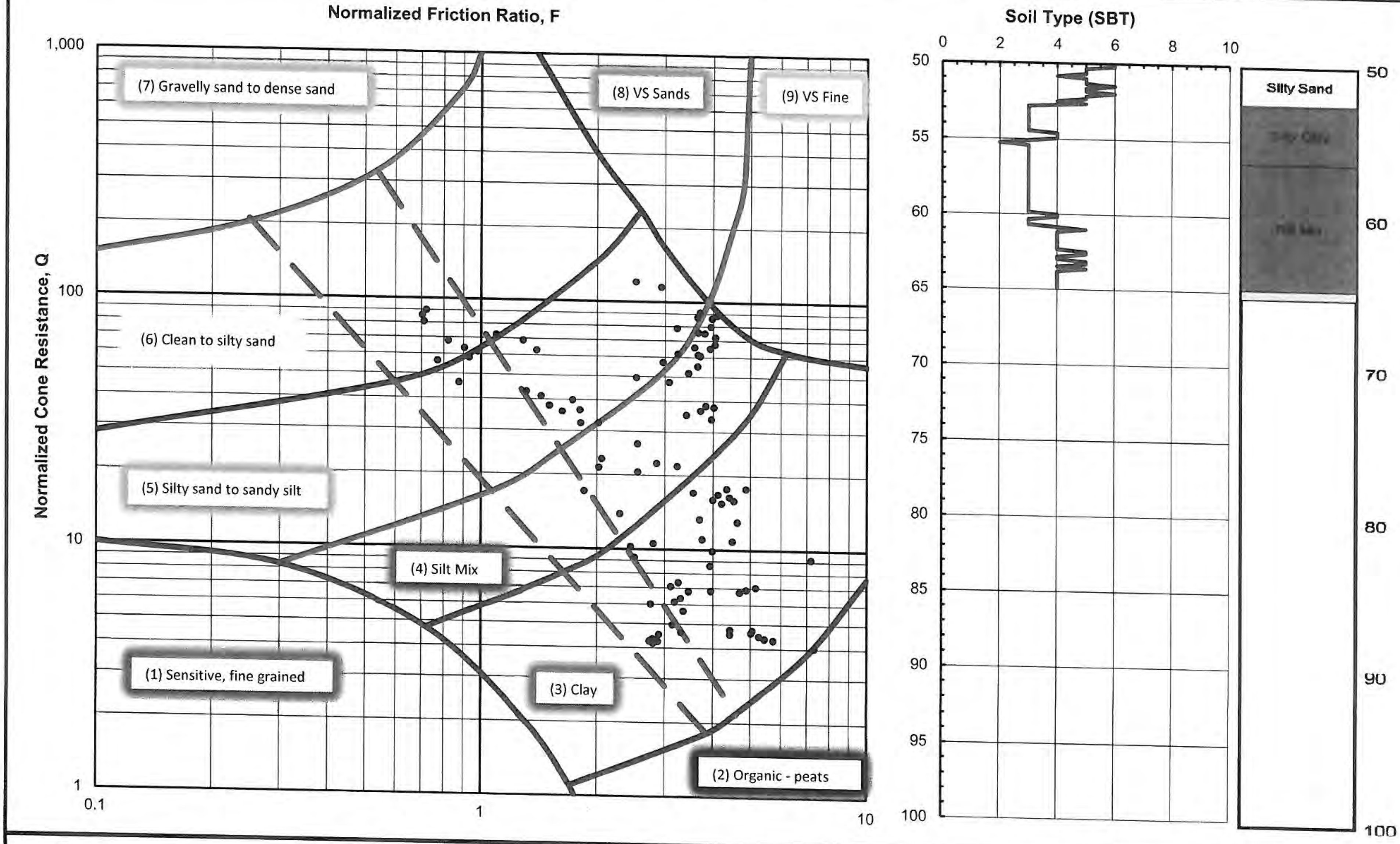
Document No. 15-0006
Project No. IR619
FIGURE A-15a



GROUP DELTA

SOIL CLASSIFICATION (CPT-4)

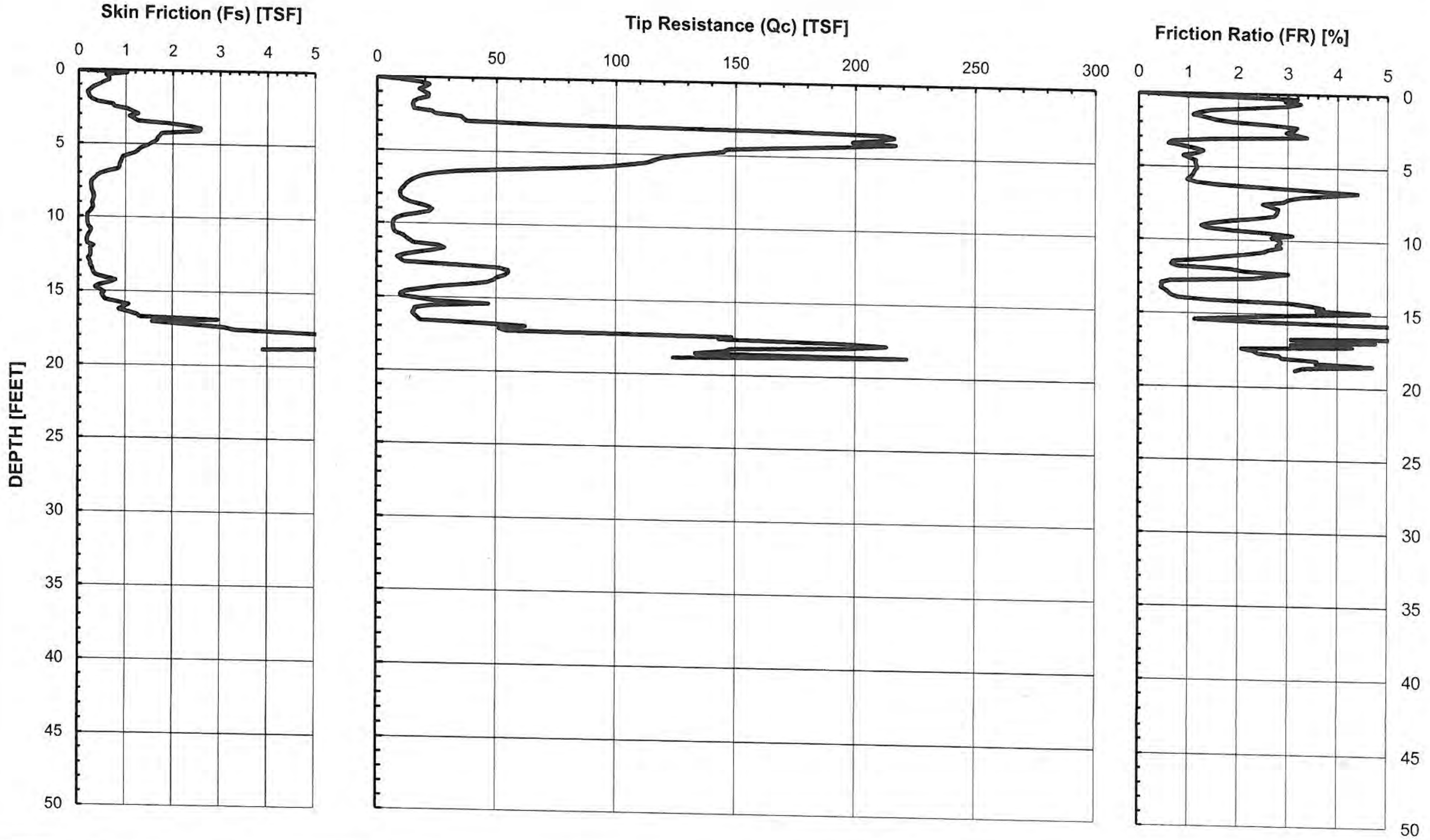
Document No. 15-0006
Project No. IR619
FIGURE A-15b



GROUP DELTA

SOIL CLASSIFICATION (CPT-4)

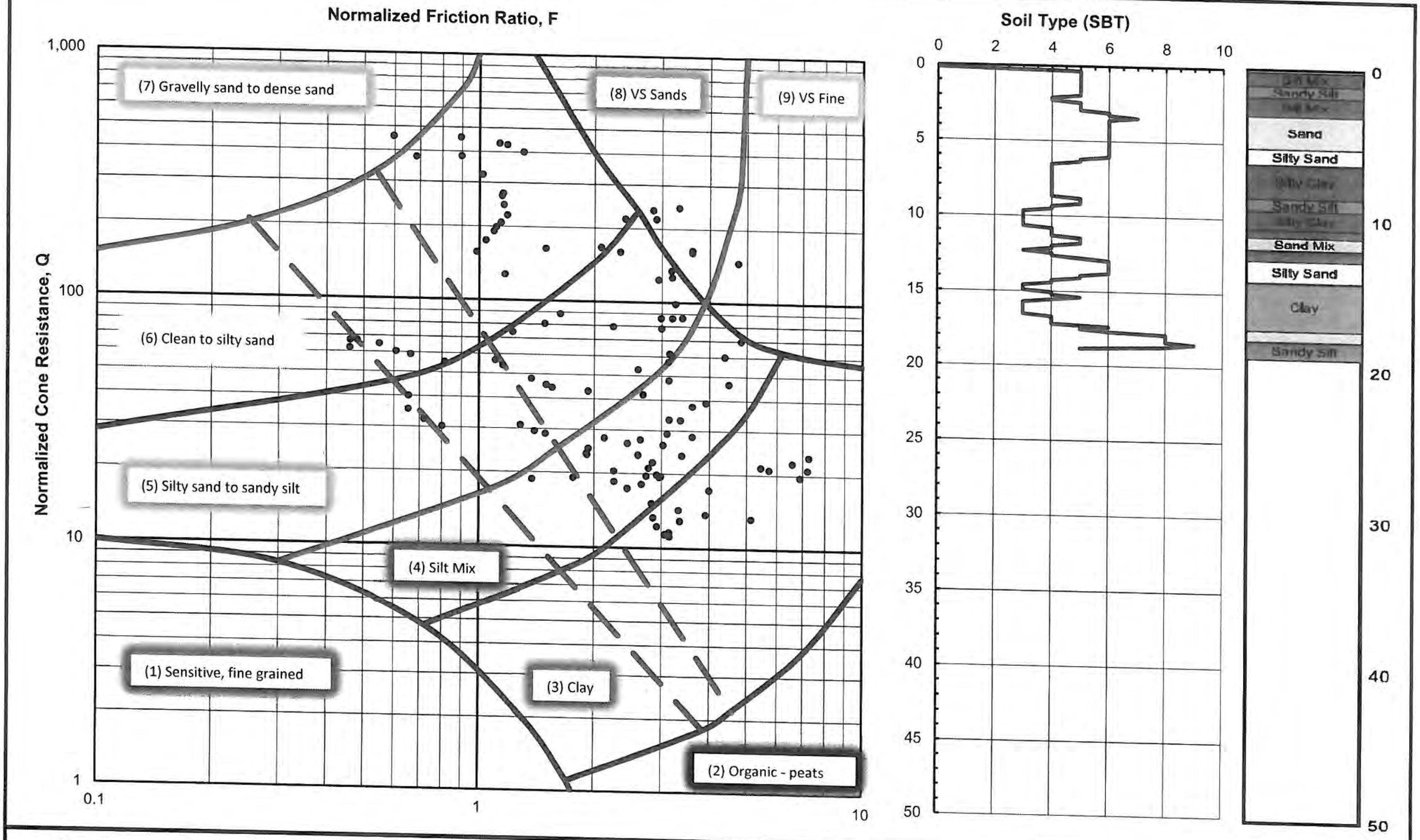
Document No. 15-0006
Project No. IR619
FIGURE A-15b



GROUP DELTA

CONE PENETOMETER DATA (CPT-5)

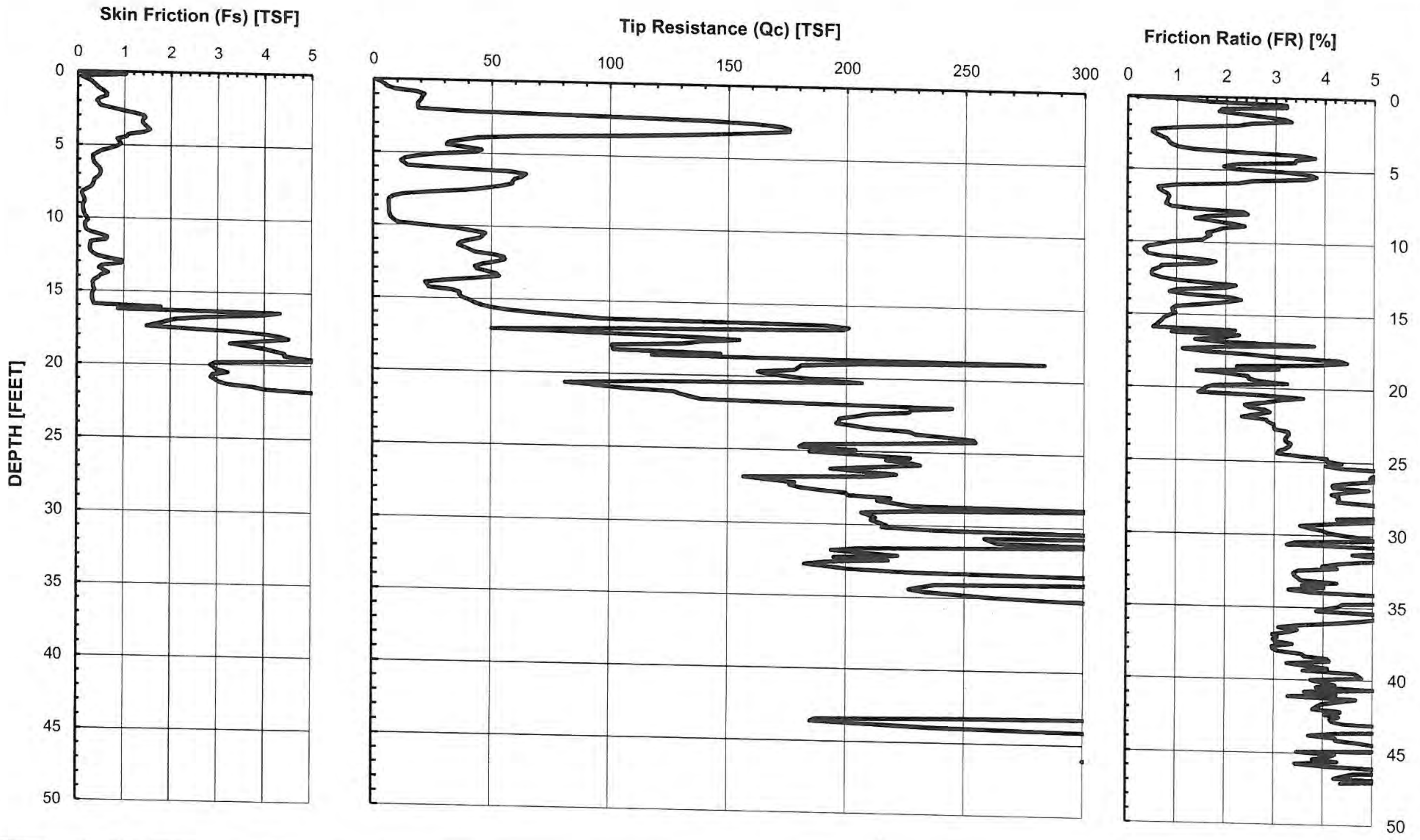
Document No. 15-0006
Project No. IR619
FIGURE A-16a



GROUP DELTA

SOIL CLASSIFICATION (CPT-5)

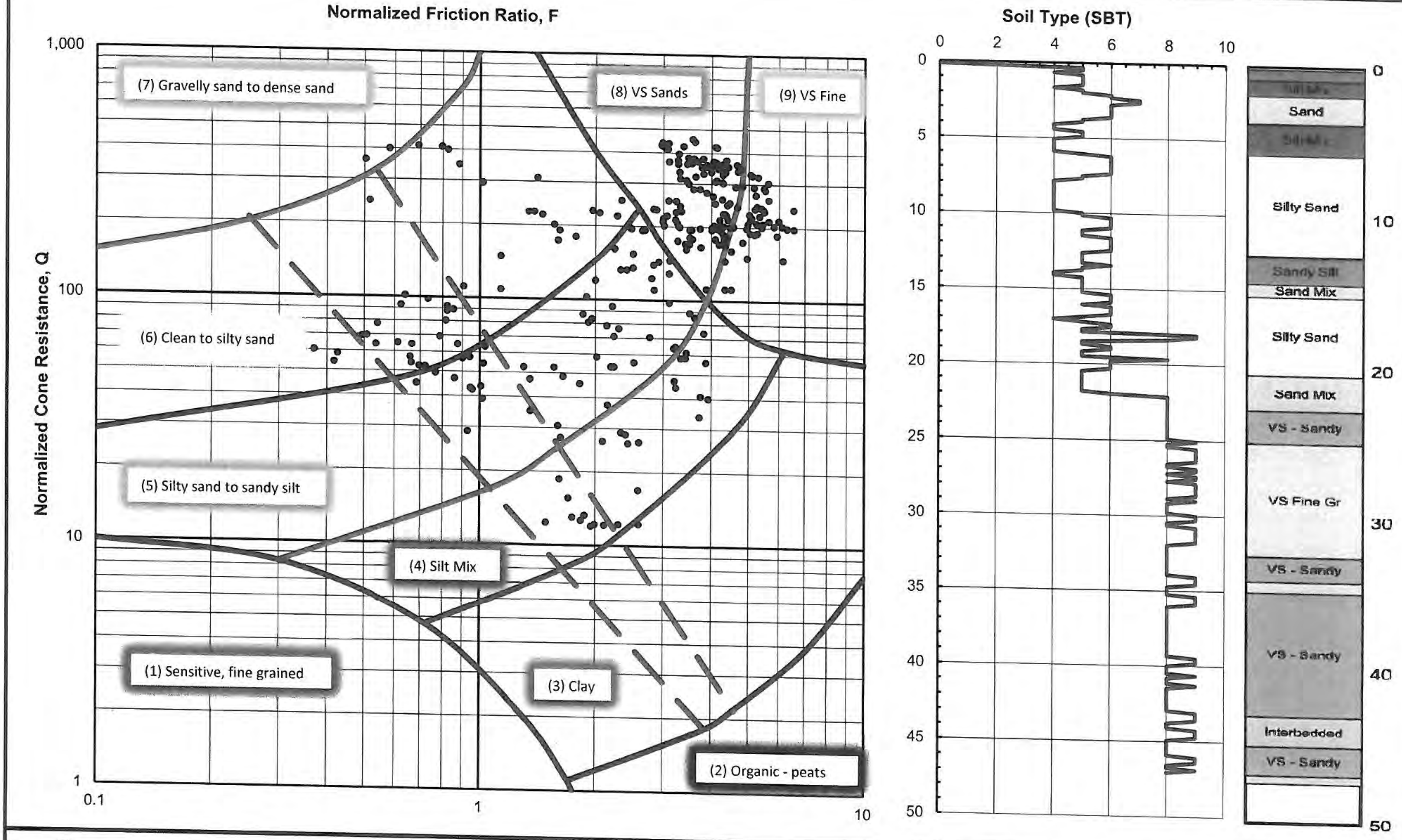
Document No. 15-0006
Project No. IR619
FIGURE A-16b



GROUP DELTA

CONE PENETOMETER DATA (CPT-6)

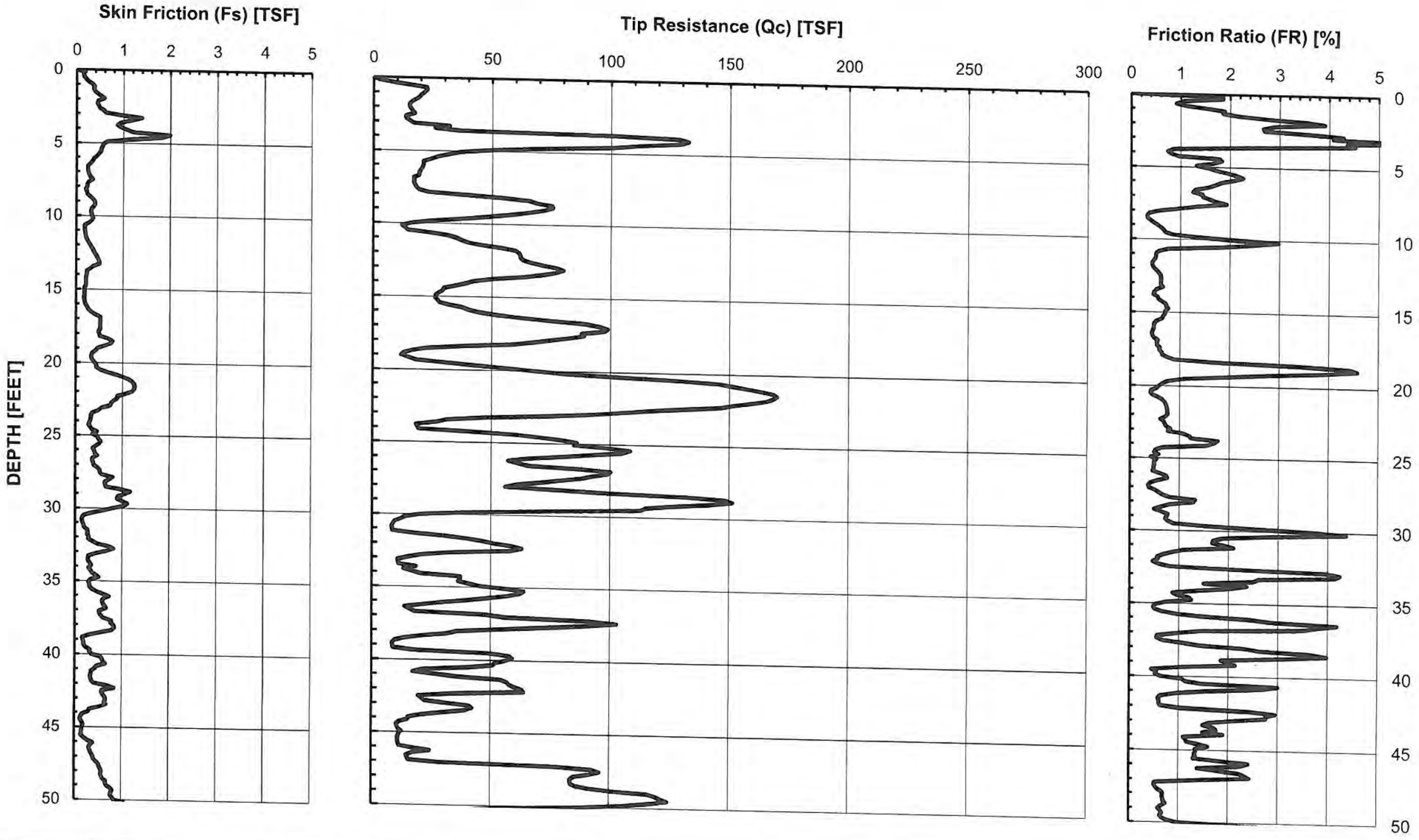
Document No. 15-0006
Project No. IR619
FIGURE A-17a



GROUP DELTA

SOIL CLASSIFICATION (CPT-6)

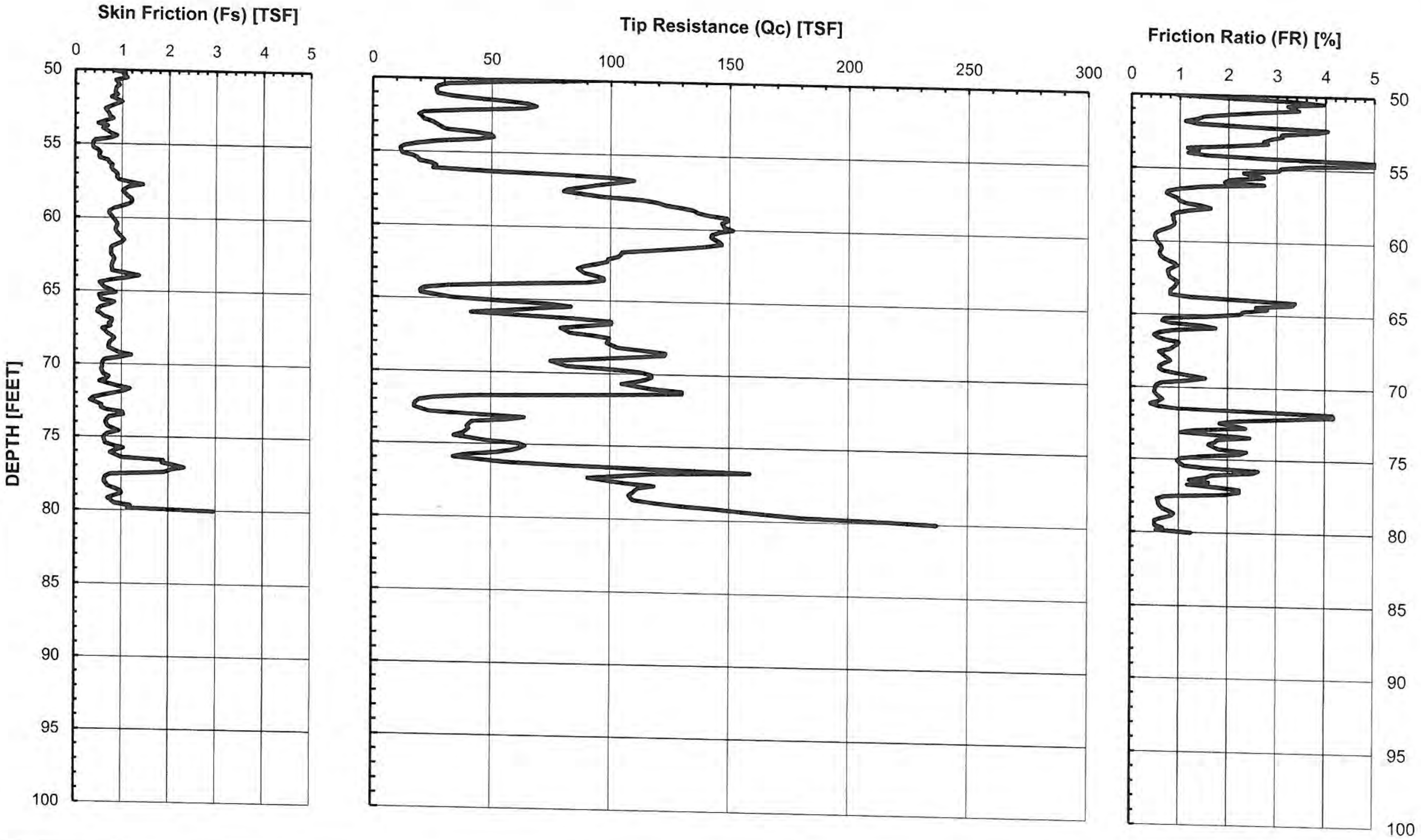
Document No. 15-0006
Project No. IR619
FIGURE A-17b



GROUP DELTA

CONE PENETOMETER DATA (CPT-7)

Document No. 15-0006
Project No. IR619
FIGURE A-18a



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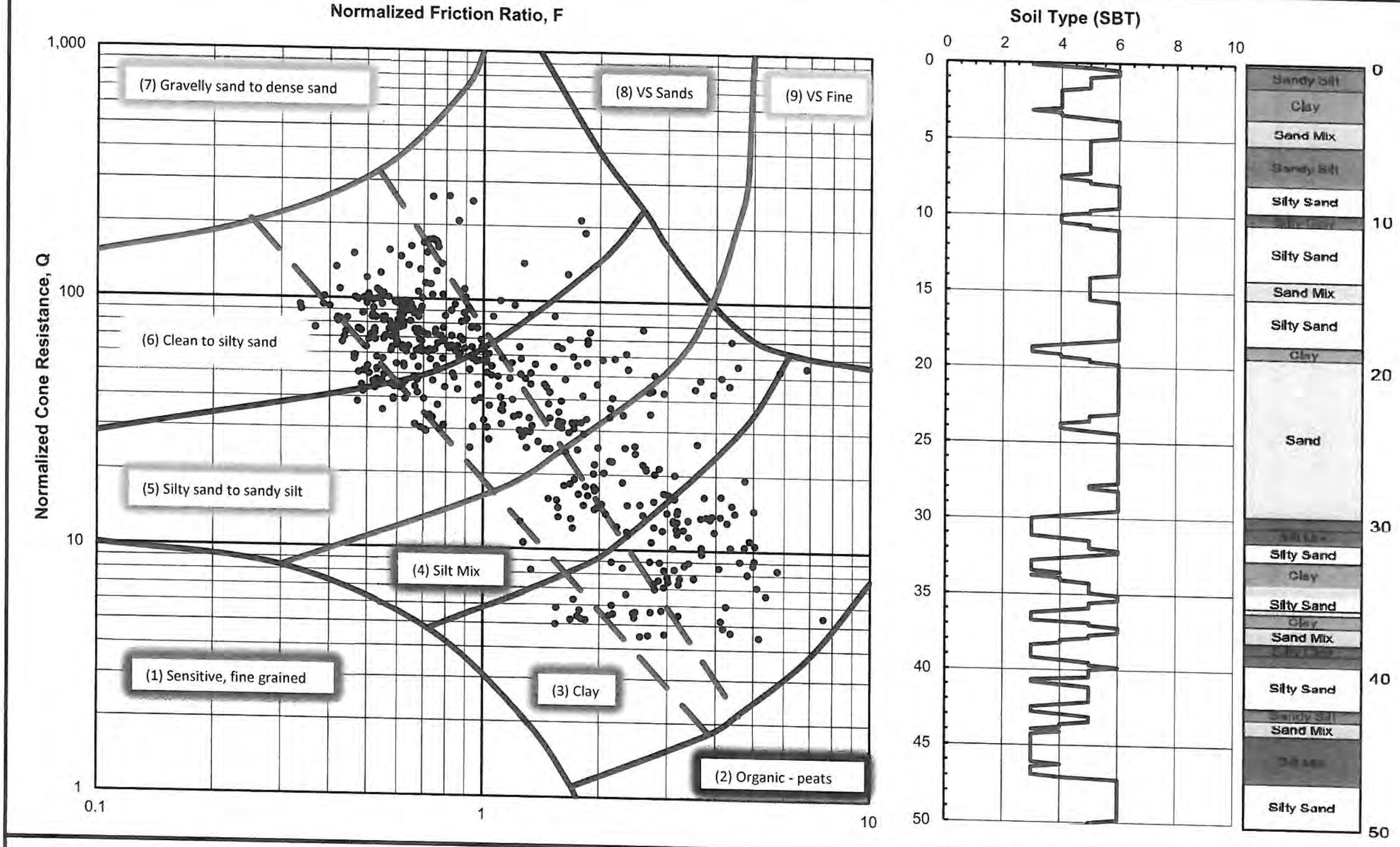
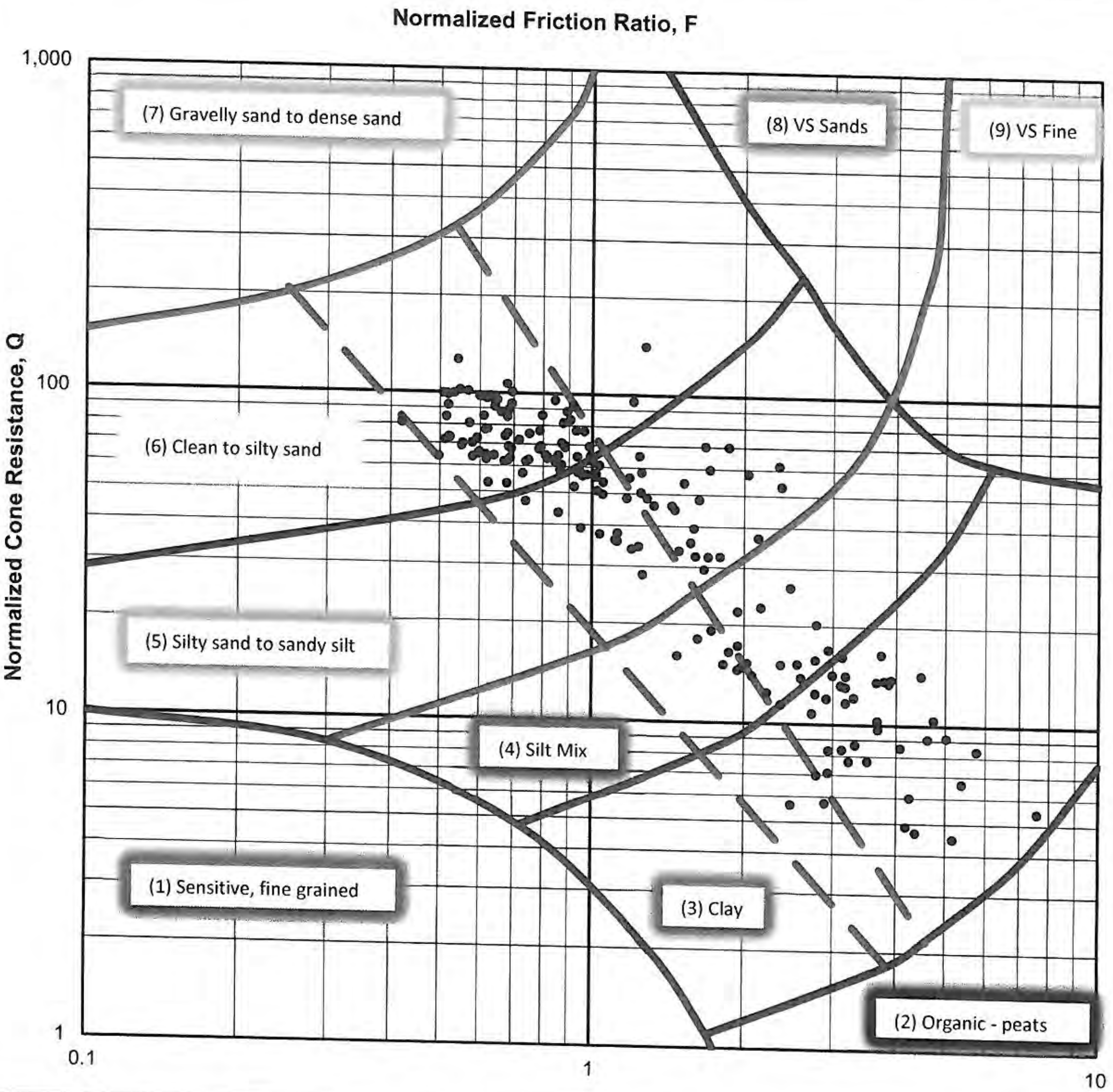
Document No. 15-0006
Project No. IR619
FIGURE A-18a

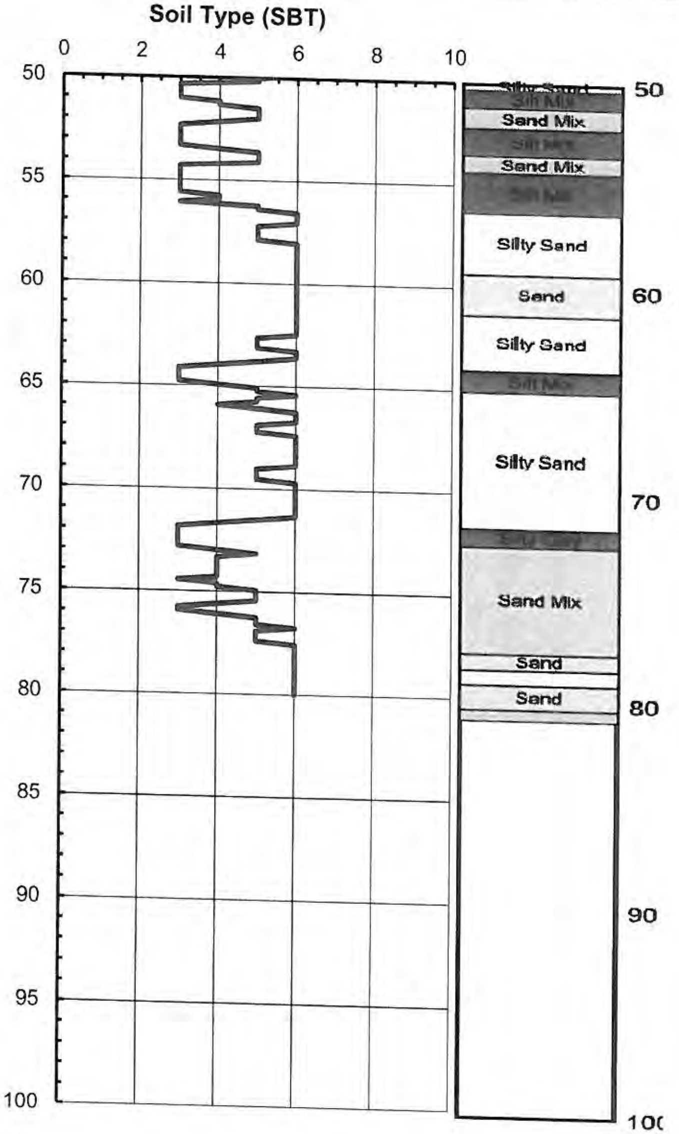


GROUP DELTA

SOIL CLASSIFICATION (CPT-7)

Document No. 15-0006
Project No. IR619
FIGURE A-18b





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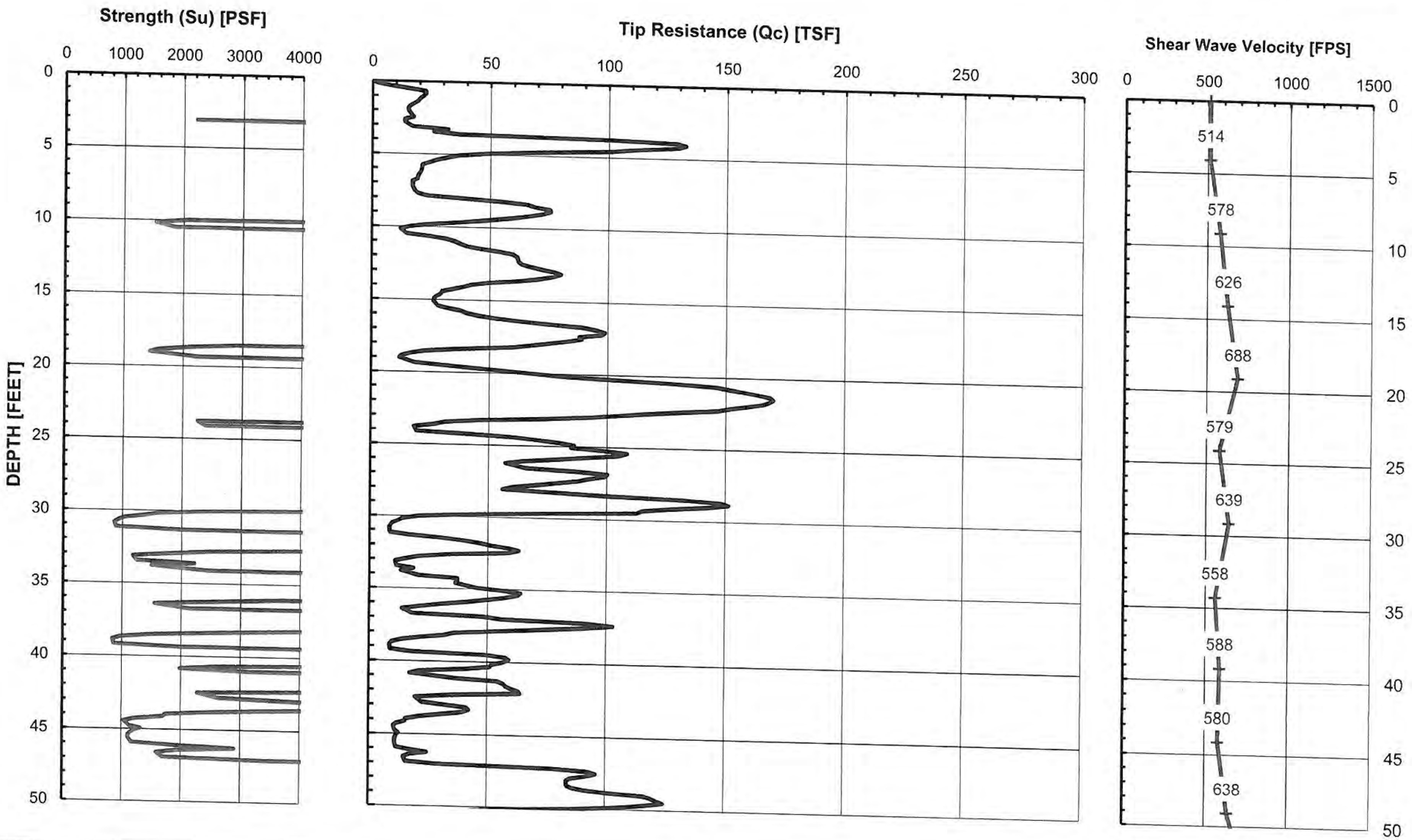
SOIL CLASSIFICATION (CPT-7)

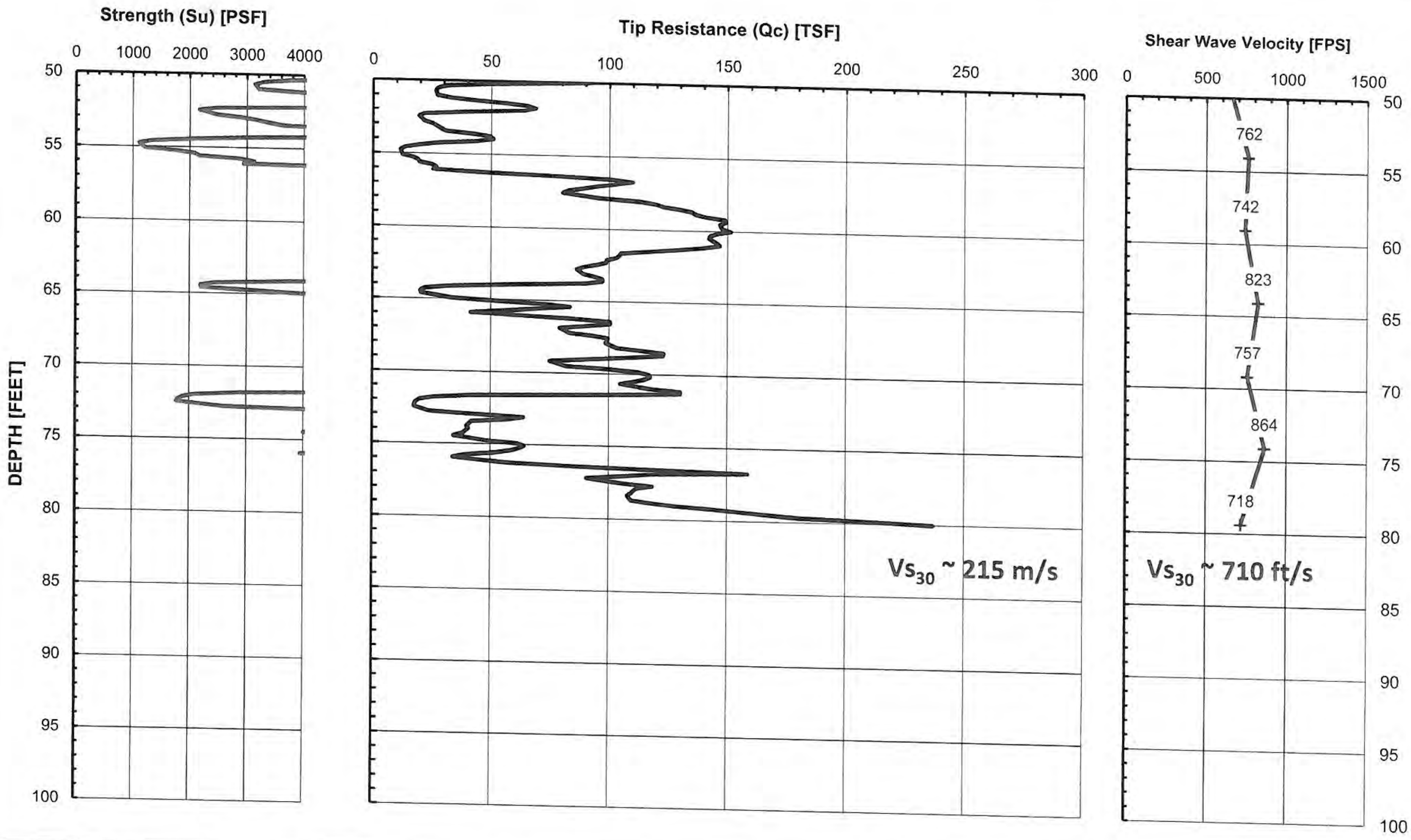
Document No. 15-0006
Project No. IR619
FIGURE A-18b



GROUP DELTA

SHEAR WAVE VELOCITY DATA (CPT-7)

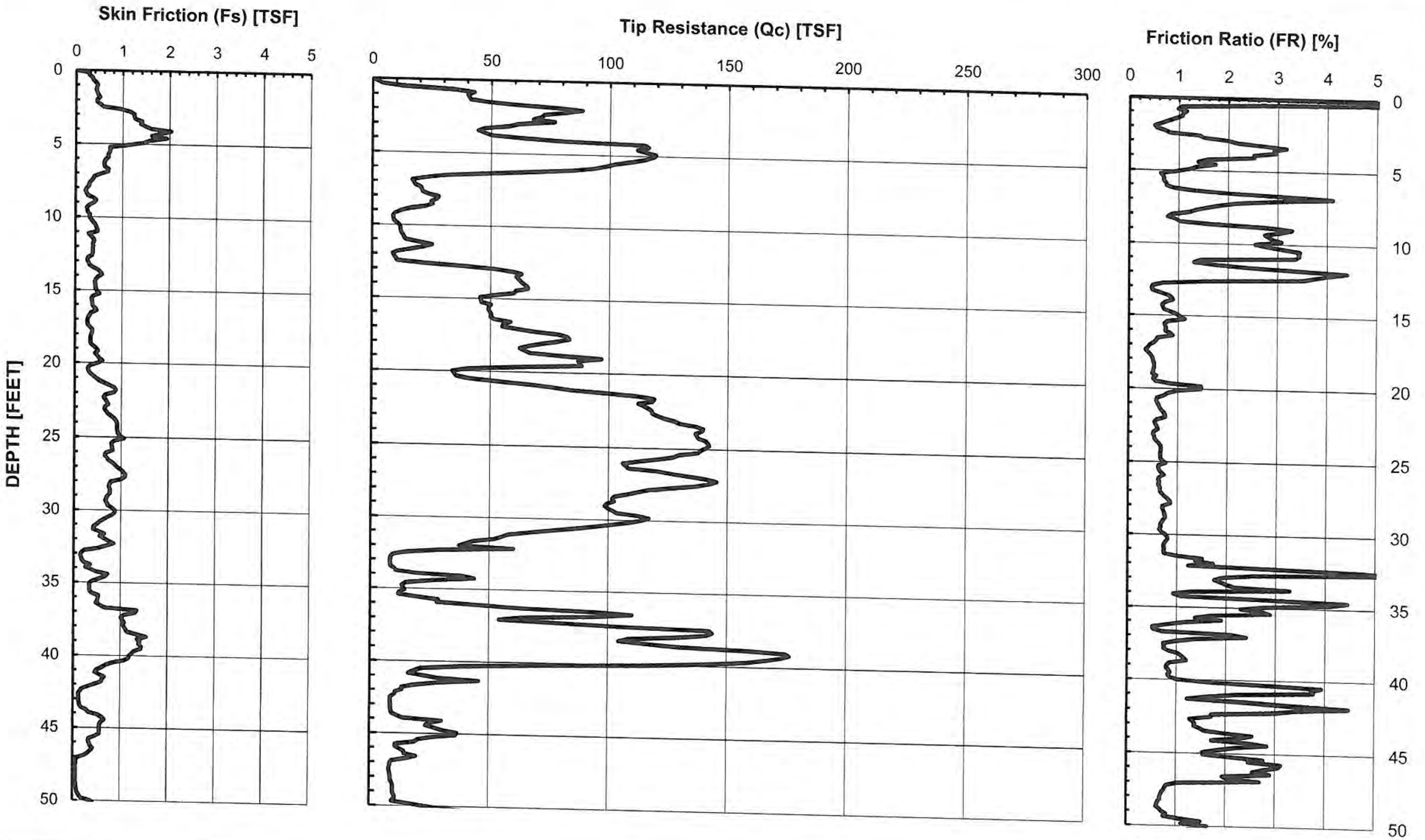
Document No. 15-0006
Project No. IR619
FIGURE A-18c



GROUP DELTA

SHEAR WAVE VELOCITY DATA (CPT-7)

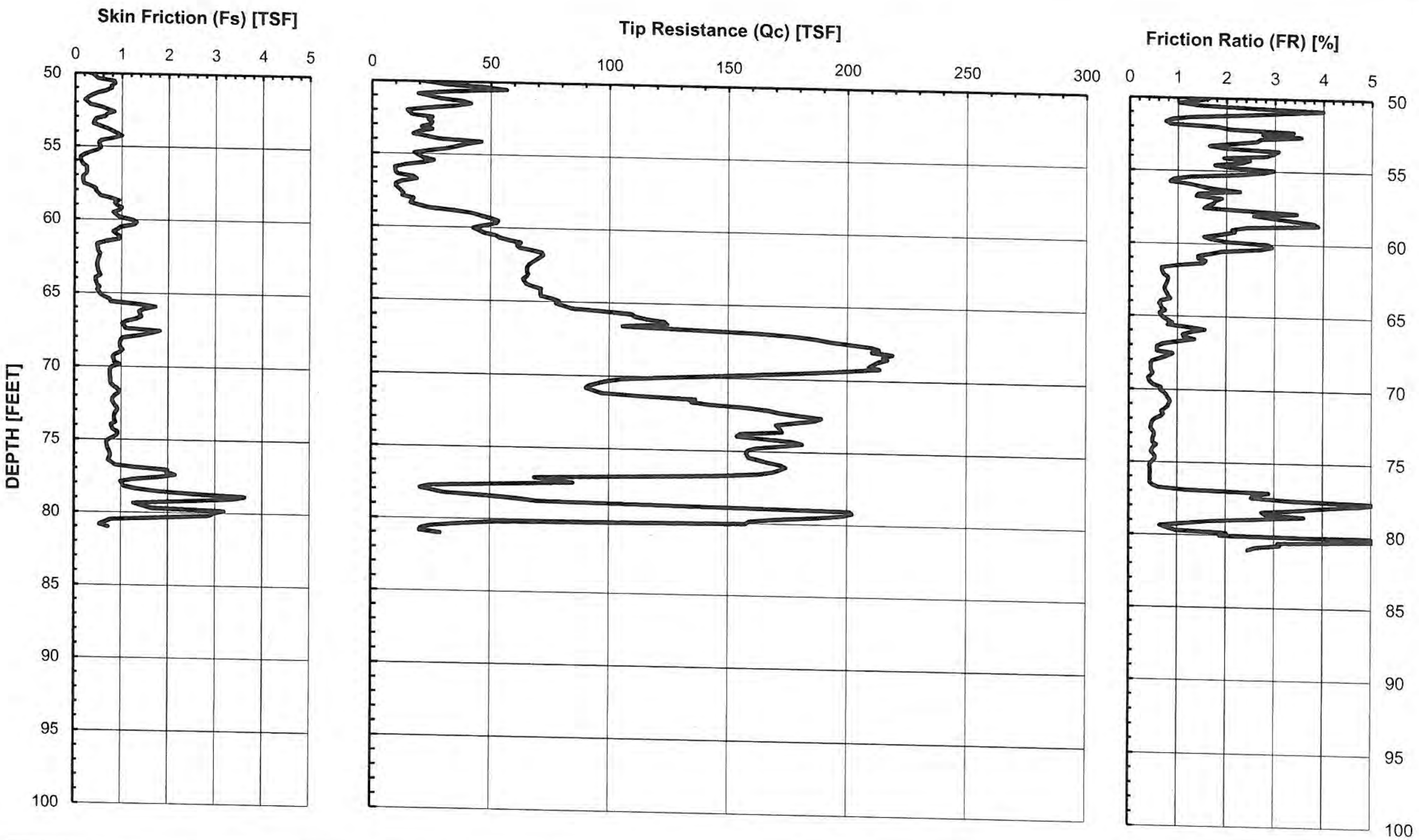
Document No. 15-0006
Project No. IR619
FIGURE A-18c



GROUP DELTA

CONE PENETOMETER DATA (CPT-8)

Document No. 15-0006
Project No. IR619
FIGURE A-19a



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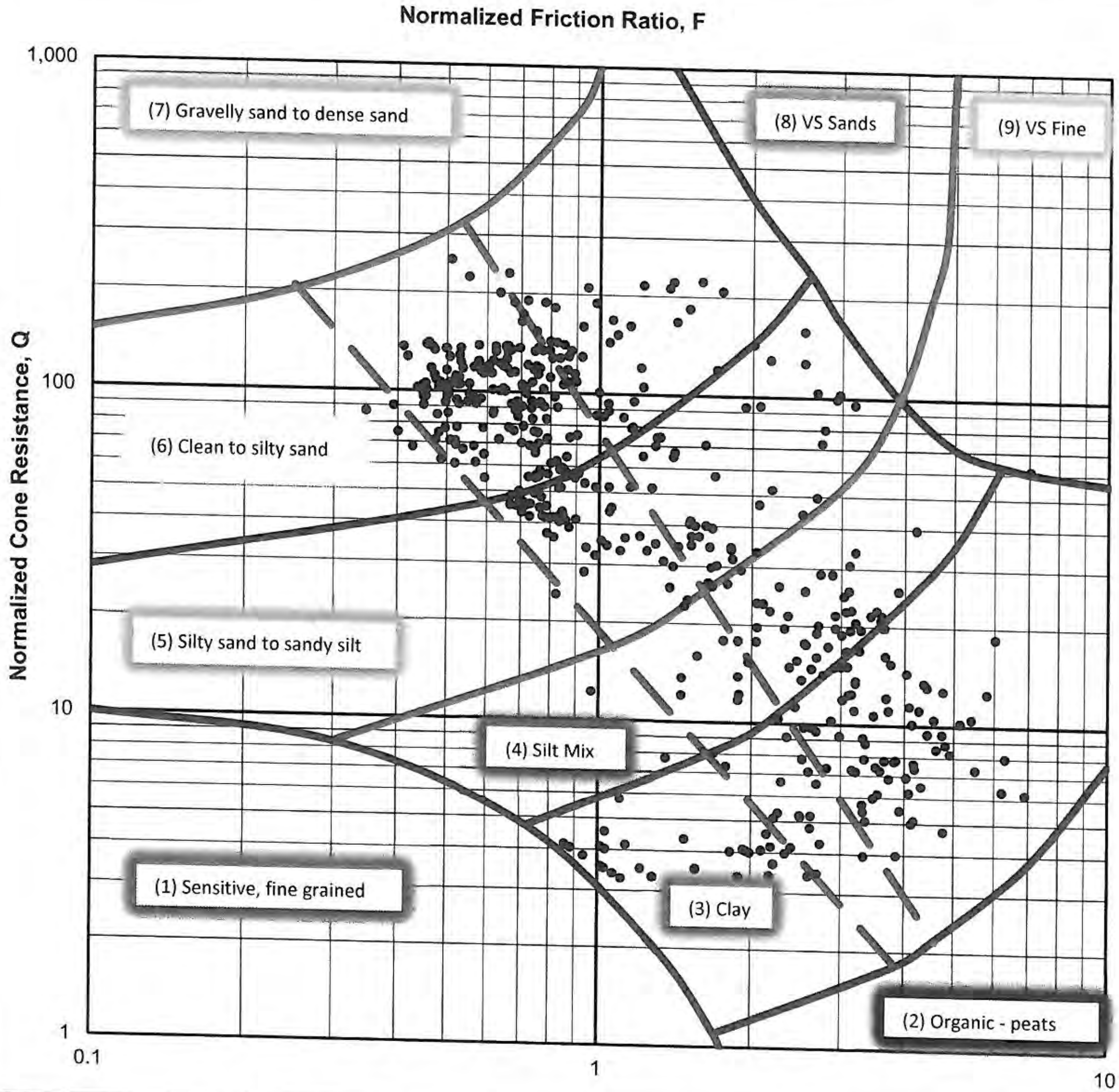
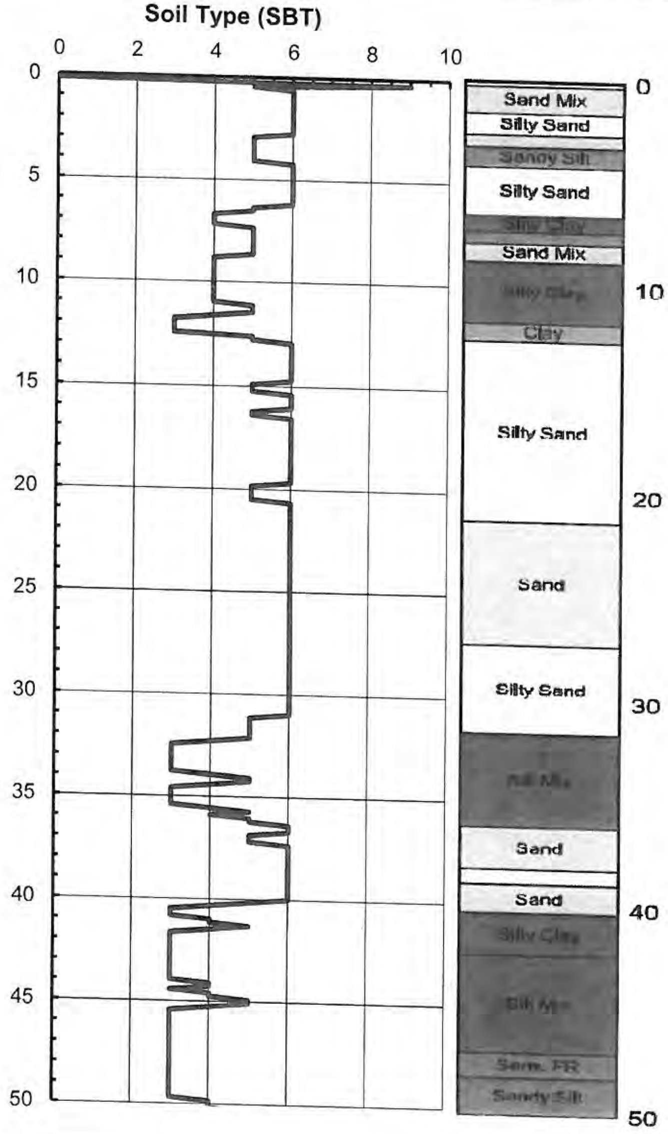
CONE PENETOMETER DATA (CPT-8)

Document No. 15-0006
Project No. IR619
FIGURE A-19a

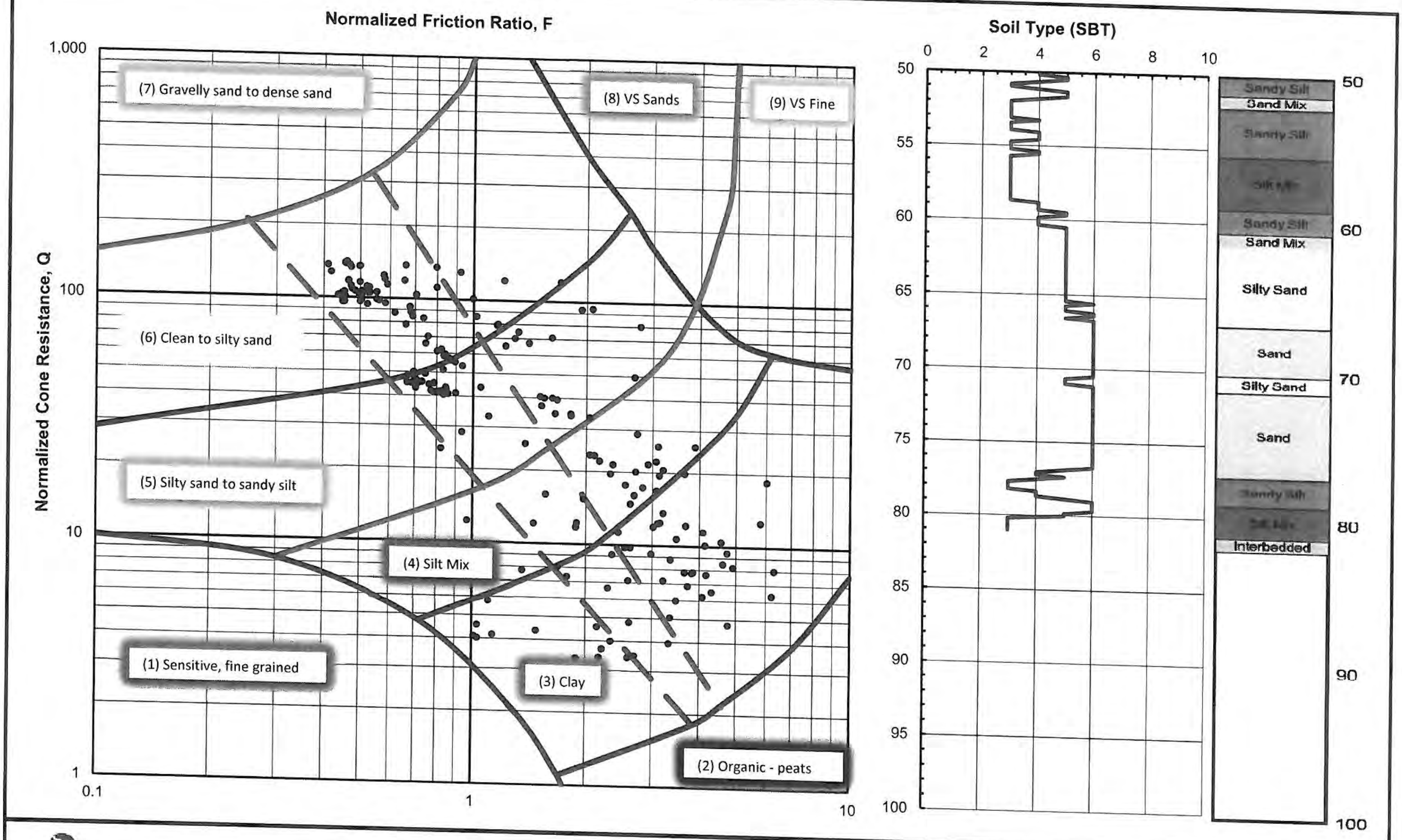




GROUP DELTA

SOIL CLASSIFICATION (CPT-8)

Document No. 15-0006
Project No. IR619
FIGURE A-19b



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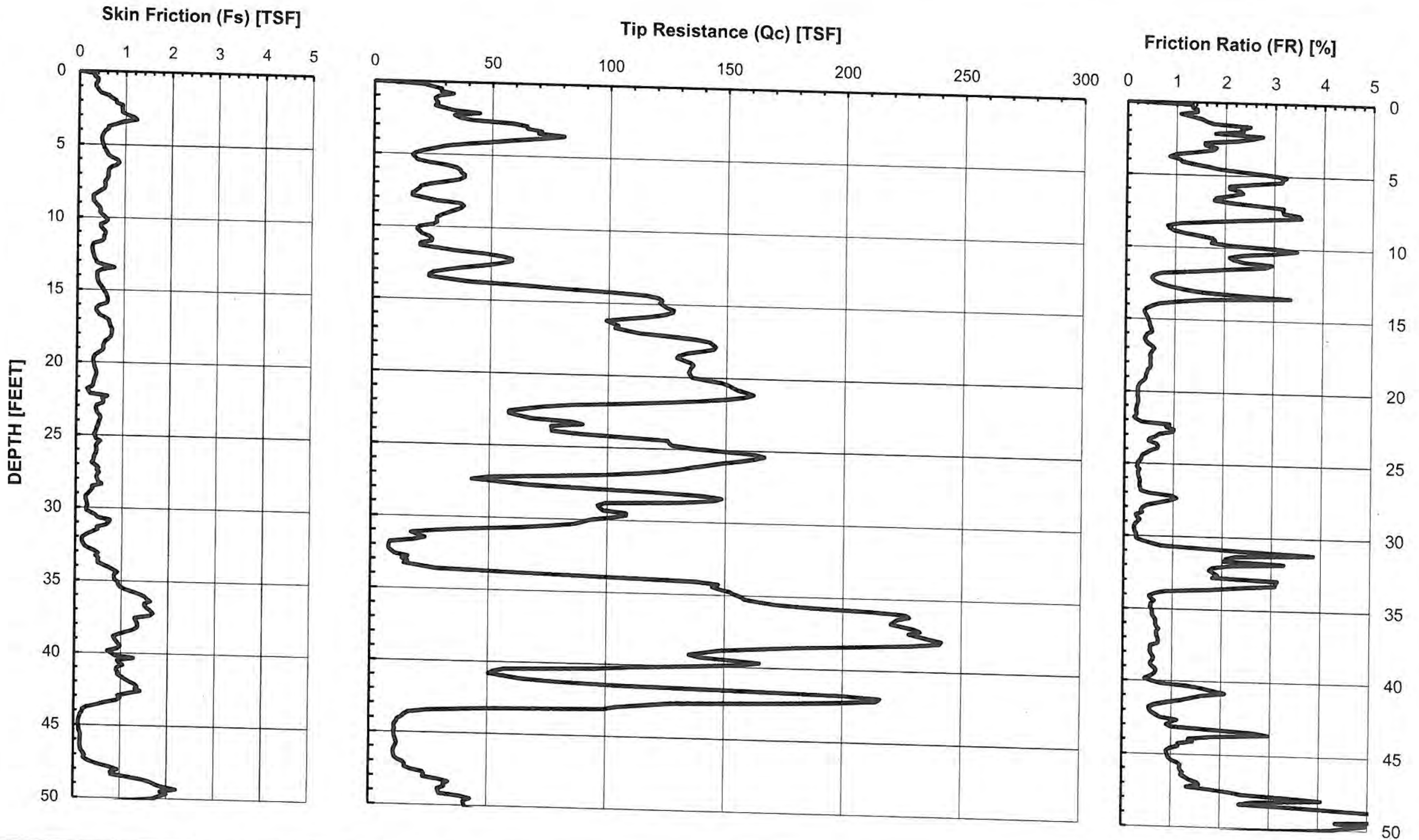
SOIL CLASSIFICATION (CPT-8)

Document No. 15-0006
Project No. IR619
FIGURE A-19b



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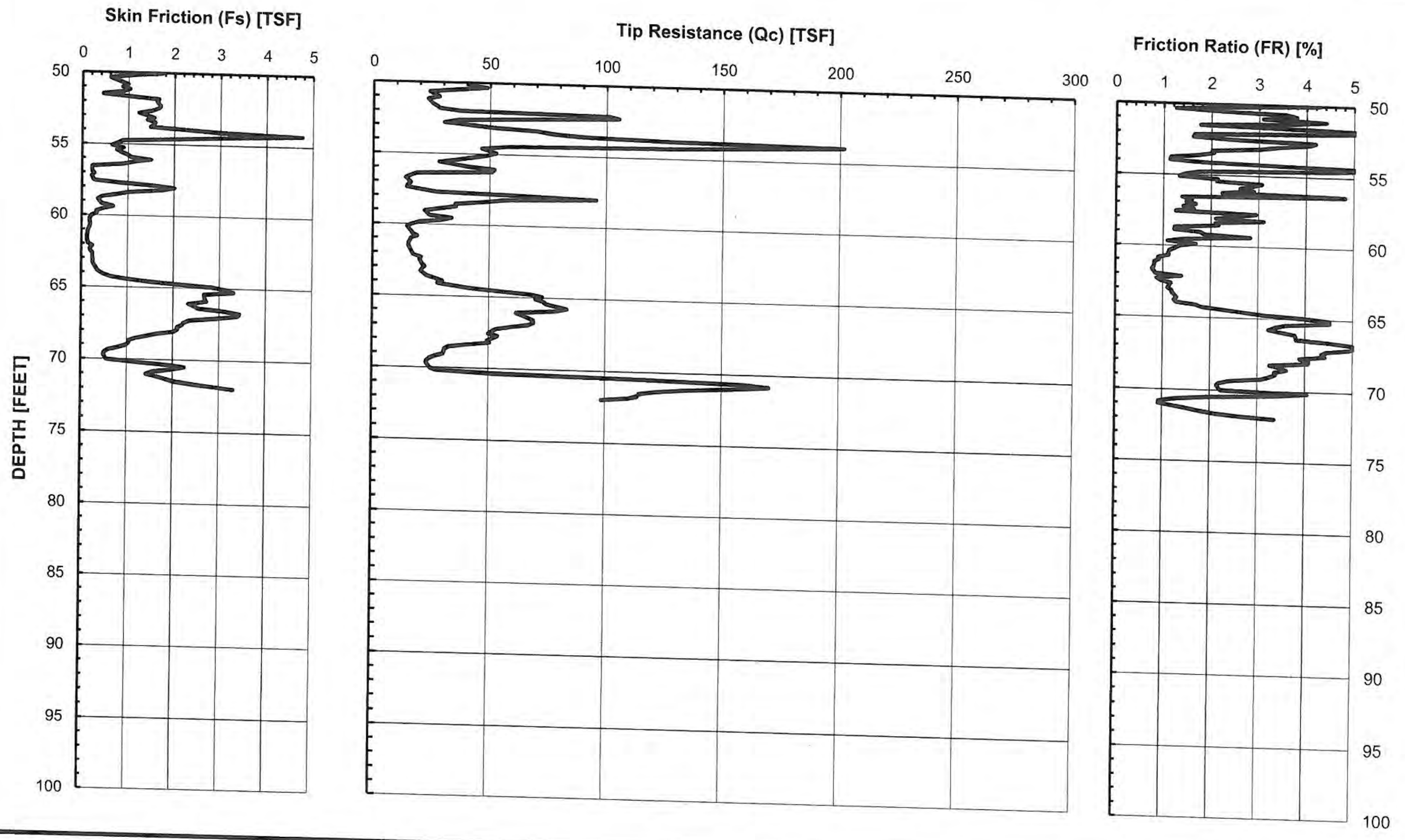
CONE PENETOMETER DATA (CPT-9)

Document No. 15-0006
Project No. IR619
FIGURE A-20a



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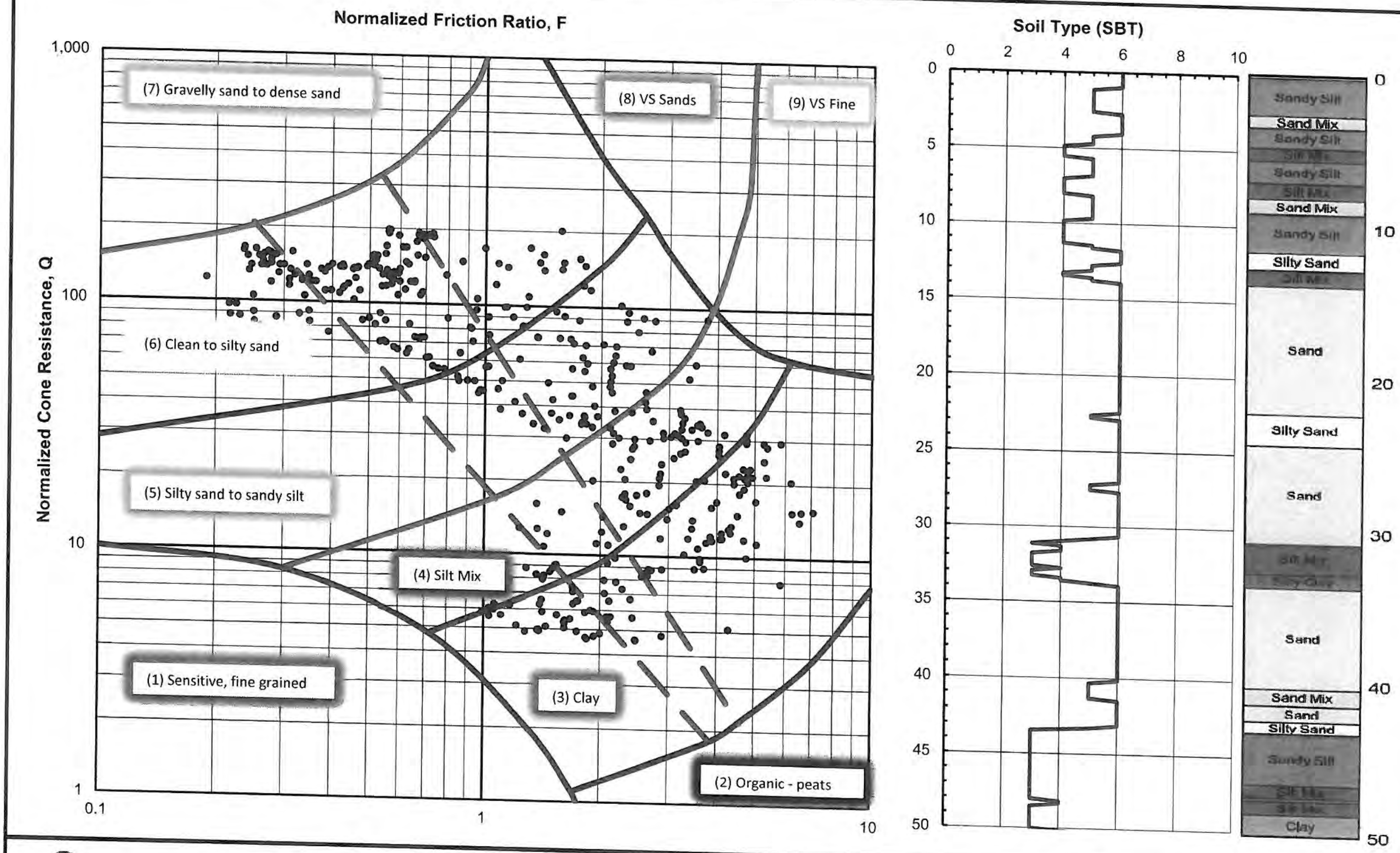
CONE PENETOMETER DATA (CPT-9)

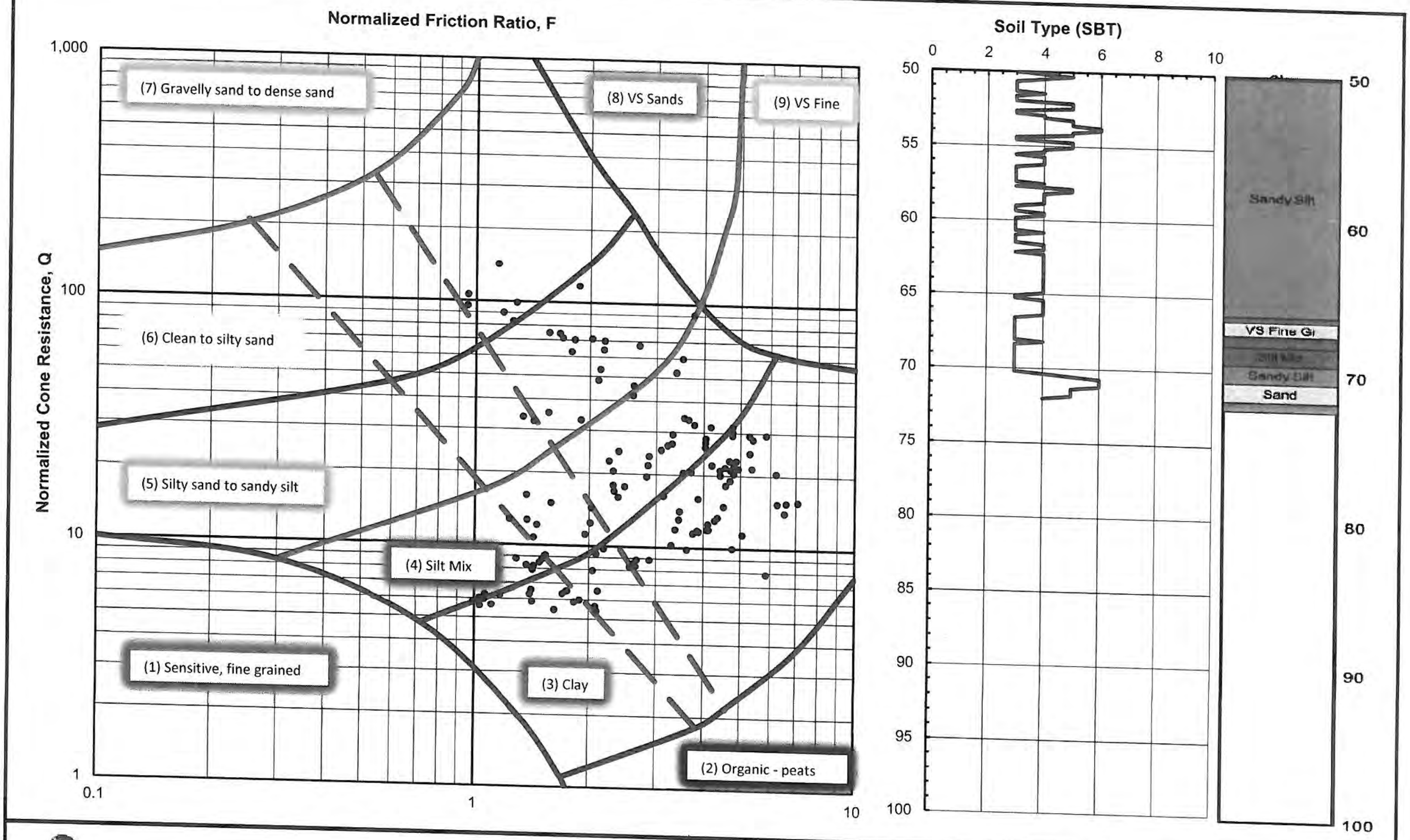
Document No. 15-0006
Project No. IR619
FIGURE A-20a



GROUP DELTA

SOIL CLASSIFICATION (CPT-9)

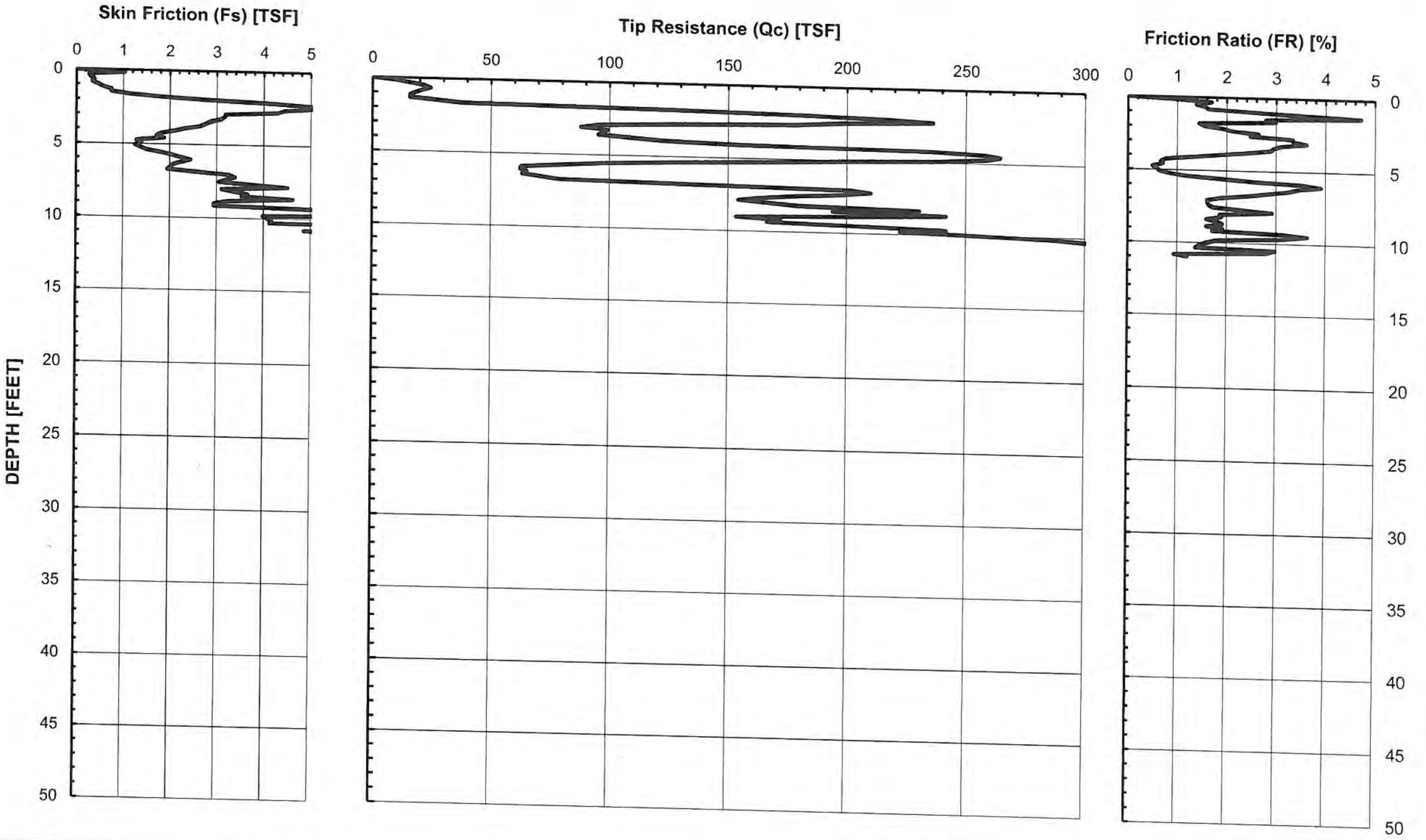
Document No. 15-0006
Project No. IR619
FIGURE A-20b



GROUP DELTA

SOIL CLASSIFICATION (CPT-9)

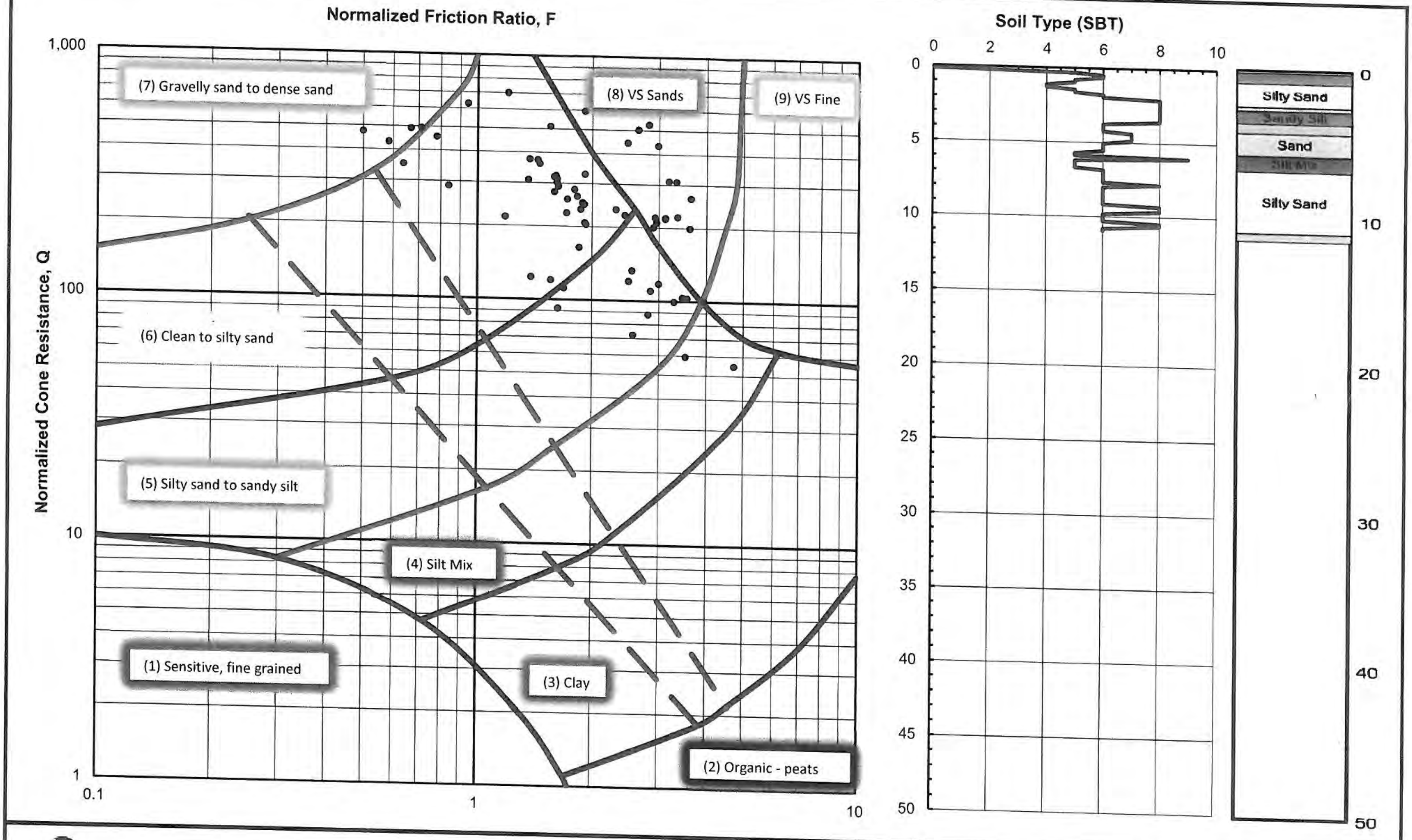
Document No. 15-0006
Project No. IR619
FIGURE A-20b



GROUP DELTA

CONE PENETOMETER DATA (CPT-10)

Document No. 15-0006
Project No. IR619
FIGURE A-21a



GROUP DELTA

SOIL CLASSIFICATION (CPT-10)

Document No. 15-0006
Project No. IR619
FIGURE A-21b

APPENDIX C

LABORATORY TEST RESULTS

THIS INVESTIGATION

Riverwalk
Project Number: 11077-01

APPENDIX
SUMMARY OF SOIL LABORATORY DATA

San Diego, CA

Boring/Sample Information						Field Wet Density (pcf)	Field Dry Density (pcf)	Field Moisture Content (%)	Degree of Sat. (%)	Sieve/ Hydrometer		Atterberg Limits		USCS Group Symbol	Direct Shear				Compaction		Expansion Index	R-Value	Soluble Sulfate Content (% by wt)	Remarks
															Ultimate		Peak							
Boring No.	Sample No.	Depth (feet)	End Depth (feet)	Elevation (feet)	Blow Count (N)					Fines Content (% pass. #200)	Clay Content (% pass. 2µ)	LL (%)	PI (%)		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)	Maximum Dry Density (pcf)	Optimum Moisture Content (%)				
B- 1	B-1	0.0		23.0			113.0	19.7		24		40	24	SC	150	27	200	27	126.0	9.5	54	6	0.18	
B- 1	D-2	10.0		13.0	11	101.3	71.9	40.8	82.1	81		44	18	CL										Consol
B- 1	D-5	25.0		-2.0	53	124.2	99.6	24.7	96.6	6				SP-SM										
B- 1	D-8	40.0		-17.0	10	120.2	89.0	35.1	100.0	16		NP	NP	SM										
B- 1	D-9	45.0		-22.0	50/5"	126.2	103.2	22.3	95.1	9				SP-SM										
B- 1	D-11	55.0		-32.0	14	121.5	93.8	29.5	100.0	59		53	35	CH										
B- 1	D-14	70.0		-47.0	14	132.4	112.6	17.6	95.5	41		29	16	SC										
B- 2	B-1	0.0		25.0						28		NP	NP	SM					129.0	9.0	13		0.1	
B- 3	B-1	0.0		26.0						26		NP	NP	SM										
B- 3	D-1	5.0		21.0	21	117.8	89.9	31.0	96.0	31				SM										
B- 3	D-2	10.0		16.0	12	115.9	95.8	20.9	74.6					SM										Consol
B- 3	D-4	20.0		6.0	11	120.3	91.8	31.1	100.0			NP	NP	SP-SM										Consol
B- 3	D-12	60.0		-34.0	42	127.8	109.5	16.6	83.5	62		40	25	CL										
B- 4	D-4	20.0		11.5	31	137.0	118.9	15.2	98.6	13				SP-SM										
B- 5	D-3	15.0		43.0	47	131.7	113.1	16.4	90.7	38		37	21	SC										
B- 5	D-9	45.0		13.0	82/11.5"	136.8	129.1	6.0	52.7	8				SW-SM										
B- 6	D-1	5.0		34.0	36	136.8	120.6	13.4	91.2	40				SC										Consol
B- 6	D-2	10.0		29.0	41	135.3	120.2	12.6	84.7			31	18	SC										
B- 8	B-1	0.0		47.0																	16		0.06	
B- 9	D-1	5.0		25.5	33	120.4	104.0	15.8	68.7	28				SC										Consol
B- 9	D-5	20.0		10.5	24	123.9	99.7	24.2	94.8	5				SP										
B-10	D-2	10.0		13.0	8	112.1	92.3	21.5	70.1	3		NP	NP	SP										Consol
B-10	D-4	20.0		3.0	23	126.2	104.4	20.9	91.9	6				SP-SM										Consol
B-10	D-10	50.0		-27.0	29	123.6	93.5	32.2	100.0	19				SM										
B-10	D-13	65.0		-42.0	15	125.8	91.9	36.9	100.0	10				SP-SM										
B-11	D-1	5.0		15.0	10	126.2	107.7	17.2	82.2					SM										Consol
B-11	D-2	10.0		10.0	18	128.0	108.0	18.5	89.2					SM-SP										Consol
B-12	B-1	0.0		17.0																	0		0.08	
B-12	D-1	5.0		12.0	11	123.3	100.9	22.2	89.4	25	6			SM										
B-12	D-3	15.0		2.0	10	124.6	97.5	27.8	100.0	5				SP										
B-12	D-7	35.0		-18.0	12	115.8	86.3	34.1	96.8	79		41	21	CL										
B-13	D-2	10.0		6.0	6	122.0	98.8	23.5	90.0	4				SP										Consol
B-13	D-5	25.0		-9.0	6	112.5	79.8	41.0	99.6	44		NP	NP	SM										
B-13	D-6	30.0		-14.0	20	120.8	96.1	25.7	92.2	5				SP										
B-13	D-11	55.0		-39.0	39	124.3	94.4	31.7	100.0	8				SP-SM										

NMG Geotechnical, Inc.

Riverwalk
Project Number: 11077-01

APPENDIX
SUMMARY OF SOIL LABORATORY DATA

San Diego, CA

Boring/Sample Information										Sieve/ Hydrometer		Atterberg Limits			Direct Shear				Compaction					
															Ultimate		Peak							
Boring No.	Sample No.	Depth (feet)	End Depth (feet)	Elevation (feet)	Blow Count (N)	Field Wet Density (pcf)	Field Dry Density (pcf)	Field Moisture Content (%)	Degree of Sat. (%)	Fines Content (% pass. #200)	Clay Content (% pass. 2µ)	LL (%)	PI (%)	USCS Group Symbol	Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	Expansion Index	R-Value	Soluble Sulfate Content (% by wt)	Remarks
B-14	D-3	15.0		9.0	11	120.9	101.3	19.4	79.0					SP										Consol
B-14	D-5	25.0		-1.0	42	128.4	103.5	24.0	100.0	8				SM-SP										
B-15	D-1	5.0		14.0	28	110.8	102.5	8.2	34.2	7	2			SP-SM	0	32	0	42						
B-15	D-3	15.0		4.0	17	124.0	100.1	23.9	94.4					SM-SP										Consol
B-15	D-4	20.0		-1.0	6	121.4	89.8	35.2	100.0	7				SM-SP										
B-15	D-5	25.0		-6.0	13	119.0	91.7	29.8	96.0	33				SC										Consol
B-15	D-8	40.0		-21.0	15	125.4	104.3	20.2	88.7					SM-SP										Consol
B-16	D-2	10.0		12.5	17	122.1	95.8	27.5	97.8	23				SM										
B-16	D-4	20.0		2.5	41	127.5	104.3	22.2	97.5	21				SM										
B-16	D-7	35.0		-12.5	28	115.5	84.4	36.8	99.8			NP	NP	SM										Consol
B-17	B-1	0.0		24.0																	0		0.05	
B-17	D-1	5.0		19.0	20	101.2	91.2	11.0	35.1	11				SP-SM										Consol
B-17	D-5	25.0		-1.0	32	123.4	98.5	25.2	95.9	5				SP										
B-17	D-8	40.0		-16.0	19	121.6	90.1	35.0	100.0	82				ML										
B-18	D-2	10.0		16.0	13	111.0	88.0	26.1	77.1	4				SP										
B-18	D-3	15.0		11.0	8	118.1	91.2	29.5	94.0					SP-SM										Consol
P-2	B-1	0.0		35.0			108.3	21.3		25				SC	25	28	100	28	120.5	9.0				
P-2	D-1	5.0		30.0	40	129.1	116.3	11.0	66.2	19				SM										

NMG Geotechnical, Inc.

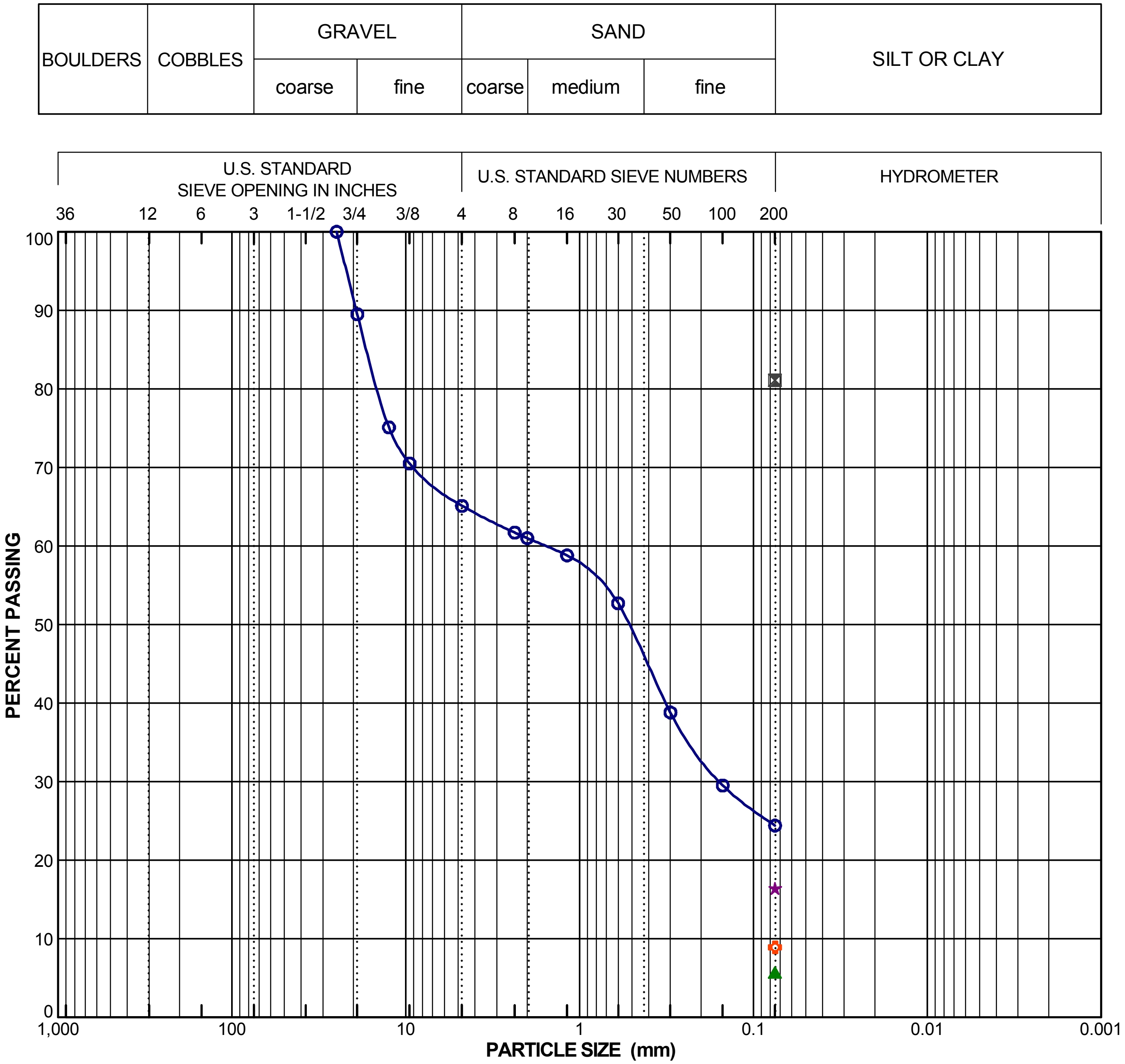
Hines/Riverwalk
Project Number: 11077-02

APPENDIX
SUMMARY OF SOIL LABORATORY DATA

San Diego, California

Boring/Sample Information						Field Wet Density (pcf)	Field Dry Density (pcf)	Field Moisture Content (%)	Degree of Sat. (%)	Sieve/ Hydrometer		Atterberg Limits		USCS Group Symbol	Direct Shear				Compaction		Expansion Index	R-Value	Soluble Sulfate Content (% by wt)	Remarks
Boring No.	Sample No.	Depth (feet)	End Depth (feet)	Elevation (feet)	Blow Count (N)					Fines Content (% pass. #200)	Clay Content (% pass. 2µ)	LL (%)	PI (%)		Ultimate		Peak		Maximum Dry Density (pcf)	Optimum Moisture Content (%)				
															Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)						
B-19	B-1	0.0		22.0										SM					127.5	10.0				
B-19	D-3	7.5		14.5	5	112.4	96.9	16.0	58.4	64	11			ML										
B-19	D-4	10.0		12.0	2	117.5	87.4	34.5	100.0					CL										Consol
B-19	D-5	15.0		7.0	15	124.1	107.4	15.6	74.0	4				SP										
B-19	D-6	20.0		2.0	17	119.2	96.9	23.0	84.0	6				SP-SM										Consol
B-19	D-13	55.0		-33.0	6	133.8	113.4	17.9	99.8	36				SC										Consol
B-20	D-4	10.0		12.0	7	121.3	94.7	28.0	97.1	28				SM										Consol
B-20	D-4a	10.1		11.9			92.4	30.6						SM										Consol
B-20	D-6	20.0		2.0	9	126.6	107.9	17.3	83.3	2				SP										
B-20	D-8	30.0		-8.0	17	129.5	106.3	21.8	100.0	4				SP										
B-20	D-10	40.0		-18.0	12	142.7	122.8	16.2	100.0	23				SC										
B-21	D-1	5.0		28.0	58	117.6	100.9	16.6	66.7	23				SM										
B-21	D-6	25.0		8.0	24	121.6	97.1	25.3	92.9	4				SP										
B-22	D-3	7.5		13.5	8	116.6	95.7	21.8	77.3	2				SP										
B-22	D-6	20.0		1.0	58	125.4	106.0	18.3	83.8	6				SP-SM										
B-22	D-9	35.0		-14.0	56	127.8	105.9	20.6	94.3	6				SP-SM										
B-22	D-12	50.0		-29.0	11	126.0	104.3	20.8	91.2	30				SM										
B-23	D-3	15.0		21.8	10	100.0	88.8	12.7	38.1	33				SM										Consol
B-23	D-4	20.0		16.8	10	132.4	116.2	13.9	83.7					SM										Consol
B-25	D-4	10.0		13.0	3	119.3	98.3	21.3	80.7					SM										Consol
B-25	D-5	15.0		8.0	25	128.1	107.8	18.8	90.2	4				SP										
B-26	B-1	0.0		21.0										SM					115.0	11.0				
B-26	D-3	7.5		13.5	13	124.1	101.1	22.8	92.1	9				SP-SM	100	28	300	31						
B-26	D-4	10.0		11.0	11	124.5	103.5	20.3	87.3	10	3			SP-SM										Consol
B-26	D-8	30.0		-9.0	7	120.6	91.8	31.3	100.0	64		NP	NP	ML										
B-26	D-9	35.0		-14.0	7	125.0	100.9	23.9	96.3	36				SM										Consol
B-27	B-1	0.0		23.0										SM					107.0	14.0				
B-27	D-2	5.0		18.0	18	98.3	94.9	3.5	12.3	3				SP	50	29	150	31						
B-27	D-3	7.5		15.5	10	94.2	91.0	3.6	11.3	4	2			SP										
B-27	D-6	20.0		3.0	17	123.4	98.6	25.2	96.0					SM	0	30	0	36						
B-28	D-2	10.0		19.5	35	116.5	107.6	8.3	39.4					SM										Consol
B-28	D-3	20.0		9.5	5	118.1	99.4	18.8	73.0	11				SM-SP										
B-29	D-1	5.0		15.5	5	114.2	76.2	49.9	100.0	63		33	14	CL										Consol
B-29	D-2	10.0		10.5	23	122.5	97.2	26.0	95.7					SM	100	29	200	34						
B-29	D-3	15.0		5.5	15	125.1	101.3	23.4	95.5					SM										Consol

Sheet 1 of 1



Symbol	Boring Number	Sample Number	Depth (feet)	Field Moisture (%)	LL	PI	Activity PI/-2μ	C_u	C_c	Passing No. 200 Sieve (%)	Passing 2μ (%)	USCS
○	B- 1	B-1	0.0	20	40	24				24		SC
⊠	B- 1	D-2	10.0	41	44	18				81		CL
▲	B- 1	D-5	25.0	25						6		SP-SM
★	B- 1	D-8	40.0	35	NP	NP				16		SM
✿	B- 1	D-9	45.0	22						9		SP-SM

PARTICLE SIZE DISTRIBUTION

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.

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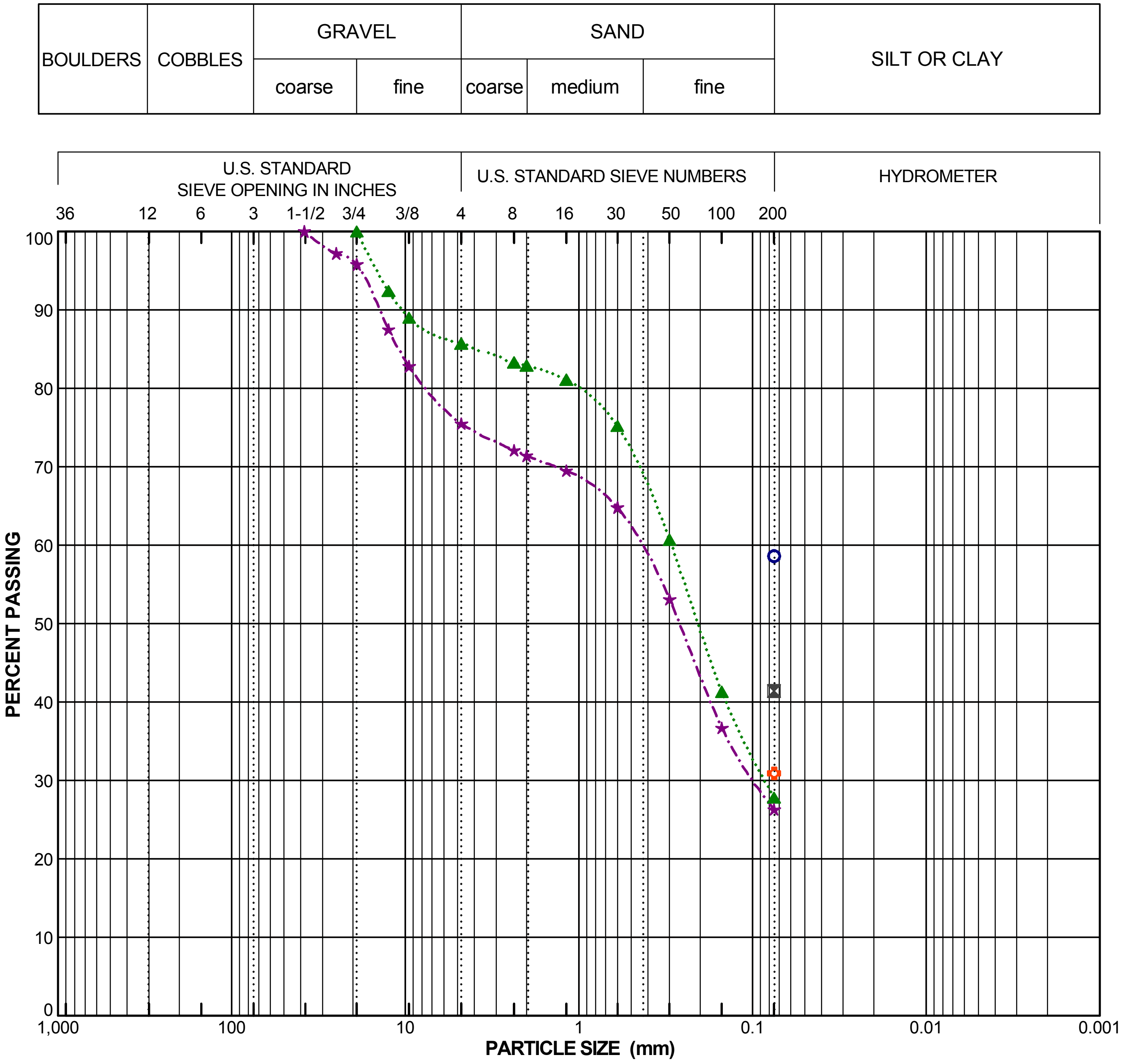


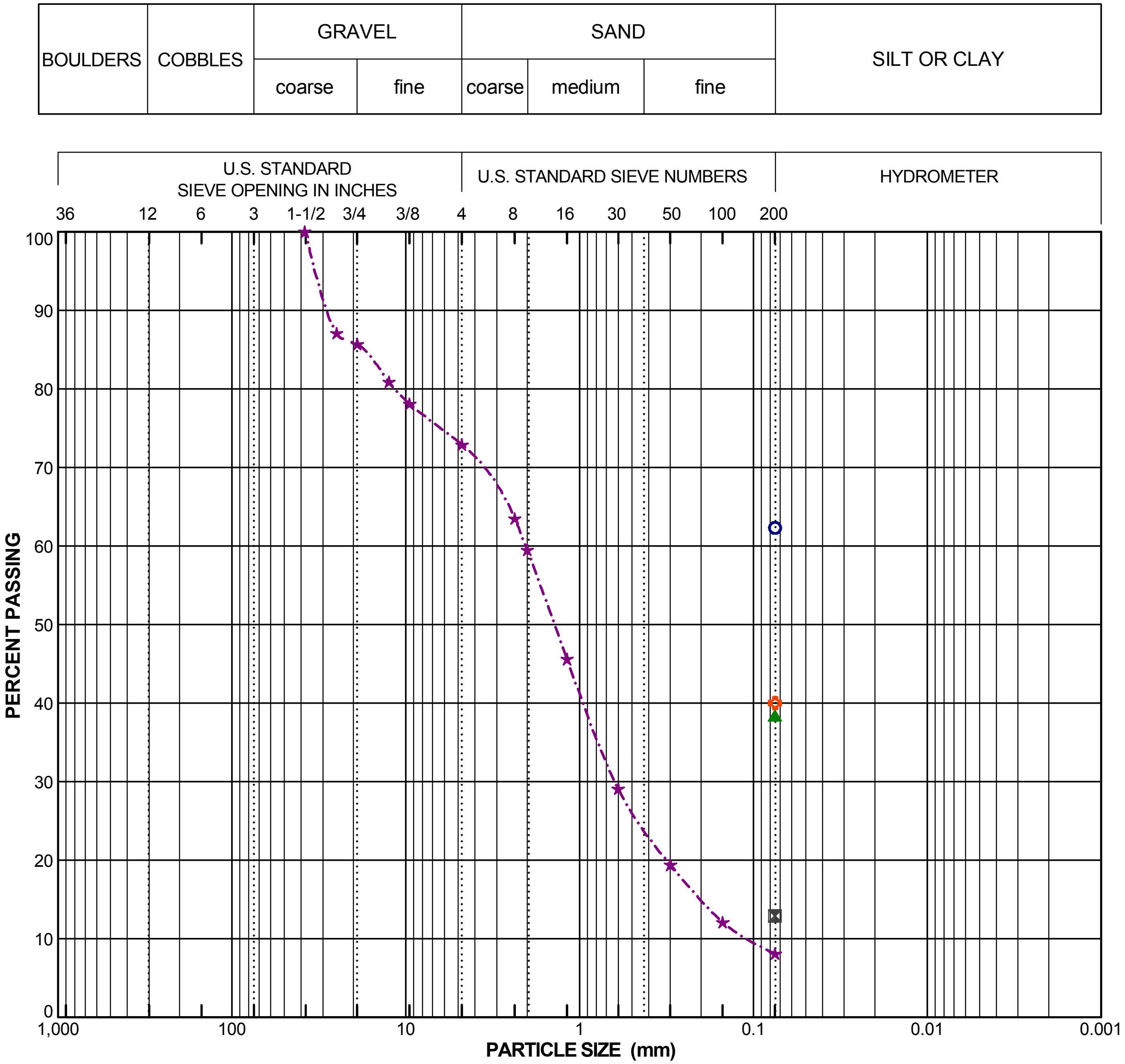
Symbol	Boring Number	Sample Number	Depth (feet)	Field Moisture (%)	LL	PI	Activity PI/-2μ	C_u	C_c	Passing No. 200 Sieve (%)	Passing 2μ (%)	USCS
○	B- 1	D-11	55.0	30	53	35				59		CH
☒	B- 1	D-14	70.0	18	29	16				41		SC
▲	B- 2	B-1	0.0		NP	NP				28		SM
★	B- 3	B-1	0.0		NP	NP				26		SM
✿	B- 3	D-1	5.0	31						31		SM

PARTICLE SIZE DISTRIBUTION

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.

Template: NMSIV; Prj ID: 11077-01.GPJ; Printed: 3/8/19

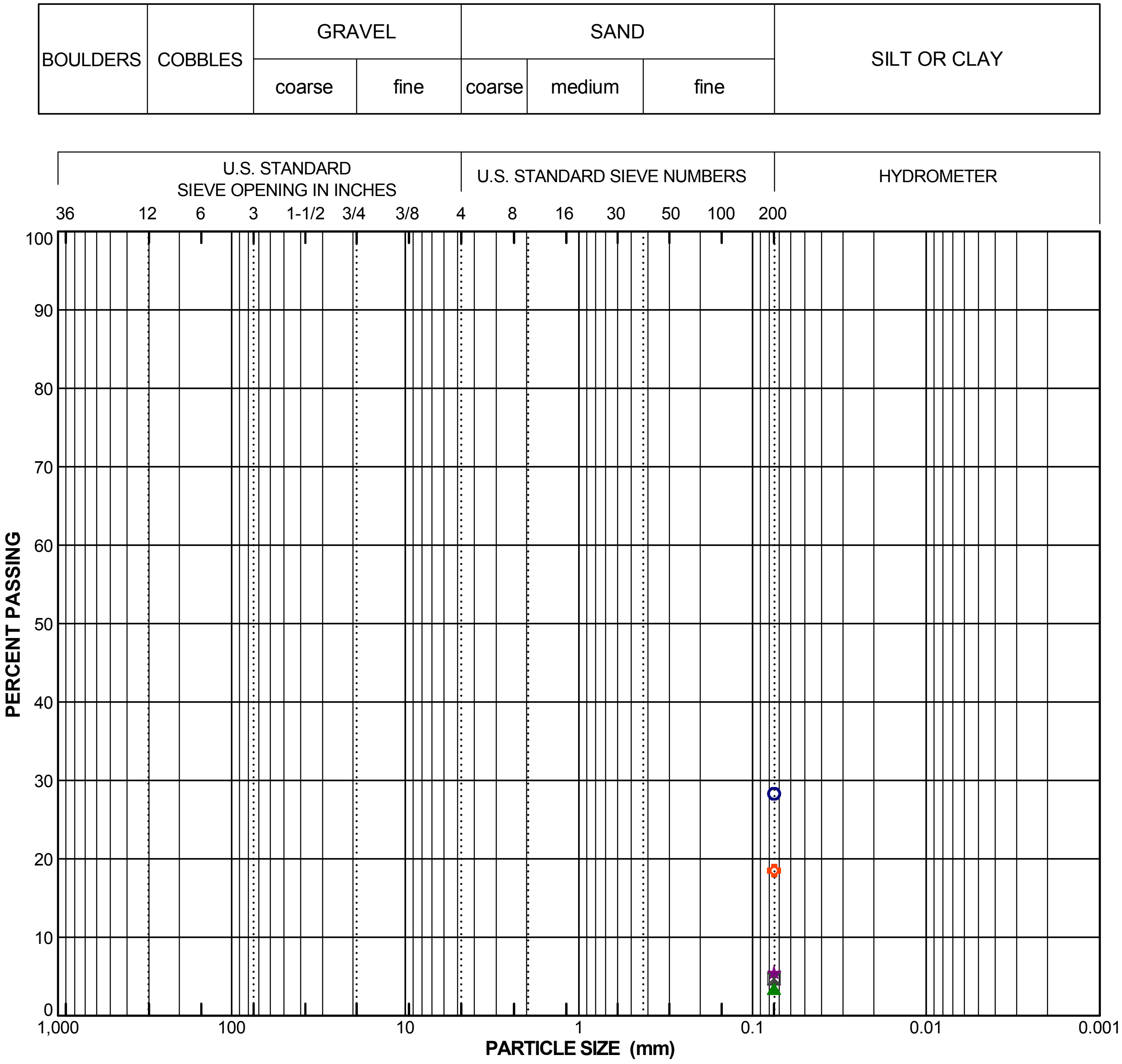


Symbol	Boring Number	Sample Number	Depth (feet)	Field Moisture (%)	LL	PI	Activity PI/-2µ	C_u	C_c	Passing No. 200 Sieve (%)	Passing 2µ (%)	USCS
○	B- 3	D-12	60.0	17	40	25				62		CL
☒	B- 4	D-4	20.0	15						13		SP-SM
▲	B- 5	D-3	15.0	16	37	21				38		SC
★	B- 5	D-9	45.0	6				19.6	1.8	8		SW-SM
✿	B- 6	D-1	5.0	13						40		SC

PARTICLE SIZE DISTRIBUTION

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.

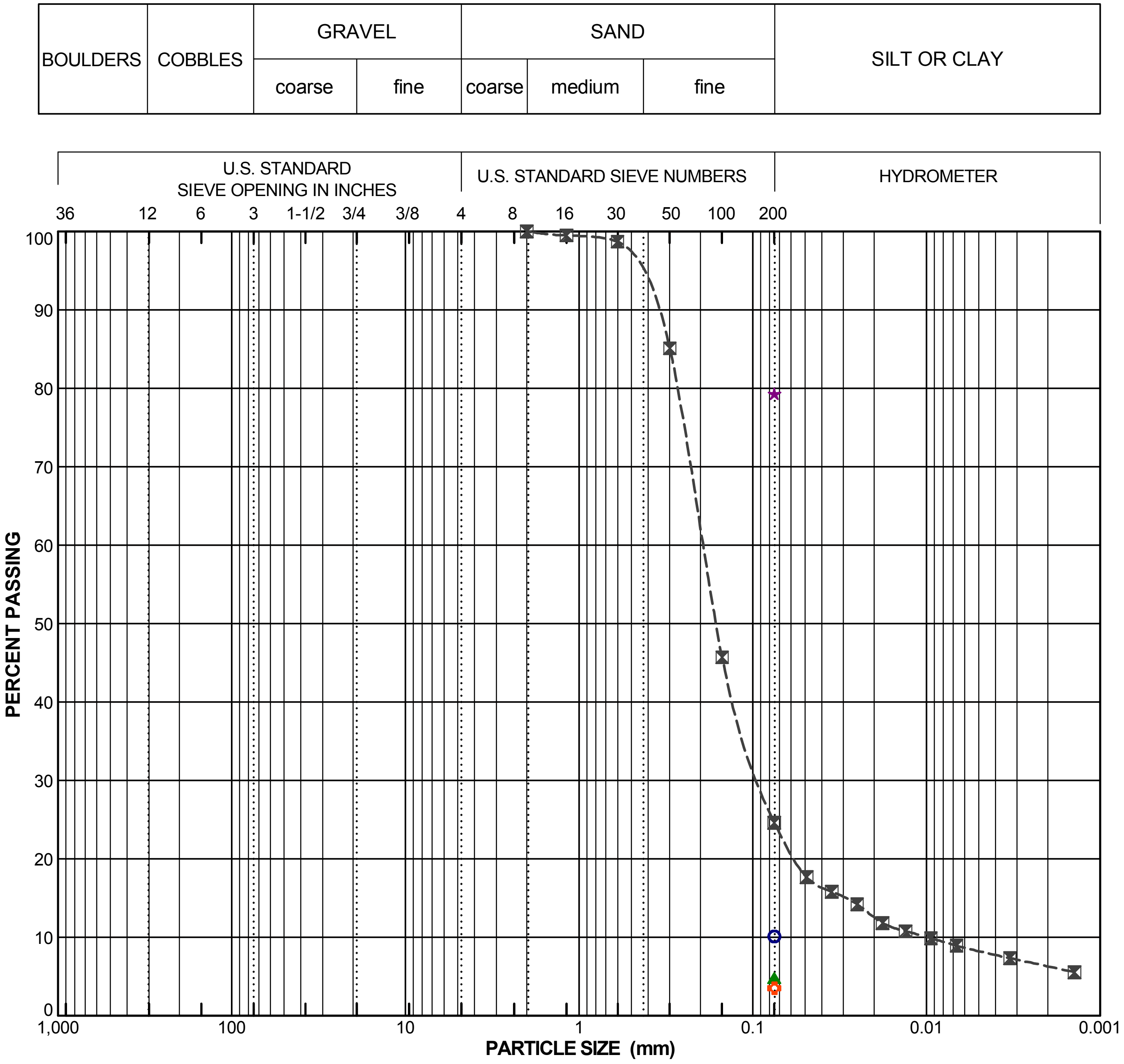


Symbol	Boring Number	Sample Number	Depth (feet)	Field Moisture (%)	LL	PI	Activity PI/-2μ	C_u	C_c	Passing No. 200 Sieve (%)	Passing 2μ (%)	USCS
○	B- 9	D-1	5.0	16						28		SC
☒	B- 9	D-5	20.0	24						5		SP
▲	B-10	D-2	10.0	21	NP	NP				3		SP
★	B-10	D-4	20.0	21						6		SP-SM
✿	B-10	D-10	50.0	32						19		SM

PARTICLE SIZE DISTRIBUTION

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.

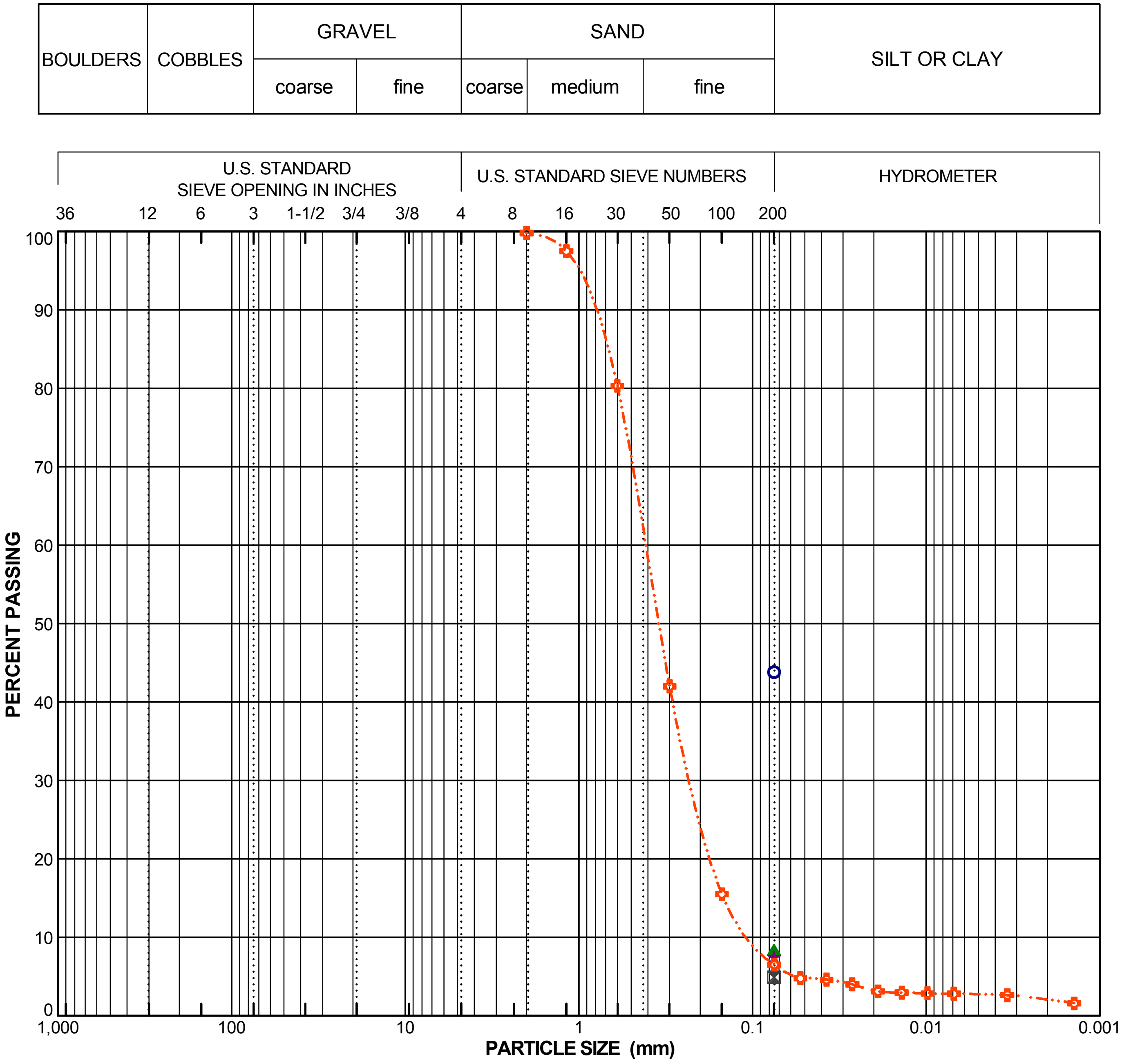


Symbol	Boring Number	Sample Number	Depth (feet)	Field Moisture (%)	LL	PI	Activity PI/-2μ	C_u	C_c	Passing No. 200 Sieve (%)	Passing 2μ (%)	USCS
○	B-10	D-13	65.0	37						10		SP-SM
☒	B-12	D-1	5.0	22						25	6	SM
▲	B-12	D-3	15.0	28						5		SP
★	B-12	D-7	35.0	34	41	21				79		CL
✿	B-13	D-2	10.0	24						4		SP

PARTICLE SIZE DISTRIBUTION

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.

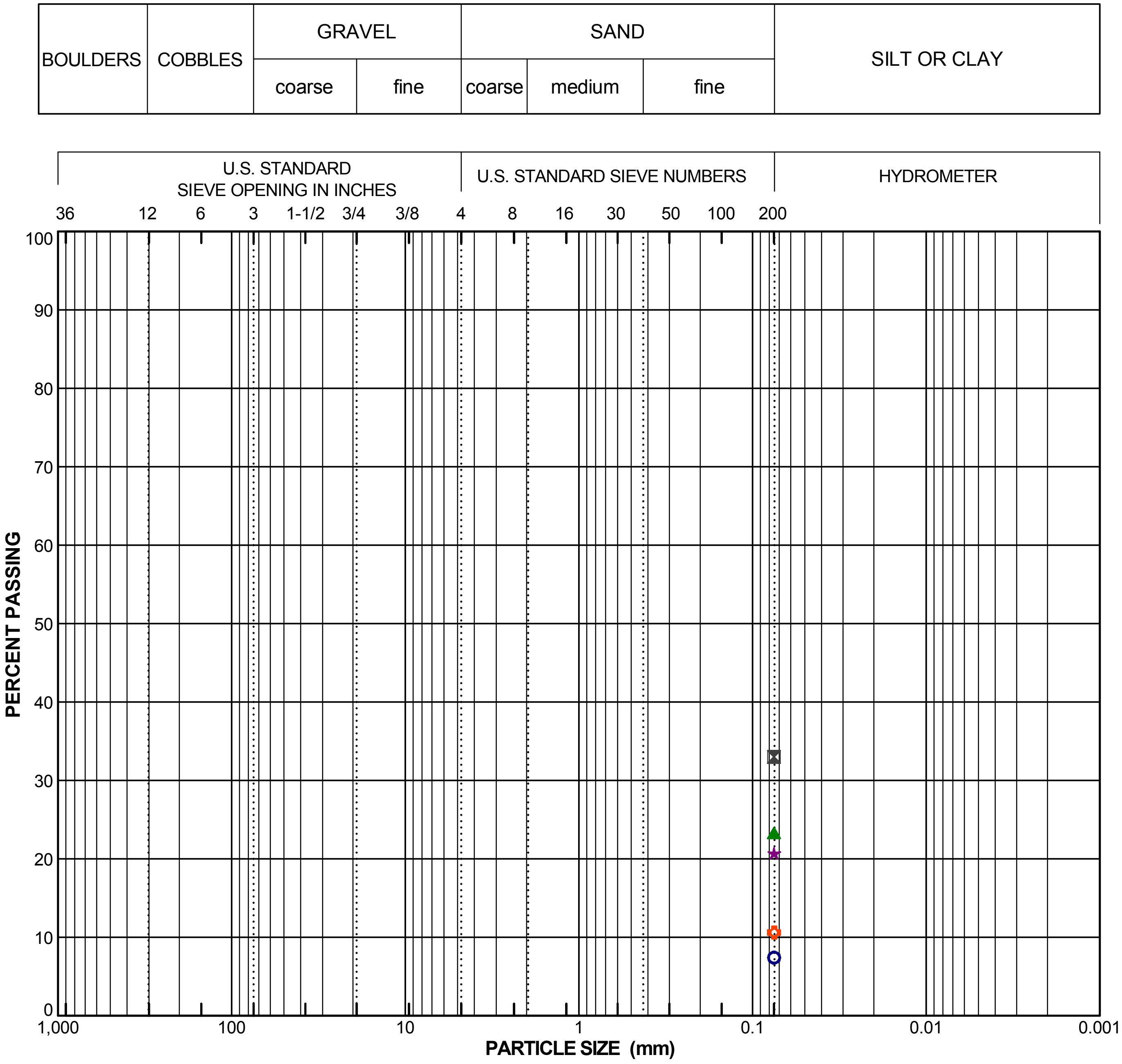


Symbol	Boring Number	Sample Number	Depth (feet)	Field Moisture (%)	LL	PI	Activity PI/-2μ	C_u	C_c	Passing No. 200 Sieve (%)	Passing 2μ (%)	USCS
○	B-13	D-5	25.0	41	NP	NP				44		SM
☒	B-13	D-6	30.0	26						5		SP
▲	B-13	D-11	55.0	32						8		SP-SM
★	B-14	D-5	25.0	24						8		SM-SP
✿	B-15	D-1	5.0	8				4.2	1.2	7	2	SP-SM

PARTICLE SIZE DISTRIBUTION

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.

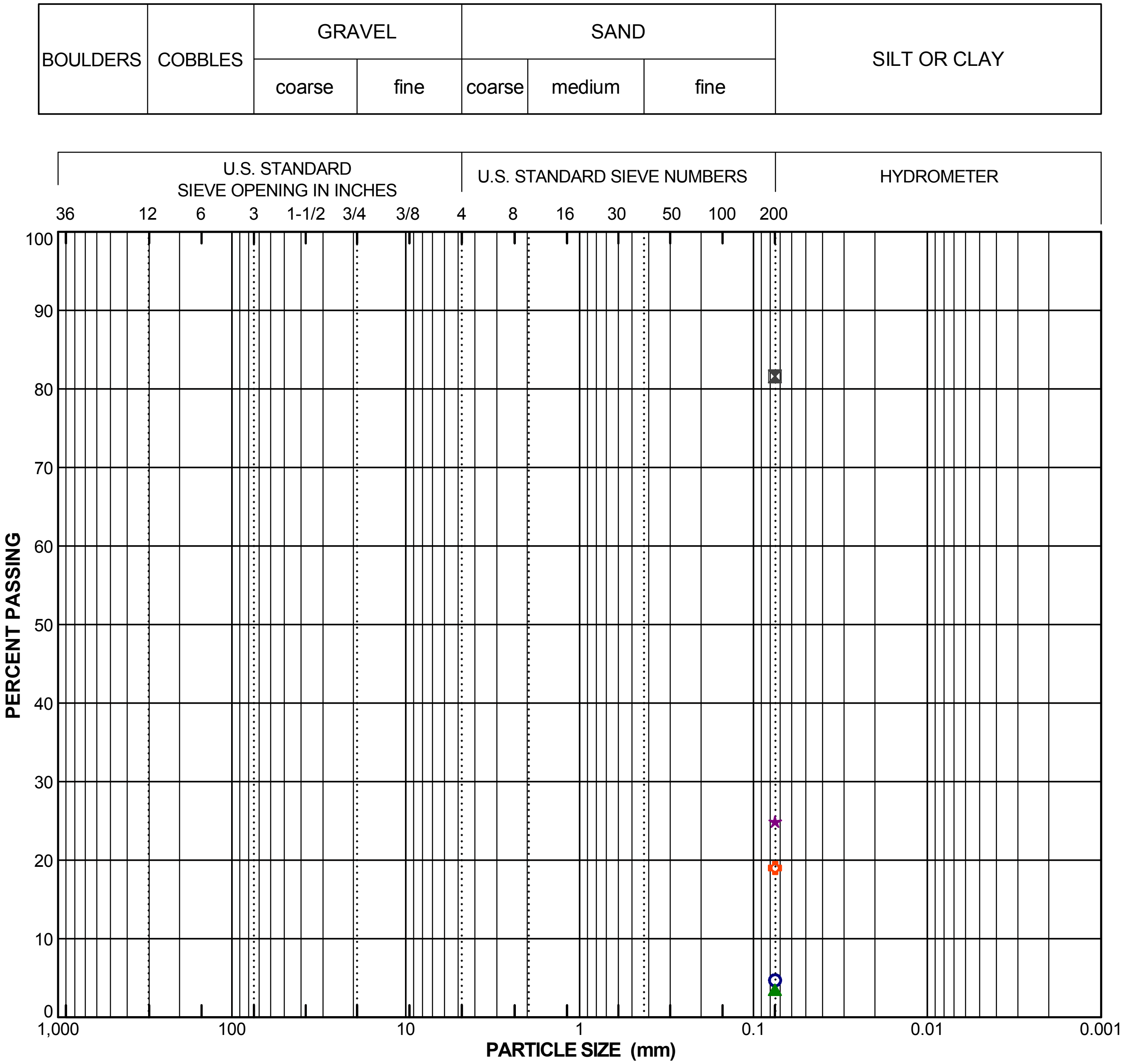


Symbol	Boring Number	Sample Number	Depth (feet)	Field Moisture (%)	LL	PI	Activity PI/-2μ	C_u	C_c	Passing No. 200 Sieve (%)	Passing 2μ (%)	USCS
○	B-15	D-4	20.0	35						7		SM-SP
⊠	B-15	D-5	25.0	30						33		SC
▲	B-16	D-2	10.0	28						23		SM
★	B-16	D-4	20.0	22						21		SM
✿	B-17	D-1	5.0	11						11		SP-SM

PARTICLE SIZE DISTRIBUTION

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.

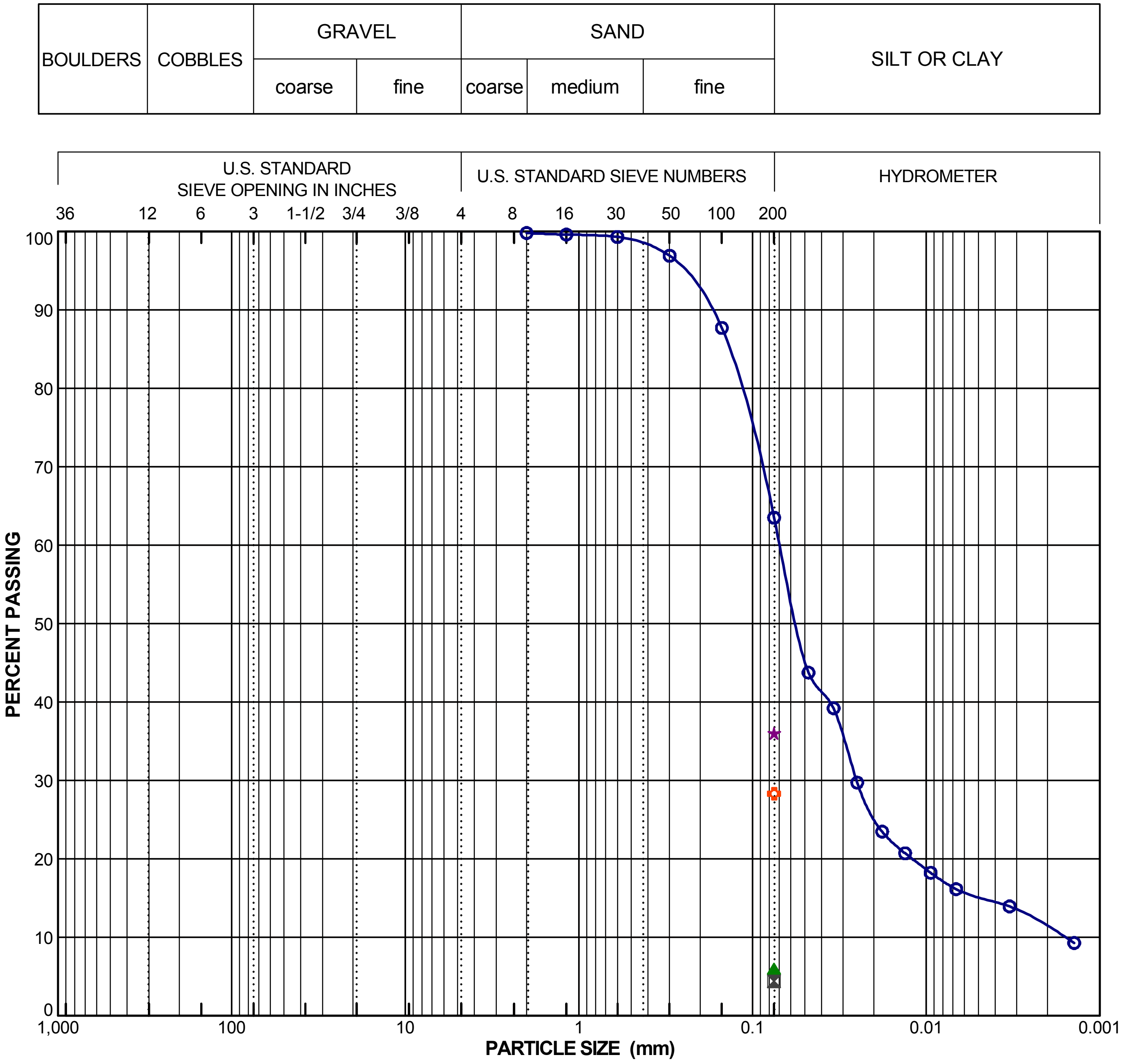


Symbol	Boring Number	Sample Number	Depth (feet)	Field Moisture (%)	LL	PI	Activity PI/-2μ	C_u	C_c	Passing No. 200 Sieve (%)	Passing 2μ (%)	USCS
○	B-17	D-5	25.0	25						5		SP
⊠	B-17	D-8	40.0	35						82		ML
▲	B-18	D-2	10.0	26						4		SP
★	P-2	B-1	0.0	21						25		SC
✿	P-2	D-1	5.0	11						19		SM

PARTICLE SIZE DISTRIBUTION

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.

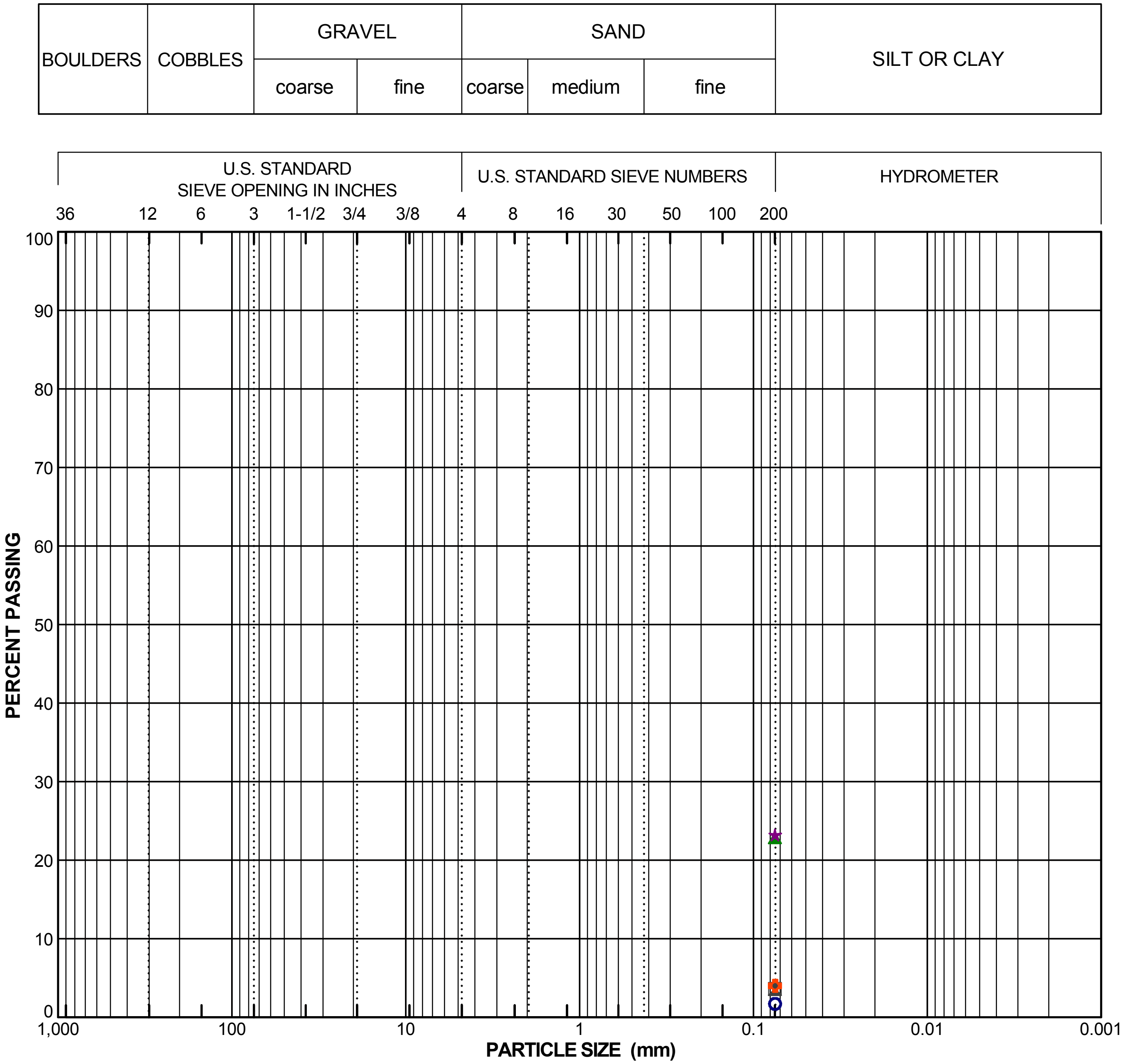


Symbol	Boring Number	Sample Number	Depth (feet)	Field Moisture (%)	LL	PI	Activity PI/-2µ	C_u	C_c	Passing No. 200 Sieve (%)	Passing 2µ (%)	USCS
○	B-19	D-3	7.5	16						64	11	ML
⊠	B-19	D-5	15.0	16						4		SP
▲	B-19	D-6	20.0	23						6		SP-SM
★	B-19	D-13	55.0	18						36		SC
✿	B-20	D-4	10.0	28						28		SM

PARTICLE SIZE DISTRIBUTION

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

NMG Geotechnical, Inc.

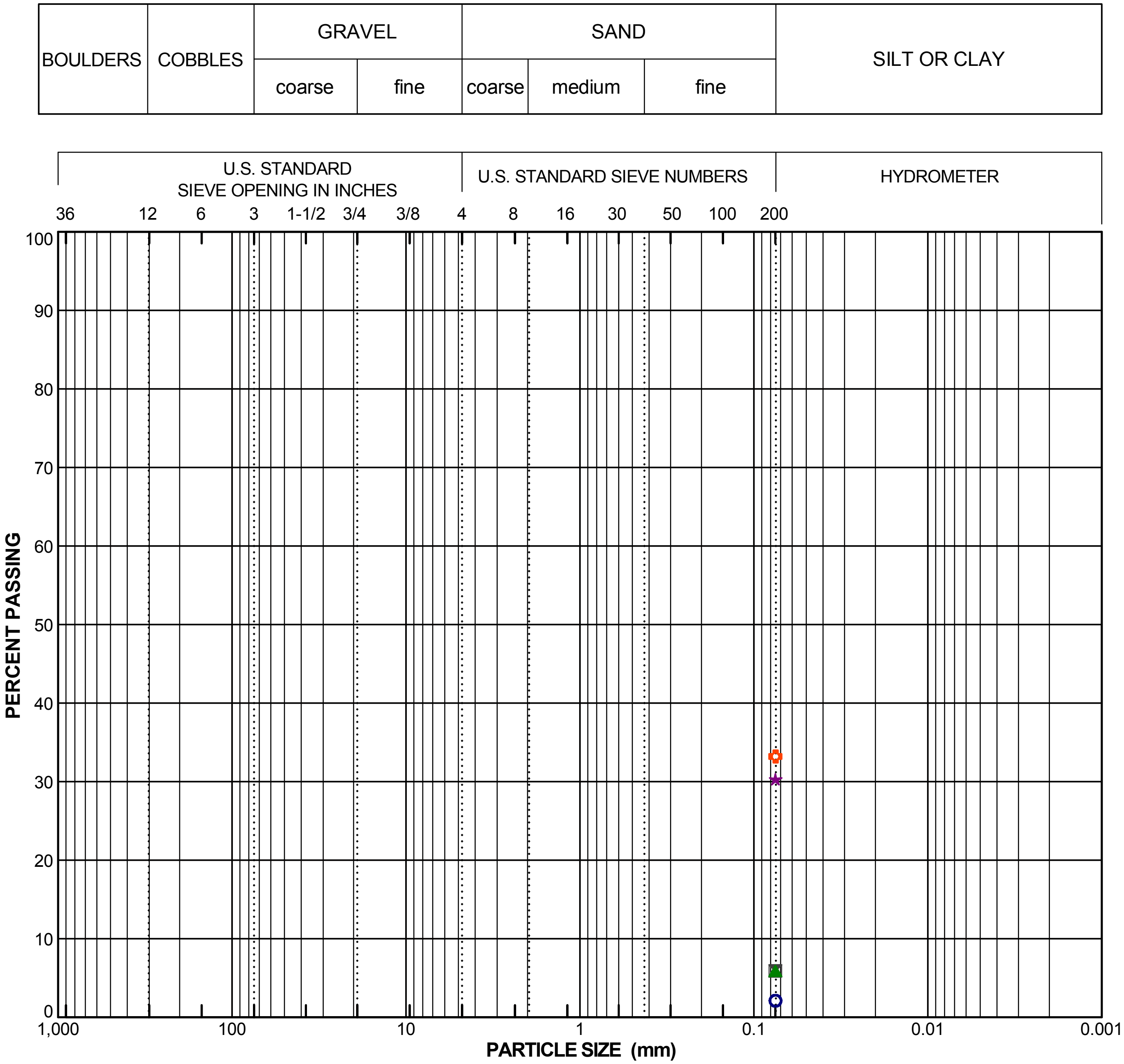


Symbol	Boring Number	Sample Number	Depth (feet)	Field Moisture (%)	LL	PI	Activity PI/-2μ	C_u	C_c	Passing No. 200 Sieve (%)	Passing 2μ (%)	USCS
○	B-20	D-6	20.0	17						2		SP
⊠	B-20	D-8	30.0	22						4		SP
▲	B-20	D-10	40.0	16						23		SC
★	B-21	D-1	5.0	17						23		SM
✿	B-21	D-6	25.0	25						4		SP

PARTICLE SIZE DISTRIBUTION

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

NMG Geotechnical, Inc.

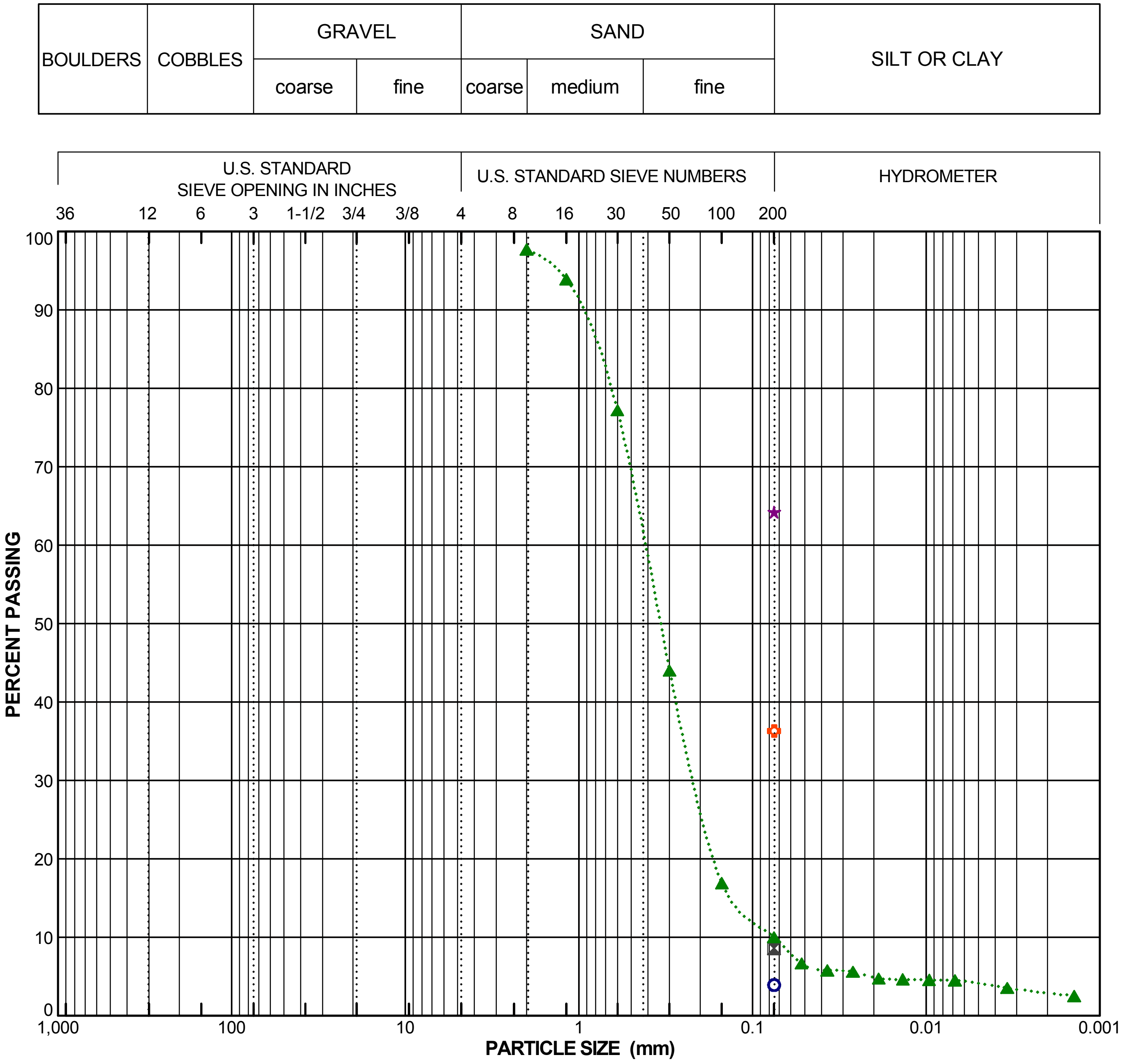


Symbol	Boring Number	Sample Number	Depth (feet)	Field Moisture (%)	LL	PI	Activity PI/-2μ	C_u	C_c	Passing No. 200 Sieve (%)	Passing 2μ (%)	USCS
○	B-22	D-3	7.5	22						2		SP
⊠	B-22	D-6	20.0	18						6		SP-SM
▲	B-22	D-9	35.0	21						6		SP-SM
★	B-22	D-12	50.0	21						30		SM
✿	B-23	D-3	15.0	13						33		SM

PARTICLE SIZE DISTRIBUTION

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

NMG Geotechnical, Inc.

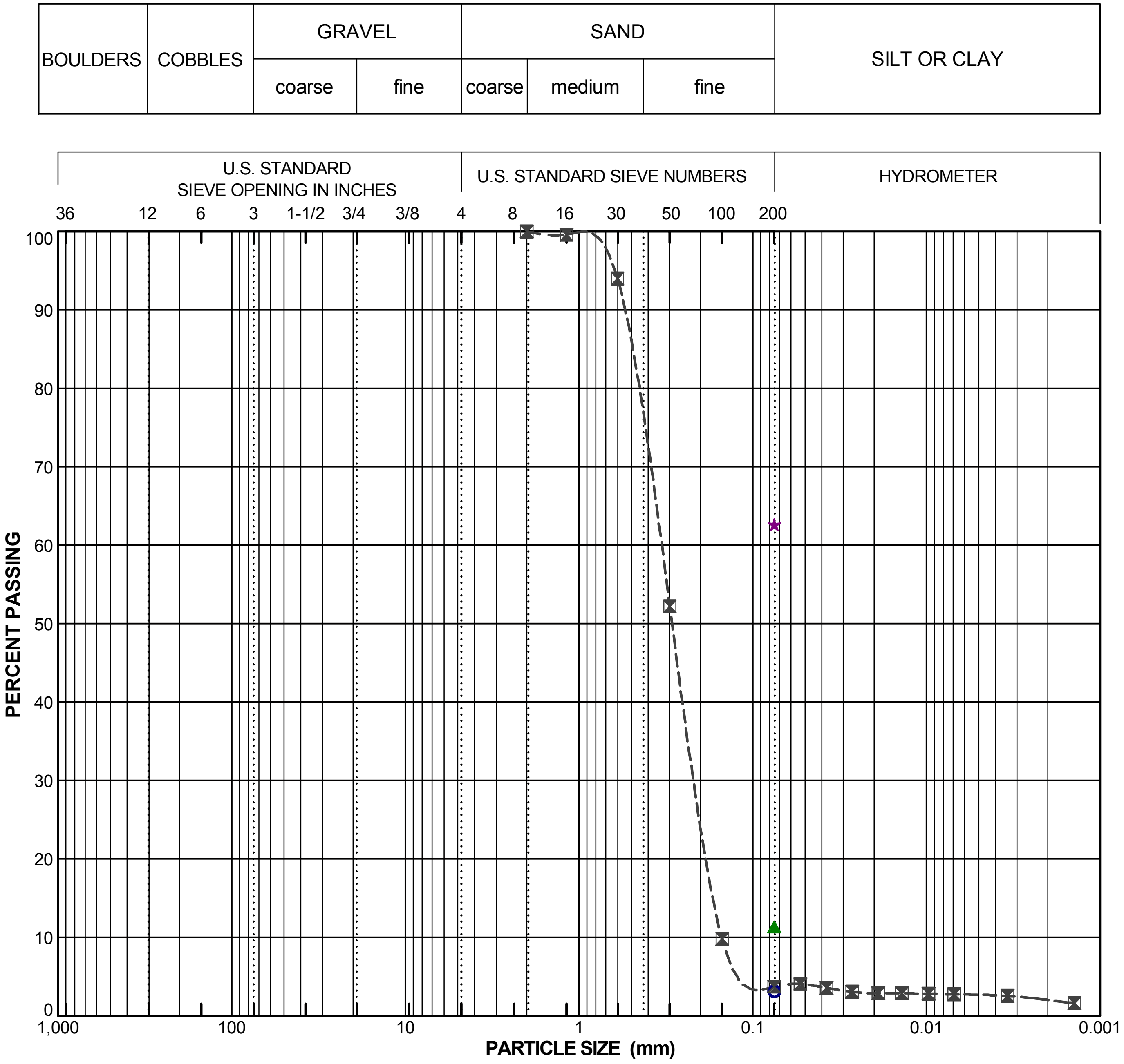


Symbol	Boring Number	Sample Number	Depth (feet)	Field Moisture (%)	LL	PI	Activity PI/-2µ	C_u	C_c	Passing No. 200 Sieve (%)	Passing 2µ (%)	USCS
○	B-25	D-5	15.0	19						4		SP
⊠	B-26	D-3	7.5	23						9		SP-SM
▲	B-26	D-4	10.0	20				5.6	1.4	10	3	SP-SM
★	B-26	D-8	30.0	31	NP	NP				64		ML
✿	B-26	D-9	35.0	24						36		SM

PARTICLE SIZE DISTRIBUTION

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

NMG Geotechnical, Inc.

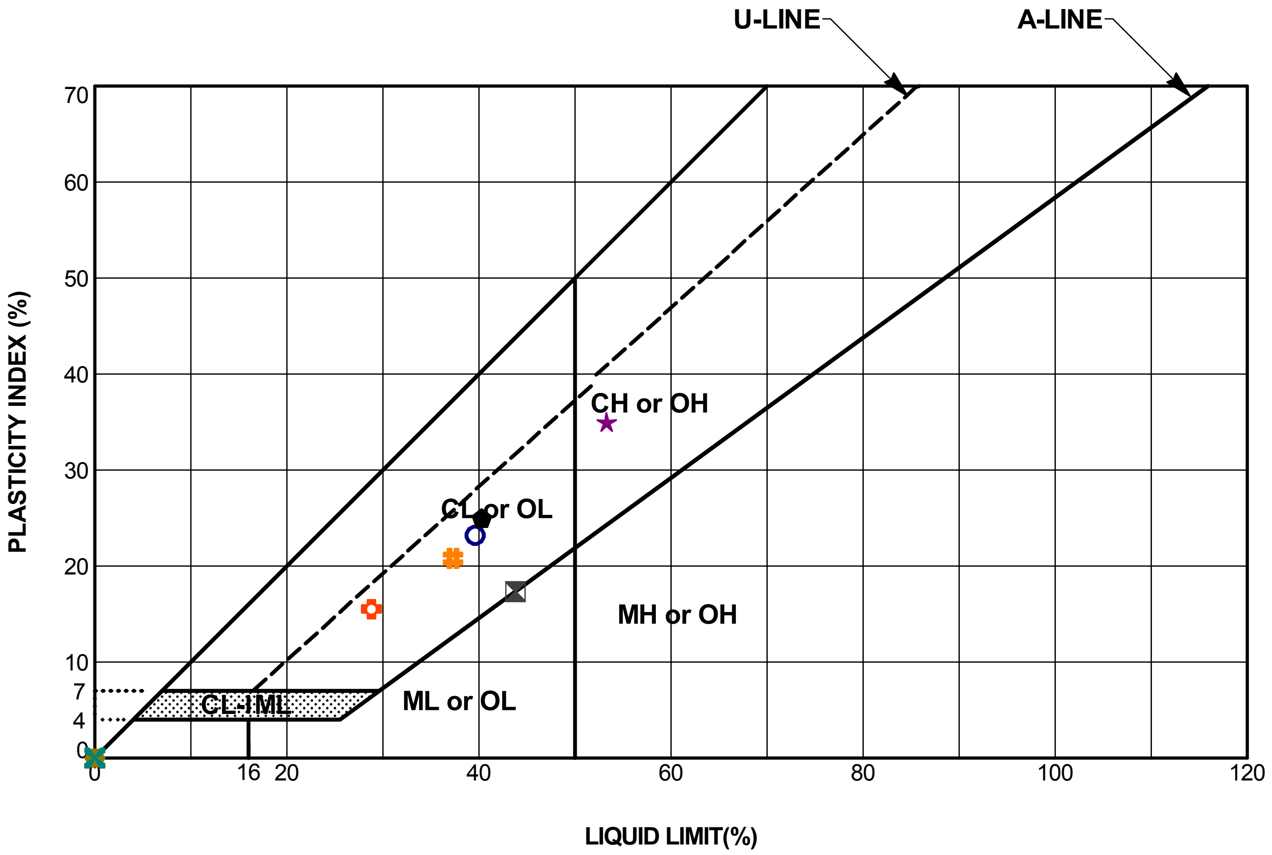


Symbol	Boring Number	Sample Number	Depth (feet)	Field Moisture (%)	LL	PI	Activity PI/-2μ	Cu	Cc	Passing No. 200 Sieve (%)	Passing 2μ (%)	USCS
○	B-27	D-2	5.0	4						3		SP
⧗	B-27	D-3	7.5	4				2.3	0.8	4	2	SP
▲	B-28	D-3	20.0	19						11		SM-SP
★	B-29	D-1	5.0	50	33	14				63		CL

PARTICLE SIZE DISTRIBUTION

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

NMG Geotechnical, Inc.

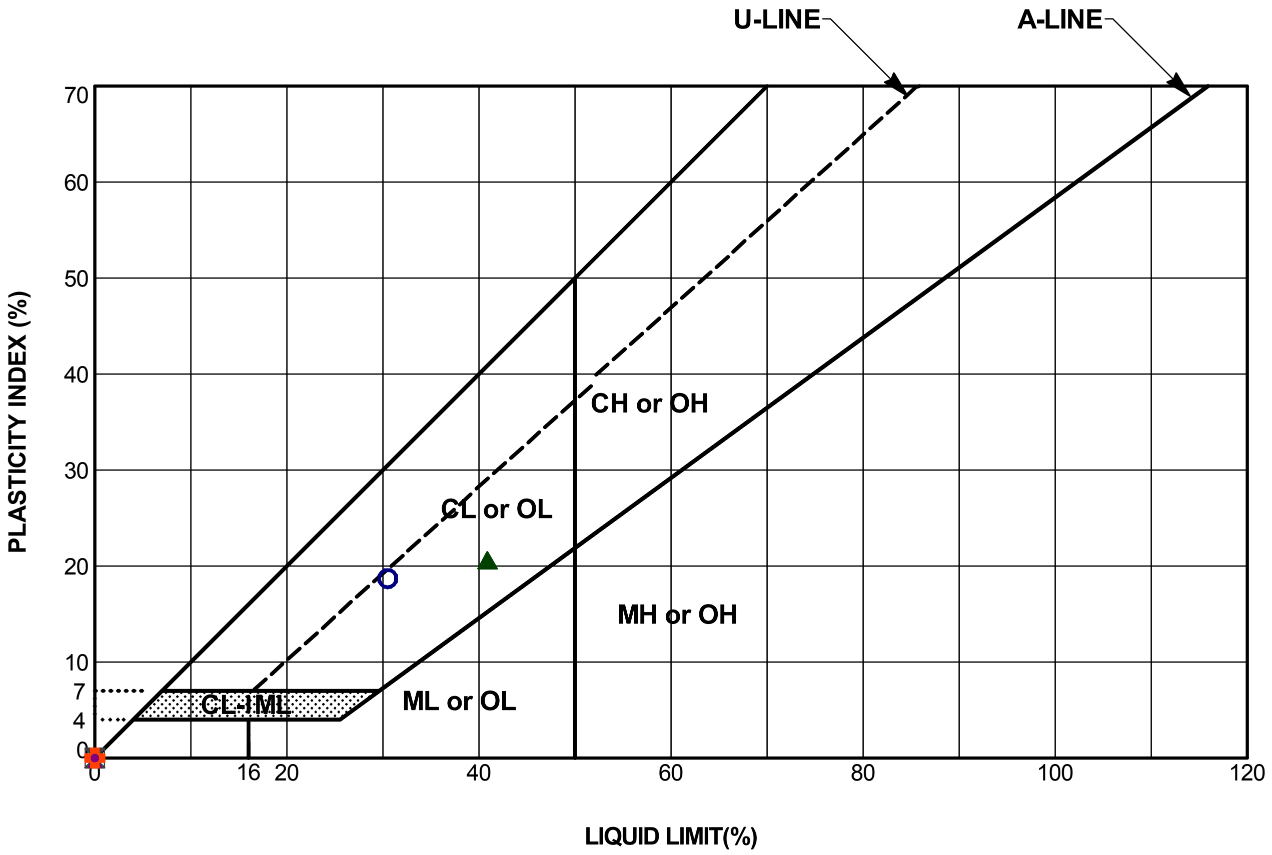


Symbol	Boring Number	Sample Number	Depth (feet)	Passing No. 200 Sieve (%)	LL	PI	USCS	Description
○	B- 1	B-1	0.0	24	40	24	SC	(Qal) Brown clayey SAND
⊠	B- 1	D-2	10.0	81	44	18	CL	(Qal) Dark grayish brown sandy CLAY
▲	B- 1	D-8	40.0	16	NP	NP	SM	(Qal) Dark gray silty SAND
★	B- 1	D-11	55.0	59	53	35	CH	(Qal) Dark gray sandy CLAY
✿	B- 1	D-14	70.0	41	29	16	SC	(Qal) Dark brown clayey SAND
◇	B- 2	B-1	0.0	28	NP	NP	SM	(Afu) Brown silty SAND
⬢	B- 3	B-1	0.0	26	NP	NP	SM	(Afu) Dark brown silty SAND
✖	B- 3	D-4	20.0		NP	NP	SP-SM	(Qal) Dark yellowish brown SAND
⬟	B- 3	D-12	60.0	62	40	25	CL	(Qal) Brown sandy silty CLAY
✱	B- 5	D-3	15.0	38	37	21	SC	(Qal) Reddish brown clayey SAND

PLASTICITY CHART

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.

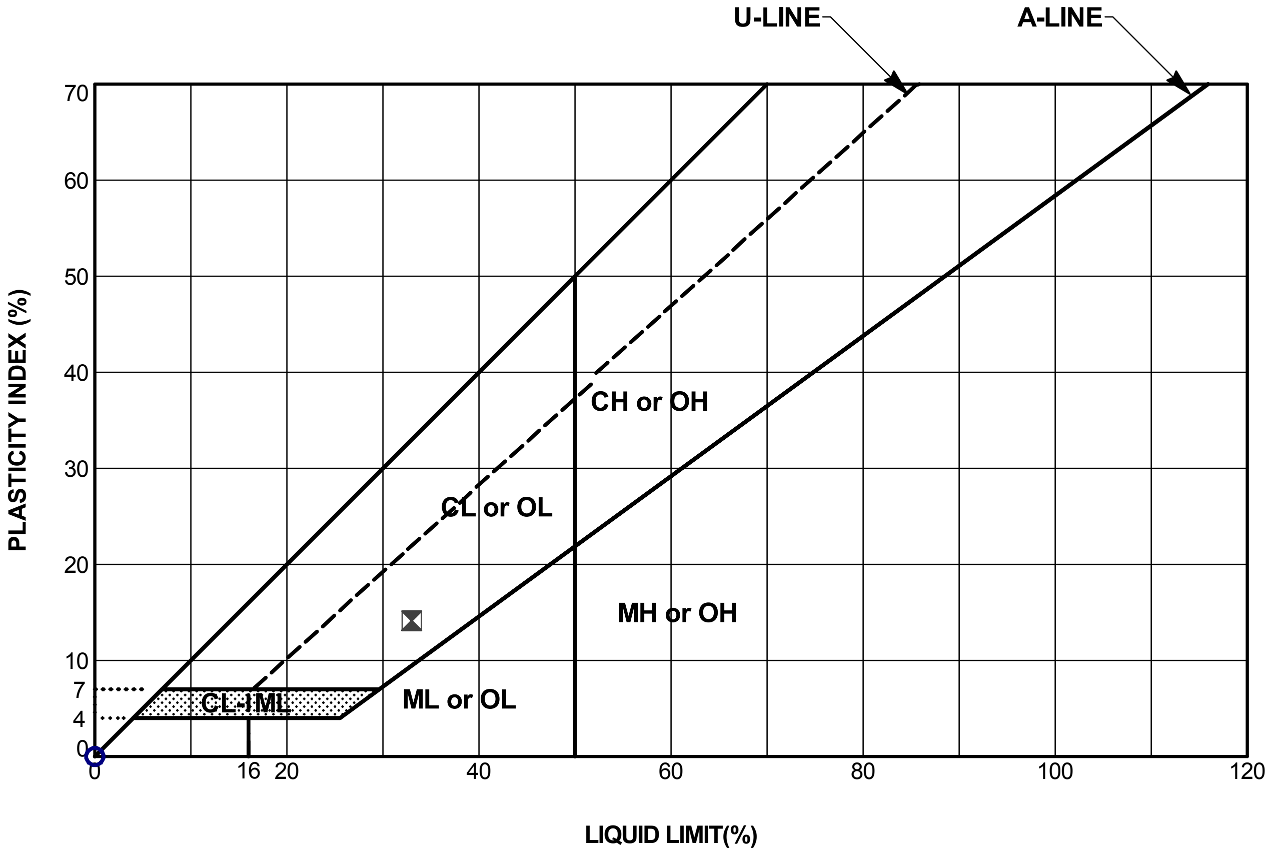


Symbol	Boring Number	Sample Number	Depth (feet)	Passing No. 200 Sieve (%)	LL	PI	USCS	Description
○	B- 6	D-2	10.0		31	18	SC	(Qtr) Reddish brown clayey SAND
☒	B-10	D-2	10.0	3	NP	NP	SP	(Qal) Olive gray SAND
▲	B-12	D-7	35.0	79	41	21	CL	(Qal) Dark gray sandy CLAY
★	B-13	D-5	25.0	44	NP	NP	SM	(Qal) Dark gray silty SAND
✿	B-16	D-7	35.0		NP	NP	SM	(Qal) Dark grayish brown silty SAND

PLASTICITY CHART

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.

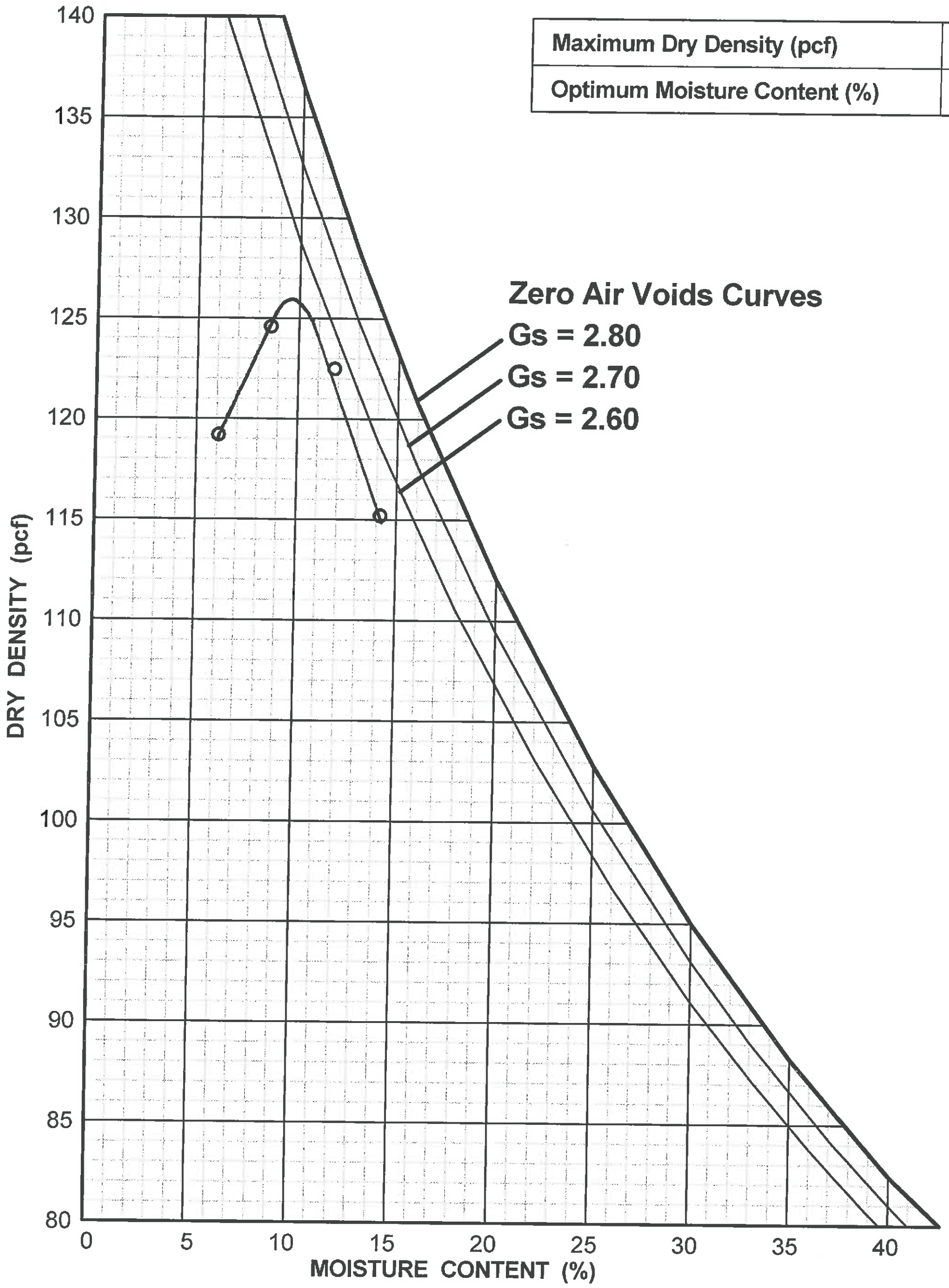


Symbol	Boring Number	Sample Number	Depth (feet)	Passing No. 200 Sieve (%)	LL	PI	USCS	Description
○	B-26	D-8	30.0	64	NP	NP	ML	(Qal) Dark gray sandy SILT
☒	B-29	D-1	5.0	63	33	14	CL	(Qal) Dark grayish brown sandy CLAY

PLASTICITY CHART

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

NMG Geotechnical, Inc.



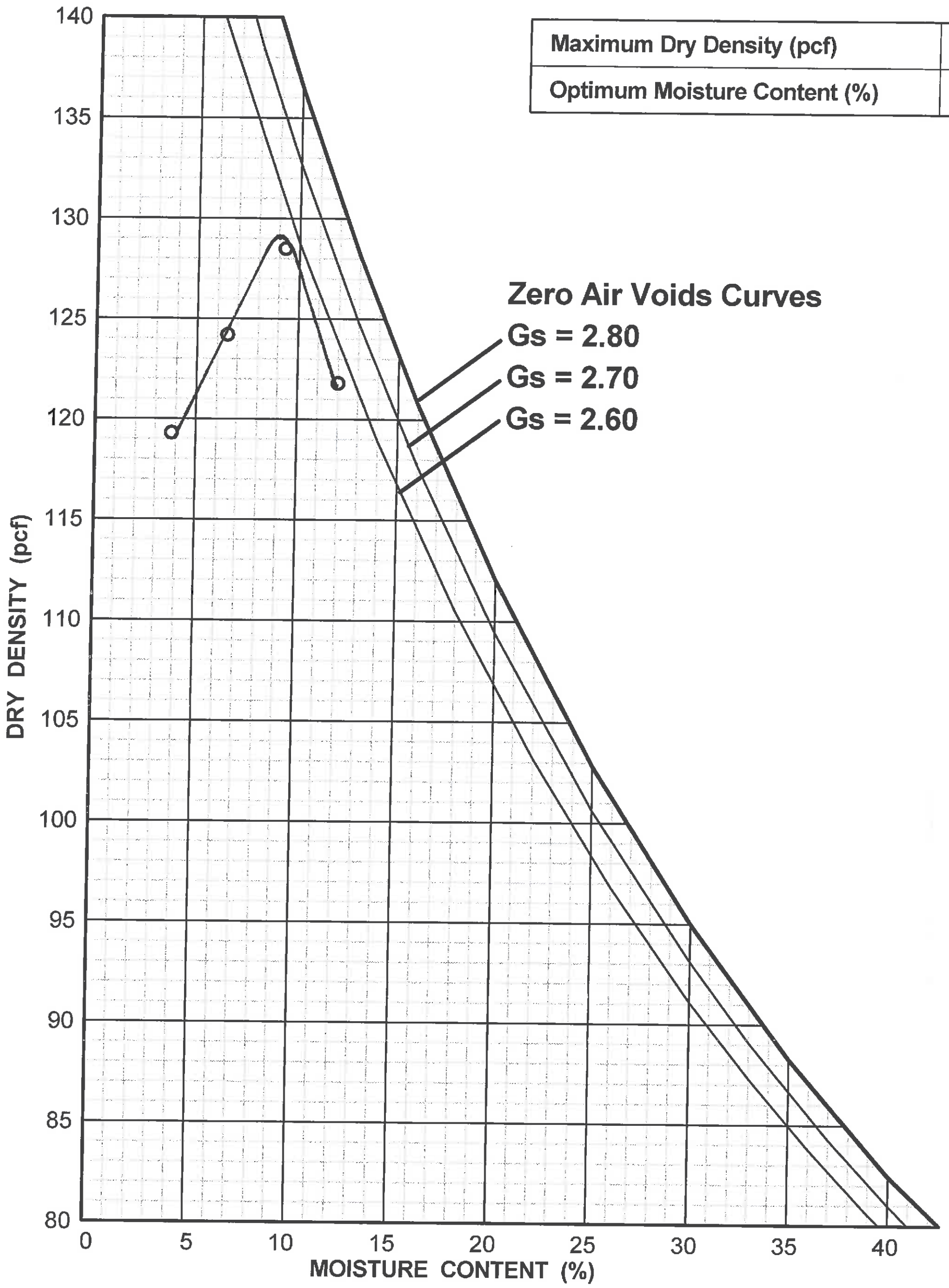
Maximum Dry Density (pcf)	126.0
Optimum Moisture Content (%)	9.5

Boring No. B- 1	**Sample No. B-1**	**Depth: 0.0 ft**
Sample Description: (Qal) Brown clayey SAND		**USCS:** SC
Liquid Limit: 40	**Plasticity Index:** 24	**Percent Passing No. 200 Sieve:** 24
Comments: 1557A		

COMPACTION TEST RESULTS

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.



Maximum Dry Density (pcf)	129.0
Optimum Moisture Content (%)	9.0

Boring No. B- 2	**Sample No. B-1**	**Depth: 0.0 ft**
Sample Description: (Afu) Brown silty SAND		**USCS:** SM
Liquid Limit: NP	**Plasticity Index:** NP	**Percent Passing No. 200 Sieve:** 28
Comments: 1557B		

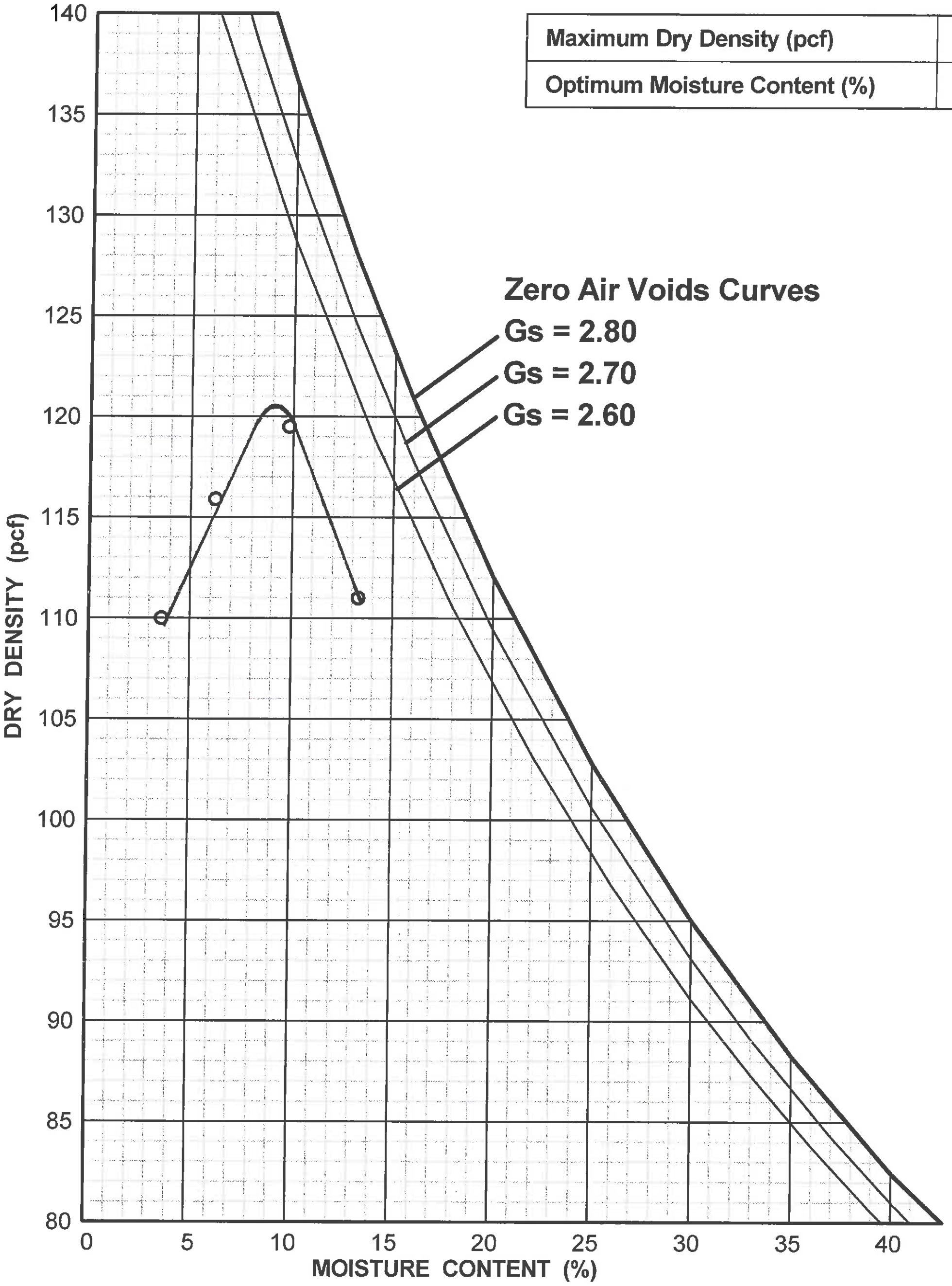
COMPACTION TEST RESULTS

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.

Template: NMCOMP; Prj ID: 11077-01.GPJ; Printed: 9/5/17

Maximum Dry Density (pcf)	120.5
Optimum Moisture Content (%)	9.0



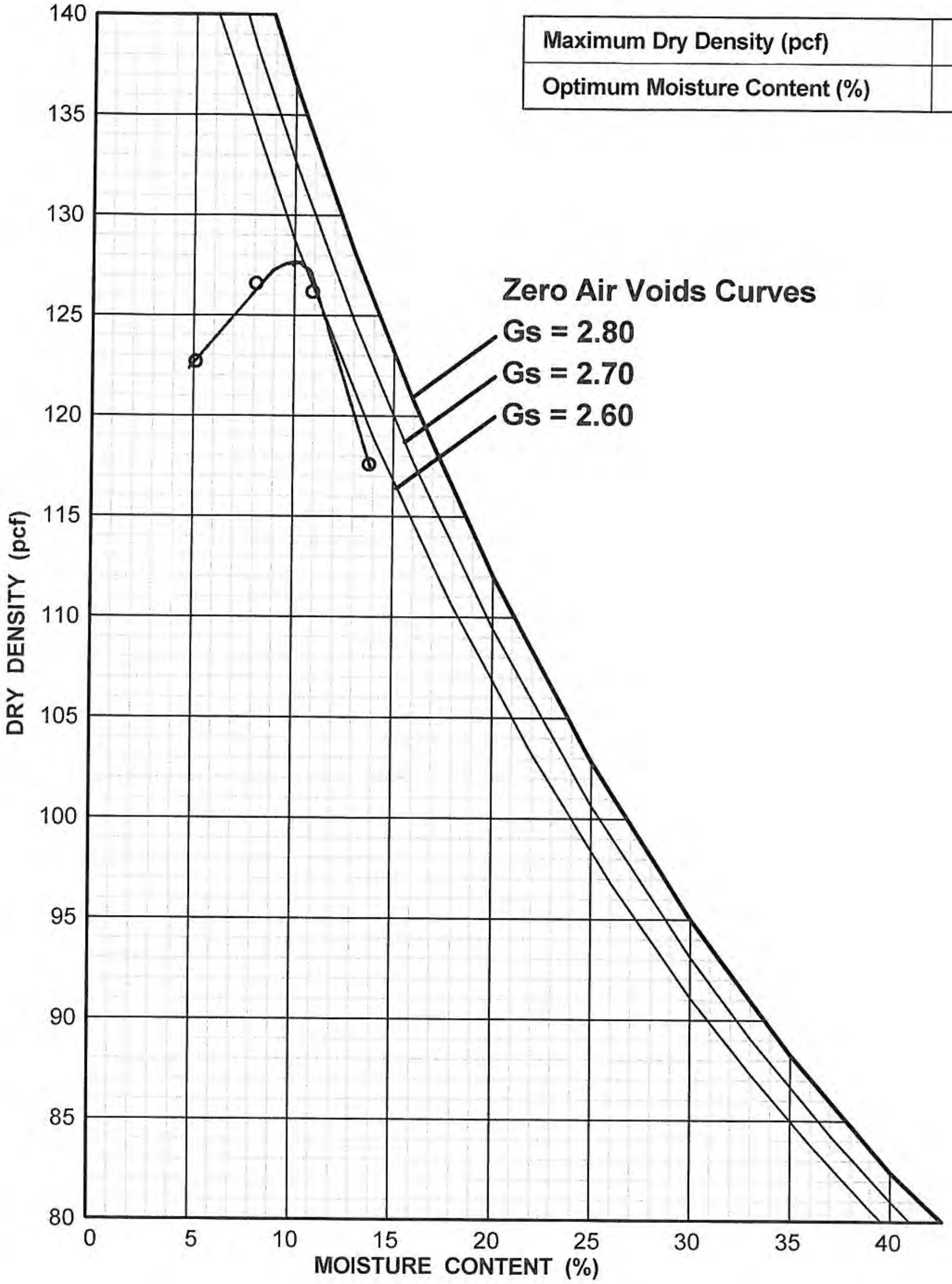
Boring No. P-2	**Sample No. B-1**	**Depth: 0.0 ft**
Sample Description: (Af) Reddish brown clayey SAND		**USCS:** SC
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:** 25
Comments: 1557A		

COMPACTION TEST RESULTS

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.

Maximum Dry Density (pcf)	127.5
Optimum Moisture Content (%)	10.0

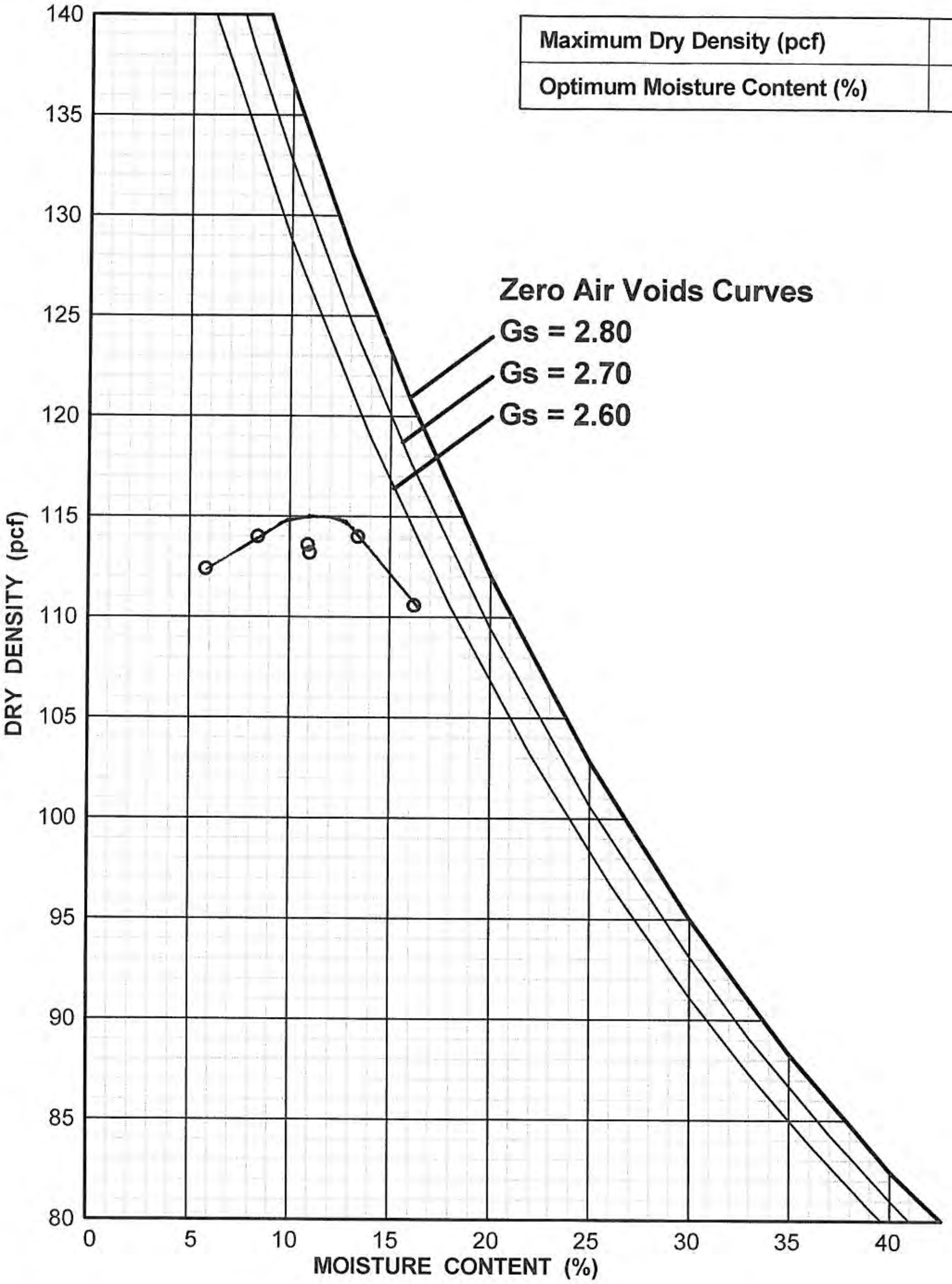


Boring No. B-19	**Sample No. B-1**	**Depth: 0.0 ft**
Sample Description: (Qal) Dark brown silty SAND		**USCS:** SM
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**
Comments: 1557A		

COMPACTION TEST RESULTS

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

NMG Geotechnical, Inc.



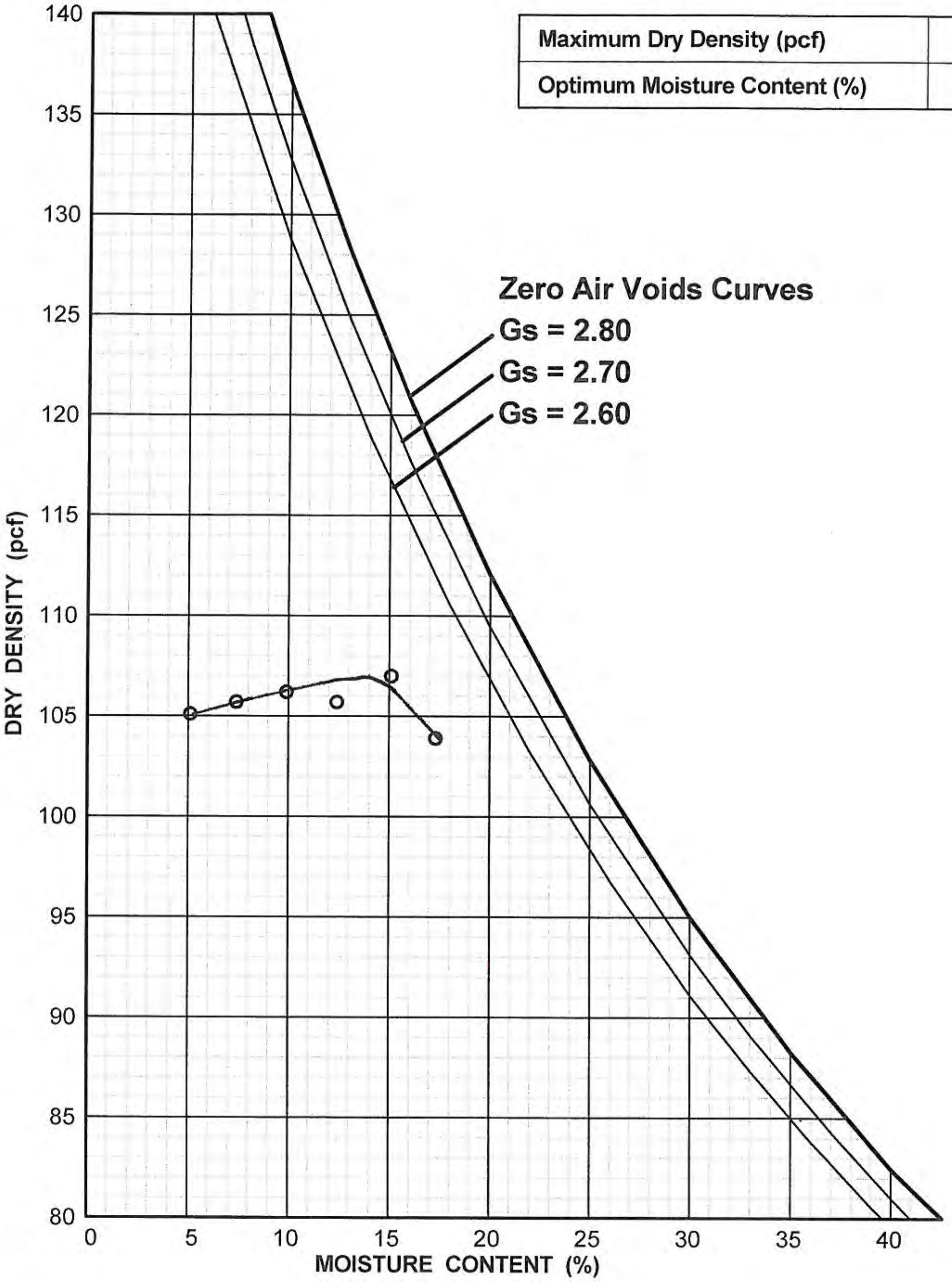
Maximum Dry Density (pcf)	**115.0**
Optimum Moisture Content (%)	**11.0**

Boring No. B-26	**Sample No. B-1**	**Depth: 0.0 ft**
Sample Description: (Qal) Brown silty SAND		**USCS:** SM
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**
Comments: 1557A		

COMPACTION TEST RESULTS

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

NMG Geotechnical, Inc.



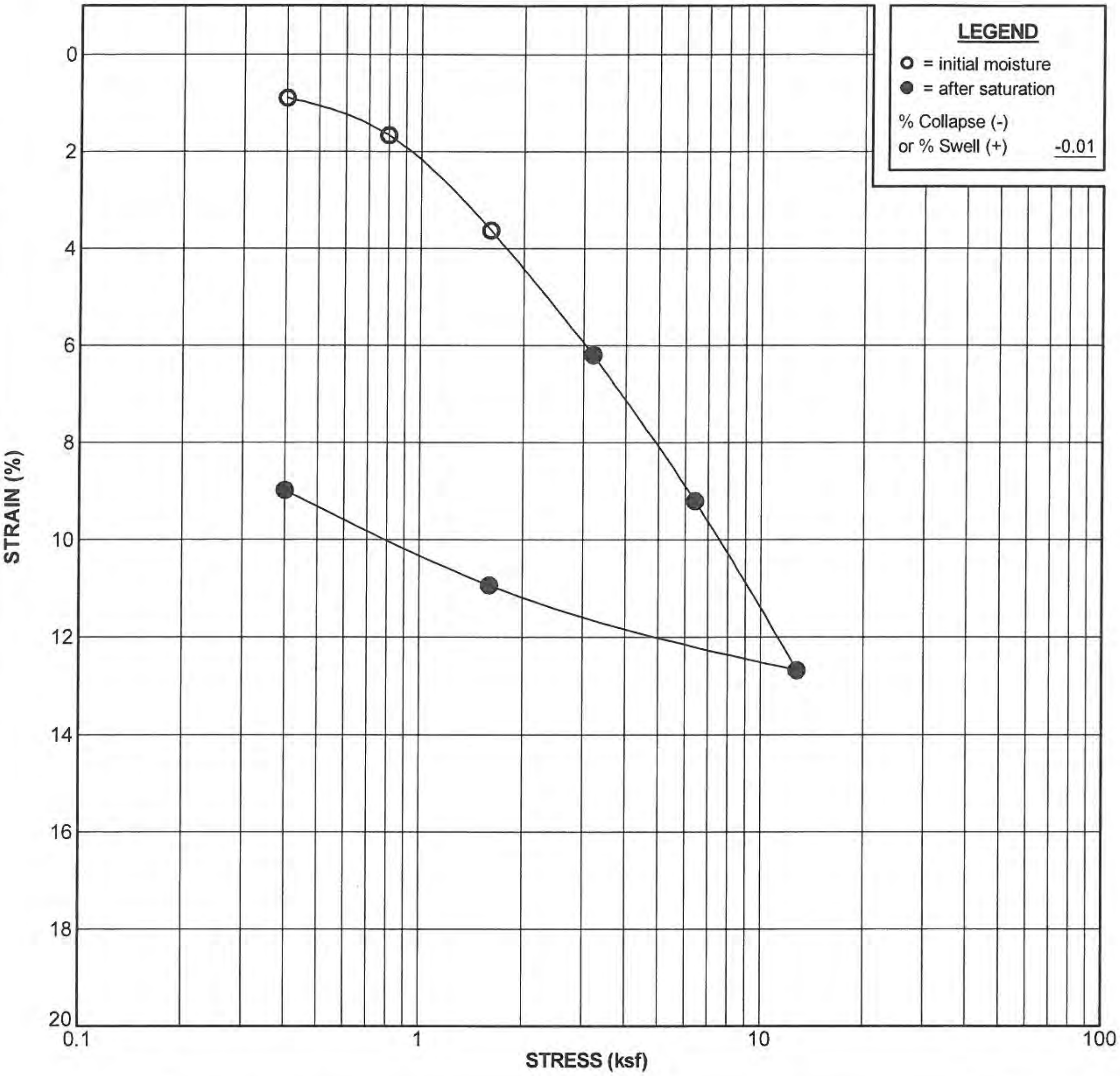
Maximum Dry Density (pcf)	**107.0**
Optimum Moisture Content (%)	**14.0**

Boring No. B-27	**Sample No. B-1**	**Depth: 0.0 ft**
Sample Description: (Qal) Dark brown silty SAND		**USCS:** SM
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**
Comments: 1557A		

COMPACTION TEST RESULTS

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

NMG Geotechnical, Inc.



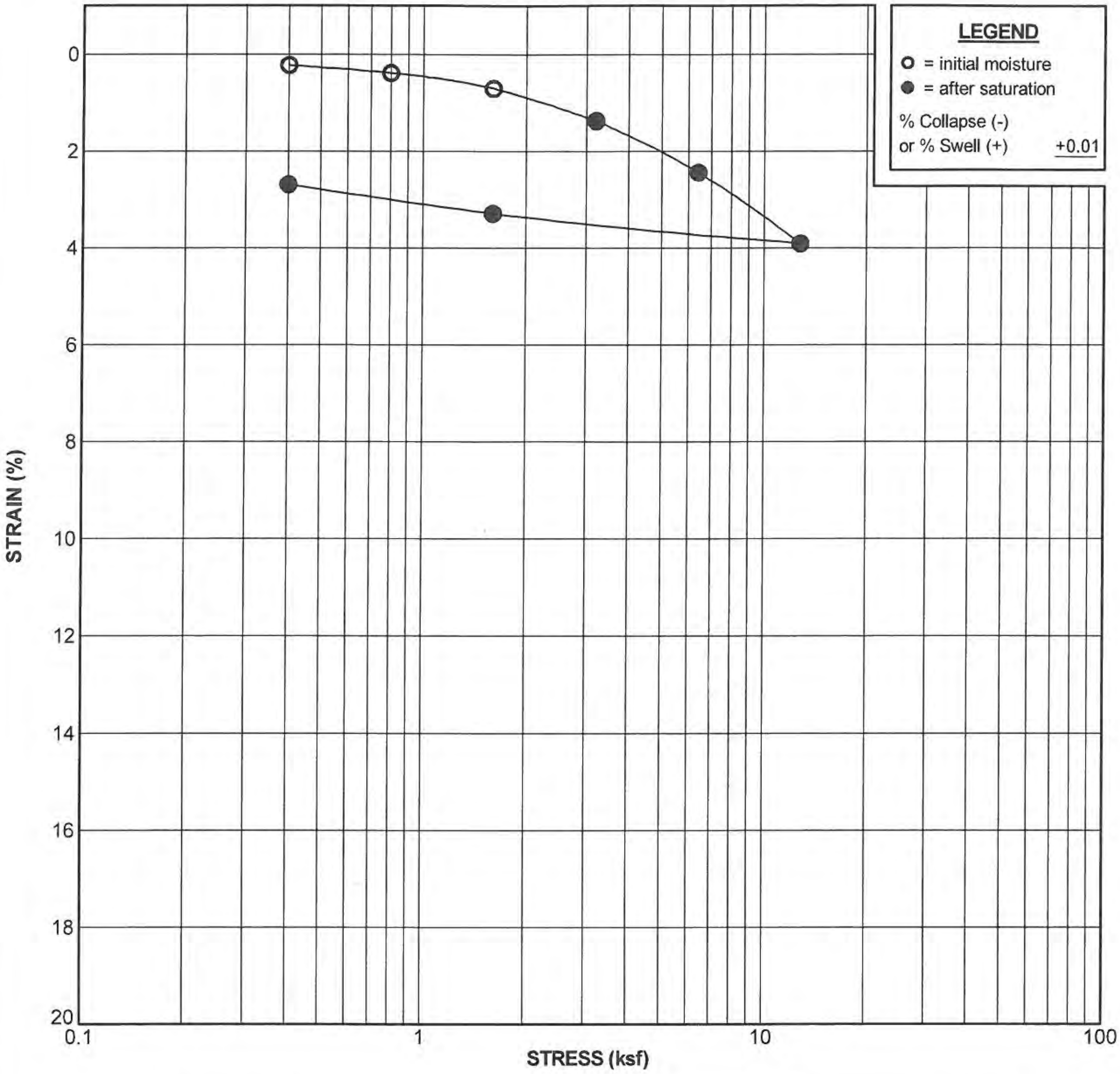
Boring No. B- 1	**Sample No. D-2**	**Depth: 10.0 ft**
Sample Description: (Qal) Dark grayish brown sandy CLAY		**USCS:** CL
Liquid Limit: 44	**Plasticity Index:** 18	**Percent Passing No. 200 Sieve:** 81

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	32.3	75.8	71.3	1.223
Final	36.1	82.6	93.7	1.040

CONSOLIDATION TEST RESULTS

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.



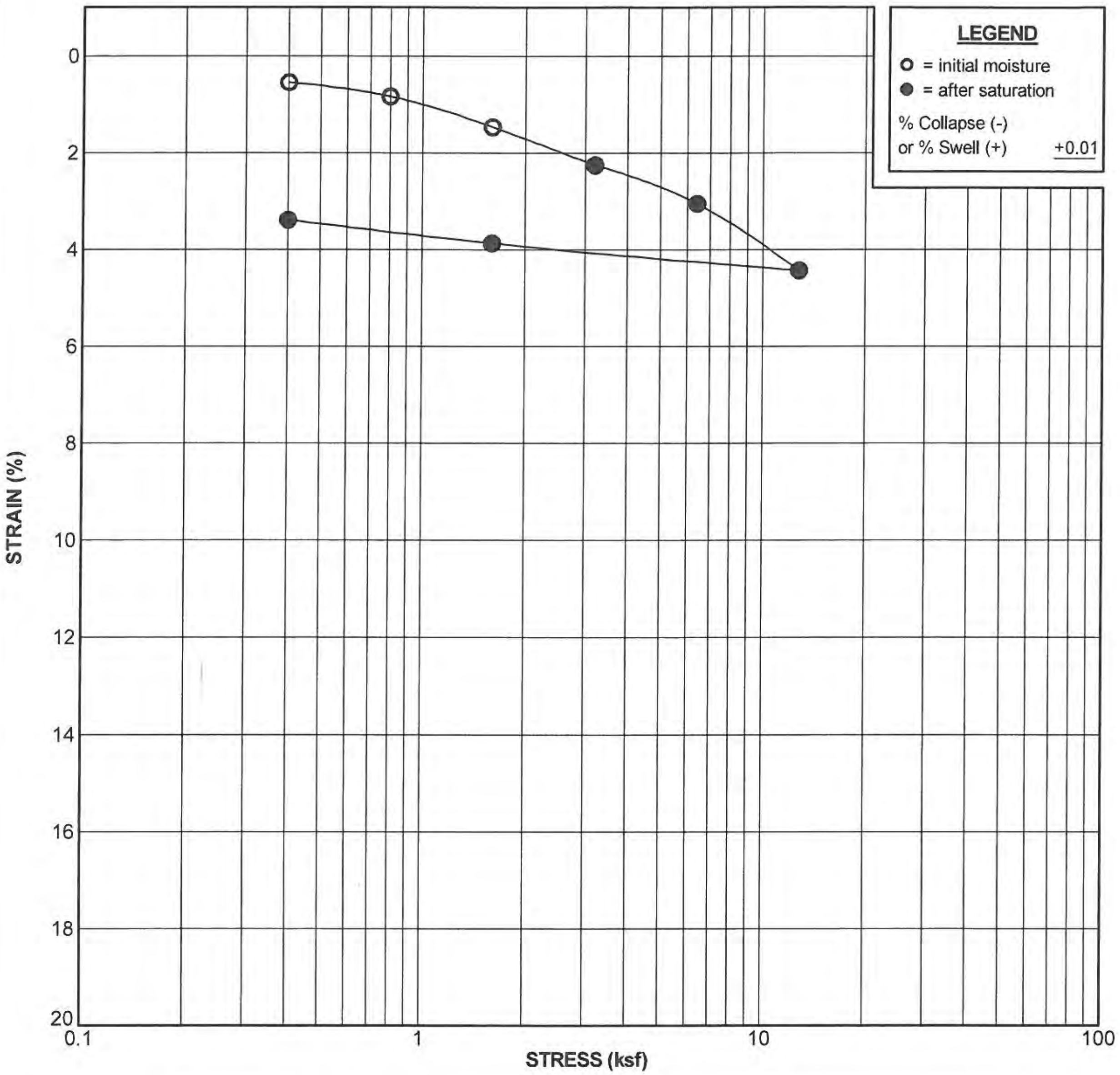
Boring No. B- 3	**Sample No. D-2**	**Depth: 10.0 ft**
Sample Description: (Qal) Dark brown silty SAND		**USCS:** SM
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	15.2	102.6	63.9	0.642
Final	20.1	105.4	90.7	0.598

CONSOLIDATION TEST RESULTS

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.



Boring No. B- 3 **Sample No. D-4** **Depth: 20.0 ft**

Sample Description: (Qal) Dark yellowish brown SAND **USCS:** SP-SM

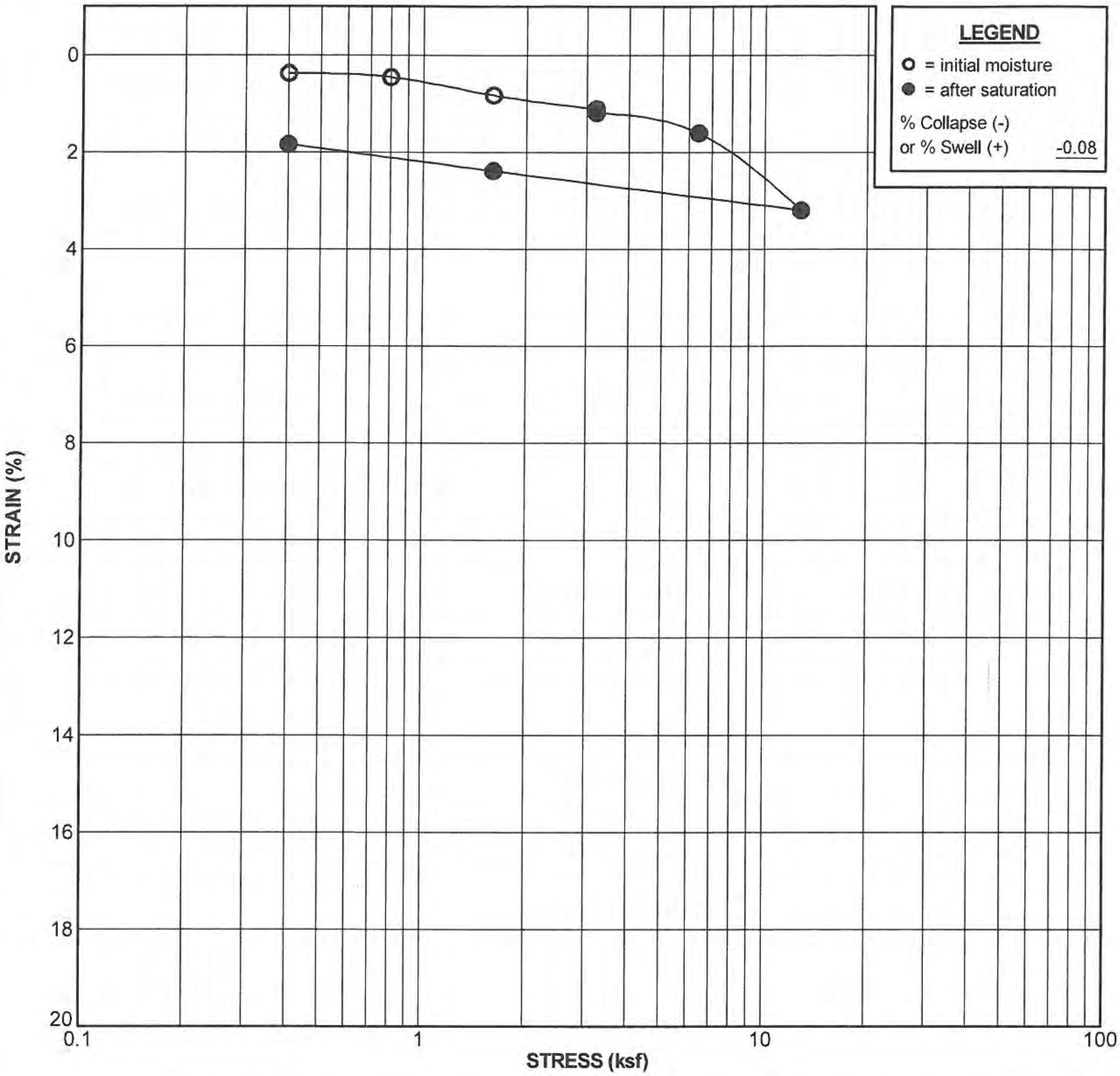
Liquid Limit: NP **Plasticity Index:** NP **Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	31.4	90.9	96.1	0.908
Final	30.4	94.0	100.0	0.845

CONSOLIDATION TEST RESULTS

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.



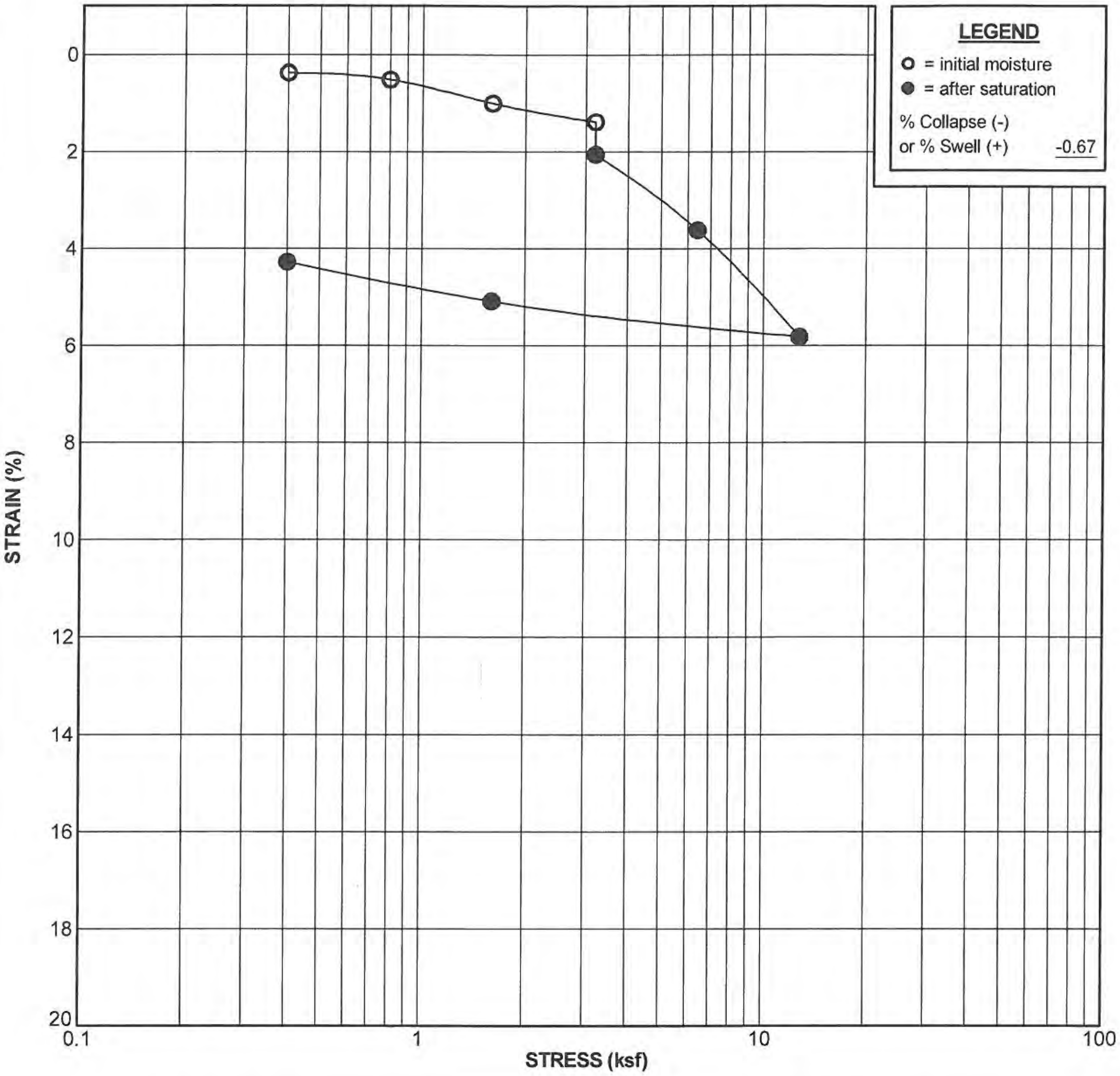
Boring No. B- 6	**Sample No. D-1**	**Depth: 5.0 ft**
Sample Description: (Qtr) Reddish brown clayey SAND		**USCS:** SC
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:** 40

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	12.3	120.5	83.4	0.398
Final	13.3	122.7	96.2	0.373

CONSOLIDATION TEST RESULTS

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.



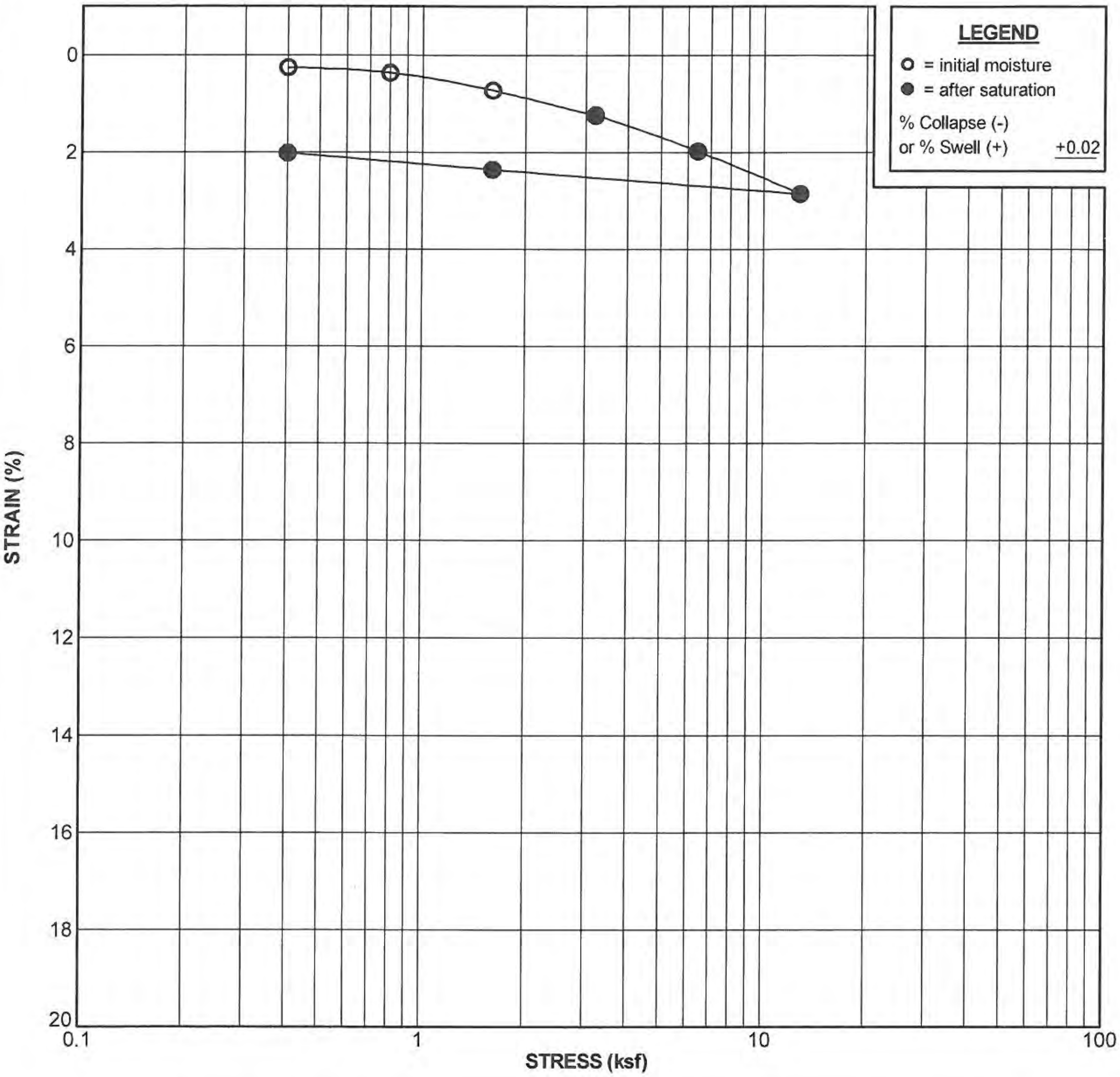
Boring No. B- 9	**Sample No. D-1**	**Depth: 5.0 ft**
Sample Description: (Af) Brown clayey SAND		**USCS:** SC
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:** 28

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	10.0	108.8	49.2	0.549
Final	16.3	113.5	90.9	0.484

CONSOLIDATION TEST RESULTS

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.



Boring No. B-10	**Sample No. D-2**	**Depth: 10.0 ft**
Sample Description: (Qal) Olive gray SAND		**USCS:** SP
Liquid Limit: NP	**Plasticity Index:** NP	**Percent Passing No. 200 Sieve:** 3

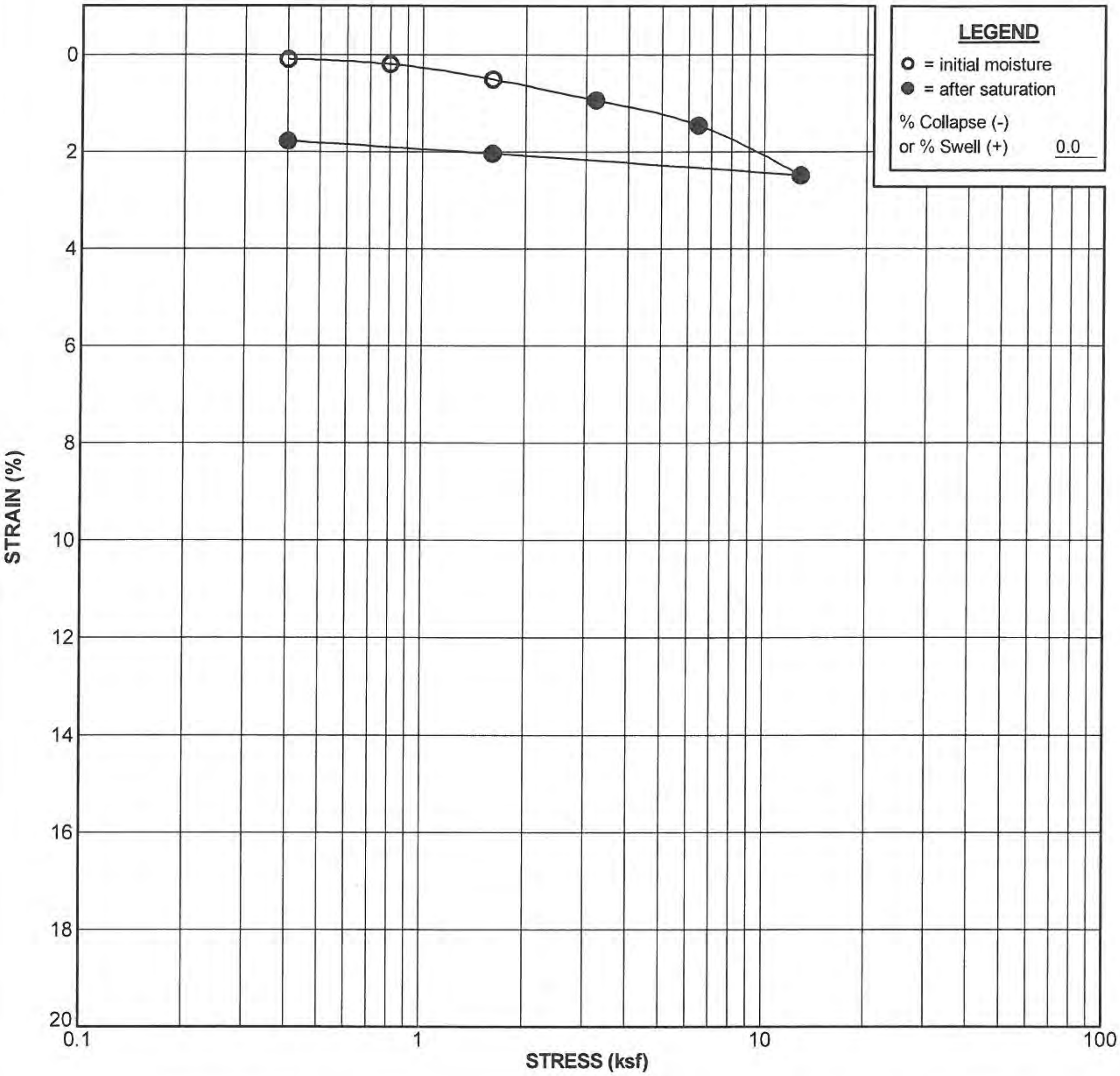
Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	25.1	87.9	73.9	0.917
Final	30.0	89.7	92.2	0.878

CONSOLIDATION TEST RESULTS

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.

Template: NMCONS; Prj ID: 11077-01.GPJ; Printed: 3/8/19



Boring No. B-10	**Sample No. D-4**	**Depth: 20.0 ft**

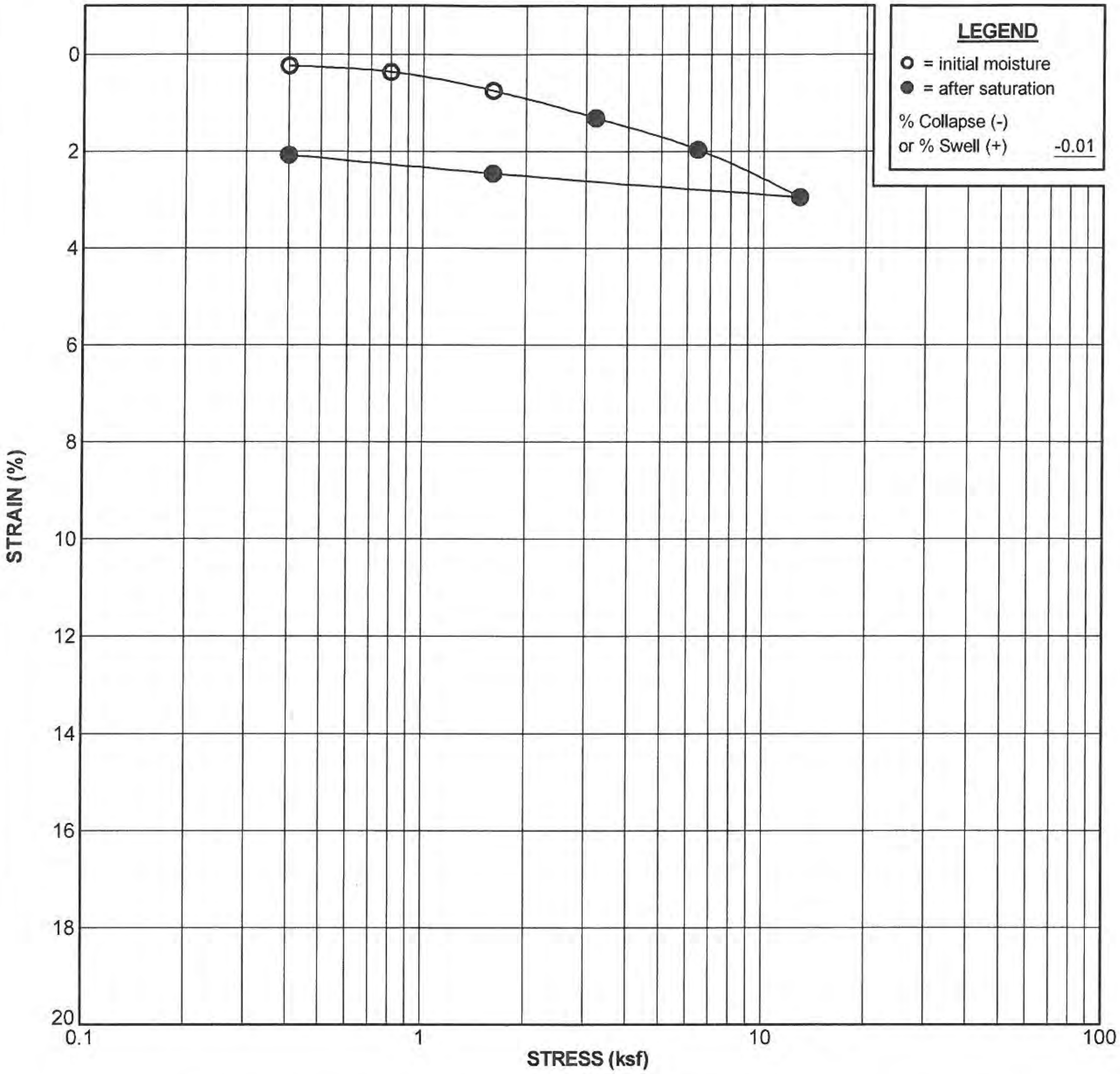
Sample Description: (Qal) Light grayish brown SAND		**USCS:** SP-SM
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:** 6

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	21.9	98.5	83.2	0.710
Final	23.8	100.3	94.5	0.680

CONSOLIDATION TEST RESULTS

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.



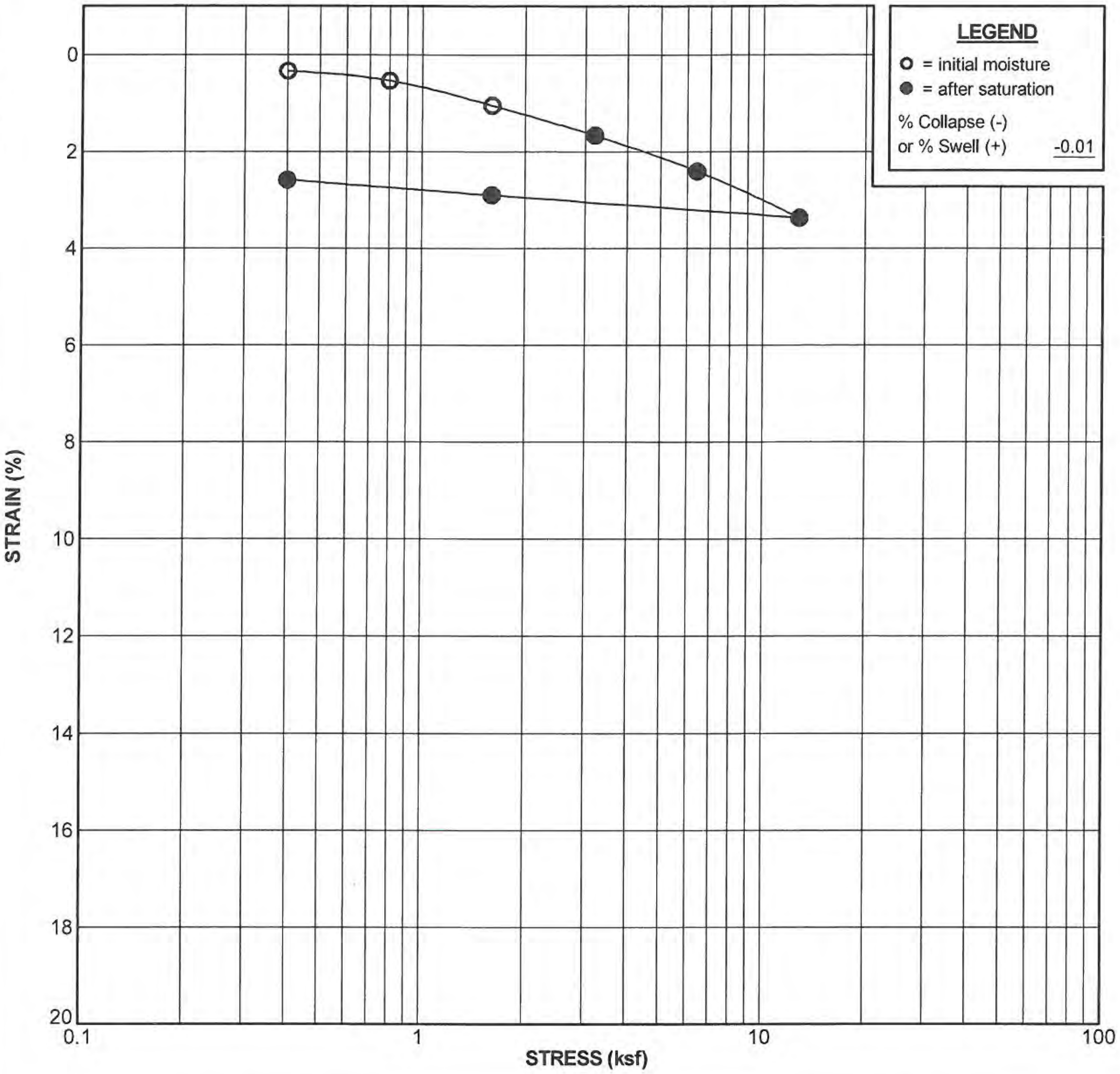
Boring No. B-11	**Sample No. D-1**	**Depth: 5.0 ft**
Sample Description: (Qal) Dark yellowish brown silty SAND		**USCS:** SM
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	12.9	102.9	54.7	0.637
Final	20.4	105.0	91.1	0.605

CONSOLIDATION TEST RESULTS

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.



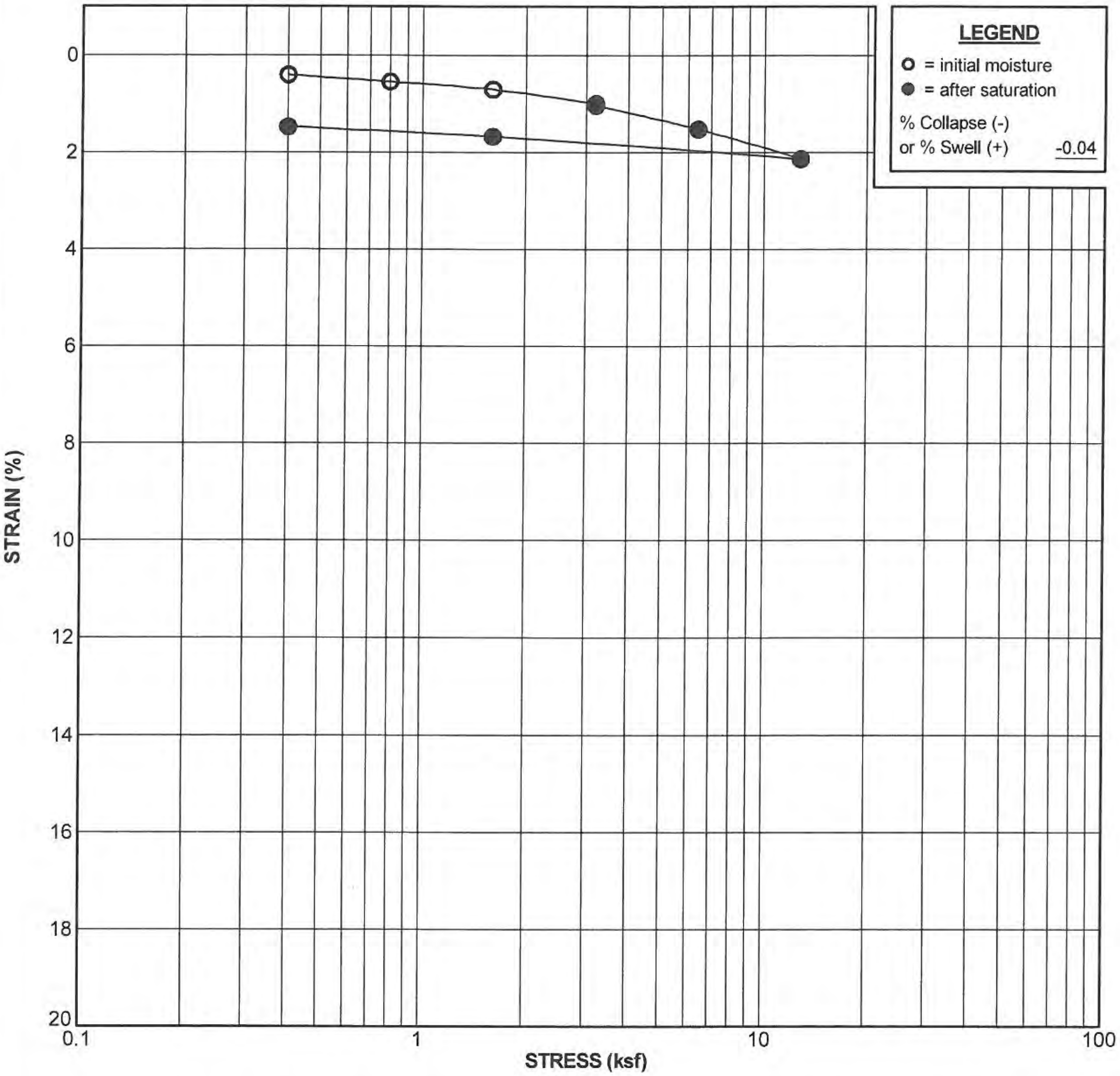
Boring No. B-11	**Sample No. D-2**	**Depth: 10.0 ft**
Sample Description: (Qal) Dark brown silty SAND		**USCS:** SM-SP
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	18.3	105.2	82.1	0.602
Final	20.1	105.1	90.0	0.603

CONSOLIDATION TEST RESULTS

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.



Boring No. B-13 **Sample No. D-2** **Depth: 10.0 ft**

Sample Description: (Qal) Gray SAND **USCS:** SP

Liquid Limit: **Plasticity Index:** **Percent Passing No. 200 Sieve:** 4

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	25.1	98.2	92.8	0.741
Final	26.1	99.7	100.0	0.715

CONSOLIDATION TEST RESULTS

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

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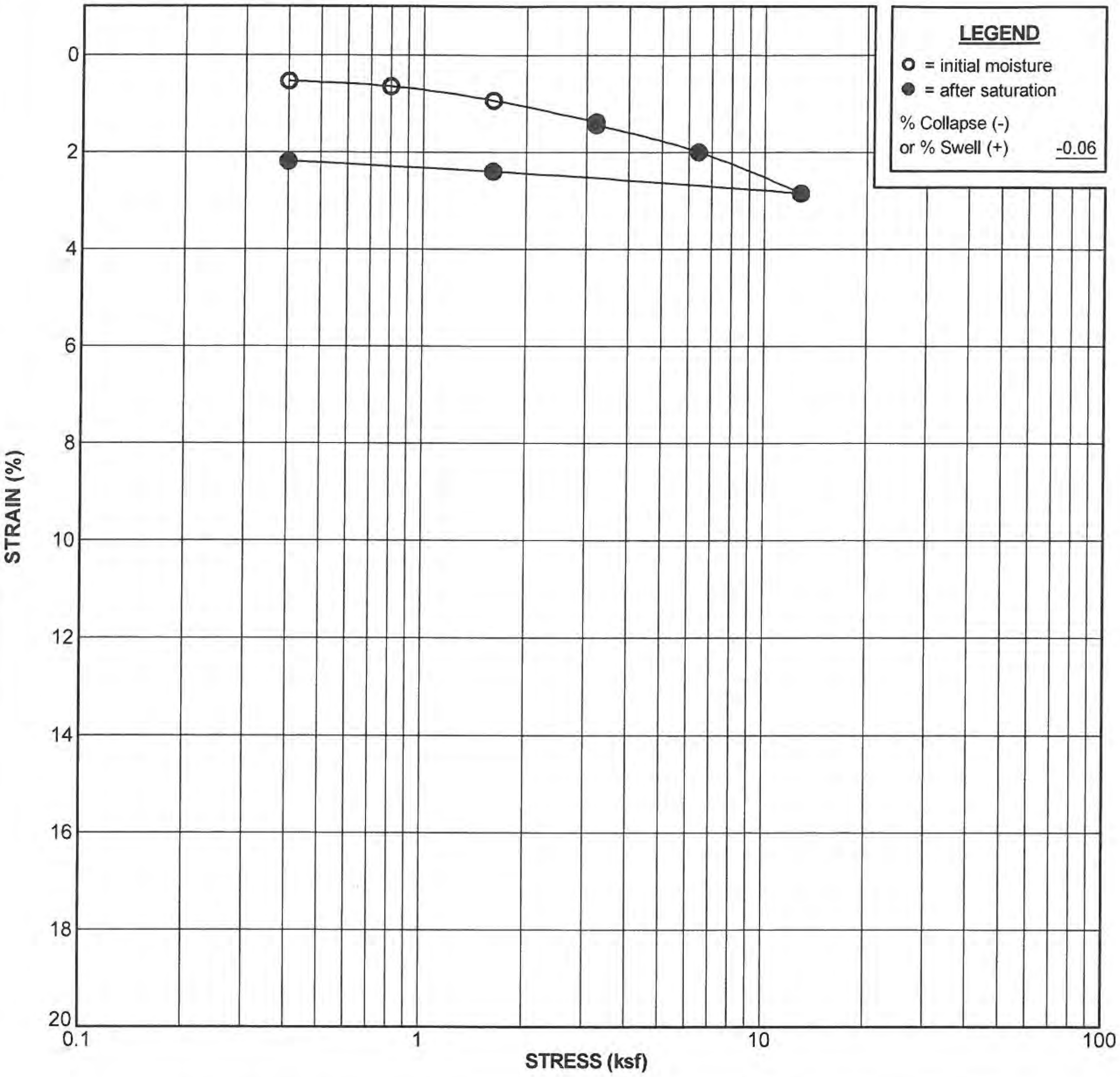

Boring No. B-14	Sample No. D-3	Depth: 15.0 ft
Sample Description: (Qal) Yellowish gray SAND		USCS: SP
Liquid Limit:	Plasticity Index:	Percent Passing No. 200 Sieve:

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	22.1	97.8	82.6	0.723
Final	24.5	99.9	96.4	0.686

CONSOLIDATION TEST RESULTS

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

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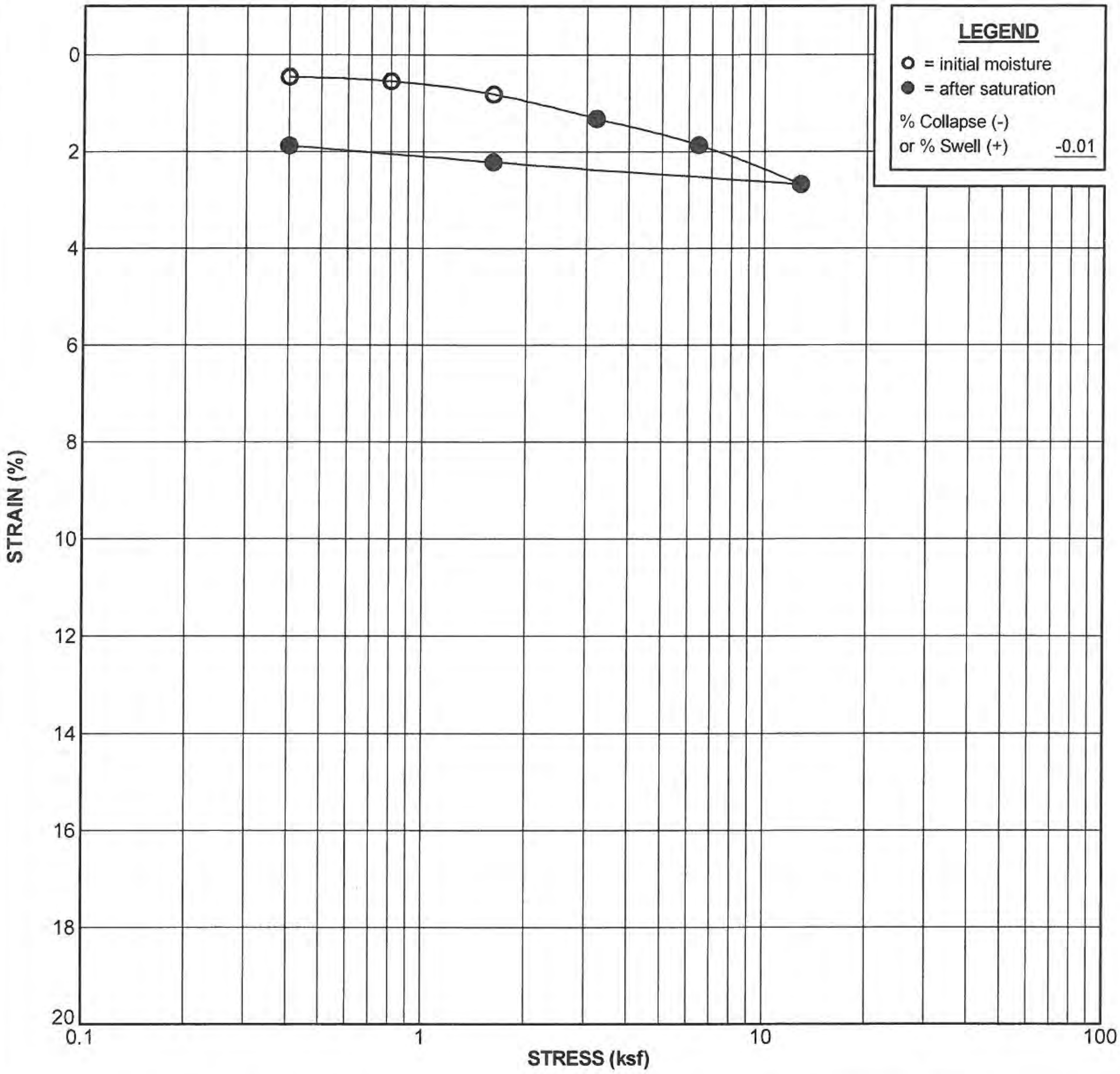

Boring No. B-15	**Sample No. D-3**	**Depth: 15.0 ft**
Sample Description: (Qal) Dark gray silty SAND		**USCS:** SM-SP
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	25.3	98.1	94.7	0.724
Final	25.5	99.9	99.8	0.693

CONSOLIDATION TEST RESULTS

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

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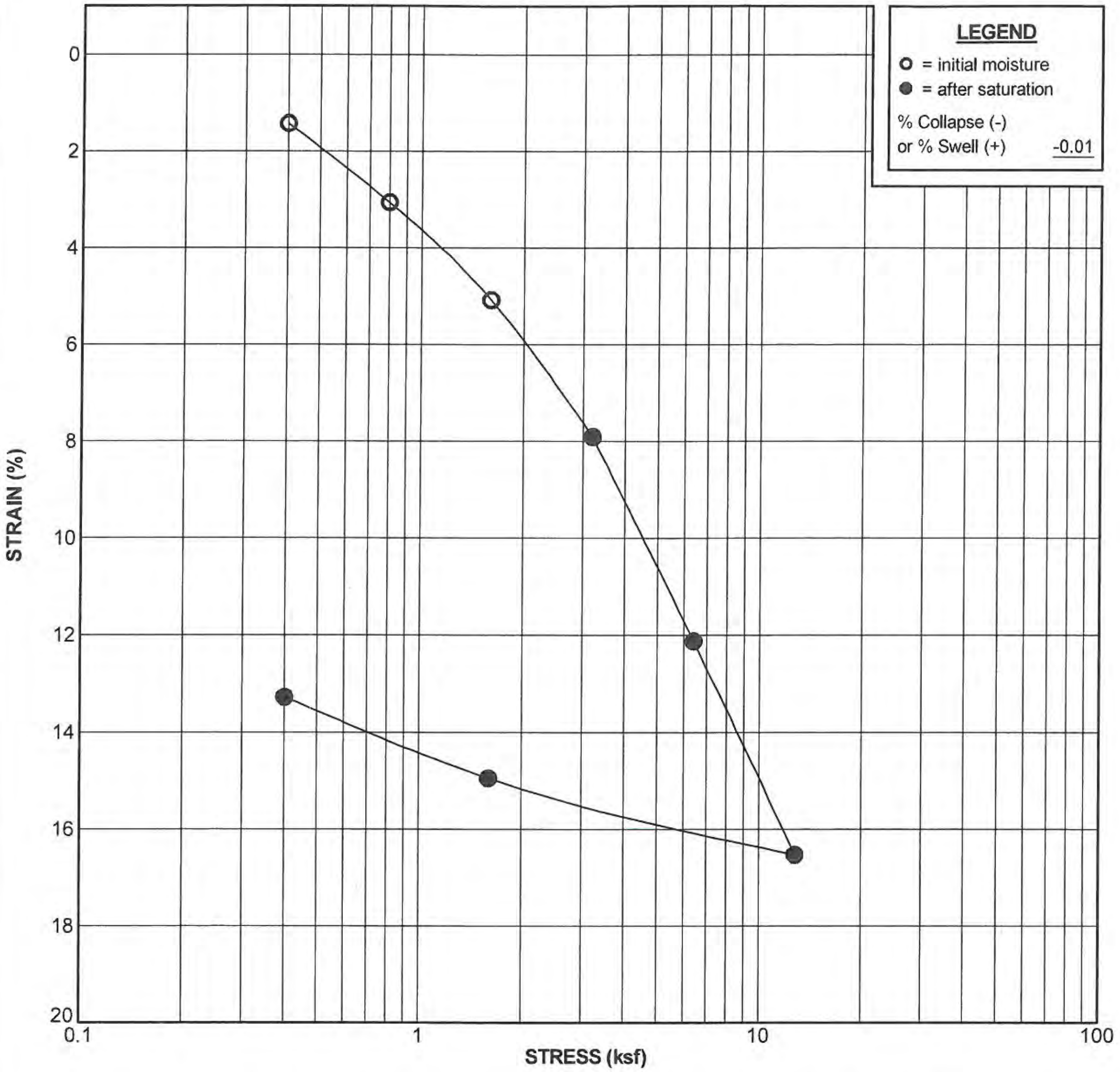

Boring No. B-15	**Sample No. D-5**	**Depth: 25.0 ft**
Sample Description: (Qal) Dark gray silty clayey SAND		**USCS:** SC
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:** 33

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	40.4	79.1	96.5	1.130
Final	30.1	89.6	92.3	0.880

CONSOLIDATION TEST RESULTS

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

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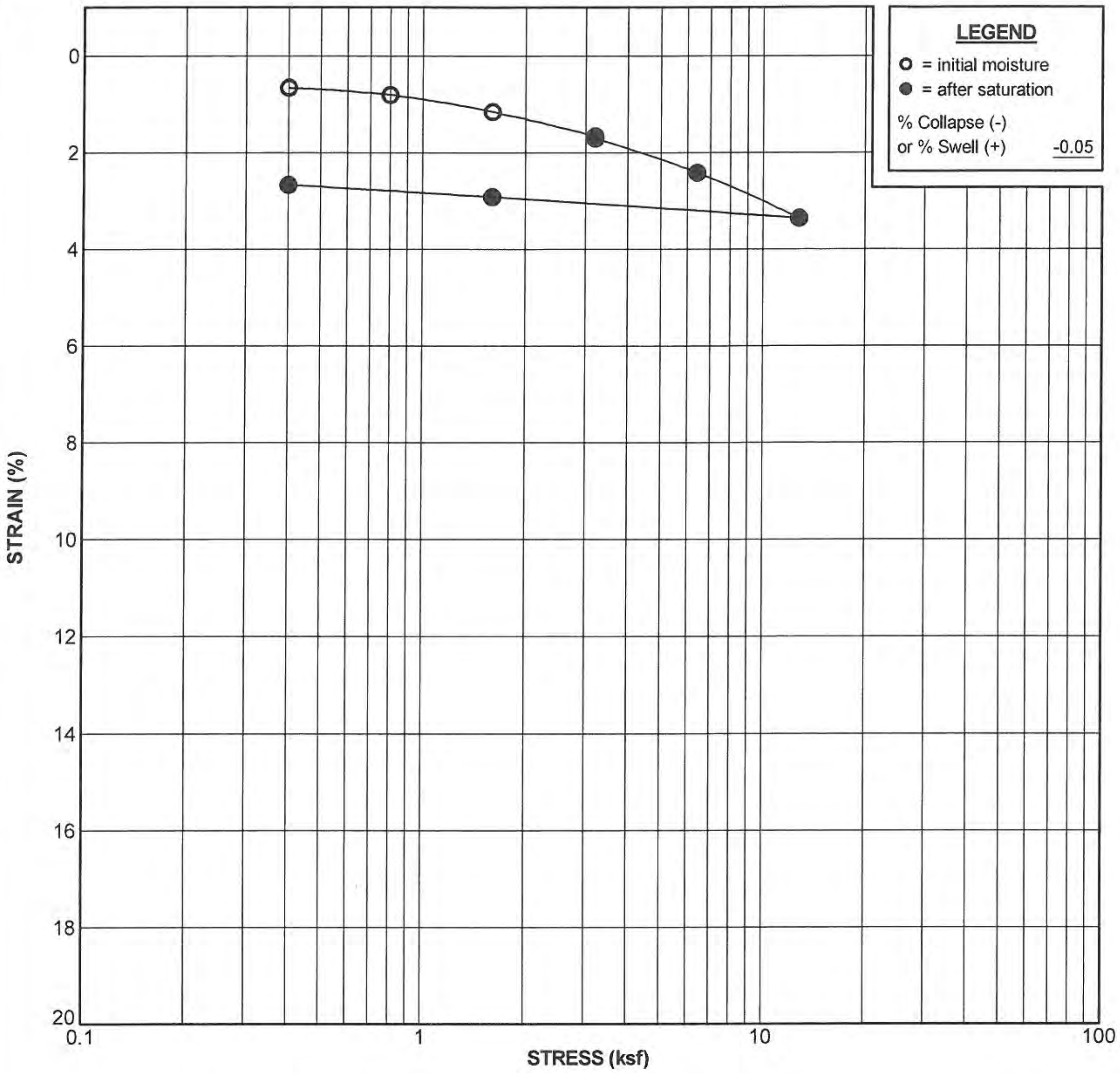


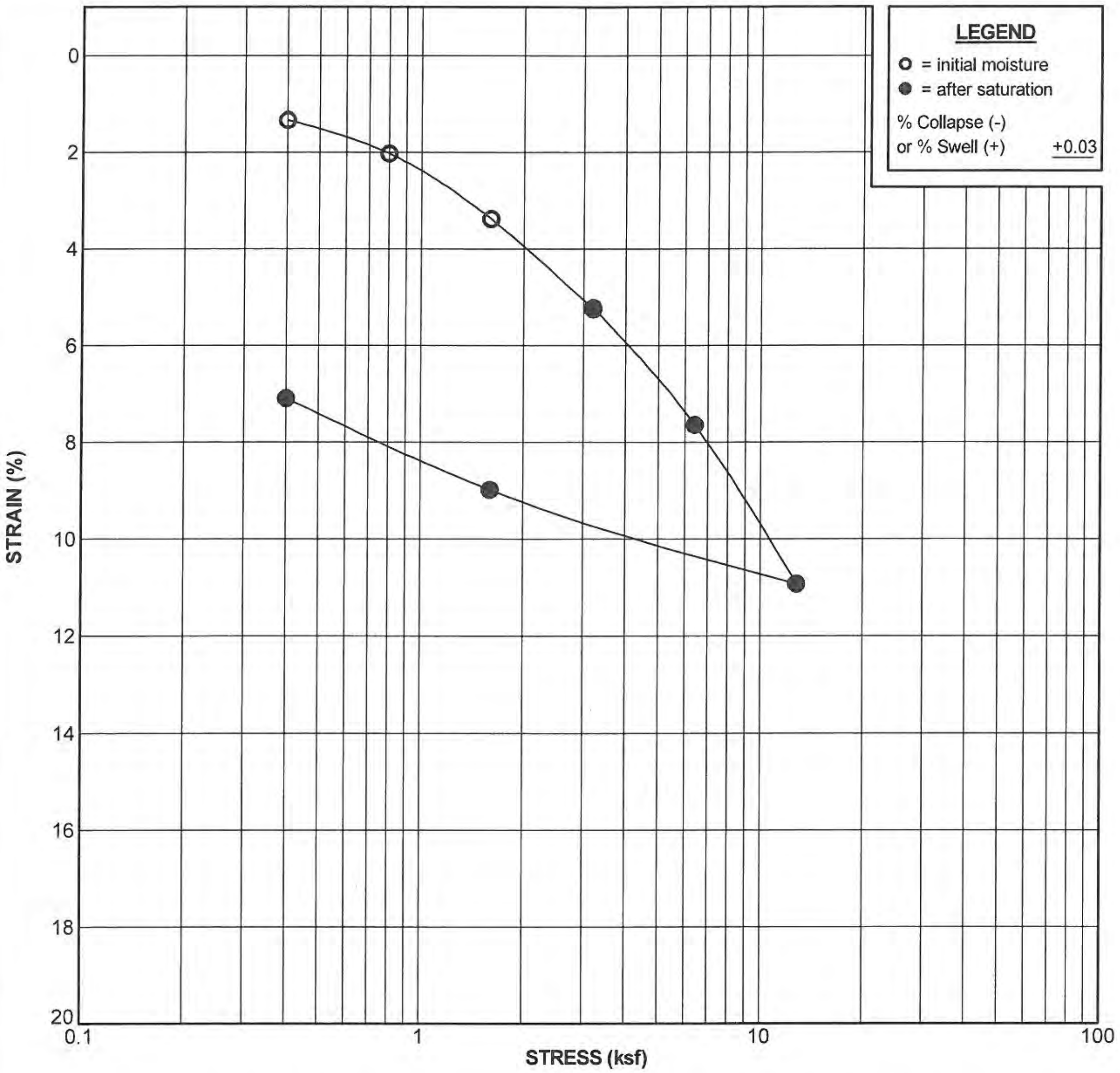
Boring No. B-15	**Sample No. D-8**	**Depth: 40.0 ft**
Sample Description: (Qal) Dark gray silty SAND		**USCS:** SM-SP
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	23.6	95.8	84.0	0.759
Final	25.7	98.4	97.4	0.712

CONSOLIDATION TEST RESULTS

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.



Boring No. B-16 **Sample No. D-7** **Depth: 35.0 ft**

Sample Description: (Qal) Dark grayish brown silty SAND **USCS:** SM

Liquid Limit: NP **Plasticity Index:** NP **Percent Passing No. 200 Sieve:**

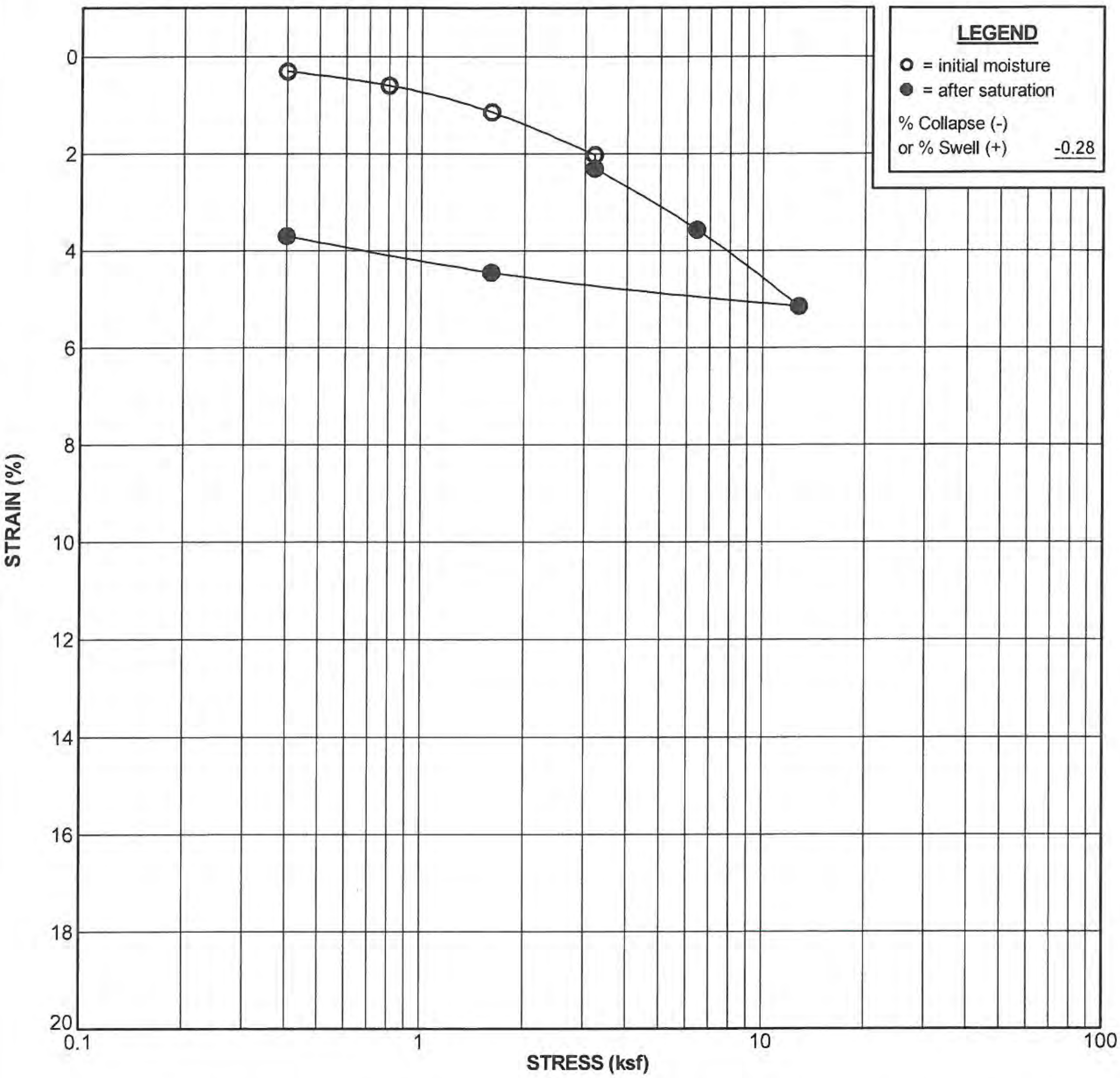
Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	39.6	80.0	92.3	1.223
Final	37.5	85.7	99.4	1.075

CONSOLIDATION TEST RESULTS

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.

Template: NMCONS; Prj ID: 11077-01.GPJ; Printed: 3/8/19



Boring No. B-17 **Sample No. D-1** **Depth: 5.0 ft**

Sample Description: (Qal) Yellowish brown silty SAND **USCS:** SP-SM

Liquid Limit: **Plasticity Index:** **Percent Passing No. 200 Sieve:** 11

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	8.4	87.7	24.6	0.921
Final	29.1	90.9	92.1	0.853

CONSOLIDATION TEST RESULTS

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

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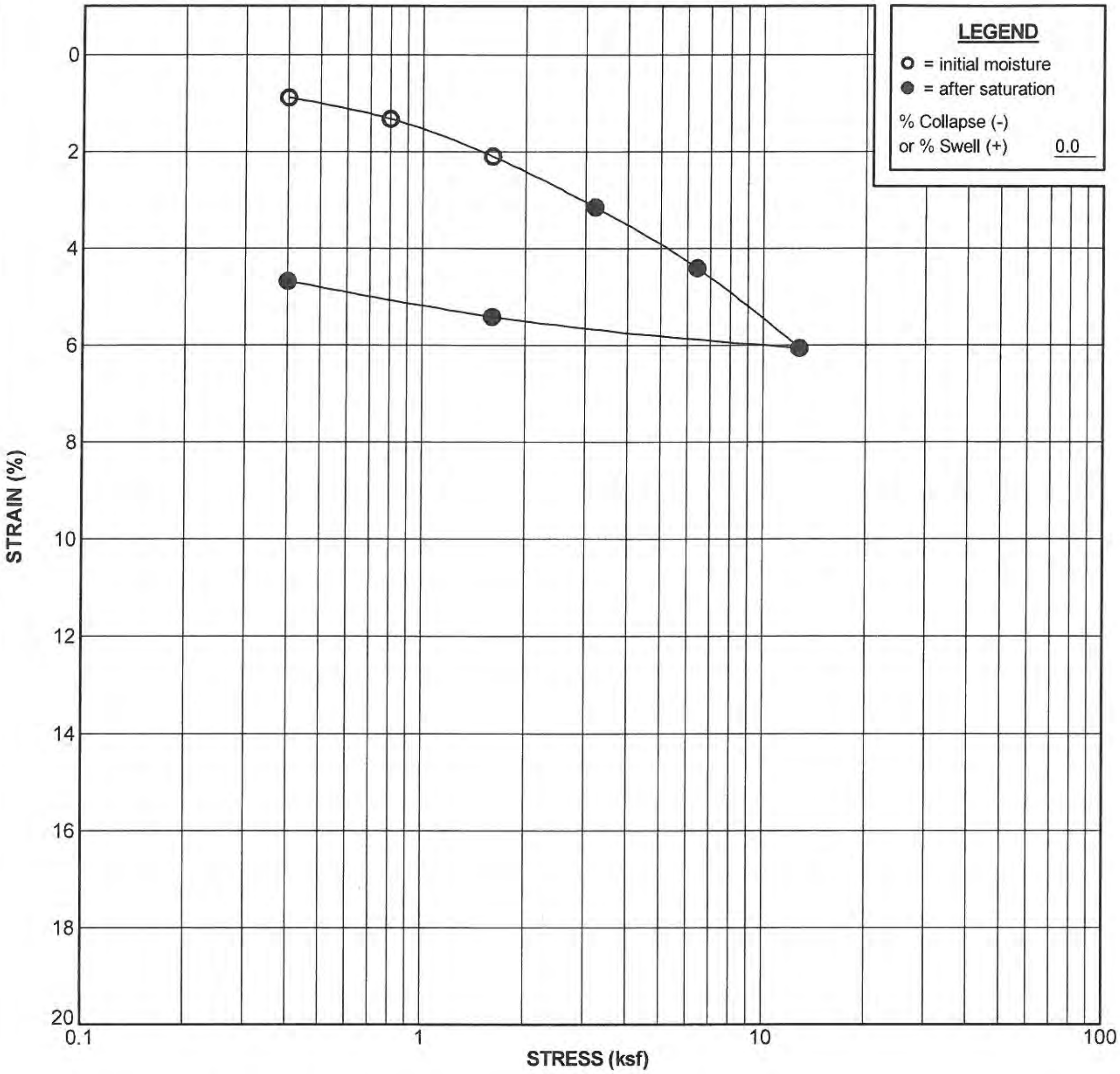

Boring No. B-18	**Sample No. D-3**	**Depth: 15.0 ft**
Sample Description: (Qal) Yellowish brown silty SAND		**USCS:** SP-SM
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	29.9	89.9	91.2	0.895
Final	29.6	94.1	99.7	0.810

CONSOLIDATION TEST RESULTS

Riverwalk
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PROJECT NO. 11077-01

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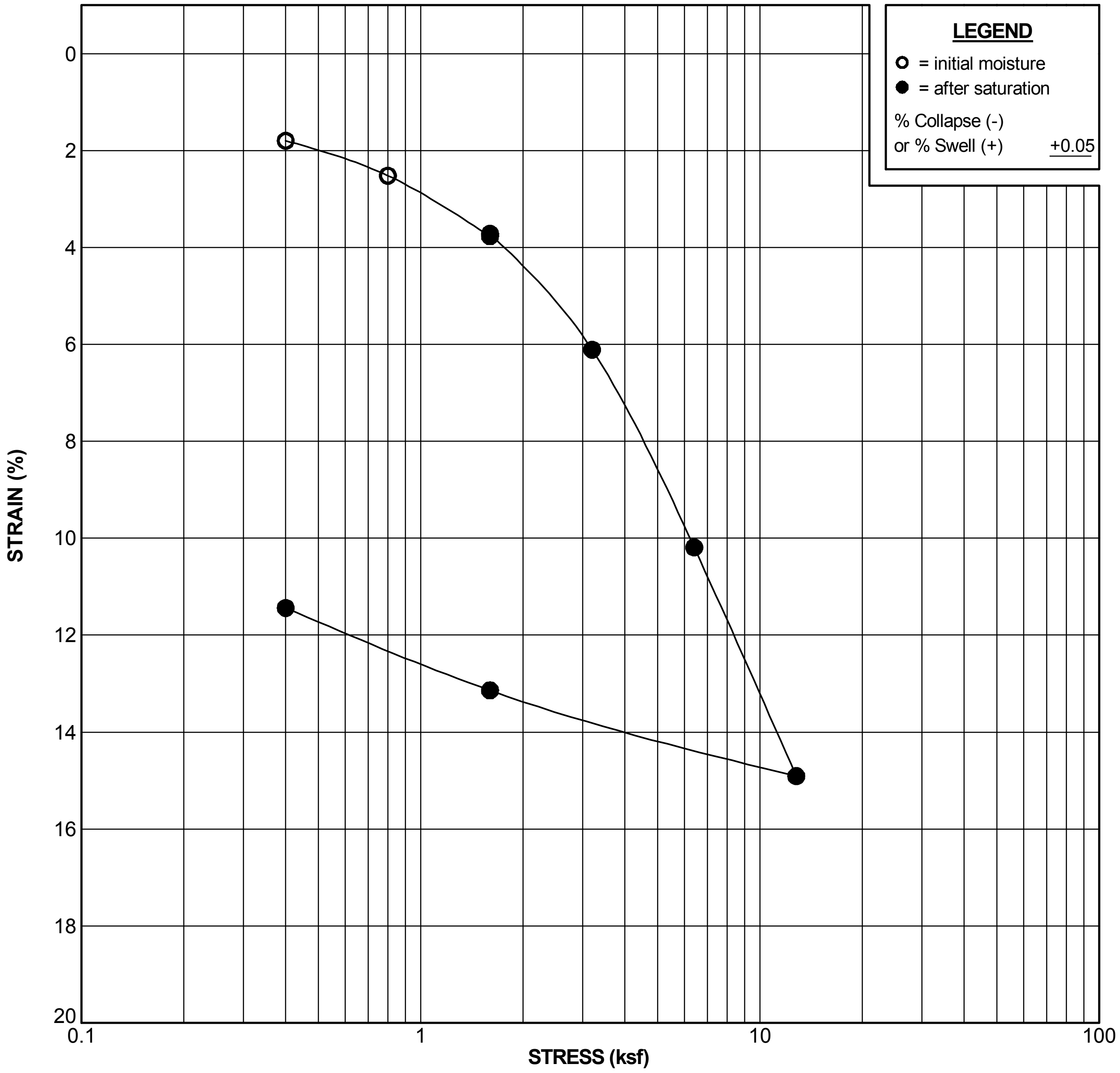

Boring No. B-19	**Sample No. D-4**	**Depth: 10.0 ft**
Sample Description: (Qal) Dark brown silty CLAY		**USCS:** CL
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	35.1	84.3	94.9	0.999
Final	28.5	93.9	96.9	0.794

CONSOLIDATION TEST RESULTS

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

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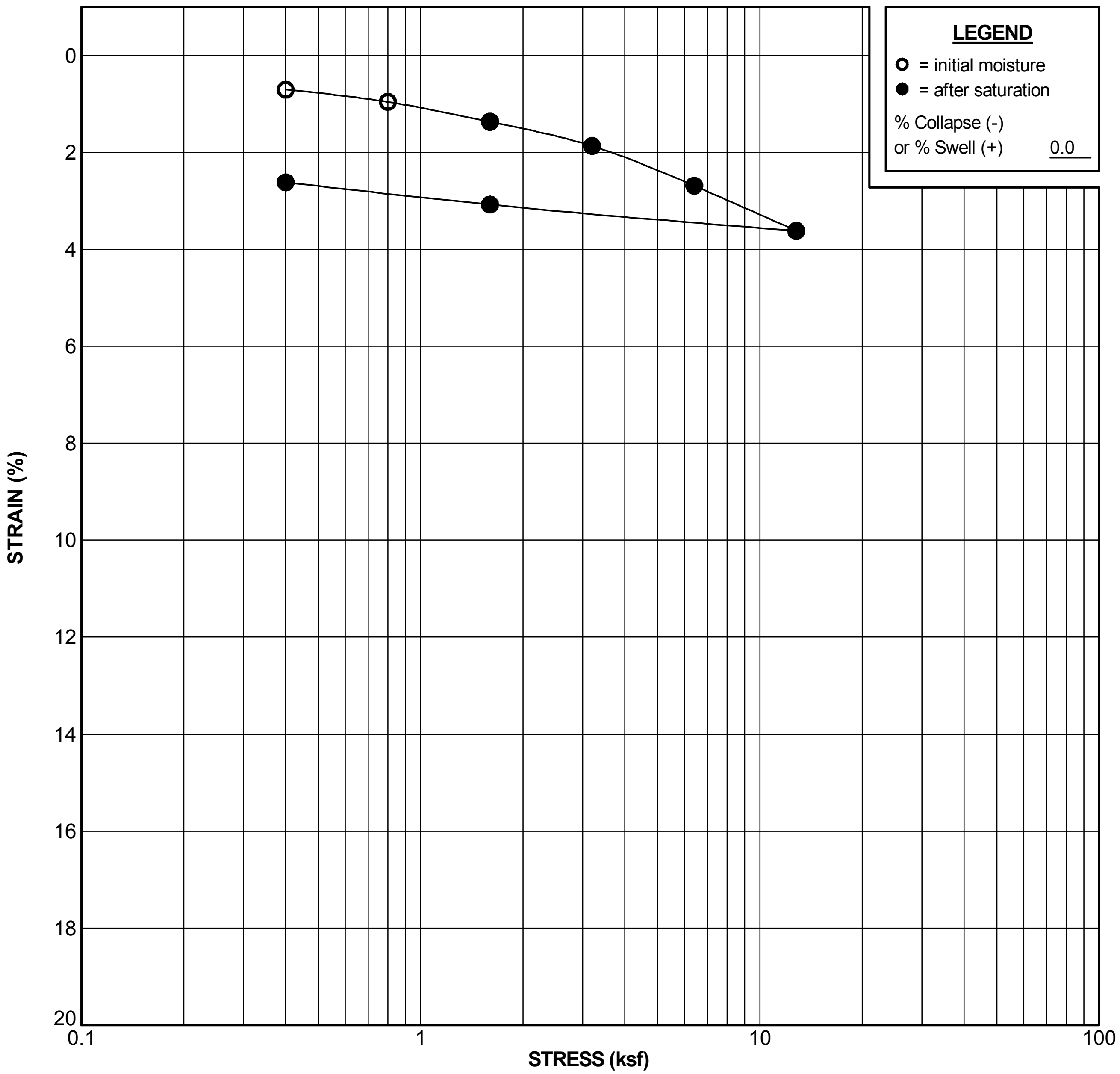

Boring No. B-19	**Sample No. D-6**	**Depth: 20.0 ft**

Sample Description: (Qal) Gray SAND/silty SAND		**USCS:** SP-SM
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:** 6

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	21.9	98.5	83.2	0.710
Final	23.5	101.1	95.2	0.666

CONSOLIDATION TEST RESULTS

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

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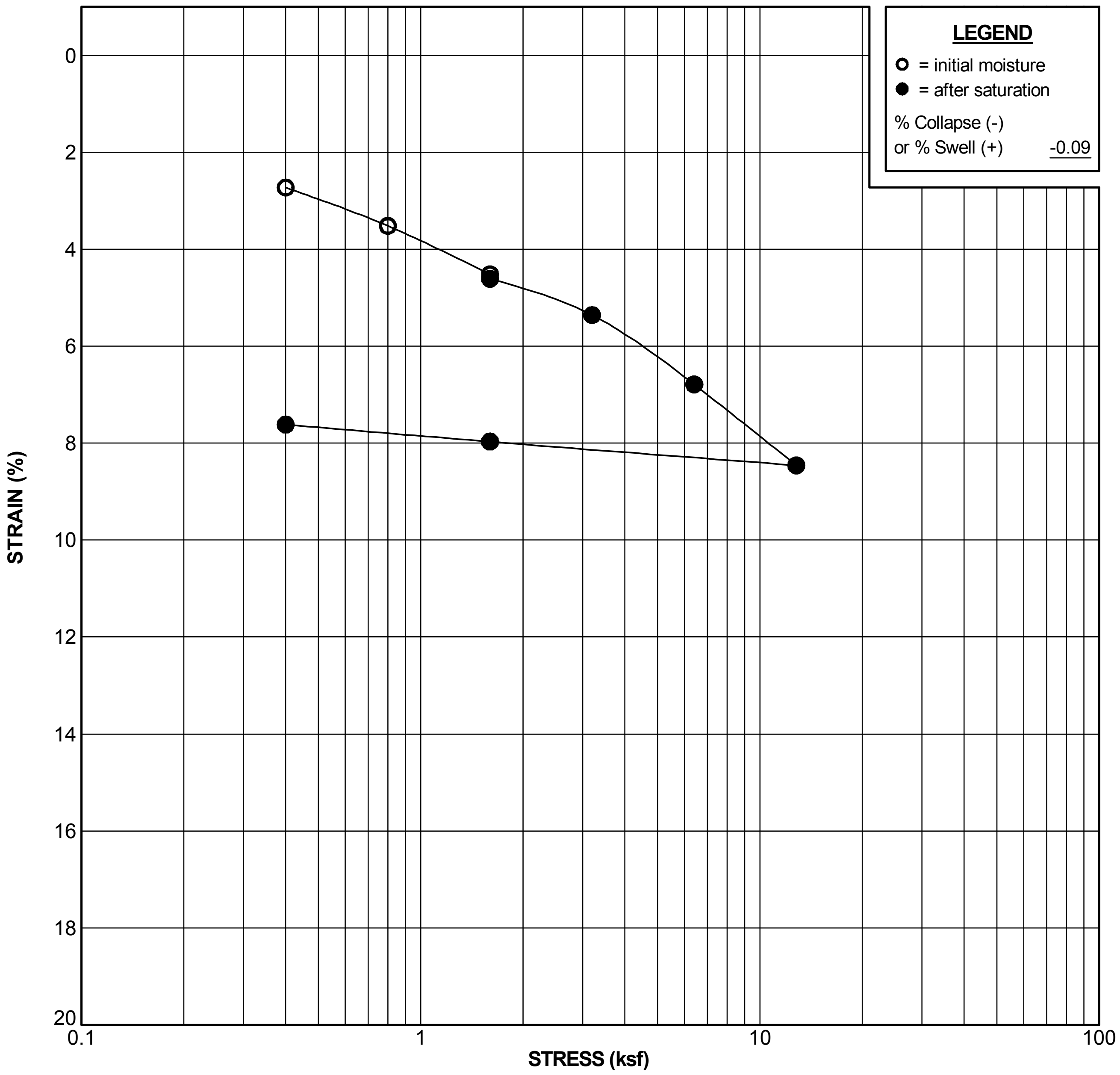


Boring No. B-19	**Sample No. D-13**	**Depth: 55.0 ft**

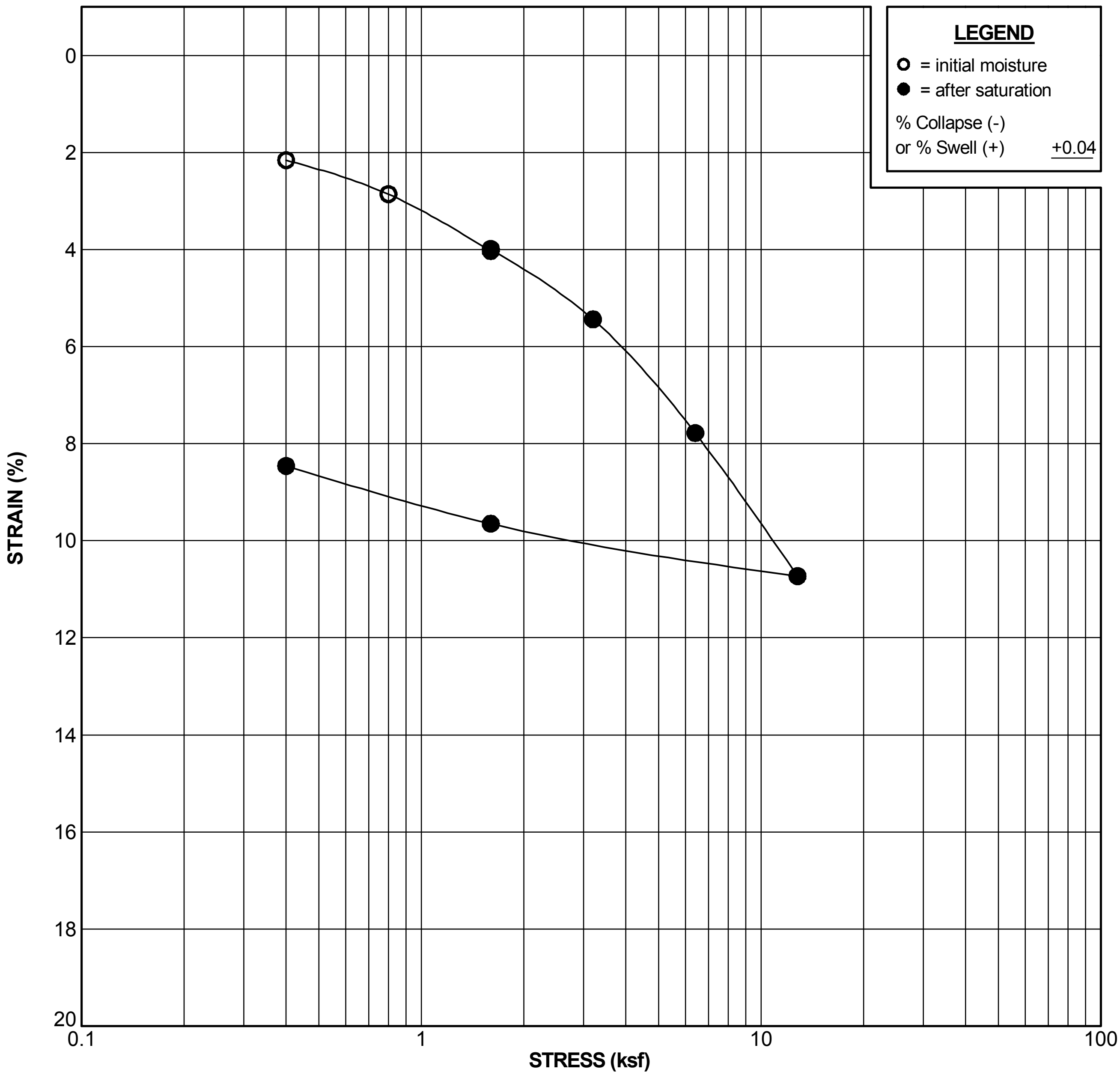
Sample Description: (Qal) Dark brown clayey SAND		**USCS:** SC
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:** 36

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	18.3	112.1	98.2	0.503
Final	14.3	120.6	97.3	0.397

CONSOLIDATION TEST RESULTS

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

NMG Geotechnical, Inc.



Boring No. B-20	**Sample No. D-4**	**Depth: 10.0 ft**
Sample Description: (Qal) Dark olive brown silty SAND		**USCS:** SM
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:** 28

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	32.3	90.0	94.7	0.969
Final	28.7	97.6	99.9	0.816

CONSOLIDATION TEST RESULTS

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

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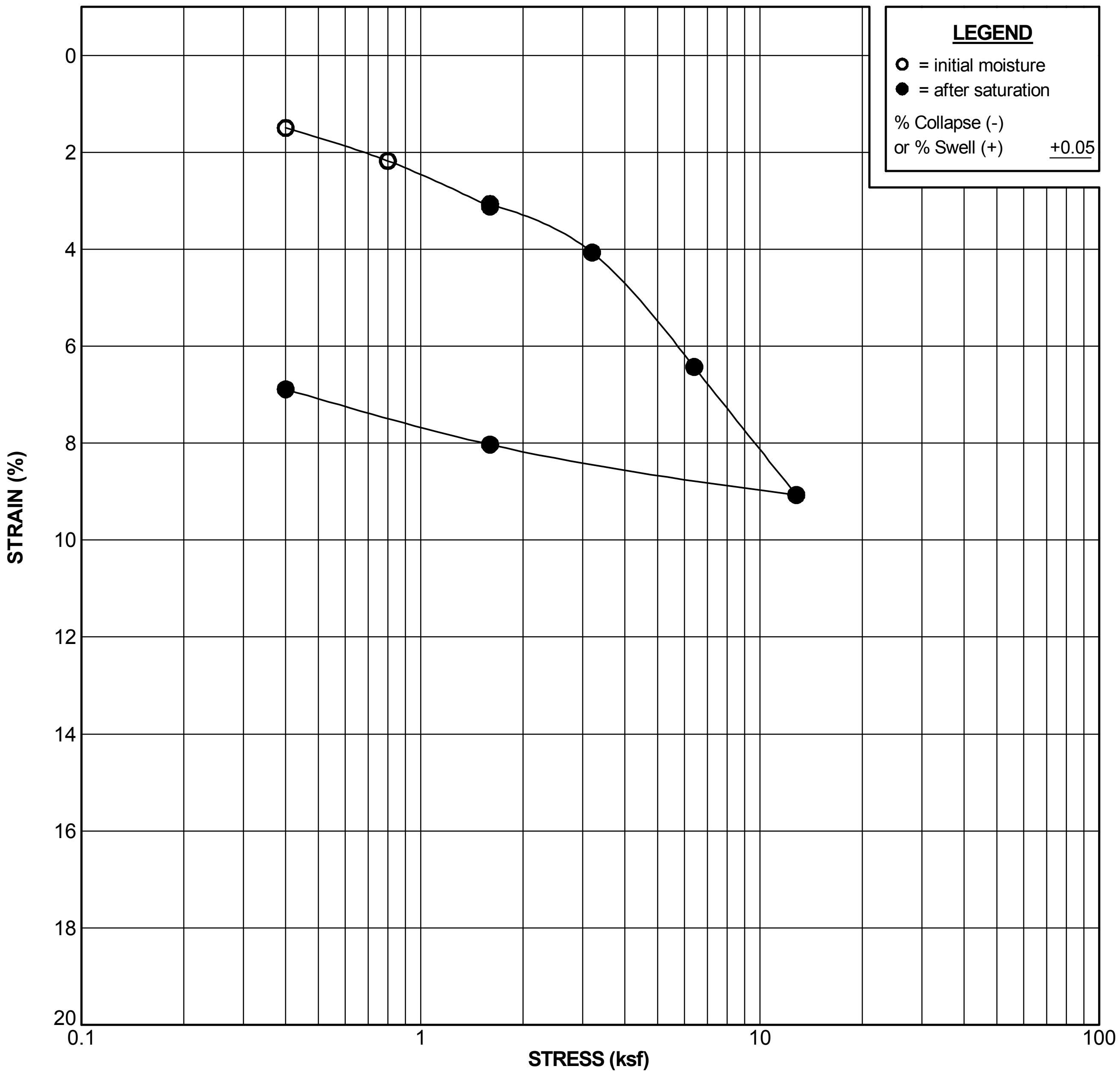

Boring No. B-20	**Sample No. D-4a**	**Depth: 10.1 ft**
Sample Description: (Qal) Dark olive gray silty SAND		**USCS:** SM
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	30.6	92.4	94.0	0.931
Final	28.2	98.8	100.0	0.806

CONSOLIDATION TEST RESULTS

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

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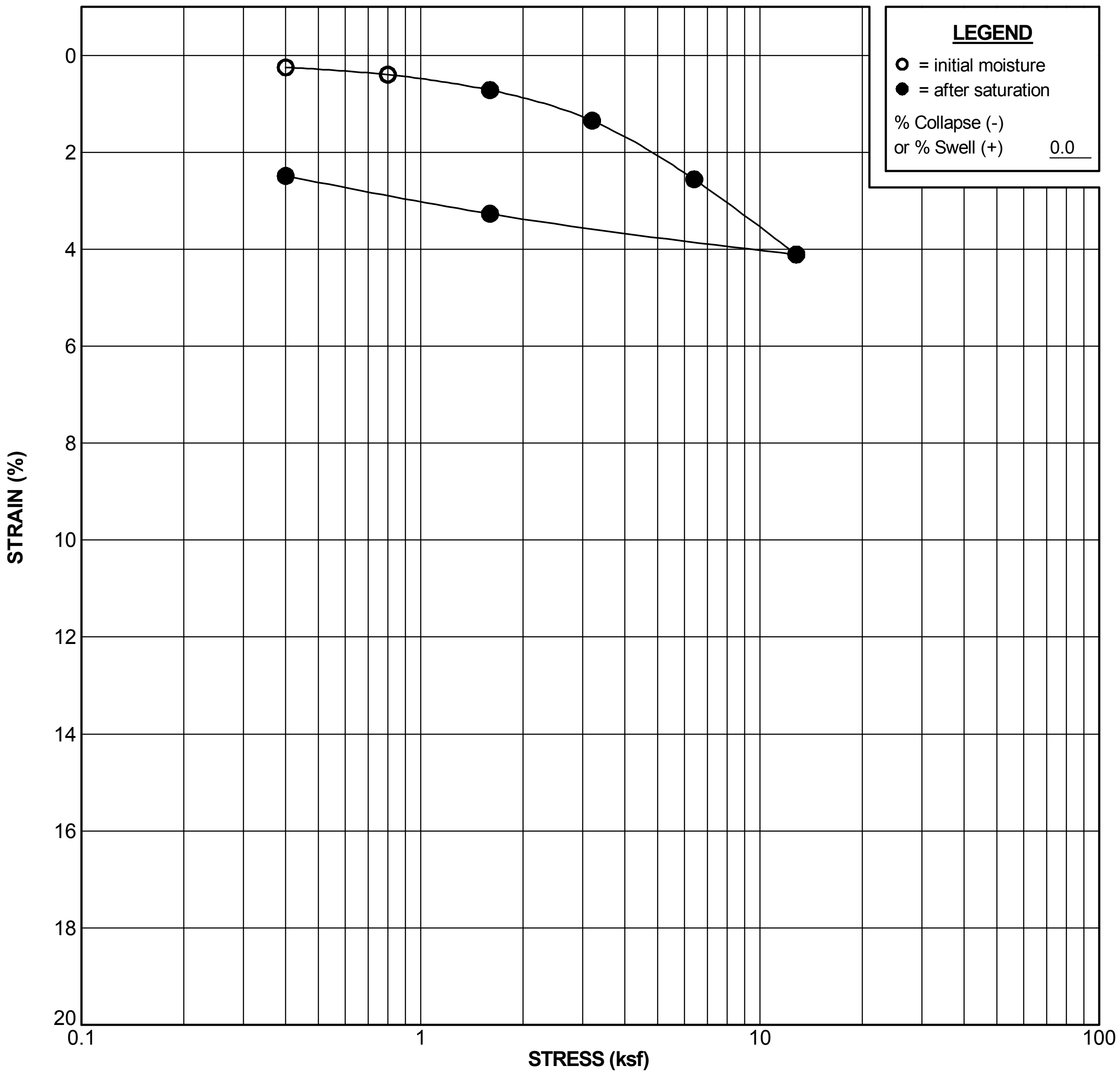

Boring No. B-23	**Sample No. D-3**	**Depth: 15.0 ft**
Sample Description: (Qal) Dark olive brown silty SAND		**USCS:** SM
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:** 33

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	25.2	85.5	70.1	0.971
Final	32.4	87.6	94.7	0.923

CONSOLIDATION TEST RESULTS

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

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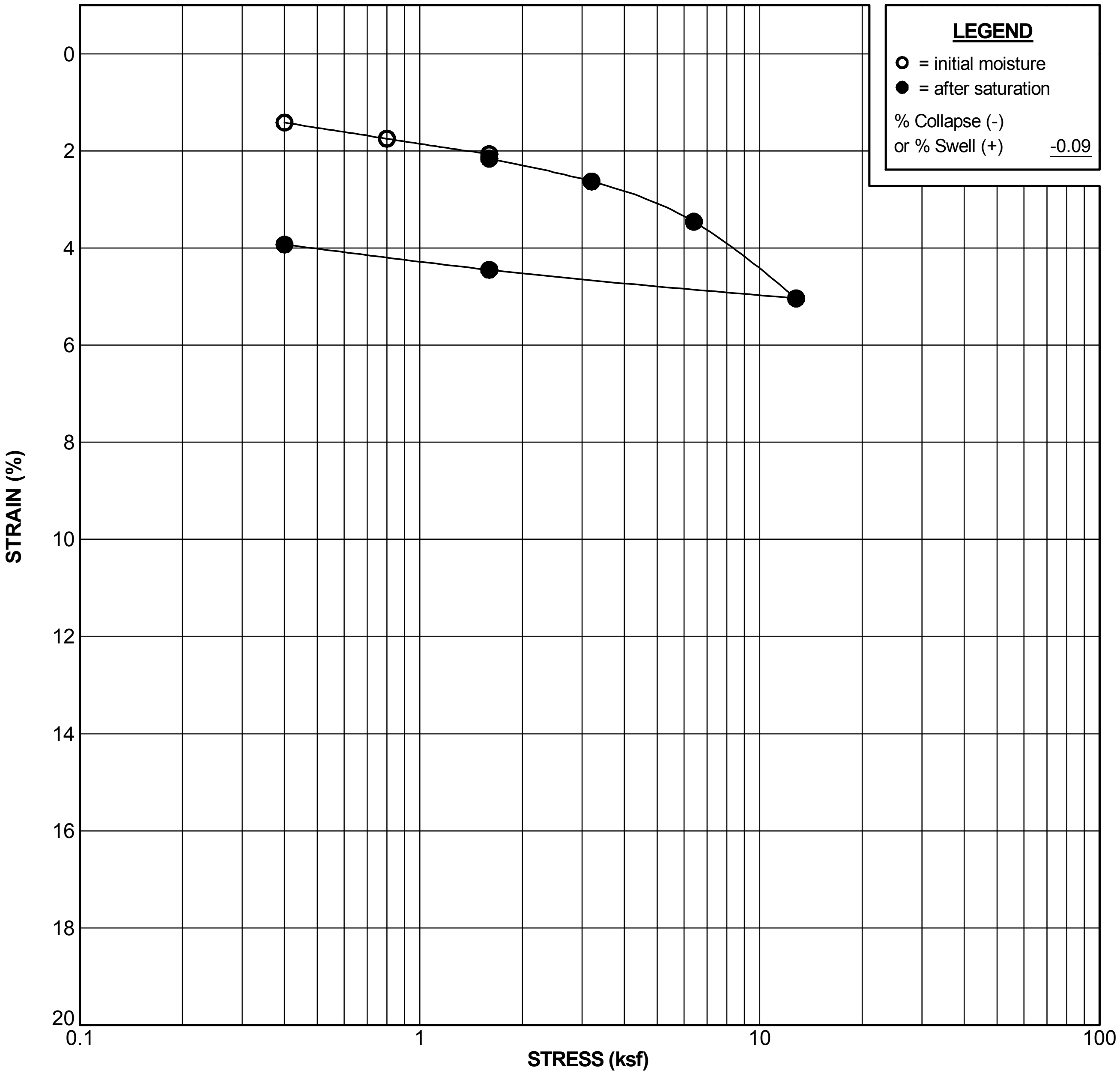

Boring No. B-23	**Sample No. D-4**	**Depth: 20.0 ft**
Sample Description: (Qal) Dark grayish brown silty SAND		**USCS:** SM
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	16.3	115.5	95.9	0.459
Final	14.8	120.0	98.9	0.404

CONSOLIDATION TEST RESULTS

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

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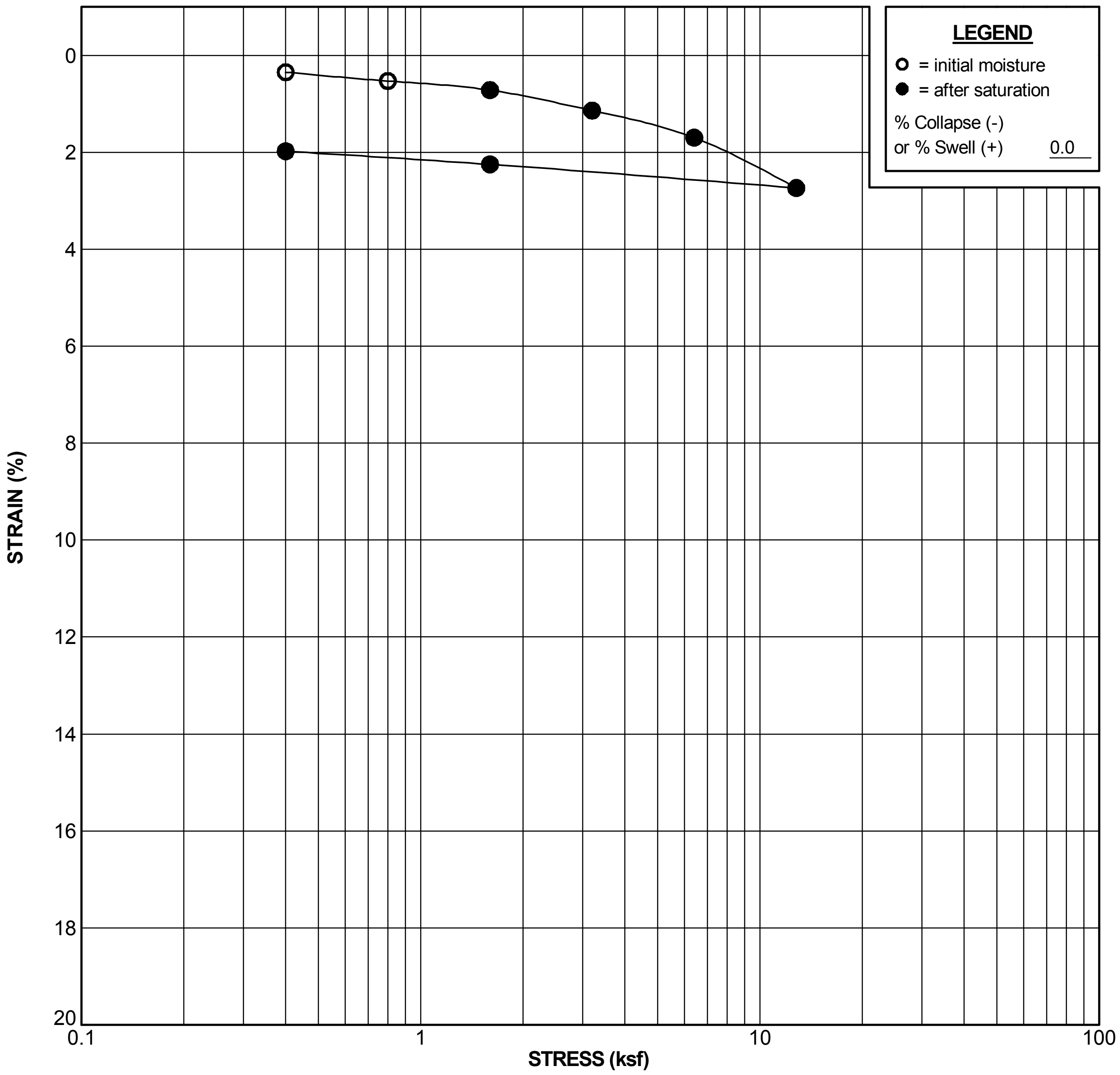

Boring No. B-25	**Sample No. D-4**	**Depth: 10.0 ft**
Sample Description: (Qal) Olive brown silty SAND		**USCS:** SM
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	23.3	97.5	86.4	0.728
Final	23.8	99.4	92.5	0.695

CONSOLIDATION TEST RESULTS

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

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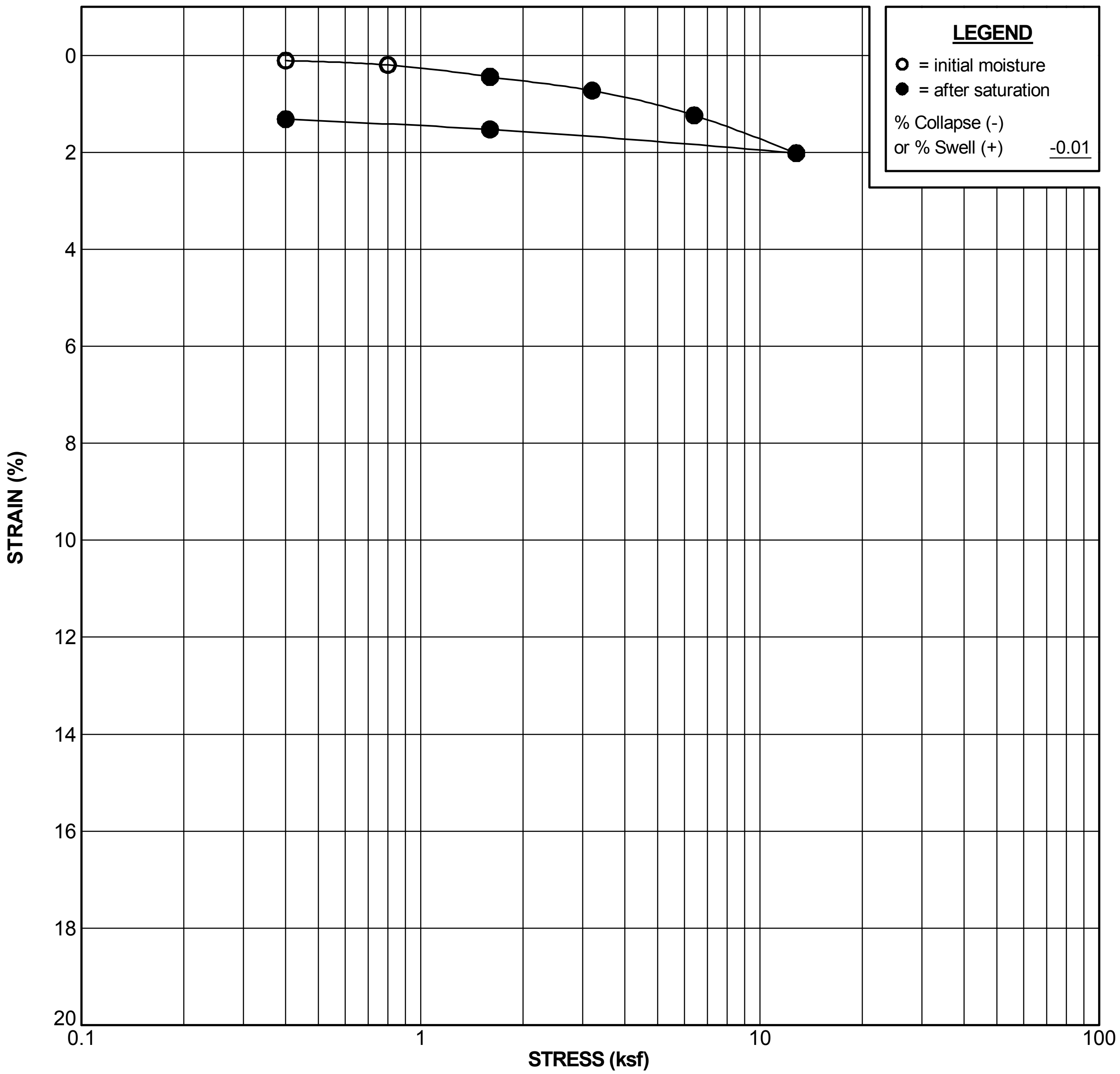

Boring No. B-26	**Sample No. D-4**	**Depth: 10.0 ft**
Sample Description: (Qal) Olive brown silty SAND		**USCS:** SP-SM
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:** 10

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	20.2	102.1	83.9	0.650
Final	21.1	103.4	90.5	0.629

CONSOLIDATION TEST RESULTS

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

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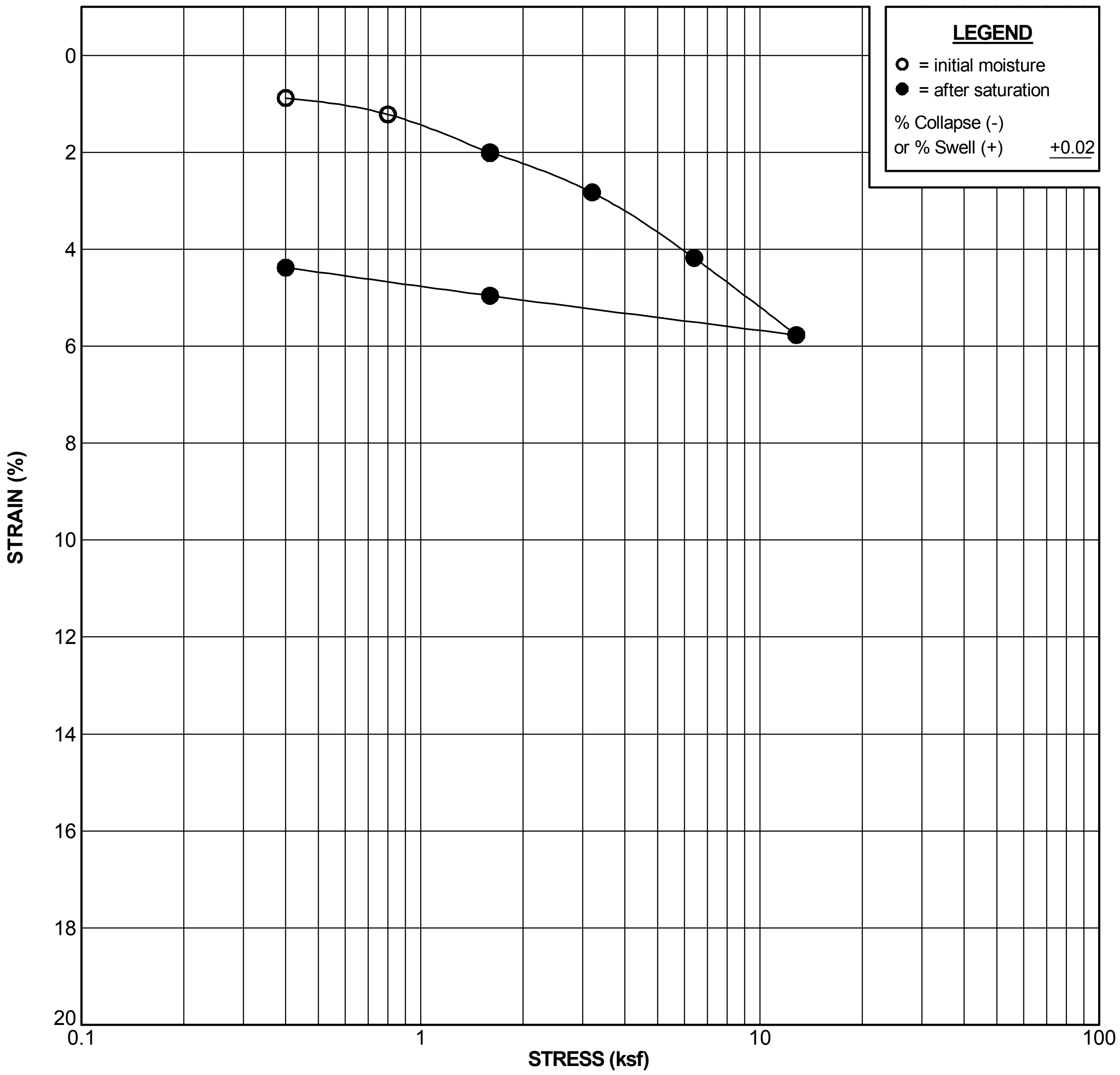

Boring No. B-26	**Sample No. D-9**	**Depth: 35.0 ft**
Sample Description: (Afu) Dark olive gray silty SAND		**USCS:** SM
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:** 36

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	27.4	96.5	99.2	0.746
Final	24.7	100.7	99.1	0.673

CONSOLIDATION TEST RESULTS

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

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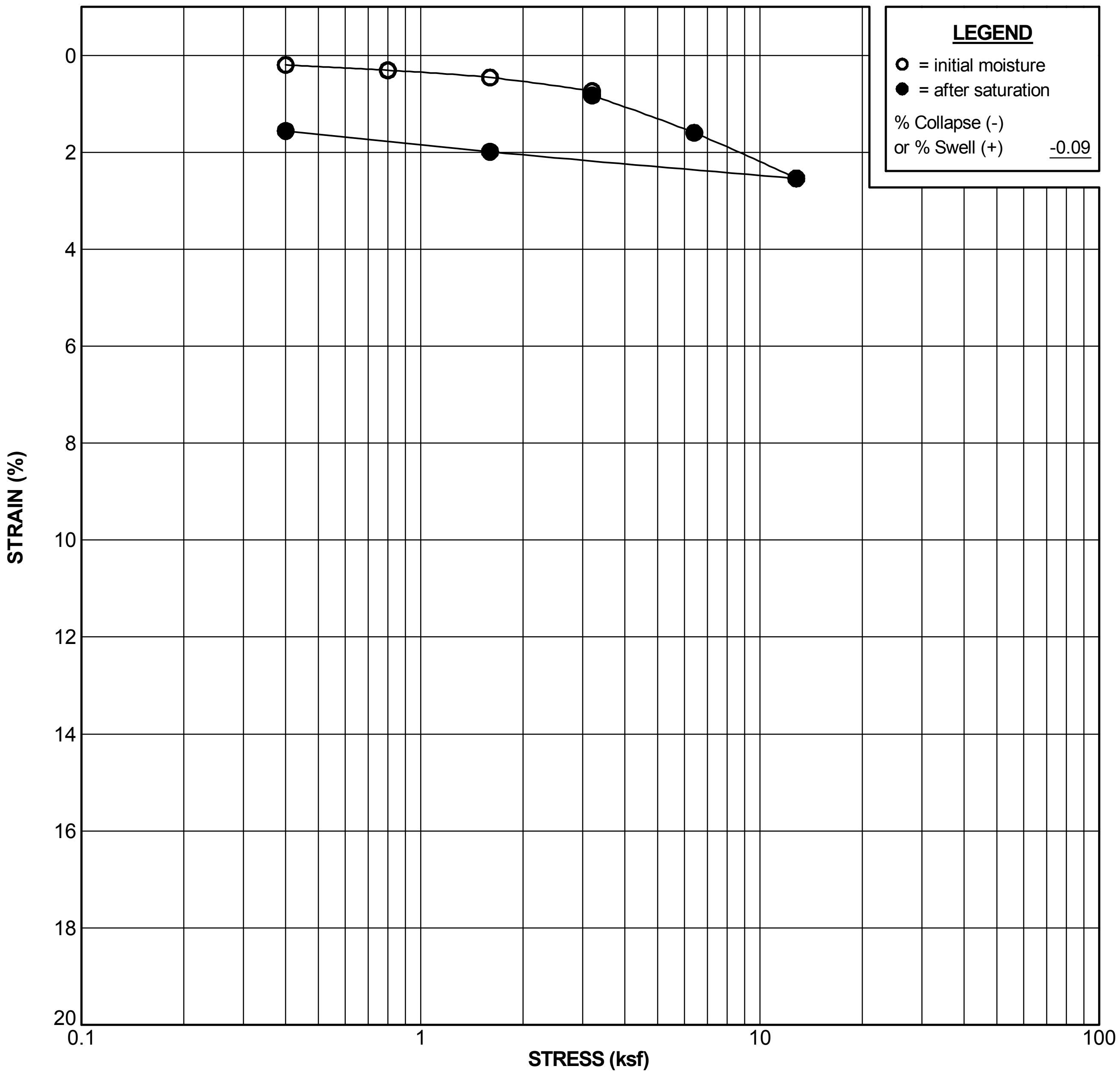

Boring No. B-28	**Sample No. D-2**	**Depth: 10.0 ft**
Sample Description: (Qal) Dark brown silty SAND		**USCS:** SM
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	9.2	106.2	42.4	0.586
Final	18.9	107.9	90.9	0.561

CONSOLIDATION TEST RESULTS

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

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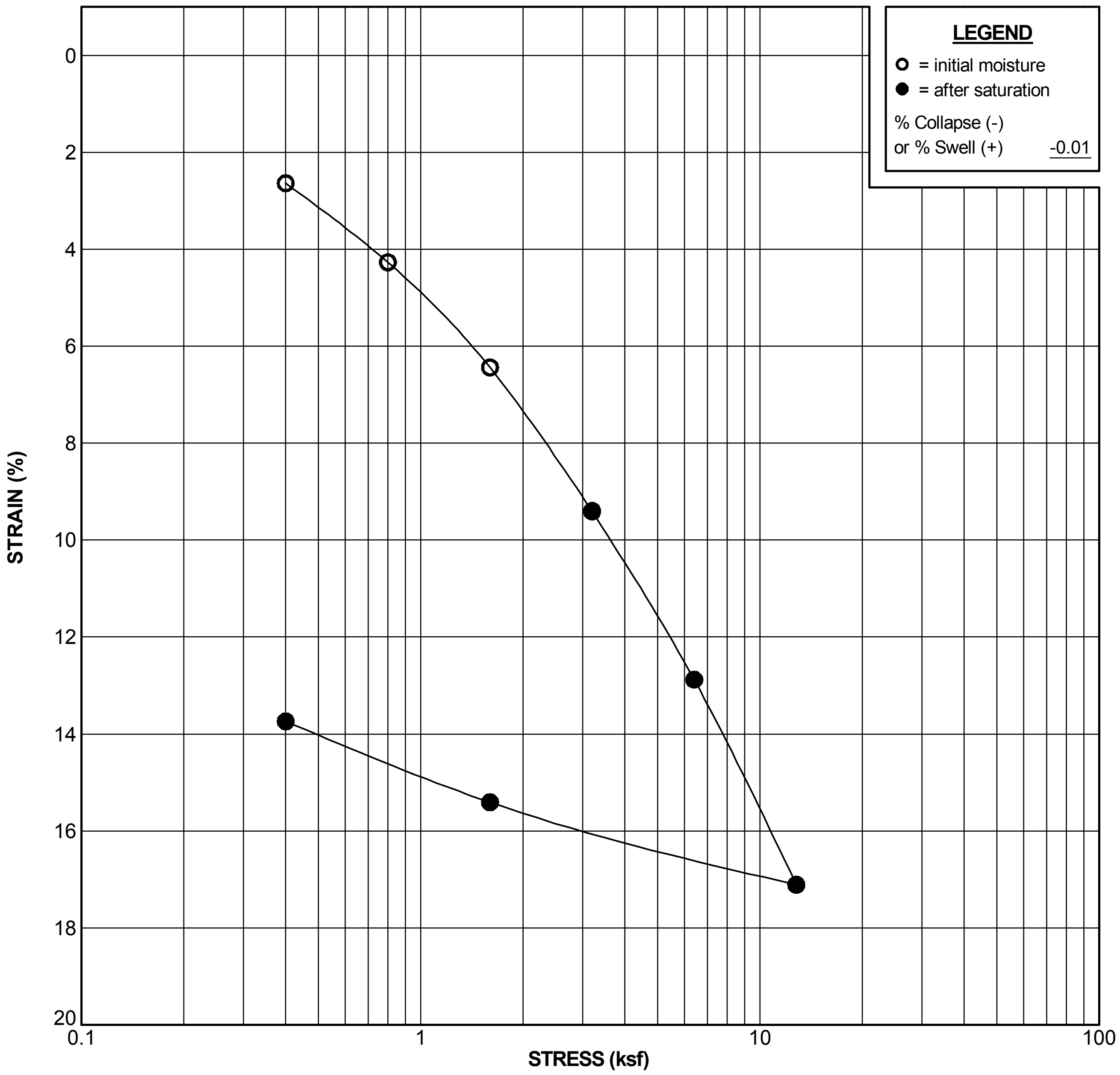

Boring No. B-29	**Sample No. D-1**	**Depth: 5.0 ft**	
Sample Description:	(Qal) Dark grayish brown sandy CLAY	**USCS:**	CL
Liquid Limit: 33	**Plasticity Index:** 14	**Percent Passing No. 200 Sieve:**	63

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	44.4	76.9	100.0	1.207
Final	32.2	87.5	93.2	0.940

CONSOLIDATION TEST RESULTS

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

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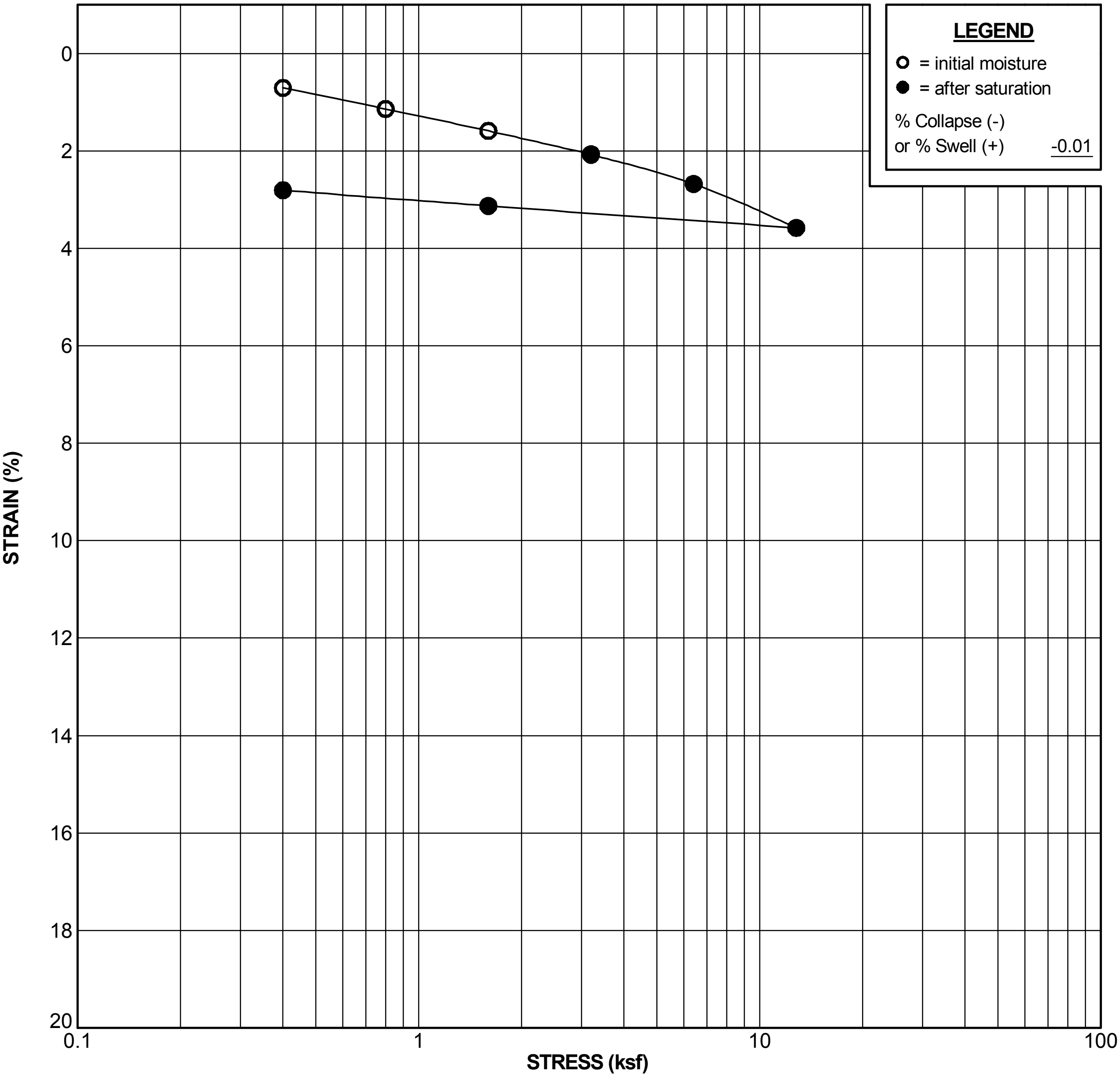

Boring No. B-29	**Sample No. D-3**	**Depth: 15.0 ft**
Sample Description: (Qal) Dark olive brown silty SAND		**USCS:** SM
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	23.6	100.9	90.3	0.732
Final	24.3	103.8	99.6	0.683

CONSOLIDATION TEST RESULTS

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

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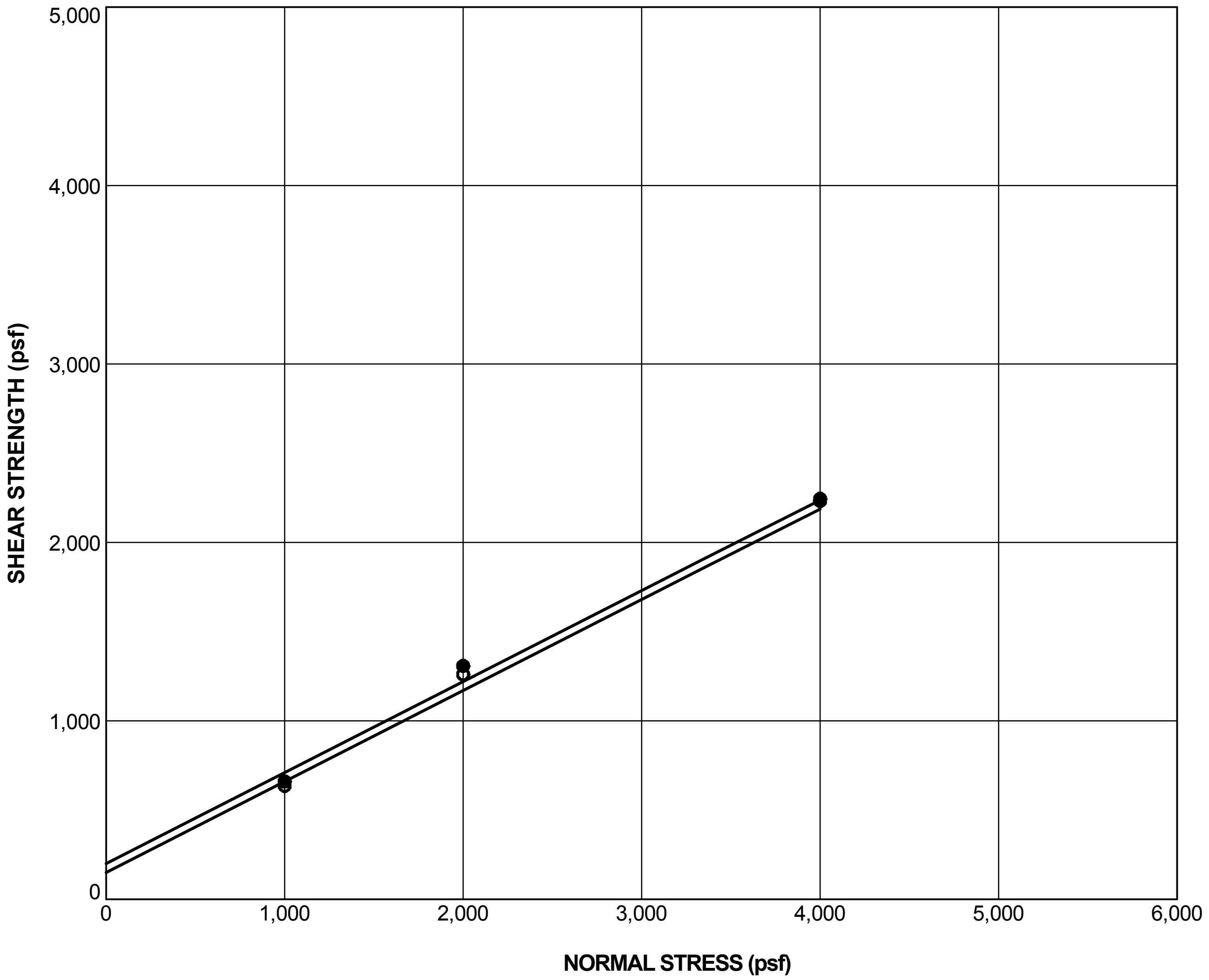


Boring No. B- 1		**Sample No. B-1**		**Depth: 0.0 ft**	
Sample Description:	(Qal) Brown clayey SAND			**USCS:**	SC
Liquid Limit:	40	**Plasticity Index:**	24	**Percent Passing No. 200 Sieve:**	24
Final Moisture Content (%):	19.7	**Final Dry Density (pcf):**	113.0	**Degree of Saturation (%):**	99
Sample Type:	Remolded to 90%	**Rate of Shear (in./min.):**	0.005		

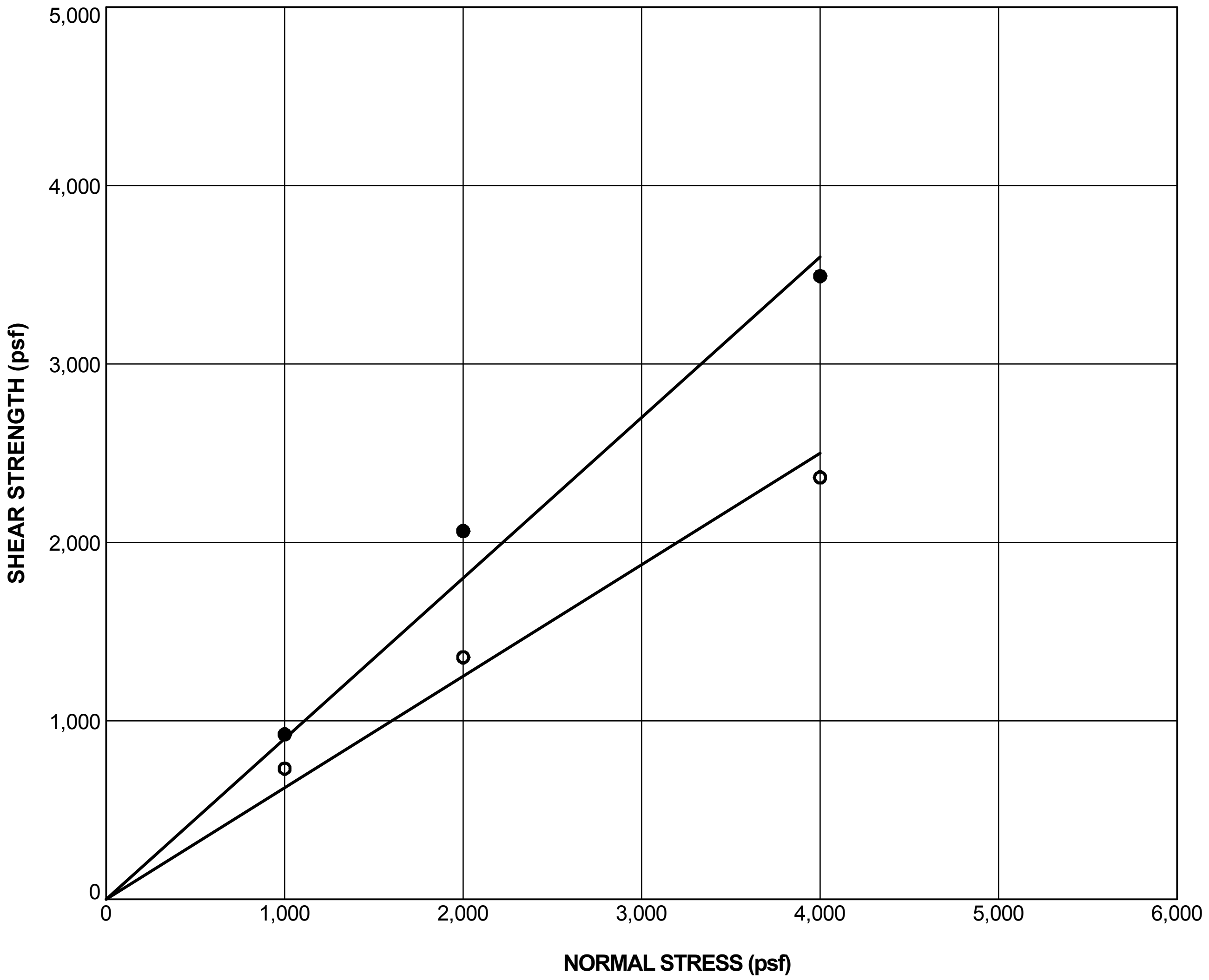
SHEAR STRENGTH PARAMETERS

Parameter	Peak ●	Ultimate ○
Cohesion (psf)	200	150
Friction Angle (degrees)	27.0	27.0

DIRECT SHEAR TEST RESULTS

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.



Boring No. B-15	**Sample No. D-1**	**Depth: 5.0 ft**

Sample Description:	(Qal) Yellowish brown SAND			**USCS:**	SP-SM
Liquid Limit:		**Plasticity Index:**		**Percent Passing No. 200 Sieve:**	7
Final Moisture Content (%):	26.1	**Final Dry Density (pcf):**	98.3	**Degree of Saturation (%):**	99
Sample Type:	Undisturbed	**Rate of Shear (in./min.):**	0.05		

SHEAR STRENGTH PARAMETERS

Parameter	Peak ●	Ultimate ○
Cohesion (psf)	0	0
Friction Angle (degrees)	42.0	32.0

DIRECT SHEAR TEST RESULTS

Riverwalk
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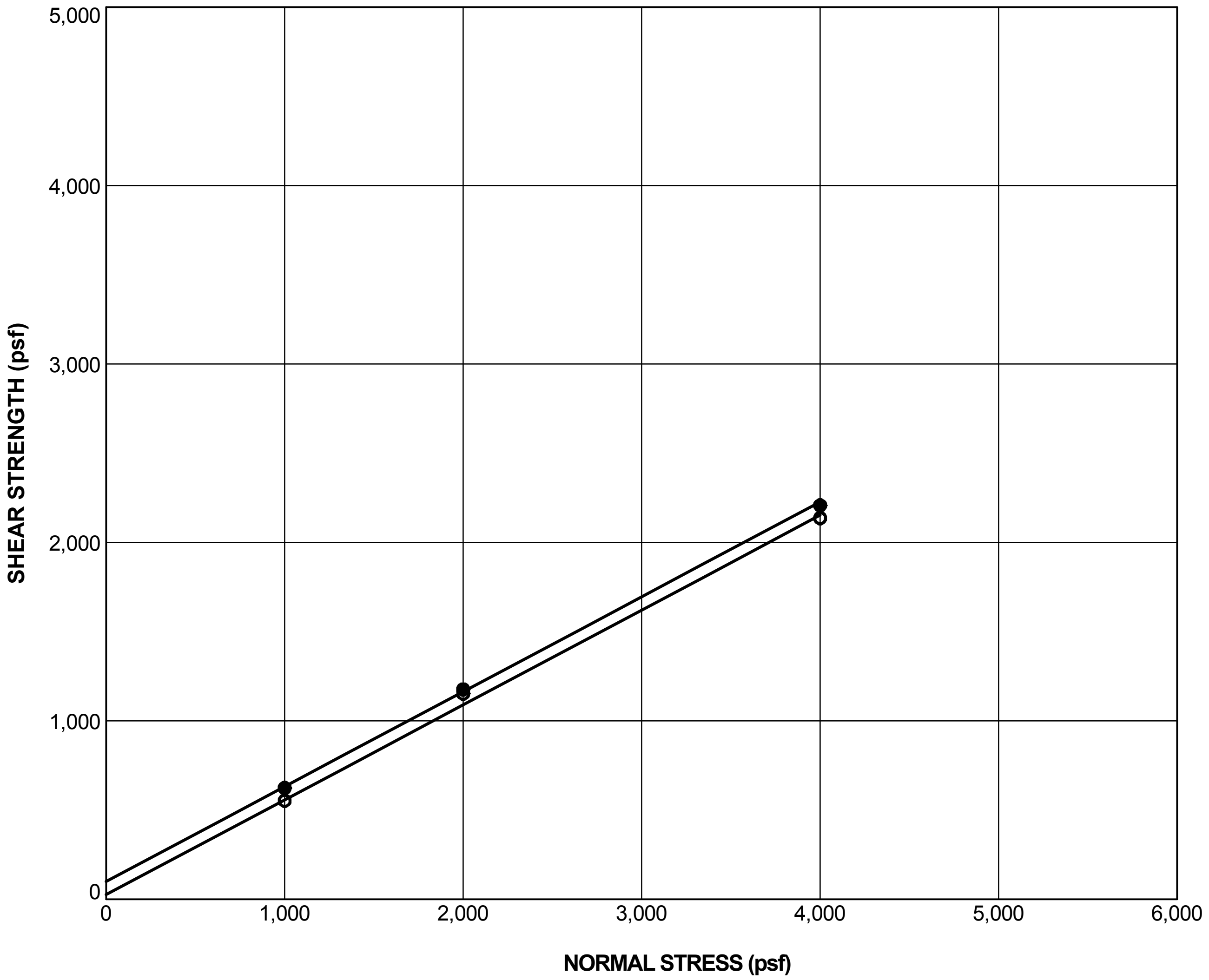
NMG Geotechnical, Inc.



Boring No. P-2	**Sample No. B-1**	**Depth: 0.0 ft**

Sample Description: (Af) Reddish brown clayey SAND		**USCS:** SC
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:** 25
Final Moisture Content (%): 21.3	**Final Dry Density (pcf):** 108.3	**Degree of Saturation (%):** 100
Sample Type: Remolded to 90%	**Rate of Shear (in./min.):** 0.005	

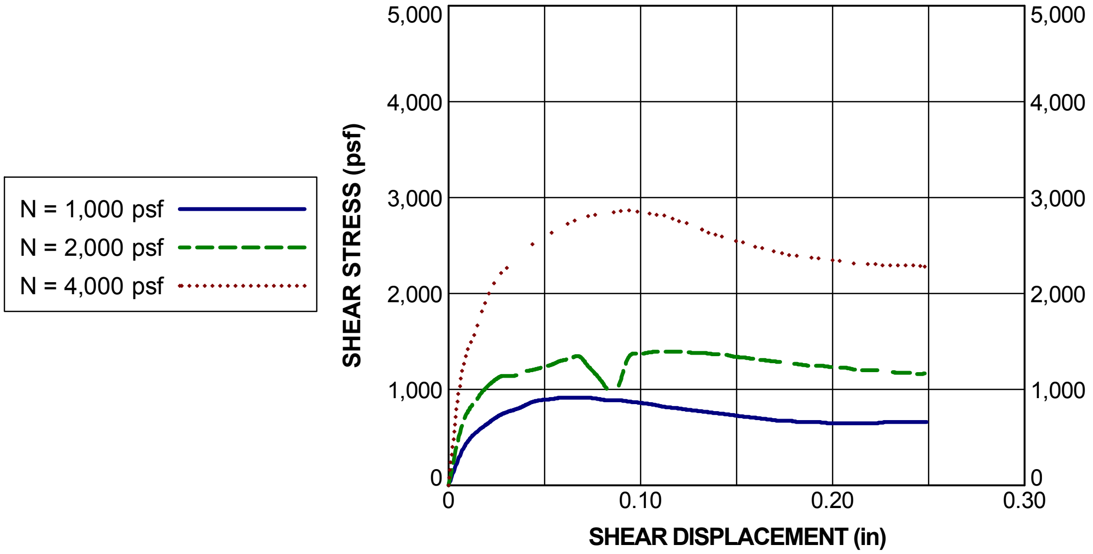
SHEAR STRENGTH PARAMETERS

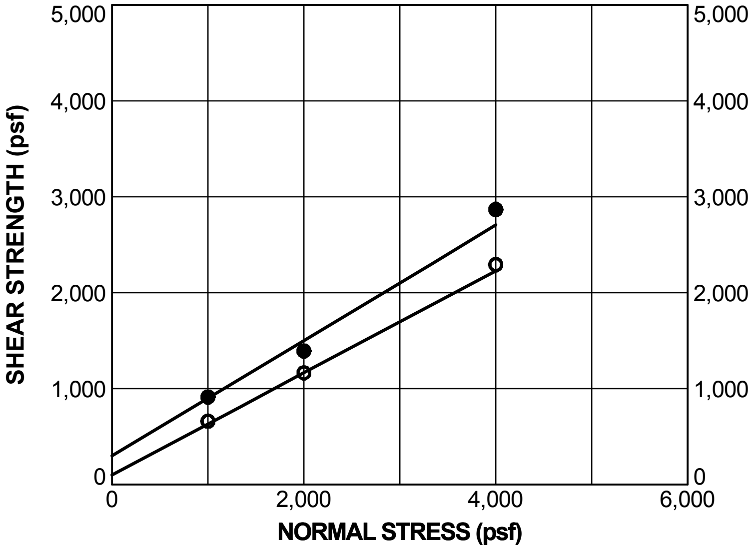
Parameter	Peak ●	Ultimate ○
Cohesion (psf)	100	25
Friction Angle (degrees)	28.0	28.0

DIRECT SHEAR TEST RESULTS

Riverwalk
San Diego, CA
PROJECT NO. 11077-01

NMG Geotechnical, Inc.





Boring No. B-26	**Sample No. D-3**	**Depth: 7.5 ft**	
Sample Description:	(Qal) Olive brown SAND/silty SAND	**USCS:**	SP-SM
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**	9
Final Moisture Content (%): 31.5	**Final Dry Density (pcf):** 97.8	**Degree of Saturation (%):**	100
Sample Type: Undisturbed	**Rate of Shear (in./min.):** 0.05		

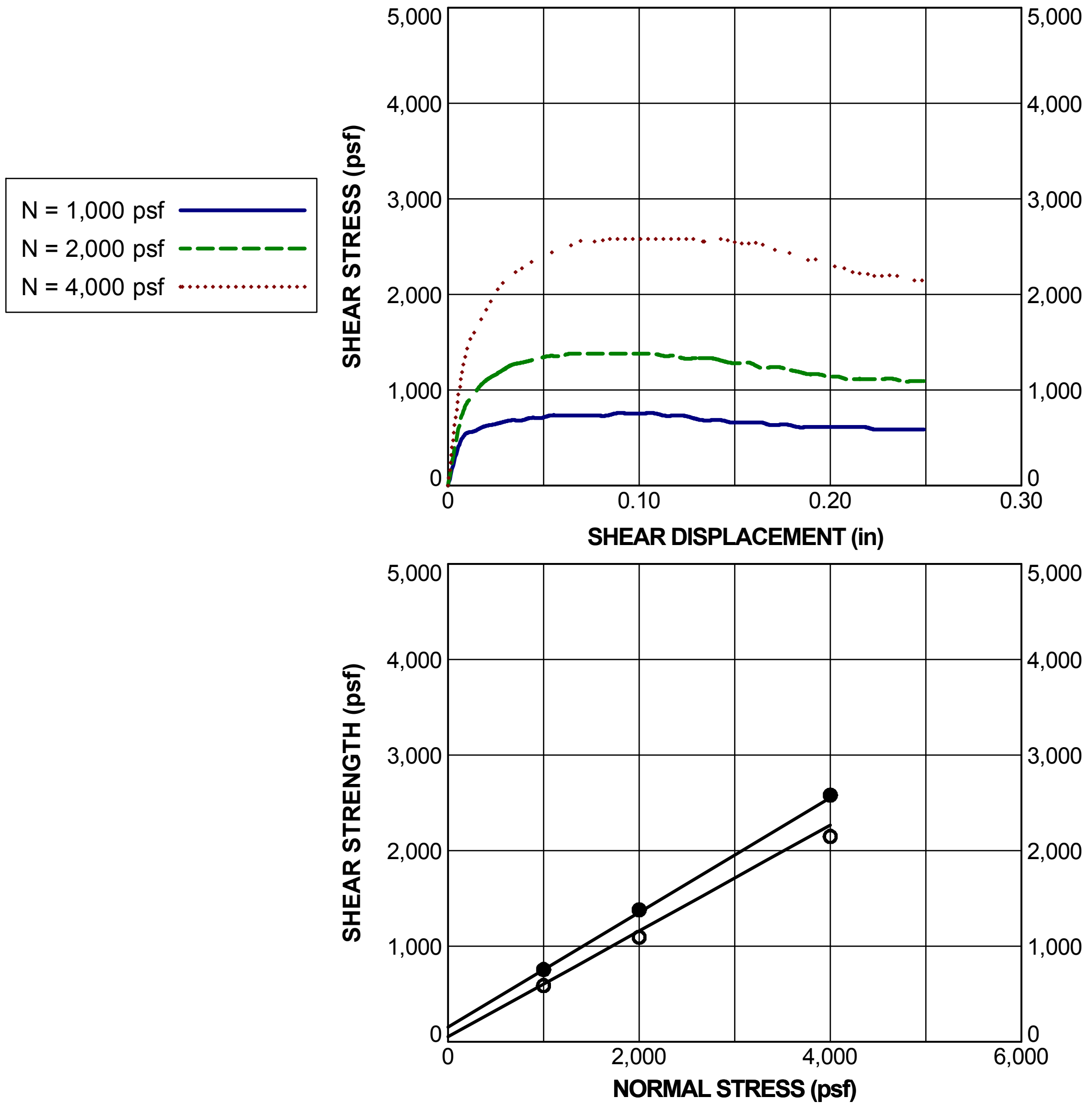
SHEAR STRENGTH PARAMETERS

Parameter	Peak ●	Ultimate ○
Cohesion (psf)	300	100
Friction Angle (degrees)	31.0	28.0

DIRECT SHEAR TEST RESULTS

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

NMG Geotechnical, Inc.



Boring No. B-27	**Sample No. D-2**	**Depth: 5.0 ft**

Sample Description:	(Qal) Light olive gray SAND			**USCS:**	SP
Liquid Limit:		**Plasticity Index:**		**Percent Passing No. 200 Sieve:**	3
Final Moisture Content (%):	33.3	**Final Dry Density (pcf):**	90.2	**Degree of Saturation (%):**	100
Sample Type:	Undisturbed	**Rate of Shear (in./min.):**	0.05		

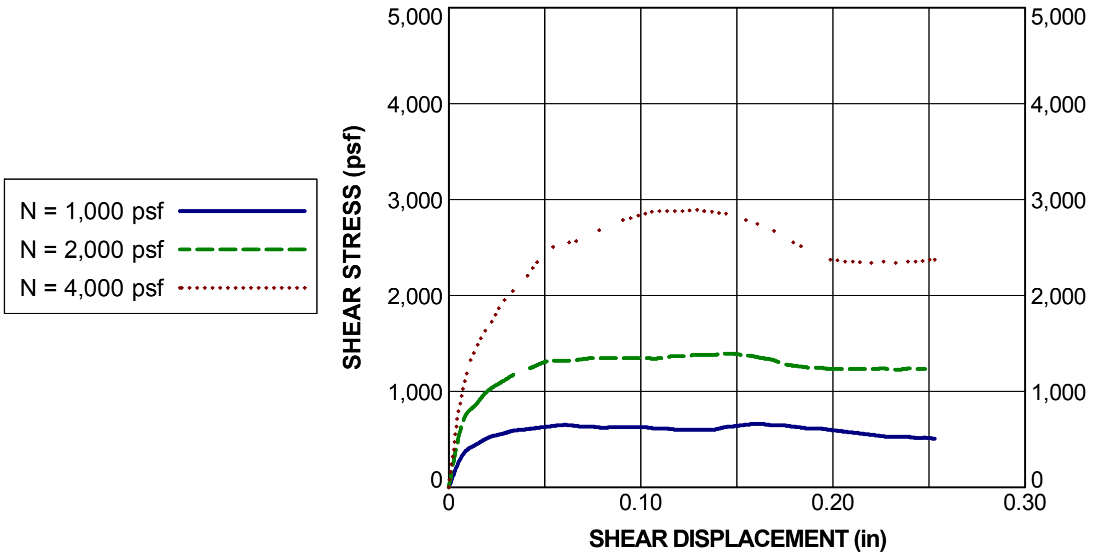
SHEAR STRENGTH PARAMETERS

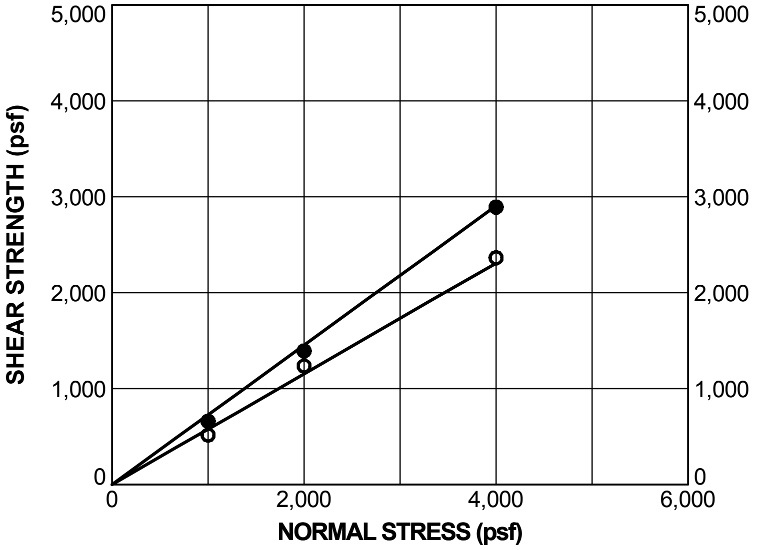
Parameter	Peak ●	Ultimate ○
Cohesion (psf)	150	50
Friction Angle (degrees)	31.0	29.0

DIRECT SHEAR TEST RESULTS

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

NMG Geotechnical, Inc.





Boring No. B-27	**Sample No. D-6**	**Depth: 20.0 ft**
Sample Description: (Qal) Olive gray silty SAND w/ mica		**USCS:** SM
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**
Final Moisture Content (%): 33.4	**Final Dry Density (pcf):** 92.7	**Degree of Saturation (%):** 100
Sample Type: Undistrubed	**Rate of Shear (in./min.):** 0.05	

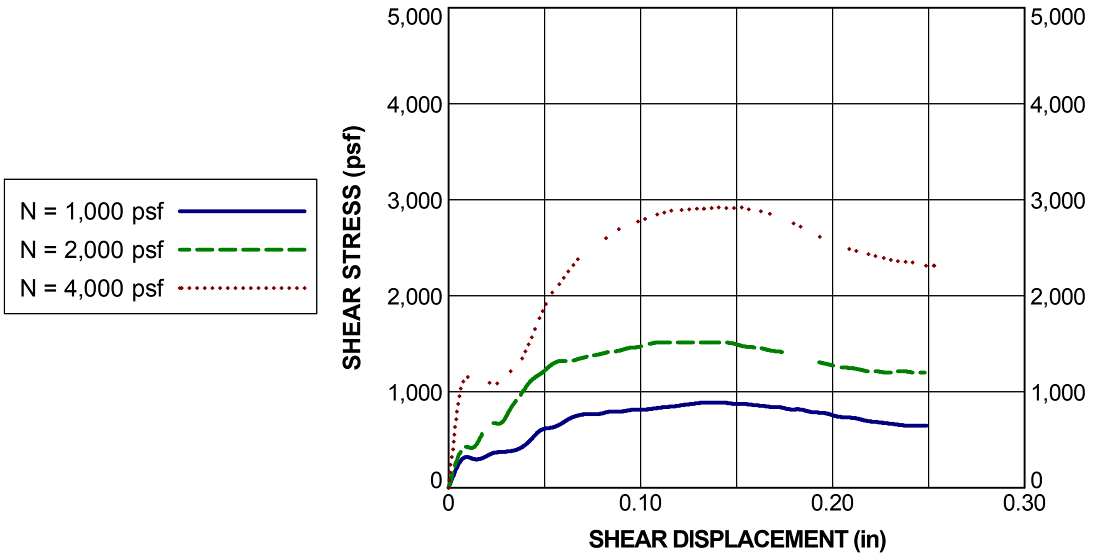
SHEAR STRENGTH PARAMETERS

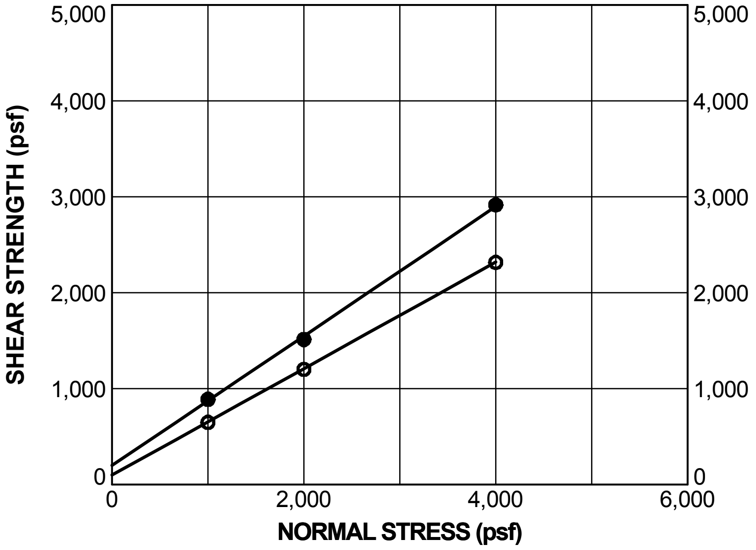
Parameter	Peak ●	Ultimate ○
Cohesion (psf)	0	0
Friction Angle (degrees)	36.0	30.0

DIRECT SHEAR TEST RESULTS

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

NMG Geotechnical, Inc.





Boring No. B-29		**Sample No. D-2**		**Depth: 10.0 ft**	
Sample Description:	(Qal) Olive brown silty SAND			**USCS:**	SM
Liquid Limit:		**Plasticity Index:**		**Percent Passing No. 200 Sieve:**	
Final Moisture Content (%):	39.0	**Final Dry Density (pcf):**	89.2	**Degree of Saturation (%):**	100
Sample Type:	Undisturbed	**Rate of Shear (in./min.):**	0.05		

SHEAR STRENGTH PARAMETERS

Parameter	Peak ●	Ultimate ○
Cohesion (psf)	200	100
Friction Angle (degrees)	34.0	29.0

DIRECT SHEAR TEST RESULTS

Hines/Riverwalk
San Diego, California
PROJECT NO. 11077-02

NMG Geotechnical, Inc.

Sample	*Compacted Moisture (%)*	*Compacted Dry Density (pcf)*	*Final Moisture (%)*	*Volumetric Swell (%)*	*Expansion Index[1] Value/Method*		*Expansive Classification[2]*	*Soluble Sulfate (%)*	*Sulfate Exposure[3]*
B-1 B-1 0-5'	10.5	107.6	21.9	5.4	54	A	Medium	0.18	Moderate
B-2 B-1 0-5'	7.5	112.5	17.2	1.7	13	B	Very Low	0.10	Moderate
B-8 B-1 0-5'	9.0	117.4	14.7	1.3	16	B	Very Low	0.06	Negligible
B-12 B-1 0-5'	8.5	107.5	18.2	0.0	0	B	Very Low	0.08	Negligible
B-17 B-1 0-5'	8.5	108.8	16.7	-0.1	0	B	Very Low	0.05	Negligible

Test Method:

ASTM D4829

HACH SF-1 (Turbidimetric)

Notes:

1. Expansion Index (EI) method of determination*:*
   - **[A]** E.I. determined by adjusting water content to achieve a 50 ±1% degree of saturation
   - **[B]** E.I. calculated based on measured saturation within the range of 40% and 60%
2. ASTM D4829 *(Classification of Expansive Soil)*
3. ACI-318 Table 4.2.1 *(Requirement for Concrete Exposed to Sulfate-Containing Solutions)*

Expansion Index and Soluble Sulfate Test Results

(FRM001 Rev.5)

Project No. 11077-01

Project Name: Riverwalk

NMG

R-VALUE TEST DATA CTM 301 / ASTM D2844

Project: IAC / Riverwalk	Project No: 11077-01	Date: 11/4/2015
Boring Trench No: B-1	Sample No: B-1	Sample Depth: 0-5'

Field Description:

Lab Description: Brown Sand w/ some clay

Specimen Number	1	2	3	4
Mold Number	1	2	3	
Water Adjustment (g)	+50	+70	+90	
Compactor Pressure (psi)	200	110	65	
Exudation Pressure (psi)	580	325	220	
Gross Weight (g)	3175.9	3205.1	3214.6	
Mold Tare (g)	2095.9	2114.7	2099.4	
Wet Weight (g)	1080.0	1090.4	1115.2	
Sample Height (in)	2.40	2.50	2.60	
Initial Dial Reading	0.0607	0.0507	0.0512	
Final Dial Reading	0.0630	0.0515	0.0516	
Expansion (in $x10^{-4}$)	23	8	4	
Stability(psi) at 2,000 lbs (160 psi)	58 126	68 146	74 154	
Turns Displacement	2.91	3.03	3.76	
R-Value Uncorrected	19	7	3	
R-Value Corrected	18	7	4	
Moisture Content (%)	11.6	14.5	16.9	
Dry Density (pcf)	122.2	115.4	111.2	
Assumed Traffic Index	4.0	4.0	4.0	
G.E. by Stability	0.84	0.95	0.98	
G.E. by Expansion	0.77	0.27	0.13	
G_f	1.25			

Moisture Content				
Dish No.	TT	EEE	DD	
Weight of Moist Soil and Dish (g)	258.0	281.7	226.3	
Weight of Dry Soil and Dish (g)	236.4	252.4	200.8	
Water Loss (g)	21.6	29.3	25.5	
Weight of Dish (g)	50.5	50.1	49.8	
Dry Soil (g)	185.9	202.3	151	
Moisture Content (%)	11.6	14.5	16.9	

R-Value by Exudation = 6

R-Value by Expansion = 22

R-Value at Equilibrium = 6 by Exudation

The data above is based upon processing and testing samples as received from the field. Test procedures in accordance with latest revisions to Department of Transportation, State of California, Materials & Research Test Method No. 301 and/or ASTM Standard D2844

Remarks: A traffic index of 4.0 was used for calculation purposes.

Set up by: TG Run by: TG

Calculated by: TG Checked by: BAJ Date Completed: 11/5/2015

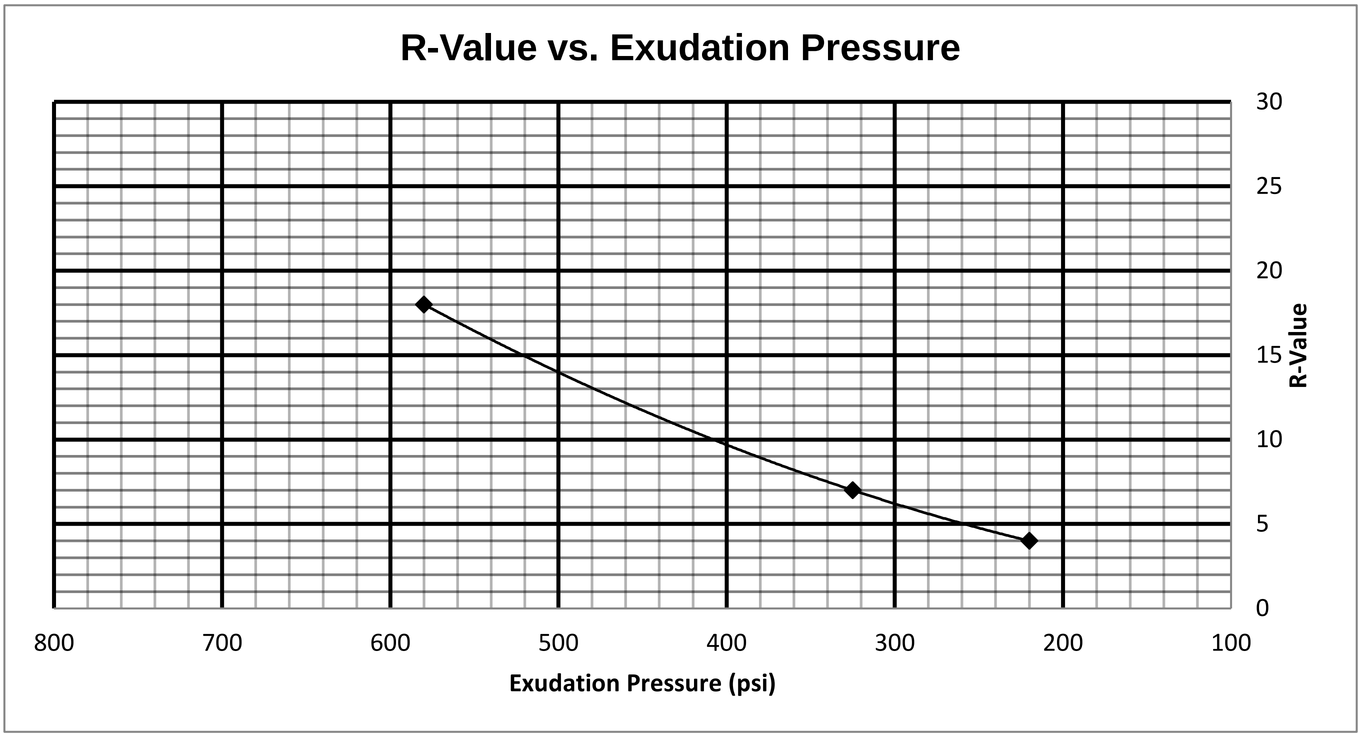
NMG Geotechnical, Inc.

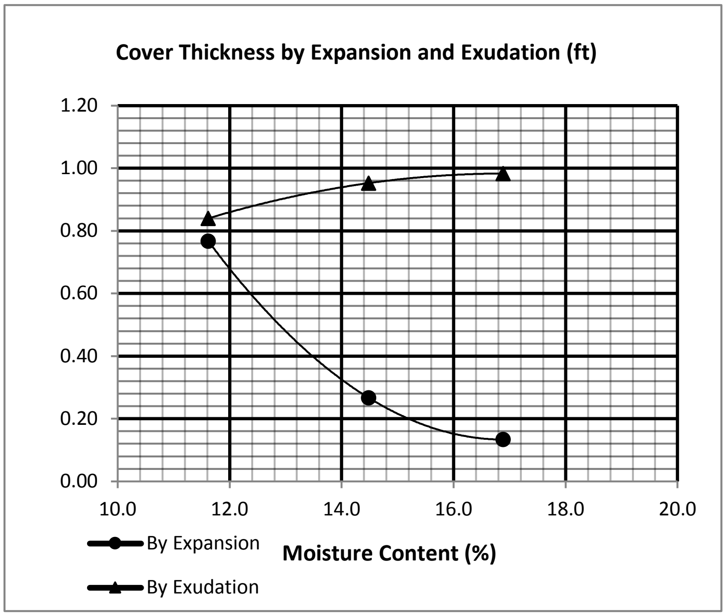
R-VALUE GRAPHICAL PRESENTATION

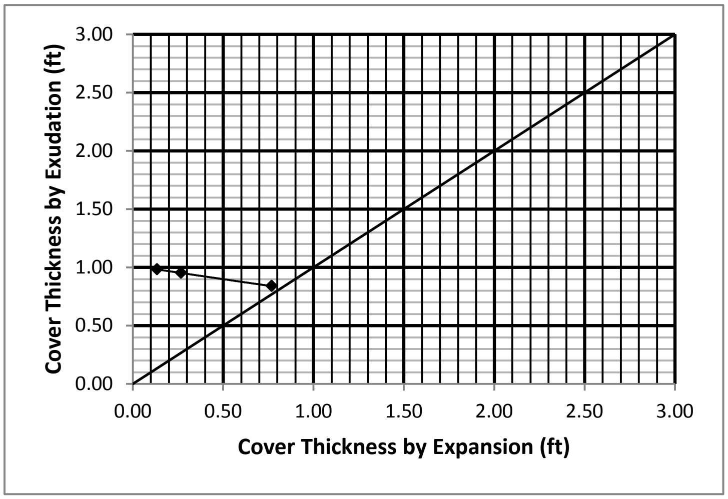
Project: IAC / Riverwalk	Project No: 11077-01	Date: 11/4/2015
Boring Trench No: B-1	Sample No: B-1	Sample Depth: 0-5'

Field Description:

Lab Description: Brown Sand w/ some clay







Cover Thickness (ft) = 0.80

The data above is based upon processing and testing samples as received from the field. Test procedures in accordance with latest revisions to Department of Transportation, State of California, Materials & Research Test Method No. 301 and/or ASTM Standard D2844

Remarks: A traffic index of 4.0 was used for calculation purposes.

Set up by: TG Run by: TG

Calculated by: TG Checked by: BAJ Date Completed: 11/5/2015

NMG Geotechnical, Inc.

From NMG
Report dated 2/20/18

Boring No.	B-19	B-26	B-27					
Sample No.	B-1	B-1	B-1					
Depth (ft.)	N/A	N/A	N/A					
Sample Type	Bulk	Bulk	Bulk					
Soil Identification	Not noted	Not noted	Not noted					
Moisture Correction								
Wet Weight of Soil + Container (g)	0.0	0.0	0.0					
Dry Weight of Soil + Container (g)	0.0	0.0	0.0					
Weight of Container (g)	1.0	1.0	1.0					
Moisture Content (%)	0.0	0.0	0.0					
Sample Dry Weight Determination								
Weight of Sample + Container (g)	324.0	353.3	290.1					
Weight of Container (g)	39.1	39.3	37.7					
Weight of Dry Sample (g)	284.9	314.0	252.4					
Container No.:								
After Wash								
Method (A or B)	B	B	B					
Dry Weight of Sample + Cont. (g)	254.0	289.6	273.8					
Weight of Container (g)	39.1	39.3	37.7					
Dry Weight of Sample (g)	214.9	250.3	236.1					
% Passing No. 200 Sieve	**24.6**	**20.3**	**6.5**					
% Retained No. 200 Sieve	75.4	79.7	93.5					

Leighton

PERCENT PASSING
No. 200 SIEVE
ASTM D 1140

Project Name: Hines/Riverwalk
Project No.: 11077-02
Client Name: NMG Geotechnical, Inc.
Tested By: A. Santos Date: 01/08/18

Leighton

SATURATED HYDRAULIC CONDUCTIVITY

FALLING HEAD METHOD

ASTM D 5084

Project Name: Hines/Riverwalk
Tested by: A. Santos
Date: 01/09/18
Project No.: 11077-02
Input By: J. Ward
Date: 01/15/18
Boring No.: B-19
Sample Type: Remold
Sample No.: B-1
Depth (ft.) N/A
Soil Identification: Olive silty sand (SM)

		INITIAL CONDITION	FINAL CONDITION
Diameter (in)	1	2.524	2.533
	2	2.524	2.533
	3	2.524	2.533
	Average	2.524	2.533
Height (in)	1	3.041	3.055
	2	3.040	3.057
	3	3.040	3.056
	Average	3.040	3.056
Moisture Content (%)		10.29	16.73
Wt. Wet Sample + Container (g)		217.20	612.10
Wt. Dry Sample + Container (g)		202.56	535.30
Wt. Container (g)		60.30	76.20
Density and Saturation			
Wt. Wet Sample + Container (g)		510.90	Calculated from initial dry weight and final moisture
Wt. Container (g)		0.00	
Wet Density (pcf)		127.9	133.8
Dry Density (pcf)		116.0	114.6
Void Ratio		0.453	0.471
Total Porosity		0.312	0.320
Pore Volume (cc)		77.7	80.8
% Saturation		61.3	95.9

Specific Gravity, Gs (assumed) = 2.70

Back Pressure Saturation

B Value (%) = 95

Consolidation

Cell Pressure (psi) = 96.32
Back Pressure(psi) = 91.38
Effective Pressure (psi) = 4.94
Burette Area (sq. in.)= 0.408
Initial Burette Ht.(cm)= 15.5
Final Burette Ht.(cm)= 16.1

Leighton

SATURATED HYDRAULIC CONDUCTIVITY

FALLING HEAD METHOD (ASTM D 5084)

Project Name:	Hines/Riverwalk	Cell Pressure:	96.32 psi	Initial Sample Height:	3.0403 in
Project No:	11077-02	Bottom Pressure (Pb):	94.21 psi	Initial Area of Sample:	5.0034 in.^{2}
Boring No.:	B-19	Top Pressure (Pt):	91.38 psi	Final Sample Ht.* (L):	3.0339 in
Sample No. :	B-1	Consolidation Pressure:	4.94 psi	Final Sample Area* (A):	4.9823 in.^{2}
Depth(ft):	N/A	Burette Area (influent) (Ai):	0.408 in.^{2}		
Sample Type:	Remold	Burette Area (effluent) (Ao):	0.358 in.^{2}		
Soil Identification:	Olive silty sand (SM)	Vol. Change During Consol.:	0.096 in.^{3}		

* After Consolidation

Date	Time (min.)	Incremental Elapsed Time (t) (min)	Temperature (°C)	Water Height Influent Burette (hi) (cm)	Water Height Effluent Burette (ho) (cm)	Uncorrected Hydraulic Conductivity (cm/sec)	Corrected Conductivity at 20 °C (cm/sec)	Inflow Rate / Outflow Rate
12-Jan-18	10:28:00	0		24.7	4.4	Initial Reading		
12-Jan-18	10:30:00	2	21.8	23.9	5.5	2.1E-05	2.1E-05	0.83
12-Jan-18	10:34:00	4	21.8	22.1	7.3	2.1E-05	2.0E-05	1.14
12-Jan-18	10:40:00	6	21.8	19.7	9.9	1.9E-05	1.9E-05	1.05
12-Jan-18	10:49:00	9	21.8	16.1	13.7	2.0E-05	1.9E-05	1.08
12-Jan-18	10:58:00	9	21.8	12.7	17.3	1.9E-05	1.9E-05	1.08
12-Jan-18	11:08:00	10	21.8	9.0	21.1	1.9E-05	1.9E-05	1.11

RESULTS	
Hydraulic Conductivity (cm/sec)	
Average of Last 4 Readings	**1.9E-05**
Upper Limit	2.3E-05
Lower Limit	1.4E-05
Remarks	

k=Ai.Ao.L.ln(h1/h2)/(A.t.(Ai+Ao)) where h1, h2= ((Pb-Pt)/Y+(hi-ho) at t0-(change in hi + change in ho) at t1 and t2

Leighton

SATURATED HYDRAULIC CONDUCTIVITY

FALLING HEAD METHOD

ASTM D 5084

Project Name: Hines/Riverwalk
Tested by: A. Santos
Date: 01/09/18
Project No.: 11077-02
Input By: J. Ward
Date: 01/15/18
Boring No.: B-26
Sample Type: Remold
Sample No.: B-1
Depth (ft.) N/A
Soil Identification: Olive silty sand (SM)

		INITIAL CONDITION	FINAL CONDITION
Diameter (in)	1	2.523	2.530
	2	2.523	2.531
	3	2.523	2.530
	Average	2.523	2.530
Height (in)	1	3.071	3.134
	2	3.070	3.138
	3	3.070	3.135
	Average	3.070	3.136
Moisture Content (%)		9.68	25.01
Wt. Wet Sample + Container (g)		186.20	589.30
Wt. Dry Sample + Container (g)		174.80	486.70
Wt. Container (g)		57.00	76.50
Density and Saturation			
Wt. Wet Sample + Container (g)		453.00	Calculated from initial dry weight and final moisture
Wt. Container (g)		0.00	
Wet Density (pcf)		112.4	124.7
Dry Density (pcf)		102.5	99.8
Void Ratio		0.644	0.689
Total Porosity		0.392	0.408
Pore Volume (cc)		98.6	105.4
% Saturation		40.5	98.0

Specific Gravity, Gs (assumed) = 2.70

Back Pressure Saturation

B Value (%) = 96

Consolidation

Cell Pressure (psi) = 106.61
Back Pressure(psi) = 101.65
Effective Pressure (psi) = 4.96
Burette Area (sq. in.)= 0.397
Initial Burette Ht.(cm)= 8.1
Final Burette Ht.(cm)= 8.9

Leighton

SATURATED HYDRAULIC CONDUCTIVITY

FALLING HEAD METHOD (ASTM D 5084)

Project Name: Hines/Riverwalk
Project No: 11077-02
Boring No.: B-26
Sample No. : B-1
Depth(ft): N/A
Sample Type: Remold
Soil Identification: Olive silty sand (SM)

Cell Pressure: 106.61 psi
Bottom Pressure (Pb): 103.38 psi
Top Pressure (Pt): 101.65 psi
Consolidation Pressure: 4.96 psi
Burette Area (influent) (Ai): 0.397 in.^{2}
Burette Area (effluent) (Ao): 0.386 in.^{2}
Vol. Change During Consol.: 0.125 in.^{3}

Initial Sample Height: 3.0703 in
Initial Area of Sample: 4.9995 in.^{2}
Final Sample Ht.* (L): 3.0620 in
Final Sample Area* (A): 4.9723 in.^{2}

* After Consolidation

Date	Time (min.)	Incremental Elapsed Time (t) (min)	Temperature (°C)	Water Height Influent Burette (hi) (cm)	Water Height Effluent Burette (ho) (cm)	Uncorrected Hydraulic Conductivity (cm/sec)	Corrected Conductivity at 20 °C (cm/sec)	Inflow Rate / Outflow Rate
12-Jan-18	10:30:00	0		25.3	4.3	Initial Reading		
12-Jan-18	10:30:30	0.5	21.8	22.0	7.8	5.0E-04	4.8E-04	0.97
12-Jan-18	10:31:00	0.5	21.8	19.2	10.6	4.3E-04	4.1E-04	1.03
12-Jan-18	10:31:30	0.5	21.8	16.3	13.6	4.7E-04	4.5E-04	0.99
12-Jan-18	10:32:00	0.5	21.8	13.6	16.3	4.5E-04	4.3E-04	1.03
12-Jan-18	10:32:30	0.5	21.8	11.0	19.1	4.7E-04	4.5E-04	0.96
12-Jan-18	10:33:00	0.5	21.8	8.6	21.5	4.4E-04	4.2E-04	1.03
12-Jan-18	10:33:30	0.5	21.8	6.2	23.9	4.6E-04	4.4E-04	1.03

RESULTS	
Hydraulic Conductivity (cm/sec)	
Average of Last 4 Readings	**4.4E-04**
Upper Limit	5.5E-04
Lower Limit	3.3E-04
Remarks	

k=Ai.Ao.L.ln(h1/h2)/(A.t.(Ai+Ao)) where h1, h2= ((Pb-Pt)/Y+(hi-ho) at t0-(change in hi + change in ho) at t1 and t2

Leighton

PERMEABILITY OF GRANULAR SOILS (CONSTANT HEAD)

ASTM D 2434

Project Name: Hines/Riverwalk
Project No: 11077-02
Boring No. : B-27
Sample No. : B-1
Depth(ft): N/A
Sample Type: Remold
Soil Description: Olive poorly-graded sand with silt (SP-SM)

Tested by: A. Santos
Date Tested: 01/10/18
Date Sampled: N/A
Checked by: J. Ward
Date Checked: 01/15/18
Max Density Values: 96.0 @ 12.0

CONDITION OF SPECIMEN

Diameter: 11.38 cm
Sample Area, A: 101.71 cm^2
Length, L: 11.30 cm
Weight: 2722 g
Wet Density: 105.8 pcf
Dry Density: 94.7 pcf
Relative Density, %: 98.6 of MDD
Max particle size: N/A in
% Oversized not used: N/A %
Specific Gravity (assumed): 2.70
Void Ratio, e: 0.779
Height Before (H_1): 8.06 in
Height After (H_2): 1.841 in
Sample Height: 6.219 in

Moisture Content:

	Before		After	
Wet weight of soil + tare:	1050.0	g	657.1	g
Dry weight of soil + tare:	948.0	g	540.2	g
Weight of tare:	77.6	g	76.5	g
Tare designation:	750		737	
Moisture Content:	11.7	%	25.2	%

Notes:

Compaction Method Used: Tamping rod

PERMEABILITY TEST DATA

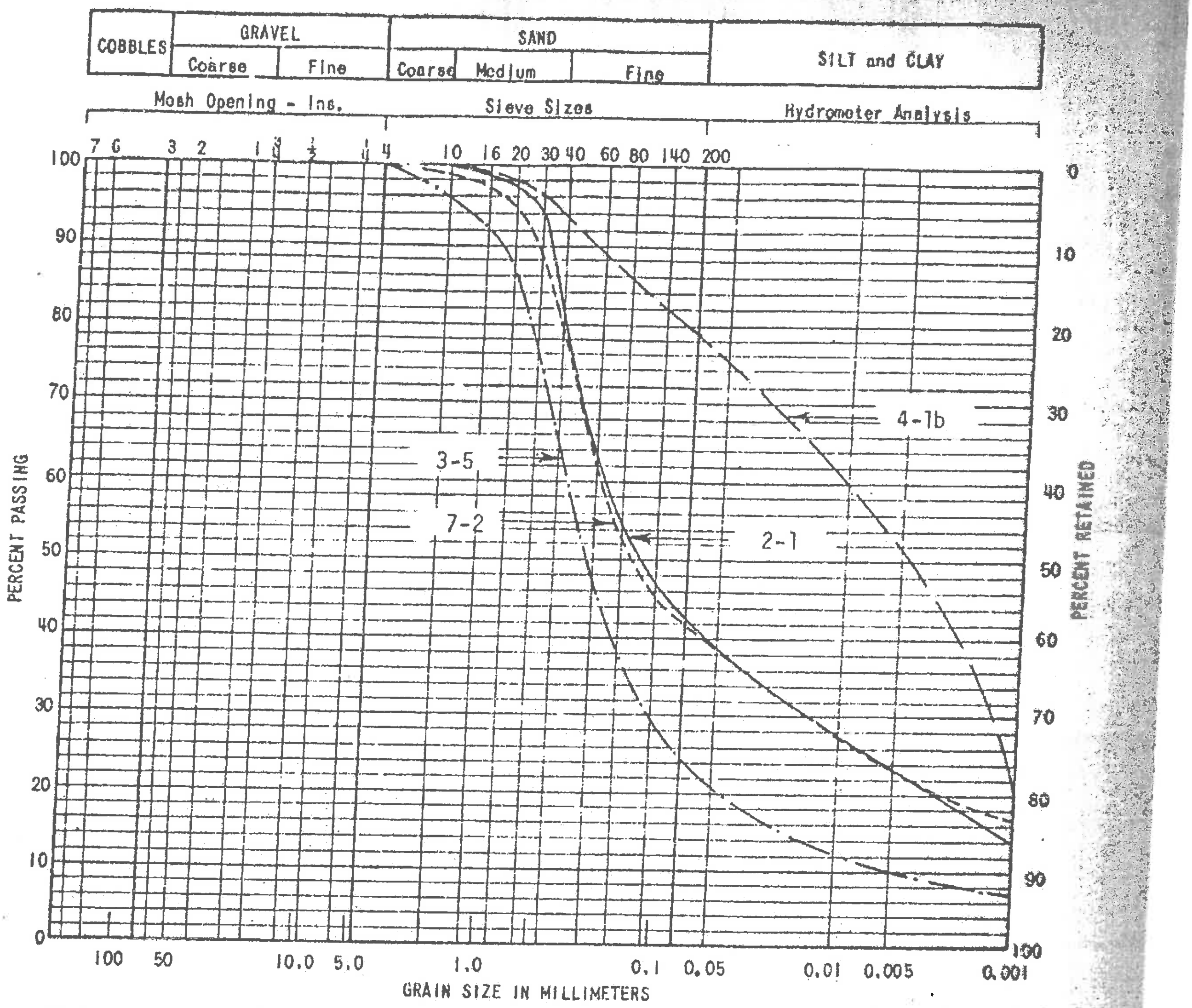
Date	Trial No.	Manometer Readings (cm)		Head, h (cm)	Quantity of Flow, Q (ml) or (cm^3)	Total Time of Discharge, t (sec)	Velocity, $v = Q/At$	Hydraulic Gradient, $i = h/L$	Water Temp. (°C)	Coefficient of Permeability, $k = QL/Ath$ (cm/sec)	Ratio of Viscosity of Water at Test Temp. to Viscosity at 20°C	Coefficient of Permeability, k, at Water Temperature of 20°C
		H1	H2									
01/10/18	1	23.5	86.5	63.0	200.0	463	0.0042	5.575	22.2	7.53E-04	0.951	7.16E-04
01/10/18	2	21.0	86.0	65.0	180.0	430	0.0041	5.752	22.2	7.13E-04	0.951	6.78E-04
01/10/18	3	22.0	85.0	63.0	192.4	440	0.0043	5.575	22.3	7.71E-04	0.949	7.32E-04

Average Coefficient of Permeability across all test runs, cm/sec: 7.09E-04

Average Coefficient of Permeability, in/hr: 1.00

LABORATORY TEST RESULTS
BY OTHERS

LABORATORY RESULTS
BY WOODWARD CLYDE (1975)



SAMPLE	CLASSIFICATION AND SYMBOL	*LL	*PI
W-2 - 1	Clayey fine sand (SC)	27	12
W-3 - 5	Silty sand (SM)	--	--
W-4 - 1b	Sandy to silty clay (CL-ML)	33	9
W-7 - 2	Clayey fine sand (SC)	--	--

*LL = Liquid Limit
*PI = Plasticity Index

GRAIN SIZE DISTRIBUTION CURVES

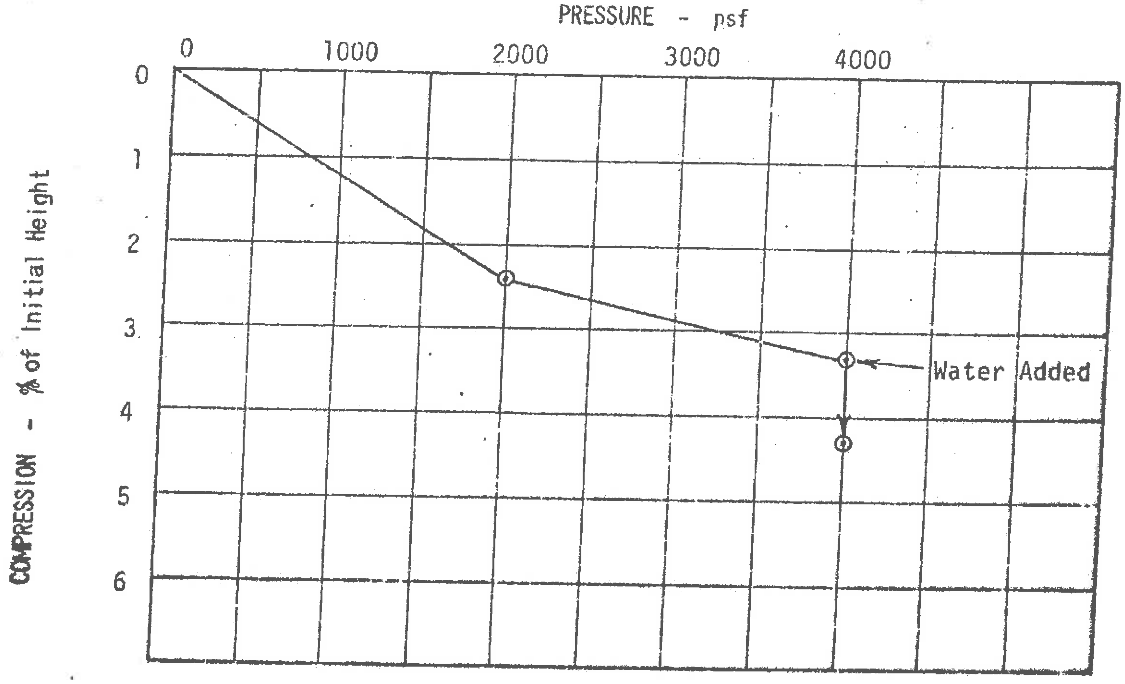
FRIARS VILLAGE CONDOMINIUMS

DRAWN BY: ALS	CHECKED BY:	PROJECT NO: 73-240A	DATE: 6-11-75	FIGURE NO: 5

WOODWARD-CLYDE CONSULTANTS

RESULTS OF CONFINED COMPRESSION TESTS

Sample Number	Initial			Final			Pressure	Compression
	Dry Density	Water Content	Saturation	Dry Density	Water Content	Saturation		
	pcf	%	%	pcf	%	%	psf	% of Initial Height
W-2 - 1	111.0	10.7	58	116.1	14.8	90	4000	4.3



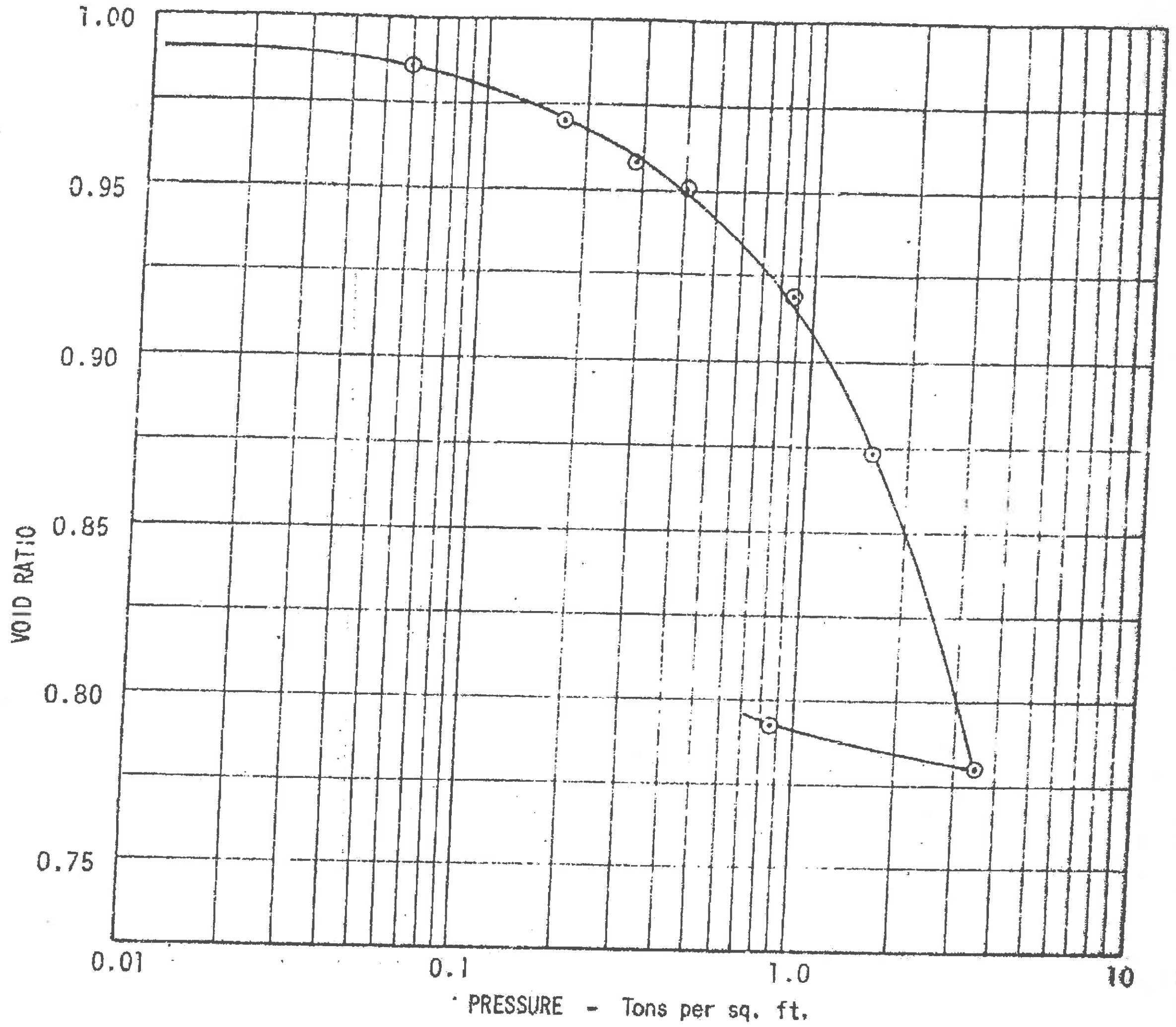
CONFINED COMPRESSION TESTS

FRIARS VILLAGE CONDOMINIUMS

DRAWN BY: ALS	CHECKED BY:	PROJECT NO: 73-240A	DATE: 6-11-75	FIGURE NO: 10

WOODWARD-CLYDE CONSULTANTS

SAMPLE W4 - 1b



INITIAL DRY DENSITY, pcf	86.1	SPECIFIC GRAVITY OF SOLIDS	2.73
INITIAL WATER CONTENT, %	35.3	INITIAL VOID RATIO, e_o	0.99
INITIAL SATURATION, %	97.8	COMPRESSION INDEX, C_c	0.25
FINAL DRY DENSITY, pcf	95.3	SWELL INDEX, C_s	0.03
FINAL WATER CONTENT, %	28.8	EFFECTIVE OVERBURDEN PRESS, P'_o, tsf	0.59
FINAL SATURATION, %	99.1	MAX. PAST PRESSURE, P_c, tsf	0.60

CONSOLIDATION TEST

FRIARS VILLAGE CONDOMINIUMS

DRAWN BY: ALS	CHECKED BY: ME	PROJECT NO: 73-240A	DATE: 6-11-75	FIGURE NO: 11

WOODWARD-CLYDE CONSULTANTS

LABORATORY TEST RESULTS
BY LEIGHTON & ASSOCIATES (1995, 1997)

1995

APPENDIX C

Laboratory Testing Procedures and Test Results

Consolidation Tests: Consolidation tests were performed on selected, relatively undisturbed ring samples. Samples were placed in a consolidometer and loads were applied in geometric progression. The percent hydroconsolidation for the pertinent load cycle was recorded as the ratio of the amount of vertical compression to the original 1-inch height.

Sample Location	Percent Hydroconsolidation
B-1, 4'-5'	0.57
B-2, 20'-21'	0.36

Moisture and Density Determination Tests: Moisture content and dry density determinations were performed on relatively undisturbed samples obtained from the test borings. The results of these tests are presented in the boring logs. Where applicable, only moisture content was determined from "undisturbed" or disturbed samples.

1997

APPENDIX C

Laboratory Testing Procedures and Test Results

Direct Shear Tests: Direct shear tests were performed on selected remolded and/or undisturbed samples which were soaked for a minimum of 24 hours under a surcharge equal to the applied normal force during testing. After transfer of the sample to the shear box, and reloading the sample, pore pressures set up in the sample due to the transfer were allowed to dissipate for a period of approximately 1 hour prior to application of shearing force. The samples were tested under various normal loads, a motor-driven, strain-controlled, direct-shear testing apparatus at a strain rate of 0.05 inches per minute. The test results are presented below.

Sample Location	Friction Angle (degrees)	Apparent Cohesion (psf)
B-2, 55'-56'	46	140
B-3, 60'-61'	42	0
B-4, 40'-41'	45	75

Moisture and Density Determination Tests: Moisture content and dry density determinations were performed on relatively undisturbed samples obtained from the test borings. The results of these tests are presented in the boring logs. Where applicable, only moisture content was determined from "undisturbed" or disturbed samples.

Percent Passing No. 200 Sieve: Soil samples obtained during the field study were tested for the percentage of materials passing the Number 200 sieve per ASTM D422. This data was used to evaluate liquefaction potential. The results are presented below:

Sample Location	% Finer than No. 200 Sieve
B-1, 34'-35'	13.1
B-2, 15'-16'	2.2
B-2, 20'-21'	3.6
B-2, 35'-36'	71.5
B-3, 15'-16'	2.1
B-3, 30'-31'	5.6
B-3, 25'-26'	5.1
B-4, 10'-11'	4.4
B-4, 30'-31'	2.9

1997

APPENDIX C (Continued)

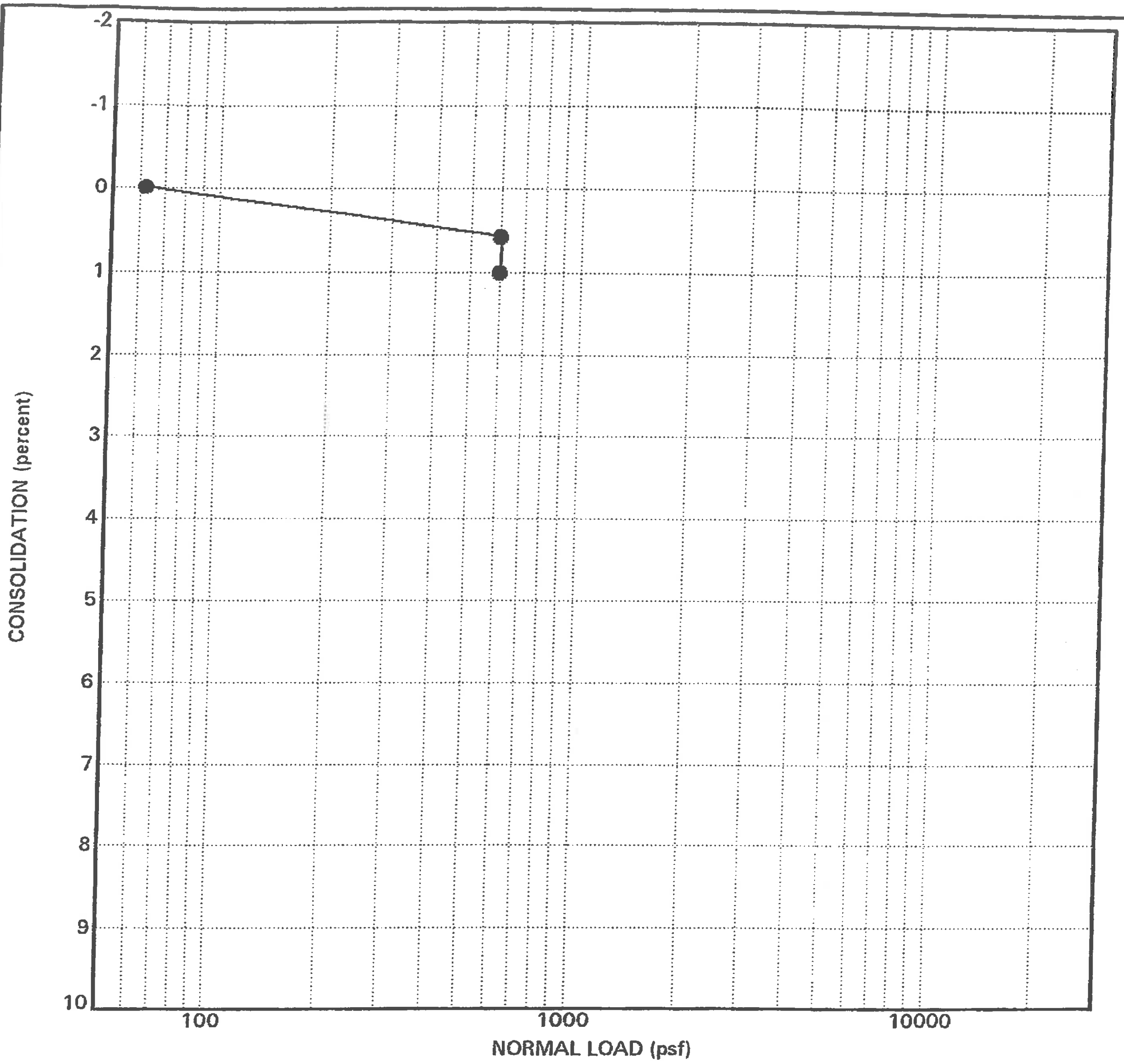
Soluble Sulfates and Chlorides: The soluble sulfate and chloride content of selected samples were determined by standard geochemical methods. The test results are presented in the table below:

Sample Location	Chloride Content (%)	Potential Degree of Chloride Attack*	Sulfate Content (%)	Potential Degree of Sulfate Attack**
B-2, 5'-6'	<0.003	Positive	<0.005	Negligible
B-2, 20'-21'	--	--	<0.005	Negligible
B-3, 15'-16'	0.05	Positive	--	--
B-3, 25'-26'	0.05	Positive	--	--
B-4, 5'-6'	--	--	<0.005	Negligible
B-4, 45'-46'	--	--	<0.005	Negligible

* City of San Diego Clean Water Program Guidelines, 1992.

** Based on the 1994 edition of the Uniform Building Code, Table No. 19-A-3, prepared by the International Conference of Building Officials (ICBO, 1994).

LABORATORY TEST RESULTS BY SHEPARDSON (1998, 2003)



SAMPLE DATA	
Sample Location and Depth (feet):	B- 1 @ 5.5
Soil Type and Visual Description:	sand, gray
Sampling Method/Sample Type:	H / insitu

TEST RESULTS

USCS Group Symbol	Moisture Content (%)		Dry Density (pcf)	
	Initial	Final	Initial	Final
	2.7	28.7	86	87
Water Added @ (psf):	600	Expansion(+)/Hydrocompression(-) (%):		-0.43

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ENGINEERING ASSOCIATES INC.

Geotechnical Consultants:
Engineers-Geologists

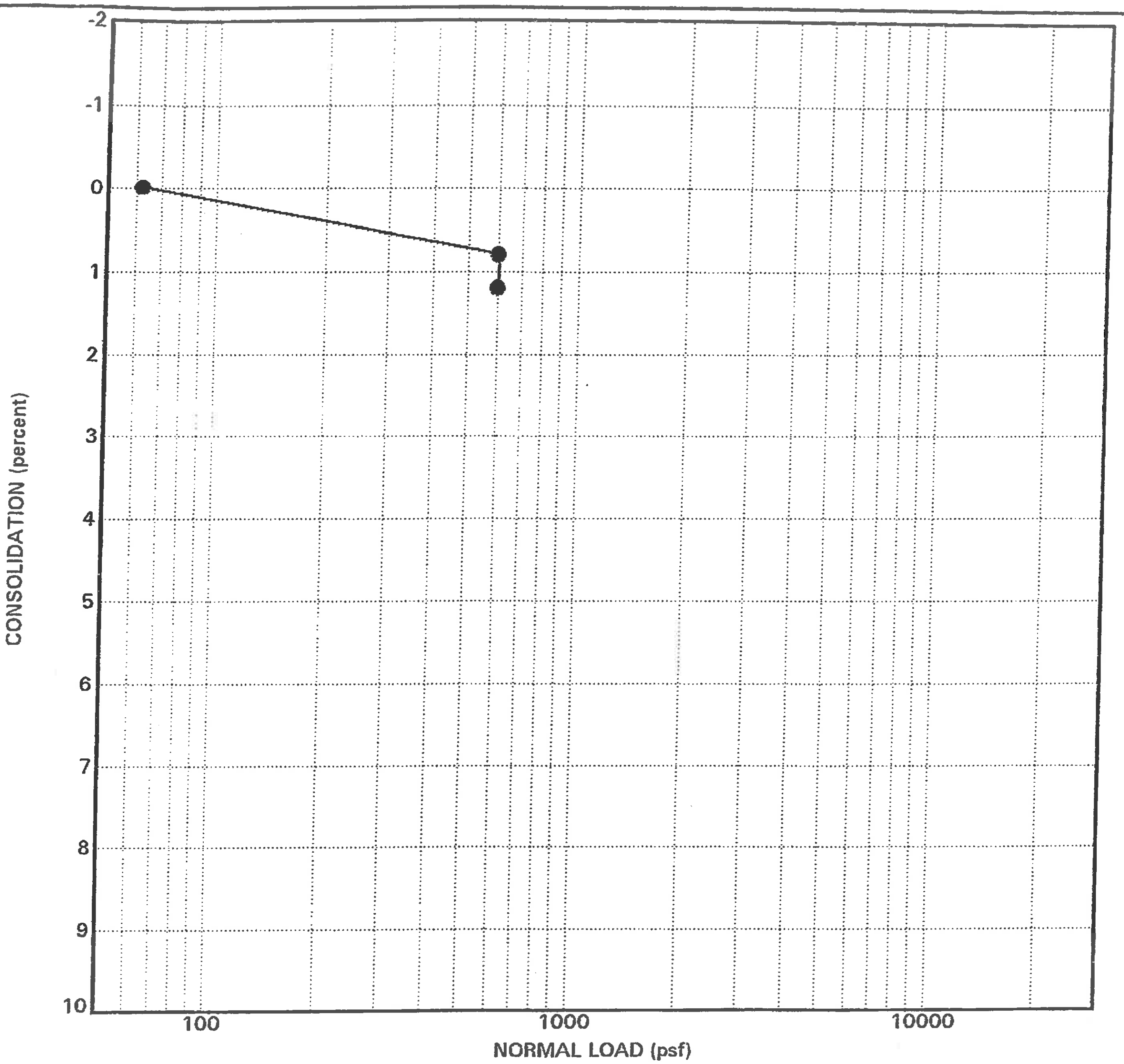
Date: September, 1998

Project No.: 97149-01

Consolidation Test
RIVERWALK COMMERCIAL CENTER

Plate
C1

CN1 98



SAMPLE DATA	
Sample Location and Depth (feet):	B- 2 @ 5.5
Soil Type and Visual Description:	sand, gray
Sampling Method/Sample Type:	H / insitu

TEST RESULTS				
USCS Group Symbol	Moisture Content (%)		Dry Density (pcf)	
	Initial	Final	Initial	Final
	5.9	30.7	85	86
Water Added @ (psf):	600	Expansion(+)/Hydrocompression(-) (%):		-0.4

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Consolidation Test
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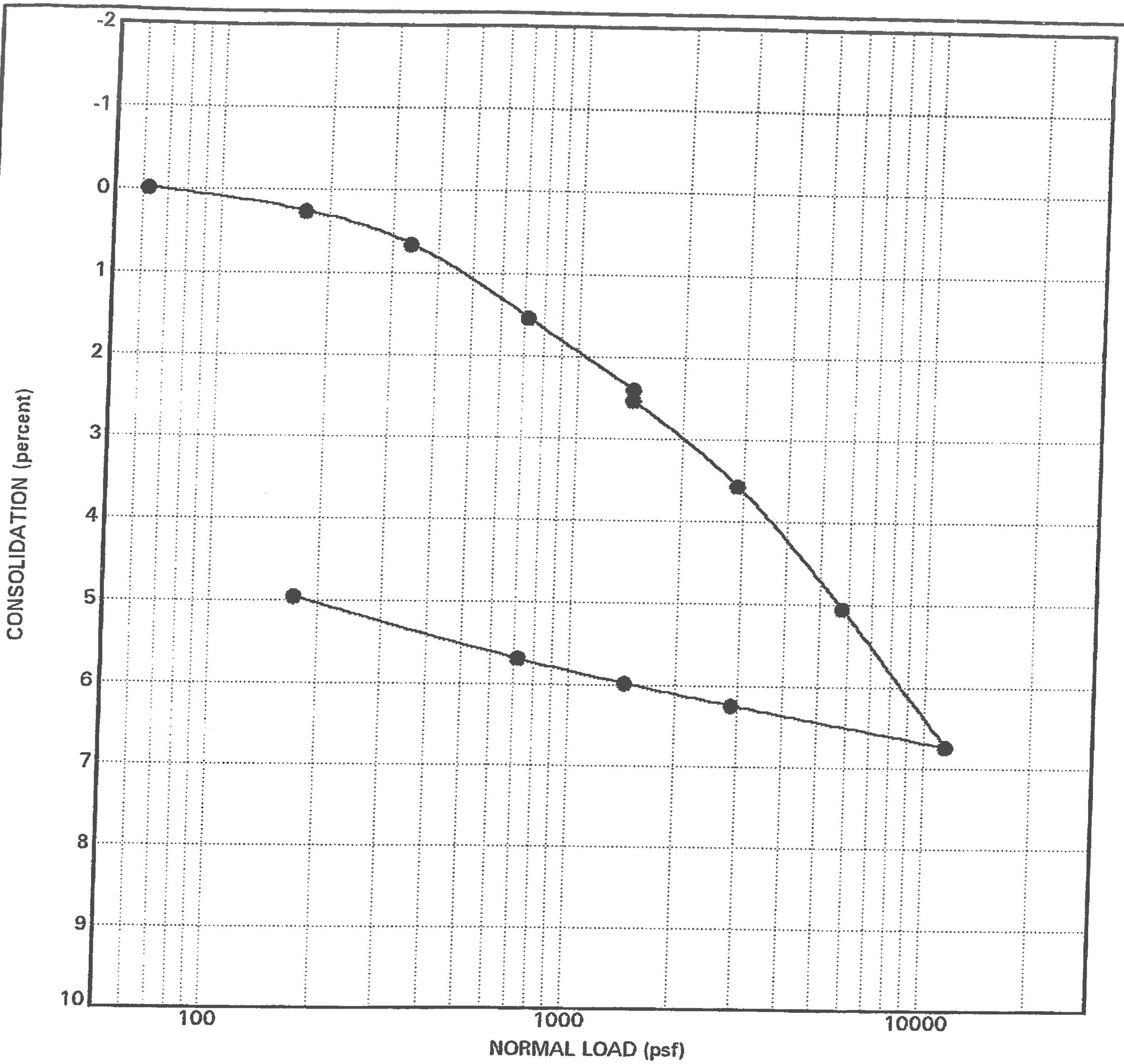
Plate
C2

CN1 98



SAMPLE DATA	
Sample Location and Depth (feet):	B- 2 @ 60.5
Soil Type and Visual Description:	silty sand, dark gray
Sampling Method/Sample Type:	H / insitu

TEST RESULTS				
USCS Group Symbol	Moisture Content (%)		Dry Density (pcf)	
	Initial	Final	Initial	Final
	25.5	24.7	97	101
Water Added @ (psf):	1438	Expansion(+)/Hydrocompression(-) (%):		-0.13

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Date: September, 1998
Project No.: 97149-01

Consolidation Test
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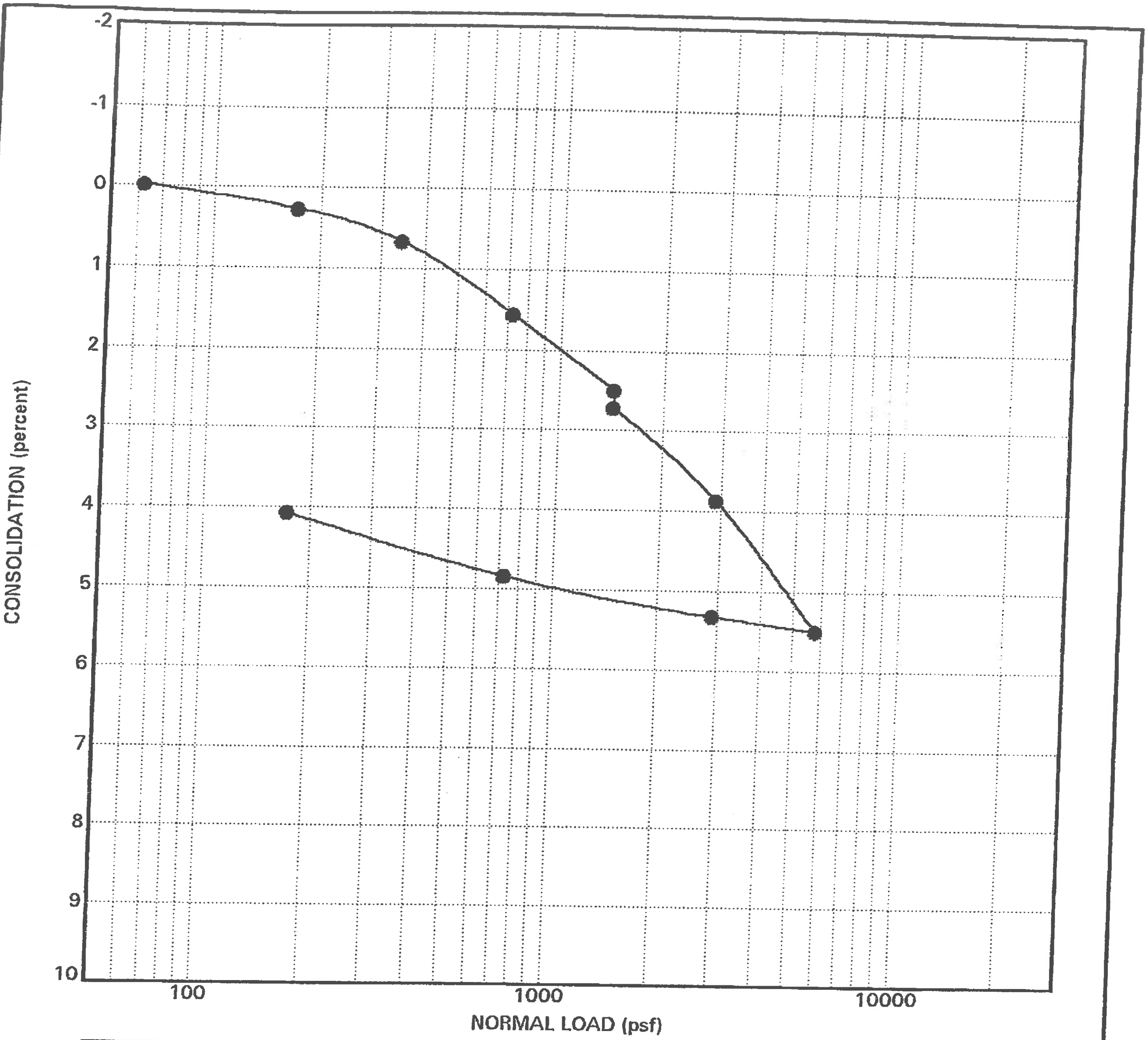
Plate
C4

CN1 98



SAMPLE DATA	
Sample Location and Depth (feet):	B- 2 @ 10.5
Soil Type and Visual Description:	sand, gray
Sampling Method/Sample Type:	H / insitu

TEST RESULTS				
USCS Group Symbol	Moisture Content (%)		Dry Density (pcf)	
	Initial	Final	Initial	Final
	26.0	29.1	88	92
Water Added @ (psf):	1433	Expansion(+)/Hydrocompression(-) (%):	-0.22	

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Date: September, 1998

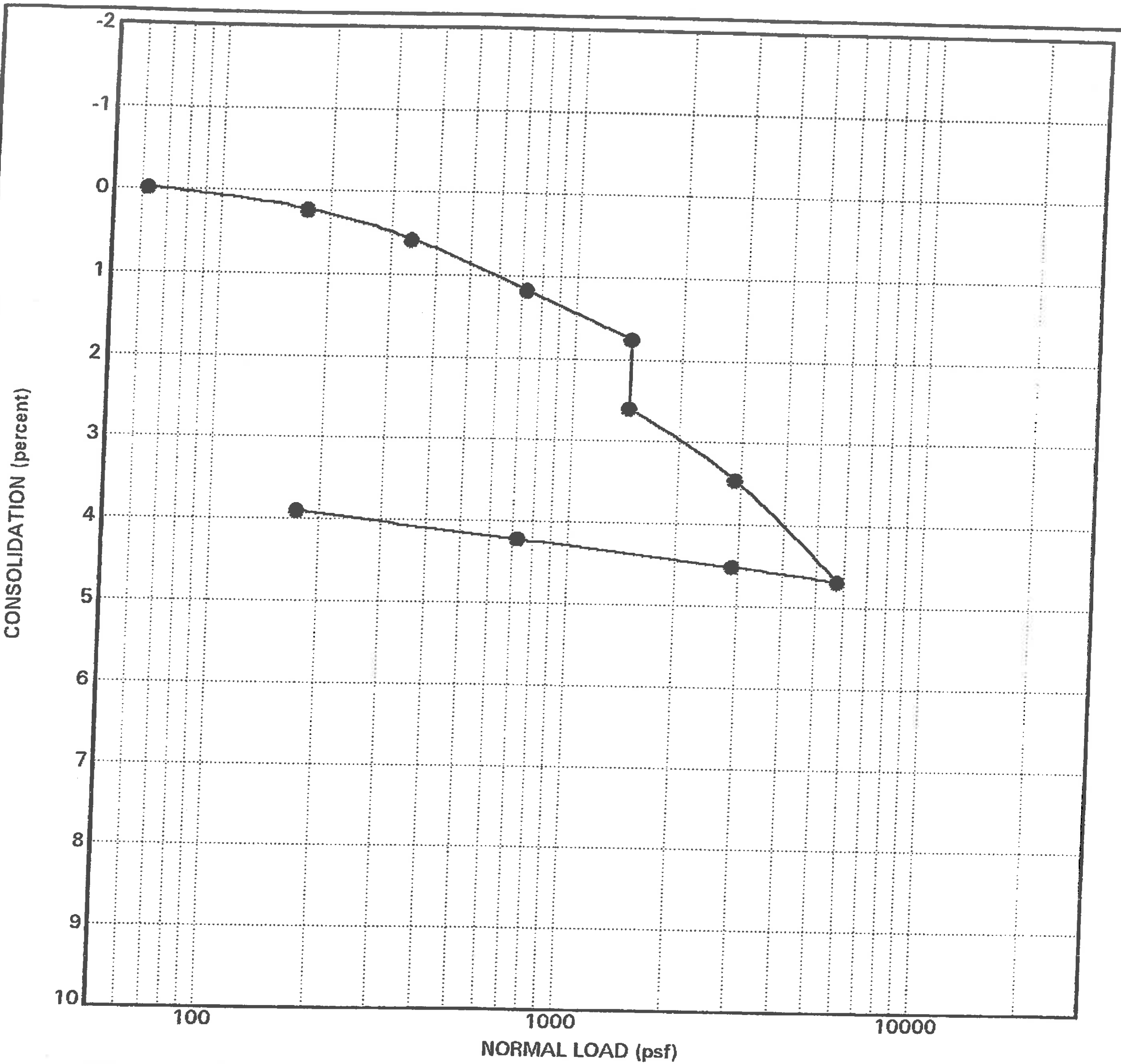
Project No.: 97149-01

Consolidation Test

RIVERWALK COMMERCIAL CENTER

Plate
C3

CN1 98



SAMPLE DATA	
Sample Location and Depth (feet):	B- 3 @ 8.5
Soil Type and Visual Description:	sand, gray
Sampling Method/Sample Type:	H / insitu

TEST RESULTS

USCS Group Symbol	Moisture Content (%)		Dry Density (pcf)	
	Initial	Final	Initial	Final
	4.7	26.7	92	96
Water Added @ (psf):	1437	Expansion(+)/Hydrocompression(-) (%):		-0.84

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Consolidation Test
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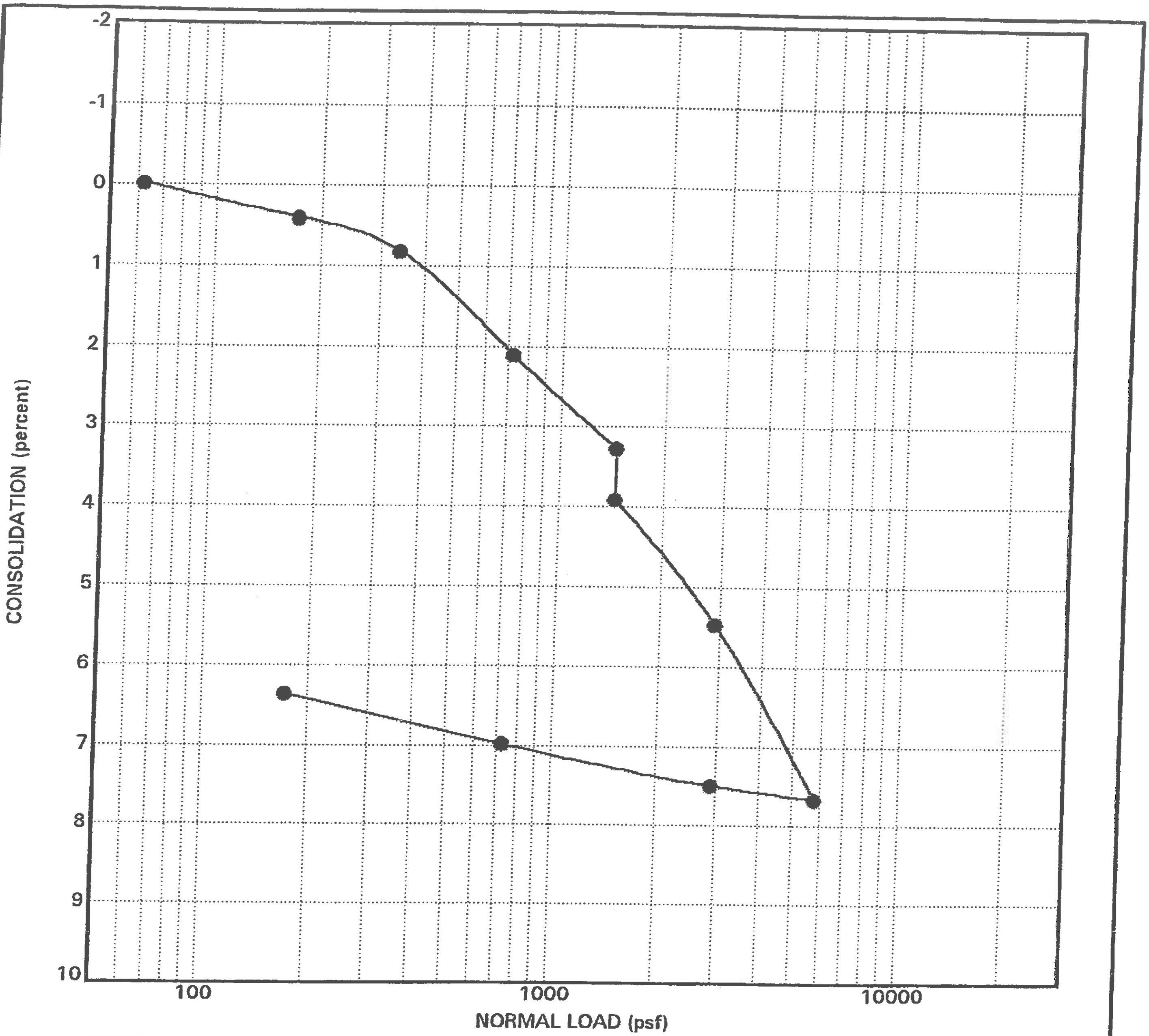
Plate
C5

CN1 98



SAMPLE DATA	
Sample Location and Depth (feet):	B- 4 @ 8.5
Soil Type and Visual Description:	sand, gray
Sampling Method/Sample Type:	H / insitu

TEST RESULTS				
USCS Group Symbol	Moisture Content (%)		Dry Density (pcf)	
	Initial	Final	Initial	Final
	22.2	21.2	100	106
Water Added @ (psf):	1446	Expansion(+)/Hydrocompression(-) (%):		-0.64

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Project No.: 97149-01

Consolidation Test
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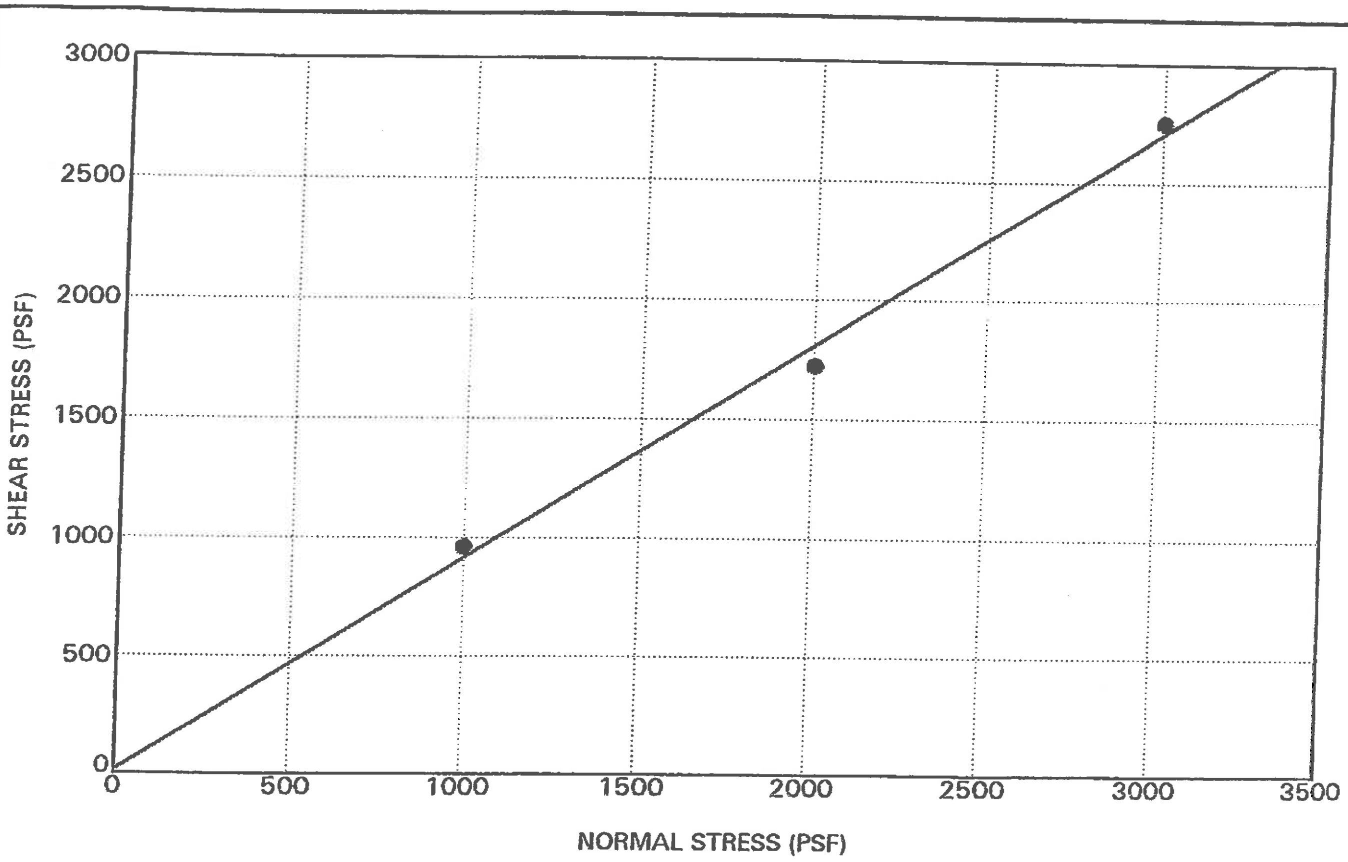
Plate
C6

CN1 98



Sample Location and Depth (feet): B- 4 @ 8.5

Soil Type and Visual Description: sand gray

Sample Type/Sampling Method*: insitu / H

USCS Group Symbol and Name:

Test Data

MOISTURE CONTENT (%)**		DRY DENSITY (pcf)**	
Initial Test:	23.9	Initial Test:	95
Final Test:	25.2		

TEST CONDITIONS: (C,D,S)

NORMAL LOADS (psf): 1000, 2000, 3000

STRAIN RATE (in/min): 0.0300

Results

INTERNAL FRICTION ANGLE (degrees)		APPARENT COHESION (psf)	
Peak:	42	Peak:	16
Ultimate:	36	Ultimate:	196

* See Explanation of Logs for sampler symbol definitions. ** Average of three test points.

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Date: September, 1998

Project No.: 97149-01

Direct Shear Test

RIVERWALK COMMERCIAL CENTER

Plate
C7

DS1 98

SIEVE ANALYSIS
PERCENT PASSING NO. 200 SIEVE

Sample	Depth	Percentage Passing No. 200 Sieve by Wt.
B- 1	8.5	2
B- 1	20.0	3
B- 2	25.5	8
B- 2	35.0	56
B- 2	50.0	55
B- 3	22.0	4
B- 3	37.5	8
B- 3	47.5	14
B- 4	8.5	56
B- 4	22.0	7
B- 4	32.5	12

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Geotechnical Consultants:
Engineers-Geologists

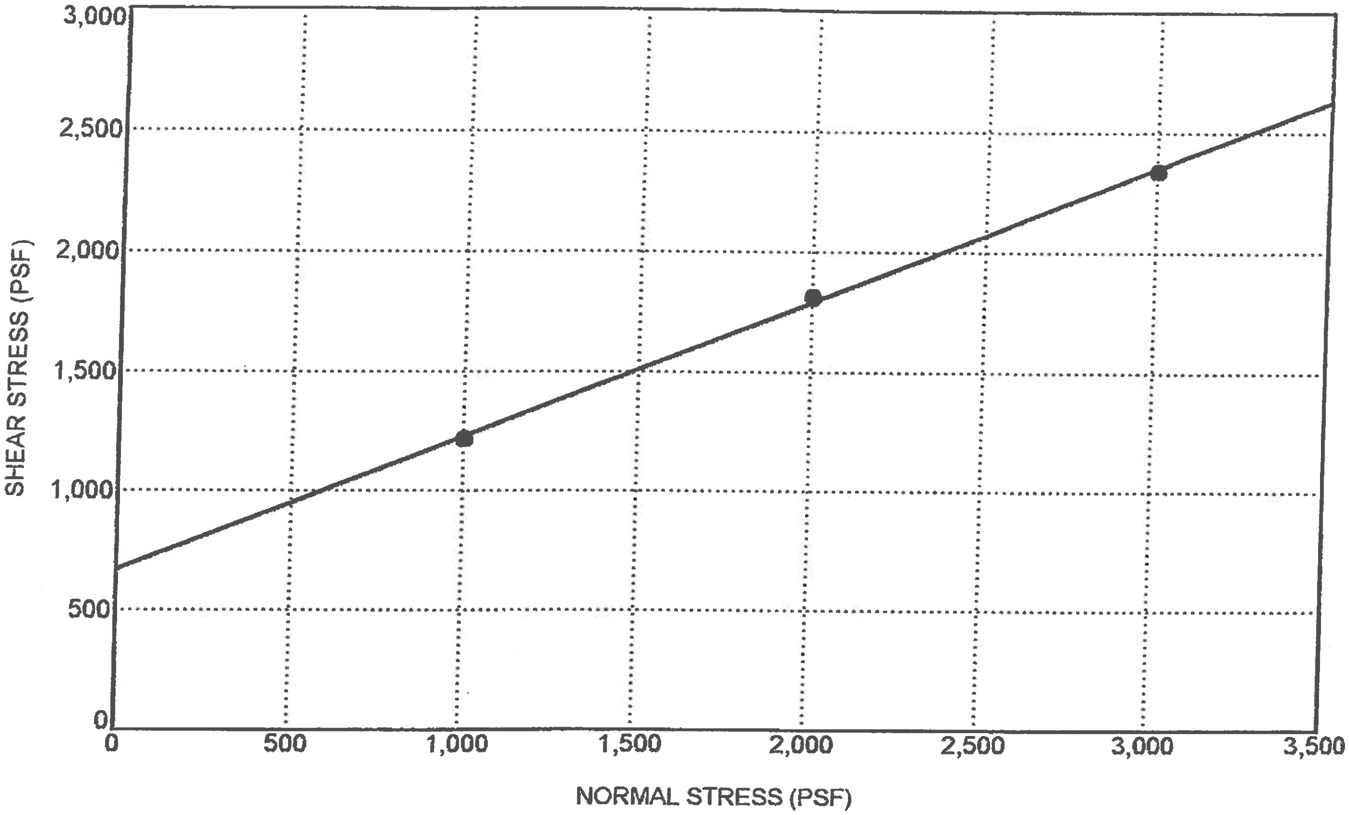
Date: September, 1998

Project No.: 97149-01

Percent Passing No. 200 Sieve
RIVERWALK COMMERCIAL CENTER

Plate
C8

#200W 98



Sample Location and Depth (feet):	B-101 @ 0.0
Soil Type and Visual Description:	Dark Yellow Tannish Brown Silty Sand
Sample Type/Sampling Method*:	Remolded / B
USCS Group Symbol and Name:	

Test Data

MOISTURE CONTENT (%)**		DRY DENSITY (pcf)**	
Initial Test:	10.9	Initial Test:	110
Final Test:	17.7		

TEST CONDITIONS:	(C,D,S)
NORMAL LOADS (psf):	1000,2000,3000
STRAIN RATE (in/min):	0.0010

Results

INTERNAL FRICTION ANGLE (degrees)		APPARENT COHESION (psf)	
Peak:	29	Peak:	669
Ultimate:	31	Ultimate:	455

* See Explanation of Logs for sampler symbol definitions.

** Average of three test points.

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Geotechnical Consultants:
Engineers-Geologists

Date: December, 2003

Project No.: 97149-03

Direct Shear Test

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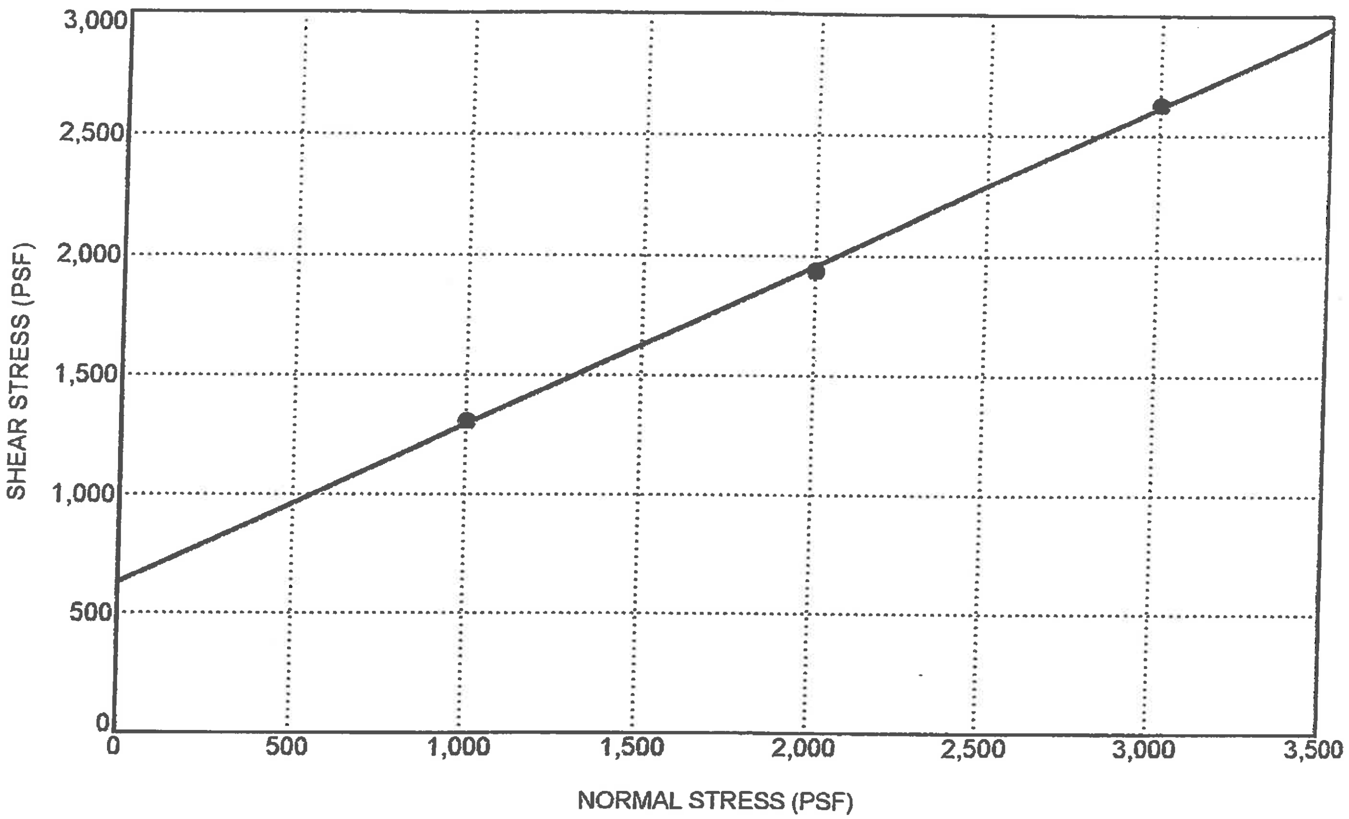
Plate
C1

DS1 03



Sample Location and Depth (feet): B-104 @ 0.0
Soil Type and Visual Description: Reddish Brown Silty Sand
Sample Type/Sampling Method*: Remolded / B
USCS Group Symbol and Name:

Test Data

MOISTURE CONTENT (%)**		DRY DENSITY (pcf)**	
Initial Test:	9.0	Initial Test:	117
Final Test:	14.8		

TEST CONDITIONS: (C,D,S)
NORMAL LOADS (psf): 1000,2000,3000
STRAIN RATE (in/min): 0.0010

Results

INTERNAL FRICTION ANGLE (degrees)		APPARENT COHESION (psf)	
Peak:	34	Peak:	633
Ultimate:	31	Ultimate:	540

* See Explanation of Logs for sampler symbol definitions.

** Average of three test points.

SHEPARDSON
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Geotechnical Consultants:
Engineers-Geologists

Date: December, 2003
Project No.: 97149-03

Direct Shear Test

RIVERWALK COMMERCIAL CENTER

Plate
C2

SIEVE ANALYSIS
PERCENT PASSING NO. 200 SIEVE

Sample	Depth	Percentage Passing No. 200 Sieve by Wt.
B-102	20.0	4
B-102	40.0	34
B-103	20.0	10
B-103	40.0	5

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ENGINEERING ASSOCIATES INC.

Geotechnical Consultants:
Engineers-Geologists

Date: December, 2003

Project No.: 97149-03

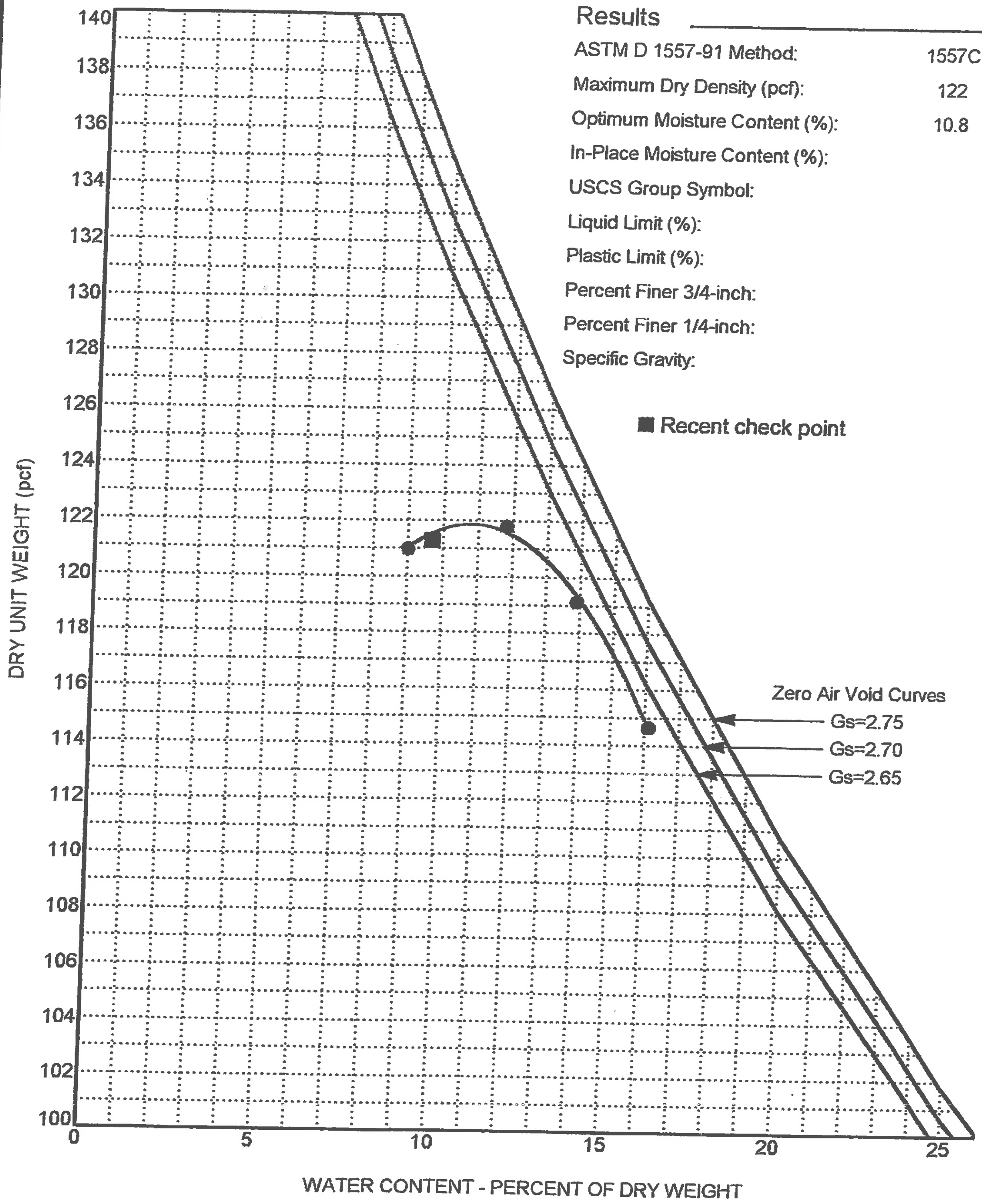
Percent Passing No. 200 Sieve
RIVERWALK COMMERCIAL CENTER

Plate
C3

#200W 03

Sample Location and Depth (feet): #4 @ 1.0

Soil Type and Visual Description: Dark Brown Sandy Silt,



Results

ASTM D 1557-91 Method:	1557C
Maximum Dry Density (pcf):	122
Optimum Moisture Content (%):	10.8
In-Place Moisture Content (%):	
USCS Group Symbol:	
Liquid Limit (%):	
Plastic Limit (%):	
Percent Finer 3/4-inch:	
Percent Finer 1/4-inch:	
Specific Gravity:	

■ Recent check point

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Geotechnical Consultants:
Engineers-Geologists

Date: December, 2003

Project No.: 97149-03

Compaction Curve

RIVERWALK COMMERCIAL CENTER

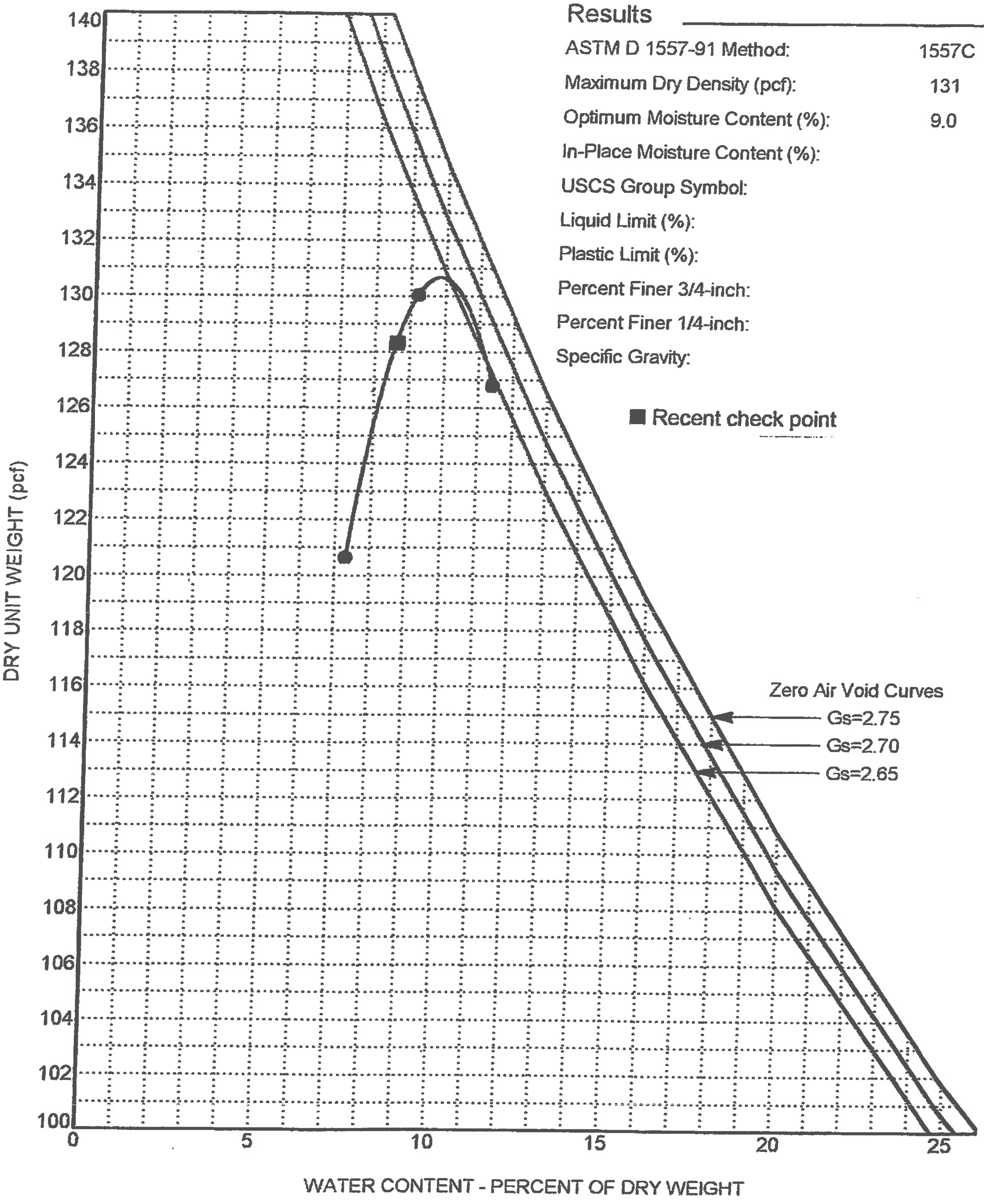
Plate
C4

CP1 03

Sample Location and Depth (feet):	#16 @ 1.0
Soil Type and Visual Description:	Reddish Brown Silty Sand,

Results

ASTM D 1557-91 Method:	1557C
Maximum Dry Density (pcf):	131
Optimum Moisture Content (%):	9.0
In-Place Moisture Content (%):	
USCS Group Symbol:	
Liquid Limit (%):	
Plastic Limit (%):	
Percent Finer 3/4-inch:	
Percent Finer 1/4-inch:	
Specific Gravity:	



SHEPARDSON
ENGINEERING ASSOCIATES INC.

Geotechnical Consultants:
Engineers-Geologists

Date: December, 2003

Project No.: 97149-03

Compaction Curve

RIVERWALK COMMERCIAL CENTER

Plate

C5

CP1 03

LABORATORY TEST RESULTS
BY GEOCON (1998, 2003)

APPENDIX B

LABORATORY TESTING

Laboratory tests were performed in accordance with generally accepted test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. Selected soil samples were tested for their in-place dry density and moisture content, grain size distribution, and shear strength characteristics.

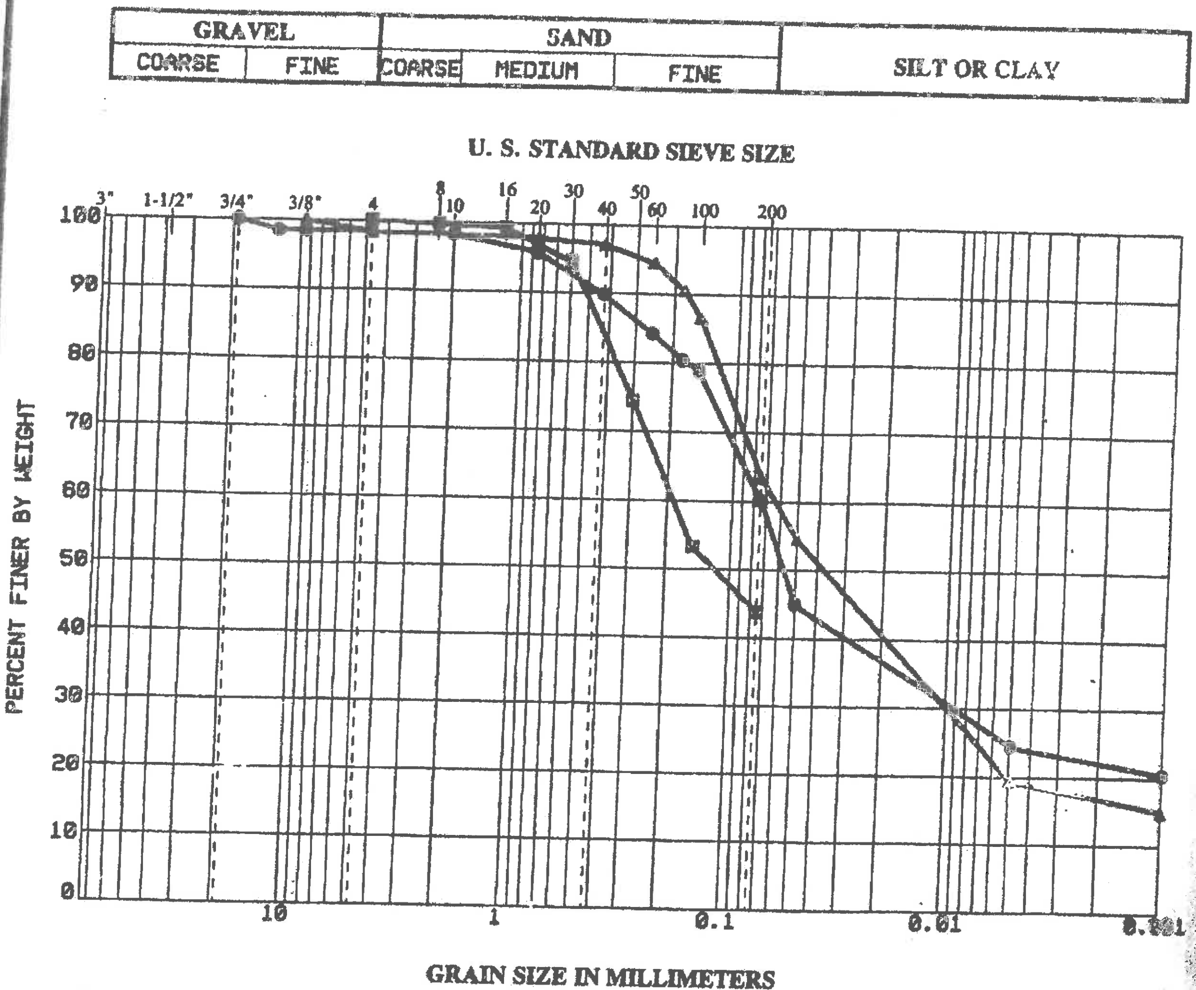
The results of our laboratory tests are presented on Table B-I and Figures B-1 to B-5. The in-place dry density and moisture content results are indicated on the exploratory boring logs.

TABLE B-I
SUMMARY OF IN-PLACE DENSITY AND DIRECT SHEAR TEST RESULTS

GC

Sample No.	Dry Density (pcf)	Moisture Content (%)	Unit Cohesion (psf)	Angle of Shear Resistance (degrees)
B-2-1	100.3	26.2	592	28
B-3-5	74.1	51.1	160	31

PROJECT NO. 06219-22-01



GC-

	SAMPLE	Depth (ft)	CLASSIFICATION	NAT WC	LL	PL	PI
●	B1-8	40.0	(ML) Sandy SILT w/some clay				
⊠	B2-2	10.0	(SM) Silty SAND w/some clay				
▲	B2-4	20.0	(ML) Sandy SILT w/some clay				

GRADATION CURVE

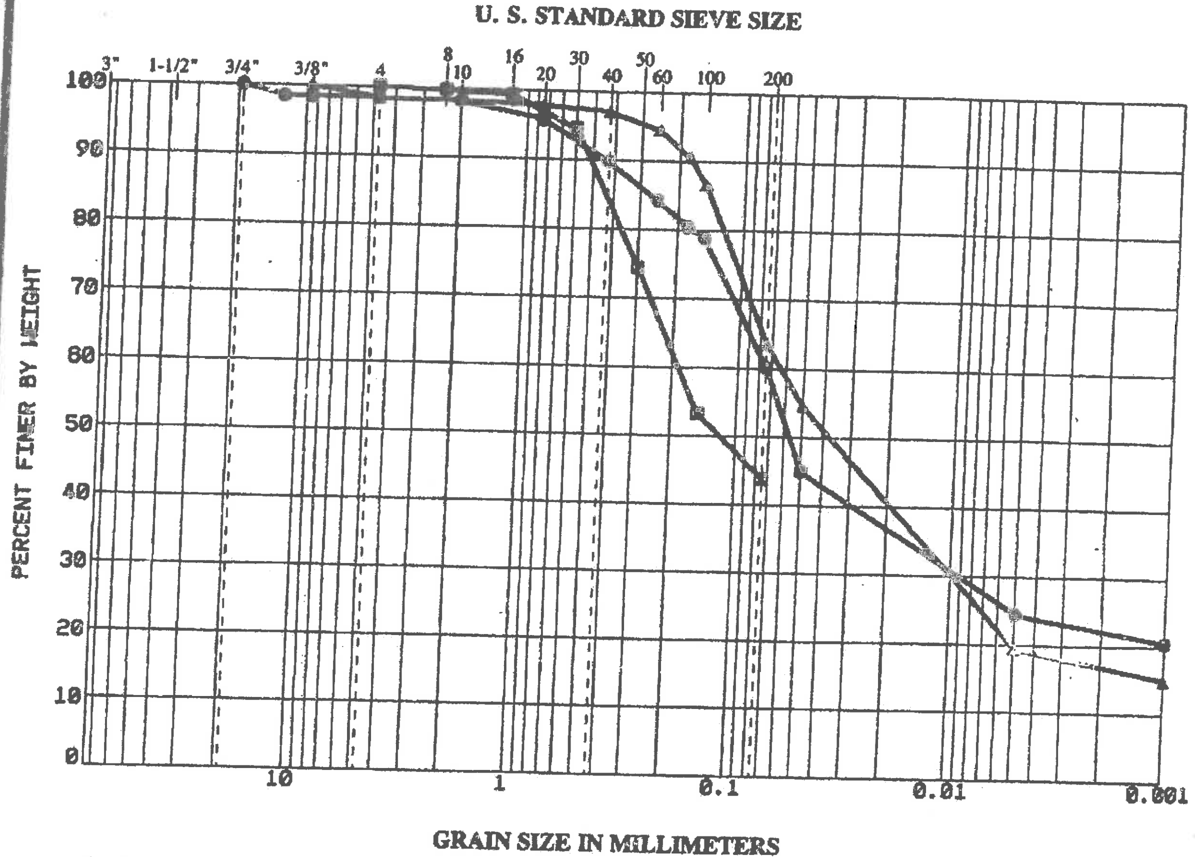
HANDLERY HOTEL

SAN DIEGO, CALIFORNIA

HANDH

PROJECT NO. 06219-22-01

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



GC-

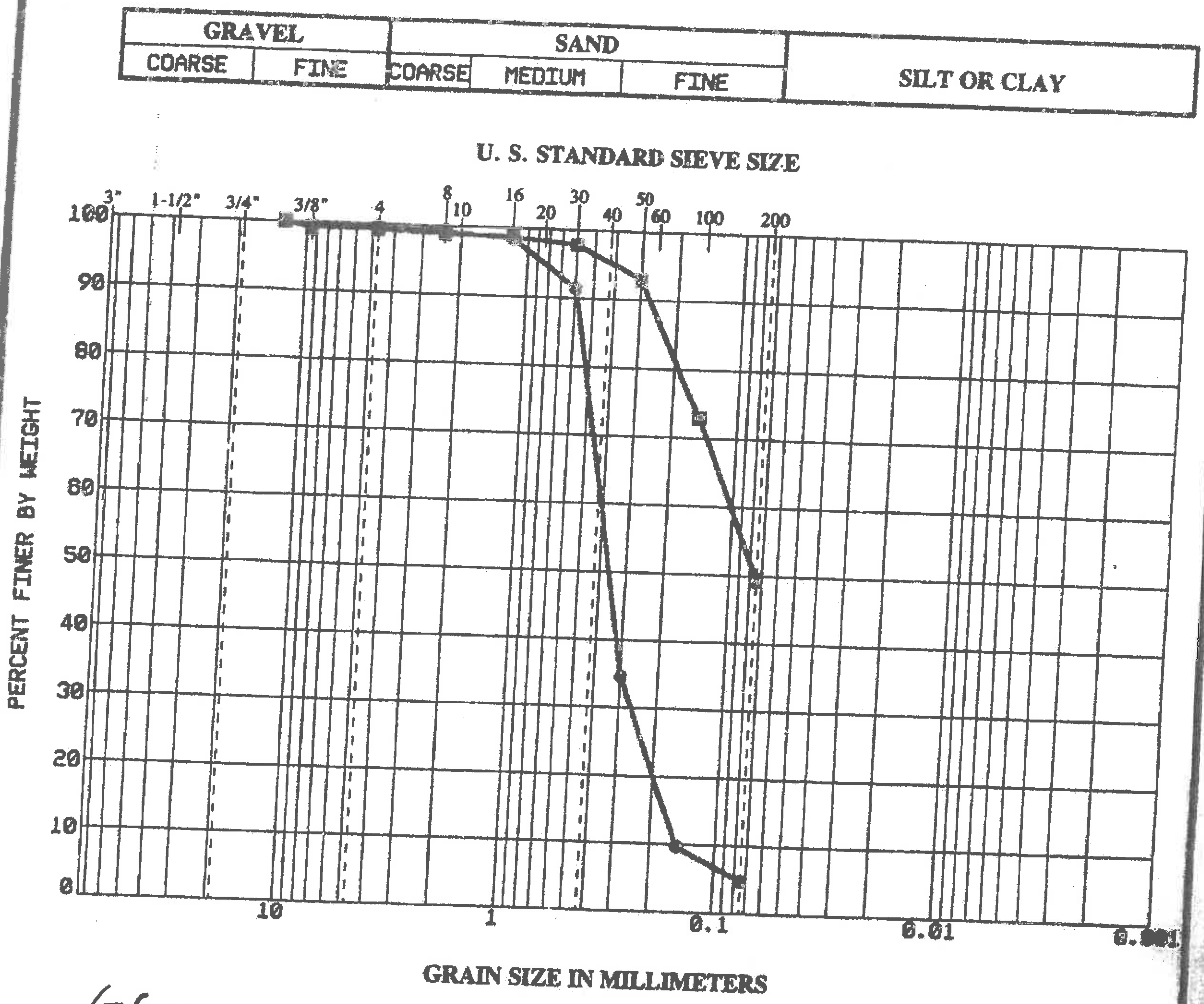
	SAMPLE	Depth (ft)	CLASSIFICATION	NAT WC	LL	PL	PI
●	B1-8	40.0	(ML) Sandy SILT w/some clay				
⊠	B2-2	10.0	(SM) Silty SAND w/some clay				
▲	B2-4	20.0	(ML) Sandy SILT w/some clay				

GRADATION CURVE

HANDLERY HOTEL

SAN DIEGO, CALIFORNIA

PROJECT NO. 06219-22-01



GC-

	SAMPLE	Depth (ft)	CLASSIFICATION	NAT WC	LL	PL	PI
●	B3-2	10.0	(SP) Fine to medium SAND w/trace silt				
☒	B3-8	40.0	(SM) Silty SAND w/some clay				

GRADATION CURVE

HANDLERY HOTEL

SAN DIEGO, CALIFORNIA

HANDH

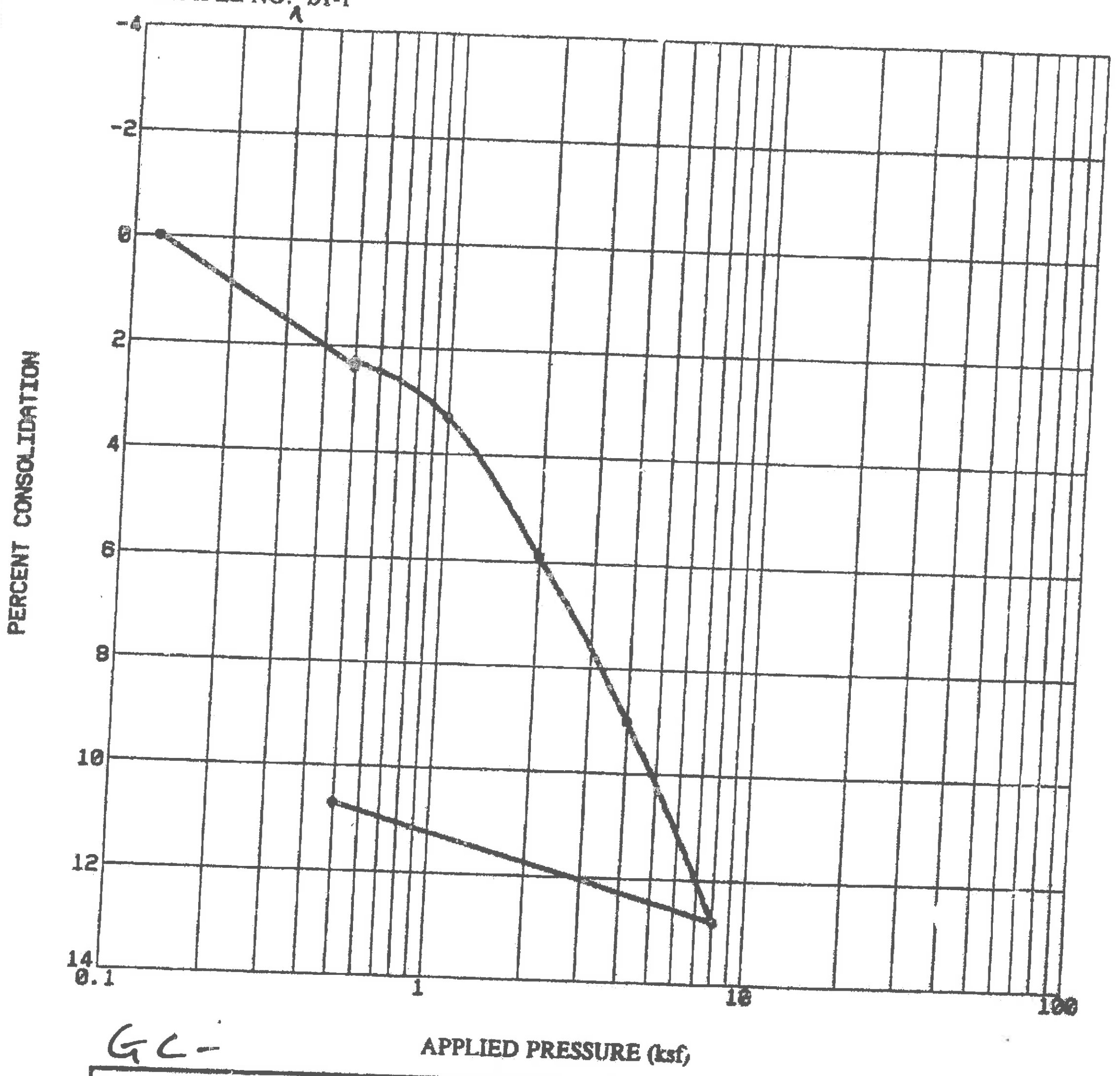
Figure B-2

03 09 2001

PROJECT NO. 06219-22-01

GC

SAMPLE NO. B1-1



GC–

Initial Dry Density (pcf)	92.0
Initial Water Content (%)	32.5

Initial Saturation (%)	100
Sample Saturated at (ksf)	0.5

CONSOLIDATION CURVE

HANDLERY HOTEL

SAN DIEGO, CALIFORNIA

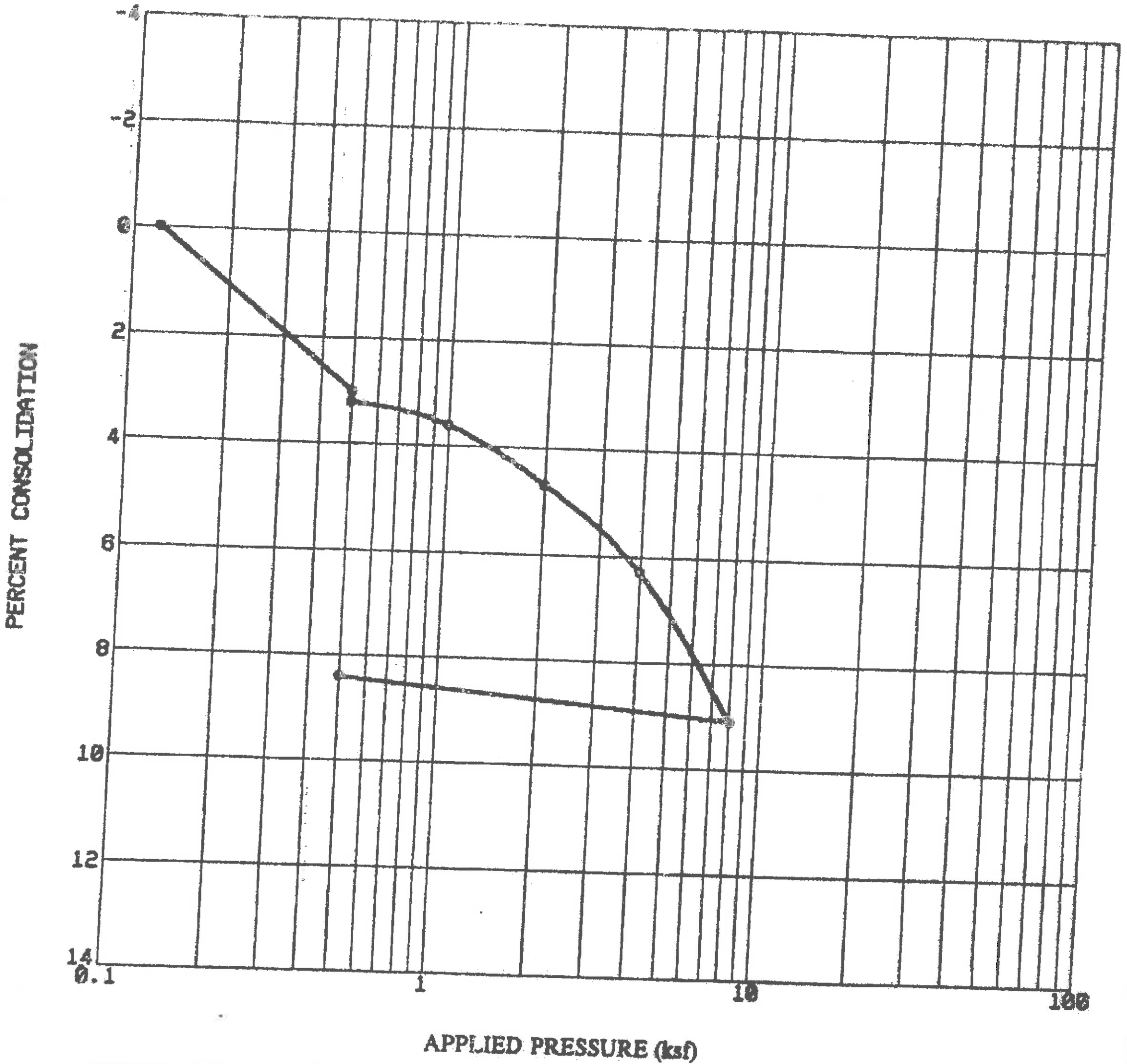
HANDH

Figure B-3

PROJECT NO. 06219-22-01

G-C

SAMPLE NO. B1-5



Initial Dry Density (pcf)	107.9
Initial Water Content (%)	22.0

Initial Saturation (%)	100
Sample Saturated at (ksf)	0.5

CONSOLIDATION CURVE

HANDLERY HOTEL

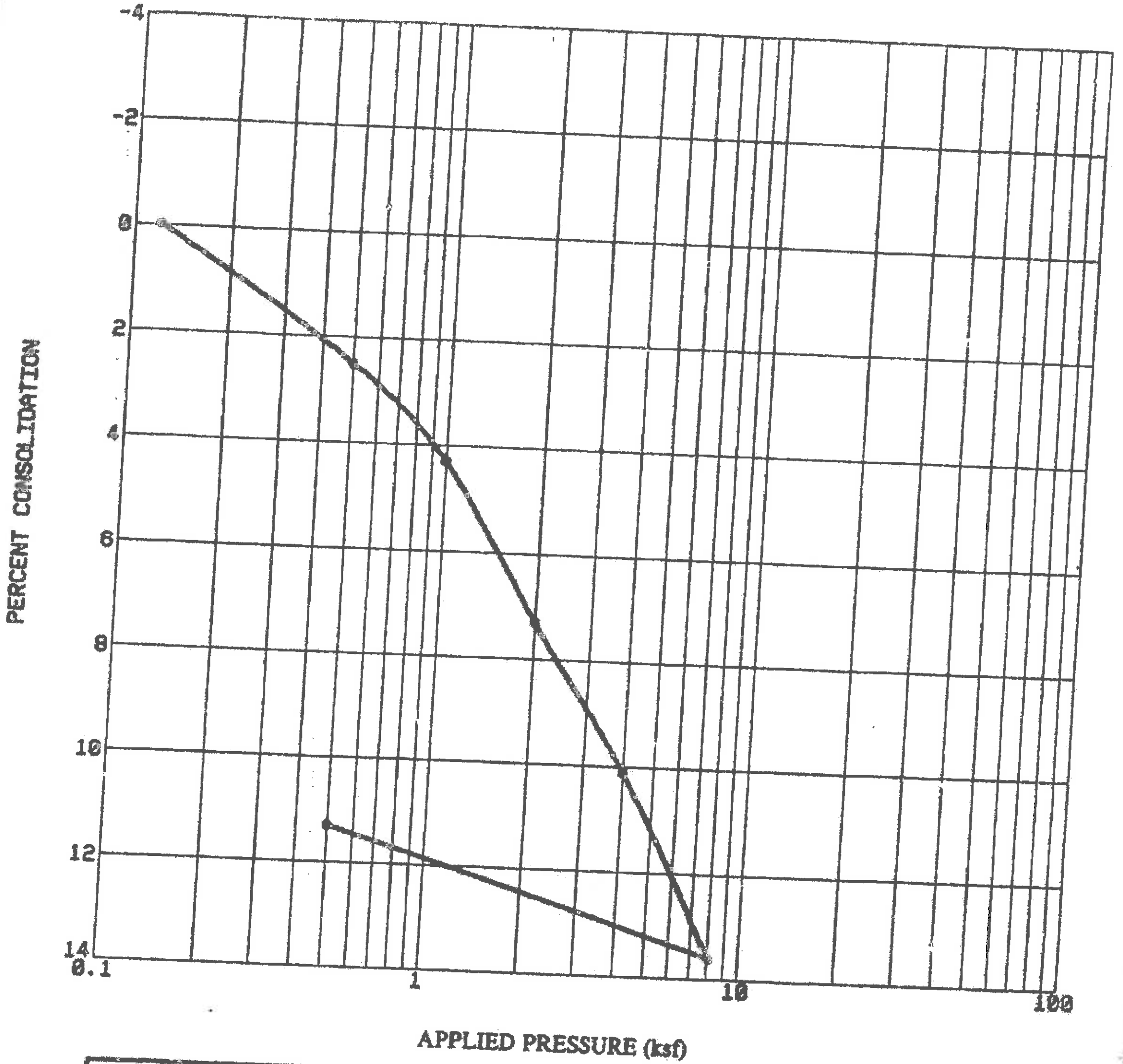
SAN DIEGO, CALIFORNIA

03 09 2001

PROJECT NO. 06219-22-01

GC

SAMPLE NO. B3-1



Initial Dry Density (pcf)	73.9
Initial Water Content (%)	41.5

Initial Saturation (%)	88.5
Sample Saturated at (ksf)	0.5

CONSOLIDATION CURVE

HANDLERY HOTEL

SAN DIEGO, CALIFORNIA

HANDM

Figure B-5

APPENDIX B

LABORATORY TESTING

Laboratory tests were performed in accordance with generally accepted test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. Selected soil samples were tested for their in-place dry density and moisture content, maximum dry density and optimum moisture content, expansion index, consolidation, and shear strength characteristics. Selected soils samples were also tested for pH, resistivity, sulfate content, and R-value.

The results of our laboratory tests are presented in Tables B-I through B-VI and on Figures B-1 through B-3. The in-place dry density and moisture content results are indicated on the exploratory boring logs.

TABLE B-I
SUMMARY OF LABORATORY MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT TEST RESULTS
(ASTM D 1557-00)

GC

Sample No.	Description	Maximum Dry Density (pcf)	Optimum Moisture Content (% dry wt.)
SB2-1	Silty SAND, trace clay and gravel	131.5	8.6

TABLE B-II
SUMMARY OF LABORATORY EXPANSION INDEX TEST RESULTS
(ASTM D 4829-95)

Sample No.	Moisture Content		Dry Density (pcf)	Expansion Index
	Before Test (%)	After Test (%)		
SB4-1	13.1	22.2	99.8	0

TABLE B-III
SUMMARY OF LABORATORY DIRECT SHEAR TEST RESULTS
(ASTM D 3080-98)

Sample No.	Dry Density (pcf)	Moisture Content (%)	Unit Cohesion (psf)	Angle of Shear Resistance (degrees)
SB2-1*	118.8	8.4	100	38

* Samples remolded to 90 percent relative compaction at optimum moisture content.

TABLE B-IV
SUMMARY OF LABORATORY POTENTIAL OF HYDROGEN (pH) AND RESISTIVITY TEST RESULTS
(CALIFORNIA TEST NO. 643)

Sample No.	pH	Resistivity (ohm centimeters)
GC SB3-1	8.3	320

TABLE B-V
SUMMARY OF LABORATORY WATER-SOLUBLE SULFATE TEST RESULTS
(CALIFORNIA TEST NO. 417)

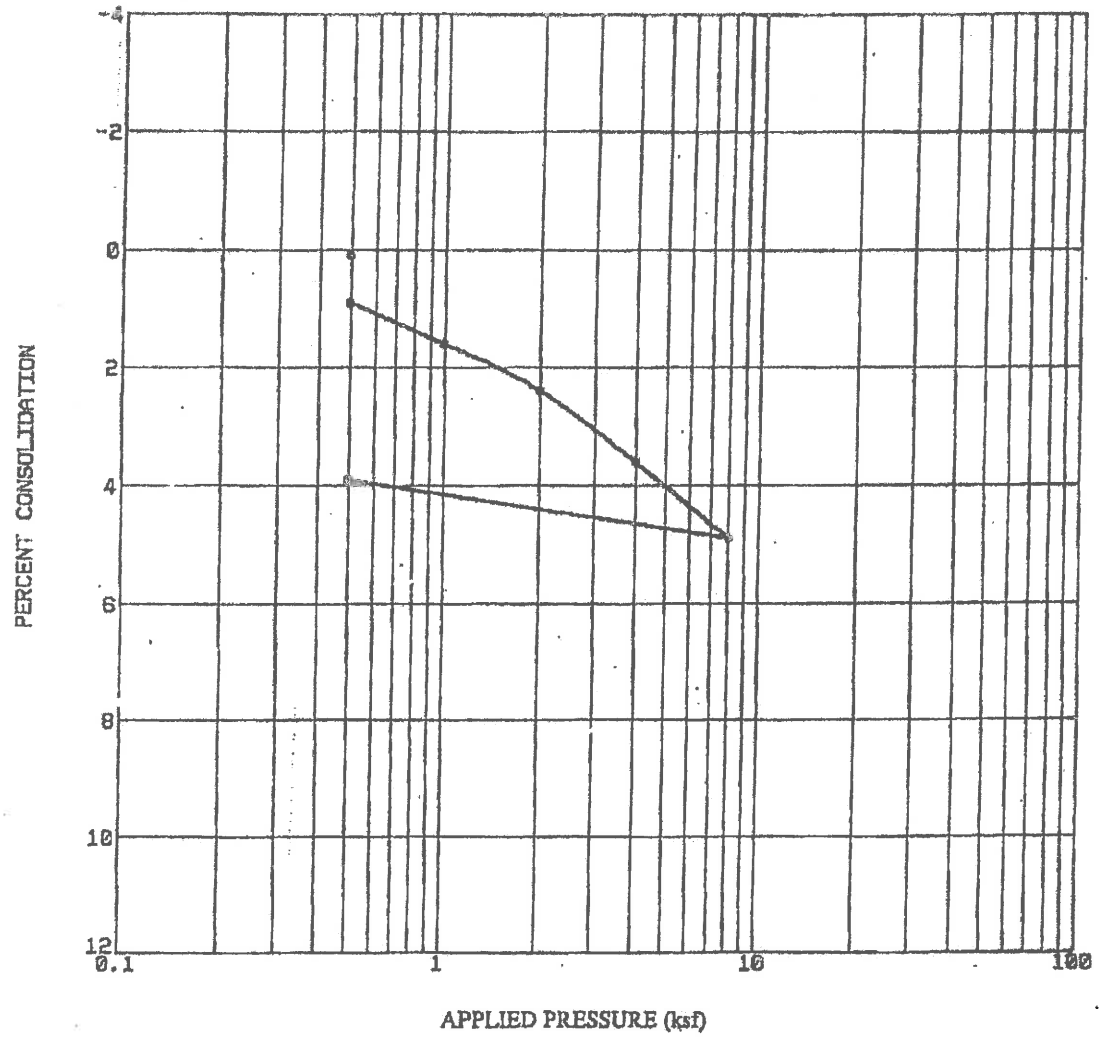
Sample No.	Water-Soluble Sulfate, ppm (%)
SB3-1	1410 (0.141)

TABLE B-VI
SUMMARY OF LABORATORY R-VALUE TEST RESULTS
(CALIFORNIA TEST 301)

Sample No.	Description	R-Value
SB1-1	Brown Silty SAND	20

PROJECT NO.

SAMPLE NO. SB2-5 GC



Initial Dry Density (pcf)	95.7	Initial Saturation (%)	100+
Initial Water Content (%)	31.7	Sample Saturated at (ksf)	.125

CONSOLIDATION CURVE

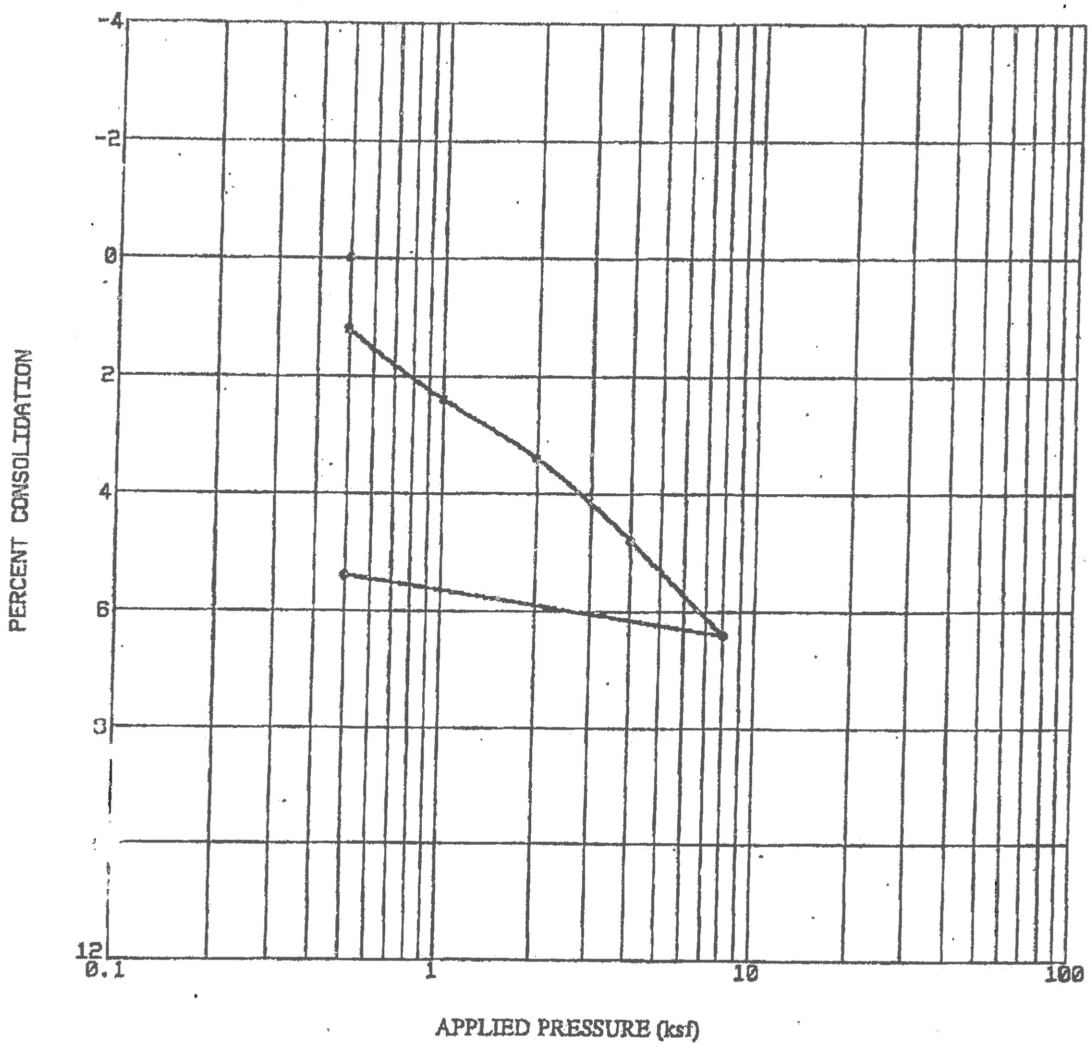
PRESIDIO VIEW

SAN DIEGO, CALIFORNIA

PROJECT NO.

GC

SAMPLE NO. SB3-4



Initial Dry Density (pcf)	101.4
Initial Water Content (%)	25.8

Initial Saturation (%)	100+
Sample Saturated at (ksf)	.125

CONSOLIDATION CURVE

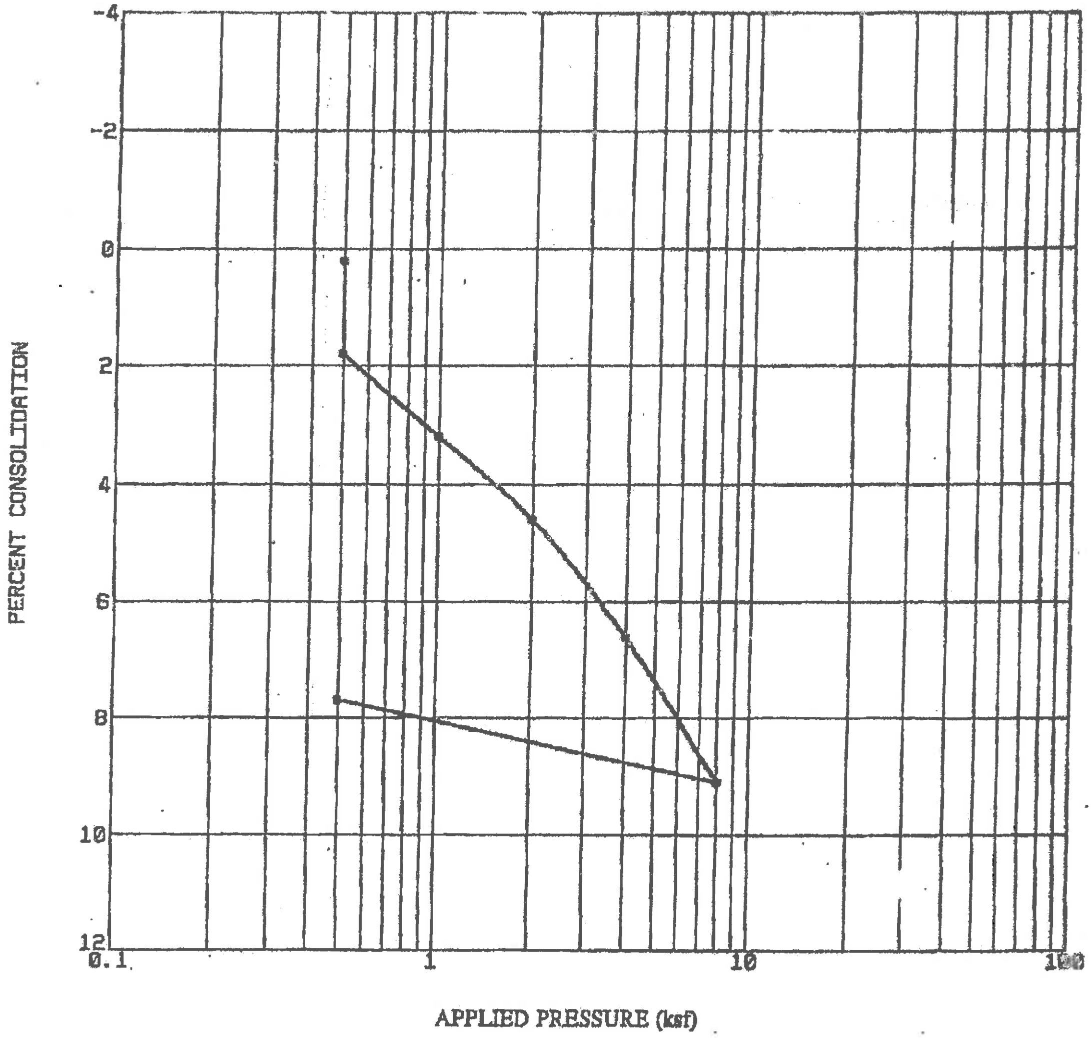
PRESIDIO VIEW

SAN DIEGO, CALIFORNIA

03 09 2001

PROJECT NO.

SAMPLE NO. GC SB4-3



Initial Dry Density (pcf)	95.5		Initial Saturation (%)	100+
Initial Water Content (%)	29.4		Sample Saturated at (ksf)	0

CONSOLIDATION CURVE

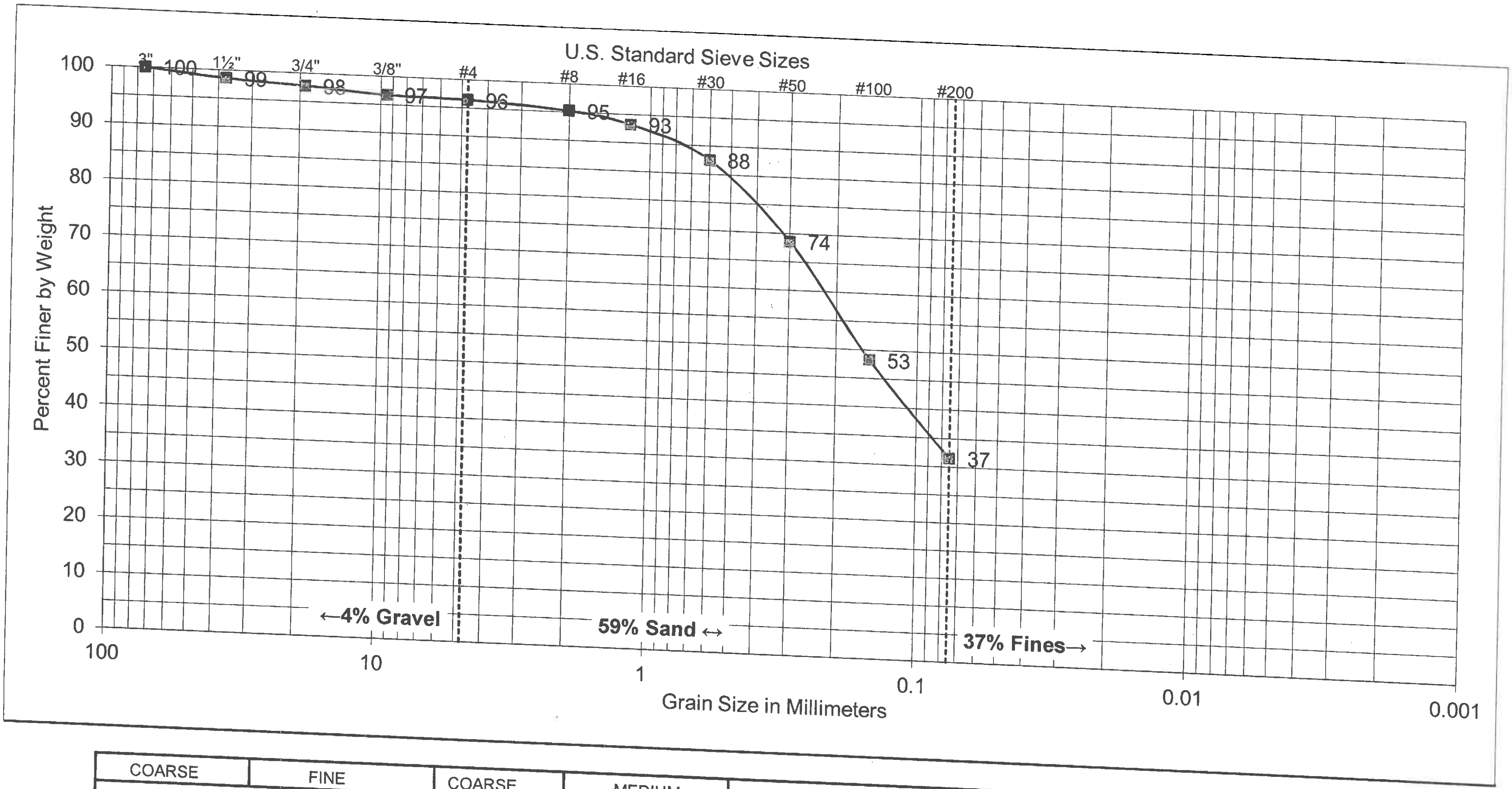
PRESIDIO VIEW

SAN DIEGO, CALIFORNIA

PRESV

Figure B-3

LABORATORY TEST RESULTS
BY GROUP DELTA (2014, 2015)



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-1

SAMPLE DEPTH: 1' - 5'

UNIFIED SOIL CLASSIFICATION: SC

DESCRIPTION: CLAYEY SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

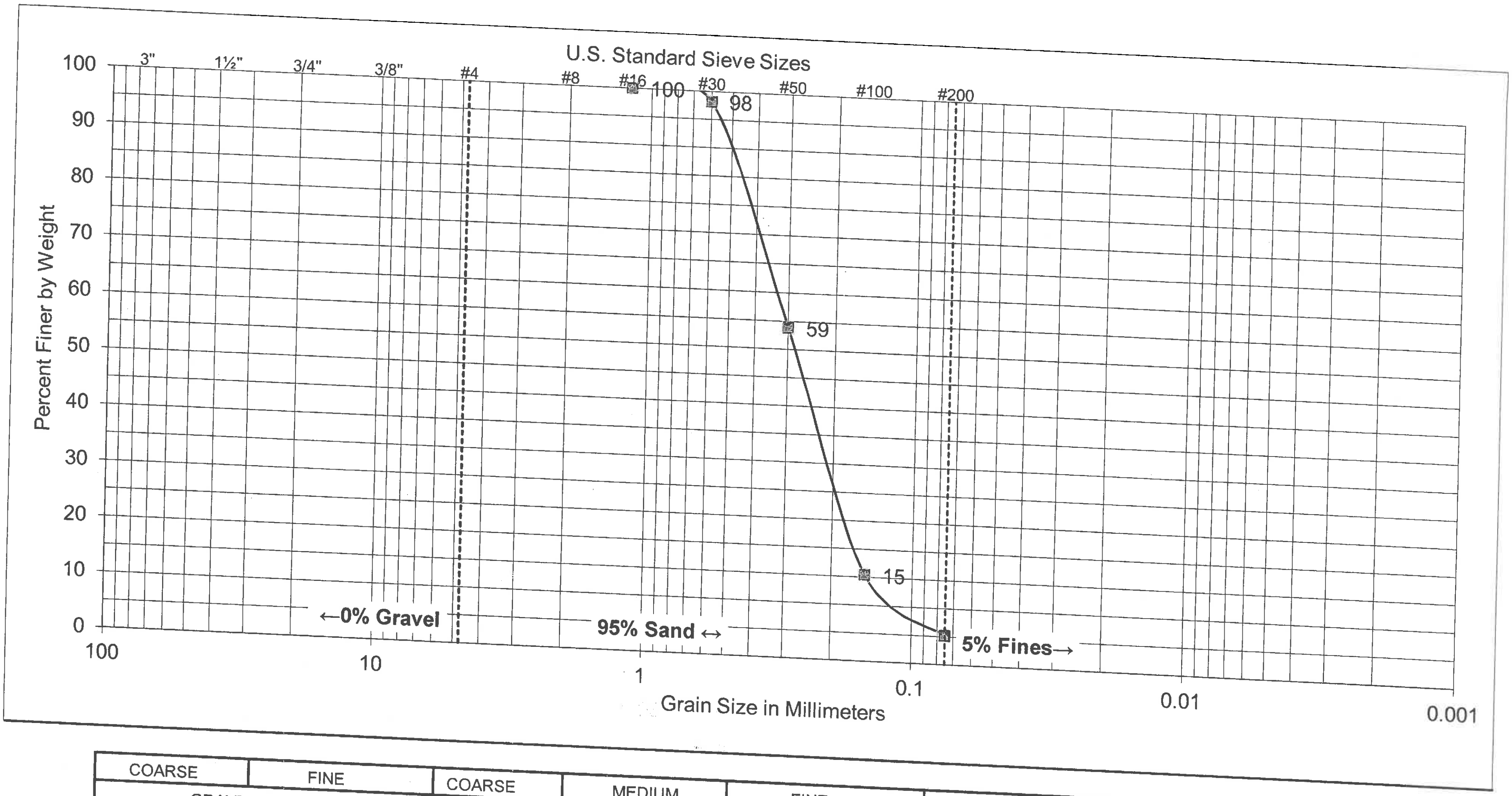
GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153

Project No. IR619

FIGURE B-1.1



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-1
SAMPLE DEPTH: 15' - 16½'

UNIFIED SOIL CLASSIFICATION: SP

DESCRIPTION: POORLY GRADED SAND

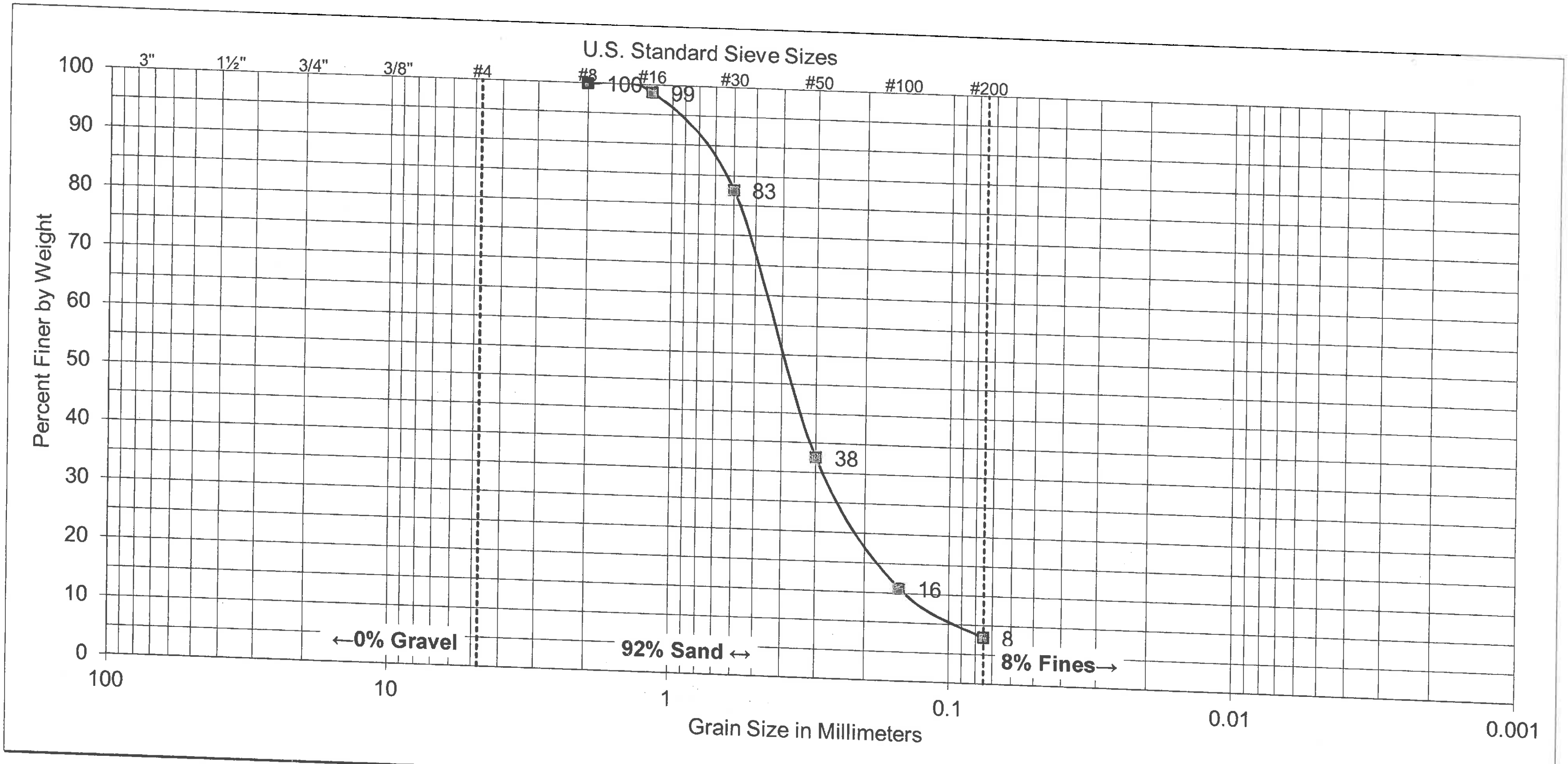
ATTERBERG LIMITS

LIQUID LIMIT: ---
PLASTIC LIMIT: ---
PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153
Project No. IR619
FIGURE B-1.2



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE	
BORING NO:	B-1
SAMPLE DEPTH:	25' - 26½'

UNIFIED SOIL CLASSIFICATION: SP-SM

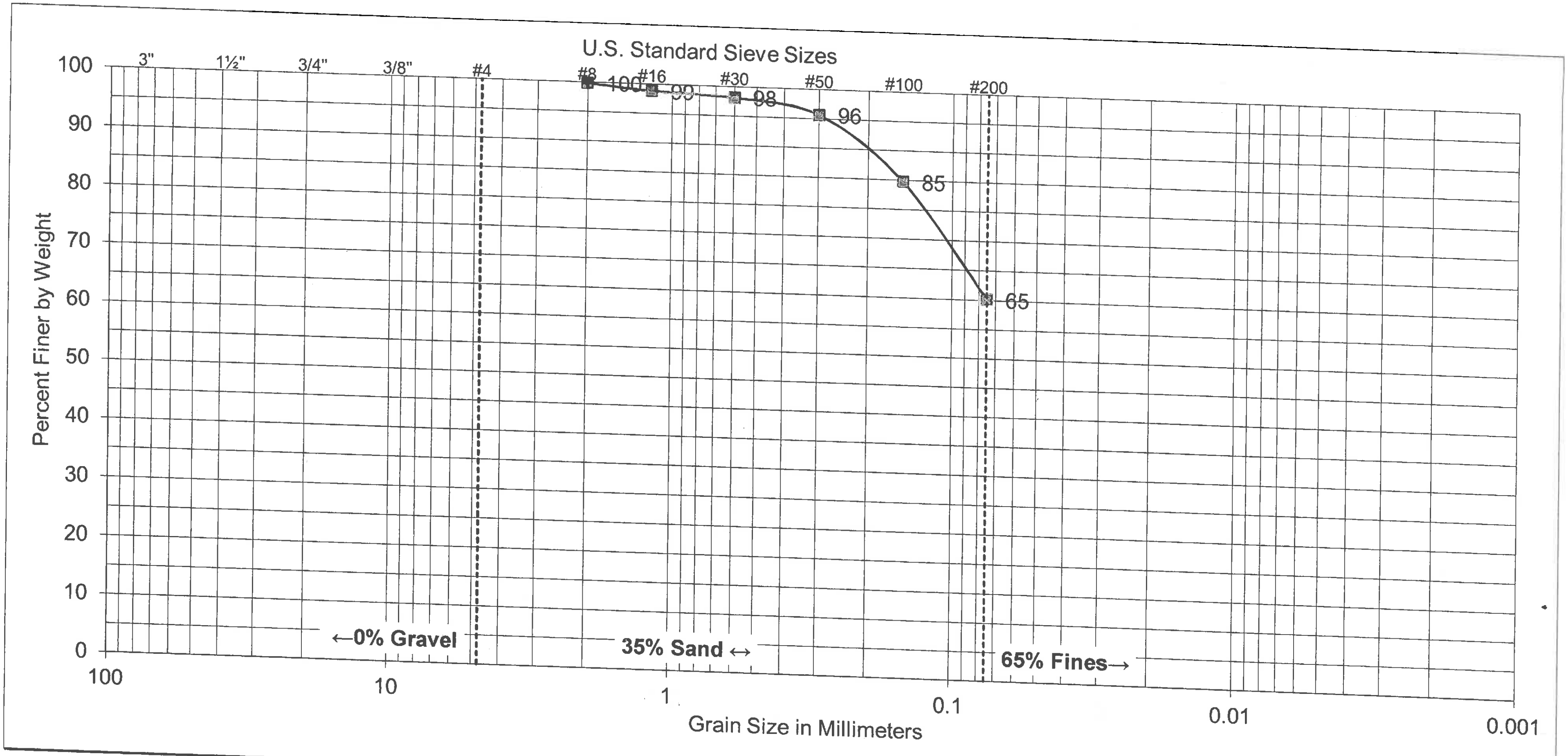
DESCRIPTION: POORLY GRADED SAND WITH SILT

ATTERBERG LIMITS	
LIQUID LIMIT:	---
PLASTIC LIMIT:	---
PLASTICITY INDEX:	---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153
Project No. IR619
FIGURE B-1.3



GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
BORING NO:	B-1
SAMPLE DEPTH:	35' - 36½'

UNIFIED SOIL CLASSIFICATION: ML

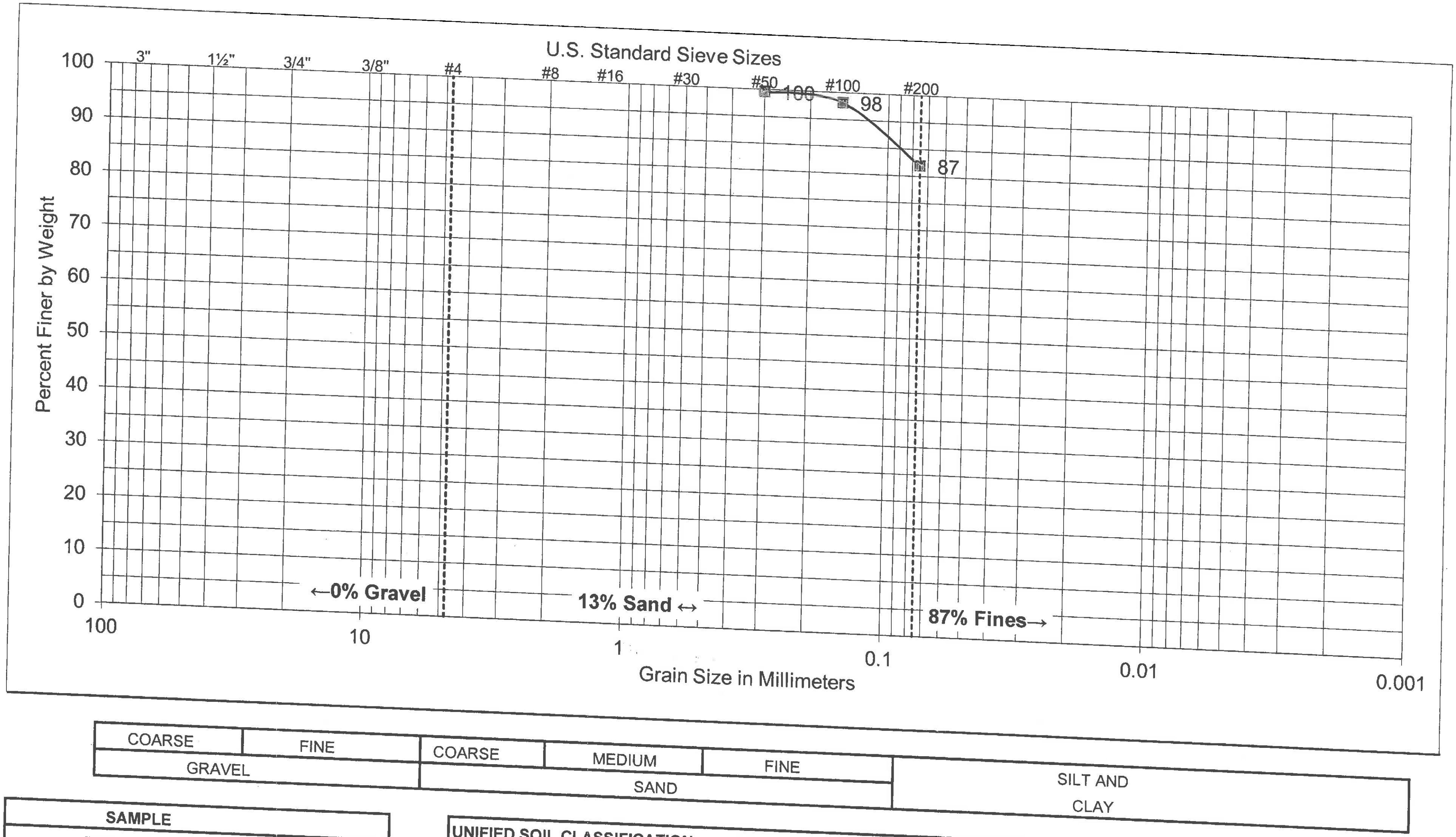
DESCRIPTION: SANDY SILT

ATTERBERG LIMITS	
LIQUID LIMIT:	---
PLASTIC LIMIT:	---
PLASTICITY INDEX:	---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153
Project No. IR619
FIGURE B-1.4



SAMPLE

BORING NO: B-1

SAMPLE DEPTH: 45' - 46½'

UNIFIED SOIL CLASSIFICATION: ML

DESCRIPTION: SILT

ATTERBERG LIMITS

LIQUID LIMIT: ---

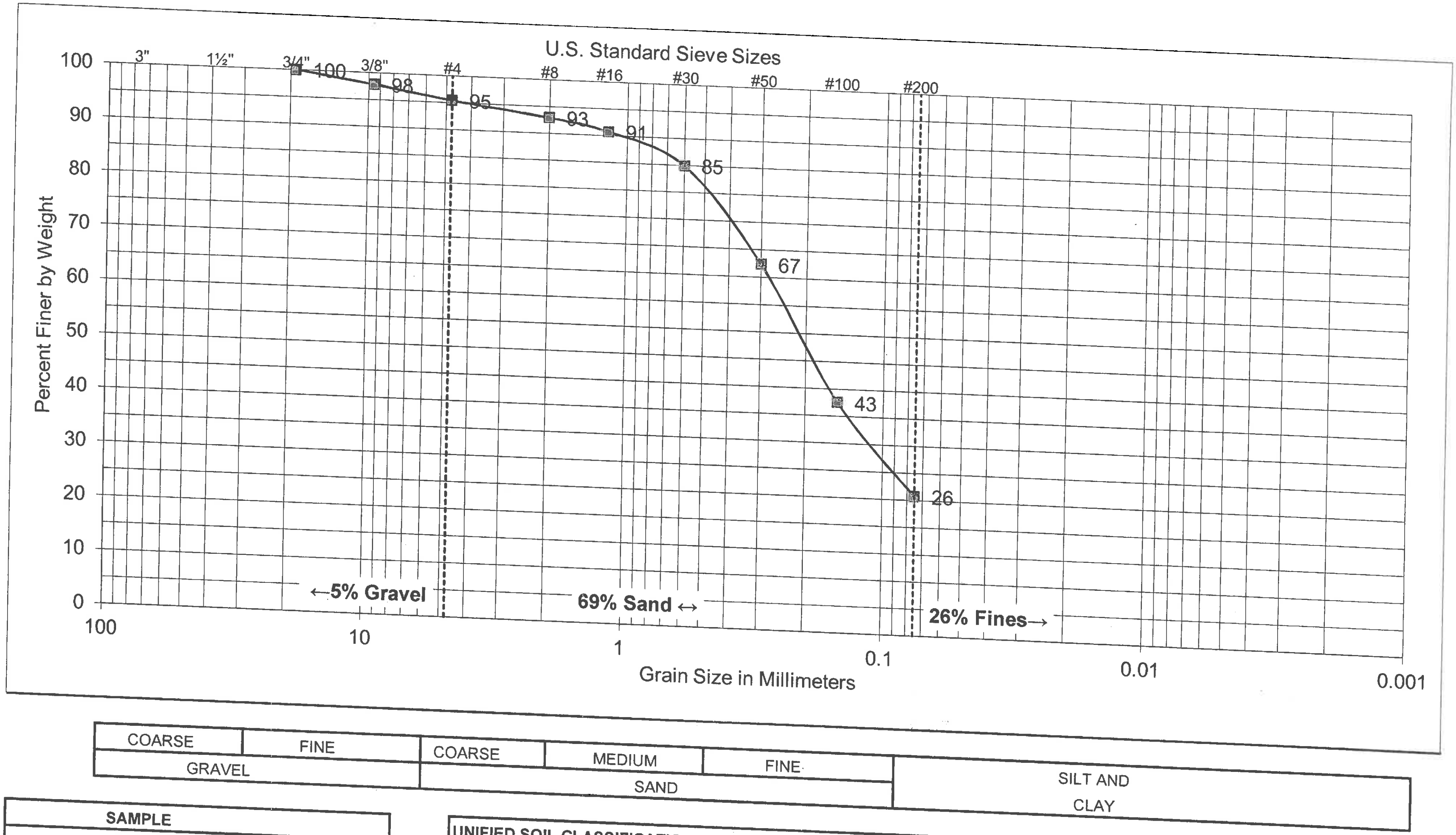
PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153
Project No. IR619
FIGURE B-1.5



SAMPLE

BORING NO: B-2

SAMPLE DEPTH: 1' - 5'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

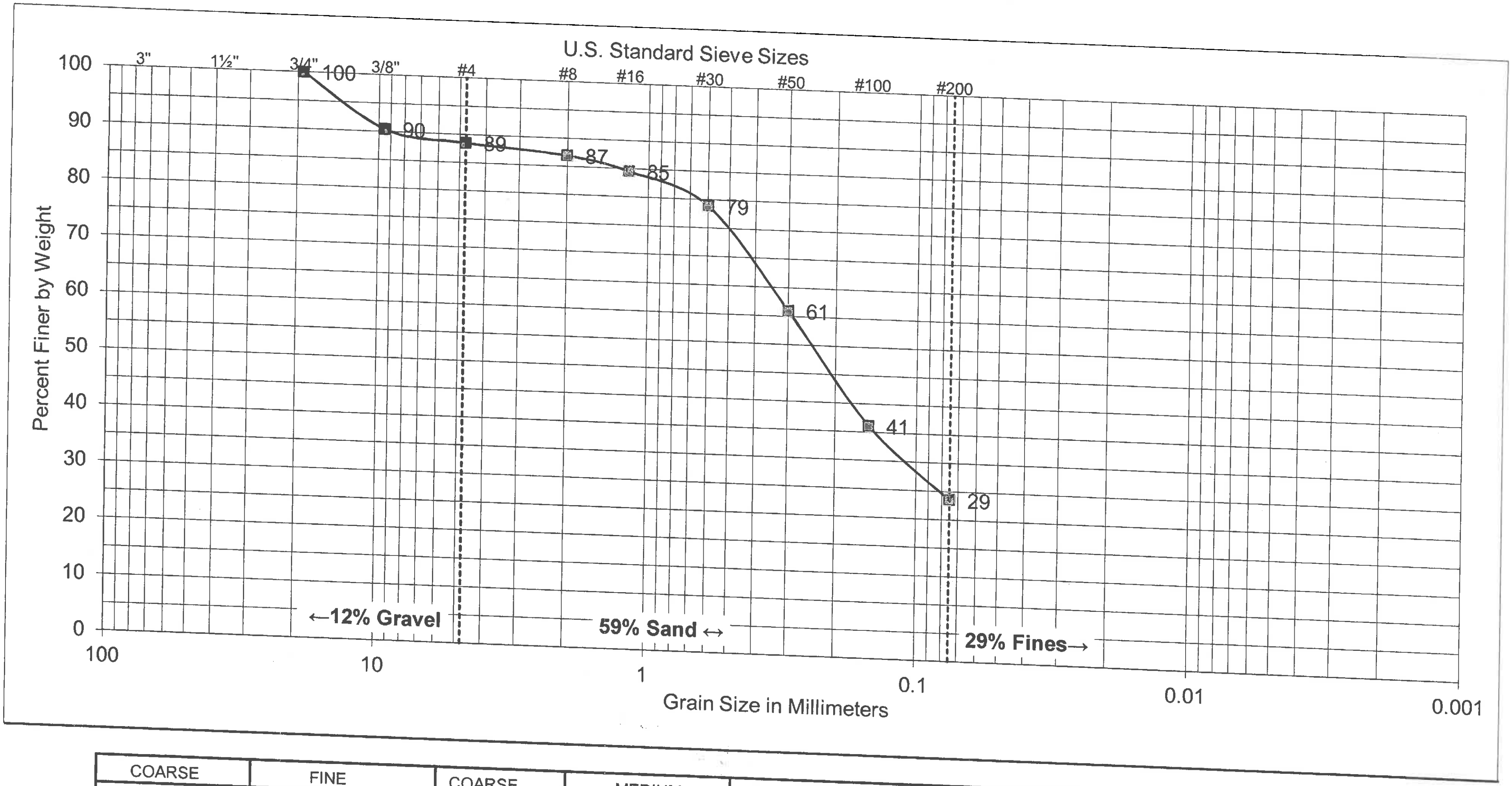
PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153
Project No. IR619
FIGURE B-1.6



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-2

SAMPLE DEPTH: 5' - 6½'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

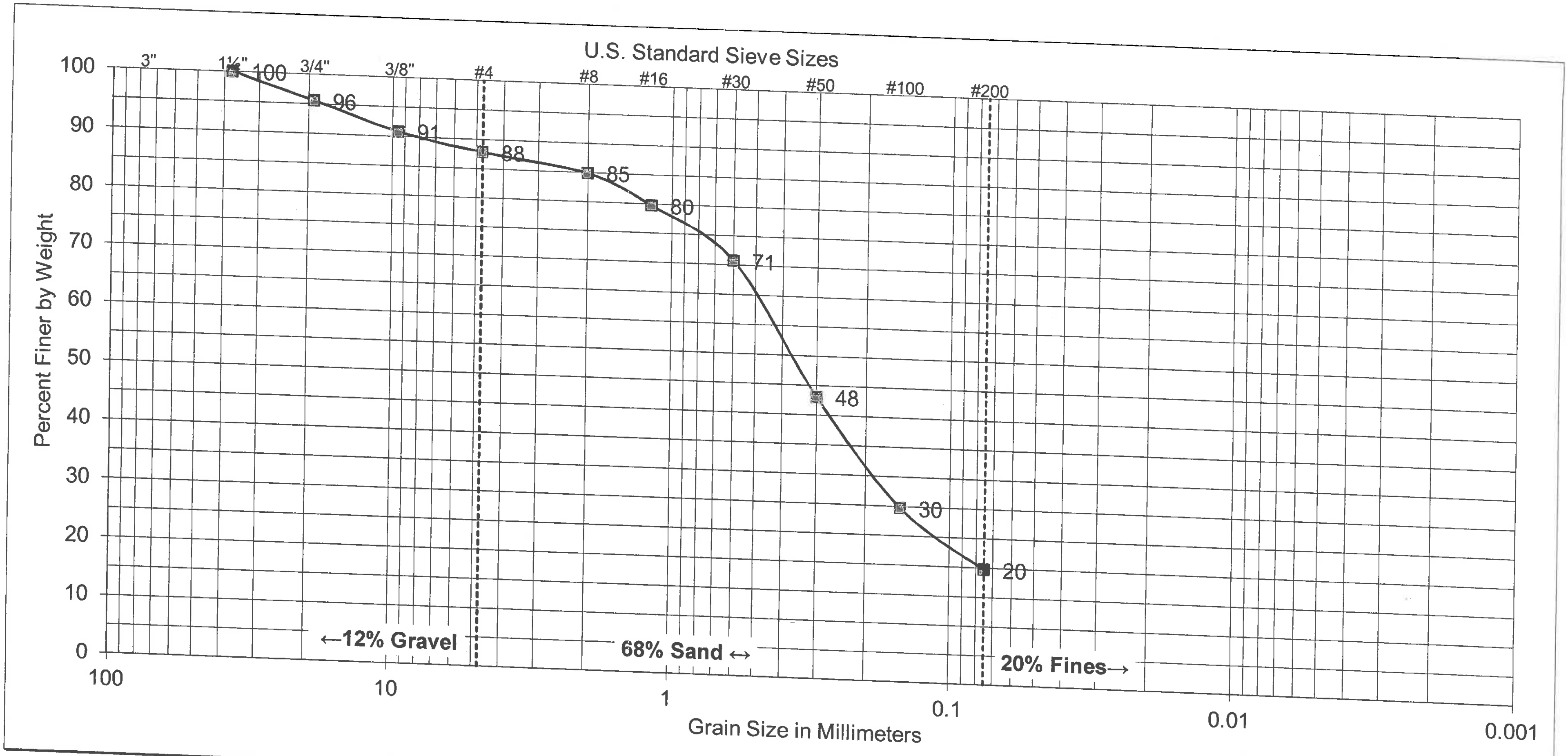
PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153
Project No. IR619
FIGURE B-1.7



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-3

SAMPLE DEPTH: 0' - 5'

UNIFIED SOIL CLASSIFICATION: SC

DESCRIPTION: CLAYEY SAND

ATTERBERG LIMITS

LIQUID LIMIT: 29

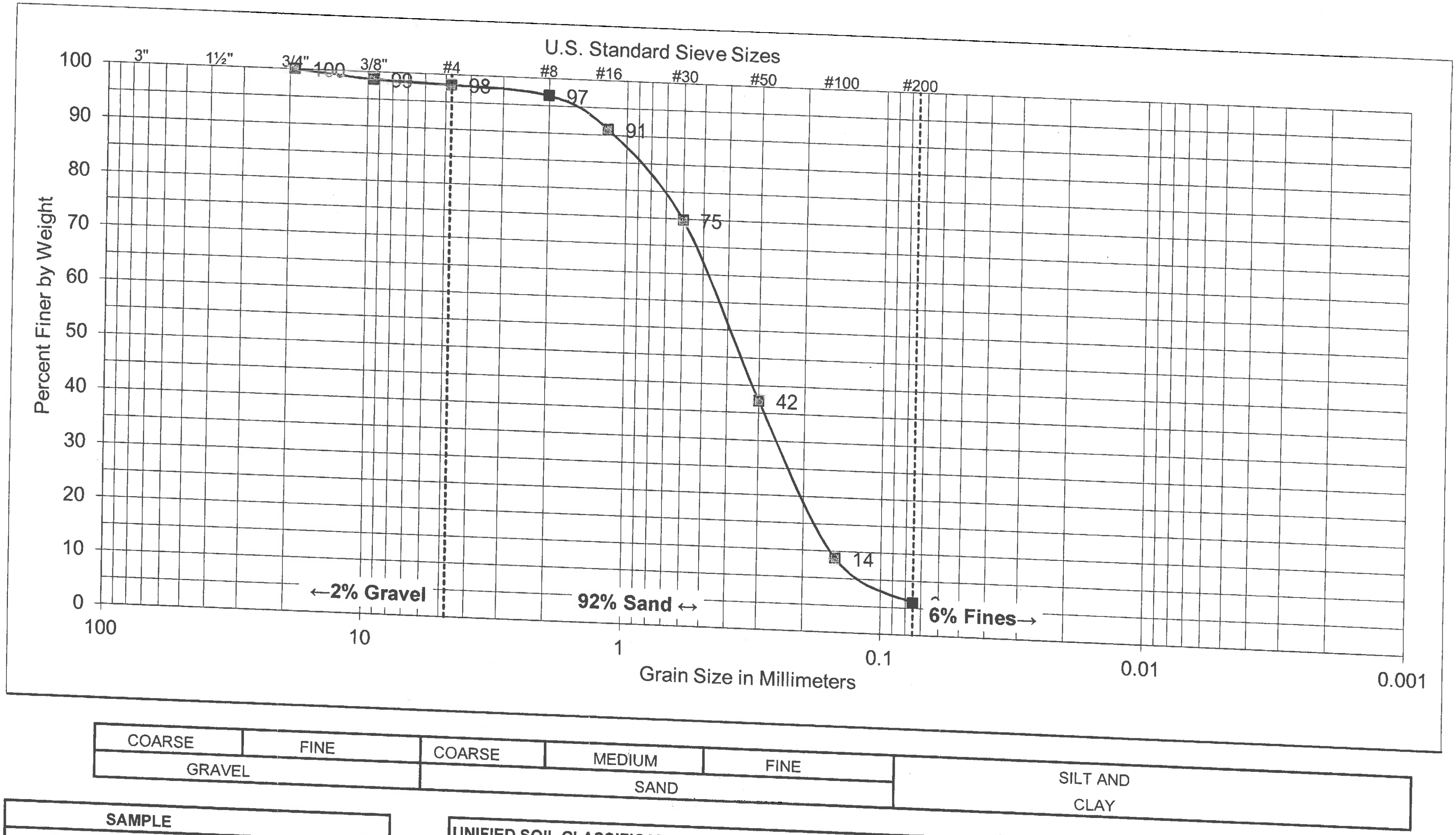
PLASTIC LIMIT: 17

PLASTICITY INDEX: 12

GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153
Project No. IR619
FIGURE B-1.8



SAMPLE

BORING NO: B-3
SAMPLE DEPTH: 15' - 16½'

UNIFIED SOIL CLASSIFICATION: SP-SM

DESCRIPTION: POORLY GRADED SAND WITH SILT

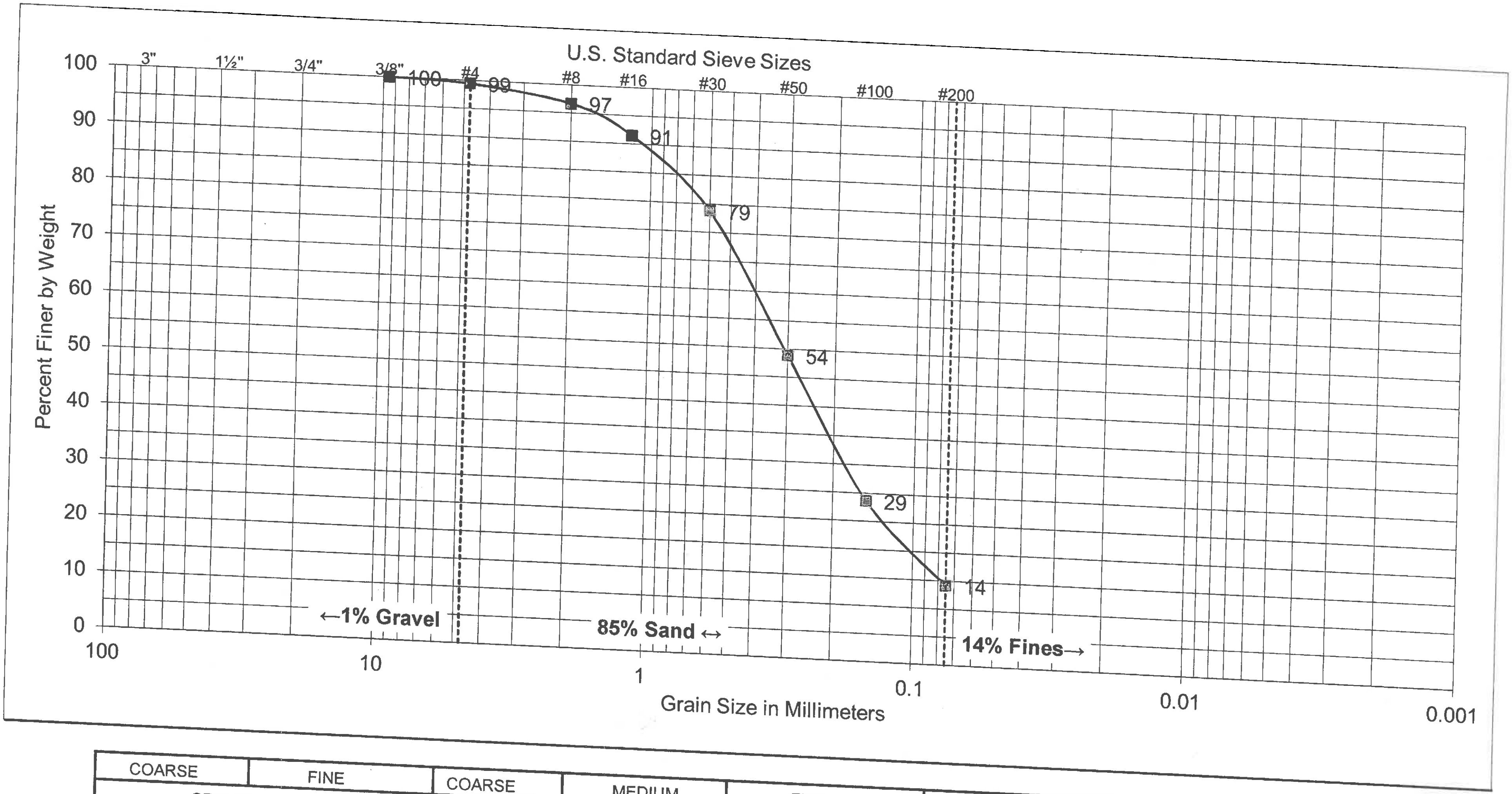
ATTERBERG LIMITS

LIQUID LIMIT: ---
PLASTIC LIMIT: ---
PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153
Project No. IR619
FIGURE B-1.9



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-3

SAMPLE DEPTH: 25' - 26½'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

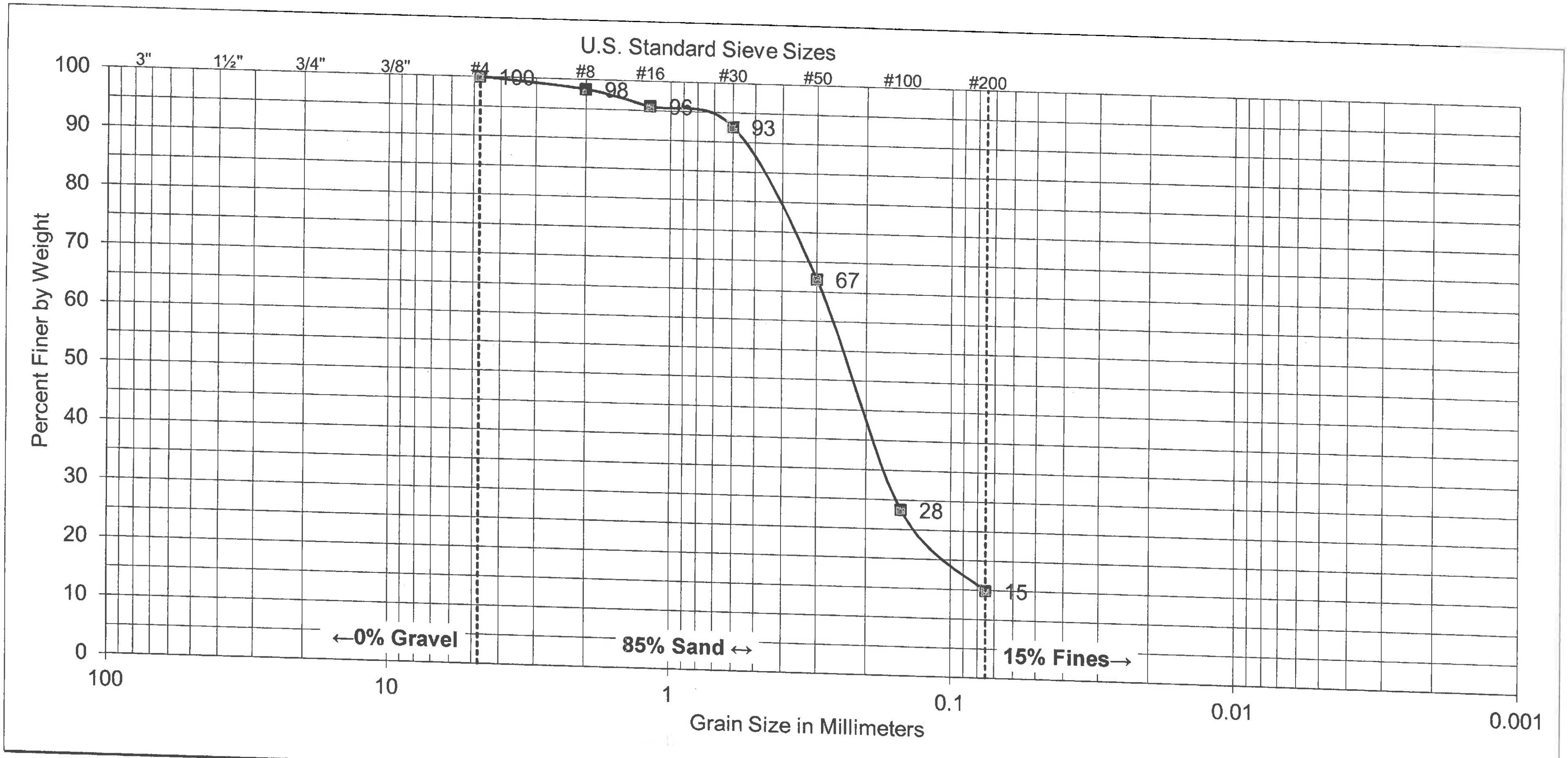
PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153
Project No. IR619
FIGURE B-1.10



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-3

SAMPLE DEPTH: 35' - 36½'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

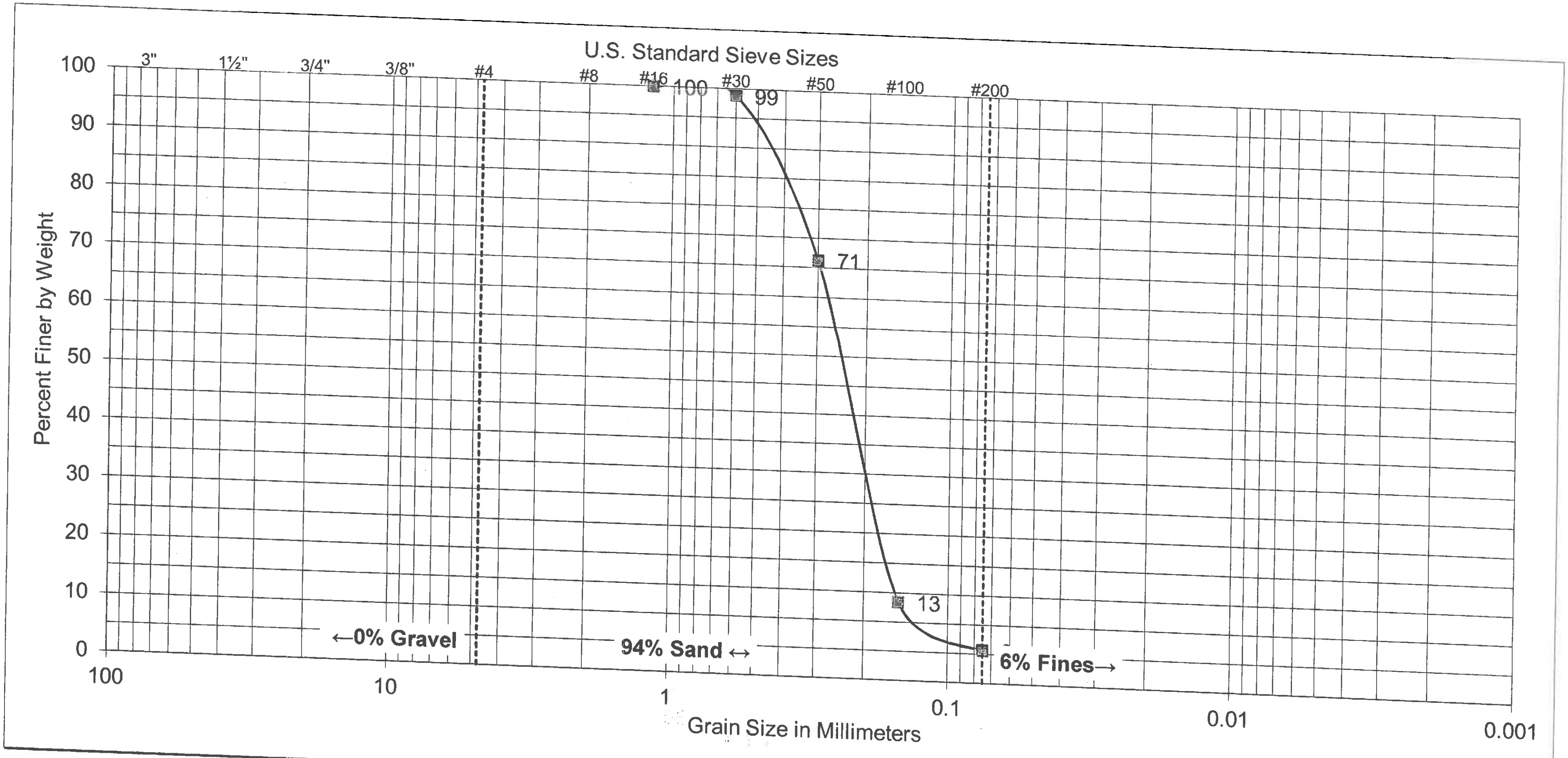
PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153
Project No. IR619
FIGURE B-1.11



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-3

SAMPLE DEPTH: 45' - 46½'

UNIFIED SOIL CLASSIFICATION: SP-SM

DESCRIPTION: POORLY GRADED SAND WITH SILT

ATTERBERG LIMITS

LIQUID LIMIT: ---

PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

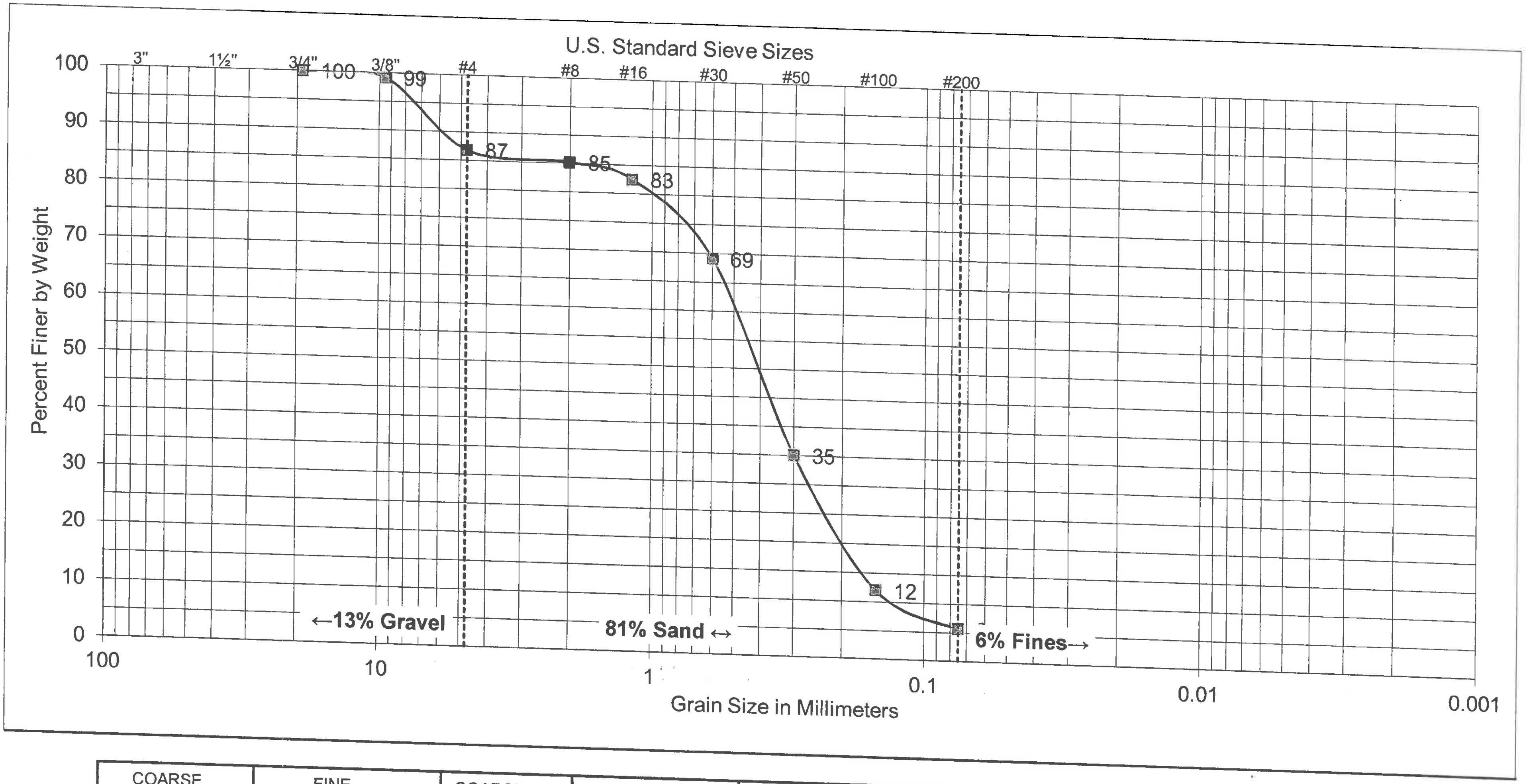
GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153

Project No. IR619

FIGURE B-1.12



GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE

BORING NO: B-4
SAMPLE DEPTH: 1' - 5'

UNIFIED SOIL CLASSIFICATION: SP-SM

DESCRIPTION: POORLY GRADED SAND WITH SILT

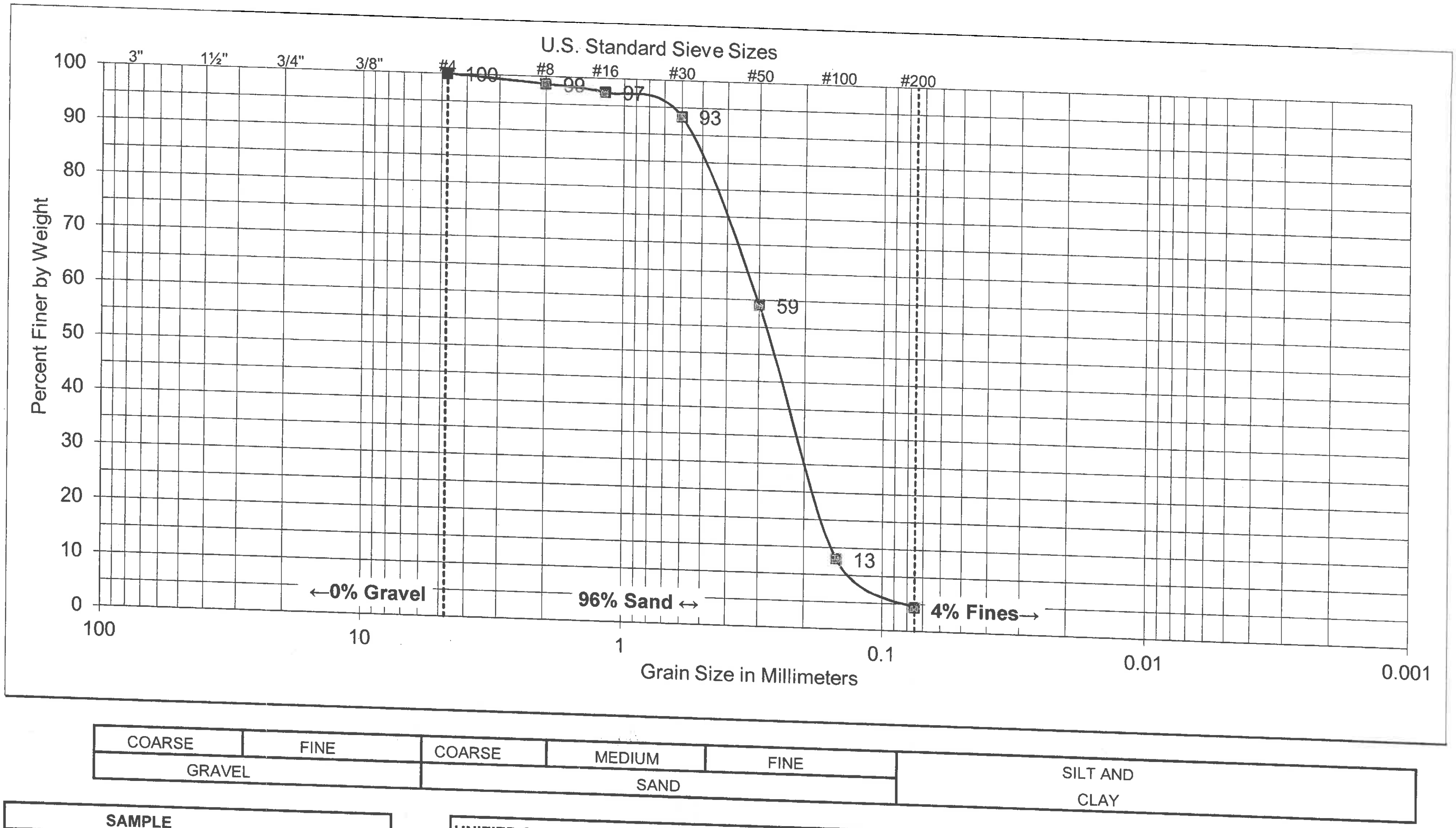
ATTERBERG LIMITS

LIQUID LIMIT: ---
PLASTIC LIMIT: ---
PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153
Project No. IR619
FIGURE B-1.13



SAMPLE

BORING NO: B-4

SAMPLE DEPTH: 10' - 11½'

UNIFIED SOIL CLASSIFICATION: SP

DESCRIPTION: POORLY GRADED SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

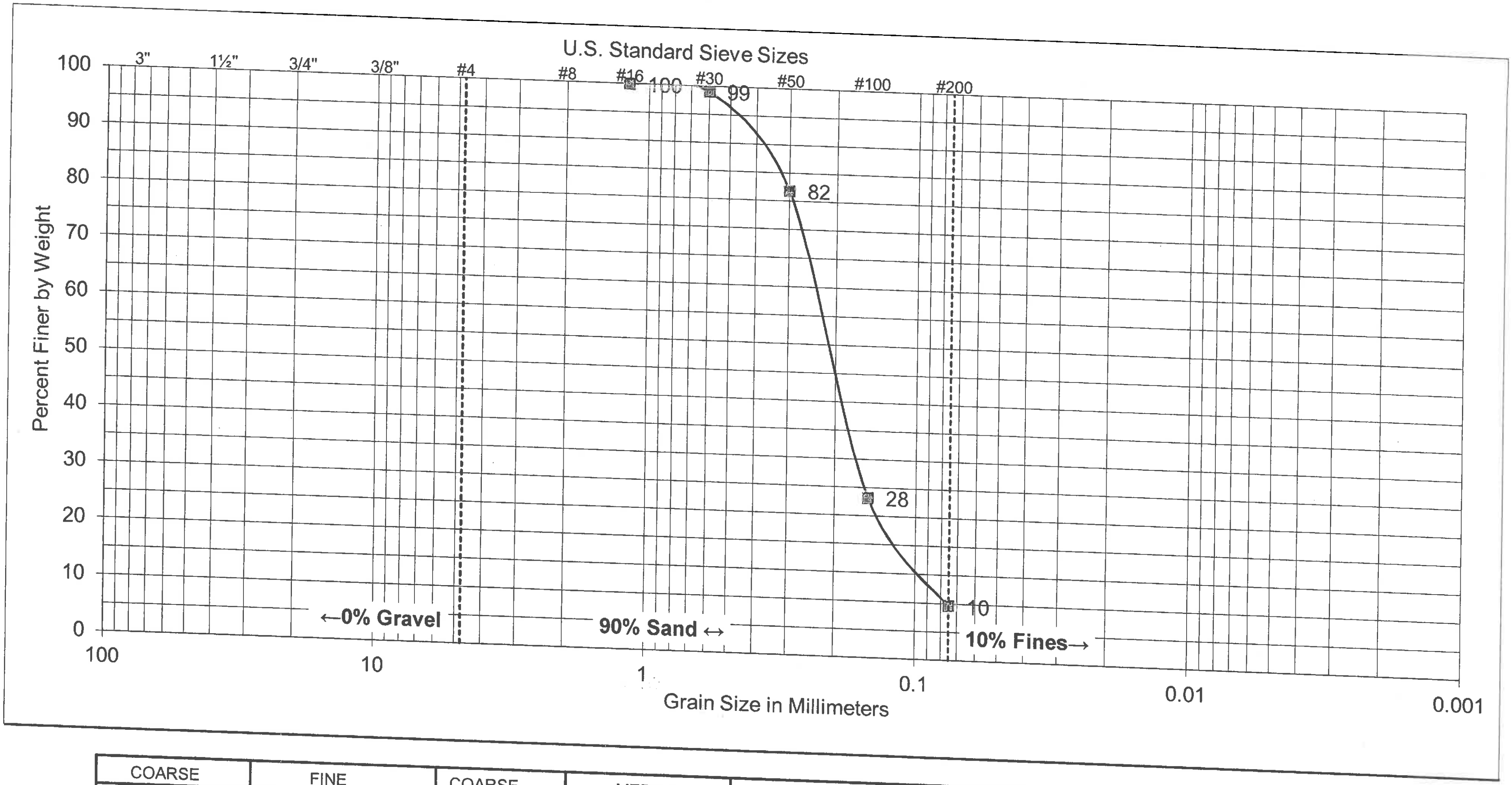
GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153

Project No. IR619

FIGURE B-1.14



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO:	B-4
SAMPLE DEPTH:	20' - 21½'

UNIFIED SOIL CLASSIFICATION: SP-SM

DESCRIPTION: POORLY GRADED SAND WITH SILT

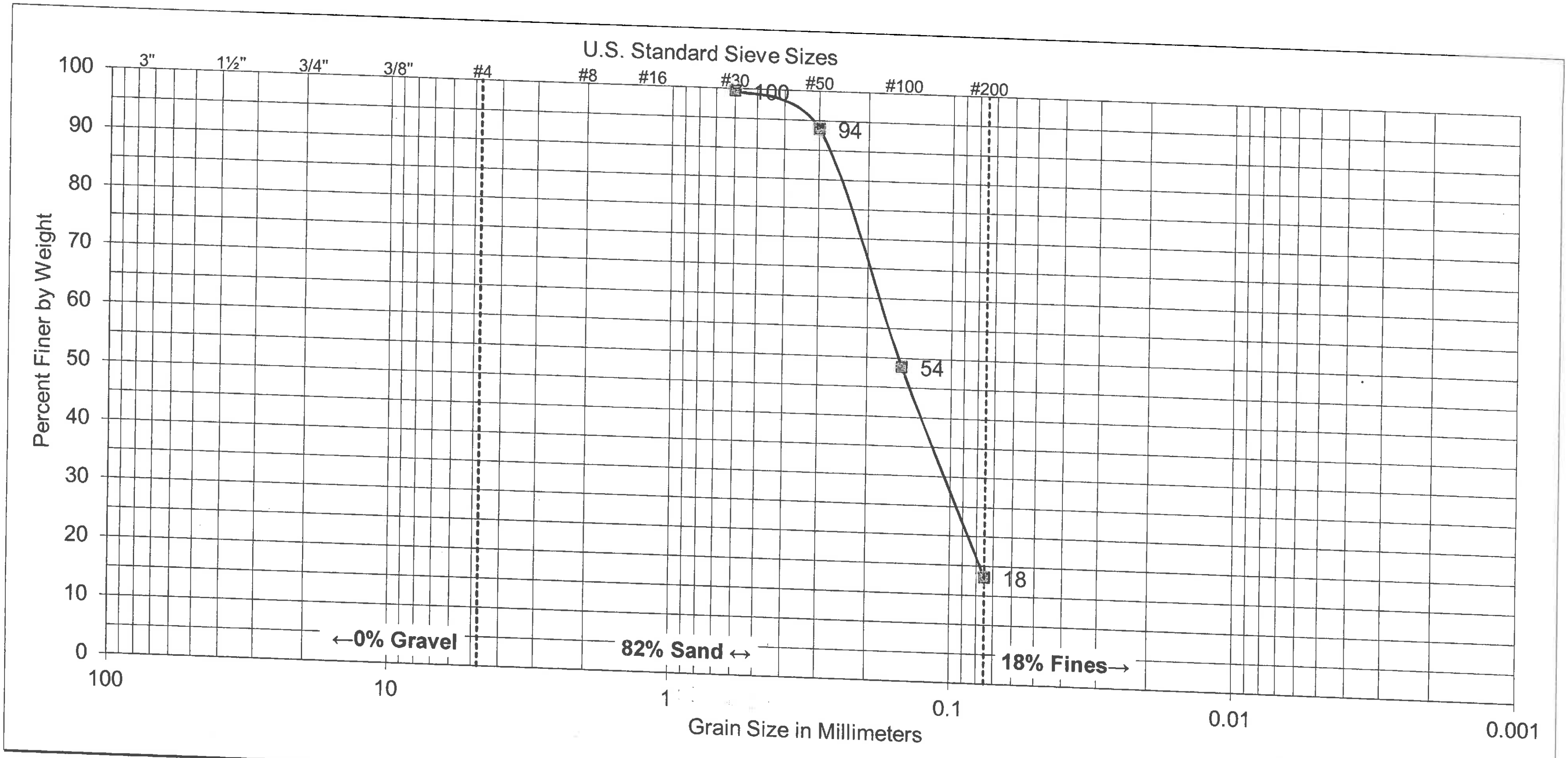
ATTERBERG LIMITS

LIQUID LIMIT:	---
PLASTIC LIMIT:	---
PLASTICITY INDEX:	---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153
Project No. IR619
FIGURE B-1.15



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-4

SAMPLE DEPTH: 30' - 31½'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

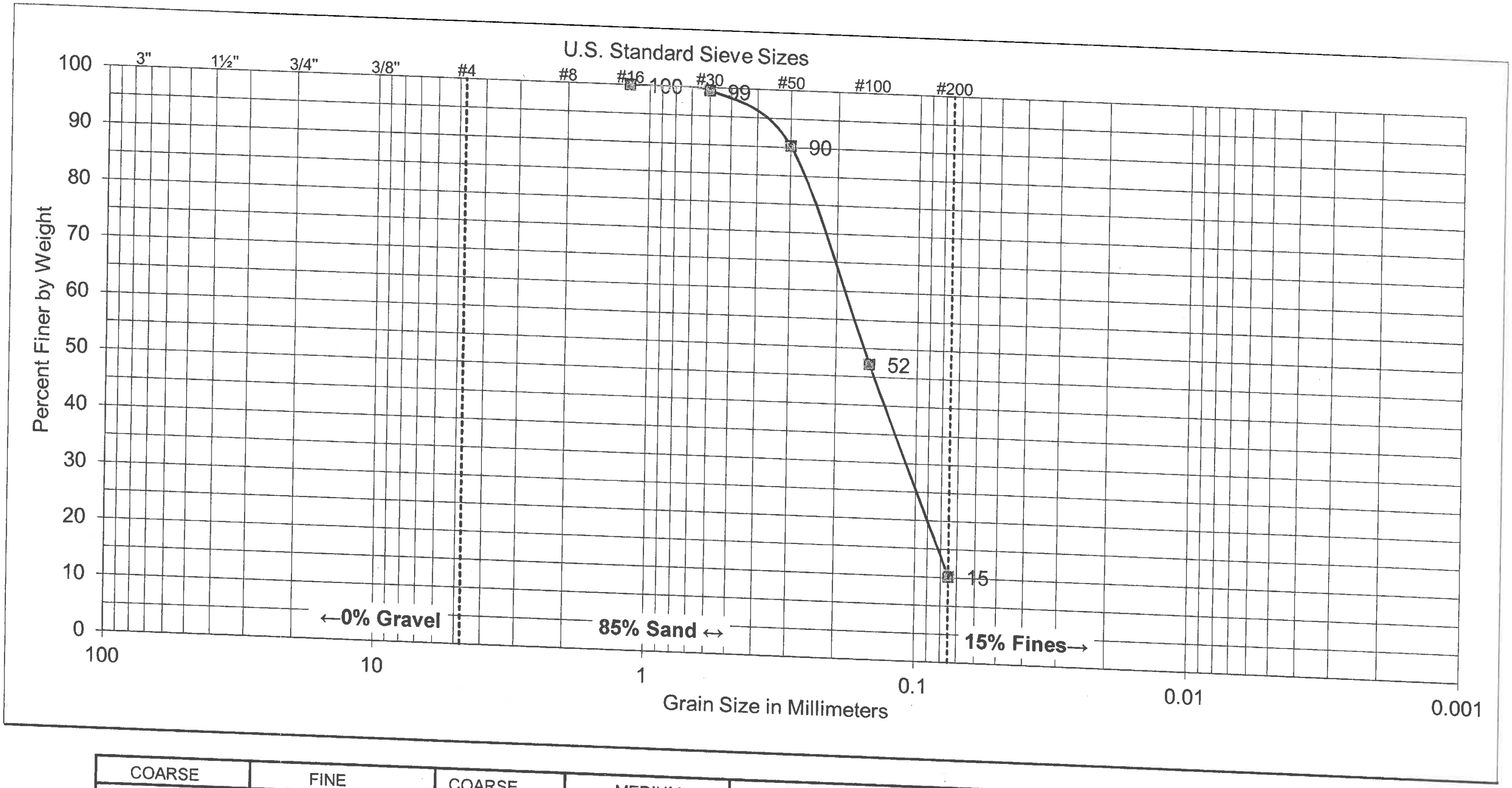
PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153
Project No. IR619
FIGURE B-1.16



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-4

SAMPLE DEPTH: 40' - 41½'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

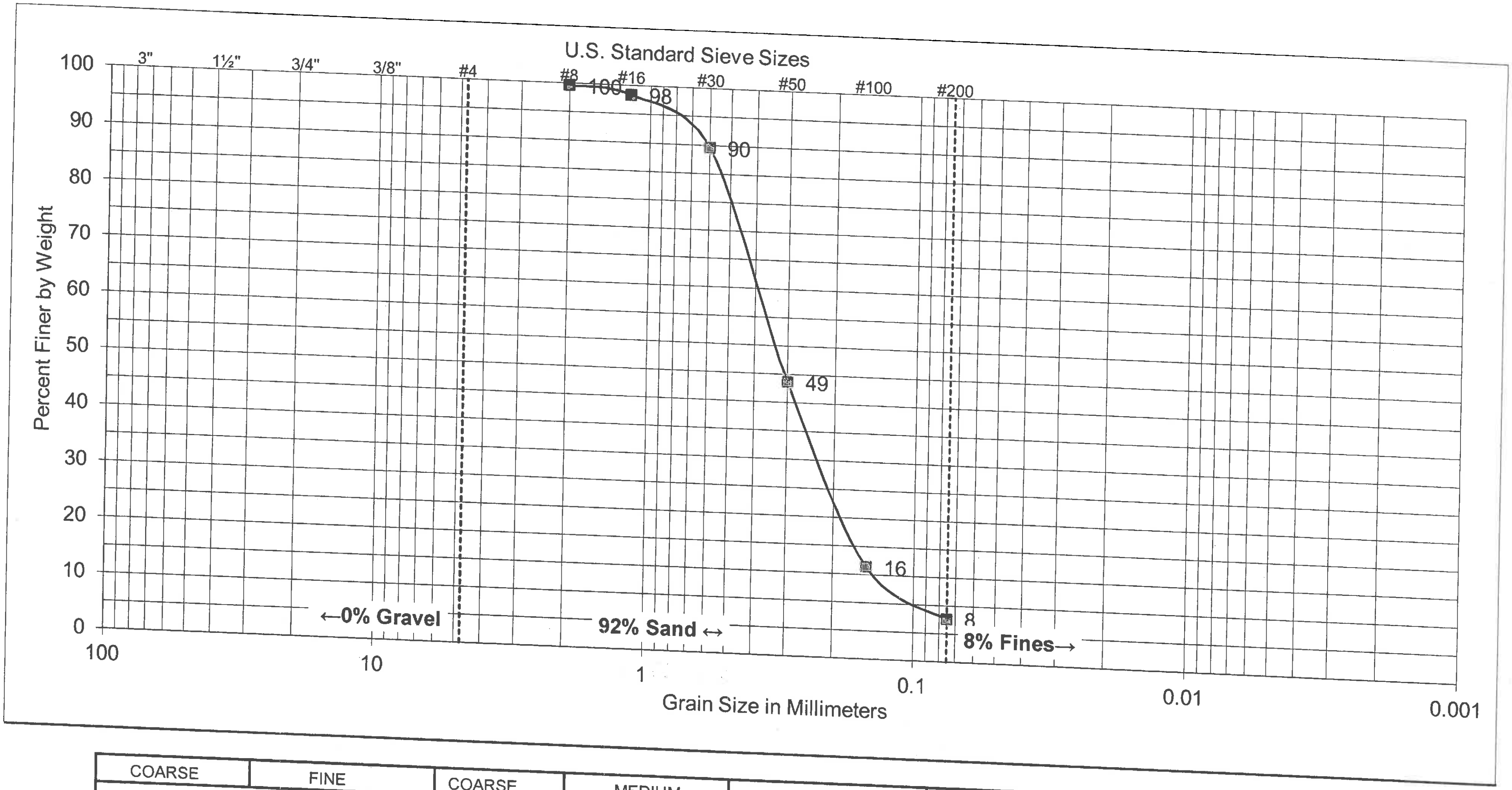
GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153

Project No. IR619

FIGURE B-1.17



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-4

SAMPLE DEPTH: 50' - 51½'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

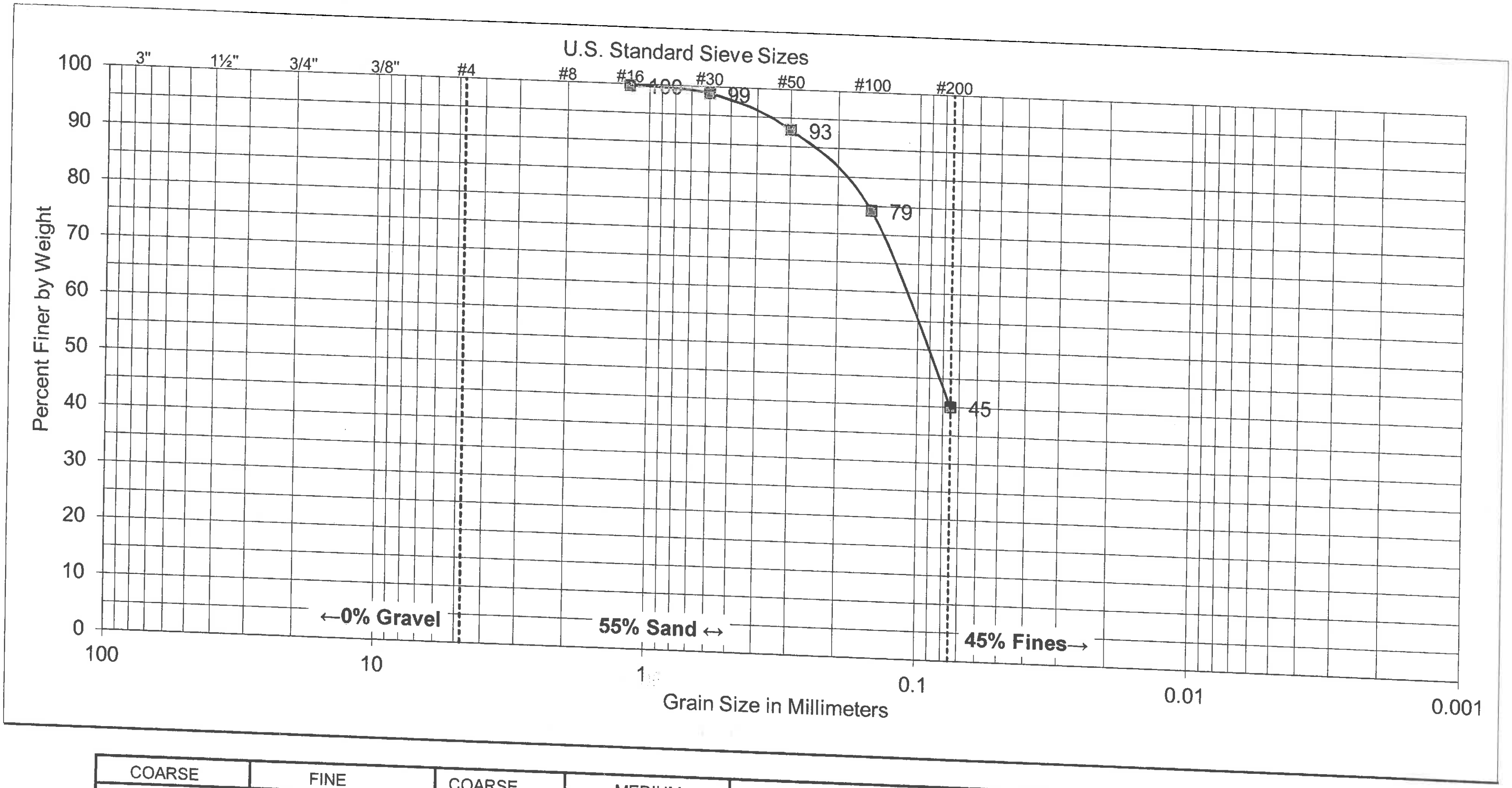
PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153
Project No. IR619
FIGURE B-1.18



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-5

SAMPLE DEPTH: 1' - 5'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

ATTERBERG LIMITS

LIQUID LIMIT: NP

PLASTIC LIMIT: NP

PLASTICITY INDEX: NP

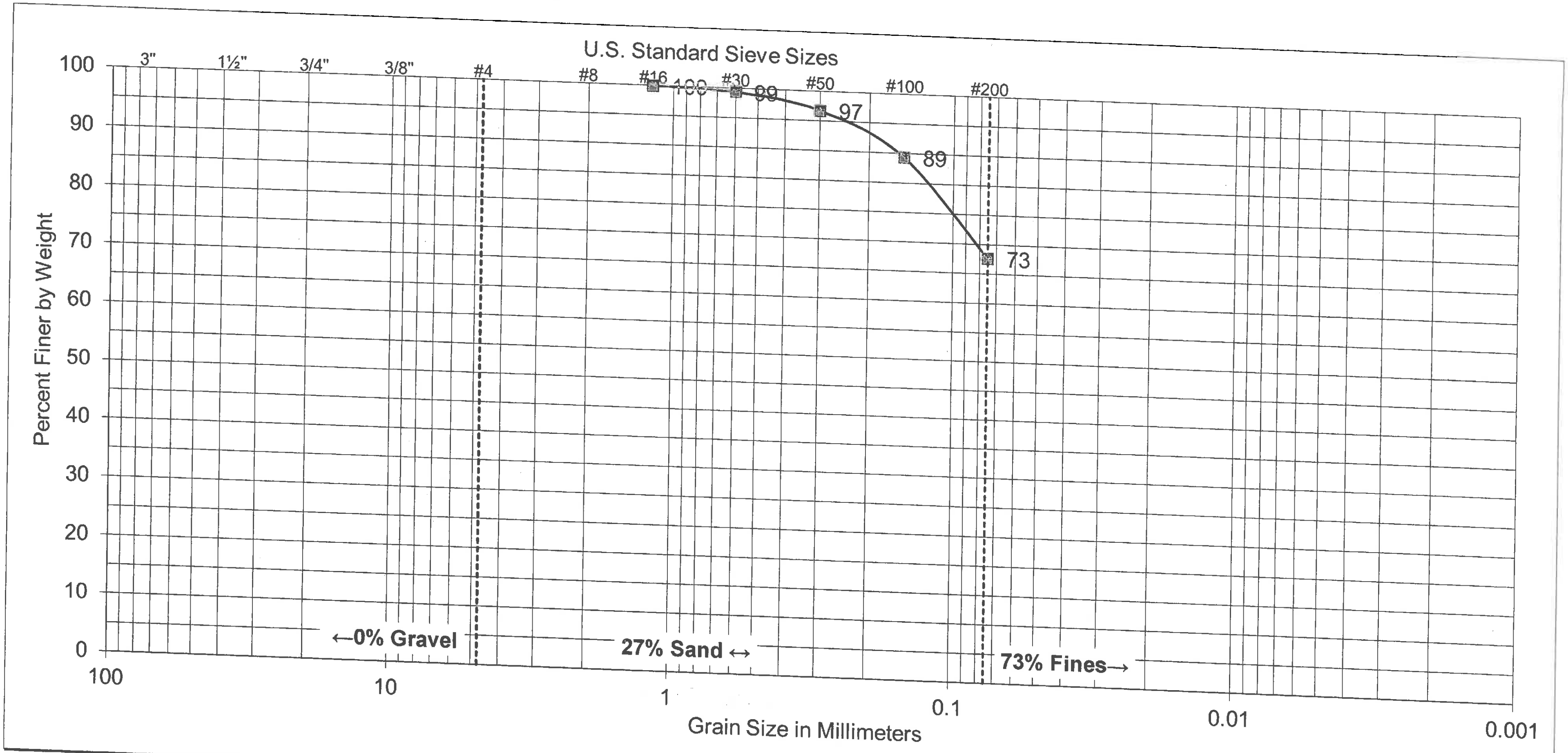
GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153

Project No. IR619

FIGURE B-1.19



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-5

SAMPLE DEPTH: 5' - 6½'

UNIFIED SOIL CLASSIFICATION: ML

DESCRIPTION: SILT WITH SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

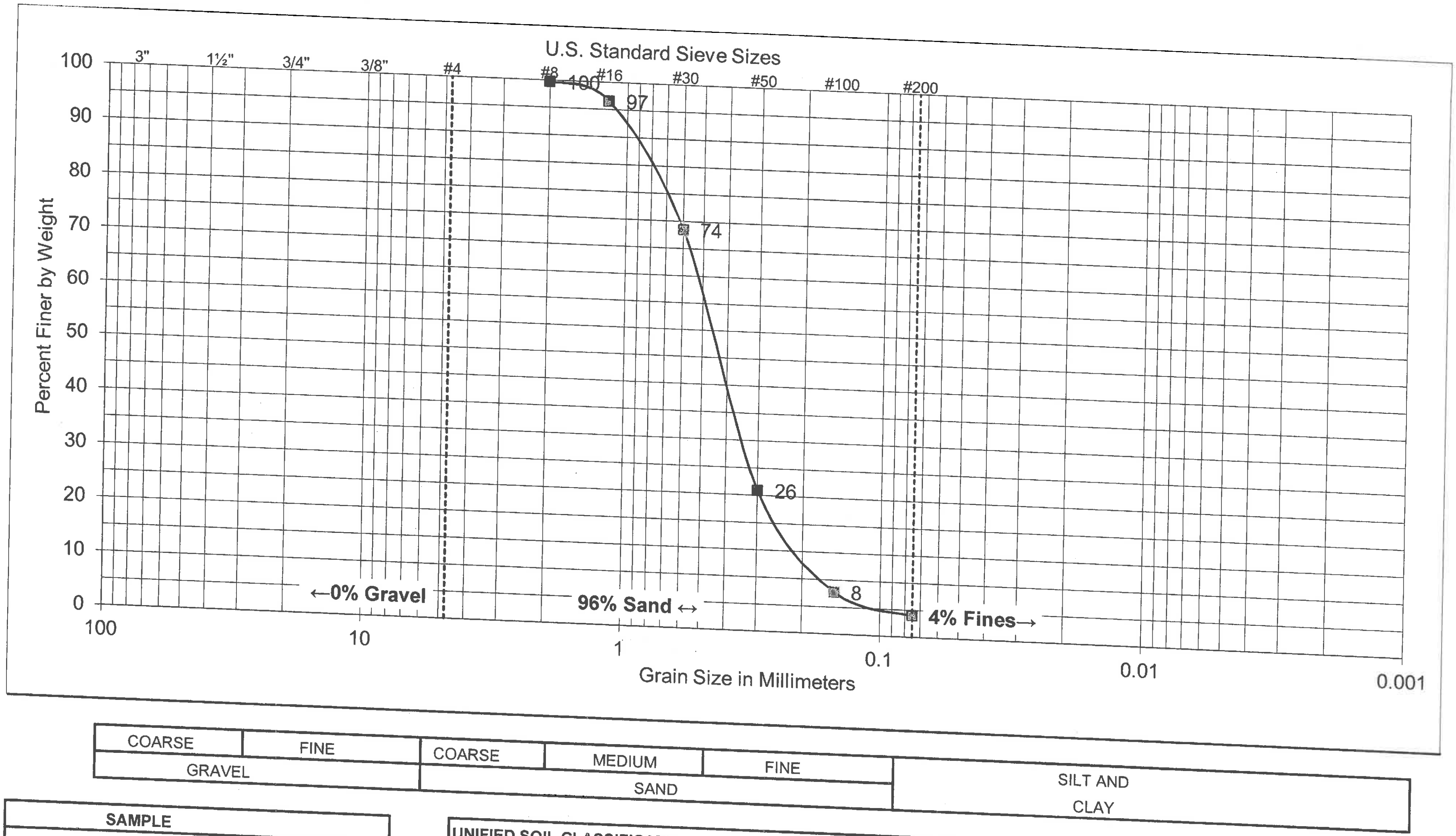
GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153

Project No. IR619

FIGURE B-1.20



SAMPLE

BORING NO: B-5

SAMPLE DEPTH: 15' - 16½'

UNIFIED SOIL CLASSIFICATION: SP

DESCRIPTION: POORLY GRADED SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

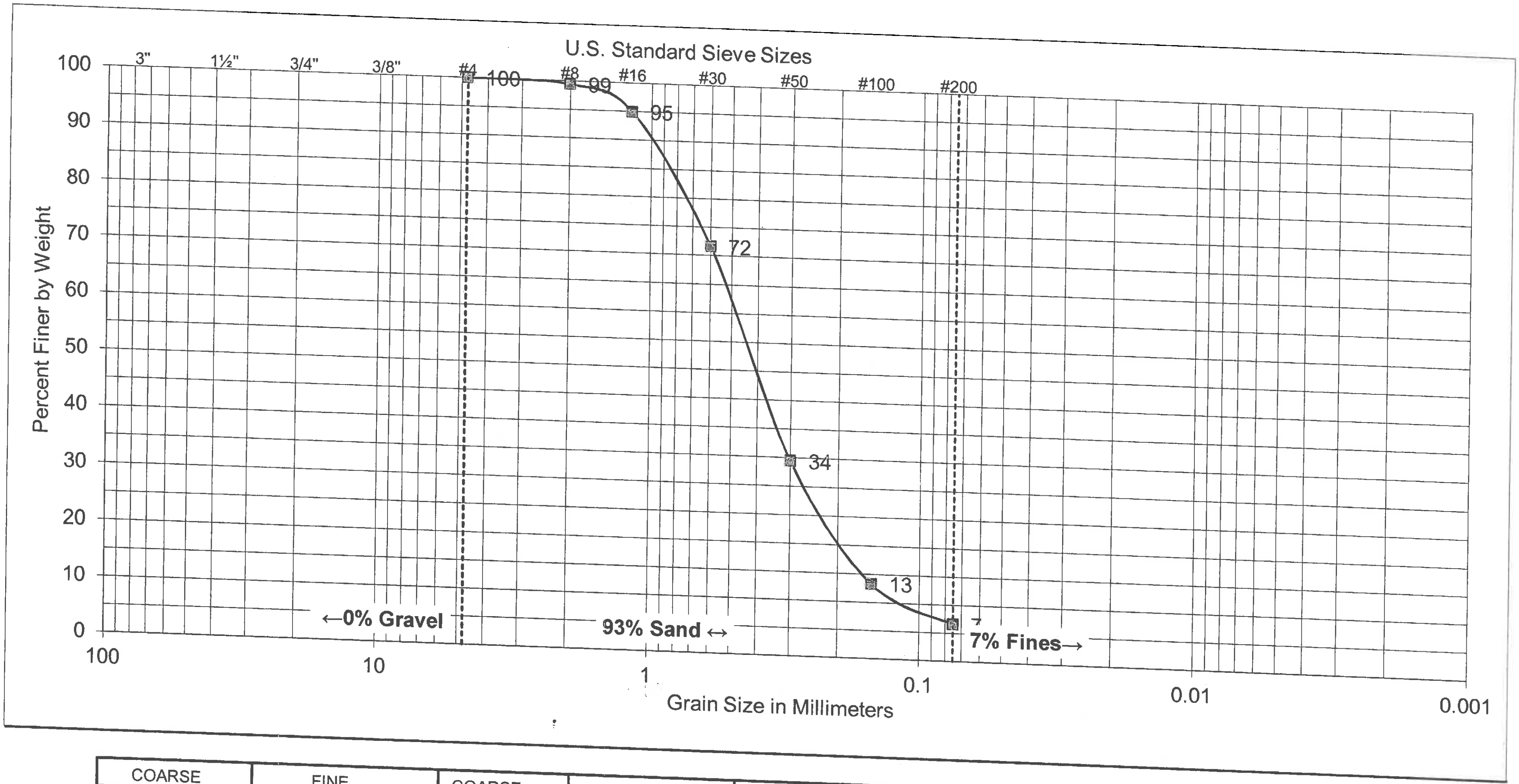
PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153
Project No. IR619
FIGURE B-1.21



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-5

SAMPLE DEPTH: 25' - 26½'

UNIFIED SOIL CLASSIFICATION: SP-SM

DESCRIPTION: POORLY GRADED SAND WITH SILT

ATTERBERG LIMITS

LIQUID LIMIT: ---

PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

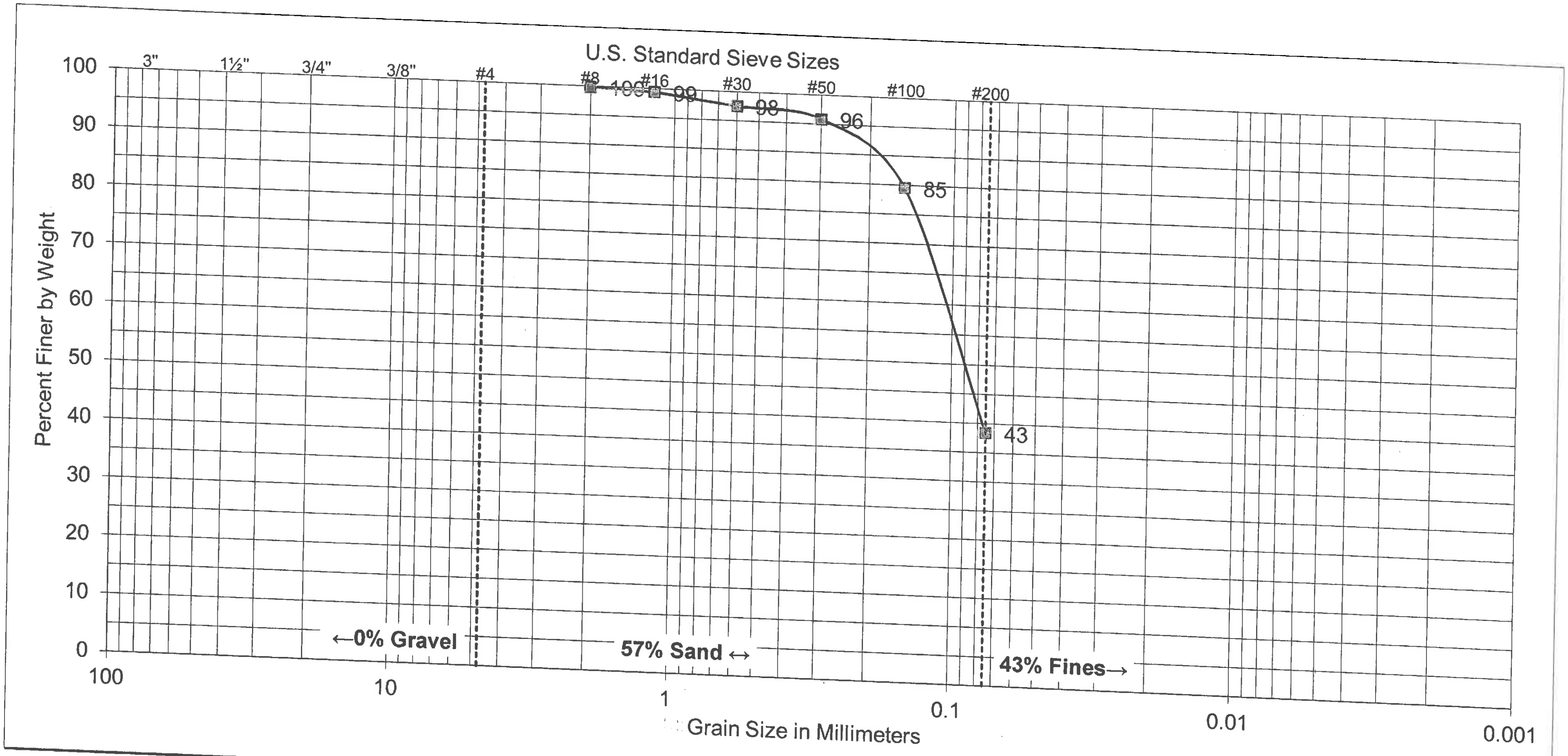
GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153

Project No. IR619

FIGURE B-1.22



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-5

SAMPLE DEPTH: 35' - 36½'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

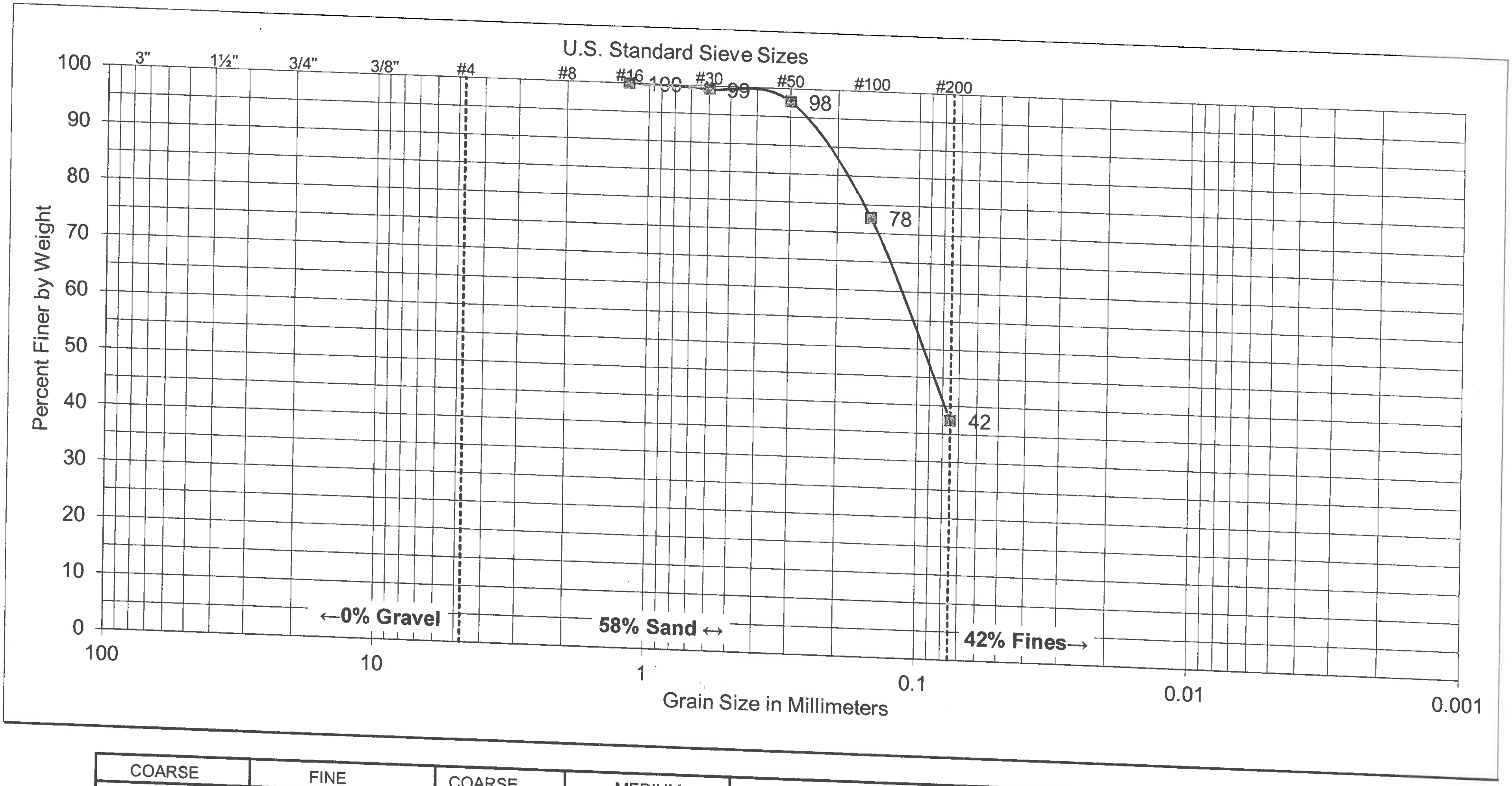
PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153
Project No. IR619
FIGURE B-1.23



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-5

SAMPLE DEPTH: 45' - 46½'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 14-0153

Project No. IR619

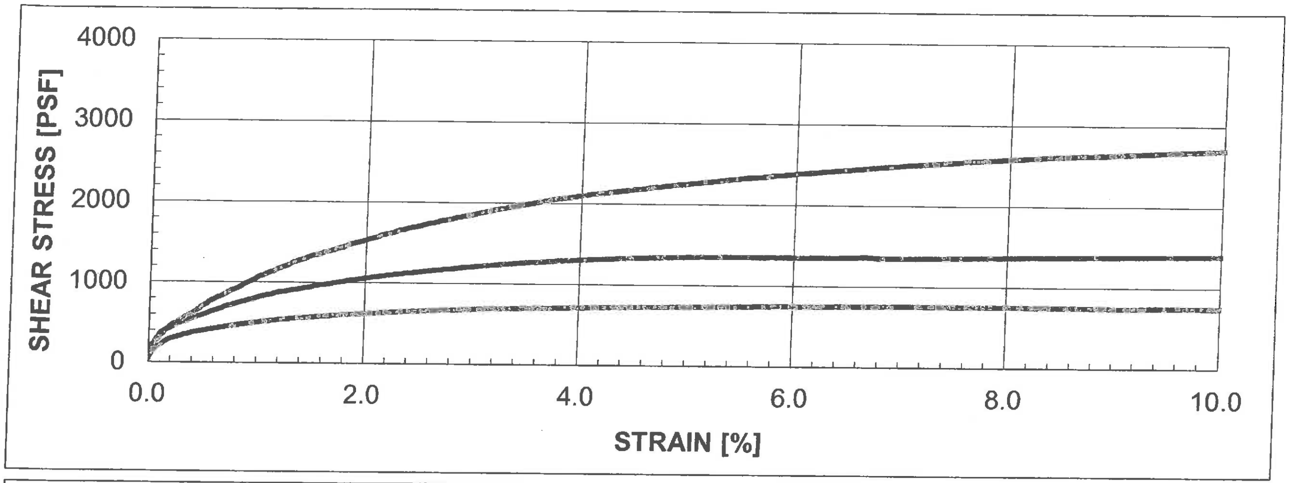
FIGURE B-1.24

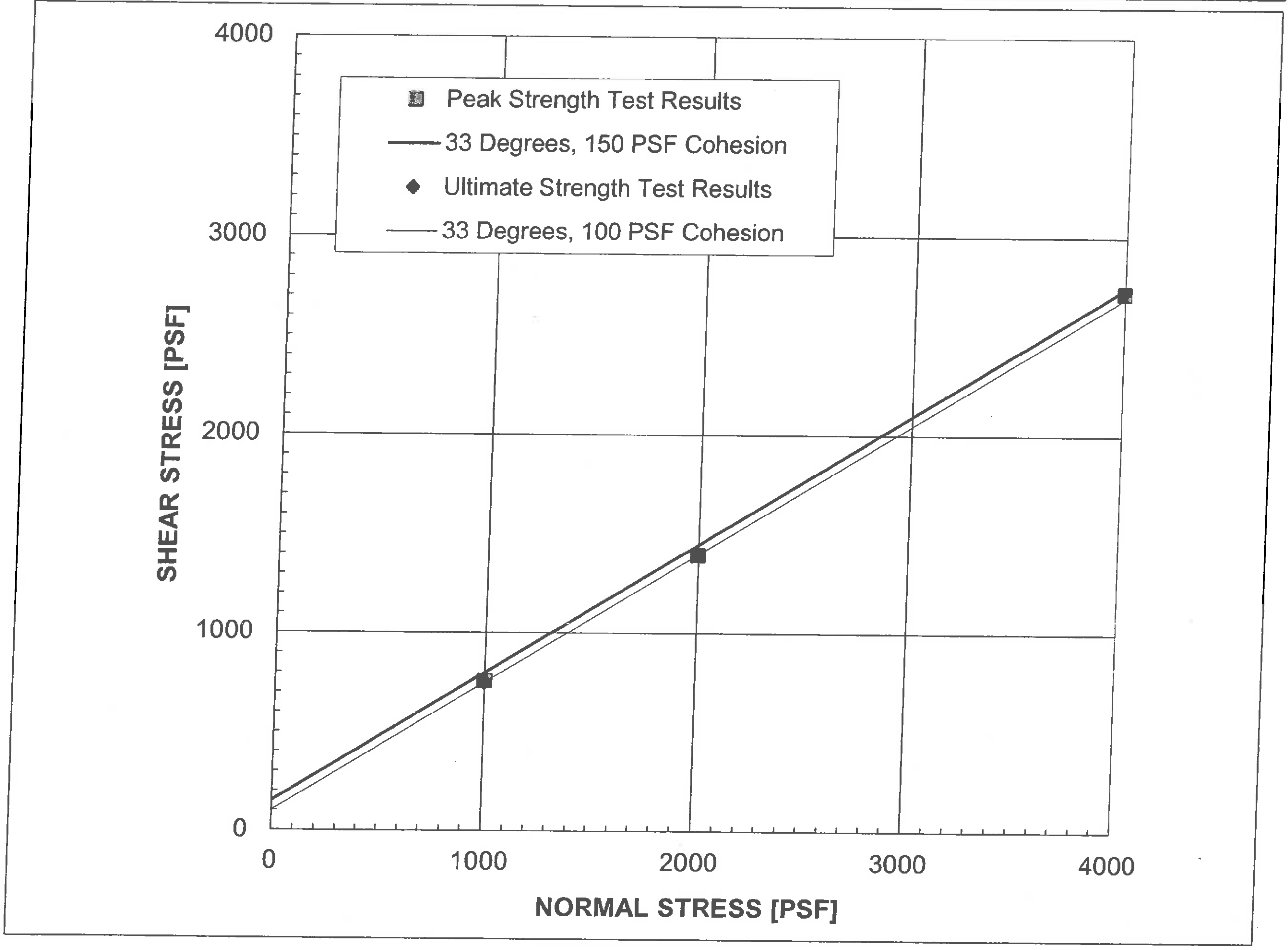
EXPANSION TEST RESULTS

(ASTM D4829)

SAMPLE	DESCRIPTION	EXPANSION INDEX
B-1 @ 1'– 5'	**FILL**: Brown clayey sand (SC).	23
B-2 @ 1'– 5'	**FILL**: Grayish brown silty sand (SM).	10
B-3 @ 0'– 5'	**FILL**: Yellowish brown clayey sand (SC).	5
B-4 @ 1'– 5'	**ALLUVIUM**: Brown poorly graded sand with silt (SP-SM).	0
B-5 @ 1'– 5'	**FILL**: Brown silty sand (SM).	17

EXPANSION INDEX	POTENTIAL EXPANSION
0 to 20	Very low
21 to 50	Low
51 to 90	Medium
91 to 130	High
Above 130	Very High





SAMPLE: B-1 @ 5' - 6½'

Alluvium:
Light brown sandy silt (ML)

	PEAK	ULTIMATE
ϕ'	33 °	33 °
C'	150 PSF	100 PSF

	IN-SITU	AS-TESTED
γ_d	78.5 PCF	78.5 PCF
w_c	25.8 %	37.0 %

STRAIN RATE: 0.0030 IN/MIN
(Sample was consolidated and drained)

GROUP DELTA **DIRECT SHEAR TEST RESULTS**

Document No. 14-0153
Project No. IR619
FIGURE B-4.1

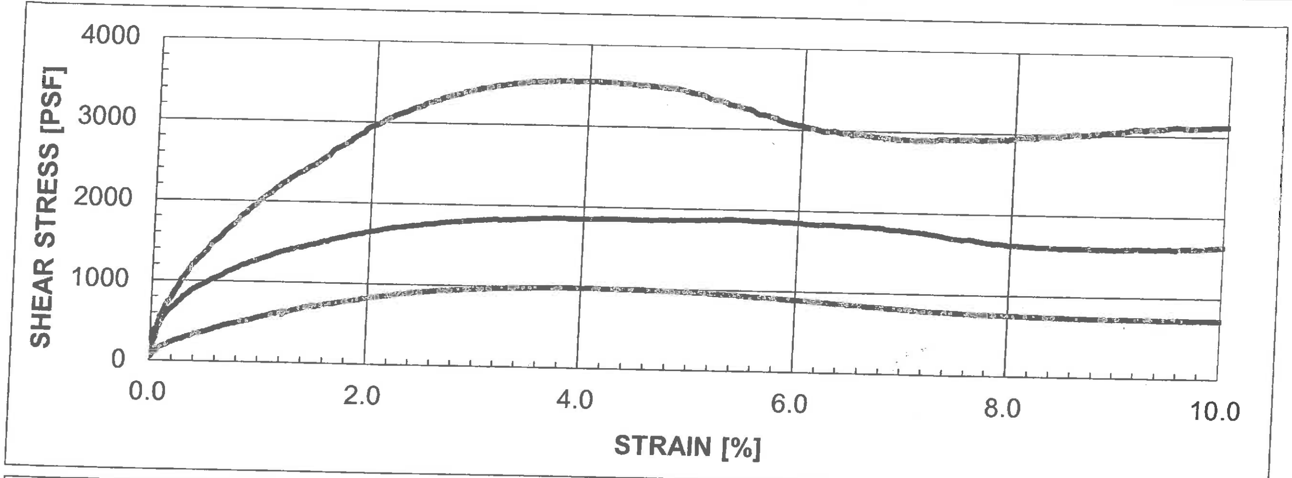
CHEMISTRY TEST RESULTS
(ASTM D516, CTM 643)

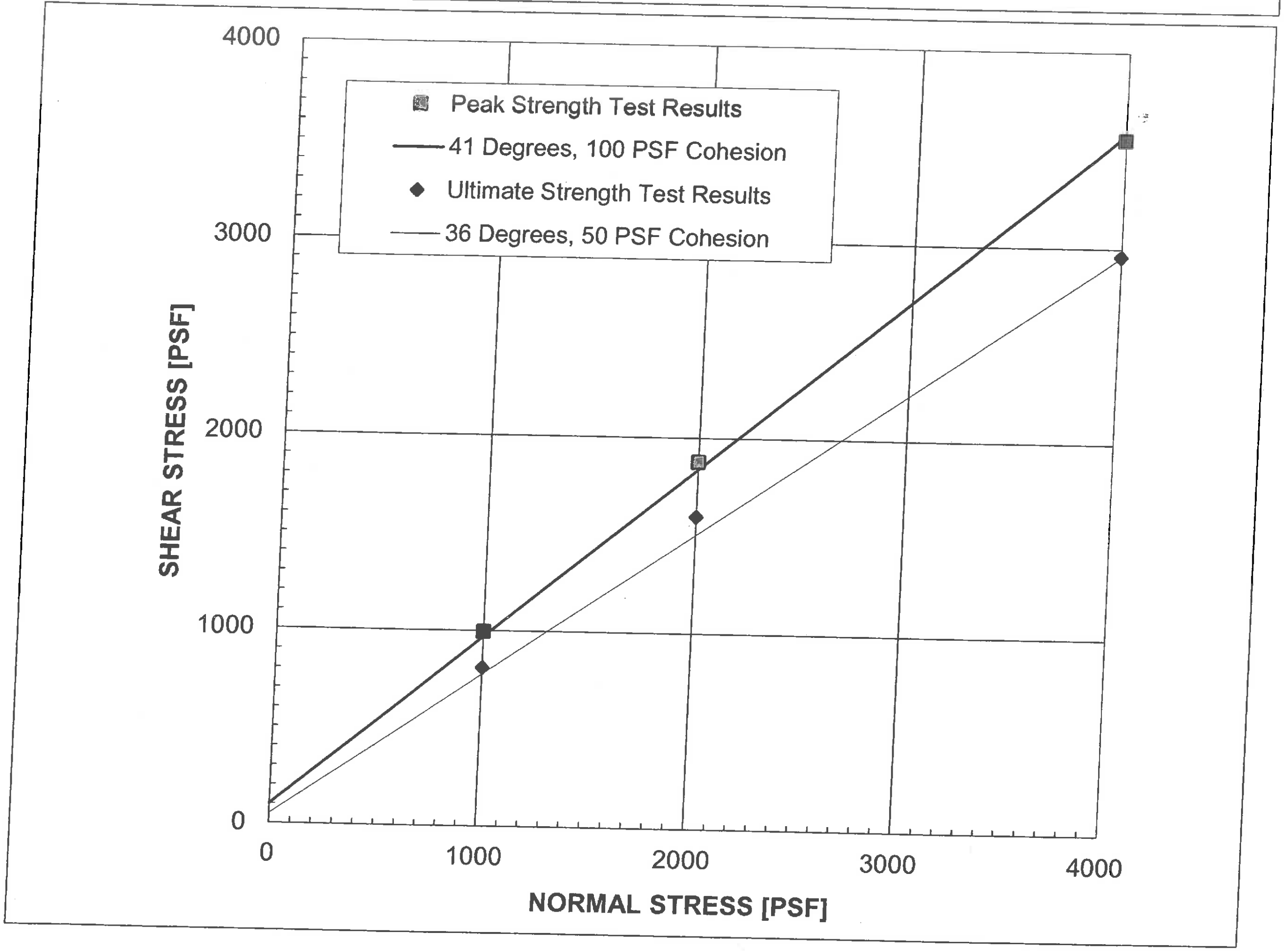
SAMPLE	pH	RESISTIVITY [OHM-CM]	SULFATE CONTENT [%]	CHLORIDE CONTENT [%]
B-1 @ 1'– 5'	7.3	390	0.10	0.07
B-2 @ 1'– 5'	7.3	630	0.08	0.03
B-3 @ 0'– 5'	7.7	530	0.03	0.02
B-4 @ 1'– 5'	7.2	1,970	< 0.01	< 0.01
B-5 @ 1'– 5'	7.4	520	0.06	0.06

SULFATE CONTENT [%]	SULFATE EXPOSURE	CEMENT TYPE
0.00 to 0.10	Negligible	-
0.10 to 0.20	Moderate	II, IP(MS), IS(MS)
0.20 to 2.00	Severe	V
Above 2.00	Very Severe	V plus pozzolan

SOIL RESISTIVITY [OHM-CM]	GENERAL DEGREE OF CORROSIVITY TO FERROUS METALS
0 to 1,000	Very Corrosive
1,000 to 2,000	Corrosive
2,000 to 5,000	Moderately Corrosive
5,000 to 10,000	Mildly Corrosive
Above 10,000	Slightly Corrosive

CHLORIDE (Cl) CONTENT [%]	GENERAL DEGREE OF CORROSIVITY TO METALS
0.00 to 0.03	Negligible
0.03 to 0.15	Corrosive
Above 0.15	Severely Corrosive





SAMPLE: B-1 @ 20' - 21½'

Alluvium:
Brown poorly graded sand with silt (SP-SM)

STRAIN RATE: 0.0040 IN/MIN
(Sample was consolidated and drained)

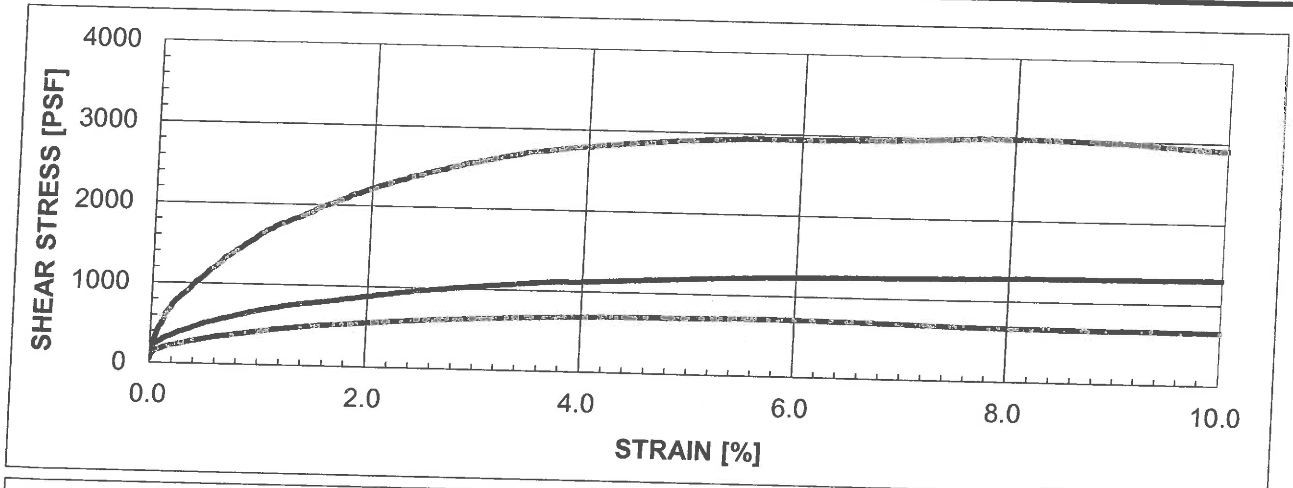
	PEAK	ULTIMATE
ϕ'	41 °	36 °
C'	100 PSF	50 PSF

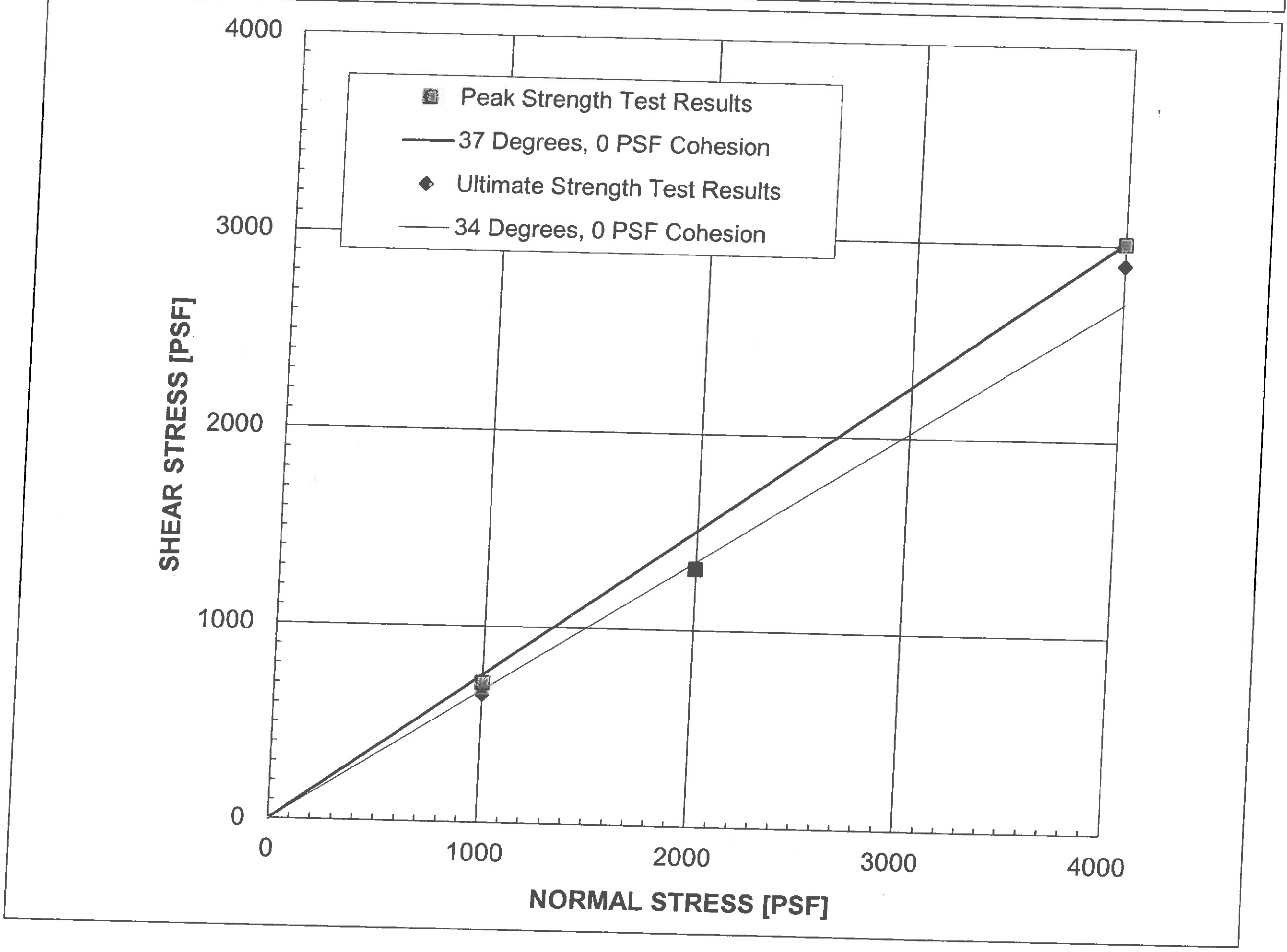
	IN-SITU	AS-TESTED
γ_d	99.8 PCF	99.8 PCF
w_c	22.9 %	26.8 %

GROUP DELTA

DIRECT SHEAR TEST RESULTS

Document No. 14-0153
Project No. IR619
FIGURE B-4.2





SAMPLE: B-5 @ 40' - 6½'

Alluvium:
Dark brown silty sand (SM)

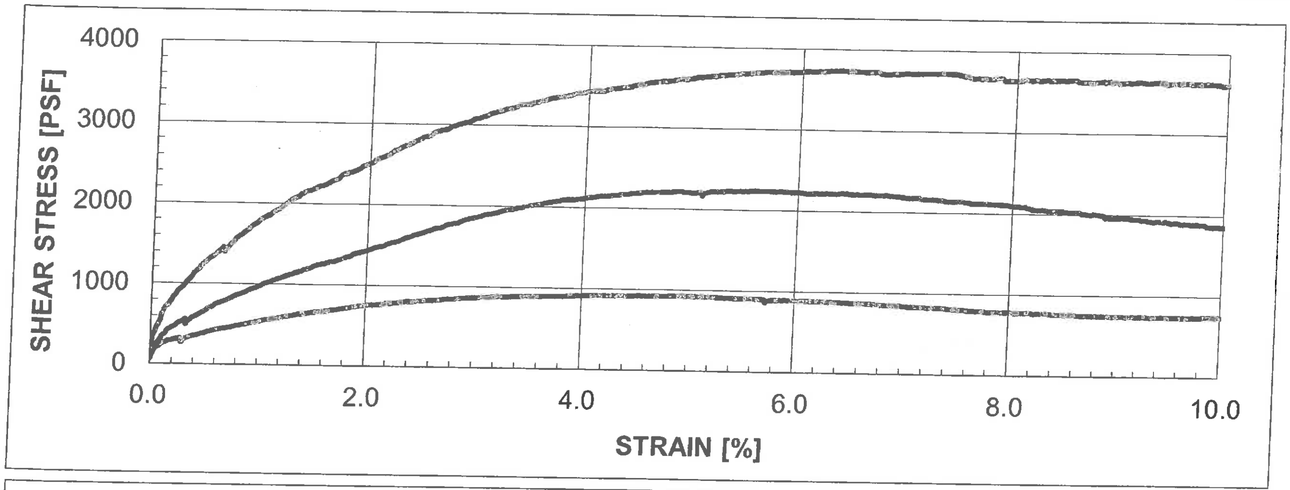
STRAIN RATE: 0.0020 IN/MIN
(Sample was consolidated and drained)

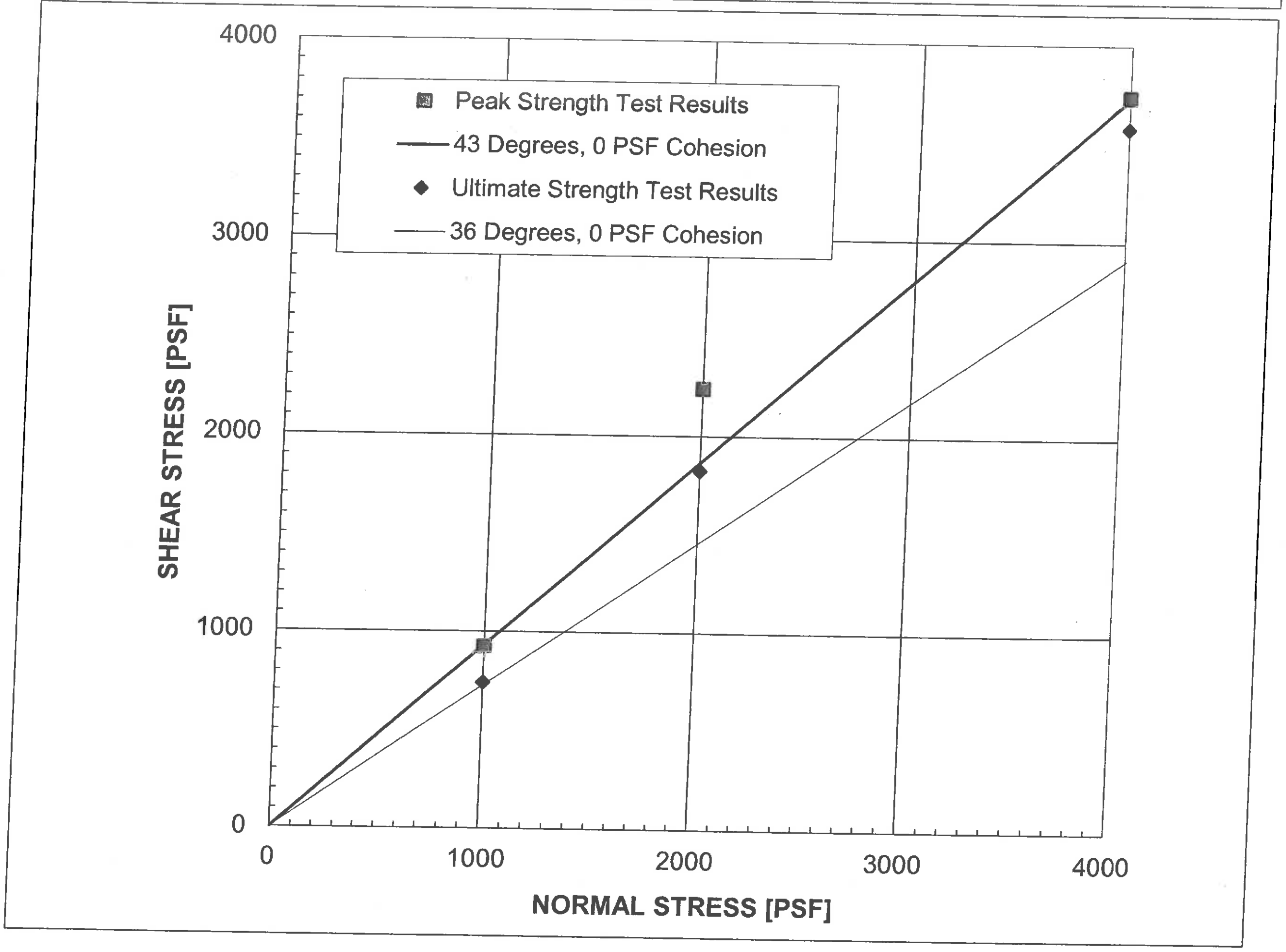
	PEAK	ULTIMATE
ϕ'	37 °	34 °
C'	0 PSF	0 PSF

	IN-SITU	AS-TESTED
γ_d	84.0 PCF	84.0 PCF
w_c	35.5 %	38.6 %

GROUP DELTA **DIRECT SHEAR TEST RESULTS**

Document No. 14-0153
Project No. IR619
FIGURE B-4.4





SAMPLE: B-4 @ 5' - 6½'

Alluvium:
Gray poorly graded sand with silt (SP-SM)

	PEAK	**ULTIMATE**
φ'	43 °	36 °
C'	0 PSF	0 PSF

STRAIN RATE: 0.0040 IN/MIN
(Sample was consolidated and drained)

	IN-SITU	**AS-TESTED**
γ_d	104.3 PCF	104.3 PCF
w_c	18.8 %	24.1 %

GROUP DELTA **DIRECT SHEAR TEST RESULTS**

Document No. 14-0153
Project No. IR619
FIGURE B-4.3

BORING NO.: B-1
BORING DEPTH: 1' - 5'
SAMPLE DESCRIPTION: Dark yellow brown clayey sand (SC)

SAMPLE DATE: 9/4/14
TEST DATE: 9/18/14

LABORATORY TEST DATA

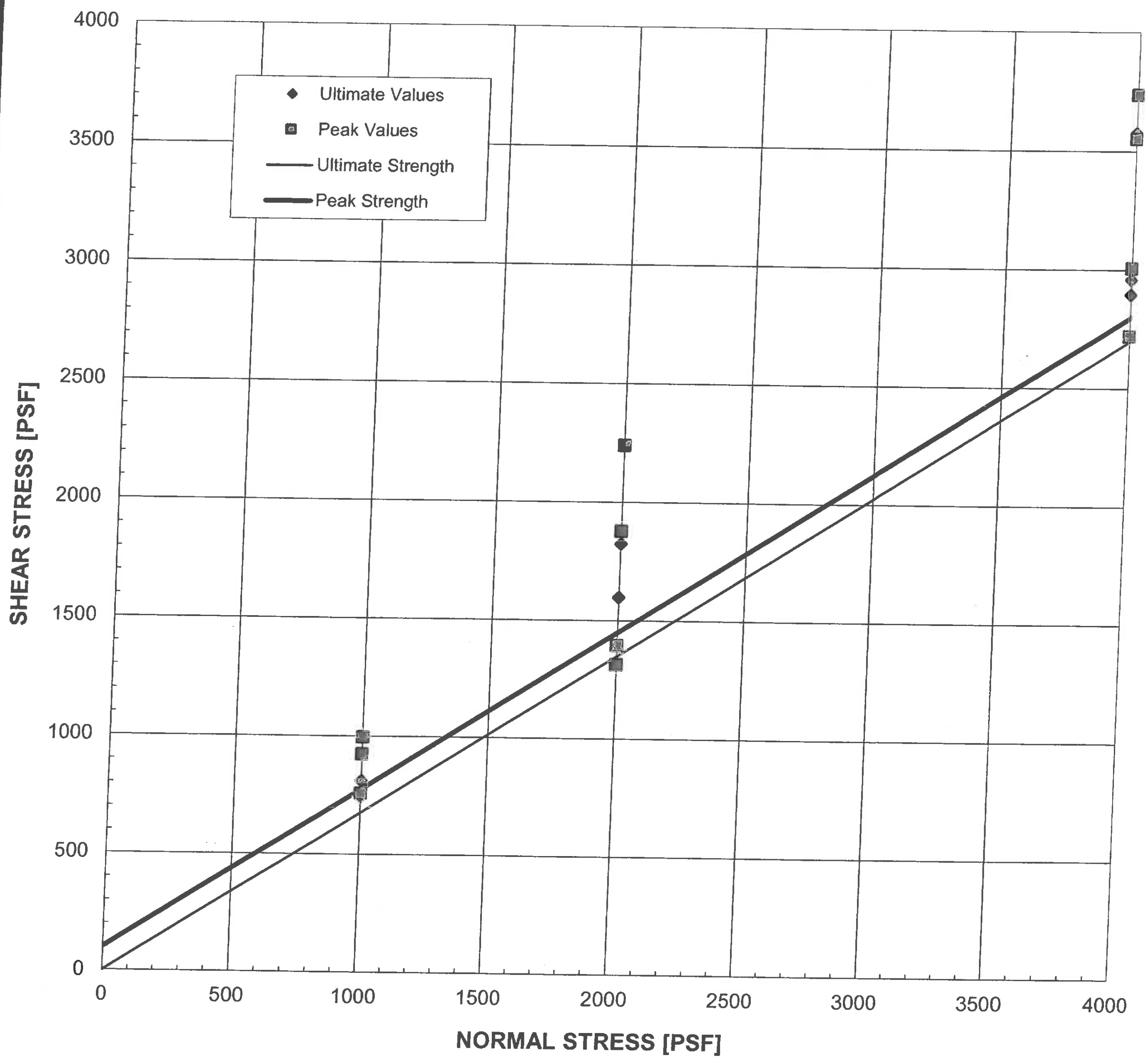
TEST SPECIMEN	1	2	3	4	5	
A COMPACTOR PRESSURE	210	225	350			[PSI]
B INITIAL MOISTURE	4.8	4.8	4.8			[%]
C BATCH SOIL WEIGHT	1200	1200	1200			[G]
D WATER ADDED	105	93	82			[ML]
E WATER ADDED (D*(100+B)/C)	9.2	8.1	7.2			[%]
F COMPACTION MOISTURE (B+E)	14.0	12.9	12.0			[%]
G MOLD WEIGHT	2113.3	2108.2	2011.0			[G]
H TOTAL BRIQUETTE WEIGHT	3225.0	3214.1	3105.2			[G]
I NET BRIQUETTE WEIGHT (H-G)	1111.7	1105.9	1094.2			[G]
J BRIQUETTE HEIGHT	2.52	2.51	2.47			[IN]
K DRY DENSITY (30.3*I/((100+F)*J))	117.3	118.2	119.9			[PCF]
L EXUDATION LOAD	1901	3029	4484			[LB]
M EXUDATION PRESSURE (L/12.54)	152	242	358			[PSI]
N STABILOMETER AT 1000 LBS	35	31	23			[PSI]
O STABILOMETER AT 2000 LBS	78	66	44			[PSI]
P DISPLACEMENT FOR 100 PSI	5.47	4.96	4.76			[Turns]
Q R VALUE BY STABILOMETER	32	42	58			
R CORRECTED R-VALUE (See Fig. 14)	32	42	58			
S EXPANSION DIAL READING	0.0023	0.0046	0.0068			[IN]
T EXPANSION PRESSURE (S*43,300)	100	199	294			[PSF]
U COVER BY STABILOMETER	0.57	0.49	0.35			[FT]
V COVER BY EXPANSION	0.77	1.53	2.27			[FT]

TRAFFIC INDEX:	5.0
GRAVEL FACTOR:	1.72
UNIT WEIGHT OF COVER [PCF]:	130
R-VALUE BY EXUDATION:	50
R-VALUE BY EXPANSION:	36
R-VALUE AT EQUILIBRIUM:	36

*Note: Gravel factor estimated from required AC pavement section using CT301, Part 6.B.2.

GROUP DELTA **R-VALUE TEST RESULTS**

Document No. 14-0153
Project No. IR619
FIGURE B-5.1a



DESCRIPTION

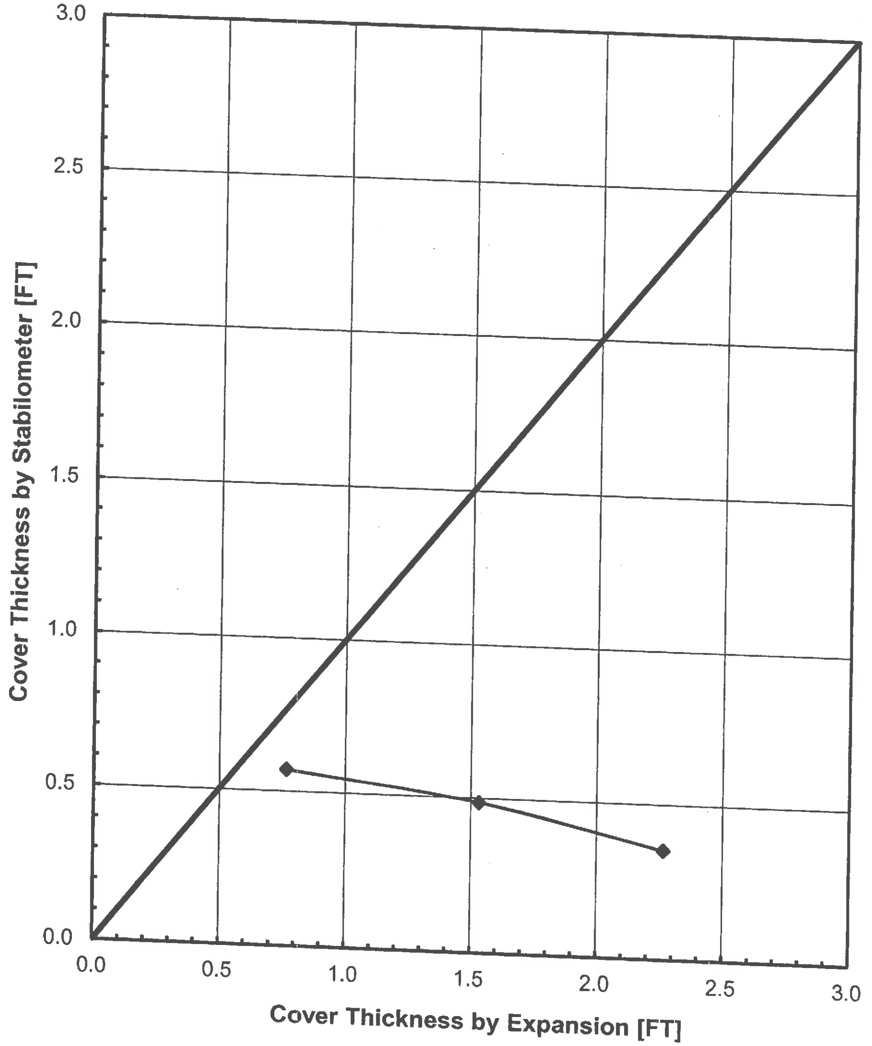
A summary of four direct shear tests on samples of the on-site alluvial soils, including the poorly graded sand with silt (SP-SM), silty sand (SM), and sandy silt (ML).

	PEAK ESTIMATE	ULTIMATE ESTIMATE
ϕ'	34 °	34 °
C'	100 PSF	0 PSF

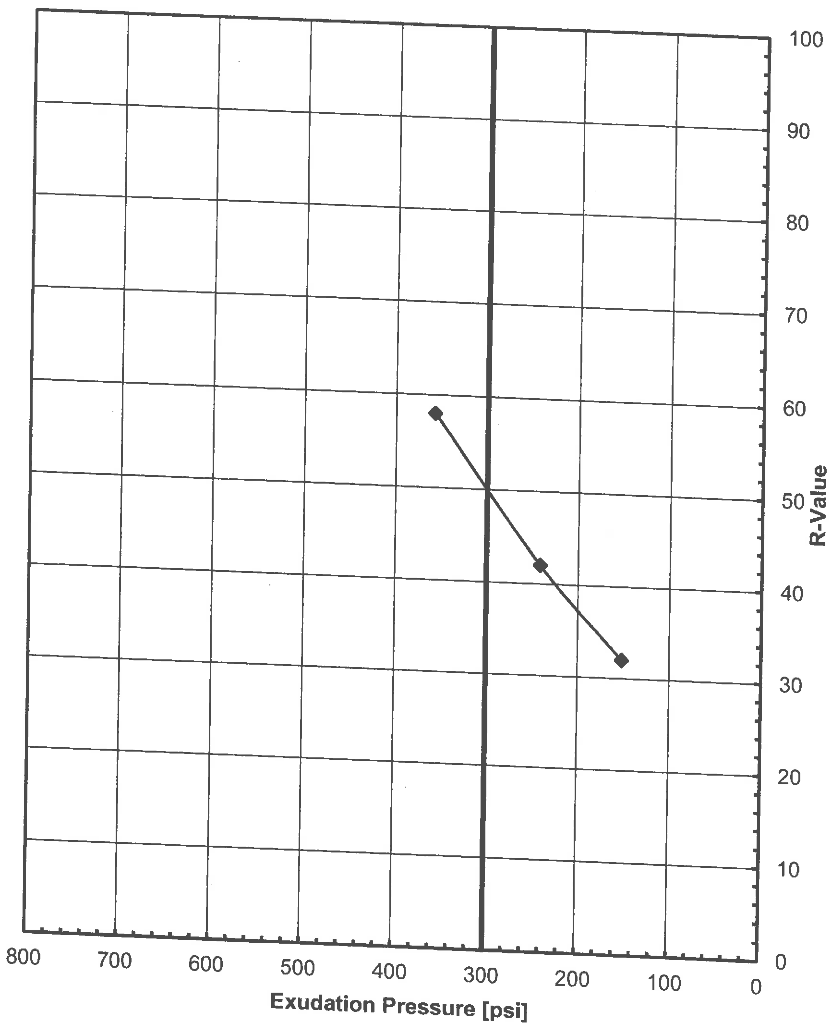
GROUP DELTA **DIRECT SHEAR TEST SUMMARY**

Document No. 14-0153
Project No. IR619
FIGURE B-4.5

Sample B-5 @ 0' - 5'



R-Value at Equilibrium: 36



GROUP DELTA

COVER AND EXUDATION CHARTS

Document No. 14-0153
Project No. IR619
FIGURE B-5.1b

BORING NO.: B-3
BORING DEPTH: 0' - 5'
SAMPLE DESCRIPTION: Yellow brown clayey sand (SC)

SAMPLE DATE: 9/3/14
TEST DATE: 9/16/14

LABORATORY TEST DATA

TEST SPECIMEN	1	2	3	4	5	
A COMPACTOR PRESSURE	290	130	240			[PSI]
B INITIAL MOISTURE	3.2	3.2	3.2			[%]
C BATCH SOIL WEIGHT	1200	1200	1200			[G]
D WATER ADDED	85	110	93			[ML]
E WATER ADDED (D*(100+B)/C)	7.3	9.5	8.0			[%]
F COMPACTION MOISTURE (B+E)	10.5	12.7	11.2			[%]
G MOLD WEIGHT	2009.6	2098.7	2111.4			[G]
H TOTAL BRIQUETTE WEIGHT	3168.6	3242.7	3188.3			[G]
I NET BRIQUETTE WEIGHT (H-G)	1159.0	1144.0	1076.9			[G]
J BRIQUETTE HEIGHT	2.54	2.55	2.39			[IN]
K DRY DENSITY (30.3*I/((100+F)*J))	125.1	120.7	122.8			[PCF]
L EXUDATION LOAD	6908	3303	4593			[LB]
M EXUDATION PRESSURE (L/12.54)	551	263	366			[PSI]
N STABILOMETER AT 1000 LBS	18	46	28			[PSI]
O STABILOMETER AT 2000 LBS	44	110	56			[PSI]
P DISPLACEMENT FOR 100 PSI	4.16	4.75	4.27			[Turns]
Q R VALUE BY STABILOMETER	61	19	52			
R CORRECTED R-VALUE (See Fig. 14)	61	19	49			
S EXPANSION DIAL READING	0.0026	0.0005	0.0016			[IN]
T EXPANSION PRESSURE (S*43,300)	113	22	69			[PSF]
U COVER BY STABILOMETER	0.33	0.68	0.43			[FT]
V COVER BY EXPANSION	0.87	0.17	0.53			[FT]

TRAFFIC INDEX:	5.0
GRAVEL FACTOR:	1.58
UNIT WEIGHT OF COVER [PCF]:	130
R-VALUE BY EXUDATION:	30
R-VALUE BY EXPANSION:	52
R-VALUE AT EQUILIBRIUM:	30

*Note: Gravel factor estimated from required AC pavement section using CT301, Part 6.B.2.

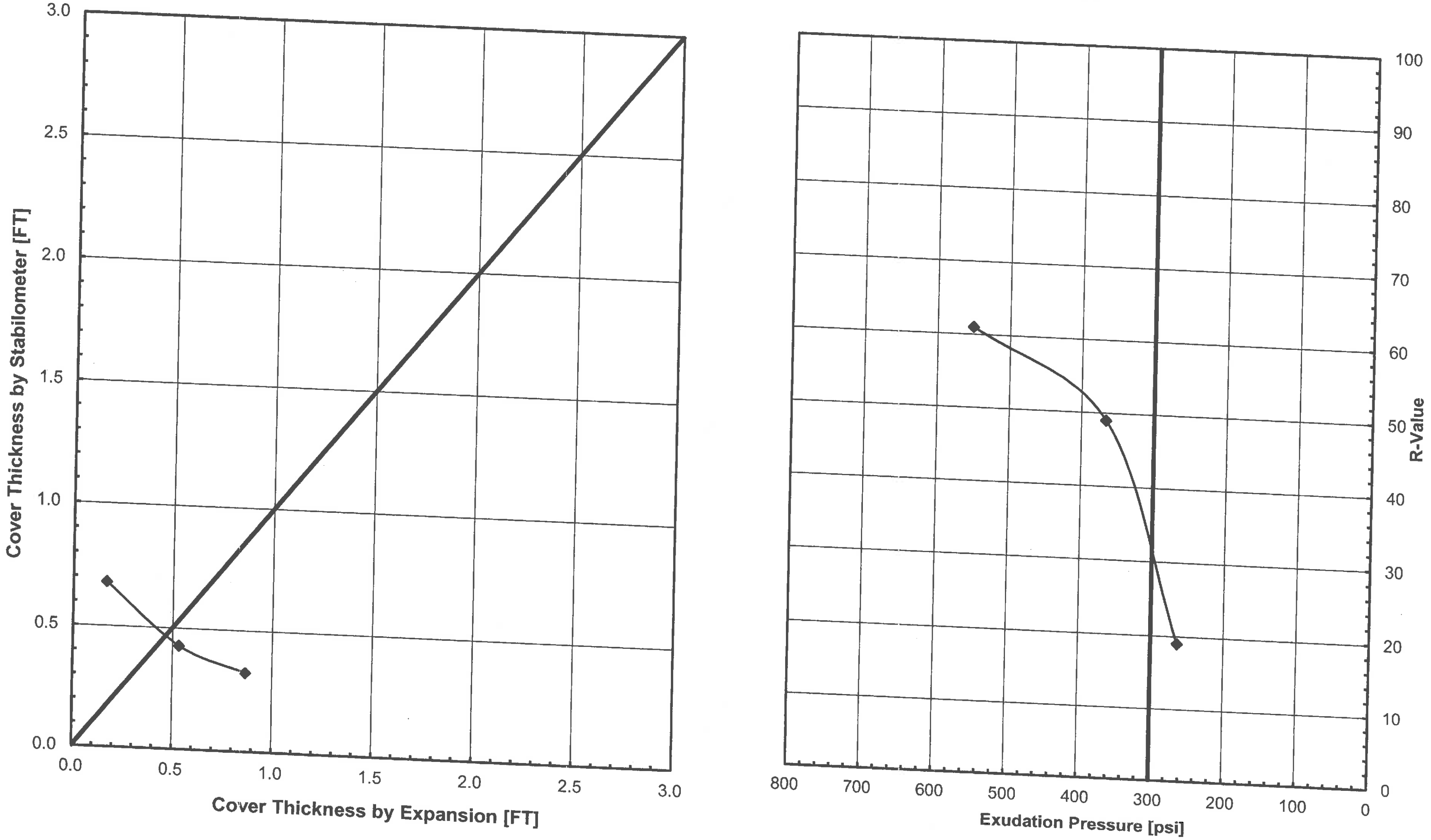
GROUP DELTA

R-VALUE TEST RESULTS

Document No. 14-0153
Project No. IR619
FIGURE B-5.2a

Sample B-5 @ 0' - 5'

R-Value at Equilibrium: 30



GROUP DELTA

COVER AND EXUDATION CHARTS

Document No. 14-0153
Project No. IR619
FIGURE B-5.2b

BORING NO.: B-4
BORING DEPTH: 1' - 5'
SAMPLE DESCRIPTION: Brown poorly graded sand with silt (SP-SM)

SAMPLE DATE: 9/3/14
TEST DATE: 9/11/14

LABORATORY TEST DATA

TEST SPECIMEN	1	2	3	4	5	
A COMPACTOR PRESSURE	350	350	350			[PSI]
B INITIAL MOISTURE	3.0	3.0	3.0			[%]
C BATCH SOIL WEIGHT	1200	1200	1200			[G]
D WATER ADDED	70	80	94			[ML]
E WATER ADDED (D*(100+B)/C)	6.0	6.9	8.1			[%]
F COMPACTION MOISTURE (B+E)	9.0	9.9	11.1			[%]
G MOLD WEIGHT	2112.2	2100.1	2114.2			[G]
H TOTAL BRIQUETTE WEIGHT	3155.4	3162.2	3205.5			[G]
I NET BRIQUETTE WEIGHT (H-G)	1043.2	1062.1	1091.3			[G]
J BRIQUETTE HEIGHT	2.47	2.47	2.53			[IN]
K DRY DENSITY (30.3*I/((100+F)*J))	117.4	118.6	117.7			[PCF]
L EXUDATION LOAD	8155	5441	3628			[LB]
M EXUDATION PRESSURE (L/12.54)	650	434	289			[PSI]
N STABILOMETER AT 1000 LBS	10	14	16			[PSI]
O STABILOMETER AT 2000 LBS	16	22	26			[PSI]
P DISPLACEMENT FOR 100 PSI	4.05	4.27	4.40			[Turns]
Q R VALUE BY STABILOMETER	85	79	75			
R CORRECTED R-VALUE (See Fig. 14)	85	79	75			
S EXPANSION DIAL READING	0.0000	0.0000	0.0000			[IN]
T EXPANSION PRESSURE (S*43,300)	0	0	0			[PSF]
U COVER BY STABILOMETER	0.13	0.18	0.21			[FT]
V COVER BY EXPANSION	0.00	0.00	0.00			[FT]

TRAFFIC INDEX:	5.0
GRAVEL FACTOR:	1.72
UNIT WEIGHT OF COVER [PCF]:	130
R-VALUE BY EXUDATION:	75
R-VALUE BY EXPANSION:	100
R-VALUE AT EQUILIBRIUM:	75

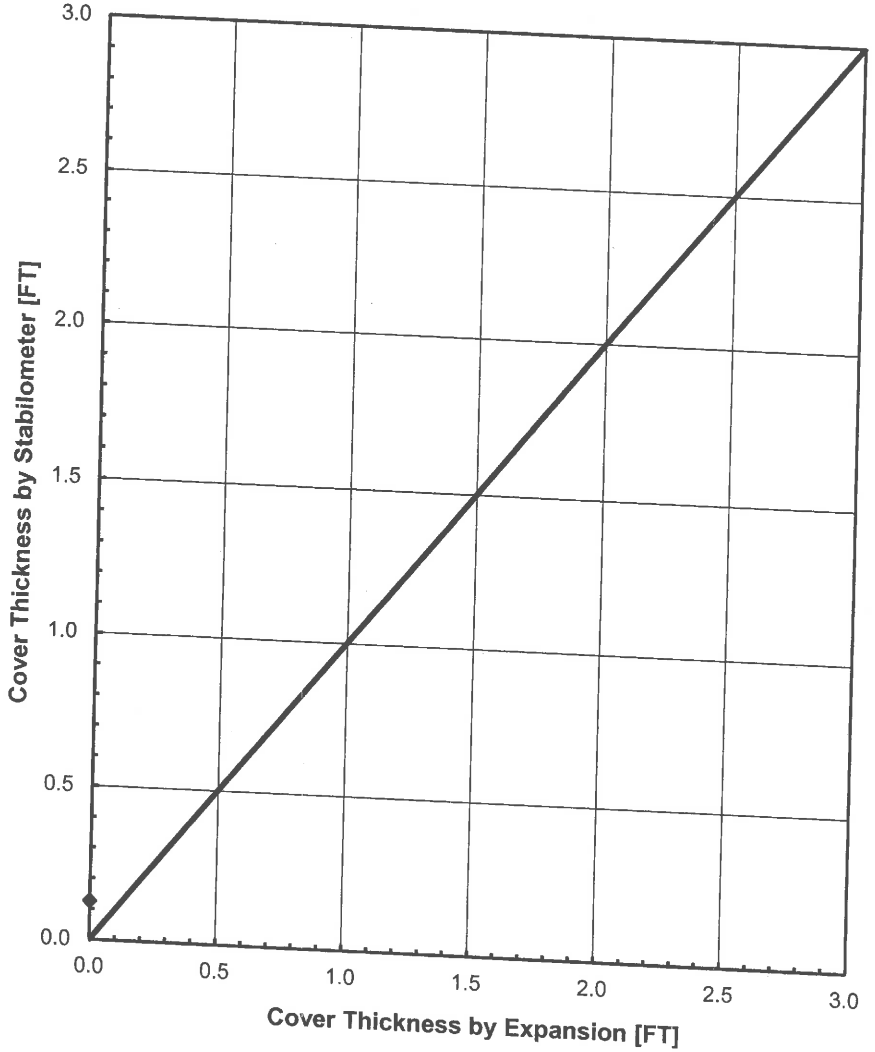
*Note: Gravel factor estimated from required AC pavement section using CT301, Part 6.B.2.

GROUP DELTA

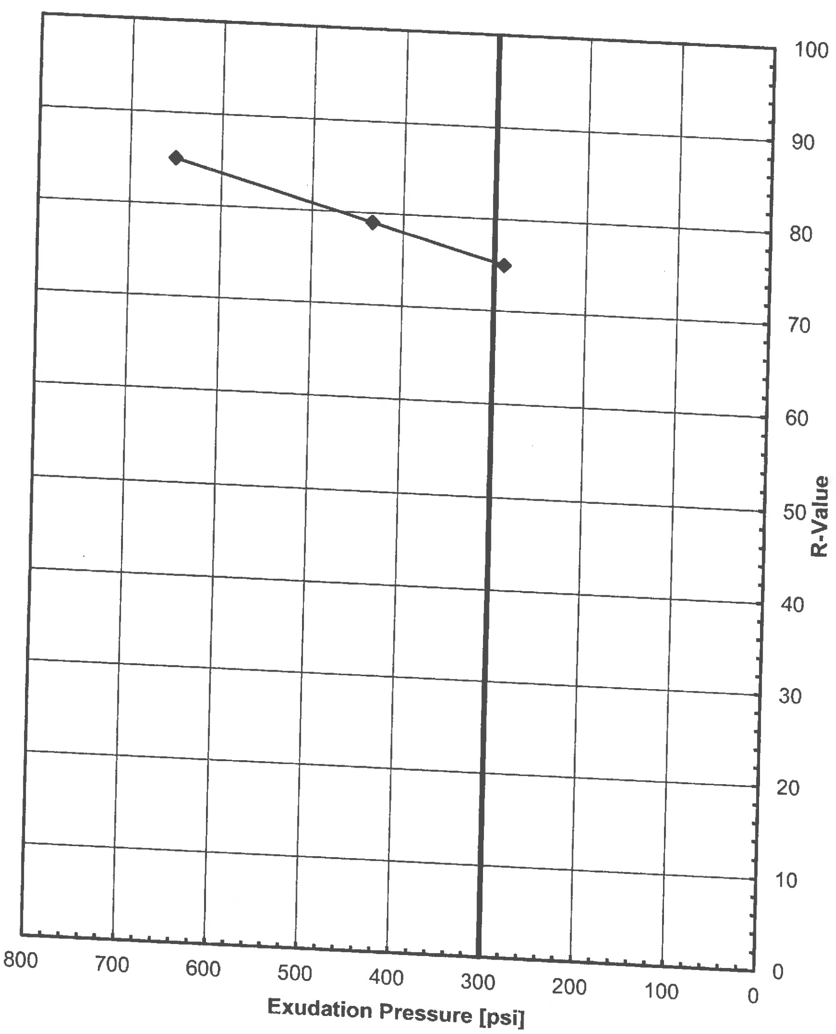
R-VALUE TEST RESULTS

Document No. 14-0153
Project No. IR619
FIGURE B-5.3a

Sample B-5 @ 0' - 5'



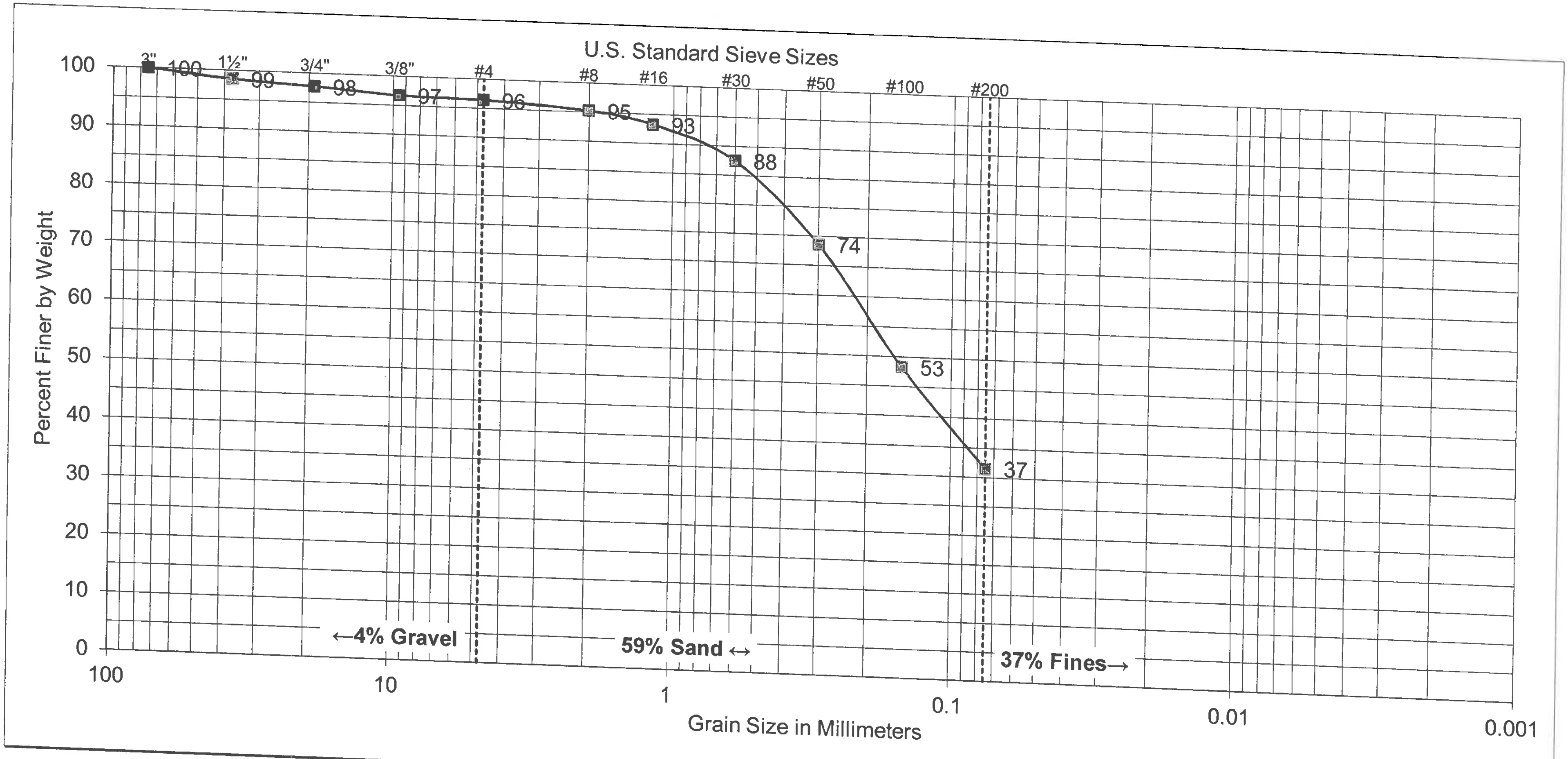
R-Value at Equilibrium: 75



GROUP DELTA

COVER AND EXUDATION CHARTS

Document No. 14-0153
Project No. IR619
FIGURE B-5.3b



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-1* (GDC, 2014a)

SAMPLE DEPTH: 1' - 5'

UNIFIED SOIL CLASSIFICATION: SC

DESCRIPTION: CLAYEY SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

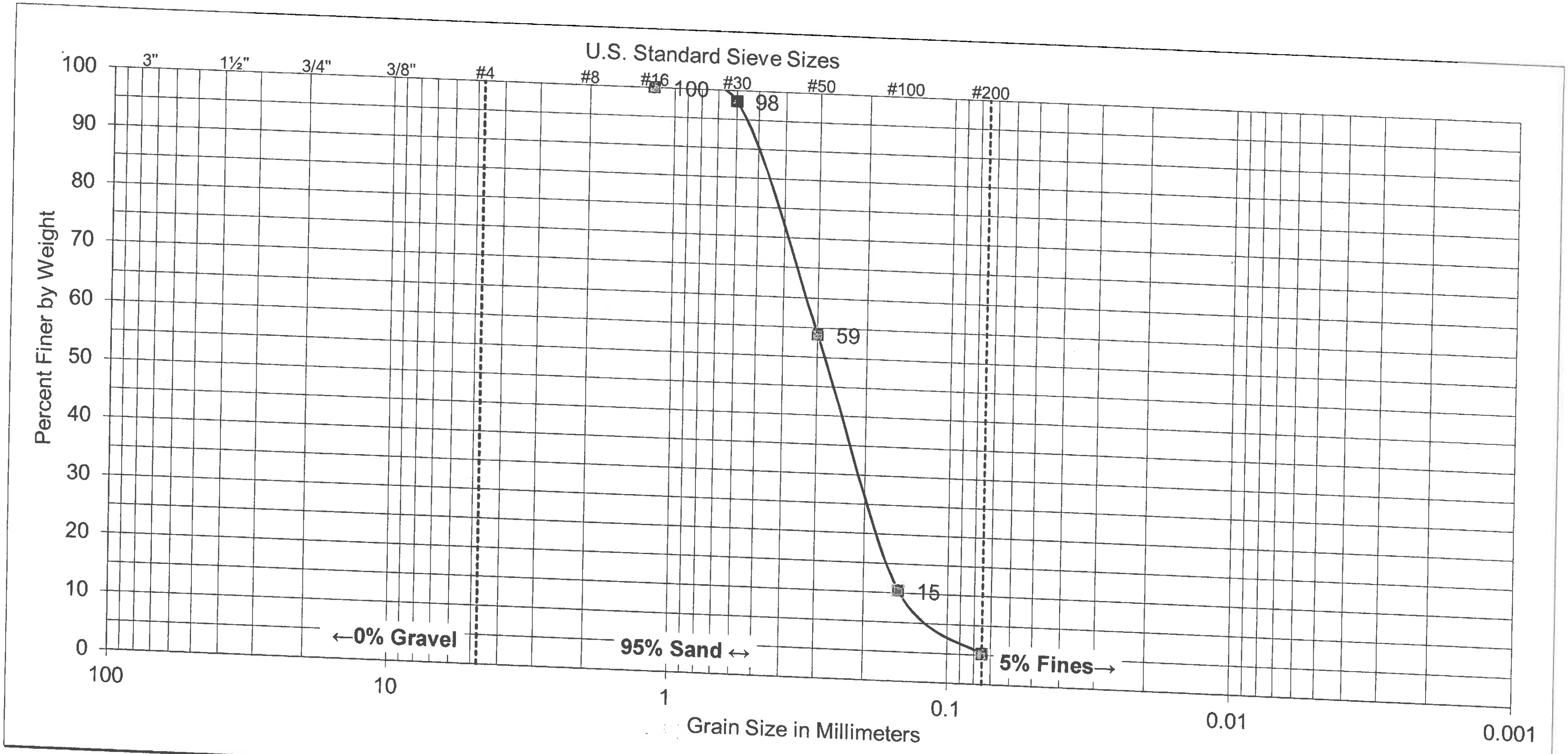
PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006
Project No. IR619
FIGURE B-1.1



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-1* (GDC, 2014a)
SAMPLE DEPTH: 15' - 16½'

UNIFIED SOIL CLASSIFICATION: SP

DESCRIPTION: POORLY GRADED SAND

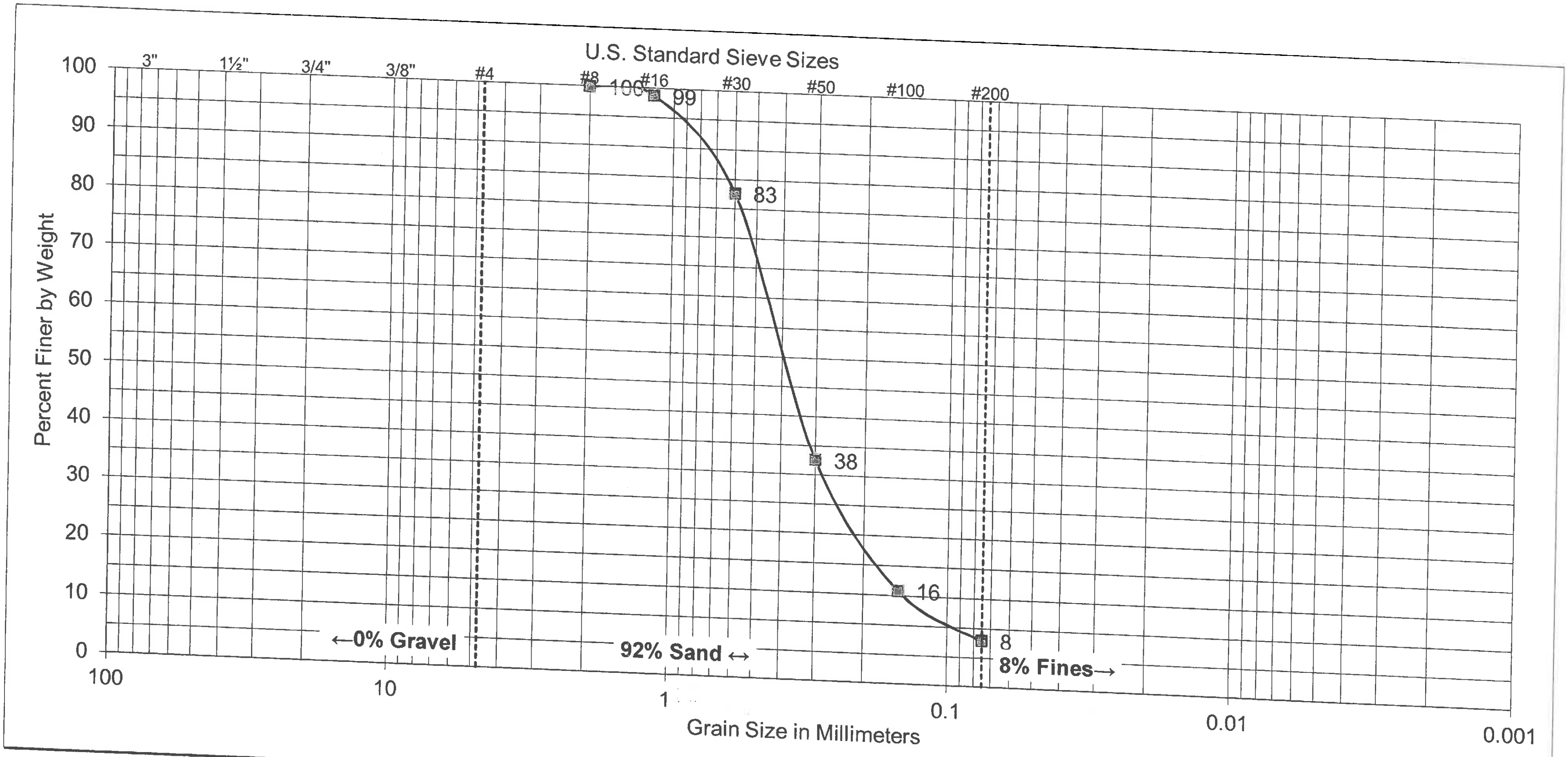
ATTERBERG LIMITS

LIQUID LIMIT: ---
PLASTIC LIMIT: ---
PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006
Project No. IR619
FIGURE B-1.2



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-1* (GDC, 2014a)
SAMPLE DEPTH: 25' - 26½'

UNIFIED SOIL CLASSIFICATION: SP-SM

DESCRIPTION: POORLY GRADED SAND WITH SILT

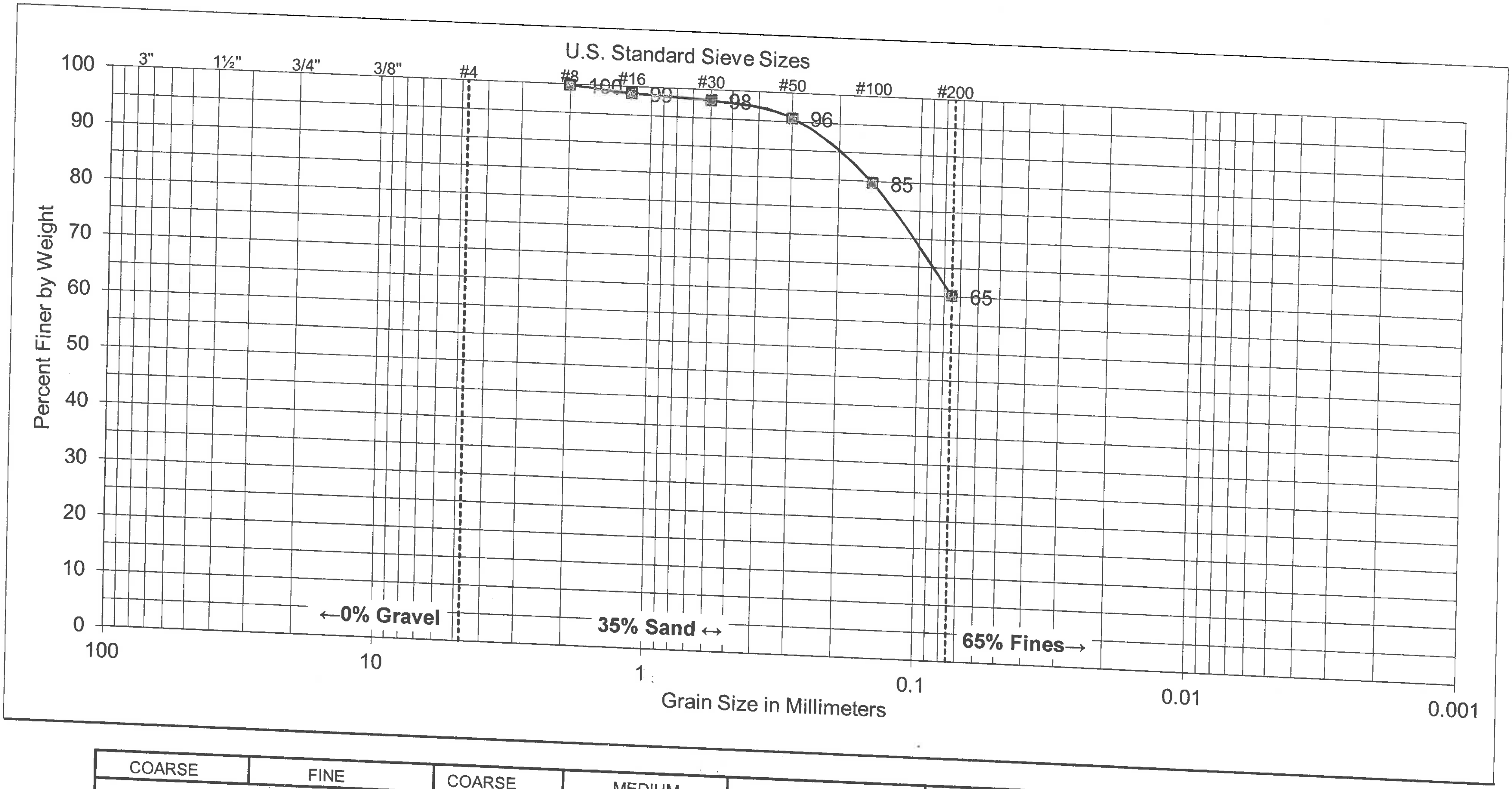
ATTERBERG LIMITS

LIQUID LIMIT: ---
PLASTIC LIMIT: ---
PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006
Project No. IR619
FIGURE B-1.3



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO:	B-1* (GDC, 2014a)
SAMPLE DEPTH:	35' - 36½'

UNIFIED SOIL CLASSIFICATION: ML

DESCRIPTION: SANDY SILT

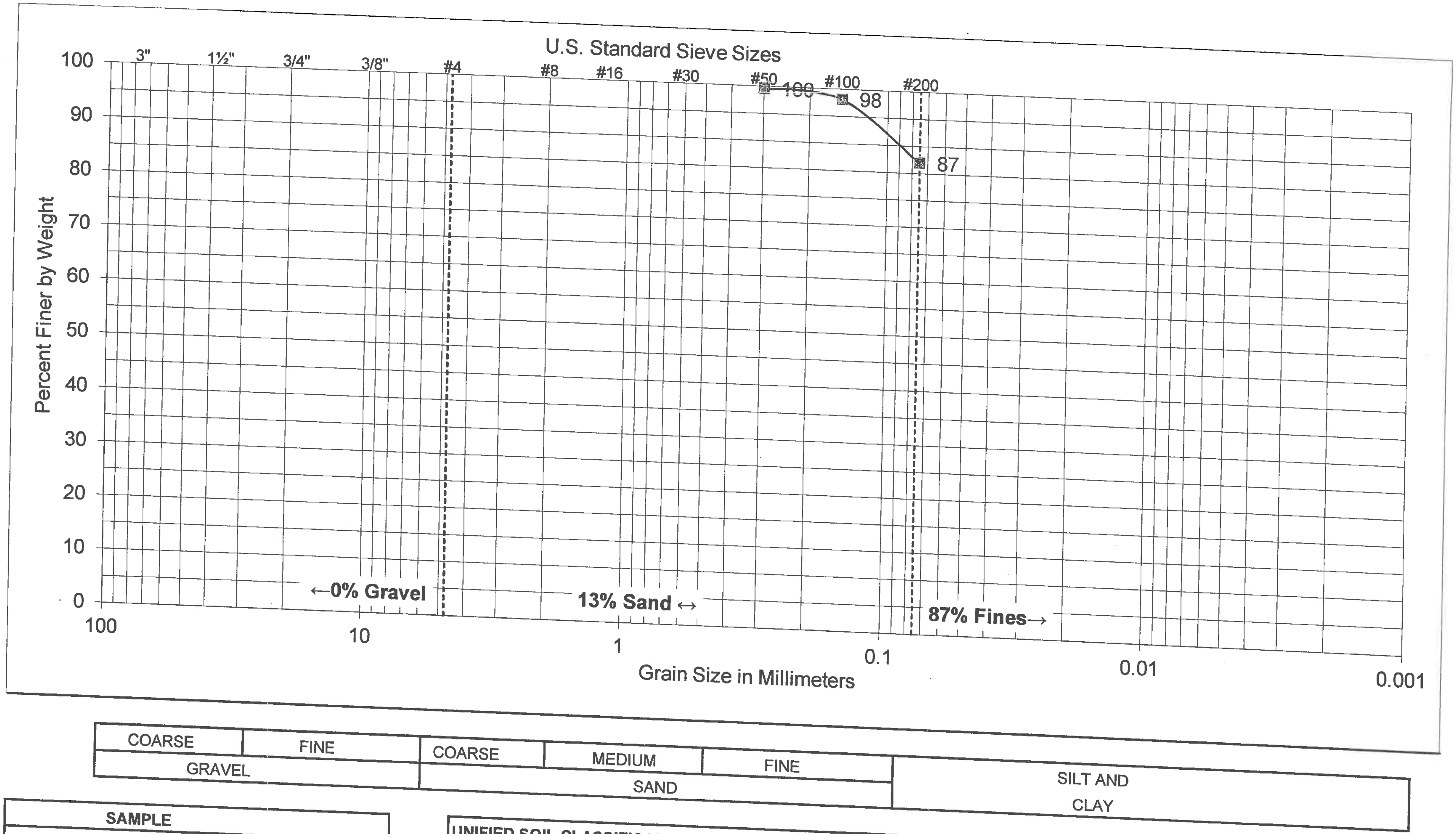
ATTERBERG LIMITS

LIQUID LIMIT: ---
PLASTIC LIMIT: ---
PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006
Project No. IR619
FIGURE B-1.4



SAMPLE	
BORING NO:	B-1* (GDC, 2014a)
SAMPLE DEPTH:	45' - 46½'

UNIFIED SOIL CLASSIFICATION: ML

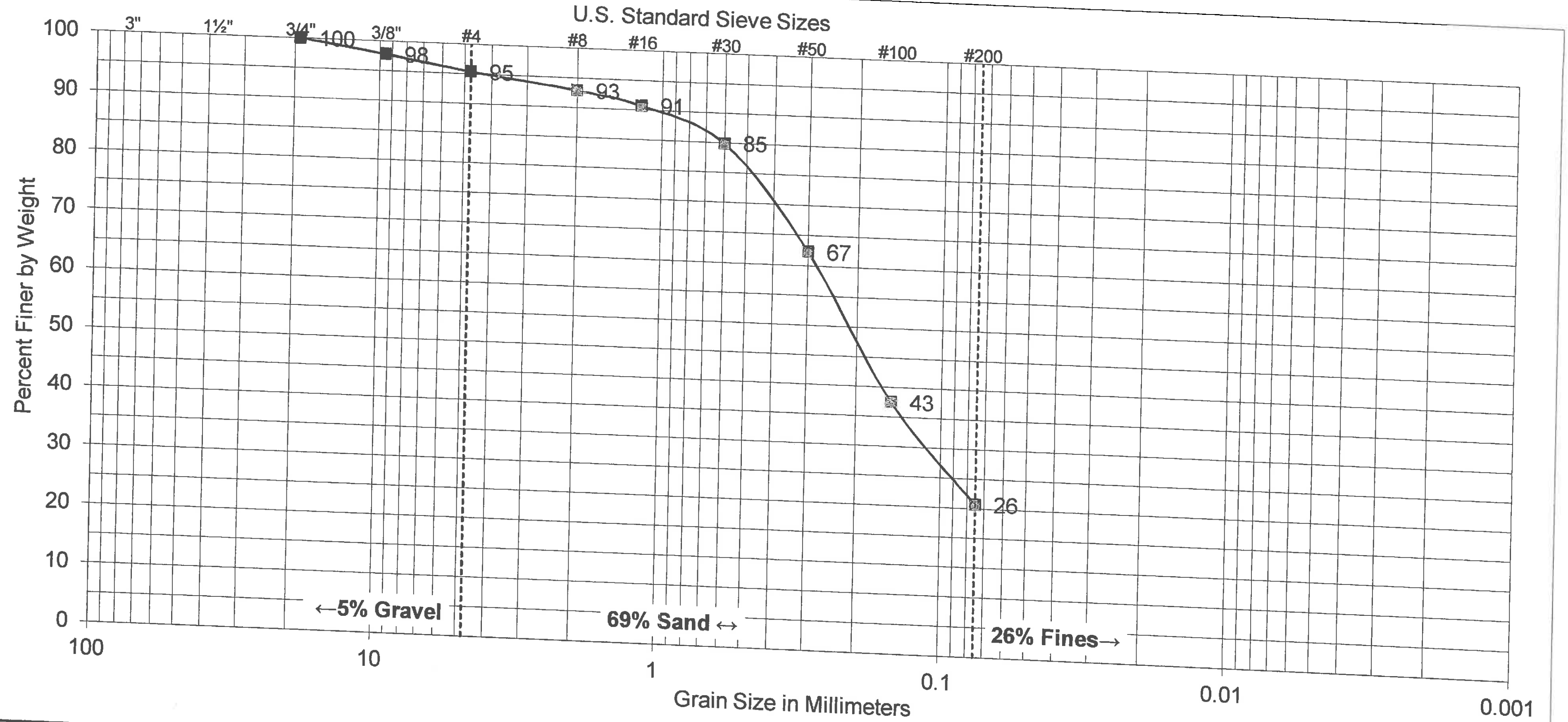
DESCRIPTION: SILT

ATTERBERG LIMITS	
LIQUID LIMIT:	---
PLASTIC LIMIT:	---
PLASTICITY INDEX:	---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006
Project No. IR619
FIGURE B-1.5



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-2* (GDC, 2014a)

SAMPLE DEPTH: 1' - 5'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

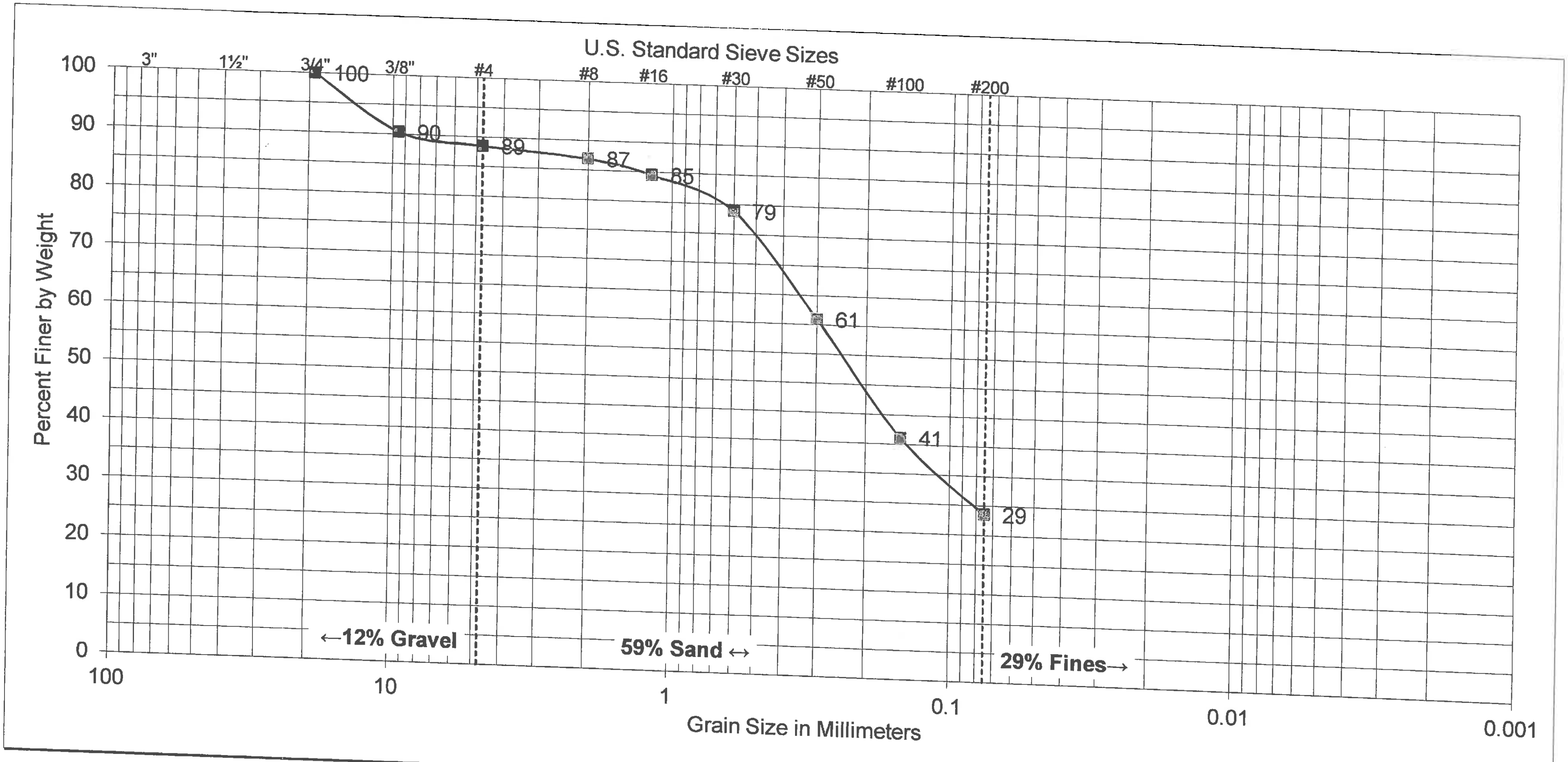
PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006
Project No. IR619
FIGURE B-1.6



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-2* (GDC, 2014a)
SAMPLE DEPTH: 5' - 6½'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

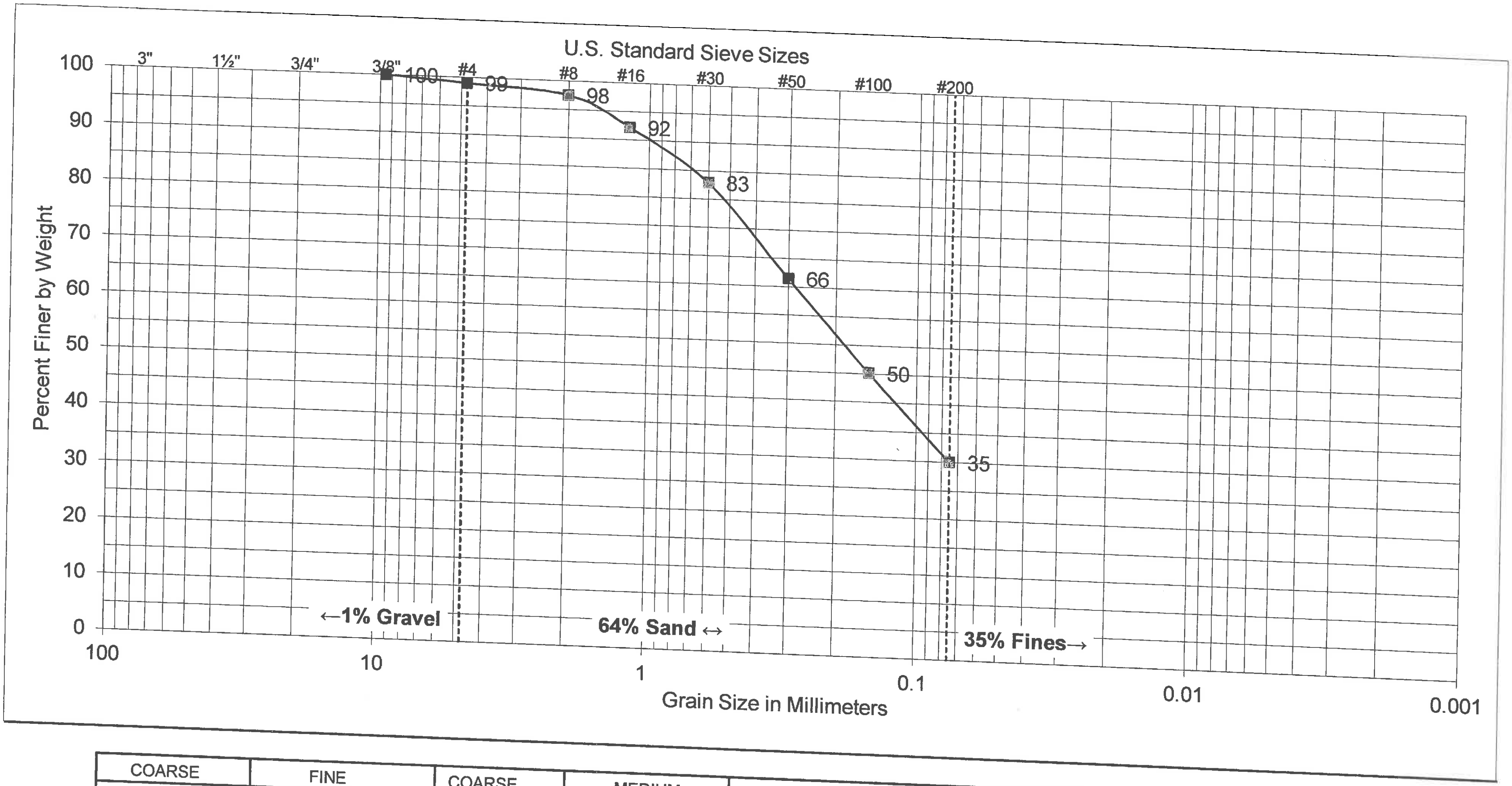
ATTERBERG LIMITS

LIQUID LIMIT: ---
PLASTIC LIMIT: ---
PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006
Project No. IR619
FIGURE B-1.7



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-1

SAMPLE DEPTH: 1' - 4'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

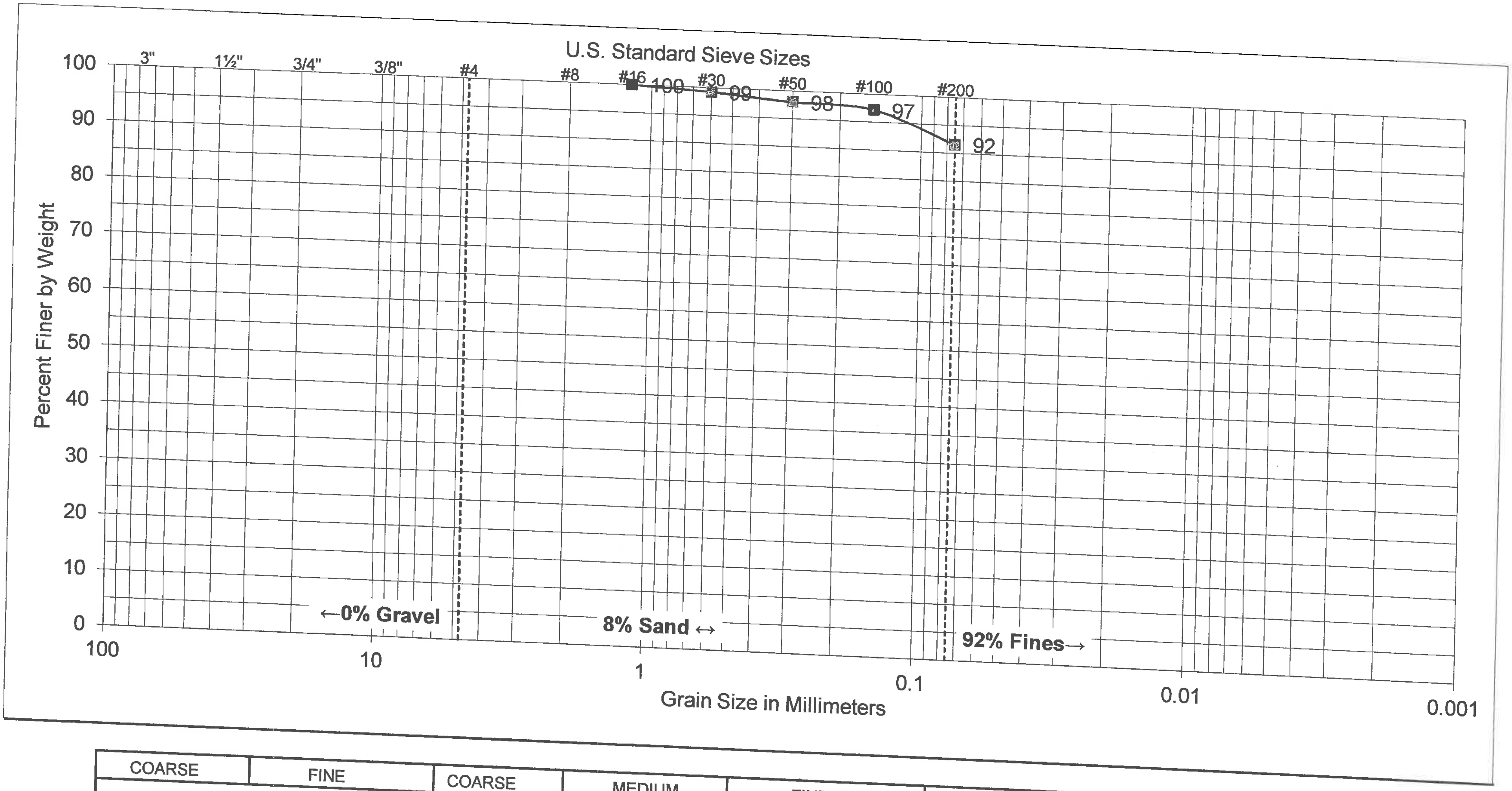
PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006
Project No. IR619
FIGURE B-1.8



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-1

SAMPLE DEPTH: 15' - 16½'

UNIFIED SOIL CLASSIFICATION: CL

DESCRIPTION: LEAN CLAY

ATTERBERG LIMITS

LIQUID LIMIT: ---

PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

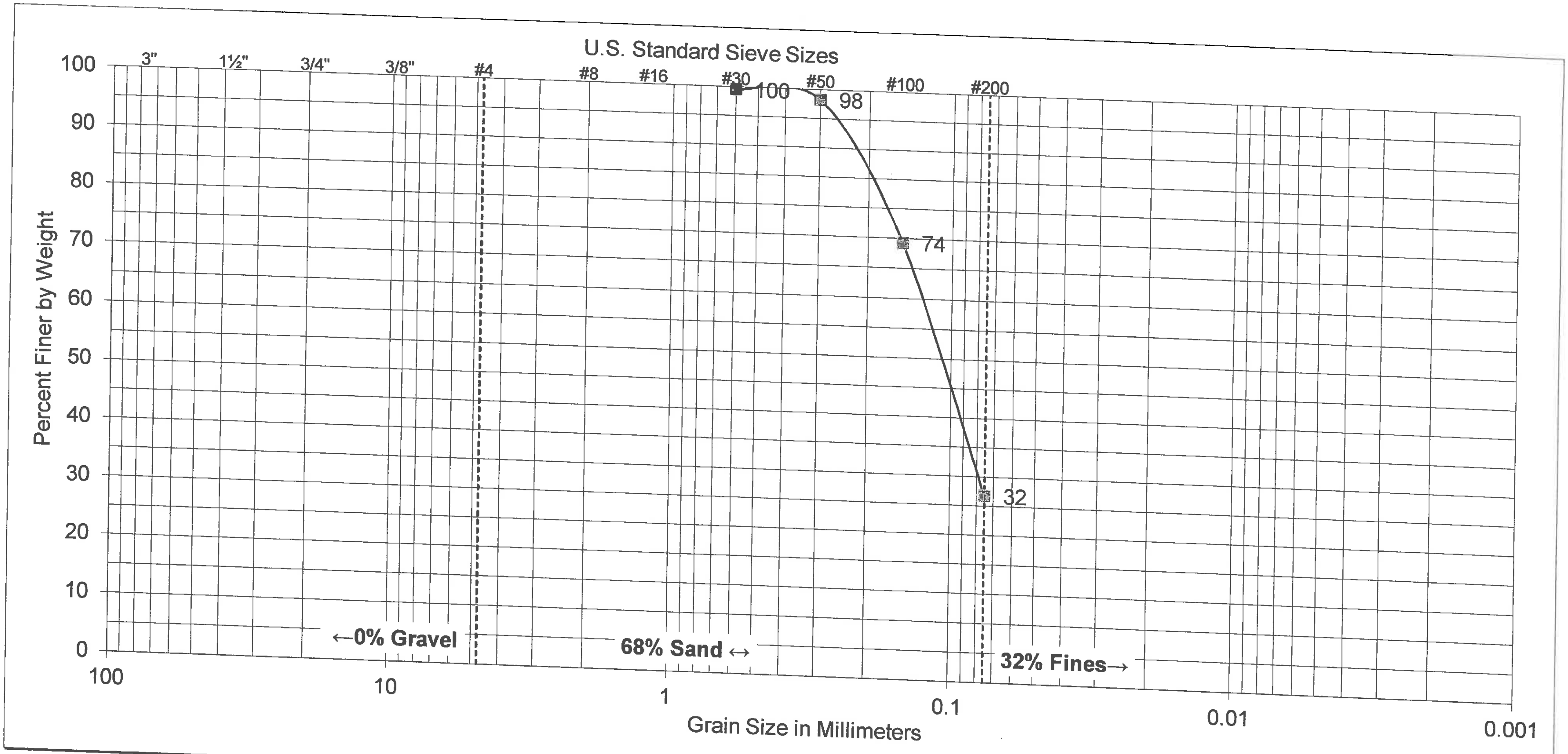
GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006

Project No. IR619

FIGURE B-1.9



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-1
SAMPLE DEPTH: 20' - 121½'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

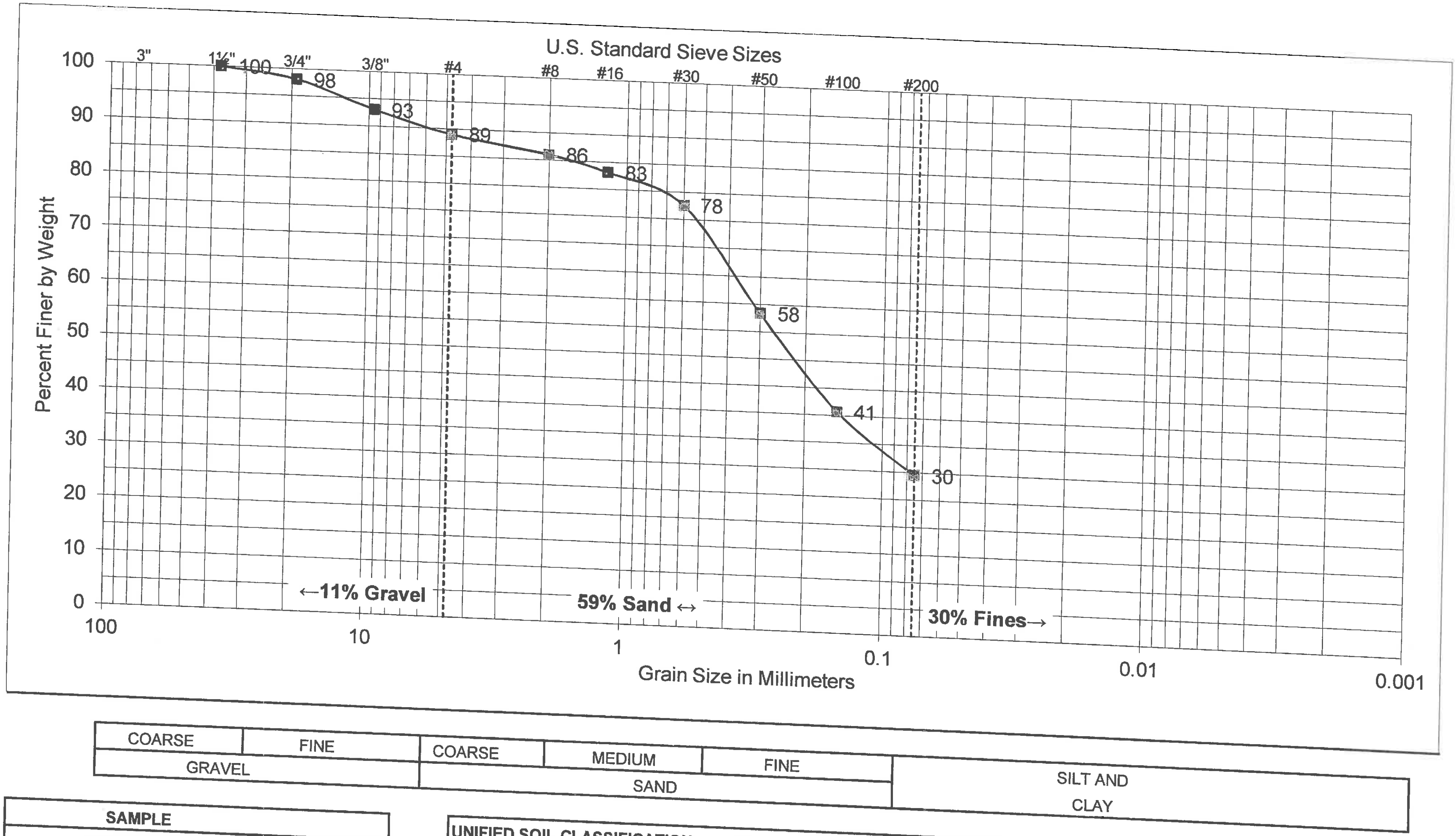
ATTERBERG LIMITS

LIQUID LIMIT: ---
PLASTIC LIMIT: ---
PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006
Project No. IR619
FIGURE B-1.10



SAMPLE

BORING NO: B-2

SAMPLE DEPTH: 0' - 4'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

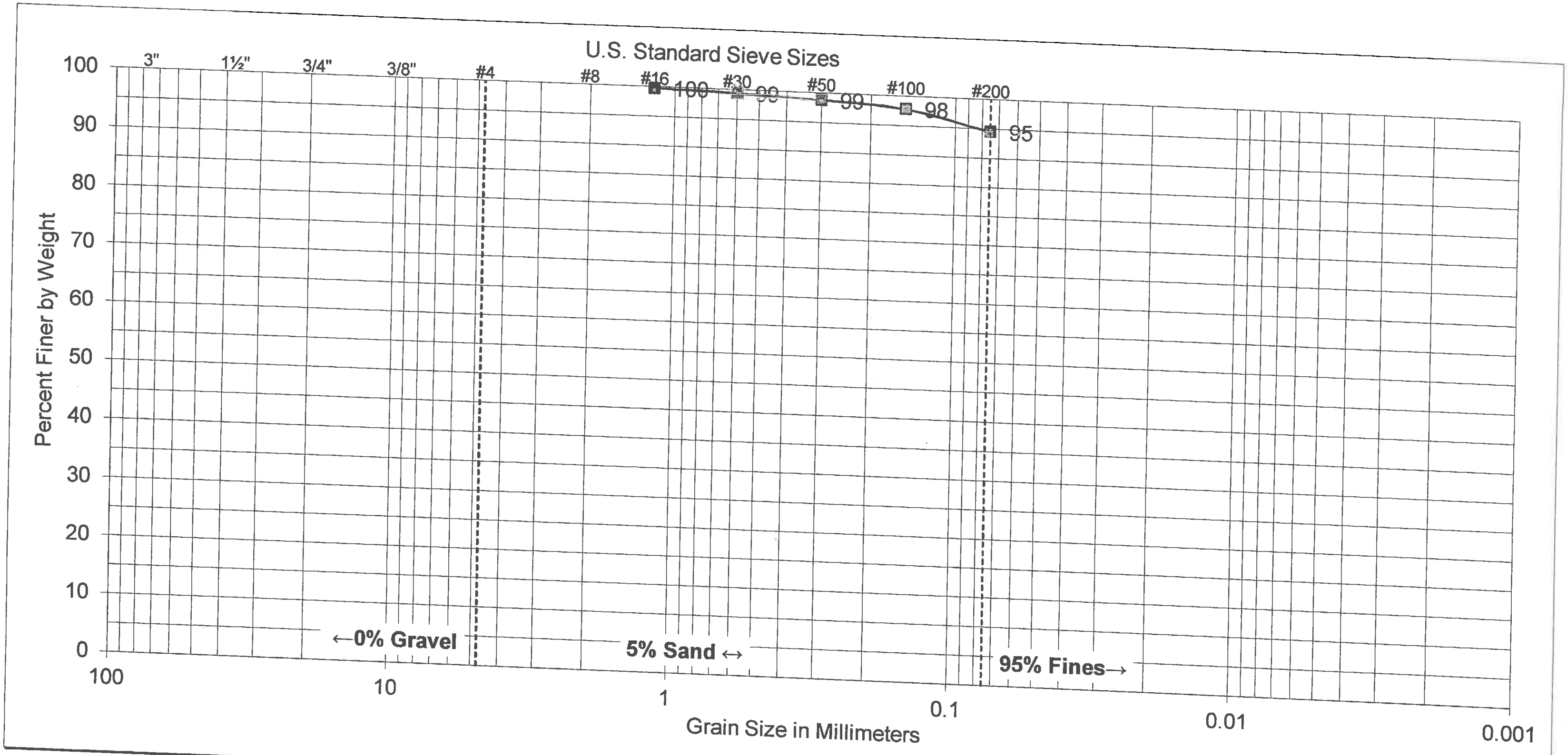
PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006
Project No. IR619
FIGURE B-1.11



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-2
SAMPLE DEPTH: 10' - 11½'

UNIFIED SOIL CLASSIFICATION: CL

DESCRIPTION: LEAN CLAY

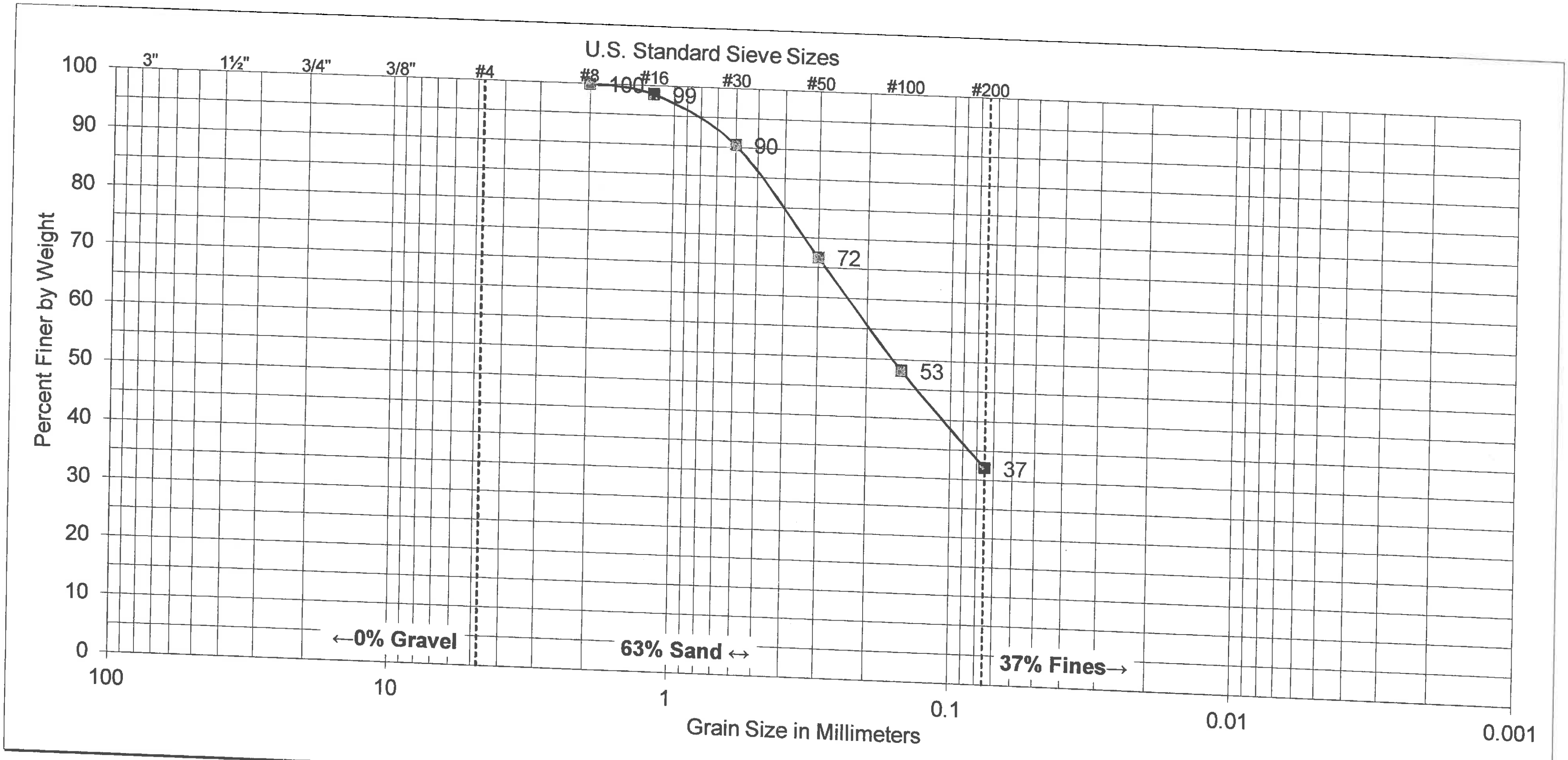
ATTERBERG LIMITS

LIQUID LIMIT: ---
PLASTIC LIMIT: ---
PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006
Project No. IR619
FIGURE B-1.12



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-2

SAMPLE DEPTH: 15' - 16½'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

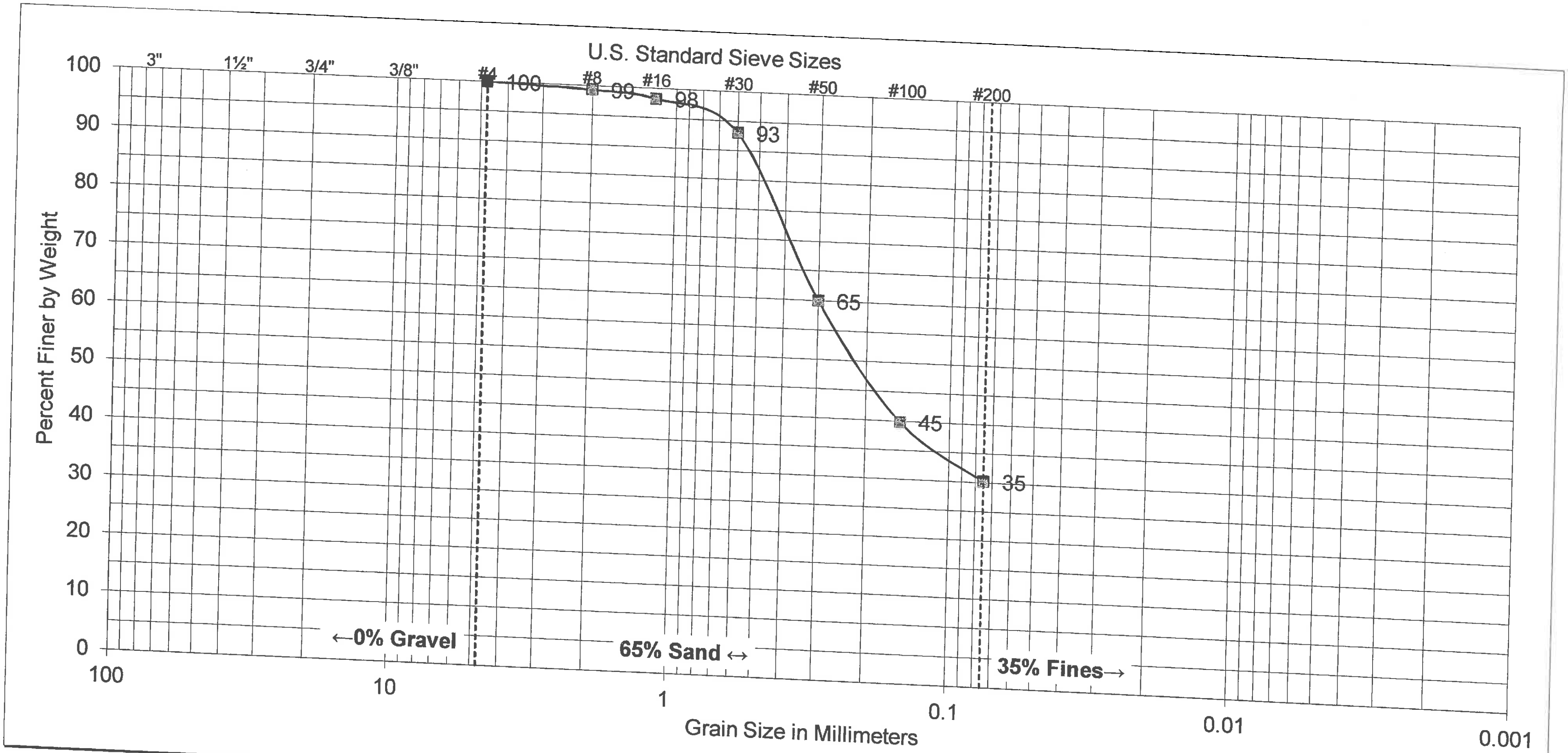
GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006

Project No. IR619

FIGURE B-1.13



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-3

SAMPLE DEPTH: 0' - 4'

UNIFIED SOIL CLASSIFICATION: SC

DESCRIPTION: CLAYEY SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

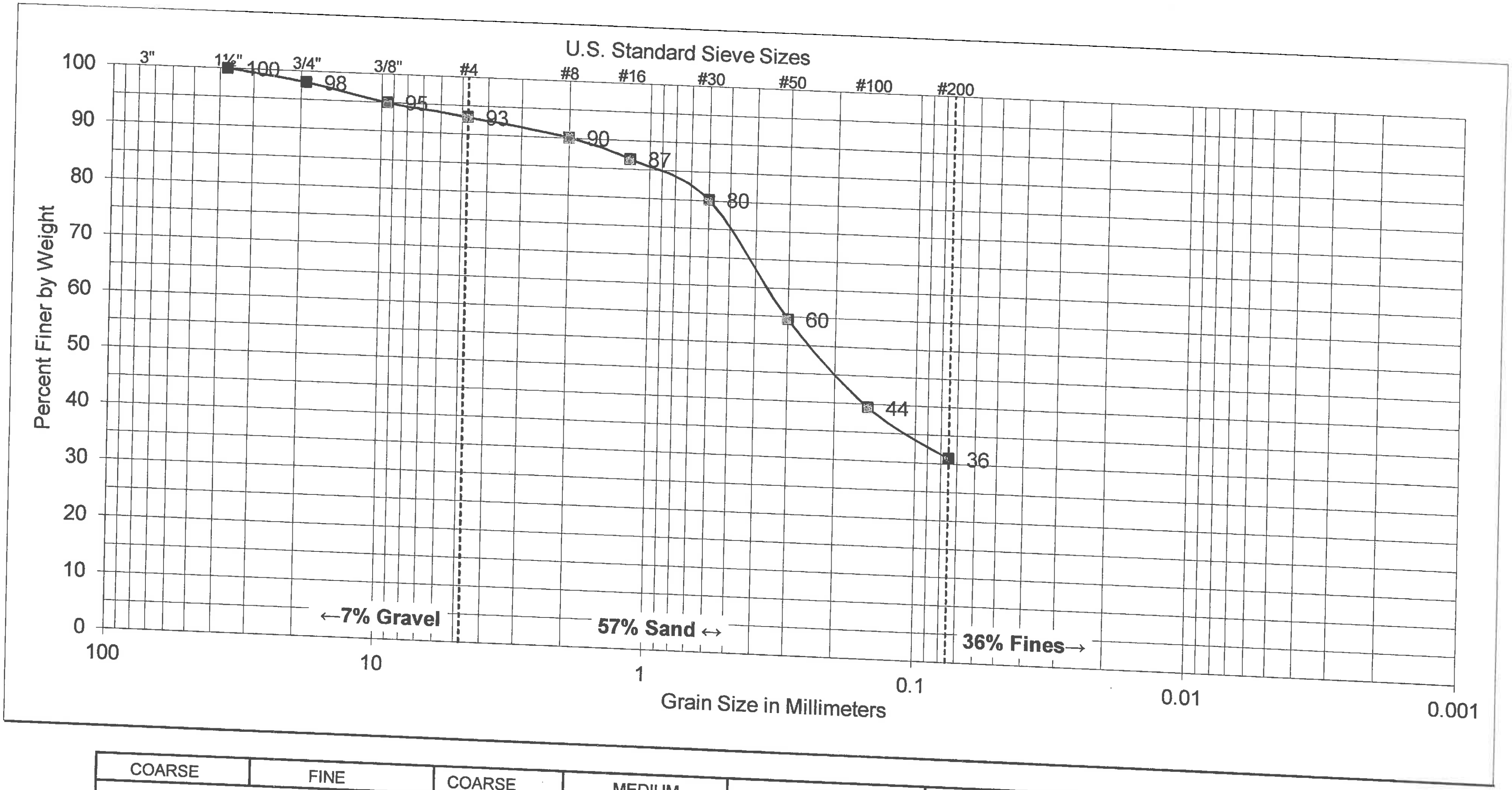
GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006

Project No. IR619

FIGURE B-1.14



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-3
SAMPLE DEPTH: 10' - 11½'

UNIFIED SOIL CLASSIFICATION: SC

DESCRIPTION: CLAYEY SAND

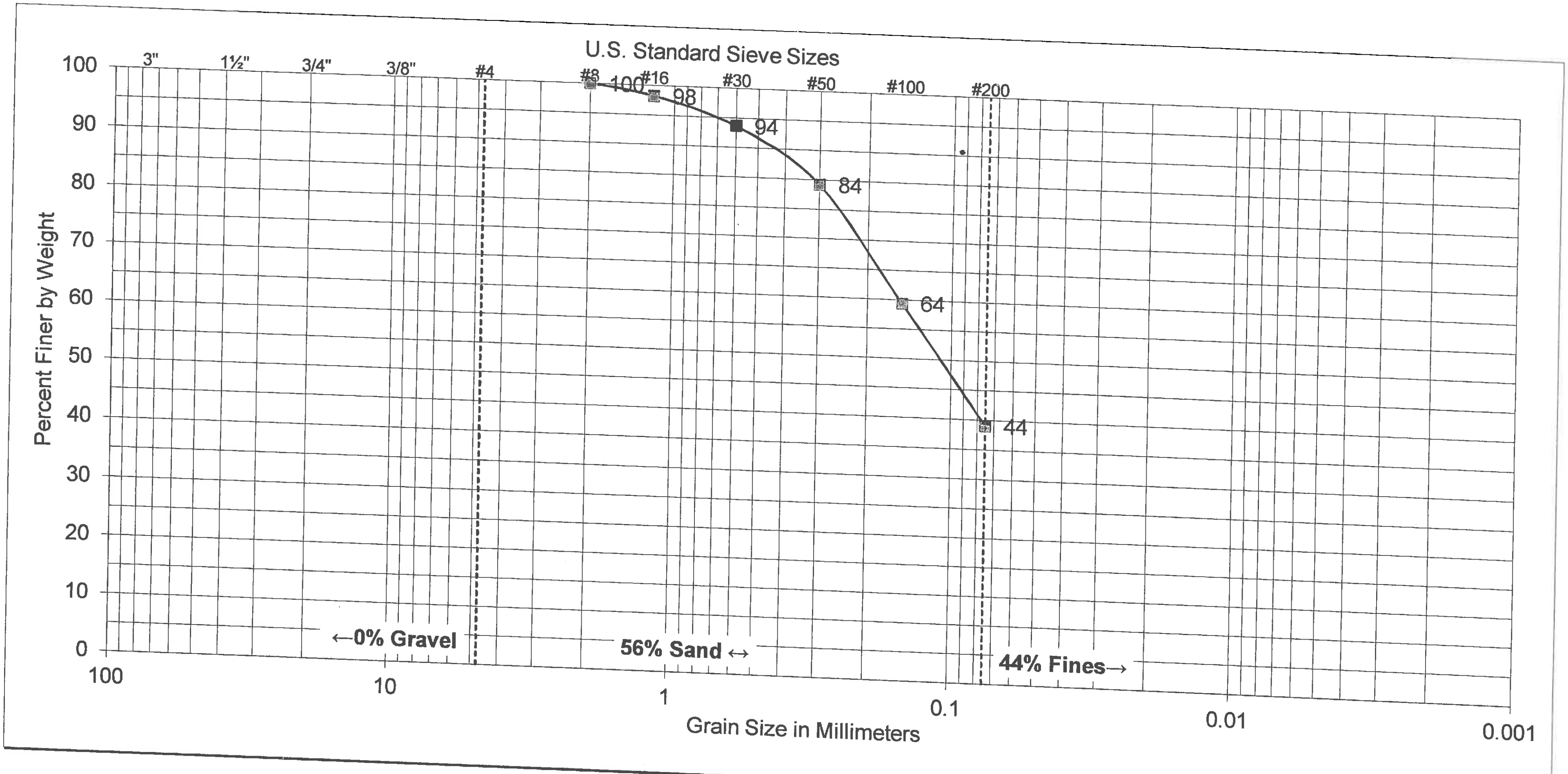
ATTERBERG LIMITS

LIQUID LIMIT: ---
PLASTIC LIMIT: ---
PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006
Project No. IR619
FIGURE B-1.15



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-3
SAMPLE DEPTH: 20' - 21½'

UNIFIED SOIL CLASSIFICATION: SC

DESCRIPTION: CLAYEY SAND

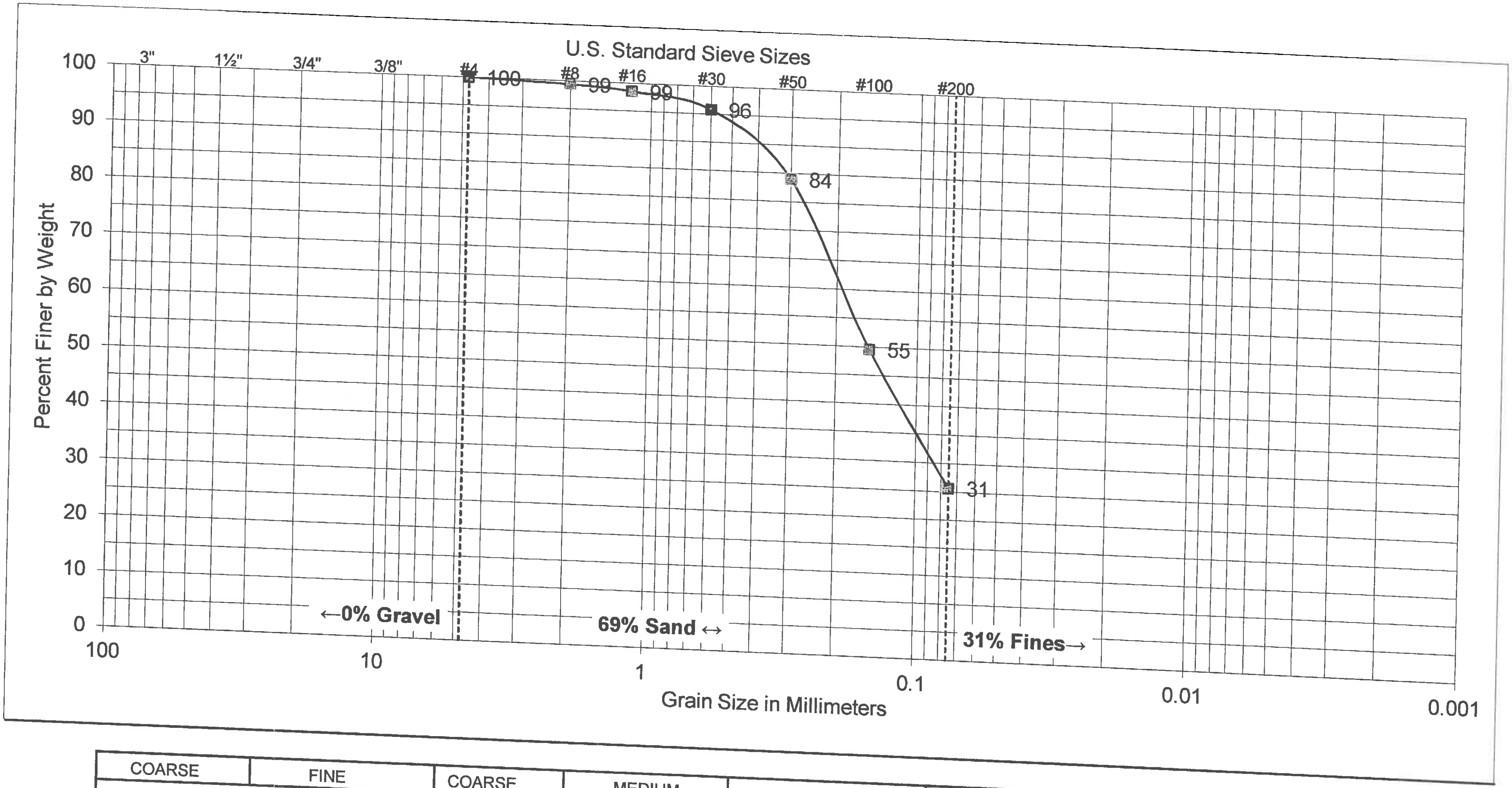
ATTERBERG LIMITS

LIQUID LIMIT: ---
PLASTIC LIMIT: ---
PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006
Project No. IR619
FIGURE B-1.16



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-4

SAMPLE DEPTH: 0' - 4'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

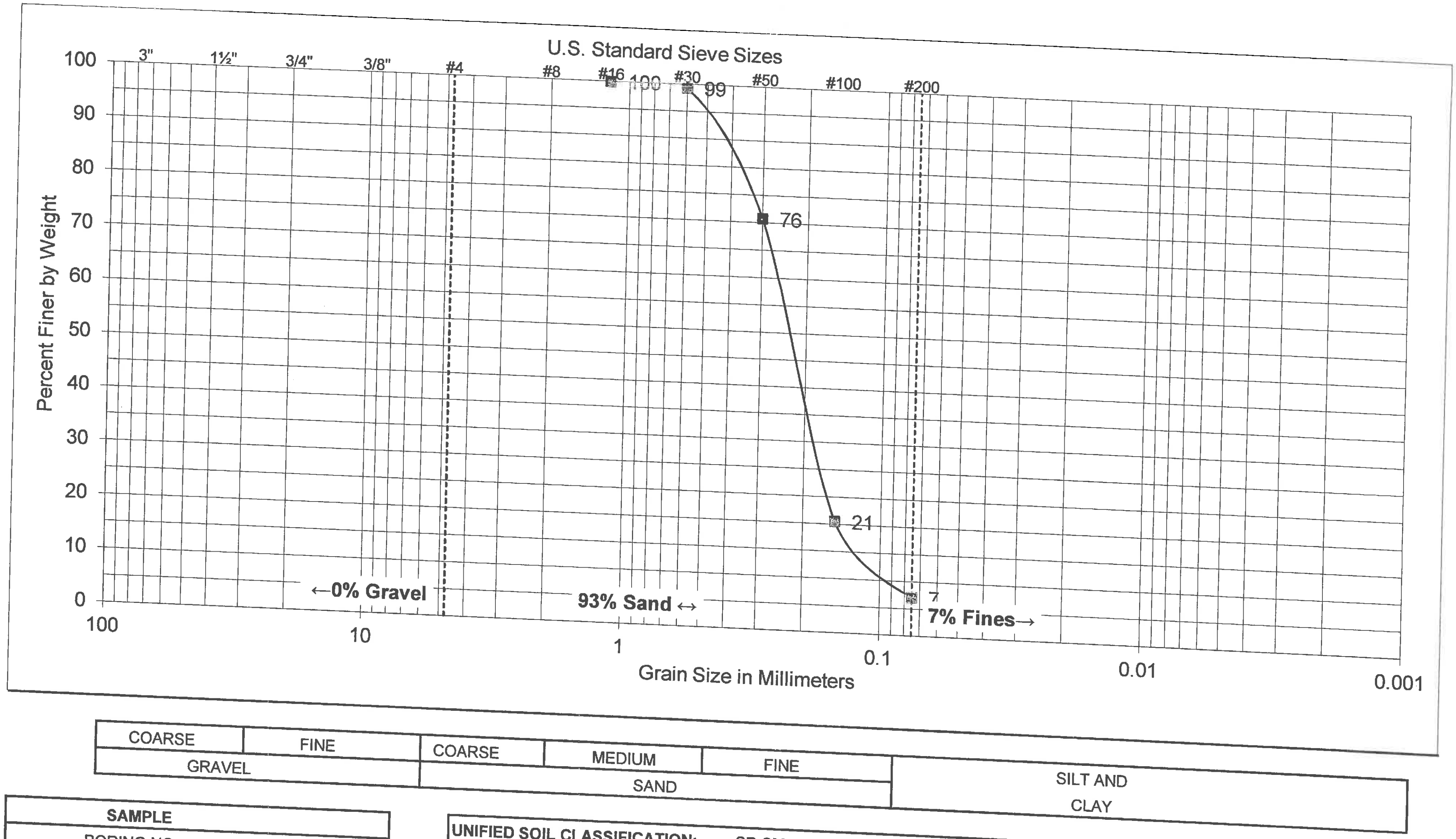
PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006
Project No. IR619
FIGURE B-1.17



SAMPLE

BORING NO: B-4

SAMPLE DEPTH: 10' - 11½'

UNIFIED SOIL CLASSIFICATION: SP-SM

DESCRIPTION: POORLY GRADED SAND WITH SILT

ATTERBERG LIMITS

LIQUID LIMIT: ---

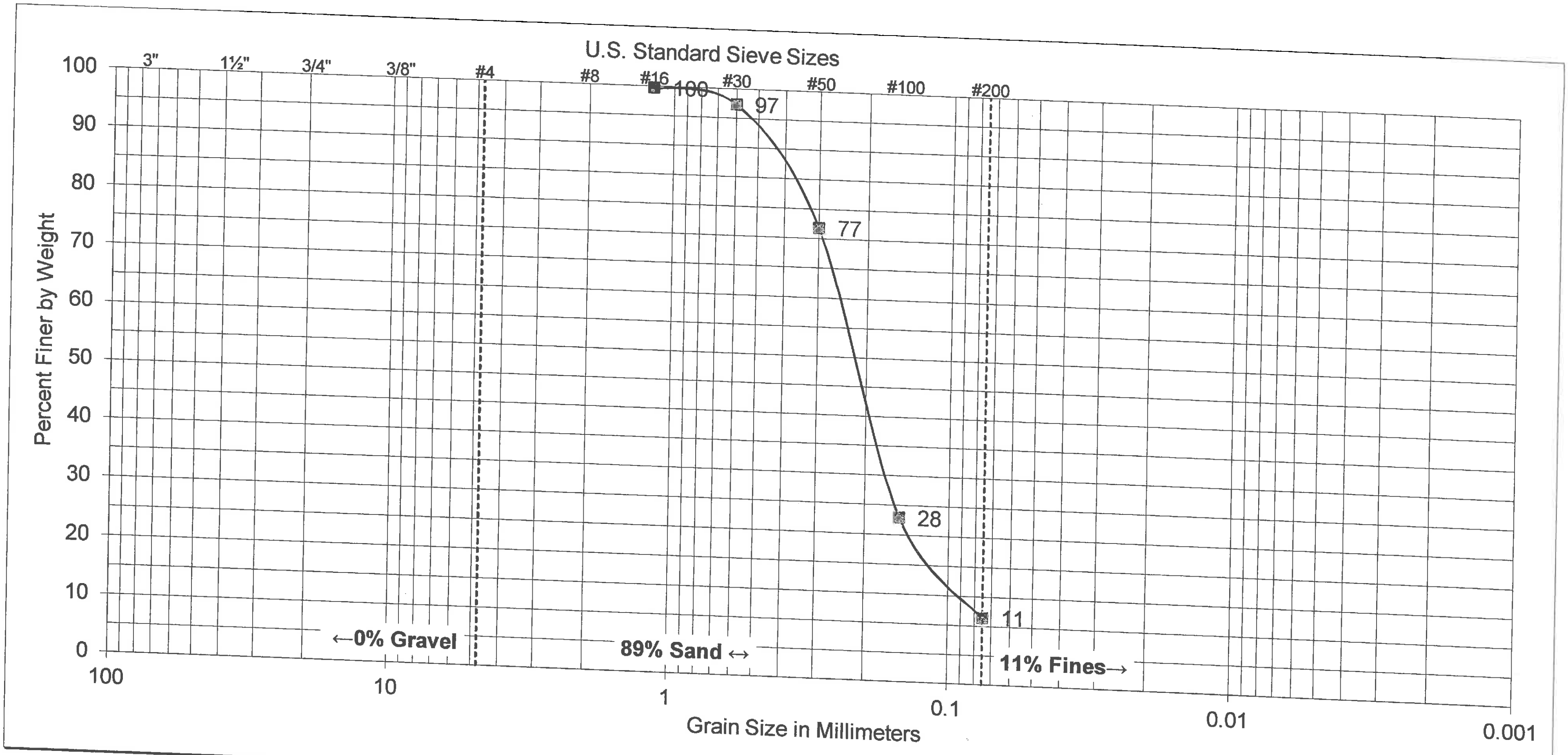
PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006
Project No. IR619
FIGURE B-1.18



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-4

SAMPLE DEPTH: 20' - 21½'

UNIFIED SOIL CLASSIFICATION: SP-SM

DESCRIPTION: POORLY GRADED SAND WITH SILT

ATTERBERG LIMITS

LIQUID LIMIT: ---

PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

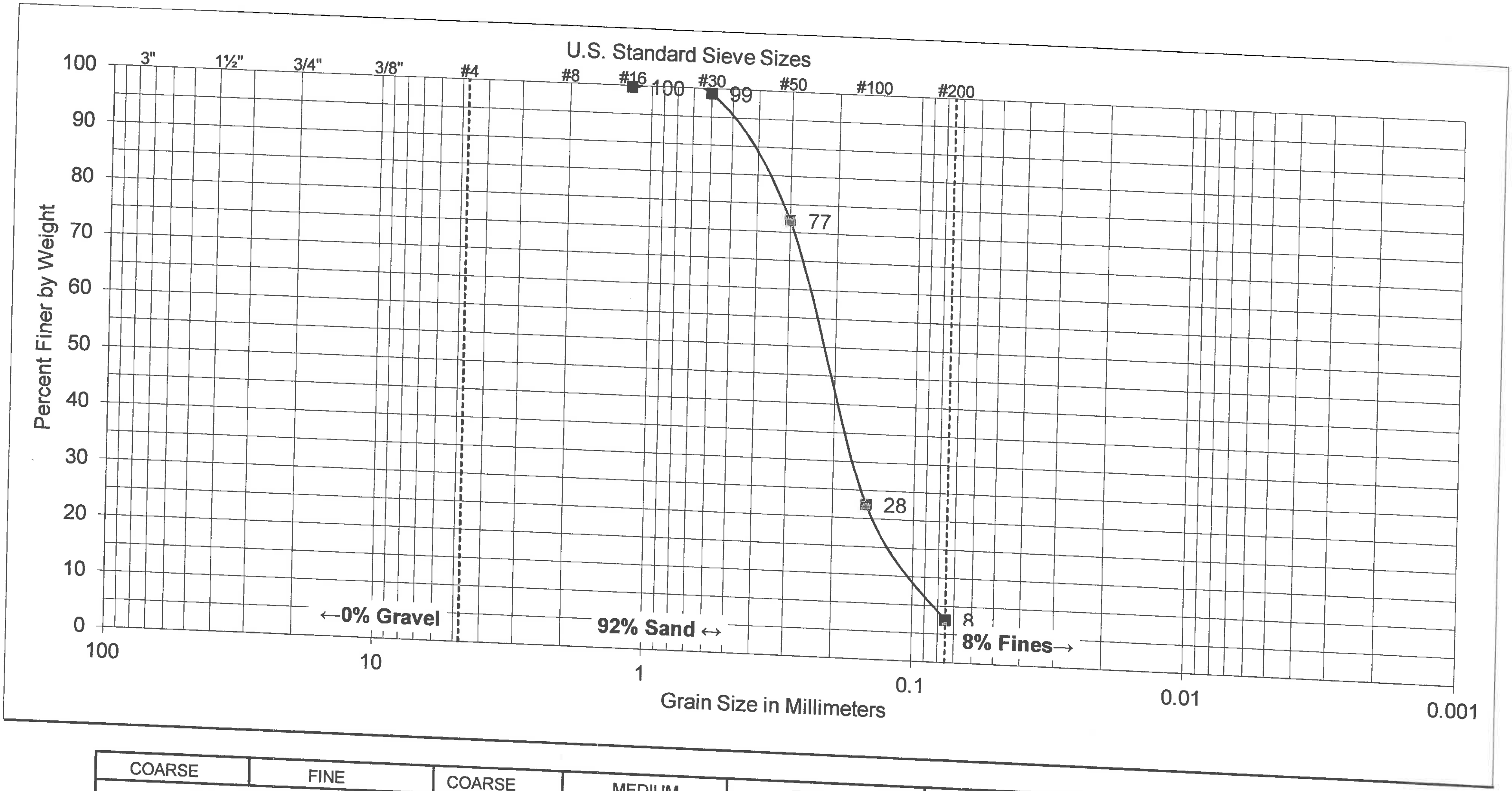
GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006

Project No. IR619

FIGURE B-1.19



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-4

SAMPLE DEPTH: 25' - 26½'

UNIFIED SOIL CLASSIFICATION: SP-SM

DESCRIPTION: POORLY GRADED SAND WITH SILT

ATTERBERG LIMITS

LIQUID LIMIT: ---

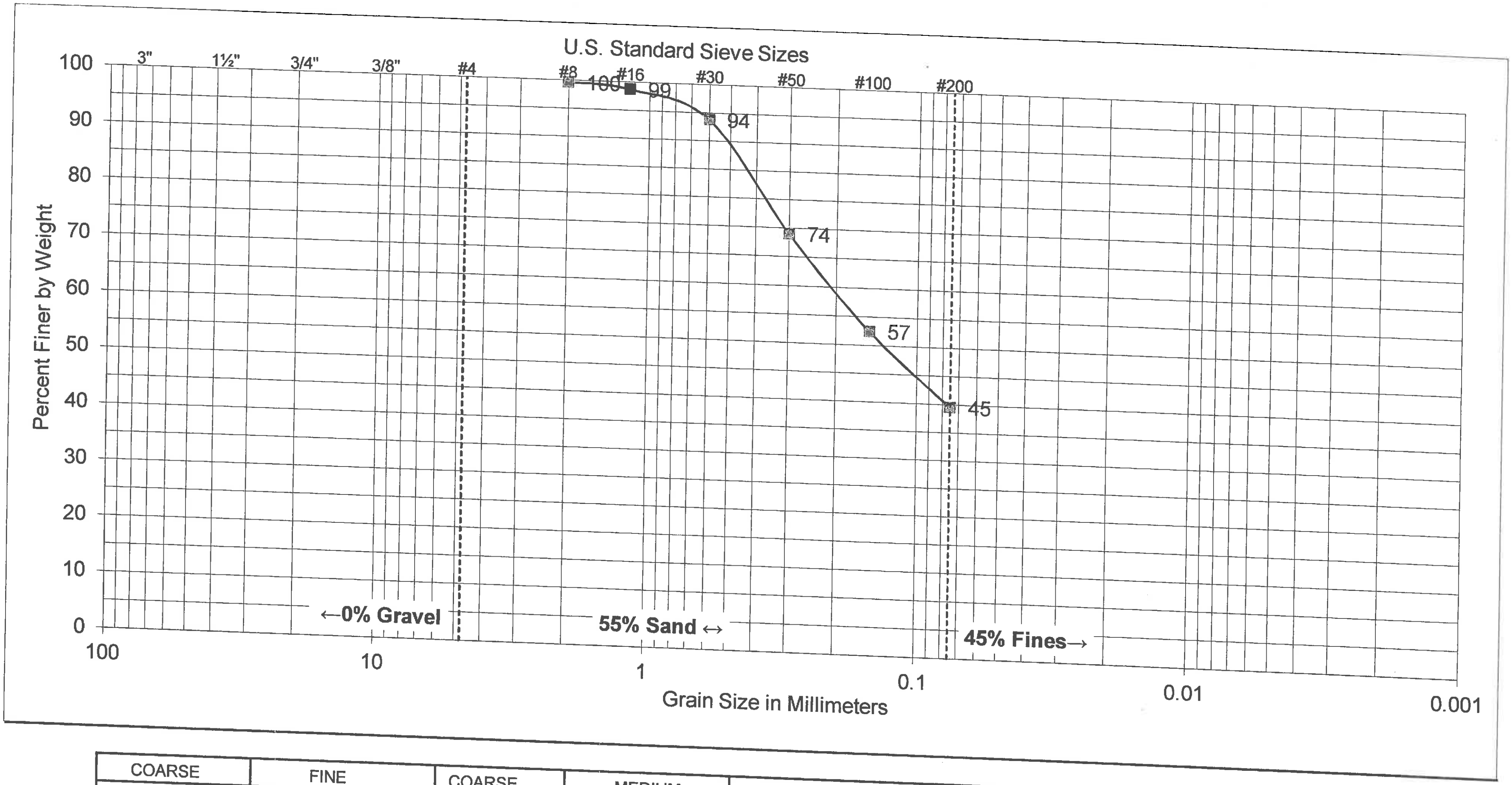
PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006
Project No. IR619
FIGURE B-1.20



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO:	B-4
SAMPLE DEPTH:	30' - 31½'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

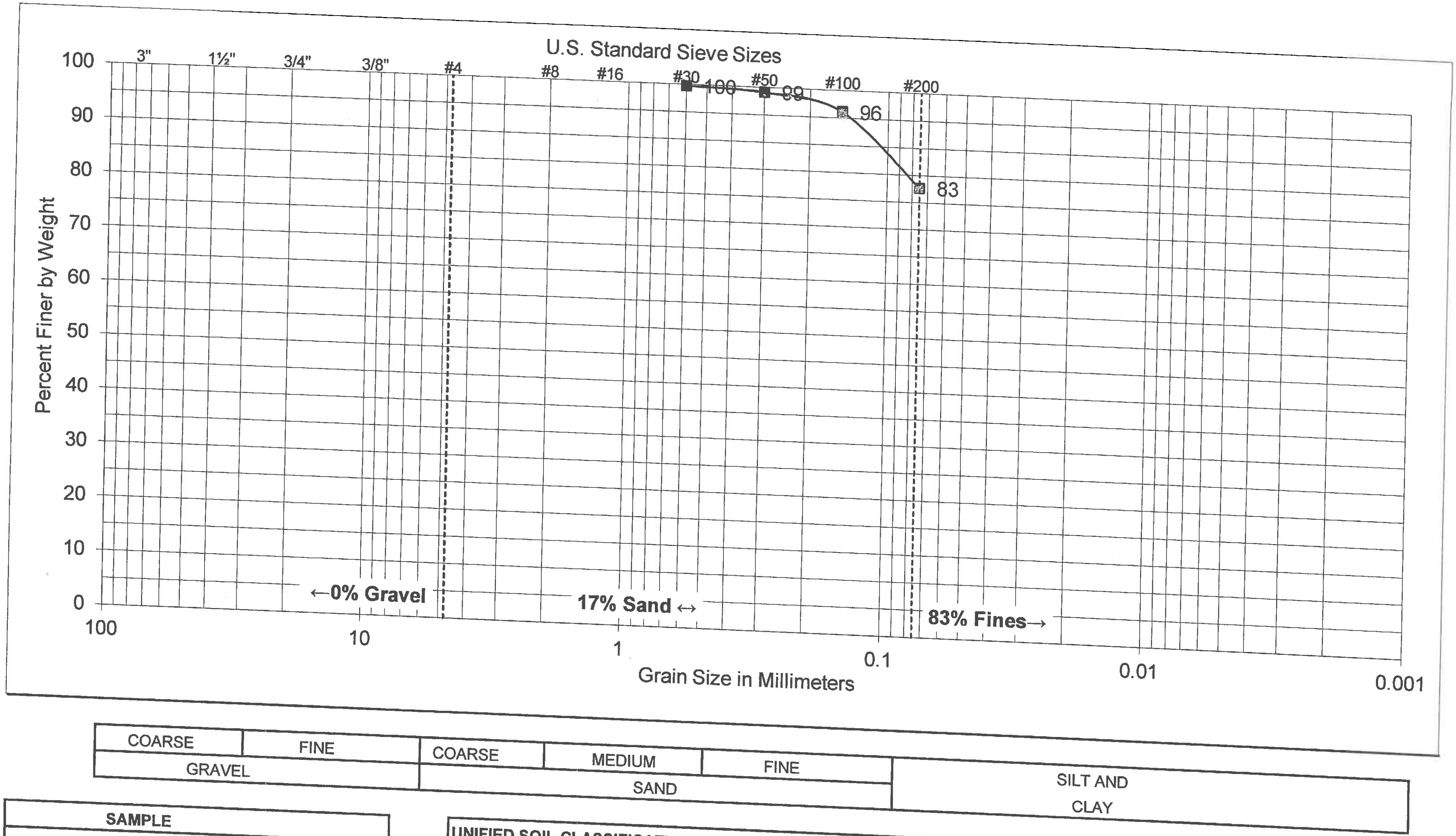
ATTERBERG LIMITS

LIQUID LIMIT:	---
PLASTIC LIMIT:	---
PLASTICITY INDEX:	---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006
Project No. IR619
FIGURE B-1.21



SAMPLE

BORING NO: B-4

SAMPLE DEPTH: 35' - 36½'

UNIFIED SOIL CLASSIFICATION: ML

DESCRIPTION: SILT WITH SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

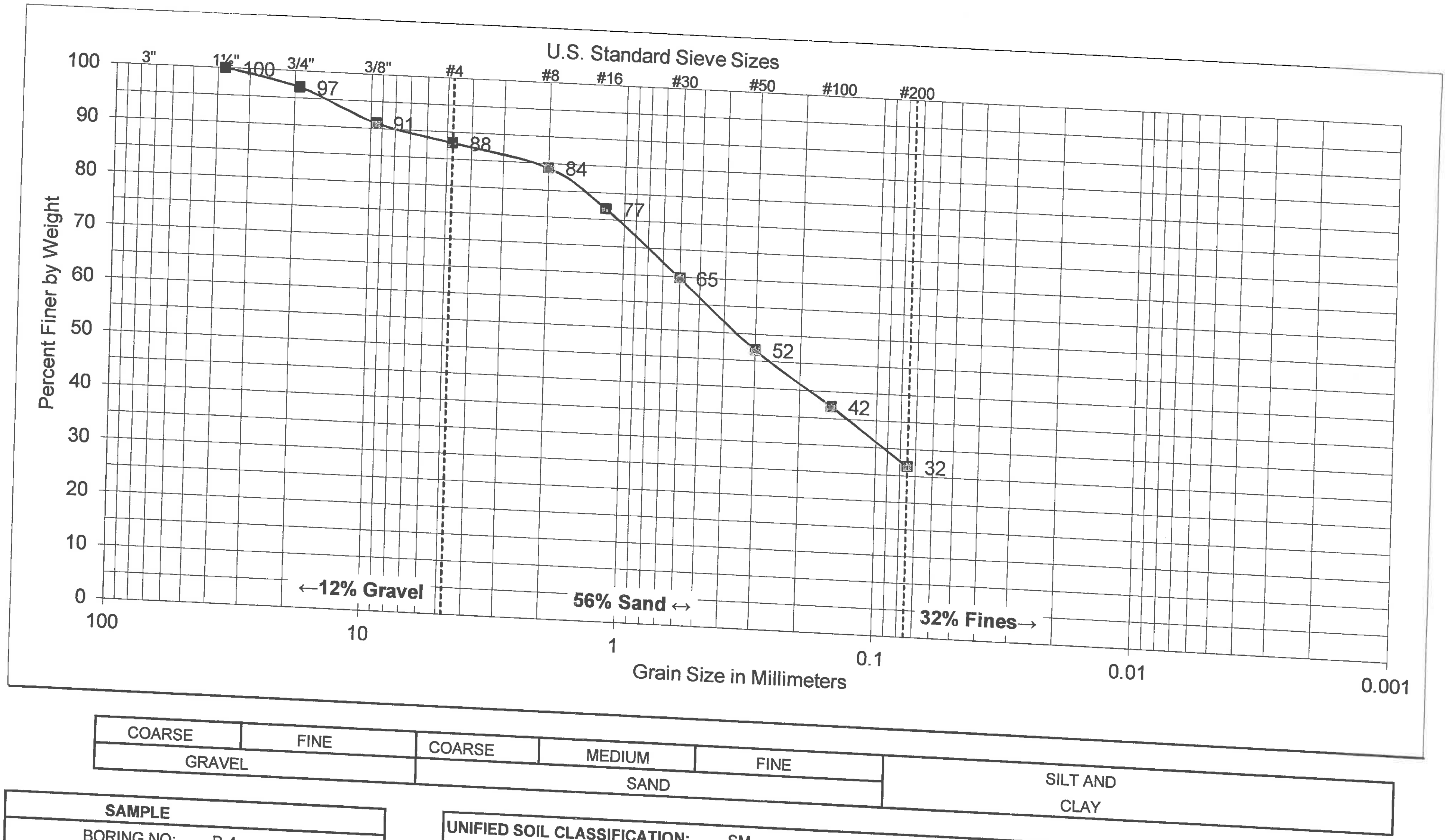
GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006

Project No. IR619

FIGURE B-1.22



SAMPLE

BORING NO: B-4

SAMPLE DEPTH: 45' - 46½'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

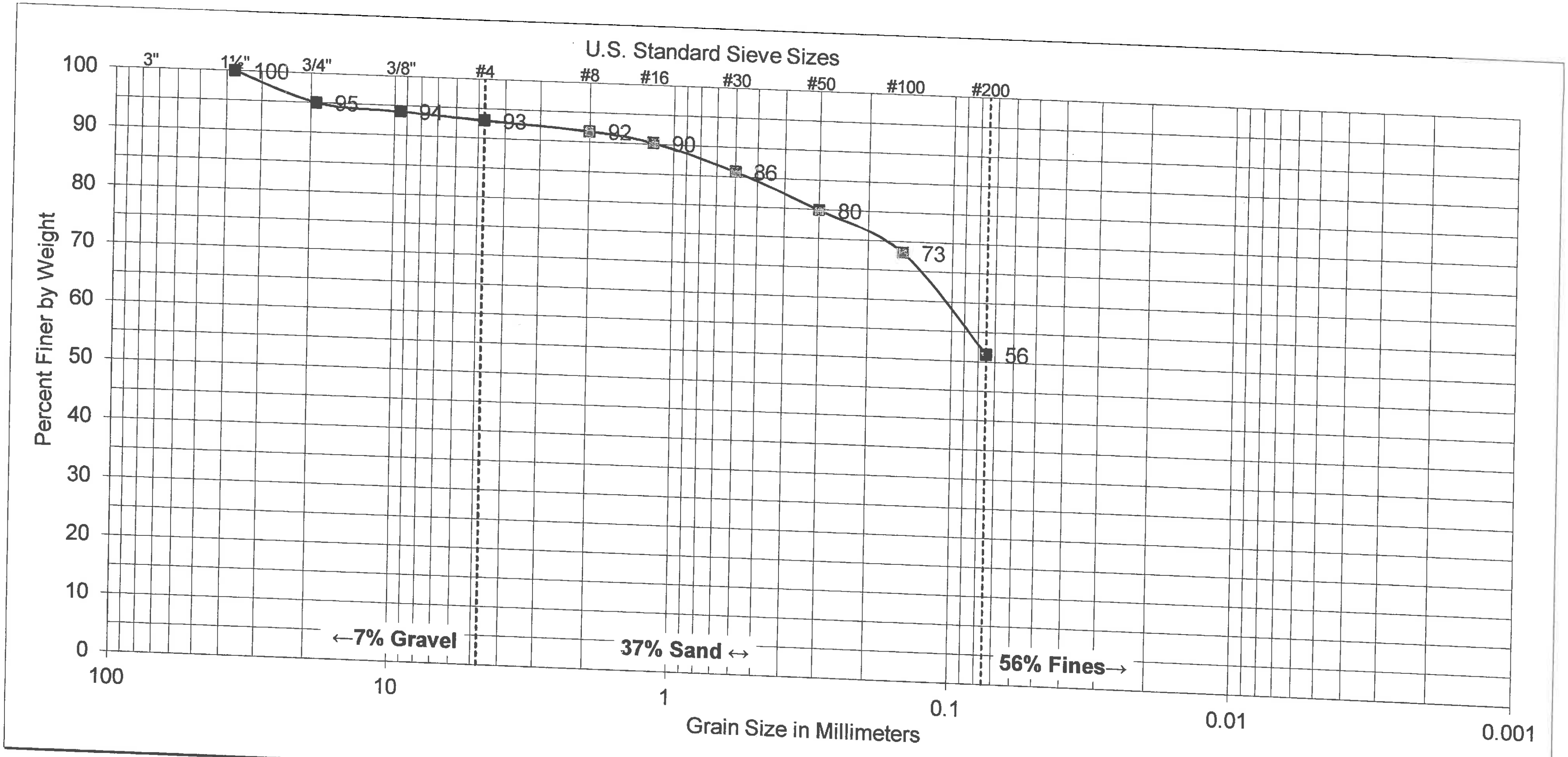
PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006
Project No. IR619
FIGURE B-1.23



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-4

SAMPLE DEPTH: 50' - 51½'

UNIFIED SOIL CLASSIFICATION: ML

DESCRIPTION: SANDY SILT

ATTERBERG LIMITS

LIQUID LIMIT: ---

PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

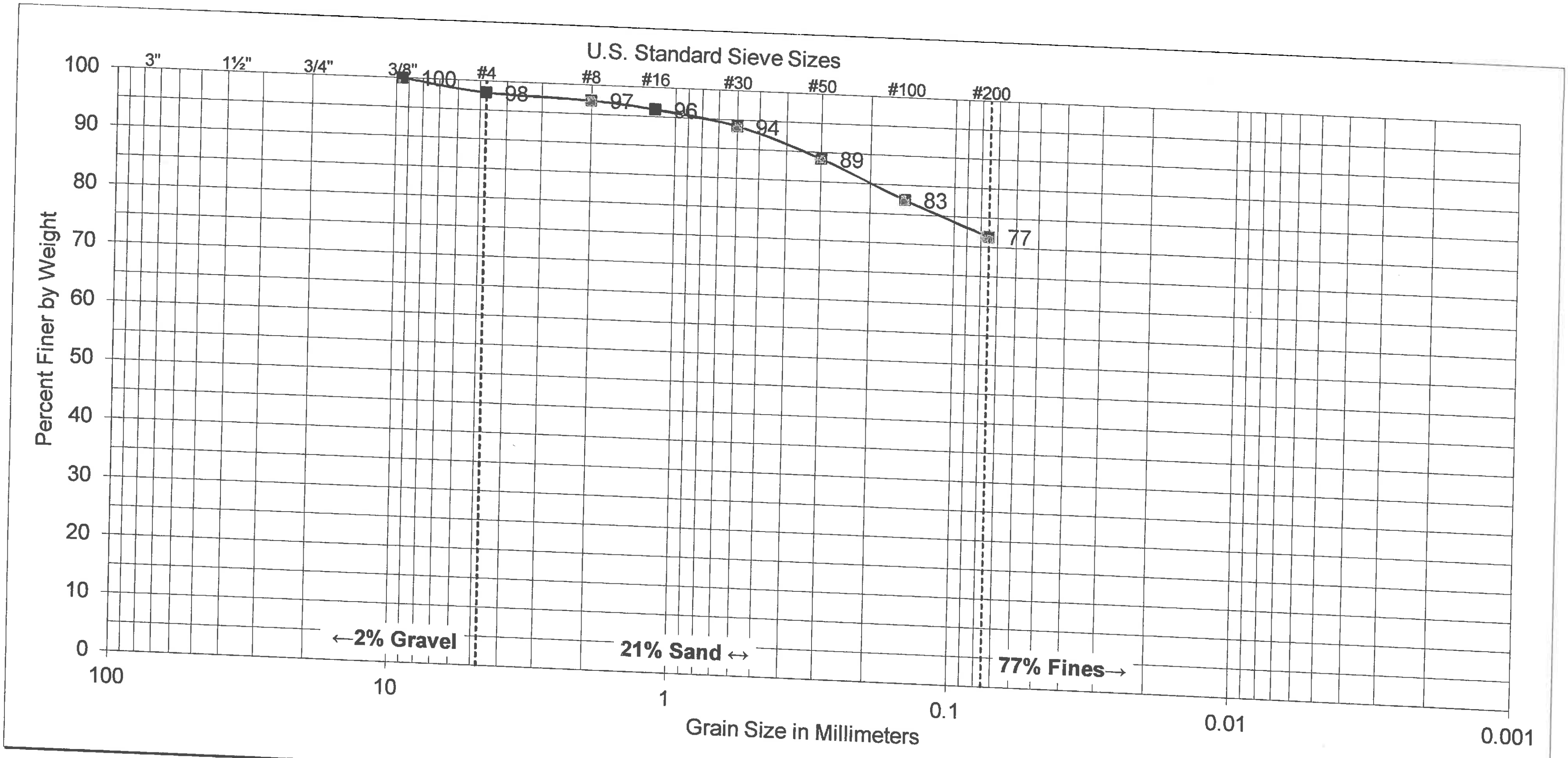
GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006

Project No. IR619

FIGURE B-1.24



GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE

BORING NO: B-5

SAMPLE DEPTH: 10' - 11½'

UNIFIED SOIL CLASSIFICATION: CL

DESCRIPTION: LEAN CLAY WITH SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

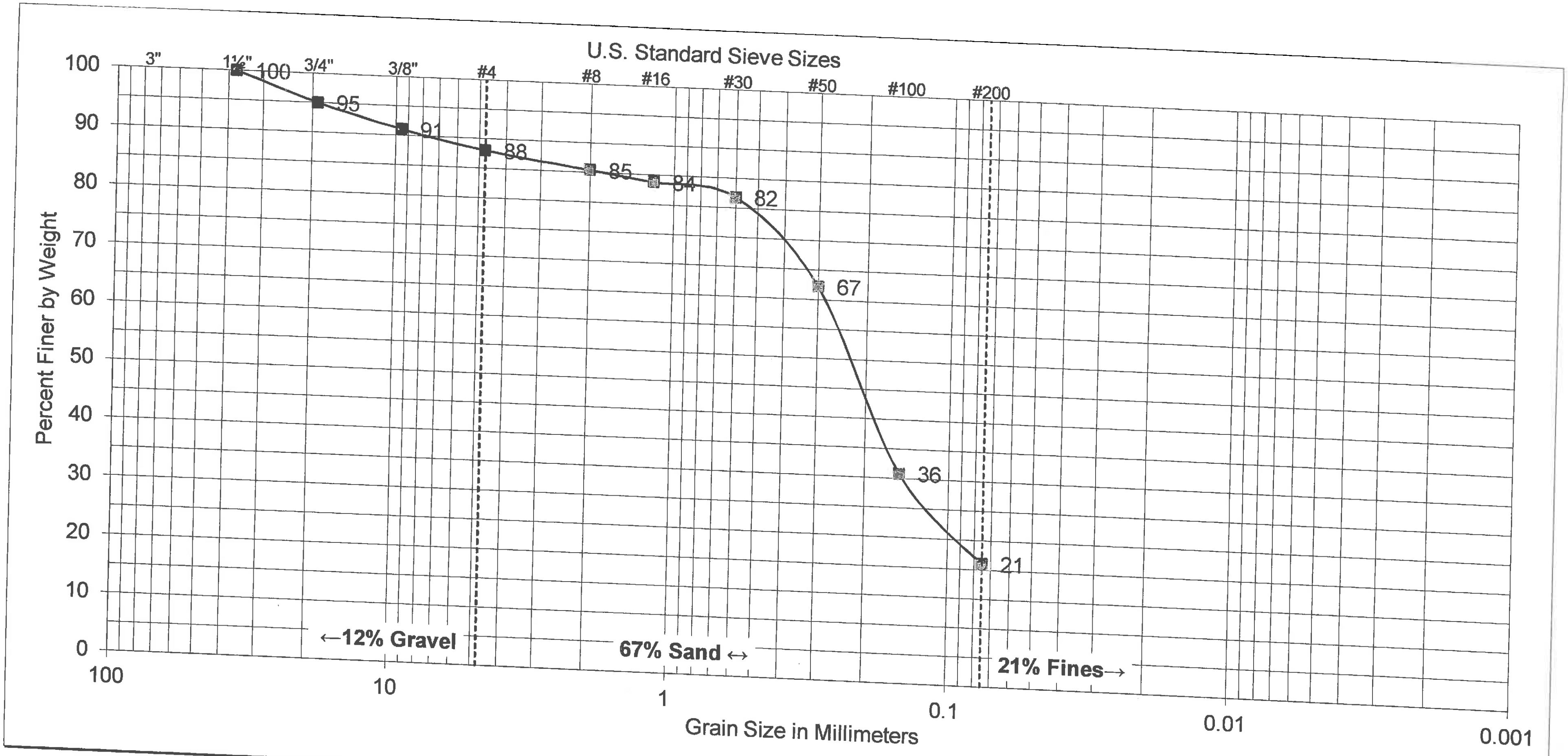
PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006
Project No. IR619
FIGURE B-1.25



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE

BORING NO: B-5

SAMPLE DEPTH: 20' - 21½'

UNIFIED SOIL CLASSIFICATION: SC

DESCRIPTION: CLAYEY SAND

ATTERBERG LIMITS

LIQUID LIMIT: ---

PLASTIC LIMIT: ---

PLASTICITY INDEX: ---

GROUP DELTA

SOIL CLASSIFICATION

Document No. 15-0006

Project No. IR619

FIGURE B-1.26

EXPANSION TEST RESULTS
(ASTM D4829)

SAMPLE	DESCRIPTION	EXPANSION INDEX
B-1* @ 1'– 5'	**FILL**: Brown clayey sand (SC).	23
B-2* @ 1'– 5'	**FILL**: Grayish brown silty sand (SM).	10
B-1 @ 1'– 4'	**FILL**: Dark brown silty sand (SM).	0
B-2 @ 0'– 4'	**FILL**: Dark brown silty sand (SM).	0
B-3 @ 0'– 4'	**FILL**: Dark brown clayey sand (SC).	14
B-4 @ 0'– 4'	**FILL**: Brown silty sand (SM).	4

Note: *Borings B-1* and B-2* were completed as part of the initial site investigation (GDC, 2014a)*

EXPANSION INDEX	POTENTIAL EXPANSION
0 to 20	Very low
21 to 50	Low
51 to 90	Medium
91 to 130	High
Above 130	Very High

CHEMISTRY TEST RESULTS
(ASTM D516, CTM 643)

SAMPLE	pH	RESISTIVITY [OHM-CM]	SULFATE CONTENT [%]	CHLORIDE CONTENT [%]
B-1* @ 1'– 5'	7.3	390	0.10	0.07
B-2* @ 1'– 5'	7.3	630	0.08	0.03
B-1 @ 1'– 4'	7.1	520	0.10	0.01
B-2 @ 0'– 4'	7.1	330	0.13	0.05
B-3 @ 0'– 4'	7.2	260	0.12	0.08
B-4 @ 0'– 4'	7.2	630	0.04	0.02

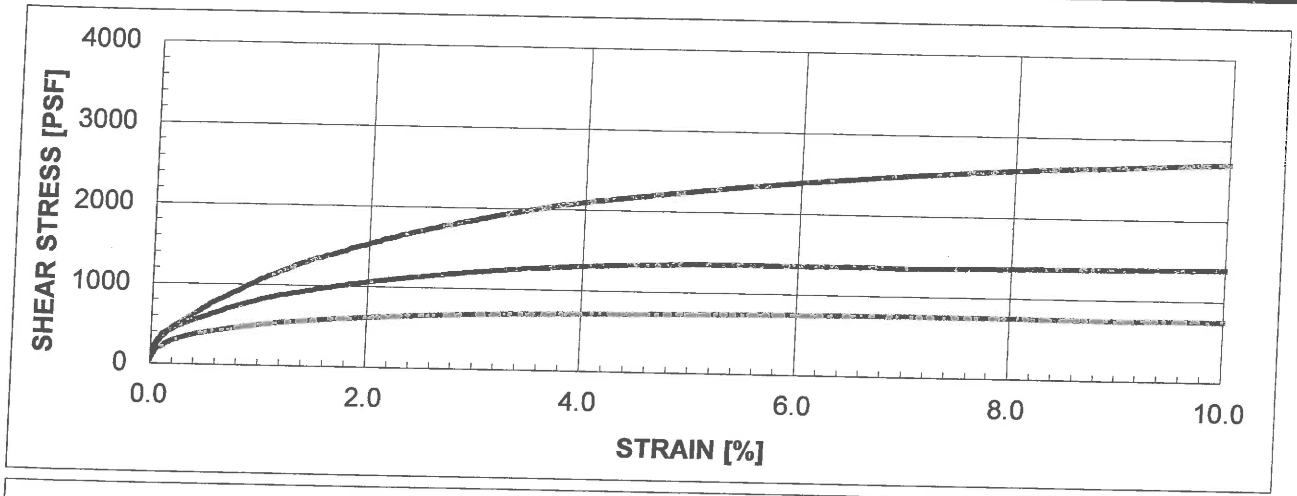
SULFATE CONTENT [%]	SULFATE EXPOSURE	CEMENT TYPE
0.00 to 0.10	Negligible	-
0.10 to 0.20	Moderate	II, IP(MS), IS(MS)
0.20 to 2.00	Severe	V
Above 2.00	Very Severe	V plus pozzolan

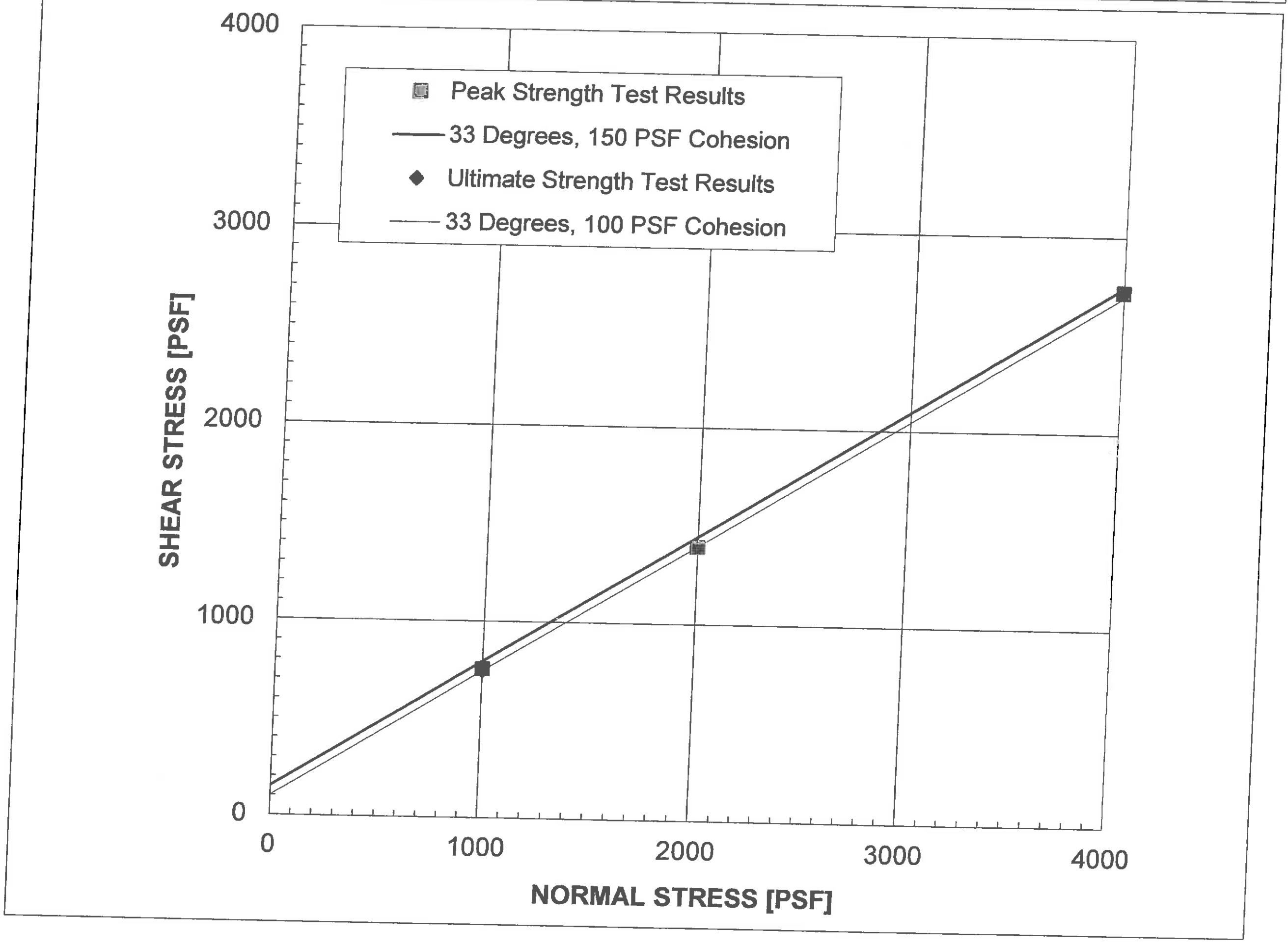
SOIL RESISTIVITY [OHM-CM]	GENERAL DEGREE OF CORROSIVITY TO FERROUS METALS
0 to 1,000	Very Corrosive
1,000 to 2,000	Corrosive
2,000 to 5,000	Moderately Corrosive
5,000 to 10,000	Mildly Corrosive
Above 10,000	Slightly Corrosive

CHLORIDE (Cl) CONTENT [%]	GENERAL DEGREE OF CORROSIVITY TO METALS
0.00 to 0.03	Negligible
0.03 to 0.15	Corrosive
Above 0.15	Severely Corrosive

MAXIMUM DENSITY & OPTIMUM MOISTURE
(ASTM D1557)

SAMPLE ID	DESCRIPTION	MAXIMUM DENSITY [lb/ft³]	OPTIMUM MOISTURE [%]
B-2 @ 0'– 4'	**FILL**: Dark brown silty sand (SM) with 0% gravel.	127.8	9.5
B-2 @ 0'– 4'	**FILL**: Dark brown silty sand (SM) with 5% gravel.	129.2	9.0
B-2 @ 0'– 4'	**FILL**: Dark brown silty sand (SM) with 10% gravel.	130.6	8.6
B-2 @ 0'– 4'	**FILL**: Dark brown silty sand (SM) with 15% gravel.	132.0	8.1
B-2 @ 0'– 4'	**FILL**: Dark brown silty sand (SM) with 20% gravel.	133.5	7.6
B-2 @ 0'– 4'	**FILL**: Dark brown silty sand (SM) with 25% gravel.	135.0	7.1
B-2 @ 0'– 4'	**FILL**: Dark brown silty sand (SM) with 30% gravel.	136.5	6.7





SAMPLE: B-1* @ 5' - 6½'

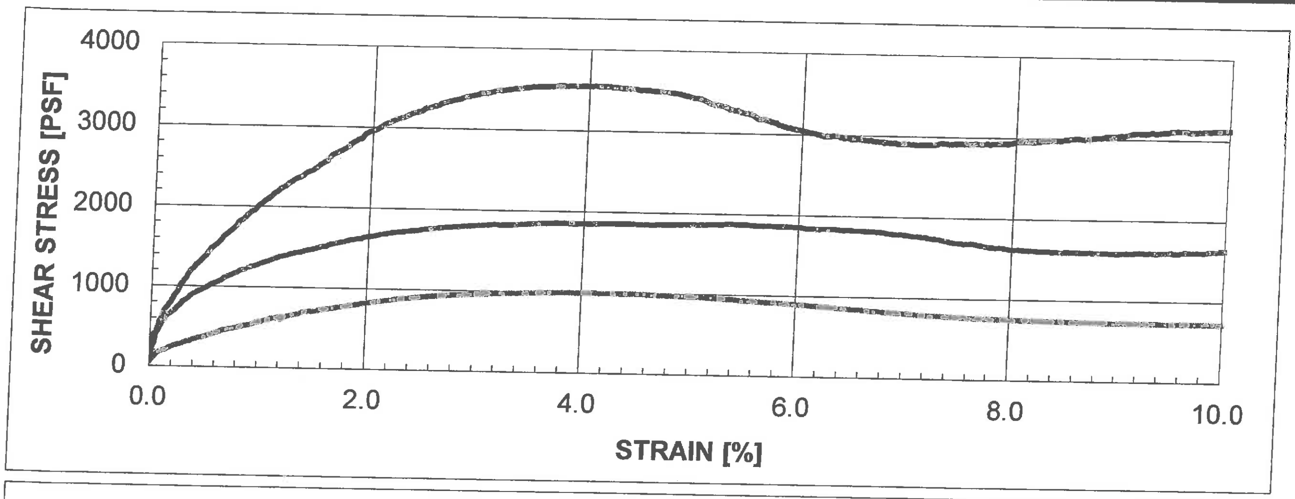
Alluvium:
Light brown sandy silt (ML)

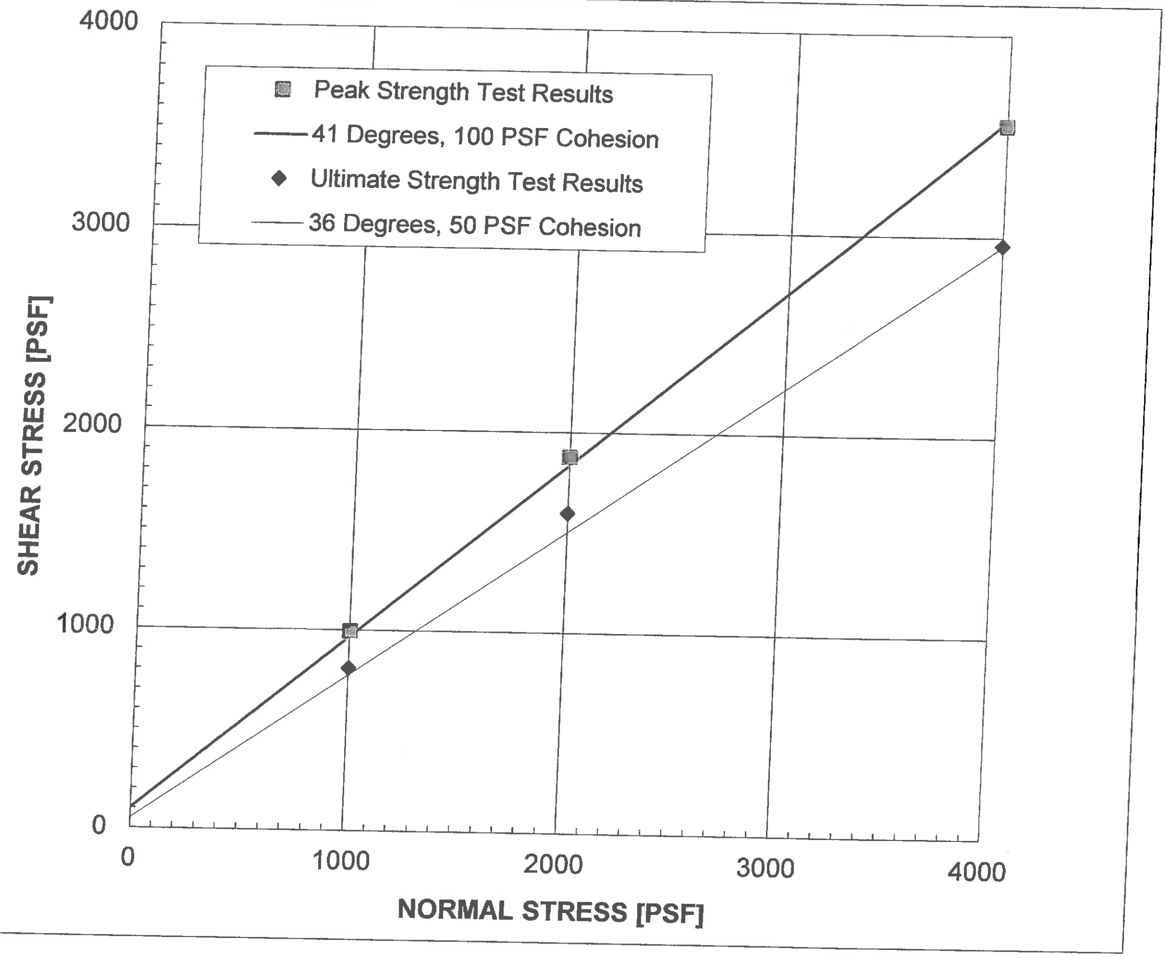
STRAIN RATE: 0.0030 IN/MIN
(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	33 °	33 °
C'	150 PSF	100 PSF

	IN-SITU	AS-TESTED
γ_d	78.5 PCF	78.5 PCF
w_c	25.8 %	37.0 %

GROUP DELTA **DIRECT SHEAR TEST RESULTS**





SAMPLE: B-1* @ 20' - 21½'

Alluvium:
Brown poorly graded sand with silt (SP-SM)

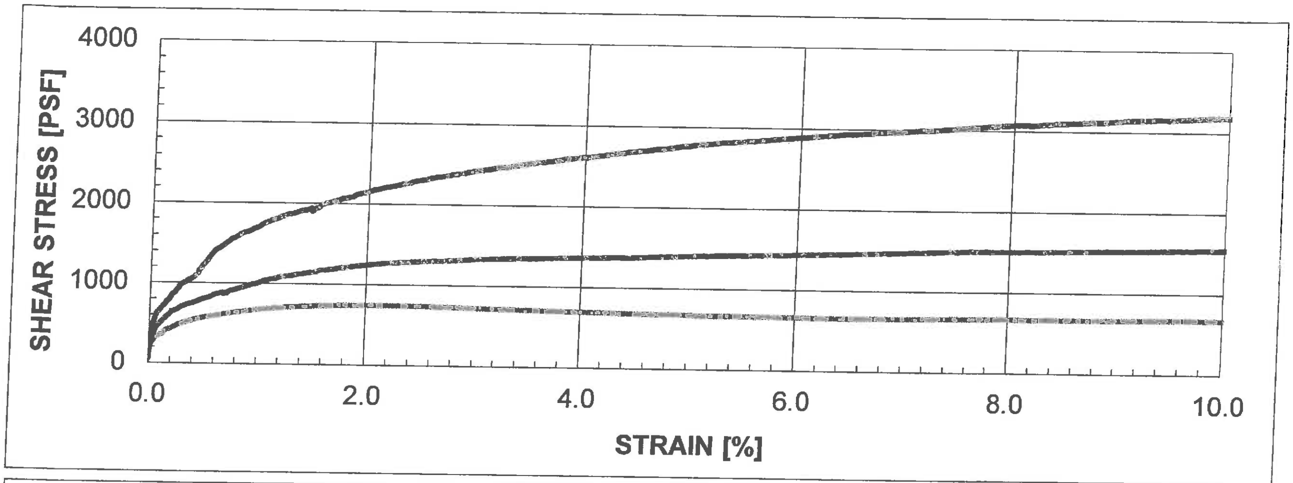
	PEAK	ULTIMATE
φ'	41 °	36 °
C'	100 PSF	50 PSF

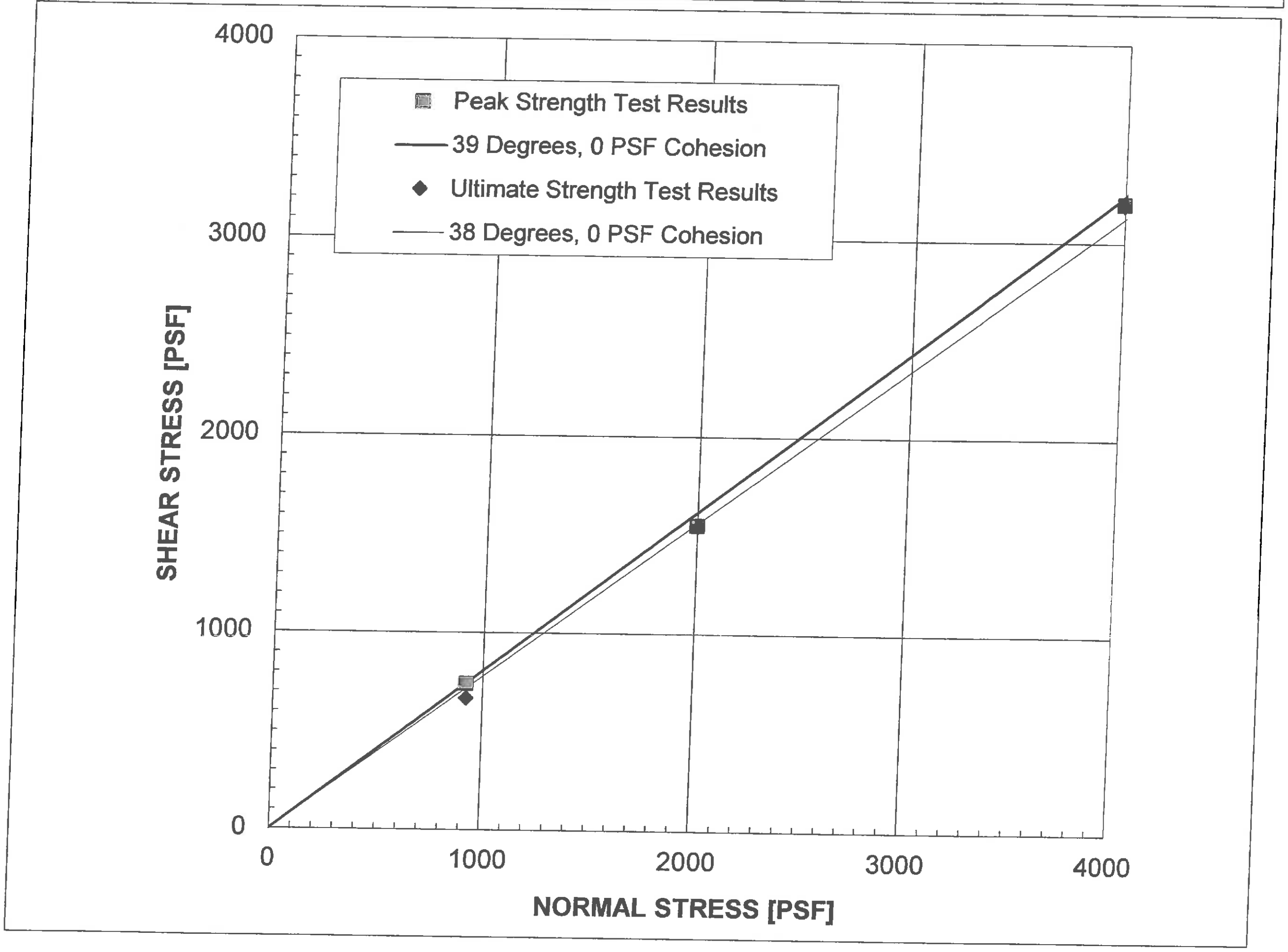
STRAIN RATE: 0.0040 IN/MIN
(Sample was consolidated and drained)

	IN-SITU	AS-TESTED
γ_d	99.8 PCF	99.8 PCF
w_c	22.9 %	26.8 %

GROUP DELTA

DIRECT SHEAR TEST RESULTS





SAMPLE: B-2 @ 0' - 4'

Fill: Dark brown silty sand (SM).
(Remolded to ~90% Maximum @ Optimum)

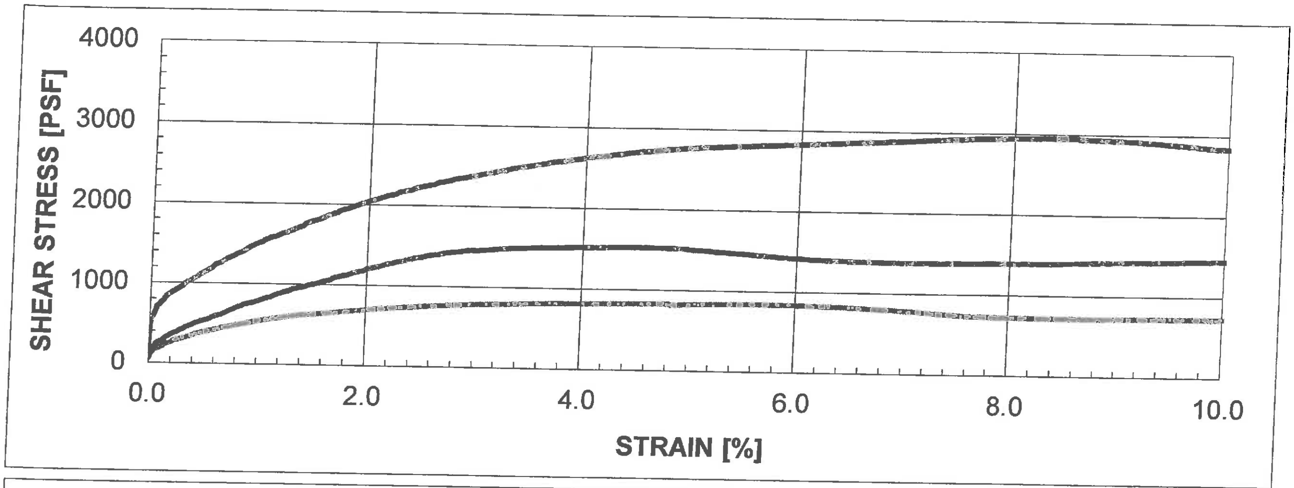
	PEAK	ULTIMATE
ϕ'	39 °	38 °
C'	0 PSF	0 PSF

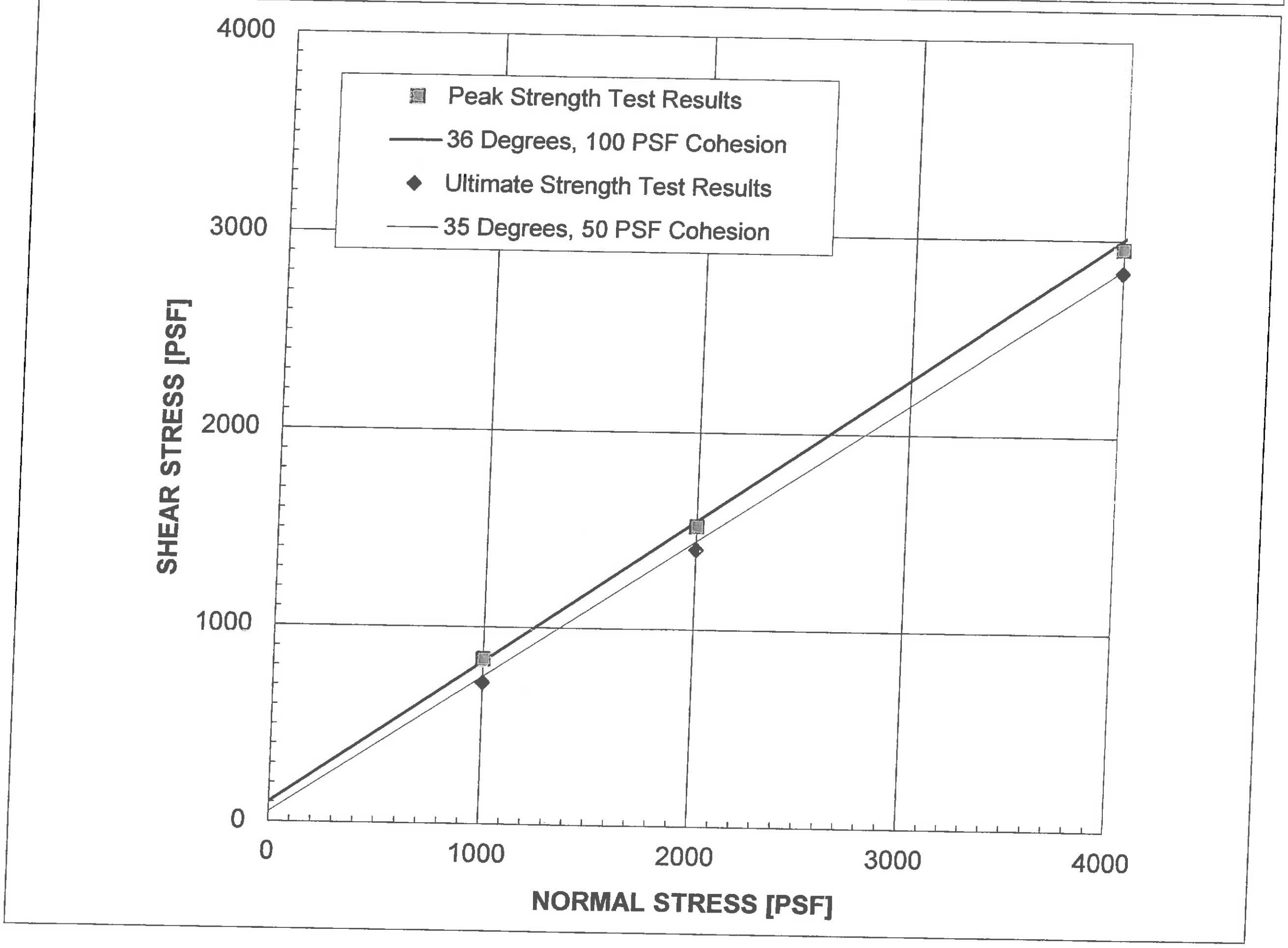
STRAIN RATE: 0.0030 IN/MIN
(Sample was consolidated and drained)

	REMOLDED	AS-TESTED
γ_d	115.3 PCF	115.3 PCF
w_c	9.2 %	17.0 %

GROUP DELTA **DIRECT SHEAR TEST RESULTS**

Document No. 15-0006
Project No. IR619
FIGURE B-5.3





SAMPLE: B-4 @ 5' - 6½'

Alluvium:
Dark brown clayey sand (SC)

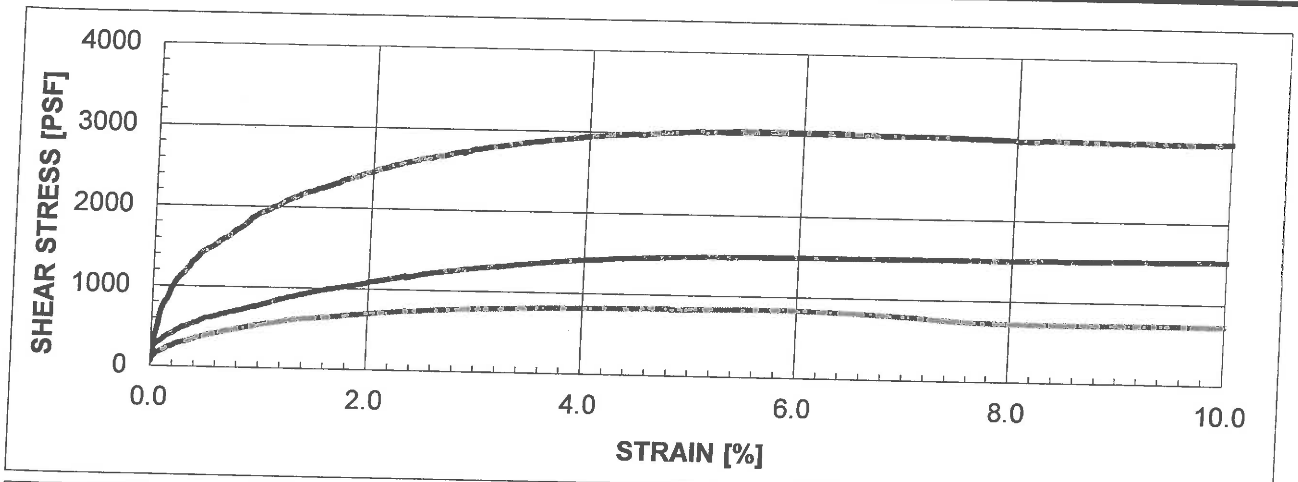
STRAIN RATE: 0.0040 IN/MIN
(Sample was consolidated and drained)

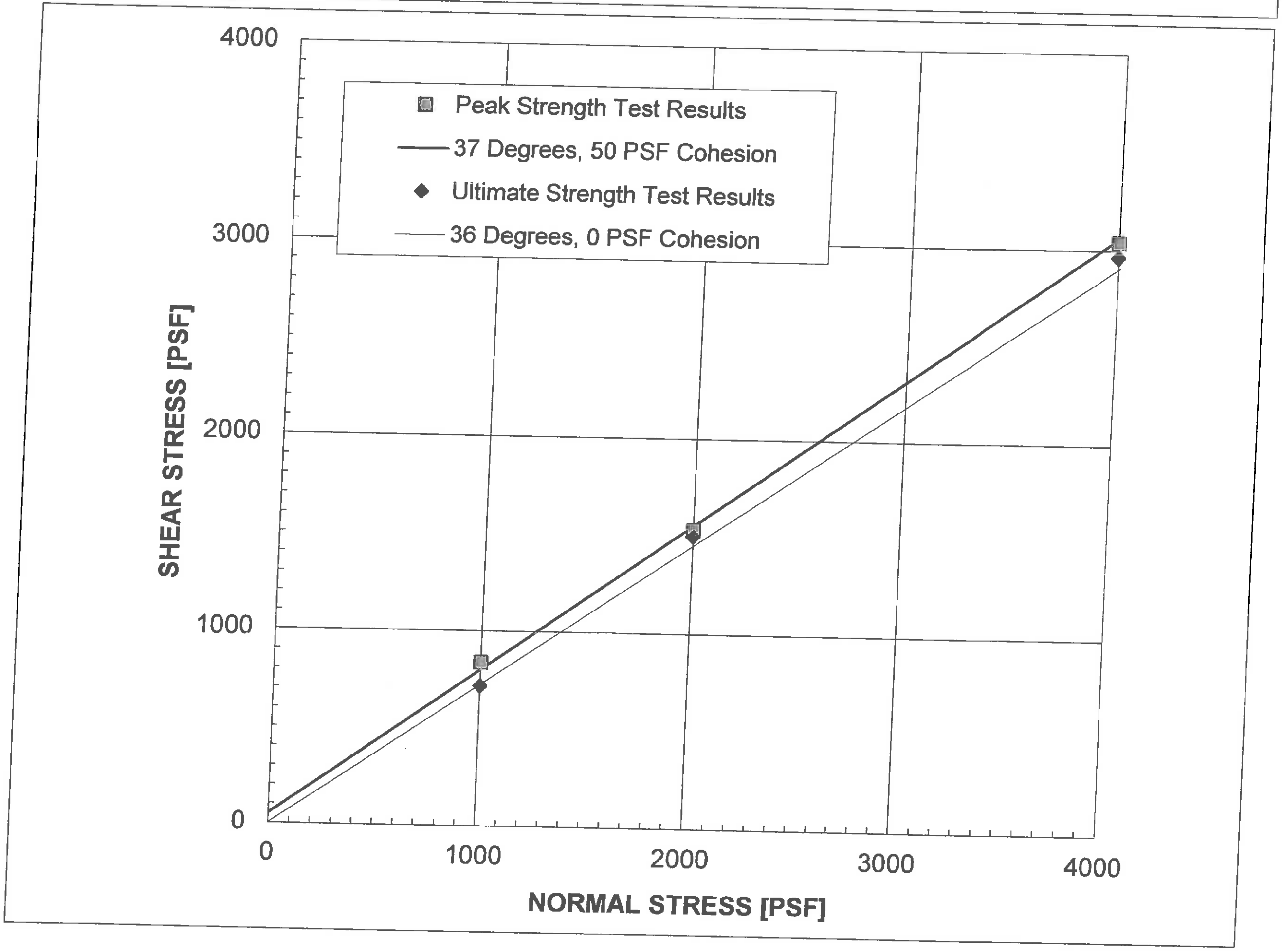
	PEAK	ULTIMATE
ϕ'	36 °	35 °
C'	100 PSF	50 PSF

	IN-SITU	AS-TESTED
γ_d	105.9 PCF	105.9 PCF
w_c	13.4 %	20.7 %

GROUP DELTA **DIRECT SHEAR TEST RESULTS**

Document No. 15-0006
Project No. IR619
FIGURE B-5.4





SAMPLE: B-5 @ 5' - 6½'

Fill:
Dark brown clayey sand (SC)

STRAIN RATE: 0.0030 IN/MIN
(Sample was consolidated and drained)

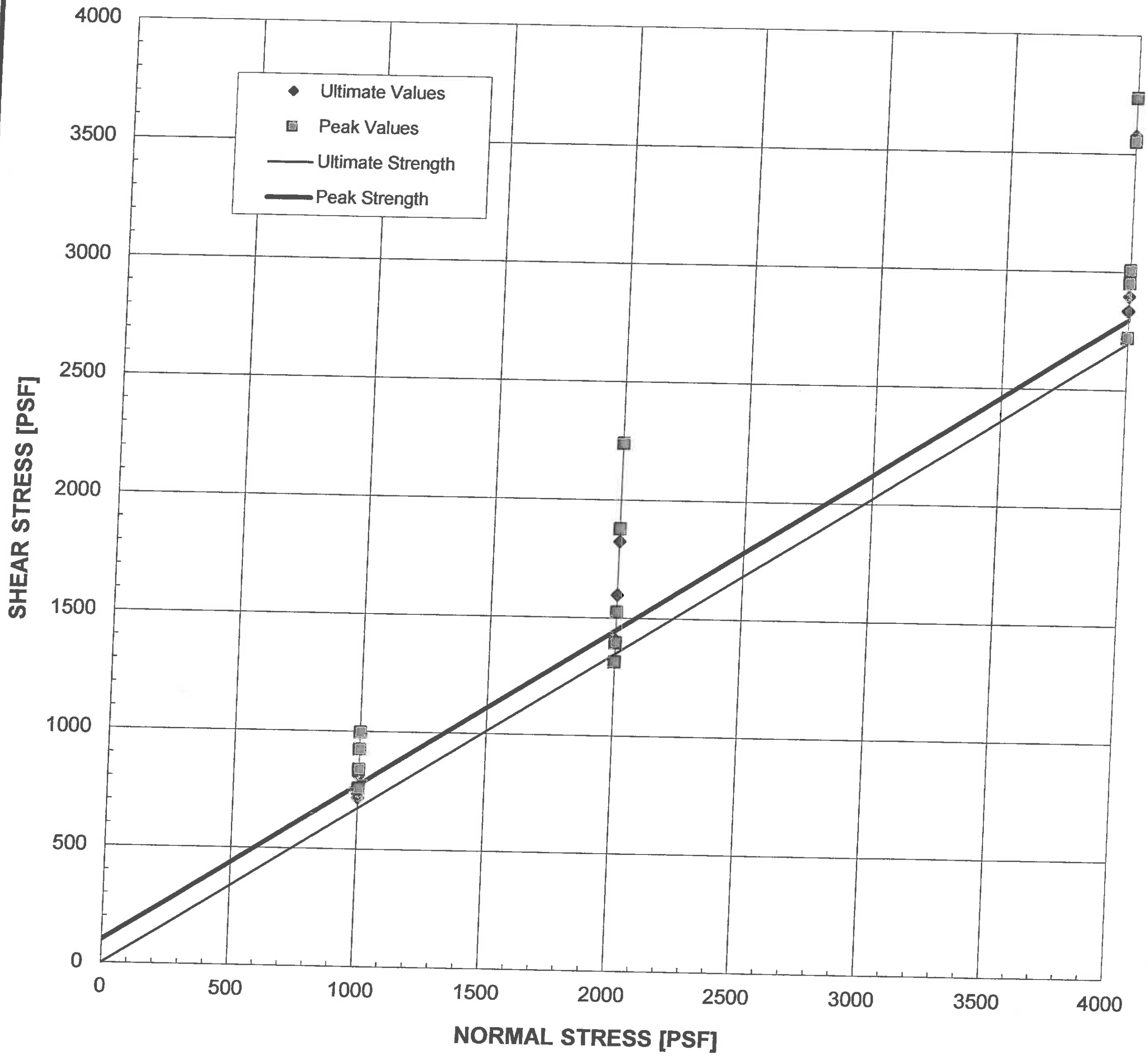
	PEAK	ULTIMATE
φ'	37 °	36 °
C'	50 PSF	0 PSF

	IN-SITU	AS-TESTED
γ_d	112.3 PCF	112.3 PCF
w_c	12.6 %	17.1 %

GROUP DELTA

DIRECT SHEAR TEST RESULTS

Document No. 15-0006
Project No. IR619
FIGURE B-5.5



DESCRIPTION

A summary of five direct shear tests on samples of the on-site alluvial soils, including the poorly graded sand with silt (SP-SM), silty sand (SM), and sandy silt (ML).

	PEAK ESTIMATE	ULTIMATE ESTIMATE
ϕ'	34 °	34 °
C'	100 PSF	0 PSF

GROUP DELTA DIRECT SHEAR TEST SUMMARY

Document No. 15-0006
Project No. IR619
FIGURE B-5.6

BORING NO.: B-1*

BORING DEPTH: 1' - 5'

SAMPLE DESCRIPTION: Dark yellow brown clayey sand (SC)

SAMPLE DATE: 9/4/14

TEST DATE: 9/18/14

LABORATORY TEST DATA

	TEST SPECIMEN	1	2	3	4	5	
A	COMPACTOR PRESSURE	210	225	350			[PSI]
B	INITIAL MOISTURE	4.8	4.8	4.8			[%]
C	BATCH SOIL WEIGHT	1200	1200	1200			[G]
D	WATER ADDED	105	93	82			[ML]
E	WATER ADDED (D*(100+B)/C)	9.2	8.1	7.2			[%]
F	COMPACTION MOISTURE (B+E)	14.0	12.9	12.0			[%]
G	MOLD WEIGHT	2113.3	2108.2	2011.0			[G]
H	TOTAL BRIQUETTE WEIGHT	3225.0	3214.1	3105.2			[G]
I	NET BRIQUETTE WEIGHT (H-G)	1111.7	1105.9	1094.2			[G]
J	BRIQUETTE HEIGHT	2.52	2.51	2.47			[IN]
K	DRY DENSITY (30.3*I/((100+F)*J))	117.3	118.2	119.9			[PCF]
L	EXUDATION LOAD	1901	3029	4484			[LB]
M	EXUDATION PRESSURE (L/12.54)	152	242	358			[PSI]
N	STABILOMETER AT 1000 LBS	35	31	23			[PSI]
O	STABILOMETER AT 2000 LBS	78	66	44			[PSI]
P	DISPLACEMENT FOR 100 PSI	5.47	4.96	4.76			[Turns]
Q	R VALUE BY STABILOMETER	32	42	58			
R	CORRECTED R-VALUE (See Fig. 14)	32	42	58			
S	EXPANSION DIAL READING	0.0023	0.0046	0.0068			[IN]
T	EXPANSION PRESSURE (S*43,300)	100	199	294			[PSF]
U	COVER BY STABILOMETER	0.57	0.49	0.35			[FT]
V	COVER BY EXPANSION	0.77	1.53	2.27			[FT]

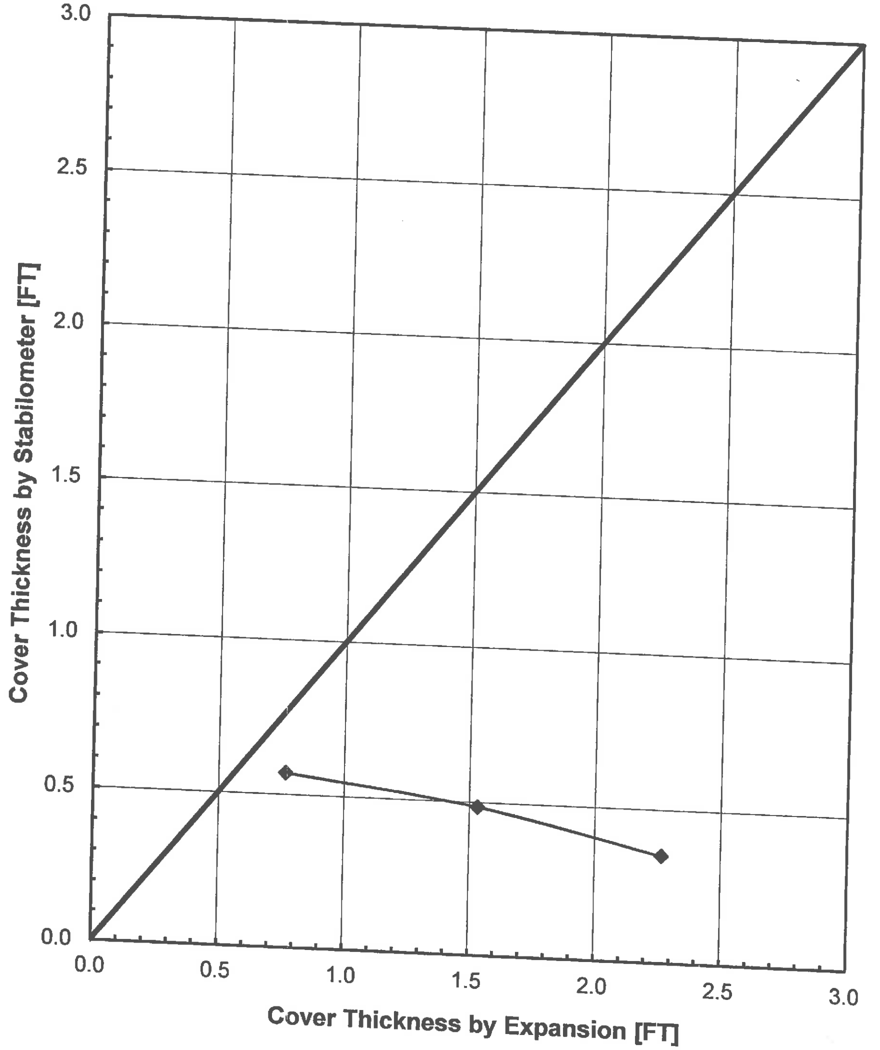
TRAFFIC INDEX:	5.0
GRAVEL FACTOR:	1.72
UNIT WEIGHT OF COVER [PCF]:	130
R-VALUE BY EXUDATION:	50
R-VALUE BY EXPANSION:	36
R-VALUE AT EQUILIBRIUM:	36

*Note: Gravel factor estimated from required AC pavement section using CT301, Part 6.B.2.

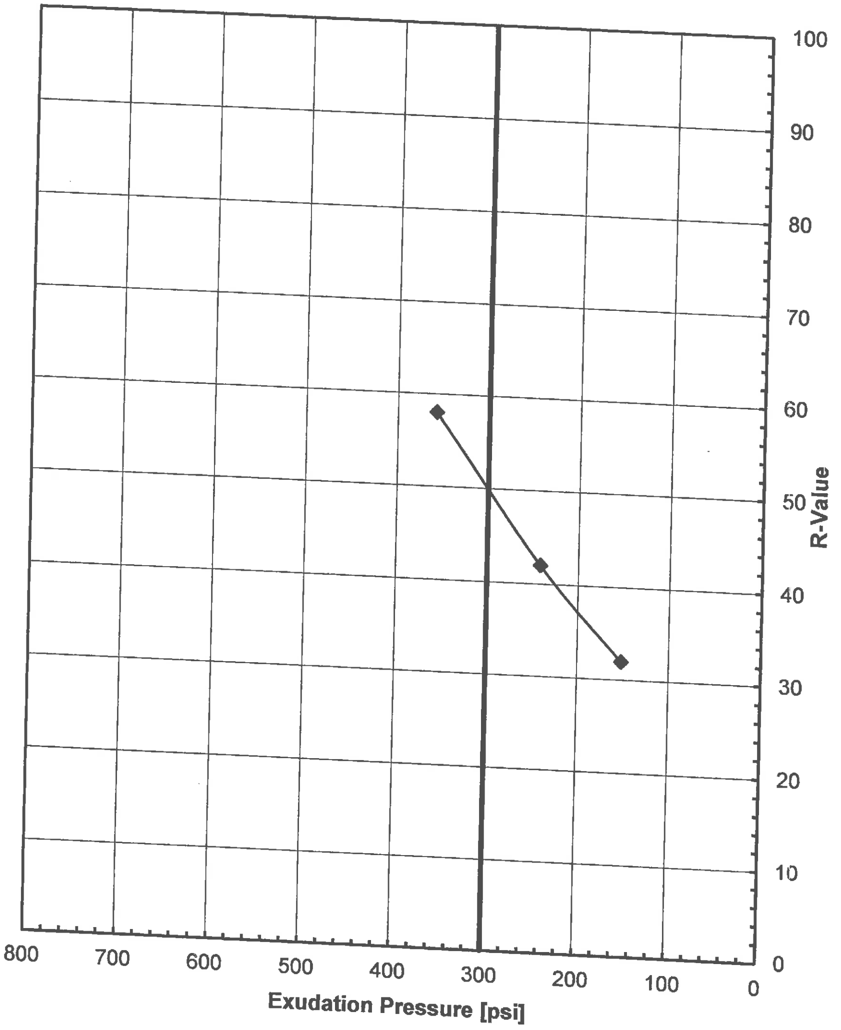
GROUP DELTA **R-VALUE TEST RESULTS**

Document No. 14-0153
Project No. IR619
FIGURE B-6.1a

Sample B-1* @ 0' - 5'



R-Value at Equilibrium: 36



GROUP DELTA

COVER AND EXUDATION CHARTS

Document No. 14-0153
Project No. IR619
FIGURE B-6.1b

BORING NO.: B-3
BORING DEPTH: 0' - 4'
SAMPLE DESCRIPTION: Dark brown clayey sand (SC)

SAMPLE DATE: 1/16/15
TEST DATE: 1/28/15

LABORATORY TEST DATA

TEST SPECIMEN	1	2	3	4	5	
A COMPACTOR PRESSURE	175	150	110			[PSI]
B INITIAL MOISTURE	2.8	2.8	2.8			[%]
C BATCH SOIL WEIGHT	1200	1200	1200			[G]
D WATER ADDED	110	120	130			[ML]
E WATER ADDED (D*(100+B)/C)	9.4	10.3	11.1			[%]
F COMPACTION MOISTURE (B+E)	12.2	13.1	13.9			[%]
G MOLD WEIGHT	2008.5	2108.1	2100.3			[G]
H TOTAL BRIQUETTE WEIGHT	3076.6	3147.9	3180.0			[G]
I NET BRIQUETTE WEIGHT (H-G)	1068.1	1039.8	1079.7			[G]
J BRIQUETTE HEIGHT	2.38	2.35	2.47			[IN]
K DRY DENSITY (30.3*I/((100+F)*J))	121.2	118.6	116.2			[PCF]
L EXUDATION LOAD	5505	3980	2544			[LB]
M EXUDATION PRESSURE (L/12.54)	439	317	203			[PSI]
N STABILOMETER AT 1000 LBS	40	54	57			[PSI]
O STABILOMETER AT 2000 LBS	98	127	130			[PSI]
P DISPLACEMENT FOR 100 PSI	4.30	4.53	4.95			[Turns]
Q R VALUE BY STABILOMETER	27	13	10			
R CORRECTED R-VALUE (See Fig. 14)	25	12	10			
S EXPANSION DIAL READING	0.0008	0.0004	0.0003			[IN]
T EXPANSION PRESSURE (S*43,300)	35	17	13			[PSF]
U COVER BY STABILOMETER	0.71	0.83	0.85			[FT]
V COVER BY EXPANSION	0.27	0.13	0.10			[FT]

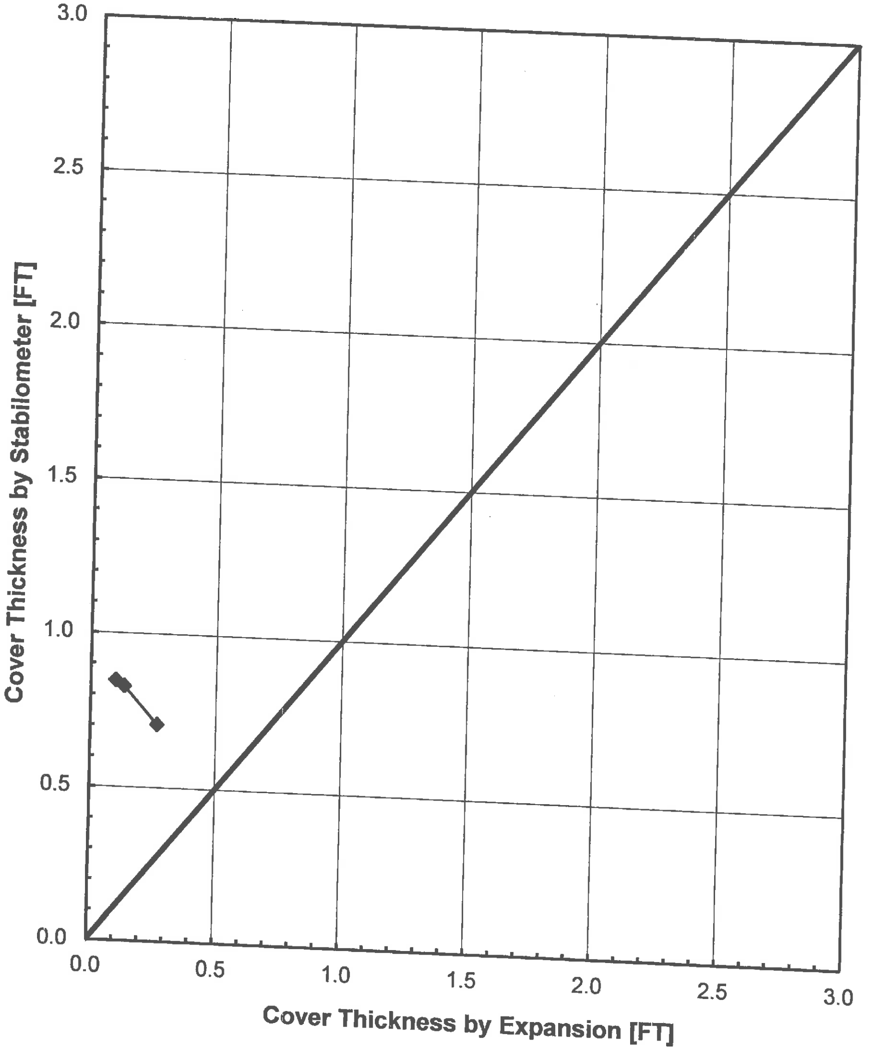
TRAFFIC INDEX:	5.0
GRAVEL FACTOR:	1.46
UNIT WEIGHT OF COVER [PCF]:	130
R-VALUE BY EXUDATION:	11
R-VALUE BY EXPANSION:	35
R-VALUE AT EQUILIBRIUM:	11

*Note: Gravel factor estimated from required AC pavement section using CT301, Part 6.B.2.

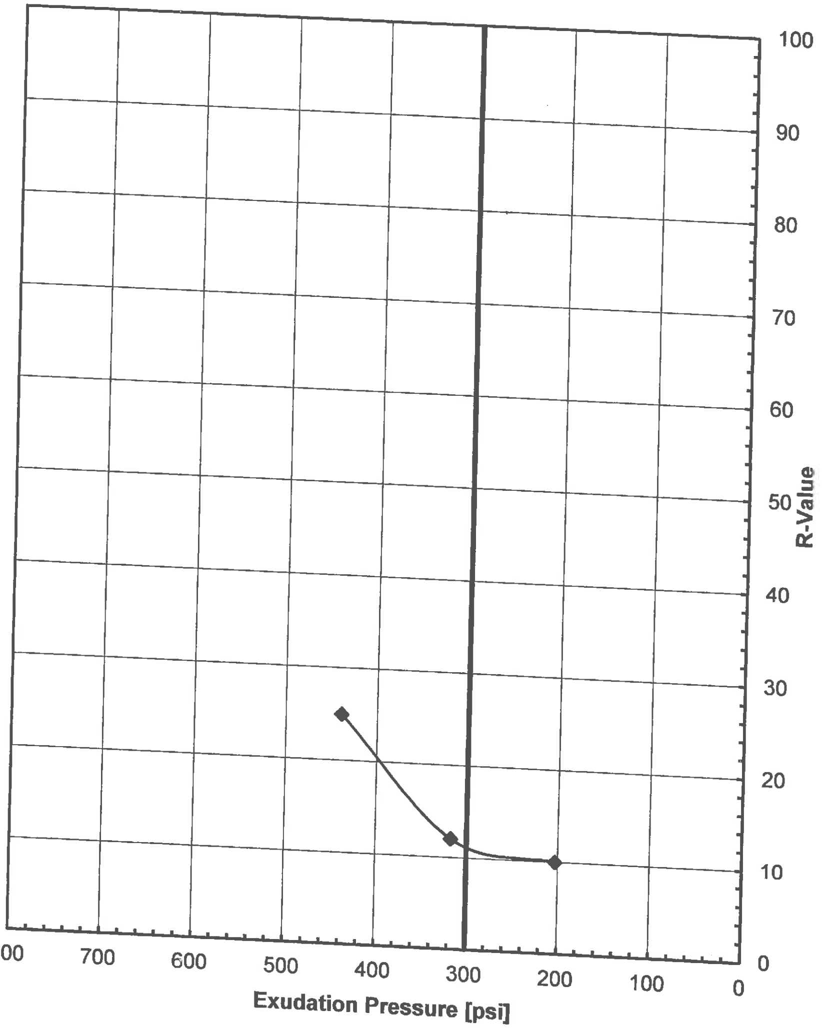
GROUP DELTA **R-VALUE TEST RESULTS**

Document No. 14-0153
Project No. IR619
FIGURE B-6.2a

Sample B-3 @ 0' - 4'



R-Value at Equilibrium: 11



GROUP DELTA

COVER AND EXUDATION CHARTS

Document No. 14-0153
Project No. IR619
FIGURE B-6.2b

APPENDIX D

Summary of Slope Stability Analysis

Cross-Section 15-15'

Filename	Description	Factor of Safety (FS)	
		Static	*Pseudostatic*
01	1.5H:1V Temporary Backcut	1.37	--

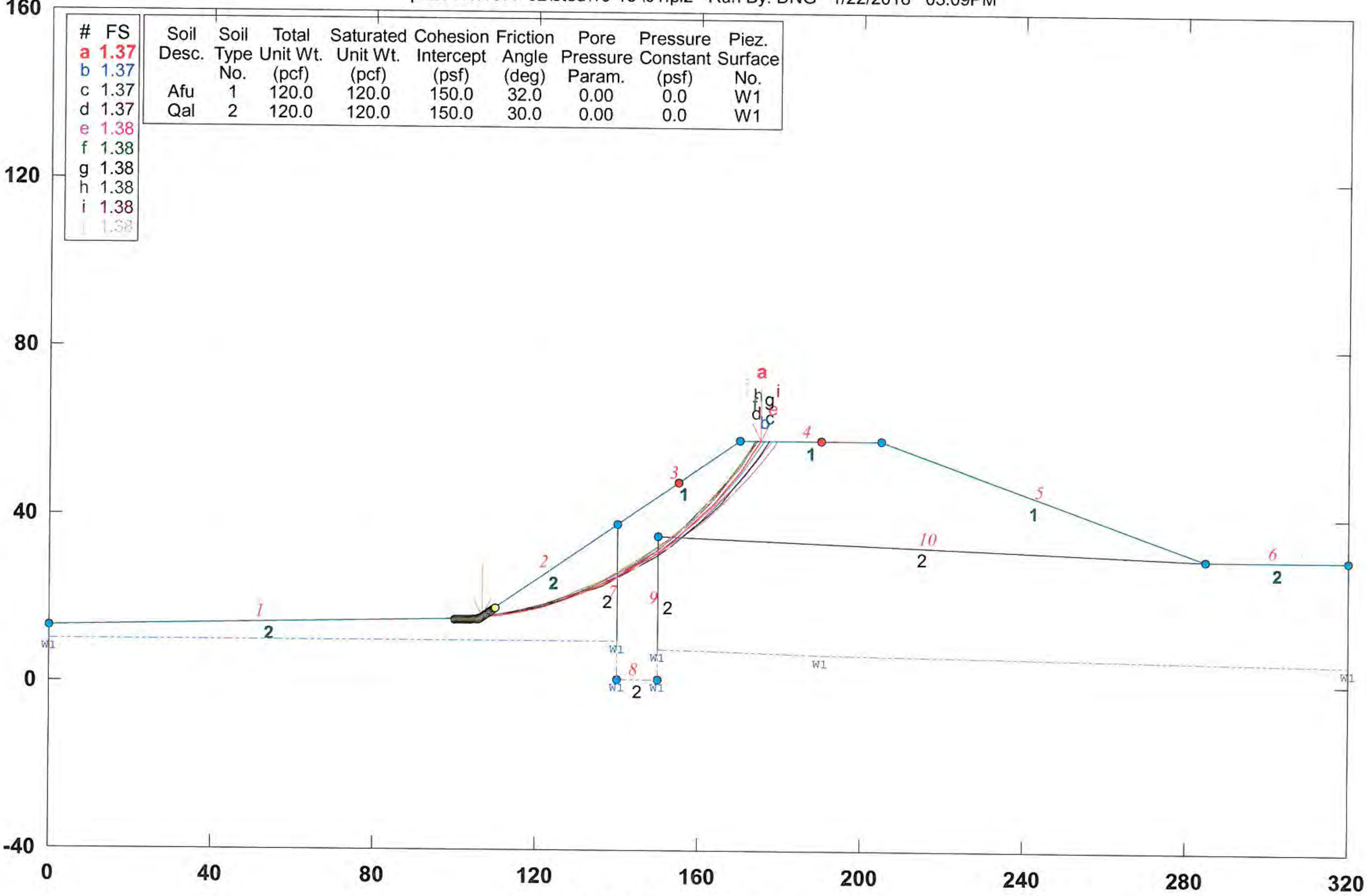
Project No.: 11077-02

Project Name: Hines/Riverwalk

NMG

Hines/Riverwalk; 15-15'; Temp Backcut

p:\2011\11077-02\sted\15-15'\01.pl2 Run By: DNG 1/22/2018 03:09PM



#	FS
a	1.37
b	1.37
c	1.37
d	1.37
e	1.38
f	1.38
g	1.38
h	1.38
i	1.38
j	1.38

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Afu	1	120.0	120.0	150.0	32.0	0.00	0.0	W1
Qal	2	120.0	120.0	150.0	30.0	0.00	0.0	W1

GSTABL7 v.2 FSmin=1.37

Safety Factors Are Calculated By The Modified Bishop Method

```
                              *** GSTABL7 ***
            ** GSTABL7 by Dr. Garry H. Gregory, Ph.D.,P.E.,D.GE **
      ** Original Version 1.0, January 1996; Current Ver. 2.005.3, Feb. 2013 **
              (All Rights Reserved-Unauthorized Use Prohibited)
 *********************************************************************************
                        SLOPE STABILITY ANALYSIS SYSTEM
        Modified Bishop, Simplified Janbu, or GLE Method of Slices.
        (Includes Spencer & Morgenstern-Price Type Analysis)
        Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
        Nonlinear Undrained Shear Strength, Curved Phi Envelope,
        Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
        Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
 *********************************************************************************
 Analysis Run Date:        1/22/2018
 Time of Run:              03:09PM
 Run By:                   DNG
 Input Data Filename:      P:\2011\11077-02\STED\15-15'\01.in
 Output Filename:          P:\2011\11077-02\STED\15-15'\01.OUT
 Unit System:              English
 Plotted Output Filename:  P:\2011\11077-02\STED\15-15'\01.PLT
 PROBLEM DESCRIPTION:  Hines/Riverwalk; 15-15'; Temp Backcut
 BOUNDARY COORDINATES
     6 Top   Boundaries
    10 Total Boundaries
 Boundary     X-Left     Y-Left    X-Right    Y-Right    Soil Type
    No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
     1          0.00      13.00     106.00      15.00        2
     2        106.00      15.00     140.00      38.00        2
     3        140.00      38.00     170.00      58.00        1
     4        170.00      58.00     205.00      58.00        1
     5        205.00      58.00     285.00      30.00        1
     6        285.00      30.00     320.00      30.00        2
     7        140.00      38.00     140.10       1.00        2
     8        140.10       1.00     150.00       1.00        2
     9        150.00       1.00     150.10      35.00        2
    10        150.10      35.00     285.00      30.00        2
 Default Y-Origin = 0.00(ft)
 Default X-Plus Value = 0.00(ft)
 Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
  2 Type(s) of Soil
 Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
 Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
  No.  (pcf)    (pcf)     (psf)     (deg)   Param.    (psf)     No.
   1   120.0    120.0     150.0     32.0    0.00       0.0       1
   2   120.0    120.0     150.0     30.0    0.00       0.0       1
 1 PIEZOMETRIC SURFACE(S) SPECIFIED
 Unit Weight of Water =  62.40 (pcf)
 Piezometric Surface No.  1 Specified by  7 Coordinate Points
 Pore Pressure Inclination Factor =  0.50
   Point       X-Water     Y-Water
    No.         (ft)        (ft)
     1          0.00       10.00
     2        139.90       10.00
     3        140.00        0.90
     4        150.00        0.90
     5        150.10        8.00
     6        190.00        7.00
     7        320.00        5.00
 A Critical Failure Surface Searching Method, Using A Random
 Technique For Generating Circular Surfaces, Has Been Specified.
 4000 Trial Surfaces Have Been Generated.
  100 Surface(s) Initiate(s) From Each Of   40 Points Equally Spaced
 Along The Ground Surface Between  X = 100.00(ft)
                              and  X = 110.00(ft)
 Each Surface Terminates Between   X = 155.00(ft)
                              and  X = 190.00(ft)
```

```
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is  Y =      0.00(ft)
 5.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
      Failure Surfaces Evaluated. They Are
      Ordered - Most Critical First.
      * * Safety Factors Are Calculated By The Modified Bishop Method * *
      Total Number of Trial Surfaces Attempted =  4000
      Number of Trial Surfaces With Valid FS = 4000
      Statistical Data On All Valid FS Values:
         FS Max =    3.074   FS Min =    1.371   FS Ave =    1.744
         Standard Deviation =     0.204   Coefficient of Variation =    11.72 %
      Failure Surface Specified By 18 Coordinate Points
        Point       X-Surf       Y-Surf
         No.         (ft)         (ft)
          1        106.667       15.451
          2        111.628       16.068
          3        116.549       16.958
          4        121.412       18.117
          5        126.205       19.542
          6        130.912       21.229
          7        135.519       23.173
          8        140.011       25.367
          9        144.377       27.805
         10        148.601       30.480
         11        152.672       33.383
         12        156.576       36.507
         13        160.303       39.840
         14        163.840       43.373
         15        167.178       47.096
         16        170.306       50.997
         17        173.214       55.065
         18        175.077       58.000
      Circle Center At X =    97.987 ; Y =   105.676 ; and Radius =    90.642
             Factor of Safety
            ***    1.371   ***
                **** END OF GSTABL7 OUTPUT ****
```

APPENDIX E

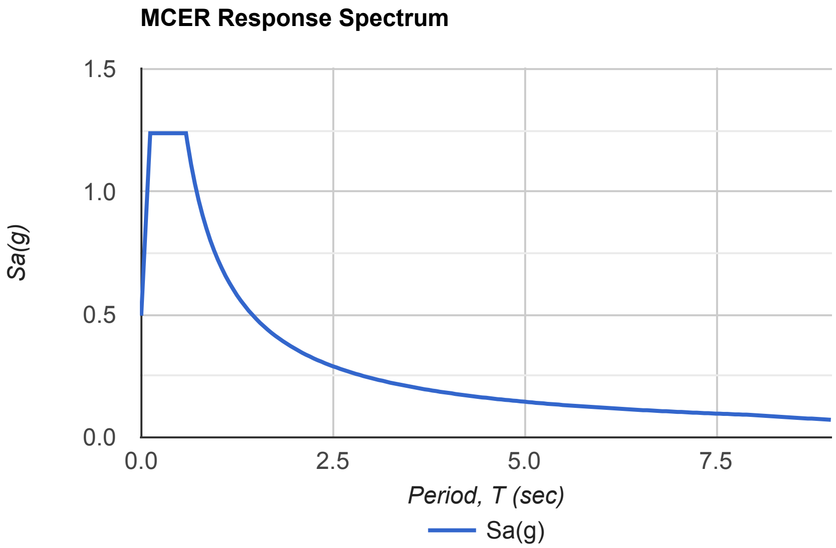
Riverwalk

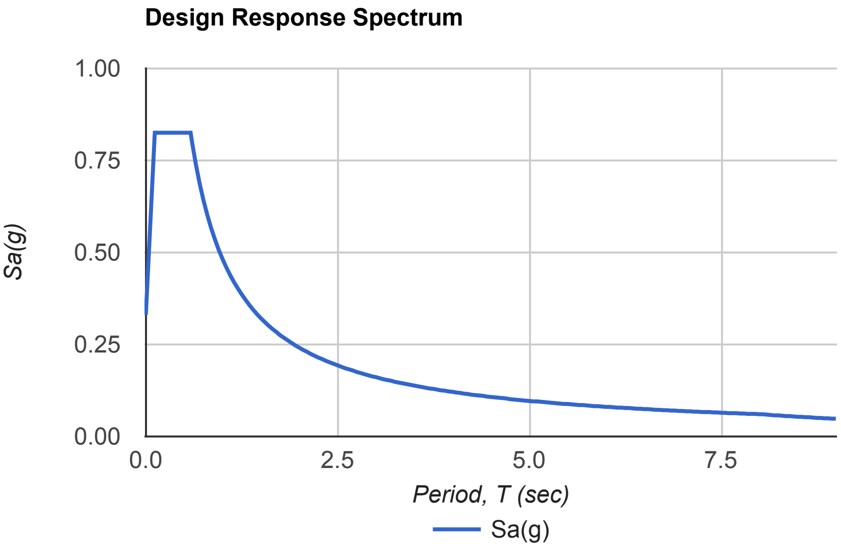
Latitude, Longitude: 32.7653, -117.1794

Date	2/27/2019, 1:37:04 PM
Design Code Reference Document	ASCE7-10
Risk Category	II
Site Class	D - Stiff Soil

Type	**Value**	**Description**
S_S	1.226	MCE_R ground motion. (for 0.2 second period)
S_1	0.474	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.238	Site-modified spectral acceleration value
S_{M1}	0.723	Site-modified spectral acceleration value
S_{DS}	0.825	Numeric seismic design value at 0.2 second SA
S_{D1}	0.482	Numeric seismic design value at 1.0 second SA

Type	**Value**	**Description**
SDC	D	Seismic design category
F_a	1.009	Site amplification factor at 0.2 second
F_v	1.526	Site amplification factor at 1.0 second
PGA	0.549	MCE_G peak ground acceleration
F_{PGA}	1	Site amplification factor at PGA
PGA_M	0.549	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.226	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.45	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	2.335	Factored deterministic acceleration value. (0.2 second)
S1RT	0.474	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.537	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	1.012	Factored deterministic acceleration value. (1.0 second)
PGAd	0.897	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.846	Mapped value of the risk coefficient at short periods
C_{R1}	0.882	Mapped value of the risk coefficient at a period of 1 s


MCER Response Spectrum
1.5
1.0
0.5
0.0
Sa(g)
0.0
2.5
5.0
7.5
Period, T (sec)
Sa(g)


Design Response Spectrum
1.00
0.75
0.50
0.25
0.00
Sa(g)
0.0
2.5
5.0
7.5
Period, T (sec)
Sa(g)

DISCLAIMER

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

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

Input

Edition

Dynamic: Conterminous U.S. 2008 (v3.3.

Latitude

Decimal degrees

32.7653

Longitude

Decimal degrees, negative values for western longitudes

-117.1794

Site Class

259 m/s (Site class D)

Spectral Period

Peak ground acceleration

Time Horizon

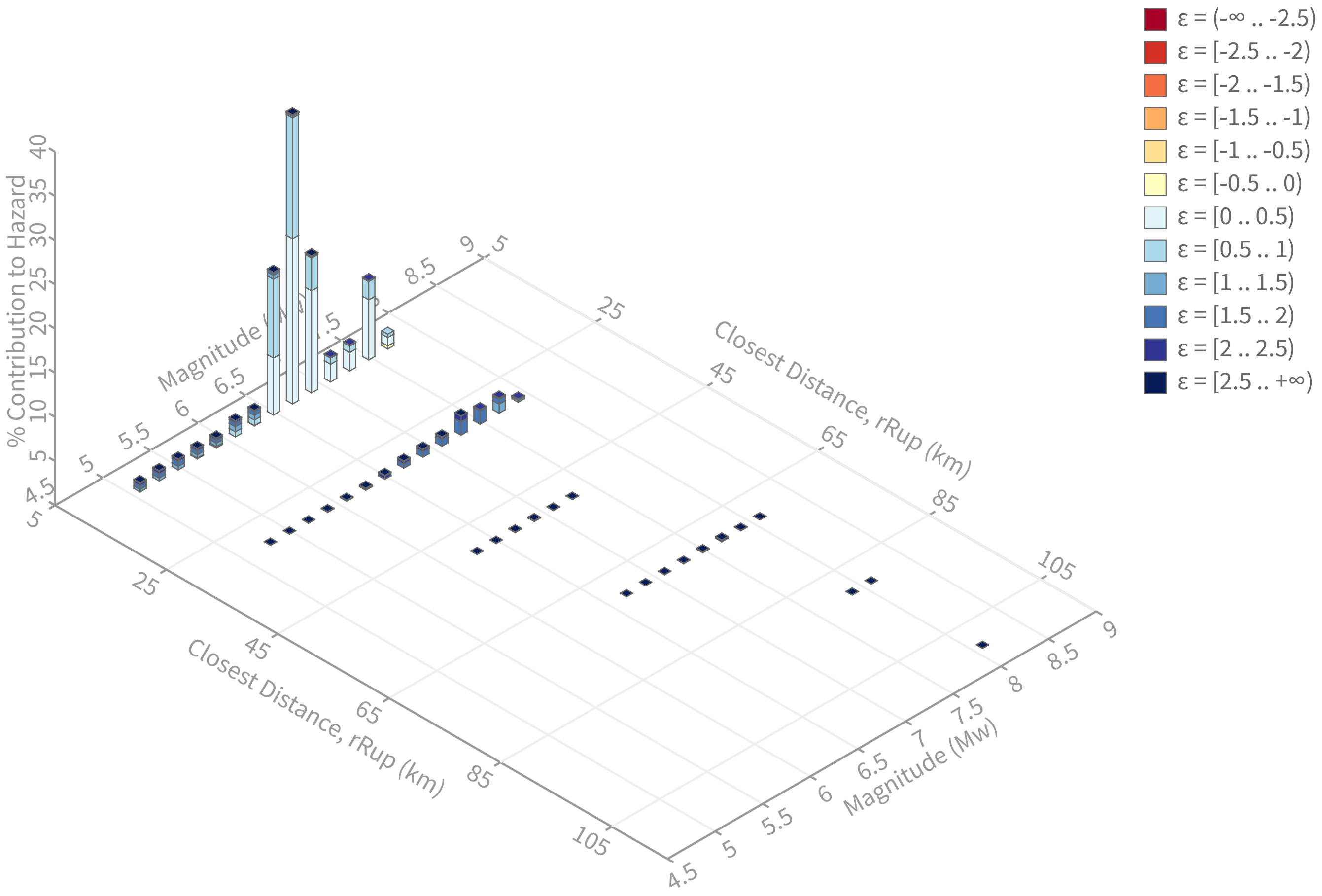
Return period in years

2475

^ Deaggregation

Component

Total ⌄



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.54755357 g

Recovered targets

Return period: 2581.9949 yrs
Exceedance rate: 0.00038729744 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.06 %

Mean (for all sources)

r: 5.2 km
m: 6.78
ε_0: 0.68 σ

Mode (largest r-m bin)

r: 2.03 km
m: 6.69
ε_0: 0.44 σ
Contribution: 32.69 %

Mode (largest ε_0 bin)

r: 1.93 km
m: 6.7
ε_0: 0.28 σ
Contribution: 18.7 %

Discretization

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

Epsilon keys

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

Deaggregation Contributors

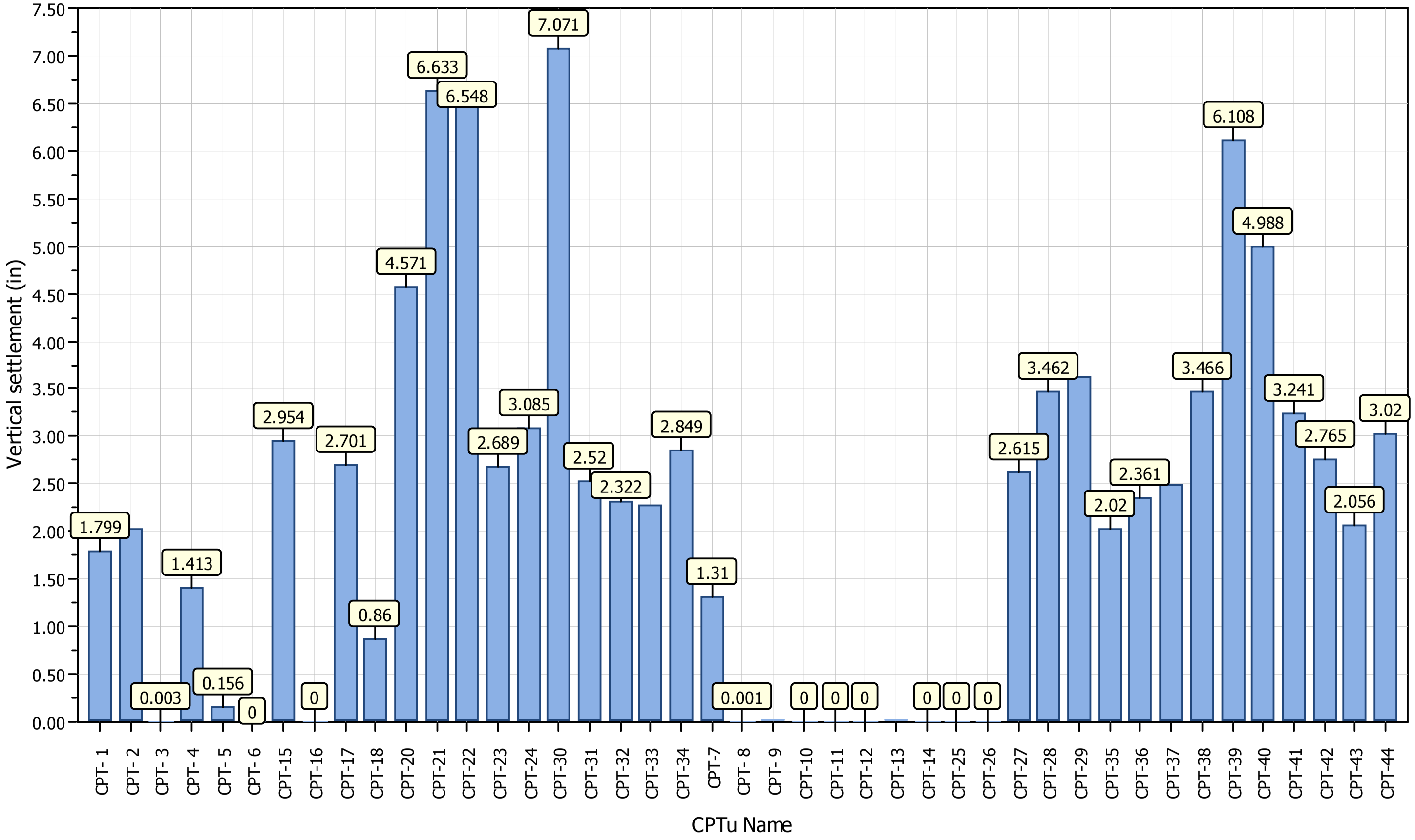
Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
bFault.ch	Fault							49.49
Rose Canyon		1.75	6.77	0.41	117.198°W	32.760°N	249.28	34.01
Newport Inglewood Connected alt 2		1.75	7.50	0.29	117.198°W	32.760°N	249.28	5.53
Newport Inglewood Connected alt 1		1.75	7.50	0.29	117.198°W	32.760°N	249.28	5.52
Coronado Bank		22.02	7.36	1.77	117.344°W	32.624°N	224.43	2.34
Palos Verdes Connected		22.03	7.71	1.59	117.344°W	32.624°N	224.43	1.99
bFault.gr	Fault							38.41
Rose Canyon		2.12	6.64	0.45	117.198°W	32.760°N	249.28	27.42
Newport Inglewood Connected alt 2		3.66	7.04	0.51	117.198°W	32.760°N	249.28	3.36
Newport Inglewood Connected alt 1		3.66	7.03	0.51	117.198°W	32.760°N	249.28	3.33
Coronado Bank		22.56	6.97	1.96	117.344°W	32.624°N	224.43	2.35
Palos Verdes Connected		22.99	7.24	1.84	117.344°W	32.624°N	224.43	1.92
CAmap.21.ch.in (opt)	Grid							3.97
PointSourceFinite: -117.179, 32.806		6.80	5.72	1.19	117.179°W	32.806°N	0.00	1.13
CAmap.24.ch.in (opt)	Grid							3.97
PointSourceFinite: -117.179, 32.806		6.80	5.72	1.19	117.179°W	32.806°N	0.00	1.13
CAmap.24.gr.in (opt)	Grid							1.85
CAmap.21.gr.in (opt)	Grid							1.85

APPENDIX F

Project title : Riverwalk

Location : San Diego, CA

Overall vertical settlements report



NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

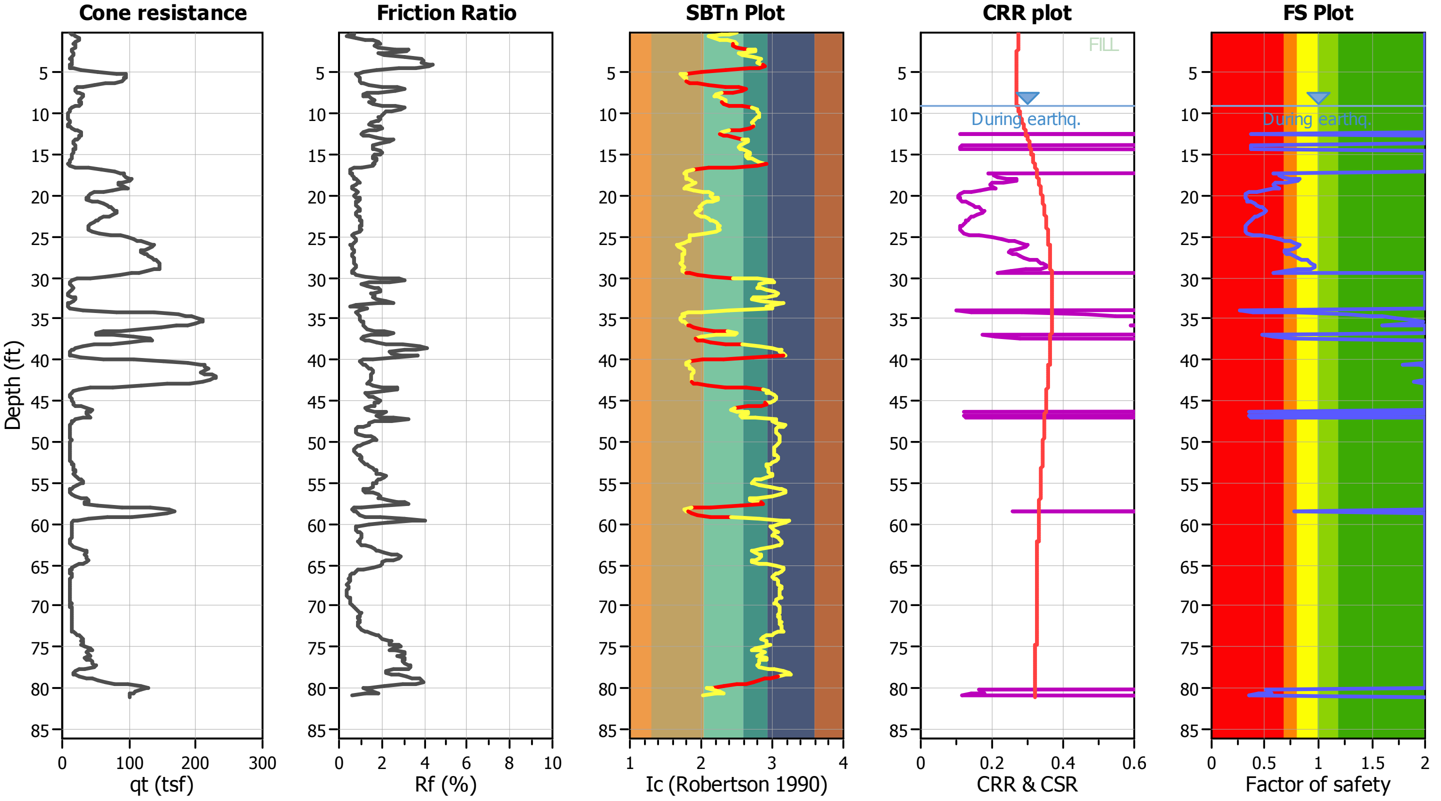
LIQUEFACTION ANALYSIS REPORT

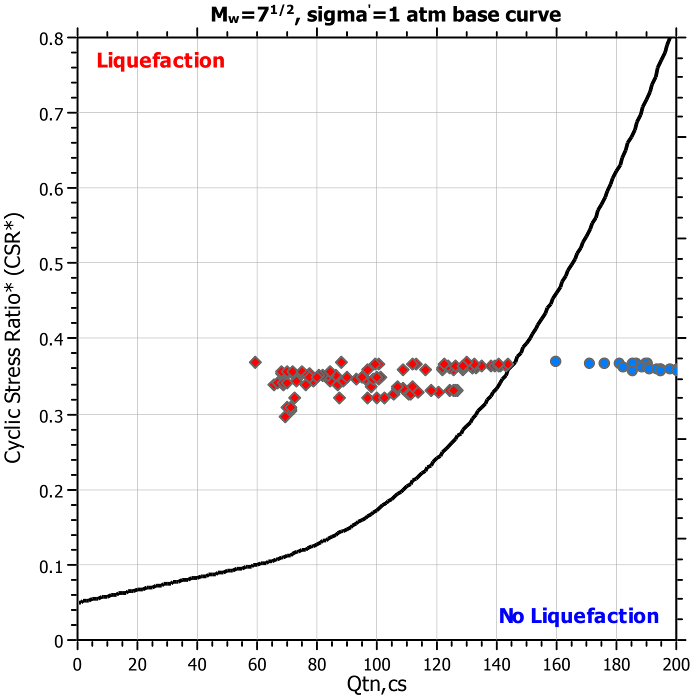
Project title : Riverwalk **Location : San Diego, CA**

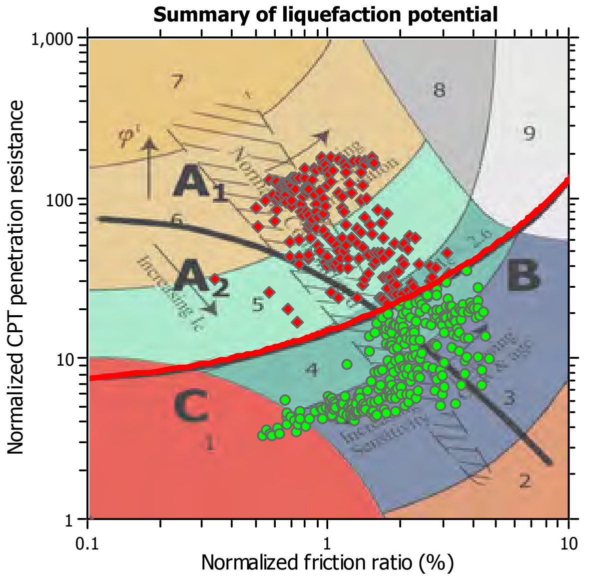
CPT file : CPT-1

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	12.00 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	19.00 ft	Fill height:	10.00 ft		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth applied:	No
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

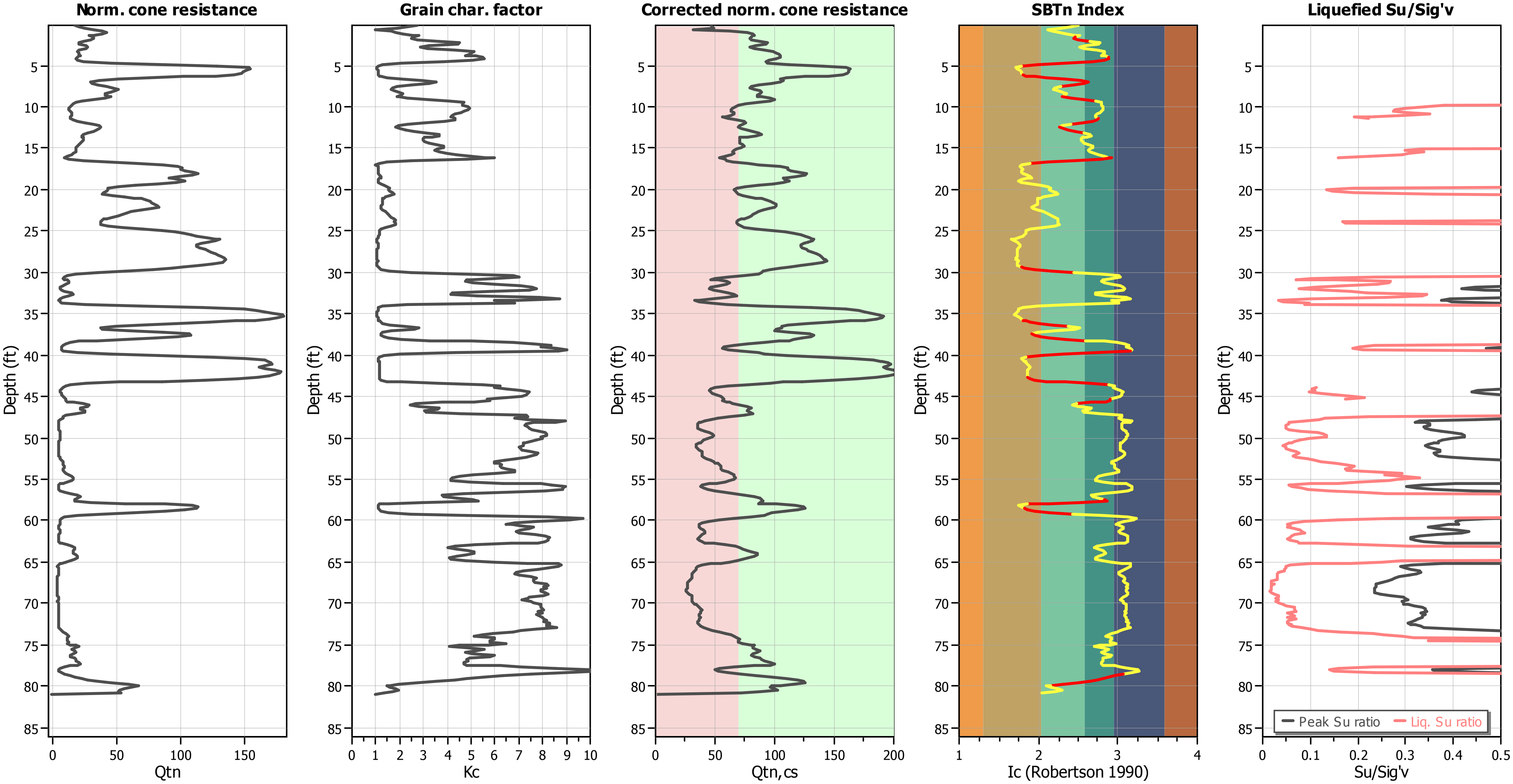






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

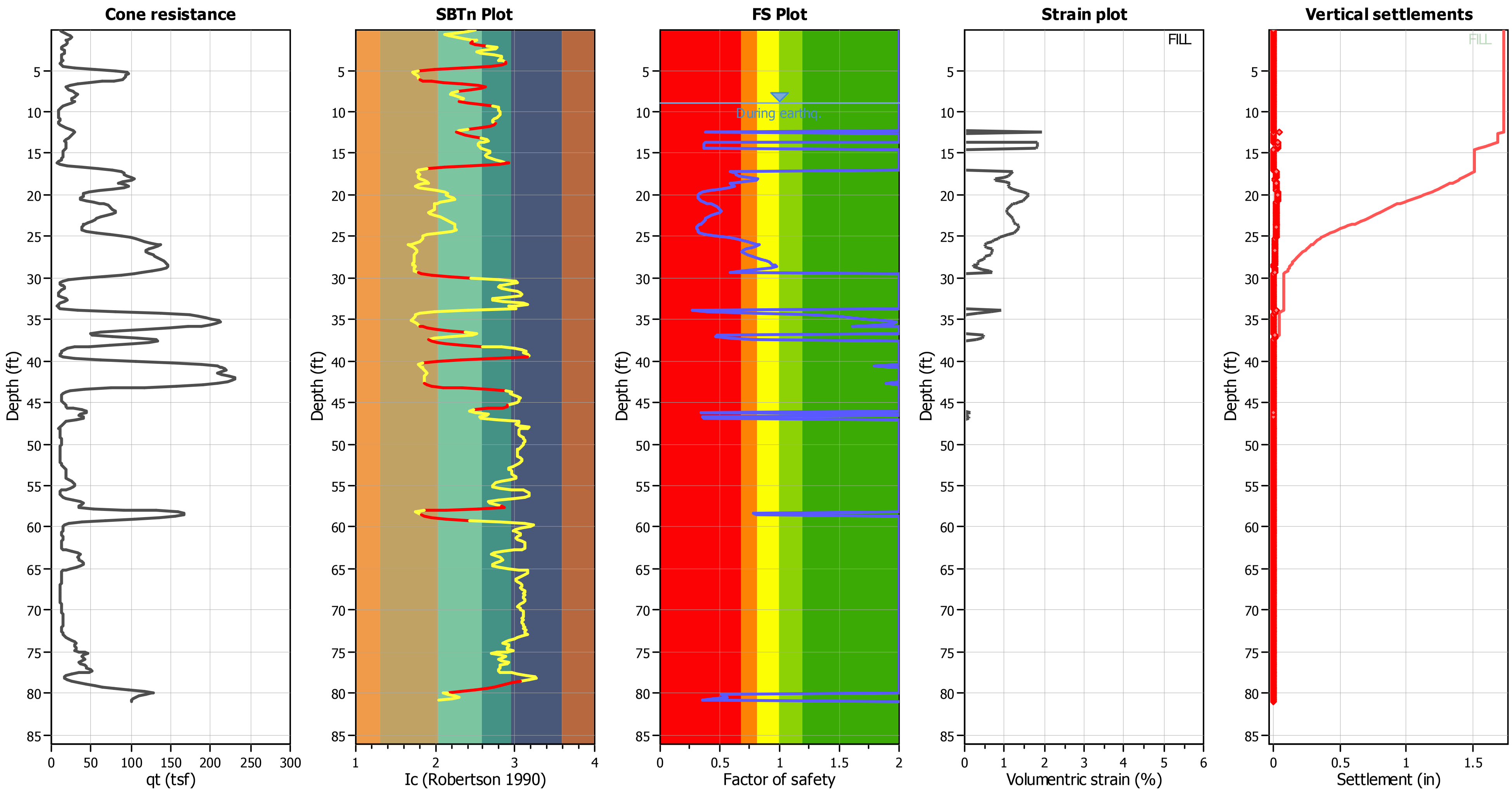
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	19.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	10.00 ft	Limit depth:	N/A

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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Irvine, CA 92614

LIQUEFACTION ANALYSIS REPORT

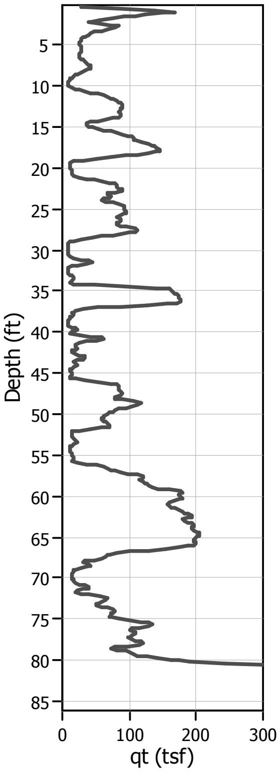
Project title : Riverwalk **Location : San Diego, CA**

CPT file : CPT- 2

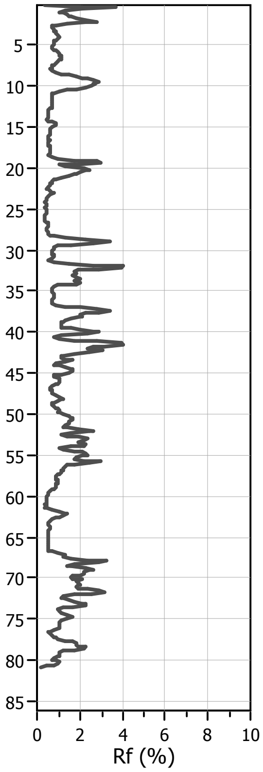
Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	9.50 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	19.50 ft	Fill height:	13.00 ft		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth applied:	No
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

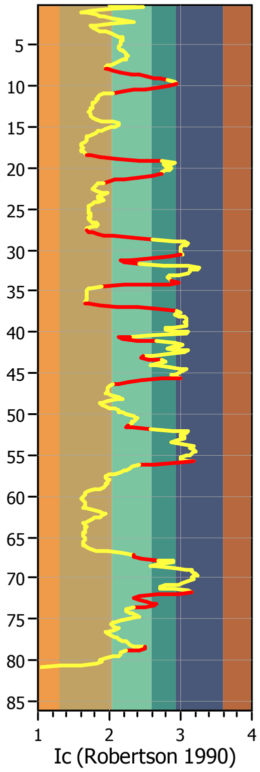
Cone resistance



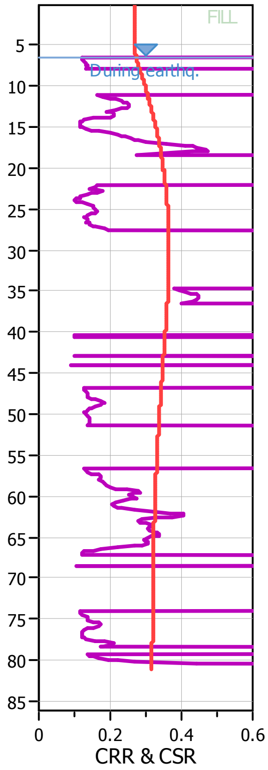
Friction Ratio



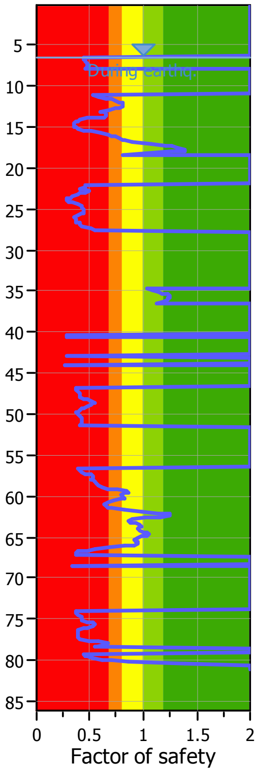
SBTn Plot



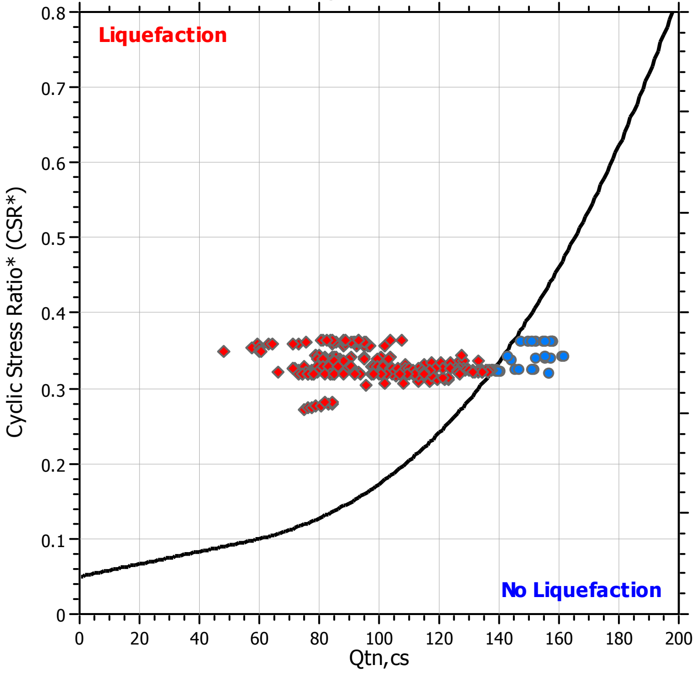
CRR plot



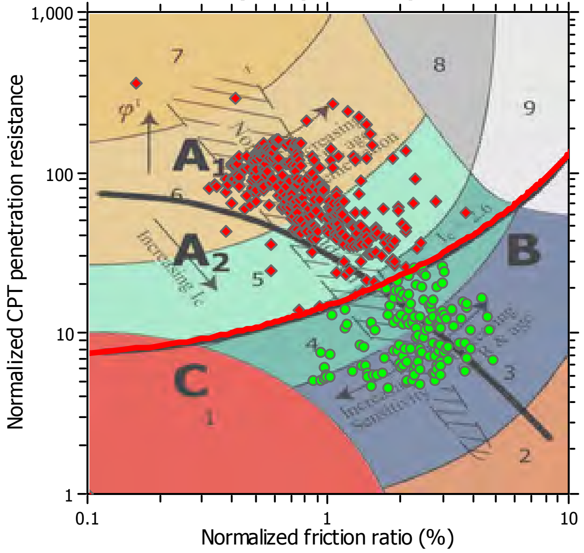
FS Plot



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

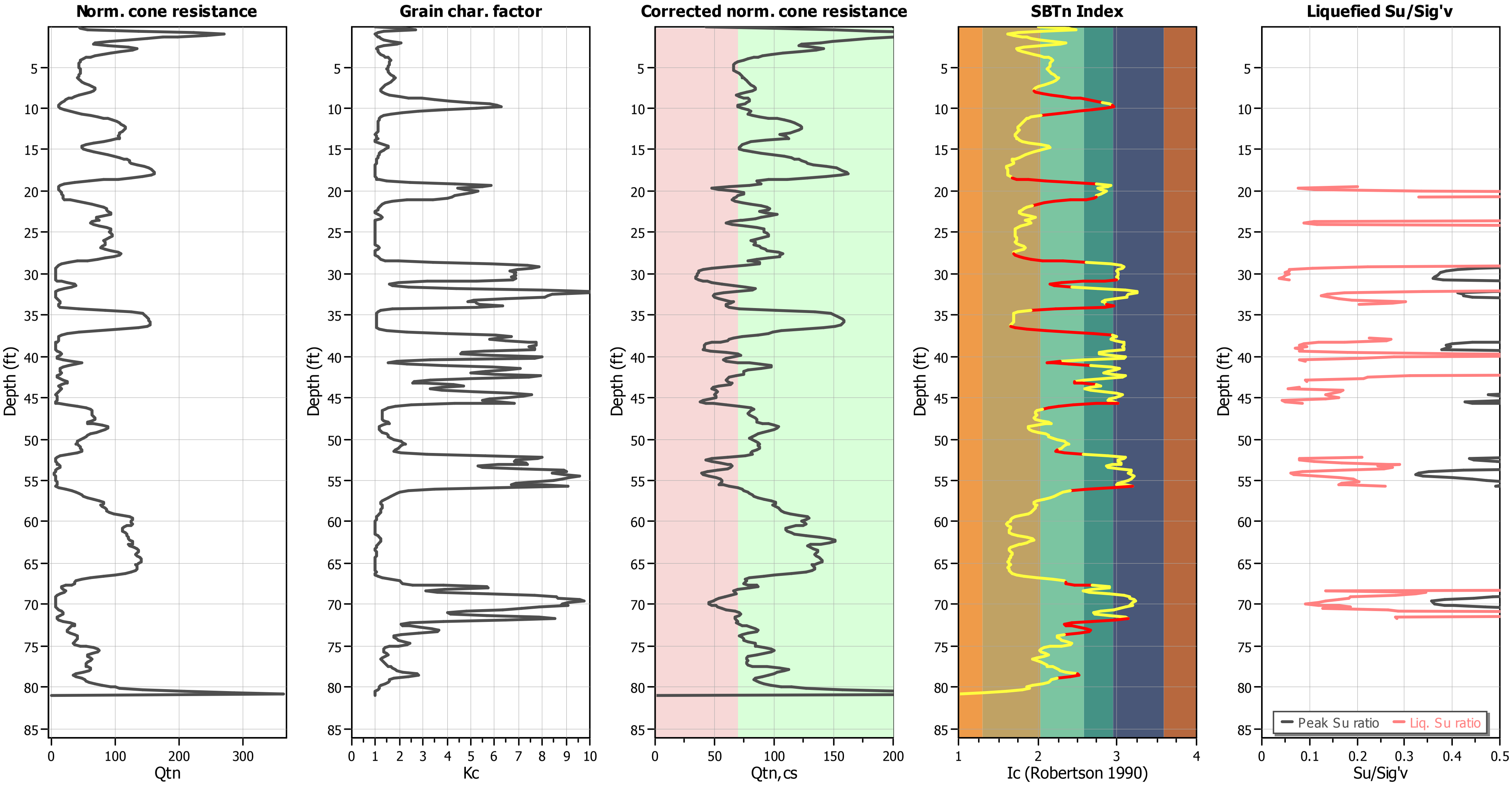


Summary of liquefaction potential



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

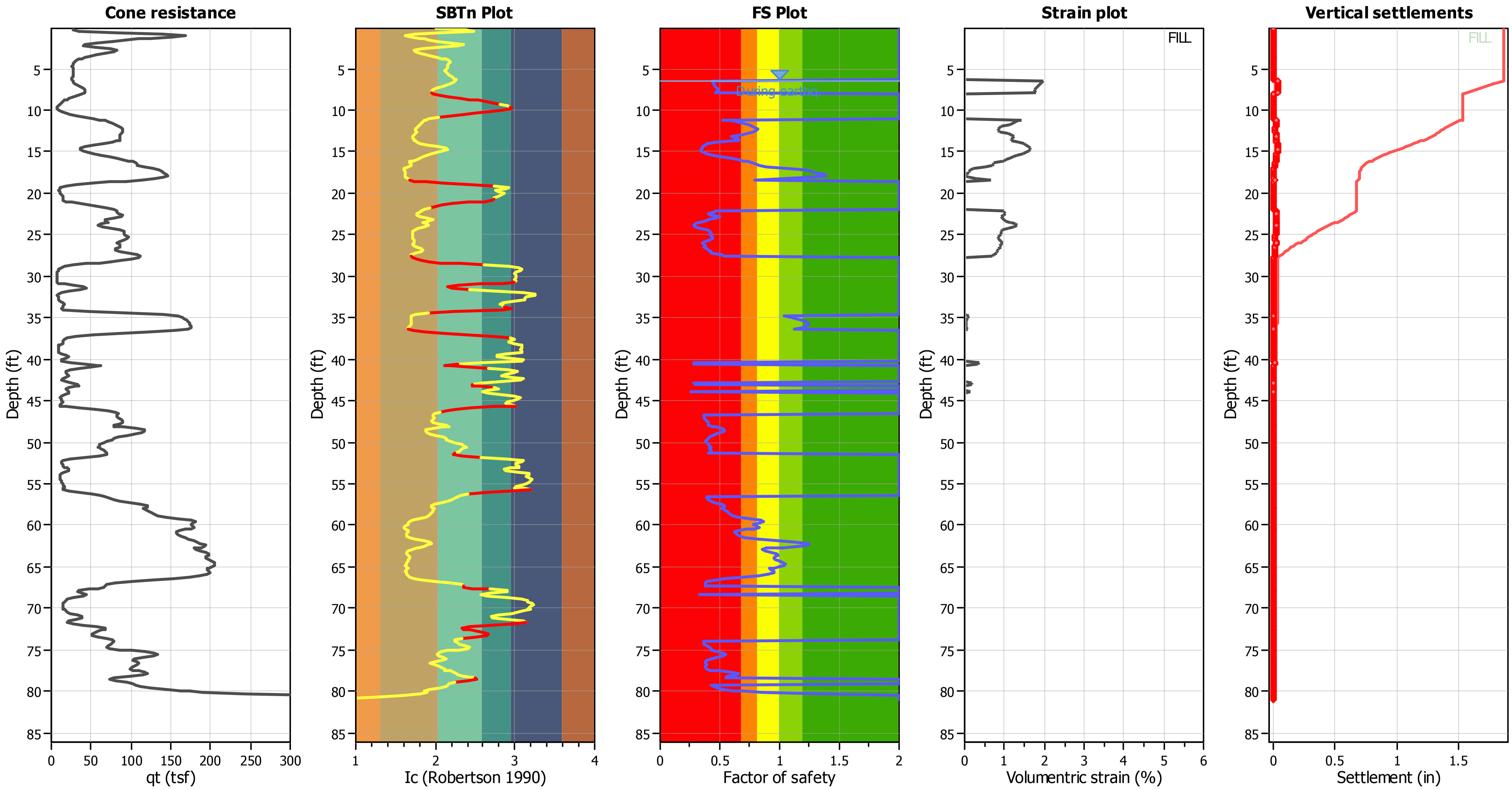
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	19.50 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	9.50 ft	Fill height:	13.00 ft	Limit depth:	N/A

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

NMG Geotechnical, Inc.
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Irvine, CA 92614

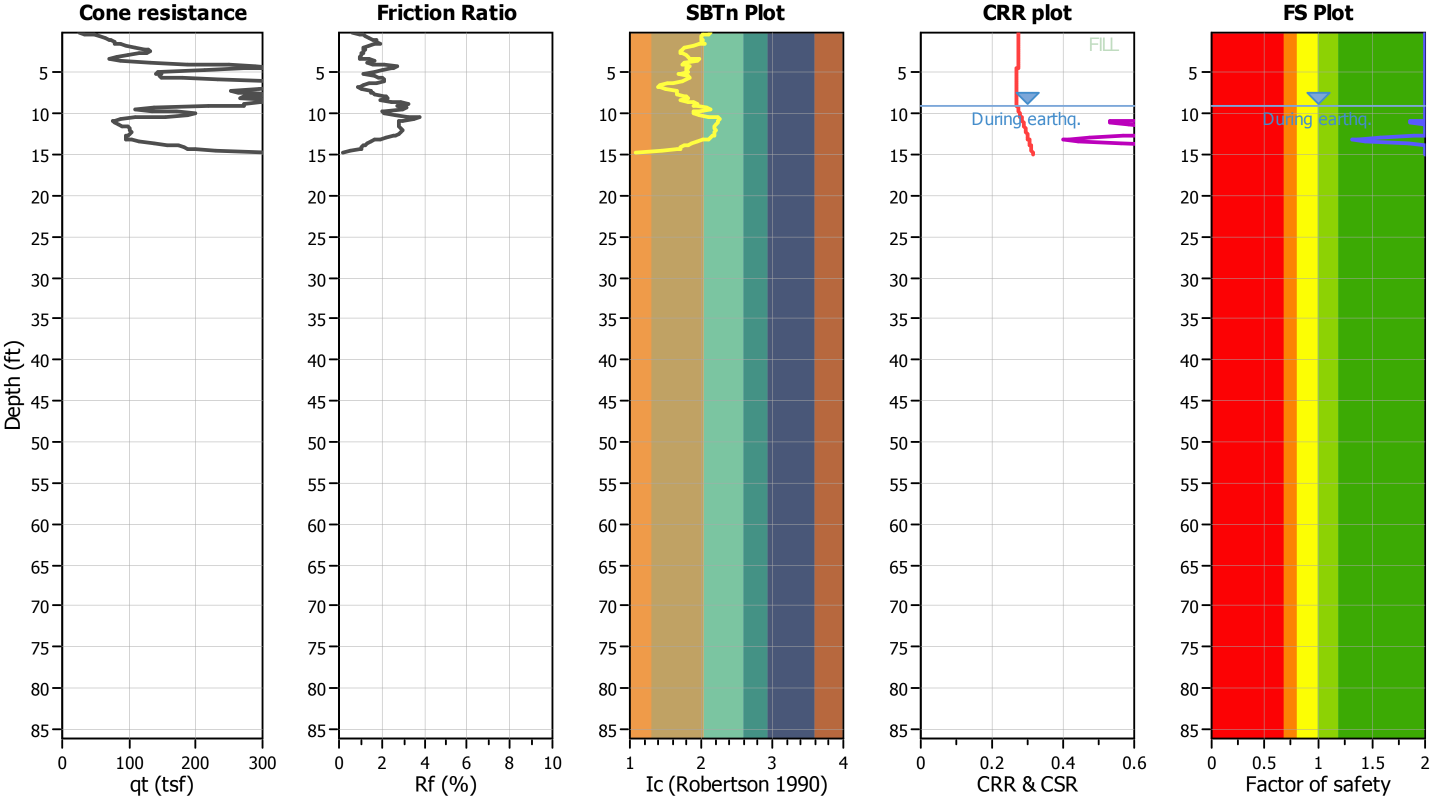
LIQUEFACTION ANALYSIS REPORT

Project title : Riverwalk **Location : San Diego, CA**

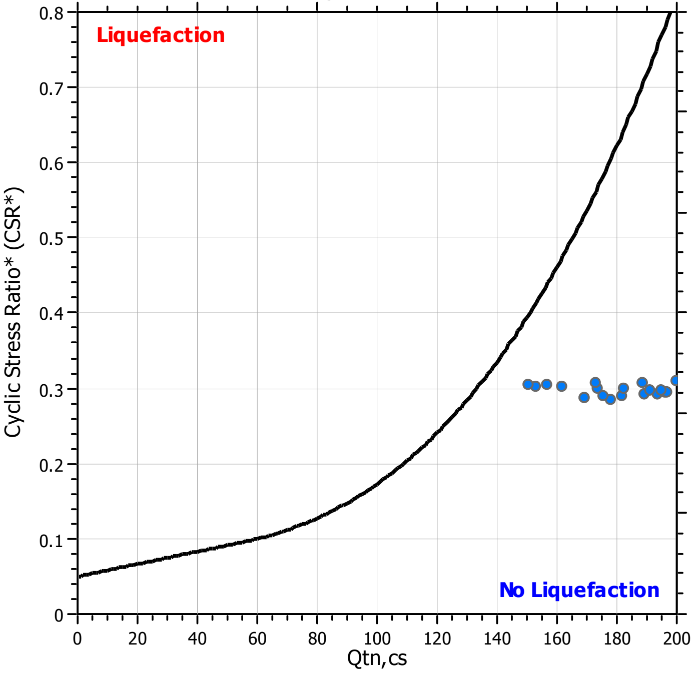
CPT file : CPT- 3

Input parameters and analysis data

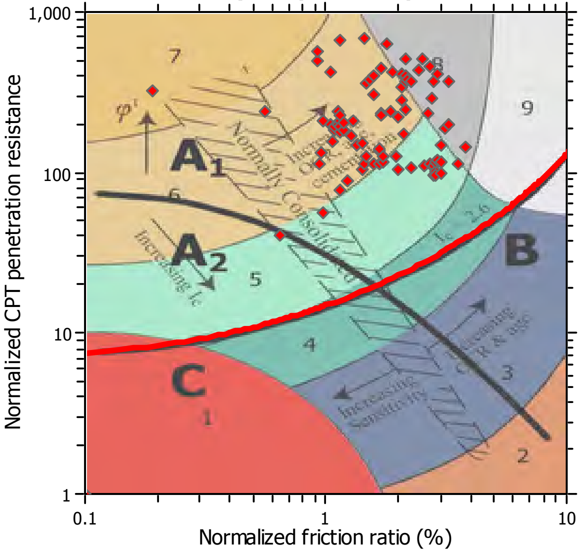
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	12.00 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	17.00 ft	Fill height:	8.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		



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

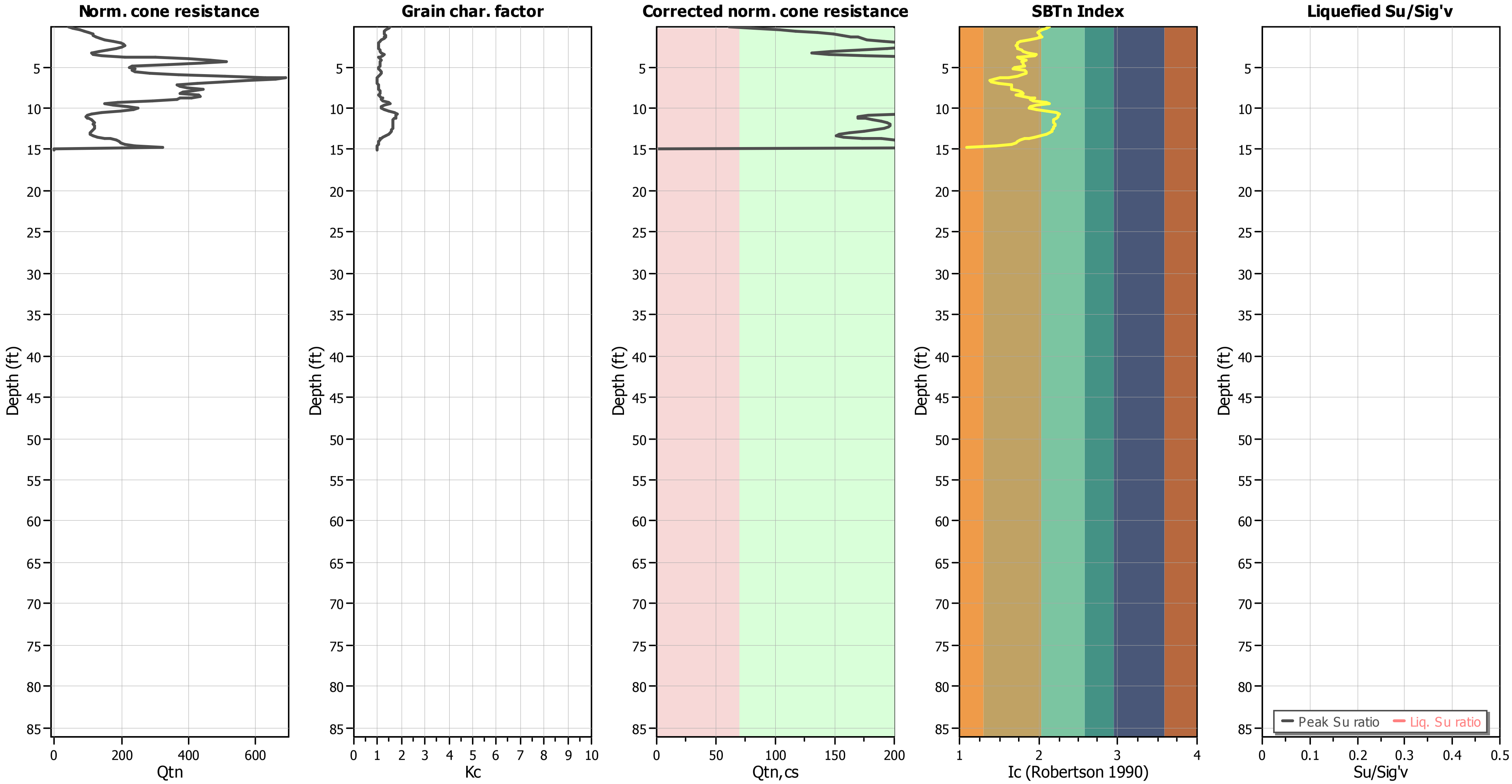


Summary of liquefaction potential



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

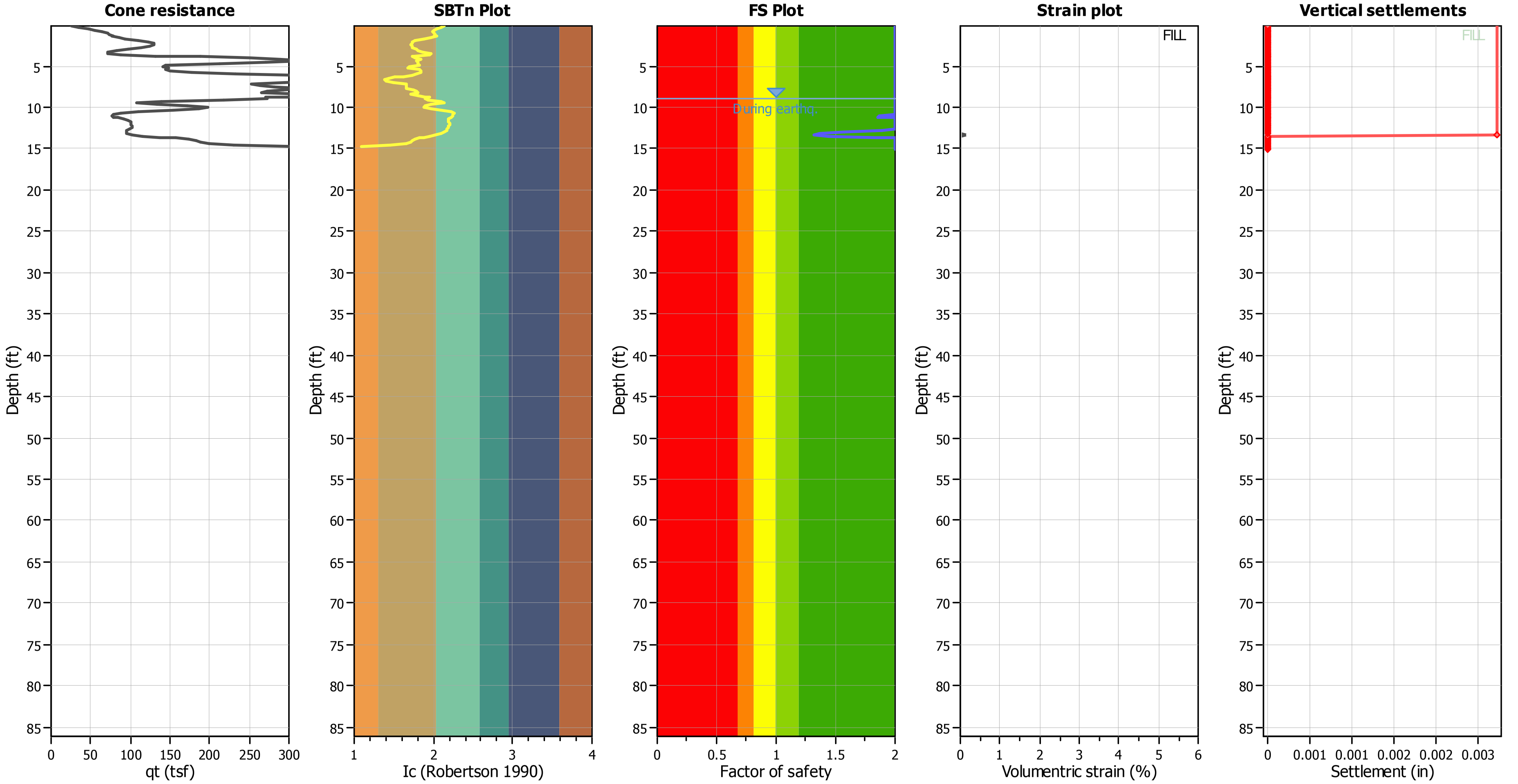
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	17.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	8.00 ft	Limit depth:	N/A

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

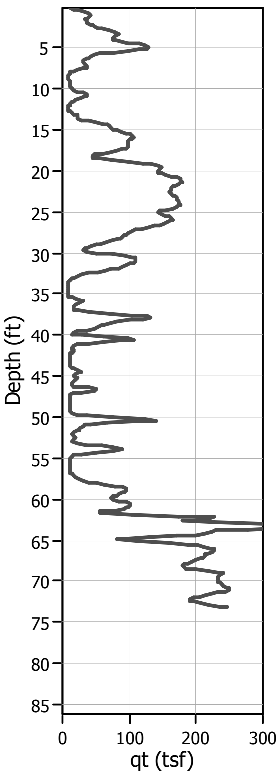
Project title : Riverwalk **Location : San Diego, CA**

CPT file : CPT- 4

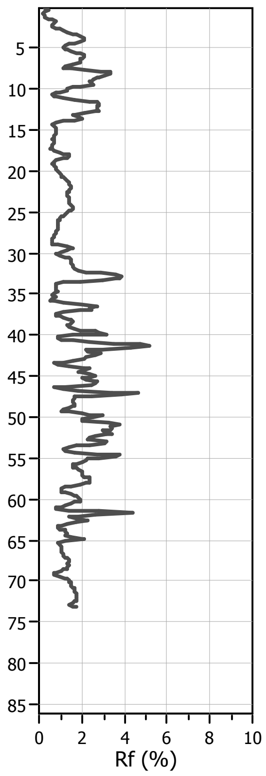
Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	13.00 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	20.00 ft	Fill height:	10.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

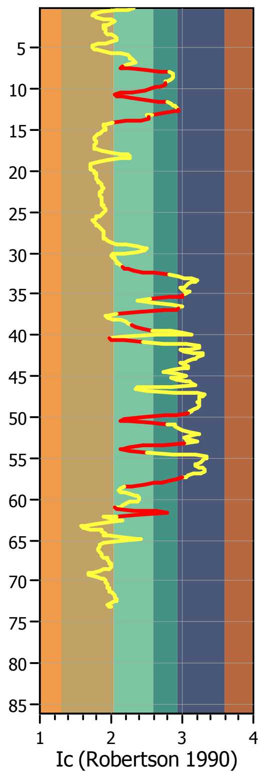
Cone resistance



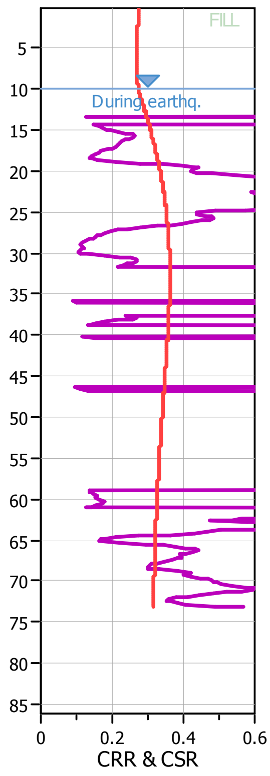
Friction Ratio



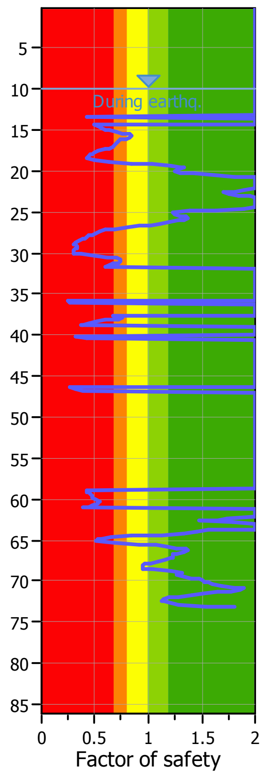
SBTn Plot



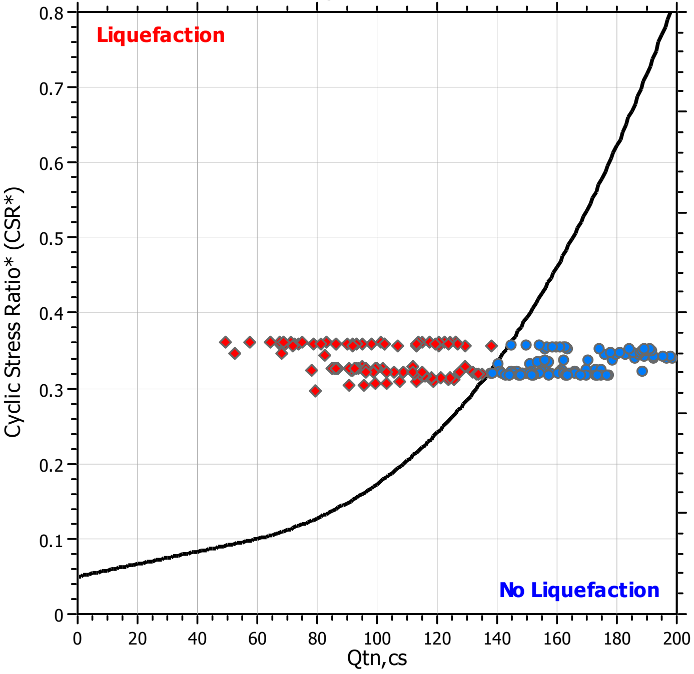
CRR plot



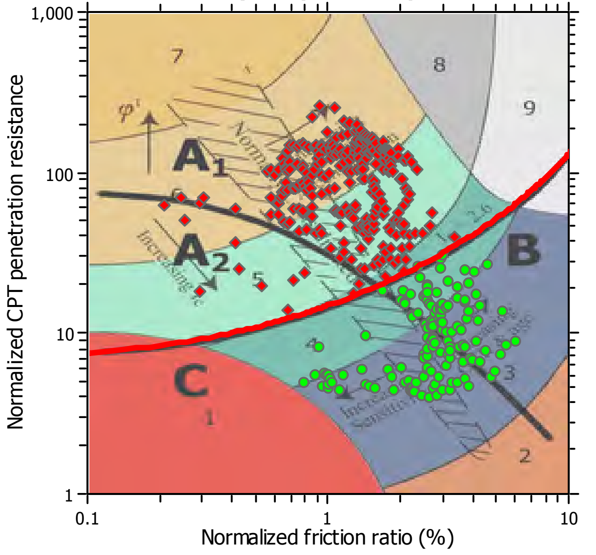
FS Plot



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

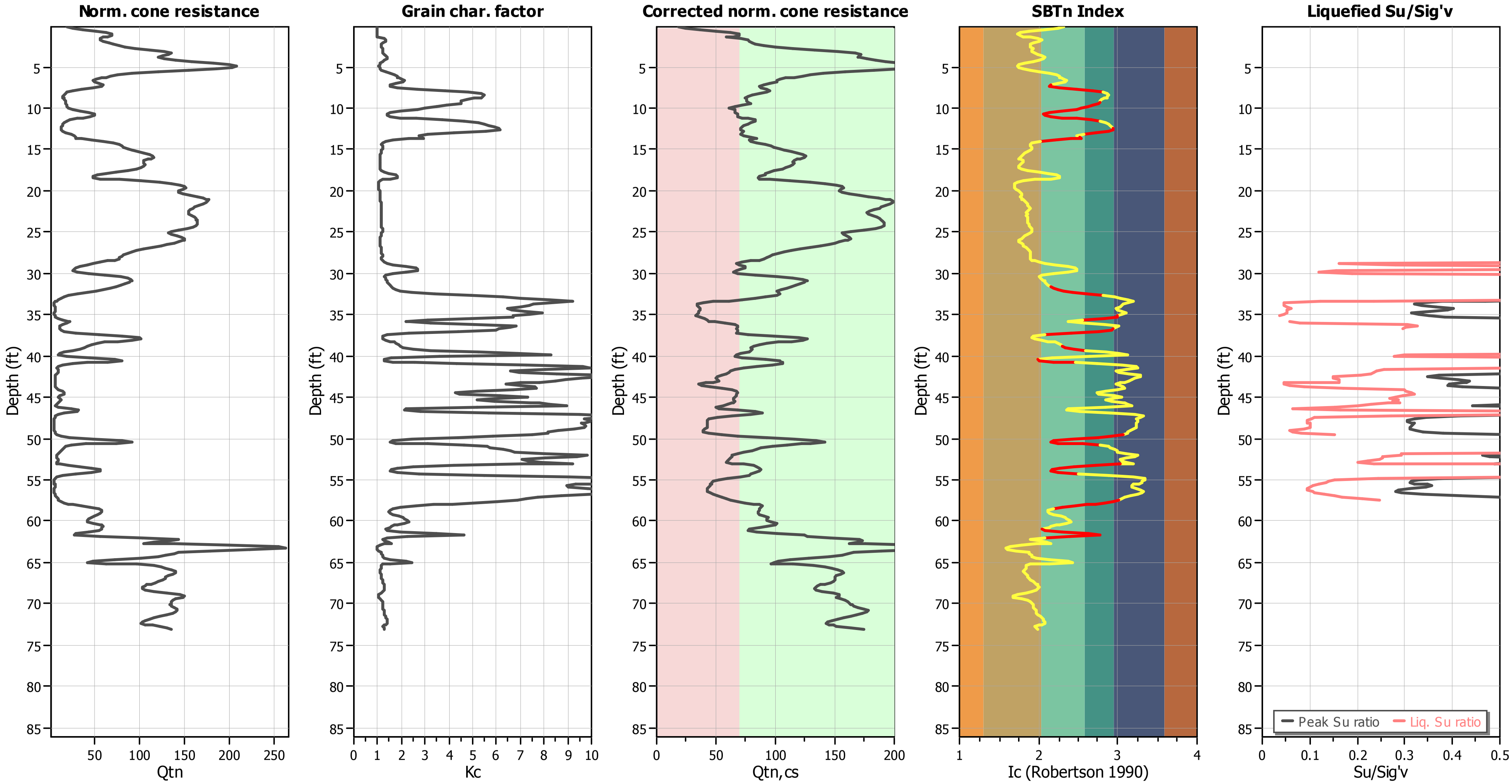


Summary of liquefaction potential



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

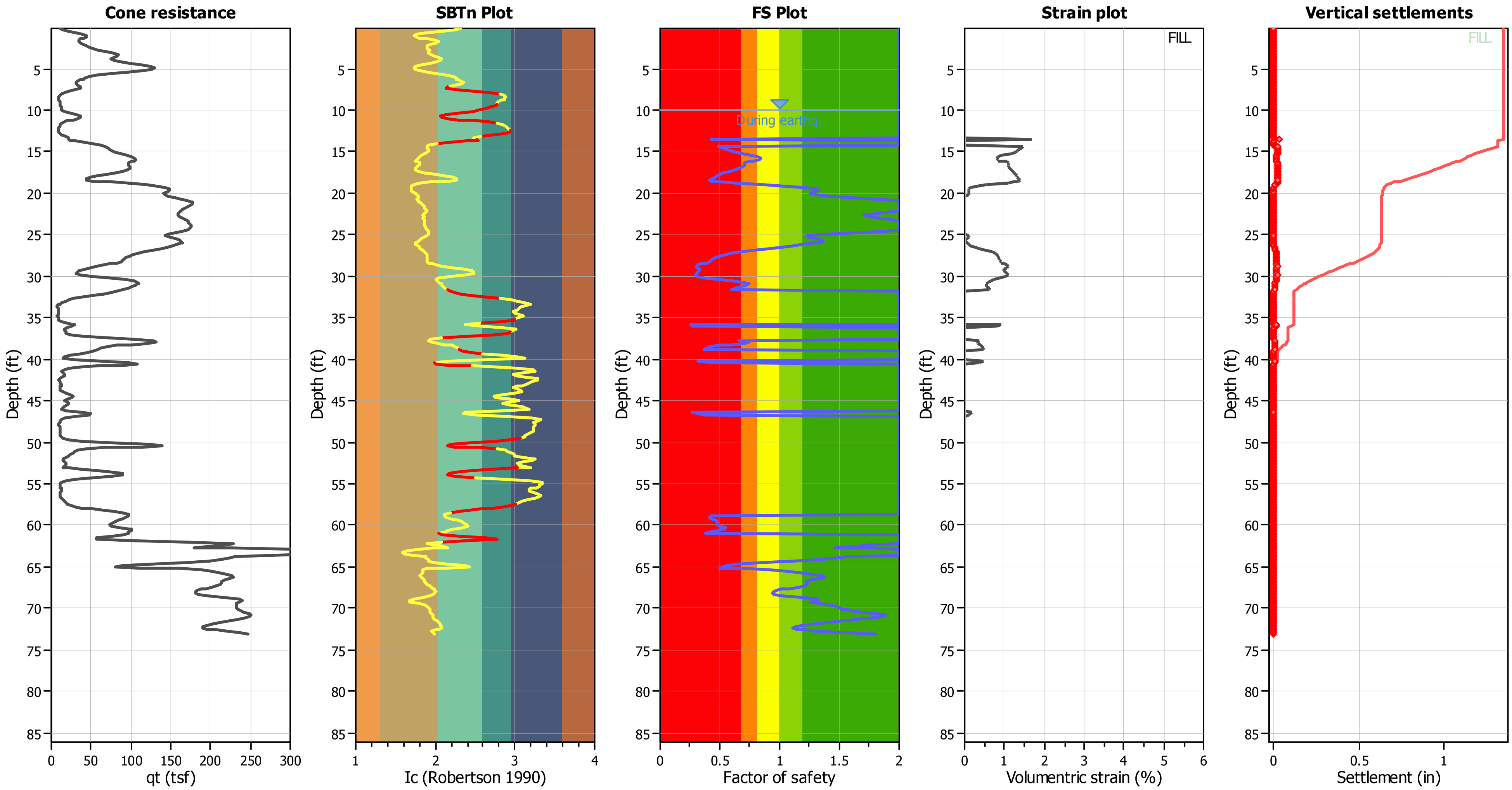
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	20.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	13.00 ft	Fill height:	10.00 ft	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

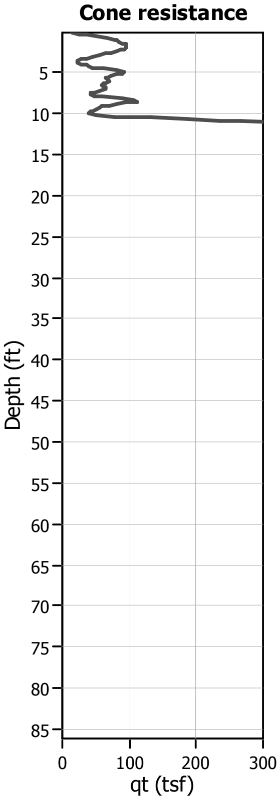
q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

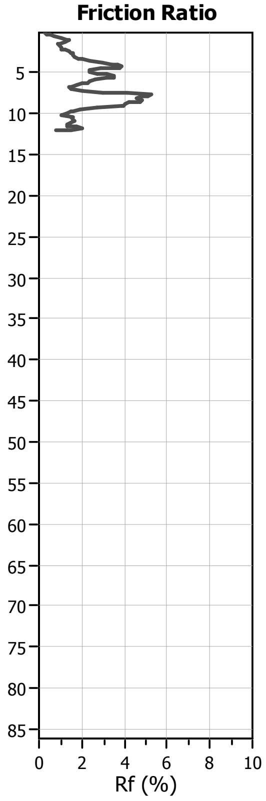
Project title : Riverwalk **Location : San Diego, CA**

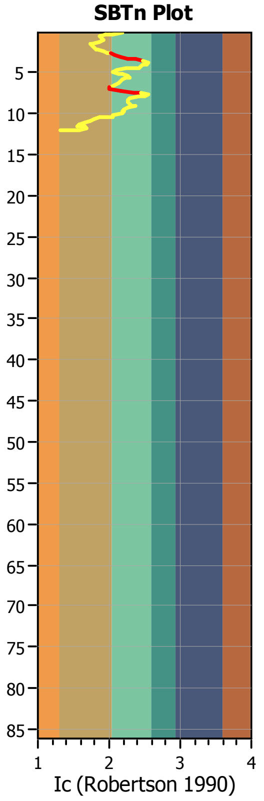
CPT file : CPT- 5

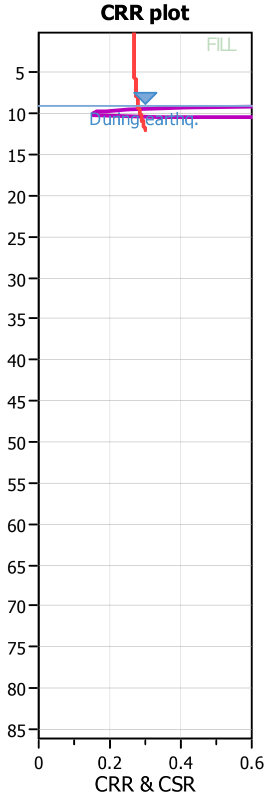
Input parameters and analysis data

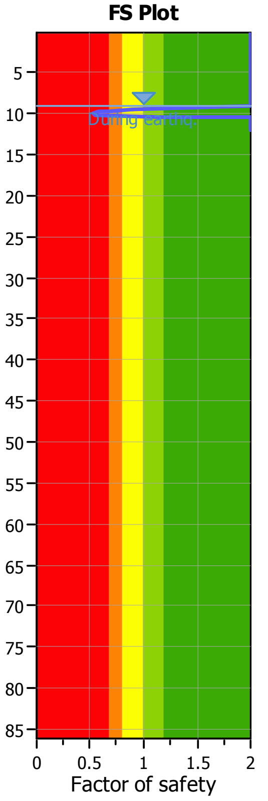
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	12.00 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	22.00 ft	Fill height:	13.00 ft		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth applied:	No
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

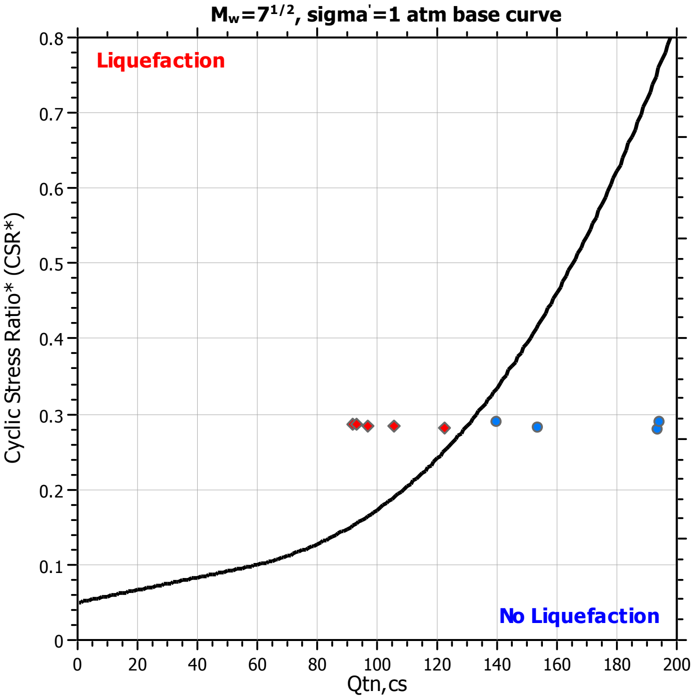

Cone resistance

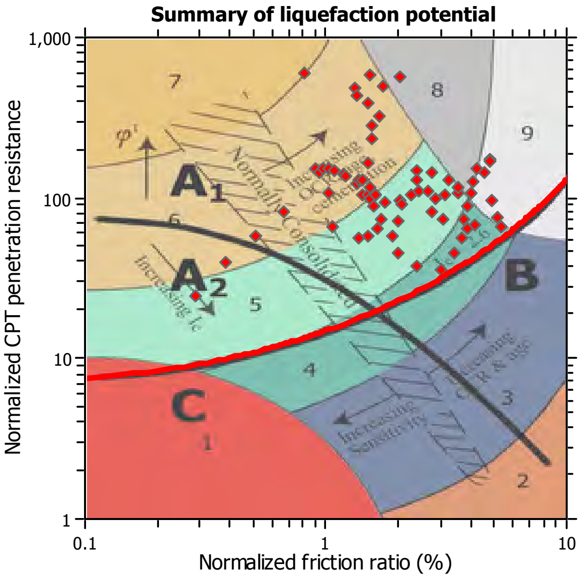

Friction Ratio


SBTn Plot


CRR plot

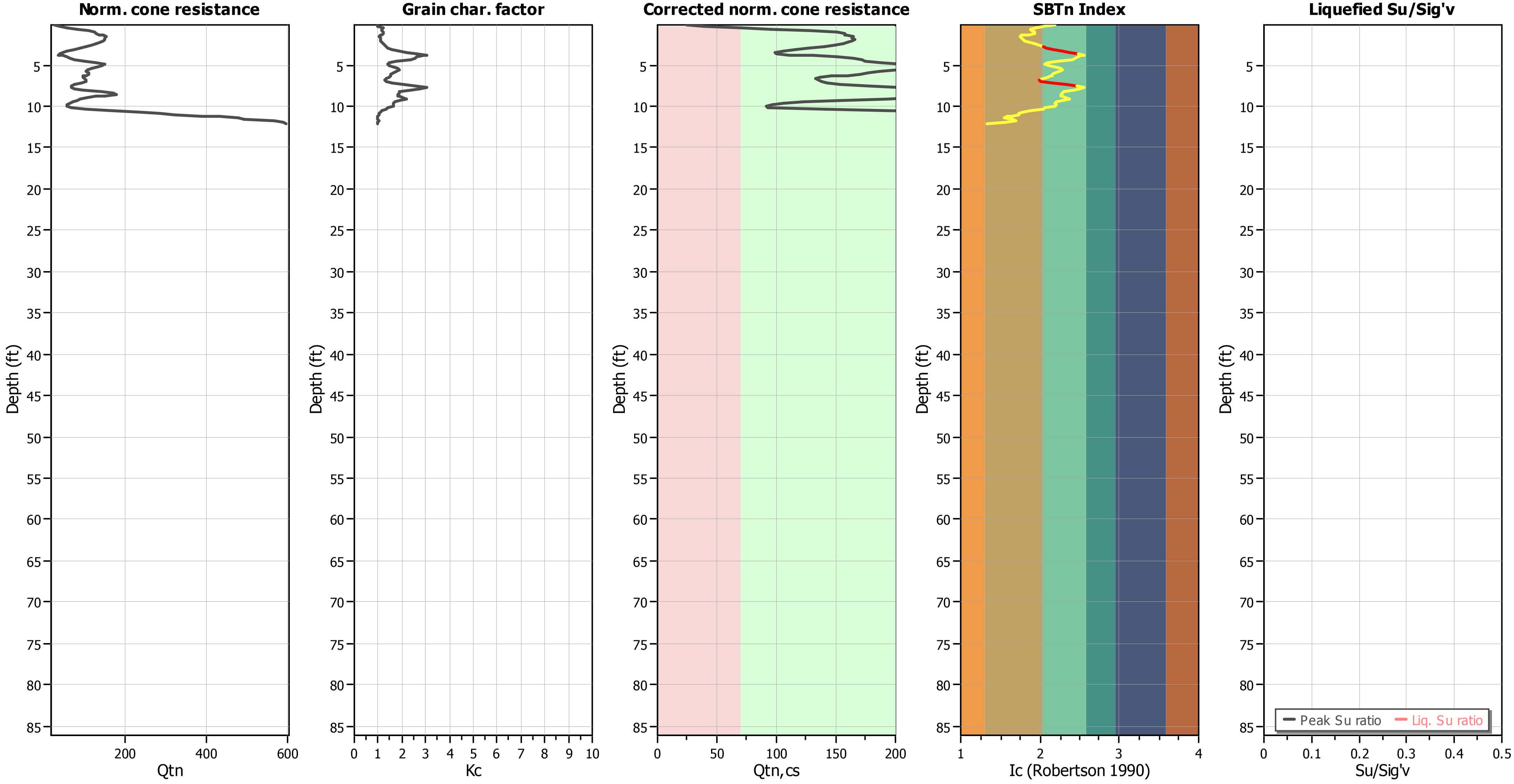

FS Plot


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


Summary of liquefaction potential

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

Check for strength loss plots (Robertson (2010))



Norm. cone resistance

Grain char. factor

Corrected norm. cone resistance

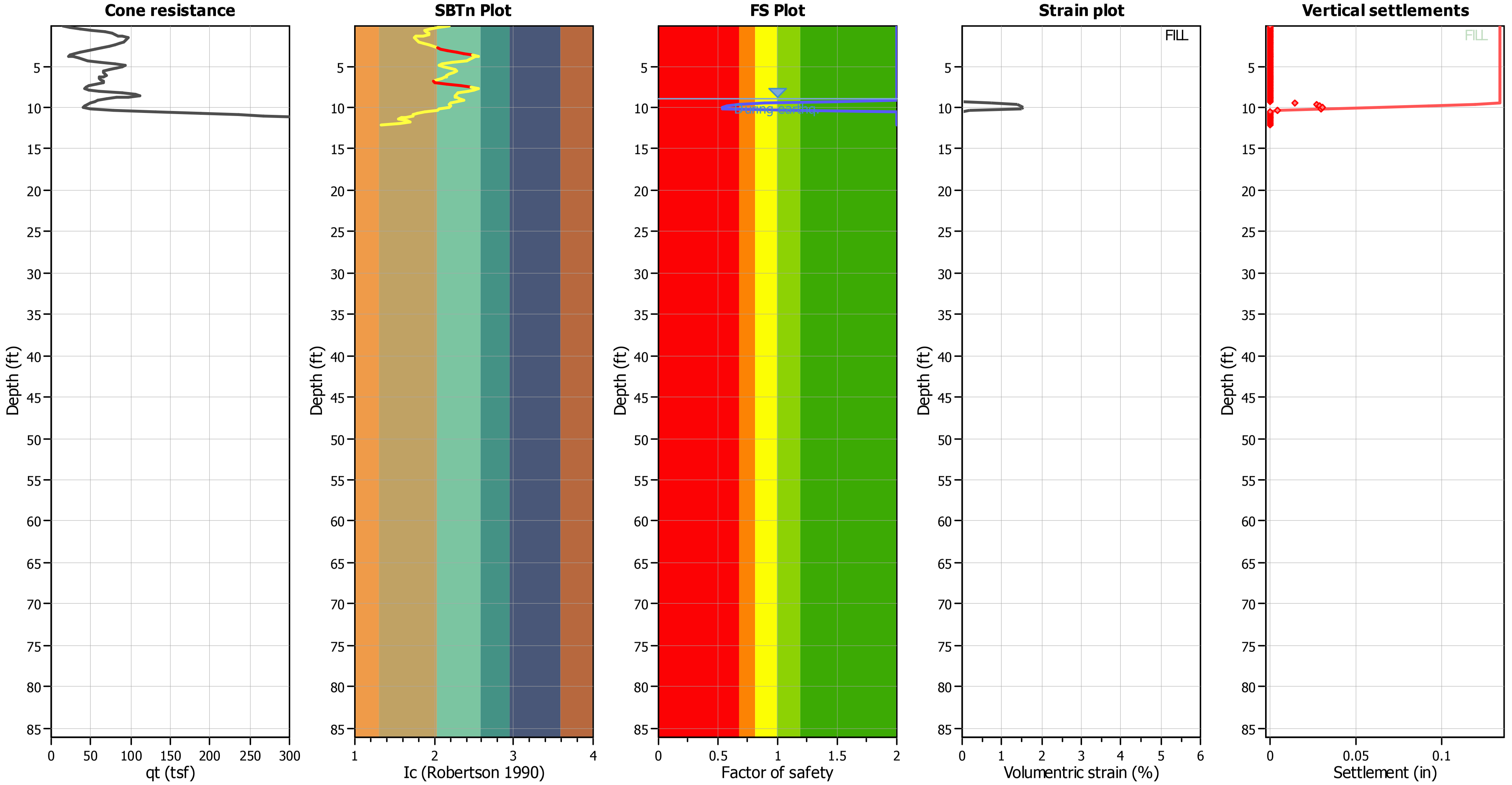
SBTn Index

Liquefied Su/Sig'v

Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	22.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	13.00 ft	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
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Volumentric strain:	Post-liquefaction volumentric strain

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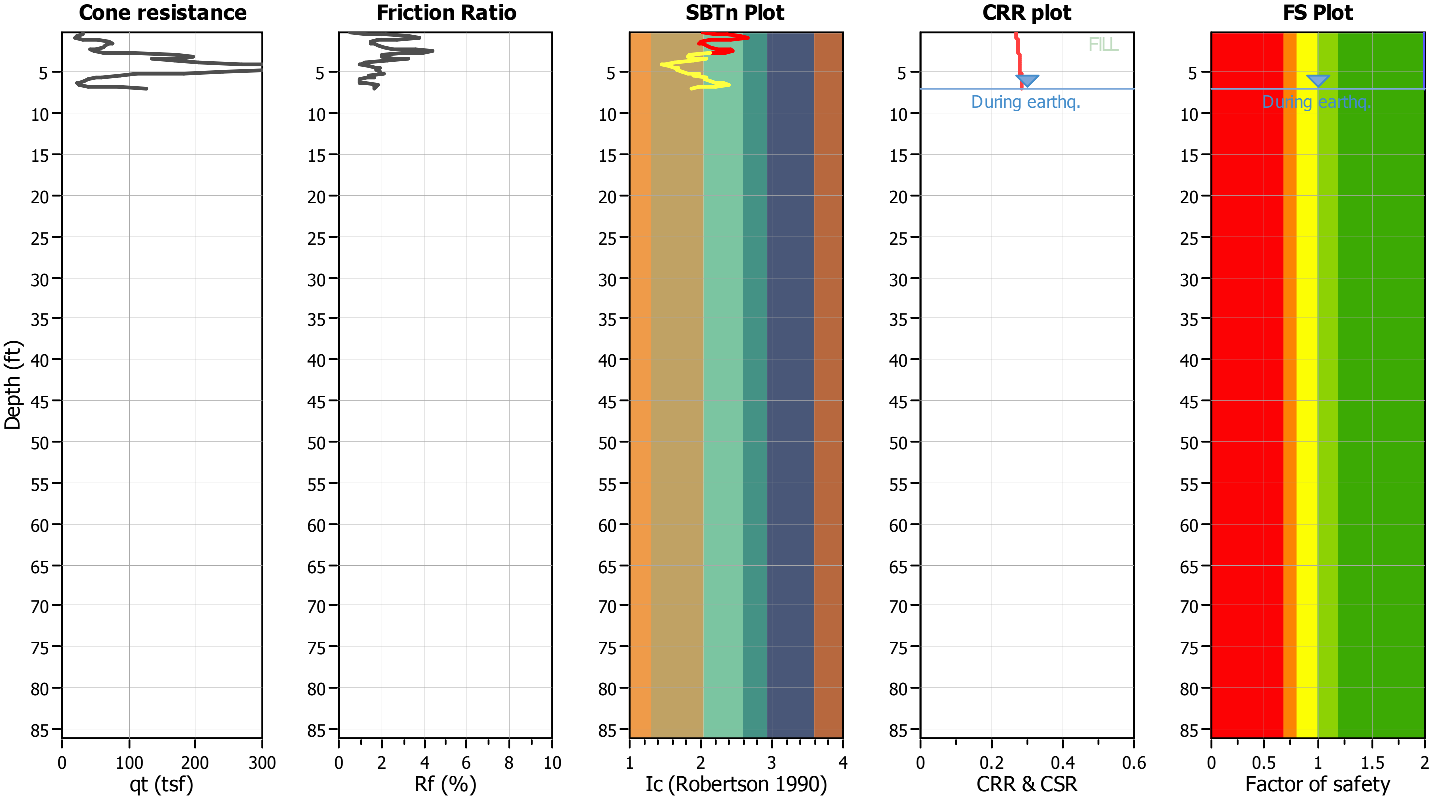
LIQUEFACTION ANALYSIS REPORT

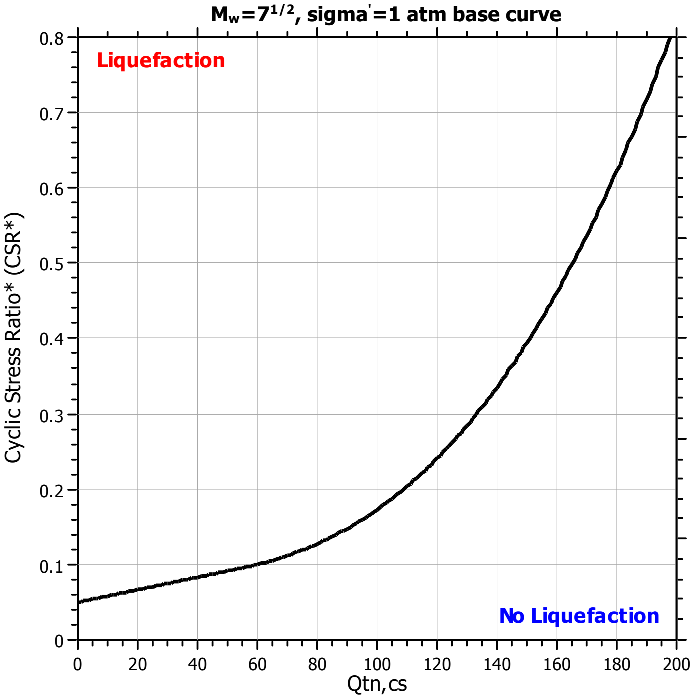
Project title : Riverwalk **Location : San Diego, CA**

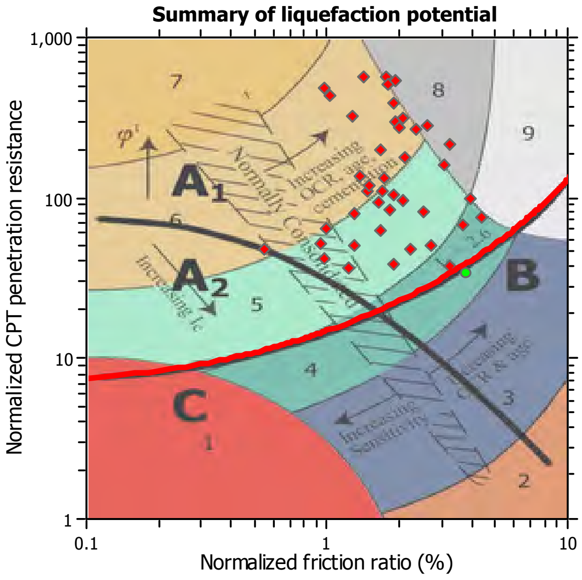
CPT file : CPT- 6

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	10.00 ft	Use fill:	Yes		
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	25.00 ft	Fill height:	18.00 ft	Clay like behavior applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth applied:	No
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_{σ} applied:	Yes	MSF method:	Method based

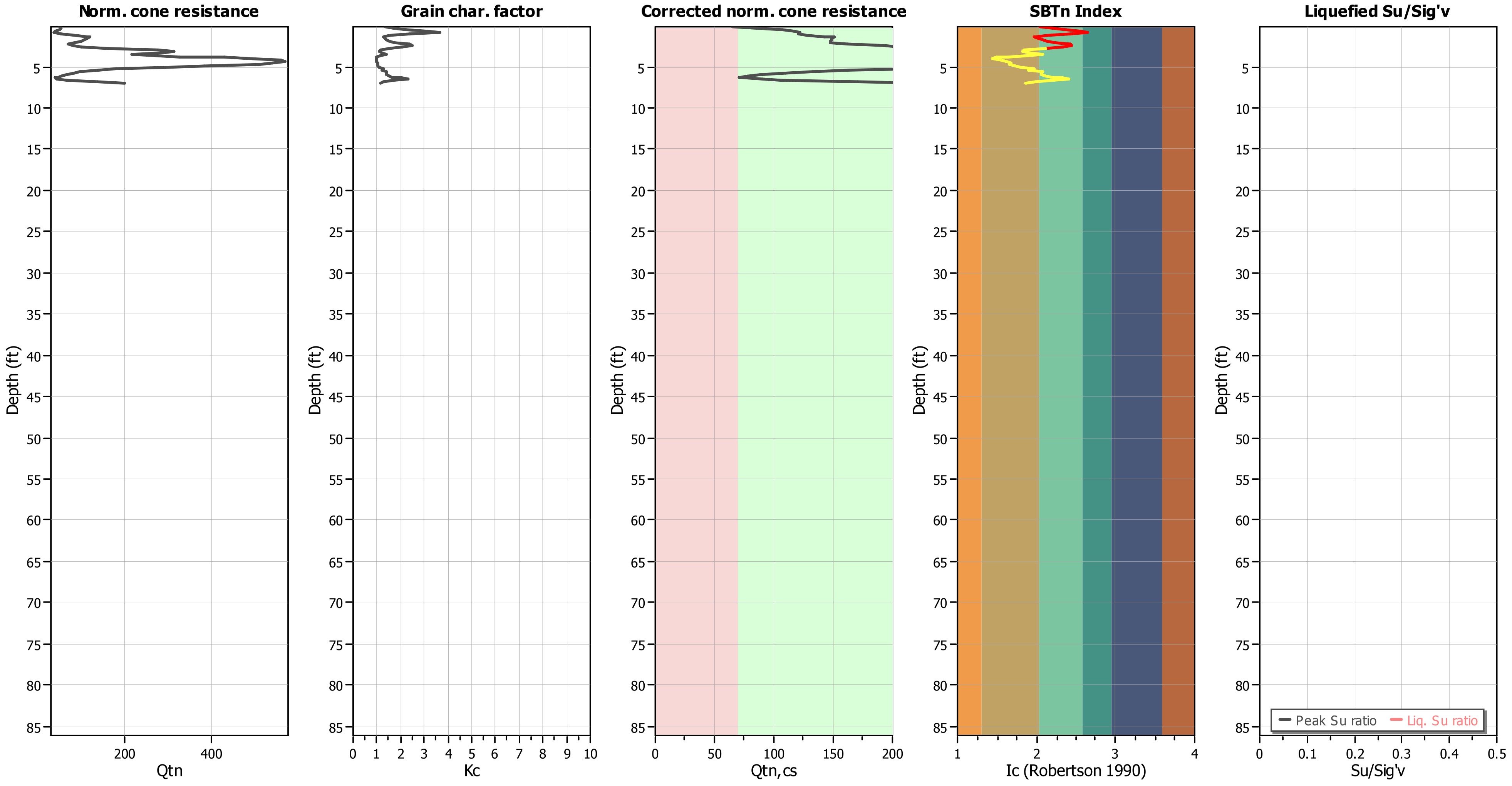






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

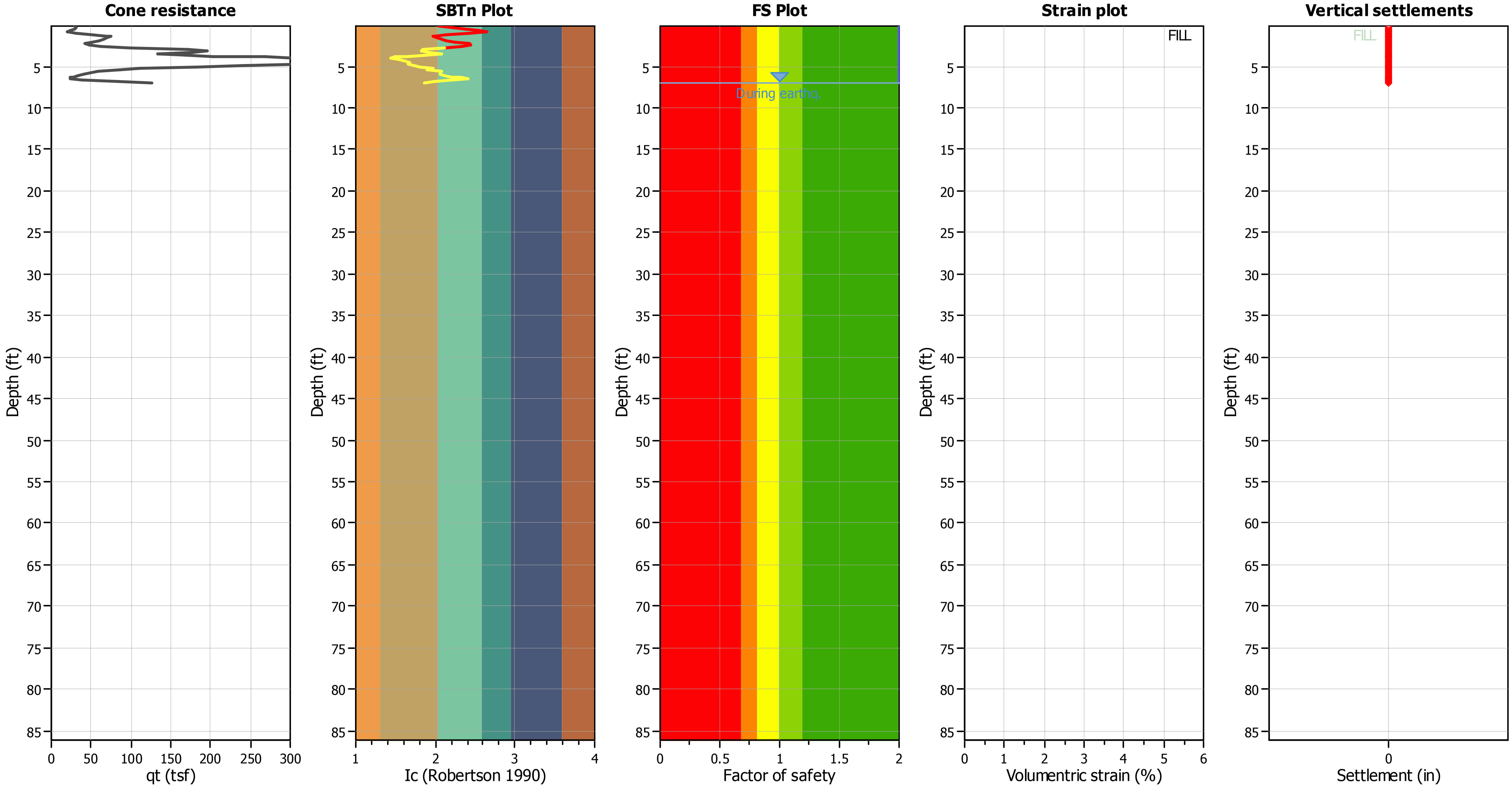
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	25.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	10.00 ft	Fill height:	18.00 ft	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

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I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

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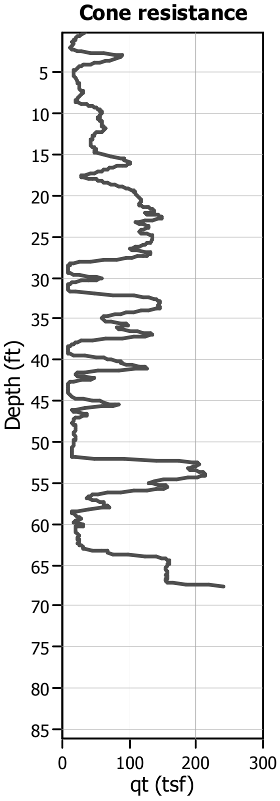
LIQUEFACTION ANALYSIS REPORT

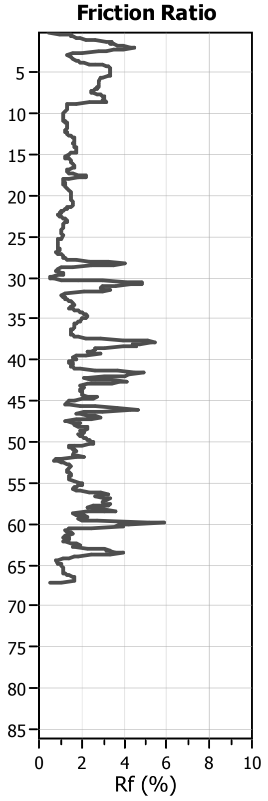
Project title : Riverwalk **Location : San Diego, CA**

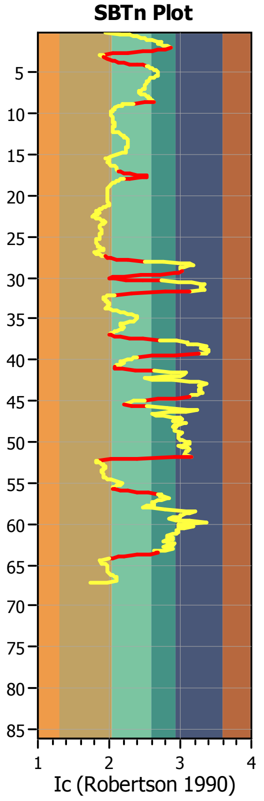
CPT file : CPT-7

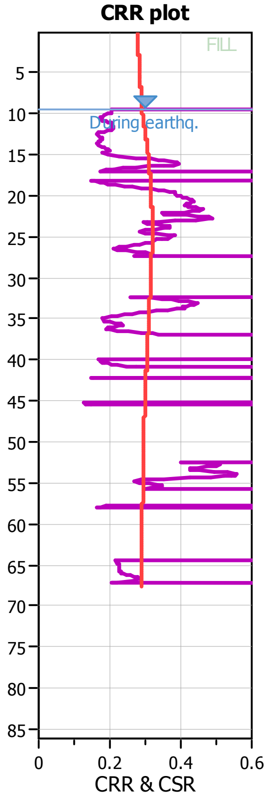
Input parameters and analysis data

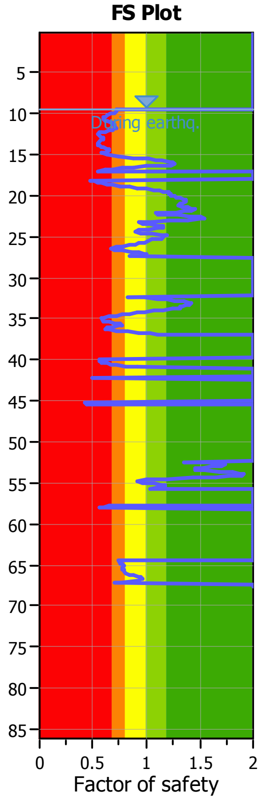
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	10.50 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	30.50 ft	Fill height:	21.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

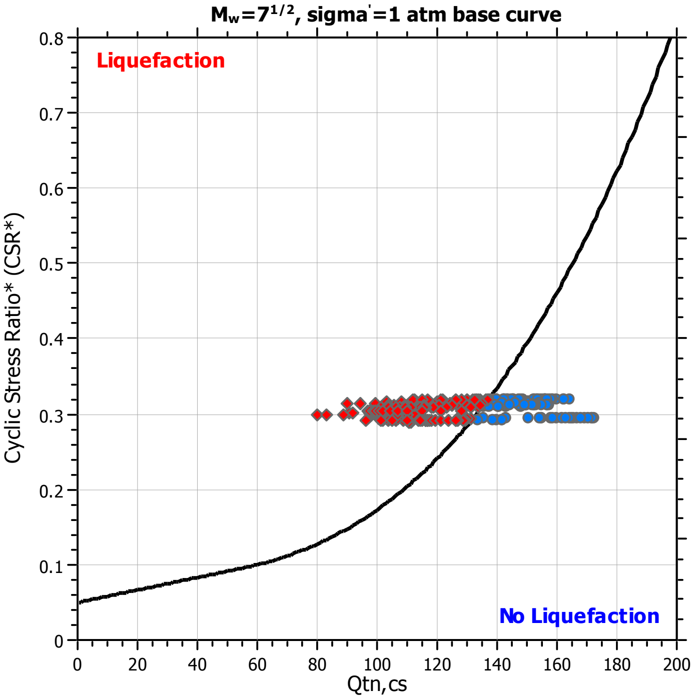

Cone resistance

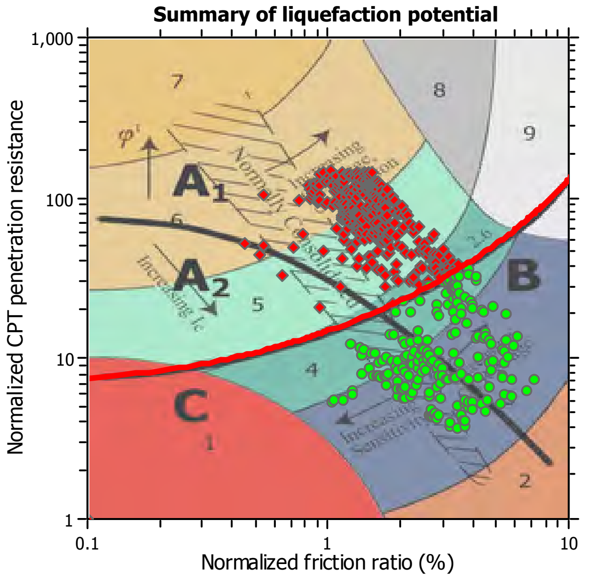

Friction Ratio


SBTn Plot


CRR plot

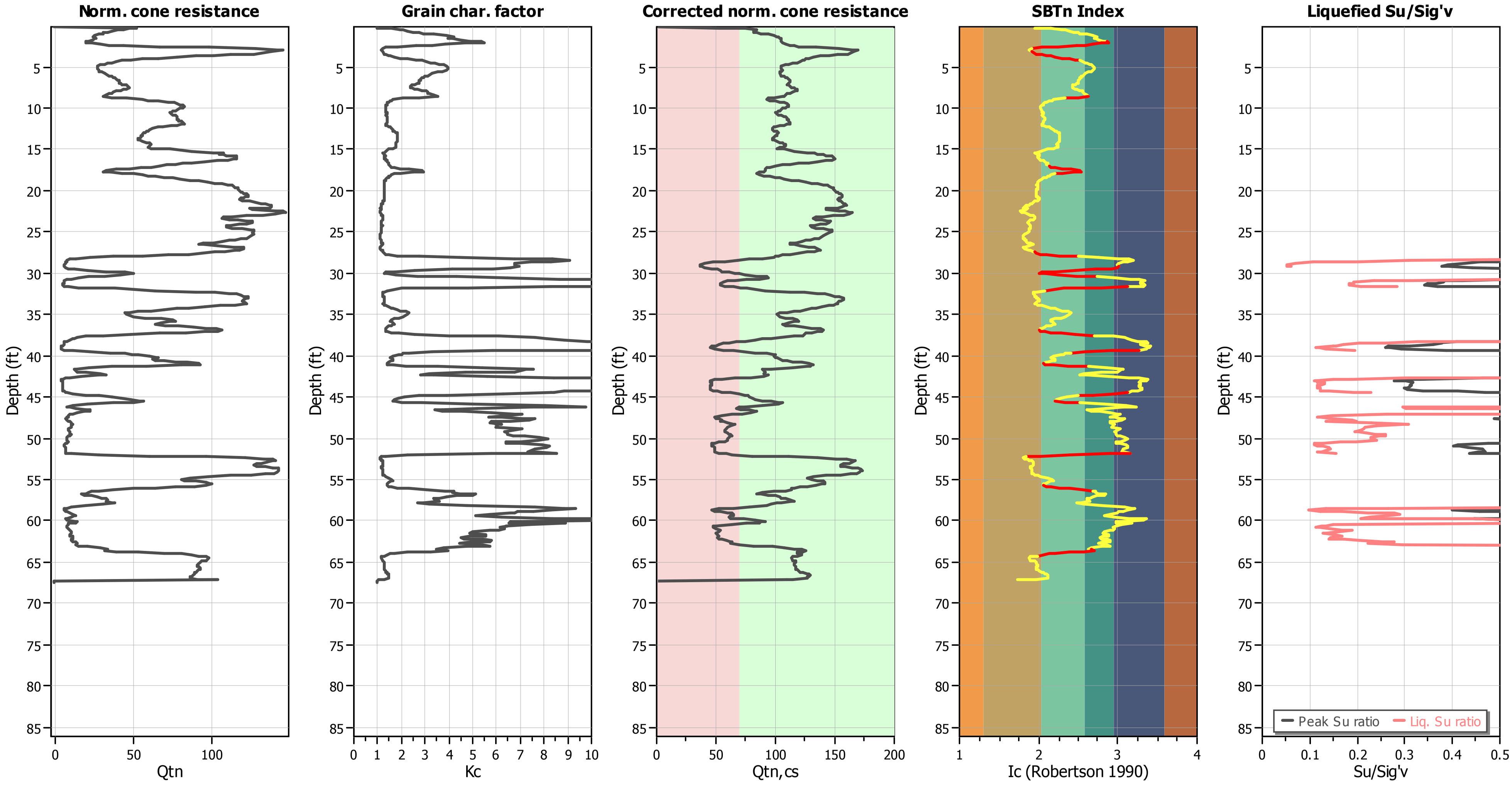

FS Plot


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


Summary of liquefaction potential

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

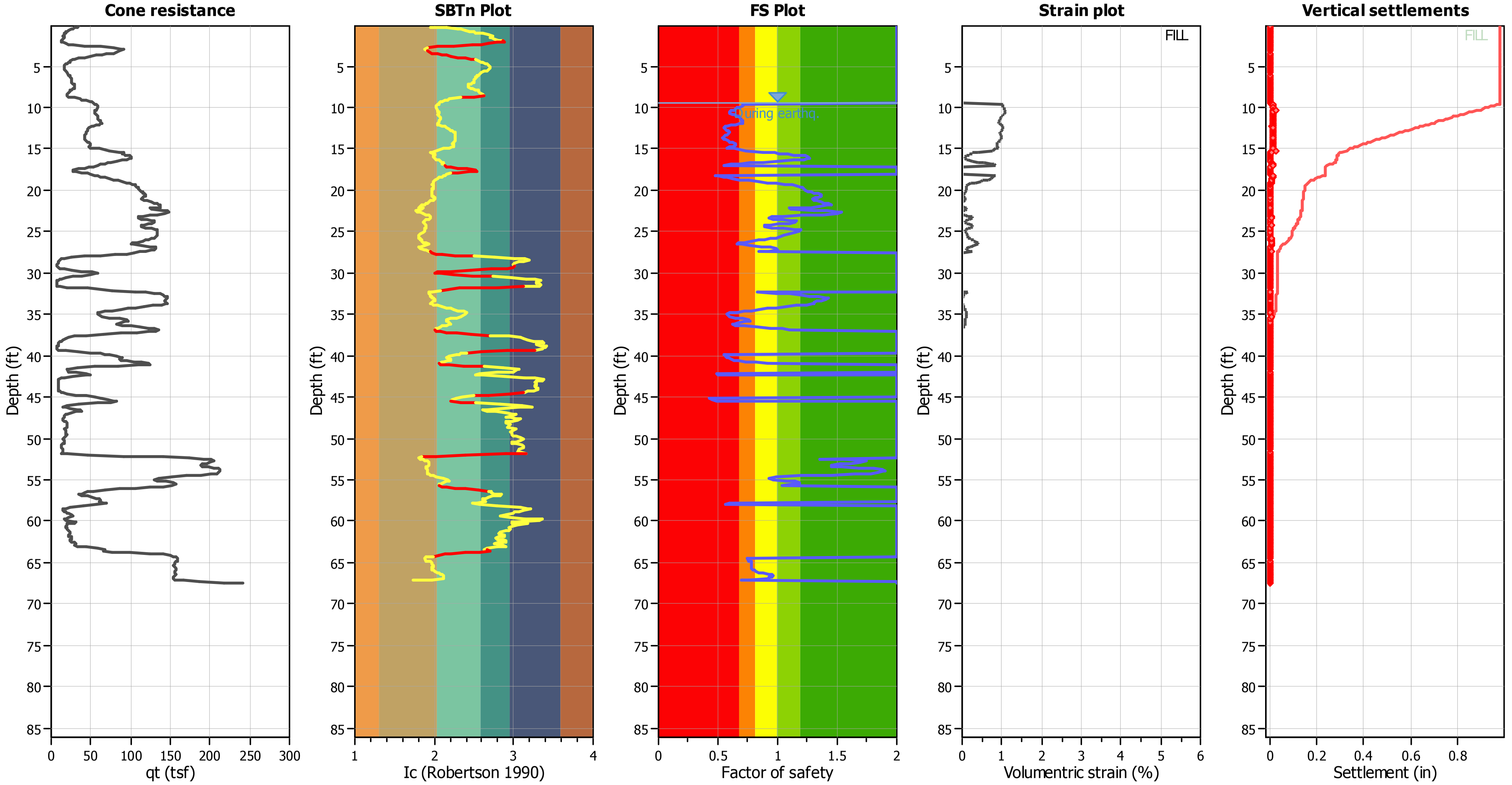
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	30.50 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	21.00 ft	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

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I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

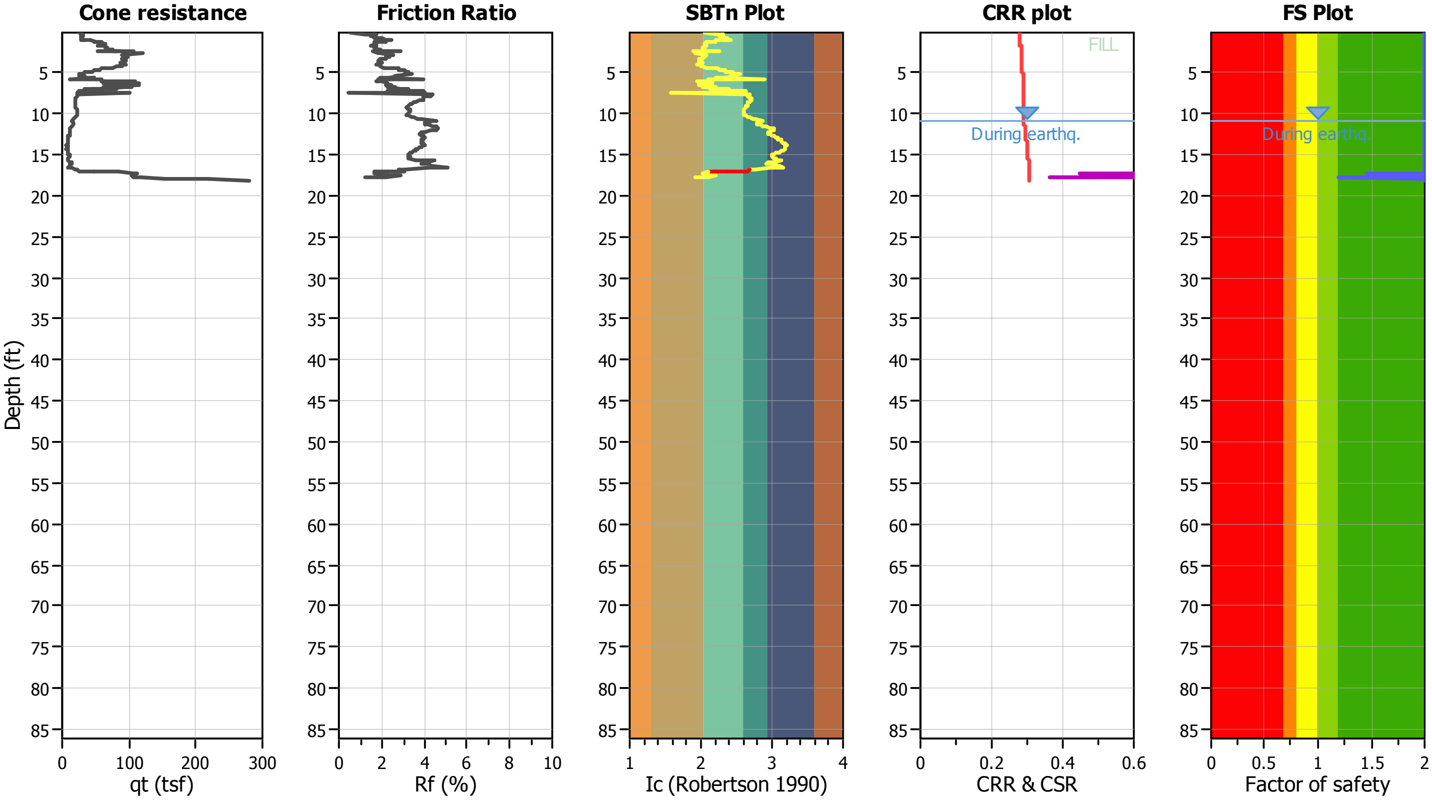
LIQUEFACTION ANALYSIS REPORT

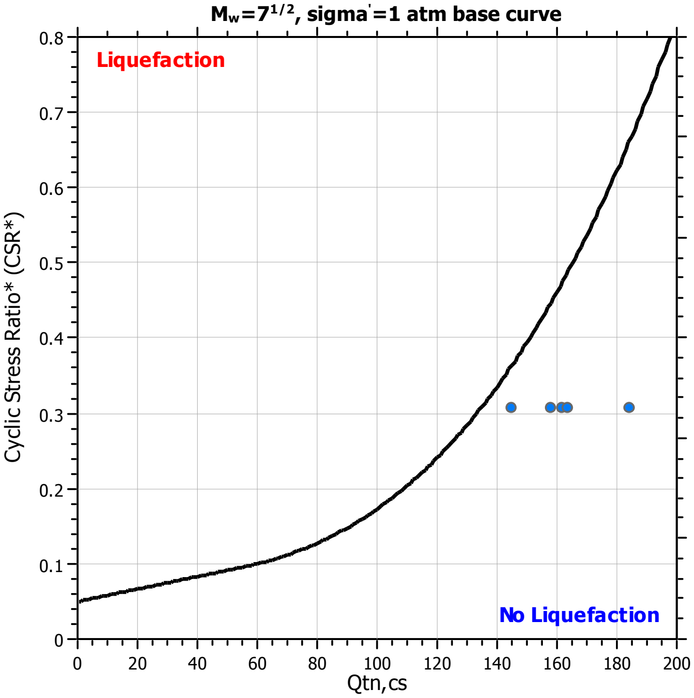
Project title : Riverwalk **Location : San Diego, CA**

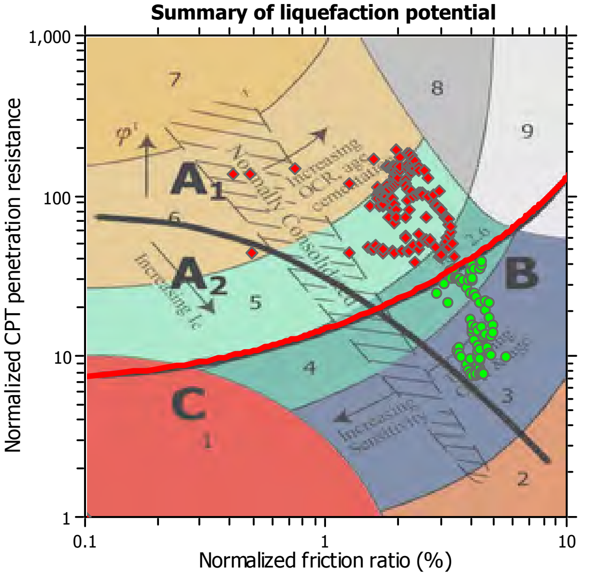
CPT file : CPT- 8

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	14.00 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	33.00 ft	Fill height:	22.00 ft		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth applied:	No
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.55	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
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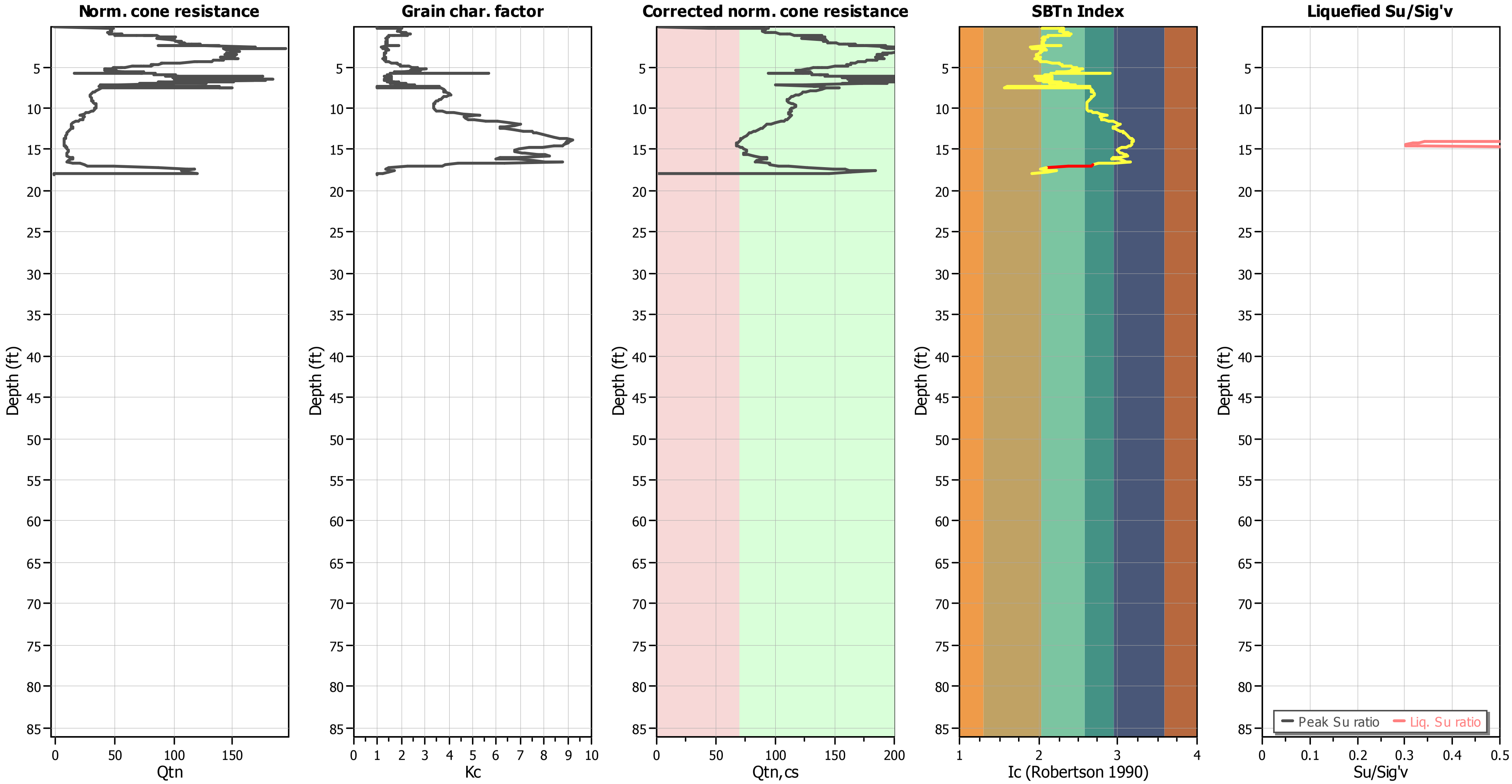
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

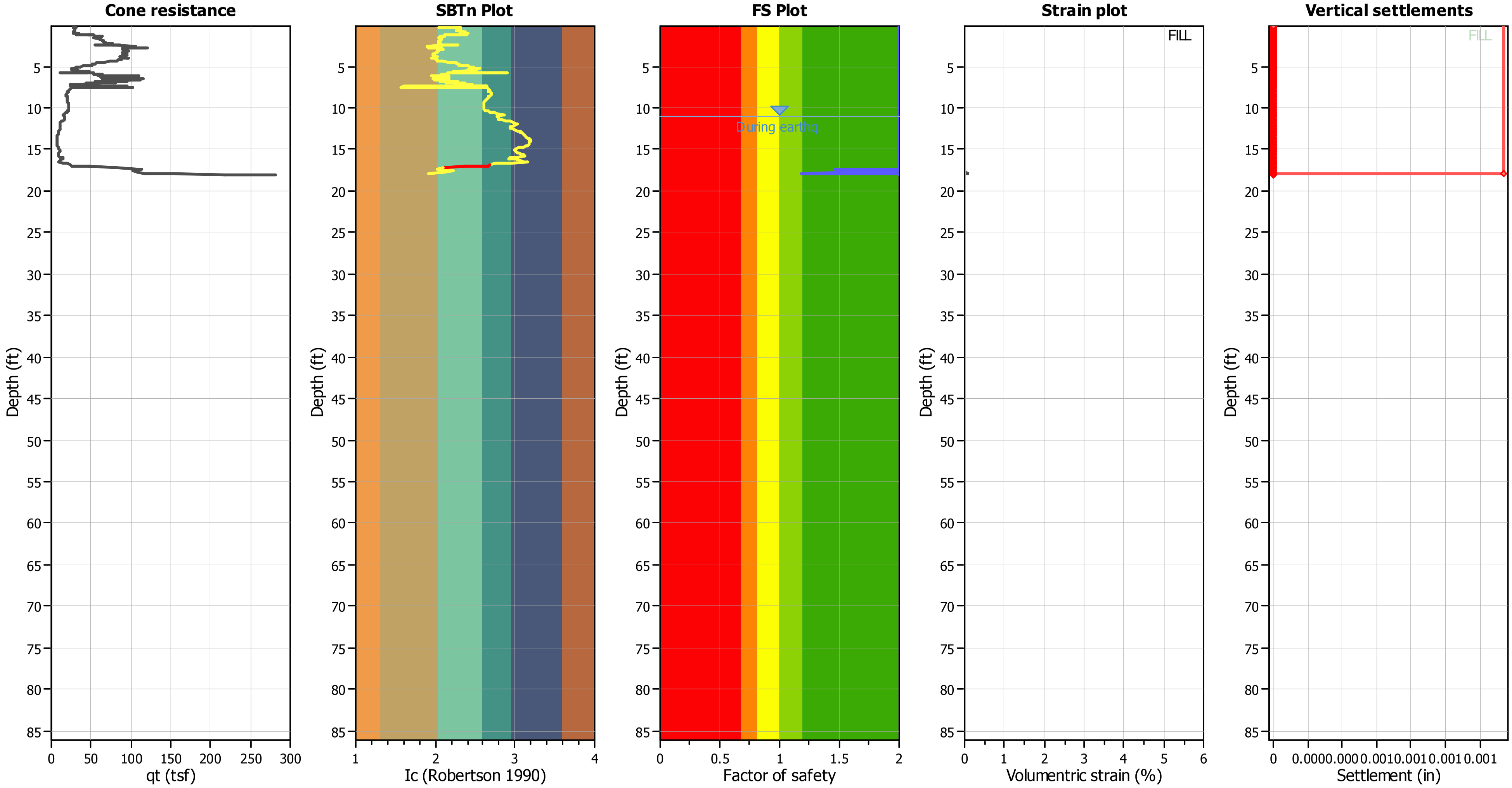
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	33.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	14.00 ft	Fill height:	22.00 ft	Limit depth:	N/A

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

LIQUEFACTION ANALYSIS REPORT

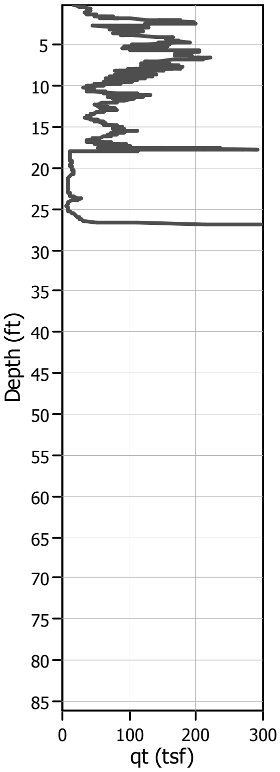
Project title : Riverwalk **Location : San Diego, CA**

CPT file : CPT- 9

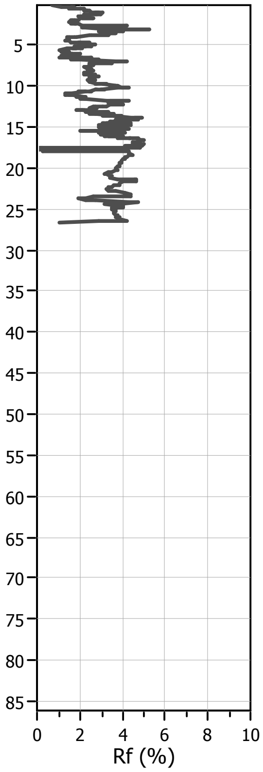
Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	25.00 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	33.00 ft	Fill height:	11.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

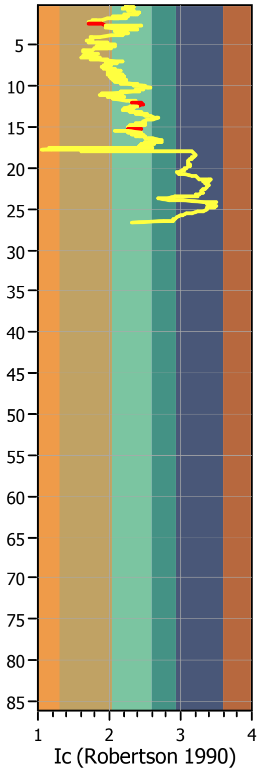
Cone resistance



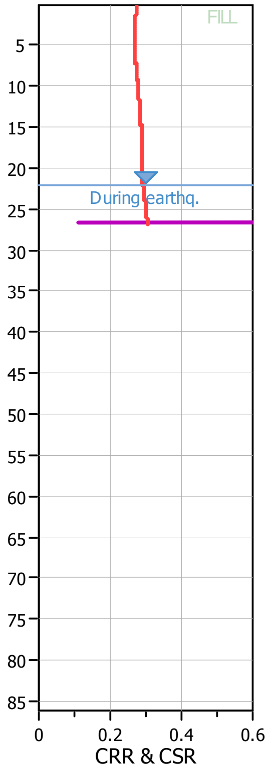
Friction Ratio



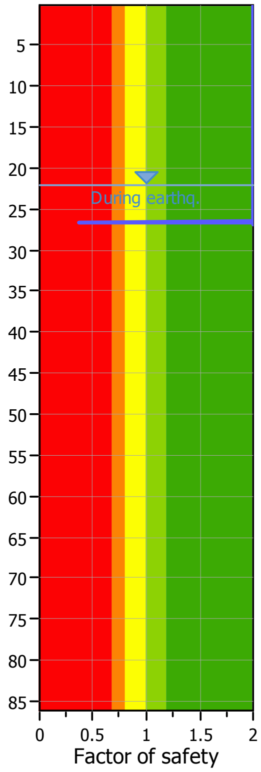
SBTn Plot



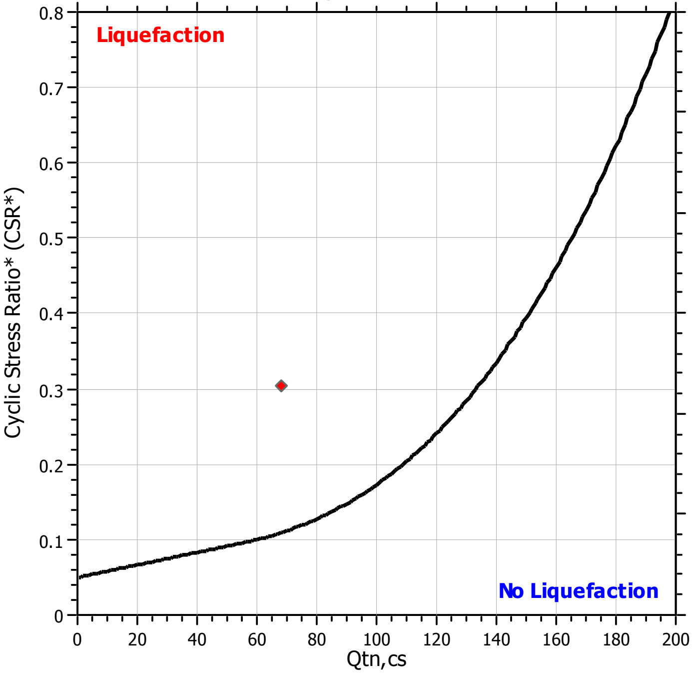
CRR plot



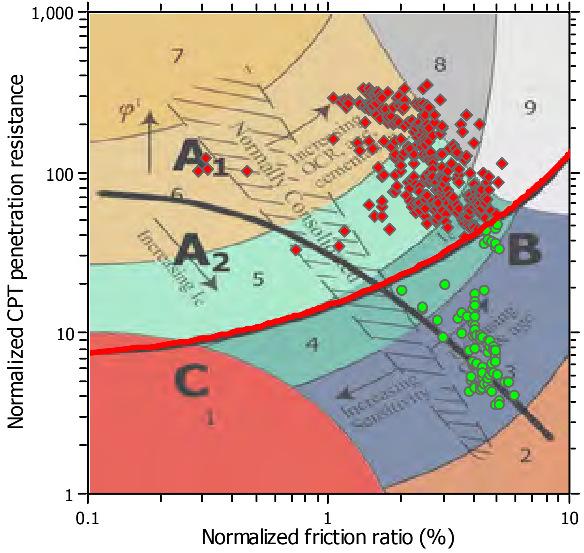
FS Plot



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

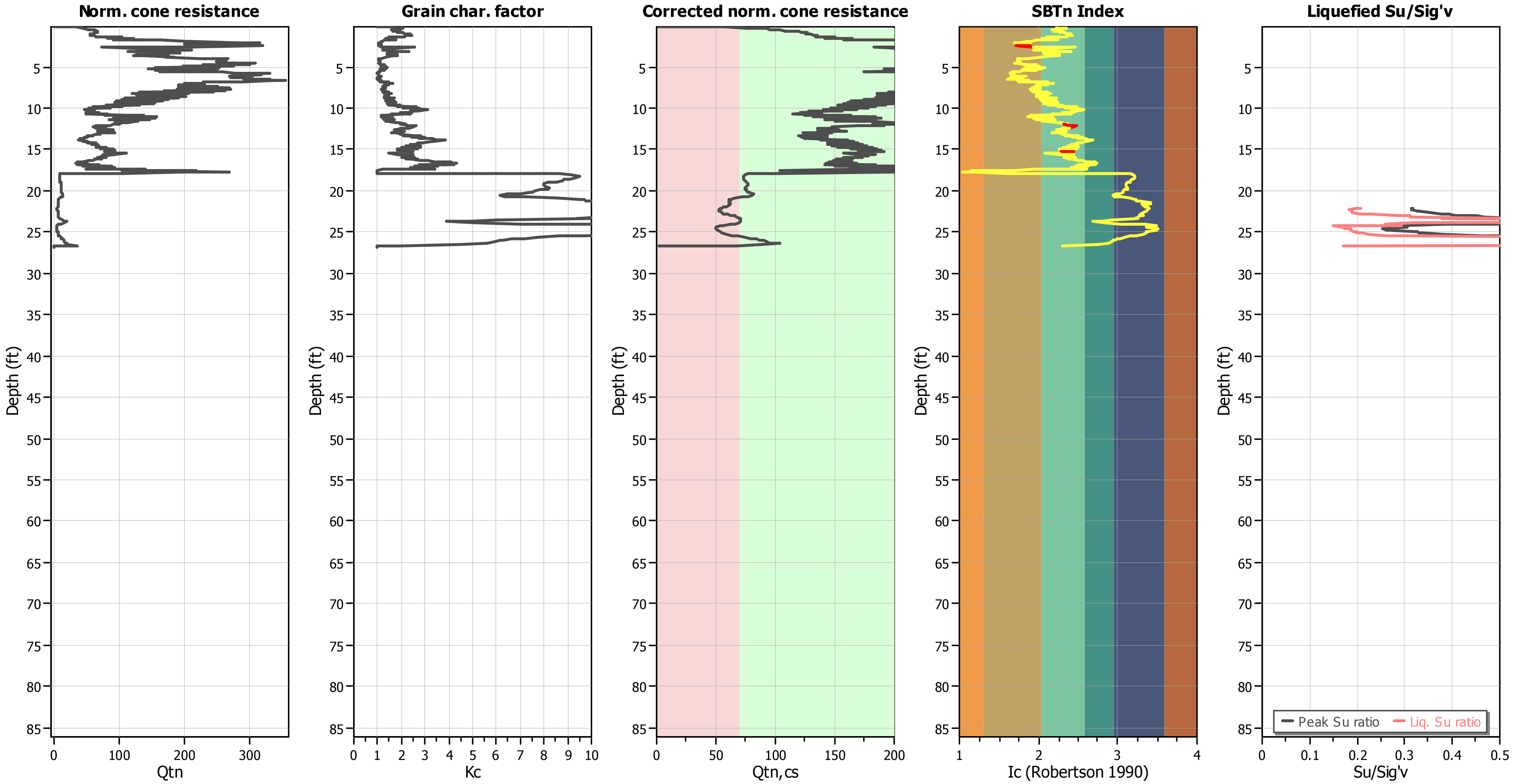


Summary of liquefaction potential



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

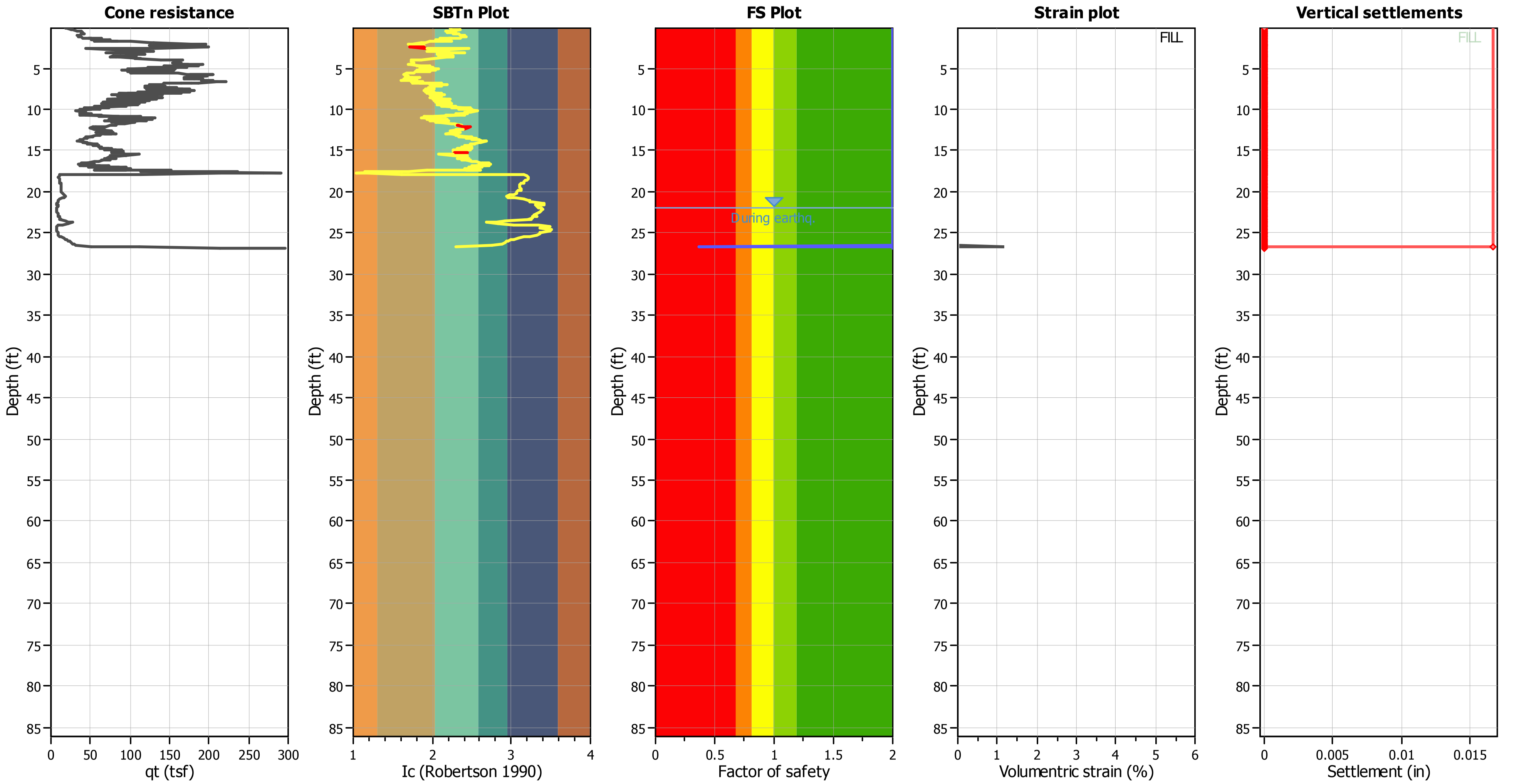
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	33.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	25.00 ft	Fill height:	11.00 ft	Limit depth:	N/A

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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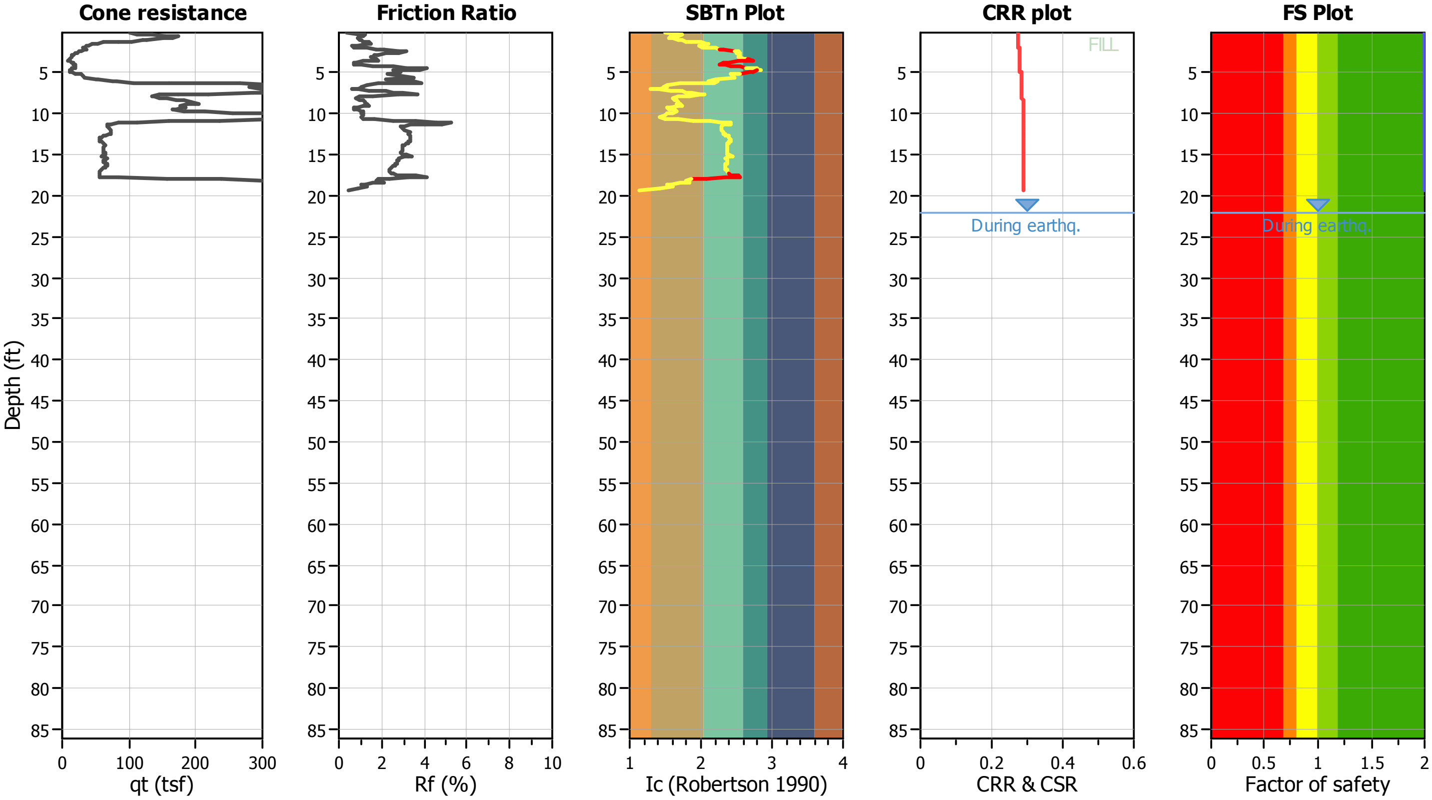
LIQUEFACTION ANALYSIS REPORT

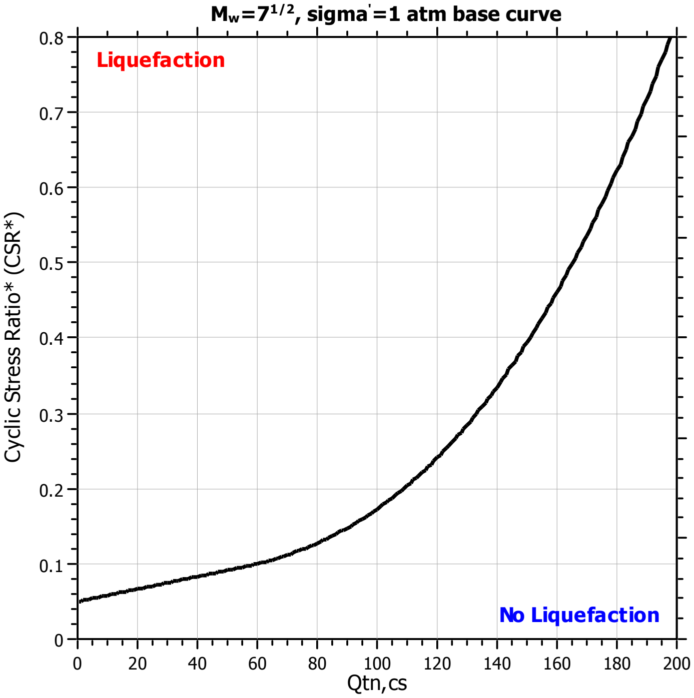
Project title : Riverwalk **Location : San Diego, CA**

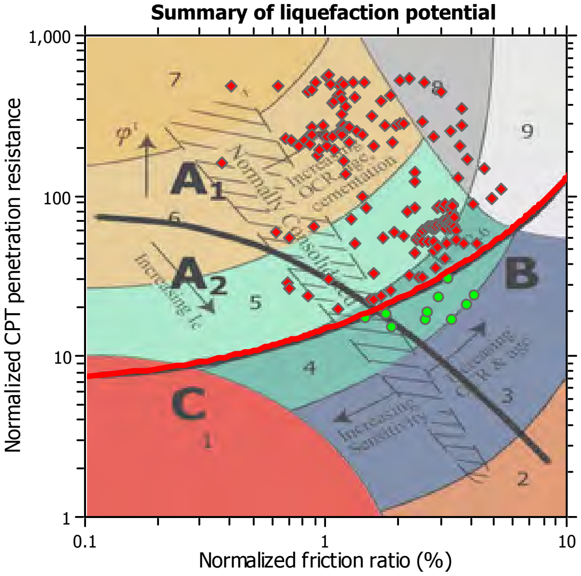
CPT file : CPT-10

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	25.00 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	41.00 ft	Fill height:	19.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

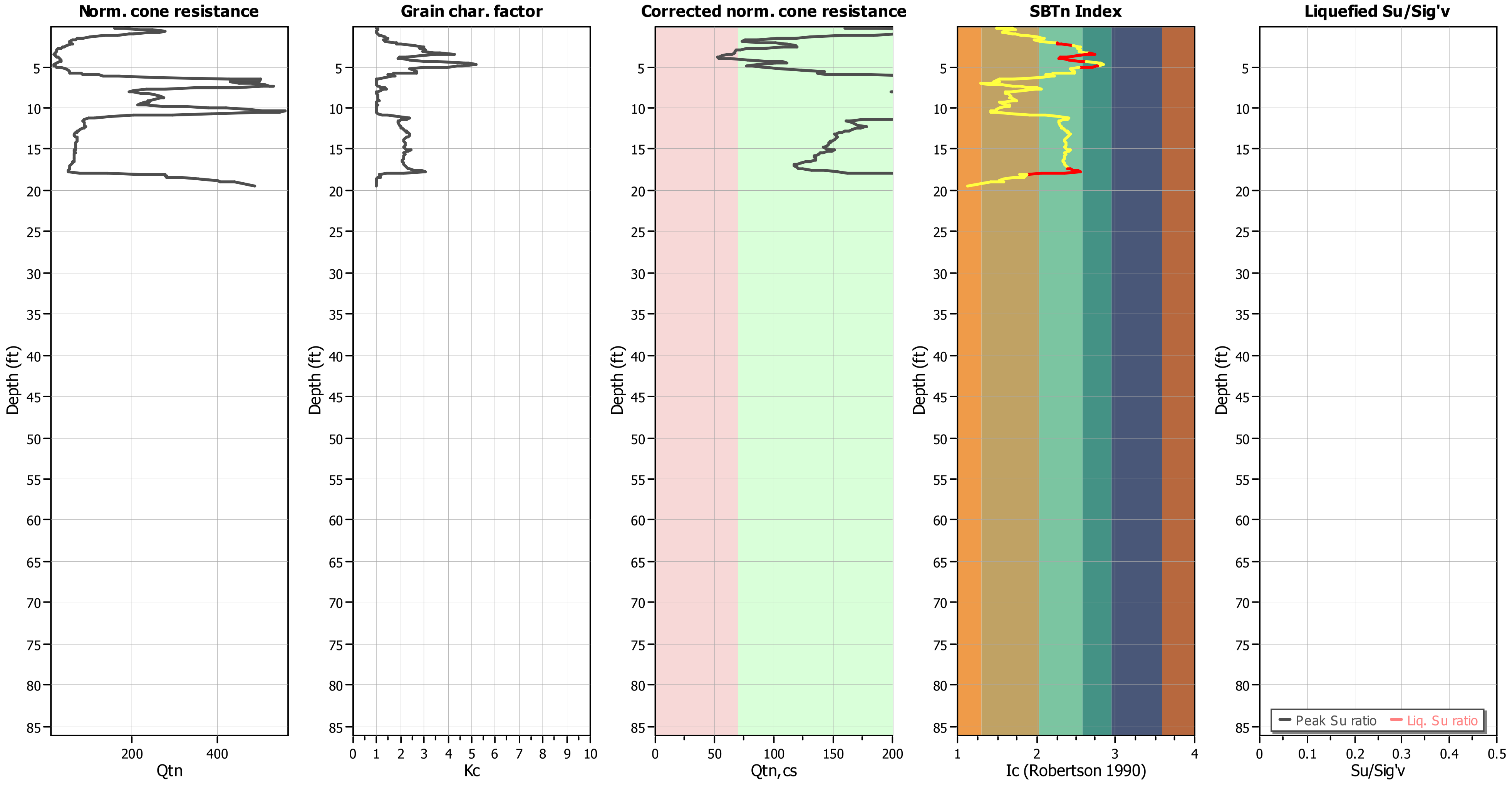






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

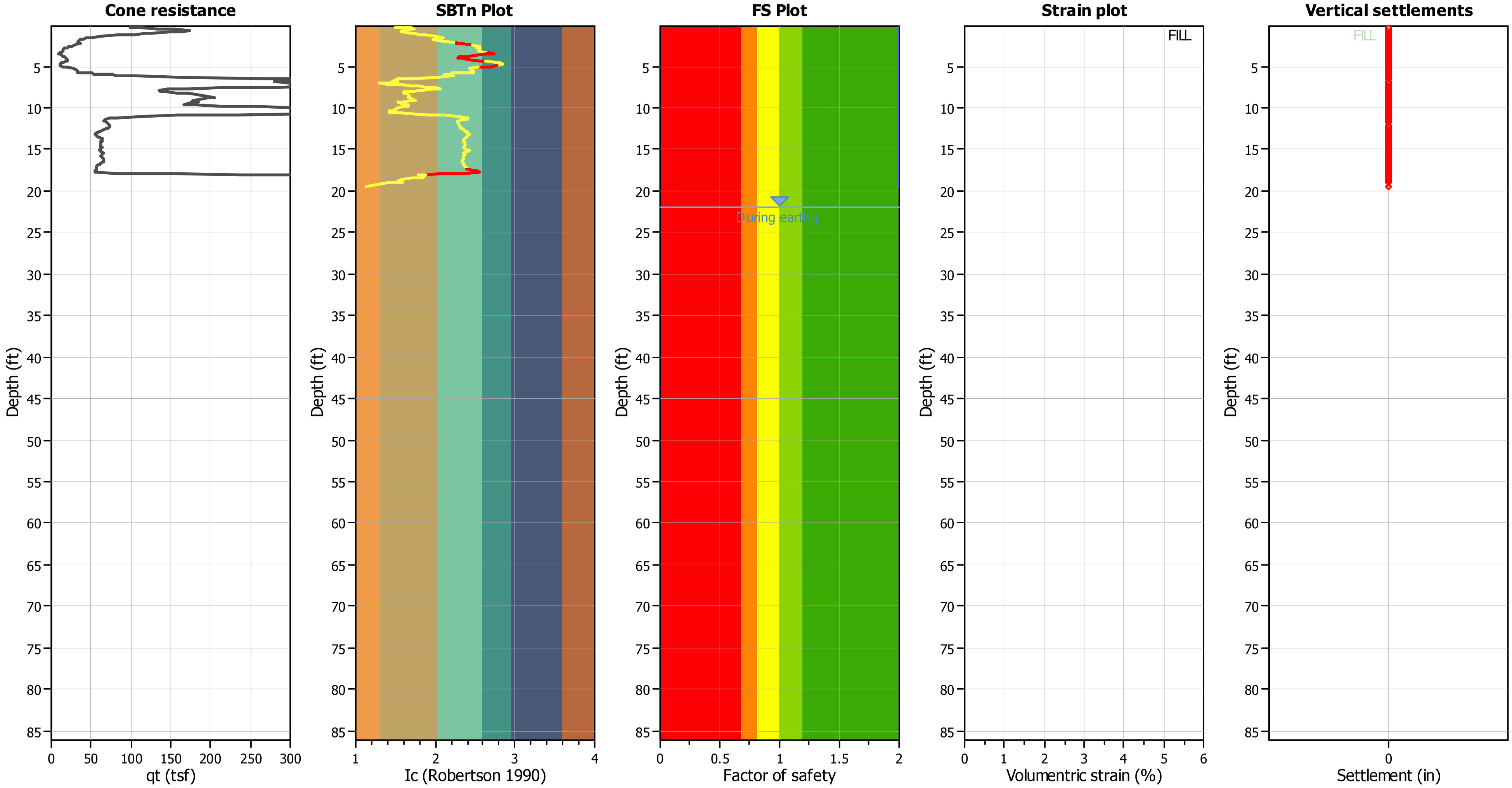
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	41.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	25.00 ft	Fill height:	19.00 ft	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
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Volumentric strain:	Post-liquefaction volumentric strain

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LIQUEFACTION ANALYSIS REPORT

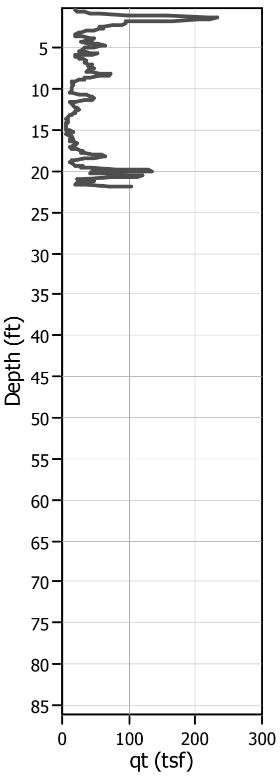
Project title : Riverwalk **Location : San Diego, CA**

CPT file : CPT-11

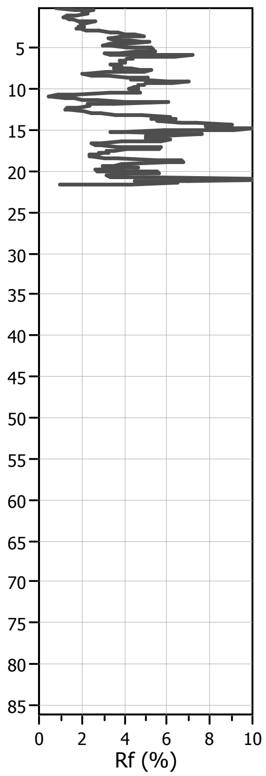
Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	29.00 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	39.00 ft	Fill height:	13.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

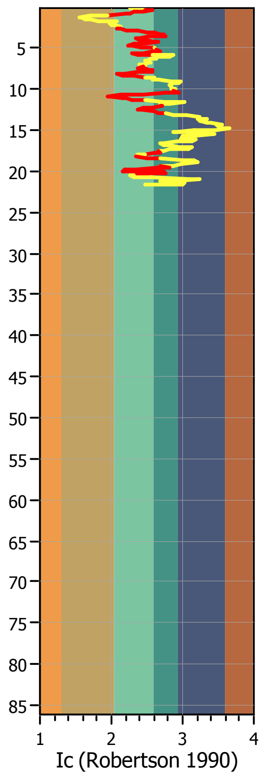
Cone resistance



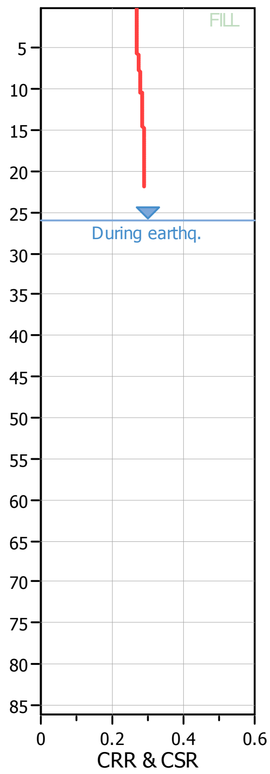
Friction Ratio



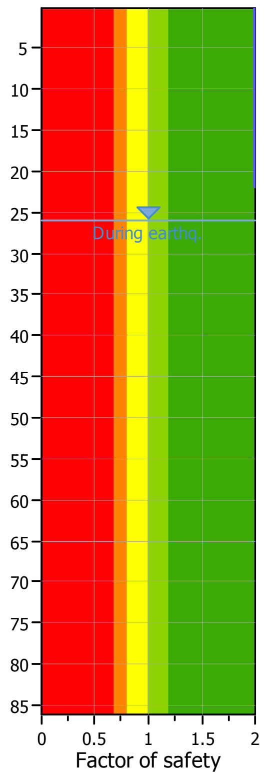
SBTn Plot



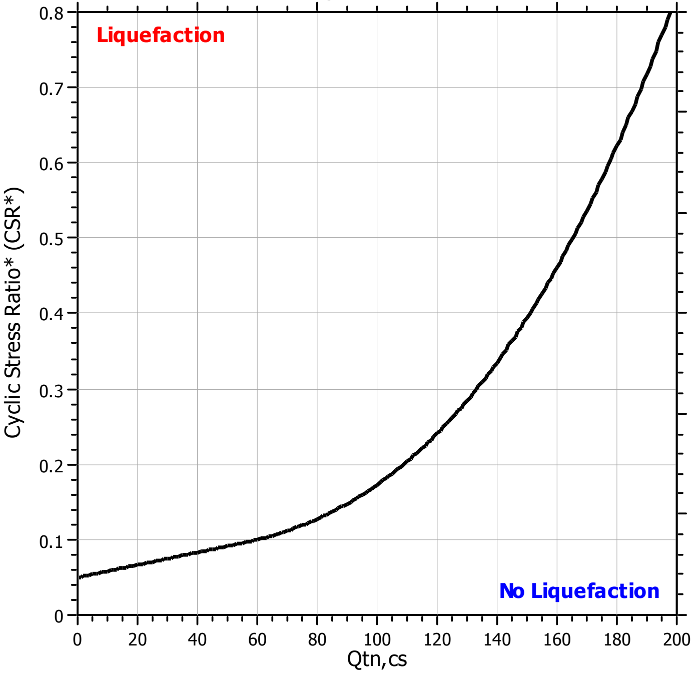
CRR plot



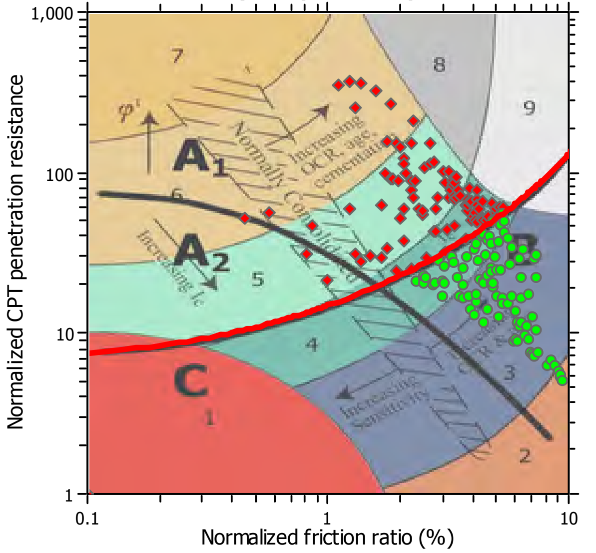
FS Plot



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

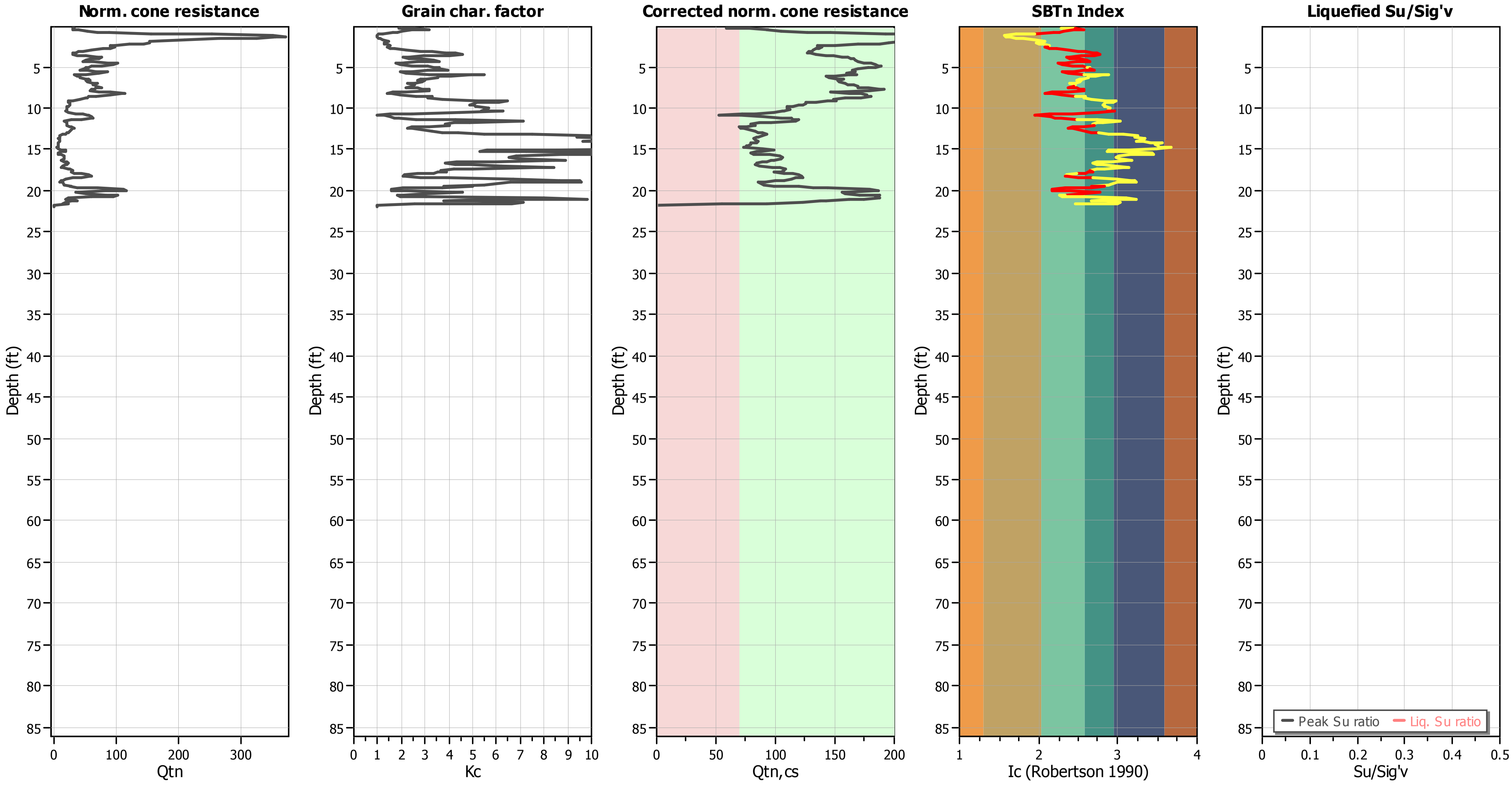


Summary of liquefaction potential



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

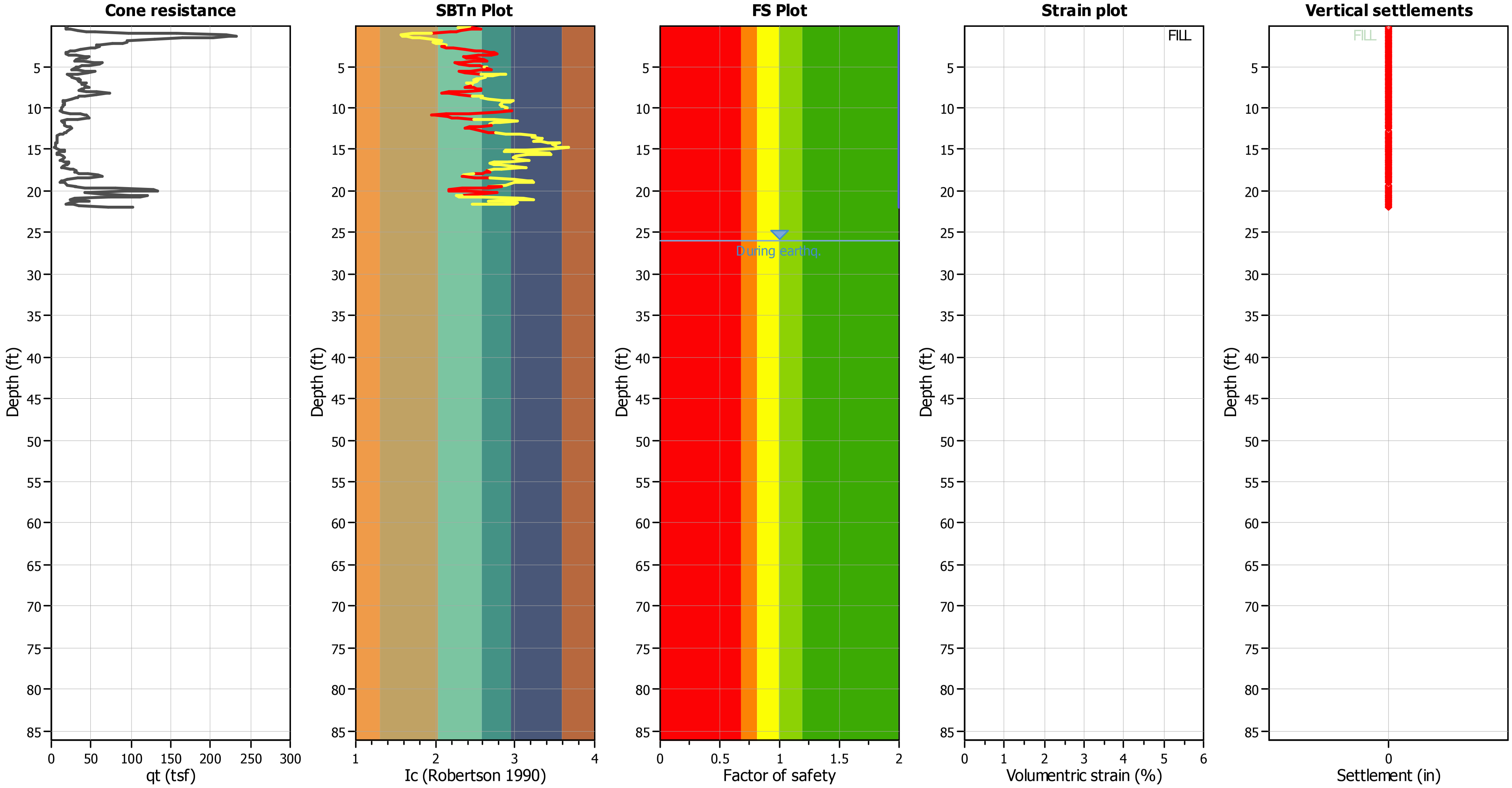
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	39.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	29.00 ft	Fill height:	13.00 ft	Limit depth:	N/A

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

LIQUEFACTION ANALYSIS REPORT

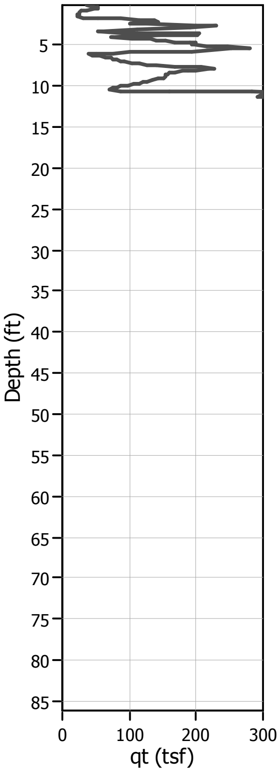
Project title : Riverwalk **Location : San Diego, CA**

CPT file : CPT-12

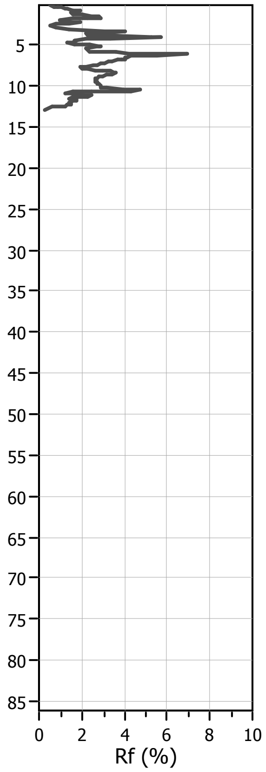
Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	18.00 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	38.00 ft	Fill height:	23.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

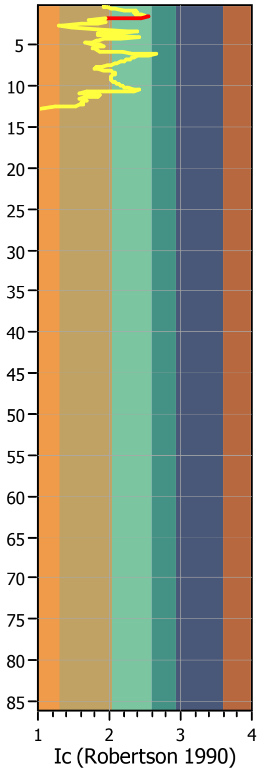
Cone resistance



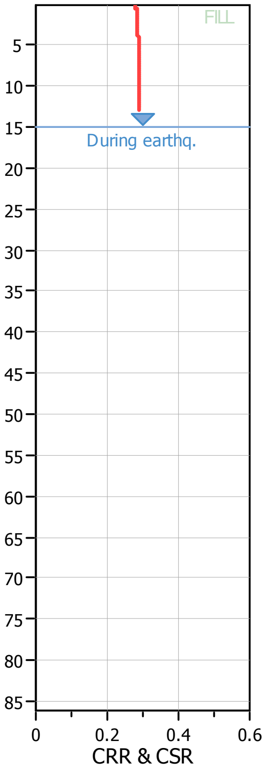
Friction Ratio



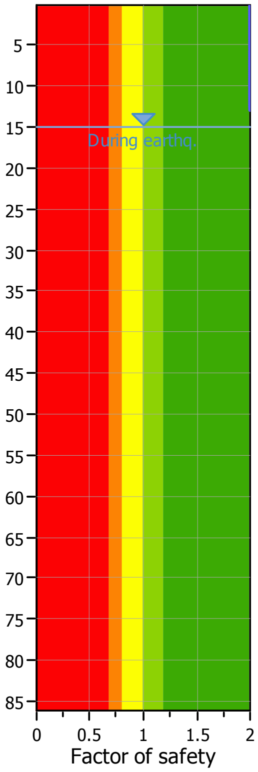
SBTn Plot



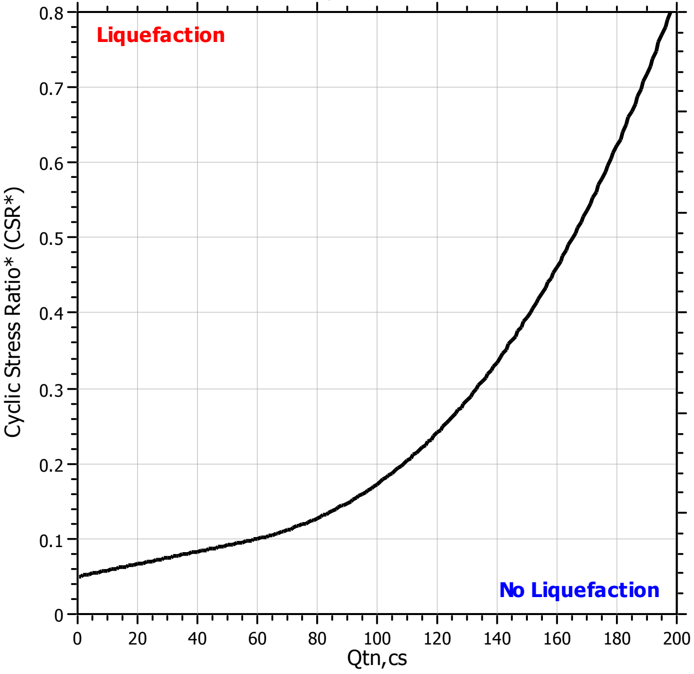
CRR plot



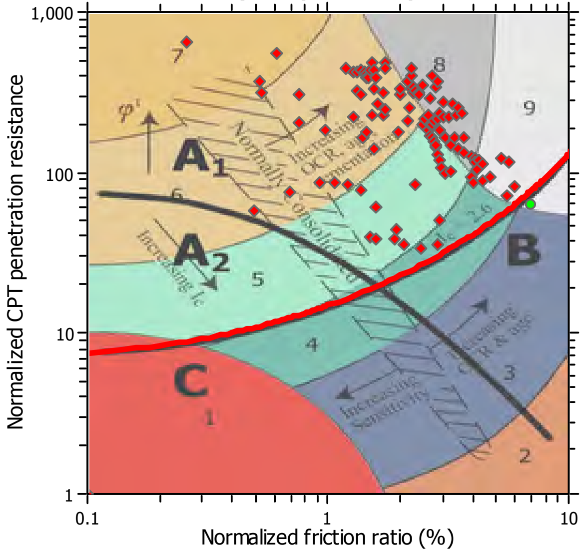
FS Plot



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

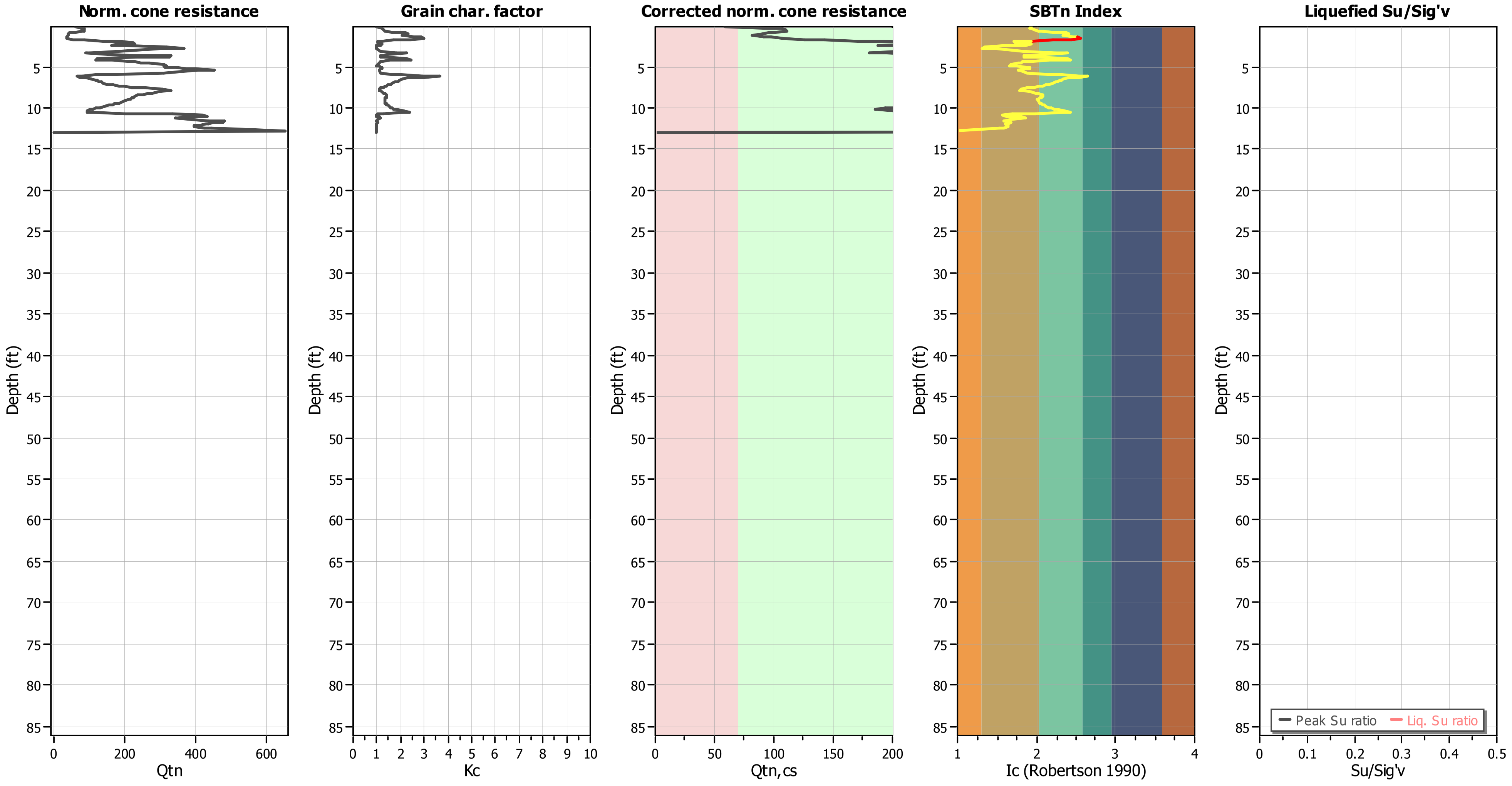


Summary of liquefaction potential



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

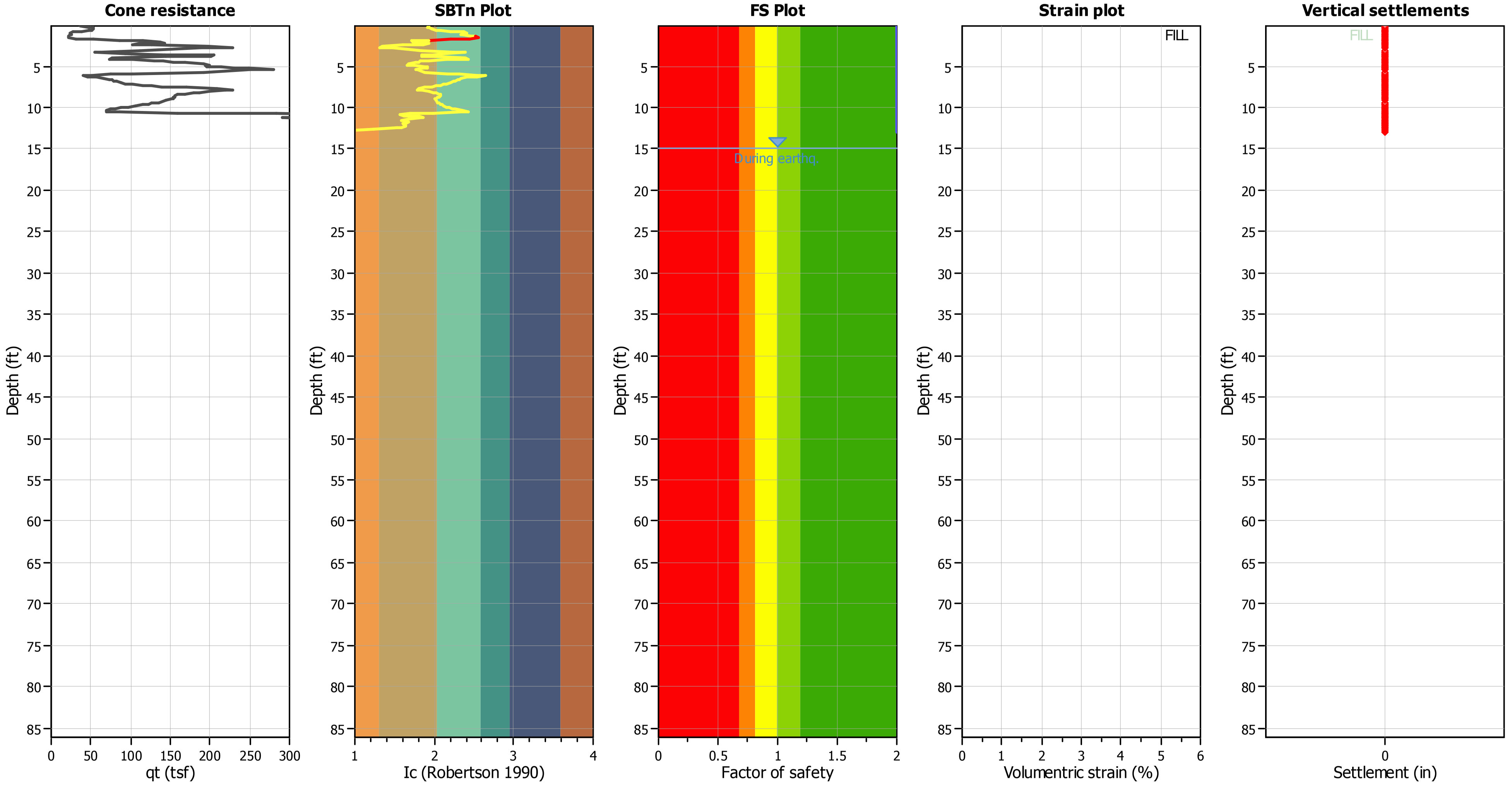
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	38.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	18.00 ft	Fill height:	23.00 ft	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

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Volumentric strain: Post-liquefaction volumentric strain

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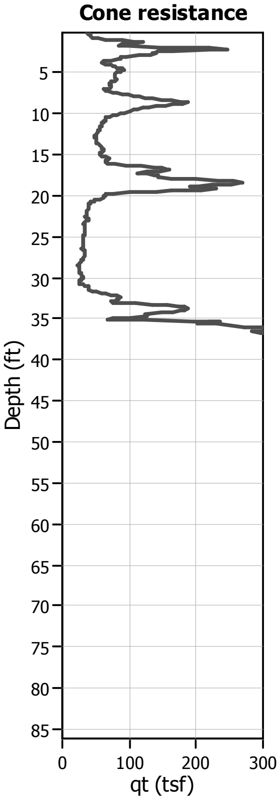
LIQUEFACTION ANALYSIS REPORT

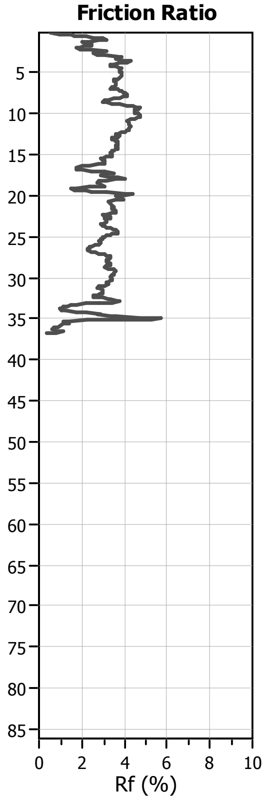
Project title : Riverwalk **Location : San Diego, CA**

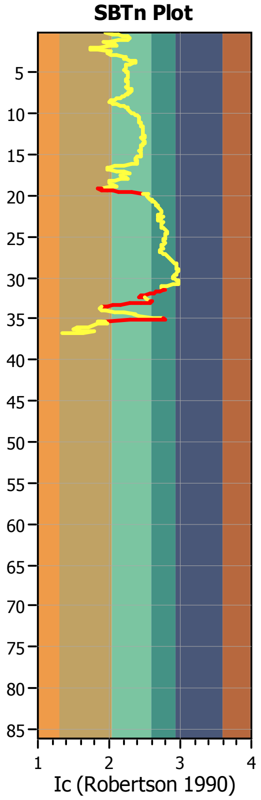
CPT file : CPT-13

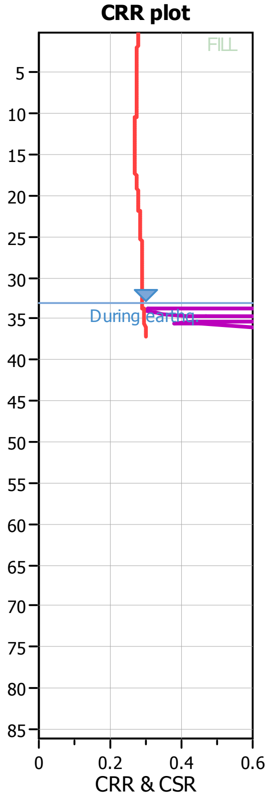
Input parameters and analysis data

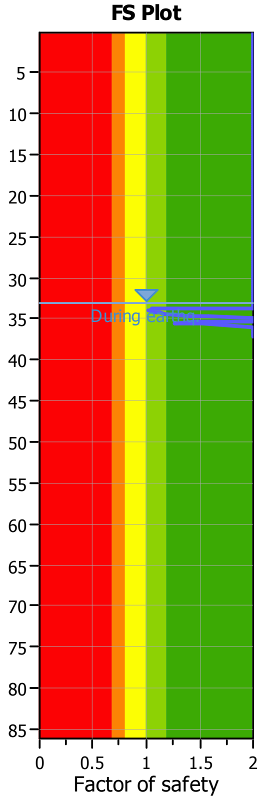
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	36.00 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	35.00 ft	Fill height:	2.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	19.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

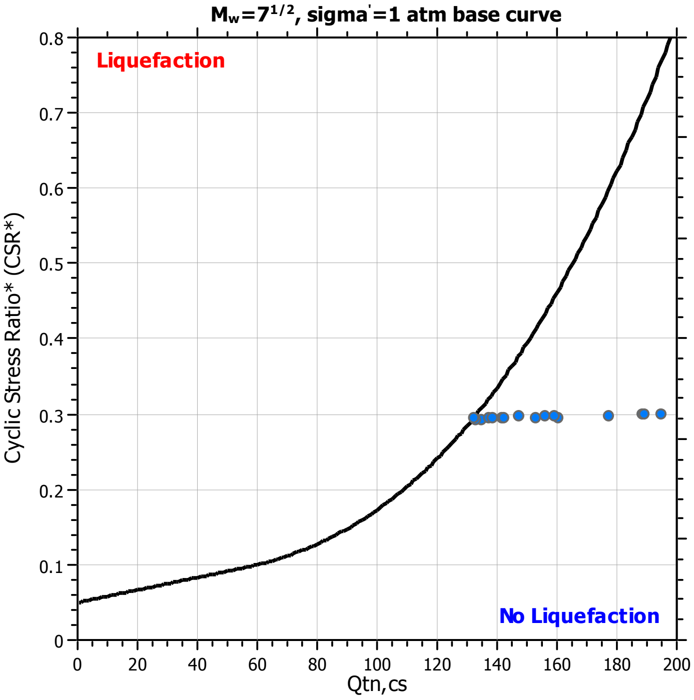


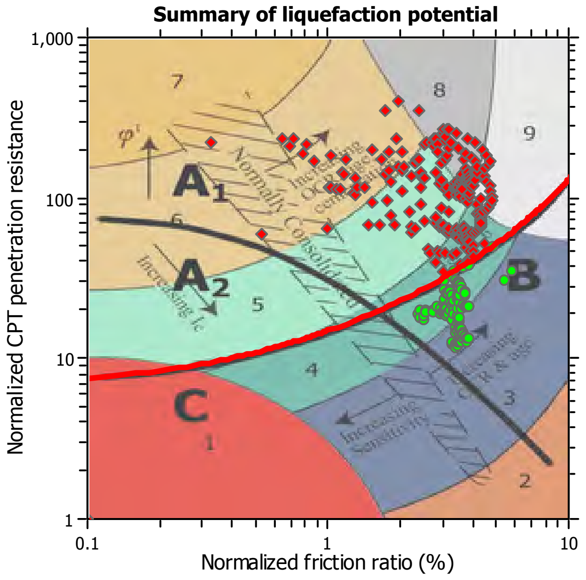






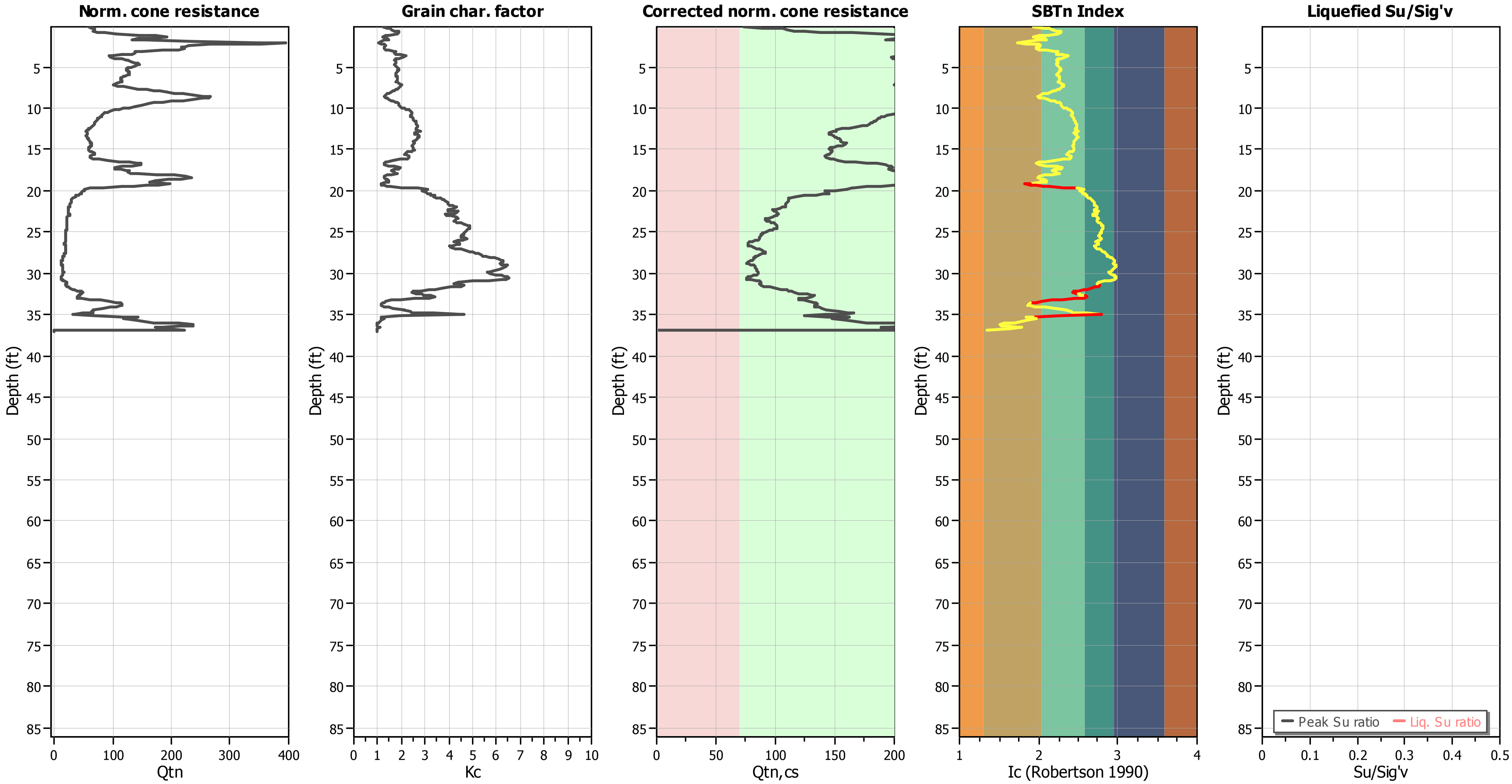






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

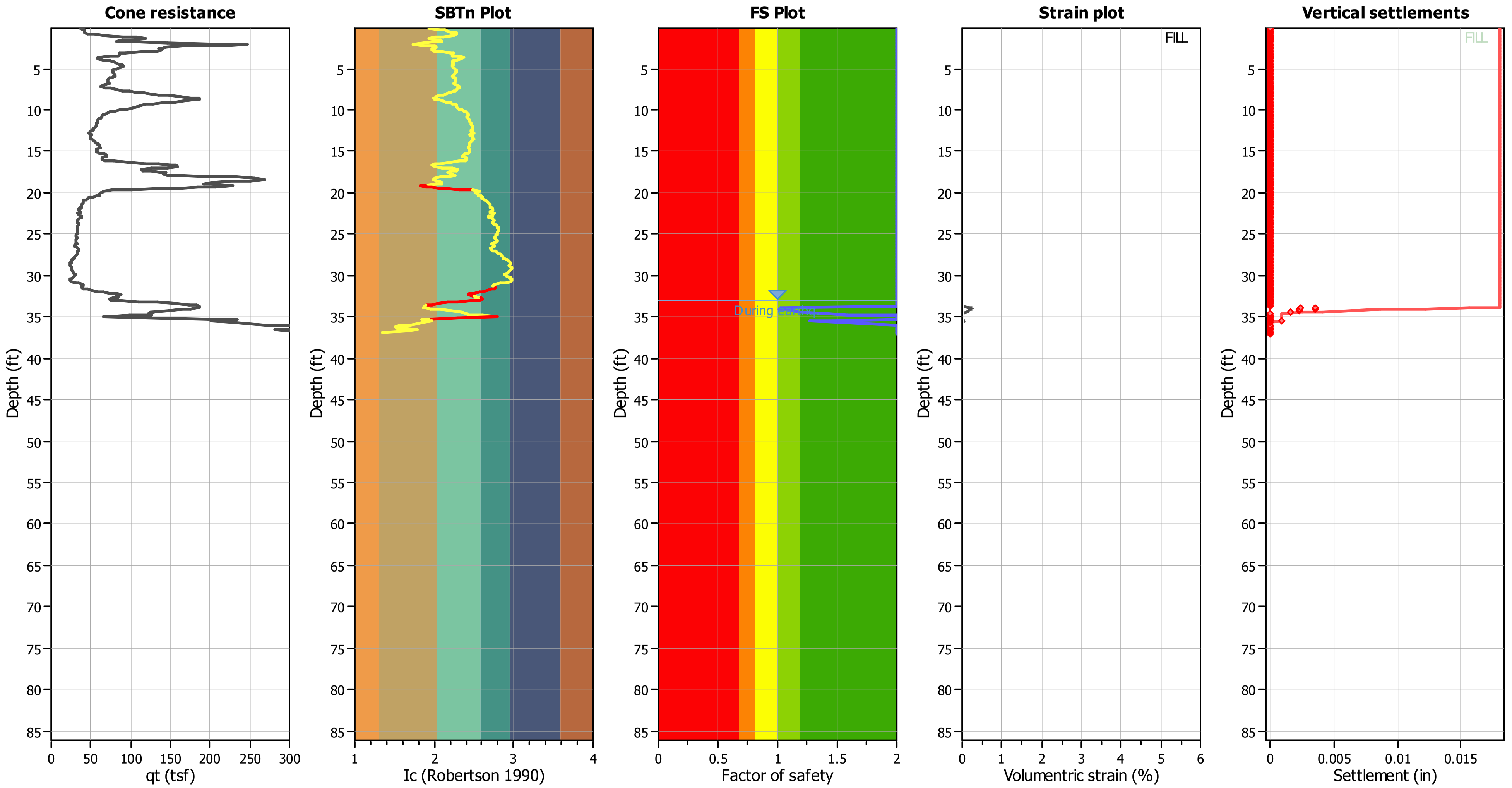
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	35.00 ft	Fill weight:	19.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	36.00 ft	Fill height:	2.00 ft	Limit depth:	N/A

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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Irvine, CA 92614

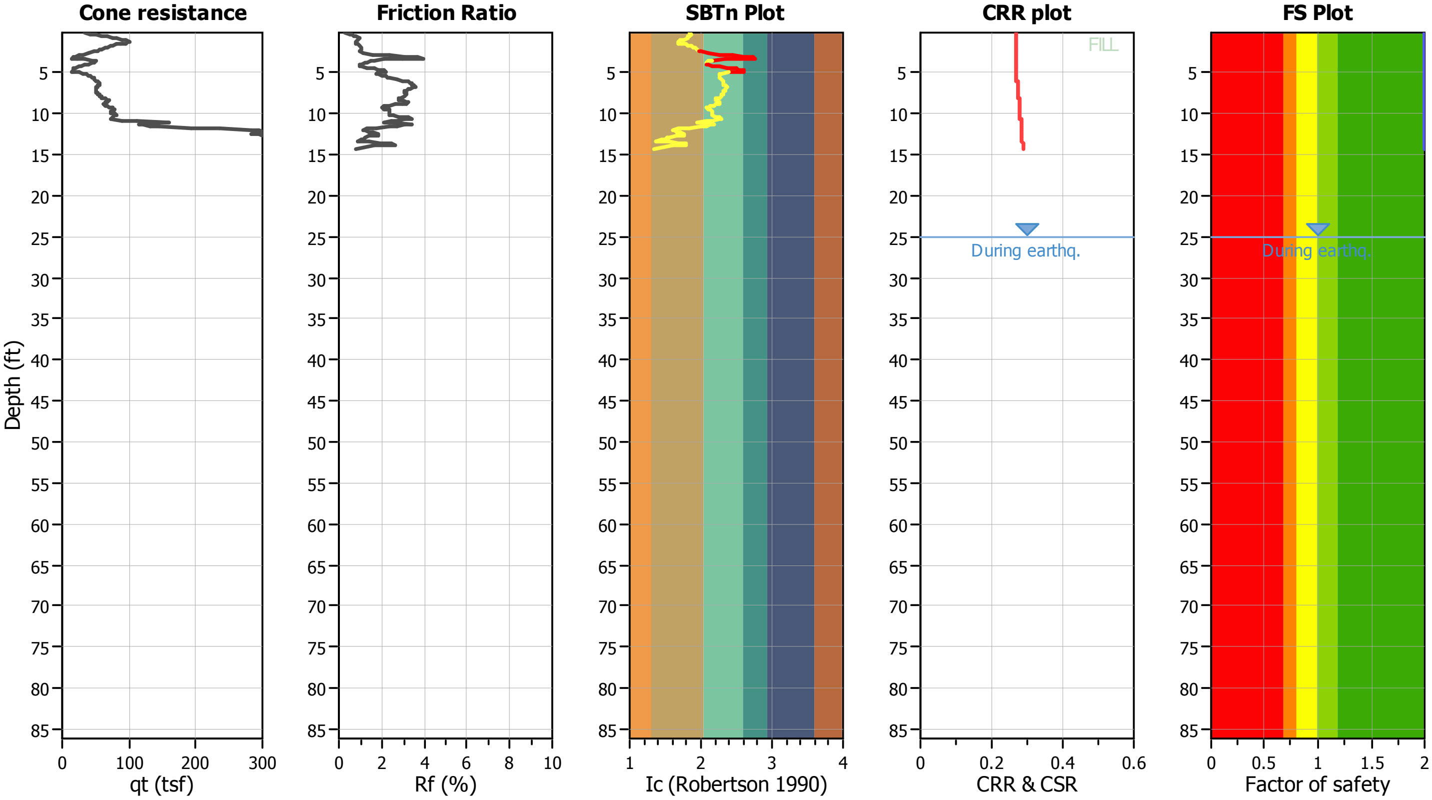
LIQUEFACTION ANALYSIS REPORT

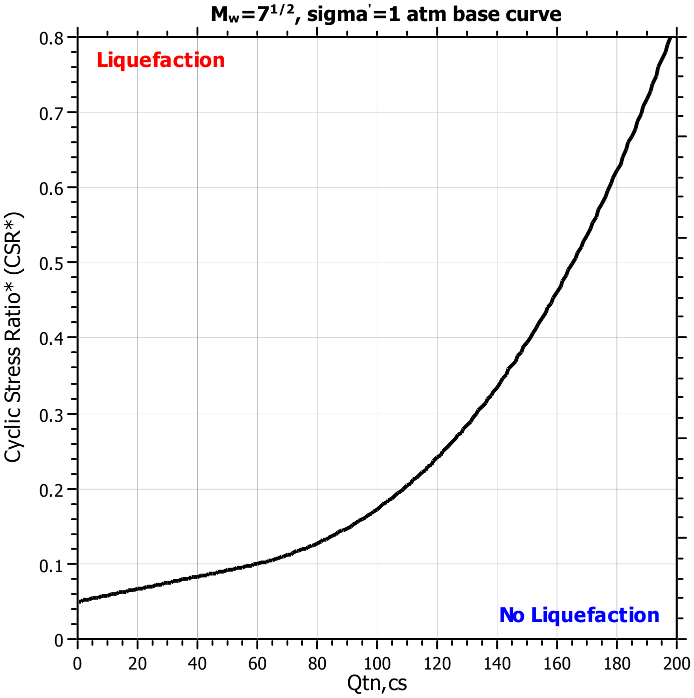
Project title : Riverwalk **Location : San Diego, CA**

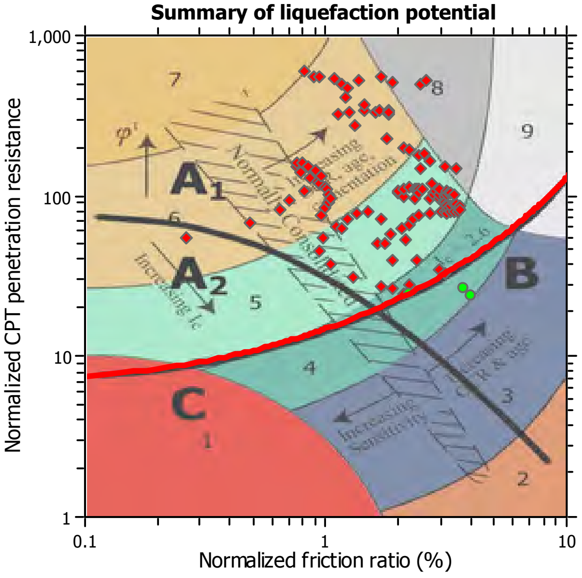
CPT file : CPT-14

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	28.00 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	38.00 ft	Fill height:	13.00 ft		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth applied:	No
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

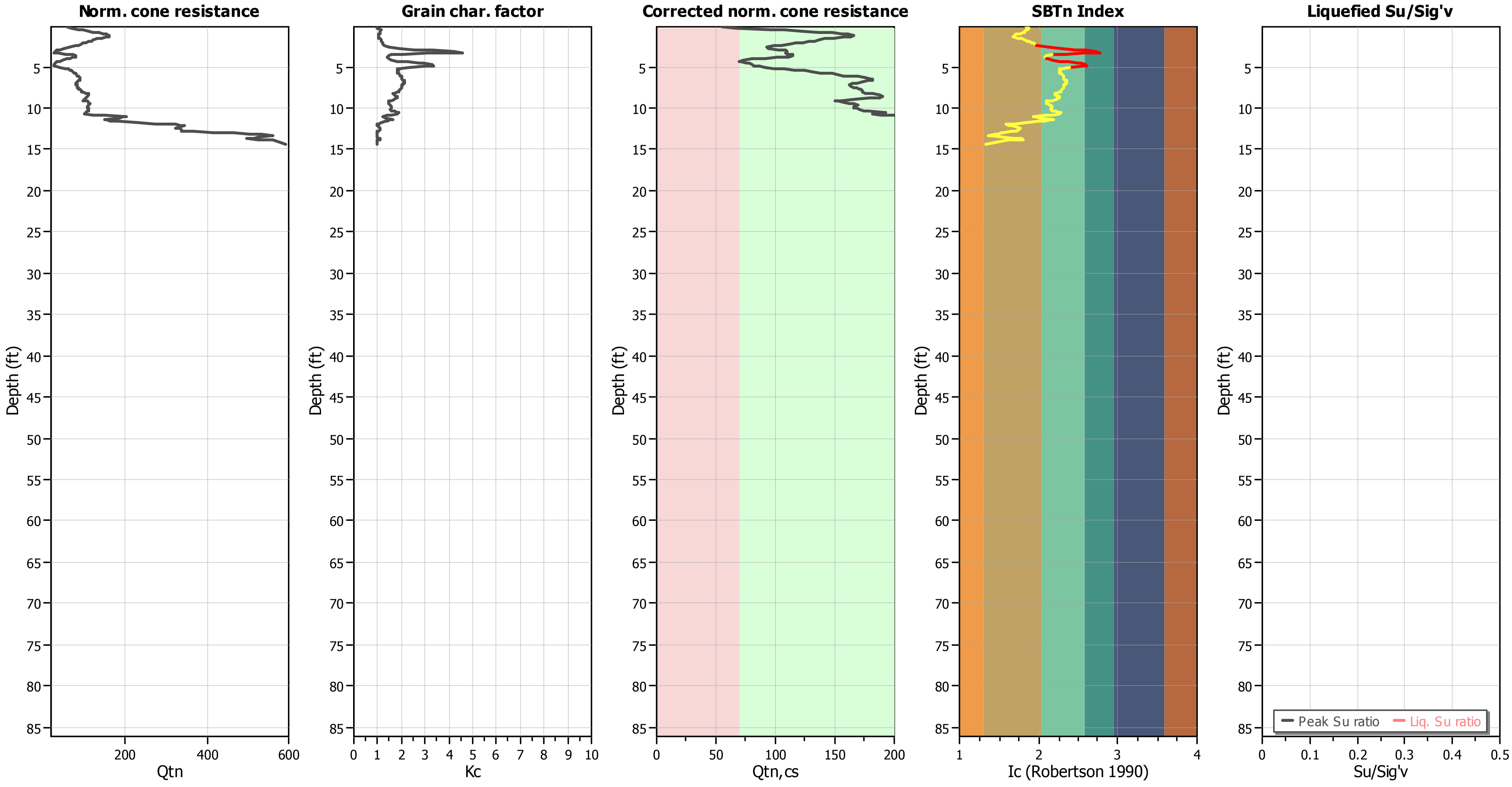






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

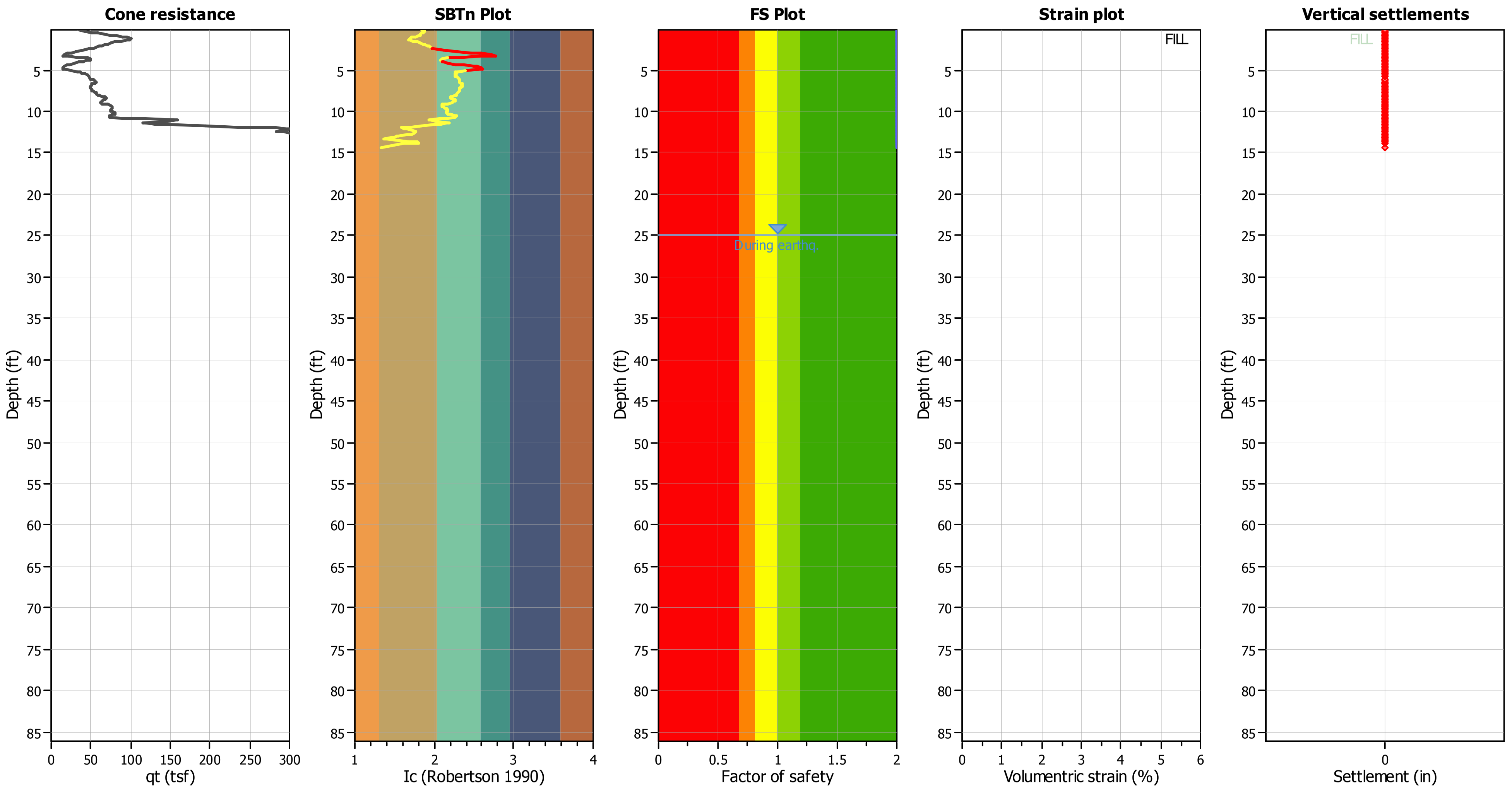
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	38.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	28.00 ft	Fill height:	13.00 ft	Limit depth:	N/A

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

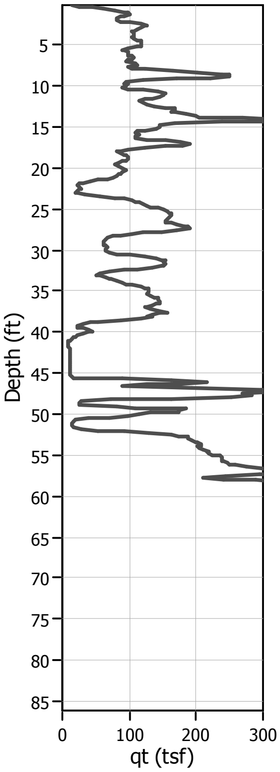
LIQUEFACTION ANALYSIS REPORT

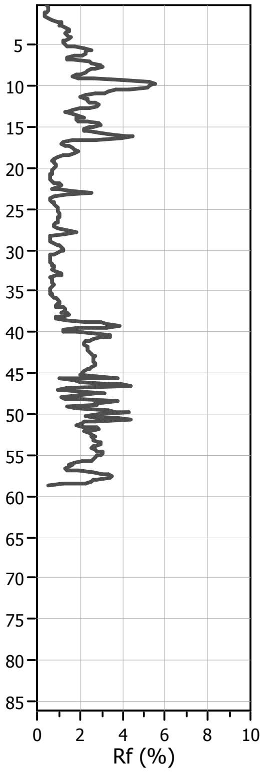
Project title : Riverwalk **Location : San Diego, CA**

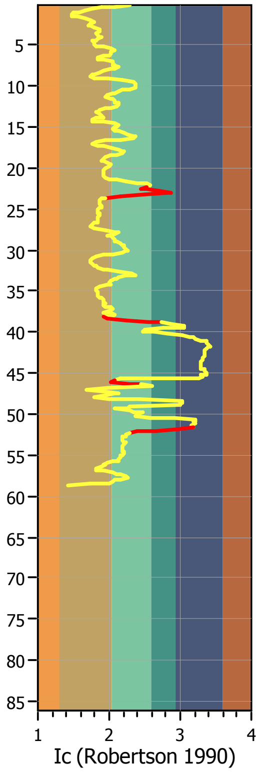
CPT file : CPT-15

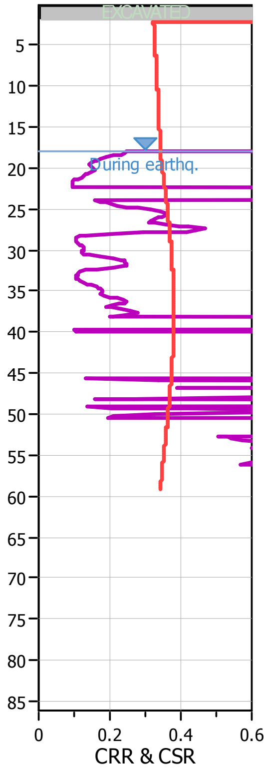
Input parameters and analysis data

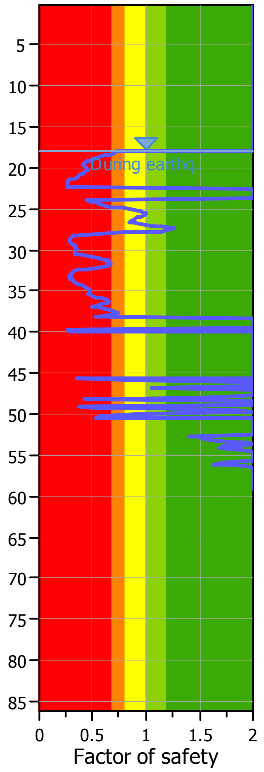
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	21.00 ft	Excavation:	Yes		
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	18.00 ft	Excavation depth:	2.00 ft	Clay like behavior applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Footing load:	2.00 tsf	Limit depth applied:	No
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

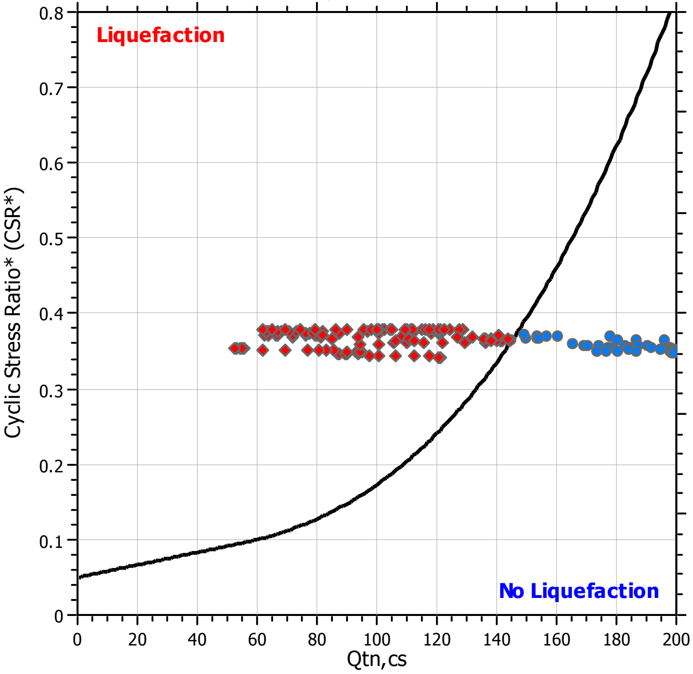

Cone resistance

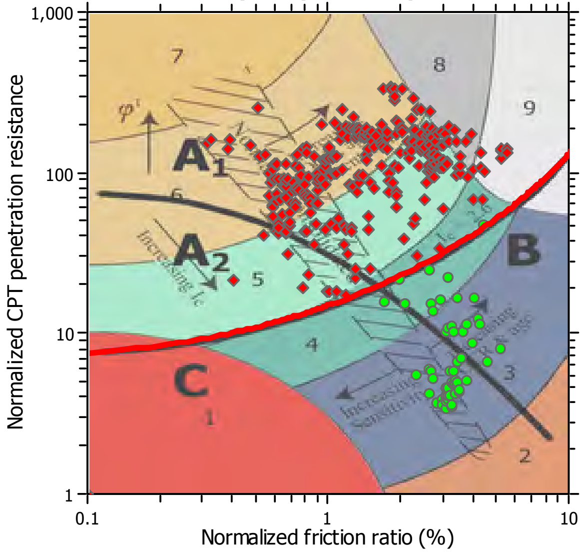

Friction Ratio


SBTn Plot


CRR plot

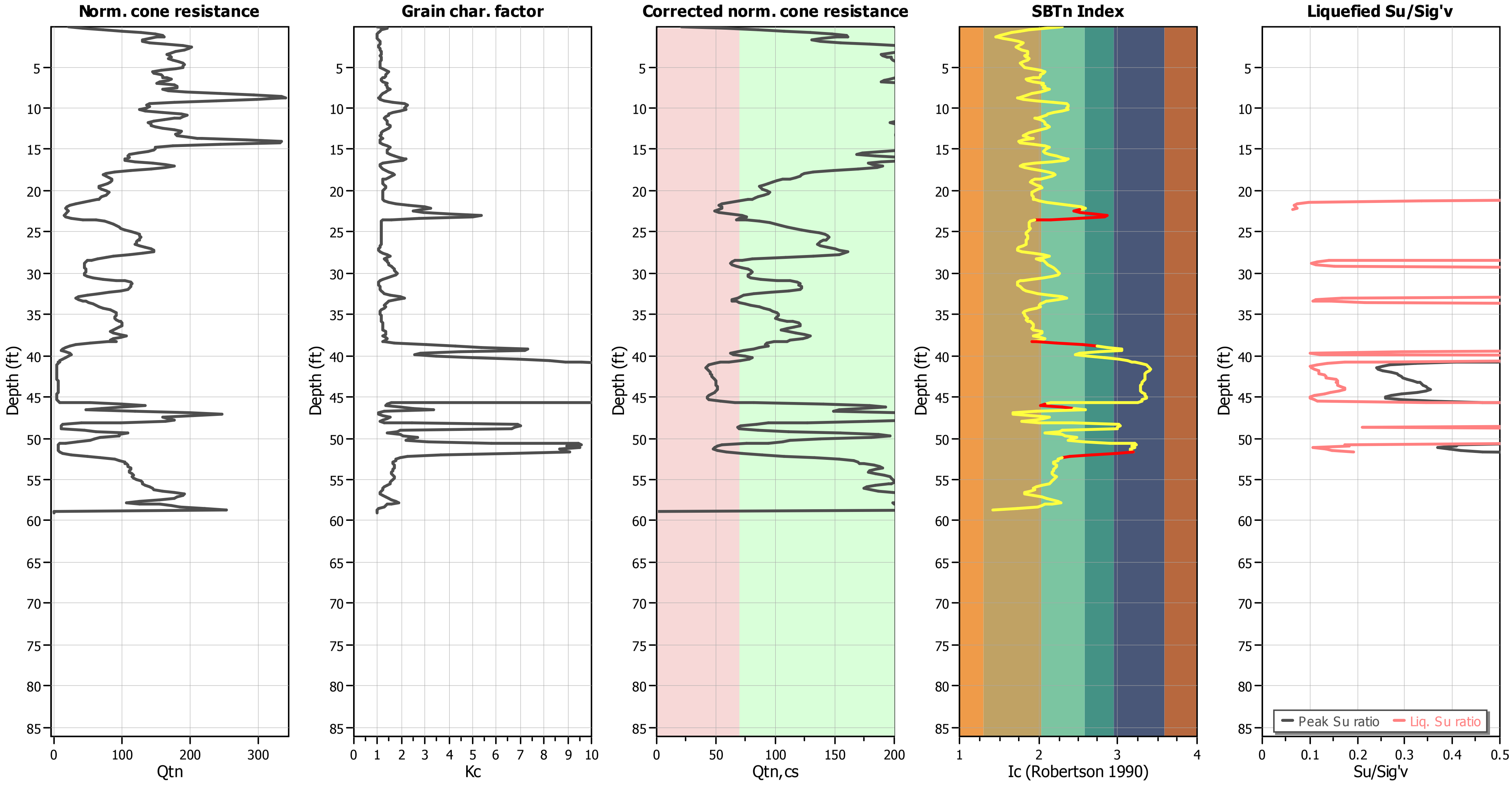

FS Plot


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


Summary of liquefaction potential

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

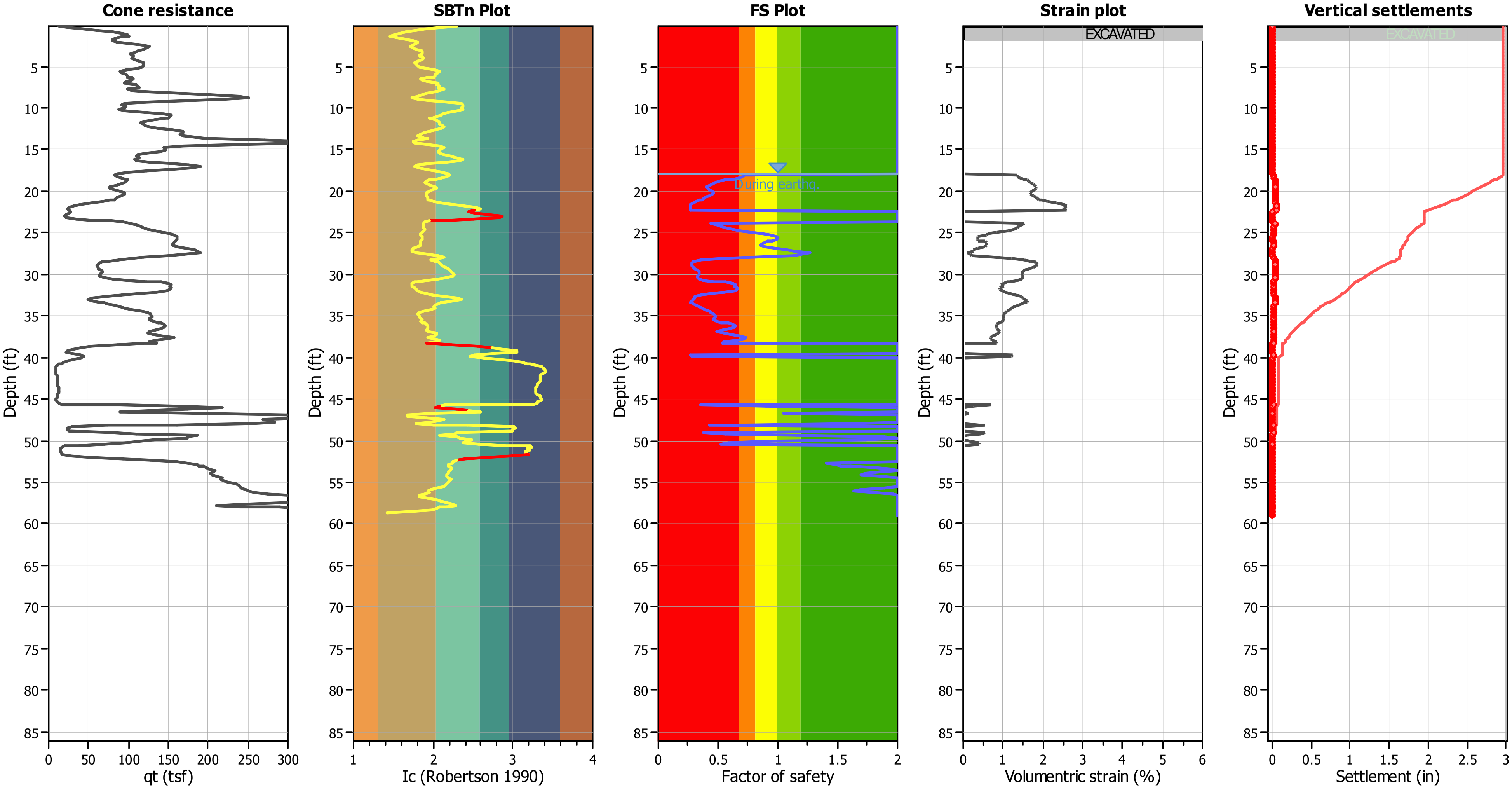
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	18.00 ft	Footing load:	2.00 tsf
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Excavation:	Yes	Limit depth applied:	No
Depth to water table (insitu):	21.00 ft	Excavation depth:	2.00 ft	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
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Volumentric strain:	Post-liquefaction volumentric strain

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LIQUEFACTION ANALYSIS REPORT

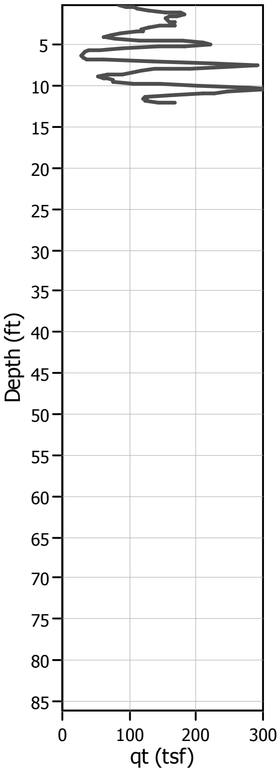
Project title : Riverwalk **Location : San Diego, CA**

CPT file : CPT-16

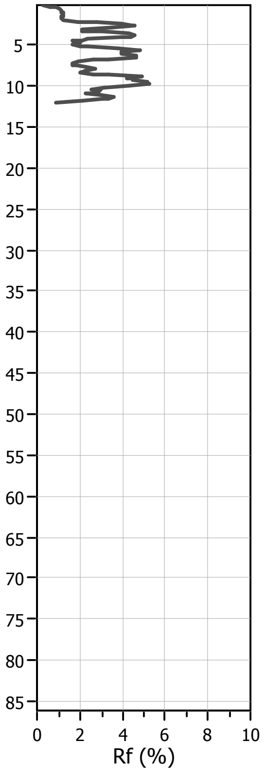
Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	17.00 ft	Use fill:	Yes		
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	15.00 ft	Fill height:	1.00 ft	Clay like behavior applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth applied:	No
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

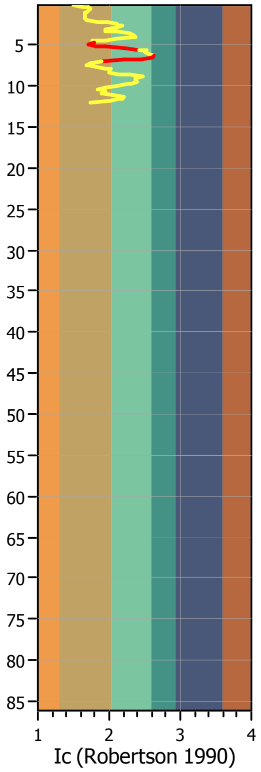
Cone resistance



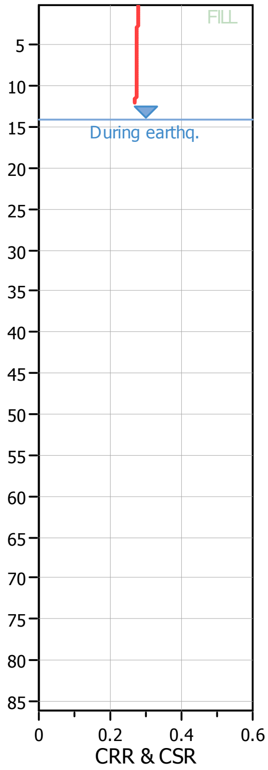
Friction Ratio



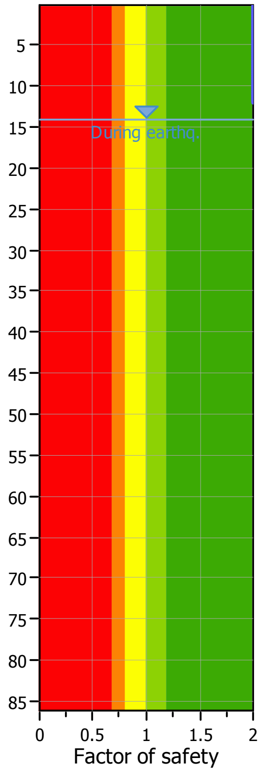
SBTn Plot



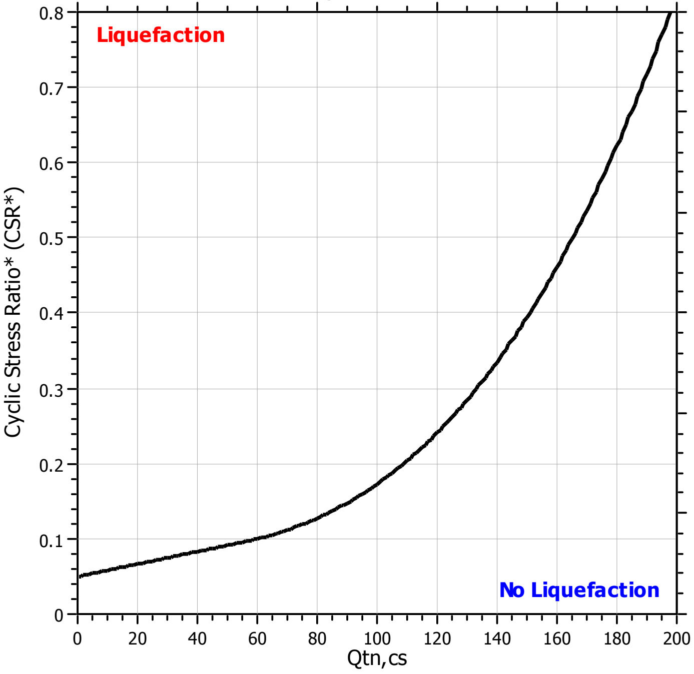
CRR plot



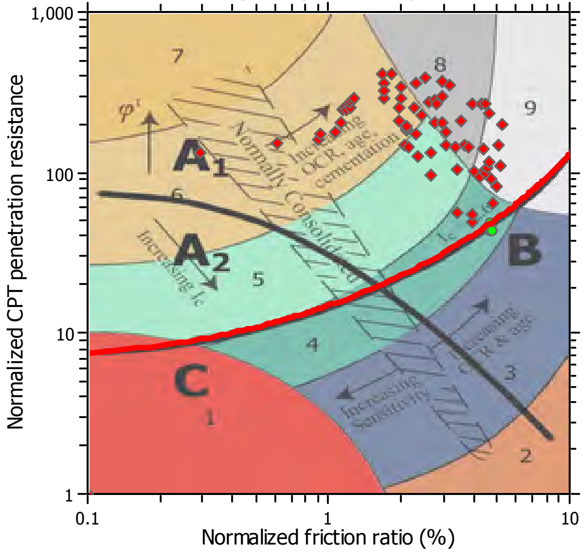
FS Plot



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

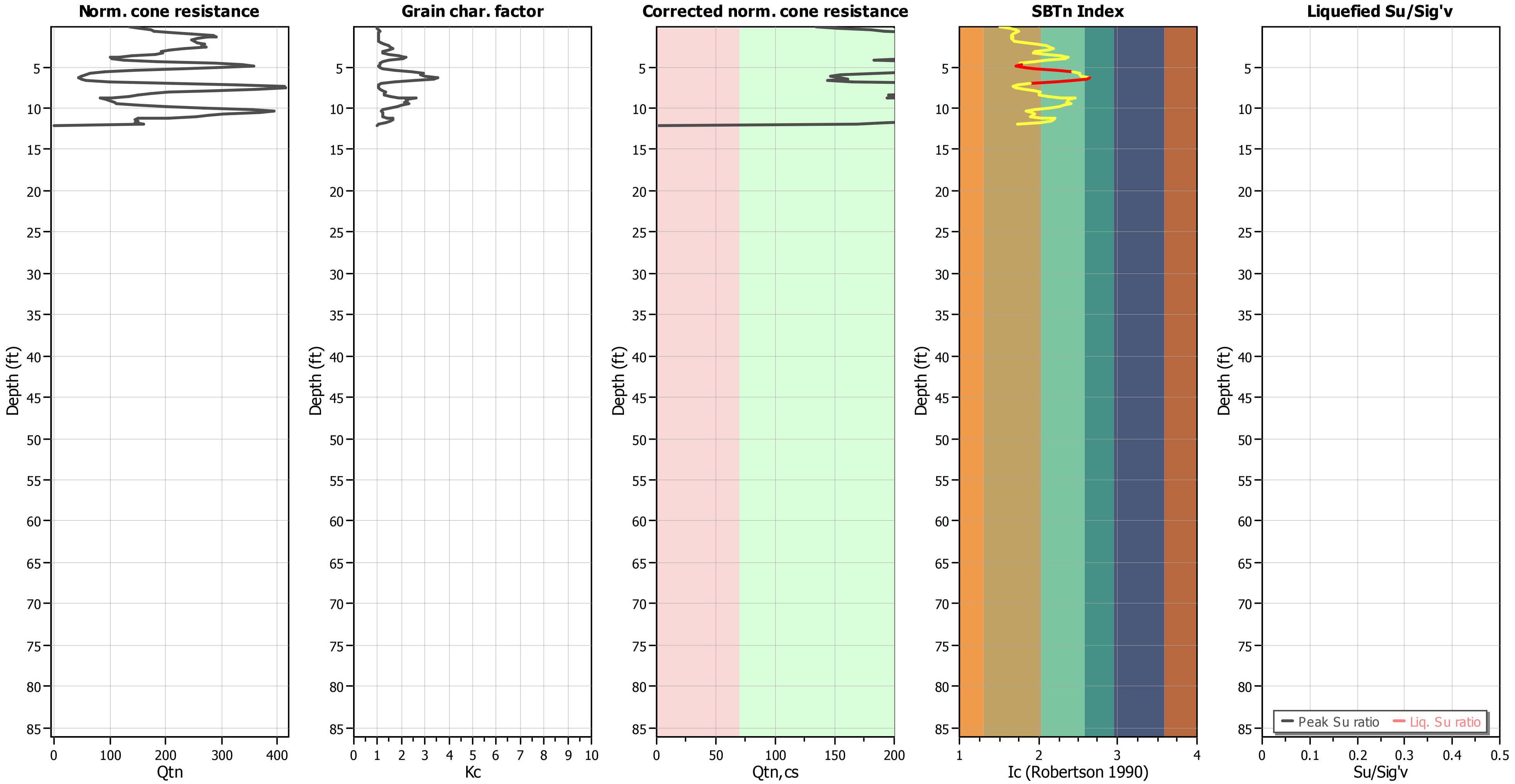


Summary of liquefaction potential



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

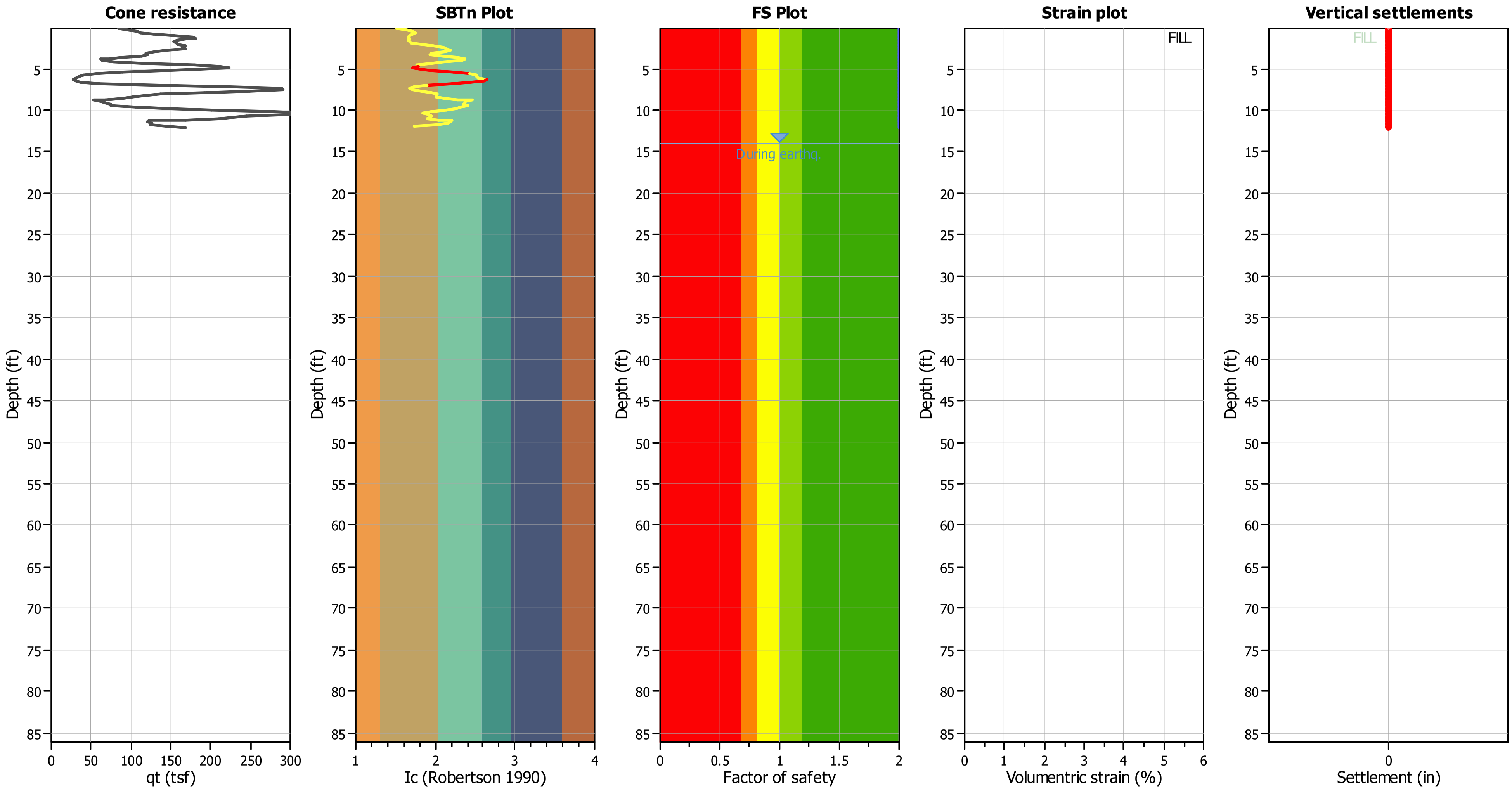
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	15.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	17.00 ft	Fill height:	1.00 ft	Limit depth:	N/A

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

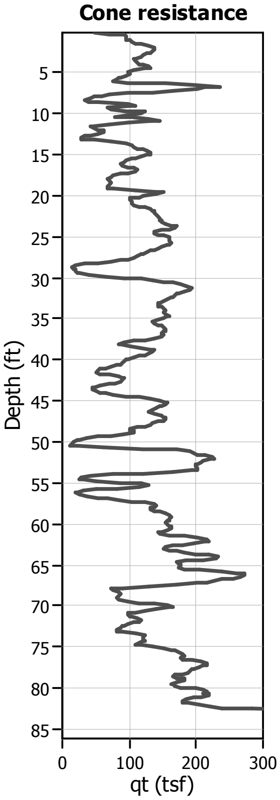
LIQUEFACTION ANALYSIS REPORT

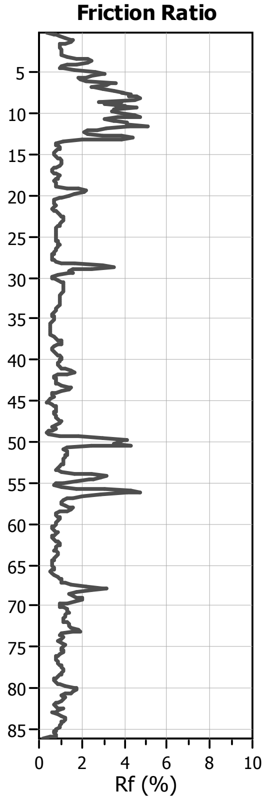
Project title : Riverwalk **Location : San Diego, CA**

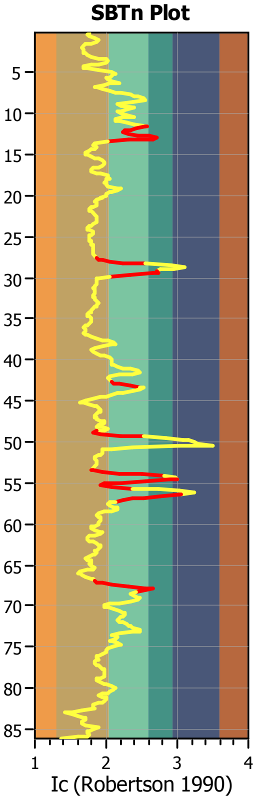
CPT file : CPT-17

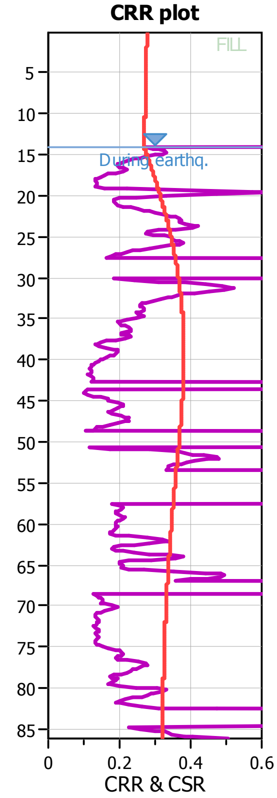
Input parameters and analysis data

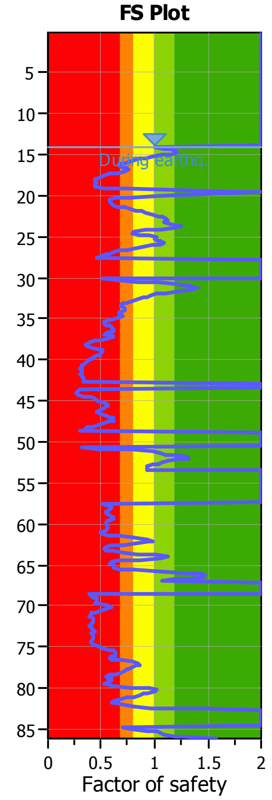
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	17.00 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	16.00 ft	Fill height:	2.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

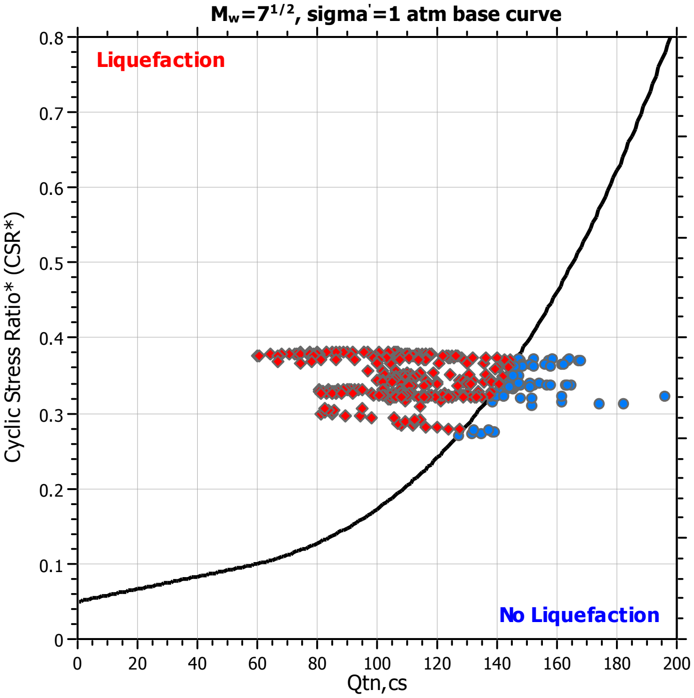

Cone resistance

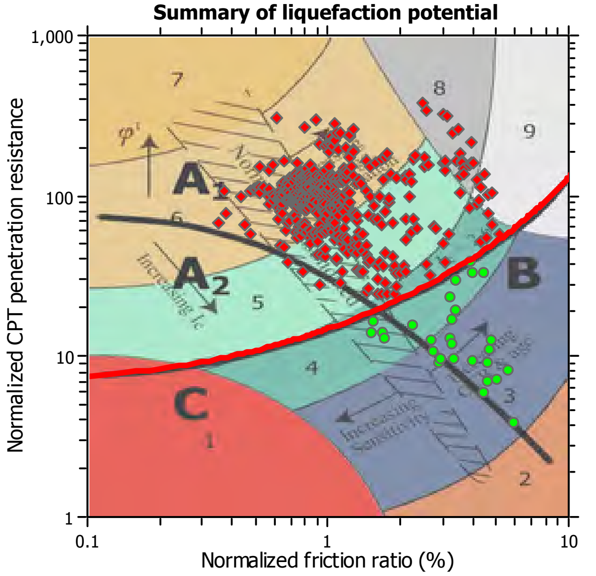

Friction Ratio


SBTn Plot


CRR plot

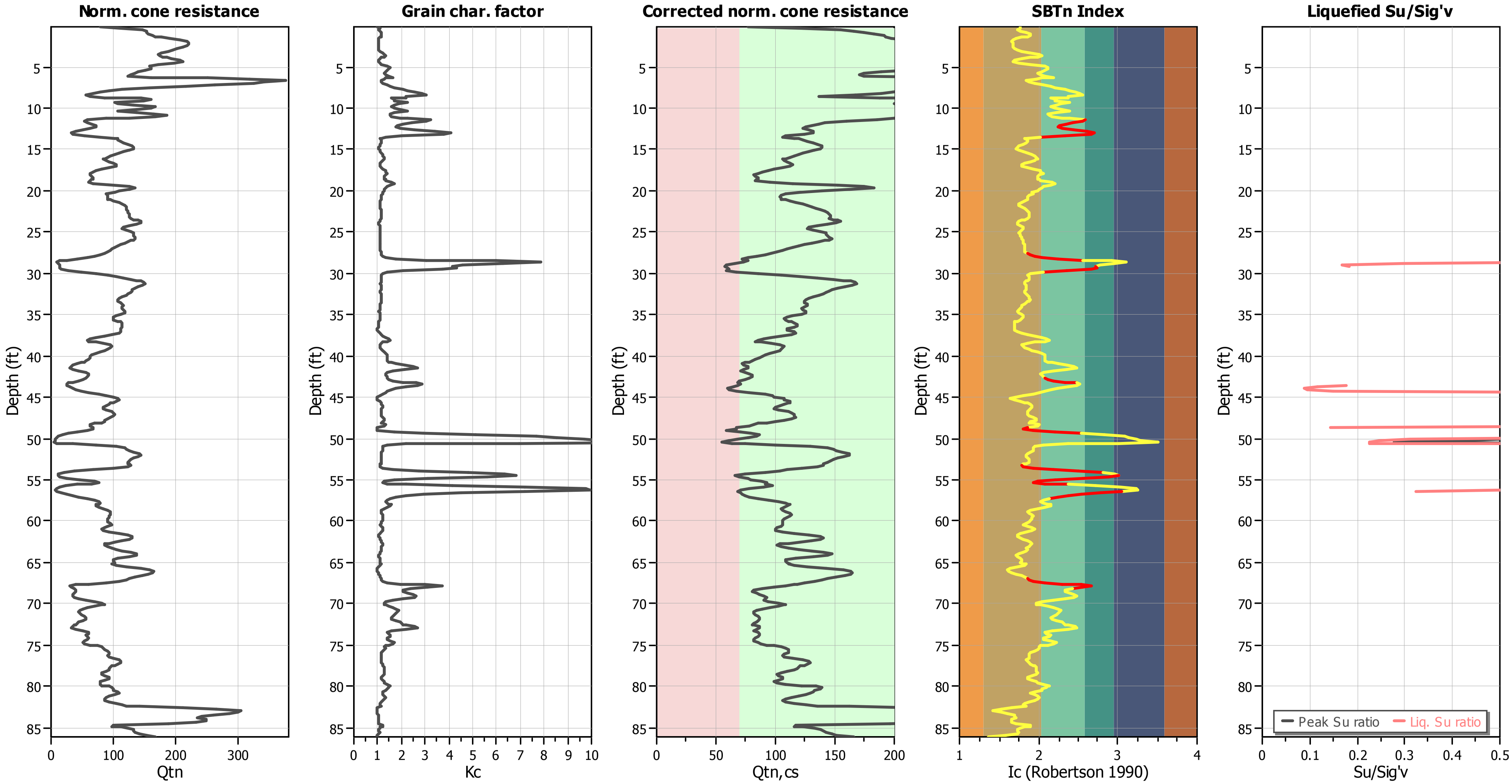

FS Plot


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


Summary of liquefaction potential

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

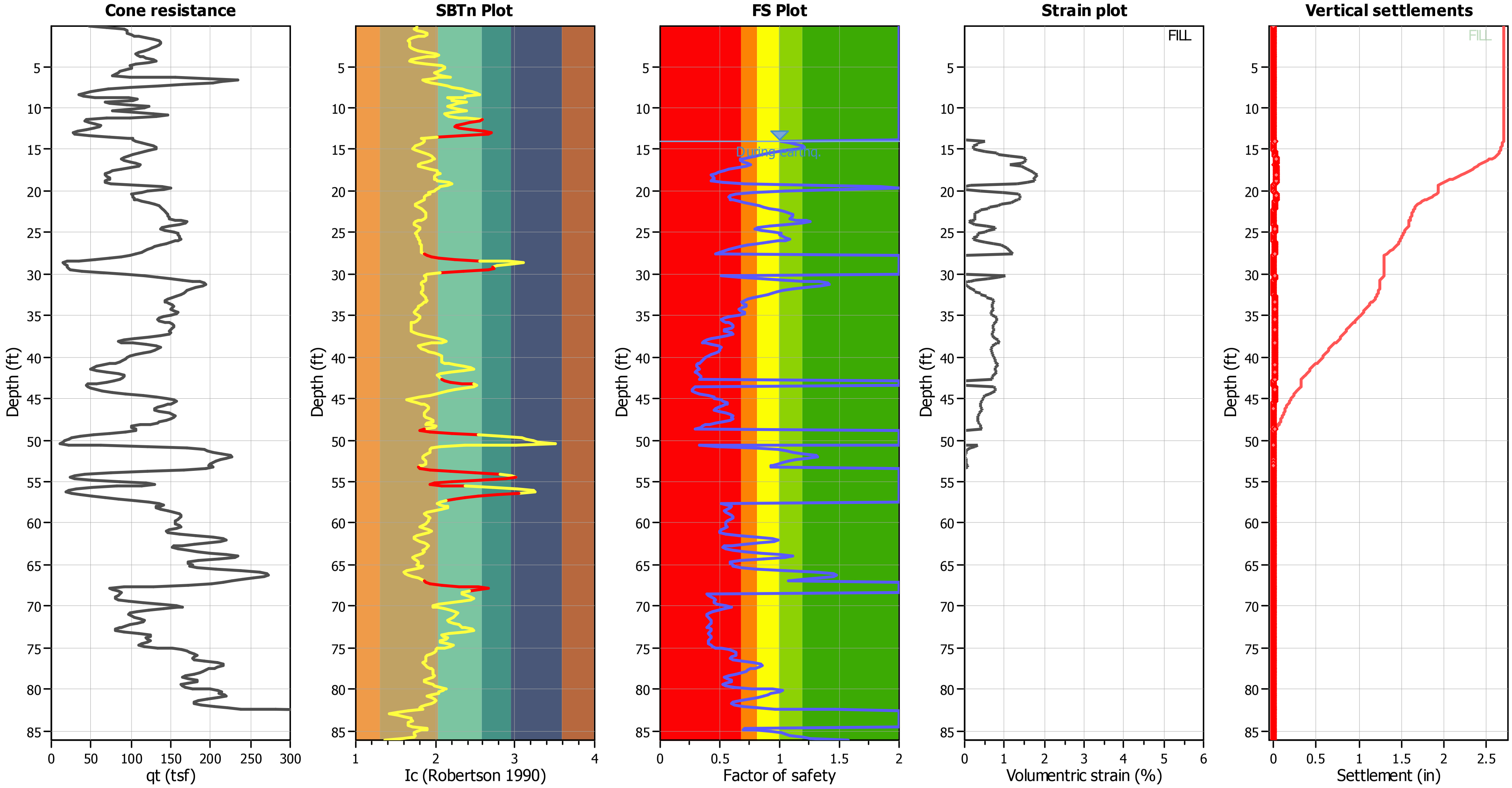
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	16.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	17.00 ft	Fill height:	2.00 ft	Limit depth:	N/A

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

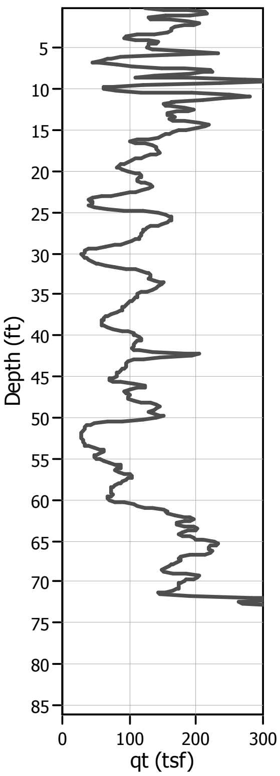
Project title : Riverwalk **Location : San Diego, CA**

CPT file : CPT-18

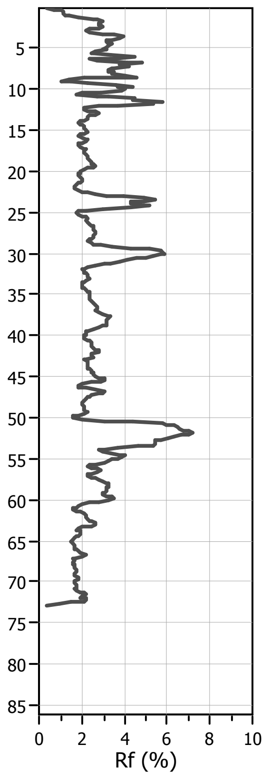
Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	17.00 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	16.00 ft	Fill height:	2.00 ft		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth applied:	No
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

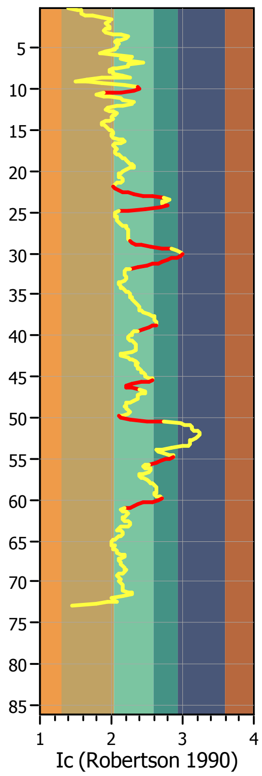
Cone resistance



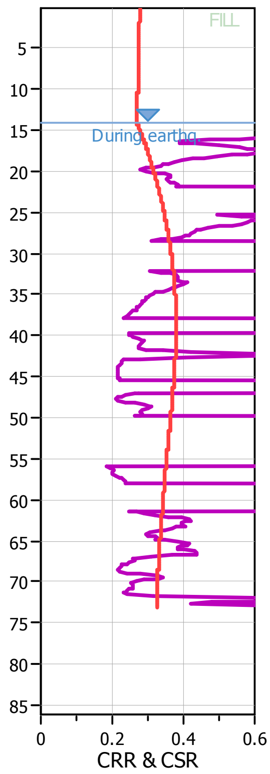
Friction Ratio



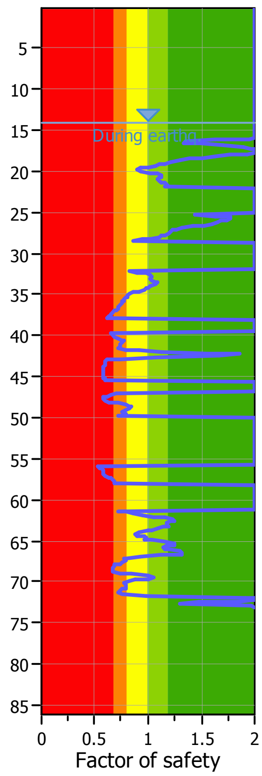
SBTn Plot



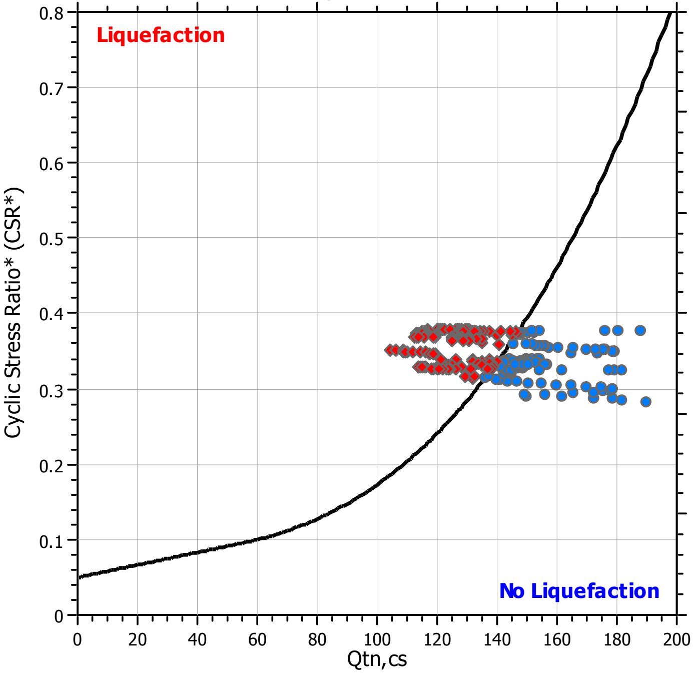
CRR plot



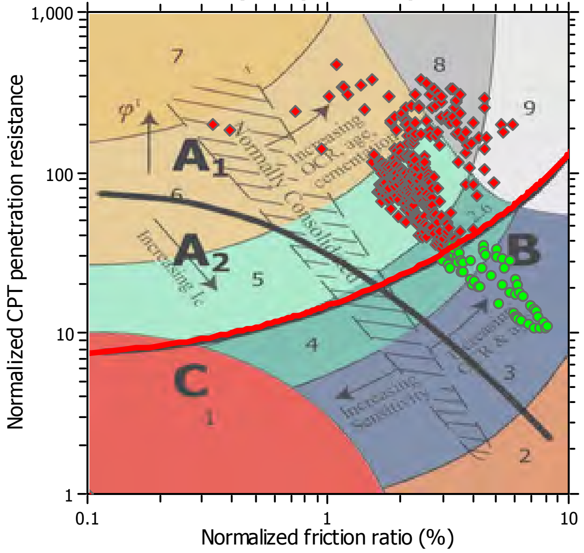
FS Plot



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



Summary of liquefaction potential



Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
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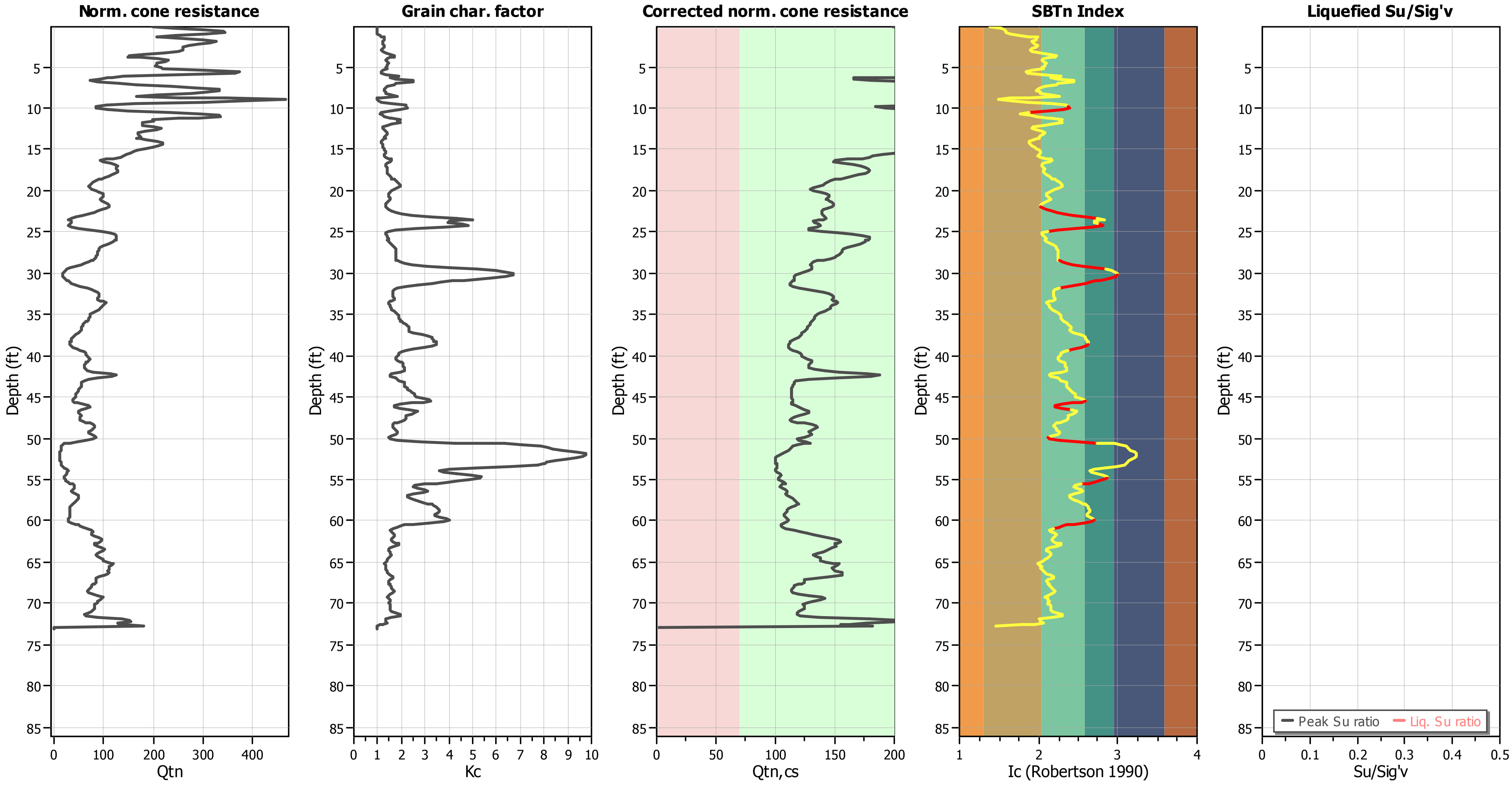
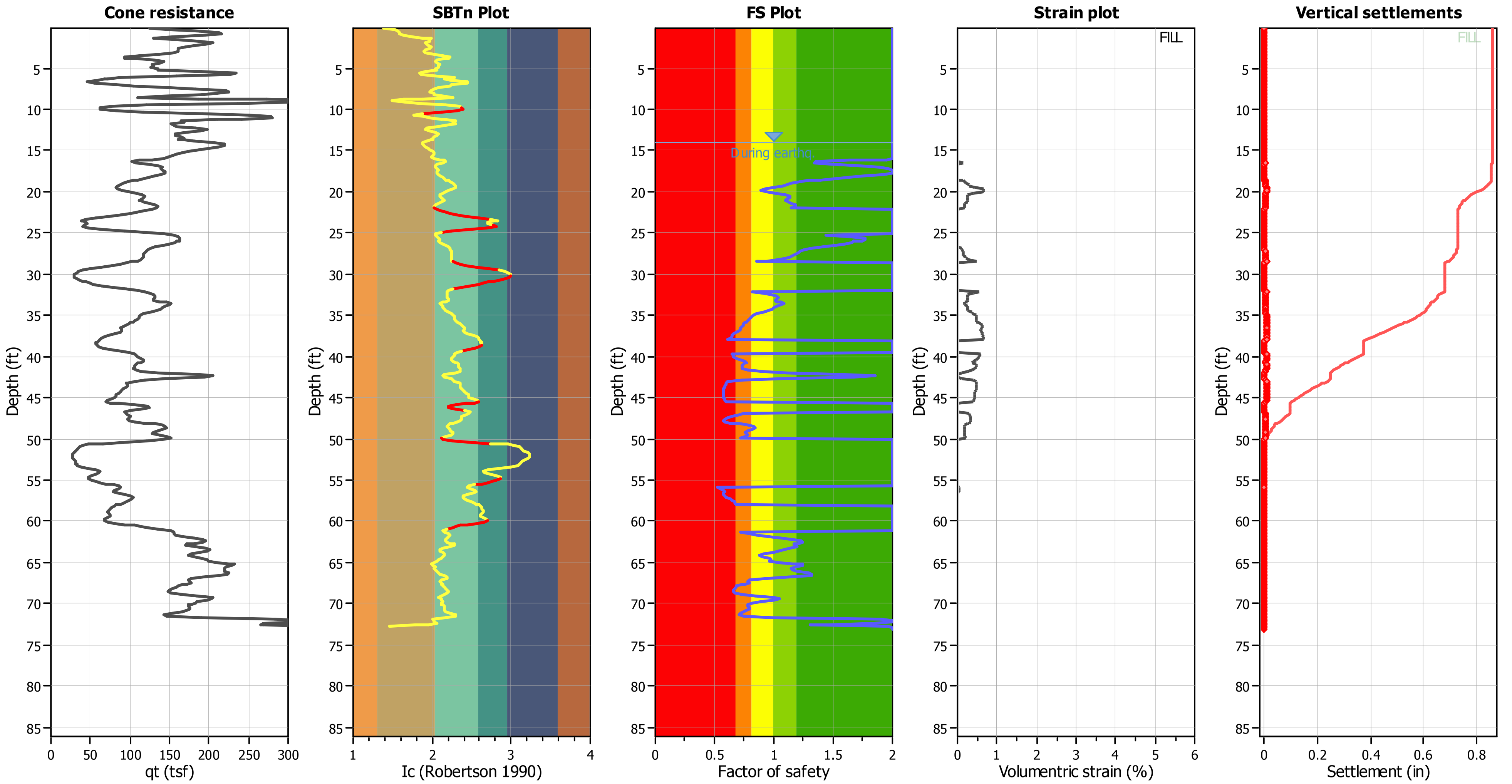
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	16.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	17.00 ft	Fill height:	2.00 ft	Limit depth:	N/A

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

NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

LIQUEFACTION ANALYSIS REPORT

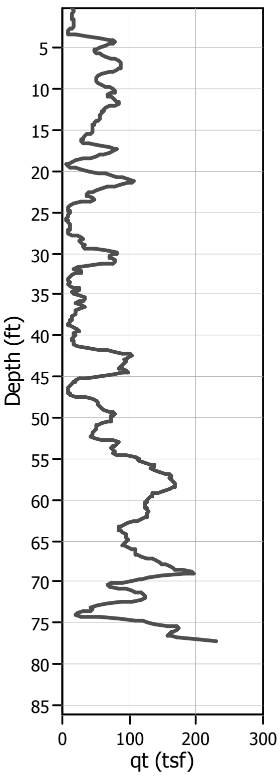
Project title : Riverwalk **Location : San Diego, CA**

CPT file : CPT-20

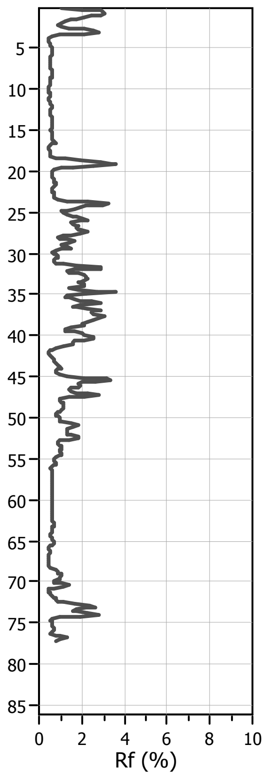
Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	7.00 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	6.00 ft	Fill height:	2.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

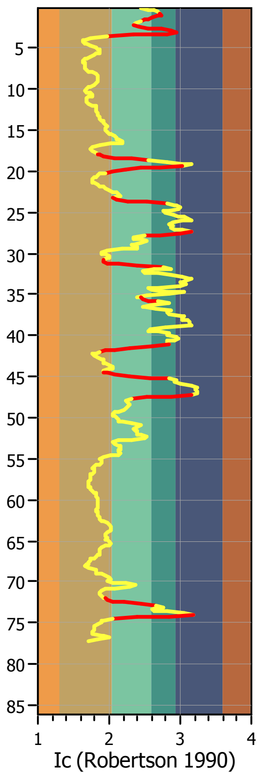
Cone resistance



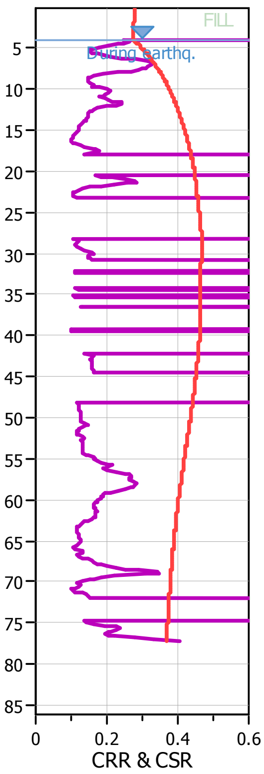
Friction Ratio



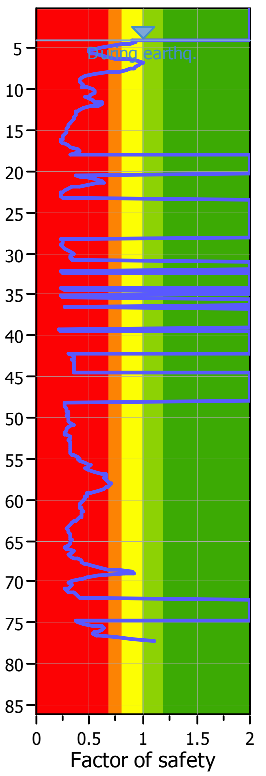
SBTn Plot



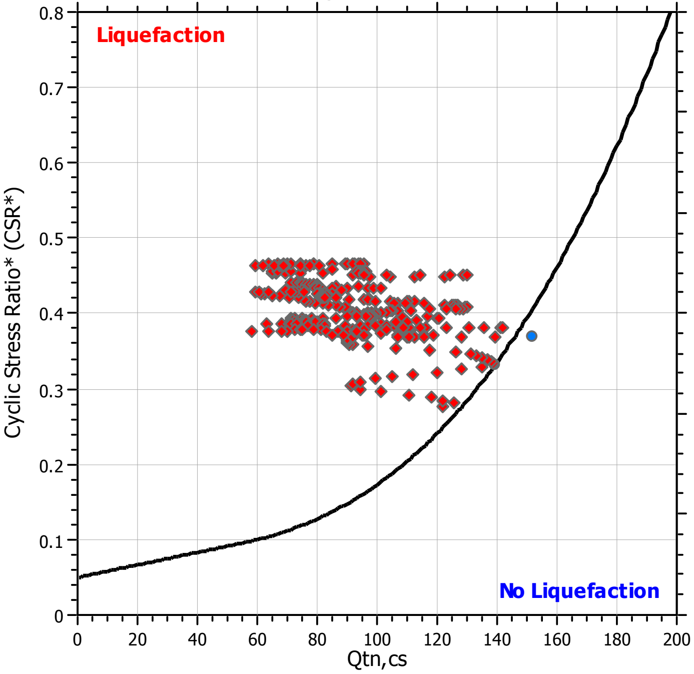
CRR plot



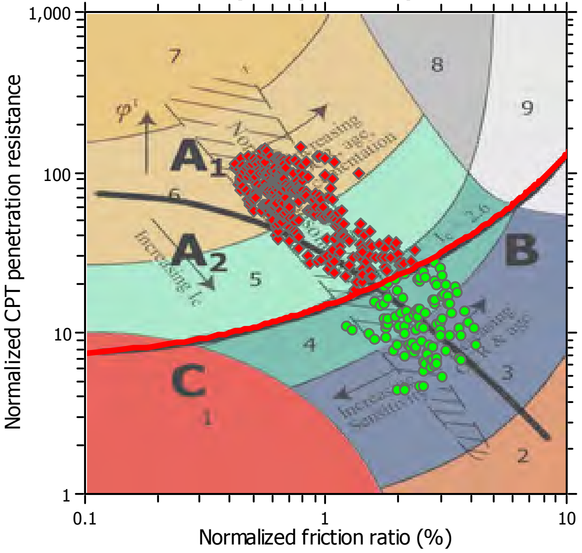
FS Plot



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

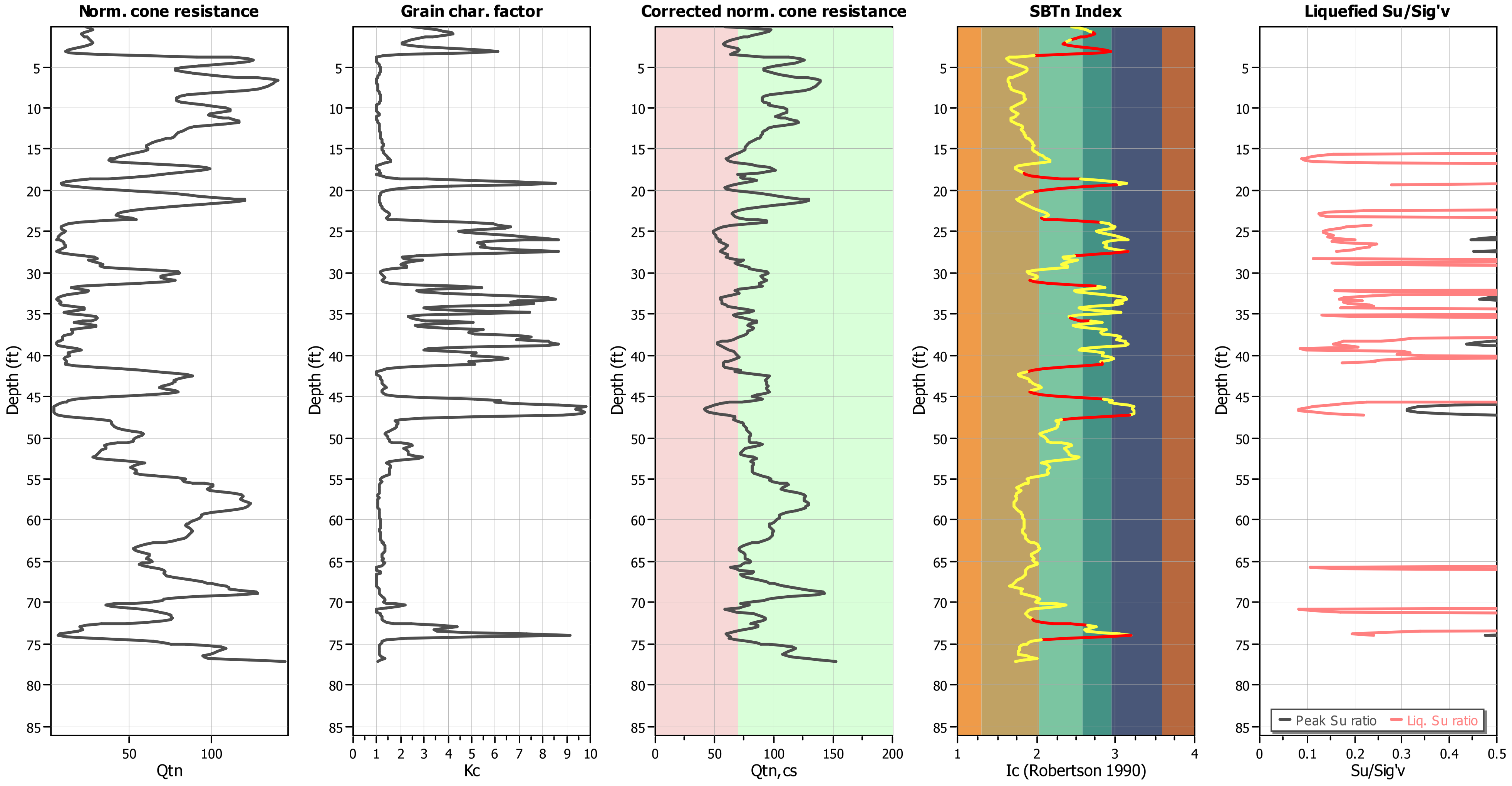


Summary of liquefaction potential



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

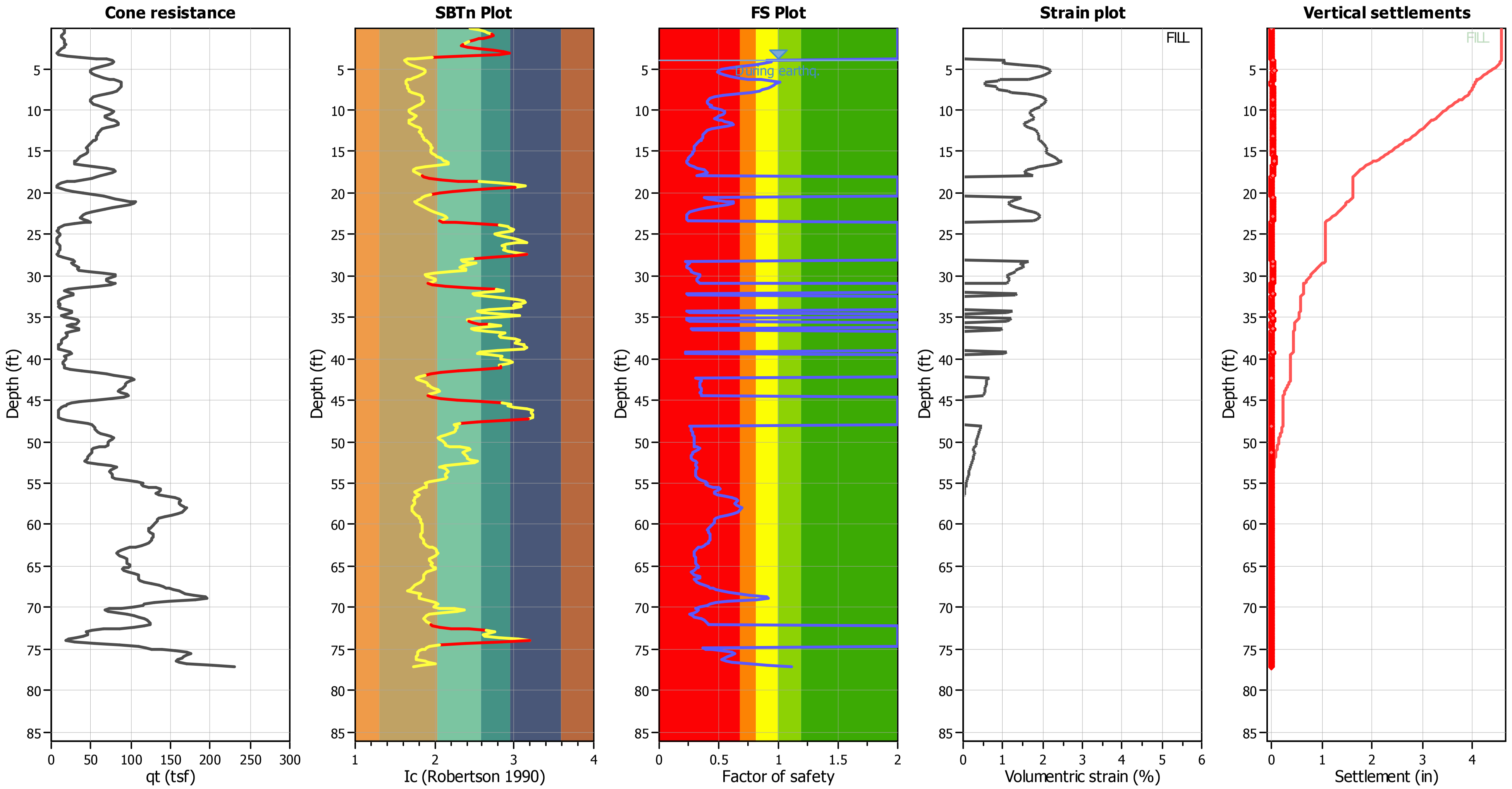
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	7.00 ft	Fill height:	2.00 ft	Limit depth:	N/A

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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Irvine, CA 92614

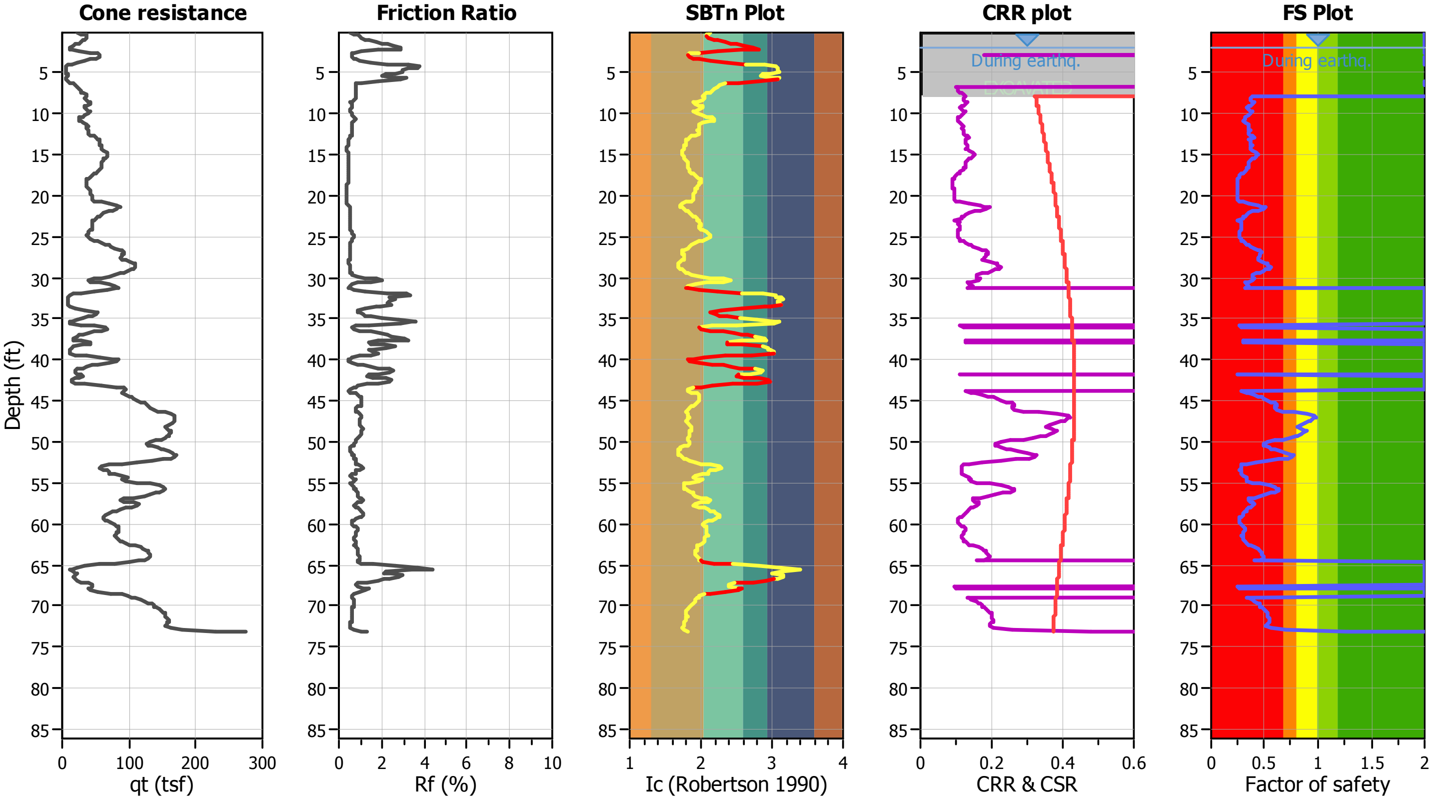
LIQUEFACTION ANALYSIS REPORT

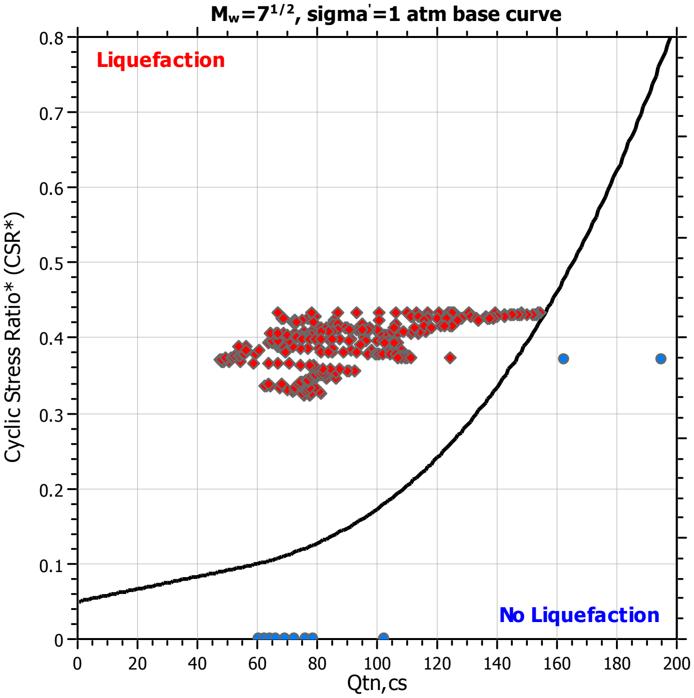
Project title : Riverwalk **Location : San Diego, CA**

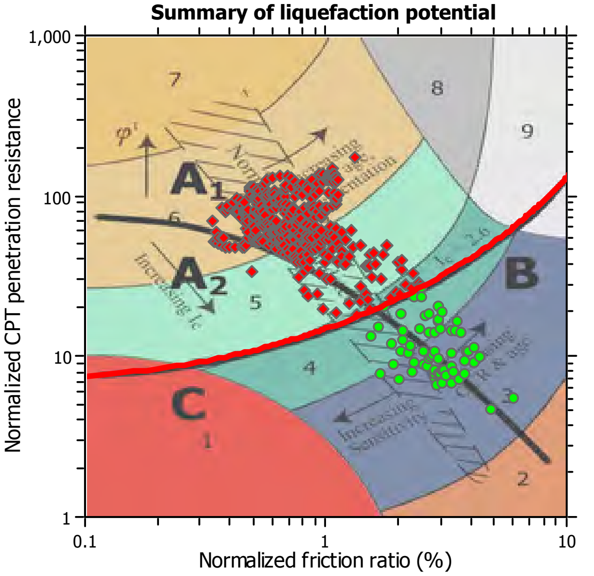
CPT file : CPT-21

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	6.00 ft	Excavation:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	2.00 ft	Excavation depth:	8.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Footing load:	2.00 tsf	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

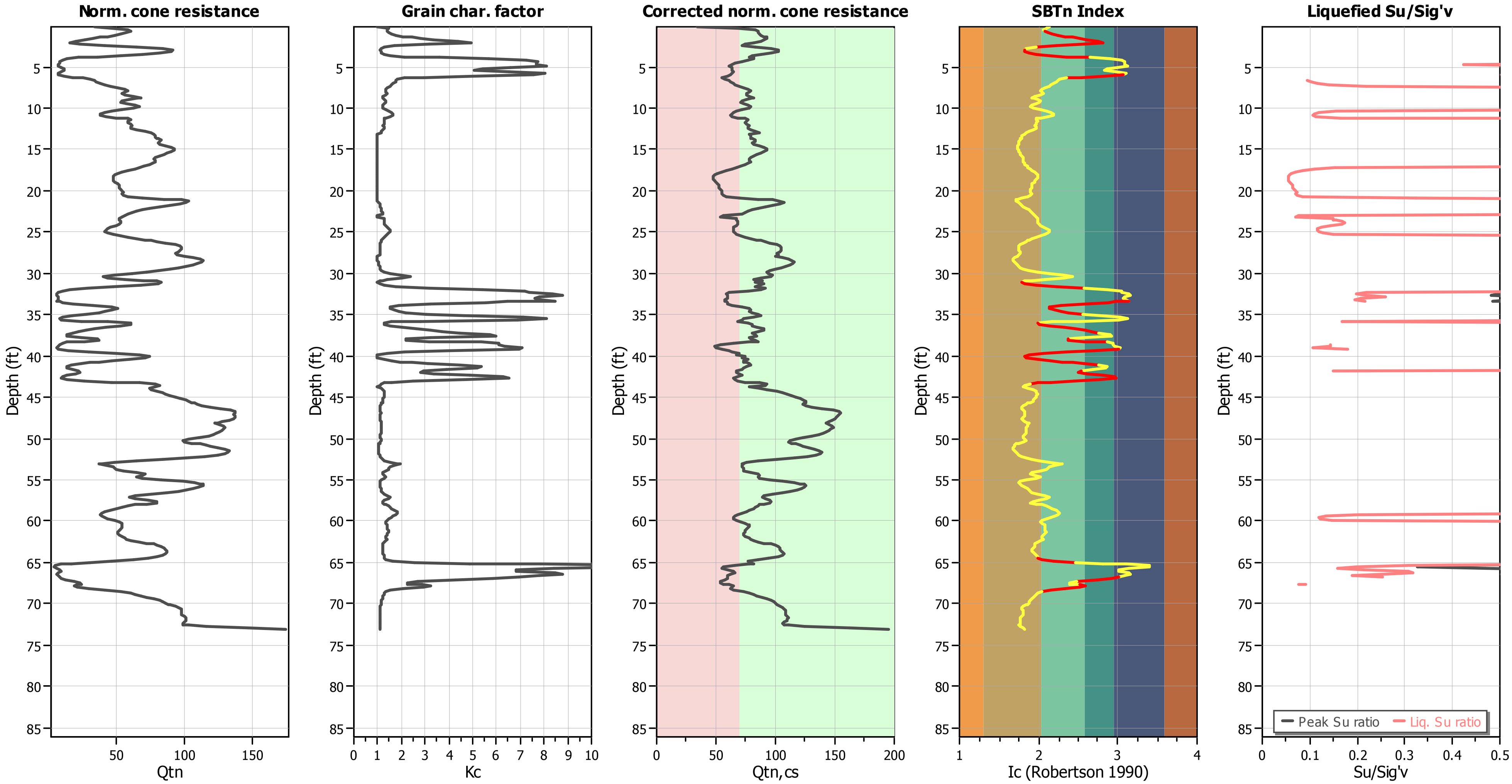

Cone resistance **Friction Ratio** **SBTn Plot** **CRR plot** **FS Plot**


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


Summary of liquefaction potential

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

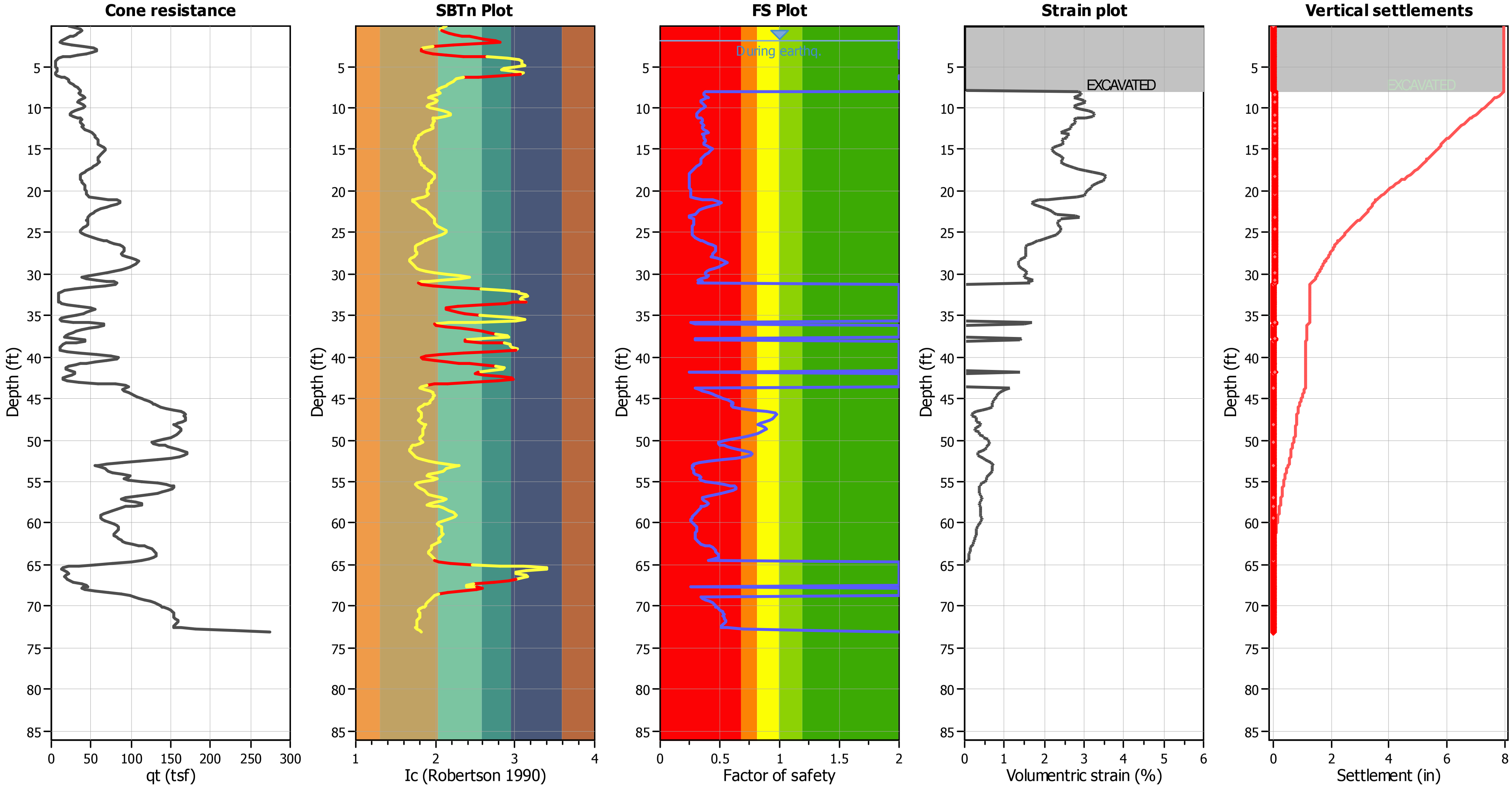
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	2.00 ft	Footing load:	2.00 tsf
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Excavation:	Yes	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Excavation depth:	8.00 ft	Limit depth:	N/A

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

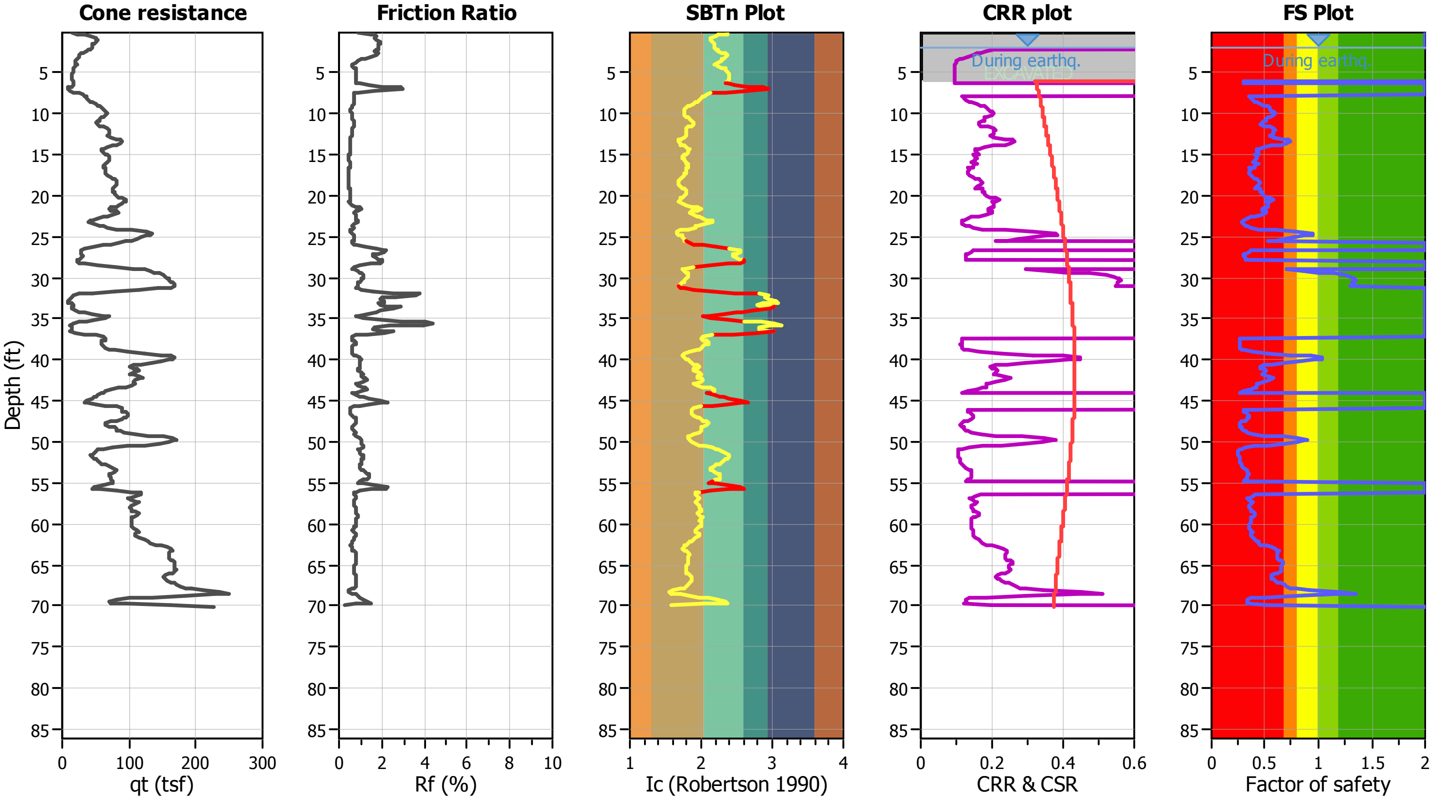
LIQUEFACTION ANALYSIS REPORT

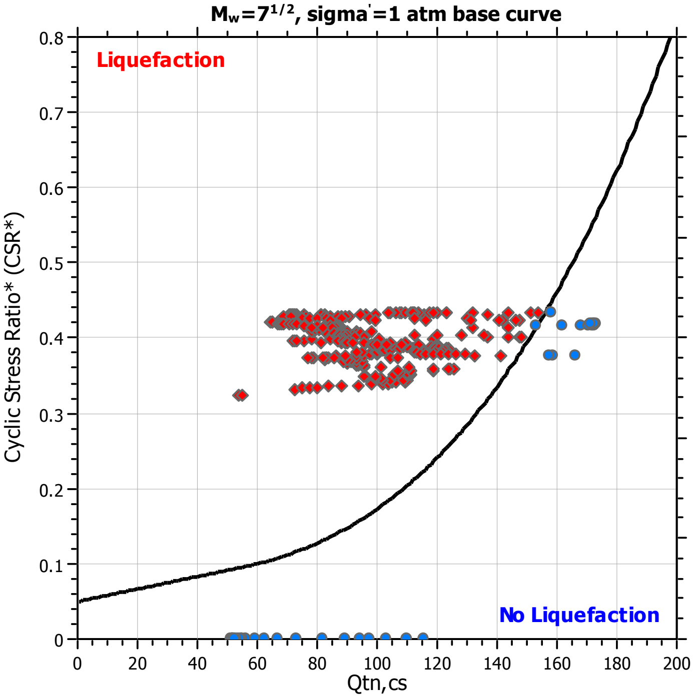
Project title : Riverwalk **Location : San Diego, CA**

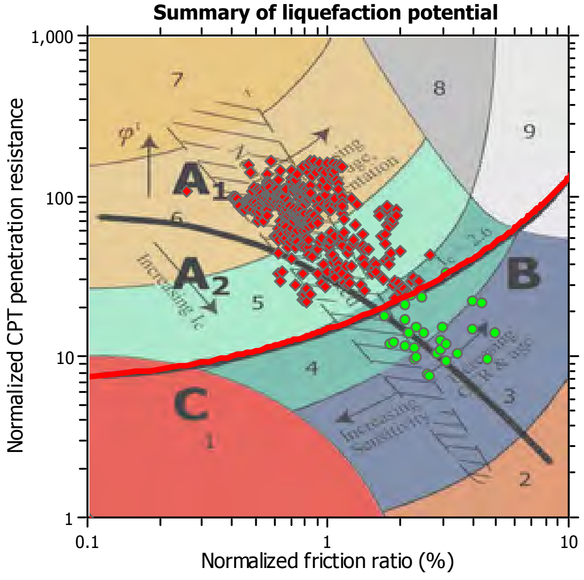
CPT file : CPT-22

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	6.00 ft	Excavation:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	2.00 ft	Excavation depth:	6.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Footing load:	2.00 tsf	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

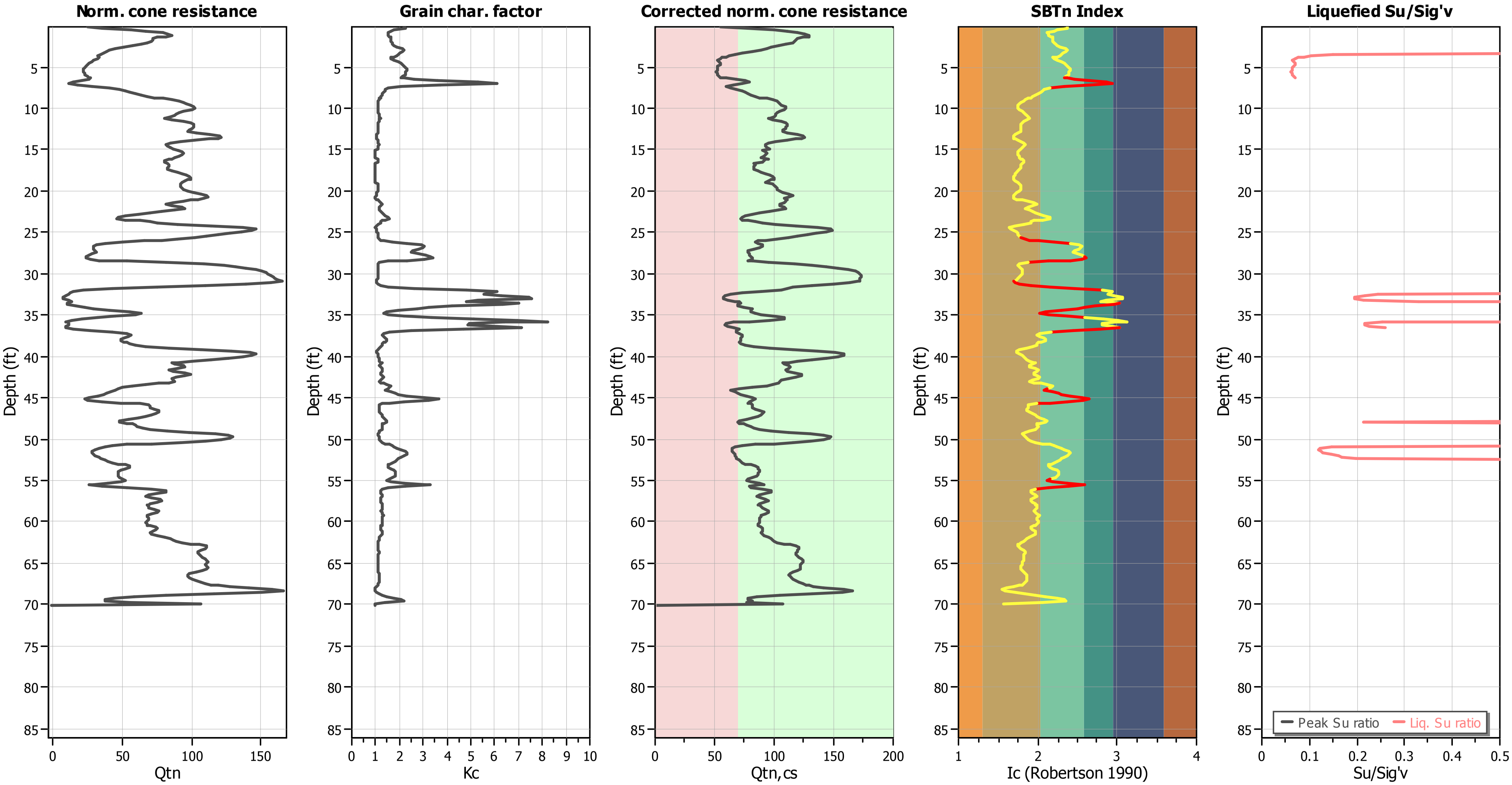






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

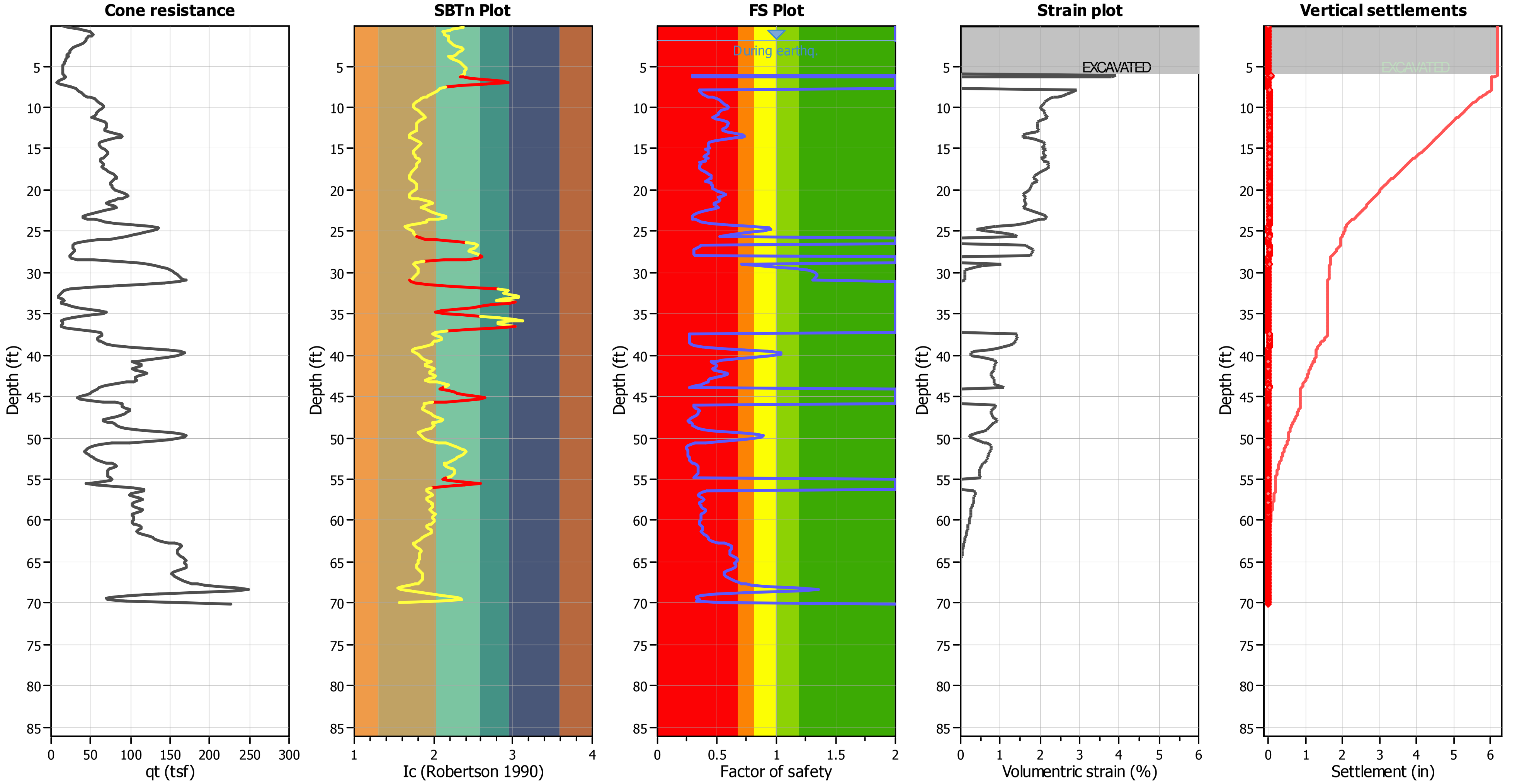
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	2.00 ft	Footing load:	2.00 tsf
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Excavation:	Yes	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Excavation depth:	6.00 ft	Limit depth:	N/A

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

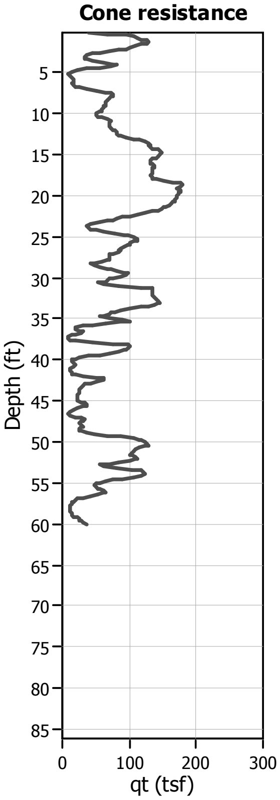
LIQUEFACTION ANALYSIS REPORT

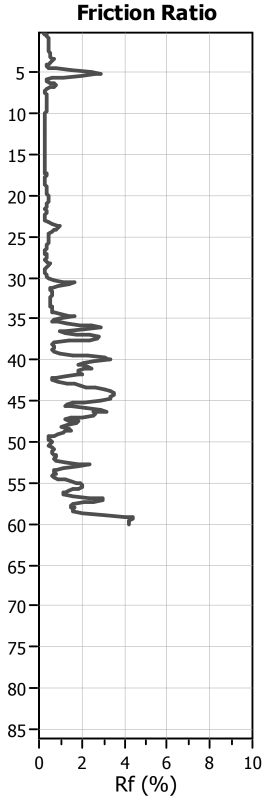
Project title : Riverwalk **Location : San Diego, CA**

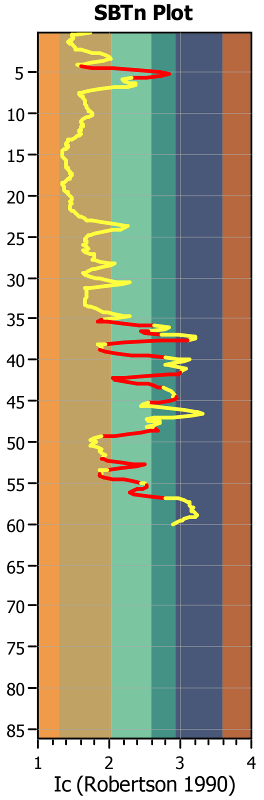
CPT file : CPT-23

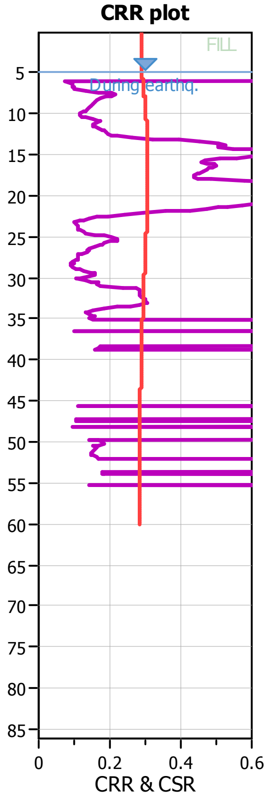
Input parameters and analysis data

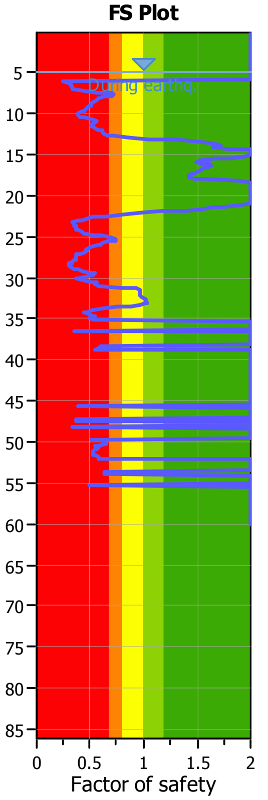
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	8.00 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	34.00 ft	Fill height:	29.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_{σ} applied:	Yes		

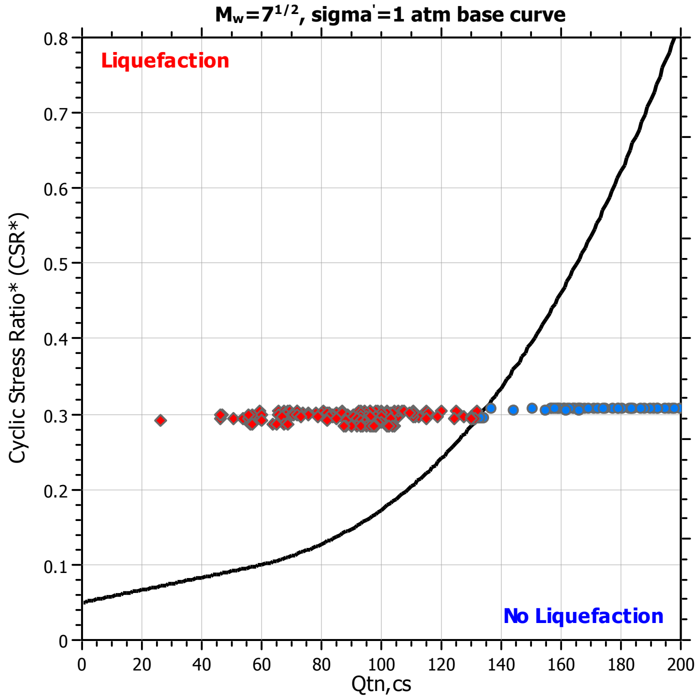

Cone resistance

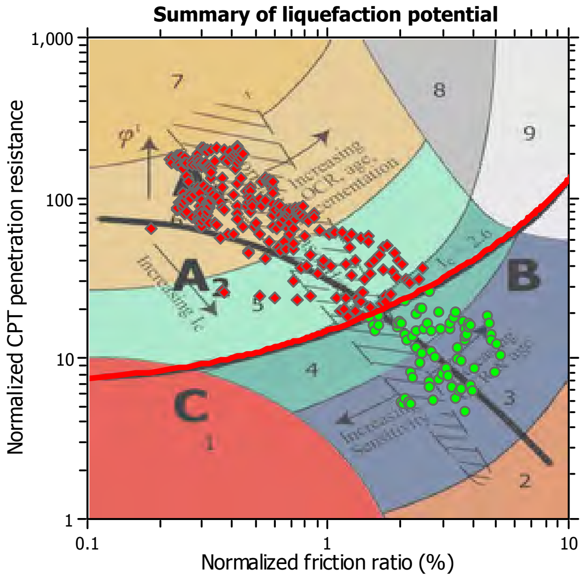

Friction Ratio


SBTn Plot


CRR plot

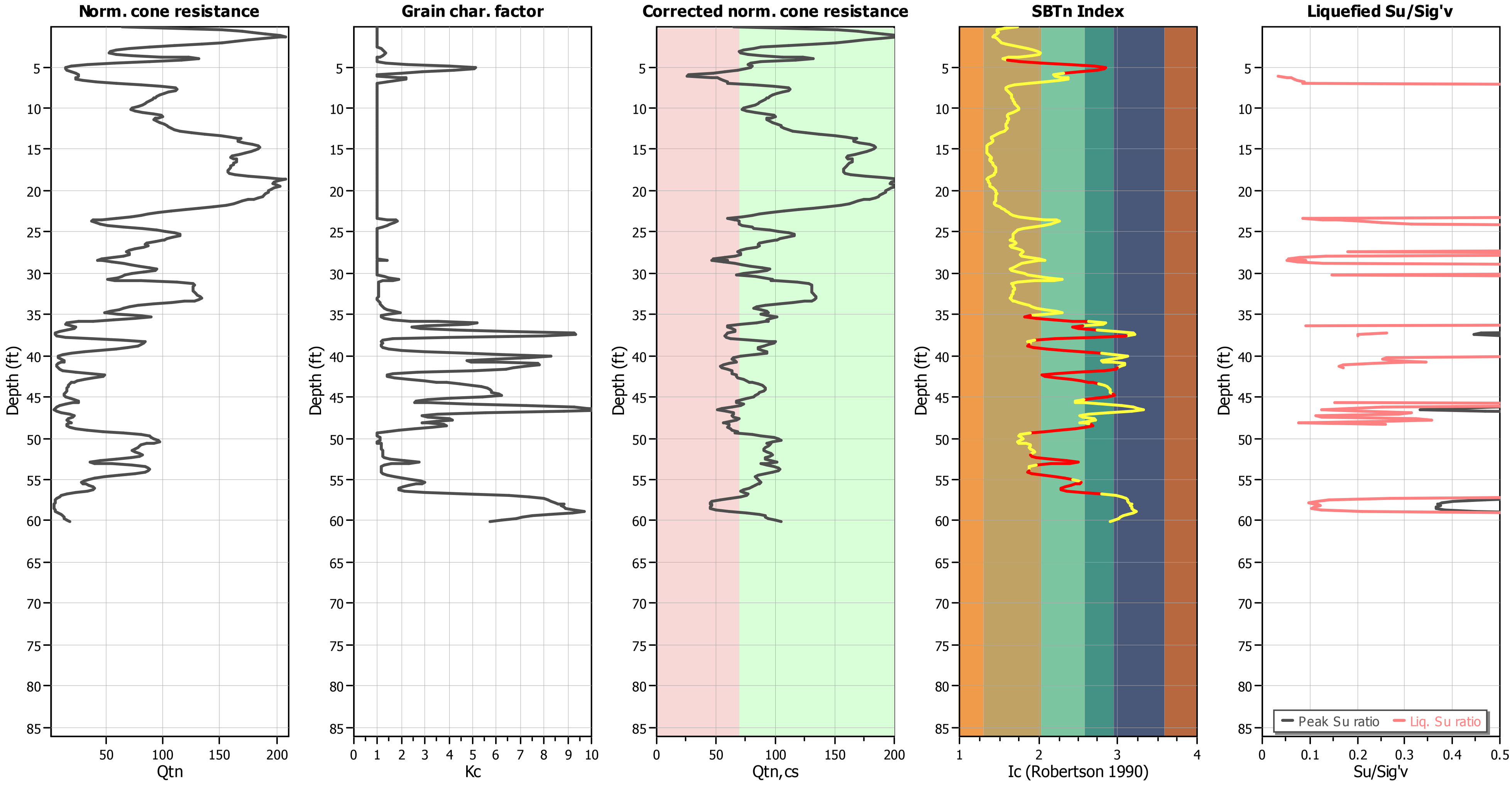

FS Plot


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


Summary of liquefaction potential

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

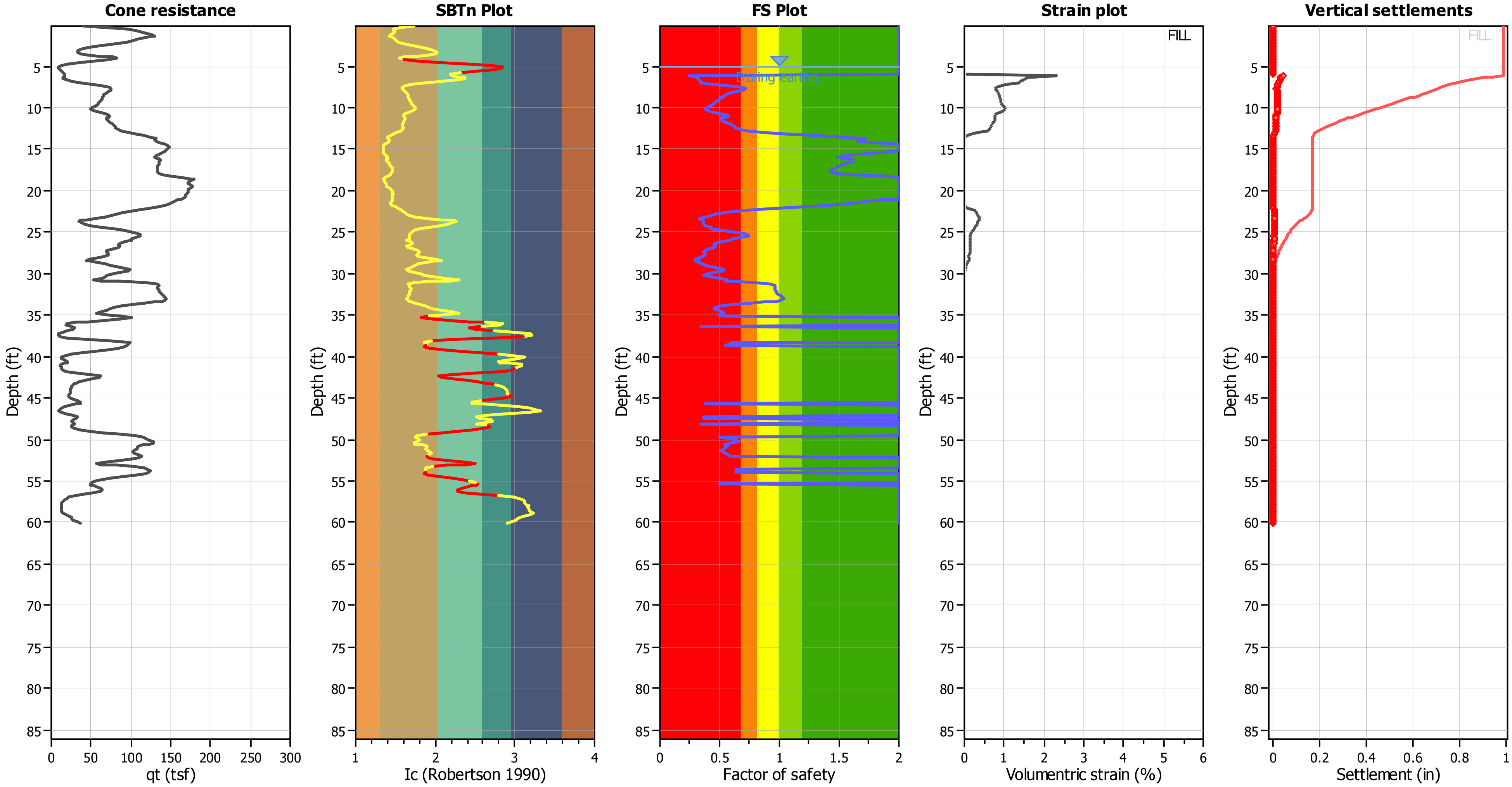
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	34.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	8.00 ft	Fill height:	29.00 ft	Limit depth:	N/A

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

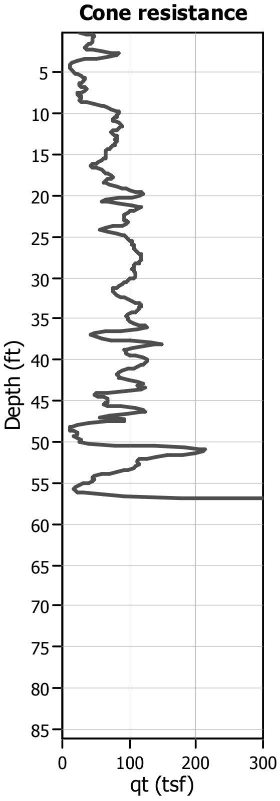
LIQUEFACTION ANALYSIS REPORT

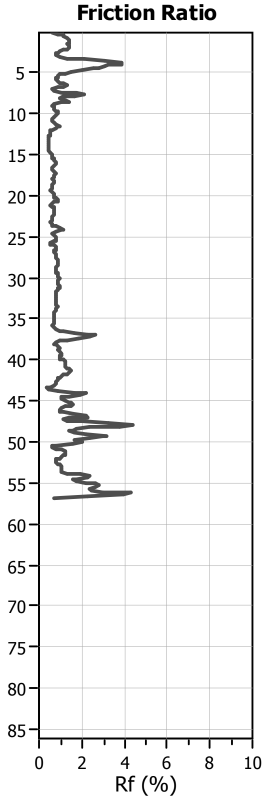
Project title : Riverwalk **Location : San Diego, CA**

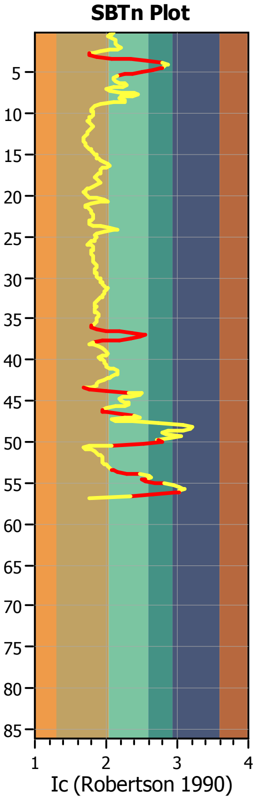
CPT file : CPT-24

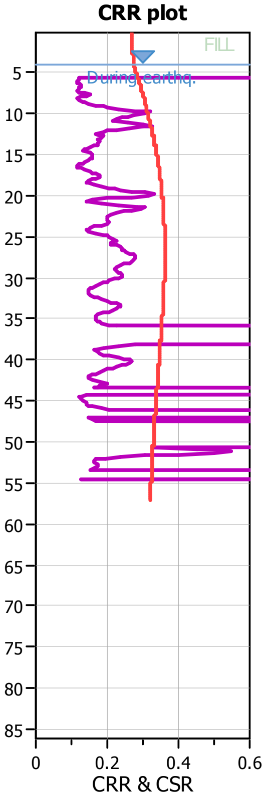
Input parameters and analysis data

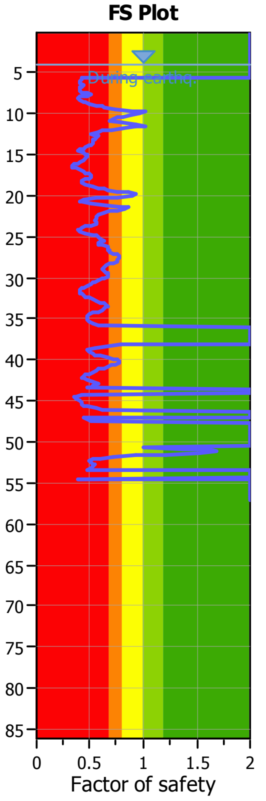
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	8.00 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	20.00 ft	Fill height:	16.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

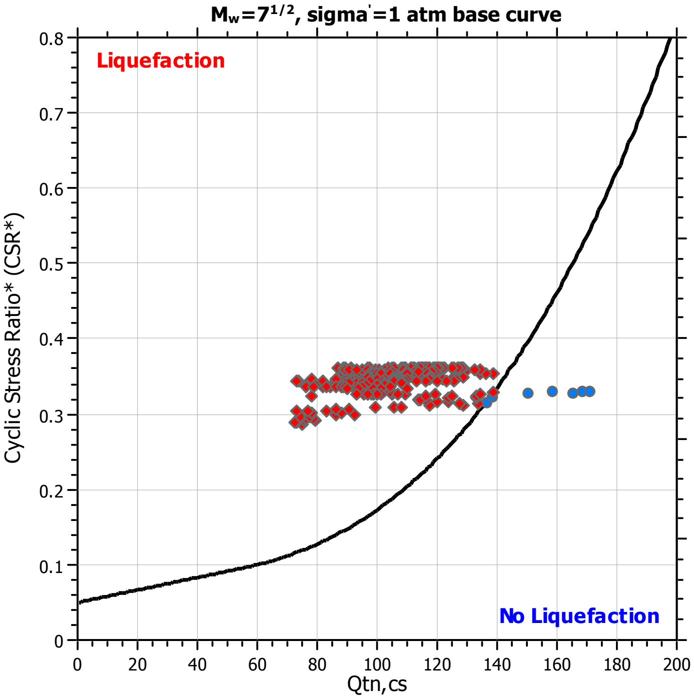

Cone resistance

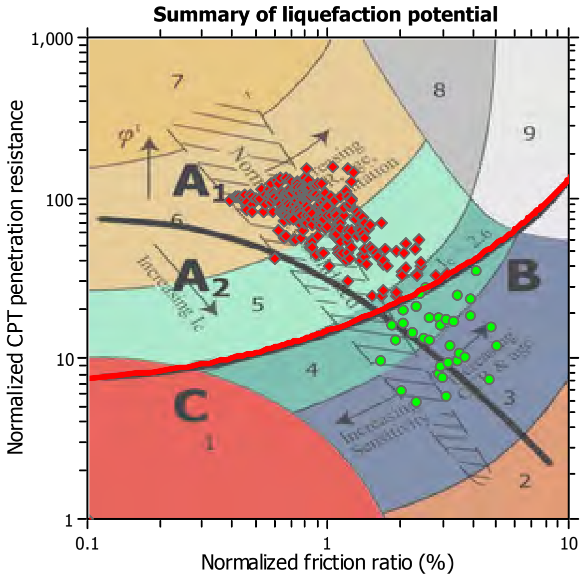

Friction Ratio


SBTn Plot


CRR plot

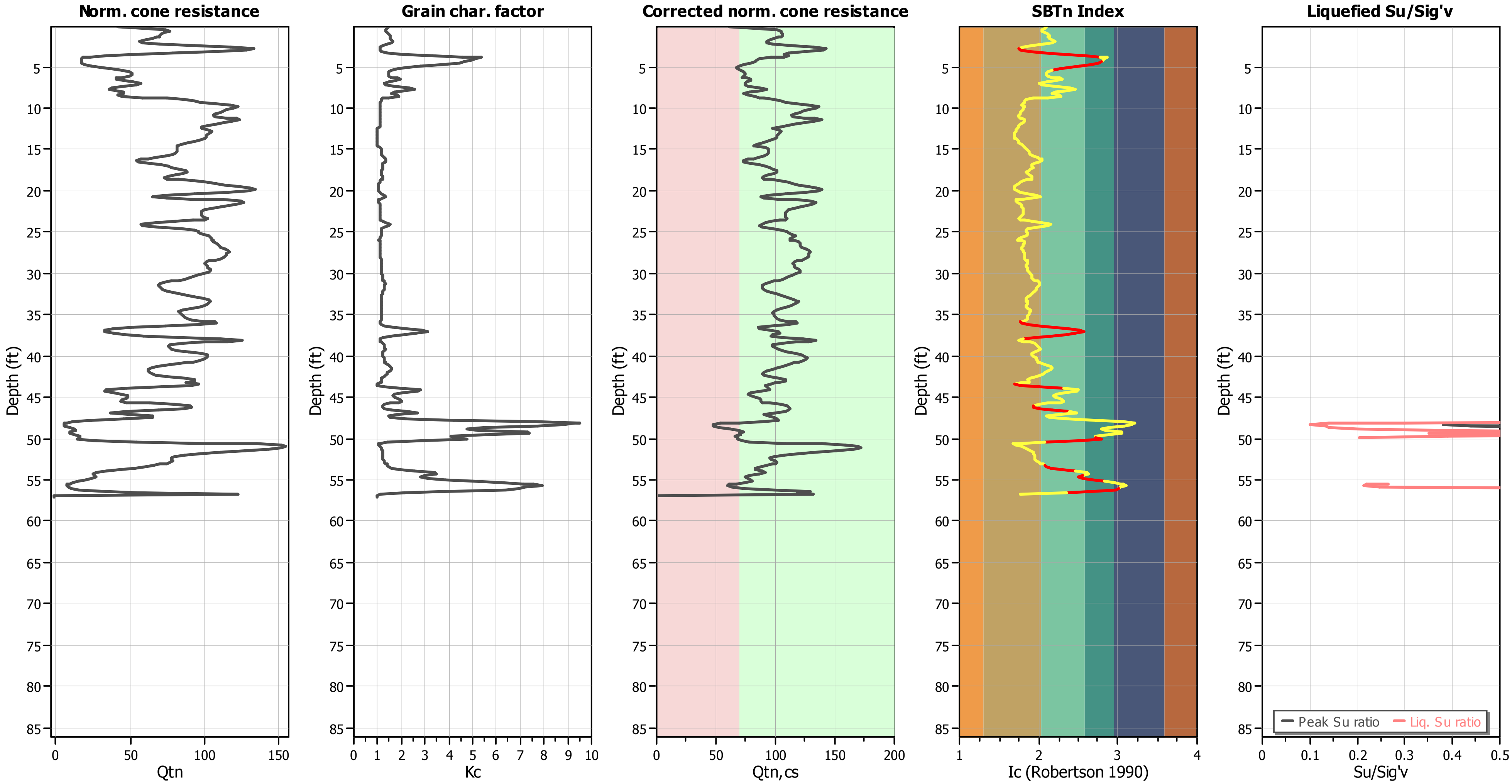

FS Plot


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


Summary of liquefaction potential

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

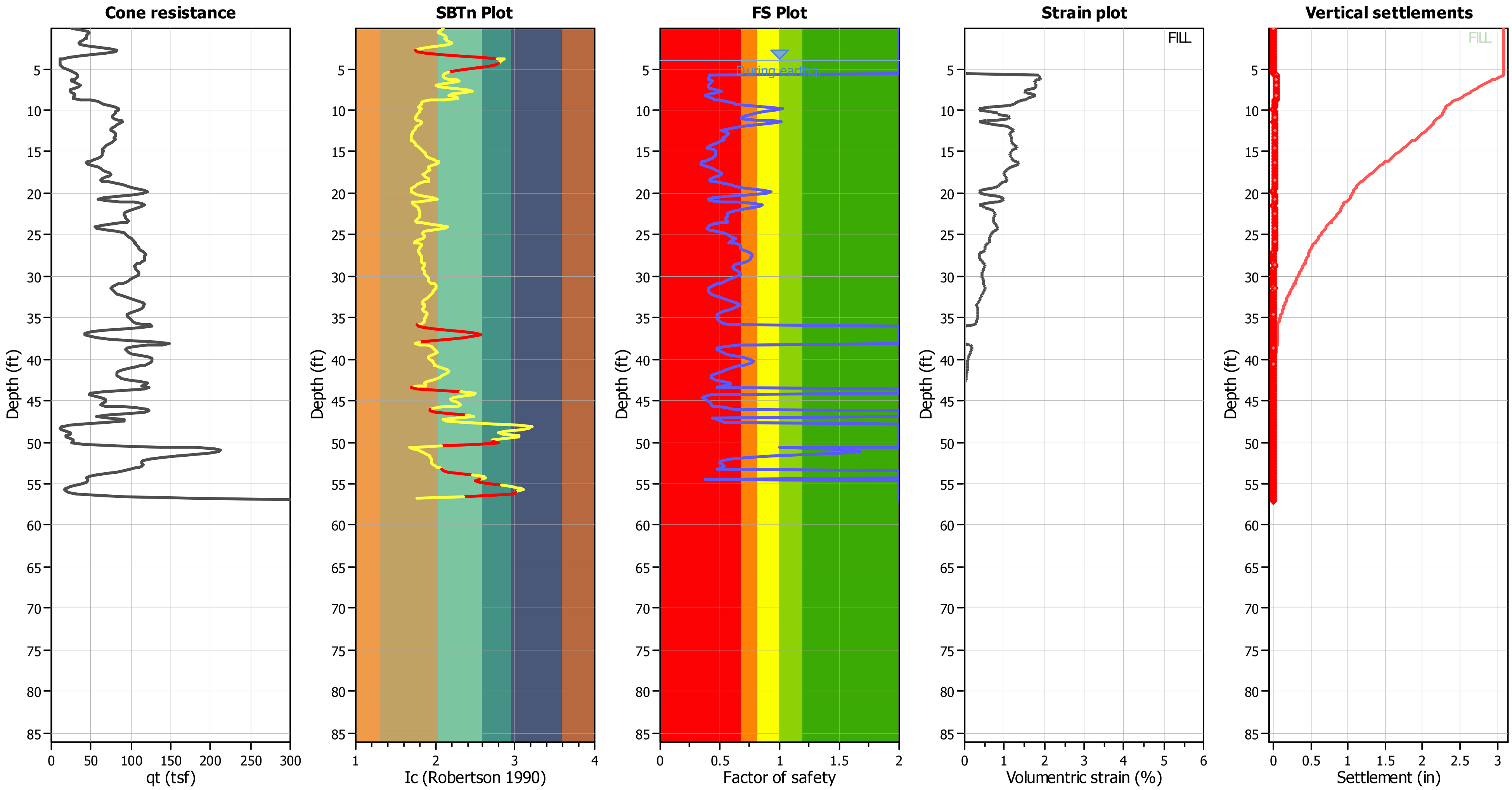
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	20.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	8.00 ft	Fill height:	16.00 ft	Limit depth:	N/A

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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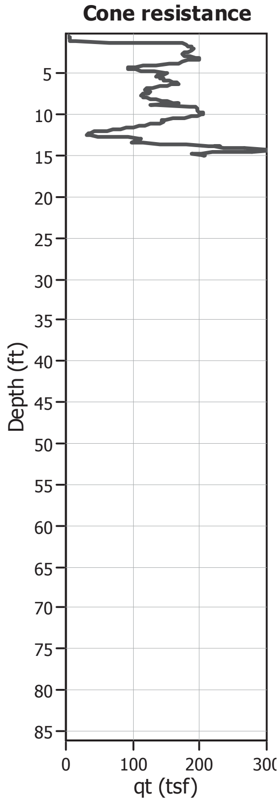
LIQUEFACTION ANALYSIS REPORT

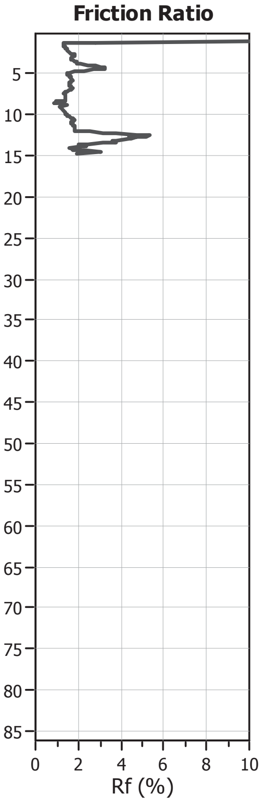
Project title : Riverwalk **Location : San Diego, CA**

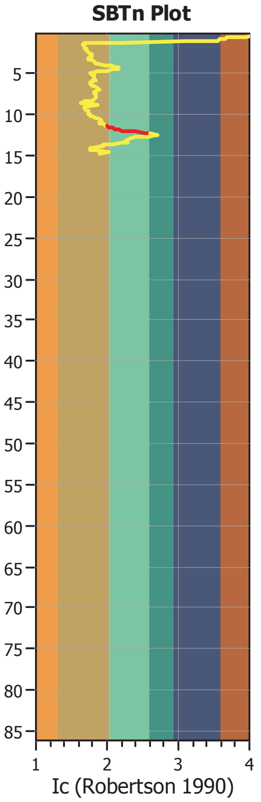
CPT file : CPT-25

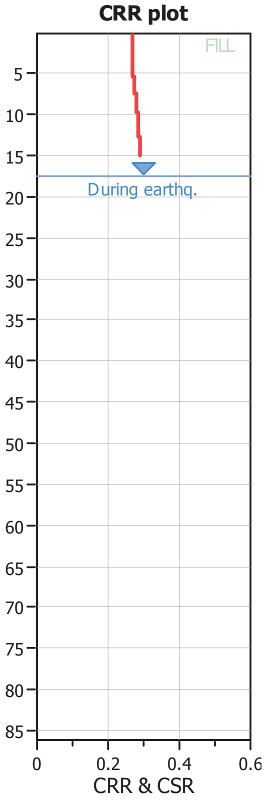
Input parameters and analysis data

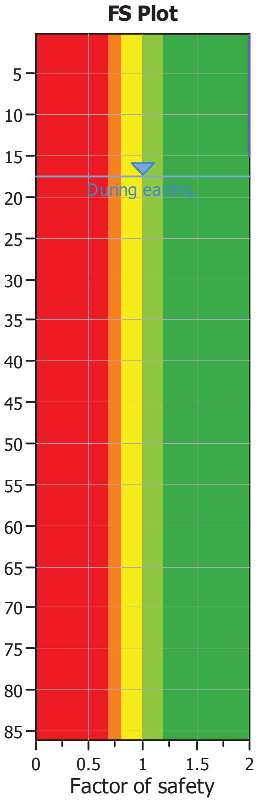
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	21.50 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	30.50 ft	Fill height:	13.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

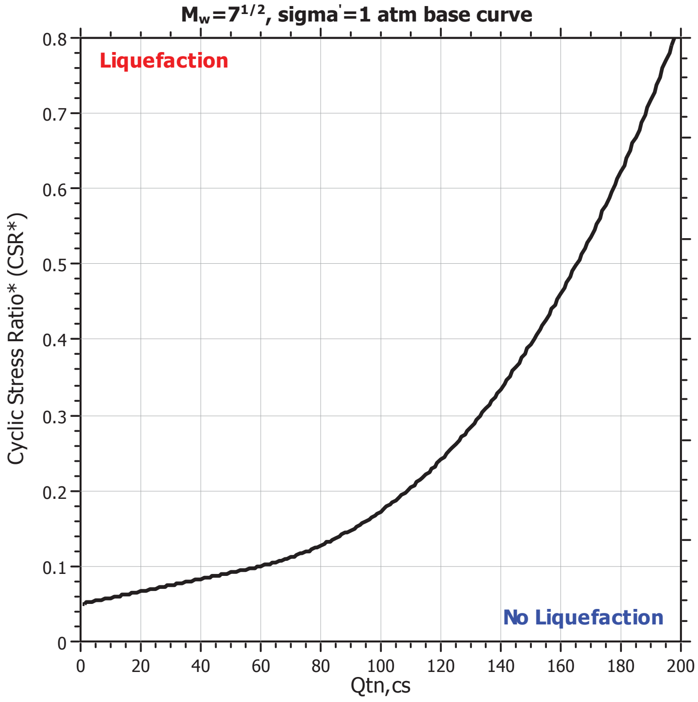

Cone resistance

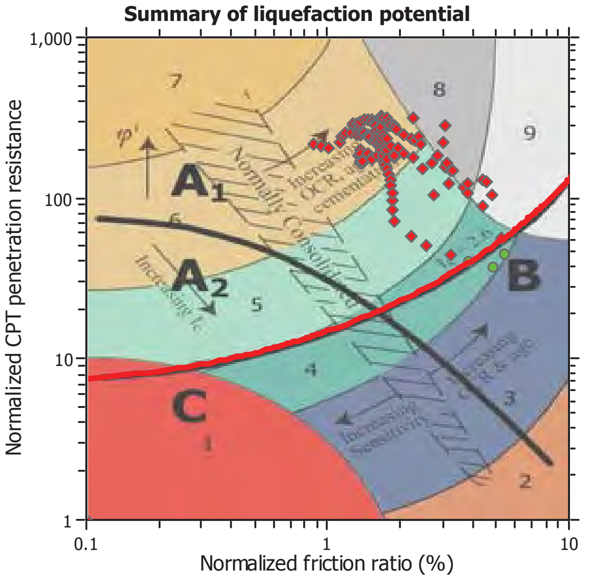

Friction Ratio


SBTn Plot


CRR plot

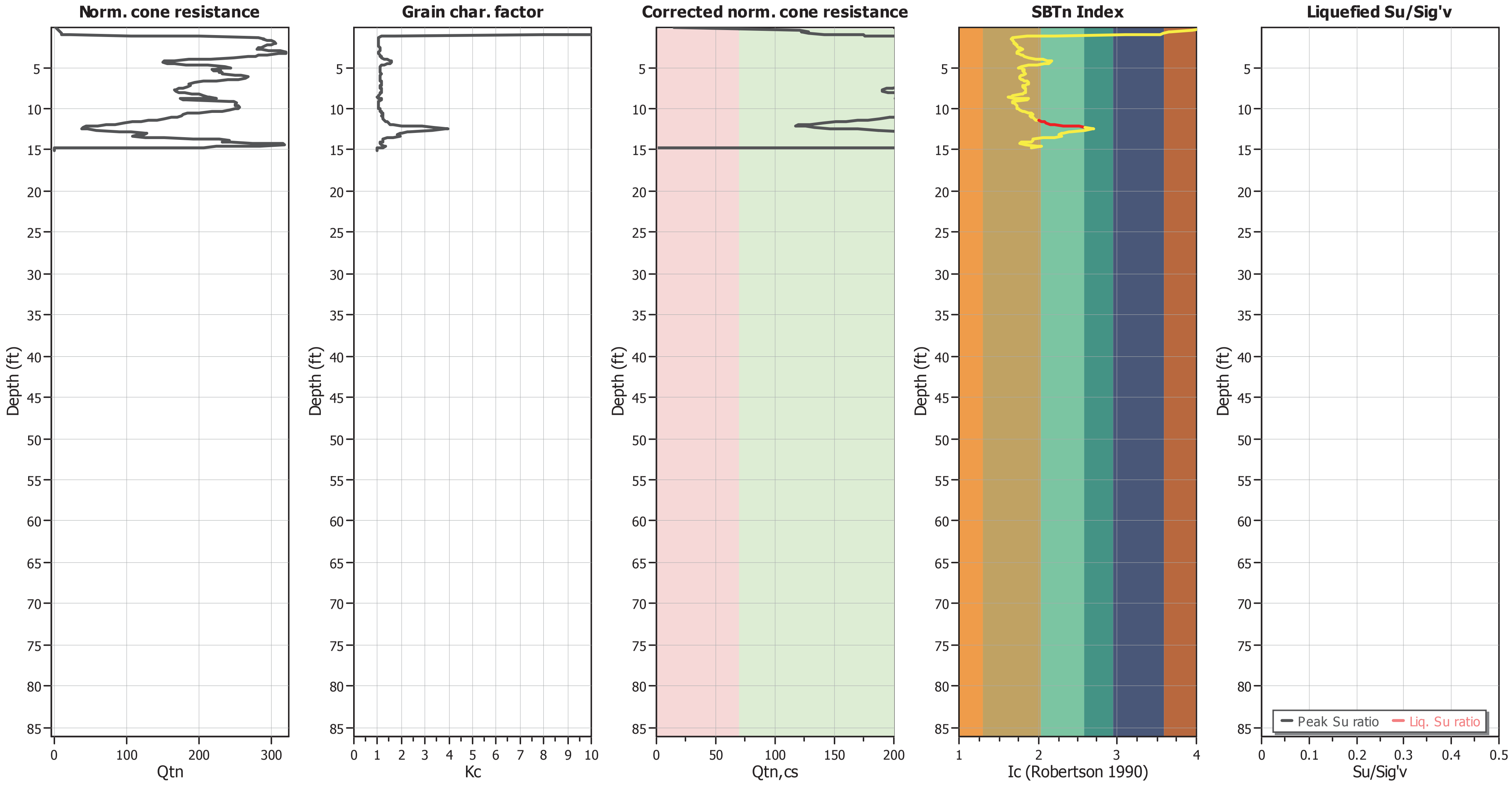

FS Plot


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


Summary of liquefaction potential

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

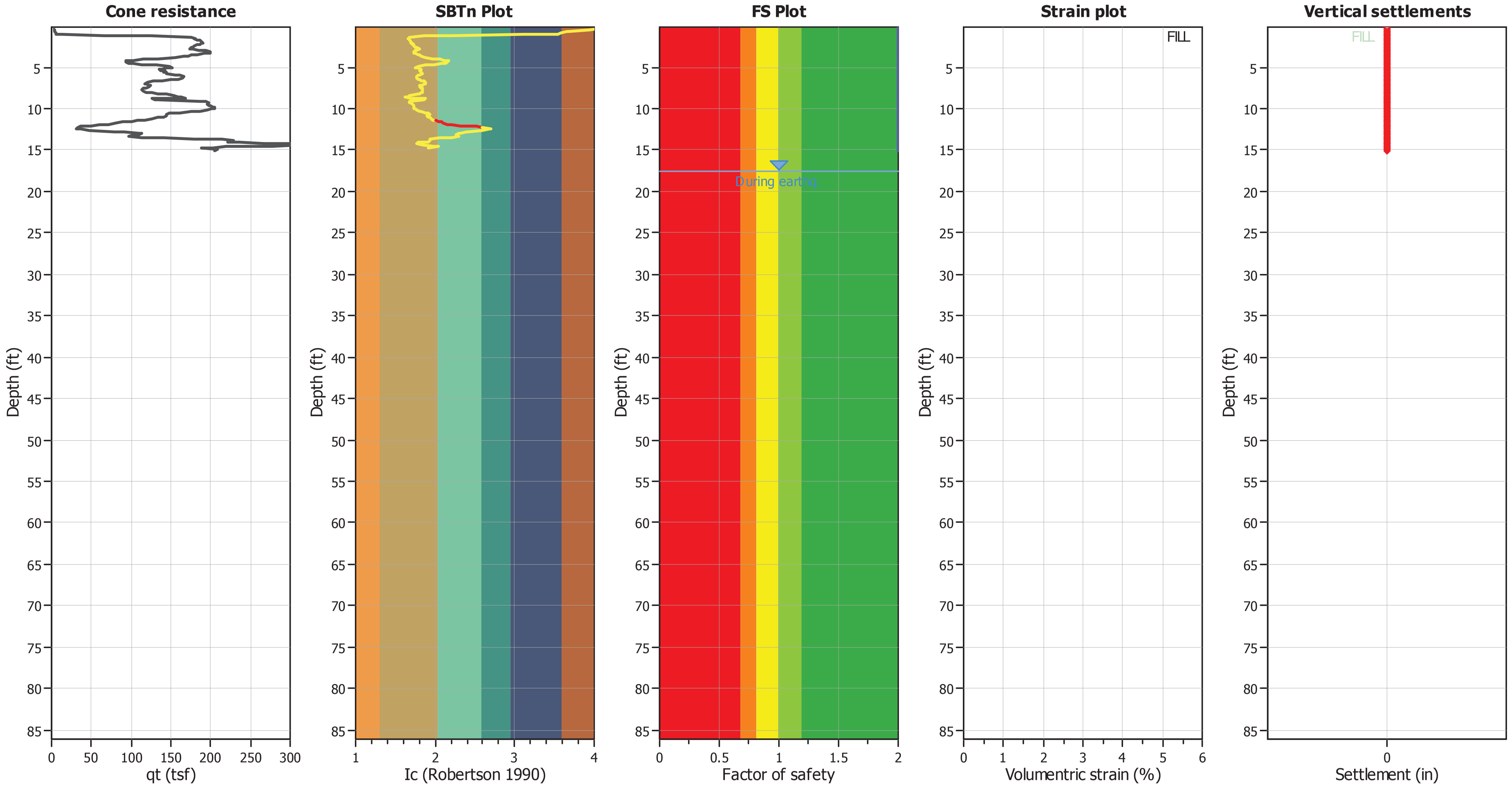
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	30.50 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	21.50 ft	Fill height:	13.00 ft	Limit depth:	N/A

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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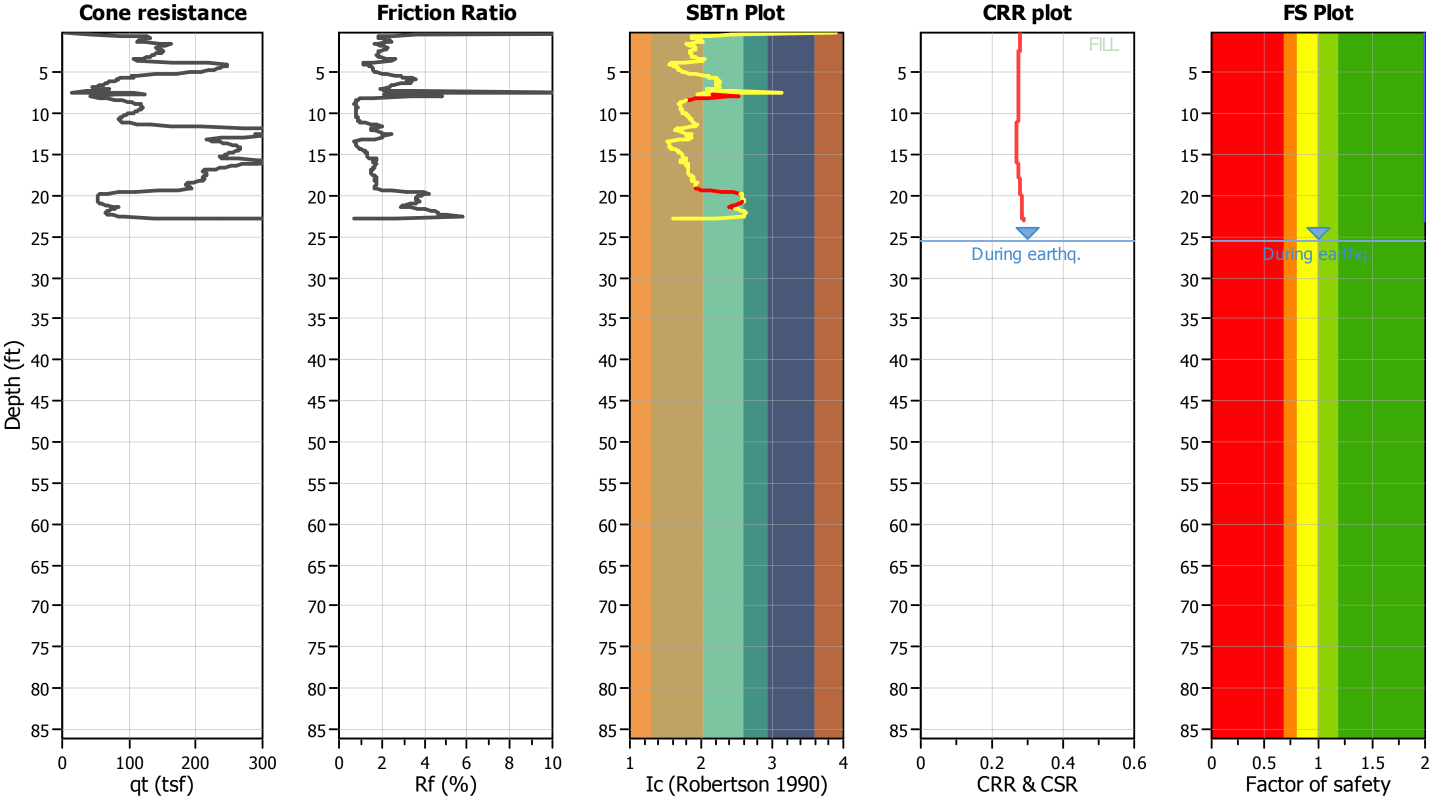
LIQUEFACTION ANALYSIS REPORT

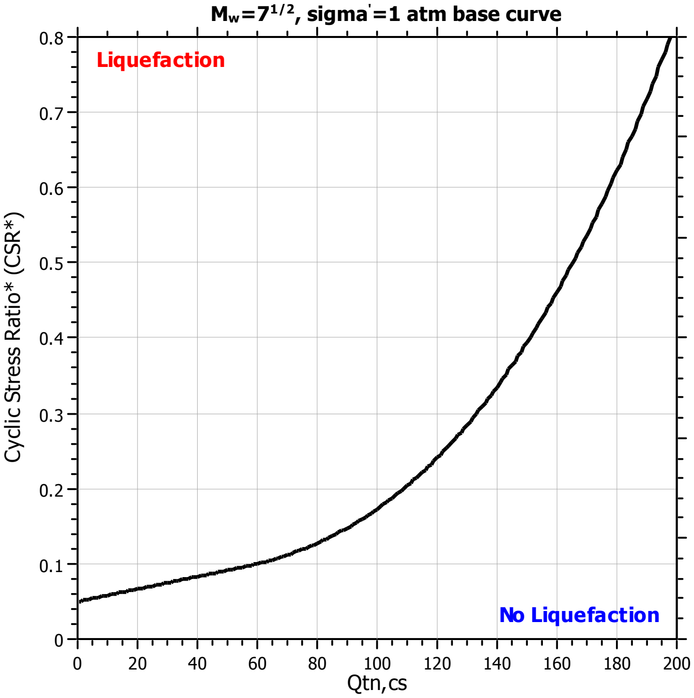
Project title : Riverwalk **Location : San Diego, CA**

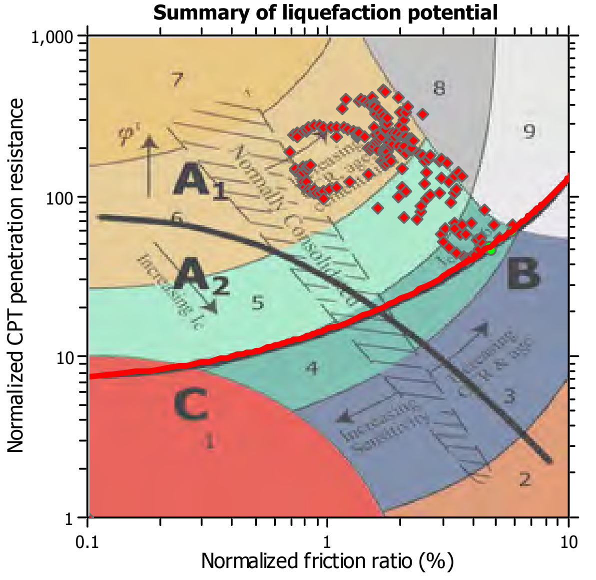
CPT file : CPT-26

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	29.50 ft	Use fill:	Yes		
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	27.00 ft	Fill height:	1.50 ft	Clay like behavior applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth applied:	No
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

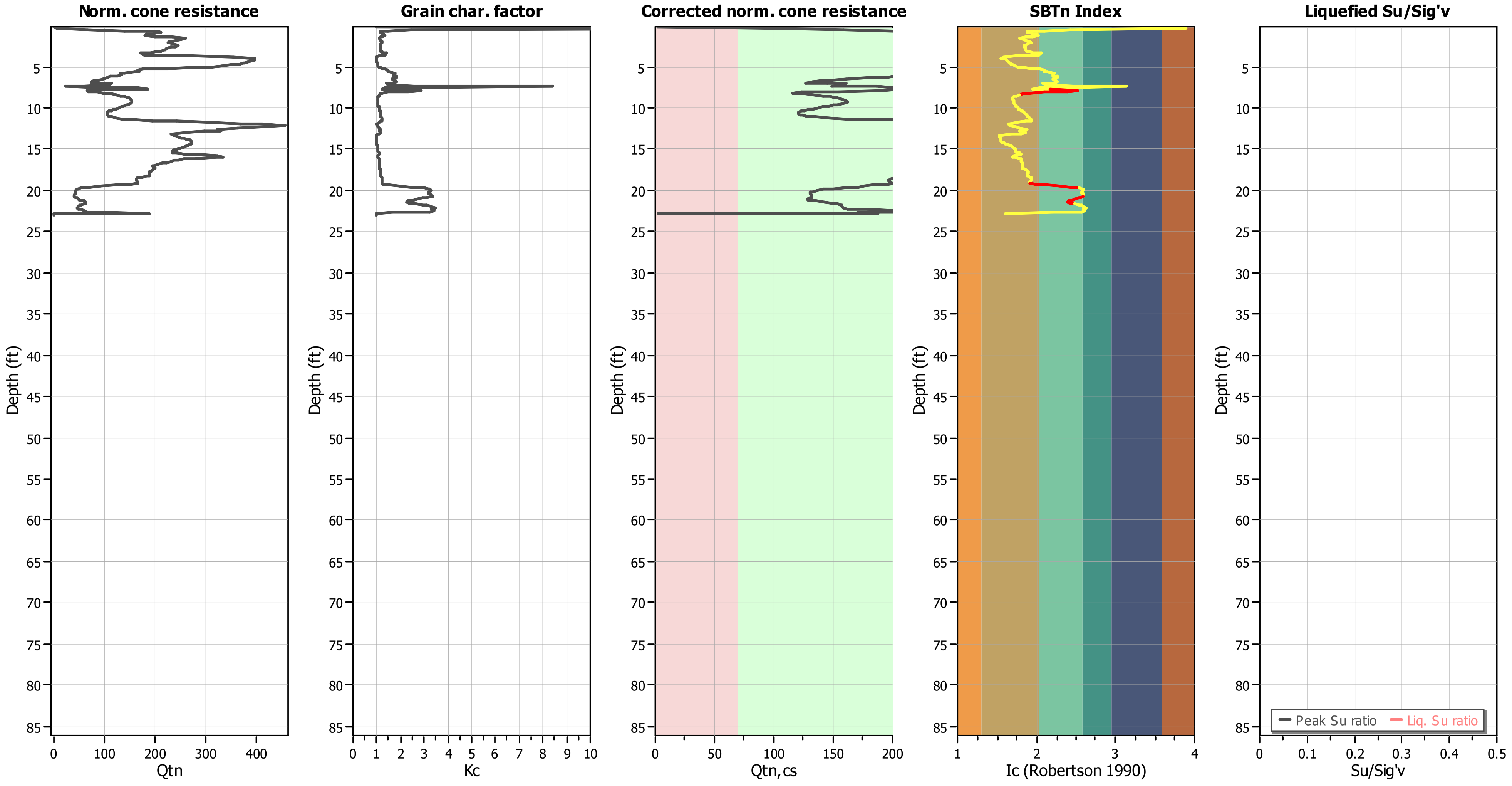






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

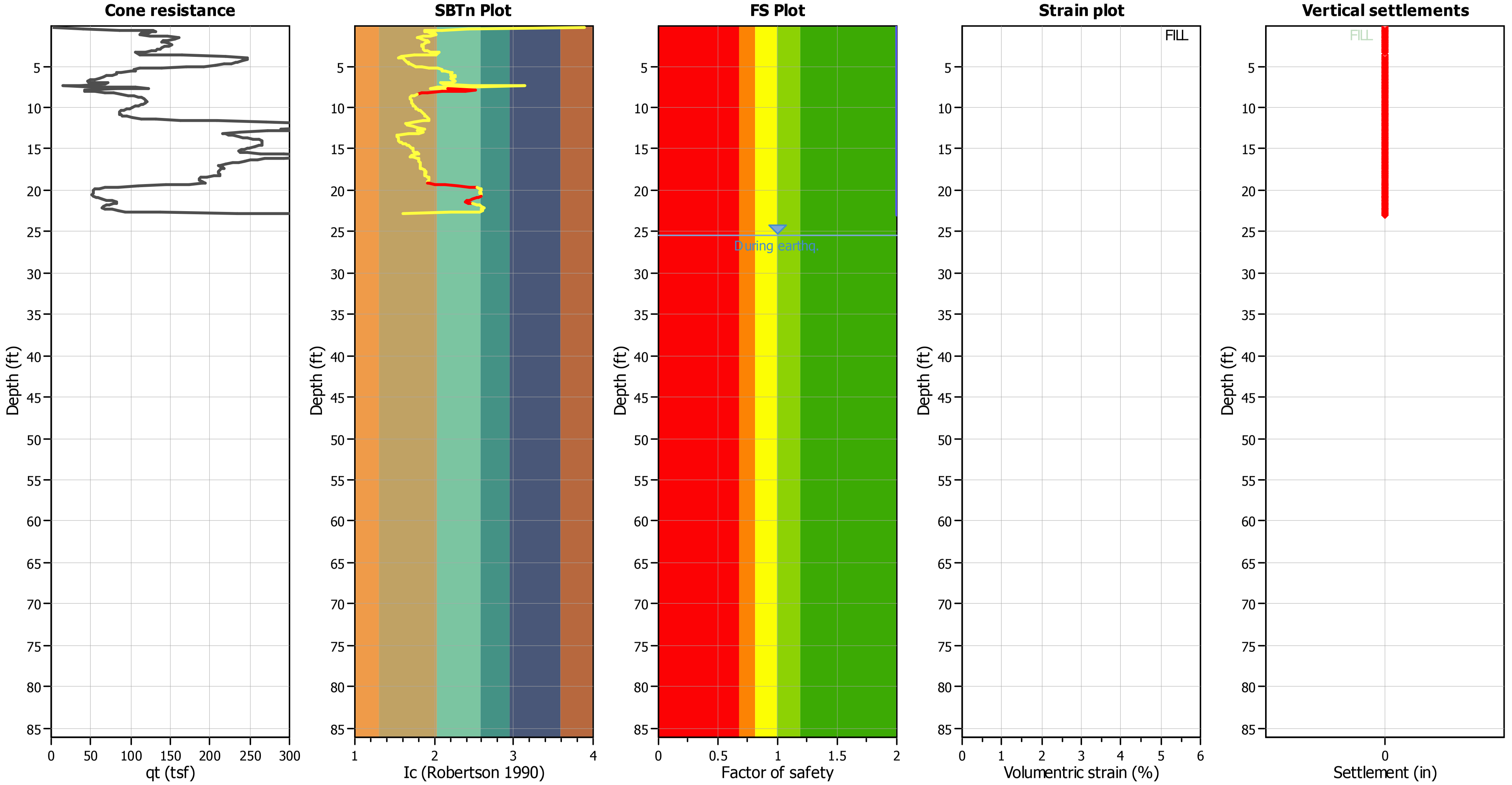
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	27.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	29.50 ft	Fill height:	1.50 ft	Limit depth:	N/A

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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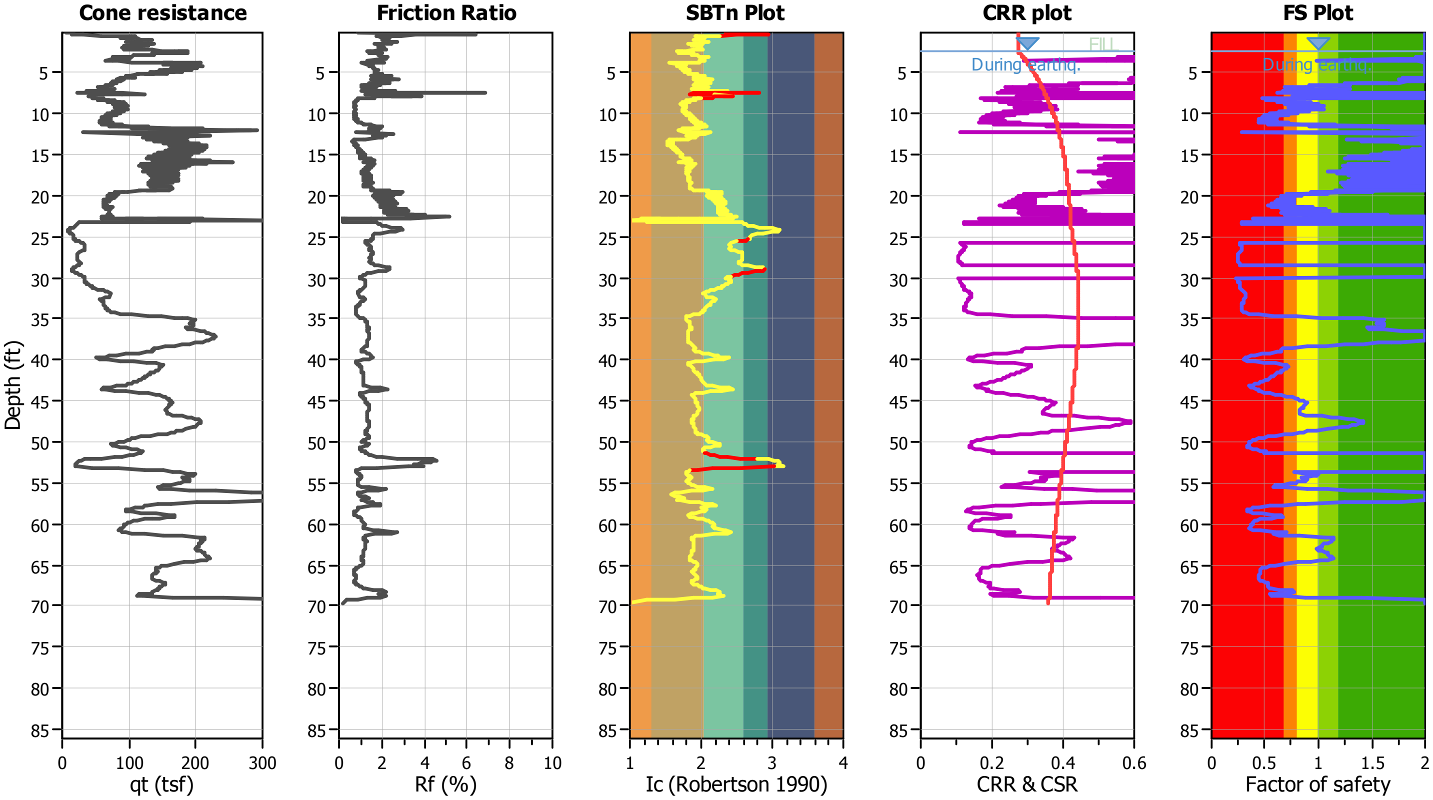
LIQUEFACTION ANALYSIS REPORT

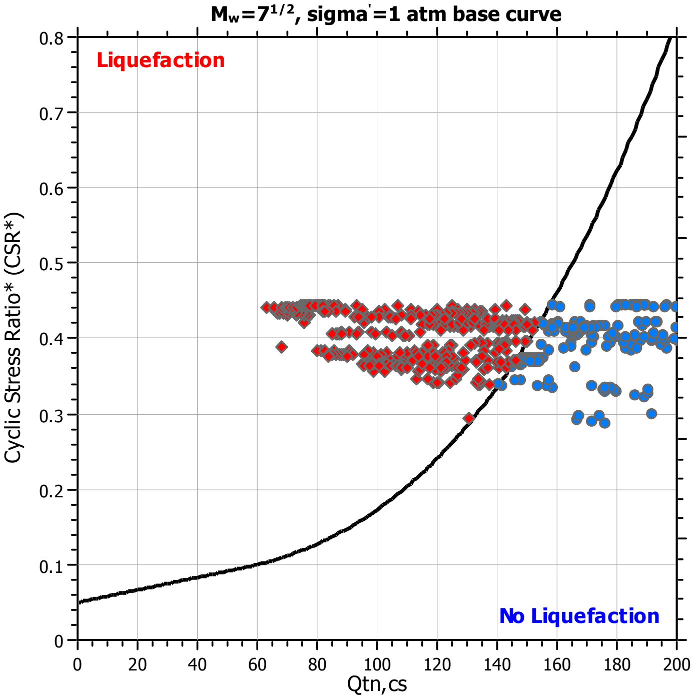
Project title : Riverwalk **Location : San Diego, CA**

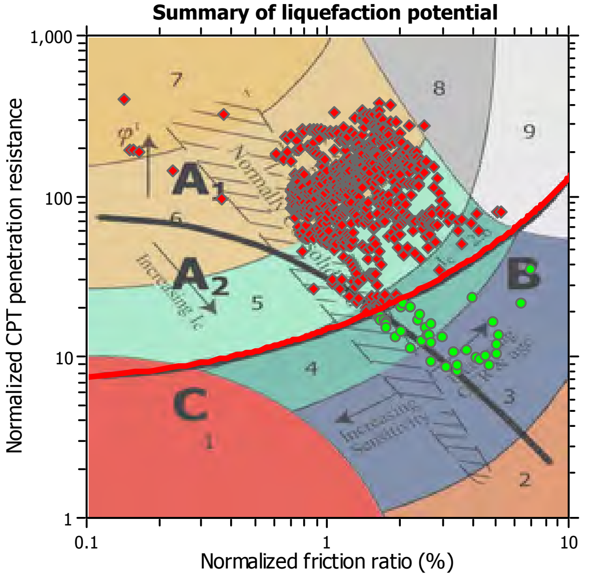
CPT file : CPT-27

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	6.50 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	6.50 ft	Fill height:	4.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

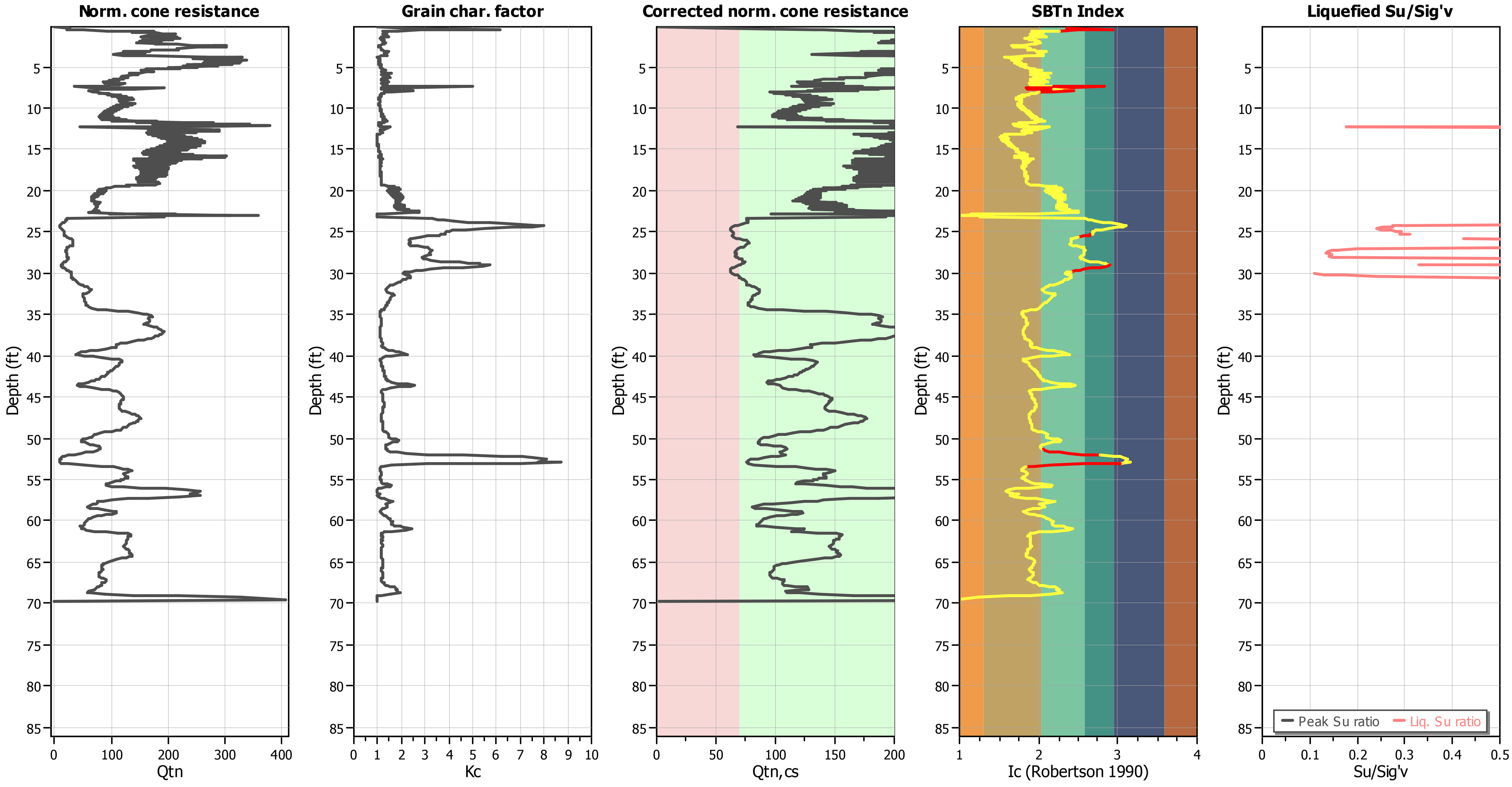






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

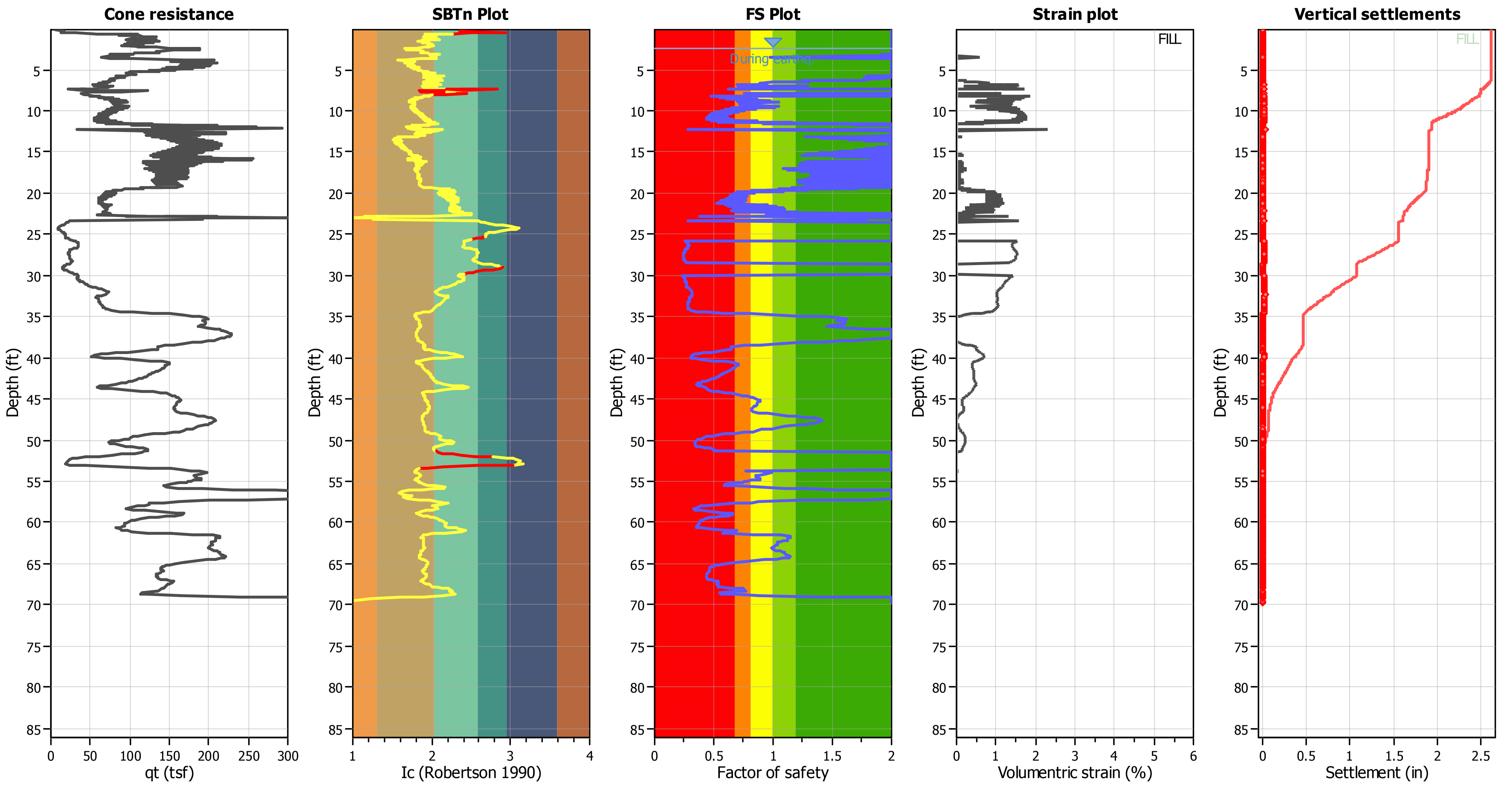
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.50 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	6.50 ft	Fill height:	4.00 ft	Limit depth:	N/A

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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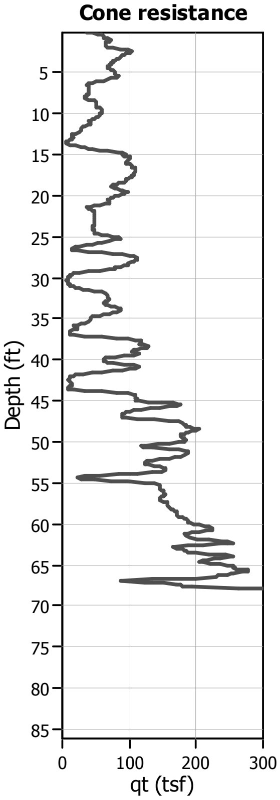
LIQUEFACTION ANALYSIS REPORT

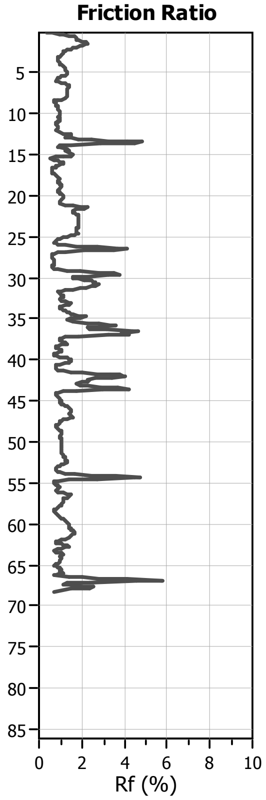
Project title : Riverwalk **Location : San Diego, CA**

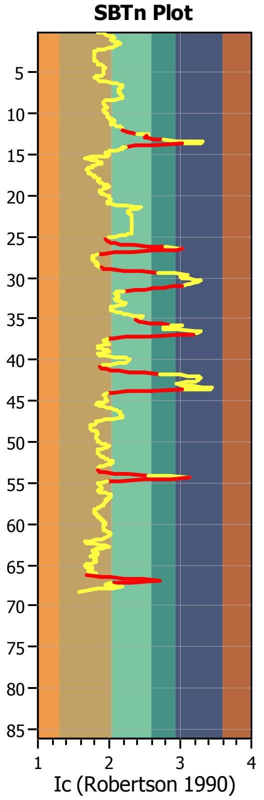
CPT file : CPT-28

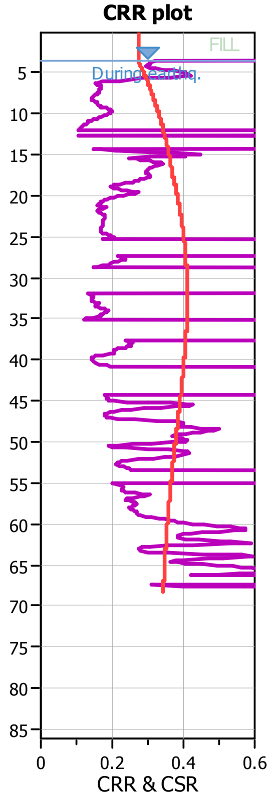
Input parameters and analysis data

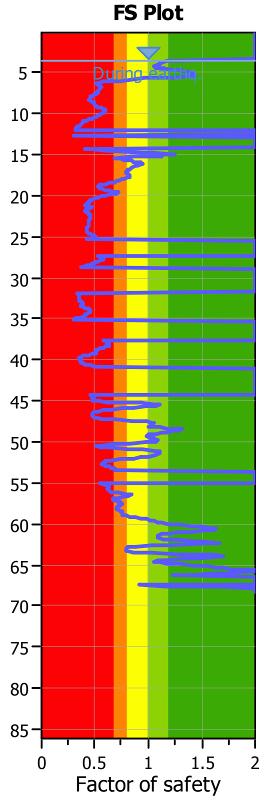
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	7.50 ft	Use fill:	Yes		
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	11.50 ft	Fill height:	8.00 ft	Clay like behavior applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth applied:	No
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

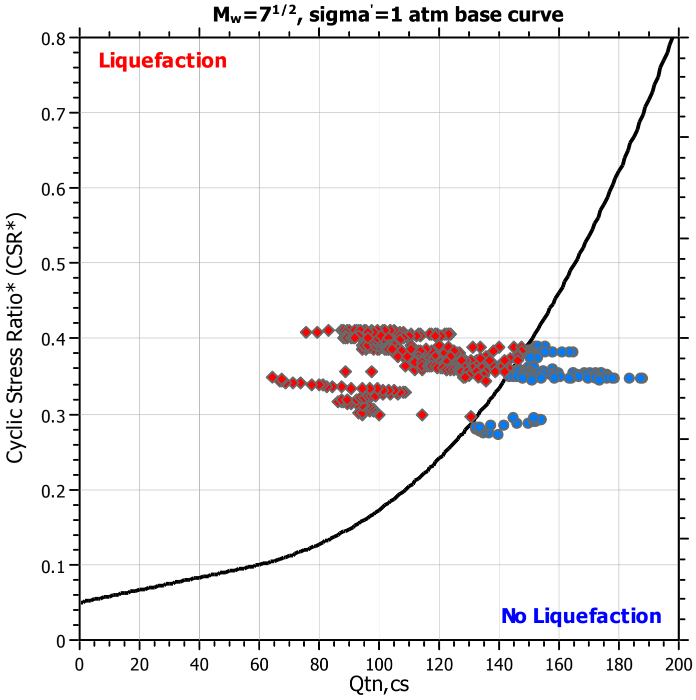

Cone resistance

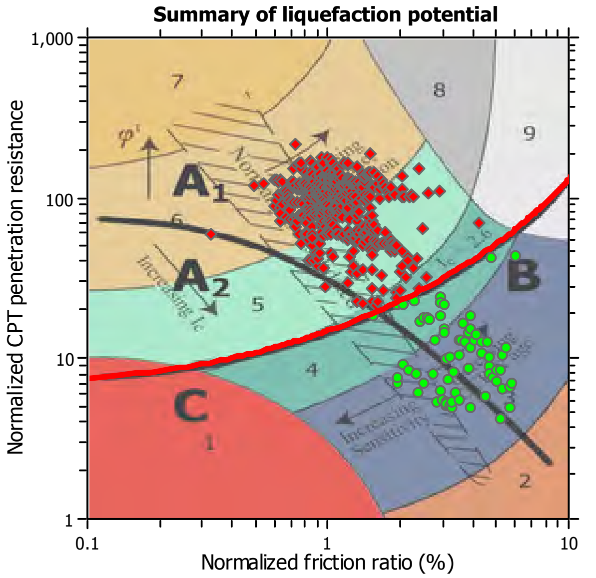

Friction Ratio


SBTn Plot


CRR plot

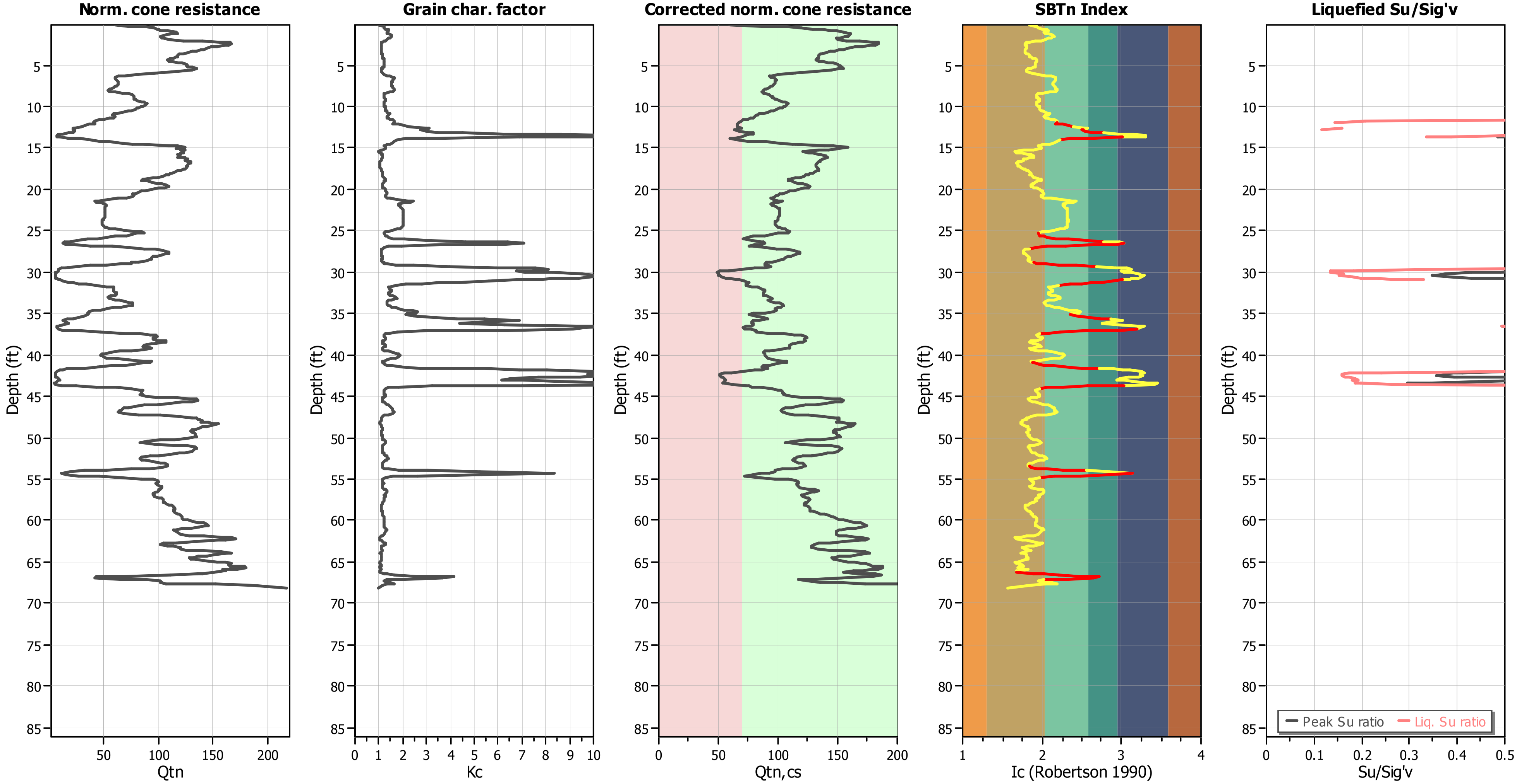

FS Plot


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


Summary of liquefaction potential

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

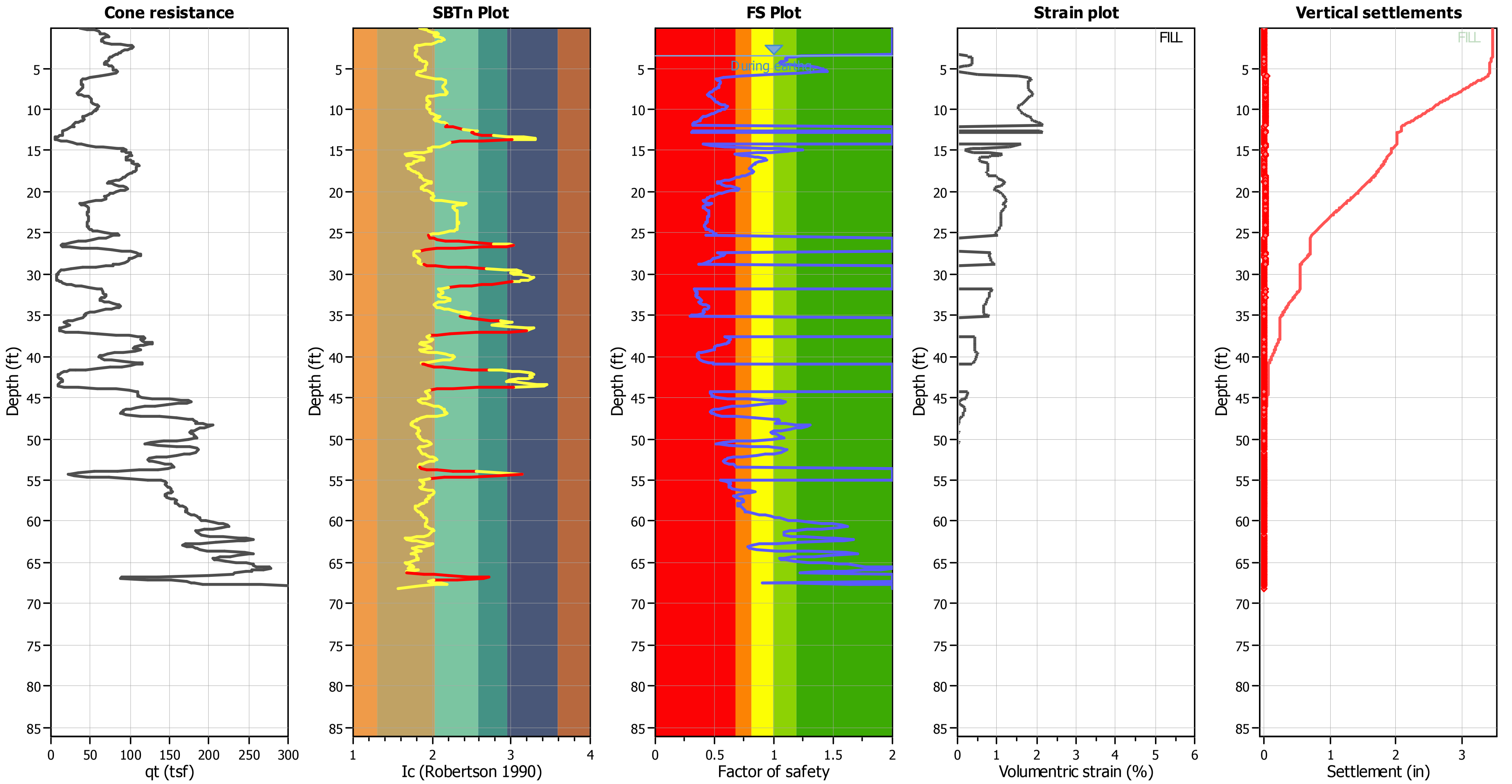
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	11.50 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	7.50 ft	Fill height:	8.00 ft	Limit depth:	N/A

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

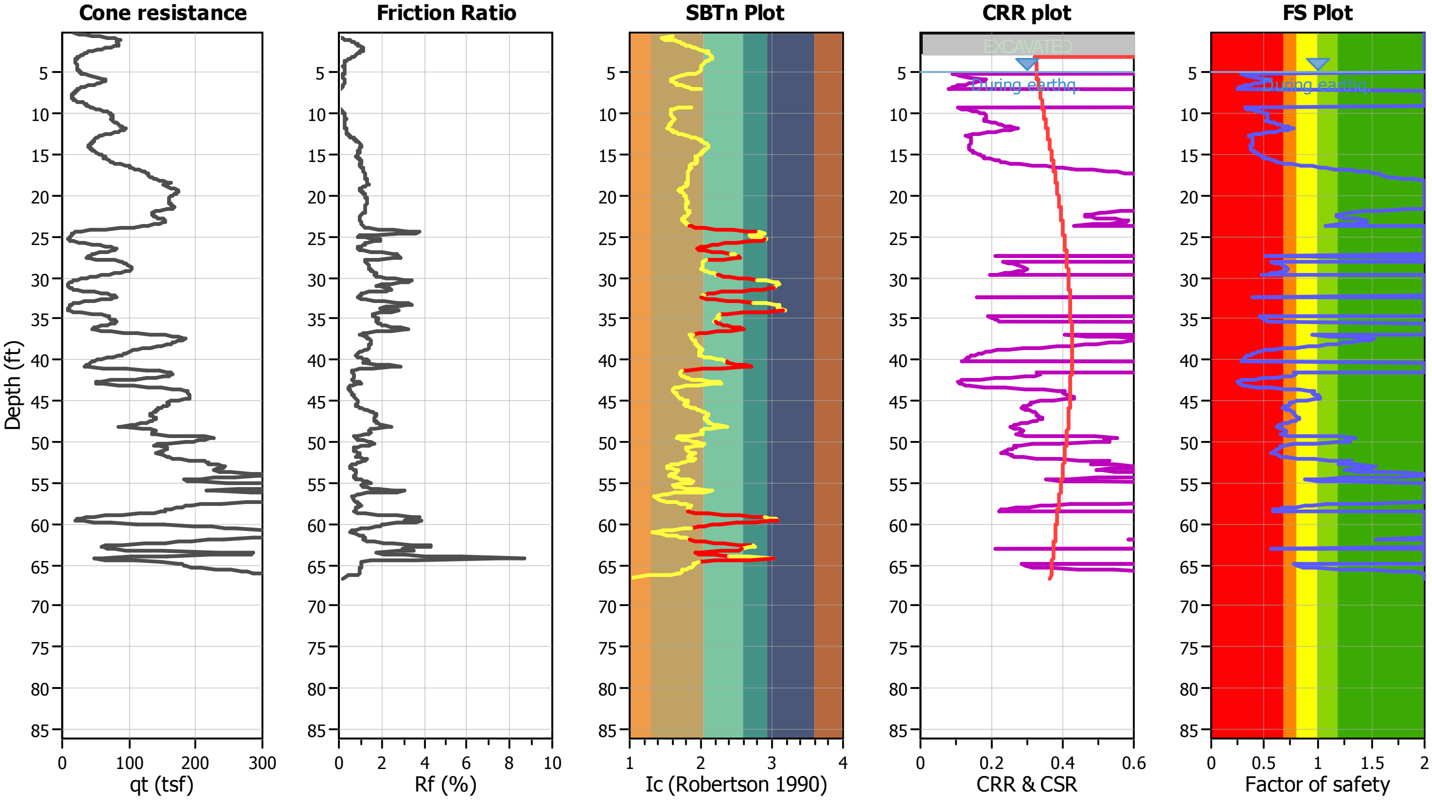
LIQUEFACTION ANALYSIS REPORT

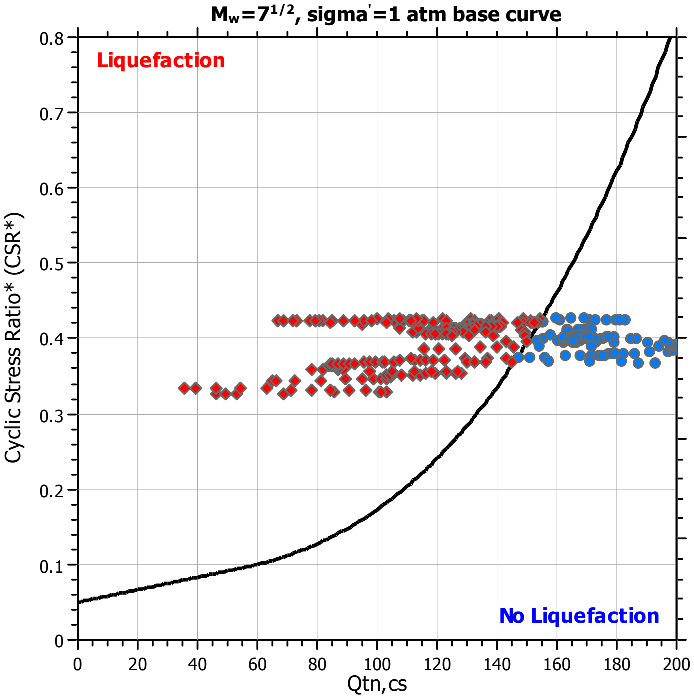
Project title : Riverwalk **Location : San Diego, CA**

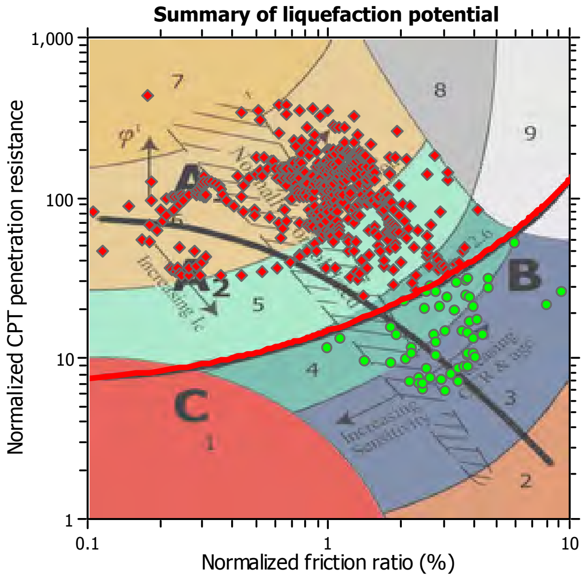
CPT file : CPT-29

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	9.00 ft	Excavation:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	5.00 ft	Excavation depth:	3.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Footing load:	2.00 tsf	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		







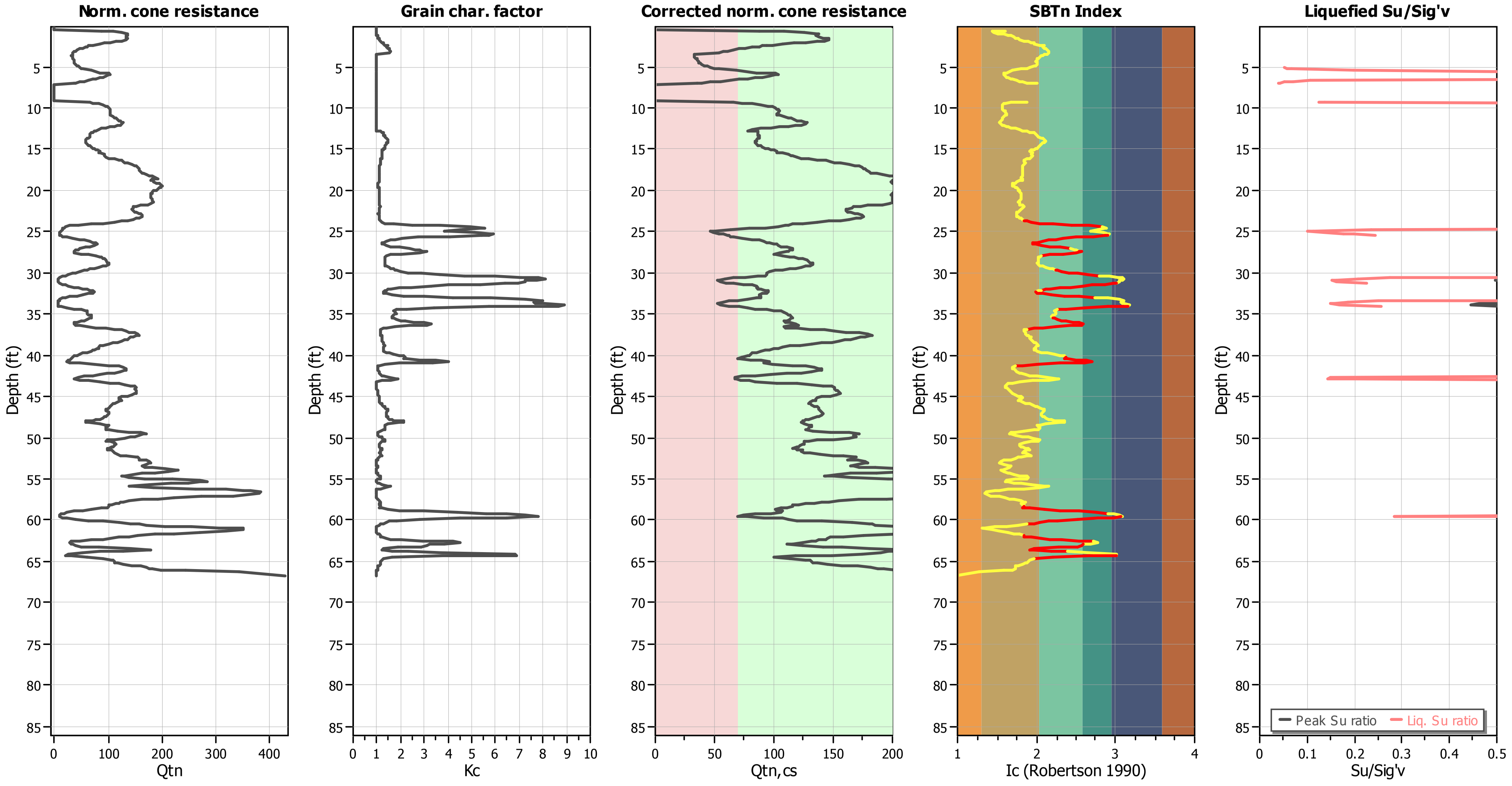
Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading

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

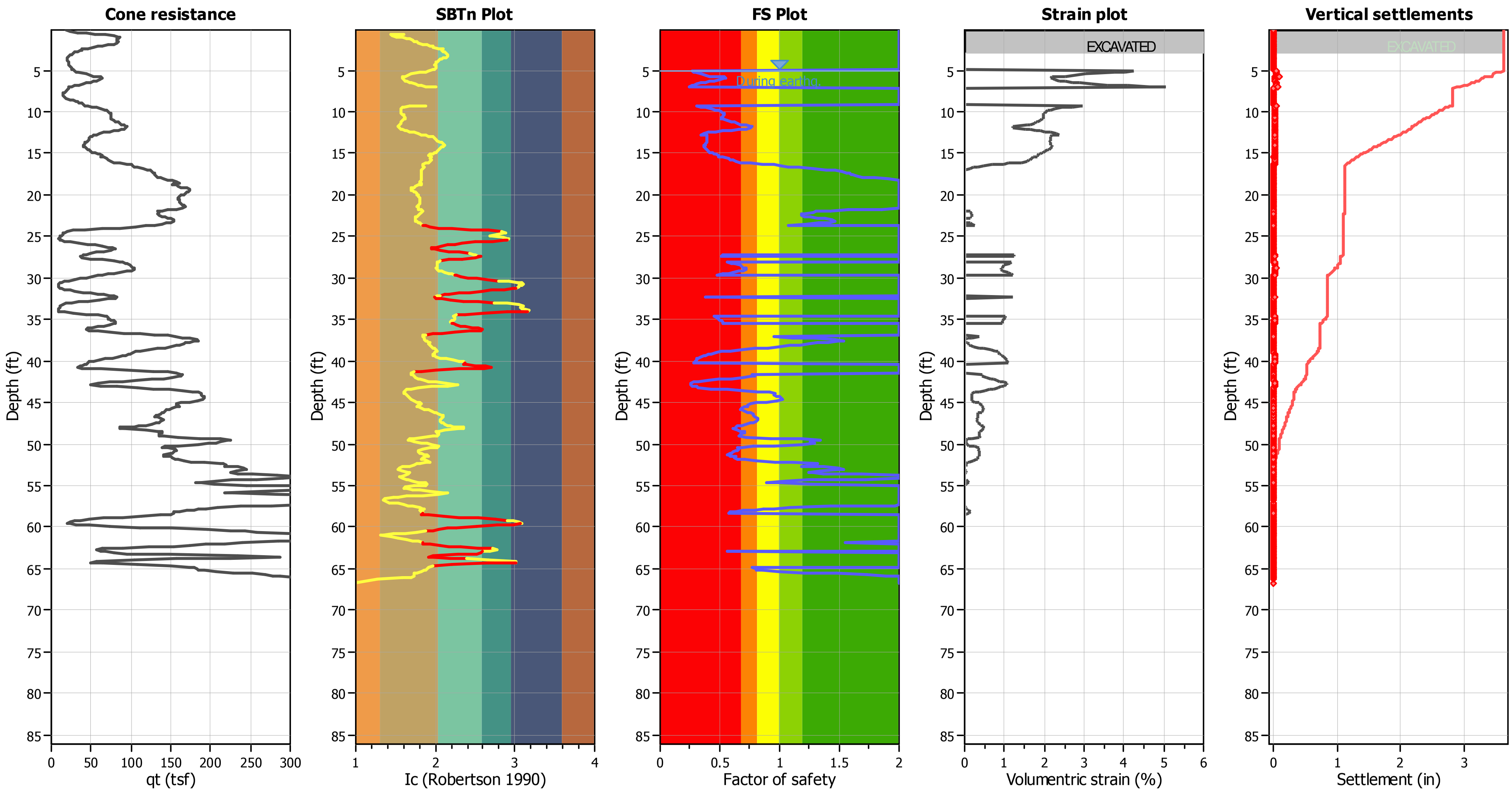
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	5.00 ft	Footing load:	2.00 tsf
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Excavation:	Yes	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Excavation depth:	3.00 ft	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

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I_c: Soil Behaviour Type Index
FS: Calculated Factor of Safety against liquefaction
Volumentric strain: Post-liquefaction volumentric strain

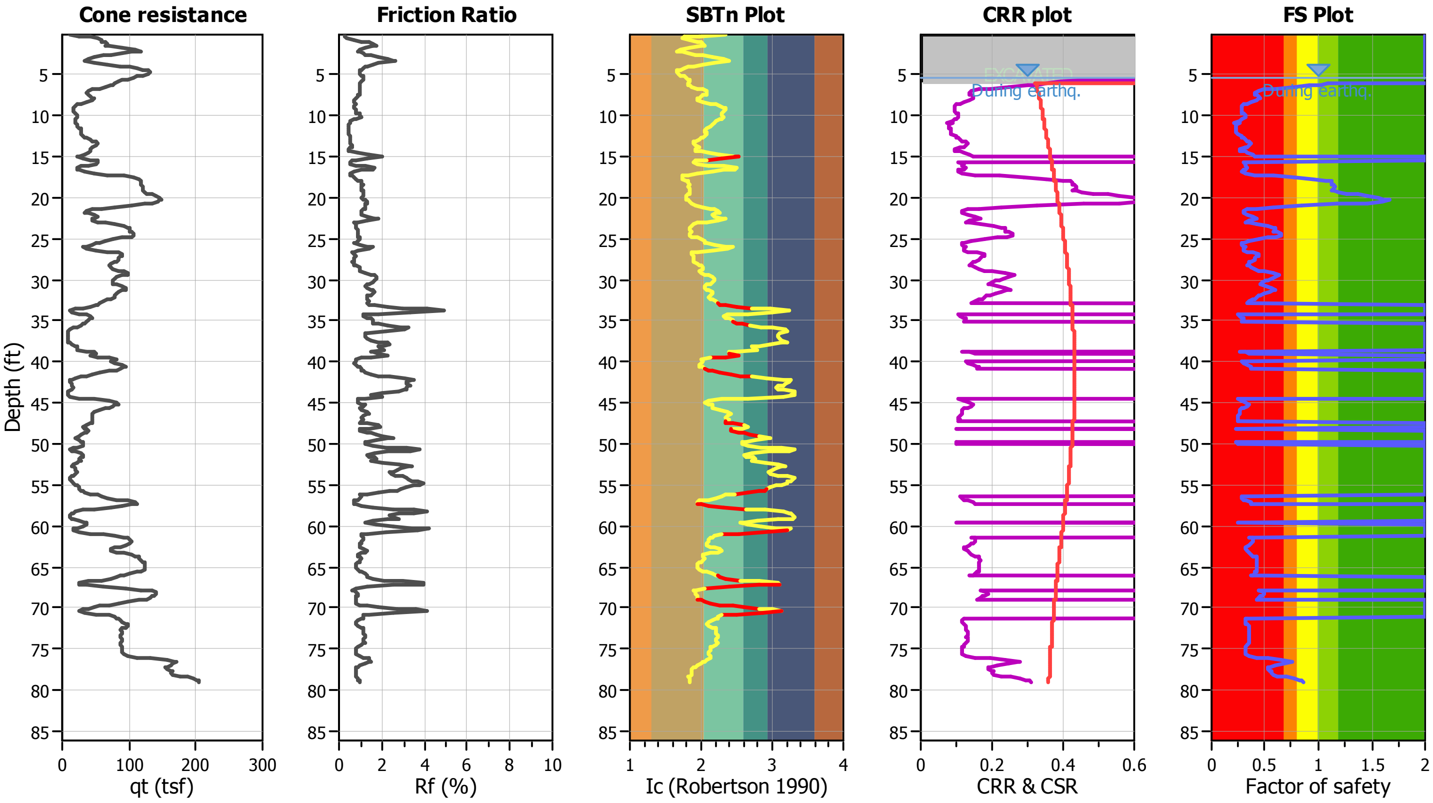
LIQUEFACTION ANALYSIS REPORT

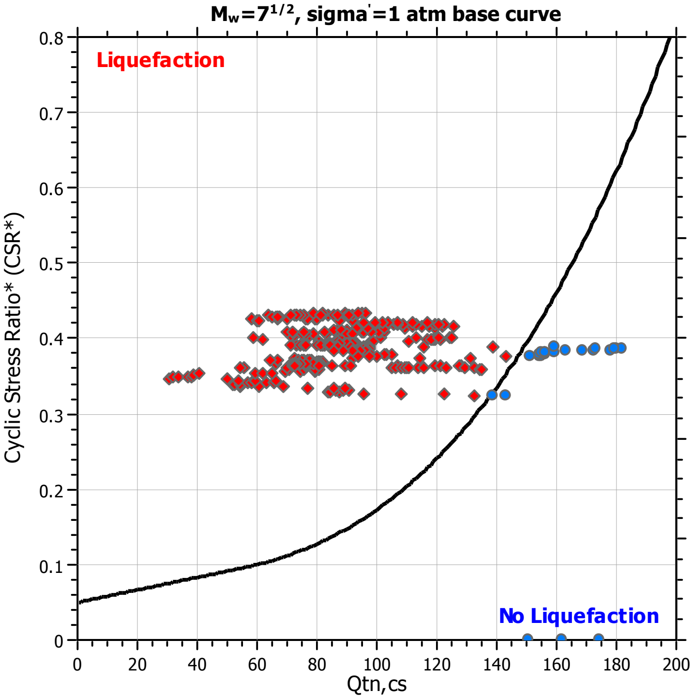
Project title : Riverwalk **Location : San Diego, CA**

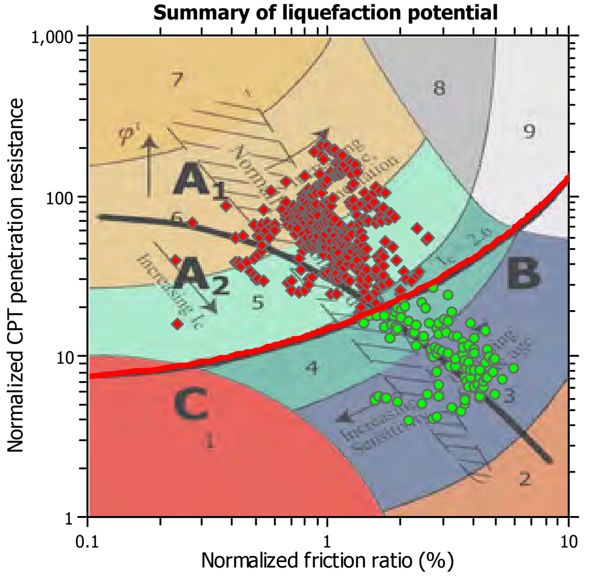
CPT file : CPT-30

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	8.50 ft	Excavation:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	5.50 ft	Excavation depth:	6.00 ft		
Points to test:	Based on Ic value	Average results interval:	3	Footing load:	2.00 tsf	Limit depth applied:	No
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.55	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
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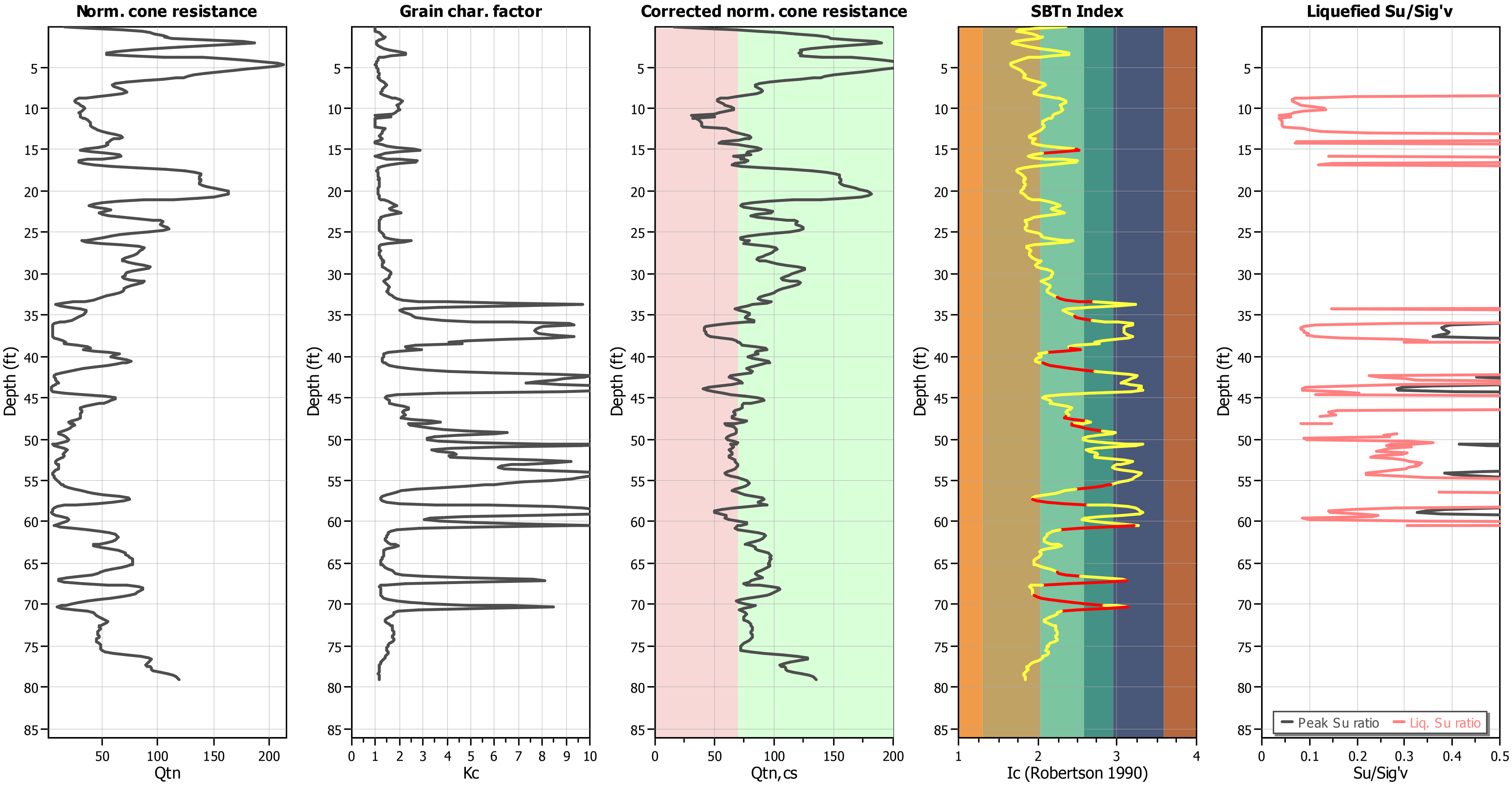
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

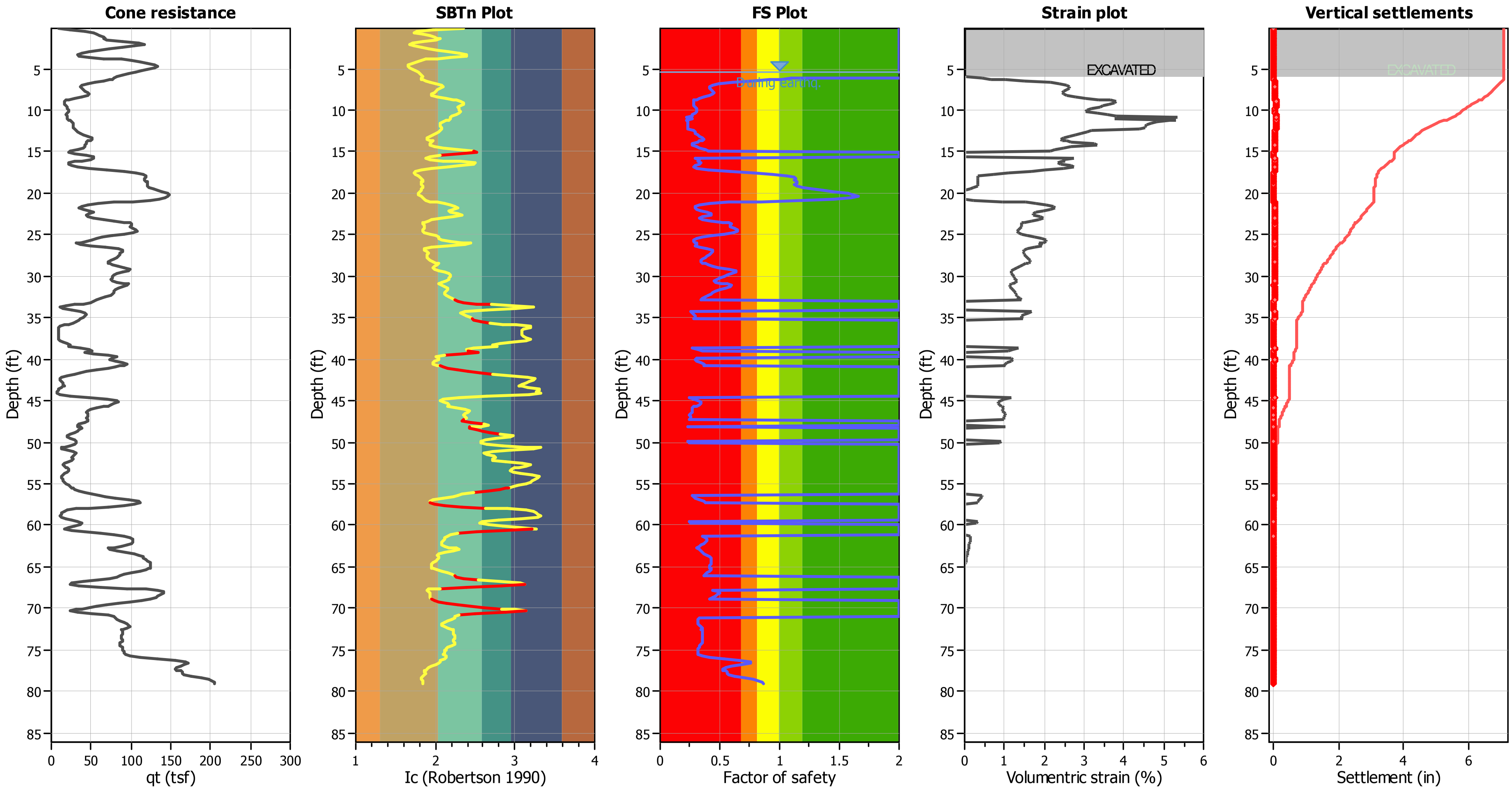
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	5.50 ft	Footing load:	2.00 tsf
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Excavation:	Yes	Limit depth applied:	No
Depth to water table (insitu):	8.50 ft	Excavation depth:	6.00 ft	Limit depth:	N/A

Estimation of post-earthquake settlements



Cone resistance

SBTn Plot

FS Plot

Strain plot

Vertical 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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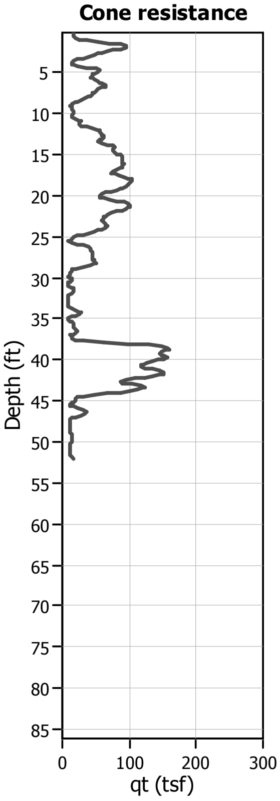
LIQUEFACTION ANALYSIS REPORT

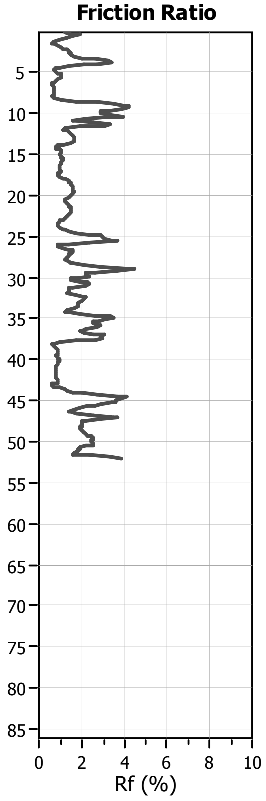
Project title : Riverwalk **Location : San Diego, CA**

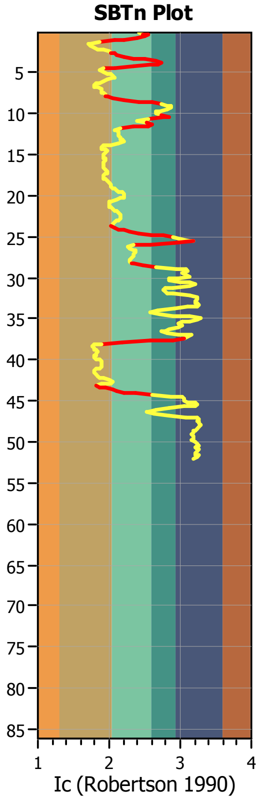
CPT file : CPT-31

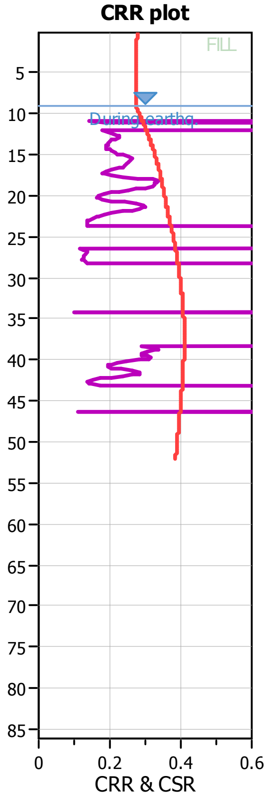
Input parameters and analysis data

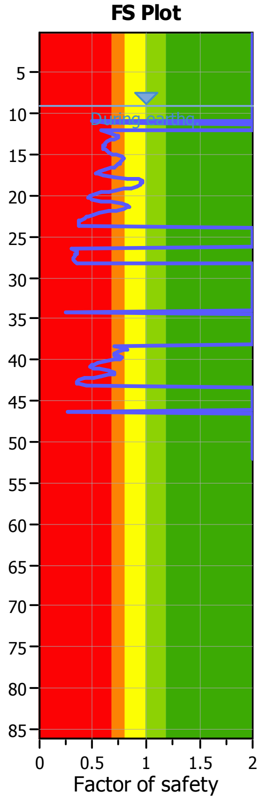
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	12.00 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	12.00 ft	Fill height:	3.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

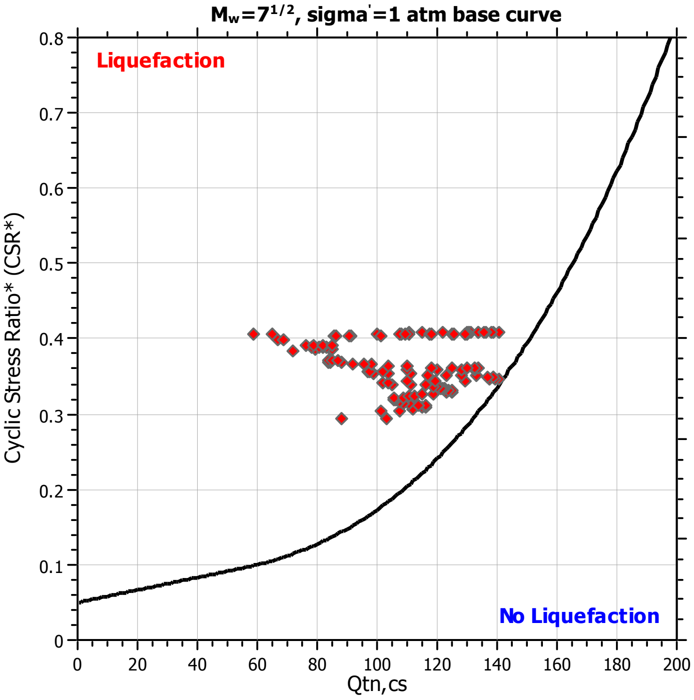


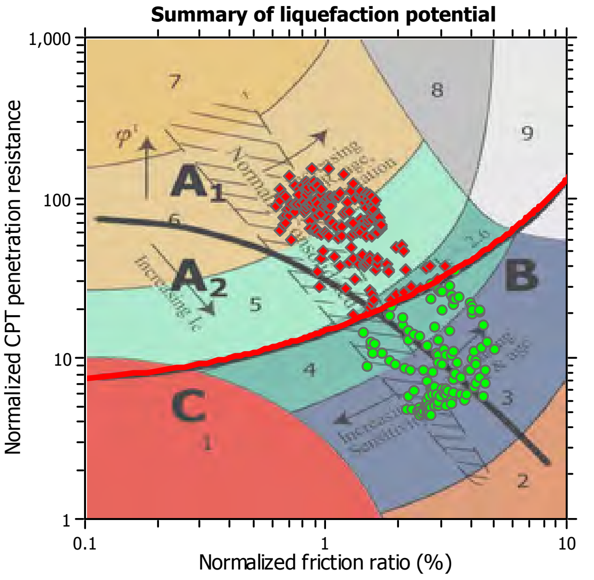






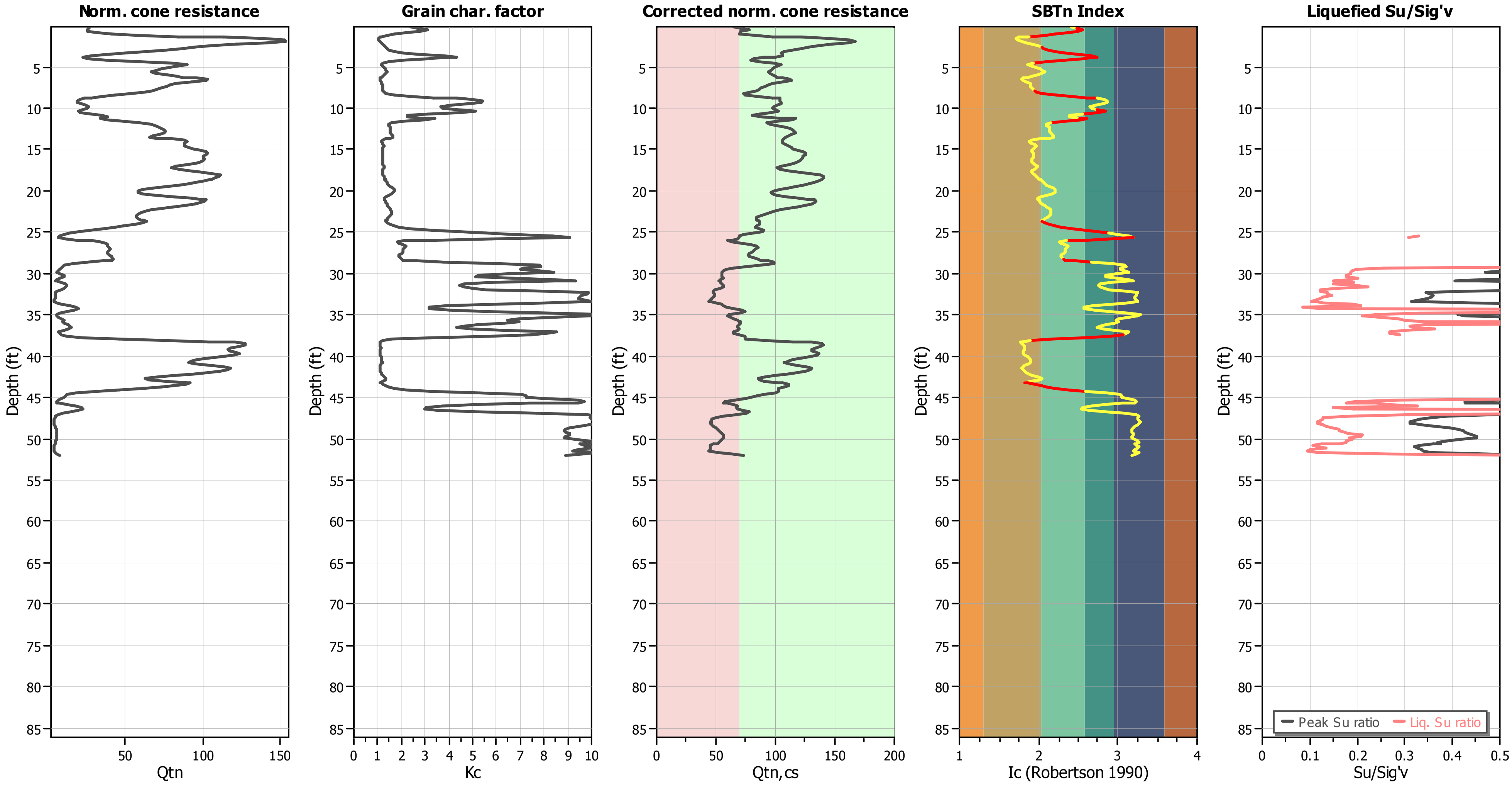






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

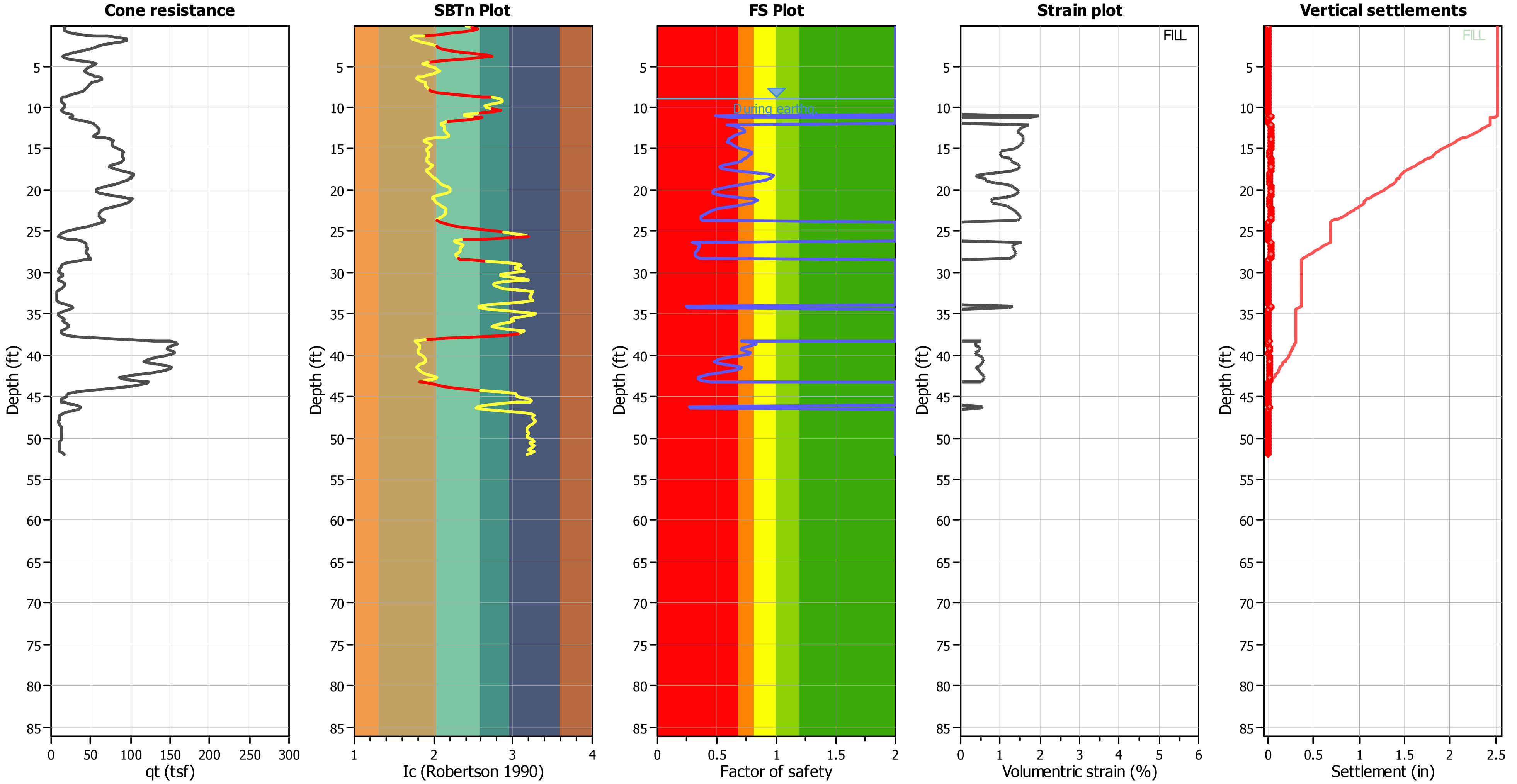
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	3.00 ft	Limit depth:	N/A

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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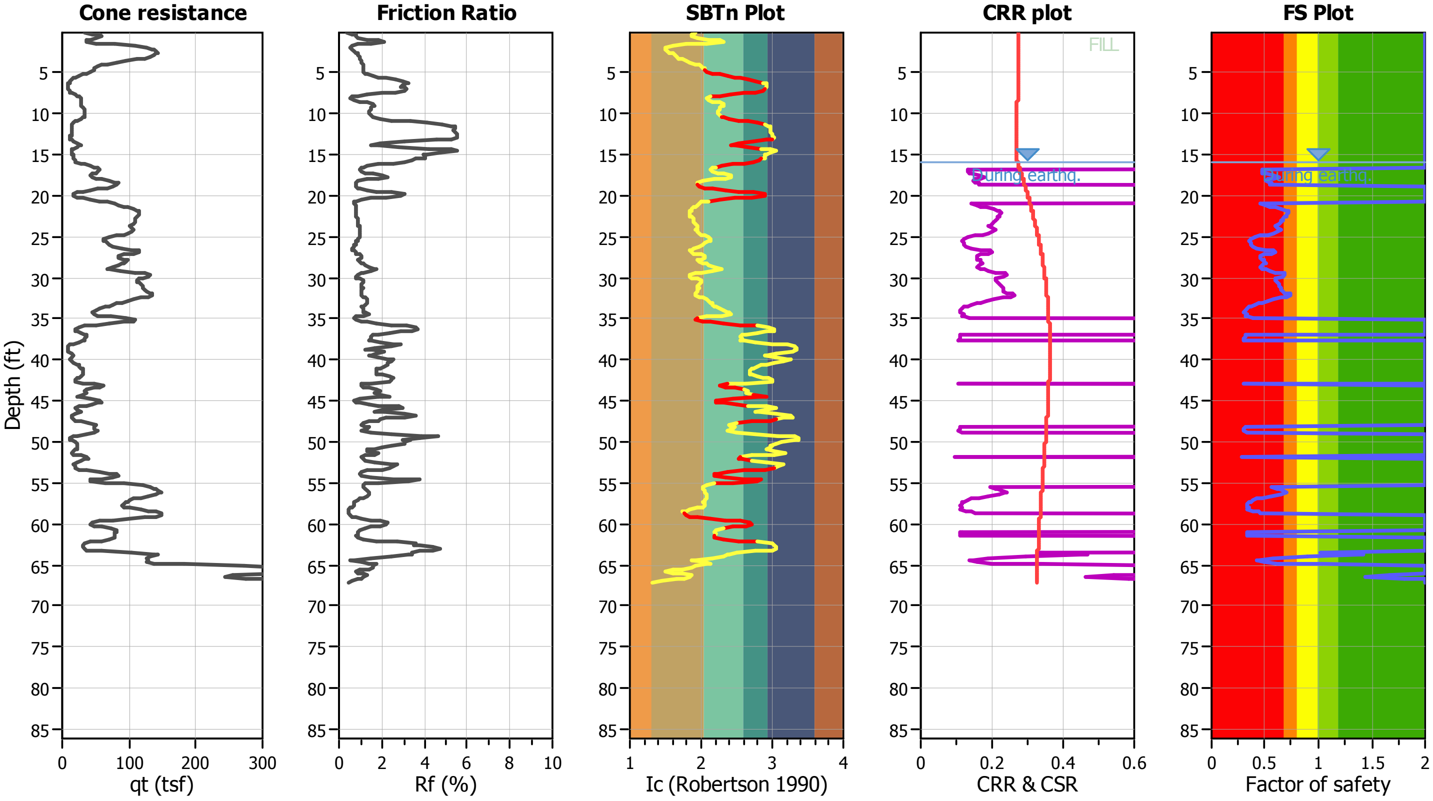
LIQUEFACTION ANALYSIS REPORT

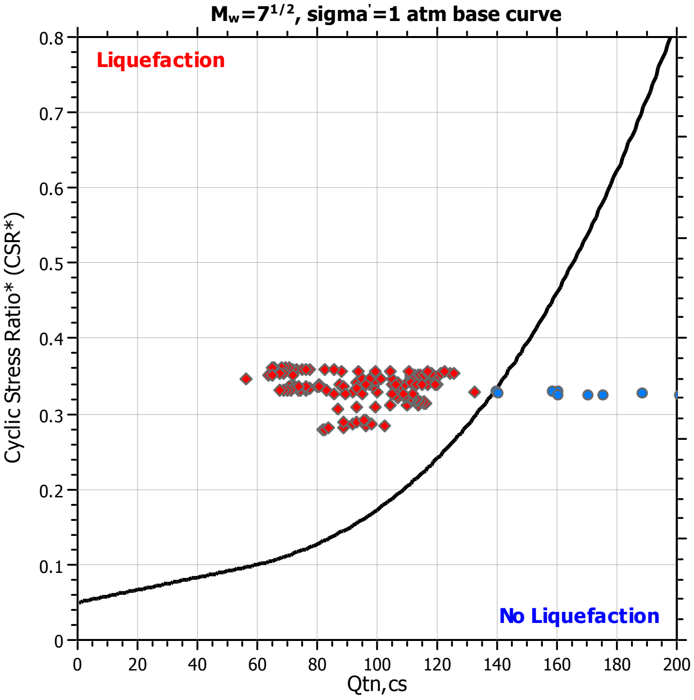
Project title : Riverwalk **Location : San Diego, CA**

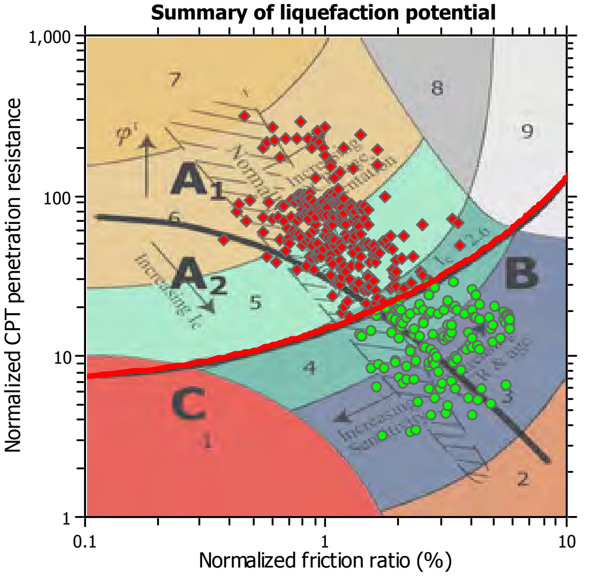
CPT file : CPT-32

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	19.00 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	20.00 ft	Fill height:	4.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

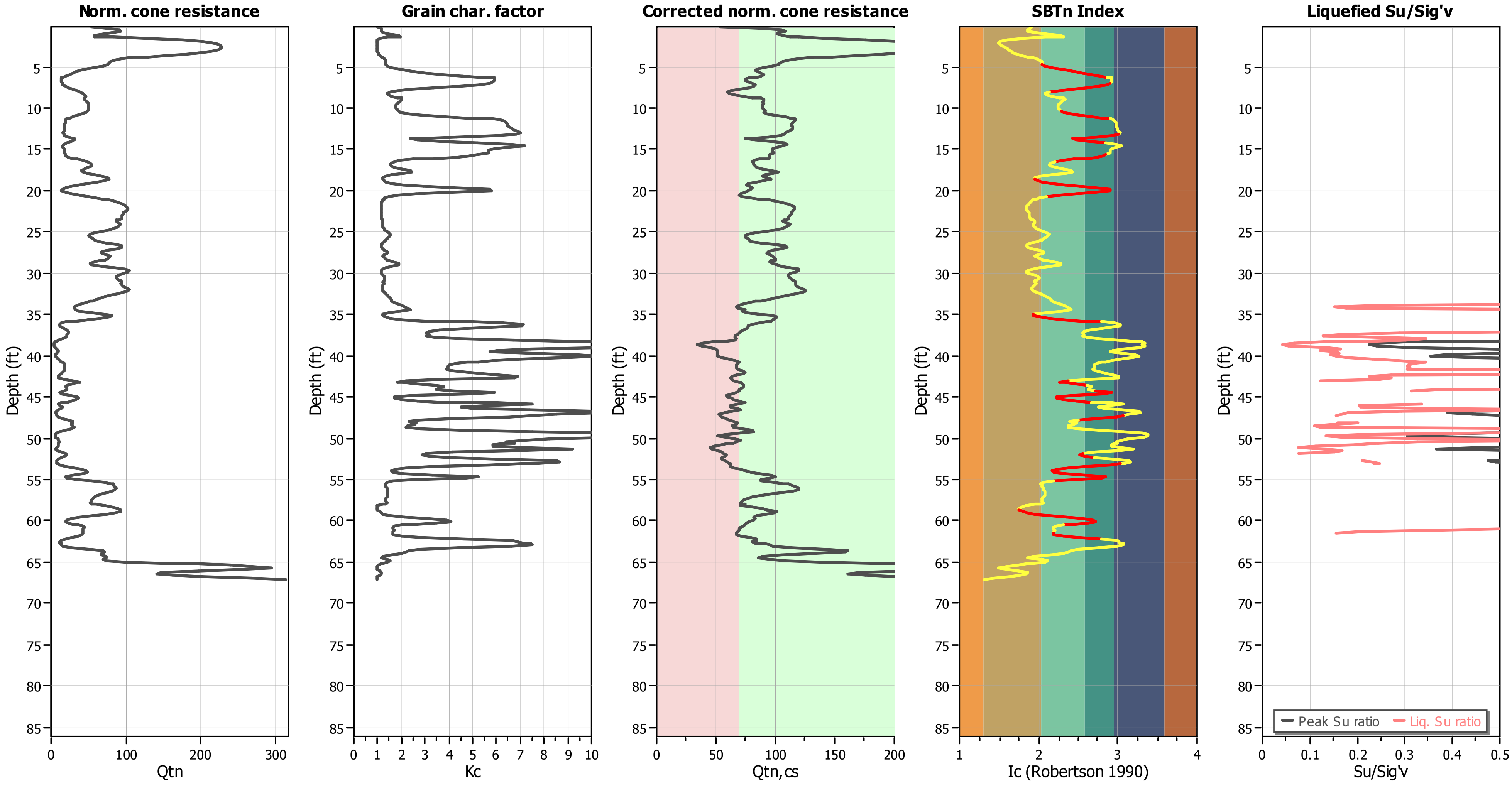






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

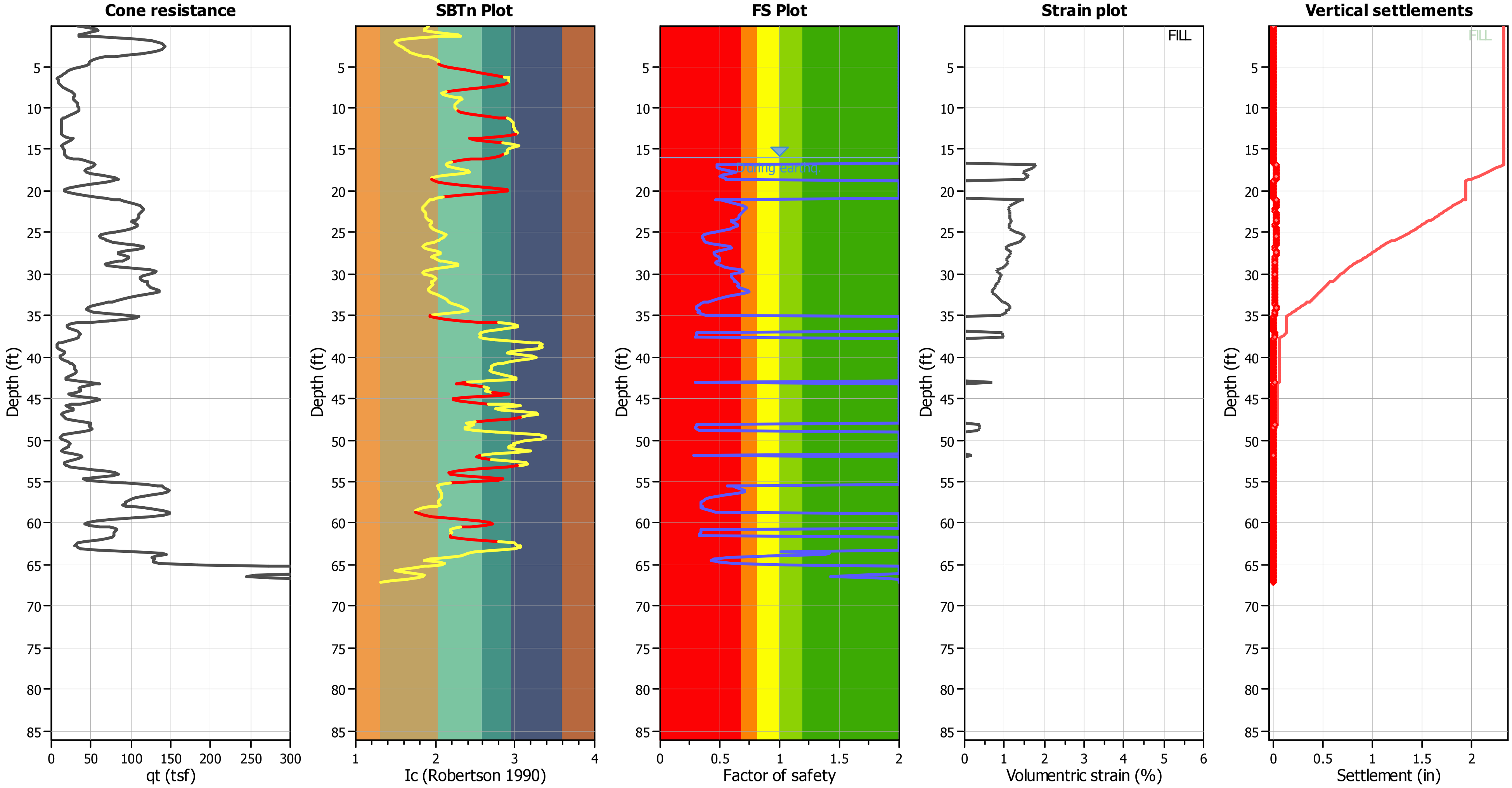
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	20.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	19.00 ft	Fill height:	4.00 ft	Limit depth:	N/A

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

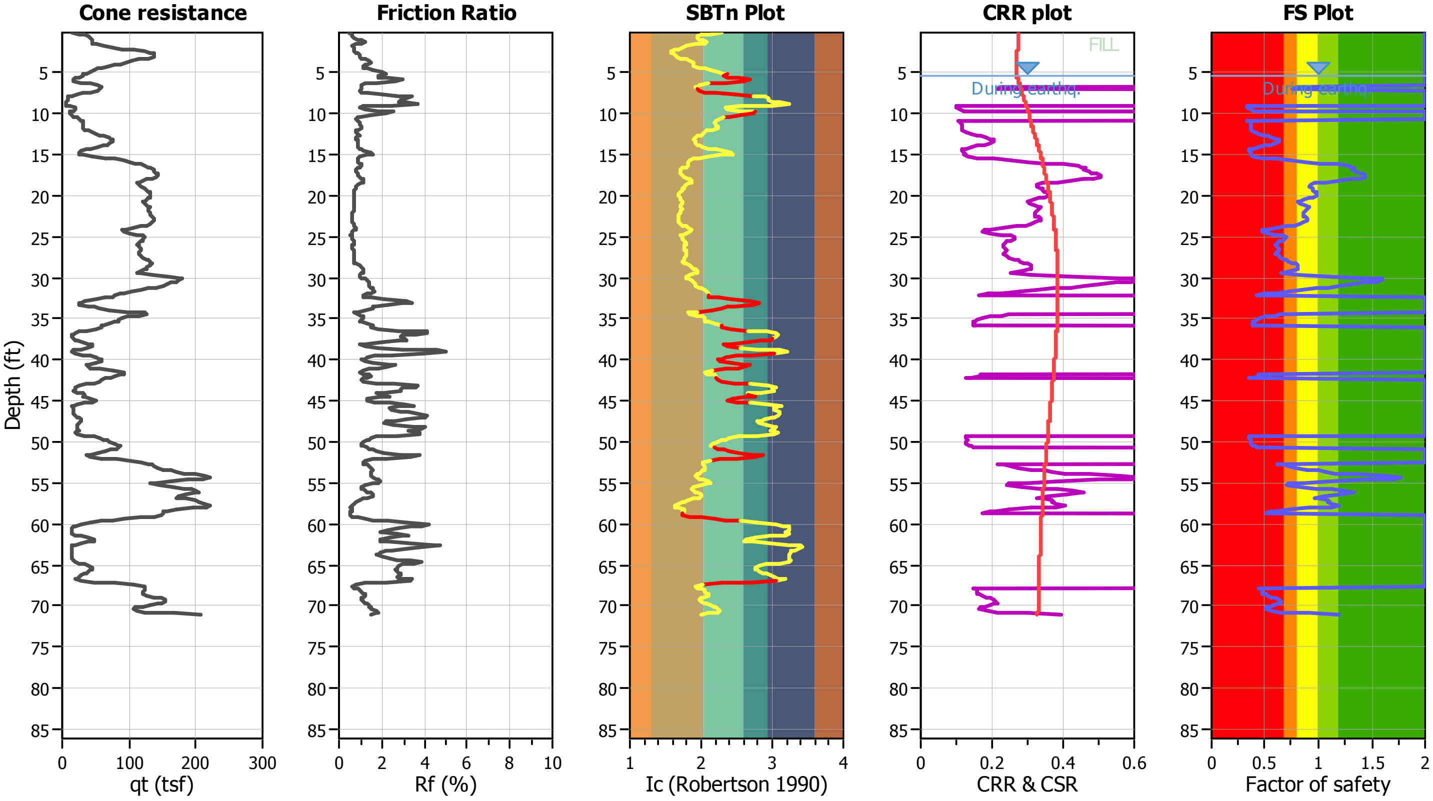
LIQUEFACTION ANALYSIS REPORT

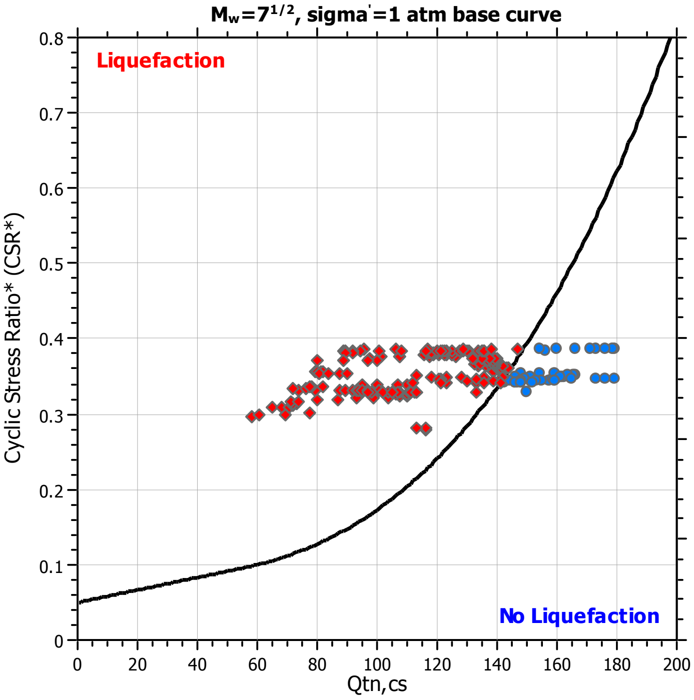
Project title : Riverwalk **Location : San Diego, CA**

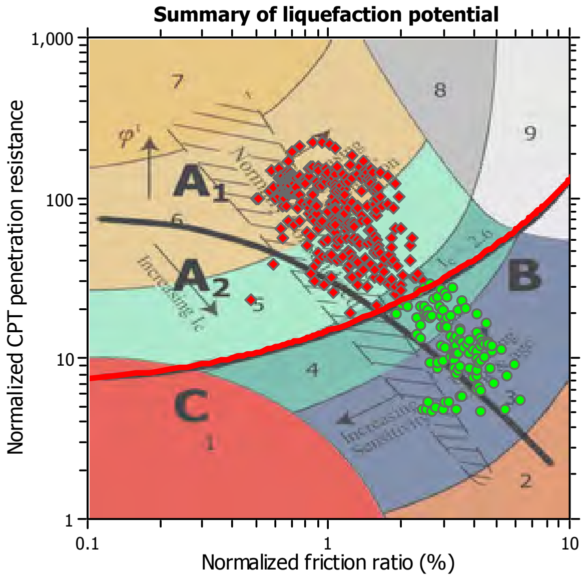
CPT file : CPT-33

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	10.50 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	15.50 ft	Fill height:	10.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

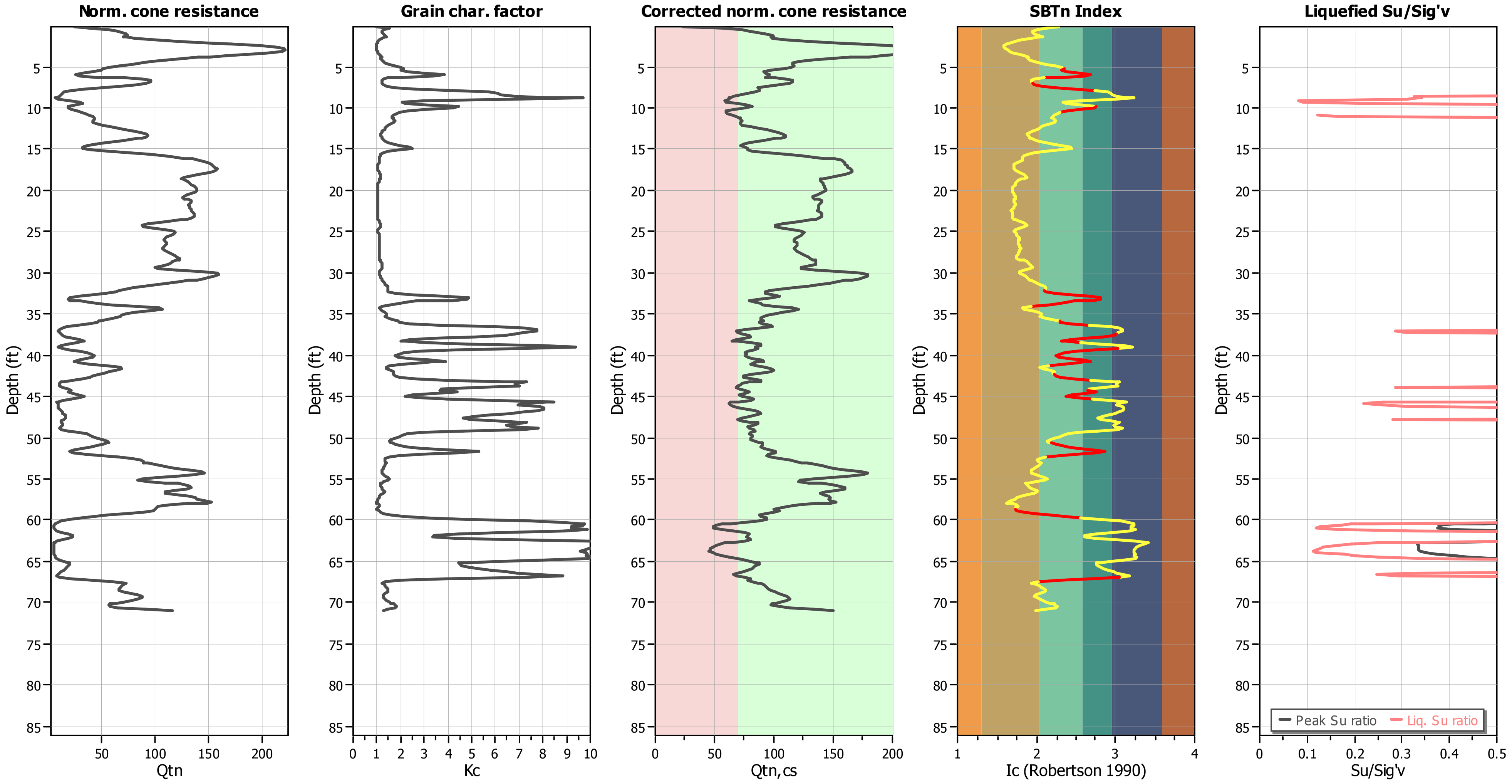






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

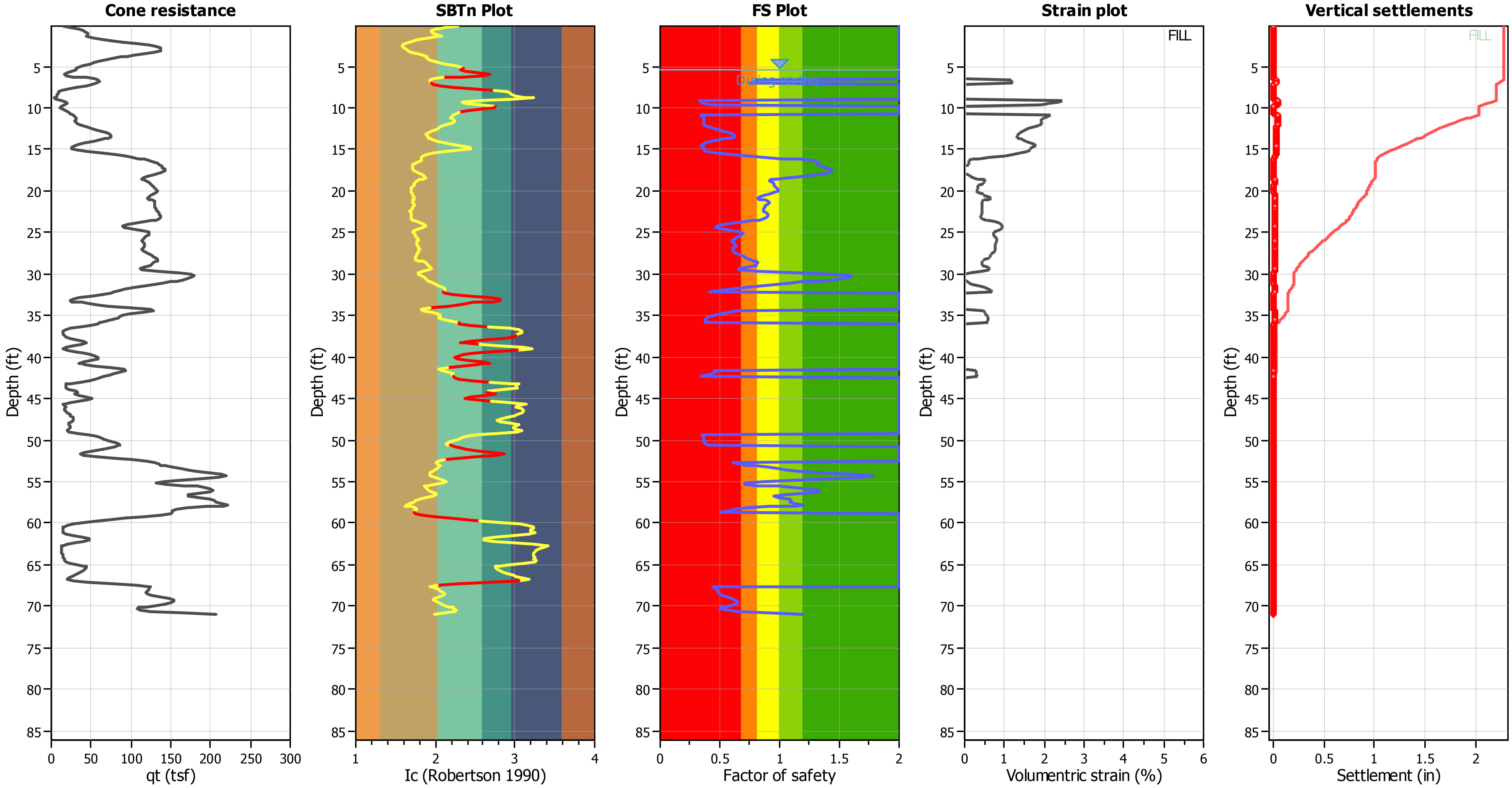
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	15.50 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	10.50 ft	Fill height:	10.00 ft	Limit depth:	N/A

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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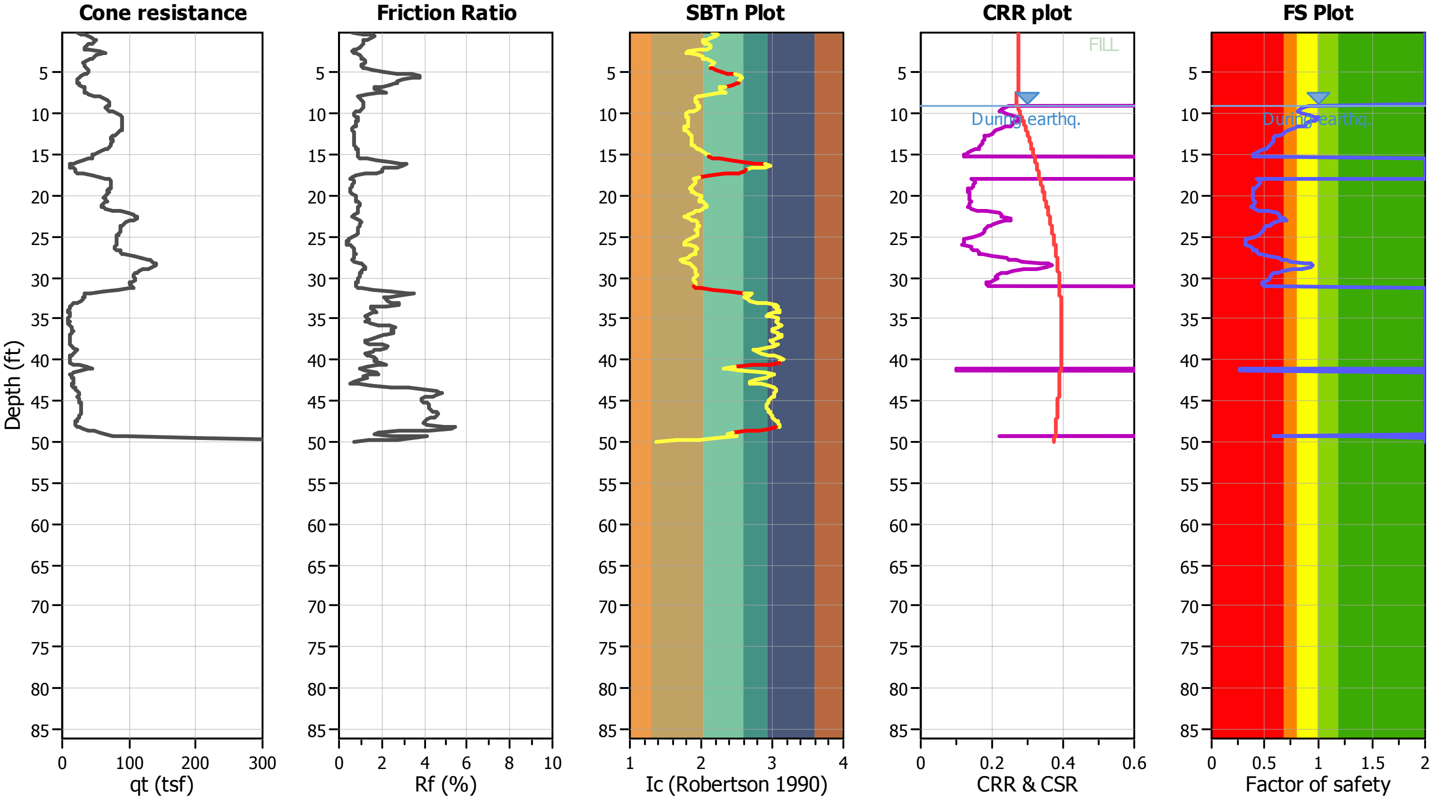
LIQUEFACTION ANALYSIS REPORT

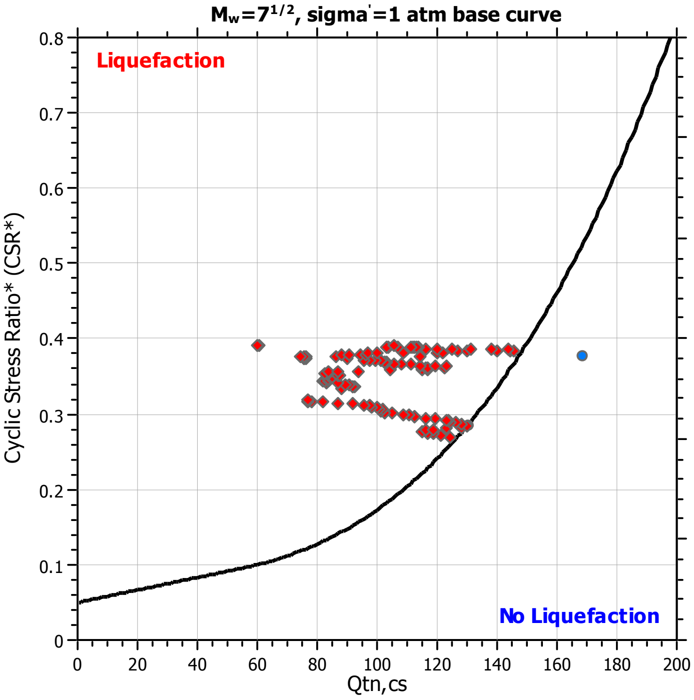
Project title : Riverwalk **Location : San Diego, CA**

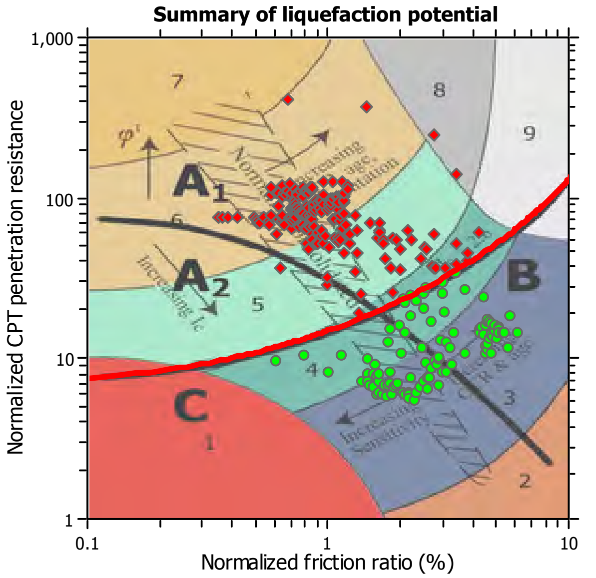
CPT file : CPT-34

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	12.00 ft	Use fill:	Yes	Clay like behavior	
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	14.00 ft	Fill height:	5.00 ft	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth applied:	No
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

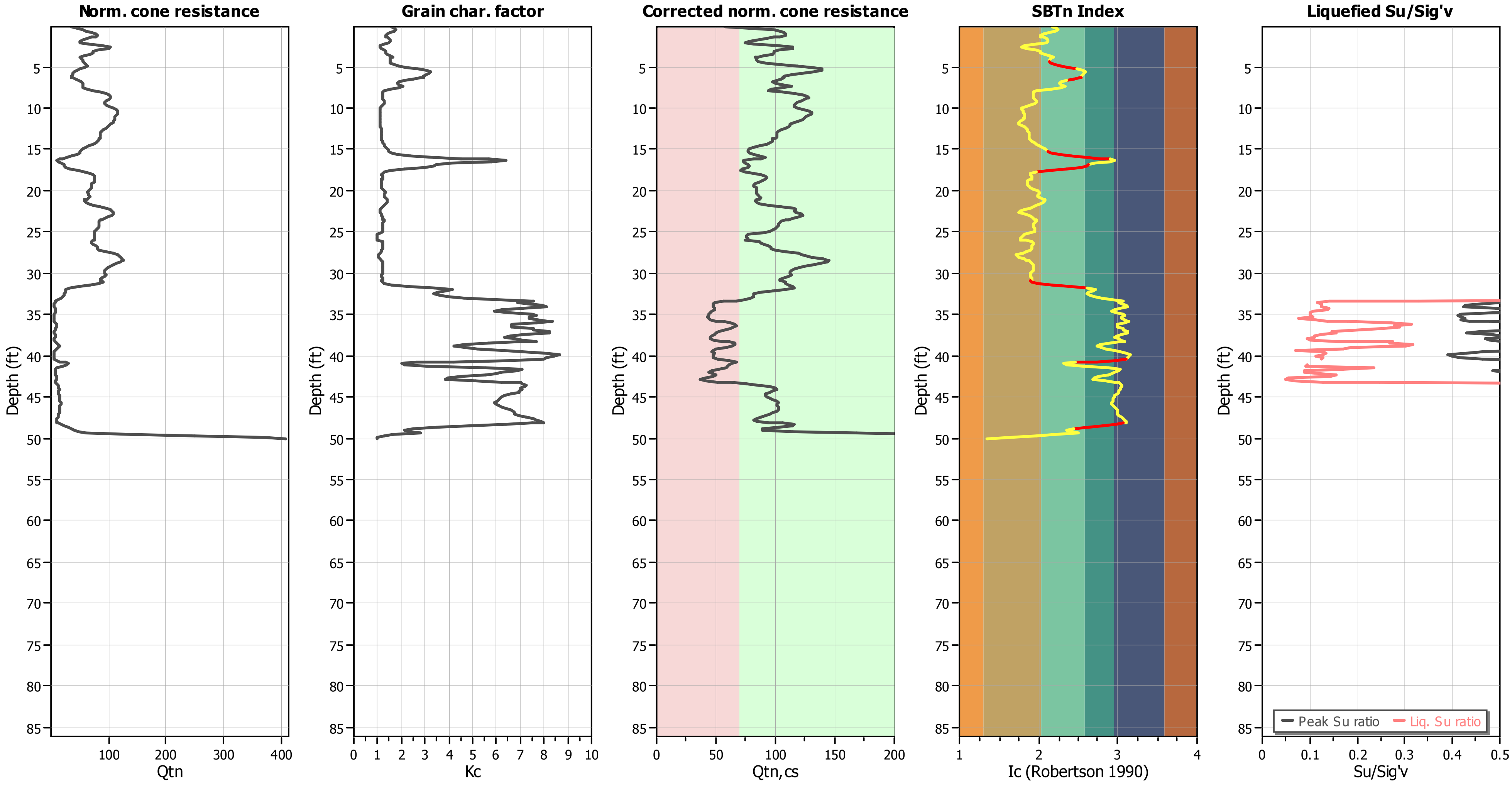






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

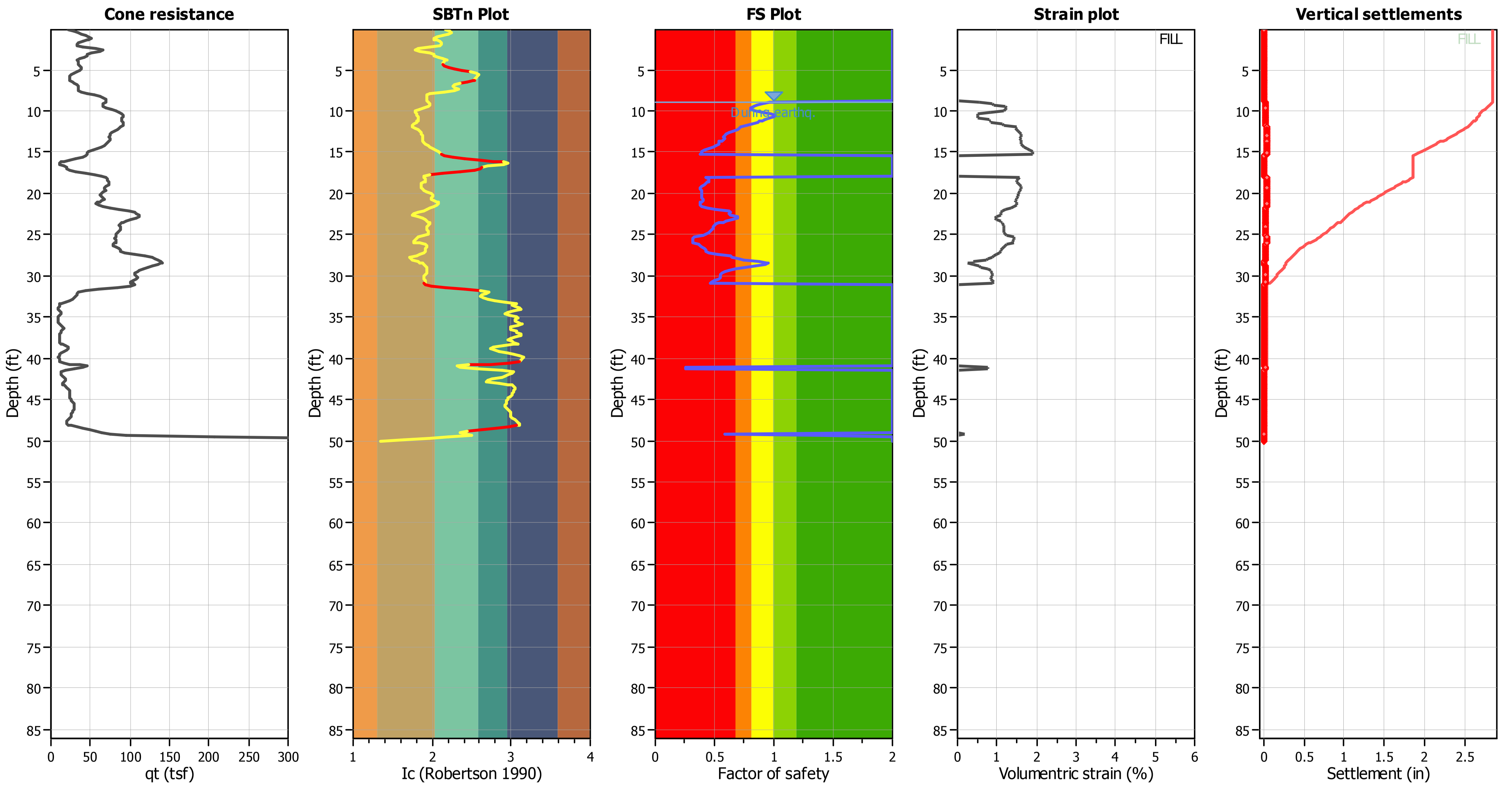
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	14.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	5.00 ft	Limit depth:	N/A

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

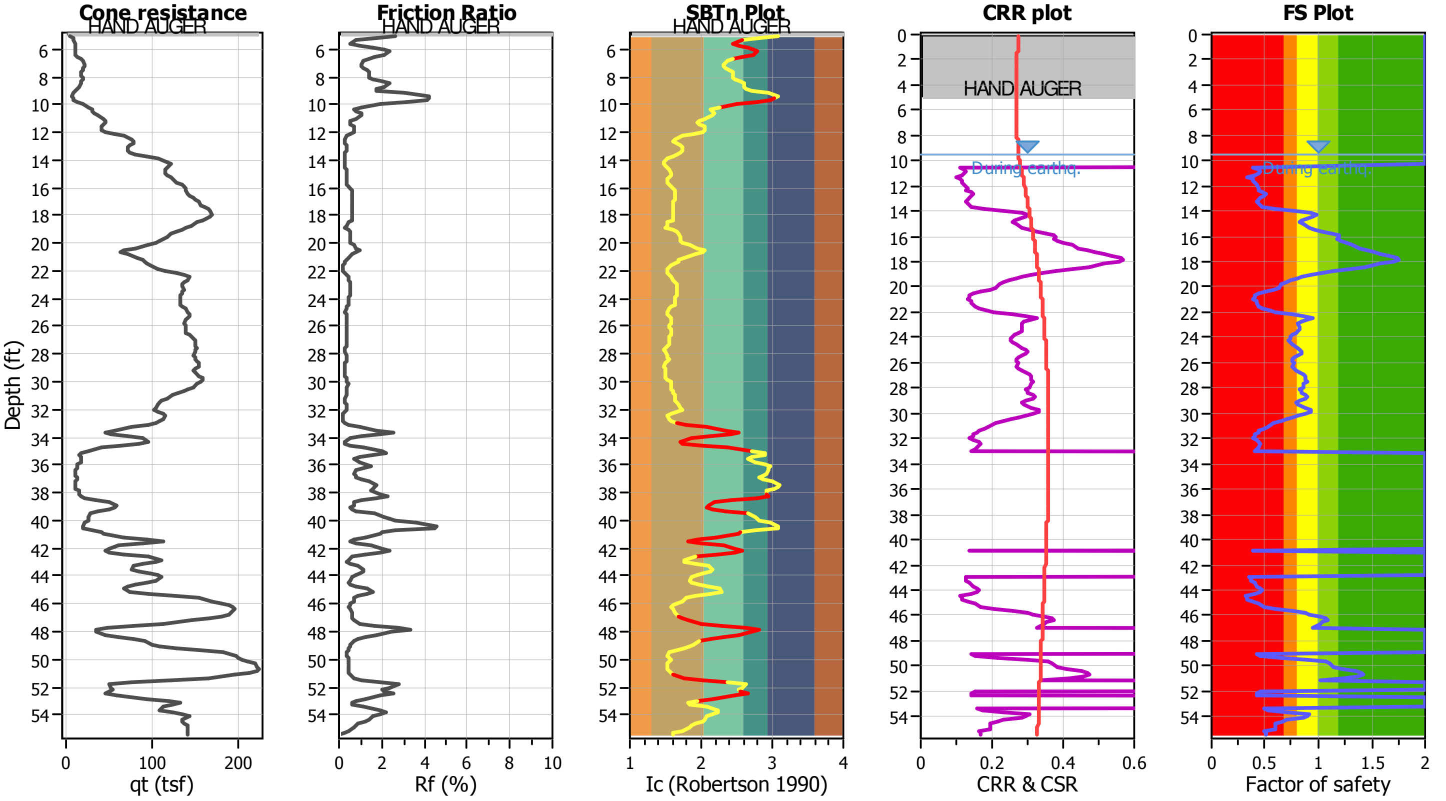
LIQUEFACTION ANALYSIS REPORT

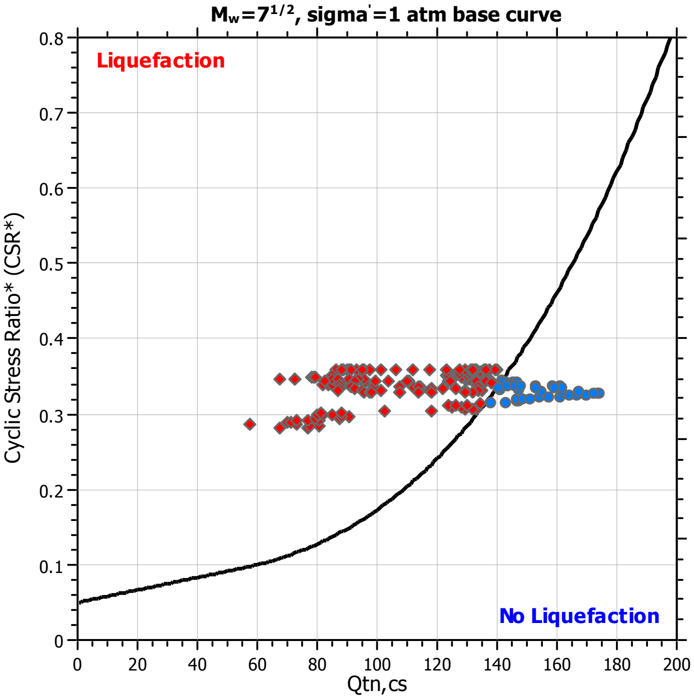
Project title : Riverwalk **Location : San Diego, CA**

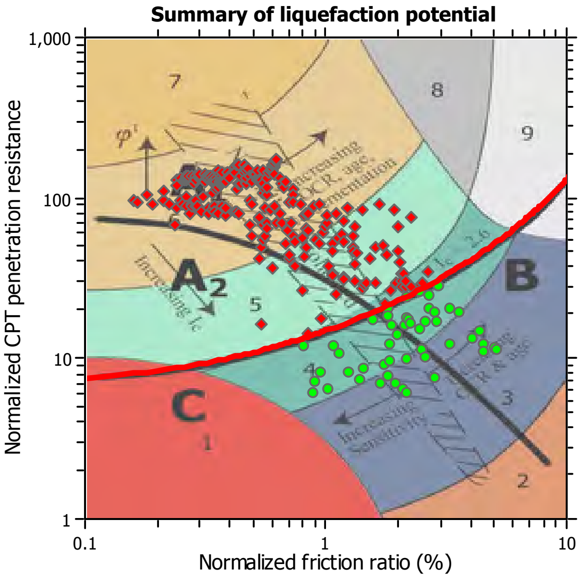
CPT file : CPT-35

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	13.50 ft	Use fill:	Yes		
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	20.50 ft	Fill height:	11.00 ft	Clay like behavior applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth applied:	No
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

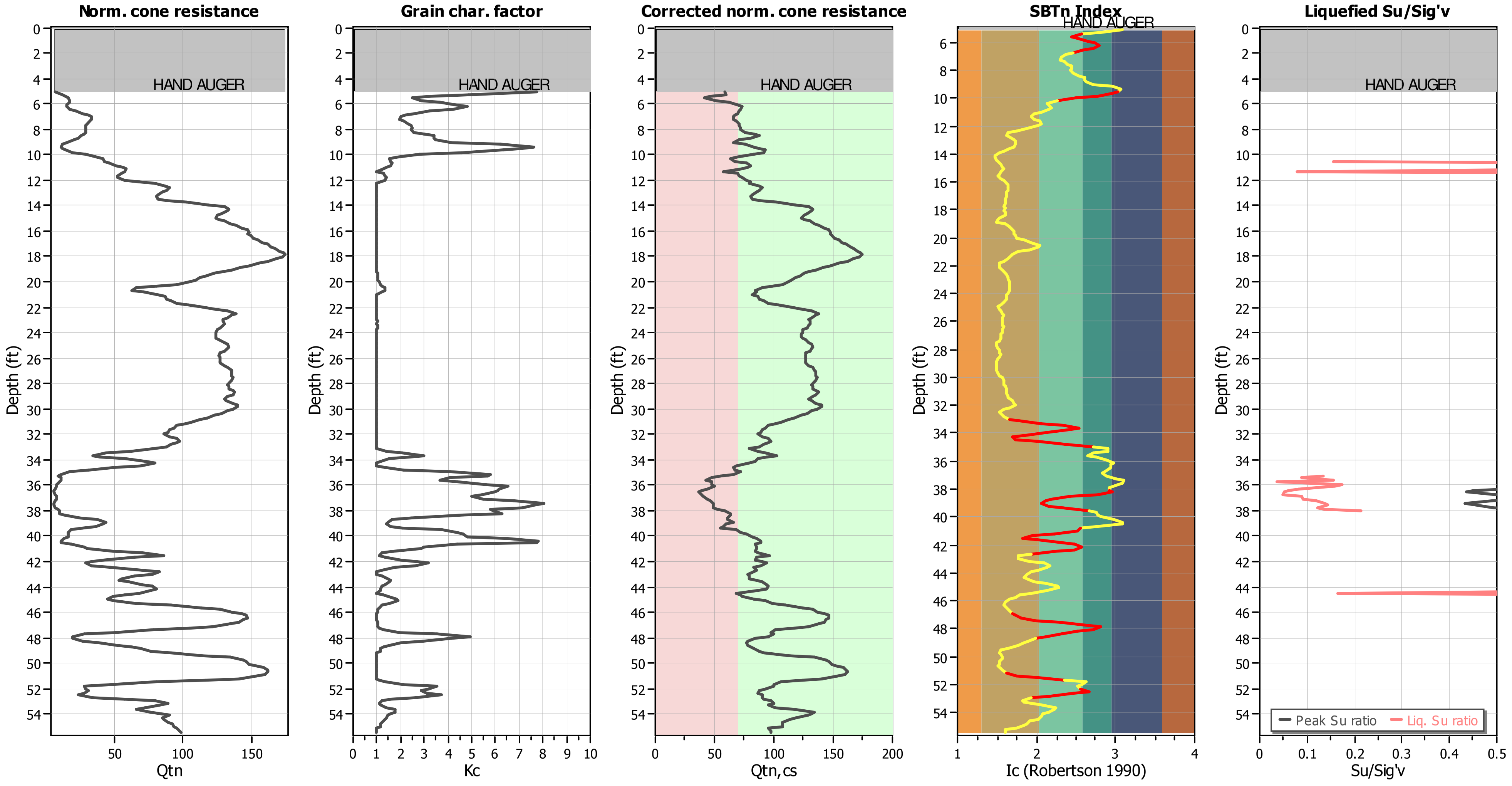






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

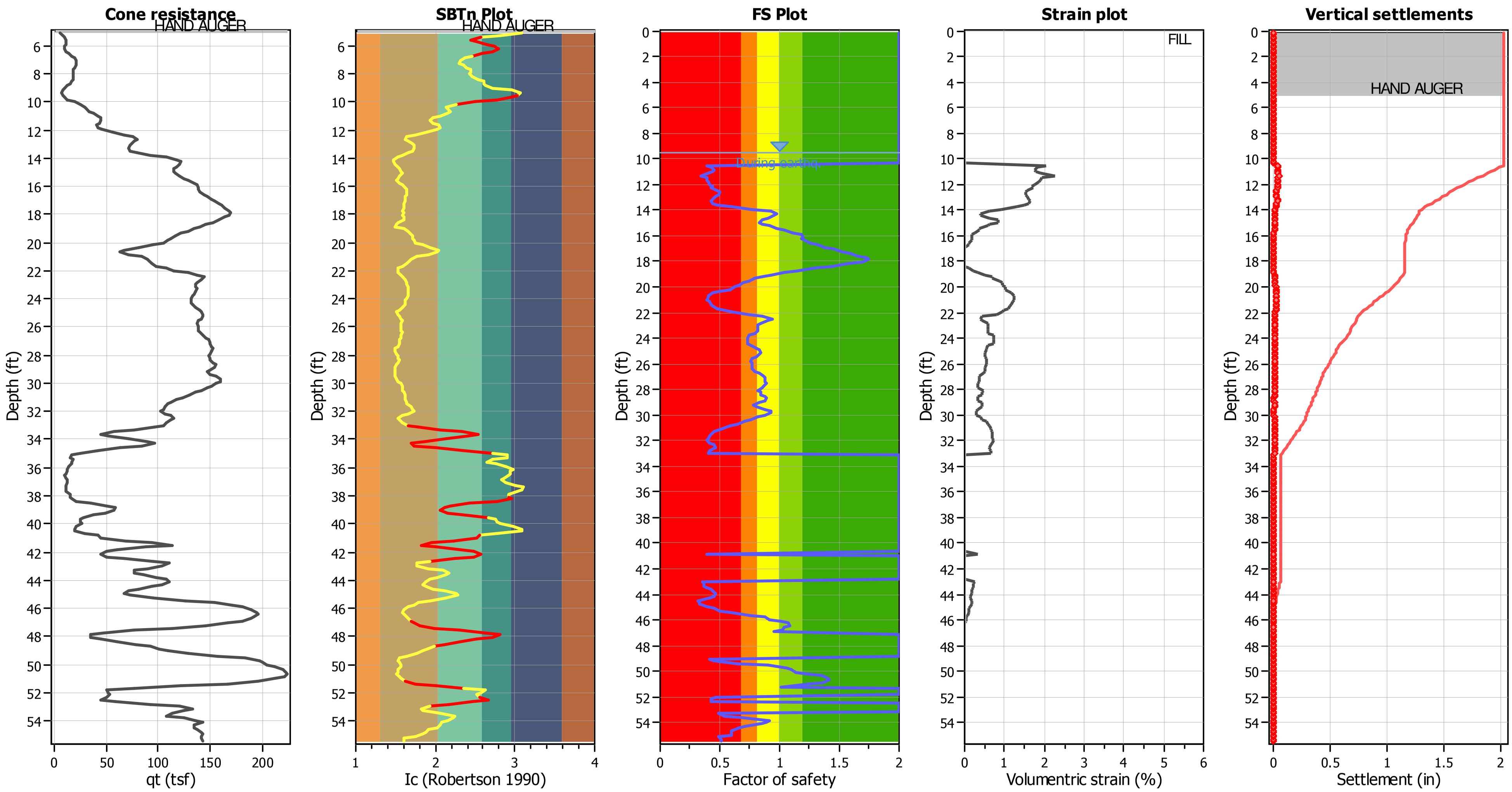
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	20.50 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	13.50 ft	Fill height:	11.00 ft	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
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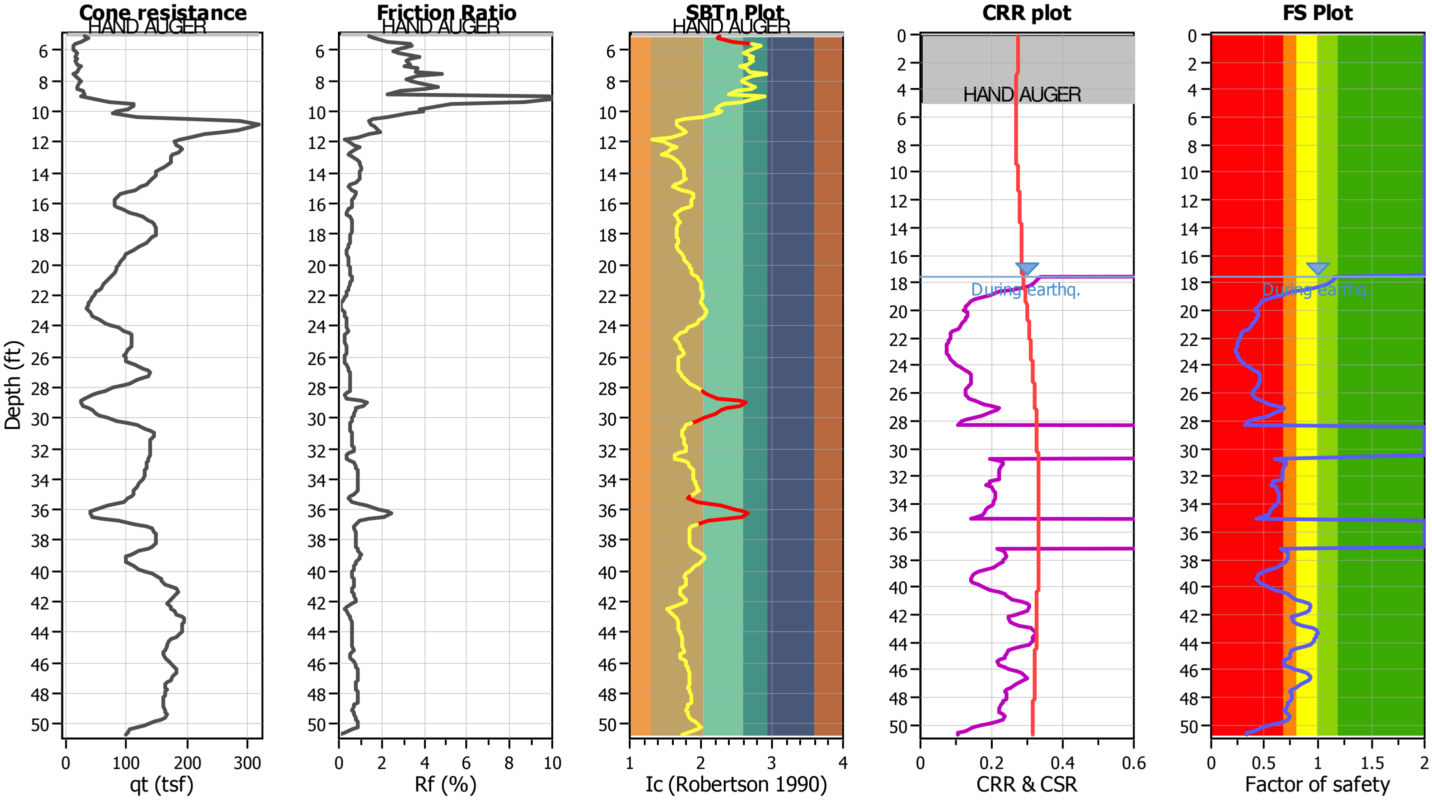
LIQUEFACTION ANALYSIS REPORT

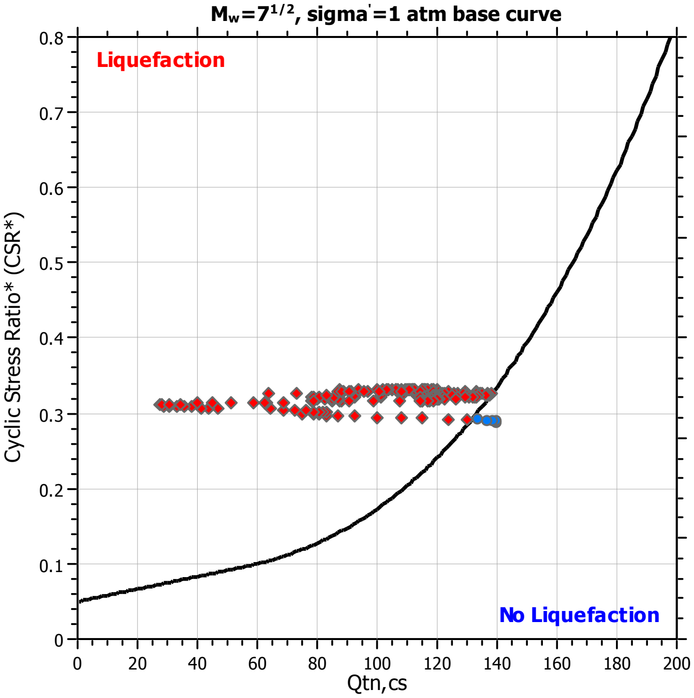
Project title : Riverwalk **Location : San Diego, CA**

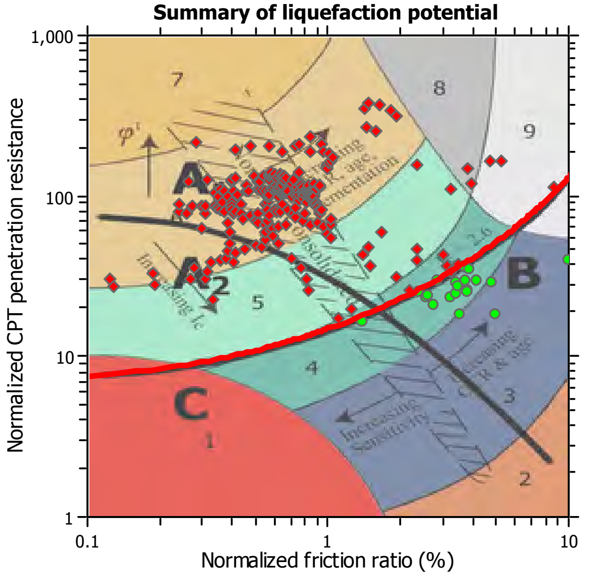
CPT file : CPT-36

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	21.50 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	27.00 ft	Fill height:	9.50 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

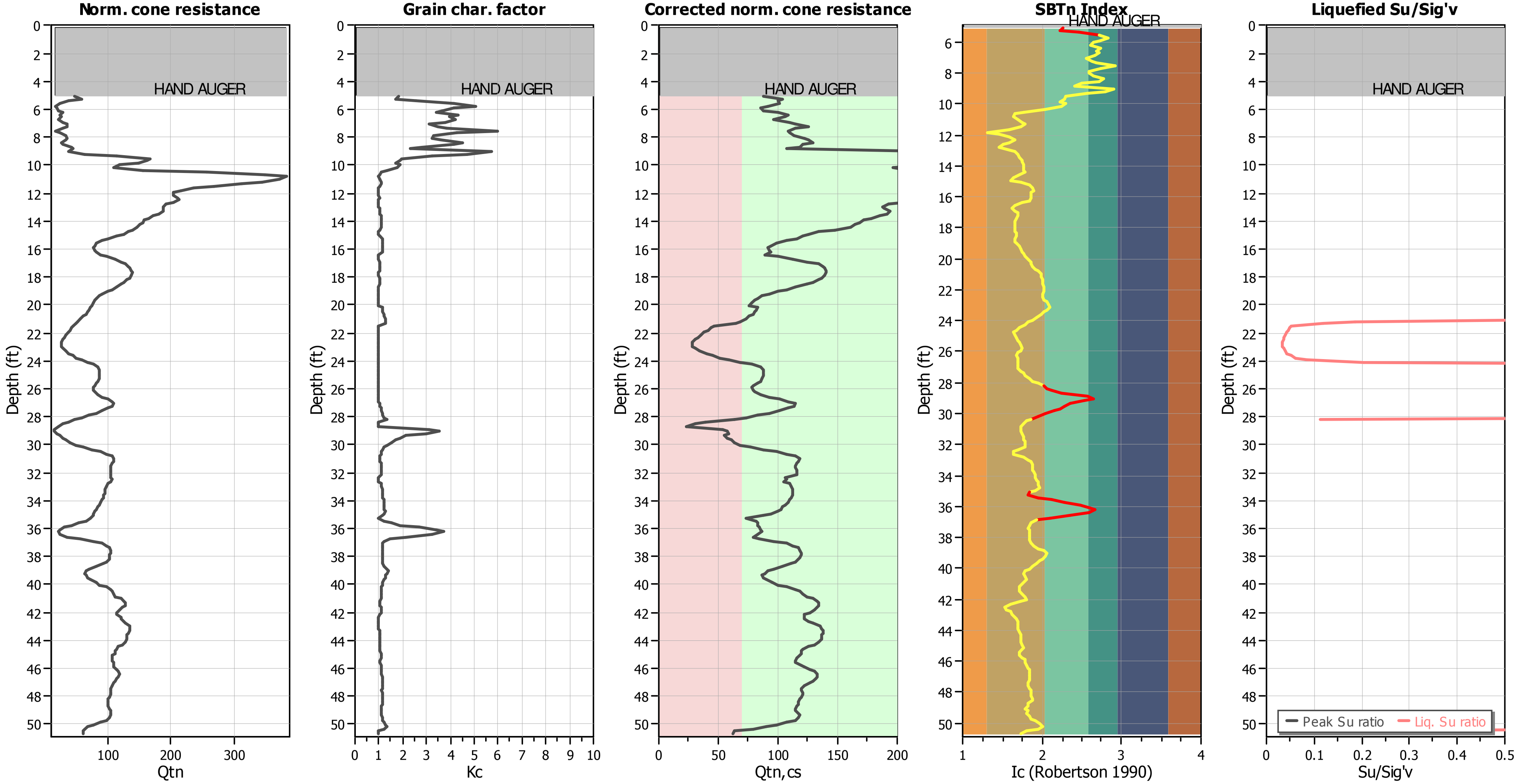






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

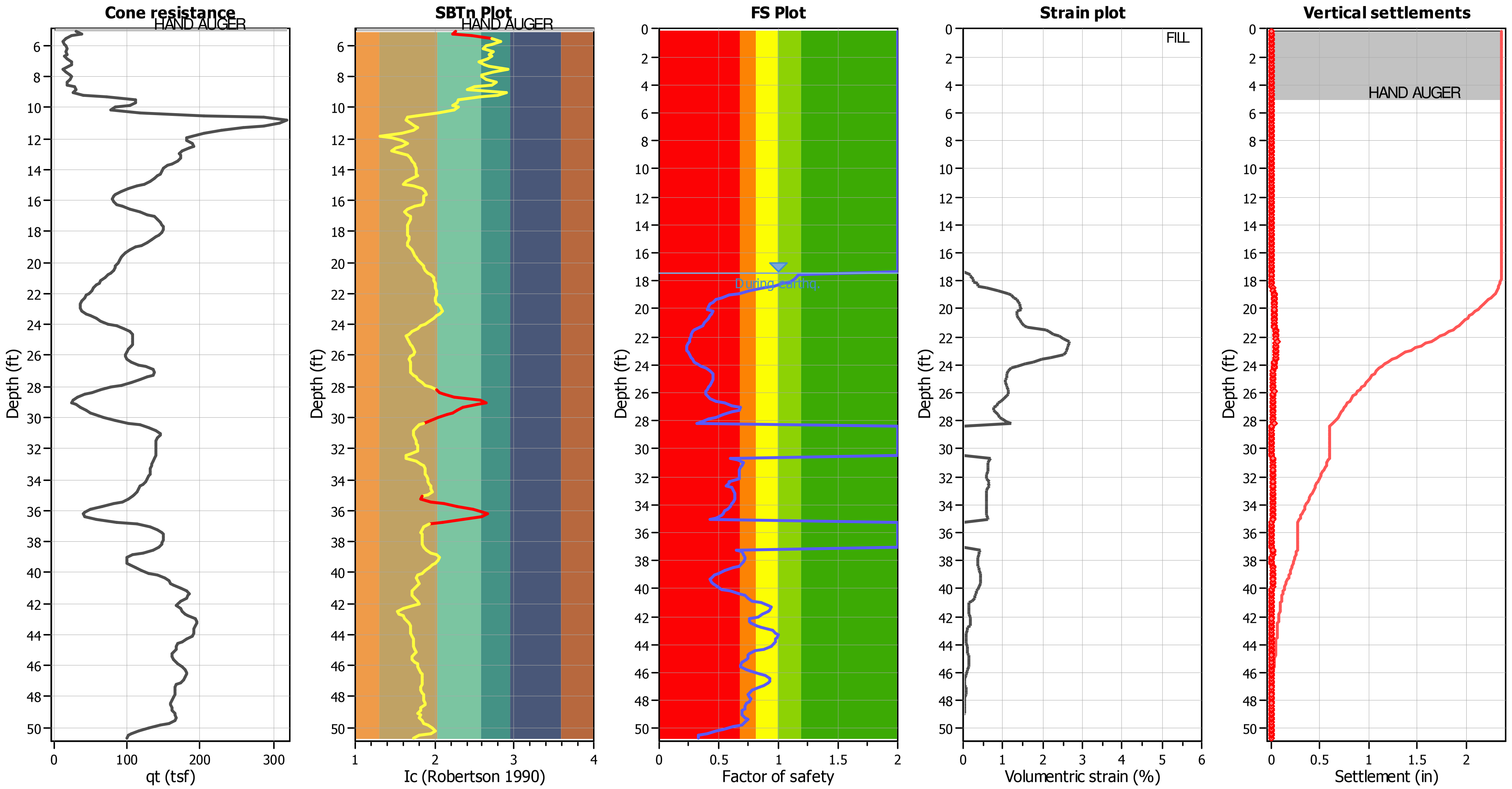
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	27.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	21.50 ft	Fill height:	9.50 ft	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

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FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

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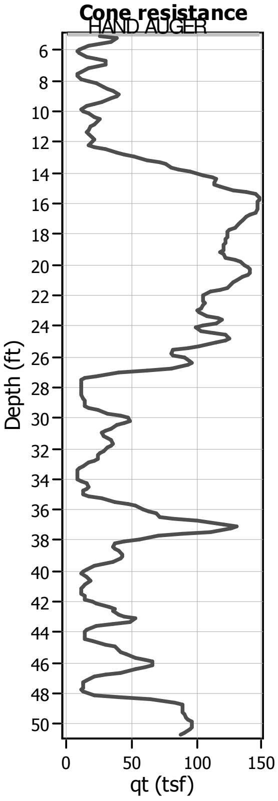
LIQUEFACTION ANALYSIS REPORT

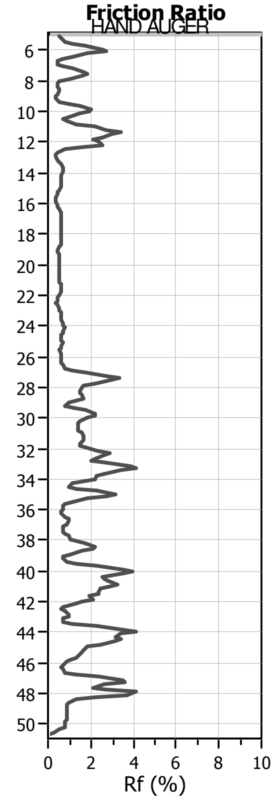
Project title : Riverwalk **Location : San Diego, CA**

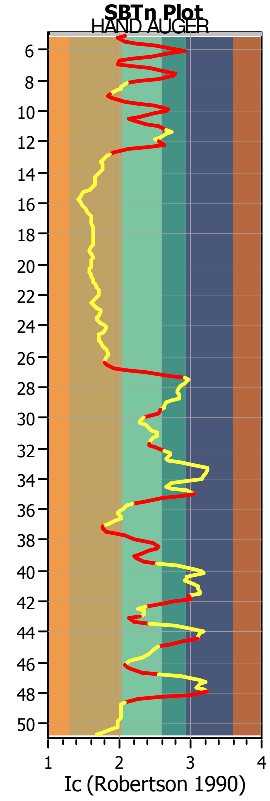
CPT file : CPT-37

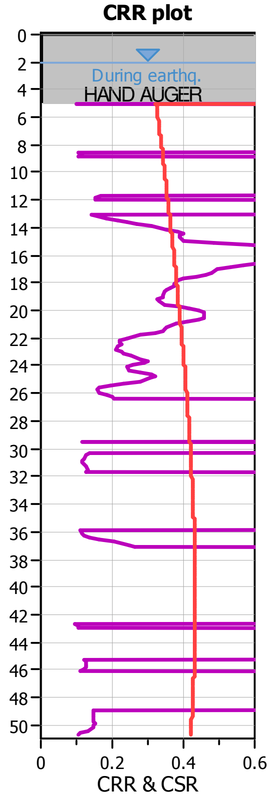
Input parameters and analysis data

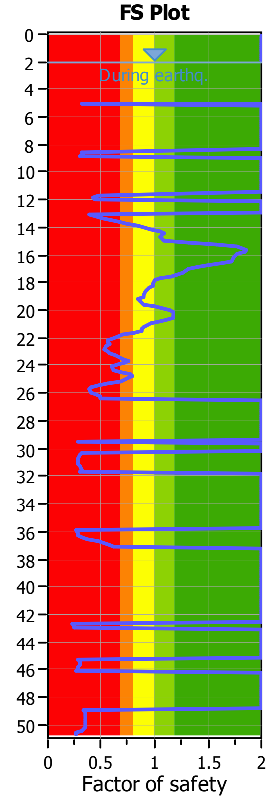
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	6.00 ft	Excavation:	Yes		
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	2.00 ft	Excavation depth:	5.00 ft	Clay like behavior applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Footing load:	2.00 tsf	Limit depth applied:	No
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

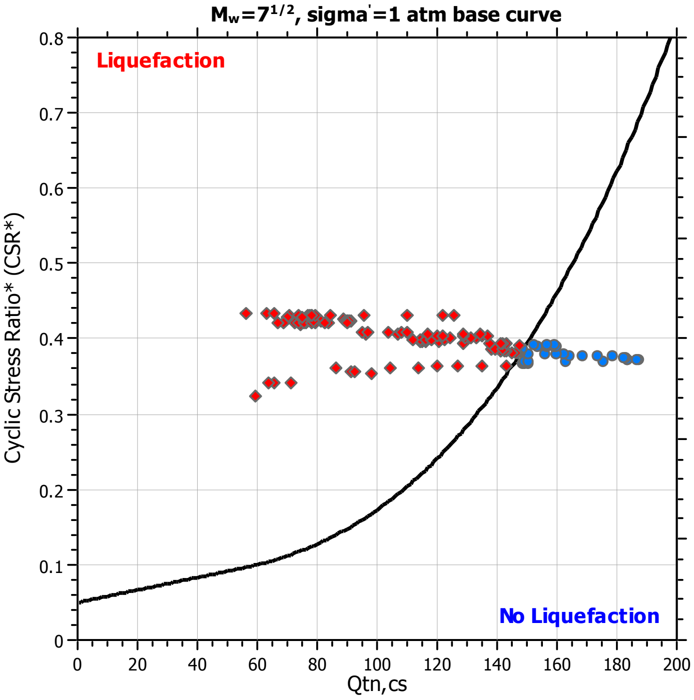


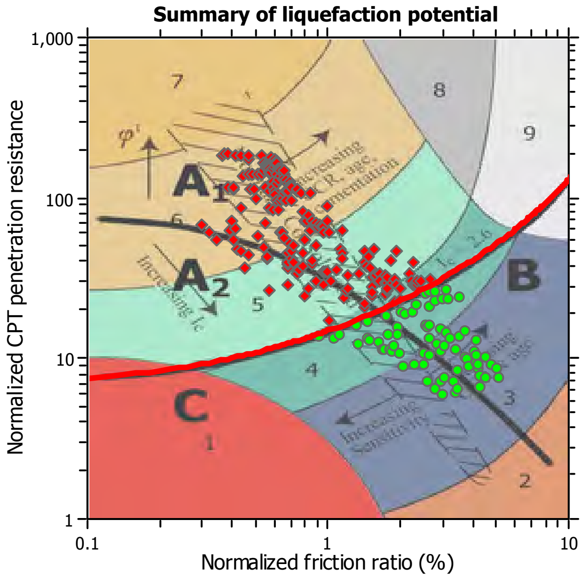












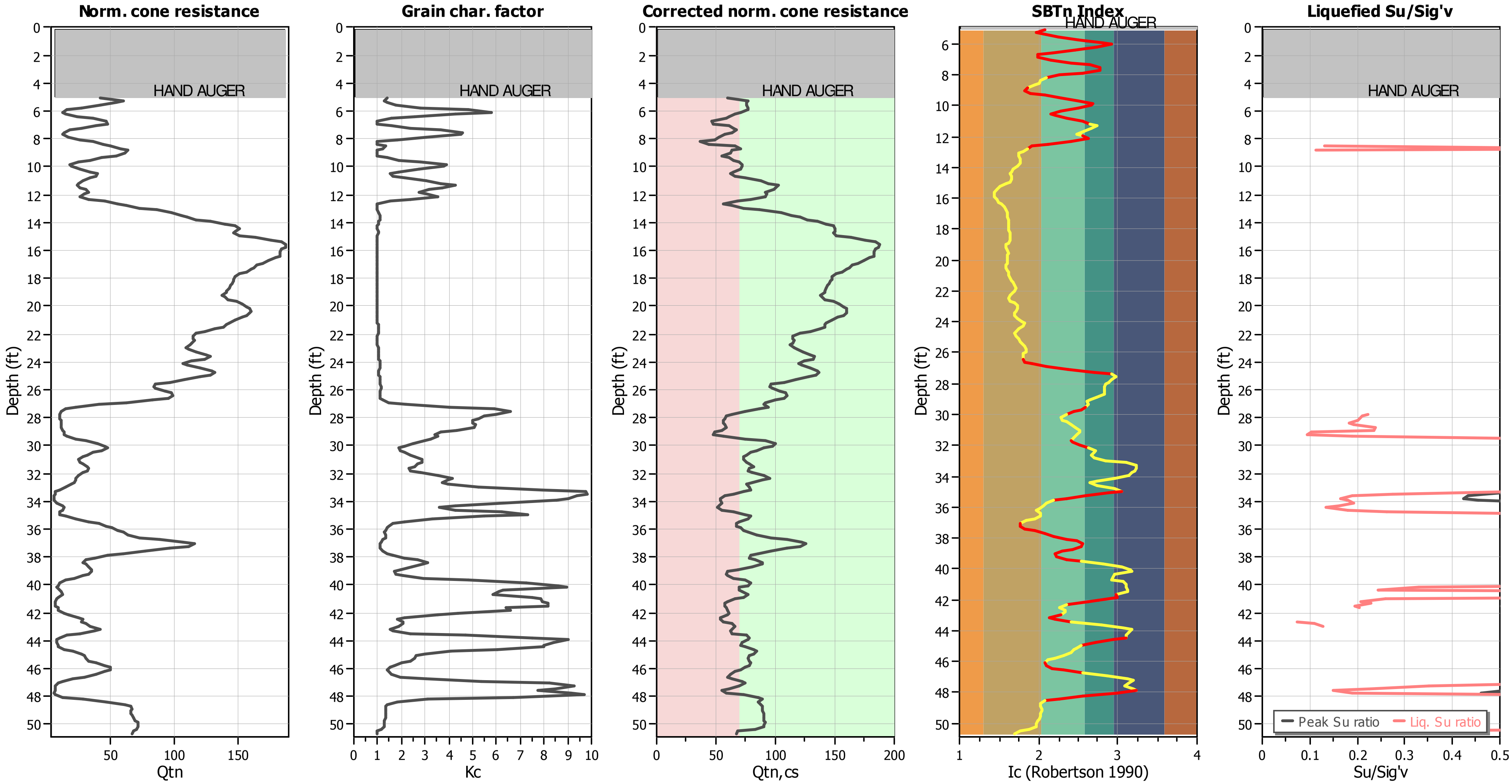
Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading

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

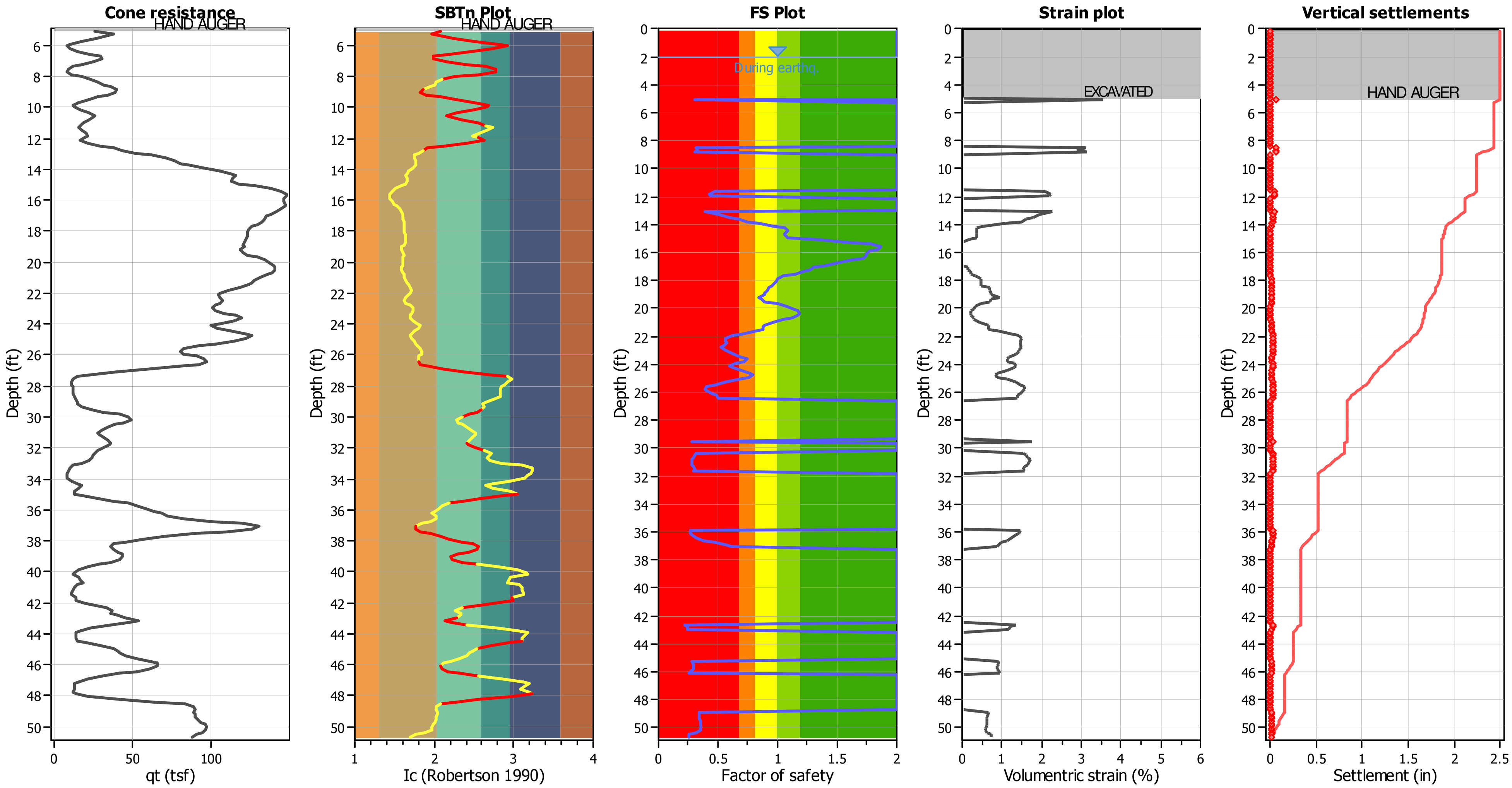
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	2.00 ft	Footing load:	2.00 tsf
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Excavation:	Yes	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Excavation depth:	5.00 ft	Limit depth:	N/A

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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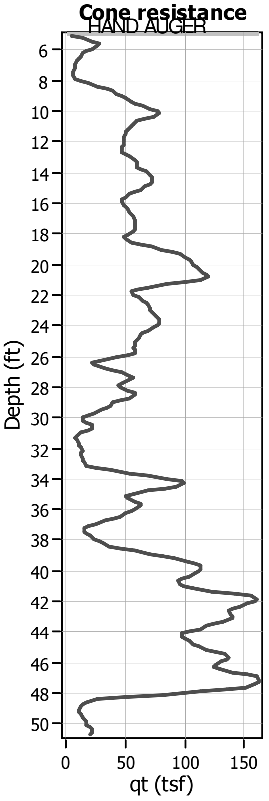
LIQUEFACTION ANALYSIS REPORT

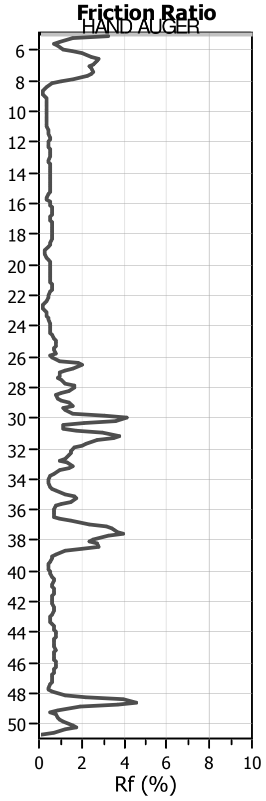
Project title : Riverwalk **Location : San Diego, CA**

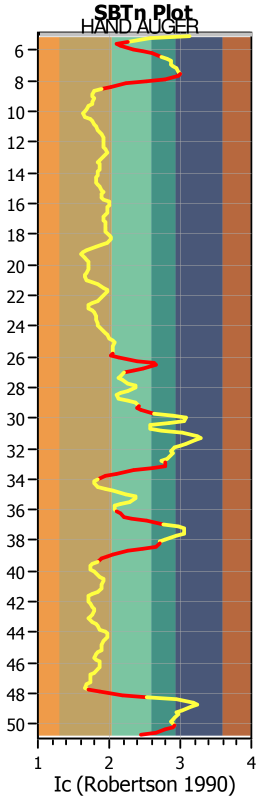
CPT file : CPT-38

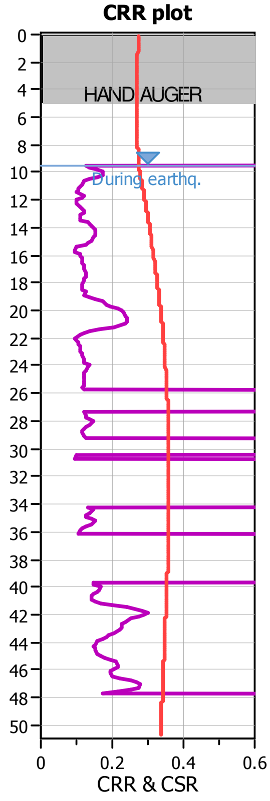
Input parameters and analysis data

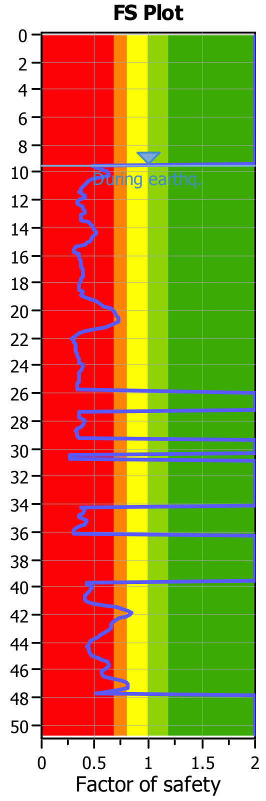
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	12.50 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	20.50 ft	Fill height:	11.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

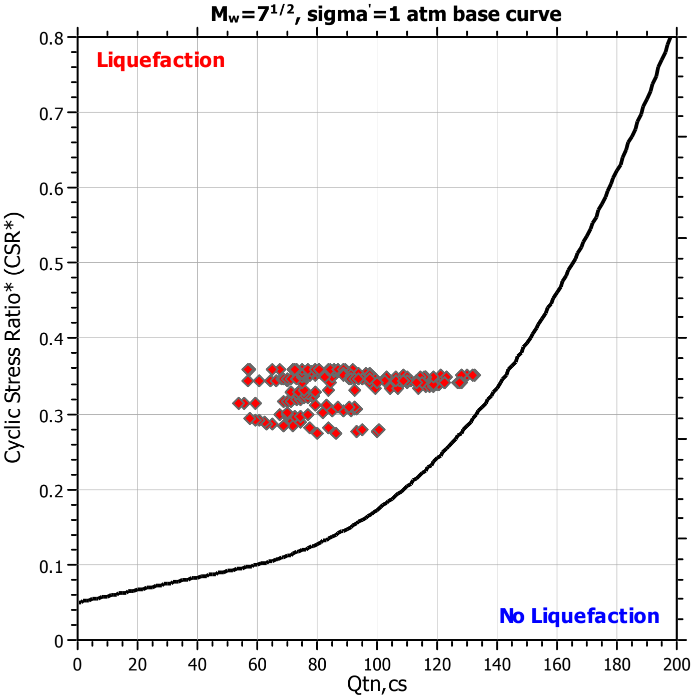


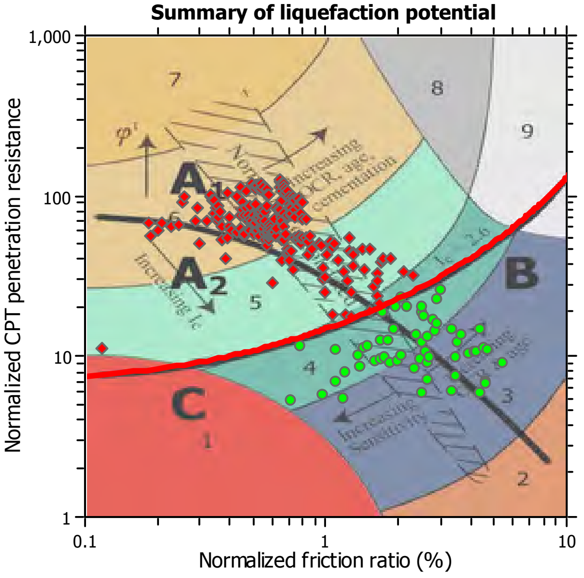






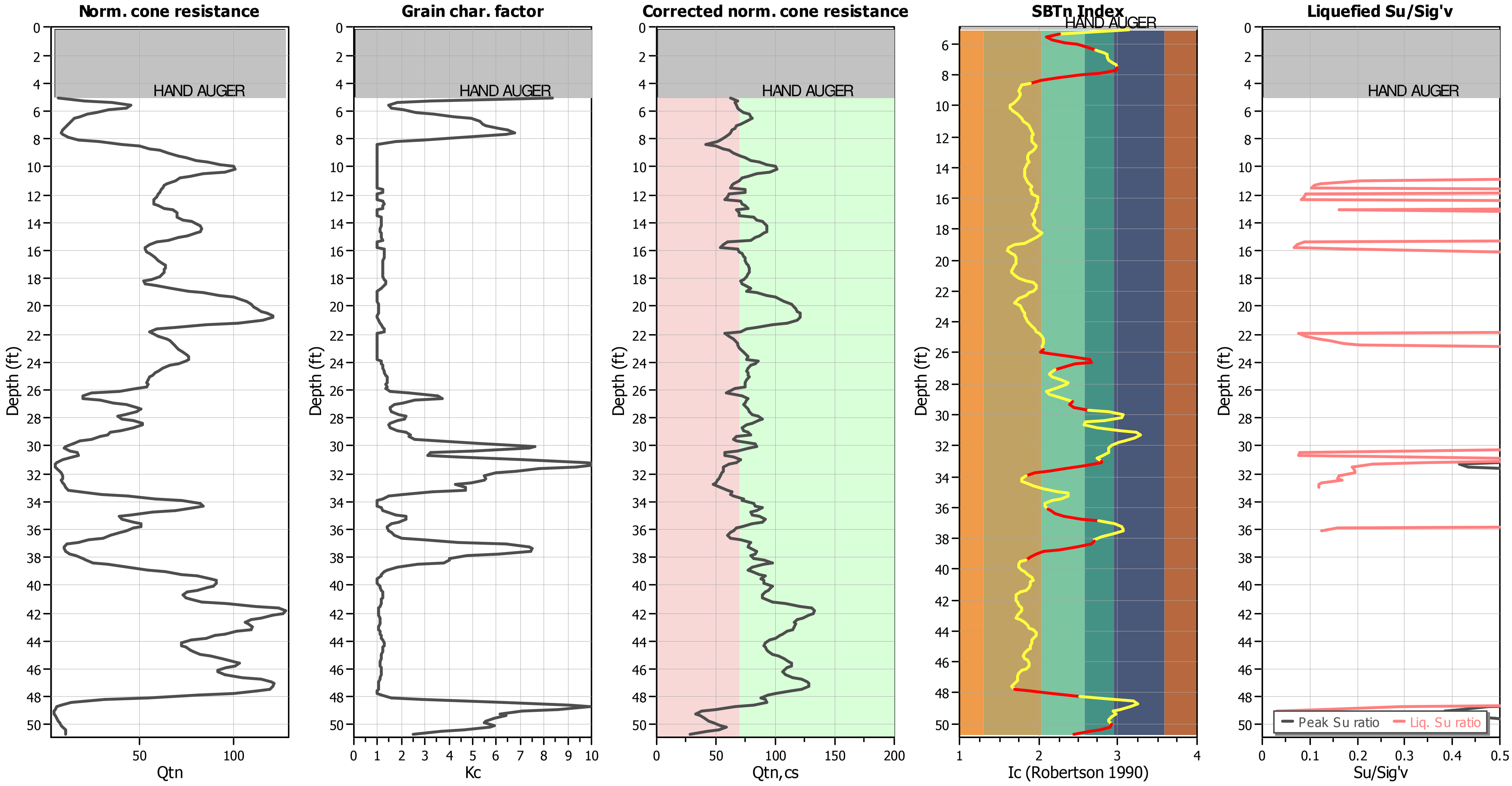






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

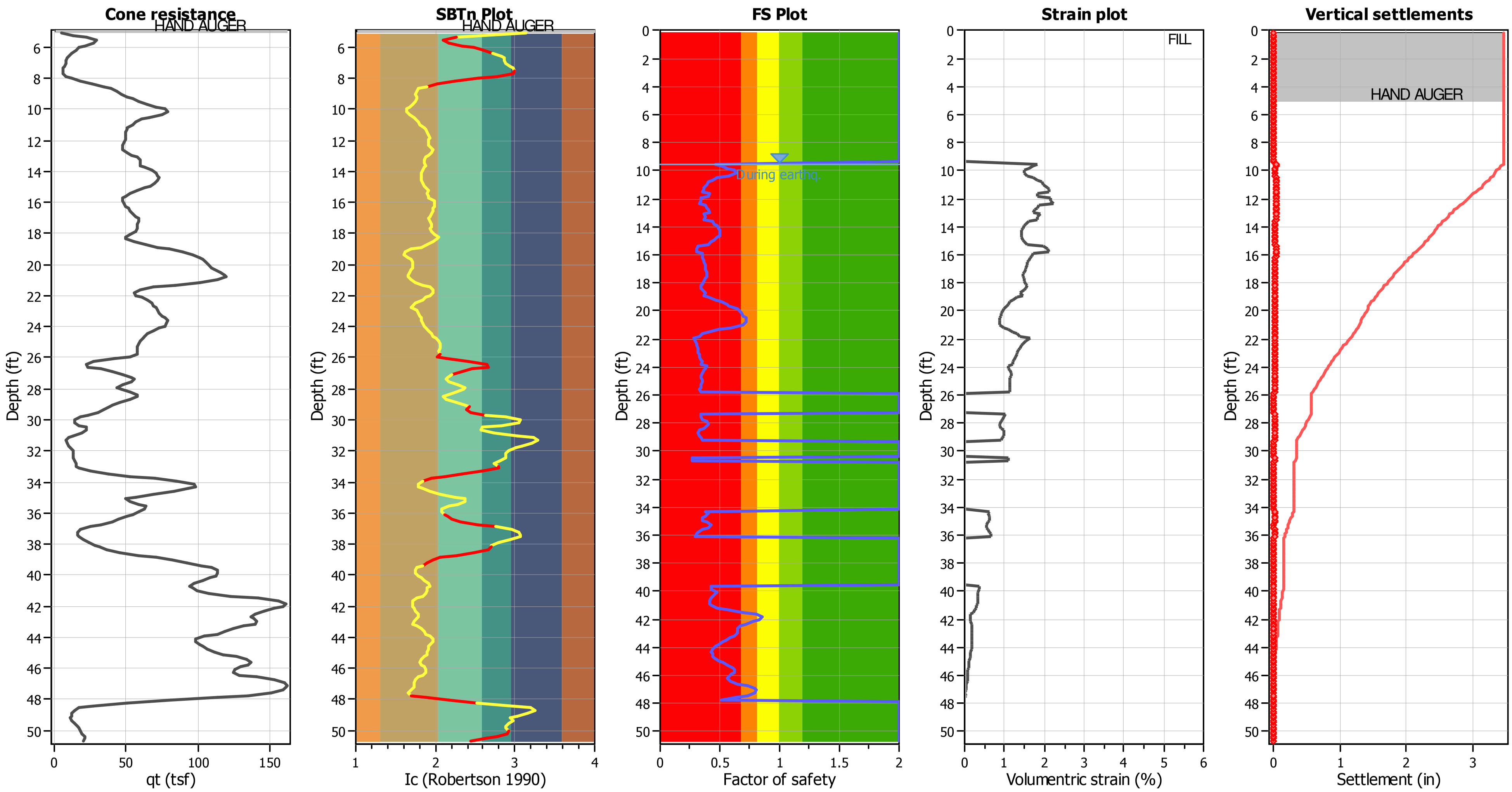
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	20.50 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	12.50 ft	Fill height:	11.00 ft	Limit depth:	N/A

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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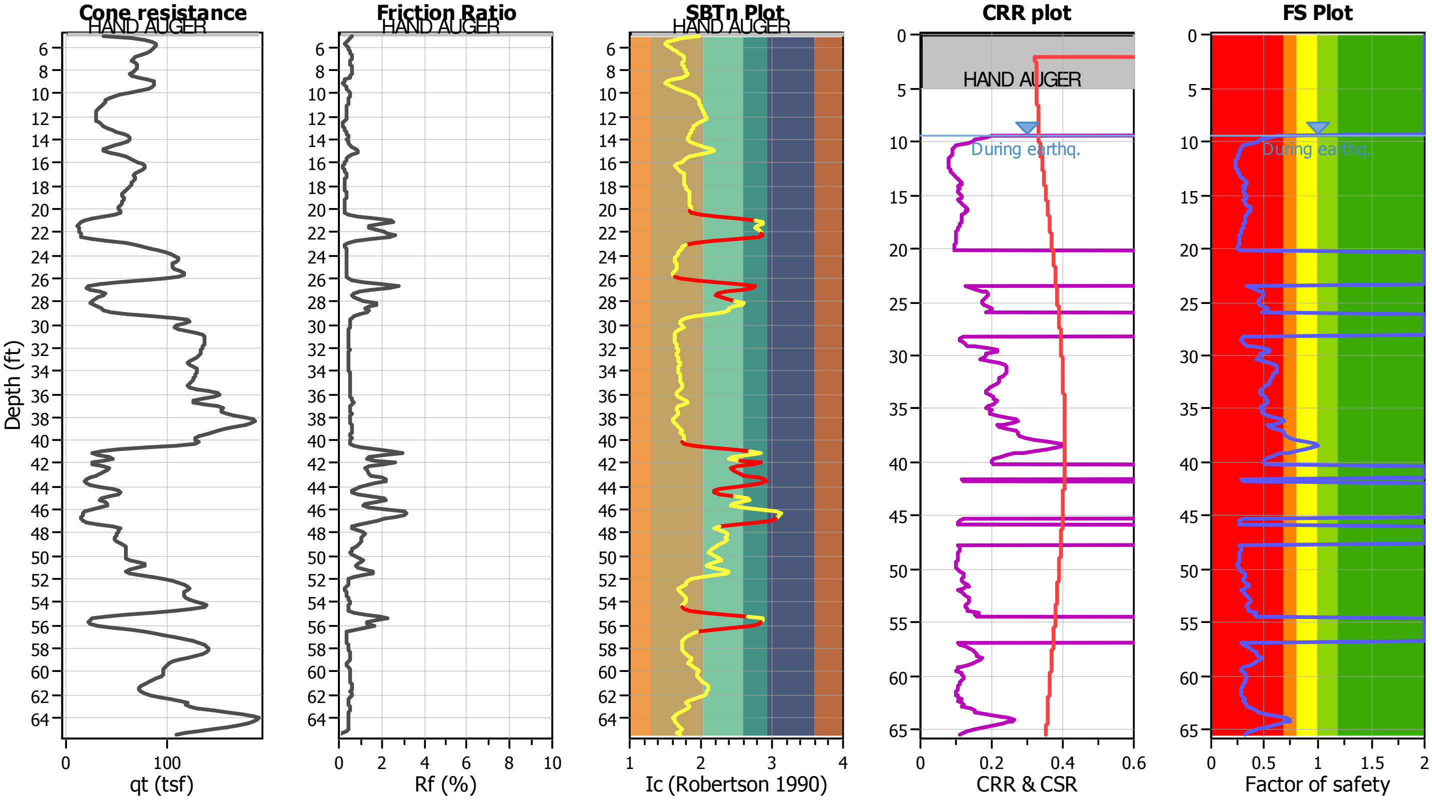
LIQUEFACTION ANALYSIS REPORT

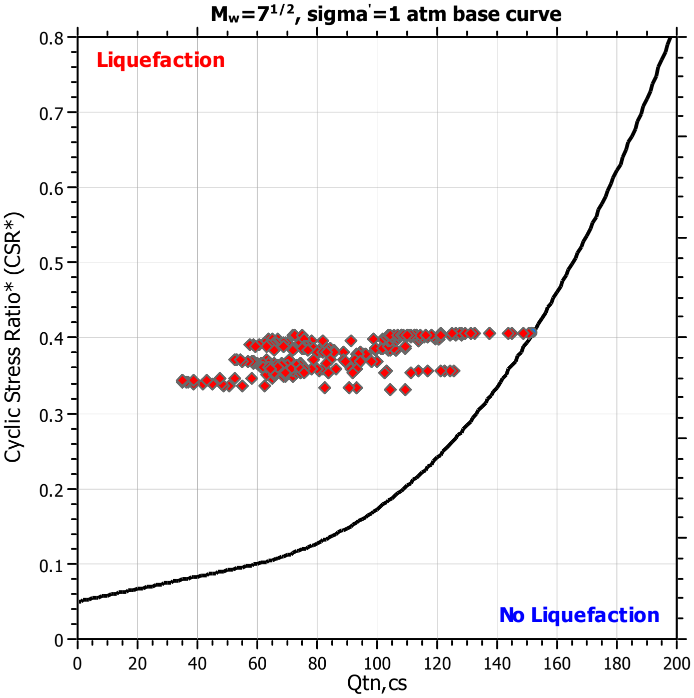
Project title : Riverwalk **Location : San Diego, CA**

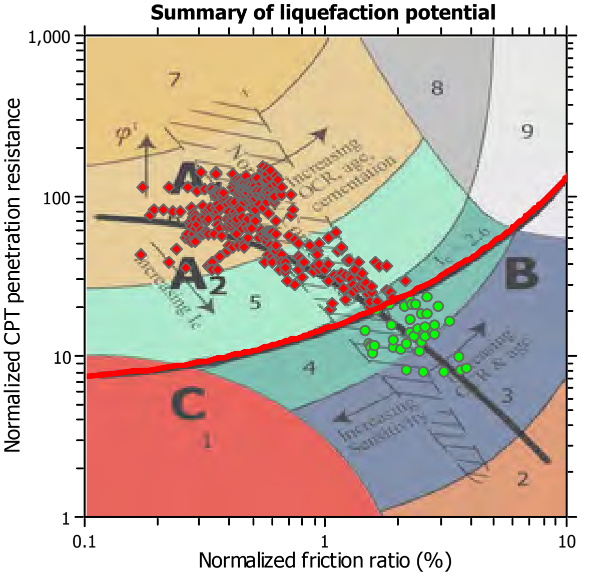
CPT file : CPT-39

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	12.50 ft	Excavation:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	9.50 ft	Excavation depth:	2.00 ft		
Points to test:	Based on Ic value	Average results interval:	3	Footing load:	2.00 tsf	Limit depth applied:	No
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

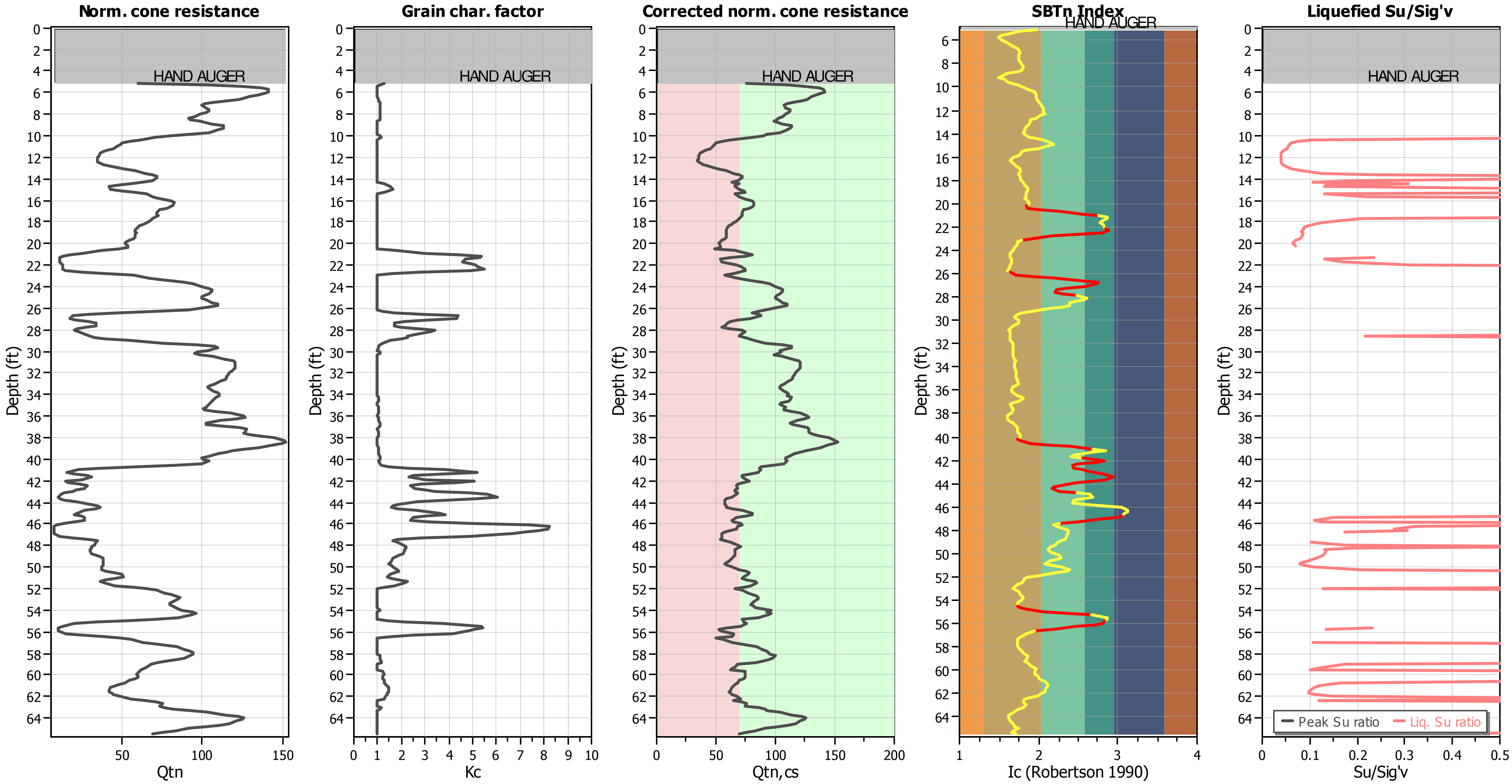






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

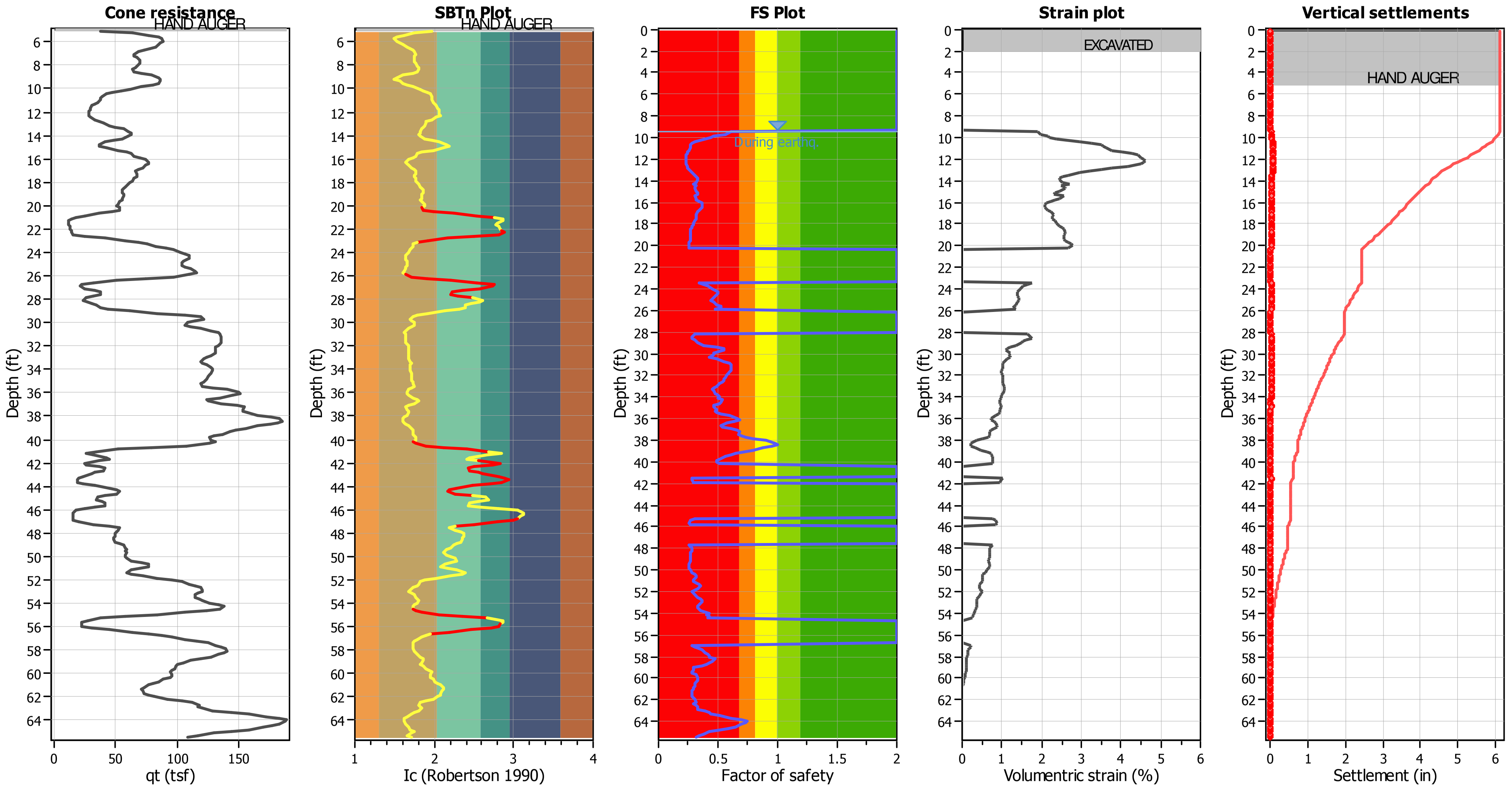
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	9.50 ft	Footing load:	2.00 tsf
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Excavation:	Yes	Limit depth applied:	No
Depth to water table (insitu):	12.50 ft	Excavation depth:	2.00 ft	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

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Volumentric strain:	Post-liquefaction volumentric strain

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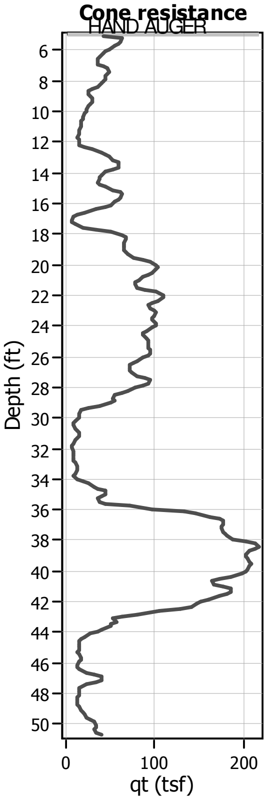
LIQUEFACTION ANALYSIS REPORT

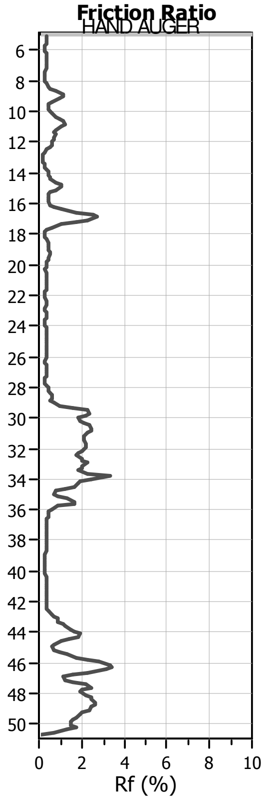
Project title : Riverwalk **Location : San Diego, CA**

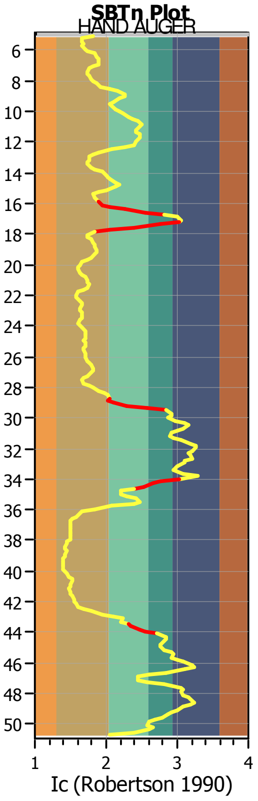
CPT file : CPT-40

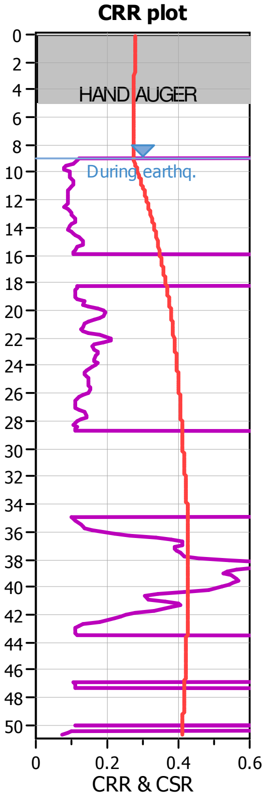
Input parameters and analysis data

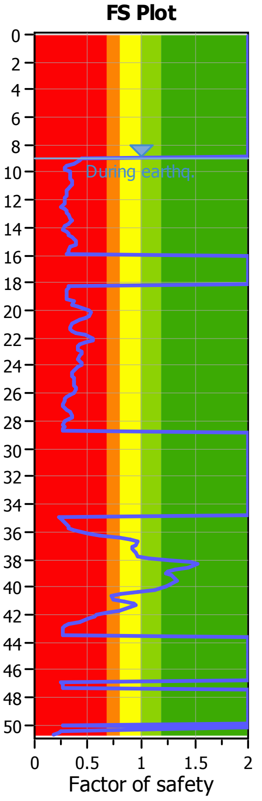
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	12.00 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	10.00 ft	Fill height:	1.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_{σ} applied:	Yes		

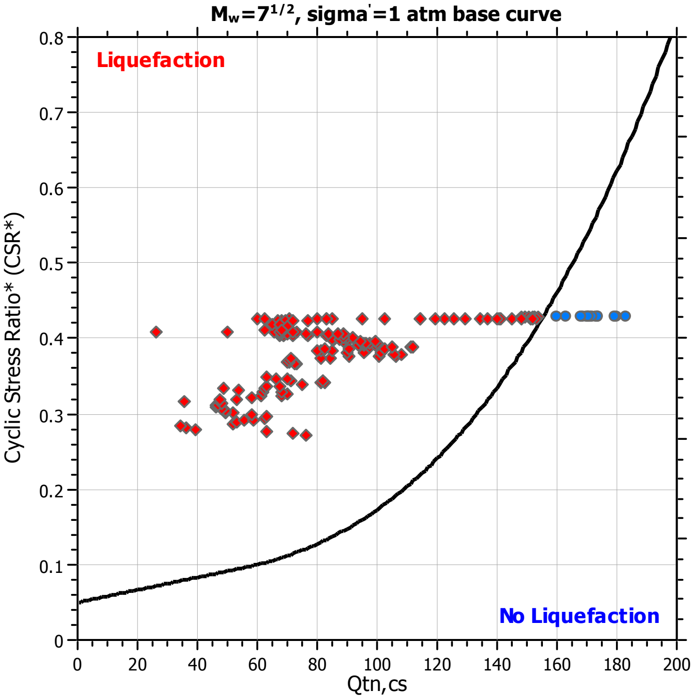

Cone resistance

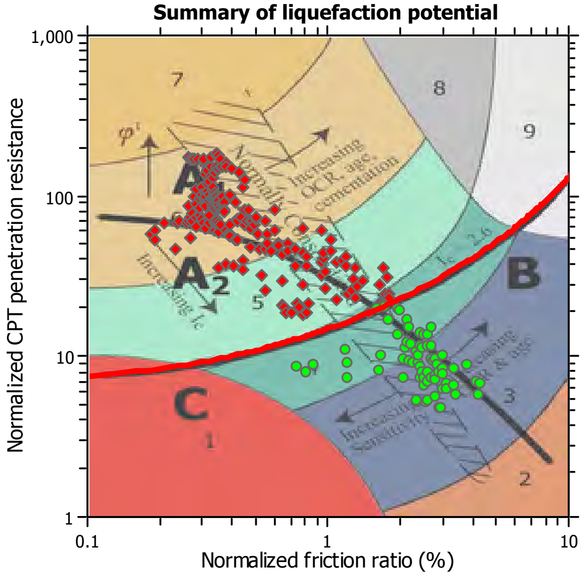

Friction Ratio


SBTn Plot


CRR plot

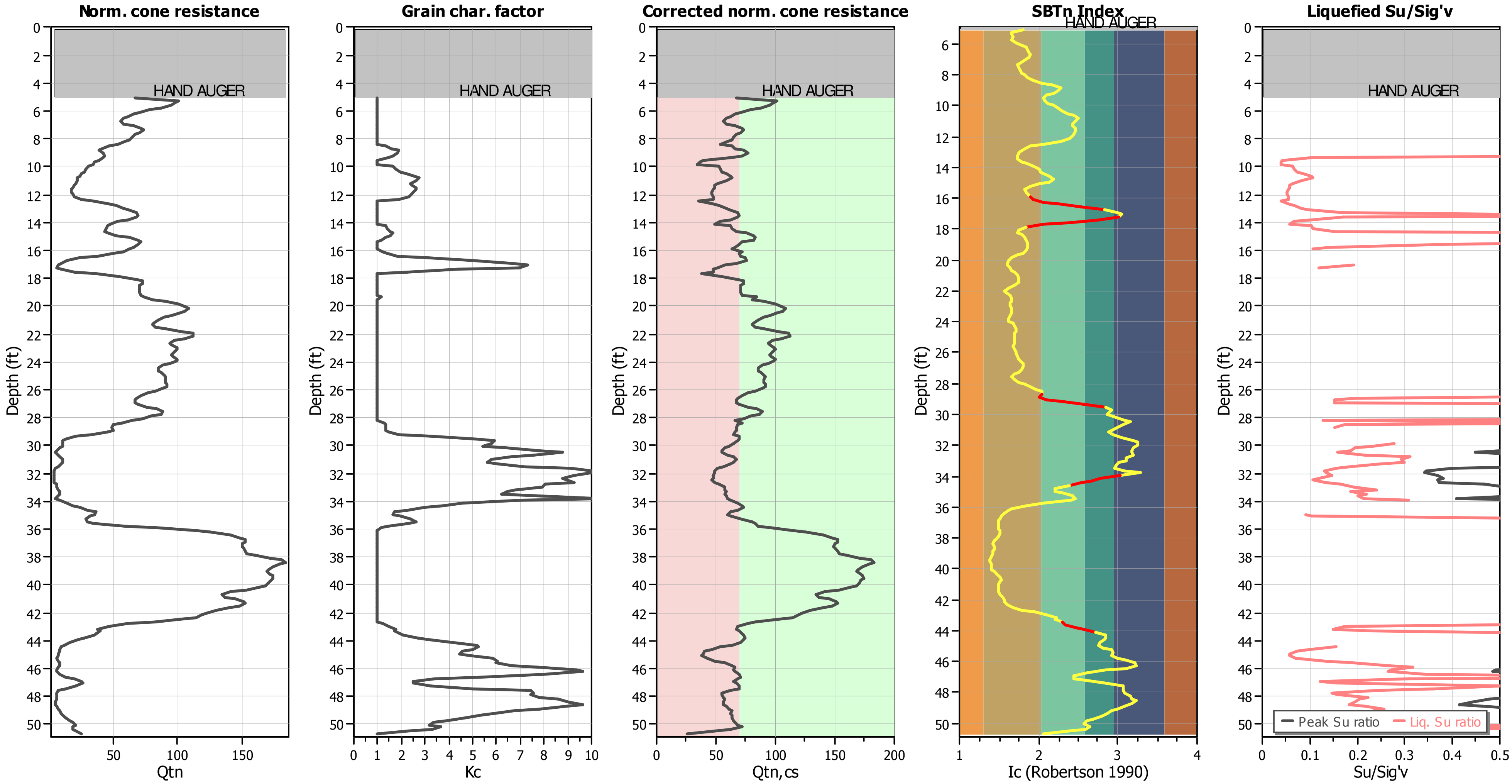

FS Plot


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


Summary of liquefaction potential

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

Check for strength loss plots (Robertson (2010))



Norm. cone resistance

Grain char. factor

Corrected norm. cone resistance

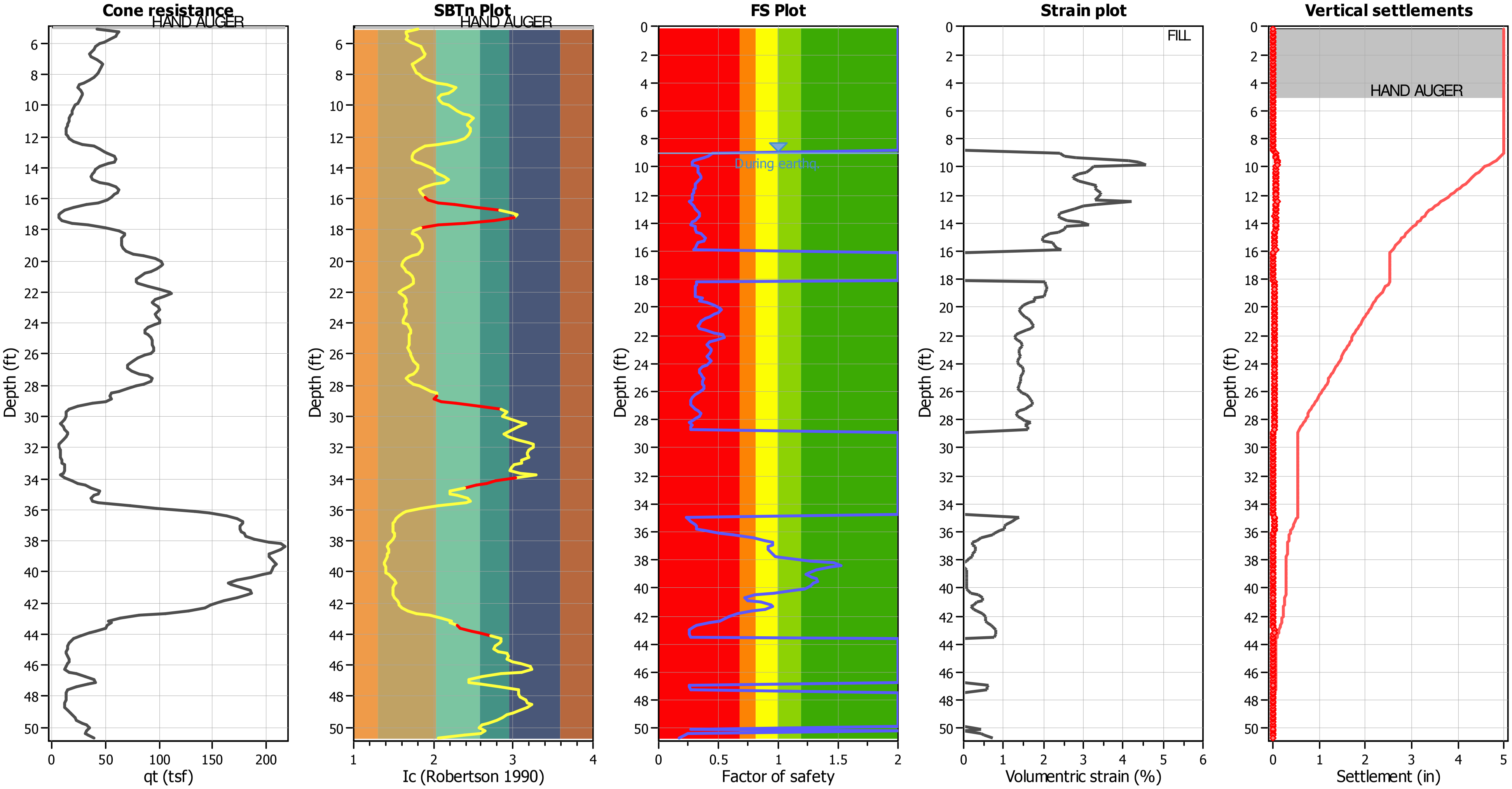
SBTn Index

Liquefied Su/Sig'v

Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	10.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	12.00 ft	Fill height:	1.00 ft	Limit depth:	N/A

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

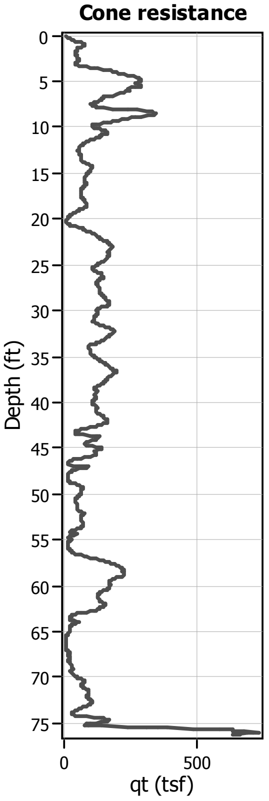
LIQUEFACTION ANALYSIS REPORT

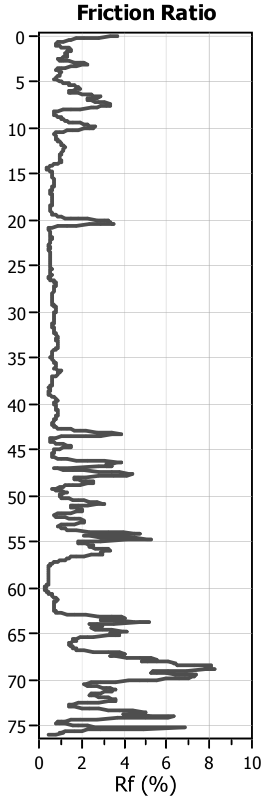
Project title : Riverwalk **Location : San Diego, CA**

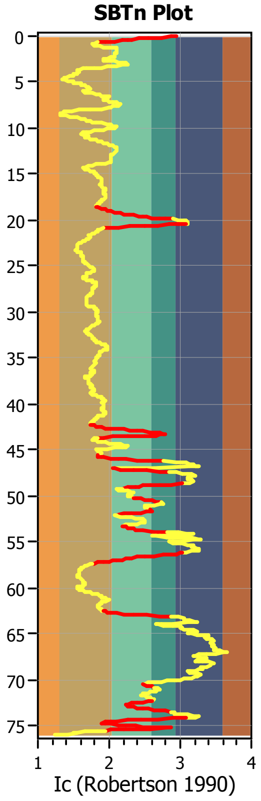
CPT file : CPT-41

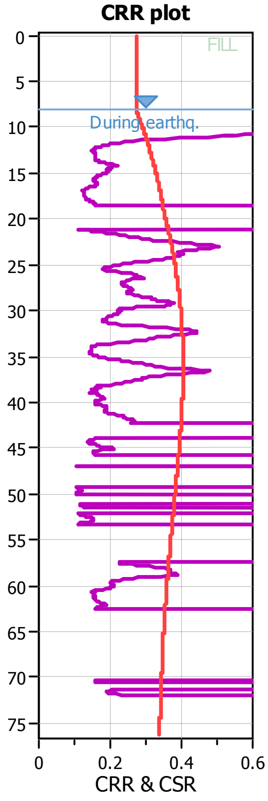
Input parameters and analysis data

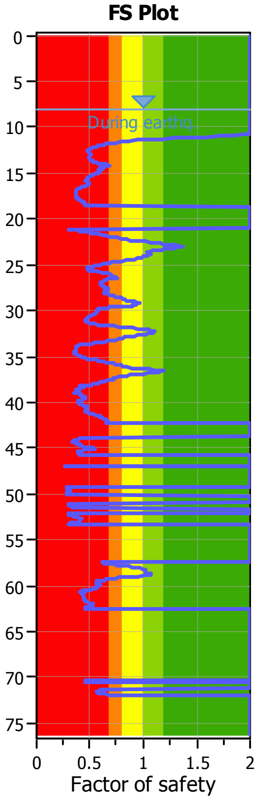
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	14.70 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	12.00 ft	Fill height:	4.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

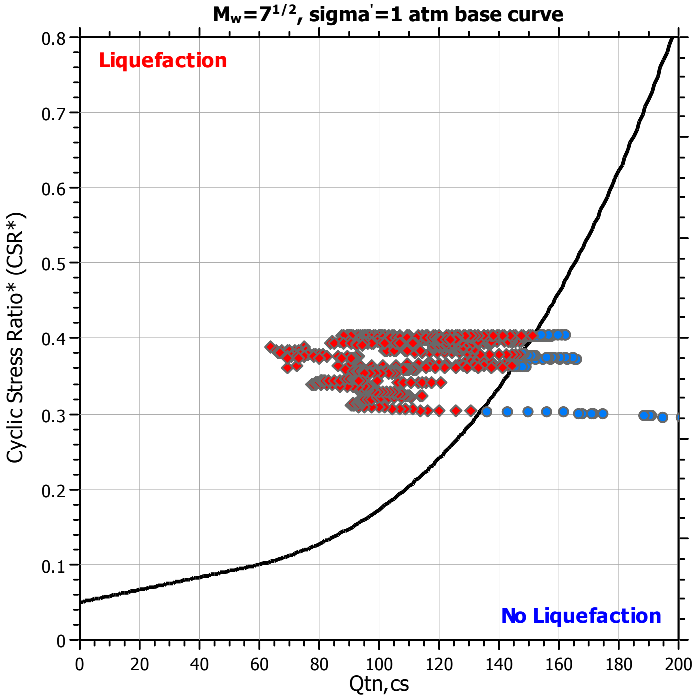

Cone resistance

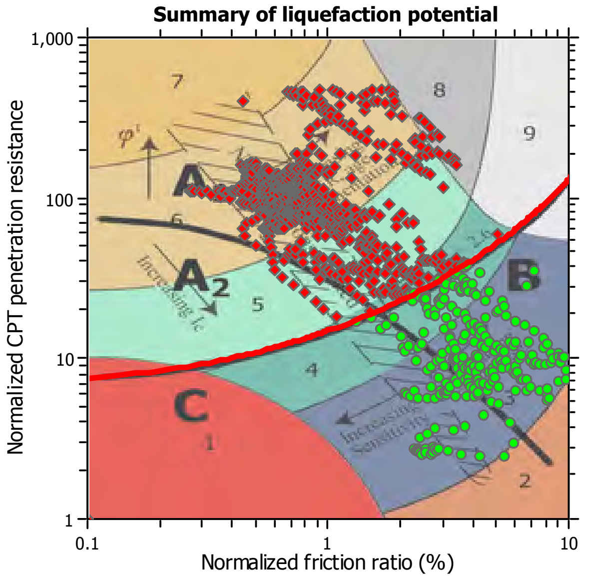

Friction Ratio


SBTn Plot


CRR plot

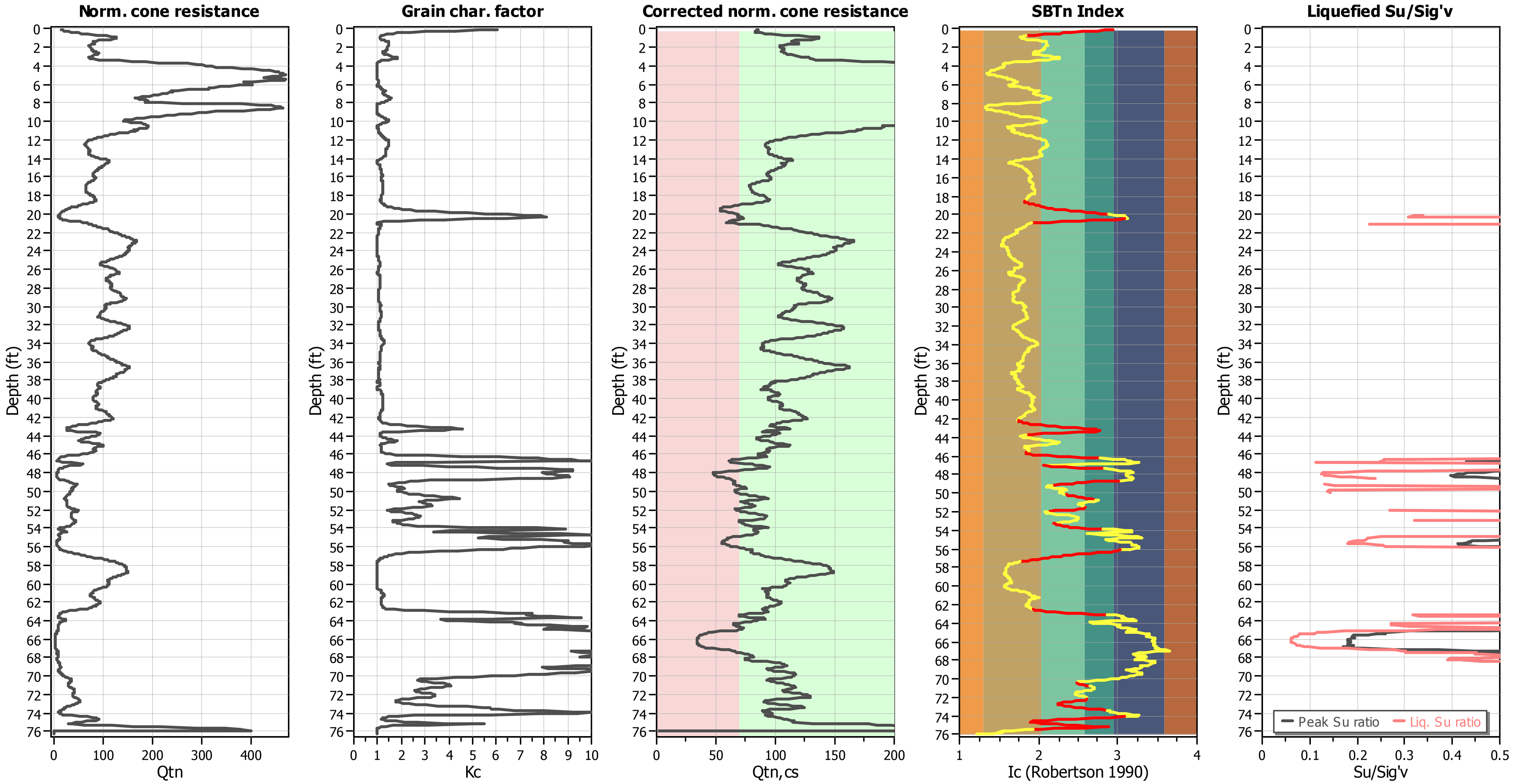

FS Plot


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


Summary of liquefaction potential

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

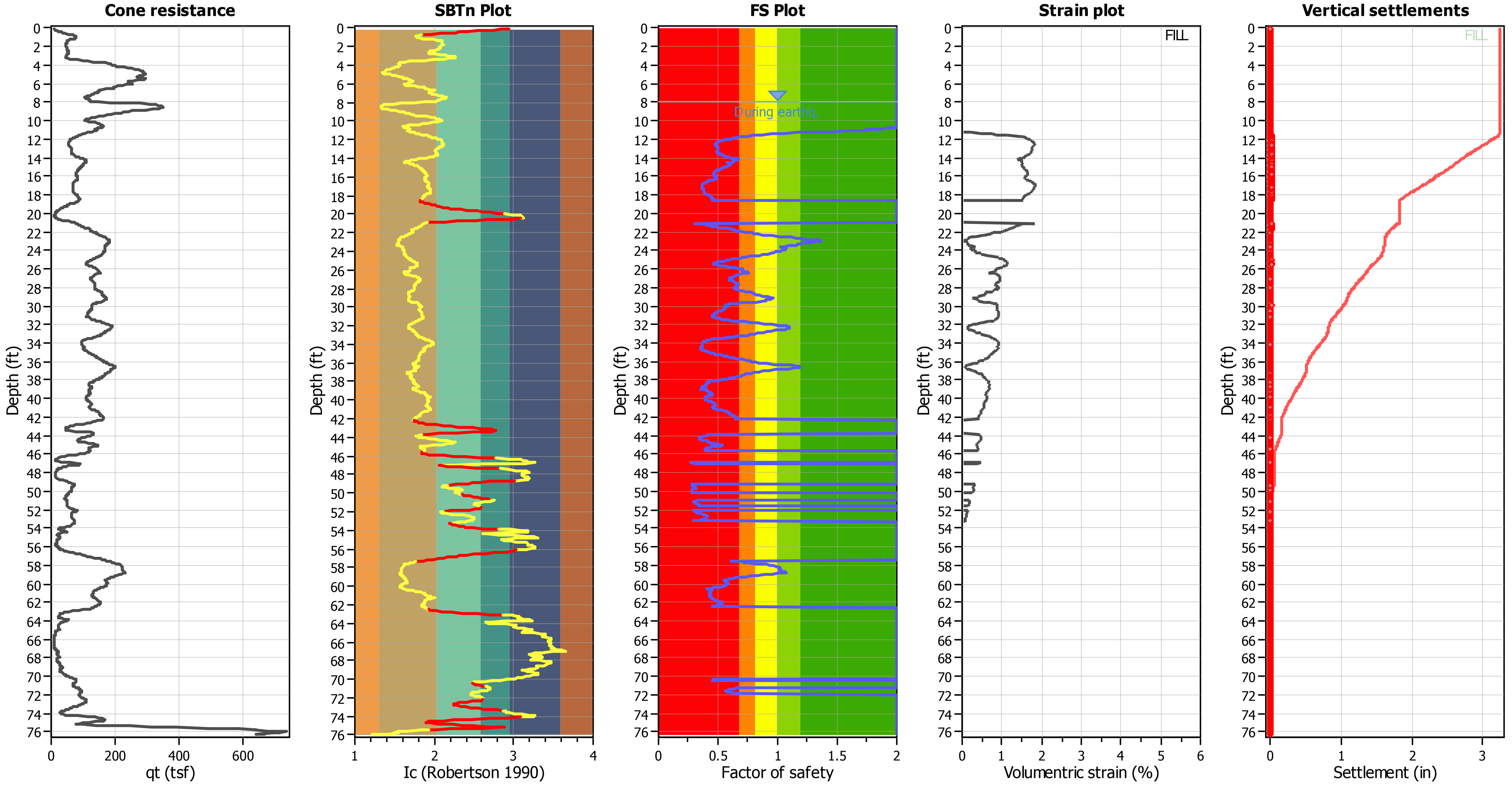
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	12.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	14.70 ft	Fill height:	4.00 ft	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

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Volumentric strain:	Post-liquefaction volumentric strain

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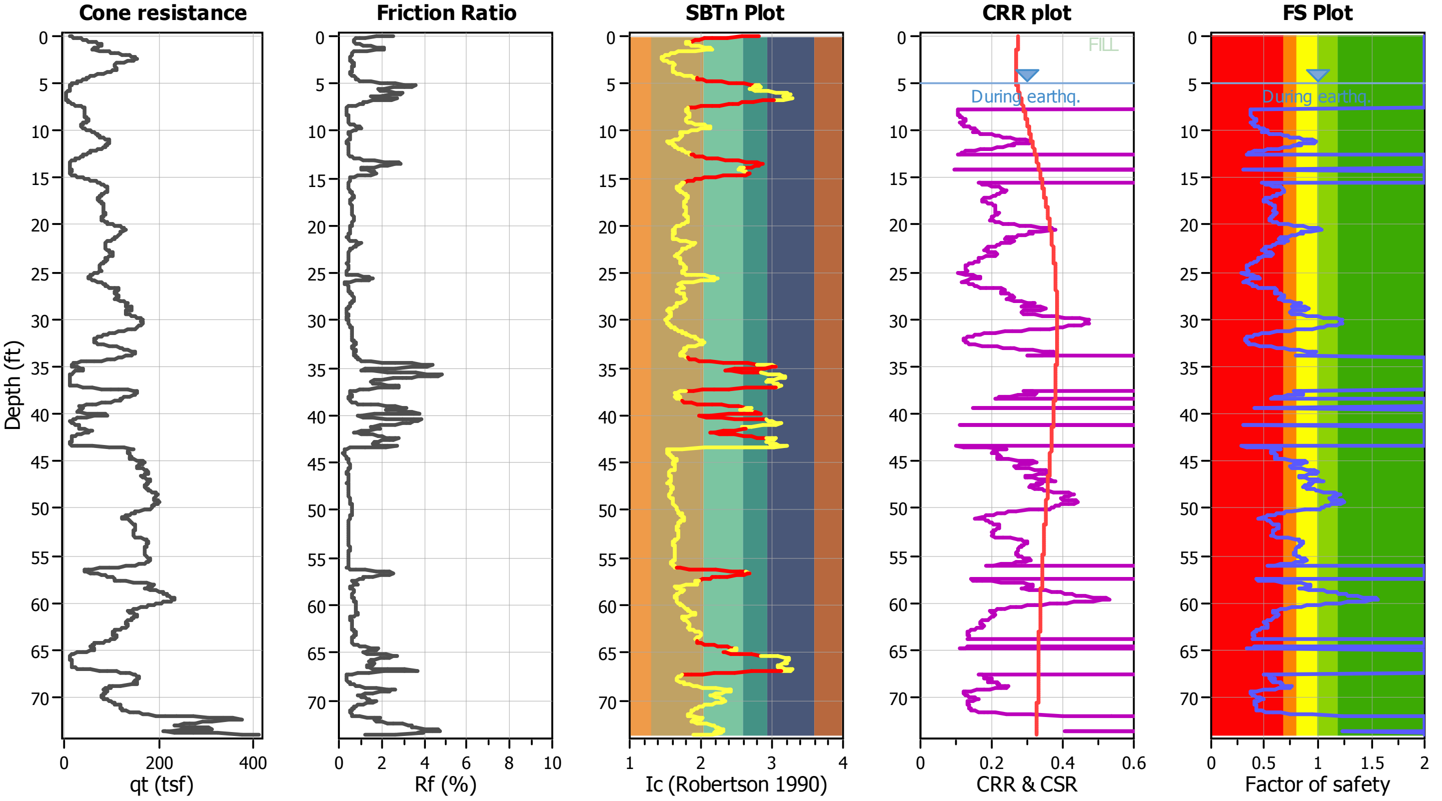
LIQUEFACTION ANALYSIS REPORT

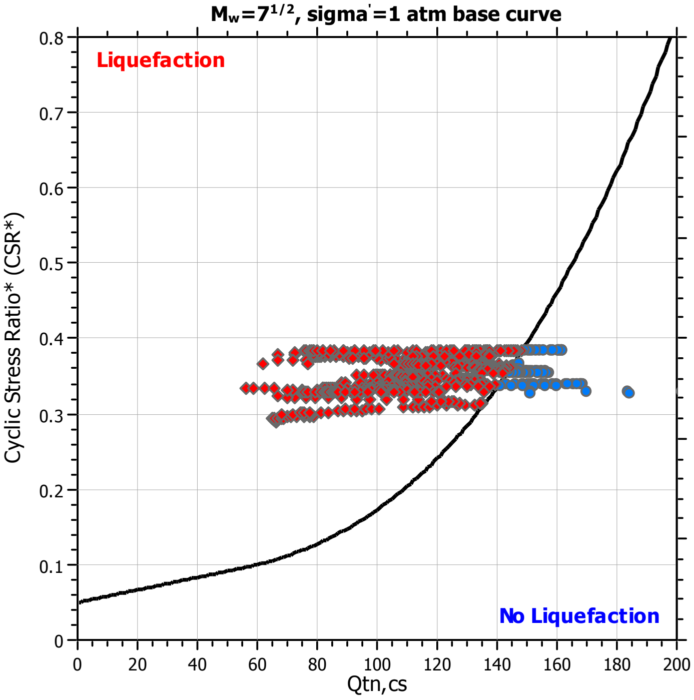
Project title : Riverwalk **Location : San Diego, CA**

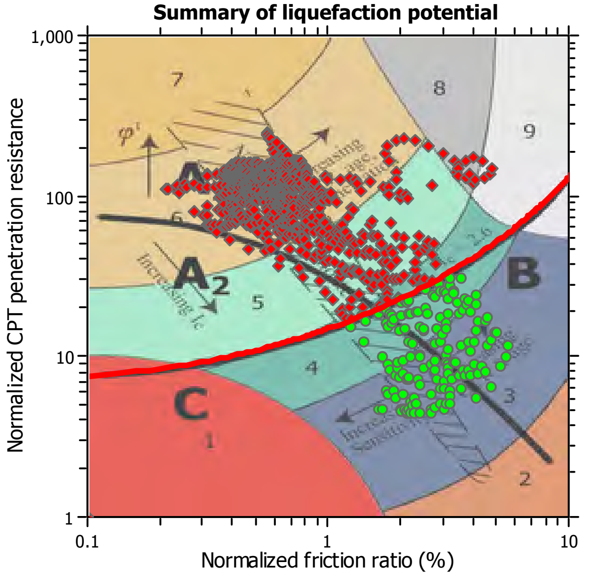
CPT file : CPT-42

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	6.20 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	16.00 ft	Fill height:	11.00 ft		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth applied:	No
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.55	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
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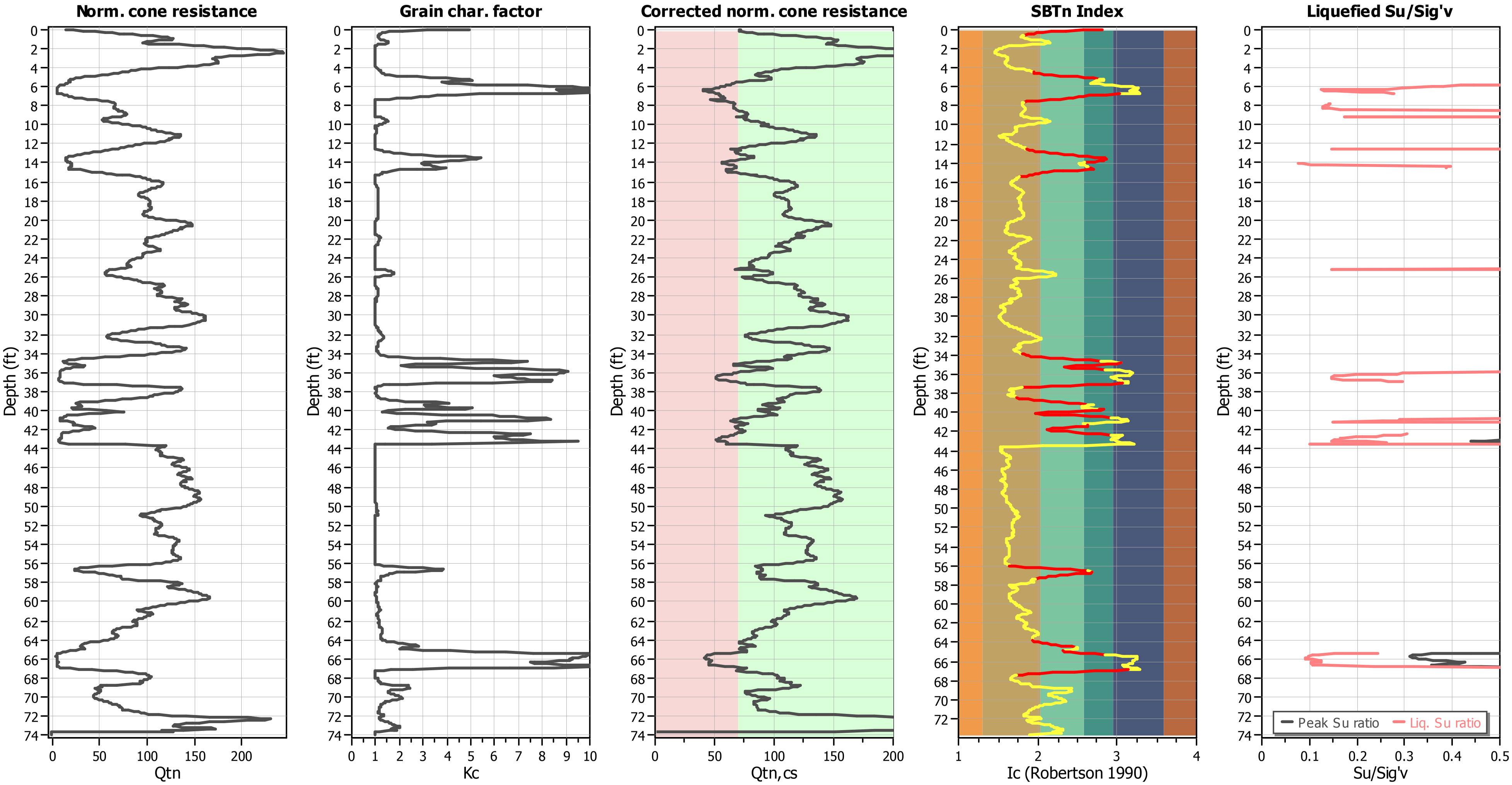
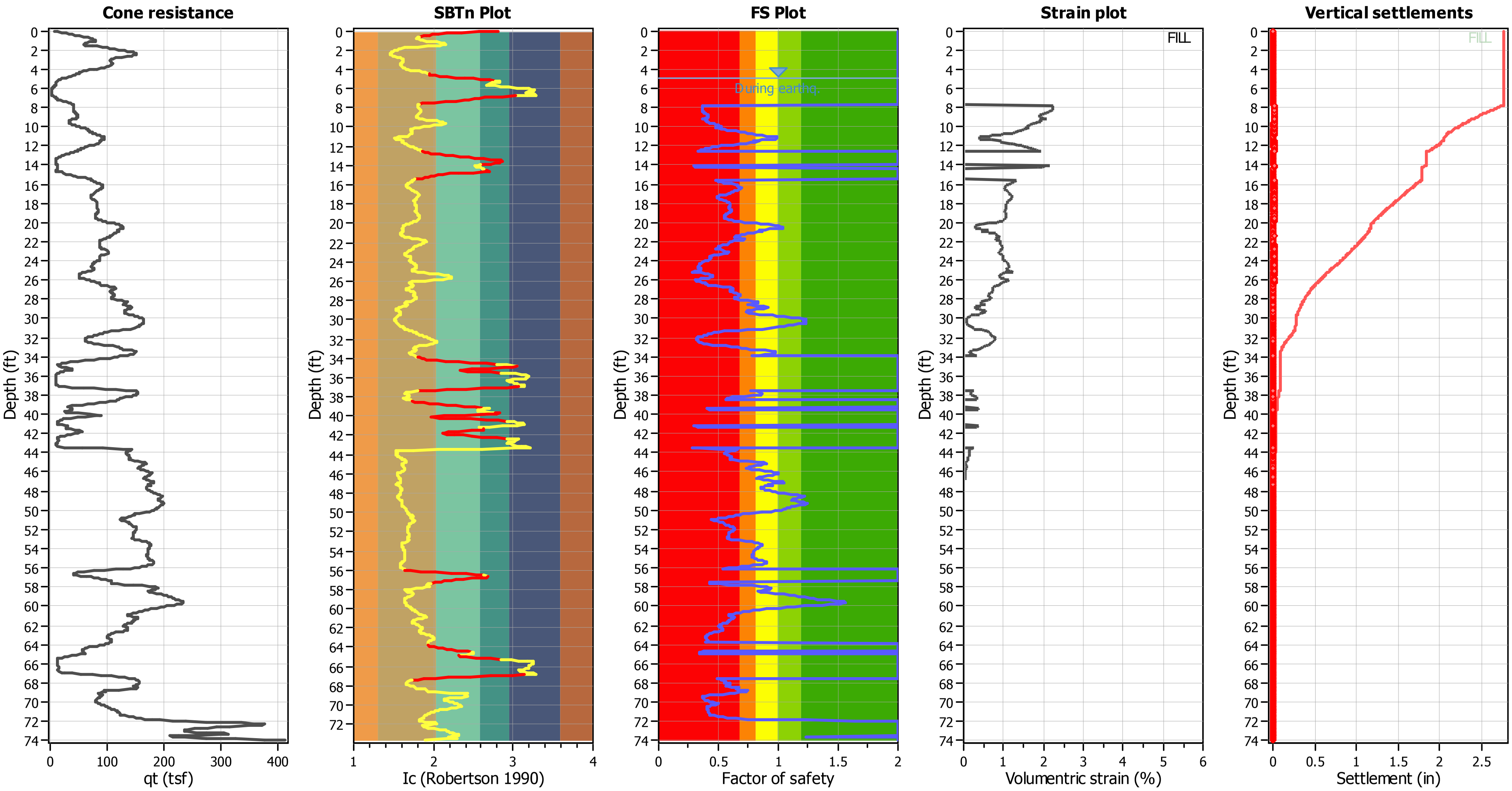
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	16.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	6.20 ft	Fill height:	11.00 ft	Limit depth:	N/A

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

NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

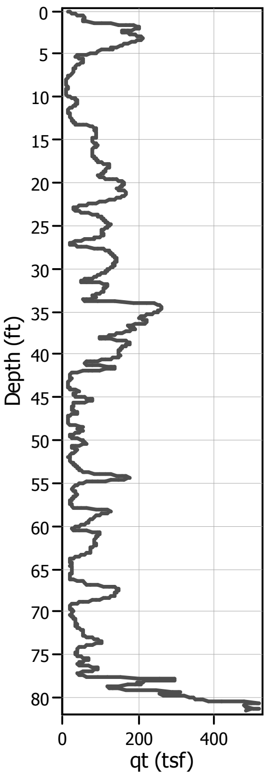
LIQUEFACTION ANALYSIS REPORT

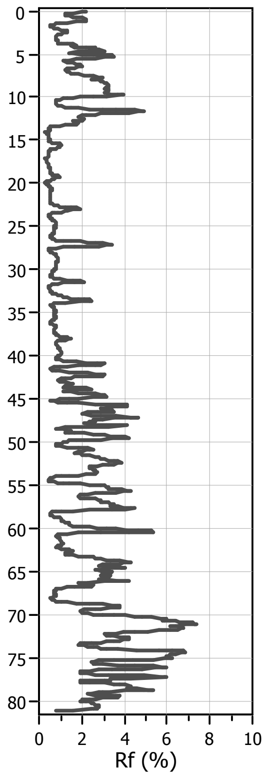
Project title : Riverwalk **Location : San Diego, CA**

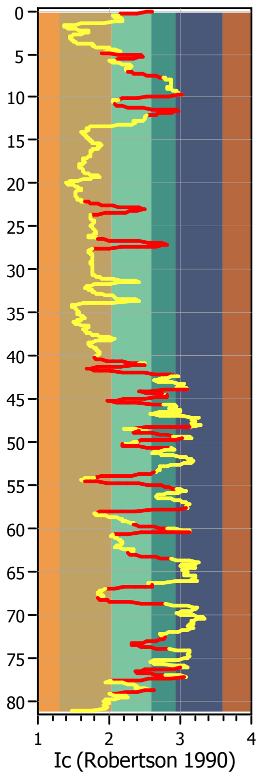
CPT file : CPT-43

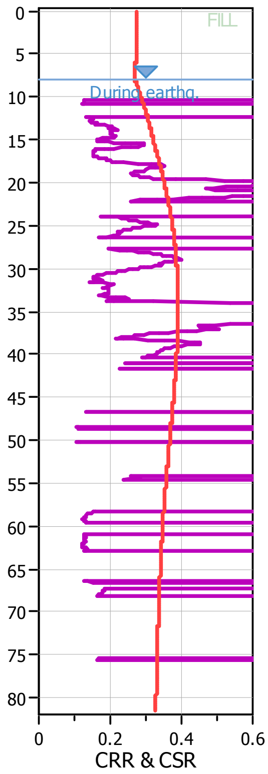
Input parameters and analysis data

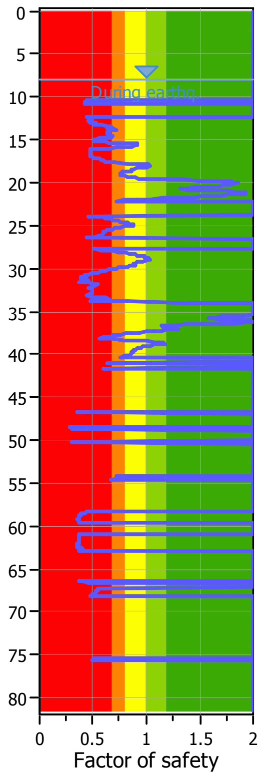
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	6.20 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	14.50 ft	Fill height:	6.50 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft^3	Limit depth:	N/A
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.55	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		


Cone resistance

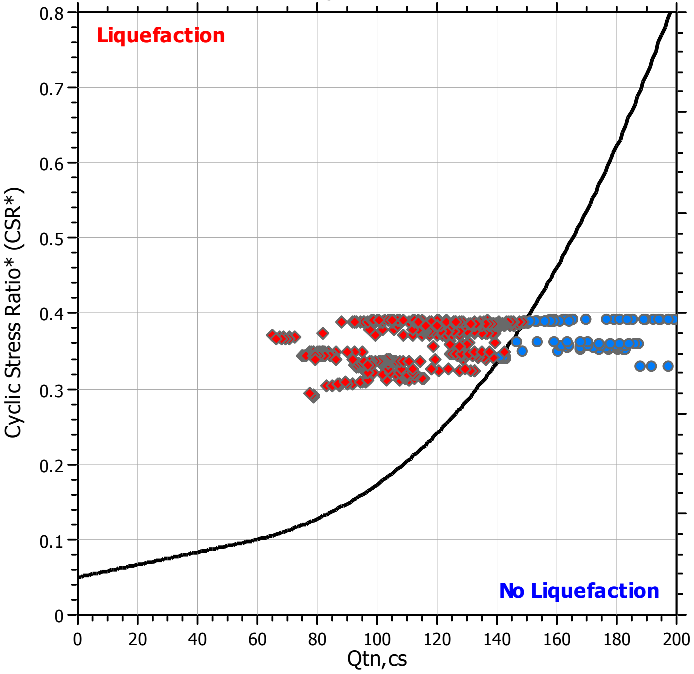

Friction Ratio


SBTn Plot

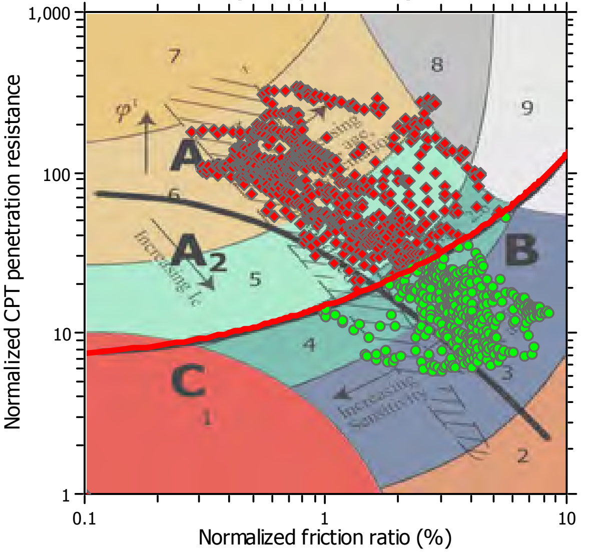

CRR plot


FS Plot

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

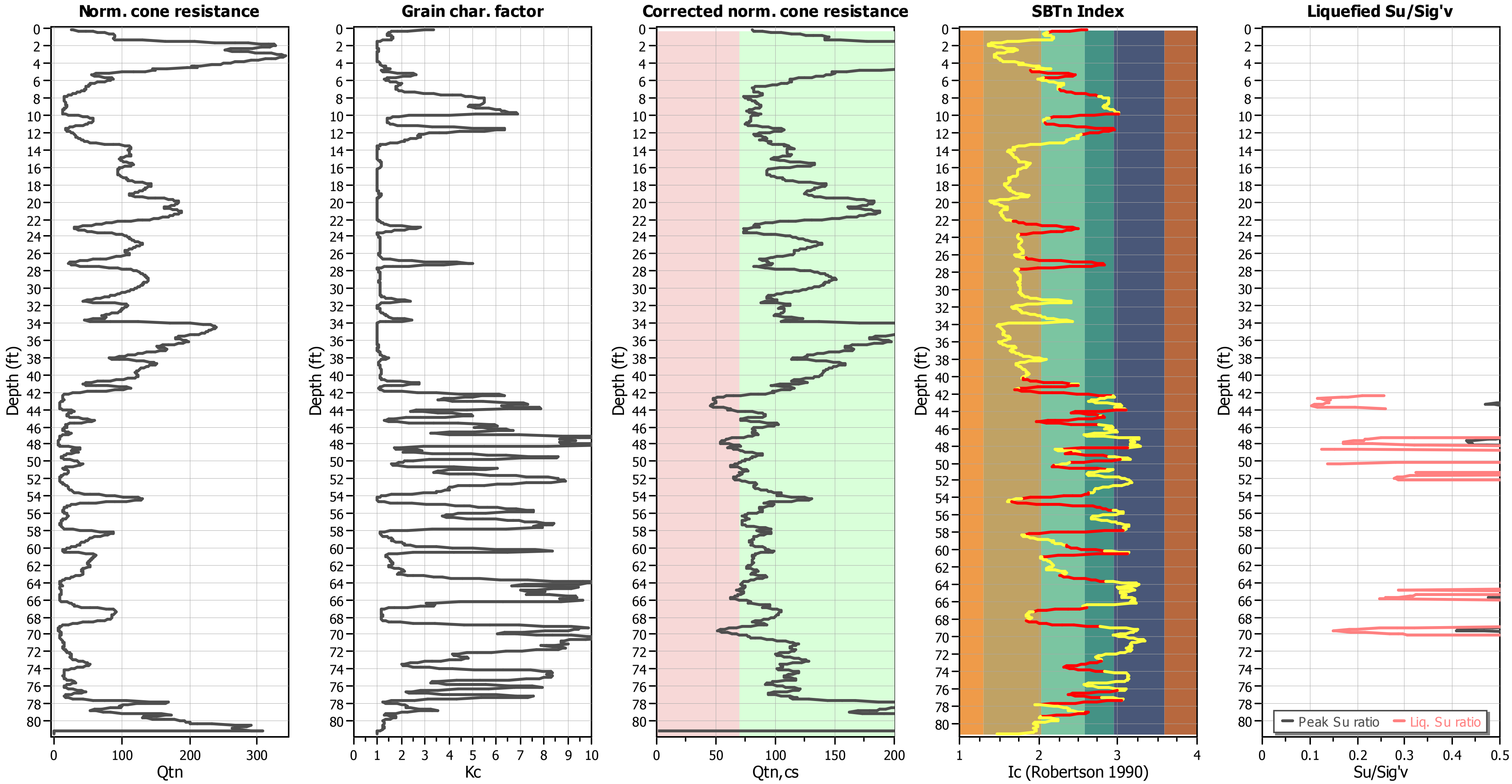


Summary of liquefaction potential



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

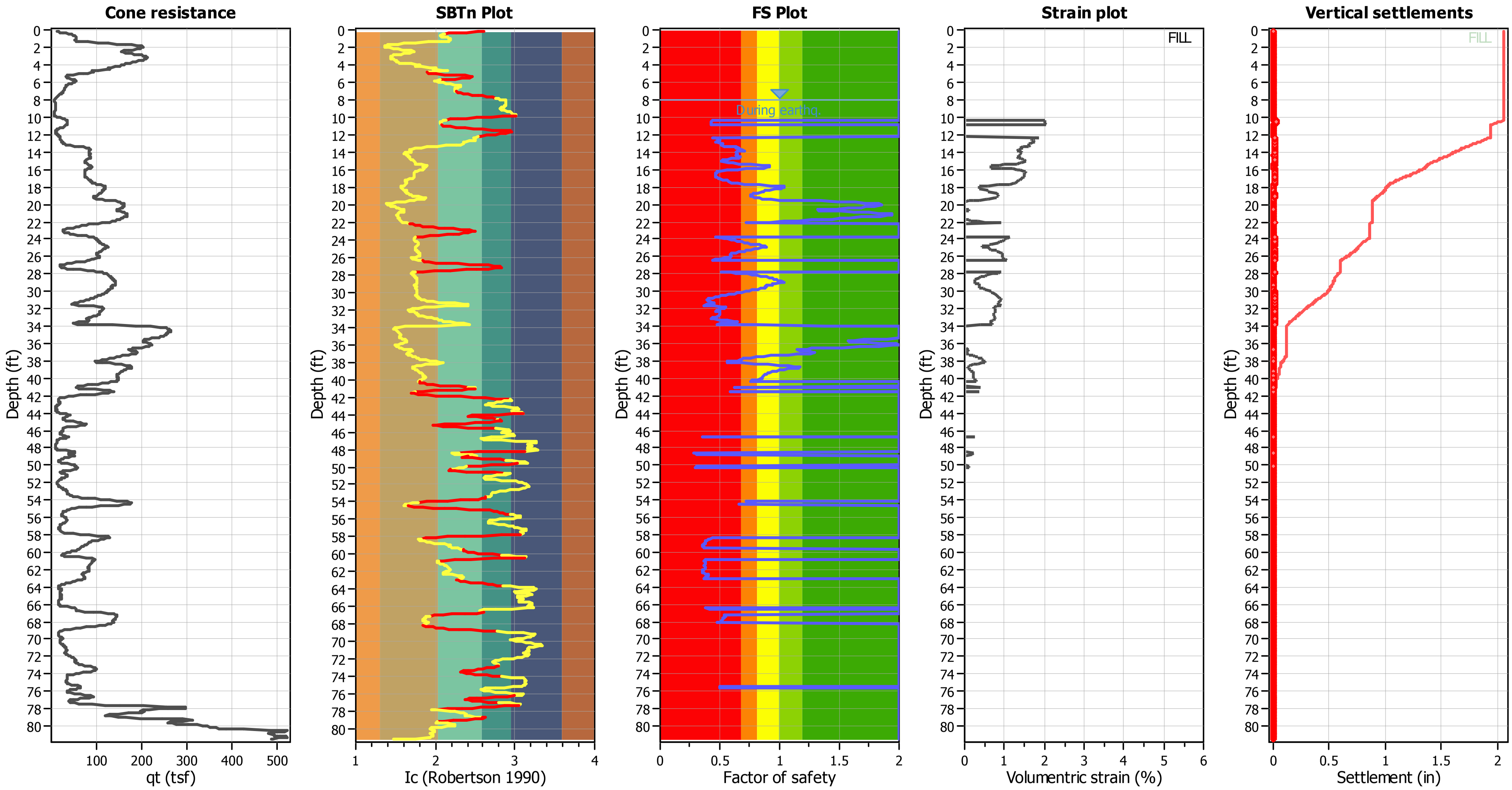
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	14.50 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	6.20 ft	Fill height:	6.50 ft	Limit depth:	N/A

Estimation of post-earthquake settlements



Abbreviations

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I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

LIQUEFACTION ANALYSIS REPORT

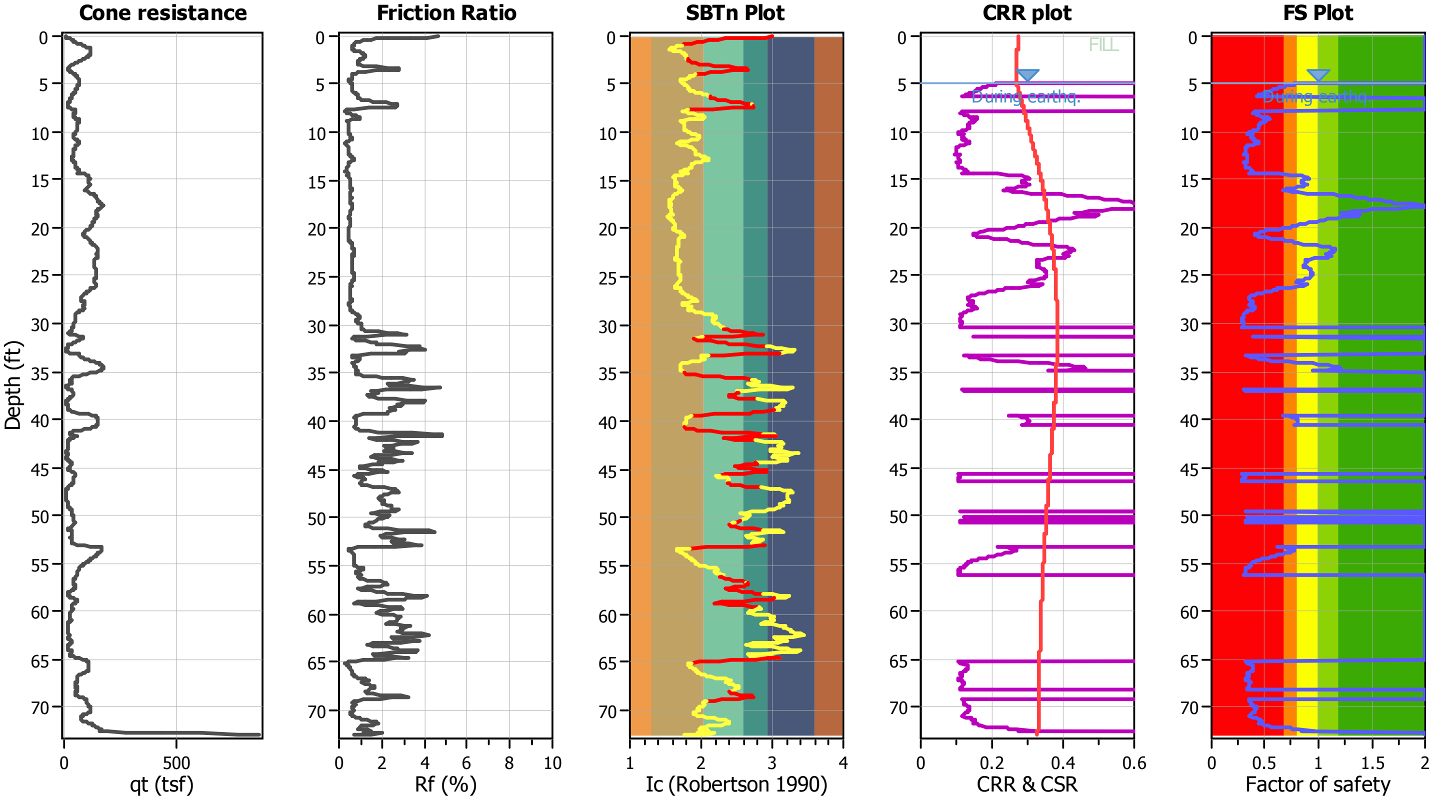
Project title : Riverwalk

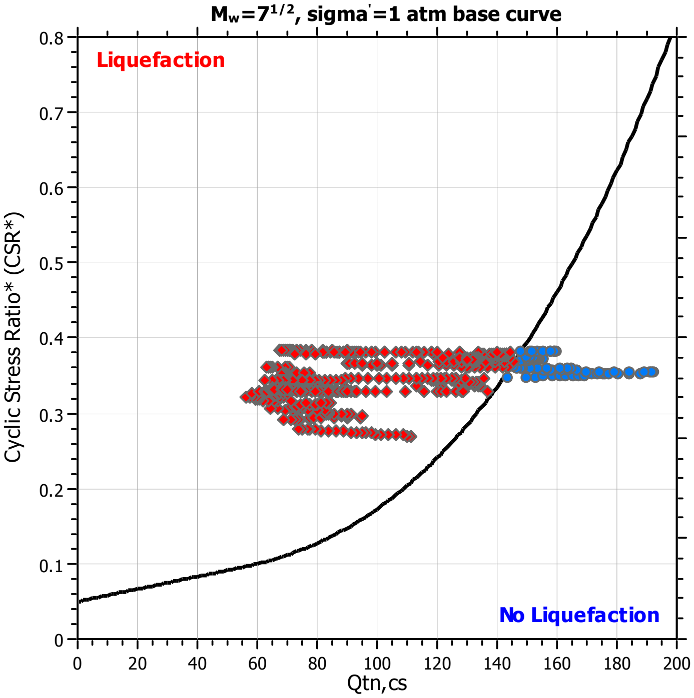
Location : San Diego, CA

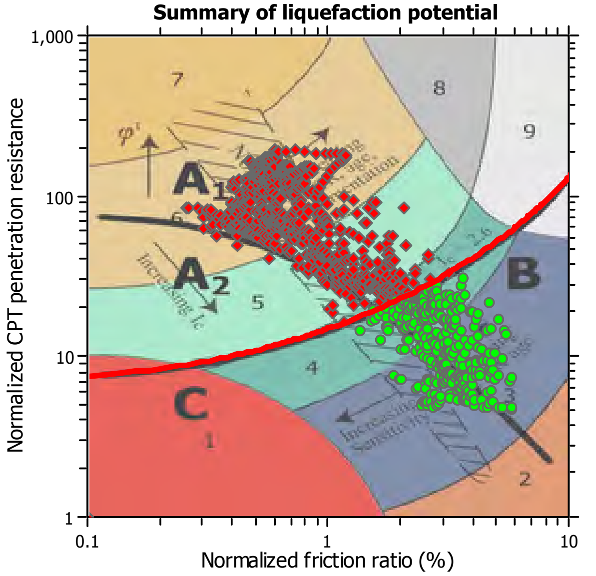
CPT file : CPT-44

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	9.00 ft	Use fill:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	16.00 ft	Fill height:	11.00 ft		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	120.00 lb/ft³	Limit depth applied:	No
Earthquake magnitude M_w:	6.80	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.55	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
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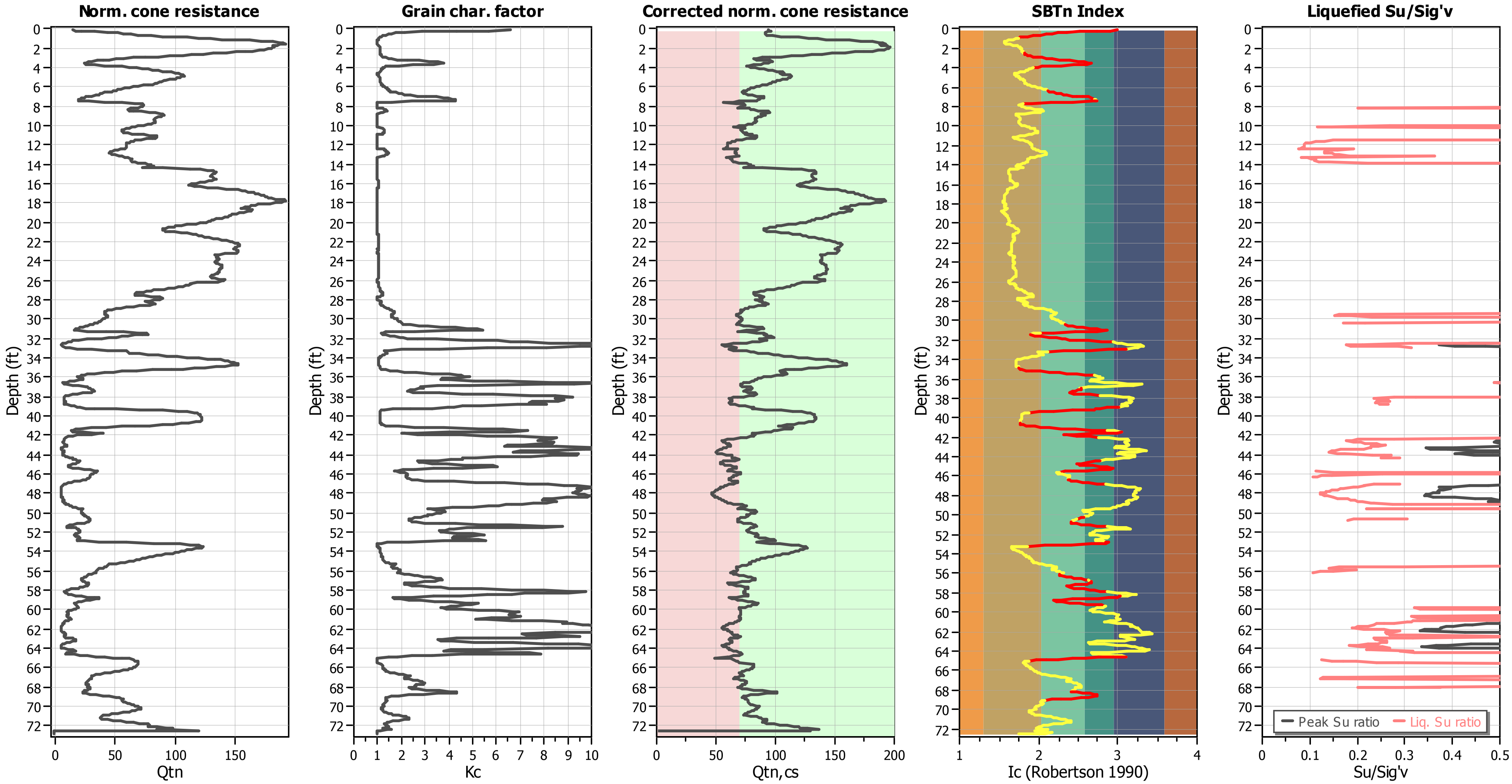
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

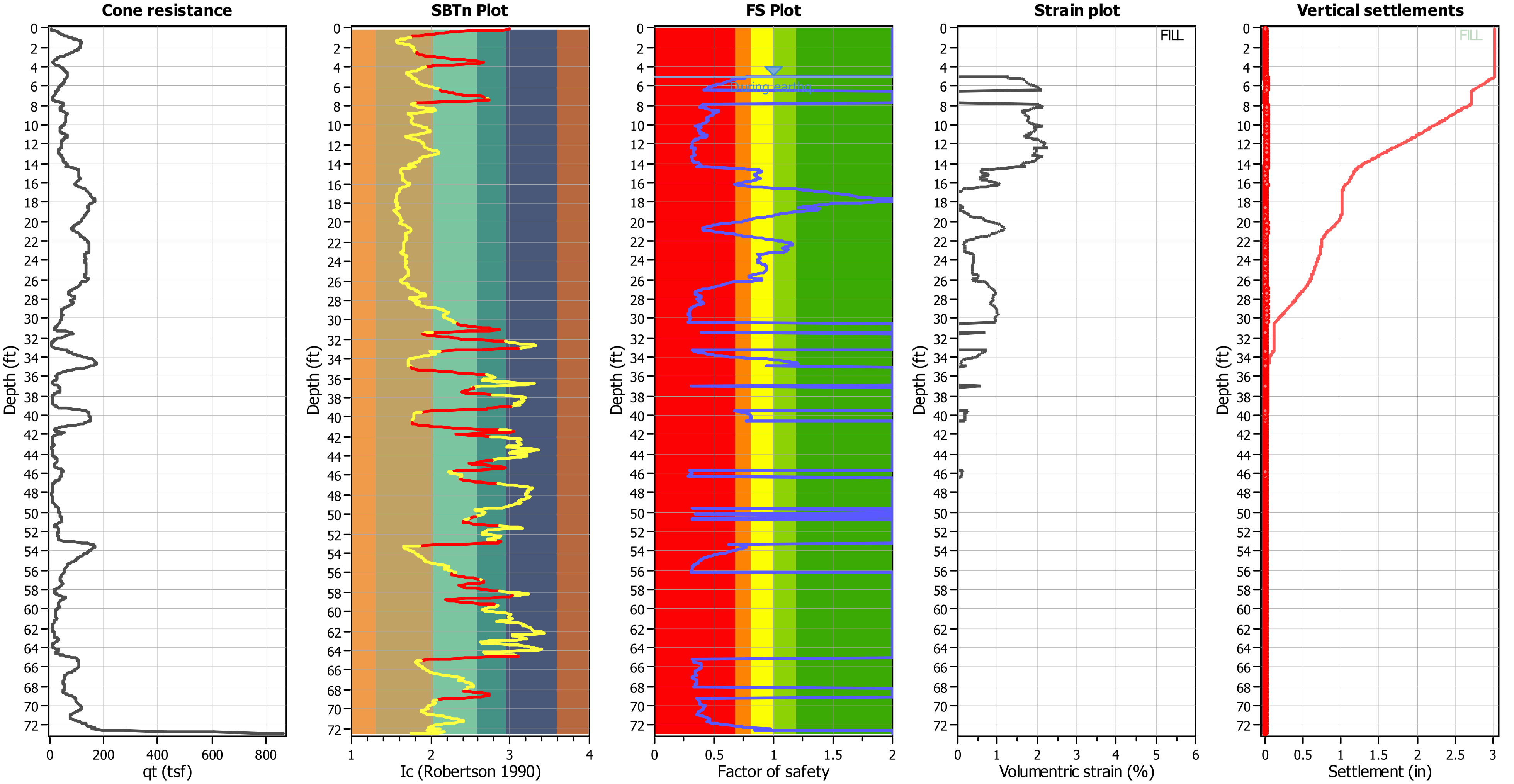
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	16.00 ft	Fill weight:	120.00 lb/ft^3
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	Yes	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	11.00 ft	Limit depth:	N/A

Estimation of post-earthquake settlements

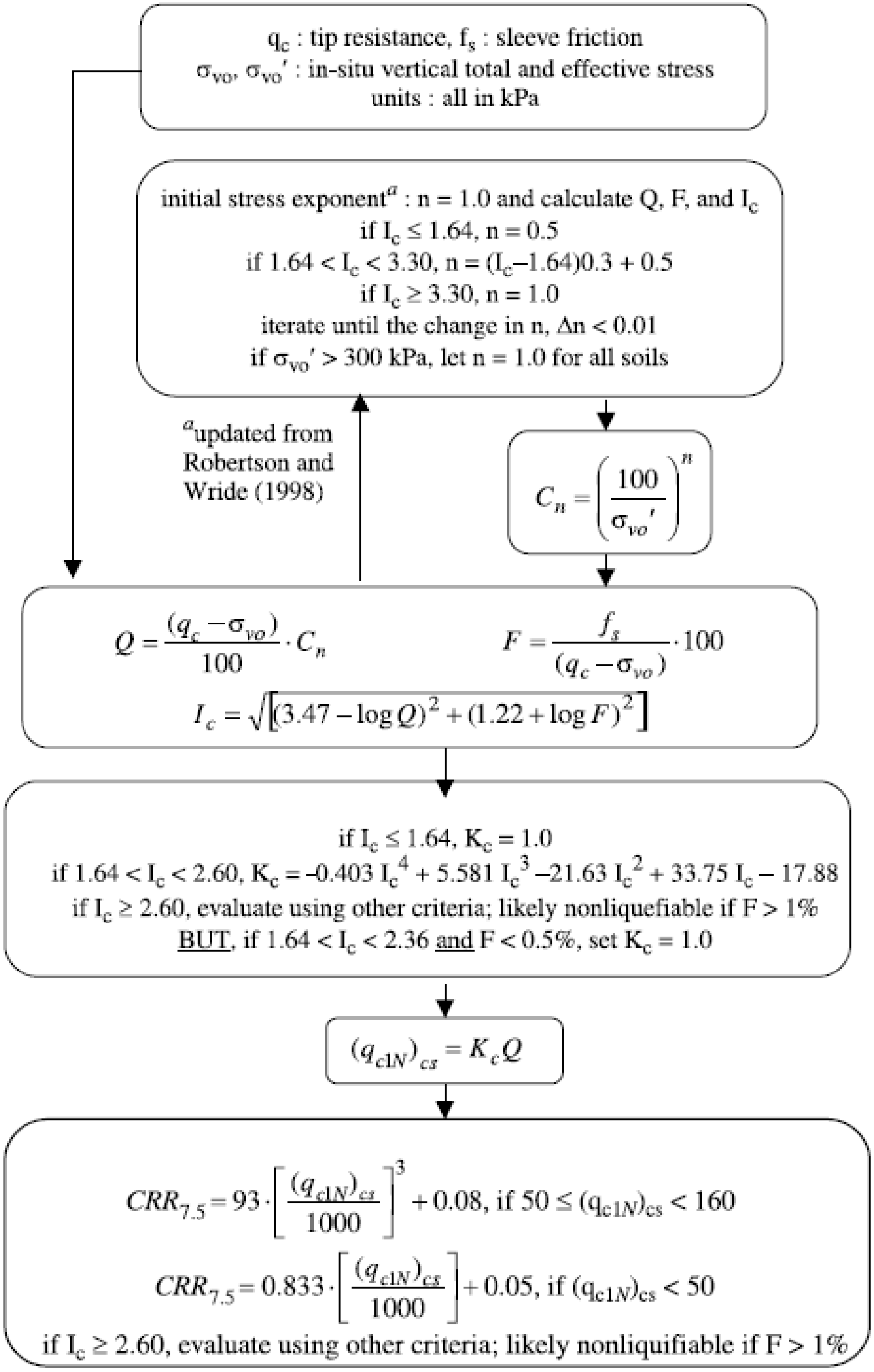


Abbreviations

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]:



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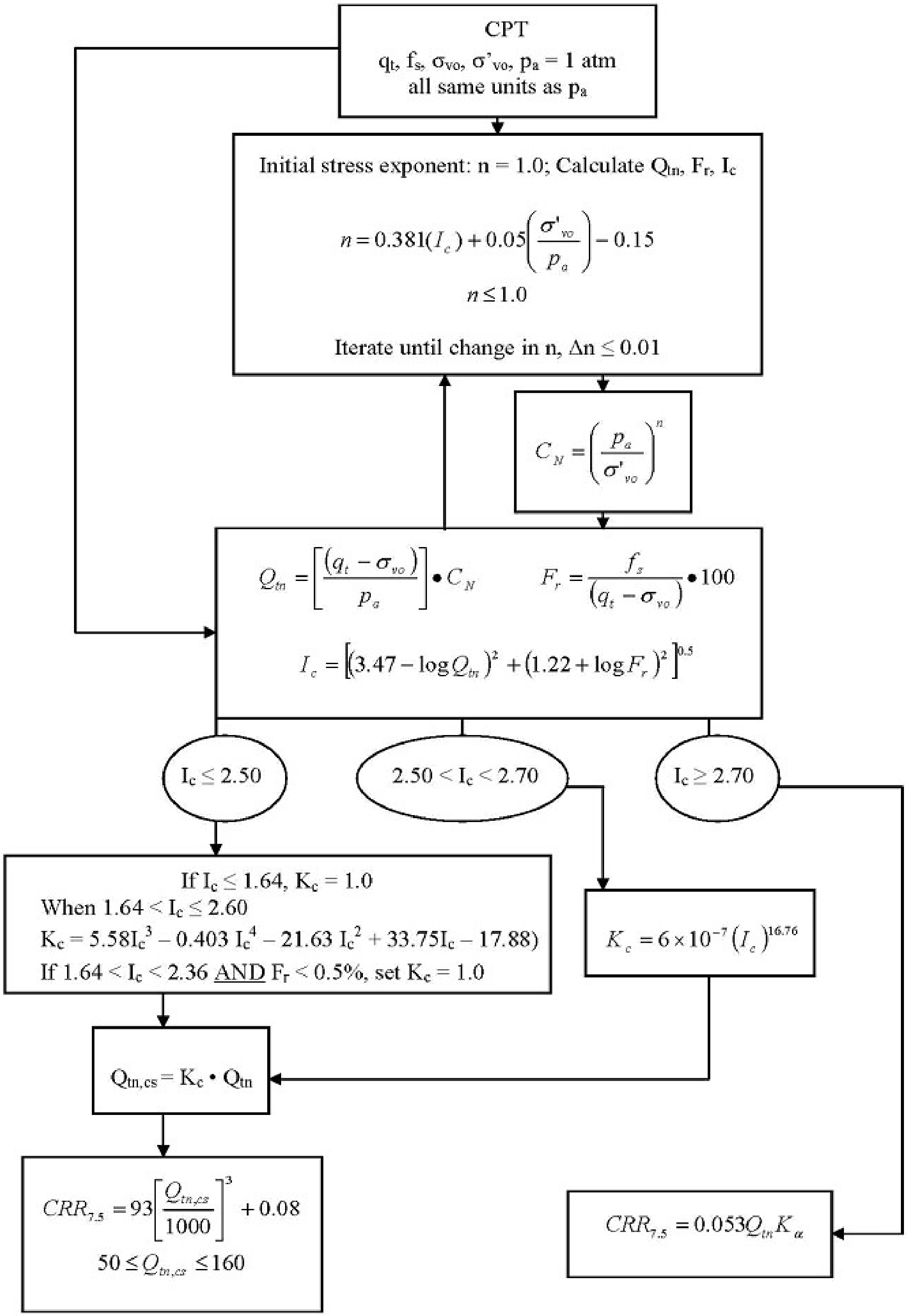
[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

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]:



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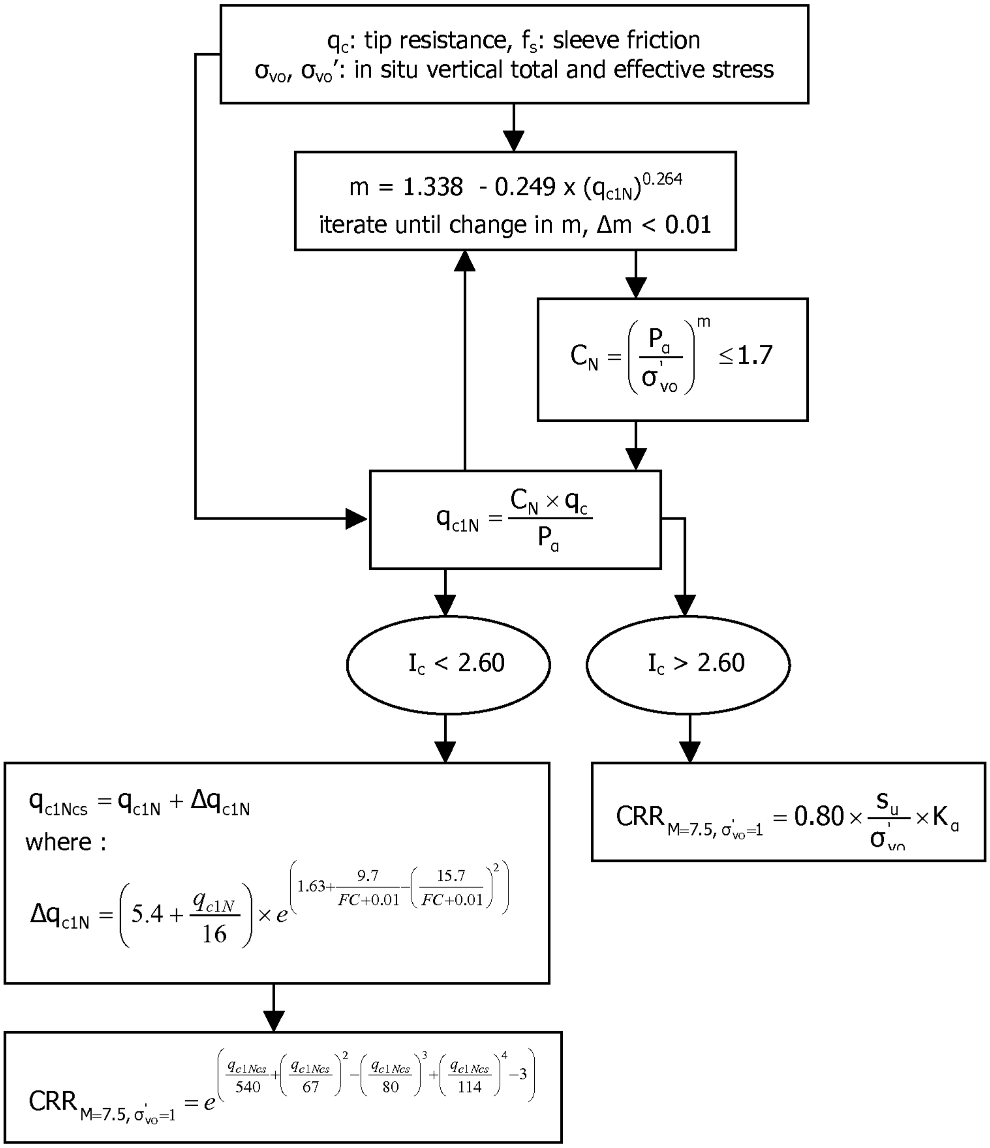
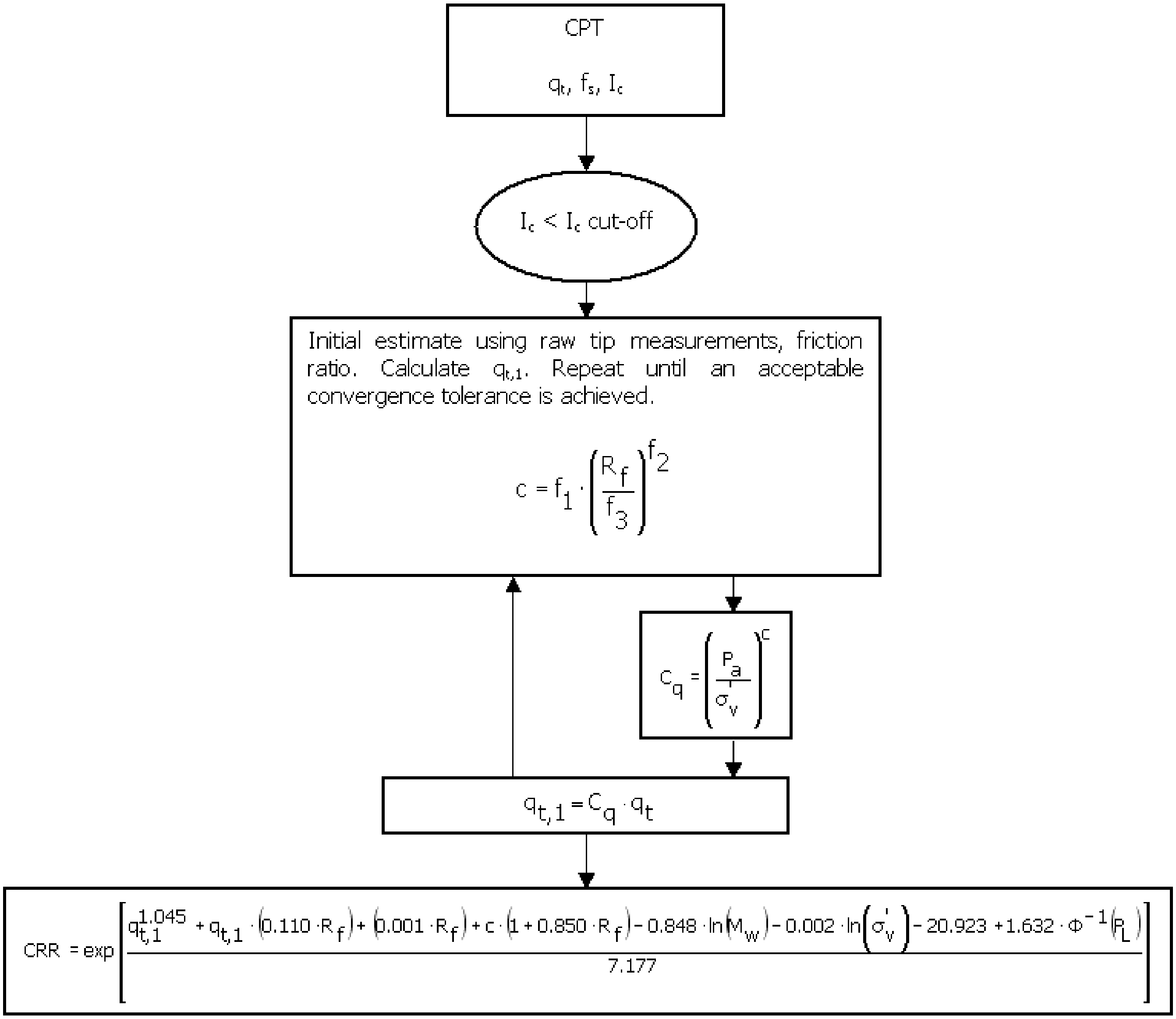
[1] P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering – from case history to practice, IS-Tokyo, June 2009

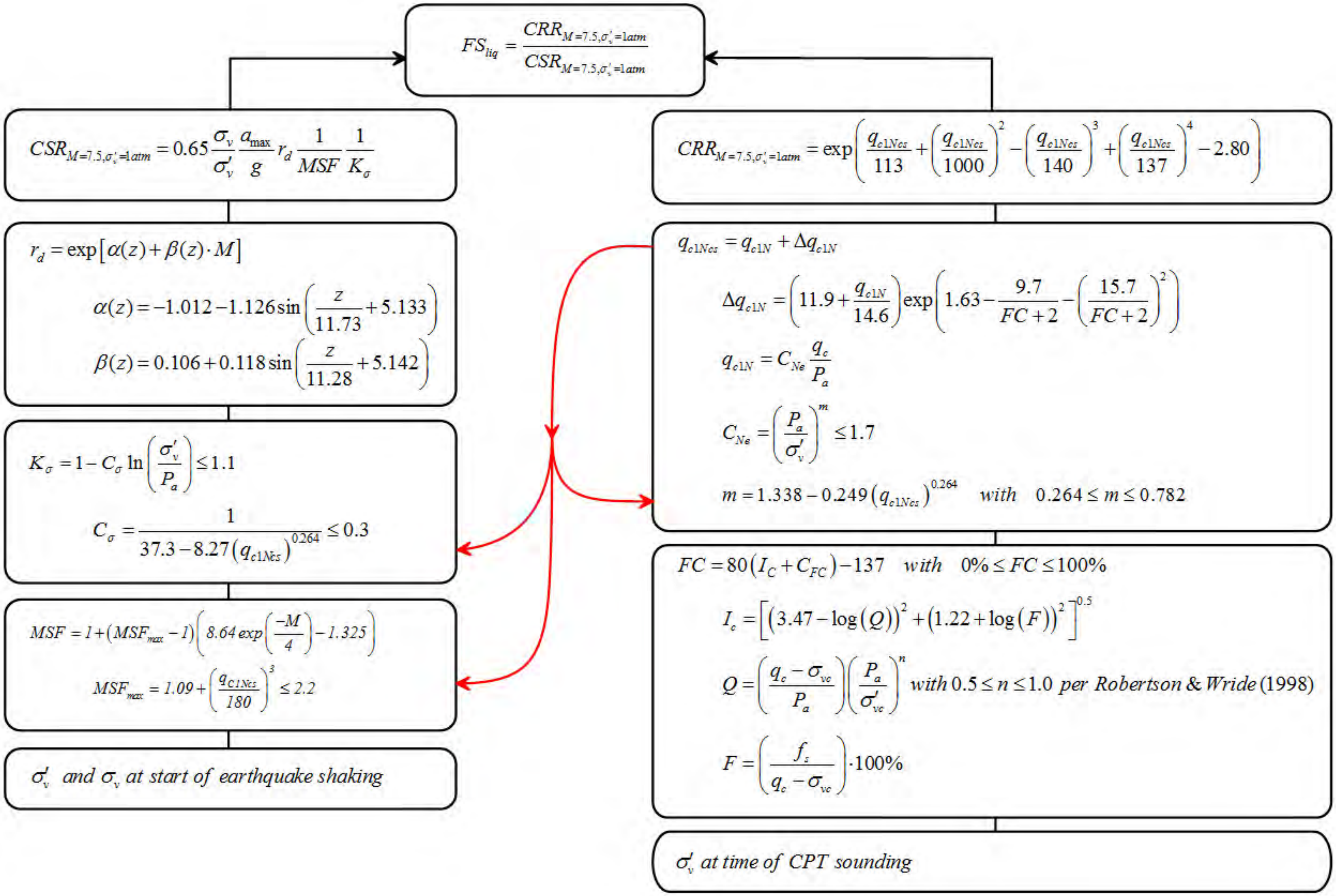
Procedure for the evaluation of soil liquefaction resistance, Idriss & Boulanger (2008)



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



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



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

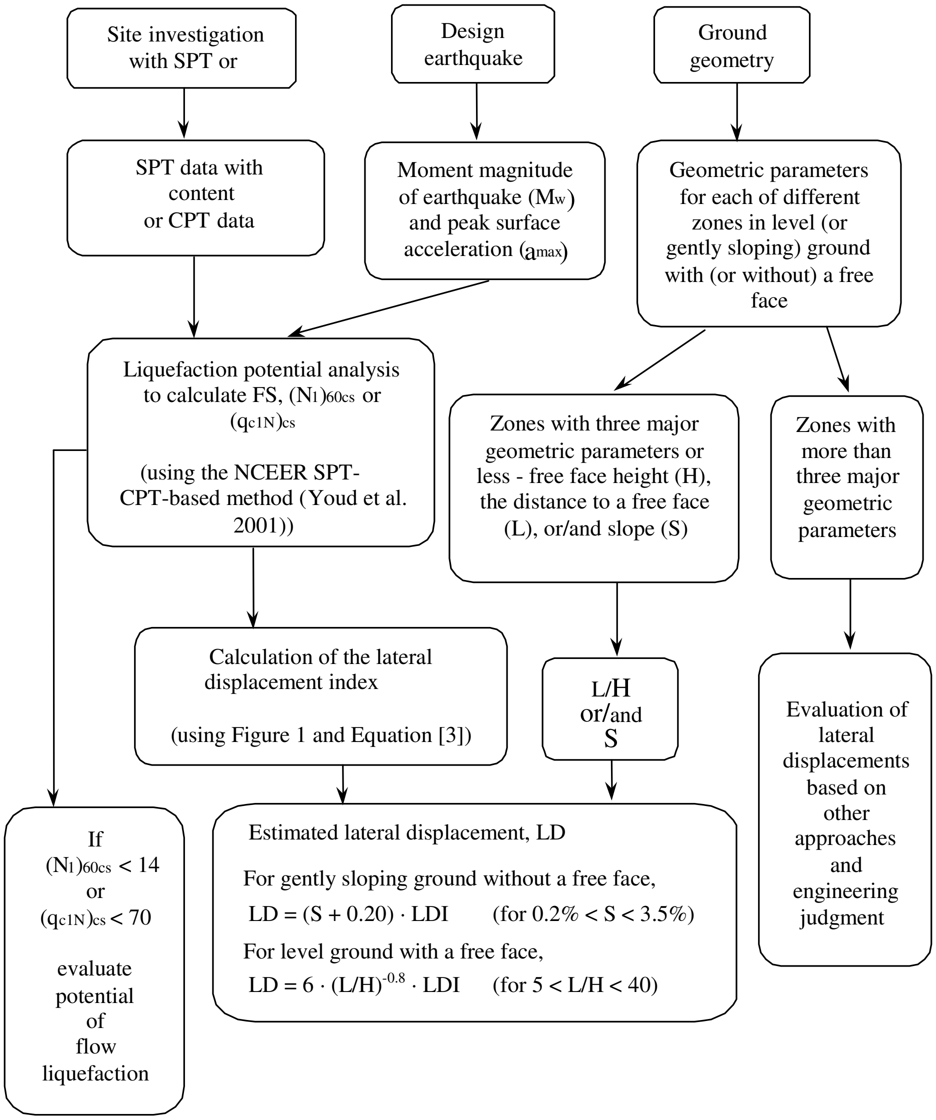
$$I_c = \left[\left(3.47-\log(Q)\right)^2+\left(1.22+\log(F)\right)^2\right]^{0.5}$$

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

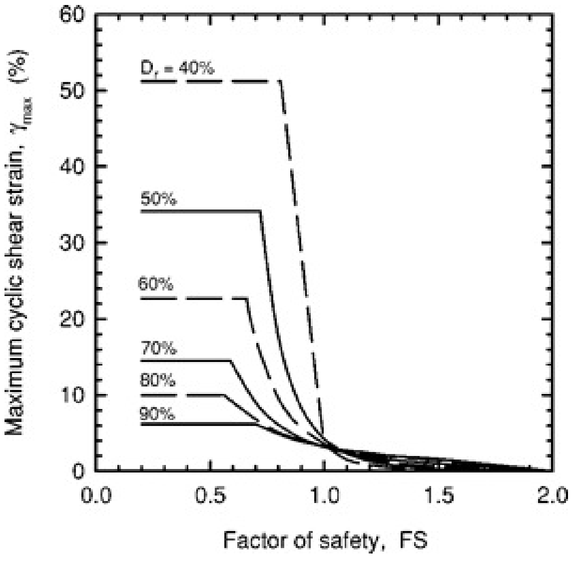
$$F = \left(\frac{f_s}{q_c-\sigma_{vc}}\right)\cdot 100\%$$

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**

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

[1] **Equation [3]**

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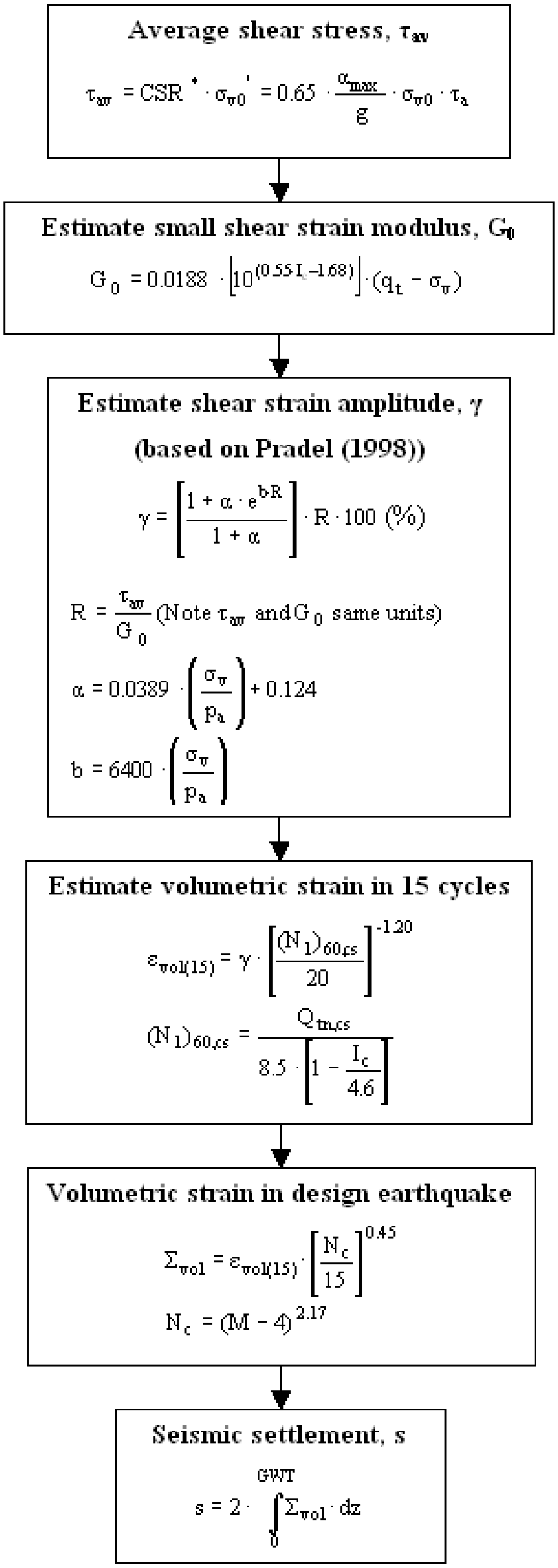
[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

Procedure for the estimation of seismic induced settlements in dry sands



Average shear stress, τ_{av}

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

Estimate small shear strain modulus, G_0

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

Estimate shear strain amplitude, γ

(based on Pradel (1998))

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

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

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

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

Estimate volumetric strain in 15 cycles

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

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

Volumetric strain in design earthquake

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

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

Seismic settlement, s

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

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

Liquefaction Potential Index (LPI) calculation procedure

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

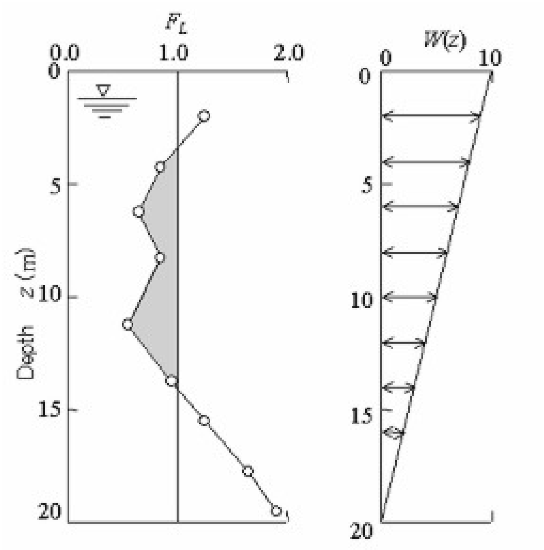
To estimate the severity of liquefaction extent at a given site, LPI is calculated based on the following equation:

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

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 G

APPENDIX G

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

1.0 General

1.1 Intent: These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 Geotechnical Consultant: Prior to commencement of work, the owner shall employ a geotechnical consultant. The geotechnical consultant shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include natural ground after it has been cleared for receiving fill but before fill is placed, bottoms of all "remedial removal" areas, all key bottoms, and benches made on sloping ground to receive fill.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to determine the attained level of compaction. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

1.3 The Earthwork Contractor: The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with the plans and specifications.

The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "spreads" of work and the estimated quantities of daily earthwork contemplated for the site prior to commencement of grading. The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified.

2.0 Preparation of Areas to be Filled

2.1 Clearing and Grubbing: Vegetation, such as brush, grass, roots, and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). No fill lift shall contain more than 5 percent of organic matter. Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed.

2.2 Processing: Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until soils are broken down and free of large clay lumps or clods and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

2.3 Overexcavation: In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as evaluated by the Geotechnical Consultant during grading.

2.4 Benching: Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. Please see the Standard Details for a graphic illustration. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise overexcavated to provide a flat subgrade for the fill.

2.5 Evaluation/Acceptance of Fill Areas: All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

3.0 Fill Material

3.1 General: Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

3.2 Oversize: Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 12 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

3.3 Import: If importing of fill material is required for grading, proposed import material shall meet the requirements of Section 3.1. The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so that its suitability can be determined and appropriate tests performed.

4.0 Fill Placement and Compaction

4.1 Fill Layers: Approved fill material shall be placed in areas prepared to receive fill (per Section 3.0) in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

4.2 Fill Moisture Conditioning: Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM Test Method D1557-91).

4.3 Compaction of Fill: After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557-91). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

4.4 Compaction of Fill Slopes: In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557-91.

4.5 Compaction Testing: Field tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

4.6 Frequency of Compaction Testing: Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

4.7 Compaction Test Locations: The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two grade stakes within a horizontal distance of 100 feet and vertically less than 5 feet apart from potential test locations shall be provided.

5.0 Subdrain Installation

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the grading plan, and the Standard Details. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land surveyor/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.

6.0 Excavation

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

7.0 Trench Backfills

7.1 Contractor shall follow all OHSA and Cal/OSHA requirements for safety of trench excavations.

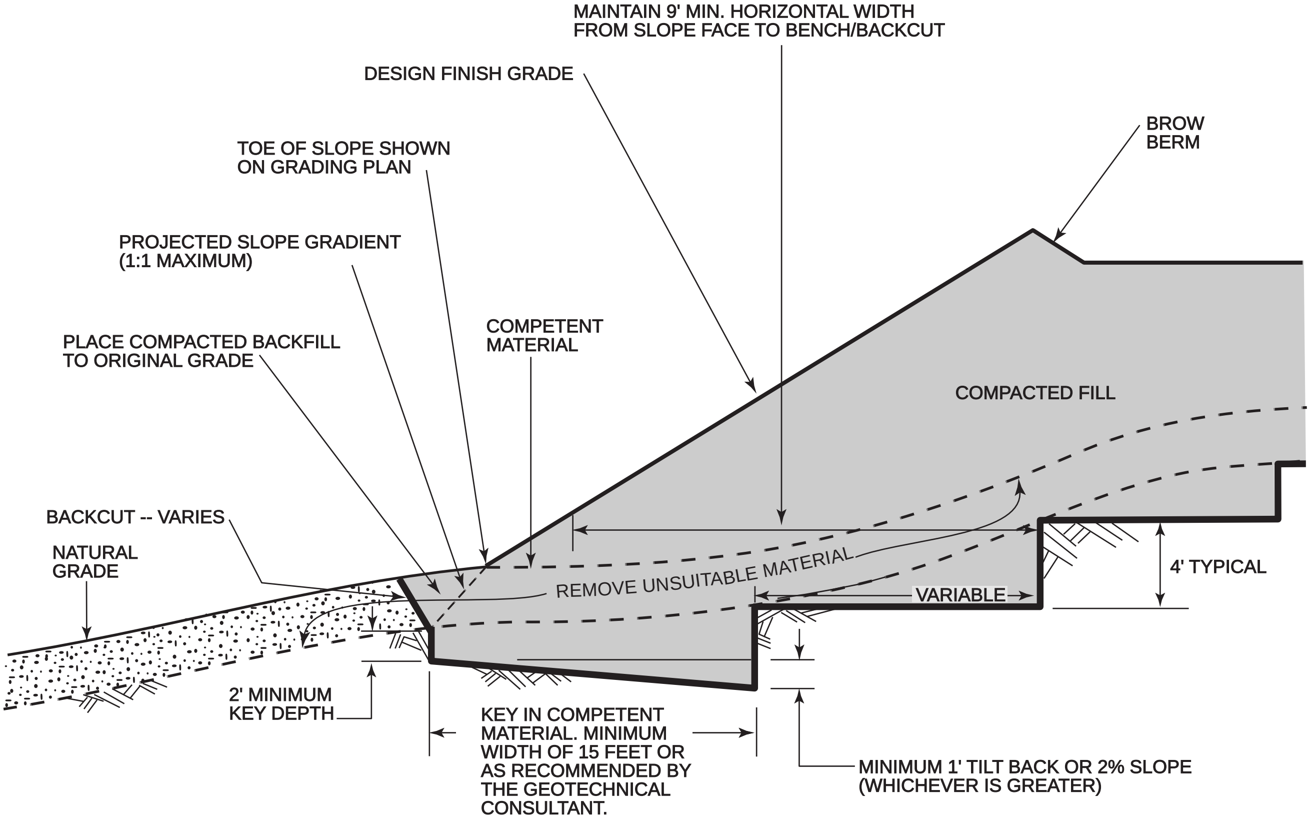
7.2 Bedding and backfill of utility trenches shall be done in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum 90 percent of maximum from 1 foot above the top of the conduit to the surface, except in traveled ways (see Section 7.6 below).

7.3 Jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.

7.4 Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill.

7.5 Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

7.6 Trench backfill in the upper foot measured from finish grade within existing or future traveled way, shoulder, and other paved areas (or areas to receive pavement) should be placed to a minimum 95 percent relative compaction.



NOTE: BENCHING SHALL BE REQUIRED WHEN NATURAL SLOPES ARE EQUAL TO OR STEEPER THAN 5:1 OR WHEN RECOMMENDED BY THE SOIL ENGINEER. WHERE THE NATURAL SLOPE APPROACHES OR EXCEEDS THE DESIGN SLOPE RATIO, SPECIAL RECOMMENDATIONS WILL BE PROVIDED BY THE GEOTECHNICAL ENGINEER.

FIGURE 1

TYPICAL FILL KEY ABOVE NATURAL SLOPE
MINIMUM STANDARD GRADING DETAILS

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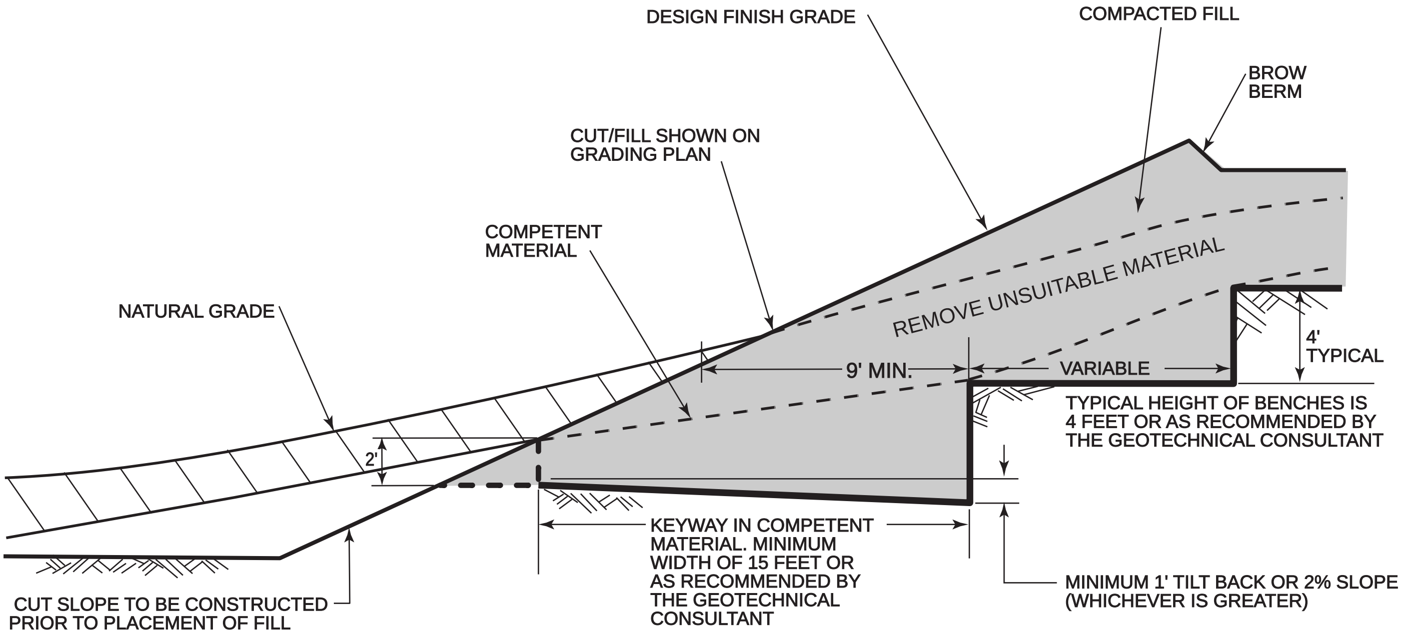
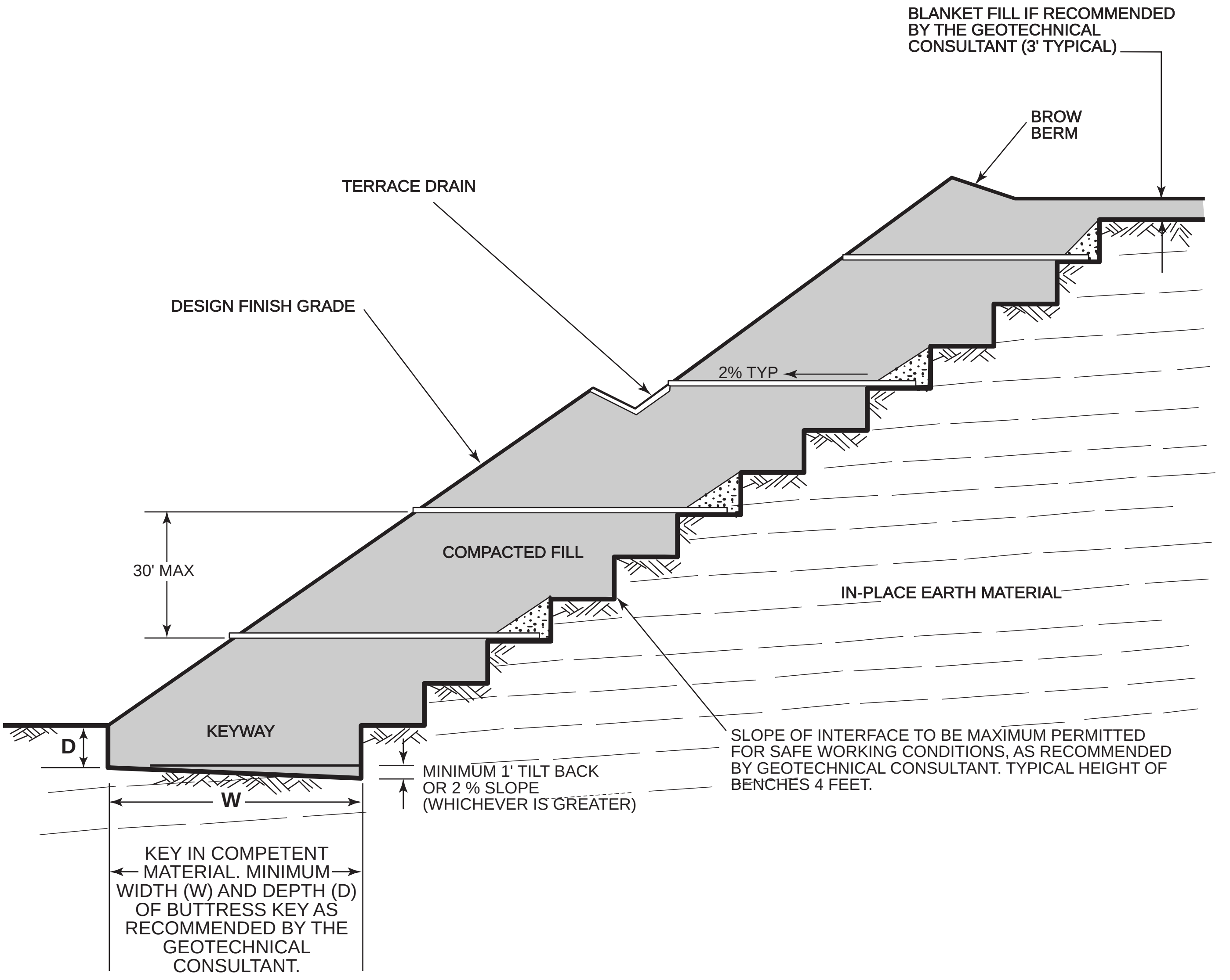


NOTE: THE FILL PORTION OF THE SLOPE SHALL BE COMPACTED AS STATED IN THE PROJECT SPECIFICATIONS.

FIGURE 2

TYPICAL FILL ABOVE CUT SLOPE
MINIMUM STANDARD GRADING DETAILS

NMG
Geotechnical, Inc.



NOTE: SUBDRAIN DETAILS, SEE FIGURE 5.

FIGURE 3

TYPICAL BUTTRESS FILL
MINIMUM STANDARD GRADING DETAILS

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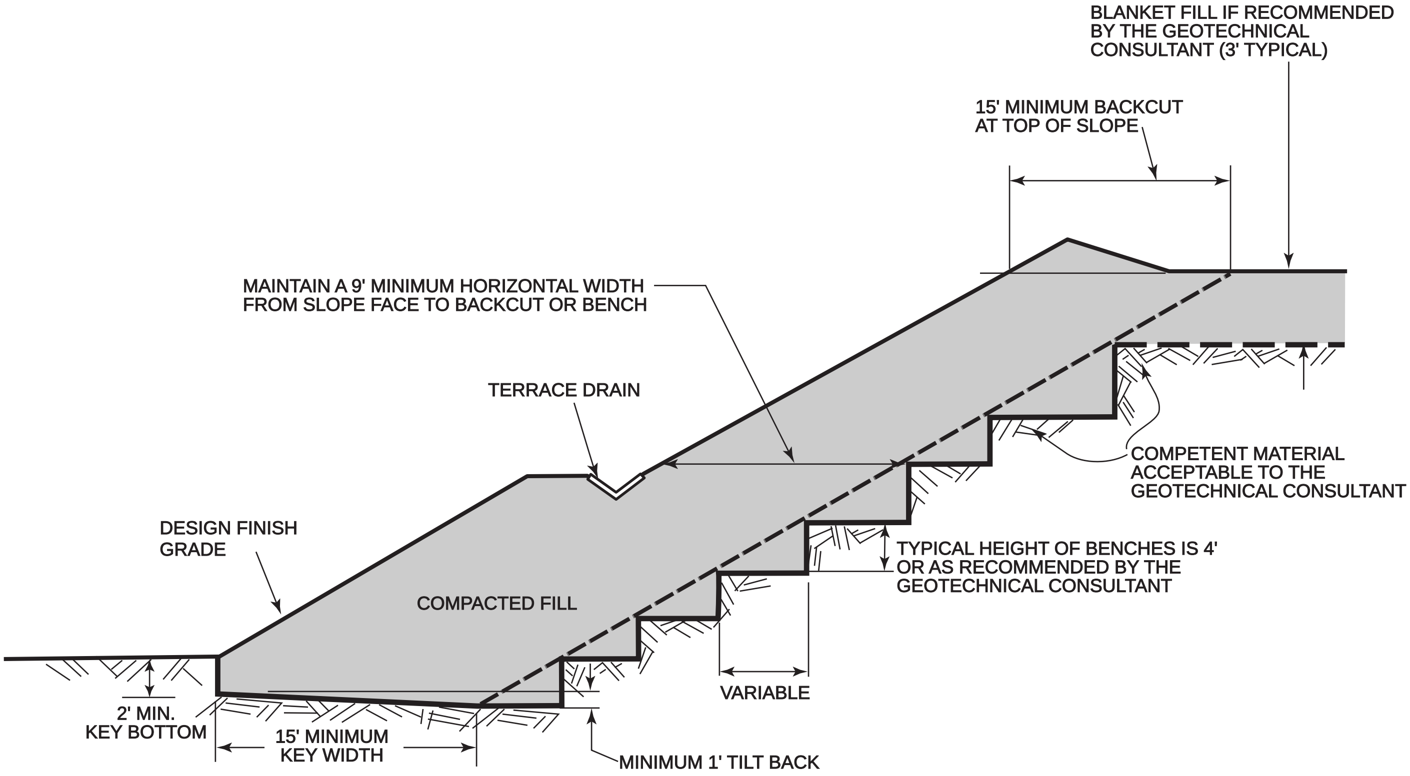
Geotechnical, Inc.



NOTE:
SEE FIGURE 5 FOR TYPICAL SUBDRAIN DETAILS FOR STABILIZATION FILLS

FIGURE 4

TYPICAL STABILIZATION FILL
MINIMUM STANDARD GRADING DETAILS

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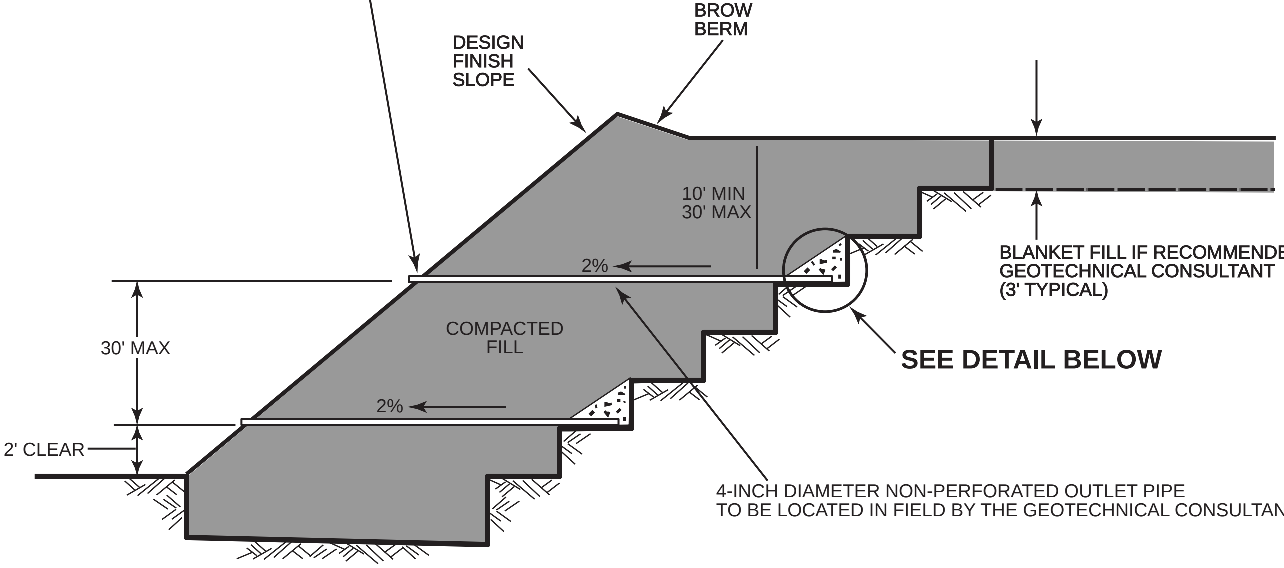
OUTLETS TO BE SPACED AT 100' MAXIMUM INTERVALS. EXTEND 12 INCHES BEYOND FACE OF SLOPE AT TIME OF ROUGH GRADING CONSTRUCTION.



BLANKET FILL IF RECOMMENDED BY GEOTECHNICAL CONSULTANT (3' TYPICAL)

4-INCH DIAMETER NON-PERFORATED OUTLET PIPE TO BE LOCATED IN FIELD BY THE GEOTECHNICAL CONSULTANT

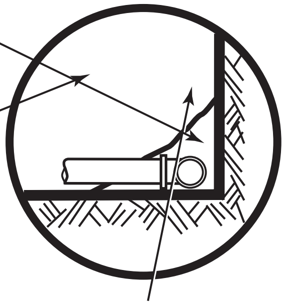
DETAIL

FILTER MATERIAL - MINIMUM OF THREE CUBIC FEET PER FOOT OF PIPE. SEE FILTER MATERIAL SPECIFICATION.

ALTERNATE: IN LIEU OF FILTER MATERIAL, THREE CUBIC FEET OF GRAVEL PER FOOT OF SUBDRAIN (WITHOUT PIPE) MAY BE ENCASED IN FILTER FABRIC. SEE GRAVEL SPECIFICATION, AND FIGURE 6 FOR FILTER FABRIC SPECIFICATION

"GRAVEL" TO CONSIST OF 1/2" TO 1" CRUSHED ROCK PER STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION.

FILTER FABRIC SHALL BE LAPPED A MINIMUM OF 12 INCHES ON ALL JOINTS.



OUTLET PIPE TO BE CONNECTED TO SUBDRAIN PIPE WITH TEE OR ELBOW

MINIMUM 4-INCH DIAMETER SCHEDULE 40 ASTM D1527 OR D1785 OR SDR 35 ASTM D2751 OR D 3034. FOR FILL DEPTH OF 90 FEET OR GREATER, USE ONLY SCHEDULE 40 OR EQUIVALENT. THERE SHALL BE A MINIMUM OF 8 UNIFORMLY SPACED PERFORATIONS PER FOOT OF PIPE INSTALLED WITH PERFORATIONS ON BOTTOM OF PIPE. PROVIDE CAP AT UPSTREAM END OF PIPE. SLOPE AT 2 PERCENT TO OUTLET PIPE.

"FILTER MATERIAL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT.

SIEVE SIZE	PERCENTAGE PASSING
1"	100
3/4"	90-100
3/8"	40-100
NO. 4	25-40
NO. 8	18-33
NO. 30	5-15
NO. 50	0-7
NO. 200	0-3

NOTE:
TRENCH FOR OUTLET PIPES TO BE BACKFILLED WITH ON-SITE SOIL.

FIGURE 5

TYPICAL STABILIZATION AND BUTTRESS FILL SUBDRAINS
MINIMUM STANDARD GRADING DETAILS

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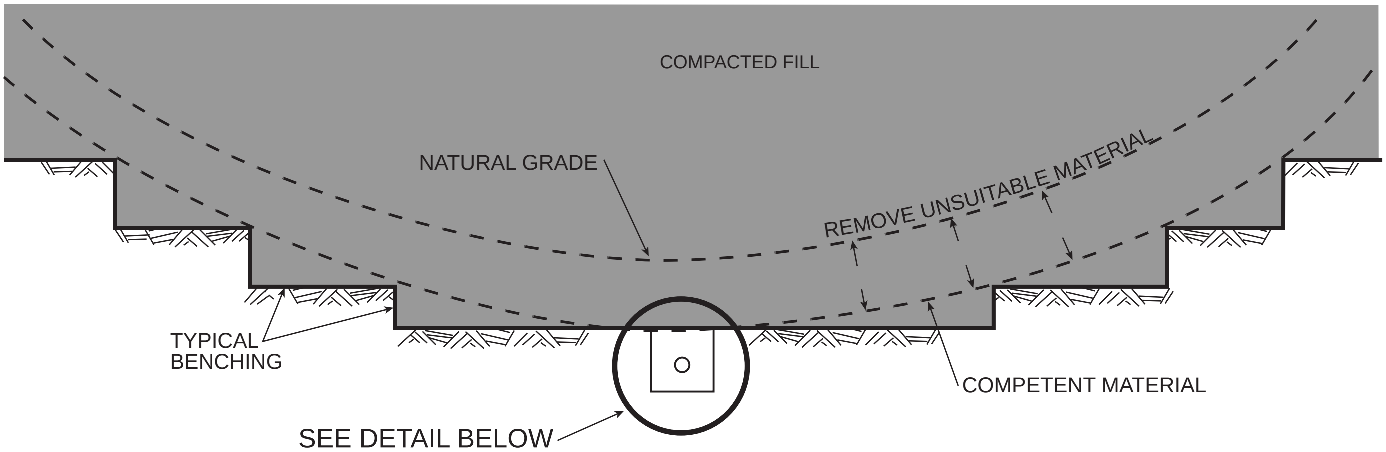
8/96 STAB. BUTTRESS FILL SUBDRAINS.ai



FILTER FABRICS SHALL BE PERMEABLE NON-WOVEN POLYESTER, NYLON, OR POLYPROPYLENE MATERIAL CONFORMING TO THE FOLLOWING:

1) GRAB TENSILE STRENGTH. POUNDS, MIN. ASTM D 4632...90

2) ELONGATION, AT PEAK LOAD, PERCENT, MIN. ASTM D 4632..50

3) PUNCTURE STRENGTH, LBS., MIN. ASTM D 3787...45

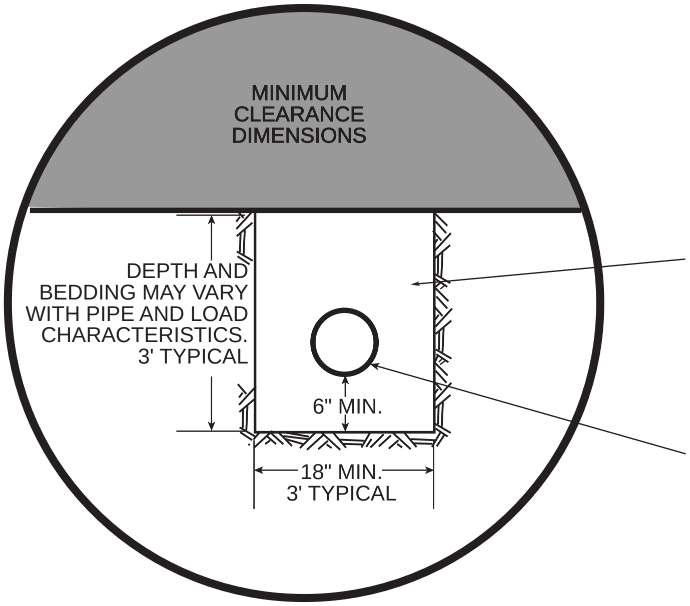
4) COEFFICIENT OF WATER PERMITTIVITY, 1/SEC. ASTM D 4491...>0.7

5) BURST STRENGTH, P.S.I., MIN. ASTM D 3786...180

NOTES: DOWNSTREAM 20' OF PIPE AT OUTLET SHALL BE NON-PERFORATED AND BACKFILLED WITH FINE-GRAINED MATERIAL

PIPE SHALL BE A MINIMUM OF 4-INCH DIAMETER. FOR RUNS OF 500 FEET OR MORE, USE 6-INCH DIAMETER PIPE, OR AS RECOMMENDED BY THE GEOTECHNICAL CONSULTANT

DETAIL



FILTER MATERIAL - MINIMUM OF NINE CUBIC FEET PER FOOT OF PIPE. SEE FIGURE 5 FOR FILTER MATERIAL SPECIFICATIONS.

ALTERNATE: IN LIEU OF FILTER MATERIAL, NINE CUBIC FEET OF GRAVEL PER FOOT OF SUBDRAIN (WITHOUT PIPE) MAY BE ENCASED IN FILTER FABRIC. SEE FIGURE 5 TO GRAVEL SPECIFICATION. SEE ABOVE FOR FILTER FABRIC SPECIFICATION. FILTER FABRIC SHALL BE LAPPED MINIMUM OF 12 INCHES ON ALL JOINTS.

MINIMUM 4 INCH DIAMETER SCHEDULE 40 ASTM D 1527, OR D 1785, OR SDR 35 ASTM 2751 OR D 3034. FOR FILL DEPTH OF 90 FEET OR GREATER, USE ONLY SCHEDULE 40 OR APPROVED EQUIVALENT. THERE SHALL BE A MINIMUM OF 8 UNIFORMLY SPACED PERFORATIONS PER FOOT OF PIPE INSTALLED WITH PERFORATIONS ON BOTTOM OF PIPE.

FIGURE 6

TYPICAL CANYON SUBDRAIN
MINIMUM STANDARD GRADING DETAILS

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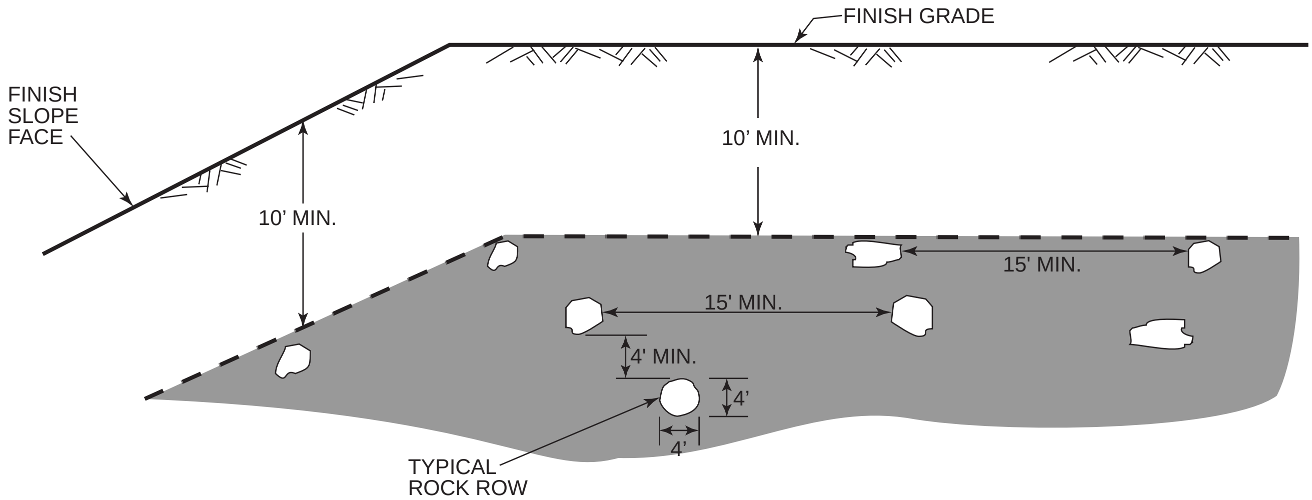
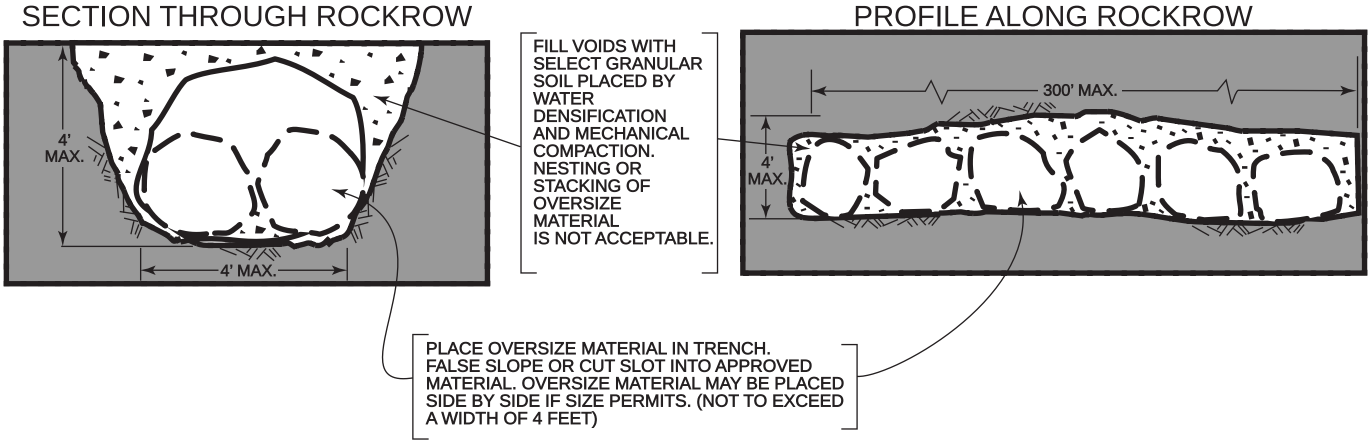
Geotechnical, Inc.

Rev. 8/96 CANYON SUBDRAIN.ai



SECTION THROUGH ROCKROW

PROFILE ALONG ROCKROW



FILL VOIDS WITH SELECT GRANULAR SOIL PLACED BY WATER DENSIFICATION AND MECHANICAL COMPACTION. NESTING OR STACKING OF OVERSIZE MATERIAL IS NOT ACCEPTABLE.

PLACE OVERSIZE MATERIAL IN TRENCH. FALSE SLOPE OR CUT SLOT INTO APPROVED MATERIAL. OVERSIZE MATERIAL MAY BE PLACED SIDE BY SIDE IF SIZE PERMITS. (NOT TO EXCEED A WIDTH OF 4 FEET)

NOTES:

A) OVERSIZED ROCK IS DEFINED AS LARGER THAN 12" IN SIZE (IN GREATEST DIMENSION).

B) SPACE BETWEEN ROCKROWS SHOULD BE ONE EQUIPMENT WIDTH OR A MINIMUM OF 15 FEET.

C) THE WIDTH AND HEIGHT OF THE ROCKROW SHALL BE LIMITED TO FOUR FEET AND THE LENGTH LIMITED TO 300 FEET UNLESS APPROVED OTHERWISE BY THE GEOTECHNICAL CONSULTANT. OVERSIZE SHOULD BE PLACED WITH FLATEST SIDE ON THE BOTTOM.

D) OVERSIZE MATERIAL EXCEEDING FOUR FEET MAY BE PLACED ON AN INDIVIDUAL BASIS IF APPROVED BY THE GEOTECHNICAL CONSULTANT.

E) FILLING OF VOIDS WILL REQUIRE SELECT GRANULAR SOIL (SE > 20, OR LESS THAN 20 PERCENT FINES) AS APPROVED BY THE GEOTECHNICAL CONSULTANT. VOIDS IN THE ROCKROW TO BE FILLED BY WATER DENSIFYING GRANULAR SOIL INTO PLACE ALONG WITH MECHANICAL COMPACTION EFFORT.

F) IF APPROVED BY THE GEOTECHNICAL CONSULTANT, ROCKROWS MAY BE PLACED DIRECTLY ON COMPETENT MATERIALS OR BEDROCK, PROVIDED ADEQUATE SPACE IS AVAILABLE FOR COMPACTION.

G) THE FIRST LIFT OF MATERIAL ABOVE THE ROCKROW SHALL CONSIST OF GRANULAR MATERIAL AND SHALL BE PROOF-ROLLED WITH A D-8 OR LARGER DOZER OR EQUIVALENT.

H) ROCKROWS NEAR SLOPES SHOULD BE ORIENTED PARALLEL TO SLOPE FACE.

I) NESTING OR STACKING OF ROCKS IS NOT ACCEPTABLE.

FIGURE 7

TYPICAL OVERSIZE ROCK PLACEMENT METHOD
MINIMUM STANDARD GRADING DETAIL
FOR STRUCTURAL FILL

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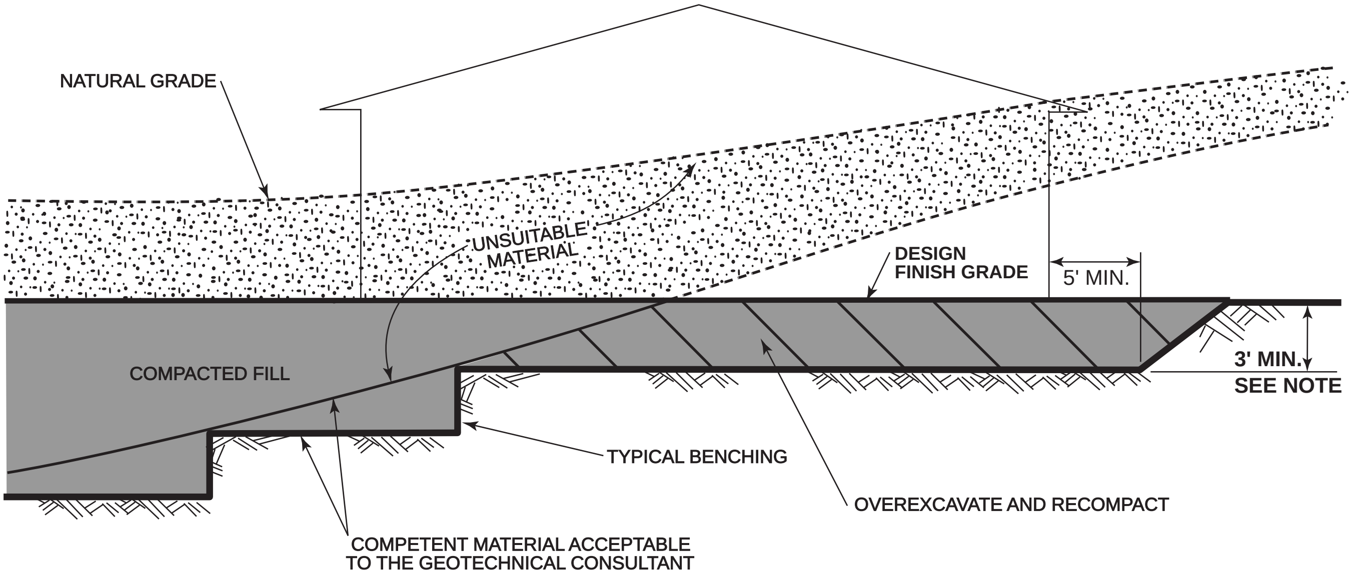
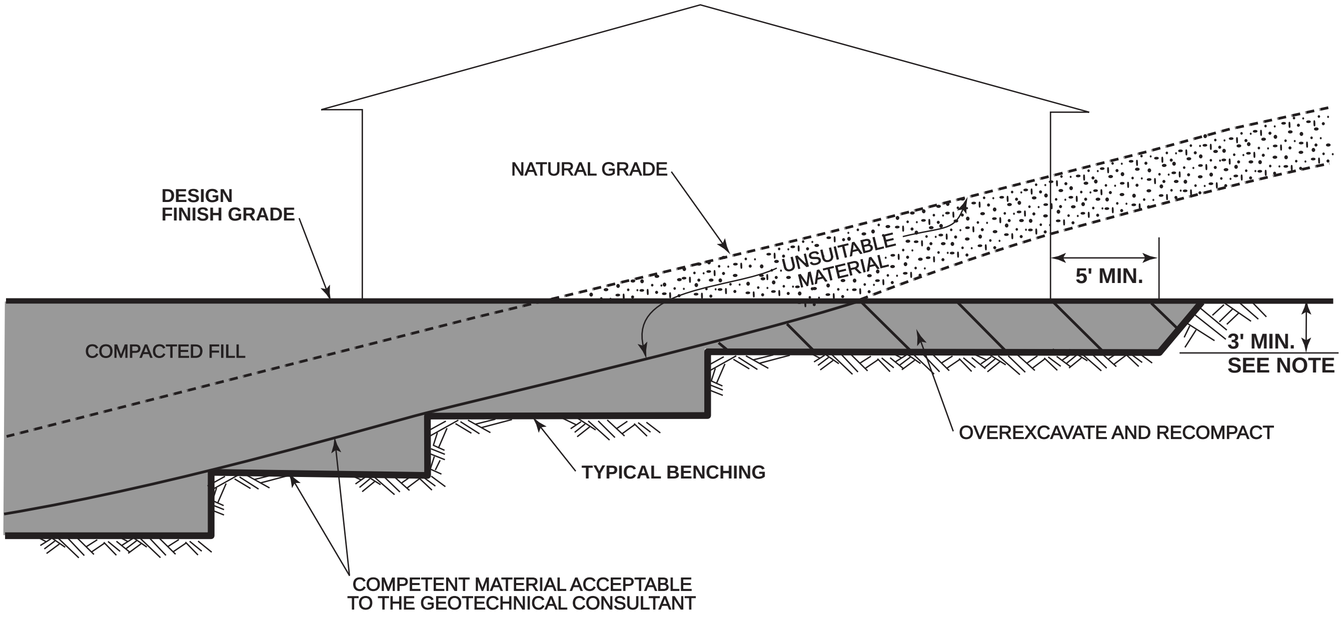
Geotechnical, Inc.

3/04 TYP OVERSIZE ROCK PLACEMENT.ai

CUT LOT



CUT FILL LOT (TRANSITION)



NOTE: DEEPER THAN THE 3-FOOT OVEREXCAVATION MAY BE RECOMMENDED BY THE GEOTECHNICAL CONSULTANT IN STEEP TRANSITIONS.

FIGURE 8

TYPICAL OVEREXCAVATION OF DAYLIGHT LINE
MINIMUM STANDARD GRADING DETAILS

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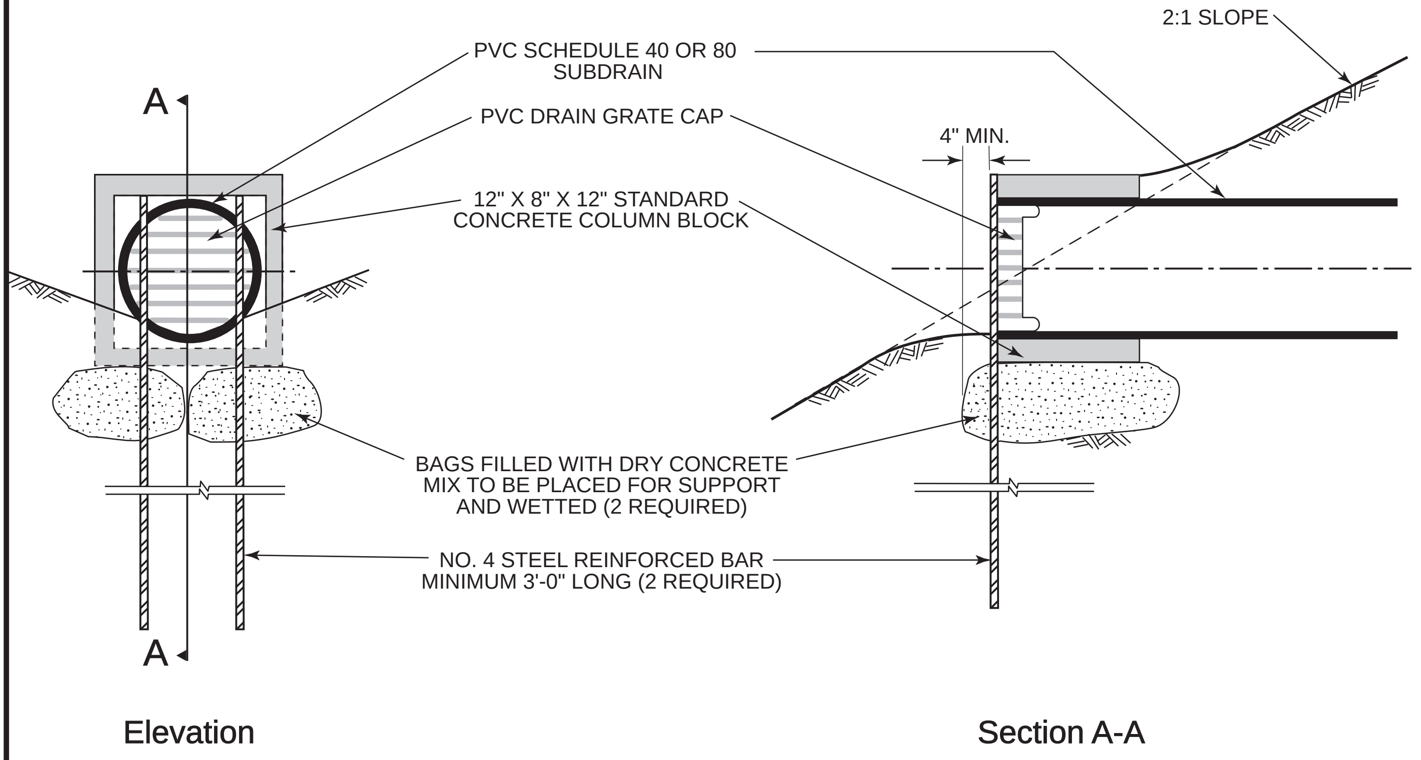
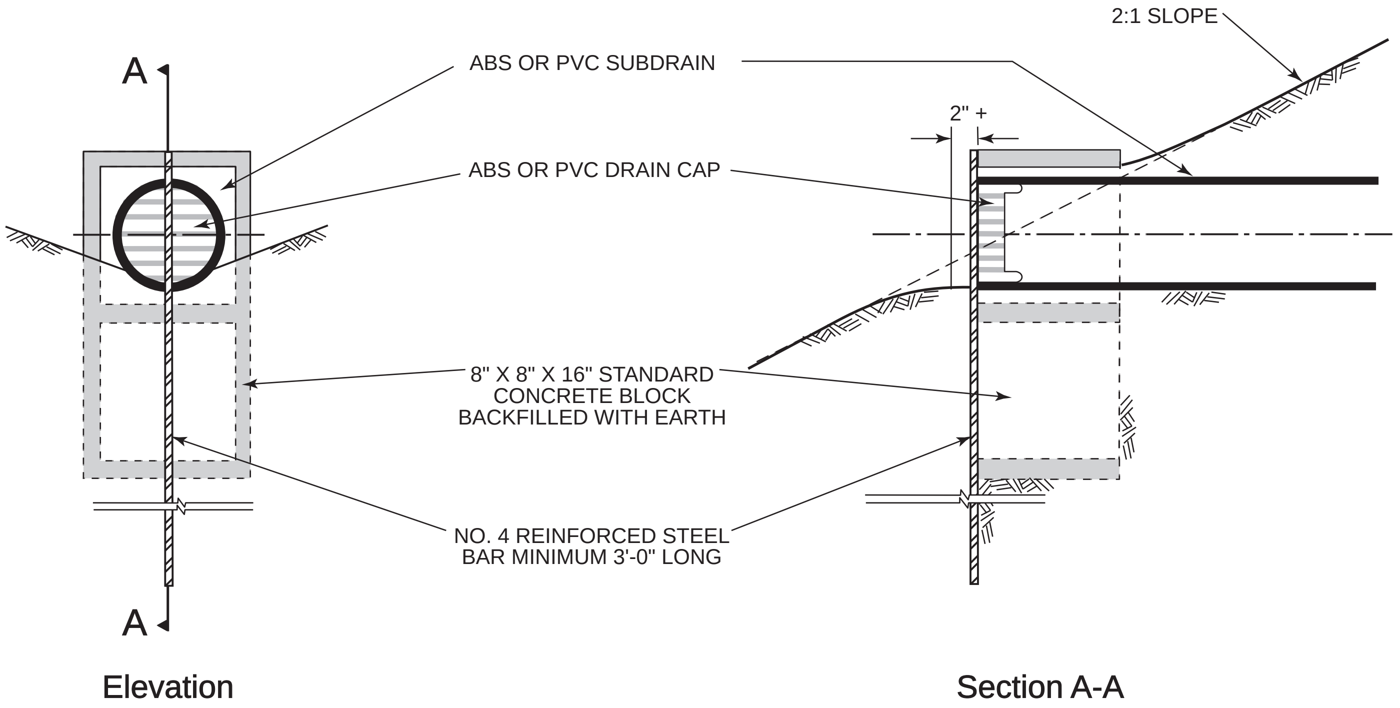
SUBDRAIN OUTLET MARKER - 6" AND 8" PIPE



SUBDRAIN OUTLET MARKER - 4" PIPE



SUBDRAIN OUTLET MARKER
MINIMUM STANDARD GRADING DETAILS

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LEGEND

EARTH UNITS - CIRCLED WHERE BURIED

Af_L	ARTIFICIAL FILL PLACED FOR CLUBHOUSE AND PARKING LOT
Af	ARTIFICIAL FILL, PLACED FOR RIVERWALK COMMERCIAL CENTER
Aft	ARTIFICIAL FILL, PLACED DURING TROLLEY CONSTRUCTION
Afu	UNDOCUMENTED ARTIFICIAL FILL
Qal	ALLUVIUM
Qtr	RIVER TERRACE DEPOSIT

SYMBOLS - LOCATIONS ARE APPROXIMATE, QUERIED WHERE UNCERTAIN

— — — — · · · · ·	GEOLOGIC CONTACT, DOTTED WHERE BURIED
● B-29 T.D. 81' Tsc@78' ▼@6.2' (el. 14.3')	HOLLOW STEM BORING BY NMG GEOTECHNICAL SHOWING DEPTH OF EARTH UNIT, DEPTH AND ELEVATION OF GROUNDWATER, AND TOTAL DEPTH, (R) INDICATES REFUSAL. BDRX INDICATES BEDROCK
▲ CPT-42 T.D. 74'	CONE PENETROMETER TEST PROBE LOCATION, BY NMG GEOTECHNICAL THIS INVESTIGATION. (R) INDICATES REFUSAL
◕ GB-5*	ROTARY WASH BORING GROUP DELTA REPORT DATED 9/30/14
△ GCPT-10*	CPT BY GROUP DELTA REPORT DATED 9/30/14
◕ GB-5	ROTARY WASH BORING GROUP DELTA REPORT DATED 2/5/15
△ GCPT-10	CPT BY GROUP DELTA REPORT DATED 2/5/15
⊕ GCB-3	ROTARY WASH BORING BY GEOCON REPORT DATED DECEMBER 1998
○ GCSB-3	HOLLOW STEM BORING BY GEOCON REPORT DATED 1/22/03
◑ W-7	CONTINOUS FLIGHT AUGER BORING WOODWARD CLYDE REPORT DATED 6/20/75
⊕ LB-2	HOLLOW STEM BORING BY LEIGHTON, REPORT DATED 11/14/95
◒ LB-4a	HOLLOW STEM BORING BY LEIGHTON, REPORT DATED 4/28/97
⊙ SB-4 SB-104 (el. 18') T.D. 82.5'	HOLLOW STEM BORING BY SHEPARDSON, REPORTS DATED 10/5/98 AND 12/22/03 SHOWING TOP OF BORING ELEVATION WHERE DIFFERENT THAN EXISTING GRADE
✦ Well-2 T.D. 105'	APPROXIMATE LOCATION OF GOLF COURSE GROUNDWATER WELLS
18├──┤18'	CROSS-SECTION
▬ ▬ ▬ ▬	LIMITS OF REMEDIAL GRADING

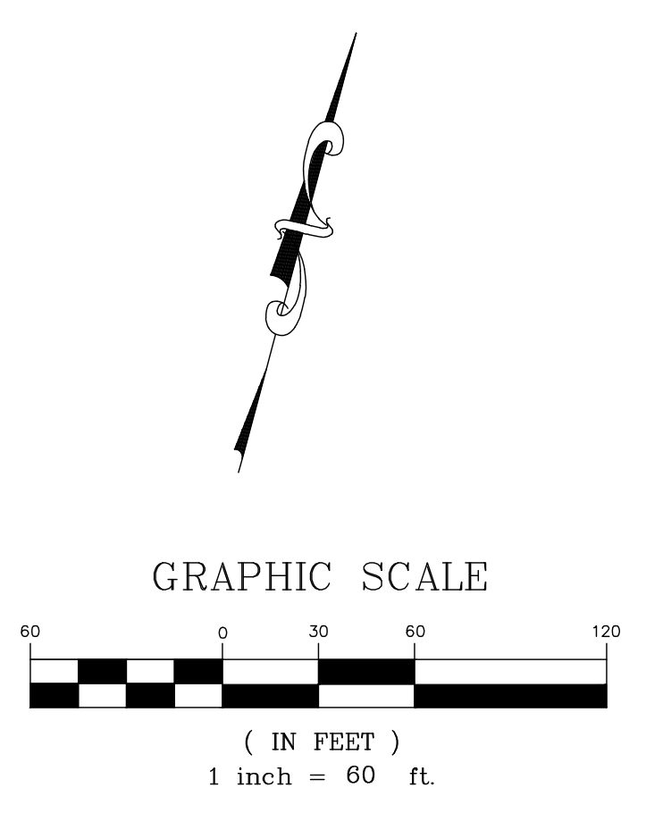


PLATE 1

UPDATED GEOTECHNICAL MAP FOR PROPOSED RIVERWALK MIXED-USE DEVELOPMENT CITY OF SAN DEIGO, CALIFORNIA

Project No.: 11077-02 By:RS/TW
Project Name:Hines/Riverwalk
Date: 11/27/19 SCALE: 1" = 60'

NMG
Geotechnical, Inc.

Drawing: P:\2011\11077-02\Drafting_WP\Plates 60-scale.dwg Layout

LEGEND

EARTH UNITS - CIRCLED WHERE BURIED

Af_L	ARTIFICIAL FILL PLACED FOR CLUBHOUSE AND PARKING LOT
Af	ARTIFICIAL FILL, PLACED FOR RIVERWALK COMMERCIAL CENTER
Aft	ARTIFICIAL FILL, PLACED DURING TROLLEY CONSTRUCTION
Afu	UNDOCUMENTED ARTIFICIAL FILL
Qal	ALLUVIUM
Qtr	RIVER TERRACE DEPOSIT

SYMBOLS - LOCATIONS ARE APPROXIMATE, QUERIED WHERE UNCERTAIN

— — — —······	GEOLOGIC CONTACT, DOTTED WHERE BURIED
● B-29 T.D. 81' Tsc@78' ▼@6.2' (el. 14.3')	HOLLOW STEM BORING BY NMG GEOTECHNICAL SHOWING DEPTH OF EARTH UNIT, DEPTH AND ELEVATION OF GROUNDWATER, AND TOTAL DEPTH, (R) INDICATES REFUSAL. BDRX INDICATES BEDROCK
▲ CPT-42 T.D. 74'	CONE PENETROMETER TEST PROBE LOCATION, BY NMG GEOTECHNICAL THIS INVESTIGATION. (R) INDICATES REFUSAL
◕ GB-5*	ROTARY WASH BORING GROUP DELTA REPORT DATED 9/30/14
△ GCPT-10*	CPT BY GROUP DELTA REPORT DATED 9/30/14
◕ GB-5	ROTARY WASH BORING GROUP DELTA REPORT DATED 2/5/15
△ GCPT-10	CPT BY GROUP DELTA REPORT DATED 2/5/15
⊕ GCB-3	ROTARY WASH BORING BY GEOCON REPORT DATED DECEMBER 1998
○ GCSB-3	HOLLOW STEM BORING BY GEOCON REPORT DATED 1/22/03
◑ W-7	CONTINOUS FLIGHT AUGER BORING WOODWARD CLYDE REPORT DATED 6/20/75
⊕ LB-2	HOLLOW STEM BORING BY LEIGHTON, REPORT DATED 11/14/95
◒ LB-4a	HOLLOW STEM BORING BY LEIGHTON, REPORT DATED 4/28/97
⊙ SB-4 SB-104 (el. 18') T.D. 82.5'	HOLLOW STEM BORING BY SHEPARDSON, REPORTS DATED 10/5/98 AND 12/22/03 SHOWING TOP OF BORING ELEVATION WHERE DIFFERENT THAN EXISTING GRADE
✦ Well-2 T.D. 105'	APPROXIMATE LOCATION OF GOLF COURSE GROUNDWATER WELLS
18├──┤18'	CROSS-SECTION
▬ ▬ ▬ ▬	LIMITS OF REMEDIAL GRADING

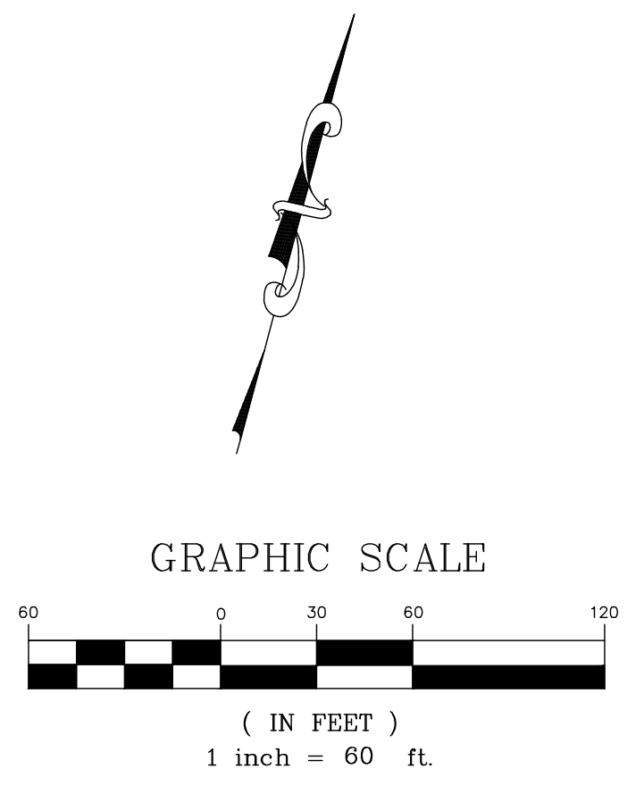


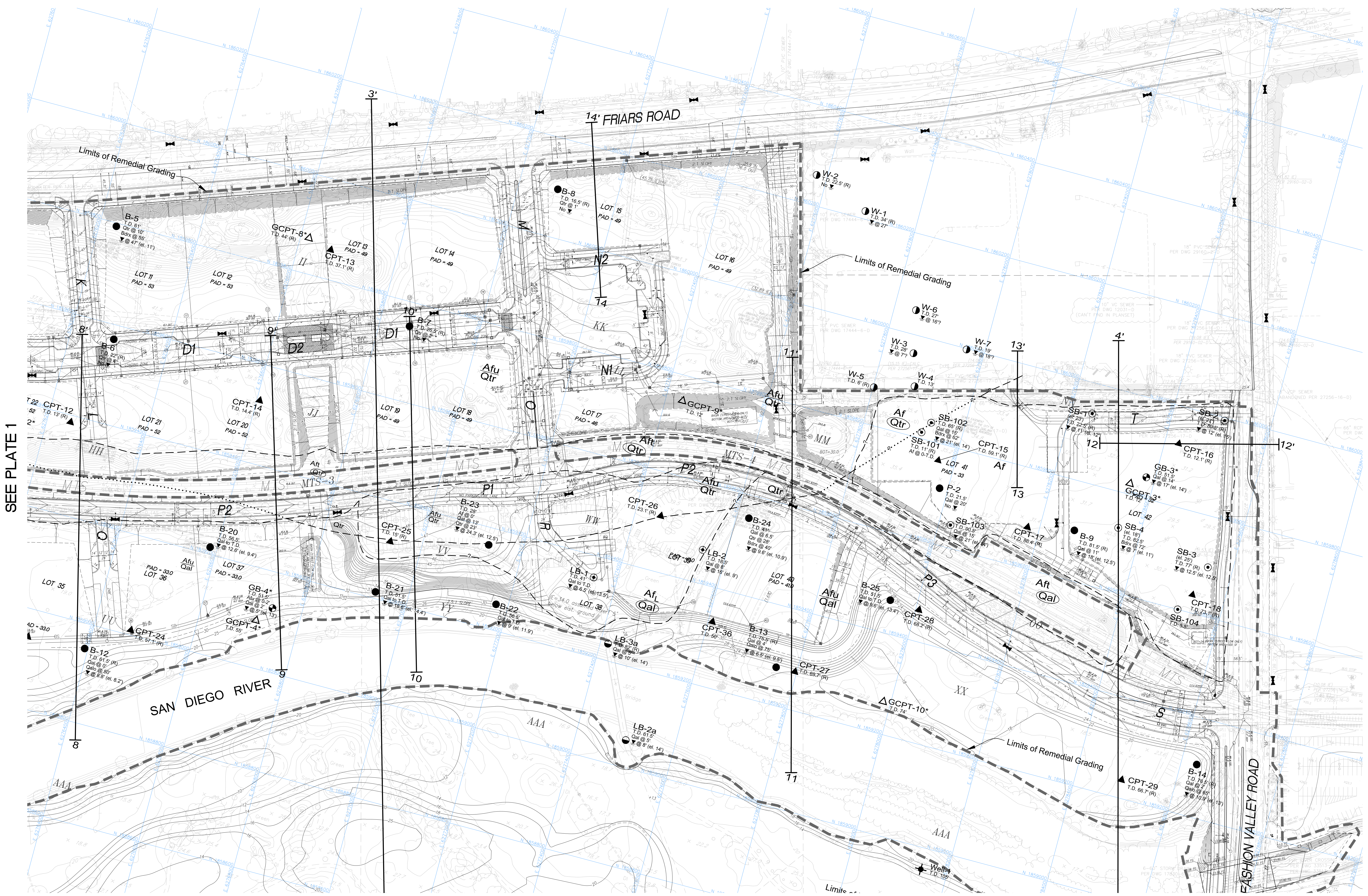
PLATE 1

UPDATED GEOTECHNICAL MAP FOR PROPOSED
RIVERWALK MIXED-USE DEVELOPMENT
CITY OF SAN DEIGO, CALIFORNIA

Project No.: 11077-02 By:RS/TW
Project Name:Hines/Riverwalk
Date: 11/27/19 SCALE: 1" = 60'

NMG
Geotechnical, Inc.

Drawing: P:\2011\11077-02\Drafting_WIP\Plates 60-scale.dwg Layout: 1 Last Saved: Wed Apr 17, 2019 – 4:52pm Last Plotted: Thu Nov 21, 2019 – 2:02pm By: jschneider



SEE PLATE 4

GRAPHIC SCALE

60 0 30 60 120

(IN FEET)
1 inch = 60 ft.

PLATE 2

Project No.: 11077-02	By:RS/TW	NMG Geotechnical, Inc.
Project Name:Hines/Riverwalk		
Date: 11/27/19	SCALE: 1" = 60'	

Drawing: P:\2011\11077-02\Drafting_WIP\Plates 60-scale.dwg

SEE PLATE 1

SEE PLATE 4

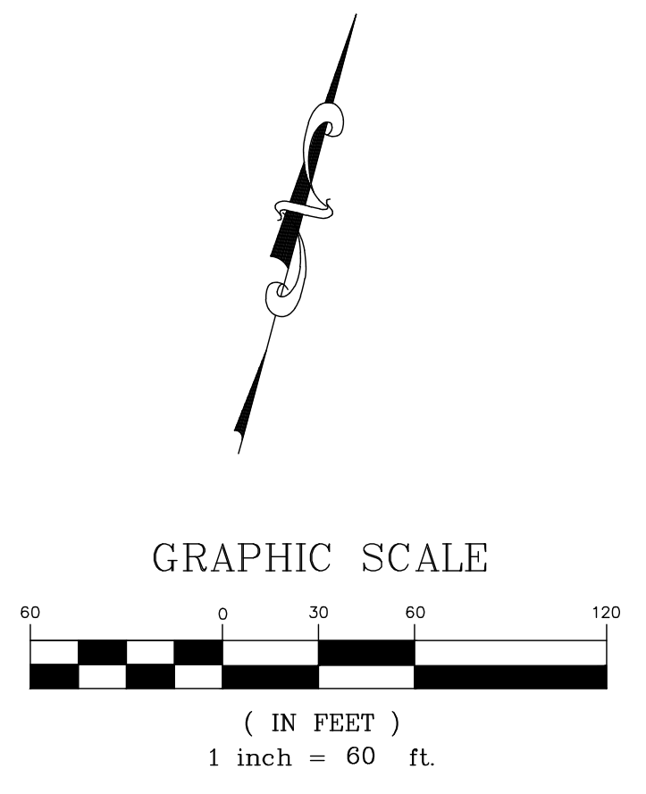
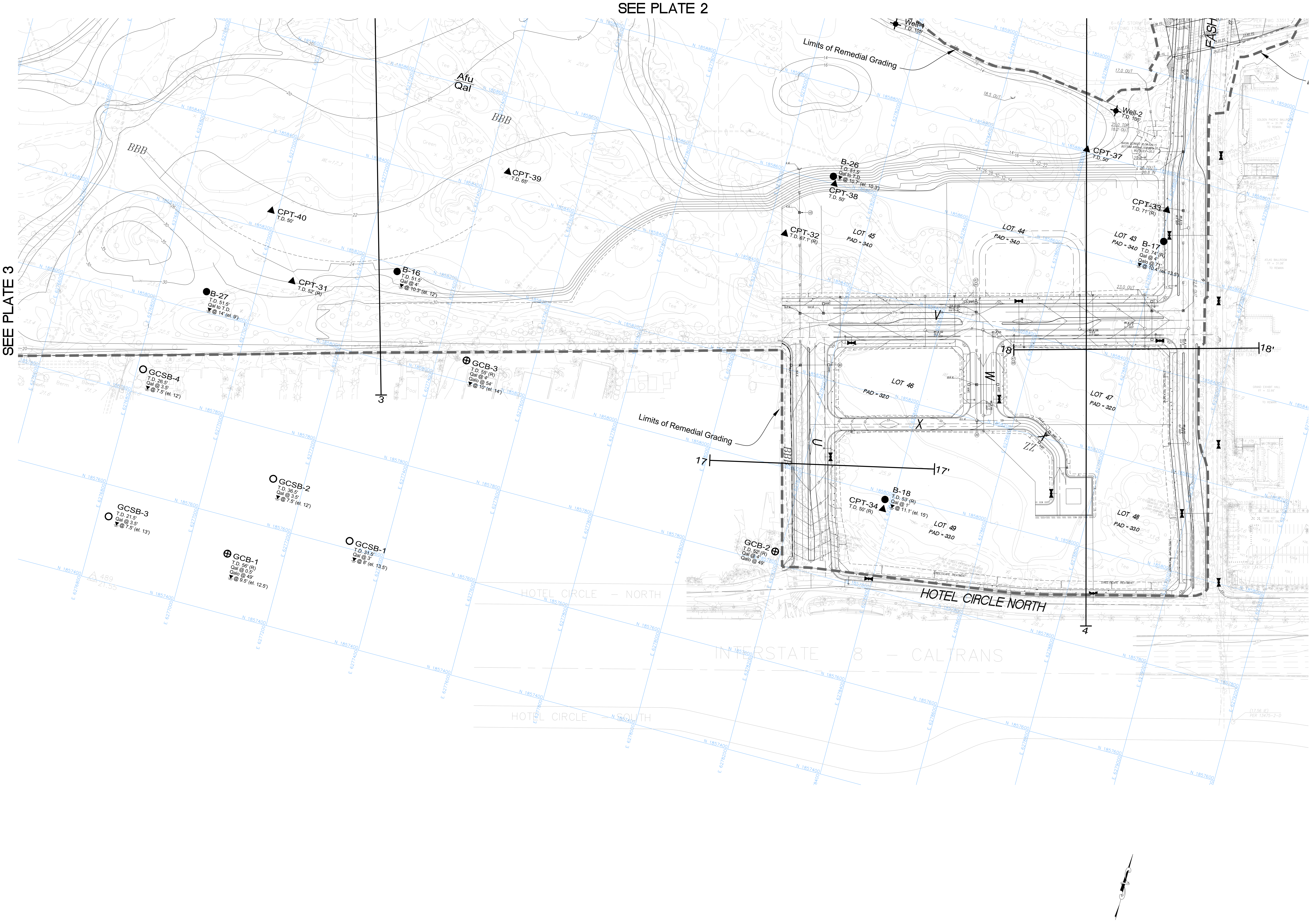


PLATE 3

Project No.: 11077-02 By:RS/TW
Project Name:Hines/Riverwalk
Date: 11/27/19 SCALE: 1" = 60'

NMG
Geotechnical, Inc.

Drawing: P:\2011\11077-02\Drafting_WIP\Plates 60-scale.dwg



GRAPHIC SCALE

60 0 30 60 120

(IN FEET)
1 inch = 60 ft.

PLATE 4

Project No.: 11077-02 By:RS/TW
Project Name:Hines/Riverwalk
Date: 11/27/19 SCALE: 1" = 60'

NMG
Geotechnical, Inc.

Drawing: P:\2011\11077-02\Drafting_WIP\Plates 60-scale.dwg Layout: 4 Last Saved: Wed Apr 17, 2019 - 4:52pm Last Plotted: Thu Nov 21, 2019 - 2:04pm By: jschneider

GRAPHIC SCALE

100	0	50	100	200

(IN FEET)
1 inch = 100 ft.

LEGEND

EARTH UNITS - CIRCLED WHERE BURIED

🟩	NO GROUND IMPROVEMENT NEEDED, REMOVALS OF 5 TO 15 FEET DEEP. NEEDED IN FILL AREAS OR OVERECAVATION 5 FEET BELOW BUILDING SUBGRADE OR FINISH GRADE IN CUT AREAS
🟨	REMEDIAL REMOVALS TO ELEVATIONS OF 13 TO 15 FEET MSL. GROUND IMPROVEMENT NEEDED 10 FEET BELOW REMOVAL BOTTOM WITHIN BUILDING FOOTPRINT AND 5 FEET OUTSIDE FOOTPRINT
🟧	REMEDIAL REMOVALS TO ELEVATIONS OF 13 TO 17 FEET MSL. GROUND IMPROVEMENT NEEDED 15 FEET BELOW REMOVAL BOTTOM WITHIN BUILDING FOOTPRINT AND 5 FEET OUTSIDE FOOTPRINT
🟫	REMEDIAL REMOVALS TO ELEVATIONS OF 11 TO 16 FEET MSL. GROUND IMPROVEMENT NEEDED 20 FEET BELOW REMOVAL BOTTOM WITHIN BUILDING FOOTPRINT AND 5 FEET OUTSIDE FOOTPRINT
🟦	DESIGN FILL SLOPE NEXT TO RIVER THAT WILL NEED DEEPER GROUND IMPROVEMENT TO MITIGATE POTENTIAL LATERAL SPREAD
— — — —	LIMITS OF REMEDIAL GRADING
18├──┤18'	CROSS-SECTION

PLATE 5

PRELIMINARY REMEDIAL MEASURES AND GROUND IMPROVEMENT MAP
FOR PROPOSED MIXED USE DEVELOPMENT
RIVERWALK GOLF COURSE
SAN DIEGO, CALIFORNIA

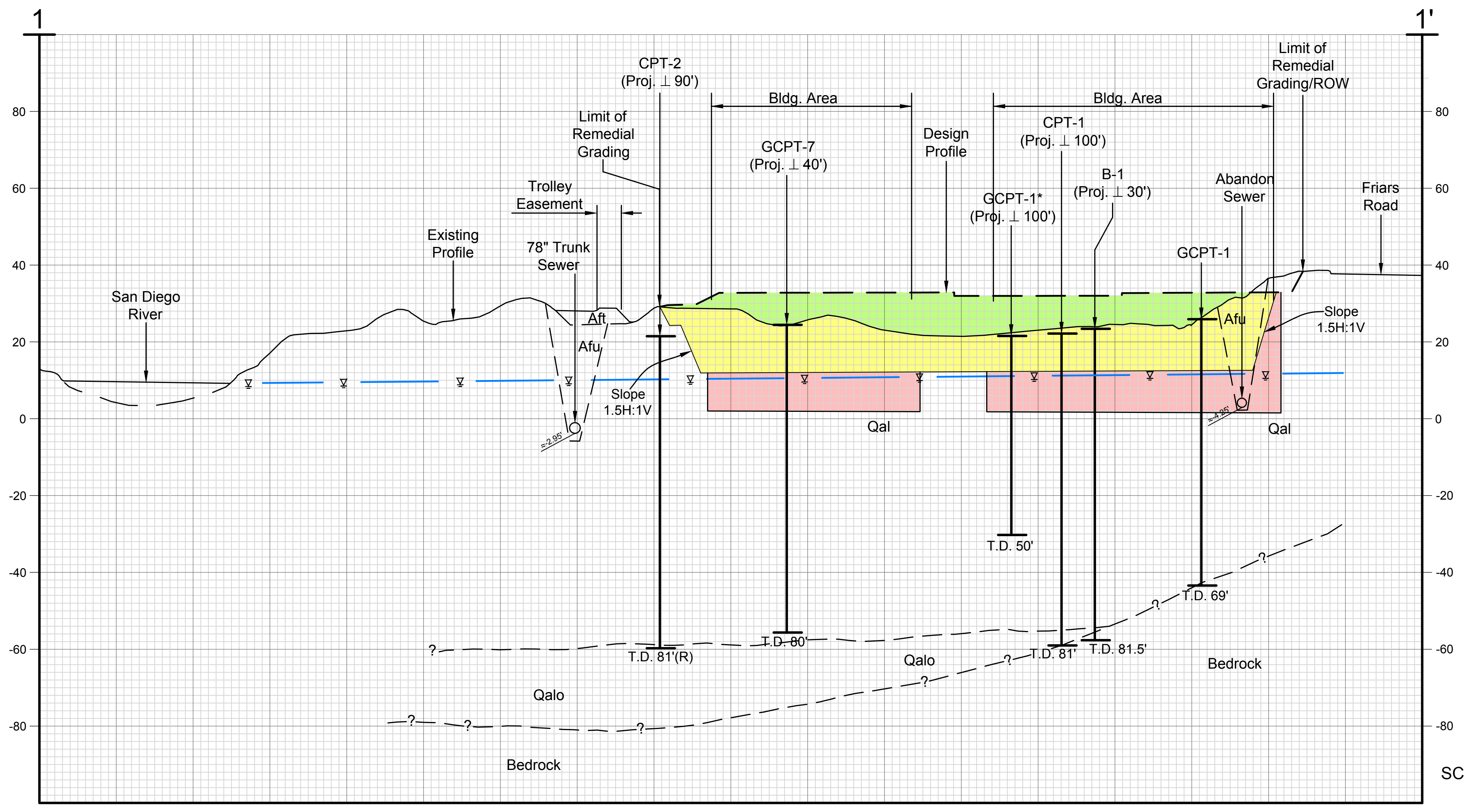
Project No.: 11077-02
Project Name:Riverwalk
Date: 11/27/19
By: RS/TW
SCALE: 1" = 100'

NMG
Geotechnical, Inc.

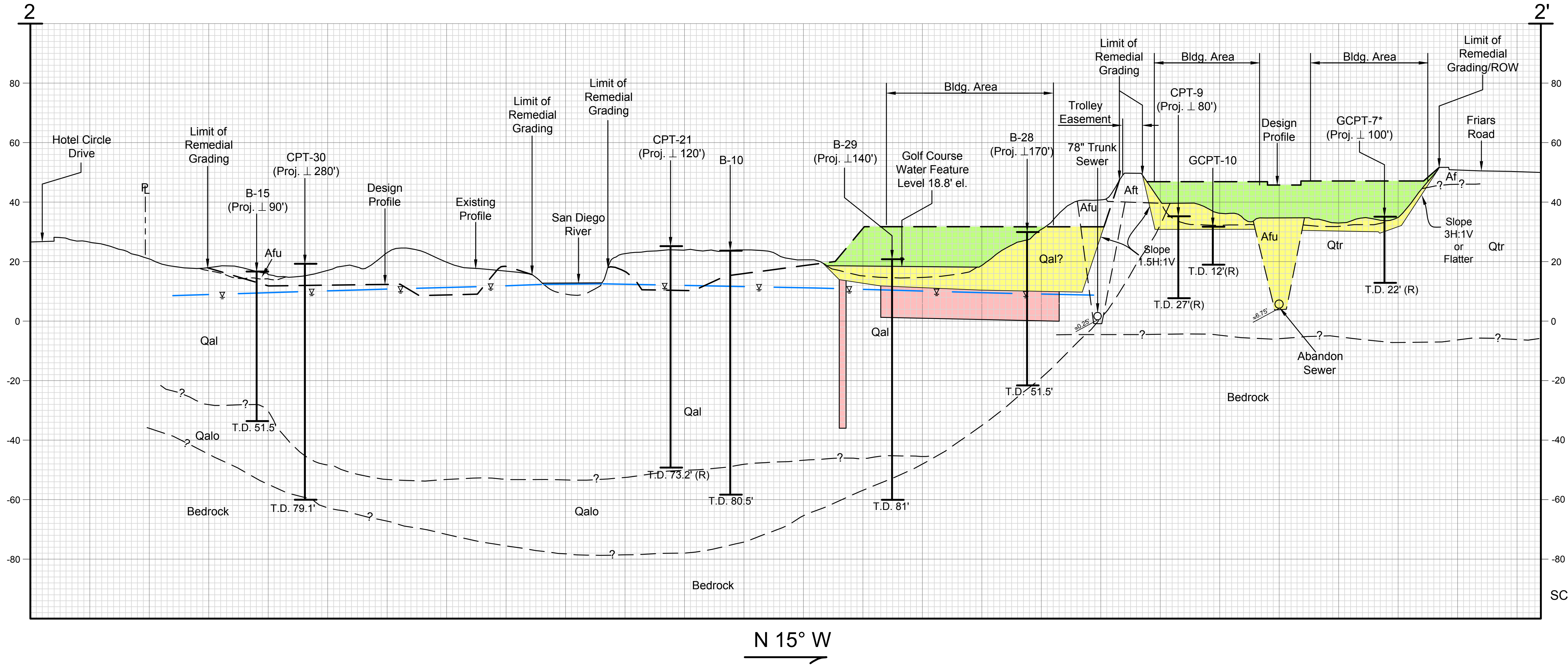
Drawing: P:\2011\11077-02\Drafting_WIP\Plate 5 Remedial Measures.dwg Layout: 5 Last Saved: Wed Apr 17, 2019 – 4:56pm Last Plotted: Thu Nov 21, 2019 – 2:07pm By: jschneider

LEGEND

🟩	PROPOSED COMPACTED FILL
🟨	RECOMMENDED REMEDIAL REMOVAL TO BE REPLACED WITH COMPACTED FILL
🟥	RECOMMENDED ZONE OF GROUND IMPROVEMENT
—∇—	EXISTING GROUNDWATER TABLE

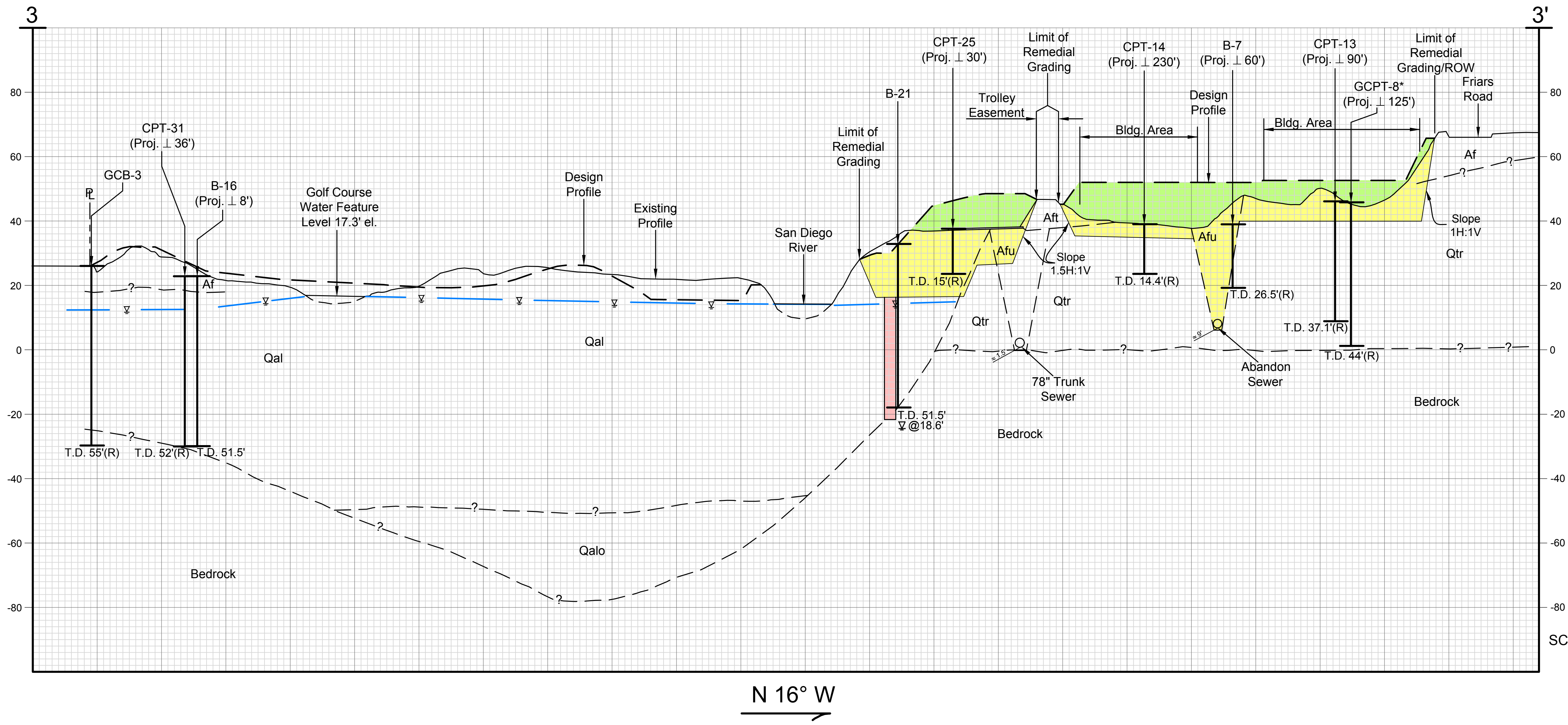


EXAGGERATED SCALE
SCALE: HORIZONTAL 1"=100'
VERTICAL 1"=20'



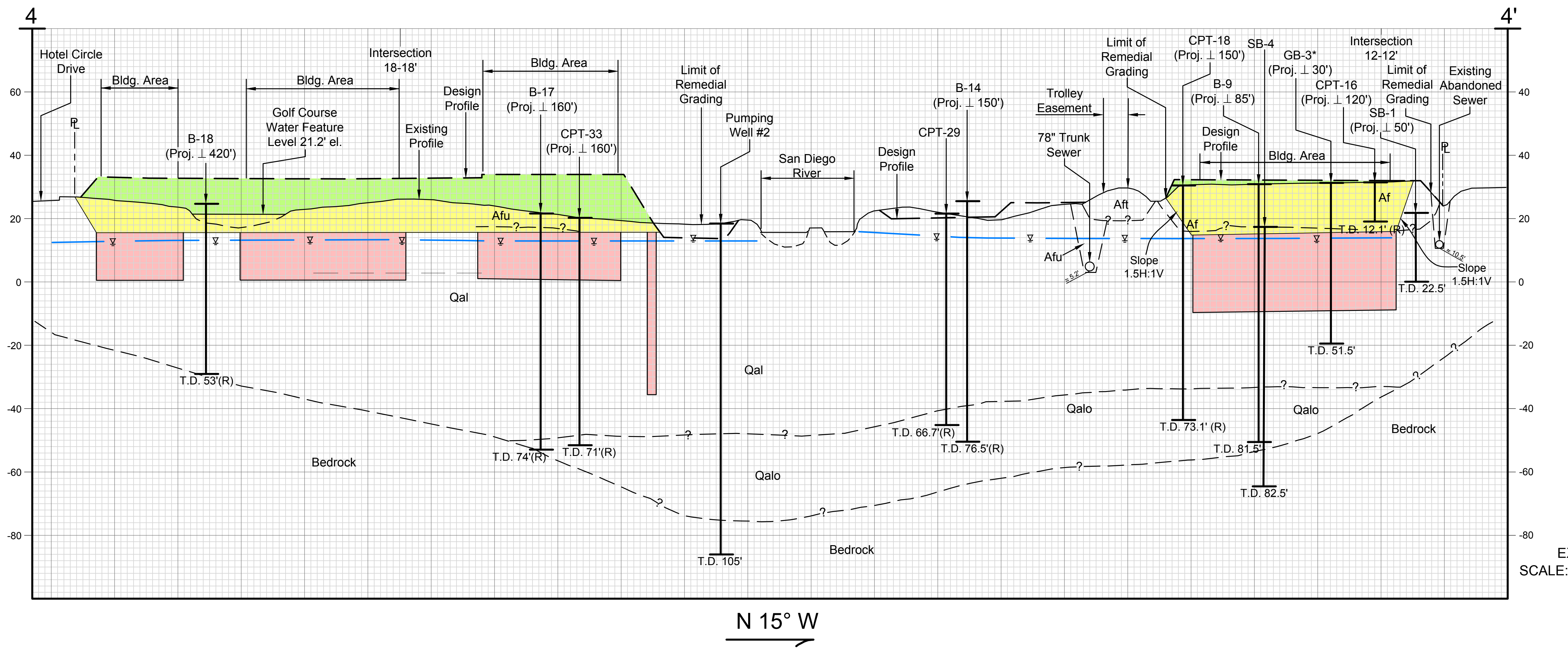
N 15° W

EXAGGERATED SCALE
SCALE: HORIZONTAL 1"=100'
VERTICAL 1"=20'



N 16° W

EXAGGERATED SCALE
SCALE: HORIZONTAL 1"=100'
VERTICAL 1"=20'



N 15° W

EXAGGERATED SCALE
SCALE: HORIZONTAL 1"=100'
VERTICAL 1"=20'

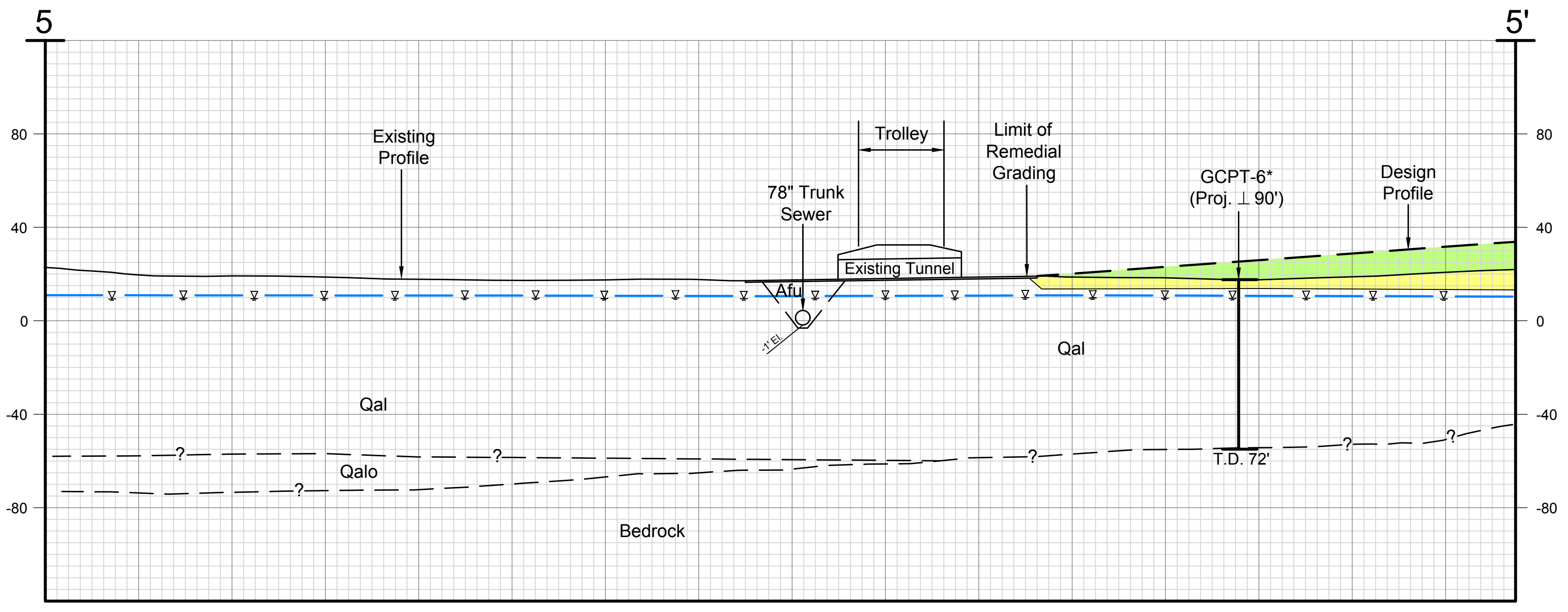
PLATE 6

Project No.: 11077-02
Project Name:Riverwalk
Date: 11/27/19
By: RS/TW
SCALE: AS NOTED
NMG
Geotechnical, Inc.

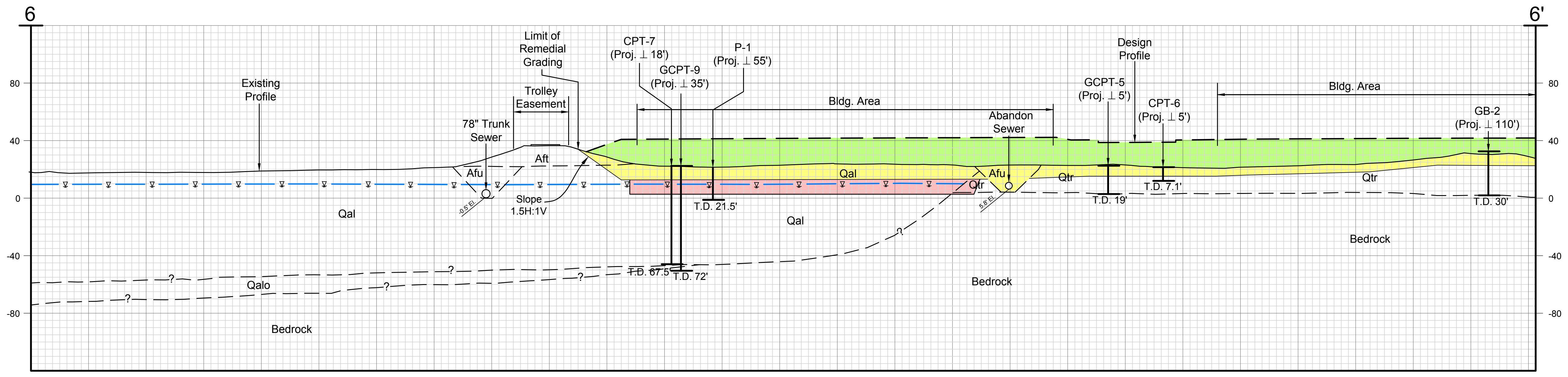
Drawing: P:\2011\11077-02\Drafting_WIP\Plate 2 Xsections 10 grid.dwg Layout: 2 Last Saved: Fri Nov 22, 2019 – 9:12am Last Plotted: Fri Nov 22, 2019 – 9:22am By: jschneider

LEGEND

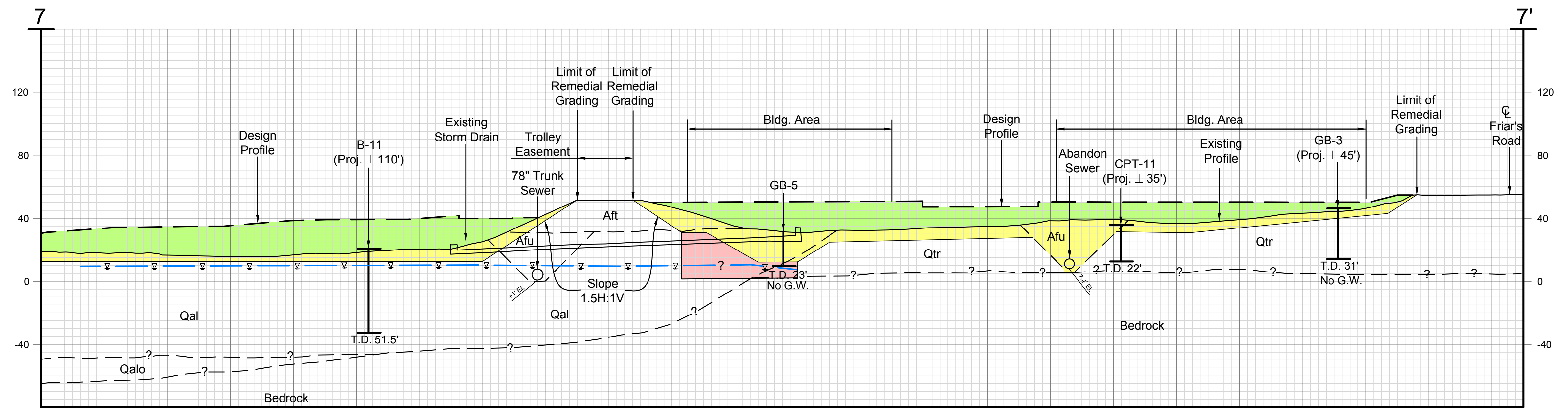
🟩	PROPOSED COMPACTED FILL
🟨	RECOMMENDED REMEDIAL REMOVAL TO BE REPLACED WITH COMPACTED FILL
🟥	RECOMMENDED ZONE OF GROUND IMPROVEMENT
—⊽—	EXISTING GROUNDWATER TABLE



N 19° W



N 18° W



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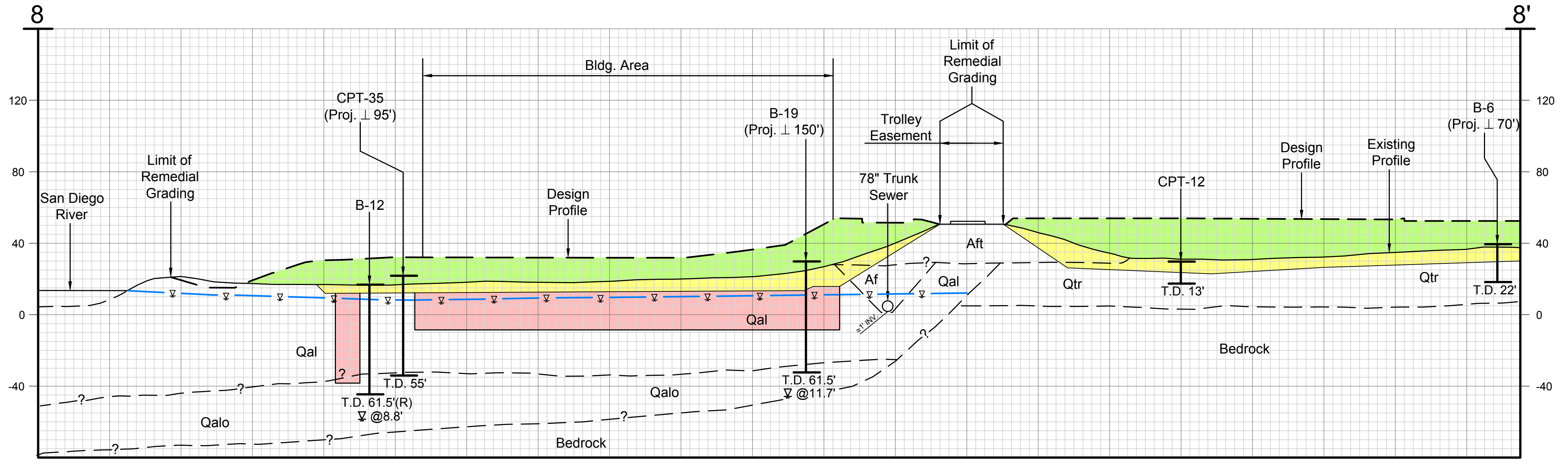

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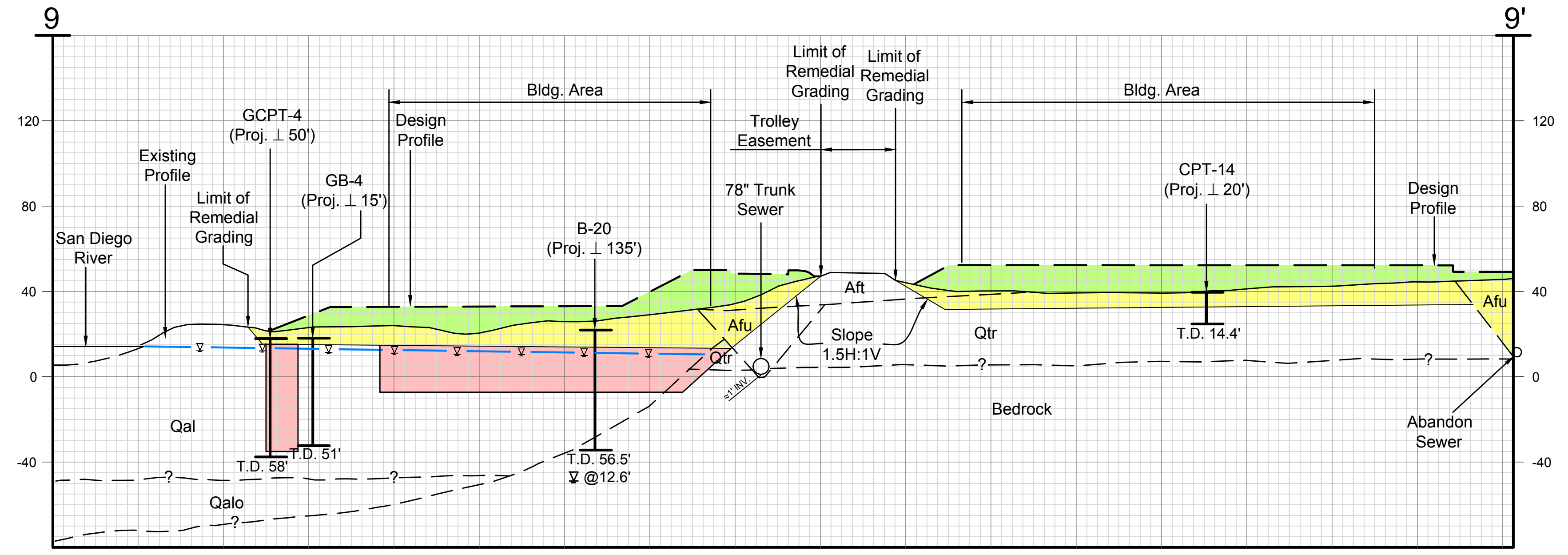

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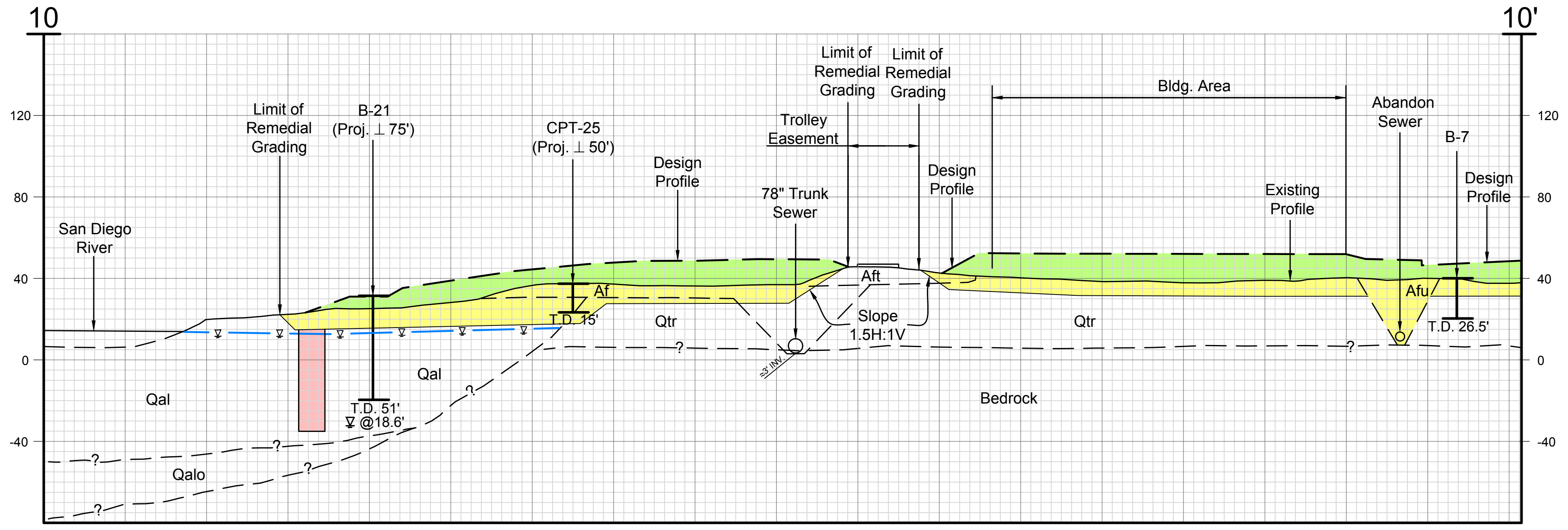


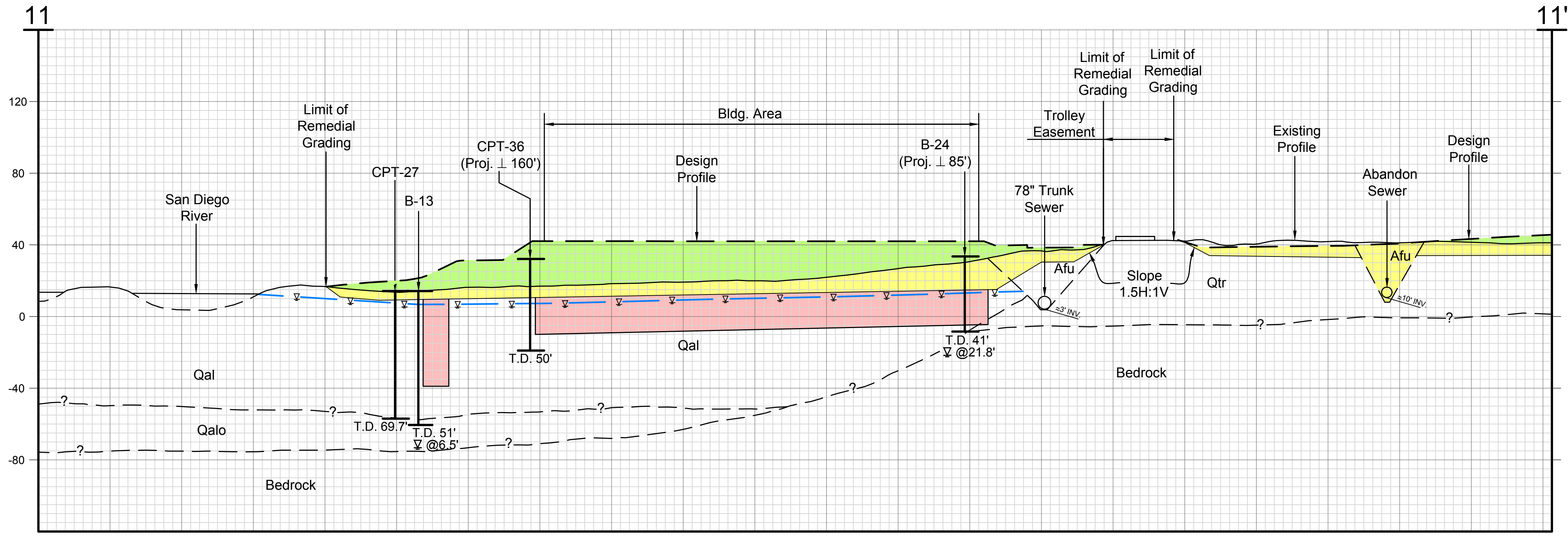
N 16° W

PLATE 7

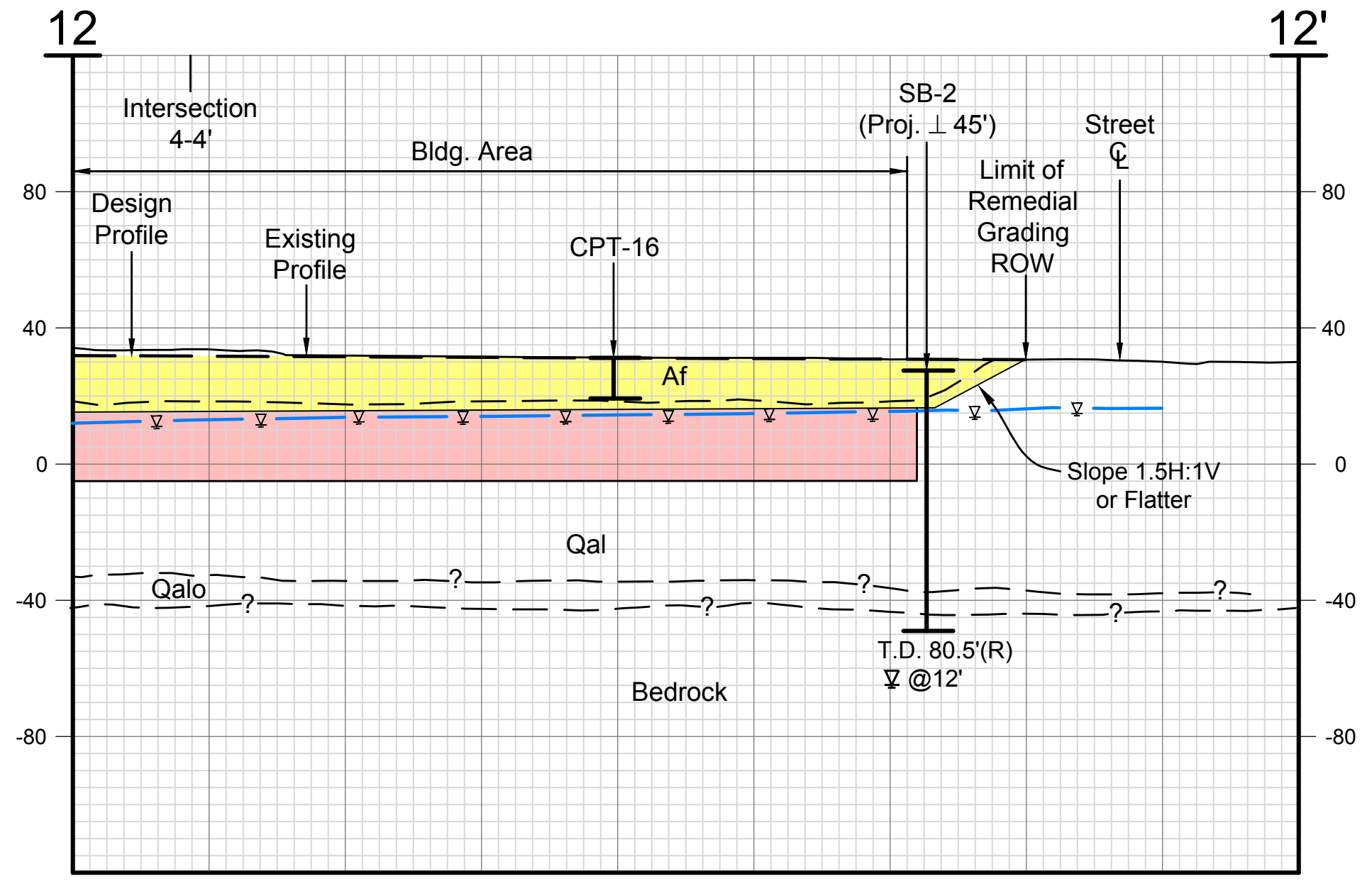
Project No.: 11077-02
Project Name:Riverwalk
Date: 11/27/19
By: RS/TW
SCALE: 1" = 40'
NMG
Geotechnical, Inc.

LEGEND

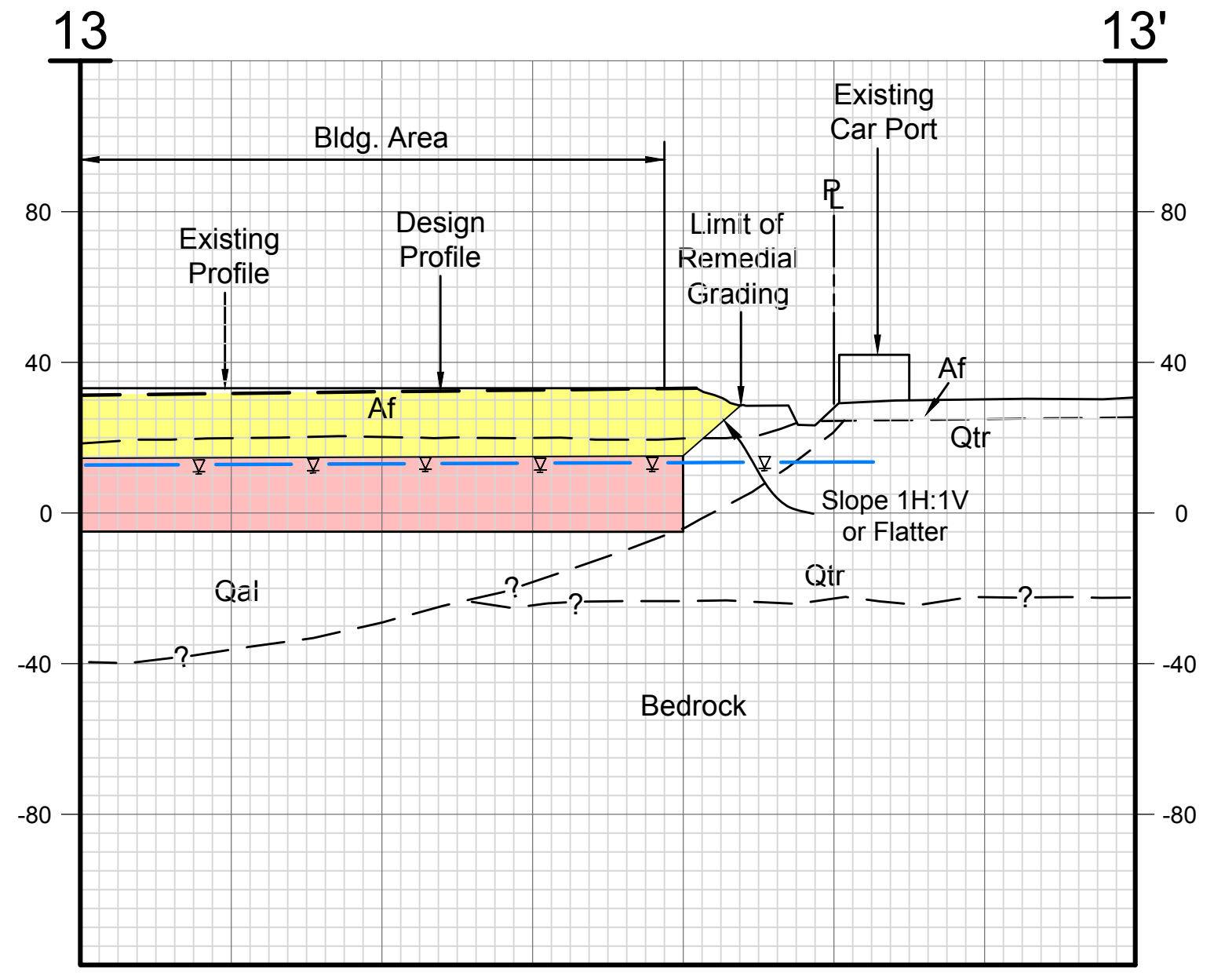
🟩	PROPOSED COMPACTED FILL
🟨	RECOMMENDED REMEDIAL REMOVAL TO BE REPLACED WITH COMPACTED FILL
🟥	RECOMMENDED ZONE OF GROUND IMPROVEMENT
— ⊽ —	EXISTING GROUNDWATER TABLE



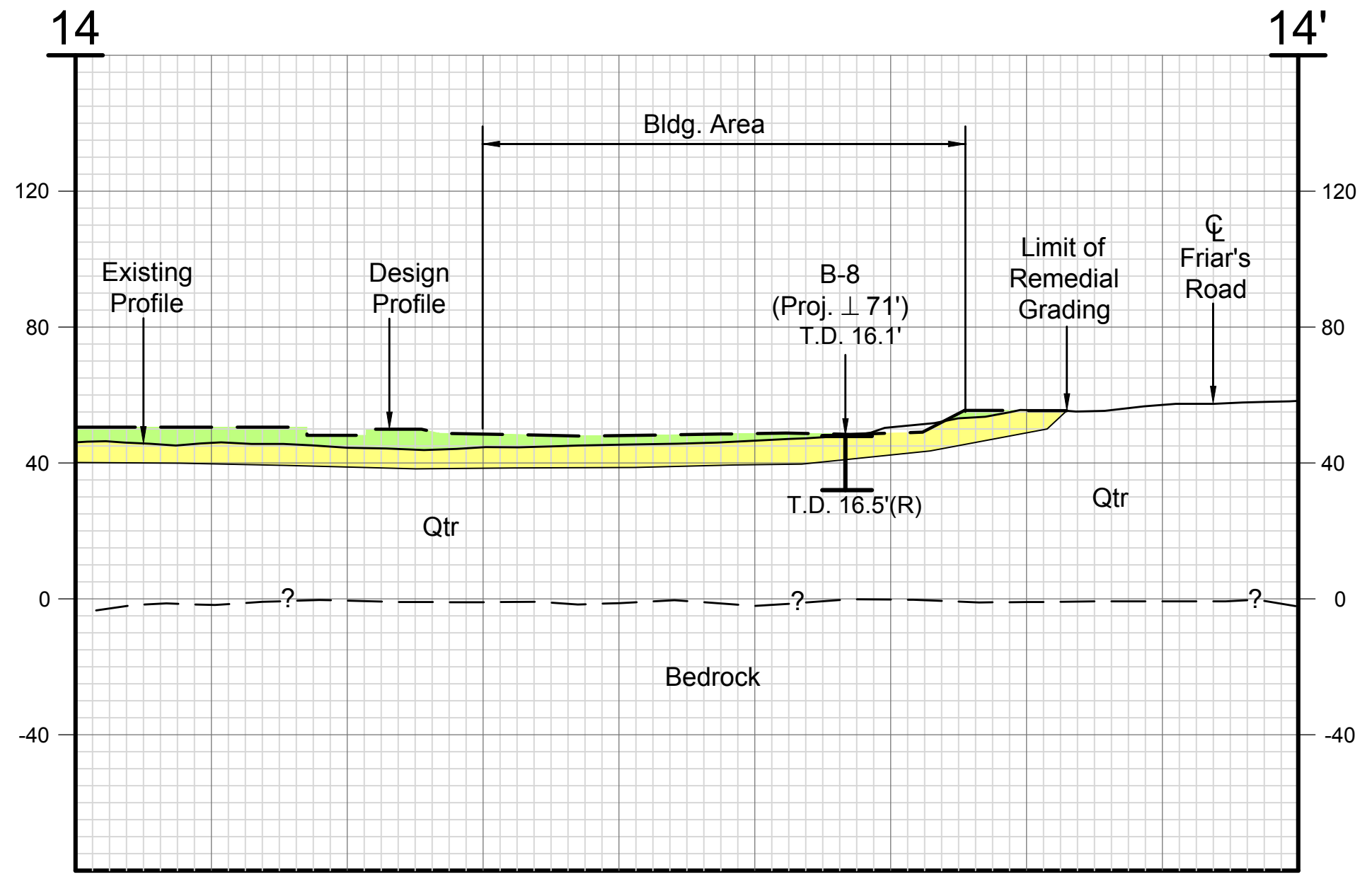
N 17° W



N 75° E



N 15° W



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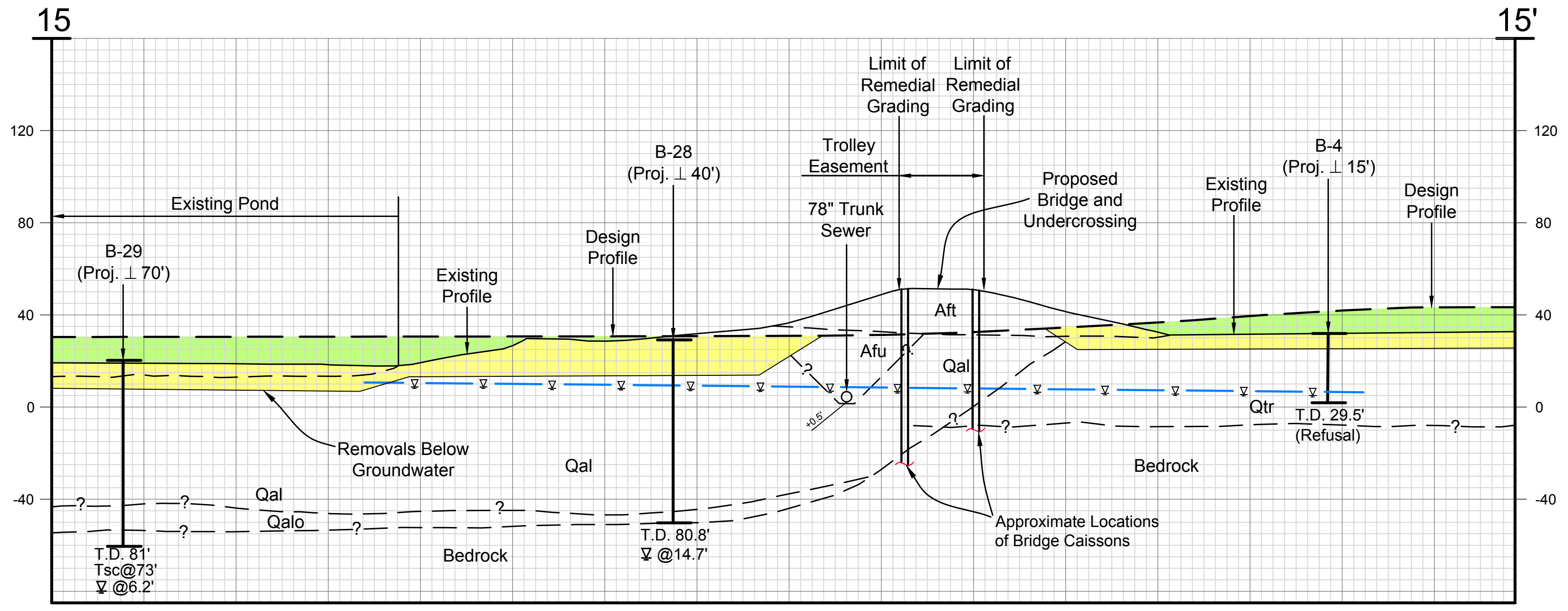

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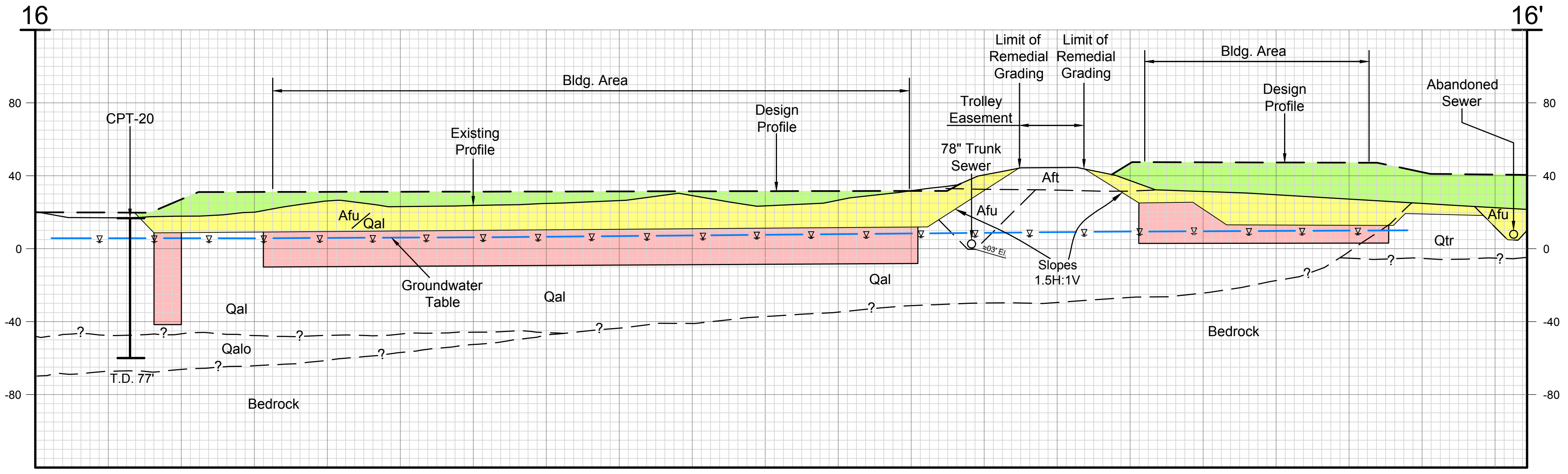
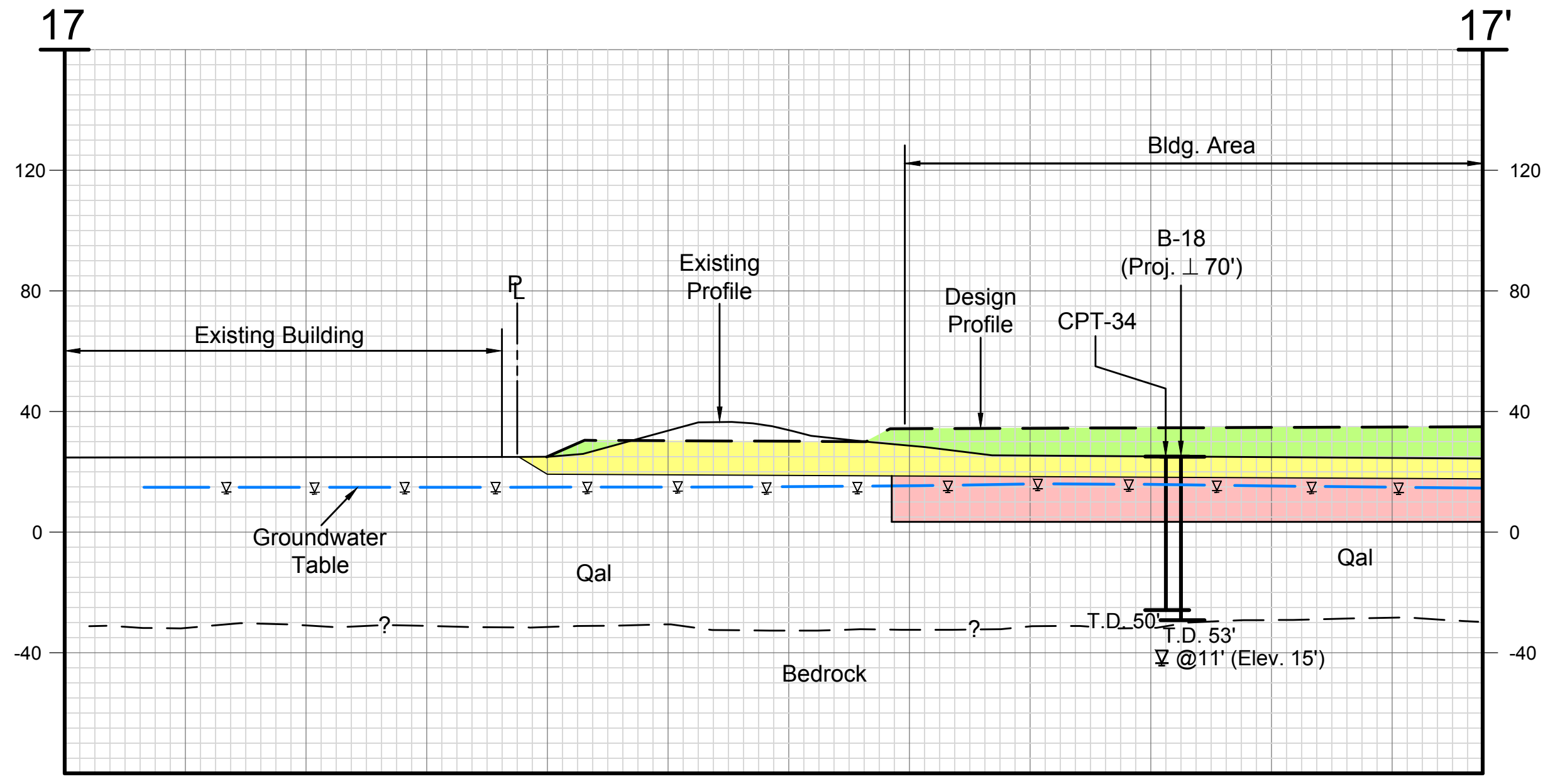
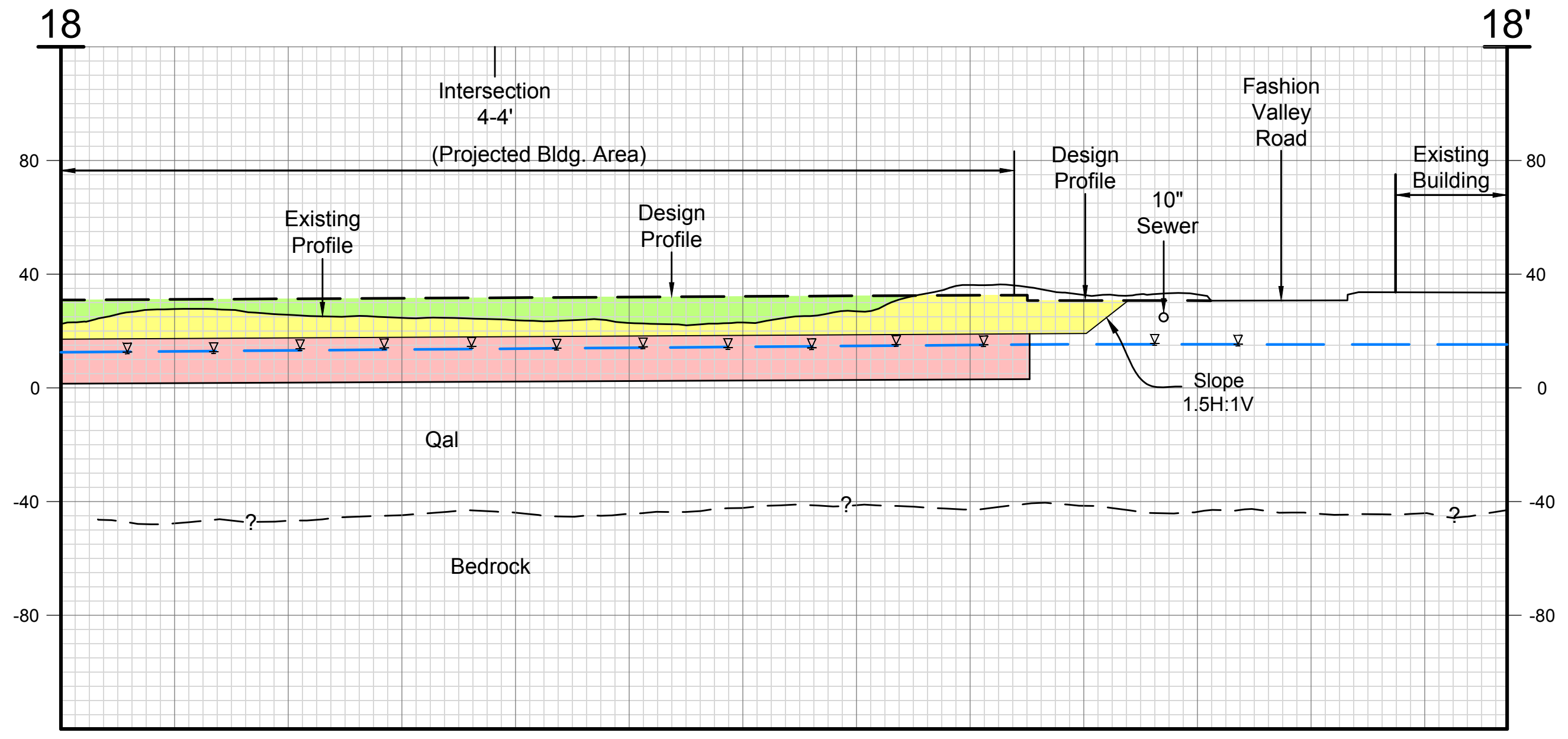


N 15° W



N 78° E



N 75° E

PLATE 8

Project No.: 11077-02	By: RS/TW
Project Name:Riverwalk	
Date: 11/27/19	SCALE: 1" = 40'

NMG
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