11.6 Geotechnical Investigation

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Report of Geotechnical Investigation,
Lido House Hotel - City Hall Site Reuse Project,
3300 Newport Boulevard,
City of Newport Beach, California

Prepared for R. D. OLSON DEVELOPMENT

December 4, 2013

GMU Project No. 13-160-00

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TRANSMITTAL

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2955 Main Street, Third Floor
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DATE: December 4, 2013

GMU PROJECT: 13-160-00

ATTENTION: Mr. Anthony Wrzosek, Vice President of Planning & Development

SUBJECT: Geotechnical Investigation, Lido House Hotel - City Hall Site Reuse Project, 3300 Newport Boulevard, City of Newport Beach, California

WE ARE SENDING THE FOLLOWING:

Three (3) wet copies and One (1) Electronic copy of our "Report of Geotechnical Investigation, Lido House Hotel, City Hall Site Reuse Project, 3300 Newport Boulevard, City of Newport Beach, California," dated December 4, 2013.

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INTRODUCTION

PURPOSE

This report presents the results of our geotechnical investigation for the planned Lido House Hotel - City Hall Site Reuse Project, located at 3300 Newport Boulevard, in the City of Newport Beach, California (see Plate 1 – Location Map). The purpose of this report is to provide a review of the current site plans; provide a summary of our geotechnical investigation, laboratory testing, data analysis, and conclusions; and then provide geotechnical recommendations pertaining to site grading and design and construction of the proposed buildings and other site improvements (i.e., pool, driveways, parking lots, site walls, exterior concrete flatwork, etc.).

SCOPE

In preparing this report, the following scope of work was performed.

1. Reviewed background information pertaining to the site, including historic aerial photographs and published geologic maps. A search of the City of Newport Beach records yielded no previous geotechnical reports for the subject site.

2. Performed an initial site reconnaissance to access current surface conditions and mark the site for Underground Service Alert.

3. Conducted a subsurface exploration program that consisted of the advancement of five (5) Cone Penetration Test (CPT) soundings to a maximum depth of 100 feet, along with five (5) hollow-stem auger drill holes, one to a depth of approximately 75 feet, two to a depth of about 15 feet for infiltration testing, and two to a depth of about 5 feet for R-value testing and pavement design. The drill holes were logged by our project engineer and samples were collected for laboratory testing.

4. Performed laboratory testing on bulk and undisturbed samples that were collected during our subsurface exploration. Laboratory testing included the determination of in-situ moisture and density, maximum dry density and optimum moisture content, particle size, Atterberg limits, expansion potential, consolidation and shear strength characteristics, chemical and specialty corrosion testing, and R-value testing.

5. Interpreted and evaluated field conditions and laboratory data.

6. Performed geotechnical engineering analyses using the field and laboratory data in conjunction with the conceptual site plan. The analysis addressed site seismicity, seismic-induced liquefaction and lateral spreading, foundation design, anticipated static settlements, retaining wall evaluation, groundwater concerns, site infiltration potential, and pavement section design.

7. Prepared this report which summarizes the results of our research, subsurface exploration, laboratory and field testing, analyses, conclusions, and recommendations relative to the subject hotel design and general adjacent site development of the subject project.

SITE LOCATION AND DESCRIPTION

The former City Hall site, located on the northeast corner of Newport Boulevard and 32nd Street, is surrounded on all four sides by commercial and business developments. The general location of the site with respect to nearby roadways and landmarks is shown on the attached Plate 1 – Location Map. The existing site improvements include concrete curbs and gutters, asphalt paved streets, parking lot drives and bays, along with concrete driveways, three 2-story buildings and one 1-story building that are of wood-frame construction with conventional foundations, along with adjacent hardscape and landscape improvements. It should be noted that a previous 1-story building was removed at an unknown date along Newport Boulevard northwest of the existing City Hall buildings (near our DH-2 drill hole location). Also, previous gas pumps and underground gas tanks were removed near the southeast corner of the site between the existing 2-story building and 32nd Street in the early 2000's. The general locations of these removed structures are shown on the attached Plate 2 – Geotechnical Map.

The majority of the site is relatively flat and level and drains by sheet flow towards the west, from Via Oporto to Newport Boulevard, to existing storm drain catch basins. There are no slopes on the site. Elevations within the site range from a high of approximately 10.1 feet above mean sea level within the southeastern portion of the site to a low of approximately 7.3 feet above mean sea level within the southwestern portion of the site. The majority of the site is covered by either asphalt pavement or concrete flatwork; however, there are planter and landscape areas that contain large lawn areas, groundcover, shrubs and occasional trees.

BACKGROUND HISTORY AND GEOLOGIC REPORTS

In order to identify and describe the site history and geologic conditions; we reviewed historical aerial photographs and published geologic maps and reports.

AERIAL PHOTOGRAPHY REVIEW

An aerial photo review was performed for the subject site in order to assess historical land use and site development. Air photos reviewed ranged from 1938 through 2013. Photos taken in 1938 show Newport Boulevard paved, but the site itself and adjacent streets were undeveloped. Photos taken in 1953 show development of the site with three initial main buildings and parking lots, and 32nd Street paved and in use. By 1959, Finley Street was constructed. Future photos show little change to the site, except for the addition of several buildings over time and the widening of Newport Boulevard. A list of aerial photographs reviewed is included in the back of the "Reference" section of this report.

PLANNED IMPROVEMENTS AND GRADING

Based on our review of the preliminary site plans, it is proposed to reuse the former City of Newport Beach City Hall site as a 99,625 square-foot 130-room upscale boutique 4-story hotel, a 3,085 square-foot spa and fitness center, a 3,470 square-foot signature restaurant, a 1,735 square foot retail space, a 4,900 square foot conference center, an outdoor pool and spa, outdoor seating areas, and a covered front lobby entryway, and 150 surface parking stalls. The hotel will be surrounded by streets, parking, drives, and wide landscape and hardscape pedestrian areas.

The existing buildings within the former City Hall site will be demolished and removed to allow construction of a new boutique hotel and its related adjacent buildings and site improvements, as mentioned above. Other changes to the old City Hall area will consist of almost the improvement of existing street, drive, and parking stall features along 32nd Street, Via Oporto, and Finley Avenue. New concrete walkways, stairways, patios, and site walls will be constructed around the new buildings. Due to their poor existing condition, it is likely that the existing parking lot and drive aisle pavement sections will need to be removed and replaced with new sections.

Through the majority of the site, proposed grades will remain essentially the same as existing grades with only minor cuts and fills of a few inches up to 1 to 2 feet being required. However, local areas will require more significant grading. We understand that the proposed buildings will have a finish floor elevation of 10.0 feet.

SUBSURFACE EXPLORATION

Our recent subsurface investigation consisted of the advancement of five (5) Cone Penetration Test (CPT) soundings to a maximum depth of 100 feet, along with five (5) hollow-stem auger drill holes, one to a depth of approximately 75 feet, two to a depth of about 15 feet (the top 5 feet used for infiltration testing), and two to a depth of about 5 feet for R-value testing and pavement design.

The logs of each boring are contained in Appendix A-1 and the Legend to Logs is presented as Plate A-1. CPT soundings were performed with a 30-ton CPT rig and a 15-cm^2 cone with readings taken every 2 cm. The CPT logs and data are contained in Appendix A-2. The approximate locations of the drill holes, pavement core holes, and CPTs are shown on Plate 2 – Geotechnical Map.

INFILTRATION TESTING

Two infiltration tests were performed in general accordance with the Santa Ana Regional Water Quality Control Board Technical Guidance Document (TGD) Appendices dated March 2011, utilizing the shallow percolation test procedure contained in Section VII.3.8. To comply with the requirements of the TGD, two (2) 8-inch-diameter test holes were excavated adjacent to drill holes DH-1 and DH-5 to a depth of approximately 5 feet using a hollow stem auger drill rig. The infiltration test hole locations are shown for ease of reference on the attached Geotechnical Map, Plate 2.

Logs for DH-1 through DH-5 are contained within Appendix A-1 and indicate that the site is underlain by approximately 5 to 6 feet of dredged fill overlying alluvial soil materials. The dredged fill materials are highly variable and consist of intermixed layers of silts, sands, and silty sands, and clayey sands while the alluvial materials consist of loose to medium dense sands to silty sands to with occasional thick layers of moderately firm to very stiff silts and clays. The holes were drilled to depths of 5 feet and infiltration was monitored from depths ranging from approximately 2 to 5 feet below grade that corresponds to the infiltration zone of a potential infiltration system.

LABORATORY TESTING

Laboratory testing for the subject investigation was performed to determine soil engineering classifications and properties. Testing included the following: in-place moisture and dry density, maximum dry density and optimum moisture content, particle size distribution, Atterberg limits, chemical corrosion suite, consolidation characteristics, undisturbed and remolded shear strengths, subgrade R-Values, sand equivalent, and expansion index tests. Laboratory procedures and recent test results are presented in our Appendix B-1 – GMU Geotechnical Laboratory Procedures and Test Results. Pertinent laboratory test data is also shown on our drill hole logs.

Laboratory test results on samples collected at the site indicate that very low expansive soils are present. Visual descriptions indicate that the on-site dredge fill materials consist of sands and silty sands, while the underlying alluvial materials consist primarily of loose to medium dense sands to silty sands with occasional thick layers of moderately firm to very stiff silts and clays. Given the exploration and laboratory data, it is our opinion that the proposed improvements should be designed assuming very low expansion potential.

The results of chemical testing indicate that the on-site soils will be very mildly corrosive to ferrous metals. The results of sulfate tests indicate that the site will have a negligible sulfate exposure to concrete as defined by the 2013 California Building Code (2013 CBC).

GEOLOGIC FINDINGS

LOCAL GEOLOGY AND SUBSURFACE SOIL CONDITIONS

Published geologic maps indicate that prior to development (pre-1900s) the site was part of the marshy area at the mouth of the Santa Ana River before it shifted westward to its current location. This marshy area consisted of estuary deposits in the form of sand bars and shallow marsh/lagoonal areas. The Newport Bay area was developed into the current configuration in the early 1900s by dredging some areas and filling others to create the existing islands. Based on our research and subsurface investigation, the site is underlain by a thin veneer of these dredge materials overlying native estuary deposits. For ease of reference, these deposits are referred to as alluvial soil in this report.

Detailed descriptions of the geologic materials beneath the site as observed during our recent subsurface exploration are described below.

Dredged Fill (Qaf)

The dredged fill materials within the site originated from the estuary and near shore deposits in the bay. These materials consist of sand to silty sand that is moist to very moist, medium dense, with scattered shell fragments. Notable structure within these deposits was not observed during our investigation.

Alluvium (Qal)

Alluvial soils were encountered underlying the dredge fill materials across the site. Where encountered, these materials consist of gray and brown sands and silts with some clays. The materials are moist to wet and loose to medium dense, with no notable structure observed.

GROUNDWATER

Groundwater was encountered within our recent drill holes and CPT soundings at elevations of about 3.5 to 4 feet above MSL (depths of 4.5 to 5 feet below existing grades). Groundwater elevations across the site are likely primarily controlled by elevation of the water within the adjacent bay. It should be noted that the groundwater elevations measured during our exploration were affected by the time of day as it relates to the local tidal cycle, and therefore should be assumed to fluctuate with the tides, the lunar cycle, and recent rainfall events.

In order to better evaluate the groundwater data collected during our investigation, these depths to groundwater were compared to the depth of historically high groundwater shown within the Seismic Hazard Zone Report for the Newport Beach Quadrangle (CDMG, 1997). These maps indicate a historical high groundwater of less than 10 feet b.g.s. which is about 5 feet lower than the elevation of groundwater found during our investigation.

Based on the above findings, groundwater may be encountered as high as 4 feet b.g.s. Consequently, the groundwater may impact proposed corrective grading (i.e. at the bottom of the removals) as well as utility trenches deeper than 4 feet b.g.s.

FAULTING AND SEISMICITY

The site is not located within the published Newport Beach Quadrangle Alquist-Priolo Earthquake Fault Zone dated July 1, 1986, and no known active faults are shown on current geologic maps for the site (CDMG, 1986). Plate 4 shows the site location with respect to regional seismic sources. The nearest known active fault is the offshore segment of the Newport-Inglewood fault, which is located approximately 0.5 kilometers southwest of the site and is capable of generating a maximum earthquake magnitude (M_w) of 7.5. The site is also located over the surface projection of the San Joaquin Hills Blind Thrust and about 9 kilometers from its rupture surface, which is capable of generating a maximum earthquake magnitude (M_w) of 7.1. Given the proximity of the site to these and numerous other active and potentially active faults, the site will likely be subject to earthquake ground motions in the future.

The site is underlain by high plasticity alluvial silts 50 feet bgs, silty sand, and sandy alluvial deposits at the upper 50 feet bgs and a relatively shallow mantle of engineered fill. The shear wave velocities were measured at SCPT-3 for the upper 100 feet. Site V_{s30} was calculated to be 514 feet per second, which resulted in a Site Soil Profile Class E (S_E, soft site). Since the site is potentially liquefiable, the soil profile may be considered S_F. However, Section 20.3.1 of ASCE 7-10 provides an exception as follows: “For structures having fundamental periods of vibration equal or less than 0.5 s, site response analysis is not required to determine spectral accelerations for liquefiable soils. Rather, a site class is permitted to be determined in accordance with Section 20.3 and the corresponding values of F_a and F_v determined from Tables 11.4-1 and 11.4-2." Therefore, the Site Class S_E was used for determination of the site spectral accelerations.

The Maximum Considered Earthquake (MCE_G) Peak Horizontal Ground Acceleration ($PHGA_M$) is 0.63g as determined in accordance with the 2010 CBC. For the purposes of our liquefaction analysis, the USGS 2008 Interactive Deaggregation website was used to determine the modal magnitude and modal distance. The deaggregation resulted in a mode magnitude of 6.97 and mode distance of less than 2.5 miles.

If requested by the project structural engineer, GMU can also provide a site-specific ground motion hazard analysis per Chapter 21 of ASCE 7-10.

SEISMIC HAZARD ZONES

The subject property is not located within an area mapped as having the potential for seismic-induced landsliding; however, it is located within an area mapped as having the potential for seismic-induced liquefaction as shown in Seismic Hazard Zone Map for the Newport Beach Quadrangle (CDMG, 1998).

GEOTECHNICAL ENGINEERING FINDINGS

LIQUEFACTION, SEISMIC SETTLEMENT, AND LATERAL SPREADING

Liquefaction Investigation

The site is located within a zone mapped as having the potential for earthquake-induced liquefaction. In addition, groundwater was observed at depths of approximately 4.5 to 5 feet bgs and granular soils were encountered below the groundwater. Therefore, liquefaction and related hazards were quantitatively evaluated utilizing the subsurface data from our CPT soundings.

Design Earthquake and Mode Magnitude

Based on the 2013 CBC, a PGA of 0.63g and Modal Magnitude of 6.97 were used for this study.

Design Groundwater Level

The referenced seismic hazard evaluation report indicates a historically high groundwater level of 10 feet bgs. Actual groundwater levels encountered during our recent exploration ranged from approximately 4.5 to 5 feet below existing site grades and the site is expected to be raised about

1.5 to 2 feet at the building areas. Therefore our analysis was performed using a design groundwater table of 6 feet below the final grade.

Liquefaction Analyses

GMU utilized CLiq version 1.7.4.34 to evaluate CPT data for liquefaction. CLiq is a commercial computer software program that applies the latest Robertson (2009) method for liquefaction analysis including post-earthquake settlement and lateral displacement for liquefiable sands and softened clays.

Liquefaction, Seismic Settlement, and Lateral Spreading Potential

Our analysis indicates that relatively thin, discrete zones within the zone of artificial fill and alluvium below the water table may be subject to liquefaction during a design seismic event. Based on our analysis, the site has a moderate potential for any adverse effects of liquefaction due to seismic-induced settlement. Our liquefaction seismic settlement calculations indicate approximately 0.7 to 2.9 inches of settlement could occur during the MCE earthquake.

Considering the site flatness and distance from the Back Bay, the site has a low potential for adverse effects due to seismic-induced lateral spreading.

Tsunamis

Tsunamis or seismic sea waves that have affected coastal southern California are generally produced by submarine fault rupture. Historical records indicate that the coast, from San Pedro to Newport Bay, has been affected by six significant tsunamis since 1868 (Vasily Tito, National Oceanographic and Atmospheric Administration, Personal Communication, June 1998). The largest waves were on the order of 6 to 8 feet. The most extensive recent damage occurred in harbor areas such as Los Angeles (Alaska - 1964, Chile - 1960).

Legg et al. (2004) investigated the tsunami hazard associated with the Catalina fault offshore of Southern California. They simulated tsunamis based on coseismic deformation of the sea floor and estimated that coastal run-up values are 5 to 13 feet, although run-up could exceed 23 feet depending upon amplification due to bathymetry and coastal configuration. Large earthquakes on the Catalina fault are relatively infrequent, with recurrence intervals of several hundred to thousands of years (Legg et al., 2004).

Tsunami Inundation Maps

In 2009, the California Emergency Management Agency, California Geological Survey, and University of Southern California partnered in an effort to create tsunami inundation maps for California. The tsunami inundation maps were generated through a modeling process that utilizes the Method of Splitting Tsunamis (MOST). This computational program models tsunami evolution and inundation based on bathymetry and topography. The modeling also utilizes a variety of tsunami source events, including "realistic local and distant earthquakes and hypothetical extreme undersea, near-shore landslides" (California Emergency Management Agency et al., 2009). Using the source, bathymetry, and topography, the tsunami modeling yields a maximum inundation line. It is important to note that the published map does not represent inundation from a single event. Rather, it is the result of combining inundation lines from multiple source events. Therefore, the entire inundation region will not likely be inundated during a single tsunami event (California Emergency Management Agency et al., 2009).

The Tsunami Inundation Map states that the "tsunami inundation map was prepared to assist cities and counties in identifying their tsunami hazard. It is intended for local jurisdictional, coastal evacuation planning uses only." Furthermore, the map conveys that it is not intended for regulatory purposes. With respect to probability, the map states that it contains "no information about the probability of any tsunami affecting any area within a specific period of time."

A Tsunami Inundation Map for Emergency Planning was published for the Newport Beach Quadrangle (California Emergency Management Agency et al., 2009). In considering the Tsunami Inundation Map with respect to the proposed Lido House development, it is critical to note three points: (1) the map is only intended for emergency planning and evacuation planning; (2) the map does not convey any information with respect to probability or timing of tsunami events; and (3) the inundation line is a conservative combination of multiple source events.

Tsunami Hazard Assessment

The proposed Lido House is located within the Tsunami inundation area, therefore, has a high potential for being affected by Tsunamis. An excerpt of the Tsunami Inundation Map for the Newport Beach Quadrangle is attached as Plate 5 to this report. However, the probability and severity of tsunami inundation in the lowland areas cannot be estimated based on current available information.

STATIC SETTLEMENT/COMPRESSIBILITY

In general, the upper 50 feet of subgrade soils were medium dense to dense granular sand materials with lenses of fine grain soils. The sand deposits are underlain by soft high plasticity silts. In addition, our laboratory testing indicated that the upper granular soils have low compressibility. Total static settlements are expected to range from 1 to 2 inches below the proposed buildings depending on the foundation bearing capacity; however, the majority of the static settlements will be completed by the end of construction.

SOIL EXPANSION

The expansion potential of the on-site dredged fill materials were assessed based on visual classifications, particle size distributions, Atterberg limits, expansion index, previous studies, and our local experience. The laboratory test summary table is contained in Appendix B-1. The dredged fills mantling the site have a very low expansion potential. Since the near surface fill materials have a predominantly very low expansion potential, the design of building slabs and exterior hardscape features that will be in contact with these materials should be designed assuming a very low expansion index.

SOIL CORROSION

To evaluate the corrosion potential of the on-site soils to both ferrous metals and concrete, representative samples were tested for pH, minimum resistivity, soluble chlorides, and soluble sulfates. The results of chemical testing (contained in Appendix B) indicate that the on-site soils should be considered very mildly corrosive to ferrous metals and possess a negligible sulfate exposure to concrete, however, <u>a moderate exposure to sulfates may be considered in design</u> for concrete placed in contact with on-site soils.

SOIL INFILTRATION RESULTS

As described previously, infiltration testing was performed within the site in general accordance with the Santa Ana Regional Water Quality Control Board Technical Guidance Document (TGD) Appendices dated March 2011, utilizing the shallow percolation test procedure contained in Section VII.3.8. Two locations were tested for infiltration between 2 to 4 feet in depth below the existing surface. The average infiltration rate varied from 1.4 inches per hour at DH-1 to 12.3 inches per hour at DH-5.

EXCAVATION CHARACTERISTICS

Rippability

The dredged fill materials and alluvial soils underlying the site can be easily excavated with conventional grading equipment such as dozers, loaders, excavators, and backhoes.

Trenching

We expect that excavation of new utility trenches can be accomplished utilizing conventional trenching machines and backhoes. Trench support requirements will be limited to those required by safety laws or other locations where trench slopes will need to be flattened or supported by shoring designed to suit the specific conditions exposed.

Volume Change

In order to aid planning for the anticipated grading, we estimate that the change in volume of on-site disturbed surficial dredged fills that are excavated and placed as new compacted fill at an average relative compaction of 92% will result in volume losses that will range from approximately 5 to 10 percent. For rough planning purposes only, an average volume loss of 7.5 percent may be assumed.

CONCLUSIONS

DEVELOPMENT FEASIBILITY

Based on the geologic and geotechnical findings, it is our opinion that proposed construction is feasible from a geotechnical standpoint. However, there are several hazards that must be mitigated to provide long-term site stability and proper support of proposed structures. The subject property will be suitable for the proposed grading and construction provided that the site hazards are mitigated in accordance with the recommendations of this report and with the City of Newport Beach grading and building requirements. It is also the opinion of GMU Geotechnical that proposed grading and construction will not adversely affect the geologic stability of adjoining properties provided grading and construction are performed in accordance with the recommendations provided in this report.

SITE PREPARATION AND GRADING RECOMMENDATIONS

GENERAL

The subject site should be precise graded in accordance with the City of Newport Beach grading code requirements (and all other applicable codes and ordinances) and the recommendations as outlined in the following sections of this report. The geotechnical aspects of future grading plans and improvement plans should be reviewed by GMU Geotechnical prior to grading and construction. Particular care should be taken to confirm that all project plans conform to the recommendations provided in this report. All planned and corrective grading should also be monitored by GMU Geotechnical to verify general compliance with the recommendations outlined in this report.

DEMOLITION AND CLEARING

Prior to the start of the planned improvements, all materials associated with the existing buildings to be removed, including footings, floor slabs, and underground utilities, should be demolished and hauled from the site. The existing asphalt pavement sections, which are inadequate and severely damaged, will also need to be demolished. Due to the limited amount of grading and fill placement that will occur, the old asphalt and base materials generated from the removal of the existing pavement sections should be either recycled or collected and hauled off-site.

The on-site dredge fill materials are suitable for use as new compacted fill from a geotechnical perspective if care is taken to remove all significant organic and other decomposable debris. Cavities and excavations created upon removal of subsurface obstructions, such as existing buried utilities, should be cleared of loose soil, shaped to provide access for backfilling and compaction equipment, and then backfilled with properly compacted fill.

The project geotechnical consultant should provide periodic observation and testing services during demolition operations to document compliance with the above recommendations. In addition, should unusual or adverse soil conditions or buried structures be encountered during grading that are not described herein, these conditions should be brought to the immediate attention of the project geotechnical consultant for corrective recommendations.

CORRECTIVE GRADING – BUILDINGS

The foundations of these new buildings and structures will be supported on engineered fill underlying the mat slab foundation system. It is recommended the existing dredge fill materials be overexcavated to a depth of at least 4 feet below the existing grades and these excavated materials be replaced as properly compacted fill placed at a minimum relative compaction of at least 92% at 2% above optimum moisture content.

CORRECTIVE GRADING – EXTERIOR PARKING, DRIVEWAY AND HARDSCAPE AREAS

It is expected that the existing surficial dredged materials will be disturbed during the demolition of the existing building, hardscape, landscape, and asphalt pavement sections. Therefore, to provide adequate support of proposed exterior improvements such as parking lots and driveways, and hardscape features such as patios, walkways, stairways and planter walls, the existing ground surfaces in these areas should be overexcavated to a depth of at least 2 feet below the existing grades and shallow foundations. These excavated materials can then be replaced as properly compacted fill at a minimum relative compaction of at least 92% at 2% above optimum moisture content.

FILL MATERIAL AND PLACEMENT

Suitability

All on-site dredge fill soils are considered suitable for use as compacted fill from a geotechnical perspective if care is taken to remove all significant organic and other decomposable debris, and separate and stockpile rock materials larger than 6 inches in maximum diameter.

Compaction Standard and Methodology

All soil material used as compacted fill, or material processed in-place or used to backfill trenches, should be moistened, dried, or blended as necessary and densified to at least 92% relative compaction as determined by ASTM Test Method D 1557. It is recommended that fills be placed a minimum of 2% above optimum moisture content.

Material Blending

The existing surficial engineered fill materials are expected to be generally slightly below optimum moisture content but may have variable moisture content depending on the season in which work is performed. The majority of the materials to be handled during grading will require some blending and addition of water to meet acceptable moisture ranges for sufficient compaction (i.e., minimum 2% above optimum moisture content).

Use of Rock or Broken Concrete

Significant rock materials greater than 6 inches in diameter are not anticipated during the subject grading. Due to the limited amount of grading and fill placement that will occur, any oversize rock materials generated during grading should be collected and hauled off-site.

TEMPORARY SLOPE STABILITY

During site grading, temporary laid back slopes up to approximately 4 to 5 feet in height are expected to be created during the construction of proposed low retaining walls. The sidewalls of these temporary slopes are expected to expose newly placed engineered fill consisting of the existing dredge fill materials.

Based on the anticipated engineering characteristics of these materials, temporary slopes to a maximum height of 4 feet may be cut vertically without shoring subject to verification of safety by the contractor. Deeper excavations should be braced, shored or, for those portions of the sidewalls above a height of 4 feet, sloped back no steeper than 1:1 (horizontal to vertical). In addition, no surcharge loads should be allowed within 10 feet from the top of the temporary slopes.

We anticipate the slopes will be temporarily stable provided the above recommendations are followed. However, modifications to these recommendations may be required based on our observations of the actual conditions exposed in the field

Our temporary slope recommendations are provided only as general guidelines, and all work associated with temporary slopes should meet the minimal requirements as set forth by CAL-OSHA. Temporary slope construction, maintenance, and safety are the responsibility of the contractor.

POST-GRADING AND GROUND IMPROVEMENT CONSIDERATIONS

UTILITY TRENCHES

Utility Trench Excavations

The subject site is underlain by approximately 5 to 6.5 feet of dredged fill materials that consist of sands and silty sands. In general, the granular sand materials were found to be medium dense to dense while the fine-grained clay and silt materials were found to be predominantly firm to very firm. Furthermore, groundwater was encountered at relatively shallow depths (4.5 to 5 feet).

For this condition, the soils above the groundwater level can be considered as OSHA soil type C and should be laid back at a maximum slope ratio of 1.5:1, horizontal to vertical. In addition, surcharge loads should not be allowed within 10 feet of the top of the excavations.

For deeper trenches, groundwater will be encountered and the contractor should develop an approach for dewatering, shoring, and addressing shallow groundwater conditions. Sumping and pumping of free water from open excavations is not expected to result in dry and stable trench conditions due to the close proximity of the adjacent bay; therefore, a dewatering system will need to be designed, installed, and operated by an experienced company specializing in groundwater dewatering systems. The dewatering system should be capable of lowering the groundwater surface to a depth of 5 feet below the bottom of the trenches. Before implementing a dewatering system, we recommend that a dewatering test program be conducted to evaluate the feasibility and efficiency of the proposed dewatering system. Dewatering should be performed and confirmed by potholing or other means prior to trench excavation. Dewatering operations will also need to comply with all NPDES regulations.

Temporary shoring will be required below the water table where saturated soils are encountered or where vertical trench sidewalls are desired. Shoring should consist of metal, plywood, and/or timber sheeting supported by braces or shields. Trench walls lacking sheeting will be unstable and experience sloughing. Trench shields will only provide worker safety and will not provide full support of the trench walls unless the shields are installed tightly against the sidewalls. Lateral pressures considered applicable for the shoring design will depend on the type of shoring system selected by the contractor and whether the site is dewatered. GMU can provide specific design values once the type of shoring is determined.

The above recommendations are presented as guidelines only and are minimum requirements. Temporary trench excavation construction, maintenance, and safety are the responsibility of the pipeline contractor. The contractor should retain a qualified and experienced registered engineer to design any shoring systems in accordance with OSHA criteria. The shoring engineer should evaluate the adequacy of the shoring design parameters provided in this report and make appropriate modifications as necessary. The design should consider local groundwater levels as reported herein and that groundwater levels may change over time as a result of tidal influences.

Utility Trench Subgrade Stabilization

Prior to pipeline bedding placement, the trench subgrades should be firm and unyielding. If unsuitable subgrade soils are encountered, the contractor should consult with the project geotechnical engineer to provide subgrade stabilization. Stabilization may generally consist of the placement of crushed rock or processed miscellaneous base. Crushed rock, if used, would need to be encased in filter fabric. Specific recommendations would be dependent on actual conditions encountered.

Utility Trench Backfill Considerations

Backfill compaction of utility trenches should be such that no significant settlement will occur. Backfill for all of these trenches should be compacted to at least 92% relative compaction subject to sufficient observation and testing. Flooding in the trench zone is not recommended. If native material with a sand equivalent less than 30 is used for backfill, it should be placed at near-optimum moisture content and mechanically compacted. Jetting or flooding of granular material should not be used to consolidate backfill in trenches adjacent to any foundation elements.

Where trenches closely parallel a footing (i.e., for retaining walls) and the trench bottom is located within a 1 horizontal to 1 vertical plane projected downward and outward from any structure footing, a minimum 1½-sack concrete slurry backfill should be utilized to backfill the portion of the trench below this plane. The use of concrete slurry is not required for backfill where a narrow trench crosses a footing at about right angles.

We suggest that these recommendations be included as a specification in all subcontracts for underground improvements. In addition, the design of all underground conduits, pipelines, or utilities should also consider the potentially corrosive nature of the on-site groundwater to metals, as previously described in this report.

SURFACE DRAINAGE

Surface drainage should be carefully controlled to prevent runoff over graded sloping surfaces and ponding of water on flat pad areas. Positive drainage away from graded slopes is essential to reduce the potential for erosion or saturation of sloping surfaces. Maintaining positive drainage of all landscaping areas along with avoiding over-irrigation will help minimize the possibility of "perched" groundwater accumulating slightly below the graded surfaces. All drainage at the site should be in minimum conformance with the applicable City of Newport Beach codes and standards.

FOUNDATION DESIGN RECOMMENDATIONS

STRUCTURE SEISMIC DESIGN

The site is not within an Alquist-Priolo Earthquake Fault Zone, and no known active faults are shown on current geologic maps as crossing the site. The nearest known active fault is the offshore segment of the Newport-Inglewood fault, which is located approximately 0.5 kilometers southwest of the site and is capable of generating a maximum earthquake magnitude (M_w) of 7.5. The site is also located over the surface projection of the San Joaquin Hills Blind Thrust and about 9 kilometers from its rupture surface, which is capable of generating a maximum earthquake magnitude (M_w) of 7.1. Given the proximity of the site to these and numerous other active and potentially active faults, the site will likely be subject to significant earthquake ground motions in the future.

The average shear wave velocity for the upper 100 feet of subsurface soils (V_{s30}) was estimated to be 514 feet per second based on the shear wave velocity measurements at SCPT-3. We have assumed that the site is underlain by a S_E soil profile. The seismic design coefficients based on ASCE 7-10 and 2013 CBC are listed in Table 1.

Table 1. 2013 CBC Site Categorization and Site Coefficients

Categorization/Coefficient	**Design Value**
Soil Profile Type (Table 20.3-1)	S_E
Short Period Spectral Acceleration S_s**	1.704g
1-sec. Period Spectral Acceleration S_1**	0.630g
Site Coefficient F_a (Table 11.4-1)**	0.9
Site Coefficient F_v (Table 11.4-2)**	2.4
Short Period MCE* Spectral Acceleration S_{MS}**	1.533g
1-sec. Period MCE Spectral Acceleration S_{M1}**	1.511g
Short Period Design Spectral Acceleration S_{DS}**	1.022g
1-sec. Period Design Spectral Acceleration S_{D1}**	1.008g
MCE Peak Ground Acceleration (PGA, Figure 22-7)	0.70
Site Coefficient F_{PGA} (Table 11.8-1)**	0.9
MCE Peak Ground Acceleration (PGA_M)	0.63
Modal Contributing Magnitude to MCE Event	6.97

* MCE: Maximum Considered Earthquake
** Values Obtained from USGS Earthquake Hazards Program website is based on the ASCE7-10 and 2013 CBC and site coordinates of N33.6165 ^{o} and W 117.929^o.

Based on the 2013 California Building Code (2013 CBC), the peak ground acceleration (PGA_M) for liquefaction evaluation is 0.63g for the MCE event. This PHGA is associated with a modal earthquake magnitude of 6.97 at a modal distance of 2.5 miles from the site using the USGS 2008 Interactive Deaggregation website.

It should be recognized that much of southern California is subject to some level of damaging ground shaking as a result of movement along the major active (and potentially active) fault zones that characterize this region.

If requested by the project structural engineer, GMU can also provide a site-specific ground motion hazard analysis per ASCE 7-10 Chapter 21.

GENERAL

The following preliminary foundation design recommendations are provided based on anticipated conditions at the completion of anticipated grading; however, these recommendations are based on conceptual plans that may be revised during the plan check process. Ultimate construction and grading within the site should be in accordance with all applicable provisions of the grading and building codes of the City of Newport Beach, the applicable CBC, and all of the recommendations of the project civil and geotechnical consultants involved in the final site development.

Geotechnical Design Parameters for Mat Foundations

To minimize the adverse effects of the earthquake-induced settlements and provide repairable foundation systems after the design earthquake, we recommend supporting the proposed structures by structural mat slab(s). The mat slab(s) will bridge over the potential localized deformations after the earthquake and may also be re-leveled after the earthquake without major costs.

Corrective Grading
We recommend that the existing fill and alluvial soils be excavated beneath the entire footprint of the structures to a minimum depth of at least 4 feet below the planned mat foundation. Removals should extend laterally to at least 5 feet from the base of the outside of the mat foundation. Artificial fill/alluvium derived from the excavated soils should be compacted to a minimum of 92% relative compaction per ASTM 1557.

Design Parameters
An allowable net static bearing capacity of 2,000 pounds per square foot may be used for design of the mat foundation(s). A lateral sliding coefficient of 0.35 is recommended. The mat thickness and amount of reinforcement should be determined by a Registered (Structural) Engineer in the State of California. For structures supported by mat foundations, we recommend using a subgrade reaction coefficient defined as:

$$K_b = K_{v1} * \left[\frac{(m+0.5)}{1.5m}\right] * \left[\frac{(B+1)}{2B}\right]^2$$

Where:

K_{v1}: Normalized subgrade reaction coefficient (namely, corresponding to a 1 foot square bearing plate), estimated at 100 pounds per cubic inch (pci) for engineered fill subgrade. It should be noted that this value applies to dry or moist materials, with groundwater at a depth of at least 1.5B below the base of the footing. If groundwater is at the base of the footing, use $K_{v1}/2$ to calculate settlements.

B: Width of the mat foundation measured in feet.

m: Ratio of length over width of a rectangular footing.

Circular, hexagonal, and octagonal foundation shapes can be approximated to an equivalent square. Based on the maximum bearing pressure of 2,000 psf below the mat slabs, we estimate that total static mat slab settlement should be less than approximately 2 inches, with 1 inch of post-construction total settlement, and a post-construction static differential movement of less than approximately ½-inch. The estimated settlements may be further refined when the final mat slab contact pressures become available.

MOISTURE VAPOR BARRIERS

Due to the existing shallow groundwater table, a vapor barrier equivalent to Stego 15 should be utilized. The barrier should be installed as follows:

- Below the slabs of all buildings with habitable areas or moisture-sensitive floor coverings.
- Installed per manufacture's specifications as well as with all applicable recognized installation procedures such as ASTM E 1643-98.
- Joints between the sheets and the openings for utility piping should be lapped and taped. If the barrier is not continuously placed across footings/ribs, the barrier should, as a minimum, be lapped into the sides of the footing/rib trenches down to the bottom of the trench.
- Punctures in the vapor barrier should be repaired prior to concrete placement.
- Prior to placing the barrier, a minimum of 4 inches of ¾-inch graded rock should be placed over the subgrade. The need for sand and/or the amount of sand above the moisture vapor retarder should be specified by the structural engineer. The selection of sand above the retarder is not a geotechnical engineering issue and is hence outside our purview. If the structural engineer requires sand above the barrier, it should consist of 1 to 2 inches of clean sand with a minimum sand equivalent of 30.

WATER VAPOR TRANSMISSION

As discussed above, placement of a moisture vapor barrier below certain slab areas is recommended. This moisture vapor barrier recommendation is intended only to reduce moisture vapor transmissions from the soil beneath the concrete and is consistent with the current standard of the industry for construction in Southern California. It is not intended to provide a "waterproof" or "vapor proof" barrier or reduce vapor transmission from sources above the barrier. Sources above the barrier include any sand placed on top of the barrier (i.e., to be determined by the project structural designer) and from the concrete itself (i.e., vapor emitted during the curing process). The evaluation of water vapor from any source and its effect on any aspect of the proposed living space above the slab (i.e., floor covering applicability, mold growth, etc.) is outside our purview and the scope of this report.

FLOOR COVERINGS

Prior to the placement of flooring, the floor slabs should be properly cured and tested to verify that the water vapor transmission rate (WVTR) is compatible with the flooring requirements.

CONCRETE

Based on the previously and recently performed laboratory testing, the onsite soils have negligible moderate concentrations of sulfates per Section 1904.3 of the 2013 CBC. In addition, concrete will have a potential exposure to seawater. Consequently, we recommend that minimum Type II/V cement along with a maximum water/cement ratio of 0.50 and a minimum compressive strength of 4,000 psi be used for all structural foundations in contact with the onsite soils. This recommendation will serve to minimize the potential of water and/or vapor transmission through the concrete and minimize the potential for physical attack to concrete from non-sulfate based salts. In addition, wet curing of the concrete as described in ACI Publication 308 should be considered.

The aforementioned recommendations in regards to concrete are made from a soils perspective only. Final concrete mix design as well as any concrete testing is outside our purview. All applicable codes, ordinances, regulations, and guidelines should be followed in regard to designing a durable concrete with respect to the potential for detrimental exposure from the on-site soils and/or changes in the environment.

CORROSION PROTECTION OF METAL STRUCTURES

The results of the laboratory chemical tests performed on soil samples collected within and adjacent to the subject area indicate that the on-site soils are very mildly corrosive to ferrous metals. Consequently, metal structures which will be in direct contact with the soil (i.e., underground metal conduits, pipelines, metal sign posts, metal door frames, etc.) and/or in close proximity to the soil (wrought iron fencing, etc.) may be subject to slight corrosion. The use of special coatings or cathodic protection around buried metal structures has been shown to be beneficial in reducing corrosion potential due to soil and groundwater. The potential for corrosion of ferrous metal reinforcing elements embedded in structural concrete will be reduced by the use of the recommended maximum water/cement ratio for concrete.

The laboratory testing program performed for this project does not address the potential for corrosion to copper piping. In this regard, a corrosion engineer should be consulted to perform more detailed testing and develop appropriate mitigation measures (if necessary). Otherwise, the on-site soils should be considered corrosive to copper.

The above discussion is provided for general guidance in regards to the corrosiveness of the on-site soils to typical metal structures used for construction. Detailed corrosion testing and recommendations for protecting buried ferrous metal and/or copper elements is beyond our purview.

SITE WALL AND RETAINING WALL DESIGN CRITERIA

General

Exterior site retaining and screen walls are proposed within landscape and parking areas. The criteria contained in the following sections may be used for the design and construction of these walls.

Retaining Wall Design Parameters

Recommendations are provided for the site exterior retaining walls. Recommendations are provided for both cantilever and restrained walls. Calculations to support the recommendations are contained in the attached Appendix D.

- Foundation: Cantilever wall with spread footings.
- Footing Width: 24 inches minimum.
- Minimum Depth: 18 inches below lowest outside adjacent grade
- Minimum Footing Reinforcement: Four #4 bars; two at top and two at bottom of footing (footings to be continuous across openings such as footpath gates).
- Allowable Bearing Capacity: 2000 psf with a minimum embedment of 18 inches (may be increased 15% for each additional foot of width or embedment to a maximum of 3,000 psf).
- Bearing Material: At least a 2-foot-thick section of engineered fill.
- Coefficient of Friction: 0.35
- Unit Weight of Backfill: 125 pcf
- Passive Earth Pressure: 300 psf/ft of depth (disregard top soil and upper 6 inches).
- Static Lateral Earth Pressures: 63 pcf (At-Rest).
  40 pcf (Active).
- Seismic Earth Pressure: 20 pcf (inverted triangular distribution).
- Traffic Loading Pressures: 120 psf (where applicable).
- Backdrainage: A backdrainage system should be placed behind all retaining walls and drain to an appropriate approved drainage facility.
- Waterproofing: All walls should be waterproofed. Detailed waterproofing recommendations are beyond our purview.
- Backfill: On-site, relatively non-expansive soil materials may be used to backfill retaining walls. The backfill materials should be approved by the geotechnical consultant with respect to their characteristics prior to placement. All wall backfill should be should be

moistened, dried, or blended as necessary to achieve a minimum of 2% over optimum moisture content, and compacted to at least 92% relative compaction as determined by ASTM Test Method D 1557.

- Control Joints: Control/construction joints should be implemented and designed by structural engineer. As a minimum, control/construction joints should be provided at maximum intervals of 15 to 20 feet and at all angle points and other locations where differential movement is likely to occur.

Screen Walls

For standard screen walls on flat ground, footings should be a minimum of 24 inches deep below the lowest outside adjacent grade. Wall foundations should be reinforced with two #4 bars top and bottom, and joints in the wall should be placed at regular intervals on the order of 10 to 20 feet. The wall foundation shall be underlain by at least a 2-foot-thick section of engineered fill.

POLE FOUNDATIONS

Pole foundations will be required for the light bollards for the new parking area. As a minimum, the pole foundations should be at least 18 inches in diameter and at least 3 feet deep; however, the actual dimensions should be determined by the project structural engineer based on the following design parameters.

<u>Bearing Materials</u>. The pole foundations may bear into engineered fill approved by a representative from GMU.

<u>Bearing Values</u>. End-bearing capacity and skin friction may be combined to determine the allowable bearing capacities of the pole foundations. An allowable bearing pressure of 2000 pounds per square foot (psf) may be used for pole foundations at least 18 inches in diameter and embedded a minimum of 3 feet below the lowest adjacent grade. A value of 350 pounds per square foot may be used to determine the skin friction between the concrete and surrounding soil.

<u>Lateral Load Design</u>. Lateral loads may be resisted by friction at the base of the foundations and by passive resistance within the adjacent earth materials. A coefficient of friction of 0.35 may be used between the foundations and the recommended bearing material. For passive resistance, an allowable passive earth pressure of 300 pounds per foot of pile diameter per foot of depth into competent bearing material may be used; however, passive resistance should be ignored within the upper foot due to possible disturbance during drilling. The passive resistance may be assumed to be acting over an area equivalent to two pile diameters.

SWIMMING POOL AND SPA RECOMMENDATIONS

Allowable Bearing and Lateral Earth Pressures

The pool and spa shells may be designed using an allowable bearing value of 1,500 pounds per square foot. Due to the low expansive nature of the onsite soils, pool and spa walls should be designed assuming that an earth pressure equivalent to a fluid having a density of 75 pounds per cubic foot is acting on the outer surface of the pool walls. Pool and spa walls should also be designed to resist lateral surcharge pressures imposed by any adjacent footings or structures in addition to the above lateral earth pressure.

Settlement

We understand that the proposed swimming pool will have a maximum depth of 4 feet. Considering that the site is expected to be raised 2 feet and the earthwork recommendations provided in this report, it is anticipated that the swimming pool will be underlain by engineered fill. We recommend supporting the swimming pool by a minimum of 2 feet of engineered fill. Based on these conditions, settlement of the pool is expected to be negligible. The project structural engineer shall consider resisting buoyancy forces due to the potential groundwater table oscillations, which may occur during the life time of the pool.

Temporary Access Ramps

It is essential that all backfill placed within temporary access ramps extending into the pool and spa excavations be properly compacted and tested. This is intended to mitigate excessive settlement of the backfill and subsequent damage to concrete decking or other structures placed on the backfill.

Pool and Spa Bottoms

If unsuitable soils are encountered, the bottom of the pool or spa excavation may need to be over-excavated and replaced to pool subgrade with compacted fill. As an alternative, the reinforcing steel in the area of a transition area may be increased to account for the differences in engineering properties and the potential differential behavior.

Plumbing

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

Although the pool excavation may be free of water at the time of construction, future irrigation could result in the development of perched water zones which could affect subsurface improvements. Heavy-duty pipes and flexible couplings should be used for the pool plumbing system to minimize leaking which may produce additional pressures on the pool shell. In addition, installation of a pressure valve in the pool bottom should be used to mitigate potential buildup of pressure.

Cement Types

For moderately corrosive soils, cement shall be Type II/V and concrete shall have a minimum water to cement ratio of 0.50. Final concrete mix design is outside our purview.

Geotechnical Observations and Limitations

In general, all below grade improvements must be constructed by qualified professionals utilizing appropriate designs which account for the on-site (lot) geotechnical and geologic conditions. Observation/testing should be performed by GMU during pool/spa excavation to verify exposed soil conditions are consistent with the assumed design conditions.

It should be noted that implementation of the above recommendations only serve to reduce the subgrade adverse effects such as the potential for expansive soil related movements including slope creep and lateral fill extension. The recommendations are not intended to eliminate these types of movements. Consequently, some distortion should be anticipated if those conditions exist.

POOL AND SPA DECKING

Thickness and Joint Spacing

To reduce the potential for unsightly cracking, concrete pool and spa decking should be at least 5 inches thick and provided with construction joints or expansion joints every 6 feet or less. All open construction joints in pool and spa decking should be sealed with an approved waterproof, flexible joint sealer. Pool and spa decking should be underlain by a layer of crushed rock, gravel, or clean sand having a minimum thickness of 5 inches.

Reinforcement

Concrete pool and spa decking should be reinforced with No. 4 bars spaced 18 inches on centers, both ways. The reinforcement should be positioned near the middle of the slabs by means of concrete chairs or brick. Reinforcing bars should be provided across all joints to mitigate differential vertical movement of the slab sections. Structurally tying the decking to the pool wall is highly recommended. This will require structural reinforcement of the decking and consideration for additional loading on the pool wall. If doweling is not performed, differential movement should be anticipated.

Subgrade Preparation

As a further measure to mitigate cracking and/or shifting of concrete flatwork, the subgrade soils below concrete decking should be compacted to a minimum relative compaction of 92% and then thoroughly watered to achieve a moisture content that is at least 2% over optimum. This moisture content should extend to a depth of approximately 12 inches into the subgrade soils and be maintained in the subgrade during concrete placement to promote uniform curing of the concrete. Flooding or ponding of the subgrade is not considered feasible to achieve the above moisture conditions since this method would likely require construction of numerous earth berms to contain the water. Therefore, moisture conditioning should be achieved with sprinklers or a light spray applied to the subgrade over a period of several days just prior to pouring concrete. Soil density and presoaking should be observed, tested, and accepted by GMU prior to pouring the concrete.

All concrete has a tendency to crack, and cracks in concrete can be caused by many different factors. When constructing concrete decks, patios, sidewalks, etc., it is important that the ground on which these improvements are to rest be properly prepared, including moisture conditioning. Slab thickness, location of joints, reinforcement, and concrete mixture must also be appropriate for the intended use. Proper placement, finishing, and curing of concrete are also very important factors in minimizing cracking.

CONCRETE FLATWORK DESIGN

Thickness and Joint Spacing

To reduce the potential for unsightly cracking and trip hazards, concrete walkways and patios should be at least 4 inches thick and provided with construction joints or expansion joints every 5 feet or less. Concrete walkways and patios should be underlain by a 4-inch-thick layer of Class 2 crushed aggregate base (CAB), crushed miscellaneous base (CMB), or clean sand having a sand equivalent of at least 30, which should then be placed on top of the soil subgrade, moisture conditioned to at least 2% over optimum moisture, and compacted to at least 90% relative compaction.

Reinforcement

Concrete walkways and patios should be reinforced with No. 3 bars spaced 18 inches on centers, both ways. The reinforcement should be positioned near the middle of the slabs by means of concrete chairs or brick. Reinforcing bars should be provided across all joints to mitigate differential vertical movement of the slab sections. Walkways and patios should also be dowelled into adjacent curbs using 9-inch speed dowels with No. 3 bars or ½-inch steel or fiberglass bars at 18 inches on centers. If doweling is not performed, differential movement should be anticipated.

Subgrade Preparation

As a further measure to mitigate cracking and/or shifting of concrete flatwork, the subgrade soils below concrete walkways and patios should be compacted to a minimum relative compaction of 92% and then thoroughly watered to achieve a moisture content that is at least 2% over optimum. This moisture content should extend to a depth of approximately 12 inches into the subgrade soils and be maintained in the subgrade during concrete placement to promote uniform curing of the concrete. Flooding or ponding of the subgrade is not considered feasible to achieve the above moisture conditions since this method would likely require construction of numerous earth berms to contain the water. Therefore, moisture conditioning should be achieved with sprinklers or a light spray applied to the subgrade over a period of several days just prior to pouring concrete. Soil density and presoaking should be observed, tested, and accepted by GMU prior to pouring the concrete.

All concrete has a tendency to crack, and cracks in concrete can be caused by many different factors. When constructing concrete decks, patios, walkways, etc., it is important that the ground on which these improvements are to rest be properly prepared, including moisture conditioning. Slab thickness, location of joints, reinforcement, and concrete mixture must also be appropriate for the intended use. Proper placement, finishing, and curing of concrete are also very important factors in minimizing cracking.

PAVEMENT DESIGN CONSIDERATIONS

GENERAL

It is expected that the parking lots, the streets, and the driveways within the site will be constructed with both asphalt pavement and Portland cement concrete. Therefore, recommendations for both types of pavement are provided in the following sections. In order to accommodate City of Newport Beach fire-truck and trash truck loading, a traffic index (T.I.) of 5.5 has been assumed for the drive areas, whereas a T.I. of 4.0 has been assumed for the parking stall areas.

R-value tests were performed during our recent geotechnical subsurface investigation. The result of the current R-value test yielded a 69. For design purposes, we recommend utilizing an R-value of 40, which will need to be confirmed during specific grading activities in each pavement area of the site.

ASPHALT PAVEMENT DESIGN

Based on an anticipated R-value of 40 to be obtained after precise grading of pavement subgrade areas, the following pavement thicknesses should be anticipated:

Location	R-Value	Traffic Index	Asphalt Concrete (in.)	Aggregate Base (in.)
Car Parking Stalls	40	4.0	3.0	4.0
Drive Aisles	40	5.5	4.0	6.0

Asphalt pavement structural sections should consist of crushed miscellaneous base (CMB) or crushed aggregate base materials (CAB) and asphalt concrete materials (AC) of a type meeting the minimum City of Newport Beach requirements. The subgrade soils should be moisture conditioned to a minimum 2% above the optimum moisture content to a depth of at least 6 inches, and compacted to at least 92% relative compaction (per ASTM 1557). The CMB or CAB and AC should be compacted to at least 95% relative compaction (per ASTM 1557).

CONCRETE PAVEMENT DESIGN

Driveways and appurtenant concrete paving, such as trash receptacle bays, will require Portland cement concrete (PCC) pavement. Assuming a T.I. of 6 to 7, a design section of 8 inches of PCC over 6 inches aggregate base (AB) should be adequate. The AB should be Class 2 compacted to a minimum of 95% relative compaction as per ASTM D 1557.

FULL DEPTH RECLAMATION (FDR) ALTERNATIVE PAVEMENT FOR PARKING AREAS

Since minor grade changes are planned for the re-grading of the Planning Area 1 parking areas, and based on site conditions and our experience, we believe the most efficient pavement rehabilitation alternative to replacement with a conventional asphalt over base pavement section would be to utilize what is called “full depth reclamation” (FDR) utilizing a 12-inch-thick section of site reclaimed on-site AC and AB mixed with 6% cement to provide the new base for a new 4-inch-thick AC layer to be paved on top.

FDR has significant advantages over conventional pavement sections including the following major benefits:

- Savings in up-front costs (reusing materials, less excavation and import).
- Increased strength for weak in-place soils/long-term life (20- to 30-year design life).
- Reduced truck traffic to import and export materials.
- Environmental benefits and reduced community construction impact.
- Cautionary measures should be taken to avoid damaging existing utilities to ensure clearance for removal depths.

FDR can be performed in a similar construction schedule as presented below:

- Day 1 – Mill existing 1-inch top AC pavement surface and export. Light traffic can still drive on remaining AC section.
- Day 2 – Pulverize remaining AC and AB plus several inches of soil subgrade for a total of 12-inches of pulverization, mix in 6% Portland cement, moisture condition, and then compact to 95% relative compaction. Light traffic can drive on the FDR base layer at the end of the same day typically. Heavy truck traffic will be restricted.
- Day 3 – Curing FDR base layer. Closed to heavy truck traffic but light traffic can typically drive on FDR base.
- Day 4 – Micro crack FDR, place base 3-inch-thick or 4-inch-thick conventional Hot Mix Asphalt (HMA) AC layer and compact to 95% relative compaction. Light traffic can drive on base pavement section at the end of the same day.
- Day 5 – Heavier truck traffic can now be placed on new pavement section.

PERMEABLE INTERLOCKING CONCRETE PAVEMENT (PICP)

We understand that Permeable Interlocking Concrete Pavement (PICP) in the designated parking areas of Planning Area 1 may utilize permeable interlocking concrete pavers (such as "Eco-Stone") and will assume subgrade soil conditions (R-value of at least 40) according to the "Design Manual for Permeable Interlocking Concrete Pavements" by ICPI (2011). The structural base thickness will need to be designed by the project civil engineer in order to meet storage requirements. This minimum section assumes a T.I. of up to 6.3 (GMU assumes a T.I. of 5.5 for the mixed use of the drive areas in this portion of the site) and calls for a 3⅛" (80 mm) concrete paver, over compacted layers of 2" of bedding course sand (ASTM No. 8 aggregate), over 4" of ASTM No. 57 stone as open-graded base, over 6" of ASTM No. 2 stone as open-graded sub base, over a Class 1 geotextile fabric* (highest strength) per AASHTO M-288.

*Due to the presence of fine-grained silts and seashells in the existing dredge fill soils that will likely function as subgrade support for the PICP, GMU recommends using a Class 1 geotextile fabric (highest strength) placed both vertically at the sides of all PICP excavations and on top of the compacted subgrade soil below the stone sub-base layer in order to protect the bottom and sides of the open-graded base and sub-base. This geotextile fabric must meet AASHTO M-288 Class 1 geotextile strength property and subsurface drainage requirements (see attached Table 3-3 and Table 3-4 from Page 31 of the ICPI Design Manual (2011) for AASHTO M-288 requirements).

CONCRETE INTERLOCKING VEHICULAR AND PEDESTRIAN PAVERS

We understand that portions of the project site will utilize 3⅛-inch-thick (80 mm.) vehicular concrete interlocking pavers placed on a section of at least 1-inch-thick bedding sand. These vehicular pavers are also planned as a part of the subject project in order to provide City of Newport Beach Fire Department vehicle access capable of supporting 72,000 pounds of imposed loading. GMU recommends that the on-site soil subgrade in these site vehicular areas be scarified to a depth of 6 inches, moisture conditioned to at least 2% above the optimum moisture content, and compacted to at least 92% relative compaction. A geotextile fabric such as Mirafi 600X or equivalent should be placed on top of the compacted subgrade across the entire vehicular interlocking paver area. Based upon the on-site soils having an estimated R-value of 40, a 12-inch-thick layer of Class 2 crushed aggregate base (CAB), crushed miscellaneous base (CMB), or equivalent should be moisture conditioned to at least optimum moisture and compacted to at least 95% relative compaction in order to support the interlocking pavers. Concrete bands adjacent to the vehicular interlocking pavers should consist of a design section of 8 inches of PCC over at least 6 inches of AB or equivalent, moisture conditioned to at least optimum moisture, and compacted to at least 95% relative compaction.

We further understand that in certain designated site pedestrian areas, 2⅜-inch-thick (60 mm.) concrete interlocking pavers placed on a section of at least 1-inch-thick bedding sand are planned. GMU recommends that prior to the installation of the pavers and bedding sand in these pedestrian areas, the on-site soil subgrade should be scarified to a depth of 6 inches, moisture conditioned to at least 2% above the optimum moisture content, and compacted to at least 92% relative compaction. A 4-inch-thick layer of Class 2 crushed aggregate base (CAB), crushed miscellaneous base (CMB), or equivalent should then be placed on top of the soil subgrade, moisture conditioned to at least optimum moisture, and compacted to at least 95% relative compaction in order to support the interlocking pavers in these pedestrian areas.

PLAN REVIEW/ GEOTECHNICAL TESTING AND OBSERVATIONS DURING CONSTRUCTION/ FUTURE REPORTS

Plan Review

Our office should review all future grading, foundation, and shoring plans for the site.

Geotechnical Observation and Testing

It is recommended that geotechnical observation and testing be performed by this firm during the following stages of construction and precise grading:

- During site clearing and grubbing.
- During all site grading and fill placement.
- During removal of any buried lines or other subsurface structures.
- During all phases of excavation.
- During shoring installation.
- During installation of foundation and floor slab elements.
- During all phases of corrective, ground improvement, and precise grading including removals, scarification, ground improvement and preparation, moisture conditioning, proof-rolling, over-excavation, FDR treatment, and placement and compaction of all fill materials.
- During backfill of structure walls and underground utilities.
- During pavement and hardscape section placement and compaction.
- When any unusual conditions are encountered.

Future Reports

GMU should perform geotechnical reviews and provide geotechnical response letters to support the permit process for the grading, shoring, and building department reviews to support this report. The final project precise grading plans and foundation plans for the project should also be reviewed by our office. In addition, geotechnical observation reports will be required following construction and grading.

LIMITATIONS

All parties reviewing or utilizing this report should recognize that the findings, conclusions, and recommendations presented represent the results of our professional geological and geotechnical engineering efforts and judgments. Due to the inexact nature of the state of the art of these professions and the possible occurrence of undetected variables in subsurface conditions, we cannot guarantee that the conditions actually encountered during grading and foundation installation will be identical to those observed and sampled during our study or that there are no unknown subsurface conditions which could have an adverse effect on the use of the property. We have exercised a degree of care comparable to the standard of practice presently maintained by other professionals in the fields of geotechnical engineering and engineering geology, and believe that our findings present a reasonably representative description of geotechnical conditions and their probable influence on the grading and use of the property.

Because our conclusions and recommendations are based on a limited amount of current and previous geotechnical exploration and analysis, all parties should recognize the need for possible revisions to our conclusions and recommendations during grading of the project. Additionally, our conclusions and recommendations are based on the assumption that our firm will act as the geotechnical engineer of record during precise grading and construction of the project to observe the actual conditions exposed, to verify our design concepts and the grading contractor's general compliance with the project geotechnical specifications, and to provide our revised conclusions and recommendations should subsurface conditions differ significantly from those used as the basis for our conclusions and recommendations presented in this report. It should be further noted that the recommendations presented herein are intended solely to minimize the effects of post-construction soil movements. Consequently, minor cracking and/or distortion of all on-site improvements should be anticipated.

The following services are outside our purview:

- Detailed corrosion testing and recommendations for protecting buried ferrous metal and/or copper elements.
- Environmental testing and/or evaluation of any kind.

CLOSURE

We are pleased to present the results of our geotechnical investigation for this project. The Plates and Appendices A through D which complete this report are listed in the Table of Contents.

If you have any questions concerning our findings or recommendations, please do not hesitate to contact us and we will be happy to discuss them with you.

Respectfully submitted,

GMU GEOTECHNICAL, INC.

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dra/13-160-00R (12-4-13)

TECHNICAL REFERENCES

California Division of Mines and Geology, 1986, "Special Studies Zones for Newport Beach 7.5-Minute Quadrangles, Orange County, California," CDMG Special Studies Zones Map.

California Division of Mines and Geology, 1997, "Seismic Hazard Zone Report for the Anaheim and Newport Beach 7.5-Minute Quadrangles, Orange County, California," CDMG Seismic Hazard Zone Report 03.

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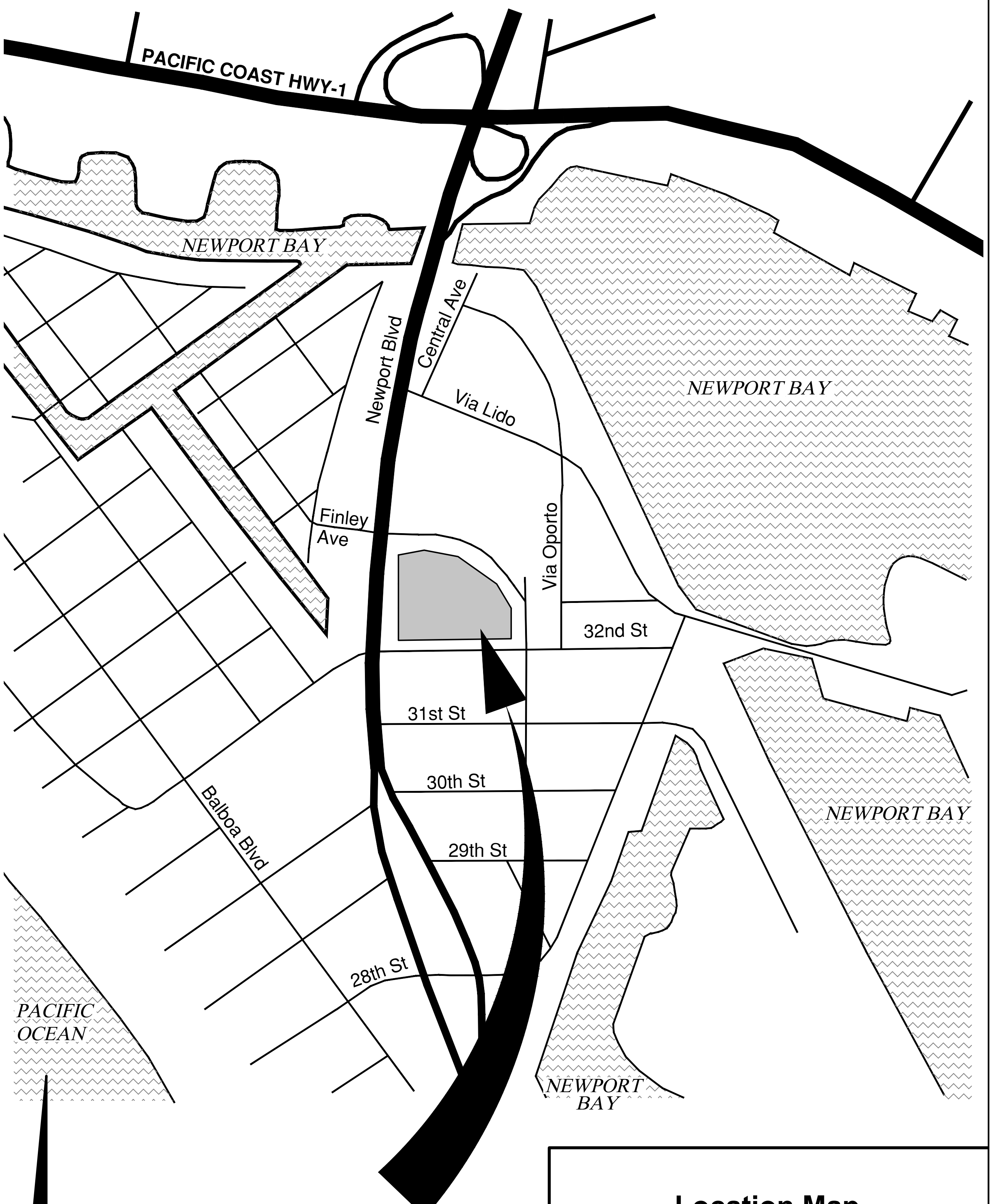
"Permeable Interlocking Concrete Pavements, Selection, Design, Construction, and Maintenance," Interlocking Concrete Pavement Institute (ICPI), Second Edition 2001.

SCEC, 1999, "Recommended Procedure for Implementation of DMG Special Publication 117 Guidelines for Analyzing and Mitigating Liquefaction in California," Martin, G.R. and Lew, M., March 1999, 63 pp.

AERIAL PHOTOGRAPHS

DATE	FLIGHT	PHOTO
4-19-99	C136-41	58-59
9-23-97	C117-41	1-2
1-28-95	Cl02-40	142-143
2-2-93	C86-8	3-4
1-20-92	C85-13	22-23
11-14-87	C-1	0032-0034
1-9-87	F	265-266
3-30-83	218-6	28-29
1-31-81	211-5	21-22
2-26-80	80033	215-216
12-14-78	203-5	36-37
12-28-76	181-5	24-25
1-28-75	157-5	27-28
10-29-73	132-5	17-18
6-28-71	94	05-06
1-31-70	81-8	201-202
1-3-67	1	47-48
3-24-59	R12	142-143 (Eastern)
3-24-59	R11	136-137 (Western)
6-2-53	6K	66-67



PROJECT SITE

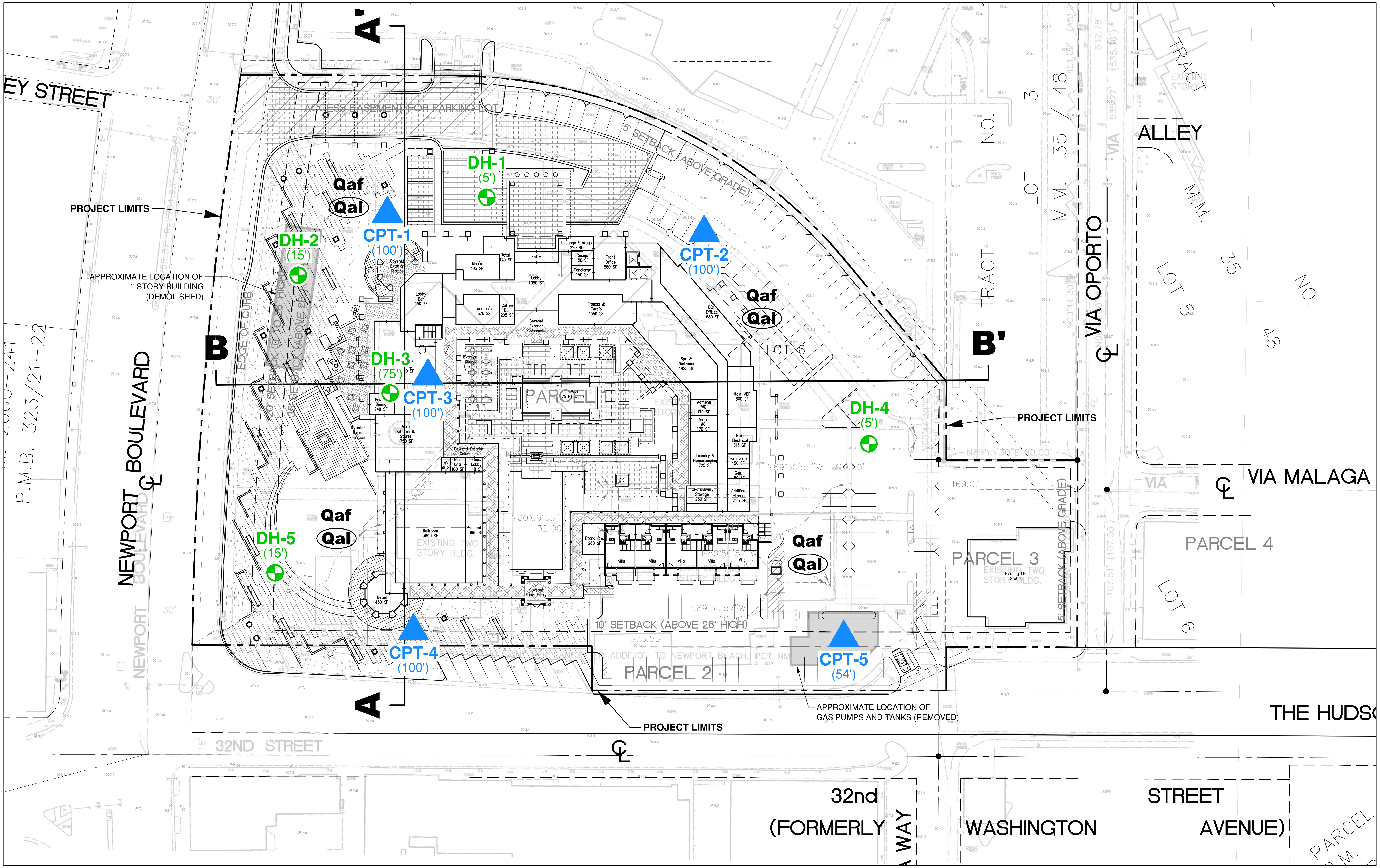
SCALE: 1"=500'

Location Map

GMU GEOTECHNICAL, INC.

Date:	December 4, 2013	Plate 1
Project No.:	13-160-00	

DRAWING: q:\2013\13-160-00\dwg\1316000_plate 1_location map.dwg PLOTTED: 11/20/2013 11:09 AM BY: Jesus Meza



GEOTECHNICAL LEGEND

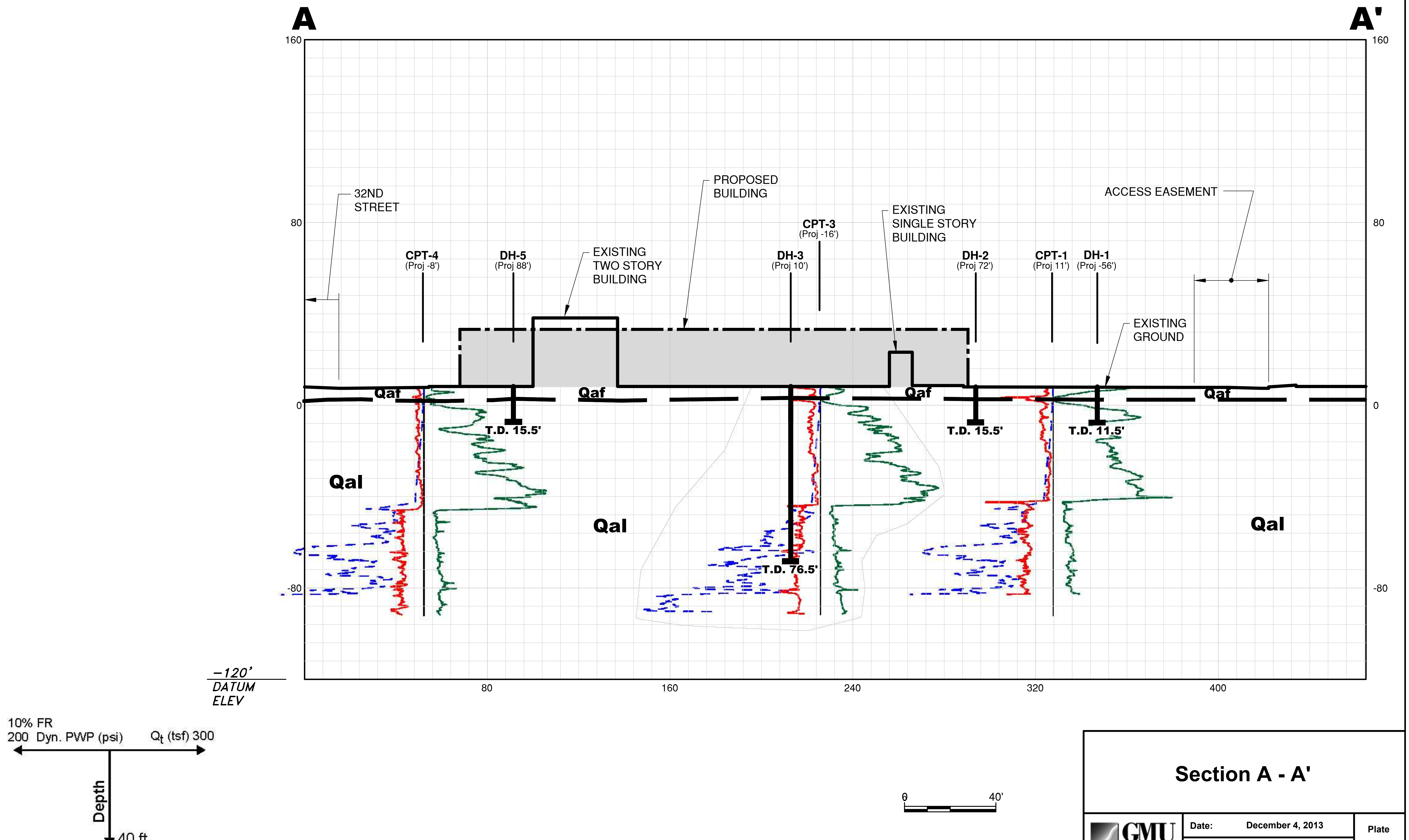
Qaf	DREDGED FILL
Qal	ALLUVIUM (BURIED)
CPT-1	APPROXIMATE LOCATION OF CPT
DH-4	APPROXIMATE LOCTION OF DRILL HOLE
— - —	PROJECT LIMITS

SCALE: 1/8" = 1'-0"

Geotechnical Map

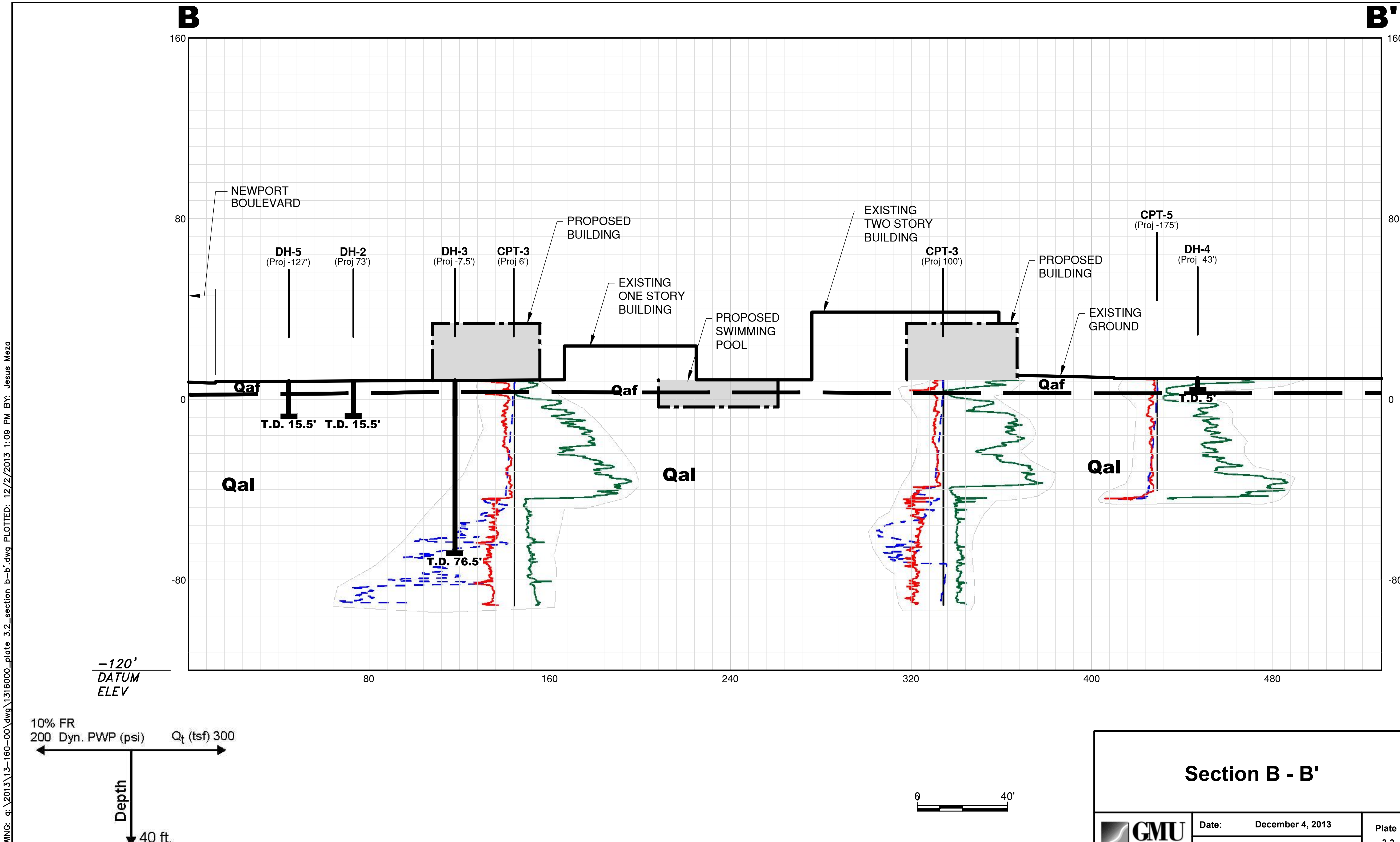
GMU GEOTECHNICAL, INC.	Date: December 4, 2013	Plate 2
	Project No.: 13-160-00	

DRAWING: q:\2013\13-160-00\dwg\1316000_plate 2_geo map.dwg PLOTTED: 12/3/2013 10:11 AM BY: Jesus Meza



Section A - A'

GMU GEOTECHNICAL, INC.	Date:	December 4, 2013	Plate 3.1
	Project No.:	13-160-00	



Section B - B'

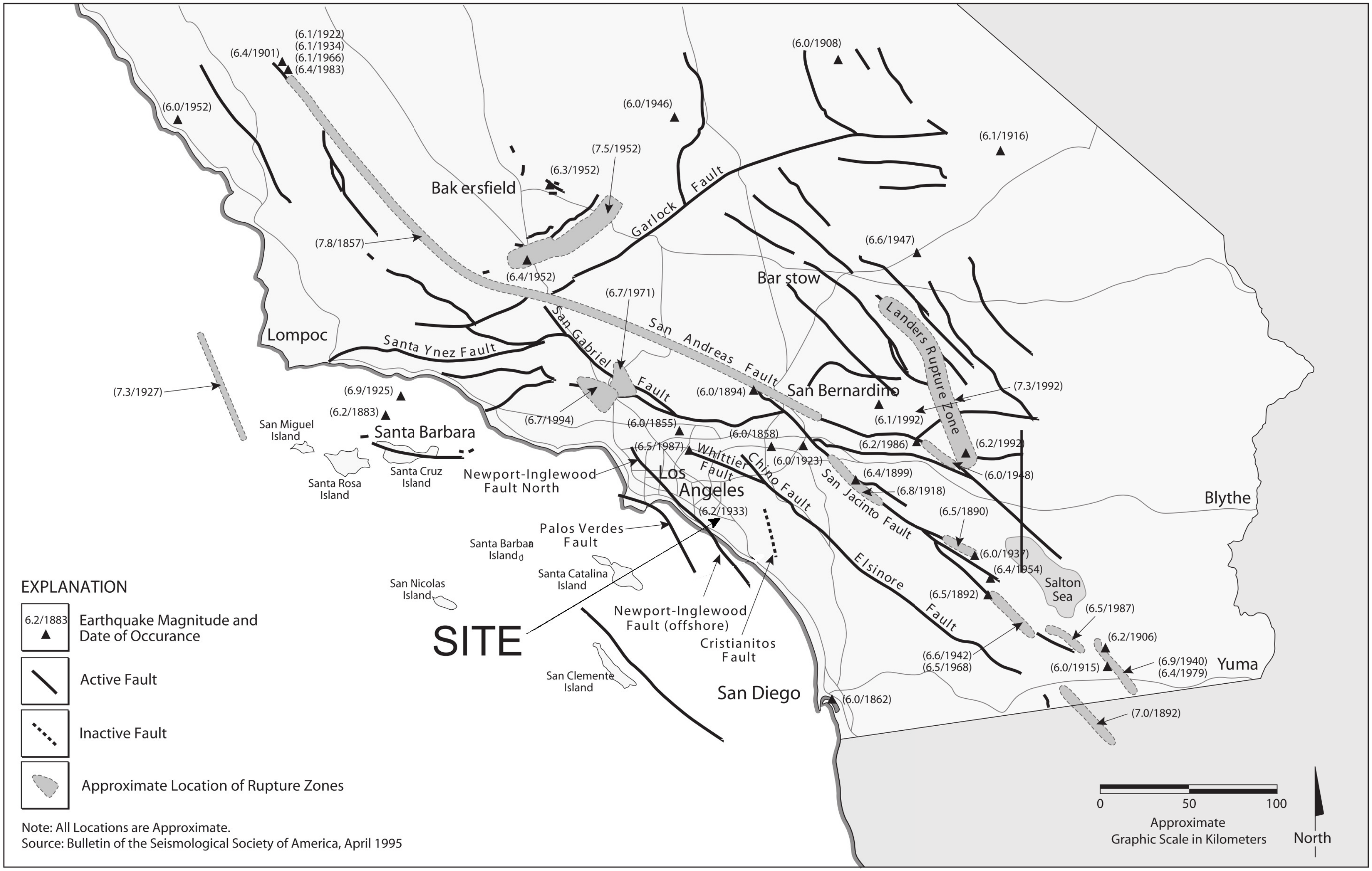
GMU GEOTECHNICAL, INC.

Date: December 4, 2013

Project No.: 13-160-00

Plate 3.2

DRAWING: q:\2013\13-160-00\dwg\1316000_plate 3.2_section b-b'.dwg PLOTTED: 12/2/2013 1:09 PM BY: Jesus Meza

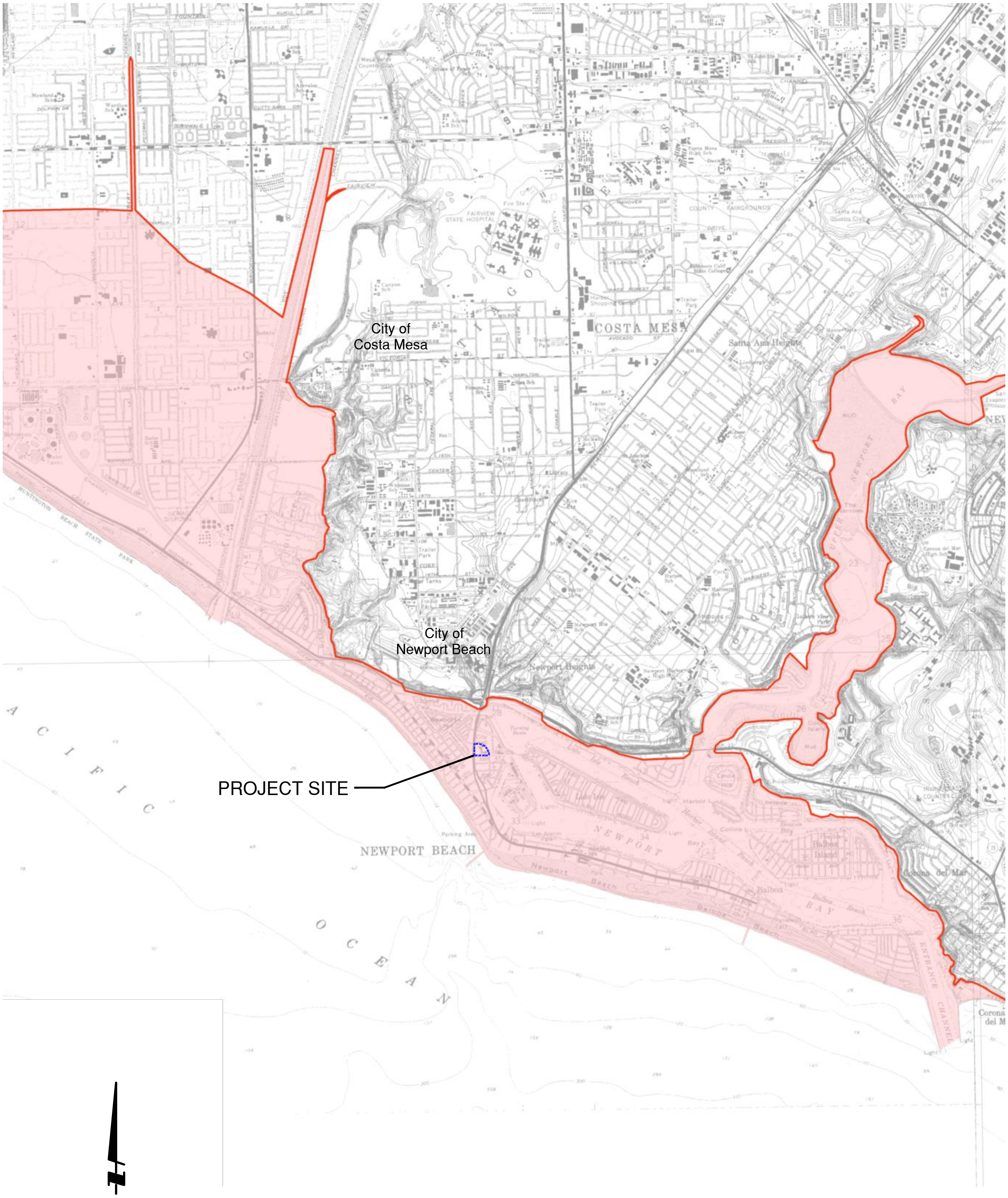


GMU GEOTECHNICAL, INC.

REGIONAL SEISMICITY:
Location of Major Active Surface Faults, Significant Inactive Faults, and Major Earthquake Epicenters (M>6.0)

Plate 4

P4-1/1/2002



MAP EXPLANATION

Tsunami Inundation Line

Tsunami Inundation Area

TSUNAMI INUNDATION MAP FOR EMERGENCY PLANNING

GMU GEOTECHNICAL, INC.	Date: DECEMBER 4, 2013	Plate 5
	Project No.: 13-160-00	

DRAWING: q:\2013\13-160-00\dwg\1316000_plate 5_inundation map.dwg PLOTTED: 12/2/2013 1:07 PM BY: Jesus Meza

APPENDIX A

GMU
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APPENDIX A-1

GMU Geotechnical Exploration Procedures
and Drill Hole Logs

GMU
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APPENDIX A-1

GMU GEOTECHNICAL EXPLORATION PROCEDURES AND LOGS

Our exploration within the subject site consisted of drilling 5 hollow stem auger drill holes (DH-1 through DH-5). There were also 5 CPT soundings (CPT-1 through CPT-5) advanced on the site. Approximate locations of the drill holes and CPTs are shown on Plate 2 – Geotechnical Map. Our drill holes were logged by a Certified Engineering Geologist and bulk and undisturbed samples of the excavated soils were collected. "Undisturbed" drive samples were taken using a 3.0-inch outside diameter split spoon sampler which contained 2.416-inch-diameter brass sample sleeves 6 inches in length. Standard Penetration Tests (SPT) using a 2.0-inch outside diameter split spoon sampler without liners were driven in the drill holes at select depths in between the relatively undisturbed samples. Blow counts recorded during sampling from the drive samplers are shown on the drill hole logs including SPT blow counts for each 6 inches of sample advancement ("N" values would be the blow counts for the last 12 inches of sampler advancement). The logs of each boring are contained in this Appendix A-1, and the Legend to Logs is presented as Plate A-1. CPT soundings were performed with a 30-ton CPT rig and a 15-cm^2 cone with readings taken every 2 cm. The CPT logs and data are contained in Appendix A-2.

The geologic and engineering field descriptions and classifications that appear on these logs are prepared according to Corps of Engineers and Bureau of Reclamation standards. Major soil classifications are prepared according to the Unified Soil Classification System as modified by ASTM Standard No. 2487. Since the descriptions and classifications that appear on the Log of Borings are intended to be that which most accurately describe a given interval of a boring (frequently an interval of several feet), discrepancies do occur in the Unified Soil Classification System nomenclature between that interval and a particular sample in that interval. For example, an 8-foot-thick interval in a log may be identified as silty sand (SM) while one sample taken within the interval may have individually been identified as sandy silt (ML). This discrepancy is frequently allowed to remain to emphasize the occurrence of local textural variations in the interval.

The descriptive terminology of the logs is modified from current ASTM Standards to suit the purposes of this study and is summarized as follows:

a. Soil Type - per Legend to Logs

b. Color - at field moisture

c. Moisture - (as estimated during exploration)
"dry" - very little or no moisture
"damp" - some moisture but less than optimum for compaction
"moist" - near optimum
"very moist - above optimum
"wet/saturated"- containing free moisture

d. Grain size - "fine", "medium" and "coarse"

e. Density (granular soils)
"very loose"
"loose"
"medium dense"
"dense"
"very dense"

f. Consistency (cohesive soils)
"very soft"
"soft"
"firm"
"stiff"
"very stiff"
"hard"

g. Seepage (as estimated during exploration)
"slight/minor" - < 0.3 gpm
"moderate" - 0.3 - 1 gpm
"heavy" - > 1 gpm

MAJOR DIVISIONS			Group Letter	Symbol	TYPICAL NAMES
COARSE-GRAINED SOILS More Than 50% Retained On No.200 Sieve Based on The Material Passing The 3-Inch (75mm) Sieve. Reference: ASTM Standard D2487	**GRAVELS** 50% or More of Coarse Fraction Retained on No.4 Sieve	Clean Gravels	GW		Well Graded Gravels and Gravel-Sand Mixtures, Little or No Fines.
			GP		Poorly Graded Gravels and Gravel-Sand Mixtures Little or No Fines.
		Gravels With Fines	GM		Silty Gravels, Gravel-Sand-Silt Mixtures.
			GC		Clayey Gravels, Gravel-Sand-Clay Mixtures.
	SANDS More Than 50% of Coarse Fraction Passes No.4 Sieve	Clean Sands	SW		Well Graded Sands and Gravelly Sands, Little or No Fines.
			SP		Poorly Graded Sands and Gravelly Sands, Little or No Fines.
		Sands With Fines	SM		Silty Sands, Sand-Silt Mixtures.
			SC		Clayey Sands, Sand-Clay Mixtures.
FINE-GRAINED SOILS 50% or More Passe The No.200 Sieve Based on The Material Passing The 3-Inch (75mm) Sieve. Reference: ASTM Standard D2487	**SILTS AND CLAYS** Liquid Limit Less Than 50%		ML		Inorganic Silts, 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 50% or Greater		MH		Inorganic Silts, Micaceous or Diatomaceous Fine Sandy or Silty Soils, Elastic Silts.
			CH		Inorganic Clays of High Plasticity, Fat Clays.
			OH		Organic Clays of Medium To High Plasticity, Organic Silts.
HIGHLY ORGANIC SOILS			PT		Peat and Other Highly Organic Soils.

The descriptive terminology of the logs is modified from current ASTM Standards to suit the purposes of this study

ADDITIONAL TESTS

- DS = Direct Shear
- HY = Hydrometer Test
- TC = Triaxial Compression Test
- UC = Unconfined Compression
- CN = Consolidation Test
- (T) = Time Rate
- EX = Expansion Test
- CP = Compaction Test
- PS = Particle Size Distribution
- EI = Expansion Index
- SE = Sand Equivalent Test
- AL = Atterberg Limits
- FC = Chemical Tests
- RV = Resistance Value
- SG = Specific Gravity
- SU = Sulfates
- CH = Chlorides
- MR = Minimum Resistivity
- pH
- (N) = Natural Undisturbed Sample
- (R) = Remolded Sample
- CS = Collapse Test/Swell-Settlement

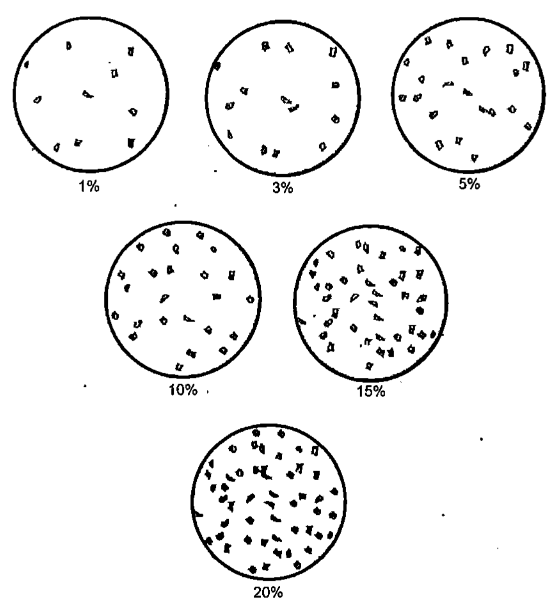
GEOLOGIC NOMENCLATURE

B = Bedding C = Contact J = Joint
F = Fracture Flt = Fault S = Shear
RS = Rupture Surface = Seepage
= Groundwater

SAMPLE SYMBOLS

- Undisturbed Sample (California Sample)
- Undisturbed Sample (Shelby Tube)
- Bulk Sample
- Unsuccessful Sampling Attempt
- SPT Sample

10: 10 Blows for 12-Inches Penetration
6/4: 6 Blows Per 4-Inches Penetration
P: Push
(13): Uncorrected Blow Counts ("N" Values) for 12-Inches Penetration- Standard Penetration Test (SPT)



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LEGEND TO LOGS

ASTM Designation: D 2487
(Based on Unified Soil Classification System)

Plate **A-1**

SOIL DENSITY/CONSISTENCY

FINE GRAINED

Consistency	Field Test	SPT (#blows/foot)	Mod (#blows/foot)
Very Soft	Easily penetrated by thumb, exudes between fingers	<2	<3
Soft	Easily penetrated one inch by thumb, molded by fingers	2-4	3-6
Firm	Penetrated over 1/2 inch by thumb with moderate effort	4-8	6-12
Stiff	Penetrated about 1/2 inch by thumb with great effort	8-15	12-25
Very Stiff	Readily indented by thumbnail	15-30	25-50
Hard	Indented with difficulty by thumbnail	>30	>50

COARSE GRAINED

Density	Field Test	SPT (#blows/foot)	Mod (#blows/foot)
Very Loose	Easily penetrated with 0.5" rod pushed by hand	<4	<5
Loose	Easily penetrated with 0.5" rod pushed by hand	4-10	5-12
Medium Dense	Easily penetrated 1' with 0.5" rod driven by 5lb hammer	10-30	12-35
Dense	Dificult to penetrat 1' with 0.5" rod driven by 5lb hammer	31-50	35-60
Very Dense	Penetrated few inches with 0.5" rod driven by 5lb hammer	>50	>60

BEDROCK HARDNESS

Density	Field Test	SPT (#blows/foot)
Soft	Can be crushed by hand, soil like and structureless	1-30
Moderately Hard	Can be grooved with fingernails, crumbles with hammer	30-50
Hard	Can't break by hand, can be grooved with knife	50-100
Very Hard	Scratches with knife, chips with hammer blows	>100

MODIFIERS

Trace	1%
Few	1-5%
Some	5-12%
Numerous	12-20%
Abundant	>20%

GRAIN SIZE

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

MOISTURE CONTENT

Dry- Very little or no moisture
Damp- Some moisture but less than optimum
Moist- Near optimum
Very Moist- Above optimum
Wet/Saturated- Contains free moisture

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LEGEND TO LOGS

Plate
A-2

P8-11/16/2012

Project: Lido House Hotel	**Log of Drill Hole DH-1**
Project Location: Newport Beach	Sheet 1 of 1
Project Number: 13-160-00	

Date(s) Drilled	**10/28/13**	Logged By	**RLD**	Checked By	**DRA**
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**2R Drilling**	Total Depth of Drill Hole	**11.5 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**8**	Approx. Surface Elevation, ft MSL	**8.0**
Groundwater Depth [Elevation], feet	**4.5 [3.5]**	Sampling Method(s)	**Open drive sampler with 6-inch sleeve/SPT**	Drill Hole Backfill	**Cuttings**
Remarks	**Infiltration Test Hole**			Driving Method and Drop	**140 lb auto hammer**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			ASPHALT PAVEMENT		3" AC / 2.5" AB						
			DREDGED FILL (Qaf)		SAND with some SILT (SP); brown, moist, medium dense, coarse grained, some seashell fragments		4 6 9	140	20	95	RV
5											
	5		ALLUVIUM (Qal)		SILTY SAND (SM); grayish brown, wet, medium dense, fine grained sand, low plasticity silt ▽		5 3 2	140	51	69	
0					SILTY SAND (SM); dark gray, wet, medium dense, fine grained		5 10 17	140	26	104	
	10				SILTY SAND (SM); dark gray, wet, medium dense, fine grained		3 7 10	140			
					Total depth = 11.5 feet Groundwater @ 4.5 feet No caving						

DH_REV3 13-160-00.GPJ GMULAB.GPJ 12/2/13

GMU GEOTECHNICAL, INC.

Drill Hole DH-1

Project: Lido House Hotel	**Log of Drill Hole DH-2**
Project Location: Newport Beach	Sheet 1 of 1
Project Number: 13-160-00	

Date(s) Drilled	**10/28/13**	Logged By	**RLD**	Checked By	**DRA**
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**2R Drilling**	Total Depth of Drill Hole	**15.5 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**8**	Approx. Surface Elevation, ft MSL	**8.0**
Groundwater Depth [Elevation], feet	**4.0 [4.0]**	Sampling Method(s)	**Open drive sampler with 6-inch sleeve/SPT**	Drill Hole Backfill	**Cuttings**
Remarks				Driving Method and Drop	**140 lb auto hammer**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	NUMBER OF BLOWS	DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
			GRASS AND SOD		Grass and rootlets						
			DREDGED FILL (Qaf)		SILTY SAND (SM); tan, moist, medium dense, coarse grained, trace seashells						SE
							11 13 16	140	7	108	
5											
			ALLUVIUM (Qal)		SILTY SAND to SANDY SILT (SM-ML); dark gray to dark brown, wet, medium dense, fine grained, low plasticity		5 7 4	140	57	71	
	5										
0					SILTY SAND (SM); dark gray, wet, medium dense, fine grained		2 4 8	140			
	10				SILTY SAND (SM); dark gray, wet, medium dense, fine grained		4 11 17	140	24	104	
-5											
	15				SILTY SAND (SM); brown to dark gray, wet, medium dense, fine grained		4 11 19	140			
					Total depth = 15.5 feet Groundwater @ 4.0 feet No caving						

DH_REV3 13-160-00.GPJ GMULAB.GPJ 12/2/13

GMU GEOTECHNICAL, INC.

Drill Hole DH-2

Project: Lido House Hotel	Log of Drill Hole DH-3
Project Location: Newport Beach	Sheet 1 of 4
Project Number: 13-160-00	

Date(s) Drilled	10/28/13	Logged By	RLD	Checked By	DRA
Drilling Method	Hollow Stem Auger	Drilling Contractor	2R Drilling	Total Depth of Drill Hole	76.5 feet
Drill Rig Type	CME 75	Diameter(s) of Hole, inches	8	Approx. Surface Elevation, ft MSL	8.5
Groundwater Depth [Elevation], feet	5.0 [3.5]	Sampling Method(s)	Open drive sampler with 6-inch sleeve/SPT	Drill Hole Backfill	Cuttings
Remarks				Driving Method and Drop	140 lb auto hammer

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			GRASS AND SOD		Grass and rootlets						
			DREDGED FILL (Qaf)		SILTY SAND (SM); light brown, damp to moist, medium dense, trace seashells						EI, FC
5					SAND with some SILT (SP); light brown, moist, medium dense, fine grained, trace seashells		3 4 4	140			
	5		**ALLUVIUM (Qal)**		SANDY CLAY (CL); dark brown, wet, soft, fine grained		4 3 2	140	51	64	DS
0					SILTY SAND (SM); dark brown, wet, loose, fine grained, trace rootlets and organics		1 3 5	140			
	10				SILTY SAND (SM); dark brown, wet, medium dense, fine grained		8 14 14	140	28	98	CN, TR
-5	15				SILTY SAND (SM); dark brown, wet, medium dense, fine grained		3 4 4	140	29		PS
-10											

DH_REV3 13-160-00.GPJ GMULAB.GPJ 12/2/13

GMU GEOTECHNICAL, INC.

Project: Lido House Hotel	Log of Drill Hole DH-3
Project Location: Newport Beach	Sheet 2 of 4
Project Number: 13-160-00	

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
					SAND with some SILT (SP); grayish brown, wet, dense, fine grained		5 16 40	140	24	101	
-15											
	25				SILTY SAND (SM); dark gray, wet, medium dense, fine grained		2 4 6	140	26		PS
-20											
	30				No Recovery		7 24 37	140			
-25											
	35				SILTY SAND (SM); dark gray, wet, medium dense, coarse grained		5 12 15	140			
-30											
	40				SAND with some SILT (SP); dark gray, wet, medium dense, coarse grained		6 10 22	140	24		
-35											

DH_REV3 13-160-00.GPJ GMULAB.GPJ 12/2/13

GMU GEOTECHNICAL, INC.

Project: Lido House Hotel	**Log of Drill Hole DH-3**
Project Location: Newport Beach	Sheet 3 of 4
Project Number: 13-160-00	

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
					No Recovery		4 8 15	140			
-40											
	50				No Recovery		5 8 17	140			
-45											
	55				SILTY CLAY (CL); dark brown, wet, stiff, low plasticity		3 6 6	140			
-50											
	60				SILT (MH); dark brown, moist, very stiff, high plasticity		8 21 23	140	45	74	
-55											
	65				SILT (MH); dark brown, moist, very stiff, high plasticity		6 8 11	140	58		PS, HY, AL
-60											

DH_REV3 13-160-00.GPJ GMULAB.GPJ 12/2/13

GMU GEOTECHNICAL, INC.

Project: Lido House Hotel	Log of Drill Hole DH-3
Project Location: Newport Beach	Sheet 4 of 4
Project Number: 13-160-00	

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE	NUMBER OF BLOWS	DRIVING WEIGHT, lbs	MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
					SILT (MH); dark brown, moist, very stiff, high plasticity		12 20 27	140	54	68	
-65											
	75				SILT (MH); dark brown, wet, very stiff, high plasticity		8 15 15	140			
					Total depth = 76.5 feet Groundwater @ 5.0 feet Caving near 15 feet						

DH_REV3 13-160-00.GPJ GMULAB.GPJ 12/2/13

GMU GEOTECHNICAL, INC.

Drill Hole DH-3

Project: Lido House Hotel	Log of Drill Hole DH-4
Project Location: Newport Beach	Sheet 1 of 1
Project Number: 13-160-00	

Date(s) Drilled	10/28/13	Logged By	RLD	Checked By	DRA
Drilling Method	Hollow Stem Auger	Drilling Contractor	2R Drilling	Total Depth of Drill Hole	6.5 feet
Drill Rig Type	CME 75	Diameter(s) of Hole, inches	8	Approx. Surface Elevation, ft MSL	9.5
Groundwater Depth [Elevation], feet	N/A [0.0]	Sampling Method(s)	Open drive sampler with 6-inch sleeve/SPT	Drill Hole Backfill	Cuttings
Remarks				Driving Method and Drop	140 lb auto hammer

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			ASPHALT PAVEMENT		3.5" AC / 2.5" AB						
			DREDGED FILL (Qaf)		SAND with some SILT (SP); tanish brown, moist, medium dense, fine grained, some seashells		7 10 13	140	3	105	CP, DS, FC
5	5				No Recovery		9 3 3	140			
					Total depth = 6.5 feet No groundwater No caving						

DH_REV3 13-160-00.GPJ GMULAB.GPJ 12/2/13

GMU GEOTECHNICAL, INC.

Drill Hole DH-4

Project: Lido House Hotel **Project Location:** Newport Beach **Project Number:** 13-160-00	# Log of Drill Hole DH-5 Sheet 1 of 1

Date(s) Drilled	10/28/13	Logged By	RLD	Checked By	DRA
Drilling Method	Hollow Stem Auger	Drilling Contractor	2R Drilling	Total Depth of Drill Hole	15.5 feet
Drill Rig Type	CME 75	Diameter(s) of Hole, inches	8	Approx. Surface Elevation, ft MSL	8.5
Groundwater Depth [Elevation], feet	5.0 [3.5]	Sampling Method(s)	Open drive sampler with 6-inch sleeve/SPT	Drill Hole Backfill	Cuttings
Remarks	Infiltration Test Hole			Driving Method and Drop	140 lb auto hammer

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			GRASS AND SOD		Grass and rootlets						
			DREDGED FILL (Qaf)		SAND (SP); tan, very moist, medium dense, coarse grained, trace seashells		7 15 12	140	3	104	
5			**ALLUVIUM (Qal)**		SANDY CLAY to SILT (CL-ML); tan to dark brown, wet, soft, coarse grained, low plasticity ∇		3 3 2	140	35	83	
	5										
0					SILTY SAND (SM); dark brown, wet, medium dense, fine grained, trace rootlets		2 4 6	140			
	10				SILTY SAND (SM); dark grayish black, wet, medium dense, fine graines		4 8 16	140	28	96	
-5					SILTY SAND (SM); dark gray, wet, medium dense, fine grained		3 7 10	140			
	15										
					Total depth = 15.5 feet Groundwater @ 5.0 feet No caving						

DH_REV3 13-160-00.GPJ GMULAB.GPJ 12/2/13

GMU GEOTECHNICAL, INC.

Drill Hole DH-5

APPENDIX A-2

CPT Logs and Data by Kehoe
for GMU Geotechnical

GMU
GEOTECHNICAL, INC.

SUMMARY

OF

CONE PENETRATION TEST DATA

Project:

Lido House Hotel
3300 Newport Blvd.
Newport Beach, CA
October 23-24, 2013

Prepared for:

Mr. Dave Atkinson
GMU Geotechnical, Inc.
23241 Arroyo Vista
Rancho Santa Margarita, CA 92688-2611
Office (949) 888-6513 / Fax (949) 888-1380

Prepared by:

KEHOE TESTING & ENGINEERING
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Huntington Beach, CA 92649-1518
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www.kehoetesting.com

TABLE OF CONTENTS

SUMMARY

OF

CONE PENETRATION TEST DATA

1. INTRODUCTION

This report presents the results of a Cone Penetration Test (CPT) program carried out for the Lido House Hotel project located at 3300 Newport Blvd. in Newport Beach, California. The work was performed by Kehoe Testing & Engineering (KTE) on October 23-24, 2013. The scope of work was performed as directed by GMU Geotechnical, Inc. personnel.

2. SUMMARY OF FIELD WORK

The fieldwork consisted of performing CPT soundings at five locations to determine the soil lithology. Groundwater measurements and hole collapse depths provided in **TABLE 2.1** are for information only. The readings indicate the apparent depth to which the hole is open and the apparent water level (if encountered) in the CPT probe hole at the time of measurement upon completion of the CPT. KTE does not warranty the accuracy of the measurements and the reported water levels may not represent the true or stabilized groundwater levels.

LOCATION	DEPTH OF CPT (ft)	COMMENTS/NOTES:
CPT-1	91	Refusal, groundwater @ 6 ft
CPT-2	100	Groundwater @ 6 ft
CPT-3	100	Hole open to 5 ft (dry)
CPT-4	100	Groundwater @ 6 ft
CPT-5	54	Refusal, groundwater @ 6 ft

TABLE 2.1 - Summary of CPT Soundings

3. FIELD EQUIPMENT & PROCEDURES

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

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

At location CPT-3, shear wave measurements were obtained at approximately 5-foot intervals. The shear wave is generated using an air-actuated hammer, which is located inside the front jack of the CPT rig. The cone has a triaxial geophone, which recorded the shear wave signal generated by the air hammer.

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

4. CONE PENETRATION TEST DATA & INTERPRETATION

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

Tables of basic CPT output from the interpretation program CPeT-IT are provided for CPT data averaged over one foot intervals in the Appendix. Spreadsheet files of the averaged basic CPT output and averaged estimated geotechnical parameters are also included for use in further geotechnical analysis. We recommend a geotechnical engineer review the assumed input parameters and the calculated output from the CPeT-IT program. A summary of the equations used for the tabulated parameters is provided in the Appendix.

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

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

Sincerely,

KEHOE TESTING & ENGINEERING

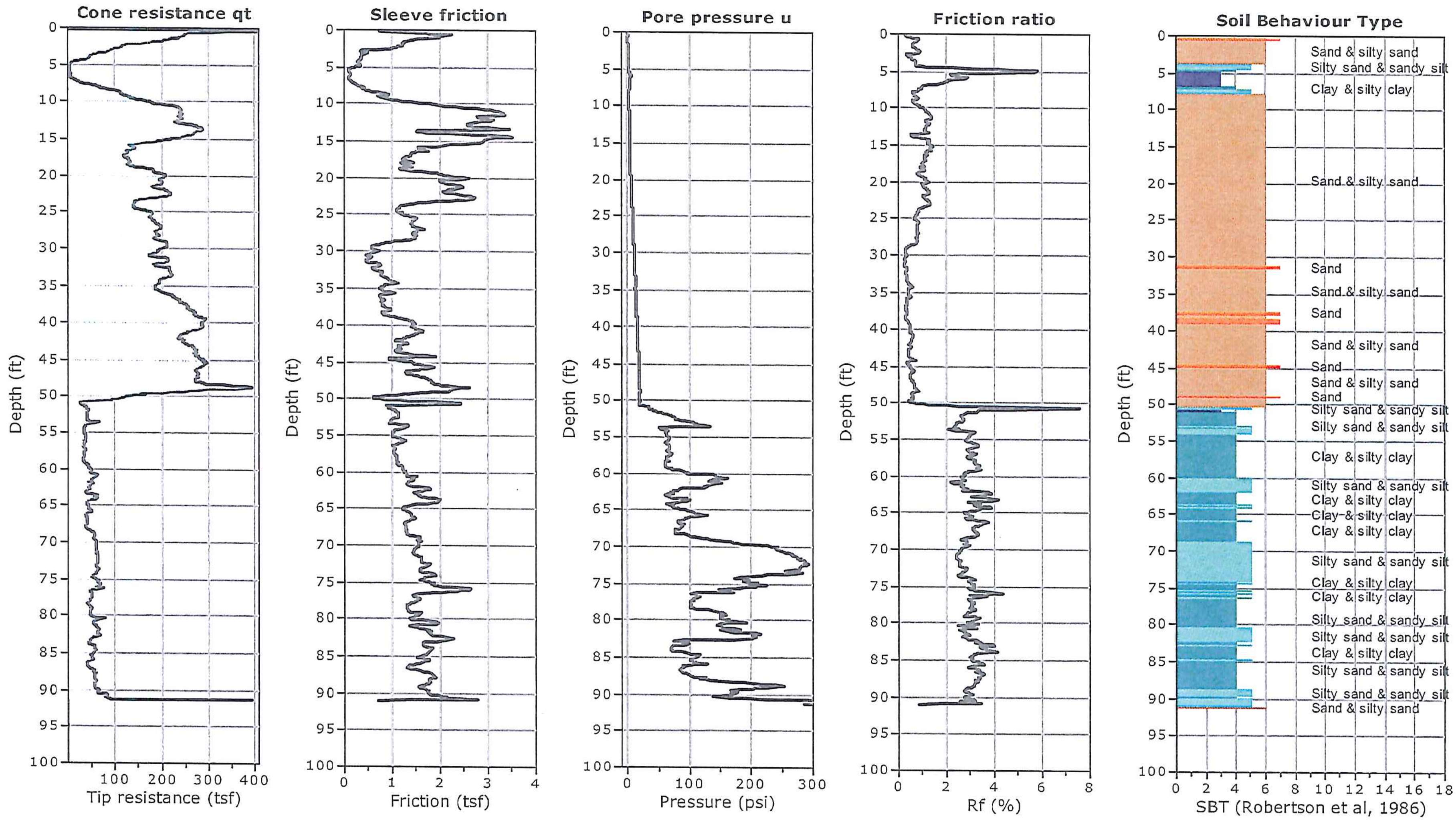
Richard W. Koester, Jr.
General Manager

APPENDIX

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

Project: GMU Geotechnical/Lido House Hotel
Location: 3300 Newport Blvd. Newport Beach, CA

CPT: CPT-1
Total depth: 91.23 ft, Date: 10/23/2013
Cone Type: Vertek



CPeT-IT v.1.7.6.3 - CPTU data presentation & interpretation software - Report created on: 10/24/2013, 7:04:41 AM
Project file: C:\GMUNewportBch10-13\CPeT Data\Plot Data\Plotss.cpt

Kehoe Testing and Engineering
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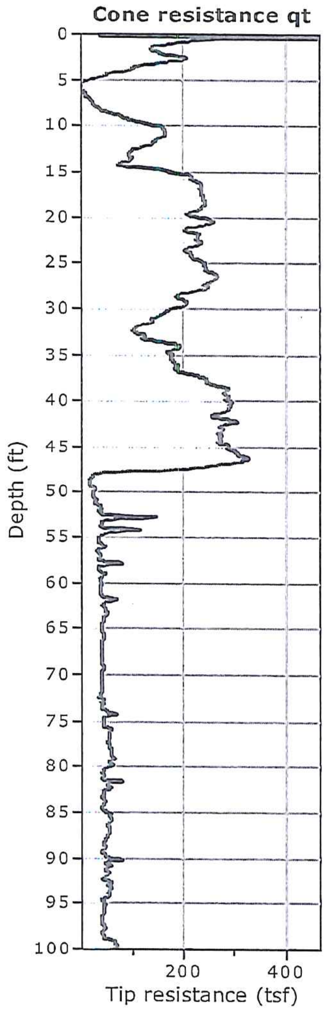
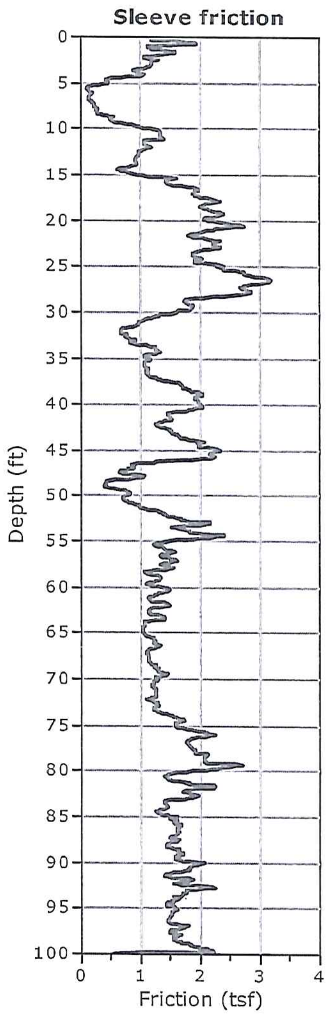
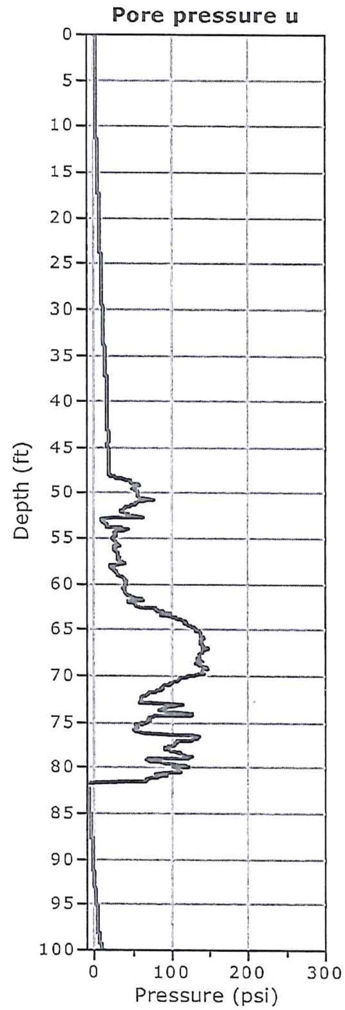
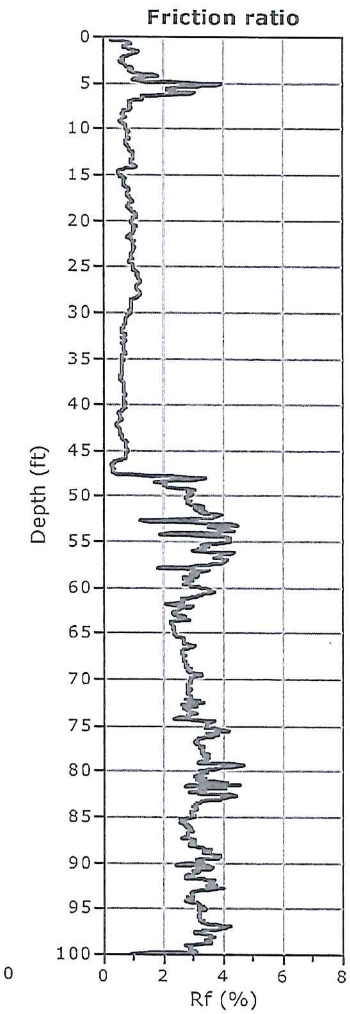
Project: GMU Geotechnical/Lido House Hotel
Location: 3300 Newport Blvd. Newport Beach, CA

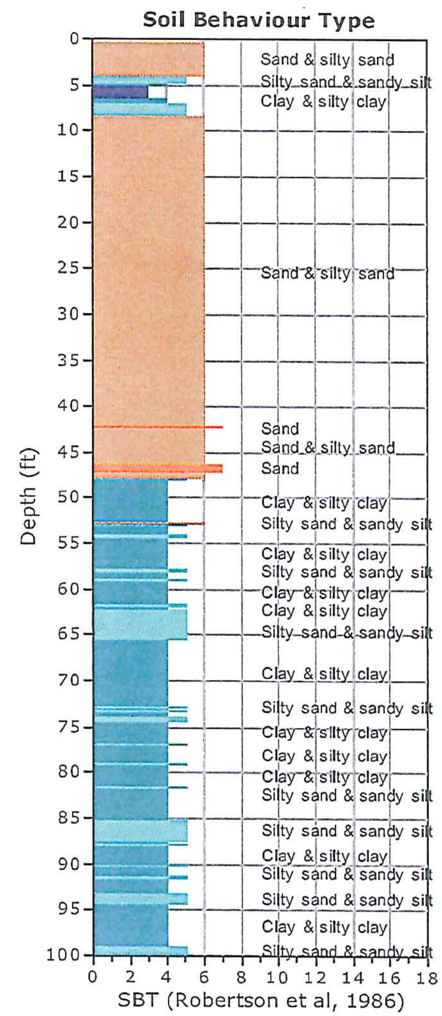
CPT: CPT-2
Total depth: 100.13 ft, Date: 10/23/2013
Cone Type: Vertek











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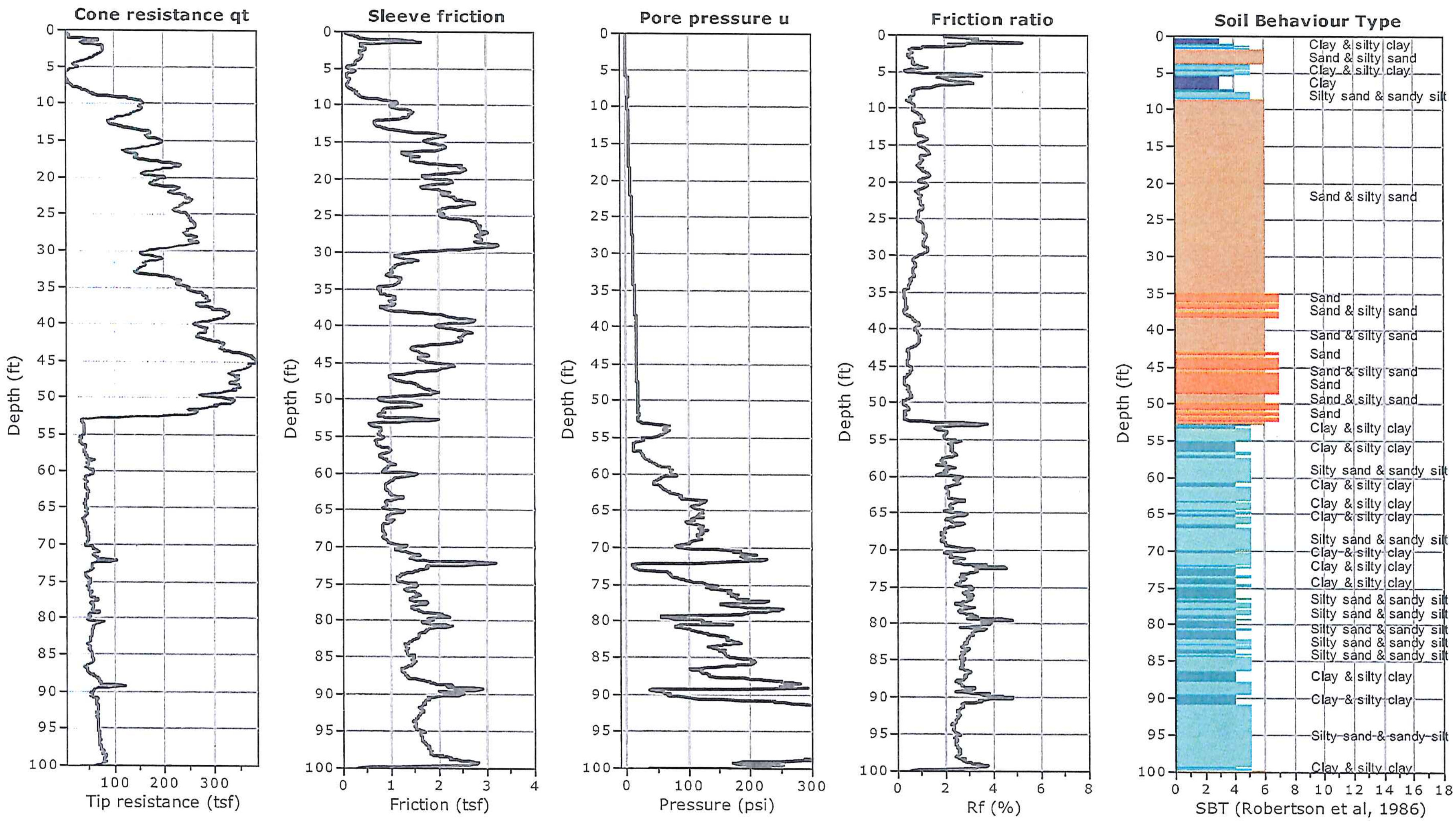
Project: GMU Geotechnical/Lido House Hotel
Location: 3300 Newport Blvd. Newport Beach, CA

CPT: CPT-3
Total depth: 100.07 ft, Date: 10/23/2013
Cone Type: Vertek



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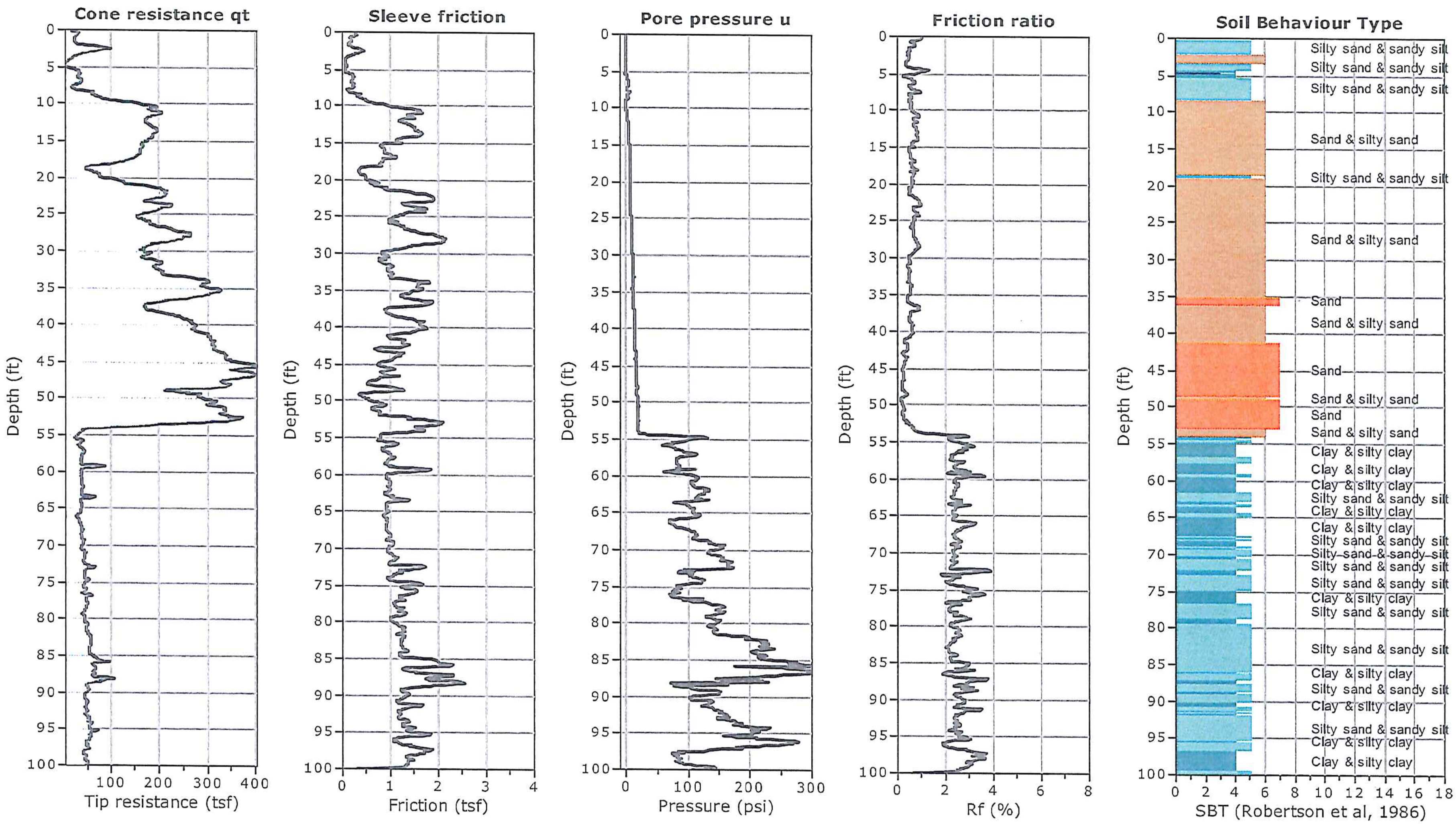
Project: GMU Geotechnical/Lido House Hotel
Location: 3300 Newport Blvd. Newport Beach, CA

CPT: CPT-4
Total depth: 100.19 ft, Date: 10/23/2013
Cone Type: Vertek



CPeT-IT v.1.7.6.3 - CPTU data presentation & interpretation software - Report created on: 10/24/2013, 7:07:31 AM
Project file: C:\GMUNewportBch10-13\CPeT Data\Plot Data\Plotss.cpt

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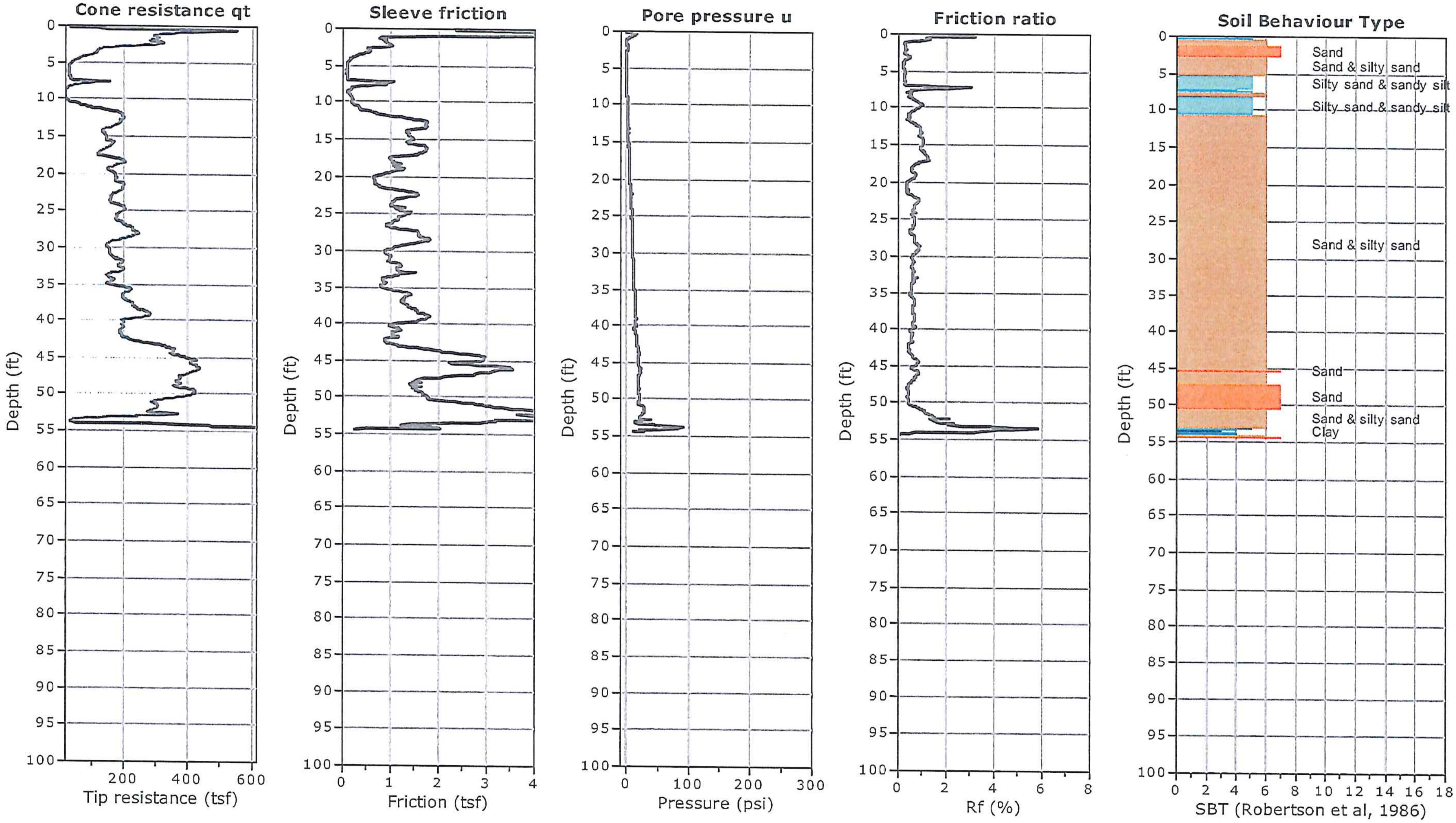
Project: GMU Geotechnical/Lido House Hotel
Location: 3300 Newport Blvd. Newport Beach, CA

CPT: CPT-5
Total depth: 54.46 ft, Date: 10/24/2013
Cone Type: Vertek



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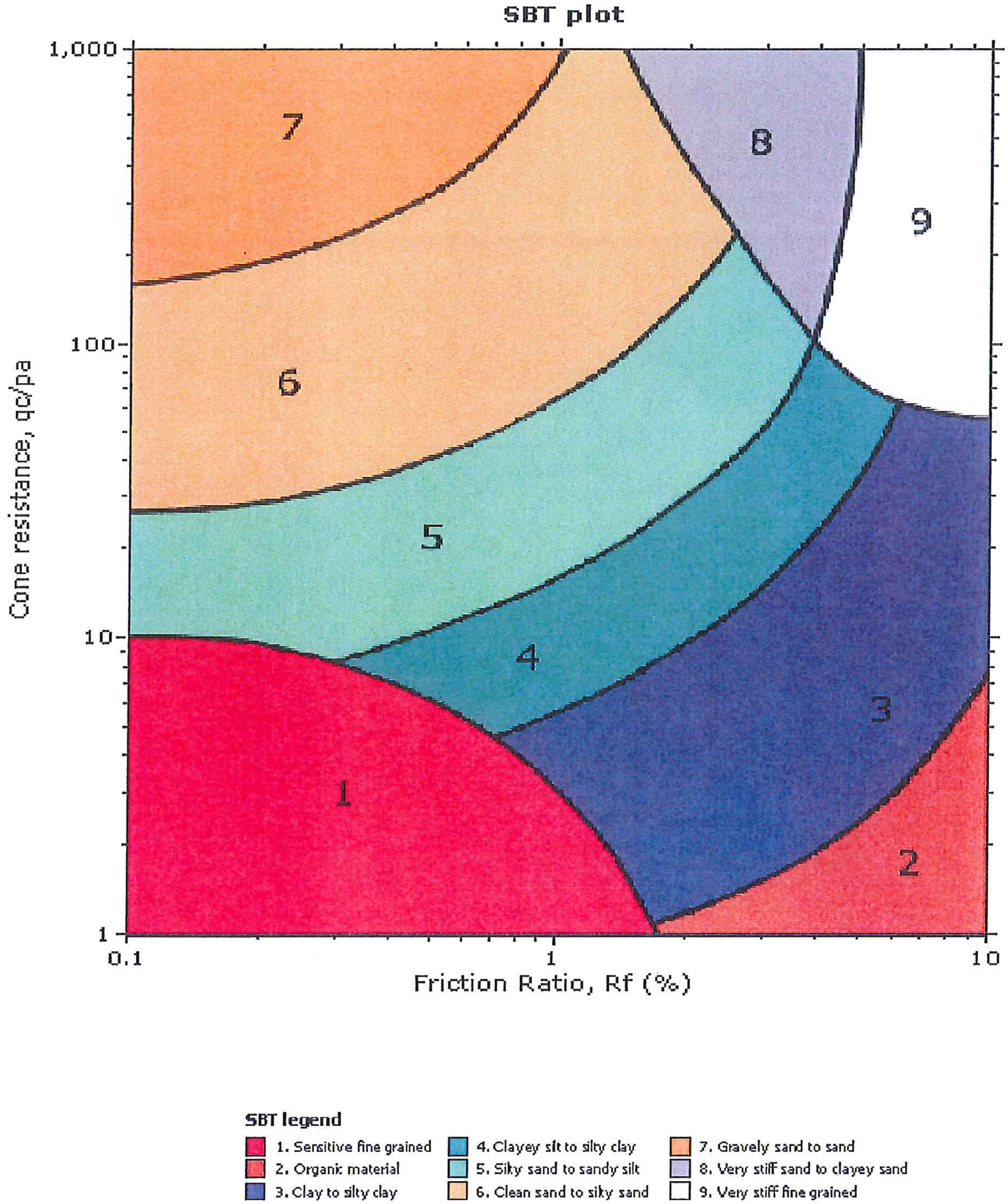


	CPT-1	In situ data										Basic output data								
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	245.4	1.94	0.2	0.79	245.402	0.7905	6	1.57163	128.5418	0.06427	0	0.0643	3817.3	0.7908	6E-05	6	0.3777	2	1.377	463.7299
2	166.1	1.22	0.92	0.74	166.111	0.7345	6	1.67413	124.1961	0.12637	0	0.1264	1313.5	0.735	0.0004	6	0.4117	2	1.4586	313.739
3	87.3	0.34	1.5	0.39	87.3184	0.3894	6	1.75209	113.279	0.18301	0	0.183	476.13	0.3902	0.0012	6	0.4275	2	1.493	164.7003
4	45.3	0.33	1.16	0.72	45.3142	0.7283	5	2.13323	111.4607	0.23874	0	0.2387	188.81	0.7321	0.0019	6	0.5788	2	1.8832	85.20011
5	3.6	0.21	1.67	5.68	3.62044	5.8004	3	3.543	101.9901	0.28973	0	0.2897	11.496	6.305	0.0361	3	1	2	3.3486	6.29559
6	3.9	0.13	6.26	3.16	3.97662	3.2691	3	3.37481	98.70995	0.33909	0	0.3391	10.727	3.5739	0.1239	3	1	2	3.1741	6.87554
7	13.9	0.14	3.47	1.01	13.9425	1.0041	4	2.6488	102.3119	0.39024	0.0312	0.359	37.745	1.033	0.0161	5	0.7824	2	2.4027	25.61596
8	67.4	0.41	2.68	0.6	67.4328	0.608	6	1.9448	114.0185	0.44725	0.0624	0.3849	174.05	0.6121	0.002	6	0.5352	1.7182	1.7517	108.7705
9	113	0.77	2.11	0.68	113.026	0.6813	6	1.78521	119.8896	0.5072	0.0936	0.4136	272.05	0.6843	0.0005	6	0.4904	1.5851	1.6307	168.5591
10	172.8	1.7	2.49	0.99	172.83	0.9836	6	1.74665	126.7204	0.57056	0.1248	0.4458	386.44	0.9869	0.0003	6	0.4886	1.5256	1.6217	248.373
11	239.5	3.21	3.07	1.34	239.538	1.3401	6	1.74881	132.1675	0.63664	0.156	0.4806	497.04	1.3437	0.0003	6	0.4999	1.4836	1.6465	334.9606
12	228.3	2.91	3.59	1.27	228.344	1.2744	6	1.74551	131.3329	0.70231	0.1872	0.5151	441.93	1.2783	0.0003	6	0.5026	1.4359	1.6494	308.9255
13	254.3	2.75	3.96	1.08	254.348	1.0812	6	1.66085	131.1821	0.7679	0.2184	0.5495	461.47	1.0845	0.0003	6	0.4767	1.3666	1.5771	327.515
14	268.2	2.72	4.51	1.01	268.255	1.014	6	1.62464	131.2317	0.83352	0.2496	0.5839	457.98	1.0171	0.0003	6	0.468	1.3208	1.5499	333.807
15	216.8	2.91	4.43	1.34	216.854	1.3419	6	1.77712	131.2069	0.89912	0.2808	0.6183	349.26	1.3475	0.0002	6	0.5276	1.3277	1.702	270.976
16	132.2	1.56	3.71	1.18	132.245	1.1796	6	1.88524	125.4388	0.96184	0.312	0.6498	202.02	1.1883	-3E-04	6	0.568	1.319	1.804	163.6559
17	127.1	1.39	4.39	1.1	127.154	1.0932	6	1.87535	124.4988	1.02409	0.3432	0.6809	185.24	1.102	-2E-04	6	0.5684	1.2847	1.8011	153.1438
18	131.2	1.34	4.59	1.02	131.256	1.0209	6	1.84524	124.3082	1.08624	0.3744	0.7118	182.86	1.0294	-3E-04	6	0.5615	1.2493	1.7794	153.6909
19	165.4	1.33	4.76	0.8	165.458	0.8038	6	1.70111	124.8182	1.14865	0.4056	0.7431	221.13	0.8095	-4E-04	6	0.5127	1.1987	1.6472	186.1361
20	208.4	2.52	5.57	1.21	208.468	1.2088	6	1.7544	130.0579	1.21368	0.4368	0.7769	266.78	1.2159	-2E-04	6	0.5384	1.181	1.7104	231.3179
21	199.5	2.37	6.18	1.19	199.576	1.1875	6	1.76146	129.5025	1.27843	0.468	0.8104	244.68	1.1952	-1E-04	6	0.5448	1.1564	1.7232	216.7136
22	196.6	2.11	6.9	1.07	196.684	1.0728	6	1.73367	128.6167	1.34274	0.4992	0.8435	231.57	1.0802	-1E-05	6	0.5382	1.1297	1.7016	208.5614
23	180.9	2.44	7.04	1.35	180.986	1.3482	6	1.83076	129.477	1.40748	0.5304	0.8771	204.75	1.3587	-1E-04	6	0.579	1.1148	1.804	189.1928
24	140.1	1.16	7.67	0.83	140.194	0.8274	6	1.7638	123.4134	1.46919	0.5616	0.9076	152.85	0.8362	-7E-05	6	0.5568	1.0892	1.7421	142.8003
25	176.3	1.17	8.43	0.66	176.403	0.6633	6	1.62563	124.0365	1.5312	0.5928	0.9384	186.35	0.6691	8E-05	6	0.5081	1.0629	1.6107	175.6648
26	180.3	1.42	8.55	0.79	180.405	0.7871	6	1.667	125.5082	1.59396	0.624	0.97	184.35	0.7941	-5E-05	6	0.5275	1.047	1.6577	176.9253
27	199.1	1.63	9.12	0.82	199.212	0.8182	6	1.6468	126.7592	1.65734	0.6552	1.0021	197.13	0.8251	1E-05	6	0.5234	1.0289	1.643	192.0919
28	189.1	1.57	9.56	0.83	189.217	0.8297	6	1.66723	126.3593	1.72052	0.6864	1.0341	181.31	0.8374	1E-05	6	0.5347	1.0123	1.669	179.3863
29	201.7	0.84	10	0.42	201.822	0.4162	6	1.45585	121.9403	1.78149	0.7176	1.0639	188.03	0.4199	1E-05	6	0.4573	0.9975	1.4621	188.5849
30	196.2	0.72	10.73	0.37	196.331	0.3667	6	1.43488	120.7451	1.84186	0.7488	1.0931	177.93	0.3702	0.0001	6	0.4526	0.9854	1.4459	181.1252
31	174.4	0.51	11.09	0.29	174.536	0.2922	6	1.42804	117.9349	1.90083	0.78	1.1208	154.02	0.2954	0.0001	6	0.4533	0.9742	1.4444	158.9503
32	196.9	0.75	11.29	0.38	197.038	0.3806	6	1.44249	121.0526	1.96135	0.8112	1.1502	169.61	0.3845	1E-05	6	0.4616	0.9622	1.4625	177.3999
33	217.4	0.77	12.28	0.35	217.55	0.3539	6	1.38919	121.4867	2.0221	0.8424	1.1797	182.7	0.3573	0.0002	6	0.444	0.9529	1.4123	194.0891
34	200.1	0.97	12.13	0.48	200.248	0.4844	6	1.49751	122.9741	2.08358	0.8736	1.21	163.77	0.4895	0	6	0.489	0.9365	1.5267	175.3933
35	186.8	0.76	12.1	0.41	186.948	0.4065	6	1.47738	121.0213	2.14409	0.9048	1.2393	149.12	0.4113	-2E-04	6	0.4846	0.9263	1.512	161.7761
36	203	0.71	13.49	0.35	203.165	0.3495	6	1.41103	120.7262	2.20446	0.936	1.2685	158.43	0.3533	0.0002	6	0.4617	0.9197	1.4483	174.671
37	235.2	0.78	13.55	0.33	235.366	0.3314	6	1.34491	121.7731	2.26534	0.9672	1.2981	179.56	0.3346	4E-05	6	0.4384	0.9143	1.3834	201.4117
38	249	0.96	13.55	0.39	249.166	0.3853	6	1.36198	123.4313	2.32706	0.9984	1.3287	185.78	0.3889	-9E-05	6	0.4476	0.9031	1.4036	210.6815
39	271.7	1.16	15.1	0.43	271.885	0.4267	6	1.35887	125.0289	2.38957	1.0296	1.36	198.16	0.4304	0.0002	6	0.4487	0.8935	1.4027	227.5671
40	285.8	1.41	15.89	0.49	285.994	0.493	6	1.38243	126.5803	2.45286	1.0608	1.3921	203.68	0.4973	0.0003	6	0.4604	0.8814	1.4294	236.1791
41	263.6	1.56	15.67	0.59	263.792	0.5914	6	1.4614	127.1229	2.51643	1.092	1.4244	183.43	0.5971	0.0001	6	0.4945	0.8633	1.5148	213.1709
42	235.5	1.08	16.02	0.46	235.696	0.4582	6	1.42673	124.1576	2.5785	1.1232	1.4553	160.18	0.4633	0.0001	6	0.4853	0.8567	1.4868	188.7423
43	256.3	1.12	16.51	0.43	256.502	0.4366	6	1.38492	124.63	2.64082	1.1544	1.4864	170.79	0.4412	0.0001	6	0.4714	0.852	1.4464	204.4035
44	270.5	1.48	17.38	0.55	270.713	0.5467	6	1.4301	126.8009	2.70422	1.1856	1.5186	176.48	0.5522	0.0003	6	0.4912	0.8374	1.4944	212.1024
45	291.4	1.43	17.51	0.49	291.614	0.4904	6	1.37455	126.7308	2.76759	1.2168	1.5508	186.26	0.4951	0.0002	6	0.472	0.8349	1.44	227.9172
46	264.1	1.54	18.04	0.58	264.321	0.5826	6	1.45638	127.0334	2.8311	1.248	1.5831	165.18	0.5889	0.0002	6	0.5076	0.815	1.5296	201.4186
47	274.8	1.66	18.79	0.61	275.03	0.6036	6	1.45423	127.6793	2.89494	1.2792	1.6157	168.43	0.61	0.0003	6	0.5094	0.806	1.53	207.3064
48	279.2	1.97	18.32	0.7	279.424	0.705	6	1.49664	128.9707	2.95943	1.3104	1.649	167.65	0.7126	3E-05	6	0.5285	0.791	1.5762	206.664
49	303.4	1.86	18.49	0.61	303.626	0.6126	6	1.42791	128.7529	3.0238	1.3416	1.6822	178.7	0.6188	-3E-05	6	0.504	0.7916	1.5077	224.8956
50	120	0.63	19.81	0.52	120.242	0.5239	6	1.69794	118.5723	3.08309	1.3728	1.7103	68.503	0.5377	0.0005	6	0.6257	0.7405	1.8236	81.99006
51	25.5	0.85	34.87	3.27	25.9268	3.2785	4	2.70965	117.0218	3.1416	1.404	1.7376	13.113	3.7305	0.0486	3	1	0.609	2.957	13.11303
52	41.6	1.13	67.01	2.66	42.4202	2.6638	4	2.48862	120.3061	3.20175	1.4352	1.7666	22.201	2.8813	0.0864	4	0.9627	0.6105	2.7011	22.62868
53	39.1	0.97	105.4	2.38	40.3901	2.4016	4	2.4753	119.0693	3.26129	1.4664	1.7949	20.686	2.6125	0.1649	4	0.9633	0.6011	2.6991	21.09073
54	38.9	1.25	52.09	3.15	39.5376	3.1616	4	2.56098	120.8729	3.32172	1.4976	1.8241	19.854	3.4515	0.0622	4	1	0.5801	2.7944	19.85383
55	33.9	0.99	68.1	2.84	34.7335	2.8503	4	2.57342	118.8507	3.38115	1.5288	1.8524	16.926	3.1577	0.1076	4	1	0.5712	2.825	16.92574
56	34.9	1.19	65.53	3.33	35.7021	3.3331	4	2.60927	120.2641	3.44128	1.56	1.8813	17.148	3.6887	0.0979	3	1	0.5624	2.8621	17.14831
57	31.1	1.03	61.88	3.23	31.8574	3.2332	4	2.63761	118.9297	3.50075	1.5912	1.9096	14.85	3.6323	0.101	3	1	0.5541	2.9071	14.84994
58	33.9	1.1	59.72	3.17	34.631	3.1764	4	2.60525	119.6144	3.56055	1.6224	1.9382	16.031	3.5403	0.0862	3	1	0.5459	2.874	16.03093
59	32.7	1.12	60.24	3.35	33.4373	3.3496	4	2.63193	119.6607	3.62038	1.6536	1.9668	15.16	3.7563	0.09	3	1	0.538	2.909	15.16025
60	43.8	1.24	98.67	2.74	45.0077	2.7551	4	2.47916	121.1302	3.68095	1.6848	1.9962	20.703	3.0005	0.1311	4	0.9882	0.5341	2.7397	20.85847
61	51	1.44	115.82	2.73	52.4176	2.7472	5	2.42955	122.596	3.74225	1.716	2.0263	24.022	2.9584	0.1361	4	0.9674	0.5334	2.6808	24.53747
62	50.8	1.44	114.21	2.76	52.1979	2.7587	5	2.43213	122.5858	3.80354	1.7472	2.0563	23.534	2.9756	0.1338	4	0.9724	0.5241	2.6903	23.97053
63	38.8	1.6	61.66	4.04	39.5547	4.045	4	2.63392	122.6802	3.86488	1.7784	2.0865	17.105	4.4831	0.0746	3	1	0.5071	2.9166	17.10528
64	59.4	1.9	72.82	3.15	60.2913	3.1514	4	2.42734	124.9657	3.92736	1.8096	2.1178	26.615	3.371	0.0609	4	0.9728	0.5092	2.6838	27.12223
65	43.3	1.18	94.81	2.65	44.4605	2.654	4	2.47229	120.7375	3.98773	1.8408	2.1469	18.851	2.9155	0.1232	4	1	0.4929	2.7667	18.85143

66	41.9	1.41	87.95	3.27	42.9765	3.2809	4	2.54521	121.9576	4.04871	1.872	2.1767	17.884	3.6221	0.1146	3	1	0.4861	2.8429	17.88377
67	38.4	1.23	87.3	3.11	39.4686	3.1164	4	2.55736	120.7506	4.10909	1.9032	2.2059	16.03	3.4786	0.1239	3	1	0.4797	2.8693	16.02959
68	37.4	1.29	76.9	3.36	38.3413	3.3645	4	2.58904	121.0284	4.1696	1.9344	2.2352	15.288	3.7751	0.1054	3	1	0.4734	2.9074	15.28796
69	53.9	1.57	134.76	2.82	55.5495	2.8263	5	2.4197	123.37	4.23129	1.9656	2.2657	22.65	3.0593	0.1508	4	0.9922	0.4698	2.715	22.7844
70	56.3	1.55	243.26	2.6	59.2775	2.6148	5	2.37598	123.4346	4.293	1.9968	2.2962	23.946	2.819	0.2822	4	0.9758	0.4695	2.6696	24.39848
71	55.5	1.43	265.49	2.41	58.7496	2.4341	5	2.35749	122.8232	4.35441	2.028	2.3264	23.382	2.6289	0.3141	4	0.9729	0.4647	2.658	23.88671
72	59.7	1.6	286.97	2.52	63.2125	2.5311	5	2.34603	123.8237	4.41633	2.0592	2.3571	24.944	2.7213	0.3164	4	0.9691	0.4602	2.6441	25.56936
73	56.9	1.66	279.34	2.72	60.3191	2.752	5	2.3859	123.9788	4.47832	2.0904	2.3879	23.385	2.9727	0.3227	4	0.9909	0.4464	2.6959	23.55817
74	56.4	1.9	194.17	3.21	58.7766	3.2326	4	2.44297	124.9037	4.54077	2.1216	2.4192	22.419	3.5032	0.2187	4	1	0.4374	2.7577	22.41923
75	55.5	1.77	200.36	3.03	57.9524	3.0542	5	2.42995	124.3506	4.60294	2.1528	2.4501	21.774	3.3178	0.2301	4	1	0.4319	2.7525	21.77402
76	56.6	2.51	144.11	4.28	58.3639	4.3006	4	2.53434	126.9237	4.6664	2.184	2.4824	21.631	4.6743	0.1526	3	1	0.4262	2.8511	21.63124
77	48.1	1.43	103.3	2.9	49.3644	2.8968	4	2.46432	122.3987	4.7276	2.2152	2.5124	17.767	3.2036	0.117	4	1	0.4212	2.8121	17.76656
78	44.6	1.36	102.35	2.96	45.8528	2.966	4	2.49478	121.8515	4.78853	2.2464	2.5421	16.153	3.3119	0.1248	3	1	0.4162	2.8537	16.15348
79	47.3	1.28	153.68	2.6	49.181	2.6026	5	2.43401	121.5788	4.84932	2.2776	2.5717	17.238	2.8873	0.1982	4	1	0.4114	2.7951	17.23817
80	46.2	1.37	162.38	2.83	48.1875	2.8431	4	2.46646	122.0262	4.91033	2.3088	2.6015	16.635	3.1656	0.2168	3	1	0.4067	2.8316	16.63527
81	50.7	1.34	153.79	2.53	52.5824	2.5484	5	2.40639	122.0771	4.97137	2.34	2.6314	18.094	2.8145	0.1834	4	1	0.4021	2.7716	18.09362
82	61.5	1.78	207.25	2.77	64.0367	2.7797	5	2.37035	124.6353	5.03369	2.3712	2.6625	22.161	3.0168	0.2127	4	1	0.3974	2.7206	22.16087
83	47.9	1.95	93.76	3.96	49.0476	3.9757	4	2.5621	124.6524	5.09601	2.4024	2.6936	16.317	4.4367	0.0989	3	1	0.3928	2.9294	16.31696
84	53.2	1.81	69.26	3.34	54.0477	3.3489	4	2.47961	124.344	5.15819	2.4336	2.7246	17.944	3.7022	0.0522	3	1	0.3884	2.8477	17.94384
85	50.7	1.59	109.03	3.05	52.0345	3.0557	4	2.46364	123.3032	5.21984	2.4648	2.755	16.992	3.3964	0.115	3	1	0.3841	2.843	16.99239
86	47.2	1.5	111.71	3.07	48.5673	3.0885	4	2.48853	122.7087	5.28119	2.496	2.7852	15.542	3.4653	0.1282	3	1	0.3799	2.8789	15.54152
87	44.4	1.61	87.92	3.52	45.4761	3.5403	4	2.55013	123.0661	5.34273	2.5272	2.8155	14.254	4.0116	0.0948	3	1	0.3758	2.9476	14.25432
88	53.9	1.82	113.19	3.29	55.2855	3.292	4	2.46739	124.4395	5.40495	2.5584	2.8466	17.523	3.6487	0.1121	3	1	0.3717	2.8518	17.52317
89	54.7	1.56	231.04	2.7	57.5279	2.7117	5	2.3963	123.4086	5.46665	2.5896	2.8771	18.095	2.9965	0.2698	4	1	0.3678	2.7881	18.09537
90	61.7	1.7	167.7	2.66	63.7527	2.6666	5	2.3591	124.288	5.52879	2.6208	2.908	20.022	2.9198	0.1624	4	1	0.3639	2.7464	20.022
91	71.3	0	308.76	0	75.0792	0	0	0	769.6	5.91359	2.652	3.2616	21.206	0	0.2831	0	1	0.3244	0	0

CPT-2 In situ data — Basic output data

Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ā (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	177.9	0.96	0.72	0.54	177.909	0.5396	6	1.56678	122.6098	0.0613	0	0.0613	2901	0.5398	0.0003	6	0.3636	2	1.3405	336.1614
2	154.5	1.27	0.96	0.82	154.512	0.8219	6	1.72985	124.3135	0.12346	0	0.1235	1250.5	0.8226	0.0005	6	0.4335	2	1.5161	291.8195
3	170.1	1.18	1.04	0.7	170.113	0.6937	6	1.65021	124.0102	0.18547	0	0.1855	916.21	0.6944	0.0004	6	0.4049	2	1.4335	321.1908
4	83.5	1.05	0.95	1.26	83.5116	1.2573	5	2.05294	121.4209	0.24618	0	0.2462	338.23	1.261	0.0008	6	0.5605	2	1.8344	157.3855
5	14.7	0.44	0.64	3.03	14.7078	2.9916	3	2.8794	110.8212	0.30159	0	0.3016	47.768	3.0542	0.0032	4	0.8757	2	2.6548	27.2302
6	5.9	0.15	1.75	2.52	5.92142	2.5332	3	3.16956	100.7281	0.35195	0	0.352	15.825	2.6933	0.0226	3	0.9914	2	2.9521	10.52722
7	17.2	0.16	1.99	0.92	17.2244	0.9289	5	2.55178	103.8046	0.40385	0.0312	0.3727	45.137	0.9512	0.0067	5	0.7454	2	2.3038	31.79355
8	33.8	0.29	1.83	0.85	33.8224	0.8574	5	2.27868	109.8019	0.45876	0.0624	0.3964	84.176	0.8692	0.0021	6	0.6517	1.8963	2.0521	59.79356
9	81	0.49	1.99	0.61	81.0244	0.6048	6	1.87571	115.7706	0.51664	0.0936	0.423	190.31	0.6086	0.0006	6	0.5203	1.6112	1.708	122.5894
10	151.7	1.13	2.38	0.75	151.729	0.7448	6	1.70812	123.4145	0.57835	0.1248	0.4536	333.26	0.7476	0.0003	6	0.4732	1.4932	1.5805	213.2963
11	165.6	1.37	2.66	0.83	165.633	0.8271	6	1.709	125.0376	0.64087	0.156	0.4849	340.28	0.8303	0.0002	6	0.4798	1.4542	1.5937	226.7463
12	137.2	1.16	3.25	0.85	137.24	0.8452	6	1.77684	123.3614	0.70255	0.1872	0.5154	264.94	0.8496	0.0003	6	0.5073	1.4405	1.6621	185.8738
13	96.8	0.95	3.51	0.98	96.843	0.981	6	1.93483	121.0498	0.76307	0.2184	0.5447	176.4	0.9888	0.0004	6	0.567	1.4572	1.8151	132.3223
14	78.8	0.85	3.59	1.08	78.8439	1.0781	6	2.03027	119.7345	0.82294	0.2496	0.5733	136.08	1.0895	0.0001	6	0.6056	1.4493	1.9125	106.864
15	174	1	3.73	0.57	174.046	0.5746	6	1.591	122.8549	0.88437	0.2808	0.6036	286.9	0.5775	-7E-05	6	0.4531	1.2896	1.5086	211.0512
16	226.3	1.46	4.39	0.65	226.354	0.645	6	1.53591	126.2649	0.9475	0.312	0.6355	354.69	0.6477	2E-05	6	0.4391	1.2509	1.4678	266.481
17	234.7	1.9	5.02	0.81	234.761	0.8093	6	1.59243	128.2812	1.01164	0.3432	0.6684	349.69	0.8128	8E-05	6	0.4648	1.238	1.5311	273.4906
18	239	2	5.56	0.84	239.068	0.8366	6	1.59712	128.7009	1.07599	0.3744	0.7016	339.22	0.8404	0.0001	6	0.4707	1.2134	1.5424	272.9197
19	235.9	2.22	6.12	0.94	235.975	0.9408	6	1.63785	129.4327	1.14071	0.4056	0.7351	319.46	0.9454	0.0002	6	0.49	1.1954	1.5887	265.3027
20	229	2.1	6.44	0.92	229.079	0.9167	6	1.63856	128.9538	1.20518	0.4368	0.7684	296.56	0.9216	0.0001	6	0.494	1.1712	1.595	252.2352
21	227.7	2.23	6.78	0.98	227.783	0.979	6	1.66096	129.3794	1.26987	0.468	0.8019	282.48	0.9845	9E-05	6	0.5063	1.1507	1.6233	246.3422
22	225.1	2.11	6.78	0.94	225.183	0.937	6	1.65058	128.9467	1.33435	0.4992	0.8352	268.04	0.9426	-5E-05	6	0.5062	1.1272	1.6187	238.4746
23	226	2.3	7.18	1.02	226.088	1.0173	6	1.67535	129.5874	1.39914	0.5304	0.8687	258.64	1.0236	-6E-05	6	0.5194	1.1079	1.6492	235.2515
24	215.4	1.96	7.59	0.91	215.493	0.9095	6	1.65462	128.2999	1.46329	0.5616	0.9017	237.36	0.9158	-7E-05	6	0.5153	1.0859	1.6339	219.6554
25	241.5	2.3	8.22	0.95	241.601	0.952	6	1.63462	129.7492	1.52816	0.5928	0.9354	256.66	0.958	0	6	0.5115	1.0651	1.62	241.6594
26	255.5	2.81	8.37	1.1	255.602	1.0994	6	1.66492	131.352	1.59384	0.624	0.9698	261.91	1.1063	-8E-05	6	0.5267	1.047	1.6558	251.3302
27	251.4	2.75	8.93	1.09	251.509	1.0934	6	1.66773	131.1547	1.65942	0.6552	1.0042	248.8	1.1007	-5E-05	6	0.5314	1.0282	1.6639	242.7802
28	227	2.78	9.41	1.22	227.115	1.2241	6	1.73379	130.9853	1.72491	0.6864	1.0385	217.03	1.2334	-4E-05	6	0.5603	1.0105	1.7355	215.2555
29	197.3	1.75	9.7	0.89	197.419	0.8864	6	1.67372	127.257	1.78854	0.7176	1.0709	182.67	0.8945	-1E-04	6	0.5412	0.9935	1.6813	183.6846
30	178.3	1.61	10.05	0.9	178.423	0.9024	6	1.71078	126.4001	1.85174	0.7488	1.1029	160.09	0.9118	-1E-04	6	0.5592	0.9771	1.7245	163.047
31	137.4	0.98	10.36	0.71	137.527	0.7126	6	1.72919	122.1327	1.91281	0.78	1.1328	119.72	0.7226	-3E-04	6	0.5707	0.9618	1.751	123.2728
32	109.7	0.68	10.74	0.62	109.831	0.6191	6	1.77123	118.9102	1.97226	0.8112	1.1611	92.897	0.6305	-4E-04	6	0.5914	0.9466	1.8018	96.48915
33	123.8	0.89	11.49	0.72	123.941	0.7181	6	1.76687	121.1742	2.03285	0.8424	1.1905	102.4	0.7301	-1E-04	6	0.5926	0.9326	1.8011	107.442
34	190.8	1.22	12.56	0.64	190.954	0.6389	6	1.58882	124.536	2.09512	0.8736	1.2215	154.61	0.646	0.0002	6	0.5254	0.9273	1.6207	165.5158
35	178.4	1.13	13.24	0.63	178.562	0.6328	6	1.60855	123.8117	2.15702	0.9048	1.2522	140.87	0.6406	0.0003	6	0.5367	0.9136	1.6465	152.3073
36	185.9	1.08	13.79	0.58	186.069	0.5804	6	1.571	123.581	2.21881	0.936	1.2828	143.32	0.5874	0.0003	6	0.5251	0.9038	1.6128	157.0429
37	208.1	1.19	14.33	0.57	208.275	0.5714	6	1.52875	124.5656	2.28109	0.9672	1.3139	156.78	0.5777	0.0003	6	0.5113	0.8952	1.5728	174.2793
38	247.5	1.69	14.92	0.68	247.683	0.6823	6	1.52391	127.5549	2.34487	0.9984	1.3465	182.21	0.6889	0.0003	6	0.5114	0.8841	1.5688	204.9798
39	280.1	2.01	15.64	0.72	280.291	0.7171	6	1.50098	129.1254	2.40944	1.0296	1.3798	201.39	0.7233	0.0004	6	0.5048	0.8746	1.5474	229.6833
40	289	1.9	16.33	0.66	289.2	0.657	6	1.46434	128.7899	2.47383	1.0608	1.413	202.92	0.6627	0.0004	6	0.4936	0.8669	1.514	234.9235
41	284.4	1.44	16.61	0.51	284.603	0.506	6	1.39148	126.7225	2.53719	1.092	1.4452	195.18	0.5105	0.0004	6	0.4689	0.864	1.445	230.3226
42	289.1	1.29	16.15	0.45	289.298	0.4459	6	1.35021	125.9575	2.60017	1.1232	1.477	194.11	0.45	0.0001	6	0.4559	0.859	1.4069	232.7376
43	272.7	1.49	16.78	0.55	272.905	0.546	6	1.42711	126.8698	2.6636	1.1544	1.5092	179.06	0.5514	0.0002	6	0.489	0.8406	1.4899	214.6877
44	267.8	2.05	17.47	0.77	268.014	0.7649	6	1.53463	129.1603	2.72819	1.1856	1.5426	171.97	0.7728	0.0003	6	0.5336	0.8178	1.6029	205.0311
45	284.5	2.3	17.18	0.81	284.71	0.8078	6	1.53386	130.1497	2.79326	1.2168	1.5765	178.83	0.8158	7E-05	6	0.5358	0.8077	1.6043	215.1895
46	308.3	1.83	18.27	0.59	308.524	0.5932	6	1.41311	128.673	2.8576	1.248	1.6096	189.9	0.5987	0.0002	6	0.4915	0.8137	1.4839	235.0589
47	257.6	0.81	18.33	0.31	257.824	0.3142	7	1.2991	122.2715	2.91873	1.2792	1.6395	155.47	0.3178	0.0002	6	0.4528	0.8201	1.3785	197.5732
48	30.4	0.98	19.07	3.19	30.6334	3.1991	4	2.64748	118.47	2.97797	1.3104	1.6676	16.584	3.5436	0.0023	3	1	0.6345	2.8627	16.58431
49	18.1	0.43	54.92	2.25	18.7722	2.2906	4	2.72565	111.2481	3.03359	1.3416	1.692	9.3018	2.7321	0.166	3	1	0.6254	3.0002	9.30184
50	25.5	0.72	55.22	2.72	26.1759	2.7506	4	2.65821	115.8306	3.09151	1.3728	1.7187	13.431	3.119	0.1128	3	1	0.6156	2.9021	13.43126
51	28.9	0.98	47.13	3.31	29.4769	3.3246	4	2.67105	118.3761	3.15069	1.404	1.7467	15.072	3.7225	0.0756	3	1	0.6058	2.9085	15.072
52	34.7	1.38	31.38	3.93	35.0841	3.9334	4	2.66339	121.3054	3.21135	1.4352	1.7762	17.945	4.3297	0.0259	3	1	0.5957	2.8909	17.94488
53	61.1	2.15	8.2	3.5	61.2004	3.5131	4	2.45645	125.9067	3.2743	1.4664	1.8079	32.041	3.7116	-0.015	4	0.9444	0.603	2.6477	33.00857
54	59.7	1.74	40.04	2.88	60.1901	2.8908	5	2.40148	124.3179	3.33646	1.4976	1.8389	30.918	3.0605	0.0244	4	0.9279	0.5988	2.6002	32.17485
55	33.9	1.43	22.49	4.19	34.1753	4.1843	4	2.69005	121.5018	3.39721	1.5288	1.8684	16.473	4.6462	0.0029	3	1	0.5663	2.9391	16.47286
56	48.5	1.57	26.69	3.22	48.8267	3.2155	4	2.49891	123.0554	3.45874	1.56	1.8987	23.894	3.4606	0.008	4	0.9796	0.5639	2.7292	24.17996
57	39.3	1.61	30.53	4.05	39.6737	4.0581	4	2.63395	122.7332	3.5201	1.5912	1.9289	18.743	4.4532	0.0168	3	1	0.5486	2.8844	18.74306
58	53.8	1.48	17.92	2.74	54.0193	2.7398	5	2.41921	122.8699	3.58154	1.6224	1.9591	25.745	2.9343	-0.007	4	0.9536	0.5558	2.6528	26.49192
59	50.1	1.34	28.88	2.64	50.4535	2.6559	5	2.43175	121.9763	3.64253	1.6536	1.9889	23.536	2.8626	0.0091	4	0.9647	0.544	2.6784	24.06655
60	41.7	1.38	42.39	3.27	42.2189	3.2687	4	2.54976	121.7569	3.70341	1.6848	2.0186	19.08	3.583	0.0355	3	1	0.5242	2.8181	19.08022
61	38.5	1.17	41.81	3	39.0118	2.9991	4	2.54999	120.3563	3.76358	1.716	2.0476	17.215	3.3193	0.0367	3	1	0.5168	2.8324	17.21451
62	55.2	1.47	40.2	2.63	55.6921	2.6395	5	2.39848	122.8947	3.82503	1.7472	2.0778	24.962	2.8342	0.0221	4	0.9597	0.5233	2.6541	25.65056
63	47.7	1.18	86.42	2.42	48.7578	2.4201	5	2.41572	120.9625	3.88551	1.7784	2.1071	21.296	2.6297	0.099	4	0.9752	0.5108	2.6916	21.6619
64	45.6	1.06	117.6	2.25	47.0394	2.2534	5	2.40703	120.0903	3.94556	1.8096	2.136	20.175	2.4598	0.1545	4	0.9772	0.5034	2.6931	20.50127
65	41.8	1.04	131.89	2.39	43.4143	2.3955	5	2.45074	119.7553	4.00544	1.8408	2.1646	18.206	2.639	0.1943	4	1	0.4888	2.7527	18.20579
66	43.6	1.22	139.52	2.67	45.3077	2.6927	4	2.47036	121.0274	4.06595	1.872	2.194	18.798	2.9582	0.1982	4	1	0.4823	2.7716	18.79796
67	40.3	1.09	147.24	2.56	42.1022	2.5889	4	2.48291	120.024	4.12596	1.9032	2.2228	17.085	2.8702	0.229	4	1	0.476	2.7967	17.08517
68	40	1.12	135.02	2.69	41.6526	2.6889	4	2.49726	120.1965	4.18606	1.9344	2.2517	16.64	2.9893	0.2078	4	1	0.4699	2.8164	16.63954
69	43.8	1.27	143.4	2.77	45.5552	2.7878	4	2.4787	121.3346	4.24673	1.9656	2.2811	18.109	3.0744	0.2024	4	1	0.4639	2.7946	18.10881
70	41.5	1.26	121.08	2.92	42.982	2.9315	4	2.51207	121.1349	4.30729	1.9968	2.3105	16.739	3.2579	0.1738	3	1	0.458	2.8371	16.73872
71	41.9	1.24	91.54	2.87	43.0205	2.8824	4	2.50686	121.02	4.3678	2.028	2.3398	16.52	3.2081	0.1181	3	1	0.4522	2.8375	16.5196
72	40.1	1.17	68	2.85	40.9323	2.8584	4	2.52053	120.4735	4.42804	2.0592	2.3688	15.41	3.2051	0.0777	3	1	0.4467	2.8613	15.41018
73	39.4	1.24	89.39	3.06	40.4941	3.0622	4	2.54398	120.8724	4.48848	2.0904	2.3981	15.014	3.4439	0.1207	3	1	0.4412	2.8892	15.01438
74	53	1.54	119.1	2.82	54.4578	2.8279	5	2.42611	123.1804	4.55007	2.1216	2.4285	20.551	3.0857	0.1293	4	1	0.4357	2.7523	20.55111
75	45.2	1.58	63.84	3.43	45.9814	3.4362	4	2.53768	122.9554	4.61155	2.1528	2.4588	16.826	3.8192	0.0591	3	1	0.4303	2.878	16.8256
76	58.1	2.29	50.78	3.89	58.7216	3.8998	4	2.5016	126.2674	4.67468	2.184	2.4907	21.7	4.2371	0.0272	3	1	0.4248	2.822	21.69965
77	55.6	1.79	111.07	3.14	56.9595	3.1426	4	2.44399	124.3907	4.73687	2.2152	2.5217	20.71	3.4276	0.1107	4	1	0.4196	2.7783	20.7095
78	58.7	2.05	93.66	3.41	59.8464	3.4254	4	2.45536	125.5036	4.79963	2.2464	2.5532	21.56	3.7241	0.0817	4	1	0.4144	2.7878	21.55969
79	64.8	2.09	75.34	3.17	65.7222	3.1801	5	2.40385	125.8735	4.86256	2.2776	2.585	23.544	3.4341	0.0517	4	1	0.4093	2.7359	23.5437
80	55.3	1.88	97.5	3.32	56.4934	3.3278	4	2.46405	124.7296	4.92493	2.3088	2.6161	19.712	3.6456	0.0914	3	1	0.4045	2.8119	19.71176
81	46.5	1.49	84.27	3.12	47.5315	3.1348	4	2.49977	122.6071	4.98623	2.34	2.6462	16.078	3.5022	0.0876	3	1	0.3999	2.8701	16.07767
82	53.3	1.82	-9.35	3.42	53.1856	3.422	4	2.49117	124.3451	5.0484	2.3712	2.6772	17.98	3.7809	-0.063	3	1	0.3952	2.8528	17.98038
83	43.6	1.69	-7.5	3.87	43.5082	3.8843	4	2.59195	123.313	5.11006	2.4024	2.7077	14.181	4.4013	-0.077	3	1	0.3908	2.9745	14.1813
84	46.1	1.43	-6.94	3.1	46.0151	3.1077	4	2.50745	122.2273	5.17117	2.4336	2.7376	14.92	3.5011	-0.072	3	1	0.3865	2.8957	14.91974
85	52.8	1.6	-6.46	3.03	52.7209	3.0349	4	2.45748	123.381	5.23286	2.4648	2.7681	17.156	3.3693	-0.062	3	1	0.3823	2.8376	17.15569
86	59.4	1.63	-5.42	2.75	59.3337	2.7472	5	2.39051	123.8052	5.29477	2.496	2.7988	19.308	3.0164	-0.053	4	1	0.3781	2.7675	19.30811

87	56.3	1.58	-4.95	2.8	56.2394	2.8094	5	2.41403	123.4466	5.35649	2.5272	2.8293	17.984	3.1052	-0.057	4	1	0.374	2.7996	17.98434
88	50.1	1.43	-3.75	2.85	50.0541	2.8569	4	2.45581	122.4325	5.41771	2.5584	2.8593	15.611	3.2037	-0.063	3	1	0.3701	2.8567	15.61091
89	46.5	1.7	-3.28	3.65	46.4599	3.6591	4	2.55343	123.5163	5.47946	2.5896	2.8899	14.181	4.1483	-0.069	3	1	0.3661	2.9584	14.18073
90	61.1	2.04	-2.64	3.35	61.0677	3.3406	4	2.44144	125.5171	5.54222	2.6208	2.9214	19.006	3.674	-0.051	3	1	0.3622	2.8262	19.0063
91	53.2	1.66	-2.07	3.12	53.1747	3.1218	4	2.46332	123.6713	5.60406	2.652	2.9521	16.114	3.4896	-0.059	3	1	0.3584	2.8684	16.11438
92	47.5	1.73	-0.06	3.64	47.4993	3.6422	4	2.54515	123.6982	5.66591	2.6832	2.9827	14.025	4.1355	-0.064	3	1	0.3548	2.9613	14.02529
93	53.2	1.8	0.34	3.39	53.2042	3.3832	4	2.48758	124.2651	5.72804	2.7144	3.0136	15.754	3.7914	-0.057	3	1	0.3511	2.8984	15.75374
94	55	1.64	1.43	2.98	55.0175	2.9809	5	2.43873	123.6657	5.78987	2.7456	3.0443	16.171	3.3315	-0.054	3	1	0.3476	2.8548	16.17057
95	46.6	1.59	2.11	3.42	46.6258	3.4101	4	2.53103	123.0355	5.85139	2.7768	3.0746	13.262	3.8995	-0.064	3	1	0.3442	2.9648	13.26174
96	46.4	1.48	4.2	3.18	46.4514	3.1861	4	2.51187	122.5018	5.91264	2.808	3.1046	13.057	3.6508	-0.062	3	1	0.3408	2.9528	13.05747
97	41.8	1.74	4.1	4.14	41.8502	4.1577	4	2.62467	123.4316	5.97436	2.8392	3.1352	11.443	4.8501	-0.071	3	1	0.3375	3.0736	11.44307
98	43.8	1.6	4.83	3.64	43.8591	3.648	4	2.57048	122.9322	6.03582	2.8704	3.1654	11.949	4.2302	-0.067	3	1	0.3343	3.0222	11.94889
99	64.5	1.82	6.85	2.82	64.5838	2.818	5	2.37191	124.8187	6.09823	2.9016	3.1966	18.296	3.1119	-0.041	4	1	0.331	2.7943	18.296
100	60.6	0	9.91	0	60.7213	0	0	0	769.6	6.48303	2.9328	3.5502	15.277	0	-0.041	0	1	0.298	0	0

CPT-3 In situ data Basic output data

Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ã (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	31.3	1.08	-0.41	3.44	31.295	3.451	4	2.66207	119.2331	0.05962	0	0.0596	523.94	3.4576	-1E-03	4	0.7845	2	2.4453	59.04003
2	74.1	0.42	0.41	0.57	74.105	0.5668	6	1.89397	114.4249	0.11683	0	0.1168	633.3	0.5677	0.0004	6	0.4819	2	1.644	139.85
3	69.7	0.4	0.37	0.57	69.7045	0.5739	6	1.91957	113.9186	0.17379	0	0.1738	400.09	0.5753	0.0004	6	0.4942	2	1.6692	131.4247
4	40.4	0.29	0.33	0.72	40.404	0.7178	5	2.17317	110.2355	0.22891	0	0.2289	175.51	0.7218	0.0006	6	0.5927	2	1.9209	75.93768
5	26.4	0.09	-0.14	0.35	26.3983	0.3409	5	2.20537	100.636	0.27922	0	0.2792	93.542	0.3446	-4E-04	6	0.599	2	1.9312	49.36937
6	4.6	0.08	1.03	1.78	4.61261	1.7344	3	3.18454	95.51934	0.32698	0	0.327	13.107	1.8667	0.0173	3	0.9947	2	2.9639	8.10054
7	6.5	0.11	3.38	1.63	6.54137	1.6816	3	3.04408	98.70154	0.37633	0.0312	0.3451	17.863	1.7843	0.0344	4	0.9401	2	2.8182	11.65294
8	32.2	0.23	3.14	0.7	32.2384	0.7134	5	2.25763	107.9888	0.43033	0.0624	0.3679	86.452	0.7231	0.0052	6	0.6353	1.9564	2.0141	58.8104
9	89.1	0.4	2.73	0.45	89.1334	0.4488	6	1.77366	114.5183	0.48759	0.0936	0.394	225	0.4512	0.0012	6	0.4781	1.6038	1.6015	134.3615
10	154.9	0.97	2.57	0.63	154.931	0.6261	6	1.65378	122.3483	0.54876	0.1248	0.424	364.14	0.6283	0.0004	6	0.4485	1.5071	1.5194	219.8853
11	144.7	1.47	2.88	1.02	144.735	1.0157	6	1.81227	125.2241	0.61137	0.156	0.4554	316.5	1.02	0.0004	6	0.512	1.5398	1.6817	209.7321
12	100.6	0.51	3.13	0.5	100.638	0.5068	6	1.75517	116.592	0.66967	0.1872	0.4825	207.2	0.5102	0.0004	6	0.4894	1.4686	1.6197	138.7553
13	105.4	0.81	3.6	0.77	105.444	0.7682	6	1.84048	120.0908	0.72972	0.2184	0.5113	204.79	0.7735	0.0004	6	0.5271	1.4671	1.7146	145.1922
14	170.8	2.11	3.92	1.24	170.848	1.235	6	1.82014	128.2732	0.79385	0.2496	0.5443	312.45	1.2408	0.0002	6	0.531	1.4233	1.7203	228.7509
15	196.7	1.74	4.2	0.88	196.751	0.8844	6	1.67407	127.2068	0.85746	0.2808	0.5767	339.71	0.8882	0.0001	6	0.4821	1.34	1.5881	248.0782
16	151.8	2.06	4.23	1.36	151.852	1.3566	6	1.88504	127.8102	0.92136	0.312	0.6094	247.69	1.3649	-5E-05	6	0.5635	1.3647	1.7973	194.6645
17	143.9	1.53	4.55	1.06	143.956	1.0628	6	1.82739	125.5037	0.98411	0.3432	0.6409	223.08	1.0701	-1E-04	6	0.5457	1.3146	1.7466	177.6338
18	215.1	2	5.12	0.93	215.163	0.9295	6	1.66183	128.4439	1.04833	0.3744	0.6739	317.71	0.9341	-3E-05	6	0.491	1.248	1.5991	252.5299
19	179.3	2.46	5.51	1.37	179.367	1.3715	6	1.83889	129.5149	1.11309	0.4056	0.7075	251.95	1.3801	-5E-05	6	0.5608	1.2533	1.778	211.1286
20	200.8	1.77	5.86	0.88	200.872	0.8812	6	1.66652	127.3824	1.17678	0.4368	0.74	269.86	0.8864	-7E-05	6	0.5004	1.196	1.6155	225.7135
21	176	1.62	6.02	0.92	176.074	0.9201	6	1.72076	126.4131	1.23999	0.468	0.772	226.47	0.9266	-2E-04	6	0.5242	1.1797	1.6738	194.9223
22	203.1	2.03	7.42	1	203.191	0.9991	6	1.70161	128.4132	1.3042	0.4992	0.805	250.79	1.0055	0.0002	6	0.5216	1.1533	1.663	220.0454
23	255.5	2.55	8.14	1	255.6	0.9977	6	1.63322	130.6416	1.36952	0.5304	0.8391	302.97	1.003	0.0002	6	0.5005	1.1231	1.6034	269.8393
24	231.7	2.07	8.78	0.89	231.807	0.893	6	1.62678	128.8774	1.43396	0.5616	0.8724	264.08	0.8985	0.0003	6	0.5015	1.1016	1.6017	239.852
25	246.5	1.96	9.26	0.79	246.613	0.7948	6	1.57177	128.6289	1.49827	0.5928	0.9055	270.7	0.7996	0.0003	6	0.4845	1.0784	1.5527	249.8166
26	256.1	2.78	9.1	1.08	256.211	1.085	6	1.65994	131.2793	1.56391	0.624	0.9399	270.93	1.0917	0.0001	6	0.5217	1.0638	1.6463	256.0049
27	246.2	2.87	9.74	1.17	246.319	1.1652	6	1.69454	131.4164	1.62962	0.6552	0.9744	251.11	1.1729	0.0002	6	0.5385	1.0454	1.6861	241.7438
28	261.1	2.77	10.14	1.06	261.224	1.0604	6	1.64688	131.3002	1.69527	0.6864	1.0089	257.25	1.0673	0.0002	6	0.524	1.0253	1.6438	251.4777
29	258.7	3.23	10.46	1.25	258.828	1.2479	6	1.70354	132.4019	1.76147	0.7176	1.0439	246.26	1.2565	0.0001	6	0.5492	1.0075	1.7057	244.7637
30	168.2	1.53	10.46	0.91	168.328	0.9089	6	1.73139	125.8851	1.82441	0.7488	1.0756	154.8	0.9189	3E-05	6	0.5642	0.9908	1.741	155.9099
31	192.8	1.41	10.54	0.73	192.929	0.7308	6	1.62378	125.6202	1.88722	0.78	1.1072	172.54	0.7381	-1E-04	6	0.5262	0.9764	1.6376	176.2905
32	161.8	1.09	10.85	0.67	161.933	0.6731	6	1.65838	123.3095	1.94888	0.8112	1.1377	140.62	0.6813	-2E-04	6	0.5435	0.9614	1.6791	145.3555
33	140.9	0.97	11.27	0.68	141.038	0.6878	6	1.71106	122.1192	2.00994	0.8424	1.1675	119.08	0.6977	-2E-04	6	0.5678	0.9457	1.7389	124.2525
34	231.2	1.15	12.19	0.5	231.349	0.4971	6	1.45511	124.5717	2.07222	0.8736	1.1986	191.28	0.5016	2E-05	6	0.4708	0.943	1.4805	204.3305
35	248	0.7	12.49	0.28	248.153	0.2821	7	1.28802	121.1103	2.13278	0.9048	1.228	200.35	0.2845	-2E-05	7	0.4094	0.9409	1.3158	218.7615
36	278.5	1.02	13.52	0.36	278.665	0.366	7	1.30967	124.1478	2.19485	0.936	1.2589	219.62	0.3689	0.0001	6	0.42	0.9296	1.34	242.9014
37	280.7	1.06	13.49	0.38	280.865	0.3774	7	1.31495	124.4485	2.25708	0.9672	1.2899	216	0.3805	1E-05	6	0.425	0.9193	1.3491	242.0519
38	309.9	1.18	14.16	0.38	310.073	0.3806	7	1.28328	125.4745	2.31981	0.9984	1.3214	232.9	0.3834	7E-05	7	0.4152	0.9119	1.3194	265.2207
39	321.2	2.46	14.92	0.76	321.383	0.7654	6	1.48115	130.9373	2.38528	1.0296	1.3557	235.3	0.7712	0.0001	6	0.4938	0.8848	1.5217	266.7518
40	246.2	1.88	15	0.76	246.384	0.763	6	1.5595	128.3217	2.44944	1.0608	1.3886	175.66	0.7707	8E-05	6	0.5292	0.866	1.6104	199.6476
41	283.9	2.45	14.79	0.86	284.081	0.8624	6	1.55549	130.6066	2.51475	1.092	1.4228	197.9	0.8701	-1E-04	6	0.5297	0.8549	1.6073	227.4782
42	283	2.47	15.13	0.87	283.185	0.8722	6	1.56006	130.6583	2.58007	1.1232	1.4569	192.61	0.8802	-1E-04	6	0.5347	0.8428	1.6163	223.5147
43	316.3	1.43	15.54	0.45	316.49	0.4518	7	1.32437	126.9305	2.64354	1.1544	1.4891	210.76	0.4556	-1E-04	6	0.4462	0.8586	1.3799	254.6689
44	354.3	1.79	16.2	0.51	354.498	0.5049	7	1.32107	128.8501	2.70796	1.1856	1.5224	231.08	0.5088	-5E-05	6	0.4467	0.85	1.3771	282.6078
45	386.6	1.96	15.72	0.51	386.792	0.5067	7	1.29536	129.7266	2.77283	1.2168	1.556	246.79	0.5104	-2E-04	6	0.4388	0.8443	1.3523	306.4296
46	359.9	1.91	16.09	0.53	360.097	0.5304	7	1.3313	129.3631	2.83751	1.248	1.5895	224.76	0.5346	-3E-04	6	0.4564	0.8305	1.3942	280.4152
47	344.6	0.97	16.81	0.28	344.806	0.2813	7	1.16773	124.2995	2.89966	1.2792	1.6205	210.99	0.2837	-2E-04	7	0.3967	0.8444	1.2337	272.8588
48	329.8	1.57	17.46	0.48	330.014	0.4757	7	1.32584	127.716	2.96352	1.3104	1.6531	197.84	0.4801	-2E-04	6	0.461	0.8141	1.3984	251.6242
49	337.4	1.99	18.1	0.59	337.622	0.5894	6	1.38358	129.5061	3.02827	1.3416	1.6867	198.38	0.5948	-1E-04	6	0.4859	0.7973	1.4595	252.1152
50	327.1	0.67	18.75	0.2	327.33	0.2047	7	1.11426	121.4652	3.089	1.3728	1.7162	188.93	0.2066	-7E-05	7	0.3853	0.83	1.1916	254.3381
51	306.1	1.1	19.23	0.36	306.335	0.3591	7	1.27187	124.9312	3.15147	1.404	1.7475	173.5	0.3628	-6E-05	6	0.4498	0.798	1.3572	228.6501
52	262.1	0.74	19.42	0.28	262.338	0.2821	7	1.26746	121.6525	3.21229	1.4352	1.7771	145.81	0.2856	-1E-04	6	0.4533	0.7906	1.3625	193.6016
53	34.4	1.23	25.02	3.53	34.7062	3.544	4	2.63623	120.437	3.27251	1.4664	1.8061	17.404	3.913	0.0107	3	1	0.5859	2.8732	17.40408
54	33.8	0.79	64.14	2.29	34.5851	2.2842	4	2.51335	117.189	3.33111	1.4976	1.8335	17.046	2.5277	0.0998	4	0.9893	0.5805	2.7626	17.14699
55	36.2	0.85	33.12	2.31	36.6054	2.3221	4	2.49874	117.8631	3.39004	1.5288	1.8612	17.846	2.5591	0.0258	4	0.9854	0.5732	2.7489	17.9941
56	30.4	0.7	11.02	2.28	30.5349	2.2925	4	2.55664	116.0002	3.44804	1.56	1.888	14.347	2.5843	-0.028	4	1	0.5604	2.8312	14.34655
57	39.8	0.99	22.71	2.46	40.078	2.4702	4	2.48579	119.1997	3.50764	1.5912	1.9164	19.082	2.7071	0.0012	4	0.9845	0.5572	2.7398	19.2587
58	44.4	0.81	32.41	1.81	44.7967	1.8082	5	2.36219	118.0029	3.56664	1.6224	1.9442	21.206	1.9646	0.0173	4	0.9368	0.5656	2.6103	22.03789
59	44	0.94	55.07	2.1	44.6741	2.1041	5	2.40482	119.0853	3.62618	1.6536	1.9726	20.809	2.29	0.0563	4	0.957	0.551	2.6601	21.37446
60	55	1.55	73.02	2.76	55.8938	2.7731	5	2.41206	123.2913	3.68783	1.6848	2.003	26.063	2.969	0.0684	4	0.9553	0.5435	2.652	26.81719
61	39.5	1.03	45.84	2.56	40.0611	2.5711	4	2.49724	119.4885	3.74757	1.716	2.0316	17.875	2.8364	0.0436	4	1	0.5208	2.7779	17.87457
62	41.5	0.89	58.45	2.1	42.2154	2.1082	5	2.42427	118.5473	3.80685	1.7472	2.0597	18.648	2.3172	0.0641	4	0.9784	0.5212	2.7059	18.91794
63	43.9	0.99	87.6	2.2	44.9722	2.2014	5	2.41525	119.4808	3.86659	1.7784	2.0882	19.685	2.4084	0.1102	4	0.9761	0.515	2.6962	20.00738
64	39.7	0.86	120.82	2.09	41.1788	2.0885	5	2.43	118.2358	3.92571	1.8096	2.1161	17.605	2.3085	0.1849	4	0.9903	0.5034	2.728	17.72386
65	40.6	1.17	122.44	2.77	42.0987	2.7792	4	2.5033	120.542	3.98598	1.8408	2.1452	17.767	3.0698	0.183	4	1	0.4933	2.8008	17.76669
66	39.2	0.93	105.43	2.29	40.4905	2.2968	5	2.46199	118.7673	4.04536	1.872	2.1734	16.769	2.5518	0.1569	4	1	0.4869	2.7729	16.76901
67	38.2	0.82	119.12	2.07	39.658	2.0677	5	2.43993	117.7955	4.10426	1.9032	2.2011	16.153	2.3064	0.1877	4	1	0.4807	2.7606	16.15304
68	44.1	0.84	120.47	1.84	45.5746	1.8431	5	2.36158	118.311	4.16341	1.9344	2.229	18.578	2.0284	0.1627	4	0.9736	0.4841	2.6719	18.94774
69	45	0.92	111.04	1.97	46.3591	1.9845	5	2.37619	119.0183	4.22292	1.9656	2.2573	18.666	2.1834	0.1431	4	0.982	0.4752	2.6908	18.92248
70	38.1	1.27	87.5	3.22	39.171	3.2422	4	2.57133	120.9663	4.28341	1.9968	2.2866	15.257	3.6403	0.1233	3	1	0.4627	2.8984	15.25737
71	63.1	1.57	136.1	2.42	64.7659	2.4241	5	2.32545	123.7444	4.34528	2.028	2.3173	26.074	2.5985	0.1286	4	0.9555	0.4728	2.6131	26.9993
72	70.5	2.69	157.37	3.7	72.4262	3.7141	4	2.42397	127.957	4.40926	2.0592	2.3501	28.943	3.9549	0.1363	4	0.993	0.4528	2.7067	29.1052
73	52	1.73	17.93	3.31	52.2195	3.3129	4	2.48697	123.9293	4.47122	2.0904	2.3808	20.055	3.6232	-0.017	3	1	0.4444	2.8044	20.05537
74	41.6	1.18	76.63	2.76	42.538	2.774	4	2.49939	120.6296	4.53154	2.1216	2.4099	15.771	3.1047	0.0894	3	1	0.4391	2.8449	15.77072
75	46.2	1.49	130.31	3.11	47.795	3.1175	4	2.49637	122.6206	4.59285	2.1528	2.4401	17.705	3.4489	0.1673	3	1	0.4336	2.8331	17.70547
76	45.8	1.34	160.86	2.8	47.7689	2.8052	4	2.4653	121.8429	4.65377	2.184	2.4698	17.457	3.108	0.218	4	1	0.4284	2.8101	17.45717
77	47	1.38	187.97	2.79	49.3008	2.7992	4	2.45459	122.1351	4.71483	2.2152	2.4996	17.837	3.0952	0.2539	4	1	0.4233	2.8016	17.83697
78	49.4	1.42	179.92	2.74	51.6022	2.7518	5	2.43503	122.4555	4.77606	2.2464	2.5297	18.511	3.0325	0.2287	4	1	0.4183	2.7834	18.51083
79	51.4	1.63	183.87	3.02	53.6506	3.0382	4	2.45234	123.5596	4.83784	2.2776	2.5602	19.066	3.3393	0.2246	4	1	0.4133	2.7992	19.06567
80	46.1	1.83	120.53	3.82	47.5753	3.8465	4	2.56131	124.1133	4.8999	2.3088	2.5911	16.47	4.2882	0.1493	3	1	0.4084	2.9169	16.46999
81	56.6	1.92	86.38	3.32	57.6573	3.33	4	2.458	124.9334	4.96237	2.34	2.6224	20.094	3.6436	0.0736	3	1	0.4035	2.8053	20.09442
82	50.5	1.56	150.16	2.96	52.338	2.9806	4	2.45435	123.178	5.02395	2.3712	2.6528	17.836	3.2971	0.1784	4	1	0.3989	2.8185	17.8358
83	47.5	1.37	184.18	2.74	49.7544	2.7535	5	2.44683	122.1042	5.08501	2.4024	2.6826	16.651	3.067	0.2431	4	1	0.3944	2.8229	16.65147
84	48.1	1.33	153.98	2.64	49.9847	2.6608	5	2.43528	121.8987	5.14596	2.4336	2.7124	16.531	2.9662	0.193	4	1	0.3901	2.8167	16.53129
85	51.6	1.49	169.38	2.76	53.6732	2.7761	5	2.42516	122.9035	5.20741	2.4648	2.7426	17.671	3.0743	0.2008	4	1	0.3858	2.803	17.67143
86	52.9	1.43	187.29	2.58	55.1924	2.5909	5	2.39582	122.6709	5.26874	2.496	2.7727	18.005	2.8644	0.2201	4	1	0.3816	2.7779	18.00516

87	42.2	1.22	120.99	2.78	43.6809	2.793	4	2.49279	120.9382	5.32921	2.5272	2.802	13.687	3.1811	0.1613	3	1	0.3776	2.9006	13.6872
88	57.4	1.59	227.84	2.63	60.1888	2.6417	5	2.37425	123.6583	5.39104	2.5584	2.8326	19.345	2.9016	0.2527	4	1	0.3735	2.7566	19.34509
89	66.5	2.03	246.06	2.9	69.5118	2.9204	5	2.36037	125.7971	5.45394	2.5896	2.8643	22.364	3.169	0.2361	4	1	0.3694	2.7309	22.36391
90	56	2.54	68.28	4.45	56.8358	4.469	4	2.5544	126.946	5.51741	2.6208	2.8966	17.717	4.9495	0.0447	3	1	0.3653	2.9328	17.71667
91	60.7	1.71	240	2.67	63.6376	2.6871	5	2.36199	124.3265	5.57958	2.652	2.9276	19.831	2.9453	0.252	4	1	0.3614	2.752	19.83143
92	60.1	1.61	358.24	2.47	64.4849	2.4967	5	2.33567	123.9179	5.64154	2.6832	2.9583	19.891	2.7361	0.3927	4	1	0.3577	2.7315	19.89069
93	59.6	1.58	320.11	2.48	63.5182	2.4875	5	2.33929	123.7434	5.70341	2.7144	2.989	19.342	2.7329	0.3517	4	1	0.354	2.7408	19.34246
94	59.9	1.53	325.19	2.37	63.8803	2.3951	5	2.32618	123.522	5.76517	2.7456	3.0196	19.246	2.6327	0.3556	4	1	0.3504	2.7328	19.24618
95	61.3	1.67	330.14	2.53	65.3409	2.5558	5	2.3386	124.2178	5.82728	2.7768	3.0505	19.51	2.8061	0.3528	4	1	0.3469	2.7448	19.50962
96	63.3	1.63	321.5	2.41	67.2352	2.4243	5	2.31374	124.1101	5.88933	2.808	3.0813	19.909	2.6571	0.3316	4	1	0.3434	2.7234	19.90887
97	62.9	1.78	317.42	2.65	66.7852	2.6653	5	2.34454	124.7378	5.9517	2.8392	3.1125	19.545	2.926	0.329	4	1	0.34	2.7553	19.5449
98	70.1	1.8	404.93	2.37	75.0563	2.3982	5	2.27624	125.1044	6.01425	2.8704	3.1439	21.961	2.6071	0.3807	4	1	0.3366	2.6846	21.96098
99	76.2	2.39	227.01	3.02	78.9786	3.0261	5	2.33313	127.303	6.0779	2.9016	3.1763	22.951	3.2784	0.1844	4	1	0.3331	2.7315	22.95142
100	40.8	0	107.83	0	42.1198	0	0	0	769.6	6.4627	2.9328	3.5299	10.101	0	0.1355	0	1	0.2998	0	0

Depth (ft)	CPT-4 qc (tsf)	In situ data fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ā (pcf)	σ,v (tsf)	u0 (tsf)	Basic output data σ'vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	26	0.17	0	0.65	26	0.6539	5	2.32309	105.2525	0.05263	0	0.0526	493.05	0.6552	0	6	0.637	2	2.0592	49.04485
2	38.4	0.19	0.06	0.49	38.4007	0.4948	5	2.11778	107.0175	0.10613	0	0.1061	360.81	0.4962	0.0001	6	0.5608	2	1.8525	72.38316
3	53.2	0.26	0.1	0.49	53.2012	0.4887	6	1.98856	110.1076	0.16119	0	0.1612	329.06	0.4902	0.0001	6	0.516	2	1.7281	100.2545
4	14.5	0.05	0.14	0.37	14.5017	0.3448	5	2.45302	94.87413	0.20863	0	0.2086	68.511	0.3498	0.0007	5	0.6892	2	2.1768	27.01631
5	8.7	0.06	0.09	0.73	8.7011	0.6896	4	2.76557	94.9623	0.25611	0	0.2561	32.974	0.7105	0.0008	5	0.8174	2	2.5074	15.96244
6	33.7	0.23	1.95	0.69	33.7239	0.682	5	2.23113	108.0986	0.31016	0	0.3102	107.73	0.6883	0.0042	6	0.6177	2	1.9765	63.15747
7	38.5	0.22	3.33	0.56	38.5408	0.5708	5	2.14391	108.099	0.36421	0.0312	0.333	114.64	0.5763	0.0055	6	0.587	1.9711	1.892	71.11798
8	23.7	0.12	5.09	0.52	23.7623	0.505	5	2.31108	102.4844	0.41545	0.0624	0.3531	66.129	0.514	0.013	6	0.6473	2	2.049	44.12943
9	70.3	0.41	-2.81	0.58	70.2656	0.5835	6	1.92028	114.1189	0.47251	0.0936	0.3789	184.2	0.5875	-0.004	6	0.5256	1.7156	1.7274	113.161
10	160.6	0.98	0.12	0.61	160.601	0.6102	6	1.63461	122.511	0.53376	0.1248	0.409	391.4	0.6122	-7E-04	6	0.4395	1.5186	1.4978	229.7259
11	191.8	1.64	1.73	0.86	191.821	0.855	6	1.67184	126.7118	0.59712	0.156	0.4411	433.5	0.8576	-2E-04	6	0.4616	1.4976	1.5514	270.6488
12	171.7	1.08	3.17	0.63	171.739	0.6289	6	1.61994	123.3855	0.65881	0.1872	0.4716	362.76	0.6313	0.0002	6	0.4449	1.4327	1.5041	231.6406
13	181.6	1.49	3.67	0.82	181.645	0.8203	6	1.67686	125.877	0.72175	0.2184	0.5034	359.44	0.8236	0.0003	6	0.4719	1.4199	1.5705	242.7811
14	186.8	1.56	4.57	0.83	186.856	0.8349	6	1.67304	126.2819	0.78489	0.2496	0.5353	347.61	0.8384	0.0004	6	0.4754	1.3826	1.5757	243.1282
15	173.2	0.97	5.31	0.56	173.265	0.5598	6	1.58563	122.6211	0.8462	0.2808	0.5654	304.95	0.5626	0.0006	6	0.4458	1.3223	1.4944	215.4698
16	161.3	0.86	5.69	0.53	161.37	0.5329	6	1.59744	121.5669	0.90699	0.312	0.595	269.69	0.536	0.0006	6	0.4536	1.2984	1.511	196.9026
17	152.8	1.1	5.88	0.72	152.872	0.7196	6	1.69608	123.2359	0.9686	0.3432	0.6254	242.89	0.7241	0.0005	6	0.4945	1.297	1.6144	186.192
18	100.4	0.79	6.17	0.79	100.476	0.7863	6	1.86332	119.7902	1.0285	0.3744	0.6541	152.04	0.7944	0.0007	6	0.5581	1.3079	1.7776	122.9235
19	53	0.32	6.56	0.6	53.0803	0.6029	6	2.03271	111.6214	1.08431	0.4056	0.6787	76.61	0.6154	0.0013	6	0.6217	1.3179	1.9416	64.76394
20	84.1	0.5	6.67	0.6	84.1816	0.594	6	1.85749	116.0116	1.14231	0.4368	0.7055	117.7	0.6021	0.0005	6	0.5625	1.2561	1.7829	98.57643
21	151.3	0.82	6.68	0.54	151.382	0.5417	6	1.62401	121.0626	1.20285	0.468	0.7349	204.37	0.546	9E-05	6	0.482	1.1921	1.5678	169.1969
22	212.7	1.79	6.17	0.84	212.776	0.8413	6	1.63458	127.605	1.26665	0.4992	0.7675	275.6	0.8463	-3E-04	6	0.492	1.1712	1.59	234.1137
23	170.4	1.59	5.98	0.93	170.473	0.9327	6	1.73503	126.1975	1.32975	0.5304	0.7994	211.6	0.94	-6E-04	6	0.5329	1.1612	1.6932	185.62
24	205.9	1.75	6.68	0.85	205.982	0.8496	6	1.64765	127.3605	1.39343	0.5616	0.8318	245.95	0.8554	-4E-04	6	0.5044	1.129	1.6145	218.303
25	161.6	1.11	7.88	0.69	161.696	0.6865	6	1.66427	123.439	1.45515	0.5928	0.8624	185.82	0.6927	-2E-04	6	0.5136	1.1108	1.6348	168.2198
26	180	1.04	8.91	0.58	180.109	0.5774	6	1.58065	123.2254	1.51676	0.624	0.8928	200.05	0.5823	0.0001	6	0.4857	1.086	1.5579	183.3064
27	225.7	1.56	8.83	0.69	225.808	0.6909	6	1.55682	126.7437	1.58013	0.6552	0.9249	242.43	0.6957	-9E-05	6	0.4808	1.0668	1.5407	226.074
28	250.8	2.14	7.83	0.85	250.896	0.8529	6	1.58862	129.3137	1.64479	0.6864	0.9584	260.07	0.8586	-5E-04	6	0.4966	1.0504	1.578	247.431
29	185	1.44	9.19	0.78	185.112	0.7779	6	1.65527	125.6734	1.70762	0.7176	0.99	185.25	0.7852	-3E-04	6	0.5254	1.0356	1.6497	179.4963
30	167.7	0.78	10.23	0.46	167.825	0.4648	6	1.54895	120.9482	1.7681	0.7488	1.0193	162.91	0.4697	-7E-05	6	0.4883	1.0184	1.5489	159.8276
31	175.6	0.72	11.21	0.41	175.737	0.4097	6	1.50156	120.4749	1.82834	0.78	1.0483	165.89	0.414	0.0002	6	0.4734	1.0044	1.5063	165.0819
32	186.8	0.96	10.9	0.51	186.933	0.5136	6	1.53666	122.7305	1.8897	0.8112	1.0785	171.57	0.5188	-1E-04	6	0.49	0.9907	1.5461	173.2534
33	201.8	0.98	11.39	0.49	201.939	0.4853	6	1.49509	123.0697	1.95124	0.8424	1.1088	180.36	0.49	-1E-04	6	0.4772	0.9779	1.5087	184.8283
34	302.5	1.64	10.41	0.54	302.627	0.5419	6	1.39191	127.8238	2.01515	0.8736	1.1416	263.34	0.5456	-4E-04	6	0.4399	0.9672	1.4066	274.7739
35	305.6	1.61	10.26	0.53	305.726	0.5266	6	1.38018	127.7136	2.07901	0.9048	1.1742	258.6	0.5302	-6E-04	6	0.4386	0.9554	1.3989	274.1631
36	292.2	1.24	10.23	0.42	292.325	0.4242	6	1.33285	125.6936	2.14185	0.936	1.2059	240.65	0.4273	-7E-04	6	0.4238	0.9461	1.356	259.47
37	182.5	1.59	11.3	0.87	182.638	0.8706	6	1.69272	126.3656	2.20503	0.9672	1.2378	145.77	0.8812	-9E-04	6	0.5672	0.9149	1.7285	156.0058
38	177.3	0.93	14.13	0.52	177.473	0.524	6	1.55993	122.3715	2.26622	0.9984	1.2678	138.2	0.5308	0.0001	6	0.5197	0.9103	1.6005	150.7333
39	246.5	1.53	13.28	0.62	246.663	0.6203	6	1.49689	126.8171	2.32963	1.0296	1.3	187.94	0.6262	-3E-04	6	0.4965	0.9028	1.5357	208.4729
40	275	1.75	13.23	0.63	275.162	0.636	6	1.46981	128.0668	2.39366	1.0608	1.3329	204.65	0.6416	-4E-04	6	0.4886	0.8933	1.5107	230.2933
41	286.2	1.04	13.19	0.36	286.361	0.3632	7	1.29816	124.3564	2.45584	1.092	1.3638	208.17	0.3663	-5E-04	6	0.4255	0.8976	1.3412	240.8488
42	306.2	1.21	13.43	0.4	306.364	0.395	7	1.29746	125.6288	2.51866	1.1232	1.3955	217.74	0.3982	-5E-04	6	0.4276	0.8884	1.3428	255.1139
43	286.4	0.66	14.35	0.23	286.576	0.2303	7	1.18956	121.0309	2.57917	1.1544	1.4248	199.33	0.2324	-4E-04	7	0.3894	0.8906	1.239	239.0355
44	337.6	1.08	13.77	0.32	337.769	0.3198	7	1.20761	125.0352	2.64169	1.1856	1.4561	230.16	0.3223	-6E-04	7	0.3977	0.8808	1.2569	278.9523
45	368.1	0.71	15.44	0.19	368.289	0.1928	7	1.05684	122.1771	2.70278	1.2168	1.486	246.02	0.1942	-3E-04	7	0.3416	0.8905	1.1057	307.6711
46	351.5	0.76	15.21	0.21	351.686	0.2161	7	1.09866	122.5625	2.76406	1.248	1.5161	230.15	0.2178	-4E-04	7	0.3608	0.8783	1.1523	289.6366
47	350.7	0.75	15.86	0.21	350.894	0.2137	7	1.09711	122.4601	2.82529	1.2792	1.5461	225.13	0.2155	-4E-04	7	0.3628	0.8715	1.154	286.6662
48	347.6	0.81	17.1	0.23	347.809	0.2329	7	1.11951	123.0017	2.88679	1.3104	1.5764	218.81	0.2348	-2E-04	7	0.3742	0.8614	1.1801	280.8023
49	213.5	0.35	17.01	0.16	213.708	0.1638	7	1.24303	115.6741	2.94463	1.3416	1.603	131.48	0.1661	-6E-04	6	0.4302	0.8363	1.3237	166.5894
50	292.3	0.48	18.52	0.16	292.527	0.1641	7	1.11661	118.7509	3.004	1.3728	1.6312	177.49	0.1658	-1E-04	7	0.3801	0.8483	1.1886	232.115
51	316.7	0.58	18.62	0.18	316.928	0.183	7	1.10452	120.331	3.06417	1.404	1.6602	189.06	0.1848	-2E-04	7	0.377	0.8438	1.1769	250.2974
52	318.5	1.01	19.25	0.32	318.736	0.3169	7	1.22555	124.4034	3.12637	1.4352	1.6912	186.62	0.32	-2E-04	7	0.4264	0.8188	1.3027	244.22
53	337.4	2.03	18.23	0.6	337.623	0.6013	6	1.38977	129.6517	3.19119	1.4664	1.7248	193.9	0.607	-5E-04	6	0.4917	0.7864	1.4701	248.5627
54	58	1.53	20.72	2.62	58.2536	2.6265	5	2.38279	123.2971	3.25284	1.4976	1.7552	31.335	2.7818	-1E-04	4	0.9113	0.6305	2.5671	32.77318
55	29.4	0.8	99.62	2.6	30.6194	2.6127	4	2.59119	116.984	3.31133	1.5288	1.7825	15.32	2.9295	0.2067	4	1	0.5936	2.84	15.31976
56	36.1	1.01	76.97	2.73	37.0421	2.7266	4	2.53967	119.154	3.37091	1.56	1.8109	18.594	2.9996	0.1183	4	0.9944	0.5861	2.778	18.64983
57	40.5	0.95	104.88	2.26	41.7837	2.2736	5	2.4487	118.9996	3.43041	1.5912	1.8392	20.853	2.477	0.1554	4	0.9586	0.5886	2.6811	21.33586
58	37.4	0.95	80.98	2.45	38.3912	2.4745	4	2.50052	118.7931	3.48981	1.6224	1.8674	18.69	2.722	0.1206	4	0.9856	0.5713	2.7488	18.84308
59	36.6	0.93	87	2.47	37.6649	2.4691	4	2.50625	118.5908	3.5491	1.6536	1.8955	17.998	2.726	0.1351	4	0.9931	0.5605	2.7637	18.07095
60	36.5	0.93	111.64	2.43	37.8665	2.456	4	2.50299	118.6038	3.60841	1.6848	1.9236	17.809	2.7147	0.1855	4	0.9954	0.5516	2.7668	17.8583
61	38.3	1	104.29	2.52	39.5765	2.5268	4	2.49633	119.2426	3.66803	1.716	1.952	18.395	2.7849	0.1613	4	0.995	0.5437	2.7621	18.45198
62	40.8	1	132.02	2.34	42.4159	2.3576	5	2.45391	119.4116	3.72773	1.7472	1.9805	19.534	2.5848	0.2005	4	0.9794	0.5412	2.7183	19.78809
63	33.2	1	113.78	2.86	34.5927	2.8908	4	2.57875	118.9143	3.78719	1.7784	2.0088	15.335	3.2462	0.2082	3	1	0.5267	2.8663	15.33534
64	35.7	0.86	96.23	2.32	36.8779	2.332	4	2.49743	117.9667	3.84617	1.8096	2.0366	16.219	2.6036	0.155	4	1	0.5196	2.7897	16.21925
65	37.3	0.95	107.81	2.46	38.6196	2.4599	4	2.49689	118.8076	3.90558	1.8408	2.0648	16.812	2.7367	0.1706	4	1	0.5125	2.7899	16.81248
66	26.6	0.9	68.2	3.27	27.4348	3.2805	4	2.69102	117.5779	3.96437	1.872	2.0924	11.217	3.8346	0.1295	3	1	0.5057	3.0183	11.21716
67	35.5	0.91	92.79	2.46	36.6358	2.4839	4	2.51714	118.3642	4.02355	1.9032	2.1204	15.381	2.7904	0.1465	4	1	0.499	2.8261	15.38059
68	39.8	0.99	114.88	2.39	41.2061	2.4026	5	2.46879	119.2674	4.08318	1.9344	2.1488	17.276	2.6668	0.1707	4	1	0.4924	2.7737	17.27628
69	38.5	1.05	130.03	2.61	40.0916	2.619	4	2.50223	119.6311	4.143	1.9656	2.1774	16.51	2.9208	0.2058	4	1	0.486	2.8131	16.50988
70	38.8	0.95	138.34	2.34	40.4933	2.3461	5	2.4679	118.9231	4.20246	1.9968	2.2057	16.454	2.6177	0.2194	4	1	0.4797	2.7861	16.45351
71	45.5	1.07	147.21	2.24	47.3019	2.2621	5	2.40628	120.1725	4.26255	2.028	2.2346	19.261	2.4861	0.1992	4	0.991	0.4767	2.7153	19.39075
72	42.1	0.96	164.01	2.15	44.1075	2.1765	5	2.41851	119.2082	4.32215	2.0592	2.263	17.581	2.413	0.2451	4	1	0.4676	2.742	17.58119
73	64	1.19	84.12	1.82	65.0296	1.8299	5	2.2416	121.7266	4.38301	2.0904	2.2926	26.453	1.9622	0.0654	4	0.9209	0.4906	2.5244	28.12164
74	44.8	0.94	126.1	2.01	46.3435	2.0283	5	2.38238	119.1748	4.4426	2.1216	2.321	18.053	2.2434	0.1661	4	0.9938	0.4581	2.7125	18.14103
75	44.3	1.35	76.26	2.97	45.2334	2.9845	4	2.50096	121.7643	4.50348	2.1528	2.3507	17.327	3.3145	0.082	3	1	0.4501	2.8298	17.32686
76	48.4	1.5	79.5	3.04	49.3731	3.0381	4	2.47843	122.7488	4.56486	2.184	2.3809	18.82	3.3476	0.079	4	1	0.4444	2.8042	18.82021
77	47.3	1.27	112.87	2.6	48.6815	2.6088	5	2.43799	121.4965	4.6256	2.2152	2.4104	18.277	2.8827	0.1342	4	1	0.439	2.7744	18.2774
78	49	1.27	150.07	2.49	50.8369	2.4982	5	2.41141	121.6021	4.68641	2.2464	2.44	18.914	2.7519	0.1855	4	1	0.4337	2.7504	18.91407
79	40.5	1.25	129.37	2.97	42.0835	2.9703	4	2.5227	121.0251	4.74692	2.2776	2.4693	15.12	3.3479	0.1885	3	1	0.4285	2.8793	15.12019
80	44.1	1.05	143.63	2.29	45.858	2.2897	5	2.41992	119.9589	4.8069	2.3088	2.4981	16.433	2.5578	0.1957	4	1	0.4236	2.7806	16.43296
81	47.9	1.23	140.92	2.46	49.6249	2.4786	5	2.41691	121.3091	4.86755	2.34	2.5276	17.708	2.7482	0.1744	4	1	0.4186	2.7729	17.70777
82	51.1	1.26	193.75	2.35	53.4715	2.3564	5	2.37812	121.6675	4.92839	2.3712	2.5572	18.983	2.5956	0.2385	4	1	0.4138	2.7339	18.98302
83	55.2	1.2	210.14	2.06	57.7721	2.0771	5	2.31656	121.4992	4.98914	2.4024	2.5867	20.405	2.2735	0.2411	4	0.9912	0.4123	2.6717	20.56644
84	51.9	1.33	201.23	2.44	54.3631	2.4465	5	2.38376	122.1035	5.05019	2.4336	2.6166	18.846	2.6971	0.2445	4	1	0.4044	2.7464	18.84625
85	57.6	1.79	243.19	2.93	60.5767	2.9549	5	2.40617	124.5409	5.11246	2.4648	2.6477	20.948	3.2273	0.2713	4	1	0.3996	2.758	20.9484
86	62.1	2.1	235.9	3.22	64.9874	3.2314	5	2.41224	125.881	5.1754	2.496	2.6794	22.323	3.511	0.2422	4	1	0.3949	2.7598	22.32293

87	61.5	1,52	254.62	2.34	64.6166	2.3523	5	2.31719	123.502	5.23715	2,5272	2.71	21,912	2.5598	0,2662	4	0,9993	0.3907	2.6803	21,92549
88	89,6	2,34	203.77	2,53	92.0941	2.5409	5	2.23213	127,523	5.30091	2,5584	2,7425	31.647	2,6961	0.1396	4	0,9538	0,4032	2,5553	33,07225
89	47,9	1,26	120,1	2,53	49.37	2.5522	5	2.42707	121,4729	5.36165	2,5896	2,7721	15,876	2,8631	0,1377	4	1	0,3817	2,8216	15,87577
90	47,9	1,34	96,5	2,73	49.0812	2.7302	5	2,44867	121,909	5,4226	2.6208	2,8018	15,582	3,0693	0,0991	3	1	0,3777	2,8461	15,58232
91	45,9	1,17	132	2.44	47,5157	2,4624	5	2.42908	120,8373	5.48302	2,652	2,831	14,847	2,7836	0,163	4	1	0,3738	2,8378	14,84718
92	44,9	1,18	154,01	2,5	46,7851	2,5222	5	2,44104	120,8618	5,54345	2,6832	2,8603	14,419	2,8612	0,2038	3	1	0,3699	2,8551	14,41888
93	43,7	1,14	147,67	2,5	45,5075	2,5051	5	2,44809	120,5419	5,60372	2,7144	2,8893	13,811	2,8569	0,1984	3	1	0,3662	2,8699	13,81077
94	49,8	1,22	189,37	2,33	52,1179	2,3409	5	2,38448	121,3689	5,66441	2,7456	2,9188	15,915	2,6263	0,2344	4	1	0,3625	2,7986	15,91523
95	55,5	1,64	199,99	2,81	57,9479	2,8301	5	2,40687	123,7923	5,7263	2,7768	2,9495	17,705	3,1405	0,2226	4	1	0,3587	2,808	17,70521
96	53,1	1,05	278,06	1,84	56,5035	1,8583	5	2,29208	120,468	5,78654	2,808	2,9785	17,027	2,0703	0,3394	4	1	0,3552	2,7151	17,02746
97	47,2	1,51	183,12	3,03	49,4414	3,0541	4	2,47956	122,8008	5,84794	2,8392	3,0087	14,489	3,4638	0,2373	3	1	0,3517	2,903	14,48895
98	41,6	1,53	73,33	3,6	42,4976	3,6002	4	2,57642	122,5279	5,9092	2,8704	3,0388	12,04	4,1817	0,0659	3	1	0,3482	3,0166	12,04039
99	44,4	1,37	83,84	3,01	45,4262	3,0159	4	2,50268	121,8823	5,97014	2,9016	3,0685	12,858	3,4722	0,0795	3	1	0,3448	2,945	12,85824
100	44,1	0	107,17	0	45,4118	0	0	0	769,6	6,35494	2,9328	3,4221	11,413	0	0,1225	0	1	0,3092	0	0

	CPT-5	In situ data										Basic output data								
Depth (ft)	qc (tsf)	fs (tsf)	u (psi)	Other	qt (tsf)	Rf(%)	SBT	Ic SBT	ā (pcf)	ó,v (tsf)	u0 (tsf)	ó',vo (tsf)	Qt1	Fr (%)	Bq	SBTn	n	Cn	Ic	Qtn
1	323.8	2.48	1.64	0.77	323.82	0.7659	6	1.47914	131.0149	0.06551	0	0.0655	4942.3	0.766	0.0004	7	0.3478	2	1.2985	611.9499
2	279.4	0.94	0.34	0.34	279.404	0.3364	7	1.28716	123.5567	0.12729	0	0.1273	2194.1	0.3366	9E-05	7	0.2716	1.7773	1.0937	469.1114
3	139.6	0.51	-0.08	0.36	139.599	0.3653	6	1.56018	117.3902	0.18598	0	0.186	749.61	0.3658	-4E-05	6	0.3672	1.8933	1.3285	249.4562
4	91	0.19	-0.23	0.21	90.9972	0.2088	6	1.6276	109.1217	0.24054	0	0.2405	377.3	0.2094	-2E-04	6	0.3914	1.7858	1.394	153.1686
5	37.1	0.1	-0.34	0.26	37.0958	0.2696	6	2.03219	102.2367	0.29166	0	0.2917	126.19	0.2717	-7E-04	6	0.5333	1.9881	1.7565	69.15131
6	30.7	0.08	-0.45	0.25	30.6945	0.2606	5	2.10582	100.142	0.34173	0	0.3417	88.821	0.2636	-0.001	6	0.5713	1.9073	1.8467	54.71283
7	33	0.11	-0.34	0.34	32.9958	0.3334	5	2.11112	102.6484	0.39306	0.0312	0.3619	90.099	0.3374	-0.002	6	0.5785	1.8603	1.8681	57.31908
8	53.4	0.2	0.24	0.38	53.4029	0.3745	6	1.93694	108.1971	0.44715	0.0624	0.3848	137.64	0.3777	-9E-04	6	0.5278	1.7057	1.7329	85.36643
9	21	0.14	0.68	0.65	21.0083	0.6664	5	2.40989	103.3119	0.49881	0.0936	0.4052	50.615	0.6826	-0.002	5	0.6952	1.9489	2.1665	37.77637
10	22.2	0.19	1.91	0.84	22.2234	0.855	5	2.43714	105.6835	0.55165	0.1248	0.4269	50.771	0.8767	0.0006	5	0.7126	1.9096	2.2086	39.11195
11	82	0.35	1.75	0.43	82.0214	0.4267	6	1.79473	113.3384	0.60832	0.156	0.4523	179.99	0.4299	-4E-04	6	0.4957	1.5239	1.6403	117.2544
12	195.1	1.04	2.71	0.53	195.133	0.533	6	1.53178	123.4208	0.67003	0.1872	0.4828	402.76	0.5348	4E-05	6	0.4154	1.3853	1.4253	254.5952
13	185.7	1.72	2.83	0.93	185.735	0.9261	6	1.70596	126.9816	0.73352	0.2184	0.5151	359.14	0.9297	-8E-05	6	0.4848	1.4176	1.603	247.8613
14	126.8	1.33	2.22	1.05	126.827	1.0487	6	1.86412	124.1697	0.79561	0.2496	0.546	230.82	1.0553	-7E-04	6	0.544	1.4332	1.7544	170.7111
15	144.2	1.49	2.78	1.04	144.234	1.033	6	1.81838	125.3145	0.85826	0.2808	0.5775	248.29	1.0392	-6E-04	6	0.5331	1.381	1.7217	187.1339
16	163.4	1.74	3.03	1.06	163.437	1.0646	6	1.78799	126.7543	0.92164	0.312	0.6096	266.58	1.0707	-6E-04	6	0.5276	1.3377	1.7032	205.45
17	128	1.54	3.17	1.2	128.039	1.2028	6	1.90125	125.2655	0.98427	0.3432	0.6411	198.19	1.2121	-9E-04	6	0.5725	1.3323	1.8171	159.9753
18	180	1.05	4.05	0.58	180.05	0.5832	6	1.58343	123.2946	1.04592	0.3744	0.6715	266.56	0.5866	-5E-04	6	0.4596	1.2324	1.517	208.4935
19	165.2	1.24	4.16	0.75	165.251	0.7504	6	1.6819	124.3024	1.10807	0.4056	0.7025	233.66	0.7554	-7E-04	6	0.5002	1.2274	1.6195	190.403
20	170.4	0.65	4.73	0.38	170.458	0.3813	6	1.49567	119.6521	1.1679	0.4368	0.7311	231.56	0.384	-6E-04	6	0.4337	1.1739	1.4415	187.8153
21	171.4	0.67	5.61	0.39	171.469	0.3907	6	1.49921	119.8883	1.22784	0.468	0.7598	224.05	0.3936	-4E-04	6	0.4387	1.1563	1.4509	186.0436
22	196.2	1.33	7.43	0.68	196.291	0.6776	6	1.59637	125.2349	1.29046	0.4992	0.7913	246.44	0.6821	0.0002	6	0.48	1.1497	1.5553	211.8755
23	158.6	1.13	6.9	0.71	158.684	0.7121	6	1.68071	123.5238	1.35222	0.5304	0.8218	191.44	0.7182	-2E-04	6	0.5148	1.1389	1.6429	169.3488
24	165.7	1.02	7.36	0.61	165.79	0.6152	6	1.62595	122.8813	1.41366	0.5616	0.8521	192.92	0.6205	-2E-04	6	0.4979	1.1139	1.5947	173.0359
25	196.1	1.35	7.58	0.69	196.193	0.6881	6	1.60096	125.3429	1.47633	0.5928	0.8835	220.38	0.6933	-2E-04	6	0.4925	1.0929	1.5768	201.1131
26	174.6	1.09	7.92	0.63	174.697	0.6239	6	1.61203	123.4946	1.53808	0.624	0.9141	189.43	0.6295	-3E-04	6	0.5003	1.0759	1.5929	176.0773
27	207.9	1.15	8.41	0.56	208.003	0.5529	6	1.5201	124.3123	1.60024	0.6552	0.945	218.41	0.5572	-2E-04	6	0.469	1.0544	1.5071	205.685
28	242.8	1.54	9.12	0.63	242.912	0.634	6	1.50821	126.8274	1.66365	0.6864	0.9773	246.86	0.6384	-1E-04	6	0.468	1.0379	1.5006	236.6406
29	168.2	1.46	8.38	0.87	168.303	0.8675	6	1.7177	125.5421	1.72642	0.7176	1.0088	165.12	0.8765	-7E-04	6	0.5513	1.0267	1.7156	161.6233
30	150.3	0.89	9.35	0.59	150.414	0.5917	6	1.64906	121.6463	1.78725	0.7488	1.0385	143.12	0.5988	-5E-04	6	0.5288	1.01	1.6529	141.8653
31	156.2	0.97	10.45	0.62	156.328	0.6205	6	1.64831	122.3702	1.84843	0.78	1.0684	144.59	0.6279	-2E-04	6	0.5319	0.9949	1.6573	145.2439
32	192.6	1.22	10.75	0.63	192.732	0.633	6	1.58315	124.5586	1.91071	0.8112	1.0995	173.55	0.6393	-2E-04	6	0.51	0.9806	1.5958	176.8461
33	198.5	1.47	11.53	0.74	198.641	0.74	6	1.61802	125.9963	1.97371	0.8424	1.1313	173.84	0.7475	-6E-05	6	0.5266	0.9654	1.6355	179.4337
34	153.8	0.82	11.73	0.53	153.944	0.5327	6	1.61383	121.1035	2.03426	0.8736	1.1607	130.88	0.5398	-2E-04	6	0.5294	0.9522	1.6392	136.7049
35	157	0.8	12.18	0.51	157.149	0.5091	6	1.59508	120.9731	2.09475	0.9048	1.19	130.3	0.516	-2E-04	6	0.5255	0.9402	1.6251	137.7699
36	211.3	1.42	13.35	0.67	211.463	0.6715	6	1.56958	125.8956	2.15769	0.936	1.2217	171.32	0.6784	0.0001	6	0.5175	0.9283	1.6001	183.6291
37	198.7	1.18	13.36	0.59	198.864	0.5934	6	1.55469	124.3911	2.21989	0.9672	1.2527	156.98	0.6001	-3E-05	6	0.5153	0.9167	1.5908	170.3618
38	227.3	1.46	13.36	0.64	227.464	0.6419	6	1.53291	126.2768	2.28303	0.9984	1.2846	175.29	0.6484	-2E-04	6	0.5093	0.9059	1.5712	192.7926
39	279	1.82	14.77	0.65	279.181	0.6519	6	1.47282	128.3891	2.34722	1.0296	1.3176	210.1	0.6574	0.0001	6	0.4881	0.8985	1.5115	235.065
40	194.8	1.13	15.49	0.58	194.99	0.5795	6	1.55476	124.0263	2.40924	1.0608	1.3484	142.82	0.5868	0.0003	6	0.5255	0.8804	1.6056	160.2325
41	195.6	1.21	13.91	0.62	195.77	0.6181	6	1.57127	124.5366	2.4715	1.092	1.3795	140.12	0.626	-5E-04	6	0.535	0.8677	1.6267	158.5163
42	190.3	0.95	15.21	0.5	190.486	0.4987	6	1.52246	122.6998	2.53285	1.1232	1.4097	133.33	0.5054	-2E-04	6	0.5197	0.8615	1.5827	153.0315
43	255	1.13	17.28	0.44	255.212	0.4428	6	1.3904	124.6828	2.5952	1.1544	1.4408	175.33	0.4473	0.0004	6	0.4692	0.8652	1.4464	206.5511
44	346.5	2.38	19.47	0.69	346.738	0.6864	6	1.42389	130.8806	2.66064	1.1856	1.475	233.27	0.6917	0.0006	6	0.4822	0.852	1.4762	277.0549
45	392.2	2.89	19.21	0.74	392.435	0.7364	6	1.41182	132.6032	2.72694	1.2168	1.5101	258.06	0.7416	0.0004	6	0.4794	0.8432	1.4645	310.5681
46	419.9	3.48	22.36	0.83	420.174	0.8282	6	1.43325	134.1291	2.794	1.248	1.546	269.97	0.8338	0.0009	6	0.4899	0.8305	1.4878	327.5829
47	407.9	2.76	18.47	0.68	408.126	0.6763	6	1.37249	132.362	2.86018	1.2792	1.581	256.34	0.681	0.0001	6	0.47	0.828	1.431	317.1408
48	366.6	1.56	18.45	0.43	366.826	0.4253	7	1.25907	127.9271	2.92415	1.3104	1.6138	225.5	0.4287	5E-05	7	0.4305	0.8338	1.3233	286.7709
49	363.7	1.38	17.31	0.38	363.912	0.3792	7	1.2287	127.0106	2.98765	1.3416	1.6461	219.27	0.3824	-3E-04	7	0.4218	0.83	1.2963	283.1008
50	410.8	1.78	20.5	0.43	411.051	0.433	7	1.22848	129.1701	3.05224	1.3728	1.6794	242.94	0.4363	0.0003	7	0.423	0.8225	1.2952	317.1547
51	286.9	2.97	28.21	1.03	287.245	1.034	6	1.61179	132.0419	3.11826	1.404	1.7143	165.74	1.0453	0.0022	6	0.5784	0.7565	1.699	203.1356
52	285.6	4.18	25.39	1.46	285.911	1.462	6	1.73094	134.5311	3.18552	1.4352	1.7503	161.53	1.4785	0.0014	6	0.6275	0.7292	1.8234	194.8388
53	208.1	5.01	18.11	2.41	208.322	2.4049	5	1.98646	135.0842	3.25307	1.4664	1.7867	114.78	2.4431	-8E-04	5	0.7343	0.6807	2.0993	131.9178
54	147.8	1.72	78.34	1.16	148.759	1.1562	6	1.84229	126.4402	3.31629	1.4976	1.8187	79.971	1.1826	0.0285	6	0.6887	0.6886	1.9756	94.65678

3300 Newport Blvd
Newport Beach, CA

CPT Shear Wave Measurements

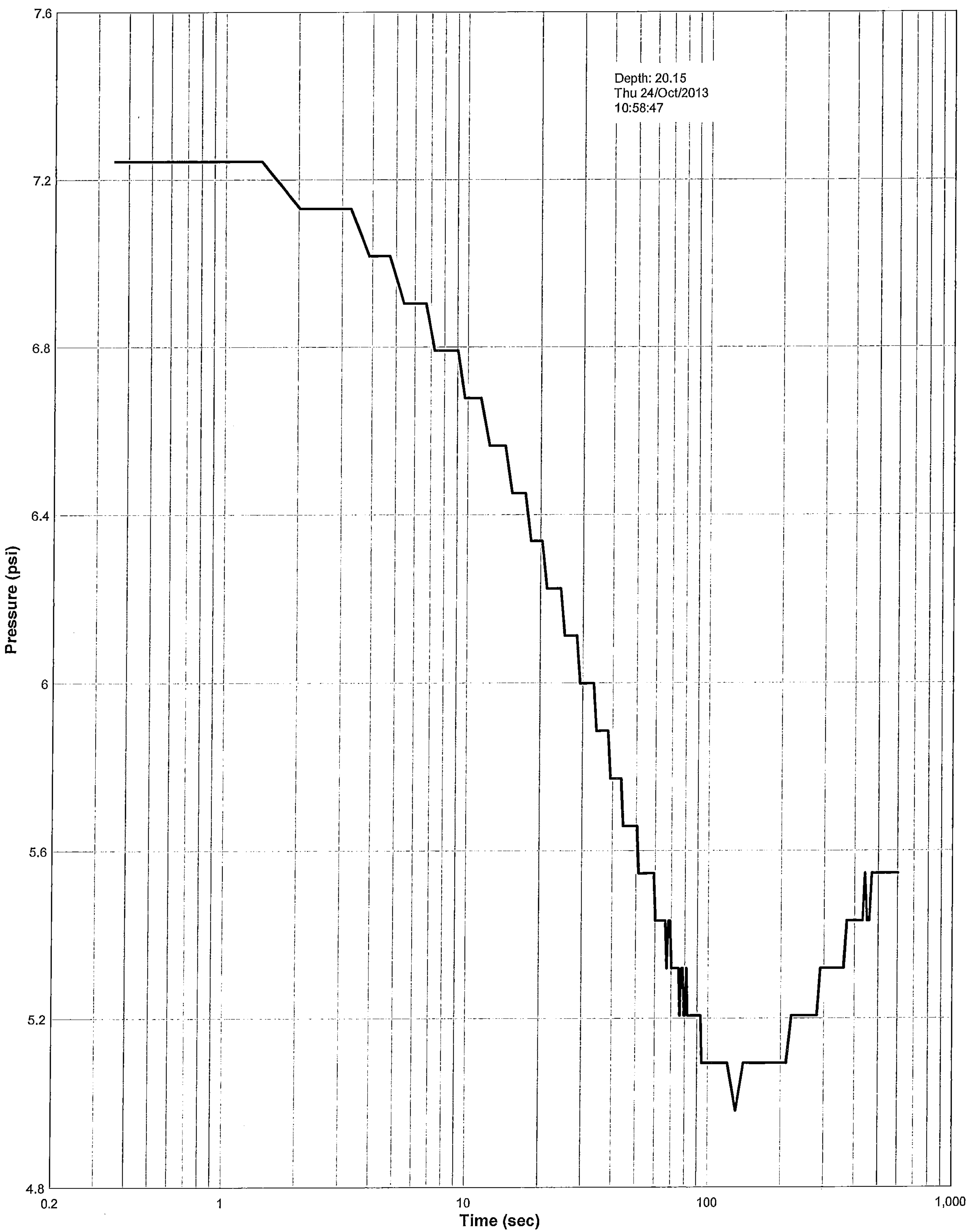
CPT-3	Tip Depth (ft)	Geophone Depth (ft)	Travel Distance (ft)	S-Wave Arrival (msec)	S-Wave Velocity from Surface (ft/sec)	Interval S-Wave Velocity (ft/sec)
	5.22	4.22	6.54	18.22	359.10	
	10.25	9.25	10.51	30.58	343.85	321.36
	15.16	14.16	15.02	38.11	394.04	597.87
	20.16	19.16	19.80	45.32	436.93	663.64
	25.12	24.12	24.63	53.19	463.11	613.87
	30.22	29.22	29.64	60.95	486.38	645.86
	36.46	35.46	35.81	70.81	505.73	625.36
	40.28	39.28	39.60	76.23	519.44	698.56
	45.17	44.17	44.45	83.24	534.02	692.60
	50.19	49.19	49.44	88.51	558.62	947.13
	55.00	54.00	54.23	95.17	569.83	718.85
	60.08	59.08	59.29	102.92	576.09	652.93
	65.42	64.42	64.61	110.01	587.34	750.71
	70.00	69.00	69.18	116.12	595.77	747.49
	75.13	74.13	74.30	122.86	604.74	759.27
	80.13	79.13	79.29	128.34	617.80	910.47
	85.04	84.04	84.19	134.03	628.13	861.30
	90.12	89.12	89.26	138.91	642.58	1039.25
	95.11	94.11	94.24	144.00	654.46	978.90
	100.07	99.07	99.20	149.85	661.97	846.73

Shear Wave Source Offset = 5 ft

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

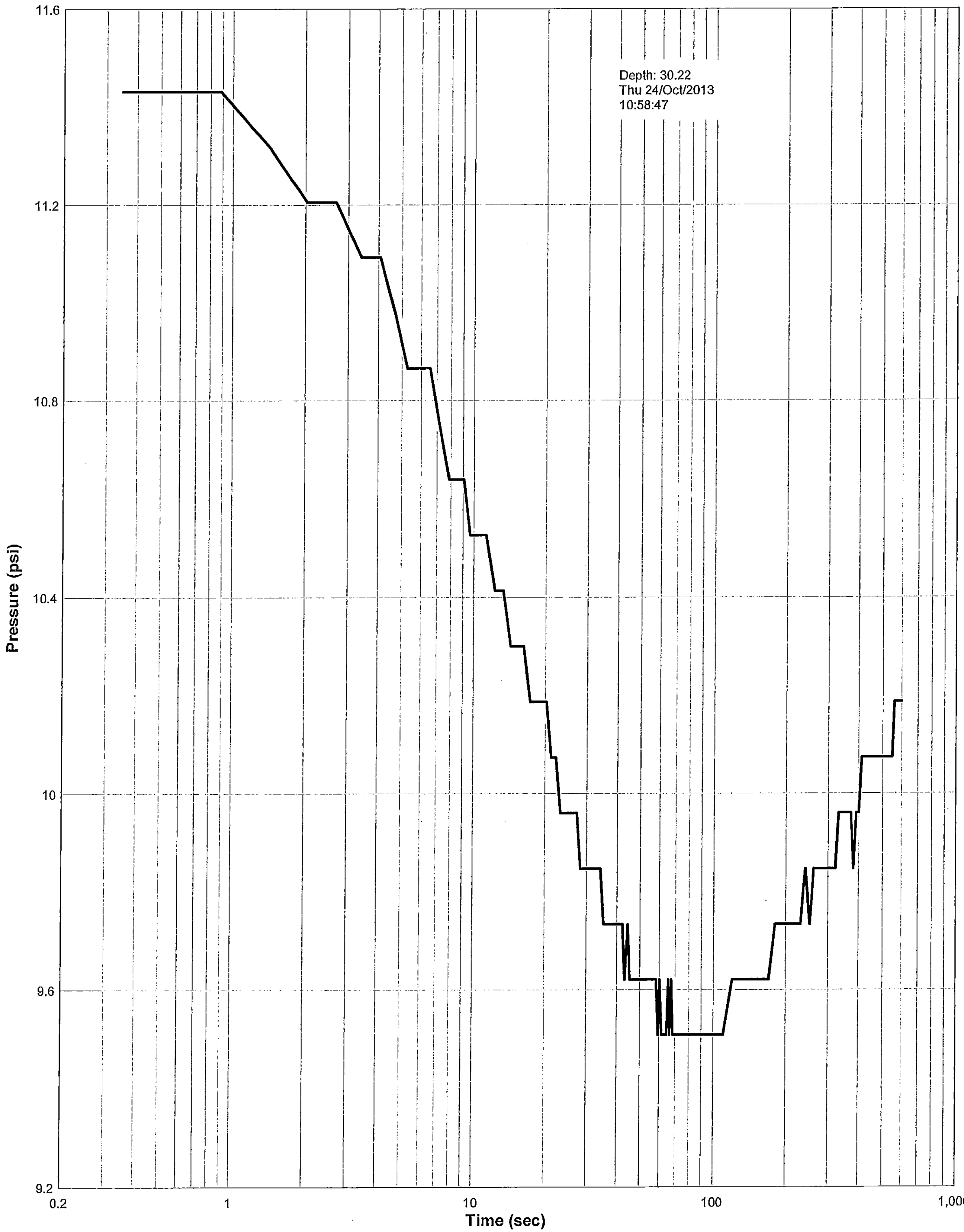
GMU Geotechnical, Inc. CPT-5

Kehoe Testing



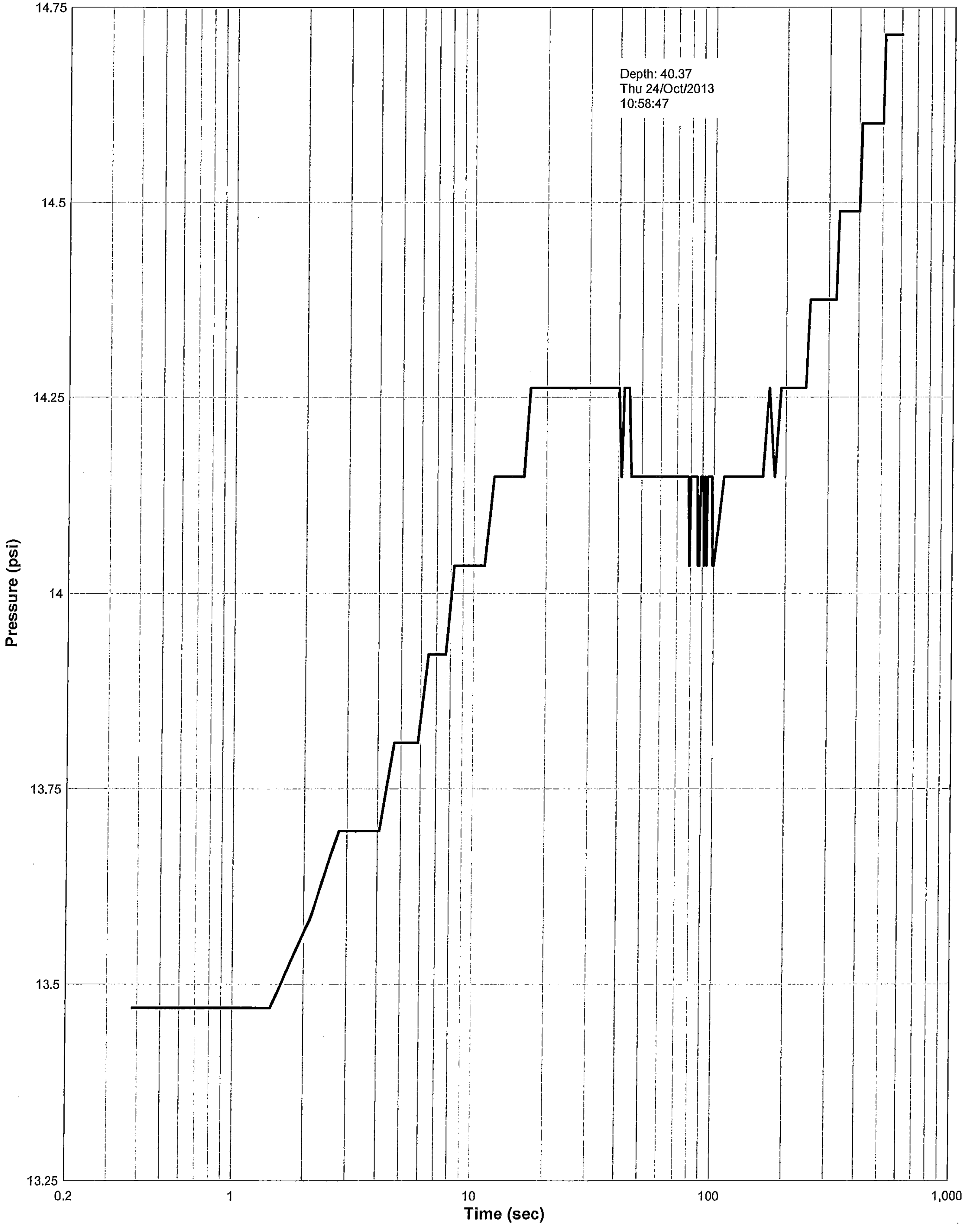
GMU Geotechnical, Inc. CPT-5

Kehoe Testing



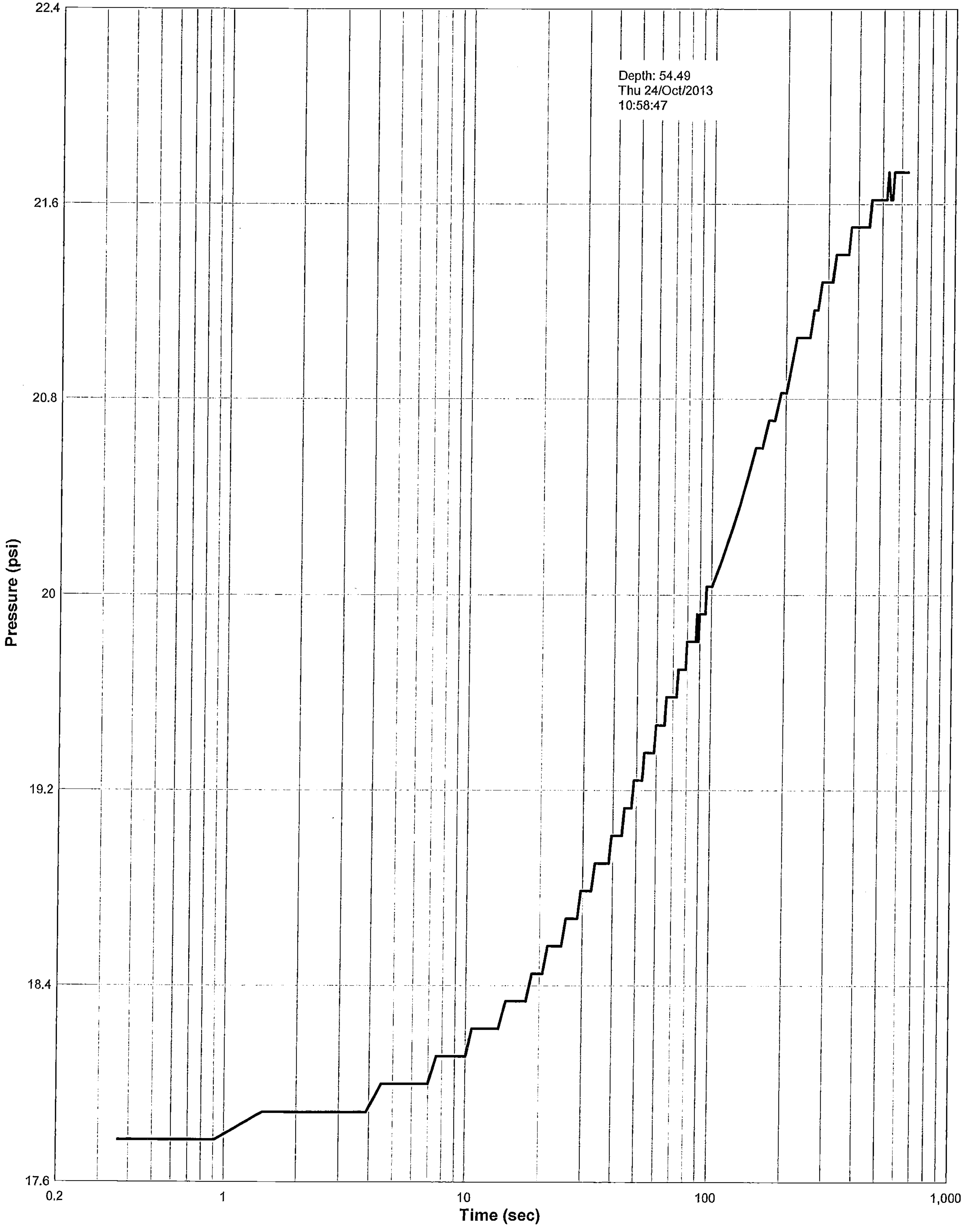
GMU Geotechnical, Inc. CPT-5

Kehoe Testing



GMU Geotechnical, Inc. CPT-5

Kehoe Testing



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

:: Unit Weight, g (kN/m³) ::

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

where g_w = water unit weight

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

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

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

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

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

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

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

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

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

:: Relative Density, Dr (%) ::

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

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

:: State Parameter, ψ ::

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

:: Peak drained friction angle, φ (°) ::

$$\varphi = 17.60 + 11 \cdot \log(Q_{tn})$$

(applicable only to SBT_n: 5, 6, 7 and 8)

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

If $I_c > 2.20$

$a = 14$ for $Q_{tn} > 14$

$a = Q_{tn}$ for $Q_{tn} \leq 14$

$M_{CPT} = a \cdot (q_t - \sigma_v)$

If $I_c \leq 2.20$

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

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

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

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

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

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

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

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

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

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

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

:: Overconsolidation Ratio, OCR ::

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

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

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

:: In situ Stress Ratio, Ko ::

$$K_0 = 0.1 \cdot \left(\frac{q_t - \sigma_v}{\sigma'_{vo}}\right)$$

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

:: Soil Sensitivity, S_t ::

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

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

:: Effective Stress Friction Angle, φ' (°) ::

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

(applicable for $0.10 < B_q < 1.00$)

References

- Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 4th Edition, July 2010
- Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

APPENDIX B

GMU
GEOTECHNICAL, INC.

APPENDIX B-1

GMU Geotechnical Laboratory Procedures
and Test Results

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APPENDIX B

GMU GEOTECHNICAL LABORATORY PROCEDURES AND TEST RESULTS

GENERAL

The following are laboratory test procedures and laboratory test results performed by GMU.

MOISTURE AND DENSITY

Field moisture content and in-place density were determined for each 6-inch sample sleeve of undisturbed soil material obtained from the borings. The field moisture content was determined in general accordance with ASTM Test Method D 2216 by obtaining one-half the moisture sample from each end of the 6-inch sleeve. The in-place dry density of the sample was determined by using the wet weight of the entire sample.

At the same time the field moisture content and in-place density were determined, the soil material at each end of the sleeve was classified according to the Unified Soil Classification System. The results of the field moisture content and in-place density determinations are contained in a following section of this Appendix B. The results of the visual classifications were used for general reference.

SUMMARY OF MATERIAL PROPERTIES

Material properties of the representative soils at the site were determined by performing particle size distribution and Atterberg limit tests. Detailed test results are described in a following section of this Appendix B.

PARTICLE SIZE DISTRIBUTION

As part of the engineering classification of the materials underlying the site, representative samples were tested to determine the distribution of particle sizes. The distribution was determined in general accordance with ASTM Test Method D 422 using U.S. Standard Sieve Openings 3", 1.5", ¾, ⅜, and U.S. Standard Sieve Nos. 4, 10, 20, 40, 60, 100, and 200. In addition, standard hydrometer tests were performed to determine the distribution of particle sizes passing the No. 200 sieve (i.e., silt and clay-size particles). The results of the tests are contained in this Appendix B-1.

ATTERBERG LIMITS

As part of the engineering classification of the soil material, representative samples of the on-site soil materials were tested to determine relative plasticity. This relative plasticity is based on the Atterberg limits determined in general accordance with ASTM Test Method D 4318. The results of these tests are contained in this Appendix B.

CONSOLIDATION TESTS

The one-dimensional consolidation properties of "undisturbed" native soil and bedrock samples were evaluated according to the provisions of ASTM Test Method D 2435. Sample diameter was 2.416 inches and sample height was 1.00 inch. Water was added during the test at approximate insitu normal loads to evaluate the potential for hydro-collapse and to produce saturation during the remainder of the testing. Consolidation readings were taken regularly during each load increment until the change in sample height was less than approximately 0.0001 inch over a two-hour period. The graphic presentation of consolidation data is a representation of volume change in axial load. As a result, both expansion and consolidation are illustrated. The results of the consolidation load tests are summarized in this Appendix B.

COMPACTION TESTS

Selected bulk samples of representative soil materials were tested to determine the maximum dry density and optimum moisture content of the soil. These compactive characteristics were determined in general accordance with ASTM Test Method D 1557. The results of these tests are contained in this Appendix B.

DIRECT SHEAR STRENGTH TESTS

Direct shear tests were performed on "undisturbed" and remolded specimens of samples of the typical on-site soil materials obtained from our drill holes. The general philosophy and procedure of the tests were in accordance with ASTM Test Method D 3080 - "Direct Shear Tests for Soils Under Consolidated Drained Conditions".

The tests are single shear tests and are performed using a sample diameter of 2.416 inches and a height of 1.00 inch. The normal load is applied by a vertical dead load system. A constant rate of strain is applied to the upper one-half of the sample until failure occurs. Shear stress is monitored by a strain gauge-type precision load cell and deflection is measured with a digital dial indicator. This data is transferred electronically to data acquisition software which plots shear strength vs. deflection. The shear strength plots are then interpreted to determine either peak or ultimate shear strengths. Residual strengths were obtained through multiple shear box reversals. A strain rate compatible with the grain size distribution of the soils was utilized. The interpreted results of these tests are presented in this Appendix B.

EXPANSION TESTS

To provide a standard definition of one-dimensional expansion, expansion index tests were performed on representative samples in general accordance with ASTM Test Method D 4829. The results from this test procedure are reported as an "expansion index." The results of these tests are contained in this Appendix B.

R-VALUE TESTS

Bulk samples representative of the underlying on-site materials were tested to measure the response of a compacted sample to a vertically applied pressure under specific conditions. The R-value of a material is determined when the material is in a state of saturation such that water will be exuded from the compacted test specimen when a 16.8 kN load (2.07 MPa) is applied. The results from these test procedures are reported in this Appendix B.

CHEMICAL TESTS

The corrosion potential of typical on-site soil materials under long-term contact with both metal and concrete was determined by chemical and electrical resistance tests. The soluble sulfate testing for potential concrete corrosion was performed in general accordance with California Test Method 417. The minimum resistivity testing for potential metal corrosion was performed in general accordance with California Test Method 643 and the concentration of soluble chlorides was performed in general accordance with California Test Method 422. The results are presented on Table B-1 in this Appendix B.

SAND EQUIVALENT

To determine the suitability of select onsite soils for use as pipe bedding, samples were tested to determine, under saturated conditions, the relative proportions of clay-like or plastic fines and dust in granular soils and fine aggregates that pass the 4.75-mm (No. 4) sieve. These tests were determined in accordance with ASTM Test Method D 2419. The results of the tests are contained in this Appendix B.

TABLE B-1
SUMMARY OF SOIL LABORATORY DATA

Sample Information			Geologic Unit	USCS Group Symbol	In Situ Water Content, %	In Situ Dry Unit Weight, pcf	In Situ Saturation, %	Sieve/Hydrometer				Atterberg Limits			Compaction		Expansion Index	R-Value	Chemical Test Results			
Boring Number	Depth, feet	Elevation, feet						Gravel, %	Sand, %	<#200, %	<2µ, %	LL	PL	PI	Maximum Dry Unit Weight, pcf	Optimum Water Content, %			pH	Sulfate (ppm)	Chloride (ppm)	Min. Resistivity (ohm/cm)
DH-1	1	7.0		SP														69				
DH-1	2	6.0		SP	20.1	95	71															
DH-1	4	4.0	Qal	SM	51.1	69	96															
DH-1	8	0.0	Qal	SM	26.0	104	116															
DH-2	2	6.0		SM	6.7	108	34															
DH-2	4	4.0	Qal	SM-ML	57.3	71	113															
DH-2	10	-2.0	Qal	SM	24.3	104	109															
DH-3	1	7.5		SM													0		7.3	0	90	13500
DH-3	5	3.5	Qal	CL	50.6	64	85															
DH-3	10	-1.5	Qal	SM	28.1	98	109															
DH-3	15	-6.5	Qal	SM	28.9			0	76	24												
DH-3	20	-11.5	Qal	SP	23.5	101	98															
DH-3	25	-16.5	Qal	SM	26.4			0	78	22												
DH-3	40	-31.5	Qal	SP	23.9																	
DH-3	60	-51.5	Qal	MH	45.3	74	98															
DH-3	65	-56.5	Qal	MH	58.1			0	7	93	42	83	38	45								
DH-3	70	-61.5	Qal	MH	53.6	68	98															
DH-4	1	8.5		SP											112.5	11.5			7.3	65	186	12200
DH-4	2	7.5		SP	3.0	105	14															
DH-5	2	6.5		SP	3.3	104	15															
DH-5	4	4.5	Qal	CL-ML	34.6	83	92															
DH-5	10	-1.5	Qal	SM	28.1	96	103															

Project: Lido House Hotel
Project No. 13-160-00

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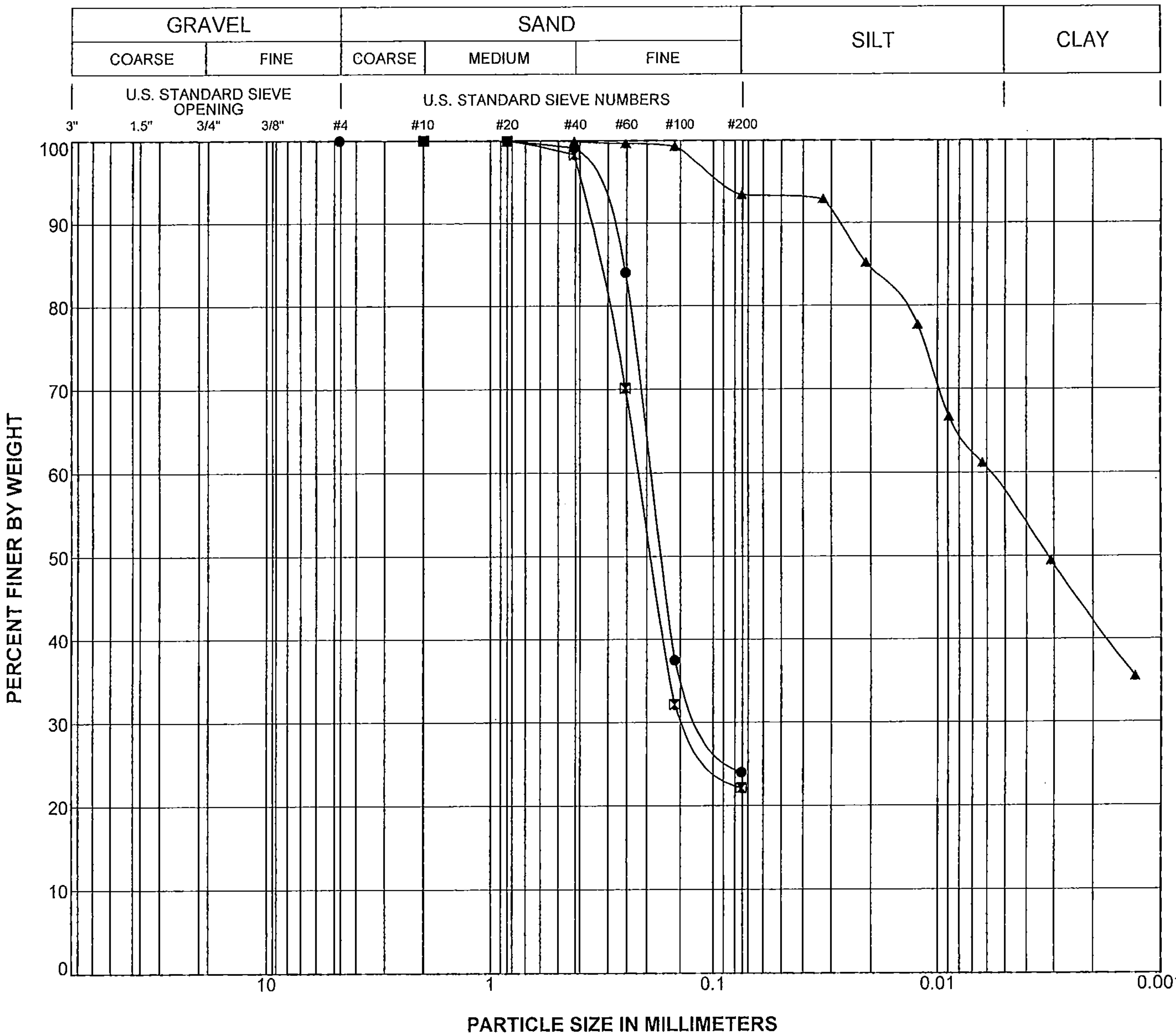

Boring Number	Depth (feet)	Geologic Unit	Symbol	LL	PI	Classification
DH-3	15.0		●			Silty Sand (SM)
DH-3	25.0		⊠			Silty Sand (SM)
DH-3	65.0		▲	83	45	ELASTIC SILT(MH)

GMU_GRAIN_SIZE 13-160-00.GPJ 11/13/13

PARTICLE SIZE DISTRIBUTION

Project: Lido House Hotel

Project No. 13-160-00

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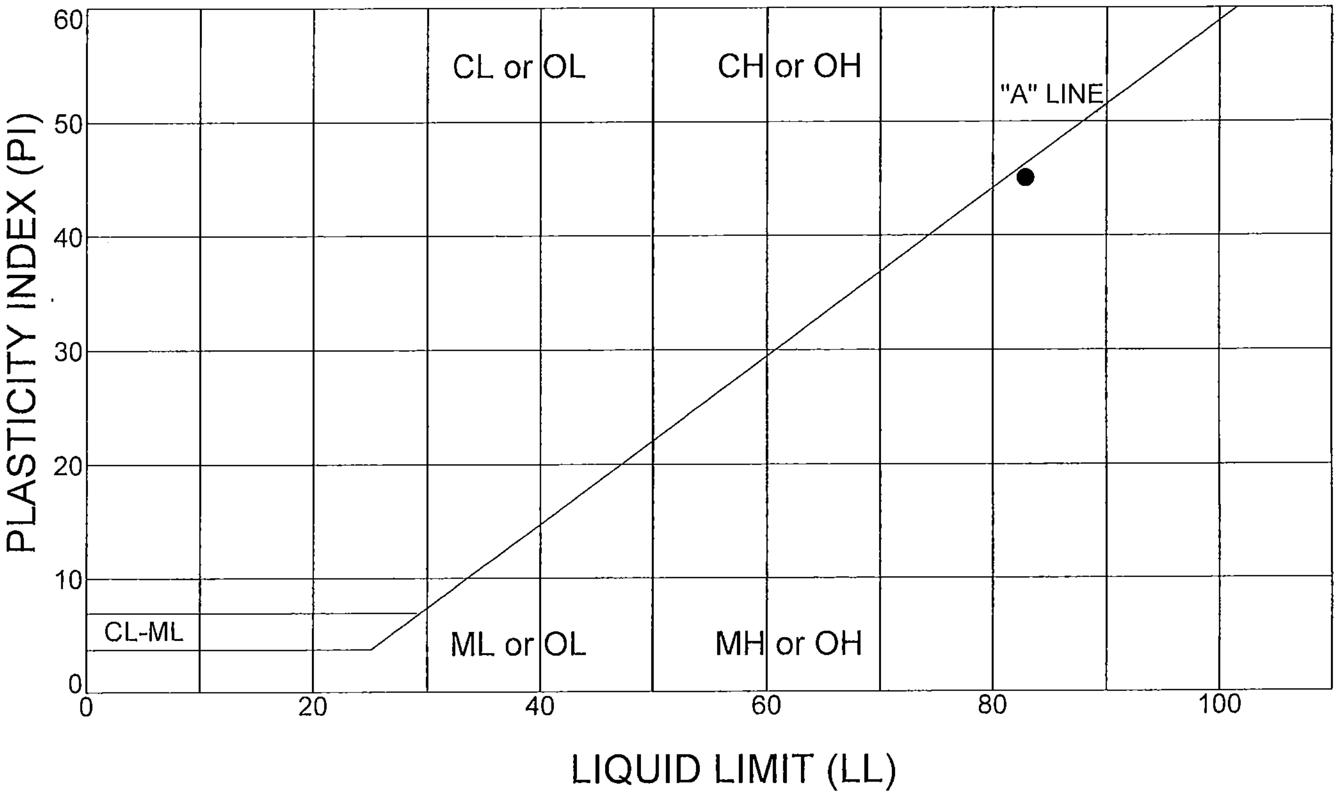

Boring Number	Depth (feet)	Geologic Unit	Test Symbol	Insitu Water Content (%)	LL	PL	PI	Classification
DH-3	65.0		●	58	83	38	45	Elastic Silt (MH)

LIMITS 13-160-00.GPJ 11/13/13

ATTERBERG LIMITS

Project: Lido House Hotel

Project No. 13-160-00

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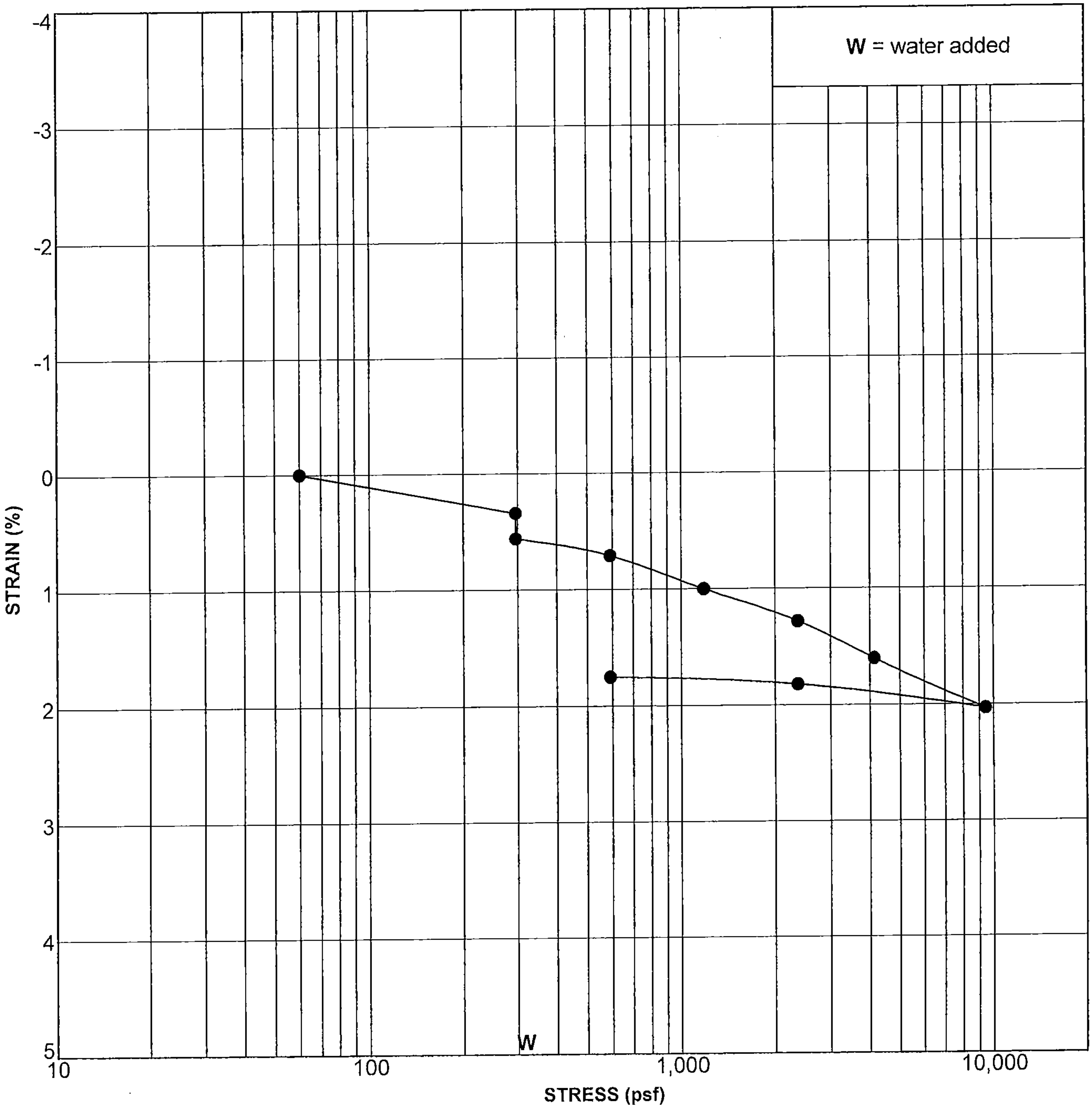

Boring Number	Depth (feet)	Geologic Unit	Symbol	In Situ or Remolded Sample	% Hydro-Collapse	Classification
DH-3	10.0		●	In Situ	0.22	Silty Sand (SM)
			⊠	In Situ		
			▲	In Situ		
			★	In Situ		

CONSOLIDATION TEST DATA

Project: Lido House Hotel
Project No. 13-160-00

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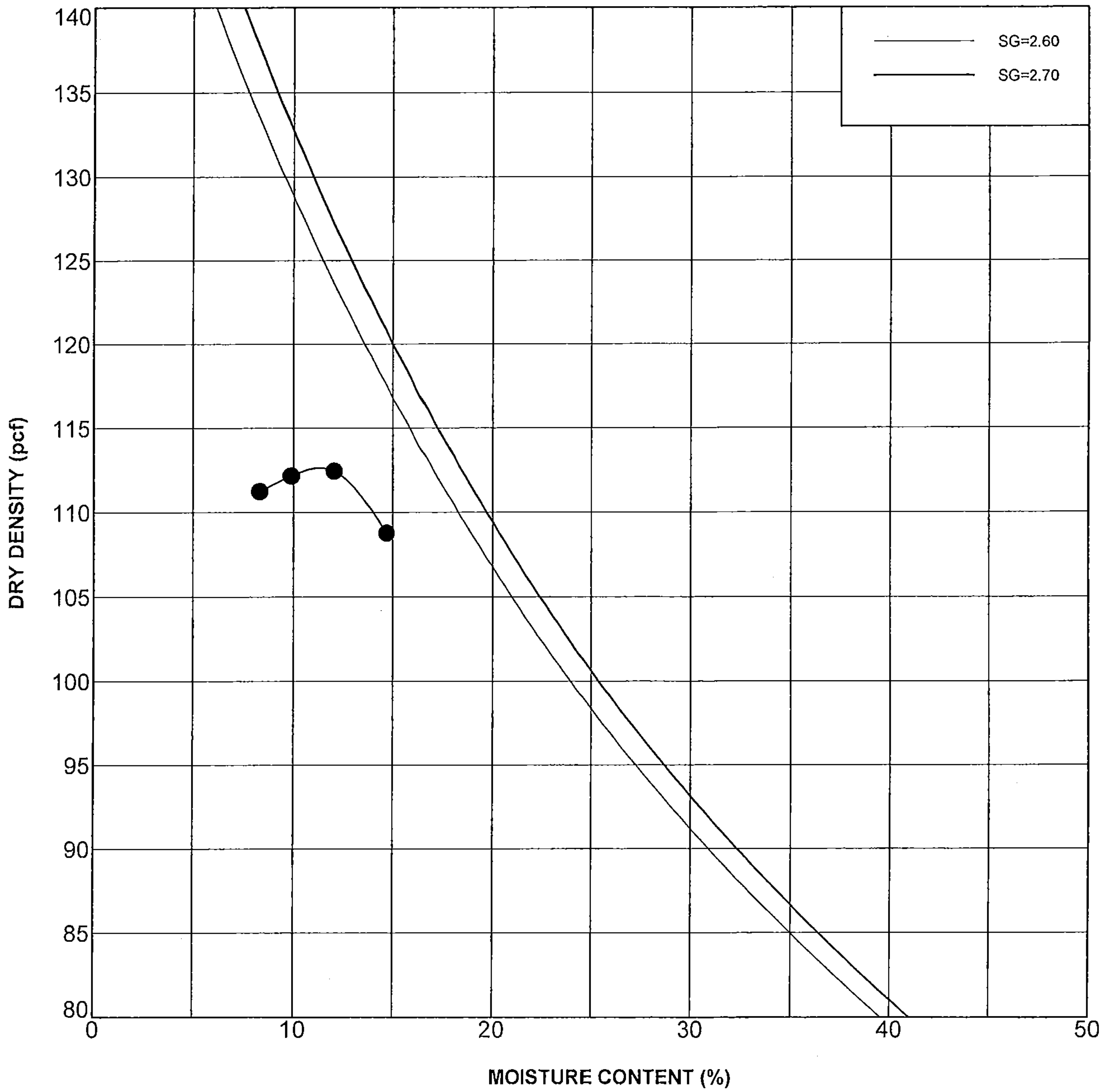

Boring Number	Depth (feet)	Geologic Unit	Symbol	Maximum Dry Density, pcf	Optimum Moisture Content, %	Classification
DH-4	1.0		●	112.5	11.5	Poorly Graded Sand (SP)

DVTCOMP 13-160-00.GPJ 11/13/13

COMPACTION TEST DATA

Project: Lido House Hotel

Project No. 13-160-00

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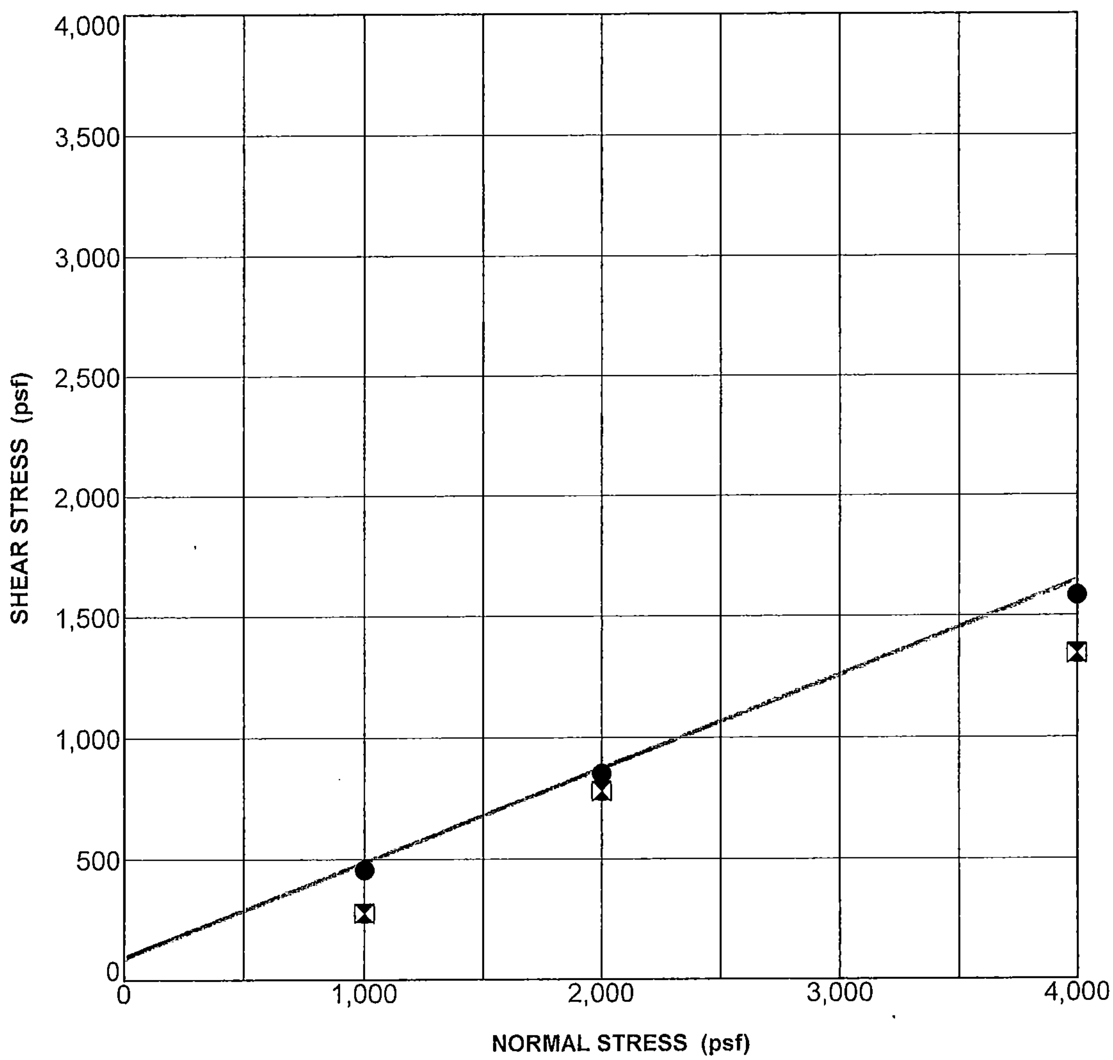

SAMPLE AND TEST DESCRIPTION
Sample Location: DH-3 @ 5.0 ft **Geologic Unit:** **Classification:** Silty Clay (CL)
Strain Rate (in/min): 0.005 **Sample Preparation:** Undisturbed
Notes: Sample saturated prior and during shearing

STRENGTH PARAMETERS		
STRENGTH TYPE	COHESION (psf)	FRICTION ANGLE (degrees)
● Peak Strength	90	21.0
⊠ Ultimate Strength	0	19.0

SHEAR TEST DATA

Project: Lido House Hotel
Project No. 13-160-00

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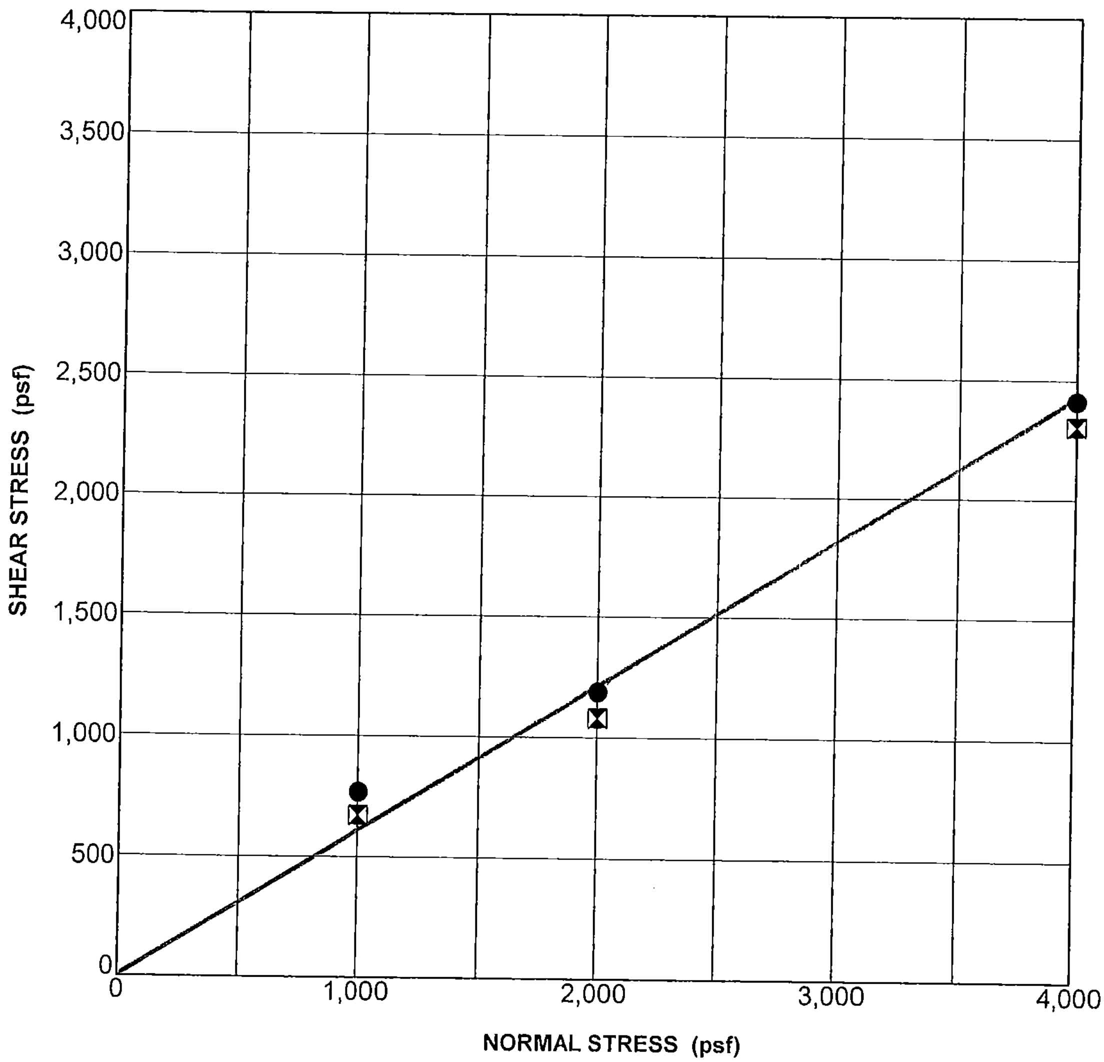

SAMPLE AND TEST DESCRIPTION		
Sample Location: DH-4 @ 1.0 ft	**Geologic Unit:**	**Classification:** Poorly Graded Sand (SP)
Strain Rate (in/min): 0.01	**Sample Preparation:** Remolded	
Notes: 90% compaction at optimum		

STRENGTH TYPE	COHESION (psf)	FRICTION ANGLE (degrees)
● Peak Strength	0	31.0
⊠ Ultimate Strength	0	29.0

SHEAR TEST DATA

Project: Lido House Hotel
Project No. 13-160-00

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EXPANSION INDEX of SOILS

ASTM D 4829

Project Name:	Lido House Newport Beach	Tested By:	JV	Date:	11/12/2013
Project No. :	13-160-00	Checked By:	JV	Date:	11/13/2013
Drill Hole No.:	DH-3	TRACT #			
Depth, ft.:	1-5				
Visual Sample Description:	SM				

Dry Wt. of Soil + Cont. (gm.)	1000.00
Wt. of Container No. (gm.)	0.00
Dry Wt. of Soil (gm.)	1000.00
Weight Soil Retained on #4 Sieve	0.00
Percent Passing # 4	100.00

	MOLDED SPECIMEN	Before Test	After Test
	Specimen Diameter (in.)	4.00	
	Specimen Height (in.)	1.0000	
G	Wt. Comp. Soil + Mold (gm.)	575.10	
H	Wt. of Mold (gm.)	192.10	
	Specific Gravity (Assumed)	2.70	
	Container No.	C	
A	Wet Wt. of Soil + Cont. (gm.)	146.50	0.00
B	Dry Wt. of Soil + Cont. (gm.)	138.80	0.00
D	Wt. of Container (gm.)	70.10	0.00
F	Moisture Content (%)	11.21	#DIV/0!
J	Wet Density (pcf)	116.1	
K	Dry Density (pcf)	104.4	
	Void Ratio	0.615	
	Total Porosity	0.381	
	Pore Volume (cc)	78.4	
L	Degree of Saturation (%) [S meas]	**49.2**	

SPECIMEN INUNDATION in distilled water for the period of 24 h or expansion rate < 0.0002 in./h.

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Readings (in.)
11/12/13	10:45	1.0	0	0.0979
11/12/13	10:55	1.0	10	0.0969
Add Distilled Water to the Specimen				
11/12/13	11:19	1.0	24	0.0964
11/12/13	16:50	1.0	355	0.0959
11/13/13	6:45	1.0	1190	0.0968
11/13/13	6:45	1.0	1190	0.0968

Expansion Index (EI_{meas}) = ((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	-0.1
Expansion Index $(EI)_{50}$ = $EI_{meas} - (50 - S_{meas})x((65+EI_{meas}) / (220-S_{meas}))$	**0**
	VERY LOW

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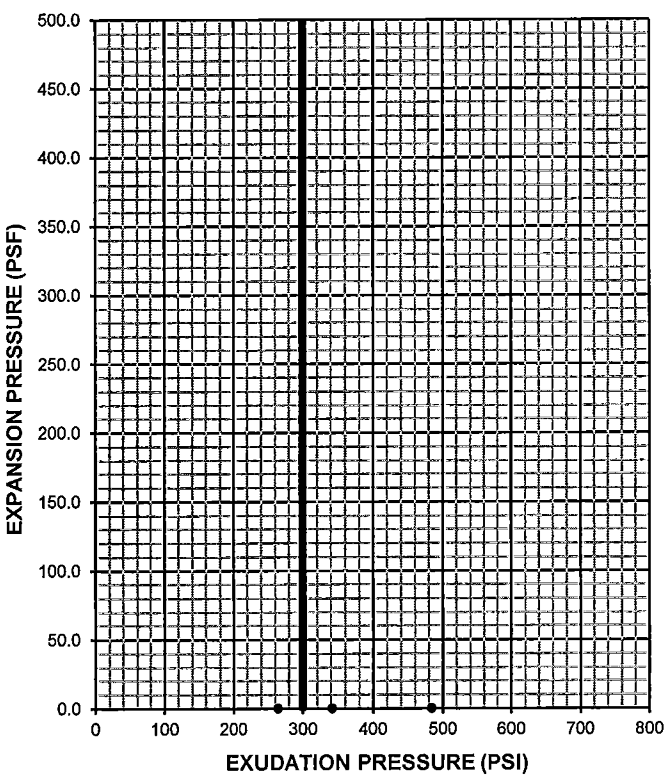
R-VALUE TEST RESULTS

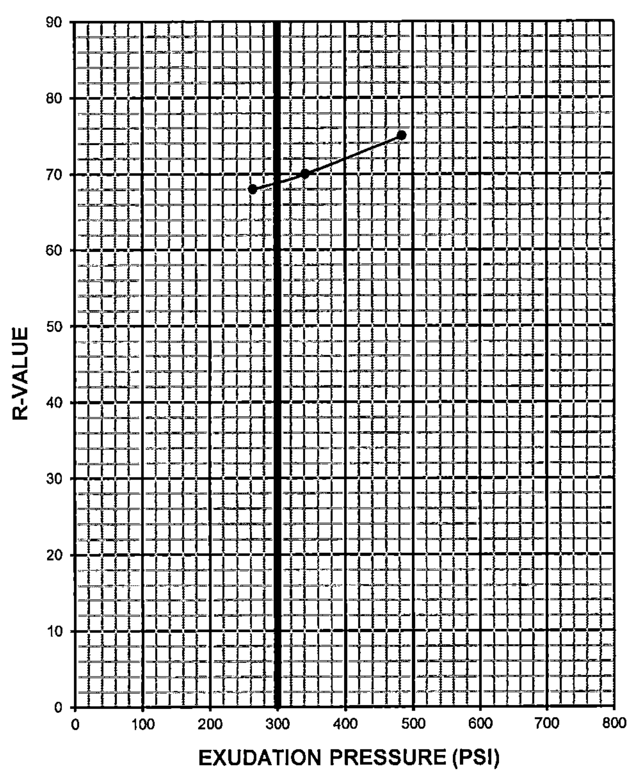
PROJECT NAME:	Lido House Nweport Beach	PROJECT NUMBER:	13-160-00
SAMPLE LOCATION:	Newport Beach	SAMPLE NUMBER:	DH-1 @ 1'-3'
SAMPLE DESCRIPTION:	Poorly Graded Sand (SP)	TECHNICIAN:	JV
		DATE TESTED	11/12/2013

TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION %	11.5	10.7	10.2
WEIGHT OF SAMPLE, grams	1025	994	1013
HEIGHT OF SAMPLE, Inches	2.62	2.51	2.56
DRY DENSITY, pcf	106.3	108.4	108.8
COMPACTOR AIR PRESSURE, psi	250	250	250
EXUDATION PRESSURE, psi	264	342	484
EXPANSION, Inches x 10exp-4	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	30	28	24
TURNS DISPLACEMENT	5.10	5.00	4.66
R-VALUE UNCORRECTED	68	70	75
R-VALUE CORRECTED	68	70	75
EXPANSION PRESSURE (psf)	0.0	0.0	0.0

EXPANSION PRESSURE VS. EXUDATION PRESSURE



R-VALUE VS. EXUDATION PRESSURE



R-VALUE AT 300 PSI EXUDATION PRESSURE :	69
EXP. PRESSURE AT 300 PSI EXUDATION PRESSURE (PSF) :	0

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SOIL CORROSIVITY TESTS

DOT CA TEST 417/422/ 643

Project Name:	Lido House Hotel	Tested By :	EE/MF Date 11/07/13
Project No. :	13-160-00	Data Input By:	MF Date 11/13/13
Pad #'S:	0 - 1'	Depth (ft.) :	1' - 5'
Sample No. :	DH-3	Flask #	S1
Sample Description:	Silty Sand (SM)		

Chloride Content, DOT California Test 422 / **Sulfate Content, DOT California Test 417**

Sample used from flask (ml)	25.0		Sample used from flask (ml)	20.0	
Initial Burette Reading (ml)	15.9		Total Diluted amount (ml)	100.0	
Final Burette Reading (ml)	17.40		Spectrophotometer reading	0.000	
Silver Nitrate usen in titration (ml)	1.50		% Transmittance	100.00	
Chloride (ppm)	90.0		**Sulfate (ppm)**	0.0	

Soil Resistivity, DOT California Test 643

Remolded Specimen	Moisture Adjustments			
Water Added (ml)	45	50	50	50
Adj. Moisture Content (%)	7.5%	15.8%	24.2%	32.5%
Soil Temperature (C)	22.3	20.6	20.5	19.7
Resistance Reading (ohm)	38000	27000	12000	13000
Soil Resistivity (ohm-cm)	44460.0	30442.5	13500.0	14365.0
Remolded Specimen	Moisture Adjustments			
Water Added (ml)				
Adj. Moisture Content (%)				
Soil Temperature (C)				
Resistance Reading (ohm)				
Soil Resistivity (ohm-cm)				

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH
DOT CA Test 532 / 643		DOT CA Test 417 1999	DOT CA Test 422	DOT CA Test 532 / 643
13500	**24.2**	**0**	**90**	**7.3**

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SOIL CORROSIVITY TESTS
DOT CA TEST 417/422/ 643

Project Name:	Lido House Hotel	Tested By :	EE/MF Date 11/07/13
Project No. :	13-160-00	Data Input By:	MF Date 11/13/13
Pad #'S:	0 - 1'	Depth (ft.) :	1.0' - 4.0'
Sample No. :	DH-4	Flask #	S2
Sample Description:	Poorly Graded Sand (SP)		

Chloride Content, DOT California Test 422			Sulfate Content, DOT California Test 417		
Sample used from flask (ml)	25.0		Sample used from flask (ml)	20.0	
Initial Burette Reading (ml)	0.1		Total Diluted amount (ml)	100.0	
Final Burette Reading (ml)	3.20		Spectrophotometer reading	0.045	
Silver Nitrate usen in titration (ml)	3.10		% Transmittance	98.00	
Chloride (ppm)	186.0		**Sulfate (ppm)**	64.9	

Soil Resistivity, DOT California Test 643

Remolded Specimen	Moisture Adjustments			
Water Added (ml)	45	50	50	
Adj. Moisture Content (%)	7.5%	15.8%	24.2%	
Soil Temperature (C)	21.9	20.6	20.0	
Resistance Reading (ohm)	19000	11000	11000	
Soil Resistivity (ohm-cm)	22040.0	12402.5	12237.5	
Remolded Specimen	Moisture Adjustments			
Water Added (ml)				
Adj. Moisture Content (%)				
Soil Temperature (C)				
Resistance Reading (ohm)				
Soil Resistivity (ohm-cm)	0.0	0.0	0.0	0.0

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH
DOT CA Test 532 / 643		DOT CA Test 417 1999	DOT CA Test 422	DOT CA Test 532 / 643
12200	**25.0**	**65**	**186**	**7.3**

SAND EQUIVALENT TEST RESULTS

BORING NUMBER	DEPTH	GEOLOGIC UNIT	USCS	SAND EQUIVALENT
DH-2	1'-3'	Qaf	SP	72

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4329

APPENDIX C

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APPENDIX C

Liquefaction Analysis

(Including Liquefaction-Induced Settlement and Lateral Spread)

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http://www.geologismiki.gr

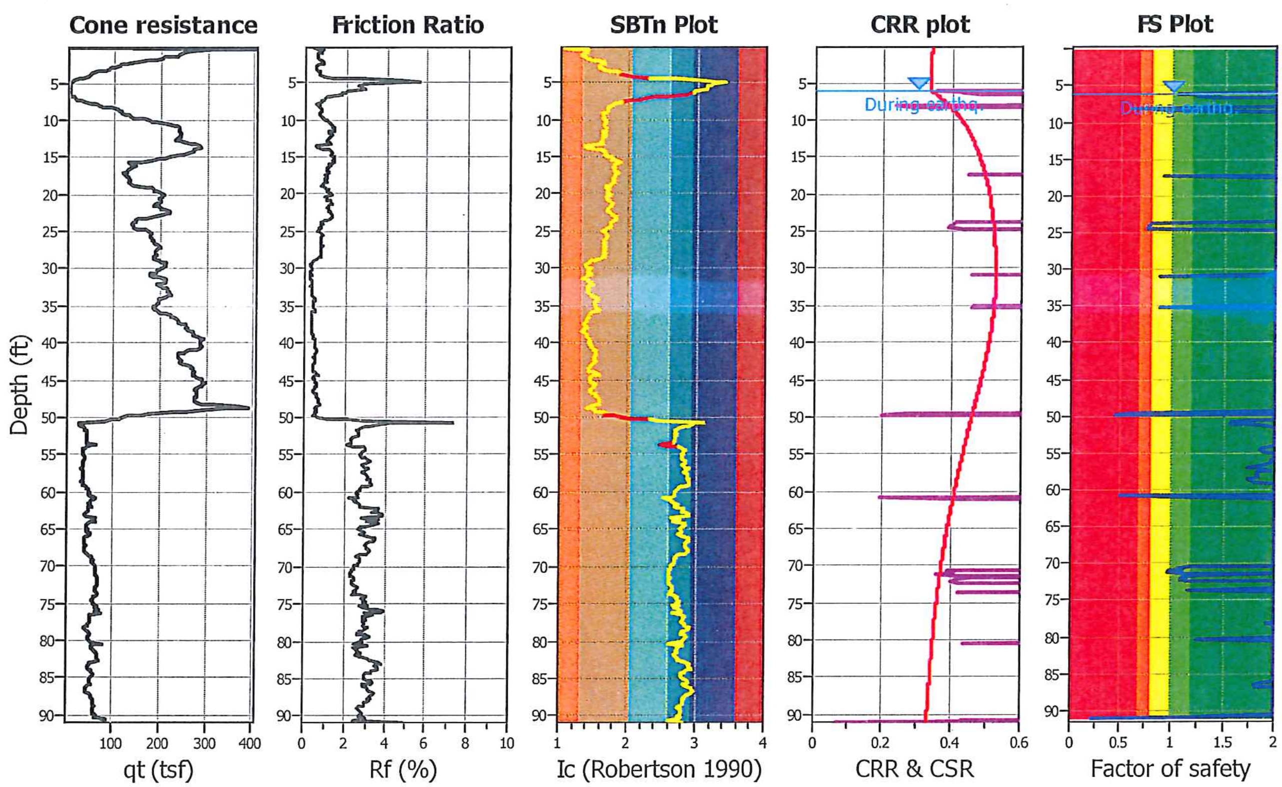
LIQUEFACTION ANALYSIS REPORT

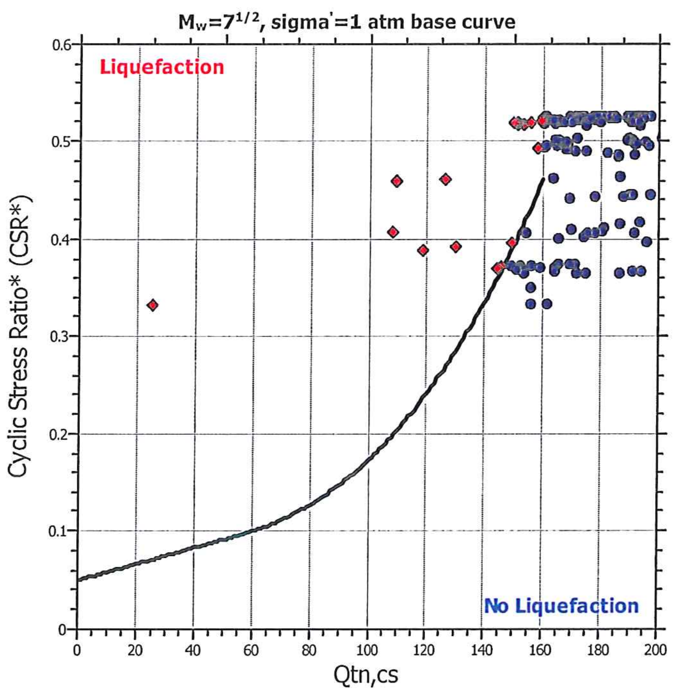
Project title : Lido House Hotel **Location : Balboa Penesula**

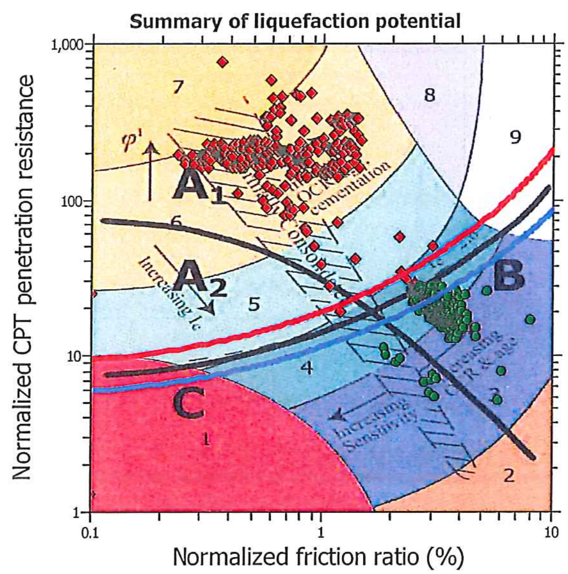
CPT file : CPT-1

Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	6.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	6.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.97	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.63	Unit weight calculation:	Based on SBT	K_σ applied:	No		

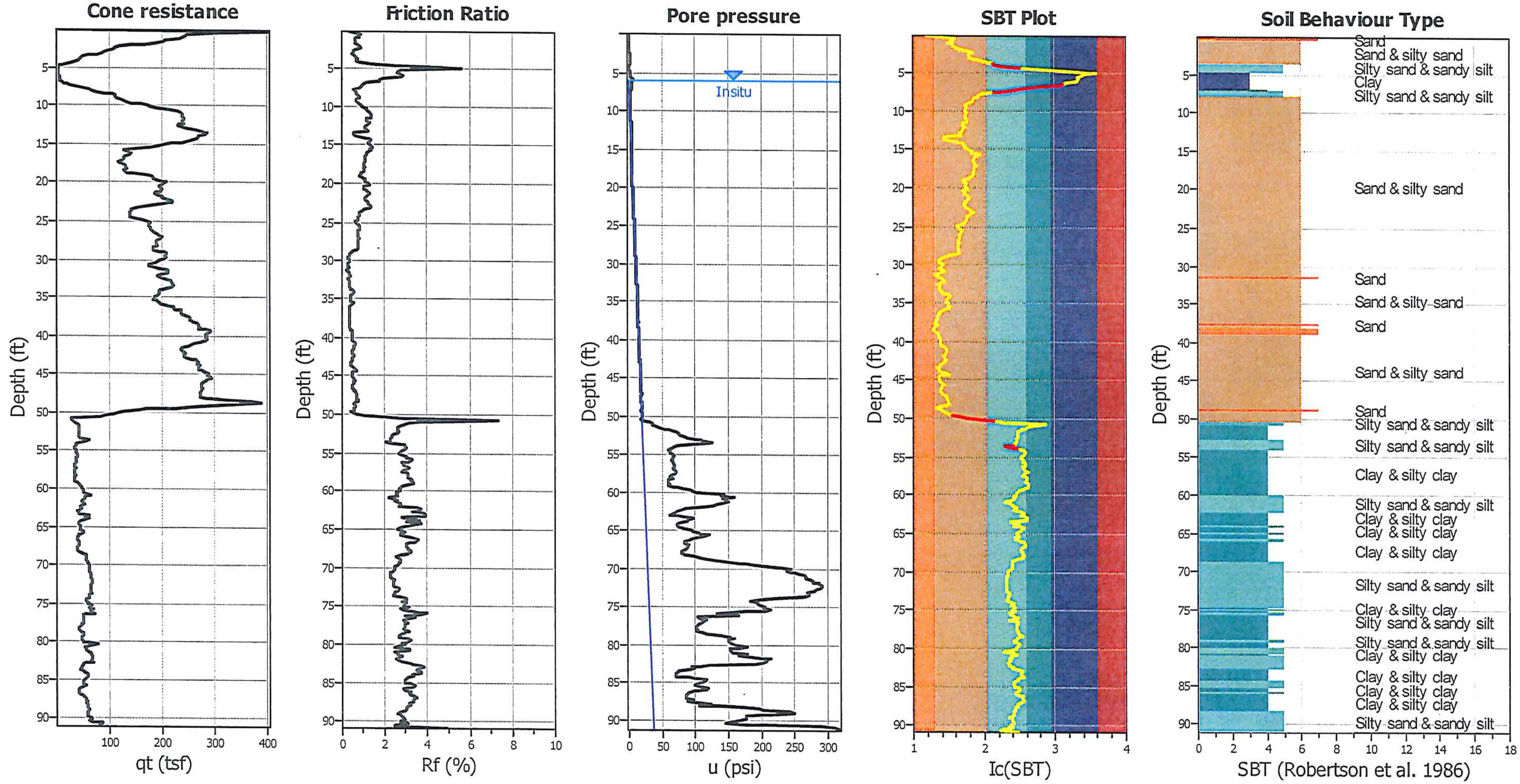






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



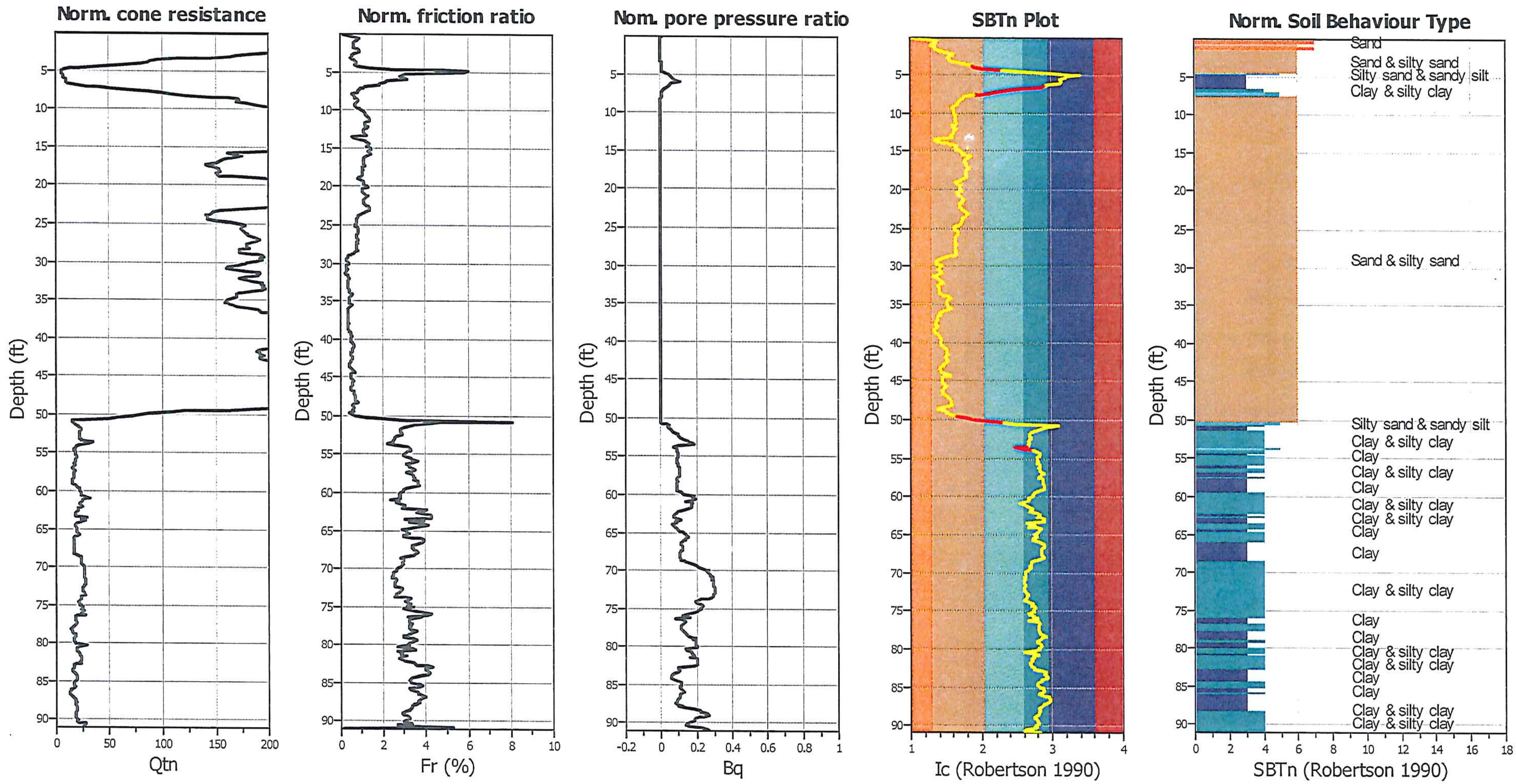
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.97	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



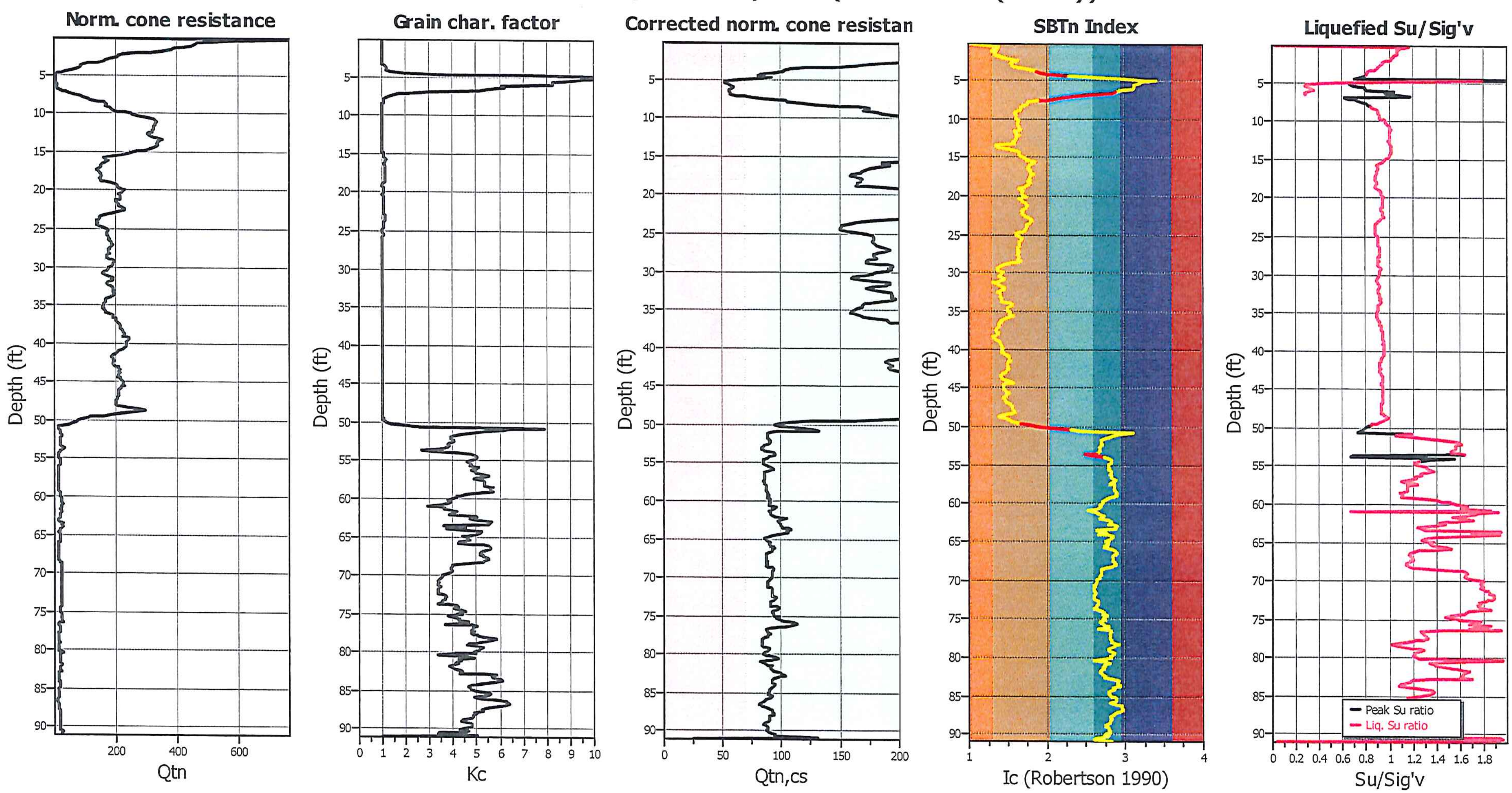
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.97	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

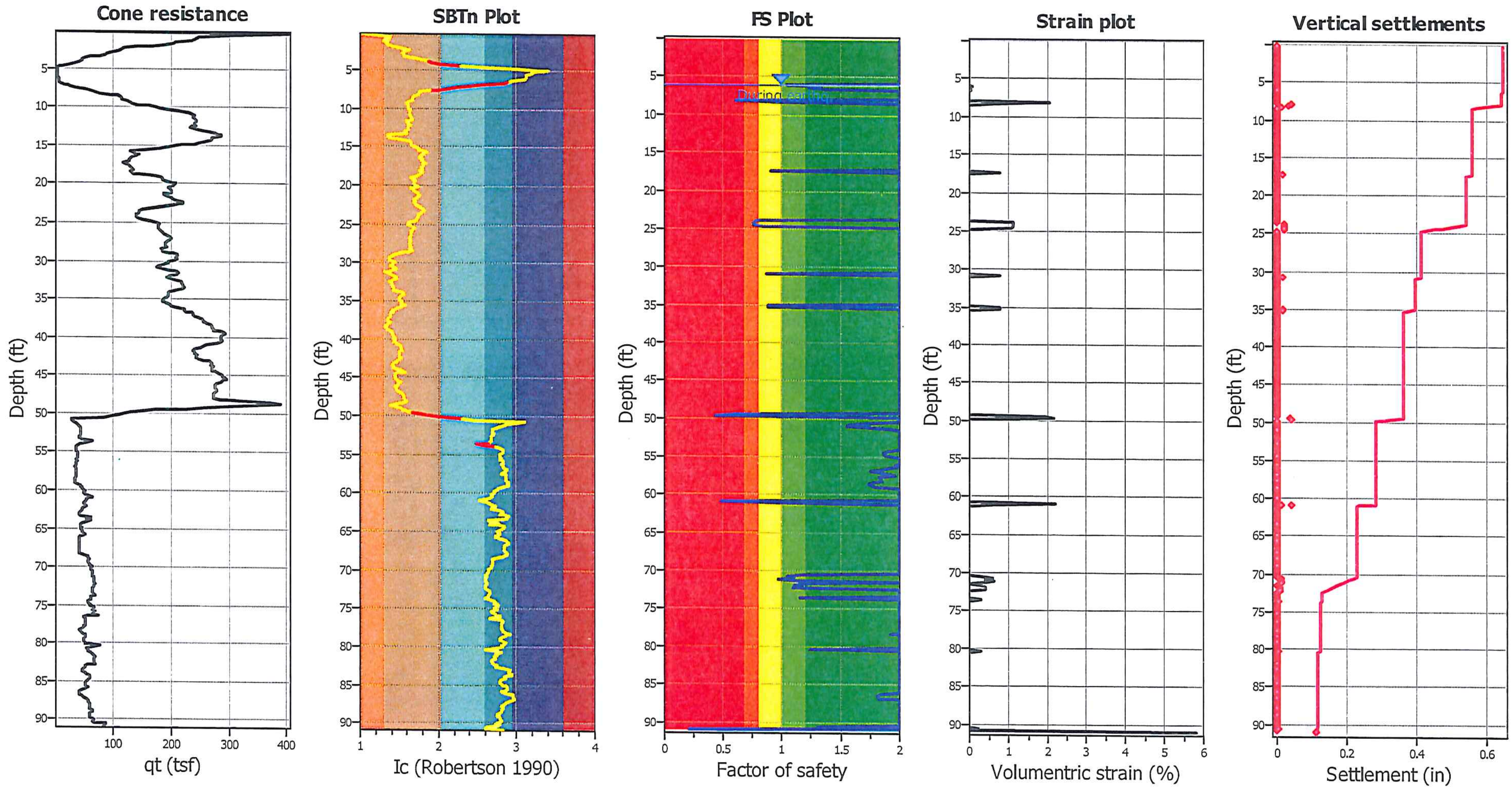
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.97	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	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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http://www.geologismiki.gr

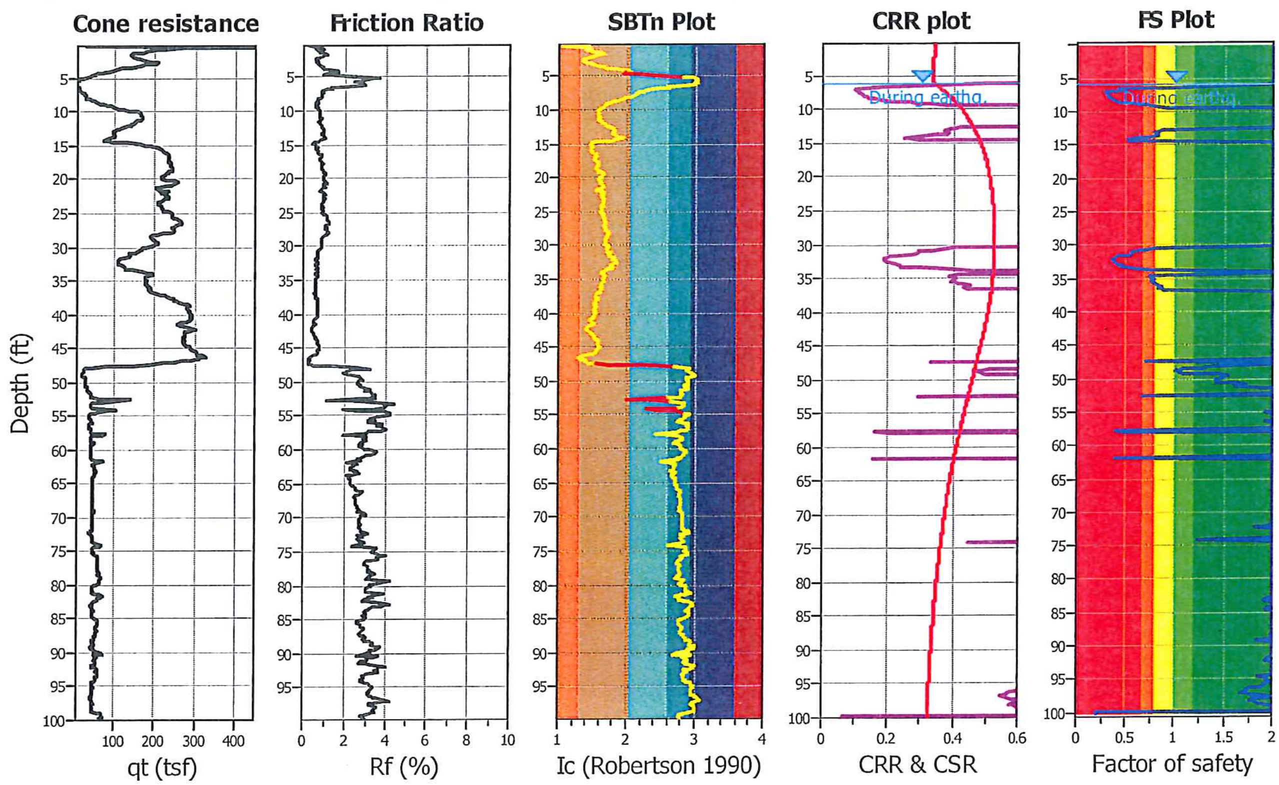
LIQUEFACTION ANALYSIS REPORT

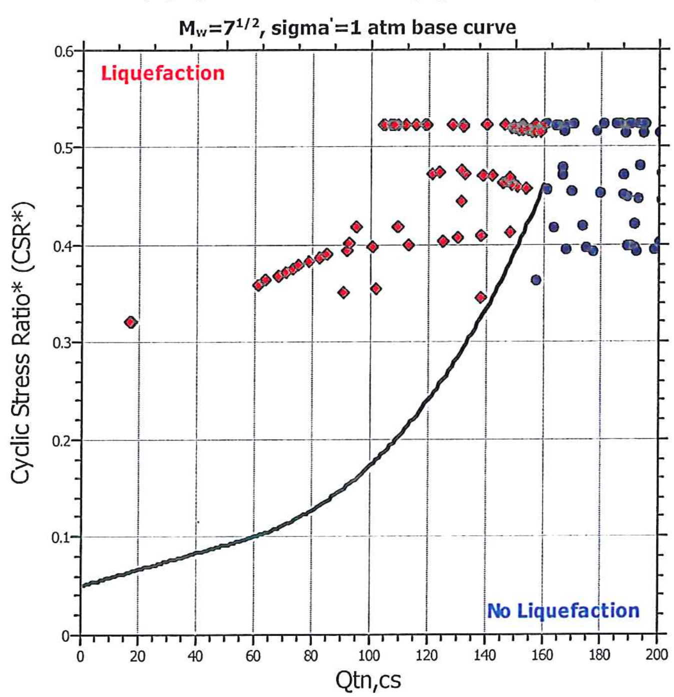
Project title : Lido House Hotel **Location : Balboa Penesula**

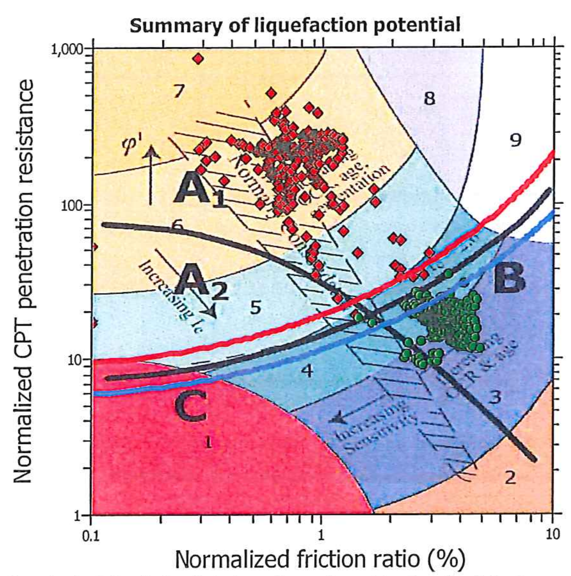
CPT file : CPT-2

Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	6.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	6.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.97	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.63	Unit weight calculation:	Based on SBT	K_σ applied:	No		

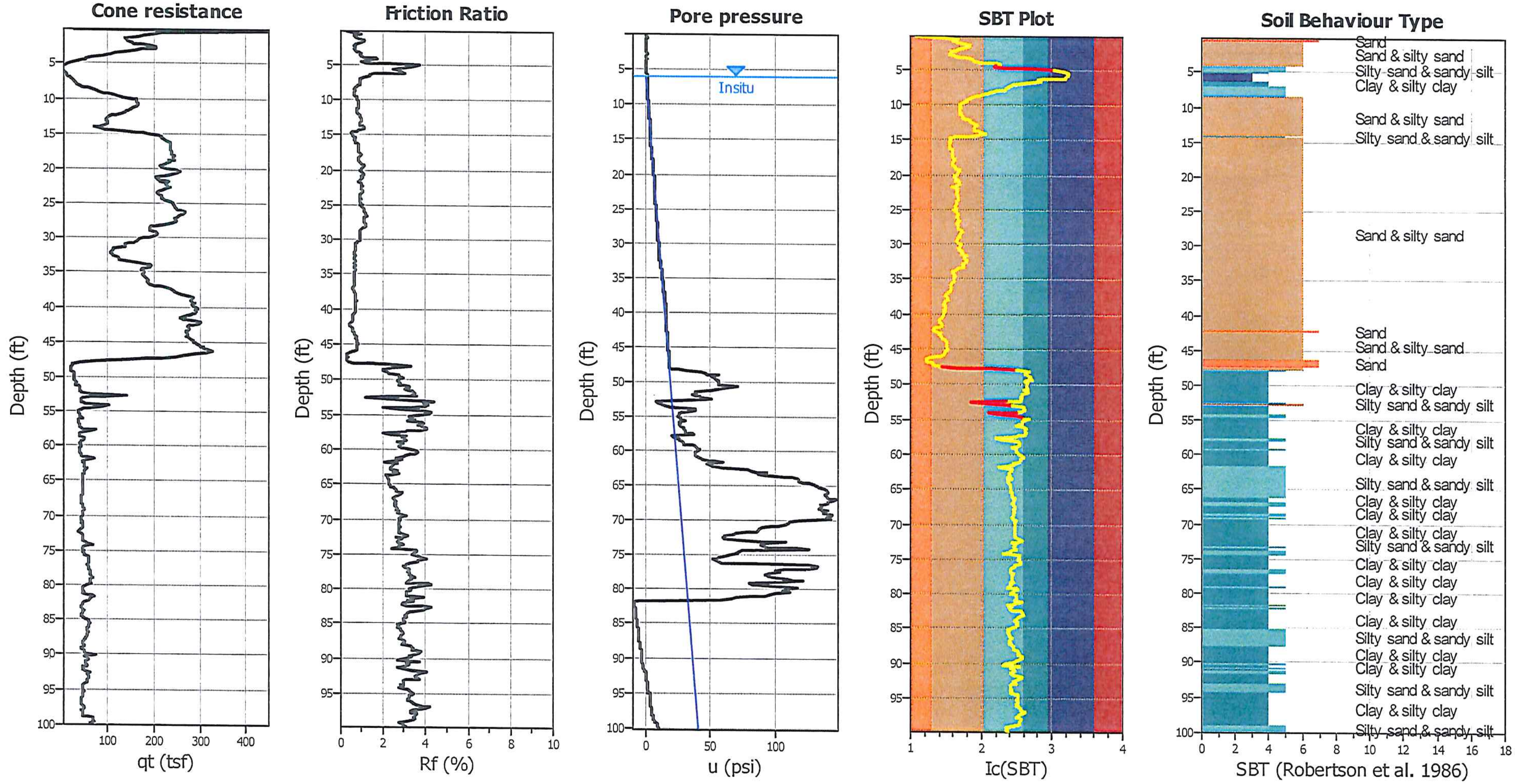






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



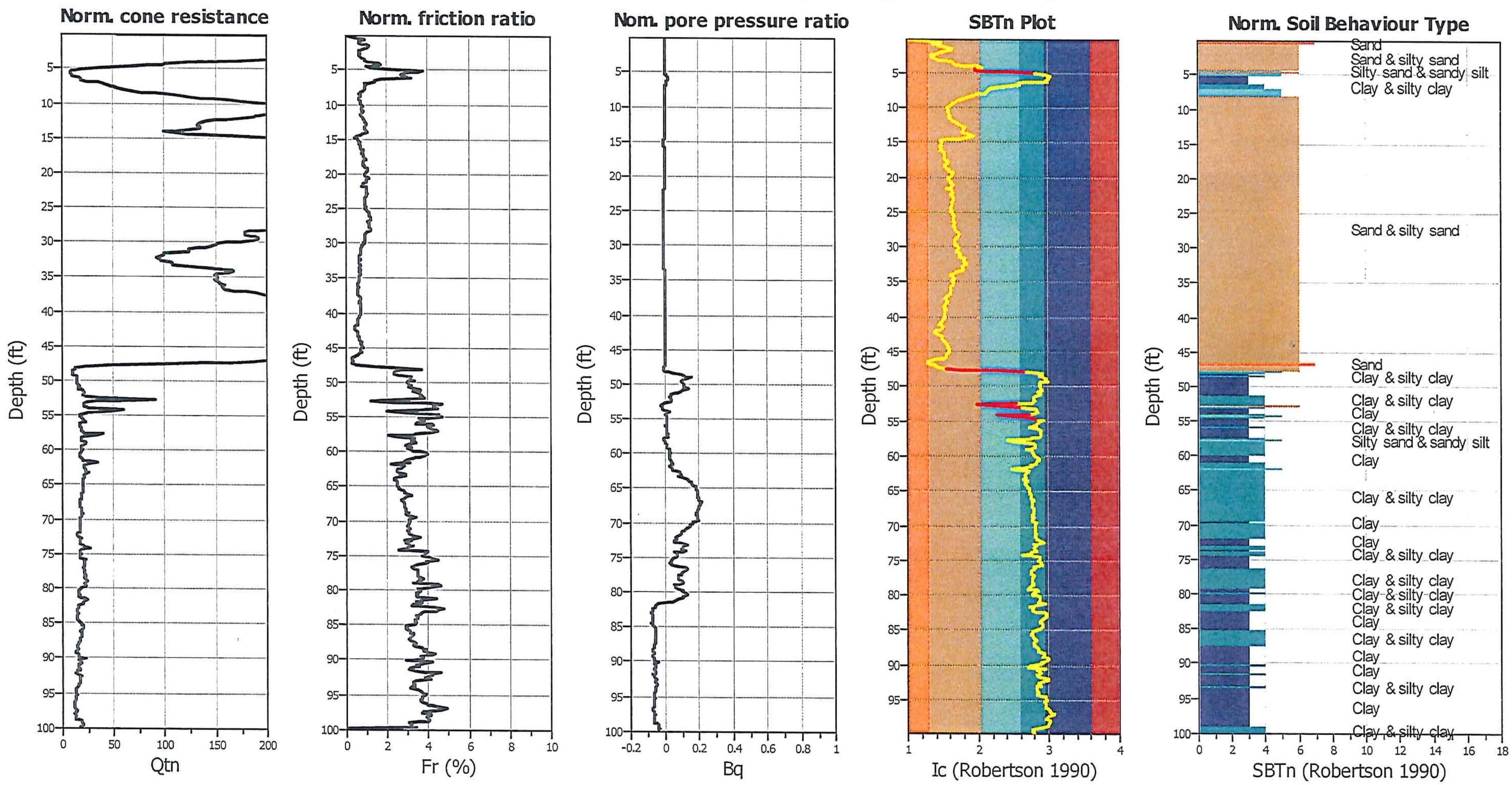
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.97	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



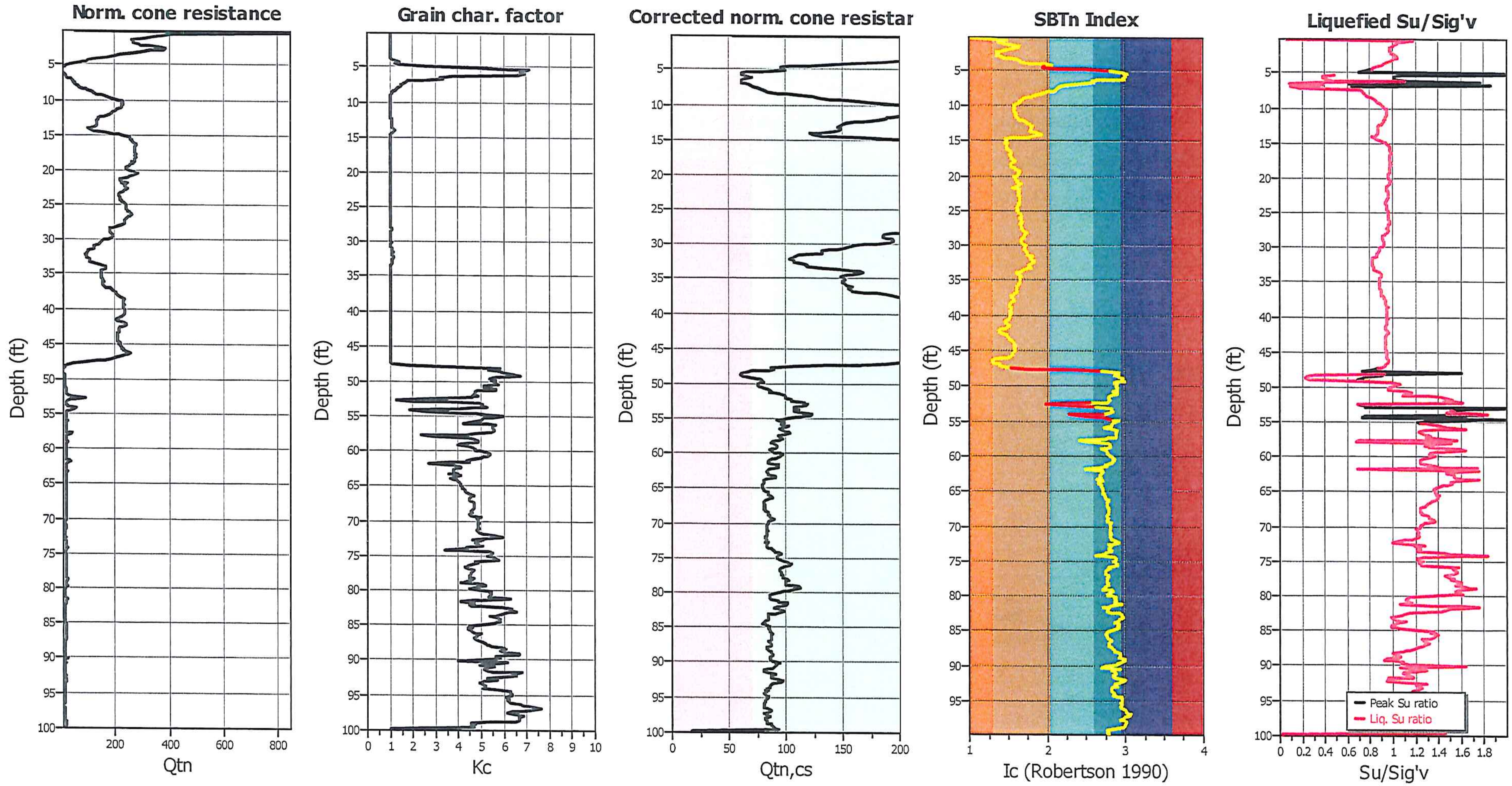
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.97	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Check for strength loss plots (Robertson (2010))



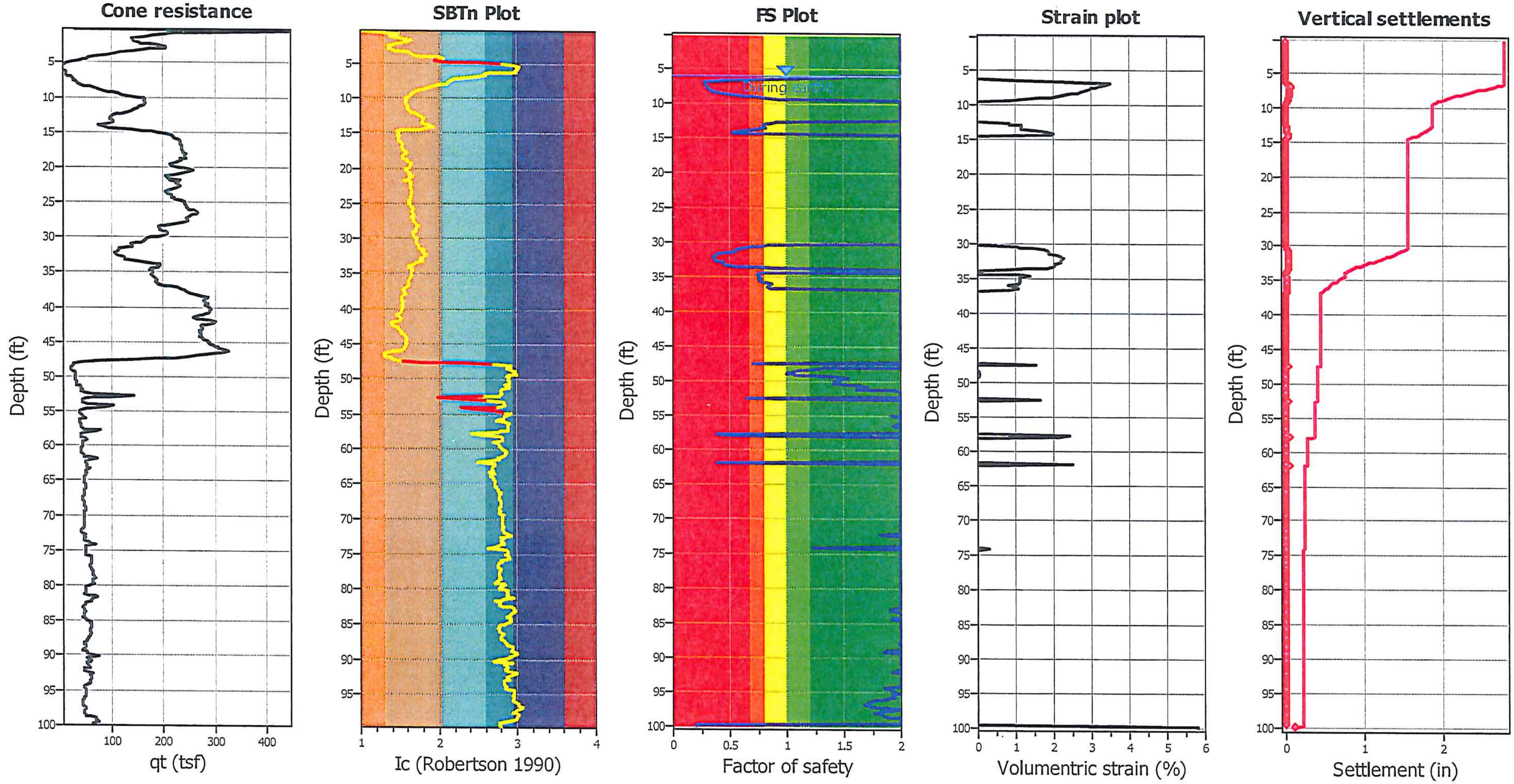
Input parameters and analysis data

Analysis method:	Robertson (2009)
Fines correction method:	Robertson (2009)
Points to test:	Based on Ic value
Earthquake magnitude M_w:	6.97
Peak ground acceleration:	0.63
Depth to water table (insitu):	6.00 ft

Depth to water table (erthq.):	6.00 ft
Average results interval:	1
Ic cut-off value:	2.60
Unit weight calculation:	Based on SBT
Use fill:	No
Fill height:	N/A

Fill weight:	N/A
Transition detect. applied:	Yes
K_σ applied:	No
Clay like behavior applied:	All soils
Limit depth applied:	No
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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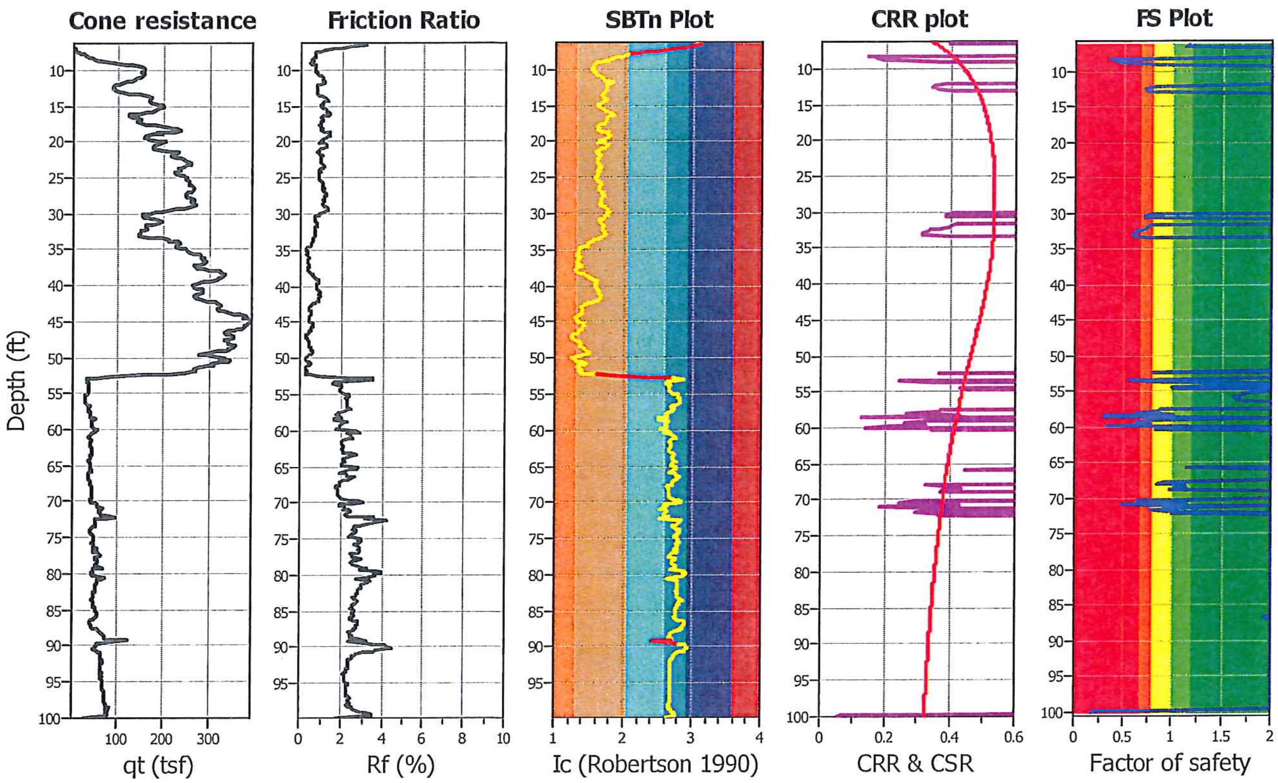
LIQUEFACTION ANALYSIS REPORT

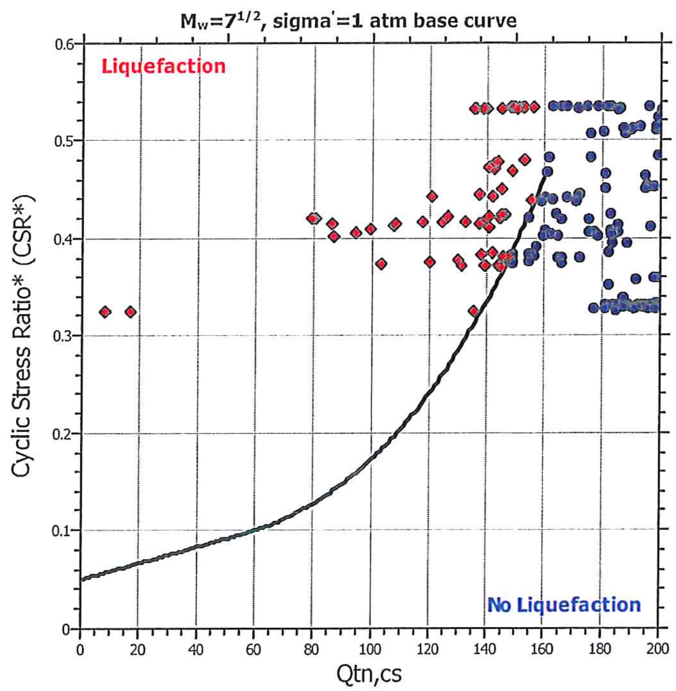
Project title : Lido House Hotel **Location : Balboa Penesula**

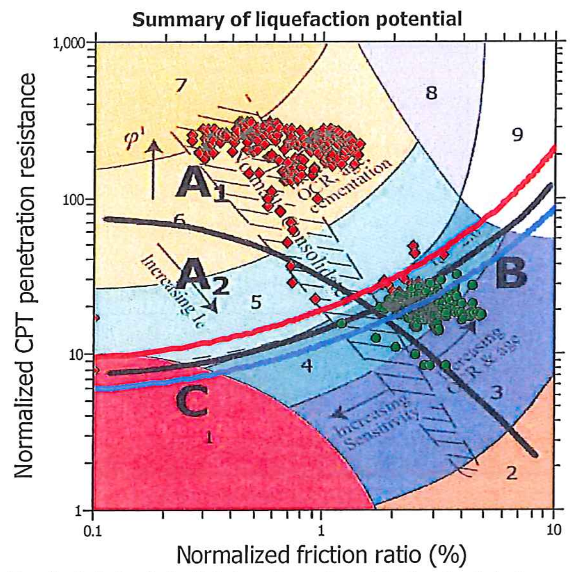
CPT file : CPT-3

Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	6.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	6.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.97	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.63	Unit weight calculation:	Based on SBT	K_σ applied:	No		

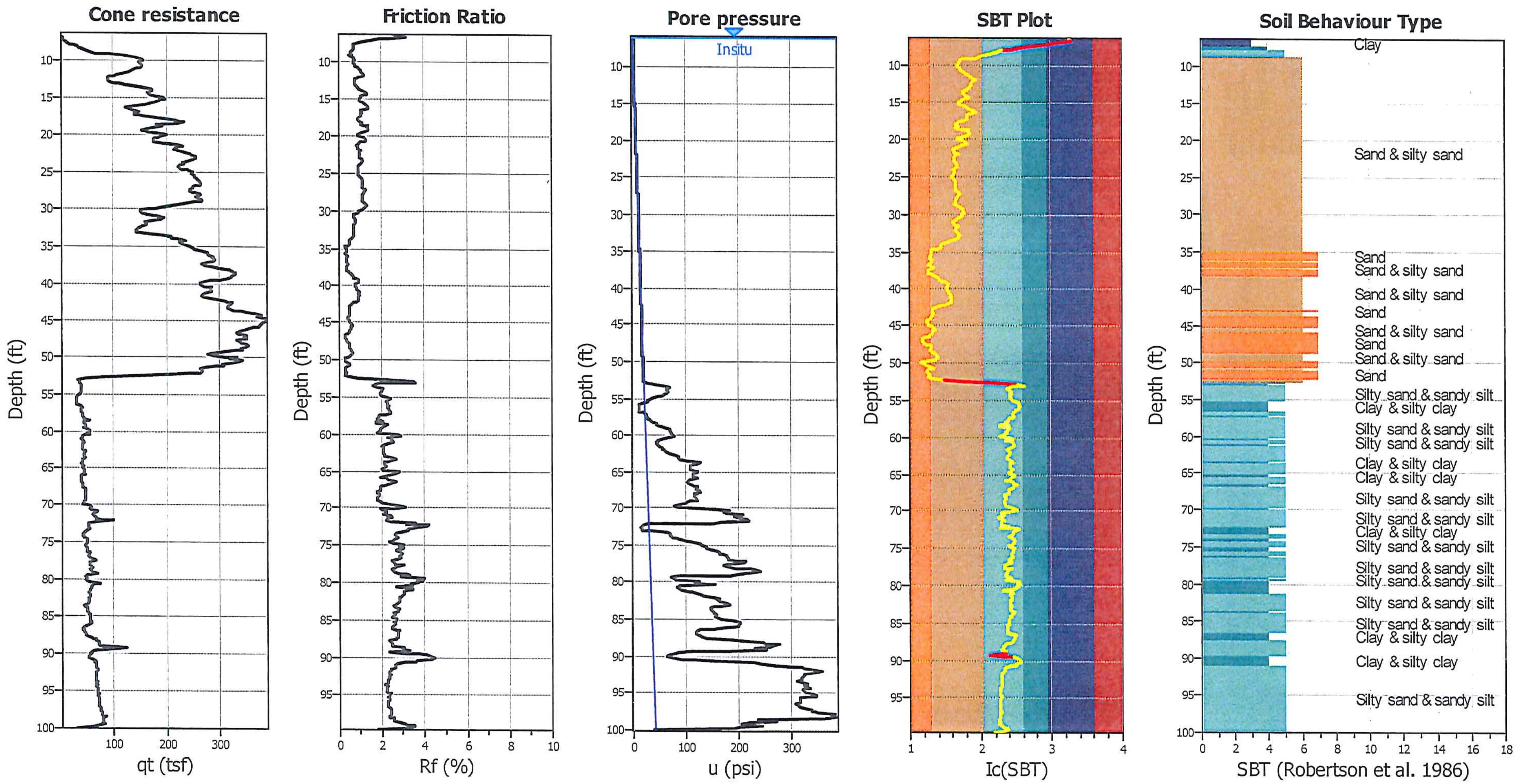






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



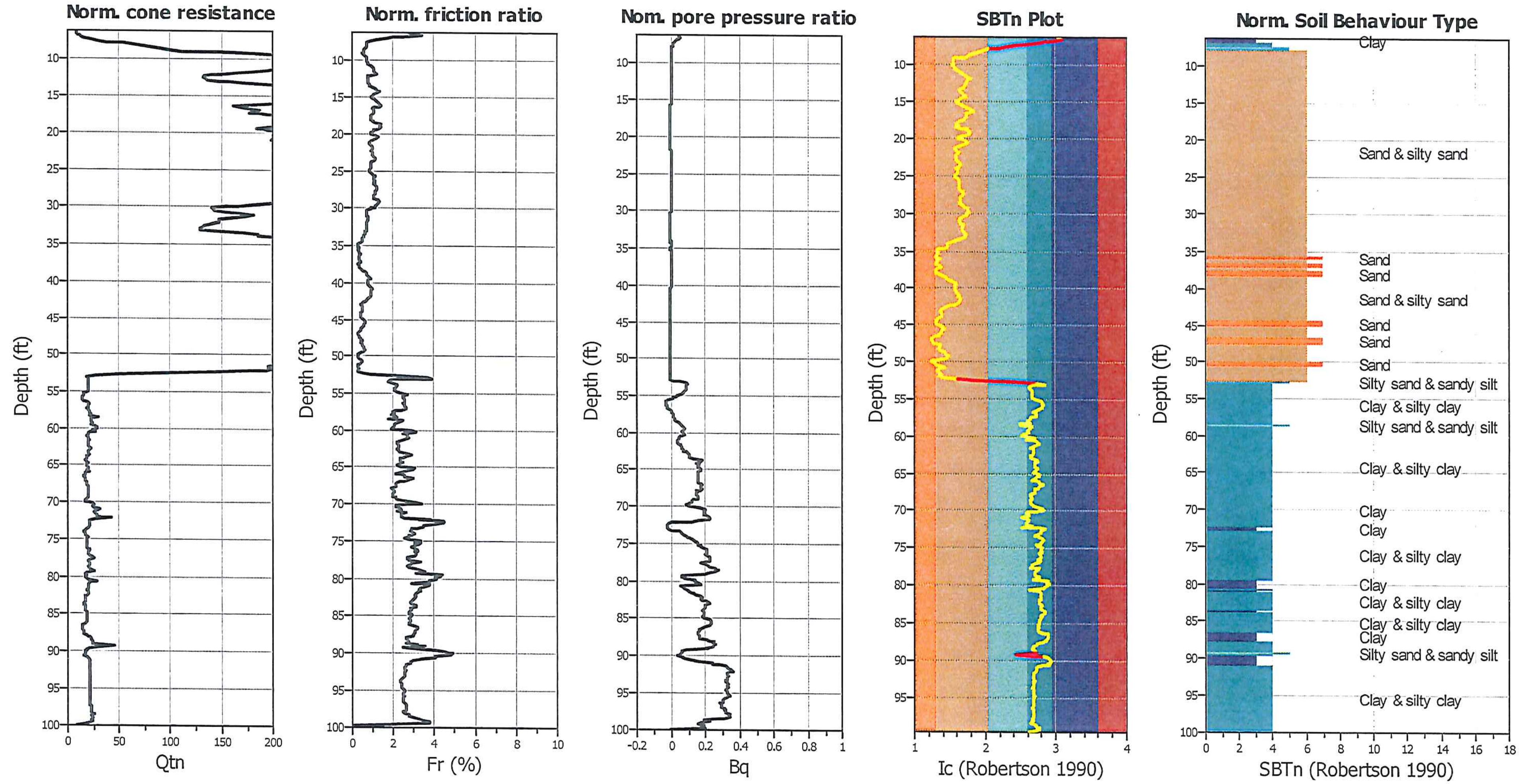
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.97	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



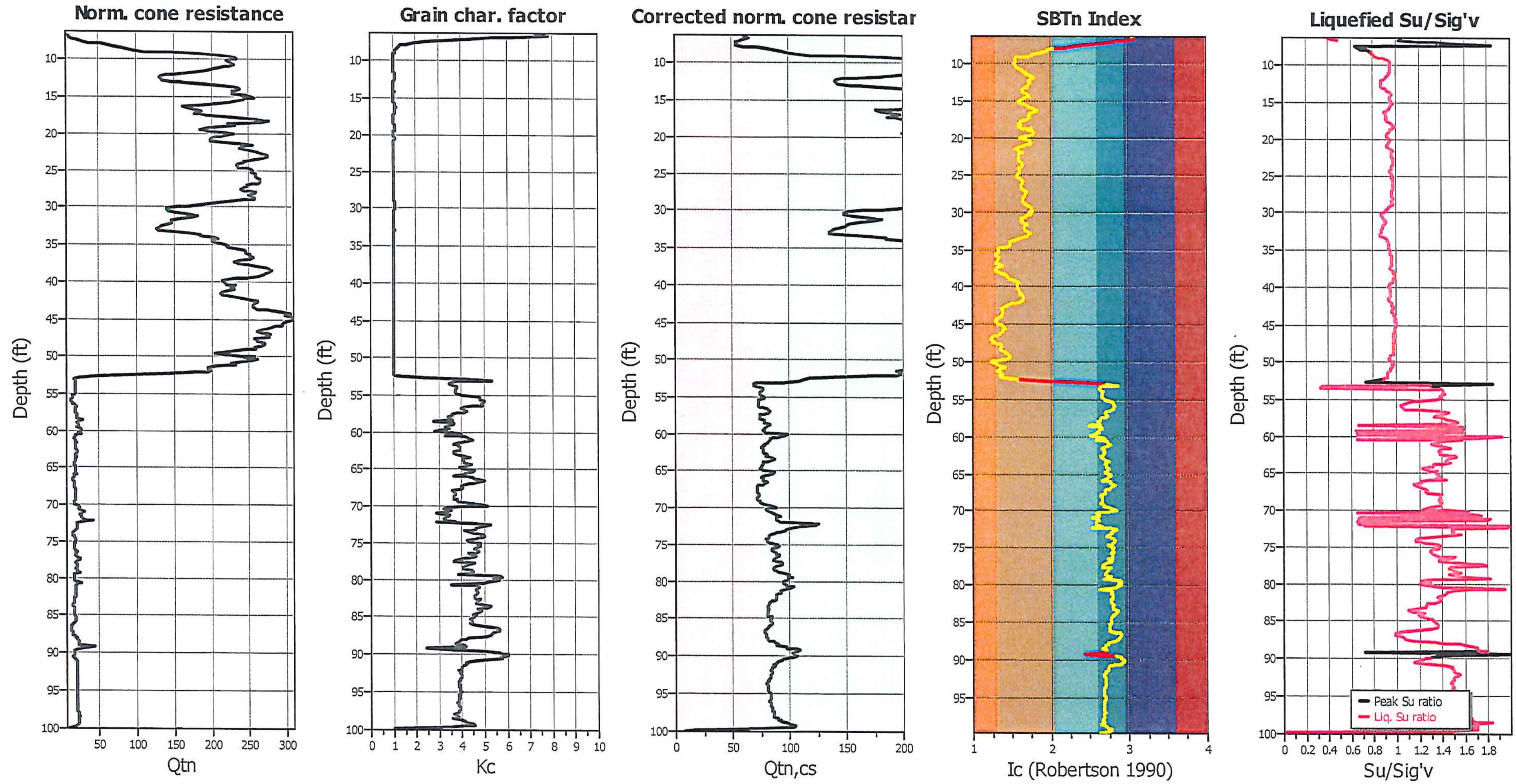
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.97	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

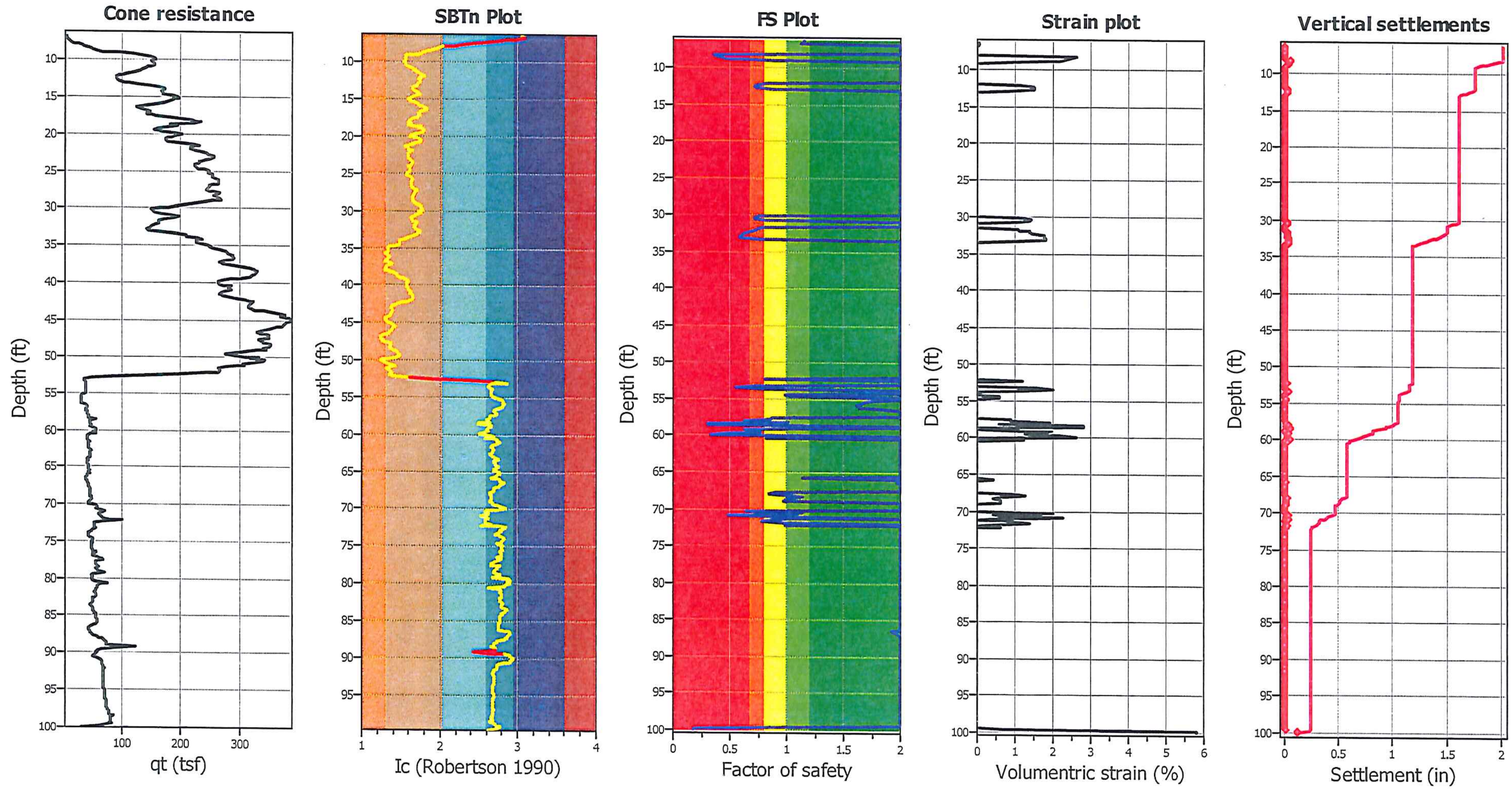
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.97	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	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

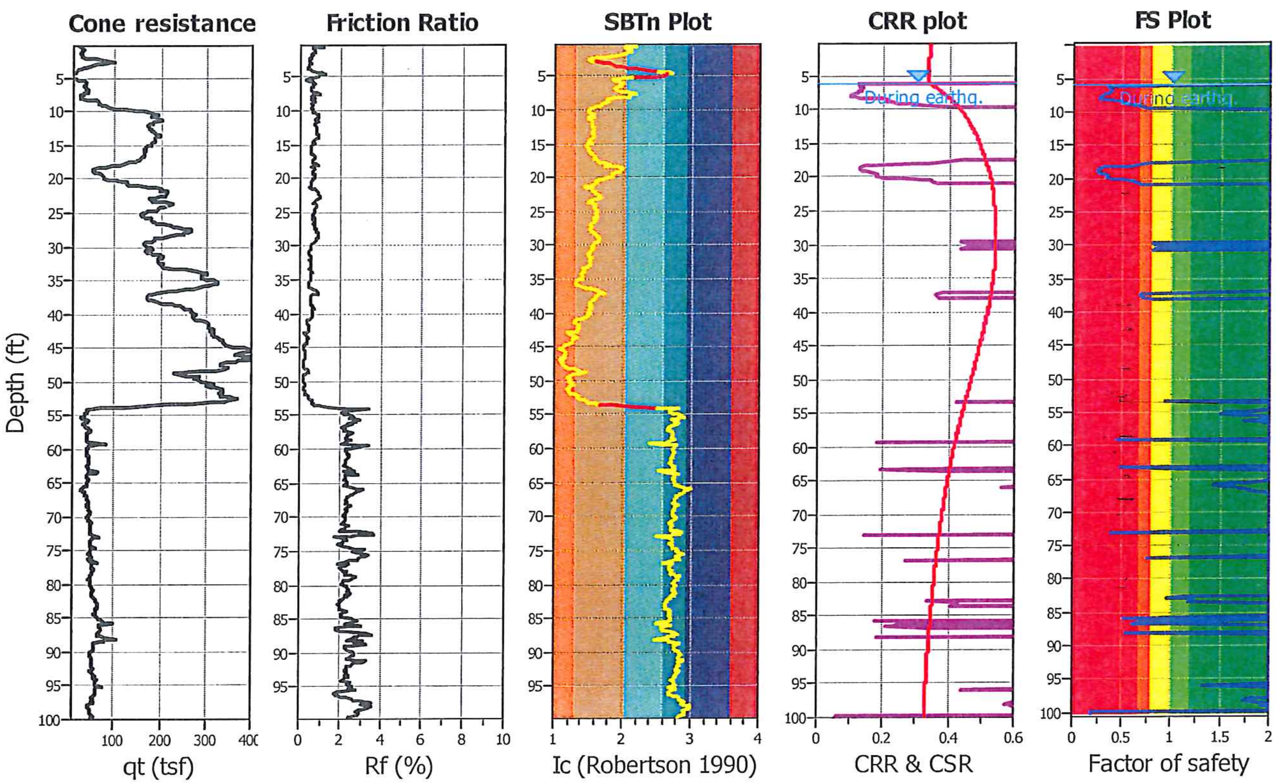
LIQUEFACTION ANALYSIS REPORT

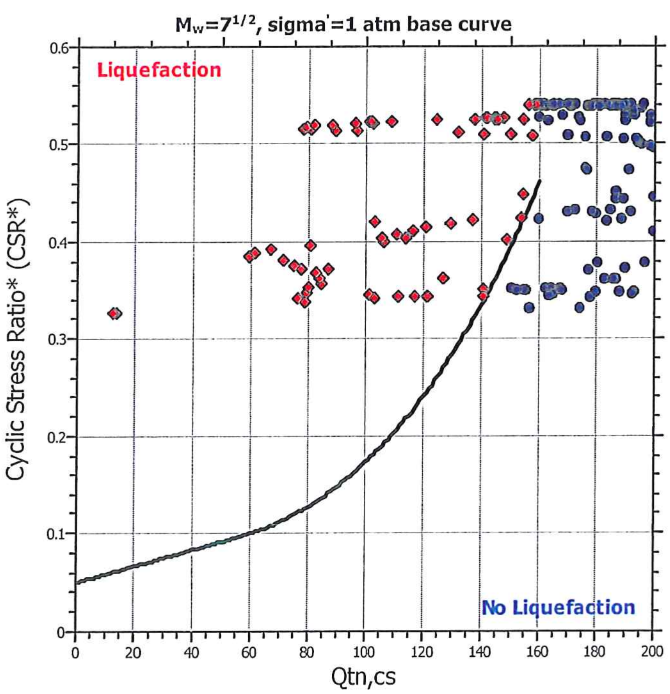
Project title : Lido House Hotel **Location : Balboa Penesula**

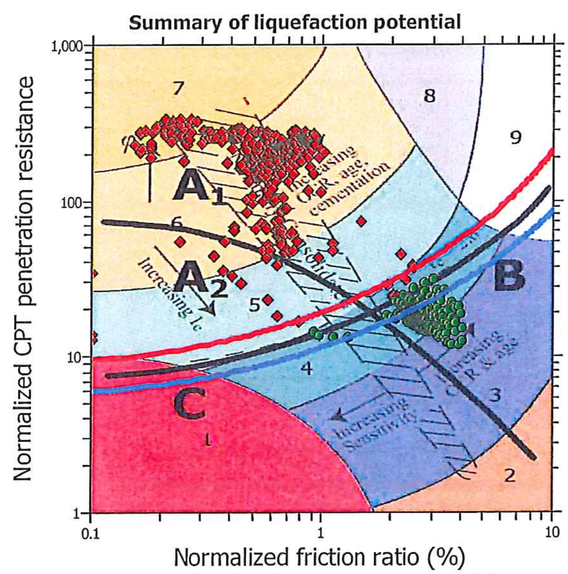
CPT file : CPT-4

Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	6.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	6.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.97	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.63	Unit weight calculation:	Based on SBT	K_σ applied:	No		

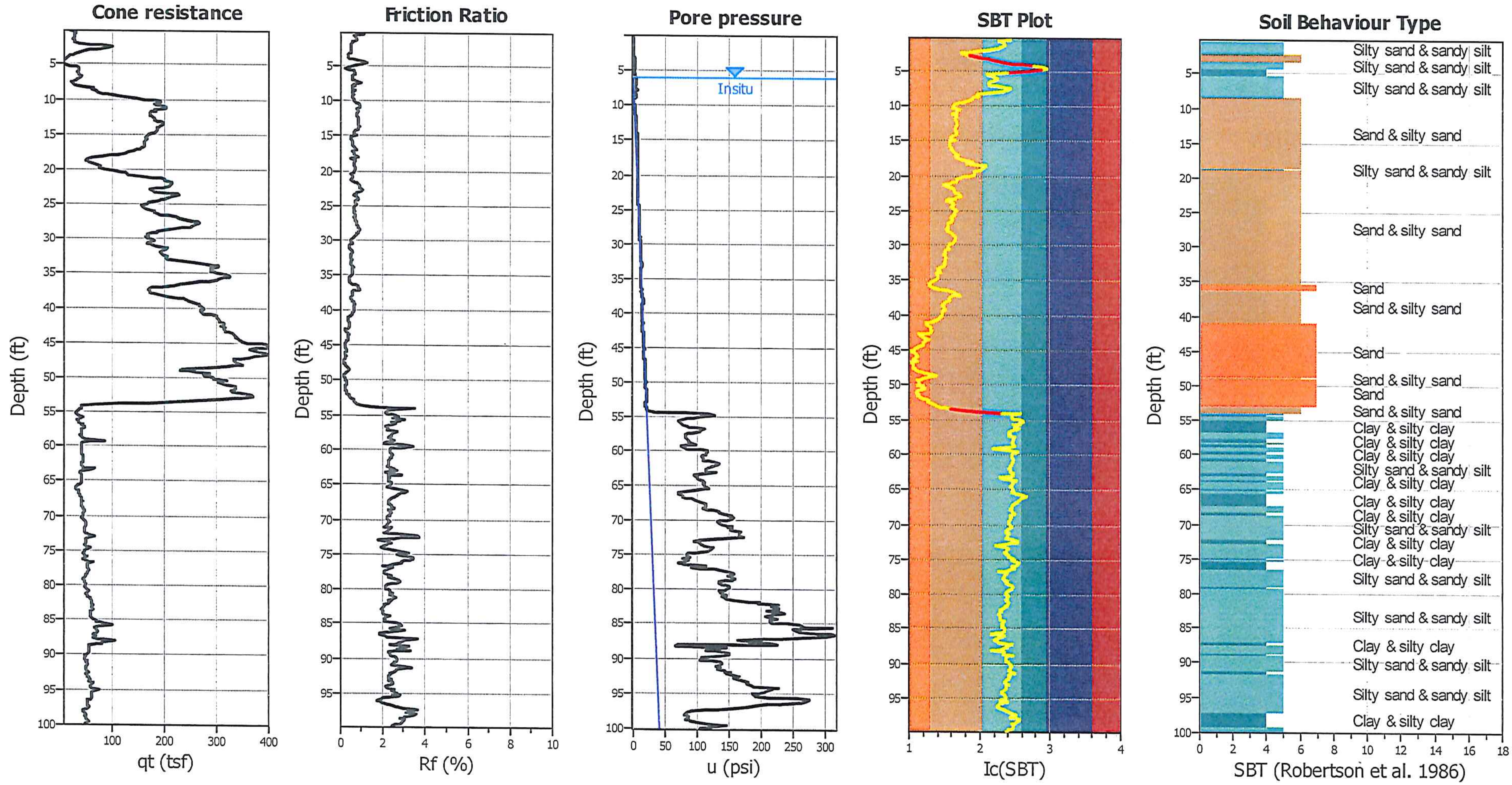






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



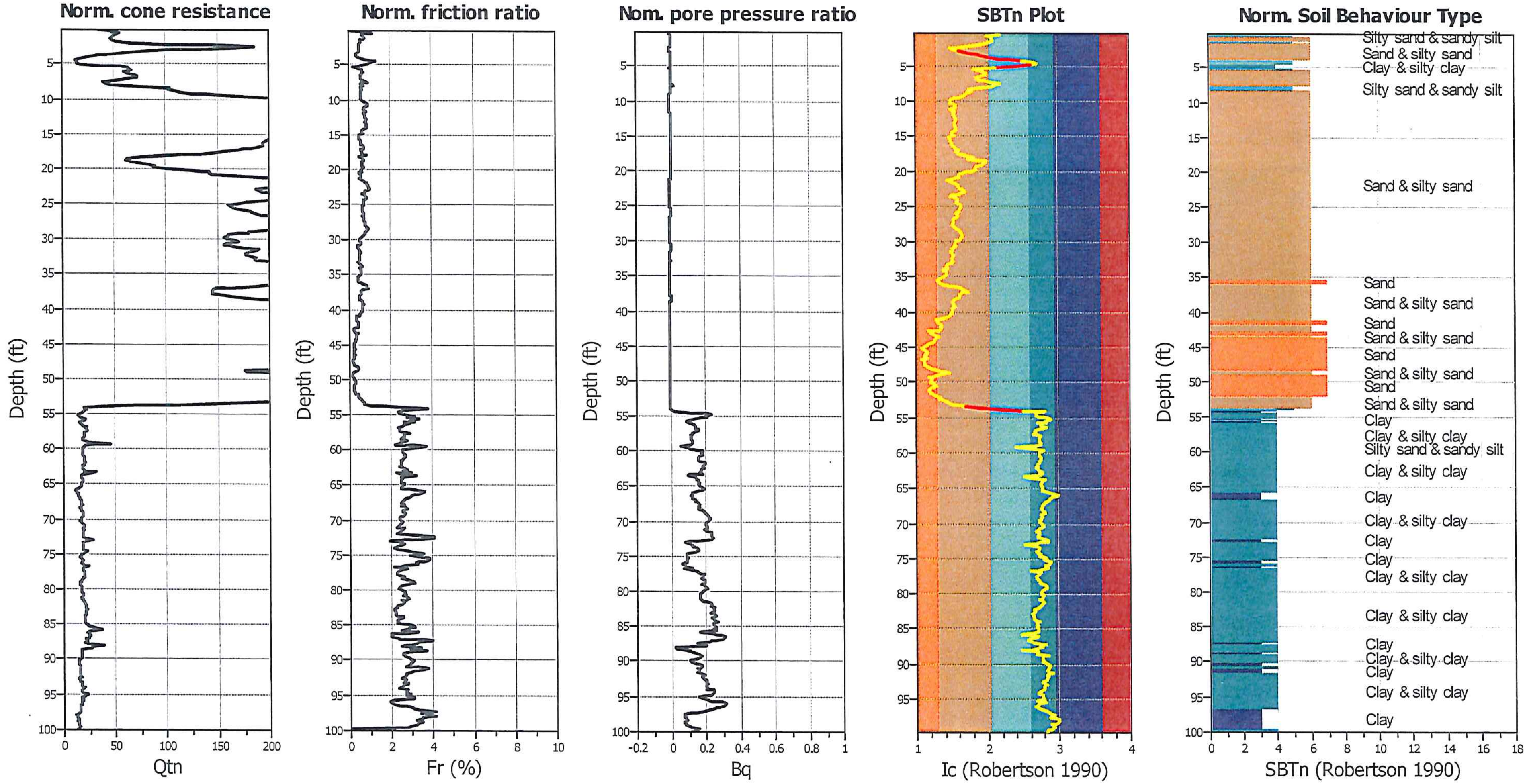
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.97	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



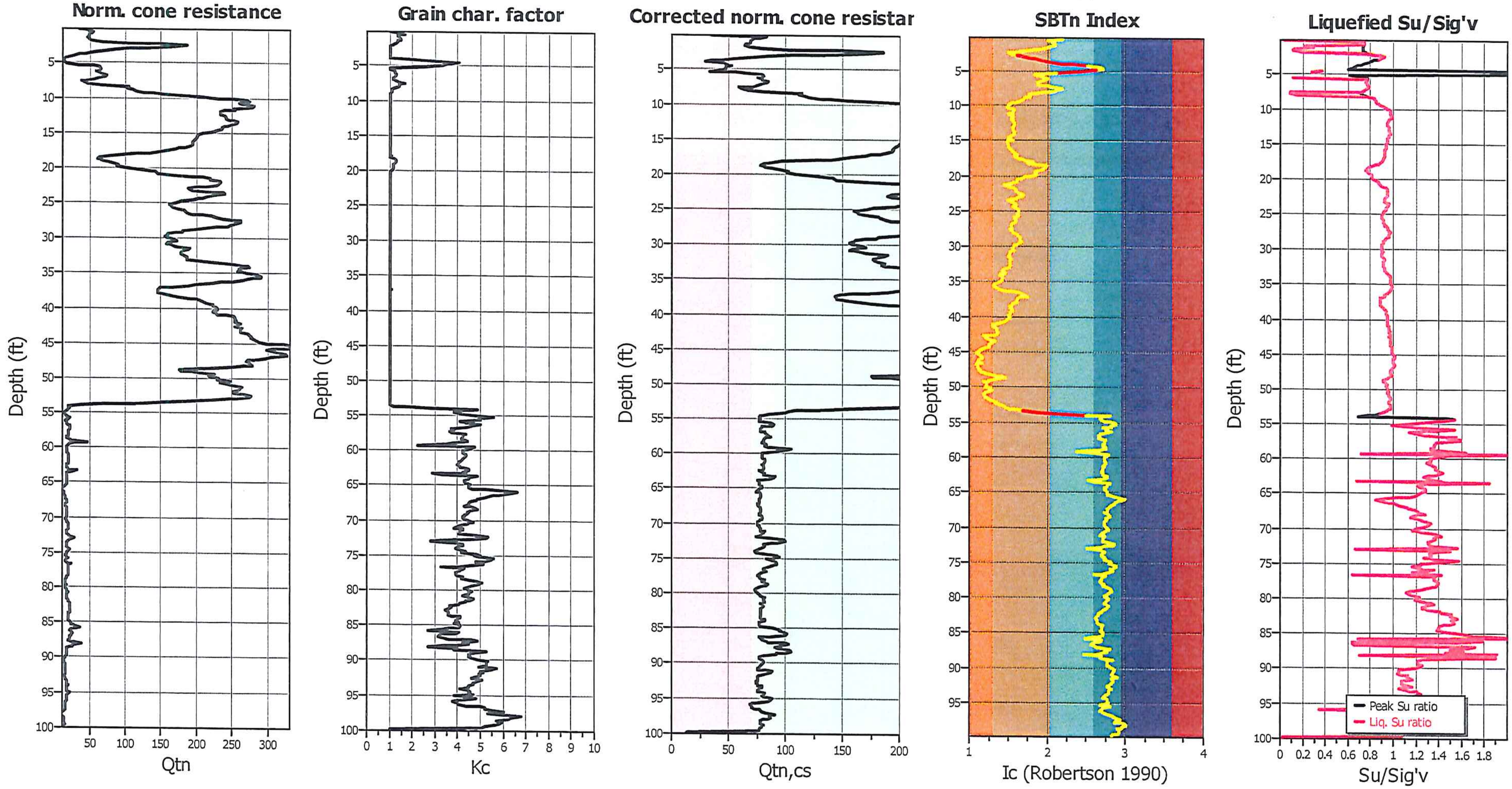
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.97	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

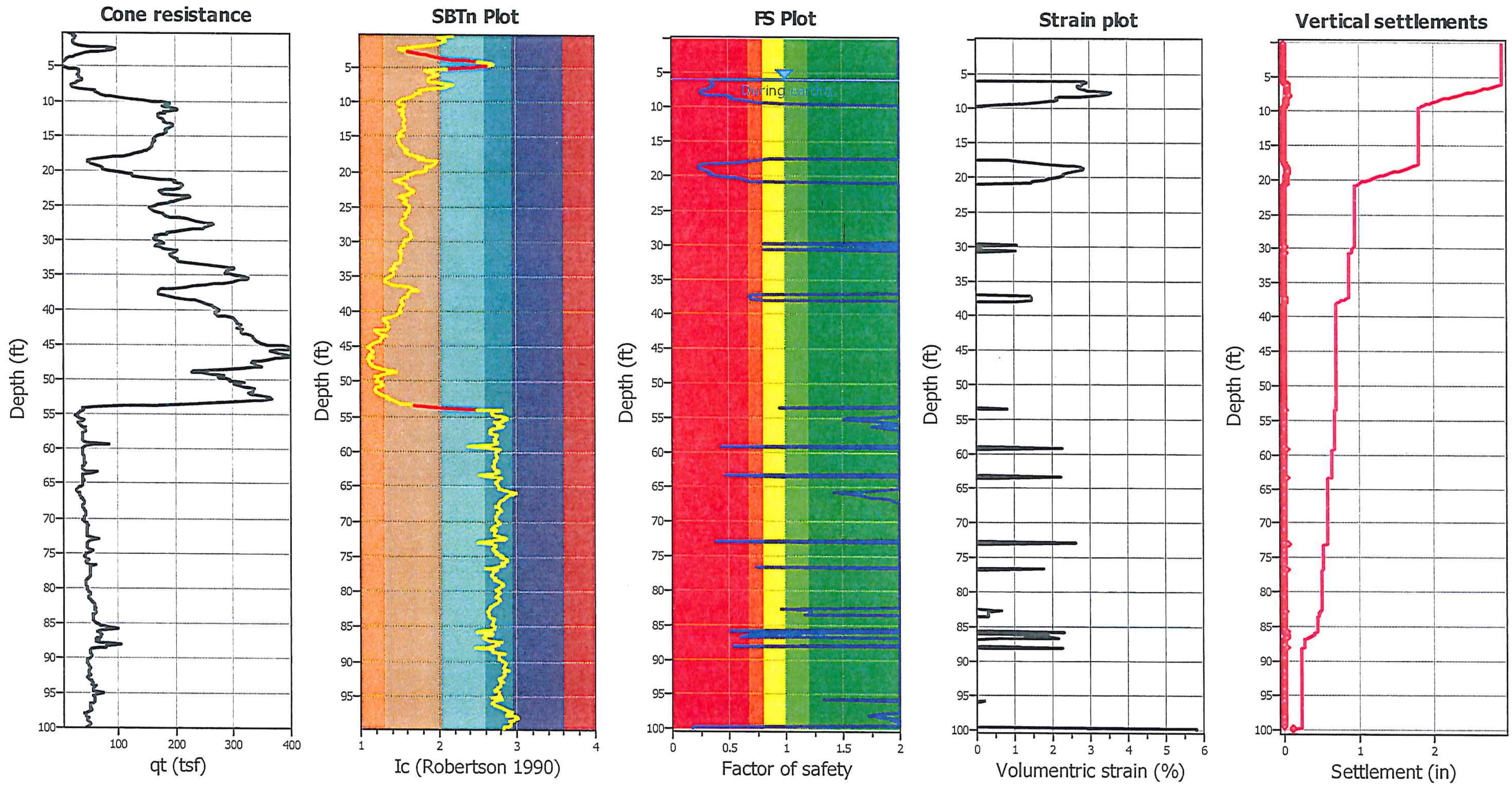
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.97	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	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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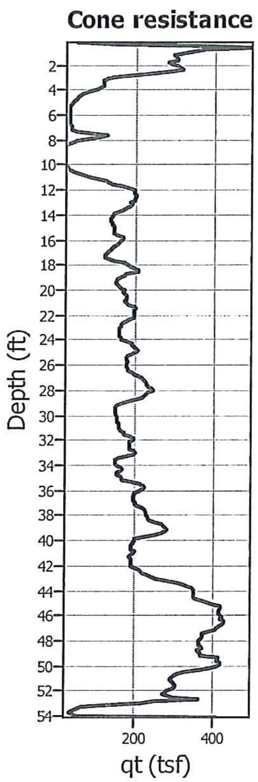
LIQUEFACTION ANALYSIS REPORT

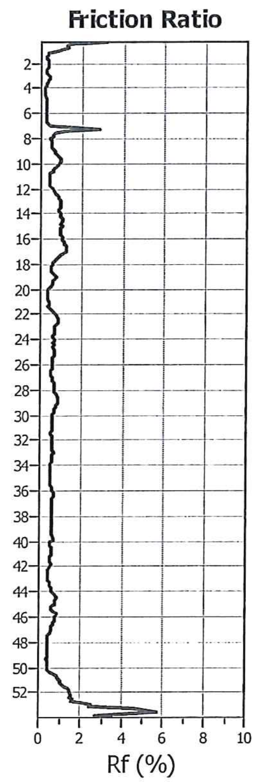
Project title : Lido House Hotel **Location : Balboa Penesula**

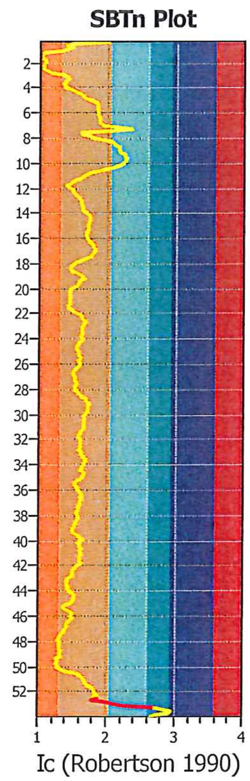
CPT file : CPT-5

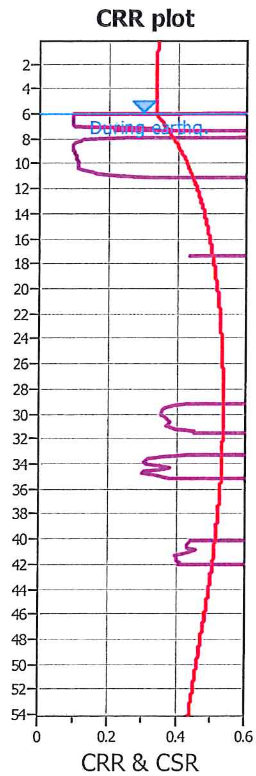
Input parameters and analysis data

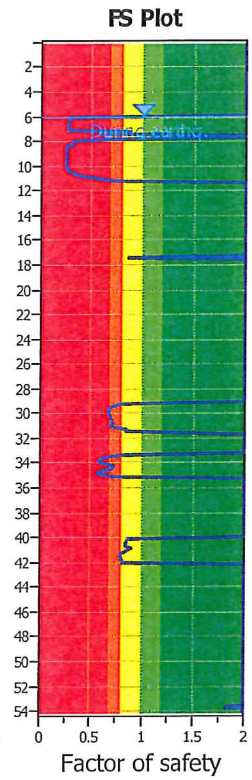
Analysis method:	Robertson (2009)	G.W.T. (in-situ):	6.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	6.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.97	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.63	Unit weight calculation:	Based on SBT	K_σ applied:	No		

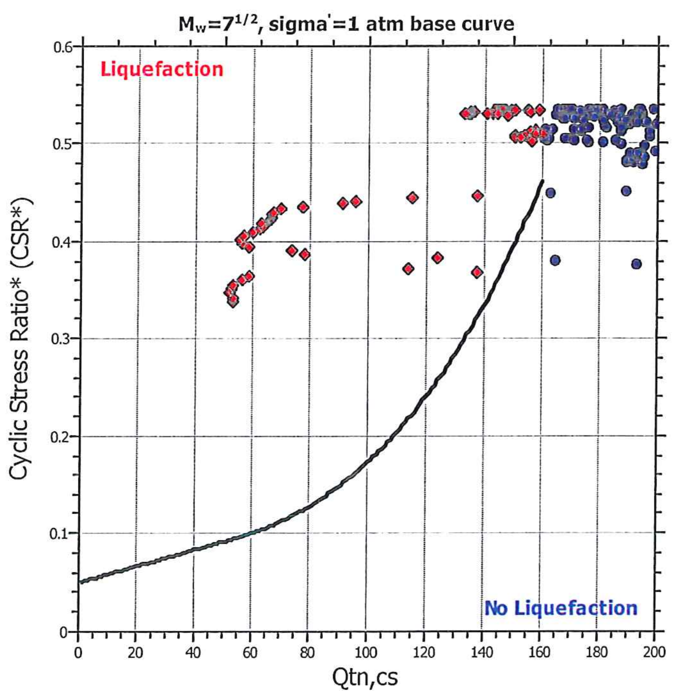


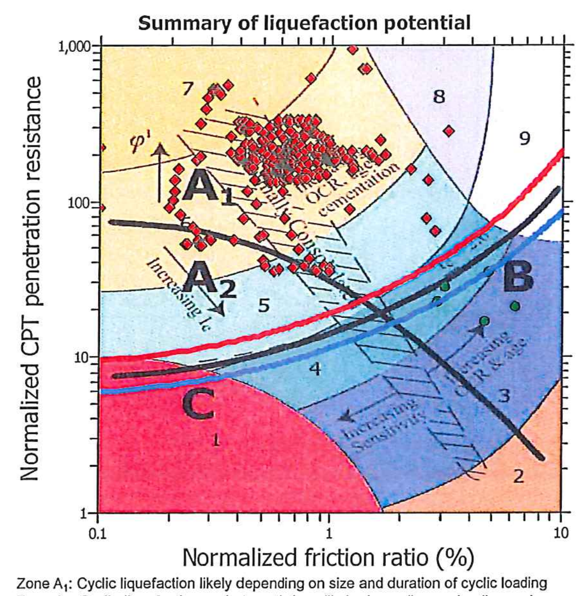








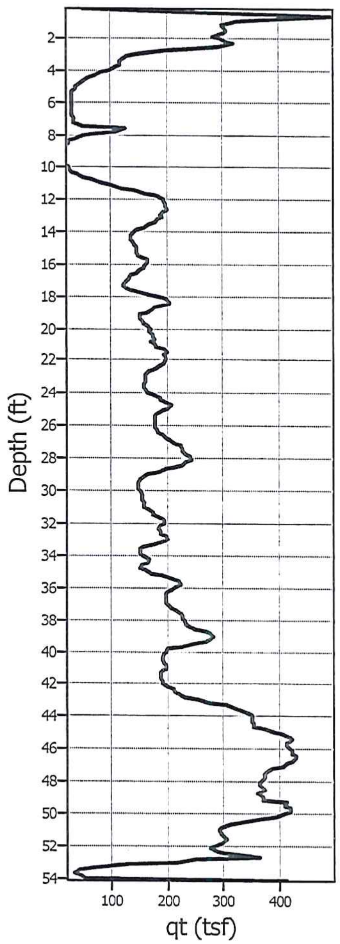




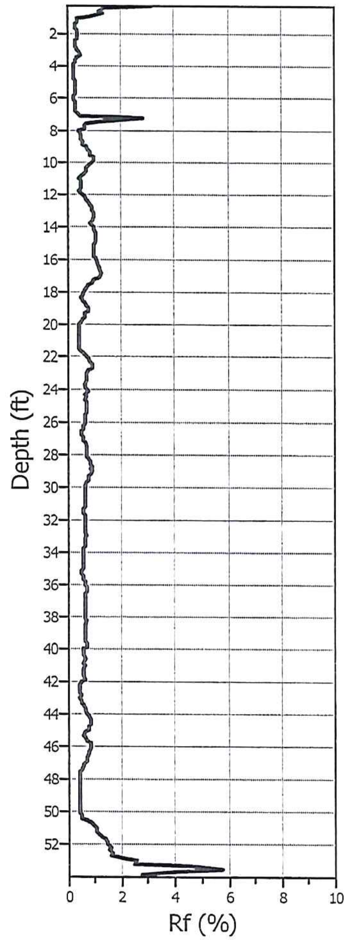
Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots

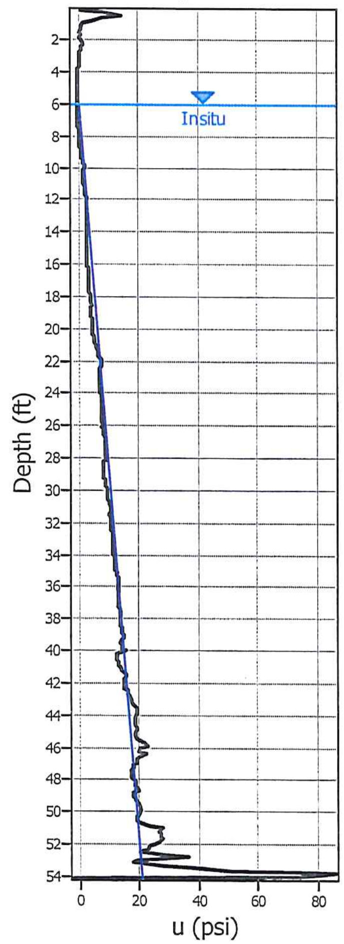
Cone resistance



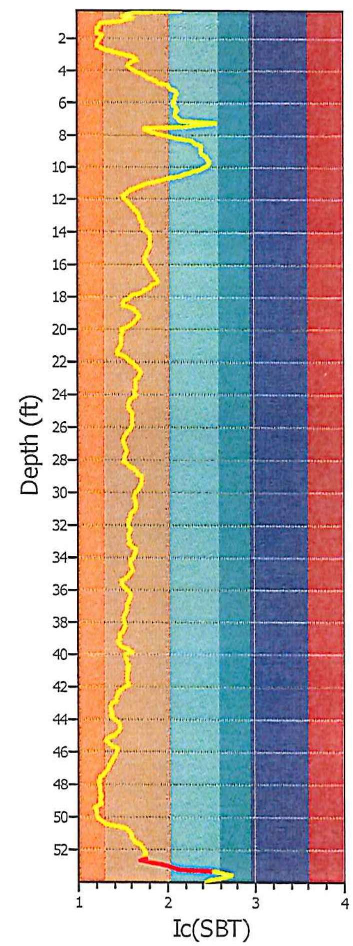
Friction Ratio



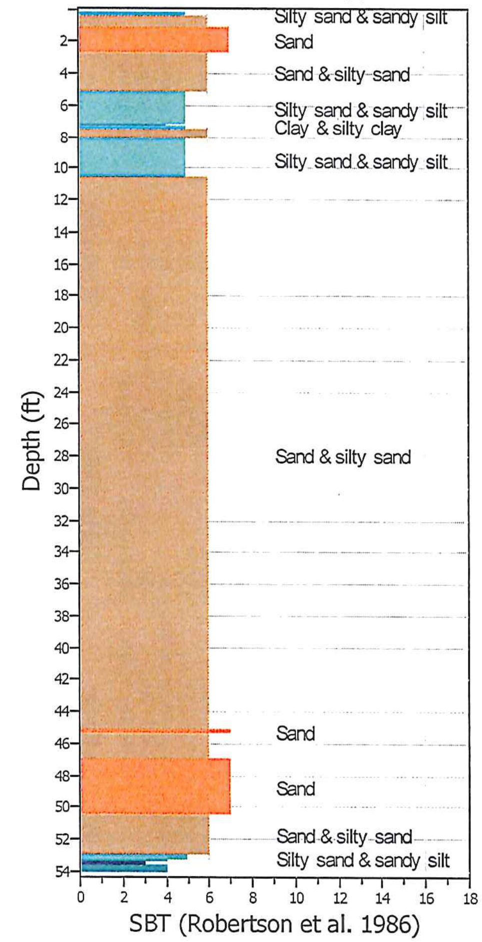
Pore pressure



SBT Plot



Soil Behaviour Type



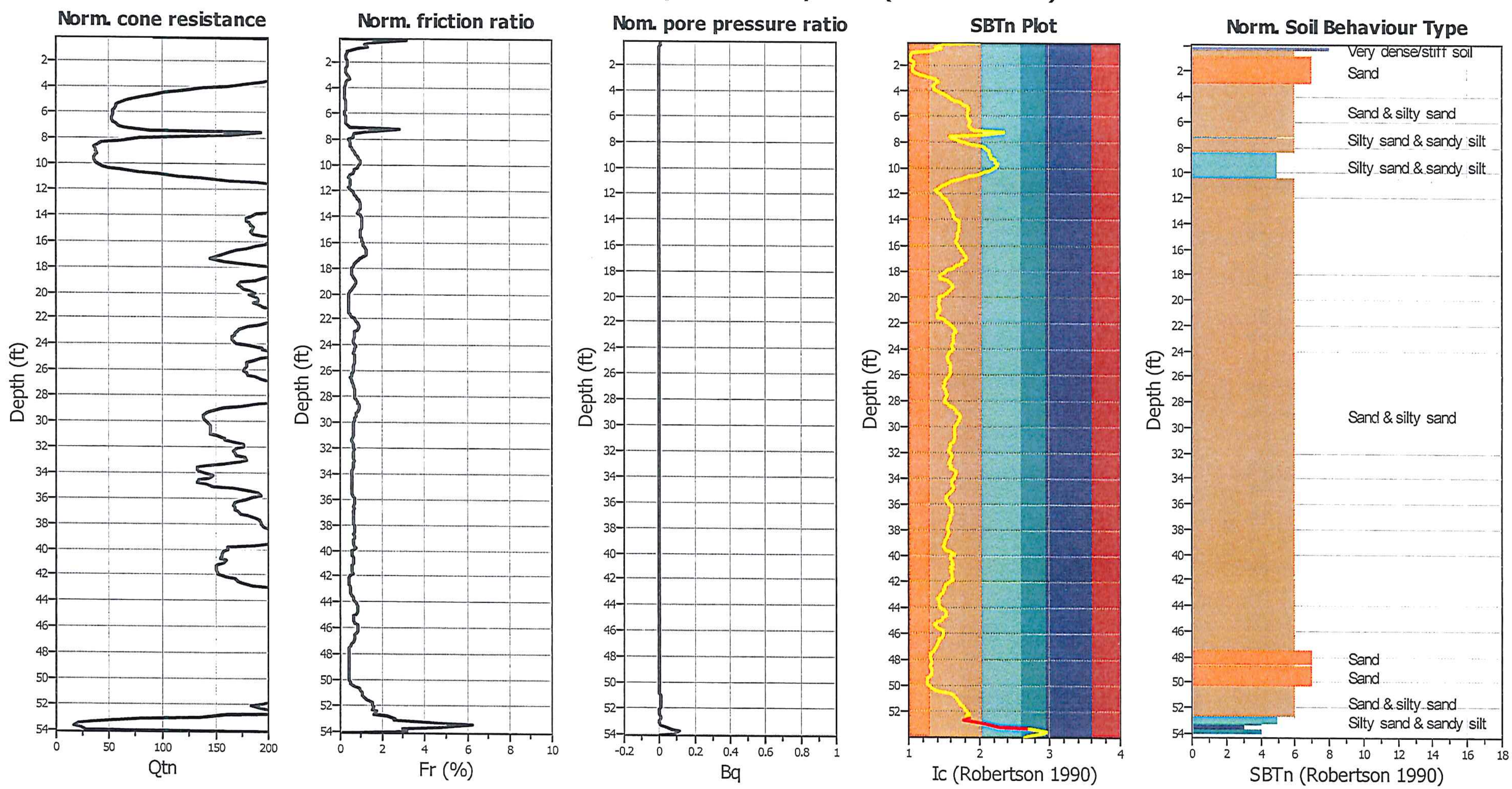
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.97	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

CPT basic interpretation plots (normalized)



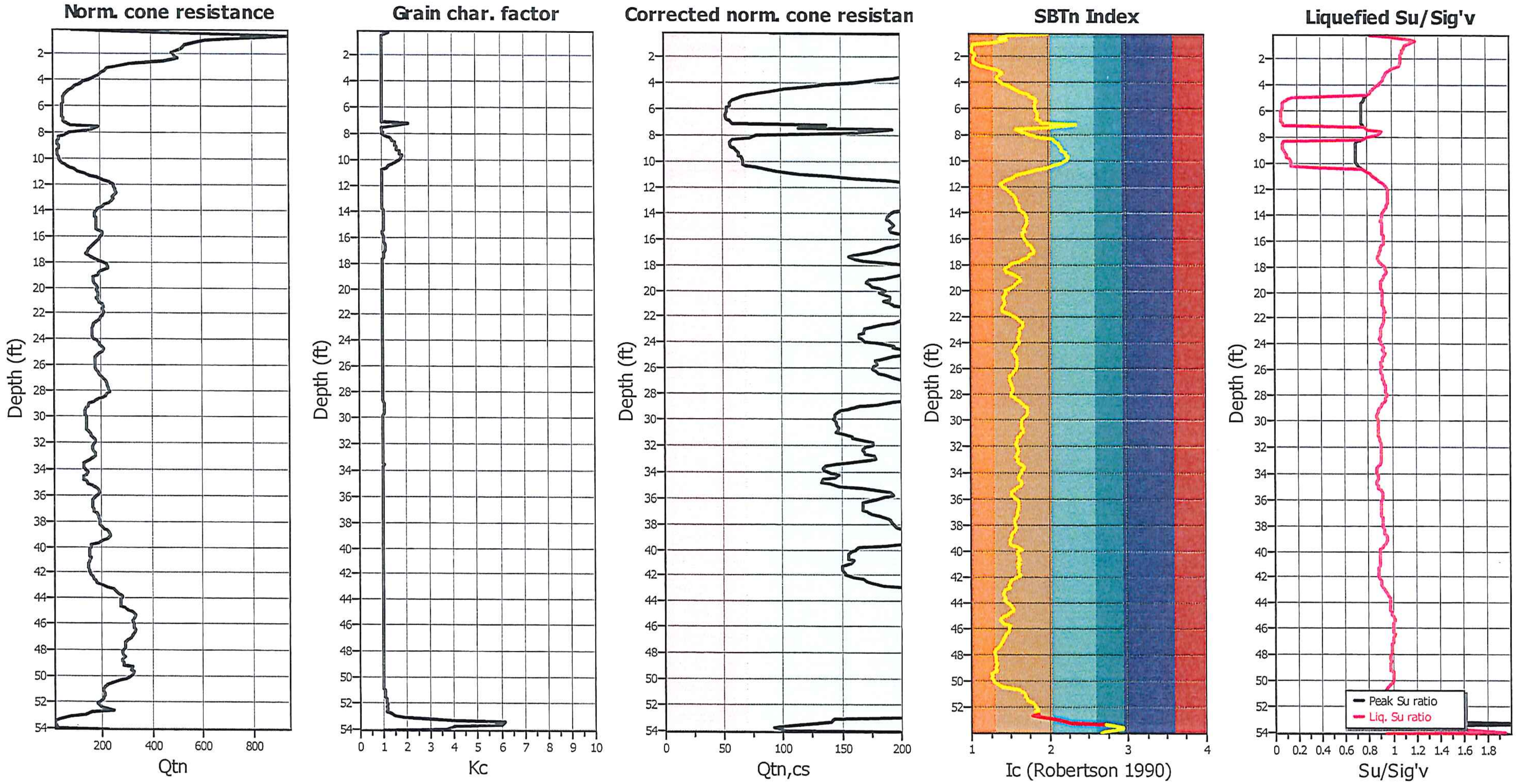
Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.97	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

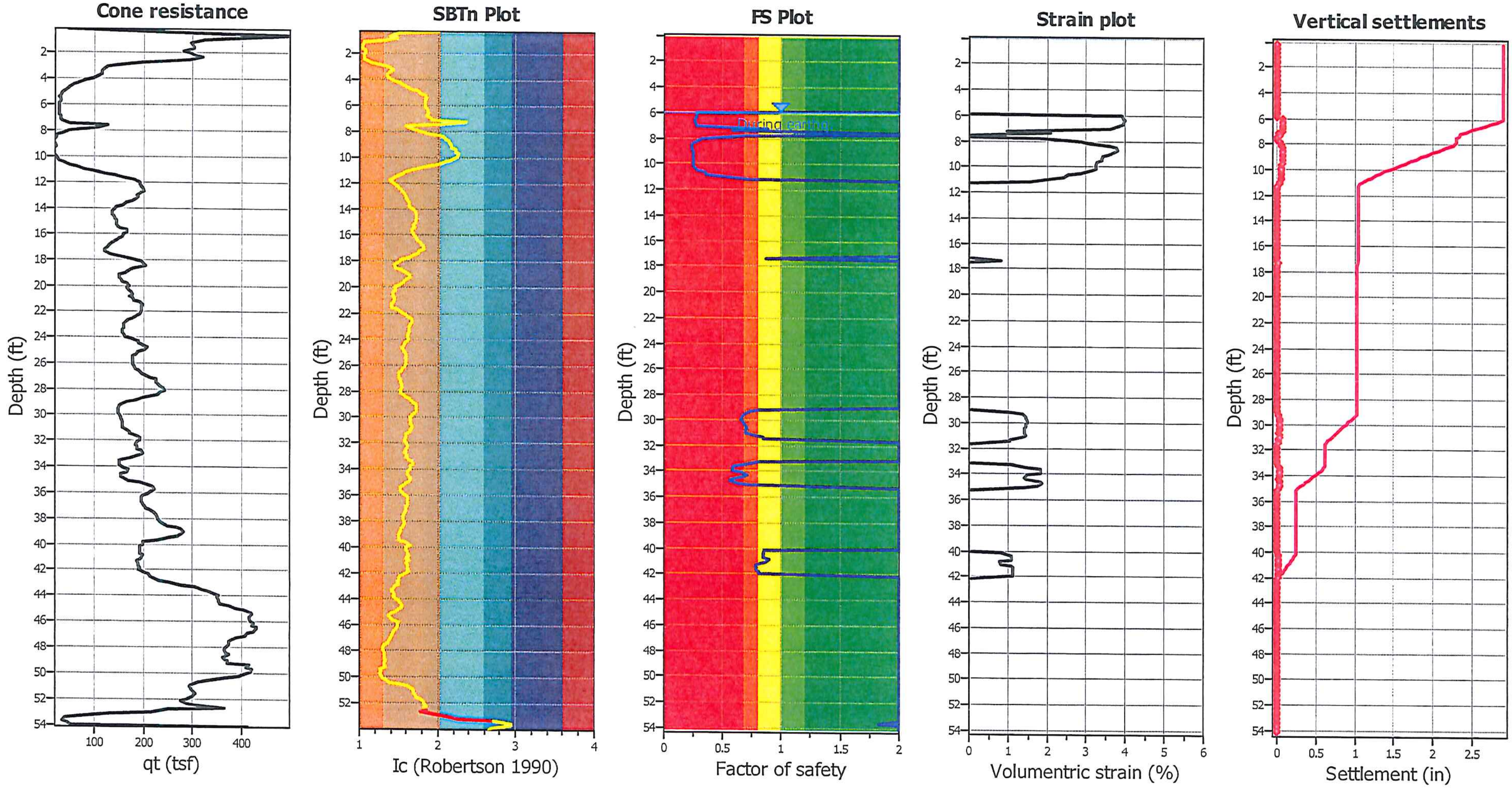
Check for strength loss plots (Robertson (2010))



Input parameters and analysis data

Analysis method:	Robertson (2009)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	Robertson (2009)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.97	Unit weight calculation:	Based on SBT	Clay like behavior applied:	All soils
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	N/A

Estimation of post-earthquake settlements



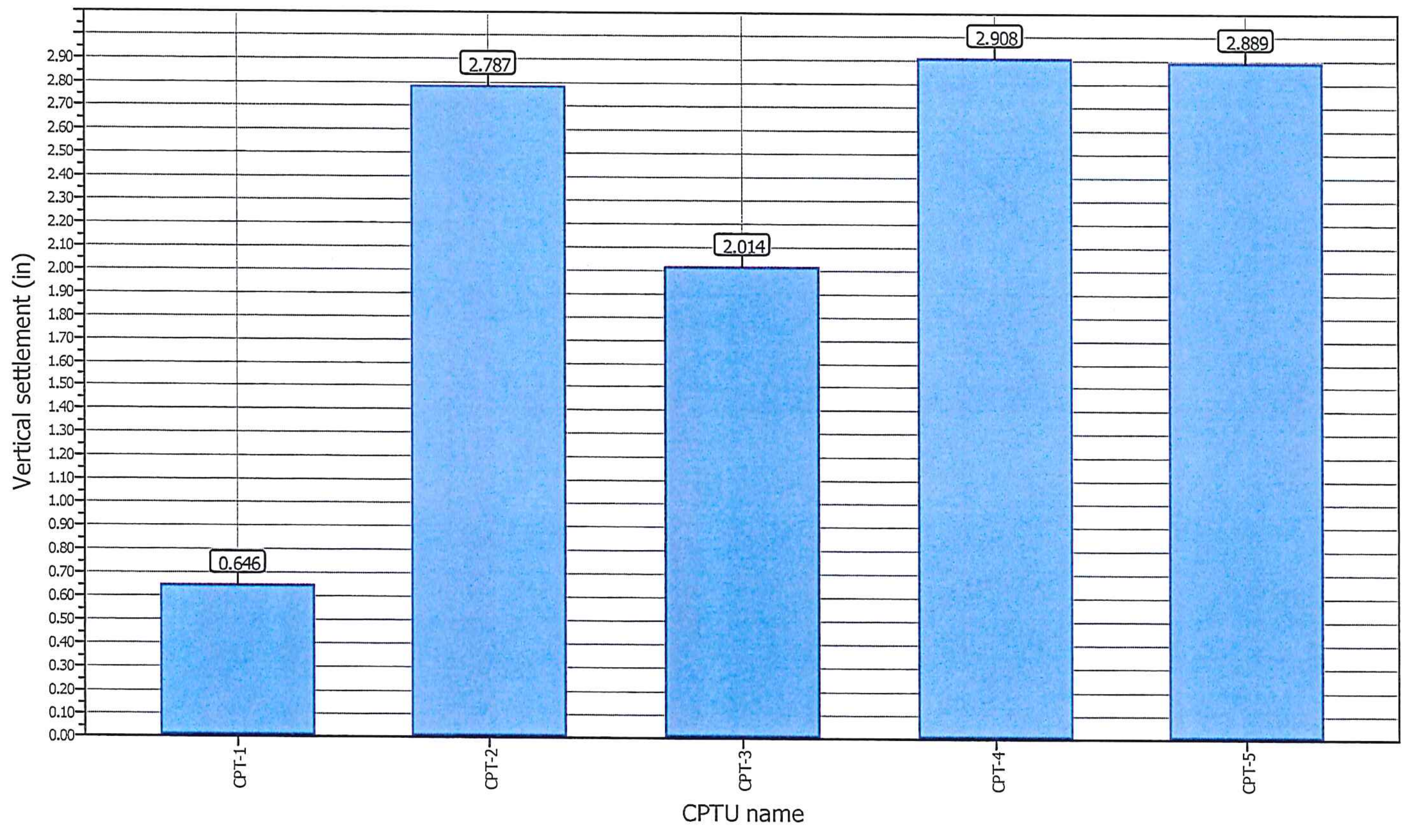
Abbreviations

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 : Lido House Hotel

Location : Balboa Penesula

Overall vertical settlements report



APPENDIX D

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GEOTECHNICAL, INC.

APPENDIX D

Retaining Wall Design Parameters

GMU
GEOTECHNICAL, INC.

BEARING CAPACITY FOR SHALLOW FOOTINGS

(DM 7.2)

Length	Base	Depth	c	φ	γ	q
ft	ft	ft	psf	degrees	pcf	psf
100	2	1.5	50	30	125	187.5

N_q	N_c	N_γ
19.3	32	17

q_{all} (ksf) (FS=3)

Square Footing

q_{ult}	q_{all}
(ksf)	(ksf)
6.93	2.31

	Base/Length (ft)				Increase from	Increase from
	2	3	4	5	2x2 to 3x3	3x3 to 4x4
Depth (ft)	(2'x2')	(3'x3')	(4'x4')	(5'x5')		
2	2.87	3.15	3.44	3.72	0.283	0.283
3	3.67	3.96	4.24	4.52	0.283	0.283
4	4.48	4.76	5.04	5.33	0.283	0.283
Inc. from 1.5 to 2.5	0.804	0.804	0.804	0.804		
Inc. from 2.5 to 3.5	0.804	0.804	0.804	0.804		

200 psf and 500 psf for every foot increase in footing width and depth, respectively

Continuous Footing

q_{ult}	q_{all}
(ksf)	(ksf)
7.34	2.45

	Base (ft)					
Depth (ft)	1.5	2	2.5	3	Inc. from 1.5 to 2.5	Inc. from 2 to 3
1.5	2.27	2.45	2.63	2.80	0.354	0.354
2.5	3.08	3.25	3.43	3.61	0.354	0.354
3.5	3.88	4.06	4.23	4.41	0.354	0.354
Inc. from 1.5 to 2.5	0.804	0.804	0.804	0.804		
Inc. from 2.5 to 3.5	0.804	0.804	0.804	0.804		

300 psf and 500 psf for every foot increase in footing width and depth, respectively

Circular Footing

	Diameter (ft)					
Depth (ft)	2	3	4	5	Inc. from 2 to 3	Inc. from 3 to 4
1.5	2.32	2.54	2.75	2.96	**0.213**	**0.213**
2.5	3.13	3.34	3.55	3.77	**0.213**	**0.213**
3.5	3.93	4.15	4.36	4.57	**0.213**	**0.213**
Inc. from 1.5 to 2.5	0.804	0.804	0.804	0.804		
Inc. from 2.5 to 3.5	0.804	0.804	0.804	0.804		

Retaing Wall Lateral Earth Pressures
Summary of Variou Conditions

REQUIRED INPUT PARAMETERS
OUTPUT DATA
Information Required to Be Read for Design

PGA (g):	0.42
K_h/PGA[+]:	0.5

[+]NOTE:

AASHTO seismic design for highway bridges (1983) recommends:	Kh: 0.5 PGA

Whitman and Liao (1985) recommend for M=7

Kh as a Function of PGA & Expected Displacements		
For Displacement to less than (in)	PGA = 0.2g	PGA = 0.4g
1	0.13	0.3
4	0.1	0.25

Use kv of 0.1 & 0.05 for gravity and anchored sheet pile walls, respectively.
Assume the vertical acceleration upward, downward, & zero. Use the conservative results.
$a_h=k_h*g$, $a_v=k_v*g$

γ_t (pcf):	125
Mc (%):	15
γ_b (pcf):	62.6
Gs:	2.65
K_h (g):	0.21
K_v (g):	0

	Degrees	
Friction Angle (ϕ'):	30	
Increase the Strength for Dynamic Event?	no	
Dynamic Firction Angle (ATAN[1.33*TAN(ϕ')]:	30.00	
Ratio* of δ/ϕ' :	0.5	* ϕ/2 < δ < 2ϕ/3
r_u= Δu/σ_v' (%):	0	

$P_{AE} = 0.5*K_{AE}*[\gamma_t*(1-k_v)]*H^2$

Vertical Wall with flat Backfill

KA:	**0.30**			
	Dry/Moist	**Submerged Ru=0, Restrained Water**	**Submerged Ru=0, Free Water**	**Submerged, Ru, Restrained Water**
Mononobe-Okabe, Whitman & Christian 1970, K_{AE}:	**0.46**	**0.76**	**0.61**	**0.76**
		K_{WD} (@ 0.4H form Base):	**0.25**	
KAE-KA:	**0.16**	**0.45**	**0.56**	**0.45**

RECOMMENDED DESIGN VALUES FOR DRAINED CONDITION		
EFP Active Pressure (pcf):	**38**	**Round Up to 40**
EFP At Rest Pressure (pcf):	**63**	
EFP Seismic (pcf):	**20**	

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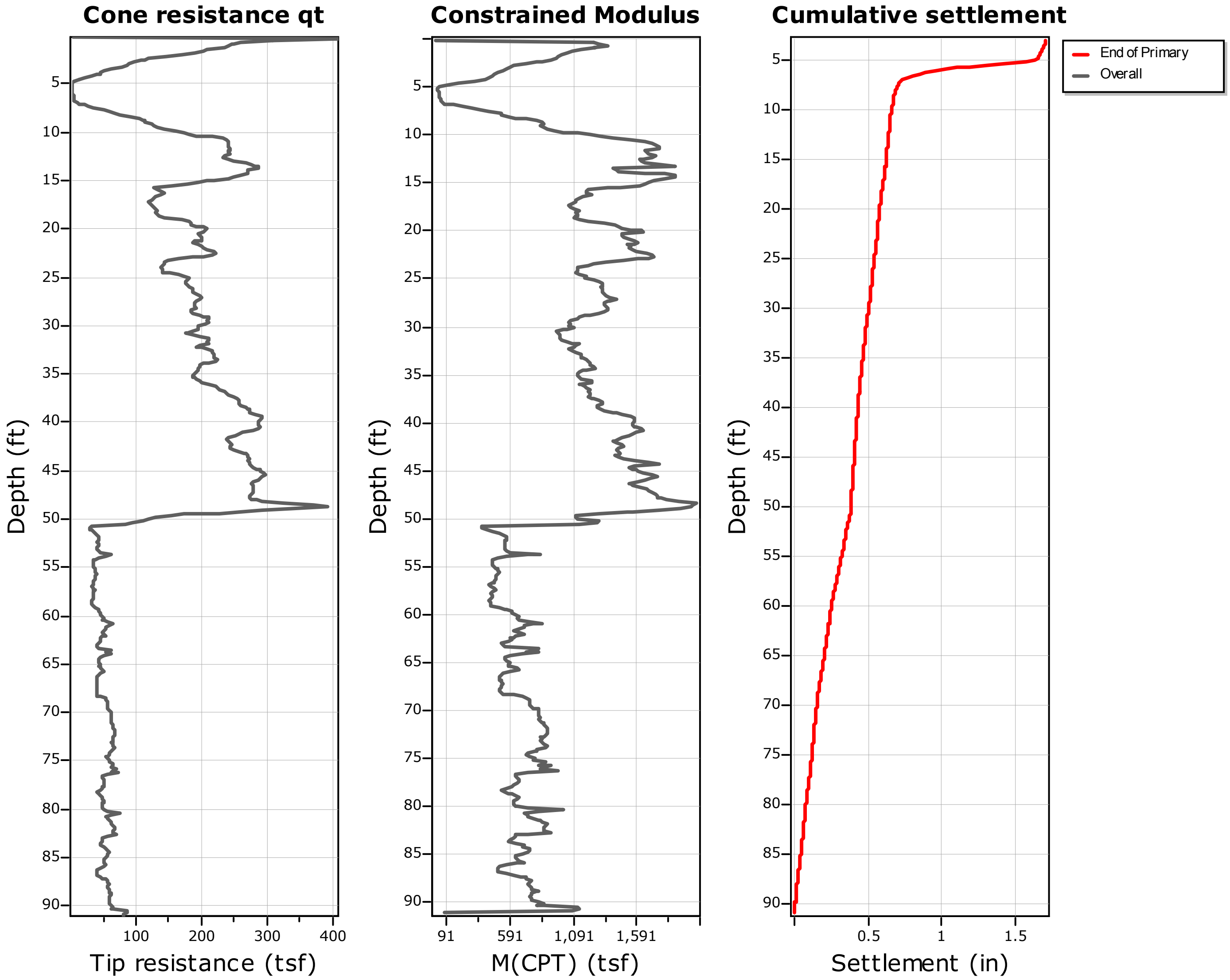
Project:
Location:

CPT: CPT-01
Total depth: 91.04 ft, Date: 10/23/2013
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Kehoe
Cone Operator: Uknown

Settlements calculation according to theory of elasticity*



Caclulation properties

Footing type: Rectangular
Footing width: 125.00 (ft)
L/B: 2.0
Footing pressure: 1.00 (tsf)
Embedment depth: 3.00 (ft)
Footing is rigid: Yes
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: No
Time period for primary consolidation: N/A
Time period for second. settlements: N/A

* Primary settlements calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlements calculation is performed according to the following formula:

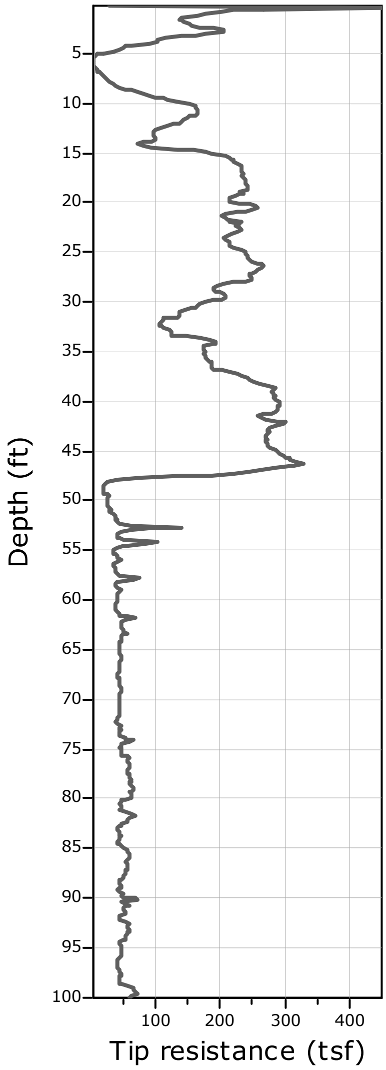
$$S = C_a \cdot \Delta z \cdot \log(t)$$

CPT: CPT-02
Total depth: 100.07 ft, Date: 10/23/2013
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Kehoe
Cone Operator: Uknown

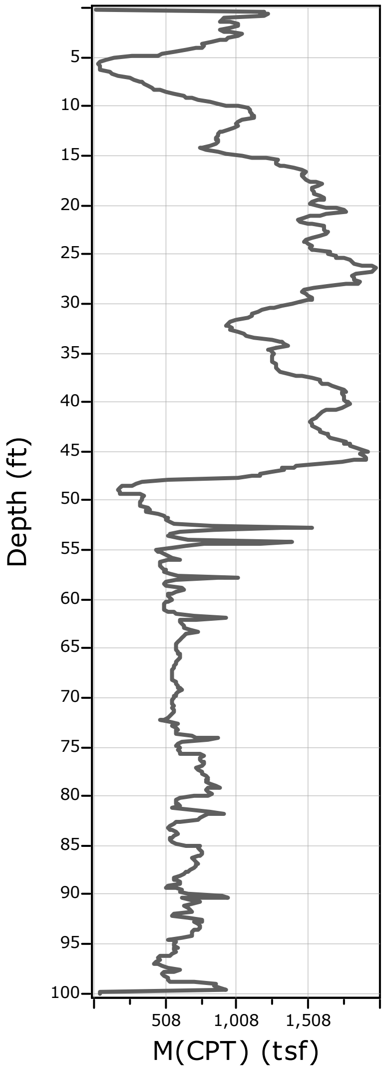
Project:
Location:

Settlements calculation according to theory of elasticity*

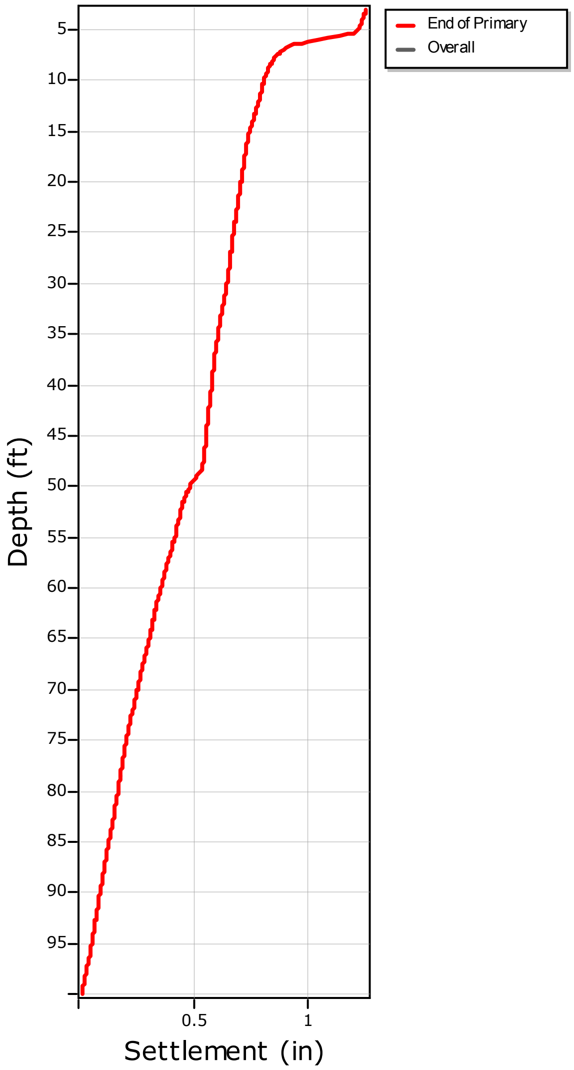
Cone resistance qt



Constrained Modulus



Cumulative settlement



Caclulation properties

Footing type: Rectangular
Footing width: 125.00 (ft)
L/B: 2.0
Footing pressure: 1.00 (tsf)
Embedment depth: 3.00 (ft)
Footing is rigid: Yes
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: No
Time period for primary consolidation: N/A
Time period for second. settlements: N/A

* Primary settlements calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlements calculation is performed according to the following formula:

$$S = C_a \cdot \Delta z \cdot \log(t)$$

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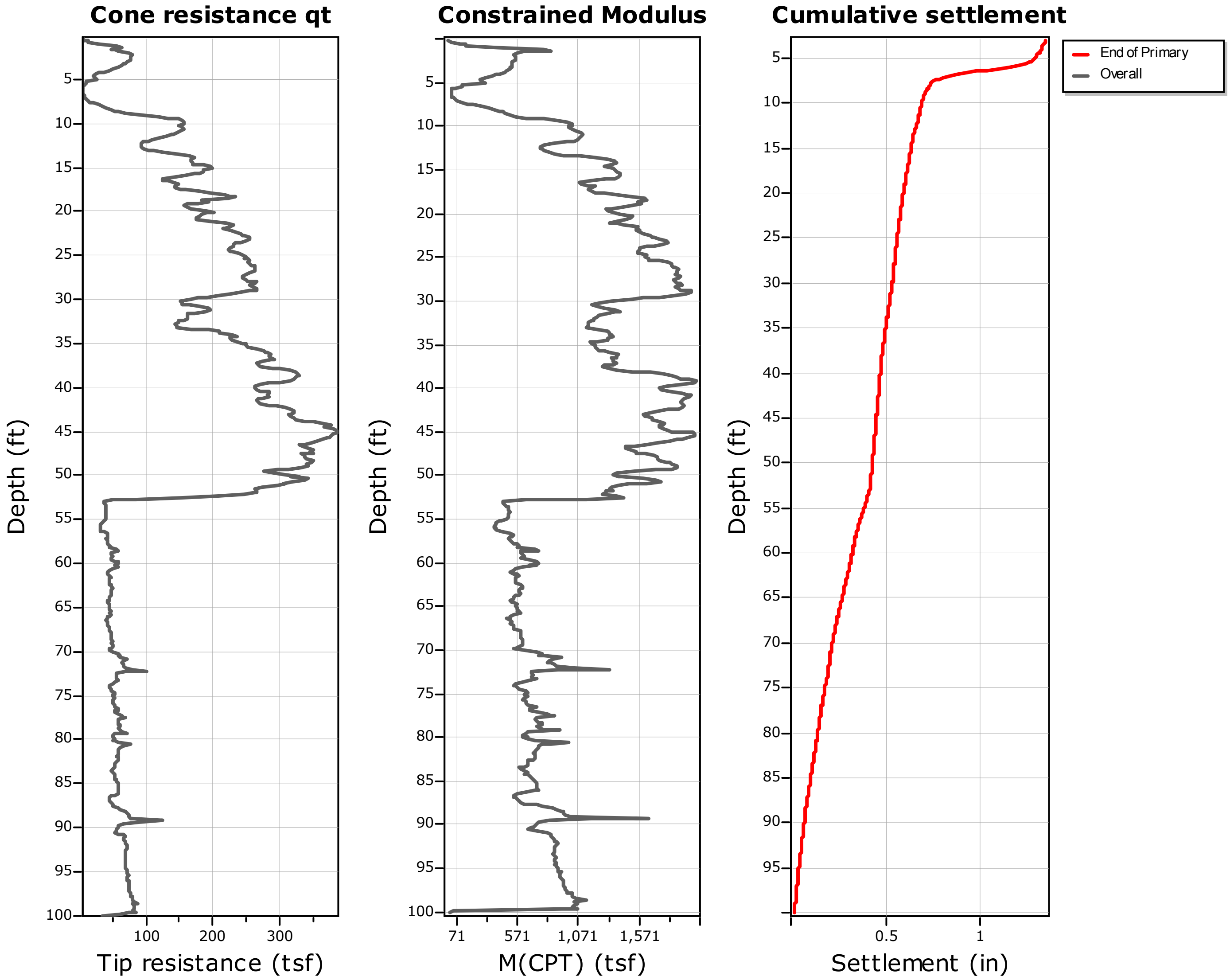
Project:
Location:

CPT: CPT-03
Total depth: 100.07 ft, Date: 10/23/2013
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Kehoe
Cone Operator: Uknown

Settlements calculation according to theory of elasticity*



Caclulation properties

Footing type: Rectangular
Footing width: 125.00 (ft)
L/B: 2.0
Footing pressure: 1.00 (tsf)
Embedment depth: 3.00 (ft)
Footing is rigid: Yes
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: No
Time period for primary consolidation: N/A
Time period for second. settlements: N/A

* Primary settlements calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlements calculation is performed according to the following formula:

$$S = C_a \cdot \Delta z \cdot \log(t)$$

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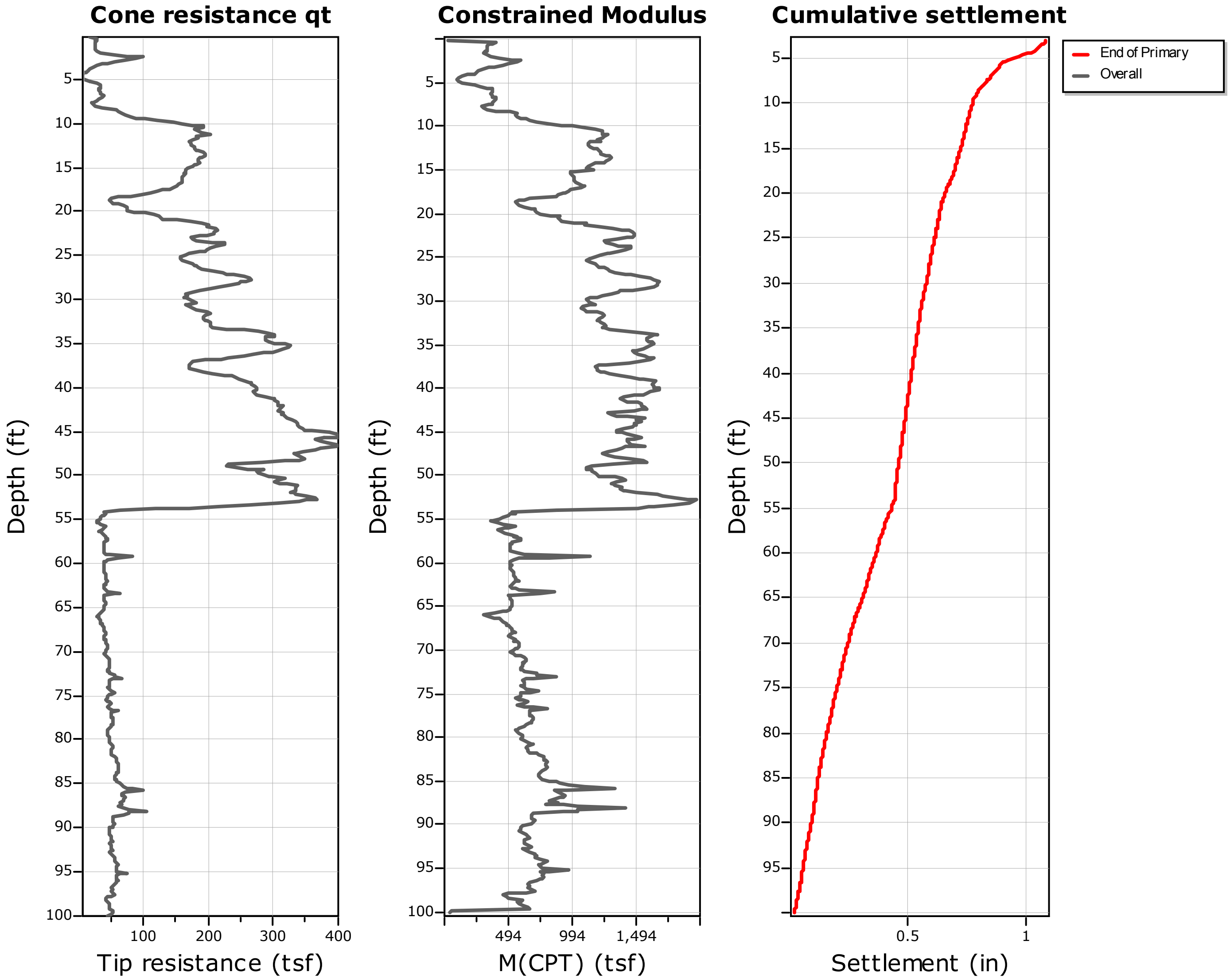
CPT: CPT-04
Total depth: 100.07 ft, Date: 10/23/2013
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Kehoe
Cone Operator: Uknown

Project:
Location:

Settlements calculation according to theory of elasticity*



Caclulation properties

Footing type: Rectangular
Footing width: 125.00 (ft)
L/B: 2.0
Footing pressure: 1.00 (tsf)
Embedment depth: 3.00 (ft)
Footing is rigid: Yes
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: No
Time period for primary consolidation: N/A
Time period for second. settlements: N/A

* Primary settlements calculation is performed according to the following formula:

$$S = \sum \frac{\Delta \sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlements calculation is performed according to the following formula:

$$S = C_a \cdot \Delta z \cdot \log(t)$$